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

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

PORT OF CORPUS CHRISTI AUTHORITY'S CLOSING ARGUMENT ON REMAND

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LIST OF DEFINITIONS, ABBREVIATIONS AND ACRONYMS

1. “ADCP” means Acoustic Doppler Current Profiler.
2. "ALJs” means Administrative Law Judges.
3. “Application” means the Port of Corpus Christi Authority of Nueces County’s application for TPDES Permit No. WQ0005253000.
4. “Aransas Channel” means the Aransas Channel identified on Figure 1 below.
5. “Aransas Pass” means the Aransas Pass identified on Figure 1 below.
6. “ASCE” means American Society of Civil Engineers.
7. “CCH” means the Contested Case Hearing.
8. “CCSC” means the Corpus Christi Ship Channel.
9. “CWA” means the Federal Clean Water Act.
10. “Diffuser” means the multi-port diffuser designed by Dr. Lial Tischler and described in Dr. Tischler’s memo of June 24, 2021, in the Revised Application.
11. “Effluent” means the water identified in the Draft Permit with the outflow from the Facility to be discharged into the CCSC pursuant to the terms of the Draft Permit.
12. “EPA” means Environmental Protection Agency.
13. “Executive Director” or “ED” means the Executive Director of the TCEQ.
14. “Facility” means the desalination facility proposed in the Revised Application.
15. “Harbor Island” means Harbor Island identified on Figure 1 below.
16. “HHMZ” means Human Health Mixing Zone.
17. “LOEC” means Lowest Observed Effect Concentration.
18. “Lydia Ann Channel” means the Lydia Ann Channel identified on Figure 1 below.
19. “MGD” means Million Gallons Per Day.
20. “MZ” means Mixing Zone also referred to as the Aquatic Life Mixing Zone.
21. “NOAA” means National Oceanic and Atmospheric Association.
22. “NOEC” means No Observed Effect Concentration.

23. “Outfall” or “Outfall 001” means the location of the effluent discharge identified in the Revised Application and identified on Figure 1 below.

24. “PAC” means Port Aransas Conservancy.

25. “Permit” or “Draft Permit” means the version of TPDES Permit No. WQ0005253000 submitted by the TCEQ Executive Director in September 2021.

26. “Port Authority” means the Port of Corpus Christi Authority of Nueces County, Texas.

27. “PPT” means Parts Per Thousand.

28. “Prior Draft Permit” means the version of TPDES Permit No. WQ0005253000 submitted by the TCEQ Executive Director in 2020 prior to the Remand Order.

29. “Protestants” means all the individuals or organizations that are parties to the Contested Case Hearing opposing the Draft Permit.

30. “Remand Order” means the Order from the Texas Commission on Environmental Quality dated May 26, 2021.

31. “Revised Application” means the revision of June 24, 2021, to the Port of Corpus Christi Authority of Nueces County’s Application for TPDES Permit No. WQ0005253000 and associated documents.

32. “SOAH” means State Office of Administrative Hearings.

33. “SWQS” means Texas Surface Water Quality Standards.

34. “TBELs” means Technology-Based Effluent Limits.

35. “TCEQ” means Texas Commission on Environmental Quality.

36. “TPDES” means Texas Pollution Discharge Elimination System.

37. “WQBELs” means Water Quality-Based Effluent Limits.

38. “ZID” means Zone of Initial Dilution.

39. “40 C.F.R.” means Code of Federal Regulations Title 40.

40. “30 T.A.C.” means Texas Administrative Code Title 30.

PORT OF CORPUS CHRISTI AUTHORITY'S
CLOSING ARGUMENT ON REMAND

Applicant Port of Corpus Christi Authority of Nueces County (the "Port Authority") files this Closing Brief on Remand, and would show this Court as follows:

I.
INTRODUCTION

In May 2021, the TCEQ remanded the Draft Permit, requesting additional evidence on specific identified issues, and thus created the opportunity for the Port Authority to undertake more robust testing, modeling and analysis of the proposed Harbor Island desalination process (including the Outfall). A substantial quantum of new data was collected by the Port Authority for the proposed discharge. The Port Authority also retained additional world-renowned experts to fully evaluate all information germane to the proposed discharge. As demonstrated herein, the scientific evidence overwhelmingly confirms that the proposed permit is protective of the environment; is not harmful to the most sensitive of species (even in early larval stage development); will not adversely impact recreational activities, commercial fishing/fisheries and marine life; complies with the applicable regulations to ensure that the Draft Permit is protective of water quality; and is accurate and includes all appropriate and necessary requirements.

The Texas Legislature has declared that "every effort must be made to secure and develop plentiful and cost-effective water supplies to meet the ever-increasing demand for water."[1] The Port Authority agrees with the Texas Legislature on the importance of desalination for the future of the State of Texas. PAC's expert witnesses concede that south Texas is "becoming more desert like,"[2] and that "[n]ow is the time to act for desalination."[3] Population growth in our area causes

[1] See H.B. 2031.

[2] Tr. Vol. 5 at 1075; Tr. Vol. 6 at 1465-1466.

[3] Tr. Vol. 5 at 1075; *see also* Tr. Vol. 6 at 1466.

water to be taken from our rivers, and "desalination is a means to reducing pressure on environmental water [for] the health of our bays and estuaries."[4] Absent desalination, there is the potential that "our bays and estuaries will become elongated and coastal sewage ponds" (as conceded by PAC expert Dr. Larry McKinney).[5] A denial of the Draft Permit is not a solution, but rather a giant step towards certain degradation of our Texas coastal treasures.

There are many species that thrive in the Nueces/Mission-Aransas estuary systems. Given that some are more sensitive and others less to their environs, the most conservative analysis of any potential environmental impact considers the locality's most sensitive species. The parties have substantially agreed that the Red Drum is the most sensitive species – especially in early stages of development.[6] Although the most sensitive species, Red Drum are also an incredibly resilient species.[7] There seems to be consensus that Red Drum adults, juveniles, fingerlings, and later-stage larvae successfully osmoregulate even when exposed to abrupt changes of salinity concentrations, which in any event will not occur in this case.[8] Hence, the parties' focus during the hearing on remand turned to a concern for Red Drum larvae (especially 3-day-old Red Drum larvae).[9] To appreciate the context of even such a possible exposure, the following should be considered:

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[4] Tr. Vol. 5 at 1078; *see also* Tr. Vol. 6 at 1466.

[5] Tr. Vol. 6 at 1466-1467.

[6] *See* Dr. Andrew Esbaugh's pre-filed direct testimony (**before remand), at 10; see also hearing testimony (November 5, 2020), at 59-60 and 69; see also Tr. Vol. 1 at 38; see also Tr. Vol. 5 at 1070, 1198,1283-1285; see also Tr. Vol. 6 at 1299; see also Tr. Vol. 8 at 1284, 1285, 1921, 1929; see also PAC-48R at 8, 11 and 18.

[7] See Brauner, et al, Extreme Environments: Hypersaline Alkaline, and Ion-Poor Waters, Fish Physiology – Euryhaline Fishes, Chapter 9 (2013), at p. 454-455. *See also* Tr. Vol. 6 at 1361-1364.

[8] See Esbaugh, et al. (2021), Osmoregulatory plasticity during hypersaline acclimation in red drum, *Sciaenops ocellatus,* Journal of Comparative Physiology B (2021) 191: 731-740 (APP-53-R); Esbaugh, et al. (2018), Effects of salinity and hypoxia-induced hyperventilation on oxygen consumption and cost of osmoregulation in the estuarine red drum (*Sciaenops ocellatus*) (APP-54-R).

[9] See PAC-48R KN-3.

1. Billions of Red Drum larvae are carried by tidal currents through the Aransas Inlet (during season);[10]
2. Over half (up to 80%+) are carried through the Lydia Anne Channel and Aransas Channel, and the balance (20% to 50%) to the Corpus Christi Ship Channel ("CCSC");[11]
3. These "red drum larvae are primarily located near the surface"[12] – and thus most would not come into contact with the proposed discharge plume;
4. Only 2% are exposed to the mixing zone[13] (98% of the Red Drum larvae are carried via CCSC's zone of passage without plume contact); and
5. Only 3.3% are 3-day-old larvae (the vulnerable stage per PAC's experts' testimony).[14]

Therefore, the percentage of 3-day-old Red Drum larvae exposed (as compared to total number Red Drum larvae entering Aransas Inlet) is de minimus as can be seen from the following

[10] For the most part, spawning season is September, October, and November (92 days). The uncontradicted evidence is that 47,000,000 gallons of seawater pass through the CCSC each day (as measured by Acoustic Doppler Current Profiler ("ADCP") at Harbor Island. *See* Craig Jones pre-filed remand testimony, APP-CJ-1-R at p. 10. The uncontradicted evidence is that this is 60% of the seawater that passes through the Aransas Inlet each day. See Brown, Holt (2005), at p. 18. Thus, approximately 78,333,333,333 gallons (297 million cubic meters) of seawater pass through the Aransas Inlet each day. The uncontroverted evidence is that the concentration of Red Drum larvae during the season is 100 per 100 cubic meters (or 1 per cubic meter on average). *See* PAC-46-R, at p. 13. Therefore, 297,000,000 x 92 days = the number of larvae passing through the Aransas Inlet per season (or 27,324,000,000 (27 billion)). While this is an estimate, it can be seen that an incredibly large number certainly pass through the Aransas Inlet each season.

[11] 80%+ are carried to Lydia Anne Channel and Aransas Channel, and less than 20% are carried through CCSC. *See* Dawson, et al. (2021); Tr. Vol. 6 at 1397-1406; *compare* Brown, et al. (2000); Brown, Holt et al. (2004); see also Tr. Vol. 6 at 1403-1406. To err on the side of caution, calculations will assume 20% - 50% are carried through the CCSC.

[12] *See* Dr. James Tolan deposition filed, at p. 182 (larvae "much more abundant on the surface"). If "primarily located" and/or "much more abundant" means 50% or more, then half or more of the eggs and early-stage larvae would float over the proposed discharge plume. Dr. Tolan's statement is consistent with the overwhelming weight of literature: Holt, et al (2004), at p. 185 (Exhibit APP-JT-1-R); Holt, et al. (2005), at p. 35; Atlantic States Marine Fisheries Commission *Addendum 1 to Amendment 2 to The Red Drum Fishery Management Plan: Habitat Needs & Concerns*, August 2013 at Chapter 4, at p. 36; hearing testimony of Scott Holt, see also Tr. Vol. 6 at 1366, 1382-1385, and 1391-1394; and https://thefishsite.com/articles/cultured-aquatic-species-red-drum.

[13] Tr. Vol. 5 at 1071.

[14] Red Drum larval stage lasts thirty (30) days. Assuming equal distribution in red drum larval age, 1 of 30 is 3.3%. The eggs resist abrupt salinity variations, and Red Drum larvae older than 3-days more successfully osmoregulate (3-day-old Red Drum larvae osmoregulate, but less successfully if exposed for 24 hours or more).

arithmetic: (100%[15] x (20% or 50%)[16] x 50%[17] x 2%[18] x 3.3%[19] = 0.000066 - .000165). This amount is not significant, and essentially all will survive (given exposure times to greater than 45 ppt for only seconds or minutes, not hours or days).[20] This analysis applies to all resident marine life (given that Red Drum are the most sensitive species, and early-life larvae are the species' most sensitive stage).

Modern reverse osmosis facilities' treatment processes effectively remove any/all additives (so that the only real constituent of concern is concentrated salinity).[21] The CORMIX modeling that the Port Authority's experts have performed establishes that the concentrated salinity discharged will disperse in seconds or minutes (not hours or days).[22] Dr. Furnans' SUNTANS modeling confirms that there will not be accumulation of the salinity discharged (0 – 1 ppt increase).[23] Science unequivocally appreciates that the impact, if any, upon the marine environment (including marine life) is a function of dose (concentration) and time of exposure. The permitting of the Port Authority's Outfall in the CCSC near Harbor Island was originally considered by the University of Texas Marine Science Institute ("UTMSI") – before it became the object of PAC's campaign to oppose it. By the application of science without bias, UTMSI's Executive Director (Robert Dickey) publicly declared:

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[15] 100% = all Red Drum larvae carried through the Aransas Inlet. See footnote 11.

[16] Per Dawson, et al (2021), likely only 20% of red drum larvae are carried through CCSC. Earlier articles suggest that perhaps 50% or so red drum larvae are carried through the CCSC. Thus, the calculations herein consider that 20% - 50% of red drum larvae entering the Aransas Inlet are carried through CCSC (giving all doubt in favor of being more cautious, and more protective). See also footnote 12.

[17] See footnote 13.

[18] See footnote 14.

[19] See footnote 15.

[20] See full discussion hereinbelow.

[21] See APP-AW-1-R at pp. 12-13.

[22] See APP-KD-9-R and APP-KD-10-R; see also APP-RP-10-R; see also PAC-51R-SS-5; Tr. Vol. 7 1676-1684.

[23] See APP-JF-1-R, at p. 6; see also APP-JF-3-R.

> "At this time [prior to August 2018], the UTMSI team found little reason to be concerned about brine discharge. Due to the tidal cycle and massive volumes of seawater exchanged with the nearby Gulf of Mexico every day, salinity was not expected to be significantly affected in the channel [CCSC], [Corpus Christi] bay and [Nueces / Mission Aransas] estuary systems."[24]

Dr. Dickey's statement was published on November 18, 2020, and it currently may be viewed on UTMSI's website.[25] It is titled: "Science Informs Decisions" – and the Port Authority humbly suggests that we allow science to inform this decision.

In contrast, PAC chooses instead to ignore EPA QA/QC (quality assurance/quality control) requirements,[26] apply study methodologies designed by attorneys[27] and wrought with "sloppy"[28] laboratory performance and unkept data,[29] and advocate for imposition of a double standard (one analysis for the affluent, and a different standard for the poor communities who are without a voice).[30] Specifically, Dr. Kristin Nielsen acknowledges that Texas Water Code § 5.134 requires that the TCEQ can accept testing laboratory data *only* from an appropriately accredited facility (and hers is not accredited), yet Dr. Nielsen argues the Texas law does not apply to her.[31] Also, Dr. Nielsen's own attorney introduced the word "sloppy"[32] into the discussion, but only after many, many laboratory errors and variances were identified (as will be more fully discussed

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[24] Tr. Vol. 6 at 1328-1329. (email from Dr. Joan Holt applauding Dr. Dickey's public statement). For completeness, compare Sally Palmer's published comment; Tr. Vol. 6 at 1331.

[25] *https://utmsi.utexas.edu/about/science-informs-decisions*

[26] Tr. Vol. 8 at 2077-2085, 2104-2105 (Dr. Nielsen constantly argues Texas Water Code sec. 5.134 Quality Control/Quality Assurance Requirements do not apply because her academic laboratory is not a commercial laboratory).

[27] Tr. Vol. 7 at 1822-1826.

[28] Tr. Vol. 9 at 2151.

[29] Tr. Vol. 9 at 2171-2202.

[30] Tr. Vol. 5 at 1154-1158.

[31] Tr. Vol. 8 at 2077-2085, 2104-2105 (Dr. Nielsen constantly argues Texas Water Code sec. 5.134 Quality Control/Quality Assurance Requirements do not apply because her academic laboratory is not a commercial laboratory).

[32] Tr. Vol. 9 at 2151.

below).[33] Finally, PAC's arguments simply make no sense: on the one hand, PAC expert Dr. Gregory Stunz is steadfast and on record recommending issuance of a desalination discharge permit for the Inner Harbor (Corpus Christi Bay) because resident marine species naturally tolerate salinity concentrations from 28 ppt to 42 ppt;[34] yet on the other hand, PAC experts argue that the Harbor Island desalination Draft Permit must not be issued because resident marine species (red drum larvae) have an LC50 (half die) at 37.7 ppt.[35] Marine species' salinity tolerances do not change by zip code. **It is impossible that the same marine species live full and re-productive lives at 42 ppt, but half die when exposed to 37.7 ppt.** Worse yet, PAC's proffer of a 37.7 ppt threshold for support of a desalination process discharge is not only contrary to Texas law (30 TAC § 307.6(e)) and impossible to achieve (despite faint claims in support of desalination), but also flies in the face of common sense and biology given that naturally occurring salinities are certainly greater than 38 ppt (supposedly lethal, says PAC) for several months during each year.[36] PAC's theory of the case turns Charles Darwin's theory of evolution upside down by arguing that Red Drum – their eggs and larvae – have evolved to live in local habitats that are lethal to the species' early life stages. PAC's contradictions cannot be reconciled with science (but rather only by application of poorly informed public opinion and consideration of socio-economic factors).[37]

Contrary to what Protestants have alleged, the science demonstrates that the location of the diffuser is **not** in a sensitive area, will **not** cause damage to the ecosystem, and the Application **is** supported by and in compliance with Texas law. If a few individuals and two non-governmental

[33] Tr. Vol. 9 at 2171-2202; see also APP-60-R.

[34] Tr. Vol. 5 at 1071.

[35] Tr. Vol. 8 at 1977-1978.

[36] APP-LF-1R at p. 41.

[37] Tr. Vol. 5 at 1154-1158.

organizations can thwart the will of the state and local governments to provide a critical supply of water for the people they serve by virtue of speculation, misinformation, flawed data and NIMBY-ism – as opposed to the scientific evidence that the Port Authority has presented – then there will never be seawater desalination in Texas – anywhere. That is an unacceptable result. As even Protestants' own expert admits, now is the time to act for desalination. The Port Authority agrees. As demonstrated below, the evidence shows that the permit meets all of the legal requirements, is protective of the environment and should be granted.

II.
STATEMENT OF FACTS

In its May 26, 2021 Interim Order ("Remand Order"), the Commission set a deadline of June 25, 2021 for the Port Authority to provide information to all parties "including the depth of the channel, site-specific ambient velocity, and the depth of the diffuser."[38] By the end of the thirty (30) days, the Port Authority collected and provided the requested information and much more.

A. Information Obtained Post Remand.

Under the direction of Parsons Environmental & Infrastructure ("Parsons"), the Port Authority collected detailed bathymetric data over the width of the CCSC at the proposed location of the discharge and for several hundred meters in either direction.[39] This bathymetric survey and the underlying data was provided to all parties for review and analysis. The Remand Order requested clarification about the depth of the diffuser.[40] The Port Authority responded by providing information regarding the depth of the diffuser as designed by Dr. Lial Tischler. As set

[38] AR-R 2, at 2, § II ("A 30-day deadline is SET from the issuance of the Commission's Order for the Applicant to provide revised information to all parties including the depth of the channel, site-specific ambient velocity, and the depth of the diffuser").

[39] APP-KD-3-R, at 18, Figure 4. The bathymetric data largely confirms the 2019 bathymetric survey of the CCSC up to the confluence of the CCSC with the Lydia Ann Channel and Aransas Channel.

[40] AR-R 2, Tab G to Administrative Record on Remand at 2, § II.

forth in both Dr. Tischler's memo made part of the Application and his direct testimony, the diffuser's depth is 19.5 meters (64 feet) below the surface of the water.[41]

The Port Authority also gathered ambient tidal velocity data. The Port Authority utilized two types of Acoustic Doppler Current Profilers ("ADCPs"). The first ADCP[42] was mounted in a fixed position at approximately five (5) feet deep on a piling near the northern shore of the CCSC aimed south-southwest across the deepest part of the depression (the "Fixed ADCP").[43] The second ADCP[44] was mounted in a downward-looking vertical position attached to the survey boat (the "Boat-Mounted ADCP").[45] The Fixed ADCP collected data continuously for approximately 48 hours from June 8 to June 10, 2021.

In addition to providing the information specifically requested by the TCEQ, the Port Authority also provided field water quality profile measurements from both the location of the discharge[46] and the location of the intake[47] and the Port Authority provided water quality data from multiple samples taken at the location of the intake, including analyses for metals, volatile organics, semi-volatile organics, and other analytes.[48] This new water quality data was used to complete tables 1, 2, 3 and 6 of the Application.[49] Also, salinity and temperature data was collected from the TCEQ's Surface Water Quality Monitoring ("SWQM") station 13468 in the Gulf of

[41] APP-LT-5-R, at 2, Table 1; APP-LT-1-R at 17.

[42] APP-KD-3-R, at 3, Figure 2 (Teledyne RD Instruments Workhorse Horizontal 300 kHz ADCP).

[43] APP-KD-3-R, at. 3-4.

[44] APP-KD-3-R, at 4, Figure 3 (Teledyne RD Instruments Workhorse Sentinel 600 kHz ADCP).

[45] APP-KD-3-R, at 4.

[46] APP-KD-3-R, Table 3, at 8-10.

[47] APP-KD-3-R, Table 4, at 11.

[48] APP-KD-3-R, Table 5, at. 12-17.

[49] AR-4-R, Tab I to Administrative Record on Remand at 234-237.

Mexico, in closest proximity to the intake location, and this data was provided and used for purposes of calculating the density of the effluent supporting the CORMIX modeling.[50]

Finally, the Port Authority also arranged for an accredited, third-party laboratory to test the salinity tolerances for EPA-approved species. Stillmeadows laboratory conducted chronic seven-day salinity toxicity testing[51] using the EPA and TCEQ approved species (mysid shrimp and inland silverside) required for WET testing in the Draft Permit at salinity concentrations up to 45 ppt. Stillmeadows also performed short-term acute testing (mysid shrimp and inland silverside) with salinity concentrations as high as 55 ppt.[52] The chronic tests results demonstrated that there were no lethal or sublethal effects on either species over the seven-day exposure period.[53] The short-term test results revealed that two-minute exposures up to 55 ppt (designed to simulate a marine larvae being carried through the proposed discharge plume) had no lethal and no sub-lethal impacts.[54] At 55 ppt, all test organisms survived for the test period, and no significant mortality was observed even after 24 hours.[55] The results of these tests, along with the CORMIX modeling results, were produced to all parties.

B. Revised Draft Permit.

After the Remand Order, the Port Authority submitted revisions to the Application, including the information requested by the TCEQ, the additional information and revisions to certain portions of the Application, and information about the revised diffuser design and revised effluent information based on the water quality data collected on behalf of the Port Authority by

[50] APP-KD-1-R at 17.

[51] APP-RP-6-R; APP-RP-7-R.

[52] APP-RP-9-R.

[53] APP-RP-6-R and APP-RP-7-R.

[54] APP-RP-1-R Rebuttal at 3-4.

[55] APP-RP-1-R Rebuttal at 4.

Parsons.[56] After receiving this information in June 2021, TCEQ requested clarification from the Port Authority for some of the information provided.[57] The Port Authority provided the clarifications requested by TCEQ.[58] The TCEQ Water Quality Assessment staff, who performed a technical review, provided their recommendations to the permit coordinator Shannon Gibson in their revised memorandum. Shannon Gibson also performed a technical review and then revised the Draft Permit.[59] The revised Draft Permit was also reviewed by Mike Linder, the team leader of the industrial permitting team.[60] On September 1, 2021, the Draft Permit and supporting documents were provided to the Port Authority and all parties to the contested case hearing.

C. Location.

The Port Authority's proposed location for permitting of its high velocity diffuser is 229 feet south of Harbor Island. This location was selected for several reasons: (1) Good Flushing – the amount of water exchange is likely the most significant factor allowing for rapid dilution; (2) Depth of Water (discharge 64' below surface) – deep water enhances rapid dilution because there is ambient water above and below the point of discharge (not just to the side of the point of discharge); (3) Point of Intake Offshore – the Harbor Island location allows for intake of offshore, good quality water which supports a cleaner discharge; (4) Less Sensitive Discharge Area – the CCSC is an already disturbed habitat, rather than a more pristine bay or offshore waters; and (5) Other Factors – turbulence caused by frequent ship and other commercial traffic, and strong currents, enhances mixing (dilution).

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[56] *See* AR-R-4, Tab I to Administrative Record.

[57] AR-R-3, Tab H to Administrative Record.

[58] *See* ED-7 Remand.

[59] ED-SG-1 Remand at 4.

[60] *Id*.

The Port Authority's proposed location is not within the boundaries of the Redfish Bay State Scientific Area (as claimed by PAC in these proceedings).[61] The Port Authority's proposed location is within an area designated as Essential Fish Habitat ("EFH"), as are all bays, estuaries, gulfs and oceans for the United States' east coast, west coast, and Gulf of Mexico (an important fact not shared by PAC in these proceedings).[62] If EFH were appropriate to consider, then there would be no seawater desalination in the United States (period). The Port Authority's proposed discharge is not in the western reaches of our Nueces/Mission-Aransas estuarine area made the focus of concerns because of the poor flushing of the CCSC Inner Harbor/Nueces Bay/western Corpus Christi Bay. The Port Authority's proposed location is not in an area where seagrasses can ever grow because of the depth and turbidity of the water.[63]

D. Process.

Alex Wesner is the only expert witness who is qualified to express opinions about whether the proposed Harbor Island reverse osmosis ("RO") facility's discharge effluent would comply with Texas regulatory requirements. Mr. Wesner made clear his certain opinion that the "final outfall stream from the Harbor Island Desalination Project [will] meet and exceed all applicable permit requirements . . . ."[64] Alex Wesner further provided uncontradicted testimony that there are various treatment technologies available to remedy whatever constituents of concern, if any, may be identified as construction and processing details become more fully known. Desalination facilities in Australia and California (and other countries) have successfully navigated strict

[61] Exhibit AP-LR-1R (referring to Exhibit PF 1-1 at p. 21).

[62] Tr. Vol. 6 at 1461- 1471.

[63] APP-JT-1, at 171-178; 192-193; see also Deposition of Dr. James Tolan, at pp. 171-178, 193-193.

[64] See APP-AW-1-R at p. 12.

regulatory frameworks – and there is no reason to believe that a state-of-the-art desalination facility built and operated on Harbor Island would do anything less.

E. Larval Exposure.

"Aransas Inlet" is the waterway between Mustang Island (at the City of Port Aransas) and St. Joseph's Island (to the north). The Aransas Inlet splits into three (3) channels or waterways: CCSC, Lydia Ann Channel, and Aransas Channel (not to be confused with the Aransas Inlet). Red Drum females produce "between 160,000 and 3,270,000 eggs per batch . . . , with a mean batch fecundity of 1,540,000 eggs . . . ." Each Red Drum female spawn several times each season. Approximately 27 billion Red Drum eggs/larvae are carried through the Aransas Inlet each season.[65] The most recent study (relying upon current technologies and updated/improved methodologies) confirms that most (perhaps 80%) are carried via Lydia Anne Channel and Aransas Channel to Aransas Bay and Redfish Bay (north)[66] – thus never passing through the CCSC near Harbor Island. This Dawson (2021) study was NOT engaged for purposes of litigation. The remaining 20% of Red Drum larvae being carried through the Aransas Inlet (perhaps as many as 50%) are carried through the CCSC. The Dawson (2021) study speaks for itself. Simply stated as Exhibit EA 1-2 illustrates, the Aransas Inlet is of much greater importance than the Corpus Christi Ship Channel (at Harbor Island).

[65] See calculation, at footnote 10.

[66] Dawson (et al), *Potential Effects of Deepening of the Aransas Ship Channel on Particle Transport: Implications for Recruitment of Estuarine Dependent Larvae* (March 2021), at Table 4, 13.25% transport through CCSC, and remaining 86.75% travel through Lydia Ann Channel and Aransas Channel; see also Tr. Vol. 6 at 197-1406; see also Brown, Holt (et al), *Simulating larval supply to estuarine nursery areas: how important are physical processes to the supply of larvae to the Aransas Pass Inlet?,* Fisheries Oceanography 13:3 (2004)(pp. 181-196, generally), at p. 190, reporting "approximately 80% of the particles [larvae] travel toward Aransas Bay via Lydia Ann and only 16% enter the CC Ship Channel. During this same interval, the division of the flow between the channels (CC Ship Channel, Lydia Ann, Aransas) remained 60, 30, and 10%." See also Tr. Vol. 6 at 1403-1406.

Scientific studies also inform us of the specific gravity of Red Drum eggs and early-stage larvae. Red Drum eggs and early-stage larvae float at or near the surface:

- "Red drum . . . eggs [] are buoyant at salinities greater than 25 and sink at lower salinities."[67]
- "The eggs are positively buoyant in salinities greater than 25% [25 ppt]."[68]
- "Live, fertilized eggs are buoyant"[69]
- "The largest number of eggs collected during the study was in depths ranging from 1.5 – 2.1 m and highest concentrations of eggs were found at the edge of the channel."[70]
- "After hatching, larvae continue to float in the water column as long as salinity and associated water density is sufficient for buoyancy."[71]
- "Upon hatching, red drum larvae are pelagic."[72] (inhabiting upper waters).
- "A major part of marine fish eggs are confined to the upper mixed layer, and are termed *pelagic eggs*."[73]
- "Recent surveys of red drum larvae in the coastal region adjacent to the Aransas Pass inlet show that red drum larvae are primarily located near the surface."[74]
- "To simulate red drum larval transport, passive particles were introduced into the circulation model and tracked . . . particles were released in the nearshore region (inside 20m depth contour) at a depth of 0.5m below the surface and held at that depth for the entire simulation."[75] Scott Holt (PAC's expert) released the particles

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[67] Tr. Vol. 6 at 1382- 1383; see also Brown, Holt, et al., (2004), at p. 185.

[68] https://thefishsite.com/articles/cultured-aquatic-species-red-drum.

[69] Tr. Vol. 6 at 1385; see also Southern Regional Aquaculture Center at p. 12.

[70] Atlantic States Marine Fisheries Commission *Addendum 1 to Amendment 2 to The Red Drum Fishery Management Plan: Habitat Needs & Concerns*, August 2013 at Chapter 4, p. 36; see also Tr. Vol. 6 at. 1387-1389.

[71] Tr. Vol. 6 at 1383; see also Southern Regional Aquaculture Center at p. 12.

[72] Tr. Vol. 6 at 1385-1386; see also Atlantic States Marine Fisheries Commission *Addendum 1 to Amendment 2 to The Red Drum Fishery Management Plan: Habitat Needs & Concerns*, August 2013 at Chapter 4, at p. 37; citing Johnson 1978; Holt et al 1981) ("pelagic" means inhabiting the upper waters of the open sea).

[73] Tr. Vol. 6 at 1389; see also Sundby (et al), The Principles of Buoyancy in Marine Fish Eggs and Their Vertical Distributions across the World Oceans, *PLoS ONE* 10 (10): e0138821. Doi:10.1371/journal.pone.0138821 (2015), at p. 10.

[74] Tr. Vol. at 1382; see also Brown, Holt, et al., (2004), at p. 185.

[75] Brown, Holt, et al., (2004), p. 186; see also Brown, Holt, et al., (2005) at p. 35.

at sunset to correspond to actual spawning times, and at 0.5m to simulate fact that eggs/larvae are at or near the surface.

Scott Holt (PAC's expert witness) has repeatedly published studies stating that Red Drum eggs and early-stage larvae are found at or near the surface. Dr. James Tolan was a graduate school student working for Scott Holt and is now a marine biologist (presently employed by Texas Parks & Wildlife Department ("TPWD")). Dr. James Tolan was the person doing the hands-on research for Scott Holt (early 2000s), and testified as follows:

Q. I'm talking about the specific gravity of Redfish drum or, excuse me, red drum larvae and eggs. They float, generally, in salinity greater than 25 parts per thousand. Correct?
A. Yes, yes.[76] . . .
Q. And then it says, recent studies of red drum larvae in the coastal region adjacent to the Aransas Pass inlet showed that red drum larvae are primarily located near the surface. Did I read that correctly?
A. Yes.
Q. And do you agree with that?
A. Based on the sampling that I did in Scott Holt's lab, yes, they were much more abundant on the surface."[77]

Scott Holt (and all PAC experts) now take the position that Red Drum eggs and early-stage larvae are distributed throughout the water column (else Red Drum eggs and early-stage larvae would never come into contact with the concentrated salinity plume, as proposed). In support of this PAC argument, Scott Holt opines that water turbulence causes Red Drum larvae to be evenly distributed throughout the water column (the same turbulence that PAC argues does not exist to disperse (better mix) the proposed near Harbor Island effluent discharge).

To the extent to which Red Drum may be distributed throughout the water column (perhaps not evenly, but some) by turbulence, those that are carried to the CCSC (20% - 50%) enjoy a 98% zone of passage (thus, never coming into contact with any increased salinity from the proposed

[76]See deposition of Dr. James Tolan at p. 176 (AP-JTJ-1).

[77] See deposition of Dr. James Tolan at pp. 181-182 (AP-JT-1).

discharge). Dr. Gregory Stunz has testified that 2% of the CCSC may be affected by the concentrated salinity plume.[78] The Port Authority's expert witnesses have made calculations that the cross-sectional area of the concentrated salinity plume greater than 45ppt is less than 5% (depending upon the speed of the tidal currents).[79]

Finally, PAC correctly recognizes that not all Red Drum eggs/larvae are created equally. The age of Red Drum eggs/larvae give rise to at least two important differences that have consequence to present considerations: (1) early-stage Red Drum larvae (3-day old) may not osmoregulate as well as older (4-day old+) Red Drum larvae; and (2) most Red Drum larvae (less than 20-day old) are not competent to settle. Both of these important life-stage features are deserving of comment:

1. Red drum eggs are substantially impermeable,[80] and thus not impacted by changes in ambient concentrations of salinity.[81] Even Dr. Kristen Nielsen acknowledges that red drum eggs are not adversely impacted by higher salinity concentrations.[82] Dr. Nielsen focused her concerns upon 2-day old and 3-day old red drum larvae, only.[83] Dr. Nielsen concedes that 4-day old and older red drum larvae are able to more fully osmoregulate[84] (as do adult Red Drum).[85]
2. Of equal importance is the fact that not all Red Drum larvae are able to successfully settle to suitable nursery habitats (a pre-requisite to recruitment/reproduction).

> " . . . the timing of the [red drum] larval transport to an estuarine habitat is an important factor in recruitment. If larvae are transported to a suitable

[78] Tr. Vol. 5 at 1071/

[79] APP-RP-1-R at 33; see also APP-RP-10-R

[80] Tr. Vol. 7 at 1841-1842.

[81] Tr. Vol. 7 at 1841-1842.

[82] Tr. Vol. 7 at 1841-1842.

[83] See ages in test 1, and test 2/test 3.

[84] Tr. Vol. 7 at 1840-1842; see also Tr. Vol. 8 at 2032.

[85] See APP-53-R and APP-54-R.

> settlement habitat but are insufficiently developed ("precompetent phase"), they will not be able to respond to the environment and settle."[86]
>
> "When the [red drum] larvae are 2 – 3 weeks old, they can settle in estuarine nursery grounds, primarily sea grass habitats [*Holt et al*., 1983; *Rooker and Holt*, 1997; *Rooker et al*., 1999]."[87]
>
> "A significant source of larval mortality may be associated with larvae being transported away from a suitable settlement habitat during this precompetent phase and their inability to reach a suitable habitat when they are competent [*Jackson and Strathmann*, 1981].[88]
>
> "The majority of the particles [larvae] entering on the flood tide are expelled a maximum distance of about 7 km offshore. . . during the subsequent ebb tide in a tidal jet (Fibure 12). Most of these particles [larvae] do not reenter the inlet during the next flood tide because they are seaward of the flood water source region."[89]

More simply stated: 2-day old and 3-day old red drum larvae that might pass near the proposed Harbor Island discharge location are "precompetent," and will not be able to settle. Though not adversely impacted given that any dose is slight and exposure limited to seconds or minutes (not hours or days), these "precompetent" red drum larvae are unable to settle – and thus likely to be rejected offshore by the subsequent ebb tide (forever lost to recruitment). Only the two to three week old larvae (or older) are competent to settle in the available nursery habitats (and these osmoregulate with great success).

A comprehensive understanding of the life-cycle of Red Drum – and Red Drum larvae specifically – makes clear that few (if any) Red Drum – or Red Drum larvae – would ever be exposed to the Outfall. There are likely billions of Red Drum eggs and larvae that enter the

[86] Brown, (2000), at 24,154; see also Tr. Vol. 8 at 20, 21.

[87] Brown, (2000), at 24,154; see also Tr. Vol. 8 at 20,21.

[88] Brown, (2000), at p. 24,154; see also Tr. Vol. 8 at 2022.

[89] Brown, Holt (2000), at p. 24,151; see also Tr. Vol. 8 at 2010, 2014.

Aransas Inlet each season. These eggs and larvae are naturally buoyant (most abundant at or near the surface). Most are carried to Aransas Bay and Redfish Bay (north) via Lydia Anne Channel and Aransas Channel (never passing through the CCSC near the proposed discharge location). The red drum eggs and larvae at or near the surface never come into contact with the discharge. For those that are mixed by turbulence into the water column (the same turbulence that would assure rapid mixing of the proposed discharge), there is a 98% zone of passage within the CCSC (around the proposed discharge plume). For those that would pass through the proposed discharge plume (only 0.0066% - 0.0165% of the 3-day old larvae that entered the Aransas Inlet), the exposure would be for seconds or minutes (not hours or days) to concentrated salinity greater than 45ppt. Of all of the Red Drum larvae entering the Aransas Inlet, only those in the competent phase (older than two (2) weeks of age) may successfully settle (and these are fully capable of osmoregulation to avoid any adverse consequence of a relatively brief exposure to a higher salinity concentration). This is how the published literature informs us of Red Drum eggs and larvae exposure to the proposed desalination discharge.

F. CORMIX and SUNTANS modeling.

CORMIX Modeling. On remand, the Port Authority's revised application relies upon a new diffuser designed by Dr. Lial Tischler, the only witness in the proceeding for any party who has experience with the use of CORMIX for the design and implementation of effluent diffusers for effluent discharges. The Protestants did not challenge any of Dr. Tischler's testimony on cross-examination. Dr. Tischler, who has designed dozens of diffusers which have been placed in service at facilities as close as Corpus Christi and Port Arthur, Texas and as far away as London, England and Shanghai, China,[90] designed the new diffuser to account for the wide range of ambient

[90] APP-LT-3-R.

velocities which occur in the CCSC in the area of the proposed discharge. Dr. Tischler's diffuser design results in the greatest portion of dilution occurring in the area in close proximity to the outfall. This is proven by the modeling of not only Dr. Tischler and the TCEQ's modeler Katie Cunningham, but also by a majority of the modeling conducted by Dr. Scott Socolofsky, PAC's principal modeling expert witness.[91]

In all scenarios run by Dr. Tischler and Katie Cunningham with ambient flow at .2 m/s and above (tested by Katie Cunningham at as high as 2.0 m/s), the dilution achieved is essentially the same; that is, a centerline concentration of effluent at 14.6% at the edge of the ZID (defined as 28 meters from the discharge), 8.9% effluent at the boundary of the MZ (defined as 84.3 m from the discharge) and between 5.0% and 5.4% at the HHMZ (defined as 160.5 m from the discharge).[92] Changes in the ambient or effluent density did not make a substantial difference with the diffuser's performance.[93]

PAC's Dr. Scott Socolofsky's CORMIX modeling also demonstrate consistency of results (as found by Dr. Lial Tischler and TCEQ's Katie Cunningham).[94] Only in the scenarios in which Dr. Socolofsky placed an artificial vertical wall in close proximity to the diffuser was the mixing performance significantly reduced. As discussed in more detail below, placing this vertical wall close enough to eliminate the water for mixing was a scholarly pursuit to test how the mixing

[91] APP-LT-1-R Rebuttal, pp. 7-8; *See also* PAC-51R SS-5.

[92] APP-LT-14-R at 9-10, Table 8; ED-KC-1 Remand at 31-32, *See also* APP-KD-9-R (Excel), APP-KD-10-R (Excel), AR-R-5, Tab J to Administrative Record on Remand at 145-146.

[93] *See* APP-LT-14-R at 10 ("Variations in ambient densities did not have a significant impact on model results.").

[94] APP-LT-1-R Rebuttal at 7-8; *See also* APP-51-R; comparing TCEQ CORMIX results for 50% RO recovery Summer 95th percentile salinity conservative mode run with standard schematization with Socolofsky 50% RO Recovery Summer 95th percentile salinity conservative mode run placing bank 35 meters from the diffuser and 90 foot (27.4 m) depth, Socolofsky 50% RO Recovery Summer 95th percentile salinity conservative mode runs placing bank 35 meters from the diffuser using 72 foot (22 m) depth; Socolofsky 50% RO Recovery Summer 95th percentile salinity conservative mode run placing bank 20 meters from diffuser using 70.8 foot (21.57 m) depth and Socolofsky 50% RO Recovery Summer 95th percentile salinity brine mode runs using 1.5 meter risers and using 0.0 meter risers.

would be impacted had there been a vertical wall (a "sensitivity" analysis), but it had no basis in reality. As such, all the reasonable schematization shows results consistent with the TCEQ's critical dilution as used for the Draft Permit.

SUNTANS Modeling. Prior to the Port Authority's application being referred for a contested case hearing, the Port Authority engaged LRE Water along with the University of Texas (Austin) to conduct far-field modeling. Dr. Jordan Furnans performed SUNTANS modeling to determine if the proposed discharge would create an increase in the salinity in the CCSC and/or the Corpus Christi Bay. The results of the modeling study, which was conducted using data from a two-year period (from 2010 a "wet" year and from 2011 a "dry" year), concluded that a dense plume would not form on the bottom with daily tidal fluctuations continuously mixing the discharge so that stratification is never persistent. The study also concluded that there would be a 0.0 – 1.0 ppt possible increase in salinity in the area of the discharge and the Corpus Christi Bay system[95] After remand, Dr. Furnans confirmed that the original SUNTANS modeling remained valid because the minor change in the location of the diffuser does not change the grid cell into which the effluent is being discharged; and changing the percentage effluent at the edge of the mixing zone does not affect the SUNTANS ability to account for all the additional salt introduced by the desalination effluent discharge.[96]

III.
LEGAL STANDARD

In its Remand Order, the TCEQ determined that "the appropriate legal standard for non-numerical criteria" for "evaluating the impacts to aquatic organisms that move through a zone of

[95] APP-JF-R at 5.

[96] APP-JF-R at 8.

initial dilution" is that found in 30 Texas Administrative Code § 307.6(e)(1).[97] Under that standard, "[a]cute toxicity levels may be exceeded in a ZID, but there must be no *significant lethality* to aquatic organisms that move through a ZID.…"[98]

The Texas Government Code and Texas Administrative Code mandate that in a contested case regarding a permit application, the TCEQ's filing of the administrative record "establishes a prima facie demonstration that the executive director's draft permit meets all state and federal legal and technical requirements, and, if issued consistent with the executive director's draft permit, would protect human health and safety, the environment, and physical property."[99] Once the prima facie demonstration is established, it may only be rebutted by a party challenging the permit "presenting evidence regarding the referred issues demonstrating that the draft permit violates a specifically applicable state or federal legal or technical requirement."[100] Only if a party challenging the permit successfully rebuts the prima facie demonstration does the applicant or the TCEQ Executive Director have a duty to "present additional evidence to support the executive director's draft permit."[101]

As a matter of law, the TCEQ Executive Director's filing of a new administrative record and new revised Draft Permit with the remand of this matter on the referred issues set forth in the TCEQ's Interim Order triggered a new prima facie demonstration. Thus, Protestants have the burden to rebut the prima facie demonstration with evidence establishing that the revised Draft Permit violates a specifically applicable state or federal legal or technical requirement. For the

[97] AR-R 2, pg. 1, § 1(1).

[98] 30 TAC § 307.6(e)(1) (emphasis added).

[99] TEX. GOV'T CODE § 2003.047(i)(i-1); 30 TAC § 80.17(c)(1).

[100] TEX. GOV'T CODE § 2003.047(i)(i-2); 30 TAC § 80.17(c)(2).

[101] TEX. GOV'T CODE § 2003.047(i)(i-3); 30 TAC § 80.17(c)(3).

reasons set forth herein, Protestants have not met their burden. As such, the burden of proof has not shifted back to the Port Authority or TCEQ Executive Director to present additional evidence to support the TCEQ Executive Director's revised Draft Permit.

Under the TCEQ rules on contested case hearings, the "burden of proof is on the moving party by a preponderance of the evidence."[102] In the event that Protestants have presented "evidence regarding the referred issues demonstrating that the draft permit violates a specifically applicable state or federal legal or technical requirement"[103] (which Protestants have not), the Port Authority has responded with a preponderance of the evidence (and more) to support issuance of the Draft Permit.

IV.
ARGUMENT

A. Whether the proposed discharge will adversely impact: the marine environment, aquatic life, and wildlife, including birds and endangered or threatened species, spawning eggs, or larval migration issue (Issue 2.A)?

1. Because Red Drum, the most sensitive species to changes in salinity, will not be adversely affected by the Outfall, no marine species will be.

The Port Authority's and Protestants' expert witnesses have confirmed, repeatedly, that Red Drum are the most sensitive resident marine species to changes in salinity concentrations. Therefore, if Red Drum are not going to be adversely affected by the Outfall, then it stands to reason that no other species will be adversely affected.

a. The consensus of experts agree that Red Drum is the most sensitive species to salinity changes.

The Red Drum species is the most sensitive species to salinity changes from an Outfall. Protestants' own expert, Dr. Andrew Esbaugh, confirmed that Red Drum is still his biggest concern

[102] 30 TAC § 80.17(a).

[103] TEX. GOV'T CODE § 2003.047(i)(i-2); 30 TAC § 80.17(c)(2).

with regard to the acute effects of desalination effluent.[104] At the original hearing in November 2020, Dr. Esbaugh testified that that he reviewed the applicable literature for salinity and identified Red Drum as the most sensitive species in the databases that he consulted.[105] In addition to Dr. Esbaugh's testimony, Dr. Daniel Schlenk testified that Red Drum early life stages should "be probably utilized in terms of determining a threshold" for toxicity testing for the Outfall.[106] Dr. Schlenk also testified that Red Drum "serve as a surrogate for other species that have sensitive life stages."[107] Dr. Gregory Stunz testified at the original hearing that Red Drum were one of the sensitive species to salinity changes,[108] and on remand, he referred to it as a sentinel species.[109] Dr. Stunz also agreed that Red Drum would be most sensitive species as to latent mortality,[110] and he agreed that Red Drum are particularly sensitive to changes in salinity.[111] Dr. Kristin Nielsen conducted her testing upon Red Drum, presumably because she determined that it was the most sensitive species to salinity changes from the Outfall. Dr. Nielsen testified at the hearing on remand that Red Drum are "particularly" sensitive to salinity stress during their early life stages.[112] She also referred to Red Drum as the species that is the "driver of risk."[113] Dr. Lance Fontenot, the Port Authority's expert witness, agrees that Red Drum are a useful surrogate species for determining any effects of salinity upon marine life in the CCSC. Dr. Fontenot testified that Red

[104] PAC-45R at 10.

[105] November 5, 2020 at pp. 59-60; and Tr. Vol. 5 at 1284-85.

[106] Tr. Vol. 8 at 1921.

[107] Tr. Vol. 8 at 1929.

[108] November 5, 2020 at p. 69.

[109] PAC-52R at p. 15; see also Tr. Vol. 5 at 1070.

[110] Tr. Vol. 5 at 1198.

[111] Tr. Vol. 5 at 1098, 1299.

[112] PAC-48R at 8, 11.

[113] PAC-48R at 18.

drum are a "key target species," and one of the species he targeted for evaluation following the EPA's risk assessment protocol.[114]

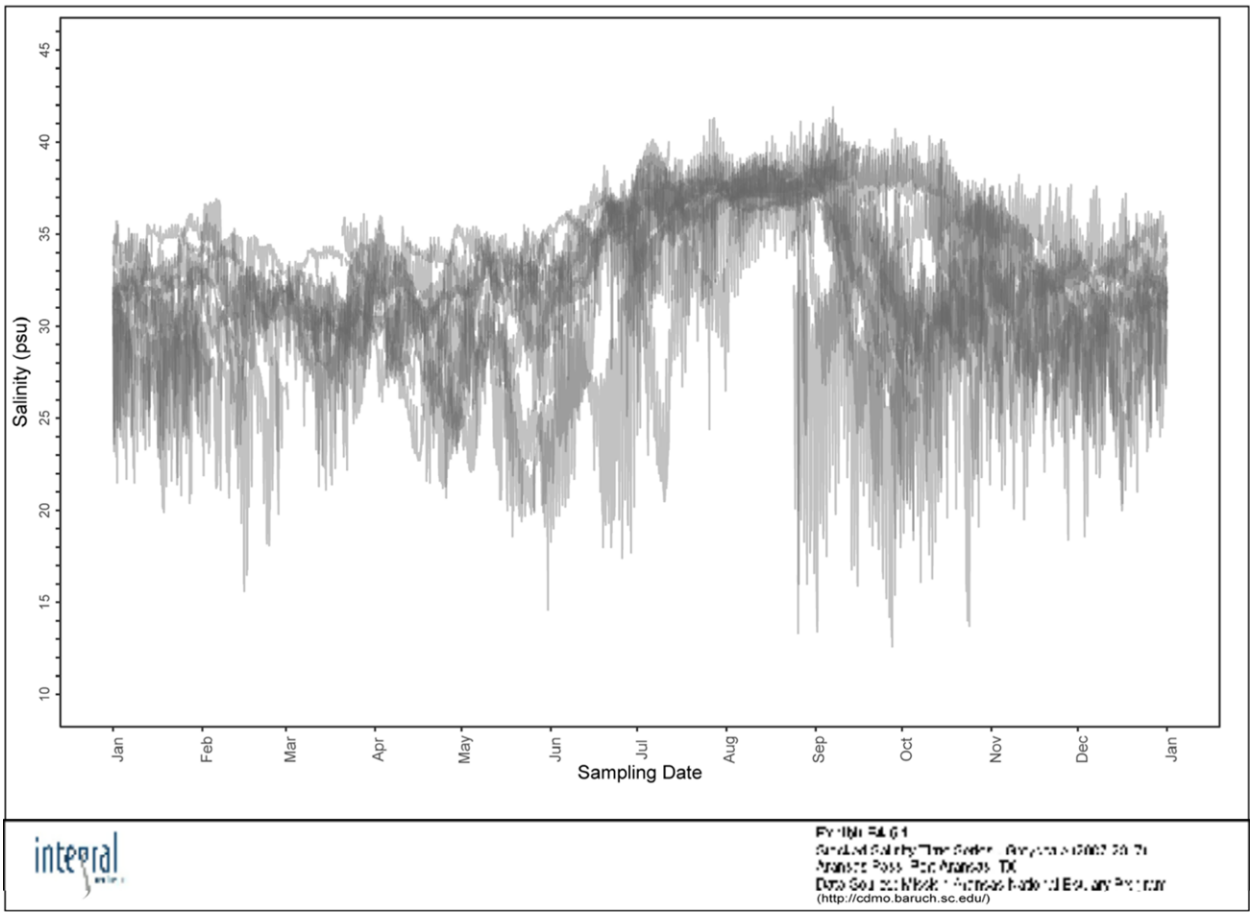
All parties agree on the importance of Red Drum to the analysis, and thus the Port Authority will focus much of its argument upon the Red Drum and its life cycle. At the same time, Dr. Fontenot also conducted an exhaustive analysis of the potential effects of salinity on other species in the area of the Outfall, determining that they would not suffer any adverse effects.

b. Red Drum survive and thrive in the Corpus Christi Bay system with naturally occurring substantial fluctuations in salinity.

The evidence presented at the original hearing and on remand establishes that Red Drum thrive in the Nueces/Mission-Aransas estuary systems (including the area of the CCSC) – with naturally occurring substantial fluctuations in salinity. Dr. Lance Fontenot provided Exhibit EA 5-1 to illustrate the naturally occurring changes in salinity between 2007 and 2017.[115] It demonstrates a "striking visual confirmation of the large fluctuations in salinity that occur naturally in this system on a day-to-day basis throughout the year":

[114] APP-LF-1-R at 25.

[115] APP-LF-1R at 41.



Dr. Fontenot also prepared two other exhibits demonstrating the salinity changes in the area of the Outfall, Exhibits EA 5-2 and 5-3. Exhibit EA 5-2 demonstrates that daily salinities can fluctuate from <1 ppt to >5 ppt, including large changes, both up and down, over days or weeks, in response to weather events such as drought, excessive rainfall, or seasonal changes.[116] Dr. Fontenot states that "the aquatic species that live and thrive in such an environment have evolved physiological mechanisms to cope with the constantly changing salinity levels in their environment."[117] Protestants have presented no data to refute Dr. Fontenot's analysis of the naturally occurring ambient fluctuations in salinity for the area of the proposed discharge. To the contrary, Protestants

[116] APP-LF-1R at 42.

[117] APP-LF-1R at 42.

assert that when the salinity in the CCSC rises above 37.7 ppt, one-half (LT50) of all early-stage Red Drum larvae die[118] (a claim by Protestants that defies common sense and Charles Darwin's theory evolution given that Red Drum thrive with salinity concentrations between 28 ppt and 43 ppt).[119]

c. The Draft Permit is protective of Red Drum adults and juveniles.

On remand, the scientific evidence established that adult Red Drum can tolerate significant instantaneous changes in salinity (up to 30 ppt), without suffering adverse effects.[120] This species' tolerance to such abrupt salinity changes hold true even when the adult Red Drum are also deprived of oxygen.[121] Dr. Fontenot identified several sources confirming that Red Drum can withstand salinities of up to 60 ppt which is a salinity concentration substantially higher than the salinity concentrations from the Outfall.[122] Dr. Esbaugh confirmed the ability of juvenile and adult Red Drum to osmoregulate during his cross examination.[123] Dr. Esbaugh testified about his study entitled "Osmoregulatory Plasticity During Hypersaline Acclimation in Red Drum."[124] In that study, the Red Drum were anywhere from 6 to 12 months old, which Dr. Esbaugh stated was an "early life stage" for Red Drum.[125] These Red Drum were moved from 30 ppt salinity to 60 ppt salinity, an increase of 100%, with no period of time for acclimation.[126] The test lasted 72 hours,

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[118] (Nielsen, Test 3).

[119] APP-55-R; see also APP-56-R.

[120] See Esbaugh, et al. (2021), Osmoregulatory plasticity during hypersaline acclimation in red drum, *Sciaenops ocellatus,* Journal of Comparative Physiology B (2021) 191: 731-740.

[121] See Esbaugh, et al. (2018), Effects of salinity and hypoxia-induced hyperventilation on oxygen consumption and cost of osmoregulation in the estuarine red drum (*Sciaenops ocellatus*).

[122] APP-LF-1R at 47.

[123] Tr. Vol. 8 at 1878-1879, 1885-1886.

[124] Tr. Vol. 8 at 1957; see also APP-53R.

[125] Tr. Vol. 8 at 1958, 1962.

[126] Tr. Vol. 8 at 1959:1-22.

during which time none of the Red Drum died.[127] Dr. Esbaugh agreed that this test demonstrated no survival concerns were created by the desalination plant for juvenile Red Drum or adults.[128] Dr. Esbaugh conceded that he did not anticipate a problem for the juveniles or adult Red Drum that he studied for a 2 ppt to 5 ppt or 10 ppt change in salinity from the Outfall. Dr. Schlenk also testified that he agreed that Dr. Esbaugh was an authority on fish physiology, and that he did not disagree with Dr. Esbaugh's research on the ability of juvenile and adult Red Drum to withstand substantial salinity changes.[129] Mr. Randy Palachek testified in this matter that "the real takeaway is that Red Drum are incredibly tolerant of higher salinity environments, even though there seems to be consensus that Red Drum are the most environmentally sensitive for the local bay and estuary system."[130] Protestants have no credible basis for challenging the substantial evidence or the testimony of their own experts on this issue (or that of Randy Palachek).

d. The Outfall will not harm Red Drum eggs or early life stages.

On remand, the scientific evidence established that Red Drum eggs and early life stages can tolerate hours (24h) of exposure to salinity concentrations greater than 45 ppt without suffering adverse effects. All scientific literature considers lethality/toxicity as a function of the 'dose' of a given toxicant (e.g., salinity) and 'time of exposure.' Eco-toxicity tests literally count the number of organisms killed when exposed to a quantified toxicant (the dose of the toxicant) for a known amount of time (time of exposure). Thus, only after a reasonable understanding of the modeling (above) will an evaluation of an organism's tolerance be meaningful.

Texas Water Code § 5.134 applies to these proceedings:

[127] Tr. Vol. 8 at 1959, 1963.

[128] Tr. Vol. 8 at 1960, 1962.

[129] Tr. Vol. 8 at 1874-1875.

[130] APP-RP-1-R at 38.

> "The commission may accept environmental testing laboratory data and analysis for use in commission decisions regarding any matter under the commission's jurisdiction relating to permits or other authorizations, compliance matters, enforcement actions, or corrective actions only if the data and analysis is prepared by an environmental testing laboratory accredited by the commission under Subchapter R or an environmental testing laboratory described in Subsection (b) or (e)."

The Port Authority accomplished testing in compliance with Texas Water Code § 5.134. Specifically, the "study [was] conducted in compliance with Texas Pollution Discharge Elimination System (TPDES) permit requirements; and in accordance with Texas Water Code Chapter 5, Subchapter R, Title 30 Texas Administrative Code Chapter 25 and the National Environmental Laboratory Accreditation Program (NELAP), Certificate Number T104704352-20-13."[131] The Port Authority engaged Stillmeadow (a third-party laboratory) to test EPA approved marine species (mysid shrimp and inland silverside) – and evaluate these selected marine species' tolerance to higher saline conditions. For both mysid shrimp and inland silverside, EPA test method 821-R-02-014 was applied (June, 2021). This test type is referred to as the 7-day Static Renewal Short Term Chronic Toxicity Test. For mysid shrimp, the NOEC (no observed effect concentration) was the highest salinity tested: 45 ppt (for survival). For inland silverside, the NOEC was the highest salinity tested: 45 ppt (for survival). For both mysid shrimp and inland silverside, there was no statistically significant variation for each test species' survival with exposures to salinity concentrations ranging from 25 ppt to 45 ppt. For both mysid shrimp and inland silverside, both mean dry weight and growth were measured to test for sub-lethal effects (if any). Test results verify that there was no statistically significant variation for each test species' mean dry weight with exposures to salinity concentrations ranging from 25 ppt to 45 ppt – and verify a NOEC for growth (measured to consider sub-lethal effects) at 45 ppt. In other words, the

[131] APP-RP-6-R, at p. 4; see also APP-RP-7-R at p.4; see also APP-RP-8-R, at p. 4; see also APP-RP-9-R, at p. 4.

EPA testing revealed that these marine species are not adversely impacted by 7-day exposures to 45 ppt (considering both survival and sub-lethal effects).

The Port Authority subsequently (July 2021) engaged this same Stillmeadow laboratory to conduct 'shock' exposure testing (a temporary exposure to higher salinity concentrations intended to simulate an organism passing through the ZID). Per EPA requirements, mysid shrimp and inland silverside – again – were the chosen test species. EPA test method 821-R-02-012 was applied. This particular test may be correctly referred to as the 2-minute Static Acute test. Test species were exposed to 35 ppt (control), 45 ppt, 50 ppt, and 55 ppt for two minutes. One hundred percent survived, and laboratory analysis concluded that this exposure's endpoint found a NOEC of 55 ppt for mysid shrimp and inland silverside.

Although PAC's experts in staged-fashion harmoniously criticize testing of mysid shrimp and inland silverside as not representative of Red Drum sensitivity, published literature (not for purposes of litigation) proves otherwise. In a controlled setting, mysid shrimp (3 – 6 day old) and inland silverside (7 – 11 day old) were "exposed to balanced solutions ranging in salinity from near zero to more than 80% [80ppt]."[132] For mysid shrimp, the study concluded that the lethal concentration for 50% lethality ("LC50") was 43.03 ppt (at 48 hours). For inland silverside, the study concluded that the LC50 was 44 ppt (at 48 hours).[133] Dr. Gregory Stunz was asked whether this data proved that mysid shrimp, inland silverside, and Red Drum larvae shared the same tolerance to higher concentrations of salinity, and Dr. Stunz replied: "roughly the same."[134] This rough equivalency is confirmed by various published articles more fully discussed, below. By

[132] Pillard, et al. (1998), at p. 430.

[133] Pillard, et al. (1998), at p. 430; see also Tr. Vol. 5 at 1289-1291.

[134] Tr. Vol. 5 at 1292.

way of example, Kesaulya et al. (2018)[135] " . . . shows that red drum eggs can hatch within a wide range of salinities with best hatch-out and growth rates occurring between 33 – 43 ppt" (strongly suggesting that mysid shrimp and inland silverside may be more sensitive to higher salinity concentrations than Red Drum larvae). Without reference to any science or even published literature, Protestants' experts dismiss the 'rough equivalence' of these test species. With all due respect, science should not be so glibly dismissed – but rather should inform our decisions.

Academic studies of Red Drum, and Red Drum eggs and larvae, substantially coincide with the data revealed by the Stillmeadow test results. There are many academic studies to inform our understanding of how Red Drum (including Red Drum eggs and larvae) will respond to the Harbor Island proposed desalination discharge. We have good (non-litigation) data for Red Drum:

- Robertson et al, 1988:[136] Red drum embryos **NOEC (no-effect concentrations) at 45 ppt.** " . . . Red drum [E]mbryos were used in toxicity trials." The authors evaluated the effects of osmotic shock and latent mortality by instantaneously exposing morula-stage embryos (1.5 - 2 hours post fertilization) and tail-bud-stage embryos (12-13 hours post fertilization) of the Red Drum reared at 30 ppt to salinities of 37.5 ppt, 45 ppt, 60 ppt, and 95 ppt for 20 minutes, after which the test organisms were returned to 30 ppt and monitored. Unhatched, dead, and living embryos were counted 40 hours after fertilization to determine hatching success and survival. The results showed no effect at 45 ppt and a significant effect at 60 ppt.

- Brauner et al, 2013:[137] "The Sciaenidae (drums) were the most diverse family . . . with 10-13 species present. In the [Laguna Madre] lagoon, 15 species have been recorded at salinities greater than 60 ppt**,** and an additional 10 are known to be able to tolerate even higher salinities (Bayly, 1972). However, at higher salinities few species dominate and only larger individual fish are found, indicating a lack of recruitment (Tunnell and Judd, 2002)."

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[135] Kesaulya (et al), Effects of Hypersaline Conditions on the Growth and Survival of Larval Red Drum, *Jordan Journal of Biological Science*, 12 No. 1 (2019) 119-122, APP-55-R.

[136] Robertson (et al), Toxicity of the Cryoprotectants Glycerol, Dimethyl Sulfoxide, Ethylene Glycol, Methanol, Sucrose, and Sea Salt Solutions to the Embryos of Red Drum, The Progressive Fish-Culturist, 50 (1988) 148-154. see also Tr. Vol. 8 at 2067-2069.

[137] Brauner, et al, Extreme Environments: Hypersaline Alkaline, and Ion-Poor Waters, Fish Physiology – Euryhaline Fishes, Chapter 9 (2013), at p. 454-455; see also Tr. Vol. 5 at 1097-1105.

- Stunz, et al, 2015:[138] "Salinity tolerances: . . . The Corpus Christi Bay system has natural salinities ranging from 28 – 42 ppt, with an average around 35 ppt. We know that the resident marine species [in Corpus Christi Bay (red fish and their larvae)] can tolerate salinities within this range; . . . ."

- Kesaulya et al, 2018:[139] "This study shows that red drum eggs can hatch within a wide range of salinities with best hatch-out and growth rates occurring between 33 – 43 ppt." "Red drum eggs held at the 38 ppt showed the highest percentage of hatching success, ..."

- Nielsen, et al (2021): abrupt short-term salinity tolerance testing of red drum larvae demonstrated by transfer of larvae from 28 ppt to 68.7 ppt, and 35 ppt to 68.7 ppt (2 tests); demonstrating larvae had an LT50 for 47.7 minutes and 65.0 minutes, respectively, after this shock treatment of over 245% and 196%, respectively, above culture/hatch water. At 50.4 ppt, red drum larvae demonstrated LT50 for 24 hours.

- With a separate test protocol, Dr. Nielsen found that red drum eggs and early-stage larvae had same hatch and survival success at 31 ppt (control), 35 ppt, 40 ppt, and 45 ppt – a NOEC of at least 45 ppt for this most sensitive marine species. (See PAC-48R KN-3).

There are many sources of information that demonstrate Red Drum – and Red Drum eggs and larvae – have the ability to resist toxicity from increased salinity (i.e., osmoregulate upon encountering higher saline conditions). All of the above-referenced studies and test results provide data about Red Drum (fish, or eggs and larvae, or both). All demonstrate that Red Drum – and Red Drum eggs and larvae – are successful with hours and hours (up to 24 hours) of exposure to at least 45 ppt. None of these studies suggest that Red Drum – or Red Drum eggs or larvae – suffer adverse impacts from exposures of seconds or minutes. This data comes to us from several sources, including some from PAC's expert witnesses in this matter.

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[138] Stunz, et al, Identification and Characterization of Potential Environmental Impacts Mitigation Measures Related to Intake and Discharge Facilities of Seawater Desalination Plants: Variable Salinity Desalination Demonstration Project – City of Corpus Christi, Harte Research Institute for Gulf of Mexico Studies – Texas A&M University Corpus Christi, at pp. 9-11. (APP-56-R).

[139] Kesaulya (et al), Effects of Hypersaline Conditions on the Growth and Survival of Larval Red Drum, *Jordan Journal of Biological Science*, 12 No. 1 (2019) 119-122; APP-55-R.

With a data-based understanding of Red Drum egg and early-stage larvae tolerance for increases of salinity concentrations, the next obvious step is to consider duration (time) of exposure. As more fully set forth in the Statement of Facts (above), published literature and sworn testimony confirms:

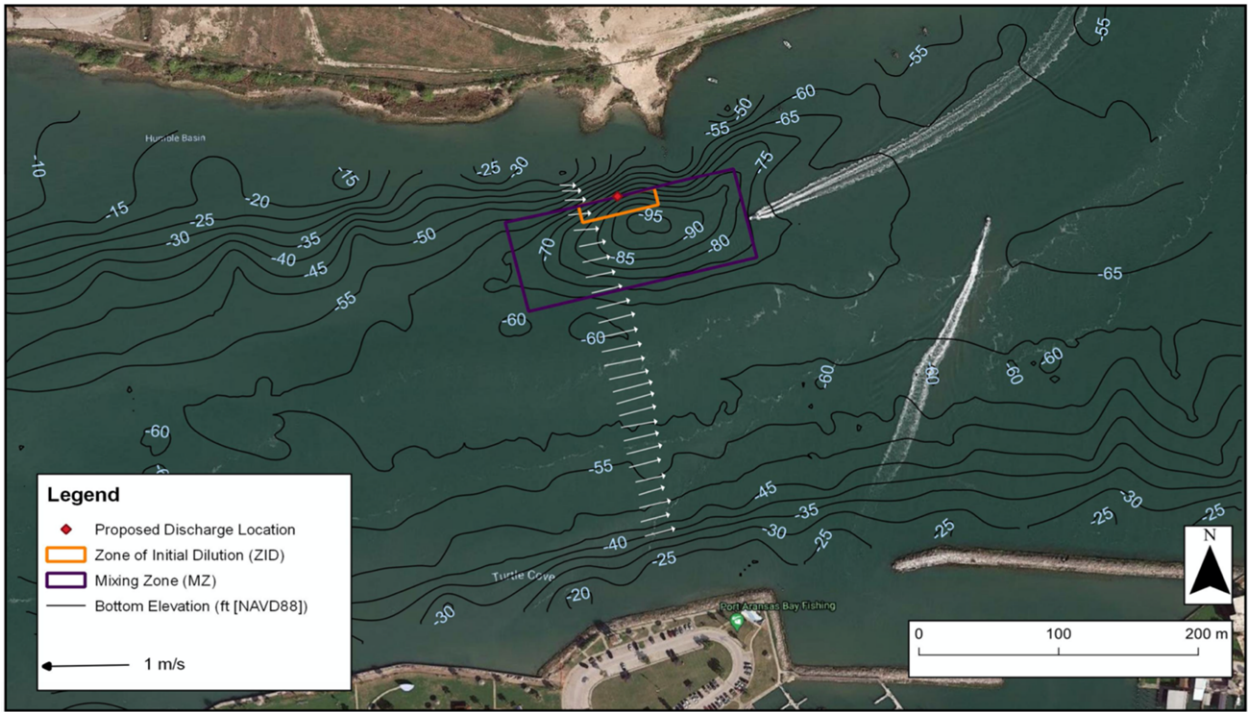
- Only a portion of Red Drum eggs and larvae will even travel through the CCSC. The Port Authority experts (relying upon Dawson, et al. (2021) and Brown, Holt, et al (2004)) have established that a high percentage of Red Drum eggs and larvae will travel through the Lydia Ann Channel and the Aransas Channel without coming into contact with the Outfall.

- For those eggs and larvae that travel through the CCSC, the more sensitive eggs and early-stage larvae float at or near the surface (see multiple literature references above, and the testimony of Dr. James Tolan quoted above). As such, Red Drum eggs and early-stage larvae at or near the surface never come into contact with the proposed discharge plume.

- For those eggs and larvae that travel through the CCSC near the Outfall, 95% - 98% of these eggs and larvae will be carried through the zone of passage (outside of the ZID), and will not be in proximity with salinity changes.[140] This is best illustrated by Exhibit APP-CJ-10-R which demonstrates the relative size of the Mixing Zone and ZID where effluent plume will be most concentrated in comparison to the overall width of the channel. In addition, Dr. Stunz testified that he only expected 2% of the marine life eggs and larvae to travel through the Mixing Zone for the Outfall.[141] As a result, the vast majority of Red Drum eggs and larvae will have no exposure to the Outfall.

[140] APP-RP-1-R at 44; see also APP-RP-10-R.

[141] Tr. Vol. 5 at 1071.



- For that small percentage of Red Drum eggs and larvae that are carried by tidal currents through the ZID, science informs that these Red Drum eggs and larvae are able to tolerate higher salinity concentrations: Robertson (1988) (> 45ppt for 20 minutes exposure is NOEC); Kesaulaya (2018) (best hatch and survival up to 43 ppt); Stunz (2015) (resident marine species thrive up to 42 ppt); and Nielsen (2021) (1-day to 3-day old red drum larvae show NOEC at 45 ppt for 24 hours). All data confirms that all eggs/larvae carried through the ZID may be exposed to higher salinities for seconds or minutes (not hours or days).

Dr. Lance Fontenot's independent literature review also revealed that there will be no adverse effects on Red Drum eggs and larvae. In Figure RE 1-3, Dr. Fontenot demonstrated that the expected salinity exposures from the Outfall will fall well below any of the salinity levels that would cause harm to Red Drum eggs or larvae.

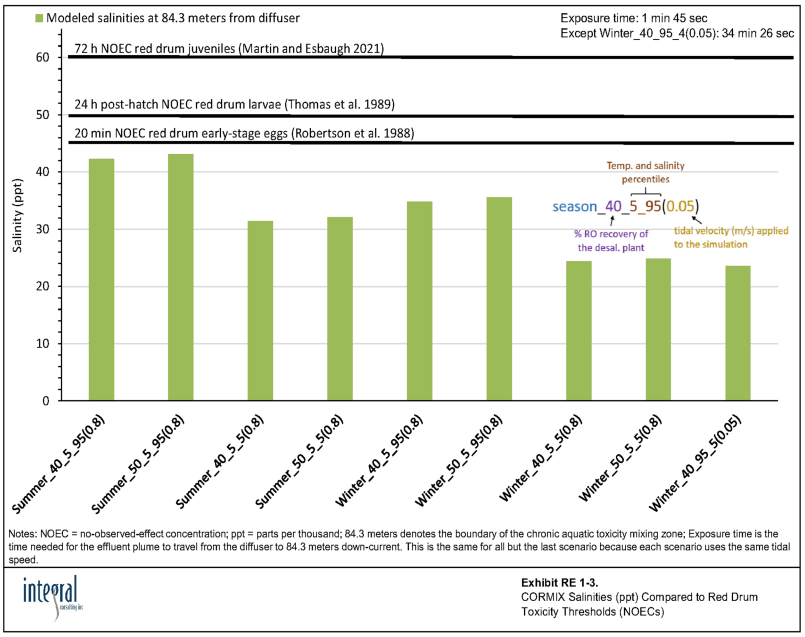


Exhibit RE 1-3.
CORMIX Salinities (ppt) Compared to Red Drum Toxicity Thresholds (NOECs)

In addition, the exposure times for the Red Drum eggs and larvae in the literature that Dr. Fontenot identified are many times higher than the exposure times will be for marine species carried through the ZID. Dr. Fontenot's Exhibit EFA 1-1 also illustrates the results of his literature review demonstrating that Red Drum eggs, larvae and juveniles will not be adversely affected by increases in salinity from the Outfall.

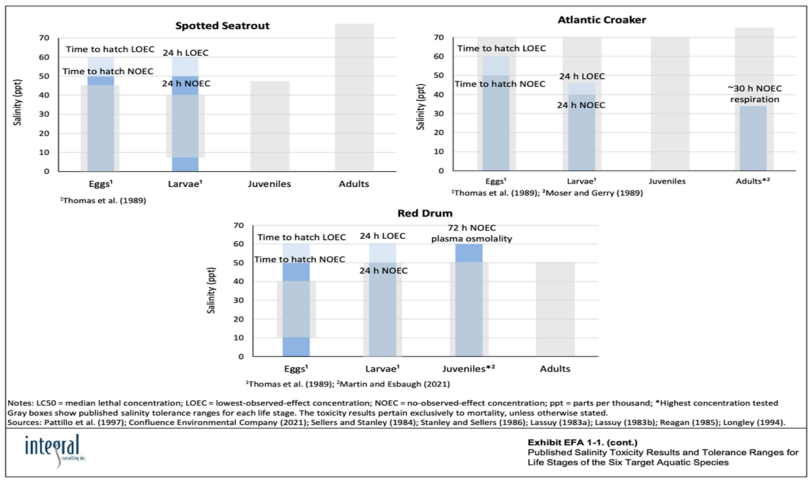


Exhibit EFA 1-1. (cont.)
Published Salinity Toxicity Results and Tolerance Ranges for Life Stages of the Six Target Aquatic Species

This exhibit demonstrates that "when only examining the most relevant exposure durations (i.e., the shortest durations) the available published LOECs for the eggs (significant differences in time to hatch) and larvae (survival at 24 hours post hatch) of spotted seatrout and red drum are up to 60 ppt and LOECs of 45 to 60 ppt were reported for Atlantic croaker."[142] " [T]he Stillmeadow test results demonstrated that if you submerged these three EPA-test species in salinities of 45ppt for a week, these species suffered no increased lethality or sub-lethal effects."[143] It is important to note that "under no scenario will any marine organism be exposed to 45 ppt from the outfall for longer than a few minutes. Under any realistic exposure scenario, the duration of time that a marine organism will be exposed to this concentration from the discharge is a few minutes or less."[144] An overwhelming weight of the evidence supports the Port Authority's argument that the effluent will not have a significant effect on the aquatic life in the CCSC.[145]

e. Protestants' testing is invalid and cannot be used in determining the issues on remand.

Dr. Kristin Nielsen's testing[146] (PAC-48R KN-3), on which almost every PAC biology expert relies, is invalid. The TCEQ Executive Director filed an objection to Dr. Nielsen's pre-filed testimony, the results of her toxicity testing and her opinions, as well as all other testimony by any experts relying on Dr. Nielsen's toxicity testing, based on Texas Water Code § 5.134. Section 5.134 requires that all environmental testing laboratory data and analysis used by the

[142] APP-LF-1-R at 47.

[143] APP-RP-1-R at 17.

[144] APP-RP-1-Rat 17.

[145] APP-RP-1-R at 17.

[146] PAC-48R KN-3

commission for decisions under the TCEQ Commissioner's jurisdiction must be from an accredited environmental testing laboratory. The laboratory Dr. Nielsen used in her study is not accredited by the TCEQ.[147] Neither is it accredited by the National Laboratory Accreditation program.[148] This fact disqualifies Dr. Nielsen's study from consideration in ruling upon the Draft Permit.

During the hearing on cross examination, Dr. Nielsen admitted that she had recommended some toxicity testing that Protestants' attorneys had rejected[149] and that she permitted Protestants' attorney to change her testing protocol.[150] More fundamentally, as the testimony during the hearing established, Dr. Nielsen's testing data contained many errors and failed to account for temperature, salinity, and dissolved oxygen fluctuations in her testing data and controls that preclude her test results from consideration. In fact, Dr. Nielsen's failure to control the dissolved oxygen in violation of EPA testing standards requires the tests to be disregarded because there is an alternate explanation for her results (i.e., gas bubble disease ("GBD")), as confirmed by Dr. Nielsen and Dr. Kirk Dean).[151]

The Port Authority experts Dr. Kirk Dean and Dr. Lance Fontenot agree that Dr. Kristin Nielsen's study is not reliable. Dr. Dean, in his direct and rebuttal testimony,[152] highlighted some of his myriad concerns with Dr. Nielsen's bioassays used in her study:

- Dr. Nielsen's report acknowledges that the study design deviates from EPA WET methods.

[147] Tr. Vol. 7 at 1797.

[148] Tr. Vol. 7 at 1797.

[149] Tr. Vol. 7 at 1822-1826; see also APP-60-R.

[150] Transcript at p 1826-27.

[151] Transcript at p. 672-73.

[152] App-KD-1-R; App-KD-1-R Rebuttal.

- Dr. Nielsen used non-standard endpoints to measure growth.[153] And her analysis of those non-standard endpoints introduced subjective bias into her results.[154]

- The EPA Methods require randomization, and the information provided by Dr. Nielsen does not demonstrate that the design was appropriately randomized, which would potentially bias the results and thus invalidate the statistical conclusions.[155]

- Dr. Nielsen's data tables for tests 2 and 3 introduce a variable "cohort" to divide the treatments, but this "cohort" is not described in the report. "If the organisms or experimental conditions were different for the two cohorts, they are not true replicates, nor can they be directly compared to a control treatment for different conditions."[156] This may have "compromised independence" of the study.[157]

- There are also issues with the controls in the testing. "With only 4 replicates in the control, it is very hard to determine if the data follow the normal distribution or not, so there is a strong possibility that inappropriate statistical methods could be applied, and incorrect conclusions could be made."[158]

- There were issues with quality assurance and control (due to her lab not being TCEQ or NELAP accredited) as well as issues with measured temperatures and salinities (the measured temperatures and salinities in some treatments varied by an amount greater than is allowed in EPA WET methods).[159]

- The methods used in the Nielsen study were not those recommended by the EPA. In addition, when Dr. Dean used the recommended EPA statistical methods, Dr. Dean's calculations resulted in substantially different results than Dr. Nielsen reported.[160]

- The Nielsen test failed the EPA acceptability criteria due to insufficient survival in the control; and

- Dr. Dean got different results in the growth analysis, seeing no statistically significant differences in length or body surface area, in contrast to Dr. Nielsen's report of a statistically significant difference.[161]

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[153] APP-KD-1-R at 26.

[154] APP-KD-1-R at 26-27.

[155] APP-KD-1-R at 27.

[156] APP-KD-1-R at 27.

[157] APP-KD-1-R at 27.

[158] APP-KD-1-R at 28.

[159] APP-KD-1-R at 28, 29.

[160] APP-KD-1-R at 29-30.

[161] APP-KD-1-R at 30.

Lastly, Dr. Dean discovered further quality control issues with Dr. Nielsen's laboratory practices and discrepancies between her various versions of the reports, manuscripts, and raw data that further demonstrate the lack of reliability of the study.[162] Dr. Fontenot testified in his rebuttal that Dr. Nielsen's tests do not stand up to scrutiny. He stated that one "cannot determine the 72 h LC50 for Red Drum from Dr. Nielsen's studies."[163] According to Dr. Fontenot, "[i]n sum, Dr. Nielsen's work cannot be accepted in the face of: (i) her claim that the natural environment for the Red Drum in the CCSC is harmful; (ii) her deviation from the testing protocol she claims to be following; and (iii) her toxicity test results are at odds with the other published literature on early life stages of the Red Drum."[164] Dr. Nielsen's study should not be considered as it was performed in an unaccredited lab, and is flawed in methodology, protocols, and implementation; and therefore unreliable. Most all of the independent data corresponds with the other data – except Dr. Nielsen's data is out of the mainstream, flawed, and thus properly dismissed.

2. The Port Authority's CORMIX and SUNTANS modeling demonstrates no adverse effects to marine life from the Outfall.

a. The Port Authority's experts have demonstrated through CORMIX and SUNTANS that the Outfall will not cause excessive exposure to increased salinity.

Mr. Palachek testified that the CCSC - where the Outfall will be located - has naturally variable ambient salinity. As a result, a potential contribution of less than 0.625% , the largest amount of increase in salinity that Dr. Furnans calculated from the Outfall would not cause adverse effects on the environment or marine life.[165] The CORMIX modeling establishes that the plume of

[162] APP-KD-1-R Rebuttal at 7.

[163] APP-LF-1-R Rebuttal at 2.

[164] APP-LF-1-R Rebuttal at 5.

[165] APP-RP-1-R at 31.

effluent will only affect a small portion (less than 5%) of the CCSC area under most conditions when the flow is above 0.2 m/sec. When flows are less than this, the plume salinity center line will be approximately 1 ppt or less above ambient at 200m. Therefore, Mr. Palachek concluded that the effluent permitted under the Draft Permit will result in no adverse effects if the Port Authority operates the facility in line with the Application and the Draft Permit requirements.[166]

In addition, Mr. Palachek confirmed that "the highest exposures are in the ZID and mixing zone – and these exposures last minutes (not hours) to concentrations about 2 ppt higher than background. In all exposures modeled, the plume is less than 2 ppt above background within 15 minutes. These exposure concentrations and times will not result in significant adverse impacts to the fish, eggs, larvae, or other marine life within the ZID, mixing zone or outside the mixing zone."[167]

Even in slack tide, the exposure will be minimal. Mr. Palachek testified in his rebuttal that "[i]n a very theoretical sense, if a larvae would have just passed through the mixing zone when flows were the lowest 0.14 m/sec, stayed at that distance during slack tide and then moved back on opposite tide, that would be a maximum of 36 minutes of exposure (15 minutes for incoming, 6 minutes slack, and 15 minutes outgoing). This unlikely series of events would represent being exposed twice but would still not be a significant exposure to cause death to Red Drum larvae. As noted above, the discharge is only 0.2% of the total tidal exchange per day."[168]

The Port Authority's expert Dr. Lial Tischler, in his direct testimony, also affirmatively disagreed with any suggestion that marine organisms would be exposed to high levels of salinity for an extended period of time:

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[166] APP-RP-1-R at 31-32.

[167] APP-RP-1-R Rebuttal at 4.

[168] APP-RP-1-R Rebuttal at 8.

> The accumulation and/or an extended period of "storage" of water with higher levels of salinity than the ambient channel salinity is physically impossible. The maximum density of the desalination brine before it mixes with the channel water is 1048.15 grams/kg (g/kg) which is equivalent to a specific gravity (a measure of relative density with respect to fresh water at 4 °C) of 1.048. The specific gravity of sand and clay particles ranges from 2.6-2.8, which is over 2.5 times greater than the maximum specific gravity of the brine before dilution. Thus, it is obvious that if the existing tidal current structure at this location in the CCSC can create and sustain the depression, water with elevated salinity will be continuously swept out by the currents. Finally, it is impossible for the salinity concentration in the bottom of the depression to increase to a concentration greater than the salinity of the plume when it enters the depression. This is physical fact because there is no way to increase the salinity of water other than by evaporation or reverse osmosis and neither of these processes occurs in the bottom of the channel.[169]

Dr. Craig Jones, another Port Authority expert, agreed with Dr. Tischler. He testified that "the deeper portion of the CCSC channel is a region of higher flow and mixing."[170] He cites to the CORMIX analysis and Exhibit APP-CJ-16-R, stating they demonstrate that due to the daily tidal flow present in the channel, the jets are deflected downstream away from the diffuser within 10 m of the ports. "Once the ambient flow deflects the high momentum jets in the downstream direction, the ambient flow readily transports and mixes the subsequent plume. In other words, under the velocity conditions present in the majority of the time in the channel, the plume is readily transported."[171] He concludes by stating that "there is no support for the hypothesis that higher levels of salinity would collect in the deeper region for any significant period of time."[172]

b. Protestants' Experts Cannot Rely Upon Dr. Socolofsky's Modeling or the Eddy to Support Their Opinions.

[169] App-LT-1-R at 58.

[170] APP-CJ-1-R at 25.

[171] APP-CJ-1-R at 25.

[172] APP-CJ-1-R at 25.

Protestants' experts attempt to rely upon Dr. Socolofsky's modeling to support their opinions that the Outfall will cause harm to marine species. Dr. Esbaugh relied heavily on Dr. Socolofsky's modeling in his direct testimony as did Mr. Holt, Dr. Nielsen, and Dr. Stunz.[173]

Protestants' experts cannot rely upon Dr. Socolofsky's modeling to establish their opinions for the fundamental reason that Dr. Socolofsky does not identify which of his dozens of modeling runs he thinks applies to the Outfall.[174] Because Dr. Socolofsky does not support a particular model result, then neither can Protestants' experts who have no expertise in CORMIX modeling.

PAC's experts' reliance upon the non-existent eddy is equally unavailing. The data obtained by the Port Authority on the ambient tidal velocity establishes that there is no eddy in the area of the Outfall.[175] Only one of PAC's experts, Dr. Austin, included an opinion in his direct testimony that there is an eddy close to the area of the diffuser.[176] But at the hearing, he admitted that he does not have any basis to conclude that the depression is an eddy:

> **Q: My question here is simple. It's just simply: Do you have any basis to conclude that the depression is, in fact, derived from an eddy?**
>
> A: *No. That – that was from, I believe the original reports in those proceedings. I read that, you know, and I know, now, that they're -- that the applicant is the different type thing so that probably just my term that has stuck with me.* I do know – I mean, I fish there. I've been there. There is a – there is an odd circular issue that happens there from time to time, you know, so it does happen. But regardless, the point I was making, whether it's derived from eddy or not, there is a depression that area, and I think as Mr. Allison referred to, there is some form of depression deeper, a hole, something there.[177]
>
> **Q: Do you have any – do you really have any science to tell you there's an eddy today?**
>
> A: Today?
>
> **Q: Yes.**

[173] PAC-52R at 11.

[174] Tr. Vol. 7 at 1661-1662.

[175] APP-CJ-R at 19-20; APP-CJ-1-R Rebuttal at 12; APP-JF-1-R Rebuttal at 12-13.

[176] PAC-44R at 24.

[177] Tr. Vol. 6 at 1501 (emphasis added).

A: I don't know that there's an eddy currently formed in the channel or that there has been one today.[178]

Dr. Austin further stated that he had no photographic proof of the supposed eddy other than the one taken in 1956 that is included in his direct testimony.[179] He does not have a video of the eddy, he has not tried to take a photograph of it, and he did not even take a trip and go out and look at the supposed eddy.[180] Moreover, when asked whether ADCP data supported his direct testimony that there is an eddy, he admitted that "it'd be very difficult to tell if there was an eddy in that data, especially not knowing exactly where it is or where it was pointing," and that he had found no evidence of an eddy in that data.[181] There simply is no evidence in this record of a persistent eddy, and it cannot support Protestants' experts' opinions that marine life will be exposed to increased salinity concentrations in the area of the Outfall.

c. Exposures are based upon combined factors that are speculative and without evidentiary support.

A number of PAC's experts testified not just about increased salinity and its purported effect on early stage Red Drum, but they argue that other factors will combine with the salinity to cause harm. They do not, however, provide sufficient support that any such combined effects will take place at the Outfall. Dr. Nielsen, for instance, includes opinions in direct testimony about a "cocktail of natural stressors." Again, however, she provided no data or support for these opinions that are applicable to the outfall or the Draft Permit. Dr. Stunz also brings up the topic of other "stressors." None of this testimony regarding other contaminants, stressors, or natural factors should carry weight in this proceeding, as it is not supported by competent evidence and will be

[178] Tr. Vol. 6 at 1523.

[179] Tr. Vol. 6 at 1525.

[180] Tr. Vol. 6 at 1525.

[181] Tr. Vol. 6 at 1527-28.

addressed with the WET testing required in the Draft Permit. The Port Authority submitted the testimony of Alex Wesner who testified that he would expect the Outfall to contain metals or other chemicals of concern and that the Outfall would meet the applicable regulatory requirements.[182] In addition, Mr. Wesner confirmed that if any chemicals were identified during the operation of the desalination plant, then existing technology will permit appropriate processes to address those chemicals.

d. No other species has been identified that will suffer harm as a result of the Outfall.

The Port Authority's expert Dr. Lance Fontenot performed an extensive and detailed EPA Environmental Risk Assessment (ERA) analysis to provide an accurate assessment of the habitats and types of receptors at the Outfall and used reasonably conservative assumptions regarding the exposures of representative receptors, the chemicals of concern (COCs), and the appropriate toxicity reference values for the COCs.[183] He conducted his risk assessment consistent with the EPA's guidelines and in so doing, he considered numerous species in his direct and rebuttal testimony. He has used this EPA-approved process at more than 50 sites to prepare ERA checklists, at 12 sites to prepare screening-level ERAs and at 8 sites to prepare baseline ERAs and perform site-specific ecological studies.[184]

In his direct testimony, Dr. Fontenot reviewed the eastern oyster, blue crab, white shrimp, red drum, Atlantic croaker, and spotted seatrout species.[185] On rebuttal, Dr. Fontenot addressed the concerns of PAC expert Mr. Holt that the Outfall would adversely affect planktonic life. Mr. Holt mentioned that various groups of organisms may be found in the water column of the CCSC

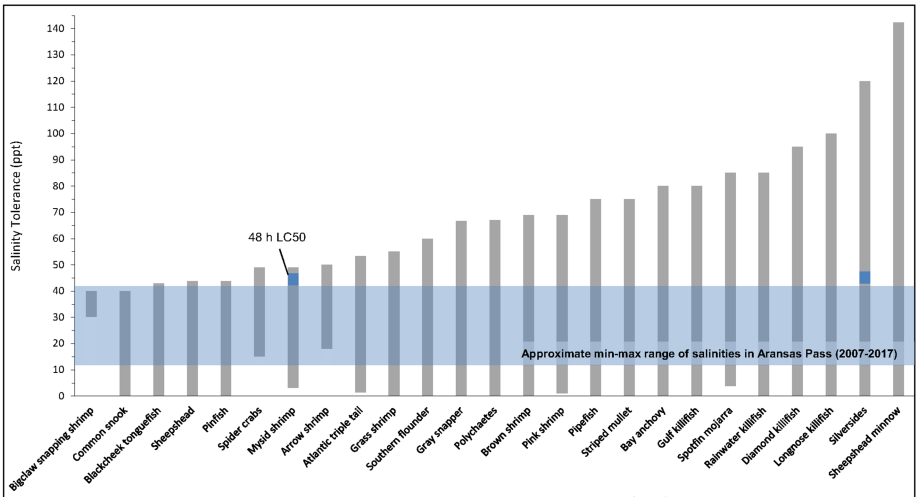
[182] APP-AW-1-R at 12.

[183] APP-LF-1R at 11.

[184] APP-LF-1R at 12.

[185] APP-LF-1-R at 27.

at various times but did not provide any supporting evidence from the published literature to demonstrate that any of them would be affected by the short-term exposures to higher salinities that would last for only a few minutes in the ZID.[186] In response to Mr. Holt's concerns, Dr. Fontenot reviewed the species list and the published literature to actually obtain salinity tolerance data for many additional species that might be located in or near the CCSC.[187] Dr. Fontenot's exhibits APP-LFR 4 and APP-LFR-5 summarize the outcome of this work, and they demonstrate that all the species, which have the potential to be present in the CCSC, are tolerant to a wide range of salinities.[188]



Notes: ppt = parts per thousand; CCSC = Corpus Christi Ship Channel; Blue boxes show 48 h median lethal concentrations (LC50s) of 43 ppt for mysid shrimp and 44 ppt for inland silverside (Pillard et al., 1999); Several species were excluded because either little data exists (Pattillo et al. 1995) or they were not expected to occur in the ship channel.

References: Allen and Baltz 1997; Anderson et al. 2020; Baltz et al. 1993; Barba et al. 2005; Barba Macías 2012; Bayly 1972; Belgrad et al. 2021; Benson ed. 1982; Berdan et al. 2020; Brockmann 1974; Bursey 1982; Cházaro-Olvera et al. 2020; Confluence Environmental Company 2021; Corrêa and Vianna 2016; Crego and Peterson 1997; Curran and Wilber 2019; Davila-Jimenez et al. 2019; De Lisle and Roberts 1986; Dragovich and Kelly 1964; Fuller et al. 2007; Fuller 2008; Getz et al. 2021; Ghedotti and Davis 2013; Gracia-López et al. 2006; Greeley 1984; Griffith 1974; Gulf States Marine Fisheries Commission 2016; Hastings and Yerger 1971; Herrera-Barquin et al. 2018; Huber et al. 2014; Hunnewell 2013; Janicki Environmental 2003; Lyster 1965; Maciorowski et al. 1987; Martin and Finucane 1968; McDaniel 2020; McKenney 1994; Mobley and Jones 2009; Munroe 1998; Nordlie and Haney 1998; Nordlie 1987; 2006; Ogren and Brusher 1977; Partridge et al. 2007; Patillo et al. 1995; Patillo et al. 1997; Peters et al. 1998; Pillard et al. 1999; Pope et al., 2006; Rhody et al. 2010; Ritter and Montagna 1999; Simpson and Gunter 1956; Switzer et al. 2004; Van Digglen and Montagna 2016; Vega-Cendejas and Santillana 2004

integral consulting inc.

Exhibit 5. Salinity tolerance ranges (based on field observations) of additional fish and invertebrate species that may occur in the Corpus Christi Ship Channel as compared to the min-max salinities measured in Aransas Pass between 2007-2017

[186] APP-LF-1-R Rebuttal at 9.

[187] APP-LF-1-R Rebuttal at 9.

[188] APP-LF-1-R Rebuttal at 9.

B. Whether the proposed discharge will adversely affect recreational activities commercial fishing, or fisheries in Corpus Christi Bay and ship channel? (Issue 2.C).

As established above, the proposed discharge will not adversely impact the marine environment. Accordingly, and as a natural consequence, the proposed discharge will not impact recreational activities, commercial fishing, or fisheries in Corpus Christi Bay and CCSC.

The Port Authority's expert Randy Palachek testified specifically on this issue. He testified that the Outfall will not adversely impact recreational activities, commercial fishing, or fisheries in CCSC.[189] He opined that the TSWQS are protective of both human health and the environment. He further stated that the "TSWQS were developed to be protective of aquatic organisms and human health through water consumption, fish consumption, recreational uses, including swimming, fishing, etc. They are also protective of all designated uses established for each water quality segment."[190] Moreover, it is undisputed that the diffuser will be well below the surface, 60 ft below, and therefore will not interfere with boating or other surface water uses of the CCSC. The Port Authority incorporates by reference its arguments from the preceding section in support of the Draft Permit on this issue.

C. Whether the Application and the representations contained therein are complete and accurate? (Issue 2.D).

On remand, the Port Authority provided substantial changes to the Application to address perceived deficiencies in the original. The Port Authority provided water quality data from an accredited laboratory and from samples taken in the proposed area of the intake which was then used for determining the expected composition of the discharge.[191] The water quality based effluent limitations for TPDES permits are established using the TCEQ's TEXTOX program

[189] APP-RP-1-R at 6.

[190] APP-RP-1-R at 27.

[191] AR-R-4 at 31-149.

which follows the procedures described in the TCEQ Implementation Procedures ("IPs") for deriving effluent limitations.[192] The Executive Director has confirmed that the information provided by the Port Authority was complete and included everything needed for the Executive Director to complete the review of the permit.[193] Randy Palachek confirmed that the drafting of the Application on Remand was conducted in compliance with TCEQ rules for TPDES permitting.[194] Dr. Tischler confirmed that the revised application was complete, providing the TCEQ with everything needed to prepare the TPDES permit.[195]

Some of Protestants' witnesses claimed that the Application should have contained additional toxicological or environmental data, but none identified any specific information which was required by state or federal rules that was not included in the Application.[196] Protestants' only witness who directly opined on whether the Application was complete and accurate was Bruce Wiland. Mr. Wiland's opinions regarding whether the Application is complete and accurate are based on what he perceives to be internal inconsistencies in the location of the diffuser and the bathymetric contours of the ship channel.[197] The Application requests a latitude and longitude for the discharge to determine who is listed as affected landowners.[198] Information regarding the depth of the channel at the discharge and the overall depth of the channel are needed for input to the CORMIX model.[199] The rules do not require an applicant to provide a detailed bathymetry. In

[192] ED-SG-1 Remand at 15; *see also* (Exhibit ED-1 Remand, pp 132 – 142).

[193] ED-SG-1 Remand at 13-15, ED-KC-1 Remand at 35.

[194] APP-RP-1-R at 28.

[195] APP-LT-1-R at 40-41.

[196] PAC-48R at 7-8.

[197] PAC-53R Revised at 5-6, 10-19.

[198] PFD at 79-80; *see also* AR-R-4 at 225, 231,

[199] ED-KC-1 Remand at 24.

providing the new bathymetric contours, the Port Authority provided more than was required by the rules.

Mr. Wiland states that the location of the diffuser accuracy is important because they impact the modeling outputs,[200] that the discharge location determines who receives public notice,[201] and that after assembly, possible response teams need to know where the diffuser is located.[202] While Mr. Wiland spent considerable time attempting to show minor differences in the exact location of the diffuser array or bathymetric contours, the result of his efforts were that in the 1200+ foot-wide ship channel, he perceived differences from between 11 and 30 feet.[203]

On cross-examination, Mr. Wiland admitted that he cannot say that the minor differences that he perceives would make any actual difference.[204] And a review of the CORMIX modeling results produced by Scott Socolofsky proves that a minor difference in the location of the diffuser does not impact the modeling of the effluent plume.[205]

Finally, Mr. Wiland postulates that the location of the diffuser is needed after it is put into operation in case there is a need for a response team to respond to a problem with the diffuser, because it likely will not be visible from the water surface.[206] Of course, Mr. Wiland does not offer the opinion that the movement of a 100-foot-long diffuser by a few feet will make it difficult

[200] PAC-53R Revised at 18.

[201] PAC-53R Revised at 19.

[202] PAC-53R Revised at 19.

[203] PAC-53R Revised at 10-11.

[204] Tr. Vol. 6 at 1573:21 – 1574:2 (Q. Now, with respect to whether this is significant, I believe you testified that you have not looked at whether this -- the 229 feet from the shore or 189 feet from the shoreline makes any difference in terms of the outcome of the CORMIX model, correct? A. Yes. I was leaving that to the people that did the CORMIX models.).

[205] Dr. Socolofsky's CORMIX runs show that even moving the distance to the bank from 229 ft (70 m) to half that distance (35 m) does not change the mixing efficiency. See § 4.D. below.

[206] PAC-53R Revised at 19.

to find. As Dr. Tischler explained, the exact location will be determined during final design and construction when they can see exactly what the local conditions are under the water. Even sixty-four feet under the surface, the movement of the diffuser by a few yards will not hamper locating a 100-foot-long diffuser with twenty 4-to-6 foot risers and ports. And at that time, the latitude and longitude of the exact diffuser location will be measured and the location specification adjusted, if needed.

D. Whether the modeling complies with applicable regulations to ensure the Draft Permit is protective of water quality, including utilizing accurate inputs? (Issue 2.G).

The TCEQ's Implementation Procedures specifically provide for the use of CORMIX when there is an effluent discharge using a diffuser.[207] The TCEQ has also developed CORMIX standard operating procedures ("SOPs") to provide guidance for running the model.[208] On remand for the Draft Permit, the Port Authority and the TCEQ were able to use site-specific ambient velocity data, instead of using the SOPs' default figure of 0.05 m/s for the ambient velocity.[209] The Port Authority's modeling experts, Dr. Tischler and Dr. Jones, have confirmed that the CORMIX modeling used for the Draft Permit is correct and complies with the TSWQS. Protestants have not presented any evidence that the TCEQ and the Port Authority have failed to comply with the rules applicable to the use of the CORMIX model for the discharge. And while some of Protestants' witnesses continue to claim that CORMIX cannot reliably predict mixing of

[207] ED-1 Remand at 82; *see also* PFD at 29.

[208] ED-4 Remand.

[209] ED-4 Remand at 1. (The ambient velocity may be provided by the applicant or, if not, the modeler should assume a small velocity (0.05 m/s); *See also*, APP-LT-5 at 3-4.

the effluent in the channel,[210] the witnesses who actually ran the CORMIX model, including PAC witnesses Scott Socolofsky and Tim Osting, agree that it can be used reliably.[211]

1. The parties are in agreement on many of the CORMIX model inputs.

There are numerous inputs that the CORMIX model needs to produce its output, or prediction, files.[212] The required inputs include the details of the diffuser design, such as the number of ports, distance between risers and ports, length of the diffuser barrel, port diameter, port angle to channel flow, and port angle to horizontal (water surface).[213] CORMIX also requires the user to provide information regarding the density of the effluent and the ambient receiving waters[214] and the effluent discharge flow rate or discharge velocity.[215] The CORMIX model requires the user to provide a constant ambient flow velocity for each run, but a range of ambient velocities can be tested using multiple runs. On remand, the CORMIX modeling by all parties looked at a broad range of ambient velocities.[216]

For the majority of the inputs required by the CORMIX model, all parties are in general agreement. There was no significant disagreement between any of the witnesses who performed CORMIX modeling as to the ambient or effluent densities to be used. The inputs for the details of

[210] *See* PAC-45R at 10; PAC-47R at 11, 23; PAC-52R at 11-12.

[211] PAC-49R at 22, PAC-51R at 40.

[212] These .prd files provide information about the mixing efficiency (provided in terms of percentage of effluent) at given distances from the discharge location as well as information regarding the size, location and speed of travel of the plume. *See e.g.*, APP-35-R through APP-45-R; APP-47-R through APP-49-R

[213] APP-LT-5-R at 2, Table 1.

[214] ED-4 Remand at 3-4; Although not discussed by any of the modelers, the roughness of the channel is represented by a Manning's n value (ED-4 Remand at 1, APP-LT-7-R at 45, ED-KC-1 at 19) and wind speed is also a specified input in CORMIX. (ED-4 Remand at 2; APP-LT-7-R at 50-51, ED-KC-1 at 19, 32-33).

[215] *See* APP-LT-7 at 43.

[216] Katie Cunningham conducted modeling runs using ambient velocities from 0.05 m/s up to 2.0 m/s, Lial Tischler used ambient velocities from 0.05 m/s to 1.5 m/s and Scott Socolofsky conducted modeling runs from 0.0 m/s to 1.2 m/s.

the diffuser design and the discharge flow rate were also the same throughout the CORMIX modeling by all parties for the desalination plant running at full capacity.[217]

2. The differences in CORMIX modeling among the parties are for the inputs necessary for schematization.

All the witnesses who conducted CORMIX modeling for this hearing agree that CORMIX requires the use of schematization.[218] In determining the issue of whether the CORMIX modeling includes accurate inputs, this schematization must be considered.[219] In addition to the CORMIX inputs identified above, the CORMIX inputs required for the schematization include the distance from the diffuser to the shoreline, and the depth of the diffuser, and in the brine mode, the slope of the bank.[220] There are also inputs for the localized bottom depth (designated as HD in the model) and the average depth of the channel (designated in the model as HA) needed for schematization.[221] The parties differ in the inputs used for the schematization for CORMIX.

3. The Port Authority has correctly applied the inputs for the CORMIX modeling.

One thing that is clear from the multitude of CORMIX runs that have been performed by witnesses for the TCEQ, the Port Authority and Protestants, is that Dr. Tischler's diffuser design demonstrates efficient mixing through a broad range of ambient conditions and CORMIX inputs.[222] The numerous CORMIX runs performed demonstrate that Dr. Tischler's diffuser design

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[217] In addition, all of the witnesses who performed CORMIX modeling used the same Manning's n value and wind speed, and all modeled the discharge as unbounded.

[218] PAC-51R at 22-23; PAC 49R at 20; ED-KC-1 Remand at 30; APP-LT-1-R at 22.

[219] Some of Protestants' non-modeler witnesses still cling to the misguided notion that the channel conditions are just too complicated to use CORMIX, or presumably any other model, to predict mixing of the effluent discharge. *See* PAC-45R at 10, PAC-47R at 11, 23, PAC-52R at 11-12. The ALJs should discount these opinions because the witnesses expressing these opinions do not have the education, training or experience to testify on CORMIX.

[220] APP-LT-7-R at 44-47.

[221] ED-KC-1 at 24: See also Tr. Vol. 7 at 1715:5-10.

[222] *See, e.g.*, APP-51-R.

is not subject to significant changes in efficiency due to changes in densities[223] or changes in ambient velocity.[224] As Dr. Tischler explained, this resiliency is a result of the fact that his high-rate diffuser design induces the majority of the mixing, dilutions to 16% effluent or better along the plume centerline, within 25 meters of diffuser.[225] A more detailed review of the CORMIX results for this case also demonstrates that the mixing efficiency is not significantly impacted by reasonable changes to the location of the diffuser (as represented by the distance to the bank in the modeling) or to the depth of the channel (as represented by the depth at the discharge or average depth).[226] Nor is the mixing efficiency adversely impacted by potential stratification of the waterbody[227] or the use of the brine mode in place of the conservative mode.[228]

4. Protestants' complaints about Dr. Tischler's CORMIX modeling are invalid.

Protestants argue that any differences in the CORMIX inputs will result in different mixing results thus implying that a high level of precision is required in the CORMIX inputs in order for CORMIX to provide reliable predictions of effluent mixing. For example, Protestants have argued that any change in the location of the diffuser would require them to completely redo the modeling to determine if mixing efficiency would be impacted. The CORMIX results using Dr. Tischler's

[223] *See* APP-LT-14-R at 5-10 ("Variations in ambient densities did not have a significant impact on model results.").

[224] APP-LT-14 at 9-10, Table 8; ED-KC-1 Remand at 31-32; AR-R-5 at 145- 146, . (In all cases run by Dr. Tischler and Katie Cunningham, where the ambient flow is .2 m/s and above (tested by Katie Cunningham to as high as 2.0 m/s) the dilution is essentially the same, with the centerline concentration of effluent at 14.6% at the edge of the ZID (defined as 28 meters from the discharge), 8.9% effluent at the boundary of the MZ (defined as 84.3 m from the discharge) and between 5.0% and 5.4% at the HHMZ (defined as 160.5 m from the discharge). *See* APP-KD-9-R (excel), APP-KD-10-R (excel).

[225] APP-LT-1-R Rebuttal at 7.

[226] *See* APP-51-R.

[227] APP-LT-14-R at 7 (After running multiple stratification cases, Katie Cunningham found that "[f]or all stratification cases, CORMIX noted that the ambient density stratification was unimportant and that the discharge would behave as if the ambient were unstratified. None of these stratification cases resulted in more stringent model predictions."); ED-KC-1 Remand at 31.

[228] APP-LT-1-R Rebuttal at 10; see also APP-51-R.

diffuser design prove that this is simply not true.[229] As stated above, Dr. Tischler's modeling for the diffuser demonstrates that the mixing occurs through a broad range of ambient conditions and locations.

Much of Bruce Wiland's testimony is focused on whether the diffuser is located precisely 229 feet from the shore.[230] But the CORMIX modeling results from PAC witness Scott Socolofsky demonstrate that only radical changes to the diffuser location make any significant change to the diffuser's mixing. Using the inputs for the 50% RO recovery, summer 95th percentile salinity run at 0.8 m/s used by the TCEQ and the Port Authority, Dr. Socolofsky changed the input for the location of the diffuser from approximately 70 m (229 feet) to approximately 35 m (115 feet) and the results showed effluent concentrations at the centerline at the edge of the mixing zones of 14.1% ZID, 8.6% MZ and 4.4% HHMZ.[231] Dr. Socolofsky's decreasing the distance to the shoreline by 50% still resulted in lower effluent percentages at the edge of the mixing zones than the TCEQ's critical conditions used for the Draft Permit: 14.6%, 8.9% and 5.4%.[232] In other words, Protestants' own CORMIX modeling demonstrates that moving the location of the diffuser by over 100 feet does not affect the mixing of the Outfall and will still be within compliance of the Draft Permit.

Protestants also claimed that designation of the depth of the channel would have significant impact to the mixing efficiency because of the interaction of the plume with the bottom. Once again, Protestants' CORMIX modeling establishes that moving the bottom of the channel up, so that the plume impacts the bottom more quickly, does not have a significant impact on the mixing

[229] APP-51-R.

[230] *See* PAC-53R Revised at 10-19.

[231] See APP-51-R at 2 (SS_Summer 50%_95_Salinty (0.8) – 35 m From Bank (For this run, Dr. Socolofsky kept the depth of the ports at 64 feet and depth of the channel at 90 feet as used in the original modeling).

[232] ED-KC-1 Remand at 33.

efficiency. In addition to moving the discharge to 35 meters from the shore in the paragraph above, Scott Socolofsky ran a CORMIX run using the same 50% recovery, summer 95th percentile salinity at 35 meters from the bank but also moving the bottom of the channel up 22 meters (72 feet) instead of the 27.4 meters (90 ft) used in the modeling by the Port Authority and the TCEQ. Once again, the model results for centerline effluent percentages at the edge of the mixing zones show no significant differences in the percentage of effluent at the edge of the mixing zones: 14.3% ZID, 8.8% MZ, 4.5% HHMZ.[233] Dr. Socolofsky admitted on cross-examination that even moving the bottom of the channel to 64 feet (19.5 meters) and discharging at the same height would not make a significant difference in terms of the mixing.[234] Even when Dr. Socolofsky moved the discharge to only 20 meters from the shoreline, and moved the depth of the discharge up to 63 feet and the local depth of the channel to under 71 feet, this combination of changes did not result in a significant change to the mixing efficiency.[235] Therefore, Protestants' claims about changing the bottom depth of the channel where the Outfall is located are invalid.

Protestants devote much of their argument on CORMIX modeling to the claim that the model should be run with the shoreline right next to the diffuser. The ALJs should reject Protestants' radical schematization of putting a fictitious vertical wall in close proximity to the diffuser because it is divorced from reality. Protestants' modeling witnesses claim that they conducted a "sensitivity analysis" to determine how the model reacted to "boundary interactions."[236] However, adding a vertical wall next to the diffuser does not test the actual

[233] *See* APP-51-R at 2 (SS_Summer 50%_95 Salinity (0.8)_Shallow) (the depth of the discharge ports remained at 64 feet for this run).

[234] Tr. Vol. 7 at 1733-1734.

[235] APP-51-R at 2 (SS_Summer 50%_95_Salinity (0.8)_20 m Bank.

[236] PAC-51-R at 23:19-21. ("I conducted sensitivity runs with bank distances ranging from zero to 68 ft based on my analysis of the bathymetry at the site."). While Dr. Socolofsky conducted sensitivity runs, he admits that he cannot

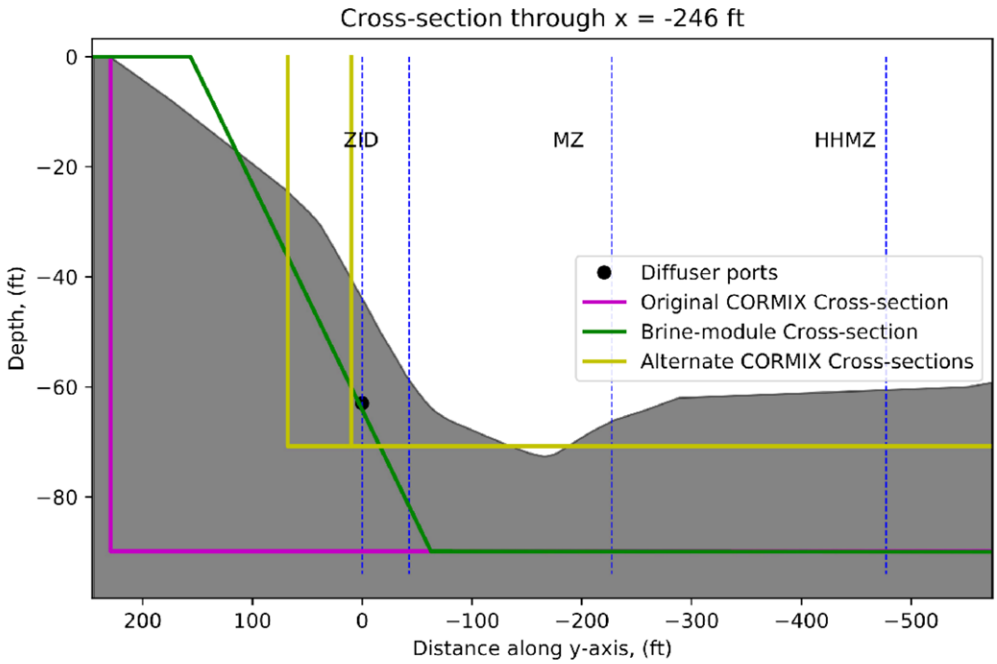
boundary with which the plume may come into contact (the slanting bottom of the channel), but instead forces the model to treat the plume as if it will come in contact with a vertical wall (which eliminates all water on the shoreside of the plume for mixing purposes). As noted by Dr. Tischler, where there is a vertical wall, the CORMIX model assumes that there is no water outside the vertical wall to dilute the plume as it moves along its boundary.[237] Dr. Socolofsky admits as much in his prefiled testimony.[238]

In attempting to support their opinions, Protestants provided the ALJs with a series of diagrams that provide a misleading picture of the Outfall and its relative location with respect to the bottom of the CCSC and the shoreline near where it will be located. The following exhibit is illustrative of these misleading exhibits:

say which predictions are correct. (Tr. Vol. 7 at 1661-1662) In fact, counsel for PAC admits that they were not looking for the answer. (Tr. Vol. 9 at 2287:23 – 2288:8).

[237] APP-LT-1-R Rebuttal at 14.

[238] *See* PAC-51R at 14, Table 1 (Note the figures are the same for 0 and 3 meters away from the bank, because the model predicts the plume immediately contacts the bank in both those cases. It is this attachment to the bank that reduces mixing.).



PAC-51R SS-6

As both Dr. Jones and Dr. Tischler noted in their testimony, diagrams such as the one identified above are not accurate and should not be used to reach decisions regarding the Draft Permit any more than the following diagram is an accurate picture of a Ford F-150.

1 vertical to 1 horizontal

6 vertical to 1 horizontal

The figure illustrates the effect of vertical scale exaggeration on the shape of an everyday object. Vertical exaggeration is not suitable for portraying or examining real-world geometric features.

APP-CJ-21-R

As Dr. Tischler noted in his testimony, Protestants' claim that CORMIX should be run with a vertical wall next to the Diffuser is incorrect and misleading:

> The higher and lower elevations in the channel bottom will not restrict the dilution of the effluent plume as calculated in CORMIX because there is available dilution water on all sides of the plume, including the channel bottom before the plume centerline reaches it. There is a minimum water depth of approximately 48 ft at MLT above the bottom of the channel in every cross-section shown in Exhibit APP-CJ-20-R. PAC's witnesses' testimony would have one believe that the water above and on both sides of the plume that is flowing through the channel on both ebb and flood tides is not available to dilute the salinity in the effluent plume. All of the various current and ambient/effluent density conditions modeled with CORMIX by TCEQ, the Port Authority and PAC's witnesses, demonstrate that the effluent plume centerline never contacts the shoreline in the near-field region where rapid mixing occurs.[239]

In conclusion, the CORMIX modeling demonstrates that Dr. Tischler's diffuser design produced efficient mixing which will lower the percent effluent to the levels set forth in the Draft Permit and will ensure the Draft Permit is protective of water quality. Dr. Socolofsky admits that his sensitivity analysis does not provide an answer as to which scenario best represents the mixing he would expect in real life.[240] With his years of experience designing and testing diffusers that are in service in the field, Dr. Tischler has no such indecision regarding his CORMIX predictions or the ability of his diffuser to readily mix the effluent.

5. The SUNTANS modeling also confirms that the Outfall will comply with the TSWQS.

The SUNTANS modeling, while not required, adds assurance that water quality will be protected. TCEQ procedures do not require that far-field modeling be conducted in connection with the Draft Permit. However, the Port Authority wanted further assurance that the proposed discharge would not have long-term impacts that the CORMIX modeling is not designed to

[239] APP-LT-R Rebuttal at 4-5.

[240] Tr. Vol 7. at 1661-1662.

investigate. On remand, Protestants have not offered a credible challenge to whether the SUNTANS modeling conducted by Dr. Jordan Furnans used accurate inputs or whether the model was appropriate for modeling the long term far-field effect of the discharge, nor did they cross-examine him.

The record is undisputed that Dr. Furnans' SUNTANS modeling is the only modeling that takes into account the impacts of all the forces that impact the effluent plume when the tidal direction changes multiple times per day. The CORMIX predictions in the far field are no substitute for a long-term model such as SUNTANS.[241]

Protestants' claim that the SUNTANS model needs smaller triangles to detect the plume on the bottom of the ship channel ignores the fact that the cells of the SUNTANS model have a vertical resolution (cell height) of one foot, which is more than small enough to take into account any remaining plume which exists after it transitions to the far field.[242] As Dr. Furnans testified, the SUNTANS model indicates sufficient mixing and advection of the brine discharge so as to minimize salinity buildup in any modeled grid cells, with salinity increases always less than 1 ppt over the simulated 2-year timeframe. There is not a buildup of salinity resulting from this proposed discharge, due to the rapid and dynamic non-uniform flow within the vicinity of the discharge which the SUNTANS model captures in the far field to a much better degree than does the CORMIX model.[243]

Protestants' claims that the SUNTANS modeling is deficient rings hollow and they have no long term modeling of their own to suggest that the SUNTANS conclusions are not accurate.

[241] APP-JF-1-R Rebuttal at 1-3, APP-LT-1-R Rebuttal at 20-21.

[242] APP-JF-1-R Rebuttal at 2.

[243] APP-JF-1-R Rebuttal at 2.

E. Whether the Executive Director's antidegradation review was accurate? (Issue 2.H).

Peter Schaefer of the TCEQ testified that the TCEQ's antidegradation review established that the Permit would not degrade the water in Corpus Christi Bay or the Ship Channel.[244] Antidegradation review is performed to ensure that a new or increased discharge will not significantly degrade existing water quality.[245]

Mr. Schaefer is the Leader of the Standards Implementation Team of the Water Quality Assessment Section of TCEQ's Water Quality Division, which is the TCEQ section responsible for performing antidegradation reviews.[246] Mr. Schaefer testified that the antidegradation review was based on rigorous technical reviews by TCEQ staff members with specialized expertise and training.[247] He also testified that the antidegradation review was performed in accordance with TCEQ rules and regulations, which are found at 30 TAC § 307.5.[248] The TCEQ performed Tier 1 and Tier 2 reviews.[249]

Mr. Schaefer testified that the TCEQ's antidegradation review involved numerous steps, including:

- Determining the appropriate water quality uses and criteria for the receiving waters in the assessed reach.[250]
- Assigning critical conditions for the outfall location.[251]

[244] ED-PS-1 Remand at 22.

[245] APP-LT-1-R at 34-35.

[246] APP-LT-1-R at 36, 51.

[247] ED-PS-1 Remand at 5.

[248] ED-PS-1 Remand at 9, 24.

[249] ED-PS-1 Remand at 27-29.

[250] ED-PS-1 Remand at 25.

[251] ED-PS-1 Remand at 25.

- Evaluating the impacts on water quality in the receiving waters to ensure that permitted effluent limits will maintain instream criteria for dissolved oxygen, nutrients, turbidity, dissolved solids, temperature, and toxic pollutants.[252]

- Performing water quality screenings using the critical condition information, local water quality information and expected pollutant loading from the discharge.[253] Degradation is not expected to occur from increased loading of toxic pollutants when the concentrations are below that which requires an effluent limit. The TCEQ's results showed that at the most extreme conditions, the mass of total salt would increase by less than 1% at the diffuser location. This provides additional evidence supporting the TCEQ's conclusion that the discharge of brine as proposed would not constitute degradation of the receiving waters with respect to salt.[254]

- Performing 24-hour acute, 48-hour acute, and 7-day chronic Whole Effluent Toxicity (WET) tests using various salinities up to 45 ppt. All species tested (*Cyprinodon variegatus*, *Menidia beryllina* and *Mysidopsis bahia*) passed the 24-hour acute, 48-hour acute, and 7-day chronic survival and growth WET tests at all dilutions tested.[255]

Mr. Schaefer testified that after performing these tests, the TCEQ concluded, based on the weight of evidence, that degradation would not occur as a result of the discharge if permitted.[256]

The Port Authority's expert Dr. Lial Tischler testified regarding the antidegradation review. He testified that the TCEQ's antidegradation review done on remand was even more thorough than that done before the first hearing.[257] He testified that in its remand antidegradation review, the "TCEQ more thoroughly evaluated the increases in salinity in the CCSC and Corpus Christi Bay resulting from the proposed discharge, taking into account the limited area affected by the ZID and mixing zone for the discharge and the fact that ambient (natural) salinity gradients in the receiving waters would be virtually unaffected by the proposed discharge."[258] Dr. Tischler

[252] ED-PS-1 Remand at. 25.

[253] ED-PS-1 Remand at 26.

[254] ED-PS-1 Remand at 26.

[255] ED-PS-1 Remand at 27.

[256] ED-PS-1 Remand at 27.

[257] APP-LT-1-R at 39.

[258] APP-LT-1-R at 39.

agreed with Mr. Schaefer that the TCEQ antidegradation review was accurate and that it complied with the Tier 1 and Tier 2 antidegradation policies.[259]

F. Whether the Draft Permit includes all necessary and appropriate requirements? (Issue 2.I).

On remand, Dr. Tischler designed a diffuser that addresses the issues identified in the first hearing that is effective under all ambient conditions in the CCSC. The Port Authority also collected detailed bathymetry and ambient velocity data and conducted sampling of the water from the source area. The Port Authority conducted toxicity testing and submitted revisions to the Application, including the revised diffuser design and revised effluent information based on the water quality data collected on behalf of the Port Authority by Parsons.[260] After receiving this information in June 2021, the TCEQ requested clarification from the Port Authority for some of the information provided.[261]

After the Port Authority provided the clarifications requested by the TCEQ,[262] the TCEQ Water Quality Assessment staff, who performed a technical review, provided their recommendations to the permit coordinator Shannon Gibson in their revised memorandum. Shannon Gibson also performed a technical review and then revised the Draft Permit in accordance with the recommendations from the Water Quality Assessment staff and following the appropriate state and federal regulations, guidance, and policies for the protection of waters of the state.[263] The revised Draft Permit was also reviewed by Mike Linder, the team leader of the industrial permitting

[259] APP-LT-1-R at 50-51.

[260] *See* AR-R-4,Tab I to Administrative Record on Remand.

[261] AR-R-3, Tab H to Administrative Record on Remand.

[262] *See* ED-7 Remand.

[263] ED-SG-1 at 4.

team. [264] On September 1, 2021, the Draft Permit and supporting documents were provided to the Port Authority and all parties.

The Draft Permit and the Executive Director's Statement of Basis/Technical were reviewed by Dr. Lial Tischler, who has extensive experience with TCEQ discharge permits. He testified that the permit specifies the daily maximum and daily average flow limits, and required daily monitoring for TSS, TDS, chloride and sulfate and pH.[265] He also testified as to the other, non-numeric controls and requirements which apply to the discharge including the allowable effluent concentration at the ZID and the requirements for specific chemical analysis of the discharge, which include all pollutants listed in the SWQS at 30 T.A.C. § 307.6.[266] After his review of the Draft Permit and Statement of Basis/Technical Summery, Dr. Tischler concluded that the Draft Permit includes all appropriate and necessary requirements.[267] Randy Palachek also offered his opinion that the Draft Permit meets the TSWQS and includes all appropriate and necessary requirements to be protective of marine life.[268]

TCEQ staff tasked with the review of TPDES permits have also confirmed that the Draft Permit meets all appropriate and necessary requirements.[269] Protestants continue to complain, however, that the Draft Permit lacks certain requirements or that the requirements should be changed such as:

- Effluent limits at the boundaries of the MZ and HHMZ;[270]
- Information reflecting some of the specific chemicals used in the process;

[264] *Id*.

[265] APP-LT-1-R at 41-42.

[266] APP-LT-1-R at 42.

[267] APP-LT-1-R at 51.

[268] APP-RP-1-R at 4.

[269] ED-JM-1 Remand at 31, ED-KC-1 Remand at 35, ED-PS-1 Remand at 43, ED-SC-1 Remand at 31.

[270] Tr. Vol. 9 at 2286.

- Requiring testing of effluent percentage at the ZID;[271] and
- WET testing with non-standard species.[272]

Regarding effluent limits at the MZ and HHMZ, Katie Cunningham noted that, while the Permit does not expressly provide for limits on the effluent percentages at boundaries other than the ZID, the limits at the MZ and HHMZ are still part of the permit because they are included in the screening criteria for the TEXTOX runs and development of the WET limits. Therefore, even without stating the limits for the MZ and the HHMZ, the Permit is adequate and complies with the TSWQS.[273]

Regarding the specific chemical additives used in the process which are not currently listed in the Application, at a new plant, the specific chemicals supplied by vendors are not determined until just prior to startup of the particular unit in which they are used. Therefore, it is always the practice with new plants to provide generic descriptions of the chemicals in the application.[274] Prior to the use of any chemicals additives which are not currently listed in the permit application, the Port Authority is required to provide fact sheets, Safety Data Sheets, and expected concentrations to TCEQ for its review.[275]

The classes of chemicals that are planned to be used at the desalination plant include coagulants, flocculants, and oxidizing agents. These chemical additives are effective at low concentrations (mg/L) so their mass (lb/day) is low.[276] They are also expensive, so plants are incentivized to use only the amounts necessary to achieve the required treatment efficiencies. The

[271] PAC-51R at 33-35.

[272] *See* PAC-45R at 17, PAC-47R at 25, PAC-50R at 8.

[273] Tr. Vol. 9 at 2321-2322.

[274] APP-LT-1-R at 43-44.

[275] APP-RP-1-R at 35, APP-LT-1-R at 43-44.

[276] APP-LT-1-R at 43.

coagulants and flocculants react with small, suspended solids to form large solid particles that will settle rapidly. Thus, the majority of the mass of the chemical additives is captured in the settled particles (the clarifier sludge) that will be dewatered and disposed of separately, i.e., they are not part of the permitted wastewater discharge.[277] After the specific chemical additives and concentrations are provided, the TCEQ will then determine if any additional limits or reporting are required.[278]

Protestants suggest WET testing on non-standard test species. But the reasons for using approved test species, and certified laboratories, are obvious from the multitude of issues documented with the salinity testing conducted by Dr. Kristin Nielsen. WET testing was not originally required by the Permit, but was agreed to by the Port Authority in response to comments by the Texas Parks and Wildlife Department[279].

EPA Region 6 determines the test species that can be used for WET testing in TPDES permits. For chronic and acute marine testing, the default test species are mysid shrimp and inland silverside.[280] Based on the average of testing results found in Pillard, et al. 1999 and Voorhees 2013, mysid shrimp had had an LC_{50} for salinity of 45.5 ppt which is considerably lower than the LC_{50} for salinity for both brown shrimp (55.6 ppt) and white shrimp (54 ppt), two local shrimp species.[281] Similarly inland silverside were proven sensitive to salinity with a 48-hour LC_{50} of 44 ppt (Pillard, et al. 1999).[282] This value is similar to the average LC_{50} for spotted seatrout (43.5

[277] APP-LT-1-R at 43.

[278] APP-LT-1-R at 43.

[279] PDF at 55; see also ED-KC-1 at 4; ED-KC-6 at 60 (Nov. 2020 hearing)

[280] ED-MP-1 Remand at 4.

[281] APP-LF-1-R Rebuttal at 5-6.

[282] APP-RP-1-R Rebuttal at 8.

ppt) and red drum (43.7 ppt).[283] Hence, the inland silverside has sensitivity to salinity similar to highly-relevant local species present in the Nueces estuary.[284] TCEQ and EPA have approved the WET testing standards and changing those standards to use different species - the testing of which have not been validated or approved - is neither allowed nor advisable.[285]

V.
MOTION TO ALLOCATE COST OF TRANSCRIPT

Pursuant to Order No. 5, Memorializing Preliminary Hearing and Establishing Procedural Schedule, the Port Authority was ordered to "arrange for and pay a court reporter to record and transcribe the hearing on the merits," subject to reimbursement from the parties when the TCEQ issues its final decision on the Draft Permit.[286] At that time, the "costs of the recording and transcription may be allocated among the parties."[287] In the Proposal for Decision after the first hearing, the ALJs recommended that the transcript costs be divided equally between the Port Authority and Protestants.[288]

At the hearing on remand, the Port Authority incurred reporting and transcription costs in the amount of $51,106.50 for the March 11, 2022 prehearing conference and hearing on the merits from March 14-25, 2022.[289] The Port Authority respectfully requests assessment of these costs among the parties in a fair and reasonable manner.

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[283] APP-LFR-2.

[284] APP-LF-1-R Rebuttal at 6.

[285] ED-MP-1 Remand at 4-5.

[286] Order No. 5 at 5-6; 30 TEX. ADMIN. CODE § 80.23(b)(5).

[287] Order No. 5 at 5-6; 30 TEX. ADMIN. CODE § 80.23(b)(5).

[288] PFD at 86.

[289] The invoices for the reporting and transcription costs are attached as Attachment A. $20,663.50 of the total cost is for fees for an expedited transcript.

Assessment of reporting and transcription costs may be allocated pursuant to the factors set forth by 30 Texas Administrative Code § 80.23(d). Because the Executive Director of the TCEQ and OPIC are statutory parties who cannot appeal the final decision of the TCEQ, the TCEQ and OPIC cannot be assessed reporting and transcription costs.[290] The remaining potential parties to assess these costs are PAC, James King, Tammy King, Edward Steves, and Sam Steves.[291]

The costs of reporting and transcription should be allocated to PAC, James King, Tammy King, Edward Steves, and Sam Steves for the following reasons:

- PAC, James King, Tammy King, Edward Steves, and Sam Steves have the financial means to contribute their fair share of the reporting and transcription costs and there is no evidence to the contrary;[292]
- PAC, James King, Tammy King, Edward Steves, and Sam Steves fully participated in the hearing by extensively examining witnesses and presenting testimony and exhibits;[293]
- PAC, James King, Tammy King, Edward Steves, and Sam Steves stand to benefit from transcription of the proceeding in preparation of their written closing arguments, replies to closing arguments, and creation of an evidentiary record;[294] and
- But for their request for a contested case hearing and the testimony they presented through their witnesses, there would have been no need for the transcript.

Therefore, the costs of reporting and transcription should be allocated to PAC, James King,

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[290] 30 TEX. ADMIN. CODE § 80.23(d)(2) ("The commission will not assess reporting or transcription costs to statutory parties who are precluded by law from appealing any ruling, decision, or other act of the commission.").

[291] The Port Authority does not assert that costs should be allocated to Audubon Texas or the self-represented individual Protestants, Stacey Bartlett, Sarah Searight, Lisa Turcotte, Jo Ellen Krueger, Mark Grosse, and Cara Denney.

[292] 30 TEX. ADMIN. CODE § 80.23(d)(1)(B). Evidenced by their numerous motions, depositions, and other filings in this proceeding, these Protestants have sufficient resources to pay their fair share of the costs. Additionally, these Protestants are all represented by private counsel, which is further evidence that they have the financial means to pay the costs.

[293] 30 TEX. ADMIN. CODE § 80.23(d)(1)(C).

[294] 30 TEX. ADMIN. CODE § 80.23(d)(1)(D).

Tammy King, Edward Steves, and Sam Steves, collectively.[295]

VI.
CONCLUSION AND PRAYER

The evidence introduced during the hearing on Remand establishes that the Draft Permit is protective of the environment, is not harmful to the most sensitive of species even in its early larval stage, will not adversely impact recreational activities, commercial fishing/fisheries and marine life, complies with the applicable regulations to ensure that the Draft Permit is protective of water quality, is accurate and includes all appropriate and necessary requirements.

The importance of seawater desalination to the State of Texas cannot be overstated. The Texas Legislature supports desalination and will provide a crucial water supply in the face of ever-increasing water scarcity. The Port Authority's extensive testing, modeling and evidence based upon science show that the proposed desalination process will protect the environment, will avoid the degradation and death of our vital estuaries and provide a critically-needed and sustainable water supply to ensure the continued health and growth of the Corpus Christi Bay. The Port Authority requests that the ALJs issue a finding in support of the Draft Permit on all issues referred to them on Remand.

[295] At a minimum, no less than 50% of the costs of reporting and transcription should be allocated to PAC, James King, Tammy King, Edward Steves, and Sam Steves.

Respectfully submitted,

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CERTIFICATE OF SERVICE

I certify that on April 12, 2022, a true and correct copy of the foregoing was sent *via* e-mail to all parties.

/s/ Earnest W. Wotring
Earnest W. Wotring