4.7 HYDROLOGY AND WATER QUALITY

4.7.1 Introduction and Methodology

This section focuses on the project components that have the potential to impact water, water resources, and water quality during construction and/or operation of the proposed project. This analysis also examines runoff and water quality issues associated with construction of the proposed facilities, as well as marine water quality issues associated with the proposed desalination plant's discharge.

The analysis is based on the following documents: *Hydrodynamic Modeling of Dispersion and Dilution of Concentrated Seawater Produced by the Ocean Desalination Project at the Encina Power Plant, Carlsbad, CA (2001) and Hydrodynamic Modeling of Dispersion and Dilution of Concentrated Seawater Produced by the Ocean Desalination Project at the Encina Power Plant, Carlsbad, CA, Part II: Saline Anomalies due to Theoretical Extreme Case Hydraulic Scenarios (2005), prepared by Dr. Scott Jenkins and Joseph Wasyl; Carlsbad Desalination Plant Source Water Quality Characterization (2003), prepared by Poseidon Resources Corporation. Carlsbad Desalination Plant Product Water Quality Characterization (2003), prepared by Poseidon Resources Corporation; Carlsbad Desalination Plant Water Discharge Streams Characterization/Discharge Toxicity Analysis (2003), prepared by Poseidon Resources Corporation; the Water Quality Control Plan for the San Diego Basin (Region 9) (1995) prepared by the California Regional Water Quality Control Board San Diego Region; the California Ocean Plan (1997) prepared by the State Water Resources Control Board; Order No. 2000-3 NPDES Permit No. CA0001350, Waste Discharge Requirements for Cabrillo Power I LLC Encina Power Station, San Diego County, Prepared by the California Regional Water Quality Control Board, San Diego Region (2000); and the Drainage Area Management Plan (1994) prepared by the State Water Resources Control Board.*

4.7.2 Existing Conditions

The proposed project is located in the northern portion of San Diego County, within the coastal City of Carlsbad. The climate of San Diego County is characterized by an inter-annual cycle that typically exhibits long, warm, dry summers and mild, sometimes wet winters. Generally, weather patterns are dominated by a semi-permanent high pressure cell located over the Pacific Ocean. This high pressure cell maintains clear skies for much of the year, but relaxes in winter allowing extra-tropical cyclones with associated cold fronts to travel episodically through the region, providing the preponderance of the annual rainfall totals. The average rainfall is about

10-13 inches per year, most of which falls between November and February. The average mean temperature for the area is approximately 65 degrees in the coastal zone and 57 degrees in the surrounding foothills. The inter-annual climate cycle causes a seasonal variation in both ocean temperature and salinity as a consequence of solar heating and evaporation during warm dry summers, and cloud convection with precipitation during winter.

The San Diego County coastal zone is subject to climate cycles of about 20-30 years duration known as the Pacific/North American (PNA) pattern (for atmospheric pressure) or the Pacific Decadal Oscillation or PDO (for sea surface temperature). A dry *La Niña* dominated period extended from about 1945-1977, followed by an episodically wet period from 1978-1998 that included the occurrence of 6 strong El Niño events. The average annual rainfall increases by about 38% from the dry to the wet portions of the cycle. Furthermore, both the minimum and maximum ranges in rainfall are higher in the wet period, while the averages of the 6 major rainfall events in 21-year periods before and after the climate change (1977/78) are about 8 to 9 inches greater during the wet period. The PNA/PDO climate cycles accentuate the inter-annual variability and produce the extremes in the natural ranges of variability of ocean temperature and salinity.

Hydrologic Setting

The project site is located between the San Luis Rey River to the north, and the San Marcos Creek to the south, two of the San Diego Region's thirteen principal stream systems. The project site is in the City of Carlsbad, within the Carlsbad Hydrologic Unit (CHU) of the California Water Quality Control Board's Region 9 – San Diego. The CHU reaches inland nearly 24 miles to just northeast of Lake Wohlford. The maximum elevation of the CHU is approximately 2,400 feet and it extends to sea level at the Pacific Ocean.

Watersheds

The desalination plant site is situated within the Agua Hedionda Lagoon watershed, which has a total drainage area of approximately 29 square miles in the cities of Carlsbad, Vista, Oceanside, and San Diego County. The main stream in the watershed is Agua Hedionda Creek, which begins on the southwestern slopes of the San Marcos Mountains in north San Diego County, flowing generally southwestward to the Agua Hedionda Lagoon and the Pacific Ocean.

The offsite pipeline areas are located in the Agua Hedionda Lagoon watershed as noted above, and are also within the Buena Vista Lagoon watershed. The Buena Vista Lagoon has a total drainage area of approximately 23 square miles in the cities of Oceanside, Carlsbad, Vista, and unincorporated San Diego County. The main stream is Buena Vista Creek, which begins in the northeast portion of the City of Vista on the western slopes of the San Marcos Mountains, flowing generally westward to the Buena Vista Lagoon and the Pacific Ocean.

Site Drainage

Existing impervious surfaces at the Encina Power Station (EPS) cover approximately 38 percent of the site. Drainage at the EPS consists of several storm water conveyance and discharge structures located on the site. These include sumps, pump pits, swales and ditches. In addition to conveyance systems generated on-site, a 96-inch storm drain pipe that discharges to the Agua Hedionda Lagoon at the north end of the EPS contains flow from offsite sources in the Carlsbad Area. In addition to surface and subsurface drains throughout the site, multiple roof drains divert storm water to the ground surface, which then follow the local topography generally leading toward Carlsbad Boulevard. During periods of rain, storm water runoff is generally diverted by surface gradients and curbing to storm water inlets and drainage channels located throughout the site. The nearest surface water bodies are the Pacific Ocean directly to the west and the Agua Hedionda Lagoon directly to the north. The Encina Power Station is covered by an Industrial Activities Storm Water Permit and implements a Storm Water Management Plan pursuant to the National Pollutant Discharge Elimination System (NPDES) storm water regulations.

Drainage in the vicinity of offsite pipelines generally consists of storm drains associated with residential, commercial, and industrial development that ultimately empties into the Pacific Ocean through the Agua Hedionda and Buena Vista watersheds. Some of the offsite pipelines would be located in vacant and open space areas where stormwater evaporates or percolates into the ground, or flows through natural drainages into existing storm drains.

Flooding

The proposed plant site is not located within the Special Flood Hazard Area as shown on the 2003 City of Carlsbad Zoning Map, and is not located within the 100-year flood zone as shown in the Final Master EIR for the 1994 City of Carlsbad General Plan Update. Some of the offsite pipeline areas are located in the 100-year flood zone for Buena Vista Creek and Agua Hedionda Creek.

Surface Water

The San Diego Region has thirteen principal stream systems originating in the western highlands that flow to the Pacific Ocean. Most of the streams of the San Diego Region are interrupted in character, having both perennial and ephemeral components due to the rainfall pattern and the development of surface water impoundments.

The nearest surface water drainage to the plant site is Agua Hedionda Creek. Beneficial uses of Agua Hedionda Creek include municipal and domestic supply, agricultural, industrial services, contact and non-contact water recreation, and wildlife and warm freshwater habitat.

In addition to Agua Hedionda Creek, the offsite pipeline areas are also located near the surface water of Buena Vista Creek. Beneficial uses of Buena Vista Creek include municipal and domestic supply, agricultural, industrial services, contact and non-contact water recreation, wildlife and warm freshwater habitat, and preservation of rare and endangered species.

Groundwater

Groundwater is defined as subsurface water that occurs beneath the water table in fully saturated soils and geologic formations. All major drainage basins in the San Diego Region contain ground water basins. The basins are relatively small in area and usually shallow. Although these ground water basins are limited in size, the ground water yield from the basins has been historically important to the development of the Region. A number of the larger ground water basins can be of future significance in the San Diego Region for storage of both imported waters and reclaimed wastewaters. Nearly all of the local ground waters of the region have been intensively developed for municipal and agricultural supply purposes. Groundwater bearing formations that are sufficiently permeable to transmit and yield significant quantities of water are called aquifers.

The Water Quality Control Plan for the San Diego Basin does not include any existing or potential beneficial uses of groundwater for the Buena Vista or Agua Hedionda watersheds. The groundwater table at the plant site was encountered during drilling at a depth of 20.8 to 28.9 feet below the existing ground surface (or at an approximate elevation of 1.1 to 14.2 feet mean sea level) (GeoLogic Associates, 2004).

Coastal Waters

Coastal waters in the vicinity of the project include the Pacific Ocean, Agua Hedionda Lagoon, and Buena Vista Lagoon. The existing beneficial uses of San Diego County beaches and nearshore areas include water contact recreation (e.g., surfing, swimming), non-contact recreation (e.g., walking, jogging), sport fishing, aquaculture, shellfish harvesting, municipal and domestic supply, preservation of rare and endangered species, marine and wildlife habitat, areas of special biological significance, and navigation. Agua Hedionda Lagoon is designated as an estuarine habitat and has the same beneficial uses as the Pacific Ocean except for commercial fishing, areas of special biological significance, spawning of aquatic organisms, and navigation. Buena Vista Lagoon is a designated Ecological Reserve by the California Fish and Game Commission and a portion of the lagoon is a bird sanctuary. Buena Vista Lagoon has existing beneficial uses of contact (fishing only) and non-contact water recreation, areas of special biological significance, marine and wildlife habitat, preservation of rare and endangered species, warm freshwater habitat, and has potential for beneficial use as an estuarine habitat.

Natural water temperatures in the Pacific Ocean fluctuate throughout the year in response to seasonal and diurnal variations in solar irradiance and ocean currents as well as meteorological factors such as wind, air temperature, relative humidity, cloud cover, ocean waves, and turbulence. Natural surface water temperatures are coolest in December through March and warmest in August through September, with mean annual range of 12-19 degrees Celsius. The maximum recorded daily mean temperature is 25.1 ^{o}C occurring during the summer of the 1993 El Niño and the minimum is 9.9 ^{o}C, recorded during the winter of the 1999-2000 La Niña. The 20.5 year mean temperature is 17.6 ^{o}C and the natural range of variability of local ocean temperature is 86% of the mean. Salinities in the project area average 33.5 parts per thousand (ppt) The maximum recorded salinity is 34.44 ppt (parts per thousand) and the minimum is 31.26 ppt., both recorded concurrent with the 1993 El Niño. Thus, the natural range of variability of local ocean salinity is 10% of the mean. The upper 100 meters of the water column is well mixed and well oxygenated (greater than 50 percent saturated).

The desalination plant site is located within the existing Encina Power Station, which is adjacent to Agua Hedionda Lagoon and across Carlsbad Boulevard from the Pacific Ocean and Carlsbad State Beach. The existing power plant is currently permitted to intake up to 857 mgd of cooling seawater from Agua Hedionda Lagoon, although active pumping capacity is limited to 808 mgd. Cooling water is pumped through an existing water intake structure located on the northwest portion of power plant site on the lagoon frontage. After being used to cool the plant's condensers, the seawater flows into a discharge tunnel. The concrete tunnel conveys the cooling water into an on-site discharge pond before traveling through box culverts under Carlsbad Boulevard into a riprap-lined channel with a surface discharge into the Pacific Ocean. The Encina Power Station has a NPDES permit from the San Diego Regional Water Quality Control Board (RWQCB) to intake and discharge a maximum of 857 mgd of water as part of the utility operations.

Surface Water Quality Issues

The Carlsbad Watershed Urban Runoff Management Program prepared by the California Water Quality Control Board's Region 9 – San Diego, identified the following major water quality problems in the Carlsbad Hydrologic Unit: fecal coliform or bacterial indicators and sedimentation and siltation. The San Diego Regional Water Quality Control Board 303(d) list of impaired waterbodies included Agua Hedionda Creek for total dissolved solids, Agua Hedionda Lagoon for bacteria indicators and sedimentation/siltation, Buena Vista Lagoon for bacteria indicators, nutrients, and sedimentation/siltation, and the Pacific Ocean shoreline for bacteria indicators at Buena Vista Creek, Carlsbad City Beach at Carlsbad Village Drive, and Carlsbad State Beach at Pine Avenue.

Marine Setting

A geophysical survey of the nearshore vicinity of the EPS was conducted by Coastal Environments (Elwany et al., 1998a and b) to characterize topography, habitat types, and sediment thickness for a sediment transport study. In general, the seafloor topography gently slopes offshore to the southwest. The nearshore area upcoast of the intake channel consists of predominantly rocky outcrops, with the offshore areas almost exclusively sand. The northern rocky-outcrop area extends fewer than 1,000 ft downcoast (south) of the inlet channel. Downcoast, extending approximately 1,000 feet past the discharge channel, the bottom is entirely sandy until the rocky outcrops of the Terra Mar headlands are reached. Offshore sediment depth is generally less than 4 ft thick in about 48 ft water depth. There are some exceptions, such as deeper pockets between the northern and southern outcrop areas. These may be associated with erosional channels created in the lagoon watershed when sea level was lower. Sediment thickness continues to deepen offshore to greater than 12 ft in about 70 ft of water.

Hard substrate areas are generally considered more biologically productive than sandy areas and compose a much smaller percentage of the offshore habitat. Therefore, they are held at an environmental premium. Consequently, an important aspect of this study with respect to effluent discharge is the distribution and proximity of hard substrate to the discharge channel. The area in the immediate vicinity of the discharge is sand with hard substrate beginning at approximately 2,200 ft upcoast and 1,200-1,500 ft downcoast of the discharge channel. However, the sediment cover in these areas is highly variable in response to typically bi-annual beach disposal of dredged sand from Agua Hedionda Lagoon as well as seasonal variations in the equilibrium beach profiles.

Applicable Plans and Policies

The State Water Resources Control Board (SWRCB) has established objectives for the protection of marine water quality in the California Ocean Plan and the Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California (Thermal Plan). The objectives and standards represent levels that allow beneficial uses of the water to continue unimpaired. Some of the objectives and standards from the Ocean Plan and Thermal Plan include the following:

- ***Thermal Plan:*** Water quality objectives for existing discharge into coastal waters require that elevated temperature wastes shall comply with limitations necessary to assure protection of the beneficial uses and areas of special biological significance. Water quality objectives for new discharges to coastal waters require that: (1) Elevated temperature wastes shall be discharged to the open ocean away from the shoreline to achieve dispersion through the vertical water column; (2) Elevated temperature wastes shall be discharged a sufficient distance from areas of special biological significance to assure the maintenance of natural temperature in these areas; (3) The maximum temperature of thermal waste discharges shall not exceed the natural temperature of receiving waters by more than 20°F; (4) The discharge of elevated temperature wastes shall not result in increases in the natural water temperature exceeding 4°F at (a) the shoreline, (b) the surface of any ocean substrate, or (c) the ocean surface beyond 1,000 feet from the discharge system. The surface temperature limitation shall be maintained at least 50 percent of the duration of any complete tidal cycle; and (5) Additional limitations shall be imposed when necessary to assure protection of beneficial uses.

- ***Bacterial Characteristics:*** Samples of water from each sampling station shall have a density of total coliform less than 1,000 per 100 ml (10 per ml), provided that not more than 20 percent of the samples at any sampling station, in any 30-day period, may exceed 1,000 per 100 ml (10 per ml), and provided further that no single sample when verified by a repeat sample taken within 48 hours shall exceed 10,000 per 100 ml (100 per ml). In addition, the fecal coliform density based on a minimum of not less than five samples for any 30-day period, shall not exceed a geometric mean of 200 per 100 ml nor shall more than 10 percent of the total samples during any 60-day period exceed 400 per 100 ml. For all areas where shellfish may be harvested for human consumption, as determined by the Regional Board, the median total coliform density shall not exceed 70 per 100 ml, and not more than 10 percent of the samples shall exceed 230 per 100 ml.

- ***Physical Characteristics:*** Ocean waters shall be free of visible floating particulates, grease, oil, and discoloration. Natural light shall not be significantly reduced at any point outside the initial dilution zone as the result of the discharge of waste. In addition, the rate of deposition of inert solids and the characteristics of inert solids in ocean sediments shall not be changed such that benthic communities are degraded.

- ***Chemical Characteristics:*** The dissolved oxygen concentration shall not at any time be depressed more than 10 percent from that which occurs naturally as a result of the discharge of oxygen demanding waste materials, while the pH shall not be changed at any time more than 0.2 units from that which occurs naturally. In addition, the amounts of dissolved sulfide, nutrient materials, and harmful substances in marine sediments shall be limited so as not to negatively impact marine life.

- ***Biological Characteristics:*** Marine communities, including vertebrate, invertebrate, and plant species shall not be degraded (i.e. significant differences in major biotic groups). In addition, the natural taste, odor, and color of marine resources used for human consumption shall not be altered, nor shall the concentration of organic materials bioaccumulate to levels that are harmful to human health.

- ***Radioactivity:*** Discharge of radioactive waste shall not degrade marine life.

- ***General Requirements:*** 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.

National Pollutant Discharge Elimination System (NPDES)

In order to discharge effluent to the ocean, an NPDES permit is required. The San Diego Regional Water Quality Control Board is responsible for issuing this permit, which must meet the requirements of the Federal Clean Water Act, California Water Code, California Ocean Plan, and Comprehensive Water Quality Control Plan (Basin Plan) for the San Diego Region. The California Ocean Plan sets the concentration limitations for contaminants in receiving waters that would apply to the proposed discharge outside the zone of initial dilution (ZID).

4.7.3 Significance Criteria

The California Ocean Plan does not specify requirements or water quality objectives concerning reverse osmosis concentrate discharge. However, 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:

- 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.

In addition, based on the CEQA Guidelines, Appendix G, the project would have a significant effect related to hydrology and water quality if it would:

- Violate any water quality standards or waste discharge requirements;
- Substantially deplete groundwater supplies or interfere substantially with ground water recharge such that there would be a net deficit in aquifer volume or a lowering of the local ground water table level (i.e., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted);
- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site;
- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner, which would result in flooding on- or off-site;
- Create or contribute runoff water, which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff;
- Otherwise substantially degrade water quality;
- Place housing within a 100-year flood hazard area as mapped on a Federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood delineation map;
- Place within 100-year flood hazard area structures, which would impede or redirect flood flows;
- Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam;
- Result in inundation by seiche, tsunami, or mudflow;

4.7.4 Impacts

Short-Term Surface Water Quality Impacts

During construction of the off-site pipeline areas and the plant site, bare soils would be exposed; soil and material stockpiles would be established; and fuels, lubricants and solid and liquid wastes would be stored within active construction areas. If the construction areas are not properly managed to contain loose soils and liquid and solid contaminants, potentially significant short-term water quality impacts could occur.

Since the project (plant site and offsite pipeline areas) would disturb more than one acre of soil, the applicant must file a Notice of Intent (NOI) with the RWQCB and obtain a General Construction Activity Storm Water Permit, pursuant to the NPDES regulations established under the Clean Water Act (CWA). This permit requires preparation and implementation of a Storm Water Pollution Prevention Plan (SWPPP), which is intended to prevent degradation of surface and ground waters during the grading and construction process. Significant impacts would be avoided through implementation of Best Management Practices (BMPs) that would address erosion/sedimentation, spill prevention, waste management, dust suppression, cleaning and maintenance measures that will be part of the General Construction Activity Stormwater Permit. Minimum requirements for construction BMPs that would reduce impacts to less than significant levels are provided below in *Section 4.7.5*. For impacts related to the development of the desalination plant in particular, the project will also require preparation of a Storm Water Management Plan (SWMP) to demonstrate compliance with the City of Carlsbad Standard Urban Stormwater Mitigation Plan (SUSMP).

Long-Term Surface Water Quality Impacts

As the proposed off-site pipelines would be subsurface, and would not result in an increase in impervious surfaces, or long-term pollutant discharges, there are no expected long-term impacts to hydrology and water quality. Long-term water quality impacts at the desalination plant site are discussed below.

Flooding

As discussed above under Existing Conditions, the proposed plant site is not located within flood zones, however, some of the off-site pipeline areas are located in 100-year flood zones. During construction, placement of construction materials, including equipment, pipes, shoring, and spoils, could temporarily impede or redirect flows. While these impacts are temporary, a proposed mitigation measure requires the applicant to construct in the flood zones only in the dry months (May to September) unless otherwise determined acceptable by the City following review of construction details and plans. Following pipeline construction, surface features would be restored. Operation of the off-site pipelines would not impede or redirect flood flows, and would not expose people or structures to flooding as the pipelines would be underground.

Storm Water Drainage

The proposed grading activities and development of the proposed desalination plant site would result in a minor increase of impervious surface (2.5 acres) from the plant building and structures, an expanded access road turnaround, and small parking area associated with the new plant. The project proposes to capture runoff from the roof of the desalination plant and parking areas and convey the runoff to the source water intake for filtration and ultimate domestic use. Remaining additional flows from the other minor improvements as noted will be routed into the existing stormwater conveyance system, which will subsequently be added to the discharge channel into the ocean.

A Storm Water Management Plan (SWMP) will be completed for the proposed project as required by the Regional Water Quality Control Board (RWQCB). In addition, as required by NPDES, a Storm Water Pollution Prevention Plan (SWPPP) will be developed to assure that attention will be focused on controlling those on-site contaminants that could affect stormwater runoff. Minimum requirements for those plans are included as mitigation measures, outlined below.

Construction of the off-site pipelines would not result in increased impervious surface and would not impact storm water drainage. Due to its limited size, the offsite pump station would result in a negligible amount of impervious surfaces being created. Project impacts to storm water drainage would be less than significant.

Desalination Plant Source Water

Suppliers of domestic water must obtain a supply permit from the California Department of Health Services (DHS). In addition, the Safe Drinking Water Act (SDWA) designates that the Federal EPA set standards for contaminants in drinking water, with the DHS responsible for enforcement. The California Surface Water Treatment Regulation (SWTR) requires public water suppliers who utilize surface waters to conduct a sanitary survey of the watershed every five years. This survey should evaluate watershed contaminant sources, source water quality, water treatment capabilities, and treated water quality. The sanitary survey should also include recommendations for improving and protecting source water quality. In order to obtain a new domestic water supply permit, the DHS also requires a source water assessment, which delineates watershed and protection zones, specifies contamination sources, and assesses the significance of those contaminants at the water treatment plant intake. The study must meet the requirements of the Drinking Water Source Assessment and Protection Program (DWSAP).

The supply water for the desalination plant will come from the cooling system discharge of the EPS, which draws its water directly from the Agua Hedionda Lagoon. The lagoon consists of three shallow water basins containing approximately 230 acres of water surface. The lagoon is kept permanently open to the Pacific Ocean by the combination of a rip rap inlet jetty with maintenance dredging. Freshwater flows into the lagoon is primarily from Agua Hedionda Creek. The Agua Hedionda Lagoon watershed covers approximately 30 square miles and includes parts of the cities of Carlsbad, Oceanside, and Vista and the unincorporated communities of Buena and Twin Oaks .

Ocean Water Quality – Effects of Desalination Plant Discharge

The primary issues related to ocean water quality are associated with increased salinity in the discharge from the reverse osmosis process. Operation of the proposed plant would result in production of up to 50 million gallons per day (mgd) of water with twice the salt content of the intake seawater. Potential effects that the discharge of the concentrated seawater could have on the receiving waters is dependent on a number of variables, including the operation of the power plant (how much cooling water is available for dilution prior to discharge into the ocean), and environmental conditions, including variables that have a role in mixing and dispersing the discharge, such as wave action, tidal action, wind action and ambient water salinity and temperature. In order to determine how these variables interact with respect to dispersal of the discharge, a numerical hydrodynamic model was configured to estimate salinity levels under a variety of conditions. The model was calibrated and validated in coastal waters off Southern California prior to this application. The following provides an outline of the model structure.

Hydrodynamic Modeling

A hydrodynamic modeling study was conducted of the nearshore waters in the Pacific Ocean, and the adjacent Agua Hedionda Lagoon (APPENDIX E). The purpose of this study was to evaluate the mixing and dilution of the combined desalination plant/cooling water discharge in the Pacific Ocean, and assess the potential for recirculation of the desalination plant discharge into Agua Hedionda Lagoon.

The amount of salinity from the combined discharge will depend upon the level of operation of the Encina Power Station and the proposed desalination plant. Dispersion of increased salinity in nearshore waters will depend on a variety of environmental factors. Therefore, the model simulated scenarios to show a variety of conditions based on seven controlling variables as further explained below. The model utilizes data collected over a 20.5 year period containing

7,523 consecutive days between 1980 and 2000, to determine impacts under conditions that represent potential scenarios based on historically occurring trends.

Model Input

The seven parameters selected as the most important variables for controlling dilution and dispersion of effluent in the ocean are: 1) ocean temperature, 2) salinity, 3) water level, 4) power plant flow rate, 5) winds, 6) waves, and 7) currents. Oceanographic and wind data available for the area over a 20.5-year historical period were utilized to determine the parameters of the study scenarios. When the necessary data were not available, such as for tidal and wave-driven currents, numerical models were used. The ranges and averages of the parameters controlling the fate of an effluent in the nearshore area are shown in *Table 4.7-1*.

TABLE 4.7-1
Ranges and Averages for Boundary Conditions and Forcing Functions Used in Hydrodynamic Modeling

Parameter (Extent of Data)	Minimum	Maximum	Average
Ocean temperature (surface, daily mean)	9.9° C (49.8 F)	25.1° C (77.2 F)	17.5° C (63.5 F)
Ocean salinity (surface)	31.26 ppt	34.44 ppt	33.52 ppt
Ocean water level (National Geodetic Vertical Datum (NGVD))	-4.66 ft	5.35 ft	0.19 ft
Delta T (1999 data)	Approximately 1.0 C (1.8 F)	Approximately 10 C (18° F)	5.5° C (9.9 F)
Wave height	0.16 m	4.51 m	0.87 m
Tidal Current speed (daily maximums)	8.7 cm/sec	77.1 cm/sec	45.1 cm/sec
Wind speed (daily mean)	0.0 knots	19.6 knots	4.9 knots
Power plant flow rate (1999 data, hourly readings)	Approximately 220 MGD	808 MGD	550 MGD

Hydrodynamic Modeling Scenarios

Various scenarios were examined in the Hydrodynamic Modeling Study (Jenkins and Wasyl 2001 and 2005) using numerical modeling. This section summarizes the results of these studies, which present the mathematics supporting the numerical modeling results in detail. In addition, Jenkins and Wasyl calibrated the numerical model against temperature depth profiles offshore of the project site conducted over a nearshore sampling grid during February and March 1989 (Jenkins et al., 1989).

As noted, the Hydrodynamic Modeling Study addresses the extreme and average cases based on historical trends. For the historical extreme case, it is assumed that only the cooling water circulation pumps for Unit 4 would be in operation. There are two pumps associated with Unit 4. Consideration of the unheated operating condition is important to salinity dilution because the unheated desalination plant discharge is heavier than the heated discharge (heat from power plant cooling provides buoyancy to the discharge and thus results in better dispersion of the combined discharge within the water column), and therefore, bottom salinities are projected to be higher under the unheated scenarios. The following six scenarios were examined (Jenkins and Wasyl, 2001, 2004).

Extreme and Average Cases:

1. A worst-case day,
2. An average day,
3. A worst-case month, and
4. An average month.

Historical Extreme Cases:

1. Unheated Unit 4 (2 cooling water circulation pumps), and
2. Heated Unit 4 (2 cooling water circulation pumps).

The historical worst-case scenarios were based upon simultaneous occurrence of these variables in combination, which would minimize nearshore mixing and heat dissipation and cause elevated temperatures and/or salinities to persist. The criteria used to select the data typifying the worst-case scenarios are given in *Table 4.7-2*.

Discharge Impacts

Salinity

Salinity in this region of the ocean is relatively constant, with maximum variation over a 20.5-year period of approximately 10%. In Southern California (represented by SIO [Scripps Institution of Oceanography] pier data), the average sea-surface salinity was 33.52 ppt and ranged from 31.26 to 34.44 ppt. The distribution of the range around the mean is asymmetrical, with lower values due to freshwater runoff during winter, and higher values due to the upwelling of deeper, more saline waters or the influx of high salinity water mass from Southern Baja California during El Niño summers.

TABLE 4.7-2
Criteria for Selection of Historical Worst-Case Scenario Combinations of Variables

Variable	Search Criteria of Jenkins & Wasyl (2001)	Explanation of Search Criteria Choice
Plant Flow Rate	Maximize (for thermal impacts) Minimize (for saline impacts)	High flow increases heat discharge and increases potential for recirculation. Low flow reduces in-the-pipe dilution of sea salts.
Ocean Salinity	Maximize	Higher ocean S% leads to higher RO discharge concentration.
Ocean Temperature	Maximize	Higher temperatures cause greater stress on marine organisms.
Ocean Water Levels	Minimize	Lower water levels result in less mixing in discharge channel.
Waves	Minimize	Smaller waves result in less mixing in the surfzone.
Currents	Minimize	Weaker currents result in less advection and less offshore dilution.
Winds	Minimize	Weaker winds result in less surface mixing and less dilution, both inshore and offshore.

The present discharge from the Encina Power Station results in a surface plume due to the thermally buoyant properties of the effluent. In contrast, the desalination plant's concentrate discharge would be denser than the ambient seawater, and the discharge plume would sink under every operational condition. During periods of reduced mixing, the primary impact on the marine environment will be on the benthic community. As noted in *Table 4.7-3*, on the seafloor at the edge of the ZID, maximum salinities for the four scenarios of worst-day, worst-month, average-day, and average-month will exceed the range of natural variability by less than 0.8 ppt. The results for the historical worst-case scenarios indicate that the natural range of salinity would be exceeded by less than 15 percent due to reduced flow from the power plant and the simultaneous occurrence of minimal natural mixing conditions in the vicinity of the discharge channel.. Under these conditions the salinities were projected to be 1.9 to 3.8 ppt above the natural range of ocean salinity.

TABLE 4.7-3
Average and Worst-Case Scenarios for Thermal and Salinity Impacts on the Seafloor at the Edge of the Zone of Initial Dilution

Scenario	Plant Inflow Rate (MGD)	Bottom Minimum Dilution Factor (1000 ft from discharge jetties)	Bottom Maximum Salinity Anomaly (ppt)			Bottom Temperature Anomaly (° C) (1000 ft from discharge jetties)	Probability of Occurrence
			(1,000 ft from discharge jetties)	Above Average Ambient (1,000 ft from discharge jetties)	Above Maximum Ambient (1,000 ft from discharge jetties)		
Worst day	726	20 to 1	35.2	1.7	0.8	1.7	less than 1%
Average day	576	32 to 1	34.6	1.1	0.2	0.8	---
Worst month	703	25 to 1	34.8	1.3	0.4	1.2	less than 1%
Average month	527	35 to 1	34.4	0.9	0	0.8	---
Unit 4 historical extreme (2 pumps, unheated)	304	7.1 to 1	38.2	4.7	3.8	0	less than 1%
Unit 4 historical extreme (2 pumps, heated)	304	12 to 1	36.3	2.8	1.9	-	less than 1%

The worst-day and worst-month scenarios were based on extreme historical operating conditions. However, saline impacts were minimal because the initial dilution was high (high discharge flow rate from the Encina Power Station due to high energy demand). The temperature change data input to the model was kept constant at 5.5 °C (9.9 °F). Thermal impacts were within the limits of the Thermal Plan. *Figure 4.7-1* shows how the discharge flow rate of the power plant affects the end-of-pipe salinity. As shown in *Figure 4.7-1*, the salinity of the desalination plant discharge increases sharply once the power plant flow rate drops below the historical extreme operating scenario (Unit-4 scenario of 304 mgd).

Consideration of the unheated operating condition is important to salinity dilution because as previously noted, the unheated concentrate discharge is heavier than the heated discharge (heat from power plant cooling provides buoyancy to the discharge and thus results in better dispersion of the hypersaline discharge within the water column), and therefore, bottom salinities are projected to be higher under the unheated scenarios.

Figure 4.7-1

The following *Table 4.7-4* provides a summary of salinity ranges under the "historical extreme" operational scenario:

TABLE 4.7-4
Maximum Salinities for
Unit 4 Historical Extreme (2 pumps, unheated) Operating Scenarios

Scenario 50 MGD/ RO Process	Plant Inflow Rate (MGD)	Bottom Maximum Salinity (point of discharge)	Bottom Maximum Salinity (1,000 ft from discharge jetties)	Water Column Maximum Salinity (depth averaged)	Water Column Maximum Salinity (1,000 ft from discharge jetties)	Modeled Probability of Occurrence
Unit 4 historical extreme (2 pumps, unheated)	304	40.11 ppt	38.2 ppt	36.0 ppt	35.2 ppt	less than 1%

To better understand the probability of occurrence for this extreme scenario, as reported in the right column in *Table 4.7-4, Figure 4.7-2* displays salinity levels by their percentage of occurrence and cumulative probablility.

Figure 4.7-2 provides a context for consideration of the likelihood of occurrence for the various operating scenarios analyzed. As noted in *Figure 4.7-2*, the highest likelihood of occurrence data are clustered around the historical average power plant cooling water flow rate. Because the Unit 4 historical extreme scenario requires the simultaneous occurrence of low power plant flow rate and minimal natural mixing conditions in the vicinity of the discharge channel, it has a less than 1% probability of occurrence.

The historical record of plant flow and environmental variables on which *Figure 4.7.2* is based indicates that 95% of the time the maximum salinity at the edge of the ZID would be less than 36.2. Extended exposure to salinity levels above 40 ppt would be avoided under all proposed operating conditions. As measured against the significance thresholds, an end-of-pipe salinity greater than 40 ppt has a probability of occurrence that is also less than 1%. The salinity levels for the hard bottom habitat will always be below the significance criteria established for this habitat (38.4 ppt).

In addition, as noted in *Section 4.3*, salinity levels anticipated under the "historical extreme" scenario with 254 mgd of net flow combined with the simultaneous occurrence of minimal natural mixing conditions in the vicinity of the discharge channel would have a likelihood of less than 1% occurrence and were not found to result in any substantial adverse effects to marine

Figure 4.7-2

organisms found within the project vicinity. Therefore no significant effects would occur under this "historical extreme" scenario. Therefore impacts to ocean water quality resulting from desalination plant operations would be less than significant.

Temperature

Ocean temperatures in the vicinity of the Encina Power Station are characterized by the data from the Scripps Institution of Oceanography pier. Sea surface temperatures over a 20.5-year period ranged from 9.9 ^{o}C to 25.1 ^{o}C (49.8 ^{o} F to 77.2 ^{o}F), with a mean of 17.5 ^{o}C (63.5 ^{o}F).

Thermal objectives for discharge from new facilities are defined in the California Ocean Plan. The most relevant requirement is as follows:

- The discharge of elevated temperature wastes should not result in increases in the natural water temperature exceeding 2.2 ^{o}C (4 ^{o}F) at the (a) shoreline, (b) surface of any ocean substrate, or c) ocean surface beyond 305 m (1000 ft) from the discharge system. The surface temperature limitation shall be maintained at least 50% of the duration of any complete tidal cycle.

As described above, the combined discharge is denser than the ambient seawater, even under conditions when heated discharge from the power plant is assumed. It therefore, sinks under all operating conditions. Relative to the California Ocean Plan objectives, the Unit 4 Historical Extreme (heated) does not result in thermal increase of 2.2 ^{o}C (4 ^{o}F) or greater at any point. The historical extreme case that assumes no power plant heating has no thermal impacts. Therefore, impacts related to thermal discharge are considered to be less than significant under all operating scenarios.

Recirculation and Impact on the Lagoon

The potential for the recirculation of the discharge back into the lagoon and into the intake was examined and found to be insignificant.

The intake for the power plant is located in the southwestern portion of the western basin of the Agua Hedionda Lagoon. The models examined the potential for recirculation by computing dilution throughout the lagoon. The worst-case condition resulted in a bottom salinity at the inlet of the lagoon of less than 33.7 ppt. This salinity value falls below the threshold of 36.8 ppt and impacts are considered to be less than significant. Dilution of the combined discharge (heat and sea salt concentrate) within the lagoon varied from 1,000 to 1 at the west end of the West Basin, increasing to 300,000 to 1 at the plant intake and in the East Basin. Therefore, the recirculation of the combined thermal and saline discharge is negligible and less than significant.

Sediment Transport

The combined discharge will have less than significant impacts on sediment transport compared to the currently permitted, power-plant-only discharge. Since the combined discharge volume will be lessened, the discharge-stream offshore velocity will also be lessened, thereby lessening the overall impact on natural longshore sand transport.

Chemicals, Metals, and Cleaning Solutions

As described in *Section 3.0, Project Description,* various chemicals and cleaning solutions will be used in the desalination process. The pretreatment of the water with ferric sulphate and the intermittent pulsing of sodium hypochlorite (chlorine) will have no impacts on ocean water quality, because the flocculated ferric sulphate will be removed by sand filters, and the chlorine will be scrubbed with sodium bisulfite prior to passing through the RO membranes. The intermittent use of sodium bisulfite may also lower the dissolved oxygen during the period of chlorine treatment, which generally lasts for a few hours. The California Ocean Plan limits the decrease in dissolved oxygen to no more than 10% of the ambient level at the edge of the ZID. The seawater is slightly alkaline (has pH of 7.8 to 8.3) and sulfuric acid would be added as needed to make the natural source seawater more neutral before membrane treatment. The maximum dosage of sulfuric acid that may be used for seawater alkalinity neutralization is 30 mg/L. Typically, this dosage will be between 15 and 20 mg/L.

Because the seawater has a high alkalinity, the amount of hydroxide ions in the seawater is more than 10 times higher than the amount of hydrogen ions. Sulfuric acid, which contains an excess of hydrogen ions, is added in dosage to bring a balance between the hydroxide and hydrogen ions in the source seawater, i.e. to reduce the pH from alkaline (pH of 7.8 to 8.3) to neutral (pH of 7). The added sulfuric acid reacts with the seawater creating two environmentally safe products: water (from the reaction of the excess hydroxide ions of the seawater and excess hydrogen ions of the acid) and sulfates. When the concentrate is mixed with the power plant discharge, the pH of the combined discharge is increased to 7.8, within the range of ambient conditions. Therefore sulfuric acid addition is not expected to result in non-compliance with the Ocean Plan pH limit of 0.2 pH unit deviation from the ambient ocean water.

All piping and other desalination plant materials in contact with the seawater will be made of high-grade stainless steel, concrete or plastic. Therefore, no significant amount of corrosion byproducts is expected in the desalination plant discharge.

Table 4.7-5 shows the naturally occurring metals found in seawater, the desalination plant discharge concentrations, and the minimum initial dilution required to meet the California Ocean Plan water quality objectives. Based on this table, the initial minimum dilution required to meet the water quality objectives would be one part seawater to one part RO discharge.

TABLE 4.7-5
California Ocean Plan Water Quality Limitations

Parameter	Unit	Water Quality Objective, 6-Month Median (Co)	Water Quality Objective, Daily Maximum	Background Seawater Concentration (Cs)	RO Discharge Concentration (Ce)	Minimum Dilution Requirement (Dm)
Arsenic	µg/L	-	8	3	6	None
Copper	µg/L	3	12	2	4	1
Mercury	µg/L	0.04	0.16	0.0005	0.001	None
Silver	µg/L	0.7	2.8	0.16	0.32	None
Zinc	µg/L	20	80	8	16	None

Under all operating scenarios, including the Unit 4 and Historical Extreme case, the 1:1 minimum dilution requirement is achieved. Therefore, impacts would be less than significant.

Surfing Points

A delta formation has formed seaward of the outlet jetties on an otherwise simple plane beach profile, creating a surfing break. This surfing point is known as “Warm Water Jetties,” because the water directly around the jetties is significantly warmer than that of the neighboring beach.

By providing relief in the bathymetry, the delta produces surfable waves and is essentially a ramp/focus configuration (Scarfe, Elwany, Black, and Mead, 2003). The ramp acts to reduce the directional spread of waves approaching the shore and steepens them through the shoaling process. Surfing quality varies with tide, swell, and delta shape, and conditions are best when there is a large quantity of sand.

During operation of the desalination plant, the flow will be reduced by roughly 5%, thus possibly reducing the quantity of sand to the delta. This slight change should not affect surf quality, but it may move the delta slightly inshore. In addition, smaller scale wedge features may appear inshore of the delta. These conditions may create longer surfing rides, but would not substantially affect water quality, or recreational opportunities.

4.7.5 Mitigation Measures

4.7-1 Prior to issuance of a grading permits, building permit or demolition permit, whichever occurs first s or other permits, the project applicant shall demonstrate compliance with all applicable regulations established by the United States Environmental Protection Agency (USEPA) as set forth in the National Pollutant Discharge Elimination System (NPDES) permit requirements for urban runoff and storm water discharge and any regulations adopted by the city within which construction will take place, pursuant to the NPDES regulations or requirements of that city (Carlsbad, Oceanside and Vista). Further, the applicant shall file a Notice of Intent (NOI) with the State Water Resources Control Board to obtain coverage under the NPDES General Permit for Storm Water Discharges Associated with Construction Activity and shall implement a Storm Water Pollution Prevention Plan (SWPPP) concurrent with the commencement of grading activities. The SWPPP shall include both construction and post-construction pollution prevention and pollution control measures and shall identify funding mechanisms for post-construction control measures. The SWPPP shall also be sent to the North County Transit District for review and comment.

The following best management practices shall be adhered to during construction:

- Gravel bags, silt fences, etc. shall be placed along the edge of all work areas as determined appropriate by the City's construction inspector in order to contain particulates prior to contact with receiving waters.
- All concrete washing and spoils dumping will occur in a designated location.
- Construction stockpiles will be covered in order to prevent blow-off or runoff during weather events.
- A pollution control education plan shall be developed by the General Contractor and implemented throughout all phases of development and construction.
- Severe weather event erosion control materials and devices shall be stored onsite for use as needed.
- Other best management practices as determined necessary by the cities.

4.7-2 Prior to issuance of grading or building permits, whichever occurs first, the applicant shall submit for City approval a Storm Water Management Plan (SWMP). The SWMP shall demonstrate compliance with the city of Carlsbad Standard Urban Storm water Mitigation Plan (SUSMP), Order 2001-01, issued by the San Diego Region of the California Regional Water Quality Control Board and City of Carlsbad Municipal Code.

4.7-3 Construction within any area the City of Carlsbad identifies as a 100-year flood hazard shall occur only during dry months (May 1 – September 30). The City may waive this restriction if the applicant satisfactorily demonstrates, as determined by the City, that construction would not impede or redirect flood flows and would not expose people or structures to flooding. Such demonstration shall occur before the City issues grading or other permits to permit construction in the flood hazard area in the wet months and may require the applicant to submit plans and details regarding the type, location, quantities and duration of construction equipment and materials as well as any other information that the City may require.

4.7.6 Level of Significance After Mitigation

No significant impacts to hydrology or water quality would result after implementation of mitigation measures.