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

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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** |

# EXHIBIT PAC-53R

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

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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

# BRUCE l. WILAND

# ON BEHALF OF

# PORT ARANSAS CONSERVANCY

# SUBMITTED ON FEBRUARY 2, 2022

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

| | | |
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| **IN THE MATTER OF THE** | **§** | **BEFORE THE STATE OFFICE** |
| **APPLICATION OF PORT OF** | **§** | |
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| **PERMIT NO. WQ0005253000** | **§** | **ADMINISTRATIVE HEARINGS** |

**REMAND PREFILED TESTIMONY OF BRUCE L. WILAND**

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# REMAND PREFILED TESTIMONY OF BRUCE L. WILAND

## I. INTRODUCTION

**Q: PLEASE STATE YOUR NAME.**

A: Bruce Wiland.

**Q: PLEASE STATE YOUR ADDRESS.**

A: Wiland Consulting, Inc., 1510 Oxford Avenue, Austin TX 78704.

**Q: PLEASE BRIEFLY DESCRIBE YOUR OCCUPATION.**

A: I am a professional engineer specializing in environmental engineering. I have been a registered professional engineer in the State of Texas since 1978.

**Q: WHAT HAVE YOU BEEN ASKED TO DO RELATED TO THIS APPLICATION?**

A: I was engaged by the Port Aransas Conservancy ("the Conservancy") to work with it and its counsel on the pre-remand TPDES application of the Port of Corpus Christi Authority ("the POCC") and to provide testimony on the issues referred for the initial hearing. After that matter was remanded, I was asked to perform similar work with regard to the POCC's June 25, 2021 post-remand application. I have been asked to review a number of documents and prepare this supplemental direct testimony.

**Q: MR. WILAND, THE TCEQ COMMISSIONERS REMANDED SEVEN (7) ISSUES TO THE STATE OFFICE OF ADMINISTRATIVE HEARINGS FOR FURTHER TRIAL. THESE ISSUES WERE, IN SUMMARY:**

**1) IMPACTS AND EXTENT OF IMPACTS ON AQUATIC ORGANISMS THAT MOVE THROUGH A ZONE OF INITIAL DILUTION;**

**2) IMPACTS OF THE PROPOSED DISCHARGE ON MARINE LIFE AND TERRESTRIAL LIFE THAT IS DEPENDING ON THE MARINE ENVIRONMENT;**

**3) IMPACTS OF THE PROPOSED DISCHARGE ON RECREATIONAL ACTIVITIES, COMMERCIAL FISHING, OR FISHERIES IN CORPUS CHRISTI BAY AND THE SHIP CHANNEL;**

**4) WHETHER THE APPLICATION AND REPRESENTATIONS CONTAINED, THEREIN, ARE COMPLETE AND ACCURATE;**

**5) WHETHER THE MODELING UTILIZED ACCURATE INPUTS AND COMPLIES WITH APPLICABLE REGULATIONS TO ENSURE THE DRAFT PERMIT IS PROTECTIVE OF WATER QUALITY;**

**6) WHETHER THE EXECUTIVE DIRECTOR'S ANTI-DEGRADATION REVIEW WAS ACCURATE; AND**

**7) WHETHER THE DRAFT PERMIT INCLUDES ALL APPROPRIATE AND NECESSARY REQUIREMENTS.**

**Q. ON WHICH OF THESE ISSUES HAVE YOU BEEN ASKED TO OPINE?**

A: I have been asked to address the last four of those issues.

**Q. WHAT RESOURCES DID YOU RELY UPON, OTHER THAN YOUR OWN EXPERTISE AND EXPERIENCE IN PREPARING FOR THIS TESTIMONY AND YOUR OPINIONS?**

A. In addition to the documents and other resources I identified in my pre-remand testimony, such as the review of a number of documents on the CORMIX model, I have reviewed parts of the post-remand application and other documents provided by the POCC and the TCEQ Executive Director; these documents are included within Tabs I and J of what I understand to be referred to as the "administrative record." I have discussed aspects of my work and the work of other experts with some of the Conservancy's experts, including Dr. Scott Socolofsky, Mr. Tim Osting, and Dr. Barney Austin.

**Q. ARE THESE THE TYPES OF RESOURCES GENERALLY RELIED ON BY EXPERTS IN YOUR FIELD?**

A. Yes.

**Q: BEFORE YOU WERE ENGAGED, HAD YOU DONE ANY WORK INVOLVING THE PROPOSED DISCHARGE OR OTHER ASPECTS OF THE DESALINATION FACILITY PROPOSED BY THE POCC?**

A: No.

**Q: HAVE YOU DONE ANY WORK FOR THE POCC IN THE PAST?**

A: No.

## II. SUMMARY OF YOUR OPINIONS

**Q: PLEASE TELL THE ALJS VERY BRIEFLY YOUR OPINIONS ON THE FOUR TOPICS YOU WERE ASKED TO ADDRESS. I WILL RETURN TO EACH FOR A MORE THOROUGH EXPLANATION, LATER.**

A: (1) I understand the "Application and representations contained therein," to refer to the materials in Tab I of the administrative record. Those materials are not complete and accurate,

because they are internally inconsistent regarding the location of the diffuser, are internally inconsistent regarding the contours of the floor of the ship channel in the vicinity of the diffuser. The materials also do not characterize the contaminants to be added to the effluent by the desalination process.

(2) Because of the ambiguities and omissions of input data that I just noted, the modeling cannot be said to have used accurate inputs and cannot be said to indicate, let alone to ensure, the Draft Permit will be protective of water quality.

(3) The Executive Director's antidegradation review was not accurate, because it relies on the outputs of the modeling which, as I have just noted, is untrustworthy and is based on a *de minimis* standard that the Executive Director has not defined; it also appears not to have evaluated the impacts of changes in salinity concentrations, whether measured as a function of time or of distance.

(4) The Draft Permit does not include appropriate requirements, because it does not require instream, i.e., in the water body, monitoring to confirm that the effluent percentage at the boundary of the ZID never exceeds 14.6% or that the effluent plume dimensions or contaminant concentrations are as the modeling predicts they would be at any location.

## III. QUALIFICATIONS

**Q: PLEASE IDENTIFY WHAT HAS BEEN MARKED AS EXHIBIT PAC-R53 BW-1.**

A**:** That exhibit is a copy of my current resume.

**Q: IS THIS A TRUE AND ACCURATE COPY OF YOUR RESUME?**

A: Yes.

**Q. IS IT ANY DIFFERENT FROM THE ONE THAT WAS ATTACHED TO YOUR 2020 WRITTEN DIRECT TESTIMONY?**

A. No.

*PAC offers Exhibit PAC-53R BW-1.*

**Q: PLEASE BRIEFLY DESCRIBE YOUR EDUCATIONAL BACKGROUND THAT IS A BASIS FOR YOUR TESTIMONY IN THIS PHASE OF THE PROCEEDING**

A: I have a Bachelor of Engineering Science from The University of Texas at Austin, which I received in January 1974. I have a Master of Science in Environmental Health Engineering from The University of Texas at Austin, which I received in December 1975. I have also attended a number of short courses since graduation, as shown on my resume, as well as meeting the annual Continuing Education requirements for my Professional Engineer's license.

**Q: PLEASE BRIEFLY DESCRIBE YOUR PROFESSIONAL EXPERIENCE THAT IS A BASIS FOR YOUR TESTIMONY HERE.**

A: For ten years, from 1976 to 1986, I worked for the State environmental agency, which is now the Texas Commission on Environmental Quality, where I was responsible for performing work in water resource analysis and modeling of water quality. I then worked for the consulting engineering firm Jones & Neuse from 1986 to 1991 where I directed a staff of engineers and biologists responsible for water quality projects, including work on applications for discharge permits, environmental site assessments, environmental audits, evaluation of regulatory impacts, and preliminary engineering assistance in industrial wastewater design. I have been an independent engineering consultant since 1991, conducting engineering and environmental studies and evaluations for water quality, air quality, and hazardous and solid waste projects.

**Q: IF I REFER TO THE STATE AGENCY AS TCEQ AND NOT A PRIOR AGENCY NAME, CAN WE AGREE THAT I AM REFERRING TO THE TCEQ AND ITS PREDECESSORS, IF THE QUESTION RELATES TO TCEQ OR ITS PREDECESSORS?**

A: Yes.

**Q: PLEASE DESCRIBE IN MORE DETAIL YOUR WORK EXPERIENCE THAT RELATES TO YOUR TESTIMONY HERE.**

A: I have conducted numerous modeling simulations including both steady-state and dynamic models. I developed the QUAL-TX water quality model used by the State of Texas and the LA-QUAL water quality model used by the State of Louisiana to evaluate impacts on receiving waters of wastewater discharges. I have work experience related to four desalination or reverse osmosis projects. I worked for the applicant in three of these instances (City of Electra, North Texas Municipal Water District, and Chem-Tex) and for a protestant in one instance (discharge into Possum Kingdom reservoir). I have worked on projects involving CORMIX in two instances, both on behalf of protestants (related to a Formosa Plastics discharge to Lavaca Bay and a City of Abilene discharge into Possum Kingdom reservoir).

**Q: HAVE YOU EVER TESTIFIED AS AN EXPERT WITNESS IN A TRIAL OR ADMINISTRATIVE HEARING**

A: Yes.

**Q: PLEASE DESCRIBE BRIEFLY FOR THE ALJS YOUR PREVIOUS EXPERIENCE IN THIS REGARD.**

A: While working for the State, I participated in a number of administrative permit hearings testifying for the Executive Director. I do not recall the specific permits. While working for Jones & Neuse, I also participated in a number of administrative permit hearings testifying as an expert witness for Applicants. As an independent consultant, I have provided testimony in my expert capacity in two district court proceedings, and a number of administrative hearings.

**Q: HAVE YOU PERFORMED WORK FOR A DESALINATION FACILITY IN THE CORPUS CHRISTI BAY AREA?**

A: Yes.

**Q: PLEASE TELL US A BIT ABOUT THAT.**

A: I performed work as a subcontractor to James Miertschin and Associates, which was a subcontractor to Zephyr Engineering on the waste water discharge permit application filed by ChemTex. I modeled salinity in the Corpus Christi Inner Harbor from a proposed 9 MGD desalination plant with a 96 parts per thousand ("ppt") salinity effluent. For this work, I used

the one-dimensional steady-state QUAL-TX computer model and the two-dimensional dynamic CE-QUAL-W2 computer model.

**Q: WHAT WAS THE PURPOSE OF THE WORK?**

A: The purpose of the work was to determine if locating an intake near the discharge of the high-salinity reject water would result in a feedback loop and steadily increase salinity in the intake. The work also involved investigation of the best locations for the intake and outfalls.

**Q: WHAT WERE THE RESULTS OF YOUR WORK?**

A: The steady-state model indicated an overall increase of salinity in the Corpus Christi Bay Inner Harbor of about 8 ppt. As I recall, the dynamic model showed a significantly smaller increase in the average ambient salinity. Because of this disparity, I remember discussing both the possibility of conducting a dye study to better define the mixing of the effluent and ambient water and the need to monitor the salinity in the Corpus Christi Bay Inner Harbor after the discharge began in order to determine whether the modeling results were accurate.

**Q: PLEASE PROVIDE MORE DETAILS ON THE WORK YOU HAVE DONE ON EVALUATIONS OF OR FOR INDUSTRIAL WASTE DISCHARGES IN THE PAST.**

A: When at TCEQ, I wrote the waste load evaluation for the Houston Ship Channel. That waste load evaluation set the basic permit limitations for discharge permits in the entire Houston Ship Channel watershed for both municipal and industrial dischargers. I also sat on the agency's Executive Review Committee that reviewed all permits, including industrial permits, prior to issuance to ensure that they met applicable regulations and would not degrade water quality. While at Jones & Neuse, I prepared or supervised numerous industrial wastewater permit applications, which applications included those for discharges from refineries, bulk handling facilities, and manufacturing facilities. I conducted wastewater treatment evaluations of industrial facilities, including electroplaters, petroleum refiners, and chemical manufacturers.

## IV. YOUR OPINIONS AND THEIR BASES IN MORE DETAIL

### A. THE DISCHARGE LOCATION AND THE LOCAL BATHYMETRY

**Q: RETURNING TO YOUR EARLIER OPINION THAT THE AMENDED POST-REMAND APPLICATION MATERIALS ARE NOT COMPLETE AND ACCURATE, CAN YOU ELABORATE FOR THE ALJS AS TO WHY YOU BELIEVE THAT?**

A: Yes. The bathymetry, i.e., the contours of the channel floor, on the map (Figure 1) used by Dr. Tischler for his June 24, 2021 diffuser analysis is incorrectly located. And, the location of the discharge on that map is, similarly, incorrectly located.

**Q: WHAT SUPPORTS YOUR TESTIMONY THAT THE CONTOURS ARE INCORRECTLY LOCATED?**

A: The Figure 1 bathymetry is not consistent with the bathymetry provided by the POCC for its original application. See, Exhibit PAC-3 BW-4 from the pre-remand hearing. Nor is it consistent with the bathymetry available from the Corps of Engineers for 2019, the most recent year I had available to me. (This bathymetry is a layer in Exhibit PAC-53R BW-16.) More importantly, the Figure 1 bathymetry is not even consistent with the bathymetry in Figure 4 of the 24 Jun 2021 Parsons Summary Technical Memorandum, which is also included in the materials of the June 25, 2021 amended application. The bathymetry in the vicinity of the discharge on Figure 1 used by Dr. Tischler was shifted to the south from what I believe to be the accurate map of the bathymetry by about 30 feet.

**Q: OK, BEFORE TURNING TO YOUR CRITICISM OF THE AMENDED APPLICATION'S REPRESENTATION OF THE DISCHARGE LOCATION, CAN YOU EXPLAIN WHERE THE DISCHARGE LOCATION IS RELATED TO THE OVERALL DIFFUSER CONFIGURATION?**

A: The discharge location is where the effluent exits the diffuser ports into the waters of the ship channel. My understanding is that the ports are on risers, i.e., pipes leading up from the diffuser barrel and that the diffuser barrel will be connected to the pipeline transporting the saline effluent from the desalination facility. That diffuser barrel is buried into the north side-

slope of the channel, as I understand it. This side-slope continues down into a hole that is deeper than the dredged channel.

**Q: WHAT IS YOUR SUPPORT FOR THE TESTIMONY THAT THE FIGURE 1 DISCHARGE LOCATION IS INCORRECT?**

A: I have made the necessary assumption that the latitude and longitude for the discharge location given in the application materials filed by the POCC June 25, 2021 correctly identify the discharge location. There are latitude and longitude figures provided by the POCC for the discharge point on page 9 of its Industrial Wastewater Application Administrative Report and page 6 of the Industrial Wastewater Application Technical Report. See, Admin. Rec. Tab I, pp. 00225 and 00231. The location shown on Dr. Tischler's Figure 1 map is elsewhere and is incorrect. Moreover, assuming the bathymetry shown in Figure 4 of the 24 Jun 2021 Parsons Summary Technical Memorandum, the ports for the diffuser at the depth given for the diffuser ports in Table 1 of Dr. Tischler's technical memo would not be in the water but would be buried in the north side slope of the hole.

**Q: I SEE DR. JONES, IN HIS DIRECT TESTIMONY, HAS ALSO OFFERED SOME GRAPHICS RELATED TO THE DISCHARGE LOCATION. ARE HIS CONSISTENT WITH THE LATITUDE-LONGITUDE COORDINATES SET FORTH IN THE AMENDED APPLICATION FORMS?**

A: No. The location of the discharge shown on exhibits APP-CJ-10-R to APP-CJ-16-R for Dr. Jones' direct testimony are also not consistent with the post-remand application representations and show the discharge 57 feet southwest or toward Corpus Christi Bay from the latitude and longitude location specified in the post-remand application. Additionally, Exhibit APP-CJ-7-R and APP-CJ-19-R for Dr. Jones' testimony gives another location for the discharge, although this location is relatively close (11 ft) from the correct latitude and longitude. To the extent that these locations affected the depths used in the calculations and subsequent opinions of the POCC's experts, their conclusions would not be reliable.

**Q: DO YOU HAVE ANY GRAPHICS THAT WOULD HELP US UNDERSTAND THESE INCONSISTENCIES YOU HAVE DESCRIBED?**

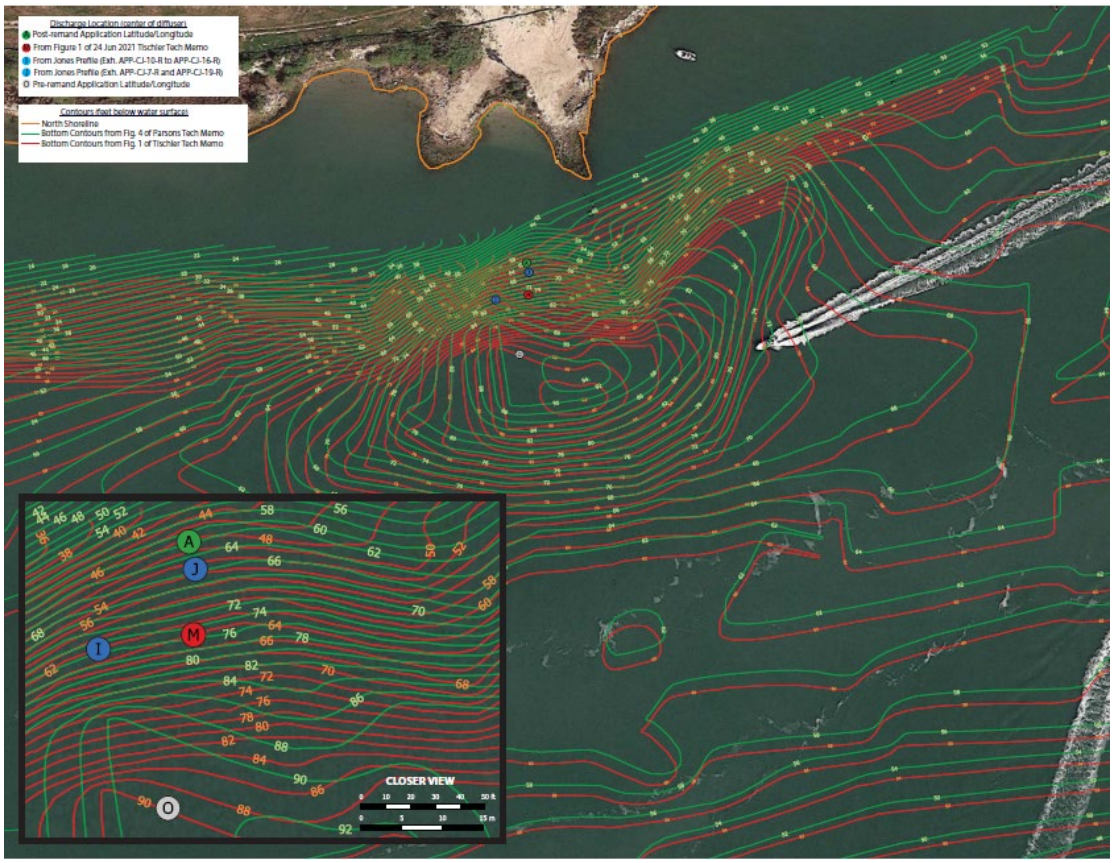
A: Yes. I have prepared two, Remand Exhibits PAC-53R BW-2 and PAC-53R BW-3.

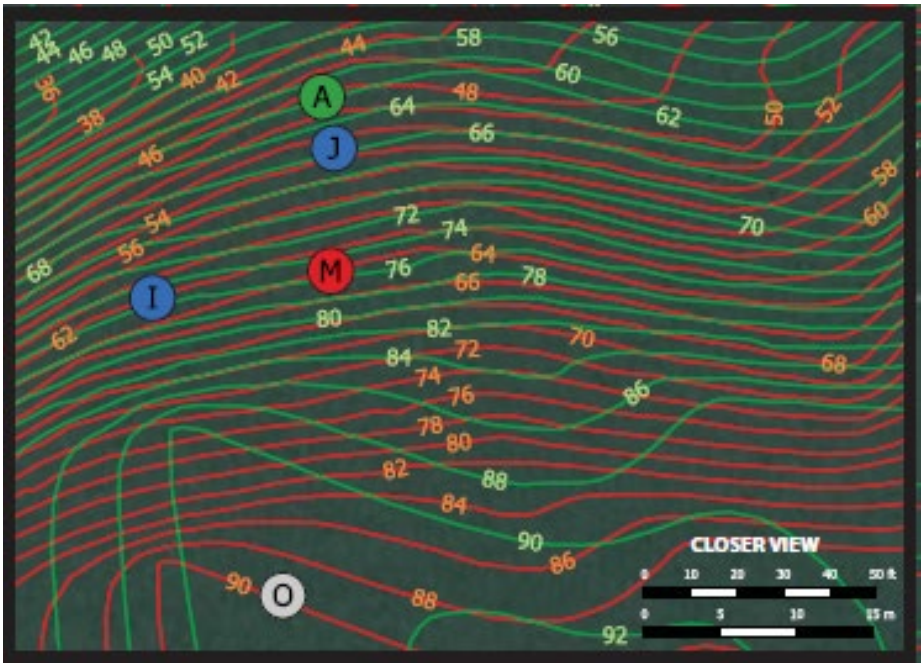
**Q: PLEASE DESCRIBE THESE FOR US.**

A: Remand Exhibit PAC-53R BW-2 (contour comparison) is one I prepared. It depicts the channel floor contours as shown on Figure 1 of Dr. Tischler's memo from the June 25, 2021 Amended Application in green (see Admin. Rec. Tab I, p. 00254) and the floor contours shown on Figure 4 of the Parsons Summary Technical Memorandum from the same application in red (see Admin. Rec. Tab I, p. 00185). The background aerial photo which provides the background for the bathymetry in Exhibit PAC-53R BW-2 is the same one as was used in the two figures from the Amended Application.

**Q: HOW WERE THE CONTOURS DEVELOPED?**

A: The contours were developed by georeferencing the two figures to a georeferenced Google aerial map (same background aerial photo in the figures) and then tracing the contours.






**Q: WHAT IS THE SIGNIFICANCE OF THE SMALL COLORED DOTS AMID THE CONTOURS ON EXHIBIT PAC-53R BW-2, ALSO DEPICTED ABOVE?**

A: The dots show the different locations the Port or its witnesses have claimed the discharge point will be located under the amended application. As you can see, the Port and its witnesses have not been consistent in their understanding of the discharge location. Exhibit PAC-53R BW-2 (see, particularly, the inset) shows the discharge location as shown on the Amended Application Tischler Figure 1 map and separately, the discharge location as given by the latitude and longitude in that version of the application. The red dot with the letter "M" represents the discharge location as shown by a filled yellow circle on the map in Tischler Figure 1. This red dot does not correspond to the latitude and longitude location in the Amended Application. The green dot with the letter "A" corresponds to the discharge location as given by the latitude and longitude in the Amended Application. The blue dots with the letters "I" and "J" correspond to the two discharge locations as shown in the Exhibits from Dr. Jones' direct testimony. Figure 4 of the Parsons Technical Memorandum did not include a discharge location. You can see from Exhibit PAC-53R BW-2 that the locations of the contours are not consistent between the two Amended Application technical memoranda figures and

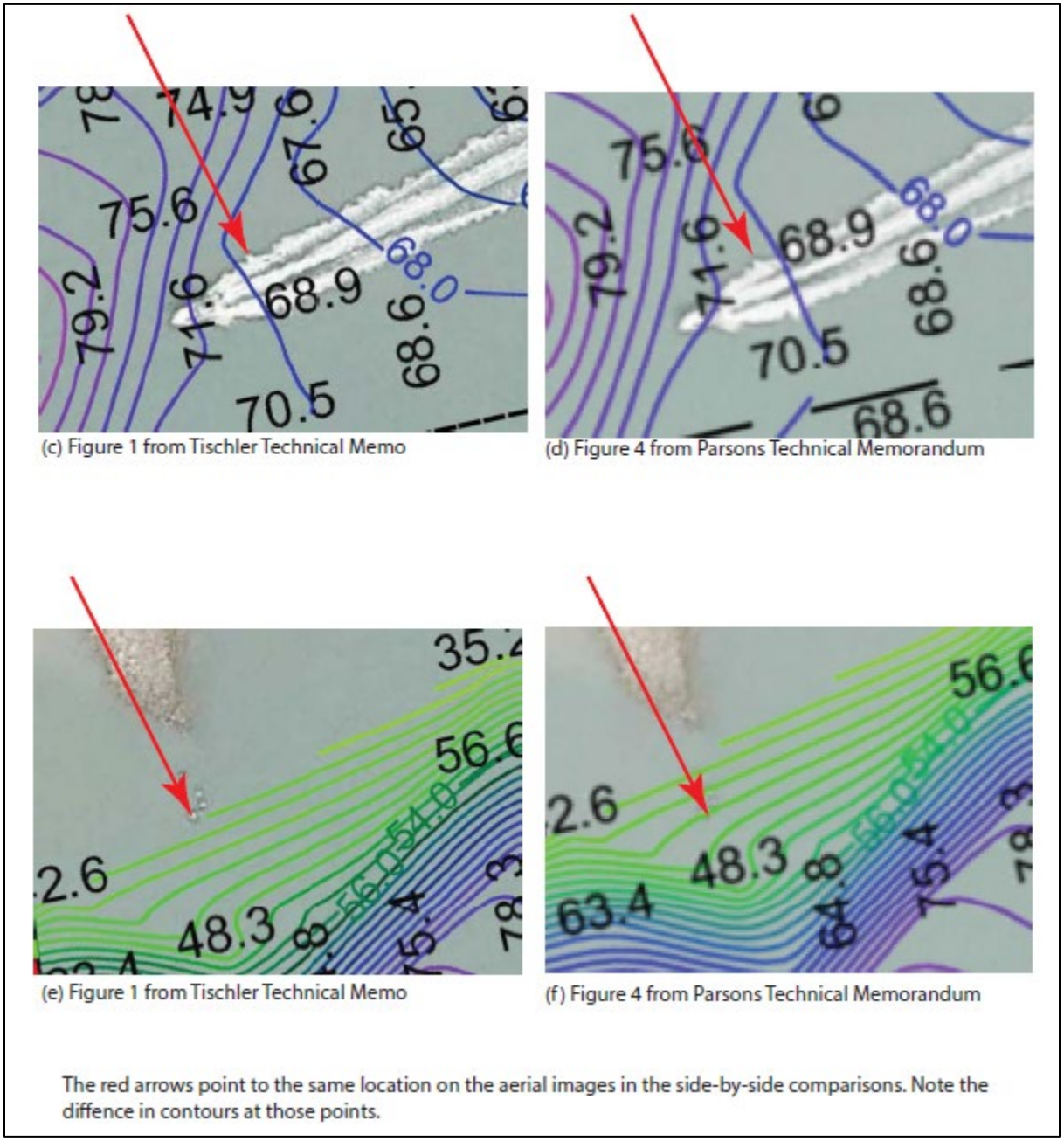
that the locations of the discharge points on the Tischler technical memo Figure 1 do not match the latitude and longitude specifications in the Amended Application forms. You can also see the differences in the contour locations in Exhibit PAC-53R BW-3.

**Q: YOU SAID, EARLIER, THAT YOU FEEL THE MORE NORTHERN DEPICTION OF THE BATHYMETRY IS CORRECTLY LOCATED. WHY DO YOU THINK THAT?**

A: It is my opinion that the green dot is where the discharge is actually located. I think we have to assume that the latitude and longitude figures recited at two places in the June 25, 2021 Amended Application are correct. The red contours are the ones that are more consistent with the prior bathymetry prepared by Wood for the POCC's original application and that of the Corps of Engineers. Also, if discharge location "M" and the contours on the Amended Application Figure 1 map are moved in unison so that location "M" is at the correct latitude and longitude, the contours between the two figures come closer to matching.

**Q: AND, WHAT DOES REMAND EXHIBIT PAC-53R BW-3 SHOW US?**

A: Exhibit PAC 53R BW-3 is another exhibit I prepared. It shows identically cropped, aligned, and scaled excerpts from the two June 25, 2021 Amended Application maps that were used to create Exhibit PAC 53R BW-2. This exhibit helps one see that, while the contours in the two application figures have the same basic shape and labeling, the difference in contour locations between the two Amended Application maps is about 34 feet. In the vicinity of the discharge, this corresponds to a difference in depth of about 14 feet. Below are the enlarged depictions from page 2 of Exhibit PAC 53R BW-3, showing that the contour lines do not match up, as shown by looking at the common reference points on each map.




(c) Figure 1 from Tischler Technical Memo

(d) Figure 4 from Parsons Technical Memorandum

(e) Figure 1 from Tischler Technical Memo

(f) Figure 4 from Parsons Technical Memorandum

The red arrows point to the same location on the aerial images in the side-by-side comparisons. Note the diffence in contours at those points.

*PAC offers Exhibits PAC-53R BW-2 and PAC-53R BW-3.*

**Q: THESE "PLAN" VIEW EXHIBITS ARE INSTRUCTIVE, BUT HAVE YOU ALSO PREPARED ANY CROSS-SECTION GRAPHICS THAT WILL HELP US?**

A: Yes. I have an exhibit PAC-53R BW-4.

**Q: PLEASE TELL US ABOUT THAT EXHIBIT.**

A: It is a figure I prepared showing the bottom profile along the ship channel and across it. When I say "ship channel," I am referring to the entire channel from the shoreline of Harbor Island south to the shoreline of Mustang Island. If I discuss the more narrow dredged Corpus Christi

Ship Channel as defined by the Corps of Engineers, I will refer to it as the Ship Channel as authorized by the Corps of Engineers or CCSC-COE. The CCSC-COE is represented as the area between the light blue vertical dashed lines on the top figure in PAC-53R BW-4.

The top figure in PAC-53R BW-4 shows the profiles across the ship channel for the bathymetry shown in the two POCC figures discussed, above. The top-figure view is what someone beneath the water looking downstream (toward the Gulf) would see in a vertical north-south plane. The transect in red is based on the contours from Figure 1 of the Tischler Technical Memo in the Amended Application. The northern part of this Figure 1 profile near the location of the proposed diffuser is obviously offset further south of the green profile, which is based on the contours from Figure 4 of the Parsons Technical Memo.

The intermittent black lines mark the depths that Dr. Tischler showed in Table 1 of his technical memorandum and what Ms. Cunningham used for her modeling.

The bottom figure on PAC-53R BW-4 is a bottom profile parallel to the CCSC-COE, looking from west (on the left) to east (on the right) and running through the diffuser as located by the latitude and longitude given in the Amended Application. The discharge location is at 0.0 feet on this lower figure and is shown at the center of this lower figure.

Exhibit PAC-53R BW-6 shows the transects (in plan view on an aerial photograph of the area) from which the profiles in BW-4 were taken.

**Q: BEFORE YOU GO ON, PLEASE EXPLAIN THE SCALES YOU USED IN EXHIBIT PAC-53R BW-4.**

A: In the initial hearing, I included a couple of profile exhibits similar to PAC-53R BW-4, but for the surroundings of the discharge point as it was understood to be at that earlier time. I used the scales the POCC had used in its application to show the bottom of the ship channel, and, for consistency, I continued to use those scales for PAC-53R BW-4. The scale of the depth axis is not the same as the scale for the other axis, so the figure makes it appear that the hole

in the ship channel is a little more dramatic than it is. However, it makes it much easier to show more detail and label features. For comparison, Exhibit PAC-53R BW-4a shows the identical profiles using the same scale for the vertical and horizontal axes.

**Q: WHAT DOES THE TOP FIGURE OF EXHIBIT PAC-53R BW-4 SHOW?**

A: The most significant point may be that the discharge location is not in the water, regardless of the bathymetry used. As I said, the green dot is at the latitude and longitude specified in the Amended remand Application, and its depth is at the depth that Dr. Tischler specified in Table 1 of his technical memo. If that is the correct location, the discharge ports are buried about 2.8 feet below the channel bottom. If the red contours, the ones from Figure 1 of the Tischler Technical Memo, were used with the discharge at the latitude and longitude specified in the Amended Application, the discharge structure would be about 40 feet into the side of the channel side-slope. It will not be there, obviously, but the location of the outfall is important for the model, given the discharge point's proximity to the side-slope. The discharge plume can contact the "wall" of the side-slope (i.e., the northernmost wall of the ship channel), with consequences that Dr. Socolofsky addresses.

**Q: WHAT DOES THE BOTTOM FIGURE OF EXHIBIT PAC-53R BW-4 SHOW?**

A: This transect shows the location of the discharge – the line of 20 ports – being below the bottom surface of the channel, not in the water. Again, this location is based on the depth that Dr. Tischler specified in Table 1 of this technical memo.

This bottom figure also shows another major problem for projecting the travel of the effluent plume. Most of the modeling predicts that the effluent plume will flow a very short distance south toward the dredged CCSC-COE during the high-velocity currents and that the currents will then, take the effluent plume either west or east – in from or out to the Gulf. For this to happen, the plume would have to climb up over or around the extensions of the "hills" shown to the left and right of the discharge point in the figure; these "hills," themselves, are

extensions of the small fingers of land that make up the cove just north of the discharge point and clearly visible on all the aerial images of this area.

The "hills" are cross-sections of roughly north-south subsurface ridges. The one on the east is shown more clearly on the lower figure (b) in BW-3. Note the wedge of shallow water south of the point of the land and running through the "48.3" and "86.3" depth labels. That ridge does drop as it goes out, but it remains higher than the level of the diffuser, as the hill to the right on the lower transect on PAC-53R BW-4 shows; the plume runs into this small north-south ridge before it gets to the edge of the ZID. I understand Dr. Socolofsky will testify this blockage to movement of the plume reduces mixing and is not accounted for in the CORMIX modeling.

*PAC offers Exhibits PAC-53R BW-4, PAC-53R BW-5, and PAC-53R BW-6.*

**Q: WHAT IS THE SIGNIFICANCE OF THESE INCONSISTENCIES REGARDING THE DIFFUSER LOCATION AND THE CONTOURS OF THE SHIP CHANNEL FLOOR?**

A: First and foremost is that the point of discharge relative to conditions near the discharge, as well as the nearby conditions themselves, directly impact the model outputs. It makes a difference, in terms of output, what data one feeds into a model. In this instance, while I assume the POCC is not actually going to put its diffuser ports beneath the soil of the hole, the location of the discharge in relation to the side slope of the hole is important. I understand Dr. Socolofsky will discuss this more in his testimony and provide modeling demonstrating this.

Also, the inconsistency of the information will create problems for anyone trying to model the mixing of the effluent or relying upon the representations in the amended application to enforce the permit. The TCEQ requires accurate applications and corrections when errors are identified. The draft permit, at Permit Conditions 1.b, provides that the permit

is granted on the basis of the information supplied and representations made by the permittee and relying upon the accuracy and completeness of that information and those representations.

The location of the discharge also determines who receives public notice and who can participate in this proceeding and future amendments. While applicants may be given some leeway with minor inconsequential errors in information in their applications, for the location of the discharge there can be little or no errors allowed because the discharge location drives the evaluation of the impacts of the proposed discharge. That is why the agency requires latitude and longitude coordinates, not just a map with the discharge location approximated.

Finally, if there were to be a leak in the diffuser assembly once it is in operation, any response team fielded by the POCC, TCEQ, TPWD or others would need to know where the diffuser is located, because it likely will not be visible from the water surface.

**Q: DO YOU HAVE ANY OTHER CONCERNS ABOUT THE ACCURACY OF THE MODELING?**

A: Yes. It is unclear whether the values for some of the input parameters used in the modeling are correct. Table 1 of Dr. Tischler's June 24, 2021 Technical Memo provides the Diffuser Specifications upon which Ms. Cunningham relied for her modeling. However, the prediction (.PRD) files produced by the POCC for Dr. Tischler's modeling, those that he presumably used to create his Table 4, reflect different specifications than those shown in Table 1. Table 1 indicates that the ports are 7.9 m (25.9 ft) above the depth of the channel at the location of discharge, while the prediction files indicate that the ports are 9.1 m (29.9 ft) above the depth of the channel at the location of discharge. Additionally, the bank distance used by Ms. Cunningham in her modeling is 69.8 m (229 ft) while the bank distance used by Dr. Tischler is 61.0 m (200 ft). Finally, the average channel depth used by Ms. Cunningham in her modeling is 22.0 m (72.2 ft) while Dr. Tischler used 27.4 m (89.9 ft). It is unclear the level of impact, if any, these differences have on the modeling results. But, these inconsistencies do

raise concerns about whether the correct input values were used in the modeling of either Ms. Cunningham or Dr. Tischler.

## B. MIXING ZONE CONFIGURATIONS

**Q: YOU EARLIER SAID YOU HAD SOME OPINIONS REGARDING WHETHER THE MODELING SUPPORTING THE AMENDED APPLICATION UTILIZED ACCURATE INPUTS AND COMPLIES WITH APPLICABLE REGULATIONS TO ENSURE THE DRAFT PERMIT IS PROTECTIVE OF WATER QUALITY. CAN YOU EXPLAIN TO US THOSE OPINIONS?**

A: Certainly. I have just explained at some length why I believe the modeling inputs were inaccurate and, therefore, not in compliance with TCEQ regulations and guidance. Additionally, I do not believe the dimensions of the ZID are consistent with the agency's previous interpretations of the regulations and that the dimensions of none of the mixing zones can be said to ensure protection of water quality.

**Q: PLEASE EXPLAIN THE MIXING ZONES ISSUE THAT YOU SEE.**

A: Exhibits BW-7 through BW-10 show various mixing zone configurations. BW-7 shows configurations for the Zone of Initial Dilution, BW-8 shows configurations for the Aquatic Life Mixing Zone, BW-9 shows configurations for the Human Health Mixing Zone, and BW-10 shows the mixing zone configurations from the pre-remand draft permit and those from the post-remand draft permit in plan view on an aerial image.

**Q: HOW DO THESE EXHIBITS HELP US UNDERSTAND THE CONCERN YOU HAVE REGARDING THE DIMENSIONS OF THE MIXING ZONES?**

A: I prepared these exhibits to explain how mixing zone configurations are determined and to show the changes made with the dimensions used for the mixing zones between the pre-remand draft permit and the post-remand draft permit. The areas of the pre- and post-remand mixing zones remain the same, but lengths and widths of the mixing zones have changed. The exhibits show that the mixing zone dimensions used in the post-remand draft permit are now longer parallel to the channel than was the case for the zones developed for the original pre-

remand draft permit. This means the locations where the effluent plume crosses the boundaries of a mixing zone in the higher current-velocity scenarios is farther away from the discharge point, giving the effluent plume more time and distance in which to mix. If the dimensions used by Ms. Cunningham for her modeling of the original application were used for the Amended Application analyses, the maximum effluent percentage at the boundaries of the mixing zones would be higher.

*PAC offers Exhibits PAC-53R BW-7, PAC-53R BW-8, PAC-53R BW-9 and PAC-53R BW-10.*

**Q: IS THERE A STANDARD METHOD OF SETTING THE MIXING ZONE DIMENSIONS?**

A: The Texas Water Quality Standards do not define a method for determining the size or shape of the Aquatic Life and Human Health Mixing Zones. That document does, however, provide for a maximum size and a general orientation for the Zone of Initial Dilution (ZID). The Water Quality Standards (§307.8(b)(2)(C)) state the following:

> "ZIDs must not exceed the following sizes: . . . (C) a 50-foot radius in all directions (or equivalent volume or area for diffuser systems) from a discharge point in a bay, a tidal river, an estuary, or the Gulf of Mexico."

Beyond that, the *Procedures to Implement the Texas Surface Water Quality Standards* (RG-194) provides some guidance for the Aquatic Life and Human Health Mixing Zones. The IP (p.72) provides the following guidance for the Aquatic Life Mixing Zone:

> "Mixing zones for discharges into bays, estuaries, and wide tidal rivers (≥400 feet across) are expressed in the permit as a radius that extends over the receiving water in all directions. The typical mixing zone radius is no greater than 200 feet but does not exceed one-half the width of the receiving water at the discharge point."

The IP (p.79) provides the following guidance for the Human Health Mixing Zone:

> "The typical human health mixing zone radius for bays, estuaries, and wide tidal rivers extends no greater than 400 feet in all directions over the receiving water from the point of discharge."

The only other TCEQ guidance on mixing zone configurations is given in the CORMIX Standard Operating Procedure (dated 15 Jun 2012). It provides this additional guidance for multiport diffusers:

> "For multiport diffuser discharges, the ZID and both mixing zones typically will be rectangular in shape and equal in area to the standard ZID and mixing zone sizes. The ZID and mixing zones may be centered on or aligned along the diffuser barrel. The position of the ZID and mixing zones relative to the diffuser will depend on two things:
> 1) the nature of the receiving water (tidally reversing or one-direction flow)
> 2) the orientation of the diffuser ports to the receiving water current."

Thus, the Water Quality Standards and Implementation Procedures only require that the areas of the resulting mixing zones to be equivalent to those given in the guidance for a circle and that the edges of the mixing zones be the same distance from the diffuser in all directions. It is only in the CORMIX SOP that the TCEQ accedes to the diffuser position being moved to lie on the edge of the mixing zones, but the SOP does not provide any further guidance on the configuration of the length and width.

**Q: HOW DOES TCEQ DETERMINE THE AREA OF THE MIXING ZONES FOR A DIFFUSER?**

A: The TCEQ first determines the maximum area based on a single point discharge. This is demonstrated by illustration (a) for each mixing zones in Exhibits PAC-53R BW-7 through PAC-53R BW-9. Then, the TCEQ has typically applied a formula that is derived from the directive that the diffuser be the same distance from the edges of the mixing zone in all directions. This is demonstrated by illustration (b) for each of the mixing zones in Exhibits PAC-53R BW-7 through PAC-53R BW-9.

**Q: WHEN THE TCEQ ALLOWS THE DIFFUSER TO BE MOVED TO THE EDGE OF THE MIXING ZONE, HOW HAS TCEQ DETERMINED THE DIMENSIONS OF THE MIXING ZONE IN THE PAST?**

A: Typically, the TCEQ has first applied the formula demonstrated by illustration (b) and then shifted the entire mixing zone so that the centerline of the diffuser is aligned with one edge of the mixing zone, while still centering the length of the diffuser between the shorter edges of the mixing zone. This is demonstrated by illustration (c) for each of the mixing zones in Exhibits PAC-53R BW-7 through PAC-53R BW-9.

**Q: CAN YOU CITE ANY EXAMPLES OF THIS?**

A: Yes. The mixing zones for the Occidental Chemical permit (WQ0003083000) which discharges into the La Quinta Channel of Corpus Christi Bay was configured this way.

**Q: DID THE TCEQ USE THIS METHOD IN THE FIRST HEARING?**

A: Yes. Ms. Cunningham conducted the modeling, and the pre-remand draft permit was prepared, in accordance with the way TCEQ has typically configured the mixing zones. Ms. Cunningham also testified that she believed the approach she took was appropriate. (See, Exh. ED-KC-1, p. 18:22-19:2.)

**Q: HAVE THE MIXING ZONES IN THE POST-REMAND MODELING CONDUCTED BY TCEQ BEEN CONFIGURED IN THIS WAY?**

A: No. Although the area is the same, Ms. Cunningham has conducted the post-remand modeling in accordance with the zone configurations first used by the POCC in the pre-remand modeling. This is demonstrated by illustration (d) for each of the mixing zones in Exhibits PAC-53R BW-7 through PAC-53R BW-9.

**Q: WERE THE MIXING ZONES IN THE PRE-REMAND TCEQ MODELING AND DRAFT PERMIT CONFIGURED IN THE SAME WAY AS IN THE POST-REMAND MODELING AND DRAFT PERMIT?**

A: No. As I stated previously, Ms. Cunningham conducted the modeling, and the pre-remand draft permit was prepared in accordance with the way TCEQ has typically configured the mixing zones. However, the mixing zones as the POCC had proposed them in its pre-remand modeling have now been accepted by the ED's staff.

**Q: WHAT MIXING ZONES CONFIGURATIONS DID THE POCC USE IN ITS POST-REMAND MODELING?**

A: Dr. Tischler proposed an even more lengthened mixing zone than the POCC's originally proposed mixing zones, with half of the zone for ebb tide and the other half for flood tide. This expanded mixing zone is demonstrated by illustration (e) for each of the mixing zones in Exhibits PAC-53R BW-7 through PAC-53R BW-9. This effectively doubles the size of the mixing zone and exceeds the size allowed by the Water Quality Standards and Implementation Procedures.

**Q: DID TCEQ ACCEPT DR. TISCHLER'S LENGTHENED CONFIGURATION?**

A: No. Ms. Cunningham rejected that.

**Q: WHAT IS YOUR OPINION ON WHETHER THE LONGER AND NARROWER MIXING ZONES ARE APPROPRIATE?**

A: The TCEQ provided no reason for changing its past method and the decision on how to design the mixing zones should not be left to applicant's discretion. When the POCC originally proposed narrow rectangles in the original application, TCEQ did not accept those proposals. In the case of the Amended Application, the ED apparently acquiesced to the use of the more narrow mixing zones (although not the lengthened zones proposed by Dr. Tischler) for the modeling conducted by Ms. Cunningham.

**Q: DID THE CHANGE IN MIXING ZONE CONFIGURATION MAKE ANY DIFFERENCE TO THE PREDICTED EFFLUENT PERCENTAGES BETWEEN THE PRE-REMAND MODELING AND THE POST-REMAND MODELING?**

A: Yes. While I did not run the CORMIX model, I have prepared figures PAC-53R BW-11 through PAC-53R BW-15 from the CORMIX output files, and it shows that difference.

**Q: PLEASE IDENTIFY EXHIBITS PAC-53R BW-11 THROUGH PAC-53R BW-15.**

A: Each of these exhibits shows the different modeled scenarios and effluent predictions at the various mixing zone boundaries and according to modeling done by the different parties for the POCC's Amended Application. Each line on each exhibit characterizes a scenario (i.e., ambient and effluent conditions and modeled depths and distances). DISTB is the modeled

distance to bank from the diffuser; HA is the modeled average depth of the channel; HD is the modeled depth of the channel at the discharge location; H0 is the port height above the channel bottom, and HD-H0 is the depth of the diffuser ports below the water surface. These tables also give the percent effluent, salinity, salinity increase (difference between ambient and predicted), and the percent salinity increase at the boundaries of the Zone of Initial Dilution, Aquatic Life Mixing Zone, and Human Health Mixing Zone. A letter "x" (along the channel) or "y" (across the channel) at the end of each of the mixing zone data sets indicates at which boundary the stated values were predicted.

**Q: BRIEFLY, HOW ARE THE EXHIBITS DIFFERENT FROM ONE ANOTHER?**

A: Exhibit PAC-53R BW-11 shows the results of the TCEQ remand modeling using the original (pre-remand) TCEQ mixing zone configuration. Exhibit PAC-53R BW-12 shows the results of the TCEQ remand modeling using the new (post-remand) TCEQ mixing zone configuration which is also the same as the original (pre-remand) POCC mixing zone configuration. Exhibit PAC-53R BW-13 shows the results of the POCC remand modeling using the original (pre-remand) TCEQ mixing zone configuration. Exhibit PAC-53R BW-14 shows the results of the POCC remand modeling using the new (post-remand) TCEQ mixing zone configuration which is also the same as the original (pre-remand) POCC mixing zone configuration. Exhibit PAC-53R BW-15 shows the results of the POCC remand modeling using the new (post-remand) POCC mixing zone configuration proposed by Dr. Tischler in his direct testimony.

**Q: WHAT DO THESE TABLES SHOW FOR THE TCEQ MODELING (EXHIBIT PAC-53R BW-11 AND PAC-53R BW-12)?**

A: They show how the mixing zone sizes affect the predicted results. If you look in the column for percent effluent (%EFF), you will see that the maximum effluent percentage predicted using the original (pre-remand) TCEQ mixing zone configuration is higher than that using the new (post-remand) TCEQ mixing zone configuration (which is the same as the original POCC

mixing zone configuration), i.e., 15.85% vs. 14.57%, 10.24 vs. 8.93%, and 7.72% vs. 5.20% for the ZID, Aquatic Life, and Human Health mixing zones, respectively.

**Q: WHAT DO THESE TABLES SHOW FOR THE POCC MODELING (EXHIBITS PAC-53R BW-13, BW-14, AND BW-15)?**

A: They similarly show how the mixing zone sizes affect the predicted results. If you look in the column for percent effluent (%EFF), you will see that the maximum effluent percentage predicted using the original TCEQ mixing zone configuration is higher than that using the new POCC mixing zone configuration of Dr. Tischler, i.e., 15.85% vs. 10.73%, 10.24 vs. 4.86%, and 7.72% vs. 3.37% for the ZID, Aquatic Life, and Human Health mixing zones, respectively. The differences in maximum effluent percentages between the original (pre-remand) TCEQ mixing zone configuration and the new (post-remand) TCEQ mixing zone configuration is the same as for the TCEQ modeling.

*PAC offers Exhibits PAC-53R BW-11, PAC-53R BW-12, PAC-53R BW-13, PAC-53R BW-14, and PAC-53R BW-15.*

**Q: MR. WILAND, PRIOR TO DISCUSSING THESE LAST EXHIBITS/TABLES, YOU DISCUSSED A NUMBER OF AERIAL PHOTOS AND "PLAN" VIEWS OF THE CONTOURS AND TRANSECTS DEPICTING THE AREA OF THE PROPOSED DISCHARGE. THE ALJS AND COMMISSIONERS ARE GOING TO HAVE DIFFICULTY KEEPING TRACK OF ALL THESE AND COMPARING ONE TO ANOTHER. I UNDERSTAND YOU HAVE CREATED AN AID FOR MANAGING THESE. IS THAT SO?**

A. Yes. I have created a PDF that has many layers one may turn on and off and, thereby, see on one screen various combinations of layers. This PDF captures in one document most of the aerials I have discussed. The panel to the left of the images is where the layers are itemized. Opaque areas, e.g., the aerial photos and base maps, of the highest layer that is turned on obscure any opaque areas of layers turned on and below the highest layer. No part of layers that are not turned on will appear in the main image. Exhibit PAC-53R BW-16 is the layered PDF.

*PAC offers Exhibit PAC-53R BW-16.*

**Q: WHAT HAVE YOU DONE TO ENSURE THAT THESE IMAGES, THESE LAYERS, OVERLIE ONE ANOTHER CORRECTLY, SO THAT A PARTICULAR LATITUDE AND LONGITUDINAL POINT IN ONE ALIGNS WITH THE SAME LATITUDE AND LONGITUDE POINT IN OTHERS?**

A: The NAIP (National Agriculture Imagery Program) aerials, the TOP (Texas Orthoimagery Program) aerials, and the Corps of Engineers 2019 contours were already georeferenced by the originating agency when I obtained them. I then georeferenced the Google Earth map to the 2018 / 2020 NAIP maps using QGIS software. (Google Earth maps are pre-georeferenced, but the georeferencing is generally not as precise as the NAIP aerials.) I subsequently georeferenced the base maps from the applicant's exhibits to the Google Earth map because that Google Earth map is the image that is the background for most of the Applicant's maps. All of the vector layers were created from the base maps by such techniques as tracing, entering latitudes and longitudes, or measuring distances in the QGIS program.

**Q: I SEE THAT EXHIBIT PAC-53R BW-16 HAS A "LEGENDS" LAYER AND 20 OTHER LABELED LAYERS. MOST OF THESE LAYERS' LABELS WILL LIKELY BE RECOGNIZED BY THE ALJS AND THE COMMISSIONERS, BUT A FEW MAY NOT BE. COULD YOU EXPLAIN THE SOURCES FOR THE LAYERS WITH LABELS NOTED WITH "NAIP," "TOP" AND "USDA"?**

A: I obtained the NAIP and TOP maps from the TNRIS (Texas Natural Resources Information System), a division of the Texas Water Development Board. The USDA 1956 aerial was obtained from the National Archives and originated with the U.S. Department of Agriculture.

**Q: ARE THE AERIAL IMAGES AND THE BASE MAP IMAGES SHOWN IN EXHIBIT PAC-53R BW 16 THE FULL SIZE IMAGES THAT YOU USED FOR GEOREFERENCING?**

A: No, many of the layers in Exhibit 16 are cropped versions of larger images to allow focusing on the area near the diffuser. As an example, Exhibit 17 shows the full size of the aerial image from 1956 that was used to create the 1956 layer in Exhibit 16.

*PAC offers Exhibit PAC-53R BW-17.*

## C. ANTIDEGRADATION ANALYSES

**Q: LET US TURN NOW TO ANY RESERVATIONS YOU MAY HAVE REGARDING THE ED'S ANTIDEGRADATION REVIEW. DO YOU BELIEVE IT TO HAVE BEEN ADEQUATE?**

A: No, I do not. That opinion comes in large measure from the opinions already stated, above. The inconsistencies and errors that underly the inputs to the modeling in this case and the mismatch of the CORMIX model and unusually irregular terrain beneath and alongside the discharge point do not provide the antidegradation analyst a reliable estimate of plume salinity concentrations or concentration increases in and at the boundary of the aquatic life or other mixing zones.

**Q: IN ADDITION TO THE PROBLEM OF ITS RELIANCE ON THE MODELING, HAVE YOU IDENTIFIED OTHER PROBLEMS WITH THE ANTIDEGRADATION REVIEW?**

A: Yes. There have been no determinations of the worst-case conditions for salinity and salinity increases at the boundary of the aquatic life or other mixing zones. The modeling in this case, even were it reliable, aims only to establish the percentage of effluent in a sample of the water column at various locations. This would provide a way to determine the worst-case conditions for most pollutants. However, when salinity is the constituent of concern and it is being discharged into a saline water body, such as is the case, here, knowing the percentage of effluent in a sample does not necessarily tell one the worst-case salinity condition, because ambient salinity in the receiving water is ignored. Even a small percentage of saline effluent could add to the background, ambient-water salinity and push the total salinity above acceptable limits in the receiving water.

**Q: HAVE YOU REVIEWED THE ED'S DOCUMENTATION OF ITS ANTIDEGRADATION REVIEW AND, IF SO, WHY DO YOU NOT FIND IT PERSUASIVE?**

A: I have reviewed that documentation. The most detailed explanation we have of the ED's antidegradation review is Mr. Schaefer's 2½-page August 19, 2021 WQS worksheet (Admin.

Rec. Tab J, pp. 103-105). It relies on the unreliable modeling. It does not quantify the threshold beyond which a salinity increase or a salinity gradient increase would exceed a *de minimis* level. It argues for an "assimilative capacity" analysis analogous to the analysis that might aid the antidegradation review, were there numerical standards for salinity, but it does not establish what the assimilative capacity is of the waters in the aquatic life mixing zone or elsewhere. It invokes Dr. Furnans' salinity mass balance calculations for the entire ship channel, but it does not quantify the additional salt loading that would degrade either aquatic life uses or water quality. In general, the ED has not determined what salinity concentration would begin to cause an adverse impact on the aquatic life or what change in salinity concentrations over what distance or time would begin to have an adverse impact on aquatic life. Without this information, the ED cannot complete even the Tier 1 antidegradation review.

## D. DRAFT PERMIT DEFICIENCIES

**Q: PLEASE SUMMARIZE YOUR OPINION ON WHETHER THE DRAFT PERMIT INCLUDES ALL APPROPRIATE AND NECESSARY REQUIREMENTS.**

A: It does not contain all the necessary requirements. There are two major deficiencies in the permit: absence of in-stream monitoring requirements and discharge limitations.

**Q: PLEASE EXPLAIN THOSE FOR US.**

A: In-stream monitoring of the discharge should be included in any permit that is issued. There is a need to evaluate the actual mixing. It is not reasonable to simply rely upon the predictions of the CORMIX model to determine the actual mixing performance or to assure that the POCC complies with permit conditions.

The permit needs in-stream limitations for effluent percentages, not only at the boundaries of the ZID but, also, at the boundaries of the Aquatic Life Mixing Zone and the Human Health Mixing Zone.

**Q: YOU INDICATED THESE WERE THE MAJOR DEFICIENCIES. ARE THERE OTHERS WORTH MENTIONING?**

A: Yes. There is no process required by the draft permit for determining if or to what extent the mixing predictions from the CORMIX model are reliable at this location. There should be a requirement for monitoring of the discharge plume at different discharge rates and different tidal conditions that will occur. The bathymetry and the non-uniform flow conditions near the discharge point introduce very complex factors that make it unreasonable to rely on the CORMIX modeling, alone, to determine by inference the impacts of the discharge on the marine environment of the ship channel and on the species for which it is habitat or a passage corridor.

**Q: YOU HAVE REFERRED TO A NUMBER OF EXHIBITS IN THIS TESTIMONY. DO EACH OF THESE EXHIBITS ACCURATELY REFLECT WHAT THE EXHIBIT, GENERALLY, SUPPLEMENTED BY YOUR NARRATIVE, PURPORTS TO DEPICT.**

A: Yes, each does.

## V. CONCLUSION

**Q: DOES THIS CONCLUDE YOUR TESTIMONY?**

A: Yes, although I would like to reserve the right to supplement this testimony, if I am provided with additional information related to my opinions.