Environmental
Research and
Consulting

February 4, 2019

Josie McKinley
Poseidon Water
5780 Fleet Street, Suite 140
Carlsbad, CA 92008

Re: Appendix IIIII-2: Technical Memorandum: Responses to Agency Requests for Information about Copper Nickel Wedgewire Screens

Dear Josie,

I am pleased to submit this final memorandum (memo) which provides responses to requests for information received from agency staff on January 14, 2019 regarding the potential use of coper nickel wedgewire screens (WWS) for the proposed Huntington Beach Desalination Plant.

I look forward to receiving your feedback on this final memo. Please feel free to call with any questions or comments.

Sincerely,

Timothy W. Hogan
TWB Environmental Research and Consulting, Inc.

Introduction

The CA State Lands Commission's (SLC) concluded in the Final Supplemental Environmental Impact Report (FSEIR) "*some studies have shown screens fabricated of copper-nickel alloy provides the greatest resistance to biofouling (SWRCB 2015b), they also corrode more easily and the copper may leach into the water column, resulting in degraded water quality and potentially adversely affecting marine organisms*." However, in Applicant Proposed Measure 8 (Composition and Maintenance of Wedgewire Screens), Poseidon has reserved the right to use copper nickel WWS if they can demonstrate *"to the satisfaction of California State Lands Commission staff that the use of copper nickel alloy screens would not result in chemical leaching in excess of Ocean Plan Water Quality Objectives for Protection of Marine Life standards."* To that end, Poseidon submitted Appendix IIIII on November 28, 2018.

On January 14, 2019, Poseidon received a list of nine (9) questions from the Santa Ana Regional Water Quality Control Board. The information requests included input from staff of the California Coastal Commission and the State Water Resources Control Board.

The information requests and their respective responses are provided below. Responses were prepared by TWB Environmental Research and Consulting with assistance from Miller Marine Science & Consulting, Inc.

Requests for Information

1. **Request:** Clarify which information in the submitted report was provided by Poseidon to the SLC for their CEQA analysis of the Cu-Ni WWS and which information is being provided by Poseidon to state agencies anew to support the Cu-Ni WWS proposal.

   Response: The information contained in Appendix IIIII, dated November 28, 2018, and the subsequent responses to RWQCB questions regarding copper nickel Wedgewire Screens (WWS) were not previously provided to the CA State Lands Commission (SLC) staff as part of the SLC CEQA analysis (i.e., FSEIR). Instead, Appendix IIIII and these subsequent responses to questions provides the analysis Poseidon prepared to support the use of copper nickel WWS consistent with FSEIR Applicant Proposed Measure 8, which states "*The composition of the screens shall be stainless steel, unless Poseidon demonstrates to the satisfaction of California State Lands Commission staff that the use of copper nickel alloy screens would not result in chemical leaching in excess of Ocean Plan Water Quality Objectives for Protection of Marine Life standards. Such demonstration must be based on data that has been reviewed and approved by the State and Regional Water Boards' staff and California Coastal Commission staff*."

   The Regional Board has prevailing statutory authority over water quality and copper is a constituent regulated under the California Ocean Plan. Poseidon is first seeking approval

from the Regional Board to implement copper nickel WWS through the amendment and renewal of Order No. RB-2011-0046, NPDES No. CA8000403. If approved by the Regional Board Poseidon will then incorporate the copper nickel WWS Project design feature into a SLC Lease Amendment application.

2. **Request:** Page 1 mentions a "protective layer of corrosion byproducts on the metal's surface." More discussion of what this phrase means is needed. Please cite which study in appendix 1 is being referenced.

   Response: The "protective layer of corrosion byproducts on the metal's surface" is described in the first paragraph of Appendix 1 of ROWD Appendix IIIII, dated November 28, 2018. "Protective" refers to the fact that once the layers of byproducts are formed, they confer both protection to the underlying metal from a high rate of corrosion and protection from the attachment of biofouling organisms. "Layer" refers to the fact that the byproducts that develop after immersion in seawater are bound to the metal's surface. There are two layers referred to in the literature: a cuprous oxide later and a cuprous hydroxide (or cuprous hydroxychloride) layer. It is the outer layer, which is more loosely attached, that confers the biofouling resistance. The studies used in generating the narrative in Appendix 1 are:

   1. Michel et al. 2011. An Assessment of the Biofouling Resistance and Copper Release Rate of 90-10 Copper-Nickel Alloy. NACE Corrosion 2011 Conference &Expo, Paper No. 11352.
   2. Tuthill, A.H. 1987. Guidelines for the Use of Copper Alloys in Seawater. Materials Performance 26(9):12-22.

3. **Request:** Provide documentation for the "available environmental monitoring data" regarding ambient copper concentrations so that Water Boards' staff can review this information.

   Response: Please find attached the requested data. There are three files corresponding to the three datasets referenced in Appendix 2 of Appendix IIIII, dated November 28, 2018:

   - Table 2.1 and Figure 2.1 refer to HBGS monitoring data. That data is attached as the Excel file labelled "*HBGS eSMR data*". Please note that the eSMR values from 10/2017 were J-flagged with DNQ; Poseidon did not use these values for that reason.
   - Figure 2.2 refers to data from NOAA's National Mussel Watch (NMW) program related to monitoring at stations on the jetties of Anaheim and Newport Bays. That data is attached as the Excel file labelled "*CEDEN mussel watch data*".
   - Table 2.2 refers to El Estero Wastewater Treatment Plant sampling results. That data is attached as the Excel file labelled "*El Estero eSMR_Analytical_Report 11418*". The Charles E. Meyer Desalination Plant in Santa Barbara discharges its brine via the El Estero WWTP outfall after commingling. These data were queried

from the State Water Resources Control Board California Integrated Water Quality System (CIWQS) database for eSMR.

4. **Request:** The results in table 4 appear to be based on an outdated NPDES permit. Please revise these calculations to reflect Poseidon's currently proposed dilution of 14.5:1 or an explanation of why the results in this report are applicable.

   Response: Poseidon assumes that Regional Board's staff's citation of the 14.5:1 ratio is a reference to the Brine Mixing Zone ("BMZ") and that this dilution was taken from ROWD App BBBBB. When referring to salinity, dilution is referenced to the regulatory BMZ (328 ft from the discharge). When referring to other constituents of the effluent (e.g., copper), dilution is referenced to the Zone of Initial Dilution ("ZID"). Alden's most recent modeling (ROWD Appendix NNNNN -Alden 2019) shows that the dilution ratio at the BMZ (2 ppt over ambient) is 15:1 at 130 ft. (35.5 ppt contour varies from 30 ft to 130 ft with an average radius of 73.4 feet). However, the edge of the ZID is approximately 1,675 ft from the discharge where the dilution ratio is 100:1. In addition, Alden 2019 lists the following dilution ratios at specific distances:

Salinity and Dilution Ratio vs. Offshore Distance from Linear Diffuser

	Distance Seaward from the Farthest Offshore Nozzle (ft)			
Description	**130**	**328**	**1,000**	**1,675**
Salinity (ppt)	35.5	34.6	34.0	33.8
Dilution	15	27	61	100

In short, 14.5:1 is a higher dilution ratio than 7.5:1. Therefore, the conclusions in the memo are applicable and conservative. Using 14.5:1 or 100:1 (ZID dilution ratio) means that the copper is more dilute than if we used 7.5:1, so the risk of exceeding any of the water quality objectives is even lower. The updated Table 4 values based on the dilution ratios discussed above are as follows:

	Copper Limit (µg/L)		
Water Quality Objective	**Dilution Ratio of 14.5:1[1]**	**1,000-ft Dilution Ratio of 61:1[2]**	**1,675-ft ZID Dilution Ratio of 100:1[3]**
Max Total Copper (6-Month Median)	18	64	103
Daily Maximum Copper	153	622	1,012
Instantaneous Maximum Copper	436	1,738	2,830

[1] Dilution ratio of 14.5:1 referenced to the BMZ per ROWD Appendix BBBB
[2] 1,000-ft based on the 2012 NPDES permit ZID.
[3] 1,675-ft ZID based on ROWD Appendix NNNNN.

5. **Request:** Give a detail description of the proposed cleaning procedure for the Cu-Ni WWS and discuss whether the cleaning would be done using boat-based air-burst and scrubbing while the intake is shutdown or in a different manner.

   Response: The FSEIR prepared by the SLC provides a detailed description of the proposed cleaning procedures. Please note, however, that the cleaning procedures described in the FSEIR are based on the use of passive stainless steel screens, not copper nickel.

   There are two components to keeping a WWS clean: 1) managing free-floating debris and 2) managing biofouling. Each of these are discussed in greater detail below.

   - Airbursting will be used to manage free-floating debris that may interact with the WWS. The boat-based airbursting procedure for stainless steel WWS is described in the FSEIR, Part III in Table 2-6 on page 2-31. The text from the FSEIR is included here for convenience:

     A boat-based air burst system would use an onboard compressor and flexible air hosing. The boat would be periodically moored above the offshore intake location, and the wedgewire screens would be fitted with flanges to allow temporary connection of the hose. Divers would air burst screens individually and in sequence by moving the air hose from one screen to the next.

     Poseidon anticipates implementing this process as a maintenance approach for keeping the screens clean. Therefore, gravity anchor blocks (see Figure 2-10) would be placed on the ocean floor to keep the boat on station during the air burst process. Ensuring that the service boat can remain on-station would be important because this would allow the divers to properly connect the compressed air hose to each

screen. The gravity anchors would be installed during construction of the wedgewire intake system and surface buoys would be deployed when the system begins operating (if and when manual diver cleaning is deemed to be ineffective).

It is important to note that, like any technology, WWS cleaning approaches are constantly evolving as vendors seek to develop solutions for a wider range of applications. Boat-based air bursting was chosen for the SLC EIR because it represents the most conservative CEQA approach, meaning potentially the largest environmental impact.

- Manual cleaning by divers will be used to manage biofouling on the passive WWS. The manual cleaning procedure for stainless steel WWS is described in the FSEIR, Part III in Table 2-6 on page 2-31. Manual cleaning of copper nickel WWS would be less frequent and less aggressive since biofouling would be significantly less than on a passive stainless steel WWS. Specifically, "scrubbing" is too harsh of a term to describe the manual cleaning that would be required of a copper nickel WWS. As stated on page 9 of Appendix IIIII: "*Manual cleaning is not expected to be aggressive enough to disturb the protective layer*." Cleaning may be as gentle as rubbing the screen surface with a gloved hand since we would expect only soft growth (e.g., biofilm) rather than hard macrofouling organisms (e.g., barnacles and mussels). The text from the FSEIR (stainless steel WWS) is included here for convenience and I have highlighted text that would not apply to copper nickel WWS:

  This method uses divers working on a regular schedule to keep the screens clean. The divers would physically scrape and/or pressure wash the screen faces, most likely occurring during a regularly-scheduled inspection. While it is possible to design a wedgewire screen array in which individual screens could be removed, a clean-in-place (CIP) method would likely be implemented due to simplicity (i.e., a diver would be required regardless of whether screens are removed for cleaning or by CIP). Manual cleaning would require a minimum of two divers in the water and two crew members on the service boat stationed over the intake site. A service boat would be temporarily anchored over the offshore intake location. The divers would deploy over the offshore intake location and remain connected by a cord (with a video feed) to the service boat. One boat-based crew member would monitor the divers via video and the other crew member would be responsible for the boat. The divers would manually scrape the external screen surfaces with hand tools and the liberated biofouling debris would be passively swept from the offshore intake location. When the divers return to the service boat, the anchor would be weighed and the service boat would depart from the offshore intake location.

6. **Request:** Compute the concentration of copper in the water column adjacent to the Cu-Ni WWS during periods of shutdown and/or during periods of cleaning of the WWS.

Response: Note that it is not anticipated that the WWS cleaning will require the intake to be shut down. The table below provides an estimate of the daily mass of copper that could potentially be released during a planned shutdown of the intake system for general HBDP maintenance. The daily mass is converted to a concentration based on dissolution into the total volume of the ZID. Note that concentrations are provided for the legacy 1,000-ft ZID and the ZID as recently estimated in ROWD Appendix NNNNN.

			ZID Volume (m^3)		Copper Conc ($g/m^3/day$)	
Corrosion Rate (mil/yr)	Note on Corrosion Rate	Mass of Copper Potentially Released (grams/day)	1000-ft ZID[4]	1675-ft ZID[5]	1000-ft ZID[4]	1675-ft ZID[5]
0.709	Based on corrosion after 1 yr[1]	457	1,751,176	4,913,143	0.00026	0.00009
0.10	Based on corrosion after 5 yrs[2]	64	1,751,176	4,913,143	0.00004	0.00001
0.05	Based on corrosion after 14 yrs[3]	32	1,751,176	4,913,143	0.00002	0.00001

[1] Corrosion rate from Tetra Tech. 2016. Final Intake Biofouling and Corrosion Study. West Basin Ocean Water Desalination Demonstration Facility Intake Biofouling and Corrosion Study. Prepared for the West Basin Municipal Water District, January 13, 2016.
[2] Corrosion rate from Efird, K. 1976. The Interrelation of Corrosion and Fouling of Metals in Seawater. NACE Corrosion, Ontario, April 1975.
[3] Corrosion rate from Efird, K. and D.B. Anderson. 1975. Seawater Corrosion of 90-10 and 70-30 Cu-Ni: 14 Year Exposures. Materials Performance, November 1975.
[4] 1,000-ft ZID based on the 2012 NPDES permit.
[5] 1,675-ft ZID based on ROWD Appendix NNNNN.

7. **Request**: Discuss the potential deposition and accumulation of Cu on the surrounding seafloor (sediment column) and impacts to benthic organisms.

   Response: While any intake flow is occurring, no deposition and accumulation of Cu will occur on the surrounding seafloor near the intake. Measurable amounts of copper are not anticipated to be released from the WWS during a shutdown; however, if copper is released it will be dissolved in seawater and transported passively in the water column from the

intake area. Please note that shutdown of the HBDP is not planned to be more than two weeks each year; therefore, the risk of copper being released, deposited and accumulated on the surrounding seafloor near the intake is extremely low and therefore, Poseidon is not anticipating any significant impacts to the benthic community.

8. **Request:** Propose a monitoring strategy to measure the release of copper into the sediment and water column surrounding the intake structure during periods of intake shutdown and/or WWS cleaning.

   Response: It is not anticipated that the WWS cleaning will require the intake to be shut down. It is also unlikely that measurable amounts of copper will leach from the WWS to the surrounding environment during a planned intake system shutdown. During the first year of operations (i.e., when the highest corrosion rate would be expected – see response to question 6 above), and if the intake system is completely shutdown for two weeks or greater, the following sampling strategy could be used to verify this:

   1. Collect water samples at near bottom and midwater column at 3 sites positioned on the same isobath as the WWS array center point. The 3 sites consist of two reference sites: 1) 1000 ft upcoast, 2) 1000 ft downcoast, and 3) as close to the middle of the WWS array that can be achieved without risk of the van veen hitting or being caught on any part of the submerged intake infrastructure.
   2. Collect the upper 2 cm of sediment at each of the same 3 sites listed in above) using a chemically-clean van veen grab (stainless steel if possible) as prescribed by the Southern California Coastal Water Research Project (SCCRWP) BIGHT regional monitoring protocols
   3. Sample within 72 hrs before shutdown starts to capture baseline conditions as close to the start of the planned shutdown
   4. Sample during the planned shutdown. If screen cleaning is to occur at the same time as the planned shutdown, sample as close to the end of cleaning as is feasible (safety, access, holding time consideration).
   5. Test water samples using EPA Method 1640
   6. Test sediment samples using EPA Method 3050B or an alternative method approved under 40 CFR 136.

9. **Request:** We could not verify the data that was referenced in a 14-year corrosion study. We could not find the research paper pertaining to the 14-year corrosion study referenced in the report. Again, we request that Poseidon submit a copy of the 14-year corrosion study to verify the data.

   Response: Poseidon has reached out to both the author and the publisher directly and through social media but has not yet received a full copy of the paper. We will send it as

soon as received, pending no copyright issues. However, there is a more recent citation for the corrosion rate referenced in the study. As we indicated previously, please note that the paper published one year after (Efird 1976, for which a link has previously been supplied for download), also references the corrosion rate used in the Efird and Anderson (1975) paper:

This concept was further substantiated by a removal in another experiment where 70-30 Cu-Ni panels that had been exposed in seawater for 14 years, with corrosion rates of .05 mpy, were only slightly fouled as shown in Figure 11.