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-46R

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REMAND PREFILED TESTIMONY

OF

SCOTT A. HOLT

ON BEHALF OF

PORT ARANSAS CONSERVANCY

SUBMITTED ON FEBRUARY 2, 2022

SOAH DOCKET NO. 582-20-1895
TCEQ DOCKET NO. TCEQ. 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 SCOTT A. HOLT

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REMAND PREFILED TESTIMONY OF SCOTT A. HOLT

I. INTRODUCTION

Q. PLEASE STATE YOUR NAME.

A. Scott A. Holt.

Q. HAVE YOU REVIEWED YOUR SEPTEMBER 25, 2020 PREFILED TESTIMONY, ADMITTED AS EXHIBIT PAC-4 (INCLUDING EXHIBITS THERETO, PAC-4 SH-1 AND PAC-4 SH-2)?

A. Yes.

Q. IS THE SUBSTANCE OF EXHIBIT PAC-4 (INCLUDING EXHIBITS THERETO, PAC-4 SH-1 AND PAC-4 SH-2) STILL TRUE AND ACCURATE?

A. Yes.

Q. DO YOU ADOPT YOUR PREVIOUS TESTIMONY IN EXHIBIT PAC-4 (INCLUDING EXHIBITS THERETO, PAC-4 SH-1 AND PAC-4 SH-2) AND INCORPORATE IT AS THOUGH FULLY SET FORTH HEREIN?

A. Yes.

Q. HAVE YOU REVIEWED YOUR NOVEMBER 4-5, 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 Port Aransas Conservancy ("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 effect 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: Gregory Stunz, Scott Socolofsky, Kristin Nielsen, Larry McKinney, Daniel Schlenk, 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 my opinions. I have relied on data and information produced by those experts in forming my opinions.

II. QUALIFICATIONS

Q. PLEASE BRIEFLY DESCRIBE YOUR EDUCATIONAL BACKGROUND THAT IS A BASIS FOR YOUR TESTIMONY HERE.

A. I have a B.S. and M.S. in Wildlife and Fisheries Science form Texas A&M University and worked for 35 years as a research scientist at the University of Texas Marine Science Institute where I did research on the ecology of fish populations with a concentration on the early life stages

III. 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.

IV. OPINIONS

Q. PLEASE EXPLAIN YOUR TESTIMONY THAT YOU EXPECT THERE WILL BE SIGNIFICANT LETHALITY TO AQUATIC ORGANISMS THAT MOVE THROUGH THE ZID.

A. There are hundreds, probably thousands of species that occur in the Aransas Pass Inlet and the Corpus Christi Ship Channel. They all fall under the umbrella of the term "aquatic organisms." We do not know the sensitivity of all of those organisms to substantial, abrupt changes in salinity, but we know that some species that occur there are sensitive to abrupt salinity changes, and we know that there will be abrupt salinity changes in the ZID, and it is a reasonable assumption that many other species are sensitive as well. The evidence indicates that the adverse impacts to those salinity-sensitive species will include lethality to a significant portion of such organisms..

Q. WHAT IS THE ZID AS YOU UNDERSTAND IT?

A. I understand that ZID is an acronym for Zone of Initial Dilution. It is described as 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. My understanding is

that the ZID is defined by TCEQ as the area of a circle that has a radius of 50 feet, that means it has an area of 7,854 square feet (sq. ft.). It is also my understanding that where multi-port diffusers are used, the circle can be stated as a rectangle as long as it contains the same area as the circle mentioned above.

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

A. This is portions of the deposition of Katie Cunningham that I 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, which I have reviewed.

PAC offers Exhibit PAC-65R.

Q. WHAT DID YOU LEARN FROM KATIE CUNNINGHAM'S TESTIMONY?

A. Ms. Cunningham testified that the dimensions of the rectangle are not predetermined and can be chosen by the applicant as long as the area of the rectangle remains the same as the area of a circle of 50 foot radius. I also saw in Ms. Cunningham's deposition testimony her determination that the various zones extend from the bottom of the water column to the surface for 90 feet.

Q. WHAT ARE THOSE DIMENSIONS FOR THIS APPLICATION?

A. At page 207, Ms. Cunningham testified that the dimensions of the ZID would be 184' X 43' X 90'. The area of a rectangle of those dimensions (i.e. excluding the height) would be 7,912 sq. ft. rather than 7,854 but I assume they consider that close enough. I also noted 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. Yes.

Q. AND WHAT RESULTS DID YOU GET?

A. The volume of water contained in the ZID, the Aquatic Life Mixing Zone, and the Human Health Mixing Zone is presented below:

Zone	TCEQ's dimensions	Cubic feet of water (cubic meters)
Zone of Initial Dilution ("ZID")	184' X 43' X 90'	712,080 (20,164 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 to Sarah Garza from Lial Tischler (the "Tischler memo"), which I have reviewed.

PAC offers Exhibit PAC-66R.

Q. WHAT ELSE DO YOU KNOW ABOUT THE ZID?

A. It is the area closest to the outfall, which will be fitted with a diffuser. The Tischler memo provides the following information: 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 unknown. There will be 20 ports; their estimated length is unknown. 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. It is my understanding that the discharge salinity will be essentially double the intake salinity at a 50% recovery rate. At page 3, the Tischler memo indicates that the salinity of the discharge will range from a low of 35.9 parts per thousand ("ppt") to a high of 68.7 ppt depending on the time of year, and salinity of intake water. In fact, in sixteen scenarios, only twice was the salinity of the effluent below 40 ppt. Further, in ten of the sixteen modeled scenarios, Dr. Tischler's memo states that salinity of the effluent will be greater than 50 ppt.

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 range of 23.24 ppt to 40.57 ppt.

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

A. Yes. I understand that the 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 seen numbers reported as percent of discharge, or ppt above ambient, or absolute salinities. Depending on, I assume, differences in input parameters or assumptions for the models, the estimates range from the low-40s to the mid-50s (that refers to ppt).

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

Yes. 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.

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

A. Yes. I have reviewed Ms. Cunningham deposition where she testified about her modeling and I reviewed Exhibit 29 to her deposition. Among other things, that exhibit reflects salinity at the ZID as high as 44.68 ppt.

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

A. This is a set of modeling results from Scott Socolofsky that I reviewed.

PAC offers Exhibit PAC-67R.

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

A. Yes. I understand that the Port's Amended Application does not adequately identify the exact location of the diffuser vis-à-vis the sloping bank. Therefore, the diffuser has been modeled as several different locations with various distances from the sloping bank, ranging from zero meters from the bank up to 15 meters from the bank. 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 distance of the diffuser from the sloping bank that is reflected in the Port's Amended Application is 0 meters.

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

A. No, not from a modeling perspective. I am not qualified to do that and have not attempted to. I have considered all of the various opinions offered regarding the expected increase in salinity within the Corpus Christi Ship Channel. It is not disputed that the discharge is negatively buoyant. It is the opinion of Dr. Scott Socolofsky that any discharge that falls into the 90 foot hole will accumulate there. Even if the highly saline brine moves out of the hole through entrainment of ambient water flowing by, it will just be continuously replaced with more highly saline brine since the plant will operate continuously. His 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. These predictions do not seem to be captured within the construct of the various mixing zones.

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. But I can add to that previous testimony based on new information.

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

A. Actually, one must be concerned about all species that utilize the Corpus Christi Ship Channel and the Aransas Pass Ship Channel. Every species plays a role in the web of life, even if we do not appreciate what that role may be. I am, however, particularly concerned about species which are planktonic (or have a planktonic life stage), that must traverse the tidal inlet in the movement from (typically) offshore spawning area to estuarine nursery areas. There are other life-history strategies as well that present vulnerability. Adverse effects on even one species can ripple through the entire food web in this area.

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

A. I don't really know. You have to realize the breadth of that question. We are not just talking about shrimp and crabs, or even the shrimp-like and crab-like things. We are talking about the larval stages (and some adults too) of clams, snails, starfish, sponges, barnacles, worms, etc. In addition to those kinds of organisms that most people can at least recognize the names of, there are a multitude of other things most folks have never even heard of like chaetognaths and salps. The question specifically mentioned invertebrates, but as we go down the phylogenetic order we get to components of the zooplankton that, these days, are not really considered either plant or animal. These include radiolarians, foraminiferans, dinoflagellates, etc. We still have not mentioned bacteria and viruses, very important components of the ecosystem. Finally, we have to mention the plants. It has correctly been pointed out that there are no seagrasses in the immediate vicinity of the outfall but there are lots of planktonic plants – phytoplankton. They are incredibly abundant and, like on land, serve as the base of the food chain. In summary, there are probably many thousands of "non-vertebrate" species in the Ship Channel.

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

A. This question is a bit more manageable. Vertebrates in the Ship Channel are primarily fishes with a few reptiles and a couple of mammals thrown in. There are around 1500 species of fish known in the Gulf of Mexico. Of course, all of those are not found in the ship channel, and I still do not have an exact answer, but there are probably at least a hundred species found here.

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 Greg Stunz and I contributed to.

PAC offers Exhibit PAC-68R.

Q. ARE YOU STILL CONCERNED ABOUT THE RED DRUM?

A. Yes. The red drum is an iconic species that was discussed a lot in the last hearing. There are good reasons for that. It is sensitive to changes in salinity. Its larvae rely on the Aransas Pass and the Ship Channel to get to the estuary. It is also a species of great economic value to the State of Texas. It is a very recognizable species, even to those who do not live in this region, and who are not commercial or recreational anglers.

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.

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

A. It is a power point presentation on a study I performed with my wife, Dr. G. Joan Holt, titled *Lateral Distribution of Fish and Shrimp Larvae Across the Aransas Pass Tidal Inlet.*

PAC offers Exhibit PAC-69R.

Q. WHY DON'T YOU AGREE WITH THE ASSERTION THAT RED DRUM LARVAE ARE ONLY FOUND IN THE UPPER WATER COLUMN?

A. Quite simply, red drum eggs and larvae are found throughout the water column in the Ship Channel. They are positively buoyant in most situations but only slightly so. Even though red drum eggs will float on the surface in a still beaker of water on a lab bench, they are easily mixed into, and throughout, the water column by turbulence. Larvae never really

float on the surface, even in a still lab beaker. In nature, they are distributed pretty much from top to bottom, throughout the water column, even in the Aransas Pass inlet.

Q. IS THERE A WAY TO COUNT THE NUMBER OF ORGANISMS IN THE WATER

A. Yes. I would not say we actually count them, but we can estimate their density. The nets we use have a calibrated flowmeter, something like an odometer, that lets us measure the amount of water we have filtered and from that we can estimate density. In the estuarine environment we typically use 100 cubic meters as the standard unit of measure. We can determine the density of an organism by taking the actual number we catch in a known volume of water and normalizing that out to a consistent volume. In our case that is typically 100 cubic meters. From those actual counts of organisms in a sample we can extrapolate the numbers out to larger volumes of water or larger areas if we know the distribution of the organism. We determine that from multiple samples in multiple locations.

Q. CAN YOU GIVE US SOME EXAMPLES OF COUNTS OF ORGANISMS IN THE TIDAL INLET?

A. Yes, but with a caveat. One must realize that virtually every species out there has some type of seasonality, whether it is simply winter verses summer abundance, spawning season, migration patterns or other sources of variation. The point being that while there are always lots of individuals of many species in the inlet at any given time, not every species is there all the time. During the spawning season, during the peaks of immigration, there can be up to 100 red drum larvae in 100 cubic meters of channel water. In scientific papers, we do not typically report it this way, but that would be 1 larva per 1 cubic meter of water. Other species of interest are more abundant. We have data showing that Atlantic Croaker, for instance can be found in densities of 200 to 300 per 100 cubic meters and shrimp postlarvae can be found at densities of 4000-5000 per 100 cubic meters. Densities

of other smaller organisms can be much higher. In Corpus Christi Bay, a small copepod called *Acartia tonsa* can be found at densities up to 2,000,000 per 100 cubic meter.

Q. HAVE YOU PERFORMED ANY CALCULATIONS REGARDING THE NUMBERS OF AQUATIC ORGANISMS THAT COULD BE AFFECTED BY THE DISCHARGE?

A. Yes.

Q. PLEASE IDENTIFY THE DOCUMENTS MARKED AS EXHIBIT PAC-74R AND PAC-75R.

A. The Port produced an Excel document in August 2020. I used the formulas to create two additional spreadsheets and calculations to determine the volume of ambient water needed to dilute the discharge. Those are found in Exhibit PAC-74R. Exhibit PAC-75R contains a single page of notes I created as a simple illustration of dilution.

PAC offers Exhibit PAC-74R and Exhibit PAC-75R.

Q. PLEASE EXPLAIN.

A. It is my understanding the spreadsheet was designed to provide data for them to correctly add salt or brine to a cell in the brine discharge model. The spreadsheet had a lot of material that was of no interest to me but the first few rows of the spreadsheet, rows 4-15 to be exact, provided a handy calculator to show the volume of ambient water needed to dilute a given volume of brine water to a certain salinity. One could do this on a calculator, but this was much easier. I left the original spreadsheet intact but copied the calculations over to several other spreadsheets to examine other scenarios. The draft permit will allow the Port to discharge 95.6 million gallons per day on average. For simplicity, assume the discharge had salinity of 60 ppt, and the ambient receiving waters have a salinity of 30 ppt (see the 30_40 ppt dilution worksheet). We want to determine how much ambient water would be required to dilute the plume to achieve salinity of 40 ppt. The 40 ppt is a value shown in several studies to be at the lower end of the range of toxicity for several species and also

represents an increase of 10 ppt from ambient. Both of those are thought to represent critical values. To achieve that dilution requires 191 million gallons of ambient water per day. That is 723,771 cubic meters of water per day – That could equate to approximately 723,000 red drum larvae during the peak of spawning season, or up to 1.8 million Atlantic croaker larvae, or 32 million shrimp postlarvae that will be entrained within the plume in one day to achieve dilution down to 40 ppt. If one uses the "worst-case" numbers used in some of the modeling efforts, (ambient waters near 40 ppt and a discharge of 69 or so), then the amount of ambient water needed for the dilution (to near 40 ppt) increases substantially, with up to 10 to 20 million cubic meters of water, and organisms in that water. The point being that very large volumes of ambient water are required to dilute the brine down to reasonable levels.

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. Several times in my deposition it was asserted that the paper proved "80 percent of the larvae went towards Lydia Ann and Aransas Channel and about 20 percent to the Corpus Christi Ship Channel." 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. First, I have talked to Clint Dawson since my deposition, and he pointed out that the purpose of the paper was to compare the number of particles that arrive at given locations within the estuary under different modeled channel depths. Comparing actual utilization of the different channels branching off the tidal inlet was not even part of the study. The difference in number of particles recorded in each channel was simply a function of the where they actually counted particles. They chose to count particles encountering seagrass beds as an

endpoint. The seagrass bed location chosen in Lydia Ann/Aransas Bay is much more in the direct path of the tidal flow than the beds chosen as the counting point in Corpus Christi Bay and hence there are many more particles counted in the Lydia Ann site. The data cannot be used for what the Port is claiming they show.

Q. COULD THAT QUESTION BE ADDRESSED WITH A STUDY DESIGNED FOR THAT PURPOSE?

A. Yes, and in fact it has been done.

Q. PLEASE IDENTIFY THE DOCUMENT MARKED AS EXHIBIT PAC-46R-SH-1.

A. This is a paper by Cheryl Brown, published in 2000. This was Exhibit 4 to my deposition.

PAC offers Exhibit PAC-46R-SH-1.

Q. WHAT IS THE SIGNIFICANCE OF THIS PAPER?

As part of her modeling work of the Aransas Pass Tidal Inlet, Cheryl Brown created transects across each of the inlet branches in appropriate locations to correctly address the distribution issue and counted particles passing the transects. She found, much as expected, that the distribution of particles essentially matched the distribution of the water flow, (page 24151 in that paper). She found that approximately 60% of the particles are transported into the CC Ship Channel. In addition, it seems to me that the number of species, or what portion of any life stage of any species, that can be found outside the Corpus Christi Ship Channel seems irrelevant to the question of whether the discharge will cause significant lethality to aquatic organisms that are entrained in the dilution water or that move through the theoretical ZID.

Q. PLEASE IDENTIFY THE DOCUMENTS MARKED AS EXHIBIT PAC-71R, EXHIBIT PAC-72R, AND EXHIBIT PAC-46R-SH-2.

A. These are high quality scientific studies regarding salinity tolerances of different fish. Exhibit PAC-71R, discusses the salinity tolerance of larvae of the red snapper. Exhibit PAC-72R focuses on the acute toxicity of salt cavern brine on early life stages of striped

bass. Finally, Exhibit PAC-46R-SH-2 addresses the influence of salinity on the distribution of the calanoid copepod.

Q. DID YOU RELY ON THESE STUDIES TO INFORM YOUR OPINION?

A. Yes.

PAC offers Exhibit PAC-71R, Exhibit PAC-72R, and Exhibit PAC-46R-SH-2.

Q. HOW CAN YOU SAY THAT YOU EXPECT THERE WILL BE SIGNIFICANT LETHALITY TO AQUATIC ORGANISMS THAT ENCOUNTER THE BRINE DISCHARGE?

A. Some of the modeling results indicate a concentration of salinity in the discharge of well over 50 ppt. That is really high for this environment. Even relatively short exposures to large instantaneous changes to salinity have been shown to cause high mortality. Also modest differences in salinity can be lethal due to the abrupt nature of the change. Work by Cervetto suggests that an increase of 10-15 ppt over ambient salinity had a greater influence on mortality of a copepod (*Arcitia tonsa*, which occurs locally) than absolute salinity. Thus, it is likely a similar result would occur with numerous species that abruptly come into contact with the elevated salinities of the discharge plume. This is supported by Dr. Esbaugh's prior testimony regarding the efforts made by researchers to maintain salinity balances when transporting aquatic life. Abrupt changes like that which would occur under the Port's proposed discharge are known to be lethal.

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

A. This is a study of salinity tolerance in larvae of several relevant species that was submitted to the Texas Water Development Board. It was Exhibit 33 to my deposition.

PAC offers Exhibit PAC-73R.

Q. WHAT IS THE RELEVANCE OF THIS STUDY?

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. Both reflect that when you move from 40 ppt to 45 ppt there is dramatically reduced survival – stated another way, dramatically increased death.

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 pointed out previously, there is experimental evidence of substantial mortality to aquatic organisms over short time scales. Second, as has been pointed out by the toxicology experts, duration of an exposure trial does show not show how long it took for the test organism to die; it is just the endpoint of the trial. I am aware that the Port points to studies such as Exhibit PAC-74R and says "this 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, 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. Third, the modeling does not 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 movement in the Ship Channel can be sluggish for long periods. These conditions mean that 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. Additionally it seems that regardless of the current speed, there is certain quantity of ambient water that is required to dilute the brine discharge and the organisms in that ambient water will be exposed to sharply elevated salinities during that period of dilution. Finally, 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. The Port's Amended Application reflects naturally occurring conditions in the Port Aransas area already result in salinities up to 40.57-ppt.

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. Compared to other species that are found in the Ship Channel, these two test subjects are relatively hardy species. There are numerous examples in studies presented in this case that show other species are, in fact, sensitive to the levels of salinity change we expect to see here. At least two species that occur in the Ship Channel (red drum and the copepod *Arcatia tonsa*) are known to be sensitive to salinity changes and the channel is full of many other organisms for which the salinity tolerance is not known.

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.

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

A. In the Port's submission I saw 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. However, instantaneous contact with water of that velocity will likely cause substantial damage, likely death, to any soft-bodied organism like fish larvae.

V. CONCLUSION

Q. WHAT ARE YOUR CONCLUSIONS ABOUT THIS PROPOSED BRINE DISCHARGE?

A. I think the brine discharge from the proposed desalination plant at this location represents a significant threat to marine organisms living in and passing through the inlet. The continuous discharge, with salinity levels of up to nearly 70 ppt at times, will require a significant quantity of ambient water to dilute it back to salinity levels that are even reasonably safe for many marine organisms and there are innumerable individuals of a multitude of species in that ambient water that would are likely to be negatively impacted by the elevated salinities.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.