SOAH DOCKET NO. 582-20-1895
TCEQ DOCKET NO. 2019-1156-IWD

IN THE MATTER OF THE	**§**	**BEFORE THE STATE OFFICE**
APPLICATION OF PORT OF	**§**	
CORPUS CHRISTI AUTHORITY OF	**§**	**OF**
NUECES COUNTY FOR TPDES	**§**	
PERMIT NO. WQ0005253000	**§**	**ADMINISTRATIVE HEARINGS**

EXHIBIT PAC-50R

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REMAND PREFILED TESTIMONY

OF

DANIEL SCHLENK

ON BEHALF OF

PORT ARANSAS CONSERVANCY

SUBMITTED ON FEBRUARY 2, 2022

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LIST OF EXHIBITS

PAC-50R DS-1	Curriculum Vitae of Daniel Schlenk
PAC-50R-DS-2	Roberts, P., Jenkins, S., Paduan, J., Schlenk, D, and J. Weis. 2012. Management of Brine Discharges to Coastal Waters, Recommendations of a Science Advisory Panel. Environmental Review Panel (ERP). Southern California Coastal Water Research Project. Technical Report 694.
PAC-50R-DS-3	Excerpts from USA 1991 Technical Support Document for Water-Quality Based Toxics Control, with highlights of certain relevant portions.
PAC-59R	EPA December 15th Interim Objection and Request for Additional Information.
PAC-54R	Dr. Nathan Knott Comments re: Roberts, P, et al. Report.

I. INTRODUCTION

Q. PLEASE STATE YOUR NAME.

A. Daniel Schlenk.

Q. PLEASE BRIEFLY DESCRIBE YOUR OCCUPATION.

A. I am a Professor of Aquatic Ecotoxicology at the University of California, Riverside. I have been studying the fate and effects of chemicals and salinity, alone and in combination, on aquatic organisms for approximately 25 years.

Q. HAVE YOU AUTHORED ANY PEER-REVIEWED ARTICLES RELEVANT TO YOUR EVALUATION IN THIS MATTER?

A. Yes.

Q. PLEASE EXPLAIN.

A. Of the more than 320 peer-reviewed articles and book chapters I have authored, approximately 50 have focused on the impacts of salinity or desalinization discharge on biota.

Q. IN YOUR CURRENT WORK, HAVE YOU PERFORMED OR OVERSEEN RESEARCH STUDIES RELATED TO THE EVALUATION OF THE IMPACT OF DESALINATION DISCHARGES UPON AQUATIC LIFE?

A. Yes, I have been involved in several such studies.

Q. WHAT ARE SOME OF THE MOST SIGNIFICANT EXAMPLES OF SUCH STUDIES?

A. In my own laboratory, we have evaluated the impacts of desalinization discharge from the Monterey Bay Aquarium on fish development. In addition, we have evaluated the impact of reverse osmosis treatment (the same process used in desalinization) on removal of endocrine disrupting substances. Lastly, I have worked extensively with the Orange County Sanitation District which discharges a mixture of secondary wastewater and brine resulting from reverse osmosis treatment (similar to desalinization) and evaluated the

impact of this discharge on biota. We have also identified novel chlorinated byproducts of pharmaceutical agents that were present within the brine/wastewater mixture.

Q. DO YOU HAVE AN EDITORIAL ROLE IN ANY PEER-REVIEW JOURNALS RELATED TO YOUR OPINIONS IN THIS MATTER?

A. Yes. Since 2016, I have been an associate editor of the Journal *Environmental Science and Technology.* Since 2016, I have also been an associate editor of the Journal *Environmental Science and Technology Letters.* I have been on the editorial boards of *Aquatic Toxicology* since 2001, *Marine Environmental Research* since 2000, and *Toxicological Sciences* since 2000. I was also co-editor in chief for *Aquatic Toxicology* from 2005 to 2011.

Q. PLEASE IDENTIFY EXHIBIT PAC-50R DS-1.

A. Exhibit PAC-50R DS-1 is a copy of my current Curriculum Vitae.

PAC offers Exhibit PAC-50R DS-1.

Q. HAVE YOU BEEN INVOLVED IN ANY WORK THAT FORMED THE CALIFORNIA OCEAN PLAN AS IT RELATED TO DESALINATION DISCHARGES INTO COASTAL WATERS?

A. Yes. In support of the development of California's 2015 Ocean Plan, I served on a Science Advisory Panel that was convened to advise the State of California on the best practices for brine disposal in coastal waters. The panel was comprised of members with expertise in physical oceanography, modeling, ecology, and toxicology. On that panel, I provided expert analysis regarding the ecological and toxicological impacts of desalination brine discharges upon aquatic life.

Q. WHAT TYPES OF MATERIAL DID THAT PANEL REVIEW?

A. We reviewed extensive material, including peer-reviewed publications, gray literature, and technical memorandums, as well as National Pollutant Discharge Elimination System (NPDES) permits that had been issued, discharge regulations from around the world, and the results of monitoring studies.

Q. IN YOUR WORK ON THAT PANEL, DID YOU GAIN KNOWLEDGE REGARDING THE RELATIVE ECOLOGICAL IMPACTS OF DIFFERENT SETTINGS FOR BRINE DISCHARGES?

A. Yes. We worked together as a group. While I am not a modeler, on that panel we received several presentations regarding the relative impacts of a brine discharge in different settings, including the role that bathymetric holes and barriers to dilution play in the potential aquatic impact of desalination discharges.

Q. IN YOUR WORK ON THAT PANEL, AND YOUR OTHER PRIOR WORK, DID YOU GAIN KNOWLEDGE REGARDING THE POTENTIAL FOR CONSTITUENTS WITHIN THE INTAKE WATER TO BE CONCENTRATED AS A RESULT OF THE DESALINATION PROCESS?

A. Yes. We addressed this possibility in our report.

Q. IN YOUR WORK ON THAT PANEL, AND YOUR OTHER PRIOR WORK, DID YOU GAIN KNOWLEDGE REGARDING THE TYPES OF CHEMICALS USED IN THE DESALINATION PROCESS?

A. Yes. I became aware of the use of anti-foulant chemicals that are used throughout the treatment process as well as anti-scalant compounds as well as flocculants and coagulants that are used to maintain appropriate filtration during the desalinization process.

Q. HAS THAT PANEL REPORT BEEN REFERENCED BY ENTITIES IN TEXAS?

A. Yes. Our recommendations were noted by the Marine Seawater Desalination Diversion and Discharge Zones Study jointly completed by the Texas Parks and Wildlife Department and the Texas General Land Office, as reflected in Exhibit PAC-7 at page 18 of 43. Our recommendations have also been referenced by the Texas Parks and Wildlife Department in that agency's comments on the Port's application under consideration in this hearing, as reflected in Exhibit PAC-37 at page 3.

Q. PLEASE IDENTIFY EXHIBIT PAC-50R DS-2.

A. Exhibit PAC-50R DS-2 is a copy of that panel report.

PAC offers Exhibit PAC-50R DS-2.

Q. HAVE YOU SERVED ON ANY OTHER PANELS OR ADVISORY GROUPS RELATED TO DESALINATION DISCHARGES?

A. Yes. I served as a Scientific Advisor on a research project in Western Australia (National Centre of Excellence in Desalination Australia) that was evaluating the impacts of desalinization discharge on aquatic biota. I was also a Scientific Partner for the SanOcean Project through the University of Stavanger Norway/University of Cape Town, South Africa and InPART group which was a consortium focused on the impacts of desalinization discharge.

II. SUMMARY OF OPINIONS

Q. HAVE YOU DEVELOPED OPINIONS REGARDING THE POTENTIAL IMPACT OF THE SALINITY INCREASES UPON AQUATIC LIFE AS A RESULT OF THE PROPOSED DISCHARGE?

A. Yes.

Q. PLEASE SUMMARIZE THOSE OPINIONS.

A. It is my opinion that that the Applicant has not provided adequate information and data needed to demonstrate that the discharge will not significantly adversely impact the marine environment, aquatic life, and wildlife.

Q. HAVE YOU DEVELOPED OPINIONS REGARDING THE WHOLE EFFLUENT TOXICITY (WET) TEST RESULTS SUPPLIED BY THE PORT OF CORPUS CHRISTI TO THE TCEQ EXECUTIVE DIRECTOR ON JUNE 25, 2021?

A. Yes.

Q. PLEASE SUMMARIZE THOSE OPINIONS.

A. It is my opinion that the whole effluent toxicity (WET) test results fail to utilize proper biological endpoints, fail to utilize proper species, and fail to address the proper duration of exposure that would demonstrate that the discharge will not have significant adverse impacts on the marine environment and aquatic life in the receiving waters. In particular, the WET testing provided fails to provide sufficient biological endpoints because it does not address relevant sublethal biological endpoints that are likely to be impacted by the

discharge, such as reproduction and development. The use of growth as a sublethal biological endpoint does not sufficiently demonstrate that the proposed discharge will not cause other significant sublethal impacts. In addition, the species utilized are not appropriately sensitive species to reflect the potential impact of the discharge, the primary concern of which is salinity. Rather, the WET testing evaluates species that are more salinity-tolerant than many of the species existing in the receiving waterbody. Furthermore, a continuous hypersaline discharge, such as the discharge proposed here, would potentially result in the continuous exposure of species to hypersaline conditions, particularly in the hole beneath the discharge where the Applicant has not demonstrated that persistent hypersaline conditions will not exist. Thus, aquatic species within the receiving waters will potentially be exposed to hypersaline conditions for durations in excess of the durations addressed in the WET testing provided by the Applicant.

Q. HAVE YOU DEVELOPED OPINIONS REGARDING THE WHOLE EFFLUENT TOXICITY REQUIREMENTS CONTAINED IN THE REVISED DRAFT PERMIT NOW PENDING IN THIS MATTER?

A. Yes.

Q. PLEASE SUMMARIZE THOSE OPINIONS.

A. It is my opinion that the WET test requirements will not assure that the discharge will not significantly adversely impact the marine environment, aquatic life, and wildlife, for reasons similar to those expressed above with regard to the WET testing supplied in the application.

Q. HAVE YOU DEVELOPED OPINIONS REGARDING THE NATURE OF CONTAMINANTS THAT MAY BE CONTAINED IN THE EFFLUENT OTHER THAN SALINITY?

A. Yes.

Q. **PLEASE SUMMARIZE THOSE OPINIONS.**

A. It is my opinion that the Applicant has not demonstrated that non-saline constituents in the discharge will not result in significant adverse impacts upon the marine environment and aquatic life. As one example, chlorine will be utilized in the desalination plant, and will undergo interactions with other constituents of the effluent and will result in the presence of chlorinated byproduct chemicals such as trihalomethanes, which are potentially harmful to aquatic life after continuous exposure. The effluent will necessarily contain other chemicals associated with the desalination process, such as coagulants and flocculants, and the Port has not demonstrated that these constituents will not be present in amounts that would have adverse environmental impact, particularly in light of interactions that may occur between the various chemicals and constituents potentially present in the discharge. Additionally, the potential exists that constituents within the intake water will be concentrated through the desalination process to a level that will be significantly harmful to the marine environment. The Applicant has not proven that chemicals taken within the intake are at concentrations that will not cause adverse effects in biota.

III. RELEVANT EPA GUIDANCE

Q. I WOULD LIKE TO BEGIN BY DISCUSSING SOME OF THE EPA GUIDANCE RELATED TO THE ISSUES RAISED BY THE PORT'S APPLICATION. CAN YOU PLEASE IDENTIFY EXHIBIT PAC-50R DS-3?

A. Yes. Exhibit PAC-50R DS-3 is a copy of the EPA's 1991 Technical Support Document for Water-Quality Based Toxics Control. This copy has been highlighted to identify portions that may be particularly relevant to the Port's Application.

PAC offers Exhibit PAC-50R DS-3.

Q. DOES THIS GUIDANCE ADDRESS EPA'S "INTEGRATED" APPROACH TO WATER-QUALITY BASED TOXICS CONTROL?

A. Yes. Within this document, EPA emphasizes that its toxics control regulation adopted in 1989 included an integrated approach to be used in water-quality based toxics control. This

integrated approach requires a joint consideration of biological assessments, whole effluent toxicity evaluations, and chemical-specific limitations. As EPA notes in this guidance, each of those techniques has its limitations, and no single approach can be relied upon to ensure protection of aquatic life and human health. This is discussed at page 12 of the Exhibit.

Q. IN YOUR OPINION, DOES THAT POINT RELATE TO THE ISSUES RAISED IN THIS CASE?

A. Yes. This point emphasizes that the impacts of the Port's proposed discharge must be viewed wholistically. It would be improper to rely upon WET testing alone to provide protection for aquatic life, particularly to the exclusion of aquatic assessments such as those provided by experts in the field.

Q. HAS EPA IN ANY WAY NOTED THIS PRINCIPLE WITH REGARD TO THE PORT'S APPLICATION?

A. Yes. In correspondence to the TCEQ dated December 15th, 2021, at page 7, EPA commented to the TCEQ that:

> EPA would like to note that WET testing is a part of EPA's integrated strategy in the assessment of water quality, which includes the use of three control approaches (the other two being chemical-specific limits and biological criteria). As such, EPA reminds TCEQ that WET is not intended to take the place of any other biological assessment that is appropriate for water quality assessment of this receiving stream.

This illustrates that EPA's integrated approach to water-quality based toxics control, as set forth in the 1991 Technical Support Document, remains EPA's required approach to toxics control.

Q. PLEASE IDENTIFY EXHIBIT PAC-59R.

A. Exhibit PAC-59R is a copy of EPA's December 15th Interim Objection and Request for Additional Information regarding the Port's application. The language just discussed is at page 7 of this Exhibit.

PAC offers Exhibit PAC-59R.

Q. DID YOU RELY UPON EXHIBIT PAC-59R IN THE FORMATION OF YOUR OPINIONS EXPRESSED IN THIS TESTIMONY?

A. Yes.

Q. IS EXHIBIT PAC-59R THE TYPE OF INFORMATION RELIED UPON BY EXPERTS IN YOUR FIELD?

A. Yes.

Q. DOES THE 1991 TECHNICAL SUPPORT DOCUMENT INCLUDE GUIDANCE ADDRESSING HOW TO CONSIDER THE AQUATIC IMPACTS OF A CONTINUOUS DISCHARGE?

A. Yes. Within this guidance, EPA notes that in the case of a continuous discharge, the concentration of contaminants within the receiving water are continually being refreshed in the area of the discharge. Thus, EPA notes that under such circumstances the toxicity can be considered conservative and persistent in the area within the mixing zone. The guidance goes on to note that persistency of contaminants may particularly be a problem in estuarine environments where toxicity is not flushed away quickly. This is discussed at page 44 of Exhibit PAC-50R-DS-3.

Q. DOES THIS HAVE RELEVANCE TO THE EVALUATION OF THE PORT'S DISCHARGE?

A. Yes. There seems to be some contention by the Port that organisms will not be exposed to contaminants in the discharge for significant periods of time. As this guidance indicates, any time that you are dealing with a continuous discharge, it is appropriate to consider the impact of a persistent exposure in the mixing zone, because even if the discharge plume dilutes as it moves away from the discharge point, an area of significant concentration remains. From my discussions with PAC's modelers, it seems that the Port has not demonstrated that persistent concentrations of constituents such as salinity will not exist within areas near the discharge point, such as the hole near the discharge point. The Port's

contention that exposures should be assumed to be short in duration is contrary to this EPA guidance.

IV. SIGNIFICANT SUBLETHAL TOXICITY TO AQUATIC ORGANISMS THAT MOVE THROUGH THE MIXING ZONE

Q. HAVE YOU REVIEWED THE AUGUST 24, 2018 COMMENTS BY THE TEXAS PARKS AND WILDLIFE DEPARTMENT WITH REGARD TO THE PORT'S APPLICATION, WHICH ARE EXHIBIT PAC-37 IN THIS MATTER?

A. Yes.

Q. DO THOSE COMMENTS CONTAIN A RECOMMENDED LIMIT ON THE MAGNITUDE OF THE SALINITY CHANGE THAT SHOULD BE ALLOWED TO MAINTAIN PROTECTION OF AQUATIC ORGANISMS?

A. Yes.

Q. WHAT IS THAT LIMIT?

A. Texas Parks and Wildlife Department recommends that salinity increases at the mixing zone boundary should be limited to no more than 5% above that occurring naturally, or an absolute increment of 2 practical salinity units above that occurring naturally, whichever is less.

Q. ARE "PRACTICAL SALINITY UNITS" AND "PARTS PER THOUSAND" EQUIVALENT?

A. Yes. In oceanic settings, practical salinity units (psu) are typically expressed as g of salt/kg of water which represents one part of solute per 1000 parts of water. Thus, the term parts per thousand (ppt or ‰) can be used interchangeably with psu. PSU and ppt are typical measurements of salinity within ambient waters and allow temporal as well as spatial comparisons.

Q. DID TPWD IDENTIFY A SOURCE FOR THIS STANDARD?

A. Yes. TPWD referenced the 2012 report, "Management of Brine Discharges to Coastal Waters, Recommendations of a Science Advisory Panel." I served on that panel.

Q. SO, ARE YOU FAMILIAR WITH HOW THAT PANEL'S RECOMMENDED LIMIT OF THE LESSER OF 5% ABOVE AMBIENT, OR 2 PPT, WAS DEVELOPED?

A. Yes.

Q. PLEASE EXPLAIN.

A. In the work of the Scientific Advisory Panel, those recommended limits were developed using other standards from several countries and, comparing those standards of toxicity thresholds derived from other literature sources, a composite value was determined.

Q. IN YOUR OPINION, WOULD AN INCREASE OF 5% ABOVE AMBIENT, OR 2 PPT AT THE BOUNDARY OF THE MIXING ZONE, POTENTIALLY RESULT IN ADVERSE IMPACTS UPON AQUATIC LIFE IN VICINITY OF THE PORT'S PROPOSED DISCHARGE?

A. Yes.

Q. PLEASE EXPLAIN?

A. Multiple studies have indicated that a change of 2 ppt or more at the boundary of the mixing zone is a no observed effect concentration. That is the threshold at which effects occur. Impacts of salinity changes above that threshold include impaired development of invertebrates as well as altered photosynthetic processes in seagrasses and, specifically in red drum fish larvae, the percentage of hatched embryos and survival of larvae was impaired at a 2 ppt increase above ambient salinity.

Q. WOULD THE PROPOSED DISCHARGE POTENTIALLY INCREASE THE SALINITY AT THE BOUNDARY OF THE MIXING ZONE?

A. Based on information demonstrated by other PAC experts, the discharge will increase salinity at the boundary of the mixing zone under virtually all circumstances by more than 5% above ambient, and the discharge will frequently increase salinity at the boundary of the mixing zone by more than 2 ppt.

Q. ARE YOU FAMILIAR WITH THE BATHYMETRY IN THE AREA OF THE DISCHARGE?

A. Yes. From my review of the documentation provided, there is a sunken area where the discharge will occur.

Q. BASED ON YOUR EXPERIENCE WITH THE EVALUATION OF DESALINATION WASTEWATER DISCHARGES, COULD THIS BATHYMETRY IMPACT THE EXPOSURE OF AQUATIC LIFE TO ELEVATED SALINITY LEVELS?

A. Yes. Based upon my participation in panels addressing brine discharge, without adequate mixing and diffusion, the higher density of the brine causes the discharge to remain within sunken areas of the sea floor.

Q. IS THAT HOLE LOCATED WITHIN THE MIXING ZONE FOR THE DISCHARGE?

A. Yes.

Q. IN YOUR OPINION, WOULD THE POTENTIAL INCREASE IN SALINITY RESULTING FROM THE PROPOSED DISCHARGE POTENTIALLY RESULT IN SIGNIFICANT SUBLETHAL TOXICITY TO AQUATIC ORGANISMS THAT MOVE THROUGH THE MIXING ZONE?

A. Yes.

Q. PLEASE EXPLAIN.

A. Given that most international standards use a 2 ppt/5% standard salinity increase at the discharge area, and this value has been confirmed by studies performed on early life stage red drum, any increase beyond this standard would likely cause additional stress leading to impaired development to organisms entrained within the mixing zone or passing through the mixing zone.

V. SIGNIFICANT LETHALITY TO ORGANISMS THAT MOVE THROUGH ZONE OF INITIAL DILUTION

Q. BASED ON THE INFORMATION YOU HAVE REVIEWED, WHAT IS THE POTENTIAL CHANGE IN SALINITY RESULTING FROM THE DISCHARGE AT THE BOUNDARY OF THE ZID?

A. Based on information provided by other PAC experts, salinity levels at the ZID boundary will be increased by amounts potentially exceeding the 2 ppt/5% standard. Using 95

percentile estimates from the CORMIX model, an estimated ambient salinity would be approximately 40.6 ppt. Estimates of salinity from the diffuser incorporating bank obstructions indicated that percentages of effluent would range from 55.02 to 20.61 within the ZID, 41.37 to 12.9 within the mixing zone, and 24.47 to 6.22 in the HHMZ. These ranges were calculated based on 3–15-meter distances of the diffuser from the modeled bank. The resulting changes in ppt would be 11.02 to 3.38 in the ZID. All of these values exceed the 2 ppt/5% above ambient salinity threshold.

Q. DOES THE HOLE IN THE VICINITY OF THE PROPOSED DISCHARGE INCLUDE AREAS OF THE ZID?

A. Yes.

Q. CONSIDERING THE MAGNITUDE OF POTENTIAL SALINITY INCREASES WITHIN THE ZID, AND THE LOCATION OF THE HOLE WITHIN THE ZID, WOULD THE PROPOSED DISCHARGE POTENTIALLY CAUSE SIGNIFICANT LETHALITY TO ORGANISMS THAT MOVE THROUGH THE ZID?

A. Yes. Since the higher saline water will likely pool within the depression, exposure to entrained life forms (larvae, plankton, etc.) within this area will be exacerbated as dilution by the upper water column will be slower than if discharge occurred on a flat-planar surface bottom. The enhanced duration of exposure will likely lead to greater sublethal and lethal toxicity to the entrained biota.

Q. HAVE YOU REVIEWED THE TOXICITY TESTING PERFORMED BY DR. KRISTIN NIELSEN REGARDING THE IMPACTS OF HYPERSALINITY ON EARLY LIFE STAGE RED DRUM?

A. Yes.

Q. DOES THAT TESTING INFORM YOUR OPINION?

A. Yes.

Q. PLEASE EXPLAIN.

A. Her results show that developmental toxicity occurs in early life stage red drum exposed to salinities at 2 ppt above ambient salinity. This is borne out by reduced hatch in exposed

embryos as well as lethality in larvae that do hatch. These data are consistent with world-wide standards of a 2 ppt/5% change above ambient salinity for protection of aquatic life.

Q. HAVE YOU REVIEWED KIRK DEAN'S CRITIQUES OF THE TOXICITY TESTING PERFORMED BY KRISTIN NIELSEN, COMMENCING ON PAGE 23 OF HIS TESTIMONY?

A. Yes.

Q. DOES HIS TESTIMONY ALTER YOUR OPINION THAT DR. NIELSEN'S TOXICITY TESTS ARE RELIABLE FOR PURPOSES OF EVALUATING THE POTENTIAL IMPACT OF THE PORT'S PROPOSED DISCHARGE ON MARINE LIFE?

A. No.

Q. PLEASE EXPLAIN.

A. It is my opinion that Dr. Dean's critiques fail to acknowledge Dr. Nielson's use of range finding experiments which are typically used in toxicity testing with biota. Range finding studies are used to determine appropriate dosing and duration for subsequent toxicity studies where calculations with lesser uncertainty may be made.

VI. OPINIONS SPECIFICALLY REGARDING WET TESTING RESULTS PROVIDED BY THE PORT

Q. BEFORE WE REVIEW SPECIFIC ISSUES RELATED TO THE WET TESTING PROVIDED BY THE PORT, I WOULD LIKE TO PLACE WET TESTING IN CONTEXT. AS A GENERAL MATTER, DOES WET TESTING NECESSARILY PROVIDE AN ACCURATE REFLECTION OF THE IMPACT AN EFFLUENT WILL HAVE UPON THE ENVIRONMENT IN THE AREA OF A DISCHARGE?

A. No.

Q. PLEASE EXPLAIN.

A. WET testing occurs using only a limited number of species in a controlled laboratory environment. WET testing will not provide an accurate reflection of the toxicity of a discharge if the organisms used are not equally sensitive to the contaminant at issue as the species present in the environment. In addition, organisms within the natural environment may be subject to factors such as temperature conditions, hydrodynamic conditions, and

variations in dissolved oxygen. An effluent concentration that does not result in an impact within the controlled laboratory environment could result in an impact in the natural environment due to the cumulative action of these stressors upon the organism. In addition, WET tests do not reflect the potential for contaminants to bioaccumulate within an organism, nor do WET tests necessarily reflect the long-term population impacts that an effluent may have, especially when reproduction is not evaluated. While WET testing is a valuable tool, it is also subject to limitations.

Q. DOES THE 1991 TECHNICAL SUPPORT DOCUMENT RECOGNIZE THESE LIMITATIONS?

A. Yes. For example, if you look to page 42 of Exhibit PAC-50R-DS-3, it notes that limitations of WET testing include the fact that few species are tested and that ambient conditions may differ from the conditions in the WET test, as well as noting that a WET test will not reflect the potential persistency of a contaminant in the environment nor the long-term cumulative impact of a contaminant.

Q. WHAT WET TESTING INFORMATION WAS PROVIDED BY THE PORT IN THE MATERIAL SUBMITTED JUNE 25, 2021?

A. The Port supplied two WET test studies. One study involved Short-Term Chronic Toxicity of Salinity to the Inland Silverside (*Menicia beryllina*) Under Static-Renewal Test Conditions. The other involved Short-Term Chronic Toxicity of Salinity to the Mysid Shrimp (*Mysidopsis bahia*) Under Static-Renewal Test Conditions.

Q. I WOULD LIKE TO FIRST CONSIDER THE INLAND SILVERSIDE TEST. IN YOUR OPINION, DO THE RESULTS OF THIS TEST DEMONSTRATE THAT THERE WILL BE NO SIGNIFICANT LETHALITY TO AQUATIC ORGANISMS THAT WOULD MOVE THROUGH THE ZONE OF INITIAL DILUTION AS DESIGNATED FOR THE PORT'S DISCHARGE?

A. No.

Q. PLEASE EXPLAIN.

A. The inland silverside is one of the least sensitive WET testing species to evaluate the acute impacts of salinity. As indicated in the subsequent report from Stillmeadow Inc. dated July 28, 2021, 100% survival was noted at concentrations above 55 ppt. That testing was performed after submission of the material by the Port on June 25th. These values are similar for other WET testing fish species such as topminnow (*Atherinops affinis*) which are in the same family (atherinidae) and Japanese medaka (*Oryzias latipes*) performed by our laboratory that indicated insensitivity. In addition to species insensitivity, the life stages used to conduct the WET testing are not the most sensitive as well. For example, topminnow and silversides are usually 7-11 days old when testing is performed. Observations in the July 28, 2021 study were only evaluated for 2 minutes. Typically, acute toxicity evaluations in fish occur over 4 days (96 hrs) for acute studies, or 7 days for chronic studies. The observation at only 2 minutes would likely underestimate toxicity due to the shorter duration of exposure.

A. In addition, exposure to 7–11-day larvae is not as sensitive as conducting tests immediately after fertilization. Voorhees et al. demonstrated that developmental stages of abalone and sand dollar were more sensitive to brine impacts (1-2 ppt above ambient) compared to larval fish in the same family as silversides (20-25 ppt above ambient). Thus, the inland silverside would not only be considered a poor surrogate species to evaluate impacts of brine on marine biota, but the life stage and biological endpoint of 2-minute survival would also not be appropriate to evaluate the impacts of salinity on marine biota. The fact that the larval stage of an endemic species (red drum) has been tested and shows sensitivity at 1-2 ppt above ambient provides further evidence that the selection of this particular species

of fish would not be an appropriate surrogate for endemic species that reside in the area of proposed discharge.

Q. WHEN YOU USE THE TERM "ENDPOINT" WITH REGARD TO WET TESTING, WHAT DOES THAT MEAN?

A. In WET testing, the "endpoint" is the biological effect being measured. Endpoints can differ in the type of effect being measured, or in the time at which that effect is measured. The lethal endpoint measures whether an organism is dead. Sublethal endpoints would include effects such as growth or development. "Growth" as an endpoint measures either the length or mass of an organism after chemical or stressor treatment. Development, on the other hand, measures the ability of an early life stage to develop to the next stage. For example, once fertilization occurs, cells begin to divide in the embryo and reach a specific cell-number by a certain period. The disruption of the number of cells after a certain period can be measured by counting the number of cells within a developing organism after chemical or stressor treatment.

Q. IN YOUR OPINION, DO THE RESULTS OF THE INLAND SILVERSIDE TEST DEMONSTRATE THAT THERE WILL BE NO SIGNIFICANT SUBLETHAL TOXICITY TO AQUATIC ORGANISMS THAT MOVE THROUGH THE MIXING ZONE?

A. No.

Q. PLEASE EXPLAIN.

A. In addition to 2-minute lethality measurements which were examined by the July 2021 Stillmeadow study, a chronic 7-day exposure WET test was conducted on inland silverside (dated June 23, 2021). After 7 days, survival and the sublethal measurement of growth were also evaluated following exposures to a limited number of salinity regimes. No effect was observed in salinity concentrations beyond 20 ppt above ambient. While growth assessments are considered sublethal measurements, this measurement does not

demonstrate that other sublethal toxicity will not occur to aquatic organisms that move through the mixing zone. As discussed above, development is a much more sensitive endpoint and, given the location of the discharge in an area where marine organism development is occurring, growth in an insensitive surrogate species would not prove that significant sublethal toxicity would not occur following exposure to brine. If salinity concentrations are exceeding the threshold of 2-3 ppt above ambient salinity, then an assay or test with a species that can detect that change is needed to evaluate impacts of a potential discharge. Chronic growth and survival as well as 2-minute survival within this species do not provide the sensitivity to assess lethal nor sublethal affects to marine organisms in the zone of initial dilution or in the mixing zone.

Q. NOW, I WOULD LIKE TO CONSIDER THE MYSID SHRIMP TEST. IN YOUR OPINION, DO THE RESULTS OF THIS TEST DEMONSTRATE THAT THERE WILL BE NO SIGNIFICANT LETHALITY TO AQUATIC ORGANISMS THAT WOULD MOVE THROUGH THE ZONE OF INITIAL DILUTION AS DESIGNATED FOR THE PORT'S DISCHARGE?

A. No.

Q. PLEASE EXPLAIN.

A. As discussed above for inland silverside, mysid shrimp serve as surrogate species in WET testing in an attempt to determine impact to endemic species. As with the selection of inland silverside, the choice of mysid shrimp to evaluate impacts of salinity on marine invertebrates or other biota is not adequate. As discussed above, Voorhees et al. demonstrated that neither the growth nor survival of mysid shrimp were affected at concentrations greater than 10-15 ppt above ambient. The survival measurements of mysid shrimp are not of adequate sensitivity to detect impacts of lethality to marine organisms in the zone of initial dilution.

Q. IN YOUR OPINION, DO THE RESULTS OF THE MYSID SHRIMP TEST DEMONSTRATE THAT THERE WILL BE NO SIGNIFICANT SUBLETHAL

TOXICITY TO AQUATIC ORGANISMS THAT MOVE THROUGH THE MIXING ZONE?

A. No.

Q. PLEASE EXPLAIN.

A. As with the inland silverside WET test, growth of mysid shrimp is used to evaluate sublethal impacts of salinity. As indicated in Voorhees et al, growth of mysid shrimp is not a sensitive measurement of sublethal impacts relative to other invertebrates. Reproduction or development using other WET organisms would provide better surrogates for sublethal effects in marine organisms. Thus, the mysid shrimp WET test would not show that significant sublethal toxicity will not occur in aquatic organisms that move through the mixing zone.

VII. OPINIONS SPECIFICALLY REGARDING WET TESTING REQUIREMENTS OF DRAFT PERMIT

Q. NOW, I WOULD LIKE TO MOVE ON TO CONSIDER THE WET TESTING REQUIREMENTS CONTAINED IN THE DRAFT PERMIT. WHAT SPECIES ARE REQUIRED TO BE TESTED BY THE BIOMONITORING REQUIREMENTS OF THE PERMIT?

A. The biomonitoring requirements of the permit involve testing of mysid shrimp and inland silverside.

Q. ARE THESE THE SAME SPECIES UTILIZED IN THE WET TESTING PROVIDED IN SUPPORT OF THE APPLICATION?

A. Yes.

Q. IN YOUR OPINION, DOES THE INCLUSION OF THESE REQUIREMENTS ENSURE THAT THERE WILL BE NO SIGNIFICANT LETHALITY TO AQUATIC ORGANISMS THAT WOULD MOVE THROUGH THE ZONE OF INITIAL DILUTION AS DESIGNATED FOR THE PORT'S DISCHARGE?

A. No.

Q. PLEASE EXPLAIN.

A. No. These tests will not accurately represent the impacts of the effluent upon the native species for the same reasons that the results of the salinity tests provided in the application

do not provide an accurate representation of the impact that the effluent will have upon the aquatic species at this location. Utilizing insensitive species as surrogates and insensitive life stages to assess potential impact will not provide proof that lethality will not occur to aquatic organisms that these WET testing species are supposed to represent.

Q. WILL THESE TESTS DEMONSTRATE THAT THERE WILL BE NO SIGNIFICANT SUBLETHAL TOXICITY TO AQUATIC ORGANISMS THAT MOVE THROUGH THE MIXING ZONE?

A. No. These tests will not accurately represent the impacts of the effluent upon the native species for the same reasons that the results of the salinity tests provided in the application do not provide an accurate representation of the impact that the effluent will have upon the aquatic species at this location. As stated above, it is inappropriate to use an insensitive test species or life stage to evaluate the impacts of discharge to aquatic biota that are exposed to that discharge.

VIII. NON-SALINITY CONTAMINANTS

A. Relevant EPA Guidance

Q. DOES THE 1991 EPA TECHNICAL SUPPORT DOCUMENT PROVIDE GUIDANCE REGARDING TOXIC COMPOUNDS WITHIN COASTAL DISCHARGES?

A. Yes. At page 45 of Exhibit PAC-50R-DS-3, the TSD notes that:

> For coastal discharges, certain toxic compounds are more often found to cause impacts in marine estuarine environments. Due to physical and chemical processes that tend to trap pollutants in estuaries (sedimentation, salinity flux, etc.) the discharge of these compounds, at very low concentrations over a long period of time, may allow them to accumulate to toxic concentrations.

This reflects the error in assuming that a contaminant will not have an impact merely because it is in very low concentrations.

B. Contaminants Added in Facility Processes

Q. WILL THE PROCESSES AT THE PROPOSED FACILITY RESULT IN ANY ADDITION OF CONTAMINANTS TO THE WASTEWATER?

A. Yes.

Q. PLEASE EXPLAIN.

A. As reflected in the process flow diagram contained in the application, the process at the proposed plant will include the addition of chlorine, flocculants, and coagulants.

Q. COULD THE CHLORINE ADDED TO THE WASTEWATER HAVE ANY ADVERSE IMPACTS UPON AQUATIC LIFE IN THE RECEIVING WATERS?

A. Yes.

Q. PLEASE EXPLAIN.

A. Chlorine is an oxidant typically added to influent water to diminish unwanted microbial growth in the treatment process. If organic material is present when chlorine is added, halogenated byproducts are produced and include halomethanes as well as chlorinated and brominated derivatives that can be mutagenic/carcinogenic and developmental toxicants.

Q. WHAT DO YOU MEAN BY "HALOGENATED BYPRODUCTS"?

A. A halogenated byproduct would be a chemical that has been modified such that halogens (Cl or Br) are added on to the structure of that parent chemical.

Q. WHAT DO YOU MEAN BY "DEVELOPMENTAL TOXICANT"?

A. A developmental toxicant is a chemical or agent that inhibits or disrupts normal development within a life stage of an organism.

Q. WHAT IS A FLOCCULANT?

A. A flocculant is a compound added to help precipitate unwanted organic and inorganic material during the treatment process in order to prevent fouling of the membranes used to filter the water.

Q. HAS THE PORT IDENTIFIED THE FLOCCULANTS OR COAGULANTS THAT IT INTENDS TO USE AT THE PROPOSED FACILITY?

A. No.

Q. COULD A FLOCCULANT/COAGULANT CONTAIN ANY CHEMICALS OF CONCERN TO THE AQUATIC LIFE IN THE AREA?

A. Yes, often various metallic agents (aluminum or iron based) as well as polymers which, when concentrated, could cause toxicity.

Q. DOES THE PROCESS FLOW DIAGRAM PROVIDED BY THE PORT APPEAR TO INCLUDE ALL CHEMICALS THAT WILL BE USED FOR CLEANING AT THE FACILITY?

A. No, in some cases other metallic agents that are copper based may also be used as antifouling agents, as well as other materials that remove mineral deposits (anti-scalants).

Q. COULD OTHER CLEANING CHEMICALS POTENTIALLY HAVE AN ADVERSE IMPACT UPON AQUATIC LIFE IN THE VICINITY OF THE DISCHARGE?

A. Yes, if concentrated to levels above the toxicity threshold, aquatic life could be affected.

C. Contaminants Concentrated in Facility Process

Q. AT A DESALINATION FACILITY, DOES THE POTENTIAL EXIST FOR CHEMICALS IN THE INTAKE WATER TO BECOME CONCENTRATED THROUGH THE DESALINATION PROCESS PRIOR TO DISCHARGE?

A. Yes.

Q. PLEASE EXPLAIN.

A. In general, chemicals that are not removed by coagulation or flocculation are concentrated in the brine. Depending on the amount of water undergoing filtration, this can range between 5- and 10-fold.

Q. HAS THE PORT PROVIDED SAMPLING DATA WHICH IT PURPORTS TO REFLECT THE CONCENTRATION OF POTENTIAL CONTAMINANTS IN THE INTAKE WATER?

A. Yes. The supplemental materials submitted June 25, 2021 included the analysis of water samples that the Port claims were taken near the location of the intake for the plant.

Q. HOW WERE THESE SAMPLES COLLECTED?

A. According to the June 24, 2021 Parsons Technical Memorandum, the grab samples were collected using a 12-volt battery-powered peristaltic pump with new tubing for each day's sample collection. The tubing intake was positioned at half of the total water depth, and a

small rigid plastic-coated weight was securely zip-tied 3 feet above the tubing intake to keep the intake end at mid water column depth. Due to high winds and large waves, the boat motor had to be run continuously to hold position while sampling.

Q. IN YOUR OPINION WAS THE ANALYSIS OF THESE SAMPLES PERFORMED IN ACCORDANCE WITH PROPER PROTOCOL TO DETERMINE THE CONCENTRATION OF POTENTIAL CONTAMINANTS IN THE INTAKE WATER?

A. No.

Q. PLEASE EXPLAIN.

A. As indicated in the Parsons Sampling document of June 24, 2021, in Table 5, EPA method E625.1/SW8270C was used to measure contaminants within the intake water. This method is used primarily for wastewater discharge measurements and has elevated reporting limits for the contaminants. In this particular case, the reported values for the oil-derived polyaromatic hydrocarbon (PAH), anthracene, were noted to be <5 ug/L. This is significant because the USEPA ecological screening value (ESV) standard for anthracene in surface water is 0.43 ug/L. A surface water method 8270E (SW-846) analysis should have been used since its reporting limits are 0.1 ug/L for anthracene and would encompass the threshold of 0.43 ug/L. The reporting limits for all PAHs were <5 ug/L and thus would not be able to detect compounds below effects thresholds.

Q. ARE THERE ANY PARTICULAR CONSTITUENTS POTENTIALLY CONTAINED IN THE INTAKE WATER THAT WOULD BE OF CONCERN IF CONTAINED WITHIN THE DISCHARGE?

A. Yes.

Q. PLEASE EXPLAIN.

A. As indicated above, if anthracene was detected at 0.1 ug/L in the intake water, and a 10-fold concentration occurs, the discharge concentration (1.0 ug/L) within the brine would

be above the biological effects threshold of 0.43. Similarly, if a harmful algal bloom were to occur, algal toxins would be concentrated and released at that higher concentration.

IX. SPECIFIC RESPONSE TO TESTIMONY BY DR. KNOTT

Q. NOW, I WOULD LIKE TO SPECIFICALLY CONSIDER SOME OF THE TESTIMONY THAT HAS BEEN OFFERED BY WITNESSES FOR THE PORT. HAVE YOU REVIEWED THE TESTIMONY OF DR. NATHAN KNOTT?

A. Yes.

Q. AT PAGES 13 – 15 OF HIS TESTIMONY, DR. KNOTT DISCUSSES THE CIRCUMSTANCES AT THE SYDNEY DESALINATION PLANT. IN YOUR OPINION, DO THE PERFORMANCE AND ENVIRONMENTAL IMPACTS OBSERVED AT THE SYDNEY PLANT JUSTIFY A FINDING THAT THE PORT'S PROPOSED DISCHARGE WILL NOT ADVERSELY IMPACT MARINE LIFE?

A. No.

Q. PLEASE EXPLAIN.

A. The Sydney desalination plant has a much different discharge location. It has a diffuser which allows discharge to the open ocean and rapid dilution of the brine solute within the discharge.

Q. AT PAGE 17 OF HIS TESTIMONY, DR. KNOTT STATES THAT "I DO BELIEVE THAT SCIENCE OVERWHELMINGLY INFORMS US THAT THE PROPOSED HARBOR ISLAND DESALINATION FACILITY DISCHARGE WILL HAVE LITTLE TO NO IMPACT ON MARINE LIFE" AND OFFERS HIS BASIS FOR THAT OPINION. IN YOUR OPINION, HOW IS THE ANALYSIS HE OFFERS FLAWED?

A. Based upon his opinion, he is estimating dilution to readily occur within the Harbor Island zone due to diffuser function. While this may indeed be true in open ocean discharge scenarios, his assessment for this particular site where bathymetry and entrainment of larval biota are more likely to occur is fundamentally flawed. The two discharge locations are so different, it is akin to comparing an Olympic swimming pool to a Jacuzzi.

Q. NOW I WOULD LIKE TO TURN TO EXHIBIT PAC-54R. CAN YOU PLEASE IDENTIFY THIS EXHIBIT?

A. Yes. This is a copy of the review comments provided by Dr. Nathan Knott to the scientific advisory panel with regard to the study I have provided as Exhibit PAC-50R-DS-2. The report provided to the State Water Board of California was peer-reviewed to determine that the conclusions and recommendations made by the panel were scientifically sound.

PAC offers Exhibit PAC-54R.

Q. IS THIS THE SAME DR. KNOTT AS IS NOW TESTIFYING IN THIS MATTER ON BEHALF OF THE PORT?

A. Yes.

Q. HOW DID YOU OBTAIN THIS COPY?

A. I went to the website for our report and viewed the comments provided by external reviewers.

Q. IN YOUR OPINION, DOES THIS REVIEW REFLECT ANY FEEDBACK BY DR. KNOTT THAT IS RELEVANT TO A CONSIDERATION OF THE PORT'S APPLICATION?

A. Yes. In this review, Dr. Knott commented that, "Based on the documents provided for review (Jenkins et al, 2021, Phillips et al, 2012, Jenkins and Wasyl 2013 & the Draft Staff Report) and my knowledge of this research area (Roberts, Johnston & Knott 2010), I believe that a salinity limit of two parts per thousand above natural background salinity would be an appropriate limit to protect the marine communities of California."

Q. IN YOUR OPINION, WOULD APPROVAL OF THE PORT'S APPLICATION BE CONSISTENT WITH THIS COMMENT PROVIDED BY DR. KNOTT?

A. No. The proposed discharge would result in an increase of salinity of greater than two parts per thousand above natural background in the area of the discharge. So, the Port's proposed discharge does not comply with the limit endorsed by Dr. Knott in this review.

X. SPECIFIC RESPONSE TO TESTIMONY OF DR. FONTENOT

Q. DR. LANCE FONTENOT HAS OFFERED WHAT HE ASSERTS TO BE AN ENVIRONMENTAL RISK ASSESSMENT RELATING TO THE PORT'S PROPOSED DISCHARGE. DO YOU CONCUR WITH DR. FONTENOT'S METHODS AND CONCLUSIONS AS EXPRESSED IN HIS TESTIMONY?

A. No.

Q. PLEASE EXPLAIN.

Typical ecological risk assessments possess 4 components. The first is a Problem Formulation Step where the specific aspects of the site and chemicals of concern are identified. Dr. Fontenot fails to report that this particular site has significant bathymetry impediments to the movement of hypersaline water. He fails to note the relationship between deposition of dense water within holes or depressions within this specific location and the uncertainties of movement out of these holes leading to enhanced exposure duration. For the Exposure Assessment component of the risk assessment, Dr. Fontenot bases his estimates on a CORMIX model calculation that has significant uncertainty. Neither bathymetry nor depth are discussed as potential factors of uncertainty in this model. Similarly, the "worst-case" scenario of slack tide during maximum salinity regimes that may occur during drought is disregarded. For the Effects Assessment component, he fails to list conservative thresholds of effect due to excessively low durations of exposure. He also fails to note the insensitivity of the species selection for testing performed to evaluate potential effects. Lastly, in the Risk Characterization section, Dr. Fontenot fails to discuss any uncertainty within any of the exposure or effect calculations he has made. Given the uncertainties with both exposure and effect assessments in this particular case, it is customary practice to include uncertainty (aka Safety) factors (in some cases 10-100x) to protect against underestimations of risk. For all of these reasons, I find Dr. Fontenot's opinions to be unreliable for determining the impacts of the Port's proposed discharge.

XI. CONCLUSION

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.