CARLSBAD SEAWATER DESALINATION PROJECT

SAN DIEGO REGIONAL WATER QUALITY CONTROL BOARD

REGION 9, SAN DIEGO REGION

ORDER NO. R-9-2006-0065

NPDES NO. CA0109223

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April 9, 2008

FLOW, ENTRAINMENT AND IMPINGEMENT MINIMIZATION PLAN

March 6, 2008

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EXECUTIVE SUMMARY

PLAN PURPOSE

The San Diego Regional Water Quality Control Board (Regional Board) adopted Order No. R9-2006-0065 (Permit) for Poseidon Resources Corporation's (Poseidon) Carlsbad Desalination Project (CDP) discharge to the Pacific Ocean via the existing Encina Power Station (EPS) discharge channel. The CDP is planned to operate in conjunction with the EPS by using the EPS cooling water discharge as its source water whenever the power plant is operating.

In the event that the EPS were to cease operations, and Poseidon were to independently operate the seawater intake and outfall for the benefit of the CDP, such independent operation will require additional review pursuant to Water Code Section 13142.5(b). Water Code Section 13142.5(b) requires industrial facilities using seawater for processing to use the best available site, design, technology, *and* mitigation feasible to minimize impacts to marine life.

This Flow, Entrainment and Impingement Minimization Plan (Plan) is developed in fulfillment of the above-stated requirements and contains site-specific activities, procedures, practices and mitigation plans which Poseidon proposes to implement to minimize impacts to marine organisms when the Carlsbad Desalination Project intake requirements exceed the volume of water being discharged by the EPS.

PLAN COMPLIANCE

As shown in Table ES-1, the Plan addresses each of the provisions of Water Code Section 13142.5(b):

- Identifies the best available site feasible to minimize Project related impacts to marine life;
- Identifies the best available design feasible to minimize Project related impacts to marine life;
- Identifies the best available technology feasible to minimize Project related impacts to marine life;
- Quantifies the unavoidable impacts to marine life; and
- Establishes a state-agency coordinated process for identification of the best available mitigation feasible to minimize Project related impacts to marine life.

Table ES-1 Design, Technology and Mitigation Measures to Minimize Impacts to Marine Life		
Category	**Feature**	**Result**
1. Site	Proposed location at Encina Power Station (EPS)	Best available site for the project, no feasible and less environmentally damaging alternative locations.
1. Design	Use of EPS discharge as source water	Sixty-one percent reduction of entrainment and impingement impacts attributable to the CDP
2. Design	Reduction in inlet screen velocity	Reduction of impingement of marine organisms
3. Design	Reduction in fine screen velocity	Reduction of impingement of marine organisms
4. Design	Ambient temperature processing	Eliminate entrainment mortality associated with the elevated seawater temperature
5. Design	Elimination of heat treatment	Eliminate mortality associated with heat treatment.
1. Technology	Installation of VFDs on CDP intake pumps	Reduce the total intake flow for the desalination facility to no more than that needed at any given time, thereby minimizing the entrainment of marine organisms.
2. Technology	Installation of micro-screens	Micro-screens (120 μ) minimize entrainment and impingement impacts to marine organisms by screening the fish larvae and plankton from the seawater.
3. Technology	Installation of low impact prefiltration technology	UF filtrations system minimizes entrainment and impingement impacts to marine organisms by screening the small plankton from the seawater.
4. Technology	Return to the ocean of marine organisms captured by the screens and filters	Minimize entrainment and impingement impacts to marine organisms captured by the screens and filters by returning the organisms to the ocean.
5. Technology	After ten years of operation, State Lands Commission (SLC) to analyze environmental effects of facility and the availability of alternative technologies that may reduce any impacts.	SLC may require Poseidon install additional technology as are reasonable and as are consistent with applicable state and federal laws and regulations. This ensures that the CDP operations at that time are using technologies that the SLC determines may reduce any impacts and are appropriate in light of environmental review.
1. Mitigation	Implementation of project mitigation plan developed pursuant to a state-agency coordinated process described in Chapter 6.	Compensate for unavoidable entrainment and impingement impacts and enhance the coastal environment.
2. Mitigation	Preservation of Agua Hedionda Lagoon though continued maintenance dredging and Lagoon stewardship.	Preserve and protect highly productive marine habitat; maintain and enhance opportunities for public access and recreation; provide sand for beach replenishment and grunion spawning habitat; maintain adequate water quality to support aquaculture, fish hatchery and natural fish habitat; and provide a new high-quality water supply.
3. Mitigation	Fund watershed education programs at the AHL Foundation Discovery Center.	Helps ensure the long-term health and vitality of Agua Hedionda Lagoon and the surrounding watershed.

PROPOSED MITIGATION APPROACH

Poseidon is using all feasible methods to minimize or reduce its entrainment impacts. These methods are likely to reduce the Project related impacts to marine life well below the levels identified in Chapter 5. To minimize unavoidable Project related impacts to marine life, Poseidon has voluntarily committed to a state-agency coordinated process to identify the best available mitigation feasible. The objective of the mitigation portion of this plan is to identify mitigation needs, set forth mitigation goals, and present a plan and approach for achieving the goals.

Recognizing that mitigation opportunities in Agua Hedionda Lagoon may be limited, Poseidon proposes a comprehensive but flexible approach for mitigating potential impacts. This approach is based on:

- Conservatively estimating maximum potential impacts
- Identifying goals and objectives of the mitigation program
- Identifying any available mitigation opportunities in Agua Hedionda Lagoon that meet the goals and objectives
- Identifying additional offsite mitigation that meets the mitigation goals
- Developing an action plan and schedule for coordinating with regulatory and resource agencies to finalize locations and acreages selected for the proposed mitigation.

Investigations to date have not identified any mitigation opportunities within Agua Hedionda Lagoon that meet the goals of the program. As a result, the proposed mitigation plan includes a core offsite mitigation program that meets the plan goals and objectives that is being developed in parallel with Poseidon's continued effort to identify feasible mitigation opportunities in Agua Hedionda Lagoon.

Poseidon recognizes the need and priority of implementing mitigation in Agua Hedionda Lagoon if feasible. Poseidon also recognizes that mitigation requirements and regulations of the various review agencies differ, and additional agency coordination is required to insure that needs of all applicable agencies are addressed.

Accordingly, while this plan identifies a core offsite mitigation project, the mitigation plan also presents an implementation action schedule that includes additional coordination activities to either (1) confirm the lack of opportunities, or (2) identify if new mitigation options exist within Agua Hedionda Lagoon.

Poseidon will be contacting the Department of Fish & Game to more fully assess the potential for restoration opportunities in Agua Hedionda Lagoon. If subsequent Agua Hedionda Lagoon mitigation is determined to be feasible, Poseidon will coordinate with regulatory agencies to implement such mitigation.

If Agua Hedionda Lagoon mitigation is confirmed as infeasible, Poseidon will implement the proposed offsite mitigation project.

Table ES-2 summarizes the implementation action schedule for the proposed mitigation plan.

Table ES-2
Mitigation Implementation Approach and Schedule

Element	Actions/Objectives	Schedule
Submittal of draft Minimization Plan to Regional Board	• Public and agency review of revised draft Plan	March 2008
Regional Board consideration of Minimization Plan	• Approval of Plan • Regional Board provides directions on Plan implementation	April 2008
Contacts with California Department of Fish & Game to assess mitigation opportunities in Agua Hedionda Lagoon	• Assess mitigation opportunities for saltwater marsh creation in Agua Hedionda Lagoon via dredging	March 2008
Supplemental contacts with other resource agencies	• Identify (or conform lack of) additional mitigation opportunities in Agua Hedionda Lagoon	April 2008
Convene meeting of resource agencies; Regional Board and Coastal Commission.	• Identify (or confirm lack of) additional mitigation opportunities in Agua Hedionda Lagoon • If applicable, address agency requirements for Agua Hedionda Lagoon mitigation and determine overall implementation feasibility • Address mitigation rations/requirements for core offsite mitigation project in San Dieguito Lagoon	April 2008
Finalize and distribute mitigation program implementation details	• Agency review of implementation details	May 2008
Modify/finalize implementation program details (if applicable)	• Agency review and approval • May involve additional inter-agency coordination meeting	June 2008
Coastal Commission consideration of mitigation project(s)	• Coastal Commission approval of mitigation project	July 2008

REGULATORY ASSURANCE OF PLAN ADEQUACY

There are a number of regulatory assurances in place to confirm the adequacy of the proposed restoration plan. The Regional Board, Coastal Commission and State Lands

Commission have ongoing jurisdiction over the proposed Project to insure the adequacy of the proposed restoration plan.

Additionally, ten years after the lease is issued, that the CDP will be subject to further environmental review by the State Lands Commission (SLC) to analyze all environmental effects of facility operations and alternative technologies that may reduce any impacts found. SLC may require additional requirements as are reasonable and as are consistent with applicable state and federal laws and regulations.

This approach will ensure that the stand-alone CDP operations continue to use the best available site, design, technology and mitigation feasible to minimize Project related impacts to marine life.

CHAPTER 1

INTRODUCTION

1.1 PURPOSE OF THE PLAN

The San Diego Regional Water Quality Control Board (Regional Board) adopted Order No. R9-2006-0065 (Permit) for Poseidon Resources Corporation's (Poseidon) Carlsbad Desalination Project (CDP) discharge to the Pacific Ocean via the existing Encina Power Station (EPS) discharge channel. The CDP is planned to operate in conjunction with the EPS by using the EPS cooling water discharge as its source water whenever the power plant is operating.

When operating in conjunction with the power plant, the desalination plant feedwater intake would not increase the volume or the velocity of the power station cooling water intake. As a result, the incremental impacts to marine associated with the CDP operating in conjunction with the EPS would not trigger the need for additional technology or mitigation to minimize impacts to marine life.

However, in the event that the EPS were to cease operations, and Poseidon were to independently operate the seawater intake and outfall for the benefit of the CDP, such independent operation will require additional review pursuant to Water Code Section 13142.5(b).[1] Water Code Section 13142.5(b) requires industrial facilities using seawater for processing to use the best available <u>site</u>, <u>design</u>, <u>technology</u>, *and* <u>mitigation</u> feasible to minimize impacts to marine life.

The Regional Water Board recognized that future EPS flows may not follow historical trends and required Poseidon prepare this Flow, Entrainment and Impingement Minimization Plan (Minimization Plan) to assess the feasibility of site-specific plans, procedures, and practices to be implemented and/or mitigation measures to minimize the impacts to marine organisms when the CDP intake requirements exceed the volume of water being discharged by the EPS.[2] The Regional Board review and approval of the Minimization Plan will address any additional review required pursuant to Water Code Section 13142.5(b).[3]

This Flow, Entrainment and Impingement Minimization Plan (Plan) is developed in fulfillment of the above-stated requirements and contains site-specific activities, procedures, practices and mitigation measures which are planned to be implemented to

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[1] Permit at F-49.

[2] Permit at Section VI.2.e provides: "The Discharger shall submit a Flow, Entrainment and Impingement Minimization Plan within 180 days of adoption of the Order. The plan shall assess the feasibility of site-specific plans, procedures, and practices to be implemented and/or mitigation measures to minimize the impacts to marine organisms when the CDP intake requirements exceed the volume of water being discharged by the EPS. The plan is subject to the approval of the Regional Water Board and is modified as directed by the Regional Water Board."

[3] Permit at F-50.

minimize impacts to marine organisms when the Carlsbad Desalination Project (hereafter referred to as CDP or Project) intake requirements exceed the volume of water being discharged by the EPS.

1.2 PLAN ORGANIZATION

The Plan is organized so to sequentially analyze the steps that have been take by Poseidon to address each of the provisions of Water Code Section 13142.5(b):

- Chapter 2 identifies best available <u>site</u> feasible to minimize Project related impacts to marine life;

- Chapter 3 identifies best available <u>design</u> feasible to minimize Project related impacts to marine life;

- Chapter 4 evaluates identifies best available <u>technology</u> feasible to minimize Project related impacts to marine life;

- Chapter 5 quantifies the unavoidable impacts to marine life; and

- Chapter 6 establishes a coordinated state-agency directed process for identification of best available <u>mitigation</u> feasible to minimize Project related impacts to marine life

1.3 PLAN DEVELOPMENT

In anticipation that the EPS might not always satisfy the CDP's source water demands, the Regional Board required Poseidon to submit the Plan within 180 days of the adoption of the Permit. The Permit states:[4]

> The Regional Board recognizes that future EPS flows may not follow historical trends. For this reason, it is warranted to require the Discharger prepare a Flow, Entrainment, and Impingement Minimization Plan. The Flow, Entrainment, and Impingement Minimization Plan shall be submitted within 180 days of adoption of the Order. The plan shall assess the feasibility of site-specific plans, procedures, and practices to be implemented and/or mitigation measures to minimize the impacts to marine organisms when the CDP intake requirements exceed the volume of water being discharge by the EPS. The plan shall be subject to the approval of the Regional Water Board and shall be modified as directed by the Regional Water Board.

[4] Permit at F-48.

The Plan has been under development for past 12 months. The original Plan was submitted to the Regional Board on February 12, 2007. Shortly thereafter, the Regional Board posted the Plan and related correspondence on its website for public review and comment. Poseidon revised the Plan in response to comments received from the Regional Board and the public and resubmitted it to the Regional Board on July 2, 2007.

The Regional Board posted the revised Plan and related correspondence on its website for public review and comment. To supplement the Plan, Poseidon also submitted to the Regional Board a Coastal Habitat Restoration and Enhancement Plan (CHREP) that includes a summary projects to accomplish the mitigation element of the Plan. On February 19, 2008, the Regional Board provided Poseidon with written comments from its review of the revised Plan and CHREP. In response to Regional Board comments, Poseidon submitted this revised Plan dated March 4, 2008 to the Regional Board. The revised Plan is subject to the approval of the Regional Board.

CHAPTER 2

SITE

INTRODUCTION

Pursuant to Water Code Section 13142.5(b), this Chapter identifies the best available site feasible to minimize Project related impacts to marine life. This Chapter is broken down into four sections:

- *The first section describes the proposed site and existing power plant facilities.*
- *The second section describes alternative sites that were considered and rejected.*
- *The third section describes why the proposed Project location is the best available site feasible to minimize Project related impacts to marine life.*
- *The fourth section concludes that proposed location for the Project is the best available and there are no feasible and less environmentally damaging alternative locations.*

2.1 PROPOSED SITE

The Carlsbad Desalination Project (CDP) is proposed to be located adjacent to the Encina Power Station (EPS) owned by Cabrillo Power I LLC (Cabrillo). An important consideration for this location is the availability of an existing seawater intake and discharge facilities as well as close proximity to the local regional water distribution systems. The desalination plant would be located on a site currently occupied by a surplus fuel oil storage tank. The tank would be removed, and the desalination plant would be constructed in its place. Integration of the operation of the desalination facility with the existing power plant operation would require two main points of interconnection – seawater intake and concentrate discharge.

The Encina Power Plant withdraws cooling water from the Pacific Ocean via Agua Hedionda Lagoon. After passing through the intake structure (Figure 2-1), trash racks, and traveling screens, the cooling water is pumped through the condensers for the five steam generator units located on site. Depending on the number of generating units in operation, the amount of cooling water circulated through the plant ranges from zero to over 800 MGD.

Figure 2-1 Intake Structure

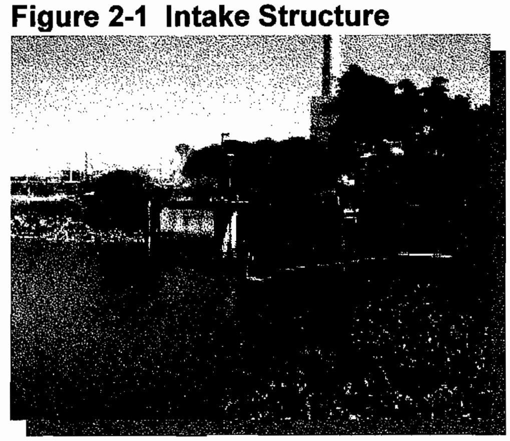


Figure 2-2 Discharge Pond

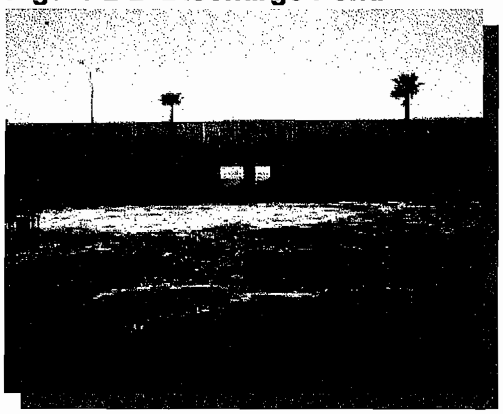
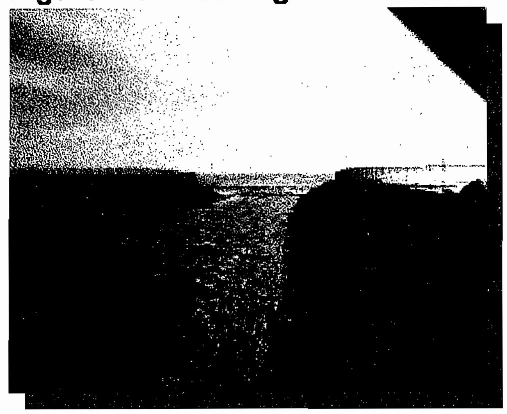


Figure 2-3 Discharge Channel



The primary diversion point for the source of water to the desalination plant would be downstream of the condenser outlet.

The seawater intake would divert seawater from the power plant's cooling water discharge channel to the inlet of the desalination facility. The intake facilities would consist of a diversion structure, pipeline, and a pump station to transport water from the cooling water discharge channel to the inlet of the desalination facility. The pump station would consist of high-volume, low-head vertical turbine pumps.

The EPS discharges seawater to the Pacific Ocean via a discharge pond (Figure 2-2) and channel that extends 500 feet west of Carlsbad Boulevard (Figure 2-3). The concentrated seawater from the desalination process would be mixed with power plant discharge. The discharge facilities would consist of a pipeline (up to 48-inch diameter) from the outlet of the desalination facility back to the existing discharge channel. The discharge point would be located downstream of the diversion point for the intake to prevent re-circulation of the concentrate back to the inlet of the desalination facility.

2.1.1 Existing Power Plant Facilities

The EPS is a once-through cooling power plant which uses seawater to remove waste heat from the power generation process. Cooling water is withdrawn from the Pacific Ocean via the Aqua Hedionda Lagoon. The cooling water intake structure complex is located approximately 2,200 feet from the ocean inlet of the lagoon. Variations in the water surface level due to tide are from low -5.07 feet to a high +4.83 feet from the mean sea level (MSL). The intake structure is located in the lagoon approximately 525 feet north of the generating units.

The mouth of the intake structure is 49 feet wide. Water passes first trough metal coarse screens (trash racks with vertical bars spaced 3-1/2 inches apart) to screen large debris and marine life. The intake forebay tapers into two 12-foot wide intake tunnels. From these tunnels the seawater flow is split among four six-foot wide conveyance tunnels. Tunnels 1 and 2 deliver seawater to intakes for power plant generation Units 1, 2 and 3. Tunnels 3 and 4 carry cooling water to intakes for power plant generation Units 4 and 5, respectively. Vertical traveling screens are located ahead of each of the intakes of pumps.

Each pump intake consists of two circulating water pump cells and one or two service pump cells. During normal operation, one circulating pump serves each half of the condenser, i.e., when one unit is online, both pumps are in operation.

A total of seven vertical screens are installed to remove marine life and debris that has passed through the trash racks. The screens are conventional through-flow, vertically rotating, single entry-single exit, band-type metal screens which are mounted in the screen wells of the intake channel. Each screen consists of series of baskets or screen panels attached to a chain drive. The screening surface is made of 3/8-inch stainless steel mesh panels, with the exception of the Unit 5 screens, which have 5/8-inch square openings.

The screens rotate automatically when the buildup of debris on the screening surface causes the water level behind the screen to drop below that of the water in front of the screen and a predetermined water level differential is reached. The screens can also be pre-set to rotate automatically at a present interval of time. The screen's rotational speed is 3 feet per minute, making one complete revolution in approximately 20 minutes. A screen wash system using seawater from the intake tunnel washes debris from the traveling screen into a debris trough. Accumulated debris are discharged periodically back to the ocean via the power plant discharge lagoon. Table 2-1 summarizes the capacity of the individual power plant intake pumps.

The EPS intake pumping station consists of cooling water intake pumps that convey water through the condensers of the electricity generation units of the power plant and has a total capacity of 794.9 MGD (552,000 gpm). The service water pumps have a combined capacity is 62.1 MGD (43,200 gpm). During temporary shutdown of the power plant generation units, only the cooling water pumps are taken out of service. The service water pumps remain in operation at all times in order to maintain the functionality of the power plant. If the power plant is shut down permanently, than the service water pumps will not be operational.

The volume of cooling water passing through the power plant intake power station at any given time is dependent upon the number of cooling water pumps and service water pumps that are in operation. With all of the pumps in operation, the maximum permitted power plant discharge volume is 857 MGD or about 595,000 gallons gpm.

TABLE 2-1

SUMMARY OF EPS POWER GENERATING CAPACITY AND FLOWS

Unit #	Date on Line*	Capacity (MW)	Number of Cooling Water Pumps	Cooling Water Flow (gpm)**	Service Pump Water Flow (gpm)**	Total (MGD)
1	1954	107	2	48,000	3,000	73
2	1956	104	2	48,000	3,000	73
3	1958	110	2	48,000	6,000	78
4	1973	287	2	200,000	13,000	307
5	1978	315	2	208,000	18,200	326
Gas turbine	1968	16	0	0	0	0
			Total:	**552,000**	**43,200**	**857**

* Encina Power Station NPDES Permit No. CA0001350, Order No. 2000-03, SDRWCB.
** Encina Power Station Supplemental 316(b) Report (EA Engineering, Science, and Technology 1997).

2.2 ALTERNATIVE SITES

There are only three possible sites in the City of Carlsbad that could accommodate a project of this nature. These are: (1) the Encina Power Station (EPS); (2) Encina Water Pollution Control Facility (EWPCF); and (3) Maerkle Reservoir. Among these, EPS is the only site in reasonable proximity to the seawater intake, the outfall, and key delivery points of the distribution system of the largest user of the desalinated seawater – the City of Carlsbad. This location allows the Project to optimize the cost of delivery of the produced water and minimize the environmental impacts associated with construction and operation of the Project. This particular site also offers the advantage of avoiding the construction of major new intake and discharge facilities, which provides significant environmental and cost benefits.

The Project EIR analyzed the viability of alternative sites for the seawater desalination plant within the boundaries of the EPS and alternative sites within the boundaries of the EWPCF.[1] The Coastal Commission Staff requested an evaluation of other potential locations for the desalination facility and its associated infrastructure. As a result, Poseidon added the Maerkle Reservoir site to the list of alternative sites to be considered. The sites evaluated by the Poseidon and the City of Carlsbad are the only parcels in the entire City of Carlsbad with compatible land use designation and sufficient space

[1] See Final EIR – 03-05 for the Precise Development Plan and Desalination Plant Project SCH #2004041081, City of Carlsbad, p. 4.8-17, June 13, 2006, Section 6.0, Alternatives to the Proposed Action, Subsection 6.2 - Alternative Site Location, pages 6-1 and 6-2.

available to accommodate the desalination facility. The merits of each site are summarized below.

2.2.1 Encina Power Station.

Alternative sites at the EPS were found infeasible because the power plant owner has reserved the remaining portion of the site to—accommodate future power plant modifications, upgrades or construction of new power plant facilities.

2.2.2 Encina Water Pollution Control Facility.

The site located within the boundaries of the EWPCF can only accommodate a desalination plant with a 10 MGD production capacity, due to outfall constraints. A desalination plant of 10 MGD production capacity will be inadequate to satisfy the demand of even one of the users of desalinated water from the Project – the City of Carlsbad, with a demand of up to 25 MGD. This deficiency renders the use of the EWPCF site infeasible. In addition, the use of this site would require construction of a 2-mile long, 72-inch diameter intake pipeline to convey the source seawater from the power plant cooling canal to the EWPCF site, which would have significant cost impacts on the Project and additional environmental and traffic impacts resulting from the construction of such a large pipeline. Installation of a new intake at the EWPCF site is cost-prohibitive.

2.2.3 Maerkle Reservoir.

Maerkle Reservoir is the only other area within the City of Carlsbad that offers compatible land use and is of suitable size to accommodate the Project. The Maerkle Reservoir site is owned by the City of Carlsbad and is located 10.6 miles east of the proposed Project site.

For a number of reasons, this location does not provide a feasible alternative site. First, the public rights-of-way between Maerkle Reservoir and the Pacific Ocean do not have sufficient space to accommodate a 72-inch intake pipeline and a 48-inch concentrate line (Poseidon, 2007). Second, it would be extremely disruptive to the public and the environment to acquire sufficient public and private property outside existing public rights-of-way to construct the pipelines. Third, over 100 MGD of seawater would have to be pumped to an elevation of 531 feet for processing, compared to pumping the seawater to an elevation of 70 feet at the proposed site. Fourth, because the Maerkle site is zoned as "Open Space," a "Public Utility" zoning designation would be incompatible with the Carlsbad General Plan and the proposed Project would be in direct conflict with the adjacent residential retirement community of Ocean Hills. Fifth, such a proposal would be in direct conflict with the City of Carlsbad's objective *"[t]o locate and design a* *desalination plant in a manner that maximizes efficiency for construction and operation and minimizes environmental effects."*

Finally, the additional construction and operating costs associated with piping and pumping the seawater and concentrate over this additional distance would represent a 20 percent increase in the cost of water. Such an increase in cost would render the Project infeasible while providing no measurable benefit to the public or the environment. An additional 10.6 miles of 72-inch seawater supply line would cost approximately $57.1 million. The enlarged pump station to accommodate the additional 461 feet of pump lift required to move the seawater to the alternative site would cost an additional $8.0 million. The additional cost of the 10.6 mile, 48-inch concentrate return line would be $29.6 million. In summary, the alternative Project site at Maerkle Reservoir would result in a $94.7 million (35 percent) increase in the capital budget for the Project (Poseidon, 2006).

Similarly, the alternative Project site at Maerkle Reservoir would result in three significant changes to the Project operating budget arising out of the increase in the amount of energy necessary to pump seawater to an inland location at a higher elevation, which would result in a net increase in operating cost for the Project. First, the cost to pump the seawater from the intake to the alternative plant site would increase $6.7 million per year. Second, the cost to pump the product water from the plant to the intended use area would decrease $3.0 million per year due to the fact that the product water is being pumped from a starting elevation of 511 feet rather than sea level. Finally, the energy recovery opportunity associated with the discharge of the concentrate from 511 feet down to sea level will result in an additional $1.1 million reduction in operating cost. The net increase in operating cost for the alternative Project located at Maerkle Reservoir would be $2.6 million per year (10 percent) (Poseidon, 2006).

The environmental issues associated with the construction of a 10.6-mile, 72-inch intake pipe and a 10.6-mile, 48–inch discharge line, compared to the proposed single 10.6-mile 48-inch product water conveyance pipeline, would be significant. There would be an approximately 225% increase in the volume of material that would need to be excavated. All of this material would need to be trucked offsite for disposal, resulting in over 200% increase in construction-related air quality impacts and traffic impacts over that already accounted for in the Project EIR due to the hauling of pipeline-related excavation material (Poseidon, 2007).

The 72-inch pipeline would likely be constructed in designated open-space or on private property for almost the entire length of the alignment due to the lack of space for additional utilities within existing rights-of-way. Construction-related activities could cause temporary disruption and impacts to an additional 40 feet of private property or public open space along the entire length of the pipeline. Much of this alignment is sensitive habitat such as coastal sage scrub which may prohibit the construction methods that are the basis of the cost estimates provided above. Alternatively, the construction impacts would require mitigation in the form of replacement habitat per the ratios set forth in section 4.3 of the EIR. Tunneling and mitigation costs associated with this alternative could be in the tens of millions of dollars. For these reasons, the alternative Project location at Maerkle Reservoir is financially and environmentally infeasible. In addition, the alternative location is not properly zoned for a desalination facility.

2.3 BEST AVAILABLE SITE

The proposed location for the CDP at the EPS is the best available site for the Project for a number of reasons:

- The site is properly zoned and the proposed use is consistent with other uses in the area.
- The location of the proposed desalination facility adjacent to the existing EPS has a number of environmental and cost advantages that cannot be matched at any other location within the service area to which water will be delivered. These advantages are as follows:
  - Least environmental impacts;
  - Lowest energy consumption;
  - Least disruption to public and private property;
  - Lowest construction cost; and
  - Lowest operating cost.

The proposed site is the only feasible location for the proposed Project in the service area and presents a unique opportunity for minimizing environmental impacts in a cost-effective manner. Locating the desalination facility further inland increases costs, which would indirectly increase the cost of the water to consumers, and increases construction-related disruptions to the public and the environment due to the need to construct a 72-inch and 48-inch pipeline instead of a single 48-inch pipeline, with no clear environmental benefit. Any of the proposed alternatives to co-location would require fundamental changes to the Project, which in turn would require complete redesign and re-engineering, as well as new entitlements from the City of Carlsbad and a new NPDES permit from the Regional Board. Poseidon has already invested eight years developing and obtaining permits for the Project. The potential delays posed by the alternative locations also would preclude the successful completion of the Project within a reasonable time. Therefore, such alternatives are not feasible.

The City of Carlsbad determined that, from a land use planning perspective, the best site for the desalination facility in the entire City of Carlsbad was the parcel in the northwest corner of the power plant property where Fuel Oil Tank No. 3 is currently located.[2] This location was selected specifically to further the City of Carlsbad Redevelopment Plan goals related to facilitating the conversion and relocation of the power plant east of the railroad tracks and enhancement of commercial and recreational opportunities in the area

[2] Final EIR – 03-05 for the Precise Development Plan and Desalination Plant Project SCH #2004041081, City of Carlsbad, p. 4.8-17, June 13, 2006.

west of the railroad tracks currently occupied by the existing power plant. This location leaves the majority of the site open for potential redevelopment at some future date and will create no significant impacts to relocation of the power plant to a site to the east of the railroad tracks or infrastructure needed to serve a power plant at this location.[3]

The Coastal Act provides for special consideration of coastal-dependent industrial facilities. Even if a coastal-dependent project is found to be inconsistent with certain Coastal Act goals, it can be approved upon application of a three part test – (1) that alternative locations are infeasible or more environmentally damaging; (2) that adverse environmental effects are mitigated to the maximum extent feasible; and (3) that to do otherwise (i.e., deny the project) would adversely affect the public welfare.[4]

The Coastal Commission determined that Poseidon's proposed seawater desalination facility would be a coastal-dependent industrial facility, as it would need to be sited on or adjacent to the sea in order to function at all.[5] In applying the three tests above, the Commission found (1) that there are no feasible and less environmentally damaging alternative locations available the Project;[6] (2) that the proposed Project as conditioned mitigates its impacts to the maximum extent feasible;[7] and (3) that facility is a necessary part of the region's water portfolio and denial of the Project would adversely affect the public welfare.[8]

2.4 CONCLUSION

The proposed location for the CDP at the EPS is the best available site for the Project. There are no feasible and less environmentally damaging alternative locations for the Project.

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[3] Id.
[4] See Coastal Commission Recommended Revised Findings Coastal Development Permit for Poseidon Carlsbad Desalination Project, page 91 of 108; http://documents.coastal.ca.gov/reports/2008/3/W25a-3-2008.pdf
[5] Id.
[6] See Recommended Revised Findings Coastal Development Permit for Poseidon Carlsbad Desalination Project, page 92 of 108; http://documents.coastal.ca.gov/reports/2008/3/W25a-3-2008.pdf
[7] Id. at 93.
[8] Id. at 99 and 100.

CHAPTER 3

DESIGN

INTRODUCTION

Pursuant to Water Code Section 13142.5(b), this Chapter identifies the best available design feasible to minimize Project related impacts to marine life. This Chapter is broken down into eight sections:

- *The first section provides a general description of the design features that have been incorporated into the Project to minimize Project related impacts to marine life.*
- *The second section describes the desalination plant intake and discharge facilities and modes of operation.*
- *The third section describes the design feature to use the power plant discharge to the maximum extent feasible to minimize Project related impacts to marine life.*
- *The fourth section describes the design feature to reduce the velocity of seawater through the intake to the maximum extent feasible to minimize the impacts to marine life.*
- *The fifth section describes the design feature to reduce the velocity of seawater through the fine screens to the maximum extent feasible to minimize the impacts to marine life.*
- *The sixth section describes design feature to process ambient temperature seawater to the maximum extent feasible to minimize temperature related impacts to marine life.*
- *The seventh section describes design feature to eliminate heat treatment to the maximum extent feasible to minimize the impacts to marine life.*
- *The eighth section summarizes the design features and the resulting impact they have on minimizing Project related impacts to marine life.*

3.1 DESIGN FEATURES

The Carlsbad seawater desalination project (CDP) incorporates a number of design features that would minimize impingement and entrainment impacts associated with this project. The CDP is designed to use the existing intake and discharge facilities of the Encina Power Generation Station (EPS). When EPS is producing electricity and using 304 MGD or more of seawater for once-through cooling, the proposed desalination plant operation would cause a *de minimis* increase in impingement and entrainment of marine organisms.

Under conditions when the EPS operation is temporarily or permanently discontinued, the desalination plant will continue to use the existing power plant intake and discharge facilities. Under this condition, the impingement and entrainment impacts of the desalination plant operations would be significantly lower than those caused by the EPS operations at the same intake flow, due to a number of differences in the desalination plant and power plant intake design and operations. The key differences are summarized below and described in the following sections:

1. **Use of EPS discharge as source water for CDP.** In 2007 seawater pumping by the EPS would have met 61 percent of the CPD flow requirements, resulting in a 61 percent reduction of entrainment and impingement impacts attributable to the CDP.

2. **Reduction in inlet screen velocity.** The CPD is designed for intake flow of 304 MGD. At this rate of flow, the velocity of the seawater entering the inlet channel is at or below 0.5 feet per second (fps), resulting in impingement losses being reduced to an insignificant level.

3. **Reduction in fine screen velocity**. Under stand-alone operations, the CDP seawater supply would be pumped through an optimum combination of the existing fine screens and condensers serving the power plant so to minimize the velocity and turbulence of the water moving through the system. Lowering velocity and turbulence of the seawater would lessen the physical damage to marine life; resulting in a reduction of impingement and entrainment mortality.

4. **Ambient temperature processing.** One of the factors contributing to entrainment mortality of marine organisms during power plant operations is the increase of the seawater temperature during the once-through cooling process. Under stand-alone operations, the CDP would be designed to use ambient temperature seawater instead of heated seawater, which would eliminate entrainment mortality associated with the elevated seawater temperature.

5. **Elimination of heat treatment.** Periodic heat treatment of the power plant intake and discharge has significant contribution to entrainment and impingement mortality. Under stand-alone operations of the desalination plant, the heat treatment of the intake and discharge would be discontinued and associated entrainment and impingement mortality would be eliminated.

3.2 DESALINATION PLANT INTAKE AND DISCHARGE CONFIGURATION

The seawater desalination plant intake and discharge facilities would be located adjacent to the Encina Power Plant. A key feature of the proposed design is the direct connection of the desalination plant intake and discharge facilities to the discharge canal of the power generation plant. This approach allows using the power plant cooling water as both source water for the seawater desalination plant and as a blending water to reduce the salinity of the desalination plant concentrate prior to the discharge to the ocean.

Figure 3-1 illustrates the configuration of the desalination plant and EPS intake and discharge facilities. As shown on this figure, under conditions when both the desalination facility and the power plant are operating, seawater collected from Agua Hedionda Lagoon enters the power plant intake facilities, passes through the 3.5-inch inlet screens at the mouth of the intake structure, and subsequently through the vertical travelling screens, and then it is pumped through the plant's condensers. The warm seawater released from the condensers is conveyed to the ocean via discharge canal. The CDP intake structure would be connected to this discharge canal and would divert an average of 104 MGD of the cooling water for production of fresh water.

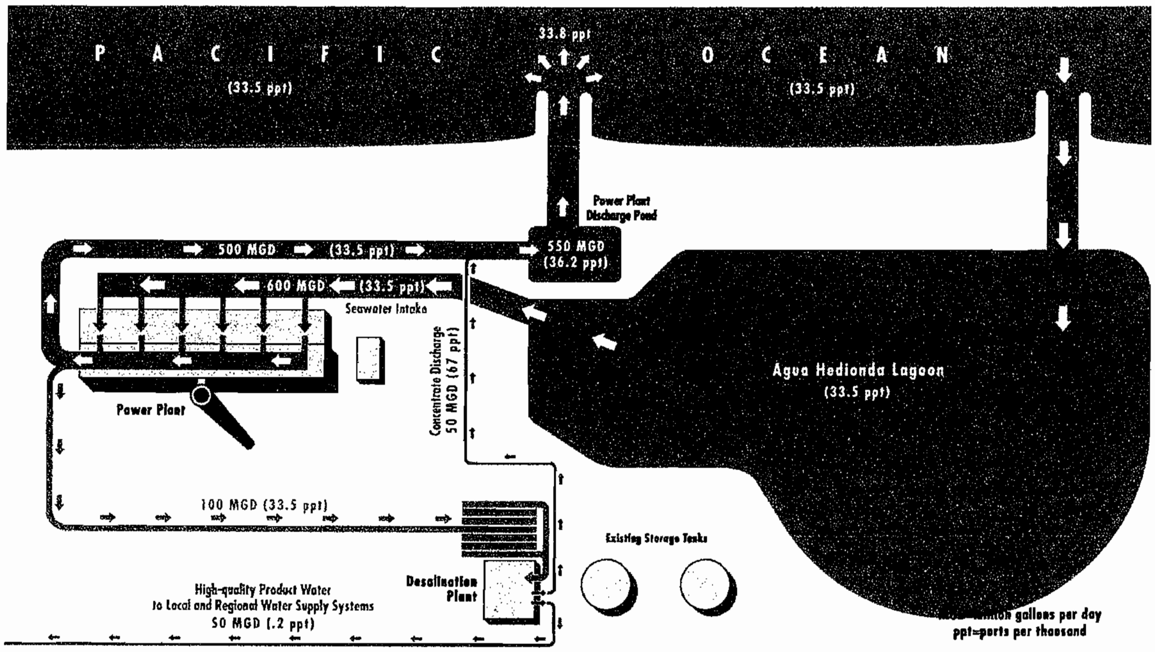


Figure 3-1 –Carlsbad Desalination Plant and Encina Power Station

Approximately 50 MGD of the seawater would be desalinated via reverse osmosis treatment and conveyed for potable use. The remaining 54 MGD would have salinity approximately two times higher than that of the ocean water (67 ppt vs. 33.5 ppt). This seawater concentrate would be returned to the power plant discharge canal downstream of the point of intake for blending with the cooling water prior to conveyance to the Pacific Ocean. A minimum of 200 MGD of cooling water would be needed to blend with the 54 MGD of concentrate in order to reduce the desalination plant discharge salinity below the limit of 40/44 ppt (daily/hourly average) established by the Regional Board Order R9-2006-0065 for this project. Therefore, the total volume of cooling water required for normal operation of the desalination plant is 304 MGD.

If the power plant discharge flow is equal to or higher than 304 MGD, then the cooling water discharge volume is adequate to sustain desalination plant operations. Under this condition, since no additional seawater is collected for production of drinking water, the incremental impingement and entrainment impacts of the desalination plant operations is minimal, especially taking under consideration that the power plant operations are assumed to cause 100 percent mortality of the entrained marine organisms.

Under the conditions of temporary or permanent power plant shutdown, or curtailed power generation that results in cooling water discharge below 304 MGD, the existing power plant intake system would need to be operated to collect up to 304 MGD of seawater for the desalination plant. This seawater will pass sequentially through the power plant inlet screens (bar racks), the fine vertical screens, the power plant intake pumps and the power plant condensers before it reaches the desalination plant intake pump station. The features incorporated in the desalination plant design to reduce impingement, entrainment and flow collection under such "stand-alone" operating conditions are discussed below.

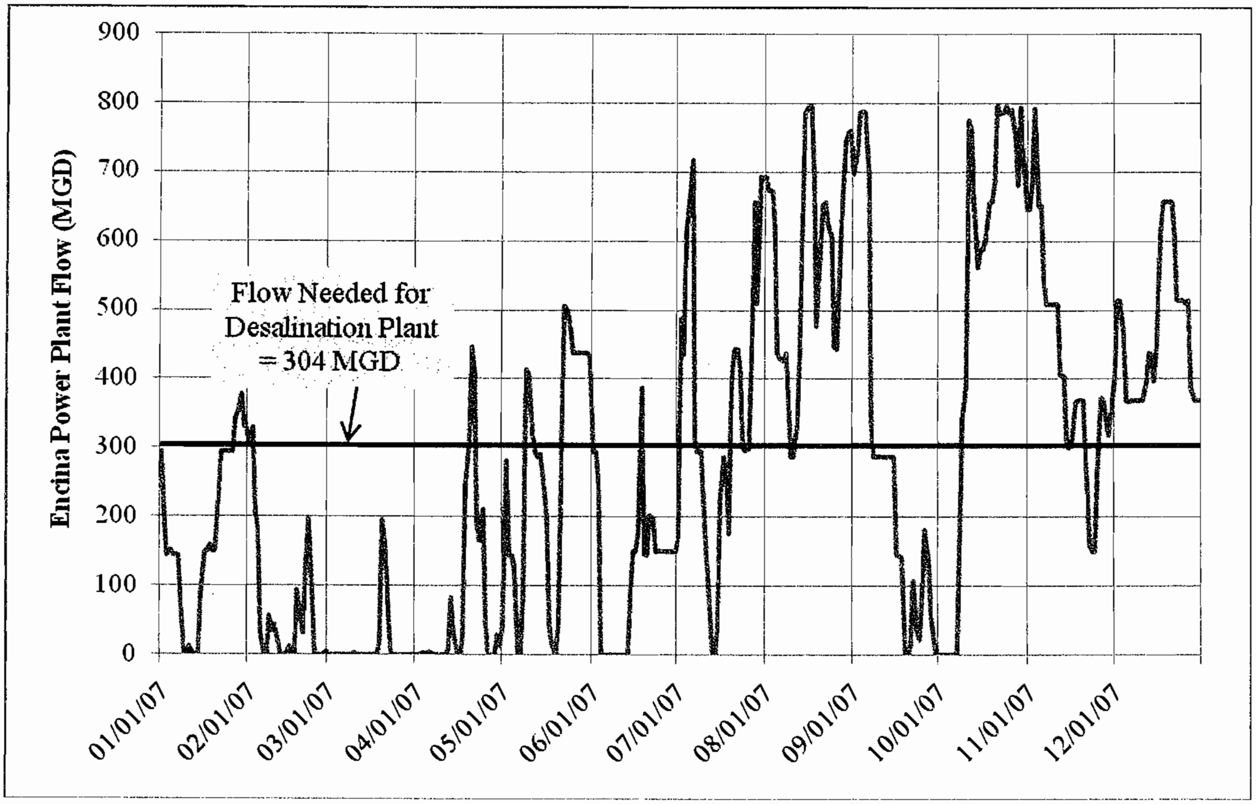
3.3 USE OF EPS DISCHARGE AS SOURCE WATER FOR CDP

The CDP is designed to use the existing intake and discharge facilities of the Encina Power Generation Station (EPS). When EPS is producing electricity and using 304 MGD or more of seawater for once-through cooling, the proposed desalination plant operation would cause a *de minimis* increase in impingement and entrainment of marine organisms.

Under conditions when the EPS operation is temporarily or permanently discontinued, the desalination plant will continue to use the existing power plant intake and discharge facilities. Under this condition, the impingement and entrainment impacts of the desalination plant operations would be significantly lower than those caused by the EPS operations at the same intake flow, due to a number of differences in the desalination plant and power plant intake design and operations.

Figure 3-2 provides a comparison of the 2007 EPS cooling water discharge to the flow needed to support CDP operations. Under 2007 operating conditions, the EPS discharge would provide 61 percent of the CDP annual seawater intake requirements and the CDP would have withdrawn an additional 39 percent of its source water from the EPS intake to make up the deficit in supply available from the EPS discharge. Under these operating conditions, the entrainment and impingement impact that would be attributed to the desalination operations would be limited to only 39 % of that identified in Chapter 5 for the stand-alone desalination facility operations. The CDP's direct use of the EPS discharge, coupled with other design and technology features described in Chapters 3 and 4, would result in a substantial reduction in the CDP entrainment and impingement impacts.

Figure 3-2
2007 EPS Cooling Water Discharge versus CDP Flow Requirements



3.4 REDUCTION IN INLET SCREEN VELOCITY

The CDP was designed for intake flow of 304 MGD (50 percent recovery) to minimize the impingement and entrainment of marine organisms under stand-alone operations. Higher intake flow, although preferable from a point of view of ease of desalination plant operations, would result in elevated potential for impingement and entrainment.

Impingement losses associated with the collection of seawater at the power plant intake would be reduced when the through-screen velocity at the inlet intake screens (bar racks) is equal to or less than 0.5 fps because this velocity would be low enough to allow some of the marine organisms to swim away from the inlet mount and to avoid potential harm from impingement.

At the design flow of 304 MGD needed for CDP operations, the inlet screen velocity would be less than or equal to 0.5 fps, thereby creating flow conditions that would reduce impingement losses to a less than significant level.

3.5 REDUCE FINE SCREEN VELOCITY

During stand-alone operations, the power plant intake pumps and screens will be operated in modified configuration that minimizes the through-screen velocity and thereby reduces potential impingement of marine organisms that reach these screens.

3.5.1 Description of Power Plant Intake Screen and Pump System

A detailed description of the power plant intake system is provided in Section 2. After the seawater passes through the inlet screens (bar racks) the intake forebay tapers into two 12-foot wide intake tunnels. From these tunnels the seawater enters one of four 6-foot wide conveyance tunnels. Cooling water for conveyance tunnels 1 and 2 passes though two vertical traveling screens to prevent fish, grass, kelp, and debris from entering intakes for power plant generation Units 1, 2 and 3. Conveyance tunnels 3 and 4 carry cooling water to intakes for power plant generation Units 4 and 5, respectively. Intakes for Unit 4 and 5 are equipped with two and three vertical travelling screens, respectively.

As electrical demand varies, the number of generating units in operation and the number of cooling water pumps needed to supply those units will also vary. Over the period of 2002 to 2005, the EPS has reported combined discharge flows ranging from 99.8 MGD to 794.9 MGD with a daily average of 600.4 MGD. Over the 20.5 year period of January 1980 to mid 2000 the average discharge flow was 550 MGD. In 2007, the average annual intake flow was 276 MGD. For comparison, the total intake flow needed for stand-alone operations of the desalination plant is 304 MGD.

3.5.2 Typical Mode of EPS Vertical Screen and Intake Pump Operations

As discussed in the previous section, each of the five power generation units is equipped with two cooling water pumps both of which operate when a given generating unit is producing electricity. All six pumps of power generation units 1, 2 and 3 share two common vertical screens of identical size (3/8-inch) and capacity. The two pumps of unit 4 are serviced by two 3/8-inch screens, and the two pumps of unit 5 are serviced by three 5/8-inch screens located in a common channel upstream of the pumps. With all pumps in operation, the through screen velocity of the vertical screens typically is higher than 0.5 fps, thereby contributing to the impingement of marine organisms that may have reached these screens.

3.5.3 Modified Utilization of the EPS Intake Screens and Pumps During Stand-Alone Operations of the Desalination Plant

Desalination plant operation is independent from the power production process and therefore, the existing EPS intake pumps do not need to be operated coupled with the intake screens of a given unit. This design flexibility of the desalination plant allows a greater number of screens to collect the volume of water needed for the CDP operation. For example, if the power plant needs to generate 287 MW of electricity, typically unit 4 (see Table 2-1) would be used for power generation and both intake pumps and screens associated with this unit would be in service. Under this operational condition, the cooling water flow used would be 307 MGD.

If the desalination plant is operated in stand-alone condition (i.e. no power is generated) then there is greater pump selection flexibility. For example, rather than using two intake pumps of unit 4, the desalination plant would collect similar amount of seawater by running only one pump of unit 4, and one pump of unit 5. However, in this case approximately the same amount of flow would be screened through five screens (the two screens of unit 4 and the three screens of unit 5), thereby reducing the through-screen velocity to at least a half. This significant reduction of the through screen velocity would allow to reduce the impingement of marine life on the vertical screens as well. Such impingement reduction cannot be achieved if the power plant intake pumps are used to deliver cooling water for power generation because when a given power generation unit is used to generate electricity, than both cooling pumps must be in operation simultaneously to provide adequate amount of cooling water for the normal operation of this unit. If the power plant discontinues power generation, than cooling pump operation can be decoupled from the operation of the condensers and this in turns allows to pump the same flow through two over times larger screening area and therefore to reduce the through screen velocity more than two times.

3.6 ELIMINATION OF HEAT-RELATED ENTRAINMENT MORTALITY

The seawater desalination plant will be designed with the flexibility to operate using warm water from the power plant condensers when they are in operation; and cold seawater when the power plant is not generating energy. This design feature will also avoid the need to preheat the intake seawater in the future if and when the power plant once-through cooling operation is discontinued. Elevated seawater temperature may increase the mortality of the entrained marine life. Since under stand-alone conditions the source seawater will not be heated this entrainment mortality factor will be eliminated.

3.7 ELIMINATION OF HEAT TREATMENT RELATED MORTALITY

Under the current mode of operations, the power plant completes heat treatment of the intake facilities every 6 to 8 weeks for 6 to 8 hours per event. Since seawater is re-circulated during the heat treatment event (i.e. no new seawater is collected or discharged), there is 100% mortality of the marine organisms residing in the intake canals unless they are physically removed prior to exposure to elevated temperature. Desalination plant operations would not require heat treatment of the existing intake and discharge facilities and marine organism mortality associated with the heat treatment events will be eliminated. Instead, the power plant intake and discharge system will be cleaned periodically by circulation of plastic scrubbing balls that will be circulated through the system via the existing pumps in a close cycle process. The scrubbing calls will be introduced at the beginning of the cleaning process and captured at the end of the process. The size of the scrubbing balls is usually 0.5 inches and they will move freely within the channels and piping at relatively low velocity (3 to 5 fps).

3.8 SUMMARY OF DESALINATION PLANT DESIGN FEATURES TO MINIMIZE IMPACTS TO MARINE LIFE

The design features are included in the CDP to minimize impacts to marine organisms are summarized in Table 3-1.

TABLE 3-1

DESIGN FEATURES TO MINIMIZE IMPACTS TO MARINE LIFE

Category	Feature	Result
1. Design	Use of EPS discharge as source water for CDP	Sixty-one percent reduction of entrainment and impingement impacts attributable to the CDP
2. Design	Reduction in inlet screen velocity	Reduction of impingement of marine organisms
3. Design	Reduction in fine screen velocity	Reduction of impingement of marine organisms
4. Design	Ambient temperature processing	Eliminate entrainment mortality associated with the elevated seawater temperature
5. Design	Elimination of heat treatment	Entrainment and impingement mortality associated with heat treatment would be eliminated

CHAPTER 4

TECHNOLOGY

INTRODUCTION

Pursuant to Water Code Section 13142.5(b), this Chapter identifies the best available technology feasible to minimize Project related impacts to marine life. This Chapter is broken down into five sections:

- *The first section describes constraints and opportunities associated with inclusion of technology features in the Project to minimize Project related impacts to marine life.*
- *The second section assesses the feasibility of alternative intake technologies to minimize Project related impacts to marine life.*
- *The third section assesses the feasibility of alternative intake screening technologies to minimize Project related impacts to marine life.*
- *The fourth section assesses the feasibility of alternative desalination technologies to minimize Project related impacts to marine life.*
- *The fifth section summarizes the feasibility assessment of technology features and the resulting impact they have on minimizing Project related impacts to marine life.*

4.1 FEASIBILITY CONSIDERATIONS

Poseidon conducted a feasibility assessment of the best available technology for reduction of entrainment and impingement impacts. This assessment resulted in the identification of those technologies that are feasible for implementation under the site-specific conditions of the proposed project. For the purposes of this assessment, we relied upon the definition of feasible set forth in the California Environmental Quality Act (CEQA) Guidelines: *"'Feasible' means capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors*" (CEQA Guidelines, § 15364).

Site-specific conditions dictate that a fundamental feasibility constraint associated with potential entrainment and impingement reduction technologies is that the technology must be compatible with both CDP and EPS operations. In its recommended amendment of the EPS intake and outfall lease to authorize use of these facilities by the CDP, the State Lands Commission (SLC) staff recognized entrainment and impingement minimization measures cannot interfere with, or interrupt ongoing power plant operations:[1]

[1] State Lands Commission October 24, 2007 recommended Amendment of Lease PRC 8727.1

> *12. Without interference with, or interruption of, power plant scheduled operations and at its sole cost and expense, Poseidon Resources, as a separate obligation, shall use the best available design, technology, and mitigation measures at all times during with this Lease is in effect to minimize the intake (impingement and entrainment) and mortality of all forms of marine life associated with the operation of the desalination facility as determined by the San Diego Regional Water Quality Control Board or any other federal, state, or local entity.*

When the EPS permanently ceases use of the once-through cooling water system, additional entrainment and impingement technologies may become feasible. While no timeline has been established as to when this might occur, SLC's proposed Lease Amendment requires that in ten years SLC would evaluate the feasibility of the implementation of those additional technologies it determines are appropriate in light of an environmental review it would undertake at that time:[2]

> *14. Ten years from October 30, 2007, Lessor will undertake an environmental review of the ongoing impacts of the operation of the desalination facility to determine if additional requirements pursuant to Paragraph 12 are required. Lessor will hire a qualified independent environmental consultant at the sole expense of Poseidon Resources with the intent to analyze all environmental effects of facility operations and alternative technologies that may reduce any impacts found. Lessor may require, and Poseidon Resources shall comply with, such additional requirements as are reasonable and as are consistent with applicable state and federal laws and regulations and as Lessor determines are appropriate in light of the environmental review.*

The CDP design includes the best available technology that has been determined to be feasible for the site specific conditions and size of this project and to minimize impingement and entrainment of marine organisms in the intake seawater. The selection of the desalination plant intake, screening and seawater treatment technologies planned to be used for this project is based on thorough analysis and investigation of a number of alternative seawater intake, screening and treatment technologies.

The following intake alternatives were analyzed:

- Subsurface intake (vertical and horizontal beach wells, slant wells, and infiltration galleries);
- New open ocean intake;
- Modifications to the existing power plant intake system; and
- Installation of variable frequency drives (VFDs) on seawater intake pumps.

Screening technologies compared to identify BTA included:

- Fish net, acoustic and air bubble barriers upstream of the existing intake inlet mouth;

[2] Id.

- New screening technologies to replace the existing inlet screens (bar racks) and fine vertical traveling screens;

Desalination plant treatment technologies for reduced entrainment and improved survival included:

- Installation of micro screens ahead of the pretreatment system;
- Use of membrane pretreatment technology that allows to avoid the use of seawater conditioning chemicals;
- Return to the ocean of marine organisms captured at the desalination plant micro-screens and the pretreatment filters.

The following combination of intake, screening and treatment technologies were found to be feasible impingement, entrainment and flow reduction technology measures for the site-specific conditions of the Carlsbad project:

1. **Installation of VFDs on Desalination Plant Intake Pumps.** The desalination plant intake pump station design will incorporate variable frequency drives to reduce the total intake flow for the desalination facility to no more than that needed at any given time, thereby minimizing the entrainment of marine organisms.

2. **Installation of micro-screens.** Micro-screens (120 µ) minimize entrainment and impingement impacts to marine organisms by screening the fish larvae and plankton from the seawater.

3. **Installation of low impact pretreatment technology.** The desalination facility will rely on low pressure, chemical free membrane pretreatment filtration technology to minimize entrainment and impingement impacts to marine organisms that have passed through the micro screens by filtering the organisms from the seawater via 0.02 µ filters.

4. **Return to the ocean of marine organisms captured by the screens and filters.** Minimize entrainment and impingement impacts to marine organisms captured by the screens and filters by returning them to the ocean.

The assessment of the various technologies considered for impingement, entrainment and flow reduction is presented below.

4.2 ALTERNATIVE DESALINATION PLANT INTAKE TECHNOLOGIES

4.2.1 Desalination Plant Subsurface Intakes

The feasibility of using subsurface intakes (beach wells, slant wells, horizontal wells, and filtration galleries) was evaluated in detail during the EIR and Coastal Commission review phases of this project. A thorough review of the site-specific applicability of subsurface intakes and a comprehensive hydro-geological study of the use of subsurface intakes in the vicinity of the proposed desalination plant site indicate that subsurface intakes are not viable due to limited production capacity of the subsurface geological formation, the potential to trigger subsidence in the vicinity of the site and the poor water quality of the collected source water. The geotechnical evaluation relied on drilling and testing information and near shore sediment surveys to assess the feasibility of using vertical, slant, and horizontal wells as seawater intake structures for the proposed project.

Vertical Intake Wells: Vertical intake wells consist of water collection systems that are drilled vertically into a coastal aquifer. A well yield of about 2,100 gpm would be expected from a properly constructed, large diameter production well at the test well location in Agua Hedionda Lagoon. Modeling results indicate that up to nine vertical wells could be placed in the 700 foot wide alluvial channel, each pumping about 2,100 gpm. Therefore, the maximum production from vertical wells placed under optimum conditions would be about 20,000 gpm (28.8 MGD). Given that the test well was placed in the optimum location, this would represent the upper limit of expected well yields from the alluvial deposits in the coastal basins of San Diego County, which is consistent with historic observations.

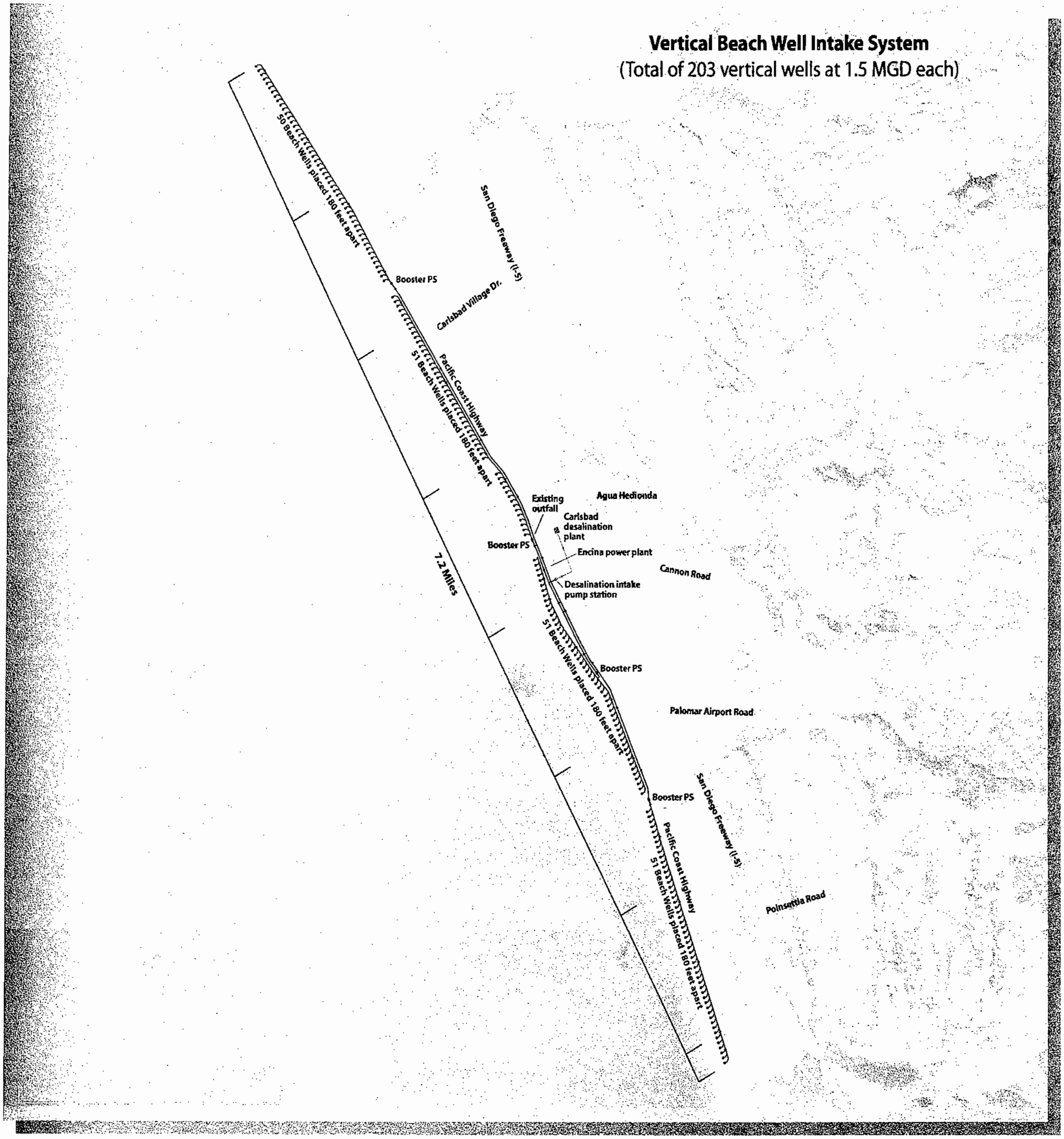
To meet the 304 MGD seawater demand of the project, 253 wells of a 1.5 MGD intake capacity each would have to be constructed. As shown in Figure 4-1, the vertical well intake system would impact 7.2 miles of coastline to collect and transport the water to the proposed desalination facility. As a result, the vertical well intake system is not the environmentally preferred alternative.

Use of vertical intake wells is not viable for the site-specific conditions of this project due to the limited transmissivity and yield capacity of the wells. The implementation of this scenario would require installation of very large number of wells (253) for which beach property is not available. The length of beach that would be occupied by desalination plant intake using vertical wells would be over seven miles and the total cost of the implementation of such intake would be approximately $650 million. See Attachment 1 for a detailed cost estimate. In summary, the vertical well intake alternative is not the environmentally preferred alternative, technically infeasible, and cost prohibitive.

Slant Wells. Slant wells are subsurface intake wells drilled at an angle and extending under the ocean floor to maximize the collection of seawater and the beneficial effect of the filtration of the collected water through the ocean floor sediments. Collection of 304 MGD of seawater needed for this project would require the use of 76 slant intake wells of capacity of 5 MGD each. The total length of beach occupied by slant wells would be over 4 miles and the construction costs for implementation of this alternative would exceed $410 million. See Attachment 1 for a detailed cost estimate.

The use of slant wells does not offer any advantage in this setting. The well field for which maximum production rates were calculated for vertical wells is located on sand spit located approximately 100 ft from Agua Hedionda and 300 ft from the Pacific Ocean. Those constant

Figure 4-1 - Vertical Beach Well Intake System



head conditions were taken into account when assessing the yield of this type of subsurface intake.

The use of slant wells increases the screened thickness of saturated sediment slightly (a 45 degree well would result in a 20 percent increase in screened thickness over a vertical well) and places the screened section more directly below the constant head lagoon or ocean boundary condition. The close proximity of the well field to the constant head condition already achieves this, with a little increase in yield resulting from the slant well. Due to the site-specific hydrogeological conditions (low transmissivity of the ocean floor sediments and near shore aquifer) the use of slant wells is also not viable for the Carlsbad seawater desalination project. In summary, the slant well intake alternative is not the environmentally preferred alternative, technically infeasible, and cost prohibitive.

Horizontal Wells. Horizontal wells are subsurface intakes which have a number of horizontal collection arms that extend into the coastal aquifer from a central collection cason in which the source water is collected. The water is pumped from the cason to the desalination plant intake pump station, which in turn pumps it through the plant pretreatment system.

The use of horizontal wells, if the alluvial channel can be tapped offshore and the well can be kept inside this alluvial channel, can theoretically produce greatly increased yields by markedly increasing the screened length of the well in contact with permeable sediments.

However, the diameter of the collection arms of the horizontal wells is limited to 12 inches (and most are 8-inch or smaller), in turn limiting the production rate to 1,760 gpm (2.5 MGD) per well. This conclusion was also confirmed by the Dana Point Ocean Desalination Project test well that documented a yield of 1,660 gpm (2.4 MGD) from a 12 inch diameter well in that location. Analysis of the sediment properties indicates that this would be achieved with a horizontal well extending approximately 200 ft below the Pacific Ocean or Agua Hedionda. Because of the constant head boundary at the ocean bottom or bottom of Agua Hedionda, there would be minimal interference between multiple horizontal wells, but the practicalities of drilling horizontal wells limit the space no less than about 50 ft. Given the limited width of the alluvial channel, only about 14 horizontal wells could be placed in the channel, for a total production rate of 28,000 gpm (40 MGD), still far below the project demand of 304 MGD. This approach assumes that additional exploration work will prove that elevated TDS concentrations in groundwater in the most permeable strata can be overcome.

Even if ideal conditions for this type of wells are assumed to exist (i.e., each well could collect 5 MGD rather than the 2.5 MGD determined based on actual hydrogeological data), horizontal well intake construction would include the installation of a total of 76 wells. The total length of coastal seashore impacted by this type of well intake would be 4.3 miles. As shown in Figures 4-2 and 4-3, the horizontal intake system would include nine large pump stations located on Tamarac State Beach and would impact 500 acres of shoreline and sensitive nearshore habitat. As a result, the horizontal intake system is not the environmentally preferred alternative. The cost for construction of horizontal well intake system for collection of 304 MGD of seawater needed for the desalination plant operation is estimated at $438 million. See Attachment 1 for a

Figure 4-2 - Horizontal Drain Intake System

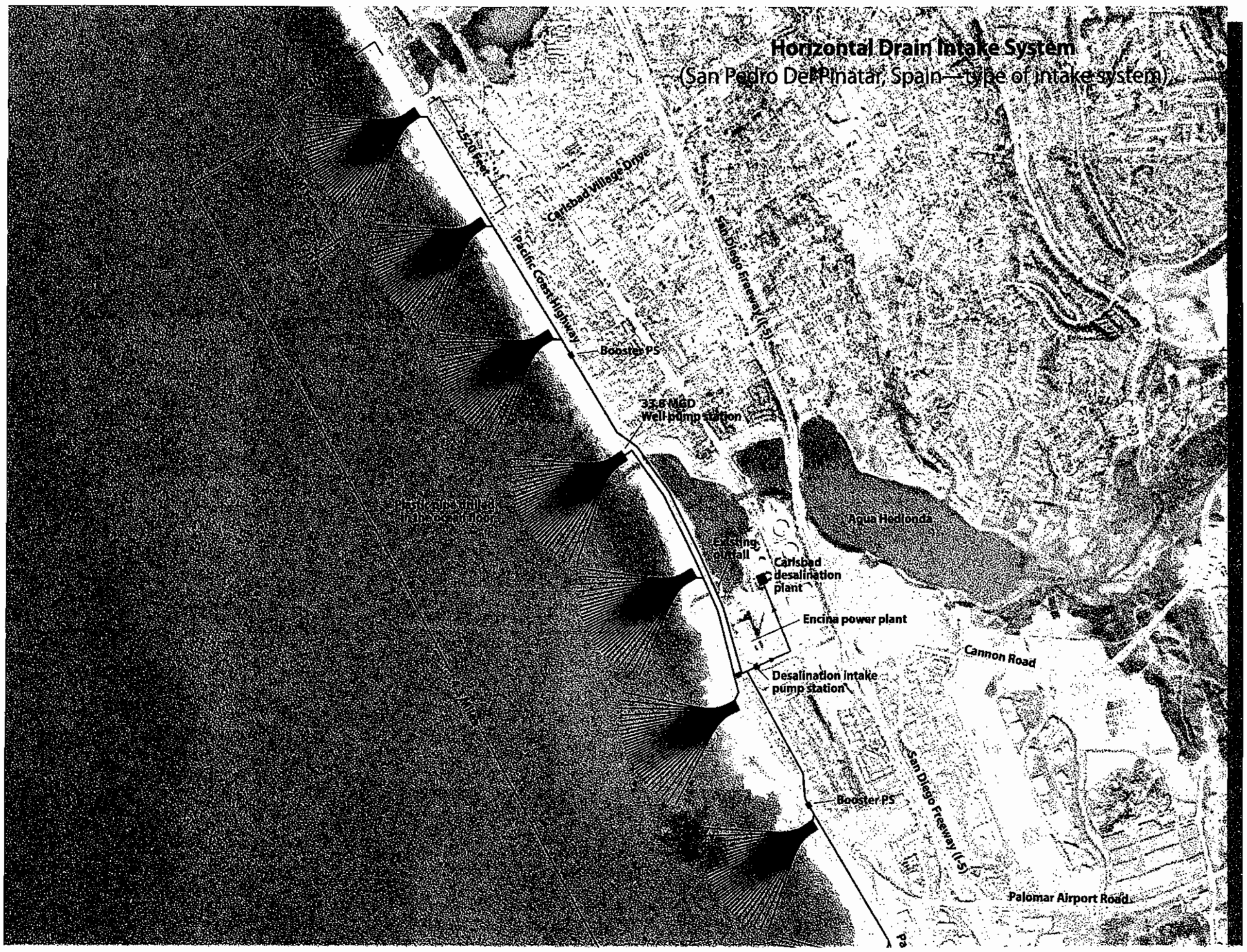
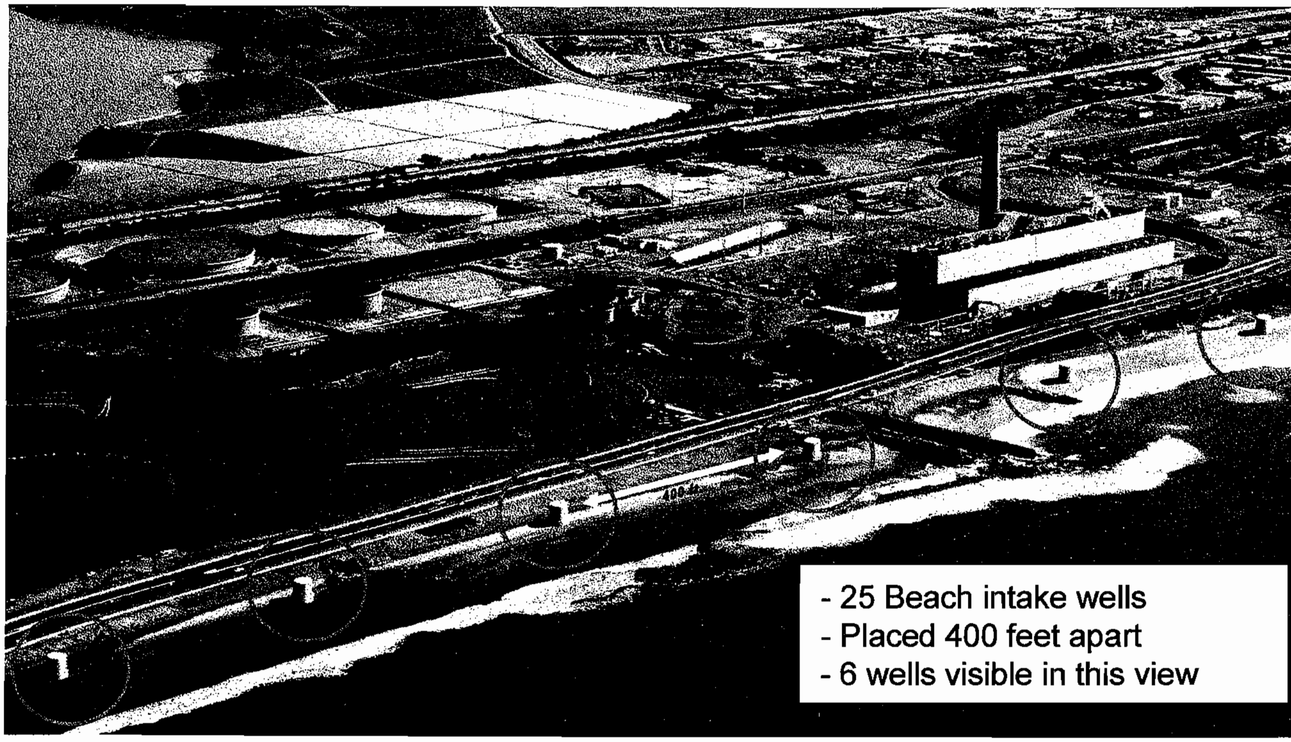


Figure 4-3 – Pump Stations with Horizontal Intakes



detailed cost estimate. In summary, the horizontal intake alternative is not the environmentally preferred alternative, and is technically infeasible, and cost prohibitive.

Subsurface Infiltration Gallery (Fukuoka Type Intake). The subsurface infiltration gallery intake system consists of a submerged slow sand media filtration system located at the bottom of the ocean in the near-shore surf zone, which is connected to a series of intake wells located on the shore. As such, seabed filter beds are sized and configured using the same design criteria as slow sand filters. The design surface loading rate of the filter media is typically between 0.05 to 0.10 gpm/sq ft. Approximately one inch of sand is removed from the surface of the filter bed every 6 to 12 months for a period of three years, after which the removed sand is replaced with new sand to its original depth. As it can be seen on Figures 4-4 and 4-5, the ocean floor has to be excavated to install the intake piping of the wells and pipes are buried at the bottom of the ocean floor.

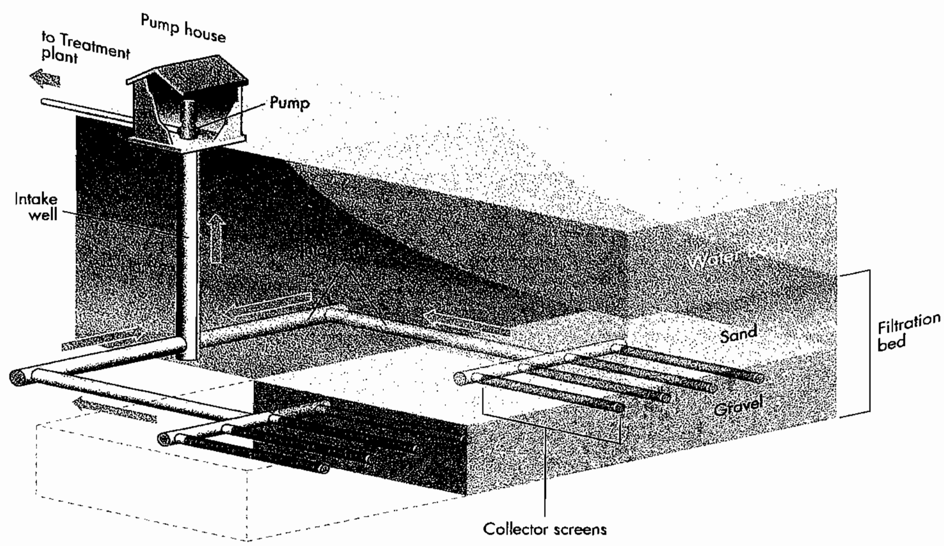


Figure 4-4 – Subsurface Infiltration Gallery (Fukuoka Type Intake)

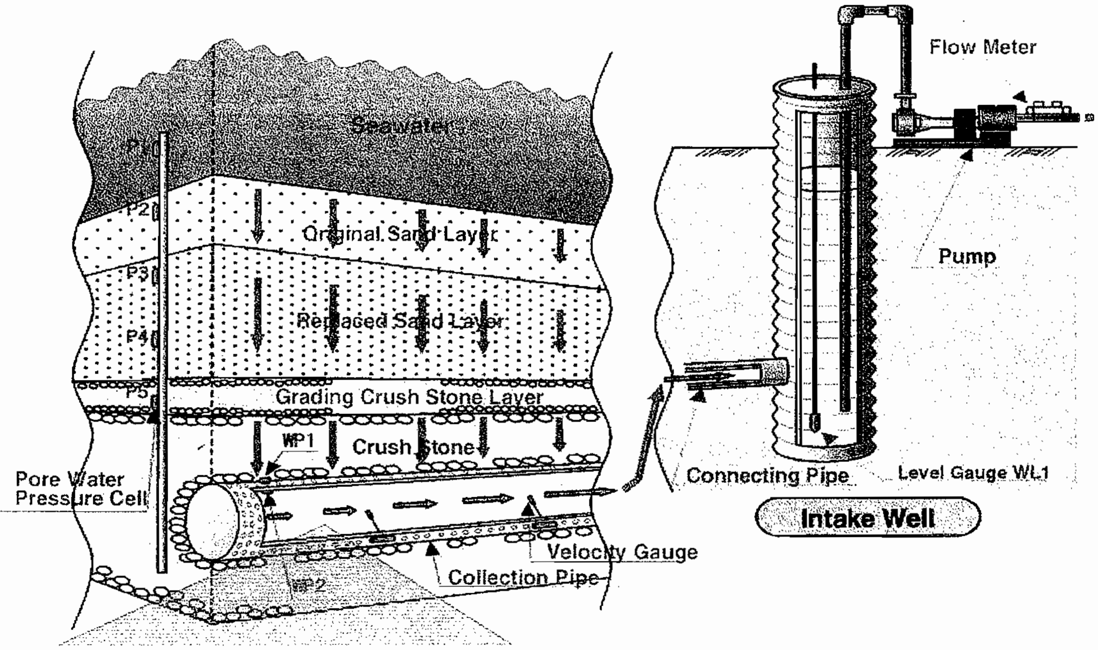


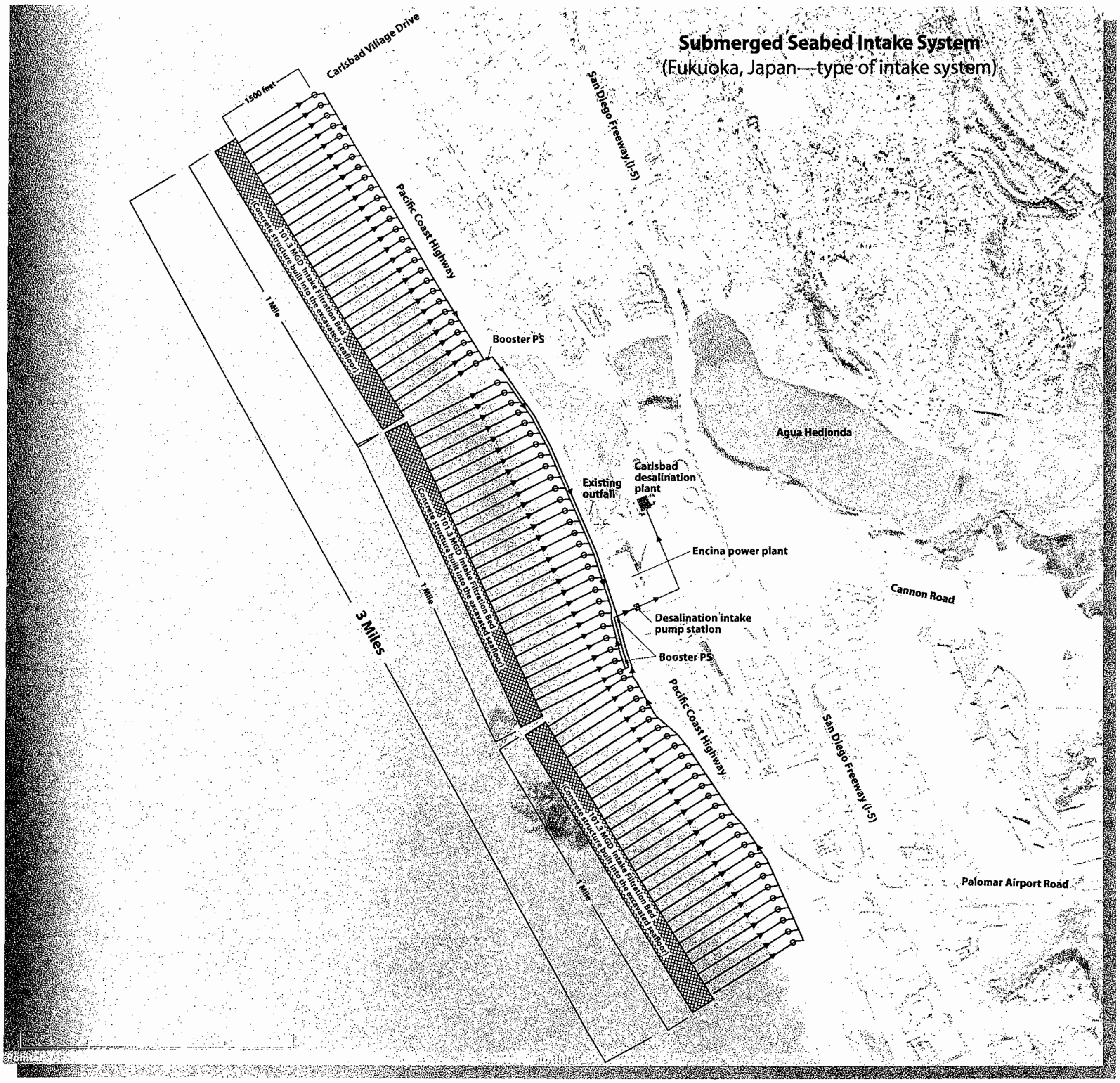
Figure 4-5 – A Cross-Section of Subsurface Infiltration Gallery

For the source water intake feed rate of 304 MGD needed for the Carlsbad seawater desalination project the total area of the ocean floor needed to be excavated to build a seabed intake system of adequate size is 146 acres. As shown in Figure 4-6, a submerged seabed intake system sized to meet the needs of the Carlsbad Desalination Project would impact three linear miles of sensitive nearshore hard bottom kelp forest habitat. The excavation of 146 acre/3-mile long strip of the ocean floor at depth of 15 feet in the surf zone to install a seabed filter system of adequate size to supply the Carlsbad desalination project, will result in a very significant impact on the benthic marine organisms in this location. In addition, the subsurface seabed intake system would have a similar effect on Tamarac State Beach. To collect the seawater from the filter bed and transfer it to the desalination facility, the intake system would require 78 collector pipelines on the ocean floor connected to 78 pump stations that would be installed on the State beach.

The cost for construction of subsurface seabed intake system for collection of 304 MGD of seawater needed for the desalination plant operation is estimated at $647 million. See Attachment 1 for a detailed cost estimate. In summary, the subsurface seabed intake alternative is not the environmentally preferred alternative, technically infeasible, and cost prohibitive.

Water Quality Issues for Subsurface Intakes. Based on the results of actual intake well test completed in the vicinity of the EPS, a key fatal flaw of the beach well water quality was the high salinity of this water. The total dissolved solids (TDS) concentration in the water was on the order of 60,000 mg/L, nearly twice that of typical seawater (33,500 mg/L). The test well water also had elevated iron and suspended solids content. The pumping test was extended for nearly a month at 330 gpm (0.5 MGD) to determine if additional pumping would cause the TDS,

Figure 4-6 - Submerged Seabed Intake System



iron and suspended solids concentrations to approach that of the nearby seawater. After 30 days of pumping, the quality of the water withdrawn from the well did not improve significantly.

Summary Evaluation of Subsurface Intake Feasibility. The site-specific hydrogeologic studies used to evaluate the feasibility of use of alternative subsurface intakes for this project demonstrate that the alternative intakes that were evaluated are incapable of providing sufficient seawater to support the proposed project. None of the subsurface intake systems considered (vertical wells, slant wells, or horizontal wells) can only deliver a fraction of the 304 MGD of seawater needed for environmentally safe operation of the CDP. The maximum capacity that could be delivered using subsurface intakes is 28,000 gpm (40 MGD), which is substantially below the needed intake flow. Additionally, the quality of the water available from the subsurface intake (salinity twice that of seawater, excessive iron and high suspended solids) would be untreatable. Additionally, the alternative subsurface intake systems were determined not to be the environmentally preferred alternative. Taking into account economic, environmental and technological factors, the alternatives subsurface intakes are not capable of being accomplished in a successful manner within a reasonable period of time; and therefore, have been determined to be infeasible. The Coastal Commission draft findings agree with this conclusion: "find that subsurface intakes appear to be an infeasible alternative."[3]

4.2.2 Construction of New Open Intake for the Desalination Plant

Poseidon also evaluated whether the construction and operation of a new offshore intake to serve the seawater supply needs of the desalination project would be a viable alternative to the use of the existing intake at the Encina Power Generation Station and whether this approach would result in reduced impacts to marine resources.

Specifically, Poseidon studied whether an offshore intake would reduce the frequency of dredging of Agua Hedionda Lagoon under the stand-alone desalination facility operation; and whether a construction of a new intake would reduce environmental impacts as compared to the use of the existing Encina Power Station intake under the stand-alone desalination facility operation. The analysis included the review of the environmental impact report (EIR) for the Agua Hedionda Inlet Jetty Extension Project (Jetty EIR). This EIR identified an offshore intake as an environmentally preferred alternative to the proposed extension of the inlet jetty. Poseidon prepared two studies that demonstrate the construction of a new offshore intake would not reduce the frequency of dredging of Agua Hedionda Lagoon and it is not the environmentally preferred alternative.

The first study addresses whether an offshore intake would reduce the frequency of dredging of Agua Hedionda Lagoon under the stand-alone desalination facility operation.[4] This study concluded that the dredging frequency needed for normal operation of the stand alone desalination facility would be approximately once every three years when adhering to present

[3] See Coastal Commission Recommended Revised Findings Coastal Development Permit for Poseidon Carlsbad Desalination Project, page 50 of 108; http://documents.coastal.ca.gov/reports/2008/3/W25a-3-2008.pdf

[4] *Comparative Analysis of Intake Flow Rate on Sand Influx Rates at Agua Hedionda Lagoon: Low-Flow vs. No-Flow Alternatives*, Jenkins and Waysl, September 28, 2007

dredging practices. Under the "no power plant and no desalination project" scenario, the minimum dredging volume required to keep Agua Hedionda open to the Pacific Ocean would be about 15 percent less than for the stand-alone desalination facility. This 15 percent reduction however, would not be sufficient to allow the dredge frequency to be extended beyond once every three years due to schedule limitations that prohibit dredging during least tern nesting season. Given the variability in the actual sand transport from year to year and the accuracy of the modeling, there isn't any discernable difference between the estimated dredging frequency and related environmental impacts associated with the operation of stand-alone desalination facility versus the "no power plant, nor desalination project" scenario.

The second study addresses whether an offshore intake would result in fewer environmental impacts than the use of the existing Encina Power Station intake under the stand-alone desalination facility operation.[5] Here the authors evaluate the Jetty EIR and conclude that the draft EIR did not adequately evaluate the environmental impacts associated with constructing an offshore intake. The Jetty EIR did not assess the biological impacts of installing a large diameter pipe 1000 feet offshore, which depending on placement, would potentially destroy existing rocky reef outcroppings occurring offshore. The Jetty EIR did not evaluate the down coast effects of an intake structure on habitat, sand flow, or sedimentation.

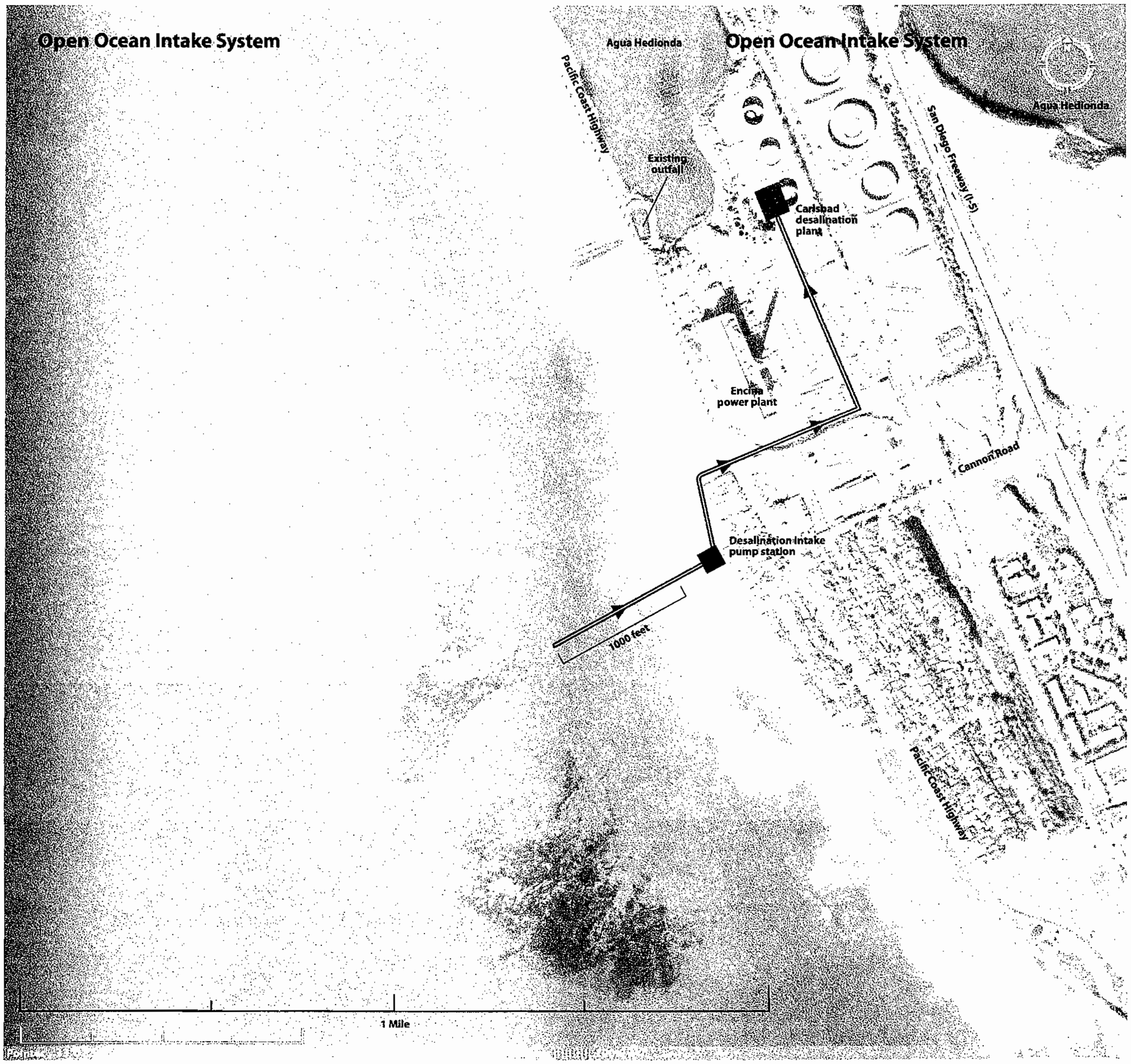
Further, the Jetty EIR did not adequately evaluate entrainment and impingement effects. Based on the environmental analysis of the area for potential location of a new offshore intake, Poseidon is of the opinion that an offshore intake has the potential to affect a greater diversity of adult and juvenile organisms as well as both phyto- and zooplankton species than is currently impacted by the existing intake at the Encina Power Station. The estimated cost of the new offshore intake shown in Figure 4-7 is approximately $150 million (see Attachment 1).

In conclusion, construction of a new open water intake would not result in significant reduction in dredging frequency, would cause permanent construction related impacts to the marine environment and would shift entrainment impacts to a more sensitive area of the marine environment that would affect a greater diversity species. As compared to the environmental impacts caused by the existing EPS intake, the new offshore intake is not the environmentally preferred alternative. Taking into account economic, environmental and technological factors, the alternatives intake is not capable of being accomplished in a successful manner within a reasonable period of time; and therefore, have been determined to be infeasible. The Coastal Commission draft findings agree with conclusion: "determined that alternative intakes that might avoid or minimize environmental impacts are infeasible or would cause greater environmental damage."[6]

[5] *Issues Related to the Use of the Agua Hedionda Inlet Jetty Extension EIR to Recommend An Alternative Seawater Intake for the Carlsbad Desalination Project,* Graham, Le Page and Mayer, October 8, 2007

[6] See Coastal Commission Recommended Revised Findings Coastal Development Permit for Poseidon Carlsbad Desalination Project, page 63 of 108; http://documents.coastal.ca.gov/reports/2008/3/W25a-3-2008.pdf

Figure 4-7 – Open Ocean Intake System



4.3 ALTERNATIVE POWER PLANT INTAKE & SCREENING TECHNOLOGIES

A number of alternative intake and screening technologies were evaluated to determine whether they offer a viable and cost-effective reduction of impingement and entrainment associated with the desalination plant operations under the conditions of a complete shutdown of EPS operations. As indicated previously, under these conditions, the EPS intake facilities (combination of screens and pumps) will be operated to collect a total flow of 304 MGD which is 38 percent of the installed EPS intake pump capacity.

Under the stand-alone desalination plant operations, the existing power plant intake facilities will be operated at reduced flow and fewer pumps will be collecting water through the same existing intake screening facilities. The velocity of the water flowing into the intake would be reduced to 0.5 fps or less. This alone will substantially reduce the impingement impacts associated with the desalination plant operations to a level that the Coastal Commission acknowledged is "a *de minimis* impact."[7]

Technologies listed in Table 4-1 have been evaluated based upon feasibility for implementation at the facility, including the following:

- Ability to achieve a significant reduction in impingement and entrainment (IM&E) for all species, taking into account variations in abundance of all life stages;
- Feasibility of implementation at the facility;
- Cost of implementation (including installed costs and annual O&M costs);
- Impact upon facility operations.

4.3.1 Fish Screens and Fish Handling and Return System

This alternative would include the replacement of the existing traveling screens within the tunnel system with new traveling screens that have features that could enhance fish survival are designed with the latest fish removal features, including the Fletcher type buckets on the screen baskets (Ristroph-type screens), dual pressure spray systems (low pressure to remove fish, and high pressure to remove remaining debris), and separate sluicing systems for discarding trash and returning the impinged fish back to the Aqua Hedionda Lagoon (AHL) or the ocean.

[7] See Id. at 46.

TABLE 4-1

POTENTIAL IMPINGEMENT/ENTRAINMENT REDUCTION TECHNOLOGIES

Technology	Impact Reduction Potential	
	Impingement	Entrainment
Modified traveling screens with fish return	Yes	No
Replacement of existing traveling screens with fine mesh screens	Yes	Yes
New fine mesh screening structure	Yes	Yes
Cylindrical wedge-wire screens – fine slot width	Yes	Yes
Fish barrier net	Yes	No
Aquatic filter barrier (e.g. Gunderboom)	Yes	Yes
Fine mesh dual flow screens	Yes	Yes
Modular inclined screens	Yes	No
Angled screen system – fine mesh	Yes	Yes
Behavior barriers (e.g. light, sound, bubble curtain)	Maybe	No

The modified screening system could potentially improve impingement survival. This system however will have a negative effect in terms of entrainment reduction, because the intake pumps will need to collect more source water (3 MGD) to service the dual pressure spray system of the new screens. In addition, a fish return system is required as part of this scenario to transport fish washed from the screens alive back to the water body to a location where they would not be subject to re-entrainment into the intake.

The capital cost associated with this impingement reduction alternative is estimated at: US$5.7 million. The annual O&M costs for such system are estimated at $200,000 over the costs of operation of the existing intake screening system.

Poseidon considers this alternative to be infeasible for the following reasons:

- The impingement impacts of the proposed Project (0.96 kgs per day of fish species that are highly abundant in the area) have been found by the Coastal Commission, CEQA lead and others to be insignificant.
- Substantial construction costs for a limited benefit;
- The implementation of this alternative will result in increased entrainment because of the significant volume of additional seawater needed to be collected to operate the screen.

4.3.2 New Power Plant Intake and Fine Mesh Screening Structure

Fine mesh traveling screens have been tested and found to retain and collect fish larvae with some success. Application of fine mesh traveling screen technology for EPS would require the construction of a complete new screen structure located at the south shore of the lagoon, including both coarse and fine mesh traveling screen systems and fish collection and return systems. This alternative would replace the existing trash rack structure with a much larger screening structure. Major modifications to the existing tunnel system would be required. Additionally, an appropriate and suitable location to return collected fish, shellfish, and their eggs and larvae would have to be constructed.

The demolition of the existing intake structure; removal of the existing screens; construction of a new intake structure; and installation of new coarse and fine mesh screens equipped with fish collection and return systems; would require a total construction expenditure of $53.3 million. Similar to the previous technology, the implementation of this alternative will also require additional intake flow (4 MGD to 5 MGD) for the operation of the coarse and fine mesh screen organism retrieval and return systems. The additional O&M costs associated with the operation of this system are $300,000 per year.

Poseidon considers this alternative infeasible for the following reasons:

- The impingement and entrainment impacts of the proposed Project have been found by the CEQA lead and others to be insignificant.
- Poseidon has committed to restore and enhance at least 37 of marine wetlands habitat that significantly overcompensates for the limited impact of the Project to marine resources.
- Uncertain survival of the captured marine organisms.
- Substantial increase in Project construction costs for a very limited benefit.

4.3.3 Cylindrical Wedge-Wire Screens – Fine Slot Width

Wedge-wire screens are passive intake systems, which operate on the principle of achieving very low approach velocities at the screening media. Wedge-wire screens installed with small slot openings reduce impingement and entrainment and is an EPA approved technology for compliance with the US EPA 316(b) Phase II rule provided the following conditions exist:

- The cooling water intake structure is located in a freshwater river or stream;
- The cooling water intake structure is situated such that sufficient ambient counter currents exist to promote cleaning of the screen face;
- The through screen design intake velocity is 0.5 ft/s or less;
- The slot size is appropriate for the size of eggs, larvae, and juveniles of any fish and shellfish to be protected at the site; and
- The entire water flow is directed through the technology.

Wedge-wire screens are designed to be placed in a water body where significant prevailing ambient cross flow current velocities (≥ 1 ft/s) exist. This cross flow allows organisms that would otherwise be impinged on the wedge-wire intake to be carried away with the flow. An integral part of a typical wedge-wire screen system is an air burst back-flush system, which directs a charge of compressed air to each screen unit to blow off debris and impinged organisms back into the water body where they would be carried away from the screen unit by the ambient cross flow currents.

The EPS, located on the tidal Agua Hedionda Lagoon, would not meet the first two EPA criteria discussed above. First, the intake is not located on a freshwater river. Second, there is not sufficient crosscurrent in the lagoon to sweep organisms and debris away from the screen units; so debris and organisms back-flushed from the screens would immediately re-impinge on the screens following the back-flush cycle. For these reasons, Poseidon considers this alternative infeasible.

4.3.4 Fish Net Barrier

A fish net barrier, as it would be applied to the EPS intake system, is a mesh curtain installed in the source water body in front of the exiting intake structure such that all flow to the intake screens passes through the net, blocking entrance to the intake of all aquatic life forms large enough to be blocked by the net mesh. The net barrier is sized large enough to have very low approach and through net velocities to preclude impingement of juvenile fish with limited swimming ability. The mesh size must be large enough to preclude excessive fouling during operation, while at the same time small enough to keep the marine organisms out of the intake system. These conditions typically limit the mesh size such that adult and a percentage of juvenile fish can be blocked. The mesh is not fine enough to block most larvae and eggs. The fish net barrier could potentially reduce impingement; however, it would not meet reduce the entrainment of eggs and larvae.

The fish net barrier technology is still experimental, with very few successful installations. Using a 20 gpm/ft^2 design loading rate, a net area of approximately 30,000 ft^2 would be required for EPS. Maintaining such a large net moored in the lagoon is not practical. In addition, the fish barrier is a passive screening device, which is subject to fouling and has no means for self-cleaning. This technology would be rapidly clogged with kelp and other debris. The services of a diving contractor would be required to remove the net for cleaning onshore and to replace the fouled net with a clean net on each cleaning cycle. For these reasons, this technology is not practically feasible for implementation at EPS and further evaluation is not warranted.

4.3.5 Aquatic Filter Barrier

An aquatic filter barrier system, such as the Gunderboom Marine Life Exclusion System (MLES)™, is a moored water permeable barrier with fine mesh openings that is designed to prevent both impingement and entrainment of ichthyoplankton and juvenile aquatic life. An integral part of the MLES is an air-burst back flush system similar in concept to the air burst system used with wedge-wire screen systems to back flush impinged organisms and debris into the water body to be carried away by ambient cross currents.

The MLES has much smaller mesh openings and would block fish eggs and larvae from being entrained into the intake. These smaller organisms would be impinged permanently on the barrier due to the lack of cross currents to carry them away. Consequently, this technology is not feasible for implementation at the existing EPS intake and further evaluation is not warranted.

4.3.6 Fine Mesh Dual Flow Screens

A modified dual flow traveling water screen is similar to the through flow design, but this type of screen would be turned 90 degrees to the direction of the flow so that its two faces would be parallel to the incoming water flow. When equipped with fine mesh screening media, the average 0.5 fps approach velocity to the screen face would have to be met by the dual flow screen design. Water flow enters the dual flow screen through both the ascending and the descending screen faces, and then flows out between the two faces. All of the fish handling features of the Ristroph screen design would be incorporated in the dual flow screen design.

The dual flow screen configuration has been shown to produce low survival rates for fish larvae. This is because of the longer impingement time endured by organisms impinged on the descending face of the screen. This longer impingement time is suspected to result in higher mortality rates than similar fine mesh screens with a flow through screen design.

The primary advantage of this screen configuration is the elimination of debris carryover into the circulating water system. Also, because both ascending and descending screen faces are utilized, there is greater screening area available for a given screen width than with the conventional through-flow configuration.

However, the dual flow screen can create adverse flow conditions in the approach flow to the circulating water pumps. The flow exiting the dual flow screens is turbulent with an exit velocity of greater than 3 fps. Modifications to the pump bays downstream of the screens, usually in the form of baffles to break up and laterally distribute the concentrated flow prior to reaching the circulating water pumps would be required.

The implementation of this technology to the EPS CWIS would require an entirely new intake screen structure similar to the fine mesh through flow intake screen structure discussed previously. The dual flow fine mesh screen configuration offers no advantages in terms reduction of impingement and entrainment mortality as compared to through flow fine mesh traveling screens discussed above and in fact would probably not perform as well as the through flow design. The design concept for the dual flow screen structure would be similar to the through flow fine mesh screen structure with trash racks, coarse mesh traveling screens and fine mesh traveling screens in each screen train. The implementation cost and operation and maintenance costs for this facility would be of the same order of magnitude as for the through flow screen structure. Dual flow screen technology does not offer a significant performance or cost advantage as compared with through flow screen technology. Therefore, the use of this technology for the EPS is not recommended.

4.3.7 Modular Inclined Screens

Modular Inclined Screen (MIS) is a fish protection technology for water intakes developed and tested by the Electric Power Research Institute (EPRI). This technology was developed specifically to bypass fish around turbines at hydro-electric stations. The MIS is a modular design including an inclined section of wedge-wire screen mounted on a pivot shaft and enclosed within a modular structure. The pivot shaft enables the screen to be tilted to back-flush debris from the screen. The screen is enclosed within a self-contained module, designed to provide a uniform velocity distribution along the length of the screen surface. Transition guide walls taper in along the downstream third of the screen, which guide fish to a bypass flume. A full size prototype module would be capable of screening up to 800 cfs (518 MGD) at an approach velocity of 10 ft/sec.

The MIS design underwent hydraulic model studies and biological effectiveness testing at Alden Research Laboratory to refine the hydraulic design and test its capability to divert fish alive. Eleven species of freshwater fish were tested including Atlantic salmon smolt, coho salmon, Chinook salmon, brown trout, rainbow trout, blueback herring, American shad and others. After some refinements in the design were made during this testing, the results showed that most of these species and sizes of fish can be safely diverted.

Following laboratory testing, the MIS design was field tested at the Green Island Hydroelectric Project on the Hudson River in New York in the fall of 1995. In addition to the MIS, the effectiveness of a strobe light system was also studied to determine its ability to divert blueback herring from the river to the MIS. Results for rainbow trout, golden shiner and blueback herring, which were released directly into the MIS module were similar to the laboratory test results in terms of fish survivability. The limited amount of naturally entrained blueback herring did not allow reliable evaluation of test results.

The MIS technology, as tested, does not address entrainment of eggs and larvae. Also, this technology has never been tested for, or installed in, a power station with a seawater intake system. Further research would be required to evaluate the efficacy of this technology for application to a seawater intake system. MIS is not a suitable and proven technology, at this time, for retrofit to the EPS intake system. Therefore, this technology is not found viable the desalination plant intake impact.

4.3.8 Angled Screen System – Fine Mesh

Angled screens are a special application of through-flow screens where the screen faces are arranged at an angle of approximately 25 degrees to the incoming flow. The conventional through-flow screen arrangement would place the screen faces normal or 90 degrees to the incoming flow. The objective of the angled-screen arrangement is to divert fish to a fish bypass system without impinging them on the screens. Most fish would not be lifted out of the water but would be diverted back to the receiving water by screw-type centrifugal or jet pumps.

Using fine screen mesh on the traveling screens minimizes entrainment, but increases potential for impingement of organisms that would have otherwise passed through the power plant condenser tubes. Application of this technology would require construction of new angled screen structure at the south shore of the lagoon similar to the new fine mesh screen intake structure discussed previously. The angled screen facility would not provide a significant performance advantage in terms of reducing impingement and entrainment as compared to the fine mesh screen structure, and would be at least as large and a significantly more complex structure. This facility would be potentially more costly to implement and maintain than the fine mesh screen facility. Therefore, further evaluation of this technology for the EPS is not warranted.

4.3.9 Behavior Barriers

A behavioral barrier relies on avoidance or attraction responses of the target aquatic organisms to a specific stimulus to reduce the potential of entrainment or impingement. Most of the stimuli tested to date are intended to repulse the organism from the vicinity of the intake structure.

Nearly all the behavioral barrier technologies are considered to be experimental or limited in effectiveness to a single target species. There are a large number of behavioral barriers that have been evaluated at other sites, and representative examples these are discussed separately below.

4.3.10 Offshore Intake Velocity Cap

This is a behavioral technology associated with a submerged offshore intake structure(s). The velocity cap redirects the area of water withdrawal for an offshore intake located at the bottom of the water body. The cap limits the vertical extent of the offshore intake area of withdrawal and avoids water withdrawals from the typically more productive aquatic habitat closer to the surface of the water body.

This technology operates by redirecting the water withdrawal laterally from the intake (rather than vertically from an intake on the bottom), and as a result, the water entering the intake is accelerated laterally and is more likely to provide horizontal velocity cues to fish and allow fish to respond and move away from the intake. Potentially susceptible juvenile and adult fish that are able to identify these changes in water velocity as a result of their lateral line sensory system are able to respond and actively avoid the highest velocity areas near the mouth of the intake structure.

This technology potentially reduces impingement of fish by stimulating a behavioral response. The technology does not necessarily reduce entrainment, except when the redirected withdrawal takes water from closer to the bottom of the water body and where that location has lower plankton abundance.

Application of this technology to the EPS, to be fully effective, would require development of an entirely new intake system with a submerged intake structure and connecting intake conduit system installed out into the Pacific Ocean. For the reasons previously discussed, this is not a practically feasible consideration for the EPS. Therefore, further evaluation of this technology is not warranted.

4.3.11 Air Bubble Curtain

Air bubble curtains have been tested alone and in combination with strobe lights to elicit and avoidance response in fish that might otherwise be drawn into the cooling water intake. Generally, results of testing the bubble curtain have been poor based on testing completed by EPRI. Therefore, further evaluation of this technology is not warranted.

4.3.12 Strobe Lights

There has been a great deal of research with this stimulus over the last 15 years to guide fish away from intake structures. The Electric Power Research Institute has co-funded a series of research projects and reviewed the results of research in this field as well. In both laboratory studies and field applications, strobe lights were shown to effectively move selected species of fish away from the flashing lights. Most of the studies conducted to date have been with riverine fish species and for projects associated with hydroelectric generating facilities. One early study was conducted at the Roseton Generating Facility on the Hudson River in New York, another study was conducted on Lake Cayuga in New York, and others for migratory stages of Atlantic and Pacific salmon. Few species similar to those occurring in the Agua Hedionda Lagoon have been tested for avoidance response either in the lab or in actual field studies.

Laboratory testing was done for an application of strobe lights for the San Onofre Nuclear Generating Facility. Testing was conducted for white croaker, Pacific sardine and northern anchovy. The testing demonstrated no conclusive results and the California Coastal Commission found this device not useful at this station. Therefore, further evaluation of this technology is not warranted.

4.3.13 Other Lighting

Incandescent and mercury vapor lights have also been tested as a behavioral stimulus to direct fish away from an intake structure. Mercury lights have generally been tested as a means of drawing fish to a safe bypass of the intake structure as generally the light has an attractive effect on fish. Tests have not demonstrated a uniform and clearly repeatable pattern of attraction for all fish species. The mercury lights have been somewhat effective in attracting European eel, Atlantic salmon, and Pacific salmon. But results with other species including American shad, blue back herring and alewife had more variable results. One test with different life stages of Coho salmon shows both attraction and repulsion from the mercury light for the different life stages of the coho. Testing with incandescent, sodium vapor and fluorescent lamps was more limited but also had variable and species specific results.

Other lighting systems, as with most all the behavioral barrier alternatives, have not been tested with the species of fish common in Agua Hedionda Lagoon. As a result there is no basis to recommend these lights systems as an enhancement to reduce impingement or entrainment at the EPS.

4.3.14 Sound

Sound has also been extensively tested in the last 15 years as a method to alter fish impingement rates at water intake structures. Three basic groups of sound systems including percussion devices (hammer, or poppers), transducers with a wide range of frequency output, and low frequency or infrasound generators, have all been tested on a variety of fish species.

Of all the recently studied behavioral devices the sound technology has demonstrated some success with at least one group of fish species. Clupeids, such as alewife, demonstrate a clear repulsion to a specific range of high frequency sound. A device has been installed in the Fitzpatrick Nuclear Generating station on Lake Ontario in New York State, which has been effective in reducing impingement of landlocked alewives. The results were repeated with alewife at a coastal site in New Jersey. Similar results with a high frequency generator also reported a strong avoidance response for another clupeid species, the blue back herring, in a reservoir in South Carolina.

Testing of this high frequency device on many other species including weakfish, spot, Atlantic croaker, bay anchovy, American shad, blue back herring, alewife, white perch, and striped bass demonstrated a similar and strong avoidance response by American shad and blue back herring. Alewife and sockeye salmon have also been reported to be repelled by a hammer percussion device at another facility. But testing of this same device at other facilities with alewife did not yield similar results.

Although high frequency sound has potential for eliciting an avoidance response by the Alosid family of fish species, there is no data to demonstrate a clear avoidance response for the species of fish common to the Agua Hedionda Lagoon. Therefore there is no basis to use sound as a viable method to reduce impingement of fish at the EPS.

4.3.15 Installation of Variable Frequency Drives on Existing Power Plant Intake Pumps

Under this alternative, variable frequency drives would be installed on the EPS intake cooling water pumps to minimize the volume of water collected for the desalination plant operations. As indicated previously, the total volume of seawater that is required for the normal operation of the desalination plant is 304 MGD. Of this flow, 104 MGD will be collected for production of fresh water, while the remaining 200 MGD of seawater will be used to dilute the concentrated seawater from the desalination plant.

As indicated in Table 2-1, the EPS has ten cooling water pumps of total capacity of 794.9 MGD. Currently, all of these pumps are equipped with constant speed motors. Each of the five existing power generation units is coupled with two cooling pumps per unit and both pumps are operated when a given power generator is in service. Because the individual power generation units are designed to operate efficiently only at a steady-state near constant rate of electricity production and therefore, near constant thermal discharge load, reducing cooling flow by VFD in order to diminish entrainment would result in an increased temperature of the thermal discharge which in turn would have a detrimental effect on the marine organisms in the discharge area. The installation of VFDs is also limited by physical site constraints. The VFD units would need to be located near the pump motors in the existing concrete pump pit, which would need to be enlarged in order to accommodate this equipment. The cost associated with such mayor structural modifications along with the cost of the VFDs would exceed $8.5 million. Taking into consideration the limited useful life of the existing power plant, such large expenditures at this time are not prudent.

Under stand-alone operational conditions of the desalination plant, the power plant intake pumps would be operated as described in the precious section (Section 3 – Design). The cooling water pump operations will be decoupled from the condenser operations, which would substantially reduce the seawater velocity through screens. Under these conditions, the intake flow of the desalination plant (and associated entrainment) would be controlled by the VFD system of the desalination plant intake pump station. Installing an additional VDF system on the power plant intake pumps would have a negligible benefit.

In summary, installation of variable frequency drives on existing power plant intake pumps would provide limited benefits to marine life while significantly interfering with ongoing power plant operations. Taking into account economic, environmental and technological factors, this alternative has been determined to be infeasible.

4.3.16 Summary Evaluation of Power Plant Intake and Screening Alternatives

Implementation of the alternatives associated with the modification of the existing power plant intake and screening facilities were found to be infeasible because they would interfere with, or interrupt, power plant scheduled operations. Such significant modifications of the existing intake, and prolonged periods of power plant downtime are difficult to justify given the limited environmental benefit. The extended disruption to power plant operations and significant expenditures associated such modifications would not yield commensurate benefits for the following key reasons:

1. **Impingement.** The impingement impact of the stand-alone operation of the desalination plant has been found to be insignificant by both the City of Carlsbad (Project EIR) and *de minimis* according to the Coastal Commission (Draft CDP Findings) (approximately 2

lbs/day of fish).[8] Therefore, complex and costly intake modifications to reduce this already minimal impingement impact are not prudent. In addition, operational modifications of the existing EPS intake system under stand-alone CDP operation would reduce the fine screen-flow through velocity to further minimize impingement.

2. **Entrainment.** The entrainment impact of the stand-alone CDP operation is mainly driven by the volume of intake flow needed to produce fresh drinking water. In contrast with power plant operations, where water is not essential to produce electricity, in seawater desalination, seawater has to be collected and used to produce fresh water. Therefore, CDP entrainment effects cannot be avoided completely or minimized drastically by modifying the existing power plant intake facilities. Quite the opposite, many of the impingement reduction scenarios (see Sections 4.3.1, 2 &3 and 4.3.6,7&8) could increase the total flow needed for stand-alone desalination plant operations, thereby trading negligible impingement reduction benefits for incremental increase in entrainment.

Taking into account these economic, environmental and technological factors, the power plant intake screening alternatives are not capable of being accomplished in a successful manner within a reasonable period of time; and therefore, have been determined to be infeasible. The Coastal Commission draft findings agree with this conclusion: "The impingement impact of the stand-alone operation of the desalination plant has been found to be *de minimis* and insignificant"[9]; and "the Commission finds that Poseidon's proposal is using all feasible methods to minimize or reduce its entrainment impacts."[10]

When the EPS permanently ceases the use of the once-through cooling water system, additional entrainment and impingement technologies may become feasible. While no timeline has been established as to when this might occur, SLC staff is recommending that in ten years Poseidon would be required to evaluate and implement those additional technologies it determines are appropriate in light of an environmental review it would undertake at that time:[11] The draft State Lands Commission lease would require, ten years after the lease is issued, that the CDP be subject to further environmental review to ensure its operations at that time are using technologies that may reduce any impacts.

4.4 DESALINATION TECHNOLOGIES FOR IMPROVED SURVIVAL OF MARINE LIFE

Seawater desalination treatment processes and technologies differ significantly from these used in once-trough cooling power generation. In power plant installations, all of the entrained organisms pass through a complex system of power generation equipment and piping, and are exposed to thermal stress caused by high-temperature heat exchangers before they exit the power

[8] See Final Environmental Impact Report EIR 03-05 and Coastal Commission Recommended Revised Findings Coastal Development Permit for Poseidon Carlsbad Desalination Project, page 40 of 108; http://documents.coastal.ca.gov/reports/2008/3/W25a-3-2008.pdf
[9] See Coastal Commission Recommended Revised Findings Coastal Development Permit for Poseidon Carlsbad Desalination Project, page 40 of 108; http://documents.coastal.ca.gov/reports/2008/3/W25a-3-2008.pdf
[10] See Id. at 53.
[11] State Lands Commission October 24, 2007 recommended Amendment of Lease PRC 8727.1.

plant with the discharge. Therefore, typically a 100 percent mortality of marine organisms is assumed during the once-through cooling power generation process. State-of-the art reverse osmosis seawater desalination plants, such as the CDP, differ by the following key features:

1. Seawater is not heated in order to produce drinking water, which eliminates the thermal stress of marine organisms entrained in the source water flow;

2. Marine organisms are captured in the first stage of treatment (pretreatment) and therefore, do not pass through most of the desalination plant facilities, which in turn increases their chance of survival. The captured marine organisms are returned to the ocean.

The Carlsbad seawater desalination plant will incorporate a number of technologies that would reduce entrainment and increase the potential to capture marine organisms and to successfully return them to the ocean. These technologies are described below.

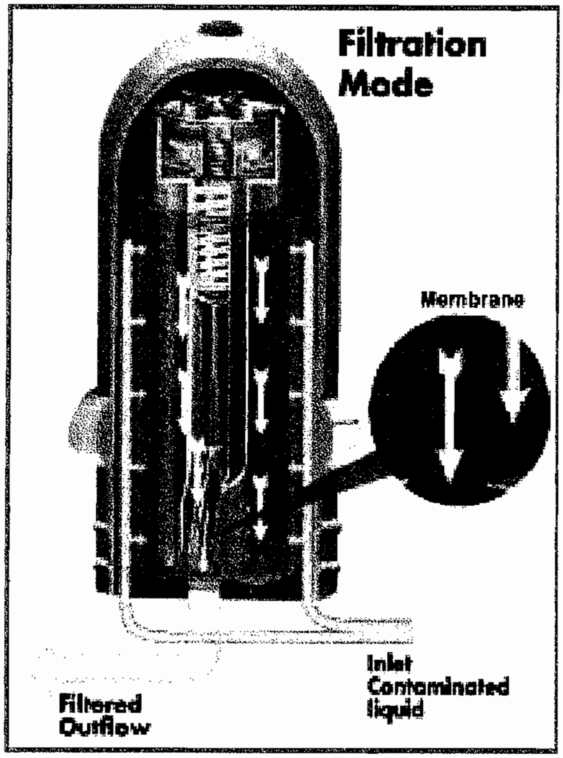
4.4.1 Installation of Variable Frequency Drives on Desalination Plant Intake Pumps

The desalination plant intake pump station will be equipped with variable frequency drive system to closely control the volume of the collected seawater. As water demand decreases during certain periods of the day and the year, the variable frequency drive system will automatically reduce the intake pump motor speed thereby decreasing intake pump flow to the minimum level needed for water production.

As in any other water treatment plant, the desalination plant production would vary diurnally and seasonally in response to water demand fluctuations. If variable frequency drive system is not available, the CDP intake pumps would collect a constant flow corresponding to the highest flow requirements of the CDP. The installation of VFD system at the intake pump station would reduce the total intake flow of the desalination plant compared to constant speed-design, which in turns would result in proportional decrease in entrainment associated with desalination plant operations. Pump motor operation at reduced speed during off-peak demand periods also would increase the chance for survival of the marine organisms entrained in the source seawater.

4.4.2 Installation of Micro-screens Ahead of Seawater Pretreatment Facilities

A very fine screen (120 micron/0.12 mm) or also known as micro-screen filtration technology is planned to be installed to filter out most of the marine organisms entrained by the desalination plant intake pumps. The micro-screens are equipped with polypropylene discs, which are diagonally grooved on both sides to a specific micron size. A series of these discs are stacked and compressed on a specially designed spine. The groove on the top of the disks runs opposite to the groove below, creating a filtration element with series of valleys and traps for marine particulates. The stack is enclosed in corrosion and pressure resistant housing. Filtration occurs while water is percolating from the peripheral end to the core of the element (Figure 4-8).



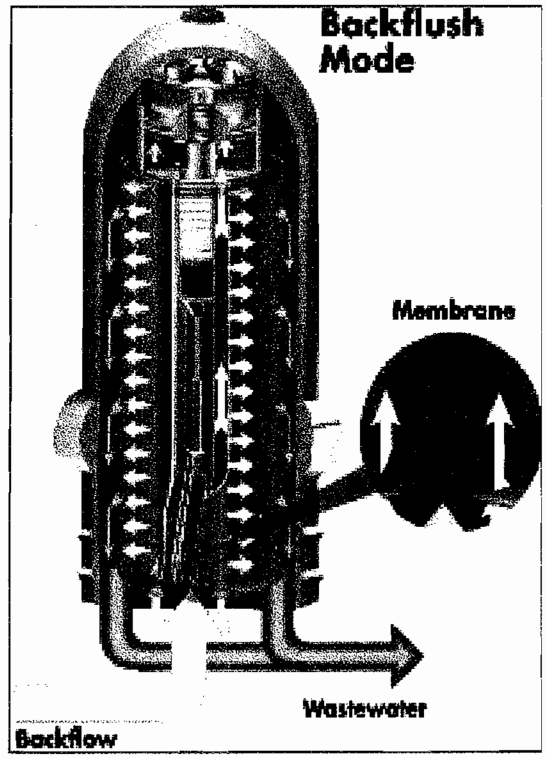


Figure 4-8. Microscreens in filtration and backwash flow modes

Since the intake seawater is already pre-screened by the 3/8 to 5/8- inch power plant intake screens, the seawater directed to the disk filters will contain debris and marine organisms smaller than 3/8-inch (9500 microns) (5/8-inch = 15.8 mm = 15,800 microns). During the filtration mode, seawater debris and marine organisms larger than 15,800 microns but smaller than 120 microns will be retained and accumulated in the cavity between the filter disks and the outer shell of the filters, thereby increasing the head loss through the filters. Once the filter head loss reaches a preset level (typically 5 psi or less) the filters enter backwash mode. All debris and marine organisms retained on the outer side of the filters are then flushed by tangential water jets of filtered seawater flow under 2 to 3 psi of pressure and the flush water is directed to a pipe, which returns the debris and marine organisms retained on the filters back to the ocean.

Because of the small size and relatively low differential pressure, these filters are likely to minimize entrainment and impingement mortality of the marine organisms in the source seawater. Since the disk filtration system is equipped with a wash water/organism return pipe, the impinged marine organisms are returned back to the ocean, thereby increasing their chance of survival. Based on US EPA source (US EPA, 2002, Technical Development Document for the Proposed Section 316 (b) Phase II Existing Facilities Rule, EPA 821-R-02003) fine mesh screens show promise for both impingement and entrainment control and "can reduce entrainment by 80 % or more". According to this source, the use of 0.5 mm (500 μ) screen at the Big Bend Power Plant in Tampa Bay area, "the system efficiency in screening fish eggs (primarily drums and bay anchovy) exceeded 95 % with 80 % latent survival for drum and 93 % efficiency for bay anchovy. For larvae (primarily drums, bay anchovies, blennies, and gobies), screening efficiency was 86 % with 65 % latent survival for drum and 66 % for bay anchovy. (Note that latent survival in control samples was also approximately 60 %). According to the same source, a full-scale test by the Tennessee Valley Authority at the John Sevier Plant showed less than half as many larvae entrained with a 0.5-mm (500 μ) screen than 1.0 mm (1,000 μ) and 2.0 mm (2,000 μ) screens combined. These data are indicative of the fact that most likely using finer screens would result in lower entrainment effect. Since the micro-screens proposed for the Carlsbad project have 120 μ openings which are smaller than the smallest fine screens used elsewhere (i.e., 500 μ), the entrainment reduction capability of these micro-screens is expected to be comparable to the fine screens tested at the full scale installations referenced above.

4.4.3 Use of Low Pressure Membrane Pretreatment System

After the source seawater is screened by the 120-μ micro-screens, this water would be conveyed to a membrane pretreatment system in order to remove practically all remaining suspended solids and particulates. The filtered water will then be pumped to the seawater reverse osmosis system for salt separation.

The pretreatment system planned to be used for the Carlsbad seawater desalination project will consist of submerged ultrafiltration (UF) hollow-fiber membranes bundled in cassettes and operated under slight vacuum – typically in a range of 2.5 to 6 psi (see Figure 4-9). The nominal fiber pore size of the UF membranes is 0.02 μ. Practically all marine organisms that were not removed by the 120-μ micro-screens (mostly algae and other phyto- and zooplankton) would be retained by the UF membranes and would periodically be returned back to the ocean during the backwash cycle of these membranes. Membrane backwash would typically be completed with air and water once every 20 to 40 minutes. No chemicals are planned to be applied for seawater conditioning prior to filtration.

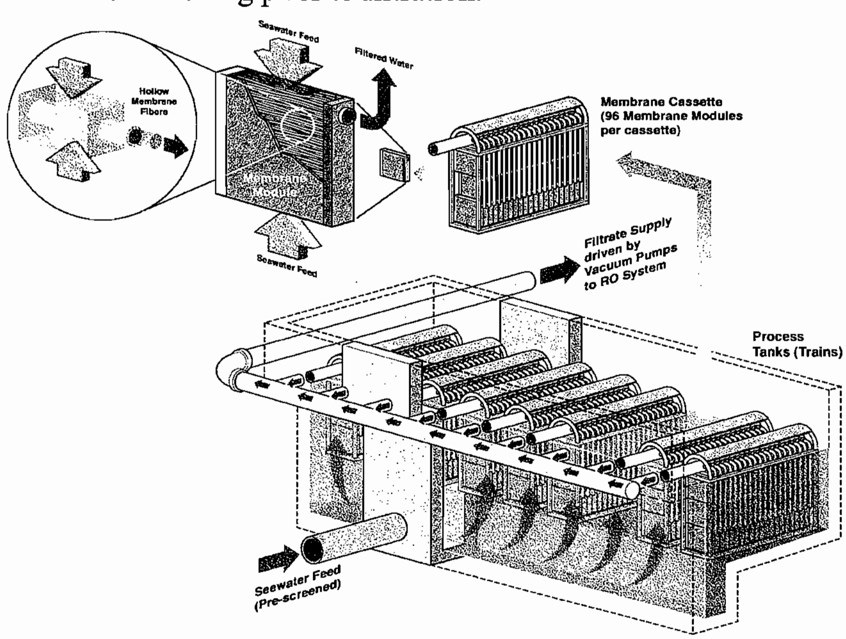


Figure 4-9 – Ultrafiltration Pretreatment System

Evaluation of the same UF pretreatment technology at the Carlsbad seawater desalination pilot plant indicates that the UF system retains all plankton and has potential to be effective entrainment reduction measure. Initial microscopic analysis of the phytoplankton in the UF system backwash completed by M-REP Consulting shows that over 70 % of algal cells maintain their integrity after passing through the micro-screens and the ultrafiltration process (see Figure 4-10).[12]

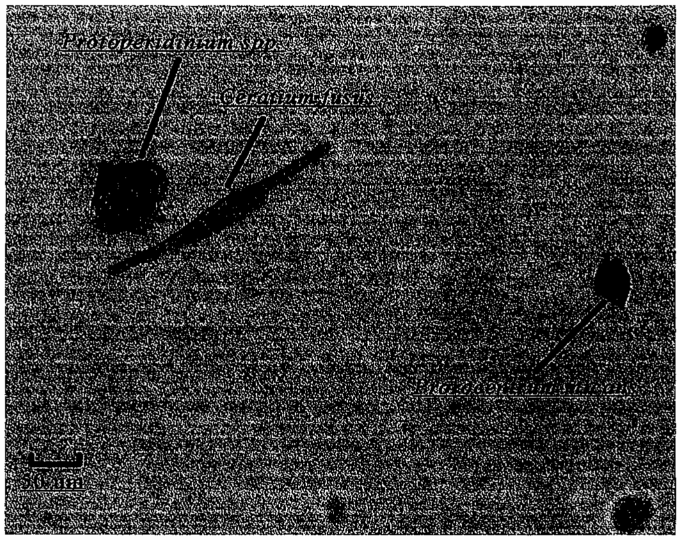


Figure 4-10 – Algae Removed by the UF Pretreatment System

4.5 SUMMARY OF THE FEASIBILITY ASSESSMENT OF TECHNOLOGY FEATURES TO MINIMIZE IMPACTS TO MARINE LIFE

A combination of intake, screening and treatment technologies were found to be feasible for the site-specific conditions of the proposed Project. The technology features are included in the CDP to minimize impacts to marine life are summarized in Table 4-2.

[12] M-Rep Consulting, Update on the preliminary results of the Carlsbad Pilot Algal Study, February 27, 2008.

TABLE 4-2

DESIGN FEATURES TO MINIMIZE IMPACTS TO MARINE LIFE

Category	Feature	Result
1. Technology	Installation of VFDs on CDP intake pumps	Reduce the total intake flow for the desalination facility to no more than that needed at any given time, thereby minimizing the entrainment of marine organisms.
2. Technology	Installation of micro-screens	Micro-screens (120 μ) minimize entrainment and impingement impacts to marine organisms by screening the fish larvae and plankton from the seawater.
3. Technology	Installation of low impact prefitration technology	The desalination facility will rely on low pressure, chemical free membrane pretreatment filtration technology to minimize entrainment and impingement impacts to marine organisms that have passed through the micro-screens by filtering the organisms from the seawater.
4. Technology	Return to the ocean of marine organisms captured by the screens and filters	Substantial reduction in entrainment and impingement impacts to marine organisms captured by the screens and membrane filter by returning the organisms to the ocean. Studies indicate potential for survival of 80 percent or more of the larvae captured by the micro-screens and 70 percent of the algae and other phyto- and zooplankton captured by the membrane filter.
5. Technology	Ten years after the lease is issued, that the CDP will be subject to further environmental review by the State Lands Commission (SLC) to analyze all environmental effects of facility operations and alternative technologies that may reduce any impacts found.	SLC may require additional requirements as are reasonable and as are consistent with applicable state and federal laws and regulations. This ensures that the CDP operations at that time are using technologies that the SLC determines may reduce any impacts and are appropriate in light of environmental review.

In addition, taking into account economic, environmental and technological factors previously discussed, the following technology alternatives intake are not capable of being accomplished in a successful manner within a reasonable period of time; and therefore, have been determined to be infeasible.

- **Installation of subsurface intakes** (beach wells, slant wells, infiltration galleries, etc.) is infeasible for the site-specific conditions of the Carlsbad project because of the limited production capacity, poor water quality of the coastal aquifer, extensive environmental damage associated with the implementation of such intakes and excess cost.

- **Construction of new open ocean intake** in the vicinity of the project site was found more environmentally damaging than the use of the existing intake located in Agua Hedionda Lagoon. This alternative is also cost-prohibitive.

- **Major physical or structural modifications to the existing power plant intake** facilities were found to be infeasible because of the very limited potential of impingement and entrainment benefits they could offer as well as practical constraints with their implementation while the power plant is in operation.

- **Installation of variable frequency drives on existing power plant intake pumps** would provide limited benefits to marine life while significantly interfering with ongoing power plant operations. Taking into account economic, environmental and technological factors, this alternative has been determined to be infeasible.

CHAPTER 5

QUANTIFICATION OF UNAVOIDABLE IMPACTS TO MARINE RESOURCES

INTRODUCTION

This Chapter provides a conservative (upper-end) quantification of the Project related impacts to marine life. This Chapter is broken down into four sections:

- *The first section describes conservative approach to quantification of the Project related impacts to marine life.*
- *The second section provides an assessment of the impingement impact of the desalination facility stand-alone operations.*
- *The third section provides an assessment of the entrainment impact of the desalination facility stand-alone operations.*
- *The fourth section provides a summary of the assessment of impingement and entrainment impacts associated with desalination facility stand-alone operation.*

5.1 CONSERVATIVE APPROACH

As previously described, the CDP is designed to use the existing intake and discharge facilities of the Encina Power Generation Station (EPS). When EPS is producing electricity and using 304 MGD or more of seawater for once-through cooling, the proposed desalination plant operation would cause a *de minimis* increase in impingement and entrainment of marine organisms.

Under conditions when the EPS operation is temporarily or permanently discontinued, the desalination plant will continue to use the existing power plant intake and discharge facilities. Under this mode of operation, the impingement and entrainment impacts of the desalination plant operations would be significantly lower than those caused by the EPS operations at the same intake flow, due to a number of differences in the desalination plant and power plant intake design and operations.

Figure 3-2 provides a comparison of the 2007 EPS cooling water discharge to the flow needed to support CDP operations. Under this operating scenario, the EPS discharge would provide 61 percent of the CDP annual seawater intake requirements and the CDP would pump the remaining source water required to support the desalination plant operations from the EPS intake. The CDP's direct use of the EPS discharge, coupled with the design and technology features described in Chapters 3 and 4, would result in a substantial reduction in the CDP entrainment and impingement impacts.

Nevertheless, Poseidon is proposing a very conservative approach to quantifying the entrainment and impingement impacts that would be used to establish the mitigation requirements for the project that:

1. Does not take any credit for design and technology features that would be incorporated into the CDP to lessen the impacts to marine life;

2. Does not take any credit for the reduction or elimination of the impact to marine life that may occur as a result of the State Lands Commission lease requirements.

3. Does not take any credit for improvements to marine resources that may come about through Poseidon's commitment to assume responsibility for preservation of Agua Hedionda Lagoon after the EPS is decommissioned.

4. Mitigates for the maximum possible impact to marine life associated with the diversion of 304 MGD of seawater from Agua Hedionda Lagoon through the restoration of approximately 37 acres of comparable marine wetlands.

5.2 IMPINGMENT EFFECT OF DESALINATION PLANT STAND-ALONE OPERATIONS

5.2.1 Methodology for Impingement Assessment

The impingement effect of any intake structure is caused by its screens and is associated with two parameters: the intake flow and the velocity of this flow through the screens. For the purposes of this analysis, the impingement effect is assumed proportional to the intake flow at velocities above 0.5 fps. If the intake through-screen velocity is below or equal to 0.5 fps, the impingement effect of the intake screens is considered to be negligible.

The impingement assessment provided herein is based on the analysis of most recent data collected at the EPC intake facilities during the period June 1, 2004 to May 31, 2005 (Attachment 2). This data was collected and analyzed by Tenera Environmental in accordance with a sampling plan and methodology approved by the San Diego Regional Water Quality Control Board (see Attachment 3).

5.2.2 Estimate of the Impingement Effect of Desalination Plant Stand-Alone Operations

The abundance and biomass of fishes, sharks, rays and invertebrates impinged on the EPS traveling screens were documented in an extensive study as part of the 316(b) Cooling Water Intake assessment submitted to the San Diego Regional Water Quality Control Board by Cabrillo Power, LLC in early 2008[1].). All impingement sampling data collected during this study are

[1] Encina Power Station cooling water system entrainment and impingement of marine organisms: Effects on the biological resources of Agua Hedionda Lagoon and the nearshore ocean environment, Tenera Environmental", January 2008.

provided in Attachment 2 of the Minimization Plan. This attachment contains data collected for all individual sampling events, including the dates and times of the sampling events. The average power plant intake flow during the 2004/2005 sampling period was 632.6 MGD. The total annual amount of impinged fish, sharks and rays for intake flow of 304 MGD, representative for stand-alone operation of the desalination plant is presented in Table 5-1. Based on these data, the average he daily biomass of impinged fish, sharks and rays during stand-alone operations of the desalination plant was estimated at 0.96 kg/day (2.11 lbs/day) for an intake flow of 304 MGD.

Table 5-1 presents impingement losses of fishes, sharks and rays during both normal operations and heat treatment operations. Since the seawater desalination plant will be shutdown during heat treatment, the operation of this plant will not be associated with the impingement losses that occur during heat treatment. Stand-alone operations of the desalination plant will not require the use of heat treatment.

TABLE 5-1

Number and weight of fishes, sharks, and rays impinged during normal operation and heat treatment surveys at EPS from June 2004 to June 2005 prorated for 304 MGD

			Normal Operations Sample Totals				Heat Treatment	
	Taxon	Common Name	Sample Count	Sample Weight (g)	Bar Rack Count	Bar Rack Weight (g)	Sample Count	Sample Weight (g)
1	*Atherinops affinis*	topsmelt	5,242	42,299	10	262	15,696	67,497
2	*Cymatogaster aggregata*	shiner surfperch	2,827	28,374-	-		18,361	196,568
3	*Anchoa compressa*	deepbody anchovy	2,079	11,606	2	21	23,356	254,266
4	*Seriphus politus*	queenfish	1,304	7,499	2	17	929	21,390
5	*Xenistius californiensis*	salema	1,061	2,390-	-		1,577	6,154
6	*Anchoa delicatissima*	slough anchovy	1,056	3,144-	-		7	10
7	Atherinopsidae	silverside	999	4,454-	-		2,105	8,661
8	*Hyperprosopon argenteum*	walleye surfperch	605	23,962	1	21	2,547	125,434
9	*Engraulis mordax*	northern anchovy	537	786-	-		92	374
10	*Leuresthes tenuis*	California grunion	489	2,280-	-		7,067	40,849
11	*Heterostichus rostratus*	giant kelpfish	344	2,612-	-		908	9,088
12	*Paralabrax maculatofasciatus*	spotted sand bass	303	4,604-	-		1,536	107,563
13	*Sardinops sagax*	Pacific sardine	268	1,480-	-		6,578	26,266
14	*Roncador stearnsi*	spotfin croaker	182	8,354	2	3,000	106	17,160
15	*Paralabrax nebulifer*	barred sand bass	151	1,541-	-		1,993	32,759
16	*Gymnura marmorata*	Calif. butterfly ray	146	60,629	1	390	70	36,821
17	*Phanerodon furcatus*	white surfperch	144	4,686-	-		53	823
18	*Strongylura exilis*	California needlefish	135	6,025-	-		158	11,899
19	*Paralabrax clathratus*	kelp bass	111	680-	-		976	13,279
20	*Porichthys myriaster*	specklefin midshipman	103	28,189-	-		218	66,860
21	unidentified chub	unidentified chub	96	877-	-		7	44

22	*Paralichthys californicus*	California halibut	95	1,729-	-		21	4,769
23	*Anisotremus davidsoni*	sargo	94	1,662-	-		963	68,528
24	*Urolophus halleri*	round stingray	79	20,589-	-		1,090	300,793
25	*Atractoscion nobilis*	white seabass	70	11,295	6	872	1,618	332,056
26	*Hypsopsetta guttulata*	diamond turbot	66	10,679	1	85	112	24,384
27	*Micrometrus minimus*	dwarf surfperch	57	562-	-	-	-	
28	*Syngnathus spp.*	pipefishes	55	161-	-		56	90
29	*Atherinopsis californiensis*	jacksmelt	54	1,152-	-		4,468	45,152
30	*Myliobatis californica*	bat ray	50	19,899	4	5,965	132	68,572
31	*Menticirrhus undulatus*	California corbina	43	1,906-	-		16	4,925
32	*Amphistichus argenteus*	barred surfperch	43	1,306-	-		34	2,528
33	*Fundulus parvipinnis*	California killifish	43	299-	-		16	41
34	unidentified fish, damaged	unid. damaged fish	36	1,060	1	70	8	262
35	Ictaluridae	catfish unid.	35	4,279-	-	-	-	
36	*Leptocottus armatus*	Pacific staghorn sculpin	32	280-	-		5	26
37	*Sphyraena argentea*	California barracuda	29	397-	-		46	1,667
38	*Lepomis cyanellus*	green sunfish	29	1,170-	-	-	-	
39	*Umbrina roncador*	yellowfin croaker	28	573-	-		127	22,399
40	*Lepomis macrochirus*	bluegill	20	670-	-	-	-	
41	*Ophichthus zophochir*	yellow snake eel	18	5,349-	-		51	17,303
42	*Citharichthys stigmaeus*	speckled sanddab	17	62-	-		1	30
43	*Brachyistius frenatus*	kelp surfperch	16	182-	-		17	598
44	*Cheilotrema saturnum*	black croaker	15	103-	-		288	9,029
45	*Embiotoca jacksoni*	black surfperch	14	1,240-	-		69	5,367
46	*Genyonemus lineatus*	white croaker	12	171-	-		9	79
47	*Platyrhinoidis triseriata*	thornback	11	4,731	1	1,500-	-	
48	*Chromis punctipinnis*	blacksmith	10	396-	-		151	4,431
49	unidentified fish	unidentified fish	10	811-	-	-	-	
50	*Porichthys notatus*	plainfin midshipman	9	1,792-	-	-	-	
51	*Hermosilla azurea*	zebra perch	9	1,097-	-		62	3,518
52	*Micropterus salmoides*	large mouth bass	9	27-	-	-	-	
53	*Trachurus symmetricus*	jack mackerel	7	7-	-		15	702
54	*Hypsoblennius gentilis*	bay blenny	7	37-	-		440	2,814
55	*Heterostichus* spp.	kelpfish	7	48-	-	-	-	
56	Engraulidae	anchovies	6	3-	-	-	-	
57	*Anchoa* spp.	anchovy	6	27-	-	-	-	
58	*Peprilus simillimus*	Pacific butterfish	5	91-	-		1	33
59	*Rhacochilus vacca*	pile surfperch	4	915-	-	-	-	
60	*Sebastes atrovirens*	kelp rockfish	4	40-	-	-	-	
61	*Pleuronichthys verticalis*	hornyhead turbot	4	190-	-		2	251
62	*Pylodictis olivaris*	flathead catfish	4	480-	-	-	-	
63	Pleuronectiformes unid.	flatfishes	4	62-	-	-	-	
64	*Syngnathus leptorhynchus*	bay pipefish	3	9-	-	-	-	
65	*Hypsoblennius gilberti*	rockpool blenny	3	16-	-		8	77
66	*Mustelus californicus*	gray smoothhound	3	1,850-	-		22	19,876
67	*Cheilopogon pinnatibarbatus*	smallhead flyingfish	3	604-	-	-	-	
68	*Ameiurus natalis*	yellow bullhead	3	220-	-	-	-	
69	*Lepomis* spp.	sunfishes	3	196-	-	-	-	

70	*Girella nigricans*	opaleye	2	346-	-		355	30,824
71	*Rhinobatos productus*	shovelnose guitarfish	2	461	2	6,200-	-	
72	*Acanthogobius flavimanus*	yellowfin goby	2	55-	-	-	-	
73	*Scomber japonicus*	Pacific mackerel	2	10-	-		15	880
74	*Hypsoblennius* spp.	blennies	2	11-	-		113	489
75	*Hypsoblennius jenkinsi*	mussel blenny	2	17-	-		175	946
76	*Paralabrax* spp.	sand bass	2	2-	-		6	19
77	*Scorpaena guttata*	Calif. scorpionfish	2	76-	-	-	-	
78	*Hyporhamphus rosae*	California halfbeak	2	23-	-		1-	
79	*Symphurus atricauda*	California tonguefish	2	15-	-	-	-	
80	*Tilapia* spp.	tilapias	2	7-	-	-	-	
81	*Sarda chiliensis*	Pacific bonito	2	1,010-	-		2	540
82	*Albula vulpes*	bonefish	2	1,192-	-		1	900
83	Sciaenidae unid.	croaker	2	3-	-		17	1,212
84	*Oxylebius pictus*	painted greenling	1	5-	-	-	-	
85	*Lyopsetta exilis*	slender sole	1	26-	-	-	-	
86	*Citharichthys sordidus*	Pacific sanddab	1	1-	-	-	-	
87	*Gibbonsia montereyensis*	crevice kelpfish	1	8-	-	-	-	
88	*Pleuronichthys ritteri*	spotted turbot	1	7-	-		13	2,745
89	*Gillichthys mirabilis*	longjaw mudsucker	1	34-	-	-	-	
90	*Dorosoma petenense*	threadfin shad	1	3-	-	-	-	
91	*Porichthys* spp.	midshipman	1	200-	-	-	-	
92	*Cynoscion parvipinnis*	shortfin corvina	1	900-	-	-	-	
93	*Mugil cephalus*	striped mullet	1	3-	-		5	3,854
94	*Paraclinus integripinnis*	reef finspot	1	4-	-		4	12
95	*Hyperprosopon* spp.	surfperch	1	115-	-		7	552
96	*Ameiurus nebulosus*	brown bullhead	1	100-	-	-	-	
97	*Micropterus dolomieu*	smallmouth bass	1	150-	-	-	-	
98	*Citharichthys* spp.	sanddabs	-	- -	-		1	3
99	*Triakis semifasciata*	leopard shark	-	- -	-		2	688
100	*Medialuna californiensis*	halfmoon	-	- -	-		53	1,864
101	*Torpedo californica*	Pacific electric ray	-	-	1	3,750-	-	
102	Scorpaenidae	scorpionfishes	-	- -	-		2	64
103	*Halichoeres semicinctus*	rock wrasse	-	- -	-		1	33
104	*Hypsypops rubicundus*	garibaldi	-	- -	-		5	1,897
105	*Seriola lalandi*	yellowtail jack	-	- -	-		21	978
106	*Dasyatis dipterura*	diamond stingray	-	- -	-		2	1,468
107	*Heterodontus francisci*	horn shark	-	- -	-		1	850
108	Zoarcidae	eelpouts	-	- -	-		1	17
			19,408	**351,672**	**34**	**22,152**	**94,991**	**2,034,900**

The daily biomass of impinged fish, sharks and rays during normal operations of 0.96 kgs/day was calculated by dividing the total annual sample weight of 351,672 grams (see last row of the second column of the Table 5-1 summarizing all impingement data) by the total number of days per year (i.e., 351,672 grams/365 days = 963.48 grams/day = 0.96 kgs/day.

While Table 5-1 presents impingement information for fish, sharks and rays, Attachment 2 also contains all impingement data for invertebrates (crab, octopus, squid, California spiny lobster, etc.) collected during the 2004/2005 impingement study referenced above. Review of this comprehensive impingement data set in Attachment 2 indicates that the both the number and the total weight of the impinged invertebrates was over 10 times smaller than that of fish, sharks and rays (i.e., less than 0.1 kgs/day).

5.2.3 Significance of Impingement Losses

As the CEQA lead agency on the Project EIR, the City of Carlsbad found that the impingement impacts associated with the stand-alone operation of the proposed desalination facility are insignificant and therefore no mitigation is required.[2] In its approval of the Coastal Development permit for the proposed Project, the Coastal Commission found that impingement impacts associated with the stand-alone desalination facility would be "*de minimis* and insignificant."[3] The Coastal Commission conditioned the project to include compensatory mitigation to lessen the effects of unavoidable entrainment and impingement impacts.[4] With the inclusion of this Special Condition 8, the Commission found that the anticipated entrainment and impingement impacts associated with the stand-alone desalination facility would be mitigated to the maximum extent feasible.[5]

5.3 METHODOLOGY FOR ASSESSMENT OF ENTRAINMENT IMPACT

5.3.1 Background Data Used for Preparation of Entrainment Assessment

The entrainment assessment associated with the desalination plant operations is based on comprehensive data collection study completed at the existing intake of the Encina Power Generation Station following a San Diego Regional Water Quality Control Board (Regional Board) approved data collection protocol during the Period of June 01, 2004 and May 31, 2005 (see Attachment 3). All samples used for the entrainment assessment were collected in front of the EPS intake with a boat-towed plankton net. This is the most up-to-date entrainment assessment available for this facility.

Tenera Environmental estimated the proportional entrainment mortality of the most commonly entrained larval fish living in Agua Hedionda Lagoon by applying the Empirical Transport Model (ETM) to the complete data set from the period of June 01, 2004 and May 31, 2005. The potential entrainment contribution of the desalination facility operations was computed based on a total flow of 304 MGD (104 MGD flow to the desalination facility and 200 MGD for dilution of the concentrated seawater).

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[2] See Final Environmental Impact Report EIR 03-05

[3] See Coastal Commission Recommended Findings Coastal Development Permit for Poseidon Carlsbad Desalination Project, page 40 of 108; http://documents.coastal.ca.gov/reports/2008/3/W25a-3-2008.pdf

[4] See Coastal Commission Recommended Findings Coastal Development Permit for Poseidon Carlsbad Desalination Project, pages 53 of 108; http://documents.coastal.ca.gov/reports/2008/3/W25a-3-2008.pdf

[5] See Coastal Commission Recommended Findings Coastal Development Permit for Poseidon Carlsbad Desalination Project, pages 3 and 4 of 108; http://documents.coastal.ca.gov/reports/2008/3/W25a-3-2008.pdf

5.3.2 Entrainment Effects Model

The Empirical Transport Model (ETM) used to assess the APF the desalination facility is based on principles used in fishery management. The number of days that the larvae are subject to entrainment, or the number of days the desalination facility is operating, is estimated using the size range of the larvae entrained. This number of operating days is then combined with the entrainment mortality (*PE*) to estimate the total mortality due to entrainment for a study period. These estimates for each study period can then be combined to calculate the average proportional mortality due to entrainment for an entire year.

The *ETM* has been proposed by the U.S. Fish and Wildlife Service to estimate mortality rates resulting from cooling water withdrawals by power plants. The *ETM* model provides an estimate of incremental mortality (a conditional estimate in absence of other mortality imposed on local larval populations by using an empirical measure of proportional entrainment (*PE*) rather than relying solely on demographic calculations. Proportional entrainment (*PE*) (an estimate of the daily mortality) to the source water population from entrainment is expanded to predict regional effects on appropriate adult populations using the *ETM*, as described below.

Empirical transport modeling permits the estimation of conditional mortality due to entrainment while accounting for the temporal variability in distribution and vulnerability of each life stage to power plant withdrawals.

The general equation to estimate *PE* for a day on which entrainment was sampled is:

$$\hat{P}E = \frac{\hat{N}_{Ei}}{\hat{N}_{Si}}$$

Where:

$\hat{N}_{Ei}$ = estimated number of larvae entrained during the day in survey i, calculated as (estimated density of larvae in the water entrained that day) × (design specified daily cooling water intake volume),

$\hat{N}_{Si}$ = estimated number of larvae in the source water that day in survey i (estimated density of larvae in the souce water that day) × (source water volume).

A source water volume is used because: 1) cooling water flow is measured in volume per time, and 2) biological sampling measures larval concentration in terms of numbers per sample volume. Entrained numbers of larvae are estimated using the volume of water withdrawn. A source population is similarly estimated using the source water volume. If one assumes that larval concentrations at the point of entrainment are the same as larval concentrations in the source population volume then it follows that:

$$\hat{P}E = \frac{\hat{V}_{Ei}}{\hat{V}_{Si}},$$

Where :

$\hat{V}_{Ei}$ = design specified daily cooling water intake volume,

$\hat{V}_{Si}$ = estimated source water volume.

The ratio of daily entrainment volume to source volume can thus serve as an estimate of daily mortality. The *PE* value is estimated for each larval duration period over the course of a year by using a source water estimate from an advection model described below.

If larval entrainment mortality is constant throughout the period and a larva is susceptible to entrainment over a larval duration of *d* days, then the proportion of larvae that escape entrainment in period *i* is:

$$(1-\hat{P}E_i)^{\hat{d}}.$$

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) study completed by Tenera Environmental. The value for *d* was computed by dividing an estimate of growth rate into the change in length based on this 99th percentile estimate. The minimum size used for computing the larval duration was determined after removing the smallest 1 percent of the values.

It is possible that aging was biased, even though standard lengths of larval fishes (i.e., measurements of minimum, mean, and maximum), and larval growth rates were applied to estimate the ages of the entrained larvae. It was assumed that larvae shorter than the minimum length were just hatched and therefore, aged at zero days. Subsequent ages were estimated using this length. Other reported data for various species suggest that hatching length can be either smaller or larger than the size estimated from the samples, and indicate that the smallest observed larvae represent either natural variation in hatch lengths within the population or shrinkage following preservation. The possibility remains that all larvae from the observed minimum length to the greatest reported hatching length (or to some other size) could have just hatched, leading to overestimation of ages for all larvae.

Sixteen larval duration periods over the course of a year were used to estimate larval mortality (P_M) due to entrainment using the following equation:

$$\hat{P}_M = \frac{1}{16}\sum_{i=1}^{16} 1-(1-\hat{P}E_i)^{\hat{d}}$$

Where:

$\hat{P}E_i$ = estimate of proportional entrainment for the ith period and

$\hat{d}$ = the estimated number of days of larval life.

The estimate of the population-wide probability of entrainment ($\hat{P}E_i$) is the central feature of the *ETM* approach. If a population is stable and stationary, then $\hat{P}_M$ estimates the effects on the fully-recruited adult age classes when uncompensated natural mortality from larva to adult is assumed.

Assumptions associated with the estimation of P_M include the following:

1) Lengths and applied growth rate of larvae accurately estimate larval duration,
2) A source population of larvae is defined by the region from which entrainment is possible,
3) Source water volume adequately describes the population, and
4) The currents used to calculate the source water volume are representative of other years.

The ratio of daily entrainment volume to source volume is used as an estimate of daily mortality. The *ETM* method estimates the source population using an estimate of the source volume of water from which larvae could possibly be entrained. It has been noted that if some members of the target group lie outside the sampling area, the *ETM* will overestimate the population mortality.

Recent work by Largier showed the value of advection and diffusion modeling in the study of larval dispersal, which is central to the *ETM* method. Ideally, three components could be considered in estimating entrainable populations: advection, diffusion, and biological behavior. An *ad hoc* approach, developed by the Technical Working Group during the Diablo Canyon Power Plant (DCPP) 316(b) study, modeled the three components using a single offshore current meter. For the present analysis, lagoon and coastal source water populations were treated separately.

Larval populations in the Agua Hedionda lagoon were computed using the lagoon segment volumes, described below. Nearshore populations were defined using the *ad hoc* approach developed by the DCPP Technical Working Group.

5.3.3 Source Water Volume Used for AHF Calculations

Agua Hedionda Lagoon is comprised of three segments: "outer", "middle", and "inner". The lagoon segments were originally dredged to a mean depth of 2.4 m (8 ft) relative to mean water level (MWL) in 1954. The horizontal areas of the outer, middle, and inner segments at MHW are 267,000 m^2 (66 acres), 110,000 m^2 (27 acres) and 1,200,000 m^2 (295 acres), respectively (Table 5-2). The tidal prism of the outer segment was calculated as 246,696 m^3 (200 acre ft) and for the middle and inner segments as 986,785 m^3 (800 acre ft). The individual volumes of the middle and inner tidal prisms were estimated to be 82,860 m^3 and 903,925 m^3 using weighting by areas. The volumes of the three segments below mean water level were computed as the volume below mean high water minus half the tidal prism (Table 5-2).

TABLE 5-2

VOLUMES OF THE OUTER, MIDDLE, AND INNER SEGMENTS OF THE AGUA HEDIONDA LAGOON

	Design Depth (m re: MWL)	Area (m^2 re: MHW)	Volume (m^3 re: MHW)	Volume (MWL) (m^3 MHW-.5 Prism)
Outer	2.4	267,000	791,356	668,006
Middle	2.4	110,000	326,027	284,597
Inner	2.4	1,200,000	3,556,656	3,104,696
Total		**1,577,000**	**4,674,039**	**4,057,299**

Figure 5-1 shows the sampling blocks used to calculate near shore source water volume. Sampling done in five (the "N" blocks) of the nine blocks was assumed to be representative of alongshore and offshore variation in abundances and therefore the volume from all nine blocks was used in calculating source water abundances. The volumes for these sampling blocks were calculated from bathymetric data for the coastal areas around Carlsbad using ArcGIS software. The total volume in these nine blocks was estimated at 283,303,115 m^3 (Table 5-3).

SDG&E have completed a three-month deployment (June, August, and November 1979) of two Endeco current meter seaward of the outer lagoon entrance. Highest current speeds occurred further offshore, with 10.06 cm/s being the average current speed. The furthest offshore station was over a bottom depth of about 24.4 m (80 ft) at California State plane 355,800 N and 6,625,000 E. The meter was set –3 m below the surface. SCCWRP reported similar current speeds with median offshore currents at Carlsbad of 8.6 cm/s in winter and 7.0–9.5 cm/s in summer from a mid-depth position over a 45 m bottom from 1979–1990.

TABLE 5-3

VOLUMES OF NEAR SHORE SAMPLING BLOCKS USED IN CALCULATING SOURCE WATER ABUNDANCES

Block	Depth (m re: MWL)	Area (m^2 re: MHW)	Volume (m^3 re: MHW)
N1	-5.3	1,195,366	5,959,236
N2	-6.4	1,653,677	9,840,181
N3	-5.6	1,775,546	9,247,259
SW1	-14.8	1,055,516	15,633,525
N4	-18.5	1,359,040	25,081,478
SW2	-17.9	1,711,379	30,499,399
SW3	-27.8	1,312,832	36,386,864
N5	-38.5	1,661,891	63,329,174
SW4	-42.8	2,046,985	87,325,998
Total		**13,772,232**	**283,303,115**

The three months of currents reported in SDG&E in 1980 were rotated to the coastline direction at the Encina Power Station (36 degrees W of N). The average current vector components were 1.702 cm/s downcoast and 0.605 cm/s offshore.

A current meter was placed in the near shore between Stations N4 and N5. The data from the meter was used to characterize currents in the near shore area that would directly affect the dispersal of planktonic organisms that could be entrained by the power plant. The data were used to define the size of the near shore component of the source water by using the current speed and the estimated larval durations of the entrained organisms.

Source water volume and depths of Agua Hedionda Lagoon were very carefully determined based on recent hydrodynamic studies of Agua Hedionda Lagoon.

5.3.4 ETM Modeling for Carlsbad Desalination Project

The effect of the proposed CDF operations on source water populations of larval fishes was evaluated in three steps. First, by computing estimates of the incremental mortality that could result from the desalination facility source seawater withdrawal over a one-day period, second by using the incremental mortality to estimate mortality over the period that the larvae are exposed to water withdrawals, and finally by placing these estimates into context based on empirical data of the number of larvae that survive EPS entrainment and are alive at the point of source seawater water withdrawal by the proposed desalination facility.

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 estimate of the number of larvae in the water withdrawn is calculated using the average concentration of larvae from samples that were collected inside the EPS cooling water intake system at a point close to the location where the desalination facility would withdraw its water.

The average concentration and variance were calculated for the in-plant surveys conducted on June 10, 2004 and May 19, 2005. The average concentration and variance from these two surveys were then used to calculate estimates of the average in-plant concentration and variance. The average variance from the two surveys was used since it best reflected the level of variation among samples over a 24-hr period. The average concentration was multiplied by desalination facility's maximum feedwater withdrawal volume of 1,150,640 m^3/day (304 MGD) to simulate effects under maximum operating conditions. Similar calculations were used to estimate the source water populations of larvae that would be affected by the proposed CDF operations. Average concentrations of larval fishes from stations in the inner, middle, and outer segments of Aqua Hedionda Lagoon, and stations in the ocean directly offshore from EPS were calculated from the thirteen surveys conducted from June 10, 2004 to May 19, 2005. The average concentrations were multiplied by the volume estimates for each of the water body segments and then combined to estimate the average source water population.

Sources of Variance in ETM

The major sources of variance in *ETM* results have been shown to include variance in estimates of larval entrainment concentrations, source water concentrations, and larval duration, in this order. Variance in estimates of entrainment and source water concentrations of fish larvae is due to spatial differences among stations, day and night diurnal changes, and temporal changes between surveys.

ETM Results

Estimates of desalination intake and source water populations for the fish taxa evaluated are presented in Table 5-4 were based on entrainment and source water data for the sampling period of June 10, 2004 to May 19, 2005. The following documents related to Poseidon's Entrainment Study are enclosed.

- Attachment 2 – Impingement Results, G1 – Traveling Screen and bar Rack Weekly Surveys, G2 – Heat Treatment Surveys
- Attachment 3 – Proposal for Information Collection Clean Water Act Section 316(b), Encina Power Station, Cabrillo Power I LLC, NPDES Permit No. CA0001350, April 1, 2006
- Attachment 4 – Updated Impingement and Entrainment Assessment, Tenera Environmental, May 2007
- Attachment 5 – Carlsbad Desalination Facility – Summary of Fish and Target Shellfish Larvae Collected for Entrainment and Source Water Studies in the Vicinity of Agua Hedionda Lagoon from June 2005 through May 2006.

TABLE 5-4

ETM VALUES FOR ENCINA POWER STATION LARVAL FISH ENTRAINMENT FOR THE PERIOD OF 01 JUN 2004 TO 31 MAY 2005 BASED ON STEADY ANNUAL INTAKE FLOW OF 304 MGD

	ETM Estimate	ETM Std.Err.	ETM + SE	ETM - SE
ETM Model Data for 3070 - Gobies	0.21599	0.30835	0.52434	-0.09236
ETM Model Data for 1495 - Blennies	0.08635	0.1347	0.22104	-0.04835
ETM Model Data for 1849 - Hypsopops	0.06484	0.13969	0.20452	-0.07485
AVERAGE	**0.122393**			
ETM Model Data for 3062 – White Croaker	0.00138	0.00281	0.00419	-0.00143
ETM Model Data for 1496 – Northern Anchovy	0.00165	0.00257	0.00422	-0.00092
ETM Model Data for 1219 – California Halibut	0.00151	0.00238	0.00389	-0.00087
ETM Model Data for 1471 - Queenfish	0.00365	0.00487	0.00852	-0.00123
ETM Model Data for 1494 – Spot Fin Croaker	0.00634	0.01531	0.02165	-0.00896
AVERAGE	**0.002906**			

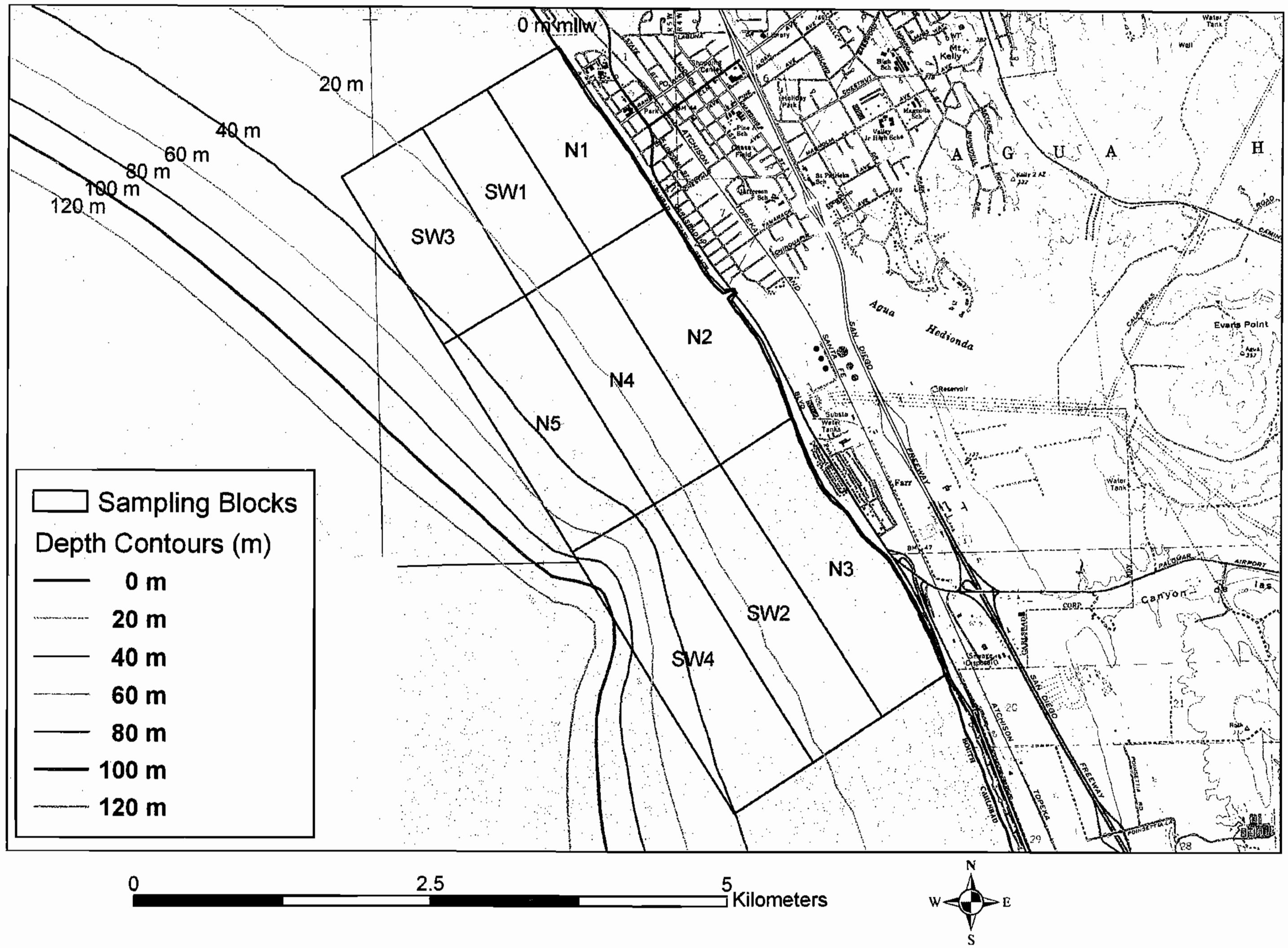

Figure 5-8 Nearshore sampling blocks used to calculate source water volumes

The average ETM value of the entrained species of 0.1224 (12.2 percent) average of ETM results for the three most commonly entrained species living in Agua Hedionda Lagoon. This approach makes it possible to establish a definitive habitat value for the source water, and is consistent with the approach taken by the California Energy Commission and their independent consultants for the AES Huntington Beach Power Generation Plant and the Morro Bay Power Plant (MBPP) in assessing and mitigating the entrainment effects of the proposed combined cycle project. The situation in Morro Bay is very analogous to the proposed Carlsbad Project because both projects are drawing water from the enclosed bays.

5.3.5 Significance of Worst-Case Scenario Entrainment Impacts

As the CEQA lead agency on the Project EIR, the City of Carlsbad found that the entrainment impacts associated with the stand-alone operation of the proposed desalination facility are insignificant and therefore no mitigation is required.[6]

The Coastal Act applies a different standard of review for projects of this nature. The Coastal Act provides that "[m]arine resources shall be maintained, enhanced, and *where feasible* restored."[7] Additionally, the adverse effects of entrainment shall be minimized where feasible.[8] In its approval of the Coastal Development permit for the proposed Project, the Coastal Commission found that Poseidon is "using all feasible methods to minimize or reduce its entrainment impacts" and conditioned the Project to include compensatory mitigation to lessen the effects of unavoidable entrainment and impingement impacts.[9] With the inclusion of this Special Condition 8, the Commission found that the anticipated entrainment and impingement impacts associated with the stand-alone desalination facility would be mitigated to the maximum extent feasible.[10]

5.4 SUMMARY AND CONCLUSIONS

The Coastal Commission found that Poseidon is using all feasible methods to minimize or reduce its impingement and entrainment impacts. These methods are likely to reduce the Project related impacts to marine life well below the levels identified herein. Nevertheless, as described in Chapter 6, Poseidon has voluntarily committed to restore and enhance sufficient coastal habitat to more than compensate for the Project impacts prior to consideration of benefits to be derived form the minimization measures.

Ten years after the lease is issued, that the CDP will be subject to further environmental review by the State Lands Commission (SLC) to analyze all environmental effects of facility operations

[6] See Final Environmental Impact Report EIR 03-05
[7] Coastal Act Sections 30230.
[8] Coastal Act Sections 30231.
[9] See Coastal Commission draft findings for Poseidon Carlsbad Desalination Project, pages 53 of 108; http://documents.coastal.ca.gov/reports/2008/3/W25a-3-2008.pdf
[10] See Coastal Commission draft findings for Poseidon Carlsbad Desalination Project, pages 3 and 4 of 108; http://documents.coastal.ca.gov/reports/2008/3/W25a-3-2008.pdf

and alternative technologies that may reduce any impacts found. SLC may require additional requirements as are reasonable and as are consistent with applicable state and federal laws and regulations. This approach will ensure that the stand-alone CDP operations continue to use the best technologies to minimize impacts to marine life and are mitigated to the maximum extent feasible.

CHAPTER 6

MITIGATION

INTRODUCTION

Pursuant to Water Code Section 13142.5(b), this Chapter establishes a state-agency coordinated process for identification of the best available mitigation feasible to minimize Project related impacts to marine life..

- *Section 6.1 describes the proposed approach to mitigation.*
- *Section 6.2 describes the assessment of the impacted area.*
- *Section 6.3 provides an assessment of the wetlands restoration needed to compensate for entrainment impacts of the desalination facility stand-alone operations.*
- *Section 6.4 describes the restoration plan development and related benefits.*
- *Section 6.5 describes opportunities for restoration and preservation of Agua Hedionda Lagoon.*
- *Section 6.6 describes opportunities for an offsite restoration program in San Dieguito Lagoon.*
- *Section 6.7 describes the regulatory assurances that are in place to insure the adequacy of the restoration plan.*

6.1 PROPOSED MITIGATION APPROACH

Poseidon is using all feasible methods to minimize or reduce its entrainment impacts. These methods are likely to reduce the Project related impacts to marine life well below the levels identified in Chapter 5. To minimize unavoidable Project related impacts to marine life, Poseidon has voluntarily committed to a state-agency coordinated process to identify the best available mitigation feasible. The objective of the mitigation portion of this plan is to identify mitigation needs, set forth mitigation goals, and present a plan and approach for achieving the goals.

Recognizing that mitigation opportunities in Agua Hedionda Lagoon may be limited, Poseidon proposes a comprehensive but flexible approach for mitigating potential impacts. This approach is based on:

- Conservatively estimating maximum potential impacts (see Section 6.2),

- Identifying goals and objectives of the mitigation program (see Section 6.4.1),
- Identifying any available mitigation opportunities in Agua Hedionda Lagoon that meet the goals and objectives (see Section 6.5),
- Identifying additional offsite mitigation that meets the mitigation goals (see Section 6.6).
- Developing an action plan and schedule for coordinating with regulatory and resource agencies to finalize locations and acreages selected for the proposed mitigation.

Investigations to date have not identified any mitigation opportunities within Agua Hedionda Lagoon (see Section 6.5) that meet the goals of the program. As a result, the proposed mitigation plan includes a core offsite mitigation program that meets the plan goals and objectives that is being developed in parallel with Poseidon's continued effort to identify feasible mitigation opportunities in Agua Hedionda Lagoon.

Poseidon recognizes the need and priority of implementing mitigation in Agua Hedionda Lagoon if feasible. Poseidon also recognizes that mitigation requirements and regulations of the various review agencies differ, and additional agency coordination is required to insure that needs of all applicable agencies are addressed.

Accordingly, while this plan identifies a core offsite mitigation project, the mitigation plan also presents an implementation action schedule that includes additional coordination activities to either (1) confirm the lack of opportunities, or (2) identify if new mitigation options exist within Agua Hedionda Lagoon.

Under the proposed plan, if subsequent Agua Hedionda Lagoon mitigation is determined to be feasible, Poseidon will coordinate with regulatory agencies to implement such mitigation.

If Agua Hedionda Lagoon mitigation is confirmed as infeasible, Poseidon will implement the proposed offsite mitigation project. Further, it is recognized that the degree of mitigation required will be dependent on mitigation ratio requirements of the various regulatory agencies. As a result, the proposed plan provides for additional coordination with the regulatory agencies to finalize agency-mandated acreage requirements.

Table 6-1 summarizes the implementation action schedule for the proposed plan.

Table 6-1
Mitigation Implementation Approach and Schedule

Element	Actions/Objectives	Schedule
Submittal of draft Minimization Plan to Regional Board	• Public and agency review of revised draft Plan	March 2008
Regional Board consideration of Minimization Plan	• Approval of Plan • Regional Board provides directions on Plan implementation	April 2008
Contacts with California Department of Fish & Game to assess mitigation opportunities in Agua Hedionda Lagoon	• Assess mitigation opportunities for saltwater marsh creation in Agua Hedionda Lagoon via dredging	March 2008
Supplemental contacts with other resource agencies	• Identify (or conform lack of) additional mitigation opportunities in Agua Hedionda Lagoon	April 2008
Convene meeting of resource agencies; Regional Board and Coastal Commission.	• Identify (or confirm lack of) additional mitigation opportunities in Agua Hedionda Lagoon • If applicable, address agency requirements for Agua Hedionda Lagoon mitigation and determine overall implementation feasibility • Address mitigation rations/requirements for core offsite mitigation project in San Dieguito Lagoon	April 2008
Finalize and distribute mitigation program implementation details	• Agency review of implementation details	May 2008
Modify/finalize implementation program details (if applicable)	• Agency review and approval • May involve additional inter-agency coordination meeting	June 2008
Coastal Commission consideration of mitigation project(s)	• Coastal Commission approval of mitigation project	July 2008

Ten years after the lease is issued, that the CDP will be subject to further environmental review by the State Lands Commission (SLC) to analyze all environmental effects of facility operations and alternative technologies that may reduce any impacts found. SLC may require additional requirements as are reasonable and as are consistent with applicable state and federal laws and regulations.

This approach will insure that the stand-alone CDP operations continue to use the best available site, design, technology and mitigation feasible to minimize Project related impacts to marine life.

6.2 CONSERVATIVE ASSESSMENT OF IMPACTED AREA

The assessment of the impacted area due to the desalination facility operation is based on a conservative assumption that the CPD will cause 100 percent mortality to the marine organisms in the seawater diverted from Agua Hedionda Lagoon. This approach to establishing the impact of the desalination plant operation is extremely conservative in that it ignores the design and technology features that have been incorporated in the proposed Project. The following design and technology features are expected to substantially lessen the impacts to marine life.

- **EPS once-through cooling system is expected to continue operating indefinitely.** The magnitude of the entrainment losses identified in Chapter 5 is estimated for continuous operation of the desalination plant on a stand-alone basis notwithstanding the fact that the EPS generating units will be available for service indefinitely. Cal-ISO would ultimately determine when they are no longer needed for grid reliability. In the meantime, seawater pumping by the EPS would likely meet a substantial portion of the CPD flow requirements (e.g., 61 percent in 2007), resulting in a comparable reduction of entrainment and impingement impacts attributable to the CDP.

- **Desalination facility impacts reduced impacts due to modified use of existing facilities.** Potential entrainment mortality that occurs within the existing power plant screens, pumps and condensers upstream of the desalination facility intake would be substantially reduced due to the relatively lower temperature, volume, velocity and turbulence of the desalination operations compared to that of the power plant.

- **Two-thirds of the water is returned to the ocean without further processing.** Only 35 percent of the seawater (104 MGD) actually enters the desalination plant and is subjected to additional processing that would potentially add to the entrainment mortality. The reminder of the seawater (200 MGD) bypasses the desalination facility and is returned to the ocean.

- **Desalination facility incorporates technology to capture marine organisms and return them to the ocean unharmed.** Eighty percent of the marine organisms in the seawater that enters the desalination plant retained by the micro-screens and returned to the ocean. The remaining marine organisms that pass through the micro-screens are subsequently rejected by the pretreatment filters and returned to the ocean. A substantial number of the organisms that are returned to the ocean are expected to survive.

6.3 ESTABLISHING RESTORATION REQUIREMENT

Poseidon is proposing to compensate for the unavoidable impact of stand-alone CDP operation by replacing or restoring comparable marine habitat. The proposed restoration plan is based on the Empirical Transport Model described in Chapter 5 that estimated the portion of the larvae of each target fish species at risk of entrainment with the intake source water. Multiplying the average percent of populations at risk by the physical area from which the fish larvae might be entrained, yields an estimate of the amount of habitat that must be restored to replace the lost fish larvae. This estimate is referred to as the area (acreage) of habitat production foregone (APF).

In order to calculate the APF, the number of lagoon habitat acreage occupied by the three most commonly entrained lagoon fish larvae[1] was multiplied by the average Proportional Entrainment Mortality (PM) for the three lagoon species identified in Chapter 5 (12.2 percent). The estimated acres of lagoon habitat for these species are based on a 2000 Coastal Conservancy Inventory of Agua Hedionda Lagoon habitat shown in Table 6-1.[2]

TABLE 6-1

WETLAND PROFILE: AGUA HEDIONDA LAGOON

Approximate Wetland Habitat Acreage

Habitat	Acres	Vegetation Source
Brackish / Freshwater	3	Cattail, bulrush and spiny rush were dominant
Mudflat / Tidal Channel	49	Not specified / Estuarine flats
Open Water	253	Eelgrass occurred in all basins
Riparian	11	Not specified
Salt Marsh	14	
Upland	61	
TOTAL	**391**	***(Riparian not included)***

[1] Ninety-eight percent of the fish larvae that would be entrained by the CDP stand-alone operations are gobies, blennies and hypsopops.

[2] The actual acreage will be confirmed through a survey of the lagoon habitats that will be conducted during the final design of Poseidon's Coastal Habitat Restoration and Enhancement Program. To the extent that the lagoon habitat acreage established in the survey is higher or lower than that included in the 2000 Inventory, The wetlands restoration plan would be proportional adjusted to account for the actual acreage identified in the survey.

The areas of Agua Hedionda Lagoon that have potential to be impacted by the CDP operations are those habitats occupied by the three most commonly entrained lagoon fish larvae. These habitats include 49 acres of mudflat/tidal channel and 253 acres of open water. It is not appropriate to include the other lagoon habitats in the APF calculation, such as brackish/freshwater, riparian, salt marsh or upland habitats that are not occupied by the impacted species.

By definition, the APF equals the acres of the lagoon habitat that have the potential to be impacted by the intake operations (302 acres) times the average PM:

$$APF = 302\ acres \times 0.122 = 36.8\ acres.$$

Thus, entrainment effect of the stand-alone operation of the desalination plant extends over 12.2 percent, or 36.8 acres of Agua Hedionda Lagoon. The restoration area needed to fully mitigate the stand-alone CDP entrainment losses is 36.8 acres.[3] The restoration requirement is estimated under worst-case conditions when the power plant is no longer operating and the existing pumps are operated solely to deliver 304 MGD of seawater for the operation of the desalination plant.

It is generally accepted that this approach results in an overestimate of the number acres that would be necessary to fully mitigate the CDP entrainment and impingement effects, resulting in a net enhancement of the coastal habitat. This is because the restored habitat provides significant environmental benefits that extend well beyond compensating for the entrainment impacts. For example, the APF calculation does not take into account the enormous ecological value of the restored acreage that will accrue to valuable wetland species completely unaffected by the intake, such as the numerous riparian birds, reptiles, benthic organisms and mammals that will utilize the habitat for foraging, cover and nesting. Nor does the calculation consider the myriad of phytoplankton, zooplankton and invertebrate species that are largely unaffected by the intake operations and benefit directly from the restored wetlands.

Similar to the approach taken throughout this assessment, the APF calculation is also based on a number of very conservative assumptions:

- **Assumes 100 percent mortality of all marine organisms entering the intake.** As indicated previously, this assumption does not take into consideration any of the design and technology features that would be incorporated in the project to avoid impact to marine life. The actual impact to marine life is expected to be substantially lower.

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[3] The methodology used to determine the area impacted by the stand-alone desalination facility operation is based on the recommendation from the Coastal Commission that Poseidon follow the approach used by the California Energy Commission for establishing mitigation requirements for the entrainment effects associated with the operation of the AES Huntington Beach power generation plant.

- **Assumes 100 percent survival of all fish larvae in their natural environment.** In fact, over 90 percent of the fish larvae are lost to predators and do not ever reach adulthood.

- **Assumes species are evenly distributed throughout the entire depth and volume of the water body.** This assumption is very conservative for the site-specific conditions of Agua Hedionda Lagoon because it is well known that some impacted species (i.e., garibaldi) mainly inhabit the rocky area near the entrance to the power plant intake.

- **Assumes the entire habitat from which the entrained fish larvae may have originated is destroyed.** This approach to identifying the restoration requirement for the stand-alone desalination facility assumes that the area of production forgone (APF) is an area of lost habitat for all marine species inhabiting this area. This assumption is extremely conservative because only a small portion of the species inhabiting Agua Hedionda Lagoon would actually enter the power plant intake.

6.4 RESTORATION PLAN DEVELOPMENT

The main objective of the restoration plan is to implement one or more activities which preserve, restore and enhance exiting wetlands, lagoons or other high-productivity near-shore coastal areas located in the vicinity of Agua Hedionda Lagoon and/or elsewhere in San Diego County. Examples of types of activities that may be included in the restoration plan include:

- Wetland Restoration;
- Coastal Lagoon Restoration;
- Restoration of Historic Sediment Elevations to Promote Reestablishment of Eelgrass Beds;
- Marine Fish Hatchery Enhancement;
- Contribution to a Marine Fish Hatchery Stocking Program;
- Artificial Reef Development;
- Kelp Bed Enhancement.

6.4.1 Key Goals and Objectives

The main objective of the restoration plan is to implement one or more activities which preserve, restore and enhance exiting wetlands, lagoons or other high-productivity near-shore coastal areas located in the vicinity of Agua Hedionda Lagoon and/or elsewhere in

San Diego County. The key restoration plan goals are:

- Creation or Restoration of Coastal Habitat. The primary objective of the restoration plan is to create or restore coastal habitat similar to that of Agua Hedionda Lagoon, which will provide measurable long term environmental benefits adequate to mitigate potential impingement and entrainment impacts associated with CDP operations.

- Development of Technically Feasible Project. The restoration plan will rely on well-established methods, techniques and technologies for development and nurturing of coastal habitat of high productivity and long-term sustainability.

- Stakeholder Acceptance for the Selected Project. Implementation of project(s) with a well-defined scope and high priority for the host community and resource agencies and organizations in charge of coastal habitat preservation, restoration development.

- Ability to Measure Performance. The restoration plan will target coastal restoration and enhancement activities with clearly defined methodology to measure performance and success.

6.4.2 Identification of Alternatives

In order to identify suitable coastal habitat enhancement alternatives, on August 31, 2007, Poseidon issued a request for expression of interest (REI) for development and implementation of coastal habitat restoration project associated with the Carlsbad. To date, Poseidon has received eight Statements of Interest for coastal restoration and enhancement projects in response to the REI issued in August 2007. Seven of these proposals include specific coastal enhancement opportunities listed below:

1. San Dieguito Coastal Habitat Restoration;

2. City of Oceanside Loma Alta Lagoon Restoration;

3. Aqua Hedionda Lagoon – Land Acquisition for Expansion of Ecological Reserve;

4. Aqua Hedionda Lagoon – Eradication of Invasive Exotic Plants and Restoration of Native Vegetation;

5. Carlsbad Aquafarm at Agua Hedionda Lagoon – Abalone Stock Enhancement;

6. Buena Vista Lagoon Ecological Reserve – Completion of Restoration/Enhancement Plan Environmental Analysis;

7. Frazee State Beach – Coastal Bluff Habitat Restoration.

A summary of the scope and key benefits of each of the seven coastal habitat enhancement projects was submitted to the Regional Board in October 2007.[4]

6.4.3 Key Restoration Project Benefits

The habitat restoration will not only compensate for the unavoidable entrainment and impingement impacts, but will also enhance the coastal environment. The proposed Restoration Plan will create pelagic and benthic habitat, salt marsh and uplands habitat, thereby extending the benefits from the proposed mitigation measure far beyond the area of actual impact of the desalination plant operations. The proposed restoration project will yield the following key benefits:

- Restore coastal wetlands habitat comparable to that found in and around Agua Hedionda Lagoon; and
- Provides sustainable, comprehensive environmental benefits for water quality, habitat diversity for species abundance and for sensitive and endangered species.

6.4.4 Project Deliverables

Poseidon intends to prepare and submit the following deliverables to the Coastal Commission and the Executive Director of the Regional Board: for review and approval of this restoration plan:

- Restoration Project Implementation Plan which will contain the following:
  - Goals, objectives, performance criteria and maintenance and monitoring to ensure the success of the proposed Restoration Plan.
  - Identification of specific creation, restoration, or enhancement measures that will be used at each site, including grading and planting plans, the timing of the mitigation measures, monitoring that will be implemented to establish baseline conditions and to determine whether the sites are meeting performance criteria.
  - Identification of contingency measures that will be implemented should any of the mitigation sites not meet performance criteria.

[4] Poseidon Resources, *Coastal Habitat Restoration and Enhancement Project*, October 2007.

- As-built plans for each site included in the Restoration Project.
- Annual monitoring reports for no less than five years or until the sites meet performance criteria.
- Legal mechanism(s) proposed to ensure permanent protection of each site – e.g., conservation easements, deed restriction, or other methods.

6.5 OPPORTUNITIES FOR RESTORATION AND PRESERVATION OF AGUA HEDIONDA LAGOON

6.5.1 Agua Hedionda Lagoon Restoration Opportunities

Poseidon has made a considerable effort to identify a restoration project in Agua Hedionda Lagoon. We sent our August 2007 Request for Expressions of Interest to a number of the organizations and individuals that are involved with the Carlsbad Watershed Network (CWN), as well as Carlsbad Aqua Farm, Hubbs Research Institute and the Agua Hedionda Lagoon Foundation. Three proposals were received from Agua Hedionda Lagoon interests:

1. Expansion of Agua Hedionda Lagoon Ecological Reserve

Project Proponent.
The proponent for this project is the Agua Hedionda Lagoon Foundation.

Project Scope
This project includes the acquisition and preservation of land near the Agua Hedionda Lagoon's Ecological Reserve to serve as a coastal habitat for wildlife and migratory birds. The land is located on the north side of Agua Hedionda Lagoon.

Project Benefits and Merits
This project will provide a means for protecting and increasing habitat for migrating birds and endangered species. It also will help insure that nearby archeological sites will remain undisturbed and adjacent Ecological Reserve is maintained as useful wildlife habitat. Foot trails through the Reserve will be proposed to the Department of Fish & Game in exchange for adding land to the Reserve. Enhancing the quality of the Agua Hedionda Lagoon Ecological Reserve will also boost eco-tourism in the area. The project is planned to be completed by the end of year 2010.

2. Agua Hedionda Lagoon – Eradication of Invasive Exotic Plants and Restoration of Native Vegetation

Project Proponent
The proponent for this project is the Agua Hedionda Lagoon Foundation.

Project Scope
The density, biomass and diversity of invasive plant species in the Agua Hedionda Lagoon Watershed are so extensive, that the ability of the natural plant communities to treat nutrients and contaminants from surface runoff into the lagoon has been diminished significantly. The scope of this project is to remove exotic invasive plant species and replace these species with appropriate native plants to restore the protective function of the lagoon watershed vegetation. The project is planned to be completed by December 2009.

Project Benefits and Merits
This project aims to restore the native vegetation in the Agua Hedionda Watershed, which is an essential step towards re-establishing the hydrologic and ecological functions of these riparian and coastal wetland habitats. The project is expected to boost the natural ability of the native riparian and wetland plant habitats to sequester contaminants carried to the lagoon by surface runoff, to reduce flooding and bank erosion, and diminish sediment transport thereby increasing the biological productivity of the Agua Hedionda Lagoon.

3. Agua Hedionda Lagoon – Abalone Stock Enhancement

Project Proponent
The proponent for this project is Carlsbad Aquafarm.

Project Scope
This project will create a stock of 100,000 abalone at the Carlsbad Aquafarm located in the Agua Hedionda Lagoon and use this stock to replenish the population of abalone near the intake to the lagoon and the project discharge area. Carlsbad Aquafarm is currently concentrating its efforts on commercial farming of the Green Abalone and also culturing both Red and Pink Abalone. The farm is well equipped with the facilities and personnel to spawn and raise abalone, as well as experienced divers familiar with abalone biology and ecology to manage and monitor the success of the project. The abalone stock enhancement project can be completed by 2011.

Project Benefits and Merits
Abalone is a key part of the Southern California coastal ecosystem. However, aggressive harvesting of this aquatic resource has resulted in stock depletion and the recent closure of both commercial and recreational fisheries for all abalone species in this region. This project will help replenish and sustain the abalone stock in the area of the Agua Hedionda Lagoon.

6.5.2 Investigation of Additional Restoration Opportunities in Agua Hedionda Lagoon

Investigations to date have not identified any mitigation opportunities within Agua Hedionda Lagoon that meet the goals of the program. As a result, the proposed mitigation plan includes a core offsite mitigation program that meets the plan goals and objectives that is being developed in parallel with Poseidon's continued effort to identify feasible mitigation opportunities in Agua Hedionda Lagoon.

Poseidon recognizes the Regional Board would prefer to see mitigation in Agua Hedionda Lagoon if feasible. Accordingly, while Section 6.6 of this plan identifies a core offsite mitigation project, the mitigation plan also presents an implementation action schedule that includes additional coordination activities to either (1) confirm the lack of opportunities, or (2) identify if new mitigation options exist within Agua Hedionda Lagoon.

Poseidon and will be contacting the Department of Fish & Game to more fully assess the potential for restoration opportunities in Agua Hedionda Lagoon. If Agua Hedionda Lagoon mitigation is determined to be feasible, Poseidon will coordinate with regulatory agencies to implement such mitigation. If Agua Hedionda Lagoon is confirmed to be infeasible, Poseidon will implement the proposed offsite mitigation project (Section 6.6).

6.5.3 Agua Hedionda Lagoon Preservation Opportunities

As shown in Figure 6-3, Agua Hedionda Lagoon currently supports a wide range of beneficial uses, including recreational activities, such as fishing, and water contact recreation. Nearly all of these uses are directly or indirectly supported by seawater flow and exchange created by circulation of seawater in the lagoon. The existing tidal exchange renews the Lagoon's water quality and flush nutrients, sediment and other watershed pollution, particularly from the Lagoon's upper reaches. In addition, the inflow of fresh supplies of ocean carry waterborne supplies of planktonic organisms that nourish the many organisms and food chains of the Lagoon, including the White Sea Bass restoration program of the Hubbs Sea World Research Institute and the aquaculture operations in the outer Lagoon.

The Lagoon is connected to the Pacific Ocean by means of a manmade channel that is artificially maintained. Seawater circulation throughout the outer, middle and inner lagoons is sustained both by routine dredging of the manmade entrance to prevent its closure. The name, Agua Hedionda, which means "stinking water" in Spanish, reflects a former stagnant condition that existed prior to the dredging of the mouth of the Lagoon.

To avoid this significant loss of highly productive marine habitat, in the absence of the ongoing operations of the EPS, Poseidon has committed to maintain circulation of the seawater, continue routine dredging of the entrance to the lagoon to prevent its closure, and deposit the sand dredged from the lagoon on adjacent beaches so as to maintain, restore and enhance habitat for grunion spawning and to maintain, restore and enhance opportunities for public access and recreation along the shoreline and within the coastal zone. To help ensure the long-term health and vitality of Agua Hedionda Lagoon and the surrounding watershed, Poseidon is funding watershed education programs at the Agua Hedionda Lagoon Foundation Discovery Center.

6.6 OFFSITE MITIGATION PROGRAM

One proposal was received that meets or exceeds the restoration plan objectives is the proposed San Dieguito Wetland Restoration Plan. The proponent of the project is the San Dieguito River Park Joint Powers Authority (JPA). The JPS's proposal is one part of a larger restoration project that has already been approved by the Coastal Commission, on October 12, 2005.[5] Additionally the San Dieguito Wetland Restoration Plan was the subject of a Final Environmental Impact Report that was prepared and certified by the San Dieguito River Park Joint Powers Authority and U.S. Fish and Wildlife Service.

Pursuant to the requirements of the Coastal Commission,[6] Southern California Edison (SCE) is creating 115 acres of tidal wetlands at San Dieguito and will keep the river mouth open in perpetuity. The San Dieguito Wetlands Restoration Project includes a new deep water lagoon on the west side of I-5, extensive finger channels on the east side of I-5 north of the river, California least tern nesting sites and berms along the river to keep the water in the riverine channel flowing to the sea without dropping sediment or flooding the newly created wetlands under normal conditions.

The proponent for Poseidon's proposed restoration project is San Dieguito River Park Joint Powers Authority (local government agency in partnership with the San Dieguito River Valley Conservancy (501 (c) (3) organization). The JPA is the agency responsible for creating a natural open space park in the San Dieguito River Valley, which will one day extend from the ocean at Del Mar to Volcan Mountain, just north of Julian.

The San Dieguito Lagoon is located approximately 12.5 miles south of Agua Hedionda Lagoon, and has been historically one of the largest lagoons in San Diego County. All property within the proposed restoration project is in public ownership. The JPA is responsible for implementing the San Dieguito River Park Master Plan. Features of the Park Master Plan include trails and interpretive programs, enhancement of the lagoon ecosystem through creation of associated native grassland and coastal sage scrub habitat, expansion of tidal wetlands beyond the SCE project limits, and creation of a series of water quality treatment ponds. The JPA is responsible for maintaining the project area and precluding any uses not consistent with the conservation of wetland habitat.

Poseidon's proposed wetlands restoration project would expand the number of acres of functional wetlands and associated habitat in San Dieguito Lagoon, by supplementing the 115-acre SCE Wetlands Restoration Project. The proposed restoration project will

[5] CDP # 6-04-88
[6] Id.

create at approximately 37 acres of marine wetlands and seasonal marsh habitat from what is now entirely disturbed land. The current state of the land chosen for this project, results from decades of fill, grading and/or agricultural use, rendering it unsuitable for supporting native species that rely on freshwater/intertidal marsh or upland habitat.

Poseidon's proposed Restoration Project would provide approximately 37 acres of coastal wetland habitat in San Dieguito Lagoon above and beyond what is included in the ongoing SCE Wetland Restoration Project. The majority of the coastal habitat will be marine wetlands located at or below the elevation of the mean high tide for this area. As shown in Figures 1 and 2, the key elements of the project are excavation and grading to create new tidal wetlands (Parcel 1), including sub-tidal, intertidal, transitional, and seasonal salt marsh habitats east of I-5.

The central feature of the proposed restoration project is the conversion of disturbed land to more valuable tidal salt marsh or open water wetland which will become a productive in-kind habitat for species similar to these impacted by impingement and entrainment related to the stand-alone desalination plant operations (i.e., gobies, blennies, etc.). All of the acreage that will be converted to tidal wetland habitat is currently disturbed upland that supports weedy, generally non-native (ruderal) vegetation. After restoration to tidal salt marsh, these habitats will be subject to tidal action throughout the year, which will enable salt marsh plants to be healthier and with higher productivity. These goals will be accomplished by grading the site to substantially create an area that is subject to regular tidal inundation.

The restoration site will be graded to match subtidal and the low tidal salt marshes of the San Dieguito Lagoon Restoration Project being constructed by Southern California Edison. Since the new wetlands will be connected to the existing tidal basin through the existing Dieguito River channel, the tidal exchange will maintain the physical and chemical conditions in the these wetlands such that marine and tidal salt marsh species (such as gobies and blennies) will be able to inhabit, disperse and persist in the wetlands created by the Poseidon's restoration project. Since Southern California Edison has already committed to maintain the mouth of the lagoon open in perpetuity, tidal circulation in the proposed new wetlands will be unrestricted.

Based on the biological survey of the existing tidal wetlands of the San Dieguito Lagoon completed as a part of the Southern California Edison Restoration Project,[7] these wetlands are of the same type of habitat that would be impacted by desalination plant operations (i.e., gobies, blennies, anchovy, topsmelt, white croaker, etc.). Therefore, the implementation of the proposed restoration project will create in-kind replacement habitat, which has 1:1 restoration value. The 1:1 restoration ratio of the proposed project is consistent with the methodology used by the California Energy Commission for establishing mitigation requirements for the entrainment effects associated with the operation of the AES Huntington Beach and Morro Bay power generation plants.

[7] SCE, *San Dieguito Wetlands Restoration Project, Final Restoration Plan*, November 2005

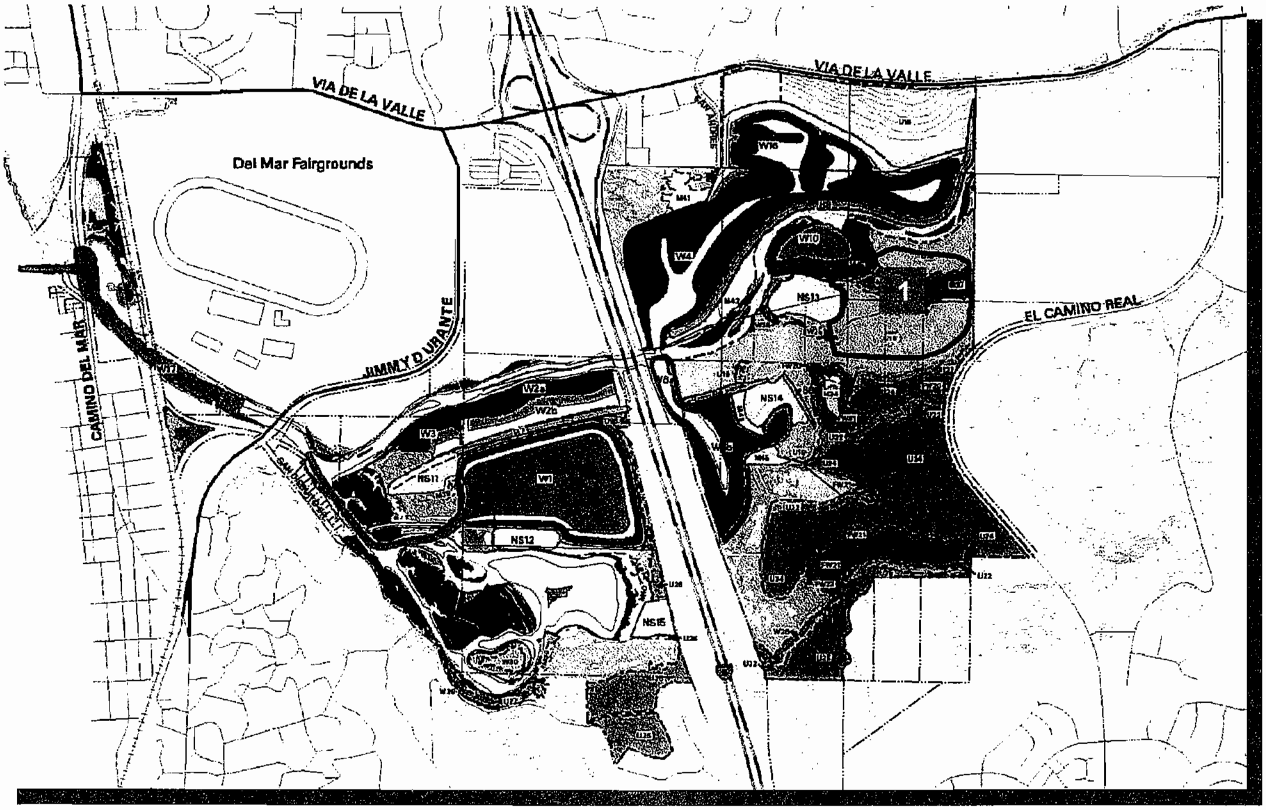

Figure 6-1 – San Dieguito Wetlands Restoration Project

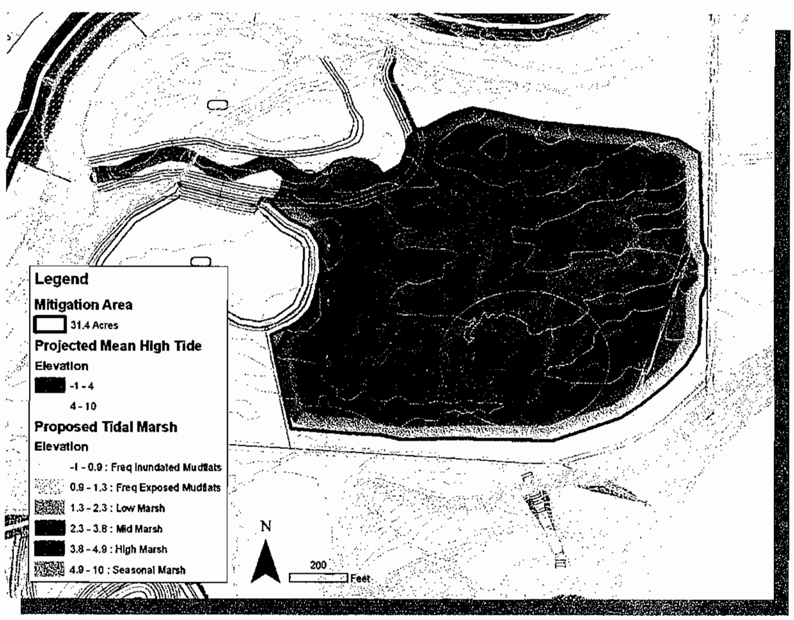

Figure 6-2 – Proposed Restoration Site

The Coastal Commission found this location to be acceptable for mitigation of the entrainment and impingement impacts of the San Onofre Nuclear Generating Station which is 45 miles away from San Dieguito Lagoon and is impacting open water fish species that don't necessarily reside in a lagoon environment. The proposed desalination facility is much closer to the proposed mitigation site (12 miles) and Poseidon is proposing to replace tidally exchanged coastal lagoon habitat with in-kind habitat.

6.7 REGULATORY ASSURANCE OF RESTORATION PLAN ADEQUACY

There are a number of regulatory assurances in place to confirm the adequacy of the proposed restoration plan. The Regional Board, Coastal Commission and State Lands Commission have ongoing jurisdiction over the proposed Project to insure the adequacy of the proposed restoration plan.

6.7.1 Regional Board

The Regional Board is insuring that Poseidon will provide adequate mitigation consistent with Water Code Section 13142.5(b) through the imposition of Special Condition 12 in the draft Lease Amendment for the proposed project:[8]

> b. *California Water Code Section 13142.5(b) Applicability. Water Code Section 13142.5(b) requires industrial facilities using seawater for processing to use the best available site, design, technology, and mitigation feasible to minimize impacts to marine life. The CDP is planned to operate in conjunction with the EPS by using the EPS cooling water discharge as its source water. When operating in conjunction with the power plant, the desalination plant feedwater intake would not increase the volume or the velocity of the power station cooling water intake nor would it increase the number of organisms impinged by the Encina Power Station cooling water intake structure. Recent studies have shown that nearly 98 percent of the larvae entrained by the EPS are dead at the point of the desalination plant intake. As a result, a de minimis number of organisms remain viable which potentially would be lost due to the incremental entrainment effect of the CDP operation. Due to the fact that the most frequently entrained species are very abundant in the area of the EPS intake, Agua Hedionda Lagoon and the Southern California Bight, species of direct recreational and commercial value would constitute less than 1 percent of all the organisms entrained by the EPS. As a result, the incremental entrainment effects of the CDP operation in conjunction with the EPS would not trigger the need for additional technology or mitigation to minimize impacts to marine life. However, in the event that the EPS were to cease operations, and the discharger were to independently operate the seawater intake and outfall for the*

[8] Regional Board Order R9-2006-0065 at F-49.

benefit of the CDP, such independent operation will require additional review pursuant to Water Code Section 13142.5(b). The Regional Water Board review and approval of the Flow Minimization, Entrainment and Impingement Minimization Plan will address any additional review required pursuant to Water Code Section 13142.5(b).

With the October 2006 approval Order R9-2006-0065, the Regional Board has ongoing jurisdiction over the Project to insure Poseidon is using the best available design, technology, and mitigation measures at all times consistent with Water Code Section 13142.5(b).

6.7.2 State Lands Commission

The State Lands Commission is insuring that Poseidon will provide adequate mitigation consistent with Public Resources Code 6370, et seq. through the imposition of Special Condition 12 in the draft Lease Amendment for the proposed project:[9]

> 12. *Poseidon Resources shall use the best available design, technology, and mitigation measures at all times during which this Lease is in effect to minimize the intake (impingement and entrainment) and mortality of all forms of marine life associated with the operation of the desalination facility as determined by the San Diego Regional Water Quality Control Board or any other federal, state, or local entity.*

With the approval of the approval the draft lease for the Project, the State Lands Commission reserves the right to terminate the lease if Poseidon is not using the best available design, technology, and mitigation measures at all times as determined by the San Diego Regional Water Quality Control Board or any other federal, state, or local entity.

6.7.3 Coastal Commission

The Coastal Commission is insuring that Poseidon will provide adequate mitigation consistent with applicable Coastal Act provisions through the imposition of Special Condition 8:[10]

1) ***Marine Life Mitigation Plan:*** *PRIOR TO ISSUANCE OF THE PERMIT, the Permittee shall submit to and obtain from the Commission approval of*

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9 State Lands Commission draft Amendment of Lease PRC 8727.1.

10 See Coastal Commission Recommended Revised Findings Coastal Development Permit for Poseidon Carlsbad Desalination Project, page 91 of 108; http://documents.coastal.ca.gov/reports/2008/3/W25a-3-2008.pdf

a Marine Life Mitigation Plan in the form of an amendment to this permit that includes the following:

a) *Documentation of the project's expected impacts to marine life due to entrainment and impingement caused by the facility's intake of water from Agua Hedionda Lagoon. This requirement can be satisfied by submitting a full copy of the Permittee's Entrainment Study conducted in 2004-2005 for this project.*

b) *To the maximum extent feasible, the mitigation shall take the form of creation, enhancement, or restoration of aquatic and wetland habitat*

c) *Goals, objectives and performance criteria for each of the proposed mitigation sites. It shall identify specific creation, restoration, or enhancement measures that will be used at each site, including grading and planting plans, the timing of the mitigation measures, monitoring that will be implemented to establish baseline conditions and to determine whether the sites are meeting performance critieria. The Plan shall also identify contingency measures that will be implemented should any of the mitigation sites not meet performance criteria.*

d) *"As-built" plans for each site and annual monitoring reports for no less than five years or until the sites meet performance criteria.*

e) *Legal mechanism(s) proposed to ensure permanent protection of each site – e.g., conservation easements, deed restriction, or other methods.*

With the approval of the Coastal Development permit for the proposed project conditioned as described above the Coastal Commission is insuring that Poseidon will provide the mitigation needed to address Project related impacts in a manner consistent with applicable Coastal Act provisions.

6.8 SUMMARY AND CONCLUSIONS

Poseidon is using all feasible methods to minimize or reduce its entrainment impacts. These methods are likely to reduce the Project related impacts to marine life well below the levels identified in Chapter 5. To minimize unavoidable Project related impacts to marine life, Poseidon has voluntarily committed to a state-agency coordinated process to identify the best available mitigation feasible. The objective of the mitigation portion of this plan is to identify mitigation needs, set forth mitigation goals, and present a plan and approach for achieving the goals.

As shown in Table 6-2, the proposed mitigation strategy includes the implementation of project a coastal wetlands restoration plan that will be developed pursuant to the state-agency coordinated process; long-term preservation of Agua Hedionda Lagoon; and/or other activities which will benefit the coastal environment in San Diego County. The restoration plan will be enforceable through conditions of approval of the project and the program's success will be monitored through performance standards, monitoring and reporting.

Additionally, ten years after the lease is issued, that the CDP will be subject to further environmental review by the State Lands Commission (SLC) to analyze all environmental effects of facility operations and alternative technologies that may reduce any impacts found. SLC may require additional requirements as are reasonable and as are consistent with applicable state and federal laws and regulations.

This approach will insure that the stand-alone CDP operations continue to use the best available site, design, technology and mitigation feasible to minimize Project related impacts to marine life.

Table 6-2
Mitigation

Category	Feature	Result
1. Mitigation	Implementation of project mitigation plan developed pursuant to a state-agency coordinated process described in Chapter 6.	Compensate for the unavoidable entrainment and impingement impacts and enhance the coastal environment.
2. Mitigation	Preservation of Agua Hedionda Lagoon though continued maintenance dredging and Lagoon stewardship.	Preserve and protect 388 acres of highly productive marine habitat; maintain and enhance opportunities for public access and recreation; provide sand for beach replenishment and grunion spawning habitat; maintain adequate water quality to support aquaculture, fish hatchery and natural fish habitat; and provide San Diego County with a new high-quality drinking water supply.
3. Mitigation	Funding watershed education programs at the Agua Hedionda Lagoon Foundation Discovery Center	Helps ensure the long-term health and vitality of Agua Hedionda Lagoon and the surrounding watershed

CHAPTER 7

CONCLUSION

7.1 PLAN PURPOSE

The San Diego Regional Water Quality Control Board (Regional Board) adopted Order No. R9-2006-0065 (Permit) for Poseidon Resources Corporation's (Poseidon) Carlsbad Desalination Project (CDP) discharge to the Pacific Ocean via the existing Encina Power Station (EPS) discharge channel. The CDP is planned to operate in conjunction with the EPS by using the EPS cooling water discharge as its source water whenever the power plant is operating.

In the event that the EPS were to cease operations, and Poseidon were to independently operate the seawater intake and outfall for the benefit of the CDP, such independent operation will require additional review pursuant to Water Code Section 13142.5(b). Water Code Section 13142.5(b) requires industrial facilities using seawater for processing to use the best available <u>site</u>, <u>design</u>, <u>technology</u>, *and* <u>mitigation</u> feasible to minimize impacts to marine life.

This Flow, Entrainment and Impingement Minimization Plan (Plan) is developed in fulfillment of the above-stated requirements and contains site-specific activities, procedures, practices and mitigation plans which Poseidon proposes to implement to minimize impacts to marine organisms when the Carlsbad Desalination Project intake requirements exceed the volume of water being discharged by the EPS.

7.2 PLAN COMPLIANCE

As shown in Table 7-1, the Plan addresses each of the provisions of Water Code Section 13142.5(b):

- Identifies the best available <u>site</u> feasible to minimize Project related impacts to marine life;
- Identifies the best available <u>design</u> feasible to minimize Project related impacts to marine life;
- Identifies the best available <u>technology</u> feasible to minimize Project related impacts to marine life;
- Quantifies the unavoidable impacts to marine life; and
- Establishes a state-agency coordinated process for identification of the best available <u>mitigation</u> feasible to minimize Project related impacts to marine life.

Table 7-1 Design, Technology and Mitigation Measures to Minimize Impacts to Marine Life		
Category	**Feature**	**Result**
1. Site	Proposed location at Encina Power Station (EPS)	Best available site for the project, no feasible and less environmentally damaging alternative locations.
1. Design	Use of EPS discharge as source water	Sixty-one percent reduction of entrainment and impingement impacts attributable to the CDP
2. Design	Reduction in inlet screen velocity	Reduction of impingement of marine organisms
3. Design	Reduction in fine screen velocity	Reduction of impingement of marine organisms
4. Design	Ambient temperature processing	Eliminate entrainment mortality associated with the elevated seawater temperature
5. Design	Elimination of heat treatment	Eliminate mortality associated with heat treatment.
1. Technology	Installation of VFDs on CDP intake pumps	Reduce the total intake flow for the desalination facility to no more than that needed at any given time, thereby minimizing the entrainment of marine organisms.
2. Technology	Installation of micro-screens	Micro-screens (120 μ) minimize entrainment and impingement impacts to marine organisms by screening the fish larvae and plankton from the seawater.
3. Technology	Installation of low impact prefitration technology	UF filtrations system minimizes entrainment and impingement impacts to marine organisms by screening the small plankton from the seawater.
4. Technology	Return to the ocean of marine organisms captured by the screens and filters	Minimize entrainment and impingement impacts to marine organisms captured by the screens and filters by returning the organisms to the ocean.
5. Technology	After ten years of operation, State Lands Commission (SLC) to analyze environmental effects of facility and the availability of alternative technologies that may reduce any impacts.	SLC may require Poseidon install additional technology as are reasonable and as are consistent with applicable state and federal laws and regulations. This ensures that the CDP operations at that time are using technologies that the SLC determines may reduce any impacts and are appropriate in light of environmental review.
1. Mitigation	Implementation of project mitigation plan developed pursuant to a state-agency coordinated process described in Chapter 6.	Compensate for unavoidable entrainment and impingement impacts and enhance the coastal environment.
2. Mitigation	Preservation of Agua Hedionda Lagoon though continued maintenance dredging and Lagoon stewardship.	Preserve and protect highly productive marine habitat; maintain and enhance opportunities for public access and recreation; provide sand for beach replenishment and grunion spawning habitat; maintain adequate water quality to support aquaculture, fish hatchery and natural fish habitat; and provide a new high-quality water supply.
3. Mitigation	Fund watershed education programs at the AHL Foundation Discovery Center.	Helps ensure the long-term health and vitality of Agua Hedionda Lagoon and the surrounding watershed.

7.3 PROPOSED MITIGATION APPROACH

Poseidon is using all feasible methods to minimize or reduce its entrainment impacts. These methods are likely to reduce the Project related impacts to marine life well below the levels identified in Chapter 5. To minimize unavoidable Project related impacts to marine life, Poseidon has voluntarily committed to a state-agency coordinated process to identify the best available mitigation feasible. The objective of the mitigation portion of this plan is to identify mitigation needs, set forth mitigation goals, and present a plan and approach for achieving the goals.

Recognizing that mitigation opportunities in Agua Hedionda Lagoon may be limited, Poseidon proposes a comprehensive but flexible approach for mitigating potential impacts. This approach is based on:

- Conservatively estimating maximum potential impacts
- Identifying goals and objectives of the mitigation program
- Identifying any available mitigation opportunities in Agua Hedionda Lagoon that meet the goals and objectives
- Identifying additional offsite mitigation that meets the mitigation goals
- Developing an action plan and schedule for coordinating with regulatory and resource agencies to finalize locations and acreages selected for the proposed mitigation.

Investigations to date have not identified any mitigation opportunities within Agua Hedionda Lagoon that meet the goals of the program. As a result, the proposed mitigation plan includes a core offsite mitigation program that meets the plan goals and objectives that is being developed in parallel with Poseidon's continued effort to identify feasible mitigation opportunities in Agua Hedionda Lagoon.

Poseidon recognizes the need and priority of implementing mitigation in Agua Hedionda Lagoon if feasible. Poseidon also recognizes that mitigation requirements and regulations of the various review agencies differ, and additional agency coordination is required to insure that needs of all applicable agencies are addressed.

Accordingly, while this plan identifies a core offsite mitigation project, the mitigation plan also presents an implementation action schedule that includes additional coordination activities to either (1) confirm the lack of opportunities, or (2) identify if new mitigation options exist within Agua Hedionda Lagoon.

Poseidon will be contacting the Department of Fish & Game to more fully assess the potential for restoration opportunities in Agua Hedionda Lagoon. If subsequent Agua Hedionda Lagoon mitigation is determined to be feasible, Poseidon will coordinate with regulatory agencies to implement such mitigation.

If Agua Hedionda Lagoon mitigation is confirmed as infeasible, Poseidon will implement the proposed offsite mitigation project.

Table 7-2 summarizes the implementation action schedule for the proposed mitigation plan.

Table 7-2
Mitigation Implementation Approach and Schedule

Element	Actions/Objectives	Schedule
Submittal of draft Minimization Plan to Regional Board	• Public and agency review of revised draft Plan	March 2008
Regional Board consideration of Minimization Plan	• Approval of Plan • Regional Board provides directions on Plan implementation	April 2008
Contacts with California Department of Fish & Game to assess mitigation opportunities in Agua Hedionda Lagoon	• Assess mitigation opportunities for saltwater marsh creation in Agua Hedionda Lagoon via dredging	March 2008
Supplemental contacts with other resource agencies	• Identify (or conform lack of) additional mitigation opportunities in Agua Hedionda Lagoon	April 2008
Convene meeting of resource agencies; Regional Board and Coastal Commission.	• Identify (or confirm lack of) additional mitigation opportunities in Agua Hedionda Lagoon • If applicable, address agency requirements for Agua Hedionda Lagoon mitigation and determine overall implementation feasibility • Address mitigation rations/requirements for core offsite mitigation project in San Dieguito Lagoon	April 2008
Finalize and distribute mitigation program implementation details	• Agency review of implementation details	May 2008
Modify/finalize implementation program details (if applicable)	• Agency review and approval • May involve additional inter-agency coordination meeting	June 2008
Coastal Commission consideration of mitigation project(s)	• Coastal Commission approval of mitigation project	July 2008

7.4 REGULATORY ASSURANCE OF PLAN ADEQUACY

There are a number of regulatory assurances in place to confirm the adequacy of the proposed restoration plan. The Regional Board, Coastal Commission and State Lands Commission have ongoing jurisdiction over the proposed Project to insure the adequacy of the proposed restoration plan.

Additionally, ten years after the lease is issued, that the CDP will be subject to further environmental review by the State Lands Commission (SLC) to analyze all environmental effects of facility operations and alternative technologies that may reduce any impacts found. SLC may require additional requirements as are reasonable and as are consistent with applicable state and federal laws and regulations.

This approach will ensure that the stand-alone CDP operations continue to use the best available site, design, technology and mitigation feasible to minimize Project related impacts to marine life.

REFERENCES

Cabrillo Power I LLC *Proposal for Information Collection Clean Water Act Section 316(b). Encina Power Station*, April 1, 2006.

California Coastal Commission. *Recommended Revised Findings Coastal Development Permit E-06-013, Poseidon Resources Carlsbad Desalination Project*, February 21, 2008.

California State Lands Commission and U.S. Army Corps of Engineers. *Draft Environmental Impact Report / Environmental Assessment – Agua Hedionda Northern Inlet Jetty Restoration*, January 2005.

City of Carlsbad. *Final Environmental Impact Report for Precise Development Plan and Desalination Plant, EIR 03-05 – SCH #2004041081.*

EPRI. 1986. Assessment of Downstream Migrant Fish Protection Technologies for Fish Protection. Prepared by Stone & Webster for EPRI. Report AP-4711. September 1986.

EPRI (Electric Power Research Institute). 1986. Assessment of Downstream Migrant Fish Protection Technologies for Hydroelectric Application. EPRI Report No. 2694-1.

EPRI 1988. Field Testing of Behavioral Barriers for Fish Exclusion at Cooling Water Intake Systems. Central Hudson Gas & Electric Company - Roseton Generating Station. Prepared by Lawler, Matuskey & Skelly Engineers. Report CS-5995. September 1988.

EPRI 1990. Fish Protection Systems for Hydro Plants. Test Results. Prepared by Stone & Webster. EPRI Report GS-6712. February 1990.

EPRI 1992. Evaluation of Strobe Lights for Fish Diversion at the York Haven Hydroelectric Project. Prepared by Stone & Webster. Report TR-101703; November 1992.

EPRI 1999. Status Report on Fish Protection at Cooling Water Intakes. Prepared by Alden Research Laboratory. Report TR-114013. November 1999.

Kuhl, G.M., and K.N. Mueller. 1988. Prairie Island Nuclear. Engineering Plant Environmental Monitoring Program 1988 Annual Report: Fine-mesh Vertical Traveling Screens Impingement Survival Study. Prepared for Northern States Power Company.

Gunderboom Promotional Brochure.

National Pollutant Discharge Elimination System-Final Regulations to Establish Requirements for Cooling Water Intake Structures at Phase I1 Existing Facilities; Federal Register No. 69, No.13 1 Friday, July 9,2004 Rules And Regulations.

P. F. Shires, E. P. Taft; "Evaluation of the Modular Inclined Screen (MIS) at the Green Island Hydroelectric Project: 1995 Test Results"; Electric Power Research Institute (EPRI) Report TR-104498; May 1996.

Poseidon Resources Corporation. Application for Coastal Development Permit, August 28, 2006, including (but not limited to) attachments:

- Final Environmental Impact Report
- Verification of All Other Permits or Approvals Applied for by Public Agencies
- City of Carlsbad Resolution No. 2006-156-EIR 03-05
- City of Carlsbad Resolution No. 420-RP 05-12
- City of Carlsbad Ordinance No. NS-805-SP 144 (H)
- City of Carlsbad Ordinance No. NS-806-PDP 00-02
- Planning Commission Resolution No. 6093 – SUP 05-04
- Planning Commission Resolution No. 6092 – CDP 04-41
- Planning Commission Resolution No. 6090 – DA 05-01 / Development Agreement Finding of Fact
- CEQA Mitigation Monitoring and Reporting Program for the FEIR
- Planning Commission Resolution No. 6094 – HMPP 05-08
- Planning Commission Resolution No. 6088 – PDP 00-02
- Planning Commission Resolution No. 6091 – RP 05-12
- Planning Commission Resolution No. 6089 – SP 144 (H)

Poseidon Resources Corporation. Response to California Coastal Commission's September 28, 2006 Request for Additional Information, November 30, 2006, including (but not limited to) attachments:

- San Diego Regional Water Quality Control Board, Order No. R9-2006-0065 ("NPDES Permit")
- Poseidon Resources Corporation. Response to California Coastal Commission's December 28, 2006 Request for Additional Information (including attachments), January 19, 2006.
- Poseidon Resources Corporation. Transmittal of Analysis of Alternative Subsurface Seawater Intake Structures, Proposed Desalination Plant, Carlsbad, CA, Wieldlin & Associates (January 30, 2007), sent February 2, 2007.
- Poseidon Resources Corporation. Response to California Coastal Commission's February 20, 2007 Request for Additional Information (including attachments), June 1, 2007.
- Poseidon Resources Corporation. Appeal of California Coastal Commission's July 3, 2007 Notice of Incomplete, July 6, 2007.
- Poseidon Resources Corporation. Response to California Coastal Commission's July 3, 2007 Request for Additional Information (including attachments), July 16, 2007.
- Poseidon Resources Corporation. Additional Analysis of Submerged Seabed Intake Gallery (including attachments), October 8, 2007.

- Poseidon Resources Corporation. Analysis of Offshore Intakes, October 8, 2007, including attachments:
    - Scott A. Jenkins, Ph.D. and Joseph Wasyl. Comparative Analysis of Intake Flow Rate on Sand Influx Rates at Agua Hedionda Lagoon: Low-Flow vs. No-Flow Alternatives, September 28, 2007.
    - J.B. Graham, S. Le Page and D. Mayer. Issues Related to the Use of the Agua Hedionda inlet Jetty Extension EIR to Recommend An Alternative Seawater Intake for the Carlsbad Desalination Project, October 8, 2007.
- Poseidon Resources Corporation. Coastal Habitat Restoration and Enhancement Plan (including attachments), October 9, 2007.
- Poseidon Resources Corporation. Transmittal of Intake Cost Estimates, October 17, 2007.
- Poseidon Resources Corporation. Transmittal of Garabaldi Study and Coastal Development Permit for Southern California Edison and San Dieguito River Valley Joint Powers Authority's San Dieguito Wetland Restoration Plan, November 7, 2007.

Public Service Electric and Gas Company. 1993. Appendix I-Modeling. Permit No. NJ0005622. Prepared by Lawler, Matusky, and Skelly Engineers, Pearl River, NY. Comments on NJPDES Draft. 82 p.

San Diego Gas and Electric (SDG&E). 1980. *Encina Power Plant Cooling Water Intake System Demonstration.* Prepared for California Regional Water Quality Control Board, San Diego Region. December 1980.

S. V. Amaral, F. C. Winchell, T. C. Cook, E. P. Taft; "Biological Evaluation of a Modular Inclined Screen for Protecting Fish at Water Intakes"; Electric Power Research Institute (EPRI) Report TR- 104121 ; May 1994.

Tenera Environmental. 2000a. Diablo Canyon Power Plant: 316(b) Demonstration Report. Prepared for Pacific Gas and Elec. Co., San Francisco, CA. Doc. No. E9-055.0.

Tenera Environmental. 2000b. Moss Landing Power Plant Modernization Project: 316(b) Resource Assessment. Prepared for Duke Energy Moss Landing, L.L.C., Oakland, CA.

Voutchkov, Nikolay. *Challenges and Considerations When Using Coastal Aquifers for Seawater Desalination*, in *Ultrapure* Water, Volume 23:6, September 2006.

Weight, R.H. "Ocean Cooling Water System for 800 MW Power Station", Journal of the Power Division, Proceedings of the American Society of Civil Engineers, Dec 1958.