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

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

EXHIBIT PAC-52R

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

REMAND PREFILED TESTIMONY

OF

GREGORY W. STUNZ

ON BEHALF OF

PORT ARANSAS CONSERVANCY

SUBMITTED ON FEBRUARY 2, 2022

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

APPLICATION BY PORT OF CORPUS CHRISTI AUTHORITY FOR WATER QUALITY PERMIT NO. WQ0005253000 IN NUECES COUNTY, TEXAS	**§**	**BEFORE THE STATE OFFICE OF ADMINISTRATIVE HEARINGS**

REMAND PREFILED TESTIMONY OF GREGORY W. STUNZ

TABLE OF CONTENTS

LIST OF EXHIBITS

Exhibit PAC-52R GS-1	Nielsen Estimating Impacts of Hypersalinity on Early Life Stage Red Drum
Exhibit PAC-52R GS-2	Marine Life Mortality Estimates
Exhibit PAC-52R GS-3	Influence of Variable Ultraviolet Radiation and Oil Exposure
Exhibit PAC-52R GS-4	Seminal Paper Waldichuk 1979
Exhibit PAC-52R GS-5	Dazed, Confused, and then hungry: Pesticides alter predator-prey interactions of estuarine organisms
Exhibit PAC-52R GS-6	Bushon Thesis
Exhibit PAC-52R GS-7	Community Ecology as a framework for predicting contaminant effects
Exhibit PAC-52R GS-8	First Large-scale ecological impact study of desalination outfall reveals trade-offs in effects of hypersalinty and hydrodynamics
Exhibit PAC-52R GS-9	Responses of Benthic Infauna to Large-Scale Sediment Disturbance in Corpus Christi Bay, Texas
Exhibit PAC-52R GS-10	Estuarine Benthos: Long-Term Community Structure Variations, Corpus Christi Bay, Texas
Exhibit PAC-52R GS-11	The soundscape of the Anthropocene ocean

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REMAND PREFILED TESTIMONY OF GREGORY W. STUNZ

I. INTRODUCTION

Q. PLEASE STATE YOUR NAME.

A. Gregory W. Stunz

Q. HAVE YOU REVIEWED YOUR SEPTEMBER 25, 2020 PREFILED TESTIMONY, ADMITTED AS EXHIBIT PAC-6 (INCLUDING EXHIBITS THERETO, PAC-6 GS-1 AND PAC-6 GS-2)?

A. Yes.

Q. IS THE SUBSTANCE OF EXHIBIT PAC-6 (INCLUDING EXHIBITS THERETO, PAC-6 GS-1 AND PAC-6 GS-2) STILL TRUE AND ACCURATE?

A. Yes.

Q. DO YOU ADOPT YOUR PREVIOUS TESTIMONY IN EXHIBIT PAC-6 (INCLUDING EXHIBITS THERETO, PAC-6 GS-1 AND PAC-6 GS-2) AND INCORPORATE IT AS THOUGH FULLY SET FORTH HEREIN?

A. Yes.

Q. HAVE YOU REVIEWED YOUR NOVEMBER 5, 2020 LIVE TESTIMONY AT THE HEARING ON THE MERITS?

A. Yes.

Q. IS THE SUBSTANCE OF THAT LIVE TESTIMONY STILL TRUE AND ACCURATE?

A. Yes.

Q. DO YOU ADOPT YOUR PREVIOUS LIVE TESTIMONY, AS ADMITTED INTO EVIDENCE, AND INCORPORATE IT AS THOUGH FULLY SET FORTH HEREIN?

A. Yes.

Q. WHAT IS THE PURPOSE OF YOUR DIRECT TESTIMONY ON REMAND?

A. I have been retained by PAC to evaluate the amended application of the Port of Corpus Christi Authority of Nueces County ("POCCA") for a water quality permit for a proposed desalination facility on Harbor Island, as well as the new draft permit prepared by the Texas Commission on Environmental Quality ("TCEQ"). I have been asked to review these

documents and provide my opinion regarding the effects of the brine discharge from the proposed desalination plant and its effects, if any, on the marine environment and aquatic life. I have also been asked to prepare this prefiled testimony and to testify at the hearing regarding the permit application.

Q. ARE YOU FAMILIAR WITH THE PORT OF CORPUS CHRISTI AUTHORITY'S CURRENT PLANS FOR THE PROPOSED DESALINATION PLANT?

A. Yes, I have become familiar with the currently proposed desalination plant by reviewing portions of (a) the amended application, (b) the Port's prefiled testimony and exhibits, and (c) the new draft permit.

Q. WAS THIS TESTIMONY PREPARED BY YOU OR UNDER YOUR DIRECT SUPERVISION AND CONTROL?

A. Yes.

Q. HAVE YOU COMMUNICATED WITH OTHER TESTIFYING WITNESSES RETAINED BY PAC AND OFFERED AS EXPERTS IN THIS CASE ON REMAND REGARDING YOUR OPINIONS?

A. Yes.

Q. WHICH OTHER TESTIFYING WITNESSES RETAINED BY PAC AND OFFERED AS EXPERTS HAVE YOU COMMUNICATED WITH IN THIS CASE ON REMAND REGARDING YOUR OPINIONS?

A: Scott Holt, Bruce Wiland, Scott Socolofsky, Kristin Nielsen, Larry McKinney, Daniel Schlenk, Barney Austin, Tim Osting, and Andrew Esbaugh.

Q. HAVE YOU RELIED ON THE OPINIONS, DATA, OR INFORMATION FROM THOSE OTHER TESTIFYING WITNESSES RETAINED BY PAC AND OFFERED AS EXPERTS IN FORMING YOUR OPINIONS?

A. I reviewed their opinions and conclusions and find them to be consistent with mine; however, I did not rely on their opinions in forming my own. I did rely on some witnesses to provide me with data within their own areas of expertise, such as providing modeling results, accessing their scientific work products regarding densities of marine larva in the inlet, and I examined toxicity results from Dr. Nielsen.

II. SUMMARY OF OPINIONS

Q. DO YOU EXPECT THERE WILL BE SIGNIFICANT LETHALITY TO AQUATIC ORGANISMS THAT MOVE THROUGH THE ZID?

A. Yes.

Q. WILL THE PROPOSED DISCHARGE ADVERSELY IMPACT THE MARINE ENVIRONMENT, AQUATIC WILDLIFE, AND WILDLIFE, INCLUDING BIRDS AND ENDANGERED SPECIES, SPAWNING EGGS, OR LARVAL MIGRATION?

A. Yes.

Q. WILL THE PROPOSED DISCHARGE ADVERSELY IMPACT RECREATIONAL ACTIVITIES, COMMERCIAL FISHING, OR FISHERIES IN CORPUS CHRISTI BAY AND THE SHIP CHANNEL?

A. Yes.

III. OPINIONS

Q. WHAT IS THE ZID AS YOU UNDERSTAND IT?

A. I understand that ZID is an acronym for Zone of Initial Dilution. It is an area within the Corpus Christi Ship Channel, in closest proximity to the outfall or discharge of the desalination plant, and its dimensions are defined by the TCEQ.

Q. PLEASE IDENTIFY THE DOCUMENT MARKED AS EXHIBIT PAC-64R.

A. This is the Deposition of Katie Cunningham, which I have reviewed.

PAC offers Exhibit PAC-64R.

Q. PLEASE IDENTIFY THE DOCUMENT MARKED AS EXHIBIT PAC-65R.

A. This is Exhibit 29 to the Deposition of Katie Cunningham.

PAC offers Exhibit PAC-65R.

Q. WHAT ARE THE DIMENSIONS OF THE ZID, AS DEFINED BY TCEQ?

A. I read some of the testimony of Katie Cunningham with the TCEQ. At page 207, she testified that the dimensions of the ZID would be 184' X 42' X 90'. Ms. Cunningham went on to testify that the dimensions of the human health mixing zone would be 1,053' X 477' X 90'. Finally, she stated that the dimensions of the aquatic life mixing zone would be 553' X 227' X 90'.

Q. DID YOU USE MS. CUNNINGHAM'S DIMENSIONS TO PERFORM SOME CALCULATIONS FOR VOLUME?

A. I did not, but I understand that Scott Holt performed those calculations. I am familiar with them, as they appear below. However, I have retained my previous, more conservative estimations regarding volume to calculate possible impacts on marine species. If Scott Holt's numbers below were used in my calculations, the predicted mortality impacts would be much greater.

Zone	TCEQ's dimensions	Cubic feet of water
Zone of Initial Dilution ("ZID")	184' X 42' X 90'	695,520 **(19,695 M^3)**
Aquatic Life Mixing Zone ("MZ")	553' X 227' X 90'	11,297,790 (319,918 m^3)
Human Health Mixing Zone ("HHMZ")	1,053' X 477' X 90'	45,205,290 **(1,280,071 M^3)**

Q. PLEASE IDENTIFY THE DOCUMENT MARKED AS EXHIBIT PAC-66R.

A. This is the June 24, 2021 memo from Lial Tischler to Sarah Garza (the "Tischler memo"), which is part of the Port's Amended Application.

PAC offers Exhibit PAC-66R.

Q. WHAT ELSE DO YOU KNOW ABOUT THE ZID AND THE UNDERLYING DISCHARGE?

A. The ZID is the area closest to the outfall, which will be fitted with a diffuser. The Tischler memo indicates that the "diffuser will be located on the north bank of the Corpus Christi Channel . . . approximately 300-350 meters (m) west of the confluence with the Lydia Ann Channel." It will be located "on the sloping north bank of the channel," and the "actual

depth of the barrel below the water surface" is not described. There will be 20 ports; their estimated length is also not described. The depth of the channel at the location of discharge is described as 27.4 meters, which is approximately 90'. The exit velocity of the effluent will be approximately 8.2 m/s at the maximum average discharge rate.

Q. WHAT WILL THE SALINITY OF THE DISCHARGE BE?

A. The Tischler memo, at page 3, indicates that the salinity of the discharge will range from a low of 35.9 ppt to a high of 68.7 ppt depending on the time of year and quality of intake water. In fact, in sixteen scenarios, only twice was the salinity of the effluent below 40 ppt. In ten of the sixteen modeled scenarios, the Tischler memo states that salinity of the effluent will be greater than 50 ppt.

Q. PLEASE IDENTIFY THE DOCUMENT MARKED AS EXHIBIT PAC-52R-GS-1.

A. This is a summary of recent laboratory tests performed by Dr. Kristin Nielsen evaluating the salinity tolerance of early life stage red drum.

PAC offers Exhibit PAC-52R-GS-1.

Q. PLEASE IDENTIFY THE DOCUMENT MARKED AS EXHIBIT PAC-71R.

A. This is a paper reporting on salinity tolerances of mangrove red snapper (sometimes referred to as the "gray" snapper.

PAC offers Exhibit PAC-71R.

Q. PLEASE IDENTIFY THE DOCUMENT MARKED AS EXHIBIT PAC-52R-GS-2.

A. This is an excel spreadsheet that I created to illustrate the potential mortality to species of varying density in the Corpus Christi Ship Channel.

PAC offers Exhibit PAC-52R-GS-2.

Q. DO YOU HAVE CONCERNS REGARDING THE SALINITY OF THE DISCHARGE?

A. These levels are very concerning from a biological and ecological impact standpoint. Dr. Nielsen's study, where she reported very high mortality rates at the short-term exposure, with relatively small changes to salinity, gives me great concern. I have also reviewed a study on a similar species we have here, the mangrove snapper, where very short-term exposure to salinity changes caused high mortality. Together, findings from these two and other studies lead me to conclude there is potential for high mortality from the proposed discharge.

Q. WHAT IS THE SALINITY OF THE RECEIVING WATER – OR AMBIENT WATER – IN THE SHIP CHANNEL?

A. It varies with time of year, temperature, and many other conditions, so there is a range. There are a number of sources for that information. One is the Tischler memo. At page 4, it provides a reasonable range of 23.24 ppt to 40.57 ppt, which is consistent with my personal observation of salinities in the area.

Q. WHAT DOES THE PERMIT SAY ABOUT SALINITY?

A. The permit actually says nothing about salinity. The permit says that the Port must maintain the diffuser to achieve a maximum dilution of 14.6 percent effluent at the edge of the ZID.

Q. DO YOU KNOW HOW THAT TRANSLATES INTO SALINITY?

A. I know what different modelers have said about how the effluent will affect salinity in the receiving waters. However, I am not an expert in terms of making these conversions based on the effluent to changes in salinity at the receiving waters. My area of concern is any abrupt change to ambient conditions (whatever they may be) and the implications for both immediate and longer-term mortality, along with sublethal and multiple stressor effects.

Q. PLEASE IDENTIFY THE DOCUMENT MARKED AS EXHIBIT PAC-52R-GS-3.

A. This is a paper titled *Influence of Variable Ultraviolet Radiation and Oil Exposure Duration on Survival of Red Drum (Sciaenops ocellatus) Larvae*.

PAC offers Exhibit PAC-52R-GS-3.

Q. PLEASE IDENTIFY THE DOCUMENT MARKED AS EXHIBIT PAC-73R.

A. This is a study by Dr. Holt at UTMSI showing salinity requirements for larval development of several estuarine fishes that occur in the area under question.

PAC offers Exhibit PAC-73R.

Q. PLEASE IDENTIFY THE DOCUMENTS MARKED AS EXHIBIT PAC-52R-GS-4.

A. This is one of many research papers from the scientific literature that show or discuss latent effects of stressors on marine animals. This particular paper is a seminal review of the topic by M. Waldichuk.

PAC offers Exhibit PAC-52R-GS-4.

Q. PLEASE IDENTIFY THE DOCUMENT MARKED AS EXHIBIT PAC-52R-GS-5.

A. This is a paper titled *Dazed, confused, and then hungry: pesticides alter predator-prey interactions of estuarine organisms.* This more recent paper focuses on a species that commonly occur at Harbor Island and is directly relevant to this case. In addition to direct immediate mortality, there will likely be a variety of delayed latent mortality, sublethal effects, and compounding multiple stressors affecting the short- and long-term survival of the marine animals.

PAC offers Exhibit PAC-52R-GS-5.

Q. HAVE YOU REVIEWED THE PORT'S ESTIMATES FOR SALINITY AT THE ZID, MZ, AND HHMZ?

A. Yes. I understand that all of the expert modelers for all parties report ranges for salinity, because it depends on a host of conditions (time of year, effluent flow rate, ambient velocity, etc.) and the inputs used in the CORMIX model. I have reviewed the prefiled testimony of Randy Palachek, including Exhibit APP-RP-10-R. That exhibit reflects estimates of "Plume Centerline Salinity above Ambient" as high as (1) 3.18 ppt at 50 m

(164'); (2) 2.32 ppt at 100 m (328'), and (3) 1.06 ppt at 200 m (656'). I have also reviewed the Tischler memo. Among other things, Table 4 shows that in some cases, salinity at the ZID could increase as much as 3.01 ppt, or 7.4%. When ambient salinity is already at 40.57, that would result in salinity of 43.58 ppt at the ZID. I am concerned about abrupt salinity changes in general. However, at these levels especially, I would have serious concerns regarding negative impacts to marine life including immediate and latent (or delayed) mortality, based on the literature that show this salinity level is an important inflection point for some species. Moreover, based on a wealth of literature, in addition to direct immediate mortality there will likely be a variety of delayed or latent mortality, sublethal effects, and compounding multiple stressors affecting the short- and long-term survival of the marine animals exposed. For example, the general concept in these works is short-term exposure to stressors such as salinity may be comparable to a "gunshot wound" from which a victim dies hours or days (or even weeks) after the fact. Or may not even die, but effectively be removed from populations or greatly impaired. Exposure to high salinity may kill immediately; or it may not. An organism may die later, or suffer an impairment preventing it from contributing to the population either through direct mortality or functional impairments causing eventual death. For example, exposure to a chemical may cause impaired reproduction, inability to avoid predation, food procurement challenges leading to starvation or reduced growth rate, and may negatively affect many others parameters that afford an individual's ability to thrive and contribute to the adult populations. The fundamental concepts of latent mortality, impairment, and compounding multiple stressors (e.g., having to simultaneously deal with salinity adaptation, avoiding predators, and food procurement are compounded causing impairment or death) have been

well-established in numerous works (hundreds of peer-reviewed papers, books, reviews, etc.) in the marine ecological literature as major factors influencing population dynamics of marine organisms indirectly or magnified in compounding ways.

Q. HAVE YOU REVIEWED THE TCEQ'S ESTIMATES FOR SALINITY AT THE ZID, MZ, AND HHMZ?

A. Yes. In her deposition (at pages 78-79), Katie Cunningham testified about her modeling and deposition Exhibit 29. Among other things, that exhibit reflects salinity at the ZID as high as 44.68 ppt. Similar to the estimates above, the likelihood of population-level impacts is great, along with direct immediate mortality, delayed mortality, sublethal effects, and compounding multiple stressors affecting the survival of the marine animals exposed.

Q. PLEASE IDENTIFY THE DOCUMENT MARKED AS EXHIBIT PAC-67R.

A. This is a summary of some of Dr. Scott Socolofsky's CORMIX modeling results.

PAC offers Exhibit PAC-67R.

Q. HAVE YOU REVIEWED THE PAC EXPERTS' ESTIMATES FOR SALINITY AT THE ZID, MZ, AND HHMZ?

A. Yes. Based on their findings, I am aware that the Port's Amended Application does not adequately identify the exact location of the diffuser vis-à-vis the sloping bank, so several locations have been modeled for distances of zero meters, up to 15 meters. Modeling those different locations provides a range of results. Among other things, Scott Socolofsky's CORMIX modeling shows salinity at the ZID ranging from a low of 46.39 ppt (if the diffuser is 15 meters from the bank), to a high of 56.06 (if the diffuser is 0 meters from the bank – the location reflected in the Port's Amended Application).

Q. DO YOU CONSIDER THESE ESTIMATES FOR SALINITY RELIABLE?

A. I believe they are more reliable than the estimates offered by the Port or the ED. I am aware that CORMIX has some serious limitations, so all of the modeling results will reflect this. These limitations cause a high degree of uncertainty, because of the dynamics of the area

and how they would affect marine life. For example, according to Ms. Cunningham (at page 161 of her deposition) the inputs in CORMIX cannot include the 90' "hole" that exists at the outfall location, even though "It's possible that the hole could affect mixing." Also CORMIX assumes that the discharge occurs in the open ocean – which Scott Socolofsky compared to "an infinitely wide channel." Clearly, and I am personally aware that the Corpus Christi Ship Channel is not infinitely wide. Additionally, CORMIX cannot model the effects of the eddy that occurs there. Based on my personal observations at the outfall site, high potential exists for multiple exposures of marine life to the plume on both the incoming, outgoing, and slack tides (continual exposure); the eddy has the potential for causing additional multiple exposures, as animals are entrained in the revolving current. Most notable is the inability of the CORMIX model to predict what will occur with salinities and the subsequent plume during a slack (i.e., no tidal movement) tide that is a frequent occurrence that can persist for hours, often multiple times per day, depending on tidal regime. This is when marine life will have a high probability of encountering abrupt and sharp increases to ambient salinity, and be exposed to high salinities for extended periods of time. Clearly, water will need to be drawn in from the surroundings to dilute the effluent from a finite source. The marine life, particularly the larva and early life phases are, by definition planktonic, and largely at the mercy of the current in terms of where they move and their distribution. Thus, to dilute the brine effluent, ambient water will be entrained, and it will carry these sensitive life stages of marine organisms with it. It will require large amounts of water, containing marine life, to dilute the brine.

Q. ARE YOU OFFERING YOUR OWN ESTIMATES FOR THE DEGREE TO WHICH THE EFFLUENT WILL INCREASE SALINITY IN THE RECEIVING WATER?

A. No. I have considered all of the various opinions offered regarding the expected increase in salinity within the Corpus Christi Ship Channel. I am also aware that everyone agrees that the discharge is negatively buoyant; it would naturally sink to the bottom unless the diffuser jets expelled it at high velocity. The draft permit allows the Port to operate the desalination plant continuously. I am concerned that any discharge that falls into the 90' hole will accumulate there, and/or even if some of the highly saline brine were to move out of the hole, it will just be continuously replaced with more highly saline brine. Scott Scolofsky's CORMIX modeling indicates that there will be a dense plume on the bottom of the channel as much as a mile away from the discharge.

Q. WHAT ARE YOUR CONCERNS REGARDING THE DISCHARGE?

A. I have all the same concerns I had with the original application and original draft permit. However, I have added to my previous opinions and testimony based on new information, since that time. This includes new mortality calculations based on recent descriptions of the plume size (although I continue to use very conservative estimates), information regarding the new location and depth of the discharge, new data regarding the hole in the Ship Channel near the discharge, the new draft permit, and expert witness information provided by the Port and TCEQ.

Q. IS THERE ONE – OR MORE THAN ONE – PARTICULAR SPECIES THAT YOU ARE MOST CONCERNED ABOUT?

A. I am concerned about (1) many species – an entire assemblage; (2) especially those that are planktonic (or have a planktonic life stage); (3) those early life-history phases (e.g., eggs, larva, and young animals; and (4) how adverse effects on even one species can ripple and cause cascading effects throughout the entire food web in this area. This could have major impact to several species' population dynamics, persistence, and sustainability of our fisheries and estuarine ecosystem.

Q. HOW MANY SPECIES OF AQUATIC INVERTEBRATES CAN BE FOUND IN THE CORPUS CHRISTI SHIP CHANNEL?

A. The Corpus Christi Ship Channel is a very rich and diverse area containing a large number of aquatic invertebrate species. Without exhaustive research on the exact number, I would estimate there are well over 100 common species that occur in the area. There are many more, probably 1000s, if one considers invertebrates in the benthos and zooplankton. There are numerous organisms that are not identifiable as specific species at various life phases. There are many that are of high economic value such as brown shrimp, white shrimp, pink shrimp, blue crab, stone crab urchin, whelks, clams, mussels, and oyster.

Q. HOW MANY SPECIES OF AQUATIC VERTEBRATES CAN BE FOUND IN THE CORPUS CHRISTI SHIP CHANNEL?

A. The Corpus Christi Ship Channel is a very rich and diverse area containing a large number of aquatic vertebrate species. Without exhaustive research on the exact number, I would estimate there are well over 100 common species of vertebrates that occur in the area. There are five species of sea turtles, bottlenose dolphins, manatees, a large number of shark species (> 10 species). Smaller fish are a predominant component, and there are about 25 species that are particularly common. Some notable species would include: red drum, spotted seatrout, southern flounder, Gulf flounder, tarpon, Atlantic croaker, black drum, sheepshead, Spanish mackerel, common snook, fat snook, mangrove snapper, sand seatrout, silver seatrout, southern kingfish, red snapper, pigfish, spadefish, triggerfish, pinfish, king mackerel, cobia, white mullet, stripped mullet, menhaden species, needlefish, Atlantic stingray, spotted eagle ray, whiting, silver perch, ladyfish, bluefish, triple tail, grouper species, spot, goby species, blenny species, anchovies, and many others.

Q. PLEASE IDENTIFY THE DOCUMENT MARKED AS EXHIBIT PAC-68R.

A. This is a list of species commonly found in the Corpus Christi Ship Channel that I compiled along with Scott Holt.

PAC offers Exhibit PAC-68R.

Q. HOW DID YOU ARRIVE AT THIS LIST?

A. I have created a list of some of the most common species that would have some economic or ecological significance. Scott Holt added some species to my original list. This by no means represents an exhaustive list. These are a general representative sample and shows the area has a very rich species assemblage of marine life. A thorough inventory of the area would reveal many more.

Q. ARE YOU STILL CONCERNED ABOUT THE RED DRUM?

A. Yes. The red drum is an iconic and sentinel species that was greatly discussed in the last hearing. There are very good reasons for that. It is sensitive to changes in salinity, and it is well-researched, making it an ideal study animal. Its larvae rely on the Port Aransas Pass and the Ship Channel to get to the estuary. The connectivity provided by the inlet is essential for this species and many others persistence and sustainability. It is also a species of great economic value to the State of Texas and the Texas Parks and Wildlife Department has been spending millions of dollars annually for many years to stock the Texas coast with red drum. It is a very recognizable species, even to those who do not live in this region, and who are not commercial or recreational anglers. While the red drum is certainly of high concern, there are many species both of economic and ecological importance that occur at much higher densities in the vicinity of the outfall. Many species are just very important to a functional estuarine ecosystem, and any negative impact to those species would cause me great concern for overall ecosystem health, and especially food web integrity. While we focus on red drum, because this animal is well-researched. it is a model

species to make predictions. However, red drum are just a very small portion of the marine life using the waters at the outfall.

Q. ARE YOU AWARE THAT THE PORT'S WITNESSES HAVE TESTIFIED THAT RED DRUM LARVAE FLOAT ON THE SURFACE OF THE CHANNEL (OR AT LEAST REMAIN IN THE UPPER WATER COLUMN), AND WILL NEVER ENCOUNTER THE HIGHLY SALINE BRINE PLUME THAT WILL BE WELL BELOW THE SURFACE?

A. Yes. I have read some of the testimony from the Port's witnesses to that effect.

Q. DO YOU AGREE?

A. No. That statement is not accurate.

Q. PLEASE IDENTIFY THE DOCUMENT MARKED AS EXHIBIT PAC-69R.

A. A. This is a presentation on researched performed by Scott Holt regarding the distribution of larvae in the Corpus Christi Bay System, including the Ship Channel.

PAC offers Exhibit PAC-69R.

Q. WHY DO YOU THINK THE RED DRUM LARVAE WILL NOT SIMPLY FLOAT SAFELY ABOVE THE PLUME?

A. It has been well-established in many studies that red drum larvae (and many other larvae) are found throughout the water column in the Ship Channel as shown from direct sampling. They are found near the surface of the water, but also evenly distributed throughout the water column to the deepest channel depths. This is a principle in larval biology known as tidal stream transport. This is a complex phenomenon for planktonic organisms to work their way into the estuary and avoid being swept back out - scientifically referred to as behavior that promotes up-estuary advection and retention. Red drum and many planktonic organisms occur throughout the water column on a daily basis, typically in response to light levels (following food source) but also responding to tidal regimes. For red drum larvae (and others) to carry out tidal stream transport for migration into the estuary, they have the ability to move up in the water column during incoming tides maximizing probability of

moving inward. During the outgoing ebb tide they move toward the bottom, where currents are typically weaker, to avoid being swept back out. Since they cannot effectively swim against a current by definition, they use this strategy to maximize their probability of being slowly swept into the estuary and seaward back and forth but more net inward migration. Thus, they use the entire water column to facilitate the migration into their estuarine nursery areas. During the spawning season, in 100 cubic meters of channel water, there will be approximately 100 red drum larvae. This could vary (by more or less) depending on a variety of seasonal and other factors. In scientific papers, we do not report it this way, but that would be an average of 1 larvae per 1 cubic meter of water. Red drum are relatively rare, compared to shrimp and mesozooplankton that occur at densities of approximately 50 and 6000 per cubic meter. They are also evenly distributed throughout the water column.

Q. HAVE YOU PERFORMED ANY CALCULATIONS REGARDING THE NUMBERS OF RED DRUM LARVAE THAT COULD BE AFFECTED BY THE DISCHARGE?

A. Yes, for red drum larvae and recently for other species as well. That is reflected in Exhibit PAC-52R-GS-2.

Q. CAN YOU EXPLAIN YOUR CALCULATIONS?

A. I ran simple, straight-forward calculations. For ease of calculation and expansion, I used a Microsoft Excel spreadsheet to facilitate my understanding. I estimated the magnitude of the daily mortality that could be expected for: (1) rare (red drum); (2) medium abundance (Penaid shrimp) (3) and highly abundant (mesozooplankton) commonly occurring species. The spreadsheet allows for easy modification to predict mortality under a variety of possible scenarios. These were very conservative calculations using an average and low abundance for each species/group based on the average daily inflow. I did not include outflow exposure and associated mortality. For example, I calculated only for incoming

tide, and did not include any mortality that would have occurred on outgoing, nor slack tide. I also ran a variety of plume sizes from very small to large (including the estimated size of the ZID). I then calculated a ratio of the plume coverage compared to the entire channel. Finally, I ran it for all possible scenarios for a variety of mortality rates from 25% to 100%. The mortality rate was exceptionally high in all cases, even under these very conservative constraints. Since I did not include exposure during outgoing nor slack tides, I would reasonably expect the mortality would be even greater than reflected in my calculations. The purpose of this exercise initially was for my own edification. I did not intend for this to be used by others, but I found this exercise increasingly informative to determining the expected mortality, and was asked about my calculations in my deposition. Finally, numbers this large can be difficult to comprehend, and I realized that my spreadsheet could facilitate that comprehension. Thus, to put those large numbers in perspective, I calculated the days it would take to "achieve" a certain magnitude of death (e.g., 2.5, 8.3 or 60 million fish) to make it more understandable Additionally, the numbers approximated the annual number of red drum produced and stocked in the bays each year with the idea to calculate the time it would take for the mortality at this site to offset the Texas Parks and Wildlife Stock Enhancement Program. This provided a real-world analogy of why I was concerned about the magnitude of the mortality that had the potential to offset the entire multi-million dollar hatchery program in a few days. By way of example, assuming a low density of red drum (0.50 larvae per cubic meter of water), and a highly saline plume of 3,000 cubic meters (far less than the 19,695 cubic meters in the ZID, based on Ms. Cunningham's testimony), and mortality of only 25%, more than 100,000 red drum larvae would be expected to die daily – on the incoming tide only. Similarly

conservative assumptions result in an estimated 6.1 million dead shrimp larvae, and more than 614 million dead mesozooplankton larvae. The numbers go up exponentially if I make less conservative assumptions. And I stress that these calculations ignore the outgoing tide and slack tide

Q. PLEASE IDENTIFY THE DOCUMENT MARKED AS EXHIBIT PAC-52R-GS-6.

A. This is the thesis of Amanda Bushon regarding the Recruitment, Spatial Distribution, and Fine-Scale Movement Patterns of Estuarine Dependent Species Through Tidal Inlets in Texas.

PAC offers Exhibit PAC-52R-GS-6.

Q. DO YOU RECALL YOUR DEPOSITION AND QUESTIONS ABOUT CLINT DAWSON'S 2021 PAPER CALLED "POTENTIAL EFFECTS OF DEEPENING OF THE ARANSAS SHIP CHANNEL ON PARTICLE TRANSPORT IMPLICATIONS FOR RECRUITMENT OF ESTUARINE DEPENDENT LARVAE"?

A. Yes. The implication seemed to be that the Corpus Christi Ship Channel is insignificant as a pathway for red drum larvae to reach the estuary. I disagree, and our empirical science with in situ sampling (i.e., not modeling and nets in the water collecting these animals) shows a large number of larvae arrive at their nursery grounds via the Corpus Christi Ship Channel. Red drum larvae (and the larvae of many other species) are very abundant in the Corpus Christi Ship Channel and have to pass the outfall area to arrive in the estuary. However, while understanding the many species that use the Corpus Christi Ship Channel as a corridor with the potential for exposure is certainly important, where they eventually end up is not directly relevant to the question of whether the discharge will cause significant lethality to aquatic organisms that move through the ZID.

Q. ARE YOU CONCERNED ABOUT SPECIES OTHER THAN RED DRUM?

A. Yes. Exhibit PAC-68R reflects only a partial list of some other species commonly found in the Ship Channel. And Exhibit PAC-52R-GS-2 uses just two other species (shrimp and

mesozooplankton), to illustrate the tremendous abundance that exists, even if most people never know it. In fact, there are species of marine life that are even more numerous than these.

Q. PLEASE IDENTIFY THE DOCUMENTS MARKED AS, EXHIBIT PAC-52R-GS-7, AND EXHIBIT PAC-52R-GS-8.

A. Exhibit PAC-52R-GS-7 is a paper titled *Community Ecology as a Framework For Predicting Contaminant Effects*, and Exhibit PAC-52R-GS-8 is a paper titled *First large-scale ecological impact study of desalination outfall reveals trade-offs in effects of hypersalinity and hydrodynamics*.

PAC offers, Exhibit PAC-52R-GS-7, and Exhibit PAC-52R-GS-8.

Q. HOW CAN YOU SAY THAT YOU EXPECT THERE WILL BE SIGNIFICANT LETHALITY TO AQUATIC ORGANISMS THAT MOVE THROUGH THE ZID?

A. Some of the modeling results indicate abrupt increases in ambient salinity that are not routinely encountered in the natural environment. This is an area that is critically important to some of the most sensitive life stages of ecologically and economically important animals, that will not have an ability to acclimate or evolve to handle such unnatural extremes. I would expect an abrupt increase of 15 ppt to kill many species of larvae almost instantly. However, even modest differences in salinity can be lethal due to the abrupt nature of the change. And then there is the issue of non-lethal effects, latent mortality, and multiple stressors discussed earlier in this testimony. In an otherwise perfect environment, just increases salinity alone might have little or no effect. However, when you couple this with one, or multiple, ecological stressors (predatory avoidance, procuring food, competitors, low dissolved oxygen) the animals often die. As an example from in the materials for this project, the Port of Corpus Christi collected water data in the area of the "hole" and found very low (even zero) dissolved oxygen concentration in some instances.

Thus, in addition to osmoregulation for water imbalance due to increased salinity, the larvae would have to deal with hypoxia (low) and even anoxic (no oxygen) conditions. The literature is robust demonstrating negative harm caused by multiple stressors effects. However, this is not accounted for in WET or other similar testing. Not considering mortality in an ecological context (and individual-based experiments) has been a major vocal criticism in the field for many years. Similar to mathematical models that rarely accurately portray the natural environment (e.g., CORMIX), single exposure salinity trials and similar WET testing that was done here do not capture the full environmental suite of stressors the animals face and must overcome for survival. Thus, increases in salinity could be the proverbial "straw that broke the larvae's back" when combined with a multitude of other biological stressors. Compounding this issue is mechanical mortality and physical disruption for these buoyant embryos. Turbulence would be a major concern (i.e., a jet stream with velocity of 8.2 m/s) for mortality as well. In fact, the Port of Corpus Christi has provided evidence (with the Clark et. al. 2018 paper) that, "High-pressure diffusers designed to reduce impacts of hypersalinity may inadvertently cause impacts through hydrodynamics." Thus, what is considered in this application as well as the Nielsen studies are "best case scenarios." In reality, these early life history phase of animals (and adults in some cases) have to cope simultaneously with a variety of factors. When considered together, this could have larger impacts well-beyond the scope of isolated studies measuring only one treatment effect (i.e., just salinity in isolation).

Q. PLEASE IDENTIFY THE DOCUMENT MARKED AS EXHIBIT PAC-73R.

A. This is a study of the salinity tolerance in larvae of spotted seatrout, red drum and Atlantic croaker presented to the Texas Water Development Board.

PAC offers Exhibit PAC-73R.

Q. WHAT DOES THIS STUDY SHOW US?

A. This is a study that I have reviewed that supports my opinions. It was published by UTMSI and studied salinity tolerance in larvae of spotted seatrout, red drum, and Atlantic croaker. Tables 12 and 13 show the survival rate of red drum and Atlantic croaker larvae ages 1, 3, 5 & 7 days when exposed to salinity of zero to 50 ppt. While mortality is seen at various salinities, there is a clear point when salinity increases from 40 ppt to 45 ppt. where there is dramatically reduced survival – stated another way, dramatically increased death.

Q. PLEASE IDENTIFY THE DOCUMENT MARKED AS EXHIBIT PAC-71R.

A. This is an important study regarding the low change in salinity tolerance of larvae of the mangrove red snapper that I have reviewed. This study shows that at even during short periods of time, abrupt exposure to small changes in salinity (from ambient) caused substantial and significant mortalities. Moreover, it also showed reduction in fish condition indices (see sublethal effects discussion above). This is an important paper, because until Dr. Nielsen performed her studies on red drum with similar findings, it is one of the few studies that reports high mortality or short time-scales for relatively small changes to ambient salinity.

PAC offers Exhibit PAC-71R.

Q. HOW CAN YOU SAY THAT YOU EXPECT THERE WILL BE SIGNIFICANT LETHALITY WHEN YOU CANNOT SAY EXACTLY HOW LONG ANY ORGANISM WILL BE EXPOSED TO ELEVATED SALINITY?

A. First, as I understand it, the CORMIX model cannot replicate the tidal influences in the Ship Channel. The flood tides come in from the Gulf and ebb tides goes back out to the Gulf. During slack tide, the water in the Ship Channel can be very still for long periods. This can occur typically once or twice per day on the order of hours depending on tidal conditions. During these times of very little or no water movement, any organism, and

especially planktonic organisms, may be exposed repeatedly as water moves back and forth, or may be exposed for longer periods when water almost stops moving altogether. Second, I am relying on personal experience. In my research I have transported early life phases (e.g., 20-30 day old and younger) red drum from Texas Parks and Wildlife holding tanks into specially designed, aerated coolers for transport to our research laboratories. Early in the experimental process, we discovered the extraordinarily sensitive nature of these early life phases to even minor salinity changes, as transferring the red drum from the tanks into water we prepared for transport sometimes resulted in a 100% mortality rate. I stress that we planned and prepared carefully for the successful transport and survival of these specimens; but virtually all of them died. We determined that the death rate could be attributed to modest differences in salinity between the TPWD tanks and our coolers. We began transporting the very young red drum in TPWD water collected from the hatchery (their acclimated source water) and virtually eliminated mortality caused by transport other than from physical damage (e.g. netting damage). Third, I have learned in this case that there are a number of chemicals for which the State has numeric limits in a discharge. Salinity is not one of them. But for those chemicals with a numeric limit, it is a binary determination – below the limit and the discharge is acceptable, but above the limit it is impermissible. Possible time exposure is irrelevant. The applicant cannot get around the numeric limits in this permit by saying "but the marine organisms will not be in contact with high levels of copper for very long." There is no rational reason it should be different for salinity. Fourth, I am aware that the Port points to laboratory studies and says "this only shows the larvae die after 18 hours of exposure" so anything less than that is safe. That is untrue. An 18-hour test only *reports* the results at the 18-hour mark. That does not

tell us that the larvae lived 17 hours and 59 minutes. For example, Exhibit PAC-73R, Table 12 indicates that three-day old red drum larvae exposed to 45 ppt salinity experienced more than 97% mortality. All that death may have occurred within the first minute. We don't know that. The literature suggests that species similar to what we have here, the mangrove red snapper, the mortality form small salinity changes occurs very rapidly in a short exposure time. Fifth, I am familiar with testing performed by Dr. Kristin Nielsen. She calculated a median lethal concentration (LC50) of 41.8-ppt for red drum larvae, and mortality began at lower salinities and in time periods shorter than 10 minutes. The Port's Amended Application reflects naturally occurring conditions in the Port Aransas area already result in salinities up to 40.57 ppt. At these high salinities only very small changes from ambient become very concerning, as studies have shown these would be inflection points for very high mortality for certain species.

Q. ANYTHING OTHER CONCERNS?

A. Yes. As I testified to previously, this marine environment is already under stress.

Q. PLEASE IDENTIFY THE DOCUMENT MARKED AS EXHIBIT PAC-70R.

A. This is a study of salinity patterns in the estuary and predicting areas of vulnerability to increase in salinity in the Coastal Bend Region and its impact on various species by using very long-term and extensive data set. I am one of the authors.

PAC offers Exhibit PAC-70R.

Q. HOW DOES IT INFORM YOUR OPINIONS HERE?

A. In the Coastal Bend Region, in a 30 year period, there were eight "wet" years with average salinity below 25.5; fourteen "average" years with salinity from 25.5 to 32.1; and eight "dry" years with average salinity above 32.1. The relationship between salinity and species diversity (of juveniles and invertebrates) was analyzed by subregion. In the 4 subregions,

diversity increased with increasing salinity to a maximal salinity point, then decreased. The salinity where diversity was maximum was estimated at 13 for Nueces Bay, 24 for south Corpus Christi Bay, 22 for north Corpus Christi Bay, and 36 for Redfish and south Aransas Bays. As salinity increased past those concentrations, species diversity decreased. It is obvious that small changes in salinity can alter overall community diversity. The optimal salinity to maintain high diversity in Corpus Christi Bay is between 22 and 24 psu, and then diversity decreases as salinity increases. The problem is that average salinity in the whole system is only about 25.5 ppt in wet years, so on average, the system is already suffering from salinity stress. Salinities in the entire middle Texas coast have been increasing over time, most likely due to reduction in inflows. Sea surface temperatures have been rising since the 1970s. Higher water temperature is a double stressor: (a) it results in lower dissolved oxygen concentrations, and (b) increases evaporation which can further increase salinity. It is common for multiple stressors to have exacerbated effects more than any of the individual components have by themselves. Acute and chronic stressor effects are enhanced when salinity increases or during hydrological disturbances. The increase in the concentrations of salts causes water to leave the cells of marine species which may result in cell dehydration which can produce smaller embryos and eventually result in the death of embryos. Lower species abundance and diversity is generally observed for salinity above 45 psu. The Corpus Christi Bay region has high annual average temperatures and salinities, and circulation within the bays of the region is sluggish. This means that the region is sensitive to changes in water borne materials because they are easily concentrated by the high evaporation rates and low flushing rates. Average salinities (without the Port's planned desalination plant) are already at levels that could impact

species abundance and diversity, and therefore, small increases in salinity could add additional pressure to a system that is already experiencing salinity stress.

Q. HAVE YOU REVIEWED THE STUDIES THAT STILLMEADOW PERFORMED FOR THE PORT ON SHORT TERM CHRONIC TOXICITY OF SALINITY?

A. Yes.

Q. DO YOU THINK THEY PROVE THAT THE DISCHARGE WILL NOT HAVE AN ADVERSE EFFECT ON AQUATIC ORGANISMS IN THE SHIP CHANNEL?

A. Not at all. The subjects used in those studies were the inland silverside and the mysid shrimp. They should have chosen species that were relevant to the area. For example, red drum, Penaeid shrimp, southern flounder or a host of other species would have been much more appropriate study subjects and easy to obtain from captive hatchery spawns; these species routinely occur in the area of the outfall. Moreover, compared to other species that are found in the Ship Channel, these two test subjects for the WET testing were not particularly sensitive to salinity. Most importantly, these species are not estuarine-dependent species, nor do they rely on migration from inlets as corridors to reach their nursery grounds and outward migrations to join adult spawning stocks. Thus, the study did not choose appropriate study subjects to make conclusions regarding impacts to marine life that occur in this area. Finally, silverside subjects were 7-11 days old and the shrimp were 7 days old. The Ship Channel is full of organisms that are less than 7 days old, and that are far more sensitive to abrupt changes in salinity.

Q. ARE YOU CONCERNED ABOUT BENTHIC ORGANISMS – THE ANIMALS THAT LIVE IN THE MUD IN THE CORPUS CHRISTI SHIP CHANNEL?

A. Yes.

Q. PLEASE IDENTIFY THE DOCUMENT MARKED AS EXHIBIT PAC-52R-GS-9.

A. This is a paper titled *Responses of Benthic Infauna to Large-Scale Sediment Disturbance in Corpus Christi Bay, Texas*.

PAC offers Exhibit PAC-52R-GS-9.

Q. PLEASE IDENTIFY THE DOCUMENT MARKED AS EXHIBIT PAC-52R-GS-10.

A. This is a paper titled Estuarine Benthos: Long-Term Community Structure Variations, Corpus Christi Bay, Texas.

PAC offers Exhibit PAC-52R-GS-10.

Q. HAVE YOU READ TESTIMONY FROM THE PORT'S EXPERTS THAT THERE IS NO "FUNCTIONING" BENTHIC COMMUNITY IN THE SHIP CHANNEL?

A. Yes. That's a remarkable statement and patently false. As someone with direct experience and research in the area, there is a flourishing benthic community of infauna and benthic and epi-benthic (on the bottom) fish that routinely use this channel. The areas along the Corpus Christi Ship Channel have been historical shrimping grounds for a variety of economically important shrimp species that burrow in the sediment (benthos) and are part of the functional benthic community. From personal experience and pulling shrimp trawls in the benthos in this location many times, upon net retrieval one finds an area teaming with benthic, epibenthic, and pelagic marine life using this area. There have been numerous studies showing effects of dredging and characterizing the benthos here. The Wilbur study directly assesses dredging in the Corpus Christi Ship channel and showed the benthic infauna recovered astonishingly quickly after dredging. The Flint and Younk study has shown a remarkable high resistance to disturbances such as both trawling disturbance and dredging may actually increase productivity and functionality. The results of this long-term study illustrated the resilience of benthic communities to disturbance. They also provided evidence supportive to hypotheses concerning the high resistance and functionality of communities to disturbance in inconstant environments.

Certainly, these studies show changes to community composition toward species with more 'colonizer' life history (e.g., more grasslands-type species versus redwood forest due to

frequent disturbance and time to reach climax community; interestingly, often times test communities are more diverse as disturbances reduced competitive interactions). Nevertheless, even with these species composition changes these were very productive and functional benthic communities. Southern and Gulf flounder are important recreational and commercial species that by definition are benthic species that bury themselves in the sediment for long periods of time. They heavily use the areas directly at the outfall location and all along the Corpus Christi Ship Channel. During the spawning migrations, the area of the proposed discharge and nearby, including "the hole," is one of the most popular fishing destinations for these benthic fish.

Q. HAVE YOU REVIEWED THE PREFILED DIRECT TESTIMONY OF DR. LANCE FONTENOT?

A. Yes.

Q. DID YOU READ DR. FONTENOT'S TESTIMONY THAT "THE BUOYANCY OF THE EARLY LIFE STAGES OF RED DRUM HAS IMPORTANT IMPLICATIONS FOR THIS SPECIES BECAUSE IT WOULD TEND TO LIMIT THE EXTENT AND DURATION OF FUTURE CONTACT WITH THE EFFLUENT?"

A. Yes.

Q. DO YOU AGREE?

A. No. First, with respect to red drum, as mentioned in detail in an earlier question in this testimony, it has been clearly shown through scientific studies that red drum and the vast majority of the other species are evenly distributed throughout the water column. This vertical distribution changes with the tide, time of day, and a variety of other factors. Clearly, these species use the entirety of the water column. Second, his examination of his six "Target Species" (American oyster, blue crab, white shrimp, red drum, Atlantic croaker, spotted trout) ignore the multitude of other species that are also found at various depths in the water column as well, and the species choice is problematic. For example, he would

have to clarify whether he is referring to the *Crassostrea virginica* the 'Eastern' oyster, and not the 'American' oyster. Both are mentioned in the report, and I'm not clear if he is referring to a different species from what we typically have in the Ship Channel. The eastern oyster and spotted seatrout would potentially occur here but these two species are not estuarine dependent. They are estuarine resident life history, and I would not consider them a direct target species that are directly relevant to the issues under consideration here.

Q. PLEASE IDENTIFY THE DOCUMENT MARKED AS EXHIBIT PAC-52R-GS-11.

A. This is a paper titled *The soundscape of the Anthropocene ocean that discusses marine noise pollution*.

PAC offers Exhibit PAC-52R-GS-11.

Q. COULD SALINITY OF 44.68 AT THE EDGE OF THE ZID BE THE TIPPING POINT IF THIS SYSTEM WERE ON THE EDGE OF COLLAPSE?

A. Yes

Q. DO YOU KNOW THAT THE TEXAS SURFACE WATER QUALITY STANDARDS REQUIRE THAT SALINITY GRADIENTS IN ESTUARIES MUST BE MAINTAINED TO SUPPORT ATTAINABLE ESTUARINE-DEPENDENT AQUATIC LIFE USES?

A. Yes

Q. WHAT IS YOUR OPINION ON THE RANGE OF SALINITY THAT WOULD SUPPORT SUCH USES?

A. My opinion is those ranges of salinities would need to be with the range that would normally occur based on seasonal patterns of rainfall and drought. For estuarine-dependent aquatic uses, these ranges could be large; however, should not contain sudden or abrupt changes that marine life could encounter, but that they have not evolved to adapt to for short-term changes (i.e., sudden abrupt changes from ambient conditions). Also, the mortality can very salinity-dependent. For example, previous studies have shown that when you naturally approach salinities of 40, then even small changes to ambient can be

very problematic, as animals such as red drum and Atlantic croaker are reaching some inflection points were only small changes to salinity above 40 can cause very high mortality.

Q. DO YOU AGREE THAT THE ARANSAS PASS INLET PLAYS A "KEY ROLE IN THE LIFE CYCLE OF ESTUARINE DEPENDENT SPECIES FOR THE CORPUS CHRISTI BAY SYSTEM?"

A. Yes, it is has been designated Essential Fish Habitat for this reason. It also plays a key role beyond the Corpus Christi Bay System and contributes to the health of the Gulf of Mexico.

Q. IS THE PROPOSED DISCHARGE LOCATION ECOLOGICALLY SENSITIVE?

A. Yes, very sensitive. This is one of the most ecologically sensitive locations in the entire Coastal Bend. Given the recruitment of red drum derived from this inlet and associated nursery/juvenile habitat, it is one of the most ecologically sensitive areas on the Gulf of Mexico. We know this through our studies of red drum populations connectivity in the northern Gulf of Mexico and what estuaries contribute to the adult stocks. This location is a major nexus and conduit for providing 'escapement' (i.e., supply of) red drum to sustain the stocks of red drum in the state offshore and federal waters of the broader Gulf of Mexico. This would be a similar situation for a number of other species such as Paneaid shrimp, forage base species such as Gulf Menhaden, and many others.

Q. IS THE ARANSAS PASS TIDAL INLET IMPORTANT TO THE LIFE CYCLE OF AQUATIC ORGANISMS FOR THE ENTIRE ECOSYSTEM?

A. Not only is it important for migration corridors, this inlet is key for a variety of ecological processes that are critical to ecosystem health. Namely, the processes occurring here fuel and help maintain a robust food web. Dynamics happening in the inlet support foundational species that support the ecosystems such as seagrasses, oyster reefs, marsh, and many other habitat types.

Q. IS THERE A HIGH CONCENTRATION OF MARINE LIFE IN THE ARANSAS PASS INLET?

A. The Aransas Pass Inlet and associated branching channels (i.e., Corpus Christi Ship Channel) have an extraordinarily high concentration of marine life compared to what is just offshore and eventually delivered to the nursery ground. This is due to the narrowing and concentrating effect of the inlets. Thus, impact in this area have a compounding exponential effect given the high abundance of concentrated marine life.

Q. IS THE ARANSAS PASS TIDAL INLET THE ONLY CONNECTION BETWEEN THE GULF OF MEXICO AND TEXAS'S BAYS AND ESTUARIES FOR MANY MILES TO THE NORTH AND SOUTH?

A. Yes, it is the only major inlet. The nearest are Pass Cavallo and the Matagorda inlet approximately 60 miles to the north and the East Cut in Lower Laguna Madre 70 miles to the south. There is small ephemeral channel (Cedar Bayou) to the north ~ 23 miles. A similar jettied channel, Packery Channel, exists ~ 15 miles to the south. Cedar Bayou is often closed more than open in recent decades depending on conditions and maintenance dredging. Our studies on Packery Channel have shown, that while important, it has a much smaller effect on the Lower Laguna Madre given its size and small tidal prism. An important consideration is that marine life migrating through these inlets do not travel far from the inlet itself and settle in highest densities nearest the inlet. Thus, local inlets dynamics and their nearby habitat are exceptionally important to local populations that occur there.

Q. CAN THE ORGANISMS THAT RELY ON THE ARANSAS PASS TIDAL INLET SIMPLY GO ELSEWHERE?

A. No, as mentioned earlier, the next major tidal inlets are too far, and the small ones, still occur at long distances and due to their size have relatively smaller impacts when open and flowing and available for migration.

Q. IS THE DISCHARGE LOCATION IDENTIFIED AS ESSENTIAL FISH HABITAT FOR RED DRUM AND SHRIMP UNDER THE MAGNUSON-STEVENS ACT?

A. Yes. Also for blue crab, gray snapper, and other federally managed species.

Q. IS WAITING TO IDENTIFY SIGNIFICANT PROBLEMS UNTIL AFTER THE DISCHARGE COMMENCES SUFFICIENT TO PROTECT THE MARINE ENVIRONMENT?

A. No. I would be very concerned that the damage that could be done in the interim could be irreversible.

Q. IS THE ARANSAS PASS TIDAL INLET THE MOST IMPORTANT MULTISPECIES SPAWNING SITE FOR THE MOST ECONOMICALLY VALUABLE SPORTFISHES IN THE REGION?

A. Yes, it is a direct spawning location for several species, and many species are spawned nearby, and those fish rely on healthy water quality to survive as they migrate from their spawning grounds to their nursery habitats.

Q. IS THE PRODUCTIVITY OF RED DRUM, SPOTTED SEATROUT, SHEEPSHEAD, BLACK DRUM AND SOUTHERN FLOUNDER DIRECTLY LINKED TO THE REPRODUCTIVE ACTIVITY THAT OCCURS AT THIS INLET?

A. Yes, their productivity is directly linked to their reproductive activity at the inlet and just nearby and migration of their newly spawned offspring.

Q. DO MARINE ORGANISMS NEED TO COME INTO DIRECT CONTACT WITH THE HIGH SALINITY PLUME IN ORDER TO SUFFER ADVERSE EFFECTS?

A. No. There are a variety of sublethal and multiple stressor effects that could occur.

Q. FOR EXAMPLE, EVEN IF RED DRUM NEVER ENCOUNTERED HIGH SALINITY, WHAT OTHER SPECIES DO THEY RELY ON FOR THEIR SURVIVAL? AND ARE THOSE SPECIES AT RISK OF ADVERSE EFFECTS FROM THE DISCHARGE?

A. For example, young red drum and many others rely on abundant concentrations of crustaceans in the zooplankton for food. These must occur in high abundance for these small fish to easily find and procure their prey. If this high density forage base (much greater than 6000/cubic meter) were compromised, the larvae would starve. There are

many other examples. One would be disruption of adult forage base. Gulf menhaden is an important component of the forage base for many marine species. They populate the estuary as small larvae and early juveniles as they migrate through the inlet. Disruption in the forage base could have major consequences to the food web and the nutritional resources this species provides for a multitude of other species. Additionally, a similar situation would exist for both the phyto- and zooplankton. These organisms form the base of the food web as primary producers (fuel sources) for the entire ecosystem. They are particularly abundant migrating in through the inlet and at the outfall location. Disruption to these primary producers would have wide-ranging cascading negative effects. In general, the sensitive nature of the estuarine ecosystem that is controlled by this inlet is what has me concerned about the negative effect of the saline discharge and why having discharge of this magnitude could be problematic for estuarine health and function.

Q. IN ADDITION TO SALINITY, DO YOU HAVE ANY OTHER CONCERNS ABOUT THE DISCHARGE IMPACTING AQUATIC ORGANISMS?

A. Yes. I am concerned about the impact of the jet spray moving at 8.2 m/s. The mechanical disruption that was discussed above has the potential to cause high mortality given the fragile and delicate nature of these organisms. Their bodies at this stage could not handle hydrodynamic pressures and physical stress. That is actually a conclusion of a paper authored by the Port's expert witness, Dr. Knott. See Exhibit PAC-52R-GS-8. It was not addressed in the amended application, draft permit, or other materials, nor by the experts that I am aware, but it is a major concern here and globally in the marine environment.

Q. EXPLAIN THESE CONCERNS ABOUT THE IMPACT OF THE JET SPRAY.

A. The mechanical injury and mortality has been discussed in previous answers. In the Port's submission I noted references to the discharge exiting the ports at a velocity of 8.2 m/s. That is markedly higher than the velocity of the ambient water in the channel at any time.

I understand that is intentional and expected to promote the mixing or dilution of the discharge into the ambient water. But at that velocity, it has the potential to greatly harm marine organisms, especially fragile planktonic organisms. I would expect any larvae of any species to simply be mortally disrupted when encountering such velocity – killed on impact.

IV. CONCLUSION

Q. PLEASE SUMMARIZE YOUR TESTIMONY AND YOUR CONCERNS.

I could not think of a worse spot on the entire Texas Coast for discharging brine in an inlet which represents Essential Fish Habitat as specified by the Magnuson-Stevens Fishery Conservation and Management Act. I have considered the GLO and TPWD report for the 84th legislature for HB 2031 recommended zones for desalination discharge and diversion, as well as their comments on this project. In this report, they clearly recommended the avoidance of tidal inlets, and included buffers of several miles away from these ecological hotspots. The irony that I have discussed regarding this application many times is that Port almost seeks to put this project in the most ecologically sensitive location possible. I think desalination is going to be important for providing Texans with reliable water supplies. However, we need to carry out desalination in a manner that is ecologically sound and minimizes potentially catastrophic ecological and economic impacts. Currently, this proposed application does not meet those criteria.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.