POSEIDON WATER

Appendix K
Intake/Discharge Entrainment Analysis

Renewal of NPDES CA0109223
Carlsbad Desalination Project

CARLSBAD DESALINATION FACILITY: ENTRAINMENT ANALYSIS FOR DILUTION AND DISCHARGE OPTIONS

July 27, 2015

Technical Memorandum

POSEIDON WATER

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INTRODUCTION

The marine environment subject to interaction with Poseidon Resources' Carlsbad Desalination Facility (CDF) was extensively studied in recent years due to the operation of the once-through-cooled Encina Power Station (EPS). Subject to the Federal Clean Water Act Section 316(b), extensive ichthyoplankton surveys were conducted to calculate the EPS entrainment and its effects on the surrounding ecosystem (Tenera 2008). The EPS study sampled two distinct ecosystems (Agua Hedionda Lagoon and the nearshore open coast waters) on a nearly monthly frequency between June 2004 and May 2005. Within the lagoon, a total of 20,601 larval fish were taken with samples predominantly (90%) comprised of gobies and combtooth blennies (*Hypsoblennius* spp.). In particular, a three-species goby complex was the most common taxonomic group. The complex, named CIQ goby, included the Arrow Goby (*Clevelandia ios*), Cheekspot Goby (*Ilypnus gilberti*), and the Shadow Goby (*Quietula y-cauda*). In the open coastal waters offshore of Agua Hedionda, a total of 16,763 larval fish were caught, with 46% of the catch represented by anchovies (likely the Northern Anchovy *Engraulis mordax*). Combtooth blennies and the CIQ goby complex that dominated the lagoon were also relatively plentiful in coastal samples, accounting for a combined 17% of the total. White Croaker (*Genyonemus lineatus*), California Halibut (*Paralichthys californicus*), Queenfish (*Seriphus politus*), and Spotfin Croaker (*Roncador stearnsii*) were four additional species caught in relatively high abundance in the coastal sampling. Together, these four species contributed an additional 13% of the total catch.

The EPS study, and other studies produced in support of Poseidon's CDF permitting applications, was reviewed by Dr. Peter Raimondi, an independent scientist with prior experience evaluating entrainment studies on behalf of California State agencies including the California Energy Commission, California Coastal Commission, and the State Water Resources Control Board. The Coastal Commission retained Dr. Raimondi to advise on the development of the CDF Marine Life Mitigation Plan. In April 2008 Dr. Raimondi determined the EPS study, and Poseidon's use of the EPS study for the CDF, was consistent with the best available science with minor suggestions for improvement. He concluded that the study provided adequate data to determine the types and numbers of organisms that would be subject to entrainment. His strongest recommendation was for the inclusion of an error estimate in calculating mitigation for desalination intakes.

These prior EPS and CDF studies focused on seawater-intake entrainment and did not calculate potential entrainment resulting from the use of a multi-port diffuser discharge. The recently passed amendment to the California Ocean Plan (Appendix 1) provided multiple brine discharge options, each with specific conditions surrounding their usage. Each option has the goal of minimizing the salinity differences between the brine and ambient conditions at the edge of the mixing

zone. Two primary options include flow augmentation and multi-port diffusers. Each represents potential sources of added entrainment mortality.

When operational, the CDF will draw 127 million gallons per day (MGD) for potable water production. Approximately 60 MGD will be discharged as waste brine in need of dilution to ambient salinity in accordance with the Ocean Plan Amendment. The first dilution option, flow augmentation, is expected to require an additional 171 MGD to dilute the brine to ambient levels. This additional seawater withdrawal would be used to dilute the brine in the discharge conduit prior to discharging to the receiving waters. The multi-port diffuser option will discharge the expected 60 MGD of brine. Multi-port diffusers function by discharging the brine through multiple small nozzles to increase the mixing rate with the ambient receiving waters. This assumes sufficient entrainment of ambient receiving waters to dilute the brine to within two parts per thousand (2 ppt) of ambient salinity with 23% of the entrained volume, or 217 MGD in the CDF case, resulting in mortal larval entrainment.

The purpose of this report is to calculate the Area of Production Foregone (APF) for each brine dilution option under consideration for the CDF. This analysis will evaluate each option by calculating the APF and comparing these results to determine which discharge option will likely be the most environmentally friendly.

METHODS

Data Source

The EPS impingement mortality and entrainment characterization study (Tenera 2008) was used as the primary larval-entrainment data source, similar to prior CDF assessments. Entrainment estimates in the EPS study were calculated for both the actual cooling-water flow and the maximum permitted cooling-water flow. This was possible because entrainment estimates were the result of multiplying the sampled larval density by the water volume in question, such as the monthly maximum permitted cooling water withdrawn through the intake. Entrainment estimates were directly proportional to the quantity of water flowing through the intake.

The reverse osmosis production raw seawater volume and flow augmentation calculations were derived by applying a scaling factor to the average daily entrainment estimates calculated using maximum flow in Appendix F1 of Tenera (2008). Maximum flow was used because the constant flow excluded seasonal variation in power demand that impacts cooling-water needs. This simplified the calculations as the CDF flow was also assumed to be constant. All eight species (described below) used for both seawater intake analyses were subjected to this technique and multiplied by a scaling factor of 0.14819 (127 MGD/857 MGD for reverse osmosis) and 0.19953 (171 MGD/857 MGD for flow augmentation) for each survey to derive entrainment estimates. These entrainment estimates were used in

calculations described below for the Empirical Transport Model (ETM) to derive the APF.

Potential diffuser-induced entrainment estimates were calculated using data from stations near the potential diffuser site located at Station N4, which was 1.2 km offshore of the Agua Hedionda Lagoon mouth and 1.7 km offshore of the CDF (Figure 1) (Tenera 2008). Station N2 was not considered in this analysis due to its location well inshore of the proposed diffuser site where it was less representative of the ichthyoplankton community likely to occur near the diffuser.

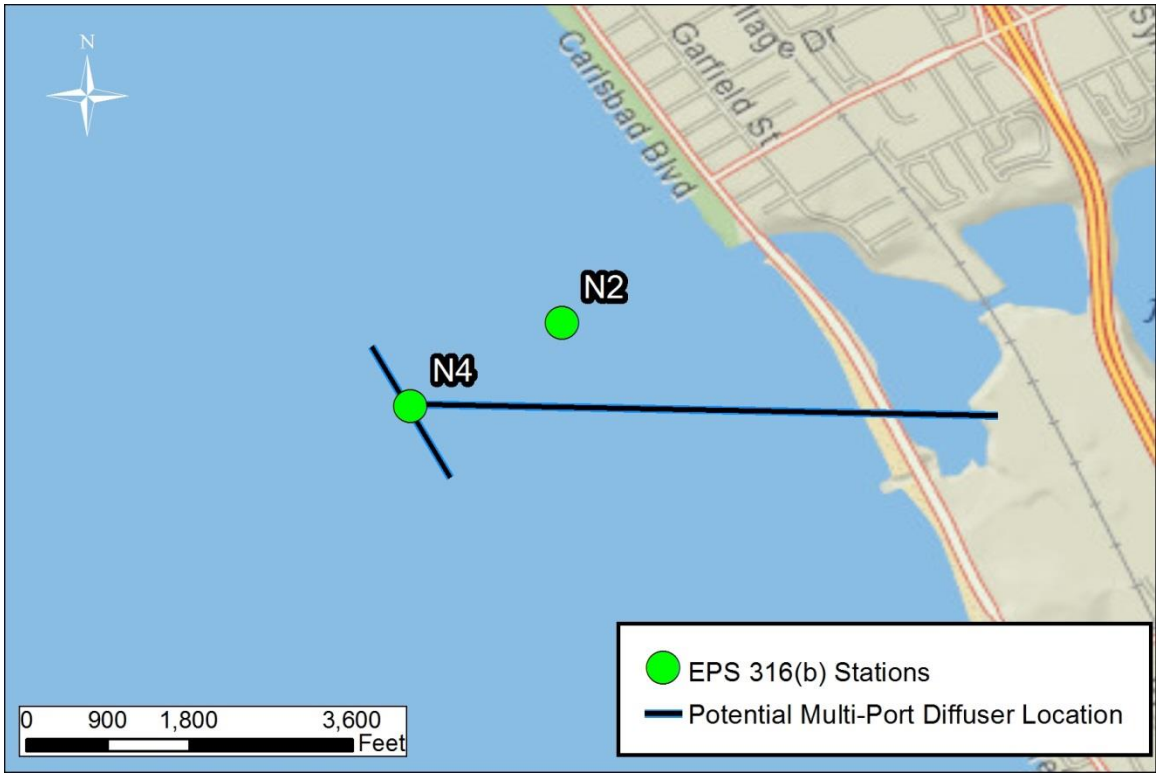

FIGURE 1. MAP OF THE SOURCE WATER STATIONS OCCUPIED DURING THE ENCINA POWER STATION 316(B) ENTRAINMENT CHARACTERIZATION STUDY THAT WERE CONSIDERED POTENTIALLY REPRESENTATIVE OF THE PROPOSED MULTI-PORT DIFFUSER LOCATION CONDITIONS.

Under the multi-port diffuser option, the CDF is expected to discharge 60 MGD, and this will entrain surrounding waters as it is discharged. This entrainment will result in mixing to reduce the brine salinities to ambient levels. The volume used in this analysis equals the calculated volume needed to be entrained by the diffuser discharge to dilute the brine to within 2 ppt of the ambient salinity. Per the Ocean Plan Amendment (May 5, 2015 version, Appendix 1), 23% of the entrained receiving water volume, or 217 MGD, represents the volume of water, and associated ichthyoplankton, subject to discharge entrainment mortality.

Taxa Selection

Taxa selected for this analysis were consistent with those used in similar analysis during the EPS study (Tenera 2008). The eight taxa used (Table 2) differed in relative abundance between the lagoon and coastal sampling sites. While none of the taxa common to the lagoon support a fishery (commercial and/or recreational), all five of the coastal taxa are fished to varying degrees. Northern Anchovy supports the largest fishery of the group with 378,210 lbs. commercially landed in San Diego County in 2013 (the most recent year with data available; DFW 2014). California Halibut supported the next largest commercial fishery of the group with 15,527 lbs. landed in San Diego County, while the remaining taxa had either less than 510 lbs. landed or are not open to commercial harvest. Spotfin Croaker is not open to commercial harvest, but is taken by recreational anglers fishing in the surf zone (Miller et al. 2011). Garibaldi is the California State Marine Fish and is thus protected from fishing harvest. California Halibut supports a prized recreational fishery, while Queenfish and White Croaker are commonly taken by recreational anglers fishing from public piers (Love 2006; Miller et al. 2011).

TABLE 1. TAXA SELECTED FOR INCLUSION IN THE AREA OF PRODUCTION FOREGONE CALCULATIONS. PARAMETERS USED IN THE DECISION TO SELECT THESE TAXA AS REPRESENTATIVE INCLUDE PERCENT OF THE SAMPLES COLLECTED IN THE AGUA HEDIONDA LAGOON AND THE COASTAL WATERS OFFSHORE THE LAGOON ENTRANCE, EXISTENCE AND RELATIVE SIZE OF THE FISHERY (COMMERCIAL AND/OR RECREATIONAL), THE POUNDS COMMERCIALLY LANDED IN SAN DIEGO COUNTY IN 2013, AND WHETHER OR NOT THE TAXA IS PROTECTED FROM ANY HARVEST.

Taxa	Percent of Lagoon Sample	Percent of Coastal Sample	Fishery	Pounds Landed	Protected
CIQ goby	62%	5%	No	0	No
combtooth blennies	28%	12%	No	0	No
Garibaldi	1%	1%	No	NA	Yes
Northern Anchovy*	4%	46%	Large	378,210	No
White Croaker	<1%	5%	Small	183	No
California Halibut	<1%	4%	Medium	15,257	No
Queenfish	<1%	2%	Small	504	No
Spotfin Croaker	<1%	2%	Small	NA	No
Total Abundance All Taxa	20,601	16,763			
***Unidentified anchovies assumed to be Northern Anchovy NA = Not Allowed**					

Modeling

Taxa-specific calculations were completed for each month of sampling in accordance with the Amendment (Appendix 1) and examples by Dr. Peter Raimondi (Appendix 2) using the ETM to derive the APF. The methods described below were used for both brine dilution options. Some variables used in each calculation

remained constant through all analyses with that reported in Tenera (2008) and are presented in Appendix 3a. Parameters for diffuser entrainment are provided in Appendix 3b.

The proportion entrained (P_e) was derived by multiplying the entrainment estimated for each brine dilution option by the source-water population represented in Appendix 3a. The P_e was used to calculate the proportional mortality (P_m) in the equation for each survey:

$$P_m = 1 - \sum_{i=1}^{13} f_i \, (1 - PE_i \cdot P_s)^d$$

where

PE_i = estimate of proportional entrainment for the *i*th survey,

P_S = estimate of the proportion of the total source water population represented by the sampled population,

f_i = proportion of the total annual source water population present during the *i*th survey, and

d = the estimated number of days of larval life.

Parameters P_s, f_i, and *d* were taken from Tenera (2008) as they applied to this evaluation in the same manner as for the original EPS 316(b) study. The longshore/cross shelf scaling factor (P_s) was applicable only to the offshore stations where the current direction (longshore or offshore) was a significant factor affecting the abundance of ichthyoplankton near the diffuser site and subject to entrainment mortality. No such current patterns affect the lagoon. Therefore, P_s was included in calculations for offshore taxa (Northern Anchovy, White Croaker, California Halibut, Queenfish, and Spotfin Croaker), but not the remaining estuarine taxa.

The APF is the product of multiplying the average P_m for each taxon by its estimated source-water area. The eight fish taxa selected for analysis represent a wide range of habitat preferences and life history strategies. Therefore, after splitting the taxa into two groups (estuarine and open coast) based on their predominant habitat affinity, consistent with Dr. Raimondi's approach, the average APF and standard error was calculated by habitat. The average plus 95% confidence interval APF was calculated using the NORM.INV function in MS-Excel substituting standard error for standard deviation as suggested by Dr. Raimondi (Appendix 2).

Inclusion of P_s

The modeling description provided above is consistent with Appendix E of the OPA Substitute Environmental Document available at

http://www.waterboards.ca.gov/water_issues/programs/ocean/desalination/docs/amendment/150424_appendix_e.pdf. It includes the parameter P_s, which is defined by as ratio of the area or volume of sampled source water to a larger area or water volume encompassing the source population of the taxa of interest (Parker and DeMartini 1989). If an estimate of the larval (or adult) population in the larger area is available, the value can be estimated assuming the distribution in the larger area is uniform (Steinbeck et al. 2007). If true, the value of P_s for the proportion of the population will be the same as the proportion computed using area or volume. The P_s is applied to open populations, such as along the open coast rather than in coastal embayments and lagoons where a reasonable assumption is the source population is contained within the bay or lagoon.

Prior presentations of the APF calculated for the CDF suggest some deviation from the model described above. During the development of this analysis, Dr. Raimondi's example from his 2008 presentation to the California Coastal Commission was reviewed and found that his calculations of the coastal taxa ETM apparently did not include P_s. Recalculation of the available data could only arrive at Dr. Raimondi's proportional mortality (P_m) values if P_s was excluded from the model with respect to the five open coast taxa. These calculations were included in Appendix 4. Therefore, to remain consistent with prior APF assessments of the CDF and the modeling guidelines in Appendix E of the Substitute Environmental Document, both modeling approaches were used here.

RESULTS

The resulting APF estimates are presented in Table 1. The APF estimates for each brine dilution option indicate flow augmentation of 171 MGD would result in the smallest APF using the assumptions and guidance in the Ocean Plan Amendment. Use of a multi-port diffuser would result in an estimated APF 40% larger than what could be expected from flow augmentation if P_s is included in the model. If P_s is excluded from the model, the difference becomes even more startling with a nearly five-fold increase in entrainment impacts as the APF increases from 77 acres for flow augmentation to 374 acres for an offshore multiport diffuser.

TABLE 2. THE CALCULATED AREA OF PRODUCTION FOREGONE (IN ACRES) AS A FUNCTION OF THE POTENTIALLY AFFECTED HABITAT FOR REVERSE OSMOSIS (RO) ASSUMING 127 MILLION GALLONS PER DAY (MGD), FLOW AUGMENTATION (FA) ASSUMING 171 MGD, AND MULTIPORT DIFFUSER (DIFFUSER) ASSUMING 217 MGD.

Taxa Category	RO	FA	Diffuser
With Ps in accordance with Appendix E			
Estuarine	27	36	2
Ocean	9	12	65
Total	**36**	**48**	**67**
Without Ps in accordance with Dr. Raimondi's CCC			
Estuarine	27	36	2
Ocean	31	41	372
Total	**58**	**77**	**374**

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Appendix 1

May 5, 2015 Redline Version of the Ocean Plan Amendment

Draft Final Amendment to the Water Quality Control Plan for Ocean Waters of California Addressing Desalination Facility Intakes, Brine Discharges, and Incorporating Other Nonsubstantive Changes.

This May 5, 2015 draft reflects changes circulated on April 24, 2015 in blue single underline and ~~red single strikethrough~~**.** Additional changes since April 24, 2015, including changes in Change Sheet #1 and Change Sheet #2 circulated on May 1, 2015 and May 4, 2015 respectively, are reflected in blue double underline and ~~red double strikethrough~~. Text that has been moved, but not changed, is reflected in green double underline and ~~green double strikethrough~~.

[NOTE: the proposed Desalination Amendment, if adopted, will be inserted into chapter III.M, not L, of the Ocean Plan.]

M. Implementation Provisions for Desalination Facilities*

1. Applicability and General Provisions

a. Chapter III.~~L~~ M applies to desalination facilities* using seawater.* Chapter III.~~L~~M.2 does not apply to desalination facilities* operated by a federal agency. Chapter III.~~L~~M.2, ~~L~~M.3, and ~~L~~M.4 do not apply to portable desalination facilities* that withdraw less than 0.10 million gallons per day (MGD) of seawater* and are operated by a governmental agency. These standards do not alter or limit in any way the authority of any public agency to implement its statutory obligations. The Executive Director of the State Water Board may temporarily waive the application of chapter III.~~L~~ M to desalination facilities* that are operating to serve as a critical short term water supply during a state of emergency as declared by the Governor.

b. Definitions of New, Expanded, and Existing Facilities:

(1) For purposes of chapter III.~~L~~M, "existing facilities" means desalination facilities* that have been issued an NPDES permit and all building permits and other governmental approvals necessary to commence construction for which the owner or operator has relied in good faith on those previously-issued permits and approvals and commenced construction of the facility beyond site grading prior to [effective date of this Plan]. ~~Existing facilities do not include a facility for which permits and approvals were issued and construction commenced after January 1, 1977, but for which a regional water board did not make a determination of the best site, design, technology, and mitigations measures feasible, pursuant to Water Code section 13142.5, subdivision (b) (hereafter Water Code section 13142.5(b)).~~

(2) For purposes of chapter III.~~L~~M, "expanded facilities" means existing facilities for which, after [effective date of the Plan], the owner or

operator does either of the following in a manner that could increase intake or mortality of all forms of marine life * beyond that which was originally approved in any NPDES permit or Water Code section 13142.5, subdivision (b) (hereafter Water Code section 13142.5(b)) determination:* 1) increases the amount of seawater* used either exclusively by the facility or used by the facility in conjunction with other facilities or uses, or 2) changes the design or operation of the facility. To the extent that the desalination facility* is co-located with another facility that withdraws water for a different purpose and that other facility reduces the volume of water withdrawn to a level less than the desalination facility's* volume of water withdrawn, the desalination facility* is considered to be an expanded facility.

(3) For purposes of chapter III.~~L~~M, "new facilities" means desalination facilities* that are not existing facilities or expanded facilities.

c. Chapter III.~~L~~M.2 (Water Code §13142.5(b) Determinations for New and Expanded Facilities: Site, Design, Technology, and Mitigation Measures) applies to new and expanded desalination facilities* withdrawing seawater.*

d. Chapter III.~~L~~M.3 (Receiving Water Limitation for Salinity*) applies to all desalination facilities* that discharge into ocean waters* and wastewater facilities that receive brine* from seawater* desalination facilities* and discharge into ocean waters.*

e. Chapter III.~~L~~M.4 (Monitoring and Reporting Programs) applies to all desalination facilities* that discharge into ocean waters.* Chapter III.~~L~~M.4 shall not apply to a wastewater facility that receives brine* from a seawater* desalination facility* and discharges~~ing~~ a positively buoyant commingled effluent through an existing wastewater outfall that is covered under an existing NPDES permit as long as the owner or operator monitors for compliance with the receiving water limitation set forth in chapter III.~~L~~M.3. For the purposes of chapter III.~~L~~M.4, a positively buoyant commingled effluent shall mean that the commingled plume rises when it enters the receiving water body due to salinity* levels in the commingled discharge being lower than the natural background salinity.*

f. References to the regional water board include the regional water board acting under delegated authority. For provisions that require consultation between regional water board and State Water Board staff, the regional water board shall notify and consult with the State Water Board staff prior to making a final determination on the item requiring consultation.

g. All desalination facilities must comply with all other applicable sections of the Ocean Plan.

2. Water Code section 13142.5(b) Determinations for New and Expanded Facilities: Site, Design, Technology, and Mitigation Measures Feasibility Considerations

    a. General Considerations

        (1) The owner or operator shall submit a request for a Water Code section 13142.5(b) determination to the appropriate regional water board as early as practicable. This request shall include sufficient information for the regional water board to conduct the analyses described below. The regional water board in consultation with the State Water Board staff may require an owner or operator to provide additional studies or information if needed, including any information necessary to identify and assess other potential sources of mortality to all forms of marine life. All studies and models are subject to the approval of the regional water board in consultation with State Water Board staff. The regional water board may require an owner or operator to hire a neutral third party entity to review studies and models and make recommendations to the regional water board.

        (2) The regional water board shall conduct a Water Code section 13142.5(b) analysis of all new and expanded desalination facilities.* A Water Code section 13142.5(b) analysis may include future expansions at the facility. The regional water board shall first analyze separately as independent considerations a range of feasible* alternatives for the best available site, the best available design, the best available technology, and the best available mitigation measures to minimize intake and mortality of all forms of marine life.* Then, the regional water board shall consider all four factors collectively and determine the best combination of feasible* alternatives to minimize intake and mortality of all forms of marine life.* The best combination of alternatives may not always include the best alternative under each individual factor because some alternatives may be mutually exclusive, redundant, or not feasible* in combination.

        (3) The regional water board's Water Code section 13142.5(b) analysis for expanded facilities may be limited to those expansions or other changes that result in the increased intake or mortality of all forms of marine life,* unless the regional water board determines that additional measures that minimize intake and mortality of all forms of marine life* are feasible* for the existing portions of the facility.

        (4) In conducting the Water Code section 13142.5(b) determination, the regional water boards shall consult with other state agencies involved in the permitting of that facility, including, but not limited to: California Coastal Commission, California State Lands Commission, and California Department of Fish and Wildlife. The regional water board

shall consider project-specific decisions made by other state agencies; however, the regional water board is not limited to project-specific requirements set forth by other agencies and may include additional requirements in a Water Code section 13142.5(b) determination.

(5) A regional water board may expressly condition a Water Code section 13142.5(b) determination based on the expectation of the occurrence of a future event. Such future events may include, but are not limited to, the permanent shutdown of a co-located power plant with intake structures shared with the desalination facility* or a reduction in the volume of wastewater available for the dilution of brine.* The regional water board must make a new Water Code section 13142.5(b) determination if the foreseeable future event occurs.

(a) The owner or operator shall provide notice to the regional water board as soon as it becomes aware that the expected future event will occur, and shall submit a new request for a Water Code section 13142.5(b) determination to the regional water board at least one year prior to the event occurring. If the owner or operator does not become aware that the event will occur at least one year prior to the event occurring, the owner or operator shall submit the request as soon as possible.

(b) The regional water board may allow up to five years from the date of the event for the owner or operator to make modifications to the facility required by a new Water Code section 13142.5(b) determination, provided that the regional water board finds that 1) any water supply interruption resulting from the facility modifications requires additional time for water users to obtain a temporary replacement supply or 2) such a compliance period is otherwise in the public interest and reasonably required for modification of the facility to comply with the determination.

(c) If the regional water board makes a Water Code section 13142.5(b) determination for a desalination facility* that will be co-located with a power plant, the regional water board shall condition its determination on the power plant remaining in compliance with the Water Quality Control Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling.

b. Site is the general onshore and offshore location of a new or expanded facility. There may be multiple potential facility design configurations within any given site. For each potential site, in order to determine whether a proposed facility site is the best available site feasible* to minimize intake and

mortality of all forms of marine life,* the regional water board shall require the owner or operator to:

(1) Consider whether subsurface intakes* are feasible.*

(2) Consider whether the identified need for desalinated* water is consistent with an applicable adopted ~~county general plans, integrated regional water management plans, or~~ urban water management plan~~s~~ prepared in accordance with Water Code section 10631, or if no urban water management plan is available, other water planning documents such as a county general plan or integrated regional water management plan~~if these plans are unavailable~~.

(3) Analyze the feasibility of placing intake, discharge, and other facility infrastructure in a location that avoid impacts to sensitive habitats* and sensitive species.

(4) Analyze the direct and indirect effects on all forms of marine life* resulting from facility construction and operation, individually and in combination with potential anthropogenic effects on all forms of marine life* resulting from other past, present, and reasonably foreseeable future activities within the area affected by the facility.

(5) Analyze oceanographic geologic, hydrogeologic, and seafloor topographic conditions at the site, so that the siting of a facility, including the intakes and discharges, minimizes the intake and mortality of all forms of marine life.*

(6) Analyze the presence of existing discharge infrastructure, and the availability of wastewater to dilute the facility's brine* discharge.

(7) Ensure that the intake and discharge structures are not located within a MPA or SWQPA* with the exception of intake structures ~~without~~ that do not have marine life mortality associated with the construction, operation, and maintenance of the intake structures ~~related marine life mortality~~ (e.g. slant wells). Discharges shall be sited at a sufficient distance from a MPA or SWQPA* so that the salinity* within the boundaries of a MPA or SWQPA* does not exceed natural background salinity.* To the extent feasible,* surface intakes shall be sited so as to maximize the distance from a MPA or SWQPA.*

c. Design is the size, layout, form, and function of a facility, including the intake capacity and the configuration and type of infrastructure, including intake and outfall structures. The regional water board shall require that the owner or operator perform the following in determining whether a proposed facility

design is the best available design feasible* to minimize intake and mortality of all forms of marine life:*

(1) For each potential site, analyze the potential design configurations of the intake, discharge, and other facility infrastructure to avoid impacts to sensitive habitats* and sensitive species.

(2) If the regional water board determines that subsurface intakes* are not feasible* and surface water intakes are proposed instead, analyze potential designs for those intakes in order to minimize the intake and mortality of all forms of marine life.*

(3) Design the outfall so that the brine mixing zone* does not encompass or otherwise adversely affect existing sensitive habitat.*

(4) Design the outfall so that discharges do not result in dense, negatively-buoyant plumes that result in adverse effects due to elevated salinity* or hypoxic conditions occurring outside the brine mixing zone.* An owner or operator must demonstrate that the outfall meets this requirement through plume modeling and/or field studies. Modeling and field studies shall be approved by the regional water board in consultation with State Water Board staff.

(5) Design outfall structures to minimize the suspension of benthic sediments.

d. Technology is the type of equipment, materials,* and methods that are used to construct and operate the design components of the desalination facility.* The regional water board shall apply the following considerations in determining whether a proposed technology is the best available technology feasible* to minimize intake and mortality of all forms of marine life*:

(1) Considerations for Intake Technology:

(a) Subject to ~~Section~~ chapter ~~L~~ M.2.a.(2), the regional water board in consultation with State Water Board staff shall require subsurface intakes* unless it determines that subsurface intakes* are not feasible* based upon a comparative analysis of the factors listed below for surface and subsurface intakes.* A design capacity in excess of the need for desalinated* water as identified in chapter III.~~L~~M.2.b.(2) shall not be used by itself to declare subsurface intakes* as not feasible.*

i. The regional water board shall consider the following factors in determining feasibility of subsurface intakes:* geotechnical data, hydrogeology, benthic topography, oceanographic conditions,

presence of sensitive habitats,* presence of sensitive species, energy use for the entire facility; ~~impact on freshwater aquifers, local water supply, and existing water users; desalinated* water conveyance, existing infrastructure,~~ design constraints (engineering, constructability), and project life cycle cost. Project life cycle cost shall be determined by evaluating the total cost of planning, design, land acquisition, construction, operations, maintenance, mitigation, equipment replacement and disposal over the lifetime of the facility, in addition to the cost of decommissioning the facility. Subsurface intakes* shall not be determined to be economically infeasible solely because subsurface intakes* may be more expensive than surface intakes. Subsurface intakes* may be determined to be economically infeasible if the additional costs or lost profitability associated with subsurface intakes,* as compared to surface intakes, would render the desalination facility* not economically viable. In addition, the regional water board may evaluate other site- and facility-specific factors.

ii. If the regional water board determines that subsurface intakes* are not feasible* for the proposed intake design capacity, it shall determine whether subsurface intakes* are feasible* for a reasonable range of alternative intake design capacities. The regional water board may find that a combination of subsurface* and surface intakes is the best feasible* alternative to minimize intake and mortality of marine life and meet the identified need for desalinated water as described in chapter III.M.2.b.(2).

(b) Installation and maintenance of a subsurface intake* shall avoid, to the maximum extent feasible,* the disturbance of sensitive habitats* and sensitive species.

(c) If subsurface intakes* are not feasible,* the regional water board may approve a surface water intake subject to the following conditions:

i. The regional water board shall require that surface water intakes be screened. Screens must be functional while the facility is withdrawing seawater.*

ii. In order to reduce entrainment, all surface water intakes must be screened with a 1.0 mm (0.04 in) or smaller slot size screen when the desalination facility* is withdrawing seawater.*

iii. An owner or operator may use an alternative method of preventing entrainment so long as the alternative method

results in intake and mortality of eggs, larvae, and juvenile organisms that is less than or equivalent to a 1.0 mm (0.04 in) slot size screen. The owner or operator must demonstrate the effectiveness of the alternative method to the regional water board. The owner or operator must conduct a study to demonstrate the effectiveness of the alternative method, and use an Empirical Transport Model* (ETM)/ Area of Production Forgone* (APF) approach* to estimate entrainment. The study period shall be at least 12 consecutive months. Sampling for environmental studies shall be designed to account for variation in oceanographic or hydrologic conditions and larval abundance and diversity such that abundance estimates are reasonably accurate. Samples must be collected using a mesh size no larger than 335 microns and individuals collected shall be identified to the lowest taxonomical level practicable. The ETM/APF analysis* shall evaluate entrainment for a broad range of species, species morphologies, and sizes under the environmental and operational conditions that are representative of the entrained species and the conditions at the full-scale desalination facility.* At their discretion, the regional water boards may permit the use of existing entrainment data to meet this requirement.

iv. In order to minimize impingement, through-screen velocity at the surface water intake shall not exceed 0.15 meters per second (0.5 feet per second).

(2) Considerations for Brine* Discharge Technology:

(a) The preferred technology for minimizing intake and mortality of all forms of marine life* resulting from brine* discharge ~~disposal~~ is to commingle brine* with wastewater (e.g., agricultural, municipal, industrial, power plant cooling water, etc.) that would otherwise be discharged to the ocean. The wastewater must provide adequate dilution to ensure salinity* of the commingled discharge meets the receiving water limitation for salinity* in chapter III.M.3. ~~is less than or equal to the natural background salinity,* or the commingled discharge shall be discharged through multiport diffusers.*~~ Nothing in this section shall preclude future recycling of the wastewater.

(b) Multiport diffusers* are the next best method for disposing of brine* when the brine* cannot be diluted by wastewater and when there are no live organisms in the discharge. Multiport diffusers* shall be engineered to maximize dilution, minimize the size of the brine mixing zone,* minimize the suspension of benthic sediments, and minimize mortality of all forms of marine life.*

(c) Brine* discharge ~~disposal~~ technologies other than wastewater dilution and multiport diffusers,* ~~such as flow augmentation,*~~ may be used if an owner or operator can demonstrate to the regional water board that the technology provides a comparable level of intake and mortality of all forms of marine life* as wastewater dilution if wastewater is available, or multiport diffusers* if wastewater is unavailable. The owner or operator must evaluate all of the individual and cumulative effects of the proposed alternative discharge method on the intake and mortality of all forms of marine life*, including (where applicable); intake-related entrainment, osmotic stress, turbulence that occurs during water conveyance and mixing, and shearing stress at the point of discharge. When determining the ~~level of protection provided by~~intake and mortality associated with a brine* discharge ~~disposal~~ technology or combination of technologies, the regional water board shall require the owner or operator to use empirical studies or modeling to:

i. Estimate intake entrainment impacts using an ETM/APF approach.*

ii. Estimate degradation of all forms of marine life* from elevated salinity* within the brine mixing zone,* including osmotic stresses, the size of impacted area, and the duration that all forms of marine life* are exposed to the toxic conditions. Considerations shall be given to the most sensitive species, and community structure and function.

iii. Estimate the intake and mortality of all forms of marine life* that occurs as a result of water conveyance, in-plant turbulence or mixing, and waste* discharge.

iv. Within ~~three years~~18 months of beginning operation, submit to the regional water board an empirical study that evaluates intake and mortality of all forms of marine life* associated with ~~flow augmentation*~~the alternative brine* discharge technology. The study must evaluate impacts caused by any augmented intake volume, intake and pump technology, water conveyance, waste brine* mixing, and effluent discharge. Unless demonstrated otherwise, organisms entrained by ~~flow augmentation*~~ the alternative brine* discharge technology are assumed to have a mortality rate of 100 percent. The study period shall be at least 12 consecutive months. If the regional water board requires a study period longer than 12 months, the final report must be

submitted to the regional water board within 6 months of the completion of the empirical study.

v. If the empirical study shows that ~~flow augmentation*~~the alternative brine* discharge ~~disposal~~ technology ~~is less protective of~~ results in more intake and mortality of all forms of marine life* than a facility using wastewater dilution or multiport diffusers,* then the facility must either (1) cease using ~~flow augmentation*~~ the alternative brine* discharge technology and install and use wastewater dilution or multiport diffusers* to discharge brine* waste, or (2) re-design the ~~flow augmentation*~~the alternative brine* discharge technology system to minimize intake and mortality of all forms of marine life* to a level that is comparable with wastewater dilution if wastewater is available, or multiport diffusers* if wastewater is unavailable,* subject to regional water board approval.

(d) Flow augmentation* as an alternative brine* discharge technology is prohibited with the following exceptions:

i. At facilities that use subsurface intakes* to supply augmented flow water for dilution. Facilities that use subsurface intakes* to supply augmented flow water for dilution are exempt from the requirements of chapter III.M.2.d.(2)(c) if the facility meets the receiving water limitation for salinity* in chapter III.M.3.

ii. At a facility that has received a conditional Water Code section 13142.5(b) determination and is over 80 percent constructed by [the effective date of this plan]. If the ~~An~~owner or operator of the facility proposes ~~proposing~~ to use flow augmentation* as an alternative brine* discharge technology, the facility must: ~~U~~use low turbulence intakes (e.g., screw centrifugal pumps or axial flow pumps) and conveyance pipes~~.~~; c~~C~~onvey and mix dilution water in a manner that limits thermal stress, osmotic stress, turbulent shear stress, and other factors that could cause intake and mortality of all forms of marine life*; ~~Facilities proposing to using flow augmentation* must~~ comply with chapter III.~~L~~M.2.d.(1); ~~Facilities proposing to using flow augmentation* through surface intakes are prohibited from~~ and not discharge~~ing~~ through multiport diffusers.*

iii. Within three years of beginning operation, submit to the regional water board an empirical study that evaluates intake and mortality of all forms of marine life* associated with flow augmentation*. The study must evaluate impacts caused by augmented intake volume, intake and pump technology, water conveyance, waste brine* mixing, and effluent discharge. Unless demonstrated otherwise, organisms entrained by flow augmentation* are assumed to have a mortality rate of 100 percent. The study period shall be at least 12 consecutive months.

iv. If the empirical study shows that flow augmentation* is less protective of all forms of marine life* than a facility using wastewater dilution or multiport diffusers,* then the facility must either (1) cease using flow augmentation* technology and install and use wastewater dilution or multiport diffusers* to discharge brine* waste, or (2) re-design the flow augmentation* system to minimize intake and mortality of all forms of marine life* to a level that is comparable with wastewater dilution if wastewater is available, or multiport diffusers if wastewater is unavailable,* subject to regional water board approval.

v. Facilities proposing to using flow augmentation* must comply with chapter III.L.2.d.(1).

vi. Facilities proposing to using flow augmentation* through surface intakes are prohibited from discharging through multiport diffusers.*

(e) Facilities that use subsurface intakes* to supply augmented flow water for dilution are exempt from the requirements of chapter III.L.2.d.(2) if the facility meets the receiving water limitation for salinity in chapter III.L.3.

e. Mitigation for the purposes of this section is the replacement of all forms of marine life* or habitat that is lost due to the construction and operation of a desalination facility* after minimizing intake and mortality of all forms of marine life* through best available site, design, and technology. The regional water board shall ensure an owner or operator fully mitigates for the operational lifetime of the facility and uses the best available mitigation measures feasible* to minimize intake and mortality of all forms of marine life.* The owner or operator may choose whether to satisfy a facility's mitigation measures pursuant to chapter III.~~L~~M.2.e.(3) or, if available, ~~L~~M.2.e.(4), or a combination of the two.

(1) *Marine Life Mortality Report.* The owner or operator of a facility shall submit a report to the regional water board estimating the marine life mortality resulting from construction and operation of the facility after

implementation of the facility's required site, design, and technology measures.

(a) For operational mortality related to intakes, the report shall include a detailed entrainment study. The entrainment study period shall be at least 12 consecutive months and sampling shall be designed to account for variation in oceanographic or hydrologic conditions and larval abundance and diversity such that abundance estimates are reasonably accurate. At their discretion, the regional water boards may permit the use of existing entrainment data from the facility to meet this requirement. Samples must be collected using a mesh size no larger than 335 microns and individuals collected shall be identified to the lowest taxonomical level practicable. The ETM/APF analysis* shall be representative of the entrained species collected using the 335 micron net. The APF* shall be calculated using a one-sided, upper 95 percent confidence bound for the 95th percentile of the APF distribution.

[*****NOTE: This language is optional additional language for the board members to consider at the May 6, 2015 board meeting***: *An owner or operator may use an alternative mitigation assessment method if the method assesses intake and mortality of all forms of marine life* and can be used to determine the number of mitigation acres needed to fully mitigate for the impacts. The method must be peer reviewed by a neutral third party expert review panel and then approved by the regional water board in consultation with the State Water Board staff.***]***

An owner or operator with subsurface intakes* is not required to do an ETM/APF analysis* for their intakes and is not required to mitigate for intake-related operational mortality. The regional water board may apply a one percent reduction to the APF* acreage calculated in the Marine Life Mortality Report to account for the reduction in entrainment ~~reduction~~ of all forms of marine life* when using a 1.0 mm slot size screen.

(b) For operational mortality related to discharges, the report shall estimate the area in which salinity* exceeds 2.0 parts per thousand above natural background salinity* or a facility-specific alternative receiving water limitation (see ~~SL~~chapter III.M.3). The area in excess of the receiving water limitation for salinity* shall be determined by modeling and confirmed with monitoring. The report shall use any acceptable approach approved by the regional water board for evaluating mortality that occurs due to shearing stress resulting from the facility's discharge, including any incremental increase in mortality resulting from a commingled discharge.

(c) For construction-related mortality, the report shall use any acceptable approach approved by the regional water board for evaluating the mortality that occurs within the area disturbed by the facility's construction. The regional water board may determine that the construction-related disturbance does not require mitigation because the disturbance is temporary and the habitat is naturally restored.

(d) Upon approval of the report by the regional water board in consultation with State Water Board staff, the calculated marine life mortality shall form the basis for the mitigation provided pursuant to this section.

(2) The owner or operator shall mitigate for the mortality of all forms of marine life* determined in the report above by choosing to either complete a mitigation project as described in chapter III.~~L~~M.2.e.(3) or, if an appropriate fee-based mitigation program is available, provide funding for the program as described in chapter III.~~L~~M.2.e.(4). The mitigation project or the use of a fee-based mitigation program and the amount of the fee that the owner or operator must pay is subject to regional water board approval.

(3) *Mitigation Option 1: Complete a Mitigation Project.* The mitigation project must satisfy the following provisions:

(a) The owner or operator shall submit a Mitigation Plan. Mitigation Plans shall include: project objectives, site selection, site protection instrument (the legal arrangement or instrument that will be used to ensure the long-term protection of the compensatory mitigation project site), baseline site conditions, a mitigation work plan, a maintenance plan, a long-term management plan, an adaptive management plan, performance standards and success criteria, monitoring requirements, and financial assurances.

(b) The mitigation project must meet the following requirements:

i. Mitigation shall be accomplished through expansion, restoration or creation of one or more of the following: kelp beds,* estuaries,* coastal wetlands, natural reefs, MPAs, or other projects approved by the regional water board that will mitigate for intake and mortality of all forms of marine life* associated with the facility.

ii. The owner or operator shall demonstrate that the project fully mitigates for intake-related marine life mortality by including expansion, restoration, or creation of habitat based on the APF* acreage calculated in the Marine Life Mortality Report above. The owner or operator using

surface water intakes shall do modeling to evaluate the areal extent of the mitigation project's production area to confirm that it overlaps the facility's source water body.* Impacts on the mitigation project due to entrainment by the facility must be offset by adding compensatory acreage to the mitigation project.

iii. The owner or operator shall demonstrate that the project also fully mitigates for the discharge-related marine life mortality projected in the Marine Life Mortality Report above.

iv. The owner or operator shall demonstrate that the project also fully mitigates for the construction-related marine life mortality identified in the Marine Life Mortality Report above.

v. The regional water board may permit out-of-kind mitigation* for mitigation of open water or soft-bottom species. In-kind mitigation* shall be done for all other species whenever feasible.*

vi. For out-of-kind mitigation,* an owner or operator shall evaluate the biological productivity of the impacted open water or soft-bottom habitat calculated in the Marine Life Mortality Report and the proposed mitigation habitat. If the mitigation habitat is a more biologically productive habitat (e.g. wetlands, estuaries,* rocky reefs, kelp beds,* eelgrass beds,* surfgrass beds*), the regional water boards may apply a mitigation ratio based on the relative biological productivity of the impacted open water or soft-bottom habitat and the mitigation habitat. The mitigation ratio shall not be less than one acre of mitigation habitat for every ten acres of impacted open water or soft-bottom habitat.

vii. For in-kind mitigation,* the mitigation ratio shall not be less than one acre of mitigation habitat for every one acre of impacted habitat.

viii. For both in-kind* and out-of-kind mitigation,* the regional water boards may increase the required mitigation ratio for any species and impacted natural habitat calculated in the Marine Life Mortality Report when appropriate to account for imprecisions associated with mitigation, including but not limited to, the likelihood of success, temporal delays in productivity, and the difficulty of restoring or establishing the desired productivity functions.

ix. The rationale for the mitigation ratios must be documented in the administrative record for the permit action.

(c) The Mitigation Plan is subject to approval by the regional water board in consultation with State Water Board staff and with other agencies having authority to condition approval of the project and require mitigation.

(4) *Mitigation Option 2: Fee-based Mitigation Program*. If the regional water board determines that an appropriate fee-based mitigation program has been established by a public agency, and that payment of a fee to the mitigation program will result in the creation and ongoing implementation of a mitigation project that meets the requirements of ~~section~~ chapter ~~L~~ M.2.e.(3), the owner or operator may pay a fee to the mitigation program in lieu of completing a mitigation project.

(a) The agency that manages the fee-based mitigation program must have legal and budgetary authority to accept and spend mitigation funds, a history of successful mitigation projects documented by having set and met performance standards for past projects, and stable financial backing in order to manage mitigation sites for the operational life of the facility.

(b) The amount of the fee shall be based on the cost of the mitigation project, or if the project is designed to mitigate cumulative impacts from multiple desalination facilities or other development projects, the amount of the fee shall be based on the desalination facility's** fair share of the cost of the mitigation project.

(c) The manager of the fee-based mitigation program must consult with the California Department of Fish and Wildlife, Ocean Protection Council, Coastal Commission, State Lands Commission, and State and regional water boards to develop mitigation projects that will best compensate for intake and mortality of all forms of marine life* caused by the desalination facility.* Mitigation projects that increase or enhance the viability and sustainability of all forms of marine life* in Marine Protected Areas are preferred, if feasible.*

(5) California Department of Fish and Wildlife, the regional water board, and State Water Board may perform audits or site inspections of any mitigation project.

(6) An owner or operator, or a manager of a fee-based mitigation program, must submit a mitigation project performance report to the regional water board 180 days prior to the expiration date of their NPDES permit.

(7) For conditionally permitted facilities or expanded facilities, the regional water boards may:

(a) Account for previously-approved mitigation projects associated with a facility when making a new Water Code section 13142.5(b) determination.

(b) Require additional mitigation when making a new Water Code section 13142.5(b) determination for any additional mortality of all forms of marine life resulting from the occurrence of the conditional event or the expansion of the facility. The additional mitigation must be to compensate for any additional construction, discharge, or other increases in intake or impacts or an increase in intake and mortality of all forms of marine life.*

3. Receiving Water Limitation for Salinity*

a. Chapter III.~~L~~M.3 is applicable to all desalination facilities discharging brine* into ocean waters,* including facilities that commingle brine* and wastewater.

b. The receiving water limitation for salinity* shall be established as described below:

(1) Discharges shall not exceed a daily maximum of 2.0 parts per thousand (ppt) above natural background salinity* measured no further than 100 meters (328 ft) horizontally from ~~the~~ each discharge point. There is no vertical limit to this zone.

(2) In determining an effluent limit necessary to meet this receiving water limitation, permit writers shall use the formula in chapter III.C.4 that has been modified for brine* discharges as follows:

Equation 1: Ce= Co + Dm(2.0 ppt)
Ce= (2.0 ppt + Cs) + Dm(2.0 ppt)

Where:

Ce= the effluent concentration limit, ppt
Co= the salinity* concentration to be met at the completion of initial* dilution= 2.0 ppt + Cs
Cs= the natural background salinity,* ppt
Dm= minimum probable initial dilution* expressed as parts seawater* per part brine* discharge

(a) The fixed distance referenced in the initial dilution* definition shall be no more than 100 meters (328 feet).

(b) In addition, the owner or operator shall develop a dilution factor (Dm) based on the distance of 100 meters (328 feet) or initial dilution,* whichever is smaller. The dilution factor (Dm) shall be developed within the brine mixing zone* using applicable water quality models that have been approved by the regional water boards in consultation with State Water Board staff.

(c) The value 2.0 ppt in Equation 1 is the maximum incremental increase above ~~ambient~~ natural background salinity* (Cs) allowed at the edge of the brine mixing zone.* A regional water board may substitute an alternative numeric value for 2.0 ppt in Equation 1 based upon the results of a facility-specific alternative salinity* receiving water limitation study, as described in chapter III.~~L~~M.3.c below.

c. An owner or operator may submit a proposal to the regional water board for approval of an alternative (other than 2 ppt) salinity* receiving water limitation to be met no further than 100 meters horizontally from the discharge. There is no vertical limit to this zone.

(1) To determine whether a proposed facility-specific alternative receiving water limitation is adequately protective of beneficial uses, an owner or operator shall:

(a) Establish baseline biological conditions at the discharge location and at reference locations over a 12-month period prior to commencing brine* discharge. The biologic surveys must characterize the ecologic composition of habitat and marine life using measures established by the regional water board. At their discretion, the regional water boards may permit the use of existing data to meet this requirement.

(b) Conduct at least the following chronic toxicity* Whole Effluent Toxicity (WET) tests: germination and growth for giant kelp (*Macrocystis pyrifera)*; development for red abalone (*Haliotis refescens)*; development and fertilization for purple urchin (*Strongleocentrotus purpuratus)*; development and fertilization for sand dollar (*Dendraster excentricus)*; larval growth rate for topsmelt (*Atherniops affinis)*. WET tests shall be performed by an Environmental Laboratory Accreditation Program (ELAP) certified laboratory.

(c) The regional water board in consultation with State Water Board staff may require an owner or operator to do additional toxicity studies if needed.

(2) The regional water board in consultation with the State Water Board staff may require an owner or operator to provide additional studies or information in order to approve a facility-specific alternative receiving water limitation for salinity.*

(3) The facility-specific alternative receiving water limitation shall be based on the lowest observed effect concentration (LOEC)* for the most sensitive species and toxicity endpoint as determined in the chronic toxicity* studies. The regional water board in consultation with State Water Board staff has discretion to approve the proposed facility-specific alternative receiving water limitation for salinity.*

~~(4)~~ The regional water board shall review a facility's monitoring data, the studies as required in chapter III.~~L~~M.4 below, or any other information that the regional water board deems to be relevant to periodically assess whether the facility-specific alternative receiving water limitation for salinity* is adequately protective of beneficial uses. The regional water board may eliminate or revise a facility-specific alternative receiving water limitation for salinity* based on its assessment of the data.

d. The owner or operator of a facility that has received a conditional Water Code section 13142.5(b) determination and is over 80 percent constructed by [the effective date of this plan] that proposes flow augmentation* using a surface water intake may submit a proposal to the regional water board in consultation with the State Water Board staff for approval of an alternative brine mixing zone* not to exceed 200 meters laterally from the discharge point and throughout the water column. The owner or operator of such a facility must demonstrate, in accordance with chapter III.M.2.d.(2)(c), that the combination of the alternative brine mixing zone* and flow augmentation* using a surface water intake provide a comparable level of intake and mortality of all forms of marine life* as the combination of the standard brine mixing zone* and wastewater dilution if wastewater is available, or multiport diffusers* if wastewater is unavailable. In addition to the analysis of the effects required by chapter III.M.2.d.(2)(c), the owner or operator must also evaluate the individual and cumulative effects of the alternative brine mixing zone* on the intake and mortality of all forms of marine life.* In no case may the discharge result in hypoxic conditions outside of the alternative brine mixing zone.* If an alternative brine mixing zone* is approved, the alternative distance and the areal extent of the alternative brine mixing zone* shall be used in lieu of the standard brine mixing zone* for all purposes, including establishing an effluent limitation and a receiving water limitation for salinity, in chapter III.M.

e. Existing facilities that do not meet the receiving water limitation at the edge of the brine mixing zone* and throughout the water column by [the effective date

of this plan] must either: 1) establish a facility-specific alternative receiving water limitation for salinity* as described in chapter III.~~L~~M.3.c; or, 2) upgrade the facility's brine* discharge method in order to meet the receiving water limitation in chapter III.~~L~~M.3.b in accordance with the State Water Board's Compliance Schedule Policy, as set forth in (e) below. An owner or operator that chooses to upgrade the facility's method of brine* discharge ~~disposal~~:

(1) Must demonstrate to the regional water board that the brine* discharge does not negatively impact sensitive habitats,* sensitive species, MPAs, or SWQPAs.*

(2) Is subject to the Considerations for Brine* Discharge Technology described in chapter III.~~L~~M.2.d.(2).

f. The regional water board may grant compliance schedules for the requirements for brine* waste discharges for desalination facilities.* All compliance schedules shall be in accordance with the State Water Board's Compliance Schedule Policy, except that the salinity* receiving water limitation set forth in chapters III.~~L~~M.3.b and III.~~L~~M.3.c. shall be considered to be a "new water quality objective" as used in the Compliance Schedule Policy.

g. The regional water board in consultation with the State Water Board staff may require an owner or operator to provide additional studies or information if needed. All studies and models are subject to the approval of the regional water board in consultation with State Water Board staff. The regional water board may require an owner or operator to hire a neutral third party entity to review studies and models and make recommendations to the regional water board.

4. Monitoring and Reporting Programs

a. The owner or operator of a desalination facility* must submit a Monitoring and Reporting Plan to the regional water board for approval. The Monitoring and Reporting Plan shall include monitoring of effluent and receiving water characteristics and impacts to all forms of marine life.* The Monitoring and Reporting Plan shall, at a minimum, include monitoring for benthic community health, aquatic life toxicity, hypoxia, and receiving water characteristics consistent with Appendix III of this Plan and for compliance with the receiving water limitation in chapter III.~~L~~M.3. Receiving water monitoring for salinity* shall be conducted at times when the monitoring locations are most likely affected by the discharge. For new or expanded facilities the following additional requirements apply:

(1) An owner or operator must perform facility-specific monitoring to demonstrate compliance with the receiving water limitation for salinity,* and evaluate the potential effects of the discharge within the water column, bottom sediments, and the benthic communities. Facility-specific monitoring is required until the regional water board determines that a regional monitoring program is adequate to ensure compliance with the receiving water limitation. The monitoring and reporting plan shall be reviewed, and revised if necessary, upon NPDES permit renewal.

(2) Baseline biological conditions shall be established at the discharge location and at a reference location prior to commencement of construction. The owner or operator is required to conduct biological surveys (e.g., Before-After Control-Impact study), that will evaluate the differences between biological communities at a reference site and at the discharge location before and after the discharge commences. The regional water board will use the data and results from the surveys and any other applicable data for evaluating and renewing the requirements set forth in a facility's NPDES permit.

Add the following new definitions to, and amend existing definitions in, Appendix I of the Ocean Plan.

ALL FORMS OF MARINE LIFE includes all life stages of all marine species.

AREA PRODUCTION FOREGONE (APF), also known as habitat production foregone, is an estimate of the area that is required to produce (replace) the same amount of larvae or propagules* that are removed via entrainment at a desalination facility's* intakes. APF is calculated by multiplying the proportional mortality* by the source water body,* which are both determined using an empirical transport model.*

BRINE is the byproduct of desalinated* water having a salinity* concentration greater than a desalination facility's* intake source water.

BRINE MIXING ZONE is the area where salinity* may exceed~~s~~ 2.0 parts per thousand above natural background salinity,* or the concentration of salinity* approved as part of an alternative receiving water limitation. The standard brine mixing zone shall not exceed 100 meters (328 feet) laterally from the points of discharge and throughout the water column. An alternative brine mixing zone, if approved as described in chapter III.M.3.d, shall not exceed 200 meters (656 feet) laterally from the points of discharge and throughout the water column. The brine mixing zone is an allocated impact zone where there may be toxic effects on marine life due to elevated salinity.

DESALINATION FACILITY is an industrial facility that processes water to remove salts and other components from the source water to produce water that is less saline than the source water.

EELGRASS BEDS are aggregations of the aquatic plant species of the genus *Zostera*.

EMPIRICAL TRANSPORT MODEL (ETM) is a methodology for determining the spatial area known as the source water body* that contains the source water population, which are the organisms that are at risk of entrainment as determined by factors that may include but are not limited to biological, hydrodynamic, and oceanographic data. ETM can also be used to estimate proportional mortality,* P_m.

ETM/APF APPROACH or ANALYSIS. For guidance on how to perform an ETM/APF analysis please see Appendix E of the Staff Report for Amendment to the Water Quality Control Plan for Ocean Waters of California Addressing Desalination Facility Intakes, Brine* Discharges, and the Incorporation of Other Non-substantive Changes.

FEASIBLE, for the purposes of chapter III.~~L~~M, shall mean capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social, and technological factors.

FLOW AUGMENTATION is a type of in-plant dilution and occurs when a desalination facility* withdraws additional source water for the specific purpose of diluting brine* prior to discharge.

IN-KIND MITIGATION is when the habitat or species lost is the same as what is replaced through mitigation.

KELP BEDS are aggregations of marine algae of the order Laminariales, including species in the genera *Macrocystis, Nereocystis, and Pelagophycus*. Kelp beds include the total foliage canopy throughout the water column.

LOEC is the lowest observed effect concentration or the lowest concentration of effluent that causes observable adverse effects in exposed test organisms.

MARKET SQUID NURSERIES are comprised of numerous egg capsules, each containing approximately 200 developing embryos, attached in clusters or mops to sandy substrate with moderate water flow. Market squid (*Doryteuthis opalescens*) nurseries occur at a wide range of depths; however, mop densities are greatest in shallow, nearshore waters between ten and 100 meters (328 feet) deep.

MULTIPORT DIFFUSERS are linear structures consisting of spaced ports or nozzles that are installed on submerged marine outfalls. For the purposes of chapter III.~~L~~M, multiport diffusers discharge brine* waste into an ambient receiving water body and enable rapid mixing, dispersal, and dilution of brine* within a relatively small area.

NATURAL BACKGROUND SALINITY is the salinity* at a location that results from naturally occurring processes and is without apparent human influence. For purposes of determining natural background salinity, the regional water board may approve the use of:

(1) the mean monthly natural background salinity ~~shall be used~~. Mean monthly natural background salinity shall be determined by averaging 20 years of historical salinity* data in the proximity of the proposed discharge location and at the depth of the proposed discharge, when feasible.* For historical data not recorded in parts per thousand, the regional water boards may accept converted data at their discretion.

When historical data are not available, natural background salinity shall be determined by measuring salinity* at depth of proposed discharge for three years, on a weekly basis prior to a desalination facility* discharging brine,* and the mean monthly natural salinity* shall be used to determine natural background salinity~~.~~; or

(2) the actual salinity at ~~Facilities shall establish~~ a reference location, or reference locations, that is representative of ~~with similar~~ natural background salinity at the discharge location ~~to be used for comparison in ongoing monitoring of brine*discharges~~. The reference locations shall be without apparent human influence, including wastewater outfalls and brine discharges.

Either method to establish natural background salinity may be used for the purpose of determining compliance with the receiving water limitation or an effluent limitation for salinity. If a reference location(s) is used for compliance monitoring, the permit should specify that historical data shall be used if reference location data becomes unavailable. An owner or operator shall submit to the regional water board all necessary information to establish natural background salinity.

OUT-OF-KIND MITIGATION is when the habitat or species lost is different than what is replaced through mitigation.

PROPAGULES are structures that are capable of propagating an organism to the next stage in its life cycle via dispersal. Dispersal is the movement of individuals from their birth site to their reproductive grounds.

PROPORTIONAL MORTALITY, P_m, is percentage of larval organisms or propagules* in the source water body* that is expected to be entrained at a desalination facility's* intake. It is assumed that all entrained larvae or propagules* die as a result of entrainment.

SALINITY is a measure of the dissolved salts in a volume of water. For the purposes of this Plan, salinity shall be measured using a standard method approved by the regional water board (e.g. Standard Method 2520 B, EPA Method 120.1, EPA Method 160.1) and reported in parts per thousand (ppt). For historical salinity data not recorded in parts per thousand, the regional water boards may accept converted data at their discretion.

SEAWATER is salt water that is in or from the ocean. For the purposes of chapter III.~~L~~M, seawater includes tidally influenced waters in coastal estuaries and lagoons and underground salt water beneath the seafloor, beach, or other contiguous land with hydrologic connectivity to the ocean.

SENSITIVE HABITATS, for the purposes of this Plan, are kelp beds,* rocky substrate, surfgrass beds,* eelgrass beds,* oyster beds, spawning grounds for state or federally managed species, market squid nurseries,* or other habitats in need of special protection as determined by the Water Boards.

SOURCE WATER BODY is the spatial area that contains the organisms that are at risk of entrainment at a desalination facility* as determined by factors that may include but are not limited to biological, hydrodynamic, and oceanographic data.

SUBSURFACE INTAKE, for the purposes of chapter III.~~L~~M, is an intake withdrawing seawater* from the area beneath the ocean floor or beneath the surface of the earth inland from the ocean.

SURFGRASS BEDS are aggregations of marine flowering plants of the genus *Phyllospadix*.

Appendix 2

Dr. Peter Raimondi's Power Point Presentation to the California Coastal Commission

Review of Carlsbad Seawater Desalinization Project (CDP)

- General comments on report
- Assessment of calculations of Pm
  - Estuarine species
  - Open water species
- Assessment of mitigation alternative using APF calculations
  - Math
  - Habitats

General Comments

1) As written, the report could not be evaluated for the technical merits of the entrainment study or estimation of APF
   a) Tenera provided both a meeting to discuss the report and also provided the material needed to assess the entrainment study and APF calculations.
2) My assessment is based in part on calculations I did using material from the CDP report, the 316B report from Encina Power plant and from direct communication with Tenera
   a) Such calculations include: uncertainty analysis and APF for open coast species
3) The study design for entrainment sampling including source water sampling is consistent with recent entrainment studies conducted under 316B rules

General Comments

4) Calculations of Pm, SWB and APF are generally consistent with recent studies
   a) Note additional calculations shown in this presentation for uncertainty and open water species
5) Proposed mitigation at San Dieguito is the most likely alternative to lead to compensation for losses of estuarine larvae due to entrainment – if habitat created more closely mimics source water body
6) No mitigation was proposed for losses of larvae from open water habitats
   a) APF is small but non-zero
   b) Mitigation options with direct nexus to impact are difficult

Review of Carlsbad Seawater Desalinization Project (CDP)

- General comments on report
- Assessment of calculations of Pm
  - Estuarine species
  - Open water species
- Assessment of mitigation alternative using APF calculations
  - Math
  - Habitats

Assessment of calculations of Pm

- Proportional mortality (Pm) estimates are calculated using standard methodology
- Source water estimation is complicated for estuarine species (but in my opinion – correct)
- Source water estimation is standard for open water species
- Estimation of error rates is mathematically correct but, in my opinion, not appropriate for use in APF calculations
  - More about this later
- Uncertainty of estimates, particularly as they affect APF calculations is not adequately discussed
  - More about this later

Understanding Proportional Mortality (Pm)

- Pm is the proportion of larvae at risk that are estimated to die as a result of entrainment
- Larvae at risk is determined by source water body (SWB) which differs for estuarine vs open water species
  - For estuarine species, it is generally the area of Agua Hediondo Lagoon that could produce larvae entrained
  - For open water species, it is the area from which larvae could have traveled from and then be entrained
    - Based on age of larvae entrained

Calculated Pm, Standard Errors (SE) and Source water body (SWB) estimates

Species	Pm	Calcuated SE	Ratio SE/ Pm	Source water body *	Units
Estuarine					
Blennies	0.08635	0.1347	1.56	302	Acres
Gobies	0.21599	0.3084	1.43	302	Acres
Garibaldi	0.06484	0.1397	2.15	302	Acres
Open Water					
White Croaker	0.00138	0.0028	2.04	45	Km along shore
Northern Anchovy	0.00165	0.0026	1.56	21	Km along shore
California Halibut	0.00151	0.0024	1.58	37	Km along shore
Queenfish	0.00365	0.0049	1.33	27	Km along shore
Spotfin Croaker	0.00634	0.0153	2.41	19	Km along shore

*The source water body for estuarine species is actually different from this value, however it is assumed that larval production is primarily from 302 acres in Agua Hediondo Lagoon

Review of Carlsbad Seawater Desalinization Project (CDP)

- General comments on report
- Assessment of calculations of Pm
  - Estuarine species
  - Open water species
- Assessment of mitigation alternative using APF calculations
  - Math
  - Habitats

Use of Area of Production Foregone (APF) to estimate mitigation required to mitigate entrainment losses

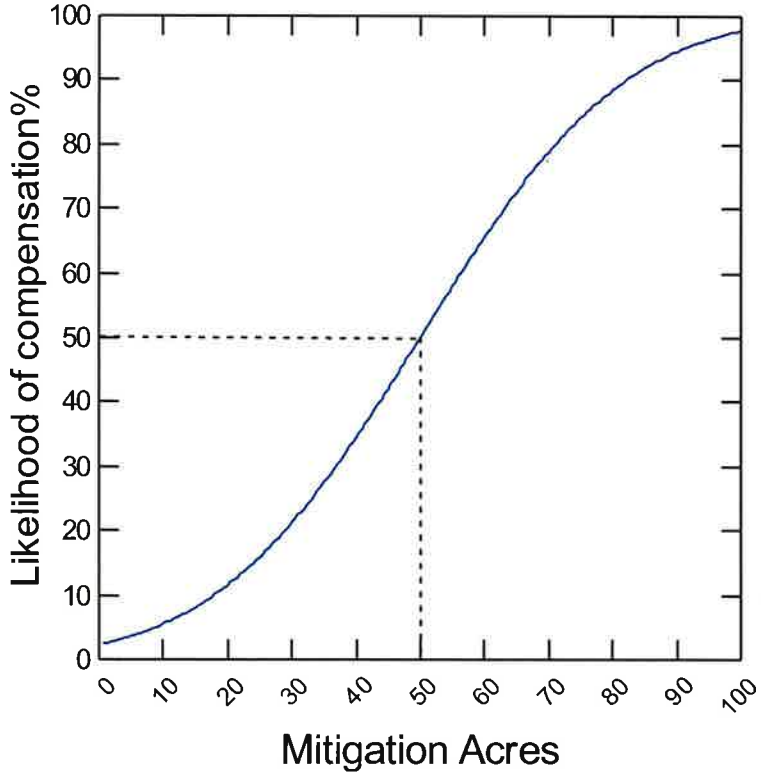
- Goal is to determine area required to provide sufficient habitat to produce larvae lost to entrainment
  - This area is the product of Pm and SWB
  - For example if the source water body (SWB) = 500 acres and Pm is 0.1 then the APF is

500 acres x 0.1 = 50 acres

  - This means that 50 new acres ***having a similar habitat mix as that in the SWB*** would produce larvae sufficient to make up for those lost to entrainment
  - This assumes no uncertainty in the estimation of Pm and SWB
    - The major issue is the error rate associated with estimation of Pm

Understanding uncertainty of compensation through mitigation using APF (direct impacts only)

For example: assume 500 acre SWB, Pm = 0.1, Standard Error / Pm = 0.5



For average likelihood (50%) , Acres ~ 50. This means that with the uncertainty associated with sampling, there is a 50% or greater likelihood that 50 new acres will provide full compensation for lost larval resources.

This assumes:

1. Mitigation acres are similar to those in SWB
2. Restoration is successful

Understanding uncertainty of compensation through mitigation using APF (direct impacts only)

Uncertainty in estimating compensation value of proposed mitigation is primarily related to error in estimation of Pm:

1)What is correct estimate of error?

a) Sampling error associated with estimation of Pm – *as shown in report*
   i. Source water concentrations of larvae – calculated error rates are very high and **probably not realistic** for use with respect to Pm
   ii. Entrainment concentrations of larvae – error rates are low and **probably not realistic** for use with respect to Pm

b) Error assuming each species' Pm is an independent replicate
   i. The most appropriate calculation of error, given the standard logic behind the use of APF

Now – consider the ratio of SE/Pm – which expresses uncertainty in terms of units of impact

Use of error in calculations

- Use of error to calculate cumulative confidence curves relies on decision as to which estimate of error is appropriate.
- I used a normal cumulative function to generate confidence curves.
  - This relies on mean value and estimate of the standard deviation of the population of means.
  - I concluded that sample standard deviation was inappropriate for use using this function and instead used the sample standard error as an estimate of the standard deviation of the population of means. Hence the calculation was:
    - Prob = ZCF((acres – mean acres)/calculated SE)
    - Where ZCF is the normal cumulative function
  - The use of SE led to more conservative (lower) estimate of (eg) 80% confidence limit than would have been the case if standard deviation was used.
  - This was evaluated using resampling approaches where possible (which make no assumptions about normality).

Calculated Pm, Standard Errors (SE) and Source water body (SWB) estimates

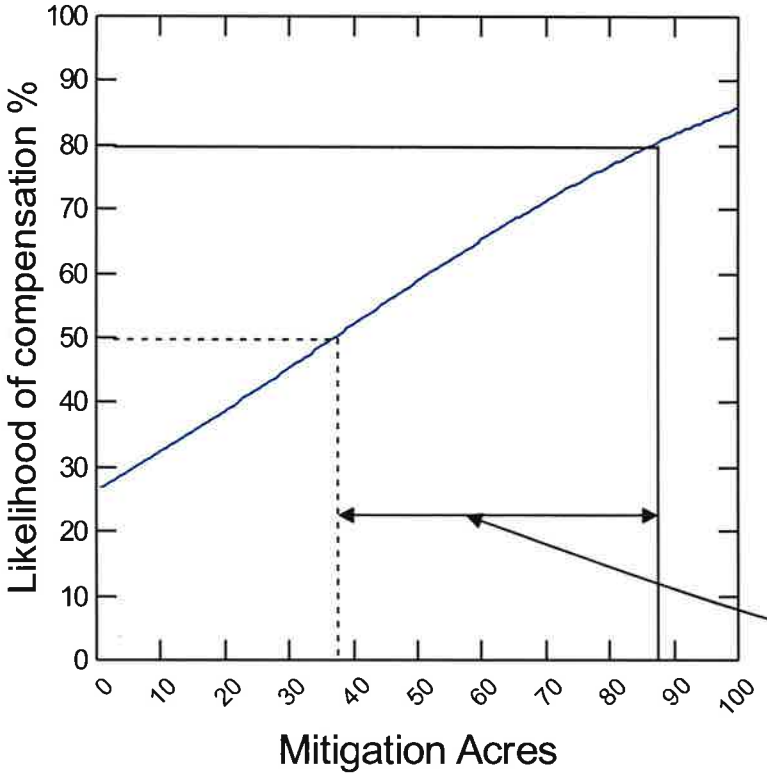
Species	Pm	Calcuated SE	Ratio SE/ Pm	Source water body	Units
Estuarine					
Blennies	0.08635	0.1347	1.56	302	Acres
Gobies	0.21599	0.3084	1.43	302	Acres
Garibaldi	0.06484	0.1397	2.15	302	Acres
Open Water					
White Croaker	0.00138	0.0028	2.04	45	Km along shore
Northern Anchovy	0.00165	0.0026	1.56	21	Km along shore
California Halibut	0.00151	0.0024	1.58	37	Km along shore
Queenfish	0.00365	0.0049	1.33	27	Km along shore
Spotfin Croaker	0.00634	0.0153	2.41	19	Km along shore

These are huge

Uncertainty of compensation through mitigation using APF

Estuarine Species (direct impacts only)

Case 1: using error rate calculated in report (SE dominated by source water concentration of larvae)

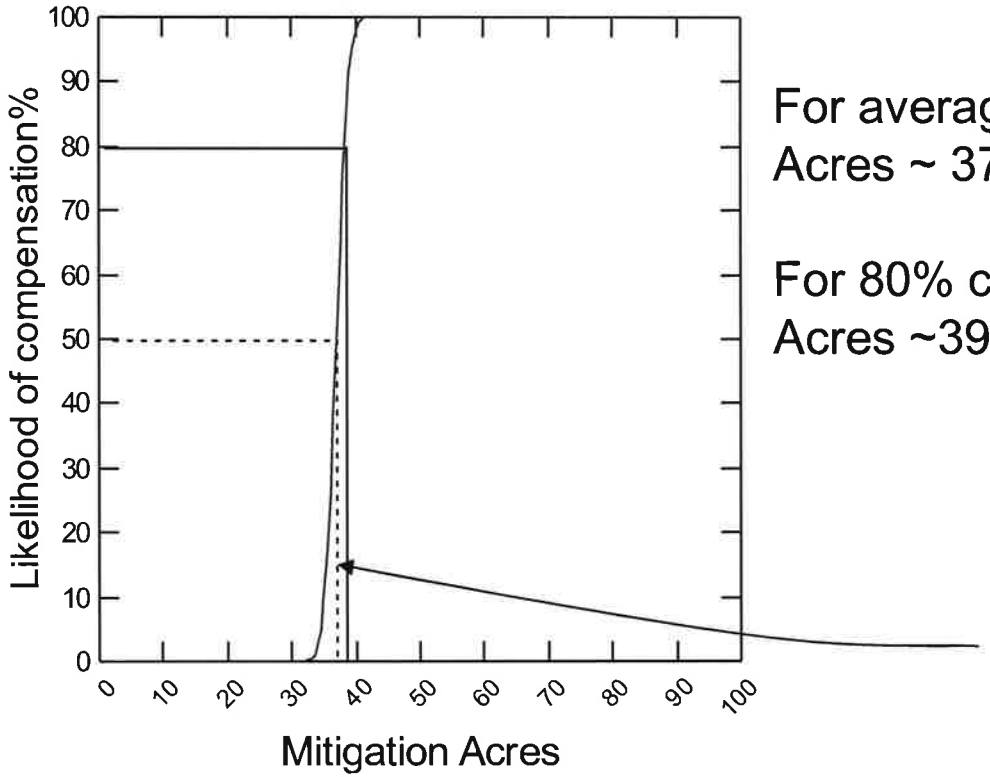


For average likelihood (50%)
Acres ~ 37

For 80% confidence level
Acres ~ 87

Big difference due to
Large SE/Pm ratio

Uncertainty of compensation through mitigation using APF
Estuarine Species (direct impacts only)
Case 2: using error rate calculated from entrainment estimates only (SE very low)



For average likelihood (50%)
Acres ~ 37

For 80% confidence level
Acres ~39

Small difference due to
Small SE/Pm ratio

Calculated Pm, Standard Errors (SE) and Source water body (SWB) estimates

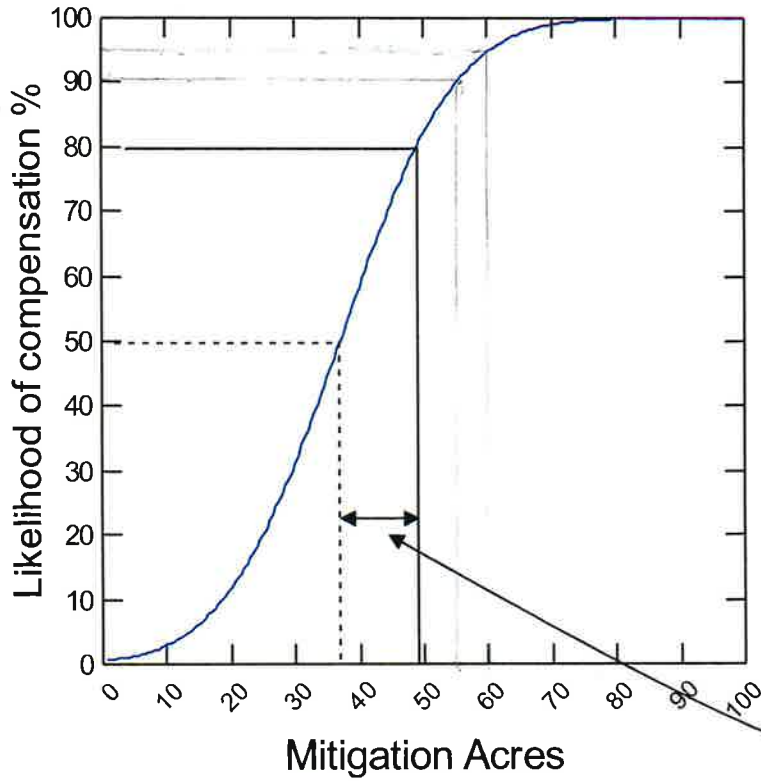
Species	Pm	Calcuated SE	Ratio SE/ Pm	Source water body	Units	APF	Source water body	Units	APF
Estuarine									
Blennies	0.08635	0.1347	1.56	302	Acres	26.0777			
Gobies	0.21599	0.3084	1.43	302	Acres	65.2290			
Garibaldi	0.06484	0.1397	2.15	302	Acres	19.5817			
Average	**0.12239**	0.1942				**36.9628**			
SE						**14.2570**			
Ratio SE/Pm						**0.3857**			
Open Water									
White Croaker	0.00138	0.0028	2.04	45	Km along shore*	0.0621	33365	Acres	46.0440
Northern Anchovy	0.00165	0.0026	1.56	21	Km along shore*	0.0347	15570	Acres	25.6912
California Halibut	0.00151	0.0024	1.58	37	Km along shore*	0.0560	27477	Acres	41.4907
Queenfish	0.00365	0.0049	1.33	27	Km along shore*	0.1000	20309	Acres	74.1289
Spotfin Croaker	0.00634	0.0153	2.41	19	Km along shore*	0.1175	13739	Acres	87.1029
Average						**0.0740**			**54.8916**
SE						**0.0151**			**11.2209**
Ratio SE/Pm						**0.2044**			**0.2044**

*** to a depth of 75 meters - average about 3 Km offshore**

Uncertainty of compensation through mitigation using APF

Estuarine Species (direct impacts only)

Case 3: using error rate calculated from species Pm estimates (*probably most accurate*)



For average likelihood (50%)
Acres ~ 37

For 80% confidence level
Acres ~49,

Using resampling
80% confidence level
Acres ~ 50

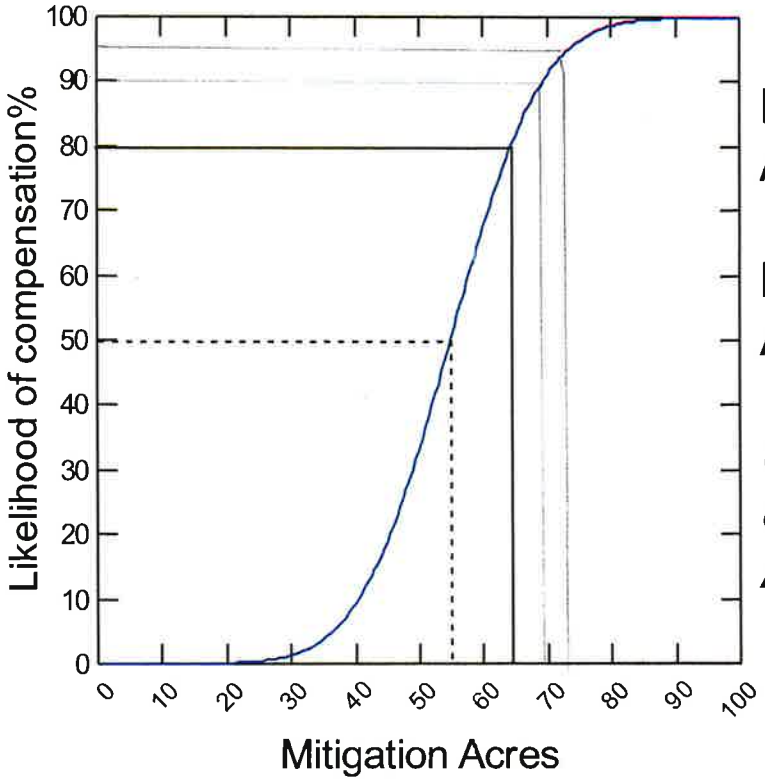
Relatively small difference due to appropriate SE/Pm ratio

Calculated Pm, Standard Errors (SE) and Source water body (SWB) estimates

Species	Pm	Calcuated SE	Ratio SE/ Pm	Source water body	Units	APF	Source water body	Units	APF
Estuarine									
Blennies	0.08635	0.1347	1.56	302	Acres	26.0777			
Gobies	0.21599	0.3084	1.43	302	Acres	65.2290			
Garibaldi	0.06484	0.1397	2.15	302	Acres	19.5817			
Average	**0.12239**	0.1942				**36.9628**			
SE						**14.2570**			
Ratio SE/Pm						**0.3857**			
Open Water									
White Croaker	0.00138	0.0028	2.04	45	Km along shore*	0.0621	33365	Acres	46.0440
Northern Anchovy	0.00165	0.0026	1.56	21	Km along shore*	0.0347	15570	Acres	25.6912
California Halibut	0.00151	0.0024	1.58	37	Km along shore*	0.0560	27477	Acres	41.4907
Queenfish	0.00365	0.0049	1.33	27	Km along shore*	0.1000	20309	Acres	74.1289
Spotfin Croaker	0.00634	0.0153	2.41	19	Km along shore*	0.1175	13739	Acres	87.1029
Average						**0.0740**			**54.8916**
SE						**0.0151**			**11.2209**
Ratio SE/Pm						**0.2044**			**0.2044**

*** to a depth of 75 meters - average about 3 Km offshore**

Uncertainty of compensation through mitigation using APF **Open Coast** Species (direct impacts only) Using error rate calculated from species Pm estimates (*probably most accurate*)



For average likelihood (50%)
Acres ~ 55

For 80% confidence level
Acres ~ 64

Using resampling
80% confidence level
Acres ~ 63

APF summary

1) APF for estuarine species
    1) Mean APF = 37 acres
    2) 80% confidence limit = 49 acres
    3) Habitat mix for mitigation should include mudflat / tidal channel and open water habitat
2) APF for open coast species
    1) Mean APF = 55 acres
    2) 80% confidence limit = 64 acres
    3) Habitat is primarily open water, sandy bottom
    4) Relatively small area
    5) No mitigation options discussed
        a) Options that could lead to direct compensation are difficult

Proposed Wetland Mitigation

1) Logic of APF as applied to wetland mitigation is appropriate for estuarine species losses
2) In my opinion the most appropriate mitigation discussed is offsite wetland creation at San Dieguito
   a) The mix of habitats should mirror those used in calculating APF at Agua Hediondo – currently they do not (use of salt marsh at San Dieguito)
   b) The ongoing restoration at San Dieguito, along with inlet maintenance and required monitoring make this the area most likely to be successfully used for compensatory mitigation
   c) Mitigation at Agua Hediondo as described, is unlikely to provide direct compensation for lost larval resources

Comments on discussion of "conservative assumptions" for APF

1) "Assumes 100% mortality of all marine organisms entering the intake"
   a) This is true but it is the same assumption that is made in all recent entrainment determinations. Moreover there is no study of post-entrainment larval survival that has been conducted in field conditions
2) "Assumes 100 % survival of all fish larvae in their natural environment"
   a) No such assumption is made. The only assumption concerning survival is that there is no compensatory mortality that affects Pm calculations.

Comments on discussion of "conservative assumptions" for APF

3) "Assumes species are evenly distributed throughout the entire depth and volume of the water body"
   a) No such assumption is made. The major assumption is that creation of a similar mix of habitats to that found in the source water body will lead to compensation for all species lost due to entrainment.
4) "Assumes the entire habitat from which the entrained fish larvae may have originated is destroyed"
   a) No such assumption is made concerning the source water body. APF calculations are based on the idea of estimating the area that would need to be added in order to lead to the compensatory production of larvae lost to entrainment. Other features of the source water body are assumed not to have been damaged.

Appendix 3

Brine Dilution Option Model Parameters Used

APPENDIX 3A. FLOW AUGMENTATION EMPIRICAL TRANSPORT MODEL AND AREA PRODUCTION FOREGONE MODEL PARAMETERS FOR EACH TAXON USED IN THE ANALYSIS. SURVEY = SURVEY IDENTIFIER FROM ENCINA POWER STATION 316(B) STUDY, ENTRAINMENT (ESTIMATE), SWP = SOURCE WATER POPULATION, P_E = PROPORTION ENTRAINED, DURATION = NUMBER OF DAYS THE LARVAE ARE EXPOSED TO ENTRAINMENT, P_M = PROPORTIONAL MORTALITY, AREA = SOURCE WATER AREA IN ACRES, F_I = WEIGHTING FACTOR, AND P_S = LONGSHORE-CROSS SHELF CURRENT SCALING FACTOR.

Survey	Entrainment	SWP	P_e	Duration	P_m	Area	f_i	P_s
CIQ Goby								
EPSEA001	1,333,379	293,477,734	0.004543	11.5	0.05102	302	0.116	
EPSEA002	1,050,423	146,640,669	0.007163	11.5	0.079349	302	0.0316	
EPSEA003	2,365,748	143,505,301	0.016485	11.5	0.174002	302	0.07955	
EPSEA004	4,525,063	177,952,299	0.025429	11.5	0.256369	302	0.18595	
EPSEA005	1,462,671	94,586,619	0.015464	11.5	0.164081	302	0.06335	
EPSEA006	724,020	68,450,670	0.010577	11.5	0.115105	302	0.04577	
EPSEA007	266,152	43,014,350	0.006188	11.5	0.06889	302	0.02347	
EPSEA008	151,148	49,901,581	0.003029	11.5	0.034284	302	0.02729	
EPSEA009	170,435	54,370,974	0.003135	11.5	0.035461	302	0.03878	
EPSEA010	763,455	245,900,000	0.003105	11.5	0.035128	302	0.14489	
EPSEA011	1,748,311	161,690,423	0.010813	11.5	0.117524	302	0.11674	
EPSEA012	1,715,525	82,917,234	0.02069	11.5	0.213707	302	0.0369	
EPSEA013	2,431,519	172,827,046	0.014069	11.5	0.150361	302	0.08971	
Engraulidae								
EPSEA001	11,564	107,327,778	0.000108	7.7	0.000829	15570	0.02259	0.30
EPSEA002	3,334	28,322,034	0.000118	7.7	0.000906	15570	0.00187	0.30
EPSEA003	39,527	151,219,847	0.000261	7.7	0.002011	15570	0.02319	0.30
EPSEA004	7,408	45,835,802	0.000162	7.7	0.001244	15570	0.01464	0.30
EPSEA005	2,947	295,420,000	9.98E-06	7.7	7.68E-05	15570	0.03618	0.30
EPSEA006	2,870	102,742,857	2.79E-05	7.7	0.000215	15570	0.01157	0.30
EPSEA007	31,103	133,230,769	0.000233	7.7	0.001796	15570	0.01404	0.30
EPSEA008	0	0	0	7.7	0	15570	0.00011	0.30
EPSEA009	1,440	80,211,111	1.8E-05	7.7	0.000138	15570	0.00834	0.30
EPSEA010	33,053	141,583,761	0.00023	7.7	0.00179	1557	0.0123	0.3

			3		6	0		0
EPSEA011	209,001	2,992,711,429	6.98E-05	7.7	0.000538	15570	0.42247	0.30
EPSEA012	434,373	4,442,744,898	9.78E-05	7.7	0.000753	15570	0.42965	0.30
EPSEA013	353,503	32,585,102	0.010849	7.7	0.08056	15570	0.00305	0.30
Genyonemus lineatus								
EPSEA001	0	0	0	26.5	0	33365	0.00001	0.14
EPSEA002	0	0	0	26.5	0	33365	0.00187	0.14
EPSEA003	0	0	0	26.5	0	33365	0.00989	0.14
EPSEA004	1,252	19,018,182	6.58E-05	26.5	0.001743	33365	0.02103	0.14
EPSEA005	10,739	768,885,714	1.4E-05	26.5	0.00037	33365	0.35414	0.14
EPSEA006	0	0	0	26.5	0	33365	0.03043	0.14
EPSEA007	5,124	214,000,000	2.39E-05	26.5	0.000634	33365	0.07183	0.14
EPSEA008	1,597	20,012,500	7.98E-05	26.5	0.002113	33365	0.00574	0.14
EPSEA009	4,207	72,696,552	5.79E-05	26.5	0.001532	33365	0.04775	0.14
EPSEA010	17,266	309,035,714	5.59E-05	26.5	0.00148	33365	0.13805	0.14
EPSEA011	5,941	595,480,000	9.98E-06	26.5	0.000264	33365	0.26954	0.14
EPSEA012	13,130	78,340,476	0.000168	26.5	0.004432	33365	0.04449	0.14
EPSEA013	0	0	0	26.5	0	33365	0.00523	0.14
***Hypsoblennius* spp.**								
EPSEA001	1,755,765	122,964,799	0.014279	2.7	0.038086	302	0.29923	
EPSEA002	775,070	102,599,392	0.007554	2.7	0.020266	302	0.12245	
EPSEA003	1,202,788	130,194,514	0.009238	2.7	0.024748	302	0.13375	
EPSEA004	2,524,840	85,423,155	0.029557	2.7	0.077812	302	0.26395	
EPSEA005	1,331,007	38,654,476	0.034433	2.7	0.090271	302	0.05771	
EPSEA006	178,538	3,575,251	0.049937	2.7	0.129174	302	0.00319	
EPSEA007	207,734	6,849,793	0.030327	2.7	0.079787	302	0.00523	
EPSEA008	7,607	121,364	0.062679	2.7	0.16035	302	0.00035	
EPSEA009	5,521	37,106	0.14879	2.7	0.35271	302	0.00004	
EPSEA010	0	0	0	2.7	0	302	0.00001	
EPSEA011	64,394	2,517,945	0.025574	2.7	0.067558	302	0.00327	
EPSEA012	112,731	8,021,780	0.014053	2.7	0.037492	302	0.00885	
EPSEA013	1,156,003	70,463,841	0.01640	2.7	0.04368	302	0.1019	

			6				7	
Hypsypops rubicundus								
EPSEA001	173,936	11,180,121	0.015558	2.2	0.033908	302	0.62469	
EPSEA002	15,156	1,072,096	0.014137	2.2	0.030837	302	0.05168	
EPSEA003	49,549	6,331,591	0.007826	2.2	0.017136	302	0.17163	
EPSEA004	10,737	403,638	0.026601	2.2	0.057589	302	0.04004	
EPSEA005	0	0	0	2.2	0	302	0	
EPSEA006	0	0	0	2.2	0	302	0	
EPSEA007	0	0	0	2.2	0	302	0	
EPSEA008	0	0	0	2.2	0	302	0	
EPSEA009	0	0	0	2.2	0	302	0	
EPSEA010	0	0	0	2.2	0	302	0	
EPSEA011	0	0	0	2.2	0	302	0	
EPSEA012	19,774	581,135	0.034027	2.2	0.073334	302	0.01825	
EPSEA013	75,814	1,961,969	0.038642	2.2	0.083046	302	0.09371	
Paralichthys californicus								
EPSEA001	1,555	48,700,000	3.19E-05	31.1	0.000993	27477	0.03876	0.17
EPSEA002	0	0	0	31.1	0	27477	0.03912	0.17
EPSEA003	0	0	0	31.1	0	27477	0.2564	0.17
EPSEA004	1,351	67,730,000	1.99E-05	31.1	0.00062	27477	0.08947	0.17
EPSEA005	8,791	489,522,222	1.8E-05	31.1	0.000558	27477	0.36188	0.17
EPSEA006	3,389	51,463,636	6.59E-05	31.1	0.002046	27477	0.04843	0.17
EPSEA007	1,131	23,612,500	4.79E-05	31.1	0.001489	27477	0.01426	0.17
EPSEA008	1,435	9,340,260	0.000154	31.1	0.004767	27477	0.00498	0.17
EPSEA009	2,851	7,601,064	0.000375	31.1	0.011599	27477	0.00915	0.17
EPSEA010	3,720	56,490,909	6.59E-05	31.1	0.002046	27477	0.04461	0.17
EPSEA011	1,176	73,687,500	1.6E-05	31.1	0.000496	27477	0.06386	0.17
EPSEA012	4,607	19,734,188	0.000233	31.1	0.007235	27477	0.01923	0.17
EPSEA013	1,378	9,590,278	0.000144	31.1	0.004459	27477	0.00985	0.17
Roncador stearnsii								
EPSEA001	1,555	59,938,462	2.59E-05	11.4	0.000296	13739	0.27272	0.34
EPSEA002	1,663	59,542,857	2.79E-05	11.4	0.000318	13739	0.15573	0.34
EPSEA003	22,180	37,052,667	0.000599	11.4	0.006803	13739	0.1705	0.34
EPSEA004	1,351	9,152,703	0.000148	11.4	0.001681	13739	0.06863	0.34
EPSEA005	43,396	74,995,172	0.00057	11.4	0.00657	1373	0.3323	0.3

			9		7	9	9	4
EPSEA006	0	0	0	11.4	0	13739	0	0.34
EPSEA007	0	0	0	11.4	0	13739	0	0.34
EPSEA008	0	0	0	11.4	0	13739	0	0.34
EPSEA009	0	0	0	11.4	0	13739	0	0.34
EPSEA010	0	0	0	11.4	0	13739	0	0.34
EPSEA011	0	0	0	11.4	0	13739	0	0.34
EPSEA012	0	0	0	11.4	0	13739	0.00003	0.34
EPSEA013	0	0	0	11.4	0	13739	0	0.34
Seriphus politus								
EPSEA001	4,304	61,634,286	6.98E-05	21.6	0.001507	20309	0.15001	0.23
EPSEA002	0	0	0	21.6	0	20309	0.23205	0.23
EPSEA003	0	0	0	21.6	0	20309	0.12955	0.23
EPSEA004	4,132	9,411,818	0.000439	21.6	0.00944	20309	0.03996	0.23
EPSEA005	34,787	249,057,143	0.00014	21.6	0.003013	20309	0.4408	0.23
EPSEA006	3,090	2,547,204	0.001213	21.6	0.025878	20309	0.00522	0.23
EPSEA007	0	0	0	21.6	0	20309	0	0.23
EPSEA008	0	0	0	21.6	0	20309	0	0.23
EPSEA009	0	0	0	21.6	0	20309	0	0.23
EPSEA010	0	0	0	21.6	0	20309	0	0.23
EPSEA011	0	0	0	21.6	0	20309	0	0.23
EPSEA012	0	0	0	21.6	0	20309	0.00242	0.23
EPSEA013	0	0	0	21.6	0	20309	0	0.23

APPENDIX 3B. DIFFUSER DISCHARGE USING DATA FROM STATION N4 EMPIRICAL TRANSPORT MODEL AND AREA PRODUCTION FOREGONE MODEL PARAMETERS FOR EACH TAXON USED IN THE ANALYSIS. SURVEY = SURVEY IDENTIFIER FROM ENCINA POWER STATION 316(B) STUDY, ENTRAINMENT (ESTIMATE), P_E = PROPORTION ENTRAINED, AND P_M = PROPORTIONAL MORTALITY. THE SWP, DURATION, AREA, F_I, AND P_S DATA PRESENTED IN APPENDIX 3A ARE USED IN THIS ANALYSIS AS WELL.

Survey	Entrainment	P_e	P_m
CIQ Goby			
EPSEA001	0	0	0
EPSEA002	7,379	5.032E-05	0.000578
EPSEA003	12,763	8.894E-05	0.001022
EPSEA004	67,450	0.000379	0.00435
EPSEA005	22,984	0.000243	0.002791
EPSEA006	0	0	0
EPSEA007	0	0	0
EPSEA008	3,670	7.354E-05	0.000845
EPSEA009	11,825	0.0002175	0.002498
EPSEA010	29,818	0.0001213	0.001394
EPSEA011	8,253	5.104E-05	0.000587
EPSEA012	3,900	4.703E-05	0.000541
EPSEA013	12,537	7.254E-05	0.000834
Engraulidae			
EPSEA001	231,195	0.0021541	0.016467
EPSEA002	36,811	0.0012997	0.009964
EPSEA003	234,901	0.0015534	0.011899
EPSEA004	55,730	0.0012159	0.009324
EPSEA005	93,424	0.0003162	0.002432
EPSEA006	58,589	0.0005702	0.004383
EPSEA007	145,092	0.001089	0.008355
EPSEA008	0	0	0
EPSEA009	47,428	0.0005913	0.004544
EPSEA010	34,079	0.0002407	0.001852
EPSEA011	1,566,548	0.0005235	0.004024
EPSEA012	3,622,445	0.0008154	0.006261
EPSEA013	7,643	0.0002346	0.001805
Genyonemus lineatus			
EPSEA001	0	0	0
EPSEA002	0	0	0
EPSEA003	25,070	0	0
EPSEA004	10,184	0.0005355	0.014094
EPSEA005	378,391	0.0004921	0.01296
EPSEA006	23,238	0	0
EPSEA007	93,085	0.000435	0.011463
EPSEA008	13,012	0.0006502	0.017087
EPSEA009	50,541	0.0006952	0.018261
EPSEA010	160,336	0.0005188	0.013658
EPSEA011	177,282	0.0002977	0.00786
EPSEA012	8,409	0.0001073	0.002841

EPSEA013	8,301	0	0
***Hypsoblennius* spp.**			
EPSEA001	29,161	0.0002371	0.00064
EPSEA002	183,907	0.0017925	0.004832
EPSEA003	21,423	0.0001645	0.000444
EPSEA004	486,032	0.0056897	0.015288
EPSEA005	82,534	0.0021352	0.005754
EPSEA006	3,709	0.0010373	0.002798
EPSEA007	7,917	0.0011557	0.003117
EPSEA008	0	0	0
EPSEA009	0	0	0
EPSEA010	0	0	0
EPSEA011	3,696	0.001468	0.003959
EPSEA012	0	0	0
EPSEA013	107,616	0.0015273	0.004118
Hypsypops rubicundus			
EPSEA001	0	0	0
EPSEA002	3,167	0.0029537	0.006487
EPSEA003	7,467	0.0011793	0.002593
EPSEA004	0	0	0
EPSEA005	0	0	0
EPSEA006	0	0	0
EPSEA007	0	0	0
EPSEA008	0	0	0
EPSEA009	0	0	0
EPSEA010	0	0	0
EPSEA011	0	0	0
EPSEA012	0	0	0
EPSEA013	17,963	0.0091554	0.020031
Paralichthys californicus			
EPSEA001	27,756	0.0005699	0.017574
EPSEA002	43,600	0	0
EPSEA003	352,071	0	0
EPSEA004	116,506	0.0017202	0.052135
EPSEA005	410,717	0.000839	0.025767
EPSEA006	7,487	0.0001455	0.004515
EPSEA007	14,646	0.0006203	0.019111
EPSEA008	0	0	0
EPSEA009	3,926	0.0005166	0.015941
EPSEA010	19,719	0.0003491	0.010799
EPSEA011	33,013	0.000448	0.01384
EPSEA012	8,882	0.0004501	0.013903
EPSEA013	3,152	0.0003287	0.010172
Roncador stearnsii			
EPSEA001	40,815	0.0006809	0.007735
EPSEA002	77,537	0.0013022	0.014745
EPSEA003	49,130	0.0013259	0.015012
EPSEA004	0	0	0
EPSEA005	24,247	0.0003233	0.00368

EPSEA006	0	0	0
EPSEA007	0	0	0
EPSEA008	0	0	0
EPSEA009	0	0	0
EPSEA010	0	0	0
EPSEA011	0	0	0
EPSEA012	0	0	0
EPSEA013	0	0	0
Seriphus politus			
EPSEA001	63,528	0.0010307	0.022029
EPSEA002	71,500	0	0
EPSEA003	110,464	0	0
EPSEA004	11,030	0.0011719	0.02501
EPSEA005	187,650	0.0007534	0.016149
EPSEA006	3,709	0.001456	0.030983
EPSEA007	0	0	0
EPSEA008	0	0	0
EPSEA009	0	0	0
EPSEA010	0	0	0
EPSEA011	0	0	0
EPSEA012	0	0	0
EPSEA013	0	0	0

Appendix 4

Reanalysis of Encina Power Station Data Assuming 304 Million Gallons Per Day

Empirical transport modeling using 304 million gallons withdrawn by the CDF to calculate the proportional mortality (P_m) but excluding the ratio of source water sampled to the total source water for the species (P_s). Dr. Peter Raimondi's P_m values were drawn from his presentation to the California Coastal Commission on April 25, 2008.

Species	Habitat	P_m	Raimondi P_m	P_m Difference
CIQ Goby	Est	0.215512	0.21599	0.000
***Hypsoblennius* spp.**	Est	0.085507	0.08635	-0.001
Hypsypops rubicundus	Est	0.065375	0.06484	0.001
Engraulis mordax	OC	0.00165	0.00165	0.000
Genyonemus lineatus	OC	0.00137	0.00138	0.000
Paralichthys californicus	OC	0.001513	0.00151	0.000
Roncador stearnsii	OC	0.006371	0.00634	0.000
Seriphus politus	OC	0.003656	0.00365	0.000

Empirical transport modeling using 304 million gallons withdrawn by the CDF to calculate the proportional mortality (P_m) but including the ratio of source water sampled to the total source water for the species (P_s). Dr. Peter Raimondi's P_m values were drawn from his presentation to the California Coastal Commission on April 25, 2008.

Species	Habitat	P_m	Raimondi P_m	P_m Difference
CIQ Goby	Est	0.215512	0.21599	0.000
***Hypsoblennius* spp.**	Est	0.085507	0.08635	-0.001
Hypsypops rubicundus	Est	0.065375	0.06484	0.001
Engraulis mordax	OC	0.000501	0.00165	-0.001
Genyonemus lineatus	OC	0.000192	0.00138	-0.001
Paralichthys californicus	OC	0.000258	0.00151	-0.001
Roncador stearnsii	OC	0.002173	0.00634	-0.004
Seriphus politus	OC	0.000836	0.00365	-0.003