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-47R

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**

REMAND PREFILED TESTIMONY

OF

LARRY MCKINNEY

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 LARRY MCKINNEY

TABLE OF CONTENTS

LIST OF EXHIBITS

Exhibit PAC-47R LM-1	Dr. Larry McKinney Resume
Exhibit PAC-47R LM-2	Testimony before House Committee on Natural Resources
Exhibit PAC-47R LM-3	Conceptual Framework for Assessing Ecosystem Health
Exhibit PAC-47R LM-4	HRI – A Statement On Our Desalination Science
Exhibit PAC-47R LM-5	EPA – Quality Criteria for Water, 1986

REMAND PREFILED TESTIMONY OF LARRY MCKINNEY

I. INTRODUCTION

Q. PLEASE STATE YOUR NAME, EMPLOYER, TITLE AND BUSINESS ADDRESS.

A. My name is Larry McKinney. I am employed at the Hart Research Institute for Gulf of Mexico Studies at Texas A&M University-Corpus Christi. I serve as the Chair of Gulf Strategies for the Harte Research Institute ("HRI"). My business address is 6300 Ocean Drive, Unit 5869, Corpus Christi, Texas 78412.

Q. DO YOU RECOGNIZE THE DOCUMENT MARKED AS EXHIBIT PAC-47R LM-1?

A. Yes. This is a copy of my resume.

Q. DOES YOUR RESUME ACCURATELY DESCRIBE YOUR EDUCATION AND EXPERIENCE?

A. Yes, it does.

PAC offers Exhibit PAC-47R LM-1.

Q. PLEASE OUTLINE YOUR EDUCATIONAL BACKGROUND.

A. I received my Bachelor of Science in Zoology from Texas A&M University in 1971. I received my Ph.D. in Biology from Texas A&M University in 1976. That same year I was a Smithsonian Summer Fellow.

Q. PLEASE DESCRIBE YOUR CURRENT ROLE WITH THE HARTE RESEARCH INSTITUTE FOR GULF OF MEXICO STUDIES AND THE TYPE OF WORK YOU ARE CURRENTLY ENGAGED IN.

A. I currently serve in a senior leadership role with HRI, advising institute scientists studying issues related to the Gulf of Mexico, including ecology, species conservation, water resource development, economics, habitat loss, and fisheries. Along with reviewing and advising on the scientific aspects of the HRI mission, I am also charged with taking the results of their scientific studies and developing effective policies and actions to advance the HRI vision of an ecologically and economically sustainable Gulf of Mexico.

Q. PLEASE DESCRIBE YOUR PREVIOUS PROFESSIONAL EXPERIENCE.

A. Prior to my current chair position, I was the Executive Director of HRI from 2008 to August of 2020. As the first scientist to lead HRI, I assembled and led a diverse team of scientists and researchers with the mission of developing science-based solutions to Gulf of Mexico problems. Prior to my work at HRI, I was employed by the Texas Parks and Wildlife Department ("TPWD") from 1986 to 2008, where I assembled and led the Resource Protection Division, eventually totaling some 144 experts, including hydrologists, chemists, freshwater/marine ecologists, attorneys, and economists. The division's primary responsibility was to review every state and federal permit or action that might affect fish and wildlife and acting on those evaluations to eliminate, reduce or mitigate negative impacts through research, science-based comments or consultation, administrative hearings, legislative recommendations, and direct mitigation or corrective action. I eventually directed the Coastal Fisheries Division, overseeing all fisheries related matters for the state of Texas, and filled the role of Senior Director of Aquatic Resources, overseeing all water-related programs. From 1980 to 1986, as Director of the Texas A&M University Environmental Engineering Lab at Galveston, I led the biological assessment of the largest brine disposal project ever undertaken to create the U.S. Strategic Petroleum Reserve's storage facilities.

Q. HOW DOES THIS EXPERIENCE ENABLE YOU TO OPINE ON MATTERS RELATED TO THE WATER BODIES AND THE MARINE ENVIRONMENT THAT MAY BE IMPACTED BY THE PROPOSED PERMIT?

A. Including my graduate research, I have spent more than 50 years studying marine environmental issues and management of ecological resources around the world, but most often in the Gulf of Mexico and specifically the Texas coast. I have been directly involved in scientific studies assessing the impacts of brine discharge at three different locations

within the Gulf of Mexico. I am also a strong advocate for the use of desalination and have been studying desalination siting issues along the Texas Gulf Coast for many years. I believe that desalination, if appropriately developed, can provide water supply options that reduce or eliminate negative environmental impacts of water withdrawal or diversion from other sources like rivers. My training, experience, and direct research in these areas make me one of the most qualified experts to comment on and provide testimony regarding impacts to marine life that may result from discharging concentrated brine into the Aransas Pass Tidal Inlet, one of Texas' five major inlets.

Q. HAVE YOU PREVIOUSLY HAD EXPERIENCE OR BEEN ADMITTED AS AN EXPERT AND TESTIFIED ON MARINE ECOLOGY ISSUES IN ANY LEGAL PROCEEDINGS OR SUPERVISED OTHERS DOING SO?

A. Yes. In my role as Director of TPWD's Resource Protection Division, I served as an expert on marine ecology issues and supervised other experts participating in hearings and related permitting actions on behalf of TPWD before TCEQ and its predecessors.

Q. HAVE YOU PREVIOUSLY EVALUATED INDUSTRIAL IMPACTS ON MARINE ECOLOGY?

A. Yes. Over the period from 1986 to 2002 I evaluated or oversaw evaluation of every major industrial permit potentially impacting Texas coastal marine resources on behalf of TPWD. I have also testified on the status of marine resources at the White House Council on Environmental Quality, before U.S. Congress and the Texas Legislature. Regarding desalination, I have presented invited testimony to the Texas House Committee on Natural Resources regarding seawater desalination. I have also presented on desalination issues at seminars hosted by the Texas Legislature.

Q. DO YOU RECOGNIZE THE DOCUMENT MARKED AS EXHIBIT PAC-47R LM-2?

A. Yes. This is a copy of my testimony before the House Committee on Natural Resources.

Q. IS THIS A TRUE AND CORRECT COPY OF THAT TESTIMONY?

A. Yes, it is.

PAC offers Exhibit PAC-47R LM-2.

Q. TO WHAT PROFESSIONAL ASSOCIATIONS OR AFFILIATIONS DO YOU BELONG OR HAVE BELONGED THAT MAY BE RELEVANT TO YOUR EXPERTISE IN EVALUATING INDUSTRIAL IMPACTS ON MARINE ECOLOGY?

A. While I will refer you back to my resume for a complete listing, I will highlight some of the professional associations and affiliations in which I am currently or recently involved:

- Texas Sea Grant Science Advisory Committee 2008 – 2013, Chair 2012/2013.
- Flower Gardens National Marine Sanctuary Advisory Council, research representative - Jan 14, 2009. I was elected Chairman on March 13, 2009, and re-elected chairman on November 15, 2011.
- Gulf Alliance Ecosystem Assessment and Integration Priority Issues Team. I served as Chairman from 2007 to 2009.
- Founding member, former chair of the Gulf of Mexico University Research Collaborative ("GOMURC") and have served as a Texas board member from 2010-2020.
- Member of the NASA SSC Applied Sciences Steering Committee from 2007-2015.
- NOAA Deepwater Restoration Advisory Team from August 15, 2011-present.
- Member of the National Academy of Science Gulf Program Long-Term Environmental Trends Committee.

Q. ON WHOSE BEHALF ARE YOU SUBMITTING THIS TESTIMONY?

A. I am submitting this testimony on behalf of the Port Aransas Conservancy.

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

A. Yes.

II. PURPOSE OF DIRECT TESTIMONY

Q. WHAT IS THE PURPOSE OF YOUR DIRECT TESTIMONY IN THIS PROCEEDING?

I am submitting this direct testimony to provide an unbiased answer to the questions surrounding the ecological impact of the proposed desalination facility on the Aransas Pass Tidal Inlet and surrounding bay systems. As part of preparing this testimony, I have undertaken a risk assessment, similar to that I have undertaken many times in the past, of those potential impacts starting with an understanding the current state of Aransas Pass Tidal Inlet and the surrounding bay systems, evaluating the methodologies used to predict the movement and mixing of the brine discharges from the desalination plant, and then assessing the impact of those discharges in light of existing conditions in the receiving waters and the accuracy of the models being used. I have been asked to review documents and provide a professional assessment regarding the potential effects of the discharge of brine wastewater from the proposed desalination plant on the marine environment and aquatic life. In addition, I have been asked to attest to the credibility of those witnesses for PAC, whom I know well and with whom I work professionally, and their ability to present unbiased expert opinions. I have also been asked to prepare this pre-filed testimony, give a deposition, and to testify at the hearing related to the permit application.

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

A. I am. I have reviewed both the original and amended applications for the proposed desalination plant. In my various roles at HRI, I have been intimately involved in developing sound policies that advance the appropriate use of desalination processes along the Texas coast. As part of that responsibility, I produced, with the input of all HRI chairs

and the Executive Director, *A Statement on Our Desalination Science*, dated October 6, 2020, in direct response to numerous inquiries to HRI about the topic. It is my job to work with the team at HRI to constantly assess the health of our bay systems in the Coastal Bend, address ecosystem scale problems (such as rising salinity in our bays), and develop sustainable solutions to advance the HRI vision: an ecologically and economically sustainable Gulf of Mexico. Thus, I have been closely tracking the Port's proposed desalination plant for several years.

Q. WHAT CONTAMINANTS WILL BE DISCHARGED FROM THE DESALINATION PLANT?

A. The contaminant that concerns me the most is the highly concentrated saline water that will be discharged from the desalination plant. I understand that there will other contaminants in the discharge that will include metals, coagulants, flocculants, as well as other contaminants that occur in the intake water, which are concentrated during the desalination process and then discharged into the Aransas Pass Tidal Inlet.

Q. WHAT RESOURCES DID YOU RELY ON IN PERFORMING YOUR ANALYSIS?

A. I relied on a variety of resources, including peer-reviewed publications, reports, textbooks, theses/dissertations, and extensive professional knowledge gathered over 9 years as a researcher at Texas A&M-Galveston, 22 years working in various roles for TPWD, including as the Director of Coastal Fisheries and Director of Resource Protection, as well as 14 years serving as the Senior Executive Director and Chair for Gulf Strategies for HRI. As part of my disclosures, I provided a list of those publications, reports, and other documents I reviewed.

I also relied on my own personal investigation of these and related issues. As part of forming the Resource Protection Division at TPWD, I developed a risk assessment process to facilitate evaluation of the numerous large and complex industrial and water

development permits the Division was charged with reviewing. I based my approach on expertise developed by both EPA and NOAA. That process and experience allowed me to subsequently assemble a team of the world's leading experts to evaluate overall ecosystem health of the Texas coast. I have used that knowledge and experience to evaluate the potential impacts of coastal development and industrial activities on the health and productivity of Texas coastal ecosystems. I have paid special attention to desalination, like that proposed in this permit, as well as in Brownsville, Texas, and as proposed by other Texas entities over the years. I spent a number of years studying the discharge of brine into the ocean, starting in 1980, and am familiar with the impacts of these types of discharges. I have provided testimony before the House Committee on Natural Resources, written newspaper articles, conducted numerous interviews, and moderated and participated on technical panels regarding seawater desalination.

Q. DO YOU RECOGNIZE THE DOCUMENT MARKED AS EXHIBIT PAC-47R LM-3?

A. Yes. This is a copy of the document titled *Conceptual Framework for Assessing Ecosystem Health*, which was accepted for publication on March 19, 2019.

Q. IS THIS A TRUE AND CORRECT COPY OF THAT DOCUMENT?

A. Yes, it is.

Q. WHAT WAS YOUR ROLE IN DEVELOPING THIS DOCUMENT?

A. As I previously indicated, I assembled a team of the world's leading experts to evaluate overall ecosystem health of the Texas coast. That team worked together to develop the framework to evaluate ecosystem health, which was presented in this document.

PAC offers Exhibit PAC-47R LM-3.

Q. ARE THESE THE TYPES OF RESOURCES GENERALLY RELIED ON BY EXPERTS IN YOUR FIELD IN EVALUATING THE POTENTIAL FOR ADVERSE

IMPACTS FROM INDUSTRIAL DISCHARGES ON THE MARINE ENVIRONMENT?

A. Yes.

III. OPINIONS

Q. HAVE YOU DEVELOPED ANY OPINIONS REGARDING THE APPLICATION FILED BY THE PORT OF CORPUS CHRISTI OR THE DRAFT PERMIT PREPARED BY TCEQ?

A. Yes.

Q. WHAT IS YOUR OPINION REGARDING THE IMPACT OF THE BRINE DISCHARGE FROM THE POCCA DESALINATION PLANT ON THE MARINE ECOLOGY OF CORPUS CHRISTI BAY AND SURROUNDING WATERS?

A. Let me begin by saying that I am not opposed to desalination. In fact, I have been a proponent of desalination along the Coastal Bend for many years. I have been very clear that I believe desalination is a desirable goal and I have previously articulated the benefits that desalination can offer. That said, if desalination is not done properly, it can seriously harm the marine environment. With that in mind, my opinions are as follows:

1) As currently proposed by the Port and allowed by the Draft Permit, the discharge of highly concentrated brine into the Aransas Pass Tidal Inlet will have significant adverse impacts on marine life that migrate, spawn, feed, and live in and around the Aransas Pass Tidal Inlet, Corpus Christi Bay, and neighboring bay systems.

2) Rising salinity levels in Corpus Christi Bay and the surrounding bays are already a concern and have been since the 1990s. Originally, the concern was over reductions of freshwater inflow from the Nueces River to Nueces Bay. As it now stands, the bay system, including Nueces and Corpus Christi Bays from the mouth of the Nueces River to Aransas Pass inlet, is salinity stressed at least 53% of the time. The continual addition of highly concentrated brine into the Aransas Pass Tidal Inlet will materially increase the salinity levels in the bay system that is already salinity stressed. According to recent studies

(Montagna et al, 2021) the optimal salinity for maintaining existing biodiversity is between 22 parts per thousand ("ppt") and 24 ppt. The current average salinity, even during "wet" years of high rainfall and freshwater inflows, is 25.5 ppt. Thus, the bay system is already suffering from salinity stress. The Corpus Christi Bay region has high annual average wind speeds, temperatures, and salinities, and circulation is sluggish. In combination this means that the region is sensitive to changes in water borne materials, like brine discharges, because they are easily concentrated by high evaporation rates and difficult to disperse because of low flushing rates. An increase in salinity of even one part per thousand from a continual industrial discharge of brine will adversely impact the ecosystem in Corpus Christi Bay and surrounding bay systems. Such a discharge would likely accelerate negative trends, generating an ecological tipping point moving the system to an undesirable state that includes diminishing biodiversity, disrupted ecosystem function and productivity, and significant adverse socio-economic impacts.

3) The Applicant has conducted studies to determine the chronic toxicity of salinity on certain species in an effort to demonstrate that the salinity plume will not harm aquatic life. However, the species the Applicant tested are a) known to be more tolerant of salinity changes than other species and b) are not representative of the species of concern, namely red drum, blue crab, and shrimp.

4) The CORMIX modeling done by the Applicant and approved by the TCEQ does not accurately reflect what is actually expected to occur when brine is discharged. The model was never intended or designed to address salinity. Even if CORMIX is the only available model that can be used in support of the Application and it is applied properly, it still can only portray a generic representation of what may occur. Therefore, due to its inherent

limitations, additional evaluation must be done for it to be used as the basis for an antidegradation review.

5) The Parsons evaluation demonstrated that there are apparent stratified layers in the channel under tidal conditions where dissolved oxygen is extremely low (or even completely absent) near the outfall location. The eddy-derived depression near the outfall is likely to concentrate brine, increase the areas where there is also little to no dissolved oxygen, and prove fatal to any organisms trapped there.

6) I have worked with or known professionally several of the PAC experts, namely Dr. Greg Stunz and Mr. Scott Holt, on numerous projects over the course of several decades and have found them to be curious, hard-working, and dedicated. They are considered experts in marine ecology, fisheries management, and juvenile and larval migration, and I do not believe anyone else in the world knows more about these topics as related to the Aransas Pass Inlet and surrounding estuarine and coastal ecosystems than Dr. Stunz and Mr. Holt. Their work has, without exception, been based on a rigorous application of the scientific method, meticulous, and impartial.

Q. DO YOU RECOGNIZE THE DOCUMENT MARKED AS EXHIBIT PAC-47R LM-4?

A. Yes. This is a copy of *A Statement on Our Desalination Science*.

Q. IS THIS A TRUE AND CORRECT COPY OF THAT STATEMENT?

A. Yes.

Q. DID YOU WRITE THIS STATEMENT?

A. Yes, with the input of the HRI chairs and the Executive Director.

Q. DID YOU REVIEW THIS REPORT IN FORMING YOUR EXPERT OPINION?

A. Yes, I did. It confirmed my opinion on this matter.

PAC Offers Exhibit 47R LM-4.

Q. CAN YOU EXPLAIN THE PURPOSE OF THIS STATEMENT?

A. The statement lays out the potential use of desalination as a source of freshwater for the Coastal Bend and explains, from an ecological perspective, the pros and cons of desalination.

Q. WHAT DID HRI CONCLUDE WITH REGARD TO DESALINATION IN THE COASTAL BEND?

A. HRI's overall and primary conclusions in assessing potential desalination intake and discharge sites in Corpus Christ bay was that an offshore location of intake and discharge would be the best option to minimize impacts on biota, habitats, and water quality, and that in-shore discharge locations presented risk of significant adverse impacts.

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

A. Yes.

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

A. Greg Stunz.

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. In particular, I relied on the research of Dr. Montagna, Dr. Coffey, and Mr. Jose, who along with Dr. Stunz, recently published a report titled, *Vulnerability Assessment of Coastal Bend Bays*. This report addressed rising salinities in the Coastal Bend region and the effect of salinity change on habitat and aquatic species diversity in Corpus Christi Bay.

Q. HAVE YOU REVIEWED THE PRE-FILED TESTIMONY OF ANY PAC WITNESSES IN THE ORIGINAL HEARING CONDUCTED IN 2020?

A. Yes. I reviewed the testimony of Dr. Stunz, Mr. Holt and Mr. Trungale.

Q. Q. DID YOU AGREE WITH THE OPINIONS IN THE PRE-FILED TESTIMONY YOU REVIEWED?

A. Yes, I agree with the prefiled testimony of those witnesses I just named.

Q. EARLIER YOU STATED THAT THE DISCHARGE FROM THE PROPOSED DESALINATION PLANT COULD HAVE A SIGNIFICANT ADVERSE IMPACT ON MARINE LIFE IN AND AROUND THE ARANSAS PASS TIDAL INLET, CORPUS CHRISTI BAY AND NEIGHBORING BAY SYSTEMS. WILL YOU EXPLAIN WHY?

A. The proposed discharge will have an adverse impact on two fronts: 1) the saline plume in the immediate area of the discharge will kill millions of larvae who are unable to swim around it and physically incapable of handling the significant increase in salinity concentrations through which they will pass; and 2) Corpus Christi Bay is already salinity stressed 53% of the time and the addition of 96 million gallons per day of highly concentrated brine will likely lead to a significant decrease in biodiversity within Corpus Christi Bay.

Q. IN THE ALJS' PROPOSAL FOR DECISION, THEY DETERMINED THAT THE ARANSAS PASS INLET PLAYS A "KEY ROLE IN THE LIFE CYCLE OF ESTUARINE DEPENDENT SPECIES FOR THE CORPUS CHRISTI BAY SYSTEM." DO YOU AGREE WITH THAT CONCLUSION?

A. I certainly do. It is uncontroverted that the Aransas Pass Tidal Inlet is the primary conduit for larvae and early juvenile aquatic life to travel from the Gulf of Mexico to their nursery areas in Texas' Coastal Bend region.

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

A. Yes. The Aransas Pass Tidal Inlet is one of the most critically important features in the Coastal Bend as it serves as the spawning site and conduit through which aquatic life larvae and eggs reach the estuary ecosystems.

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. The reproductive activity that occurs at the Aransas Pass Tidal Inlet is one of the most important factors in maintaining healthy and productive populations of these fish species.

Q. WHAT IS THE VALUE OF THE REDFISH BAY STATE SCIENTIFIC AREA AND THE LIGHTHOUSE LAKES PADDLING TRAILS TO THE REGION AND HOW ARE THEY DEPENDENT UPON ARANSAS PASS INLET?

A. I established the Redfish Bay State Scientific Area through TPWD Commission rule in 2000 for the purposes of education, scientific research, and preservation of habitat with particular educational and scientific value. It is unique in many ways, containing examples of every major type of Texas coastal habitat important to recreational and commercial fisheries and is central to the sportfishing economies of the Coastal Bend. Those values – ecological, educational, and economic – depend upon successful and continued recruitment of fish, shellfish, and other species through the Aransas Pass tidal inlet. I established and mapped the Lighthouse Lakes Paddling trail in 1999 with similar purposes in mind and, like the state scientific area, Lighthouse Lakes is dependent upon recruitment through the Aransas Pass tidal inlet. Both designated sites are important nursery areas with sufficiently diverse habitats to support the complete lifecycles of economically and ecologically important marine species.

Q. HOW WILL THE PROPOSED SALINITY PLUME IMPACT LARVAE AS THEY TRAVEL THROUGH THE ARANSAS PASS TIDAL INLET TO THEIR NURSERY GROUNDS?

A. I agree with the ALJs' previous conclusion as stated in the PFD: "high salinity or saline imbalances can be fatal to aquatic life, particularly early life stages… fish larvae and embryos are particularly sensitive to changes in salinity; and that some aquatic organisms, including those in sensitive early life stages, will pass through the ZID and mixing zone and, thus, come into contact with the undiluted effluent, resulting in adverse impacts to

aquatic life." Because the Aransas Pass Tidal Inlet is *the* primary inlet for the entire region, and estuarine-dependent species concentrate in this particular area, especially larval and early-life stage individuals, the impacts of the discharge are magnified.

Q. WILL SOME AQUATIC ORGANISMS, INCLUDING THOSE IN SENSITIVE EARLY LIFE STAGES, PASS THROUGH THE ZID AND THE AQUATIC LIFE MIXING ZONE?

A. Mr. Holt provided about as good a description as I could hope to muster. Using red drum as an example, the larva hatch after about 24 hours, at which point, the embryo is essentially a yolk sac with a tail. Over the next 8-10 days the larvae begin to develop eyes, a mouth, a digestive tract. At this point, they only have undeveloped fins and undifferentiated muscles and are unable to swim. Slight vertical movement may be possible, but at this stage they are entirely dependent on the tidal current to move through the inlet into the bay systems. While the saline plume will not take up the entirety of the Aransas Pass Tidal Inlet, the fact that these larvae are planktonic means that millions of these larvae will be unable to avoid the plume and will be adversely impacted. The so-called zone of passage won't benefit the millions of larvae that pass through the plume, become dehydrated, and either die or suffer developmental impacts.

Q. DO YOU RECOGNIZE THE DOCUMENT MARKED AS EXHIBIT PAC-70R?

A. Yes. This is a copy of *Vulnerability Assessment of Coastal Bend Bays*.

Q. IS THIS THE REPORT YOU JUST MENTIONED, WRITTEN IN PART BY DR. STUNZ, AS WELL AS OTHER SCIENTISTS AT HRI.

A. Yes.

Q. DID YOU REVIEW THIS REPORT IN FORMING YOUR EXPERT OPINION?

A. Yes, I did.

PAC Offers Exhibit PAC-70R.

Q. HOW DID THIS REPORT INFORM YOUR OPINION?

A. This report demonstrates that Corpus Christi Bay is already salinity stressed 53% of the time. The addition of a concentrated saline discharge to an already salinity-stressed system will cause significant adverse impacts to our bays.

Q. WHAT DOES "SALINITY-STRESSED" MEAN?

A. Scientifically speaking, salinity stress can be defined as a salinity concentration that requires physiological responses by the affected organism to avoid interference with homeostasis and other biological processes. In other words, if an ecosystem is salinity stressed, the organisms that live in that ecosystem must make certain adaptations or develop a tolerance for continued stress in order to survive and/or complete those actions, like reproduction, to perpetuate the species. A simple example is when humans experience warm temperatures, we begin to sweat in order to maintain our internal temperature. But when we experience a heat stressed environment, we may be unable to cool ourselves to maintain a healthy temperature, resulting in heat rash, cramps, heatstroke, even death. Similarly, in salinity-stressed environments, aquatic species may be able to make certain adaptations to account for higher than optimal salinity concentrations but, depending on the concentration and the duration that the individual organism experiences the elevated salinity concentrations, an organism may experience significant adverse effects. Their particular developmental stage may also dictate their ability to tolerate or even move away from such stress.

Q. WHAT IS THE OPTIMAL SALINITY FOR THE CORPUS CHRISTI BAY SYSTEM?

A. According to a recent study conducted by HRI, the optimal salinity to maintain existing biodiversity in the Corpus Christi Bay System is between 22 and 24 ppt.

Q. WHAT DID THE STUDY CONCLUDE AS TO SALINITY LEVELS IN THE CORPUS CHRISTI BAY SYSTEM?

A. The study determined that the average salinity in the whole Corpus Christi Bay system has risen to 28.5 ppt. Even in the best conditions to lower salinities, during higher than normal rainfall periods, the average salinity in the whole system is about 25.5 ppt in those wet years, so on average, the system is already suffering from high salinity stress. For Corpus Christi Bay alone, the salinity is much higher, averaging 31.4 ppt from 1987 to 2016.

Q. HOW DOES SALINITY AT THE LEVELS FOUND IN THIS STUDY AFFECT THE AQUATIC ENVIRONMENT?

A. The study found that overall estuary community diversity in the Corpus Christi Bay System is related to salinity, and as salinity increases past the optimal range, species diversity declines, and abundance of some ecologically and economically important species will decrease. Average salinities are already at concerning levels within the system, and therefore, small increases in salinity likely would have an outsized impact on species abundance and diversity. Estuarine species can have broad tolerances for both temperature and salinity but typically they do have preferred salinity ranges. Beyond these ranges, species will avoid the area and fail to recruit to these areas because of physiological stress and related factors. Adults will migrate to other more suitable areas if they can, or they will just fail to reproduce. A specific salinity range can maintain maximum biodiversity by accommodating the preferred salinity ranges of the greatest number of species. The study denotes the ideal range to be between 22 ppt and 24 ppt for the Corpus Christi Bay system. This study concluded that once salinity increases past this preferred range, species diversity decreases. The study also evaluated impacts of salinity changes on six individual species. Each species has a different preferred salinity range and a different response to salinity concentrations. So even though all of those species are native to the Coastal Bend, salinity ranges that have no impact on one species may be fatal to another. The preferred salinity

range for white shrimp was 15 – 25 ppt. For blue crab, the preferred range was 10 – 25 ppt. For both species, population abundance decreased meaningfully at higher salinities exceeding 30 – 40 ppt. The preferred salinity ranges for Atlantic croaker were 15 – 25 ppt, which also exhibited highly variable responses to salinities exceeding 40 ppt. Brown shrimp appear to tolerate a wide range of salinities; however, their probability of occurrence declined at salinities less than 12 ppt. Finally, pinfish and sheepshead minnow exhibited the greatest tolerance to high salinities beyond 30 - 35.

Q. WILL THE DISCHARGE FROM THE PROPOSED DESALINATION PLANT INCREASE SALINITY WITHIN CORPUS CHRISTI BAY?

A. It absolutely will. This is undisputed. It is a certainty that when you discharge fluids at higher salinity levels than the ambient receiving water, the salinity levels in the receiving water will increase. The Applicant's own witness testified that the desalination brine discharge would increase salinity by 0-1 ppt in the vicinity of the discharge and throughout the Corpus Christi Bay system. This may seem de minimis in a system with a salinity range of roughly 25 ppt to 32 ppt, but it is significant in a salinity-stressed environment. Moreover, long-term trends appear to be increasing and even small but sustained salinity inputs will likely accelerate or amplify natural trends in a synergistic manner. Of course, even this assumes that the SUNTANS modeling performed by the Applicant used correct inputs and accurately predicted the increase in salinity from the proposed discharge. The confounding factor for models like SUNTANS is that the concentrated brine discharge is continuous, regardless of tidal state or other drivers like wind. The discharge of high volumes of high salinity water continues, replacing whatever is diluted or moved out of the immediate area by currents. Thus, the discharge that gets diluted is immediately replaced with new undiluted discharge, resulting in a relatively perpetual state of highly

concentrated high-salinity water through which aquatic life is passing. The salinity input from the desalination facility is not a natural one and it is not clear the model properly takes into account the persistent and ongoing nature of such discharge. Thus, the projected salinity increase could only be larger than currently projected, also increasing risk of long-term ecological harm.

Q. ARE YOU AWARE THAT THE APPLICANT CONDUCTED STUDIES TO DETERMINE THE CHRONIC TOXICITY OF SALINITY ON TWO SPECIES, THE MYSID SHRIMP AND INLAND SILVERSIDE?

A. Yes.

Q. DID THOSE STUDIES INFORM YOUR OPINION REGARDING THIS APPLICATION?

A. No, they do not because they are not helpful for determining the actual impact in this particular water body. The two species selected for chronic toxicity testing are well known to be relatively tolerant of high salinity levels. The testing of such species provides no useful information in evaluating salinity impacts on species that might be subject to discharge of concentrated brine in the Aransas Pass inlet. These species are not similar in their salinity tolerance, nor are their life cycles similar to the species of concern, namely red drum, blue crab, and shrimp. The fact that the Applicant has conducted studies to determine the chronic toxicity of salinity on the mysid shrimp and the inland silverside provides no useful information about the chronic toxicity of salinity on the species that we are most concerned about. However, we do know that red drum, blue crab, and shrimp have a lower tolerance for salinity and that due to their spawning patterns, the larvae of these species will be carried by tides from the Gulf of Mexico through the Aransas Pass Tidal Inlet and through the salinity plume created by the discharge from the proposed desalination plant on their way to the estuarine habitats where they develop into juveniles and sub-adults.

Q. HAVE YOU REVIEWED THE TESTIMONY OF APPLICANT'S WITNESS, LANCE FONTENOT?

A. I have.

Q. WHAT ARE YOUR OPINIONS OF HIS TESTIMONY?

A. I was alarmed by some of the testimony. He argues that the modeling conducted by the Applicant shows that the salinity increases are well within the salinity levels established by the EPA.

Q. WHY DOES THIS ALARM YOU?

A. For two reasons. First, he refers to this "salinity level established by the EPA" as if it is some sort of established regulation. The document *Quality Criteria for Water, 1986* that Dr. Fontenot references specifically states on page 1: "These criteria are not rules and they do not have regulatory impact." Second, according to his argument, anything less than a 10% increase of salinity above ambient salinity levels at the mixing zone boundary is acceptable. This was based on a paper published in 1953 by Rounsefell and Everhart and used as a recommendation in a 1968 NTAC Report to inform this EPA report. What we know about this topic now is significantly greater, as can be seen in the Montagna, Coffey, Jose and Stunz - 2021 study. A permanent 10% increase in salinity over naturally occurring conditions would have catastrophic impacts in the Corpus Christi Bay system. Similarly, an increase of 4 ppt would greatly diminish biodiversity in this already salinity-stressed ecosystem most likely pushing past an ecological tipping point. The suggestion that a 10% salinity increase or 4 ppt increase would comply with EPA's 1968 criteria, which as stated in the report are not rules and that have no regulatory impact, implying that there is no adverse impact on the aquatic environment demonstrates a lack of understanding of how Aransas Pass Tidal Inlet, Corpus Christi Bay, and the surrounding bays systems function. The Applicant's argument takes a general statement (which EPA indicated should not be

used as a general standard) and then applies it to an environment without regard to the circumstances of that particular environment and does not take into account what we have learned about this ecosystem and fisheries science in 69 years.

Q. DO YOU RECOGNIZE THE DOCUMENT MARKED AS EXHIBIT PAC-47R LM-5?

A. Yes. This is a copy of the EPA's *Quality Criteria for Water, 1986*.

Q. IS THIS THE DOCUMENT DR. FONTENOT WAS REFERRING TO AND WHICH STATES "THESE CRITERIA ARE NOT RULES AND THEY DO NOT HAVE REGULATORY IMPACT"?

A. Yes, it is.

PAC offers Exhibit PAC-47R LM-5.

Q. DO YOU AGREE WITH DR. FONTENOT'S TESTIMONY THAT THE PREDICTED CHANGES IN SALINITY RESULTING FROM THE DISCHARGE OF 96 MILLION GALLONS PER DAY OF CONCENTRATED BRINE WILL NOT CAUSE SIGNIFICANT IMPACTS.

A. No. As previously stated, it is my opinion that a desalination plant located within Aransas Pass Tidal Inlet will have significant adverse impacts on the marine ecosystem.

Q. HAVE YOU REVIEWED TCEQ'S ANTI-DEGRADATION ANALYSIS?

A. Yes, I have.

Q. WHAT IS YOUR OPINION ABOUT THE ANTI-DEGRADATION ANALYSIS?

A. I find the analysis to be severely lacking.

Q. CAN YOU EXPLAIN WHY?

A. The documentation provided by the Executive Director merely provides conclusory statements and provides no substantive analysis of the concerns raised in the previous hearing and does not demonstrate that the Tier 1 and Tier 2 standards are actually met. The TCEQ's Interoffice Memo summarily states:

> A Tier 1 antidegradation review has preliminarily determined that existing water quality uses will not be impaired by this permit action. Numerical and narrative criteria to protect existing uses will be maintained. A Tier 2 review has preliminarily determined that no significant degradation of water

> quality is expected in Corpus Christi Bay which has been identified as having exceptional aquatic life use. Existing uses will be maintained and protected.

However, just like in the previous hearing, the ED has not provided any support for these conclusory statements. Furthermore, the ED has failed to provide any documentation that consideration was given to the Aransas Pass inlet's key role in the life cycle of estuarine-dependent species for the Corpus Christi Bay system. Thus, the antidegradation analysis has again failed to provide the "careful consideration" required by the TSWQS. Finally, the antidegradation review is in large part based upon the findings from the CORMIX model. While TCEQ has argued that this is the only model available to it, that does not mean the results should be determinative of whether or not the Tier I and Tier 2 standards have been met. In light of the significant shortcomings of the CORMIX model in this particular application, the sensitive nature of the surrounding ecosystem, and the salinity tolerances of larvae that will pass through the ZID, a more robust anti-degradation analysis is required. Instead, the ED simply retread the same analysis that was previous rejected by the ALJs and provided no meaningful discussion or analysis of how the antidegradation determination was reached.

Q. DO YOU AGREE THAT MERELY FOLLOWING THE TCEQ'S IMPLEMENTATION PROCEDURES FOR ANTIDEGRADATION REVIEW IS "NOT SUFFICIENT ON ITS OWN TO ENSURE THE PROPOSED DISCHARGE COMPLIES WITH THE SUBSTANTIVE ANTIDEGRADATION STANDARDS?"

A. Absolutely. If the information being used to support the TCEQ's antidegradation analysis is based on a model that cannot accurately predict salinity levels at the edge of the ZID or the aquatic life mixing zone, then following the formulaic steps laid out in the Implementation Procedures cannot, by itself, demonstrate that the discharge will not cause degradation of water quality.

Q. DO YOU KNOW THAT SALINITY GRADIENTS IN ESTUARIES MUST BE MAINTAINED TO SUPPORT ATTAINABLE ESTUARINE-DEPENDENT AQUATIC LIFE USES?

A. Yes. I understand this is a requirement under the Texas Surface Water Quality Standards.

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

A. Yes.

Q. CAN SALINE IMBALANCES BE FATAL TO AQUATIC LIFE? PARTICULARLY EARLY LIFE STAGES?

A. Yes. While adult fish generally display a much greater tolerance for changes in salinity levels, significant salinity imbalances can impair feeding and reproductive capabilities or even be fatal to adults. Early life stage organisms are generally much more susceptible to environmental changes and even small changes in salinity can be fatal.

Q. WILL SOME AQUATIC ORGANISMS, INCLUDING THOSE IN SENSITIVE EARLY LIFE STAGES, COME INTO CONTACT WITH THE UNDILUTED EFFLUENT?

A. Yes.

Q. DOES CONTACT WITH THE UNDILUTED EFFLUENT RESULT IN ADVERSE IMPACTS TO AQUATIC LIFE?

A. It does.

Q. CAN EVEN SMALL INCREASES IN SALINITY HAVE ADVERSE EFFECTS, PARTICULARLY IF THE AMBIENT SALINITY IS ALREADY AT THE PHYSIOLOGICAL LIMIT FOR SOME SPECIES?

A. Yes, if salinity levels are already at a species' physiological limit, even small increases will have an adverse effect.

Q. DO YOU KNOW WHETHER THE DRAFT PERMIT'S EFFLUENT LIMIT AT THE ZID BOUNDARY WAS SET BASED ON WHAT IS PROTECTIVE OF AQUATIC LIFE?

A. The draft permit's effluent limit was based upon the results of the CORMIX modeling. The limit was established without any consideration of what is protective of aquatic life. It was based on what the model projects as achievable. So, rather than determining a safe

limit and then modeling to see if that limit is achieved, the ED modeled to see what the limit would be and then classified that limit as safe.

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

A. No, it is not. I know this is an accepted approach in cases where it seems clear that any potential problem is of a nature that can be readily corrected through some technical action. This may be possible because some minor component of the discharge is creating the problem or there are alternate disposal technologies or location options. In this case the potential issue is concentrated brine, and the primary discharge is in such quantities that no viable post construction option would be practical to remediate it.

Q. DOES THE DRAFT PERMIT REQUIRE TESTING OF SALINITY IMPACTS ON LARVAL STATES OF FISH?

A. The permit requires that the Applicant test the effluent for toxicity on the larval stage of the mysid shrimp and the inland silverside. As previously noted, both species are much more tolerant of salinity changes than the species of concern that actually live in the local waterbodies. Furthermore, the permit requires this testing after the discharge commences, which is not sufficient to protect the marine environment.

Q. HAVE YOU REVIEWED THE OPINIONS, DATA, OR INFORMATION FROM OTHER TESTIFYING WITNESSES RETAINED BY THE APPLICANT AND THE EXECUTIVE DIRECTOR IN FORMING YOUR OPINIONS?

A. I have reviewed the application, prefiled testimony, depositions, and the data provided by the Applicant and the ED.

Q. HAVE YOU BEEN PROFESSIONALLY ASSOCIATED OR WORKED WITH ANY OF THE PAC EXPERTS OUTSIDE OF THIS CASE?

A. Yes. I have previous with Dr. Stunz. Mr. Holt, and Mr. Trungale.

Q. ARE THESE INDIVIDUALS RESPECTED IN THEIR FIELDS?

A. Yes, they are

Q. ARE THEY CREDIBLE?

A. Yes, they are. Dr. Stunz is, in my opinion, the top fisheries scientist in the Gulf of Mexico and one of the best in the United States. I hired Joe Trungale and worked with him for many years at TPWD. I put my trust in his modeling capabilities for many years with regard to hydrological modeling for applications that affected fish and wildlife in the State of Texas. I have been professionally associated with Scott Holt for more than 20 years. He has been a trusted voice within the scientific community and acknowledged expert regarding fisheries ecology and life histories of aquatic species in the region.

Q. IN YOUR OPINION, WOULD THESE INDIVIDUALS ALLOW PERSONAL PREFERENCES TO AFFECT THEIR SCIENTIFIC STUDIES AND CONCLUSIONS IN THIS MATTER?

A. No, they would not.

IV. CONCLUSION

Q. WHAT ARE YOUR CONCLUSIONS REGARDING THE APPLICATION AND PROPOSED DISCHARGE INTO THE ARANSAS PASS TIDAL INLET?

A. I found the Discussion and Analysis section of the ALJs' Proposal for Decision to provide a compelling summary that succinctly discussed the ecological risks of approving the initially proposed permit. After reviewing many of the documents upon which the analysis was based and undertaking my own risk assessment based on my own knowledge and years of experience, I came to the same conclusion regarding the potential negative impact of this proposed project on the marine ecosystems of the Corpus Christi Bay System. I have further reviewed the updated application, supporting documents and various depositions, as well as new information about the health of the system. I have not changed my initial conclusion that this permit represents significant risk to the future health and productivity of the estuarine systems that depend upon the Aransas Pass Tidal Inlet. I have presented the basis of this conclusion in my deposition and in this pre-trial testimony. I do feel this is

an important project that can contribute to the ecological and economic health of the Texas coast and this region in particular, if the negative ecological effects of the discharge can be addressed. The risk of doing significant and permanent harm to one Texas most valuable coastal and estuarine resources is too great to proceed as proposed. The most obvious alternative that would allow this project to proceed without potential significant ecological harm would be to move the discharge to an offshore location in the Gulf of Mexico.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.