Tern Rookery Island Protection and Restoration, Phase I: Feasibility Study & Alternatives Analysis

GLO Contract No. 21-060-008-C668

Final Report

September 30, 2023

Prepared By:

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This report was funded in part by a Texas Coastal Management Program grant approved by the Texas Land Commissioner, providing financial assistance under the Coastal Zone Management Act of 1972, as amended, awarded by the National Oceanic and Atmospheric Administration (NOAA), Office for Coastal Management, pursuant to NOAA Award No. NA20NOS4190184. The views expressed herein are those of the author(s) and do not necessarily reflect the views of NOAA, the U.S. Department of Commerce, or any of their subagencies.

Project Background:

Tern Island, a 1.65-acre bird rookery island located in the upper Laguna Madre, is an active rookery island that supports large numbers of nesting colonial waterbirds like pelicans, egrets, skimmers, and terns. While small, the extreme importance of protecting Tern Island was recognized in the 2019 Texas Coastal Resiliency Master Plan. Ongoing erosion of the island's eastern shoreline is causing a loss of critical waterbird nesting habitat, resulting in declining colonial waterbird populations in the Coastal Bend region. Unlike many other low-lying rookery islands in this region, Tern Island has enough elevation to support a healthy shrub community that can be utilized by a large number of nesting birds. With projected sea level rise and increasing human development further limiting available nesting habitat in this region, Tern Island will likely become an even more critical nesting site soon. Protection of Tern Island from ongoing erosion and future sea level rise will help conserve and enhance an important rookery.

The Coastal Bend Bays and Estuaries Program (CBBEP) used Coastal Management Program (CMP) Cycle 25 funds to complete a feasibility study and alternatives analysis and preliminary design for the creation of an offshore structure that will protect the island from wind and wave action and make it more resilient to erosion and sea level rise. The project constitutes Phase I of the larger scale effort with success being measured by the development of up to three feasible alternatives for erosion protection of Tern Island.

Figure 1. Vicinity map and aerial images of Tern Island depicting effects of erosion 2009 – 2017.

Task 1 Summary: Contract with Engineering Firm

The CBBEP solicited proposals from engineering firms on CBBEP's "List of Pre-Qualified Engineering Firms" and awarded the project to HDR Engineering, Inc.. CBBEP had an existing Contract for Engineering Services with HDR, executed December 7, 2020 and developed a Work Order (WO) for the Tern Rookery Island Protection and Restoration, Phase I: Feasibility Study & Alternatives Analysis project. The standing Contract for Engineering Services and draft WO was sent to GLO for review on December 17, 2020 and were both approved on December 18, 2020. The WO for Engineering Services was executed on December 18, 2020 and a copy was provided to GLO on December 21, 2020.

Task 2 Summary: Feasibility Study and Alternatives Analysis

A kickoff meeting and follow up meeting were held between CBBEP and HDR Engineering on January 8, 2021 and January 18, 2021 to review project goals, scope, deliverables, timeline, and to discuss preliminary findings of the initial habitat assessment of Tern Island. Staff from CBBEP and HDR Engineering conducted the aforementioned habitat assessment of Tern Island on January 14, 2021 to identify the presence and location of natural resources within the project area. Bathymetric, topographic, and magnetometer surveys were conducted by T. Baker Smith in December 2020. The geotechnical investigation was also conducted in December 2020 and performed by Rock Engineering & Testing Laboratory, Inc.. All field work was completed prior to February 14, 2021 when access to Tern Island was restricted to avoid impacting colonial waterbird nesting activity. The geotechnical report and survey results were submitted to and approved by CBBEP on February 5, 2021. The seagrass survey report was submitted to and approved by CBBEP on March 12, 2021. A draft of the Feasibility and Alternatives Analysis Report was submitted by HDR to CBBEP on May 14, 2021 for review. CBBEP provided comment and the Final Feasibility and Alternatives Analysis Report was approved by CBBEP on June 14, 2021. The Notes from calls with engineer and the Feasibility and Alternatives Analysis Report were submitted to the GLO on 7/9/2021. Task 2 Summary report was submitted to GLO on 8/31/2021. All reports and deliverables generated under Task 2 are provided in Appendix I.

Task 3 Summary: Preliminary Engineering & Design

CBBEP was awarded funding for Phase II of this project via a GLO Coastal Erosion Planning and Response Act (CEPRA) grant for design, permitting, and construction. Following completion of the Feasibility Study, a portion of CMP project funds remained unspent. On May 24, 2021, CBBEP inquired about amending the CMP cooperative agreement for this project to allocate unspent funds towards the development of preliminary engineering design of a riprap breakwater and importing of fill for island expansion, the preferred alternative identified in the Feasibility Study. Approval from NOAA to change the scope of work was received on September 13, 2021. An amendment to CMP #21-060-008-C668 was executed on June 23, 2022, allowing for the reallocation of unspent funds and the addition of Task 3: Preliminary Engineering Design.

Due to delays in executing the GLO-CEPRA agreement, the second WO was not submitted to GLO-CMP according to the originally scheduled deliverable date of 8/31/2022. However, CBBEP, GLO-CMP, and GLO-CEPRA were in regular communication about the status of this agreement and, upon execution of the GLO-CEPRA agreement, a second WO was executed with HDR Engineering on February 10, 2023 and provided to GLO-CMP with the tenth quarterly report for this project on April 10, 2023.

A kickoff meeting was held with HDR, CBBEP and GLO-CEPRA on February 24, 2023. All additional field work was completed, including habitat delineation, bathymetric and magnetometer surveys and pipeline probing, by April 14, 2023. Preliminary (30%) designs were received from HDR on June 8, 2023 and a design review meeting between HDR, CBBEP, and GLO-CEPRA, was held on June 30, 2023. All reports and deliverables generated under Task 3 are provided in Appendix II.

Task 4 Summary: Project Monitoring & Reporting

A total of eleven quarterly reports were submitted to the GLO-CMP project manager over the course of the project. The draft final report was submitted on September 15, 2023, and the final report and closeout form was submitted by September 30, 2023.

APPENDIX I

Task 2 Deliverables
(Task 2 Summary Report, Seagrass Survey Report, Geotechnical Report, Call and Meeting Notes, Feasibility and Alternatives Analysis Report)

Project Title: Tern Rookery Island Protection and Restoration, Phase I: Feasibility Study & Alternatives Analysis

GLO Contract #: 21-060-008-C668

CBBEP Project Manager: Adrien Hilmy
ahilmy@cbbep.org
(361) 549-0667

RE: **Task 2: Feasibility Study and Alternatives Analysis**

Deliverable #3: Final Summary Report

BACKGROUND:

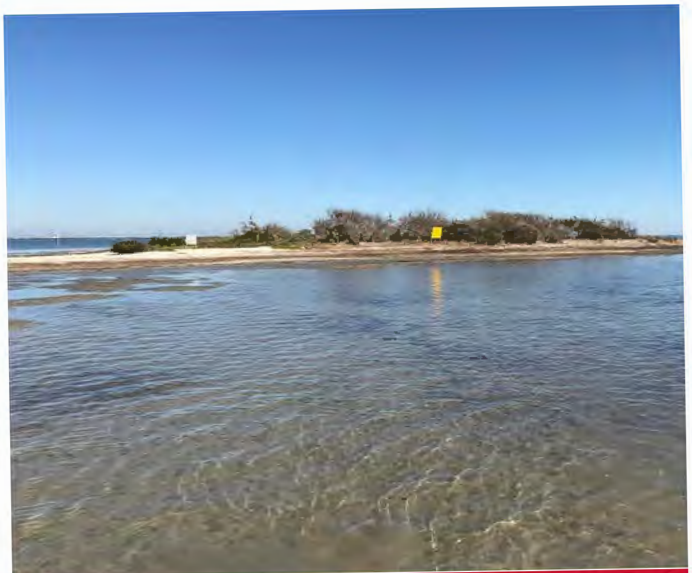
On December 7, 2020, the Coastal Bend Bays & Estuaries Program (CBBEP) executed a contract for engineering services with HDR Engineering Inc. for the development of a Feasibility Study & Alternatives Analysis Report for Phase I of the Tern Rookery Island Protection and Restoration Project. The following is a summary of activities conducted by HDR Engineering Inc. and CBBEP under Task 2: Feasibility Study and Alternatives Analysis of the GLO Contract No. 21-060-008-C668. Attached are the meeting and call notes between CBBEP and HDR Engineering Inc., the Seagrass Survey Report, Geotechnical Survey Report, and Feasibility and Alternatives Analysis Report.

WORK CONDUCTED:

A kickoff meeting and follow up meeting were held between CBBEP and HDR Engineering on January 8, 2021 and January 18, 2021 to review project goals, scope, deliverables, timeline, and to discuss preliminary findings of the initial habitat assessment of Tern Island. Staff from CBBEP and HDR Engineering conducted the aforementioned habitat assessment of Tern Island on January 14, 2021 to identify the presence and location of natural resources within the project area. Bathymetric, topographic, and magnetometer surveys were conducted by T. Baker Smith in December 2020. The geotechnical investigation was also conducted in December 2020 and performed by Rock Engineering & Testing Laboratory, Inc.. All field work was completed prior to February 14, 2021 when access to Tern Island was restricted to avoid impacting colonial waterbird nesting activity. The geotechnical report and survey results were submitted to and approved by CBBEP on February 5, 2021. The seagrass survey report was submitted to and approved by CBBEP on March 12, 2021. A draft of the Feasibility and Alternatives Analysis Report was submitted by HDR to CBBEP on May 14, 2021 for review. CBBEP provided comment and the Final Feasibility and Alternatives Analysis Report was approved by CBBEP on June 14, 2021. The *Notes from calls with engineer* and the *Feasibility and Alternatives Analysis Report* were submitted to the GLO on 7/9/2021.

Exhibit A

Seagrass Survey Report



Seagrass Survey Report

Coastal Bend Bays & Estuaries Program

Tern Rookery Island Project

Upper Laguna Madre

Nueces County, Texas

10270854

March 5, 2021

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Tables

Appendices

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1 INTRODUCTION

Coastal Bend Bays & Estuaries Program (CBBEP) proposes to construct a series of new breakwaters to protect the shoreline of Tern Rookery Island in the Upper Laguna Madre, Nueces County, Texas. Effects from high storm and tidal surges can cause extensive erosion damage to rookery islands within the Upper Laguna Madre. Tern Rookery Island experienced a loss of approximately 50 feet of shoreline on the southwestern side of the island from the effects of Hurricane Harvey in 2017 (CBBEP, 2017). The primary purpose of the proposed breakwaters is to prevent further erosion.

This report presents findings from a seagrass survey conducted within an approximate 26-acre Study Area surrounding Tern Rookery Island to assist with preliminary engineering design of the proposed breakwaters and U.S. Army Corps of Engineers (USACE) permitting.

1.1 Study Area Location

Tern Rookery Island is located within the Upper Laguna Madre, approximately a third of a mile north of the John F. Kennedy Memorial Causeway Bridge located on South Padre Island Drive and traverses the Gulf Intracoastal Waterway (GIWW) and connects to North Padre Island, Texas (**Appendix A – Figure 1, General Location Map**). The Study Area totals approximately 26 acres including the approximate 1.5-acre rookery island and 24.5 acres of open water. The approximate center coordinates of the Study Area are (latitude/longitude): 27.657874°, -97.251235° (UTM Zone 14 R, 672498.33 m E, 672498.33 m N; NAD 83).

2 METHODS

HDR Engineering, Inc. (HDR) biologist Nikki Davis, Ph.D. surveyed the Study Area for the presence of seagrass habitat on January 15, 2021. Using the line-intercept method, 17 transects were established from the shoreline to the outer limits of the Study Area (**Appendix A - Figure 2, Survey Transects Map**). HDR surveyed transects in water depths ranging from 0 to 6 feet at the time of the survey.

To determine the presence or absence of seagrass along each transect, the HDR biologist took grab samples of bottom sediment along transects using a modified post-hole digger. To verify the presence or absence of the seagrass, the samples were examined by hand for root and/or shoot structures. Seagrass presence and absence was recorded along transects using a differentially corrected global positions system (GPS) unit (Geo7X Trimble) with sub-meter accuracy.

Accuracy of field observations was diminished in instances where the bottom elevations along transects were in excess of wading depth (i.e., water depths greater than approximately 4 feet). In these instances, grab samples were taken from boat and high resolution aerial imagery were utilized to supplement collected data. Additionally, photos were taken along each transect to document existing conditions during the survey. Representative photos of the Study Area and their approximate location within the Study Area are included in **Appendix B**.

Geographic Information System (GIS) software ArcMap 10.7.1 was used to analyze collected features, calculate area, and generate figures. All point, line, and polygon data collected using the GPS receiver and displayed on subsequent figures are for review purposes only and do not represent a professional civil survey.

3 RESULTS

Water depths surrounding Tern Rookery Island at the time of the survey were relatively shallow, ranging from 0 to -5 feet. As shown on aerial imagery, the rookery island is oriented between recreation navigational channels to the southwest, east, and northeast (**Appendix A – Figure 2, Survey Transects Map**). Water depths within the channel used to access the island at the time of the field survey were between 4 and 6 feet and bottom conditions consisted of bare, soft mucky sediments.

Seagrass was observed along all 17 transects at water depths ranging from 0 to 5 feet with one seagrass presence observation at a water depth of 5 feet (**Table 1. Seagrass Transect Observations**). Seagrass beds covered 20.35 acres of the approximate 26-acre Study Area. The remaining acres consisted of the bird rookery island, approximately 1.5 acres, and bare bay bottom, approximately 4.2 acres. Shoal grass (*Halodule wrightii*) was the dominant species observed along transects, followed by patches of manatee grass (*Syringodium filiforme*) and star grass (*Halophila engelmannii*) occurring primarily within the eastern and northern portions of the Study Area.

Patchy seagrass beds were observed within proximity of the northern shoreline, about 10 to 20 feet bayward of the island. Less than 10 percent cover was observed in these patchy areas and consisted of mostly shoal grass with short leaf lengths. Patchy seagrass beds transitioned to denser beds with distance bayward of the island, starting at distances ranging from 40 to 100 feet from the shoreline. Dense seagrass beds covered the majority of the Study Area. . Bare bottom was observed adjacent to the shoreline at water depths less than 1 foot, as well as a few small patches southwest and east of Tern Rookery Island (**Appendix A – Figure 3, Seagrass Habitat Map**).

Table 1. Seagrass Transect Observations.

TRANSECT NO.	LENGTH (FT)	PRESENCE (Y/N)	WATER DEPTHS (FT)
T1	347.55	Y	0 - 2
T2	335.56	Y	0 - 2
T3	455.05	Y	0 - 1.5
T4	596.07	Y	0 - 4
T5	495.38	Y	0 - 4
T6	560.45	Y	0 - 4.5
T7	542.21	Y	0 - 4.5
T8	429.84	Y	0 - 5
T9	114.29	Y	0 - 1.5
T10	314.45	Y	0 - 2.5
T11	222.19	Y	0 - 2.5
T12	228.42	Y	0 - 2.5
T13	261.67	Y	0 - 2.5
T14	295.99	Y	0 - 2
T15	249.08	Y	0 - 2
T16	265.44	Y	0 - 2
T17	2324.94	Y	3.5 - 5

4 CONCLUSION

Seagrass distribution in Texas correlates to precipitation and freshwater inflow gradients along the Texas coast. Seagrass beds are prevalent in Texas bays from the mid-coast (Texas Coastal Bend) towards the lower coast, which relates to low rainfall and freshwater inflows. Seagrasses require clear and shallow waters among other water quality factors including salinity for long-term survival and growth (Morrison and Greening 2011).

Four of the five species of seagrass that are known to occur in Texas are present within the Upper Laguna Madre (TPWD, 1999). Based on results from the field survey, three of the four seagrass species were identified within the Study Area surrounding Tern Rookery Island. Shoal grass, manatee grass, and star grass occupy approximately 78 percent of the Study Area. The majority of seagrass beds were observed within water depths from 1 to 3 feet and no seagrass habitat was observed within water deeper than 5 feet. No seagrass was observed in samples taken within the existing navigational channels located north and south of Tern Rookery Island.

5 REFERENCES

Coastal Bend Bays & Estuaries Program (CBBEP). 2017. Post-Harvey Texas Mid-coast Rookery Island Preliminary Damage Report. Coastal Bird Program. Available online: https://www.harteresearchinstitute.org/sites/default/files/projects/Hurricane%20Harvey%20Island%20habitat%20assessment_CBBEP%20Coastal%20Bird%20Program.pdf. Accessed 02 July 2020.

Morrison, G. and Greening, H. 2011. Seagrass. In: Integrating Science and Resource Management in Tampa Bay, Florida. Eds. Yates, K.K., Greening, H., and Morrison, G. Tampa Bay Estuary Program and U.S. Geological Survey Circular 1348, 280p. Available online: https://pubs.usgs.gov/circ/1348/. Accessed 02 July 2020.

TPWD. 1999. Seagrass Conservation Plan for Texas. Texas Parks and Wildlife, Resource Protection Division. 79 p. Available online: https://tpwd.texas.gov/publications/pwdpubs/media/pwd_bk_r0400_0041.pdf. Accessed 02 July 2020.

APPENDIX A

FIGURES

FILE: O:\10270845 10191 CBBEP TERN ROCK ISLAND\MAP DOCS\FIGURES\SEAGRASS REPORT\TERN ROOK ISLAND LOCATION FIG1.MXD

GENERAL LOCATION MAP

CBBEP TERN ROOKERY ISLAND
NUECES COUNTY, TEXAS

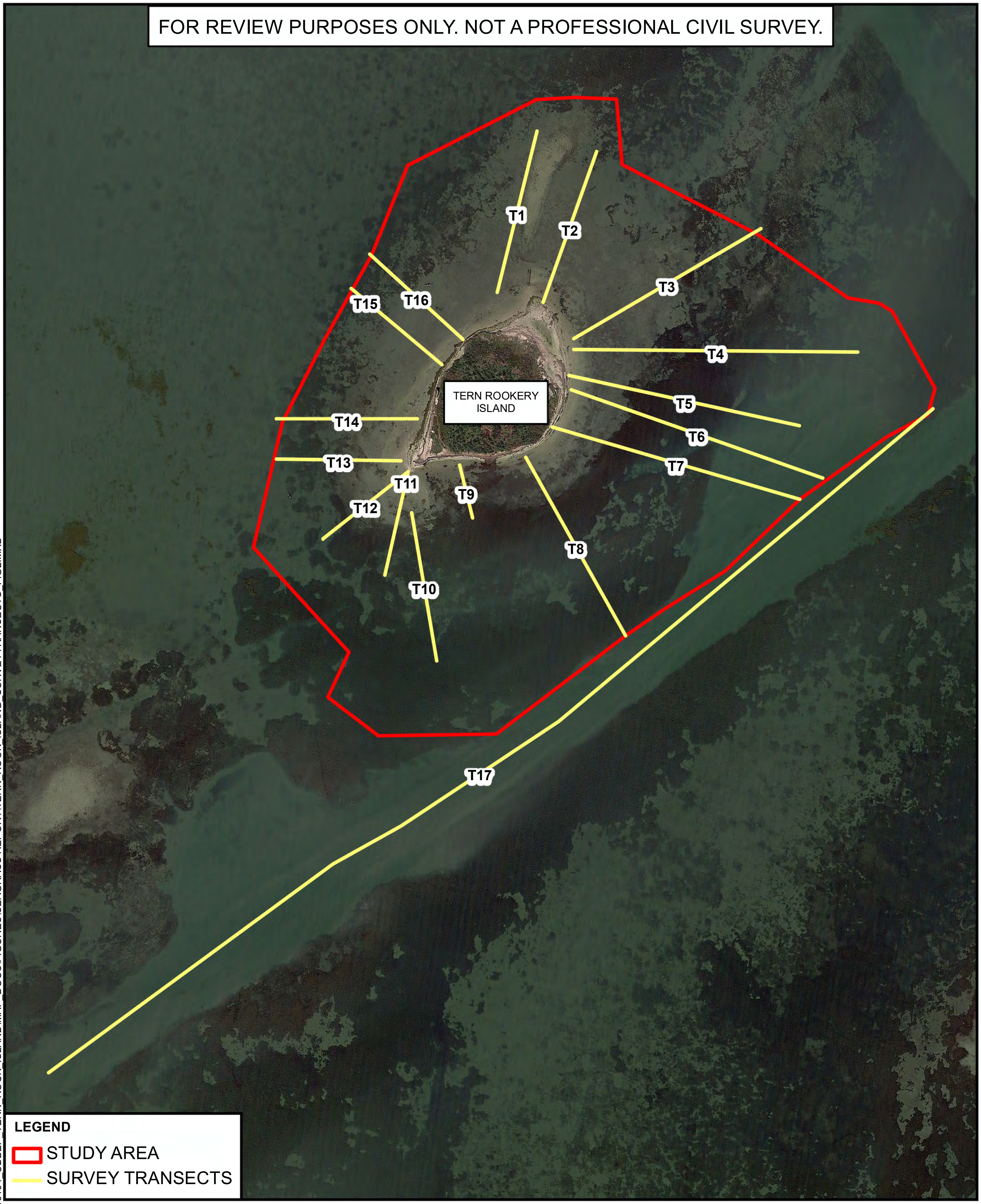
SEAGRASS SURVEY REPORT

N

0 10 20 40
Mi

MAR 2021

FIGURE 1



SURVEY TRANSECTS MAP

CBBEP TERN ROOKERY ISLAND
NUECES COUNTY, TEXAS

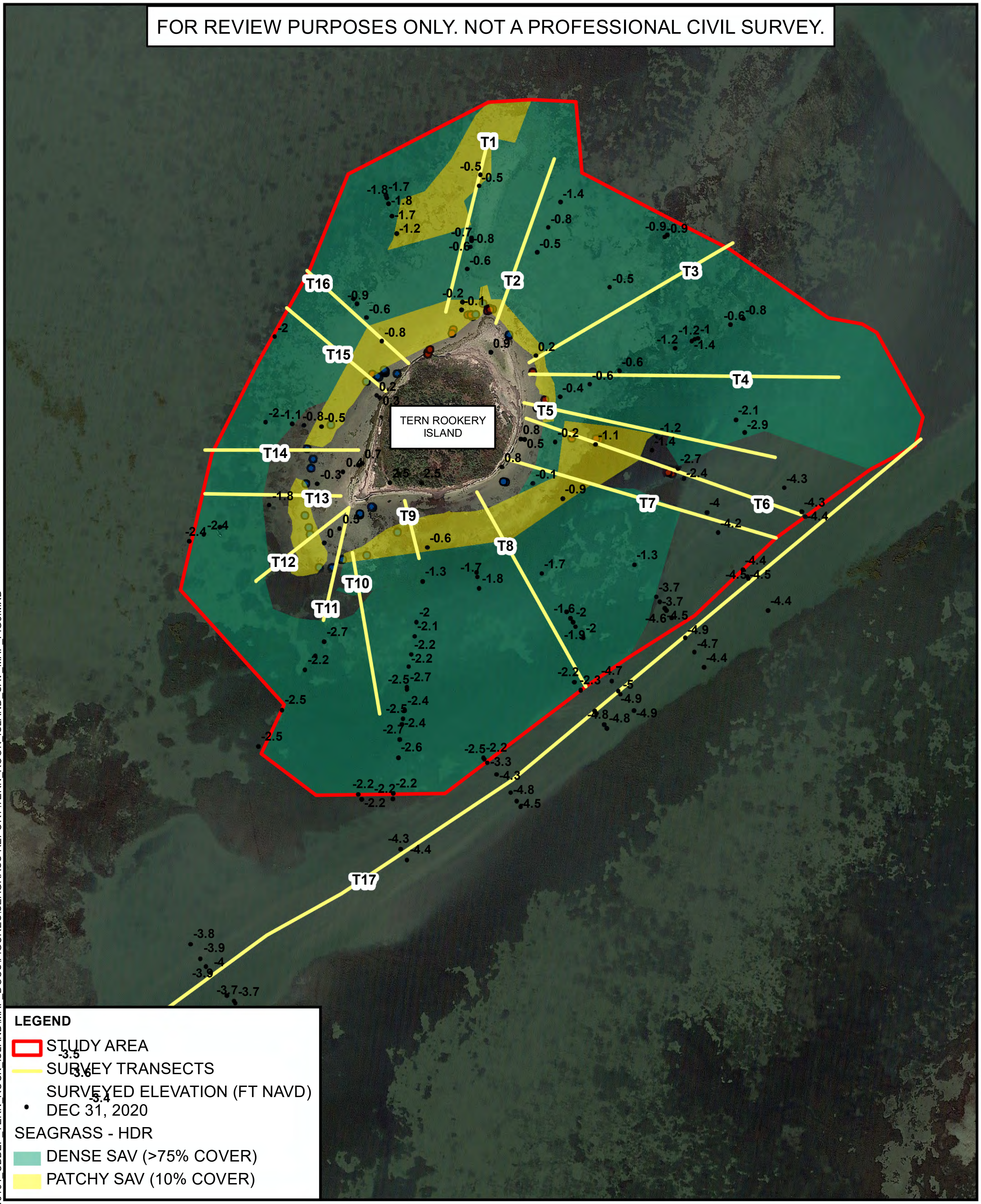
SEAGRASS SURVEY REPORT

N

0 175 350 Ft

FEB 2021

FIGURE 2



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SEAGRASS HABITAT MAP

CBBEP TERN ROOKERY ISLAND
NUECES COUNTY, TEXAS

SEAGRASS SURVEY REPORT

N

0 160 320 Ft

MAR 2021

FIGURE 3

APPENDIX B

REPRESENTATIVE SITE PHOTOGRAPHS AND MAP

Representative Site Photos

Seagrass Survey

January 15, 2021

Photo 1 – Representative photo of Tern Rookery Island. Photo taken near T12 and south of the rookery island facing north.

Photo 2 – Submerged debris observed between T1 and T2 located north of Tern Rookery Island and facing north.

Photo 3 – Representative photo of bare bottom areas within shallow water (foreground) which transitions into patchy seagrass beds (background) located south of Tern Rookery Island. Photo taken along T11 facing south.

Photo 4 – Photo taken within a dense seagrass area along T6 east of Tern Rookery Island. Photo faces southwest.

Photo 5 – Representative photo of the shoreline along Tern Rookery Island near T9 and facing northeast.

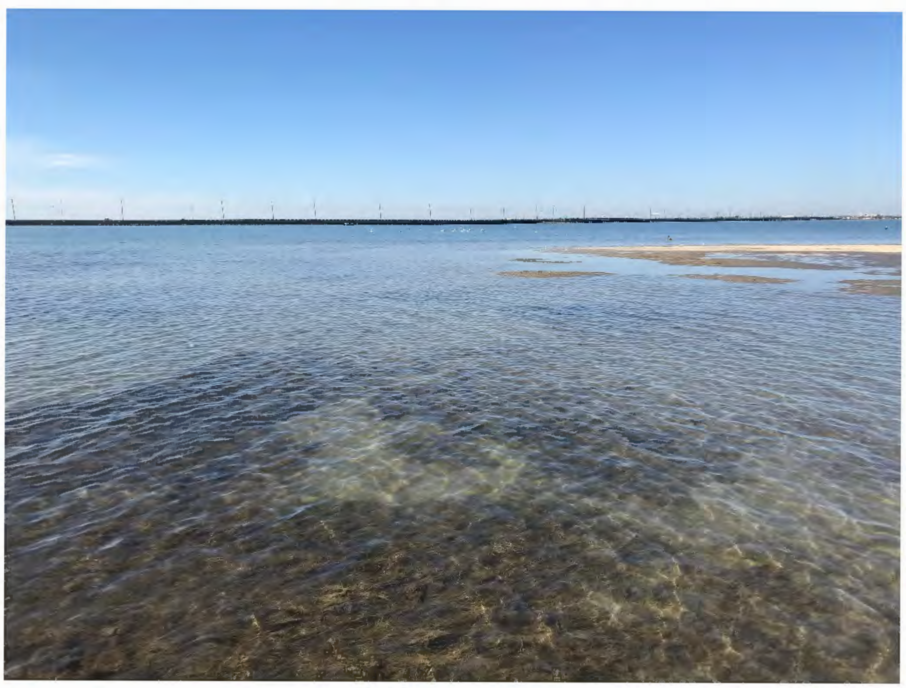

Photo 6 – Representative photo of patchy seagrass beds located south of Tern Rookery Island (right). Photo taken along T9 and facing west.

Photo 7 – Representative photo of bare ground (foreground) and great blue herons (*Ardea herodias*) beginning to roost on Tern Rookery Island (background). Photo taken along T15 west of the Rookery Island facing east.

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SITE PHOTOS MAP

CBBEP TERN ROOKERY ISLAND
NUECES COUNTY, TEXAS

SEAGRASS SURVEY REPORT

MAR 2021

FIGURE 1

Exhibit B

Geotechnical Report

• GEOTECHNICAL ENGINEERING
• MATERIALS ENGINEERING & TESTING
• SOILS • ASPHALT • CONCRETE

GEOTECHNICAL SUBSURFACE INVESTIGATION AND RECOMMENDATIONS FOR THE PROPOSED SHORELINE PROTECTION PROJECT TERN ROOKERY ISLAND CORPUS CHRISTI, TEXAS

RETL REPORT NUMBER: G121002

PREPARED FOR:

HDR ENGINEERING, INC.
555 NORTH CARANCAHUA, SUITE 1600
CORPUS CHRISTI, TEXAS 78401

JANUARY 18, 2021

PREPARED BY:

ROCK ENGINEERING & TESTING LABORATORY, INC.
6817 LEOPARD STREET
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- SOILS • ASPHALT • CONCRETE

January 18, 2021

HDR Engineering, Inc.
555 North Carancahua, Suite 1600
Corpus Christi, Texas, 78401

Attention: Mr. Daniel J. Heilman, P.E., D.CE

SUBJECT: **SUBSURFACE INVESTIGATION, LABORATOY TESTING PROGRAM, AND GEOTECHNICAL RECOMMENDATIONS FOR THE PROPOSED SHORELINE PROTECTION PROJECT**
Tern Rookery Island
Corpus Christi, Texas
RETL Job No. – G121002

Dear Mr. Heilman,

In accordance with our agreement, we have conducted a subsurface investigation, laboratory testing program, and foundation evaluation for the above referenced project. The results of this investigation, together with our recommendations, are to be found in the accompanying report, one electronic copy of which is being transmitted herewith for your records and distribution to the design team.

Often, because of design and construction details that occur on a project, questions arise concerning soil conditions and Rock Engineering and Testing Laboratory, Inc. (RETL) (TBPE Firm No. 2101), would be pleased to continue its role as the Geotechnical Engineer during project implementation.

RETL also has great interest in providing materials testing and observation services during the construction phase of this project. If you will advise us of the appropriate time to discuss these engineering services, we will be pleased to meet with you at your convenience.

Sincerely,

STATE OF TEXAS — JAMES P. BAUER — 129201 — LICENSED PROFESSIONAL ENGINEER

James P. Bauer, P.E.
Corpus Christi Branch Manager

STATE OF TEXAS — DARREN W. LANTZ — 94868 — LICENSED PROFESSIONAL ENGINEER

Darren W. Lantz, P.E.
Senior Project Engineer

TABLE OF CONTENTS

INTRODUCTION

This report presents the results of a soils exploration, laboratory testing program, and foundation analysis for the proposed Shoreline Protection Project at Tern Rookery Island, located in the upper Laguna Madre near Corpus Christi, Texas.

Authorization

The work for this project was performed in accordance with RETL proposal number P120420B dated December 7, 2020. The scope of work and fee was approved and incorporated into GEOTECH SUBCONSULTANT AGREEMENT 10270854 between HDR Engineering, Inc. (HDR) and Rock Engineering and Testing Laboratory, Inc. (RETL). The SUBCONSULTANT AGREEMENT was returned to RETL via e-mail transmission.

Purpose and Scope

The purpose of this exploration is to assist HDR in their feasibility study for a proposed riprap breakwater shoreline protection project by evaluating the soil conditions at the site and providing soil profile information, as well as foundation settlement estimates.

The scope of the exploration and analysis included the subsurface exploration, field and laboratory testing, engineering analysis and evaluation of the subsurface soils, provision of recommendations, and preparation of this report for the proposed Shoreline Protection Project at Tern Rookery Island, located in the upper Laguna Madre near Corpus Christi, Texas. Based on information provided to RETL, the Shoreline Protection Project will include the construction of a stone riprap breakwater. The proposed breakwater will be approximately 4 to 4½ feet in height, with a crest elevation approximately 3½ feet above sea level.

The scope of services did not include an environmental assessment. Any statements in this report, or on the boring logs, regarding odors, colors, unusual or suspicious items or conditions are strictly for the information of the client.

General

The information submitted for the proposed project is based on project details provided by HDR and the soil information obtained at the boring locations. If the designers require additional soil parameters to complete the design of the proposed structure, and this information can be obtained from the soil data and laboratory tests performed within the scope of work included in our proposal for this project, RETL will provide the additional information requested as a supplement to this report.

The Geotechnical Engineer states that the findings contained herein have been presented after being prepared in a manner consistent with that level of care and skill ordinarily exercised by reputable members of the Geotechnical Engineer's profession practicing contemporaneously under similar conditions in the locality of the project. RETL operates in general accordance with "*Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction*, (ASTM D3740)." No other representations are expressed or implied, and no warranty or guarantee is included or intended.

This report has been prepared for the exclusive use of HDR for the specific application for the proposed Shoreline Protection Project at Tern Rookery Island near Corpus Christi, Texas.

DESCRIPTION OF SITE

The proposed project site is located approximately 0.3 miles north of the JFK Causeway and approximately 1.1 miles west of the Gulf Intracoastal Waterway. The island is approximately 1.5 acres in size and was accessible by boat. A Site Vicinity Map is provided in the Appendix of this report. The drillers indicated that the bay bottom around the island and at the boring locations was soft.

FIELD EXPLORATION

Scope

The field exploration, to evaluate the engineering characteristics of the subsurface materials, included reconnaissance of the project site, performing the boring operations and obtaining disturbed samples. During the sample recovery operations, the soils encountered were classified and recorded on the boring logs in accordance with "*Standard Guide for Field Logging of Subsurface Exploration of Soil and Rock*, (ASTM D5434)."

Five borings were performed at this site for the purpose of providing geotechnical information. The table below provides the boring identifications, actual boring depths as measured from the mudline at the boring locations, and GPS coordinates at the boring locations.

Boring	Sampling Termination Depth (ft)	GPS Coordinates
B-1	10	N 27.65778° W 97.25190°
B-2	6	N 27.65830° W 97.25160°
B-3	10	N 27.65850° W 97.25085°
B-4	10	N 27.65783° W 97.25059°
B-5	10	N 27.65745° W 97.25112°

Boring B-2 was originally scheduled to extend to a depth of 10 feet; however, the boring was terminated at a depth of 6 feet due to refusal of the hand-operated auger equipment.

The GPS coordinates, obtained at the boring locations using a commercially available GPS, are provided in this report and on the boring logs. RETL, in coordination with HDR determined the scope of the field work. RETL located the borings in the field and performed the drilling operations. A Boring Location Plan is provided in the Appendix.

The borings performed for this project were used to determine the classification and strengths of the subgrade soils. The information provided on the boring logs includes boring locations, boring depths, soil classifications, soil strengths, and laboratory test results. The boring logs are included in the Appendix.

Drilling and Sampling Procedures

The borings were advanced using hand-operated sampling equipment continuously until reaching the planned termination depth of the boring or until refusal. The sampling operations were performed in general accordance with the procedures for "*Standard Practice for Soil Exploration and Sampling by Auger Borings,* (ASTM D1452)."

Representative grab samples were obtained for every 2 foot the sampling equipment was advanced. The soil samples obtained were placed in plastic bags, marked according to boring number, depth and any other pertinent field data, stored in special containers and delivered to the laboratory for testing.

Field Tests and Observations

Static Cone Penetrometer Tests - Portable static cone penetrometer tests were also performed at the surface of each boring, and at approximate 1 foot intervals. The portable static cone penetrometer is a device used for measuring soil consistency. The device is equipped with dual rods enabling the cone stress to be measured directly. Soil friction on the outer rod does not influence the reading. The cone is forced into the soil in increments and retracted slightly after each increment to zero the gauge, and then the cone is advanced to obtain the cone index (Qc). The cone index is always read directly from the gauge. It has units of kg/cm^2, which is essentially equal to $tons/ft^2$. The results of the portable static cone penetrometer tests are provided on the boring logs using the notation Qc.

The correlation between the cone index and soil constants is not absolute. The following empirical formulas were provided by the portable static cone penetrometer manufacturer, Boart Longyear Company, and have been determined through extensive field use of the unit:

- Standard Penetration Test Value "N"
  - N = Qc/4

- Unconfined Compressive Strength "Qu" (tsf)
  - Uniform clay and silty clays: Qu = Qc/5
  - Clayey silts: Qu = Qc/(10 to 20)

- Cohesion "C" or Undrained Shear Strength (tsf)
  - Uniform clay and silty clays: C = Qc/10
  - Clayey silts: C = Qc/(10 to 20)

Water Level Observations – All borings were performed in a marine environment and the areas were inundated with seawater.

Bay Bottom Elevations – The bay bottom elevations at the boring locations were not provided at the time of this report. The depths of water in relation to the mudline at the boring locations was recorded and are presented herein and on the boring logs provided in the Appendix.

LABORATORY TESTING PROGRAM

In addition to the field investigation, a laboratory testing program was conducted to determine additional pertinent engineering characteristics of the subsurface materials necessary in analyzing the behavior of the foundation system for the proposed project.

The laboratory testing program included supplementary visual classification (ASTM D2487) and water content tests (ASTM D2216) on the samples. In addition, selected samples were subjected to Atterberg limits tests (ASTM D4318), percent material finer than the #200 sieve tests (ASTM D1140) and Sieve Analysis (ASTM D6913).

The laboratory testing program was conducted in general accordance with applicable ASTM Specifications. The results of these tests are to be found on the accompanying boring logs and Grain Size Distribution curves provided in the Appendix.

SUBSURFACE CONDITIONS

General

The types of foundation bearing materials encountered in the test borings have been visually classified and are described in detail on the boring logs. The results of the static cone penetrometer, and other laboratory tests are presented on the boring logs. Representative samples of the soils were placed in polyethylene bags and are now stored in the laboratory for further analysis, if desired. Unless notified to the contrary, the samples will be disposed of three months after issuance of this report.

The stratification of the soil, as shown on the boring logs, represents the soil conditions at the actual boring locations. Variations may occur between, or beyond, the boring locations. Lines of demarcation represent the approximate boundary between different soil types, but the transition may be gradual, or not clearly defined.

It should be noted that, whereas the test borings were drilled and sampled by experienced drillers, it is sometimes difficult to record changes in stratification within narrow limits. In the absence of foreign substances, it is also difficult to distinguish between discolored soils and clean soil fill.

Soil Conditions

The soil conditions encountered at the project site have been summarized and soil properties including soil classification, undrained shear strength, angle of internal friction, and effective unit weight are provided in the following tables.

Soil Profile Table								
D	**Generalized Soil Description**	**LL**	**PI**	**C**	**ϕ**	**γ_e**	**-#200**	**Q_c**
0 - 6	Silty and/or Silty Clayey **SAND**	24-27	2-7	0	28	50	23-34	4-24
6 - 9½	**CLAYEY** Sand	30-41	9-24	300	0	55	34-45	2-15
9½ -10	**CLAYEY** Sand	---	---	1,200	0	55	---	10-28

Where:

D = Depth in feet below existing bay bottom
LL = Liquid Limit (%)
PI = Plasticity Index
C = Soil Cohesion, psf (undrained)
ϕ = Angle of Internal Friction, deg. (undrained)
γ_e = Effective soil unit weight, pcf
-#200 = Percent passing the No. 200 sieve (%)
Q_c = Cone Index (tsf)

Detailed descriptions of the soils encountered at the boring locations are provided on the boring logs included in the Appendix.

At the time of our field sampling services, the water depth at the boring locations (distance from the water surface to the bay bottom) was measure as indicated in the following table.

Water Depth at Time of Sampling	
Boring	**Depth (inches)**
B-1	9
B-2	9
B-3	2
B-4	3
B-5	3

FOUNDATION DISCUSSION AND RECOMMENDATIONS

Based on information provided to RETL, the proposed Shoreline Protection Project is located at Tern Rookery Island in the upper Laguna Madre near Corpus Christi, Texas. The project will include the construction of a stone riprap breakwater. The proposed breakwater will have a crest width of approximately 3 feet, will have a total height of approximately 4½ feet, with the crest being approximately 3½ feet above the water surface. The side slopes of the breakwater will be constructed at a slope of approximately 2.5 Horizontal to 1 Vertical, resulting in a base width of approximately 25 feet. A breakwater with the proposed measurements results in a ground contact pressure, assuming a SSD Unit Weight of the rock material of 160 pcf, of approximately 720 psf. The breakwater will exert a line load similar to that of a strip footing foundation.

It is RETL's opinion that during the initial placement of the stone riprap, approximately 8 to 10 inches of displacement may occur. **Once the initial displacement settlement occurs the ultimate bearing pressure is on the order of 1,000 psf resulting in a safety factor for the effective unit weight of the stone breakwater on the supporting substrate on the order of 1.4.**

Immediate settlements, which should occur within a week after complete placement of the riprap to proposed grades, warrants that the contractor top off the breakwater after the initial construction of the breakwater. Assuming that the soils beneath our boring termination depths of 10 feet are similar in characteristic to the soils near the bottom of the borings, for depths of at least 2-times the average width of the cross-sectional dimension of the breakwater, long term consolidation settlements are expected to be approximately 5 inches. A more detailed settlement analysis can be performed; however, based on the dimensions of the breakwater a supplemental field investigation will be required to obtain additional data at greater depths.

In addition, it is understood that an alternate approach of construction, including constructing the breakwater with an approximate 10-foot-wide crest and using a loaded dump truck type vehicle on the crest of the breakwater to deposit the materials, is being considered. This method of construction is expected to increase the magnitude and rate of displacement settlement during construction. In addition, immediate settlements would likely occur during construction and therefore topping off the breakwater with additional stone after a week or two will likely not be necessary. However, in order to fully evaluate the estimated magnitudes of settlement, more specific details regarding the loading and geometry of the breakwater during construction would be required.

GENERAL COMMENTS

If significant changes are made in the character or location of the proposed project, a consultation should be arranged to review any changes with respect to the prevailing soil conditions. At that time, it may be necessary to submit supplementary recommendations.

APPENDIX

- GEOTECHNICAL ENGINEERING
- CONSTRUCTION MATERIALS ENGINEERING & TESTING
- SOILS • ASPHALT • CONCRETE

SITE VICINITY MAP

January 18, 2021
Attn: Mr. Daniel Heilman, P.E., D.CE
RETL Job Number: G121002

SHORELINE PROTECTION PROJECT
Tern Rookery Island
Corpus Christi, Texas

ROCK ENGINEERING & TESTING LABORATORY, INC.

Corpus Christi
Office: 361.883.4555
Fax: 361.883.4711
6817 Leopard St.
Corpus Christi, TX 78409

San Antonio
Office: 210.495.8000
Fax: 210.495.8015
10856 Vandale
San Antonio, TX 78216

Round Rock
Office: 512.284.8022
Fax: 512.284.7764
7 Roundville Ln.
Round Rock, TX 78664

www.rocktesting.com

- GEOTECHNICAL ENGINEERING
- CONSTRUCTION MATERIALS ENGINEERING & TESTING
- SOILS • ASPHALT • CONCRETE

BORING LOCATION PLAN

January 18, 2021
Attn: Mr. Daniel Heilman, P.E., D.CE
RETL Job Number: G121002

SHORELINE PROTECTION PROJECT
Tern Rookery Island
Corpus Christi, Texas

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Office: 512.284.8022
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7 Roundville Ln.
Round Rock, TX 78664

www.rocktesting.com

LOG OF BORING B-1

Rock Engineering & Testing Lab. Inc
6817 Leopard Street
Corpus Christi, Texas 78409
Telephone: 361-883-4555
Fax: 361-883-4711

CLIENT: HDR Engineering, Inc.
PROJECT: Shoreline Protection Project
LOCATION: Tern Rookery Island
NUMBER: G121002

DATE(S) DRILLED: 1/7/2021

DRILLING METHOD(S):
Hand Auger/Russian Sampler

GROUNDWATER INFORMATION:
Mudline was 9 inches below water surface.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT Qc: TONS/SQ FT	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	0			Qc= 9								
	1	AUGER S-1		Qc= 4	32	25	20	5			23	**SILTY CLAYEY SAND**, dark gray, wet, very loose. (SC-SM)
	2			Qc= 5								
	3	AUGER S-2		Qc= 9	32							Same as above.
	4			Qc= 7								
	5	AUGER S-3		Qc= 7	34	26	20	6			28	Same as above, with shell. (SC-SM)
	6			Qc= 6								
	7	AUGER S-4		Qc= 6	54							**CLAYEY SAND**, gray, wet, firm.
	8			Qc= 9								
	9	AUGER S-5		Qc= 15	51							Same as above, very stiff.
	10			Qc= 25								Boring was terminated at a depth of 10 feet.

N - STANDARD PENETRATION TEST RESISTANCE
Qc - STATIC CONE PENETROMETER TEST INDEX
P - POCKET PENETROMETER RESISTANCE
Tv - TORVANE SHEAR STRENGTH TEST

REMARKS:
Drilling operations were performed by RETL at GPS Coordinates N° 27.65778 W° 97.25190

LOG OF BORING B-2

Rock Engineering & Testing Lab. Inc
6817 Leopard Street
Corpus Christi, Texas 78409
Telephone: 361-883-4555
Fax: 361-883-4711

CLIENT: HDR Engineering, Inc.
PROJECT: Shoreline Protection Project
LOCATION: Tern Rookery Island
NUMBER: G121002

DATE(S) DRILLED: 1/7/2021

DRILLING METHOD(S):
Hand Auger/Russian Sampler

GROUNDWATER INFORMATION:
Mudline was 9 inches below water surface.

SURFACE ELEVATION: N/A

DEPTH (FT)	SAMPLE NUMBER	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT Qc: TONS/SQ FT	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
0		Qc= 9								
1	AUGER S-1	Qc= 11	38	24	22	2			34	**SILTY SAND**, gray, wet, very loose. (SM)
2		Qc= 12								
3	AUGER S-2	Qc= 9	46							Same as above.
4		Qc= 4								
5	AUGER S-3	Qc= 7	35	31	19	12			34	**CLAYEY SAND**, with shell, gray, wet, firm. (SC)
6		Qc= 4								Boring was terminated at a depth of 6 feet due to auger refusal. (Static Cone Readings obtained to 10 feet)
7		Qc= 3								
8		Qc= 3								
9		Qc= 5								
10		Qc= 28								

N - STANDARD PENETRATION TEST RESISTANCE
Qc - STATIC CONE PENETROMETER TEST INDEX
P - POCKET PENETROMETER RESISTANCE
Tv - TORVANE SHEAR STRENGTH TEST

REMARKS:
Drilling operations were performed by RETL at GPS Coordinates
N° 27.65830 W° 97.25160

LOG OF BORING B-3

Rock Engineering & Testing Lab. Inc
6817 Leopard Street
Corpus Christi, Texas 78409
Telephone: 361-883-4555
Fax: 361-883-4711

CLIENT: HDR Engineering, Inc.
PROJECT: Shoreline Protection Project
LOCATION: Tern Rookery Island
NUMBER: G121002

DATE(S) DRILLED: 1/7/2021

DRILLING METHOD(S):
Hand Auger/Russian Sampler

GROUNDWATER INFORMATION:
Mudline was 2 inches below water surface.

SURFACE ELEVATION: N/A

DEPTH (FT)	SAMPLE NUMBER	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT Qc: TONS/SQ FT	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
0		Qc= 15								
1	AUGER S-1	Qc= 20	28							**SILTY CLAYEY SAND**, with shell, dark gray, wet, loose.
2		Qc= 15								
3	AUGER S-2	Qc= 10	32	25	18	7			25	Same as above, very loose. (SC-SM)
4		Qc= 5								
5	AUGER S-3	Qc= 5	31							Same as above.
6		Qc= 3								
7	AUGER S-4	Qc= 2	34							**CLAYEY SAND**, with shell, gray, wet, soft.
8		Qc= 3								
9	AUGER S-5	Qc=5	45							Same as above, more clay, firm.
10		Qc=10								Boring was terminated at a depth of 10 feet.

N - STANDARD PENETRATION TEST RESISTANCE
Qc - STATIC CONE PENETROMETER TEST INDEX
P - POCKET PENETROMETER RESISTANCE
Tv - TORVANE SHEAR STRENGTH TEST

REMARKS:
Drilling operations were performed by RETL at GPS Coordinates N° 27.65850 W° 97.25085

LOG OF BORING B-4

Rock Engineering & Testing Lab. Inc
6817 Leopard Street
Corpus Christi, Texas 78409
Telephone: 361-883-4555
Fax: 361-883-4711

CLIENT: HDR Engineering, Inc.
PROJECT: Shoreline Protection Project
LOCATION: Tern Rookery Island
NUMBER: G121002

DATE(S) DRILLED: 1/7/2021

DRILLING METHOD(S):
Hand Auger/Russian Sampler

GROUNDWATER INFORMATION:
Mudline was 3 inches below water surface.

SURFACE ELEVATION: N/A

Soil Symbol	Depth (ft)	Sample Number	Samples	N: Blows/ft, P: Tons/sq ft, T: Tons/sq ft, Qc: Tons/sq ft	Moisture Content (%)	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	Dry Density Pounds/cu.ft	Compressive Strength (Tons/sq ft)	Minus No. 200 Sieve (%)	Description of Stratum
	0			Qc= 9								
	1	AUGER S-1		Qc= 15	41	25	22	3			24	**<u>SILTY SAND</u>**, with shell, dark gray, wet, very loose. (SM)
	2			Qc= 3								
	3	AUGER S-2		Qc= 8	42							**<u>SILTY CLAYEY SAND</u>**, with traces of shell, dark gray, wet, very loose.
	4			Qc= 8							34	
	5	AUGER S-3		Qc= 15	36							Same as above.
	6			Qc= 18								
	7	AUGER S-4		Qc= 3	28	30	21	9				**<u>CLAYEY SAND</u>**, with shell, gray, wet, firm.
	8			Qc= 3								
	9	AUGER S-5		Qc= 7	44						45	Same as above.
				Qc= 25								
	10											Boring was terminated at a depth of 10 feet.

N - STANDARD PENETRATION TEST RESISTANCE
Qc - STATIC CONE PENETROMETER TEST INDEX
P - POCKET PENETROMETER RESISTANCE
Tv - TORVANE SHEAR STRENGTH TEST

REMARKS:
Drilling operations were performed by RETL at GPS Coordinates
N° 27.65783 W° 97.25059

LOG OF BORING B-5

Rock Engineering & Testing Lab. Inc
6817 Leopard Street
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Telephone: 361-883-4555
Fax: 361-883-4711

CLIENT: HDR Engineering, Inc.
PROJECT: Shoreline Protection Project
LOCATION: Tern Rookery Island
NUMBER: G121002

DATE(S) DRILLED: 1/7/2021

DRILLING METHOD(S):
Hand Auger/Russian Sampler

GROUNDWATER INFORMATION:
Mudline was 3 inches below water surface.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT Qc: TONS/SQ FT	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	0			Qc= 7								
	1	AUGER S-1		Qc= 24	26							**SILTY CLAYEY SAND**, with shell, dark gray, wet, very loose.
	2			Qc= 9								
	3	AUGER S-2		Qc= 11	35	27	22	5			24	Same as above, gray. (SC-SM)
	4			Qc= 5								
	5	AUGER S-3		Qc= 17	34							Same as above, loose.
	6			Qc= 3								
	7	AUGER S-4		Qc= 2	40	41	17	24			45	**CLAYEY SAND**, gray, wet, soft. (SC)
	8			Qc= 6								
	9	AUGER S-5		Qc= 5	47							Same as above, firm.
				Qc= 19								
	10											Boring was terminated at a depth of 10 feet.

N - STANDARD PENETRATION TEST RESISTANCE
Qc - STATIC CONE PENETROMETER TEST INDEX
P - POCKET PENETROMETER RESISTANCE
Tv - TORVANE SHEAR STRENGTH TEST

REMARKS:
Drilling operations were performed by RETL at GPS Coordinates N° 27.65745 W° 97.25112

Engineering & Testing
Laboratory, Inc.

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KEY TO SOIL CLASSIFICATION AND SYMBOLS

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS		SYMBOL	NAME
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well Graded Gravels or Gravel-Sand mixtures, little or no fines
		GP	Poorly Graded Gravels or Gravel-Sand mixtures, little or no fines
		GM	Silty Gravels, Gravel-Sand-Silt mixtures
		GC	Clayey Gravels, Gravel-Sand-Clay Mixtures
	SAND AND SANDY SOILS	SW	Well Graded Sands or Gravelly Sands, little or no fines
		SP	Poorly Graded Sands or Gravelly Sands, little or no fines
		SM	Silty Sands, Sand-Silt Mixtures
		SC	Clayey Sands, Sand-Clay mixtures
FINE GRAINED SOILS	SILTS AND CLAYS LL < 50	ML	Inorganic Silts and very fine Sands, Rock Flour, Silty or Clayey fine Sands or Clayey Silts
		CL	Inorganic Clays of low to medium plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays
		OL	Organic Silts and Organic Silt-Clays of low plasticity
	SILTS AND CLAYS LL > 50	MH	Inorganic Silts, Micaceous or Diatomaceous fine Sandy or Silty soils, Elastic Silts
		CH	Inorganic Clays of high plasticity, Fat Clays
		OH	Organic Clays of medium to high plasticity, Organic Silts
HIGHLY ORGANIC SOILS		PT	Peat and other Highly Organic soils

TERMS CHARACTERIZING SOIL STRUCTURE

SLICKENSIDED - having inclined planes of weakness that are slick and glossy in appearance

FISSURED - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical

LAMINATED (VARVED) - composed of thin layers of varying color and texture, usually grading from sand or silt at the bottom to clay at the top

CRUMBLY - cohesive soils which break into small blocks or crumbs on drying

CALCAREOUS - containing appreciable quantities of calcium carbonate, generally nodular

WELL GRADED - having wide range in grain sizes and substantial amounts of all intermediate particle sizes

POORLY GRADED - predominantly of one grain size uniformly graded) or having a range of sizes with some intermediate size missing (gap or skip graded)

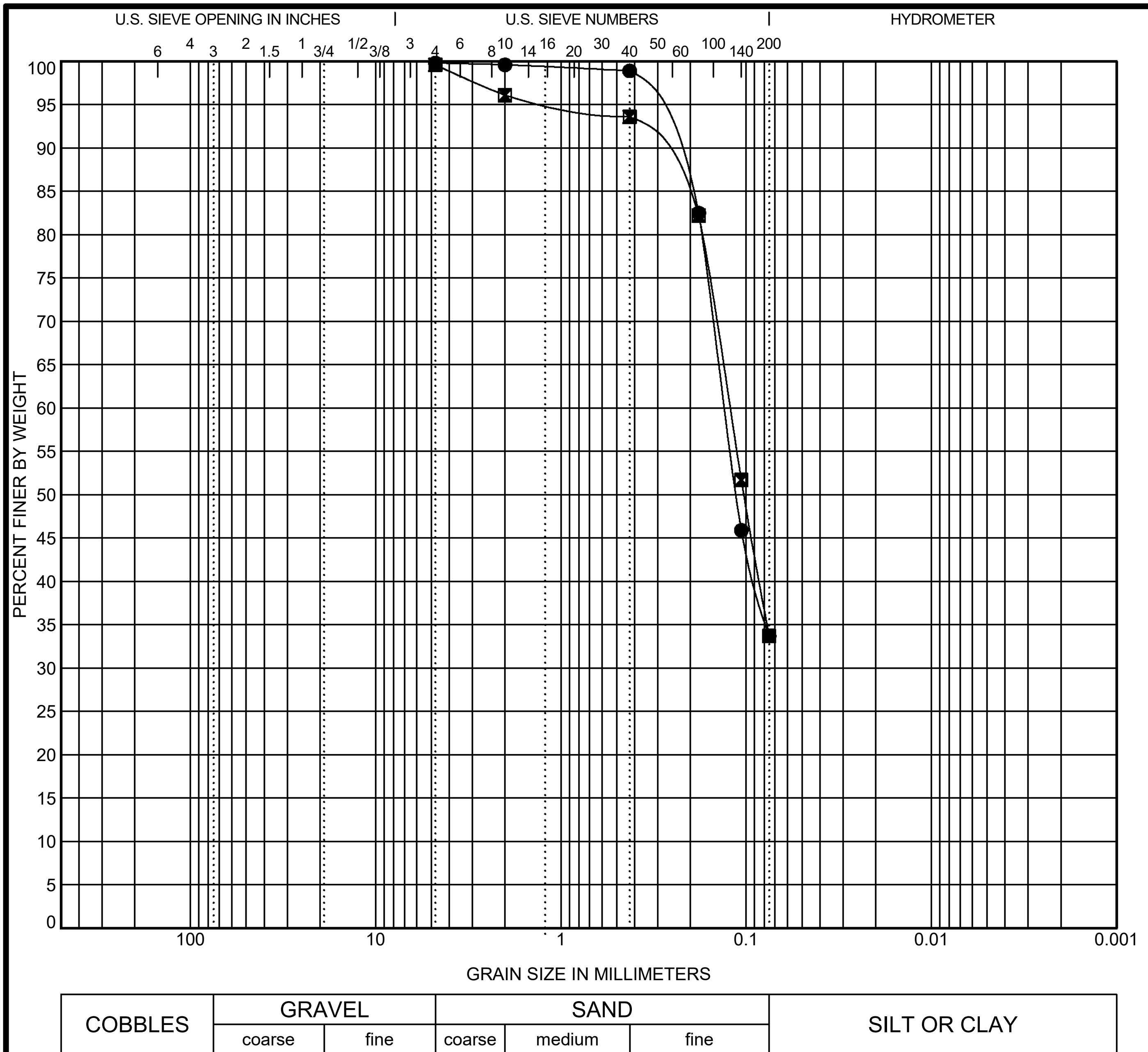
SYMBOLS FOR TEST DATA

- ∇ — Groundwater Level (Initial Reading)
- ▼ — Groundwater Level (Final Reading)
- — Shelby Tube Sample
- — SPT Samples
- — Auger Sample
- — Rock Core

TERMS DESCRIBING CONSISTENCY OF SOIL

COARSE GRAINED SOILS		FINE GRAINED SOILS		
DESCRIPTIVE TERM	NO. BLOWS/FT. STANDARD PEN. TEST	DESCRIPTIVE TERM	NO. BLOWS/FT. STANDARD PEN. TEST	UNCONFINED COMPRESSION TONS PER SQ. FT.
Very Loose	0 - 4	Very Soft	< 2	< 0.25
Loose	4 - 10	Soft	2 - 4	0.25 - 0.50
Medium	10 - 30	Firm	4 - 8	0.50 - 1.00
Dense	30 - 50	Stiff	8 - 15	1.00 - 2.00
Very Dense	over 50	Very Stiff	15 - 30	2.00 - 4.00
		Hard	over 30	over 4.00

Field Classification for "Consistency" is determined with a 0.25" diameter penetrometer



Specimen ID	Depth	Classification	LL	PL	PI	Cc	Cu
● **B-2**	**1.0'**	**Silty Sand (SM)**	**24**	**22**	**2**		
⊠ **B-4**	**4.0'**	**Silty Clayey Sand (SC-SM)**					

Specimen ID	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-2**	**1.0'**	**4.75**	**0.13**			**0.0**	**66.1**	**33.9**	
⊠ **B-4**	**4.0'**	**4.75**	**0.122**			**0.0**	**65.9**	**34.1**	

Rock Engineering & Testing Lab. Inc
6817 Leopard Street
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Telephone: 361-883-4555
Fax: 361-883-4711

GRAIN SIZE DISTRIBUTION

Project: Shoreline Protection Project

Location: Tern Rookery Island

Number: G121002

US GRAIN SIZE G121002.GPJ US LAB.GDT 1/15/21

Exhibit C

Call and Meeting Notes

Meeting Minutes & Site Visit Report

10270854

Project:	**Tern Rookery Island Protection and Restoration** **Phase 1: Feasibility Study & Alternatives Analysis**
Subject:	Kickoff Meeting(s) and Reconnaissance Site Visit
Date:	January 18, 2021
Location:	WebEx
Attendees:	Rosario Martinez (CBBEP) Leo Trevino (CBBEP) Adrien Hilmy (CBBEP) Dan Heilman (HDR) Christian LaPann-Johannessen (HDR) Nikki Davis (HDR) Rob Lewis (HDR)

This memorandum documents key information exchanged during the kickoff meeting on January 8, 2021; reconnaissance site visit on January 14, 2021; and follow-up kickoff meeting held on January 18, 2021. The meetings were held via webinar.

Notes from Kickoff Meeting on January 8, 2021

1. Adrien Hilmy will serve as CBBEP's project manager. Dan Heilman and Christian LaPann-Johannessen will serve as HDR's project managers.

2. CBBEP will let HDR know of there are any additional invoicing requirements from GLO.

3. Texas General Land Office (GLO) is contributing CMP funds to this project. GLO's project manager is Jessica Chappell. Jessica will be included on emails containing key project information.

4. Construction funds have not yet been identified for this project. There is no pre-defined limit or budget for the cost of construction.

5. The primary project goal is to protect Tern Rookery Island from erosion caused by waves, particularly along the east and southeast sides of the island. Expansion of the island through beneficial use of dredged material is not a primary objective due to the amount of seagrass that would be impacted.

6. There are no funding deadlines that affect the current project schedule.

7. Access to the island is restricted during bird nesting season (February 14 – August 31). Fieldwork will be completed prior to February 14. Construction will likely need to be scheduled to start in September (of any given year).

8. HDR's scope includes field data collection. Bathymetric/topographic and magnetometer surveying has already been completed. Habitat assessment and geotechnical investigation is expected to be completed within the next two weeks. A desktop-level cultural resources review will also be performed.

9. The objectives, goals, and technical requirements of the project were reviewed:
   a. The shoreline protection is envisioned to be rock breakwaters. Living shoreline methods incorporating non-hard elements tend to be GLO's preference for CMP projects. Living shoreline methods will also be considered but should not compromise bare-ground nester habitat.
   b. If flotation (construction access) channels are utilized, placement of material from the channels should be considered for island expansion.
   c. The project design should avoid or minimize impacts to existing seagrass and other sensitive habitat.
   d. Service life should be at least 20 years to satisfy CMP requirements.

Notes and Observations from Reconnaissance Site Visit on January 14, 2021

1. Silty cohesive sediments found around Tern Rookery Island creating soft and muddy conditions. The soil is firmer around seagrass beds and on the beach, but still appears to consist predominantly of clayey/organic soils. Soil probes taken inside the access channel revealed soft bottom conditions as well. Geotechnical analysis being performed to determine expected settlement for a rock breakwater located nearshore of Tern Rookery Island. See Photo 7.

2. Scarp face noticeable along eastern shore of Tern Rookery Island and to a lesser extent on the western side of the island (several layers of wrack lines present) suggesting wave induced erosion and forcing taking place. See Photo 2 (eastern side) and Photo 5 (western side).

3. Seagrass beds of varying coverage densities surround Tern Rookery Island. Several clear patches are present along the southern and eastern side. Seagrass beds found in sparse outcroppings in shallow depths (1-2 ft) around Tern Rookery Island. See Photo 8.

4. Limited access to Tern Rookery Island due to distance from access channel, shallow depths, and surrounding seagrass beds. The best access route for barges to utilize during the construction phrase that would minimize impact on seagrass beds is to be discussed.

5. Two deteriorating pipes (approximately 30 ft in length and 18 in. in diameter)found partially submerged at the tip of the northern beach of Tern Rookery Island.

6. Prolific bird usage of Tern Rookery Island by various species of birds.

Notes from Follow-Up Kickoff Meeting on January 18, 2021

1. Alternative analysis will consist of the following concepts:
   a. Rock breakwater with gaps

b. Rock breakwater with gaps and island expansion
c. Living shoreline

2. Island expansion concept should not consider placement of imported fill because this approach would likely be cost prohibitive. Assume fill material will be obtained from excavation below soft muck in existing channel adjacent to island. Assume material would be placed by mechanical means.

3. None of the alternatives should include vegetative planting.

Attachments: 1. Site Visit Photos
2. Preliminary Project Schedule

Photo 1: Northeastern side of Tern Rookery Island. Photo taken facing towards Flour Bluff and JFK Memorial Causeway.

Photo 2: Close up of scarp face present on eastern side of Tern Rookery Island. Photo taken facing Flour Bluff.

Photo 3: Southern spit of Tern Rookery Island facing north/northwest.
Sparse seagrass beds visible.

Photo 4: Southwestern side of Tern Rookery Island.
Photo taken facing northeast.

Photo 5: Close Up of wrack lines present along
western side of Tern Rookery Island. Photo taken facing JFK Memorial Causeway.

Photo 6: Northern beach of Tern Rookery Island.
Photo taken facing southeast towards JFK Memorial Causeway.

Photo 7: Example of cohesive soils around Tern Rookery Island.

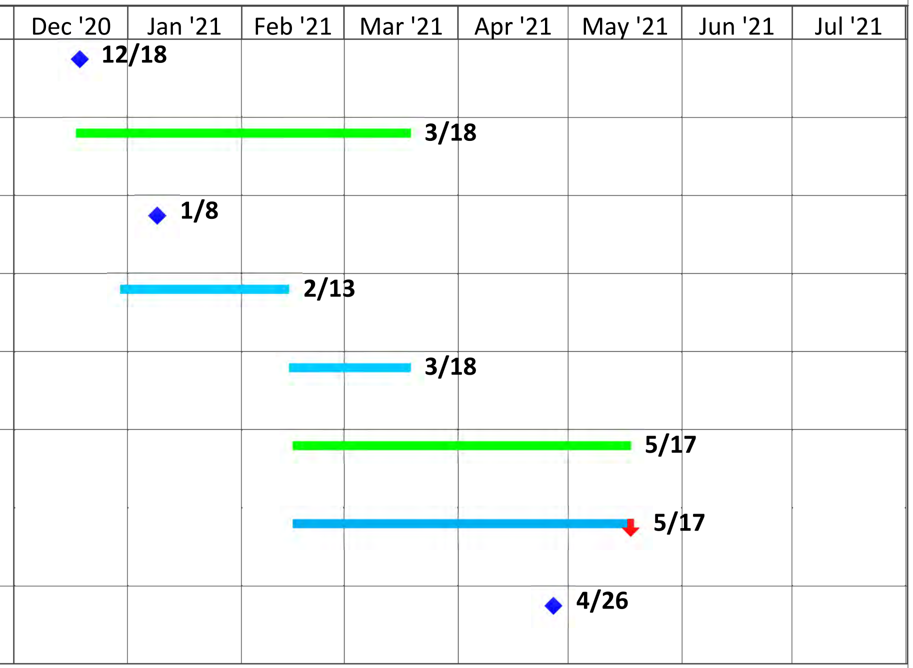
Photo 8: Example of sparse seagrass coverage found at shallow depths off Tern Rookery Island.

Photo 9: Deteriorating pipes on north side Tern Rookery Island.

Photo 10: Nesting platforms on Tern Rookery Island.

Preliminary Progress Schedule
Coastal Bend Bays and Estuaries Program
Tern Rookery Island Protection and Restoration Phase I: Feasibility Study & Alternatives Analysis
CBBEP Project No. 2138
01/08/2021

ID	Task Name	Start	Finish	Duration
1	**Notice to Proceed**	**Fri 12/18/20**	**Fri 12/18/20**	**1 day**
2	**Data Collection**	**Fri 12/18/20**	**Thu 3/18/21**	**91 days**
3	Kickoff Meeting	Fri 1/8/21	Fri 1/8/21	1 day
4	Fieldwork	Wed 12/30/20	Sat 2/13/21	46 days
5	Analysis and Reporting	Sun 2/14/21	Thu 3/18/21	33 days
6	**Conceptual Design**	**Mon 2/15/21**	**Mon 5/17/21**	**92 days**
7	Feasibilty Study and Alternatives Analysis	Mon 2/15/21	Mon 5/17/21	92 days
8	Progress Review Meeting	Mon 4/26/21	Mon 4/26/21	1 day

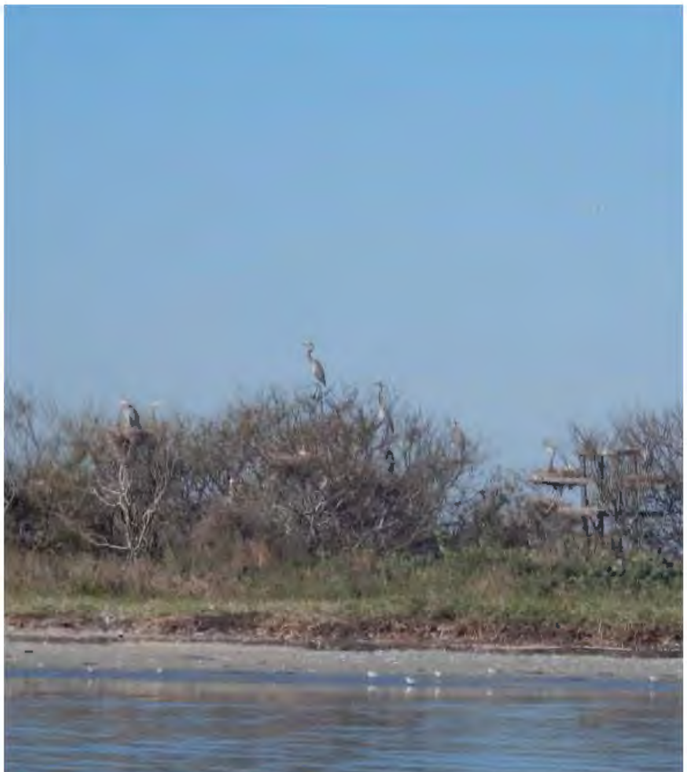


Milestone / Meeting
Deliverable
Task Duration
Work Duration

HDR Project No. 10270854

Exhibit D

Feasibility and Alternatives Analysis Report



Feasibility Study & Alternatives Analysis Report

Tern Rookery Island Protection and Restoration

Laguna Madre, Corpus Christi, TX

June 9, 2021

PRELIMINARY

THIS DOCUMENT IS RELEASED FOR THE PURPOSE OF INTERIM REVIEW AND IS NOT INTENDED TO BE USED FOR CONSTRUCTION, BIDDING OR PERMITTING PURPOSES.

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LICENSE NUMBER: 137561

June 9, 2021

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1 INTRODUCTION

The following report documents the alternatives analysis performed for the Tern Rookery Island Protection and Restoration Project. The analysis was performed for the Coastal Bend Bays & Estuaries Program (CBBEP). The intent of the project is to provide shoreline protection from wave induced erosion along Tern Rookery Island located in the Upper Laguna Madre, north of the JFK Causeway in Corpus Christi, Texas. See Figure 1 and Figure 2 for project vicinity and location maps. This report summarizes the data collection, design criteria development, and conceptual alternatives considered for this project.

Figure 1. Project vicinity

Figure 2. Project location

2 EXISTING CONDITIONS

This section summarizes habitat, survey, and geotechnical investigations, along with data gathering of meteorological and oceanographic conditions near the project site.

2.1 HABITAT ASSESSMENT

A preliminary habitat assessment was conducted by HDR in January 2021 to identify the presence and location of natural resources within the project area. The tide on the day of the habitat assessment was approximately +0.0 ft NAVD[1], weather was clear, and water visibility was approximately 2 ft. The site visit covered approximately 26 acres including 24.5 acres of open water and the 1.5-acre rookery island. HDR surveyed transects in water depths ranging from 0.0 to 5.0 ft. The survey indicated significant areas of seagrass within the project vicinity. No other natural resources, such as oysters, were observed. HDR biologists recorded the presence of seagrass based on visual observation of shoot structures and from grab samples of bottom sediment along transects using a modified post-hole digger. The grab samples were examined by hand for root and/or shoot structures. In instances where bottom elevations were in excess of wading depth, grab samples were taken from boat and high-resolution imagery were used to supplement collected data.

Seagrass was observed along all transects mostly within water depths from approximately 0.0 to 4.0 ft, and up to a depth of 5.0 ft at one location. Seagrass beds covered approximately 20.4 acres of the approximately 26-acre study area. Shoal grass (*Halodule wrightii*) was the most observed seagrass species, followed by patches of manatee grass (*Syringodium filiforme*) and star grass (*Halophila engelmannii*) occurring primarily within the northeastern portions of the study area. Patchy seagrass beds were observed within proximity of the island's northern shoreline, about 10 to 20 feet bayward of the island. Less than 10 percent cover was observed in these patchy areas and consisted of mostly shoal grass with short leaf lengths. Patchy seagrass beds transitioned to denser beds with distance bayward of the island, starting at distances ranging from 40 to 100 feet from the shoreline. Dense seagrass beds covered the majority of the study area. Bare bottom was observed adjacent to the shoreline at water depths less than 1 foot, as well as a few small patches southwest and east of Tern Rookery Island. No seagrass was observed within the relic channel located southeast of the rookery island. See Figure 3 for the approximate limits of seagrass observed. Note that the seagrass assessment documented the existing conditions during the site visit which are not necessarily the same as the conditions shown in the aerial in Figure 3. Some darker areas near the island, particularly southwest of the island, that are not mapped as seagrass were observed to be algae/etc.

[1] Unless otherwise noted, all elevations are referenced to the North American Vertical Datum of 1988 (NAVD)

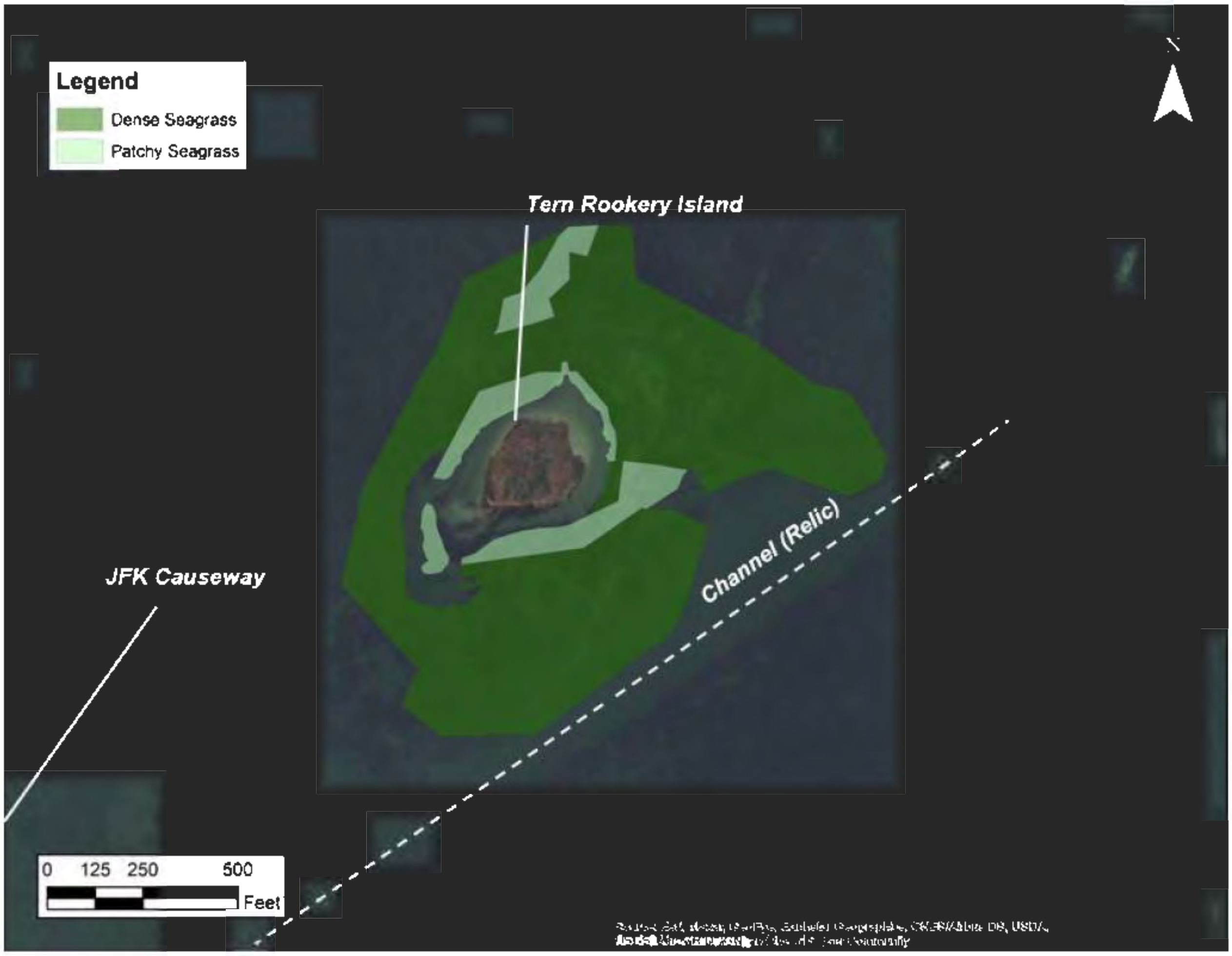


Figure 3. Habitat assessment summary

2.2 BATHYMETRIC, TOPOGRAPHIC, AND MAGNETOMETER SURVEYING

2.2.1 BATHYMETRIC AND TOPOGRAPHIC SURVEYS

Bathymetric, topographic, and magnetometer surveys were conducted by T. Baker Smith (TBS) in December 2020. Bathymetric and topographic surveys were conducted on transects around the island perpendicular to the shoreline and included one continuous transect that spanned the entire diameter of the island and the nearshore depths on each side. Additional survey transects were completed in the relic channel to the east of the island and along adjoining sections of the channel adjacent to the JFK Causeway. As shown in Figure 4, the beach profile gently slopes down to depths at or above -1.0 ft within approximately 200 ft of the shoreline. Shallower depths of -0.5 ft or less were observed on the southeastern side of the island. Topographic measurements from the center of the island revealed +3.0 ft to +4.0 ft of elevation. Transitioning down to the exposed portions of shoreline, elevations decreased to approximately +2.0 ft to

+0.7 ft. On the northern side of the island the beach extends out around 70 ft from the vegetation line, whereas the southern facing shorelines are more abrupt and show evidence of scarping and wave action. The highest measured elevation of +4 ft was observed in the center of the island.

Elevations within the entrance of the relic channel (relative to the JFK causeway) range from -3 ft to -4.0 ft and deepen to centerline elevations of -4.5 ft to -5.0 ft closer to the island. In the channel adjacent to the causeway, deeper elevations are shown in transects within closer proximity to the GIWW (Gulf Intracoastal Waterway), reporting center depths of -10.0 ft that become shallower to around -6.0 ft in transects approaching the relic channel towards Tern Rookery Island (Figure 5).

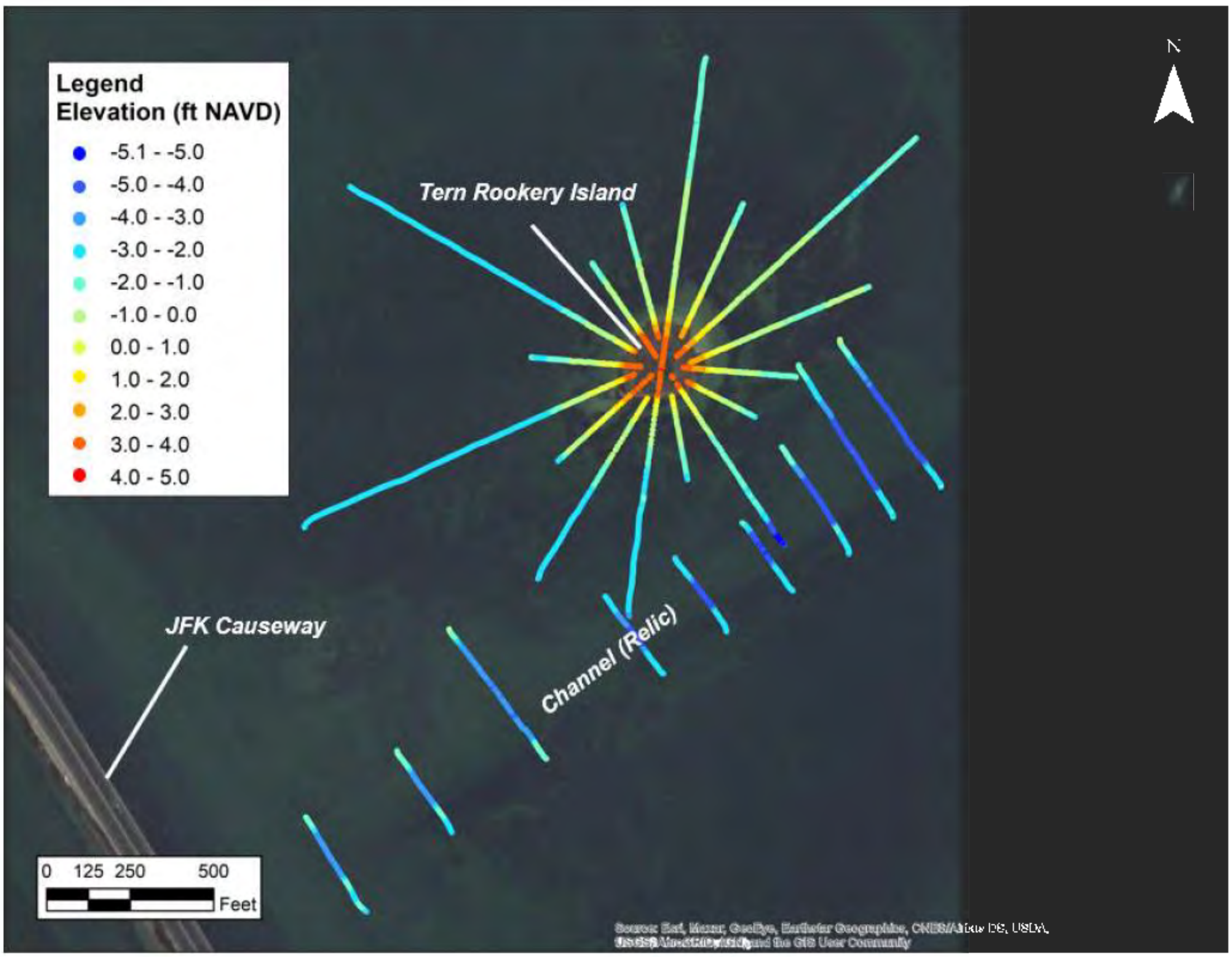


Figure 4. Bathymetric and topographic survey data for project area

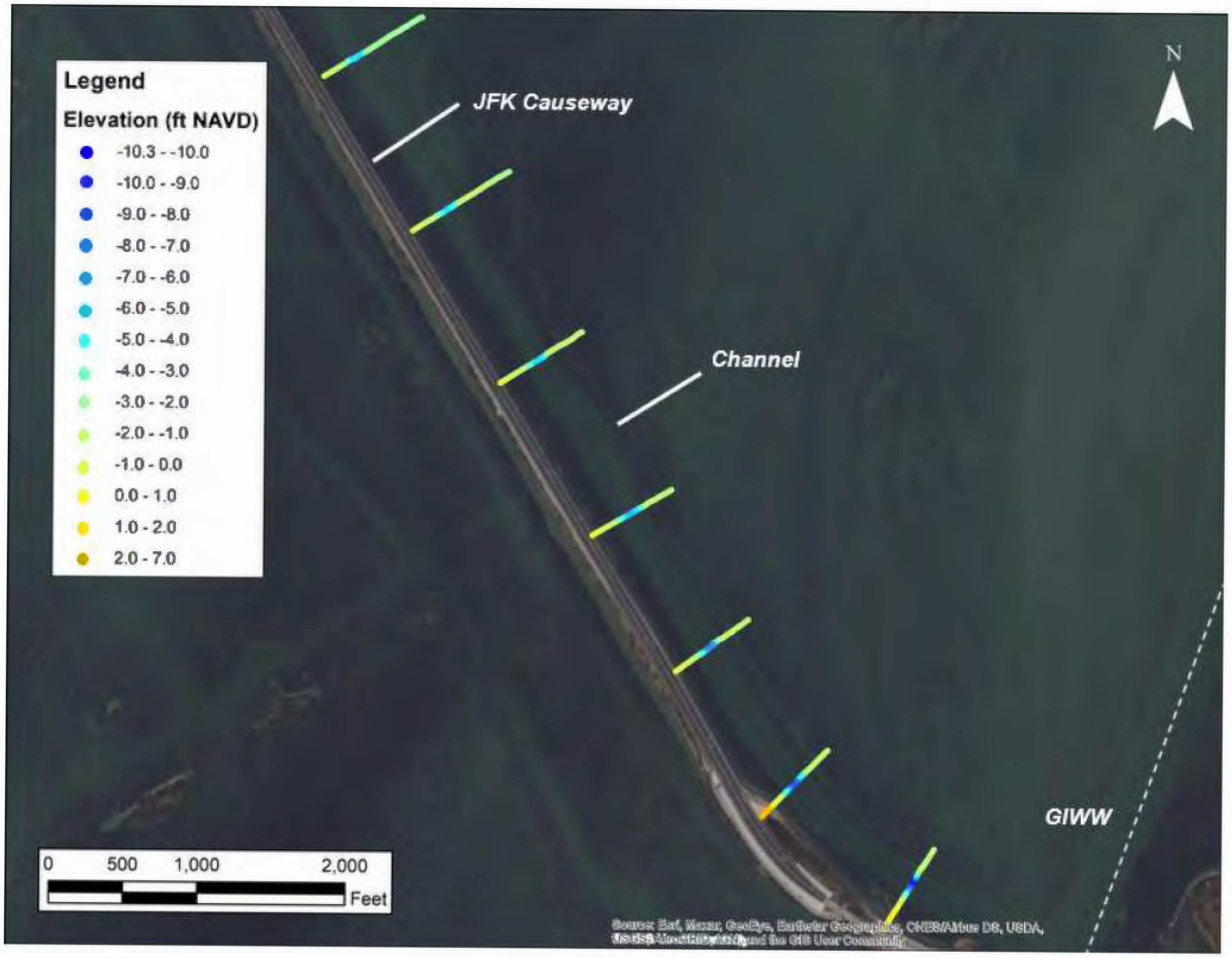


Figure 5. Bathymetric and topographic survey data for access channel

2.2.2 MAGNETOMETER SURVEY

Magnetometer survey results are shown in Figure 6 and Figure 7. These figures indicate several anomalies around the island. Included in the anomalies identified by TBS are 7 gas wells and 3 pipelines. A map of the existing pipelines was obtained from the Railroad Commission of Texas (RRC) online mapping system to help identify the anomalies. The RRC database indicates that the wells are plugged, and the pipelines are abandoned. It should be noted that the intensity of the magnetometer measurement value (expressed in the unit "gamma") decreases exponentially with distance from the target, so individual readings do not necessarily reflect size of the object. Additional probing is recommended during later project phases to provide more accurate horizontal and vertical locations of oil and gas infrastructure at the project site.

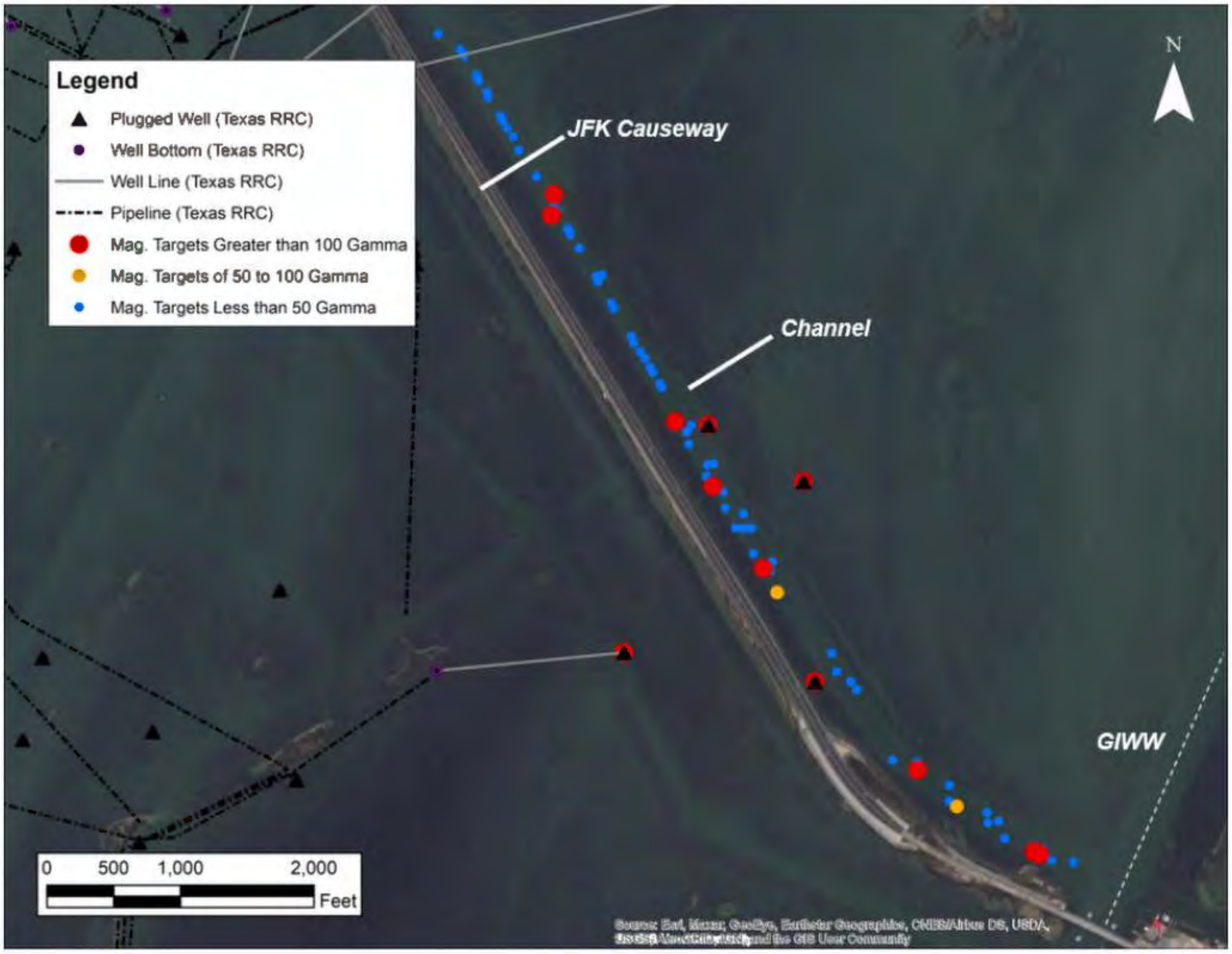


Figure 6. Hazard survey results for access channel

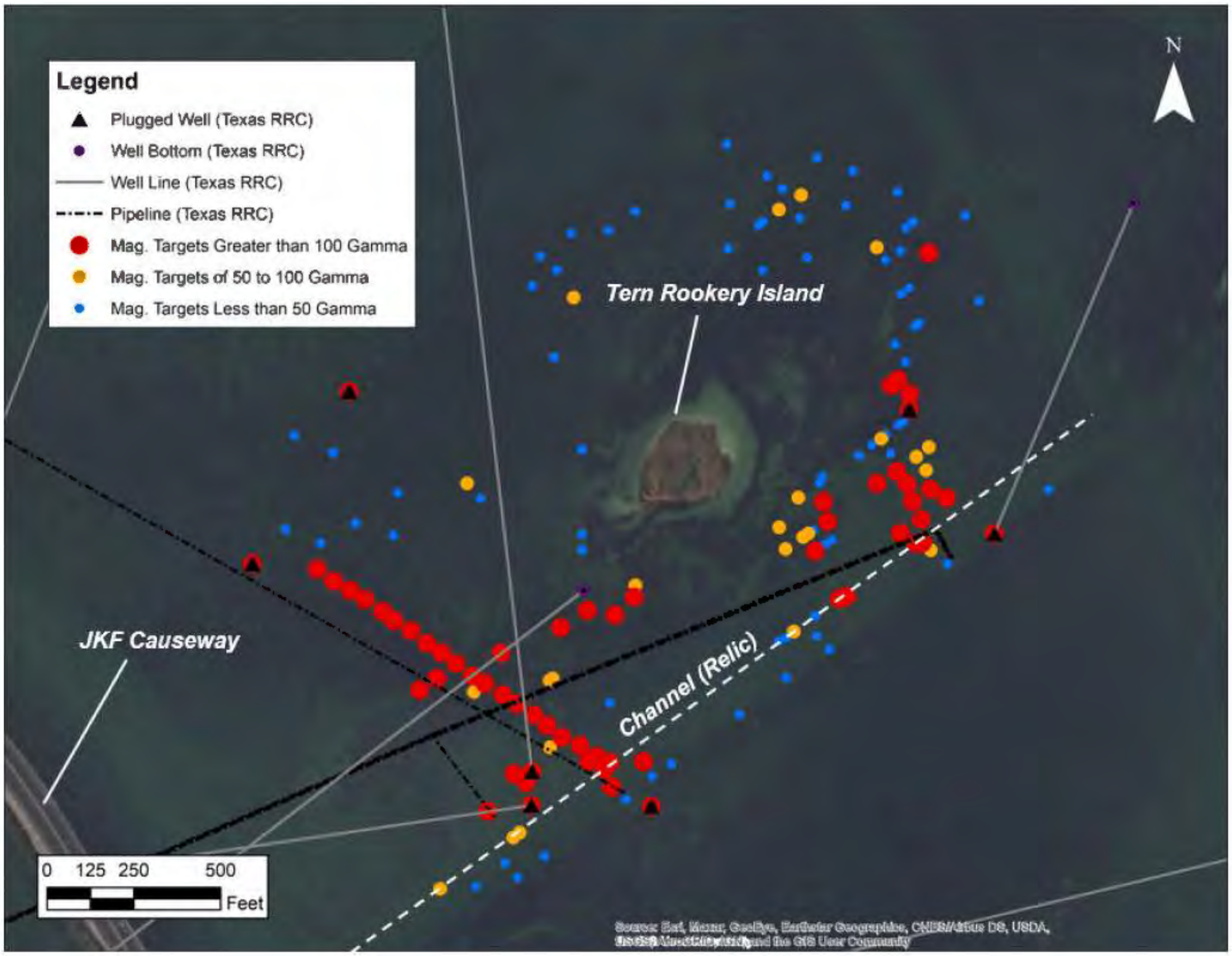


Figure 7. Hazard survey results for project area

2.3 GEOTECHNICAL INVESTIGATION

A preliminary geotechnical investigation was performed by Rock Engineering & Testing Laboratory, Inc. (RETL) and documented in their report dated January 18, 2021. Five borings were performed in the project area to identify soil types and to provide engineering recommendations for shoreline protection foundation design. The investigation showed a top layer of silty and/or silty clayey sand underlaid by a layer of clayey sand. The analysis predicted approximately 8 inches to 10 inches of initial settlement after construction of a low-crested rock breakwater (refer to Section 3 for a discussion on the shoreline protection concepts being considered for this project). Long term consolidation is expected to be approximately 5 inches. RETL determined that the soils will likely provide a suitable foundation for a low-crested rock breakwater of the type described in this alternatives analysis. Figure 8 provides the locations of the borings.

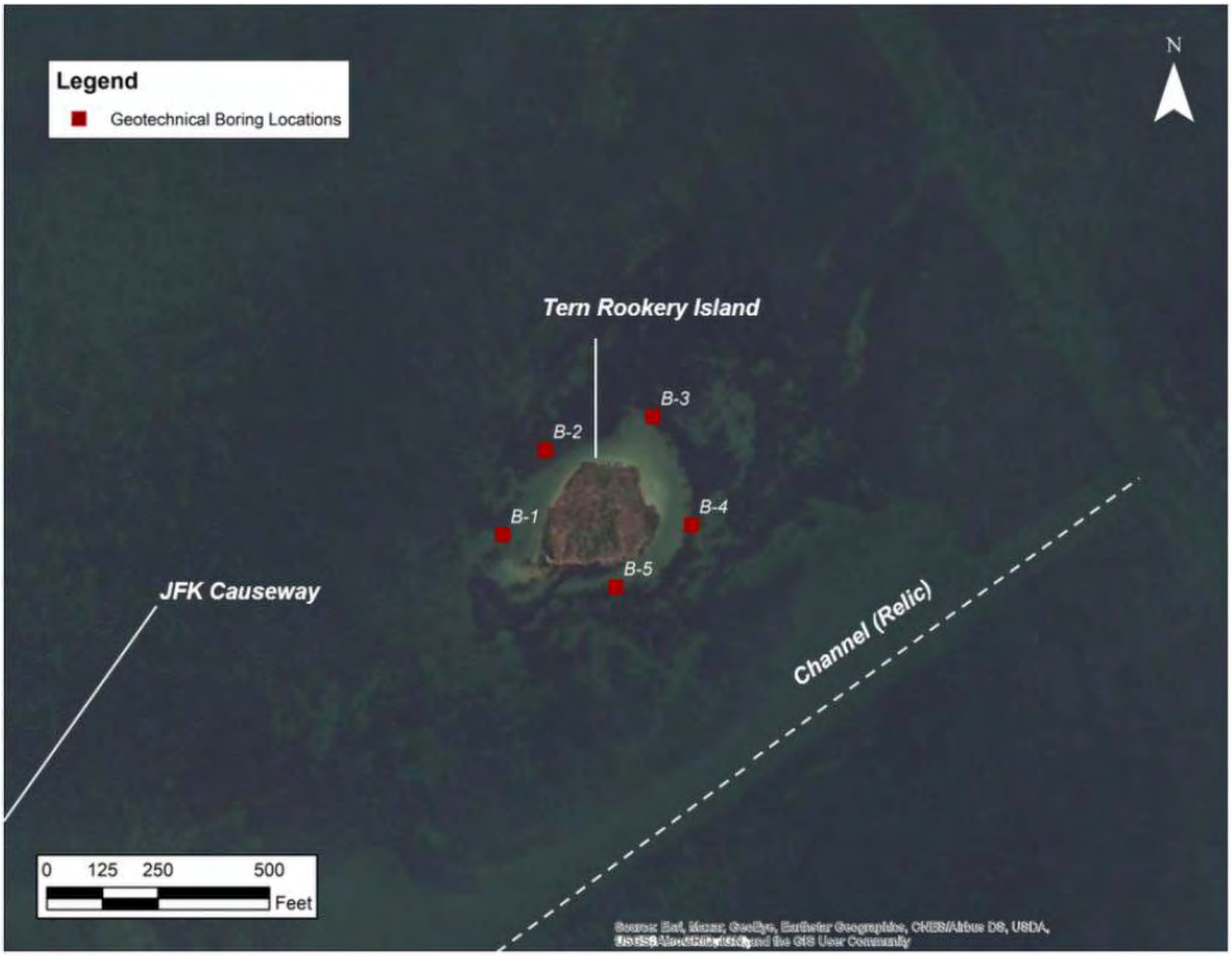


Figure 8. Geotechnical boring locations

2.4 WATER LEVEL

Water level data were obtained from the National Oceanographic and Atmospheric Administration (NOAA) Station located at Packery Channel, TX (ID: 8775792), approximately 2 miles southeast of the project site (Figure 1). Tidal datums are shown in Table 1. Hourly water level data were obtained for 2012 – 2020 and used to create an exceedance plot (Figure 9). Water level exceeded +1.0 ft approximately 50% of the data record, +1.7 ft for 10% of the record, and +2.3 ft for 1% of the record. The highest recorded water level in the observed time period was +5.4 ft during Hurricane Harvey in August 2017. Based on linear sea level change trends at the Rockport, TX (ID: 8774770) Station, sea level is predicted to rise approximately 0.4 ft in 20 years and 1.0 ft in 50 years.

Table 1. Tidal datums at Packery Channel NOAA Station (ID 8775792)	
Datum	**Elevation (ft NAVD)**
Mean Higher High Water (MHHW)	0.79
Mean High Water (MHW)	0.79
Mean Tide Level (MTL)	0.58
Mean Sea Level (MSL)	0.59
Mean Low Water (MLW)	0.36
Mean Lower Low Water (MLLW)	0.37

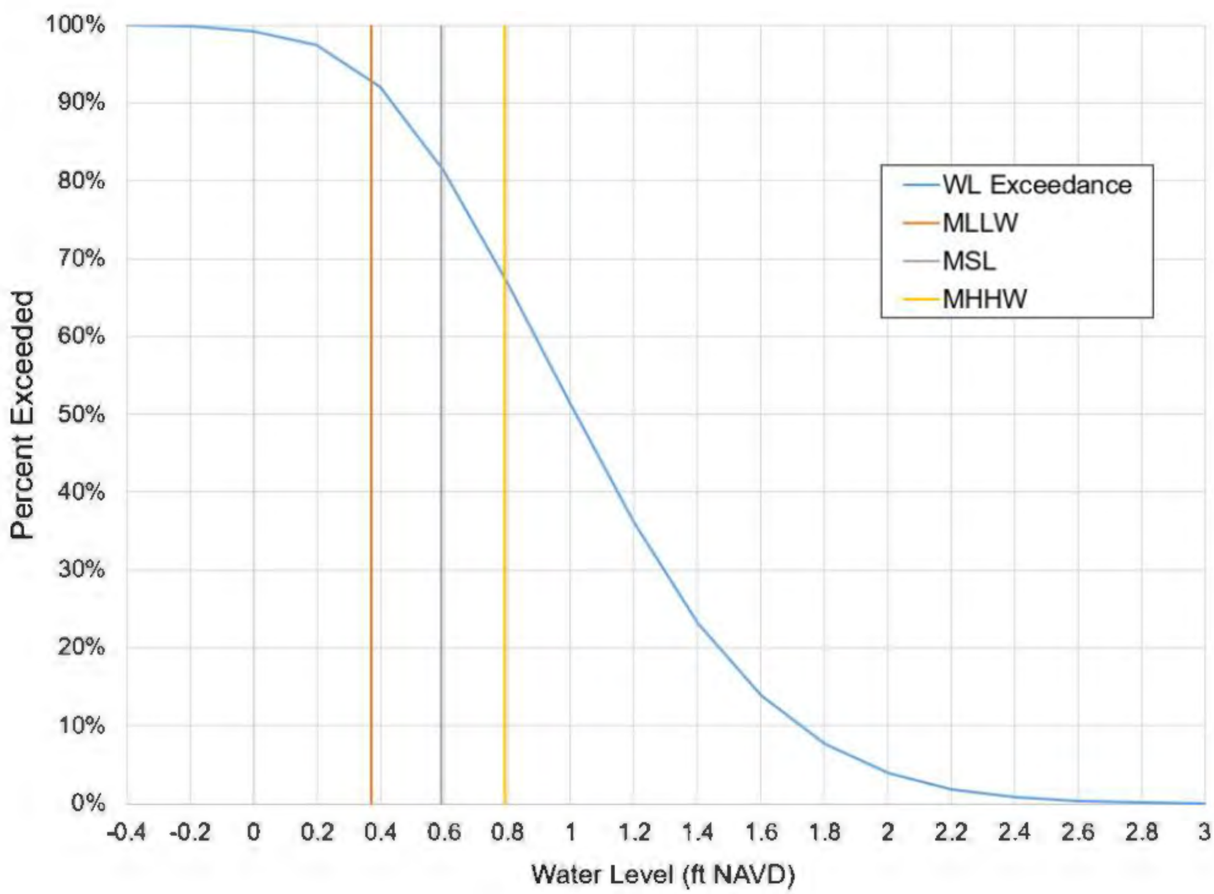


Figure 9. Water level exceedance plot for Packery Channel NOAA Station 8775792 for 2012-2020

2.5 SHORELINE CHANGE

A review of historical aerial photography from 2004 and 2020 indicates that the northern shoreline retreated approximately 45 ft (Figure 10), which equates to a rate of approximately 3 ft/yr.

Figure 10. Comparison of vegetation lines in 2004 and 2020

2.6 WIND AND WAVE CLIMATE

The project site is exposed to waves generated by wind blowing across open fetches of the upper Laguna Madre (Figure 11), but measured wave data are not readily available in the project area. To develop wave conditions at the project site, one-dimensional wave modeling was performed using the Automated Coastal Engineering System (ACES) module of the Coastal Engineering & Design Analysis System (CEDAS) developed by the United States Army Corps of Engineers (USACE). Modeled waves represent conditions that occur during strong seasonal storms.

To consider wind speeds for application in the one-dimensional model, hourly wind data were obtained from the Packery Channel NOAA Station for 2008 to 2020. These data are summarized in an exceedance plot in Figure 12 and a wind rose in Figure 13. Winds were primarily from the southeast; however, most winds over 30 mph were from the north. During the site visit in January 2021, scarping and wrack lines on the eastern and western shorelines of the island were observed, suggesting wave forcing and erosion taking place. Additionally, a review of historical aerial imagery indicates both the northern and southern shorelines have retreated over the past decades. Taking this into consideration, several wind directions were used in the wave height analysis. Although seasonal storms arriving from the north and northwest typically produce the strongest winds, the project area has more protection from the north due to neighboring islands. Thus, the longest fetches are from the southeast, which coincides with the predominant wind direction. The depths of the Upper Laguna Madre were determined to be similar between fetches, and therefore the longest fetch was conservatively used as the wave height design parameter for the project in its entirety (see Figure 11).

A design water level of +3.0 ft was selected. Based on available water data, +3.0 ft is exceeded less than 0.1% of the record. Extensive analysis of higher water levels was not included because wave energy at higher water levels is expected to pass over and not significantly impact vegetation along the shoreline, which has an elevation of approximately +2.0 ft. A water level of +3.5 ft was also included in the analysis to account for 20 years of sea level rise. Table 2 summarizes the wave analysis results.

Figure 11. Fetch applied for wave analysis

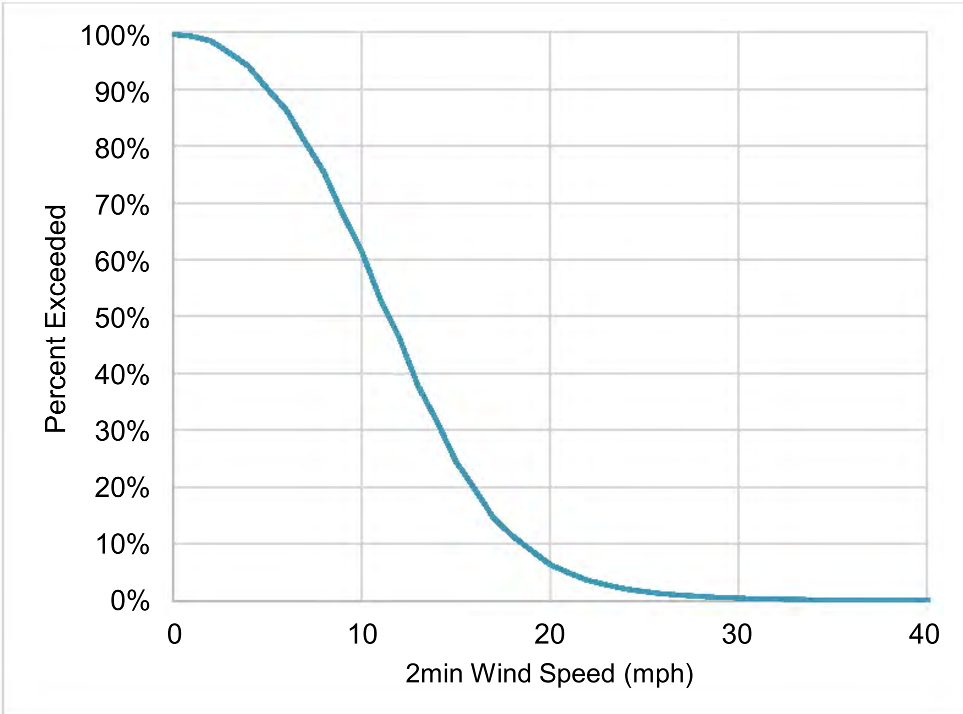


Figure 12. Wind speed exceedance plot for Packery Channel NOAA Station for 2008-2020

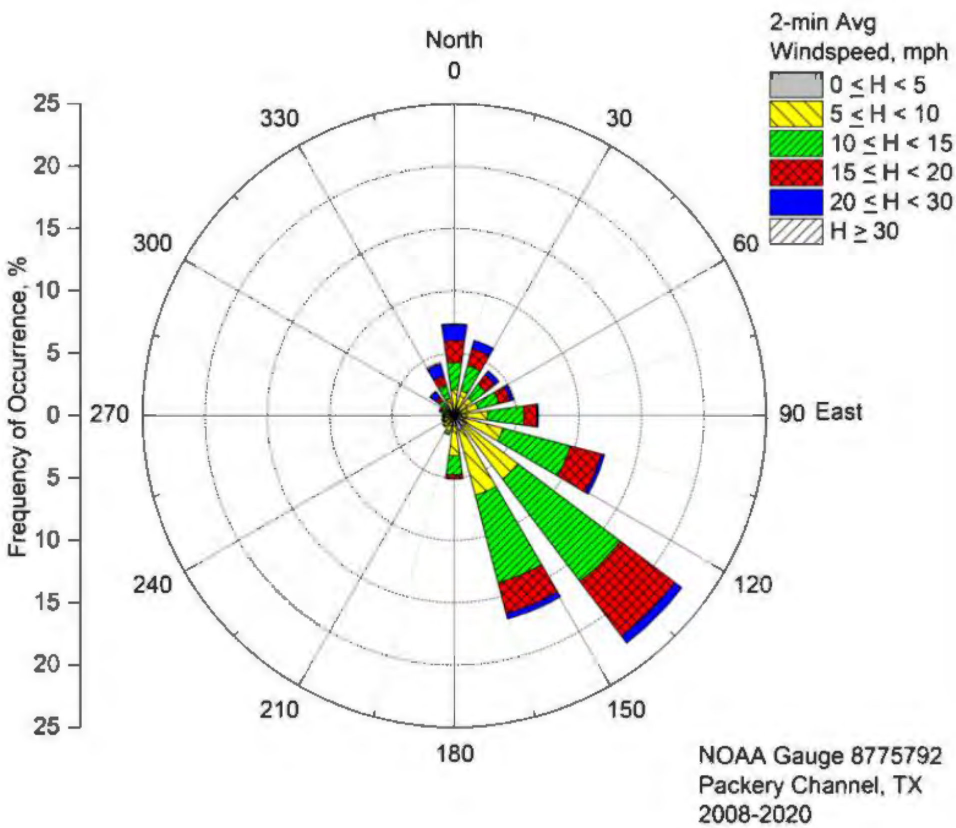


Figure 13. Wind rose for Packery Channel NOAA Station for 2008-2020

Table 2. Results from ACES wave model

Water Level (ft NAVD)	Wind Speed Classification	Wind Speed (mph)	Significant Wave Height (ft)	Peak Wave Period (s)
+3.0	25% Exceedance	13	0.6	1.6
	1% Exceedance	23	1.0	2.0
	0.1% Exceedance	31	1.3	2.2
	25-year Recurrence	65	2.3	3.1
+3.5	25% Exceedance	13	0.6	1.6
	1% Exceedance	23	1.0	2.0
	0.1% Exceedance	31	1.3	2.3
	25-year Recurrence	65	2.4	3.1

Note:
The 25-year recurrence wind speed was cited from the ASCE 7-16 return interval wind maps. It was used as the max wind speed given that it was greater than the max wind speed on the analyzed data record.

3 ALTERNATIVES ANALYSIS

Tern Rookery Island has experienced shoreline erosion on the both the north and south sides of the island due to waves generated by daily winds and seasonal storms that impact the island. To address erosion, three shoreline protection approaches were developed: riprap breakwater, island expansion, and living shoreline. The following section discusses the development of the shoreline protection alternatives with consideration to design criteria, constructability, and permitting requirements. A conceptual level opinion of probable construction cost is provided for each alternative.

3.1 DESIGN CRITERIA

The following section discusses the design considerations and criteria used in the development of the conceptual shoreline protection alternatives. A tiered approach was used to evaluate alternatives.

3.1.1 TIER 1: INITIAL SCREENING

The Tier 1 criteria were used to narrow down shoreline protection strategies that did not align with CBBEP's preferences stated during meetings, site visits, and other discussions. This initial screening focused on the following project elements:

- Structure type (composition and shape)
- Limit adverse impacts to existing habitat
- Incorporate living shoreline features

The screening matrix in Table 3 shows the results of the Tier 1 comparison. CBBEP expressed a preference for avoiding Reef Balls, geotextile tubes, and concrete structures, so they were screened out during this phase of the evaluation.

Table 3. Tier 1 Evaluation Matrix

Shoreline Protection Strategy	Structure Type (Composition and Shape)	Environmental Impact	Living Shoreline Component
Rock Breakwater			
Marsh Planting			
Shell Hash/Gravel Sill			
Beach Fill			
Reef Balls			
Geotextile Tubes			
Concrete Panels/Revetments			
Legend	Least Preferred	Intermediate	Most Preferred

3.1.2 TIER 2: FEASIBILITY

The Tier 2 criteria were used to assess the feasibility of the shoreline protection strategies that remained after the Tier 1 evaluation. As summarized in Table 4, the Tier 2 screening focused on constructability, maintenance, and permitting requirements. Detailed descriptions of the feasibility criteria and assessment results are provided in the sections below.

Table 4. Tier 2 Evaluation Matrix

Shoreline Protection Strategy	Constructability	Maintenance/ Longevity	Permitting
Rock Breakwater			
Marsh Planting			
Shell Hash/Gravel Sill			
Beach Fill			
Legend	Least Feasible	Intermediate	Most Feasible

3.1.2.1 CONSTRUCTABILITY

The following local conditions were taken into consideration for the evaluation of the constructability of each shoreline protection strategy.

1. Shallow water depths around Tern Island limit barge access.
    a. Light loaded barges can achieve a draft of approximately 1.5 ft – 3 ft depending on size.
    b. Water depths around the island are generally less than 3 ft MLLW (-3.4 ft NAVD). Note that MLLW is used when discussing navigation and access so that vessel clearance during low tide events is considered.
    c. The GIWW is maintained at -12 ft MLLW (-12.4 ft NAVD) and the relic channel near the project site is approximately -4 ft MLLW (-4.4 ft NAVD).
    d. Seasonal high tides occur during fall and spring. During these periods, particularly during late September through early November, water levels can be 0.5 to 1.0 ft above normal level. This rise in water level could aid in construction.
2. Seagrass beds are present on all sides of the island in depths of approximately 1 ft and greater. Temporary or permanent impacts will be likely as a result of construction and site access.
3. Construction will be prohibited during bird nesting season (mid-February through August).
4. Oil and gas infrastructure are present in and around project area.

Considering the above conditions, all of the alternatives listed in Table 4 are considered to have difficult, but not insurmountable, constructability constraints. However, the poor constructability rating for the shell hash/gravel sill strategy is due to the limited availability and increased cost of construction materials. The three soft shoreline strategies (marsh planting, sill, and beach fill) were assumed to avoid seagrass impacts, whereas a typical breakwater may encroach on 0-1 acres of seagrass beds, depending on alignment and construction technique. The potential temporary or permanent impacts to natural resources (seagrass) will likely impact permitting as discussed below in Section 3.1.2.3.

3.1.2.2 MAINTENANCE

Maintenance criteria considered each alternatives resistance to damage/erosion in the short and long-term. Marsh planting around the island perimeter with no other shoreline protection system scored poorly for maintenance because marsh vegetation would be susceptible to erosion from waves. In addition, *Spartina alterniflora* is relatively scarce on islands like Tern Island in the Laguna Madre, so marsh establishment on Tern Island would likely be difficult or require extensive adaptive management including replanting. The beach fill and the shell hash/gravel sill scored intermediate on the maintenance review due to their susceptibility to erosion and long-term habitat loss. The rock breakwater will provide the most feasible option for low maintenance over the project life.

3.1.2.3 PERMITTING REQUIREMENTS

USACE regulates certain activities located within waters of the U.S. under Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act. Waters of the U.S. include, but are not limited to, navigable waters, waters subject to the ebb and flow of the tide, and special aquatic sites such as wetlands, seagrass beds, and oyster reefs. As such, construction of breakwaters at Tern Rookery Island in open waters of the Laguna Madre will require a Section 10/404 permit from USACE.

The overall goal of the project is to reduce wave energy and protect the approximate 1.5-acre rookery island from further erosion. Permanent and temporary impacts to seagrass beds are expected, but the proposed design alternatives may result in an overall net increase in aquatic resource functions and services. As such, the proposed alternatives can likely be covered by a USACE Nationwide Permit (NWP) 27 as aquatic habitat restoration, enhancement, and establishment. NWP 27 allows for activities in waters of the U.S. associated with the restoration, enhancement, and establishment of tidal and non-tidal features, including the construction of small nesting islands, provided those activities result in net increase in aquatic resource functions and services. To be authorized under a NWP 27, the project must be planned, designed, and implemented so that it results in an aquatic habitat that resembles an ecological reference. A pre-construction notification (PCN) with details from the ecological reference would be required for authorization under a NWP 27.

If the USACE District Engineer determines the proposed project does not result in net increases in aquatic resource functions and services, an Individual Permit (IP) would be required. The NWP 27 approval could take between 10 to 14 months. If it is determined an IP is required, approval could take between 12 to 18 months.

The rock breakwater and shell hash/gravel sill protection strategies are expected to have permanent habitat impacts due to alignment over existing seagrass beds. Permanent impacts are expected to be approximately 0.1 acres. Marsh planting and beach fill would be placed in areas where seagrass does not exist and are not expected to have permanent impacts resulting from the footprint. All shoreline protection strategies are likely to have some temporary habitat impacts during construction which may end up as permanent impacts depending on their severity.

3.1.3 TIER 3: EFFECTIVENESS OF SHORELINE PROTECTION ALTERNATIVES

Based on their ratings in the previous evaluation, shoreline protection strategies were combined to create project alternatives. The living shoreline options were combined with harder structures to create hybrid living shoreline alternatives. As summarized in Table 5, the following criteria were used for the Tier 3 evaluation:

- Degree of wave attenuation
- Construction cost
- Habitat impact
- Habitat creation

Table 5. Tier 3 Evaluation Matrix

Shoreline Protection Alternative	Wave Attenuation	Cost	Habitat Impact	Habitat Creation
Rock Breakwater	[Green]	[Green]	[Yellow]	[Yellow]
Rock Breakwater w/ Beach Expansion	[Green]	[Red]	[Yellow]	[Green]
Rock Breakwater w/Marsh Cell	[Green]	[Yellow]	[Yellow]	[Green]
Low Crest/Wide Gravel Breakwater w/ Beach Sill	[Red]	[Yellow]	[Red]	[Yellow]
Beach Expansion	[Red]	[Green]	[Green]	[Green]
Shell Hash/Gravel Sill	[Red]	[Green]	[Green]	[Yellow]
Legend	Least Preferred	Intermediate	Most Preferred	

Based on the overall screening exercise, the following three shoreline protection alternatives were carried forward for more detailed evaluation:

1. Rock Breakwater
2. Rock Breakwater with Island Expansion
3. Rock Breakwater with Marsh

3.2 SHORELINE PROTECTION ALTERNATIVES

3.2.1 ALTERNATIVE 1: RIPRAP BREAKWATER

Riprap breakwaters can significantly reduce the transmitted wave height in both deep and shallow water and are effective in a wide range of wave energy environments. Riprap also provides hard substrate for encrusting species including oysters and barnacles and serves as habitat for juvenile fish, crabs, and other invertebrates. A geotextile fabric would be placed under the riprap to help limit scour and settling, and silt fence would be placed during construction to reduce impacts to existing seagrass. The existing conditions analysis summarized in Section 2 was applied to determine conceptual breakwater dimensions for this alternative (see Table 6).

Table 6. Conceptual Dimensions of Breakwater

Feature	Dimension	Justification	Benefits
Crest Elevation	3.5 ft NAVD	• Allows for approximately 0.5 ft of long-term settlement • Accommodates 0.5 ft of sea level rise	Wave reduction and attenuation in typical and storm conditions.
Side Slope	2H:1V	• Reduces breakwater footprint compared to 3H:1V side slopes	

The alignment and typical cross-section of a riprap breakwater depend on the accessibility of the project area. The two construction methods applicable for this project are 1) construction by excavator on a barge (Figure 14), or 2) end-on construction where the breakwater is wide enough to serve as an access road and work platform during construction (Figure 15). Based on the breakwater dimensions discussed above and a typical cross section for an end-on construction method, a wave transmission analysis indicated a transmitted wave height of 0.7 ft for the given design wind and wave conditions (see section 2.6). Transmitted wave heights less than 1.0 ft is a general threshold for estimating stability of vegetated shorelines (Shafer *et al.,* 2003). The conceptual design characteristics for both construction methods are listed in Table 7.

Figure 14. Breakwater construction by light loaded barges

Figure 15. End-on breakwater construction

Table 7. Breakwater Construction Method Comparison

Method	Crest Width (ft)	Approx. Bottom Width (ft)	Breakwater Length (ft)	Seagrass Impacts (ac)
Excavator on Barge	5	19	1,300 ft	0.06
End-on Construction	10	24		0.11

Notes:
1. A 2H:1V slope and trapezoidal cross section was used in both scenarios.
2. Ground elevation was assumed to be 0.0 ft; bottom widths can vary depending on ground elevation.
3. The same alignment was used for both construction methods.

Plan and profile views of the riprap breakwater alternative (Figure 16 and Figure 17 respectively) were developed based on the following considerations:

- The proposed breakwater alignment generally remains between the 0.0 ft and +1.0 ft depth contours to help reduce impacts to seagrass.
- Use of the “end-on” construction method.

- Ensure the northern and southern sides of the island are protected while allowing for two gaps in the overall breakwater alignment.
- Western ends of breakwaters extend into deeper water to facilitate access for end-on construction.

Figure 16. Plan view of Alternative 1: riprap breakwater

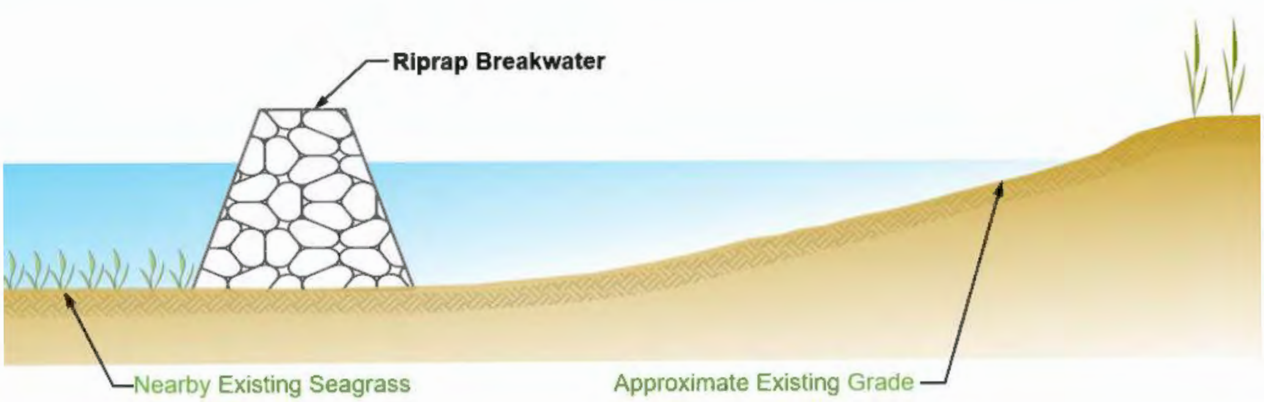


Figure 17. Conceptual section view of Alternative 1: riprap breakwater

3.2.2 RIPRAP BREAKWATER WITH ISLAND EXPANSION

This alternative would be similar to Alternative 1 with the addition of an island expansion component. Island expansion would increase the footprint of the island through placement of soil material imported from a borrow site. Given the objective of maintaining an open beach for bird nesting and gathering, sandy sediment is recommended for placement. While not listed in TGLO's "A Guide to Living Shorelines in Texas" guidance, NOAA defines beach nourishment as a type of soft shoreline stabilization and references the Systems Approach to Geomorphic Engineering (SAGE) continuum. Some of the advantages and disadvantages listed by the SAGE continuum for beach nourishments are listed below in Table 8.

Table 8. Advantages and Disadvantages to Beach Expansion

Advantages	Disadvantages
• Habitat creation, specifically beach area	• Local sediment transport maybe affected
• Easy to redesign for future work	• Additional material is needed to maintain desired shoreline; routine labor and maintenance necessary.
• Reduces permanent impact compared to hard structures	• Does not provide protection against high water levels

The breakwater dimensions and alignment for Alternative 2 are the same as Alternative 1. Imported sand would be placed to meet the approximate limits of the vegetation line (elevation ranges between +1.5 ft NAVD and +2.5 ft NAVD) to promote expansion of upland vegetation. Sand would be placed between the breakwater and island to create shoreface habitat protected from wave energy.

Table 9. Alternative 2 characteristics.

Beach Expansion Area (acre)	Beach Expansion Volume (CY)	Seagrass Impact (acre)
1.0	1,800	0.1
Note: Seagrass impacts are the same as Alternative 1		

Constructability considerations for Alternative 2 include the following:

- Based on reconnaissance field exploration, local sediment in the relic channel southeast of the island is unlikely to be suitable for island expansion. Probes taken during the site visit indicated very soft and organic soils within the channel.
- Excavating deeper to obtain more consolidated sediments is not recommended due to presence of oil and gas infrastructure (see Figure 6 and Figure 7).
- Sediment for island expansion would likely need to be acquired from an offsite (possibly upland) source and placed mechanically from a barge.

Figure 18 and Figure 19 show plan and profile views of the riprap breakwater and island expansion alternative.

Figure 18. Plan view of Alternative 2: riprap breakwater with beach expansion

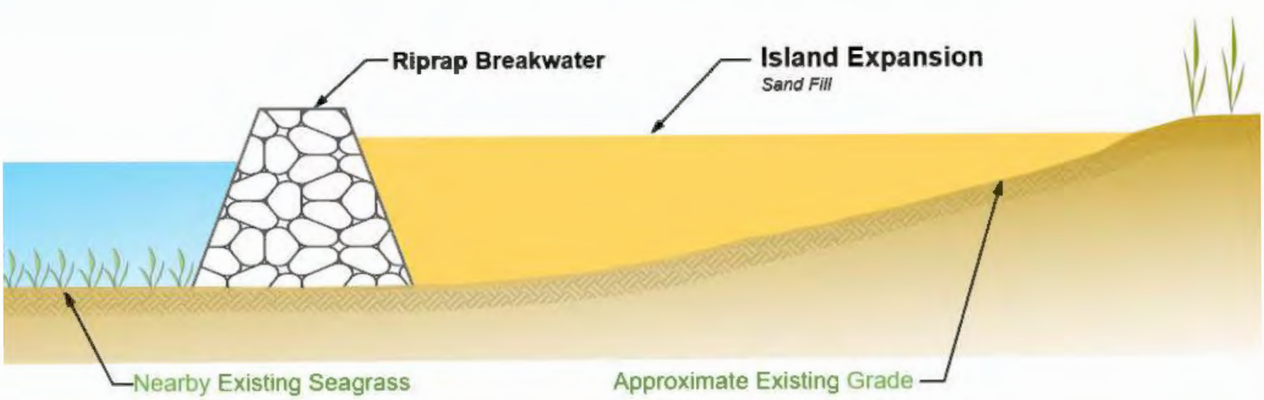


Figure 19. Conceptual section view of Alternative 2: riprap breakwater with beach expansion

3.2.3 ALTERNATIVE 3: RIPRAP BREAKWATER WITH MARSH

Alternative 3 consists of a breakwater with placement of fill for marsh creation. Incorporating marsh grass plantings in areas behind the breakwater would create new habitat and provide additional erosion protection. In addition to creating habitat for plant and animal species, marsh grass can improve water quality and provide recreational value.

The breakwater dimensions and alignment for Alternative 3 are the same as Alternative 1. Imported sand would be placed to +1.0 ft NAVD which is the approximate 50% exceedance water level. Sand would be placed and mash grass such as *Spartina alterniflora* would be planted to create a protected wetlands area.

Table 10. Alternative 3 dimensions.

Beach Expansion Area (acre)	Beach Expansion Volume (CY)	Seagrass Impact (acre)
0.7	600	0.1

Note: Seagrass impacts are the same as Alternative 1

Constructability considerations for Alternative 3 would be similar to Alternatives 1 and 2. Incorporating a wetlands component at Tern Island would require the following:

- A reference marsh survey would need to be conducted to determine the elevation range of successful *Spartina alterniflora* near Tern Island.
- Initial monitoring and maintenance may be required to ensure successful marsh establishment. Plants that die during the beginning growth stage may need to be replaced.
- Wetland planting would need to be confined to areas where open beach is not desired for bird habitat. The concept presented herein assumes the planting would be limited to sheltered areas leeward of the breakwaters, and areas adjacent to the breakwater gaps would remain as sandy/beach habitat for shorebirds.
- Marsh planting behind the breakwater may result in some of the sandy shoreface being covered by marsh grass, resulting in less sandy/beach habitat for shorebirds.

A plan and profile views of the riprap breakwater and island expansion alternative are provided in Figure 20 and Figure 21.

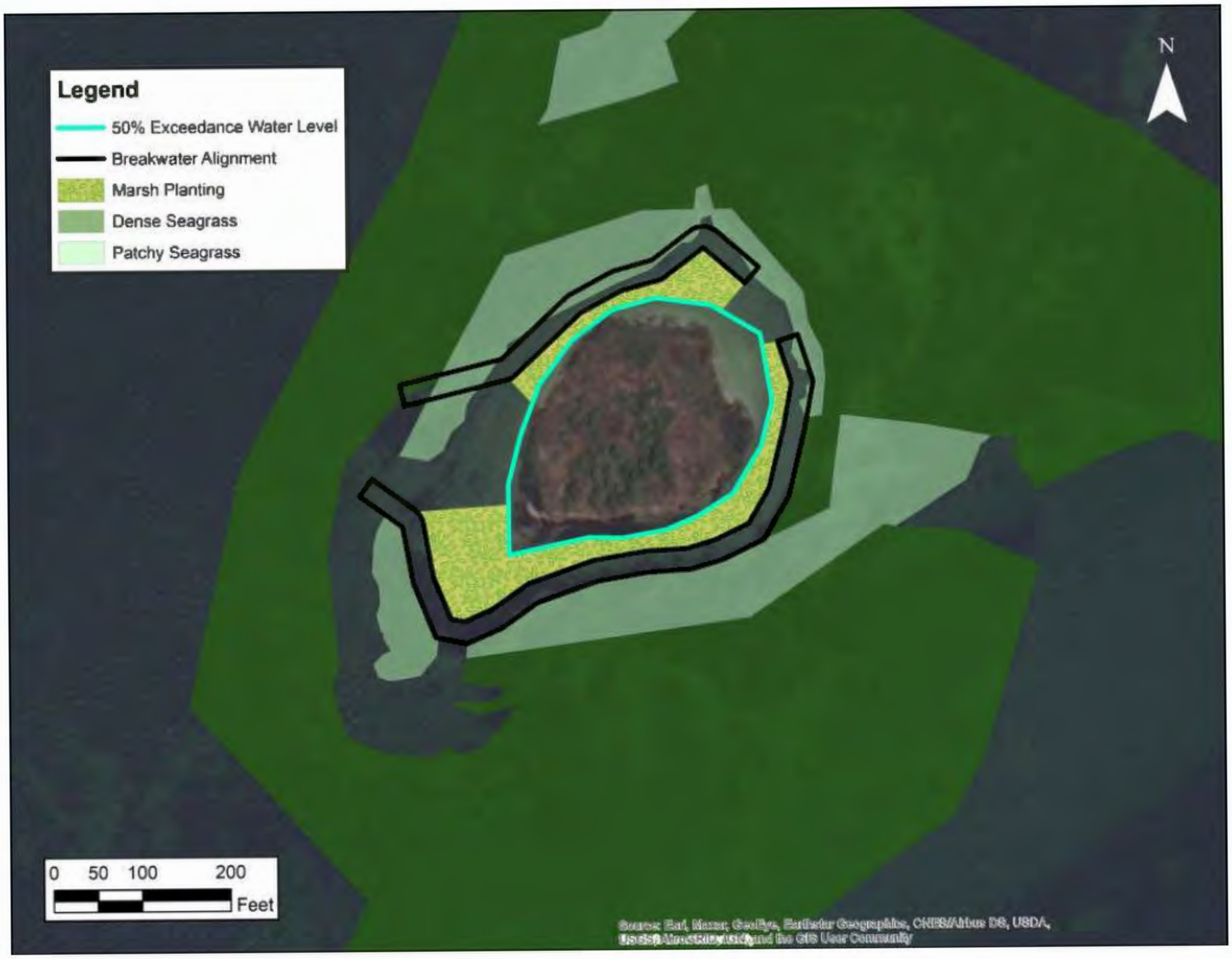


Figure 20. Plan view of Alternative 3: riprap breakwater with marsh fill and planting

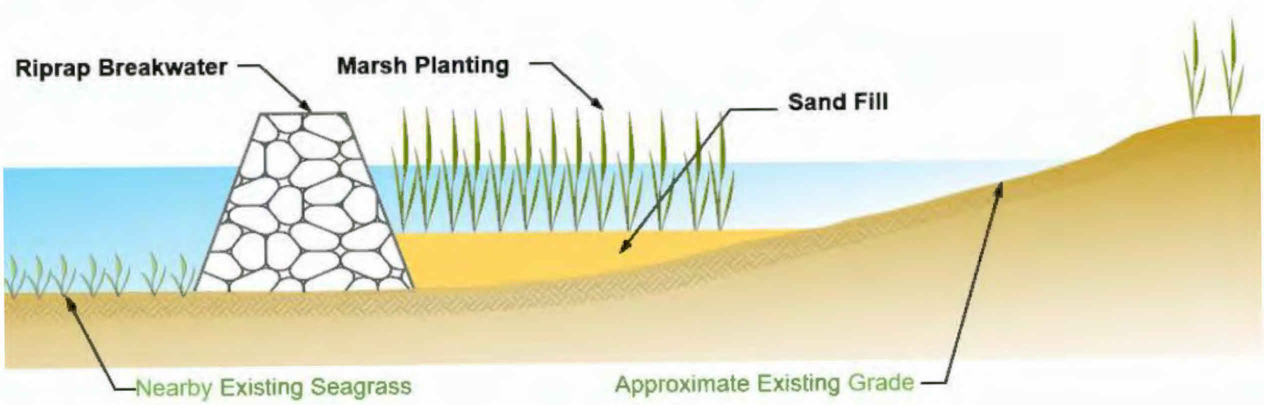


Figure 21. Conceptual section view of Alternative 3: riprap breakwater with marsh fill and planting

4 OPINION OF PROBABLE CONSTRUCTION COST

Conceptual-level opinions of probable construction costs (OPCC) were developed for each alternative. The OPCC for Alternative 1 is shown in Table 11, and the OPCC's for Alternatives 2 and 3 are shown in Table 12 and Table 13 respectively. Because Alternative 2 and Alternative 3 have the same breakwater length and volume of stone, items 1-4 of OPCC are the same for both alternatives. Environmental mitigation is not included in the OPCCs. However, if mitigation is required as a result of the permitting process, mitigation costs would need to be added.

Table 11. Conceptual OPCC for Alternative 1 – Rock Breakwater

Item	Description	Quantity	Unit	Unit Price	Extended Price
1	Mobilization / Demobilization	1	LS	$ 350,000	$ 350,000
2	Construction Surveying	1	LS	$ 30,000	$ 30,000
3	Aerial Photography	1	LS	$ 20,000	$ 20,000
4	Riprap Breakwater (1,300 LF)				
4.1	Graded Riprap	1,300	LF	$ 811	$ 1,055,000
4.2	Geotextile Fabric	1,300	LF	$ 19	$ 25,000
4.3	Silt Fence	1,300	LF	$ 4	$ 6,000
4.4	Daybeacons	4	EACH	$ 2,000	$ 8,000
				Subtotal:	$ 1,494,000
				Contingency (30%):	$ 449,000
				Total:	**$ 1,943,000**

Table 12. Conceptual OPCC for Alternative 2 – Rock Breakwater with Beach Expansion

Item	Description	Quantity	Unit	Unit Price	Extended Price
1	Mobilization / Demobilization	1	LS	$ 350,000	$ 350,000
2	Construction Surveying	1	LS	$ 30,000	$ 30,000
3	Aerial Photography	1	LS	$ 20,000	$ 20,000
4	Riprap Breakwater (1,300 LF)				
4.1	Graded Riprap	1,300	LF	$ 811	$ 1,055,000
4.2	Geotextile Fabric	1,300	LF	$ 19	$ 25,000
4.3	Silt Fence	1,300	LF	$ 4	$ 6,000
4.4	Daybeacons	4	EACH	$ 2,000	$ 8,000
5	Island Expansion				
5.1	Imported Fill	1,800	CY	$200	$360,000
				Subtotal:	$ 1,854,000
				Contingency (30%):	$ 557,000
				Total:	**$ 2,411,000**

Table 13. Conceptual OPCC Alternative 3 – Rock Breakwater with Marsh

Item	Description	Quantity	Unit	Unit Price	Extended Price
1	Mobilization / Demobilization	1	LS	$ 350,000	$ 350,000
2	Construction Surveying	1	LS	$ 30,000	$ 30,000
3	Aerial Photography	1	LS	$ 20,000	$ 20,000
4	Riprap Breakwater (1,300 LF)				
4.1	Graded Riprap	1,300	LF	$ 811	$ 1,055,000
4.2	Geotextile Fabric	1,300	LF	$ 19	$ 25,000
4.3	Silt Fence	1,300	LF	$ 4	$ 6,000
4.4	Daybeacons	4	EACH	$ 2,000	$ 8,000
5	Living Shoreline				
5.1	Imported Fill	600	CY	$100	$60,000
5.2	Planting (0.7 Acres)	7,800	SPRIG	$4	$32,000
				Subtotal:	$ 1,586,000
				Contingency (30%):	$ 476,000
				Total:	**$ 2,062,000**

5 SUMMARY AND CONCLUSIONS

This alternatives analysis was conducted to assess shoreline protection at Tern Rookery Island. Data gathering, including a meteorological and oceanographic analysis; a site visit and habitat assessment; topographic, bathymetric, and magnetometer surveying; and preliminary geotechnical testing were completed. A tiered evaluation approach was then applied to assess shoreline protection strategies based on project intent, constructability, and permitting. Based on a screening exercise, several viable protection strategies were identified and three alternatives were developed:

1. Riprap breakwater
2. Riprap breakwater with imported fill for island expansion
3. Riprap breakwater with imported fill for marsh creation

All three alternatives feature a riprap breakwater to provide protection from waves. Alternative 2 and Alternative 3 included hybrid living shoreline approaches that combine hard and soft elements. For this conceptual-level alternative analysis, the same breakwater alignment and dimensions were applied for all three alternatives. Shallow water and presence of seagrass were considered in the development of the breakwater alignments. All three alternatives are expected to permanently impact approximately 0.1 acres of patchy seagrass. The current alignment can be refined in later design phases, although that may reduce the protected area or the area available for imported fill placement. Opinions of probable construction cost were developed for each alternative. Table 14 contains a summary of the main features of each alternative.

During future design phases, the location and size of gaps may be adjusted to better suit the project goals related to protection of the island and use as bird habitat. Prior to final design, field probing is recommended to confirm locations and depths of oil and gas infrastructure surrounding the island. In addition, the applicability of NWP 27 instead of an individual permit should be confirmed.

Table 14. Alternatives Analysis Summary

Feature	Alternative 1	Alternative 2	Alternative 3
Shoreline Protection:	Riprap Breakwater	Riprap Breakwater	Riprap Breakwater
Living Shoreline Component:	None	Imported Fill for Island Expansion	Imported Fill for Marsh Planting
Crest Elevation (ft NAVD):	3.5	3.5	3.5
Side Slope (H:V):	2.0	2.0	2.0
Crest Width (ft):	10	10	10
Length (ft):	1,300	1,300	1,300
Approx. Riprap Tonnage:	4,600	4,600	4,600
Permanent Impact (acre):	0.1	0.1	0.1
Fill Elevation (ft NAVD):	N/A	+2.0 ft (approx. limit of vegetation)	+1.0 ft (50% exceedance water level)
Fill Volume (CY):	N/A	1,800	600
Planting:	No	No	Yes
Conceptual OPCC:	$ 1,943,000	$ 2,411,000	$ 2,062,000

6 REFERENCES

American Society of Civil Engineers. (2017). *Minimum Design Loads and Associated Criteria for Buildings and Other Structures.* p. 805; Retrieved January 2021

CIRIA, CUR, CETMEF (2007). *The Rock Manual. The use of rock in hydraulic engineering (2nd edition).* C683, CIRIA, London

USACE, 2005. Coastal Engineering Manual. Engineer Manual 1110-2-1100 (Part VI), U.S. Army Corps of Engineers, Washington, D.C.

Leenknecht, D.A., Szuwalski, A. and Sherlock, A.R. (1992). Automated Coastal Engineering System: User's Guide. U.S. Army Corps of Engineers, Coastal Engineering Research Center, Waterways Experiment Station, Vicksburg, MS.

National Oceanic and Atmospheric Administration (NOAA) Living Shorelines Workgroup. (2015). *Guidance for Considering the Use of Living Shorelines.*

National Oceanic and Atmospheric Association (NOAA). (2020). *Packery Channel, TX - Station ID: 8775792.* NOAA Tides and Currents.

National Oceanic and Atmospheric Association (NOAA). (2020). *Rockport, TX - Station ID: 8774770.* NOAA Tides and Currents.

Rock Engineering and Testing Laboratory, Inc. (RETL). (2020). *Geotechnical Subsurface Investogation and Recommendations for the Proposed Shoreline Protectoin Project, Triangle Tree Rookery Island, Corpus Christi,Texas.* Geotechnical Study. Report Number G121002. Prepared for HDR Engineering, Inc.

Shafer, D.J., Roland, R., and Douglas, S.L. 2003. "Preliminary Evaluation of Critical Wave Energy Thresholds at Natural and Created Coastal Wetlands." WRP Technical Notes Collection (ERDC-TN-WRP-HS-CO-2.2), U.S. Army Research and Development Center, Vicksburg, MS.

Systems Approach to Geomorphic Engineering (SAGE) ; NOAA; USACE. (2015). *Natural and Structural Measures for Shoreline Stabilization .*

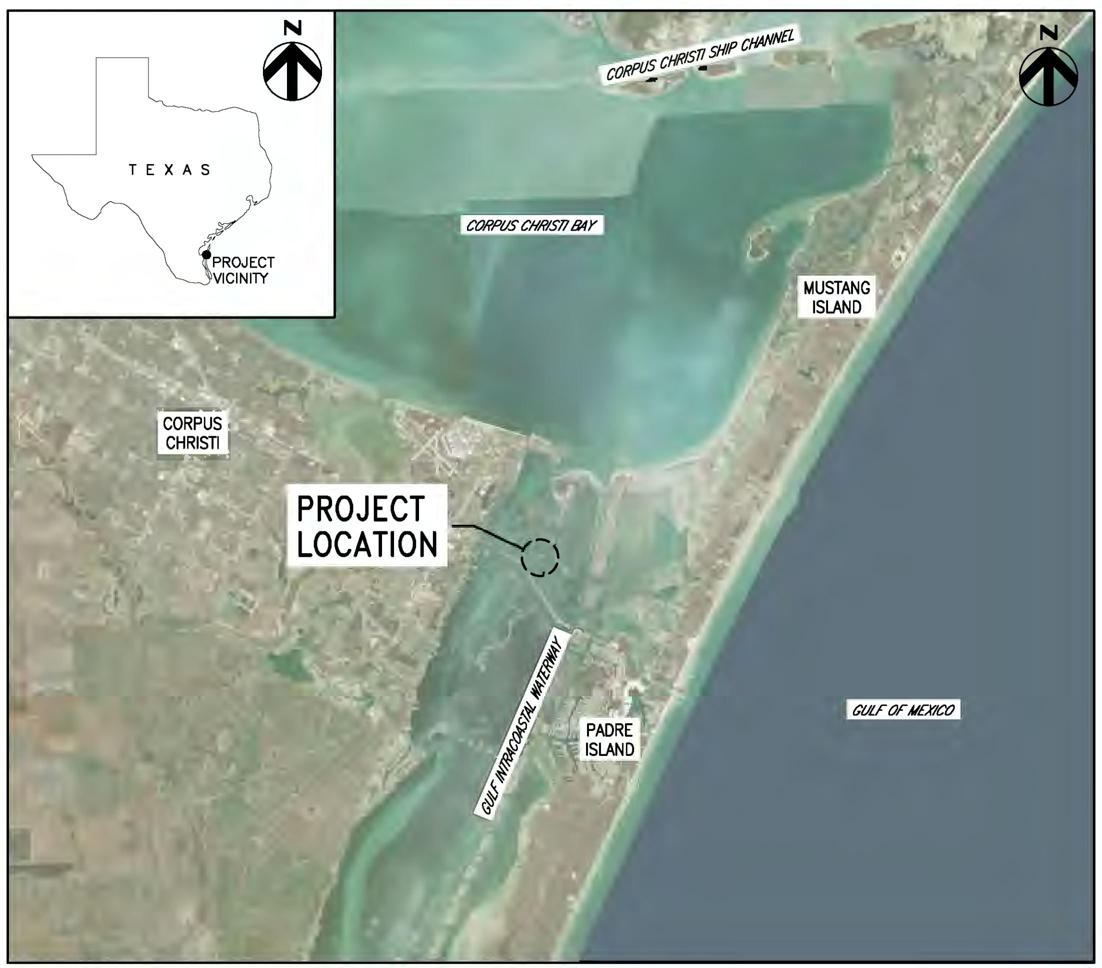
Texas General Land Office. (2020). *A Guide to Living Shorelines in Texas.*

APPENDIX II

Task 3 Deliverables
(Preliminary Engineering Designs, Wetland Delineation and Seagrass Survey Report, Bathymetry and Topographic Survey, and Magnetometer Survey)

Exhibit A
Preliminary Engineering Designs

HDR Engineering, Inc.
TBPELS Firm
Registration No. F-754



Construction Drawings For

COASTAL BEND BAYS & ESTUARIES PROGRAM

TERN ROOKERY ISLAND PROTECTION AND RESTORATION

HDR Project No. 10365350
JUNE 2023

30% SUBMITTAL PRELIMINARY

THIS DOCUMENT IS RELEASED FOR THE PURPOSE OF INTERIM REVIEW AND IS NOT INTENDED TO BE USED FOR CONSTRUCTION, BIDDING OR PERMIT PURPOSES.

ENGINEER: CHRISTIAN J. LAPANN-JOHANNESSEN
LICENSE NO.: 137561
DATE: JUNE 9, 2023

INDEX OF DRAWINGS

GENERAL LINE SYMBOLOGY

1+00	ECS ALIGNMENT
	SURVEY TRANSECT LOCATION
	APPROXIMATE EXISTING GRADE
	SILT FENCE
	APPROXIMATE PIPELINE LOCATION
	CONSTRUCTION ACCESS CORRIDOR
	GEOTEXTILE FILTER FABRIC
-2	EXISTING CONTOUR

SHEET NAMING CONVENTION

DISCIPLINE DESIGNATOR & DISCIPLINE ORDER

G	GENERAL
V	SURVEYING/MAPPING
X	DEMOLITION
C	CIVIL

EXAMPLE

0 0 — SERIES DESIGNATION

A — DISCIPLINE DESIGNATOR

- — PLACEHOLDER

0 1 — SHEET NUMBER

SITE PLAN SYMBOLOGY

	GRADED RIPRAP
	ENVIRONMENTALLY SENSITIVE AREAS
	SAND FILL
	GEOTEXTILE FILTER FABRIC
	PROPOSED ECS
15.3	SPOT ELEVATION, FT
B-01	SOIL BORING LOCATION
C2	SURVEY CONTROL POINT
	DAYBEACON
BW1-01	BREAKWATER ALIGNMENT POINT
	APPROXIMATE WELLHEAD LOCATION

ABBREVIATIONS

GRR	GRADED RIPRAP
GIWW	GULF INTRACOASTAL WATERWAY
ECS	EROSION CONTROL STRUCTURE

GENERAL SYMBOLOGY

PLAN
1/4" = 1'-0"
PLAN TITLE

ARROW INDICATES DIRECTION OF PLAN NORTH
N
NORTH ARROW

SECTION LETTER
FLAG INDICATES DIRECTION OF SECTION CUT
X
XXX
SHEET WHERE SECTION IS LOCATED
SECTION CUT MARKER

DETAIL NUMBER
#
XXX
SHEET WHERE DETAIL IS LOCATED *
DETAIL MARKER
FOR REFERENCING DETAILS INCLUDED IN DRAWING SET.

SECTION LETTER
X
XXX
SECTION
3/8" = 1'-0"
SHEET WHERE SECTION VIEW IS FIRST CUT *
SECTION TITLE

DETAIL NUMBER
X
XXX
DETAIL
1/4" = 1'-0"
SHEET WHERE DETAIL IS LOCATED *
DETAIL TITLE

* EXCEPTIONS WHERE THE SHEET NUMBER IS REPLACED BY A DASH (-).

1) FOR COMMON DETAILS, SECTIONS, ELEVATIONS OR DETAILS THAT ARE CUT OR CALLED OUT ON MULTIPLE SHEETS.

2) SECTIONS, ELEVATIONS OR DETAILS THAT ARE LOCATED ON THE SAME SHEET THEY ARE CUT OR CALLED OUT ON.

GENERAL NOTES:

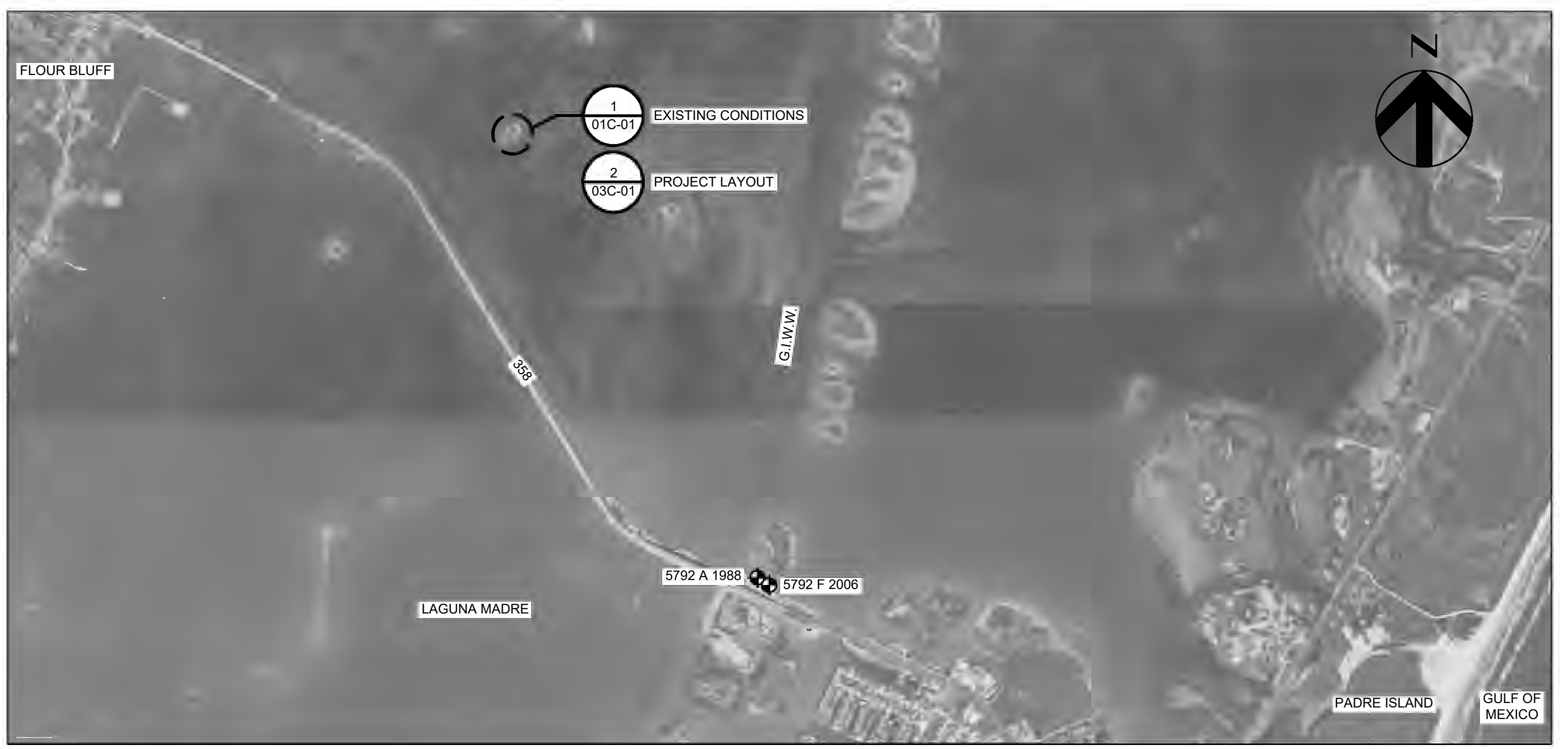
1. AERIAL PHOTOGRAPH SHOWN WAS OBTAINED BY TERRA FLIGHT AERIAL IMAGING, INC ON APRIL 16, 2023.
2. ALL EXISTING UTILITIES ARE NOT NECESSARILY SHOWN; CONTRACTOR SHALL LOCATE ALL UTILITIES PRIOR TO COMMENCING WORK.
3. CONTRACTOR SHALL VERIFY EXISTING GRADES PRIOR TO COMMENCING CONSTRUCTION ACTIVITIES. CONTRACTOR SHALL NOTIFY ENGINEER IMMEDIATELY OF ANY DISCREPANCIES OR CONFLICTS.
4. PROJECT IS WITHIN AND ADJACENT TO ENVIRONMENTALLY SENSITIVE AREAS INCLUDING SEAGRASS, TIDAL FLATS, AND ROOKERY NESTING HABITAT. CONTRACTOR SHALL AVOID IMPACTS TO THESE AREAS OUTSIDE OF WORK AREAS SHOWN IN THESE DRAWINGS DURING THE COURSE OF WORK. ANY DAMAGE CAUSED BY CONTRACTOR'S ACTIVITIES SHALL BE RESTORED AT THE EXPENSE OF CONTRACTOR AND TO THE SATISFACTION OF OWNER AND RESOURCE AGENCIES. OWNER SHALL BE THE SOLE ASSESSOR AS TO WHETHER ENVIRONMENTAL IMPACTS HAVE OCCURRED AS A RESULT OF CONTRACTOR'S ACTIVITIES. OWNER RESERVES THE RIGHT TO SUSPEND WORK AT ANY TIME IF IMPACTS OCCUR UNTIL SATISFACTORY CORRECTIVE MEASURES ARE IMPLEMENTED BY CONTRACTOR.
5. THERE ARE NO OWNER-PROVIDED STAGING AREAS FOR THIS PROJECT. CONTRACTOR SHALL OBTAIN PERMISSION FROM PROPERTY OWNERS FOR STAGING AREAS AND CONSTRUCTION ACCESS ROUTES ON PRIVATE PROPERTY. ENVIRONMENTALLY SENSITIVE AREAS SHALL NOT BE USED FOR STAGING OR ACCESS.
6. CONSTRUCTION EQUIPMENT SHALL NOT BE OPERATED OVER EXISTING MARSH VEGETATION, SEAGRASS, OR OYSTER REEFS WITHOUT PRIOR WRITTEN APPROVAL FROM ENGINEER.
7. CONTRACTOR SHALL TAKE MEASURES TO PROTECT ALL EXISTING IMPROVEMENTS WITHIN THE WORK AREA. ANY DAMAGE CAUSED BY CONTRACTOR'S ACTIVITIES SHALL BE REPLACED/REPAIRED AT THE EXPENSE OF CONTRACTOR TO THE SATISFACTION OF OWNER.
8. CONTRACTOR SHALL TAKE PRECAUTIONS, SECURE EQUIPMENT, AND PROTECT THE WORK AGAINST ADVERSE WEATHER CONDITIONS AND SURGE/WAKE FROM PASSING VESSELS REGARDLESS OF MARINE CONDITIONS.
9. PRIOR TO COMMENCING CONSTRUCTION ACTIVITIES, CONTRACTOR SHALL PERFORM A PRE-CONSTRUCTION HAZARD SURVEY OVER ALL WORK AREAS AND ACCESS CORRIDOR CHANNELS TO IDENTIFY UNCHARTED PIPELINE CROSSINGS AND OTHER POSSIBLE OBSTRUCTIONS.
10. CONTRACTOR SHALL CLEARLY MARK LIMITS OF ACCESS CORRIDOR WITH STAKES OR BUOYS FOR VERIFICATION BY ENGINEER PRIOR TO CONSTRUCTION.
11. UNLESS OTHERWISE NOTED WITHIN DRAWINGS, CONTRACTOR SHALL BE RESPONSIBLE FOR ESTABLISHING INGRESS/EGRESS ROUTES AND STAGING/MOORING AREAS. CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING ANY OBSTRUCTIONS OR UTILITIES WITHIN THESE AREAS.
12. CONTRACTOR SHALL ANTICIPATE GROUNDWATER, SURFACE WATER, AND TIDAL WATER ENTERING THE PROJECT SITE AND APPLY APPROPRIATE MEANS AND METHODS FOR CONSTRUCTION IN SOFT/WET/SATURATED SOILS.
13. LIMITS OF RELIC CHANNEL SHOWN ARE APPROXIMATE. CHANNEL HAS NOT BEEN MAINTAINED AND ACCESS CHANNEL DREDGING IS NOT PERMITTED FOR THE CURRENT PROJECT.
14. CONTRACTOR SHALL DESIGNATE A LIGHT LOADING AREA FOR TRANSFERRING OF GRADED RIPRAP BETWEEN BARGES AT THE PROJECT SITE. REFER TO SPECIFICATION 35 00 01, "CONSTRUCTION SURVEYING" AND SPECIFICATION 35 31 23, "EROSION CONTROL STRUCTURE" FOR REQUIREMENTS OF DESIGNATING THE AREA AND SURVEYING REQUIREMENTS.

SURVEY NOTES:

1. COORDINATES SHOWN ARE IN U.S. FEET AND ARE REFERENCED TO STATE PLANE, TEXAS SOUTH ZONE, NAD '83.
2. ELEVATIONS SHOWN ARE IN FEET AND REFERENCED TO NAVD '88, GEOID 18.
3. EXCEPT AS NOTED OTHERWISE, HYDROGRAPHIC AND TOPOGRAPHIC SURVEYS WERE CONDUCTED BY T. BAKER SMITH ON MARCH 29, 2023 AND REPRESENT THE CONDITIONS THAT EXISTED AT THE TIME OF THE SURVEYS.
4. MAGNETOMETER SURVEY WAS PERFORMED BY T. BAKER SMITH ON MARCH 29, 2023. SEE RESULTS IN APPENDIX D. THIS MAGNETOMETER SURVEY IS PROVIDED FOR INFORMATIONAL PURPOSES ONLY. CONTRACTOR SHALL BE RESPONSIBLE FOR DETERMINING LOCATIONS OF POTENTIAL HAZARDS, OBSTRUCTIONS, AND UTILITIES WITHIN WORK AND NAVIGATION AREAS. SEE SPECIFICATION 35 00 01, "CONSTRUCTION SURVEYING."
5. MONUMENTS FOR SURVEY CONTROL PROVIDED IN TABLE BELOW.

MONUMENTS USED FOR SURVEY CONTROL

NAME	NORTHING	EASTING	ELEVATION
5792 A 1988	17,121,538.3	1,393,149.5	2.7' NAVD88
5792 F 2006	17,121,396.8	1,393,373.7	3.0' NAVD88



1 - SURVEY MAP AND KEY MAP
N.T.S.

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Registration No. F-754

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PROJECT MANAGER	D. HEILMAN
DESIGNED BY	C. LAPANN-JOHANNESSEN
DRAWN BY	E. C., F. M.
CHECKED BY	B. GEESEY
PROJECT NUMBER	10365350

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LICENSE NO.: 137561
DATE: JUNE 9, 2023

COASTAL BEND BAYS & ESTUARIES PROGRAM

TERN ROOKERY ISLAND
PROTECTION AND RESTORATION

SURVEY MAP GENERAL NOTES AND LEGENDS

FILENAME 00G-01.DWG.DWG
SCALE AS NOTED
SHEET 00G-01

EXISTING CONDITIONS - SITE PLAN

1 / 00G-01 — 0, 400', 800'

NOTES:

1. REFER TO NOTES ON SHEET 00G-01.
2. SITE INGRESS AND EGRESS FROM GIWW SHALL BE LIMITED TO THE CONSTRUCTION ACCESS CORRIDOR. THESE LIMITS SHALL BE CLEARLY MARKED THROUGH THE DURATION OF CONSTRUCTION. CONSTRUCTION EQUIPMENT SHALL REMAIN WITHIN THESE BOUNDARIES AT ALL TIMES.
3. CONTRACTOR SHALL BE RESPONSIBLE FOR DETERMINING LOCATIONS OF ANY OBSTRUCTIONS AND UTILITIES WITHIN CONSTRUCTION ACCESS CORRIDOR OR WORK BOUNDARY.
4. PIPELINE AND WELLHEAD INFORMATION WERE OBTAINED FROM THE RAILROAD COMMISSION OF TEXAS.

CONSTRUCTION ACCESS CORRIDOR COORDINATES		
POINT NO.	NORTHING	EASTING
1	17,122,223	1,392,294
2	17,122,018	1,392,215
3	17,122,429	1,391,363
4	17,123,116	1,390,543
5	17,124,027	1,389,927
6	17,125,959	1,388,763
7	17,128,434	1,387,311
8	17,128,913	1,387,915
9	17,129,073	1,387,809
10	17,129,211	1,388,000
11	17,129,075	1,388,111
12	17,129,141	1,388,276
13	17,129,254	1,388,501
14	17,129,647	1,389,019
15	17,129,834	1,388,904
16	17,129,873	1,388,813
17	17,129,936	1,388,642
18	17,129,962	1,388,659
19	17,129,997	1,388,662
20	17,130,034	1,388,654
21	17,129,910	1,388,996
22	17,130,008	1,389,145
23	17,129,966	1,389,263
24	17,129,882	1,389,324
25	17,129,951	1,389,443
26	17,129,911	1,389,473
27	17,129,814	1,389,448
28	17,128,392	1,387,489
29	17,126,054	1,388,882
30	17,124,108	1,390,033
31	17,123,246	1,390,645
32	17,122,587	1,391,440

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CHECKED BY	B. GEESEY
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DATE: JUNE 9, 2023

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TERN ROOKERY ISLAND PROTECTION AND RESTORATION

EXISTING CONDITIONS - SITE PLAN

FILENAME: 01C-01.DWG
SCALE: AS SHOWN
SHEET: **01C-01**

NOTES:

1. SEE NOTES ON SHEET 01C-01.
2. SEE DETAIL 2 ON SHEET 05C-01 FOR LOCATION AND DIMENSIONS OF TURBIDITY CONTROLS.

2 / 00G-01 EXISTING CONDITIONS - TERN ROOKERY ISLAND

0 50' 100'

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EXISTING CONDITIONS - TERN ROOKERY ISLAND

FILENAME 01C-02.DWG
SCALE AS SHOWN
SHEET 01C-02

NOTES:

1. SEE NOTES ON SHEET 01C-01.
2. SEE DETAIL 2 ON SHEET 05C-01 FOR LOCATION AND DIMENSIONS OF TURBIDITY CONTROLS.

2 / 00G-01 PIPELINE AND ENVIRONMENTALLY SENSITIVE AREAS

0 50' 100'

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TERN ROOKERY ISLAND PROTECTION AND RESTORATION

PIPELINE AND ENVIRONMENTALLY SENSITIVE AREAS

FILENAME 02C-01.DWG
SCALE AS SHOWN
SHEET 02C-01

NOTES:

1. SEE NOTES ON SHEET 01C-01.
2. SEE DETAIL 1 ON SHEET 05C-01 FOR LOCATION AND DIMENSIONS OF TURBIDITY CONTROLS.
3. CONSTRUCTION EQUIPMENT SHALL NOT OPERATE WITHIN THE ENVIRONMENTALLY SENSITIVE AREA. THE ENVIRONMENTALLY SENSITIVE AREA IS BASED ON THE PRESENCE OF VEGETATION AND MAY SHIFT DEPENDING ON SITE CONDITIONS AT THE TIME OF CONSTRUCTION.

2
00G-01
PROJECT LAYOUT - TERN ROOKERY ISLAND
0 50' 100'

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DATE: JUNE 9, 2023

COASTAL BEND BAYS & ESTUARIES PROGRAM

TERN ROOKERY ISLAND PROTECTION AND RESTORATION

PROJECT LAYOUT - TERN ROOKERY ISLAND

FILENAME 03C-01.DWG
SCALE AS SHOWN
SHEET 03C-01

1 2 3 4 5 6 7 8

D C B A

TO BE ADDED AT 95% SUBMITTAL

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DESIGNED BY	C. LAPANN-JOHANNESSEN
DRAWN BY	E. C., F. M.
CHECKED BY	B. GEESEY
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LICENSE NO.: 137561
DATE: JUNE 9, 2023

COASTAL BEND BAYS & ESTUARIES PROGRAM

TERN ROOKERY ISLAND PROTECTION AND RESTORATION

CROSS SECTIONS 01

FILENAME 04C-01.DWG
SCALE AS SHOWN

SHEET 04C-01

1 2 3 4 5 6 7 8

D

C

TO BE ADDED AT 95% SUBMITTAL

B

A

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ISSUE	DATE	DESCRIPTION
-	06/09/2023	30% DESIGN PRELIMINARY

PROJECT MANAGER	D. HEILMAN
DESIGNED BY	C. LAPANN-JOHANNESSEN
DRAWN BY	E. C., F. M.
CHECKED BY	B. GEESEY
PROJECT NUMBER	10365350

30% SUBMITTAL PRELIMINARY

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ENGINEER: CHRISTIAN J. LAPANN-JOHANNESSEN
LICENSE NO.: 137561
DATE: JUNE 9, 2023

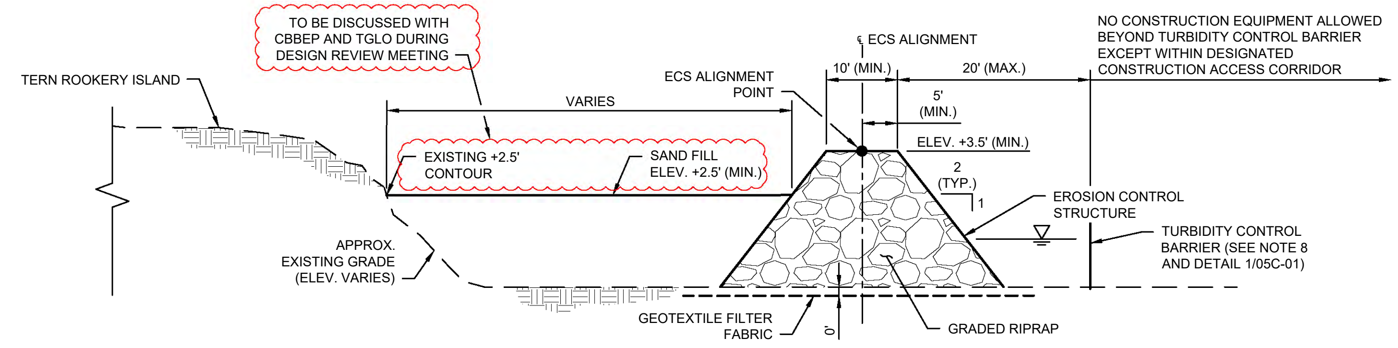
COASTAL BEND BAYS & ESTUARIES PROGRAM

TERN ROOKERY ISLAND PROTECTION AND RESTORATION

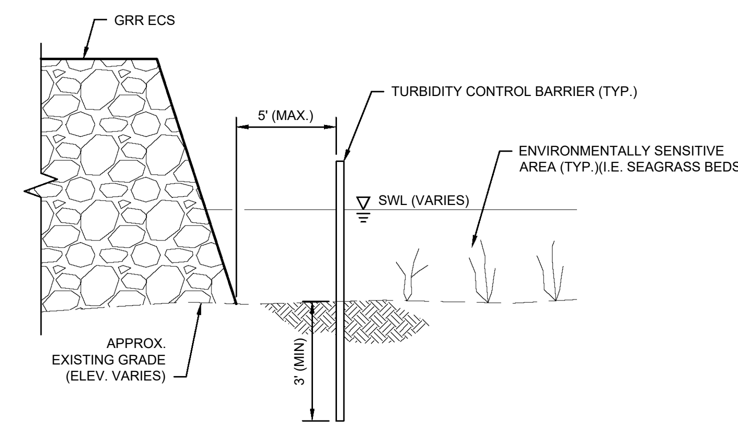
CROSS SECTIONS 02

FILENAME 04C-02.DWG
SCALE AS SHOWN

SHEET 04C-02



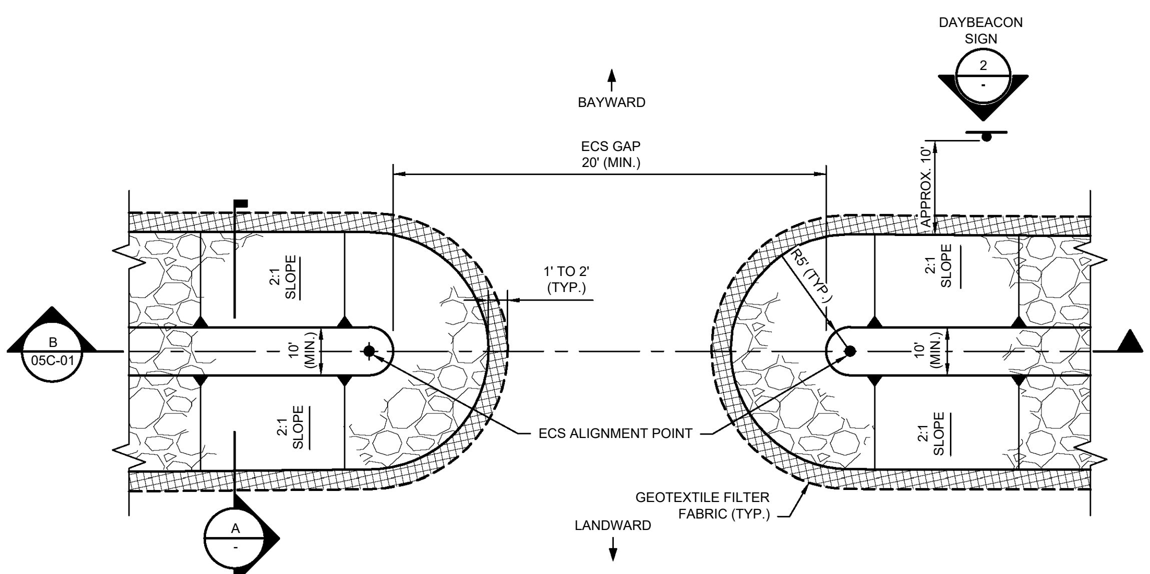
A 03C-01 TYPICAL SECTION - ECS AND FILL
NOT TO SCALE



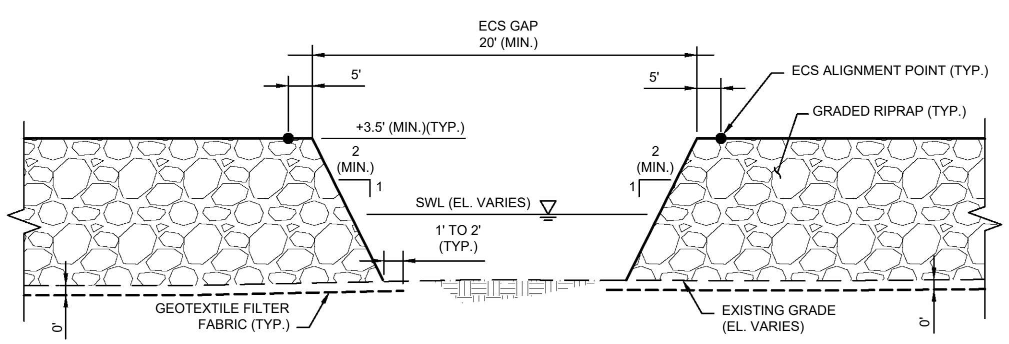
1 - TYPICAL DETAIL - SILT FENCE (ECS)
NOT TO SCALE

NOTES:

1. ALL SLOPES SHOWN ARE STEEPEST ALLOWED. ACTUAL SLOPES MAY BE LESS (I.E. "FLATTER").
2. GRADED RIPRAP PLACEMENT SHALL MAXIMIZE CONTACT BETWEEN STONES ON ALL SIDES WITH EACH STONE HAVING AT LEAST THREE POINTS OF CONTACT WITH OTHER STONES.
3. SURVEY AND CONSTRUCTION SEQUENCING SHALL BE PERFORMED IN ACCORDANCE WITH SPECIFICATION SECTION 35 00 01, "CONSTRUCTION SURVEYING."
4. REFER TO SPECIFICATIONS SECTION 35 31 23 "ECS" FOR ADDITIONAL GRADED RIPRAP REQUIREMENTS.
5. REFER TO SPECIFICATION SECTION 31 05 19.13, "GEOTEXTILES FOR EARTHWORK."
6. DAYBEACONS SHALL BE LOCATED APPROXIMATELY 10 FEET FROM SEAWARD TOE OF ECS. ALL DAYBEACON LOCATIONS SHALL BE COORDINATED WITH ENGINEER PRIOR TO DAYBEACON INSTALLATION.
7. ALL WARNING SIGN FACES SHALL BE ORIENTED TO FACE PREDOMINANT APPROACH DIRECTION OF ONCOMING BOAT TRAFFIC.
8. TURBIDITY CONTROL BARRIER SHALL CONSIST OF SILT FENCE AT A MINIMUM. SILT FENCE SHALL BE CONSTRUCTED WITH 2" x 2" TIMBER POSTS SPACED ON 6' CENTERS. FILTER FABRIC SHALL BE BURLAP, NYLON, POLYPROPYLENE OR ENGINEER APPROVED EQUAL AND REINFORCED WITH POLYESTER NETTING OR WELDED WIRE MESH. SILT FENCE SHALL BE REMOVED BY CONTRACTOR UPON COMPLETION OF ECS OR UPON APPROVAL OF ENGINEER. UPON REMOVAL, POSTS SHALL BE COMPLETELY EXTRACTED OR CUT SQUARE AT MUDLINE, NOT BROKEN OFF. AT CONTRACTOR'S OPTION, SILT CURTAIN MAY BE PLACED INSTEAD OF FENCE. TYPE OF SILT CURTAIN AND INSTALLATION METHOD SHALL BE SUBMITTED TO ENGINEER FOR REVIEW PRIOR TO INSTALLATION.



3 03C-01 TYPICAL DETAIL - GRR ECS GAP
NOT TO SCALE



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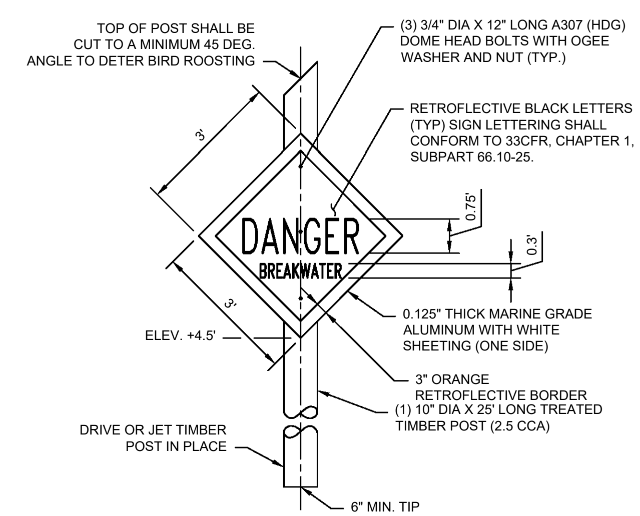

2 - TYPICAL DETAIL - DAYBEACON
NOT TO SCALE (SEE NOTE 6)

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HDR Engineering, Inc.
TBPELS Firm
Registration No. F-754

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ENGINEER: CHRISTIAN J. LAPANN-JOHANNESSEN
LICENSE NO.: 137561
DATE: JUNE 9, 2023

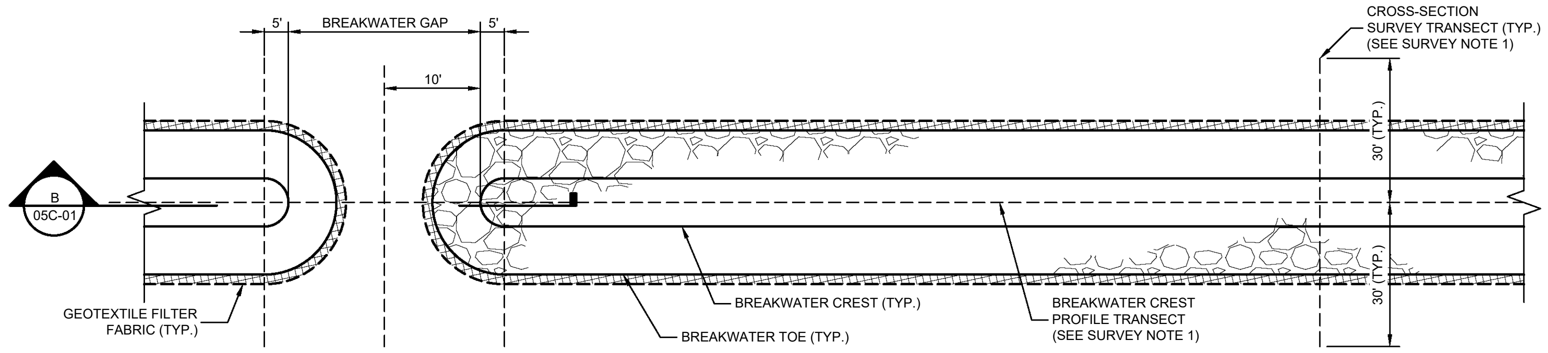
COASTAL BEND BAYS & ESTUARIES PROGRAM

TERN ROOKERY ISLAND PROTECTION AND RESTORATION

TYPICAL SECTIONS AND DETAILS 01

FILENAME 05C-01.DWG
SCALE AS SHOWN
SHEET 05C-01

1 2 3 4 5 6 7 8



1 / - TYPICAL PLAN - CONSTRUCTION SURVEY TRANSECTS

NOT TO SCALE

GRADED RIPRAP NOTES:

1. REFER TO NOTES ON SHEET 05C-01.

SURVEY NOTES:

1. SURVEY TRANSECT LOCATION AND CONSTRUCTION SEQUENCING SHALL BE PERFORMED IN ACCORDANCE WITH SPECIFICATION SECTION 35 00 01, "CONSTRUCTION SURVEYING."

D C B A

THIS SHEET PRINTED HALF SIZE

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COASTAL BEND BAYS & ESTUARIES PROGRAM

TERN ROOKERY ISLAND PROTECTION AND RESTORATION

TYPICAL SECTIONS AND DETAILS 02

FILENAME 05C-02.DWG

SCALE AS SHOWN

SHEET **05C-02**

Exhibit B
Wetland Delineation and Seagrass Survey Report

Wetland Delineation and Seagrass Survey Report for Tern Rookery Island Restoration Project

Coastal Bend Bays & Estuaries Program

Nueces County, Texas

May 12, 2023

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Tables

Appendices

1.0 Introduction

HDR Engineering, Inc. (HDR) has conducted a delineation and seagrass survey of Tern Rookery Island Project (Project Area) located in Nueces County, Texas on behalf of the Coastal Bend Bays & Estuaries Program (CBBEP). The Project Area was comprised of Tern Rockery Island (island) and surrounding water, totaling approximately 62 acres located in the Corpus Christi Bay system north of the John F. Kennedy Memorial Causeway, and near North Padre Island, Texas (**Appendix A – Figure 1, Vicinity Map**). CBBEP plans to construct, protect, and restore rookery island nesting habitat for colonial waterbirds in the Upper Laguna Madre (ULM).

The purpose of the wetland delineation is to identify areas within the Project Area likely to be considered jurisdictional by the U.S. Army Corps of Engineers (USACE) under Section 10 of the Rivers and Harbors Act of 1899 (RHA) and Section 404 of the Clean Water Act (CWA). USACE regulates excavation, installation of structures, the discharge of dredged material, and/or placement of fill material within waters of the U.S. As of the date of this report, jurisdictional waters include navigable waters, the intermittent and ephemeral tributaries of truly navigable waters, and adjacent wetlands (40 CFR 230). The 1987 USACE Wetland Delineation Manual (Environmental Laboratory, 1987) defines wetlands as areas that have positive indicators for hydrophytic vegetation, wetland hydrology, and hydric soils, or as “areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions,” with special exceptions.

2.0 Project Area Location

The Project Area is located within the Corpus Christi Bay approximately a third of a mile north of the John F. Kennedy Memorial Causeway Bridge, which traverses the Gulf Intercoastal Waterway (GIWW) in Nueces County, Texas (**Appendix A - Figure 1, Vicinity Map**). The Project Area is located on U.S. Geological Survey (USGS) 7.5-minute quadrangle map for Crane Project Area NW, TX and Oso Creek NE, TX (**Appendix A – Figures 2-1 and 2-2, Topographic Maps**). The approximate center coordinates are (Latitude/Longitude): 27.657878°,-97.251223° (UTM Zone 14 R, 672499.51 m E, 3060526.94 m N; NAD 83).

3.0 Project Area Description

3.1 Site History

The Project Area consists of Tern Rookery Island (island), which was artificially formed from the placement of dredged material from artificial channels dredged for oil and gas exploration between 1956 and 1979, and surrounding water. The island is known to provide nesting habitat for various colonial waterbird species including both tree/shrub nesters (wading birds) and ground nesters (terns, gulls, skimmers). The island allowed for sufficient elevation for organic soils to develop over time and supported native herbaceous, scrub-shrub, and tree vegetation. However, the island has eroded over time, and is continuously experiencing erosion from hurricanes and wave and wind action. In 2017 the island experienced a loss of approximately 50 feet of shoreline on the southwestern side due to Hurricane Harvey (CBBEP, 2017). CBBEP has worked on site assessments and shoreline protection strategies to restore the nesting habitat located in the Project Area.

3.2 Geology, Topography, and Hydrogeology

According to the Geologic Atlas of Texas, the Project Area consists of primarily fill and spoil deposits (F and S) that formed during the Quaternary period. F sediments are fill deposits that were dredged for the purpose of raising land surfaces and for creating additional land mass on barrier islands. S sediments are spoil deposits from dredge material with highly variable sediments, including mixed mud, silt, sand, and shell (USGS, 2023a).

The Project Area was not visible on topographic maps from 1925 through 1951. The 1951 topographic map shows the Project Area comprised of various island formations with open water, and the 2019 map shows Tern Rookery Island with a defined shoreline with small land formations and surrounding water (**Appendix A – Figure 2-1 and 2-2**). The 1951 topographic map of the Project Area reported an elevation at 2ft of the sand and mud areas that surrounded the Project Area. No elevations within the Project Area are listed on topographic maps. Previous topographic survey measurements identified elevations at the center of the island ranging from 3 ft to 4 ft, with elevations at exposed portions of the shoreline decreasing from 2ft to 0.7ft (HDR, 2021). A review of historic aerial photographs between 1956 and 2022 show significant erosion of the island shoreline and vegetation on the land (**Appendix A – Figure 3-1 and 3-2**). Land use within the Project Area appears to have been historically undeveloped sand and gravel surfaces, but more recently appears to be a mixture of vegetated and unvegetated sandy areas.

The Project Area is located on the Gulf Coast Aquifer in the Nueces-Rio Grande River Basin (Texas Water Development Board [TWDB], 2023). The Project Area is located within the Corpus Christi Bay. The Texas Commission on Environmental Quality (TCEQ) characterizes the Corpus Christi Bay as a classified estuary (Segment 2481) in the southern portion of the bay, north of the Upper Laguna Madre (TCEQ, 2022). Additionally, rainfall, tidal influences, and passing vessels provide significant contributions to the hydrology of these areas. Average annual rainfall is approximately 32 inches (U.S. Climate Data, 2023).

3.3 Soils

According to the Soil Survey for Nueces County, Texas (U.S. Department of Agriculture Soil Conservation Service [USDA SCS], 1982), one soil type (not including water) is found within the Project Area: Twinpalms occasionally flooded-Yarborough frequently flooded complex, 0 to 3 percent slopes (Sb). Sb soils are listed on the National Hydric Soil List for Texas (Natural Resources Conservation Service [NRCS], 2023a). This hydric soil type covers approximately 1 percent of the total Project Area. The remaining 99 percent is water (**Appendix A - Figure 4, Soils Map**).

TWINPALMS OCCASIONALLY FLOODED – YARBOROUGH FREQUENTLY FLOODED COMPLEX, 0 TO 3 PERCENT SLOPES (SB)

Twinpalms occasionally flooded-Yarborough frequently flooded complex, 0 to 3 percent slopes (Sb) is a poorly drained soil located in the Project Area. Sb soils consist of sandy and loamy dredge spoils derived from igneous, metamorphic and sedimentary rock. Twinpalms soils make up 55 percent and Yarborough soils make up 40 percent of this soil association, with minor components making up the remaining five percent. Yarborough soils and all minor components are hydric soils (NRCS, 2023b).

3.4 Vegetation

The Project Area is within Western Gulf Coastal Plain (Level III) and the Laguna Madre Barrier Island and Coastal Marshes (Level IV) ecoregions of Texas (EPA, 2020; Griffith et al., 2007). Typical grass species include little false bluestem (*Schizachyrium scoparium*), gulf dune crown grass (*Paspalum monostachyum*), sea-oats (*Uniola paniculata*), and bitter panic grass (*Panicum amarum*). Coastal marshes vegetation include salt-meadow cord grass (*Spartina patens*), bulrush species (*Scirpus* spp.), cattail species (*Typha* spp.), and sedge species (*Cyperus* spp. and *Carex* spp.). Dominant hydrophytic vegetation found in the Project Area includes turtleweed (Batis maritima), Carolina desert-thorn (*Lycium carolinianum*), and salt-meadow cord grass.

Erosion was prominent on the western edge of these Project Area. The highest elevation areas coincided with the majority of nesting habitat. Nesting habitat on the Project Area included mature honey mesquite (*Prosopis glandulosa*), common sunflower (*Helianthus annuus*), cheeseweed (*Malva parviflora*), and erect prickly-pear (*Opuntia stricta*) (**Appendix D – Photo 9, 10, and 13**). Estuarine emergent wetlands located in the east and west portions of the island act as transitional areas between open water and the upland tree and shrub habitat.

Open water surrounding the Project Area was shallow (between 0 and 5 ft) and dominated by shoal grass (*Halodule wrightii*), followed by less dense amounts of manatee grass (*Syringodium filiforme*), and star grass (*Halophilla engelmannii*). Submerged aquatic vegetation was observed between water depths of 0 and 5 ft at the time of sampling.

3.5 Floodplain

The Project Area is located within the Nueces-Rio Grande Coastal Basin and South Corpus Christi watershed (Hydrologic Unit Code [HUC] 8 – 12110202; USGS, 2023b). The Project Area is located within the 100-year flood zone identified as Zone VE (Flood Insurance Rate Map panel 48355C0545G dated 10-13-2022; Federal Emergency Management Agency [FEMA], 2023). Zone VE is subject to inundation by the 1-percent-or greater-annual-chance flood event with an additional hazard associated with storm waves. Base flood elevations (BFE) have been developed at selected intervals in this zone. FEMA Flood Insurance Rate Maps (FIRM) are included in **Appendix A – Figure 5, FEMA FIRM Map**.

4.0 Methods

Prior to conducting field investigations, HDR environmental scientists reviewed available background information including:

- USGS 7.5 Minute Series Topographic Maps, Crane Islands NW, TX and Oso Creek NE, TX Quadrangle Maps (1951 and 2019).
- Current and Historical Aerial Photography (Google Earth 1956 to 2022)
- NRCS Web Soil Survey for Nueces County (NRCS, 2023b) and the Soil Survey for Nueces County, Texas (USDA SCS, 1977)
- U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) (**Appendix A - Figure 6, NWI/NHD Map**)
- USGS National Hydrography Dataset (NHD) (**Appendix A - Figure 6, NWI/NHD Map**)
- FEMA FIRM (**Appendix A - Figure 5, FEMA FIRM Map**)

The field survey was conducted within the approximate 62-acre Project Area on February 27, 2023, by HDR environmental scientist Kelsea Hiebert and coastal engineer Uriah Gravois. In addition to the wetland delineation, HDR conducted a seagrass survey within the Project Area. A total of 10 transects were established prior to the field surveys. The transects started on the shoreline of the island and extended waterward into the ULM.

The delineation and proposed jurisdictional determination of waters of the U.S. (WOTUS), including wetlands, was conducted in support of the requirement of Section 10 of the RHA and Section 404 of the CWA. The delineation was conducted in accordance with the 1987 *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory, 1987) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region (Version 2.0)* (USACE, 2010). HDR also evaluated the potential for federal jurisdiction under Section 404 of the CWA over aquatic features in the Project Area based on the most recently approved guidance from USACE and U.S. Environmental Protection Agency (EPA) published December 2, 2008 (USACE and EPA, 2008). The guidance was issued pursuant to the U.S. Supreme Court findings in the Rapanos and Carabell cases and is herein referred to as the Rapanos Guidance.

Due to the current uncertainty regarding the definitions of waters to be regulated by the CWA, HDR evaluated the potential for federal jurisdiction under Section 404 of the CWA in the Project Area based on the most recently approved guidance for jurisdictional determinations, which is the Rapanos Guidance. The USACE has the regulatory authority to issue preliminary and/or approved jurisdictional determinations based on the regulations in place at the time of their assessment. Therefore, the potential jurisdictional status of features identified in this delineation and proposed jurisdictional determination reflect that of the Rapanos Guidance.

Potential jurisdictional waters (tidal) were identified by the presence of an Annual High Tide line (AHTL). According to CFR 328.3, AHTL is defined as the line of intersection of land with the water's surface at the maximum height reached by a rising tide. The AHTL may be determined, in the absence of actual data, by a line of oil or scum along shore objects, a more or less continuous deposit of fine shell or debris on the foreshore or berm, other physical markings or characteristics, vegetation lines, tidal gages, or other suitable means that delineate the general height reached by a rising tide.

Potential jurisdictional wetlands were identified based on the presence of the three required wetland criteria described in the 1987 Wetland Delineation Manual and in accordance with the latest guidelines set forth in the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plains Region (Version 2.0) (USACE, 2010). When an area was determined to be a potential jurisdictional wetland, a data point was collected to delineate wetland boundaries and corresponding upland areas. Wetland boundaries were mapped using a differentially corrected global positioning system (GPS) unit (Bad Elf Flex) with sub-meter accuracy. Geographic Information System (GIS) software was used to analyze collected features, calculate areas, and generate figures. All point, line, and polygon data collected using the GPS receiver and displayed on subsequent figures are for review purposes only and do not represent a professional civil survey.

The determination within this report is subject to review and approval by the Galveston District of the USACE, and the final jurisdictional determination is within the regulatory authority of the USACE and EPA.

5.0 Results

5.1 Potential Waters of the U.S.

A total of 14 potential WOTUS, including, estuarine emergent wetlands, open water bare bottom habitat, and submerged aquatic vegetation (seagrass beds) were identified within the Project Area, totaling approximately 61.01 acres (**Appendix A - Figure 7, Potential WOTUS**). All potential jurisdictional features are described in further detail below. A summary of potential WOTUS within the Project Area is included in **Table 1**. Wetland Determination Data Forms are included in **Appendix B**, Antecedent Precipitation Tool (APT) results are included in **Appendix C**, a photographic log with representative photos of the Project Area is included in **Appendix D**, and GPS coordinate data is in **Appendix E**.

5.1.1 ESTUARINE EMERGENT WETLANDS

Two estuarine emergent wetlands were identified within the Project Area (W-1 and W-2), totaling 0.21 acre (**Appendix A - Figure 7, Potential WOTUS**). W-1 was located along the north and eastern portion of the AHTL of the island. W-2 was located along the southwestern portion of the AHTL of the island. The wetlands were tidally influenced as they were adjacent to the ULM, Corpus Christi Bay and GIWW. The wetlands exhibited all three wetland indicators and were dominated by turtleweed, and Carolina desert-thorn (**Appendix B – Data Forms DP-1, Appendix D – Photos 1, 2, 3, and 11**). Due to adjacency to the ULM and Corpus Christi Bay, two TNW, estuarine emergent wetlands W-1 and W-2 would be considered jurisdictional.

5.1.2 BARE BOTTOM OPEN WATER HABITAT

A total of 13.06 acres of bare bottom open water habitat (OW-1 to OW-7) was surveyed within the Project Area (**Appendix A - Figure 7, Potential WOTUS**). Deep water habitat further away from the island had various depths ranging from 5 to 6 ft. The shallow water (less than 4 ft) surrounding the island contained bare bottom and open water habitat adjacent to seagrass beds. Open water habitat would be considered jurisdictional due to habitat presence within Corpus Christi Bay, a TNW.

5.1.3 SUBMERGED AQUATIC VEGETATION

A total of 47.74 acres of seagrass beds (SAV-1 to SAV-5) were identified within open water surveyed within the Project Area (**Appendix A - Figure 7, Potential WOTUS**). The dominant seagrass species was shoal grass, with less dense species including manatee grass, and star grass (**Appendix D – Photos 4, 5, 6, and 7**). Seagrass bed SAV-1 was surrounding the island within the Project Area. The majority of SAV-1 was dense in cover and observed at depths ranging between 1 to 5 ft. Seagrass beds SAV-2 to SAV-5 were located adjacent to OW-1, were patchy in cover, and observed at depths ranging between 0 to 4 ft. Seagrass beds would be considered jurisdictional due to habitat presence within Corpus Christi Bay, a TNW.

Table 1. Summary of Potential Jurisdictional Features within the Project Area

Feature Name	Type[1]	Acreage
W-1	Estuarine Emergent Wetland (E2EM)	0.15
W-2	Estuarine Emergent Wetland (E2EM)	0.06
SAV-1	Submerged Aquatic Vegetation (E2AB)	45.21
SAV-2	Submerged Aquatic Vegetation (E2AB)	0.06
SAV-3	Submerged Aquatic Vegetation (E2AB)	0.66
SAV-4	Submerged Aquatic Vegetation (E2AB)	0.86
SAV-5	Submerged Aquatic Vegetation (E2AB)	0.94
OW-1	Open Water Bare Bottom (E1UB)	4.16
OW-2	Open Water Bare Bottom (E1UB)	0.01
OW-3	Open Water Bare Bottom (E1UB)	0.08
OW-4	Open Water Bare Bottom (E1UB)	0.12
OW-5	Open Water Bare Bottom (E1UB)	0.10
OW-6	Open Water Bare Bottom (E1UB)	8.19
OW-7	Open Water Bare Bottom (E1UB)	0.40
	Total	**61.01**

[1]Classification of Wetlands and Deepwater Habitats of the United States, Cowardin *et. al* 1979

5.2 Non-Jurisdictional Features

The delineation of the Project Area did not result in the identification of non-jurisdictional aquatic features. The remaining 0.99 acres of the Project Area was determined to be upland. This area did not exhibit all three wetland indicators (**Appendix B – Data Form DP-2, and DP-3**). The upland area of the Project Area was situated at higher elevations compared to surrounding wetland and water features and consisted of primarily upland vegetation such as honey mesquite, common sunflower, cheeseweed, and erect prickly-pear (*Opuntia stricta*) covering the herbaceous layer (**Appendix D – Photo 9, 10, and 13**).

6.0 Discussion/Conclusion

It is the professional judgment of HDR that the 61.01 acres identified within the 62-acre CBBEP Project Area in Nueces County, Texas, and summarized in **Table 1** above are WOTUS under Section 10 of the RHA and/or Section 404 of the CWA. Of the 61.01 acres of WOTUS, 45.21 acres were dense seagrass beds dominated by shoal grass, and 5.23 acres were patchy seagrass beds dominated by manatee grass, and star grass. Most of these features would likely be jurisdictional because they are tidally influenced by the Laguna Madre, a TNW. It is also HDR's professional judgment that the non-jurisdictional upland area described above is not a WOTUS based on the current guidance from the USACE and the lack of direct hydrologic connection to a TNW or RPW.

This delineation and proposed jurisdictional determination of WOTUS, including wetlands, for the proposed project is based on the best professional judgment of HDR's team of environmental scientists, with extensive experience with delineation of similar resources in the South Texas region.

7.0 References

Coastal Bend Bays & Estuaries Program (CBBEP). 2017. Post-Harvey Texas Mid-coast Rookery Island Preliminary Damage Report. Coastal Bird Program. Available online: https://www.harteresearchinstitute.org/sites/default/files/projects/Hurricane%20Harvey%20Island%20habitat%20assessment_CBBEP%20Coastal%20Bird%20Program.pdf. Accessed May 8, 2023.

Environmental Laboratory. 1987. Corps of Engineers Wetland Delineation Manual. Technical Report Y-87-1. Vicksburg, MS: U.S. Army Engineer Waterways Experiment Station.

Environmental Protection Agency (EPA). 2020. Descriptions of the Level IV Ecoregions of Texas. Available online at https://gaftp.epa.gov/EPADataCommons/ORD/Ecoregions/tx/tx_back.pdf. Accessed May 8, 2023.

Federal Emergency Management Agency (FEMA). 2023. National Flood Hazard Layer (NFHL) Viewer. Available online: https://msc.fema.gov/portal/search?AddressQuery=port%20mansfield#searchresultsanchor . Accessed May 8, 2023.

Griffith, G., Bryce, S., Omernik, J. and Roger, A. 2007. Ecoregions of Texas. AS-199, Project Report to Texas Commission on Environmental Quality, 125 p.

HDR Engineering Inc. 2021. Feasibility Study & Alternatives Analysis Report. Tern Rookery Island Protection and Restoration. Prepared for the Coastal Bend Bays & Estuaries Program.

Natural Resources Conservation Service (NRCS). 2023a. National hydric soils list by state: Texas. U.S. Department of Agriculture. Available online: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcseprd1316620.html. Accessed May 8, 2023.

________. 2022b. Web Soil Survey. U.S. Department of Agriculture. Available online: https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm. Accessed May 8, 2023.

Texas Commission on Environmental Quality (TCEQ). 2022. Texas Integrated Report – Water Bodies Evaluated. Available online: https://www.tceq.texas.gov/waterquality/assessment. Accessed May 8, 2023.

Texas Water Development Board (TWDB). 2023. Water Data Interactive Viewer. Available online: https://www3.twdb.texas.gov/apps/WaterDataInteractive/GroundWaterDataViewer. Accessed May 8, 2023.

U.S. Army Corps of Engineers (USACE). 2010. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region (Version 2.0), ed. J.S.

Wakeley, R.W. Lichvar, and C.V. Noble. ERDC/EL TR-10-20. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

U.S. Army Corps of Engineers (USACE) and Environmental Protection Agency (EPA). 2008. Clean Water Act Jurisdiction Following the U.S. Supreme Court's Decision in Rapanos v. United States & Carabell v. United States.

U.S. Climate Data. 2023. Climate Corpus Christi, Nueces County, Texas. Available online: https://www.usclimatedata.com/climate/corpus-christi/texas/united-states/ustx0294. Accessed May 8, 2023.

U.S. Department of Agriculture, Natural Resources Conservation Service (USDA NRCS). 2006. *Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin.* U.S. Department of Agriculture Handbook 296.

U.S. Department of Agriculture Soil Conservation Service (USDA SCS). 1982. Soil Survey of Nueces County, Texas.

U.S. Geological Survey (USGS). 1925 and 2019. Topographic Map 1:24,000. Crane Islands NW, Texas. Available online: https://ngmdb.usgs.gov/topoview/viewer/#15/27.6488/-97.2524

________. 1925 and 2019. Topographic Map 1:24,000. Oso Creek NE, Texas. Available online: https://ngmdb.usgs.gov/topoview/viewer/#15/27.6488/-97.2524

________. 2023a. Geologic Atlas of Texas. Available online: https://txpub.usgs.gov/txgeology/. Accessed May 8, 2023.

________. 2023b. National Hydrography Dataset. Available online: https://www.usgs.gov/core-science-systems/ngp/national-hydrography/access-national-hydrography-products. Accessed May 8, 2023.

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FIGURES

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MILES

LEGEND

PROJECT AREA

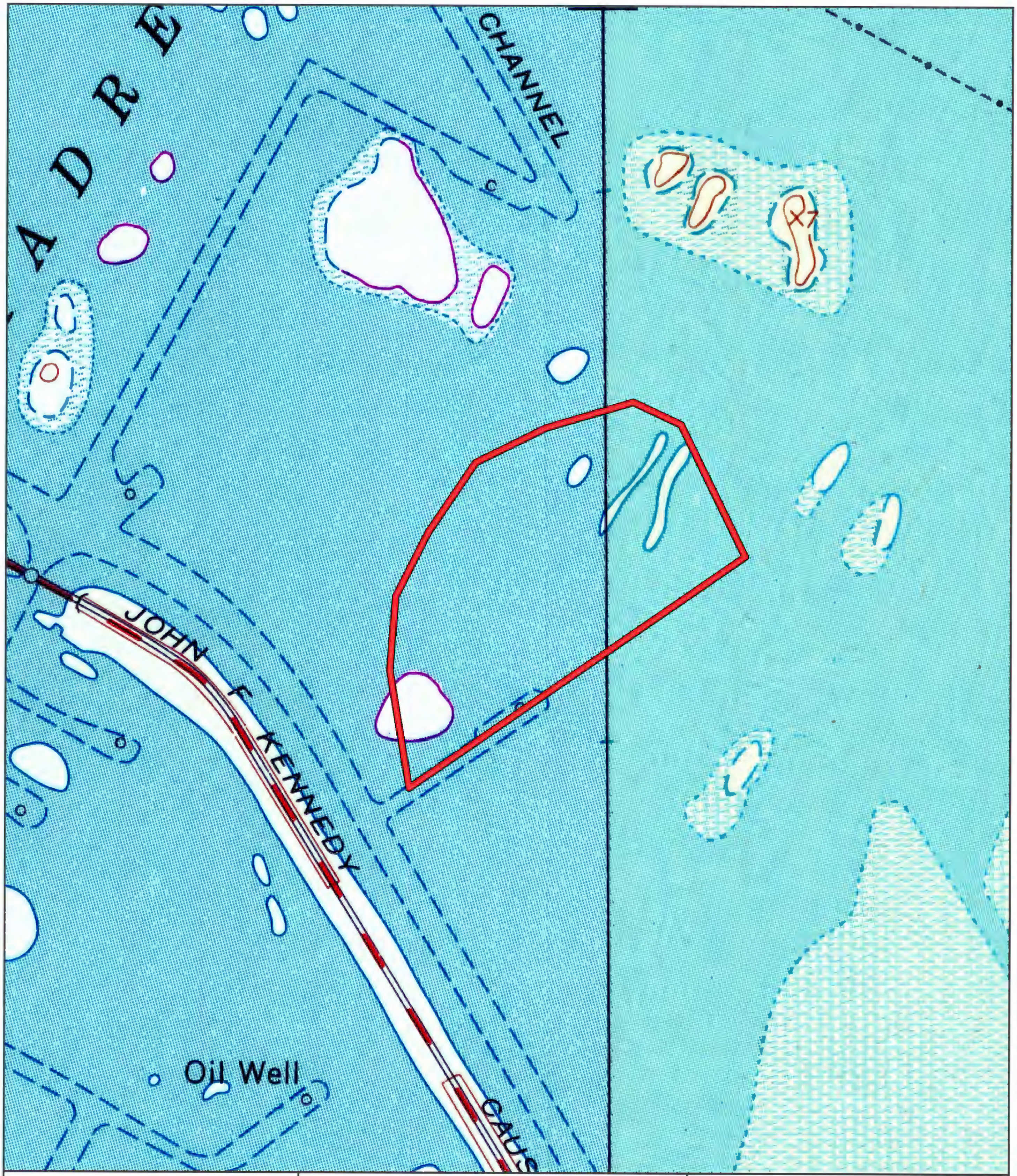
VICINITY MAP

TERN ROOKERY ISLAND RESTORATION PROJECT

MAY 2023

FIGURE 1

PATH: O:\10365350_10191_CBBEP_TERN_ROOK_ISL_REST_PHII\7.2_WIP\MAP_DOCS\TERNROOKERY_ENVIRONMENTAL.APRX - USER: JOPON - DATE: 5/9/2023



N

0 500 1,000
FEET

LEGEND

PROJECT AREA

USGS CRANE ISLANDS NW, TX 1951
USGS OSO CREEK NE, TX 1951

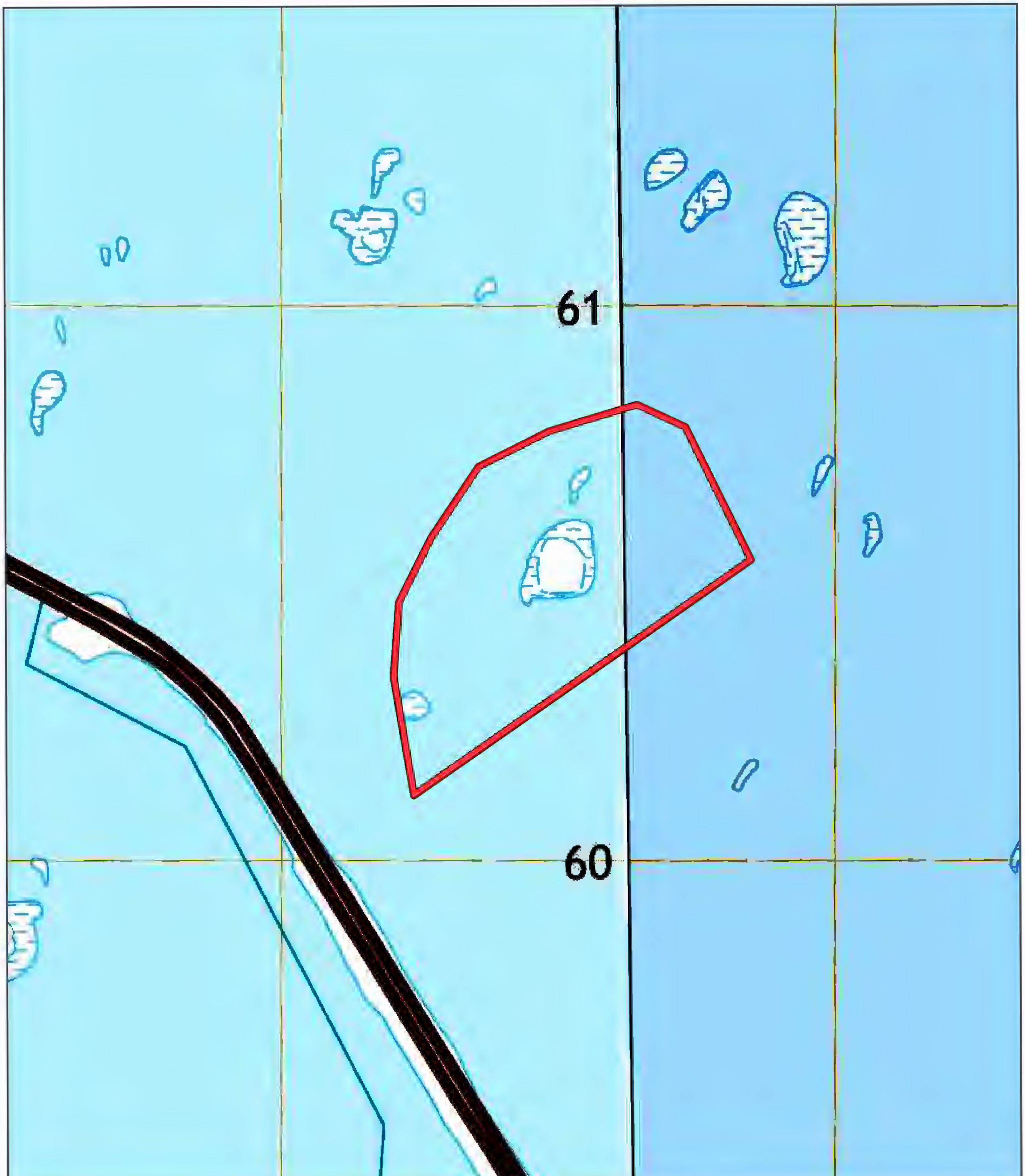
PROJECT AREA ON 1951 TOPOGRAPHIC MAP

TERN ROOKERY ISLAND
RESTORATION PROJECT

MAY 2023

FIGURE 2-1

PATH: O:\10365350_10191_CBBEP_TERN_ROOK_ISL_REST_PHII\7.2_WIP\MAP_DOCS\TERNROOKERY_ENVIRONMENTAL.APRX - USER: JOPON - DATE: 5/3/2023



N

0 500 1,000
FEET

LEGEND

PROJECT AREA

PROJECT AREA ON 2019 TOPOGRAPHIC MAP

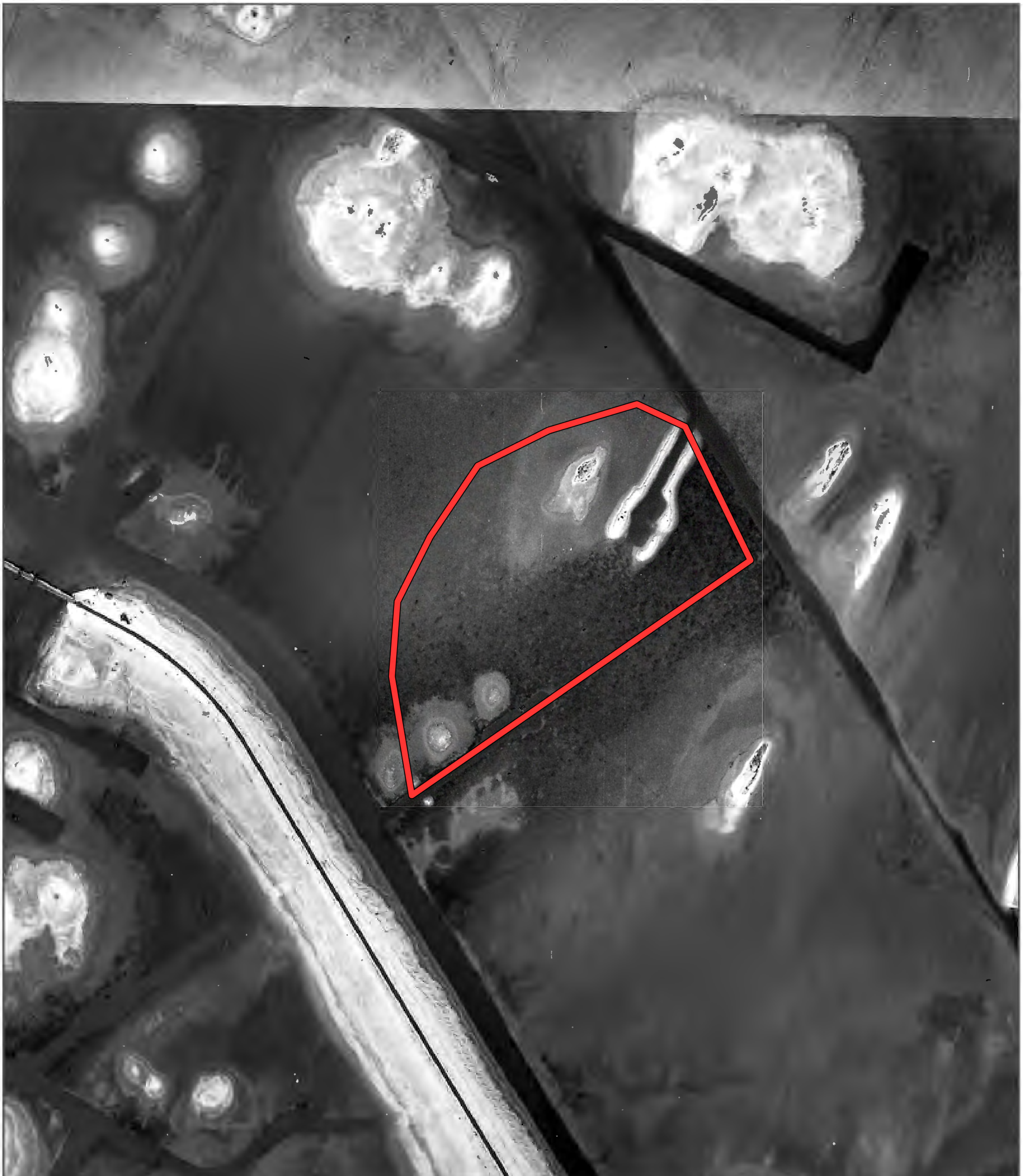
TERN ROOKERY ISLAND RESTORATION PROJECT

USGS CRANE ISLANDS NW, TX 2019
USGS OSO CREEK NE, TX 2019

MAY 2023

FIGURE 2-2

PATH: O:\10365350_10191_CBBEP_TERN_ROOK_ISL_REST_PHII\7.2_WIP\MAP_DOCS\TERNROOKERY_ENVIRONMENTAL.APRX - USER: JOPON - DATE: 5/3/2023



N

0 500 1,000
FEET

LEGEND

PROJECT AREA

PROJECT AREA ON 1956 AERIAL IMAGE

TERN ROOKERY ISLAND RESTORATION PROJECT

MAY 2023

FIGURE 3-1

PATH: O:\10365350_10191_CBBEP_TERN_ROOK_ISL_REST_PHII\7.2_WIP\MAP_DOCS\TERNROOKERY_ENVIRONMENTAL.APRX - USER: JOPON - DATE: 5/3/2023

PROJECT AREA ON 2022 AERIAL IMAGE

TERN ROOKERY ISLAND RESTORATION PROJECT

MAY 2023

FIGURE 3-2

PATH: O:\10365350_10191_CBBEP_TERN_ROOK_ISL_REST_PHII\7.2_WIP\MAP_DOCS\TERNROOKERY_ENVIRONMENTAL.APRX - USER: JOPON - DATE: 5/3/2023

Map Unit	Soil Description	Percent of Study Area
Sb	Twinpalms occasionally flooded-Yarborough frequently flooded complex, 0 to 3 percent slopes	1
W	Water	99

N

0 500 1,000
FEET

LEGEND

PROJECT AREA

SOIL MAP UNIT

SOIL SURVEY FOR NUECES COUNTY, TX

NRCS SOILS MAP

TERN ROOKERY ISLAND RESTORATION PROJECT

MAY 2023

FIGURE 4

PATH: O:\10365350_10191_CBBEP_TERN_ROOK_ISL_REST_PHI\7.2_WIP\MAP_DOCS\TERNROOKERY_ENVIRONMENTAL.APRX - USER: JOPON - DATE: 5/3/2023

N

0 500 1,000
FEET

LEGEND

PROJECT AREA

Flood Hazard Zones

1% Annual Chance Flood Hazard

FEMA NFHL FOR NUECES COUNTY, TX

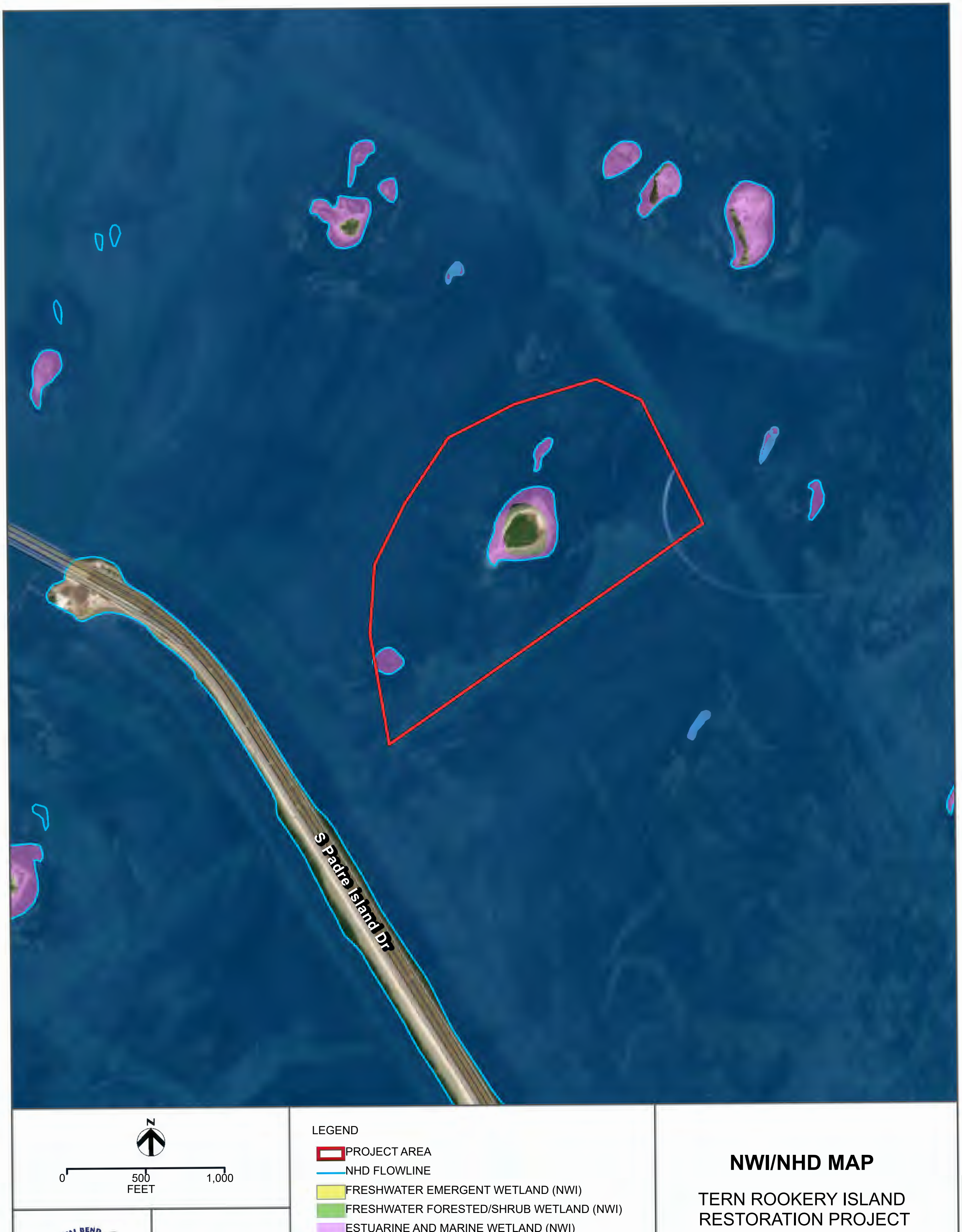
FEMA FIRM MAP

TERN ROOKERY ISLAND
RESTORATION PROJECT

MAY 2023

FIGURE 5

PATH: O:\10365350_10191_CBBEP_TERN_ROOK_ISL_REST_PHII\7.2_WIP\MAP_DOCS\TERNROOKERY_ENVIRONMENTAL.APRX - USER: JOPON - DATE: 5/3/2023



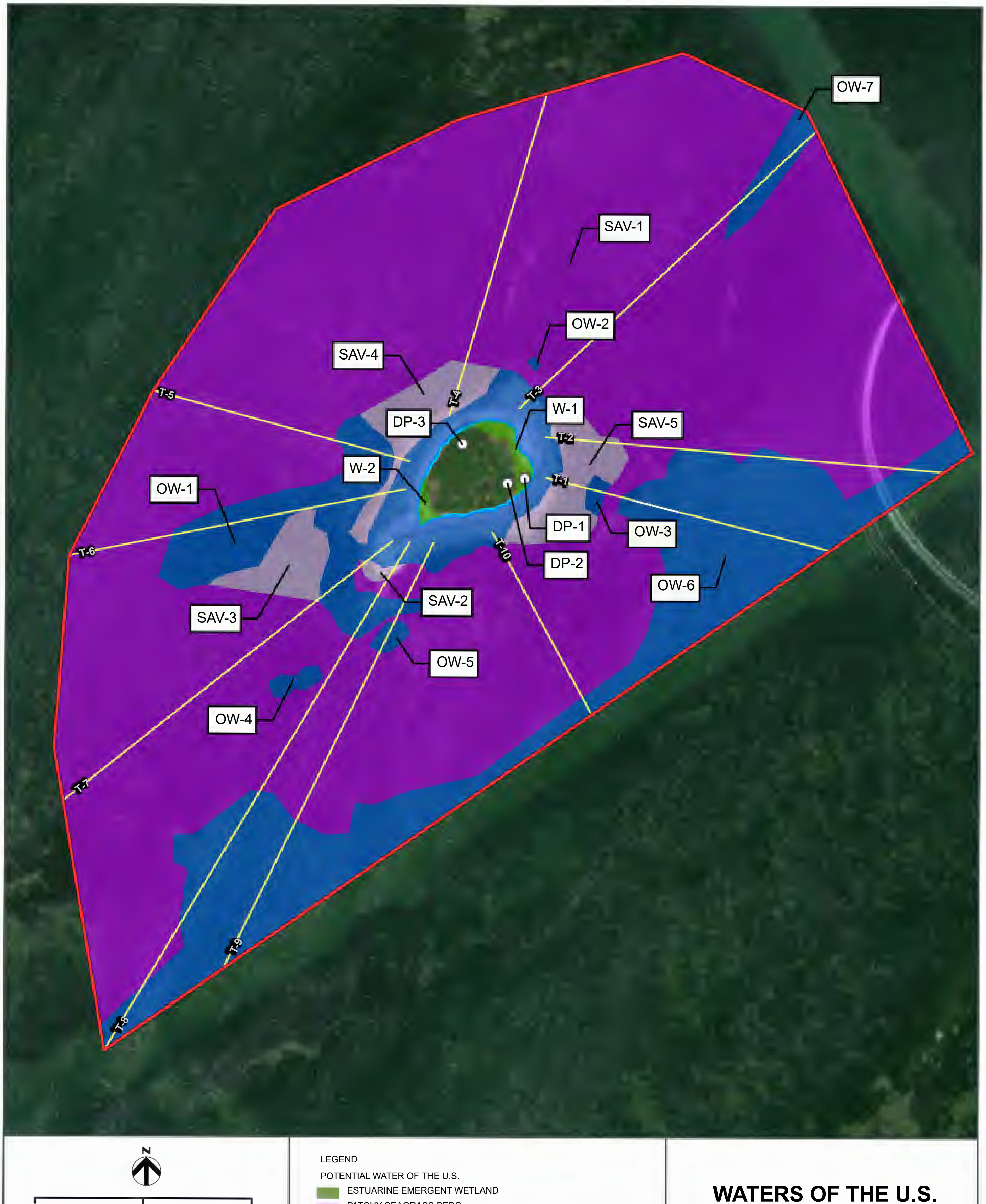
NWI/NHD MAP

TERN ROOKERY ISLAND RESTORATION PROJECT

MAY 2023

FIGURE 6

PATH: O:\10365350_10191_CBBEP_TERN_ROOK_ISL_REST_PHII\7.2_WIP\MAP_DOCS\TERNROOKERY_ENVIRONMENTAL.APRX - USER: JOPON - DATE: 5/3/2023



LEGEND

POTENTIAL WATER OF THE U.S.

- ESTUARINE EMERGENT WETLAND
- PATCHY SEAGRASS BEDS
- DENSE SEAGRASS BEDS
- OPEN WATER BOTTOM
- ANNUAL HIGH TIDE LINE

FEATURES NOT WATERS OF THE U.S.

- PROJECT AREA
- SAV TRANSECT
- DETERMINATION POINT

COASTAL BEND BAYS & ESTUARIES PROGRAM

HDR

WATERS OF THE U.S.

TERN ROOKERY ISLAND RESTORATION PROJECT

MAY 2023

FIGURE 7

PATH: O:\10365350_10191_CBBEP_TERN_ROOK_ISL_REST_PHII\7.2_WIP\MAP_DOCS\TERNROOKERY_ENVIRONMENTAL.APRX - USER: JOPON - DATE: 5/5/2023

B

WETLAND DETERMINATION DATA FORMS

WETLAND DETERMINATION DATA FORM – Atlantic and Gulf Coastal Plain Region

Project/Site: Tern Rookery Island City/County: Nueces County Sampling Date: 2/27/2023

Applicant/Owner: Coastal Bend Bays & Estuaries Program State: TX Sampling Point: DP-1

Investigator(s): Kelsea Hiebert Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Hillslope Local relief (concave, convex, none): concave Slope (%): 1

Subregion (LRR or MLRA): 150B - Gulf Coast Saline Prairies Lat: 27.657824 Long: -97.250886 Datum: NAD 83

Soil Map Unit Name: Sb—Twinpalms occasionally flooded-Yarborough frequently flooded complex, 0 to 3 percent slopes NWI classification: E2EM

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐

Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ☑ No ☐	**Is the Sampled Area within a Wetland?**	**Yes** ☑ **No** ☐
Hydric Soil Present?	Yes ☑ No ☐		
Wetland Hydrology Present?	Yes ☑ No ☐		

Remarks:

DP-1 is located within estuarine emergent wetland W-1, adjacent to the Laguna Madre and it is representative of estuarine emergent wetland W-2. Per the Antecedent Precipitation Tool, conditions at the site are normal with a severe drought index.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☑ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15) **(LRR U)**
- ☐ Hydrogen Sulfide Odor (C1)
- ☑ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☑ FAC-Neutral Test (D5)
- ☐ Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present?	Yes ☐ No ☑	Depth (inches): -	
Water Table Present?	Yes ☐ No ☑	Depth (inches): -	
Saturation Present? (includes capillary fringe)	Yes ☐ No ☑	Depth (inches): -	**Wetland Hydrology Present? Yes** ☑ **No** ☐

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Google Earth Aerial Imagery 1956-2022

Remarks:

Wetland hydrology was determined based on drift deposits, oxidized rhizospheres along living roots (primary indicators) geomorphic position and FAC-neutral test (secondary indicators).

VEGETATION (Four Strata) – Use scientific names of plants.

Sampling Point: DP-1

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	0 = Total Cover		
50% of total cover: 0	20% of total cover: 0		

Sapling/Shrub Stratum (Plot size: 15')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	0 = Total Cover		
50% of total cover: 0	20% of total cover: 0		

Herb Stratum (Plot size: 5')	Absolute % Cover	Dominant Species?	Indicator Status
1. Batis maritima	75	yes	OBL
2. Lycium carolinianum	20	yes	FACW
3. Suaeda linearis	5	no	OBL
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	100 = Total Cover		
50% of total cover: 50	20% of total cover: 20		

Woody Vine Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
	0 = Total Cover		
50% of total cover: 0	20% of total cover: 0		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	80	x 1 = 80
FACW species	20	x 2 = 40
FAC species	0	x 3 = 0
FACU species	0	x 4 = 0
UPL species	0	x 5 = 0
Column Totals:	100 (A)	120 (B)

Prevalence Index = B/A = 1.2

Hydrophytic Vegetation Indicators:

- ☑ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☑ 3 - Prevalence Index is ≤3.0[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ☑ No ☐

Remarks: (If observed, list morphological adaptations below).

Hydrophytic vegetation was determined based on the rapid test for hydrophytic vegetation, dominance test, and prevalence test.

SOIL

Sampling Point: DP-1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-2	2.5Y 5/2	75	7.5YR 4/6	10	C	M/PL	SAND	
	10YR 4/3	15					SAND	
2-7	10YR 5/2	90					SAND	HEAVY SHELL CONTENT WITHIN MATRIX
	10YR 4/3	10					SAND	
7-9	10YR 5/2	100					SAND	HEAVY SHELL CONTENT WITHIN MATRIX
9-14	10YR 5/2	85	5YR 5/8	15	C	PL	LOAMY SAND	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Organic Bodies (A6) **(LRR P, T, U)**
- ☐ 5 cm Mucky Mineral (A7) **(LRR P, T, U)**
- ☐ Muck Presence (A8) **(LRR U)**
- ☐ 1 cm Muck (A9) **(LRR P, T)**
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Coast Prairie Redox (A16) **(MLRA 150A)**
- ☐ Sandy Mucky Mineral (S1) **(LRR O, S)**
- ☐ Sandy Gleyed Matrix (S4)
- ☑ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) **(LRR P, S, T, U)**
- ☐ Polyvalue Below Surface (S8) **(LRR S, T, U)**
- ☐ Thin Dark Surface (S9) **(LRR S, T, U)**
- ☐ Loamy Mucky Mineral (F1) **(LRR O)**
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Marl (F10) **(LRR U)**
- ☐ Depleted Ochric (F11) **(MLRA 151)**
- ☐ Iron-Manganese Masses (F12) **(LRR O, P, T)**
- ☐ Umbric Surface (F13) **(LRR P, T, U)**
- ☐ Delta Ochric (F17) **(MLRA 151)**
- ☐ Reduced Vertic (F18) **(MLRA 150A, 150B)**
- ☐ Piedmont Floodplain Soils (F19) **(MLRA 149A)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 149A, 153C, 153D)**

Indicators for Problematic Hydric Soils[3]:

- ☐ 1 cm Muck (A9) **(LRR O)**
- ☐ 2 cm Muck (A10) **(LRR S)**
- ☐ Reduced Vertic (F18) **(outside MLRA 150A,B)**
- ☐ Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 153B)**
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: -

Depth (inches): -

Hydric Soil Present? Yes ☑ No ☐

Remarks:

Hydric soils were determined to be present based on hydric soil indicator S5 within the soil profile. Therefore, W-1 and W-2 met the hydric soil indicator.

WETLAND DETERMINATION DATA FORM – Atlantic and Gulf Coastal Plain Region

Project/Site: Tern Rookery Island City/County: Nueces County Sampling Date: 2/27/2023

Applicant/Owner: Coastal Bend Bays & Estuaries Program State: TX Sampling Point: DP-2

Investigator(s): Kelsea Hiebert Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Terrace Local relief (concave, convex, none): convex Slope (%): 1

Subregion (LRR or MLRA): 150B - Gulf Coast Saline Prairies Lat: 27.657795 Long: -97.251008 Datum: NAD 83

Soil Map Unit Name: Sb—Twinpalms occasionally flooded-Yarborough frequently flooded complex, 0 to 3 percent slopes NWI classification: UPL

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐

Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ☐	No ☑
Hydric Soil Present?	Yes ☐	No ☑
Wetland Hydrology Present?	Yes ☐	No ☑

Is the Sampled Area within a Wetland? **Yes** ☐ **No** ☑

Remarks:

DP-2 is located on the upland portion of the study area. This area is the highest location on the island and is used as bird nesting habitat by common wading bird species along the Texas Gulf Coast. DP-2 is adjacent to W-1 and W-2. Per the Antecedent Precipitation Tool, conditions at the site are normal with a severe drought index.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15) **(LRR U)**
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☑ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present?	Yes ☐	No ☑	Depth (inches): -
Water Table Present?	Yes ☐	No ☑	Depth (inches): -
Saturation Present? (includes capillary fringe)	Yes ☐	No ☑	Depth (inches): -

Wetland Hydrology Present? **Yes** ☑ **No** ☐

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Google Earth Aerial Imagery 1956-2022

Remarks:

Only one secondary wetland hydrology indicator was determined. Therefore, no wetland hydrology is present.

VEGETATION (Four Strata) – Use scientific names of plants.

Sampling Point: DP-2

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	0 = Total Cover		
50% of total cover: 0	20% of total cover: 0		

Sapling/Shrub Stratum (Plot size: 15')	Absolute % Cover	Dominant Species?	Indicator Status
1. Prosopis glandulosa	15	yes	UPL
2. Celtis pallida	5	yes	NA
3.			
4.			
5.			
6.			
7.			
8.			
	20 = Total Cover		
50% of total cover: 10	20% of total cover: 4		

Herb Stratum (Plot size: 5')	Absolute % Cover	Dominant Species?	Indicator Status
1. Helianthus annuus	20	yes	FAC
2. Spartina patens	20	yes	FACW
3. Rhynchosia americana	20	yes	NA
4. Opuntia stricta	13	no	UPL
5. Borrichia frutescens	12	no	OBL
6. Ambrosia psilostachya	5	no	FAC
7.			
8.			
9.			
10.			
11.			
12.			
	90 = Total Cover		
50% of total cover: 45	20% of total cover: 18		

Woody Vine Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
	0 = Total Cover		
50% of total cover: 0	20% of total cover: 0		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC:	2	(A)
Total Number of Dominant Species Across All Strata:	5	(B)
Percent of Dominant Species That Are OBL, FACW, or FAC:	40	(A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	12	x 1 =	12
FACW species	20	x 2 =	40
FAC species	25	x 3 =	75
FACU species	0	x 4 =	0
UPL species	53	x 5 =	265
Column Totals:	110 (A)		392 (B)

Prevalence Index = B/A = 3.56

Hydrophytic Vegetation Indicators:

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ☐ No ☑

Remarks: (If observed, list morphological adaptations below).

10% bare ground. Hydrophytic vegetation was determined to be absent based on the lack of indicators.

SOIL

Sampling Point: DP-2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-2	10YR 2/2	100					SAND	
2-4	10YR 5/3	100					SAND	
4-12	10YR 7/1	93	7.5YR 5/6	7	C	M	SAND	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Organic Bodies (A6) **(LRR P, T, U)**
- ☐ 5 cm Mucky Mineral (A7) **(LRR P, T, U)**
- ☐ Muck Presence (A8) **(LRR U)**
- ☐ 1 cm Muck (A9) **(LRR P, T)**
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Coast Prairie Redox (A16) **(MLRA 150A)**
- ☐ Sandy Mucky Mineral (S1) **(LRR O, S)**
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) **(LRR P, S, T, U)**
- ☐ Polyvalue Below Surface (S8) **(LRR S, T, U)**
- ☐ Thin Dark Surface (S9) **(LRR S, T, U)**
- ☐ Loamy Mucky Mineral (F1) **(LRR O)**
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Marl (F10) **(LRR U)**
- ☐ Depleted Ochric (F11) **(MLRA 151)**
- ☐ Iron-Manganese Masses (F12) **(LRR O, P, T)**
- ☐ Umbric Surface (F13) **(LRR P, T, U)**
- ☐ Delta Ochric (F17) **(MLRA 151)**
- ☐ Reduced Vertic (F18) **(MLRA 150A, 150B)**
- ☐ Piedmont Floodplain Soils (F19) **(MLRA 149A)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 149A, 153C, 153D)**

Indicators for Problematic Hydric Soils[3]:

- ☐ 1 cm Muck (A9) **(LRR O)**
- ☐ 2 cm Muck (A10) **(LRR S)**
- ☐ Reduced Vertic (F18) **(outside MLRA 150A,B)**
- ☐ Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 153B)**
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: -

Depth (inches): -

Hydric Soil Present? Yes ☐ No ☑

Remarks:

Hydric soils were determined to be absent based on the lack of hydric soil indicators within the soil profile.

WETLAND DETERMINATION DATA FORM – Atlantic and Gulf Coastal Plain Region

Project/Site: Tern Rookery Island City/County: Nueces County Sampling Date: 2/27/2023

Applicant/Owner: Coastal Bend Bays & Estuaries Program State: ______ Sampling Point: DP-3

Investigator(s): Kelsea Hiebert Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Terrace Local relief (concave, convex, none): none Slope (%): 0

Subregion (LRR or MLRA): 150B - Gulf Coast Saline Prairies Lat: 27.658045 Long: -97.25133 Datum: NAD 83

Soil Map Unit Name: Sb—Twinpalms occasionally flooded-Yarborough frequently flooded complex, 0 to 3 percent slopes NWI classification: UPL

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐

Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ☐	No ☑
Hydric Soil Present?	Yes ☑	No ☐
Wetland Hydrology Present?	Yes ☐	No ☑

Is the Sampled Area within a Wetland? **Yes** ☐ **No** ☑

Remarks:

DP-3 is located on the upland portion of the study area. This area is the highest location on the island and is used as bird nesting habitat by common wading bird species along the Texas Gulf Coast. DP-3 is adjacent to W-1 and W-2. Per the Antecedent Precipitation Tool, conditions at the site are normal with a severe drought index.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15) **(LRR U)**
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present?	Yes ☐	No ☑	Depth (inches): -
Water Table Present?	Yes ☐	No ☑	Depth (inches): -
Saturation Present? (includes capillary fringe)	Yes ☐	No ☑	Depth (inches): -

Wetland Hydrology Present? Yes ☐ **No** ☑

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Google Earth Aerial Imagery 1956-2022

Remarks:

Wetland hydrology was determined to be absent based on a lack of indicators.

VEGETATION (Four Strata) – Use scientific names of plants.

Sampling Point: DP-3

Tree Stratum (Plot size: 30')

#	Species	Absolute % Cover	Dominant Species?	Indicator Status
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
		0 = Total Cover		

50% of total cover: 0 20% of total cover: 0

Sapling/Shrub Stratum (Plot size: 15')

#	Species	Absolute % Cover	Dominant Species?	Indicator Status
1.	Prosopis glandulosa	20	yes	UPL
2.				
3.				
4.				
5.				
6.				
7.				
8.				
		20 = Total Cover		

50% of total cover: 10 20% of total cover: 4

Herb Stratum (Plot size: 5')

#	Species	Absolute % Cover	Dominant Species?	Indicator Status
1.	Cynodon dactylon	40	yes	FACU
2.	Malva parviflora	20	yes	NA
3.	Opuntia stricta	15	no	UPL
4.	Ambrosia psilostachya	15	no	FAC
5.	Spartina patens	10	no	FACW
6.				
7.				
8.				
9.				
10.				
11.				
12.				
		100 = Total Cover		

50% of total cover: 50 20% of total cover: 20

Woody Vine Stratum (Plot size: 30')

#	Species	Absolute % Cover	Dominant Species?	Indicator Status
1.				
2.				
3.				
4.				
5.				
		0 = Total Cover		

50% of total cover: 0 20% of total cover: 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC:	0	(A)
Total Number of Dominant Species Across All Strata:	3	(B)
Percent of Dominant Species That Are OBL, FACW, or FAC:	0	(A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	0	x 1 = 0
FACW species	10	x 2 = 20
FAC species	15	x 3 = 45
FACU species	40	x 4 = 160
UPL species	55	x 5 = 275
Column Totals:	120 (A)	500 (B)

Prevalence Index = B/A = 4.17

Hydrophytic Vegetation Indicators:

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ☐ No ☑

Remarks: (If observed, list morphological adaptations below).

Hydrophytic vegetation was determined to be absent based on the lack of indicators.

SOIL Sampling Point: DP-3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features				Texture	Remarks
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]		
0-1	10YR 2/2	100					SAND	
1-2	10YR 5/3	100					SAND	
2-8	10YR 7/1	98	7.5YR 5/8	2	C	M/PL	SAND	
8-12	10YR 7/1	93	7.5YR 5/8	7	C	M/PL	SAND	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Organic Bodies (A6) **(LRR P, T, U)**
- ☐ 5 cm Mucky Mineral (A7) **(LRR P, T, U)**
- ☐ Muck Presence (A8) **(LRR U)**
- ☐ 1 cm Muck (A9) **(LRR P, T)**
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Coast Prairie Redox (A16) **(MLRA 150A)**
- ☐ Sandy Mucky Mineral (S1) **(LRR O, S)**
- ☐ Sandy Gleyed Matrix (S4)
- ☑ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) **(LRR P, S, T, U)**
- ☐ Polyvalue Below Surface (S8) **(LRR S, T, U)**
- ☐ Thin Dark Surface (S9) **(LRR S, T, U)**
- ☐ Loamy Mucky Mineral (F1) **(LRR O)**
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Marl (F10) **(LRR U)**
- ☐ Depleted Ochric (F11) **(MLRA 151)**
- ☐ Iron-Manganese Masses (F12) **(LRR O, P, T)**
- ☐ Umbric Surface (F13) **(LRR P, T, U)**
- ☐ Delta Ochric (F17) **(MLRA 151)**
- ☐ Reduced Vertic (F18) **(MLRA 150A, 150B)**
- ☐ Piedmont Floodplain Soils (F19) **(MLRA 149A)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 149A, 153C, 153D)**

Indicators for Problematic Hydric Soils[3]:

- ☐ 1 cm Muck (A9) **(LRR O)**
- ☐ 2 cm Muck (A10) **(LRR S)**
- ☐ Reduced Vertic (F18) **(outside MLRA 150A,B)**
- ☐ Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 153B)**
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: -

Depth (inches): -

Hydric Soil Present? Yes ☑ No ☐

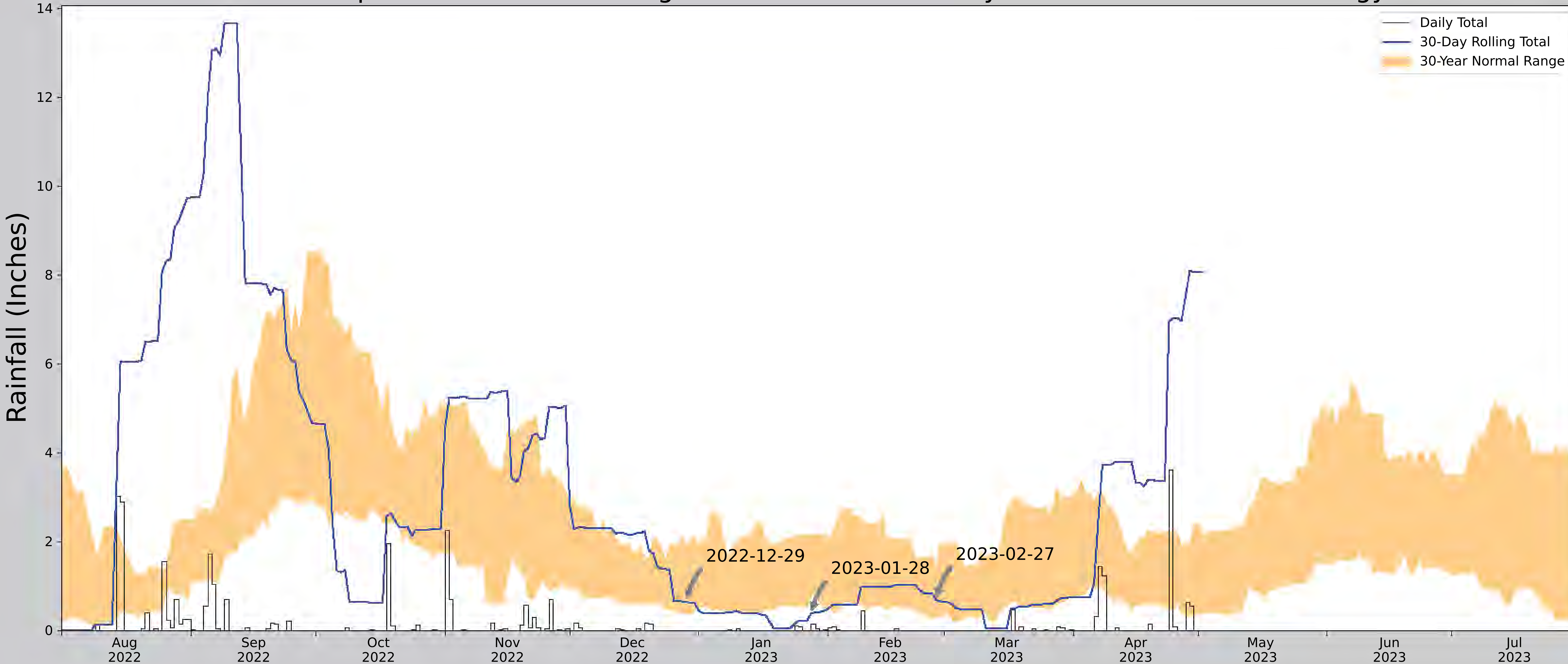
Remarks:

Hydric soils were determined to be present based on hydric soil indicator S5 within the soil profile.

C

ANTECEDENT PRECIPITATION TOOL RESULTS

Antecedent Precipitation vs Normal Range based on NOAA's Daily Global Historical Climatology Network



Coordinates	27.665210, -97.274638
Observation Date	2023-02-27
Elevation (ft)	5.315
Drought Index (PDSI)	Severe drought

30 Days Ending	30th %ile (in)	70th %ile (in)	Observed (in)	Wetness Condition	Condition Value	Month Weight	Product
2023-02-27	0.273622	1.413386	0.692913	Normal	2	3	6
2023-01-28	0.775197	2.157874	0.377953	Dry	1	2	2
2022-12-29	0.384646	1.930709	0.653543	Normal	2	1	2
Result							Normal Conditions - 10

Figure and tables made by the
Antecedent Precipitation Tool
Version 1.0

Written by Jason Deters
U.S. Army Corps of Engineers

Weather Station Name	Coordinates	Elevation (ft)	Distance (mi)	Elevation Δ	Weighted Δ	Days Normal	Days Antecedent
C C BOTANICAL GARDENS	27.6606, -97.3983	16.076	7.574	10.761	3.49	6843	90
CORPUS CHRISTI 6.1 WSW	27.6718, -97.3849	29.856	1.127	13.78	0.523	5	0
CORPUS CHRISTI 6.4 WSW	27.6865, -97.3951	36.089	1.8	20.013	0.846	1	0
CORPUS CHRISTI 5.4 WSW	27.6643, -97.3676	22.966	1.896	6.89	0.866	1	0
CORPUS CHRISTI 4.3 WSW	27.6796, -97.3569	22.966	2.853	6.89	1.304	3	0
CORPUS CHRISTI CABANISS FLD	27.7, -97.4333	29.856	3.464	13.78	1.607	15	0
CHAPMAN RCH	27.5892, -97.4547	24.934	6.021	8.858	2.763	3598	0
CORPUS CHRISTI NAS	27.6878, -97.2917	15.092	6.788	0.984	3.061	811	0
CORPUS CHRISTI NWS	27.7792, -97.5056	43.963	10.499	27.887	5.017	16	0
CORPUS CHRISTI	27.7839, -97.5114	142.06	10.974	125.984	6.321	60	0

D

REPRESENTATIVE SITE PHOTOS

Representative Site Photos

CBBEP Tern Rookery Island Restoration Project

Tern Rookery Island Delineation Report– Nueces County, Texas

February 27, 2023

Photo 1
Estuarine emergent wetland (W-1) above the annual high tide line (AHTL) and located within the northeastern portion of Tern Rookery Island (island). Note the AHTL was indicated by physical markings on the soil along the shore, continuous deposit of fine shell, debris along the foreshore and berm, and a vegetation line at the general height reached by a rising tide (background). Photo taken to the east.

Photo 2
Estuarine emergent wetland (W-2) surrounded by open water bare bottom (OW-1) and located within the southwestern portion of the island. Photo taken to the south.

Photo 3
Photo of DP-1 located within estuarine emergent wetland (W-1) and southeast of the island. DP-1 is also representative of estuarine emergent wetland (W-2). Photo taken to the south.

Photo 4
Photo of Tern Rookery Island (background) and dense seagrass (SAV-1) (foreground). Dense seagrass was observed at different water depths ranging from 1 to 5 feet. Dense seagrass consisted of shoal grass (*Halodule wrightii*). Photo. Photo taken to the southeast.

Photo 5
Photo of observed shoal grass located within dense seagrass SAV-1. Photo taken to the south.

Photo 6
Photo of patchy seagrass within SAV-4 and located northwest of the island. Patchy seagrass was observed at different depths ranging from 0 to 4 feet. This photo is representative of SAV-2 and SAV-3. Photo taken to the north.

Photo 7
Photo of patchy seagrass within SAV-5 located east of the island. Photo taken to the northeast.

Photo 8
Photo of open water bare bottom (OW-1) located around the island. Photo of OW-1 is representative of OW-2, OW-3, OW-4, OW-5, OW-6, and OW-7. Photo taken to the west.

Photo 9
Photo of upland tree/shrub habitat (background) located on the island and near DP-2. Photo taken to the northwest.

Photo 10
Photo of upland tree/shrub habitat (background) located on the island and near DP-3. Photo taken to the south.

Photo 11
Photo of herons using both open water bare bottom (OW-1) and estuarine emergent wetland (W-2). Photo taken to the southwest.

Photo 12
Photo of Tern Rockery Island with tidal flats (background) and patchy seagrass SAV-5 (foreground). Photo taken to the west.

Photo 13
Photo of bird nest within upland habitat located on the island. Photo taken to the north.

E

GPS COORDINATE DATA

Appendix E- GPS Data Log
Wetland Delineation
Tern Rookery Island Restoration
Project

ID	LABEL	LATITUDE	LONGITUDE	DISTANCE BETWEEN POINTS	PDOP	SATELLITES USED	DEVICE TYPE	GPS DATE	COLLECTOR	CORRECTION STATUS
1	AHTL	27.657808	-97.250859	0	1.1	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
2	AHTL	27.657657	-97.251015	75	1.2	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
3	AHTL	27.657627	-97.251163	49	1.3	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
4	AHTL	27.657589	-97.251352	63	1.2	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
5	AHTL	27.657579	-97.251532	58	1.2	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
6	AHTL	27.657528	-97.251632	37	1.3	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
7	AHTL	27.657712	-97.251637	67	1.1	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
8	AHTL	27.657913	-97.251556	78	1.1	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
9	AHTL	27.658059	-97.251437	65	1.1	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
10	AHTL	27.658140	-97.251335	44	1.1	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
11	AHTL	27.658179	-97.251216	41	1.1	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code

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Wetland Delineation
Tern Rookery Island Restoration
Project

ID	LABEL	LATITUDE	LONGITUDE	DISTANCE BETWEEN POINTS	PDOP	SATELLITES USED	DEVICE TYPE	GPS DATE	COLLECTOR	CORRECTION STATUS
12	AHTL	27.658161	-97.250999	70	1.2	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
13	AHTL	27.657970	-97.250875	80	1.2	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
14	AHTL	27.657874	-97.250827	38	1.1	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
15	DP-1	27.657824	-97.250886	26	1.1	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
16	DP-2	27.657795	-97.251008	41	1	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
17	W-1	27.657724	-97.250953	31	1	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
18	W-1	27.657796	-97.250947	26	0.9	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
19	W-1	27.657897	-97.250954	37	1.1	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
20	W-1	27.657980	-97.250984	32	0.9	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
21	W-1	27.658073	-97.251006	34	0.9	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
22	W-1	27.658080	-97.251085	26	1	6	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
23	W-1	27.658155	-97.251236	56	1	5	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code

Appendix E- GPS Data Log
Wetland Delineation
Tern Rookery Island Restoration
Project

ID	LABEL	LATITUDE	LONGITUDE	DISTANCE BETWEEN POINTS	PDOP	SATELLITES USED	DEVICE TYPE	GPS DATE	COLLECTOR	CORRECTION STATUS
24	W-1	27.658142	-97.251320	28	1	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
25	DP-3	27.658045	-97.251330	35	1.2	6	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
26	W-2	27.657859	-97.251587	107	1.5	6	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
27	W-2	27.657751	-97.251579	39	1.1	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
28	W-2	27.657629	-97.251549	45	1.2	6	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
29	W-2	27.657586	-97.251482	27	1.2	5	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
30	SAV	27.657761	-97.250480	330	1.9	6	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
31	PATCHY SAV	27.657800	-97.250576	34	1.6	4	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
32	PATCHY SAV	27.657823	-97.250670	32	1.2	4	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
33	OW	27.657851	-97.250735	23	1.3	6	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
34	PATCHY SAV	27.657802	-97.250536	67	1.2	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
35	SAV	27.657767	-97.250446	32	1.2	6	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code

Appendix E- GPS Data Log
Wetland Delineation
Tern Rookery Island Restoration Project

ID	LABEL	LATITUDE	LONGITUDE	DISTANCE BETWEEN POINTS	PDOP	SATELLITES USED	DEVICE TYPE	GPS DATE	COLLECTOR	CORRECTION STATUS
36	OW	27.657742	-97.250352	32	1.5	5	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
37	SAV	27.657731	-97.250316	13	2.5	4	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
38	SAV	27.657704	-97.250193	41	1.4	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
39	OW	27.657681	-97.250105	30	2.4	5	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
40	OW	27.657661	-97.250048	20	1.8	5	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
41	OW	27.657632	-97.250378	107	1.3	5	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
42	SAV	27.657523	-97.250381	39	1.5	5	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
43	PATCHY SAV	27.657548	-97.250466	29	1.5	6	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
44	PATCHY SAV	27.657659	-97.250789	112	1.4	6	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
45	PATCHY SAV	27.657579	-97.250699	41	2.1	5	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
46	PATCHY SAV	<Null>	<Null>	90	<Null>	<Null>	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
47	PATCHY SAV	27.657482	-97.250526	117	1.8	6	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code

Appendix E- GPS Data Log
Wetland Delineation
Tern Rookery Island Restoration Project

ID	LABEL	LATITUDE	LONGITUDE	DISTANCE BETWEEN POINTS	PDOP	SATELLITES USED	DEVICE TYPE	GPS DATE	COLLECTOR	CORRECTION STATUS
48	SAV	27.657429	-97.250481	24	1.1	5	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
49	PATCHY SAV	27.658039	-97.250637	227	1.2	5	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
50	PATCHY SAV	27.658103	-97.250704	32	1.4	5	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
51	PATCHY SAV	27.658106	-97.250510	63	1.1	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
52	SAV	27.658101	-97.250480	10	1.4	6	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
53	PATCHY SAV	27.658093	-97.250350	42	1.6	5	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
54	PATCHY SAV	27.658076	-97.250216	44	1.3	4	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
55	SAV	27.657950	-97.250141	52	1.2	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
56	SAV	27.657832	-97.250210	48	1.4	6	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
57	OW	27.657781	-97.251706	485	1.5	6	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
58	PATCHY SAV	27.657797	-97.251830	41	1.2	6	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
59	PATCHY SAV	27.657967	-97.251744	68	1.1	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code

Appendix E- GPS Data Log
Wetland Delineation
Tern Rookery Island Restoration Project

ID	LABEL	LATITUDE	LONGITUDE	DISTANCE BETWEEN POINTS	PDOP	SATELLITES USED	DEVICE TYPE	GPS DATE	COLLECTOR	CORRECTION STATUS
60	OW	27.657856	-97.251891	62	1.4	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
61	OW	27.657997	-97.251872	52	1.3	6	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
62	PATCHY SAV	27.658045	-97.251838	21	1.2	4	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
63	PATCHY SAV	27.658090	-97.251798	21	1.3	5	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
64	PATCHY SAV	27.658154	-97.251855	30	1.3	5	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
65	PATCHY SAV	27.658210	-97.251965	41	1.8	6	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
66	OW	27.658035	-97.252058	70	1.6	5	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
67	OW	27.658081	-97.252169	39	1.5	5	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
68	SAV	27.658020	-97.252173	22	1.4	5	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
69	SAV	27.657879	-97.252169	51	1.1	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
70	OW	27.657825	-97.252099	30	1.1	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
71	OW	27.657787	-97.252261	54	1.1	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code

Appendix E- GPS Data Log
Wetland Delineation
Tern Rookery Island Restoration Project

ID	LABEL	LATITUDE	LONGITUDE	DISTANCE BETWEEN POINTS	PDOP	SATELLITES USED	DEVICE TYPE	GPS DATE	COLLECTOR	CORRECTION STATUS
72	SAV	27.657800	-97.252332	23	1.2	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
73	OW	27.657694	-97.252328	39	1.3	6	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
74	OW	27.657688	-97.252419	30	1.1	9	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
75	PATCHY SAV	27.657617	-97.252415	26	1.1	10	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
76	OW	27.657567	-97.252346	29	1.1	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
77	OW	27.657516	-97.252161	63	1.2	6	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
78	PATCHY SAV	27.657515	-97.252122	13	1.1	6	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
79	PATCHY SAV	27.657490	-97.252000	40	1.1	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
80	OW	27.657460	-97.251951	19	1.2	6	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
81	OW	27.657334	-97.251993	48	1.5	5	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
82	SAV PATCH	27.657311	-97.252071	27	1.2	9	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
83	OW	27.657306	-97.252130	19	1.1	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code

Appendix E- GPS Data Log
Wetland Delineation
Tern Rookery Island Restoration
Project

ID	LABEL	LATITUDE	LONGITUDE	DISTANCE BETWEEN POINTS	PDOP	SATELLITES USED	DEVICE TYPE	GPS DATE	COLLECTOR	CORRECTION STATUS
84	OW	27.657208	-97.252164	37	1.2	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
85	OW	27.657121	-97.252240	40	1.3	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
86	SAV	27.657054	-97.252355	45	1.2	9	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
87	OW	27.657067	-97.252148	67	1.1	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
88	PATCHY SAV	27.657109	-97.252091	24	1.1	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
89	OW	27.657164	-97.252107	21	1.2	6	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
90	PATCH IF SAV	27.657268	-97.251771	115	1.3	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
91	PATCH SAV	27.657204	-97.251850	34	1.1	9	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
92	SAV edge	27.657151	-97.251705	51	1.1	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
93	ND PATCHY SAV BTV	27.657414	-97.250869	287	1.4	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
94	PATCHY SAV	27.657605	-97.250861	70	1	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
95	PATCHY SAV	27.657552	-97.250971	41	1.1	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code

Appendix E- GPS Data Log
Wetland Delineation
Tern Rookery Island Restoration Project

ID	LABEL	LATITUDE	LONGITUDE	DISTANCE BETWEEN POINTS	PDOP	SATELLITES USED	DEVICE TYPE	GPS DATE	COLLECTOR	CORRECTION STATUS
96	OW	27.657476	-97.251177	72	1.3	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
97	OW	27.657313	-97.251456	108	1.2	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
98	PATCHY SAV	27.657292	-97.251713	83	1.3	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
99	OW	27.657040	-97.251627	96	1	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
100	OW	27.657019	-97.251759	43	1.2	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
101	OW	27.657008	-97.251862	34	1.2	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
102	SAV	27.657064	-97.251866	20	1.3	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
103	SAV	27.657085	-97.251936	24	1.3	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
104	OW	27.657032	-97.251935	19	1	9	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
105	OW	27.656952	-97.251906	30	1	9	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
106	SAV	27.656916	-97.251881	16	1	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
107	OW	27.656883	-97.252016	45	1.2	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code

Appendix E- GPS Data Log
Wetland Delineation
Tern Rookery Island Restoration Project

ID	LABEL	LATITUDE	LONGITUDE	DISTANCE BETWEEN POINTS	PDOP	SATELLITES USED	DEVICE TYPE	GPS DATE	COLLECTOR	CORRECTION STATUS
108	OW	27.656947	-97.252095	35	0.9	9	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
109	OW	27.656846	-97.252107	37	0.9	10	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
110	PATCHY SAV	27.658175	-97.251513	520	1.1	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
111	SAV	27.658454	-97.251618	107	1.1	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
112	SAV	27.658579	-97.251407	82	1	9	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
113	SAV	27.658315	-97.251292	103	1	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
114	PATCHY SAV	27.658431	-97.251185	55	1	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
115	OW	27.658443	-97.251091	31	1	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
116	PATCHY SAV	27.658500	-97.251068	22	1.1	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
117	SAV	27.658517	-97.251013	19	1.2	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
118	PATCHY SAV	27.658543	-97.250924	30	1.2	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
119	SAV	27.658653	-97.250821	52	1.3	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code

Appendix E- GPS Data Log
Wetland Delineation
Tern Rookery Island Restoration
Project

ID	LABEL	LATITUDE	LONGITUDE	DISTANCE BETWEEN POINTS	PDOP	SATELLITES USED	DEVICE TYPE	GPS DATE	COLLECTOR	CORRECTION STATUS
120	OW	27.658550	-97.250837	38	1.1	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
121	PATCHY SAV	27.658436	-97.250835	42	1.1	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
122	OW	27.658357	-97.250859	30	1.2	6	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
123	OW	27.658262	-97.250878	35	1.9	5	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
124	OW	27.658279	-97.250700	58	1.1	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
125	PATCHY SAV	27.658268	-97.250677	9	1.2	6	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
126	OW	27.658278	-97.250580	31	1.3	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
127	SAV	27.658273	-97.250508	24	1.2	6	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
128	PATCHY SAV	27.658043	-97.250615	91	1.2	5	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
129	PATCHY SAV	27.657871	-97.250609	63	1.2	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
130	SAV	27.658645	-97.250356	293	2.3	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
131	PATCHY SAV	27.659397	-97.249891	312	1.8	9	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code

Appendix E- GPS Data Log
Wetland Delineation
Tern Rookery Island Restoration
Project

ID	LABEL	LATITUDE	LONGITUDE	DISTANCE BETWEEN POINTS	PDOP	SATELLITES USED	DEVICE TYPE	GPS DATE	COLLECTOR	CORRECTION STATUS
132	SAV	27.659927	-97.249621	212	1.4	10	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
133	OW	27.659612	-97.249269	162	0.9	10	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
134	SAV	27.659408	-97.249559	119	2.6	7	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
135	OW	27.659141	-97.248722	288	2.3	6	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
136	OW	27.657822	-97.247971	538	1.5	9	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
137	SAV	27.657823	-97.248439	152	1.5	9	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
138	SAV	27.657859	-97.248732	96	1.5	9	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
139	OW	27.657867	-97.249051	103	1.5	9	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
140	OW	27.657860	-97.249404	114	1.9	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
141	OW	27.657836	-97.249674	88	1.8	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
142	OW	27.657641	-97.249990	124	1.4	10	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
143	OW	27.657464	-97.249743	102	2.6	6	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code

Appendix E- GPS Data Log
Wetland Delineation
Tern Rookery Island Restoration Project

ID	LABEL	LATITUDE	LONGITUDE	DISTANCE BETWEEN POINTS	PDOP	SATELLITES USED	DEVICE TYPE	GPS DATE	COLLECTOR	CORRECTION STATUS
144	OW	27.657384	-97.249288	150	2.7	5	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
145	SAV	27.656191	-97.251091	727	1.5	9	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
146	SAV	27.655939	-97.252410	437	1.8	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
147	SAV	27.656414	-97.252176	189	1.4	10	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
148	OW	27.656590	-97.252391	94	1.5	9	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
149	SAV	27.656811	-97.252641	114	1.6	9	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
150	SAV	27.656805	-97.252187	147	0.9	9	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
151	OW	27.656767	-97.251905	92	1.4	10	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
152	SAV	27.656597	-97.253365	477	1.6	9	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
153	SAV	27.656229	-97.253946	231	1.7	9	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
154	SAV	27.655162	-97.253474	417	1.4	10	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
155	OW	27.655236	-97.253232	83	1.7	9	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code

Appendix E- GPS Data Log
Wetland Delineation
Tern Rookery Island Restoration
Project

ID	LABEL	LATITUDE	LONGITUDE	DISTANCE BETWEEN POINTS	PDOP	SATELLITES USED	DEVICE TYPE	GPS DATE	COLLECTOR	CORRECTION STATUS
156	OW	27.655398	-97.252910	120	1.3	11	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
157	OW	27.655451	-97.252613	98	0.8	10	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
158	OW	27.657236	-97.253392	696	1.3	10	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
159	OW	27.657542	-97.253041	159	0.9	10	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
160	OW	27.657626	-97.252638	134	0.9	9	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
161	PATCHY SAV	27.657229	-97.252779	151	1	9	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
162	SAV	27.658290	-97.252979	391	0.9	9	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
163	SAV	27.659480	-97.252171	505	1	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
164	SAV	27.659867	-97.250964	415	0.9	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code
165	SAV	27.659981	-97.250380	194	0.9	8	Bad Elf #151949	2/27/2023	KH & UG	Real-time corrected L1Code

Exhibit C
Bathymetry and Topographic Surveys

---- - P:\Y-2022\2022.0247\DWG\BATHYMETRIC SURVEY\2-6-1-2023\HDR - TERN ISLAND BATHY & TOPO SURVEY_29MAR-26MAY2023.DWG

NOTES:

1. SOUNDINGS AND TOPOGRAPHIC DATA WAS RECORDED BY T. BAKER SMITH ON 29 MARCH AND 26 MAY, 2023. SEA FLOOR CONDITIONS ARE SUBJECT TO CHANGE.
2. HORIZONTAL DATUM: NAD83 (2011), TEXAS SOUTH ZONE. ALL DISTANCES ARE U.S. SURVEY FEET (GRID).
3. VERTICAL: NAVD88 (GEOID 18)

"5792 A 1988"	"5792 F 2006"
N: 17,121,538.3'	N: 17,121,396.8'
E: 1,393,149.5'	E: 1,393,373.7'
ELEV: 2.7' NAVD88	ELEV: 3.0' NAVD88

REV. NO:	REV. DATE:	REV. DESCRIPTION:	REV. BY:
00	--/--/--		

REVISIONS

T. BAKER SMITH
A CENTURY OF SOLUTIONS
3854 FM 1069
Aransas Pass, TX 78336
(361)334-5719 - tbsmith.com
TBPLS #10194575

COVERPAGE
NOT TO SCALE

DRAWN BY:	CDW	APPROVED BY:	AWK
DATE:	06/01/2023	JOB NO:	2022.0247

DRAWING NAME:
HDR - TERN ISLAND BATHY & TOPO SURVEY_29MAR-26MAY2023

PROJECTION: TEXAS STATE PLANE SOUTH ZONE
GEO. DATUM: NAD83 (2011) | VERT. DATUM: NAVD88
GRID UNITS: US SURVEY FEET

SHEET NO: 1 OF 4

BATHYMETRIC & TOPOGRAPHIC SURVEY

HDR ENGINEERING, INC.
TERN ISLAND

AN EXHIBIT OF A
BATHYMETRIC & TOPOGRAPHIC SURVEY
LOCATED IN
LAGUNA MADRE, TEXAS

NOTES:
1. SOUNDINGS AND TOPOGRAPHIC DATA WAS RECORDED BY T. BAKER SMITH ON 29 MARCH AND 26 MAY, 2023. SEA FLOOR CONDITIONS ARE SUBJECT TO CHANGE.
2. HORIZONTAL DATUM: NAD83 (2011), TEXAS SOUTH ZONE. ALL DISTANCES ARE U.S. SURVEY FEET (GRID).
3. VERTICAL: NAVD88 (GEOID 18)

"5792 A 1988"
N: 17,121,538.3'
E: 1,393,149.5'
ELEV: 2.7' NAVD88

"5792 F 2006"
N: 17,121,396.8'
E: 1,393,373.7'
ELEV: 3.0' NAVD88

REV. NO:	REV. DATE:	REV. DESCRIPTION:	REV. BY:
00	--/--/--		

REVISIONS

T. BAKER SMITH
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3854 FM 1069
Aransas Pass, TX 78336
(361)334-5719 - tbsmith.com
TBPLS #10194575

SCALE: 1" = 100'
100 50 0 100' 200' 300'

DRAWN BY:	CDW	APPROVED BY:	AWK
DATE:	06/01/2023	JOB NO:	2022.0247

DRAWING NAME:
HDR - TERN ISLAND BATHY & TOPO SURVEY_29MAR-26MAY2023
PROJECTION: TEXAS STATE PLANE SOUTH ZONE
GEO. DATUM: NAD83 (2011) | VERT. DATUM: NAVD88
GRID UNITS: US SURVEY FEET

SHEET NO: 2 OF 4

BATHYMETRIC & TOPOGRAPHIC SURVEY

HDR ENGINEERING, INC.
TERN ISLAND
AN EXHIBIT OF A
BATHYMETRIC & TOPOGRAPHIC SURVEY
LOCATED IN
LAGUNA MADRE, TEXAS

NOTES:

1. SOUNDINGS AND TOPOGRAPHIC DATA WAS RECORDED BY T. BAKER SMITH ON 29 MARCH AND 26 MAY, 2023. SEA FLOOR CONDITIONS ARE SUBJECT TO CHANGE.
2. HORIZONTAL DATUM: NAD83 (2011), TEXAS SOUTH ZONE. ALL DISTANCES ARE U.S. SURVEY FEET (GRID).
3. VERTICAL: NAVD88 (GEOID 18)

"5792 A 1988"	"5792 F 2006"
N: 17,121,538.3'	N: 17,121,396.8'
E: 1,393,149.5'	E: 1,393,373.7'
ELEV: 2.7' NAVD88	ELEV: 3.0' NAVD88

REV. NO:	REV. DATE	REV. DESCRIPTION:	REV. BY:
00	--/--/--		

REVISIONS

T. BAKER SMITH
A CENTURY OF SOLUTIONS
3854 FM 1069
Aransas Pass, TX 78336
(361)334-5719 - tbsmith.com
TBPLS #10194575

SCALE: 1" = 100'

100 50' 0 100' 200 300'

DRAWN BY: CDW	APPROVED BY: AWK
DATE: 06/01/2023	JOB NO: 2022.0247

DRAWING NAME:
HDR - TERN ISLAND BATHY & TOPO SURVEY_29MAR-26MAY2023
PROJECTION: TEXAS STATE PLANE SOUTH ZONE
GEO. DATUM: NAD83 (2011) | VERT. DATUM: NAVD88
GRID UNITS: US SURVEY FEET

SHEET NO: 3 OF 4

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Exhibit D
Magnetometer
Survey

---- - P:\Y-2022\2022.0247\DWG\MAGNETOMETER SURVEY\HDR - TERN ISLAND MAG SURVEY_29MAR2023.DWG

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COVERPAGE
NOT TO SCALE

REV. NO: 00 | REV. DATE: --/--/-- | REV. BY: ---

REVISION DESCRIPTION:
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DRAWN BY: CDW | APPROVED BY: AWK
DATE: 04/11/2023 | JOB NO: 2022.0247

DRAWING NAME:
HDR - TERN ISLAND MAG SURVEY_29MAR2023

PROJECTION: TEXAS STATE PLANE SOUTH ZONE
GEO. DATUM: NAD83 (2011) | VERT. DATUM: NAVD88
GRID UNITS: US SURVEY FEET

SHEET NO: 1 OF 4

MAGNETOMETER SURVEY

HDR ENGINEERING, INC.

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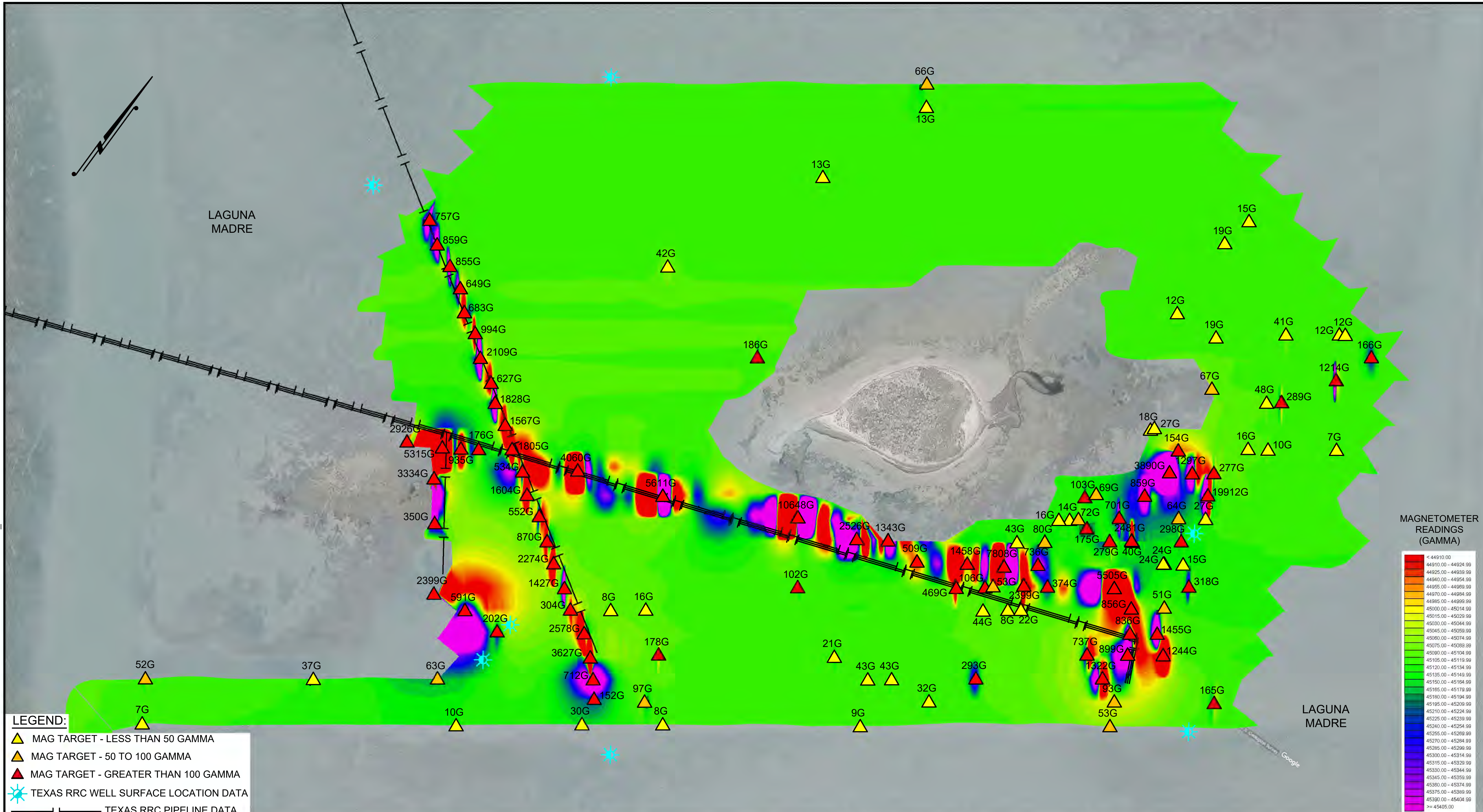

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SCALE: 1" = 200'
200' 100' 0' 200'

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TBS
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SCALE: 1" = 100'

100' 50' 0' 100'

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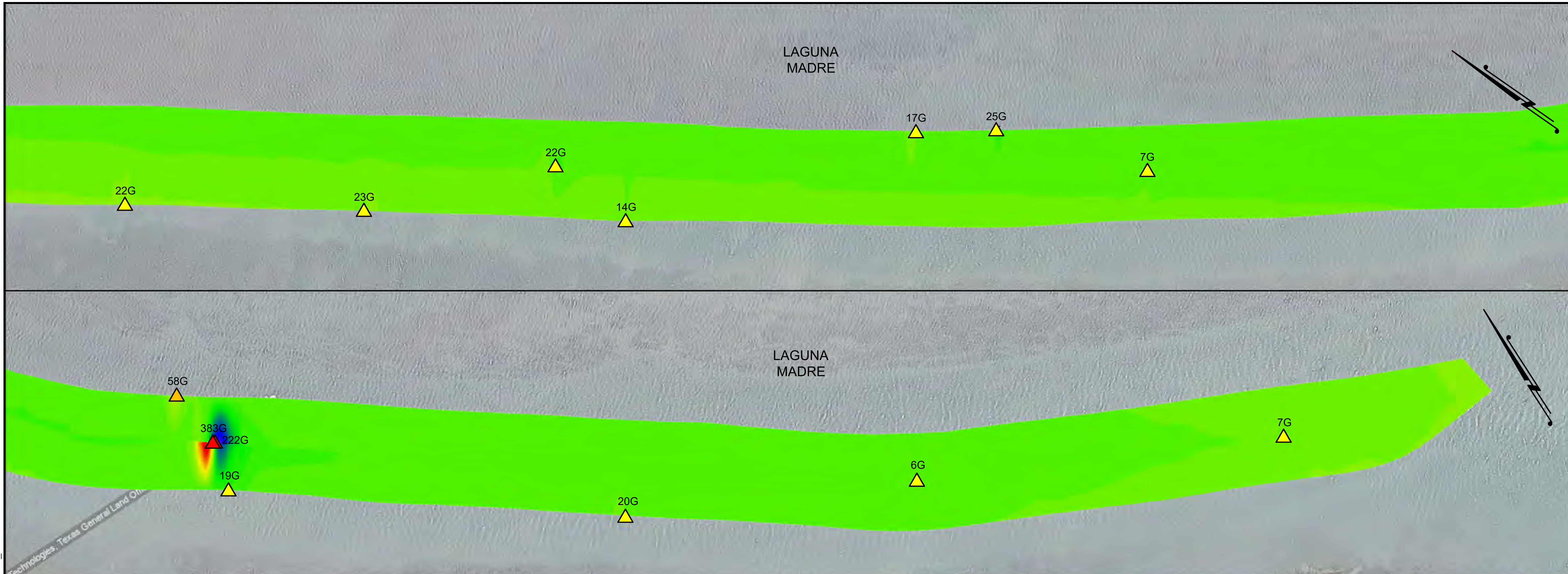

MAGNETOMETER READINGS (GAMMA)

- < 44910.00
- 44910.00 - 44924.99
- 44925.00 - 44939.99
- 44940.00 - 44954.99
- 44955.00 - 44969.99
- 44970.00 - 44984.99
- 44985.00 - 44999.99
- 45000.00 - 45014.99
- 45015.00 - 45029.99
- 45030.00 - 45044.99
- 45045.00 - 45059.99
- 45060.00 - 45074.99
- 45075.00 - 45089.99
- 45090.00 - 45104.99
- 45105.00 - 45119.99
- 45120.00 - 45134.99
- 45135.00 - 45149.99
- 45150.00 - 45164.99
- 45165.00 - 45179.99
- 45180.00 - 45194.99
- 45195.00 - 45209.99
- 45210.00 - 45224.99
- 45225.00 - 45239.99
- 45240.00 - 45254.99
- 45255.00 - 45269.99
- 45270.00 - 45284.99
- 45285.00 - 45299.99
- 45300.00 - 45314.99
- 45315.00 - 45329.99
- 45330.00 - 45344.99
- 45345.00 - 45359.99
- 45360.00 - 45374.99
- 45375.00 - 45389.99
- 45390.00 - 45404.99
- >= 45405.00

LEGEND:

- MAG TARGET - LESS THAN 50 GAMMA
- MAG TARGET - 50 TO 100 GAMMA
- MAG TARGET - GREATER THAN 100 GAMMA
- TEXAS RRC WELL SURFACE LOCATION DATA
- TEXAS RRC PIPELINE DATA

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