



November 21, 2011

Via Electronic Mail: jqiu@waterboards.ca.gov

Regional Water Quality Control Board – Santa Ana Region
3737 Main Street, Suite 500
Riverside, CA 92501-3348

RE: Waste Discharge Requirements for Poseidon Resources Huntington Beach Desalination Facility; Order No. R8-2011-0046; NPDES No. CA 8000403

Dear Chair Beswick and Board Members:

Orange County Coastkeeper (Coastkeeper) and the Surfrider Foundation (Surfrider) write on behalf of our collective membership to express our reservations with the Waste Discharge Requirements for Poseidon Resources (Surfside) L.L.C. Huntington Beach Desalination Facility Orange County, Order No. R8-2011-0046, NPDES No. CA8000403 (Tentative Order).

Coastkeeper and Surfrider assert Poseidon Resources' (Poseidon) renewal of Order No. R8-2006-0034, NPDES No. CA8000403, which remains in effect until the approval by the Regional Water Quality Control Board, Santa Ana Region (Regional Board) of Order No. R8-2011-0046, NPDES No. CA8000403, is in part premature and should include conditions on the operation of the facility until the state adopts a uniform policy on the development of ocean desalination facilities. At this time, our organizations are concerned that Poseidon is moving forward with an application for a NPDES permit for an ocean desalination project in the midst of efforts by the California Ocean Protection Council (OPC) and the State Water Resources Control Board (State Board) to develop policies and regulations guiding the development of these facilities and the approval of this Tentative Order would result in the development of a non-compliant facility that would require expensive retrofits to comply with the results of the OPC and State Board's process.

The State Board invested scarce public resources into implementing Clean Water Act Section 316(b)'s mandate requiring "the location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact."¹ The environmental impact necessitating the adoption of the once through cooling policy (OTC Policy)² was the withdrawal of billions of gallons of source water daily killing millions of fish, larvae, eggs, seals, sea lions, turtles and other creatures due to the species intake into the cooling system (entrainment) or becoming exposed to high pressure against the systems intake screens (impingement).³ The expressed purpose of the OTC Policy was to phase out this harmful technology, minimize entrainment and impingement, and consequently eliminate the adverse impacts on marine ecosystems.

¹ Federal Water (CWA) 316(b).

² See: STATEWIDE WATER QUALITY CONTROL POLICY ON THE USE OF COASTAL AND ESTUARINE WATERS FOR POWER PLANT COOLING

³ California Water Boards, *Once Through Cooling Policy Protects Marine Life and Insures Electric Grid Reliability – Fact Sheet*, 1.

Poseidon's application for a renewal of their existing NPDES permit allowing for the continued use of the Huntington Beach Generating Station's (HBGS) existing intake infrastructure would be in direct conflict with the intent of the OTC Policy adopted less than two years ago, as well as violate some of the expressed provisions in that Policy. Currently, HBGS is scheduled to phase out their once through cooling intake system and re-power their facility with high efficiency generators with closed-cycle cooling by December 31, 2020. In the interim, HBGS is prohibited from withdrawing seawater unless it is necessary for generating electricity and other emergency purposes.

The Regional Board's approval of this Tentative Order, as currently worded, would conflict with the State's sound public policy designed to dramatically reduce the intake and mortality of marine life from harmful cooling water intake systems by merely shifting the harm from power plant cooling water intakes to new facilities for ocean water desalination that are not fully compliant with the strictest interpretation of Water Code section 13142.5(b). Without employing the best site, design, technology and mitigation feasible to minimize the intake and mortality of marine life, new ocean desalination facilities can cause substantially more harm than existing power plant cooling water intakes, due to the increase in intake volume required for a continuous desalination process compared to the intermittent use by a "peaker" power generator used only when demand requires operation. In short, without some conditions placed in the Order to mitigate the intake and mortality of marine life, the continual use of the HBGS intake system by Poseidon increases the harm caused by an antiquated technology scheduled to be phased out of operation within the next decade.

Further, the proposed "short-term stand alone operation" of the Facility will violate the expressed conditions in the OTC Policy to discontinue withdrawing seawater at HBGS during times when the power plant is not generating electricity.⁴

Finally, withdrawing an additional 26.7 million gallons a day (MGD) of seawater to dilute the brine before it is discharged creates an additional intake and mortality of marine life that could be avoided by the use of superior technology – in clear violation of the mandates of the Water Code.

Coastkeeper and Surfrider limit our comments on the Tentative Order to issues with the Fact Sheet relating to incomplete and/or irrelevant analysis, misinterpretation of Water Code section 13142.5 and the California Ocean Plan -- and concerns regarding the daily discharge of large volumes of additional iron near the Huntington Beach shoreline.

For the reasons above, and those explained in more detail below, we respectfully request the conditions in the permit include:

- A prohibition on withdrawing seawater in volumes greater than what is needed for the Facility "feed water" simply to dilute the brine before it is discharged;
- Mitigating the interim impacts of the Facility seawater withdrawals by limiting the volume of the "feed water" to no more than what the power plant is discharging on any given day;
- A clear and unambiguous Re-Opener providing for a *de novo* review of the Facility for complete compliance with the Water Code section 13142.5(b) once either: a) the generator permanently ceases withdrawing seawater in volumes necessary for the currently designed capacity of the Facility, or; b) when the power plant discontinues using the site for electrical generation, or; c) once the State Board completes the adoption of a statewide policy and/or guidance document for the development of seawater desalination facilities according to the Water Code section 13142.5(b); and

⁴ See: STATEWIDE WATER QUALITY CONTROL POLICY ON THE USE OF COASTAL AND ESTUARINE WATERS FOR POWER PLANT COOLING, "Immediate and Interim Requirements," Section 2. C(2).

- A comprehensive review and analysis of permit conditions relating to additional iron discharge off the Huntington Beach shoreline.

Thank you for your consideration of these comments. We look forward to working with the Regional Water Quality Control Board to ensure protection of our precious coast and ocean.

Sincerely,

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Specific Comments on Tentative Order Fact Sheet (Attachment F)

I. General Comments

It is important to consider that although the OTC Policy was limited in application to coastal and estuarine waters for power plant cooling, the California Water Code (Water Code) does not distinguish between withdrawals of seawater for “power plants” and withdrawals for “other industrial installations.”⁵ As written, the Water Code establishes the policy of the state, with respect to water quality in coastal marine environments is that “for each new or expanded coastal powerplant *or other industrial installation* using seawater for cooling, heating, or *industrial processing*, the best available site, design, technology, and mitigation measures feasible shall be used to minimize the intake and mortality of all forms of marine life” (*emphasis added*).⁶ Poseidon proposes the development a seawater desalination facility withdrawing approximately 126.7 MGD of seawater, with approximately 100 MGD “feed water” for processing into potable water, and an additional approximate 26.7 MGD devoted to mixing the brine before discharging it to the ocean. This aggregate 126.7 MGD withdrawal of seawater is proposed to utilize an antiquated intake system that is scheduled to be phased out and therefore not otherwise operational due to its proven harmful impact, primarily the intake and mortality of marine life.

In consideration of the Water Code and the recently adopted OTC Policy, the Regional Board should adopt a Tentative Order limiting the use of the existing OTC infrastructure by Poseidon to the actual seawater volume available from the HBGS’s discharge as “source water” for the proposed desalination facility’s “temporary stand alone operation.” Further, the Facility’s withdrawal of seawater for “in-plant dilution” of harmful brine discharges should also be limited to what is available from the actual discharge from HBGS in combination with the “feed water.” Given the stated prohibitions on altering the existing intake system articulated in the Fact Sheet at Page F-25, section c (1), for the short-term, that is the best mitigation feasible for minimizing the intake and mortality of marine life, and is at least as protective of marine life as the letter and intent of the protections recently adopted in the OTC Policy.

Once the HBGS has permanently discontinued withdrawals of seawater in volumes sufficient to supply the facility “feed water” or discontinues electrical generation, we agree with the recommendation that the facility be re-evaluated for strict compliance with Water Code section 13142.5(b) as a “stand alone facility.” We only have two recommended alterations to this provision: first, the conditions for re-evaluating compliance with the Water Code should include the adoption of a statewide Policy on Ocean Desalination that is currently under development by the State Water Resources Control Board, and second the provision for re-evaluating the facility under permanent “stand alone operation” should be clearly articulated in an enforceable “re-opener” condition of approval.

The rationale for ensuring the permit under consideration is at least as protective of marine ecosystems as the OTC Policy, as well as a condition in the permit prohibiting withdrawal of seawater in greater volumes than what HBGS withdraws⁷ is supported by the USEPA’s response to comments during the Clean Water Act section 316(b)Phase II rulemaking process where the agency directly addressed the issue of co-located desalination facilities. In their response to comments USEPA concluded that: “[t]he Phase II regulations apply only to facilities that generate and transmit

⁵ Water Code 13142.5(b)

⁶ Id.

⁷ The Tentative Order refers to this operation of the facility as the “co-located operation”

or sell power, and therefore do not apply to desalination facilities *unless they share an intake with a power plant*” (*emphasis added*). USEPA went on to explain that in situations where “desalination plants share intakes with power plants...the 316(b) regulations would apply to the intake flow attributed to a desalination plant if the intake flow exceeds whatever regulatory threshold is established in the Phase I, II, or III regulations, *but the power plant would be the permitted entity*”⁸ (*emphasis added*).

USEPA’s approach implements sound public policy by recognizing the parasitic relationship desalination facilities have with coastal power plant intake systems. Co-located desalination facilities with higher water intake demands than the existing power plant must be required to minimize the intake and mortality of marine life. Again, given that the Fact Sheet itself appears to imply that modifications to the existing cooling water structure to minimize the intake and mortality of marine life cannot be accomplished without interruption of the power plant operations, and are consequently prohibited. Therefore, until improvements to the now outlawed intake structure and/or other sites, designs or technologies become available, limiting the production capacity to the volume of water discharged by HBGS is a preferred mitigation measure to reliance on an existing “after the fact” restoration project that has subsequently been prohibited by the federal courts.

In conclusion, allowance of the so-called “temporary stand alone operation”, and the additional withdrawal of up to 126.7 MGD above what the power plant is discharging would undermine the benefits to our marine environment recently adopted in the OTC Policy. Further, much of the analysis in the Fact Sheet, and the notion that there is a need for a “temporary stand alone” operation of the facility, assumes a need for full production in the near term. However, in fact there are no water purchase agreements or long-term commitments to addition of the product water to any agency supply portfolio in a specified time period. With this in mind, full production capacity is not imminent in the near future. Therefore, the Permit can, and should, include a limit on production commensurate with the volume of water discharged by the HBGS.

- II. The Regional Board must revise the “stand alone” source water intake section of the Tentative Order to accurately reflect actual source water infrastructure conditions and demand.

Attachment F of the Tentative Order relating to “Stand Alone” source water intake requirements requires significant modifications to reflect the changing realities present and anticipated to occur at the existing HBGS. As previously stated, the existing cooling water intake system utilized by HBGS is scheduled to be phased out due to generator upgrades by December 31, 2020. Therefore, the Tentative Order should make clear that seawater withdrawals for both “temporary” and “long-term” “stand alone operation”, of the facility would be “new” withdrawals regulated by strict enforcement of the Water Code. These withdrawals should be classified by the Regional Board as a departure from the existing permit authority granted to operate the HBGS facility in terms of additional water withdrawn above what the power plant withdraws for the generation of electricity (“temporary stand alone operation”) and once HBGS eliminates or reduces their withdrawal of seawater on a permanent basis to comply with the new OTC policy (“long-term stand alone operation”). In brief, we recommend that every step must be taken to minimize the intake and mortality of marine life.

For example, pages F4 to F5 of the analysis includes provisions for operation of the facility “...when it is not feasible to deliver water to the regional potable water system...” The text goes on to suggest “it may be necessary to temporarily discharge dechlorinated product water from the reverse osmosis

⁸ See Comment ID: 316bEFR.026.003 at 528
(available at <http://www.epa.gov/waterscience/316b/phase2/comments/author-ph2.pdf>)

process back into the HBGS discharge pipeline.” Further, the report states: “During these temporary periods, the maximum allowable flows returned to the ocean would not exceed 126.7 MGD....”

Please clarify if these conditions in the permit would be applicable during “temporary stand alone” and/or “permanent stand alone” operations. If these conditions would be applicable during stand alone procedures, please explain why shutting down the Facility when the delivery of the product water is infeasible is not considered as a mitigation method to minimize the intake and mortality of marine life. A provision to discontinue operation of the facility when it is not delivering the product water would be consistent with, if not mandated by, the Water Code’s mandate to minimize the intake and mortality of marine life.

In addition, on page F7, the report states that, “[b]etween 2006 and 2010, the HBGS’s annual average intake flow through the power plant ranged from 200 MGD to 268 MGD.” It is our understanding that much of that flow was for operation of Units 3 and 4, and that these units are currently being sold and scheduled for retirement **The report should make clear how much intake volume was the result of operating Units 3 and 4 during the time between 2006 and 2010 and how much intake volume would be reduced after their retirement.**

The report also fails to identify how much of the cumulative flows or annual average of daily flows was unrelated to actual power generation (which is now prohibited by the “Immediate and Interim Requirements” in the OTC Policy⁹). Furthermore, the report does not identify the number of days or duration of times when the volume of intake was significantly less than this annual average. **Please revise Attachment F to include information that would more accurately reflect a reasonably foreseeable number of days when the cooling water discharge would not meet or exceed 126.7 MGD and consequently demand “temporary stand alone operation.”**

Further, the comments on the Subsequent Environmental Impact Report (“SEIR”) on page F-15 do not adequately interpret the relevant laws. California Water Code section 13142.5(b) regulates both cooling water intakes and other industrial withdrawals of seawater. While the Clean Water Act is specific to cooling water intakes, the Water Code does not distinguish between the numerous potential seawater withdrawals – inclusive of cooling water intakes. Therefore, federal case law on cooling water intakes is relevant to interpreting section 13142.5(b). Please see our comments below on Section III (E).

Finally, there is no reasonable distinction between water withdrawn for “temporary stand alone operations” and “long term stand alone operations” as both are “new” withdrawals of seawater and should be regulated similarly under the permit. **We recommend a clarification in the Order stating that “temporary operation” of the facility may not withdraw seawater in volumes that exceed the discharge of cooling water from the HBGS. This would make a conditional permit for the operation of the facility that is consistent with the mandates of the Water Code.**

Further, we recommend deletion of the finding on “entrainment and impingement” that: “Based on discussion in Section III E, when operating under long-term stand alone conditions, the Facility can comply with mitigation requirements under CWC section 13142.5(b) by maintaining HBGS’s existing marine life mitigation program.” First, this conclusory statement is premature if it is the intent of the Board to re-open the permit for full consideration when the power plant permanently ceases to withdraw seawater in volumes

⁹ See: STATEWIDE WATER QUALITY CONTROL POLICY ON THE USE OF COASTAL AND ESTUARINE WATERS FOR POWER PLANT COOLING, “Immediate and Interim Requirements”, Section 2. C(2).

necessary for the facility as it's currently planned. Second, as discussed in our comments below on Attachment F, section III E, "after the fact" restoration is not allowed under a strict interpretation of Water Code section 13142.5(b) and relevant case law. Finally, as discussed in our comments below regarding "Stand Alone Discharge", the additional withdrawal of seawater for in-plant dilution is contrary to both the Water Code section 13142.5(b) and the Ocean Plan.

Section III E (Clean Water Act and Water Code section 13142.5(b) analysis)

On page F-20, the report states that Clean Water Act, "Section 316(b) does not apply to seawater desalination facilities, including this Facility. However, it is important to note that while the recently adopted State Water Board OTC Policy may not have "direct application" to the facility, case law on interpretation of the Clean Water Act section 316(b) is relevant when interpreting Water Code section 13142.5(b). This is significant because much, if not all, of the mitigation of the intake and mortality of marine life associated with the temporary or long term "stand alone operation" of the facility relies on "after the fact restoration." In two decisions by the Federal Second Circuit Court of Appeals (referred to as the "*Riverkeeper, Inc v. EPA* cases"), the court decided that:

Restoration measures correct for the adverse environmental impacts of impingement and entrainment; they do not minimize those impacts in the first place.

Restoration measures resemble the pre-1972 approach to water pollution, which regulated point sources based on their effect on the surrounding water and allowed sources to discharge pollutants provided the discharge did not cause water quality to dip below an acceptable level. See *CPC Int'l, Inc. v. Train*, 515 F.2d 1032, 1034-35 (8th Cir.1975). Similarly, restoration measures would allow a facility, at least in theory, to impinge and entrain unlimited numbers of organisms provided that other steps maintained acceptable water quality, here measured by wildlife levels as opposed to pollutant concentration. But "[i]t was ... dissatisfaction with water quality standards as a method of pollution control that led to the proposal that they be replaced or supplemented with `effluent limitations.'" [citation omitted] A plaintiff attempting to prove a violation of the Clean Water Act faced "a virtually unbridgeable causal gap," [citation omitted] for "the burden of proving that a particular polluter had caused the water quality to dip below the standards was all but impossible to satisfy," [citation omitted]. Allowing compliance through restoration measures would involve exactly the same hurdles. As the EPA itself recognized in the preamble to the Rule,

[B]ecause of the complexity of biological studies, it is very difficult to assess the cause and effect of cooling water intake structures on ecosystems or on important species within an ecosystem.... [U]nlike in the laboratory, where conditions are controlled, a multitude of confounding factors make biological studies very difficult to perform and make causation, in particular, difficult to determine.¹⁰

This rationale is instructive to interpreting Water Code section 13142.5(b) for several reasons. First, the Water Code does not distinguish between seawater withdrawals for cooling water and other industrial withdrawals. Second, while it is true the OTC Policy made some distinctions between the use of seawater for these different purposes, the State Water Board did not explicitly distinguish the prohibition of "after the fact restoration" that was included in the OTC Policy. Third, while there is a mention of "mitigation" in the Water Code section 13142.5(b), the term is followed by the operative language to "minimize the intake and mortality of marine life." "After the fact restoration" efforts, even if they were successful, would not mitigate the "intake and mortality" of marine life. By

¹⁰ *Riverkeeper, Inc. v. U.S. E.P.A.*, 384 F.3d 174, 189-190 (2d Cir. 2004).

definition “after the fact” restoration efforts are to “replace” the marine life after its “intake and mortality” – and the Water Code clearly mandates minimizing the intake in the first place.

Therefore, we strongly recommend eliminating any reliance on the restoration of wetlands imposed on HBGS as a condition of their California Energy Commission permit as “mitigation” for ongoing withdrawals of seawater for either the power plant or the proposed desalination Facility. In short, these “after the fact” restoration efforts have been prohibited since that condition was placed on the HBGS permit.

A. SITE ANALYSIS

Coastkeeper and Surfrider are concerned that the Site Analysis section of the Tentative Order is not placing the necessary emphasis on the requirement that the proposed site be the “best available” location feasible to “minimize the intake and mortality of all forms of marine life.”¹¹ The Regional Board is not charged with reviewing the most convenient sites, rather reviewing those sites that “minimize the intake and mortality of marine life.”

Section 2(a)(2) of the Tentative Order suggests the proposed location is the best available based upon “proportional mortality” rates of marine life populations near HBGS. Here, proportional mortality is the proportion of observed deaths from entrapment or impingement in a defined population divided by the proportion of deaths expected from this condition in a standard population.¹² The Tentative Order relies upon “other power plants in California,”¹³ when the Regional Board should have analyzed the proportional mortality based upon the use of the HBGS intake system on a discrete local population and assemblage of marine life. Section 2(a)(2) reads that the “estimated levels of proportional mortality are much less than the estimates from other coastal power plants in California.” This, according to the Tentative Order, is attributed to the homogeneity of the coastline as compared to rocky coastlines or estuarine areas elsewhere along the California coast. Comparing the proportional mortality of this proven harmful device in an area without the equivalent diversity as rocky coastlines or estuarine areas skews the results and will improperly lead to a conclusion that it will not have the level of harmful impact on local marine life. It is important at this point to note that the Water Code mandates minimizing the intake and mortality of marine life without any required showing of “significance”, distinguishing this law from others like the California Environmental Quality Act.

The site analysis section of the Tentative Order similarly misleads the reader in Sections 2(a)(4-9) by assuming the plant would operate as a “co-located” facility. The rationale provided in these subsections concluding this is the best available site feasible to minimize the intake and mortality of marine life presupposes receipt of HBGS wastewater discharge as an available intake source to the desalination facility. For example, Section 2(a)(4) argues co-locating the proposed desalination facility with the existing HBGS minimizes intake and mortality because it uses “existing HBGS intake and discharge infrastructure” and reduces the amount of source water required for desalination purposes “by using water discharged by HBGS.” The OTC Policy and the HBGS implementation plan to comply with that Policy will eliminate the withdrawal of seawater in volumes necessary for the design capacity of this Facility. Therefore, the infrastructure described in this section, absent any modifications to minimize the intake and mortality of marine life,, and the reliance on that

¹¹ Fact Sheet, page F-22

¹² U.S. Dept. of Health & Human Svc., Environmental Health & Toxicology, National Library of Medicine – National Institute of Health, <http://sis.nlm.nih.gov/enviro/iupacglossary/glossaryp.html> (Last accessed Nov. 22, 2011).

¹³ Fact Sheet, Section 2(a)(2), F-22

infrastructure in an analysis determining whether this location satisfies the mandates of the Water Code undermines the intent of the State Board in adopting the OTC Policy.

Finally, Section 2(a)(5) of the Tentative Order argues the use of an existing pipe will result in lower intake velocity and therefore lower impingement effects. The rationale provided in the subsection relies on the fact the pipe is “capable of transporting more than four times the volume of water required by the Facility.” The section fails to reference any study estimating any numerical reduction in the intake and mortality of marine life, nor any reduction in “proportional mortality” rates. In fact, there is no mention of any reduction of marine life mortality from entrainment of organisms. **We recommend further documentation to substantiate this statement before the Regional Board relies upon it prior to concluding whether the site is the best available for minimizing the intake and mortality of marine life.**

B. DESIGN ANALYSIS

We maintain similar concerns over the design analysis as we did over the project in general. **A thorough analysis of the “design” of the facility should include reducing the production capacity and/or other alternatives to make the best intake “technologies” feasible and available for the proposed facility. As we have said, the site, design, technology and mitigation measures should be considered as integrated parts to minimize the intake and mortality of marine life.**

The analysis of the facility design should also include alternative discharge technologies that meet the mandates of Water Code section 13142.5(b) to minimize the intake and mortality of marine life. As proposed, the design feature of withdrawing additional seawater for “in-plant” dilution would increase the intake volume by approximately 25%, thereby **increasing** entrainment of marine life.

Alternative brine discharge technologies have been successfully employed on seawater desalination facilities elsewhere¹⁴, and should be analyzed as an option here for eliminating the necessity of withdrawing additional seawater for so-called “in-plant dilution.”

Section 2(b)(1) of the Fact Sheet implies that the current HBGS seawater withdrawal employs the best technology available for minimizing the intake and mortality of marine life. This contradicts the findings and resulting adoption of the State Board’s OTC Policy¹⁵. Therefore, the continued use of this intake technology for “temporary stand-alone operation” of the facility would undermine the “Immediate and Interim Requirements” to discontinue the withdrawal of seawater during times when HBGS is not generating electricity in order to minimize the intake and mortality of marine life. Further, as stated above, withdrawing additional seawater for “in-plant dilution” during the “temporary stand alone operations” violates the clear mandates of the Water Code section 13142.5(b) to use the best design to minimize the intake and mortality of marine life. Finally, the Fact Sheet appears to assume that “temporary stand alone operation” is necessary without any substantiating evidence. **We recommend deleting this sub-section of the Fact Sheet. We also recommend a condition on the permit prohibiting “temporary stand alone operation” of the facility at times when the HBGS is not discharging enough water for full design production capacity, and limiting the production of the facility to what is actually discharged from the HBGS for the facility’s “source water.”**

¹⁴ See Attachment A: “Perth, Australia: Two-year Feedback on Operation and Environmental Impact”

¹⁵ See: STATEWIDE WATER QUALITY CONTROL POLICY ON THE USE OF COASTAL AND ESTUARINE WATERS FOR POWER PLANT COOLING

Section 2(b)(2) of the Fact Sheet directly contradicts the findings of the OTC Policy by asserting the use of the existing offshore intake system minimizes entrainment and impingement effects. The State Board possessed reports on the intake and mortality of marine life from the existing HBGS intake system during the development of the OTC Policy, yet the State Board concluded the existing intake failed to employ the best technology available to minimize the intake and mortality of marine life. As with the proportional mortality discussion in our critique of the site analysis, comparing other areas of the coast with different habitats and fish assemblages is irrelevant when analyzing the proposed facility's compliance with the Water Code section 13142.5(b). **We recommend deleting this sub-section of the Fact Sheet as it is irrelevant to the analysis of the design and operation of the facility in either “temporary stand alone operation” or “long term stand alone operation.” We also recommend replacing this sub-section with an analysis of the intake and mortality of marine life in terms of the proportion of the population and assemblage of species residing in the affected area, as well as the species and life stages of the species that may transit the area through their own mobility or be transported through the affected area in the ocean current.**

Sub-section 2(b)(3) is an irrelevant comparison between the volume and velocity of flows for cooling the HBGS and what would be required in a “temporary stand alone operation.” As noted above, the withdrawal of seawater for “temporary stand alone operation” and for “long term stand alone operation” of the facility are “new” withdrawals of seawater under Water Code section 13142.5(b) and must be analyzed and enforced independent of the current cooling water intake. **We recommend deleting this sub-section.**

Section 2(b)(4) defends the design of the project by arguing the existing intake infrastructure meets best available design criteria even though the technology has been proven to significantly harm marine life to a degree necessitating a more thorough Water Code Section 13142.5(b) analysis. The Tentative Order first states, that “[u]nder stand alone operations, the Discharger has little control over the intake structure.”¹⁶ The statement ignores the fact that Poseidon, as the Discharger, has complete control over the design of the facility, and consequently controls the production capacity during “temporary stand alone operation.” The incorporation of an intake system that reduces marine life intake and mortality, such as subsurface intake, would closely resemble a design matching the Water Code Section 13142.5(b) criteria.

Elsewhere in Section 2(b)(4) the Regional Board claims it will “reevaluate the Facility’s compliance with Water Code section 13142.5(b)” if the future yields “different and/or better” feasible designs for long-term stand-alone operations. The State Board is currently developing a “Policy on Ocean Desalination” that will address the design of desalination facilities and the use of once through cooling technology as an intake system for operation by a facility operator. **Coastkeeper and Surfrider recommend the Regional Board include a clear and concise “reopener” in this permit that allows for a full *de novo* review and modification of this NPDES permit once that Policy is adopted by the State Board, and provide a timeline and guidance for Poseidon’s compliance with the policy.**

In addition, we recommend the Regional Board take a holistic review of alternatives that include amending the “design” production capacity and subsurface intake mechanisms to better enable the use of the best “technology” available for minimizing the intake and mortality of marine life.

We also recommend a thorough analysis of alternative discharge technologies that would eliminate the need for increased intake volume for in-plant dilution, thereby minimizing, if

¹⁶ Section 2(b)(4)

not eliminating, the intake and mortality of marine life through use of the best design and technology for brine dilution.¹⁷

C. TECHNOLOGY ANALYSIS

Coastkeeper and Surfrider want to repeat that the analysis of the best technology available should not be confined by the “design” of the facility’s production capacity, nor by its “site.” Rather, the site, design and technology must be considered as a whole – not discrete parts. It is the proposed continuation of antiquated technology that concerns our organizations most in Water Code Section 13142.5(b)’s analysis.

Our concerns were especially heightened when we failed to read any analysis of operating the facility at production capacities that are properly limited to the volumes of cooling water discharged from uninterrupted operation of HBGS. Section 2(c)(1) states the “facility’s use of the intake and outfall provides that entrainment and impingement minimization measures cannot interfere with, or interrupt ongoing power plant operations.” To be consistent with the OTC Policy, and in particular, the prohibition of withdrawing seawater when the HBGS is not generating electricity, “temporary stand alone operation” should be prohibited. In fact, the prohibitions on employing entrainment and impingement minimization measures for this new withdrawal of seawater strengthen our assertion seeking limited production capacity from the facility under the current operation of HBGS.

Therefore, we strongly recommend that the Tentative Order be amended to support a condition in the permit that “temporary stand alone operation” is prohibited and production capacity from the proposed facility is limited by the “source water” available from HBGS’s discharge volumes.

Additionally, Section 2(c)(2) and(4) briefly describes the benefits of the horizontal velocity cap and mammal exclusion bars and the subsequent reduction in impingement rates. However, these descriptions merely addresses half of the harmful intake equation. A reduction in impingement numbers due to the velocity cap and the exclusion bars ignore the loss of marine life due to entrainment. Nothing in these sections refer to or recommend technological modifications to reduce high entrainment numbers. **Again, we recommend that without any attempt by the Discharger to minimize the intake and mortality of marine life from entrainment during the proposed “temporary stand alone operations”, the withdrawal of seawater in volumes above that used for the generation of electricity should be prohibited.**

Section 2(c)(3) of the Fact Sheet compares the reduction of impingement from the proposed “temporary stand alone operation” of desalination facility to impingement occurring from the operation of the HBGS facility. The implication is the Poseidon facility is an environmental improvement over the existing intake from HBGS. However, the section does not state that the withdrawal of seawater over and above the volumes necessary for the generation of electricity at HBGS is a “new” intake and governed by the Water Code section 13142.5(b). Therefore, it is irrelevant to compare the intake and mortality from impingement caused by the operation of HBGS to the new withdrawal of seawater for “temporary stand alone operation.” In fact, the proposed desalination facility could continue impingement decades after the cooling water intake system will be prohibited from use. The fact is, the continued use of the existing intake structure after the power plant discontinues it’s current “once through cooling” practice will be an entirely new withdrawal of seawater, and entirely new cause of the intake and mortality of marine life. **We recommend this sub-paragraph either be deleted, or modified to better explain how the “new” intake of seawater will affect the cumulative intake and mortality of marine life from the addition of “temporary stand alone operation” at this site.**

¹⁷ See e.g., Attachment A: “Perth, Australia: Two-year Feedback on Operation and Environmental Impact”

1. ANALYSIS of ALTERNATIVE INTAKES

The analyses of “Subsurface Intakes Alternatives” are inadequate. First, there is no mention of the potential benefits of minimizing the intake and mortality of marine life from these alternatives. For example, the Fact Sheet, at 6(d) lists numerous adverse impacts of a “seafloor infiltration gallery,” but fails to point out that these impacts are mostly temporary in that they result from placement of the galleries. Further, section 6(d)(4) of the Fact Sheet states there will be, “...a combined loss of 2,800 square feet of beachfront property, for a combined loss of over 2.1 acres of beachfront property and related impact to public access.” The analysis fails to recognize that much of this necessary infrastructure could be constructed below surface and have little to no long-term impacts on beachfront property or coastal access. Finally, section 6(f) considers the energy demand of such a proposed alternative. Again, this has little relation with the minimization of marine life mortality, nor the technological feasibility of this alternative intake system. These conclusions about loss of beachfront property, coastal access and energy demands are repeated in the analysis of several different types of “beach wells.”

Second, the opening paragraph of this section of the Fact Sheet concludes that these alternatives are “technologically infeasible.” However, the analysis only indicates certain short-term technological challenges to the construction, but nothing in the analysis suggests that “subsurface intakes” are technologically infeasible. It is important to note that in the definition of “Not Feasible” in the recently adopted OTC Policy, the State Water Board concluded that: “Cost is not a factor to be considered when determining feasibility under Track 1.”¹⁸ It is reasonably predictable that the prohibition of cost considerations will be adopted in the Policy on Ocean Desalination currently under development by the State Water Resources Control Board.

Third, much of the analysis is speculative. For example, the Fact Sheet uses terms such as “the potential” long term effects of dewatering local marshes¹⁹, “possible interception” of contaminated groundwater²⁰, “possible interception” of injection water for the seawater barrier²¹, “potential subsidence” of roads and structures²². These statements are not only speculative and inappropriate, but once again they have no relevance to the mandate to minimize the intake and mortality of marine life.

Finally, there is no analysis of how some of the issues raised in this section could be mitigated by reducing the designed production capacity of the facility. As stated above, Water Code section 13142.5(b) should be read in a way to harmonize all the potential sites, designs, technology and mitigation to minimize the intake and mortality of marine life. The design capacity of the facility, and the analysis based on that assumed design, appears to preclude strict enforcement of Water Code section 13142.5(b).

We strongly recommend a more thorough analysis of a Facility with a “design” production capacity that is consistent with an intake technology that results in the “best” minimization of the intake and mortality of marine life. Further, we strongly recommend re-consideration of the site of the Facility given that the existing open ocean intake for the HBGS cooling water has already been determined as inadequate for meeting the mandates to minimize the

¹⁸ STATEWIDE WATER QUALITY CONTROL POLICY ON THE USE OF COASTAL AND ESTUARINE WATERS FOR POWER PLANT COOLING, “Definition of Terms”, Section 5.

¹⁹ See Fact Sheet, 6 (g).

²⁰ Id at 6 (i)

²¹ Id at 6 (j)

²² Id at 6 (k)

intake and mortality of marine life. While this determination was based on enforcement of the Clean Water Act, it is important to note that had this analysis been applied to a “new” power plant’s proposed cooling water system, the Water Code section 13142.5(b) would have also prohibited open ocean intakes. So, given that the Water Code makes no distinction between seawater withdrawals for “cooling” from seawater withdrawals for other “industrial purposes”, the same standards for minimizing the intake and mortality of marine life are applicable to this proposed Facility. Consequently, the analysis and conclusions in the Fact Sheet are inadequate and mostly irrelevant to consideration of enforcing the mandates of Water Code section 13142.5(b).

2. MODIFICATIONS to the EXISTING INTAKE SYSTEM

We assume this analysis is both for modifications to the existing intake system for both the “short-term stand alone operations” and “long term stand alone operations.”

In regards to short-term “stand alone” operations, this analysis only provides more reasons to limit the production of the facility to what can be accomplished from the volume of water discharged from HBGS. The Fact Sheet documents that modifications to the existing infrastructure to better minimize the intake and mortality of marine life are effectively prohibited until the power plant discontinues use of the intake structure.²³ As noted above, withdrawal of seawater in excess of what is discharged by HBGS would be a “new” withdrawal of seawater for industrial purposes, and trigger immediate enforcement of the mandates in Water Code section 13142.5(b). **Therefore, compliance with the Water Codes mandate to utilize the best “mitigation” measures feasible would require limiting the “temporary” operation of the Facility by prohibiting the withdrawal of seawater in excess of what is available from the HBGS discharge.**

In regards to long-term “stand alone” operations, this analysis is premature and irrelevant. Several coastal power plants are proposing the use of screening technologies for volumes of seawater withdrawals in excess of the 100 mgd needed for this facility. It is, as yet, unclear if those technologies will succeed at minimizing the intake and mortality of marine life within the parameters of the OTC Policy. Nonetheless, the consideration of alternative technologies, designs, sites and mitigation for long-term “stand alone” operation is a question that is not before the Board in granting this permit. If the Board is to reconsider interpretation and enforcement of Water Code section 13142.5(b) once HBGS permanently ceases withdrawal of seawater in volumes sufficient for operation of the proposed facility at this design capacity, and/or the State Water Board adopts a Policy on Ocean Desalination – that would be the time for consideration of modifications to the existing intake system. We think it is appropriate that the Discharger be put on notice that all of the conditions in this permit are temporary. **We strongly recommend a clear “Re-Opener” provision in this temporary permit explicitly stating that all possible revisions to the design, site and technology of the facility to minimize the intake and mortality of marine life will be considered when the permit is re-opened for a *de novo* review.**

VARIABLE FREQUENCY DRIVES

We think this analysis is irrelevant and this technology does not fully enforce the mandates of the Water Code. Variable frequency drives are common technology in the design of seawater desalination facilities. Their use allows the Facility to regulate the volume of water withdrawn to meet different source water demands during different production volumes.

We agree that these variable frequency drives are effective at ensuring the Facility is not withdrawing

²³ See Fact Sheet, page F-25, section c. (1)

more seawater than necessary. We disagree that this technology, in and of itself, is the best approach for minimizing the intake and mortality of marine life for the so-called “temporary stand-alone operation” of the Facility. **Consequently, once again, we strongly recommend that full enforcement of the Water Code requires mitigating the intake and mortality of marine life by limiting the source water intake for the Facility to what is available from the HBGS discharge on any given day. Variable Frequency Drives are a technology that only marginally minimizes the withdrawal of seawater and are therefore not, in and of themselves, fully compliant with the mandates of the Water Code.**

D. MITIGATION ANALYSIS

It is important to note at the outset that recent case law prohibits the use of “restoration measures” in lieu of the best technology available for minimizing entrainment and impingement of marine life under the Clean Water Act.²⁴ The Second Circuit Court of Appeals first decided this issue in *Riverkeeper I*, which dealt with the proposed USEPA regulation of seawater intakes for “new” facilities withdrawing more than 50 MGD for cooling purposes. Because *Riverkeeper I* dealt with the regulation of new facilities, this decision is particularly instructive to interpreting the Water Code Section 13142.5(b) mandate of the use of the best site, design, technology and mitigation feasible to minimize the intake and mortality of marine life. While specifically identifying these mandates for cooling purposes at “new” facilities, the Water Code goes beyond the regulation of seawater intakes in the Clean Water Act and includes seawater withdrawals for all industrial purposes. Importantly, the Water Code does not distinguish between the mandates for minimizing the intake and mortality of marine life from cooling water withdrawals and other industrial purposes.

Therefore, new withdrawal of seawater for cooling would be regulated by the Water Code as well as the Clean Water Act. Consequently, the prohibition of “restoration measures” articulated in *Riverkeeper I* must be consistent with the interpretation of “mitigation” in the Water Code. And given there is no distinction in the Water Code between withdrawal of seawater for cooling purposes and any other “industrial use”, it stands to reason that the prohibition of “after the fact” restoration efforts are prohibited as mitigation for seawater desalination facilities, including this proposed Facility.

Further, the plain language in the Water Code would, in and of itself, prohibit “after the fact” restoration measures. The mandate to use the “best site, design, technology and mitigation feasible” is clearly meant to “minimize the *intake* and mortality of marine life.” By definition, after-the-fact restoration efforts do nothing to mitigate the intake and mortality of marine life.

This has been further articulated in the State Board’s “OTC Policy.” Restoration in lieu of using the best technology for reducing marine life mortality is only allowed on a temporary basis until the power plant operator meets compliance with the technology-based mandates of the Policy.

Nonetheless, the Fact Sheet heavily relies on decisions by other California regulatory agencies to permit the withdrawal of seawater for cooling the HBGS Units 3 & 4, and the imposition of restoration measures in those permits. Those permits and condition of restoration measures would be prohibited under today’s law. Transfer of that condition on existing permits to this new facility would be equally prohibited by the law.

²⁴ See *Riverkeeper, Inc. v. U.S. EPA*, 358 F.3d 174 (2d Cir. 2004) [“*Riverkeeper I*”]; *Riverkeeper, Inc. v. U.S. EPA*, 475 F.3d 83 (2d Cir. 2007) [“*Riverkeeper II*”], *rev’d on other grounds sub nom. Entergy Corp. v. Riverkeeper, Inc.*, 129 S. Ct. 1498 (2009).

Further, the Fact Sheet includes predictions of the potential entrainment and impingement of marine life in “stand alone operation” and concludes these impacts are not significant. Unlike an analysis in an Environmental Impact Report under the mandates of CEQA, the Water Code has no similar “significance threshold” nor does the term “mitigation” have the same meaning under CEQA and the Water Code. The Water Code clearly mandates “the best” measures for minimizing the intake and mortality of marine life. This cannot be interpreted to allow “second best” mitigation that would reduce the impacts to level described in CEQA as “not significant.”

In conclusion, a strict interpretation of the language in the Water Code section 13142.5(b) mandates that mitigation measure minimize the “intake and mortality” of marine life in the first place. “After the fact” restoration measures are prohibited in that, by definition, they do nothing to minimize the intake and mortality of marine life. Further, decisions by the federal courts in *Riverkeeper I* and *Riverkeeper II* invalidate the conditions of approval in the California Energy Commission permit requiring restoration of wetlands in lieu of mandating the best technology available for minimizing entrainment and impingement. The allowance of “after the fact” restoration measures would be prohibited if that permit were to be issued under current law, and transferring credit for those restoration measures in a permit issued for a new facility is equally prohibited under today’s laws.

We strongly recommend this section of the Fact Sheet be re-written, and the permit accurately reflect that “after the fact” restoration is not allowable as mitigation under today’s law. It is of no consequence or importance whether those restoration measures were permitted under past law, they are not legal today.

Finally, we re-assert that the “best mitigation feasible” for the “temporary stand alone operation” of the facility is to limit the volume of “feed water” for the Facility to the volume that is actually being discharged from the HBGS cooling water system on a daily basis. Further, we strongly recommend the Regional Board defer any consideration of “best mitigation feasible” for the “permanent stand alone operation” until the permit is ‘Re-opened’ and there is a full de novo review of compliance with the Water Code section 13142.5(b).

III. The Regional Board must revise the Discharge Requirement of the Tentative Order in order to comply with the Water Code and the Ocean Plan.

Throughout the Tentative Order, there appears to be a pre-determined assumption that the best design of the facility to meet the mandates of both the Ocean Plan and the Water Code section 12134.5(b) is to increase the intake volume by approximately 26.7 MGD for what could be described as “in-plant dilution” – that is, dilution prior to discharge of the brine. This is plainly inconsistent with the mandates of the Water Code section 13142.5(b), as well as the dilution requirements in the Ocean Plan.

The Ocean Plan states:

The mixing zone for the acute* toxicity objective shall be ten percent (10%) of the distance **from the edge of the outfall structure** to the edge of the chronic mixing zone (zone of initial dilution)²⁵.

²⁵ See: Ocean Plan, Section III. C(4)(b), page 14 (emphasis added)

The Water Code section 13142.5(b) states:

In addition to any other policies established pursuant to this division, the policies of the state with respect to water quality as it relates to the coastal marine environment are that:

(b) For each new or expanded coastal powerplant or other industrial installation using seawater for cooling, heating, or industrial processing, the best available site, design, technology, and mitigation measures feasible shall be used to minimize the intake and mortality of all forms of marine life.

The Fact Sheet analyzes compliance with the 7.5 to 1 “dilution ratio” assuming an additional intake volume of approximately 26.7 MGD over and above what is required for “source water” intake.²⁶ This additional water withdrawal during “temporary stand alone” as well as “long term stand alone” operations is not the best technology for minimizing the intake and mortality of marine life in accordance with the Water Code section 13142.5(b), nor is it consistent with the language in the Ocean Plan for the area of dilution.

First, as explained above, there are superior brine dilution technologies that could eliminate the need for withdrawing additional seawater.²⁷ Yet the Tentative Permit fails to consider these superior alternatives, much less analyze them for compliance with the mandate in the Water Code to employ the best technology available for minimizing the intake and mortality of marine life.

Also, the Ocean Plan clearly states that the zone of initial dilution (ZID) is bounded by the “edge of the outfall structure” and the outer boundaries of the ZID. A strict read of this language would preclude so-called “in-plant dilution”. Given that the Tentative Order has determined that the 7.5:1 “dilution ratio” for the dissipation of heat being discharged from the HBGS is appropriate for the discharge of the brine waste from the proposed Facility, we assume the rule would be generally applicable to all ocean discharges. It is incomprehensible, and contrary to sound public policy, to allow for the withdrawal of seawater strictly for the purpose of “in-plant dilution.”

For example, one can only imagine how a wastewater treatment facility would operate if they were allowed to withdraw seawater for “in-plant” dilution of their waste stream. In the extreme case, under the allowance for “in-plant” dilution, the wastewater facility could conceivably withdraw enough seawater to dilute the effluent to the point where it no longer violates their discharge requirements. This would allow the facility to avoid the use of any technology to treat the effluent in the first place. While this analogy is not perfect, the results are similar to what is being proposed in this Tentative Permit. That is, the Discharger is not required to employ any technology to ensure adequate dilution of the brine waste discharge within the ZID, they are instead being allowed to add to the intake and mortality of marine life by withdrawing additional seawater to simply dilute the brine and other waste materials prior to discharge.

In conclusion, the analysis of the brine discharge is inadequate in that it does not adequately analyze the best technology available for minimizing the intake and mortality of marine life in accordance with the Water Code. Further, the analysis does not fully consider, analyze, or justify the proposed use of “in-plant” dilution and its compliance with the Ocean Plan language regulating the boundaries of the discharge.

Please explain why preferable dilution technologies, such as “pressurized spray brine” or any other alternative, were not considered and analyzed as a superior alternative to

²⁶ See Fact Sheet, page F12

²⁷ See e.g., Attachment A: “Perth, Australia: Two-year Feedback on Operation and Environmental Impact”

simultaneously meet the dilution standards, meet the clear language of the Ocean Plan to do so in a “mixing zone” starting at the “edge of the outfall structure” , as well as minimizing the intake and mortality of marine life from the additional seawater withdrawal volume for “in-plant dilution”, as mandated in the Water Code.

We strongly recommend that the Final Oder include a clear prohibition on the withdrawal of 26.7 MGD of seawater, or any withdrawal of seawater, for dilution of the brine and other waste being discharged from the Facility. Instead, the Final Order should include a provision either mandating the use of the best technology available for diluting the brine in the ZID without the necessity for withdrawing additional seawater, and/or a reduction in the production capacity so that the volume of brine waste discharge will dilute within the ZID without the necessity of an additional withdrawal of seawater. These provisions in the Final Order are necessary to ensure full compliance with Water Code section 13142.5(b), as well as the strictest interpretation of the Ocean Plan.

Finally, the Final Order should include a condition mandating “real time monitoring” and requirements to reduce the production capacity or shut down the Facility if the water quality standards are not being met. Examples of this monitoring technology, and examples of when a similar seawater desalination plant was required to reduce its production capacity to meet water quality standards in Australia can be found in Attachment A to this letter.

Specific Comments on Iron Loading from Poseidon's Discharge

- I. The Regional Board must contemplate the direct and indirect consequences of increasing iron levels off Huntington Beach before approving this Tentative Order.

Coastkeeper and Surfrider are alarmed at high levels of additional iron discharge off Huntington Beach's shoreline and Poseidon's brief and dismissive analysis of the potential consequences of contributing nearly a ton of additional iron through the existing discharge pipe. Oceanic iron loading has been identified with numerous and mixed environmental consequences which have not been adequately analyzed in relation to the approval of the proposed Poseidon discharge. Some of the negative environmental consequences identified through rigorous scientific studies conducted over nearly two decades can be analyzed through the regulatory constraints placed upon Poseidon in this Tentative Order.

- A. Poseidon's waste iron discharge will contribute to nutrient loading resulting in objectionable aquatic growth and the degradation of indigenous biota in violation of their NPDES Permit.

The Tentative Order prohibits Poseidon from discharging nutrient materials which cause objectionable aquatic growth or degrade indigenous biota.²⁸ According to the approved DSEIR, Poseidon will discharge at least 1,831 pounds of iron from DP 001 per day at a concentration fifteen times greater than the normal seawater concentration of 0.30 mg/L.²⁹ Elevated levels of iron are a consequence of reverse osmosis pre-treatment methods using iron sulfate or iron chloride as a chelating agent that coagulates organic solutes and dissolved materials and also precipitates a fraction of the trace elements.³⁰

As Poseidon's DSEIR states, "iron is an important ocean nutrient (essential for the growth of phytoplankton) and is likely to be biologically assimilated by primary producer organisms (mainly phytoplankton) in the discharge plume."³¹ By increasing the availability of nutrients, thereby stimulating the growth of phytoplankton, there is the potential that stressed fish stocks may actually improve. However, there is the equally likely scenario that the discharge will produce a similar increase in the bacteria that feed on phytoplankton. Phytoplankton growth from iron discharges, according to the Woods Hole Oceanographic Institution (WHOI), may "just as equally favor less-useful pathways in the food web, making more jellyfish or algae, especially harmful algal blooms that could have impacts on fish, birds, and even marine mammals up the food chain."³²

The term harmful algae blooms (HABs) is scientific shorthand used to describe a variety of algae blooms of microscopic and macroscopic marine algae which produce toxic effects on humans or other organisms, physical impairment to fish and shellfish, discoloration and/or nuisance conditions from severe odors, or severe impacts on marine ecosystems due to oxygen depletion or overgrown habitat.³³ HABs generally begin when heavy winter rains flush nutrients from the land into the ocean and wind blows warm surface water away, resulting in cold nutrient-rich upwelling, dormant phytoplankton then hatch into swimming cells once the water warms concluding with phytoplankton

²⁸ Section V(A)(1)(c)

²⁹ Appendix N, U-6

³⁰ Appendix N, U-1

³¹ Appendix N, U-2

³² Hugh Powell, Woods Hole Oceanographic Institution, *What are the Possible Side Effects?*, <http://www.whoi.edu/oceanus/viewArticle.do?id=35668>, (January 8, 2008).

³³ NOAA, *Harmful Algal Blooms in Coastal Waters: Options for Prevention, Control and Mitigation*, Decision Analysis Series No. 10, 3 (Feb. 1997).

feeding on nutrients and multiplying.³⁴ Phytoplankton expand exponentially, with a single cell producing up to 8,000 offspring in a single week.³⁵ After the phytoplankton production hits its zenith the organic materials sink and the decomposition of materials reduces the availability of oxygen, producing anoxic conditions and causing significant marine die-offs. In addition, several off the phytoplankton offspring produce toxins that are stored in their bodies and bioaccumulate in species that feed on the algae and have sickened people humans who consume affected shellfish.

Since 1993, scientific experiments into intentional open ocean iron discharge (referred to as “iron fertilization”) proves algae can be stimulated to grow rapidly with the addition of a sufficient input of iron. According to an article in the *Proceedings of the National Academy of Sciences*, these artificially generated algae blooms “produced diatoms in the genus *Pseudo-nitzschia*, which produce a neurotoxin called domoic acid.”³⁶ Domoic acid causes seizures in higher vertebrates, such as marine mammals.³⁷ A scientific team from the University of California, Santa Barbara, concluded the “addition of iron from natural or artificial sources can stimulate the rapid growth of this harmful algae.”³⁸

Mary Silver, the lead author of the UCSB study, described how the neurotoxin producing *Pseudo-nitzschia* usually has little effect, but that “the species is incredibly responsive to iron, often becoming dominant in algal blooms that result from iron fertilization.”³⁹ “Any iron input,” she continued, “might cause a bloom of cells that make the toxin....which will get into the food chain, as it does in the coastal zone.”⁴⁰

Consistent flows of high iron concentrations of nearly a ton a day in perpetuity from the proposed desalination facility could contribute to increased HABS and low-oxygen events off Huntington Beach. Scientific experiments conducted in international ocean waters testing iron fertilization since 1993, twelve in total, have produced plankton blooms similar to those associated with HABS.⁴¹ The impact of these tests and the contribution of significant amounts of additional iron into ocean waters has led at least one scientist to conclude that they “do not, and likely will not, have the capability to say how this may impact marine food chains.”⁴²

Coastkeeper and Surfrider acknowledge the experiments conducted testing iron fertilization concern oceanic conditions and their conversion into coastal conditions may not translate into the same results. However, Poseidon acknowledges the daily contribution of a nearly a ton of iron off the Huntington Beach shoreline will at least have a direct impact on the rapid production of phytoplankton. Increased phytoplankton production off the California coast also produces various types of algae, including *Pseudo-nitzschia*, the domoic acid producing diatom commonly linked with HABS. Our chief concern regarding the discharge of additional iron off the coast is the unknown impact this significant nutrient contribution will have on the marine ecosystem in and around the discharge pipe.

³⁴ Id.

³⁵ Id.

³⁶ Id.

³⁷ See Section V.A.1.d.1 (“wastewater discharged at DP 001 shall not cause: marine communities, including vertebrate, invertebrate, and plant species [to be] degraded”).

³⁸ U. of Cal., Santa Barbara, *Iron Stimulates blooms of toxin-producing algae in open ocean, study finds*, November 8, 2010.

³⁹ Id.

⁴⁰ Id.

⁴¹ Powell, *supra* n. 33

⁴² Id.

B. The Regional Board must consider the aesthetically undesirable impact iron discharge could have on the ocean surface.

The Tentative Order prohibits discharged wastewater from causing “aesthetically undesirable discoloration of the ocean surface.”⁴³ Iron discharged from desalination plants has recently caused discoloration of surface water in plants using reverse osmosis systems. The Ashkelon desalination facility in Israel caused significant concerns within the Ministry of Environmental Protection (Ministry) following the discharge of “red water” from the discharge pipes leaving the facility.⁴⁴ The red water discharge occurs nearly every hour for approximately ten to twenty minutes and can be seen from a distance of 1 kilometer from the outfall depending on weather conditions.⁴⁵ The Ashkelon facility discharges approximately 450 tons per year as opposed to Poseidon’s proposed discharge of approximately 365 tons per year.⁴⁶

The Ministry became seriously concerned with the red discharge after discovering the influence of the iron discharge on the receiving water and the lack of research on the impact of the effect of such iron discharges to the marine environment. As a precaution, the Ministry intended to seek assurances that the Ministry of Finance would require substantial reductions in iron discharges before contracting for additional desalination facilities in Israel.

The Israeli Ministry encouraged policy makers to follow the precautionary principle concerning the adoption of desalination facilities along the coastline in recognition of the sparse scientific information available on the marine and coastal impacts these facilities may cause.⁴⁷ The precautionary principle, as used by the Ministry, states that “when an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically.”⁴⁸ The Ministry concluded that in accordance with the precautionary principle, ferric should be removed from desalination discharge, “not only for the discoloration and aesthetic matter, but also for the preventing of a potential risk for the marine environment due to high loads and accumulation with time.”⁴⁹ Coastkeeper and Surfrider strongly encourage the Regional Board to consider the Israeli example of Ashkelon and order a continued monitoring of the discharge to account for potential ecosystem changes and harmful sediment concentrations originating from the proposed increase in iron concentrations leaving DP 001.

C. The Regional Board must consider the accumulation of iron in sediments in and around the desalination plant’s discharge point.

The Tentative Order requires the waste discharge to be free of “settleable material or substances that may form sediments that may form sediments that will degrade benthic communities or other aquatic life.”⁵⁰ Appendix N of Poseidon’s DEIR acknowledges discharged iron from DP 001 will “readily bind with the others elements in seawater and sediment.”⁵¹ Coastkeeper and Surfrider have reasonable cause for concern over the accumulation of iron in sediments in and around DP 001

⁴³ Section V.A.2; *See also* Section V.A.1.c.3

⁴⁴ *Ashkelon desalination plant leaches iron into sea*, Globes Israel Business News, July 27 2008 (last accessed Nov. 18, 2011) <http://www.globes.co.il/serveen/globes/docview.asp?did=1000365853>

⁴⁵ Iris Safari & Alon Zask, Environmental Regulations for discharging Desalination Brine to the Sea and its Possible Impacts, Ministry of Environmental Protection, <http://www.ildesal.org.il/pdf/130.pdf>, 5-6

⁴⁶ *Id.* at 5.

⁴⁷ *Id.* at 6.

⁴⁸ *Id.* at 1.

⁴⁹ *Id.* at 6.

⁵⁰ *Id.*

⁵¹ Appendix N, U-2

originating from a daily discharge of at least 1,831 pounds of iron that is known to bind with sediments. The Regional Board must responsibly consider the acknowledged discharge of iron from the desalination facility and determine whether it can reconcile those facts with the restrictions placed upon the discharge in the Tentative Order. Without additional information provided by Poseidon, we do not believe the Regional Board can responsibly conclude the discharge complies with the conditions of the Tentative Order.

Coastkeeper and Surfrider are concerned that Poseidon's waste discharge of at least 1,831 pounds of iron per day may contribute to more frequent HABs leading to hypoxic zones off the Huntington Beach coast as well as the accumulation of iron in sediments in the discharge zone. The Regional Board should strongly consider the impact of this acknowledged discharge from the proposed desalination plant and how the discharge can be reconciled with Sections V(A)(1)(c), IV(A)(5)(a) and (b)'s prohibitions on sediment degradation and aquatic growth inducing nutrient discharge before adopting the renewal of Tentative Order No. R8-2006-0034, NPDES No. CA80000403.

Perth, Australia: Two-year Feed Back on Operation and Environmental Impact

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Abstract

Seawater desalination development in Australia is strongly influenced by environmental protection and sustainability. The Perth Seawater Desalination Plant (PSDP), as the first large seawater desalination project based on reverse osmosis in this part of the world, had to demonstrate its sustainability with regard to energy and environmental impact. Both subjects were treated with care during the bid preparation as well as during the plant design and construction phases. This paper outlines how the operational environmental concerns have been addressed, and is supported by more than two years of operational data.

The PSDP with a production of 143 700 cubic meters per day (45GL/yr) is able to produce 17% of the total potable water demand for the Perth Integrated Water Supply System (IWSS). The plant forms a key part of the Water Corporation's strategy of "security through diversity" taking into account Perth's growing population and the limitation of the supplies.

The main areas of environmental concern faced at the PSDP consist of dilution of the brine discharge, toxicity of the brine, a perceived threat to dissolved oxygen levels in Cockburn Sound, waste products, and energy consumption.

I. INTRODUCTION

Australia has been subjected to repetitive drought in the last decade, impacting the drinking water supply reliability mainly in the southern part of the country. In this context, seawater desalination appears to be a key alternative resource as part of the whole water management scheme. The Perth Seawater Desalination Plant (PSDP) project commenced construction in May 2005 and was a fast track project [1]. The plant is located to the south of Perth, the capital and largest city of the Australian state of Western Australia. With a Mediterranean climate (850 mm average rain fall), and a population of 1.6 million inhabitants, Perth is experiencing rapid growth and is expected to nearly double in population to 2.9 million by 2060 [2].

The PSDP with a production of 143 700 cubic meters per day (45GL/yr) is able to produce 17% of the total potable water demand for the Perth Integrated Water Supply System (IWSS). The plant forms a key part of the Water Corporation's strategy of "security through diversity" taking into account Perth's growing population and the limitation of current dam and groundwater supplies.

Seawater desalination development in Australia is strongly related to environmental impact reflection as well as sustainability. The PSDP as the first large seawater desalination project based on reverse osmosis in this part of the world, had to demonstrate its sustainability with regard to energy and environmental impact. Both subjects were treated with care during the bid preparation as well as during the plant design and construction phases. Sustainability remains a key focus area of the plant into operations.

The main areas of environmental concern faced at the PSDP and its sustainability focus consist of:

- Dilution of the brine discharge at the edge of the 'mixing zone' – 50m in all directions of the diffuser,
- Toxicity of the brine and its effect on the surrounding ecosystem,
- A perceived threat to dissolved oxygen levels in Cockburn Sound by the environmental regulator and the Cockburn Sound Management Council (who monitor the environmental 'health' of Cockburn Sound),
- Other waste products such as sludge from the dual media backwash water, and
- Energy consumption.

These items will be addressed below in more detail.

II. ENVIRONMENTAL APPROVALS

Considerable time and effort is required to obtain environmental approvals in Australia for large construction projects, sometimes taking upwards of 2 years. The Water Corporation re-activated the project in April 2004 (after being on hold), when some early hydrodynamic modelling work was also undertaken to support the application. A project timeline is listed below, which shows that even though environmental approval was given in July 2004, the environmental operating licence was not issued until less than one month before operations began:

- 2002 The Water Corporation begins to investigate desalination plants as a realistic source of water (Initially looking at a 30GL/yr plant),

- 2003 Project put on hold due to increasing rainfalls 2001-2003,
- April 2004 Project Re-Activated (and increased to 45GL/yr) due to low rainfall after being on hold since 2003,
- July 2004 Government Announcement,
- July 2004 Environmental Approval (Section 46 approval) by the Environmental Protection Authority,
- September 2004 Contract awarded for Project Definition Phase (Tender),
- February 2005 Tenders submitted,
- May 2005 Contract awarded to Multiplex Degremont Joint Venture (MDJV), construction begins,
- August 2006 Pre-commissioning begins,
- October 2006 Environmental Licence issued by the Department of Environment and Conservation,
- November 2006 First Water,
- April 2007 Practical Completion awarded.

The environmental operating licence has since been amended 3 times but only for minor operational changes to make the licence more practicable. The main monitoring requirements have remained the same.

III. BRINE MANAGEMENT

3.1 Brine dilution

Brine discharge to the environment was raised as a main constraint for the development of seawater desalination. It was perceived by some areas of the public and environmental bodies that the high salt content of the brine could impact the sensitive ecosystem of Cockburn Sound. The issue was evaluated at different levels during the project development, plant construction and into operation.

The PSDP is restricted in operations by its operational environmental licence, issued by the Department of Environment and Conservation (DEC). The licence prescribes that the PSDP's brine discharge will meet a dilution factor of 45, at a distance 50m in all directions of the diffuser (the edge of the defined mixing zone). Where:

$$\text{Dilution Factor} = (\text{SB} - \text{SS}) / (\text{SD} - \text{SS})$$

SB (psu) = Salinity of the seawater concentrate being discharged

SD (psu) = Salinity at 50m from the diffuser (average of the brine plume – see explanation of the average below)

SS (psu) = Salinity of the seawater (at inlet)

The seawater salinity at the edge of the mixing zone is measured as close as practicable to 0.5m intervals in the bottom 5m of the water column. The pycnocline due to the diffuser discharge is identified and only those depths below the pycnocline are averaged to determine the diffuser performance. Salinity is measured for at least 3 minutes at each depth then time averaged prior to the determination of the pycnocline depth and any depth averaging. A Seabird CTD instrument is used for all measurements. It

was a requirement of the Environmental Operating Licence to carry out salinity monitoring 12 times over the first year to get an appropriate spread over the seasons, then once every 2 years thereafter. The dilution factors being achieved range from 50 up to 120 at the edge of the mixing zone, depending on which direction the current is flowing, well in excess of the prescribed limitations in the environmental licence which requires a dilution of 45 times [4]. The PSDP also has the option to re-circulate seawater into the brine stream. This can be done during periods of reduced PSDP capacity in order to increase dilution, and ensure sufficient volume and velocity of the discharge in order for the diffusion to work.

The diffuser design was optimized using computer fluid dynamic models based on Roberts Equation, which allowed for the optimization of diameter and angle of discharge. During the design phase, studies were performed at the University of New South Wales using hydraulic calculation code as well as physical 1:15 scale modelling for the confirmation of the design of the outfall (Plume thickness and height, impact, ultimate dilution (<1.2 ppt at 50m objective)). The final design consists of a 1.6m diameter pipe running 500m offshore under the seabed. The terminal diffuser consists of 40 ports along the final 200 m, at about 0.5m from the seabed surface at a 60 degree angle. Later ELCOM (Estuary, Lake and Coastal Ocean Monitoring) computer modelling undertaken by the University of Western Australia (UWA) verified the model using seasonal data collected from real time monitoring sites (such as current data, salinity and temperature). This modelling was also run under a number of “worst case scenarios”, the results of this modelling is discussed in Section 3.3. Figure 1 shows the diffuser location compared to the shoreline and intake. The intake is located 200m offshore in 10m depth of water (intake screens are at mid-depth (5m)).

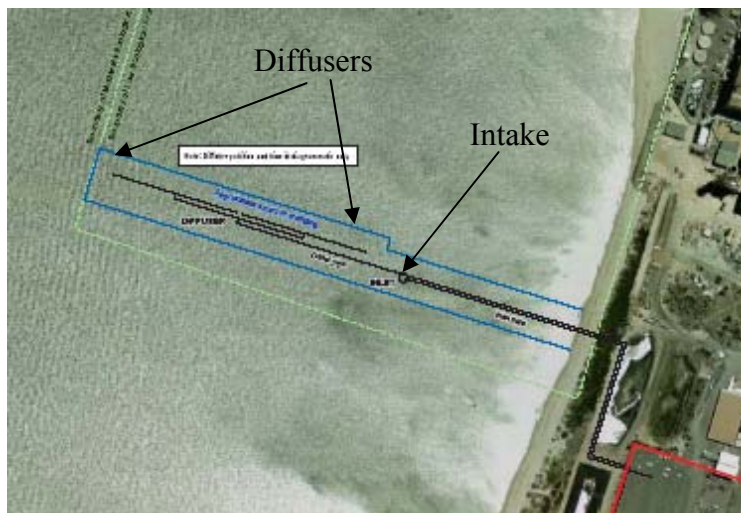


Figure 1: PSDP Diffusers, Intake and shoreline

The performance of the diffuser system was also validated at full scale by the University of Western Australia [3] using salinity measurements around the discharge points as well as hydraulic tests using a rhodamine dye tracer shown in Figure 2 and Figure 3. The experiments consisted of high-resolution profiling of temperature, conductivity, pH, dissolved oxygen, and turbidity under calm conditions over several days in December 2006 and April 2007. The time periods were chosen in an attempt to simulate calm conditions (i.e. a worst case scenario).

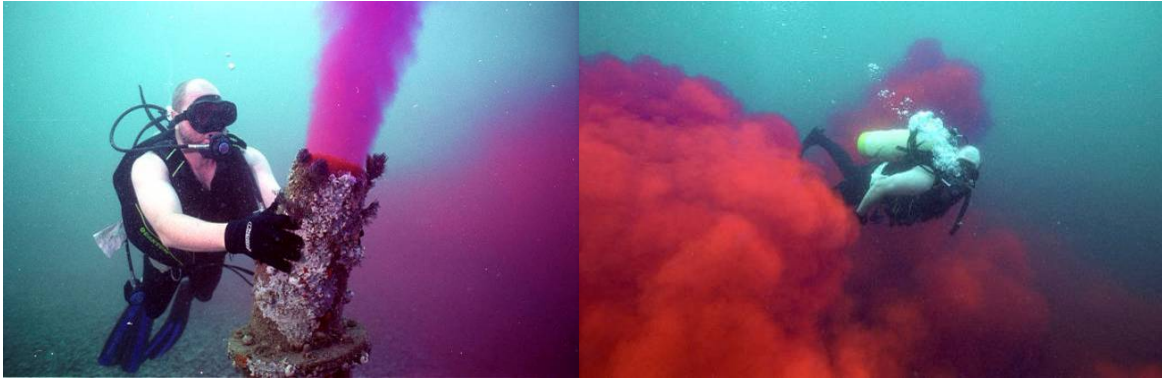


Figure 2 and 3: Rhodamine Dye tracer test

The PSDP's discharge is not affected by surrounding industry. There is a large warmer plume to the North of the PSDP which is discharged from the neighbouring power station, and although picked up in more extensive salinity and temperature sampling, it does not affect the PSDP's immediate mixing zone.

3.2 Brine toxicity

Toxicity tests were also performed to quantify the impact of the brine discharge on the most sensitive species present in Cockburn Sound [5]. Whole Effluent Toxicity (WET) testing was carried out at commissioning and after 12 months of operation. This was a ministerial condition as set by the Environmental Protection Authority (EPA). A selection of species was subject to long term contact (time frames below) with different concentration of brine and monitored to identify the dilution required for minimal environmental impact.

The toxicity of the brine samples was assessed using the following tests which are all NATA accredited (NATA - National Association of Testing Authorities is Australia's national laboratory accreditation authority):

- 72 hour macroalgal germination assay using the brown kelp *Ecklonia radiata*,
- 48 hour mussel larval development using *Mytilis edulis*,
- 72 hour algal growth test using the unicellular algae *Isochrysis galbana*,
- 28 Day copepod reproduction test using the copepod *Gladioferens imparipes*,
- 7 day larval fish growth test using the marine fish pink snapper, *Pagrus auratus*.

All toxicity tests were undertaken at Geotechnical Services (Geotech) Ecotoxicology Laboratory at Fremantle using filtered seawater obtained from Cockburn Sound as the dilution water, and brine from the PSDP. The brine sample represents typical brine discharge during normal operations, hence did not include any CIP chemicals (Note that lime sludge along with the dual media filter backwash water is sent through a de-sludging system before being discharged with the brine plume so would have been included in the PSDP discharge. This is discussed further in Section 3).

Table 1 summarizes the outcome, expressed as the degrees of dilution necessary to protect the most susceptible species at varying levels.

Protection Level with 50% confidence	Protection Value % Brine	Dilution Factor
99	6.64	15.1
95	8.15	12.3
90	9.23	10.8
80	10.93	9.2

Table 1: Dilution Factor required for different protection levels

Results show dilution rates much lower than those selected during the design phase of the project (45 times dilution), which was also verified by the dilution testing. Hence the PSDP is meeting all of its environmental commitments.

The actual diffusers themselves, after a year of operation, are heavily populated by marine growth, mussels and surrounded by feeding fish, Figure 4.



Figure 4: Marine growth around diffuser

3.3 Environmental Survey

Cockburn Sound is a sensitive area as it is characterized by relatively closed access and a variable off shore current. Cockburn Sound is formed by the presence of Garden Island to the west which is joined onto the mainland at the south by a mostly rock groyne bridge (shown later in Figure 6). Only a small opening in the bridge allows minimal mixing with the ocean at the South, most mixing comes from the North. Hence Cockburn Sound consists of a 10m shelf at the front of the PSDP, moving into a 20m basin at its deepest part, and enclosed by Garden Island further west: the bathymetry data show a deep basin, which is naturally subjected to oxygen drop during low current/wind periods.

During the PSDP's environmental approvals phase, the DEC was concerned that the brine, being denser than seawater, would sink to the deeper basin of Cockburn Sound causing a hypoxic layer and cause

dissolved oxygen (DO) levels to drop at the seabed floor. The hypothesis is represented in Figure 5 below. Under extreme hypoxic conditions fish kills can occur which was the DEC’s main concern.

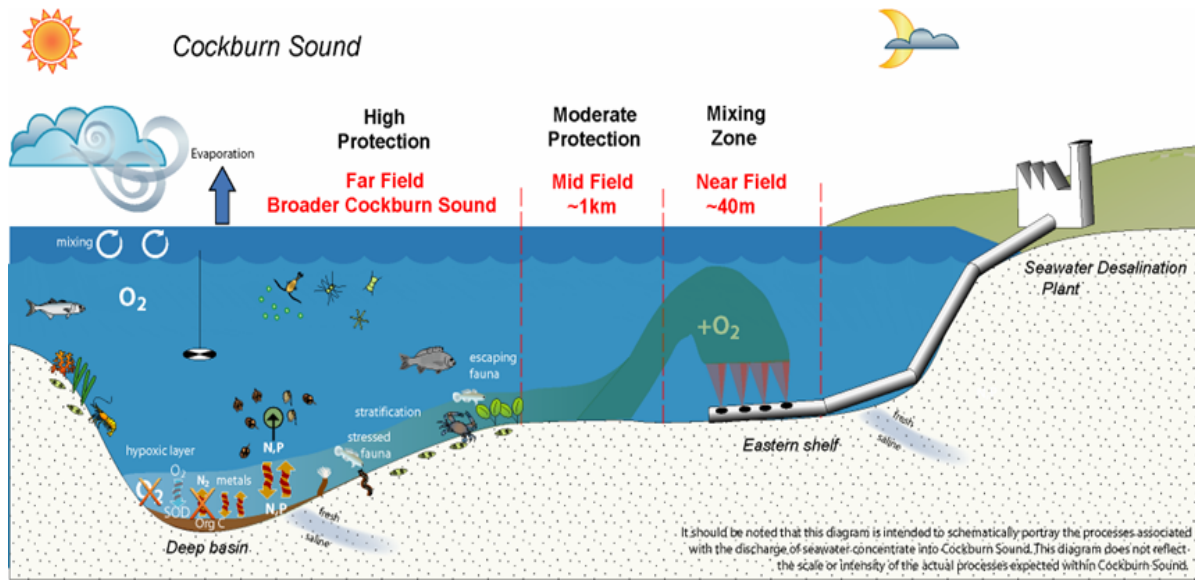


Figure 5: Hypothesis – Brine would sink to the deep basin

The concern had been expressed that under certain meteorological conditions, the brine, despite the mixing from the diffusers, would form a higher density plume which could flow over a seabed ridge into the deep basin of Cockburn Sound.

The PSDP is therefore required to monitor DO levels (a requirement of the environmental operating licence) in the deeper basin of Cockburn Sound (at 0.5m from the seabed floor), and is required to “shutdown” to 1/6th capacity when these levels fall to certain prescribed levels. This has occurred twice during 2008 (over 15 days in April and 12 days in May). The Water Corporation has 3 Real Time Monitoring Stations (RTMS) in the deeper basin of Cockburn sound, taking half hourly measurements of dissolved oxygen, temperature and salinity, and transmitting this data back to head office. A map of Cockburn Sound showing the location of the PSDP, Garden Island and the 3 RTMS is shown in Figure 6. The RTMS are located at the ‘North’, ‘Central’ and ‘South’ locations. Stirling Channel runs in a North-South location directly in front of the PSDP.

Since the environmental licence was prescribed, UWA’s rhodamine dye test has proven that the PSDP’s brine discharge is mixing well on the shelf at the front of the PSDP, and cannot even be traced in the deeper basin of Cockburn Sound [6]. Figure 7 shows UWA’s ELCOM model highlighting the density of the PSDP’s brine plume. The plume can be traced on the 10m shelf and entering into the basin through Stirling Channel getting smaller in size and becoming less dense. The plume, at the end of Stirling Channel is shown to be completely mixed with the surrounding seawater, hence can not even be traced in the deeper basin of the Sound. The plume is shown as red (at the PSDP outlet) at its strongest, then becoming more and more dilute as it transgresses across the 10m shelf of the Sound. As it exits into the 20m basin, the tracer can no longer be tracked.

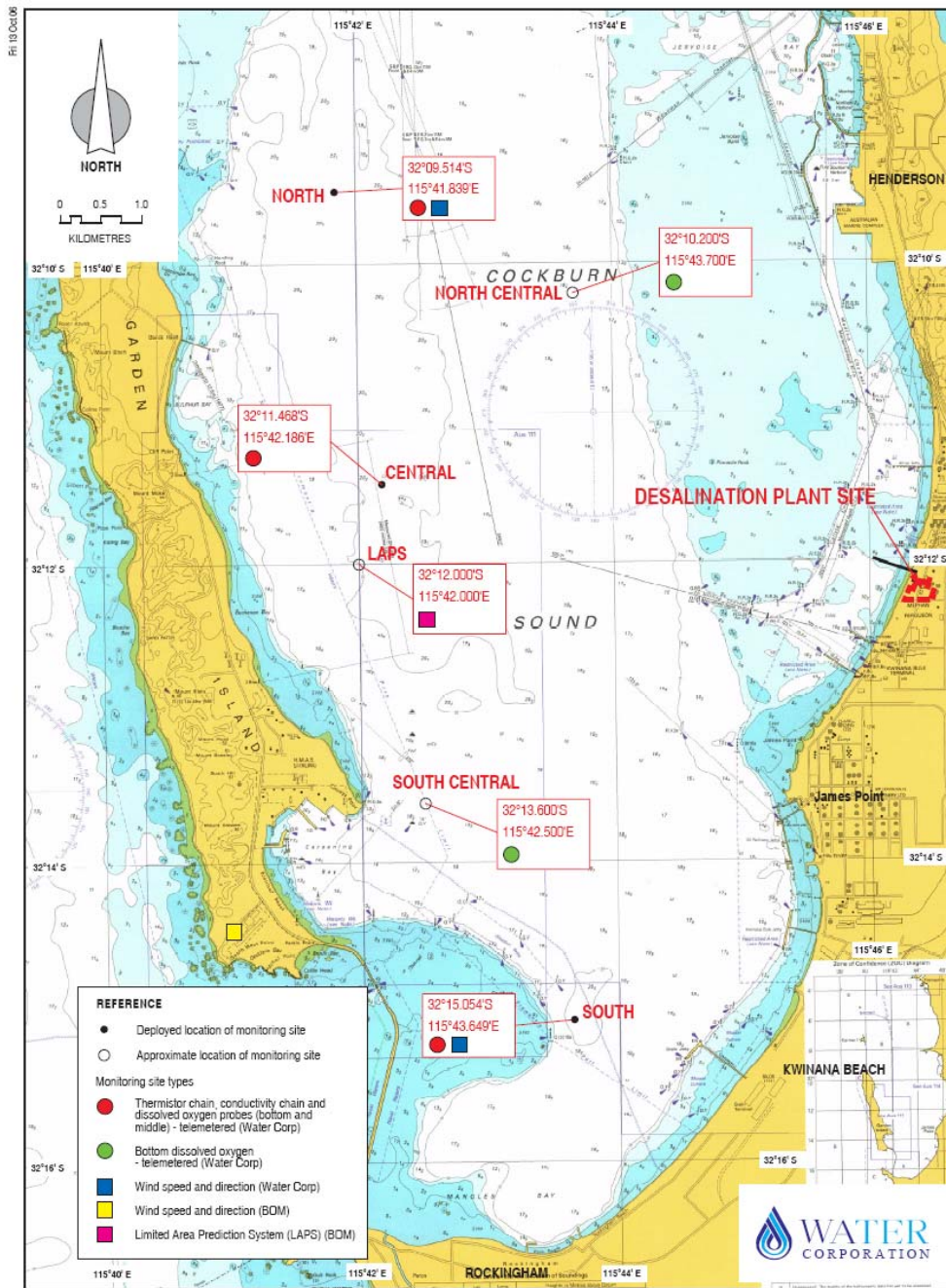


Figure 6: Map of Cockburn Sound showing the 3 Real Time Monitoring Stations at 'North', 'Central' and 'South' locations.

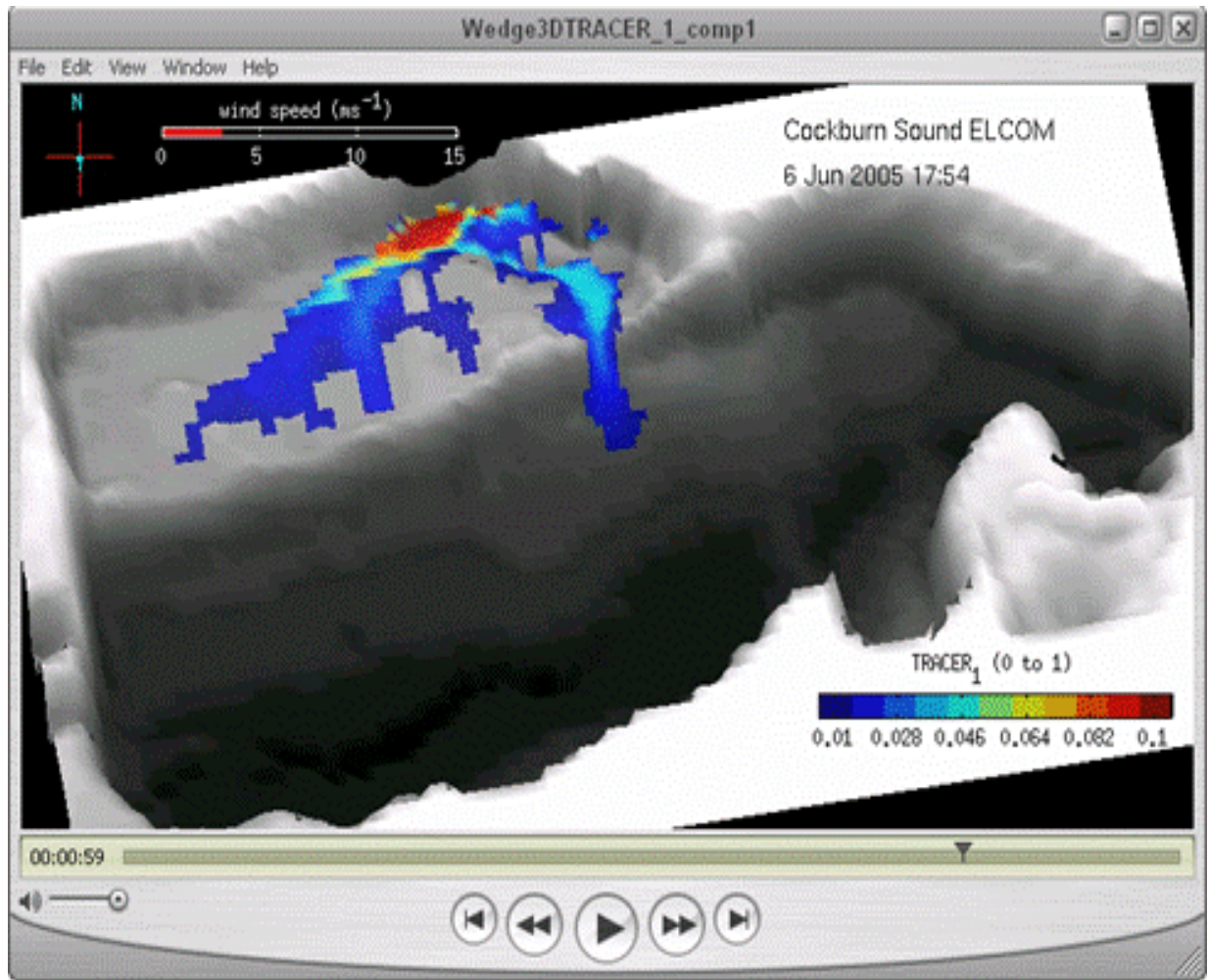


Figure 7: Field results of the Rhodamine Dye tracer test conducted by the Centre for Water Research at the University of Western Australia

If the brine plume is completely mixed at the end of the Channel, and cannot be traced in the deeper basin of Cockburn Sound (as shown in Figure 7), the PSDP can not be having any measurable effect on dissolved oxygen levels in the deeper basin of Cockburn Sound [7]. Despite this, the DEC is hesitant to remove any of the dissolved oxygen plant “shutdown” conditions, perhaps due to public perception rather than science.

The PSDP was “shutdown” to 1/6th capacity twice in 2008 due to dissolved oxygen levels at the seabed floor dropping below those required under the environmental operating licence. The two periods in April and May 2008 occurred during autumn, most likely caused by the fact that Cockburn Sound stratifies naturally particularly when long periods of calm whether can occur [8]. Cockburn Sound is generally a well mixed environment. The main cause of mixing is wind; however tides also have an effect. During autumn a number of consecutive days can occur with very little wind mixing causing Cockburn Sound to stratify and dissolved oxygen levels at the seabed floor to fall.

Seabird SBE43 dissolved oxygen sensors are used on the RTMS to measure the dissolved oxygen levels at 0.5m from the seabed floor. They are connected to the buoy via an umbilical cord, from where the data is transmitted to the Water Corporation head office via mobile phone technology. Bio-fouling is a major problem in ensuring accurate DO readings. Figure 8 shows a typical DO sensor during deployment.

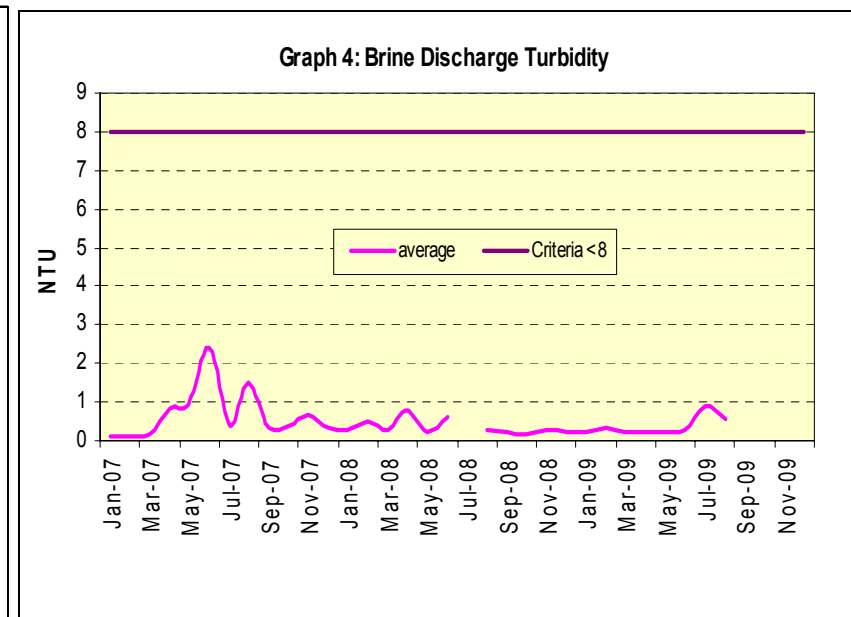
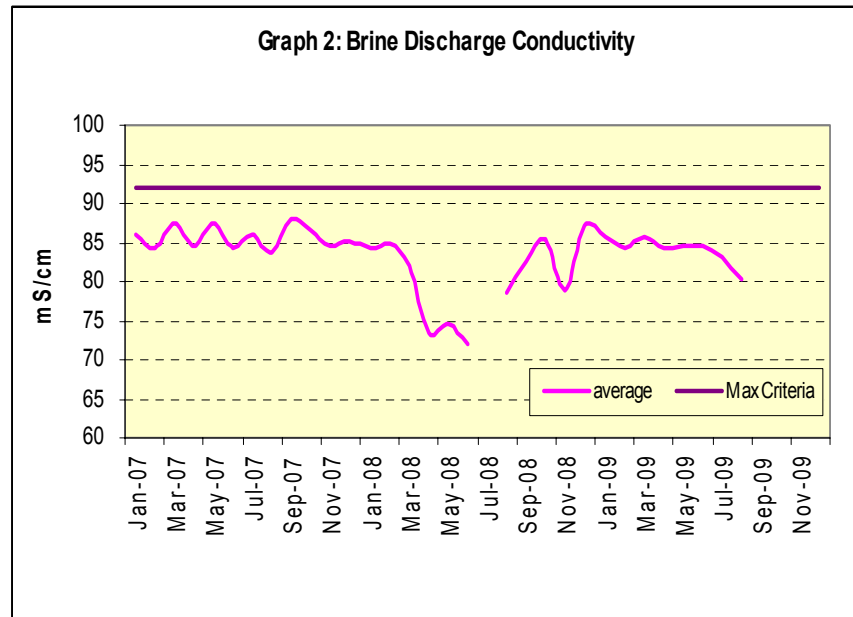
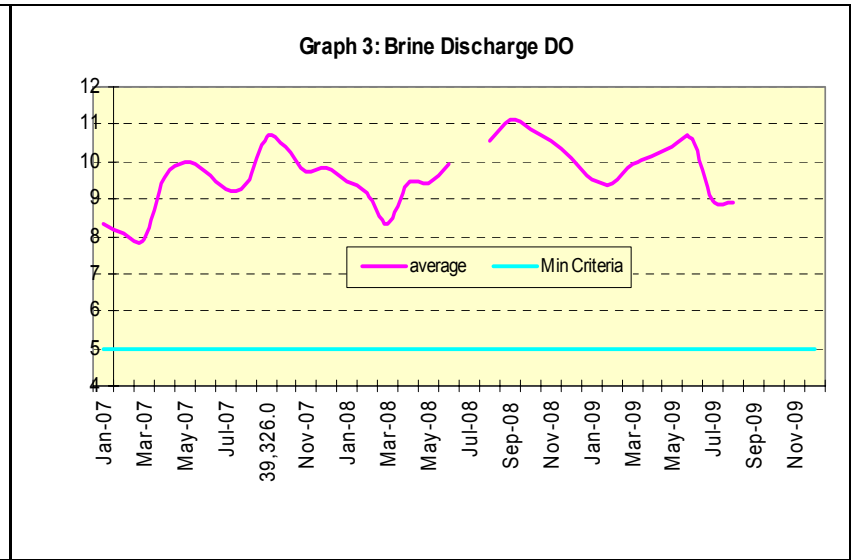
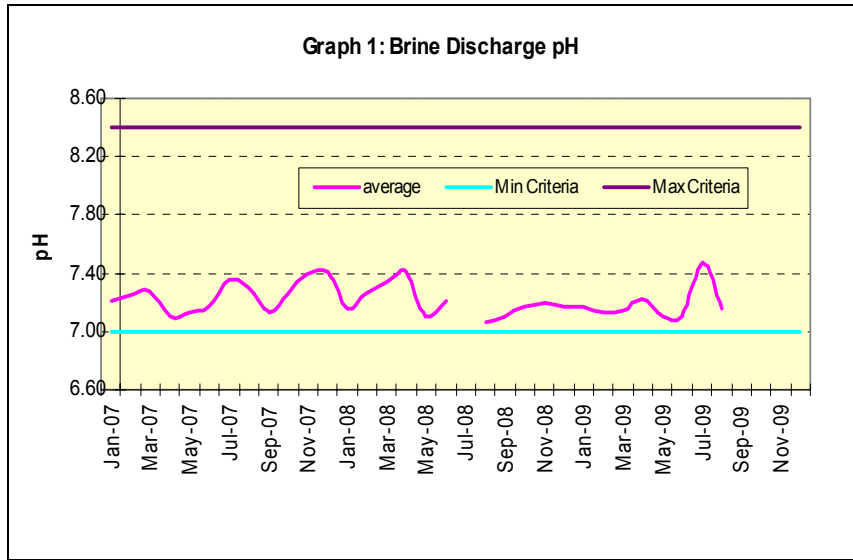


Figure 8: Typical bio-fouling on DO sensor after deployment for a couple of months.

As a result, a number of actions have been implemented in order to decrease the effects of bio-fouling including using an anti-fouling agent, using copper pipe at the entrance to the probe and using blacked out plastic piping and cases to reduce sunlight around sensitive areas. Even still, fortnightly insitu calibration of the DO probes occurs as part of the programs quality assurance. Regular maintenance on the buoys and sensors ensure their reliability.

3.4 On-line Brine Discharge Monitoring

24 hour real time on-line monitoring of the brine discharge is also a requirement of the PSDP's Water Quality Management Plan, approved by the DEC. The discharge limits were prescribed in accordance with the Cockburn Sound Environmental Quality Criteria taking into consideration the dilution effect of the diffusers. Graph's 1 – 4 show the trends of pH, Conductivity, Dissolved Oxygen and Turbidity from more than 2 years of operations. Note the dilution effect on conductivity of re-circulating seawater through the brine discharge in April/May 2008 when the PSDP had to reduce production to 1/6th capacity due to DO levels. All results have been compliant in part due to the steady state nature of the desalination process.



IV. OTHER MARINE MONITORING

In addition to the Rhodamine dye testing, dissolved oxygen monitoring and brine monitoring, an extensive Macrofauna community, sediment habitat and water quality study was undertaken. These studies were undertaken by consultants Oceanica – Marine and Estuarine Specialists. Two Macrobenthic surveys were undertaken, one in March 2006 before PSDP start up and one in March 2008 as part of the PSDP's Ministerial Conditions. The March 2006 baseline survey covered 77 sites to determine the spatial pattern in benthic macrofauna communities (grab sampling) and benthic habitat and epibenthic fauna (towed video) in the deep waters of Cockburn Sound. The repeat survey used the same methods as the 2006 survey to sample 41 of the 77 sites sampled in 2006, plus 5 new sites, in order to gain a view of some areas impacted by the PSDP, and other areas not impacted by the PSDP. The results showed that there has been a marked shift in sediment characteristics and benthic macrofaunal communities throughout the deep basin of Cockburn Sound between 2006 and 2008, however the changes are due to a regional effect, not the result of the operation of the PSDP [9]. The shift in characteristics was generally more pronounced in the northern basin than the central and southern basin. There was also no significant difference between the west or 'control' sites and the 'potential impact' sites, hence it can be deduced that a regional effect is the cause. The results highlight a requirement for a greater understanding of factors contributing to the temporal variation in the benthic communities of Cockburn Sound, however as the changes are shown to be regional (not due to the PSDP), future surveys should be conducted by the greater community, not solely the PSDP.

The water quality sampling program began in February 2005 more than one year before PSDP operations and concluded in May 2008, some two years after operations began. The monitoring program consisted of 8 water quality sites and 6 transect sites which were sampled twice per season. Overall a total of 28 water quality samples were carried out. The findings of the monitoring program support the findings of the modelling studies carried out during the development phase of the PSDP [10]. In particular the salinity impact was only evident on the eastern shelf of the Sound which was slightly higher than the ambient salinity of the receiving waters (up to 1ppt at the seabed floor), however all readings were well within the range of natural salinity variation (variable by up to 4ppt seasonally). All other parameters showed no observable effect following commissioning of the PSDP (except for TDS, which is closely linked to salinity).

V. OTHER WASTE PRODUCT MANAGEMENT

The desalination plant is equipped with a conventional pre-treatment system including screening, coagulation using ferric sulphate (with pH correction using sulphuric acid), filtration on dual media filters and safety filtration through cartridge filters [11]. The coagulation – filtration step removes suspended solids, particles and part of the organics naturally present in the seawater, that are then concentrated in the backwash water.

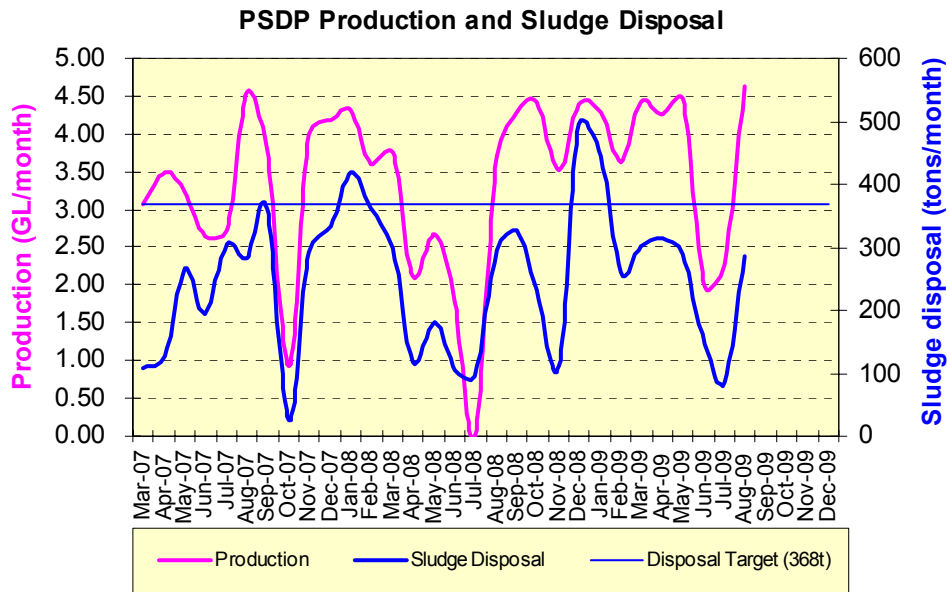
A clarification and sludge dewatering system was implemented on the PSDP to clarify the pre-treatment reject before discharge. This reduces the turbidity impact on the environment which could have had a significant negative effect on photosynthesis.

The backwash water from the Dual Media Filters (DMF's), the first filtration used at PSDP as the seawater enters the site, is settled out using a Densadeg – a settling tank consisting of lamellas and clear water channels at the top to allow the clear water to exit to the outfall tank. The sludge (taken from the

bottom of the tank) is then sent to a centrifuge to spin the solids out. The clear water is returned to the brine outfall tank; however the solids are removed from site to a landfill facility. Figure's 9 and 10 show the clear water channels of the settling tank and typical sludge removed. The PSDP's maximum target sludge removal is 368tons/month. The dewatered sludge consists of 20% solids. It is collected and mixed with mineral or organic waste and disposed to landfill at 40% solids. It was decided to install the sludge treatment facility in order to achieve minimal turbidity of the brine discharge, and to prevent any visible impact of the effluent in the surrounding waters. To date, no other use has been found for the sludge other than landfill due to the high saline content. Monthly sludge disposal can be seen in Graph 5 below. Lower sludge levels are noted during calm weather periods such as March – June. The PSDP attempts to minimize waste streams through process optimization.



Figure's 9 and 10: 'Densadeg' – settling tank and typical sludge after being put through a centrifuge



Graph 5: Monthly Production and Sludge Disposal

An additional benefit of de-sludging is that very little suspended solids are returned to Cockburn Sound, thus the brine plume is a clear water and will not discolour any of the surrounding white sands. This was also a major factor in the decision to install the de-sludging system during construction.

VI. ENERGY

Desalination is an energy consuming process. In terms of energy management, and in keeping with the sustainability strategy, the Water Corporation decided to purchase “green energy” to power the desalination plant. The Corporation has signed an agreement which led to the development of the Emu Downs Wind Farm located 30 km east of Cervantes in Western Australia’s Midwest region. This wind farm [12], which includes 48 wind turbines 1.8 MW unitary capacity has a maximal power production of 83 MW supplying 272 GWh/year into the grid, more than three times the maximum consumption of the desalination plant. All of the energy required to power the PSDP is purchased from the Emu Downs Wind Farm.

A high efficiency energy recovery system was also selected on the first reverse osmosis pass to reduce the plants energy consumption. Energy Recovery Inc - ERI PX 220 installed on the 12 first pass racks exceeds the energy recovery efficiency expected. The 16 PX 220 installed per rack have an efficiency exceeding 96%. The plant energy consumption remains below the design value of 4.1 kWh/m³, and is operated between 3.2 and 3.8 kWh/m³ (including intake and transfer into the distribution system) on this rather cold seawater ranging from 15 degrees in winter to 25 degrees in summer, and salinity of between 36 – 39g/L. Operational feed back of ERI equipment is positive after two years of operation.

VII. CONCLUSION

In conclusion, desalination has an important role in Australia, as a new source of water, with a constant and reliable availability compared to natural resources. Reverse osmosis appears as a sustainable technology as its possible impacts on the environment can be managed. The PSDP was the first large scale reverse osmosis desalination plant built in Australia, which has now spurred other plants being built in Queensland (operational Dec 2008), Sydney, Melbourne and Adelaide. As the PSDP was at the forefront of large scale desalination plants in Australia, it has lead the way in gaining environmental approvals, and is a leading model for sustainable desalination.

The unprecedented marine monitoring programme has included computer modelling for diffuser design and validation, rhodamine dye tracer tests, extensive far field dissolved oxygen tests, a water quality monitoring programme, diffuser performance monitoring programme, WET testing and Macrobenthic surveys. All studies have proven that the PSDP is having negligible impact on the surrounding environment. Impacts on seawater habitat are limited by a validated diffuser design and treatment of suspended solids.

The power consumption of RO plants is decreasing due to increasing technological gains in plant design, membrane design and energy recovery. RO plants can also easily be powered (offset) by renewable energies. Energy recovery systems such as that used at the PSDP (ERI) are now extremely efficient at recovering energy from the brine waste water (greater than 96% efficiency). Sourcing power from renewable energy (albeit offset) is an important sustainability principal employed by the PSDP, which is also now being applied by other large scale Australian desalination plants.

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