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

FLOW, ENTRAINMENT AND IMPINGEMENT MINIMIZATION PLAN

Draft

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EXECUTIVE SUMMARY

The Carlsbad seawater desalination project (CDP) is proposed to be located adjacent to the Encina Power Station (EPS) and when constructed, will use the power plant cooling water discharge as source water for production of 50 MGD of fresh drinking water and for dilution of the concentrate from the desalination process. Under normal operational conditions the EPS provides adequate volume of source and dilution water for the operation of the desalination plant, and the incremental impingement and entrainment effects and discharge impacts of the desalination plant are insignificant.

The purpose of this Flow, Entrainment and Impingement Minimization Plan (Minimization Plan) is to assess the feasibility of site-specific plans, procedures, and practices to be implemented by the Discharger (Poseidon Resources Corporation) 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.

FLOW, IMPINGMENT AND ENTRAINMENT MINIMIZATION

Based on the comprehensive analysis of a number of flow minimization, impingement and entrainment reduction alternatives, the Minimization Plan has identified the following key procedures and activities to minimize environmental impact on marine life in the vicinity of the plant intake and discharge during temporary or permanent shutdown or reduction of power plant cooling flow:

1. Limit the operation of existing power plant intake pumps and screens to one of the Operational Conditions shown in Table ES-1. Preference would be given to operational scenarios resulting in lowest intake flow that can be achieved with the pumps available at the time.

2. Whenever possible, reduce the total flow collected trough the existing power plant intake to 184.32 MGD (Operational Condition 5) by running only one of any of the six pumps of power plant generation Unit 1, 2 or 3 and one pump of power plant generation Unit 5 (22.2 % of the maximum power plant intake flow of 794.9 MGD). Acute toxicity testing and hydrodynamic modeling of the desalination plant discharge at this scenario indicates that operation of the desalination plant would meet all CDP permit requirements except the total dissolved solids limitations for combined CDP and EPS effluent.

3. Operation of the desalination plant under the condition of maximum reduction of impingement and entrainment (Operational Condition 5) could occur only if the RWQCB were to (1) increase the daily average discharge salinity limit in the current desalination plant NPDES permit from 40 ppt to 46 ppt and (2) increase the maximum daily discharge salinity permit limit from 44 ppt to at least 50 ppt.

The current average and maximum daily limits of 40 ppt and 44 ppt would allow desalination plant operations only under Operational Conditions 1, 2 and 3.

4. Impingement and entrainment associated with Operational Condition 5 are over 30 % lower than these of any of the Operational Conditions 1, 2 or 3, and therefore, the environmental benefits of this mode of operation are substantial while the environmental impact associated with the elevated salinity of the discharge is minimal.

5. In the event of an extended shutdown of EPS power generation units, Poseidon will complete periodic dredging of the Aqua Hedionda Lagoon in order to keep the lagoon entrance open and thereby to maintain the biological productivity and environmental health of the lagoon and to mitigate beach erosion along the City of Carlsbad beach shore in the vicinity of the power plant intake structure.

TABLE ES-1
ALTERNATIVE OPERATIONAL CONDITIONS OF EXISITNG INTAKE FACILITIES FOR REDUCED IMPINGMENT AND ENTRAINMENT DURING POWER PLANT SHUTDOWNS

Condition	Total Intake Flow (MGD)	Power Plant Intake Pumps in Operation	Impingement Reduction (%)(1)	Entrainment Reduction (%)(1)	Discharge Salinity Conc. (ppt)	Minimum Pelagic Dilution @ ZID(2)
1	328.33	One Pump of Any of Units 1, 2 or 3 & One Pump of Unit 4 & One Pump of Unit 5	61.7	58.7	39.5	> 28.2:1
2	322.58	One Pump of Any of Units 1, 2 or 3 & Two Pumps of Unit 4	62.2	59.4	39.6	> 28.2:1
3	316.81	Any Combination of Five out of Six Pumps of Units 1, 2 or 3 & One Pump of Unit 4	60.0	60.2	39.8	> 28.2:1
4	218.88	Two Pumps of Any of Units 1, 2 or 3 & One Pump of Unit 5	72.4	72.5	43.4	21.1:1
5(3)	184.33	One Pump of Any of Units 1, 2 or 3 & One Pump of Unit 5	79.7	76.8	46 ppt	17.7:1

Notes: (1) Estimated for Maximum Power Plant Intake Flow = 794.9 MGD.

(2) Estimated for Historical Average Conditions.
(3) Operational Condition 5 is feasible only if the Regional Board were to (1) increase the daily average discharge salinity limit in the current desalination plant NPDES permit from 40 ppt to 46 ppt and (2) increase the maximum daily discharge salinity permit limit from 44 ppt to at least 50 ppt.

The implementation of the proposed operational plan would reduce reducing impingement of marine organisms by 60 to 80 % and reduce entrainment by 59 to 77 % as compared to a baseline condition of power plant operation with all existing pumps and screens in service (total intake flow of 794.9 MGD). Operation of the power plant intake facilities at the recommended Operational Condition 5 would result in a 43% flow reduction from current minimum NPDES permit requirement of 304 MGD and a similar reduction in impingement and entrainment losses attributable to the CDP when the EPS is not operating.

CHAPTER 1

INTRODUCTION

1.1 PURPOSE

On August 16, 2006 the San Diego Regional Water Quality Control Board (RWQCB) adopted Order NO. R9-2006-0065 for Poseidon Resources Corporation's Carlsbad Desalination Project discharge to the Pacific Ocean via the Encina Power Station discharge channel. Section VI.2.e. of the adopted order provides that:

> *e. Flow, Entrainment and Impingement Minimization Plan*
>
> *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.*

This Flow, Entrainment and Impingement Minimization Plan (Minimization 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 minimize impacts to marine organisms when the Carlsbad Desalination Plant (CDP) intake requirements exceed the volume of water being discharged by the EPS.

1.2 DESCRIPTION OF EXISITNG POWER PLANT INTAKE FACILITIES

The EPS is a once-trough 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 in front of the generating units.

The mouth of the intake structure is 49 feed wide. Booms are situated in the lagoon across the front of the intake structure to screen floating debris. Water passes first trough metal coarse screens (trash racks with vertical bars spaced 3-1/2 inches apart) to screen large debris and marine species. The intake forebay tapers into two 12-foot wide intake tunnels. From these tunnels the cooling water one or more 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. Vertical traveling screens are located at the intakes of pumps for unit 4 and unit 5. Figure 1-1 provides a general schematic of the power plant intake system configuration.

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 7 (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 screens 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 1-1 summarizes the capacity of the individual power plant intake pumps.

TABLE 1-1

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).

It is important to note, that the power plant intake pumping station consists of cooling water intake pumps which convey water through the condensers of the electricity generation units of the power plant and have a total capacity of 794.9 MGD (552,000 gpm) and of service water pumps for the auxiliary systems of the power plant, which total 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 desalination plant is shut down permanently, than the service water pumps will not be operational and will not contribute to the impingement and entrainment of the power plant intake pump station. Therefore, this impingement and entrainment reduction analysis associated with the stand-alone operation of the desalination plant encompasses only the cooling water pumps and excludes the service pumps.

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 (CWPs) 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 per minute (gpm) (Year 2006 NPDES Permit No. CA0001350). This discharge encompasses both the cooling water pumps (794.9 MGD) and the service water pumps (61.2 MGD).

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 previous four years (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 and ranged from 200–808 MGD.

1.3 DESALINATION PLANT INTAKE AND DISCHARGE FACILITIES

The seawater desalination plant intake and discharge facilities would be co-located with the Encina Power Station. A key feature of the co-location concept is the direct connection of the membrane 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 1-2 illustrates the co-location configuration of the CDP and EPS intake and discharge facilities.

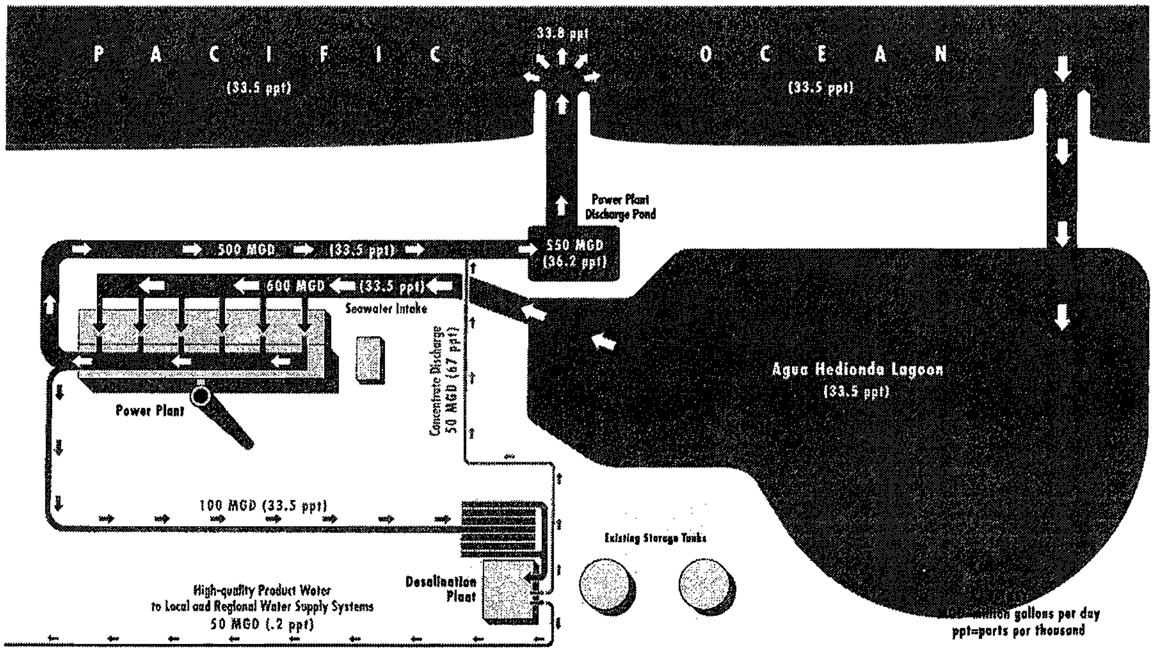


Figure 1-2 – Collocation of Carlsbad Desalination Plant and Encina Power Station

As shown on Figure 1-2, under typical operational conditions approximately 600 MGD of seawater enters the power plant intake facilities and after screening is pumped through the plant's condensers to cool them and thereby to remove the waste heat created during the electricity generation process. The Carlsbad desalination plant intake structure is connected to the end of this discharge canal and under normal operational conditions would divert 106 to 130 MGD of the 600 MGD of cooling water for production of fresh water.

Approximately 50 MGD of the diverted cooling seawater would be desalinated via reverse osmosis and conveyed for potable use. The remaining 50 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. Under average conditions, the blend of 500 MGD of cooling water and 50 MGD of concentrate would have discharge salinity of 36.2 ppt, which is within the 10 % natural fluctuation of the ocean water salinity (36.9 ppt) in the vicinity of the existing power plant discharge.

The desalination plant intake pump station would be connected to the south end of the existing power plant discharge canal. This pump station would be equipped with vertical turbine pumps which would convey the source seawater from the power plant discharge canal to the desalination plant pretreatment system. At least one seawater desalination plant intake pump would be equipped with variable frequency drive, which would be operated to minimize intake flow and optimize plant performance and operations under varying water and power demands.

1.4 DESALINATION PLANT OPERATIONS DURING PERIODS OF CURTAILED POWER GENERATION

Under the conditions of temporary or permanent power plant shutdown, the desalination plant would run the power plant intake pumps to collect water for two purposes – (1) source water for production of 50 MGD of drinking water and (2) dilution water for the 50 MGD of concentrate generated during the desalination process to levels determined in the desalination plant NPDES permit.

Under the intake and discharge limitations incorporated in the desalination plant NPDES permit, the desalination plant is permitted to collect between 100 MGD and 129 MGD of seawater in order to produce 48 to 54 MGD (average of 50 MGD) of drinking water. The dilution water needed to reduce 50 MGD of desalination plant concentrate with salinity of 67 ppt to the average daily NPDES permit discharge salinity limitation of 40 ppt is 207.7 MGD. During stand-along desalination plant operations, this dilution water would need to be collected using the power plant intake pumps along with the water needed for water production.

As indicated in Table 2 of Attachment F – Fact Sheet of the desalination plant NPDES permit, the discharge from the desalination plant consists of concentrate of 50 MGD to 54 MGD and pretreatment filter backwash flow of 4.0 MGD to 10.5 MGD. While the salinity of the concentrate is two times higher than the salinity of the source seawater (i.e., 67 ppt), the salinity of the backwash water is the same as that of the ambient seawater (i.e, 33.5 ppt). Since the filter backwash water is retuned to the ocean as well, this seawater can also be used as dilution water for the concentrate. Therefore, the volume of the backwash water can be subtracted from the additional volume of dilution seawater that needs to be collected from the ocean during power plant shutdowns in order to bring the level of salinity of the total discharge down to the current NPDES permit salinity limit of 40 ppt.

For example, as indicated previously, the dilution water needed to reduce 50 MGD of concentrate of salinity of 67 ppt down to 40 ppt, is 207.7 MGD. If the pretreatment system uses and discharges 4.0 MGD (average discharge for granular media pretreatment system), than the total flow that needs to be collected from the ocean under stand-along desalination plant operations is: 100 MGD (for desalination) + 4 MGD (for filter backwash) + 207.7 MGD (for dilution of 50 MGD of 67 ppt concentrate down to 40 ppt) – 4 MGD (to account for the fact that the backwash waster also serves as dilution water) = 307.7 MGD. Because the backwash flow is always counted as both intake source water for treatment and as discharge water available for dilution, the total volume of intake water of 307.7 MGD that needs to be collected by the power plant intake pumps to produce 50 MGD of drinking water is only dependent on the target salinity of the discharge concentrate.

As indicated in Table 2 of Attachment F – Fact Sheet (page F-5) of the current NPDES permit, the maximum daily flow of the plant may reach 54 MGD. For this condition, the dilution water needed to reduce 54 MGD of concentrate of salinity of 67 ppt down to 40 ppt is 224.3 MGD. Because the intake source water in this case will be 108 MGD (two times 54 MGD) than the total intake flow needed to accommodate this worst-case scenario is 108 MGD + 224.3 MGD = 332.3 MGD.

CHAPTER 2

ASSESMENT OF POTENTIAL FLOW MINIMIZATION MEASURES

2.1 INTRODUCTION

As indicated in Chapter 1, the total intake flow needed for the normal operation of the 50 MGD Carlsbad seawater desalination plant is 307.7 MGD. Approximately 104 MGD to 129 MGD of this flow would be required for water production and the reminder will be needed for safe disposal of the desalination plant concentrate.

The minimum flow needed for production of 50 MGD of drinking water is determined by the desalination technology proposed to be used for the Carlsbad project. The seawater membrane reverse osmosis desalination process requires the intake of a minimum of two gallons of seawater to produce one gallon of fresh water. Therefore, a minimum 100 MGD of pretreated seawater is needed to produce 50 MGD of drinking water for this project. This volume cannot be reduced further due to the process performance limitations of the reverse osmosis system. Therefore, the highest potential for overall intake flow reduction is associated with the reduction of the seawater volume needed for the dilution of the concentrate.

2.2 FACTORS DETERMINING THE MINIMUM INTAKE FLOW

As indicated in Section 2.1, the total intake flow to the seawater desalination plant could potentially be reduced by the decrease of the intake of raw seawater needed for dilution of the desalination plant concentrate. This minimum volume of water required for dilution is driven by two key limiting factors:

- The minimum volume needed to protect marine life. This volume is determined by the amount of water needed to dilute the 50 MGD of concentrate below level that could be acutely toxic for the marine organisms inhabiting the discharge area.

- The minimum volume needed to provide adequate mixing of the concentrate with the ambient seawater in the zone of initial dilution (ZID) of the discharge.

2.3 MINIMUM INTAKE FLOW NEEDED TO PROTECT MARINE LIFE

The existing desalination plant NPDES permit contains a California Ocean Plan-based performance goal for acute toxicity of the facility discharge of TUa = 0.765 (see Table 10, page 12, of NPDES Permit). In addition the permit has a daily average and average hourly total dissolved solids (salinity) limitations of 40 mg/L and 44 mg/L, respectively (see Table 9, page 12 of NPDES Permit).

The permit salinity limits were established based on a conservative analysis of the desalination plant discharge completed during the environmental impact report preparation phase of the project. In order to more accurately determine the salinity threshold at which the desalination plant concentrate can be discharged safely, Section VI.2.c.1 of the adopted NPDES Permit order requires the discharger to conduct a study using CDP pilot plant effluent to assess short-term exposure of test species to salinity concentrations that range from 36 to 60 parts per thousand (ppt). The goal of the salinity and acute toxicity special study is to assess compliance with the acute toxicity performance goal and to identify the maximum amount of salinity that can be discharged without causing acute toxicity. Recognizing that future EPS flows may be decreased, an additional goal is to identify the minimum seawater intake flows required to allow the CDP discharge to comply with salinity and acute toxicity requirements.

In conformance with the NPDES permit requirements, Poseidon Resources completed the required "Salinity and Acute Toxicity Study". Attachment 1 of this report contains the study plan for the short-term toxicity threshold evaluation. Attachment 2 includes the results from the Acute Salinity Study.

Acute toxicity testing was performed in accordance with the Study Plan provided in Attachment 1 and in with the procedures established by the USEPA guidance manual, *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms*, 5th Edition, October 2002 (EPA-821-R-02-012). The bioassay was completed using Topsmelt test organisms.

The No Observed Effect Concentration (NOEC) of the test occurred at 42 ppt of concentrate salinity. The Lowest Observed Effect Concentration (LOEC) was found to be 44 ppt. The lethal concentration for 50 % of the population (LC50) was 58.57 ppt. In addition, the No Observed Effect Time (NOET) for 60 ppt concentration was 2 hours, while the Lowest Observed Effect Time (LOET) for the 60 ppt concentration was 4 hours. The results of the Salinity and Acute Toxicity Study are summarized in Table 2-1.

TABLE 2-1

SALINITY AND ACUTE TOXICITY OF DESALINATION PLANT CONCENTRATE

Concentrate Salinity (ppt)	Test Species Survival (% of total)	Acute Toxicity of Concentrate TUa(1,2)	Average and Maximum Total Desalination Plant Intake Flow Needed (MGD)
33.5 (Control)	100	0.00	NA
36	95	0.41	720 – 777.6
38	90	0.59	422 - 456
40	**95**	**0.41**	**307.7 – 332.3**
42	97.5	0.23	247.1 – 266.8
44	85	0.69	209.5 – 226.3
46	**87.5**	**0.65**	**184 – 198.7**
48	80	0.77	165.5 – 178.8
50	55	0.97	151.5 – 163.6
52	62.5	0.93	140.5 – 151.8
54	45	1.02	131.7 – 142.2
56	55	0.97	124.4 – 134.4
58	65	0.91	118.4 – 127.8
60	37.5	1.06	113.2 – 122.3

Notes: (1) TUa calculated as: log (100 - % survival)/1.7
(2) Desalination NPDES Permit TUa Performance Goal = 0.765

Analysis of the toxicity testing data presented in Table 2-1 indicates the following:

- The NPDES permit daily average salinity limitation of 40 ppt is conservative. The NPDES permit TUa Performance Goal of 0.765 is not exceeded until salinity reaches 48 ppt and is safely met at salinity of 46 ppt or less.

- Current NPDES permit average hourly salinity limitation of 44 ppt is also very conservative. The test data indicates that no mortality effect was observed for a period of 2 hours at discharge salinity of 60 ppt.

- Concentrate of salinity of 46 ppt and acute toxicity level TUa of 0.65 complies with a reasonable margin of safety with the NPDES acute toxicity TUa performance goal of 0.765. Therefore, this concentrate salinity level could be considered as an acceptable benchmark which could be used to determine the minimum intake flow needed to protect aquatic life.

- If the average daily concentrate salinity limit is increased from 40 ppt to 46 ppt, the maximum amount of intake flow needed for stand-alone desalination plant operations can be reduced from 332.3 MGD to 198.7 MGD (40 % intake flow reduction).

2.4 MINIMUM INTAKE FLOW TO MAINTAIN ADEQUATE MIXING

As indicated previously, another key criterion to determine the minimum intake flow needed for environmentally safe plant operations is the rate of hydrodynamic mixing and dilution of the discharge with the ambient seawater in the ZID. The current NPDES permit has a specific requirement related to the minimum initial dilution of the discharge in the ZID of 15.5:1.

In order to determine discharge plume dissipation and mixing at increased concentrate discharge salinities/smaller dilution flows, the stand-alone desalination plant operations were modeled at several discharge flow rates corresponding to end-of-discharge canal salinity concentrations of 40.1 to 50.3 ppt. The flow scenarios were modeled for particular combinations of power plant intake pumps that could produce feed water flows that would yield closest to the target concentrate salinity levels in Table 2-1. The modeled scenarios are presented in Table 2-2. The results of the hydrodynamic modeling are summarized in Attachment 3 ("Near Shore Saline Effects due to Reduced Flow Rate Scenarios during Stand-Along Operations of the Carlsbad Desalination Project at Encina Generating Station", Scott Jenkins & Joseph Wasyl, 12 January 2007).

TABLE 2-2

HYDRODYNAMIC MODELING OF DESALINATION PLANT DISCHARGE AT REDUCED INTAKE FLOW AND STAND-ALONE OPERATIONS

Scenario	Total Intake Flow (MGD)	Concentrate Salinity Discharge Conc. (ppt)	Intake Pumps in Operation	Minimum Pelagic Dilution @ ZID (1)	Maximum Bottom Salinity (ppt) (1)	Benthic Area Exposed To Salinity > 36.9 ppt (acres) (1)	Flow Reduction from Current Permit Requirement (%)
1	149.8	50.3 ppt	One Pump of Unit 5	9.9:1	42.3	39.4	42.9 %
2	172.8	47.1 ppt	All Pumps Of Units 1 & 2 and One Pump of Unit 3	13.5:1	42.0	30.5	51
3	184.3	46 ppt	One Pump of Unit 5 And One Pump of Unit 1, 2 or 3	17.7:1	41.4	25.6	43
4	218.9	43.4 ppt	One Pump of Unit 5 And Two Pumps of Unit 1, 2 or 3	21.1:1	40.1	16.4	39
5	304.0	40.1 ppt	Two Pumps of Unit 4	28.2:1	38.1	8.3	0 %

(*) Note: (1) Historical Average Condition.

Review of Table 2-2 indicates the following key findings:

- Intake flows of less than 184.3 MGD (concentrate salinity > 46 ppt) will result in mixing ratio lower than the current NPDES Permit requirement of 15.5 to 1.
- At intake flow of 184.3 MGD and historical average discharge conditions the mixing ratio of 17.7 to 1, is compliant with the permit requirement of 15.5 to 1.

As indicated in Table 2-1, the discharge will also be compliant with the permit's toxicity requirements.

- Intake flow of 218.9 MGD (concentrate salinity of 43.4 ppt) will satisfy the current NPDES permit's initial dilution ratio requirement of 15.5:1 for both historic average and extreme conditions and will be compliant with the acute toxicity requirement of the NPDES permit.

- Operating the stand-alone desalination plant at intake flow of 307.7 MGD which corresponds to the current NPDES permit discharge salinity of 40 ppt, has the advantage of over 3 times smaller footprint of the benthic area exposed to elevated salinity as compared to 184.3 MGD/46 ppt scenario. However, this operational scenario would result in 40 % higher intake flow and associated impingement and entrainment impacts.

2.5 OPERATIONAL SCENARIOS OF POWER PLANT INTAKE PUMPS

The toxicity and hydrodynamic analysis of the desalination plant discharge presented in the previous two sections indicates that there are three potentially viable concentrate target intake flows at which the power plant intake pumps could be operated with minimal impact on the marine environment:

- 307.7 MGD (40 ppt of concentrate discharge);

- 218.9 MGD (43.4 ppt of concentrate discharge);

- 184.3 MGD (46 ppt of concentrate discharge).

As indicated previously, the existing power plant intake pumps are constant-speed units that can only deliver discrete flows via the operation of various combinations of individual pump units. Based on consultation with the power plant staff, the following pump operational conditions were identified to deliver the target flows listed above:

Operational Condition 1 (Target Intake Flow 307.7 MGD – 40 ppt)

• One Pump of Unit 2	- 34.56 MGD
• One Pump of Unit 4	- 144.01 MGD
• One Pump of Unit 5	- 149.76 MGD
Total =	- 328.33 MGD

Operational Condition 2 (Target Intake Flow 307.7 MGD – 40 ppt)

• One Pump of Unit 1	- 34.56 MGD
• Both Pumps of Unit 4	- 288.02 MGD
Total =	- 322.58 MGD

Operational Condition 3 (Target Intake Flow 307.7 MGD – 40 ppt)

- Both Pumps of Unit 1 - 69.12 MGD
- One Pump of Unit 2 - 34.56 MGD
- Both Pumps of Unit 3 - 69.12 MGD
- One Pump of Unit 4 - 144.01 MGD

Total = - 316.81 MGD

Operational Condition 4 (Target Intake Flow 218.9 MGD – 43.4 ppt)

- Two Pumps of Unit 1, 2 or 3 - 69.12 MGD
- One Pump of Unit 5 - 149.76 MGD

Total = - 218.88 MGD

Operational Condition 5 (Target Intake Flow 184.3 MGD – 46 ppt)

- One Pump of Unit 1, 2 or 3 - 34.56 MGD
- One Pump of Unit 5 - 149.76 MGD

Total = - 184.32 MGD

The impingement and entrainment associated with these five operational conditions will be assessed in the next sections.

CHAPTER 3

POTENTIAL IMPINGEMENT REDUCTION MEASURES

3.1 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 zero in accordance with the designation of this condition by US EPA (316 (B) Regulations) as a Best Technology Available for elimination of impingement.

3.2 RELATIVE IMPINGMENT POTENTIAL OF EXISITNG INTAKE FACILITIES

The EPS has five power generation units, each of which is serviced by two constant speed seawater intake pumps. Therefore the total number of pump units is 10. The six (6) cooling water intake pumps of power generation Units 1, 2 and 3 convey their entire flow of 207.36 MGD through two common traveling screens with 3/8-inch openings. Unit 4 has two cooling pumps of total capacity of 288.02 MGD, which flow passes through two separate 3/8-inch traveling screens. Unit 5 is cooled by two cooling pumps of total capacity of 299.54 MGD which pass all of their flow through three traveling screens. These three screens have 5/8-inch openings.

Each of the seven (7) power plant intake screens are installed in a separate intake channel. The screens are conventional through-flow vertically rotating, single entry, band type units mounted in the intake channels. Each screen consists of series of baskets (screen panels) attached to a chain drive. Cooling water passes through the wire mesh screening surface and debris in the raw seawater are retained on the screens. The screens rotate automatically when the debris buildup causes a predetermined headloss through the screens. As the screens revolve, the collected debris is lifted from the intake water surface by the upward travel of the screen baskets. The screens travel at velocity of 3 feet per minute making one complete revolution in 20 minutes. A screen wash system washes the debris from the traveling screens into screen well baskets where it is accumulated for disposal. The removed debris is returned back to the ocean periodically. Table 3-1 presents the capacities of the individual pumps and the through-screen velocities at high and low tide conditions. All velocities indicated in this table are determined for a all pumps in operation at their maximum flowrate.

TABLE 3-1

POWER PLANT INTAKE PUMP CAPACITY AND THROUGH-SCREEN VELOCITIES AT MAXIMUM COOLING PUMP FLOW (794.9 MGD)

Power Plant	**Pump Capacity (MGD)**	**Maximum Through-Screen Velocity (fps) @ High Tide (4.83 of MSL)**	**Maximum Through-Screen Velocity (fps) @ Low Tide (-5.07 of MSL)**	**Note**
Unit 1				
Pump 1 S	34.56			
Pump 1 N	34.56			All pumps of Units 1, 2 & 3 share two common screens of identical size and capacity
Total Capacity	**69.12**	1.2	2.1	
Unit 2				
Pump 2 S	34.56			
Pump 2 N	34.56			
Total Capacity	**69.12**			
Unit 3				
Pump 3 S	34.56			
Pump 3 N	34.56			
Total Capacity	**69.12**			
Unit 4				All flow pumped through two screens
Pump 4 E	144.01			
Pump 4 W	144.01	1.8	2.8	
Total Capacity	**288.02**			
Unit 5				
Pump 5 E	149.76			All flow pumped through three screens
Pump 5 W	149.76	1.0	1.6	
Total Capacity	**299.54**			

Note: MSL – mean sea level.

Because the through-screen velocity of all pump units is higher than 0.5 fps when operated at maximum flow, their relative contribution to the total impingement potential of the intake pump system will be proportional to the pump flow. Therefore, if the total maximum impingement potential of the entire power plant intake pump system is designated as 1, the individual pump units will have the relative maximum impingement potential presented in Table 3-2.

TABLE 3-2

POWER PLANT INTAKE PUMPS - RELATIVE MAXIMUM IMPINGEMENT POTENTIAL

Power Plant	**Pump Capacity (MGD)**	**Relative Maximum Impingement Potential**
Unit 1		
Pump 1 S	34.56	0.044
Pump 1 N	34.56	0.044
Total	**69.12**	**0.088**
Unit 2		
Pump 2 S	34.56	0.044
Pump 2 N	34.56	0.044
Total Capacity	**69.12**	**0.088**
Unit 3		
Pump 3 S	34.56	0.044
Pump 3 N	34.56	0.044
Total Capacity	**69.12**	**0.088**
Unit 4		
Pump 4 E	144.01	0.180
Pump 4 W	144.01	0.180
Total Capacity	**288.02**	**0.360**
Unit 5		
Pump 5 E	149.76	0.188
Pump 5 W	149.76	0.188
Total Capacity	**299.54**	**0.376**
TOTAL	**794.9**	**1.0**

Based on the last four years of operation, under typical operational conditions, the power plant runs Units 4 and 5 (a total intake flow of 587.56 MGD) only and occasionally operates additional units as needed (to average 600.4 MGD on an annual average basis). Using the breakdown shown in Table 3-2, the relative reduction of impingement for plant operation at average annual power plant flow of 600.4 MGD is shown on Table 3-3.

TABLE 3-3

POWER PLANT COOLING WATER INTAKE PUMPS - IMPINGEMENT POTENTIAL AT AVERAGE ANNUAL FLOW OF 600.4 MGD

Power Plant	Pumped Flow (MGD)	Relative Impingement Potential @ Average Flow
Unit 1		
Pump 1 S	0.0	0.0
Pump 1 N	0.0	0.0
Total	**0.0**	**0.0**
Unit 2		
Pump 2 S	0.0	0.0
Pump 2 N	0.0	0.0
Total Capacity	**0.0**	**0.0**
Unit 3		
Pump 3 S	0.0	0.0
Pump 3 N	0.0	0.0
Total Capacity	**0.0**	**0.0**
Unit 4		
Pump 4 E	144.01	0.180
Pump 4 W	144.01	0.180
Total Capacity	**288.02**	**0.360**
Unit 5		
Pump 5 E	149.76	0.188
Pump 5 W	149.76	0.188
Total Capacity	**299.54**	**0.376**
TOTAL	**794.9**	**0.736**

3.3 IMPINGEMENT REDUCTION AT ALTERNATIVE INTAKE OPERATIONAL CONDITIONS

As indicated in Chapter 2, five alternative operational conditions of the existing power plant intake pumps were identified as viable to reduce flow intake, impingement and entrainment and at the same time protect the marine environment in the area of the desalination plant discharge. These operational conditions vary by the total volume of seawater intake flow and the number and location of the power plant pumps proposed to be used to get to the specific total intake flow:

- Operational Condition 1 - Total Intake Flow of 328.33 MGD
- Operational Condition 2 - Total Intake Flow of 322.58 MGD
- Operational Condition 3 - Total Intake Flow 316.81 MGD
- Operational Condition 4 - Total Intake Flow of 218.9 MGD
- Operational Condition 5 – Total Intake Flow of 184.32 MGD

The relative impingement potential of each of these conditions is presented below. The estimate of actual through screen-velocity of each operational condition is provided in Attachment 4.

Impingement Potential of Operational Condition 1 – Intake Flow of 328.33 MGD
The proposed number, capacity and location of the intake pumps planned to be used to achieve Operational Condition 1 are listed in Table 3-4.

TABLE 3-4
IMPINGEMENT POTENTIAL OF OPERATIONAL CONDITION 1

Power Plant	Pump Capacity (MGD)	Relative Maximum Impingement Potential
Unit 1		
Pump 1 S	0.00	0.000
Pump 1 N	0.00	0.000
Total	**0.00**	**0.000**
Unit 2		
Pump 2 S	0.00	0.000
Pump 2 N	34.56	0.044 * 0.33 = 0.015
Total Capacity	**34.56**	**0.015**
Unit 3		
Pump 3 S	0.00	0.000
Pump 3 N	0.00	0.000
Total Capacity	**0.00**	**0.000**
Unit 4		
Pump 4 E	0.00	0.000
Pump 4 W	144.01	0.180
Total Capacity	**144.01**	**0.180**
Unit 5		
Pump 5 E	0.00	0.000
Pump 5 W	149.76	0.188
Total Capacity	**149.76**	**0.188**
TOTAL	**328.33**	**0.383**

Operational Condition 1 would result in impingement reduction by shutting down one pump of Unit 1 and all pumps of Units 2 and 3, while maintaining all of the common screening facilities servicing these pumps in operation. This operation will allow to reduce the velocity through the screens below 0.5 fps during periods when the actual tide elevation is between -0.687 ft and +4.83 ft above the mean sea level (see Attachment 4). Based on statistical analysis of the tide elevations, this condition is expected to occur 67 % of the time (see Attachment 4). Therefore, the impingement potential of the operating pump of Unit 1 is reduced to 33 % of maximum. This operational condition would result in 61.7 % reduction of impingement as compared to power plant operation at maximum flow of 794.92 MGD and 48 % of impingement reduction as compared to the power plant operation at daily average flow of 600.4 MGD (see Tables 3-3 and 3-4).

Impingement Potential of Operational Condition 2 – Intake Flow of 322.58 MGD
This operational condition is similar to Condition 1, with the exception that both pumps of Unit 5 are shutdown and both pumps of Unit 4 are in operation. This condition was introduced in order to provide operational flexibility in case Unit 5 pumps are out of service for routine or emergency maintenance or repair.

TABLE 3-5
IMPINGEMENT POTENTIAL AT OPERATIONAL CONDITION 2

Power Plant	**Pump Capacity (MGD)**	**Relative Maximum Impingement Potential**
Unit 1		
Pump 1 S	0.00	0.000
Pump 1 N	34.56	0.044 * 0.33 = 0.015
Total	**34.56**	**0.018**
Unit 2		
Pump 2 S	0.00	0.000
Pump 2 N	0.00	0.000
Total Capacity	**0.00**	**0.000**
Unit 3		
Pump 3 S	0.00	0.000
Pump 3 N	0.00	0.000
Total Capacity	**0.00**	**0.000**
Unit 4		
Pump 4 E	144.01	0.180
Pump 4 W	144.01	0.180
Total Capacity	**288.02**	**0.360**
Unit 5		
Pump 5 E	0.00	0.000
Pump 5 W	0.00	0.000
Total Capacity	**0.00**	**0.000**
TOTAL	**322.58**	**0.375**

This operational condition would result in 62.2 % reduction of impingement as compared to power plant operation at maximum flow of 794.92 MGD and 49.0 % of impingement reduction as compared to the power plant operation at daily average flow of 600.4 MGD.

Impingement Potential of Operational Condition 3 – Intake Flow of 316.81 MGD
Impingement reduction under Operational Condition 3 would be achieved mainly by shutting down the largest power plant intake water pumps (the cooling pumps for Unit 5). Since this scenario includes the operation of five out of six pumps of Units 1, 2 and 3, the through-screen velocity through their common screens is relatively high and therefore, no additional impingement reduction credit is assigned to this scenario under high tides.

TABLE 3-6
IMPINGEMENT POTENTIAL OF OPERATIONAL CONDITION 3

Power Plant	Pumped Flow (MGD)	Relative Impingement Potential @ Average Flow
Unit 1		
Pump 1 S	34.56	0.044
Pump 1 N	34.56	0.044
Total	**69.12**	**0.088**
Unit 2		
Pump 2 S	0.00	0.000
Pump 2 N	34.56	0.044
Total Capacity	**34.56**	**0.044**
Unit 3		
Pump 3 S	34.56	0.044
Pump 3 N	34.56	0.044
Total Capacity	**69.12**	**0.088**
Unit 4		
Pump 4 E	0.00	0.00
Pump 4 W	144.01	0.180
Total Capacity	**144.01**	**0.180**
Unit 5		
Pump 5 E	0.00	0.00
Pump 5 W	0.00	0.00
Total Capacity	**0.00**	**0.00**
TOTAL	**316.81**	**0.40**

This operational condition would result in 60.0 % reduction of impingement as compared to power plant operation at maximum flow of 794.92 MGD and 45.6 % of impingement reduction as compared to the power plant operation at daily average flow of 600.4 MGD.

Impingement Potential of Operational Condition 4 – Intake Flow of 218.88 MGD
Under this operational condition impingement is reduced by operating only two cooling water pumps of the total of six pumps for Units 1, 2 or 3 and of only one pump of Unit 5. The impingement potential of this scenario is shown in Table 3-7. Review of this table indicates that intake pump operation under this scenario would result in 72.4 % reduction of impingement as compared to power plant operation at maximum flow of 794.92 MGD and 62.5 % of impingement reduction as compared to the power plant operation at daily average flow of 600.4 MGD.

TABLE 3-7
IMPINGEMENT POTENTIAL OF OPERATIONAL CONDITION 4

Power Plant	**Pump Capacity (MGD)**	**Relative Maximum Impingement Potential**
Unit 1		
Pump 1 S	0.00	0.000
Pump 1 N	0.00	0.000
Total	**0.00**	**0.000**
Unit 2		
Pump 2 S	34.56	0.044
Pump 2 N	34.56	0.044
Total Capacity	**69.12**	**0.088**
Unit 3		
Pump 3 S	0.00	0.000
Pump 3 N	0.00	0.000
Total Capacity	**0.00**	**0.000**
Unit 4		
Pump 4 E	0.00	0.000
Pump 4 W	0.00	0.000
Total Capacity	**0.00**	**0.000**
Unit 5		
Pump 5 E	0.00	0.000
Pump 5 W	149.76	0.188
Total Capacity	**149.76**	**0.188**
TOTAL	**218.88**	**0.276**

Impingement Potential of Operational Condition 5 – Intake Flow of 184.33 MGD
This operational condition includes running only one of the six pumps of the Units 1, 2 and 3 and of one pump of Unit 5. The impingement potential of this scenario is shown in Table 3-8. This operational condition yields the highest impingement reduction potential – 79.7 % as compared to power plant operation at maximum flow of 794.92 MGD and 72.4 % of impingement reduction as compared to the power plant operation at daily average flow of 600.4 MGD.

TABLE 3-8

IMPINGEMENT POTENTIAL OF OPERATIONAL CONDITION 5

Power Plant	Pump Capacity (MGD)	Relative Maximum Impingement Potential
Unit 1		
Pump 1 S	0.00	0.000
Pump 1 N	0.00	0.000
Total	**0.00**	**0.000**
Unit 2		
Pump 2 S	0.00	0.000
Pump 2 N	34.56	0.044 * 0.33 = 0.015
Total Capacity	**34.56**	**0.015**
Unit 3		
Pump 3 S	0.00	0.000
Pump 3 N	0.00	0.000
Total Capacity	**0.00**	**0.000**
Unit 4		
Pump 4 E	0.00	0.000
Pump 4 W	0.00	0.000
Total Capacity	**0.00**	**0.000**
Unit 5		
Pump 5 E	0.00	0.000
Pump 5 W	149.76	0.188
Total Capacity	**149.76**	**0.188**
TOTAL	**184.32**	**0.203**

Comparison of Impingement Reduction of Alternative Operational Conditions
Table 3-9 summarizes the impingement reduction potential of the five operational conditions as compared to the maximum power plant intake flow of 794.92 MGD and the average power plant intake flow of 600.4 MGD. Review of the data presented in this table indicates that intake flow reduction from the current average level of 600.4 MGD to 184.33 MGD will result in a significant reduction of impingement (72.4 %) of marine organisms by the intake while maintaining environmentally safe level of salinity in the desalination plant discharge of 46 ppt. In order to implement this operational condition however, the current NPDES permit's average daily discharge salinity limit would need to be increased from 40 ppt to 46 ppt and the daily maximum discharge salinity limit would need to be raised from 44 ppt to 50 ppt or more.

Under the current NPDES average daily and daily maximum salinity limits (40 ppt and 44 ppt, respectively) and stand-alone operations of the desalination plant, the intake flow of the EPS cooling pumps can be reduced to not less than 316.81 MGD and the intake pumps can be operated under Operational Conditions 1, 2 or 3, only. Operation at these conditions will yield significantly less impingement reduction than that that can be achieved under Operational Condition 1 (49 % vs. 72.4 %).

TABLE 3-9

COMAPRISON OF IMPINGEMENT REDUCTION AT ALTERANTIVE OPERATIONAL CONDITIONS OF POWER PLANT INTAKE FLOWS

Operational Condition	Total Intake Flow (MGD)	Intake Pumps in Operation	Impingement Reduction Compared to That at Maximum Pump Flow of 794.92 MGD (%)	Impingement Reduction Compared to That at Average Pump Flow of 600.4 MGD (%)
1	328.33	One Pump of Any of Units 1, 2 or 3 & One Pump of Unit 4 & One Pump of Unit 5	61.7	48.0
2	322.58	One Pump of Any of Units 1, 2 or 3 & Two Pumps of Unit 4	62.2	49.0
3	316.81	Any Combination of Five out of Six Pumps of Units 1, 2 or 3 & One Pump of Unit 4	60.0	45.6
4	218.88	Two Pumps of Any of Units 1, 2 or 3 & One Pump of Unit 5	72.4	62.5
5	184.33	One Pump of Any of Units 1, 2 or 3 & One Pump of Unit 5	79.7	72.4

The impingement assessment of the desalination plant intake provided above represents a worst-case scenario reflective of long-term power plant shutdown – i.e. shutdown over 365 days per year and 24 hrs per day.

Based on the year 2006 track record of operational conditions, the power plant has been shut down for only 10 days. If the desalination plant was in operation in 2006, this would have corresponded to impingement increment due to the desalination plant operations of only 0.76 %, if during the time of power plant shutdown the intake is operated at 184.44 MGD to provide source water for the stand-alone operation of the desalination plant (10 days/365 days x (1-0.724) x 100 % = 0.76 %). If the power plant is shutdown for one month (30 days), the increment over the current baseline impingement potential of the power plant would be only 2.3 %.

It should be pointed out that if the power plant is shutdown for one month or more, the adverse effects on the Aqua Hedionda lagoon due to lack of circulation and the associated suppression of the bio-productivity of the lagoon are likely to be significantly higher than the 2.3 % of the incremental impingement associated with the desalination plant operations, assuming minimum intake flow of 184.33 (Operational Condition 5). Therefore, the overall effect of desalination plant stand-alone operations on the lagoon ecosystem health and productivity would be positive.

Assessment of Impingement Effect of Alternative Operational Conditions Based on Existing Studies

The abundance and biomass of fishes and invertebrates impinged on the EPGS traveling screens were documented in an extensive study as part of the 316(b) Cooling Water Intake Demonstration (SDG&E, 1980). Biological sampling was done over a period of 336 consecutive days by collecting quantitative 12-hour accumulation samples during each day and night period, using nets placed in the collector baskets of all three traveling screen systems. Combined pump flows during the 48-week study ranged from 26.5% to 100% of maximum pumping capacity (794.9 MGD) with an overall average of 80.3% (638.6 MGD).

The total amount of impinged organisms for the individual sampling events of 1980 study is presented in Table 3-10. In order to assess the potential impingement effects of projected desalination plant flows during times of shutdown of EPS, the abundances and biomass of impinged organisms recorded in this 1980 study were scaled to the flow rates of the five alternative Operational Conditions described earlier in this section. The assessment of daily biomass of impinged species for the alternative Operational Conditions is presented in Table 3-11.

Review of Table 3-11 indicates that under worst-case operational condition (Condition 3 of total intake flow of 328.33 MGD), the daily total number of impinged fish is projected to be 131 individuals per day and the total weight of this fish would be 2.8 lbs/day. Operational Condition 5 (intake flow of 184.33 MGD) will cause lowest daily impingement rate of 74 individuals per day with average weight of 1.56 lbs/day.

A more detailed examination of the species composition identified during the 1980 SDG&E Study shows that queenfish, deepbody anchovy, and topsmelt comprised over half of the fishes by number, and that round stingray, Pacific electric ray, topsmelt, and queenfish comprised much of the biomass. Large invertebrates, in comparison, comprised approximately 7% of all organisms counted and less than 10% of the total biomass.

Significance of Impingement Losses

The biomass loss assessment provided above, demonstrates that the additional flows needed to provide seawater for the desalination plant during shutdowns of EPS would have little effect on the overall annual impingement losses caused by the power plant.

TABLE 3-10

1980 SDG&E STUDY TEST DATA FOR TOTAL DAILY (24-HOUR) ABUNDANCE AND BIOMASS OF IMPINGED FISHES

			All Stations	
Time Period (1979)	**Week**	**Total Number**	**Total Weight (kg)**	**Total Flow (mgd)**
Feb 04-10	1	455	5.00	759.8
Feb 11-17	2	291	2.50	794.9
Feb 18-24	3	1,374	11.99	765.6
Feb 25-March 03	4	366	4.91	765.6
March 04-10	5	47	1.17	531.9
March 11-17	6	48	1.23	531.9
March 18-24	7	43	4.69	531.9
March 25-31	8	31	2.26	531.9
April 01-07	9	276	9.75	531.9
April 08-14	10	24	1.23	496.8
April 15-21	11	20	1.52	496.8
April 22-28	12	58	2.05	438.3
April 29-May 05	13	25	3.07	467.6
May 06-12	14	97	0.52	210.4
May 13-19	15	33	0.22	210.4
May 20-26	16	67	0.82	239.6
May 27-June 02	17	52	0.48	210.4
June 03-09	18	118	1.33	526.0
June 10-16	19	194	1.97	561.1
June 17-23	20	491	6.02	496.8
June 24-30	21	516	3.31	438.3
July 01-07	22	368	1.33	438.3
July 08-14	23	611	2.42	467.6
July 15-21	24	166	1.45	765.6
July 22-28	25	305	1.57	759.8
July 29-Aug 04	26	362	4.64	794.9
Aug 05-11	27	107	0.89	794.9
Aug 12-18	28	192	1.56	759.8
Aug 19-25	29	591	2.48	736.4
Aug 26-Sep 01	30	261	1.84	736.4
Sep 02-08	31	343	1.56	794.9
Sep 09-15	32	103	0.45	707.2
Sep 16-22	33	90	1.01	765.6
Sep 23-29	34	189	1.76	765.6
Sep 30-Oct 06	35	194	1.78	765.6
Oct 07-13	36	130	3.17	794.9
Oct 14-20	37	156	0.87	794.9
Oct 21-27	38	370	2.14	794.9
Oct 28-Nov 03	39	417	1.98	794.9
Nov 04-10	40	247	2.13	794.9
Nov 11-17	41	307	1.84	794.9
Nov 18-24	42	793	3.16	794.9
Nov 25-Dec 01	43	584	1.09	759.8
Dec 02-08	44	229	2.65	794.9
Dec 09-15	45	97	1.56	794.9
Dec 16-22	46	196	2.18	794.9
Dec 23-29	47	146	1.52	561.1
Dec 30-Jan 04 (1980)	48	48	2.84	794.9
	Average	**255**	**2.46**	**638.6**

TABLE 3-10

ASSESMENT OF DAILY (24-HR) ABOUNDANCE AND BIOMASS OF IMPINGED FISHES FOR ALTERANTIVE OPERATIONAL CONDITIONS BASED ON 1980 STG&E STUDY DATA

Operational Condition	Total Intake Flow (MGD)	Intake Pumps in Operation	Total Daily Number of Impinged Fish	Total Daily Weight of Impinged Fish (kg/lbs)
1	328.33	One Pump of Any of Units 1, 2 or 3 & One Pump of Unit 4 & One Pump of Unit 5	131	1.27/ 2.8
2	322.58	One Pump of Any of Units 1, 2 or 3 & Two Pumps of Unit 4	129	1.24/ 2.73
3	316.81	Any Combination of Five out of Six Pumps of Units 1, 2 or 3 & One Pump of Unit 4	126	1.22/ 2.69
4	218.88	Two Pumps of Any of Units 1, 2 or 3 & One Pump of Unit 5	87	0.84/ 1.85
5	184.33	One Pump of Any of Units 1, 2 or 3 & One Pump of Unit 5	74	0.71/ 1.56

3.4 ADOPTON OF POWER PLANT IMPINGEMENT REDUCTION MEASURES

The current EPS NPDES Permit (Order No. R9-2006-0043, NPDES CA0001350) requires the EPS owner to, by January 9, 2008, submit to the Regional Water Board a Comprehensive Demonstration Study to characterize impingement and entrainment, and identify specific measures for their reduction. Since the desalination plant will not be operational before the end of 2008, the technologies, operation measures and/or mitigation measures implemented by the power plant and in place at the time the desalination plant begins operations would be evaluated and would be adopted, if feasible.

CHAPTER 4

POTENTIAL ENTRAINMENT REDUCTION MEASURES

4.1 METHODOLOGY FOR ENTRAINMENT ASSESSMENT

Under the alternative Operational Conditions 1 through 5 defined in Section 2, when EPS is offline and the desalination plant is the only facility using the existing intake structure, the desalination plant may collect between 184.33 MGD (Operational Condition 5) and 328.33 MGD (Operational Condition 1) of seawater in order to produce 50 MGD of drinking water. For the purpose of this analysis, the marine organisms entrained under any of the stand-alone operational conditions are assigned 100 % mortality. The entrainment of marine organisms attributed to the alternative operational conditions of the power plant intake pumps during stand-alone desalination plant operations is determined as a function of the total volume of seawater colleted by the EPS cooling water pumps.

During the review phase of the Final EIR for the Carlsbad project, Tenera Environmental has prepared an assessment of the proportional mortality (PM) of marine organisms that could be caused by the stand-alone operation of the desalination plant at intake flow of 306 MGD. Proportional mortality is defined as the percent of the total amount of marine organisms that inhabit the area of the lagoon and the ocean in the vicinity of the lagoon entrance, which area could be influenced by the power plant intake operations. This PE assessment for an intake volume of 306 MGD is provided as Attachment 5 and is summarized in Table 4-1. This table is extended to include estimates of the entrainment assigned to the EPS cooling water pumps when these pumps are operated at maximum capacity of 794.9 MGD and daily average power plant flow of 600.4 MGD.

The available proportional mortality data presented in Table 4.1 were used to determine the entrainment associated with power plant intake facility operation under Operational Conditions 1 through 5 when the desalination plant is in a stand-alone mode.

TABLE 4-1
AVERAGE DAILY PROPORTIONAL MORTALITY (PM) ASSOCIATED WITH ENTRAINMENT AT INTAKE FLOWS OF 306 MGD, 600.4 MGD & 794.9 MGD

Fish Group	**PM @ 306 MGD (%)[1]**	**PM @ 600.4 MGD (%)**	**PM @ 794.9 MGD (%)**
CIQ Gobies	34.1	66.9	88.6
Combtooth Blennies	16.5	32.4	42.9
Northern Anchovy	1.7	3.3	4.4

Note: (1) Source - Tenera Environmental, 2006 (see Attachment 5);
(2) Calculated Proportionally to Cooling Water Pump Intake Flow.

4.2 ENTRAINMENT REDUCTION AT ALTERNATIVE INTAKE OPERATIONAL CONDITIONS

Estimates of entrainment-related proportional mortality (PM) associated with power plant's intake cooling seawater pumps at Operational Conditions 1 through 5, along with the maximum entrainment potential of each operational condition are presented in Table 4-2.

TABLE 4-2
COMAPRISON OF ENTRAINMENT REDUCTION AT ALTERANTIVE OPERATIONAL CONDITIONS OF POWER PLANT INTAKE PUMPS

Operational Condition	Total Intake Flow (MGD)	Entrainment-related Proportional Mortality (%)		Entrainment Reduction Compared to That at Maximum Pump Flow of 794.92 MGD (%)	Entrainment Reduction Compared to That at Average Pump Flow of 600.4 MGD (%)
1	328.33	CIQ Gobies	36.5	58.7	45.3
		Combtooth Blennies	17.6	58.7	45.3
		Northern Anchovy	1.8	58.7	45.3
2	322.58	CIQ Gobies	35.9	59.4	46.3
		Combtooth Blennies	17.4	59.4	46.3
		Northern Anchovy	1.8	59.4	46.3
3	316.81	CIQ Gobies	35.3	60.2	47.2
		Combtooth Blennies	17.1	60.2	47.2
		Northern Anchovy	1.8	60.2	47.2
4	218.88	CIQ Gobies	24.4	72.5	63.5
		Combtooth Blennies	11.8	72.5	63.5
		Northern Anchovy	1.2	72.5	63.5
5	184.33	CIQ Gobies	20.5	76.8	69.3
		Combtooth Blennies	9.9	76.8	69.3
		Northern Anchovy	1.0	76.8	69.3

Significance of Entrainment Losses

The loss of larval fish entrained by the Carlsbad Desalination Plant (CDP), whether the EPS is operating or not, represents a small fraction of marine organisms from the abundant and ubiquitous near shore source water populations. Using standard fisheries models for adult fishes, the loss of larvae (99 percent of which are lost to natural mortality) due to the desalination facility entrainment at any of the five operational conditions would have no effect on the species' ability to sustain their populations, including the gobies at maximum PM under Operational Condition 1% of 36.5%.

Comparison of entrainment potential of the alternative operational conditions indicate that Condition 5 (intake flow of 184.52 MGD) will yield lowest entrainment PM losses (1% to 20.5 % depending on the species). The entrainment potential of this scenario is 43.8 % lower than that of Scenario 1 (intake flow of 328.33 MGD) because of the lower total volume of seawater used by the desalination plant under this operational condition.

Species with the highest mortality (i.e. the CIQ Gobies) are not substantially impacted because of their widespread distribution and high reproductive potential due to spawning several times a year, and are able to sustain conditional larval stage mortality rates of up to 60% without a decline in adult population level (see Attachment 5). This absence of potential population level effects is especially true for the species' early larval stages. The sheer numbers of larvae that are produced overwhelm population effects of both natural mortality and high levels of conditional mortality.

The most frequently entrained species are very abundant in the area of the EPS intake, the Agua Hedionda Lagoon, and the Southern California Bight, and therefore, the actual ecological effects due to any additional entrainment from the desalination plant at any of the Operational Conditions 1 through 5 are insignificant. Species of direct recreational and commercial value constitute a very small fraction (less than 1 percent) of the entrained organisms. Therefore, the operation of the desalination facility would not cause a significant ecological impact.

California Department of Fish and Game in its Nearshore Fishery Management Plan provides for sustainable populations with harvests of up to 60 percent of unfished adult stocks. The incremental entrainment ("harvest") effect of larval fishes from the desalination facilities operation under any of the Operational Scenarios 1 through 5 scenario at total seawater intake flow of 184.52 MGD (Scenario 5) to 328.33 MGD (Scenario 1) is approximately 1 to 36.5 percent (depending on the species); losses that would have no significant effect on the source water populations to sustain themselves.

The magnitude of the entrainment losses for all operational conditions is estimated for these conditions occurring continuously (i.e., 24 hrs per day, 365 days per year). Taking into consideration that the power plant is not expected to discontinue operations any time soon, the actual entrainment effects will be even smaller. Additionally, entrainment mortality losses are not harvests in the common sense, because the larval fish are not removed from the ocean, but are returned to supply the ocean's food webs – the natural fate of at least 99 percent of larvae whether entrained or not. Generally, less than one percent of all fish larvae become reproductive adults.

4.3 ADOPTION OF POWER PLANT ENTRAINMENT REDUCTION MEASURES

As noted above, Order No. R9-2006-0043 (NPDES CA0001350) requires the EPS owner to, by January 9, 2008, submit to the Regional Water Board a Comprehensive Demonstration Study to characterize impingement and entrainment, and identify specific measures for their reduction. Since the desalination plant will not be operational before the end of 2008, the technologies, operation measures and/or mitigation measures implemented by the power plant and in place at the time the desalination plant begins operations would be evaluated and would be adopted, if feasible.

CHAPTER 5

INTAKE IMPINGEMENT AND ENRTAINMENT MINIMIZATION PLAN

5.1 RECOMMENDED POWER PLANT INTAKE SYSTEM OPERATIONS

Based on the review and evaluation of alternative modes of operation of the power plant intake facilities and the desalination plant discharge impact on the marine environment, the following plan for operation is recommended during periods of temporary shutdown of EPS electricity generation facilities:

1. Limit the operation of existing power plant intake pumps and screens to one of the Operational Conditions shown in Table 5-1. Preference would be given to operational scenarios resulting in lowest intake flow that can be achieved with the pumps available at the time this mode of operation has to be practiced.

2. Whenever possible, reduce the total flow collected trough the existing power plant intake to 184.32 MGD (Operational Condition 5) by running only one of any of the six pumps of power plant generation Unit 1, 2 or 3 and one pump of power plant generation Unit 5 (22.2 % of the maximum power plant intake flow of 794.9 MGD). Acute toxicity testing and hydrodynamic modeling of the desalination plant discharge at this scenario indicates that operation of the desalination plant will be environmentally safe.

3. Operation of the desalination plant under the condition of maximum reduction of impingement and entrainment (Operational Condition 5) could occur only if the RWQCB were to (1) increase the daily average discharge salinity limit in the current desalination plant NPDES permit from 40 ppt to 46 ppt and (2) increase the maximum daily discharge salinity permit limit from 44 ppt to at least 50 ppt. The current average and maximum daily limits of 40 ppt and 44 ppt would allow plant operation only under Operational Conditions 1, 2 and 3.

4. Impingement and entrainment associated with Operational Condition 5 are over 40 % lower than these of any of the Operational Conditions 1, 2 or 3, and therefore, the environmental benefits of this mode of operation are substantial while the environmental impact associated with the elevated salinity of the discharge is minimal.

TABLE 5-1

ALTERNATIVE OPERATIONAL CONDITIONS OF EXISITNG INTAKE FACILITIES FOR REDUCED IMPINGMENT AND ENTRAINMENT DURING POWER PLANT SHUTDOWNS

Condition	Total Intake Flow (MGD)	Power Plant Intake Pumps in Operation	Power Plant Intake Fine Screens in Operation	Daily Average Discharge Salinity Conc. (ppt)	Maximum Daily Discharge Concentration Salinity Conc. (ppt)
1	328.33	One Pump of Any of Units 1, 2 or 3 & One Pump of Unit 4 & One Pump of Unit 5	All Seven Screens In Operation.	39.5	44
2	322.58	One Pump of Any of Units 1, 2 or 3 & Two Pumps of Unit 4	All Four Screens for Units 1,2, 3 & 4 in Operation & Three Screens for Unit 5 Shutdown	39.6	44
3	316.81	Any Combination of Five out of Six Pumps of Units 1, 2 or 3 & One Pump of Unit 4	All Four Screens for Units 1,2, 3 & 4 in Operation & Three Screens for Unit 5 Shutdown.	39.8	44
4	218.88	Two Pumps of Any of Units 1, 2 or 3 & One Pump of Unit 5	All Five Screens for Units 1,2, 3 & 5 in Operation & Two Screens for Unit 4 Shutdown	43.4	50
5	184.33	One Pump of Any of Units 1, 2 or 3 & One Pump of Unit 5	All Five Screens for Units 1,2, 3 & 5 in Operation & Two Screens for Unit 4 Shutdown	46	50

5.2 INTAKE SYSTEM OPERATIONAL PROCEDURES

The Encina Power Station and the Carlsbad seawater desalination plant will be staffed 24 hours per day and 365 days per year. During temporary shutdowns of the Encina Power Station electricity generation facilities, power plant staff on duty will implement the following standard operational procedures:

1. Power plant staff will notify desalination plant staff regarding the time at which the power plant generation facilities is scheduled to be shutdown. This

notification should be forwarded to the desalination plant staff as soon as possible but no later than two (2) hours before the time of the actual shut down of the power plant electricity generation units so the desalination plant staff has adequate time to prepare for the changed mode of power plant operation.

2. Power plant staff on duty will select mode of power plant intake facility operations from the operational scenarios listed in Table 5-1. Mode of operation that should be considered first is the Operational Condition 5 (i.e., intake facility operation at 184.33 MGD). If this operational condition cannot be implemented because any of the equipment (screens, controls, pumps, etc,) needed to run at this mode of operation is down, than the power plant staff shall proceed with the selection of Operational Condition 4, 3, 2 or 1, in this sequence.

3. Power plant staff will notify the desalination plant staff on duty regarding the selected operational condition at least twenty-four (24) hours before the power plant intake facilities are actually switched to this mode, so the desalination plant is prepared to track closely the desalination plant operations and modify it as needed in order to comply with the regulatory requirements associated with the desalination plant operations. Usually the power plant cooling pumps servicing any of the electricity generation units continue to operate for 24 hours to 48 hours after the generation unit is shut down in order to cool the unit down slowly and prevent unit damage from overheating. Therefore, the power plant staff and desalination plant staff will have ample amount of time (24 to 48 hours) to select the most viable operational condition at the time of the power plant shutdown and to prepare and coordinate the power plant intake facilities (pumps, screens and service equipment) and the desalination plant operations for stand-alone operation of the desalination plant staff during the period of temporary power plant shutdown.

4. Power plant staff on duty will modify the power plant intake pumps system operations in accordance with the specific directions for intake pumps and screens required to be in operation under the selected operational condition. Notify the desalination plant staff at the time of the switch to the selected operational condition.

5. During periods of power plant shutdown, the desalination plant staff will track the desalination plant operation more closely and will monitor the salinity/conductivity of the desalination plant discharge at the discharge pond monitoring point designated in the current NPDES permit. Desalination plant staff will adjust facility operations to maintain compliance with the average daily and daily maximum limits of salinity defined in Table 5-1.

6. Power plant staff shall notify the desalination plant operational staff on duty at least two (2) hours before Encina Power Station restart electricity generation which would allow desalination plant operators to adjust facility operations if needed.

Both power plant and desalination plant staff will work in close cooperation in order to assure facility compliance with all applicable regulatory requirements. Because the operation of the desalination plant intake pumps will be interlocked with that of the power plant pumps, a complete shutdown of all power plant intake pumps will trigger an automatic shutdown of the desalination plant intake pumps. This automatic pump operation interlocking provision would prevent a situation where the desalination plant intake pumps may run during times when all of the power plant pumps are shutdown.

CHAPTER 6

POTENTIAL IMPINGEMENT AND ENTRAINMENT MITIGATION MEASURES

The previous sections of this Plan discuss the optimum operations of the Carlsbad seawater desalination plant and the intake of the existing Encina Power Station's intake facilities that allow minimizing the intake flow, impingement and entrainment while maintaining environmentally safe discharge of the desalination plant's concentrate. Under the recommended minimization plan, the power plant cooling water intake facilities would be operated at total flow of 184.32 MGD, which would result in impingement of reduction of 79.7 % and entrainment reduction of 76.8 % as compared to the power plant's impingement and entrainment at maximum intake flow of 794.92 MGD.

In addition to the impingement and entrainment described in the previous sections, in the case of permanent power plant shutdown or switch to alternative cooling system, Poseidon Resources would commit to continue the periodic dredging of the lagoon in order to facilitate desalination plant operations and to maintain the environmental health of the lagoon and to abate beach erosion in the vicinity of the desalination plant discharge.

6.1 MAINTEANCE OF LAGOON ENVIRONMENTAL HALTH AND ABATEMENT OF BEACH ERROSION

Agua Hedionda 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, which would occur naturally, and the Encina Power Station's cooling water withdrawals from the lower lagoon. Without the CDP or EPS need for water, fresh seawater flows into the lagoons would cease, and the entrance to the lagoons would be closed off by the natural long-shore transport of native beach sands. A comprehensive hydrodynamic study of the interaction between the lagoon and the ocean indicates that without the intake of seawater by the power plant cooling pumps, the entrance to the lagoon would be expected to close over time, and to remain closed most of the year (see Attachment 6). This in turn would have a very detrimental effect on the environmental health of the lagoon, on its ecosystem (including on the endangered species currently inhabiting the lagoon) and on its recreational value and beneficial use.

The Lagoon provides a wide range of beneficial uses. Nearly all of these uses are directly or indirectly affected by seawater flow and exchange created by the EPS once-through cooling flows and large circulation pumps. The existing cooling water flows (and/or future needs of the CDP) provide for fresh ocean water that renew the Lagoon's water quality and flush nutrients and other watershed pollution, particularly from the Lagoon's upper reaches. In addition, the inflow of fresh supplies of ocean water induced by the pumping and tides 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 lower Lagoon.

The lost circulation due to tidal flows through the dredged maintained channel and pumping would directly affect the Lagoon's water quality and water related activities, such as fishing, and water contact recreation, such as the very popular water ski, kayaking and swimming activities in the middle and upper lagoons. The name, Agua Hedionda, which means "stinking water" in Spanish, reflects a former condition that would revert due to increasing stagnation resulting from lack of pumping and ocean inflow through its intake channel should EPS cease to function.

To avoid this significant loss of highly productive marine habitat, in the event of extended shutdown of EPS power generation units, Poseidon would 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.

ATTACHMENT 1

TOXICITY TESTING STUDY PLAN

CARLSBAD SEAWATER DESALINATION PLANT
NPDES NO. CA0109223

STUDY PLAN

FOR EVALUATION OF SALINITY-RELATED TOXICITY TRESHOLD FOR SHORT-TERM EXPOSURE TO DESALINATION PLANT DISCHARGE

STUDY PURPOSE

The purpose of this Short-Term Exposure Threshold (STET) Study is to determine the threshold concentration of total dissolved solids (TDS or salinity) of the discharge from the Carlsbad seawater desalination plant below which a short-term exposure (30 minutes to 24 hours) of standard test organisms to this discharge does not cause acute toxicity.

The study is proposed to fulfill Poseidon Resources Corporation's obligations under the requirements of Order No. R9-2006-0065 of August 16, 2006, of the San Diego Regional Water Quality Control Board, Section VI.C.2.c.1: "Salinity-Related Toxicity Threshold for Short-Term Exposure".

BACKGROUND

The Encina Power Generation Station (EPGS) has been selected as the site for the development of the Carlsbad Seawater Desalination Plant. The source water for the 50 MGD seawater reverse osmosis (SWRO) desalination plant will be collected from the existing cooling water discharge canal of the power plant. The power plant withdraws cooling water from the Pacific Ocean via the Agua Hedionda Lagoon. The concentrate and the treated waste filter backwash water from the desalination plant will be discharged into the existing cooling water discharge channel downstream of the point of interconnection for complete mixing with the cooling water discharge from the power plant prior to its ultimate disposal to the ocean.

Under normal operations the salinity concentration of the blended discharge of cooling water and desalination plant concentrate is projected to be less than or equal to 40 parts per thousand (ppt). The operation of the intake pumps of the desalination plant will be interlocked with the power plant intake pumps. As a result a power plant intake pump shutdown will automatically trigger desalination plant intake pump shutdown. After pump shutdown, however, it takes approximately 15 to 60 minutes to empty the desalination plant concentrate line and the power plant discharge canal. The instantaneous salinity concentration of the blended discharge may exceed 40 ppt during this short shut-down interval. To accommodate such short-term events when salinity of the blended concentrate may exceed the average daily TDS limit of 40 ppt during shut-down operations, the desalination plant NPDES permit establishes an average hourly salinity limit of 44 ppt.

Initial toxicity testing performed as part of Poseidon's NPDES application indicated that a short-term salinity of 44 ppt would not result in any harm to aquatic or benthic organisms. The purpose of STET Study is to confirm the validity of the 44 ppt salinity permit threshold and to assess the suitability of changing this threshold based on acute toxicity testing of the blended discharge for a salinity range between 36 and 60 ppt. The standard acute toxicity test was selected to establish the short-term salinity threshold, because this test will characterize effects of the short-term exposure of the blended discharge on aquatic life in the area of the discharge.

STUDY PROTOCOL

The proposed STET Study will consist of series of acute effluent toxicity bioassay tests of diluted desalination plant concentrate of salinity in a range of 36 ppt to 60 ppt and time of exposure of standard test organisms to the diluted concentrate in a range of 1 hour to 96 hours. As noted above, actual desalination shut-down operations may result in effluent salinities of up to 44 ppt for an hour or less. The proposed range of STET test salinities and exposure times thus represent a range of salinities and exposure times significantly in excess of actual discharge conditions.

Test Procedures

As per the requirements of the Carlsbad Seawater Desalination Plant NPDES Permit (Attachment E, Monitoring and Reporting Program, Section V. A.) the acute effluent toxicity bioassay tests will be performed in accordance with the standard test procedures established by the USEPA guidance manual, Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, 5th Edition, October 2002 (EPA-821-R-02-012).

Test Salinities

A 24-hour composite sample of seawater desalination plant concentrate will be collected at the Carlsbad seawater desalination pilot plant and be diluted to nominal test salinities of: 36 ppt, 38 ppt, 40 ppt, 42, ppt, 44 ppt, 46 ppt, 48 ppt, 50 ppt, 52 ppt, 54 ppt, 56 ppt, 58 ppt and 60 ppt. Filtered seawater from the Carlsbad pilot plant will be used to dilute the concentrate to the test salinity levels indicated above. In addition, a control sample of standard seawater salinity will be tested for comparison.

Test Organism

Topsmelt (*Atherinops affinis*) is planned to be used as a test organism. Topsmelt is proposed for this test because it is the only EPA-approved acute effluent toxicity test organism that may be present in the immediate vicinity of the desalination plant discharge. Since topsmelt is the marine organism also used to complete the EPGS acute effluent toxicity bioassay tests, the use of this organism for the STET test will facilitate continuity and comparability of the EPGS and desalination plant discharge toxicity test results.

The bioassay laboratory will be responsible for the supply, delivery and use of the test organisms. Each batch of test organisms will be subjected to salinity concentrations (see above) ranging from 36 ppt to 60 ppt. To simulate receiving water conditions under shut-down operations (in which salinity levels may temporarily gradually increase over a period of 15 to 45 minutes), salinity concentrations will be added to the text tanks over a period of short intervals (less than one hour) until the target salinity is reached.

Survival Count Times

Under the standard acute effluent toxicity bioassay test procedure, test organism survival counts are taken at the beginning of the test (0 hrs) and after 24, 48, 72 and 96 hours of effluent exposure. Additionally, in order to reflect the fact that elevated discharge salinity conditions are not expected to occur for longer than 60 minutes, the additional organism survival counts will be taken at 1 hour, 2 hours, 4 hours, and 12 hours after the initiation of the tests.

The tests will be completed by a certified laboratory specialized in such toxicity tests (Weston Solutions, Inc., Carlsbad office). This laboratory was selected because it is currently used by the EPGS staff to complete the power plant's cooling water effluent toxicity testing.

Source and Collection of Sample of Concentrate and Dilution Seawater

As indicated previously, for the purposes of the toxicity testing, the following samples are needed: (1) desalination plant concentrate; (2) dilution seawater not affected by/mixed with the EPGS cooling water discharge. Representative composite samples of the seawater desalination plant concentrate will be obtained from Poseidon's Carlsbad seawater desalination pilot plant.

The Carlsbad pilot plant is a 25 gpm seawater desalination facility located at the Encina power plant site. The plant consists of the same treatment facilities and uses the same chemicals as these planned to be used at the full-scale Carlsbad desalination plant. Under average conditions, the pilot desalination plant intake pump diverts up to 55 gpm of seawater from the Carlsbad power plant cooling water discharge. The intake seawater is treated using a pretreatment filtration system followed by cartridge filter and reverse osmosis (RO) seawater desalination system. The basic design criteria of the pilot plant are the same as these used for the full-scale facility. The pilot plant uses the same type of cartridge filters, and number and type of reverse osmosis membranes as the full-scale facility. Typically, the pilot project generates 70 to 80 gpm of filtered seawater of ambient ocean salinity (i.e., 32 to 34 ppt), and 35 to 40 gpm of concentrate that has salinity approximately two times higher than ambient salinity (i.e., 64 to 68 ppt).

For the purposes of this test one 24-hour composite sample of desalination plant concentrate and one 24-hour composite sample of filtered effluent will be collected from sampling ports at the pilot plant. The concentrate and filtered water composite samples will consist of minimum of 4 individual grab samples collected over every 8 hours over the same 24-hour period. Alternatively, the two composite samples may be collected using automatic grab samplers connected to the filter effluent and concentrate sampling ports.

TEST IMPLEMENTATION, RESULTS AND STUDY REPORT

The proposed STET Study will be implemented within six weeks from the approval of this Study Plan. The bioassay test results will be summarized in a report, which will be submitted for review to the San Diego RWQCB staff. This report will also contain an interpretation of the test results and recommendations regarding the average hourly salinity limitation included in the current permit.

ATTACHMENT 2

ACUTE TOXICITY TESTING STUDY

RESULTS

WESTON SOLUTIONS, INC.
2433 Impala Drive
Carlsbad, CA 92008
(760) 931-8081 / (760) 931-1580 FAX
www.westonsolutions.com

January 17, 2007

Poseidon Resources Corporation
1055 Washington Boulevard,
Stamford, CT 06901
Attn: Nikolay Voutchkov

RE: Toxicity Testing Results - Test Substance RO Concentrate Comp

Dear Mr. Voutchkov:

Attached please find the report for the Topsmelt acute test performed on test substance RO-Concentrate Comp, received on January 4, 2007.

All testing was performed consistent with our laboratory's quality assurance program. All results are to be considered in their entirety, and Weston Solutions is not responsible for use of less than the complete report. Results apply only to the sample tested.

If you have any questions regarding the attached report, or require additional testing, please call me at (760) 931-8081 or email at Chris.Osuch@westonsolutions.com. Thank you for using the aquatic testing services of Weston Solutions, Inc.

Sincerely,

Chris Osuch

Chris Osuch
Carlsbad Bioassay Laboratory

Weston Solutions, Inc.

Analytical Report

Client	Poseidon	Date Received:	04 Jan 07
Project:	Desal Pilot Topsmelt Toxicity Study	Date Test Started:	05 Jan 07
Client Sample ID:	RO Concentrate Comp	Date Test Ended:	09 Jan 07
Weston Test ID:	C070105.0262	Matrix:	Liquid

96 Hour Acute Effluent Toxicity Bioassay
Weston Testing Protocol No. BIO 062C
EPA-821-R-02-012

Test Organism: ***Atherinops affinis***
Age: 15 days old

Study Design: Sample RO Concentrate Comp was diluted with filtered seawater from the desalination plant (UF Filtrate) to 13 different test salinities. A UF Filtrate Control was also tested to confirm that the dilution water did not cause toxicity. Final salinities of 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58 and 60 ppt were tested following EPA-821-R-02-012. To simulate what would occur if the power plant shuts down, the fish were acclimated to final salinities over the first 24 hours of the test. The fish were initially exposed to half of the salinity increase to start the test. The salinity was adjusted during the water renewal at 24 hours to final concentrations. In addition to the normal survival counts, additional counts were performed at 30 minutes, 1 hour, 2 hours, 4 hours and 12 hours. Standard test procedures were followed.

Concentration (ppt)	Number of Test Organisms at Start of Test	Number of Test Organisms at End of Test	Percent Survival	TUa
Control	40	40	100	N/A
UF Filtrate Control	40	40	100	N/A
36	40	38	95	0.41
38	40	36	90	0.59
40	40	38	95	0.41
42	40	39	97.5	0.23
44	40	34	85	0.69
46	40	35	87.5	0.65
48	40	32	80	0.77
50	40	22	55	0.97
52	40	25	62.5	0.93
54	40	18	45	1.02
56	40	22	55	0.97
58	40	26	65	0.91
60	40	15	37.5	1.06

Amy Mengel — QA Officer — 1/16/07 — Date

Chris Osuch — Approved — 1/17/07 — Date

Weston Solutions, Inc.

Analytical Report

Client	Poseidon	Date Received:	04 Jan 07
Project:	Desal Pilot Topsmelt Toxicity Study	Date Test Started:	05 Jan 07
Client Sample ID:	RO Concentrate Comp	Date Test Ended:	09 Jan 07
Weston Test ID:	C070105.0262	Matrix:	Liquid

96 Hour Acute Effluent Toxicity Bioassay
Weston Testing Protocol No. BIO 062C
EPA-821-R-02-012

Test Organism: *Atherinops affinis*

Acute Toxicity Statement for Sample RO Concentrate Comp

Distribution Method	Result	Variance Method	Result
Kolmogorov D Test	Non-normal; $p \leq 0.01$	N/A	could not be confirmed

Hypothesis Method	NOEC	LOEC	Point Estimation Method	LC_{50}
Wilcoxon Rank Sum Test	42 ppt	44 ppt	Linear Interpolation	58.57 ppt

Acute Toxicity Statement: Test substance RO Concentrate Comp produced 37.5 percent survival in the 60 ppt concentration at 96 hours. The LC50 at 96 hours was estimated to be 58.57 ppt.

Control and UF Filtrate Control means were not significantly different (p = 1.00).

Weston Solutions, Inc.

Analytical Report

Client	Poseidon	Date Received:	04 Jan 07
Project:	Desal Pilot Topsmelt Toxicity Study	Date Test Started:	05 Jan 07
Client Sample ID:	RO Concentrate Comp	Date Test Ended:	09 Jan 07
Weston Test ID:	C070105.0262	Matrix:	Liquid

96 Hour Acute Effluent Toxicity Bioassay
Weston Testing Protocol No. BIO 062C
EPA-821-R-02-012

Test Organism: *Atherinops affinis*

Additional statistics were performed on each concentration to determine the No Observed Effect Time (NOET), the Lowest Observed Effect Time (LOET), and the Lethal Time for 50% of the population (LT_{50}). The results are presented in the table below.

Concentration (ppt)	NOET (Hours)	LOET (Hours)	LT_{50} (Hours)
36	96	>96	>96
38	96	>96	>96
40	96	>96	>96
42	96	>96	>96
44	4	12	>96
46	96	>96	>96
48	96	>96	>96
50	4	12	>96
52	96	>96	>96
54	1	2	11
56	96	>96	>96
58	4	12	>96
60	2	4	8.67

Weston Solutions, Inc.

Analytical Report

Client	Poseidon	Date Received:	04 Jan 07
Project:	Desal Pilot Topsmelt Toxicity Study	Date Test Started:	05 Jan 07
Client Sample ID:	RO Concentrate Comp	Date Test Ended:	09 Jan 07
Weston Test ID:	C070105.0262	Matrix:	Liquid

96 Hour Acute Effluent Toxicity Bioassay
Weston Testing Protocol No.: BIO 062C
EPA-821-R-02-012

Test Organism: ***Atherinops affinis***

Test Solution Physical and Chemical Data

Total Chlorine (mg/L)			
Concentration (ppt)	Initial	Renewal	Final
Control	0.00	*	*
60	0.00	*	*

*Chlorine not detected in initial measurement of sample

Concentration (ppt)	Statistic	D.O. (mg/L)	Temp.(°C)	Salinity (ppt)	pH
Control	Mean	6.6	21.1	33.5	8.0
	Minimum	5.6	20.4	33.1	7.8
	Maximum	7.4	21.7	33.7	8.1
UF Filtrate	Mean	7.2	20.8	33.3	7.9
	Minimum	5.6	20.0	32.9	7.8
	Maximum	8.8	21.7	33.7	8.0
36	Mean	6.4	20.7	36.1	7.9
	Minimum	5.6	19.8	34.3	7.8
	Maximum	8.8	21.3	37.5	8.0
38	Mean	7.0	20.8	37.9	7.9
	Minimum	5.4	20.0	35.3	7.8
	Maximum	8.7	21.6	40.2	8.0
40	Mean	7.0	20.7	39.8	7.9
	Minimum	5.4	19.9	36.3	7.8
	Maximum	8.9	21.6	43.4	8.0
42	Mean	7.0	20.6	41.6	7.9
	Minimum	5.3	19.7	37.3	7.8
	Maximum	8.8	21.6	46.2	8.0
44	Mean	7.0	20.7	43.4	7.9
	Minimum	5.4	19.8	38.2	7.8
	Maximum	8.8	21.7	49.1	8.0

Weston Solutions, Inc.

Analytical Report

Client	Poseidon	Date Received:	04 Jan 07
Project:	Desal Pilot Topsmelt Toxicity Study	Date Test Started:	05 Jan 07
Client Sample ID:	RO Concentrate Comp	Date Test Ended:	09 Jan 07
Weston Test ID:	C070105.0262	Matrix:	Liquid

96 Hour Acute Effluent Toxicity Bioassay
Weston Testing Protocol No.: BIO 062C
EPA-821-R-02-012

Test Organism: ***Atherinops affinis***

Test Solution Physical and Chemical Data

Concentration (ppt)	Statistic	D.O. (mg/L)	Temp.(°C)	Salinity (ppt)	pH
46	Mean	7.0	20.7	45.2	7.9
	Minimum	5.3	19.7	39.2	7.8
	Maximum	8.8	21.7	52.1	8.0
48	Mean	6.9	20.7	47.2	7.9
	Minimum	5.1	20.1	40.5	7.8
	Maximum	8.8	21.3	55.0	8.0
50	Mean	6.9	20.7	48.9	7.9
	Minimum	5.4	19.9	41.2	7.8
	Maximum	8.8	21.6	57.9	8.0
52	Mean	7.0	20.8	50.8	7.9
	Minimum	5.4	20.1	41.9	7.8
	Maximum	8.8	21.8	61.0	8.0
54	Mean	7.1	20.8	52.7	7.9
	Minimum	5.5	20.2	43.1	7.8
	Maximum	8.8	21.8	63.9	8.0
56	Mean	7.0	20.9	54.4	7.9
	Minimum	5.2	20.3	44.1	7.8
	Maximum	8.7	21.8	65.9	8.0
58	Mean	7.0	21.0	55.7	7.9
	Minimum	5.6	20.3	44.9	7.8
	Maximum	8.6	21.8	65.8	8.0
60	Mean	7.1	20.9	57.2	7.9
	Minimum	5.6	20.0	45.7	7.8
	Maximum	8.7	21.7	65.8	8.0

Protocol Deviations: The test was initially started on December 19, 2006, but did not meet control survival acceptability criteria. The test was re-run on January 5, 2007 and the results are presented in this report.

Weston Solutions, Inc.

Analytical Report

Client:	Poseidon	Date Received:	04 Jan 07
Project:	Desal Pilot Topsmelt Toxicity Study	Date Test Started:	05 Jan 07
Client Sample ID:	RO Concentrate Comp	Date Test Ended:	09 Jan 07
Weston Test ID:	C070105.0262	Matrix:	Liquid

TEST: 96 Hour Acute Effluent Toxicity Bioassay, Weston Protocol No. BIO 062C, EPA-821-R-02-012

LAB CONTROL WATER: Filtered Seawater from Desalination Plant.

Dissolved Oxygen	7.4 mg/L
Temperature	21.7 °C
pH	8.1

TEST ORGANISM: Topsmelt, *Atherinops affinis* Age: 15 days old
Supplier: Aquatic BioSystems
Feeding: Fed *Artemia* nauplii *ad libitum* daily prior to testing.

TEST CHAMBER: Half liter containers, 4 replicate samples, 13 test salinities, and 4 replicate controls, brought to a 250mL final volume.

EXPERIMENTAL DESIGN:

1. Poseidon Resources personnel collected two 12 hour composite samples of both RO Concentrate and UF Filtrate ending at 1600 hours on January 3 and 0800 hours on January 4, 2007, respectively. Each sample was delivered to Weston in two 20L containers at 1020 hours on January 4. Temperatures upon arrival were 14.1 and 16.4° C for RO Concentrate, and 14.9 and 15.3°C for UF Filtrate, respectively. To create a 24 hour composite sample, the two 12 hour composites of each sample were composited at the Weston laboratory at 1040 hours on January 5, 2007. The composite samples were named RO Concentrate Comp and UF Filtrate Comp.
2. The temperature of the effluent was adjusted to 21± 1°C.
3. 10 test organisms were placed in each test container.
4. Test chambers were held at 21± 1°C for 96 hours with a photoperiod of 16 hours light: 8 hours darkness.
5. Test chambers were renewed daily.
6. Each test chamber was fed 1000 freshly hatched *Artemia* nauplii daily for the duration of the test.

MORTALITY CRITERIA: Lack of respiratory movement and lack of reaction to gentle prodding

ACCEPTIBILITY CRITERIA:

$\geq$ 90% survival in controls. Evaluation of the concentration-response relationship indicated that the data presented in this report are reliable.

REFERENCE TOXICITY: (Control Chart Included)

Toxicant: $CuSO_4$, Lot No.: 1605565, Received: 5/25/06, Opened: 6/6/06, Expires: 5/25/08.

96 Hour LC_{50}:	105.62 ppb	
Laboratory Mean:	159.08 ppb	
Test Date:	1/5/2007	Within 95 % Confidence Limits

STUDY DIRECTOR: K. Skrivseth

INVESTIGATORS: K. Skrivseth, E. Batliner, D. Weiss, A. Margolis, D. Sowersby, A. Lovell, J. Hansen

WESTON SOLUTIONS

Topsmelt 96-Hour Acute Toxicity Test

Client	Poseidon
Project:	Desal Pilot Topsmelt Toxicity Study
Client Sample ID:	RO Concentrate Comp
Weston Test ID:	C070105.0262
Species	*Atherinops affinis*

Date Received:	1/4/07
Date Test Started:	1/5/07
Date Test Ended:	1/9/07
Study Director:	K. Skrivseth
Organisms/Chamber:	10

	Conc.	Meter #	D.O. (mg/L)	Meter #	Temp (°C)	Meter #	Salinity (ppt)	Meter #	pH	Total Chlorine (mg/L)
Day 0 (0 Hours) Date: 1/5/06 Sample ID: C070105.01 C070105.02 Dilutions (Tech): KS WQ Time: 1415 Rep: stock Technician: EB	Control	7	7.4	7	21.7	6	33.1	11	8.1	0.00
	UFØ		8.0		21.7		32.9		8.0	
	36		8.1		21.3		34.3		8.0	
	38		7.7		21.6		35.3		8.0	
	40		7.7		21.6		36.3		8.0	
	42		7.7		21.6		37.3		8.0	
	44		7.8		21.7		38.2		8.0	~~0.00~~ ① ks
24 Hours (OLD) Date: 1/6/07 WQ Time: 1355 Rep: 1 Technician: KS	Control	7	5.7	7	20.9	6	33.7	10	7.9	
	UFØ		5.8		21.1		33.6		7.8	
	36		5.8		21.2		35.0		7.8	
	38		5.4		20.8		36.4		7.8	
	40		5.4		20.6		37.1		7.8	
	42		5.3		20.5		37.9		7.8	
	44		5.7		20.8		38.4		7.8	
24 Hours (Renewal Water) Date: 1/6/07 Sample ID: C070105.01 C070105.02 Dilutions (Tech): KS WQ Time: 1435 Rep: stock Technician: KS	Control	7	7.2	7	21.6	6	33.1	10	8.1	
	UFØ		8.2		21.3		32.9		8.0	
	36		8.4		21.0		37.5		8.0	
	38		8.3		21.1		40.2		7.9	
	40		8.3		21.2		43.4		7.9	
	42		8.1		21.3		46.2		7.9	
	44		8.1		21.3		49.1		7.9	
48 Hours (OLD) Date: 1/7/07 WQ Time: 1420 Rep: 2 Technician: KS	Control	6	5.6	6	21.0	5	33.7	10	7.9	
	UFØ		5.6		20.5		33.7		7.9	
	36		5.6		20.4		36.5		7.9	
	38		5.8		20.4		38.6		7.9	
	40		5.5		20.5		40.2		7.9	
	42		6.0		20.3		42.5		7.9	
	44		5.4		20.6		44.4		7.9	
48 Hours (Renewal Water) Date: 1/7/07 Sample ID: C070105.01 C070105.02 Dilutions (Tech): KS WQ Time: 1445 Rep: stock Technician: KS	Control	6	7.3	6	20.9	5	33.5	10	8.1	② ks
	UFØ		8.8		20.0		33.2		8.0	
	36		8.8		19.8		36.5		8.0	
	38		8.7		20.0		38.0		8.0	
	40		8.9		19.9		40.0		8.0	
	42		8.8		19.7		42.5		8.0	
	44		8.8		19.8		43.9		8.0	—
72 Hours (OLD) Date: 1/8/07 WQ Time: 1106 Rep: 3 Technician: KS	Control	6	6.1	6	20.7	5	33.6	10	7.9	
	UFØ		6.2		20.6		33.4		7.9	
	36		6.2		20.5		36.1		7.9	
	38		6.1		20.4		38.3		7.9	
	40		5.9		20.6		40.2		7.9	
	42		6.0		20.5		42.2		7.9	
	44		6.0		20.4		44.2		7.9	
72 Hours (Renewal Water) Date: 1/8/07 Sample ID: C070105.01 C070105.02 Dilutions (Tech): KS WQ Time: 1140 Rep: stock Technician: KS	Control	6	7.3	6	21.2	5	33.6	10	8.1	
	UFØ		8.7		21.2		33.2		8.0	
	36		8.7		21.2		36.2		8.0	
	38		8.6		21.2		38.0		7.9	
	40		8.7		21.0		40.9		7.9	
	42		8.6		21.0		42.1		7.9	
	44		8.7		20.8		44.4		7.9	
96 Hours Date: 1/9/07 WQ Time: 1020 Rep: 4 Technician: AMM	Control	6	6.0	6	20.4	5	33.7	10	7.8	③ ks
	UFØ		6.0		20.3		33.4		7.8	
	36		6.0		20.4		36.5		7.8	
	38		5.7		20.6		38.4		7.8	
	40		5.5		20.2		40.1		7.8	
	42		5.6		20.1		42.3		7.8	
	44		5.6		20.3		44.4		7.8	—

① WC 1/6/07 KS

② WC 1/9/07 ks

③ No chlorine detected at test initiation. 1/9/07 ks

Client	Poseidon
Project:	Desal Pilot Topsmelt Toxicity Study
Client Sample ID:	RO Concentrate Comp
Weston Test ID:	C070105.0262
Species	*Atherinops affinis*

Date Received:	1/4/07
Date Test Started:	1/5/07
Date Test Ended:	1/9/07
Study Director:	K.Skrivseth
Organisms/Chamber:	10

	Conc.	Meter #	D.O. (mg/L)	Meter #	Temp (°C)	Meter #	Salinity (ppt)	Meter #	pH	Total Chlorine (mg/L)
Day 0 (0 Hours) Date: 1/5/07	46	7	7.7	7	21.7	6	39.2	11	8.0	~~0.02~~ ②
Sample ID: C070105.01 C070105.02	48		7.5		21.8		40.5		8.0	
Dilutions (Tech): KS	50		7.4		21.6		41.2		8.0	
WQ Time: 1415 Rep: Stock	52		7.5		21.8		42.1		8.0	
Technician: [illegible]	54		7.5		21.8		43.1		8.0	
	56		7.5		21.8		44.1		8.0	
	58		7.4		21.8		45.1		8.0	—
24 Hours (OLD) Date: 1/6/07	46	7	5.3	7	20.7	6	39.5	10	7.8	
WQ Time: 1355 Rep: 1	48		5.1		20.7		41.2		7.8	
Technician: KS	50		5.6		20.6		41.3		7.8	
	52		5.4		20.7		41.9		7.8	
	54		5.5		20.6		43.2		7.9	
	56		5.2		20.3		44.2		7.9	
	58		5.6		20.8		44.9		7.9	
24 Hours (Renewal Water) Date: 1/6/07	46	7	8.2	7	21.3	6	52.1	10	7.9	
Sample ID: C070105.01 C070105.02	48		8.2		21.3		55.0		7.9	
Dilutions (Tech): KS	50		8.2		21.2		57.9		7.9	
WQ Time: 1435 Rep: Stock	52		8.2		21.3		61.0		7.8	
Technician: KS	54		8.0		21.4		63.9		7.8	
	56		8.1		21.5		65.9		7.8	
	58		8.1		21.6		65.8		7.8	
48 Hours (OLD) Date: 1/7/07	46	6	5.5	6	21.3	5	46.0	10	7.8	
WQ Time: 1420 Rep: 2	48		5.3		20.7		48.2		7.9	
Technician: KS	50		5.7		20.8		50.1		7.9	
	52		5.6		20.6		52.6		7.9	
	54		5.8		20.2		54.3		8.0	
	56		5.4		20.8		56.2		8.0	
	58		5.6		20.8		57.5		8.0	
48 Hours (Renewal Water) Date: 1/7/07	46	6	8.8	6	19.7	5	46.0	10	8.0	—
Sample ID: C070105.01 C070105.02	48		8.8		20.1		48.0		8.0	
Dilutions (Tech): KS	50		8.8		19.9		50.0		8.0	
WQ Time: 1445 Rep: Stock	52		8.8		20.4		51.9		8.0	
Technician: KS	54		8.8		20.5		53.9		7.9	
	56		8.7		20.5		56.0		8.0	
	58		8.6		20.6		57.9		7.9	—
72 Hours (OLD) Date: 1/8/07	46	6	6.0	6	20.4	5	46.3	10	7.9	
WQ Time: 1106 Rep: 3	48		6.2		20.4		48.2		7.9	
Technician: KS	50		6.0		20.6		50.2		7.9	
	52		6.3		20.7		52.3		8.0	
	54		6.2		20.4		54.2		8.0	
	56		6.4		20.4		56.1		8.0	
	58		6.3		20.6		①KS ~~60.~~ 58.3		8.0	
72 Hours (Renewal Water) Date: 1/8/07	46	6	8.6	6	20.9	5	46.4	10	7.9	
Sample ID: C070105.01 C070105.02	48		8.5		21.0		47.9		7.9	
Dilutions (Tech): KS	50		8.3		21.0		50.2		7.9	
WQ Time: 1140 Rep: Stock	52		8.5		21.0		51.9		7.9	
Technician: KS	54		8.6		21.1		53.9		7.9	
	56		8.5		21.2		55.9		7.9	
	58		8.5		21.2		57.9		7.8	
96 Hours Date: 1/9/07	46	6	5.5	6	20.8	5	46.4	10	7.8	—
WQ Time: 1020 Rep: 4	48		5.2		20.4		48.2		7.8	
Technician: MM	50		5.4		20.2		50.3		7.8	
	52		6.0		20.1		52.3		7.9	
	54		6.1		20.5		54.7		7.9	
	56		5.9		20.6		56.4		7.9	
	58		5.8		20.3		58.0		7.9	—

① WC 1/8/07 [illegible]
② WC 1/9/07 [illegible]

WESTON SOLUTIONS

Topsmelt 96-Hour Acute Toxicity Test

BIO062

Client	Posidon
Project:	Desal Pilot Topsmelt Toxicity Study
Client Sample ID:	RO Concentrate Comp
Weston Test ID:	C070105.0262
Species	Atherinops affinis

Date Received:	1/4/07 ①a/b
Date Test Started:	1/5/07
Date Test Ended:	1/9/07
Study Director:	K. Stringfellow
Organisms/Chamber:	10

	Conc.	Meter #	D.O. (mg/L)	Meter #	Temp (°C)	Meter #	Salinity (ppt)	Meter #	pH	Total Chlorine (mg/L)
Day 0 (0 Hours) Date: 1/5/07 ②a/b Sample ID: ~~C0705~~ C070105.01 C070105.02 Dilutions (Tech): KS WQ Time: 1415 Rep: Stock Technician: EB	60	7	7.5	7	21.7	6	46.1	11	8.0	0.00
24 Hours (OLD) Date: 1/6/07 WQ Time: 1355 Rep: 1 Technician: KS	60	7	5.6	7	21.2	6	45.7	10	8.0	
24 Hours (Renewal Water) Date: 1/6/07 Sample ID: C070105.01 C070105.02 Dilutions (Tech): KS WQ Time: 1435 Rep: Stock Technician: KS	60	7	8.1	7	21.5	6	65.8	10	7.9	
48 Hours (OLD) Date: 1/7/07 WQ Time: 1420 Rep: 2 Technician: KS	60	6	5.9	6	20.6	5	59.9	10	8.0	
48 Hours (Renewal Water) Date: 1/7/07 Sample ID: C070105.01 C070105.02 Dilutions (Tech): KS WQ Time: 1445 Rep: Stock Technician: KS	60	6	8.7	6	20.6	5	60.0	10	7.9	③a
72 Hours (OLD) Date: 1/8/07 WQ Time: 1106 Rep: 3 Technician: KS	60	6	6.5	6	20.6	5	60.3	10	8.0	
72 Hours (Renewal Water) Date: 1/8/07 Sample ID: C070105.01 C070105.02 Dilutions (Tech): KS WQ Time: 1140 Rep: Stock Technician: KS	60	6	8.4	6	21.2	5	59.9	10	7.8	
96 Hours Date: 1/9/07 WQ Time: 1020 Rep: 4 Technician: AWM	60	6	5.7	6	20.0	5	60.2	10	7.9	③a

① WD 1/5/07 EB
② IE 1/5/07 EB
③ No chlorine detected at test initiation. 1/9/07 a

WESTON SOLUTIONS

Topsmelt 96-Hour Acute Toxicity Test

Weston Test ID:	Client:	Client Sample ID:
C070105.0262	Poseidon	RO Concentrate Comp

Survival Data

Conc.	Rep	30 min.		1 Hour		2 Hours		4 Hours		12 Hours		24 Hours		48 Hours		72 Hours		96 Hours	
		Date: 1.5.07		Date: 1.5.07		Date: 1.5.07		Date: 1.5.07		Date: 1.6.07		Date: 1/6/07		Date: 1/7/07		Date: 1/8/07		Date: 1/9/07	
		Time: 1838		Time: 1910		Time: 2010		Time: 2205		Time: 0608		Renewal Time: 1629		Renewal Time: 1528		Renewal Time: 1400		End Time: 1610	
		Technician: BA		Technician: BA		Technician: BA		Technician: BA		Technician: DW		Technician: VS		Technician: VS		Technician: BA		Technician: CMM	
		# Alive	#Dead	# Alive	#Dead	# Alive	#Dead	# Alive	#Dead	# Alive	#Dead	# Alive	#Dead	# Alive	#Dead	# Alive	#Dead	# Alive	#Dead
Control	1	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø
	2	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø
	3	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø
	4	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø
UF Ø	1	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø
	2	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø
	3	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø
	4	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø
36	1	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø
	2	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø
	3	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	9	1	9	Ø	9	Ø
	4	10	Ø	10	Ø	10	Ø	10	Ø	9	1	9	Ø	9	Ø	9	Ø	9	Ø
38	1	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø
	2	10	Ø	10	Ø	10	Ø	9	1	9	Ø	8	1	8	Ø	8	Ø	8	Ø
	3	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø
	4	10	Ø	10	Ø	9	1	9	Ø	8	1	8	Ø	8	Ø	8	Ø	8	Ø
40	1	10	Ø	10	Ø	9	1	9	Ø	9	Ø	9	Ø	9	Ø	9	Ø	9	Ø
	2	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø
	3	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø
	4	10	Ø	10	Ø	10	Ø	10	Ø	9	1	9	Ø	9	Ø	9	Ø	9	Ø

Feeding Information	Day 0	24 Hours	48 Hours	72 Hours
Feed Time*:	1810	1300	1245	1055
Technician:	BA	VS	VS	VS

*Topsmelt should be fed at test initiation and approximately 2 hours before renewal at 24, 48, and 72 hours.

Start Time:	1805 BA, DW
End Time:	1610 CMM
Supplier:	ABS
Organism Batch: ABS 3444	Age: 15 days

Dilution Water Batch:	C070105.01
Hobo Temp. No.:	543494
Test Location:	Rm 3
Test Acceptability:	X ≥ 90% Survival in Control

Weston Test ID:	Client:	Client Sample ID:
C070105.0262	Poseidon	RO Concentrate Comp

Survival Data

Conc.	Rep	30 min.		1 Hour		2 Hours		4 Hours		12 Hours		24 Hours		48 Hours		72 Hours		96 Hours	
		Date: 1.5.07		Date: 1.5.07		Date: 1.5.07		Date: 1.5.07		Date: 1.6.07		Date: 1/6/07		Date: 1/7/07		Date: 1/8/07		Date: 1/9/07	
		Time: 1838		Time: 1910		Time: 2010		Time: 2205		Time: 0608		Renewal Time: 1629		Renewal Time: 1528		Renewal Time: 1400		End Time: 1610	
		Technician: EA		Technician: EA		Technician: EA		Technician: EA		Technician: DW		Technician: VS		Technician: VS		Technician: EA		Technician: UM	
		# Alive	#Dead	# Alive	#Dead	# Alive	#Dead	# Alive	#Dead	# Alive	#Dead	# Alive	#Dead	# Alive	#Dead	# Alive	#Dead	# Alive	#Dead
42	1	10	0	10	0	10	0	10	0	10	0	10	0	10	0	10	0	10	0
	2	10	0	10	0	10	0	10	0	10	0	10	0	10	0	10	0	10	0
	3	10	0	10	0	10	0	10	0	10	0	10	0	10	0	10	0	10	0
	4	10	0	10	0	9	1	9	0	9	0	9	0	9	0	9	0	9	0
44	1	10	0	10	0	10	0	10	0	9	1 NB	9	0	9	0	9	0	9	0
	2	10	0	10	0	10	0	9	1	7	2	7	0	7	0	7	0	7	0
	3	10	0	10	0	10	0	9	1	9	0	9	0	9	0	9	0	9	0
	4	10	0	10	0	10	0	10	0	9	1	9	0	9	0	9	0	9	0
46	1	9	1	9	0	9	0	7	2	7	0	7	0	7	0	7	0	7	0
	2	10	0	10	0	10	0	10	0	9	1	9	0	9	0	9	0	9	0
	3	10	0	10	0	9	1	9	0	9	0	9	0	9	0	9	0	9	0
	4	10	0	10	0	10	0	10	0	10	0	10	0	10	0	10	0	10	0
48	1	10	0	10	0	8	2	8	0	7	1	7	0	7	0	6	1	6	0
	2	10	0	10	0	10	0	9	1	9	0	9	0	9	0	9	0	9	0
	3	10	0	10	0	10	0	10	0	7	3	7	0	7	0	7	0	7	0
	4	10	0	10	0	10	0	10	0	10	0	10	0	10	0	10	0	10	0
56	1	10	0	10	0	9	1	6	3	3	3	3	0	2	1	2	0	2	0
	2	10	0	10	0	10	0	9	1	9	0	9	0	9	0	9	0	9	0
	3	10	0	10	0	10	0	9	1	6	3	5	1	5	0	5	0	5	0
	4	10	0	10	0	8	2	8	0	7	1	7	0	6	1	6	0	6	0

Feeding Information	Day 0	24 Hours	48 Hours	72 Hours
Feed Time*:	1810	1300	1245	1055
Technician:	EA	VS	VS	VS

*Topsmelt should be fed at test initiation and approximately 2 hours before renewal at 24, 48, and 72 hours.

① IE. 1.5.07 EA
② WC. 1.8.07 EA

Start Time:	1805 EA, DW.		
End Time:	1610		
Supplier:	ABS		
Organism Batch:	ABS 3444	Age:	15 days

Dilution Water Batch:	C070105.01
Hobo Temp. No.:	543494
Test Location:	Rm 3
Test Acceptability:	X ≥ 90% Survival in Control

Topsmelt 96-Hour Acute Toxicity Test

Weston Test ID:	Client:	Client Sample ID:
C070105.0262	Posidon	RO Concentrate Comp

Survival Data

Conc.	Rep	30 min.		1 Hour		2 Hours		4 Hours		12 Hours		24 Hours		48 Hours		72 Hours		96 Hours	
		Date: 1-5-07		Date: 1-5-07		Date: 1-5-07		Date: 1-5-07		Date: 01-06-07		Date: 1/6/07		Date: 1/7/07		Date: 1/8/07		Date: 1/9/07	
		Time: 1838		Time: 1910		Time: 2010		Time: 2205		Time: 0608		Renewal Time: 1629		Renewal Time: 1528		Renewal Time: 1400		End Time: 1610	
		Technician: DA		Technician: DA		Technician: DA		Technician: DA		Technician: DW		Technician: KS		Technician: KS		Technician: DA		Technician: [illegible]	
		# Alive	#Dead	# Alive	#Dead	# Alive	#Dead	# Alive	#Dead	# Alive	#Dead	# Alive	#Dead	# Alive	#Dead	# Alive	#Dead	# Alive	#Dead
52	1	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	9	1	9	Ø	9	Ø	9	Ø
	2	10	Ø	10	Ø	10	Ø	8	2	8	Ø	8	Ø	8	Ø	8	Ø	8	Ø
	3	10	Ø	7	3	6	1	5	1	4	1	4	Ø	4	Ø	4	Ø	4	Ø
	4	10	Ø	10	Ø	8	2	6	2	5	1	4	1	4	Ø	4	Ø	4	Ø
54	1	10	Ø	8	2	7	1	7	Ø	6	1	6	Ø	6	Ø	5	1	5	Ø
	2	10	Ø	9	1	8	1	8	Ø	5	3	5	Ø	5	Ø	5	Ø	5	Ø
	3	9	1	7	2	5	2	5	Ø	4	1	4	Ø	4	Ø	4	Ø	4	Ø
	4	10	Ø	10	Ø	9	1	7	2	4	3	4	Ø	4	Ø	4	Ø	4	Ø
56	1	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø	10	Ø
	2	10	Ø	10	Ø	9	1	7	2	7	Ø	7	Ø	7	Ø	7	Ø	7	Ø
	3	9	1	7	2	6	1	2	4	2	Ø	2	Ø	2	Ø	2	Ø	2	Ø
	4	10	Ø	10	Ø	10	Ø	7	3	4	3	3	1	3	Ø	3	Ø	3	Ø
58	1	10	Ø	10	Ø	9	1	9	Ø	8	1	8	Ø	8	Ø	8	Ø	8	Ø
	2	10	Ø	10	Ø	9	1	8	1	8	Ø	8	Ø	8	Ø	8	Ø	8	Ø
	3	8	2	5	3	5	Ø	5	Ø	5	Ø	5	Ø	5	Ø	5	Ø	5	Ø
	4	10	Ø	10	Ø	10	Ø	7	3	5	2	5	Ø	5	Ø	5	Ø	5	Ø
60	1	10	Ø	10	Ø	9	1	5	4	3	2	3	Ø	3	Ø	3	Ø	3	Ø
	2	10	Ø	10	Ø	9	1	8	1	3	5	3	Ø	3	Ø	3	Ø	3	Ø
	3	10	Ø	10	Ø	8	2	7	1	4	3	4	Ø	4	Ø	4	Ø	4	Ø
	4	10	Ø	10	Ø	10	Ø	7	3	5	2	5	Ø	5	Ø	5	Ø	5	Ø

Feeding Information	Day 0	24 Hours	48 Hours	72 Hours
Feed Time*:	1810	1300	1245	1055
Technician:	DA	KS	KS	KS

*Topsmelt should be fed at test initiation and approximately 2 hours before renewal at 24, 48, and 72 hours.

Start Time:	1805 DA, DW		
End Time:	1610		
Supplier:	ABS		
Organism Batch:	ABS 3444	Age:	15 days

Dilution Water Batch:	C070105.01
Hobo Temp. No.:	543494
Test Location:	Rm3
Test Acceptablility:	X ≥ 90% Survival in Control

Acute Fish Test-96 Hr Survival

Start Date:	1/5/2007 18:05	Test ID:	C070105.0262	Sample ID:	RO Concentrate Comp
End Date:	1/9/2007 16:10	Lab ID:	CCA-Weston, Carlsbad	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:	1/4/2007 08:00	Protocol:	EPAA 02-EPA Acute	Test Species:	AA-Atherinops affinis

Comments: Sample time is last sample taken of 24 hour composite, not the time the composite was created in the lab.

Conc-ppt	1	2	3	4
Control	1.0000	1.0000	1.0000	1.0000
UF Filtrate Control	1.0000	1.0000	1.0000	1.0000
36	1.0000	1.0000	0.9000	0.9000
38	1.0000	0.8000	1.0000	0.8000
40	0.9000	1.0000	1.0000	0.9000
42	1.0000	1.0000	1.0000	0.9000
44	0.9000	0.7000	0.9000	0.9000
46	0.7000	0.9000	0.9000	1.0000
48	0.6000	0.9000	0.7000	1.0000
50	0.2000	0.9000	0.5000	0.6000
52	0.9000	0.8000	0.4000	0.4000
54	0.5000	0.5000	0.4000	0.4000
56	1.0000	0.7000	0.2000	0.3000
58	0.8000	0.8000	0.5000	0.5000
60	0.3000	0.3000	0.4000	0.5000

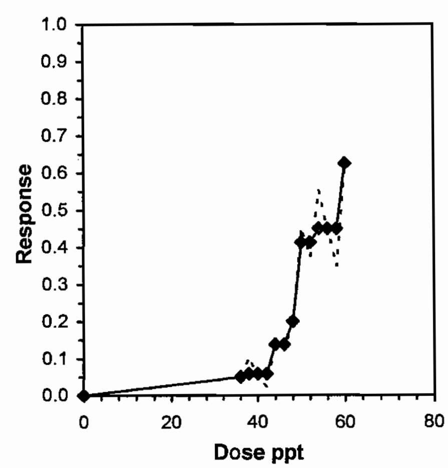
TUa			Transform: Untransformed					Rank	1-Tailed	Isotonic	
	Conc-ppt	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical	Mean	N-Mean
	Control	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4			1.0000	1.0000
	UF Filtrate Control	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4				
0.41	36	0.9500	0.9500	0.9500	0.9000	1.0000	6.077	4	14.00	12.00	0.9500	0.9500
0.59	38	0.9000	0.9000	0.9000	0.8000	1.0000	12.830	4	14.00	12.00	0.9417	0.9417
0.41	40	0.9500	0.9500	0.9500	0.9000	1.0000	6.077	4	14.00	12.00	0.9417	0.9417
0.23	42	0.9750	0.9750	0.9750	0.9000	1.0000	5.128	4	16.00	12.00	0.9417	0.9417
0.69	*44	0.8500	0.8500	0.8500	0.7000	0.9000	11.765	4	10.00	12.00	0.8625	0.8625
0.65	*46	0.8750	0.8750	0.8750	0.7000	1.0000	14.381	4	12.00	12.00	0.8625	0.8625
0.77	*48	0.8000	0.8000	0.8000	0.6000	1.0000	22.822	4	12.00	12.00	0.8000	0.8000
0.97	*50	0.5500	0.5500	0.5500	0.2000	0.9000	52.486	4	10.00	12.00	0.5875	0.5875
0.93	*52	0.6250	0.6250	0.6250	0.4000	0.9000	42.079	4	10.00	12.00	0.5875	0.5875
1.02	*54	0.4500	0.4500	0.4500	0.4000	0.5000	12.830	4	10.00	12.00	0.5500	0.5500
0.97	*56	0.5500	0.5500	0.5500	0.2000	1.0000	67.215	4	12.00	12.00	0.5500	0.5500
0.91	*58	0.6500	0.6500	0.6500	0.5000	0.8000	26.647	4	10.00	12.00	0.5500	0.5500
1.06	*60	0.3750	0.3750	0.3750	0.3000	0.5000	25.531	4	10.00	12.00	0.3750	0.3750

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates non-normal distribution (p <= 0.01)	1.04263	1.035	0.18798	1.22476
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 1.00)	0	2.44691		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Wilcoxon Rank Sum Test	42	44	42.9884	

Linear Interpolation (200 Resamples)

Point	ppt	SD	95% CL(Exp)		Skew
IC05	36.000	5.725	16.800	46.478	-0.9648
IC10	43.053	1.446	41.368	50.968	1.0565
IC15	46.400	1.683	41.358	49.543	-0.4398
IC20	48.000	1.108	41.600	49.686	-1.2139
IC25	48.471	0.931	46.118	51.988	0.9231
IC40	49.882	2.730	48.645	63.329	1.1803
IC50	58.571				



 ToxCalc v5.0.23 Reviewed by: [signature]

Test: AC-Acute Fish Test
Species: AA-Atherinops affinis
Sample ID: RO Concentrate Comp
Start Date: 1/5/2007 18:05 End Date: 1/9/2007 16:10

Test ID: C070105.0262
Protocol: EPAA 02-EPA Acute
Sample Type: DMR-Discharge Monitoring Report
Lab ID: CCA-Weston, Carlsbad

Pos	ID	Rep	Group	Start	24 Hr	48 Hr	72 Hr	96 Hr	Notes
	1	1	Control	10				10	
	2	2	Control	10				10	
	3	3	Control	10				10	
	4	4	Control	10				10	
	5	1	UF Filtrate Control	10				10	
	6	2	UF Filtrate Control	10				10	
	7	3	UF Filtrate Control	10				10	
	8	4	UF Filtrate Control	10				10	
	9	1	36.000	10				10	
	10	2	36.000	10				10	
	11	3	36.000	10				9	
	12	4	36.000	10				9	
	13	1	38.000	10				10	
	14	2	38.000	10				8	
	15	3	38.000	10				10	
	16	4	38.000	10				8	
	17	1	40.000	10				9	
	18	2	40.000	10				10	
	19	3	40.000	10				10	
	20	4	40.000	10				9	
	21	1	42.000	10				10	
	22	2	42.000	10				10	
	23	3	42.000	10				10	
	24	4	42.000	10				9	
	25	1	44.000	10				9	
	26	2	44.000	10				7	
	27	3	44.000	10				9	
	28	4	44.000	10				9	
	29	1	46.000	10				7	
	30	2	46.000	10				9	
	31	3	46.000	10				9	
	32	4	46.000	10				10	
	33	1	48.000	10				6	
	34	2	48.000	10				9	
	35	3	48.000	10				7	
	36	4	48.000	10				10	
	37	1	50.000	10				2	
	38	2	50.000	10				9	
	39	3	50.000	10				5	
	40	4	50.000	10				6	
	41	1	52.000	10				9	
	42	2	52.000	10				8	
	43	3	52.000	10				4	
	44	4	52.000	10				4	
	45	1	54.000	10				5	
	46	2	54.000	10				5	
	47	3	54.000	10				4	
	48	4	54.000	10				4	
	49	1	56.000	10				10	
	50	2	56.000	10				7	
	51	3	56.000	10				2	
	52	4	56.000	10				3	
	53	1	58.000	10				8	

Test: AC-Acute Fish Test		Test ID: C070105.0262
Species: AA-Atherinops affinis		Protocol: EPAA 02-EPA Acute
Sample ID: RO Concentrate Comp		Sample Type: DMR-Discharge Monitoring Report
Start Date: 1/5/2007 18:05	End Date: 1/9/2007 16:10	Lab ID: CCA-Weston, Carlsbad

Pos	ID	Rep	Group	Start	24 Hr	48 Hr	72 Hr	96 Hr	Notes
	54	2	58.000	10				8	
	55	3	58.000	10				5	
	56	4	58.000	10				5	
	57	1	60.000	10				3	
	58	2	60.000	10				3	
	59	3	60.000	10				4	
	60	4	60.000	10				5	

Comments: Sample time is last sample taken of 24 hour composite, not the time the composite was created in the lab.

 ToxCalc 5.0 Reviewed by: [signature]

Acute Fish Test

Start Date:	1/5/2007 18:05	Test ID:	C070105.0262	Sample ID:	36 ppt RO Concentrate Comp
End Date:	1/9/2007 16:10	Lab ID:	CCA-Weston, Carlsbad	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:	1/4/2007 08:00	Protocol:	EPAA 02-EPA Acute	Test Species:	AA-Atherinops affinis

Comments: Used to compare survival of fish to time exposed to 36 ppt concentration.

Conc-Hours	1	2	3	4
0	1.0000	1.0000	1.0000	1.0000
0.5	1.0000	1.0000	1.0000	1.0000
1	1.0000	1.0000	1.0000	1.0000
2	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000
12	1.0000	1.0000	1.0000	0.9000
24	1.0000	1.0000	1.0000	0.9000
48	1.0000	1.0000	0.9000	0.9000
72	1.0000	1.0000	0.9000	0.9000
96	1.0000	1.0000	0.9000	0.9000

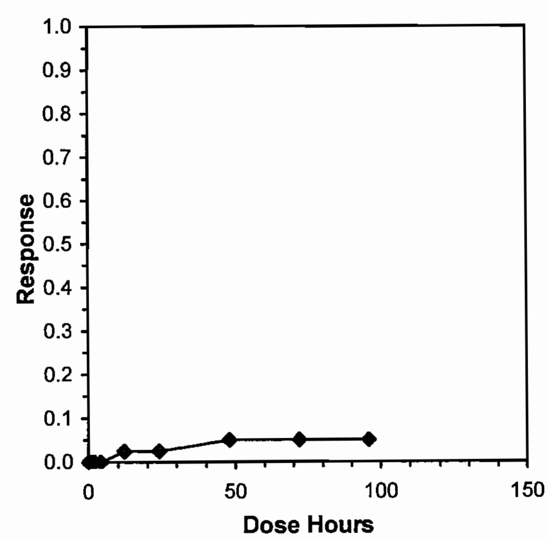
			Transform: Untransformed						1-Tailed		Isotonic	
Conc-Hours	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
0	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4				1.0000	1.0000
0.5	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4	0.000	2.540	0.0696	1.0000	1.0000
1	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4	0.000	2.540	0.0696	1.0000	1.0000
2	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4	0.000	2.540	0.0696	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4	0.000	2.540	0.0696	1.0000	1.0000
12	0.9750	0.9750	0.9750	0.9000	1.0000	5.128	4	0.913	2.540	0.0696	0.9750	0.9750
24	0.9750	0.9750	0.9750	0.9000	1.0000	5.128	4	0.913	2.540	0.0696	0.9750	0.9750
48	0.9500	0.9500	0.9500	0.9000	1.0000	6.077	4	1.826	2.540	0.0696	0.9500	0.9500
72	0.9500	0.9500	0.9500	0.9000	1.0000	6.077	4	1.826	2.540	0.0696	0.9500	0.9500
96	0.9500	0.9500	0.9500	0.9000	1.0000	6.077	4	1.826	2.540	0.0696	0.9500	0.9500

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.857002	0.919	-0.51648	-0.0863
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)	NOET	LOET	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	96	>96			0.069561	0.069561	0.002111	0.0015	0.228996	9, 30

Linear Interpolation (200 Resamples)

Point	Hours	SD	95% CL(Exp)	Skew
IT05	>96			
IT10	>96			
IT15	>96			
IT20	>96			
IT25	>96			
IT40	>96			
IT50	>96			



 ToxCalc v5.0.23 Reviewed by: [signature]

Test: AC-Acute Fish Test
Species: AA-Atherinops affinis
Sample ID: 36 ppt RO Concentrate Comp
Start Date: 1/5/2007 18:05 End Date: 1/9/2007 16:10

Test ID: C070105.0262
Protocol: EPAA 02-EPA Acute
Sample Type: DMR-Discharge Monitoring Report
Lab ID: CCA-Weston, Carlsbad

Pos	ID	Rep	Hour	Start	# Alive	Notes
	1	1	0.000	10	10	
	2	2	0.000	10	10	
	3	3	0.000	10	10	
	4	4	0.000	10	10	
	5	1	0.500	10	10	
	6	2	0.500	10	10	
	7	3	0.500	10	10	
	8	4	0.500	10	10	
	9	1	1.000	10	10	
	10	2	1.000	10	10	
	11	3	1.000	10	10	
	12	4	1.000	10	10	
	13	1	2.000	10	10	
	14	2	2.000	10	10	
	15	3	2.000	10	10	
	16	4	2.000	10	10	
	17	1	4.000	10	10	
	18	2	4.000	10	10	
	19	3	4.000	10	10	
	20	4	4.000	10	10	
	21	1	12.000	10	10	
	22	2	12.000	10	10	
	23	3	12.000	10	10	
	24	4	12.000	10	9	
	25	1	24.000	10	10	
	26	2	24.000	10	10	
	27	3	24.000	10	10	
	28	4	24.000	10	9	
	29	1	48.000	10	10	
	30	2	48.000	10	10	
	31	3	48.000	10	9	
	32	4	48.000	10	9	
	33	1	72.000	10	10	
	34	2	72.000	10	10	
	35	3	72.000	10	9	
	36	4	72.000	10	9	
	37	1	96.000	10	10	
	38	2	96.000	10	10	
	39	3	96.000	10	9	
	40	4	96.000	10	9	

Comments: Used to compare survival of fish to time exposed to 36 ppt concentration.

 ToxCalc 5.0 Reviewed by: JM

Acute Fish Test

Start Date:	1/5/2007 18:05	Test ID:	C070105.0262	Sample ID:	38 ppt RO Concentrate Comp
End Date:	1/9/2007 16:10	Lab ID:	CCA-Weston, Carlsbad	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:	1/4/2007 08:00	Protocol:	EPAA 02-EPA Acute	Test Species:	AA-Atherinops affinis

Comments: Used to compare survival of fish to time exposed to 38 ppt concentration.

Conc-Hours	1	2	3	4
0	1.0000	1.0000	1.0000	1.0000
0.5	1.0000	1.0000	1.0000	1.0000
1	1.0000	1.0000	1.0000	1.0000
2	1.0000	1.0000	1.0000	0.9000
4	1.0000	0.9000	1.0000	0.9000
12	1.0000	0.9000	1.0000	0.8000
24	1.0000	0.8000	1.0000	0.8000
48	1.0000	0.8000	1.0000	0.8000
72	1.0000	0.8000	1.0000	0.8000
96	1.0000	0.8000	1.0000	0.8000

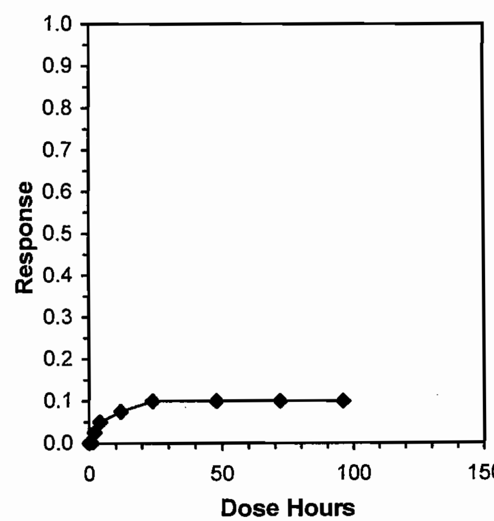
			Transform: Untransformed						1-Tailed		Isotonic	
Conc-Hours	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
0	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4				1.0000	1.0000
0.5	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4	0.000	2.540	0.1485	1.0000	1.0000
1	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4	0.000	2.540	0.1485	1.0000	1.0000
2	0.9750	0.9750	0.9750	0.9000	1.0000	5.128	4	0.428	2.540	0.1485	0.9750	0.9750
4	0.9500	0.9500	0.9500	0.9000	1.0000	6.077	4	0.855	2.540	0.1485	0.9500	0.9500
12	0.9250	0.9250	0.9250	0.8000	1.0000	10.351	4	1.283	2.540	0.1485	0.9250	0.9250
24	0.9000	0.9000	0.9000	0.8000	1.0000	12.830	4	1.711	2.540	0.1485	0.9000	0.9000
48	0.9000	0.9000	0.9000	0.8000	1.0000	12.830	4	1.711	2.540	0.1485	0.9000	0.9000
72	0.9000	0.9000	0.9000	0.8000	1.0000	12.830	4	1.711	2.540	0.1485	0.9000	0.9000
96	0.9000	0.9000	0.9000	0.8000	1.0000	12.830	4	1.711	2.540	0.1485	0.9000	0.9000

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.88643	0.919	-0.1062	-1.1176
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)	NOET	LOET	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	96	>96			0.14847	0.14847	0.00822	0.00683	0.32927	9, 30

Linear Interpolation (200 Resamples)

Point	Hours	SD	95% CL(Exp)	Skew
IT05	4.000			
IT10	24.000			
IT15	>96			
IT20	>96			
IT25	>96			
IT40	>96			
IT50	>96			



 ToxCalc v5.0.23 Reviewed by: [signature]

Test: AC-Acute Fish Test
Species: AA-Atherinops affinis
Sample ID: 38 ppt RO Concentrate Comp
Start Date: 1/5/2007 18:05 End Date: 1/9/2007 16:10

Test ID: C070105.0262
Protocol: EPAA 02-EPA Acute
Sample Type: DMR-Discharge Monitoring Report
Lab ID: CCA-Weston, Carlsbad

Pos	ID	Rep	Hour	Start	# Alive	Notes
	1	1	0.000	10	10	
	2	2	0.000	10	10	
	3	3	0.000	10	10	
	4	4	0.000	10	10	
	5	1	0.500	10	10	
	6	2	0.500	10	10	
	7	3	0.500	10	10	
	8	4	0.500	10	10	
	9	1	1.000	10	10	
	10	2	1.000	10	10	
	11	3	1.000	10	10	
	12	4	1.000	10	10	
	13	1	2.000	10	10	
	14	2	2.000	10	10	
	15	3	2.000	10	10	
	16	4	2.000	10	9	
	17	1	4.000	10	10	
	18	2	4.000	10	9	
	19	3	4.000	10	10	
	20	4	4.000	10	9	
	21	1	12.000	10	10	
	22	2	12.000	10	9	
	23	3	12.000	10	10	
	24	4	12.000	10	8	
	25	1	24.000	10	10	
	26	2	24.000	10	8	
	27	3	24.000	10	10	
	28	4	24.000	10	8	
	29	1	48.000	10	10	
	30	2	48.000	10	8	
	31	3	48.000	10	10	
	32	4	48.000	10	8	
	33	1	72.000	10	10	
	34	2	72.000	10	8	
	35	3	72.000	10	10	
	36	4	72.000	10	8	
	37	1	96.000	10	10	
	38	2	96.000	10	8	
	39	3	96.000	10	10	
	40	4	96.000	10	8	

Comments: Used to compare survival of fish to time exposed to 38 ppt concentration.

Acute Fish Test

Start Date:	1/5/2007 18:05	Test ID:	C070105.0262	Sample ID:	40 ppt RO Concentrate Comp
End Date:	1/9/2007 16:10	Lab ID:	CCA-Weston, Carlsbad	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:	1/4/2007 08:00	Protocol:	EPAA 02-EPA Acute	Test Species:	AA-Atherinops affinis

Comments: Used to compare survival of fish to time exposed to 40 ppt concentration.

Conc-Hours	1	2	3	4
0	1.0000	1.0000	1.0000	1.0000
0.5	1.0000	1.0000	1.0000	1.0000
1	1.0000	1.0000	1.0000	1.0000
2	0.9000	1.0000	1.0000	1.0000
4	0.9000	1.0000	1.0000	1.0000
12	0.9000	1.0000	1.0000	0.9000
24	0.9000	1.0000	1.0000	0.9000
48	0.9000	1.0000	1.0000	0.9000
72	0.9000	1.0000	1.0000	0.9000
96	0.9000	1.0000	1.0000	0.9000

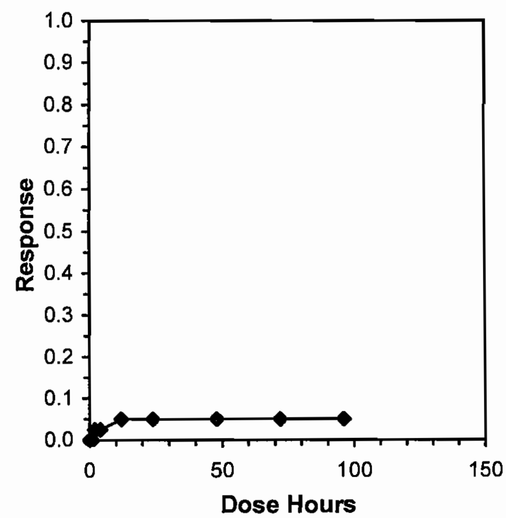
			Transform: Untransformed						1-Tailed		Isotonic	
Conc-Hours	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
0	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4				1.0000	1.0000
0.5	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4	0.000	2.540	0.0836	1.0000	1.0000
1	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4	0.000	2.540	0.0836	1.0000	1.0000
2	0.9750	0.9750	0.9750	0.9000	1.0000	5.128	4	0.760	2.540	0.0836	0.9750	0.9750
4	0.9750	0.9750	0.9750	0.9000	1.0000	5.128	4	0.760	2.540	0.0836	0.9750	0.9750
12	0.9500	0.9500	0.9500	0.9000	1.0000	6.077	4	1.519	2.540	0.0836	0.9500	0.9500
24	0.9500	0.9500	0.9500	0.9000	1.0000	6.077	4	1.519	2.540	0.0836	0.9500	0.9500
48	0.9500	0.9500	0.9500	0.9000	1.0000	6.077	4	1.519	2.540	0.0836	0.9500	0.9500
72	0.9500	0.9500	0.9500	0.9000	1.0000	6.077	4	1.519	2.540	0.0836	0.9500	0.9500
96	0.9500	0.9500	0.9500	0.9000	1.0000	6.077	4	1.519	2.540	0.0836	0.9500	0.9500

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.86051	0.919	-0.2975	-1.1929
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)	NOET	LOET	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	96	>96			0.0836	0.0836	0.00211	0.00217	0.48013	9, 30

Linear Interpolation (200 Resamples)

Point	Hours	SD	95% CL(Exp)	Skew
IT05	>96			
IT10	>96			
IT15	>96			
IT20	>96			
IT25	>96			
IT40	>96			
IT50	>96			



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Test: AC-Acute Fish Test
Species: AA-Atherinops affinis
Sample ID: 40 ppt RO Concentrate Comp
Start Date: 1/5/2007 18:05 End Date: 1/9/2007 16:10

Test ID: C070105.0262
Protocol: EPAA 02-EPA Acute
Sample Type: DMR-Discharge Monitoring Report
Lab ID: CCA-Weston, Carlsbad

Pos	ID	Rep	Hour	Start	# Alive	Notes
	1	1	0.000	10	10	
	2	2	0.000	10	10	
	3	3	0.000	10	10	
	4	4	0.000	10	10	
	5	1	0.500	10	10	
	6	2	0.500	10	10	
	7	3	0.500	10	10	
	8	4	0.500	10	10	
	9	1	1.000	10	10	
	10	2	1.000	10	10	
	11	3	1.000	10	10	
	12	4	1.000	10	10	
	13	1	2.000	10	9	
	14	2	2.000	10	10	
	15	3	2.000	10	10	
	16	4	2.000	10	10	
	17	1	4.000	10	9	
	18	2	4.000	10	10	
	19	3	4.000	10	10	
	20	4	4.000	10	10	
	21	1	12.000	10	9	
	22	2	12.000	10	10	
	23	3	12.000	10	10	
	24	4	12.000	10	9	
	25	1	24.000	10	9	
	26	2	24.000	10	10	
	27	3	24.000	10	10	
	28	4	24.000	10	9	
	29	1	48.000	10	9	
	30	2	48.000	10	10	
	31	3	48.000	10	10	
	32	4	48.000	10	9	
	33	1	72.000	10	9	
	34	2	72.000	10	10	
	35	3	72.000	10	10	
	36	4	72.000	10	9	
	37	1	96.000	10	9	
	38	2	96.000	10	10	
	39	3	96.000	10	10	
	40	4	96.000	10	9	

Comments: Used to compare survival of fish to time exposed to 40 ppt concentration.

Acute Fish Test

Start Date:	1/5/2007 18:05	Test ID:	C070105.0262	Sample ID:	42 ppt RO Concentrate Comp
End Date:	1/9/2007 16:10	Lab ID:	CCA-Weston, Carlsbad	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:	1/4/2007 08:00	Protocol:	EPAA 02-EPA Acute	Test Species:	AA-Atherinops affinis

Comments: Used to compare survival of fish to time exposed to 42 ppt concentration.

Conc-Hours	1	2	3	4
0	1.0000	1.0000	1.0000	1.0000
0.5	1.0000	1.0000	1.0000	1.0000
1	1.0000	1.0000	1.0000	1.0000
2	1.0000	1.0000	1.0000	0.9000
4	1.0000	1.0000	1.0000	0.9000
12	1.0000	1.0000	1.0000	0.9000
24	1.0000	1.0000	1.0000	0.9000
48	1.0000	1.0000	1.0000	0.9000
72	1.0000	1.0000	1.0000	0.9000
96	1.0000	1.0000	1.0000	0.9000

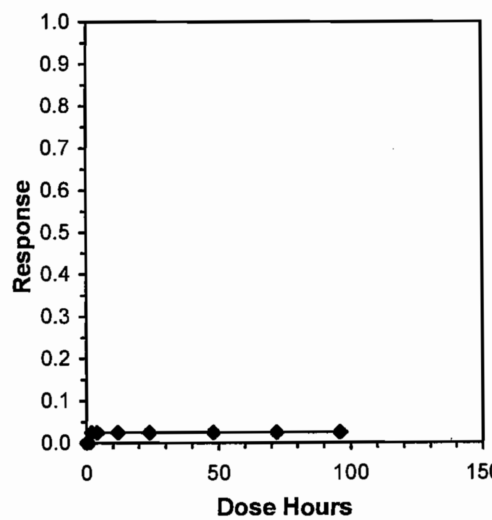
			Transform: Untransformed						1-Tailed		Isotonic	
Conc-Hours	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
0	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4				1.0000	1.0000
0.5	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4	0.000	2.540	0.0751	1.0000	1.0000
1	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4	0.000	2.540	0.0751	1.0000	1.0000
2	0.9750	0.9750	0.9750	0.9000	1.0000	5.128	4	0.845	2.540	0.0751	0.9750	0.9750
4	0.9750	0.9750	0.9750	0.9000	1.0000	5.128	4	0.845	2.540	0.0751	0.9750	0.9750
12	0.9750	0.9750	0.9750	0.9000	1.0000	5.128	4	0.845	2.540	0.0751	0.9750	0.9750
24	0.9750	0.9750	0.9750	0.9000	1.0000	5.128	4	0.845	2.540	0.0751	0.9750	0.9750
48	0.9750	0.9750	0.9750	0.9000	1.0000	5.128	4	0.845	2.540	0.0751	0.9750	0.9750
72	0.9750	0.9750	0.9750	0.9000	1.0000	5.128	4	0.845	2.540	0.0751	0.9750	0.9750
96	0.9750	0.9750	0.9750	0.9000	1.0000	5.128	4	0.845	2.540	0.0751	0.9750	0.9750

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.64765	0.919	-1.4345	0.54552
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)	NOET	LOET	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	96	>96			0.07513	0.07513	0.00058	0.00175	0.95668	9, 30

Linear Interpolation (200 Resamples)

Point	Hours	SD	95% CL(Exp)	Skew
IT05	>96			
IT10	>96			
IT15	>96			
IT20	>96			
IT25	>96			
IT40	>96			
IT50	>96			



 ToxCalc v5.0.23 Reviewed by

Test: AC-Acute Fish Test
Species: AA-Atherinops affinis
Sample ID: 42 ppt RO Concentrate Comp
Start Date: 1/5/2007 18:05 End Date: 1/9/2007 16:10

Test ID: C070105.0262
Protocol: EPAA 02-EPA Acute
Sample Type: DMR-Discharge Monitoring Report
Lab ID: CCA-Weston, Carlsbad

Pos	ID	Rep	Hour	Start	# Alive	Notes
	1	1	0.000	10	10	
	2	2	0.000	10	10	
	3	3	0.000	10	10	
	4	4	0.000	10	10	
	5	1	0.500	10	10	
	6	2	0.500	10	10	
	7	3	0.500	10	10	
	8	4	0.500	10	10	
	9	1	1.000	10	10	
	10	2	1.000	10	10	
	11	3	1.000	10	10	
	12	4	1.000	10	10	
	13	1	2.000	10	10	
	14	2	2.000	10	10	
	15	3	2.000	10	10	
	16	4	2.000	10	9	
	17	1	4.000	10	10	
	18	2	4.000	10	10	
	19	3	4.000	10	10	
	20	4	4.000	10	9	
	21	1	12.000	10	10	
	22	2	12.000	10	10	
	23	3	12.000	10	10	
	24	4	12.000	10	9	
	25	1	24.000	10	10	
	26	2	24.000	10	10	
	27	3	24.000	10	10	
	28	4	24.000	10	9	
	29	1	48.000	10	10	
	30	2	48.000	10	10	
	31	3	48.000	10	10	
	32	4	48.000	10	9	
	33	1	72.000	10	10	
	34	2	72.000	10	10	
	35	3	72.000	10	10	
	36	4	72.000	10	9	
	37	1	96.000	10	10	
	38	2	96.000	10	10	
	39	3	96.000	10	10	
	40	4	96.000	10	9	

Comments: Used to compare survival of fish to time exposed to 42 ppt concentration.

Acute Fish Test

Start Date:	1/5/2007 18:05	Test ID:	C070105.0262	Sample ID:	44 ppt RO Concentrate Comp
End Date:	1/9/2007 16:10	Lab ID:	CCA-Weston, Carlsbad	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:	1/4/2007 08:00	Protocol:	EPAA 02-EPA Acute	Test Species:	AA-Atherinops affinis

Comments: Used to compare survival of fish to time exposed to 44 ppt concentration.

Conc-Hours	1	2	3	4
0	1.0000	1.0000	1.0000	1.0000
0.5	1.0000	1.0000	1.0000	1.0000
1	1.0000	1.0000	1.0000	1.0000
2	1.0000	1.0000	1.0000	1.0000
4	1.0000	0.9000	0.9000	1.0000
12	0.9000	0.7000	0.9000	0.9000
24	0.9000	0.7000	0.9000	0.9000
48	0.9000	0.7000	0.9000	0.9000
72	0.9000	0.7000	0.9000	0.9000
96	0.9000	0.7000	0.9000	0.9000

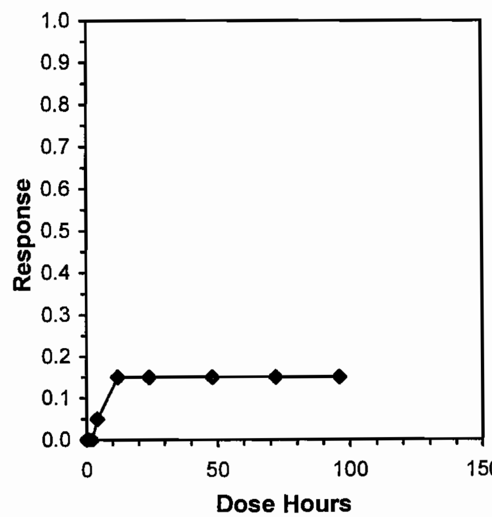
			Transform: Untransformed						1-Tailed		Isotonic	
Conc-Hours	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
0	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4				1.0000	1.0000
0.5	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4	0.000	2.540	0.1312	1.0000	1.0000
1	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4	0.000	2.540	0.1312	1.0000	1.0000
2	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4	0.000	2.540	0.1312	1.0000	1.0000
4	0.9500	0.9500	0.9500	0.9000	1.0000	6.077	4	0.968	2.540	0.1312	0.9500	0.9500
*12	0.8500	0.8500	0.8500	0.7000	0.9000	11.765	4	2.905	2.540	0.1312	0.8500	0.8500
*24	0.8500	0.8500	0.8500	0.7000	0.9000	11.765	4	2.905	2.540	0.1312	0.8500	0.8500
*48	0.8500	0.8500	0.8500	0.7000	0.9000	11.765	4	2.905	2.540	0.1312	0.8500	0.8500
*72	0.8500	0.8500	0.8500	0.7000	0.9000	11.765	4	2.905	2.540	0.1312	0.8500	0.8500
*96	0.8500	0.8500	0.8500	0.7000	0.9000	11.765	4	2.905	2.540	0.1312	0.8500	0.8500

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.70003	0.919	-1.5407	1.46363
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)	NOET	LOET	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	4	12	6.9282		0.13117	0.13117	0.02267	0.00533	0.00127	9, 30

Linear Interpolation (200 Resamples)

Point	Hours	SD	95% CL(Exp)		Skew
IT05	4.0000	1.3395	2.4000	10.4000	0.8155
IT10	8.0000	10.0399	1.6000	72.0000	3.8051
IT15	>96				
IT20	>96				
IT25	>96				
IT40	>96				
IT50	>96				



 ToxCalc v5.0.23 Reviewed by: [signature]

Test: AC-Acute Fish Test
Species: AA-Atherinops affinis
Sample ID: 44 ppt RO Concentrate Comp
Start Date: 1/5/2007 18:05 End Date: 1/9/2007 16:10

Test ID: C070105.0262
Protocol: EPAA 02-EPA Acute
Sample Type: DMR-Discharge Monitoring Report
Lab ID: CCA-Weston, Carlsbad

Pos	ID	Rep	Hour	Start	# Alive	Notes
	1	1	0.000	10	10	
	2	2	0.000	10	10	
	3	3	0.000	10	10	
	4	4	0.000	10	10	
	5	1	0.500	10	10	
	6	2	0.500	10	10	
	7	3	0.500	10	10	
	8	4	0.500	10	10	
	9	1	1.000	10	10	
	10	2	1.000	10	10	
	11	3	1.000	10	10	
	12	4	1.000	10	10	
	13	1	2.000	10	10	
	14	2	2.000	10	10	
	15	3	2.000	10	10	
	16	4	2.000	10	10	
	17	1	4.000	10	10	
	18	2	4.000	10	9	
	19	3	4.000	10	9	
	20	4	4.000	10	10	
	21	1	12.000	10	9	
	22	2	12.000	10	7	
	23	3	12.000	10	9	
	24	4	12.000	10	9	
	25	1	24.000	10	9	
	26	2	24.000	10	7	
	27	3	24.000	10	9	
	28	4	24.000	10	9	
	29	1	48.000	10	9	
	30	2	48.000	10	7	
	31	3	48.000	10	9	
	32	4	48.000	10	9	
	33	1	72.000	10	9	
	34	2	72.000	10	7	
	35	3	72.000	10	9	
	36	4	72.000	10	9	
	37	1	96.000	10	9	
	38	2	96.000	10	7	
	39	3	96.000	10	9	
	40	4	96.000	10	9	

Comments: Used to compare survival of fish to time exposed to 44 ppt concentration.

Acute Fish Test

Start Date:	1/5/2007 18:05	Test ID:	C070105.0262	Sample ID:	46 ppt RO Concentrate Comp
End Date:	1/9/2007 16:10	Lab ID:	CCA-Weston, Carlsbad	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:	1/4/2007 08:00	Protocol:	EPAA 02-EPA Acute	Test Species:	AA-Atherinops affinis

Comments: Used to compare survival of fish to time exposed to 46 ppt concentration.

Conc-Hours	1	2	3	4
0	1.0000	1.0000	1.0000	1.0000
0.5	0.9000	1.0000	1.0000	1.0000
1	0.9000	1.0000	1.0000	1.0000
2	0.9000	1.0000	0.9000	1.0000
4	0.7000	1.0000	0.9000	1.0000
12	0.7000	0.9000	0.9000	1.0000
24	0.7000	0.9000	0.9000	1.0000
48	0.7000	0.9000	0.9000	1.0000
72	0.7000	0.9000	0.9000	1.0000
96	0.7000	0.9000	0.9000	1.0000

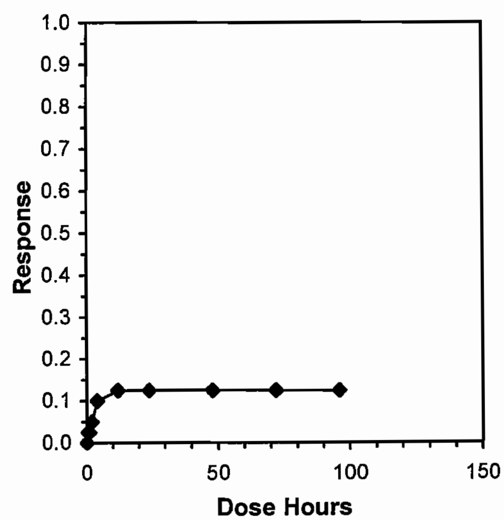
			Transform: Untransformed						1-Tailed		Isotonic	
Conc-Hours	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
0	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4				1.0000	1.0000
0.5	0.9750	0.9750	0.9750	0.9000	1.0000	5.128	4	0.341	2.540	0.1862	0.9750	0.9750
1	0.9750	0.9750	0.9750	0.9000	1.0000	5.128	4	0.341	2.540	0.1862	0.9750	0.9750
2	0.9500	0.9500	0.9500	0.9000	1.0000	6.077	4	0.682	2.540	0.1862	0.9500	0.9500
4	0.9000	0.9000	0.9000	0.7000	1.0000	15.713	4	1.364	2.540	0.1862	0.9000	0.9000
12	0.8750	0.8750	0.8750	0.7000	1.0000	14.381	4	1.705	2.540	0.1862	0.8750	0.8750
24	0.8750	0.8750	0.8750	0.7000	1.0000	14.381	4	1.705	2.540	0.1862	0.8750	0.8750
48	0.8750	0.8750	0.8750	0.7000	1.0000	14.381	4	1.705	2.540	0.1862	0.8750	0.8750
72	0.8750	0.8750	0.8750	0.7000	1.0000	14.381	4	1.705	2.540	0.1862	0.8750	0.8750
96	0.8750	0.8750	0.8750	0.7000	1.0000	14.381	4	1.705	2.540	0.1862	0.8750	0.8750

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.84452	0.919	-0.848	0.16827
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)	NOET	LOET	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	96	>96			0.18622	0.18622	0.01058	0.01075	0.47261	9, 30

Linear Interpolation (200 Resamples)

Point	Hours	SD	95% CL(Exp)		Skew
IT05	2.0000	2.9127	0.0000	11.6686	5.4444
IT10	4.0000				
IT15	>96				
IT20	>96				
IT25	>96				
IT40	>96				
IT50	>96				



Test: AC-Acute Fish Test	Test ID: C070105.0262
Species: AA-Atherinops affinis	Protocol: EPAA 02-EPA Acute
Sample ID: 46 ppt RO Concentrate Comp	Sample Type: DMR-Discharge Monitoring Report
Start Date: 1/5/2007 18:05 End Date: 1/9/2007 16:10	Lab ID: CCA-Weston, Carlsbad

Pos	ID	Rep	Hour	Start	# Alive	Notes
	1	1	0.000	10	10	
	2	2	0.000	10	10	
	3	3	0.000	10	10	
	4	4	0.000	10	10	
	5	1	0.500	10	9	
	6	2	0.500	10	10	
	7	3	0.500	10	10	
	8	4	0.500	10	10	
	9	1	1.000	10	9	
	10	2	1.000	10	10	
	11	3	1.000	10	10	
	12	4	1.000	10	10	
	13	1	2.000	10	9	
	14	2	2.000	10	10	
	15	3	2.000	10	9	
	16	4	2.000	10	10	
	17	1	4.000	10	7	
	18	2	4.000	10	10	
	19	3	4.000	10	9	
	20	4	4.000	10	10	
	21	1	12.000	10	7	
	22	2	12.000	10	9	
	23	3	12.000	10	9	
	24	4	12.000	10	10	
	25	1	24.000	10	7	
	26	2	24.000	10	9	
	27	3	24.000	10	9	
	28	4	24.000	10	10	
	29	1	48.000	10	7	
	30	2	48.000	10	9	
	31	3	48.000	10	9	
	32	4	48.000	10	10	
	33	1	72.000	10	7	
	34	2	72.000	10	9	
	35	3	72.000	10	9	
	36	4	72.000	10	10	
	37	1	96.000	10	7	
	38	2	96.000	10	9	
	39	3	96.000	10	9	
	40	4	96.000	10	10	

Comments: Used to compare survival of fish to time exposed to 46 ppt concentration

 Reviewed by: [signature]

Acute Fish Test

Start Date:	1/5/2007 18:05	Test ID:	C070105.0262	Sample ID:	48 ppt RO Concentrate Comp
End Date:	1/9/2007 16:10	Lab ID:	CCA-Weston, Carlsbad	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:	1/4/2007 08:00	Protocol:	EPAA 02-EPA Acute	Test Species:	AA-Atherinops affinis

Comments: Used to compare survival of fish to time exposed to 48 ppt concentration.

Conc-Hours	1	2	3	4
0	1.0000	1.0000	1.0000	1.0000
0.5	1.0000	1.0000	1.0000	1.0000
1	1.0000	1.0000	1.0000	1.0000
2	0.8000	1.0000	1.0000	1.0000
4	0.8000	0.9000	1.0000	1.0000
12	0.7000	0.9000	0.7000	1.0000
24	0.7000	0.9000	0.7000	1.0000
48	0.7000	0.9000	0.7000	1.0000
72	0.6000	0.9000	0.7000	1.0000
96	0.6000	0.9000	0.7000	1.0000

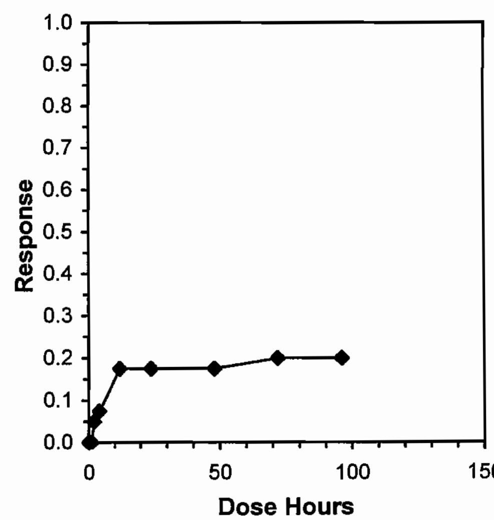
			Transform: Untransformed						1-Tailed		Isotonic	
Conc-Hours	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
0	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4				1.0000	1.0000
0.5	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4	0.000	2.540	0.2224	1.0000	1.0000
1	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4	0.000	2.540	0.2224	1.0000	1.0000
2	0.9500	0.9500	0.9500	0.8000	1.0000	10.526	4	0.571	2.540	0.2224	0.9500	0.9500
4	0.9250	0.9250	0.9250	0.8000	1.0000	10.351	4	0.857	2.540	0.2224	0.9250	0.9250
12	0.8250	0.8250	0.8250	0.7000	1.0000	18.182	4	1.999	2.540	0.2224	0.8250	0.8250
24	0.8250	0.8250	0.8250	0.7000	1.0000	18.182	4	1.999	2.540	0.2224	0.8250	0.8250
48	0.8250	0.8250	0.8250	0.7000	1.0000	18.182	4	1.999	2.540	0.2224	0.8250	0.8250
72	0.8000	0.8000	0.8000	0.6000	1.0000	22.822	4	2.284	2.540	0.2224	0.8000	0.8000
96	0.8000	0.8000	0.8000	0.6000	1.0000	22.822	4	2.284	2.540	0.2224	0.8000	0.8000

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.93335	0.919	0.03161	-0.6642
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)	NOET	LOET	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	96	>96			0.2224	0.2224	0.031	0.01533	0.07183	9, 30

Linear Interpolation (200 Resamples)

Point	Hours	SD	95% CL(Exp)		Skew
IT05	2.000	2.318	1.111	9.467	6.1902
IT10	6.000	7.141	0.000	34.966	4.8581
IT15	10.000				
IT20	>96				
IT25	>96				
IT40	>96				
IT50	>96				



Test: AC-Acute Fish Test	Test ID: C070105.0262
Species: AA-Atherinops affinis	Protocol: EPAA 02-EPA Acute
Sample ID: 48 ppt RO Concentrate Comp	Sample Type: DMR-Discharge Monitoring Report
Start Date: 1/5/2007 18:05 End Date: 1/9/2007 16:10	Lab ID: CCA-Weston, Carlsbad

Pos	ID	Rep	Hour	Start	# Alive	Notes
	1	1	0.000	10	10	
	2	2	0.000	10	10	
	3	3	0.000	10	10	
	4	4	0.000	10	10	
	5	1	0.500	10	10	
	6	2	0.500	10	10	
	7	3	0.500	10	10	
	8	4	0.500	10	10	
	9	1	1.000	10	10	
	10	2	1.000	10	10	
	11	3	1.000	10	10	
	12	4	1.000	10	10	
	13	1	2.000	10	8	
	14	2	2.000	10	10	
	15	3	2.000	10	10	
	16	4	2.000	10	10	
	17	1	4.000	10	8	
	18	2	4.000	10	9	
	19	3	4.000	10	10	
	20	4	4.000	10	10	
	21	1	12.000	10	7	
	22	2	12.000	10	9	
	23	3	12.000	10	7	
	24	4	12.000	10	10	
	25	1	24.000	10	7	
	26	2	24.000	10	9	
	27	3	24.000	10	7	
	28	4	24.000	10	10	
	29	1	48.000	10	7	
	30	2	48.000	10	9	
	31	3	48.000	10	7	
	32	4	48.000	10	10	
	33	1	72.000	10	6	
	34	2	72.000	10	9	
	35	3	72.000	10	7	
	36	4	72.000	10	10	
	37	1	96.000	10	6	
	38	2	96.000	10	9	
	39	3	96.000	10	7	
	40	4	96.000	10	10	

Comments: Used to compare survival of fish to time exposed to 48 ppt concentration.

Acute Fish Test

Start Date:	1/5/2007 18:05	Test ID:	C070105.0262	Sample ID:	50 ppt RO Concentrate Comp
End Date:	1/9/2007 16:10	Lab ID:	CCA-Weston, Carlsbad	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:	1/4/2007 08:00	Protocol:	EPAA 02-EPA Acute	Test Species:	AA-Atherinops affinis

Comments: Used to compare survival of fish to time exposed to 50 ppt concentration.

Conc-Hours	1	2	3	4
0	1.0000	1.0000	1.0000	1.0000
0.5	1.0000	1.0000	1.0000	1.0000
1	1.0000	1.0000	1.0000	1.0000
2	0.9000	1.0000	1.0000	0.8000
4	0.6000	0.9000	0.9000	0.8000
12	0.3000	0.9000	0.6000	0.7000
24	0.3000	0.9000	0.5000	0.7000
48	0.2000	0.9000	0.5000	0.6000
72	0.2000	0.9000	0.5000	0.6000
96	0.2000	0.9000	0.5000	0.6000

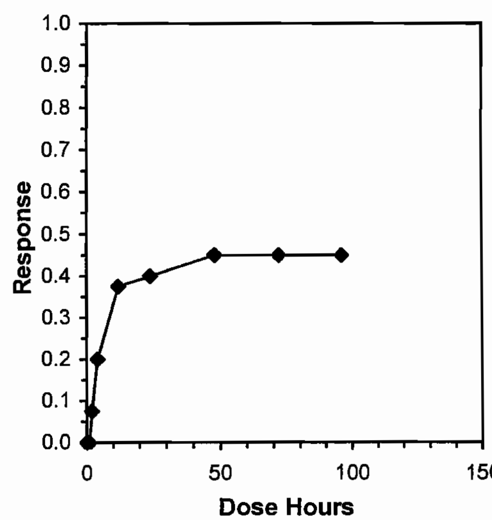
			Transform: Untransformed						1-Tailed		Isotonic	
Conc-Hours	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
0	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4				1.0000	1.0000
0.5	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4	0.000	2.540	0.3629	1.0000	1.0000
1	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4	0.000	2.540	0.3629	1.0000	1.0000
2	0.9250	0.9250	0.9250	0.8000	1.0000	10.351	4	0.525	2.540	0.3629	0.9250	0.9250
4	0.8000	0.8000	0.8000	0.6000	0.9000	17.678	4	1.400	2.540	0.3629	0.8000	0.8000
*12	0.6250	0.6250	0.6250	0.3000	0.9000	40.000	4	2.624	2.540	0.3629	0.6250	0.6250
*24	0.6000	0.6000	0.6000	0.3000	0.9000	43.033	4	2.799	2.540	0.3629	0.6000	0.6000
*48	0.5500	0.5500	0.5500	0.2000	0.9000	52.486	4	3.149	2.540	0.3629	0.5500	0.5500
*72	0.5500	0.5500	0.5500	0.2000	0.9000	52.486	4	3.149	2.540	0.3629	0.5500	0.5500
*96	0.5500	0.5500	0.5500	0.2000	0.9000	52.486	4	3.149	2.540	0.3629	0.5500	0.5500

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.88912	0.919	-0.0982	0.55881
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)	NOET	LOET	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	4	12	6.9282		0.36293	0.36293	0.16789	0.04083	0.00159	9, 30

Linear Interpolation (200 Resamples)

Point	Hours	SD	95% CL(Exp)		Skew
IT05	1.667	0.349	1.133	3.003	0.8992
IT10	2.400	0.646	1.227	4.960	0.7743
IT15	3.200	1.085	1.280	7.496	1.2255
IT20	4.000	2.362	2.167	12.640	3.9069
IT25	6.286	4.978	1.755	34.629	4.0462
IT40	24.000				
IT50	>96				



Test: AC-Acute Fish Test						Test ID: C070105.0262
Species: AA-Atherinops affinis						Protocol: EPAA 02-EPA Acute
Sample ID: 50 ppt RO Concentrate Comp						Sample Type: DMR-Discharge Monitoring Report
Start Date: 1/5/2007 18:05			End Date: 1/9/2007 16:10			Lab ID: CCA-Weston, Carlsbad

Pos	ID	Rep	Hour	Start	# Alive	Notes
	1	1	0.000	10	10	
	2	2	0.000	10	10	
	3	3	0.000	10	10	
	4	4	0.000	10	10	
	5	1	0.500	10	10	
	6	2	0.500	10	10	
	7	3	0.500	10	10	
	8	4	0.500	10	10	
	9	1	1.000	10	10	
	10	2	1.000	10	10	
	11	3	1.000	10	10	
	12	4	1.000	10	10	
	13	1	2.000	10	9	
	14	2	2.000	10	10	
	15	3	2.000	10	10	
	16	4	2.000	10	8	
	17	1	4.000	10	6	
	18	2	4.000	10	9	
	19	3	4.000	10	9	
	20	4	4.000	10	8	
	21	1	12.000	10	3	
	22	2	12.000	10	9	
	23	3	12.000	10	6	
	24	4	12.000	10	7	
	25	1	24.000	10	3	
	26	2	24.000	10	9	
	27	3	24.000	10	5	
	28	4	24.000	10	7	
	29	1	48.000	10	2	
	30	2	48.000	10	9	
	31	3	48.000	10	5	
	32	4	48.000	10	6	
	33	1	72.000	10	2	
	34	2	72.000	10	9	
	35	3	72.000	10	5	
	36	4	72.000	10	6	
	37	1	96.000	10	2	
	38	2	96.000	10	9	
	39	3	96.000	10	5	
	40	4	96.000	10	6	

Comments: Used to compare survival of fish to time exposed to 50 ppt concentration.

 ToxCalc 5.0 Reviewed by: [signature]

Acute Fish Test

Start Date:	1/5/2007 18:05	Test ID:	C070105.0262	Sample ID:	52 ppt RO Concentrate Comp
End Date:	1/9/2007 16:10	Lab ID:	CCA-Weston, Carlsbad	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:	1/4/2007 08:00	Protocol:	EPAA 02-EPA Acute	Test Species:	AA-Atherinops affinis

Comments: Used to compare survival of fish to time exposed to 52 ppt concentration.

Conc-Hours	1	2	3	4
0	1.0000	1.0000	1.0000	1.0000
0.5	1.0000	1.0000	1.0000	1.0000
1	1.0000	1.0000	0.7000	1.0000
2	1.0000	1.0000	0.6000	0.8000
4	1.0000	0.8000	0.5000	0.6000
12	1.0000	0.8000	0.4000	0.5000
24	0.9000	0.8000	0.4000	0.4000
48	0.9000	0.8000	0.4000	0.4000
72	0.9000	0.8000	0.4000	0.4000
96	0.9000	0.8000	0.4000	0.4000

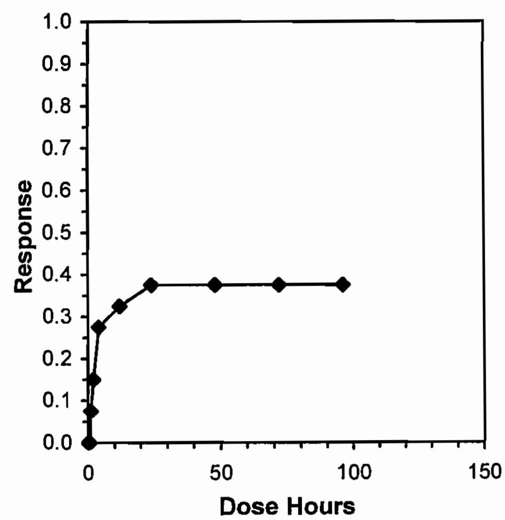
			Transform: Untransformed						1-Tailed		Isotonic	
Conc-Hours	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
0	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4				1.0000	1.0000
0.5	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4	0.000	2.540	0.3856	1.0000	1.0000
1	0.9250	0.9250	0.9250	0.7000	1.0000	16.216	4	0.494	2.540	0.3856	0.9250	0.9250
2	0.8500	0.8500	0.8500	0.6000	1.0000	22.528	4	0.988	2.540	0.3856	0.8500	0.8500
4	0.7250	0.7250	0.7250	0.5000	1.0000	30.584	4	1.812	2.540	0.3856	0.7250	0.7250
12	0.6750	0.6750	0.6750	0.4000	1.0000	40.797	4	2.141	2.540	0.3856	0.6750	0.6750
24	0.6250	0.6250	0.6250	0.4000	0.9000	42.079	4	2.470	2.540	0.3856	0.6250	0.6250
48	0.6250	0.6250	0.6250	0.4000	0.9000	42.079	4	2.470	2.540	0.3856	0.6250	0.6250
72	0.6250	0.6250	0.6250	0.4000	0.9000	42.079	4	2.470	2.540	0.3856	0.6250	0.6250
96	0.6250	0.6250	0.6250	0.4000	0.9000	42.079	4	2.470	2.540	0.3856	0.6250	0.6250

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.89327	0.919	0.05004	-1.3097
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)	NOET	LOET	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	96	>96			0.38556	0.38556	0.10281	0.04608	0.04811	9, 30

Linear Interpolation (200 Resamples)

Point	Hours	SD	95% CL(Exp)		Skew
IT05	0.8333	0.4189	0.5206	2.8602	1.3821
IT10	1.3333	0.7443	0.4413	4.3520	1.7363
IT15	2.0000	2.2555	0.2619	18.0000	3.7135
IT20	2.8000	3.5646	0.7171	22.6814	2.3143
IT25	3.6000	12.3323	1.0400	76.4869	3.0286
IT40	>96				
IT50	>96				



 ToxCalc v5.0.23 Reviewed by: [signature]

Test: AC-Acute Fish Test
Species: AA-Atherinops affinis
Sample ID: 52 ppt RO Concentrate Comp
Start Date: 1/5/2007 18:05 End Date: 1/9/2007 16:10

Test ID: C070105.0262
Protocol: EPAA 02-EPA Acute
Sample Type: DMR-Discharge Monitoring Report
Lab ID: CCA-Weston, Carlsbad

Pos	ID	Rep	Hour	Start	# Alive	Notes
	1	1	0.000	10	10	
	2	2	0.000	10	10	
	3	3	0.000	10	10	
	4	4	0.000	10	10	
	5	1	0.500	10	10	
	6	2	0.500	10	10	
	7	3	0.500	10	10	
	8	4	0.500	10	10	
	9	1	1.000	10	10	
	10	2	1.000	10	10	
	11	3	1.000	10	7	
	12	4	1.000	10	10	
	13	1	2.000	10	10	
	14	2	2.000	10	10	
	15	3	2.000	10	6	
	16	4	2.000	10	8	
	17	1	4.000	10	10	
	18	2	4.000	10	8	
	19	3	4.000	10	5	
	20	4	4.000	10	6	
	21	1	12.000	10	10	
	22	2	12.000	10	8	
	23	3	12.000	10	4	
	24	4	12.000	10	5	
	25	1	24.000	10	9	
	26	2	24.000	10	8	
	27	3	24.000	10	4	
	28	4	24.000	10	4	
	29	1	48.000	10	9	
	30	2	48.000	10	8	
	31	3	48.000	10	4	
	32	4	48.000	10	4	
	33	1	72.000	10	9	
	34	2	72.000	10	8	
	35	3	72.000	10	4	
	36	4	72.000	10	4	
	37	1	96.000	10	9	
	38	2	96.000	10	8	
	39	3	96.000	10	4	
	40	4	96.000	10	4	

Comments: Used to compare survival of fish to time exposed to 52 ppt concentration.

Acute Fish Test-24 Hr Survival

Start Date:	1/5/2007 18:05	Test ID:	C070105.0262	Sample ID:	54 ppt RO Concentrate Comp
End Date:	1/9/2007 16:10	Lab ID:	CCA-Weston, Carlsbad	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:	1/4/2007 08:00	Protocol:	EPAA 02-EPA Acute	Test Species:	AA-Atherinops affinis

Comments: Used to compare survival of fish to time exposed to 54 ppt concentration.

Conc-Hours	1	2	3	4
0	1.0000	1.0000	1.0000	1.0000
0.5	1.0000	1.0000	0.9000	1.0000
1	0.8000	0.9000	0.7000	1.0000
2	0.7000	0.8000	0.5000	0.9000
4	0.7000	0.8000	0.5000	0.7000
12	0.6000	0.5000	0.4000	0.4000
24	0.6000	0.5000	0.4000	0.4000
48	0.6000	0.5000	0.4000	0.4000
72	0.5000	0.5000	0.4000	0.4000
96	0.5000	0.5000	0.4000	0.4000

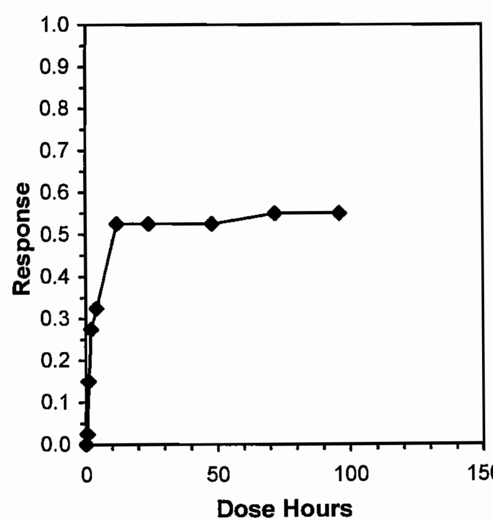
			Transform: Untransformed						1-Tailed		Isotonic	
Conc-Hours	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
0	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4				1.0000	1.0000
0.5	0.9750	0.9750	0.9750	0.9000	1.0000	5.128	4	0.357	2.540	0.1781	0.9750	0.9750
1	0.8500	0.8500	0.8500	0.7000	1.0000	15.188	4	2.139	2.540	0.1781	0.8500	0.8500
*2	0.7250	0.7250	0.7250	0.5000	0.9000	23.556	4	3.922	2.540	0.1781	0.7250	0.7250
*4	0.6750	0.6750	0.6750	0.5000	0.8000	18.642	4	4.635	2.540	0.1781	0.6750	0.6750
*12	0.4750	0.4750	0.4750	0.4000	0.6000	20.156	4	7.487	2.540	0.1781	0.4750	0.4750
*24	0.4750	0.4750	0.4750	0.4000	0.6000	20.156	4	7.487	2.540	0.1781	0.4750	0.4750
*48	0.4750	0.4750	0.4750	0.4000	0.6000	20.156	4	7.487	2.540	0.1781	0.4750	0.4750
*72	0.4500	0.4500	0.4500	0.4000	0.5000	12.830	4	7.844	2.540	0.1781	0.4500	0.4500
*96	0.4500	0.4500	0.4500	0.4000	0.5000	12.830	4	7.844	2.540	0.1781	0.4500	0.4500

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.96222	0.919	-0.2462	0.28143
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)	NOET	LOET	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	1	2	1.41421		0.1781	0.1781	0.19822	0.00983	2.1E-10	9, 30

Linear Interpolation (200 Resamples)

Point	Hours	SD	95% CL(Exp)		Skew
IT05	0.600	0.157	0.173	1.240	0.9174
IT10	0.800	0.186	0.480	1.579	1.2044
IT15	1.000	0.352	0.600	2.607	1.4602
IT20	1.400	0.534	0.582	3.562	0.7827
IT25	1.800	0.823	0.760	5.320	0.7784
IT40	7.000	1.757	1.799	11.800	-0.5099
IT50	11.000	14.147	8.835	85.560	1.6031



ToxCalc v5.0.23

Reviewed by: [signature]

Test: AC-Acute Fish Test
Species: AA-Atherinops affinis
Sample ID: 54 ppt RO Concentrate Comp
Start Date: 1/5/2007 18:05 End Date: 1/9/2007 16:10

Test ID: C070105.0262
Protocol: EPAA 02-EPA Acute
Sample Type: DMR-Discharge Monitoring Report
Lab ID: CCA-Weston, Carlsbad

Pos	ID	Rep	Hour	Start	# Alive	Notes
	1	1	0.000	10	10	
	2	2	0.000	10	10	
	3	3	0.000	10	10	
	4	4	0.000	10	10	
	5	1	0.500	10	10	
	6	2	0.500	10	10	
	7	3	0.500	10	9	
	8	4	0.500	10	10	
	9	1	1.000	10	8	
	10	2	1.000	10	9	
	11	3	1.000	10	7	
	12	4	1.000	10	10	
	13	1	2.000	10	7	
	14	2	2.000	10	8	
	15	3	2.000	10	5	
	16	4	2.000	10	9	
	17	1	4.000	10	7	
	18	2	4.000	10	8	
	19	3	4.000	10	5	
	20	4	4.000	10	7	
	21	1	12.000	10	6	
	22	2	12.000	10	5	
	23	3	12.000	10	4	
	24	4	12.000	10	4	
	25	1	24.000	10	6	
	26	2	24.000	10	5	
	27	3	24.000	10	4	
	28	4	24.000	10	4	
	29	1	48.000	10	6	
	30	2	48.000	10	5	
	31	3	48.000	10	4	
	32	4	48.000	10	4	
	33	1	72.000	10	5	
	34	2	72.000	10	5	
	35	3	72.000	10	4	
	36	4	72.000	10	4	
	37	1	96.000	10	5	
	38	2	96.000	10	5	
	39	3	96.000	10	4	
	40	4	96.000	10	4	

Comments: Used to compare survival of fish to time exposed to 54 ppt concentration.

Acute Fish Test

Start Date:	1/5/2007 18:05	Test ID:	C070105.0262	Sample ID:	56 ppt RO Concentrate Comp
End Date:	1/9/2007 16:10	Lab ID:	CCA-Weston, Carlsbad	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:	1/4/2007 08:00	Protocol:	EPAA 02-EPA Acute	Test Species:	AA-Atherinops affinis

Comments: Used to compare survival of fish to time exposed to 56 ppt concentration.

Conc-Hours	1	2	3	4
0	1.0000	1.0000	1.0000	1.0000
0.5	1.0000	1.0000	0.9000	1.0000
1	1.0000	1.0000	0.7000	1.0000
2	1.0000	0.9000	0.6000	1.0000
4	1.0000	0.7000	0.2000	0.7000
12	1.0000	0.7000	0.2000	0.4000
24	1.0000	0.7000	0.2000	0.3000
48	1.0000	0.7000	0.2000	0.3000
72	1.0000	0.7000	0.2000	0.3000
96	1.0000	0.7000	0.2000	0.3000

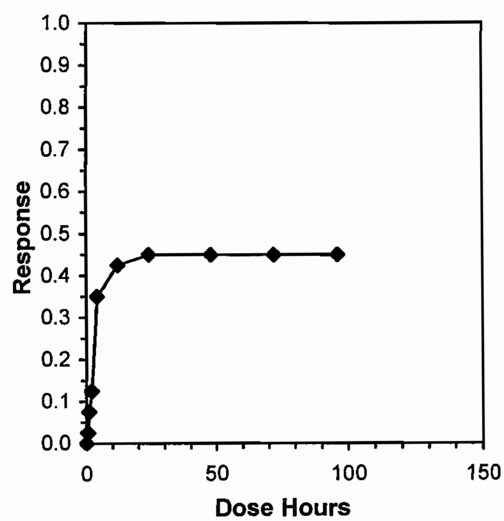
			Transform: Untransformed						1-Tailed		Isotonic	
Conc-Hours	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
0	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4				1.0000	1.0000
0.5	0.9750	0.9750	0.9750	0.9000	1.0000	5.128	4	0.122	2.540	0.5205	0.9750	0.9750
1	0.9250	0.9250	0.9250	0.7000	1.0000	16.216	4	0.366	2.540	0.5205	0.9250	0.9250
2	0.8750	0.8750	0.8750	0.6000	1.0000	21.634	4	0.610	2.540	0.5205	0.8750	0.8750
4	0.6500	0.6500	0.6500	0.2000	1.0000	51.025	4	1.708	2.540	0.5205	0.6500	0.6500
12	0.5750	0.5750	0.5750	0.2000	1.0000	60.870	4	2.074	2.540	0.5205	0.5750	0.5750
24	0.5500	0.5500	0.5500	0.2000	1.0000	67.215	4	2.196	2.540	0.5205	0.5500	0.5500
48	0.5500	0.5500	0.5500	0.2000	1.0000	67.215	4	2.196	2.540	0.5205	0.5500	0.5500
72	0.5500	0.5500	0.5500	0.2000	1.0000	67.215	4	2.196	2.540	0.5205	0.5500	0.5500
96	0.5500	0.5500	0.5500	0.2000	1.0000	67.215	4	2.196	2.540	0.5205	0.5500	0.5500

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.92623	0.919	0.14666	-0.6651
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)	NOET	LOET	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	96	>96			0.52055	0.52055	0.156	0.084	0.09845	9, 30

Linear Interpolation (200 Resamples)

Point	Hours	SD	95% CL(Exp)		Skew
IT05	0.7500	0.6153	0.0833	3.2646	0.7859
IT10	1.5000	0.8438	0.2989	4.7096	1.6439
IT15	2.2222	1.7731	0.1720	8.5770	4.3444
IT20	2.6667	2.7816	0.9950	18.0505	3.9266
IT25	3.1111	9.2279	1.2243	41.6843	5.0088
IT40	9.3333				
IT50	>96				



 ToxCalc v5.0.23 Reviewed by: [signature]

Test: AC-Acute Fish Test
Species: AA-Atherinops affinis
Sample ID: 56 ppt RO Concentrate Comp
Start Date: 1/5/2007 18:05 End Date: 1/9/2007 16:10

Test ID: C070105.0262
Protocol: EPAA 02-EPA Acute
Sample Type: DMR-Discharge Monitoring Report
Lab ID: CCA-Weston, Carlsbad

Pos	ID	Rep	Hour	Start	# Alive	Notes
	1	1	0.000	10	10	
	2	2	0.000	10	10	
	3	3	0.000	10	10	
	4	4	0.000	10	10	
	5	1	0.500	10	10	
	6	2	0.500	10	10	
	7	3	0.500	10	9	
	8	4	0.500	10	10	
	9	1	1.000	10	10	
	10	2	1.000	10	10	
	11	3	1.000	10	7	
	12	4	1.000	10	10	
	13	1	2.000	10	10	
	14	2	2.000	10	9	
	15	3	2.000	10	6	
	16	4	2.000	10	10	
	17	1	4.000	10	10	
	18	2	4.000	10	7	
	19	3	4.000	10	2	
	20	4	4.000	10	7	
	21	1	12.000	10	10	
	22	2	12.000	10	7	
	23	3	12.000	10	2	
	24	4	12.000	10	4	
	25	1	24.000	10	10	
	26	2	24.000	10	7	
	27	3	24.000	10	2	
	28	4	24.000	10	3	
	29	1	48.000	10	10	
	30	2	48.000	10	7	
	31	3	48.000	10	2	
	32	4	48.000	10	3	
	33	1	72.000	10	10	
	34	2	72.000	10	7	
	35	3	72.000	10	2	
	36	4	72.000	10	3	
	37	1	96.000	10	10	
	38	2	96.000	10	7	
	39	3	96.000	10	2	
	40	4	96.000	10	3	

Comments: Used to compare survival of fish to time exposed to 56 ppt concentration.

Acute Fish Test

Start Date:	1/5/2007 18:05	Test ID:	C070105.0262	Sample ID:	58 ppt RO Concentrate Comp
End Date:	1/9/2007 16:10	Lab ID:	CCA-Weston, Carlsbad	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:	1/4/2007 08:00	Protocol:	EPAA 02-EPA Acute	Test Species:	AA-Atherinops affinis

Comments: Used to compare survival of fish to time exposed to 58 ppt concentration.

Conc-Hours	1	2	3	4
0	1.0000	1.0000	1.0000	1.0000
0.5	1.0000	1.0000	0.8000	1.0000
1	1.0000	1.0000	0.5000	1.0000
2	0.9000	0.9000	0.5000	1.0000
4	0.9000	0.8000	0.5000	0.7000
12	0.8000	0.8000	0.5000	0.5000
24	0.8000	0.8000	0.5000	0.5000
48	0.8000	0.8000	0.5000	0.5000
72	0.8000	0.8000	0.5000	0.5000
96	0.8000	0.8000	0.5000	0.5000

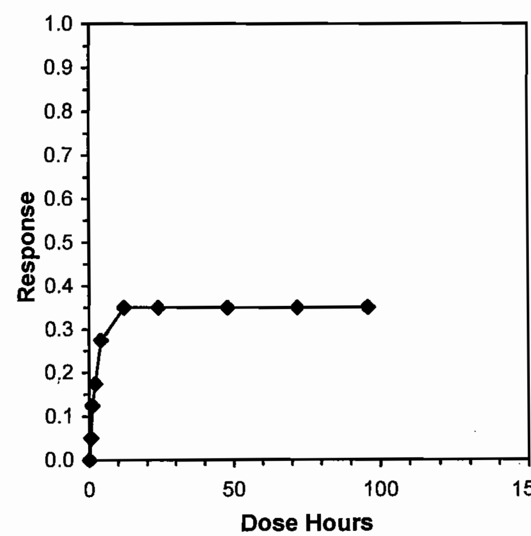
			Transform: Untransformed						1-Tailed		Isotonic	
Conc-Hours	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
0	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4				1.0000	1.0000
0.5	0.9500	0.9500	0.9500	0.8000	1.0000	10.526	4	0.408	2.540	0.3115	0.9500	0.9500
1	0.8750	0.8750	0.8750	0.5000	1.0000	28.571	4	1.019	2.540	0.3115	0.8750	0.8750
2	0.8250	0.8250	0.8250	0.5000	1.0000	26.877	4	1.427	2.540	0.3115	0.8250	0.8250
4	0.7250	0.7250	0.7250	0.5000	0.9000	23.556	4	2.242	2.540	0.3115	0.7250	0.7250
*12	0.6500	0.6500	0.6500	0.5000	0.8000	26.647	4	2.854	2.540	0.3115	0.6500	0.6500
*24	0.6500	0.6500	0.6500	0.5000	0.8000	26.647	4	2.854	2.540	0.3115	0.6500	0.6500
*48	0.6500	0.6500	0.6500	0.5000	0.8000	26.647	4	2.854	2.540	0.3115	0.6500	0.6500
*72	0.6500	0.6500	0.6500	0.5000	0.8000	26.647	4	2.854	2.540	0.3115	0.6500	0.6500
*96	0.6500	0.6500	0.6500	0.5000	0.8000	26.647	4	2.854	2.540	0.3115	0.6500	0.6500

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.862352	0.919	-0.64117	-0.62886
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)	NOET	LOET	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	4	12	6.928203		0.311517	0.311517	0.076806	0.030083	0.026038	9, 30

Linear Interpolation (200 Resamples)

Point	Hours	SD	95% CL(Exp)		Skew
IT05	0.5000	0.5035	0.0000	2.9000	1.2106
IT10	0.8333	0.6940	0.0333	3.7667	0.7702
IT15	1.5000	0.8912	0.0950	4.8067	0.7341
IT20	2.5000	1.7351	0.0000	8.8600	2.6173
IT25	3.5000	3.8666	0.0000	23.5000	2.1085
IT40	>96				
IT50	>96				



 ToxCalc v5.0.23 Reviewed by: [signature]

Test: AC-Acute Fish Test
Species: AA-Atherinops affinis
Sample ID: 58 ppt RO Concentrate Comp
Start Date: 1/5/2007 18:05 End Date: 1/9/2007 16:10

Test ID: C070105.0262
Protocol: EPAA 02-EPA Acute
Sample Type: DMR-Discharge Monitoring Report
Lab ID: CCA-Weston, Carlsbad

Pos	ID	Rep	Hour	Start	# Alive	Notes
	1	1	0.000	10	10	
	2	2	0.000	10	10	
	3	3	0.000	10	10	
	4	4	0.000	10	10	
	5	1	0.500	10	10	
	6	2	0.500	10	10	
	7	3	0.500	10	8	
	8	4	0.500	10	10	
	9	1	1.000	10	10	
	10	2	1.000	10	10	
	11	3	1.000	10	5	
	12	4	1.000	10	10	
	13	1	2.000	10	9	
	14	2	2.000	10	9	
	15	3	2.000	10	5	
	16	4	2.000	10	10	
	17	1	4.000	10	9	
	18	2	4.000	10	8	
	19	3	4.000	10	5	
	20	4	4.000	10	7	
	21	1	12.000	10	8	
	22	2	12.000	10	8	
	23	3	12.000	10	5	
	24	4	12.000	10	5	
	25	1	24.000	10	8	
	26	2	24.000	10	8	
	27	3	24.000	10	5	
	28	4	24.000	10	5	
	29	1	48.000	10	8	
	30	2	48.000	10	8	
	31	3	48.000	10	5	
	32	4	48.000	10	5	
	33	1	72.000	10	8	
	34	2	72.000	10	8	
	35	3	72.000	10	5	
	36	4	72.000	10	5	
	37	1	96.000	10	8	
	38	2	96.000	10	8	
	39	3	96.000	10	5	
	40	4	96.000	10	5	

Comments: Used to compare survival of fish to time expoused to 58 ppt concentration.

 ToxCalc 5.0 Reviewed by: [signature]

Acute Fish Test

Start Date:	1/5/2007 18:05	Test ID:	C070105.0262	Sample ID:	60 ppt RO Concentrate Comp
End Date:	1/9/2007 16:10	Lab ID:	CCA-Weston, Carlsbad	Sample Type:	DMR-Discharge Monitoring Report
Sample Date:	1/4/2007 08:00	Protocol:	EPAA 02-EPA Acute	Test Species:	AA-Atherinops affinis

Comments: Used to compare survival of fish to time exposed to 60 ppt concentration.

Conc-Hours	1	2	3	4
0	1.0000	1.0000	1.0000	1.0000
0.5	1.0000	1.0000	1.0000	1.0000
1	1.0000	1.0000	1.0000	1.0000
2	0.9000	0.9000	0.8000	1.0000
4	0.5000	0.8000	0.7000	0.7000
12	0.3000	0.3000	0.4000	0.5000
24	0.3000	0.3000	0.4000	0.5000
48	0.3000	0.3000	0.4000	0.5000
72	0.3000	0.3000	0.4000	0.5000
96	0.3000	0.3000	0.4000	0.5000

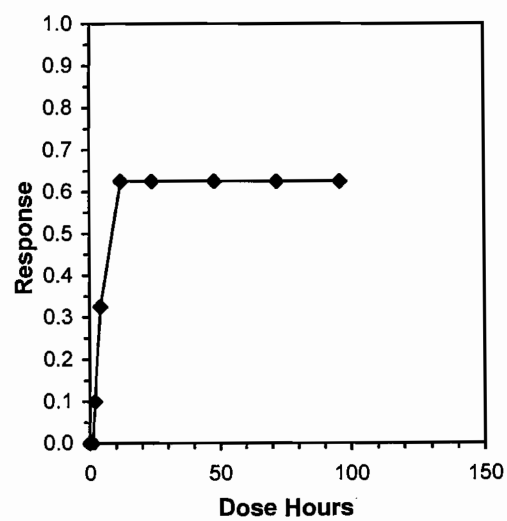
			Transform: Untransformed						1-Tailed		Isotonic	
Conc-Hours	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
0	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4				1.0000	1.0000
0.5	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4	0.000	2.540	0.1485	1.0000	1.0000
1	1.0000	1.0000	1.0000	1.0000	1.0000	0.000	4	0.000	2.540	0.1485	1.0000	1.0000
2	0.9000	0.9000	0.9000	0.8000	1.0000	9.072	4	1.711	2.540	0.1485	0.9000	0.9000
*4	0.6750	0.6750	0.6750	0.5000	0.8000	18.642	4	5.560	2.540	0.1485	0.6750	0.6750
*12	0.3750	0.3750	0.3750	0.3000	0.5000	25.531	4	10.692	2.540	0.1485	0.3750	0.3750
*24	0.3750	0.3750	0.3750	0.3000	0.5000	25.531	4	10.692	2.540	0.1485	0.3750	0.3750
*48	0.3750	0.3750	0.3750	0.3000	0.5000	25.531	4	10.692	2.540	0.1485	0.3750	0.3750
*72	0.3750	0.3750	0.3750	0.3000	0.5000	25.531	4	10.692	2.540	0.1485	0.3750	0.3750
*96	0.3750	0.3750	0.3750	0.3000	0.5000	25.531	4	10.692	2.540	0.1485	0.3750	0.3750

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.89025	0.919	0.15935	-0.0825
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)	NOET	LOET	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	2	4	2.82843		0.14847	0.14847	0.35933	0.00683	6.4E-16	9, 30

Linear Interpolation (200 Resamples)

Point	Hours	SD	95% CL(Exp)		Skew
IT05	1.5000	0.2499	1.1571	2.5680	0.9107
IT10	2.0000	0.2547	1.3143	2.8013	0.1212
IT15	2.4444	0.2663	1.5048	3.3333	-0.2839
IT20	2.8889	0.3003	2.1067	4.0267	0.0375
IT25	3.3333	0.4021	2.5329	5.2171	0.5887
IT40	6.0000	1.2092	2.5293	8.8632	-0.5447
IT50	8.6667.	0.9805	5.9891	11.4507	-1.4042



 ToxCalc v5.0.23 Reviewed by:

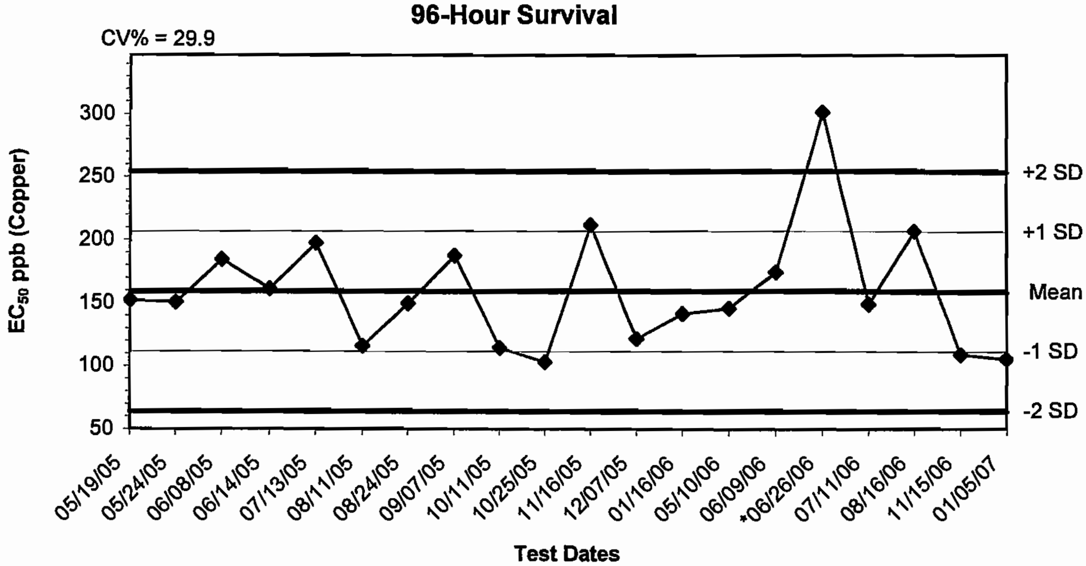
Test: AC-Acute Fish Test	Test ID: C070105.0262
Species: AA-Atherinops affinis	Protocol: EPAA 02-EPA Acute
Sample ID: 60 ppt RO Concentrate Comp	Sample Type: DMR-Discharge Monitoring Report
Start Date: 1/5/2007 18:05 End Date: 1/9/2007 16:10	Lab ID: CCA-Weston, Carlsbad

Pos	ID	Rep	Hour	Start	# Alive	Notes
	1	1	0.000	10	10	
	2	2	0.000	10	10	
	3	3	0.000	10	10	
	4	4	0.000	10	10	
	5	1	0.500	10	10	
	6	2	0.500	10	10	
	7	3	0.500	10	10	
	8	4	0.500	10	10	
	9	1	1.000	10	10	
	10	2	1.000	10	10	
	11	3	1.000	10	10	
	12	4	1.000	10	10	
	13	1	2.000	10	9	
	14	2	2.000	10	9	
	15	3	2.000	10	8	
	16	4	2.000	10	10	
	17	1	4.000	10	5	
	18	2	4.000	10	8	
	19	3	4.000	10	7	
	20	4	4.000	10	7	
	21	1	12.000	10	3	
	22	2	12.000	10	3	
	23	3	12.000	10	4	
	24	4	12.000	10	5	
	25	1	24.000	10	3	
	26	2	24.000	10	3	
	27	3	24.000	10	4	
	28	4	24.000	10	5	
	29	1	48.000	10	3	
	30	2	48.000	10	3	
	31	3	48.000	10	4	
	32	4	48.000	10	5	
	33	1	72.000	10	3	
	34	2	72.000	10	3	
	35	3	72.000	10	4	
	36	4	72.000	10	5	
	37	1	96.000	10	3	
	38	2	96.000	10	3	
	39	3	96.000	10	4	
	40	4	96.000	10	5	

Comments: Used to compare survival of fish to time exposed to 60 ppt concentration.

 ToxCalc 5.0 Reviewed by: [signature]

Atherinops affinis Reference Toxicant Control Chart:
96-Hour Survival



Dates	Values	Mean	-1 SD	-2 SD	+1 SD	+2 SD
05/19/05	152.2400	159.0758	111.5070	63.9382	206.6446	254.2134
05/24/05	150.3620	159.0758	111.5070	63.9382	206.6446	254.2134
06/08/05	184.3200	159.0758	111.5070	63.9382	206.6446	254.2134
06/14/05	160.9600	159.0758	111.5070	63.9382	206.6446	254.2134
07/13/05	197.3020	159.0758	111.5070	63.9382	206.6446	254.2134
08/11/05	115.8480	159.0758	111.5070	63.9382	206.6446	254.2134
08/24/05	149.5050	159.0758	111.5070	63.9382	206.6446	254.2134
09/07/05	187.2600	159.0758	111.5070	63.9382	206.6446	254.2134
10/11/05	114.3980	159.0758	111.5070	63.9382	206.6446	254.2134
10/25/05	103.1990	159.0758	111.5070	63.9382	206.6446	254.2134
11/16/05	211.7200	159.0758	111.5070	63.9382	206.6446	254.2134
12/07/05	121.6290	159.0758	111.5070	63.9382	206.6446	254.2134
01/16/06	141.4220	159.0758	111.5070	63.9382	206.6446	254.2134
05/10/06	145.3200	159.0758	111.5070	63.9382	206.6446	254.2134
06/09/06	174.0000	159.0758	111.5070	63.9382	206.6446	254.2134
*06/26/06	301.4970	159.0758	111.5070	63.9382	206.6446	254.2134
07/11/06	148.8500	159.0758	111.5070	63.9382	206.6446	254.2134
08/16/06	206.7660	159.0758	111.5070	63.9382	206.6446	254.2134
11/15/06	109.2980	159.0758	111.5070	63.9382	206.6446	254.2134
01/05/07	105.6200	159.0758	111.5070	63.9382	206.6446	254.2134

*Value out of 95% CI range.
Updated 1/12/07 EB

Acute Fish Test-96 Hr Survival

Start Date:	1/5/2007 16:40	Test ID:	C060525.74	Sample ID:	REF-Ref Toxicant
End Date:	1/9/2007 14:50	Lab ID:	CCA-Weston Solutions Carls	Sample Type:	CUSO-Copper sulfate
Sample Date:		Protocol:	EPAA 02-EPA Acute	Test Species:	AA-Atherinops affinis
Comments:					

Conc-ppb	1	2	3	4
Control	1.0000	1.0000	1.0000	1.0000
25	0.9000	1.0000	1.0000	1.0000
50	1.0000	0.9000	0.9000	1.0000
100	0.7000	0.6000	0.6000	0.5000
200	0.0000	0.0000	0.0000	0.1000
400	0.0000	0.0000	0.0000	0.0000

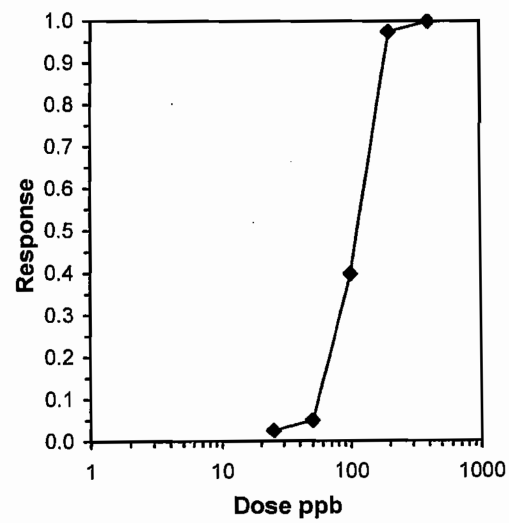
			Transform: Arcsin Square Root					Rank	1-Tailed	Number	Total
Conc-ppb	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical	Resp	Number
Control	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	4			0	40
25	0.9750	0.9750	1.3713	1.2490	1.4120	5.942	4	16.00	10.00	1	40
50	0.9500	0.9500	1.3305	1.2490	1.4120	7.072	4	14.00	10.00	2	40
*100	0.6000	0.6000	0.8872	0.7854	0.9912	9.469	4	10.00	10.00	16	40
*200	0.0250	0.0250	0.1995	0.1588	0.3218	40.840	4	10.00	10.00	39	40
*400	0.0000	0.0000	0.1588	0.1588	0.1588	0.000	4	10.00	10.00	40	40

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.94414	0.884	0.0141	-0.0718
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	50	100	70.7107	

Trimmed Spearman-Karber

Trim Level	EC50	95% CL	
0.0%			
5.0%	107.02	94.60	121.07
10.0%	108.00	94.15	123.88
20.0%	109.93	91.09	132.68
Auto-2.5%	105.62	93.09	119.85



 ToxCalc v5.0.23 Reviewed by: am

Test: AC-Acute Fish Test		Test ID: C060525.74
Species: AA-Atherinops affinis		Protocol: EPAA 02-EPA Acute
Sample ID: REF-Ref Toxicant		Sample Type: CUSO-Copper sulfate
Start Date: 1/5/2007 16:40	End Date: 1/9/2007 14:50	Lab ID: CCA-Weston Solutions Carlsbad, CA

Pos	ID	Rep	Group	Start	24 Hr	48 Hr	72 Hr	96 Hr	Notes
	1	1	Control	10				10	
	2	2	Control	10				10	
	3	3	Control	10				10	
	4	4	Control	10				10	
	5	1	25.000	10				9	
	6	2	25.000	10				10	
	7	3	25.000	10				10	
	8	4	25.000	10				10	
	9	1	50.000	10				10	
	10	2	50.000	10				9	
	11	3	50.000	10				9	
	12	4	50.000	10				10	
	13	1	100.000	10				7	
	14	2	100.000	10				6	
	15	3	100.000	10				6	
	16	4	100.000	10				5	
	17	1	200.000	10				0	
	18	2	200.000	10				0	
	19	3	200.000	10				0	
	20	4	200.000	10				1	
	21	1	400.000	10				0	
	22	2	400.000	10				0	
	23	3	400.000	10				0	
	24	4	400.000	10				0	

Comments:

WESTON SOLUTIONS

96 Hour Topsmelt
Reference Toxicant Test

Test ID: 060525.74	Replicates: 4	Study Director: E. Bathker	Location: Rm 3
Dilution Water Batch: SIO122906	Organism Batch: ABS 7444	Associated Test(s): Poseidon	No. of Organisms: 10

Toxicant: Copper Sulfate (0.509gCu/LCuSO$_4$	Lot #: 1605565	Date Prepared: (stock) 11/28/06	Initials: VS

Target Concentrations: 400 ppb	Quantity of Stock: Target: 1.572 mL	Quantity of Diluent: Target: 2000 mL
400 ppb	Actual: 1.5720	Actual: 2000.0

Serial Dilute by ½ to obtain concentrations of 200, 100, 50, and 25 ppb.

0 Hours Date: 1/5/07 WQ Time: 1540 EB Start Time: 1640 Initials: AL

STOCK

	Control	25	50	100	200	400
D.O. (mg/L)	7.4	7.3	7.3	7.2	7.2	7.2
Temperature	21.6	21.6	21.5	21.5	21.4	21.4
Salinity	33.1	33.1	33.1	33.1	33.1	33.1
pH	8.0	8.2	8.2	8.2	8.2	8.2

24 Hours Date: 1/6/07 Time: 1530 Initials: VS

Renewal Information Toxicant Amount: 1.5728 Diluent Amount: 2000.4 Initials: VS

	Control	25	50	100	200	400
No. Alive Rep 1	10	9(1)	10	8(2)	2(8)	Ø(10)
No. Alive Rep 2	10	10	9(1)	8(2)	Ø(10)	Ø(10)
No. Alive Rep 3	10	10	9(1)	8(2)	1(9)	Ø(10)
No. Alive Rep 4	10	10	10	8(2)	3(7)	Ø(10)

48 Hours Date: 1/7/07 Time: 1507 Initials: VS

Renewal Information Toxicant Amount: 0.7860 Diluent Amount: 2000.0 Initials: VS

	Control	25	50	100	200	400
No. Alive Rep 1	10	9	10	8	1(1)	—
No. Alive Rep 2	10	10	9	7(1)	—	—
No. Alive Rep 3	10	10	9	6(2)	Ø(1)	—
No. Alive Rep 4	10	10	10	7(1)	1(2)	—

WESTON SOLUTIONS

96 Hour Topsmelt
Reference Toxicant Test

C06052574

72 Hours	Date: 1/8/07		Time: 1250		Initials: VS	
Renewal Information	Toxicant Amount: 0.7863		Diluent Amount: 2000.8		Initials: VS	
	Control	25	50	100	200	400
No. Alive Rep 1	10	9	10	7(1)	ø(1)	—
No. Alive Rep 2	10	10	9	6(1)	—	—
No. Alive Rep 3	10	10	9	6	—	—
No. Alive Rep 4	10	10	10	5(2)	1	—

96 Hours Date: 1/9/07 WQ Time: 1035 am Replicate: 4 Initials: AM

STOCK

	Control	25	50	100	200	400
D.O. (mg/L)	6.1	6.2	6.1	6.8	7.1	
Temperature	20.8	20.7	20.8	20.7	20.6	
Salinity	33.7	33.7	33.7	33.7	33.6	
pH	7.9	7.9	7.9	7.9	8.0	

96 Hour Survival Data End Time: 1450 Initials: [illegible]

	Control	25	50	100	200	400
No. Alive Rep 1	10	9	10	7	—	—
No. Alive Rep 2	10	10	9	6	—	—
No. Alive Rep 3	10	10	9	6	—	—
No. Alive Rep 4	10	10	10	5	1	—

☒ Pass ☐ Fail

Notes:

WESTON SOLUTIONS

BIOASSAY SAMPLE RECEIPT

Client: Poseidon	Project: Desal Pilot Topsmelt Toxicity Study		
Weston Sample ID:	C070104.01	C070104.02	C070104.03
Client Sample ID:	UF Filtrate	RO Concentrate	UF Filtrate
Renewal Sample (Y/N):	N	N	N
Date/Time Received:	1/4/07 1020	1/4/07 1020	1/4/07 1020
Airbill #:	N/A	N/A	N/A
Sample Tracking Information Kept for Records: (Y/N)	N/A	N/A	N/A
Collection Date/Time:	1/3/07 composite at 0800 & 1600	1/3/07 composite at 0800 & 1600	1/4/07 composite at 0000 & 0800
Condition of Shipping Container:	good	good	good
Type and Capacity of Sample Container:	20L cubi	20L cubi	20L cubi
Total Sample Volume (L):	20L	20L	20L
Condition of Sampling Container:	good	good	good
Sample Container Appropriate: (Y/N)	y	y	y
Custody Seals Intact: (Y/N)	N/A	N/A	N/A
Ice or Frozen Blue Ice Present During Shipment/Transport: (Y/N)	y	y	y
Sampler's Name Present on COC Form: (Y/N)	y	y	y

TAKE THE FOLLOWING MEASUREMENTS UPON ARRIVAL

WESTON ID	Temp. (°C) (0-6°C) *	Dissolved Oxygen (mg/L)	pH	Conductivity (mS/cm) or Salinity (ppt)	Hardness (mg $CaCO_3$/L)	Alkalinity (mg $CaCO_3$/L)	Total Chlorine (mg/L)	Total Ammonia (mg NH_3/L)	Tech
C070104.01	14.9	7.9	7.9	33.0	—	—	0.00	<0.5	EB/JH
C070104.02	14.1	7.2	7.8	66.6	—	—	0.00	<0.5	EB/JH
C070104.03	15.3	7.8	8.1	33.3	—	—	0.01	<0.5	EB/JH

*Notify project manager or study director of temperatures above 6°C. Client must be notified ASAP.

If there are sample receipt problems, complete the following:

Reason for unacceptability:	
Name of Client Contact:	Contacted by:
Client Response and/or Action to be Taken:	Date Action Taken:

WESTON SOLUTIONS

BIOASSAY SAMPLE RECEIPT

Client: Poseidon	Project: Desal Pilot Topsmelt Toxicity Study		
Weston Sample ID:	C070104.04		
Client Sample ID:	RO Concentrate		
Renewal Sample (Y/N):	N		
Date/Time Received:	1/4/07 1020		
Airbill #:	N/A		
Sample Tracking Information Kept for Records: (Y/N)	N/A		
Collection Date/Time:	1/4/07 composite 0000 to 0800		
Condition of Shipping Container:	good		
Type and Capacity of Sample Container:	20L cubi		
Total Sample Volume (L):	20L		
Condition of Sampling Container:	good		
Sample Container Appropriate: (Y/N)	Y		
Custody Seals Intact: (Y/N)	Y		
Ice or Frozen Blue Ice Present During Shipment/Transport: (Y/N)	Y		
Sampler's Name Present on COC Form: (Y/N)	Y		

TAKE THE FOLLOWING MEASUREMENTS UPON ARRIVAL

WESTON ID	Temp. (°C) (0-6°C) *	Dissolved Oxygen (mg/L)	pH	Conductivity (mS/cm) or Salinity (ppt)	Hardness (mg $CaCO_3$/L)	Alkalinity (mg $CaCO_3$/L)	Total Chlorine (mg/L)	Total Ammonia (mg NH_3/L)	Tech
C070104.04	16.4	7.1	7.8	66.3	—	—	0.01	<0.5	EB/JH

*Notify project manager or study director of temperatures above 6°C. Client must be notified ASAP.

If there are sample receipt problems, complete the following:

Reason for unacceptability:	
Name of Client Contact:	Contacted by:
Client Response and/or Action to be Taken:	Date Action Taken:

WESTON SOLUTIONS

BIOASSAY SAMPLE RECEIPT

Client: Poseidon		Project: Desal Pilot Topsmelt Toxicity Study	
Weston Sample ID:	C070105.01	C070105.02	
Client Sample ID:	UF Filtrate-Comp	RO-Concentrate-Comp	
Renewal Sample (Y/N):	N	N	
Date/Time Received:	1/5/07 1040	1/5/07 1040	
Airbill #:	N/A	N/A	
Sample Tracking Information Kept for Records: (Y/N)	N/A	N/A	
Collection Date/Time:	1/5/07 ①cr 1040	1/5/07 ①cr 1040	
Condition of Shipping Container:	good	good	
Type and Capacity of Sample Container:	20 L x 2	20 L x 2	
Total Sample Volume (L):	40 L	40 L	
Condition of Sampling Container:	good	good	
Sample Container Appropriate: (Y/N)	Y	Y	
Custody Seals Intact: (Y/N)	N/A	N/A	
Ice or Frozen Blue Ice Present During Shipment/Transport: (Y/N)	Y	Y	
Sampler's Name Present on COC Form: (Y/N)	Y	Y	

TAKE THE FOLLOWING MEASUREMENTS UPON ARRIVAL

WESTON ID	Temp. (°C) (0-6°C) *	Dissolved Oxygen (mg/L)	pH	Conductivity (mS/cm) or Salinity (ppt)	Hardness (mg $CaCO_3$/L)	Alkalinity (mg $CaCO_3$/L)	Total Chlorine (mg/L)	Total Ammonia (mg NH_3/L)	Tech
C070105.01	7.4	9.3	8.2	32.9	—	—	0.01		KS
C070105.02	6.9	8.3	8.0	66.4	—	—	0.00		KS

*Notify project manager or study director of temperatures above 6°C. Client must be notified ASAP.

If there are sample receipt problems, complete the following:

Reason for unacceptability:	
Name of Client Contact:	Contacted by:
Client Response and/or Action to be Taken:	Date Action Taken:

① Time that comp was created. 1/10/07 cr

WESTON SOLUTIONS

☑ 2433 Impala Drive • Carlsbad, CA 92008 • (760) 931-8081, FAX 931-1580
☐ 98 Main St., Ste. #428 • Tiburon, CA 94920 • (415) 435-1847, FAX 435-0479
☐ 1440 Broadway, Ste. 908 • Oakland, CA 94612 • (510) 808-0302, FAX 891-9710
☐ 152 Sunset View Lane • Sequim, WA 98382 • (360) 582-1758, FAX 582-1679
☐ 4729 NE View Drive • Port Gamble, WA 98364 • (360) 297-6903, FAX 297-6905

CHAIN OF CUSTODY
13576

DATE 1-4-07 PAGE 1 OF 1

PROJECT NAME / SURVEY / PROJECT NUMBER: DESAL PILOT TOPSMELT TOXICITY STUDY
PROJECT MANAGER:
COMPANY: POSEIDON
ADDRESS: 4600 CARLSBAD BLVD
PHONE/~~FAX~~: 760-438-4843

	SAMPLE I.D.	DATE	TIME	MATRIX	INITIALS	NUMBER & TYPE OF CONTAINERS	ANALYSIS/TEST REQUESTED					PRESERVED HOW/ COMMENTS	SAMPLE TEMP. UPON RECEIPT (FOR WESTON USE ONLY)	WESTON LAB ID (FOR WESTON USE ONLY)
②	UF FILTRATE	1/3	16:00	RSW	DM	1						N/A	14.9	C070104.01
①	RO CONCENTRATE	1/3	16:00	RSW	DM	1							14.1	C070104.02
②	UF FILTRATE	1/4	8:00	RSW	DM	1							15.3	C070104.03
①	RO CONCENTRATE	1/4	8:00	RSW	DM	1							16.4	C070104.04

SPECIAL INSTRUCTIONS/COMMENTS: 1/3 COMPOSITE SAMPLE TAKEN AT 0800 & 1600 (EACH UF & RO)
1/4 " " " 0000 & 0800

SHIPPING:
Shipping VIA:
Airbill No:

SAMPLE CONDITION UPON RECEIPT (FOR WESTON USE ONLY):

	RELINQUISHED BY	RECEIVED BY	RELINQUISHED BY	RECEIVED BY	RELINQUISHED BY	RECEIVED BY
Signature	Daniel J. Marcon	Elizabeth M Bottlin	Elizabeth M. Bottlin	Yasey Scriven		
Firm	POSEIDON	Weston Solutions	Weston Solutions	Weston Solutions		
Date/Time	1-4-07	1/4/07 0950	1/4/07 1020	1/4/07 1020		

WHITE – return to originator • YELLOW – lab • PINK – retained by originator

① Both RO Concentrate samples composited in Lab to create 24 hr. Composite. New sample name RO Concentrate Comp. 1/5/07
② Both UF Fitrate samples composited in Lab to create 24 hr composite. New sample name UF Fitrate Comp. 1/5/07

ATTACHMENT 3

NEAR-SHORE SALINE EFFECTS DUE TO REDUCED FLOW RATE SCENARIOS DURING STAND-ALONE OPERATIONS OF THE CARLSBAD DESALINATION PROJECT AT ENCINA GEENRATING STATION

Near-shore Hyper-Saline Effects due to Reduced Flow Rate Scenarios during Stand-Alone Operations of the Carlsbad Desalination Project at Encina Generating Station

Submitted by:
Scott A. Jenkins, Ph. D. and Joseph Wasyl
Dr. Scott A. Jenkins Consulting
14765 Kalapana Street, Poway, CA 92064

Submitted to:
Poseidon Resources
501 West Broadway
San Diego, CA 92101

12 January 2007

TABLE OF CONTENTS:

ABSTRACT:

This study evaluates the dispersion and dilution of concentrated sea water (brine) associated with reduced flow rate operations of a stand alone desalination plant co-located at Encina Generating Station. The analysis by hydrodynamic model simulation studied the effects of reduced intake flow rates ranging from 149.8 mgd to 304 mgd for both extreme minimums and means in ocean mixing. The results are summarized in Table 1 on page 67.

We find that intake flow rates of at least 218.9 mgd of unheated source water (producing end of pipe salinity of no more than 43.3 ppt) will satisfy both acute toxicity limits of 40 ppt and existing minimum dilution standards of 15 to 1 in the *zone of initial dilution* (ZID) for all ocean mixing conditions. Intake flow rates reduced to as little as 184.3 mgd (producing end of pipe salinity of no more than 46 ppt) will satisfy both acute toxicity limits existing minimum dilution standards for average ocean mixing conditions but not for extreme minimum mixing conditions having a recurrence probability of 0.013 %. Intake flow rates between 149.8 mgd and 172.8 mgd produce hyper salinity impacts that can probably be tolerated by indigenous marine organisms during mean-ocean mixing conditions, but result in unacceptably low minimum dilution levels in the ZID according to existing NPDES permit limits set for the power plant thermal effluent.

1) Introduction:

This study evaluates the dispersion and dilution of concentrated sea water (brine) associated with reduced flow rate operations of a stand alone desalination plant co-located at Encina Generating Station. The generating station presently consumes lagoon water at an average rate of about 530 mgd, and discharges that that flow volume into the ocean at a temperature elevated above ambient by $\Delta T = 5.5^0$ C on average. Here we evaluate the production of 50 mgd of potable water by reverse osmosis (R.O.) using only 150-219 mgd of intake flow rate that remains unheated, $\Delta T = 0^0$ after blending with the brine by-product. The minimum flow rate evaluated in the certified project EIR involves intake flow rates of 304 mgd and was referred to as the "unheated historical extreme" because it combined a low flow rate condition with the historic minimum in ocean mixing to capture a worst case scenario assessment. We repeat that worst case assessment herein using even smaller intake flow rates that provide less initial dilution and higher end-of-pipe salinity. We also evaluate these low flow rate scenarios using average ocean mixing conditions to provide an indication of the more likely long term effects.

2) Initial Conditions:

The technical approach used to evaluate these new low flow rate scenarios involved the use of hydrodynamic transport models as detailed in Appendix E of the certified EIR (Jenkins and Wasyl, 2005). The initialization of those models is detailed below.

A) Flow Rates and Discharge Salinity: The power plant cooling water is drawn from the lagoon and is discharged into the ocean through an independent discharge channel located between Middle Beach and South Beach. The existing cascade of circulation and service water pumps available at Encina Generating

Station can provide a maximum once-through flow rate of 808 mgd, but has averaged about 530 over the long term (Jenkins and Wasyl, 2001). During peak user demand months for power (summer), plant flow rates are typically between 635 and 670 mgd (Elwany, et al, 2005). In the present analysis, we consider four new scenarios of reduced flow rate desalination operations producing the following discharge flow rates and end-of-pipe salinity:

Scenario 1 - Utilizing One Encina Intake Pump of Unit 5

Intake Flow Rate = 149.76 mgd of which
50 mgd – turns into potable water;
50 mgd is brine concentrate with salinity of 67 ppt
49.76 mgd – dilution water for the concentrate ($\Delta T = 0^0$)
Discharge Flow Rate = 99.76
End-of-pipe salinity = 50.3 ppt

Scenario 2 - Utilizing all pumps of Units 1 & 2 and one pump of Unit 3

Intake Flow Rate = 34.56 MGD x 5 pumps = 172.8 mgd of which
50 mgd – turns into potable water;
50 mgd is brine concentrate with salinity of 67 ppt
72.8 mgd – dilution water for the concentrate ($\Delta T = 0^0$)
Discharge Flow Rate = 122.8 mgd
End-of-pipe salinity = 47.1 ppt

Scenario 3 - Utilizing One Encina Intake Pump of Unit 5 + One Unit 1 Pump

Intake Flow Rate = 149.76 mgd + 34.56 = 184.32 of which
50 mgd – turns into potable water;
50 mgd is concentrate of salinity of 67,000 mg/L
84.32 mgd – dilution water for the concentrate ($\Delta T = 0^0$)
Discharge Flow Rate = 134.82 mgd
End-of-pipe salinity = 46 ppt

Scenario 4 - Utilizing One Encina Intake Pump of Unit 5 + Two Unit 1 Pumps

Intake Flow Rate = 149.76 mgd + 34.56 + 34.56 = 218.88 mgd of which
50 mgd – turns into potable water;
50 mgd is concentrate of salinity of 67,000 mg/L
118.88 mgd – dilution water for the concentrate ($\Delta T = 0^0$)
Discharge Flow Rate = 168.88 mgd
End-of-pipe salinity = 43.4 ppt

In addition to these four new low flow rate scenarios, we will also include the "Unheated Unit 4 Extreme Case" that was reported in Appendix E of the certified EIR (Jenkins and Wasyl, 2005). We will refer to this as the Scenario 5 low flow case that is characterized as follows:

Scenario 5 - Utilizing Two Encina Intake Pumps of Unit 4

Intake Flow Rate = 152.76 mgd x 2 = 304 mgd of which
50 mgd – turns into potable water;
50 mgd is concentrate of salinity of 67,000 mg/L
204 mgd – dilution water for the concentrate ($\Delta T = 0^0$)
Discharge Flow Rate = 254 mgd
End-of-pipe salinity = 40.11 ppt

B) Ocean Mixing Variables: Altogether there are six variables that enter into a solution for resolving the dispersion and dilution of the unheated concentrated seawater by-product discharged from the stand-alone desalination plant. These *mixing variables* may be organized into *boundary conditions* and *forcing functions*. The boundary conditions include: ocean salinity, ocean temperature and ocean water levels. The forcing function variables include waves, currents, and winds.

Overlapping 20.5 year long records of the boundary condition and forcing function variables are reconstructed in Sections 3.1 and 3.2 of Jenkins and Wasyl (2005) found in Appendix E of the certified EIR. These records contain 7,523 consecutive daily observations of each variable between 1980 and the middle of 2000. For clarity, these long term records are plotted here in Figures 1 and 2. We search this 20.5 year period for the historical combination of these variables that give an historic extreme day in the sense of benign ocean conditions that minimize mixing and dilution rates. We then overlay each of the four low flow rate scenarios on those extremely benign ocean conditions. The criteria for the historical extreme day was based on the simultaneous occurrence of the environmental variables having the highest combination of absolute salinity and temperature during the periods of minimal wave, wind, currents, and ocean water levels (including both tidal oscillations and climatic sea level anomalies). We repeat the analysis using average ocean mixing conditions. The average day scenarios were based on the 20.5 yr mean of the 6 ocean mixing variables.

C) Historical Extreme Case Assignments : The joint probability analysis produced a historical extreme day solution for 17 August 1992. This day is represented by the vertical dashed red line in Figures 1 and 2. The monthly period containing these extreme events are shown in Figures 3 and 4. The environmental factors of this day were associated with a building El Niño that subsequently climaxed in the winter of 1993. The ocean salinity was 33.51ppt, about the same as the long term mean, but the ocean temperature was 25.0 °C, within 0.1 °C of the 20.5 year maximum. The waves were only 0.16 m, which was the 20.5 year minimum. Winds were 3.4 knots and the maximum tidal current in the offshore domain was only 27.5 cm/sec (0.53 knots). The sluggish tidal current was due to

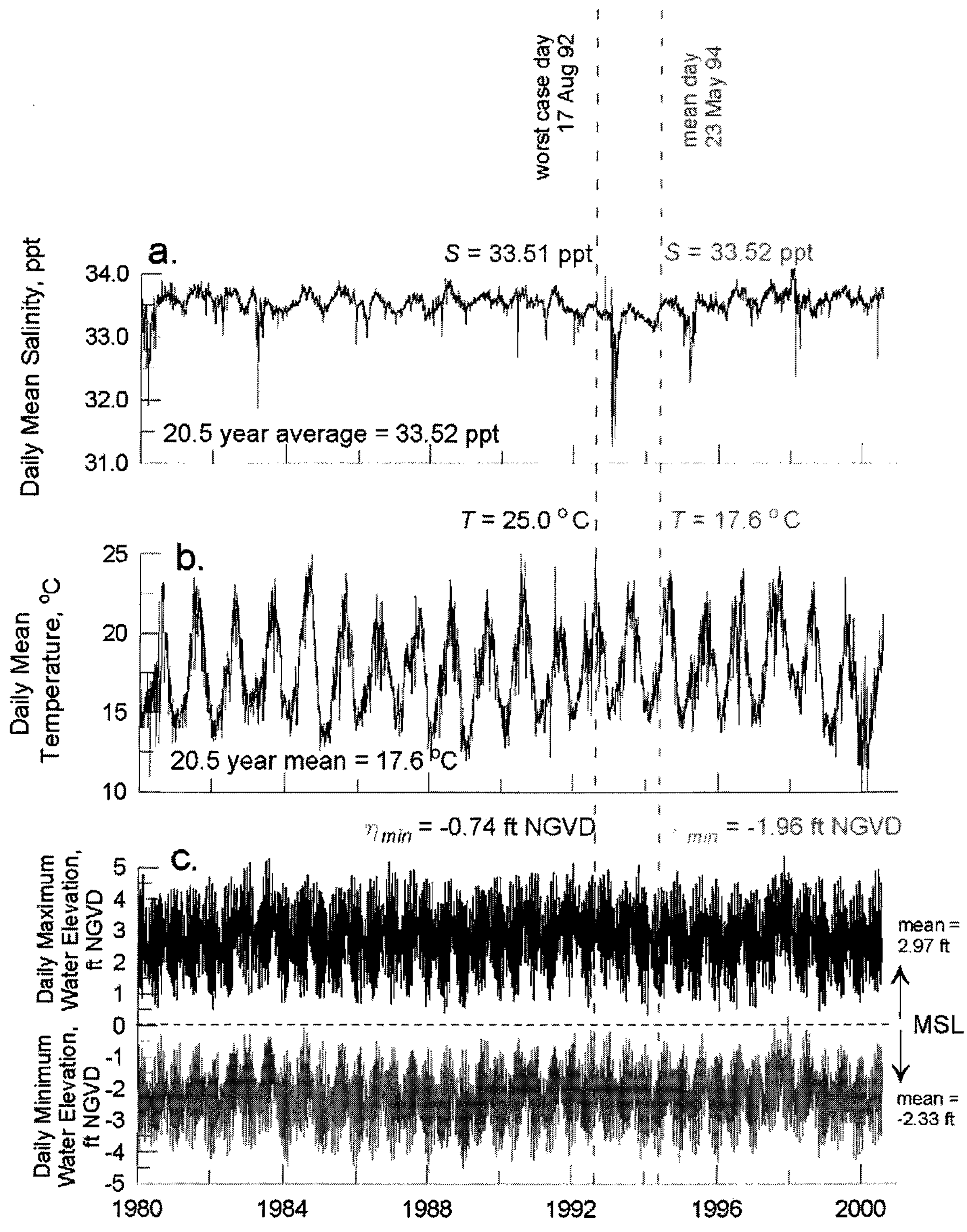


Figure 1. Period of record of boundary conditions, Encina Power Plant, 1980-2000.5: a) daily mea salinity, b) daily mean temperature, and c) daily high and low ocean water level elevati

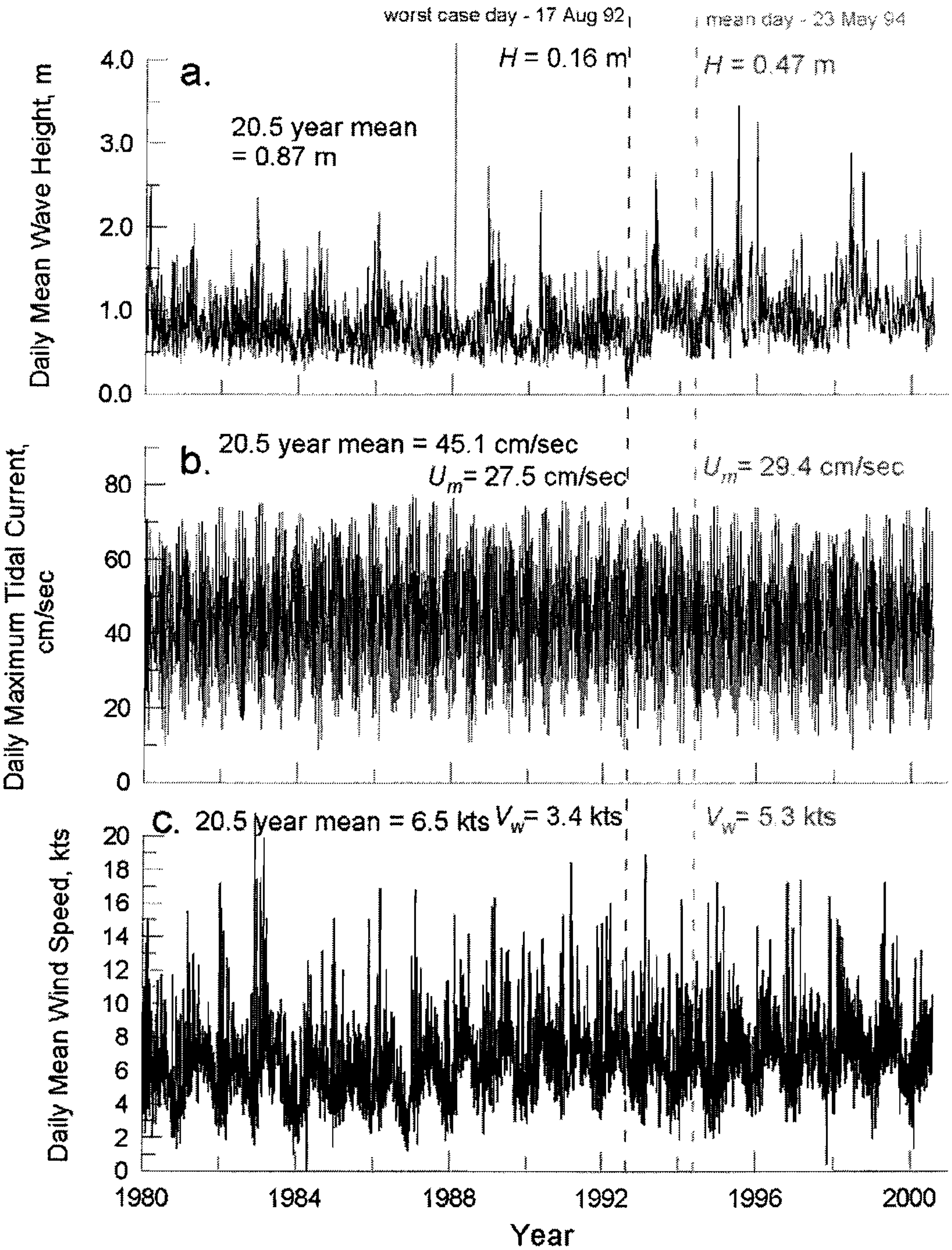


Figure 2. Period of record of forcing functions in the nearfield of Encina Power Plant, 1980-2000.5: a) daily mean wave height, b) daily maximum tidal current velocity, and c) daily mean wind.

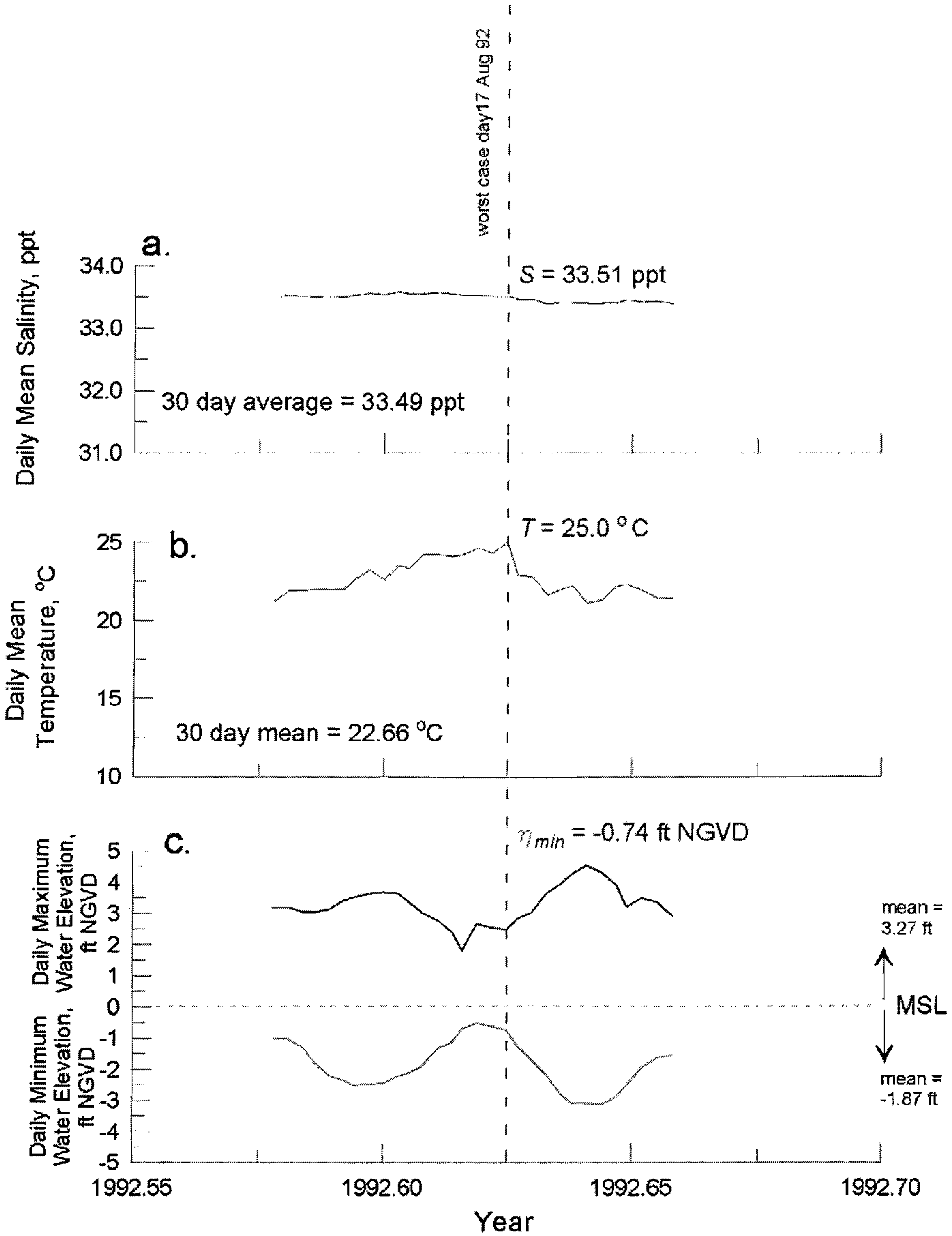


Figure 3. Boundary conditions in the nearfield of the Encina Power Plant: worst case 30 day period: a) daily mean salinity, b) mean temperature, and c) high and low ocean water elevations.

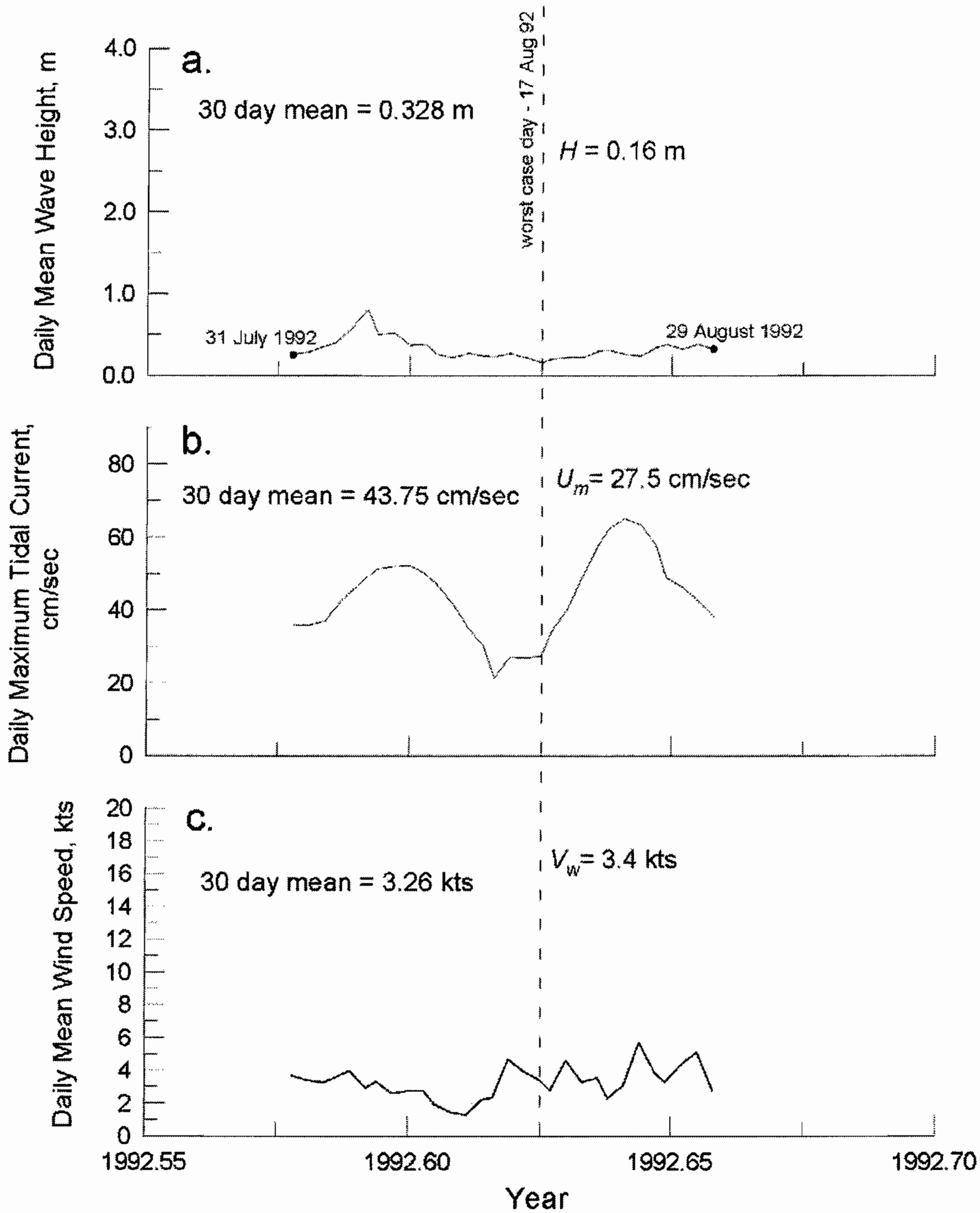


Figure 4. Forcing functions in the nearfield of Encina Power Plant, worst case 30 day period: a) daily mean wave height, b) daily maximum tidal current velocity, and c) daily mean wind.

neap tides occurring on this day with a minimum water level of -0.74 ft NGVD. This combination of environmental variables represents a situation that would place maximum thermal stress on the marine biology; and one in which the dilution of the concentrated seawater by-product of the desalination plant would occur very slowly due to minimal ocean mixing. The probability of occurrence of these worst case mixing conditions is 1day in 7,523 days, or 0.013%.

D) Average Case Assignments: The average daily combination of the 7 controlling variables over the 20.5 year period of record was found to be represented by the conditions on 23 May 1994. This day is represented in Figures 1 and 4 by the vertical dashed green line. This was a spring day with moderate temperature, winds, waves, and power generation. The Southern Oscillation Index (SOI) was zero indicating that the climate was in a neutral phase. Plant flow rate was 576 mgd, very near the annual mean of 550 mgd (Figure 3.4a). Ocean salinity was 33.52 ppt and ocean temperature was 17.6 °C, both identically the 20.5 year mean. Wave heights were 0.65 m, slightly below the 20.5 year mean, and maximum tidal currents reached 29.4 cm/sec (0.57 knots), also less than the 20.5 year mean. The daily low water level at -1.96 ft NGVD, very close to the mean low tide (MLT). Winds were 5.3 knots, slightly above the 20.5 year mean.

3) Results:

For each low flow rate scenario, results are presented for extreme and average conditions in terms of four principle model outputs: 1) salinity of the combined discharge on the sea floor, 2) dilution factors for the raw concentrate at the sea floor, 3) depth averaged salinity of the combined discharge, and 4) depth averaged dilution factors for the raw concentrate in the water column.

Salinity fields are contoured in parts per thousand (ppt) according to the color bar scale at the bottom of each plot. For purposes of comparing scenarios, the salinity scale range spans from 33.5 ppt to 55.0 ppt. Ambient ocean salinity is stated in the caption of each salinity field plot. Of particular interest in the outcome of each historical extreme scenario will be areas in which the discharge plume elevates the local salinity above 40 ppt and above 36.9 ppt.

The dilution fields are contoured in base-10 log according to the color bar scale at the bottom of each plot, with a scale range that spans from 10^0 to 10^7. We are particularly concerned about the dilution factor of the raw concentrate in the water column at the edge of the ZID, 1000 ft in any direction from the mouth of the discharge channel. The present NPDES permit for the thermal effluent requires a dilution factor of 15 to 1 at the edge of the ZID.

A) Worst-Case Hyper-Saline Effects of the Low-Flow Scenario 1:

One Unit 4 circulation pump is assumed to be operating at 149.76 mgd. After blending with the concentrated sea salts discharged from the desalination plant the combined discharge exiting the discharge channel is 99.76 mgd. No power generation is also assumed so that the Delta-T is ? $T = 0°$ C. End-of-pipe salinity is 50.3 ppt, diluted in-the-pipe from an initial salinity of 67.02 ppt for the raw concentrate. Figure 5 gives the salinity field on the sea floor resulting from the worst case mixing conditions for low-flow Scenerio 1. The salinity field is averaged over a 24 hour period. The inner core of the hyper-saline bottom

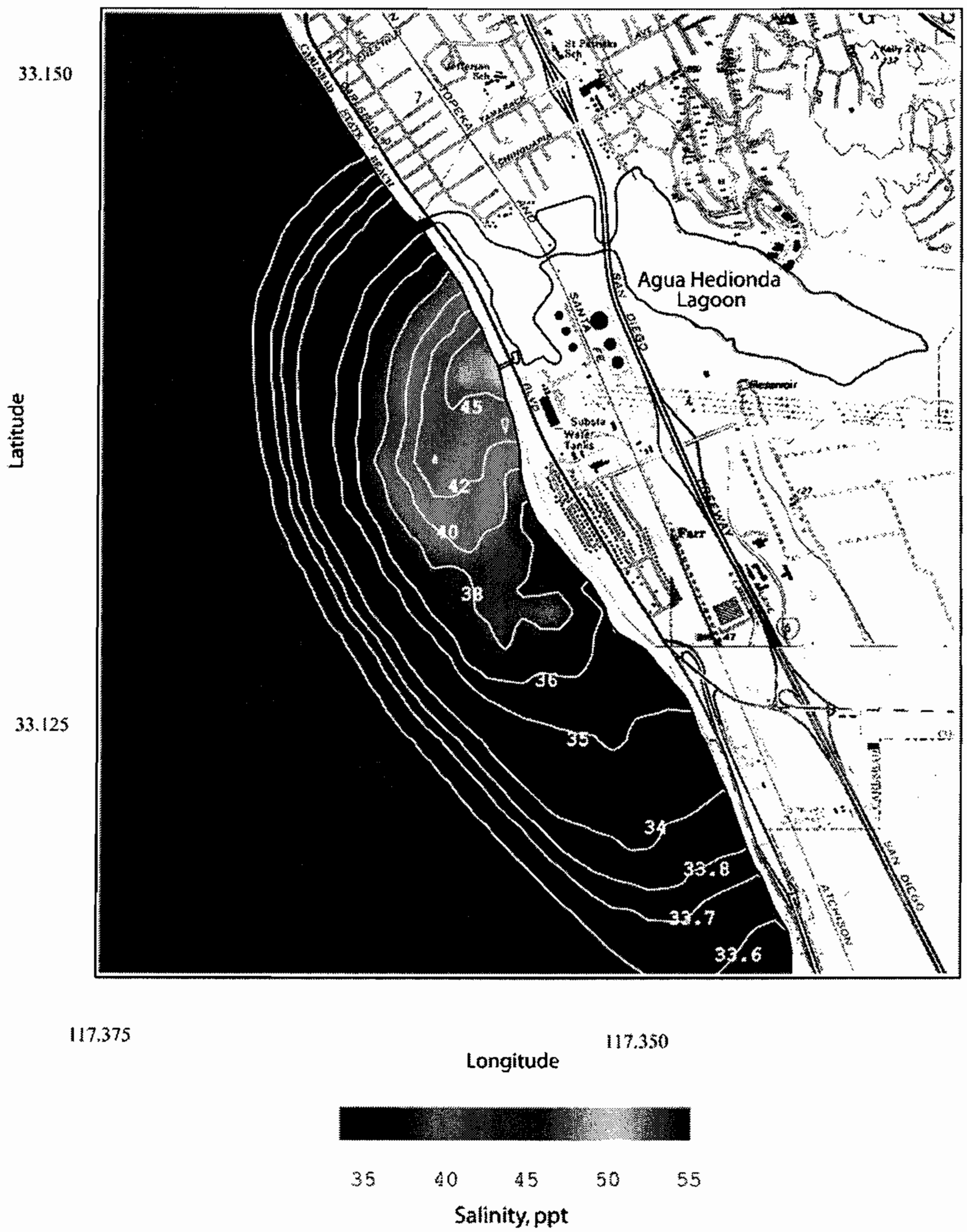


Figure 5. Scenario 1 worst case with one Unit 5 circulation pump for ΔT = 0 °C. Daily average of the bottom salinity of concentrated seawater for R.O. = 50 mgd, plant inflow rate = 149.76 mgd, combined discharge = 99.76 mgd, ambient ocean salinity = 33.51 ppt, ocean conditions - 17 Aug 1992.

boundary layer is at a maximum salinity of 48.1 ppt, but covers an area of only 1.2 acres of the sub-tidal beach face. Offshore, the hyper-saline bottom boundary layer follows a southward trajectory and exposes about 111 acres of benthic environment to salinity in excess of 40 ppt. About 248 acres of seabed are subjected to salinity elevated 10 % above ambient ocean conditions. Maximum bottom salinity found anywhere along the boundaries of the ZID is 45.0 ppt, occurring 1000 ft offshore of the discharge channel. Bottom dilution factors for the raw concentrate are shown in Figure 6 for Scenario 1 with worst case ambient mixing. Minimum dilution on the sea bed at the edge of the ZID is 2.9 to 1 and dilutions are less than 15 to 1 on 282 acres of surf zone bottom and offshore seabed.

The relatively high salinity found on the seabed is confined to a thin bottom boundary layer that fails to mix upward into the water column due to the small bottom stresses and low eddy diffusivity of the worst case mixing conditions. Above this bottom boundary layer the salinity drops rapidly. Maximum salinity in the water column for Scenario 1 in Figure 7 is found to be 41.8 ppt in the surfzone immediately seaward of the discharge jetty. The pelagic area subject to salinity in excess of 40 ppt is 3.3 acres. About 28 acres of pelagic habitat are subjected to salinity reaching 10% over ambient. Maximum water column salinity at the edge of the ZID is 38.21 ppt, found in the surf zone 1000 ft to the south of the discharge channel. Figure 8 shows that in the water column, where 316(A) dilution standards apply, minimum dilutions improve to 7.1 to 1 at the edge of the ZID. Dilutions are less than 15 to 1 in 29.6 acres of pelagic surf zone habitat.

While the worst case mixing conditions for low flow Scenario 1 produce some locally high bottom salinties in the range of 45 ppt and some minimum dilution numbers (~ 7 to 1) that are less than one would like to see in some highly

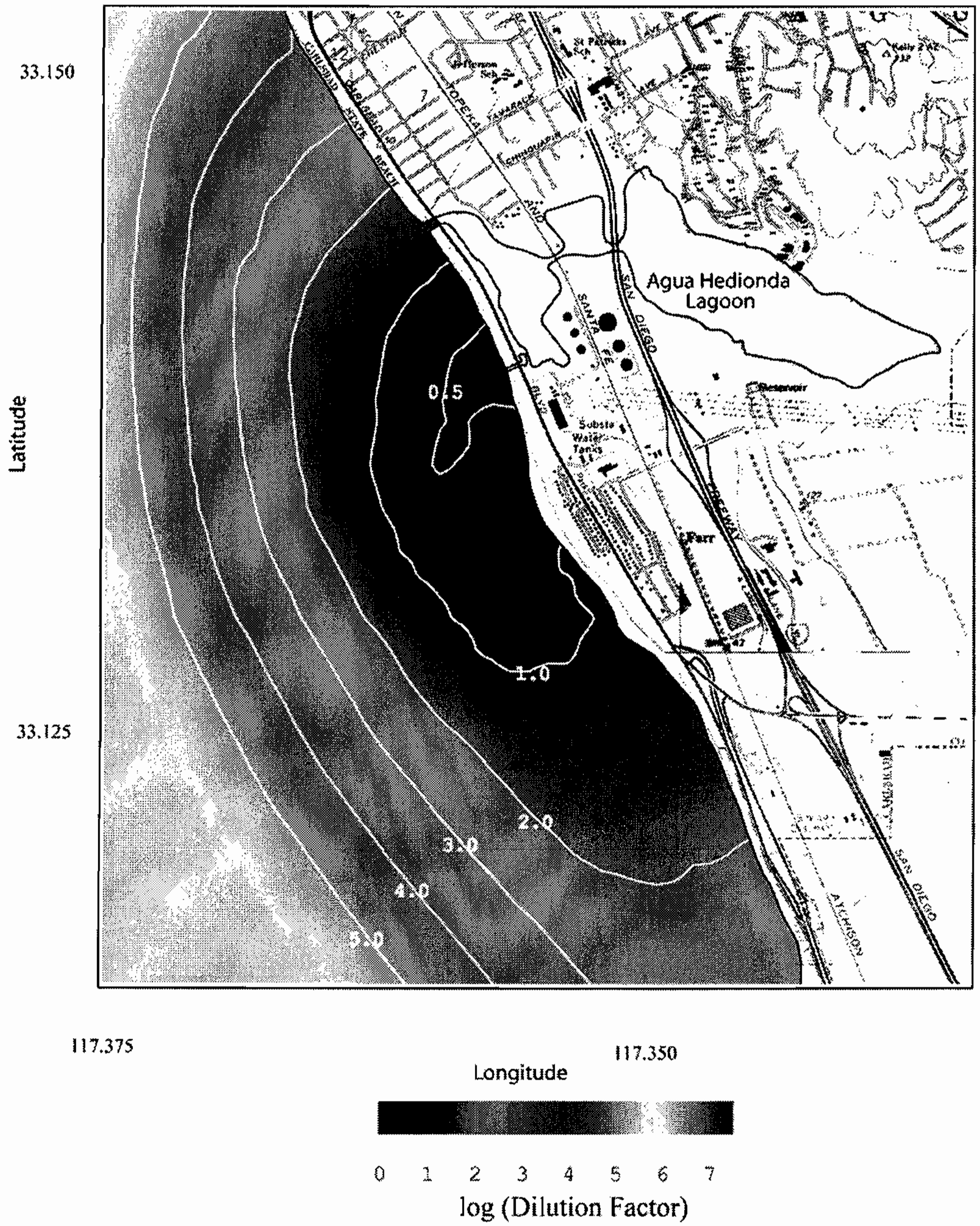


Figure 6. Scenario 1 worst case with one Unit 5 circulation pump for $\Delta T = 0\ ^{o}C$. Seafloor dilution factor for raw concentrate from desalination. R.O. = 50 mgd, plant inflow rate = 149.76 mgd, combined discharge = 99.76 mgd, ambient ocean salinity = 33.51 ppt, ocean conditions - 17 Aug 1992.

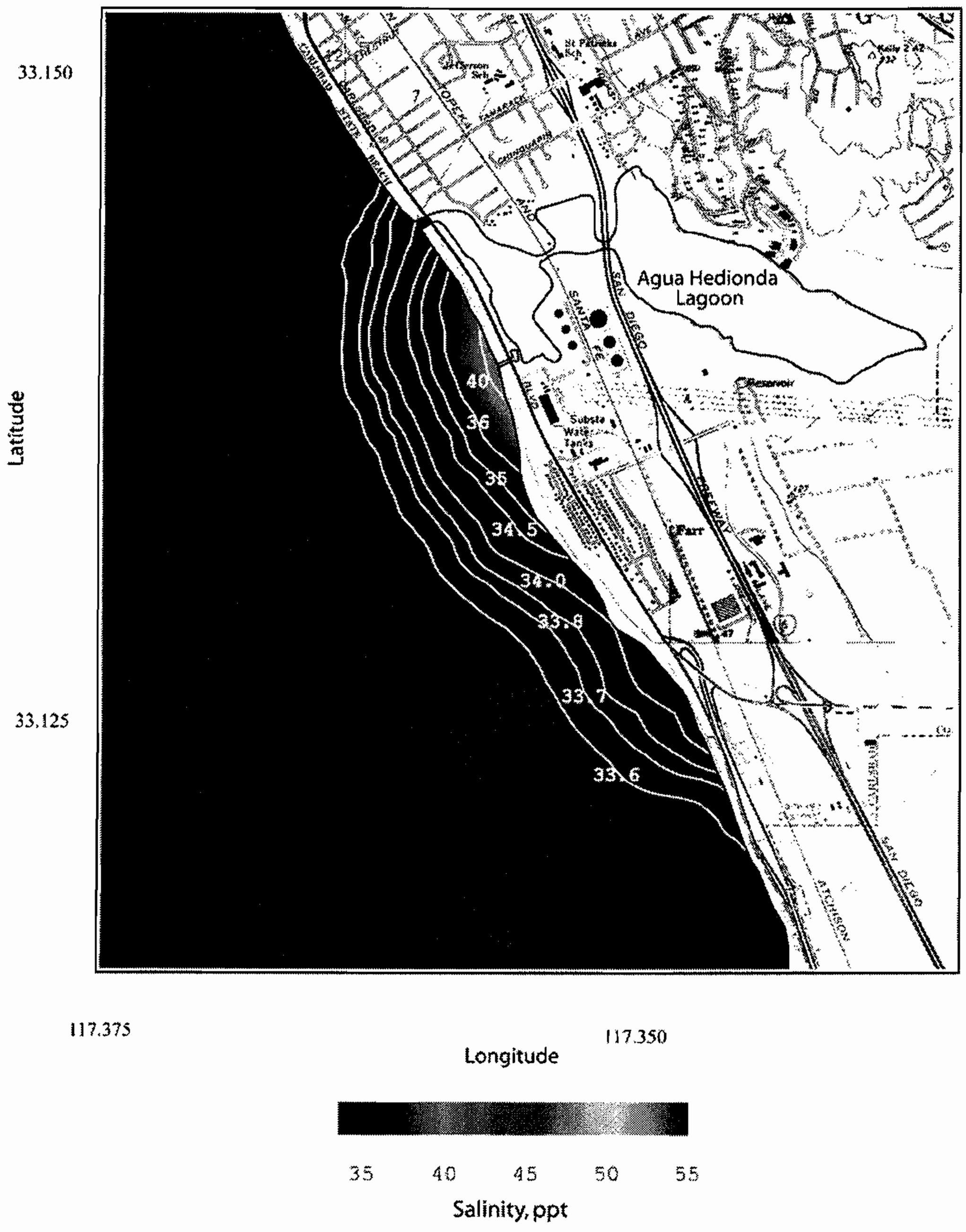


Figure 7. Scenario 1 worst case with one Unit 5 circulation pump for $\Delta T = 0$ °C. Daily depth-averaged salinity of concentrated seawater for R.O. = 50 mgd, plant inflow rate = 149.76 mgd, combined discharge = 99.76 mgd, ambient ocean salinity = 33.51 ppt, ocean conditions - 17 Aug 1992.

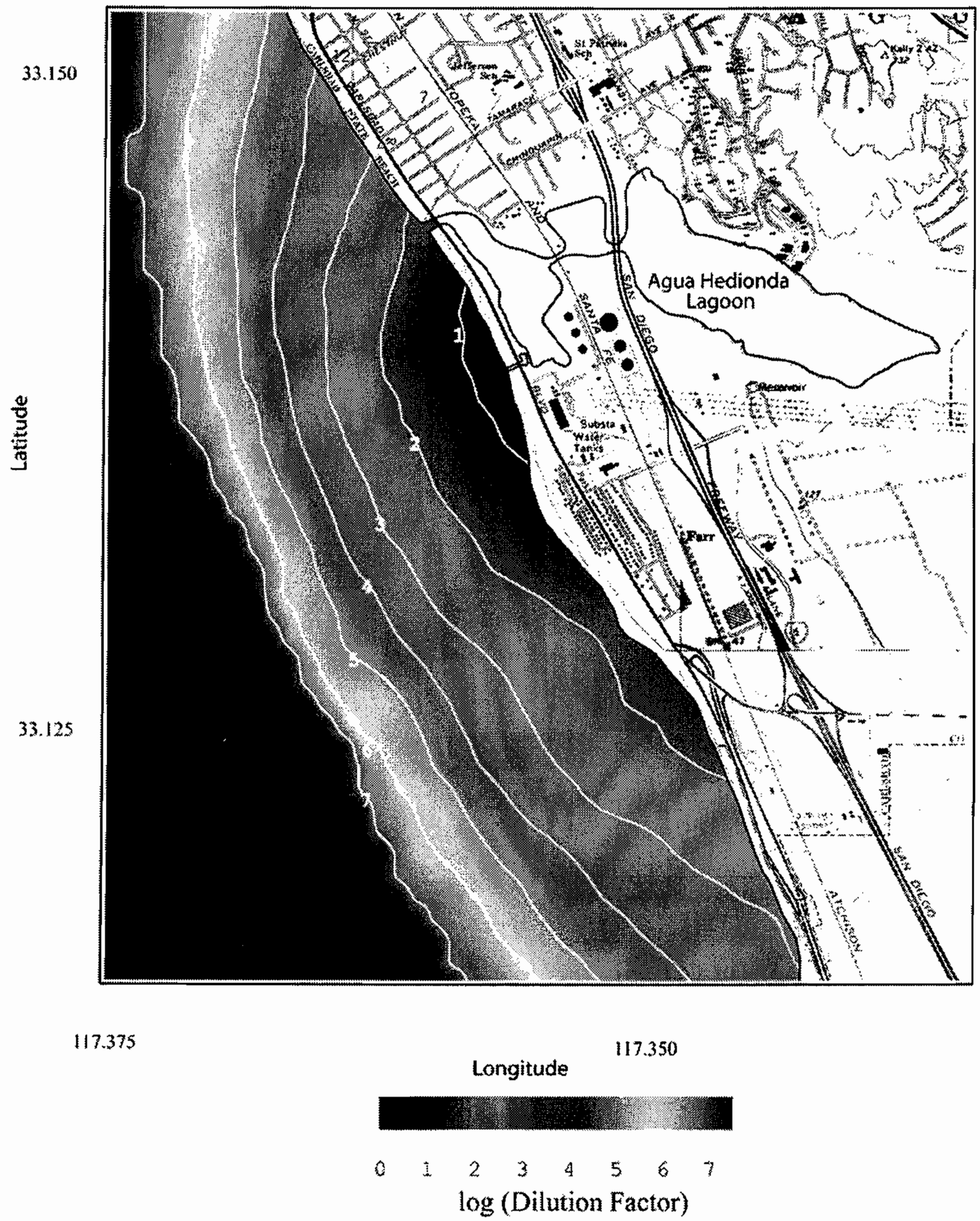


Figure 8. Scenario 1 worst case with one Unit 5 circulation pump for ΔT = 0 °C. Depth-averaged dilution factor for raw concentrate from desalination. R.O. = 50 mgd, plant inflow rate = 149.76 mgd, combined discharge = 99.76 mgd, ambient ocean salinity = 33.51 ppt, ocean conditions - 17 Aug 1992.

localized inshore areas, the minimal ocean mixing conditions that contributed to this result are quite rare, occurring 1 day in 7,523, or a recurrence probability of 0.013%.

B) Worst-Case Hyper-Saline Effects of the Low-Flow Scenario 2:

All pumps of Units 1 and 2 and one pump from Unit 3 are assumed to be operating at a combined intake flow rate of 172.8 mgd. After blending with the concentrated sea salts discharged from the desalination plant the combined discharge exiting the discharge channel is 122.8 mgd. No power generation is assumed so that the Delta-T is $\Delta T = 0^0\,C$. End-of-pipe salinity is 47.1 ppt, diluted in-the-pipe from an initial salinity of 67.02 ppt for the raw concentrate. In Figure 9 the inner core of the hyper-saline bottom boundary layer is found to be at a maximum salinity of 42.4 ppt and covers an area of 42.7 acres of the sub-tidal beach face and sandy bottom nearshore habitat. Offshore, the hyper-saline bottom boundary layer follows a southward trajectory and exposes about 87.1 acres of benthic environment to salinity in excess of 40 ppt. About 205 acres of seabed are subjected to salinity elevated 10 % above ambient ocean conditions. Maximum bottom salinity found anywhere along the boundaries of the ZID is 42.2 ppt, occurring 1000 ft offshore of the discharge channel. Bottom dilution factors for the raw concentrate in Figure 10 indicate that minimum dilution on the sea bed at the edge of the ZID is 3.86 to 1 and bottom dilutions are less than 15 to 1 on 249 acres of surf zone bottom and offshore seabed.

Maximum salinity in the water column for Scenario 2 is found in Figure 11 to be 40.3 ppt in the surfzone immediately seaward of the discharge jetty. The pelagic area subject to salinity in excess of 40 ppt is 2.8 acres. About 14.3 acres of pelagic habitat are subjected to salinity reaching 10% over ambient. Maximum

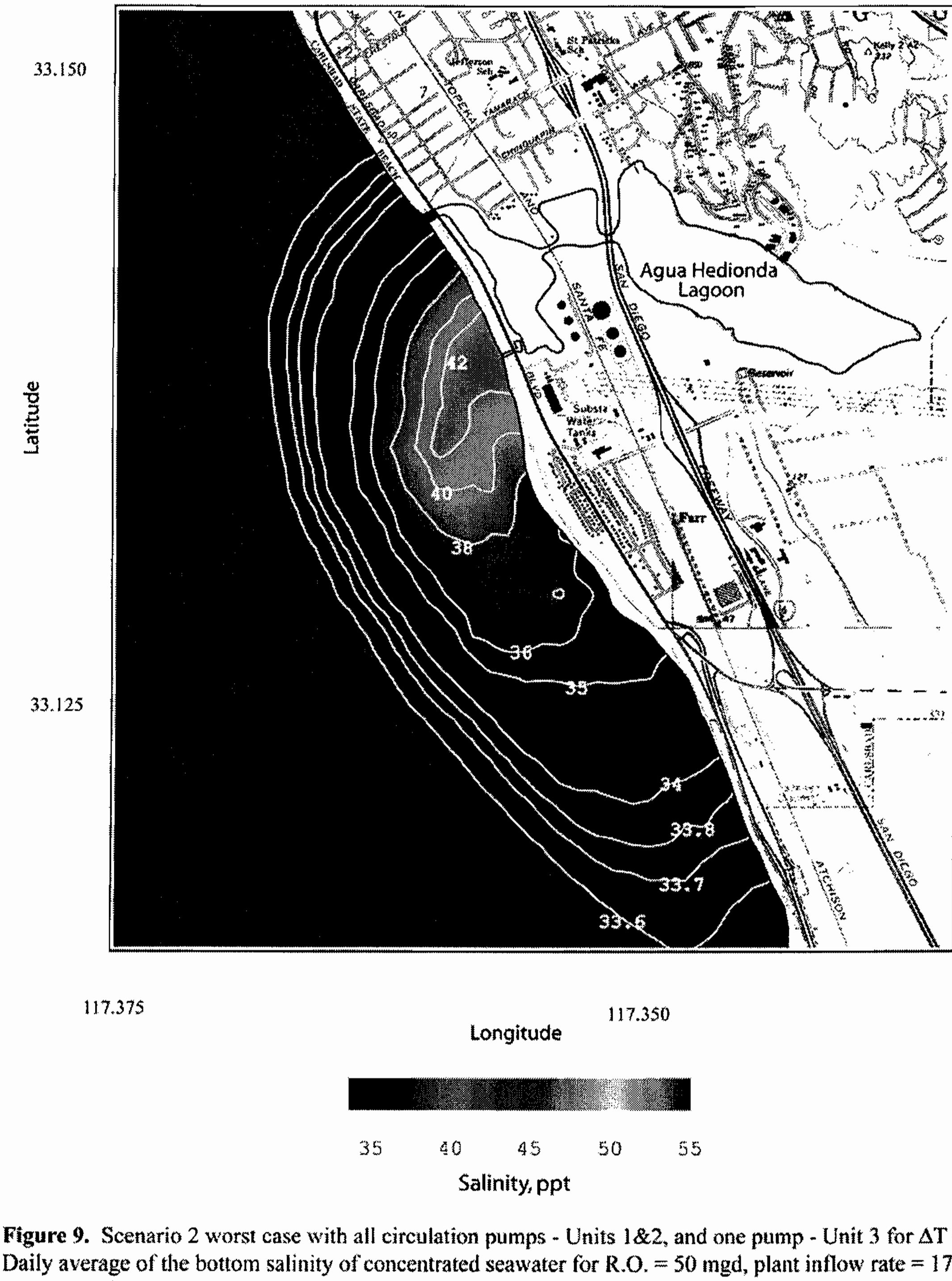


Figure 9. Scenario 2 worst case with all circulation pumps - Units 1&2, and one pump - Unit 3 for $\Delta T = 0\ ^{\circ}C$. Daily average of the bottom salinity of concentrated seawater for R.O. = 50 mgd, plant inflow rate = 172.8 mgd, combined discharge = 122.8 mgd, ambient ocean salinity = 33.51 ppt, ocean conditions - 17 Aug 1992.

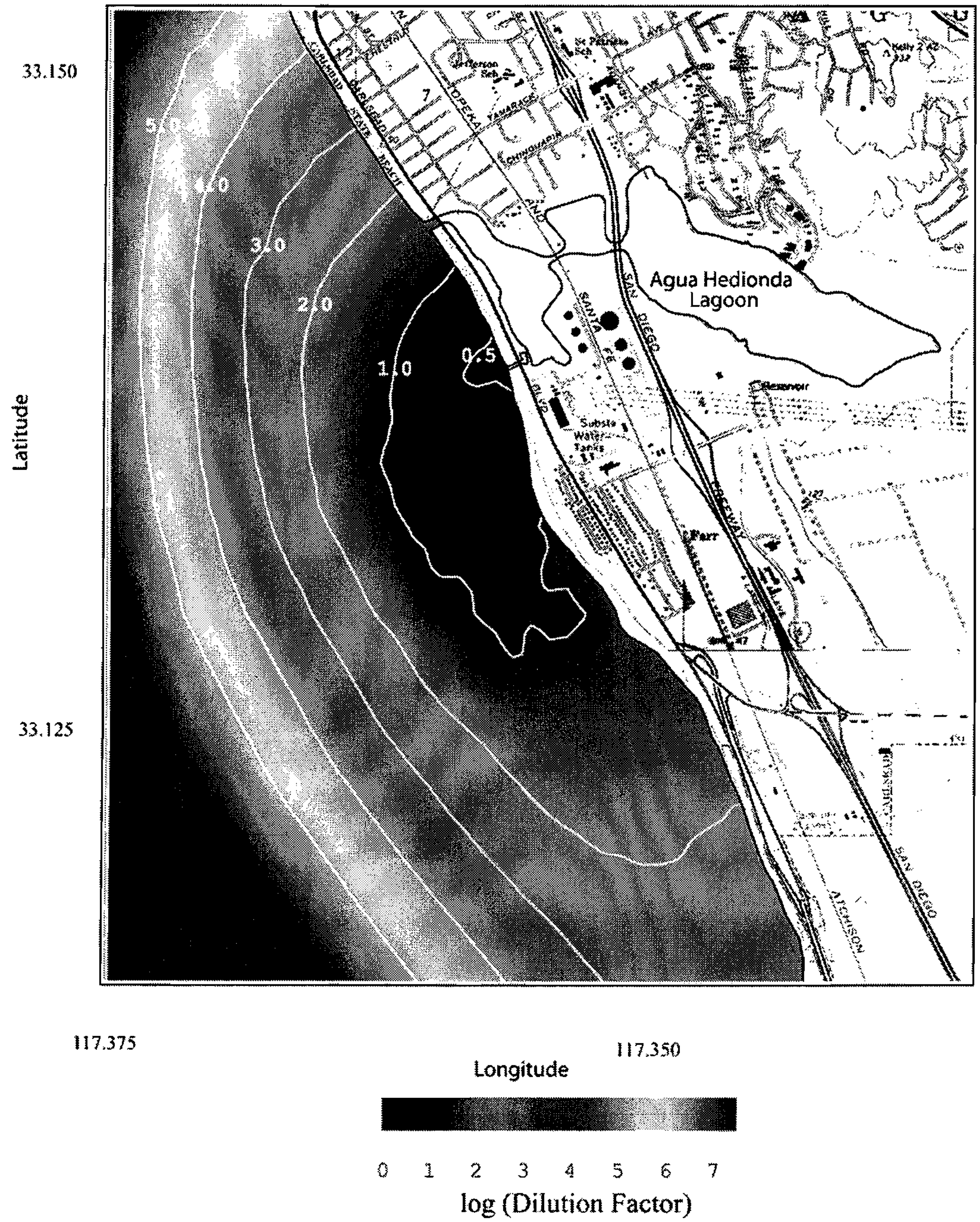


Figure 10. Scenario 2 worst case with all circulation pumps - Units 1&2, and one pump - Unit 3 for $\Delta T = 0\ ^{o}C$. Seafloor dilution factor for raw concentrate from desalination. R.O. = 50 mgd, plant inflow rate = 172.8 mgd, combined discharge = 122.8 mgd, ambient ocean salinity = 33.51 ppt, ocean conditions - 17 Aug 1992.

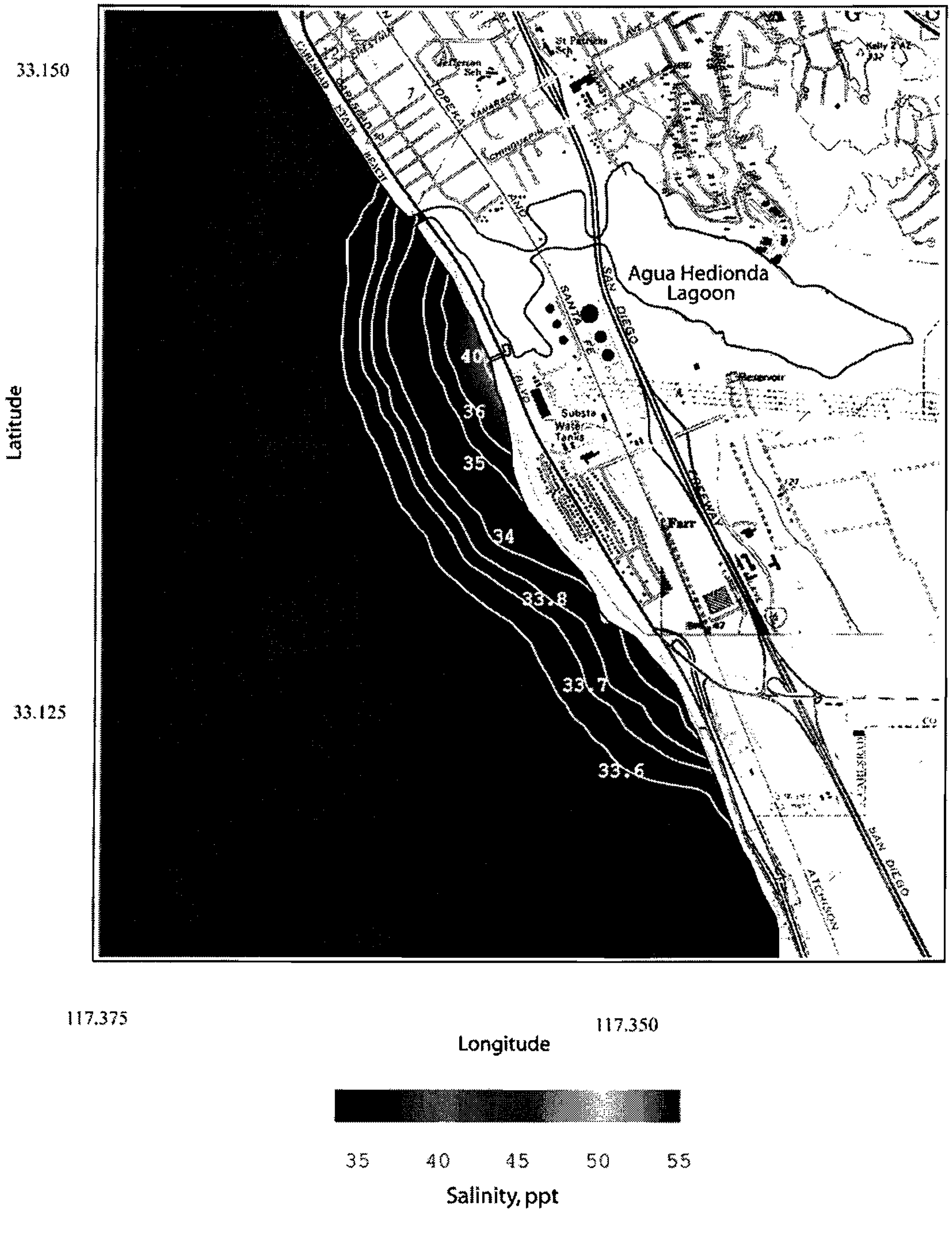


Figure 11. Scenario 2 worst case with all circulation pumps - Units 1&2, and one pump - Unit 3 for $\Delta T = 0\ ^{o}C$. Daily depth-averaged salinity of concentrated seawater for R.O. = 50 mgd, plant inflow rate = 172.8 mgd, combined discharge = 122.8 mgd, ambient ocean salinity = 33.51 ppt, ocean conditions - 17 Aug 1992.

water column salinity at the edge of the ZID is 36.9 ppt, found in the surf zone 1000 ft to the south of the discharge channel. Figure 12 shows that in the water column, where 316(A) dilution standards apply, minimum dilutions improve to 9.9 to 1 at the edge of the ZID. Dilutions are less than 15 to 1 in 23.4 acres of pelagic surf zone and nearshore habitat in the immediate neighborhood of the discharge channel. The minimal ocean mixing conditions that contributed to the Scenario 2 worst case are rare, occurring 1 day in 7,523, or a recurrence probability of 0.013%.

C) Worst-Case Hyper-Saline Effects of the Low-Flow Scenario 3:

One pump from Unit 1 and one pump from Unit 5 are assumed to be operating at a combined intake flow rate of 184.32 mgd. After blending with the concentrated sea salts discharged from the desalination plant the combined discharge exiting the discharge channel is 134.32 mgd. No power generation is assumed so that the Delta-T is $\Delta T = 0^0\,C$. End-of-pipe salinity is 46.0 ppt, diluted in-the-pipe from an initial salinity of 67.02 ppt for the raw concentrate. In Figure 13 the inner core of the hyper-saline bottom boundary layer is found to be at a maximum salinity of 42.0 ppt and covers an area of 14.7 acres of the sub-tidal beach face and sandy bottom nearshore habitat. Offshore, the hyper-saline bottom boundary layer follows a southward trajectory and exposes about 71.9 acres of benthic environment to salinity in excess of 40 ppt. About 188 acres of seabed are subjected to salinity elevated 10 % above ambient ocean conditions. Maximum bottom salinity found anywhere along the boundaries of the ZID is 42.0 ppt, occurring 1000 ft offshore of the discharge channel. Bottom dilution factors for the raw concentrate in Figure 14 indicate that minimum dilution on the sea bed at the edge of the ZID is 3.95 to 1 and bottom dilutions are less than 15 to 1 on 225 acres of surf zone bottom and offshore seabed.

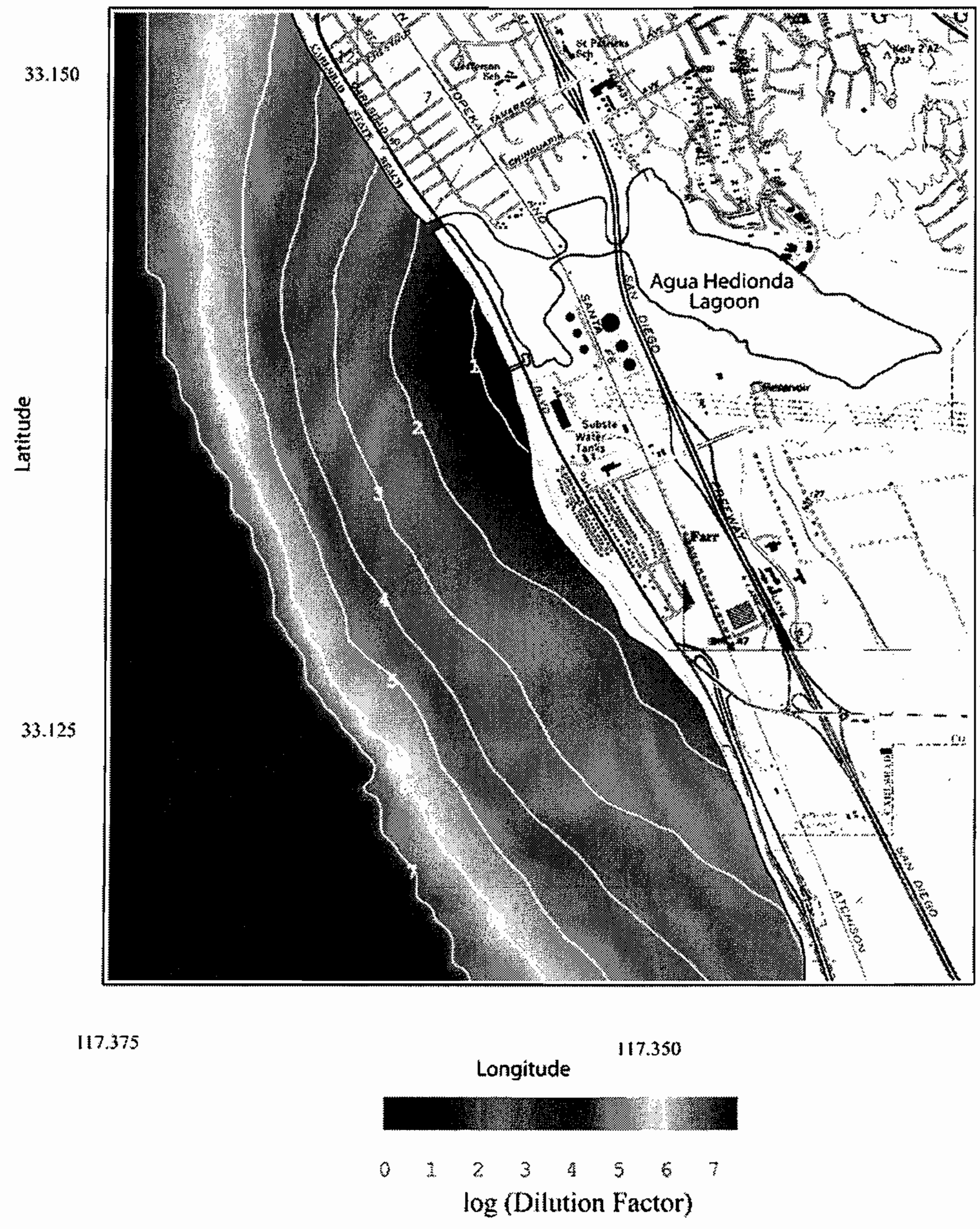


Figure 12. Scenario 2 worst case with all circulation pumps - Units 1&2, and one pump - Unit 3 for $\Delta T = 0\ ^{o}C$. Depth-averaged dilution factor for raw concentrate from desalination. R.O. = 50 mgd, plant inflow rate = 172.8 mgd, combined discharge = 122.8 mgd, ambient ocean salinity = 33.51 ppt, ocean conditions - 17 Aug 1992.

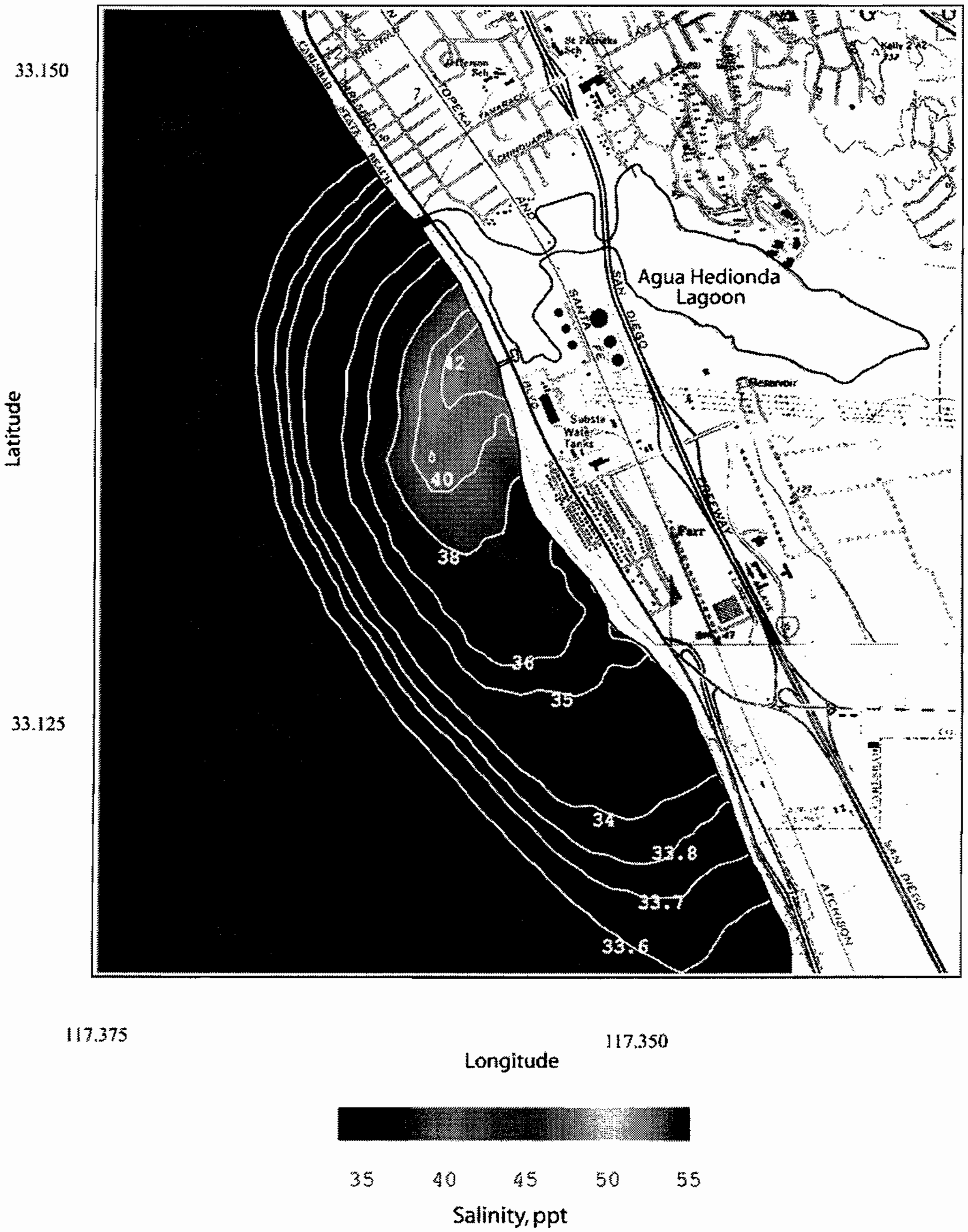


Figure 13. Scenario 3 worst case with one Unit 5 circulation pump, and one Unit 1 pump for $\Delta T = 0\ ^{o}C$. Daily average of the bottom salinity of concentrated seawater for R.O. = 50 mgd, plant inflow rate = 184.32 mgd, combined discharge = 134.32 mgd, ambient ocean salinity = 33.51 ppt, ocean conditions - 17 Aug 1992.

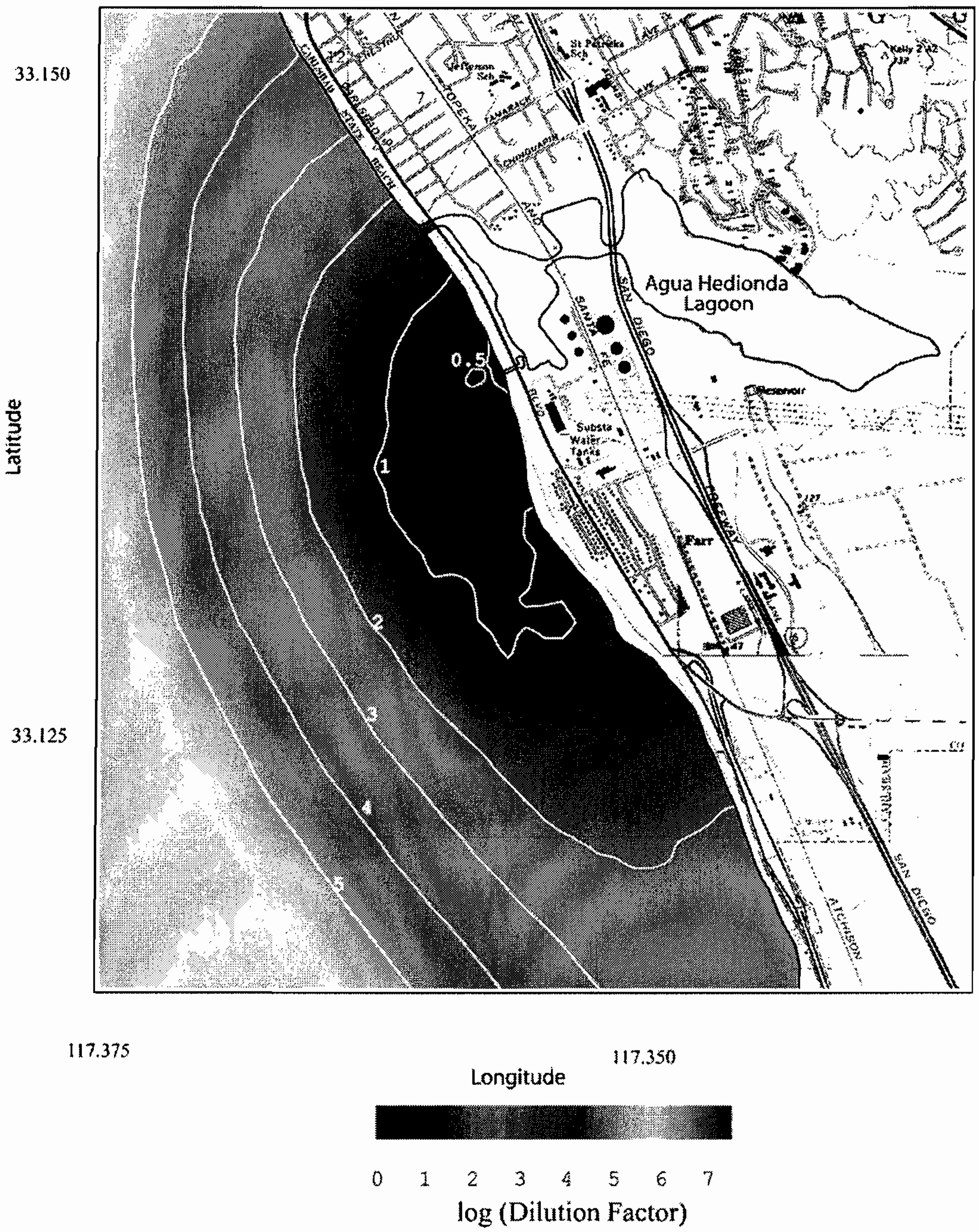


Figure 14. Scenario 3 worst case with one Unit 5 circulation pump, and one Unit 1 pump for $\Delta T = 0\ ^{o}C$. Seafloor dilution factor for raw concentrate from desalination. R.O. = 50 mgd, plant inflow rate = 184.32 mgd, combined discharge = 134.32 mgd, ambient ocean salinity = 33.51 ppt, ocean conditions - 17 Aug 1992.

Maximum salinity in the water column for worst case Scenario 3 is found in Figure 15 to be 40.0 ppt in the surfzone immediately seaward of the discharge jetty. The pelagic area subject to salinity in excess of 40 ppt is 1 acre. About 12.3 acres of pelagic habitat are subjected to salinity reaching 10% over ambient. Maximum water column salinity at the edge of the ZID is 36.7 ppt, found in the surf zone 1000 ft to the south of the discharge channel. Figure 16 shows that in the water column, where 316(A) dilution standards apply, minimum dilutions are 10.5 to 1 at the edge of the ZID. Dilutions are less than 15 to 1 in 12.9 acres of pelagic surf zone and nearshore habitat in the immediate neighborhood of the discharge channel. The minimal ocean mixing conditions that contributed to the Scenario 3 worst case are rare, occurring 1 day in 7,523, giving a recurrence probability of 0.013%.

D) Worst-Case Hyper-Saline Effects of the Low-Flow Scenario 4:

Two pumps from Unit 1 and one pump from Unit 5 are assumed to be operating at a combined intake flow rate of 218.88 mgd. After blending with the concentrated sea salts discharged from the desalination plant the combined discharge exiting the discharge channel is 168.88 mgd. No power generation is assumed so that the Delta-T is $\Delta T = 0^0\,C$. End-of-pipe salinity is 43.4 ppt, diluted in-the-pipe from an initial salinity of 67.02 ppt for the raw concentrate. In Figure 17 the inner core of the hyper-saline bottom boundary layer is found to be at a maximum salinity of 41.0 ppt and covers an area of 2.7 acres of the sub-tidal beach face and sandy bottom nearshore habitat. Offshore, the hyper-saline bottom boundary layer follows a southward trajectory and exposes about 19.9 acres of benthic environment to salinity in excess of 40 ppt. About 147 acres of seabed are subjected to salinity elevated 10 % above ambient ocean conditions. Maximum

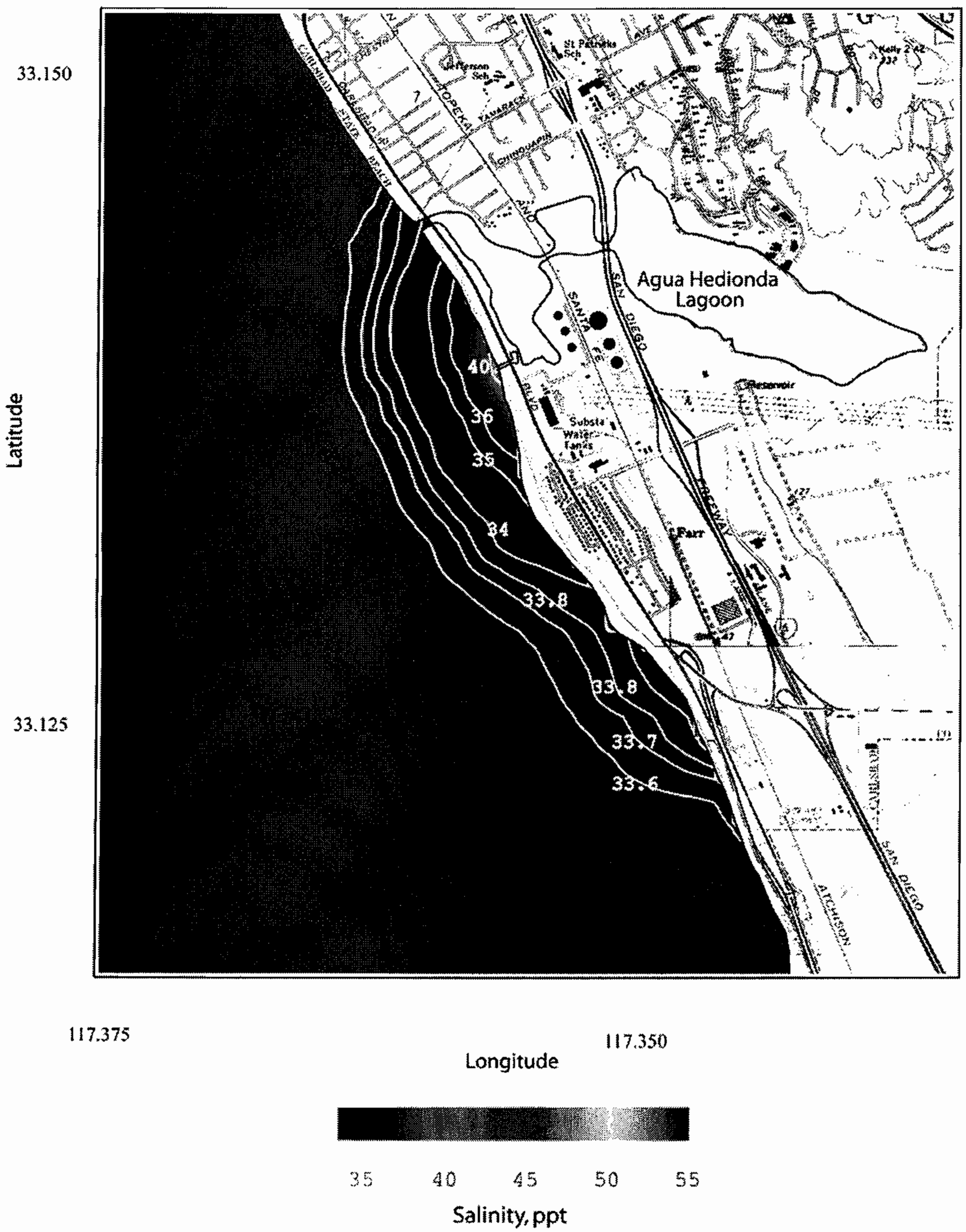


Figure 15. Scenario 3 worst case with one Unit 5 circulation pump, and one Unit 1 pump for $\Delta T = 0\ ^{o}C$. Daily depth-averaged salinity of concentrated seawater for R.O. = 50 mgd, plant inflow rate = 184.32 mgd, combined discharge = 134.32 mgd, ambient ocean salinity = 33.51 ppt, ocean conditions - 17 Aug 1992.

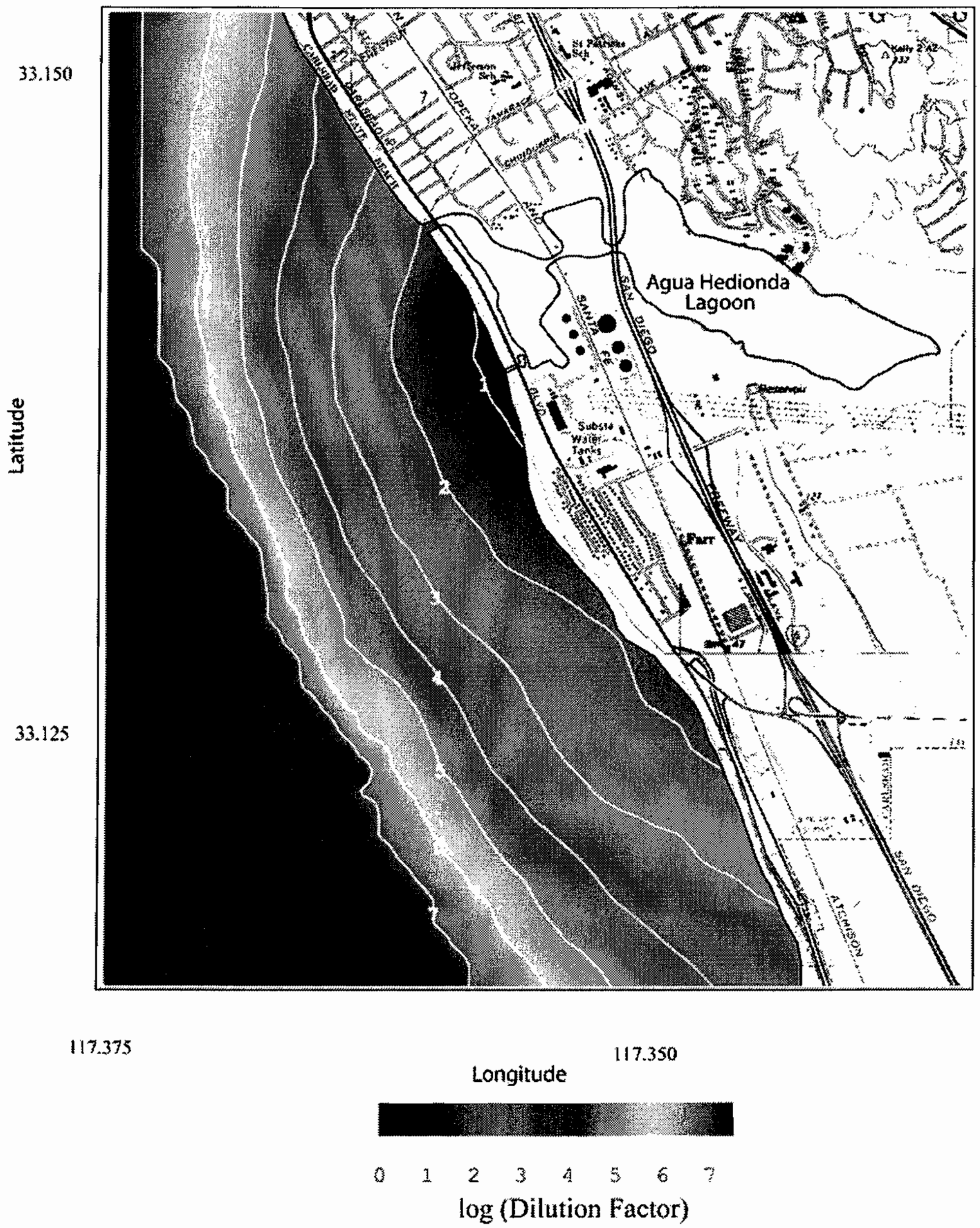


Figure 16. Scenario 3 worst case with one Unit 5 circulation pump, and one Unit 1 pump for $\Delta T = 0\ ^{O}C$. Depth-averaged dilution factor for raw concentrate from desalination. R.O. = 50 mgd, plant inflow rate = 184.32 mgd, combined discharge = 134.32 mgd, ambient ocean salinity = 33.51 ppt, ocean conditions - 17 Aug 1992.

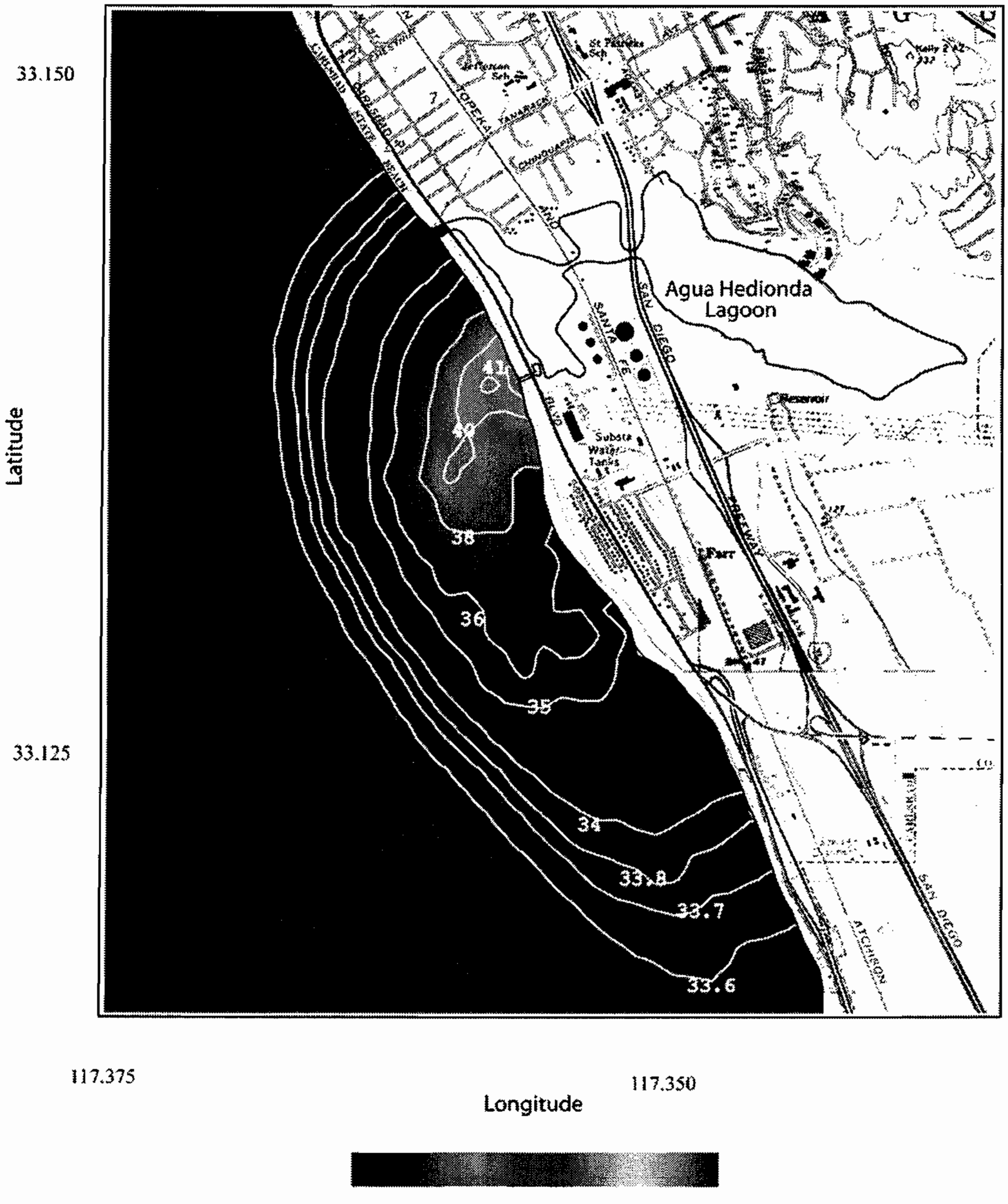


Figure 17. Scenario 4 worst case with one Unit 5 circulation pump, and two Unit 1 pumps for $\Delta T = 0\ ^{o}C$. Daily average of the bottom salinity of concentrated seawater for R.O. = 50 mgd, plant inflow rate = 218.88 mgd, combined discharge = 168.88 mgd, ambient ocean salinity = 33.51 ppt, ocean conditions - 17 Aug 1992.

bottom salinity found anywhere along the boundaries of the ZID is 40.0 ppt, occurring 1000 ft offshore of the discharge channel. Bottom dilution factors for the raw concentrate in Figure 18 indicate that minimum dilution on the sea bed at the edge of the ZID is 5.16 to 1 and bottom dilutions are less than 15 to 1 on 168 acres of surf zone bottom and offshore seabed.

Maximum salinity in the water column for worst case Scenario 4 is found in Figure 19 to be 38.0 ppt in the surfzone immediately seaward of the discharge jetty. No pelagic area is subject to salinity in excess of 40 ppt. About 8.7 acres of pelagic habitat are subjected to salinity reaching 10% over ambient. Maximum water column salinity at the edge of the ZID is 35.75 ppt, found in the surf zone 1000 ft to the north of the discharge channel. Figure 20 shows that in the water column, where 316(A) dilution standards apply, minimum dilutions are 15.0 to 1 at the edge of the ZID, in compliance with 316(A) minimum dilution permit standards. Therefore, from both a salinity tolerance and regulatory perspective, the Scenario 4 low-flow case is acceptable even for worst case mixing conditions. Dilutions are less than 15 to 1 in 8.6 acres of pelagic surf zone inside the ZID in the immediate neighborhood of the discharge channel. The minimal ocean mixing conditions that contributed to the Scenario 4 worst case are rare, occurring 1 day in 7,523, giving a recurrence probability of 0.013%.

E) Worst-Case Hyper-Saline Effects of the Low-Flow Scenario 5:

This is the "*unheated Unit 4 historical extreme case*" that was presented in Appendix E of the certified EIR. It is reproduced herein to facilitate comparisons with the worst case outcomes of low-flow Scenarios 1-4. Two pumps from Unit 4 are assumed to be operating at a combined intake flow rate of 304 mgd. After blending with the concentrated sea salts discharged from the desalination plant the combined discharge exiting the discharge channel is 254 mgd. No power

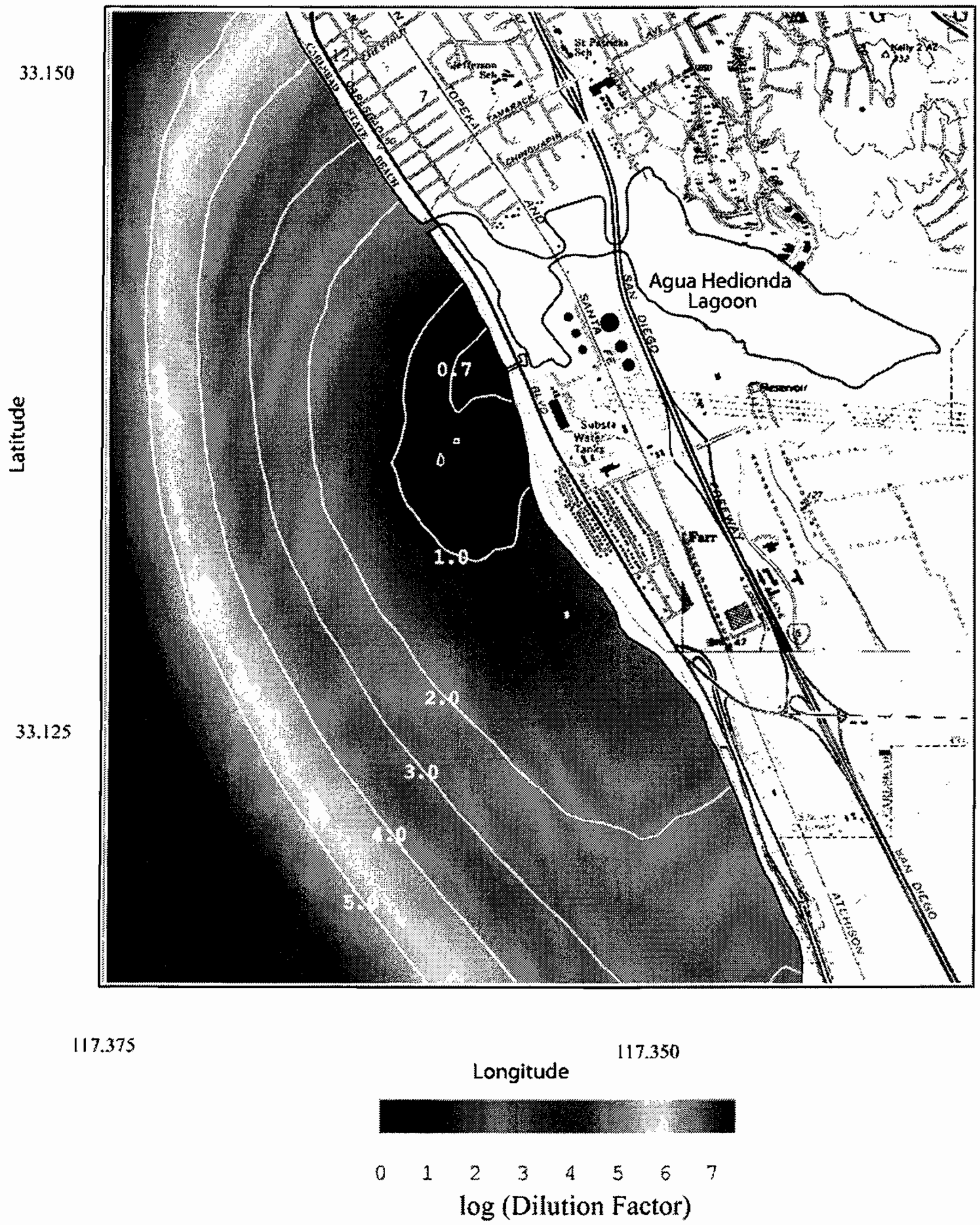


Figure 18. Scenario 4 worst case with one Unit 5 circulation pump, and two Unit 1 pumps for $\Delta T = 0\ ^{o}C$. Seafloor dilution factor for raw concentrate from desalination. R.O. = 50 mgd, plant inflow rate = 218.88 mgd, combined discharge = 168.88 mgd, ambient ocean salinity = 33.51 ppt, ocean conditions - 17 Aug 1992.

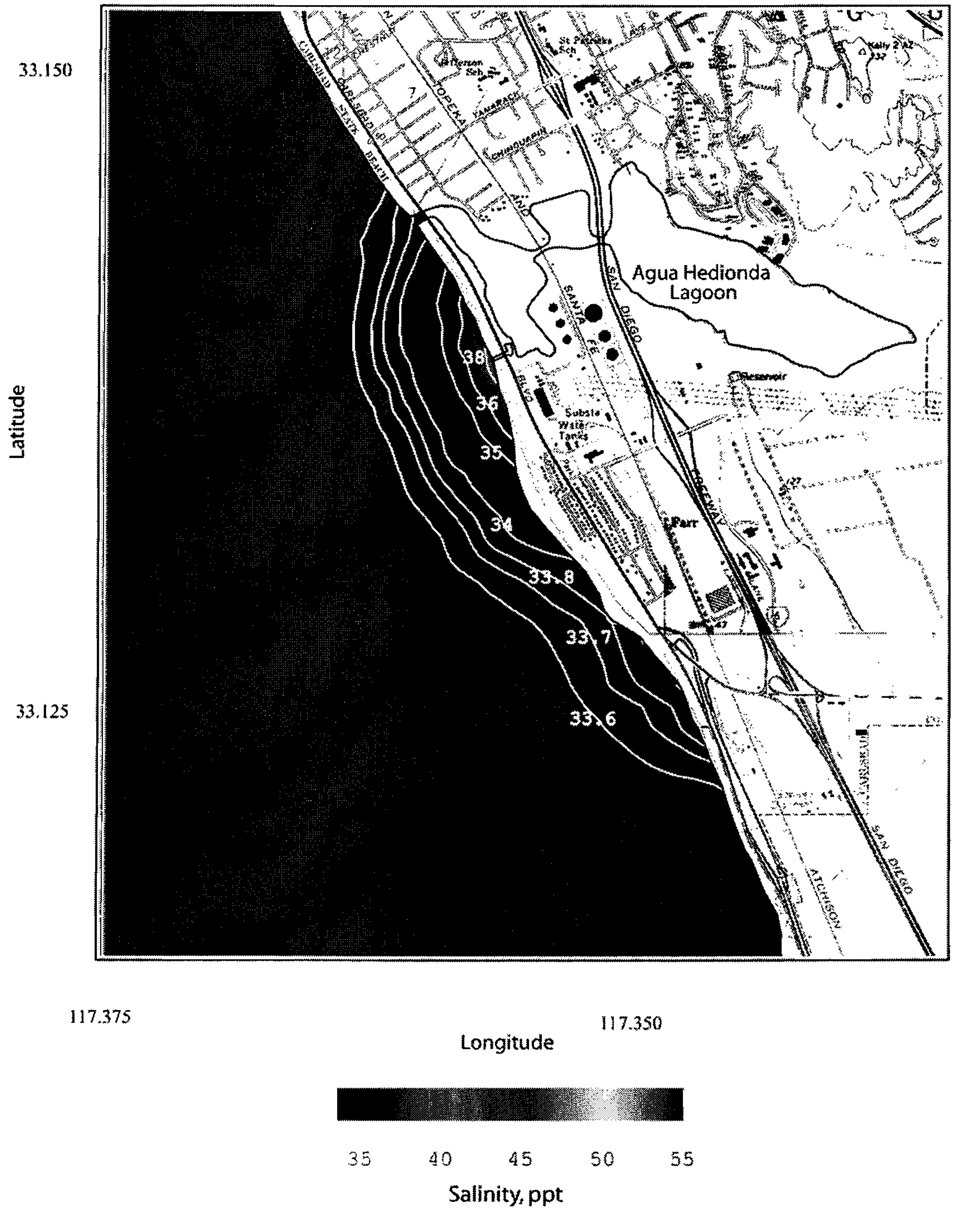


Figure 19. Scenario 4 worst case with one Unit 5 circulation pump, and two Unit 1 pumps for $\Delta T = 0\ ^{o}C$. Daily depth-averaged salinity of concentrated seawater for R.O. = 50 mgd, plant inflow rate = 218.88 mgd, combined discharge = 168.88 mgd, ambient ocean salinity = 33.51 ppt, ocean conditions - 17 Aug 1992.

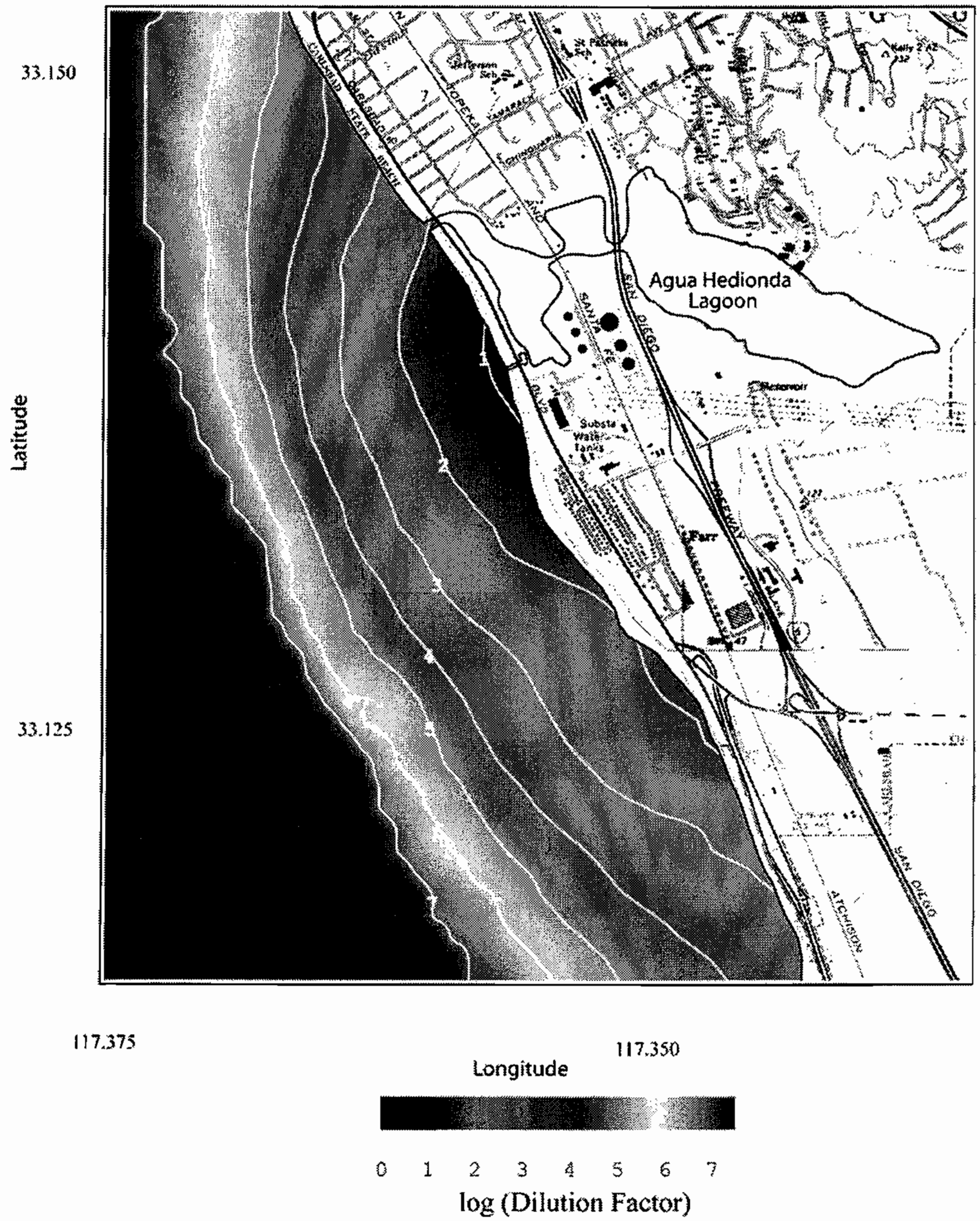


Figure 20. Scenario 4 worst case with one Unit 5 circulation pump, and two Unit 1 pumps for $\Delta T = 0\ ^{o}C$. Depth-averaged dilution factor for raw concentrate from desalination. R.O. = 50 mgd, plant inflow rate = 218.88 mgd, combined discharge = 168.88 mgd, ambient ocean salinity = 33.51 ppt, ocean conditions - 17 Aug 1992.

generation is assumed so that the Delta-T is $\Delta T = 0^{\circ}$ C. End-of-pipe salinity is 40.1 ppt, diluted in-the-pipe from an initial salinity of 67.02 ppt for the raw concentrate. In Figure 21 the inner core of the hyper-saline bottom boundary layer is found to be at a maximum salinity of 39.0 ppt and covers an area of 2.4 acres of the sub-tidal beach face and sandy bottom nearshore habitat. (Nowhere is the salinity in excess of 40 ppt). About 44 acres of seabed are subjected to salinity elevated 10 % above ambient ocean conditions. Maximum bottom salinity found anywhere along the boundaries of the ZID is 38.2 ppt, occurring 1000 ft offshore of the discharge channel. Bottom dilution factors for the raw concentrate in Figure 22 indicate that minimum dilution on the sea bed at the edge of the ZID is 7.1 to 1 and bottom dilutions are less than 15 to 1 on 75 acres of surf zone bottom and offshore seabed.

Maximum salinity in the water column for worst case Scenario 5 is found in Figure 23 to be 36.0 ppt in the surfzone immediately seaward of the discharge jetty. No pelagic area is subject to salinity in excess of 40 ppt, nor is any pelagic habitat subjected to salinity reaching 10% over ambient. Maximum water column salinity at the edge of the ZID is 35.2 ppt, found in the surf zone 1000 ft to the south of the discharge channel. Figure 24 shows that in the water column, where 316(A) dilution standards apply, minimum dilutions are 19.8 to 1 at the edge of the ZID, in compliance with 316(A) minimum dilution permit standards. Therefore, from both a salinity tolerance and regulatory perspective, the Scenario 5 low-flow case from the certified EIR is acceptable even for worst case mixing conditions. Dilutions are less than 15 to 1 in 1.1 acres of pelagic surf zone inside the ZID in the immediate neighborhood of the discharge channel. The minimal ocean mixing conditions that contributed to the Scenario 5 worst case are rare, occurring 1 day in 7,523, giving a recurrence probability of 0.013%.

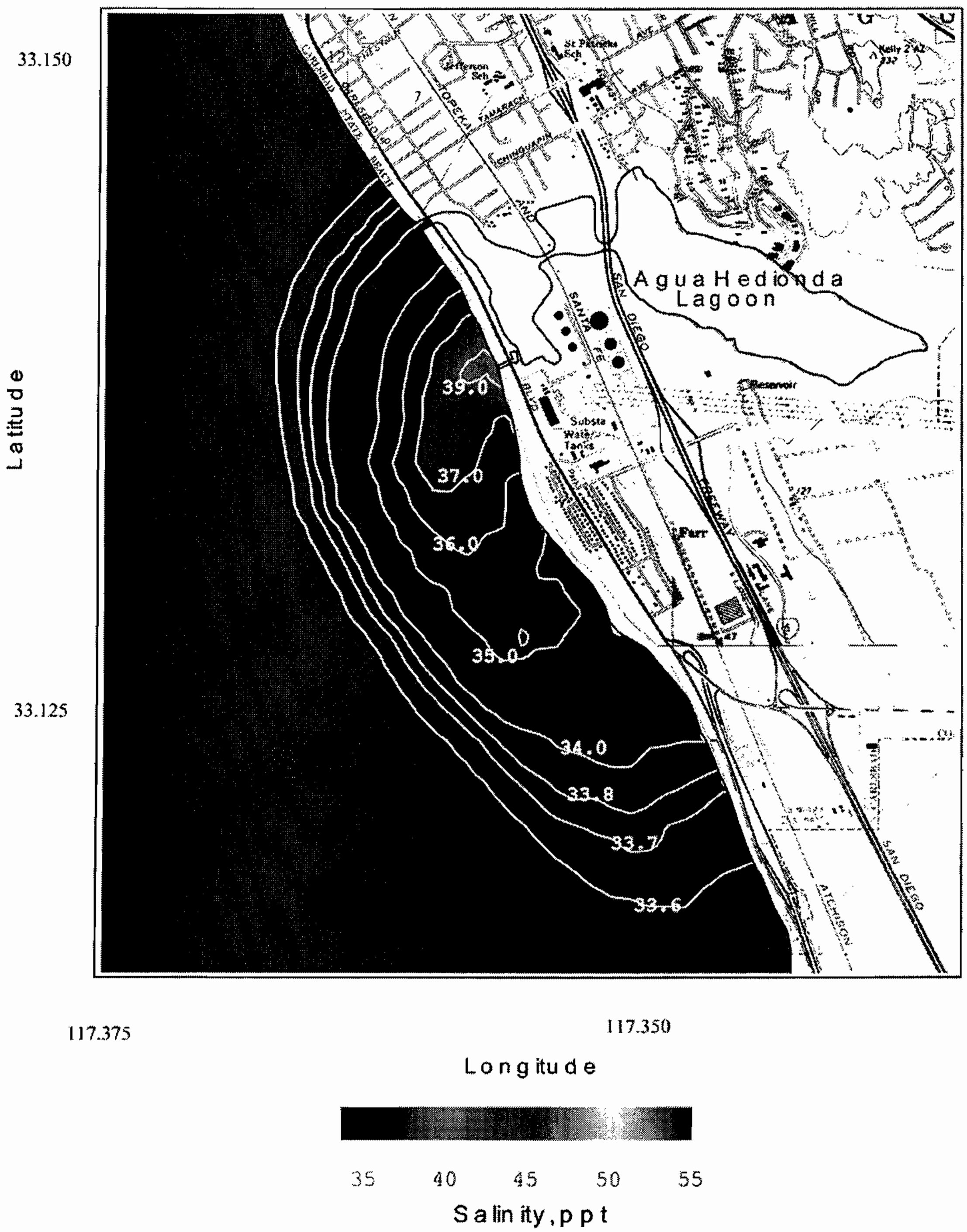


Figure 21. Scenario 5 worst case with two Unit 4 circulation 2 pumps for $\Delta T = 0\ ^{O}C$. Daily average of the bottom salinity of concentrated seawater for R.O. = 50 mgd, plant inflow rate = 304 mgd, combined discharge = 254 mgd, ambient ocean salinity = 33.51 ppt, ocean conditions - 17 Aug 1992.

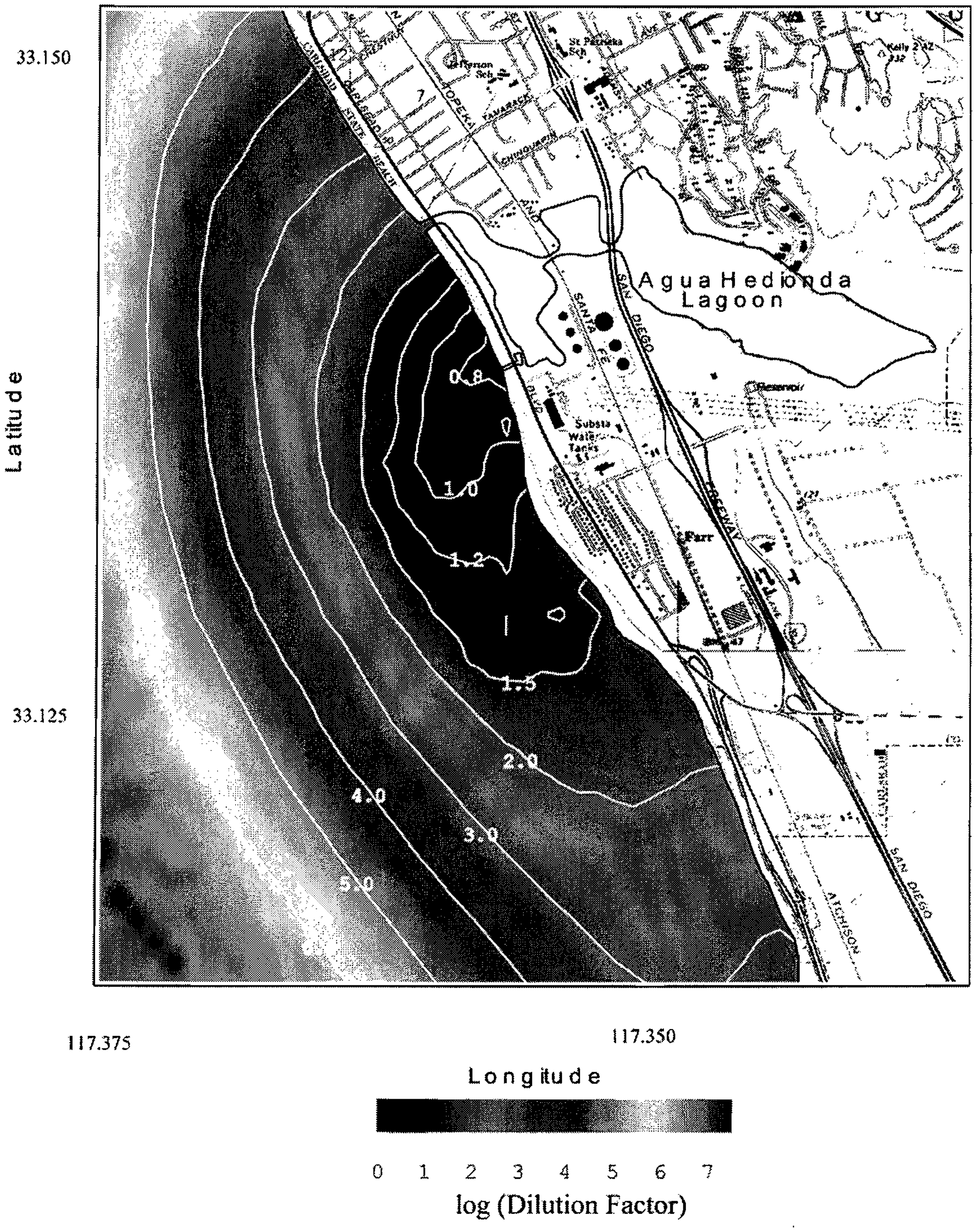


Figure 22. Scenario 5 worst case with two Unit 4 circulation pumps for $\Delta T = 0\ ^{o}C$. Seafloor dilution factor for raw concentrate from desalination. R.O. = 50 mgd, plant inflow rate = 304 mgd, combined discharge = 254 mgd, ambient ocean salinity = 33.51 ppt, ocean conditions, 17 Aug 1992.

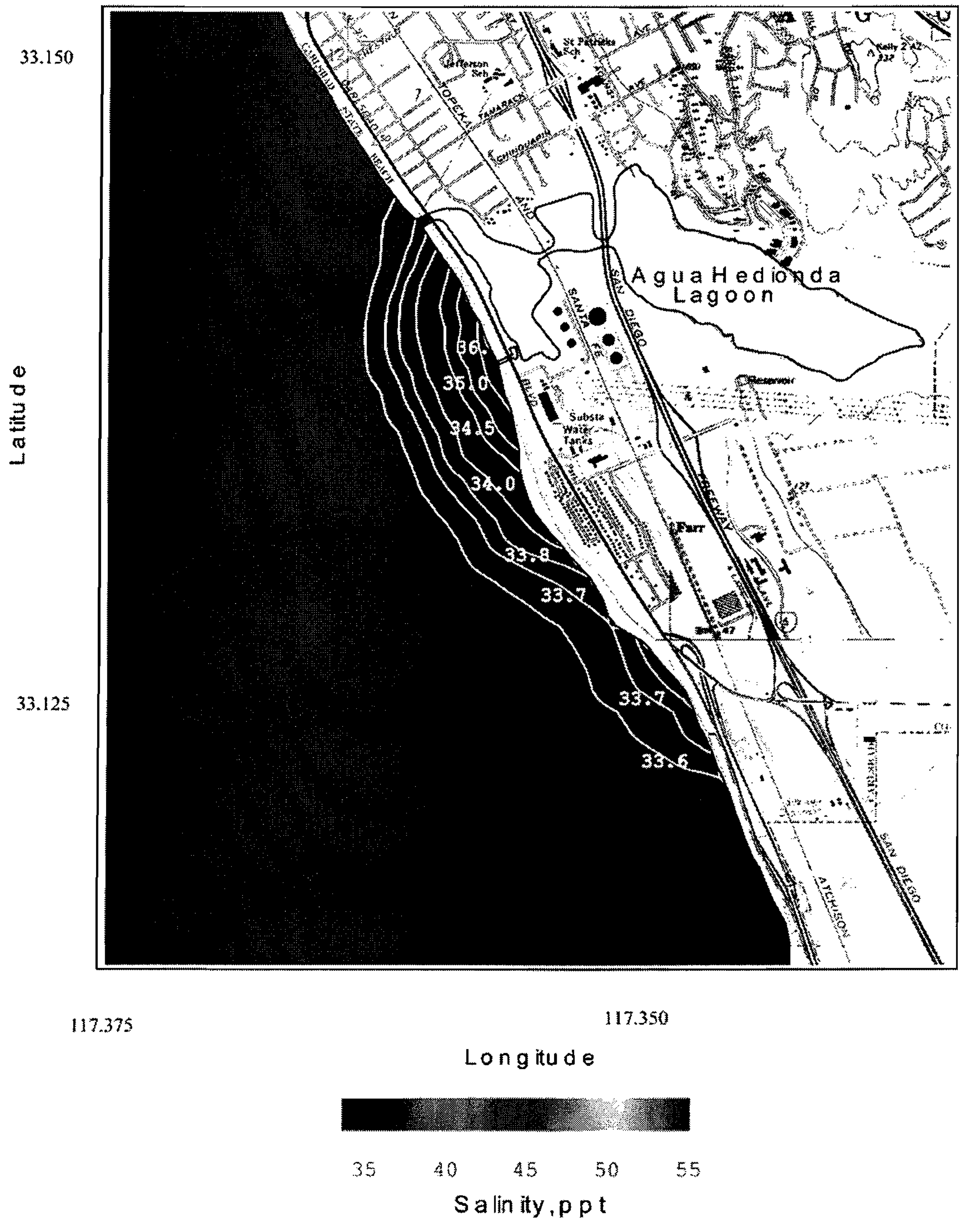


Figure 23. Scenario 5 worst case with two Unit 4 circulation pumps for $\Delta T = 0\ ^{o}C$. Daily depth-averaged salinity of concentrated seawater for R.O. = 50 mgd, plant inflow rate = 304 mgd, combined discharge = 254 mgd, ambient ocean salinity = 33.51 ppt, ocean conditions, 17 Aug 1992.

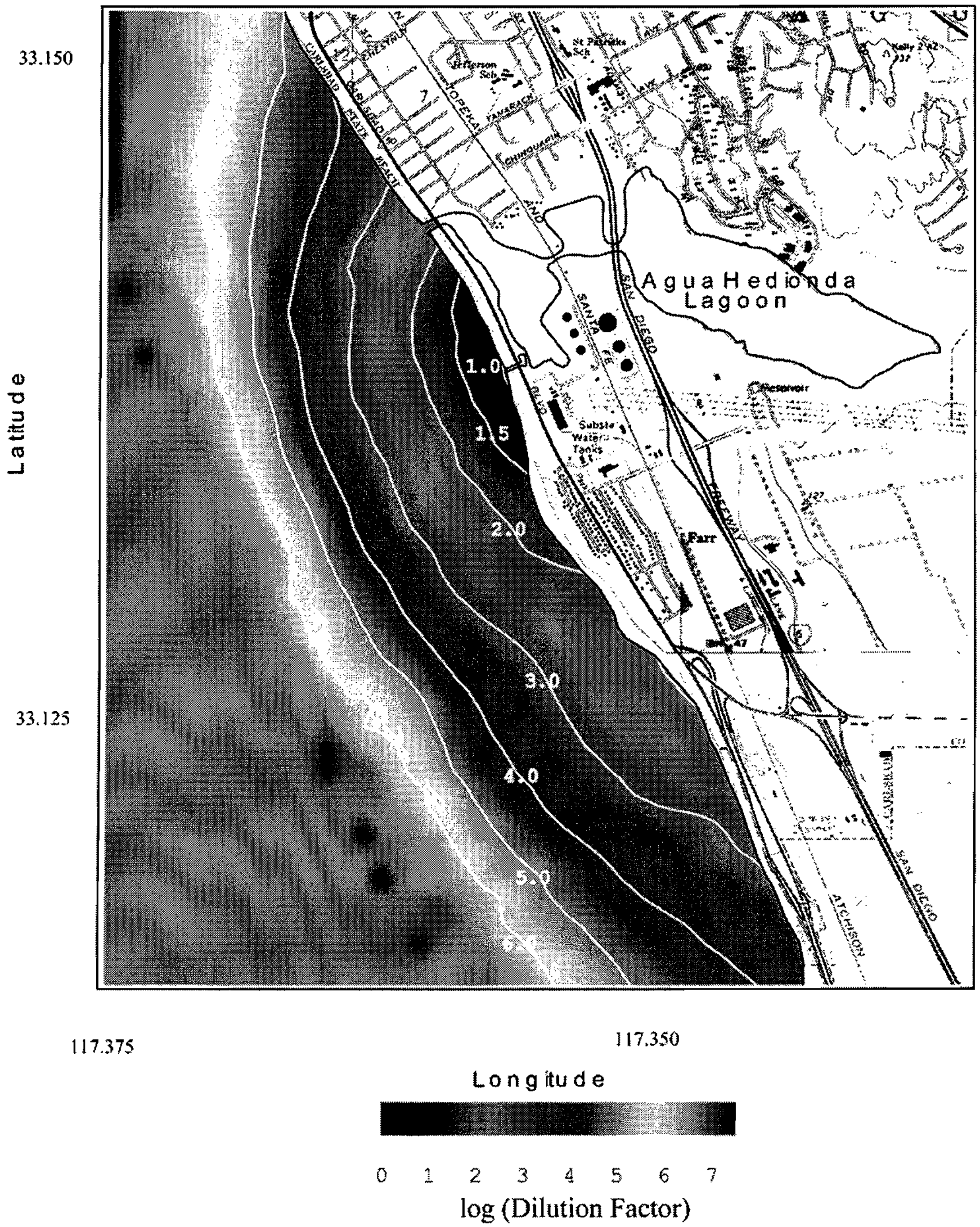


Figure 24. Scenario 5 worst case with two Unit 4 circulation pumps for $\Delta T = 0\ ^{o}C$. Depth-averaged dilution factor for raw concentrate from desalination. R.O. = 50 mgd, plant inflow rate = 304 mgd, combined discharge = 254 mgd, ambient ocean salinity = 33.51 ppt, ocean conditions, 17 Aug 1992.

F) Average-Case Hyper-Saline Effects of the Low-Flow Scenario 1:

One Unit 4 circulation pump is assumed to be operating at 149.76 with 99.76 mgd being discharged into the ocean discharge channel at a salinity of 50.3 ppt after blending with the concentrated sea salts from the desalination plant. No power generation is assumed so that the Delta-T is $\Delta T = 0^0$ C. Figure 25 gives the salinity field on the sea floor resulting from the average case mixing conditions for low-flow Scenario 1. The salinity field is averaged over a 24 hour period. Maximum bottom salinities reach 42.3 ppt and cover an area of 8.1 acres of the sub-tidal beach face and sandy bottom nearshore habitat. The hyper-saline bottom boundary layer exposes about 19.4 acres of benthic environment to salinity in excess of 40 ppt. About 39.4 acres of seabed are subjected to salinity elevated 10 % above ambient ocean conditions. Maximum bottom salinity found anywhere along the boundaries of the ZID is 40.0 ppt, occurring at the shoreline 1000 ft south of the discharge channel. Bottom dilution factors for the raw concentrate in Figure 26 indicate that minimum dilution on the sea bed at the south end of the ZID at the shoreline is 5.2 to 1 and bottom dilutions are less than 15 to 1 on 69 acres of surf zone bottom and offshore seabed.

Maximum salinity in the water column for average case Scenario 1 is found in Figure 27 to be 40.5 ppt in the surfzone immediately seaward of the discharge jetty. No pelagic area is subject to salinity in excess of 40 ppt. About 13.6 acres of pelagic habitat are subjected to salinity reaching 10% over ambient. Maximum water column salinity at the edge of the ZID is 36.9 ppt, found in the surf zone at the shoreline 1000 ft south of the discharge channel. Figure 28 shows that in the water column, where 316(A) dilution standards apply, minimum dilutions are 9.9 to 1 at the south end of the ZID. Everywhere else along the perimeter of the ZID the minimum water column dilution is greater than 15 to 1.

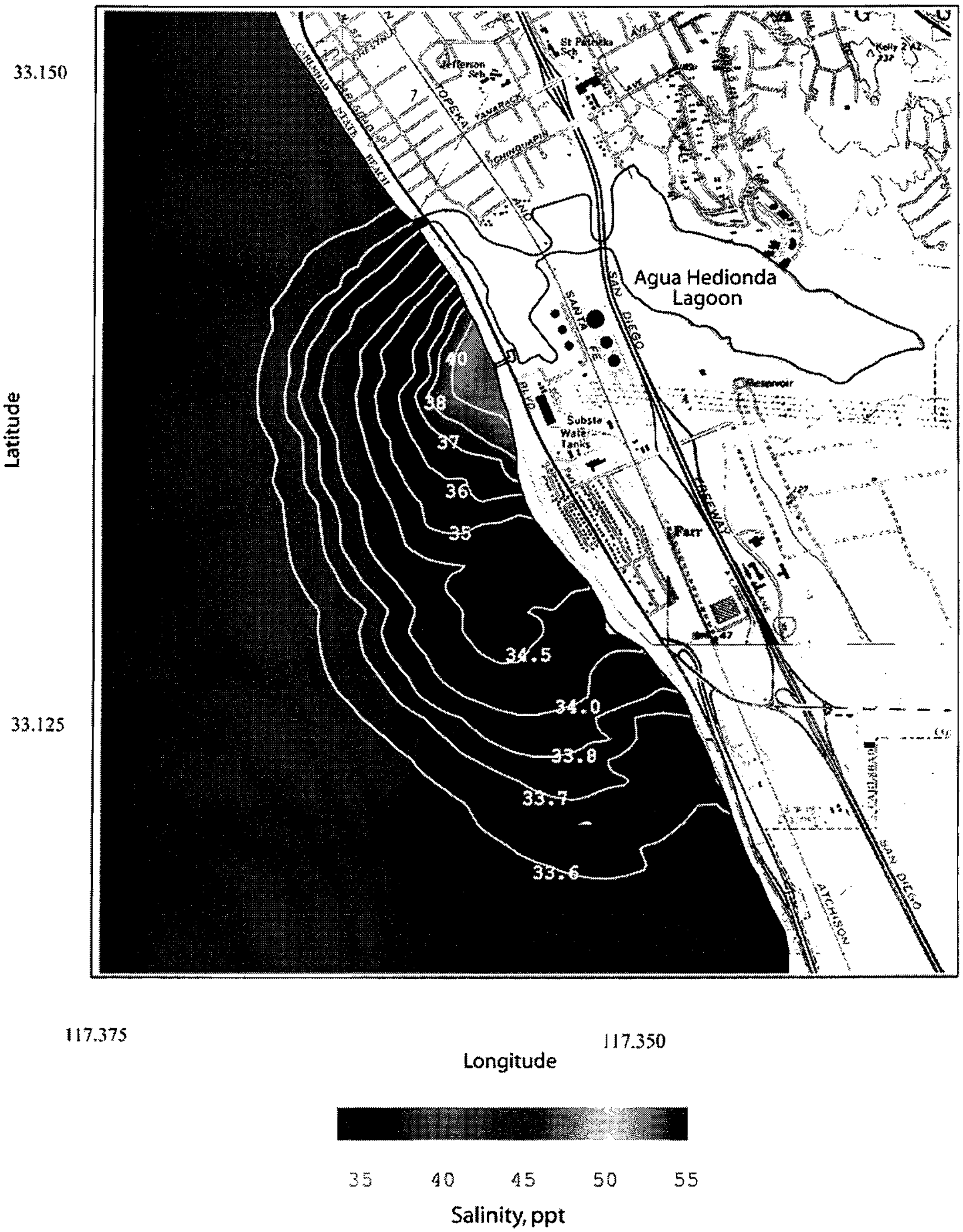


Figure 25. Scenario 1 average case with 1 Unit 5 circulation pump, for $\Delta T = 0\ ^{o}C$. Daily average of the bottom salinity of concentrated seawater for R.O. = 50 mgd, plant inflow rate = 149.76 mgd, combined discharge = 99.76 mgd, ambient ocean salinity = 33.52 ppt, ocean conditions - 23 May 1994.

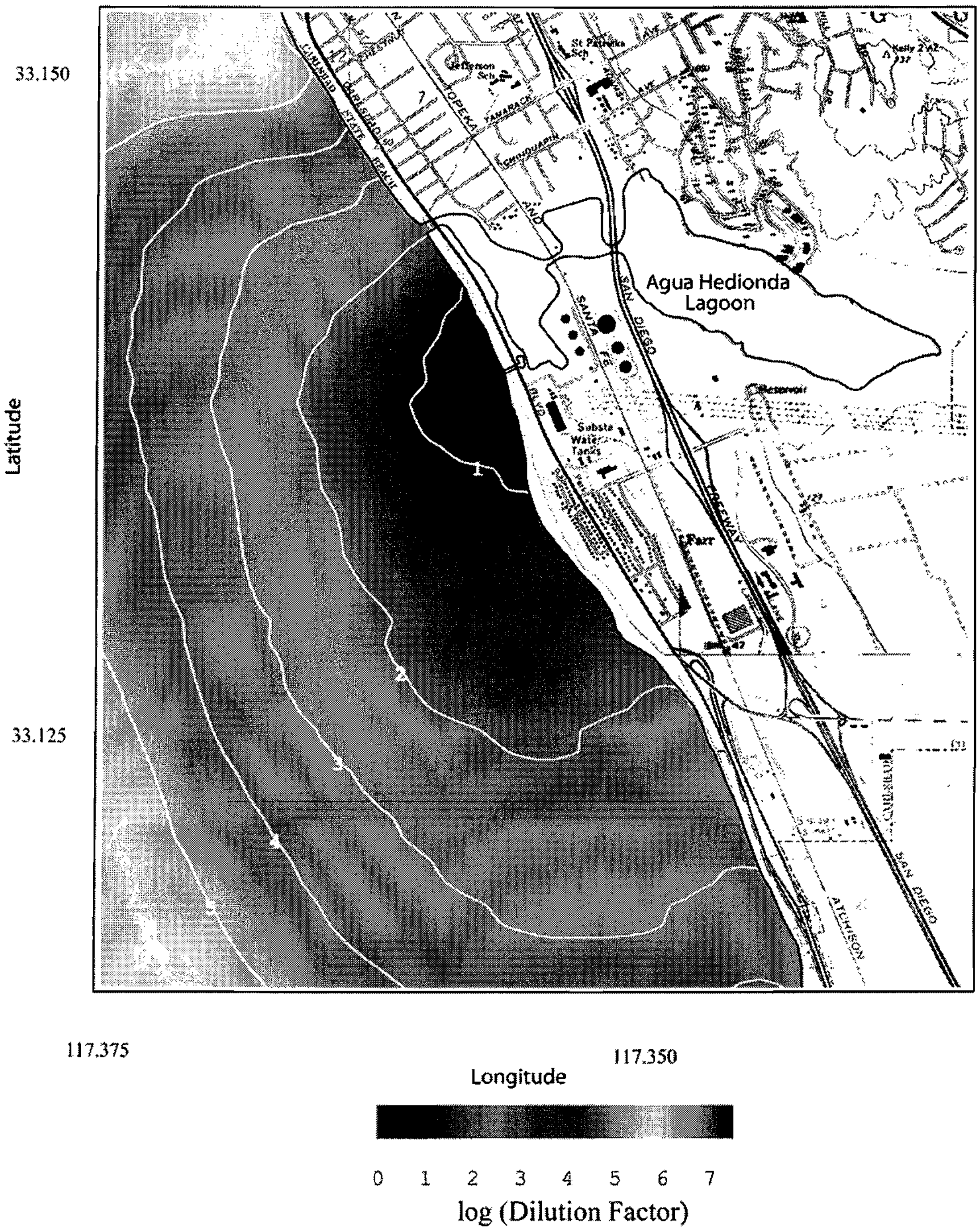


Figure 26. Scenario 1 average case with one Unit 5 circulation pump for DT = 0 ^{o}C. Seafloor dilution factor for raw concentrate from desalination. R.O. = 50 mgd, plant inflow rate = 149.76 mgd, combined discharge = 99.76 mgd, ambient ocean salinity = 33.52 ppt, ocean conditions - 23 May 1994.

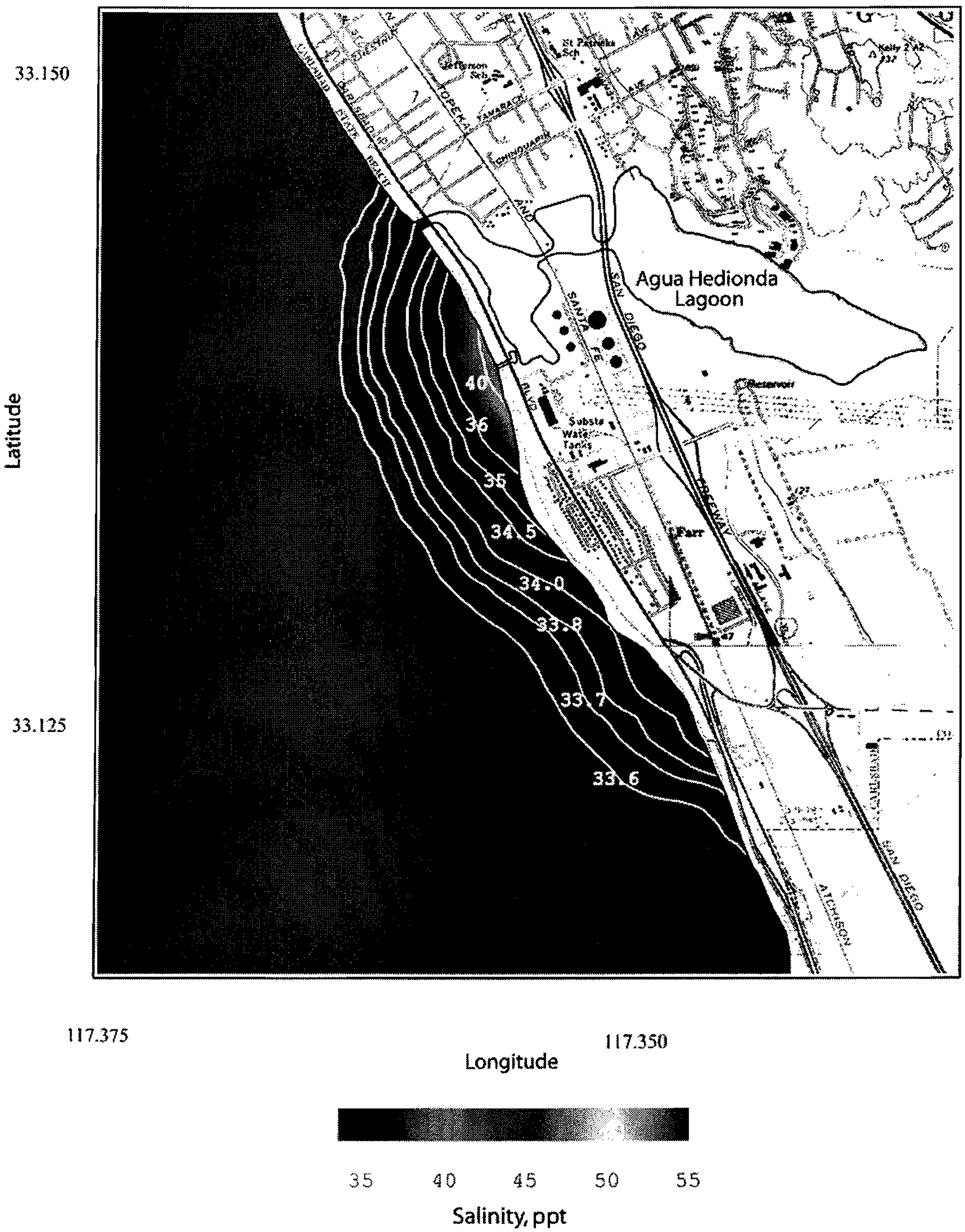


Figure 27. Scenario 1 average case with one Unit 5 circulation pump for $\Delta T = 0\ ^{o}C$. Daily depth-averaged salinity of concentrated seawater for R.O. = 50 mgd, plant inflow rate = 149.76 mgd, combined discharge = 99.76 mgd, ambient ocean salinity = 33.52 ppt, ocean conditions - 23 May 1994.

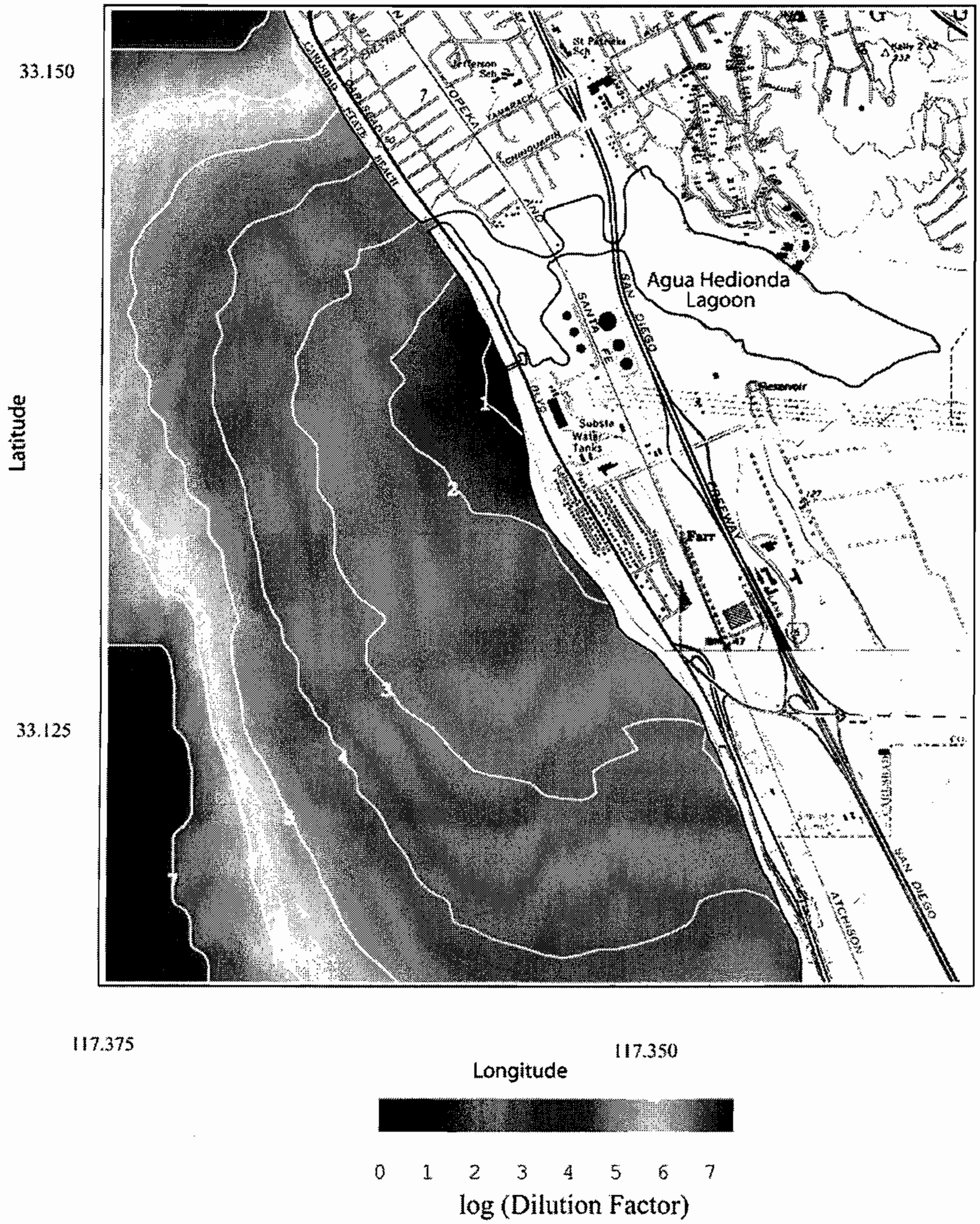


Figure 28. Scenario 1 average case with one Unit 5 circulation pump for $\Delta T = 0\ ^{0}C$. Depth-averaged dilution factor for raw concentrate from desalination. R.O. = 50 mgd, plant inflow rate = 149.76 mgd, combined discharge = 99.76 mgd, ambient ocean salinity = 33.52 ppt, ocean conditions - 23 May 1994.

Water column dilutions are less than 15 to 1 in 9.2 acres of pelagic surf zone, nearly all of which is inside the ZID in the immediate neighborhood of the discharge channel. The 20.5 year average of ocean mixing conditions that contributed to the Scenario 1 have a recurrence probability of 50%.

G) Average-Case Hyper-Saline Effects of the Low-Flow Scenario 2:

All pumps of Units 1 and 2 and one pump from Unit 3 are assumed to be operating at a combined intake flow rate of 172.8 mgd, with 122.8 mgd being discharged into the ocean discharge channel at a salinity of 47.1 ppt after blending with the concentrated sea salts from the desalination plant. No power generation is assumed so that the Delta-T is $\Delta T = 0^0$ C. Figure 29 gives the salinity field on the sea floor resulting from the average case mixing conditions for low-flow Scenario 2. The salinity field is averaged over a 24 hour period. Maximum bottom salinities reach 42.0 ppt and cover an area of 2.0 acres of the sub-tidal beach face and sandy bottom nearshore habitat. The hyper-saline bottom boundary layer exposes about 9.9 acres of benthic environment to salinity in excess of 40 ppt. About 30.5 acres of seabed are subjected to salinity elevated 10 % above ambient ocean conditions. Maximum bottom salinity found anywhere along the boundaries of the ZID is 38.8 ppt, occurring at the shoreline 1000 ft south of the discharge channel. Bottom dilution factors for the raw concentrate in Figure 30 indicate that minimum dilution on the sea bed at the south end of the ZID at the shoreline is 6.3 to 1 and bottom dilutions are less than 15 to 1 on 37.4 acres of surf zone bottom and offshore seabed.

Maximum salinity in the water column for average case Scenario 2 is found in Figure 31 to be 37.7 ppt in the surfzone immediately seaward of the discharge jetty. No pelagic area is subject to salinity in excess of 40 ppt. About 0.6 acres of pelagic habitat are subjected to salinity reaching 10% over ambient. Maximum

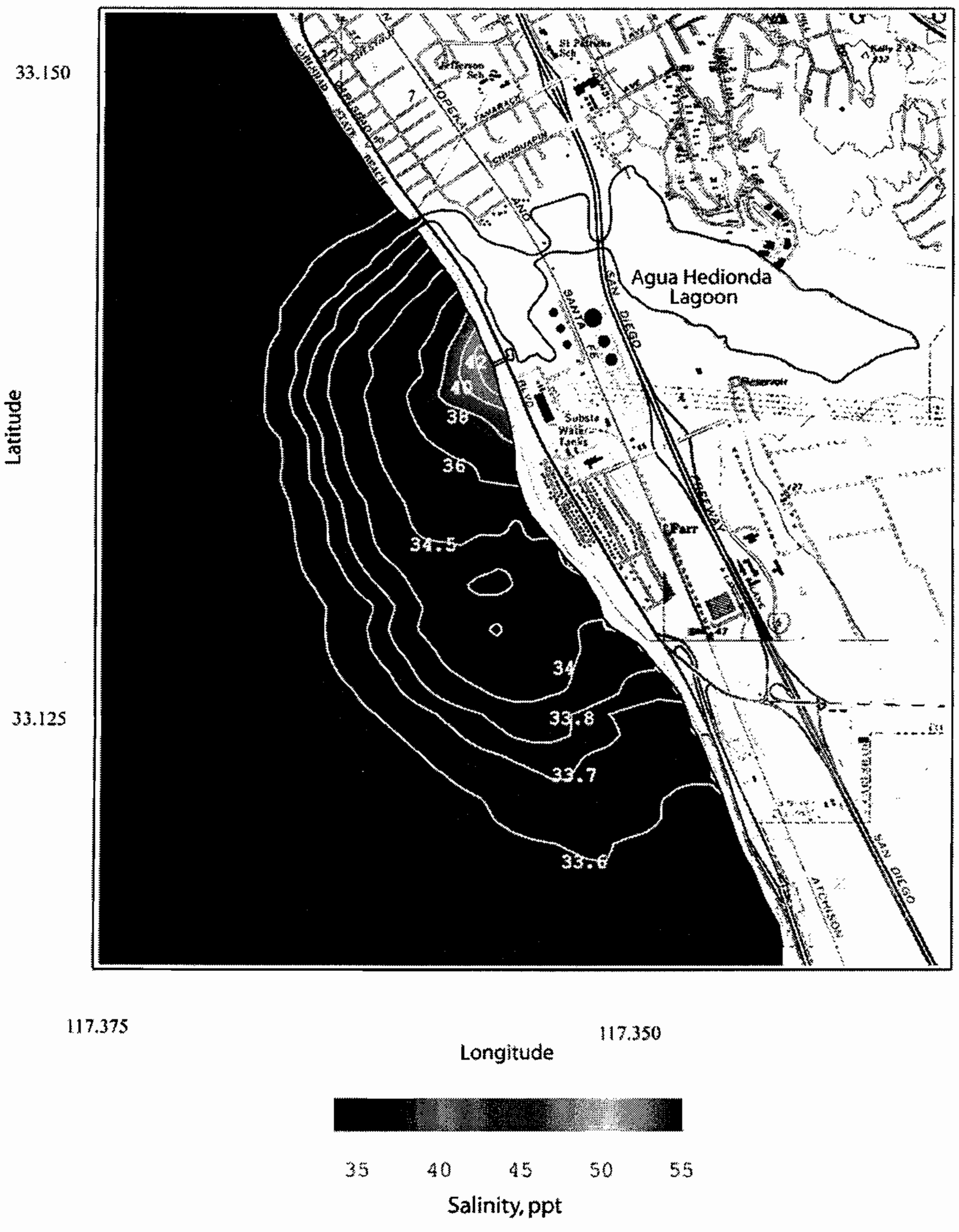


Figure 29. Scenario 2 average case with all circulation pumps - Units 1&2, and one pump - Unit 3 for $\Delta T = 0\ ^{o}C$. Daily average of the bottom salinity of concentrated seawater for R.O. = 50 mgd, plant inflow rate = 172.8 mgd, combined discharge = 122.8 mgd, ambient ocean salinity = 33.52 ppt, ocean conditions - 23 May 1994.

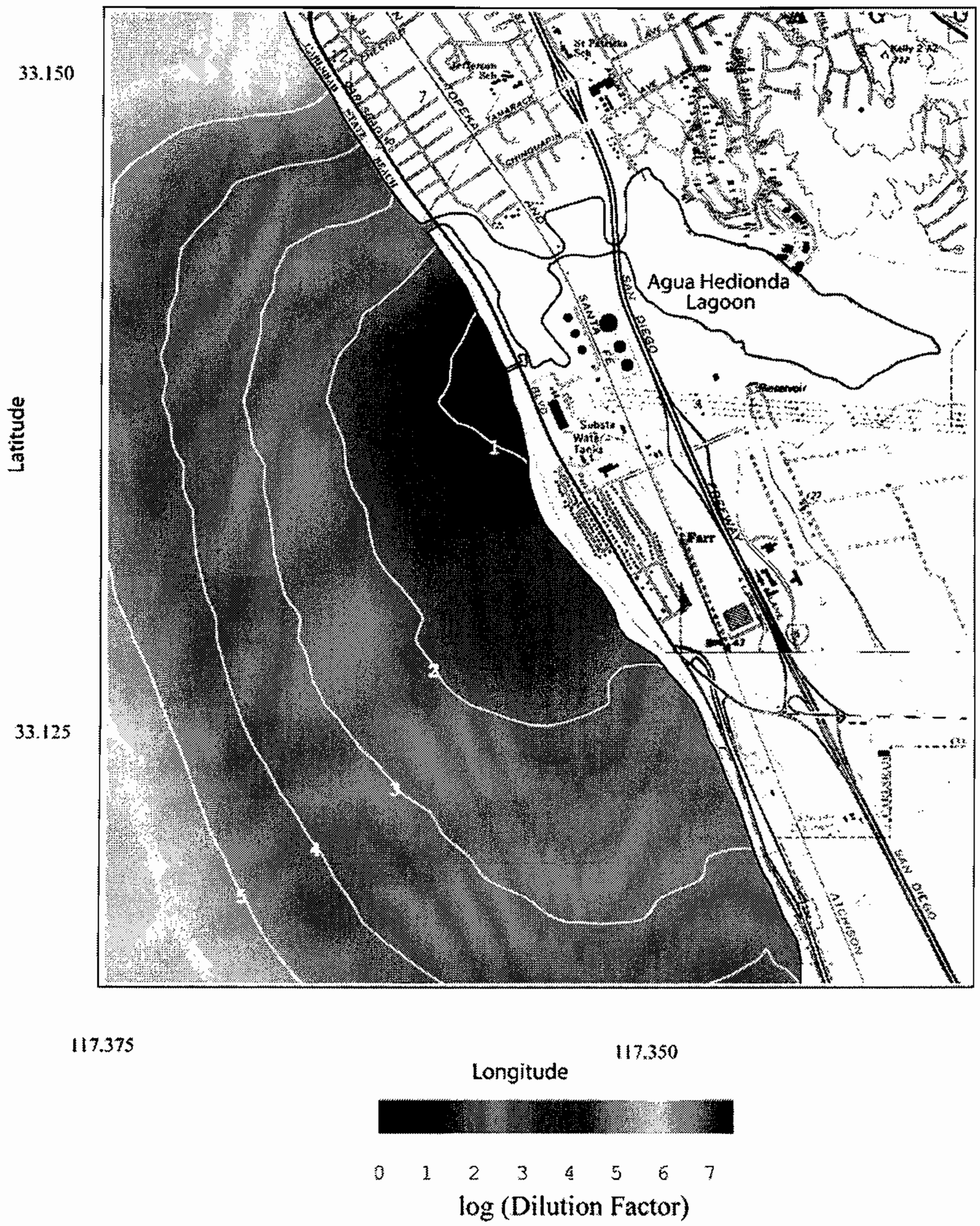


Figure 30. Scenario 2 average case with all circulation pumps - Units 1&2, and one pump - Unit 3 for $\Delta T = 0\ ^{o}C$. Seafloor dilution factor for raw concentrate from desalination. R.O. = 50 mgd, plant inflow rate = 172.8 mgd, combined discharge = 122.8 mgd, ambient ocean salinity = 33.52 ppt, ocean conditions - 23 May 1994.

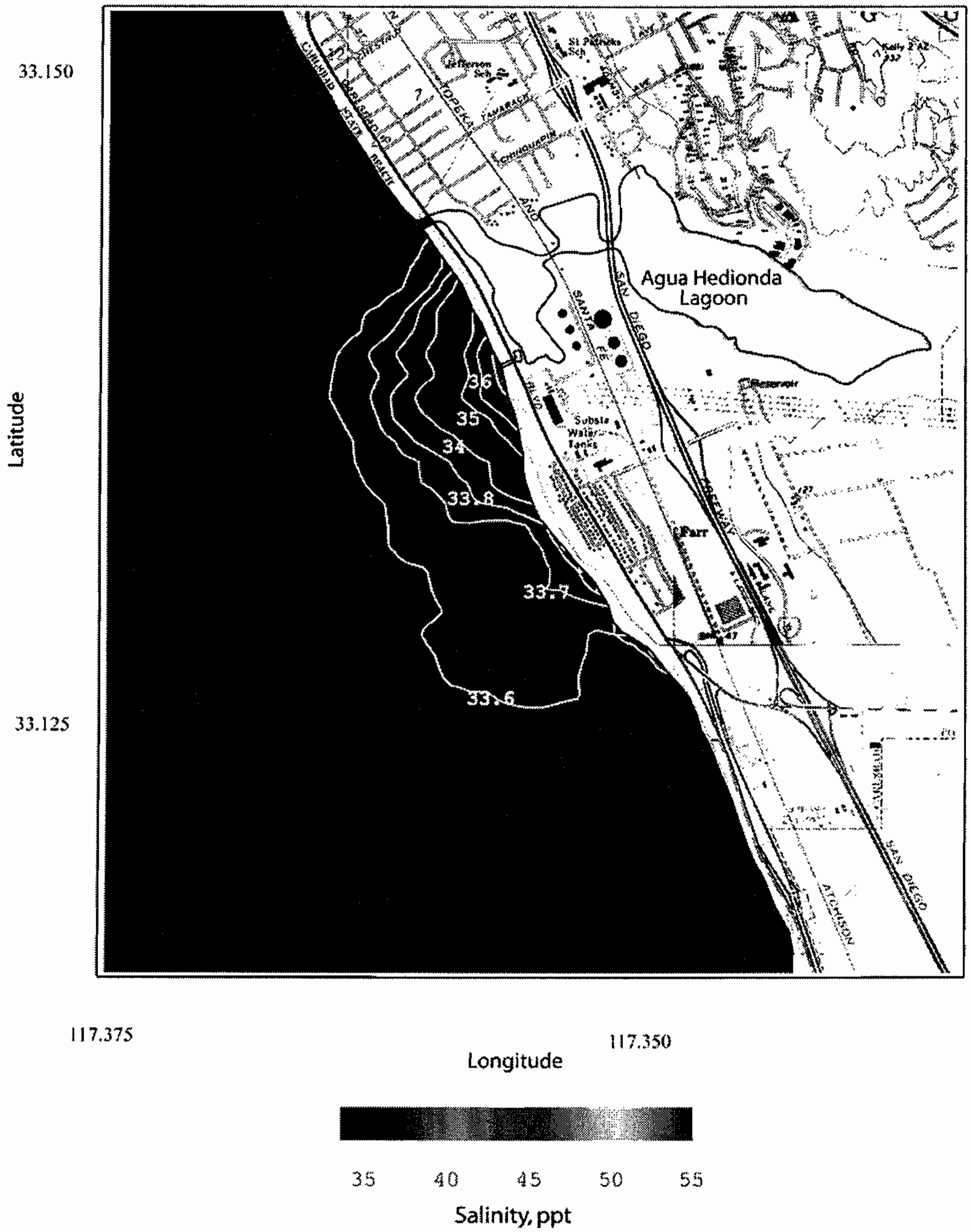


Figure 31. Scenario 2 average case with all circulation pumps - Units 1&2, and one pump - Unit 3 for $\Delta T = 0\ ^{o}C$. Daily depth-averaged salinity of concentrated seawater for R.O. = 50 mgd, plant inflow rate = 172.8 mgd, combined discharge = 122.8 mgd, ambient ocean salinity = 33.52 ppt, ocean conditions - 23 May 1994.

water column salinity at the edge of the ZID is 36.0 ppt, found in the surf zone at the shoreline 1000 ft south of the discharge channel. Figure 32 shows that in the water column, where 316(A) dilution standards apply, minimum dilutions are 13.5 to 1 at the north end of the ZID. Dilutions are less than 15 to 1 in 5.7 acres of pelagic surf zone, all of which is inside the ZID in the immediate neighborhood of the discharge channel. The 20.5 year average of ocean mixing conditions that contributed to the Scenario 2 have a recurrence probability of 50%.

H) Average-Case Hyper-Saline Effects of the Low-Flow Scenario 3:

One pump from Unit 1 and one pump from Unit 5 are assumed to be operating at a combined intake flow rate of 184.32 mgd, with 134.32 mgd being discharged into the ocean discharge channel at a salinity of 46.0 ppt after blending with the concentrated sea salts from the desalination plant. No power generation is assumed so that the Delta-T is $\Delta T = 0^0\,\text{C}$. Figure 33 gives the salinity field on the sea floor resulting from the average case mixing conditions for low-flow Scenario 3. The salinity field is averaged over a 24 hour period. Maximum bottom salinities reach 41.4 ppt and cover an area of 0.8 acres of the sub-tidal beach face and sandy bottom nearshore habitat. The hyper-saline bottom boundary layer exposes about 8.0 acres of benthic environment to salinity in excess of 40 ppt, all of which is inside the perimeter of the ZID. About 25.6 acres of seabed are subjected to salinity elevated 10 % above ambient ocean conditions. Maximum bottom salinity found anywhere along the boundaries of the ZID is 38.0 ppt, occurring at the shoreline 1000 ft south of the discharge channel. Bottom dilution factors for the raw concentrate in Figure 34 indicate that minimum dilution on the sea bed at the south end of the ZID at the shoreline is 7.5 to 1 and bottom dilutions are less than 15 to 1 on 30.1 acres of surf zone bottom and offshore seabed.

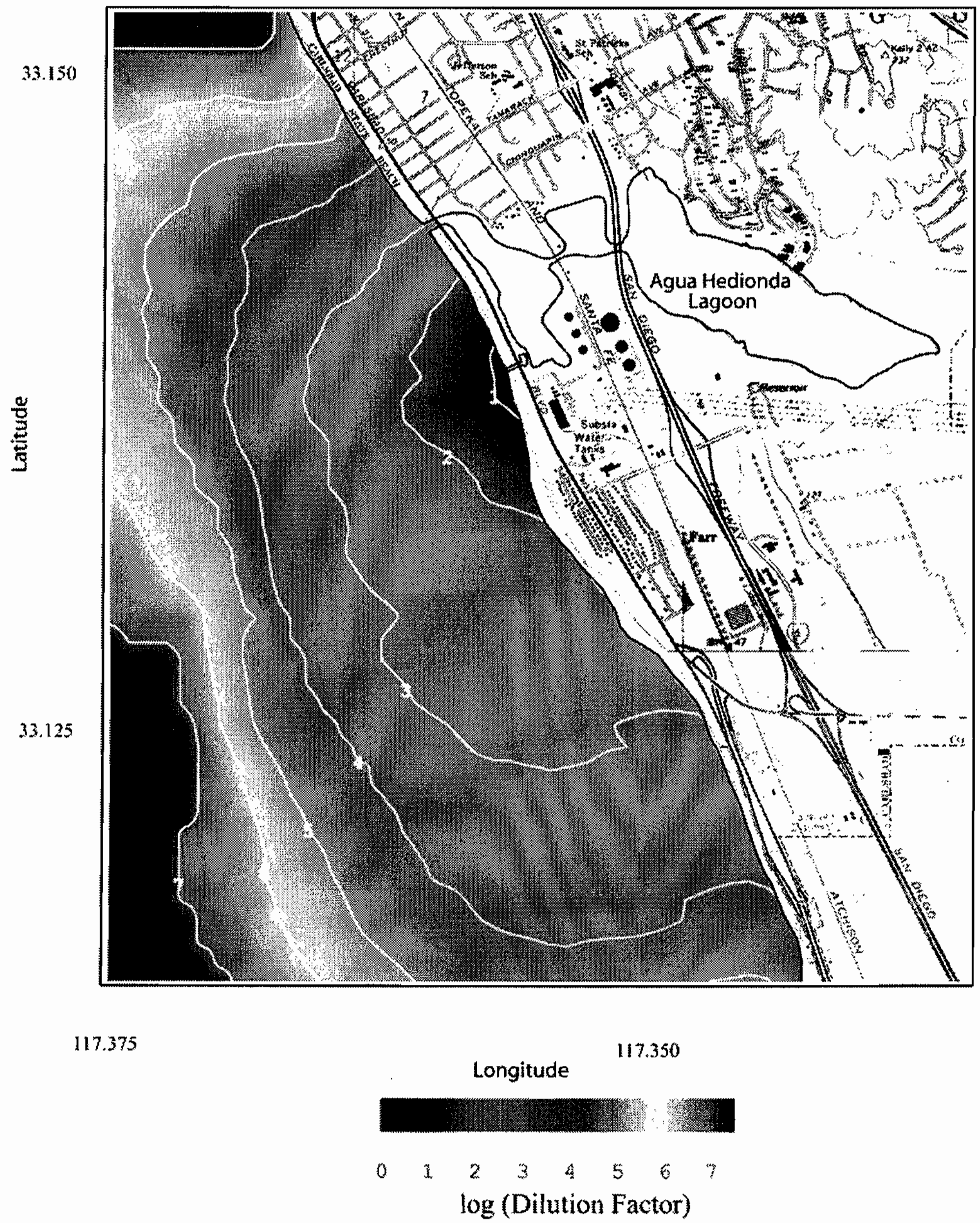


Figure 32. Scenario 2 average case with all circulation pumps - Units 1&2, and one pump - Unit 3 for $\Delta T = 0\ ^{O}C$. Depth-averaged dilution factor for raw concentrate from desalination. R.O. = 50 mgd, plant inflow rate = 172.8 mgd, combined discharge = 122.8 mgd, ambient ocean salinity = 33.52 ppt, ocean conditions - 23 May 1994.

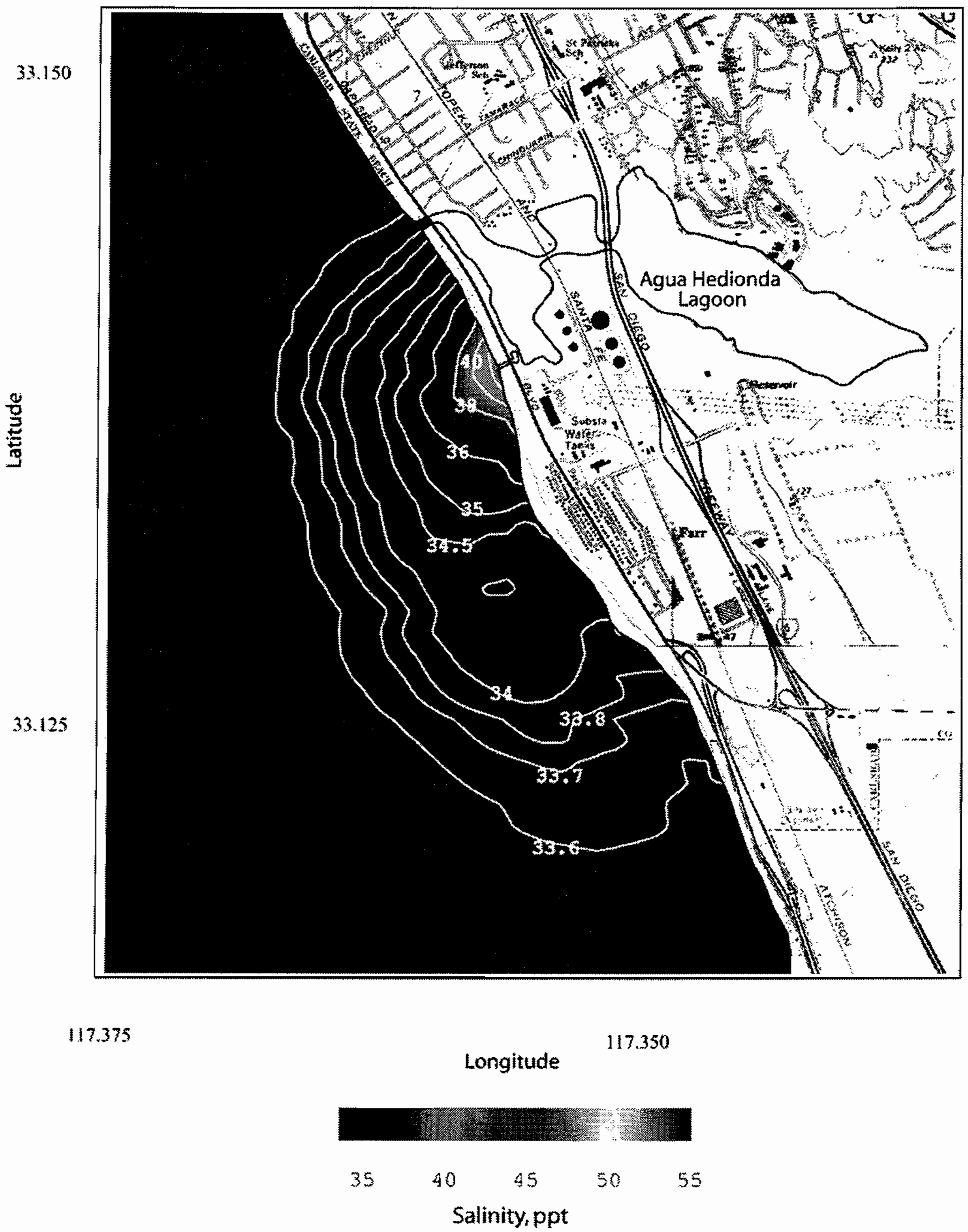


Figure 33. Scenario 3 average case with one Unit 5 circulation pump, and one Unit 1 pump for $\Delta T = 0\ ^{o}C$. Daily average of the bottom salinity of concentrated seawater for R.O. = 50 mgd, plant inflow rate = 184.32 mgd, combined discharge = 134.32 mgd, ambient ocean salinity = 33.52 ppt, ocean conditions - 23 May 1994.

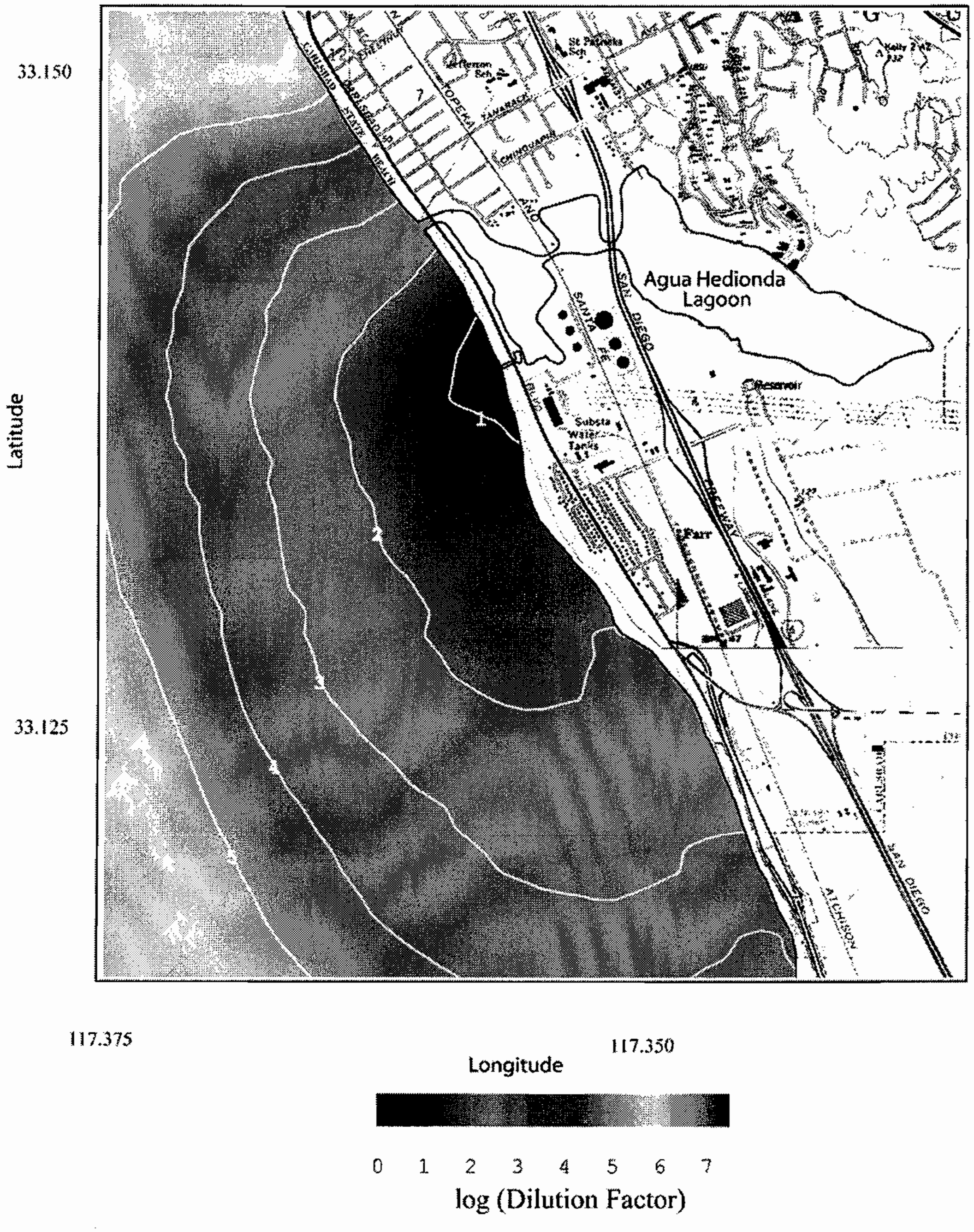


Figure 34. Scenario 3 average case with one Unit 5 circulation pump, and one Unit 1 pump for $\Delta T = 0\ ^{o}C$. Seafloor dilution factor for raw concentrate from desalination. R.O. = 50 mgd, plant inflow rate = 184.32 mgd, combined discharge = 134.32 mgd, ambient ocean salinity = 33.52 ppt, ocean conditions - 23 May 1994.

Maximum salinity in the water column for average case Scenario 3 is found in Figure 35 to be 37.0 ppt in the surfzone immediately seaward of the discharge jetty. No pelagic area is subject to salinity in excess of 40 ppt. About 0.2 acres of pelagic habitat are subjected to salinity reaching 10% over ambient. Maximum water column salinity at the edge of the ZID is 35.4 ppt, found in the surf zone at the shoreline 1000 ft south of the discharge channel. Figure 36 shows that in the water column, where 316(A) dilution standards apply, minimum dilutions are 17.7 to 1 at the north end of the ZID, in compliance with 316(A) minimum dilution permit standards. Therefore, from both a salinity tolerance and regulatory perspective, the Scenario 3 low-flow case is acceptable for average ocean mixing conditions. Dilutions are less than 15 to 1 in 4.1 acres of pelagic surf zone, all of which is inside the ZID in the immediate neighborhood of the discharge channel. The 20.5 year average of ocean mixing conditions that contributed to the Scenario 3 have a recurrence probability of 50%.

I) Average-Case Hyper-Saline Effects of the Low-Flow Scenario 4:

Two pumps from Unit 1 and one pump from Unit 5 are assumed to be operating at a combined intake flow rate of 218.88 mgd, with 168.88 mgd being discharged into the ocean discharge channel at a salinity of 43.4 ppt after blending with the concentrated sea salts from the desalination plant. No power generation is assumed so that the Delta-T is $\Delta T = 0^{0}$ C. Figure 37 gives the salinity field on the sea floor resulting from the average case mixing conditions for low-flow Scenario 4. The salinity field is averaged over a 24 hour period. Maximum bottom salinities reach 40.1 ppt and cover an area of 0.1 acres of the sub-tidal beach face and sandy bottom nearshore habitat. The hyper-saline bottom boundary layer exposes about 2.0 acres of benthic environment to salinity in excess of 40 ppt, all of which is

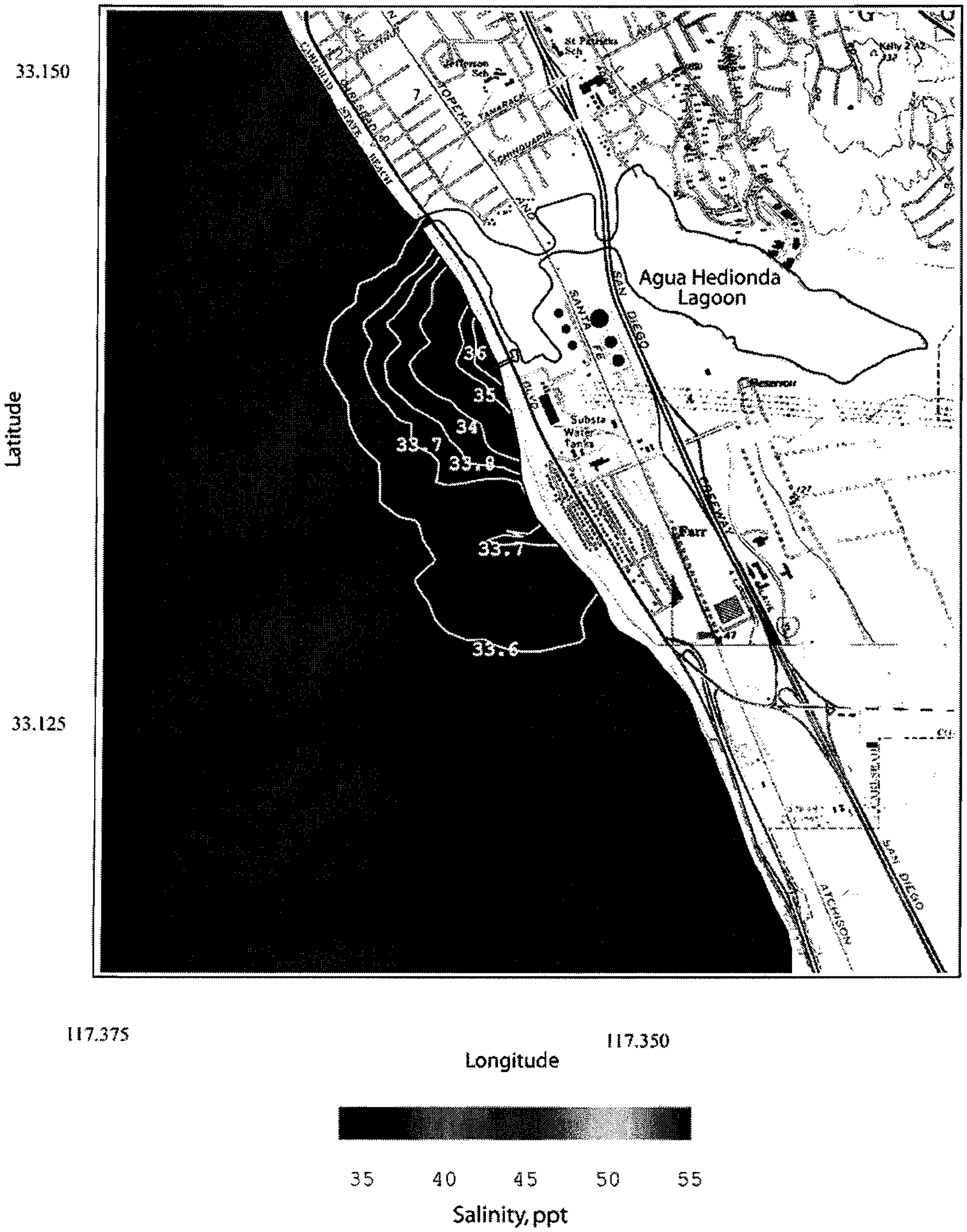


Figure 35. Scenario 3 average case with one Unit 5 circulation pump, and one Unit 1 pump for $\Delta T = 0\ ^{o}C$. Daily depth-averaged salinity of concentrated seawater for R.O. = 50 mgd, plant inflow rate = 184.32 mgd, combined discharge = 134.32 mgd, ambient ocean salinity = 33.52 ppt, ocean conditions - 23 May 1994.

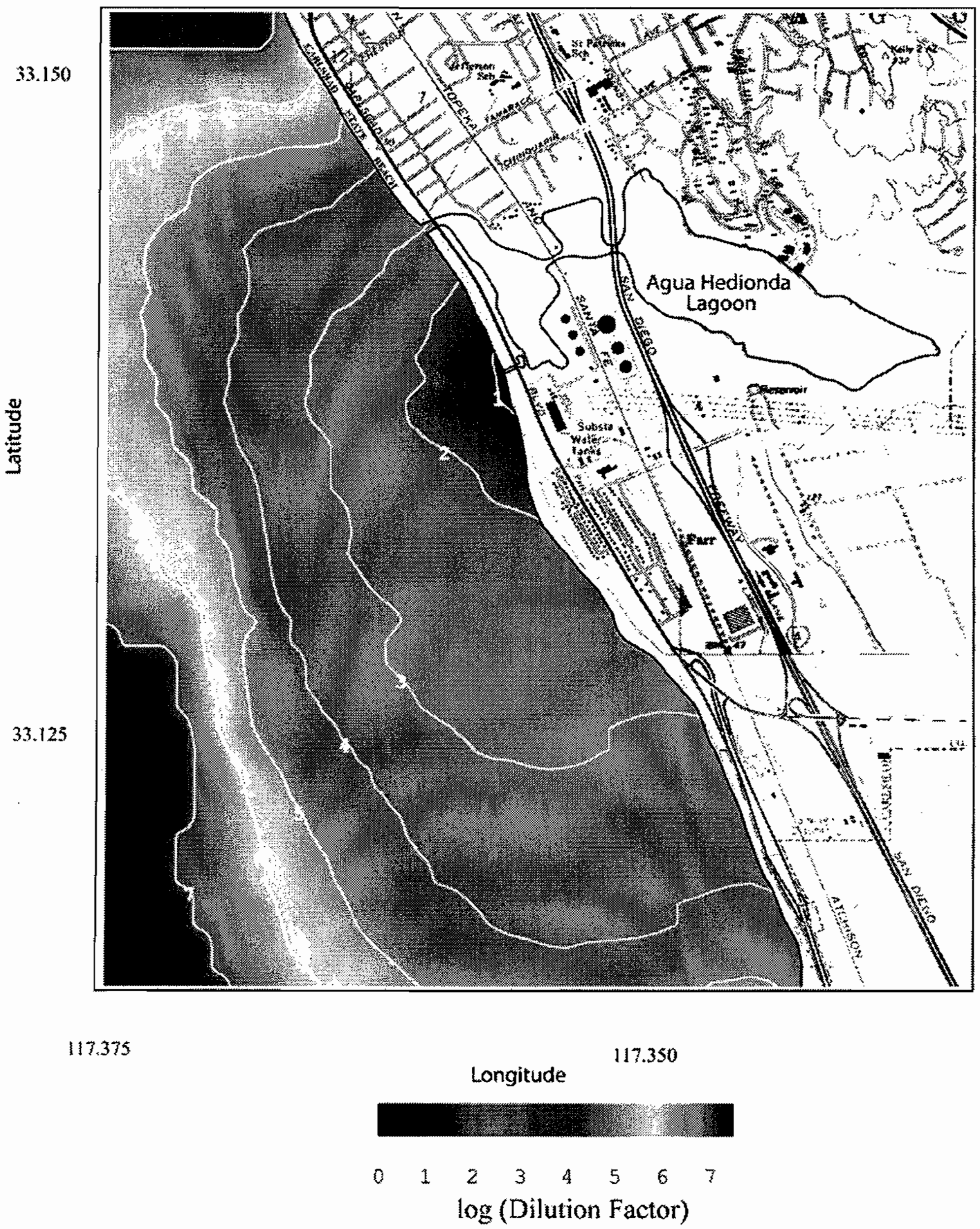


Figure 36. Scenario 3 average case with one Unit 5 circulation pump, and one Unit 1 pump for $\Delta T = 0\ ^{O}C$. Depth-averaged dilution factor for raw concentrate from desalination. R.O. = 50 mgd, plant inflow rate = 184.32 mgd, combined discharge = 134.32 mgd, ambient ocean salinity = 33.52 ppt, ocean conditions - 23 May 1994.

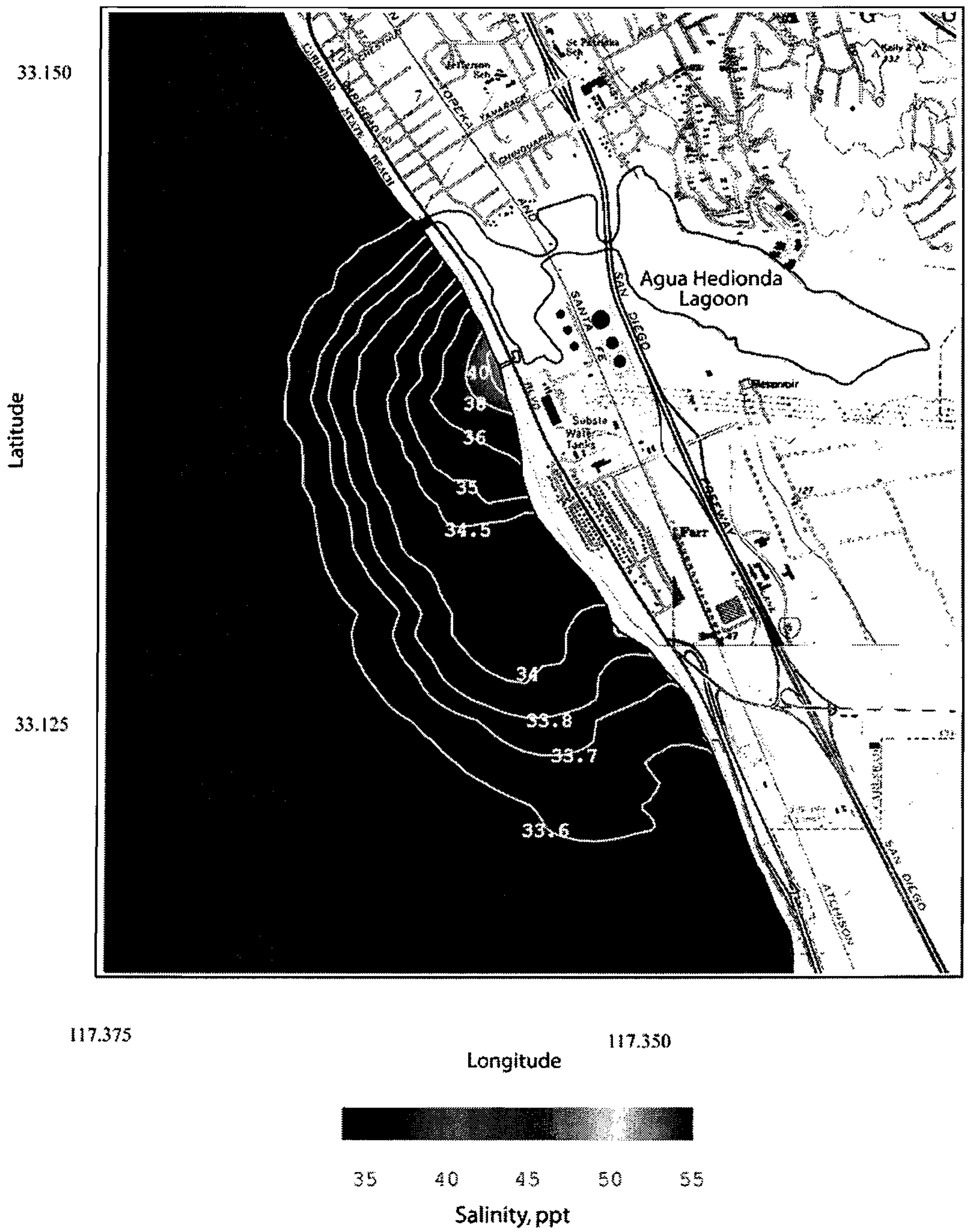


Figure 37. Scenario 4 average case with one Unit 5 circulation pump, and two Unit 1 pumps for $\Delta T = 0\ ^{o}C$. Daily average of the bottom salinity of concentrated seawater for R.O. = 50 mgd, plant inflow rate = 218.88 mgd, combined discharge = 168.88 mgd, ambient ocean salinity = 33.52 ppt, ocean conditions - 23 May 1994.

inside the perimeter of the ZID. About 16.4 acres of seabed are subjected to salinity elevated 10 % above ambient ocean conditions. Maximum bottom salinity found anywhere along the boundaries of the ZID is 37.0 ppt, occurring at the shoreline 1000 ft south of the discharge channel. Bottom dilution factors for the raw concentrate in Figure 38 indicate that minimum dilution on the sea bed at the south end of the ZID at the shoreline is 9.6 to 1 and bottom dilutions are less than 15 to 1 on 25.6 acres of surf zone bottom and offshore seabed.

Maximum salinity in the water column for average case Scenario 4 is found in Figure 39 to be 36.2 ppt in the surfzone immediately seaward of the discharge jetty. No pelagic area is subject to salinity in excess of 40 ppt, nor is any pelagic habitat subjected to salinity reaching 10% over ambient. Maximum water column salinity at the edge of the ZID is 35.1 ppt, found in the surf zone at the shoreline 1000 ft south of the discharge channel. Figure 40 shows that in the water column, where 316(A) dilution standards apply, minimum dilutions are 21.1 to 1 at the south end of the ZID, in compliance with 316(A) minimum dilution permit standards. Therefore, from both a salinity tolerance and regulatory perspective, the Scenario 4 low-flow case is acceptable for average ocean mixing conditions. Dilutions are less than 15 to 1 in 2.2 acres of pelagic surf zone, all of which is inside the ZID in the immediate neighborhood of the discharge channel. The 20.5 year average of ocean mixing conditions that contributed to the Scenario 4 have a recurrence probability of 50%.

J) Average-Case Hyper-Saline Effects of the Low-Flow Scenario 5:

Two pumps from Unit 4 are assumed to be operating at a combined intake flow rate of 304 mgd, with 254 mgd being discharged into the ocean discharge channel at a salinity of 40.11 ppt after blending with the concentrated sea salts from the desalination plant. No power generation is assumed so that the Delta-T

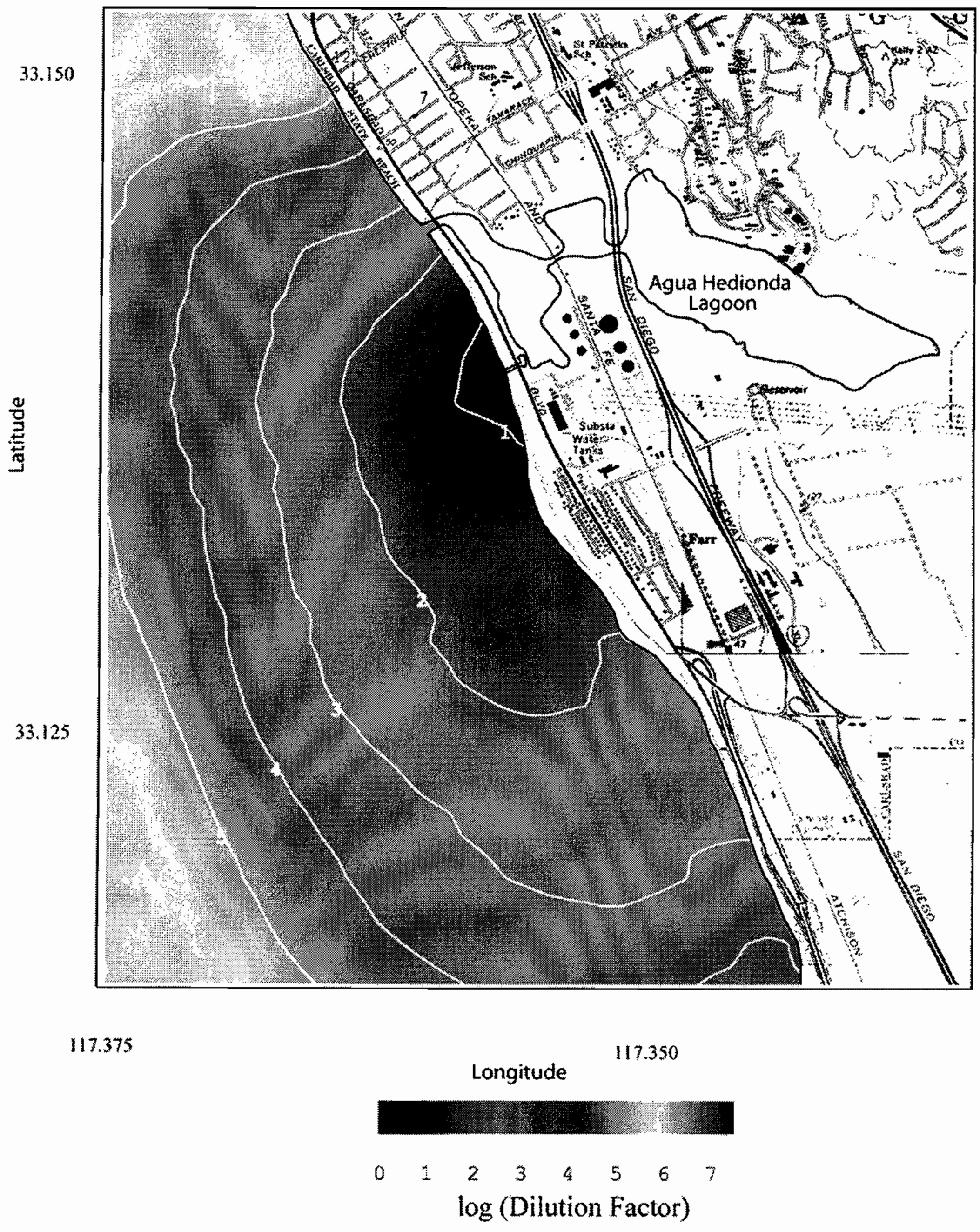


Figure 38. Scenario 4 average case with one Unit 5 circulation pump, and two Unit 1 pumps for $\Delta T = 0\ ^{o}C$. Seafloor dilution factor for raw concentrate from desalination. R.O. = 50 mgd, plant inflow rate = 218.88 mgd, combined discharge = 168.88 mgd, ambient ocean salinity = 33.52 ppt, ocean conditions - 23 May 1994.

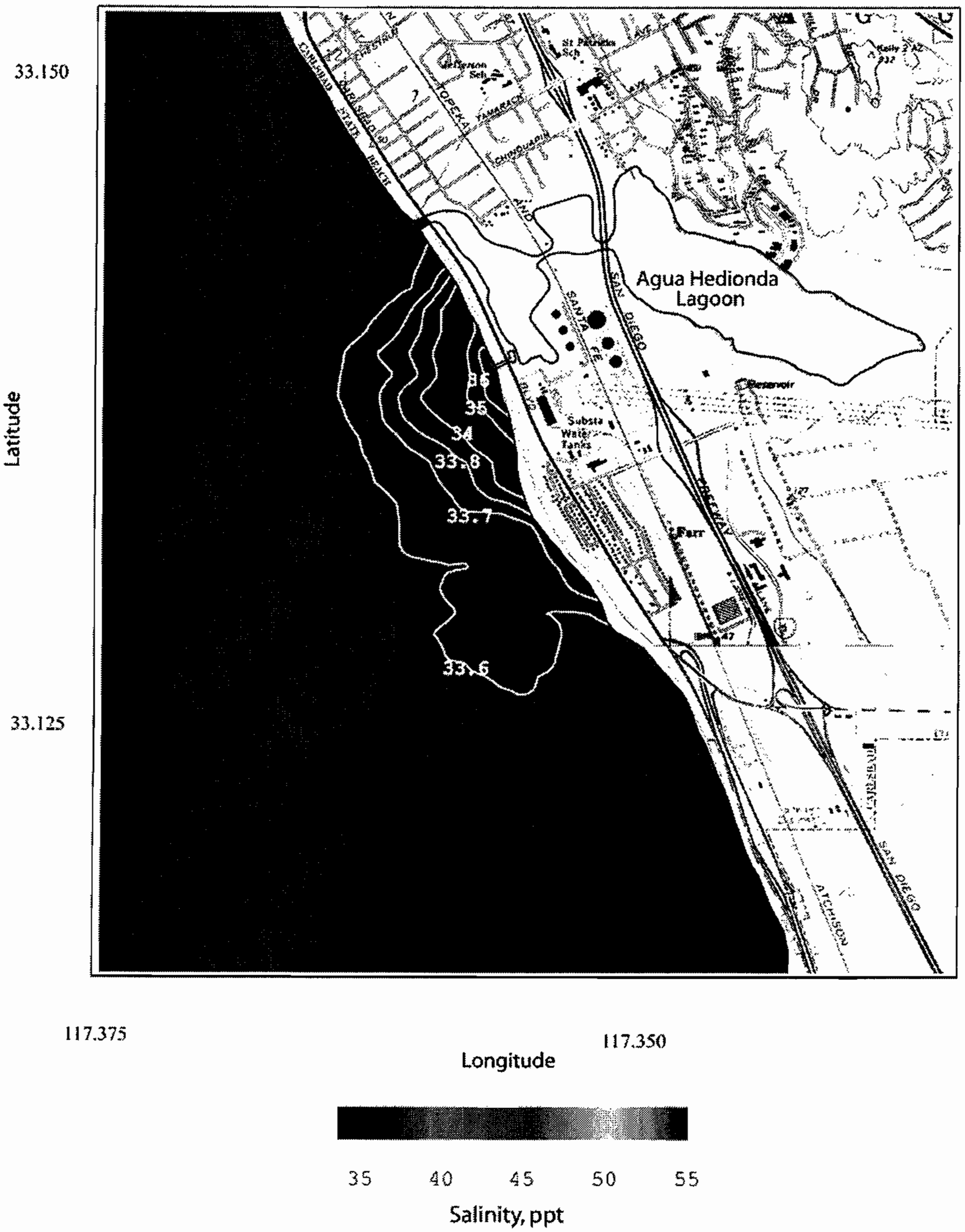


Figure 39. Scenario 4 average case with one Unit 5 circulation pump, and two Unit 1 pumps for $\Delta T = 0\ ^{o}C$. Daily depth-averaged salinity of concentrated seawater for R.O. = 50 mgd, plant inflow rate = 218.88 mgd, combined discharge = 168.88 mgd, ambient ocean salinity = 33.52 ppt, ocean conditions - 23 May 1994.

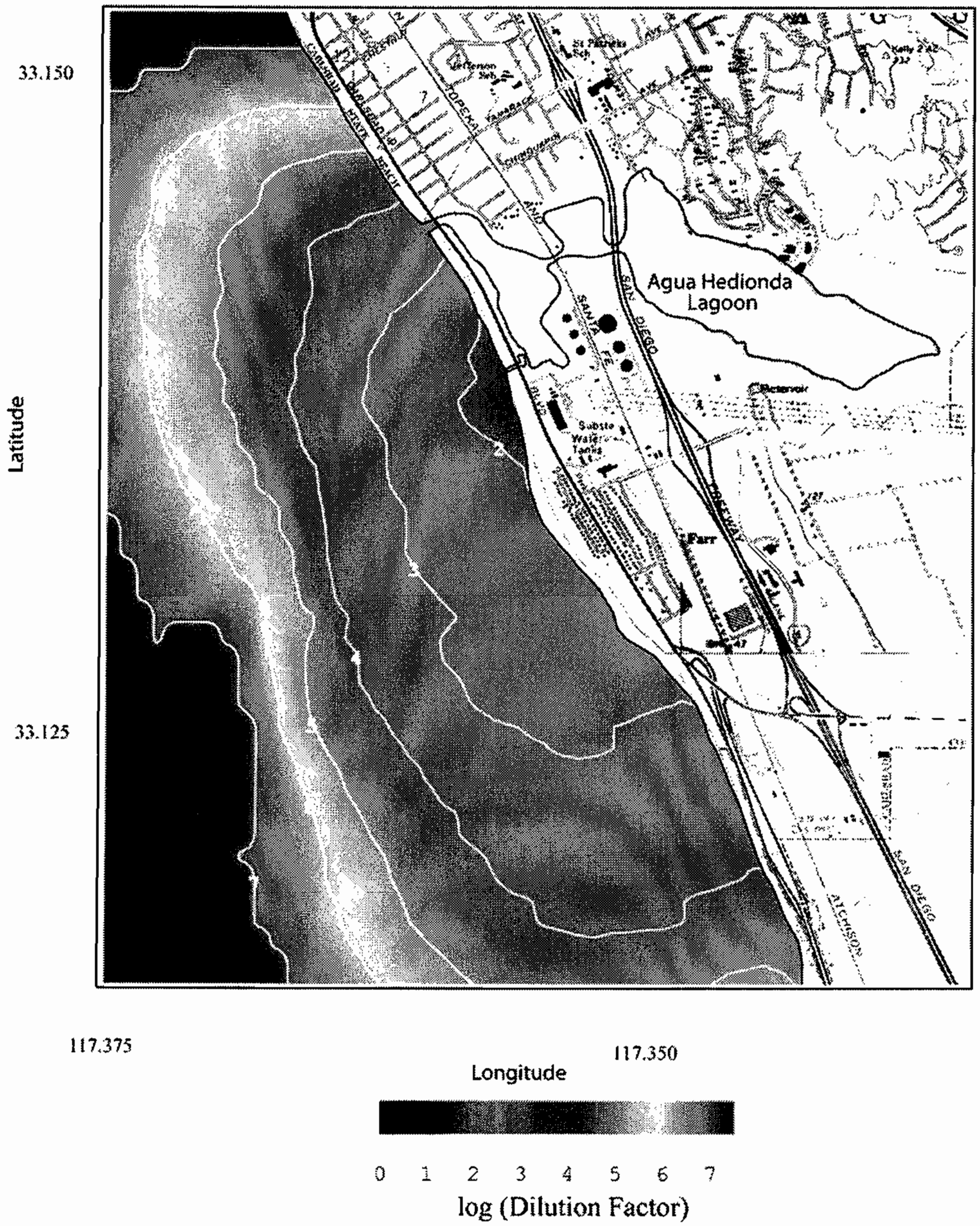


Figure 40. Scenario 4 average case with one Unit 5 circulation pump, and two Unit 1 pumps for $\Delta T = 0\ ^{o}C$. Depth-averaged dilution factor for raw concentrate from desalination. R.O. = 50 mgd, plant inflow rate = 218.88 mgd, combined discharge = 168.88 mgd, ambient ocean salinity = 33.52 ppt, ocean conditions - 23 May 1994.

is $\Delta T = 0^0$C. While these are the same pump combinations and end-of-pipe salinity as the"*unheated Unit 4 historical extreme case*" that was presented in Appendix E of the certified EIR, the average case mixing results were not given in the certified EIR. We present them herein for completeness.

Figure 41 gives the salinity field on the sea floor resulting from the average case mixing conditions for low-flow Scenario 5. The salinity field is averaged over a 24 hour period. Maximum bottom salinities reach 38.1 ppt and cover an area of 1.5 acres of the sub-tidal beach face and sandy bottom nearshore habitat. No benthic habitat is exposed to salinity in excess of 40 ppt. About 8.3 acres of seabed are subjected to salinity elevated 10 % above ambient ocean conditions. Maximum bottom salinity found anywhere along the boundaries of the ZID is 36.0 ppt, occurring at the shoreline 1000 ft south of the discharge channel. Bottom dilution factors for the raw concentrate in Figure 42 indicate that minimum dilution on the sea bed at the south end of the ZID at the shoreline is 13.5 to 1 and bottom dilutions are less than 15 to 1 on 12.4 acres of surf zone bottom and offshore seabed.

Maximum salinity in the water column for average case Scenario 5 is found in Figure 43 to be 36.0 ppt in the surfzone immediately seaward of the discharge jetty. No pelagic area is subject to salinity in excess of 40 ppt, nor is any pelagic habitat subjected to salinity reaching 10% over ambient. Maximum water column salinity at the edge of the ZID is 34.7 ppt, found in the surf zone at the shoreline 1000 ft south of the discharge channel. Figure 44 shows that in the water column, where 316(A) dilution standards apply, minimum dilutions are 28.2 to 1 at the south end of the ZID, in compliance with 316(A) minimum dilution permit standards. Therefore, from both a salinity tolerance and regulatory perspective, the

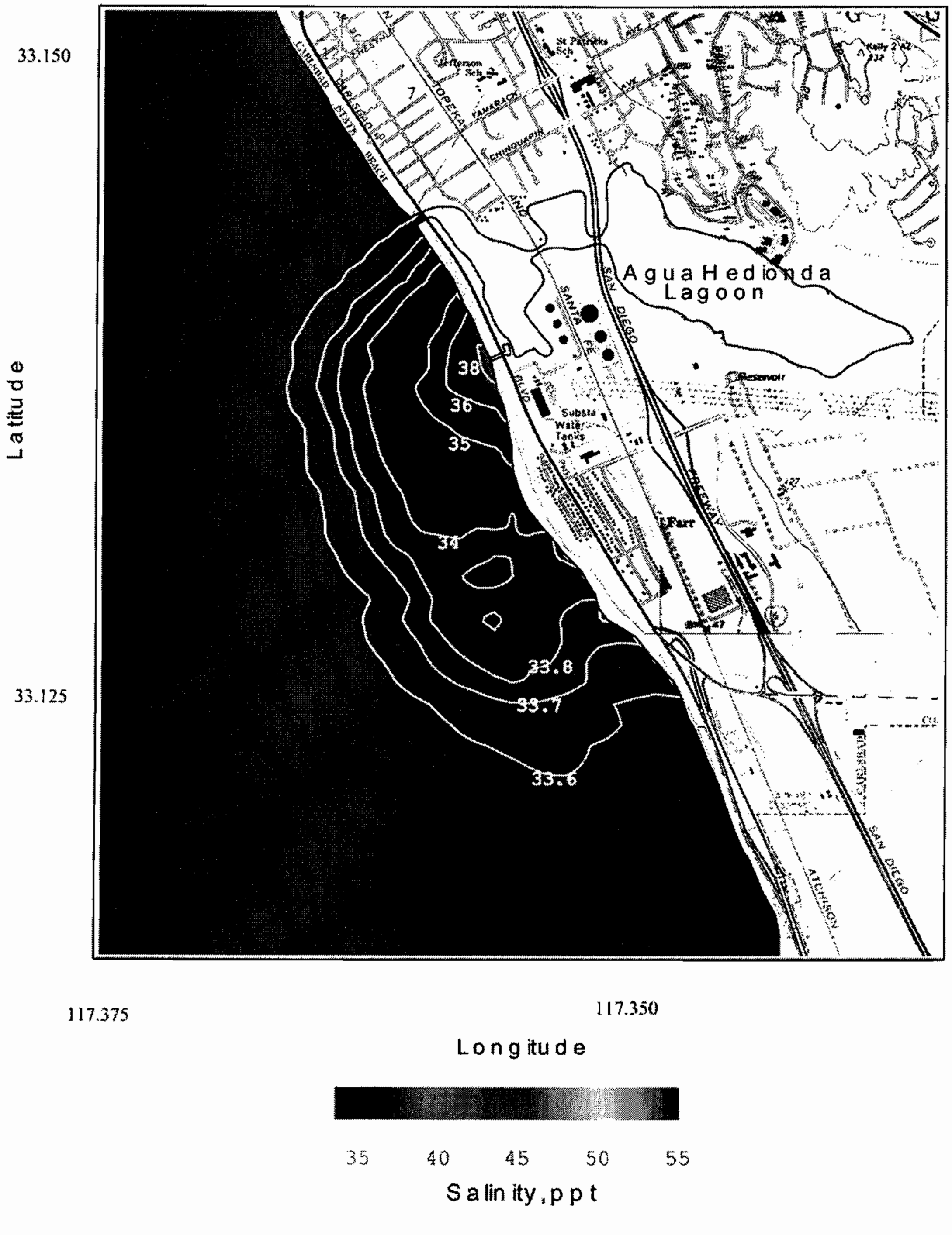


Figure 41. Scenario 5 average case with two Unit 4 circulation 2 pumps for $\Delta T = 0\ ^{o}C$. Daily average of the bottom salinity of concentrated seawater for R.O. = 50 mgd, plant inflow rate = 304 mgd, combined discharge = 254 mgd, ambient ocean salinity = 33.52 ppt, ocean conditions - 23 May 1994.

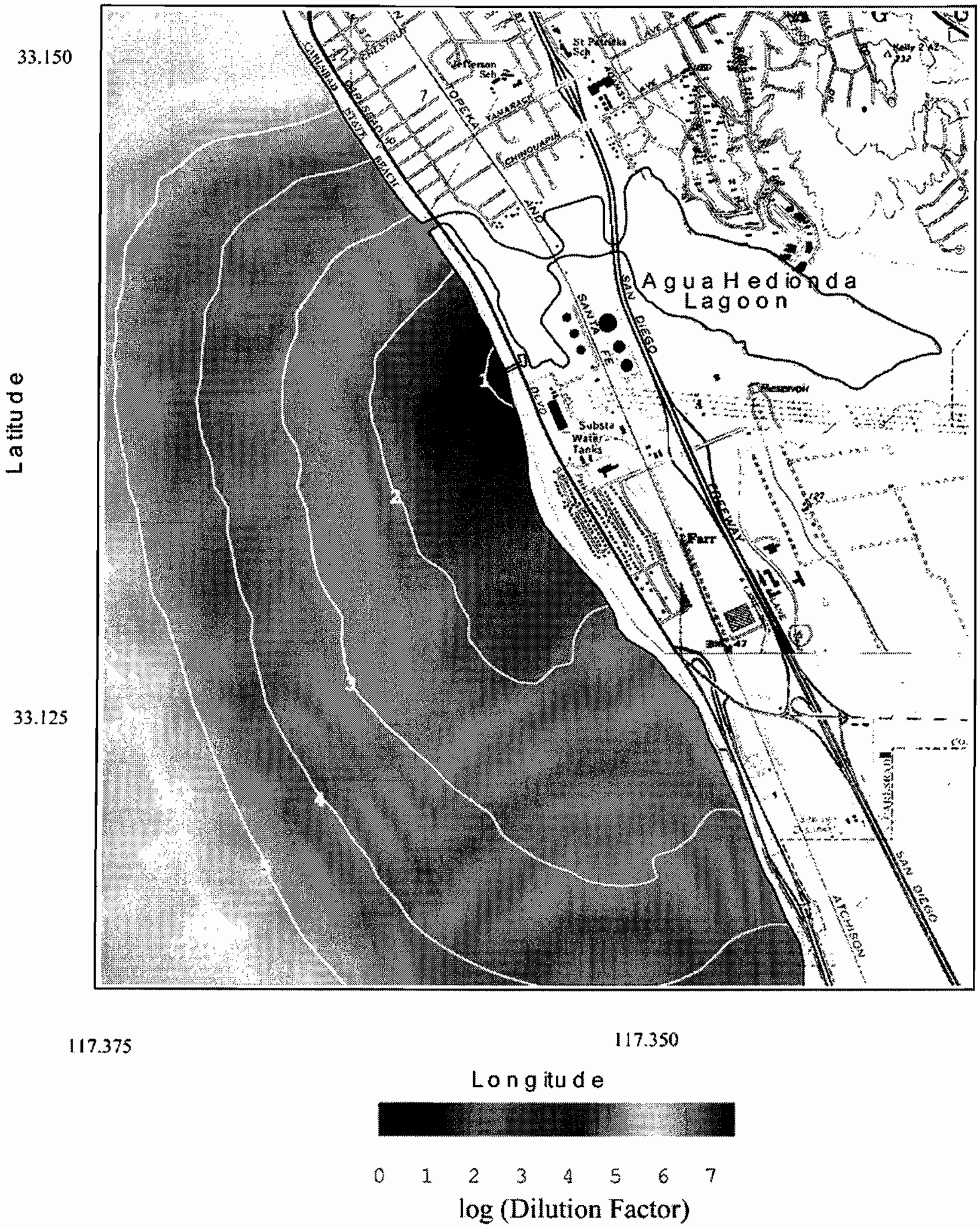


Figure 42. Scenario 5 average case with two Unit 4 circulation pumps for $\Delta T = 0\ ^{o}C$. Seafloor dilution factor for raw concentrate from desalination. R.O. = 50 mgd, plant inflow rate = 304 mgd, combined discharge = 254 mgd, ambient ocean salinity = 33.52 ppt, ocean conditions, 23 May 1994.

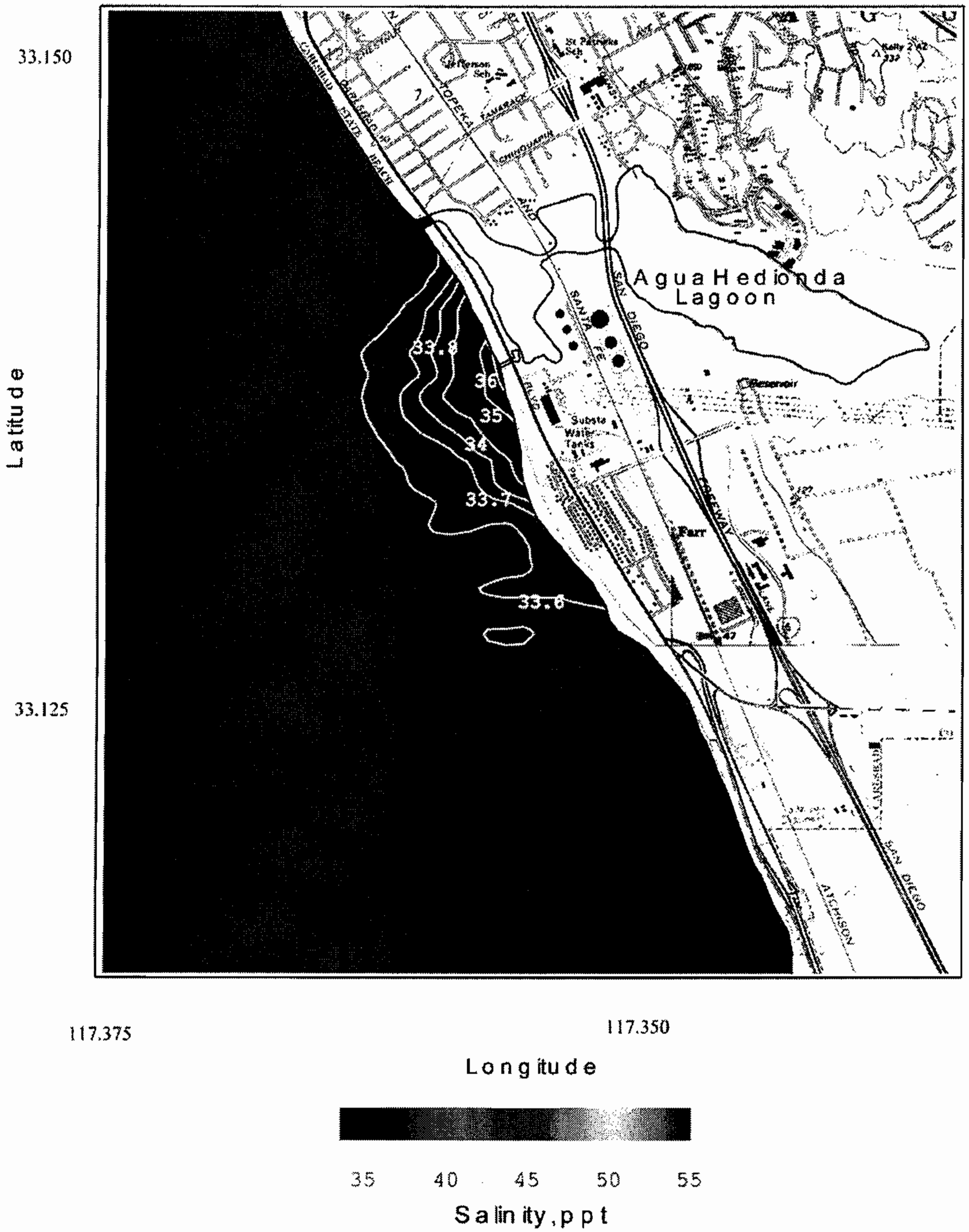


Figure 43. Scenario 5 average case with two Unit 4 circulation pumps for $\Delta T = 0\ ^{o}C$. Daily depth-averaged salinity of concentrated seawater for R.O. = 50 mgd, plant inflow rate = 304 mgd, combined discharge = 254 mgd, ambient ocean salinity = 33.52 ppt, ocean conditions, 23 May 1994.

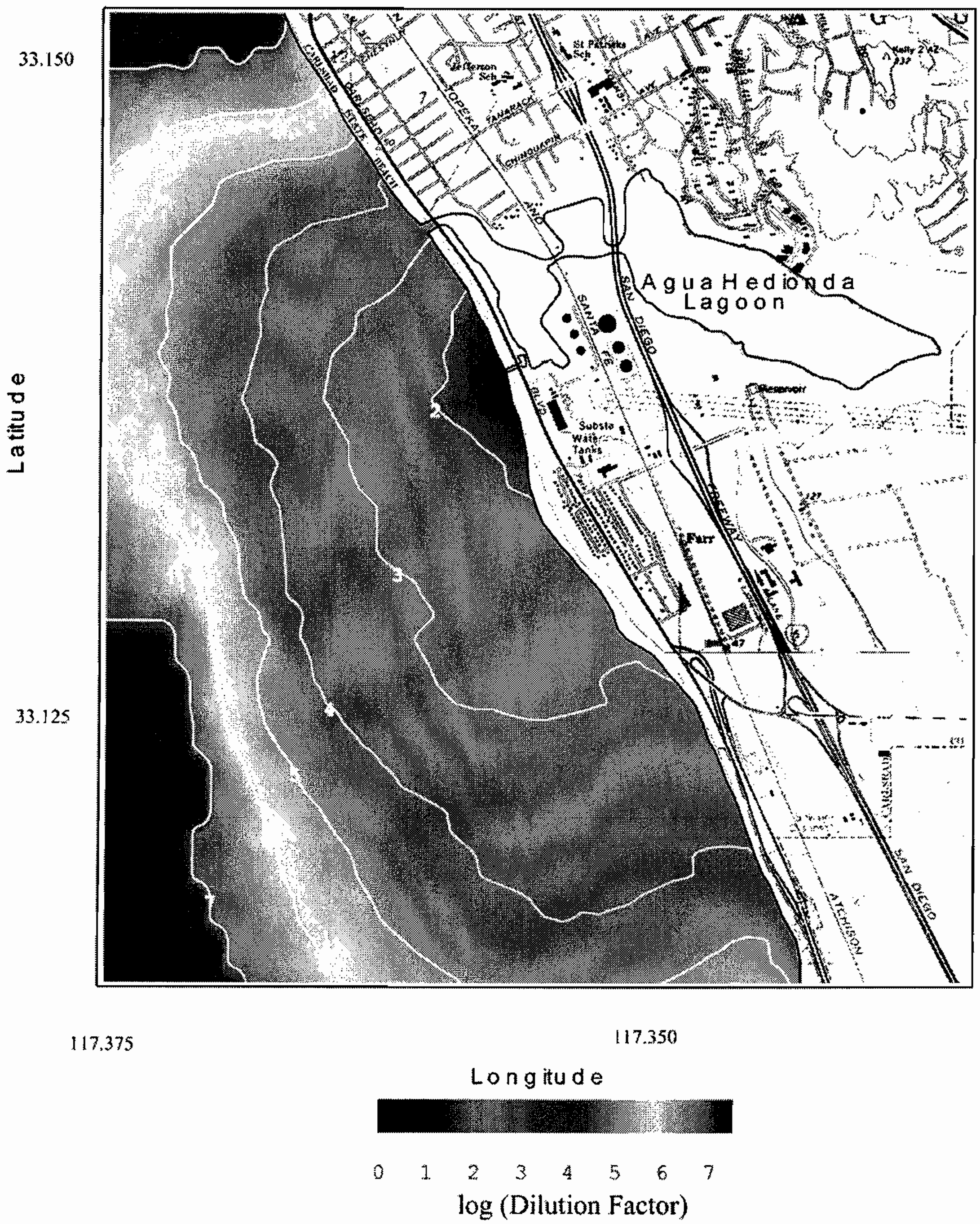


Figure 44. Scenario 5 average case with two Unit 4 circulation pumps for $\Delta T = 0\ ^{o}C$. Depth-averaged dilution factor for raw concentrate from desalination. R.O. = 50 mgd, plant inflow rate = 304 mgd, combined discharge = 254 mgd, ambient ocean salinity = 33.52 ppt, ocean conditions, 23 May 1994.

Scenario 5 low-flow case is acceptable for average ocean mixing conditions. Dilutions are less than 15 to 1 in 0.7 acres of pelagic surf zone, all of which is inside the ZID in the immediate neighborhood of the discharge channel. The 20.5 year average of ocean mixing conditions that contributed to the Scenario 4 have a recurrence probability of 50%.

4) Summary and Conclusions:

This study evaluates the dispersion and dilution of concentrated sea water (brine) associated with reduced flow rate operations of a stand alone desalination plant co-located at Encina Generating Station. The analysis by hydrodynamic model simulation studied the effects of reduced intake flow rates ranging from 149.8 mgd to 304 mgd for both extreme minimums and means in ocean mixing. The results are summarized in Table 1 below.

We find that intake flow rates of at least 218.9 mgd of unheated source water (producing end of pipe salinity of no more than 43.3 ppt) will satisfy both acute toxicity limits of 40 ppt and existing minimum dilution standards of 15 to 1 in the *zone of initial dilution* (ZID) for all ocean mixing conditions. Intake flow rates reduced to as little as 184.3 mgd (producing end of pipe salinity of no more than 46 ppt) will satisfy both acute toxicity limits existing minimum dilution standards for average ocean mixing conditions but not for extreme minimum mixing conditions having a recurrence probability of 0.013 %. Intake flow rates between 149.8 mgd and 172.8 mgd produce hyper salinity impacts that can probably be tolerated by indigenous marine organisms during mean-ocean mixing conditions, but result in unacceptably low minimum dilution levels in the ZID according to existing NPDES permit limits set for the power plant thermal effluent.

Table 1. Salinity Changes For Average and Extreme Desalination Facility Operating Conditions With and Without the Power Generation at Encina Generating Station

Scenario	Plant Inflow Rate (mgd)	Maximum Bottom Salinity (ppt)	Benthic Area Exposed to Salinity > 36.9 ppt	Maximum Water Column Salinity (ppt)	Pelagic Area Exposed to Salinity > 36.9	Minimum Pelagic Dilution at ZID	Frequency of Occurrence
Historical Average (w/ power plant)	576 (ΔT= 5.5 °C)	36.0	0.0	34.4	0.0	68.4 to 1	50%
Historical Extreme (w/ power plant)	304 (ΔT= 5.5 °C)	37.9	15	36.1	0.0	24.1 to 1	<0.01%
Scenario 1 Historical Average (w/o power plant)	149.76 (ΔT= 0 °C)	42.3	39.4	40.5	13.6	9.9 to 1	50%
Scenario 1 Historical Extreme (w/o power plant)	149.76 (ΔT= 0 °C)	48.1	248	41.8	28	7.1 to 1	0.013%
Scenario 2 Historical Average (w/o power plant)	172.8 (ΔT= 0 °C)	42.0	30.5	37.7	0.6	13.5 to 1	50%
Scenario 2 Historical Extreme (w/o power plant)	172.8 (ΔT= 0 °C)	42.4	205	40.3	14.3	9.9 to 1	0.013%
Scenario 3 Historical Average (w/o power plant)	184.3 (ΔT= 0 °C)	41.4	25.6	37.0	0.2	17.7 to 1	50%
Scenario 3 Historical Extreme (w/o power plant)	184.3 (ΔT= 0 °C)	42.0	188	40.0	12.3	10.5 to 1	0.013%
Scenario 4 Historical Average (w/o power plant)	218.9 (ΔT= 0 °C)	40.1	16.4	36.2	0.0	21.1 to 1	50%
Scenario 4 Historical Extreme (w/o power plant)	218.9 (ΔT= 0 °C)	41.0	147	38.0	8.7	15.0 to 1	0.013%
Scenario 5 Historical Average (w/o power plant)	304 (ΔT= 0 °C)	38.1	8.3	36.0	0.0	28.2 to 1	50%
Scenario 5 Historical Extreme (w/o power plant)	304 (ΔT= 0 °C)	39.0	44	36.0	0.0	19.8 to 1	0.013%

Reference:

Jenkins, S. A. And J. Wasyl, 2005, "Hydrodynamic Modeling of Dispersion and Dilution of Concentrated Seawater Produced by the Ocean Desalination Project at the Encina Power Plant, Carlsbad, CA, Part II: Saline Anomalies due to Theoretical Extreme Case Hydraulic Scenarios," submitted to Poseidon Resources, 97pp.

EIR (2005) "Precise Development Plan and Desalination Plant," EIR 03-05-Sch #2004041081, prepared for City of Carlsbad by Dudek and Associates, December, 2005.

ATTACHMENT 4

FLOW MINIMIZATION ALTERNATIVES

THROUGH-SCREEN VELOCITIES

&

LONG-TERM WEST BASIN WATER LEVEL ANALYSIS FOR ASSESSING TRESHOLD IMPINGEMENT EFFECTS OF REDUCED INTAKE FLOWS AT AGUA HEDIONDA LAGOON

FLOW MINIMIZATION ALTERNATIVES - THROUGH-SCREEN VELOCITY ASSESSMENT

EXISTING INTAKE PUMPS, SCREENS AND SCREEN VELOCITIES

Power Plant Unit Number	Pump Size			Maximum Velocity (fps) Upstream of Screens		Maximum Velocity (fps) Through the Screens		Size of Openings (in)	Screens Number		Ratio Total Area/ Openings
	gpm	MGD	cfs	High Tide 4.83	Low Tide -5.07	High Tide 4.83	Low Tide -5.07				
Unit 1											
Pump 1 S	24,000	34.56	53.52								
Pump 1 N	24,000	34.56	53.52								
Total Pump Capacity Unit 1 =	**48,000**	**69.12**	**107.04**	0.7	1.2	**1.2**	**2.1**	**3/8-inches**		**2**	**1.75**
Unit 2									Shared w/ Units 1 & 2		
Pump 2 S	24,000	34.56	53.52								
Pump 2 N	24,000	34.56	53.52								
Total Pump Capacity Unit 2 =	**48,000**	**69.12**	**107.04**	0.7	1.2	**1.2**	**2.1**	**3/8-inches**		**2**	**1.75**
Unit 3									Shared w/ Units 1 & 3		
Pump 3 S	24,000	34.56	53.52								
Pump 3 N	24,000	34.56	53.52								
Total Pump Capacity Unit 3 =	**48,000**	**69.12**	**107.04**	0.7	1.2	**1.2**	**2.1**	**3/8-inches**		**2**	**1.75**
Unit 4									Shared w/ Units 1 & 3		
Pump 4 E	100,000	144.01	223								
Pump 4 W	100,000	144.01	223								
Total Pump Capacity Unit 4 =	**200,000**	**288.02**	**446**	1.0	1.6	**1.8**	**2.8**	**3/8-inches**		**2**	**1.75**
Unit 5											
Pump 5 E	104,000	149.76	231.92								
Pump 5 W	104,000	149.77	231.92								
Total Pump Capacity Unit 5 =	**208,000**	**299.54**	**463.84**	0.7	1.1	**1.0**	**1.6**	**5/8-inches**		**3**	**1.46**

Note: Pump and Screen Parameters Listed Above Are Provided by the Encina Power Plant Staff.

CHANNEL AND SCREEN VELOCITIES WITH ALL PUMPS IN OPERATION - TOTAL INTAKE FLOW OF 794.92 MGD

Channels for Units 1,2 & 3 — **Total** — **Unit 1, 2 & 3 Flow = 322.2 cfs** — **322.2 cfs (check)**

Number of Screen Channels = 2

Channel Bottom Elevation = -20

Channel Width = 12.5

Channel Depth = 25

Water Depth in Channels (Low Tide) 10.73

Water Depth in Channels (High Tide) 19.93

Low Tide In-Channel	Velocity =	1.20	fps	Low Tide Through-Screen Velocity =	2.10

R = 5.7737839

High Tide In-Channel	Velocity =	0.65	fps	High Tide Through-Screen Velocity =	1.13

Channel for Unit 4 — **Total** — **Unit 4 Flow = 446.0 cfs** — **446 cfs (check)**

Number of Screen Channels = 2

Channel Bottom Elevation = -20

Channel Width = 11.25

Channel Depth = 25.75

Low Tide In-Channel	Velocity =	1.88	fps	Low Tide Through-Screen Velocity =	3.29

R = 5.439049587

Water Depth in Channels (Low Tide) 10.53

Water Depth in Channels (High Tide) 19.43

High Tide In-Channel	Velocity =	1.02	fps	High Tide Through-Screen Velocity =	1.79

Channel for Unit 5 — **Total** — **Unit 5 Flow =** **463.84** **cfs** — **463.84 cfs (check)**

Number of Screen Channels = 3

Channel Bottom Elevation = -20

Low Tide In-Channel	Velocity =	1.33	fps	Low Tide Through-Screen Velocity =	1.94

Channel Width = 11.25

R = 6.407599706

Channel Depth = 27.75

Water Depth in Channels (Low Tide) 10.33

Water Depth in Channels (High Tide) 19.23

High Tide In-Channel	Velocity =	0.71	fps	High Tide Through-Screen Velocity =	1.04

OPERATIONAL CONDITION 1 - TOTAL INTAKE FLOW = 316.96 MGD

Unit 1 (Both Pumps) =	69.12 MGD	107.04 cfs
Unit 2 (One Pump) =	34.56 MGD	53.52 cfs
Unit 3 (Both Pumps) =	69.12 MGD	107.04 cfs
Unit 4 (One Pump) =	144.01 MGD	223 cfs
Total Pump Flow =	**316.82 MGD**	**490.6 cfs**

Channels for Units 1,2 & 3 — **Total** — **Unit 1, 2 & 3 Flow =** **267.6** **cfs** — **267.6 cfs (check)**

Number of Screen Channels = 2

Channel Bottom Elevation = -20

Low Tide In-Channel	Velocity =	1.14	fps	Low Tide Through-Screen Velocity =	2.00

Channel Width = 12.5

R = 5.355509831

Channel Depth = 25

Water Depth in Channels (Low Tide) 9.37 ft

Water Depth in Channels (High Tide) 18.27 ft

High Tide In-Channel	Velocity =	0.59	fps	High Tide Through-Screen Velocity =	1.03

Channel for Unit 4 — **Total** — **Unit 4 Flow =** **223.0** **cfs** — **223 cfs (check)**

Number of Screen Channels = 2

Channel Bottom Elevation = -20

Low Tide In-Channel	Velocity =	1.55	fps	Low Tide Through-Screen Velocity =	2.72

Channel Width = 11.25

R = 4.073220868

Channel Depth = 25.75

Water Depth in Channels (Low Tide) 6.39

Water Depth in Channels (High Tide) 15.29

High Tide	High Tide

In-Channel	Velocity =	0.65	fps	Through-Screen Velocity =	1.13	

OPERATIONAL CONDITION 2 - TOTAL INTAKE FLOW = 322.58 MGD

Unit 1, 2 or 3 (One Pump) =	34.56 MGD	53.52 cfs
Unit 4 (Both Pumps) =	288.02 MGD	446 cfs
Total Pump Flow =	**322.58 MGD**	**499.52 cfs**

Channels for Units 1,2 & 3 — **Total** — **Unit 1, 2 & 3 Flow = 53.5 cfs** — **53.52 cfs (check)**

Number of Screen Channels = 2

Channel Bottom Elevation = -20

Channel Width = 12.5

Channel Depth = 25

Water Depth in Channels (Low Tide) 3.117 ft

Water Depth in Channels (High Tide) 12.017 ft

Low Tide				Low Tide	
In-Channel	Velocity =	0.69	fps	Through-Screen Velocity =	1.20

R = 2.494877377

High Tide				High Tide	
In-Channel	Velocity =	0.18	fps	Through-Screen Velocity =	0.31

Channel Elevation @ Screen Velocity of 0.5 fps = 0.49925989 7.5 ft

Tide Level @ Screen Velocity of 0.5 fps = -0.687 ft

Channel for Unit 4 — **Total** — **Unit 4 Flow = 446.0 cfs** — **446 cfs (check)**

Number of Screen Channels = 2

Channel Bottom Elevation = -20

Channel Width = 11.25

Channel Depth = 25.75

Water Depth in Channels (Low Tide) 10.53

Water Depth in Channels (High Tide) 19.43

Low Tide				Low Tide	
In-Channel	Velocity =	1.88	fps	Through-Screen Velocity =	3.29

R = 5.439049587

High Tide				High Tide	
In-Channel	Velocity =	1.02	fps	Through-Screen Velocity =	1.79

OPERATIONAL CONDITION 3 - TOTAL INTAKE FLOW = 328.33 MGD

Unit 1, 2 or 3 (One Pump) =	34.56 MGD	53.52 cfs
Unit 4 (One Pump) =	144.01 MGD	223 cfs
Unit 5 (One Pump) =	149.76 MGD	231.92 cfs
Total Pump Flow =	**328.33 MGD**	**508.44 cfs**

Channels for Units 1,2 & 3 — **Total** — **Unit 1,2 or 3 Flow = 53.5 cfs** — **53.52 cfs (check)**

Number of Screen Channels = 2

Channel Bottom Elevation = -20

Channel Width = 12.5

Channel Depth = 25

Low Tide				Low Tide	
In-Channel	Velocity =	0.69	fps	Through-Screen Velocity =	1.20

R = 2.494877377

Water Depth in Channels (Low Tide) 3.12 ft

Water Depth in Channels (High Tide) 12.02 ft

High Tide In-Channel	Velocity =	0.18	fps	High Tide Through-Screen Velocity =	0.31

Channel for Unit 4 **Total** **Unit 4 Flow = 223.0 cfs** **223 cfs (check)**

Number of Screen Channels = 2

Channel Bottom Elevation = -20

Low Tide In-Channel	Velocity =	1.55	fps	Low Tide Through-Screen Velocity =	2.72

Channel Width = 11.25

R = 4.073220868

Channel Depth = 25.75

Water Depth in Channels (Low Tide) 6.39

Water Depth in Channels (High Tide) 15.29

High Tide In-Channel	Velocity =	0.65	fps	High Tide Through-Screen Velocity =	1.13

Channel for Unit 5 **Total** **Unit 5 Flow = 231.74 cfs** **231.92 cfs (check)**

Number of Screen Channels = 3

Channel Bottom Elevation = -20

Low Tide In-Channel	Velocity =	1.07	fps	Low Tide Through-Screen Velocity =	1.57

Channel Width = 11.25

R = 4.640171858

Channel Depth = 27.75

Water Depth in Channels (Low Tide) 6.40

Water Depth in Channels (High Tide) 15.3

High Tide In-Channel	Velocity =	0.45	fps	High Tide Through-Screen Velocity =	0.66

OPERATIONAL CONDITION 5 - TOTAL INTAKE FLOW = 184.32 MGD

Unit 1, 2 or 3 (One Pump) =	34.56 MGD	53.52 cfs
Unit 5 (One Pump) =	149.76 MGD	231.92 cfs
Total Pump Flow =	**184.32 MGD**	**285.44 cfs**

Channels for Units 1,2 & 3 **Total** **Unit 1, 2 & 3 Flow = 53.5 cfs** **53.52 cfs (check)**

Number of Screen Channels = 2

Channel Bottom Elevation = -20

Low Tide In-Channel	Velocity =	0.69	fps	Low Tide Through-Screen Velocity =	1.20

Channel Width = 12.5

R = 2.494877377

Channel Depth = 25

Water Depth in Channels (Low Tide) 3.117 ft

Water Depth in Channels (High Tide) 12.017 ft

High Tide In-Channel	Velocity =	0.18	fps	High Tide Through-Screen Velocity =	0.31

Channel Elevation @ Screen Velocity of 0.5 fps = 0.77509611 7.5 ft

Tide Level @ Screen Velocity of 0.5 fps = -0.687 ft

Channel for Unit 5 **Total** **Unit 5 Flow = 231.74 cfs** **231.92 cfs (check)**

Number of Screen Channels =	3
Channel Bottom Elevation =	-20
Channel Width =	11.25
Channel Depth =	27.75
Water Depth in Channels (Low Tide)	6.40
Water Depth in Channels (High Tide)	15.3

Low Tide In-Channel	Velocity =	1.07	fps	Low Tide Through-Screen Velocity =	1.57

R = 4.640171858

High Tide In-Channel	Velocity =	0.45	fps	High Tide Through-Screen Velocity =	0.66

OPERATIONAL CONDITION 4 - TOTAL INTAKE FLOW = 218.88 MGD

Unit 1, 2 or 3 (Two Pumps) =	69.12 MGD	107.04 cfs
Unit 5 (One Pump) =	149.76 MGD	231.92 cfs
Total Pump Flow =	**218.88 MGD**	**338.96 cfs**

Channels for Units 1,2 & 3 **Total** **Unit 1, 2 & 3 Flow = 107.0 cfs** **107.04 cfs (check)**

Number of Screen Channels =	2
Channel Bottom Elevation =	-20
Channel Width =	12.5
Channel Depth =	25
Water Depth in Channels (Low Tide)	4.937 ft
Water Depth in Channels (High Tide)	13.837 ft

Low Tide In-Channel	Velocity =	0.87	fps	Low Tide Through-Screen Velocity =	1.52

R = 3.539169582

High Tide In-Channel	Velocity =	0.31	fps	High Tide Through-Screen Velocity =	0.54

Channel for Unit 5 **Total** **Unit 5 Flow = 231.74 cfs** **231.92 cfs (check)**

Number of Screen Channels =	3
Channel Bottom Elevation =	-20
Channel Width =	11.25
Channel Depth =	27.75
Water Depth in Channels (Low Tide)	6.40
Water Depth in Channels (High Tide)	15.3

Low Tide In-Channel	Velocity =	1.07	fps	Low Tide Through-Screen Velocity =	1.57

R = 4.640171858

High Tide In-Channel	Velocity =	0.45	fps	High Tide Through-Screen Velocity =	0.66

FLOW MINIMIZATION ALTERNATIVES - THROUGH-SCREEN VELOCITY ASSESSMENT

EXISTING INTAKE PUMPS, SCREENS AND SCREEN VELOCITIES

Power Plant Unit Number	Pump Size			Maximum Velocity (fps) Upstream of Screens		Maximum Velocity (fps) Through the Screens		Size of Openings (in)	Screens Number	Ratio Total Area/ Openings
	gpm	MGD	cfs	High Tide 4.83	Low Tide -5.07	High Tide 4.83	Low Tide -5.07			
Unit 1										
Pump 1 S	24,000	34.56	53.52							
Pump 1 N	24,000	34.56	53.52							
Total Pump Capacity Unit 1 =	**48,000**	**69.12**	**107.04**	0.7	1.2	**1.2**	**2.1**	**3/8-inches**	**2**	**1.75**
									Shared w/ Units 1 & 2	
Unit 2										
Pump 2 S	24,000	34.56	53.52							
Pump 2 N	24,000	34.56	53.52							
Total Pump Capacity Unit 2 =	**48,000**	**69.12**	**107.04**	0.7	1.2	**1.2**	**2.1**	**3/8-inches**	**2**	**1.75**
									Shared w/ Units 1 & 3	
Unit 3										
Pump 3 S	24,000	34.56	53.52							
Pump 3 N	24,000	34.56	53.52							
Total Pump Capacity Unit 3 =	**48,000**	**69.12**	**107.04**	0.7	1.2	**1.2**	**2.1**	**3/8-inches**	**2**	**1.75**
									Shared w/ Units 1 & 3	
Unit 4										
Pump 4 E	100,000	144.01	223							
Pump 4 W	100,000	144.01	223							
Total Pump Capacity Unit 4 =	**200,000**	**288.02**	**446**	1.0	1.6	**1.8**	**2.8**	**3/8-inches**	**2**	**1.75**
Unit 5										
Pump 5 E	104,000	149.76	231.92							
Pump 5 W	104,000	149.77	231.92							
Total Pump Capacity Unit 5 =	**208,000**	**299.54**	**463.84**	0.7	1.1	**1.0**	**1.6**	**5/8-inches**	**3**	**1.46**

Note: Pump and Screen Parameters Listed Above Are Provided by the Encina Power Plant Staff.

CHANNEL AND SCREEN VELOCITIES WITH ALL PUMPS IN OPERATION - TOTAL INTAKE FLOW OF 794.92 MGD

Channels for Units 1,2 & 3 — **Total** — **Unit 1, 2 & 3 Flow = 322.2 cfs** — **322.2 cfs (check)**

Number of Screen Channels = 2

Channel Bottom Elevation = -20

Low Tide In-Channel	Velocity =	1.20	fps	Low Tide Through-Screen Velocity =	2.10

R = 5.7737839

Channel Width = 12.5

Channel Depth = 25

Water Depth in Channels (Low Tide) 10.73

Water Depth in Channels (High Tide) 19.93

High Tide In-Channel	Velocity =	0.65	fps	High Tide Through-Screen Velocity =	1.13

Channel for Unit 4 — **Total** — **Unit 4 Flow = 446.0 cfs** — **446 cfs (check)**

Number of Screen Channels = 2

Channel Bottom Elevation = -20

Low Tide In-Channel	Velocity =	1.88	fps	Low Tide Through-Screen Velocity =	3.29

R = 5.439049587

Channel Width = 11.25

Channel Depth = 25.75

Water Depth in Channels (Low Tide)	10.53
Water Depth in Channels (High Tide)	19.43

High Tide				High Tide	
In-Channel	Velocity =	1.02	fps	Through-Screen Velocity =	1.79

Channel for Unit 5 — **Total** — **Unit 5 Flow = 463.84 cfs** — **463.84 cfs (check)**

Number of Screen Channels =	3
Channel Bottom Elevation =	-20
Channel Width =	11.25
Channel Depth =	27.75
Water Depth in Channels (Low Tide)	10.33
Water Depth in Channels (High Tide)	19.23

Low Tide				Low Tide	
In-Channel	Velocity =	1.33	fps	Through-Screen Velocity =	1.94
	R =	6.407599706			

High Tide				High Tide	
In-Channel	Velocity =	0.71	fps	Through-Screen Velocity =	1.04

OPERATIONAL CONDITION 1 - TOTAL INTAKE FLOW = 316.96 MGD

Unit 1 (Both Pumps) =	69.12 MGD	107.04 cfs
Unit 2 (One Pump) =	34.56 MGD	53.52 cfs
Unit 3 (Both Pumps) =	69.12 MGD	107.04 cfs
Unit 4 (One Pump) =	144.01 MGD	223 cfs
Total Pump Flow =	**316.82 MGD**	**490.6 cfs**

Channels for Units 1,2 & 3 — **Total** — **Unit 1, 2 & 3 Flow = 267.6 cfs** — **267.6 cfs (check)**

Number of Screen Channels =	2
Channel Bottom Elevation =	-20
Channel Width =	12.5
Channel Depth =	25
Water Depth in Channels (Low Tide)	9.37 ft
Water Depth in Channels (High Tide)	18.27 ft

Low Tide				Low Tide	
In-Channel	Velocity =	1.14	fps	Through-Screen Velocity =	2.00
	R =	5.355509831			

High Tide				High Tide	
In-Channel	Velocity =	0.59	fps	Through-Screen Velocity =	1.03

Channel for Unit 4 — **Total** — **Unit 4 Flow = 223.0 cfs** — **223 cfs (check)**

Number of Screen Channels =	2
Channel Bottom Elevation =	-20
Channel Width =	11.25
Channel Depth =	25.75
Water Depth in Channels (Low Tide)	6.39
Water Depth in Channels (High Tide)	15.29

Low Tide				Low Tide	
In-Channel	Velocity =	1.55	fps	Through-Screen Velocity =	2.72
	R =	4.073220868			

High Tide	High Tide

In-Channel	Velocity =	0.65	fps	Through-Screen Velocity =	1.13

OPERATIONAL CONDITION 2 - TOTAL INTAKE FLOW = 322.58 MGD

Unit 1, 2 or 3 (One Pump) =	34.56 MGD	53.52 cfs
Unit 4 (Both Pumps) =	288.02 MGD	446 cfs
Total Pump Flow =	**322.58 MGD**	**499.52 cfs**

Channels for Units 1,2 & 3 — **Total** — **Unit 1, 2 & 3 Flow = 53.5 cfs** — **53.52 cfs (check)**

Number of Screen Channels = 2

Channel Bottom Elevation = -20

Channel Width = 12.5

Channel Depth = 25

Water Depth in Channels (Low Tide) 3.117 ft

Water Depth in Channels (High Tide) 12.017 ft

Low Tide				Low Tide	
In-Channel	Velocity =	0.69	fps	Through-Screen Velocity =	1.20

R = 2.494877377

High Tide				High Tide	
In-Channel	Velocity =	0.18	fps	Through-Screen Velocity =	0.31

Channel Elevation @ Screen Velocity of 0.5 fps = 0.49925989 7.5 ft

Tide Level @ Screen Velocity of 0.5 fps = -0.687 ft

Channel for Unit 4 — **Total** — **Unit 4 Flow = 446.0 cfs** — **446 cfs (check)**

Number of Screen Channels = 2

Channel Bottom Elevation = -20

Channel Width = 11.25

Channel Depth = 25.75

Water Depth in Channels (Low Tide) 10.53

Water Depth in Channels (High Tide) 19.43

Low Tide				Low Tide	
In-Channel	Velocity =	1.88	fps	Through-Screen Velocity =	3.29

R = 5.439049587

High Tide				High Tide	
In-Channel	Velocity =	1.02	fps	Through-Screen Velocity =	1.79

OPERATIONAL CONDITION 3 - TOTAL INTAKE FLOW = 328.33 MGD

Unit 1, 2 or 3 (One Pump) =	34.56 MGD	53.52 cfs
Unit 4 (One Pump) =	144.01 MGD	223 cfs
Unit 5 (One Pump) =	149.76 MGD	231.92 cfs
Total Pump Flow =	**328.33 MGD**	**508.44 cfs**

Channels for Units 1,2 & 3 — **Total** — **Unit 1,2 or 3 Flow = 53.5 cfs** — **53.52 cfs (check)**

Number of Screen Channels = 2

Channel Bottom Elevation = -20

Channel Width = 12.5

Channel Depth = 25

Low Tide				Low Tide	
In-Channel	Velocity =	0.69	fps	Through-Screen Velocity =	1.20

R = 2.494877377

Water Depth in Channels (Low Tide)	3.12 ft								
Water Depth in Channels (High Tide)	12.02 ft								
			High Tide In-Channel	Velocity =	0.18	fps	High Tide Through-Screen Velocity =		0.31
Channel for Unit 4		**Total**	**Unit 4 Flow =**		**223.0**	**cfs**		**223 cfs (check)**	
Number of Screen Channels =	2								
Channel Bottom Elevation =	-20		Low Tide In-Channel	Velocity =	1.55	fps	Low Tide Through-Screen Velocity =		2.72
Channel Width =	11.25			R =	4.073220868				
Channel Depth =	25.75								
Water Depth in Channels (Low Tide)	6.39								
Water Depth in Channels (High Tide)	15.29								
			High Tide In-Channel	Velocity =	0.65	fps	High Tide Through-Screen Velocity =		1.13
Channel for Unit 5		**Total**	**Unit 5 Flow =**		**231.74**	**cfs**		**231.92 cfs (check)**	
Number of Screen Channels =	3								
Channel Bottom Elevation =	-20		Low Tide In-Channel	Velocity =	1.07	fps	Low Tide Through-Screen Velocity =		1.57
Channel Width =	11.25			R =	4.640171858				
Channel Depth =	27.75								
Water Depth in Channels (Low Tide)	6.40								
Water Depth in Channels (High Tide)	15.3								
			High Tide In-Channel	Velocity =	0.45	fps	High Tide Through-Screen Velocity =		0.66

OPERATIONAL CONDITION 5 - TOTAL INTAKE FLOW = 184.32 MGD

Unit 1, 2 or 3 (One Pump) =	34.56 MGD	53.52 cfs							
Unit 5 (One Pump) =	149.76 MGD	231.92 cfs							
Total Pump Flow =	**184.32 MGD**	**285.44 cfs**							
Channels for Units 1,2 & 3		**Total**	**Unit 1, 2 & 3 Flow =**		**53.5**	**cfs**		**53.52 cfs (check)**	
Number of Screen Channels =	2								
Channel Bottom Elevation =	-20		Low Tide In-Channel	Velocity =	0.69	fps	Low Tide Through-Screen Velocity =		1.20
Channel Width =	12.5			R =	2.494877377				
Channel Depth =	25								
Water Depth in Channels (Low Tide)	3.117 ft								
Water Depth in Channels (High Tide)	12.017 ft								
			High Tide In-Channel	Velocity =	0.18	fps	High Tide Through-Screen Velocity =		0.31
			Channel Elevation @ Screen Velocity of 0.5 fps =				0.77509611	7.5 ft	

Tide Level @ Screen Velocity of 0.5 fps = -0.687 ft

Channel for Unit 5		**Total**	**Unit 5 Flow =**	**231.74**	**cfs**	**231.92 cfs (check)**
Number of Screen Channels =	3					
Channel Bottom Elevation =	-20		Low Tide In-Channel Velocity =	1.07	fps	Low Tide Through-Screen Velocity = 1.57
Channel Width =	11.25		R =	4.640171858		
Channel Depth =	27.75					
Water Depth in Channels (Low Tide)	6.40					
Water Depth in Channels (High Tide)	15.3		High Tide In-Channel Velocity =	0.45	fps	High Tide Through-Screen Velocity = 0.66

OPERATIONAL CONDITION 4 - TOTAL INTAKE FLOW = 218.88 MGD

Unit 1, 2 or 3 (Two Pumps) =	69.12 MGD	107.04 cfs
Unit 5 (One Pump) =	149.76 MGD	231.92 cfs
Total Pump Flow =	**218.88 MGD**	**338.96 cfs**

Channels for Units 1,2 & 3		**Total**	**Unit 1, 2 & 3 Flow =**	**107.0**	**cfs**	**107.04 cfs (check)**
Number of Screen Channels =	2					
Channel Bottom Elevation =	-20		Low Tide In-Channel Velocity =	0.87	fps	Low Tide Through-Screen Velocity = 1.52
Channel Width =	12.5		R =	3.539169582		
Channel Depth =	25					
Water Depth in Channels (Low Tide)	4.937 ft					
Water Depth in Channels (High Tide)	13.837 ft		High Tide In-Channel Velocity =	0.31	fps	High Tide Through-Screen Velocity = 0.54

Channel for Unit 5		**Total**	**Unit 5 Flow =**	**231.74**	**cfs**	**231.92 cfs (check)**
Number of Screen Channels =	3					
Channel Bottom Elevation =	-20		Low Tide In-Channel Velocity =	1.07	fps	Low Tide Through-Screen Velocity = 1.57
Channel Width =	11.25		R =	4.640171858		
Channel Depth =	27.75					
Water Depth in Channels (Low Tide)	6.40					
Water Depth in Channels (High Tide)	15.3		High Tide In-Channel Velocity =	0.45	fps	High Tide Through-Screen Velocity = 0.66

Long-Term West Basin Water Level Analysis for Assessing Threshold Impingement Effects of Reduced Intake Flows at Agua Hedionda Lagoon

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21 January 2007

1) Introduction:

This study evaluates the long term water level variation in the West Basin of Agua Hedionda Lagoon. The objective of this analysis is to determine the persistence of water levels occurring higher than the threshold elevation for impingement losses during reduced flow rate operations of a stand alone desalination plant co-located at Encina Generating Station. There are two threshold water levels of interest for reduced flow operations ranging from 149.8 mgd to 304 mgd. These thresholds are -0.687 ft MSL and + 4.83 ft MSL. The persistence analysis of these thresholds is performed by hydrodynamic model simulation of the water elevation history in the West Basin due to tidal forcing at the ocean inlet by historic ocean water levels measured at the nearby Scripps Pier tide gage (NOAA # 931-0230) during the period of record 1980-2000. This time period was chosen because it coincides with the period of record used in the hydrodynamic studies in

Appendix E of the certified EIR (Jenkins and Wasyl, 2005). The verified ocean water level data on which this analysis is based was obtained from NOAA (2006).

Because of tidal muting by frictional losses through the ocean inlet of Agua Hedionda, it is not possible to use the Scripps Pier tide gage measurements directly to determine persistence analysis of. Such a simple approach would err on the side of over-estimating the percentage of time the water elevation in the West Basin of the lagoon met or exceeded the two threshold elevations of interest. Instead the tidal muting of the measured ocean water levels was determined through computer simulation of the lagoon tidal hydraulics. The TIDE_FEM tidal hydraulics model presented in Jenkins and Inman (1999) was gridded for a computational mesh of Agua Hedionda Lagoon as shown in Figure 1, using pre- and post dredging bathymetry from the 2002 dredge event from Jenkins and Wasyl (2003). The pre-dredging bathymetry featured the inlet bar in the west basin that was mapped during the October 2002 sounding shown in Figure 2. The post-dredging survey performed in April 2003 indicated uniform deep water throughout the west basin with depths ranging from -20 ft NGVD to – 30ft NGVD, similar to that found in Figure 2-2 of Elwany, et al (2005). The lagoon model was excited at the ocean inlet by the ocean water level elevation time series measured by the Scripps Pier tide gage for the period 1980-2000. The simulated lagoon water levels in the west basin of Agua Hedionda were then sampled at 1 hour intervals, resulting in 183,432 separate outcomes of water elevation that could be subject to statistical analysis of persistence at or above the threshold elevations of interest.

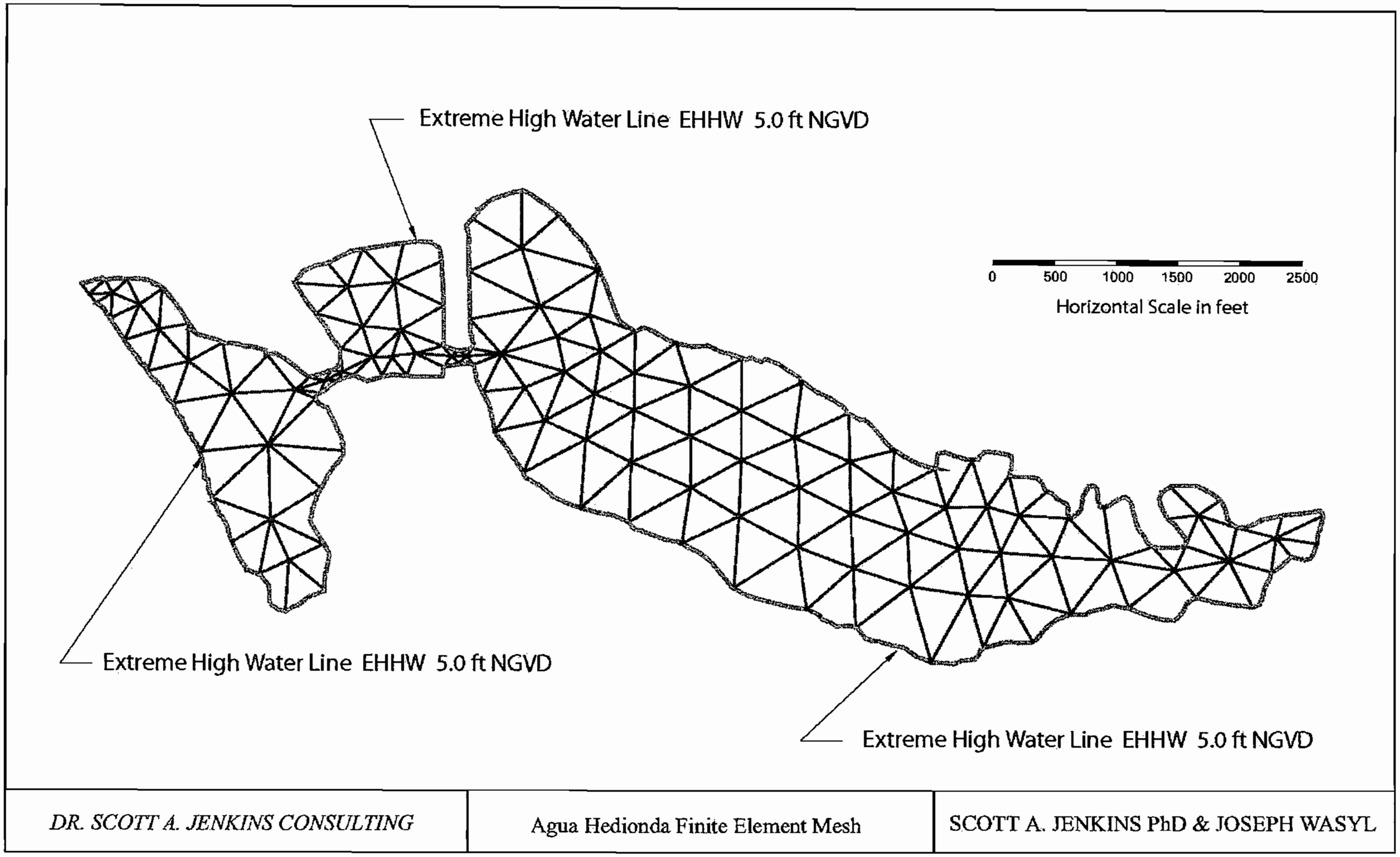

Figure 1. Computational mesh for TIDE_FEM tidal hydraulics model of Agua Hedionda Lagoon.

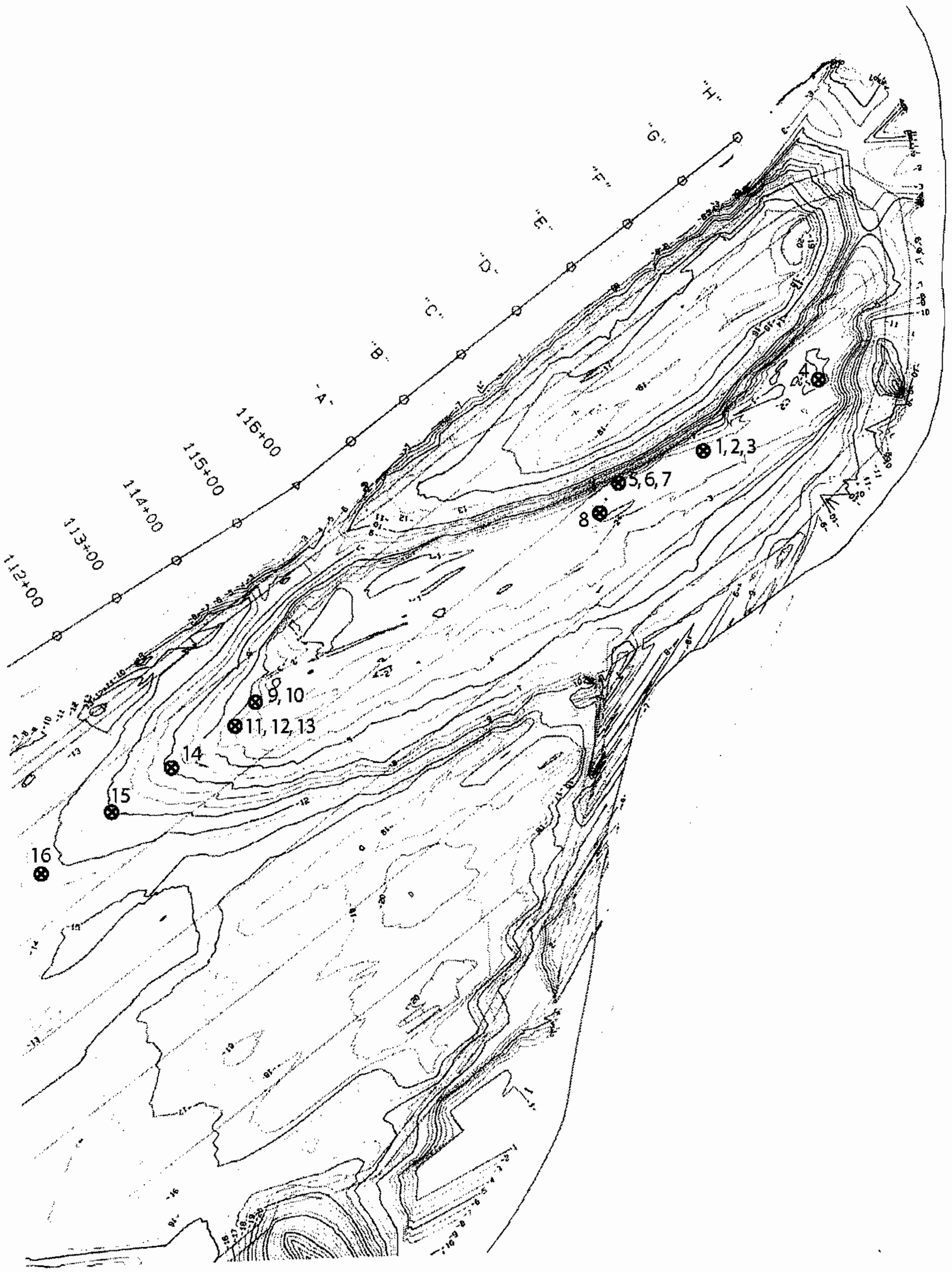

Figure 2. Location key for 12 October 2002 bottom sediment sampling.

2) Results:

Time series of the simulated West Basin water levels for each from 1980 through 2000 are given in the upper panel of Figures A-1 through A-21 in Appendix-A. The lower panel of these Figures gives the west basin water level variation for the month containing the highest water level occurring that particular year. Figure 3 presents the probability density function (defined by red histogram bars) resulting from the 183,432 hourly realizations of West Basin water level. The blue curve in Figure 3 is the cumulative probability that the water level will be greater than or equal to a particular water level. The vertical dashed green line in Figure 3 defines the water elevation at -0.687 ft MSL, above which intake flow velocities at the Unit 1 intakes are below the impingement threshold. From the cumulative probability curve, we find that water elevations equal or exceed the -0.687 ft MSL threshold 67% of the time during this 21 year period of record. Thus it is more probable that impingement would not occur at the Unit 1 intakes. On the other hand, there was only one hourly outcome in the 21 year period of record when water elevations exceeded the Unit 5 threshold elevation at +4.83 (light blue dashed vertical line); and hence impingement would remain a definite possibility for nearly any tidal regime around the Unit 5 intake.

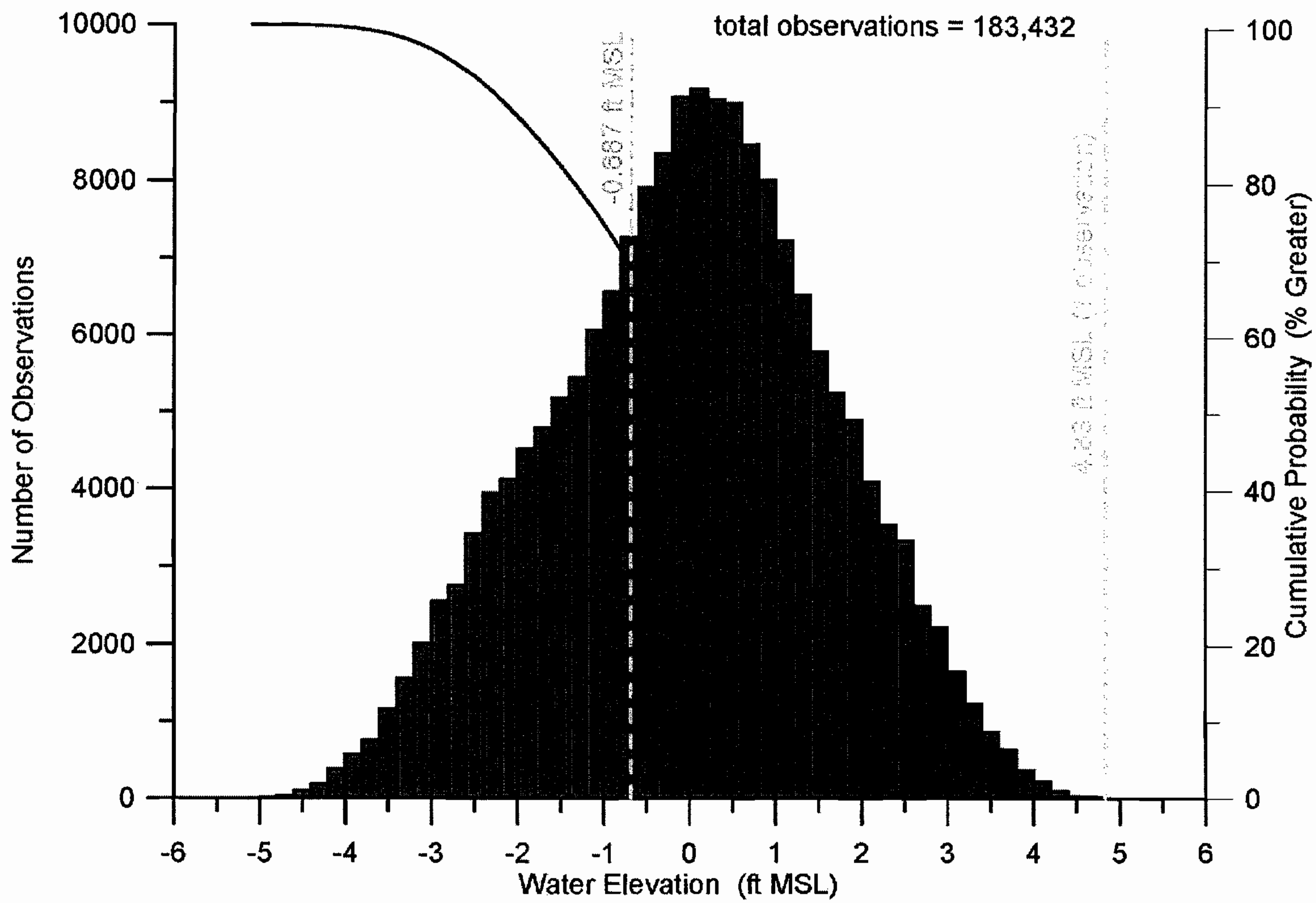

Figure 3. Probability density function and cumulative probability of the water level in the West Basin of Agua Hedionda Lagoon for the period of record 1980-2000.

Reference:

EIR (2005) "Precise Development Plan and Desalination Plant," EIR 03-05-Sch #2004041081, prepared for City of Carlsbad by Dudek and Associates, December, 2005.

Elwany, M. H. S., R. E. Flick, M. White, and K. Goodell, 2005, "Agua Hedionda Lagoon Hydrodynamic Studies," prepared for Tenera Environmental, 39 pp. + appens.

Jenkins, S. A. And J. Wasyl, 2005, "Hydrodynamic Modeling of Dispersion and Dilution of Concentrated Seawater Produced by the Ocean Desalination Project at the Encina Power Plant, Carlsbad, CA, Part II: Saline Anomalies due to Theoretical Extreme Case Hydraulic Scenarios," submitted to Poseidon Resources, 97pp.

Jenkins, S. A. and D. W. Skelly, 1988, "An Evaluation of the Coastal Data Base Pertaining to Seawater Diversion at Encina Power Plant Carlsbad, CA," submitted to San Diego Gas and Electric, Co., 56 pp.

Jenkins, S. A., D. W. Skelly, and J. Wasyl, 1989, "Dispersion and Momentum Flux Study of the Cooling Water Outfall at Agua Hedionda," submitted to San Diego Gas and Electric, Co., 36 pp. + appens.

Jenkins, S. A. and J. Wasyl, 1993, "Numerical Modeling of Tidal Hydraulics and Inlet Closures at Agua Hedionda Lagoon," submitted to San Diego Gas and Electric, Co., 91 pp.

Jenkins, S. A. and J. Wasyl, 1994, "Numerical Modeling of Tidal Hydraulics and Inlet Closures at Agua Hedionda Lagoon Part II: Risk Analysis," submitted to San Diego Gas and Electric, Co., 46 pp. + appens.

Jenkins, S. A. and J. Wasyl, 1995, "Optimization of Choke Point Channels at Agua Hedionda Lagoon using Stratford Turbulent Pressure Recovery," submitted to San Diego Gas and Electric, Co., 59 pp.

Jenkins, S. A. and J. Wasyl, 1997, "Analysis of inlet closure risks at Agua Hedionda Lagoon, CA and potential remedial measures, Part II," submitted to San Diego Gas and Electric, Co., 152 pp. + appens.

Jenkins, S. A. and J. Wasyl, 1998a, Analysis of Coastal Processes Effects Due to the San Dieguito Lagoon Restoration Project: Final Report, submitted to Southern California Edison Co., 333 pp.

Jenkins, S. A. and J. Wasyl, 1998b, Coastal Processes Analysis of Maintenance Dredging Requirements for Agua Hedionda Lagoon, submitted to San Diego Gas and Electric Co., 176 pp. + appens.

Jenkins, S. A. and D. L. Inman, 1999, A Sand transport mechanics for equilibrium in tidal inlets, *Shore and Beach*, vol. 67, no. 1, pp. 53-58.

Jenkins, S. A. and J. Wasyl, 2001, Agua Hedionda Lagoon North Jetty Resoration Project: Sand Influx Study, submitted to Cabrillo Power LLC., 178 pp. + appens.

Jenkins, S. A. and J. Wasyl, 2003, Sand Influx at Agua Hedionda Lagoon in the Aftermath of the San Diego Regional Beach Sand Project, submitted to Cabrillo Power LLC., 95 pp. + appens

Jenkins, S. A. and D. L. Inman, 2006, "Thermodynamic solutions for equilibrium beach profiles", *Jour. Geophys. Res.,* v.3, C02003, doi:10.1029, 21pp.

NOAA, 2006, Verified/Historical Water Level Data@ http://www.opsd.nos.noaa.gov/data_res.html

APPENDIX-A: Time Series of West Basin Water Levels

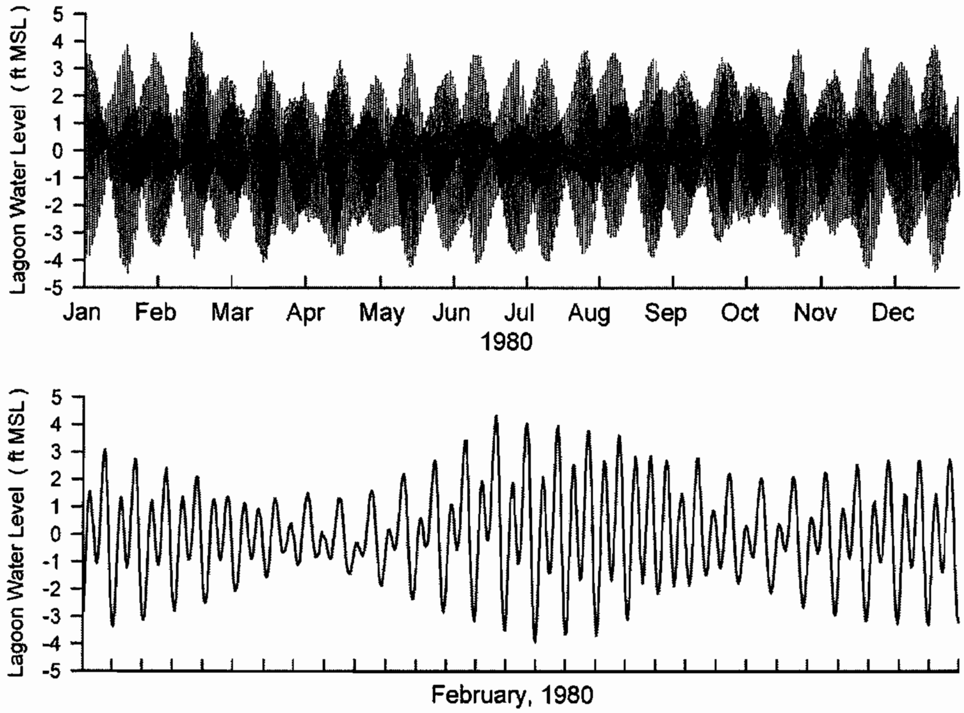

Figure A-1. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1980 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

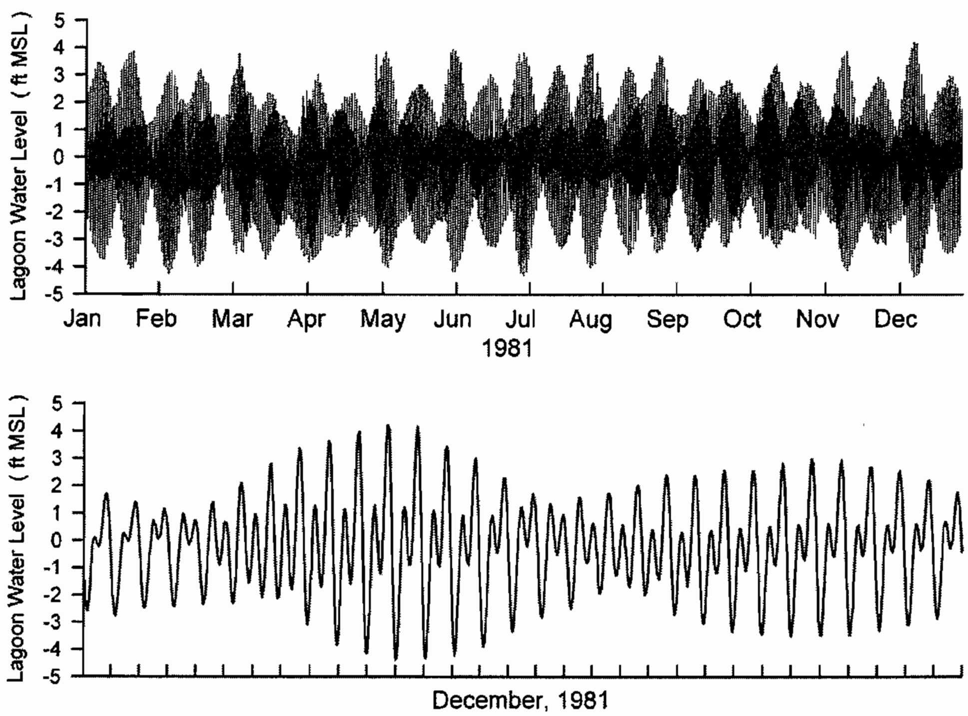

Figure A-2. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1981 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

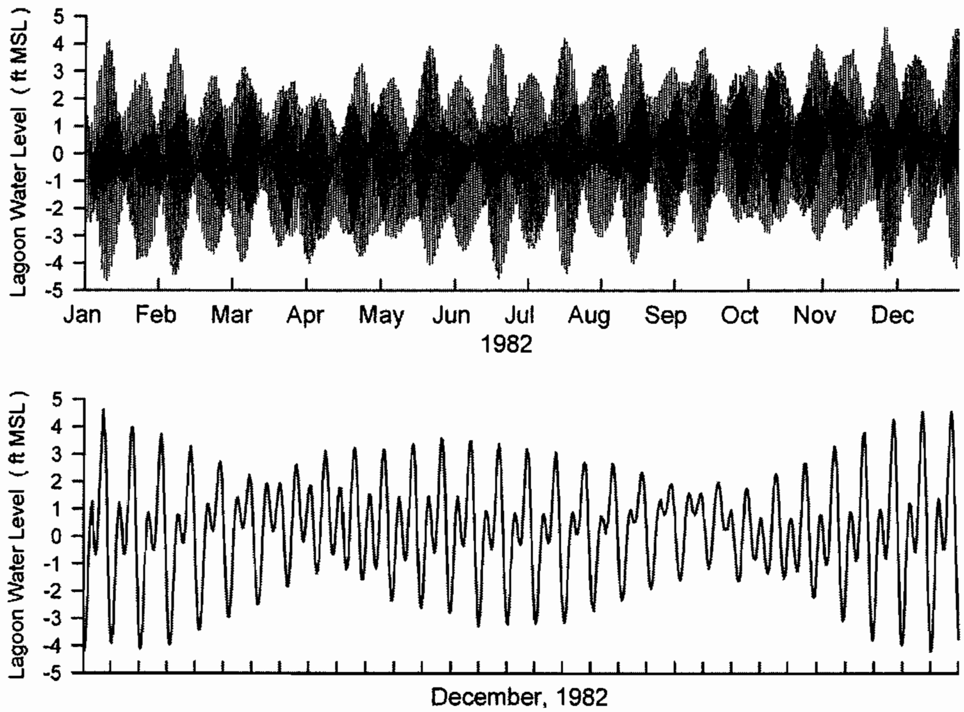

Figure A-3. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1982 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

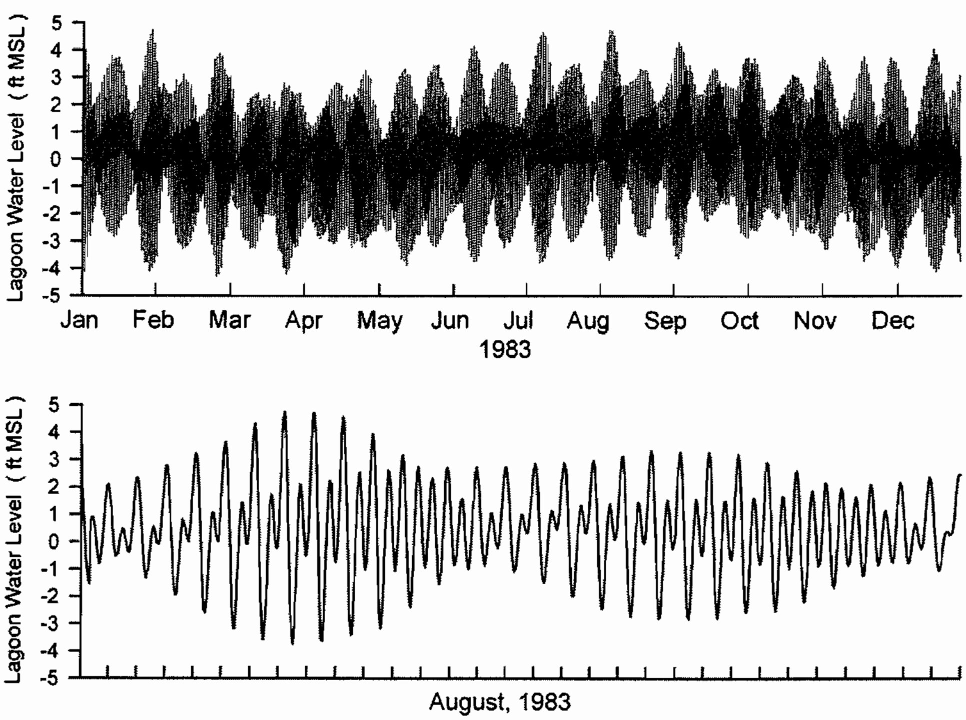

Figure A-4. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1983 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

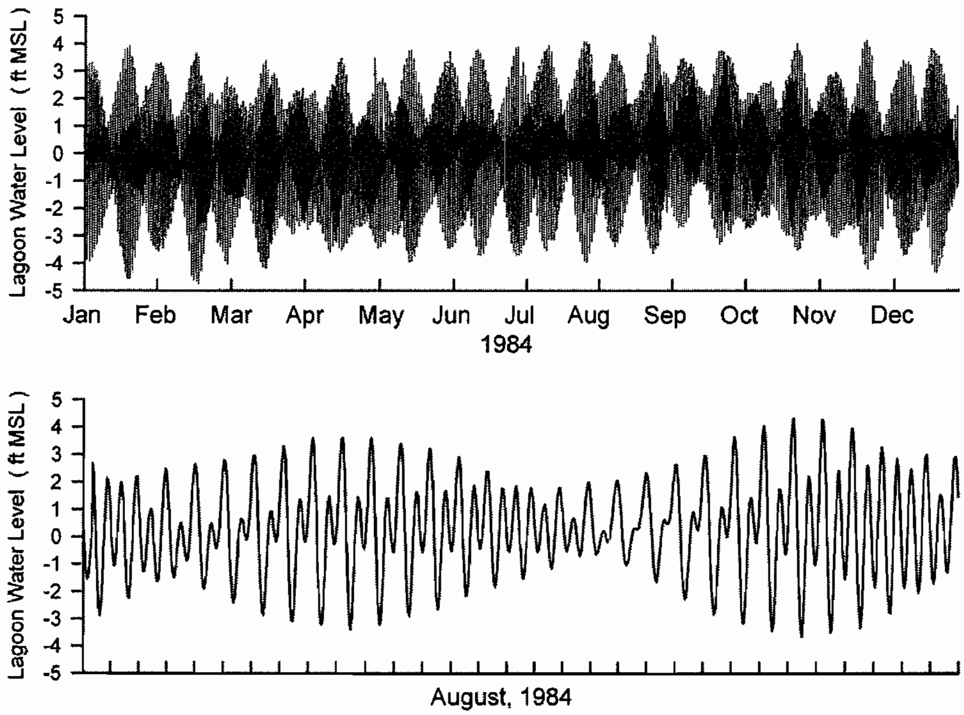

Figure A-5. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1984 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

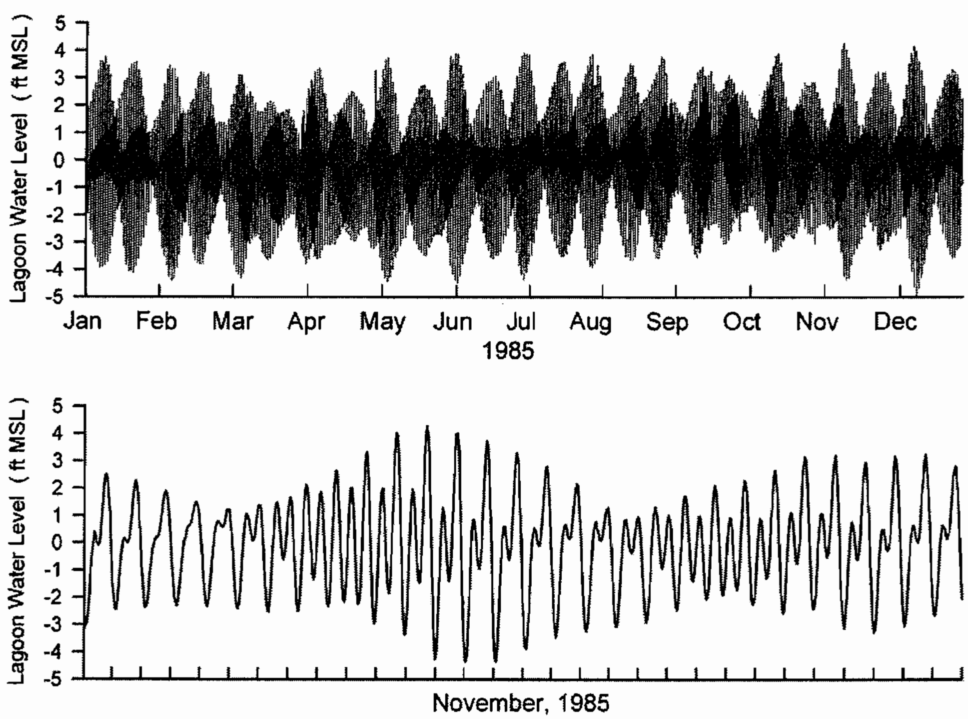

Figure A-6. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1985 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

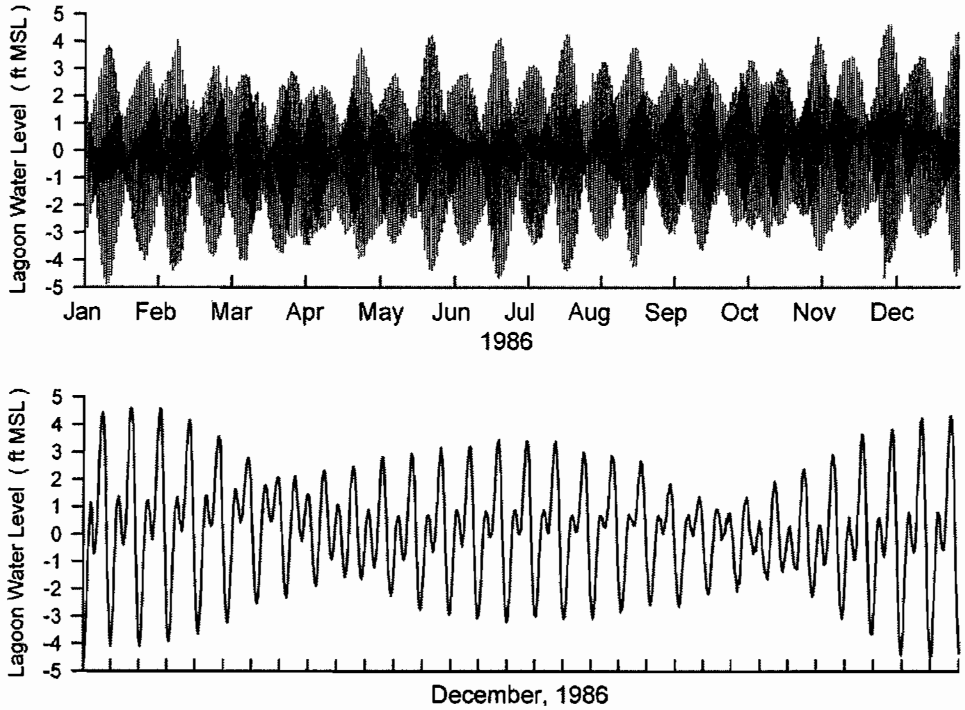

Figure A-7. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1986 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

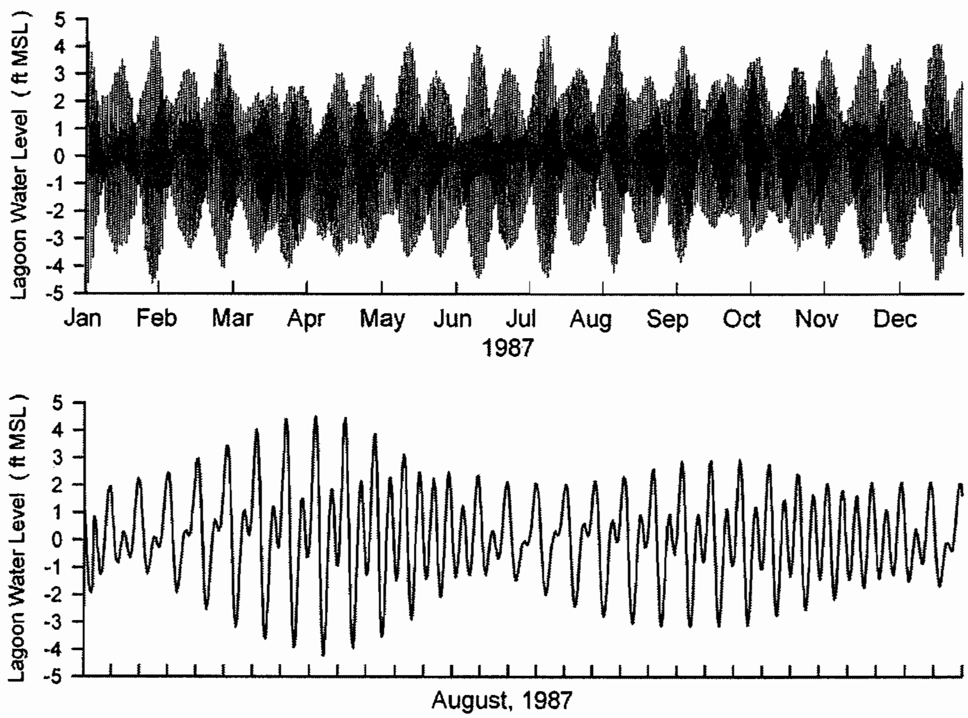

Figure A-8. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1987 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

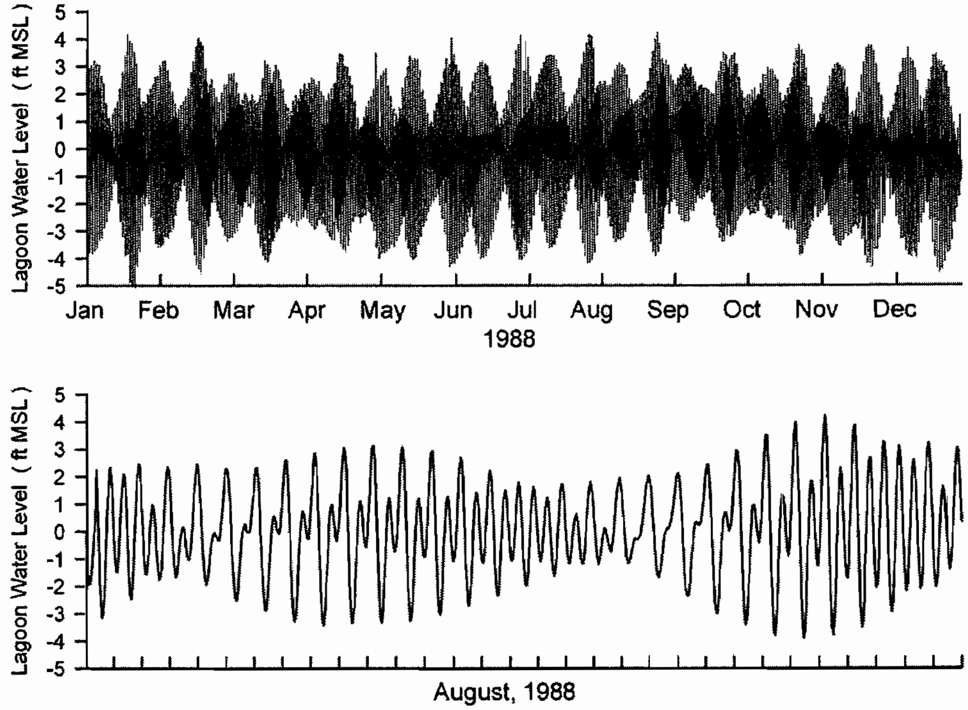

Figure A-9. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1988 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

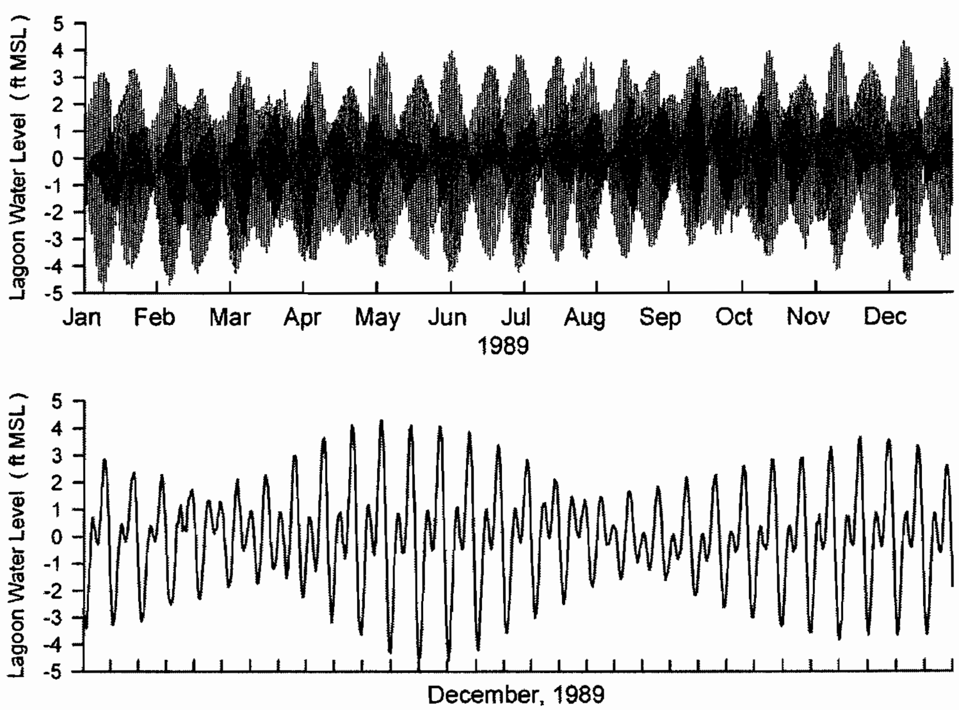

Figure A-10. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1989 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

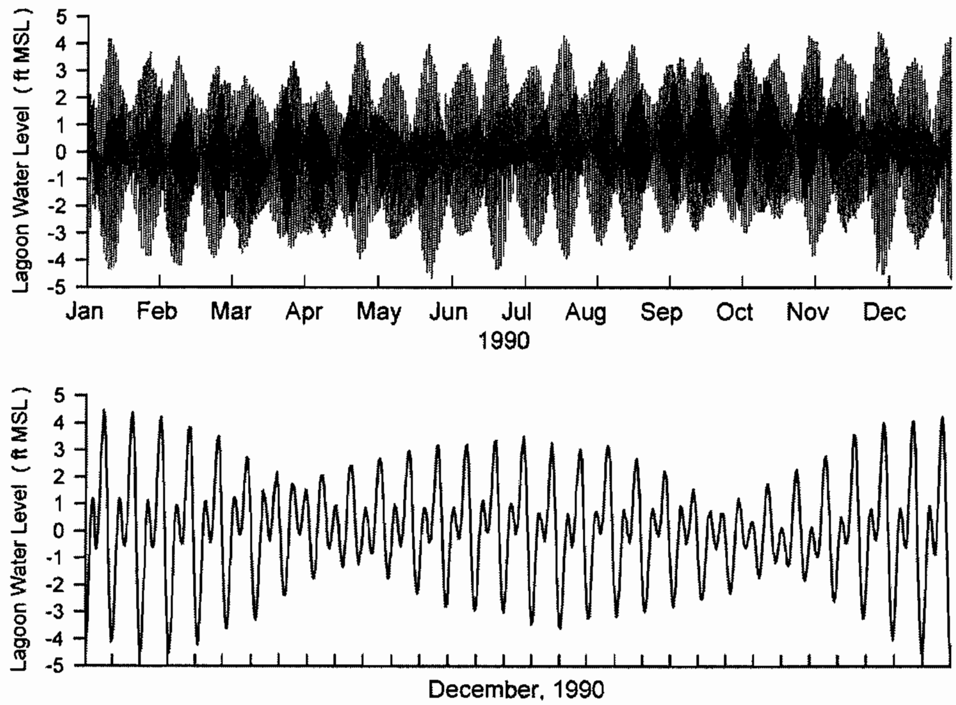

Figure A-11. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1990 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

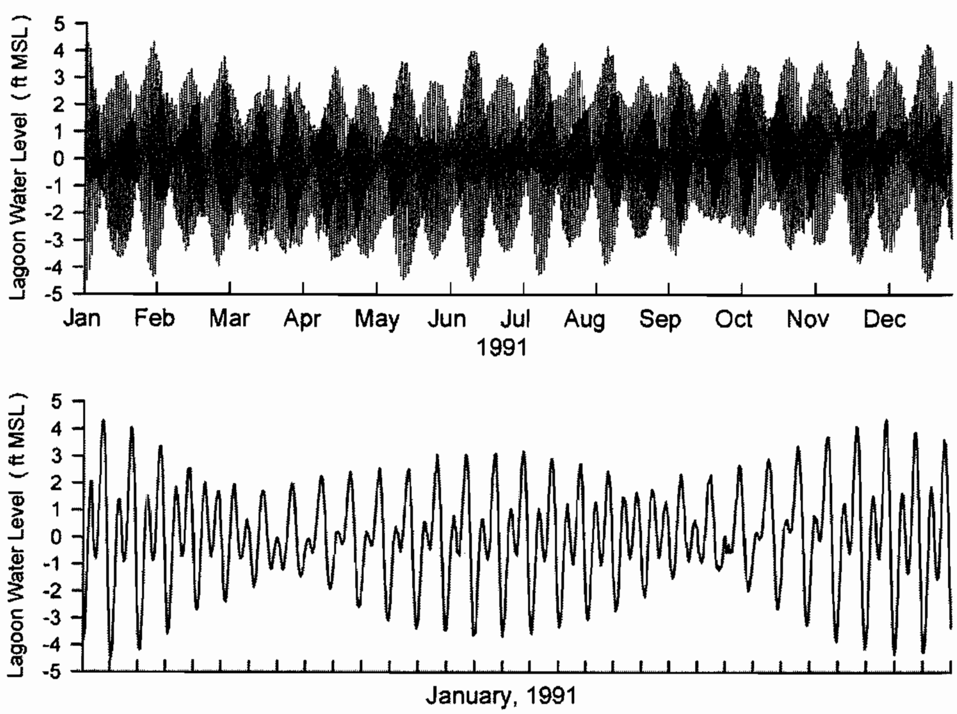

Figure A-12. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1991 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

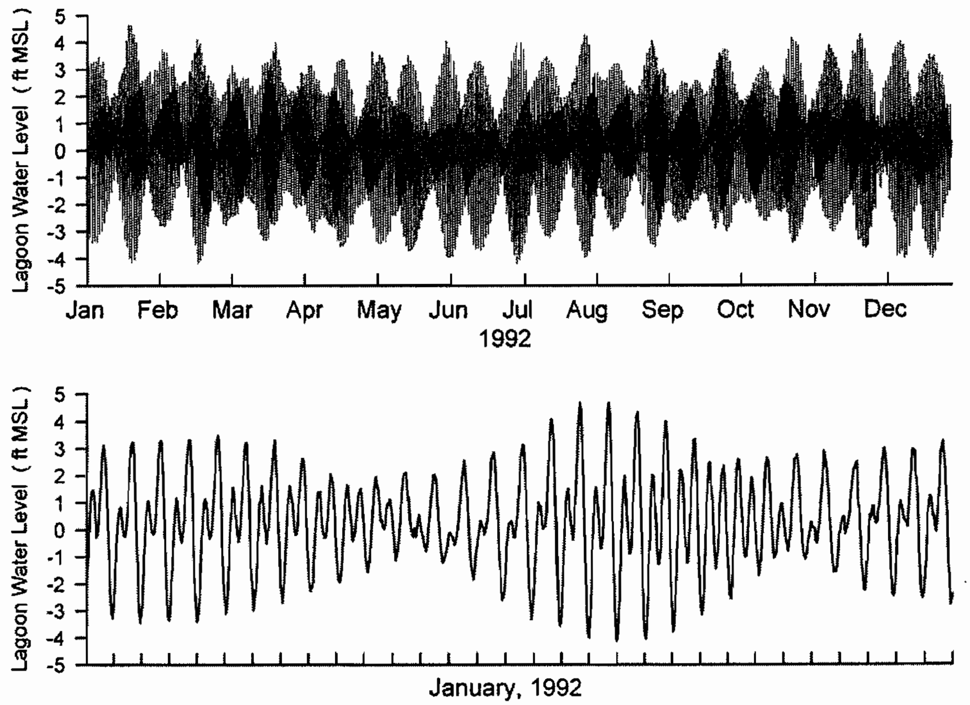

Figure A-13. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1992 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

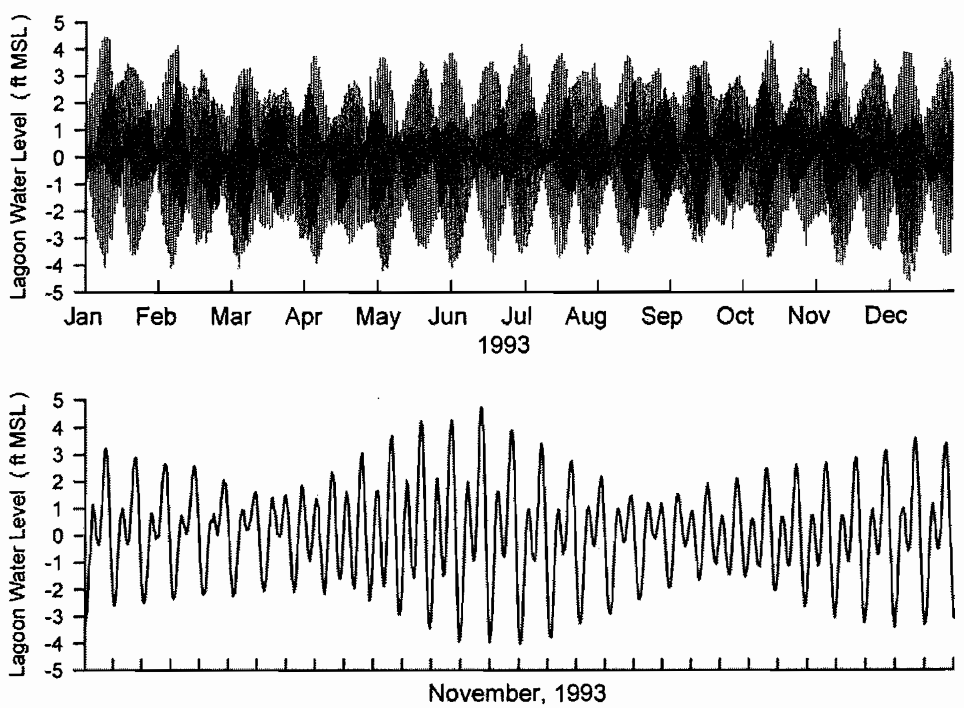

Figure A-14. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1993 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

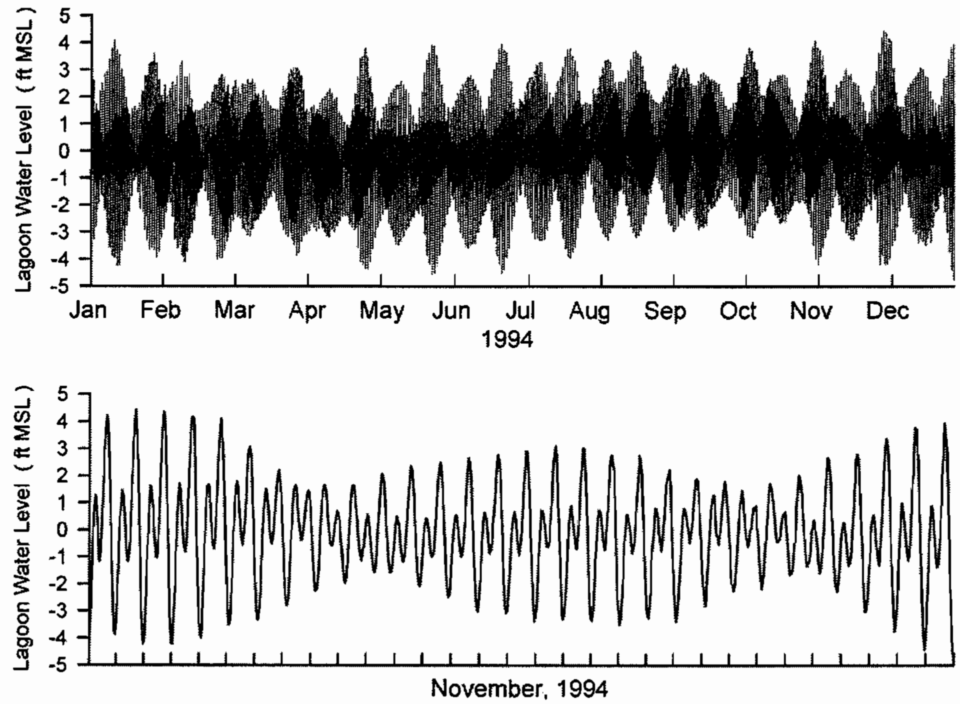

Figure A-15. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1994 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

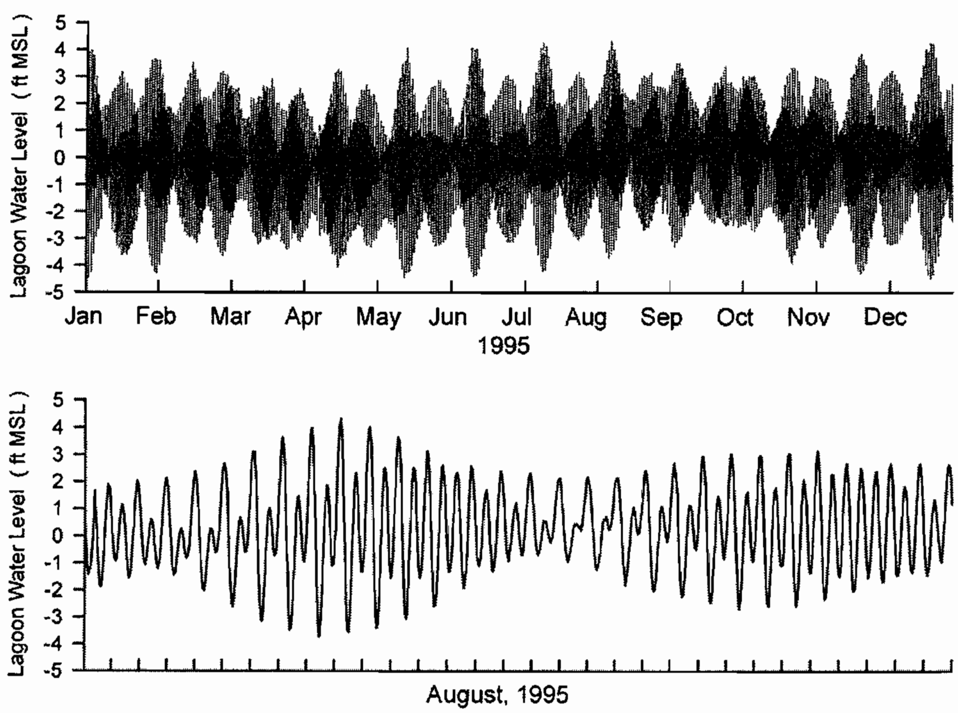

Figure A-16. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1995 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

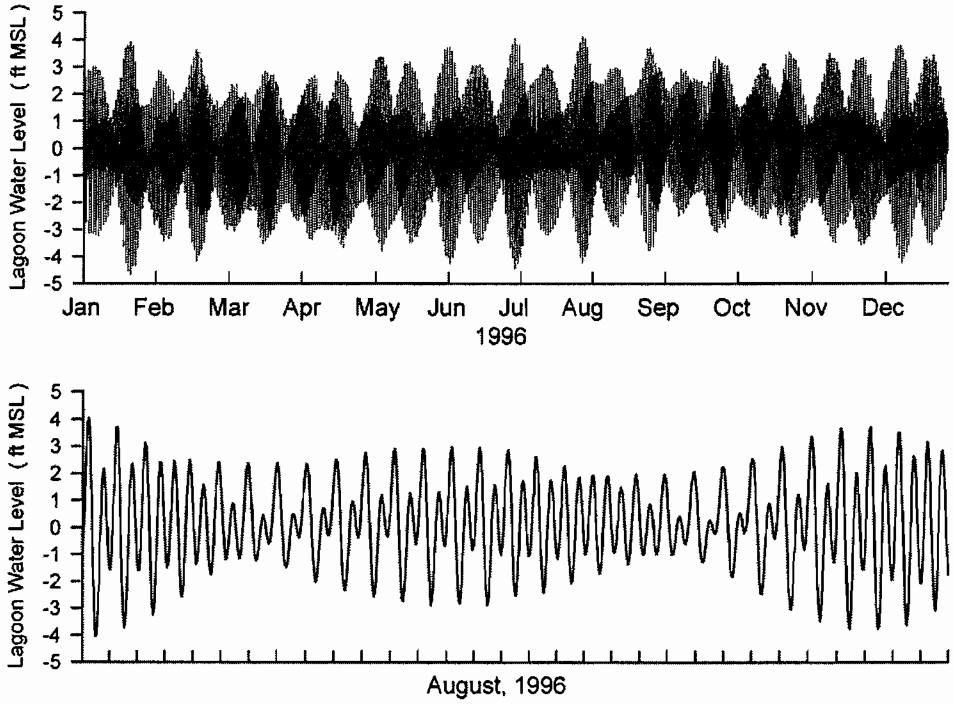

Figure A-17. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1996 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

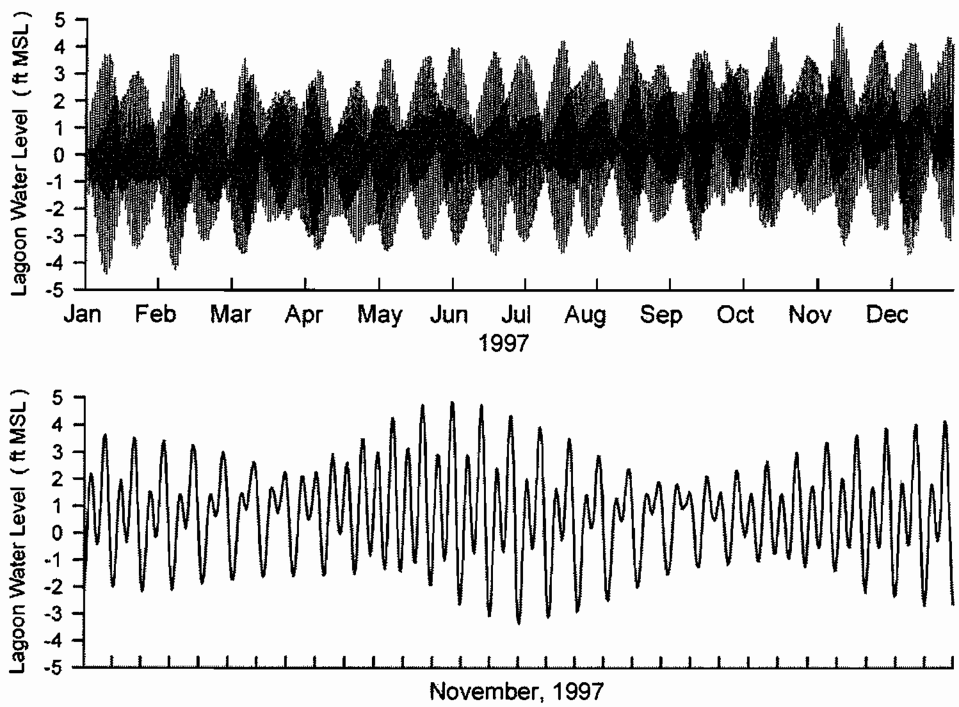

Figure A-18. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1997 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

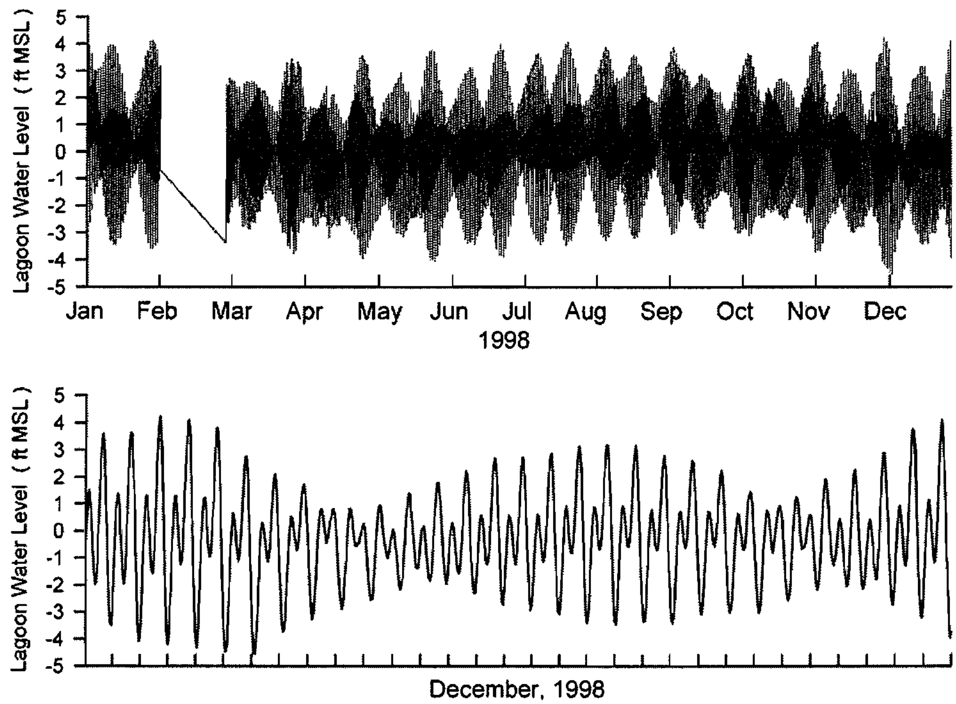

Figure A-19. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1998 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

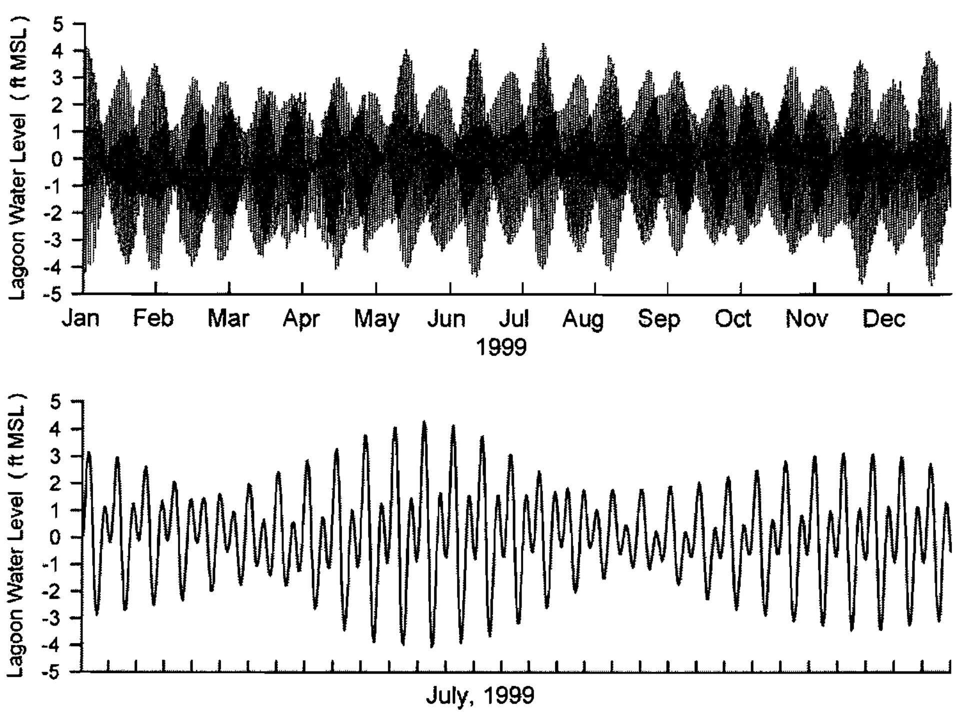

Figure A-20. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 1999 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

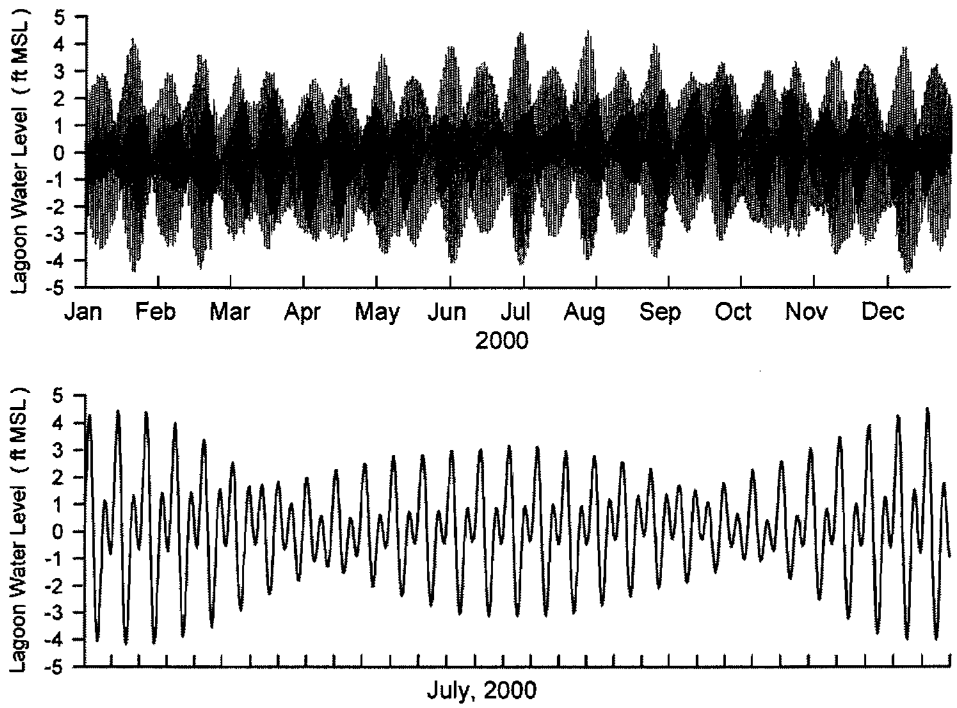

Figure A-21. Water level in West Basin of Agua Hedionda Lagoon derived from TIDE_FEM simulation using 2000 ocean water level measurements from Scripps Pier tide gauge (NOAA # 931-0230).

ATTACHMENT 5

MARINE BIOLOGY ENTRAINMENT
IN
ADDITIONAL RESPONSES TO COMMENTS ON THE FINAL EIR-03-05
FOR THE PRECISE DEVELPOMENT PLAN AND DESALINATION PLANT
PROJECT

JUNE 13, 2006

Exhibit 1

ADDITIONAL RESPONSES TO COMMENTS ON THE FINAL EIR-03-05 FOR THE PRECISE DEVELOPMENT PLAN AND DESALINATION PLANT PROJECT SCH #2004041081 June 13, 2006

1.0 INTRODUCTION

The Final EIR for the Precise Development Plan and Desalination Plant project contains a comprehensive disclosure and analysis of potential environmental effects associated with the implementation of the Precise Development Plan and Desalination Plant project. In addition, the Final EIR contains responses to public comments received during the public review period held on the Draft EIR. Following publication of the Final EIR and distribution of responses to commenting parties, certain parties continued to submit comments up to and including testimony given at the project's public hearing held by the City of Carlsbad Planning Commission on the project on May 3, 2006. In order to address all issues raised by the public on the proposed project and provide comprehensive disclosure and documentation of environmental issues associated with the project, the following additional responses to comments are provided and are hereby incorporated into the Final EIR for consideration by the Carlsbad City Council.

A review of the materials submitted to the City and of the draft minutes of the May 3, 2006, Planning Commission Hearing, identified two primary issues that would benefit from additional clarification:

1) Operation of the desalination plant independent of the Encina Power Station (EPS); and,

2) Water conservation as an "alternative" to the proposed project.

2.0 BACKGROUND

Issue 1: Operation of the Desalination Plant as a stand alone facility – separate from the EPS

The description of baseline conditions and the basis for the analysis in the Final EIR assumes the continued operation of the Encina Power Station (EPS) within the parameters of its historical operating conditions. This approach is based on a determination by the City that such a baseline condition reflects reasonably foreseeable circumstances, and therefore appropriately characterizes existing baseline conditions, in accordance with guidance provided by CEQA. Moreover, all relevant city permits specify that if the desalination plant were to operate independently, Poseidon or its successors would have to obtain new permits and undergo new CEQA compliance.

Certain public comments received on the EIR reflect different opinions on what is considered to be "reasonable" relative to assumptions for the continued operation of the EPS. Certain commentors asserted that shut-down of the EPS is relatively certain within the foreseeable future. These commentors further assert that the EIR analysis should take into account operation of the desalination plant under a scenario in which the EPS is no longer operating. While as noted above, the City believes it is reasonably foreseeable that EPS will continue to operate, the EIR does contain information that analyzes operation of the desalination plant in the absence of EPS operation. The following summary and clarification is provided to demonstrate more clearly that even if the EPS were to shut down permanently or for extended periods of time, the analysis and conclusions of the Final EIR are still accurate and valid.

Issue 2: Water Conservation as an "Alternative" to the Proposed Project

Comments received as a result of review of the Draft EIR suggest that additional or more aggressive water conservation efforts than are now being employed within the City of Carlsbad and the region could eliminate the need for the proposed project and should be addressed as an alternative to the proposed project. The EIR contains a discussion of water conservation efforts and how they relate to the proposed project, and in addition makes reference to the County Water Authority's Regional Water Facilities Master Plan, which also includes consideration of water conservation efforts relative to regional water supply. However, the information presented in these additional responses provides additional clarification and amplification on this issue.

3.0 CEQA REQUIREMENTS

CEQA Guideline Section 15088.5 states that, where the Final EIR has not yet been certified, recirculation for public review is not required unless "significant new information" is added to the document (CEQA Guideline, § 15088.5, subds. [a], [b]).

"Significant new information" requiring recirculation includes, for example, a disclosure showing that:

(1) A new significant environmental impact would result from the project or from a new mitigation measure proposed to be implemented.

(2) A substantial increase in the severity of an environmental impact would result unless mitigation measures are adopted that reduce the impact to a level of insignificance.

(3) A feasible project alternative or mitigation measure considerably different from others previously analyzed would clearly lessen the significant environmental impacts of the project, but the project's proponents decline to adopt it.

(4) The draft EIR was so fundamentally and basically inadequate and conclusory in nature that meaningful public review and comment were precluded.

None of these conditions exist with respect to the information contained in these additional responses and revisions to the Final EIR. Instead, the information provided merely clarifies and amplifies discussion already contained in the EIR, and provides background information on past policy decisions direction taken by the Carlsbad City Council. This information does not identify any new significant environmental effects, nor does it identify any increase in a previously identified significant effect. Further, information provided on project alternatives does not reveal a new alternative that could feasibly reduce any of the identified significant effects of the project. Therefore, recirculation is not required because the new information added to the EIR only clarifies, amplifies and makes insignificant modifications to an adequate EIR (CEQA Guideline, 15088.5, subd. (b)).

4.0 DISCUSSION

Issue 1: Operation of the Desalination Plant as a stand alone facility – separate from the EPS

The Lead Agency and the Applicant have analyzed the impacts of the project with and without the operations of the Encina Power Station (EPS). This information is included in the Final EIR and Appendix E thereto. The resource areas potentially impacted under the "No Power Plant Operation" scenario are (1) Aesthetics; (2) Air Quality (3) Marine Biology - brine discharge; (4) Marine Biology - entrainment/impingement; and (5) Land Use. The baseline used by the lead agency for measuring potential environmental impacts of the project under CEQA is the current physical environment ("With Power Plant Operation" scenario), including current operating conditions. However, the worst case scenario in the Final EIR analyzed the No Power Plant Operation scenario to determine the level of significance in the "historical extreme." The Final EIR contains substantial evidence that shows that the impacts from a No Power Plant Operation scenario to have the same level of significance as the With Power Plant Operation scenario for all of the impact areas.

To provide further clarification on the analysis provided for the No Power Plant Operation scenario, Section 3 of the Final EIR has been revised, and the excerpted text edits are included in Section 5.0 of these Additional Responses.

Aesthetics – The significance criteria (section 4.1.3) for Aesthetics in the Final EIR do not take into consideration the surrounding land uses when assessing visual impacts and thus the significance analysis will not change with or without the power plant in operation. Section 4.1.4 – Impacts - states that, "the project is not considered to have a substantial adverse effect on a scenic vista, or a substantially damaging effect on scenic resources because the proposed structure would represent a visual enhancement over what is currently located on the site (Page 4.1-3)." This enhancement of the area would occur with or without the operation of the EPS. Mitigation measures are proposed so that the project features are acceptable to the City of Carlsbad and conform to the City's long-term vision for the surrounding property, which includes relocation of the power plant to the back of the property and the transition of the front of the property to more public uses.

In June of 2002 the Carlsbad City Council, and in October of 2002 the Carlsbad Housing and Redevelopment Agency, adopted six principals to pursue negotiations for the purchase of water from Poseidon:

1. Improved water reliability and quality in both normal and drought periods at CWA [County Water Authority] water rates.
2. Maximize beach and lagoon access for the public.
3. Maximize open space and recreational opportunities for the public.
4. Redevelop Encina Power Plant to maximize its best public and private uses.
5. Desalination facility protected from power market fluctuations.
6. Accrue a positive economic benefit from the increased industrial development of the coastal corridor.

These principals were used to evaluate the project in addition to the Strategic Goals and 5-Year Vision Statements approved by the City Council. The project was found to be consistent with goal number 4 shown above (see pages 4.8-16 – 4.8.18 of the Final EIR), and would therefore not interfere with any future change in operation at the EPS.

Based on the clarification provided in this response, no revisions to the Final EIR text are considered to be necessary to further clarify aesthetic effects.

Air Quality. The potential indirect air quality impacts due to emissions from power generation for the desalination facility are analyzed in the Final EIR with and without the EPS as the source of power. (See page 4.2-18 of the Final EIR). The Final EIR (page 4.2-18) notes that "the desalination plant will not contain any electrical power generation facilities, and will purchase this electrical power from the local electric utility, or a power generator, broker or seller. At this time no contract has been signed for power purchases from any supplier." Because no supplier of electricity has been designated, the Final EIR analyzed the indirect emission impacts from power generation for three different scenarios: (1) if power were purchased from EPS; (2) the local utility; (3) or another power provider. The second and third scenario analyzed the No Power Plant Operation scenario impacts studied in the Final EIR, and therefore there would be no change in the Final EIR significance findings if EPS were not operational.

Based on the clarification provided in this response, no revisions to the Final EIR text are considered to be necessary to further clarify air quality effects.

Marine Biology Brine. The Final EIR for the desalination plant used the "historical extreme" operation and level of salinity to evaluate the impacts to the marine environment. In Section 4.3, Biological Resources, the Final EIR notes on page 4.3-44 that, "the EPS can run with an "unheated discharge" (i.e., no power plant operation)." The Final EIR modeled impacts of unheated "historical extreme" for flow scenarios using a discharge of 254 million gallons per day, which would represent conditions under the No Power Plant Operation scenario. Therefore the "historical extreme" conditions modeled account for impacts related to operation of the desalination facility without power plant operation and flow rates that would be generated by the desalination plant being operated independently.

On page 4.3-45, the Final EIR notes that in the "historical extreme" the "highest bottom salinities were noted with the 'unheated' [i.e., No Power Plant Operation scenario] condition due to its reduced buoyancy." Again on that page, the Final EIR states that, "...to determine worst-case conditions, the unheated conditions are examined." Therefore the No Power Plant Operation scenario is the worst case condition studied by the Final EIR.

The Analysis of Significance – Elevated Salinity Exposure Effects section of the Final EIR (page 4.3-50) indicates that significant impacts are found at an extended salinity exposure level of 40 parts per thousand (ppt). The Final EIR (page 4.3-50) indicates that under the "historical extreme" the end of pipe salinity of 40.1 ppt "...is diluted across the ZID [zone of initial dilution] to about 38.2 ppt..." Also on page 4.3-50, the Final EIR concludes that "extended exposure to salinity levels above 40 ppt would be avoided under all proposed operating conditions (emphasis added)." The Final EIR (page 4.3-51) goes on to conclude that "since the 'historical extreme' scenarios under all operating conditions would not result in salinity levels exceeding this threshold for an extended period of time, impacts related to elevated salinities would not be significant (emphasis added)."

Therefore the No Power Plant Operation scenario, or "unheated discharge" condition has been analyzed in the Final EIR and the impacts from brine discharge in this worst-case scenario were found to be less than significant.

Based on the clarification provided in this response, no revisions to the Final EIR text are considered to be necessary to further clarify effects of brine discharge on marine organisms.

Marine Biology Entrainment. Data presented in Appendix E of the Final EIR (see *Carlsbad Desalination Facility Intake Effects Assessment* (draft), dated March 3, 2005, and prepared by Tenera Enviromental) supports a finding of no significant impact for entrainment. The referenced study demonstrates that entrainment of marine organisms at the EPS is a function of the volume of water flowing through the intake. If the desalination facility were to operate at 106 million gallons per day (MGD) under the No Power Plant Operation scenario, there would be 100% mortality resulting from impingement of the larval fish caught on the desalination plant screens and filters (106 MGD represents a total maximum withdrawal volume, which represents a worst case volume, as compared to the average withdrawal volume of 104 MGD). As shown in Table 1, the entrainment loss would represent between 0.6% and 11.8% of the EPS source water supply of larvae, depending on the fish group modeled. Assuming an additional 200 MGD was allowed to flow through the intake to the discharge channel for dilution of the concentrated seawater discharge from the desalination facility, there could be additional entrainment losses. The level of impact to the organisms and associated mortality due to the diversion of the dilution water under the No Power Plant Operation scenario will be less than the impact had the water been pumped through the condensers as is modeled under the With Power Plant Operation scenario. However, lacking data to document actual mortality under the No Power Plant Operation scenario mode of operation, the possible range is 0% to 100% mortality of the larval fish in the dilution water. Under these conditions the minimum larval fish entrainment loss for the desalination facility (106 MGD) and associated dilution water (200 MGD) would be 0.6% to 11.8% and the maximum would be 1.7% to 34.1%, depending on the design of the facility and species modeled. (Table 1).

Table 1

Desalination Facility's Estimated Entrainment Loss

Under No Power Plant Operation

Fish Group	Desalination Facility Entrainment Loss	Dilution Water Entrainment Loss	Minimum Combined Entrainment Loss	Maximum Combined Entrainment Loss
CIQ gobies	11.8%	0% – 22.3%	11.8%	34.1%

Combtooth blennies	5.7%	0% - 10.8%	5.7%	16.5%
Northern anchovy	0.6%	0% - 1.1%	0.6%	1.7%

Significance of Entrainment Losses. The loss of larval fish entrained by the EPS cooling water flows, whether the EPS is operating or not, are a small fraction of marine organisms from the abundant and ubiquitous near-shore source water populations. Using standard fisheries models for adult fishes, the loss of larvae (99 percent of which are lost to natural mortality) due to the desalination facility entrainment at 306 MGD would have no effect on the species' ability to sustain their populations, including the gobies at 34.1%. As noted in Table 1 above, gobies are not substantially impacted because of their widespread distribution and high reproductive potential due to spawning several times a year and are able to sustain conditional larval stage mortality rates of 34% and higher without a decline in adult population level. This absence of population level effects for adult gobies is especially true for the species' early larval stages. The sheer numbers of larvae that are produced by the adult gobies are resistant to the effects of both natural mortality and reasonably high levels of conditional mortality.

The most frequently entrained species are very abundant in the area of EPS intake, Agua Hedionda Lagoon, and the Southern California Bight so that the actual ecological effects due to any additional entrainment from the project at either level of plant operations are insignificant. Species of direct recreational and commercial value constitute a very small fraction (less than 1 percent) of the entrained organisms. Therefore, the operation of the desalination facility does not cause a significant ecological impact. California Department of Fish and Game (2002) in their Nearshore Fishery Management Plan provides for sustainable populations with harvests of up to 60 percent of unfished adult stocks. The incremental entrainment ("harvest") effect of larval fishes from the desalination facilities operations at 106 or 306 MGD is approximately 1 to 34 percent (depending on the species); losses that would have no significant effect on the source water populations to sustain themselves. Additionally, entrainment mortality losses are not harvests in the common sense, because the larval fish are not removed from the ocean, but are returned to supply the ocean's food webs – the natural fate of at least 99 percent of larvae whether entrained or not. Generally less than one percent of all fish larvae become reproductive adults.

Revisions to the Final EIR text have been made to provide additional clarification on entrainment effects under the No Power Plant Operation scenario. Excerpts of the revised text are included in Section 5.0 of these Additional Responses.

Marine Biology Impingement. The Applicant has calculated the approach velocity of the water flowing through the EPS intake under the No Power Plant Operation scenario and determined that the velocity would not exceed 0.5 feet per second. Under these operating conditions, the intake would meet impingement mortality performance standards established in the revised 316(b) permitting requirements.

Revisions to the Final EIR text have been made to provide additional clarification on impingement effects under the No Power Plant Operation scenario. Excerpts of the revised text are included in Section 5.0 of these Additional Responses.

Land Use – The proposed project causes no significant impacts to land use and is consistent with existing land use plans with or without the existence and operation of the EPS. The project is consistent with the Public Utilities (U) land use designation in the General Plan and Zoning Ordinance and is consistent regardless of power plant operations.

In addition the project is consistent with the South Carlsbad Coastal Redevelopment Plan for the area and would continue to be consistent regardless of the operation of the power plant. The Final EIR (page 4.8-16) notes that, "The site of the desalination plant was specifically selected so as not to conflict with two redevelopment plan goals. The first goal relates to facilitating the conversion and possible relocation of the existing power plant to a smaller more efficient facility. The second goal relates to the enhancement of commercial and recreational opportunities in the plan area." Although any changes in the power plant configuration will require additional environmental review and approval, a siting study was conducted for the desalination plant in which five sites within the EPS property were reviewed to find a location for the desalination facility that was sensitive to the redevelopment plan goal and would "create the least amount of constraints on any future conversion of the Encina Power Station." (See pages 4.8-16 – 4.8.18 of the Final EIR for details.) Therefore any future changes to the EPS will not be affected by the siting of the desalination plant.

Based on the clarification provided in this response, no revisions to the Final EIR text are considered to be necessary to further clarify land use effects

Issue 2: Water Conservation/Recycled Water Only and Increased Conservation/Recycled Water as "Alternatives" to the Proposed Project

As discussed in Section 9 of the Final EIR (pages 9-1 to 9-7), a baseline assumption incorporated in the Final EIR analysis is that the water conservation and water recycling elements included in Carlsb ad Municipal Water District's 2000 Urban Water Management Plan (UWMP) and San Diego County Water Authority's 2004 Regional Water Facilities Master Plan (RWFMP) will be fully implemented. However, even with the targeted conservation and recycling in place, both the San Diego County Water Authority (CWA) and Carlsbad Municipal Water District (CMWD) identified a need for additional local water in an amount equal to or greater than the project capacity. The update to the 2000 UWMP, approved in December 2005, continues to identify that need.

The RWFMP projected that in 2002, approximately 13,700 acre-feet of recycled water was used within CWA's service area annually. This number is projected to increase to over 53,000 acre feet per year by 2020. As noted in the Final EIR, while conservation is not technically a water supply "source", it is also an important strategy employed within the region to reduce demand for water supply. Water conservation programs are maintained by MWD, CWA and local water agencies.

Even though the Final EIR references the role of conservation and recycling in local and regional water supply management and the policy direction that has been pursued relative to water conservation and recycling, certain commenting parties indicated that additional conservation/recycling should be considered as a project alternative. A discussion of water conservation and recycling efforts is provided in the Final EIR to further clarify how conservation was a consideration that helped shape policy that relates to the proposed project. Specifically, consideration of water conservation and recycling as alternatives to the proposed project has been given in past policy making. However, the level of water conservation and recycling necessary to replace the need for the proposed project has been rejected as alternatives to the project primarily for public policy reasons that are further explained in the Final EIR.

Section 15126.6(c) of the CEQA Guidelines provides for discussion of any alternatives that were considered by the lead agency but were rejected as infeasible. Additionally, Section 15132(e) states that a Final Environmental Impact Report may consist of "any other information added by the Lead Agency." Staff has included revisions to the Final EIR text to provide additional clarification on the rationale for rejection of alternatives to the proposed project that involve additional conservation and/or recycling. The revised text is included in Section 5.0 of these Additional Responses.

5.0 FINAL EIR TEXT EDITS

The following are excerpts of portions of text from the EIR that have been revised as a result of these Additional Responses. Revisions that have been made as a result of these Additional Responses are noted in strike-through (deletions) and underline (additions) text.

The following text replaces text that appears in Section 3.3 of the EIR (Starting on Page 3-14, under the Subheading "Power Plant Baseline Operating Conditions"):

Power Plant Baseline Operating Conditions

The PDP will not modify the Encina power plant's permitted operating capacity. However, the following information is provided to accomplish the City's objective of establishing baseline conditions for identifying existing facilities and operations on site for the purpose of increasing knowledge and understanding about station operation and onsite facilities. It should be noted this project does not include any modifications that would affect the power plant's operating capacity.

Power generation capacity, as described in the NPDES Permit, is provided by a total of six power generator units[1]:

- Unit 1 – 107 megawatts (MW)
- Unit 2 – 104 MW
- Unit 3 – 110 MW
- Unit 4 – 287 MW
- Unit 5 – 315 MW
- Gas Turbine – 16 MW

All of these generating units have been designated as "Reliability Must Run" (RMR) by the ISO.[2] The RMR Generation designation represents the minimum generation (number of units or MW output) required by the ISO to be available to maintain system reliability. At full production output, the Encina power plant has the capability to directly or indirectly serve roughly half of the power demand for San Diego County.

Units 1 through 5 are steam turbine generators, each with its own boiler that generates heat up to 1005 degrees Fahrenheit. Purified water runs through the boilers turning to high-pressure steam that is used to spin the turbines to generate electricity. The plant relies on seawater to cool and condense the steam after its energy is expended spinning the turbine. Seawater flows into the Agua Hedionda Lagoon through the jetty west of Carlsbad Boulevard into the outer lagoon and into an intake channel located at the southwestern end of the lagoon. The seawater is then pumped into condensers to condense the steam on a non-contact heat transfer basis, and then is returned to the ocean via a discharge channel located to the south of the lagoon's confluence with the ocean.

The power plant cooling water discharge is regulated under a National Pollutant Discharge Elimination System (NPDES) permit, issued with the Regional Water Quality Control Board. The plant is currently permitted to discharge a maximum of

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1 NPDES Permit, Order No. 2003-03, Regional Water Quality Control Board, February 16, 2000.
2 California Independent System Operator website: www.caiso.com, accessed July 29, 2004.

approximately 860 million gallons per day (mgd) of cooling water. For purposes of this analysis, data for power plant operation includes records dating from 1980 to 2000. The generators identified above were phased in from the plant's initial construction in 1952 through 1978. Therefore, the dataset used in the EIR analysis represents operation of all production units, and is considered to provide data representing the current operational characteristics from which to analyze existing baseline conditions. With that being said however, the analysis of effects associated with seawater intake and discharge are evaluated based on conditions that represent two separate scenarios, with and without operation of the EPS. The average cooling water discharge rate over the 20-year period was 576 mgd. Daily average flow rates have not fallen below 304 mgd in the 20-year dataset. As noted in the analysis presented in Section 5 of this EIR, the 304 mgd flow rate is used as the worst case operating condition, under the assumption that the discharge is "unheated", which therefore represents conditions without operation of the EPS. For purposes of this discussion, this scenario is referenced as the "No Power Plant Operation" scenario.

The following text replaces text that appears in Section 4.3.4 of the EIR (Starting on Page 4.3-35, under the Subheading "Impingement Effect"):

Impingement Effect

- The desalination plant operation does not require the power plant to increase the quantity of water withdrawn nor does it increase the velocity of the water withdrawn.

- The Carlsbad Desalination Plant will not have a separate direct lagoon or ocean intake and screening facilities, and will only use cooling water that is already screened by the EPS intake.

- Under the No Power Plant Operation scenario, approach velocity of the water flowing through the EPS intake would not exceed 0.5 feet per second. Under these operating conditions, the intake would meet impingement mortality performance standards established in the revised 316(b) permitting requirements.

- Therefore, the Carlsbad Desalination Plant will not cause any additional impingement losses to the marine organisms impinged by the EPS, under the assumed baseline EPS operating conditions, and would not result in significant impingement effects under the No Power Plant Operation scenario.

The following text replaces text that appears in Section 4.3.4 of the EIR (Starting on Page 4.3-36, under the Subheading "Entrainment Losses"):

Entrainment Losses

- Based on in-plant testing, the average observed entrainment mortality of the power plant was 97.6 percent (2.4 percent survival). Living fish larvae entrained by the Carlsbad desalination plant would represent an incremental loss of approximately 0.01 to 0.28 percent of the larvae present in the power plant source water, assuming continued operation of the EPS. Under the No Power Plant Operation scenario, living fish larvae entrained by the Carlsbad desalination plant would represent a loss of approximately 0.6% to 34.1% of the source populations, depending on the final design of the desalination facility and on the species.

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

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

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

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

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

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

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

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

Taxon	Common Name	Total Count	Percent	Cum. Percent	Mean Concentration (#/1,000 m^3)
Hypsoblennius spp.	combtooth blennies	766	46.48%	46.48%	1,119.89
CIQ gobies	CIQ goby complex	426	25.85%	72.33%	630.94
Labrisomidae unid.	labrisomid kelpfishes	205	12.44%	84.77%	291.66
Hypsypops rubicundus	garibaldi	174	10.56%	95.33%	230.14
Rimicola spp.	kelp clingfishes	13	0.79%	96.12%	17.54
Gibbonsia spp.	clinid kelpfishes	12	0.73%	96.84%	16.38
Engraulidae	anchovies	12	0.73%	97.57%	15.83
Gobiesocidae unid.	clingfishes	8	0.49%	98.06%	10.15
Sciaenidae	croakers	8	0.49%	98.54%	11.38
Blennioidei	Blennies	7	0.42%	98.97%	9.21
Atherinopsidae	Silversides	6	0.36%	99.33%	7.36
larval/post-larval fish unid.		3	0.18%	99.51%	3.50
Heterostichus rostratus	giant kelpfish	1	0.06%	99.58%	1.14
Syngnathus spp.	Pipefishes	1	0.06%	99.64%	0.92
Paralichthys californicus	California halibut	1	0.06%	99.70%	1.28
Chaenopsidae unid.	Clinids	1	0.06%	99.76%	0.92
Labridae	Wrasses	1	0.06%	99.82%	1.28
larvae, unidentified yolksac		1	0.06%	99.88%	2.45
Typhlogobius californiensis	blind goby	1	0.06%	99.94%	1.96
Agonidae unid.	Poachers	1	0.06%	100.00%	2.19
Total		1,648			

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

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

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

Date Collected	Number of Samples[1]	Total Volume Filtered (m^3)	Average Larval Fish Concentration (#/1,000 m^3) per Survey[2] (s.d. in parenthesis)	Total # Larvae Collected	Total # Alive upon Collection	Average % Survival per Survey[3] (s.d. in parenthesis)
6/16/2004	8	117	1,289.4 (754.2)	140	2	1.8 (4.7)
7/06/2004	9	112	2,443.8 (875.0)	276	13	4.3 (4.1)
7/20/2004	30	301	1,053.3 (674.6)	315	7	1.6 (4.0)
8/13/2004	30	339	564.4 (632.9)	192	2	0.005 (0.02)
8/26/2004	32	284	415.4 (350.9)	112	1	0.6 (3.2)

9/09/2004	31	342	2,027.5 (2,246.4)	590	4	0.5 (1.8)
9/23/2004	30	344	668.8 (1,134.6)	200	2	1.2 (5.5)
10/21/2004	31	347	93.0 (123.9)	31	1	5.9 (24.3)
11/02/2004	30	257	182.3 (161.9)	47	0	0
11/18/2004	30	271	132.9 (166.7)	34	2	4.6 (13.8)
11/30/2004	30	216	264.5 (291.6)	52	4	9.2 (24.2)

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

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

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

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

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

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

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

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

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

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

Northern anchovy	0.01% (0.05)

Fish larvae entrained by desalination plant represent an incremental loss of the EPS source water supply of larvae. The average observed entrainment mortality of the EPS was 97.6 percent (2.4 percent survival). Since 97.6 percent of the larvae are dead at the point of the desalination plant intake, the incremental entrainment loss on source water populations is the 2.4 percent survival rate times the desalination plant proportional entrainment for each specific species in the EPS discharge. These incremental effects range from 0.01 percent for northern anchovy to 0.28 percent for CIQ gobies (*Table 4.3-6*). The incremental mortality assumes 100 percent mortality of all organisms surviving the EPS upon withdrawal into the desalination facility. However, under the No Power Plant Operation scenario, no mortality is attributed to EPS operations and all entrainment effects are assigned to the desalination plant.

TABLE 4.3-6
Estimates of Proportional Mortality (P_m)

Fish Group	P_m based on Maximum Length at Entrainment Desalination Plant Entrainment from EPS Discharge Flow Maximum flow - 106 MGD (401,254 m³/day)	Estimate When Applying The Overall Average Survival Estimate Of 2.4 Percent[1] Incremental Entrainment Loss Due to Desalination Plant Operations Maximum flow - 106 MGD (401,254 m³/day)	P_m Based on No Power Plant Operation Scenario Desalination Plant Entrainment with Maximum flow – 306 MGD
CIQ gobies	11.8%	0.28%	34.1%
Combtooth blennies	5.7%	0.14%	16.5 %
Northern anchovy	0.6%	0.01%	1.7%

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

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

If the desalination facility were to operate at 106 million gallons per day (MGD) under the No Power Plant Operation scenario, there would be 100% mortality resulting from impingement of the larval fish caught on the screens and filters. The No Power Plant Operation scenario would increase the flow volume attributable to the desalination plant by an additional 200 MGD for dilution of the concentrated seawater discharge from the desalination facility. The level of impact to the organisms and associated mortality due to the diversion of the dilution water under the No Power Plant Operation scenario will be less than the impact had the water been pumped through the condensers as is modeled under the With Power Plant Operation scenario. However, lacking data to document actual mortality under the No Power Plant Operation scenario, the possible range is 0% to 100% mortality of the larval fish in the dilution water. Under these conditions the minimum larval fish entrainment loss for the desalination facility (106 MGD) and associated dilution water (200 MGD) would be 0.6% to 11.8% and the maximum would be 1.7% to 34.1%, depending on the design of the facility and species modeled. *(Table 4.3-6)*.

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

Significance of Entrainment Losses: The small proportion of marine organisms lost to entrainment as a result of the desalination plant would not have a substantial effect on the species' ability to sustain their populations because of their widespread distribution and high reproductive potential. The most frequently entrained species are very abundant in the area of EPS intake, Agua Hedionda Lagoon, and the Southern California Bight, and therefore, the actual ecological effects due to any additional entrainment from the desalination plant are less than significant. California Department of Fish and Game (2002) in their Nearshore Fishery Management Plan provides for sustainable populations with harvests of up to 60 percent of unfished adult stocks. The incremental entrainment (or "harvest") effect of larval fishes from the desalination plant operations between 0.01 and ~~0.28 percent~~ up to 34.1% under the No Power Plant Operation scenario depending on the design of the facility and species modeled.

The loss of larval fish entrained by the EPS cooling water flows, whether the EPS is operating or not, are a small fraction of marine organisms from the abundant and ubiquitous near-shore source water populations. Using standard fisheries models for adult fishes, the loss of larvae (99 percent of which are lost to natural mortality) due to the desalination facility entrainment at 306 MGD would have no effect on the species' ability to sustain their populations, including the gobies at 34.1%. Gobies are not substantially impacted because of their widespread distribution and high reproductive potential due to spawning several times a year, are able to sustain conditional larval stage mortality rates of 34% and higher without a decline in adult population level. This absence of population level effects for adult gobies is especially true for the species' early larval stages. The sheer numbers of larvae that are produced by the adult gobies are resistant to effects of both natural mortality and reasonably high levels of conditional mortality.

The most frequently entrained species are very abundant in the area of EPS intake, Agua Hedionda Lagoon, and the Southern California Bight so that the actual ecological effects due to any additional entrainment from the project at either level of plant operations are insignificant. Species of direct recreational and commercial value constitute less than 1 percent of the entrained organisms, and considering the fact that in general, less than one percent of all fish larvae become reproductive adults, the operation of the desalination plant would not result in significant impacts on those species. California Department of Fish and Game (2002) in their Nearshore Fishery Management Plan provides for sustainable populations with harvests of up to 60 percent of unfished adult stocks. The incremental entrainment ("harvest") effect of larval fishes from the desalination facilities operations at 106 or 306 MGD is approximately 1 to 34 percent (depending on the species); losses that would have no significant effect on the source water populations to sustain themselves. Additionally, entrainment mortality losses are not harvests in the common sense, because the larval fish are not removed from the ocean, but are returned to supply the ocean's food webs – the natural fate of at least 99 percent of larvae whether entrained or not. Generally less than one percent of all fish larvae become reproductive adults.

The following text replaces text that appears in Section 6.0 of the EIR (Starting on Page 6-1):

SECTION 6.0
ALTERNATIVES TO THE PROPOSED ACTION

In order to fully evaluate proposed projects, CEQA requires that alternatives be discussed. Section 15126.6 of the State CEQA Guidelines requires the discussion of "a range of reasonable alternatives to the project, or to the location of the project, which would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the significant effects of the project, and evaluate the comparative merits of the alternatives." The alternatives discussion is intended to "focus on alternatives to the project or its location which are capable of avoiding or substantially lessening any significant effects of the project, even if these alternatives would impede to some degree the attainment of the project objectives as listed in Section 3.0 of this EIR. The alternatives discussion focuses on the desalination plant aspect of the PDP.

The Alternatives discussion in this EIR focuses on four project alternatives: a No Project/No Development Alternative, an Alternative Site Location Alternative, a Modified Intake Design Alternative, and a Reduced Project Capacity Alternative.

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Along with the Alternatives identified in this Section, previous consideration has been given to policy options that are discussed as alternatives that have been considered and rejected for the purposes of this EIR. These alternatives include the Recycled Water Only Alternative and Increased Water Conservation/Recycled Water Alternative. These alternatives are not currently considered to be feasible project alternatives, and for that reason, are not put forward as alternatives that the City Council may select as alternatives actions to project approval. However, based on comments received on the EIR, the City of Carlsbad believes it important to emphasize and clarify past policy decisions relative to water recycling and conservation, and how those water management strategies relate to the proposed project.

Alternatives Considered but Rejected as Infeasible

Section 15126.6(c) of the CEQA Guidelines provides for discussion of any alternatives that were considered by the lead agency but were rejected as infeasible. The alternatives, identified as the Recycled Water Only Alternative and Increased Water Conservation/Recycled Water Alternative, have been considered in past decision making by the City and both have been determined to be infeasible, because they require recycling and conservation practices that go beyond what is considered to be acceptable from a public policy perspective. The following discussion provides information that explains how water recycling and conservation have and will continue to play an important role in local and regional water management. This discussion is also intended to provide a framework for understanding past policy decisions that limit the extent to which recycling and conservation can be taken without causing unacceptable social and economic effects.

Water conservation and recycling has long been a part of local and regional water supply strategies. Conservation and recycling involve social and economic impacts that are given consideration by policy makers in terms of how much these strategies are feasibly able to contribute to reducing and/or satisfying demand.

The Department of Water Resources' draft California Water Plan Update 2005 acknowledges that local efforts to conserve and reuse water must continue to be implemented *and* new water supplies must be developed (including up to 500,000 acre-feet of desalination) to ensure an adequate water supply for California's future. (California Water Plan Highlights, page 15.) Update 2005 states that if recent growth trends continue, water conservation and reuse alone will not be adequate to meet Southern California's future needs. More than 600,000 acre-feet of new supply will be needed to meet the South Coast region's needs by the year 2030.

The San Diego County Water Authority's Regional Water Facilities Master Plan has projected that an additional one million people will be added to the county over the next three decades. To keep up with this growth, it is expected that by 2020 water demands will grow by 107,000 acre feet (AF) over 2005 total projected demands to 813,000 acre feet per year (AFY). The contribution from water conservation efforts account for 54,900 AFY of estimated reduced demand today and is expected to grow by nearly 75% to a potential 93,200 AFY in reduced demand over the next 15 years. The increased demand projection of 107,000 AFY is net of the 93,200 AFY of projected savings due to ongoing and planned water conservation efforts, but still requires additional supply to meet the demands of growth in the region.

The City of Carlsbad currently imports 100% of its potable water supply. The City of Carlsbad's pursuit of seawater desalination is in direct response to growing concern over water supply reliability. This concern is driven by several factors, including climate, limited surface and groundwater supplies, expected population growth, and decreasing reliability of imported water resources stemming from the Colorado River 4.4 Plan and QSA, Sacramento-San Joaquin Bay-Delta Accord, and other regional, state and federal water issues. Conservation programs defer or limit the rate of demand for water; however, these programs cannot reliably address the City's long-term water supply needs.

The Carlsbad Municipal Water District ("CMWD") considered a variety of actions to improve its water supply reliability, diversify supplies, and reduce dependence on imported water. These actions include a commitment to implement all cost-effective water conservation and recycling opportunities. Today, CMWD has one of the most aggressive conservation and recycling programs in the San Diego region.

CMWD is also a signatory to the California Urban Water Conservation Council Memorandum of Understanding ("MOU"). Signatories to the MOU implement 14 Best Management Practices that have received a consensus among water agencies and conservation advocates as the best and most realistic methods to produce significant water savings from conservation.

Conservation on a local level is implemented through strategies identified in the Urban Water Management Plan (UWMP). The goals of the City's water conservation program are to: reduce demand for more expensive, imported water; demonstrate continued commitment to the Urban Best Management Practices (BMPs); and to ensure a reliable future water supply. The UWMP includes water demand management measures, consisting of:

- Best Management Practices / Audits
- Low consumption toilets / showerheads / faucets
- Leak detection / Metering
- Landscape programs / Drought tolerant plantings
- Public information / School education
- Commercial & Industrial conservation measures
- Water waste prohibitions

In 1991, Carlsbad adopted a five-phase Recycled Water Master Plan designed to save potable water. The result is that CMWD has the most aggressive water recycling program in the region when measured in terms of percent of supply derived from recycled water. The Recycled Water Master Plan is referenced herein.

The implementation of the water conservation and water recycling elements included in CMWD's UWMP are on schedule and are achieving the desired reduction in potable water use. These programs are designed to work in tandem with the proposed seawater desalination project to accomplish the City Council's water supply reliability goal of 90 percent water availability during a severe drought. This goal could not be met through conservation and recycling alone.

The CMWD's current UWMP, approved in 2005 and referenced herein, projects that in the year 2020 the City of Carlsbad will have 102,536 residents in the CMWD Service Area, an increase of almost 22,000 people from the 2005 Service Area population estimate. The projected water demand for the Service Area in 2020 is 28,907 acre feet (AF) per year. The UWMP has projected that 1,945 AF, or approximately 7% of the demand, will be met by conservation, a 500 AF increase over 2005 projected conservation savings. Further, recycled water is estimated to constitute 6,300 AF, or 21%, of CMWD water demand in 2020. This represents a 6% increase over recycled water supplies in 2020 estimated by the 2000 UWMP.

As an alternative to use of desalinated water for the 72% of the City's water needs that would not be supplied by conservation (7%) and recycled water (21%) in 2020, certain commentors have claimed that it is possible for the City to increase conservation or use of recycled water in a manner which eliminates the need for desalinated water from the desalination facility.

The Recycled Water Only Alternative would involve a situation where the City of Carlsbad would not utilize any external source of potable water. Under this scenario, the residents and businesses in the City would reduce their consumption of water, and only utilize water which is recycled from the City's wastewater system. The current water supply projection for 2020 – 21% recycled water and 7% conservation – would increase by some combination to 100% under this alternative. A variety of different combination of conservation and use of recycled water could be imagined under this alternative.

With this alternative, there would be no need for the desalination facility. The significant effects of the desalination facility related to air quality and growth inducement would be avoided.

Under the Recycled Water Only and Increased Conservation/Recycled Water alternatives, the City would implement more aggressive conservation measures that go beyond current BMPs as a means to meet future water demands. The City would more aggressively apply BMPs going beyond what is locally cost-effective and implement new restrictions on water use, such as limitations on residential landscape irrigating, washing vehicles, irrigating golf courses and parks and other uses, and have appropriate penalties for failure to comply with restrictions.

To more aggressively implement conservation measures beyond the current industry standard, the City would have to implement non-cost-effective BMPs, non-proven potential BMPs, and would have to enforce restrictions that could harm the City's economy and result in a drastic change in life styles. Even with the aggressive conservation measures the City has taken, coupled with planned future conservation projects, the savings would not be sufficient to offset the estimated demand forecast for 2020.

The Recycled Water Only Alternative appears to be infeasible as it does not take into account water loss and replacement. Inevitably, some water will be lost through evaporation, transportation, leaks, application to soil, and water treatment processes in industrial and public utility uses, such as waste treatment systems. Eventually, this lost water will require replacement from another water source "outside" the recycled water system. Accordingly, an argument could be made that this replacement could come from sources other than imported and desalinated water, such as stormwater. However, the City has no way of capturing stormwater for use as a potable supply as the City does not have any stormwater impoundment reservoirs.

No community in the world has achieved the level of recycling and conservation presented in the Recycled Water Only Alternative. Furthermore, the California

Department of Health Services has health based restrictions on the use of recycled water which prevent its use as a complete replacement for potable water. In addition, the general public is unwilling to use recycled water as a complete replacement for water used in cooking, bathing, washing and drinking.

The City has also previously analyzed the Increased Conservation/Recycled Water Alternative, whereby the combined level of conservation and recycled water supply would total somewhere between UWMP projections as used as the baseline assumption in this FEIR and a level of 100%, which is the level analyzed in the Recycled Water Only Alternative discussed above. (The 2000 UWMP estimates 15% of the City's water demand in 2020 would be meet by recycled water; an estimate is not provided for conservation, although the 2000 UMWP discusses conservation, the components to achieve it, and recognizes conservation as a critical part of CMWD's long term water supply needs.) A variety of different combinations of increased use of recycled water and increased conservation are covered within this alternative. Commentors did not describe a specific level of conservation or use of recycled water that they felt the City could achieve.

The Increased Conservation/Recycled Water Alternative was not presented as an actual alternative to the proposed project. No matter what level of conservation or recycled water is proposed below 100%, the City and other jurisdictions in San Diego County still face a need for potable water from some source. As a result, this is not a feasible alternative to the proposed project. For example, reaching a theoretical goal of supplying water needs through conservation and use of recycled water to meet 50% of the City's water needs still requires a source of water for the remaining 50% of the water needs. The desalination facility is still needed to supply that remaining 50%, even under this type of Conservation/Recycled Water Alternative. Thus, this Alternative would not eliminate the need for the desalination facility, nor would it eliminate the potential adverse effects of the desalination facility related to a contribution to cumulative air quality or a contribution to regional growth inducement.

An Increased Conservation/Recycled Water Alternative would permit the City to purchase less desalinated water from the desalination facility. If Carlsbad were the only customer for the desalination facility, this could result in a reduced capacity desalination facility. The impacts of a Reduced Project Capacity Alternative are analyzed in Section 6.4 of the EIR. As noted in Section 6.4 of the EIR, a Reduced Project Capacity Alternative would reduce but not eliminate the project's contribution to a cumulative air quality and cumulative regional growth inducing impacts.

In summary, the City concludes that the Increased Conservation/Recycled Water Alternative also appears to be infeasible for public policy reasons because it would require a level of conservation and use of recycled water that is unacceptable as a matter of public policy. The City previously determined the maximum acceptable levels of conservation and recycled water use that should be mandated by the City in the approval of the UWMP and the Recycled Water Master Plan, and does not believe these levels can or should be increased for many reasons, as set forth in the record before the City Council when those plans were approved. For example, due to current legal restrictions, recycled water cannot be used for bathing, cooking and other household domestic needs. Current mandated low flow toilets, showerheads and other plumbing fixtures represent the maximum feasible level of conservation from these fixtures, and at this time it is infeasible to mandate fixtures which provide higher levels of conservation.

Single family residential households use a large portion of the CMWD water supply. The 2005 UWMP estimates that in 2020, 38% of the total water supply, or 11,013 AF, can be attributed to use by these households. Single family residential water demand includes both indoor and outdoor water usage with 60% of the water usage attributed to outdoor use, primarily for landscaping. Increasing the percentage of water supply available through conservation, above the 7% conservation projection in 2020, would require an equal reduction in demand.

While reduction of water demand could occur through use of recycled water for landscape irrigation for single-family residences, this would present concerns. Installing the public infrastructure and retrofitting all single-family residences to enable use of reclaimed water for irrigation purposes would be economically infeasible. Moreover, use of reclaimed water for irrigation by private residences is also discouraged by some county health officials.

Further restrictions on outdoor water use, such as a ban on all outdoor water usage, are not acceptable as a matter of public policy. If all outdoor water usage from single family residences were prohibited, for example, a conservation of approximately 6,607 AF of water (60% of 11,013 AF) or 22% of total 2020 demand would be achieved, enhancing the total conservation supply for the City of Carlsbad in 2020 to 29% (7% + 22%). However, among other things, this alternative would require the City of Carlsbad to enact ordinances that allow only non-irrigated landscaping within the City of Carlsbad, and ordinances that ban the use of outdoor irrigation for single family residences.

The City of Carlsbad has determined that prohibition of single family residential outdoor irrigation and most outdoor landscaping is not a desired public policy goal of the City of

Carlsbad, and the City Council does not believe that this action would be in the best interest of the quality of life, or health and well being of the residents of Carlsbad.

ATTACHMENT 6

COASTAL PROCESS EFFECTS OF REDUCED INTAKE FLOWS AT AGUA HEDIONDA LAGOON

Coastal Processes Effects of Reduced Intake Flows at Agua Hedionda Lagoon

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13 December 2006

Abstract:

This study evaluates the coastal processes effects associated with reduced flow rate operations of a stand alone desalination plant co-located at Encina Generating Station. The generating station presently consumes lagoon water at an average rate of about 530 mgd. If this consumption rate were reduced to 304 mgd to maintain end-of-pipe salinity below 40 ppt, we find that the capture rates of littoral sediment would be reduced by 42.5%, thereby reducing the environmental impacts associated with maintenance dredging. Reduced flow rate operations will not increase the magnitude of cyclical variations in habitat or residence time that presently occur throughout each maintenance dredge cycle, but will increase the length of time over which those variations occur. Low flow rate operations will result in reductions of 8% to 10% in the fluxes of dissolved nutrients and oxygen into the lagoon through the ocean inlet, but this effect is relatively minor in comparison to the 17.4% decline in nutrient and D.O. flux

that occurs in the latter stages of each dredge cycle. On balance, low flow operations do not appear to create any significant adverse impacts on either the lagoon environment or the local beaches; and it could be argued that the reduction in capture rates of littoral sediment is a project benefit.

1.0) Introduction:

The present day Agua Hedionda Lagoon is not a natural geomorphic structure, rather it is a construct of modern dredging. Its west tidal basin (Figure 1) is unnaturally deep (-20 to – 32 ft NGVD) and the utilization of lagoon water for once-through cooling by the Encina Generating Station renders Agua Hedionda's hydraulics distinctly different from any other natural tidal lagoon. Power plant cooling water uptake (Q_{plant}) acts as a kind of "negative river." Whereas natural lagoons have a river or stream adding water to the lagoon, causing a net outflow at the ocean inlet, the power plant infall removes water from Agua Hedionda Lagoon, resulting in a net inflow of water (Q_{plant}) through the ocean inlet. This net inflow has several consequences for particulate transport into and out of the lagoon: 1) it draws nutritive particulate and suspended sediment from the surf zone into the lagoon, the latter forming bars and shoals (Figure 2) that subsequently restrict the tidal circulation, and 2) the net inflow of water diminishes or at times cancels the ebb flow velocities out of the inlet, thereby providing insufficient transport energy to flush sediments (essentially uphill) out of the deep west basin of the lagoon. Therefore, the plant demand for lagoon water strongly controls the rate at which Agua Hedionda traps sediment and other solid particulate.

This is a technical note on the potential coastal processes effects arising from reduced once-through flow rates at the Encina Generating Station, Carlsbad, CA. Specifically, we evaluate long-term, stand-alone operation of a proposed desalination plant at this site using the minimum once-through flow rate available with the existing hydraulic infrastructure that will allow the production of 50 mgd of potable water by reverse osmosis (R.O.) without exceeding 40 ppt salinity at end-of-pipe. When taken in combination with worst-case mixing conditions in the receiving water, this minimum flow rate configuration is referred to in the certified project EIR as the "unheated

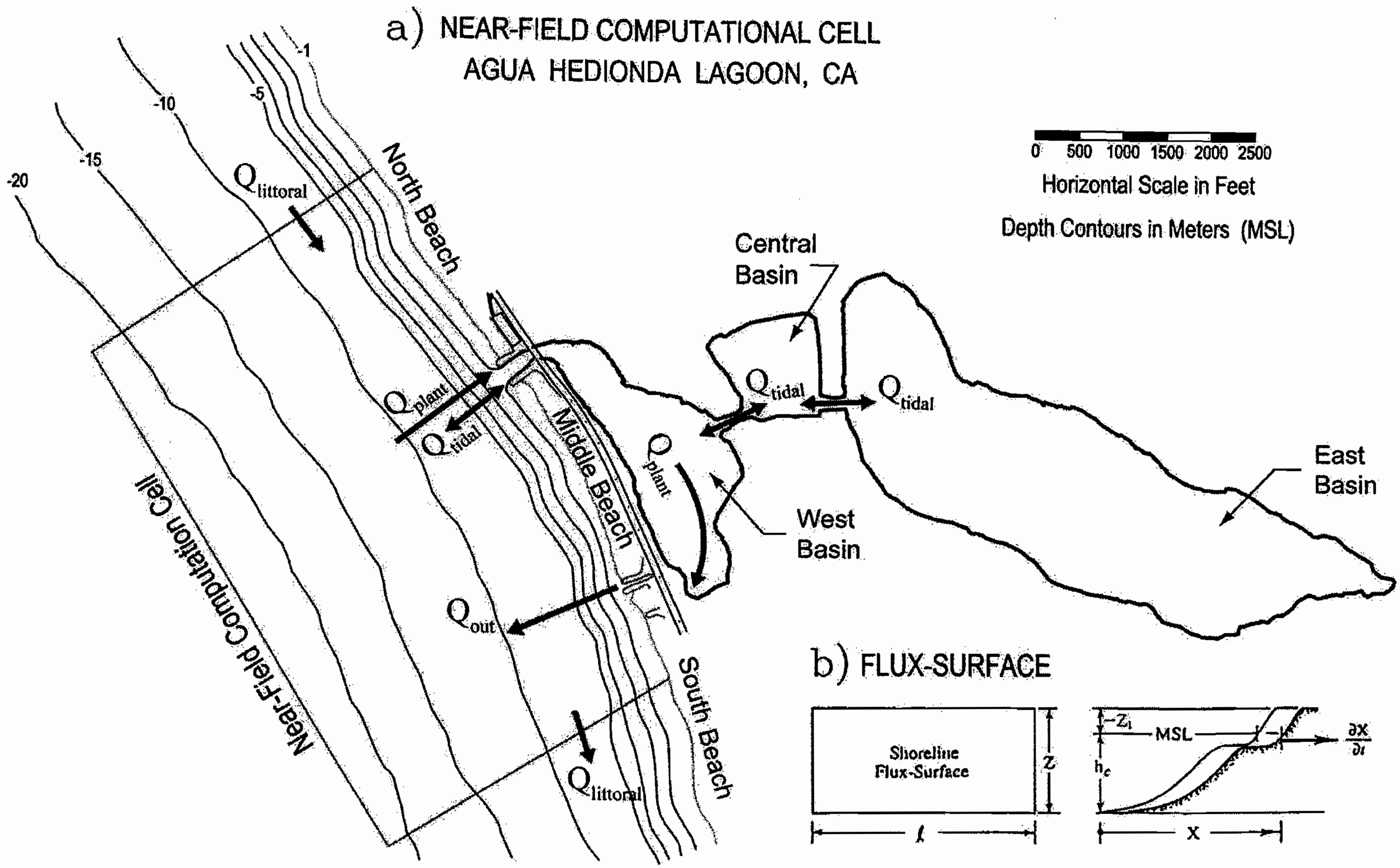

Figure 1. Near-field computational cell for calculating sediment transport at Agua Hedionda Lagoon, CA; a) Lagoon Plan View. b) Beach Cross-section.

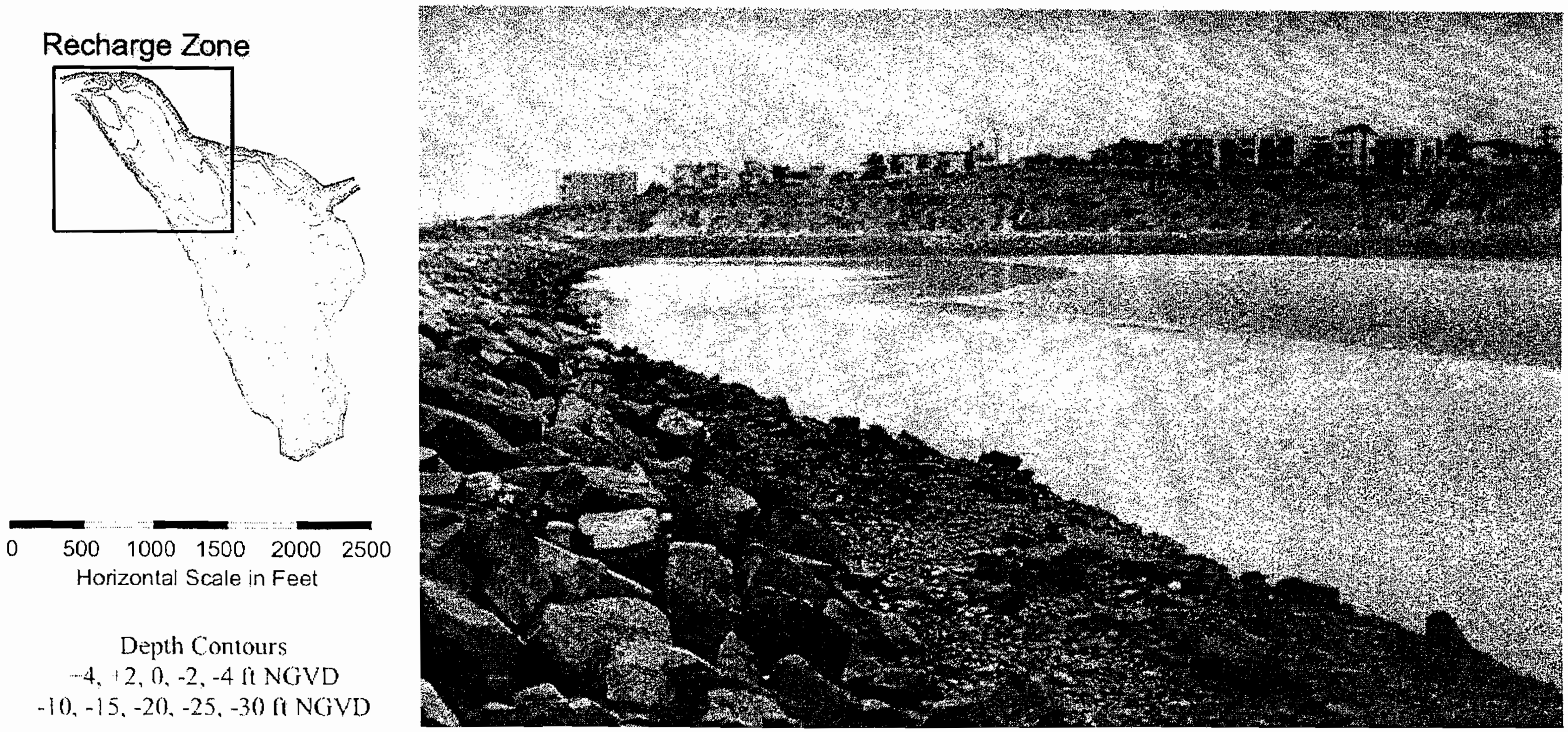

Figure 2. West Basin of Agua Hedionda Lagoon showing inlet (flood) bar formation at low tide. Insert shows the recharge area of the lagoon where this bar forms and the preponderance of maintenance dredging is performed.

historical extreme" and involves a once through flow rate of 304 mgd at the intake structure located at the southern end of the west basin of Agua Hedionda Lagoon. Table 1 below gives various operational combinations of existing circulation and service water pumps that can provide this minimum flow rate within 5%.

The existing cascade of circulation and service water pumps available at Encina Generating Station can provide a maximum once-through flow rate of 808 mgd, but has averaged about 530 over the long term (Jenkins and Wasyl, 2001). During peak user demand months for power (summer), plant flow rates are typically between 635 and 670 mgd (Elwany, et al, 2005). Thus the flow rates passing through the Encina facility during stand-alone desalination operations would be about 43% less than the present average when power generation is occurring, and 62% less than the peak flow rate capability. In this technical note, we utilize data from the existing literature to deduce probable impacts that this flow rate reduction would have on sand and nutrient flux into Agua Hedionda Lagoon and implications for the neighboring beaches and nearshore morphology.

2.0) Reduced Flow Effects on Sediment Flux

The most profound and far-reaching consequence of long-term operation of the Encina facility at reduced flow rate will be on the flux of sand into the lagoon through the ocean inlet. The sand influx controls the tidal exchange in the lagoon by regulating the depth of an inlet sill associated with inlet bars that form in the West Basin of the lagoon (see Figure 2). These sand bars restrict the effective tidal range in the lagoon and ultimately threaten closure of the inlet, thereby requiring periodic maintenance dredging to mitigate that threat. The bars are formed by sands that are suspended in the surfzone and entrained by the inflowing stream of water through the inlet. During peak demand months for power, typically 46% of the daily inflow volume is due the power plant flow rate, causing the daily outflow through the inlet to be 48% less than the inflow (Elwany, et al, 2005). As a result, the transport of sand into the lagoon through the ocean inlet has a strong inflow bias (flood dominance) that scales in direct proportion to the power plant flow rate. In the review of lagoon sedimentation that follows, we will show a correlation between sand influx rates and plant flow rates, indicating that reduction of plant flow rates will reduce the influx rate of sand into the lagoon. While this is an apparent benefit

Table 1. COMBINATIONS OF PUMPS OF TOTAL CAPACITY WITHIN 5 % OF 304 MGD

<u>Operational Condition 1 – 304.7 MGD</u>			
Unit 1 (Both Pumps)		=	68.3 MGD
	Subtotal	=	104.3 MGD (Desal Intake)
Unit 2 (2 S Pump)		=	36.0 MGD
Unit 3 (Both Pumps)		=	63.9 MGD
	Subtotal	=	200.4 MGD (Dilution)
Unit 4 (4 W Pump)		=	136.5 MGD
	Total	=	304.7 MGD (0.2 % above 304 MGD)
<u>Operational Condition 2 – 306.3 MGD</u>			
Unit 4 (Both Pumps)		=	270.4 MGD
Unit 1 (1 S Pump)		=	35.9 MGD
	Total	=	306.3 MGD (1 % above 304 MGD)
<u>Operational Condition 3 – 306.4 MGD</u>			
Unit 4 (Both Pumps)		=	270.4 MGD
Unit 2 (2 S Pump)		=	36.0 MGD
	Total	=	306.4 MGD (1 % above 304 MGD)
<u>Operational Condition 4 – 315.4 MGD</u>			
Unit 4 (4 E Pump)		=	133.9 MGD
Unit 5 (5 W Pump)		=	157.0 MGD
Unit 2 (2 N Pump)		=	24.5 MGD
	Total	=	315.4 MGD (3.8 % above 304 MGD)
<u>Operational Condition 5 – 315.4 MGD</u>			
Unit 5 (Both Pumps)		=	315.4 MGD
	Total	=	315.4 MGD (3.8 % above 304 MGD)
<u>Operational Condition 6 – 302.1 MGD</u>			
Unit 1 (Both Pumps)		=	68.3 MGD
	Total	=	104.3 MGD (Desal Intake)
Unit 2 (2 S Pump)		=	36.0 MGD
Unit 3 (Both Pumps)		=	63.9 MGD
	Total	=	197.8 MGD (Dilution)
Unit 4 (4 E Pump)		=	133.9 MGD
	Total	=	302.1 MGD (0.6 % below 304 MGD)

of stand alone operations of a desalination plant, it raises a number of cost trade-off and regulatory issues that would ultimately need to be decided.

2.1) Lagoon Sedimentation History: Prior to the 1950's, Agua Hedionda was a slough comprised of shallow marsh channels filled with anaerobic hyper-saline water and flushed only briefly during winter months when high tides and rain runoff from Agua Hedionda Creek would broach the barrier berm across the lagoon inlet. A Southern

Pacific Railroad survey of the track across Agua Hedionda in 1889 (Figure 3) shows no extensive open water areas where the present day lagoon is situated. Instead, only winding marsh channels and marsh vegetation is apparent. Also apparent in this survey map is the closed state of the inlet on the south side of the marsh plain, and a narrow barrier beach with cobble ridge system across the entire extent of Middle Beach and portions of North Beach and South Beach. (ref. Figure 1 for beach nomenclature). Thus these were historically narrow beaches that did not retain large volumes of sand given the presence of the surveyed cobble ridges.

Over a period of 247 days beginning June 1953, a total of 4,279,000 cubic yards of mostly beach grade sediment was dredged from the Agua Hedionda Lagoon system. Referring to Figure 1, the total dredge volume was 1,025,000 cubic yards from the outer or western basin, and 3,254,000 cubic yards from the middle and east basins, see Ellis (1954). This dredged material was deposited primarily on Middle Beach with residual amounts on North and South Beach, forming a large deltaic shoreline form which had the effect of widening the beach by an additional 500 ft. In order to allow the intake and discharge flows to cross this man-made delta, the intake and discharge channels were armored with rubble mound jetty structures approximately 700-750 ft. in length as measured from the center line of the Pacific Coast Highway (Jenkins and Wasyl, 2001).

The dredge delta caused wave energy to converge on this section of shoreline inducing erosion progressively over time until the original beach width at Agua Hedionda was re-established by 1956 (Jenkins and Wasyl, 2001). As the delta eroded, the un-engineered rock structures were exposed to large breaking wave forces and the intake and discharge jetties were reduced by this storm damage to their present nominal lengths circa 1960 to 1963. Meanwhile, the 4.3 million cubic yards of sand that had made up the dredged delta formation was transported southward by the net littoral drift that predominates throughout the Oceanside Littoral Cell as shown in Figure 4. In the Oceanside Littoral Cell, the prevailing wave direction is from the northwest due to the combined effects of coastline orientation, island sheltering and the most prevalent storm track which is associated with extra tropical cyclones and cold fronts from the Gulf of

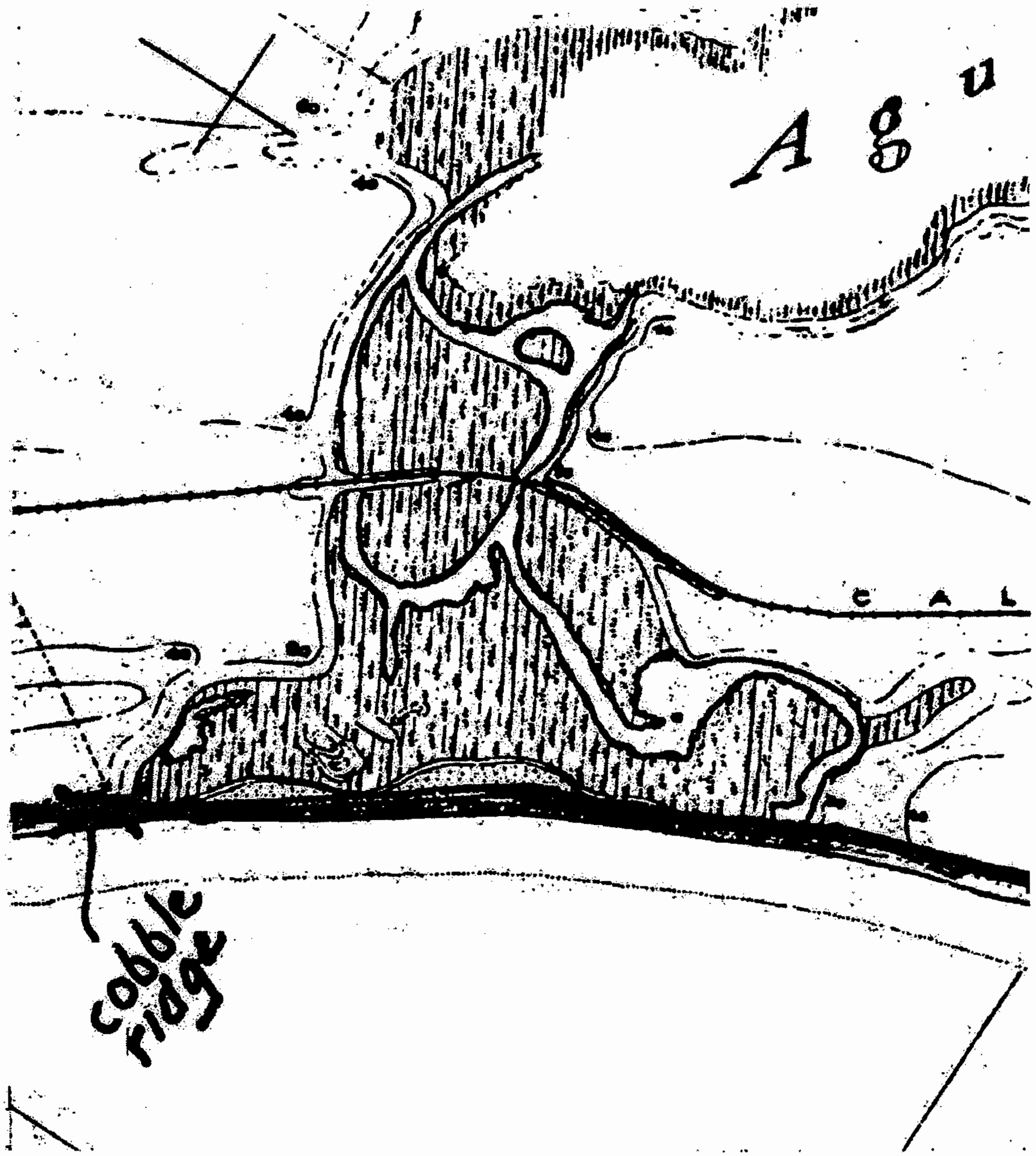

Figure 3 Railroad Survey of Agua Hedionda Lagoon, 1884.

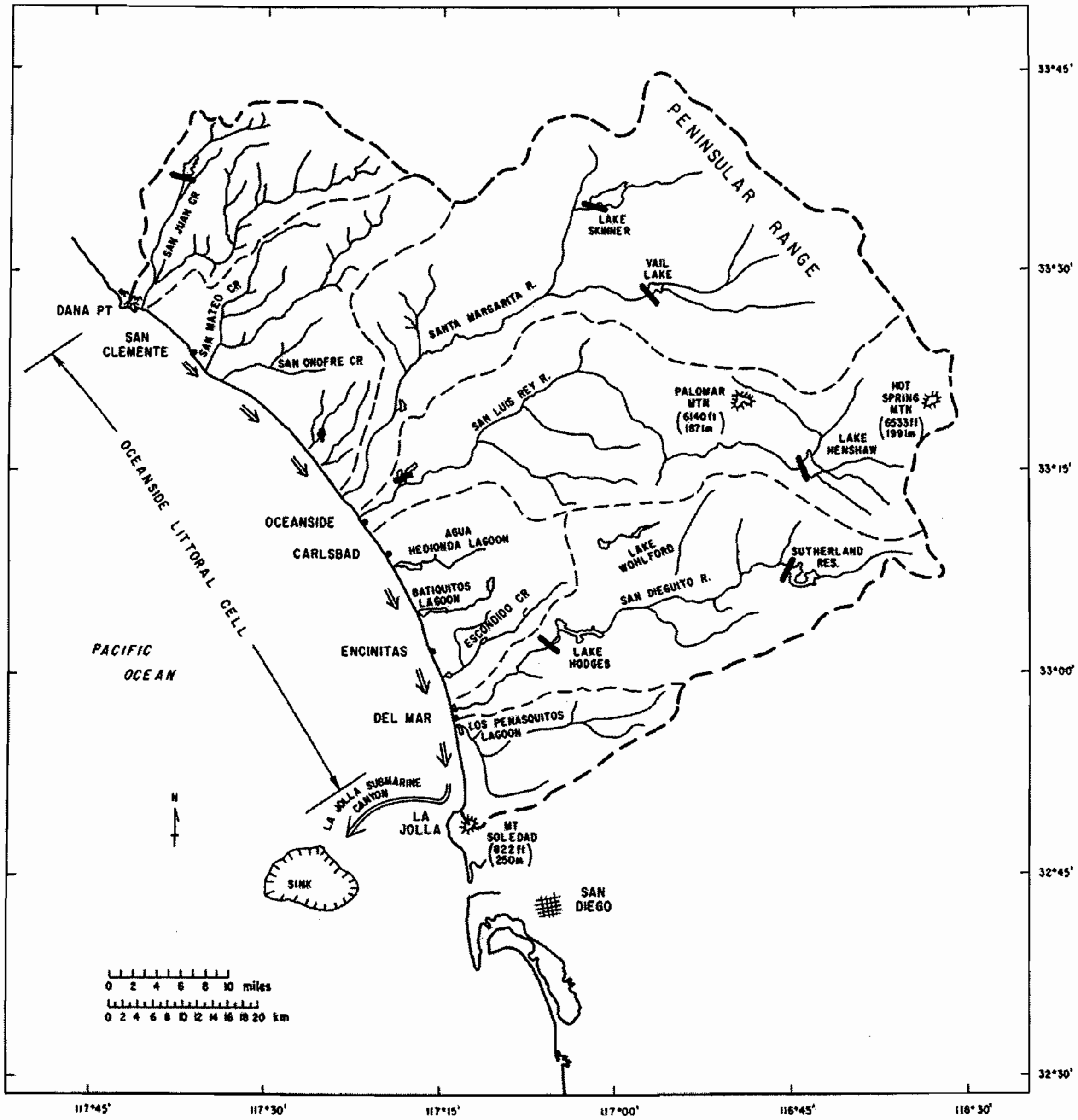

Figure 4. Oceanside Littoral Cell [Inman and Brush,1973].

Alaska. Consequently, the long-term average littoral drift is from north to south as shown in Figure 4. This southward directed littoral drift is intercepted by submarine canyons (the La Jolla and Scripps Submarine Canyons) at the extreme southern (down-drift) end of the littoral cell where it is lost in turbidity currents that flow down the shelf rise, making the Oceanside Littoral Cell is a constant loss system. The only way the beaches can remain stable in this constant loss system is by continual replacement of these sand losses. When the inflowing stream of water into Agua Hedionda entrains sand from the littoral drift and deposits it in the west basin, the beaches down-drift of the lagoon suffer a loss of sand supply unless maintenance dredging returns those sands to the beaches. Since the inflow rates increase with the rate of consumption of cooling water, it is logical to look for a relationship between dredge quantities and cooling water consumption. To quantify this relationship we examine the historic dredge and flow rate data.

Table 2 gives a listing of the complete dredging history at Agua Hedionda Lagoon. The dredging events listed as "maintenance" in Table 2 occurred within the recharge zone of the west basin (Figure 2) and give estimates of sediment influx rates when the volumes for these events are factored against the time intervals between them. Annual sand influx rates calculated in this way are compared against the annual consumption of cooling water in Figure 5. Annual consumption of cooling water is plotted against the left hand axis in Figure 5 (black) in units of millions of gallons of seawater; while the annual sand influx volume is plotted against the right hand axis (red) in units of thousands of cubic yards. The individual data appear for each year as black diamonds for flow rate and red crosses for sand influx rates. Over-laid on these data are linear best fits to each. There is a clear trend showing that the consumption of cooling water by the power plant has increased over time (in response to expansion of generating capacity and increased user demand for power); and that the sand influx rates have followed that increase. From the best fit lines derived from the 48 year period of record in Figure 5, annual consumption of cooling water by the power plant has increased nearly 5 fold (growing on average by 3.3 billion gallons per year), while the annual influx of sand has doubled (increasing by 2 thousand cubic yards per year). Although the

Table 2. Dredging and Disposal History at Agua Hedionda Lagoon (from Jenkins and Wasyl, 2001)

Dredging And Disposal History							
Year	**Dredging**				**Disposal**	**Comments**	
	Date		**Volume (yds^3)**	**Basin Dredged**	**Volume (yds^3)**	**Location Placed 1**	
	Start	Finish					
1954	Feb-54	Oct-54	4,279,319	Outer, Middle, & Inner	4,279,319	N, M, S	Initial construction dredging
1955	Aug-55	Sep-55	90,000	Outer	90,000	S	Maintenance
1957	Sep-57	Dec-57	183,000	Outer	183,000	S	Maintenance
1959-60	Oct-59	Mar-60	370,000	Outer	370,000	S	Maintenance
1961	Jan-61	Apr-61	227,000	Outer	227,000	S	Maintenance
1962-63	Sep-62	Mar-63	307,000	Outer	307,000	S	Maintenance
1964-65	Sep-64	Feb-65	222,000	Outer	222,000	S	Maintenance
1966-67	Nov-66	Apr-67	159,108	Outer	159,108	S	Maintenance
1968-69	Jan-68	Mar-69	96,740	Outer	96,740	S	Maintenance
1972	Jan-72	Feb-72	259,000	Outer	259,000	S	Maintenance
1974	Oct-74	Dec-74	341,110	Outer	341,110	M	Maintenance
1976	Oct-76	Dec-76	360,981	Outer	360,981	M	Maintenance
1979	Feb-79	Apr-79	397,555	Outer	397,555	M	Maintenance
1981	Feb-81	Apr-81	292,380	Outer	292,380	M	Maintenance
1983	Feb-83	Mar-83	278,506	Outer	278,506	M	Maintenance
1985	Oct-85	Dec-85	403,793	Outer	403,793	M	Maintenance
1988	Feb-88	Apr-88	333,930	Outer	103,000	N	Maintenance
					137,860	M	Maintenance
					93,070	S	Maintenance
1990-91	Dec-90	Apr-91	458,793	Outer	24,749	N	Maintenance
					262,852	M	Maintenance
					171,192	S	Maintenance
1992	Feb-92	Apr-92	125,976	Outer	125,976	M	Maintenance
1993	Feb-93	Apr-93	115,395	Outer	115,395	M	Maintenance
1993-94	Dec-93	Apr-94	158,996	Outer	74,825	N	Maintenance
					37,761	M	Maintenance
					46,410	S	
1995-96	Sep-95	Apr-96	443,130	Outer	106,416	N	Maintenance
					294,312	M	
					42,402	S	
1997	Sep-97	Nov-97	197,342	Outer	197,342	M	Maintenance

Table 1. Continued

Dredging And Disposal History							
Year	Dredging				Disposal	Comments	
	Date		Volume(yds³)	Basin Dredged	Volume (yd³)	Location Placed 1	
	Start	Finish					
1998	Dec-97	Feb-98	60,962	Middle	60,962	M	Modification dredging
	Feb-98	Feb-99	498,736	Inner	370,297	M	Modification dredging
					128,439	S	
1999	Feb-99	May-99	202,530	Outer	202,530	N	Maintenance
2000-01	Nov-00	Apr-01	429,084	Outer	142,000	N	Maintenance
					202,084	M	
					85,000	S	
2002	Sept02	Dec 02	190,600		190,600	M	Maintenance
Total			11,482,966		11,482,966		

N = North Beach
M = Middle
S = South Beach

coefficient of determination (R-squared) is 0.68 for the cooling water relation and 0.60 for the sand influx relation, the scatter in the data about the best fit lines is due to several transient external factors. The cooling water relationship is effected by weather events and variations in climate patterns, especially the occurrence of warm humid El Niño (ENSO) events that result in protracted heat waves, increasing user demand for power to cool homes and work places. The sand influx relationship is similarly impacted since these same ENSO events also correlate with intensification of wave climate, accelerated beach erosion and transport; and consequently more suspended sediment in the neighborhood of the lagoon inlet to be entrained by the net inflowing stream. However, the sand influx rates are further impacted by beach nourishment activities up-drift of the

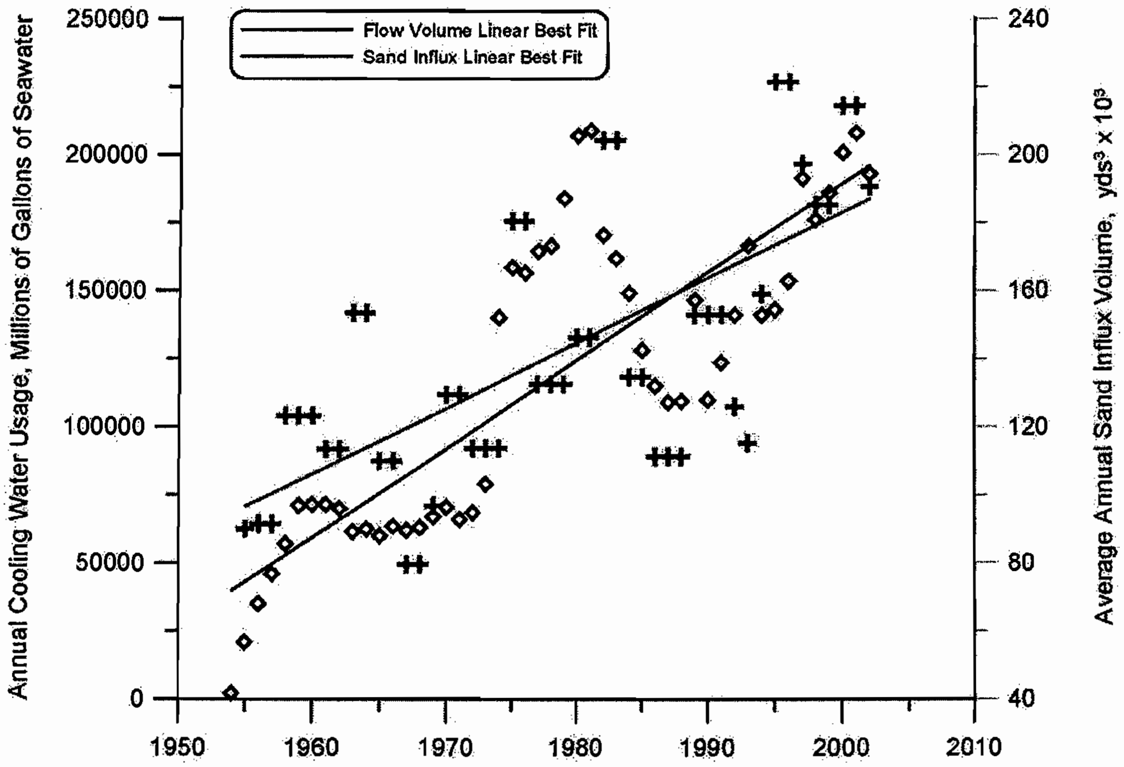

Figure 5. Time history of annual Encina cooling water usage and average annual sand influx from dredged volume for the years 1954-2002, [data from Jenkins and Wasyl, 1998 and 2003].

lagoon. Beach nourishment activities up-drift of Agua Hedionda are seen to have roughly doubled the daily influx rates to 400-600 cubic yards per day, as occurred following beach building projects in 1963, 1973, 1982, 1994 and 2001. Because of the transient impacts of beach restoration on sand influx rates, the coefficient of determination for the sand influx relation in Figure 5 is less than that for the cooling water flow rate relation. For a more detailed account of the effects of regional beach nourishment projects on sand influx rates at Agua Hedionda, see Appendix A.

2.2) Effects of Reduced Flow Operations on Sedimentation: From the flow rate and influx rate relations in Figure 5, we conclude that, on average, the lagoon presently traps 184,724 yds^3 of sand per year in response to an average daily once-through plant flow rate of 528.69 mgd. Probability analysis of inlet closure in Jenkins and Wasyl (1997,

2001) finds that the accumulated risk of inlet closure grows at 11% per year for sand influx rates of this magnitude, making inlet closure more probable than not within 4.5 years if no maintenance dredging is performed. In view of this risk, the historic dredge record in Table 2 shows that the longest interval between dredge events has been 3 years, and the predominant dredge interval has been 2 years. With in-house dredge assets home ported inside the lagoon, mobilization costs have been held to a minimum and marginal dredge costs have been running about $2.70 per cubic yard (Dyson, 2006). Thus, the costs of maintaining an open inlet (and hence, a healthy lagoon) under the present power generation operating scenario is about $499,000 per year.

If the flow rate is reduced to 304 mgd under the scenario of a stand-alone desalination plant, then the linear best fits in Figure 5 indicate that the average sand influx rates into the lagoon would be reduced to 106,218 yds^3 per year. This represents a 42.5% reduction in sand influx rates into the lagoon relative to the present power generation operating scenario. The reduction in sand influx rates reduces the accumulation of closure risk to only 6.3% per year, extending the safe interval for no dredge maintenance to 7.9 years before inlet closure would become more likely than not. Assuming the present marginal dredge cost of $2.70 per cubic yard, the annual cost of maintaining an open inlet under the reduced flow scenario would be $287,000 per year. Not factored into these cost comparisons are the costs of obtaining dredge permits and providing the pre- and post-dredging surveys and documentation necessary to obtain those permits. Dredge permits must be obtained from the City of Carlsbad, the California Coastal Commission, and the US Army Corps of Engineers on a year-to-year basis, as no blanket permits are currently issued.

Although the reduced flow rate scenario will reduce the rate of sand influx into the lagoon, it is clear that some degree of maintenance dredging must be continued for the indefinite future by whatever enterprise continues to use the lagoon for source water. While inlet closure becomes more probable than not after 7.9 years under the low flow rate scenario, it is a virtual certainty within 15 years in the absence of any form of maintenance dredging. Closure would be the consequence of about 840,000 cubic yards of sand being trapped in the west basin of the lagoon (Jenkins and Wasyl,1997, 2001), representing a permanent loss to the beaches down-drift of the lagoon. The magnitude of this loss (representing about 50% of the sand yield from the Bataquitos Lagoon Restoration) is quite significant to the down-drift beaches in Leucadia and Encinitas where chronic beach erosion has been the focus of public concern for many years. In addition to the beach impacts, inlet closure at Agua Hedionda would cause a precipitous drop in dissolved oxygen in lagoon waters (possibly even anaerobic) and a progressive transformation to hyper-saline conditions that would devastate the existing food web and related aqua culture. In time, the interior portions of the lagoon would in-fill with up-land sediments and be transformed back into the ephemeral system of marsh channels depicted in Figure 3. Hence, continued maintenance dredging of the west basin of the lagoon is vital for the continued health of the lagoon, as well as for the stability of the down-drift beaches and shoreline. The decisive question in the context of the reduced flow rate scenario is how frequently dredging should be performed.

If the presently practiced bi-annual/tri-annual dredge cycle is continued under the reduced flow rate scenario, the dredge volume will be on average 42.5 % smaller. This is a significant benefit to local beach stability (since less sand will be scavenged by the inflow from the local beach volume for any given 2 or 3 year period). However a bi-annual/tri-annual dredge cycle under reduced flow rate operations will raise the costs of maintaining an open inlet because mobilization/demobilization costs per cubic yard of dredged material will increase, and these are a major component of the total marginal dredge costs. A reasonable alternative is to base dredge scheduling on an equivalent dredge volume (~ 300 to 400 thousand cubic yards) as practiced under the existing bi-annual/tri-annual cycle, since these quantities when held and released from the lagoon appear to have an acceptable degree of impact on local beaches under present dredge permit conditions. Given these parameters, the dredge interval under the reduced flow rate scenario could be extended to once every 4 to 5 years, where rounding to nearest year gives:

$$\frac{(2yr \quad to \quad 3yr)(184{,}724 yds^3/yr)}{106{,}218 yds^3/yr} \cong 4yr \quad to \quad 5yr \qquad (1)$$

By extending the dredge cycle for low flow operations, the west basin of the lagoon will exist in a partially shoaled condition for a longer period of time. In this condition, the inlet sill depth is reduced and the inlet flow stream must proceed through constricted equilibrium tidal channels around the inlet bar. The flood flow channel forms along the north-west bank of the west basin immediately east of the HWY 101 bridge, while the ebb channel forms along the opposite bank with the inlet bar bedform lying in between. Typical morphology for this shoaled condition is shown in Figure 6 (taken from the pre-dredge survey of the west basin on 12 October 2002, prior to the 2002 maintenance dredging event). The constricted channels and reduced sill depth prevent the lagoon from fully draining during lower-low tide levels and induce hydraulic losses to friction and turbulence. These effects are referred to as *tidal muting* and reduce the tidal range throughout the interior of the lagoon system. With reduced tidal range, there is typically a reduction in inter-tidal habitat and a shift in the mix of habitat types.

3.0) Effects of Low Flow and Inlet Sedimentation on Tidal Hydraulics

To quantify potential effects associated with protracted periods of operations with a partially shoaled inlet, we perform tidal hydraulic simulations using the west bathymetry from Figure 6. The TIDE_FEM tidal hydraulics model presented in Jenkins and Inman (1999) was gridded for a computational mesh of Agua Hedionda Lagoon as shown in Figure 7, using pre- and post dredging bathymetry from the 2002 dredge event from Jenkins and Wasyl (2003). The pre-dredging bathymetry featured the inlet bar in the west basin that was mapped during the October 2002 sounding shown in Figure 6. The post-dredging survey performed in April 2003 indicated uniform deep water throughout the west basin with depths ranging from -20 ft NGVD to – 30ft NGVD, similar to that found in Figure 2-2 of Elwany, et al (2005). The lagoon model was excited at the ocean inlet by the 4.5 year maximum spring tides derived from tidal harmonic constituents for the Scripps Pier tide gage (NOAA Station #941-0230). These tides provide an assessment of the maximum tidal range effects of the pre- and post-dredging bathymetry.

Figure 8 shows how the inlet bar formation in the pre-dredging bathymetry (green) reduces the tidal range in the east basin of the lagoon relative to the tidal response for the post-dredging bathymetry (red) when that bar formation has been removed. The primary effect of the inlet bar on tidal range is to limit the degree to which the lagoon can drain during low tide. In the pre-dredge condition the lower-low water level only drops to -2.7 ft NGVD, as compared to a LLW of -4.0 ft NGVD in the post-dredge condition

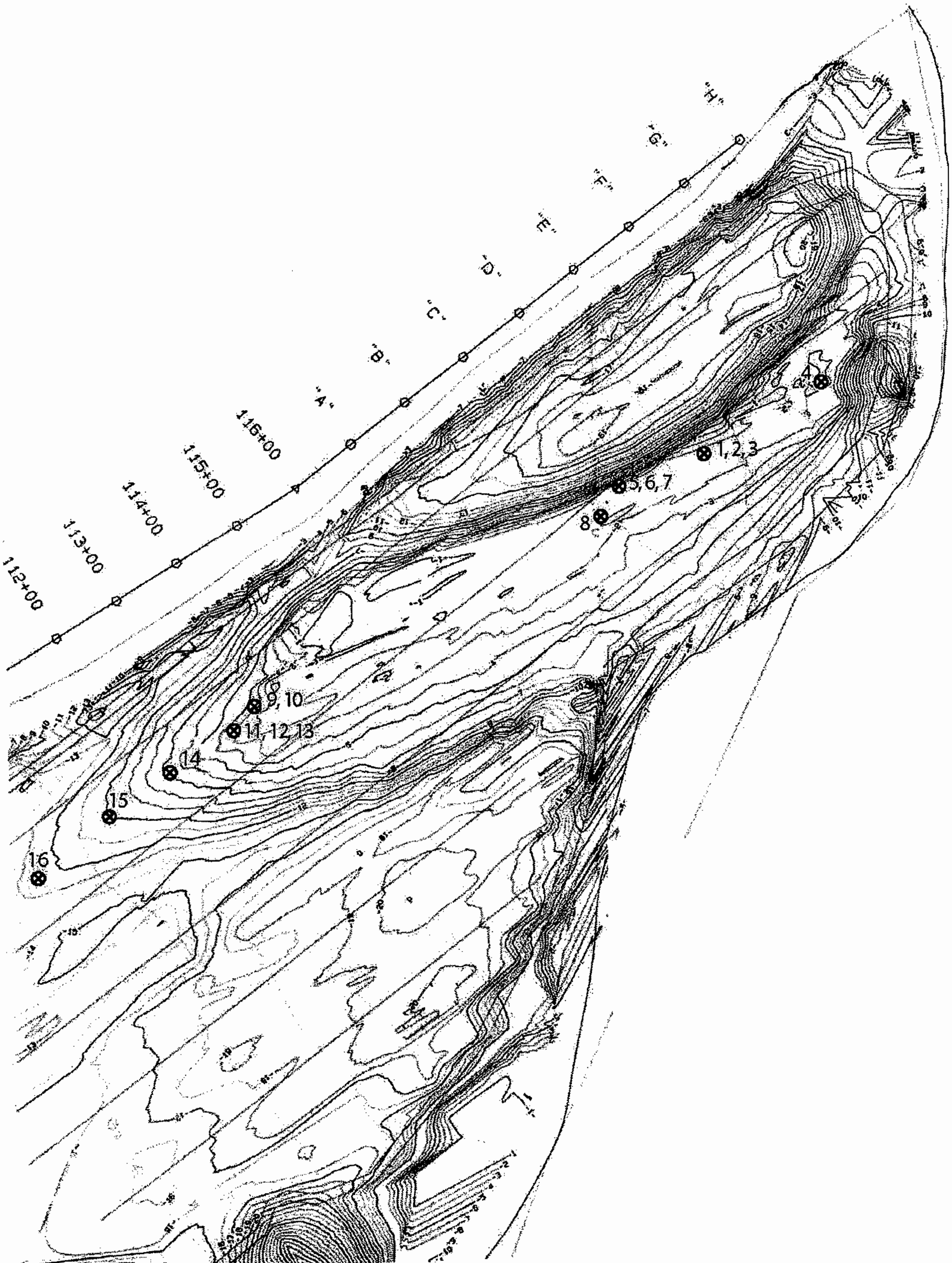

Figure 6. Location key for 12 October 2002 bottom sediment sampling.

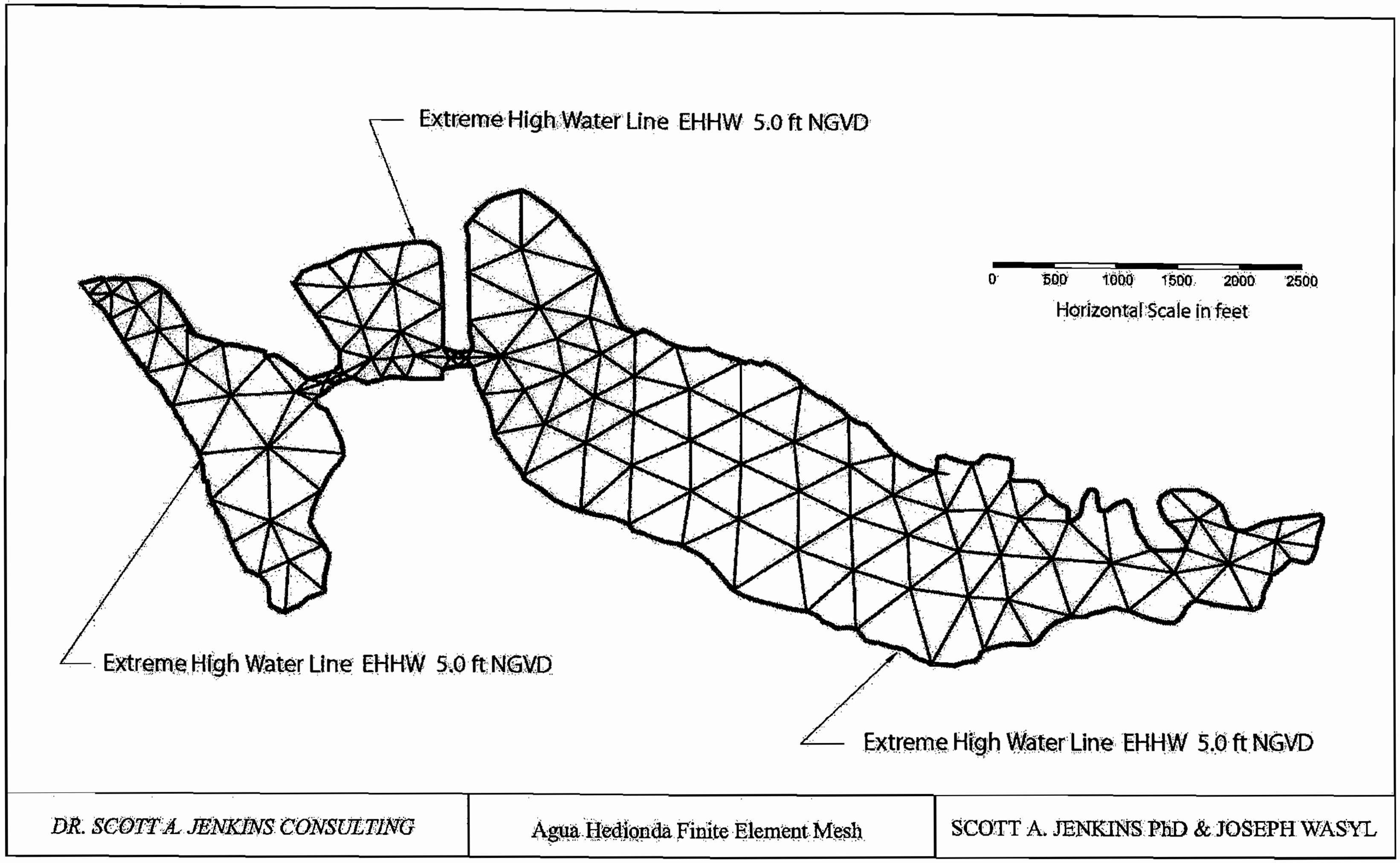

Figure 7. Computational mesh for TIDE_FEM tidal hydraulics model of Agua Hedionda Lagoon.

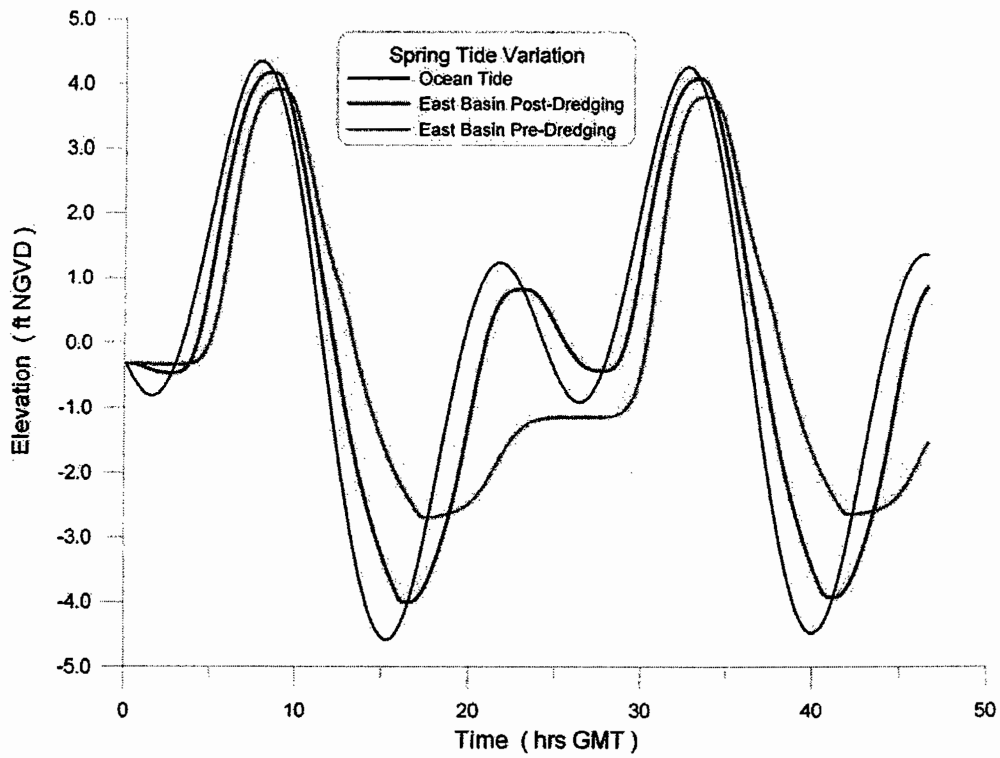

Figure 8. Effect of sedimentation on lagoon tidal range. Pre-dredging tide variation in East Basin (green); Post-dredging tides (red). Pre- and post- dredging tidal variations from TIDE_FEM simulation using ocean tides. Pre-dredging bathymetry from Jenkins & Wasyl 2003.

when the sill caused by the inlet bar is removed. The constricted inlet channels around the inlet bar also cause some muting of the higher-high water levels due to frictional losses and phase lags, with HHW for the pre-dredge condition reaching +3.9 ft NGVD as compared with +4.1 ft NGVD for HHW in the post-dredge condition. Altogether the inlet bar formation reduces the maximum diurnal tidal range by as much as 1.5 ft in the latter stages of west basin sedimentation prior to routine maintenance dredging.

To determine what effect the inlet bar exerts on lagoon habitat, we superimpose the diurnal tidal ranges obtained from hydraulic modeling on the area and volume rating functions of the lagoon derived from recent lagoon surveys by Elwany, et al (2005). Figure 9a shows that the maximum inter-tidal acreage of Agua Hedionda Lagoon is 107.9 acres due to spring tides acting on post-dredge bathymetry with no inlet bar formation. Sub-tidal acreage is 221.4 acres, giving a total lagoon habitat acreage of 329.3 acres post-maintenance dredging. Later, when shoaling develops in the west basin and a pronounced inlet bar forms, the tidal range is reduced throughout the lagoon and the maximum inter-tidal habitat is reduced by 32.9 acres to 75 acres, as indicated by the pre-dredging assessment in Figure 10a. Sub-tidal acreage is increased by 14.6 acres to 236 acres, because the reduced sill depth over the inlet bar restricts the ability of the lagoon to drain on a falling tide (Figure 8). Tidal muting of the higher-high water levels reduces the total lagoon habitat by 18.8 acres to 311 acres.

Consequently, a cyclical variation in the amount and proportions of lagoon habitat occurs throughout each dredge cycle, with the total lagoon habitat gradually declining by 5.7% following a post-dredging maximum, and reaching a minimum immediately before the mobilization of the next maintenance dredge event. This cyclical variation manifests itself most strongly in the inter-tidal habitat regime, where the habitat acreage declines by 30.5% following a post-dredging maximum. On the other hand, the sub-tidal habitat that supports the lagoon's fisheries varies inversely, with a post-dredging minimum followed by a gradual increase of as much as 6.5% prior to mobilization of the next maintenance dredge event. These variations are already built into the ecology of the present day lagoon and occur gradually enough over the existing bi-annual/tri-annual dredge cycle that significant impacts to that ecology have not been observed. What the reduced flow rate operations of a stand-alone desalination plant would do is extend the period of these variations by another 1 or 2 years (assuming the equivalent dredge volume policy of the previous section is adopted). The magnitude of the cyclical habitat variations would be the same, but those variations would evolve more slowly in time, thereby reducing the rate of cyclical decline of inter-tidal habitat and the rate of growth of sub-tidal habitat. This would give the lagoon ecology a longer response time to adapt to those cyclical changes, and presumably reduce the potential for any adverse consequences that have not yet been identified in the literature.

The other important effect of the inlet bar formation and attendant dredge cycle is on the volume exchange that occurs between the ocean and the lagoon and the residence time of water in the lagoon. Figure 9b finds that the maximum diurnal tidal prism for the post-dredge bathymetry (no inlet bar) is 2,286 acre ft. This result obtained by hydraulic simulation for the 4.5 yr spring tide maximums agrees closely with the result of 2125

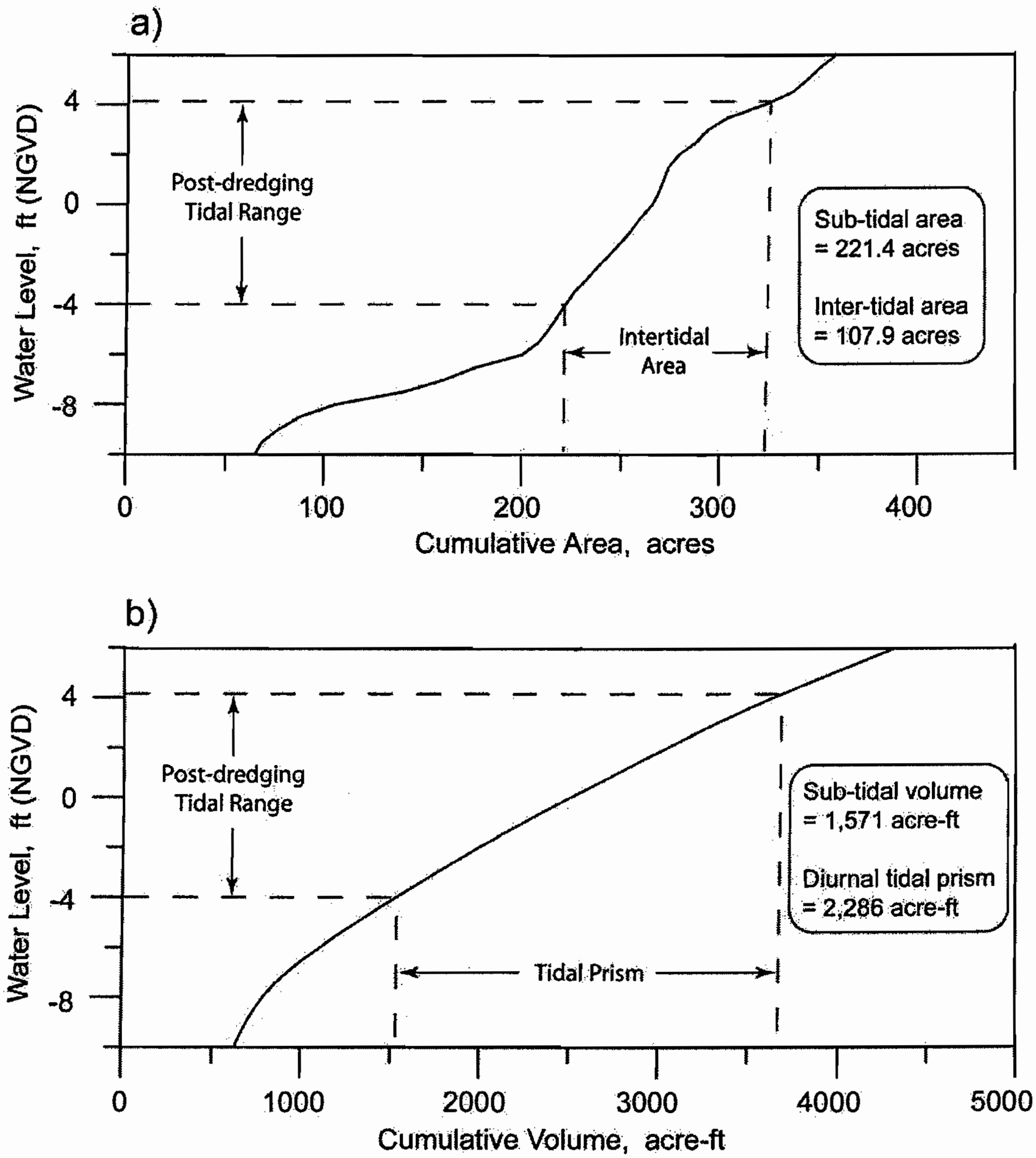

Figure 9. Post-dredging tidal hydraulics with West Basin inlet bar removed: a) Sub-tidal area and intertidal area during spring tide; b) Sub-tidal volume and diurnal tidal prism. Wetted area and volume function from Elwany et al., (2005).

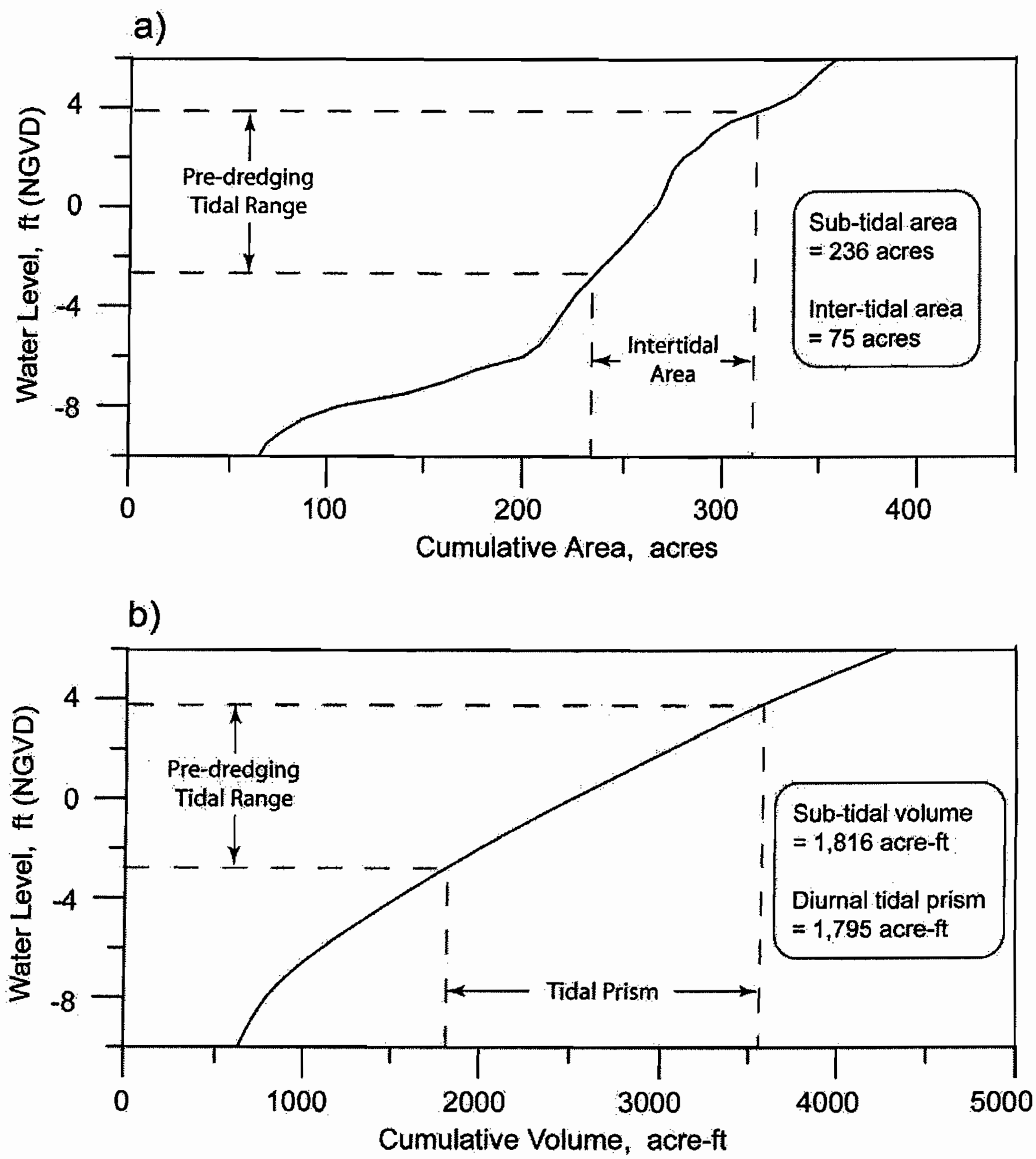

Figure 10. Pre-dredging tidal hydraulics with West Basin inlet bar per Figure 6: a) Sub-tidal area and intertidal area during spring tide; b) Sub-tidal volume and diurnal tidal prism. Wetted area and volume function from Elwany et al., (2005).

acre-ft obtained by water level measurements during spring tides in June 2005, as reported in Elwany (2005). This small discrepancy can be attributed to the larger tidal range of the ocean tides used in the hydraulic simulation in Figure 8. The hydraulic simulation in Figure 10b for the pre-dredge conditions (with well developed inlet bar) finds that the maximum diurnal tidal prism is reduced by 491 acre-ft to 1,795 acre-ft.

Thus, the west basin sedimentation diminishes the maximum diurnal prism of the lagoon by 21.5% over the course of a dredge cycle, and nearly 70% of this loss occurs in the east basin of the lagoon. Because the mass exchange between the east basin and the remainder of the lagoon is purely tidal in nature, the loss of tidal prism due to west basin sedimentation will impact the residence time of water in the highly productive east basin habitat zones. Figure 11 presents the water mass exchange rating functions of the east basin for pre- and post-dredging bathymetry. The hydraulic simulation (black) for the post-dredge bathymetry (with no inlet bar formation) gives a residence time of 3.7 days for water in the east basin. Here, residence time is taken as that point on the exchange rating curve when the percentage of old water declines to 2%. This compares with a mean value of 3.2 days reported in Elwany et al (2005) based on water level and velocity measurements over a one month period in June 2005. This is regarded as an insignificant difference that could easily be explained by differences between the 2003 bathymetry used in the hydraulic simulation versus the 2005 bathymetry that prevailed in the 2005 field measurements of Elwany et al (2005). With the reduction of tidal prism caused by the inlet bar formation, the residence time in the east basin is increased by 1 day to 4.7 days for pre-dredge bathymetry. Hence, the residence time in the largest basin of the lagoon experiences a cyclical increase of 27% of the course of the presently practiced bi-annual/tri-annual dredge cycle. This variation is not viewed to be significant as the residence time remains relatively short and oxygen deficiency or anoxic conditions have never been reported under present dredge practices. The effect of the of reduced flow operations of a stand alone desalination plant will not change the magnitude of this cyclical variation since mass exchange between the east and west basins is purely tidal. However, increasing the length of dredge cycle by 1 or 2 years under the reduced flow rate will increase the period of the residence time cycle by an equivalent duration.

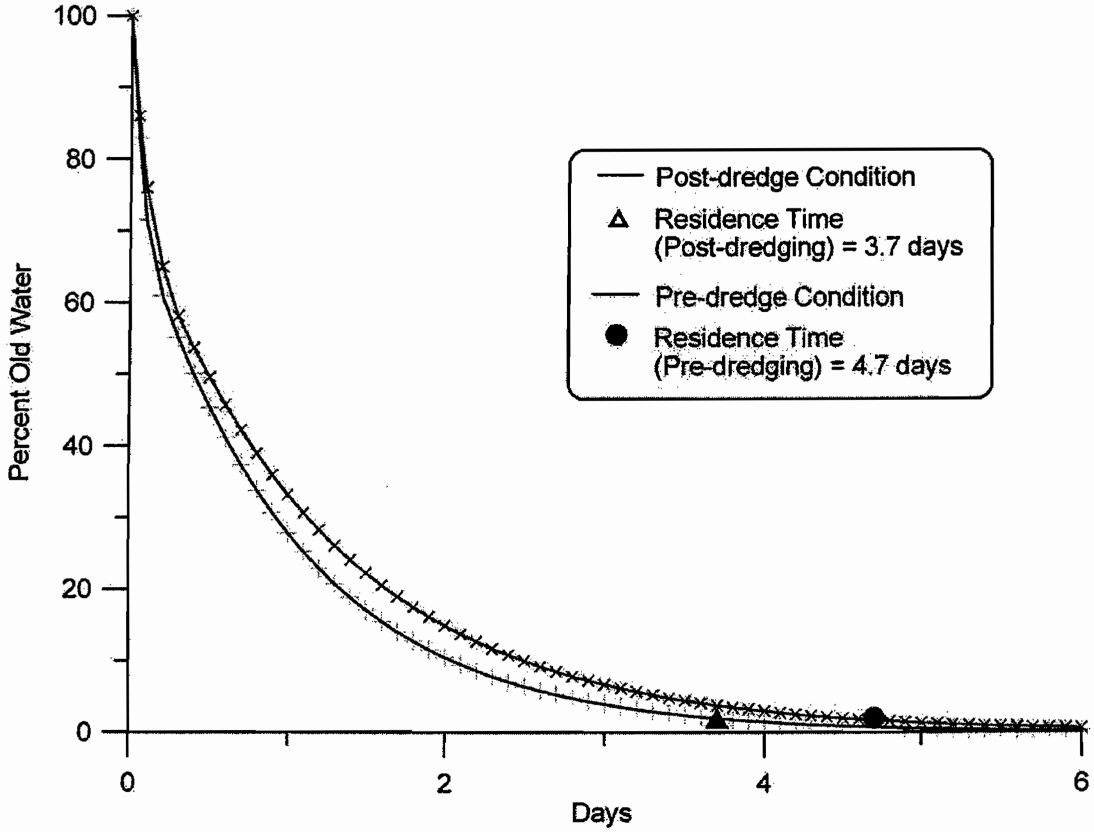

Figure 11. Water mass exchange rating function and residence time in the East Basin of Agua Hedionda Lagoon for pre-dredge (red) and post-dredge (black) bathymetry.

The effect of this longer cycle period, again, slows the rate at which biology must adapt to the cyclical increases residence time.

Reduced flow operations will affect the fluxes of nutrients and oxygen into the west basin. As commented in Section 2.2, fluxes of nutrients adsorbed to the surfaces of suspended sediment that enter the lagoon through the ocean inlet will be reduced by 42.5% under the low flow rate scenario. However, most of these sediments are sand sized and carry little if any nutrient load. The predominant nutrient load entering the lagoon through the ocean inlet is in the form of neutrally buoyant organisms and organic particles, colloids, and dissolved organic matter and oxygen. These constituents are fluxed with the inflow stream, and will be reduced by lower once-through flow rates through the plant, or by diminished tidal prism through the tidal muting effects of the inlet bar.

Elwany et al (2005) determined that on average, 46% of the daily inflow stream through the inlet was due to the power plant cooling water consumption based on water level and velocity measurements during the 5 week period between 1 June 2005 and 7 July 2005. Taking an average power plant flow rate during that period of 529 mgd and an average tidal prism of 1,700 acre ft, the flux balance obtained from this finding indicates that only 29% of the daily inflow volume would be due to the plant's circulation pumps under a low flow rate assumption of 304 mgd. This flow rate reduction would reduce the daily volume flux of new water and dissolved nutrients into the lagoon by 10.1%. However, the plants impact on dissolved nutrient influx becomes less during spring tides when a larger fraction of the inflow stream is due to pure tidal exchange (see Figure 1). The hydraulic model simulations for tidal exchange during spring tides with the post-dredge bathymetry (red line, Figure 8) indicate that only 36.4% of the daily inflow of new water is due to the power plant operating at its average annual flow rate of 529 mgd. If the plant flow rate is dropped to 304 mgd under the low flow rate scenario, then 22.7% of the daily inflow during spring tides (post-dredging) is due to the action of circulation pumps, and the nutrient flux will be reduced by 8% relative to present average pumping rates during power generation. When the west basin is in a pre-dredge configuration with a well developed inlet bar, the spring tide daily nutrient flux into the lagoon is reduced by 17.4% under present average flow rates of 529 mgd, and by 18.9% under the low flow scenario (304 mgd). Hence, inlet sedimentation and cyclical dredging causes a greater reduction on nutrient flux than would the reduction in plant flow rate under the low flow scenario of a stand alone desalination plant.

Summary and Conclusions:

Coastal processes and tidal hydraulic effects arising from reduced once-through flow rates at the Encina Generating Station, Carlsbad, CA are evaluated in the context of stand-alone operations of a co-located desalination plant. Stand alone desalination involves a once through flow rate of 304 mgd at the intake structure located at the southern end of the west basin of Agua Hedionda Lagoon. This flow rate would limit end-of-pipe salinity to no more than 40 ppt. The existing cascade of circulation and service water pumps available at Encina Generating Station can provide a maximum once-through flow rate of 808 mgd, but averages about 530 over the long term. Thus the flow rates passing through the Encina facility during stand-alone desalination operations would be about 43% less than the present average when power generation is occurring, and 62% less than the peak flow rate capability.

If the flow rate is reduced to 304 mgd under the scenario of a stand-alone desalination plant, then dredge records indicate that the average sand influx rates into the lagoon through the ocean inlet would be reduced to 106,218 yds^3/yr from a present rate of 184,724 yds^3/yr. This represents a 42.5% reduction in sand influx rates into the lagoon relative to the present power generation operating scenario. The reduction in sand influx rates reduces the accumulation of inlet closure risk to only 6.3% per year, extending the safe interval for no dredge maintenance to 7.9 years before inlet closure would become more likely than not. Assuming the present marginal dredge cost of $2.70 per cubic yard, the annual cost of maintaining an open inlet under the reduced flow scenario would be $287,000 per year as compared to present maintenance costs of $499,000 per year. If dredge scheduling is based on an equivalent dredge volume (to minimize beach impacts) as practiced under the existing bi-annual/tri-annual cycle, the dredge interval under the reduced flow rate scenario could be extended to once every 4 to 5 years.

Under existing conditions with high flow rate power generation activity, a cyclical variation in the amount and proportions of lagoon habitat occurs throughout each dredge cycle, with the total lagoon habitat gradually declining by 5.7% following a post-dredging maximum, and reaching a minimum immediately before the mobilization of the next maintenance dredge event. This cyclical variation manifests itself most strongly in the inter-tidal habitat regime, where the habitat acreage declines by 30.5% following a post-dredging maximum. On the other hand, the sub-tidal habitat that supports the lagoon's fisheries varies inversely, with a post-dredging minimum followed by a gradual increase of as much as 6.5% prior to mobilization of the next maintenance dredge event. These variations are already built into the ecology of the present day lagoon and occur gradually enough over the existing bi-annual/tri-annual dredge cycle that significant impacts to that ecology have not been observed. What the reduced flow rate operations of a stand-alone desalination plant would do is extend the period of these variations by another 1 or 2 years (assuming the equivalent dredge volume policy as stated above). The magnitude of the cyclical habitat variations would be the same, but those variations would evolve more slowly in time, thereby reducing the rate of cyclical decline of inter-tidal habitat and the rate of growth of sub-tidal habitat. This would give the lagoon ecology a longer response time to adapt to those cyclical changes.

The dredge cycle under existing high flow rate operations also impacts the volume exchange that occurs between the ocean and the lagoon, causing a cyclical variation in the residence time of water in the lagoon. West basin sedimentation diminishes the maximum diurnal prism of the lagoon by 21.5% over the course of a dredge cycle, and nearly 70% of this loss occurs in the east basin of the lagoon. With the reduction of tidal prism caused by the inlet bar formation, the residence time in the east basin is increased by 1 day to 4.7 days. Hence, the residence time in the largest basin of the lagoon experiences a cyclical increase of 27% over the course of the presently practiced bi-annual/tri-annual dredge cycle. This variation is not viewed to be significant as the residence time remains relatively short and oxygen deficiency or anoxic conditions have never been reported under present dredge practices. The effect of the of reduced flow operations of a stand alone desalination plant will not change the magnitude of this cyclical variation since mass exchange between the east and west basins is purely tidal. However, increasing the length of dredge cycle by 1 or 2 years under the reduced flow rate scenario will increase the period of the residence time cycle by an equivalent duration. The effect of this longer cycle period, again, slows the rate at which biology must adapt to the cyclical increases residence time.

Reduced flow operations will affect the fluxes of nutrients and oxygen into the west basin. Flow rate reductions to 304 mgd would reduce the average daily volume flux of new water and dissolved nutrients into the lagoon by 10.1%, (assuming a mean tidal range). However, the plant's impact on dissolved nutrient influx becomes less during spring tides when a larger fraction of the inflow stream is due to pure tidal exchange. Under the low flow rate scenario, nutrient flux will be reduced by 8% relative to present average pumping rates during power generation. When the west basin is in a pre-dredge configuration with a well developed inlet bar, the spring tide daily nutrient flux into the lagoon is reduced by 17.4% under present average flow rates of 529 mgd, and by 18.9% under the low flow scenario (304 mgd). Hence, inlet sedimentation and cyclical dredging causes a greater reduction on nutrient flux than would the reduction in plant flow rate under the low flow scenario of a stand alone desalination plant.

In conclusion, the reduced flow rate operations of a stand alone desalination plant co-located at Encina Generating Station will reduce the capture rates of littoral sediment that presently occur under higher flow rates associated with power generation, thereby reducing the environmental impacts associated with maintenance dredging. Reduced flow rate operations will not increase the magnitude of cyclical variations in habitat or residence time that presently occur throughout each maintenance dredge cycle, but will increase the length of time over which those variations occur. Low flow rate operations will result in reductions of 8% to 10% in the fluxes dissolved nutrients and oxygen into the lagoon through the ocean inlet, but this effect is relatively minor in comparison to the 17.4% decline in nutrient flux that occurs in the latter stages of each dredge cycle. On balance, low flow operations do not appear to create any significant adverse impacts on either the lagoon environment or the local beaches; and it could be argued that the reduction in capture rates of littoral sediment is a project benefit.

Bibliography

Abbott, M. B., A. Damsgaard and G. S. Rodenhuis, 1973, ASystem 21, Jupiter,@ *Jour. Hydraulic Res.*, v. 11, n. 1.

Connor, J. J. and J. D. Wang, 1973, AFinite element modeling of two-dimensional hydrodynamic circulation,@ *MIT Tech. Rpt.*, #MITSG 74-4, p. 1-57.

Elwany, M. H. S., A. L. Lindquist, R. E. Flick, W. C. O'Reilly, J. Reitzel and W. A. Boyd, 1999, "Study of Sediment Transport Conditions in the Vicinity of Agua Hedionda Lagoon," submitted to California Coastal Commission, San Diego Gas & Electric, City of Carlsbad.

Elwany, M. H. S., R. E. Flick, M. White, and K. Goodell, 2005, "Agua Hedionda Lagoon Hydrodynamic Studies," prepared for Tenera Environmental, 39 pp. + appens.

Ellis, J.D., 1954, "Dredging Final Report, Agua Hedionda Slough Encina Generating Station," San Diego Gas and Electric Co., 44pp.

Gallagher, R. H., 1981, *Finite Elements in Fluids*, John Wiley & Sons, New York, 290 pp.

Inman, D. L., M. H. S. Elwany and S. A. Jenkins, 1993, "Shorerise and bar-berm profiles on ocean beaches," *Jour. Geophys. Res.*, v. 98, n. C10, p. 18,181-199.

Inman, D. L. & S. A. Jenkins, 1999, "Climate change and the episodicity of sediment flux of small California rivers," *Jour. Geology*, v. 107, p. 251–270.

Inman, D. L. & S. A. Jenkins, 2004, "Scour and burial of objects in shallow water," p. 1020–1026 in M. Schwartz, ed., *Encyclopedia of Coastal Science*, Kluwer Academic Publishers, Dordrecht, Netherlands.

Jenkins, S. A. and D. W. Skelly, 1988, "An Evaluation of the Coastal Data Base Pertaining to Seawater Diversion at Encina Power Plant Carlsbad, CA," submitted to San Diego Gas and Electric, Co., 56 pp.

Jenkins, S. A., D. W. Skelly, and J. Wasyl, 1989, "Dispersion and Momentum Flux Study of the Cooling Water Outfall at Agua Hedionda," submitted to San Diego Gas and Electric, Co., 36 pp. + appens.

Jenkins, S. A. and J. Wasyl, 1993, "Numerical Modeling of Tidal Hydraulics and Inlet Closures at Agua Hedionda Lagoon," submitted to San Diego Gas and Electric, Co., 91 pp.

Jenkins, S. A. and J. Wasyl, 1994, "Numerical Modeling of Tidal Hydraulics and Inlet Closures at Agua Hedionda Lagoon Part II: Risk Analysis," submitted to San Diego Gas and Electric, Co., 46 pp. + appens.

Jenkins, S. A. and J. Wasyl, 1995, "Optimization of Choke Point Channels at Agua Hedionda Lagoon using Stratford Turbulent Pressure Recovery," submitted to San Diego Gas and Electric, Co., 59 pp.

Jenkins, S. A. and J. Wasyl, 1997, "Analysis of inlet closure risks at Agua Hedionda Lagoon, CA and potential remedial measures, Part II," submitted to San Diego Gas and Electric, Co., 152 pp. + appens.

Jenkins, S. A. and J. Wasyl, 1998a, Analysis of Coastal Processes Effects Due to the San Dieguito Lagoon Restoration Project: Final Report, submitted to Southern California Edison Co., 333 pp.

Jenkins, S. A. and J. Wasyl, 1998b, Coastal Processes Analysis of Maintenance Dredging Requirements for Agua Hedionda Lagoon, submitted to San Diego Gas and Electric Co., 176 pp. + appens.

Jenkins, S. A. and D. L. Inman, 1999, A Sand transport mechanics for equilibrium in tidal inlets, *Shore and Beach*, vol. 67, no. 1, pp. 53-58.

Jenkins, S. A. and J. Wasyl, 2001, Agua Hedionda Lagoon North Jetty Resoration Project: Sand Influx Study, submitted to Cabrillo Power LLC., 178 pp. + appens.

Jenkins, S. A. and J. Wasyl, 2003, Sand Influx at Agua Hedionda Lagoon in the Aftermath of the San Diego Regional Beach Sand Project, submitted to Cabrillo Power LLC., 95 pp. + appens

Jenkins, S. A. and J. Wasyl, 2005, Hydrodynamic Modeling of Dispersion and Dilution of Concentrated Sea Water Produced by the Ocean Desalination Project at the Encina Power Plant, Carlsbad, CA. Part II: Saline Anomalies due to Theoretical Extreme Case Hydraulic Scenarios, submitted to Poseidon Resources, 97 pp.

Jenkins, S. A. and D. L. Inman, 2006, "Thermodynamic solutions for equilibrium beach profiles", *Jour. Geophys. Res.*, v.3, C02003, doi:10.1029, 21pp.

Leendertse, J. J., 1970, AA water quality model for well-mixed estuaries and coastal seas,@ vol. I, *Principles of Computation*, Memorandum RM-6230-RC, The Rand Corporation, Santa Monica, California, Feb.

Liebeck, R. H., 1976, "On the design of subsonic airfoils of high lift," paper no. 6463, McDonnell Douglas Tech. Report, 25 pp.

Liebeck, R.H., and Ormsbee, A.I., "Optimization of Airfoils for Maximum Lift," *AIAA*

Journal of Aircraft, v. 7, n. 5, Sept-Oct 1970.

McCormick, B., 1979, *Aerodynamics, Aeronautics and Flight Mechanics*, John Wiley & Sons, New York, 652 pp.

NOAA, 1998, AVerified/Historical Water Level Data@ http://www.opsd.nos.noaa.gov/data_res.html

Stratford, B.S., 1959, The Prediction of Separation of the Turbulent Boundary Layer, *Jour. Fluid Mech.*, v. 5.

Stratford, B.S., 1959, An Experimental Flow with Zero Skin Friction Throughout its Region of Pressure Rise, *Jour. Fluid Mech.*, v. 5.

Weiyan, T., 1992, *Shallow Water Hydrodynamics*, Water & Power Press, Hong Kong, 434 pp.

APPENDIX-A: Beach Nourishment Projects Near Agua Hedionda Lagoon

The lagoon prior to the late 1980's typically ingested 200-300 cubic yards per day unless major up-drift nourishment occurred along Oceanside and Carlsbad beaches. Table 3 gives a listing of all dredge disposal and beach nourishment activities occurring in the neighborhood of Agua Hedionda due to activities outside the lagoon's operation. Major beach building projects at Oceanside and Carlsbad were undertaken in 1963, 1973, 1982, 1994 and 2001. The most dramatic example of this updrift nourishment impact resulted from the massive beach nourishment projects in 1982 when 923,000 cubic yards of new sand was truck hauled from the San Luis Rey River and placed on Oceanside beaches. Coincidentally, the 1983-85 biannual maintenance dredging cycle of the west basin of Agua Hedionda yielded 447,464 cubic yards. This corresponded to an average daily influx rate of 613 cubic yards per day during that two year period. Such high daily influx rates had not been seen since 1960 when 841,200 cubic yards of beach nourishment was placed on Oceanside beaches following new construction dredging and enlargement of Oceanside Harbor facilities.

After the late 1980's there was only one minor new beach nourishment project in Oceanside, involving 40,000 cubic yards in 1994. However beginning in 1988, the City of Carlsbad imposed conditions requiring back-passing defined fractions of the Agua Hedionda dredge volume north of the inlet. In 1988, 103,000 cubic yards were back-passed from Agua Hedionda to North Beach (Figure 1), resulting in an influx of 458,793 cubic yards into Agua Hedionda Lagoon by 1990, for an influx rate of about 630 cubic yards per day. During 89 days of dredging operations between December 20, 1993 and April 26, 1994, there were 74,825 cubic yards placed immediately north (updrift) of the Agua Hedionda Lagoon and inlet jetty at the North Beach disposal site. The daily influx rate during this 89 day period rose to an average of 782 cubic yards per day. In 1996 there was 106,416 cubic yards of back-passing dredged sands from Agua Hedionda to North Beach and influx rates increased to 540 cubic yards per day in the year that followed. Although the volume of back-passing has been small relative to prior nourishment efforts in Oceanside, its effect on influx was large due to the close proximity of North Beach to the inlet of Agua Hedionda and the low retention of sand on this beach in the presence of rocky substrate immediately offshore, Elwany et al. (1999) .

Table 3: Dredge Disposal and Beach Nourishment Occurring Outside of Agua Hedionda Lagoon Operations

Year	Amt. Dredged (yd^3)	Material Source	Disposal Location	Comments
1942	500000	Del Mar Boat Basin	Increase grade around Boat Basin	Material was not placed on the beach
1944	200000	Entrance Channel	Upland	Material was not placed on the beach
1955	800,000	Harbor Construction	Oceanside Beach	Dredged Material
1960	41,000	Entrance Channel	Oceanside Beach	Dredged Material
1961	481,000	Channel	Oceanside Beach	Dredged Material
1963	3,800,000	Harbor	Oceanside Beach	1.4myd3 was new
1965	111,000	Entrance Channel	Oceanside Beach	Dredged Material
1966	684,000	Entrance Channel	2nd St.-Wisconsin St.	Dredged Material
1967	178,000	Entrance Channel	3rd St.-Tyson St.	Dredged Material
1968	434,000	Entrance Channel	River-Wilconsin St.	Dredged Material
1969	353,000	Entrance Channel	River-3rd	Dredged Material
1971	552,000	Entrance Channel	3rd-Wisconsin St.	Dredged Material
1973	434,000	Santa Margarita R.	Tyson-Wisconsin St.	New Material-Beach
1974	560,000	Entrance Channel	Tyson-Whitterby	Dredged Material
1976	550,000	Entrance Channel	Tyson-Whitterby	Dredged Material
1977	318,000	Entrance Channel	Tyson-Whitterby	Dredged Material
1981	403,000	Entrance Channel	6th St.-Buccaneer	Dredged Material
1981	403,000	Offshore Borrow Site	Oceanside Beach	Dredged Material
1982	923,000	San Luis Rey R.	Oceanside Beach	New Material-Beach
1983	475,000	Entrance Channel	Tyson Street	Dredged Material
1986	450,000	Entrance Channel	Tyson Street	Dredged Material
1988	220,000	Entrance Channel	Tyson Street	Dredged Material
1990	250,000	Entrance Channel	Tyson Street	Dredged Material
1992	106,700	Bypass System	Tyson Street	Dredged Material
1993	483,000	Modified Entrance	Tyson Street	Dredged Material
1994	40,000	Santa Margarita R.	Wisconsin St.	New Material-Beach
1994	161,000	Entrance Channel	Nearshore Wisconsin	Dredged Material
1994	150,000	Bataquitos Lagoon	Inlet South Side	New Material-Beach

Table 3: (continued)

Year	Amt. Dredged (yd ^{3})	Material Source	Disposal Location	Comments
1995	1,600,000	Bataquitos Lagoon	Ponto Beach	New Material-Beach
1996	162,000	Entrance Channel	Nearshore Wisconsin	Dredged Material
1997a	150,000	Entrance Channel	Nearshore Oceanside	
1997b	100,000	Entrance Channel	Wisconsin St.	Dredged Material
	17,316,700	**Total**		
	178,017	**Average (only including maintenance dredging)**		

Following the east basin dredge project, 202,530 cubic yards were back-passed to North Beach in April 1999. A dredge survey in July 2000 determined that 360,800 cubic yards had influxed into the lagoon, increasing the daily rate to an average of 846 cubic yards per day. Altogether the percentage of lagoon dredging that has been back-passed to North Beach averages 14.7% of the total dredge volume during the 1981-2000 model period. The remaining fraction of dredge volume that was not back-passed was divided between the Middle and South Beach disposal sites. This fraction was historically split in an 85% to 15% ratio between Middle and South Beach.

In 1994-95 a major beach building effort was conducted at Ponto Beach immediately to the south of Agua Hedionda, where 1,750,000 cubic yards of beach fill was placed using dredged material from the construction of the Bataquitos Lagoon Restoration. The most recent beach building project to impact Agua Hedionda was the San Diego Regional Beach Sand Project completed in September 2001. This project placed 1.83 million cubic yards of on beaches between Oceanside and Torrey Pines, of which 921,000 cubic yards were placed in the nearfield of Agua Hedionda. Within one year following completion of the 2001 maintenance dredging of the lagoon, it was necessary to dredge the lagoon again to remove an additional 196,000 cubic yards from the west basin of the lagoon, despite an extremely dry year with below normal wave climate. During this one year period, the average wave height was only 0.8 m, which in the absence of the San Diego Regional Beach Sand Project, should have produced a sand influx volume of only 103,500 cubic yards (Jenkins and Wasyl, 2003).

Table 3 indicates that, historically, sand influx rates rise dramatically in years during and immediately following beach nourishment activities in Oceanside or back-passing in Carlsbad. This is additional evidence to validate conclusions of Inman & Jenkins (1983) that longshore transport rate in this region is sand supply limited. In other words, there is more potential transport than the available sand supply can sustain. Any artificial intervention to increase up-drift sand supply will apparently increase longshore transport rates, and thereby increase the rate of sand influx into the lagoon.