



## **Nueces Delta Environmental Monitoring Project**

Final Report

Publication CBBEP – 183

Project Number – 2411

July 2024

Prepared by:

Devon Steffan

Research Project Administrator

Texas A&M University – Corpus Christi – Conrad Blucher Institute

6300 Ocean Dr, Corpus Christi, TX 78412

Phone: 361.825.3846

E-mail: [devon.steffan@tamucc.edu](mailto:devon.steffan@tamucc.edu)

Submitted to:

**Coastal Bend Bays & Estuaries Program**

615 N. Upper Broadway, Suite 1200

Corpus Christi, TX 78401

PREPARED IN COOPERATION WITH THE TEXAS COMMISSION ON ENVIRONMENTAL  
QUALITY AND U.S. ENVIRONMENTAL PROTECTION AGENCY

This project has been funded wholly or in part by the United States Environmental Protection Agency  
under assistance agreement (number) to Texas Commission on Environmental Quality.

The contents of this document do not necessarily reflect the views and policies of the Environmental  
Protection Agency, nor does the EPA endorse trade names or recommend the use of commercial products  
mentioned in this document.

The views expressed herein are those of the authors and do not necessarily reflect the views of CBBEP or other  
organizations that may have provided funding for this project.

## TABLE OF CONTENTS

	<u>Page</u>
Introduction.....	3
Methods.....	5
Results and Discussion.....	7
Conclusions.....	11
References.....	12

### List of Tables

Table 1.	Capacity of the Rincon Bayou Pipeline.....	4
Table 2.	Rincon Bayou Pipeline pumping events to date.....	7
Table 3.	Total rainfall per year for NUDEWX and CRP.....	7

### List of Figures

Figure 1.	Nueces Delta, Corpus Christi, Texas, USA.....	4
Figure 2.	Pictures of Rincon Bayou Pipeline intake and outfall.....	5
Figure 3.	Location of salinity monitoring stations.....	6
Figure 4.	Drought conditions throughout the state of Texas.....	8
Figure 5.	NUDE2 salinity and pumping events for reporting year.....	9
Figure 6.	Pumping event for February of reporting year.....	9
Figure 7.	Pumping event for May of reporting year.....	10
Figure 8.	Salinity and tidal variations at NUEBAY and NUDE2 during a pumping event.....	11

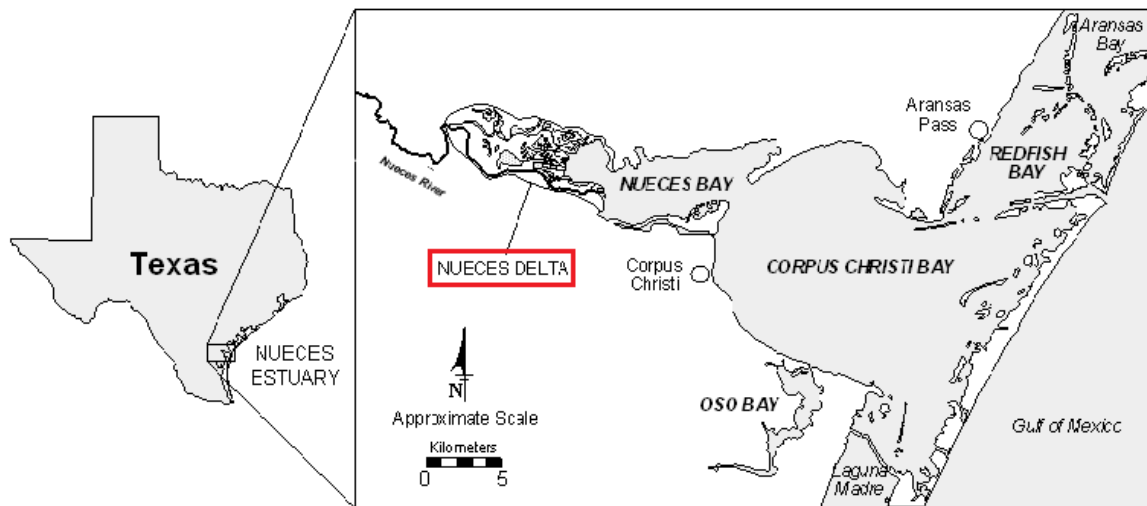
# Nueces Delta Salinity Effects from Pumping Freshwater into the Rincon Bayou

## INTRODUCTION

This project's focus is monitoring the hydrological effects sourced from the Rincon Bayou Pipeline (RBP) in the Nueces Delta near Corpus Christi, Texas (**Figure 1**). This report will highlight trends in salinity changes throughout pumping events and provide a detailed look at the effects seen during the 2023-2024 sampling year (September 1, 2023, to August 31, 2024). The results of this study are used for the continual adaptation of a water management plan that will help water managers make decisions on quantity, timing, and duration of pipeline inflows that are most productive and important to the ecology of the Nueces Delta.

The Nueces Delta has been a scientific research focus due to its hypersaline condition (Matthews and Mueller 1987; Whitley and Stockwell 1995; Montagna et al. 2002; Palmer et al. 2002; Montagna et al. 2009; Hill et al. 2011; Nueces BBEST 2011; Nueces BBASC 2012; Hodges et al. 2012). Because of watershed impoundments, riverbank modifications, and increased urbanization along the Nueces River, the Nueces Delta is no longer connected to the Nueces River, except through the Nueces River overflow channel that was permanently opened in 2001. Because of these factors, most of the freshwater flow is diverted from the river directly to the bay, bypassing the delta. The only natural means of freshwater flow through the Nueces Delta is during severe flooding events or local heavy rainfall causing the flow to over bank into the delta (BOR 2000; Pulich et al. 2002; Hill et al. 2011). Decreased inflows into the delta and prolonged Texas droughts have caused frequent hypersaline conditions in the Nueces Delta. Freshwater inundation within the Nueces Delta over the past 30 years has been insufficient in volume and distribution to maintain a healthy marsh, the lack of sediment loading in the system is leading to the delta front eroding into Nueces Bay, the marsh plants are under stress, and the connectivity of aquatic habitat is threatened (Hodges et al. 2012).

In the 1990's, studies found these hypersaline conditions could harm the ecological and biological processes of the marsh and degrade the overall health of the Nueces Estuary. This impact evoked the state of Texas to develop an inflow criterion for freshwater inflows (Dunton and Alexander 2000; Montagna et al. 2002; Palmer et al. 2002). The resultant 2001 Agreed Order, from the Texas Commission on Environmental Quality (TCEQ), requires the City of Corpus Christi (City) to provide no less than 151,000 acre-feet (186,255,757 m<sup>3</sup>) per year to the Nueces Estuary (TCEQ 1995). Each month the City is required to "pass through" inflow to the Nueces Estuary equal to the measured instream flow into the Choke Canyon Reservoir/Lake Corpus Christi Reservoir System up to a target amount (TCEQ 1995). The target amount varies by month and is calculated based on the combined storage volume of the Reservoir System. The City may receive credits for excess flow from the previous month or from relief credits based on salinity measured at the SALT03 monitoring station in Nueces Bay (Montagna et al. 2009).



**Figure 1. Location of the Nueces Delta within Texas and the Nueces Watershed.**

To efficiently deliver freshwater to the Nueces Delta, the City built the Rincon Bayou pump station and pipeline (RBP) to divert up to the first 3,000 acre-feet (3,700,446 m<sup>3</sup>) of required “pass throughs” to the upper Rincon Bayou in the Nueces Delta. The RBP became operational in November 2007. The RBP pump station includes three 350 horsepower mixed flow submersible pumps capable of moving up to 60,000 gallons per minute with all three pumps operating (**Table 1; Figure 2**). The number of days to deliver a given volume of freshwater through the RBP depends on the number of pumps used.

**Table 1. Capacity of the Rincon Bayou Pipeline**

	Number of Rincon Bayou Pumps in Operation		
	1	2	3
Flow, gallons/minute	28,000	46,000	60,000
Flow, cubic feet/second	62	102	134
Flow, acre-feet/day	124	203	265
Total kW	230	455	675

This project’s principal objective is to maintain environmental data collection stations measuring water quality parameters in Nueces Bay as a result of the freshwater releases of the RBP. The data collected during this period is made available to CBBEP personnel in support of the Rincon Bayou Pipeline Management Plan which helps water managers make decisions on quantity, timing, and duration of pipeline inflow events that are most productive and significant to the ecology of the Nueces Delta. This report focuses on identifying the RBP freshwater inflows events in the Nueces Delta and provides data collected between September 1, 2023, and August 31, 2024.



A)



B)

*Figure 2. View of RBP pumping facilities depicting A) the intake pumps located on the Nueces River above the Calallen Dam and B) the pipeline outfall in the Rincon Bayou. Photos taken by Jace Tunnell.*

## **METHODS**

The Coastal Bend Bays & Estuaries Program (CBBEP) contracts this salinity-monitoring project to the Conrad Blucher Institute for Surveying and Science (CBI) at Texas A&M University - Corpus Christi (TAMU-CC). This project includes three environmental data collection stations. Nueces Bay Weather Station (NUDEX), Nueces Delta 2 (NUDE 2), and the Nueces Bay Water

Level (NUDEBAY), are all monitoring various conditions within the Nueces River Delta and bay. (Figure 3)

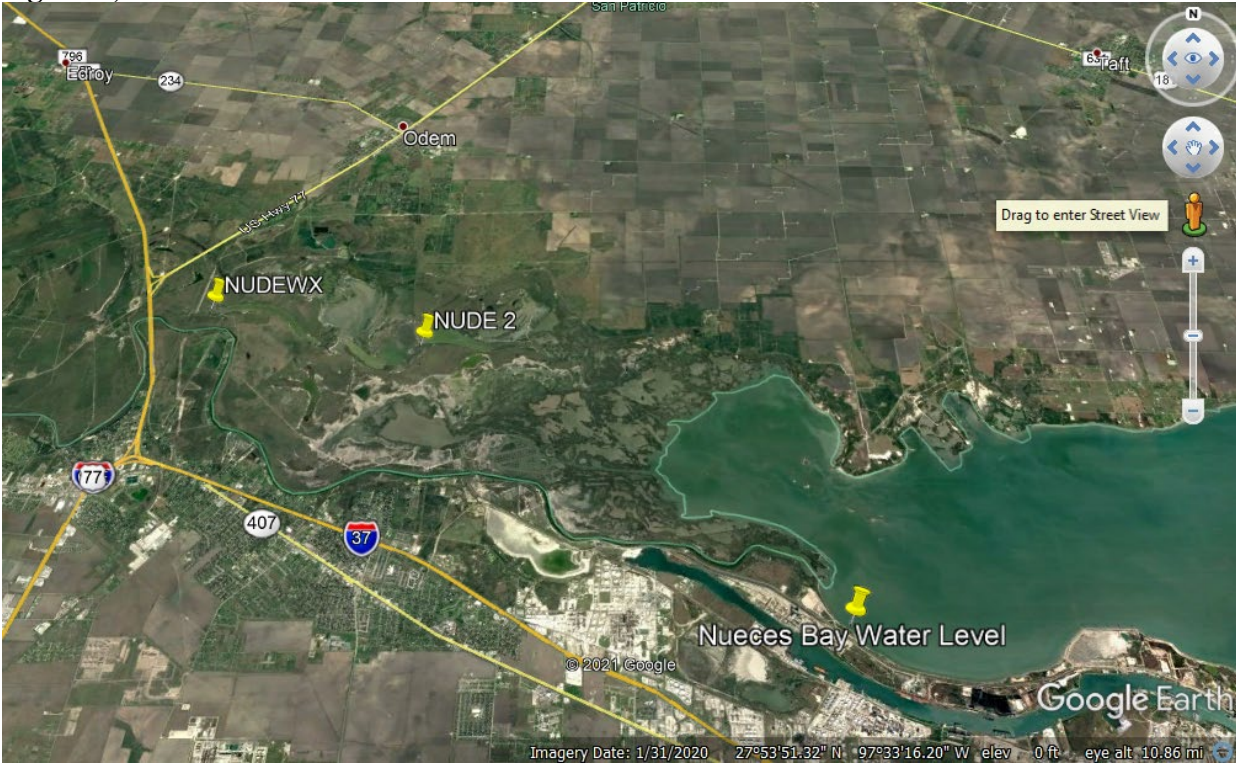


Figure 3. Map of the three environmental monitoring stations (NUDE2, NUDEWX, and NUDEBAY).

The Nueces Delta Weather Station (NUDEWX) is located on Rincon Bayou downstream from the RBP outfall (27.897582°N, -97.616524°W). The station measures wind speed (m/s), wind direction (°), barometric pressure (mbar), precipitation (mm), relative humidity (%), and solar radiation (cal/cm<sup>2</sup>/min). The CBI performs monthly maintenance to NUDEWX including a rain gauge calibration check. NUDE2 is in the middle reach of Rincon Bayou and measures conductivity and water temperature while the Nueces Bay Water Level station measures water level (m), wind speed (m/s), wind gusts (m/s), wind direction (°), and barometric pressure (mbar). NUDEBAY 185 is serviced annually following standards established by NOAA CO-OPS (<http://tidesandcurrents.noaa.gov/>). The NUDE 2 uses a Hydrolab<sup>®</sup> CMS5 water quality datasonde interfaced with cellular IP modem and is serviced monthly. The station is polled by an automated computer program designed and implemented by the Information Technology staff at CBI. Data is stored in CBI's database and available via the project webpage at <https://lighthouse.tamucc.edu/stnlist/>. The Hydrolab<sup>®</sup> CMS5, at NUDE 2, measures water quality parameters: water temperature (°C), specific conductance (µS/cm), and salinity (ppt). Activities are performed in accordance with the Quality Assurance Project Plan (QAPP).

## RESULTS AND DISCUSSION

From September 2023 to August 2024, the Nueces River Authority (NRA) reported 2 pumping events totaling 8 acre-feet (Table 2 and Figure 5). The NRA did not have the June or July 2024 reports on their website at the time of this report.

**Table 2. 2023-2024 Rincon Bayou Pumping Events**

Year	Pumping Event	Dates of Event	Duration (days)	Avg. water level (m above MSL)	Acre-Feet Pumped
2023-2024	84	February 7, 2024	1	0.44	2
	85	May 14, 2024	1	0.44	6

During this reporting period (2023-2024), the NUDEWX at 27°53'50.47"N, 97°36'58.73"W station measured 29.8in. of rainfall while the National Weather Service (National Weather Service 2024) at Corpus Christi International Airport (CRP) at 27°46'22.43"N, 97°30'8.47"W measured 28.02 in. (Table 3). Despite the 11-mile separation, both locations recorded similar rainfall events and were representative of the general meteorological conditions in the Nueces Delta watershed.

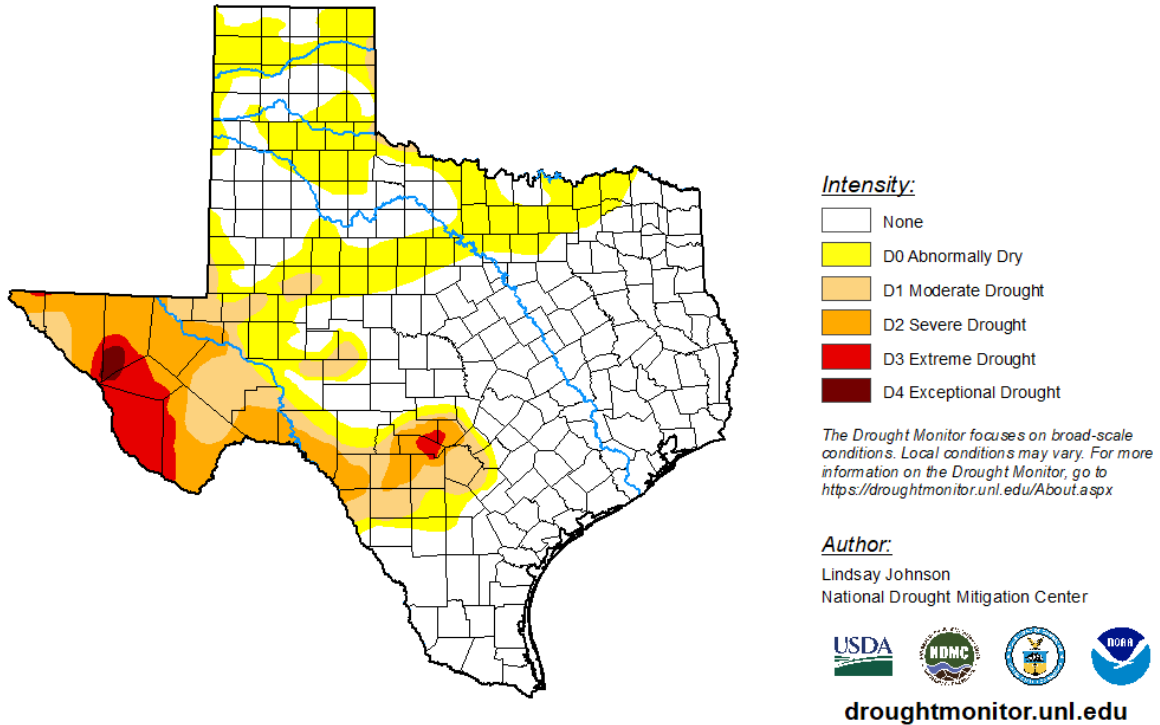
**Table 3  
Total rainfall per 2023-2024 sampling year for NUDEWX and CRP.**

2023-2024	
NUDEWX	29.8in
CRP	28.02in

The 2023-2024 sampling period 29.8in of rainfall was recorded at CRP, and 28.02 in at NUDEWX.

**U.S. Drought Monitor**  
**Texas**

**July 30, 2024**  
(Released Thursday, Aug. 1, 2024)  
Valid 8 a.m. EDT



*Figure 4. Drought condition figure throughout the state of Texas 2023-2024, which will generally be representative of drought, conditions throughout the 2023-2024 sampling year.*

As indicated in Figure 4, the state is not in a dry drought. As of August 1, 2024, Lake Corpus Christi reservoir level was 41.31 % of capacity while Choke Canyon reservoir was 21.27%.

Salinities recorded at NUDE2 generally dropped shortly after a pumping event was initiated and gradually increased after the end of a pumping event (Figure 6 and 7).



### NUDE02 Salinity and Pumping Events (September 2023–July 2024)

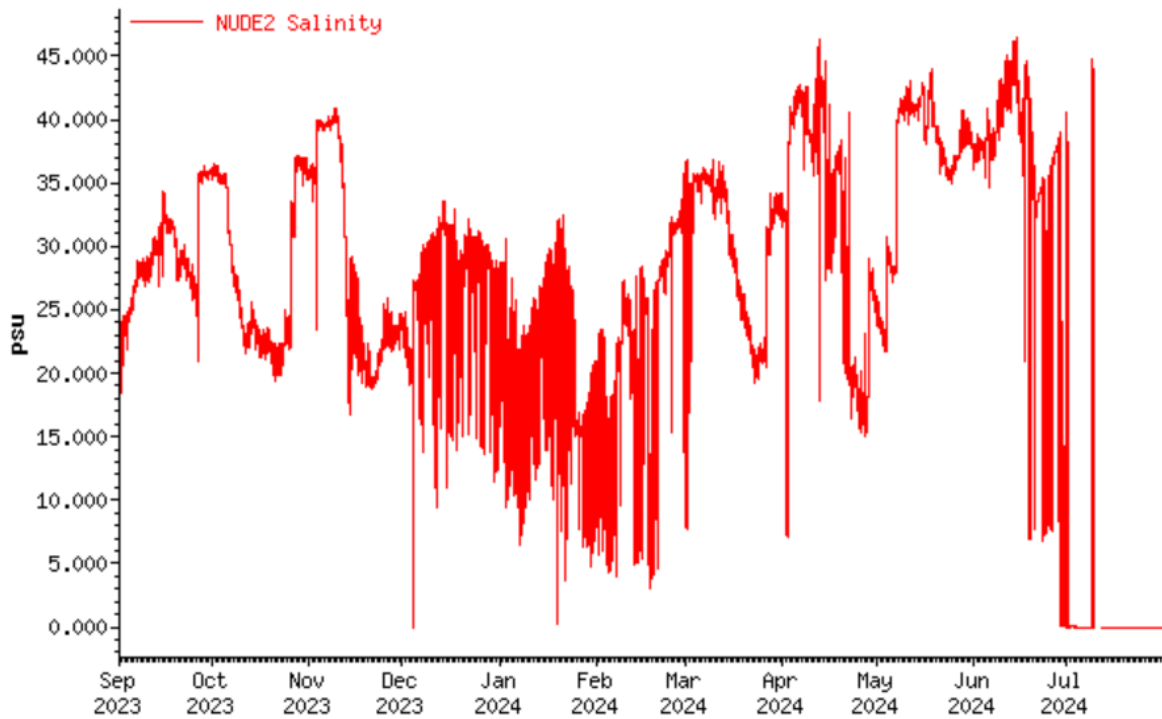


Figure 5. NUDE2 salinity during the 2023-2024 pumping event

### Feb 2024 Pumping Event

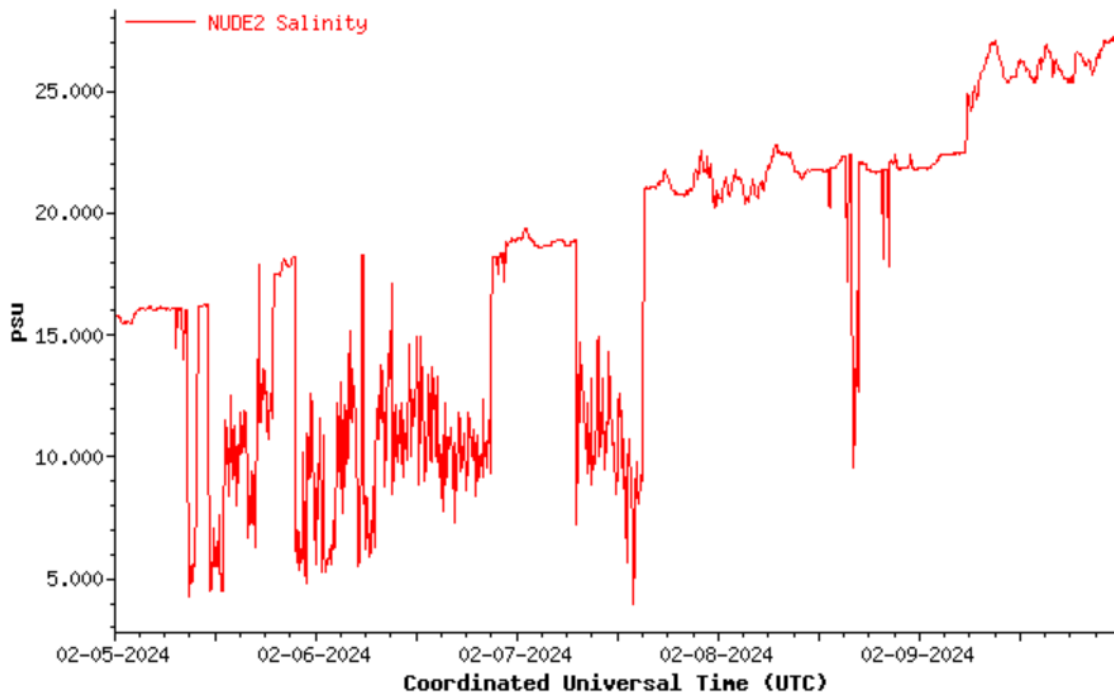


Figure 6. The February pumping event during the 2023-2024 year. Vertical lines represent the start (left line) and end (right line) of pumping events.

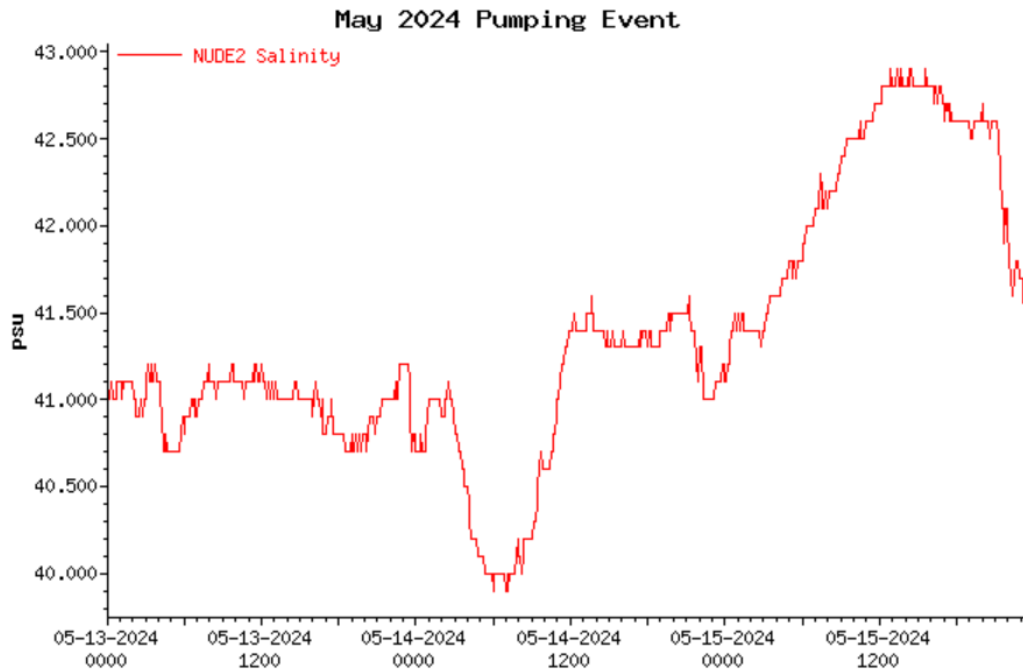


Figure 7. The May pumping event during the 2023-2024 year. Vertical lines represent the start (left line) and end (right line) of pumping events.

In addition to freshwater inflows, the salinities in the Nueces Delta are also influenced by tidal variations which will cause movements of fresh, and saltwater separated by a halocline (Adams and Tunnell 2010). As the tide rises, saltwater nearer to the bay is forced further back into the delta, and as the tide lowers, freshwater located further away from the bay is pulled closer to the bay.

Diurnal tidal variation appeared to have little to no effect on salinities at NUDE2 during pumping events. Wind direction, wind velocity, evaporation and rainfall during pumping events have all had an effect on hydrodynamics in the Nueces Delta (Adams and Tunnell 2010).

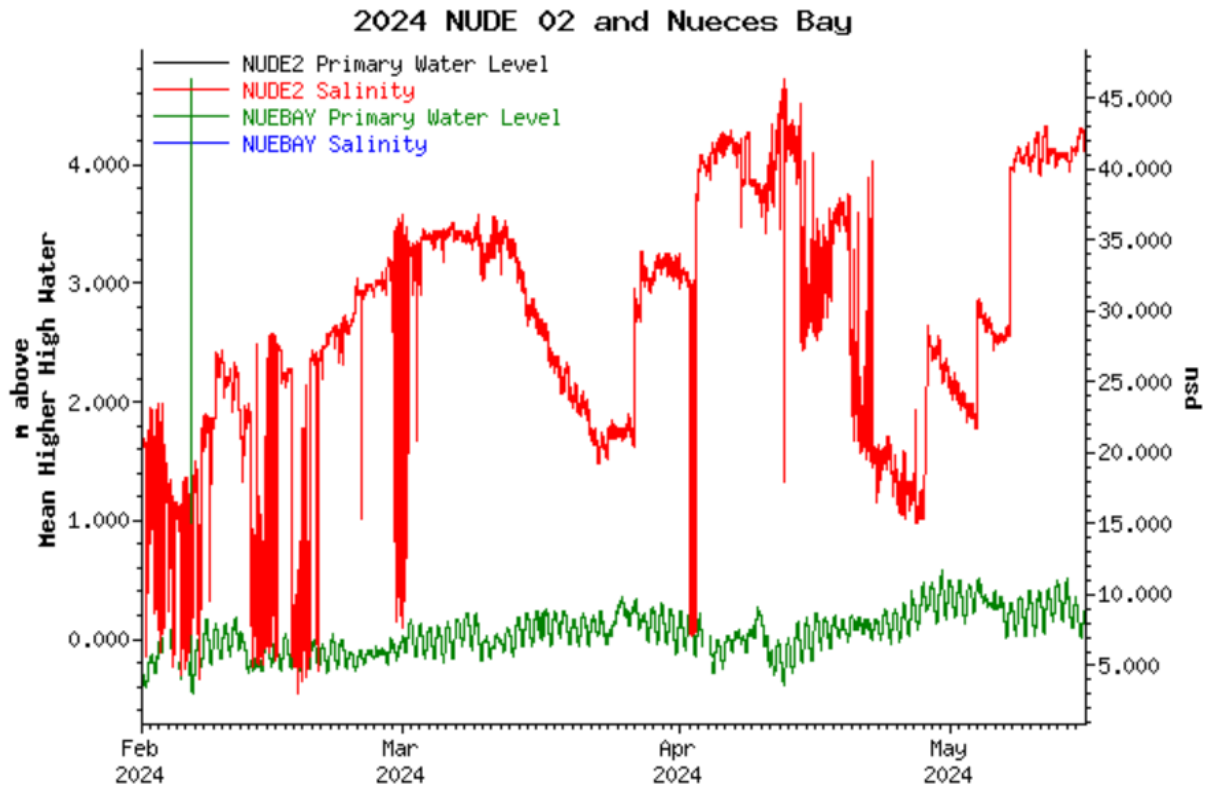


Figure 8. NUDE2 salinity (red line) and NUBAY water level (green line) during pumping event.

## CONCLUSIONS

During the reporting period there were two pumping events and minimal rainfall which did not affect the salinity as much as in previous years.

Figure 5 shows the yearlong salinity changes during the reporting period. Salinity was lower in the early months of the reporting period and gradually increased, with fluctuations, with the highest-level reporting in June 2024. Salinity levels began to diminish in July 2024 when the area received high levels of rain.

## REFERENCES

Adams, J.S. and J.W. Tunnell. 2010. Rincon Bayou Salinity Monitoring. Final Report submitted to the Coastal Bend Bays & Estuaries Program for project number 0921, Coastal Bend Bays & Estuaries Program, Publication No. CBBEP-66, 18 pp.

Bureau of Reclamation (BOR). 2000. Concluding Report: Rincon Bayou Demonstration Project. Volume II: Findings. United States Department of the Interior, Bureau of Reclamation, Oklahoma-Texas Area Office, Austin, Texas.

Dunton, K. H. and H. D. Alexander. 2000. Chapter Six: Vegetation Communities. In Bureau of Reclamation. Concluding Report: Rincon Bayou Demonstration Project. Volume II: Findings. United States Department of the Interior, Bureau of Reclamation, Oklahoma – Texas Area Office, Austin, Texas.

Hill, E. M., B. A. Nicolau, and P. V. Zimba. 2011. Habitat Management History of the Nueces Estuary, Texas, USA. *Texas Water Journal* (2)1: 97-111.

Hodges, B.R., K.H. Dunton, P.A. Montagna, and G.H. Ward. 2012. Nueces Delta Restoration Study. Final Report to the Coastal Bend Bays & Estuaries Program, Project 1001. Publication No. 84. Corpus Christi, Texas. 133 pp.

Matthews G. A. and A. J. Mueller. 1987. Freshwater inflow requirements of a Texas estuary. Coastal Zone 1987. WW Div./ASCE, Seattle Washington, 26-29 May 1987: 15 p.

Montagna, P.A., R.D. Kalke, and C. Ritter. 2002. Effect of Restored Freshwater Inflow on Macrofauna and Meiofauna in Upper Rincon Bayou, Texas, USA. *Estuaries* 25:1436–1447.

Montagna, P. A., E. M. Hill and B. Moulton. 2009. Role of science-based and adaptive management in allocating environmental flows to the Nueces Estuary, Texas, USA. In: Brebbia, C.A. and E. Tiezzi (eds.), *Ecosystems and Sustainable Development VII*, WIT Press, Southampton, UK, pp. 559-570.

National Weather Service. 2024. <http://w2.weather.gov/climate/index.php?wfo=crp>.

Nueces River Authority. 2024. <http://www.nueces-ra.org/CP/CITY/day.php>

Nueces River and Corpus Christi and Baffin Bays Basin and Bay Expert Science Team (BBEST). 2011. Environmental Flows Recommendations Report. Final Submission to the Environmental Flows Advisory Group, Nueces River and Corpus Christi and Baffin Bays Basin and Bay Area Stakeholder Committee, and Texas Commission on Environmental Quality, 285 pp.

Nueces River and Corpus Christi and Baffin Bays Basin and Bay Area Stakeholder Committee (BBASC). 2012. Environmental Flow Standards and Strategies Recommendations Report. Final Submission to the Environmental Flows Advisory Group, and Texas Commission on Environmental Quality, 112 pp.

Palmer, T.E., P.A. Montagna, and R.D. Kalke, 2002. Downstream effects of restored freshwater inflow to Rincon Bayou, Nueces Delta, Texas, USA. *Estuaries* 25pp. 1448-1456.

Pulich Jr., W. J. Tolan, W. Y. Lee, and W. Alvis. 2002. Final Report. Freshwater inflow recommendation for the Nueces Estuary. Texas Parks and Wildlife Department. Austin, Texas. 69 pp.

Texas Commission on Environmental Quality (TCEQ). 1995. Agreed Order Establishing Operational Procedures Pertaining to Special Condition B, Certificate of Adjudication No. 21-3214, Held by City of Corpus Christi et al., April 28, 1995.

Whitledge T. E. and D. A. Stockwell. 1995. The effects of mandated freshwater releases on the nutrient and pigment environment in Nueces Bay and Rincon Delta: 1990–1994. In: Jensen R, editor. Proceedings of the 24th Water for Texas Conference. 1995 Jan 26-27; Austin. College Station (TX): Texas Water Resources Institute. p. 47-51.