To: Gerald W. Bowes, Ph.D.
Manager, Cal/EPA Scientific Peer Review Program
Office of Research, Planning and Performance
State Water Resources Control Board

Original Signed by

From: Victoria A. Whitney, Deputy Director
Division of Water Quality

Date: June 18, 2014

Re: REQUEST FOR EXTERNAL PEER REVIEW OF A PROPOSED AMENDMENT TO THE WATER QUALITY CONTROL PLAN FOR CALIFORNIA OCEAN WATERS TO ADDRESS DESALINATION FACILITY INTAKES, BRINE DISCHARGES, AND TO INCORPORATE OTHER NONSUBSTANTIVE CHANGES

The State Water Resources Control Board (State Water Board), Division of Water Quality requests that reviewers be identified and assigned to provide external peer review of the proposed amendment to the State Water Quality Control Plan for California Ocean Waters (Ocean Plan) to address desalination facility intakes, brine discharges, and to incorporate other non-substantive changes (Desalination Amendments) per the requirements of Health and Safety Code section 57004.

The State Water Board developed the Desalination Amendments to address the degradation of water quality and marine communities associated with the construction and operation of desalination facilities. The issue has been identified as a high priority for the State Water Board because several new desalination facilities have been planned along the California coast to augment existing potable water supplies. Currently, the State Water Board regulates brine discharges from desalination facilities through the issuance of National Pollutant Discharge Elimination System permits. However, the Ocean Plan does not yet have an objective for elevated salinity levels in the ocean, nor does it describe how brine discharges are to be regulated and controlled. The Ocean Plan also does not address impacts to marine life from desalination facility intakes. Thus, the proposed Desalination Amendments address the following issues: 1) procedures for Regional Water Boards to evaluate the best site, design, technology, and mitigation measures to minimize adverse impacts to aquatic life at new or expanded desalination facilities; 2) industry specific receiving water limits for salinity; 3) implementation and monitoring provisions for discharges of waste brine; and 4) provisions protecting sensitive habitats, species, Marine Protected Areas, and State Water Quality Protection Areas from degradation associated with desalination intakes and discharges; and 5) monitoring requirements. We recommend reviewers be solicited with expertise in marine ecology, design of oceanographic models for discharge outfalls, marine toxicology, civil or environmental engineering, and environmental fluid mechanics.

The title of the document we request to be reviewed is the “Proposed Amendments to Statewide Water Quality Control Plan to Address Desalination Facility Intakes, Brine Discharges, and to Incorporate Other Non-substantive Changes”. The supporting document for this proposed amendment is the Substitute Environmental Document which contains the draft staff report. References and documents will be available via CD and FTP site on July 1, 2014.

A summary of the proposed Desalination Amendments is provided in Attachment 1. Scientific conclusions to be addressed by peer reviewers are listed in Attachment 2. The names of participants involved in developing the proposed Desalination Amendment are listed in Attachment 3.

If you have further questions, please feel free to contact, Dr. Maria de la Paz Carpio-Obeso, Ocean Unit Chief, at (916) 341-5858.

Summary of the Proposed Amendments to Water Quality Control Plan for California Ocean Waters to address Desalination Facilities Intakes, Brine Discharges, and to Incorporate Other Non-substantive Changes

Summary

The State Water Resources Control Board (State Water Board) is proposing an amendment to the Water Quality Control Plan for California Ocean Waters (California Ocean Plan) to establish a uniform approach for preventing adverse impacts to beneficial uses of ocean waters due to seawater intake and discharge of brine wastes from desalination facilities. The proposed amendment includes: 1) implementation procedures for Regional Water Boards to evaluate the best site, design, technology, and mitigation measures to minimize adverse impacts to aquatic life at new or expanded desalination facilities; 2) industry specific receiving water limits for salinity; 3) implementation and monitoring provisions for discharges of waste brine; 4) provisions protecting sensitive habitats, species, Marine Protected Areas, and State Water Quality Protection Areas from degradation associated with desalination intakes and discharges; and 5) monitoring requirements.

Problem Statement

Population growth in dry coastal areas of California, combined with extended droughts, dwindling local water supplies, and inter-basin transfers have increased the demand for reliable municipal water supplies, and led water agencies and managers to consider desalination as part of an overall water portfolio. The number of desalination and water recycling projects are increasing along the California coastline, making it important for the Ocean Plan to provide clear and consistent requirements.

At present, there are no Ocean Plan provisions implementing the California Water Code section 13142.5, subdivision (b) requirement that the “best available site, design, technology, and mitigation measures feasible be used to minimize the intake and mortality of all forms of marine life” by new or expanded industrial seawater intakes. Also, there are no provisions that specifically address elevated salinity in receiving waters due to brine waste discharges. Untreated brine waste discharged into the ocean has different properties than waste water treatment plant effluent. An undiluted "brine waste" plume is denser than the receiving ocean water due to its increased salinity, and can settle on the ocean floor resulting in adverse effects on bottom-dwelling marine organisms.

Project Goals

- Amend the California Ocean Plan to include the following:

    a. Applicability of the amendments to new, expanded, and existing desalination facilities.
    b. Guidance for the Regional Water Boards on how to evaluate the best site, design, technology, and mitigation measures feasible to minimize intake and mortality of all forms of marine life.
    c. A receiving water limit for salinity that is applicable to all desalination facilities.
    d. Discharge provisions to ensure sufficient dilution to meet the receiving water limit for salinity.
    e. Monitoring requirements to ensure that intake and discharge goals are being met.

Specific Expertise Requirements

- **Marine ecology (2)**
  The marine ecologist should have expertise in California marine biological species and communities and their relationship with the physical ocean environment. Knowledge of larval production of California species and larval dispersal modeling is desired.

- **Marine toxicology**
  The marine toxicologist should have expertise in the salinity tolerance range for California marine organisms and the acute and chronic adverse effects of elevated salinity in the marine environment. Knowledge of how anoxia or hypoxia impact marine organisms is also desired.

- **Marine civil or environmental engineering**
  The engineer should have expertise in the design and construction of intake screens, subsurface intakes, discharge outfalls, and multiport diffusers.

- **Environmental fluid mechanics**
  The fluid mechanics expert should have expertise in the application principles of fluid mechanics to the design of water intakes and discharges of non-buoyant waste into coastal waters. The fluid mechanics expert should be able to evaluate and compare brine dilution methods including flow augmentation (in-plant dilution), commingling with wastewater, and discharging through multiport diffusers.

References and all relevant documents will be available to the reviewers via CD and FTP site.

Description of Scientific Conclusions to be Addressed by Peer Reviewers

The statutory mandate for external scientific peer review (Health and Safety Code § 57004) states that the reviewer's responsibility is to determine whether the scientific portion of the proposed rule is based upon sound scientific knowledge, judgment, methods, and practices.

We request that each reviewer make this determination for each of the following conclusions that constitute the scientific basis of the proposed regulatory action. An explanatory statement is provided for each issue to focus the review.

The State Water Resources Control Board (State Water Board) requests that the peer reviewers review the draft Desalination Amendments to the State Water Board's California Ocean Plan, the supporting scientific literature, and Expert Review Panel reports that are the basis for the draft plan amendment.

1. A receiving water salinity limit of two parts per thousand (ppt) above natural background salinity is protective of marine communities and beneficial uses.

Typical brine from a reverse osmosis (RO) desalination facility will have a salinity concentration approximately twice that of seawater. The Southern California Coastal Water Research Project assembled a panel of experts that reviewed the effects of elevated salinity on marine organisms. The panel concluded that elevated salinity may adversely impact marine organisms when salinity is elevated 2-3 ppt above natural background. A detailed summary of these findings can be found in the Brine Discharge Panel Report (link below). A hyper-salinity toxicity study was performed by the University of California, Davis, Department of Environmental Toxicology (Granite Canyon Study) using U.S. EPA west coast toxicity test methods. The study showed red abalone, purple urchins, and sand dollars were most developmentally sensitive to brine. Developmental effects were seen in red abalone at increases of 1.6 ppt above ambient salinity. Based on the review by the Brine Discharge Panel and the results of the Granite Canyon study, staff proposed a salinity limit of no more than 2 ppt above natural background salinity. The proposed receiving water limit for salinity would apply only to desalination facilities. Discussion of this conclusion can be found in the "Issues and Alternatives" Section 8.7 of the Staff Report. The Brine Panel Report and the Granite Canyon Study can be found here:

Brine Panel Report
http://www.waterboards.ca.gov/water_issues/programs/ocean/desalination/docs/dpr.pdf

Granite Canyon Study

http://www.swrcb.ca.gov/water_issues/programs/ocean/desalination/docs/saltoxfr08012.pdf

2. A subsurface seawater intake will minimize impingement and entrainment of marine life.

Desalination facilities can withdraw seawater through surface or subsurface intakes. A surface water intake system consists of a submerged open or screened pipe that withdraws ocean water into the desalination facility. Surface water intakes pull in or entrain marine organisms along with the source water. If the intake pipe is screened, fish and other biota can become

trapped against the screens or impinged. Impinged organisms may survive, but mortality is assumed to be 100 percent for entrained organisms.

A subsurface intake pulls in water from below the ground or seafloor either through a well or infiltration gallery. Studies have shown that impingement and entrainment are minimized or eliminated through the use of subsurface intakes because the sediment acts as a natural filter and barrier in preventing organisms from being pulled into the facility. Typically, intake flow rates at subsurface intakes are too low to impinge organisms at subsurface intakes. Under the assumption that a subsurface intake results in negligible impingement and entrainment, the draft amendment proposes that facilities be required to evaluate whether subsurface intakes are a feasible method of obtaining seawater before selecting an intake system. This requirement is discussed in Section 8.3 of the Staff Report.

3. A 0.5 mm, 0.75 mm, 1.0 mm, or other slot sized screens installed on surface water intake pipes reduces entrainment.

Surface water intakes entrain biota when withdrawing seawater. Intake entrainment is considered to be fatal for any organism drawn into the RO facility. Wedgewire screening technologies have been used at power plants and desalination facilities to reduce entrainment. Studies have shown that wedgewire screens are effective at reducing entrainment. There are many studies that have reviewed entrainment at variable screen slot sizes and have shown 0.5 mm, 0.75 mm, 1.0mm, and other slot sized screens can reduce entrainment at varying degrees. Screens with small slot sizes (0.5 mm, 0.75 mm, and 1.0 mm) are assumed to be feasible and a protective mechanism to prevent marine life entrainment from a surface water intake. The State Water Board intends to select a single slot size, but is soliciting comments on whether 0.5 mm, 0.75 mm, 1.0 mm, or some other slot size is most appropriate to minimize intake and mortality of marine life. This conclusion is discussed in Section 8.3 of the Staff Report.

4. Multiport diffusers and commingling brine with other effluents can dilute brine discharge and provide protection to aquatic life.

Discharge of undiluted brine can create dense, negatively buoyant plumes that settle on the seafloor and adversely affect the benthic ecosystem. To prevent these plumes, the amendment would require brine to either be discharged through multiport diffusers or commingled with other wastewater effluents to meet the salinity receiving water limit. Commingling with a sufficient volume of wastewater can dilute brine to non-toxic levels prior to discharge and would result in either positively or neutrally buoyant plumes. Alternatively, facilities could use multiport diffusers to achieve the necessary dilution within a relatively small area. Although recent studies have found that diffusers may shear organisms and result in marine life mortality, the mortality is less than would be expected with a third brine dilution strategy, flow-augmentation. Flow-augmentation is a type of in-plant dilution where additional seawater is withdrawn from the ocean to dilute brine prior to discharge. Currently, flow-augmentation intake systems are not designed to keep organisms in the intake water alive; however, it may be possible to design a flow-augmentation system to facilitate the passage of live biota through the system and still achieve adequate brine dilution.

The Expert Review Panel on Intake Impacts and Mitigation (ERP III) was asked to compare marine life mortality that occurs as a result of diffusers to that which would occur as the result of flow augmentation. ERP III concluded that multiport diffusers and commingling brine with wastewater are the most protective methods for disposing of brine, while acknowledging the possibility of a flow augmentation design that is as protective as discharging through multiport

diffusers or commingling brine with wastewater. Consequently, the draft amendment allows for alternative technologies, such as flow-augmentation, to be used if project proponents can demonstrate them to be as environmentally protective as diffuser discharge. Brine discharge methods are discussed in Section 8.6 of the Staff Report. The ERP III Final Report can be found here:

http://www.waterboards.ca.gov/water_issues/programs/ocean/desalination/docs/erp_final.pdf

5. The Area Production Forgone (APF) method using an Empirical Transport Model (ETM) can effectively calculate the mitigation area for a facility's intakes.

The draft amendment requires that an owner or operator proposing to use a surface water intake must employ impingement and entrainment avoidance technologies; however, residual entrainment will still occur. The ETM/ APF method estimates the area of habitat (in acreage) required to compensate for intake-related mortality. The ETM/APF method was recommended by the ERP II and III as the most appropriate method to use when determining the mitigation area to compensate for intake-related mortality. This conclusion is discussed in Section 8.5 of the Staff Report. The ERP II and III Final Reports can be found here:

ERP II
http://www.waterboards.ca.gov/water_issues/programs/ocean/desalination/docs/erp_intake052512.pdf

ERP III
http://www.waterboards.ca.gov/water_issues/programs/ocean/desalination/docs/erp_final.pdf

Reviewers are not limited to addressing only the specific conclusions presented above, and are asked to contemplate the following questions:

1. In reading the Substitute Environmental Document that also comprises the Staff Report and proposed amendment language, are there any additional scientific findings that are part of the scientific basis of the proposed rule not described above?

2. Taken as a whole, is the scientific portion of the proposed rule based upon sound scientific knowledge, methods, and practices?

Reviewers should also note that some proposed actions may rely significantly on professional judgment where available scientific data are not as extensive as desired to support the statute requirement. In these situations, the proposed course of action is favored over no action.

The preceding guidance will ensure that reviewers have an opportunity to comment on all aspects of the scientific basis of the proposed Board action. At the same time, reviewers should recognize that the Board has a legal obligation to consider and respond to all feedback on the scientific portions of the proposed rule. Because of this obligation, reviewers are encouraged to focus feedback on scientific conclusions that are relevant to the central regulatory elements being proposed.

Names of Participants Involved in Developing the Proposed Desalination Amendment

1. Expert Review Panel II on Intake Impacts and Mitigation – Final Report on March 14, 2012
    a. Michael S. Foster, Moss Landing Marine Laboratories
    b. Gregor M. Cailliet, Moss Landing Marine Laboratories
    c. John Callaway, University of San Francisco
    d. Peter Raimondi, University of California, Santa Cruz
    e. John Steinbeck, Tenera Environmental

2. Expert Panel on Impacts and Effects of Brine Discharges – Final Report June 7, 2012
    a. Scott Jenkins ,Scripps Institute of Oceanography
    b. Jeffrey Paduan, Naval Post Graduate School
    c. Philip J.W. Roberts, Consulting Engineer (Georgia Institute of Technology)
    d. Daniel Schlenk, University of California, Riverside
    e. Judith Weis, Rutgers University
    f. Steve Bay, Southern California Coastal Water Research Project

3. Hyper-Salinity Toxicity Thresholds for Nine California Ocean Plan Toxicity Test Protocols – Final Report July 2012
    a. Bryn M. Phillips, UC Davis Marine Pollution Studies Lab, Granite Canyon
    b. Brian S. Anderson UC Davis Marine Pollution Studies Lab, Granite Canyon
    c. Katie Siegler; UC Davis Marine Pollution Studies Lab, Granite Canyon
    d. Jennifer P. Voorhees; UC Davis Marine Pollution Studies, Lab Granite Canyon
    e. Scott Katz, UC Davis Marine Pollution Studies Lab, Granite Canyon
    f. Lydia Jennings; UC Davis Marine Pollution Studies, Lab Granite Canyon
    g. Ron S. Tjeerdema; UC Davis Department of Environmental Toxicology

4. Scientific Review and Rebuttal of the SCCWRP Expert Panel report on Brine Discharge Management – Report submitted February 2013
    a. Daniel P. Cartamil. Southern California Coastal Water Research Project

5. Analytic Comparisons of Brine Discharge Strategies Relative to Recommendations of the SWRCB Brine Panel Report: In-Plant Dilution vs. High Velocity Diffuser Alternatives at the Carlsbad Desalination Project. Sept 20, 2013
    a. Scott A. Jenkins, Scripps Institute of Oceanography
    b. Joseph Wasyl, Scott A. Jenkins Consulting

6. Expert Review Panel III on Intake Impacts and Mitigation – Final Report Submitted October 9, 2013
    a. Michael S. Foster, Moss Landing Marine Laboratories
    b. Gregor M. Cailliet, Moss Landing Marine Laboratories
    c. John Callaway, University of San Francisco
    d. Kristina Mead Vetter, Consulting Biologist
    e. Peter Raimondi, University of California, Santa Cruz
    f. Philip J.W. Roberts, Consulting Engineer (Georgia Institute of Technology)

7. Others :
    a. Carole Reeb; Hopkins Marine Station Stanford University
    b. Nikolay Voutchkov, Water Globe Consulting
    c. David Moore, Weston at the Bioassay Laboratory in Carlsbad, CA
    d. John Hedgepeth, Tenera Environmental.