Appendix F:
TE-0171 95% Design Report

Port Fourchon Marsh Creation (TE-0171):

Coastal Wetlands Planning, Protection and Restoration Act PPL 31

95% Design Report

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EXECUTIVE SUMMARY

The TE-0171 Port Fourchon Marsh Creation project is located west of Belle Pass, southwest of Port Fourchon, in Region 3 of the Terrebonne Basin within Lafourche Parish, Louisiana. According to USGS data, the Terrebonne Basin had the greatest land loss rate in the state from 1985 to 2004. This basin has lost nearly 324,000 acres of land from 1932 to 2010.[1]

Goals defined during the TE-0171 Phase 0 process included: creating/nourishing 605 acres of marsh, evaluating the use of Belle Pass sediment for coastal restoration, demonstrating cost-sharing opportunities with local stakeholders, improving local community resilience, protecting critical infrastructure, and supporting stakeholder priorities. Phase I funding was granted through the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) in January 2022 as part of Priority Project List (PPL) 31.

The following 95% design report reflects these goals by designing a 543-acre marsh creation area (MCA). Of the 543 acres, approximately 445 acres of open water will be turned into marsh and 98 acres of existing marsh will be nourished with hydraulically dredged sediment. Hydraulic dredging will remove approximately 2.6 million cubic yards (CY) of material from Belle Pass starting at Sta. 140+00 (approximately 2.6 miles north of the end of the Port Fourchon jetties) and concluding at Sta. 360+00 (approximately 1.6 miles south of the jetties, in the Gulf of Mexico).

The dredged material will be placed in a single 543-acre cell and will be contained with earthen containment dikes (ECDs). Due to high wind and wave energies that may be present in this project area, a portion of the ECDs will be enhanced to mitigate possible expedited erosion in certain areas.

[1] Couvillion et. al. 2011

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ACRONYMS

ACM:	Articulated Concrete Mat
ASTM:	American Society for Testing and Materials
BA:	Borrow Area
BUDMAT:	Beneficial Use of Dredged Material
CEM:	Coastal Engineering Manual
CIMS:	Coastal Information Management System
CMFE:	Constructed Marsh Fill Elevation
CPRA:	Coastal Protection and Restoration Authority
CPT:	Cone Penetration Test
CRMS:	Coastwide Reference Monitoring System
CTF:	Cut-To-Fill
CUP:	Coastal Use Permit
CWPPRA:	Coastal Wetlands Planning, Protection and Restoration Act
CY:	Cubic Yard
DENR:	Louisiana Department of Energy and Natural Resources
DGA:	Data Gap Analysis
DPC:	Dredge Pipeline Corridor
EAC:	Equipment Access Channel/ Corridor
ECD:	Earthen Containment Dike
ESLR:	Eustatic Sea Level Rise
EPA:	Environmental Protection Agency
ESA:	Environmental Site Assessment
FEMA:	Federal Emergency Management Agency
FOS:	Factor of Safety
Ft:	Feet
GISE:	GIS Engineering
GLPC:	Greater Lafourche Port Commission
GPS:	Global Positioning System
GRSL:	Gulf Regional Sea Level
HME:	Healthy Marsh Elevation
HTRW:	Hazardous, Toxic, and Radioactive Waste
Hz:	Hertz
IGA:	Intergovernmental Agreement
LDWF:	Louisiana Department of Wildlife and Fisheries
LF:	Linear Feet
LL&E:	Louisiana Land and Exploration Company
LOOP:	Louisiana Offshore Oil Port
MCA:	Marsh Creation Area
MFE:	Marsh Fill Elevation
MCY:	Million Cubic Yard
MHW:	Mean High Water

Mi:	Miles
MLG:	Mean Low Gulf
MLLW:	Mean Lower Low Water
MLW:	Mean Low Water
mm:	Millimeters
ML:	Mudline
MTL:	Mean Tidal Level
OMRR&R:	Operation, Maintenance, Repair, Rehabilitation, and Replacement
NAD 83:	North American Datum of 1983
NAVD 88:	North American Vertical Datum of 1988
NDBC:	National Data Buoy Center
NOAA:	National Oceanic and Atmospheric Administration
NTP:	Notice to Proceed
PPL:	Project Priority List
PPT:	Parts Per Thousand
REC:	Recognized Environmental Condition
ROW:	Right of Way
RSLR:	Relative Sea Level Rise
RTK:	Real-Time Kinematic
SHPO:	State Historic Preservation Office
SLR:	Sea Level Rise
SONRIS:	Strategic Online Natural Resources Information System
TIN:	Triangular Irregular Networks
TMFE:	Target Marsh Fill Elevation
TY:	Target Year
USACE:	United States Army Corps of Engineers
USCS	Unified Soil Classification System
USGS:	United States Geological Survey
WRDA:	Water Resources and Development Act
WVA:	Wetland Value Assessment
Yr:	Year

1.0 INTRODUCTION

The TE-0171 Port Fourchon Marsh Creation Project (herein referred to as TE-0171) aims to create marsh utilizing hydraulically dredged material from Belle Pass. This 95% final design report was prepared to refine and further develop project features presented in the 30% design report and address comments received from the CWPPRA community following that submittal. A copy of the 30% Design Review CWPPRA Comments, including responses from the TE-0171 Project Team, can be found in Appendix K.

In the 30% design submittal, two (2) borrow areas (BA) were presented. The first was referred to as BA A, which consisted of dredging Belle Pass. The second was referred to as BA B, which included dredging the Inner Port Slips (Flotation Canal and Slips A, B, C, and D), north Bayou Lafourche, and Havoline Canal. After the completion of an Alternative Analysis report (included under Appendix B) and following the completion of the 30% Design Review Conference, the Project Team has officially selected BA A (Belle Pass) as the final and singular borrow area for TE-0171.

1.1 Authority

TE-0171 is located to the west of Belle Pass in Port Fourchon, Lafourche Parish, Louisiana (as seen in Figure 1). The Phase 0 process for this project was completed in 2021. Phase I (Engineering and Design) funding was granted through the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) in January 2022 as part of the project priority list (PPL) 31.[2] This project is included in the Terrebonne Belle Pass-Golden Meadow Marsh Creation project (ID# 123) in the 2017 and 2023 Louisiana Comprehensive Master Plans for a Sustainable Coast.[3]

1.2 Project Team

The Environmental Protection Agency (EPA) is serving as the federal project sponsor for TE-0171, and the Coastal Protection and Restoration Authority (CPRA) is serving as the local sponsor. The Greater Lafourche Port Commission (GLPC) is serving as CPRA's agent for engineering and design in addition to serving as the local stakeholder.

GLPC is responsible for the completion of the project design as per an Intergovernmental Agreement (IGA) with CPRA dated July 6, 2023. GIS Engineering (GISE) has been contracted by GLPC to provide engineering and design services. GLPC's commitment to this project is demonstrated in a letter found in Appendix A.

Additionally, GISE has subcontracted ELOS Environmental (ELOS) and Eustis Engineering (Eustis). ELOS is providing cultural resources services and Eustis is providing geotechnical engineering expertise and services. All survey work is to be completed by GISE.

[2] CWPPRA Project Priority List 31, Dec. 2021

[3] 2023 Louisiana's Comprehensive Master Plan for a Sustainable Coast, May 2023

Figure 1: TE-0171 Project Location

1.3 Project Location

The TE-0171 project area is located in Lafourche Parish, Louisiana (Figure 1). The marsh creation area (MCA) is a 543-acre cell to the west of Belle Pass with 24,596 linear feet (LF) of earthen containment dikes (ECDs). Of the 543 acres, approximately 445 acres of open water will be converted into marsh and 98 acres of existing marsh will be nourished with hydraulically dredged sediment.

The Borrow Area (BA) begins in Belle Pass at Station (Sta.) 140+00[4] and extends to the south beyond the Belle Pass jetties into the Gulf of Mexico to Sta. 360+00, for a total length of approximately 4.17 miles. The proposed dredge template begins with a channel width of 300 feet (ft) on the northern extent, through the jetties at Sta. 275+00, and widens to 475 ft on the southern extent. The proposed maximum dredging depth for the BA corresponds to an elevation of -43 ft North American Vertical Datum 88 (NAVD 88). The proposed dredge pipeline corridor (DPC) is located adjacent to Belle Pass to the west of the existing jetties and crosses the beach just

[4] Stations referenced are United States Army Corps of Engineers (USACE) station markers when applicable. All stations referenced above and throughout this report can be found in the 95% design drawings located in Appendix O.

south of the MCA. The dredge pipeline will be floating with the exception of where the dredge pipeline will cross over the beach into the MCA.

Two (2) Equipment Access Channels/Corridors (EAC) have been proposed for this project. The first is the Timbalier EAC which will run through Timbalier Bay and allow for dredging of an access channel to a maximum depth that corresponds to an elevation -6 ft NAVD88. The second EAC, referred to as the Headland EAC, will run over the southern West Belle Headland beach and is best suited for marsh buggy equipment. This EAC will run parallel to the DPC and utilize the ECD footprint from the previous CWPPRA project (TE-0052) directly south of the TE-0171 MCA.

A map of the project area, including these major project features, can be seen in Figure 2.

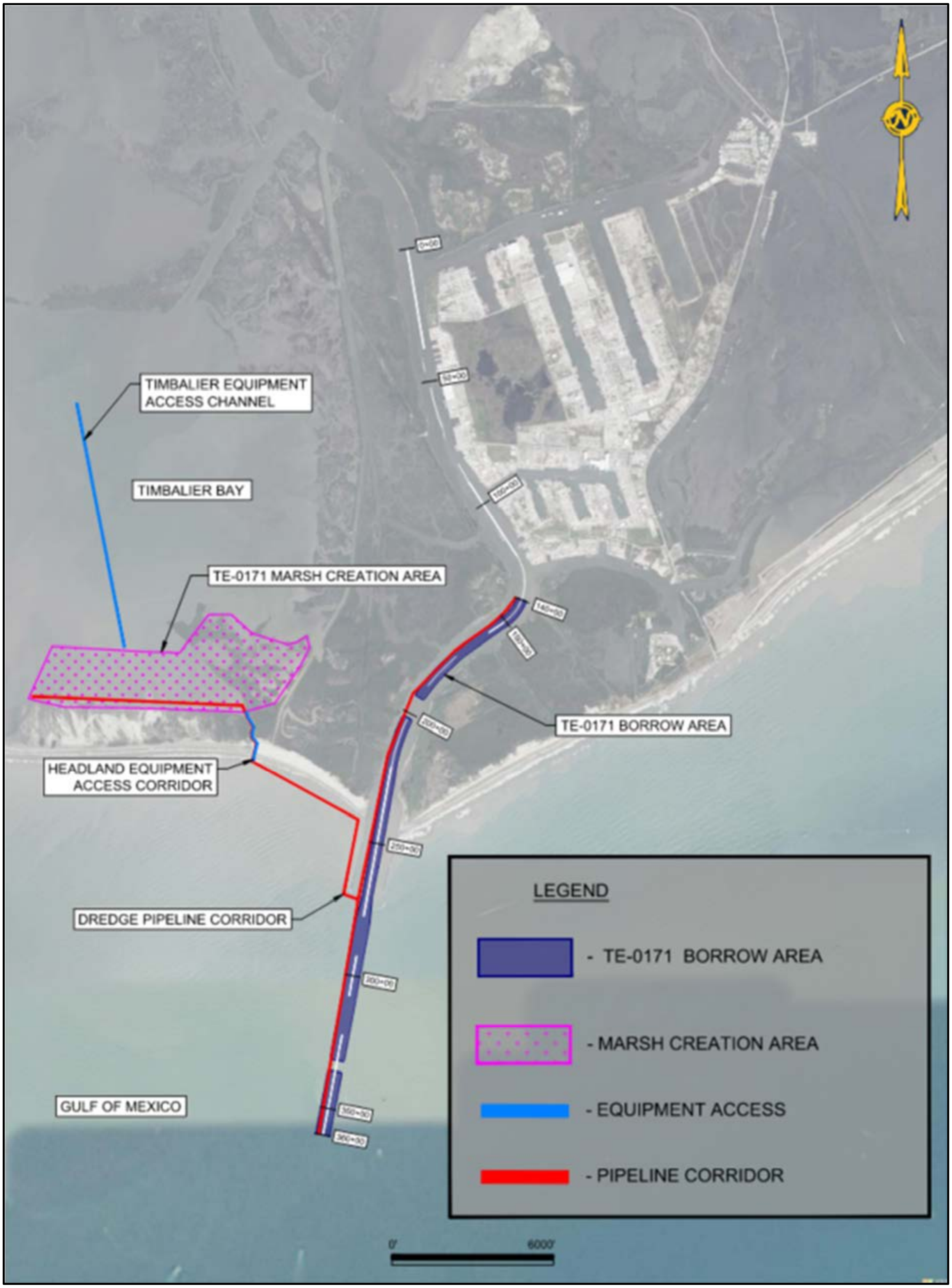

Figure 2: TE-0171 95% Project Features

1.4 Project Goals and CWPPRA Priorities

The CWPPRA Phase 0 project goals of TE-0171 included:

- Creating/nourishing 605 acres of marsh
- Evaluating the use of Belle Pass sediment for coastal restoration
- Demonstrating cost-sharing opportunities with local stakeholders
- Improving local community resilience, protecting critical infrastructure
- Supporting stakeholder priorities

CWPPRA seeks to fund projects that are cost-effective, have high synergy with other projects, are in critical areas of need, restore a critical landscape feature, and provide protection for critical infrastructure. The following sections describe how TE-0171 will meet these targets set by CWPPRA.

1.4.1 Cost Effectiveness

TE-0171 is a unique project due to cost sharing opportunities made possible by the local stakeholder (GLPC). GLPC will contribute 25% of the construction cost (up to $10M) for the construction of TE-0171 due to the recognition that this project not only accomplishes CWPPRA, state, and federal goals but also helps to support GLPC's priorities and vision for Port expansion.

GLPC's contribution will greatly help to decrease the obligated CWPPRA agencies cost. Cost information for this project has been submitted with this report to the CWPPRA Engineering Work Group. Additional information on cost can be found in Section 9.2.

1.4.2 Synergy

There are eight (8) similar marsh creation and restoration projects created by either CWPPRA, CPRA, or repair projects funded by the Federal Emergency Management Agency (FEMA) that are synergistic to TE-0171 (Table 1). Additional information on projects in this vicinity can be found in Section 4.0, and a map of these projects in relation to TE-0171 can be seen in Figure 3.

Table 1: Synergistic Projects Near TE-0171

Project ID	Project Name	Summary Information
TE-0023*[5]	West Belle Pass Headland Restoration	- Restored degrading marsh directly to the east of TE-0171 - Used Belle Pass as a borrow area - Built 184 acres of marsh with 240,000 CY and added 17,000 LF of rip rap
TE-0052*[6]	West Belle Pass Barrier Headland Restoration	- Beach, dune, and back barrier marsh restoration directly to the south of TE-0171 - Used an offshore borrow area to dredge 1,180,000 CY of sand and 1,903,000 CY of marsh fill
BA-0045[7]	Caminada Headland Beach and Dune Restoration	- 5.9-mile dune restoration project located on the east side of Belle Pass - Used the Gulf of Mexico as a borrow area for 3.65 MCY of sand
BA-0143[8]	Caminada Headland Beach and Dune Restoration Increment II	- Phase II of BA-0045 - Added 10,200 LF of sand fencing and planted vegetation
BA-0171[9]	Caminada Headlands Back Barrier Marsh Creation	- Created/nourished 942.5 acres of back barrier marsh from a Gulf of Mexico borrow area - Located behind dunes restored in BA-0045 and BA-0143
TE-0143/ TE-0118*[10]	Terrebonne Basin Barrier Island and Beach Nourishment/ West Belle Pass Headland Restoration	- Consists of three (3) MCAs, one (1) directly to the south and west of TE-0171 (marsh creation), the other two (2) are marsh nourishment areas farther west - Used 6.4 MCY to renourish TE-0052 and expand the beach westward - Major Hurricane Zeta passed over project footprint when it was 80% complete (see TE-0176)
TE-0134[11]	West Fourchon Marsh Creation & Nourishment	- Construction is expected to precede TE-0171 - Utilizes Belle Pass and Bayou Lafourche as borrow area - Will create and nourish up to 814 acres of marsh
TE-0176*[12]	West Belle Pass Headland Repair	- Reconstruction of TE-0143 - Directly to the south and west of TE-0171 - 2.6 MCY will be used from an offshore borrow area - Expected to advertise in Fall 2024 through FEMA funding

* Projects that are directly connected to TE-0171

[5] TE-0023 Project Completion Report Maintenance Dredging As-Built Drawings, March, 2000
[6] TE-0052 Project Fact Sheet, Aug. 2013; TE-0052 95% Design Report, Sept. 2009
[7] BA-0045 Final Design Report, June 2012.; BA-0045 Completion Report, Mar. 2015
[8] BA-0143 Bid Documents, Aug. 2018; BA-0143 Project Completion Report, Dec. 2022
[9] BA-0171 Project Completion Report, Aug. 2023
[10] TE-0143/0118 Bid Documents, June 2019; TE-0143/0118 Post-Zeta Engineering Assessment and Report, Mar. 2022
[11] TE-0134 Technical Memorandum, July 2023; TE-0134 95% Design Report, Oct. 2018
[12] TE-0143/0118 Post-Zeta Engineering Assessment and Report, Mar. 2022; FEMA TE-0176 Final Supplemental Environmental Assessment, May 2024

While all eight (8) projects add to the high synergy of TE-0171, TE-0052 and TE-0176 (the repair project of TE-0143/TE-0118) would greatly benefit from the construction of TE-0171 in a more direct and distinct way.

TE-0052 is located directly south of the proposed TE-0171 MCA and has seen sediment movement north of the original project's boundary due to wind and wave energy. Similarly, once both projects are completed, TE-0176 will serve as the southwest corner of TE-0171 where similar sand movement northward can be expected. Constructing TE-0171 will allow for this sediment that moves in the northern direction to renourish marsh instead of being lost in the open water. Therefore, the direct connection of TE-0052 and TE-0176 to TE-0171 allows for the construction of the latter to contribute to an impact greater than its own. Additional information on how these projects will interact with each other can be found in Section 4.1.

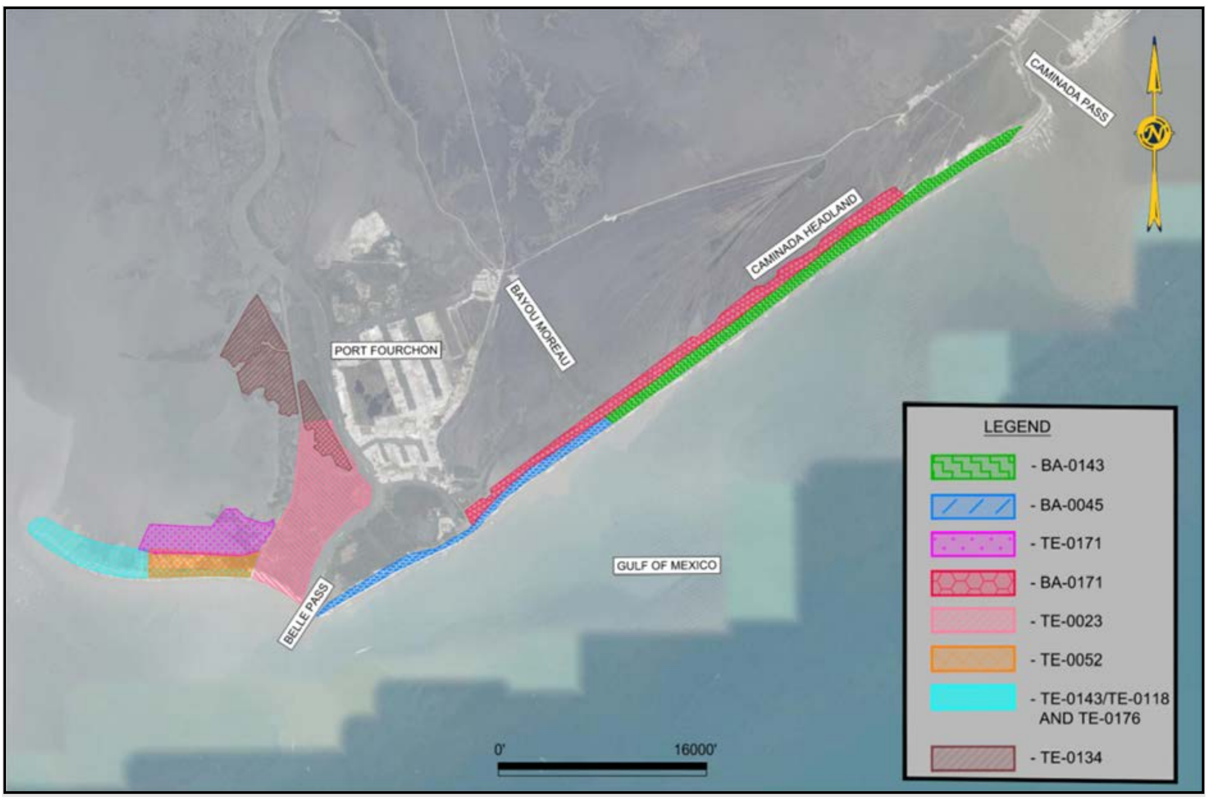

Figure 3: Projects in Synergy with TE-0171

1.4.3 Critical Area of Need

TE-0171 is located in the Terrebonne Basin, which had the greatest decrease in wetland area of any of Louisiana's coastal basins from 1932 to 2016.[15] According to the PPL31 wetland value assessment (WVA), the land loss rate per year was one of the highest in Louisiana with an

[15] Couvillion et. al. 2017

estimated -0.97%/year (yr).[16] The subsidence rate in this area is 10.21 millimeters (mm)/yr. This is equivalent to 0.67 ft over the 20-yr project life of TE-0171.[17]

A project specific example of this high land loss rate can be seen in TE-0052. Located directly south of proposed TE-0171, TE-0052 has experienced significant shoreline retreat requiring additional maintenance. As noted in the 2017 annual inspection report, the average shoreline retreat measurements between 2015-2017 inspections were approximately 79 ft/yr. The maximum shoreline retreat measurement was approximately 116 ft/yr.[18] Figure 4 demonstrates the historical change of this shoreline in the project area.

Figure 4: Historical Satellite Imagery of TE-0171 Placement Area

1.4.4 Critical Landscape Feature

TE-0171 will work in synergy with TE-0052 and TE-0176 to support the West Belle Pass Headland and protect the interior estuaries of Timbalier Bay by providing back barrier marsh to the area. The creation of TE-0171 would have an added benefit of capturing sand placed by state and federal funds dispersed by aeolian processes and potential over wash during storms. This has an added benefit of fortifying previous state and federal investments.

1.4.5 Critical Infrastructure Protection

TE-0171 will add protection to Port Fourchon, a major intermodal transfer hub servicing over 95% of the Gulf of Mexico's deep-water energy production, located approximately 1.7 miles (mi) away from the TE-0171 MCA. Additional information on Port Fourchon and its local, national, and global significance can be found in Section 3.0.

[16] Draft Phase 2 Project Information Sheet for Wetland Value Assessment, 2024
[17] Fitzpatrick et. al. 2021
[18] TE-0052 Operations, Maintenance, and Monitoring Report, Aug. 2017

1.4.6 Other Considerations

While TE-0171 addresses CWPPRA's five (5) main priorities, it also provides benefits that are supplemental to the primary goals and considerations of the CWPPRA program, including:

- Utilizing a sustainable borrow source in Belle Pass.
- Involving a cooperative landowner in the State of Louisiana and participating stakeholder in GLPC.
- Avoidance of oyster leases and existing infrastructure/pipelines within the MCA footprint.
- Possible funding participation with USACE depending on timing and overlap with the USACE's Port Fourchon Belle Pass Channel Deepening project.

1.5 Data Gap Analysis

GISE completed a final data gap analysis report (DGA) on November 14, 2023. The DGA reviewed existing data from previous studies and projects as well as data already available in order to evaluate gaps for hydrologic data, wind and wave data, survey data, geotechnical data, existing infrastructure, land rights, and oyster leases. The results of the DGA concluded that gaps existed in survey data, geotechnical data, cultural resources, pipelines, and environmental data. These gaps were addressed in order to complete this design. The processes and results of collecting this data can be found throughout this report.

1.6 Alternative Analysis

GISE completed an Alternative Analysis Report (see Appendix B) on May 3, 2024, as per the scope of work for TE-0171. Two (2) possible MCA configurations (which were considered during Phase 0) were evaluated during this analysis. Additionally, the delineated Phase 0 BA (the selected BA A) and an alternative BA (BA B) were evaluated. This resulted in GISE evaluating four (4) different alternatives in the alternative analysis (Figure 5).

In the preliminary stages of this analysis, one (1) of the MCAs was eliminated during a desktop analysis due to factors including deep water depths along the ECDs alignment and potential land rights negotiation delays. However, both BA alternatives still remained and data were collected in both areas.

After thorough evaluation of all project alternatives, the alternative analysis results indicated BA A should be selected as the final BA for TE-0171. The Project Team decided to keep BA B as an alternative option through the 30% Design phase in order to allow for feedback from the entire CWPPRA community. On August 9, 2024, after agency comments were received following the 30% Design Review Conference, the Project Team officially selected BA A as the singular and final BA for this project. BA A is the borrow source reflected through this 95% design report and is thus referred to as the 'BA'.

Figure 5: TE-0171 Evaluated Alternative Analysis Project Features

2.0 BASIS OF DESIGN

The following design documentation was prepared by GISE in collaboration with CPRA and EPA. The CPRA *Marsh Creation Design Guidelines*[19], the CPRA *Geotechnical Standards,*[20] CPRA *Surveying Standards,*[21] and the United States Army Corps of Engineers (*USACE) Coastal Engineering Manual* (CEM)[22] were used as guidance for the marsh creation design project presented in this report. CPRA and CWPPRA standards were followed throughout the design process.

3.0 PORT FOURCHON

TE-0171 is located in the immediate vicinity of Port Fourchon and was conceived as an opportunity to synergistically utilize material from the Port's primary navigation channel for marsh creation, in order to sustainably implement beneficial use of dredged materials (BUDMAT).

Port Fourchon is a major intermodal transfer hub that supports 11,000 direct Louisiana jobs while servicing over 95% of the deep-water energy produced in the Gulf of Mexico, having a $46M daily impact to the energy industry. It is the base for over 250 companies including Edison Chouest Offshore port facilities, Bollinger Fourchon, Halliburton, Hornbeck Offshore, Harvey Gulf International, and the Louisiana Offshore Oil Port (LOOP). LOOP is the nation's only deep-water oil port. It began export activities of crude oil, utilizing its existing offshore marine terminal in 2018. LOOP currently handles more than 50% of domestically produced Gulf of Mexico crude which is ultimately both exported and distributed via pipeline systems to U.S. refiners.[23] In total, LOOP handles about 1.5 million barrels of oil per day, and is connected to about 50% of the Nation's refining capacity. LOOP's offshore marine terminal is also serviced out of Port Fourchon.

Port Fourchon remains committed to innovative projects simultaneously benefitting the environment and navigation. Always on the cutting edge of offshore energy opportunities, Port Fourchon is constantly expanding and dredging will continue as a top priority. Multiple ongoing Port projects were considered when designing TE-0171. Those projects will be further discussed in the following sections.

3.1 Port Fourchon History

GLPC was first created in 1960 through LA Legislature Act 222. In 1967 Belle Pass was dredged to 12 ft deep and 125 ft wide, the first deepening project from the previous 6 ft of authorization.[24] Decades later, Port Fourchon is now the prime location for logistical support and services needed

[19] CPRA Marsh Creation Design Guidelines, Nov. 2017
[20] CPRA Geotechnical Standards, Dec. 2021
[21] CPRA Surveying Standards, Mar. 2017
[22] USACE Coastal Engineering Manual EM 1110-2-1100, Apr. 2002
[23] GLPC Port Facts Webpage, accessed July 2024
[24] GLPC History Webpage, accessed July 2024

for the Gulf of Mexico energy industry. This has become possible due to the continuous development of Port Fourchon over the past 64 years.

3.2 Historical Use of the Project Placement Area

GISE reviewed historical topographic maps (1892-2020) and aerial photography (1983-2019) as part of the HTRW/ Phase I Environmental Site Assessment (Appendix E). A majority of the MCA area has historically been open-water with Raccoon Pass to the southwest, flowing between the West Belle Pass Barrier Split and the Eastern Timbalier Barrier Islands.[27] Additionally, there has been a historic northern migration of the Eastern Timbalier Barrier Island systems since the 1880s with various changes in barrier island morphology, which include the development of overwash fans within the MCA.[27] The eastern portion of the MCA has historically been vegetated, coastal marsh with various tidal creeks and ponds. There has been noticeable erosion of the wetland area over time, which is consistent with significant coastal wetland erosion within the Terrebonne hydrologic basin.[15]

3.3 Historical Use of the Project Borrow Area

Bayou Lafourche was originally authorized as a six (6) ft deep by 60 ft wide navigation channel in the 1935 Rivers and Harbors Act. The channel was deepened to 12 ft in 1967. The USACE began placing dredged material from Bayou Lafourche and Belle Pass in an unconfined shoreline nourishment disposal site on the west side of Belle Pass in 1990. In 2000, an unconfined disposal site on the east side of the channel was implemented. The expansion of Port Fourchon in 1996 increased the authorized depth of the channel to the current fully authorized depth, with initial construction commencing in June 28, 2001.

The USACE currently maintains the Bayou Lafourche/Belle Pass channel to an elevation of -24 ft Mean Low Gulf (MLG) (-25.87 ft NAVD 88) with three (3) ft of advance maintenance from Sta. 60+00 to Sta. 240+00. The channel then deepens to -26 ft MLG (-27.87 ft NAVD 88), with four (4) ft of advance maintenance from Sta. 240+00 to Sta. 310+00. A table summarizing the existing and authorized channel elevations of Bayou Lafourche and Belle Pass can be found in Table 3 in Section 3.4.1. This section also explains the current deepening efforts of Bayou Lafourche and Belle Pass.

The USACE performs maintenance dredging as needed in order to maintain Belle Pass and Bayou Lafourche at the authorized navigable depth. Maintenance dredging occurs approximately every other year. A summary of maintenance dredging cycles that took place in Belle Pass & Bayou Lafourche from 2001 to 2021 is provided in Table 2.[28]

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[27] Kulo et. al. 2015
[28] USACE BUDM History, 2001-2007 & 2009-2019

Table 2: USACE Maintenance Dredging Cycles[28]

Year	Cubic Yards	Acres Created	Disposal Area
2001	1,830,698	38 acres of shoreline habitat	Behind west jetty
2001	127,966	6 acres of marsh habitat	Phillips Canal
2003	388,534	5 acres of shoreline habitat	Behind east jetty
2005	1,020,330	40 acres of shoreline habitat	Behind west jetty
2006	605,005	25 acres of shoreline habitat	Behind west jetty
2007	426,202	89 acres of marsh habitat	CWPPRA Project Disposal Site
2007	111,515	3 acres of shoreline habitat	Behind east Jetty
2009	638,628	10 acres of shoreline habitat	Behind east jetty
2012	353,342	13 acres of shoreline habitat	Behind west jetty
2014	174,636	1 acres of shoreline habitat	Behind west jetty
2015	872,959	17 acres of shoreline habitat	Behind west jetty
2017	402,817	No measurable acres	Behind east jetty
2019	1,282,560	5 acres of shoreline habitat	Behind east jetty
2021	380,139	11 acres of shoreline habitat	Behind east jetty

While a majority of the maintenance dredging of Belle Pass has historically been placed behind the jetties for beach nourishment, hydraulically dredged material from this area has also been used for marsh creation purposes (including CWPPRA project TE-0023).

3.4 Future Expansion of Port Fourchon

GLPC continues to expand its facilities to best service the Gulf of Mexico's deep-water vessels. This requires the continuous planning and construction of innovative projects to keep up with the everchanging industry. GLPC has many projects on the horizon in order to meet industry needs.

3.4.1 Port Fourchon Belle Pass Channel Deepening Project

A federal project to deepen Bayou Lafourche and Belle Pass was authorized by Congress in the Water Resources and Development Act of 2020 ("WRDA 2020").[29] This act was contained in the Consolidated Appropriations Act, 2021, passed on December 21, 2020, and signed into law by President Trump on December 27, 2020. The WRDA 2020 authorization for this project highlighted three (3) main conditions to be addressed prior to construction. The USACE's New Orleans District is finalizing the effort to have these conditions addressed by the Fall of 2024.

This federal project will lower the channel mudline elevation to -30.61/-32.61 ft NAVD 88 (-30/-32 ft MLLW) to increase the existing channel draft. The USACE will maintain the channel to these dimensions of -30.61 ft NAVD 88 (-30 ft MLLW) with up to three (3) ft of advance maintenance from Sta 0+00 through Sta. 240+00 and -32.61 ft NAVD88 (-32 ft MLLW) with up to

[29] U.S. Water Resources Development Act of 2020

four (4) ft of advance maintenance from Sta. 240+00 until the -32.61 ft NAVD 88 (-32 ft MLLW) contour currently assumed to be at Sta. 330+00.

The Inner Port Slips will also be deepened to an elevation of -30.61 ft NAVD 88 (-30 ft MLLW) with up to three (3) ft of advance maintenance. GLPC will be responsible for maintaining the Inner Port Slips. Table 3 shows the currently maintained and authorized depths for Bayou Lafourche and Belle Pass. The stationing reflects both USACE's and TE-0171 station numbering (as seen in Figure 7).

Table 3: Existing and Authorized Bayou Lafourche and Belle Pass Channel Dimensions

Authorization	Reach	Width (ft)	Elevation (ft MLG)	Elevation (ft MLLW)	Elevation (ft NAVD 88)	Advance Maintenance (ft)
Currently Maintained	60+00 to 240+00	300	-24.00	-25.26	-25.87	3
Currently Maintained	240+00 to 310+00	300	-26.00	-27.26	-27.87	4
Conditionally Authorized	0+00 to 240+00	300	-28.74	-30.00	-30.61	3
Conditionally Authorized	240+00 to 330+00	300	-30.74	-32.00	-32.61	4

A majority of the sediment for this deepening project is planned to go to the TE-0134 placement area. For TE-0134, dredging will start at the southern station of 330+00 and dredge northward in 300 ft wide channel cuts to a mudline elevation of -33.61 ft NAVD 88 (-33 MLLW). Once the construction of TE-0134 is completed, the only remaining project features to complete the federal portion of the Port Fourchon Belle Pass Channel Deepening Project construction will be the removal of the 10-inch (in) Chevron pipeline in Belle Pass (Sta. 199+27), removal of the 12 in gas EnLink pipeline (Sta. 335+00), and the dredging of the additional three (3) ft to complete the new cut of advance maintenance. Currently, this remaining sediment in Belle Pass is expected to be deposited in either one (1) or both of the existing USACE's unconfined disposal sites on either side of the Belle Pass jetties.

3.4.2 Fourchon Island

GLPC is in the planning and design phase of its Fourchon Island expansion project, located in close proximity to TE-0171 on the east side of Belle Pass. This expansion (Figure 6) includes the construction of a new Fourchon Island Bridge, a connector road, and a deep-water slip. This deep-water Port facility is being designed to better service the existing deep-water oil and gas platforms and vessels. Additionally, it hopes to service the anticipated Gulf of Mexico wind industry, which will require larger vessels to service the wind farms. Fourchon Island will allow for these vessels to be serviced in a convenient location in comparison to the current need to navigate to Mobile, Alabama or Houston, Texas. The completion of Fourchon Island will greatly help to bolster the Gulf of Mexico energy industry, thus helping to decrease costs and boost the economy on many levels. The creation of TE-0171 would help to protect this future asset to the country from western winds and surges.

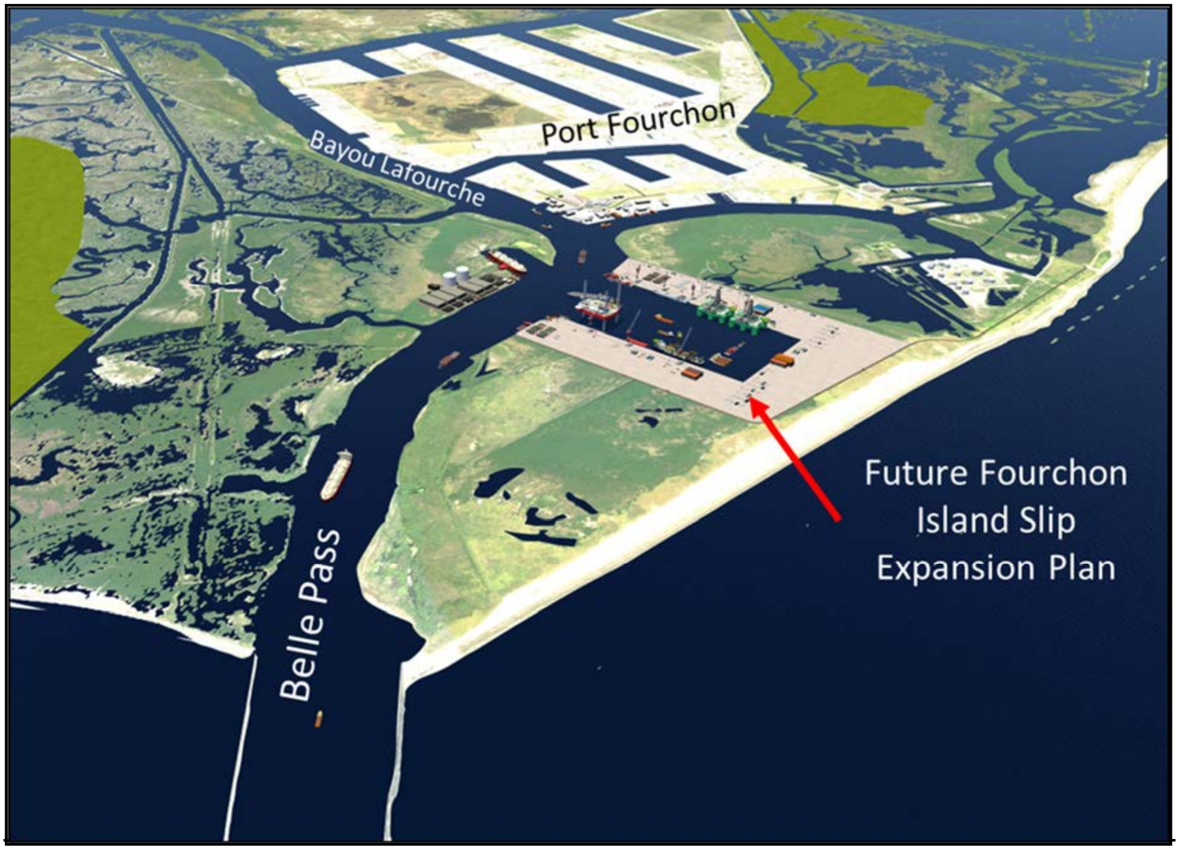

Figure 6: Fourchon Island Expansion Plans

4.0 PROJECTS RELEVANT TO TE-0171

Previous marsh creation and dredging projects in the area have allowed Port Fourchon to expand through the years. Previous marsh creation projects have used sediment from both offshore and within the Port borrow sources to create land to fortify Louisiana's coast while also protecting Port Fourchon from significant wind and wave energies. Historically, borrow sources within the Port include Bayou Lafourche, Belle Pass, and the Inner Port Slips (consisting of the Flotation Canal and Slips A, B, C, and D). Utilizing sediment available within the Port's channels has allowed not only for this area to benefit from the marsh created but also to gain efficiencies by improving, expanding, and maintaining the navigable waterways in a beneficial and sustainable way.

The following further describes past and future projects relevant to TE-0171.

4.1 Projects Relevant to the TE-0171 Marsh Creation Area

Completed in 1998, an early CWPPRA project was the West Belle Pass Headland Restoration Project (TE-0023). TE-0023 consisted of dredging portions of Belle Pass and using 1.5 million (M) cubic yards (CY) of its material to build 184 acres of marsh directly to the east of TE-0171's proposed

MCA. An additional 240,000 CY of material was also used for a beach nourishment component of this project.[30]

Another project directly connected to TE-0171 is the West Belle Pass Barrier Headland Restoration Project (TE-0052), completed in 2012. This beach, dune, and marsh restoration project borders the south of the TE-0171 MCA. It used 1.2 MCY of sand and 1.9 MCY of sediment from an off-shore source[31]. The creation of TE-0171 will help to preserve the sand in this area by keeping it from being swept into open water by strong southern winds and overtopping waves and additionally protect the area from strong northern winds. The TE-0171 Project Team has been actively collaborating with the TE-0052 Project Team to discuss the potential interactions between the two (2) projects including ECD gapping plan, hydrologic connectivity during and after construction, and the proposed TE-0171 dredge pipeline corridor. Interagency coordination will continue throughout the remainder of Phase I and into Phase II.

A final past project that connects directly to TE-0171 is the Terrebonne Basin Barrier Island and Beach Nourishment/West Belle Pass Headland Restoration Project (TE 0143/0118). This project was designed to both renourished the southern beach of TE-0052 and expand the back-barrier marsh further west. Constructed in 2020, TE 0143/0118 was hit by multiple tropical storms and hurricanes. Construction was halted for the West Belle Pass MCA after Hurricane Zeta hit in October when the project was 80% constructed. The project is to be reconstructed through FEMA under the project name TE-0176 West Belle Headland Repair Project.

Construction reports from TE-0052 and TE-0143/TE-0118 were utilized to understand the wind and wave energy that is present in this area. These reports and the design of these two (2) projects were heavily considered for design decisions made for TE-0171. The construction reports were specifically evaluated for the ECD design for TE-0171. The usage of these reports is detailed in a technical memorandum that can be found in Appendix F.

TE-0176 is currently in Engineering & Design to repair part of TE-0143/TE-0118[32]. As of May 2024, FEMA's Office of Risk Management has issued a Finding of No Significant Impact for the TE-0176 project in their Final Supplemental Environmental Assessment and is expected to go to construction prior to TE-0171[33]. This project will sit directly south west of TE-0171. Differing from the original project, TE-0176 will not be utilizing ECDs and will instead be pumping in sand to the area. Therefore, TE-0171 is expected to be built with a sandy area at the south west corner. Additionally, this project is expected to greatly change the landscape around a small area of TE-0171's MCA. Therefore, it is recommended that as-built surveys from the construction completion of TE-0176 be acquired by the TE-0171 team prior to Phase II engineering & design. This survey data would allow for minor MCA changes to be made, as needed, to maximize the synergies of TE-0171 and TE-0176.

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[30] TE-0023 Project Completion Report Maintenance Dredging As-Built Drawings, March, 2000

[31] TE-0052 Project Fact Sheet, Aug. 2013; TE-0052 95% Design Report, Sept. 2009

[32] TE-0176 CIMS Project Website, accessed July 2024

[33] FEMA TE-0176 Final Supplemental Environmental Assessment, May 2024

The TE-0171 team has been in contact with the TE-0176 team to discuss how to best design TE-0171 to maximize synergies between the two projects. Further communications with the TE-0167 team will continue, as necessary, through Phase II of TE-0171.

4.2 Projects Relevant to the TE-0171 Borrow Area

The TE-0171 BA involves dredging an active navigation channel. Dredging in this area is common and can quickly happen on an as needed basis. Due to this, two (2) potential overlaps exist between TE-0171 and other projects (Figure 7).

The first overlap is with the West Fourchon Marsh Creation and Nourishment Project (TE-0134)[34]. This project is currently in final design to create up to 814 acres of marsh and nourish 458 acres of marsh by dredging Belle Pass, Bayou Lafourche, and the Inner Port Slips to an elevation of -33.61 ft NAVD 88 (-33 ft MLLW).[11] The borrow area for this project consists of Bayou Lafourche, Belle Pass, and the Inner Port Slips. The overlap with TE-0171 occurs in Belle Pass from Sta. 140+00 to Sta. 330+00. TE-0134 will dredge this area to a final elevation of -33.61 ft NAVD 88 (-33 ft MLLW). It is anticipated that the construction of TE-0134 will precede the construction of TE-0171. Therefore, an existing mudline elevation of -33.61 ft NAVD 88 (-33 ft MLLW) has been assumed from Sta. 140+00 to Sta. 330+00 for the design of TE-0171.

A second overlapping project in this area is the Port Fourchon Belle Pass Channel Deepening Project. This project is conditionally authorized to a dredging elevation of -30.61/-32.61 ft NAVD 88 (-30 ft/-32 ft MLLW) from overlapping Sta. 140+00 to Sta. 330+00 in Belle Pass. While this footprint is covered in the dredging of TE-0134, an additional four (4) ft of advance maintenance is allowed. Therefore, a maximum channel mudline elevation of -36.61 ft NAVD 88 (-36 MLLW) is possible through this project. It is anticipated that TE-0171 will go to construction before the commencement of dredging activities under the Port Fourchon Belle Pass Channel Deepening Project.[35] This overlap with advance maintenance is not assumed to be a conflict.

Due to some schedule uncertainties associated with these different projects, GISE evaluated the current status of the overlapping projects in the area and proposed a mitigation plan for each scenario, should the current design assumptions for TE-0171 change (Table 4). Volumes expected to be removed through overlapping projects were considered in the TE-0171 BA design and are shown in Table 17 within Section 8.4.

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[34] TE-0134 Technical Memorandum, July 2023; TE-0134 95% Design Report, Oct. 2018

[35] Pipeline relocations must be completed prior to the start of dredging activities under the Port Fourchon Belle Pass Channel Deepening project.

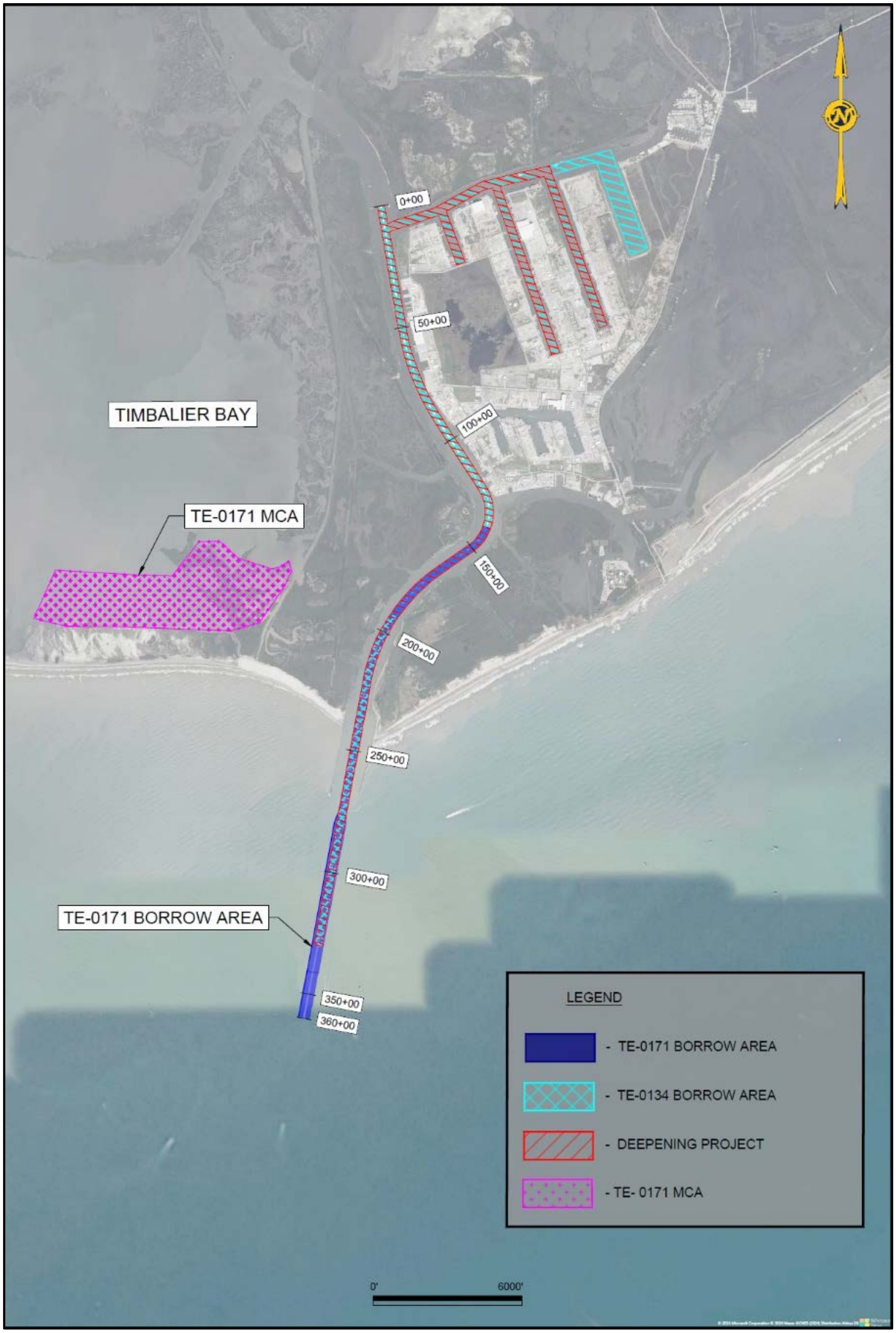

Figure 7: Port Fourchon Projects Overlapping with TE-017

Table 4: TE-0171 Overlapping Port Fourchon Projects

Chronological Project Order*	Project Name	Current Assumption	Mitigation Plan if Current Plan Changes
1	TE-0134 West Fourchon Marsh Creation and Nourishment Project	TE-0134 precedes the construction of TE-0171. Channel water bottom elevation for TE-0171 assumes post TE-0134 condition at -33 ft MLLW (-33.61 ft NAVD 88).	- If both projects go into construction at the same time, dredging activities for TE-0171 would be directed to start at the southernmost station in the Gulf of Mexico to avoid conflicts while both contractors are in the field. - If TE-0171 goes into construction before TE-0134, TE-0171 would utilize the sediment from the existing channel mudline, currently intended for TE-0134. Though this would modify the proposed borrow area footprint for TE-0171, the necessary geotechnical and survey data to adjust the design as needed has already been obtained.
2	TE-0171 Port Fourchon Marsh Creation Project		
3	Port Fourchon Belle Pass Channel Deepening Project	Due to uncertainties surrounding the timeline of the USACE deepening project (including the satisfaction of the authorization conditions, completion of the Pre-Construction Engineering and Design (PED) phase, and appropriations of construction funds) the current assumption is that TE-0171 would precede the construction of the deepening project. This means TE-0171 would remove sediment from the advance maintenance footprint of the deepening project in Belle Pass (roughly 300,000 CY** based on the latest survey data available). Potential funding participation from the USACE will be addressed at a later date, once the Deepening project's construction timeline becomes more definite.	- If the Port Fourchon Belle Pass Channel Deepening project starts dredging activities prior to the commencement of TE-0171, the currently proposed borrow area footprint for TE-0171 would need to be modified to reflect the post-deepening project conditions (existing channel water bottom elevation at -36 MLLW, from Sta. 240+00 to 330+00 in Belle Pass). The necessary geotechnical and survey data to adjust the design of the TE-0171 BA, as needed, to accommodate to this potential scenario has already been obtained.

** Project Order Number is based on the anticipated start of construction for each project.*

*** Sedimentation will continue to occur naturally in Belle Pass, which can be further affected by unforeseen events such as tropical storms or hurricanes. Therefore, predicting the exact amount of overlapping sediment with TE-0171, if any, at the start of the deepening project's construction, and without knowing the construction timeline, is difficult and will need to be re-evaluated in the future as needed.*

5.0 EXISTING CONDITIONS

5.1 Landownership

A landowner map was created by sourcing public databases available from Lafourche Parish Assessor[36], SONRIS[37], and private databases from GLPC and Louisiana Land and Exploration. Through this exercise it was determined that the MCA appears to be owned by the State of Louisiana. The entirety of the BA is a federal navigation channel and will require a Section 408 permit to dredge (see Section 10.1 and Appendix M). The DPC and proposed Headland EAC appear to be on State owned lease land. Similarly, the proposed Timbalier EAC appears to be on State owned water bottom. A map of the landowners in the area can be seen as Figure 8 and Appendix J.

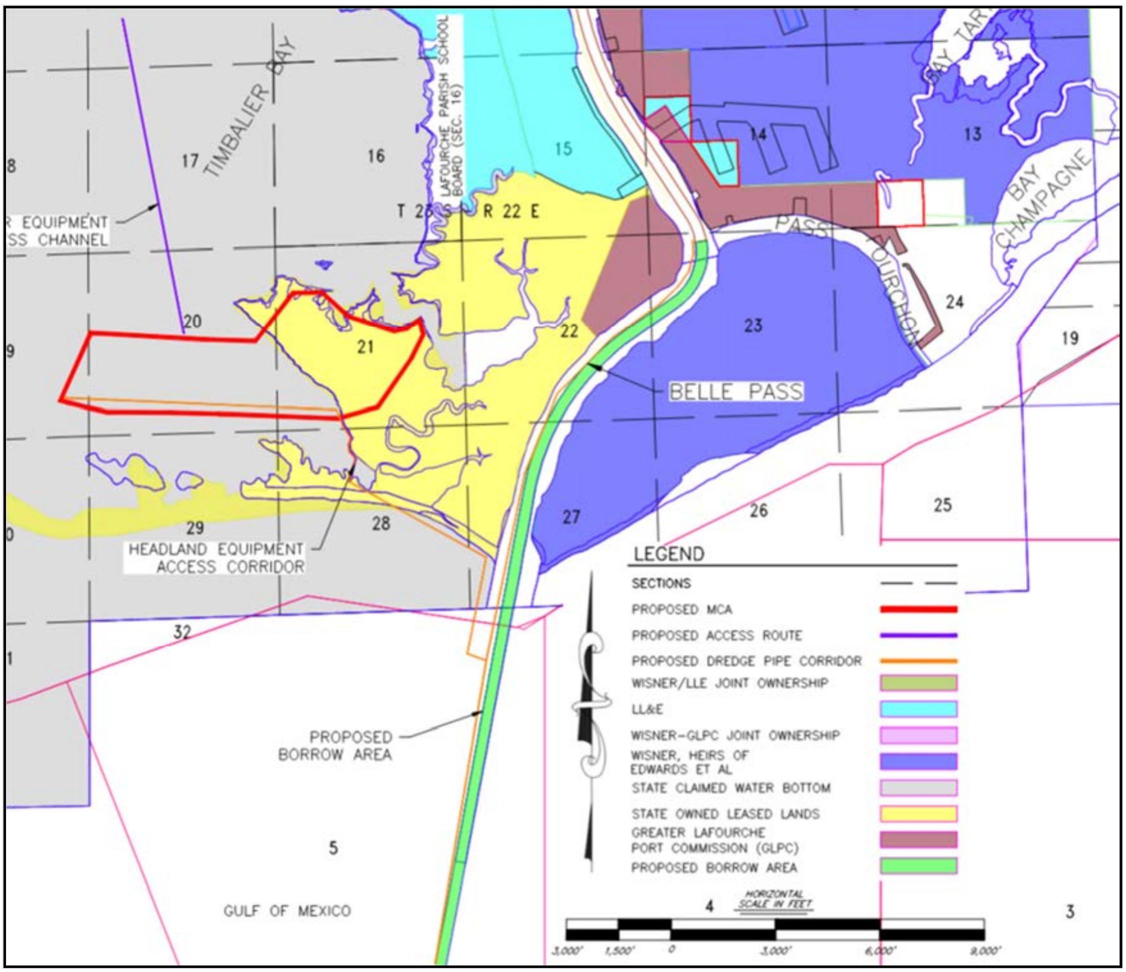

Figure 8: Landowners in TE-0171 Project Area

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[36] Lafourche Parish Assessor GIS Maps, accessed June 2024

[37] DENR SONRIS, accessed August 2023

5.2 Pipelines

As part of this design effort, GISE contacted pipeline companies in an attempt to confirm the location and status of the pipelines in the project area. GISE utilized magnetometer data to evaluate missing and unconfirmed pipelines. Pipelines were additionally probed in attempt to confirm the pipeline depth. Pipeline investigation and communications with pipeline companies will continue during Phase II of this project. Survey and pipeline probing results can be found in Appendix C.

Six (6) pipelines have been discovered in or in the immediate vicinity of the TE-0171 MCA and BA. For this project, no pipelines will be removed or relocated. Therefore, any pipelines deemed in conflict with the project will require a dredging avoidance area if located within the proposed BA. Dredge avoidance areas are currently designed to be a minimum of 100 ft in either direction of the pipeline as per GISE's experience with pipeline right of way (ROW) regulations and ongoing discussions with pipeline companies in this area for other projects. Before TE-0171 goes to construction, pipeline companies will be consulted to ensure the 100 ft dredge avoidance area is sufficient for each specific pipeline. However, the BA design has enough contingency to support the expansion of the ROW limits if needed.

Additional pipelines have been found inside the proposed DPC. The dredge pipeline will float over these existing pipelines; therefore, no further evaluation was completed at this stage of the design, as no conflict is anticipated. The owners of these pipelines will be contacted during Phase II to be notified of the TE-0171 project.

5.2.1 Pipelines in the Project Placement Area

While no pipeline crossings have been identified within the MCA, one (1) pipeline is located in close proximity to the MCA's eastern ECD alignment (Figure 9). During this 95% design phase, the eastern ECD alignment was slightly shifted westwards in order to avoid any potential conflicts with this pipeline. The current ECD alignment now has at minimum 100-ft buffer between the external toe of the ECD and the pipeline.

The pipeline along the MCA is a 16-in Kinetica line that has approximately 11 ft of cover over the line (Table 5). It is currently active and is located within the pipeline canal that runs parallel to the ECD on TE-0171's eastern side. No construction activities are expected to interfere with this existing pipeline.

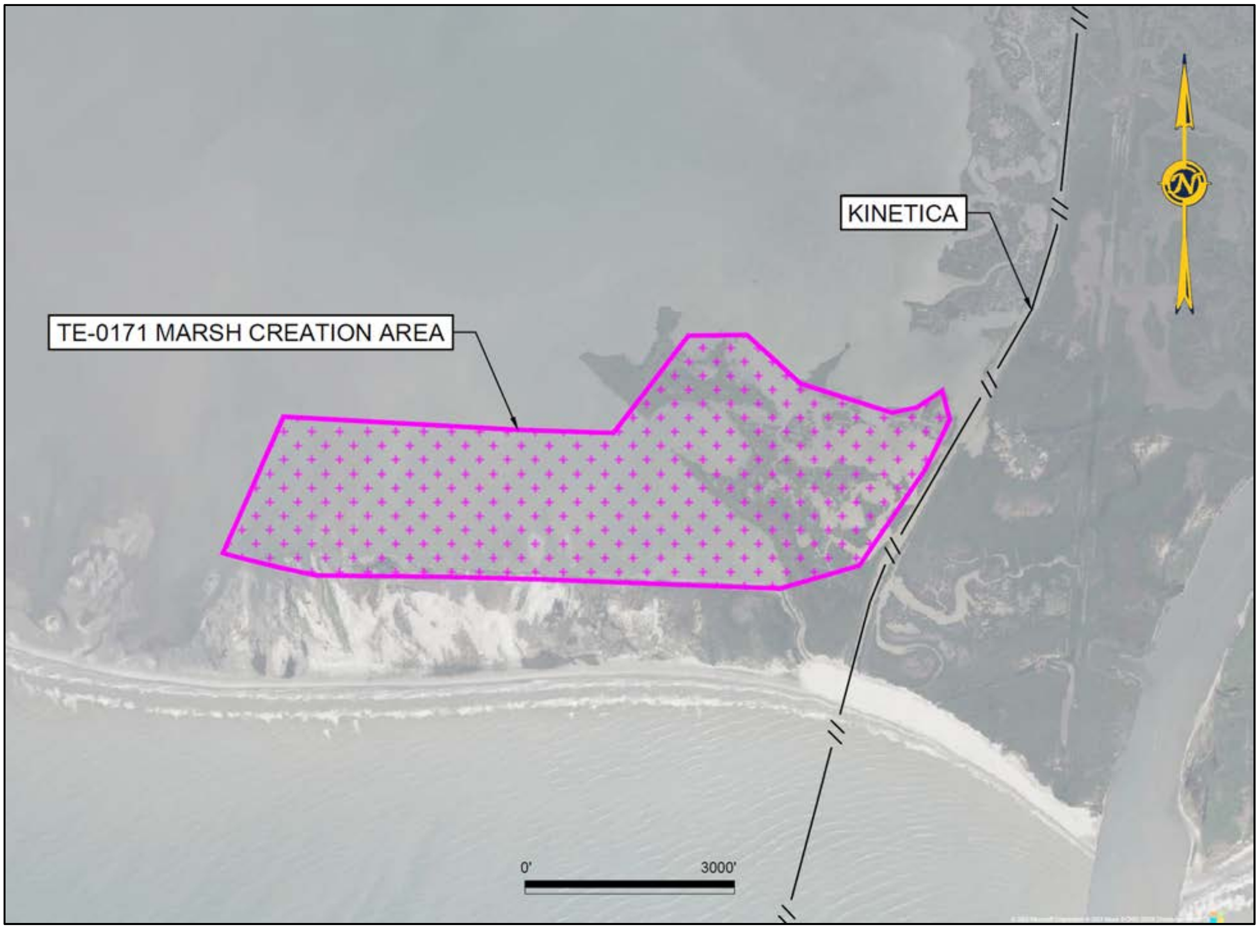

Figure 9: Pipeline Near TE-0171 MCA

Table 5: Pipelines Near the Marsh Creation Area

No.	Operator	Crossing Location	Size	Description	Depth	Crossing Conflict Status	Pipeline Status
1	Kinetica	Parallel to East ECD	16 in	Gas	-12.66 ft NAVD88	NO CONFLICT (CONFIRMED)	Active in the pipeline Canal, greater than 100 ft from eastern ECD alignment

NO CONFLICT (CONFIRMED)

5.2.2 Pipelines in the Project Borrow Area

Five (5) pipelines have been found within the BA footprint. However, only two (2) pipelines were found to be in conflict with the proposed dredging footprint. The other three (3) pipelines are either at non-conflicting depths or have been removed from the channel. Dredging avoidance areas have been designed for both of the pipelines in conflict with the BA. These avoidance areas have been considered in the design and calculation of available borrow volume.

The first pipeline in conflict is an abandoned 10-in crude oil Chevron pipeline located in Belle Pass at Sta. 199+27 at an elevation of -38.07 ft NAVD 88. This pipeline is in the early stages of removal for the Port Fourchon Belle Pass Channel Deepening project. GISE is in communication with Chevron in regards to this line and will be monitoring the progress of its removal. Once removed, this pipeline will no longer be a conflict and the avoidance area will be eliminated. GISE anticipates the removal of this pipeline before the construction of TE-0171 to be likely. However, due to its current abandoned in place status, this pipeline will remain as an avoidance area until removal of this line is completed.

The second pipeline in conflict with the BA is a 12-in abandoned in place EnLink Midstream gas pipeline. This pipeline crosses Belle Pass at Sta. 335+00 at an approximate elevation of -41.87 ft NAVD 88. While this pipeline is currently required to be removed for the Port Fourchon Belle Pass Channel Deepening project, coordination for removal has not started. This coordination and construction is expected to take up to 18 months. Therefore, it is likely that this pipeline will still be in place during the construction of TE-0171. A dredge avoidance area for this pipeline is conservatively assumed to be present through construction. However, this avoidance area can be removed if pipeline removal is completed before TE-0171 is advertised for bids.

The locations of these pipelines can be seen in Figure 10. A list of identified pipelines in the BA and their pertinent information can be found in Table 6.

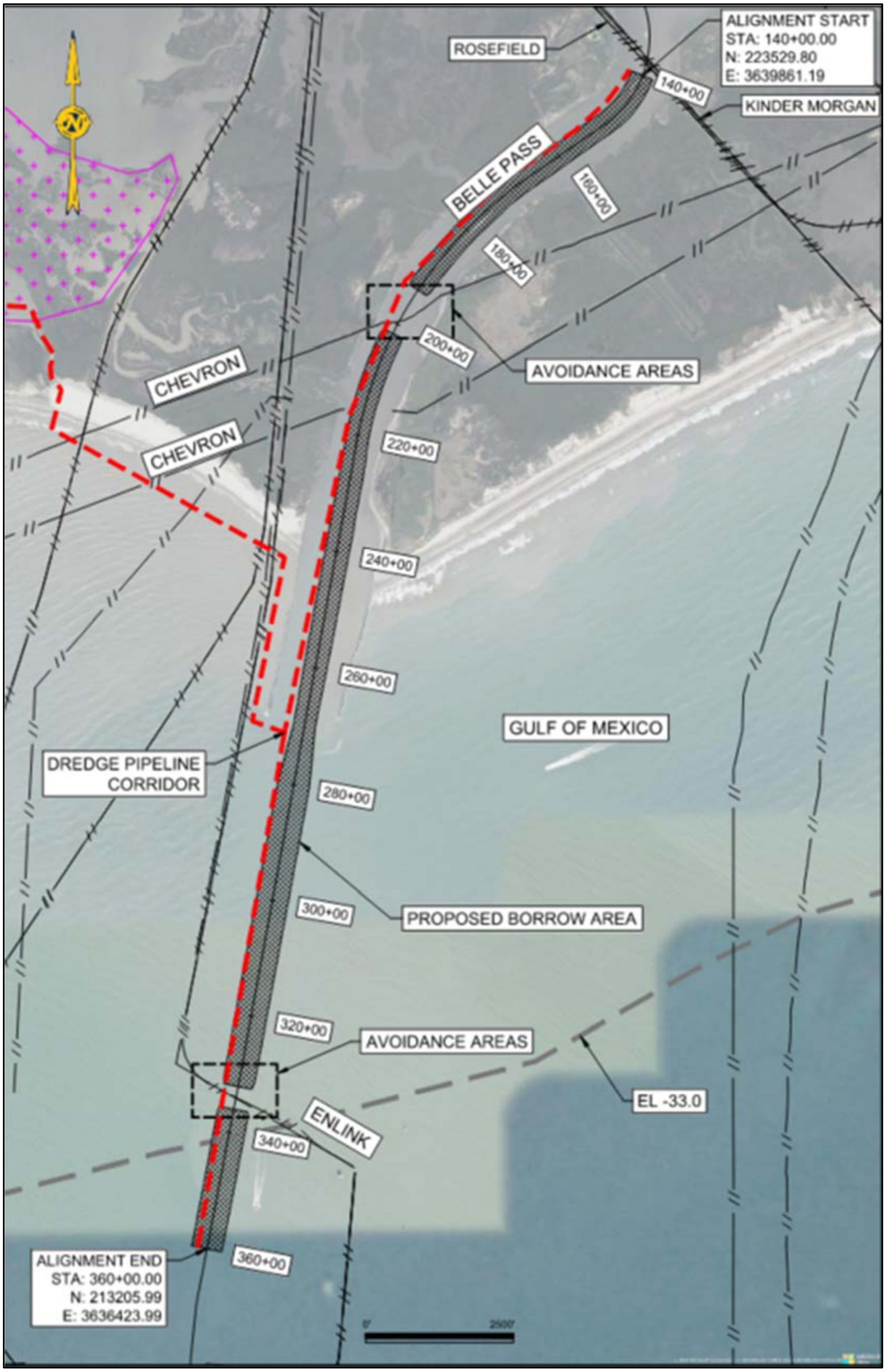

Figure 10: Pipeline Crossings within BA with Dredge Pipeline Corridor

Table 6: Identified Pipelines Crossings in BA

No.	Operator	Crossing Location	Size	Description	Depth	Crossing Conflict Status	Pipeline Status
1	Kinder Morgan	Sta. 137+50	6 in	Gas	-73.87 ft NAVD 88	NO CONFLICT (CONFIRMED)	Permanently Abandoned Outside dredging footprint
2	Rosefield Pipeline Company	Sta. 138+11	10 in	Crude Oil	-51.87 ft NAVD 88	NO CONFLICT (CONFIRMED)	Active Outside dredging footprint
3	Chevron Pipeline	Sta. 199+27	10 in	Crude Oil	-38.07 ft NAVD 88	CONFLICT (CONFIRMED)	Permanently Abandoned In the removal process
4	Chevron Pipeline	Sta. 215+00	6 in	Crude Oil	N/A	NO CONFLICT (CONFIRMED)	Removed from channel
5	EnLink Midstream	Sta. 335+00	12 in	Gas	-41.87 ft NAVD 88	CONFLICT (CONFIRMED)	Permanently Abandoned

No Conflict (Confirmed)
Conflict (Avoidance Area)

5.2.3 Pipelines in the EAC

One pipeline was discovered in the proposed Timbalier EAC for this project (Figure 11). While site access is ultimately up to the contractor's discretion, GISE proposes an EAC to be used for this project in case the contractor decides to utilize clamshell bucket equipment to build the proposed enhanced ECDs. This pipeline is the same 10-in Rosefield line seen in Table 6. While not in conflict for the proposed BA, the pipeline depth of cover does change as it moves away from the channel. Probing results concluded that if an EAC is dredged to -6 ft NAVD 88, the minimum depth of cover over the line would be 7.58 ft. GISE has been in contact with Rosefield Pipeline Company, and no concerns with excavating an EAC to -6 ft NAVD 88 have been brought up.

Coordination with Rosefield Pipeline Company will continue to take place throughout the final design phases of the project to ensure their conditions are followed for the sake of a safe implementation of the project. While GISE has designed excavation over this line and throughout the EAC, this feature is strictly optional and up to the discretion of the contractor's means and methods.

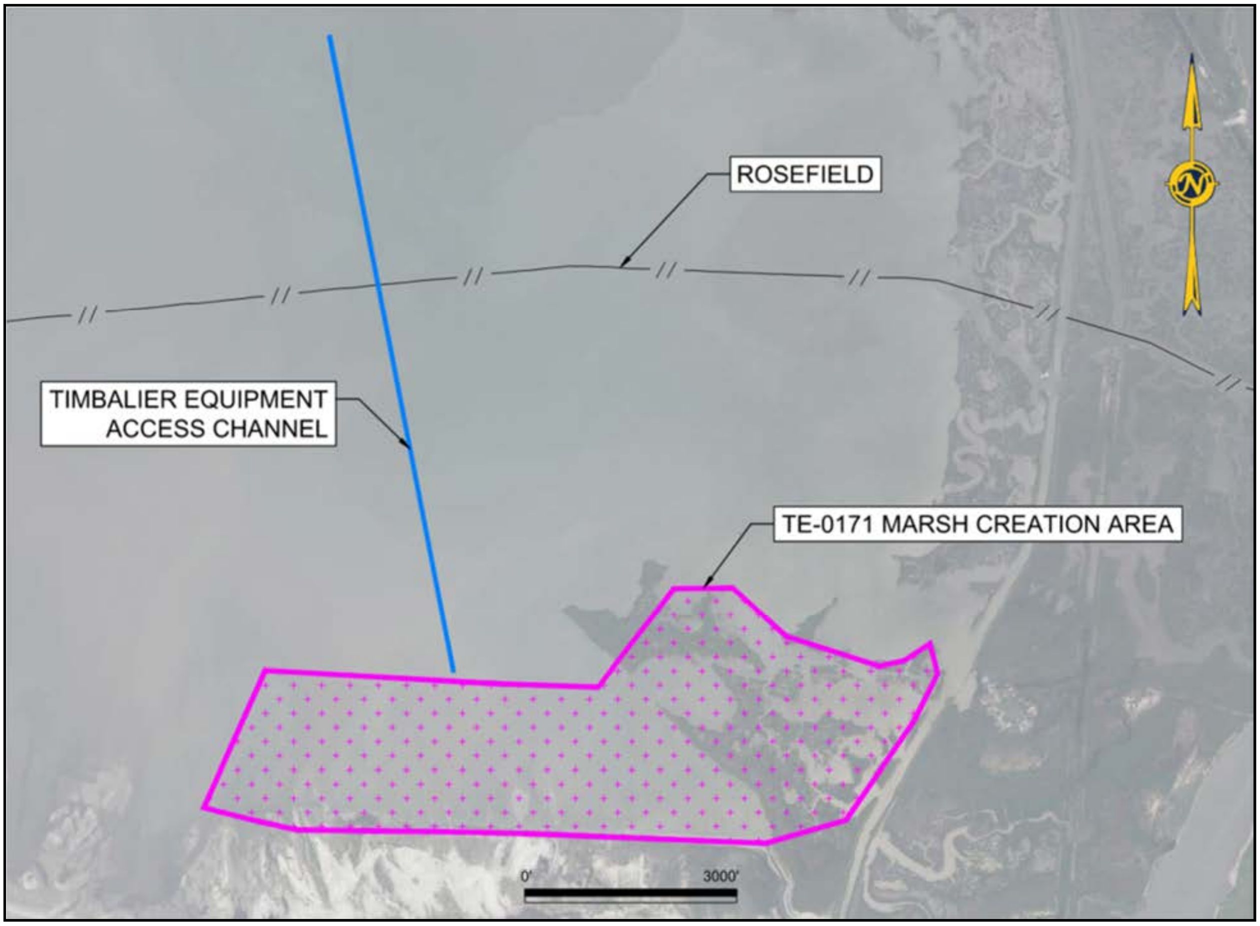

Figure 11: Pipeline Crossings within Timbalier Equipment Access Channel

5.3 Oil and Gas Wells

GISE identified nearby water, oil, and gas wells in an HTRW/Phase I Environmental Site Assessment (Appendix E). GISE completed both an EDR well search (Appendix E; Attachment E) and a Strategic Online Natural Resources Information System (SONRIS)[38] database search for wells in the area. There are four (4) dry and plugged oil and gas wells near the BA, and two (2) dry and plugged oil and gas wells near the MCA (Table 7).

Well No. 36484 is approximately 140 ft from the BA dredging footprint. Well No. 118526 and Well No. 36484 are the only two (2) wells that may be in conflict with the project's footprint. However, due to their locations and status (dry and plugged), only slight changes to the MCA and BA boundaries may be required. This will continue to be evaluated during the final design stages of this project. Well locations can be found in Figure 12.

[38] DENR SONRIS, accessed July 2024

Table 7: Nearby Identified Oil & Gas Wells

Well ID	Status	Approximate Location	Notes
127378	Dry and Plugged	Sta. 140+00 (within marsh)	No. 5 on EDR Well Search Map
34281	Dry and Plugged	Sta. 160+00 (within marsh)	No. 9 on EDR Well Search Map
36484	Dry and Plugged	Sta. 180+00 (within channel)	No. 10 on EDR Well Search Map
135111	Dry and Plugged	Sta. 215+00 (within marsh)	No. 12 on EDR Well Search Map
42559	Dry and Plugged	Western ECD of TE0052	Found on SONRIS
118526	Dry and Plugged	Northern ECD of TE0052	Found on SONRIS

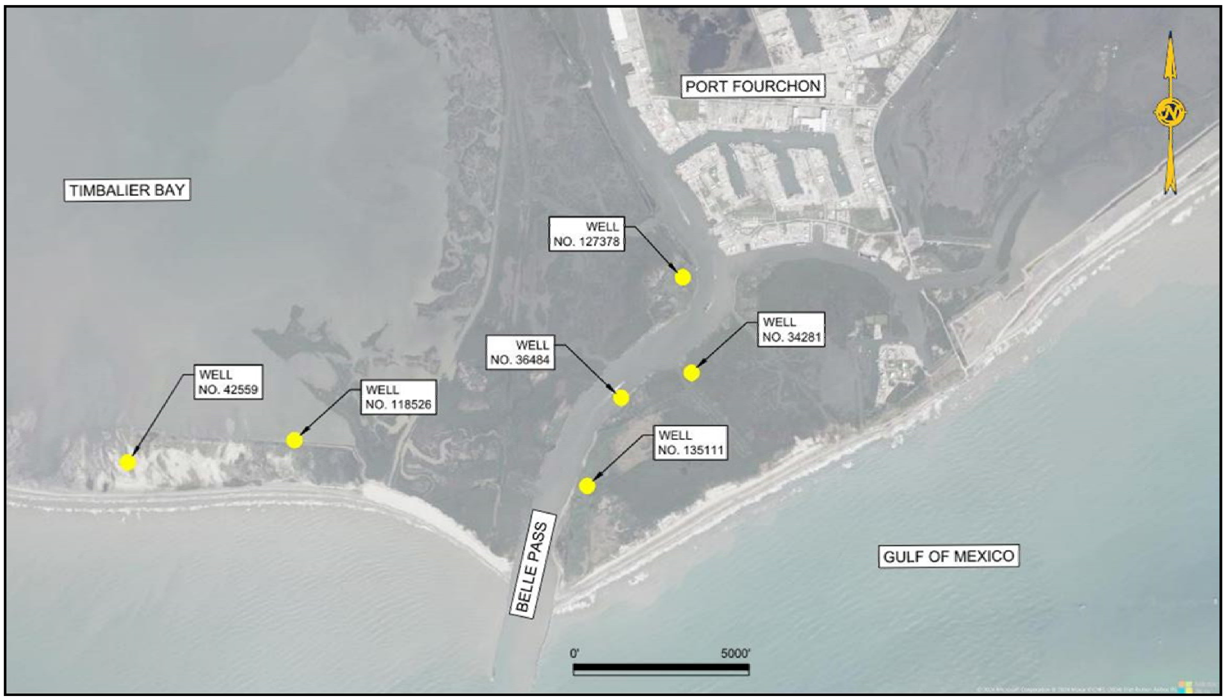

Figure 12: Oil and Gas Wells Near TE-0171

5.4 Cultural Resources

ELOS Environmental completed the cultural resources investigation for TE-0171. They were issued a Notice to Proceed (NTP) on September 21, 2023, to complete a literature review and research design desktop analysis. This desktop analysis was sent to CPRA and EPA on November 30, 2023, and it was approved on December 6, 2023.

In this desktop report, a Phase I Marine Remote Sensing Survey was recommended for the Belle Pass borrow area. On December 7, 2023, ELOS was given an NTP to begin work on the Cultural Resources Survey.

ELOS joined GISE's survey team for a field survey investigation from January 29, 2024 to February 1, 2024. GISE prepared the data sets and furnished them to ELOS on March 26, 2024.

ELOS submitted a completed Cultural Resources Assessment Report on April 3, 2024. The report concluded that none of the 411 magnetic anomalies that were found represent significant cultural resources and the project would have no adverse effects on historic properties. The final report was submitted to the State Historic Preservation Office (SHPO) on July 24, 2024. SHPO sent comments on the report on September 9, 2024. These comments have been addressed, and the final revised version can be found in Appendix D.

5.5 HTRW

GISE conducted a Phase I Environmental Site Assessment (ESA) and Hazardous, Toxic, and Radioactive Waste (HTRW) Assessment for the MCA. The ESA was performed in conformance with the scope and limitations of ASTM Practice E1527-21[39] and the All Appropriate Inquiry Standard [40 CFR §312] on the project footprint (including the alternative BA).

The scope of this assessment includes a records review of 1) historical aerial photography; 2) soil survey information; 3) registered oil and gas well and pipeline data; 4) water well data; 5) USGS 7.5-minute topographic maps; 6) historical city directories; and 7) fire insurance (Certified Sanborn) maps. Additionally, GISE reviewed a previous Port Fourchon HTRW assessment, which has a significant geographical overlap with the TE-0171 Project and included sediment contaminant testing.

The Project Team conducted a site reconnaissance of the area utilizing a drone and an outboard motor boat on February 20, 2024. Interviews were also conducted with personnel knowledgeable about the project footprint (GLPC) as well as the appropriate state (CPRA) and federal (USACE) regulatory agencies relative to the environmental history of the area.

GISE did not identify activities at the subject property or at neighboring properties that would indicate a significant potential for recognized environmental conditions (REC). A full report on the HTRW/ESA is included in Appendix E.

5.6 Oyster Lease

GISE reviewed the Louisiana Department of Wildlife and Fisheries (LDWF) oyster lease database[40] for oysters within 1,500 ft of the project area. The closest oyster leases to the MCA and the BA are greater than 1,500 ft away. However, two (2) oyster leases are just past the 1,500 ft buffer zone of the MCA. The information on these oyster leases can be found in Table 8. There is currently no need to evaluate, acquire, or extinguish these oyster leases due to their distance from the project footprint.

[39] ASTM E1527-21 Standard Practice for Environmental Site Assessments: Phase I ESA Process, Dec. 2021

[40] LDWF Oyster Map, accessed August 2024

Table 8: Nearby Oyster Lease Information

Lease ID	Lessee	Expiration	Distance from MCA (feet)
20090376	Srecka Taliancich	1/1/2025	1,730
3148920	Danny J. Gaspard	1/1/2035	1,571

5.7 Tidal Datum

A tidal datum defines the tidal phases in a project area to standard elevations. This tidal information has been utilized to determine a target marsh fill elevation (TMFE) that will optimize the health of a marsh throughout the project's life (20 years) (Section 8.2.1). Tidal datums consist of mean high water (MHW), mean low water (MLW), and mean tidal level (MTL).

Additionally, tidal datums are compared to inundation levels. This refers to the elevation at which the marsh is inundated for a certain percentage of time. Depending on the salinity level in an area, different inundation ranges are optimal for a healthy marsh. Salinity data from the Coastal Reference Monitoring System (CRMS) Station 0292 show that the average monthly salinity in this area was 24.38 parts per thousand (ppt) from January 2020 to May 2024 (Figure 13).[41] Due to the documented salinity level being greater than 9.5 ppt,[42] this location has been classified as a saline marsh. As per the recommendations in CPRA's Marsh Creation Design Manual, the optimal inundation range for saline marshes in southern Louisiana is between 20%-80%.[43]

[41] CRMS Wetlands Monitoring Data, accessed May 2024

[42] CPRA 2023 Habitat Suitability Index (HSI) Model

[43] CPRA Marsh Creation Design Guidelines, Nov. 2017

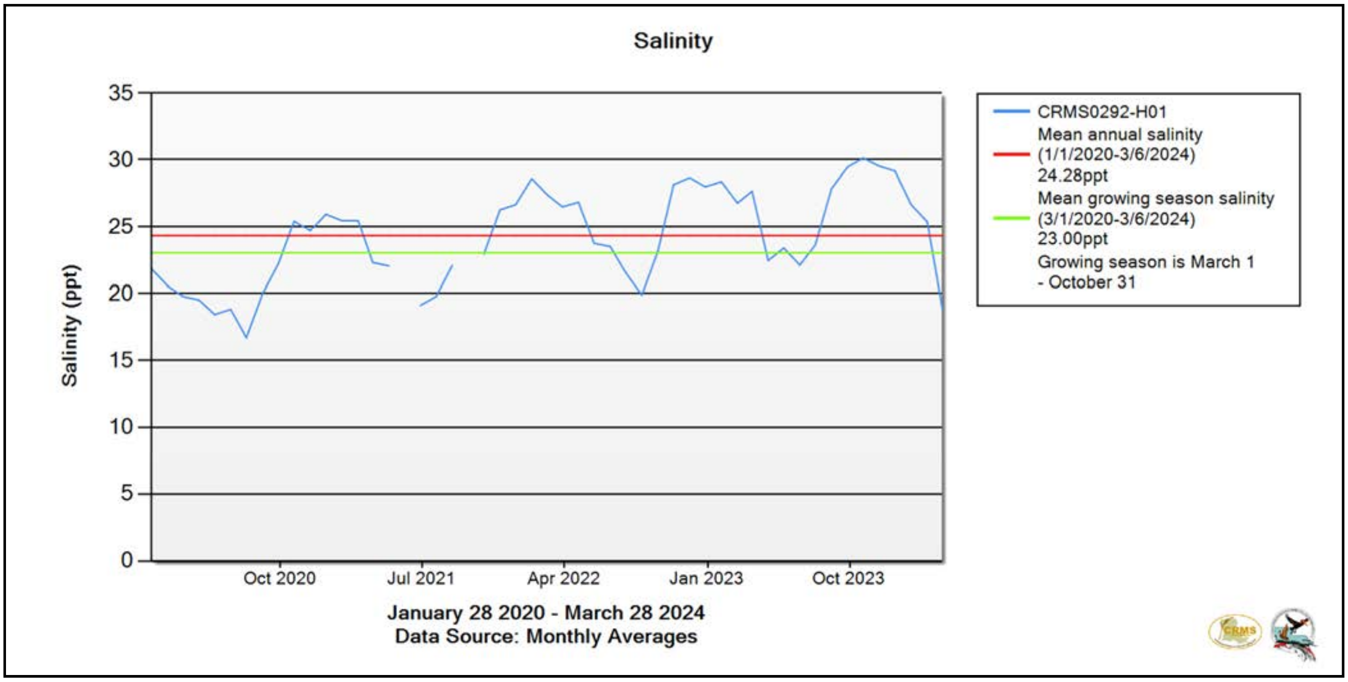

Figure 13: Historical Salinity at CRMS Station 0292[41]

GISE collected existing hydrological data from CRMS and processed the data in accordance with CPRA's Marsh Creation Design Guidelines.[19] The station used for TE-0171 was CRMS0292 (-29.14218, -90.22924). This station is located approximately 2.55 miles northeast of the MCA (shown in Figure 14). A 5-yr window (starting on January 1, 2018 and ending on December 31, 2022) was assumed for data collection.

Figure 14: Nearby CRMS Station Location

The MHW for TY 0 was determined by calculating the average of the daily highest water level readings from the five (5) years of hourly water level data collected from CRMS0292. Similarly, the MLW was determined by calculating the average of the daily lowest water level readings from the five (5) years of hourly water level data collected from CRMS0292. The MTL was then calculated by computing the mean of the MHW and MLW values. These values are summarized in **Table 9**. The TY 20 values were determined by incorporating the Eustatic Sea Level Rise (ESLR) expected throughout the project's 20-yr life.

Table 9: Tidal Datum Evaluation

Datum	Elevations (ft NAVD88 GEOID 12A)	
	TY0 (2027)	TY20 (2047)
MHW	1.309	1.840
MLW	-0.061	0.470
MTL	0.624	1.155

5.8 Relative Sea Level Rise

To properly design TE-0171 to a project life of 20 years, the Relative Sea Level Rise (RSLR) must be evaluated. RSLR can be broken down into two (2) components: ESLR and subsidence. For this project, these two (2) components were evaluated separately so that regional subsidence rates could be compared to the mudline of the MCA and the ESLR can be compared to the water levels and inundation levels individually.

CPRA's Coastal Master Plan provides Gulf Regional Sea Level (GRSL) Rise scenarios for predicting ESLR between the years 2000 and 2100. Further explanation on the GRSL rise is provided in the CPRA 2023 Coastal Master Plan: Technical Appendices, Appendix B2 "Scenario Development."[44]

Based on CPRA's common practice, the 1.0-meter (m) scenario which is denoted as the "low scenario," was chosen for the ESLR calculation. From CPRA's RSLR calculation spreadsheet, the difference in "Sea-surface Change Relative to Base Year (m)" calculations from the years 2027 to 2047 were used for tidal datum and inundation calculations. This calculation applies the Gulf historical linear ESLR of 0.0027 m/yr to the future Gulf sea level rise 1.0-m scenario to provide predicted ESLR for years 2000-2100. The difference in sea surface change calculated was used to show the difference in the water level elevations for TY 0 (2027) and TY 20 (2047). The difference between ESLR from 2027 and 2047 was calculated to be 0.532 ft.

Subsidence rate was determined based on the 2023 Coastal Master Plan Attachment B3: Determining Subsidence Rates for Use in Predictive Modeling.[17] The ecoregion eastern Terrebonne basin has a 20th percentile of 10.21 mm/yr subsidence rate which is equivalent to 0.67 ft over the project's 20-year life.

5.9 Marsh Percent Inundation Calculation

To calculate the elevation for marsh percent inundated, GISE calculated the elevation for every 10% inundated (in addition to 1%) with the data collected from CRMS.[41] This was used to create the marsh percent inundated at TY0. TY20 was also calculated for the same inundated percentages by adding to the TY0 values the difference between the 2047 RSLR and 2027 RSLR calculated in CPRA's RSLR Excel spreadsheet. The marsh percent inundation elevations can be seen in Table 10.

[44] Pahl et. al. 2023

Table 10: Percent Inundation Calculated Values

Percent Inundated	TY0 Elevation (2027) (ft NAVD 88)	TY20 Elevation (2047) (ft NAVD 88)
1%	2.161	2.692
10%	1.453	1.985
20%	**1.173**	**1.705**
30%	0.983	1.515
40%	0.813	1.345
50%	0.653	1.185
60%	0.483	1.015
70%	0.293	0.825
80%	**0.073**	**0.605**
90%	-0.217	0.315

The tidal datum elevations (MHW and MLW), determined as per Section 5.7, are represented graphically in Figure 15 with the upper and lower marsh inundation limits plus ESLR. The tidal datum (MHW+ESLR and MLW+ESLR) has been used as a reference for the design of this project, while the inundation percentages (20%+ESLR and 80%+ESLR) are to be used as the target for optimal MCA platform elevation. Figure 15 was also utilized by Eustis, along with geotechnical data, to determine the TMFE. Additional information can be found in Section 8.2.1.

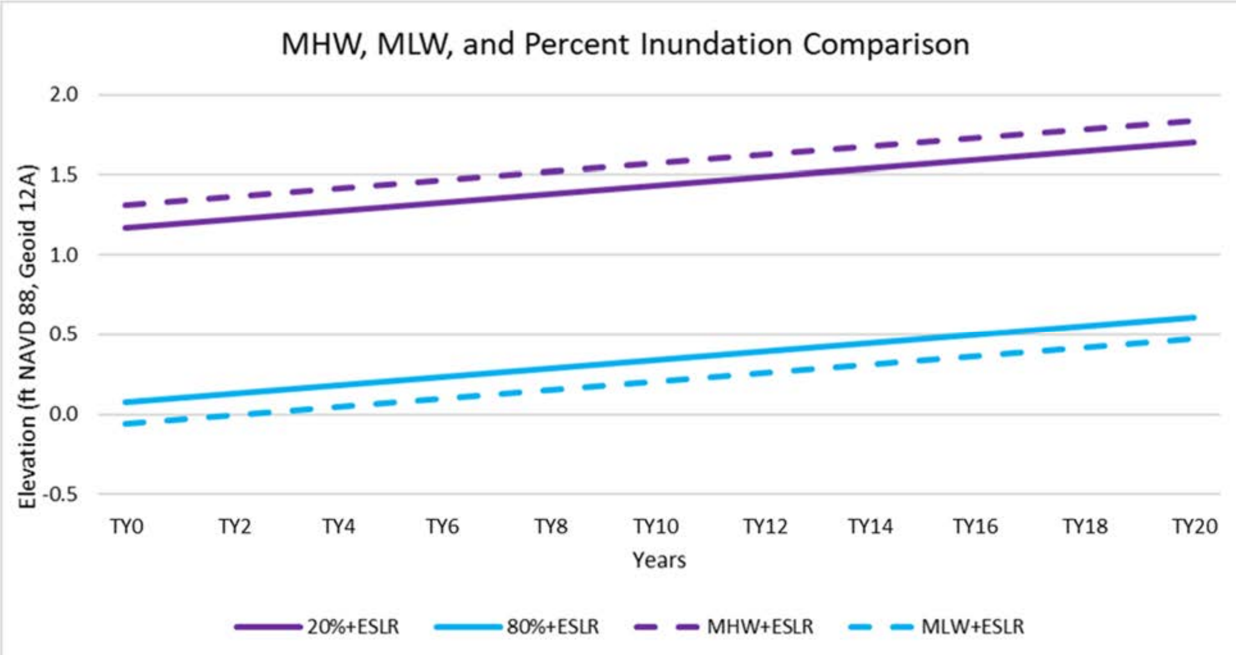

Figure 15: Tidal Datum and Percent Inundation Over Project Design Life

5.10 Wind Data

Hourly wind data from December 12, 1984 to May 22, 2022 were analyzed and averaged into monthly data. Data were collected from the National Data Buoy Center (NDBC) at stations GDIL1 and GISL 1-8761724. Both NDBC stations are located on the eastern side of Grand Isle, Louisiana. Data from GDIL1 was used until it was damaged by Hurricane Katrina after the 9th reading on August 29, 2005. Station GISL 1-8761724 replaced the broken station less than three (3) months later on November 3, 2005. The remaining wind data used were collected from this new station. While GDIL1 collected data every hour, station GISL 1-8761724 collected data every 6 minutes. In order to remain consistent, only the data points at the top of each hour from station GISL 1-8761724 were used, the rest of the data points were discarded. Table 11 shows additional information about the two (2) stations used for data collection.

Table 11: Wind Station Data Information

Wind Station	Coordinate Location	Data Collection Period	Time Period of Data Available	Distance from MCA (miles)
GDIL1	29°16’0” N 89°57’24” W	Hourly	12/17/1984 - 8/29/2005	20.1
GISL1 - 8761724	29°15’53” N 89°57’27” W	Every Six (6) Minutes	11/4/2005 - 5/22/2020	20.0

From the hourly wind data gathered from the NDBC stations, monthly wind statistics were calculated to show typical conditions that the project experiences relative to each month and can be seen in Table 12. The average monthly wind speed during this time period was 10.1 miles per hour (mph) with an average wind direction of 156° (SSE). Through further analysis of the monthly wind data, it was observed that the strongest winds occurred from November (11.1 mph) to February (11.2 mph). January had the strongest measured wind speed of 11.6 mph at an average wind direction of 151° (SSE).

Table 12: Monthly Wind Statistics

Month	Average Wind Speed (mph)	Average Wind Direction (degrees from North)
January	11.6	151
February	11.2	151
March	10.9	157
April	11.0	159
May	9.6	160
June	8.5	174
July	7.7	196
August	7.7	179
September	9.4	134
October	10.9	127
November	11.1	134
December	11.3	144
Averages	10.1	156

Directional percentage occurrence (Figure 16), directional mean windspeed (Figure 17), and directional wind speed intervals (Figure 18) were also calculated. Directional wind statistics were computed to analyze wind intensity as it pertains to cardinal wind directions. The NNW direction averaged the highest wind speed (13.2mph), while winds from the SSW averaged the lowest speed (7.7 mph). Additionally, E wind was the most commonly occurring wind direction and WNW wind was the least commonly occurring wind direction (9.48%) (Figure 18).

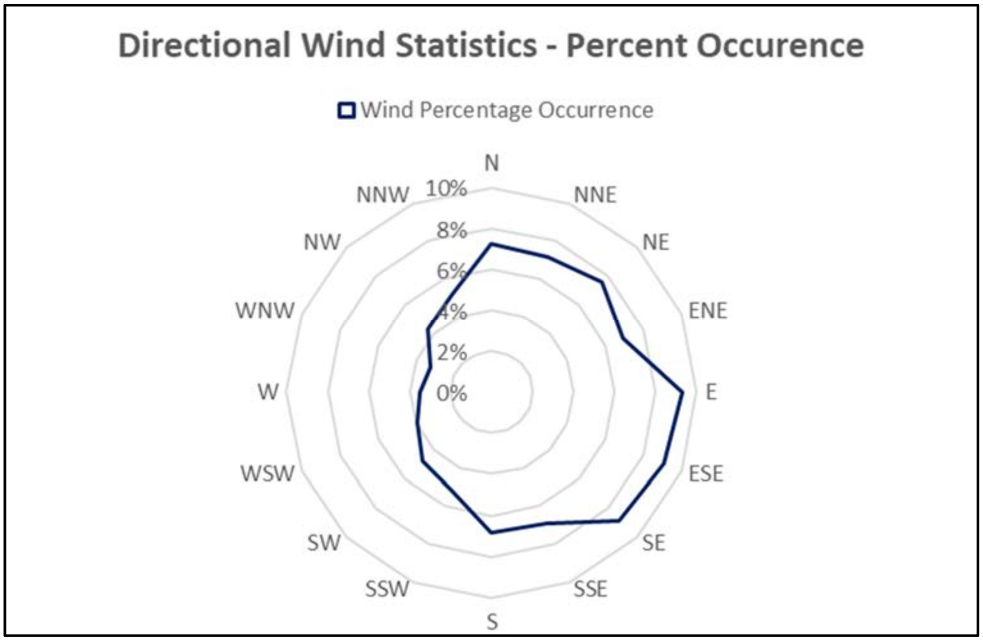

Figure 16: Directional Percentage Occurrence Wind Rose

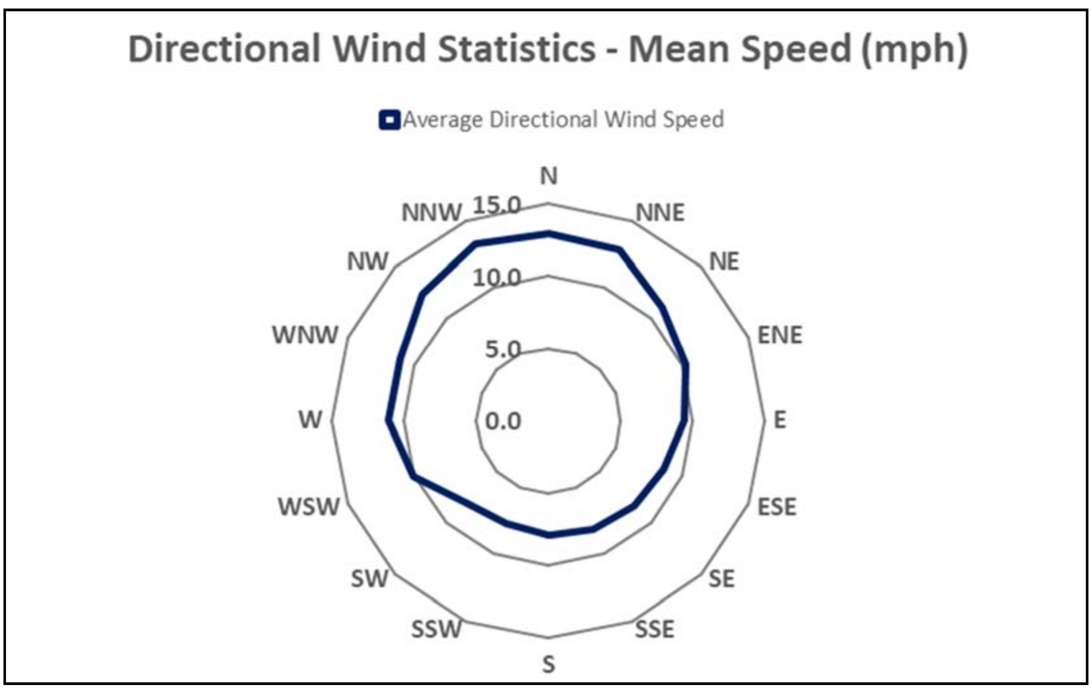

Figure 17: Directional Mean Wind Speed Wind Rose

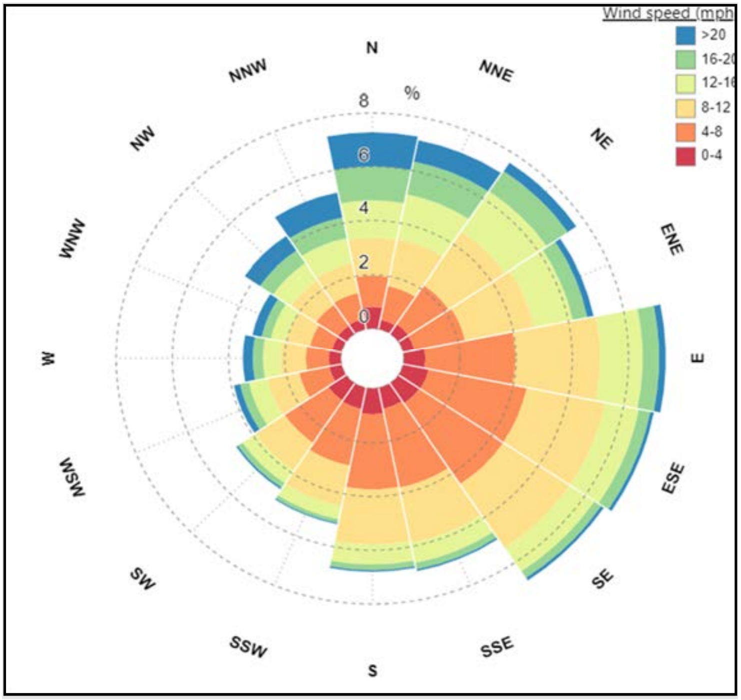

Figure 18: Directional Wind Speed and Percent Occurrence Wind Rose[45]

Finally, the 90th, 95th, and 99th wind speed percentiles were calculated at each corresponding cardinal direction. As seen in Figure 19, the highest windspeeds were found between W and N.

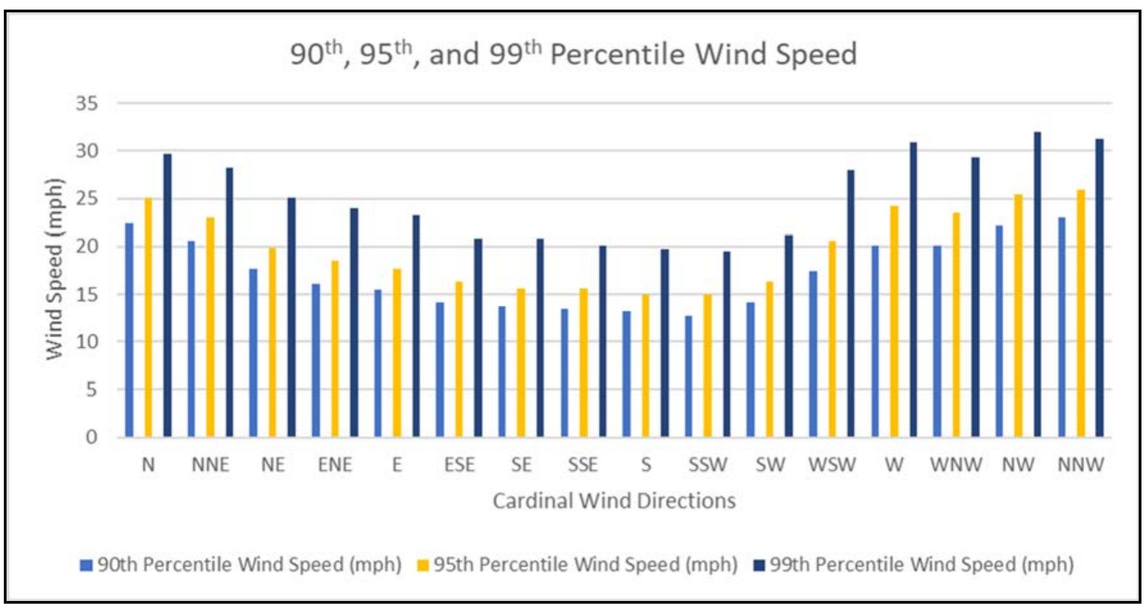

Figure 19: 90th, 95th, and 99th Percentile Wind Speeds

[45] Figure created using Windrose.xyz

5.11 Wave Data

Two (2) wave analyses were conducted by utilizing hindcasted wind conditions as described above in Section 5.10. The first analysis utilized the average wind speeds in each cardinal direction to determine the resulting average directional wave height. The second analysis evaluated the wave height in high wind scenarios by evaluating the 90th, 95th, and 99th wind speeds in each evaluated cardinal direction. ESE (112.5°) to WSW (247.5°) wind conditions were not evaluated due to TE-0171's southern border being TE-0052 and TE-0176, thus, not having direct contact to water. Normal directional conditions of wave heights and wave periods were computed in accordance with Part II of the USACE CEM by hindcasting wave conditions for normally occurring waves.[22]

Wave analyses evaluated both fetch limited and depth limited scenarios to determine the maximum height in which a wave would break in the evaluated conditions of wind speed, fetch length, and water depth.

Fetch limited scenarios were evaluated using a fetch length measurement from the approximate corner of the 30% design MCA footprint to the first encounter of land (Figure 20). While the MCA footprint has slightly changed during this 95% design phase (see Section 11.1.1 for further details) the change in distance to the first encounter of land (approximately a quarter of a mile) has been assumed to be negligible. The longest fetch was measured at 23.1 miles and occurred in the WNW (292.5°) direction.

Depth limited scenarios assumed a mudline elevation of -3.15 ft NAVD 88 (near the lowest elevation at ECD's location) and using the MHW at construction year 2027 of 1.31 ft NAVD 88 for a water depth of 4.46 ft. The resulting maximum wave height before a wave breaks given this water depth was calculated to be 3.48 ft given this max MHW depth of 4.46 ft.

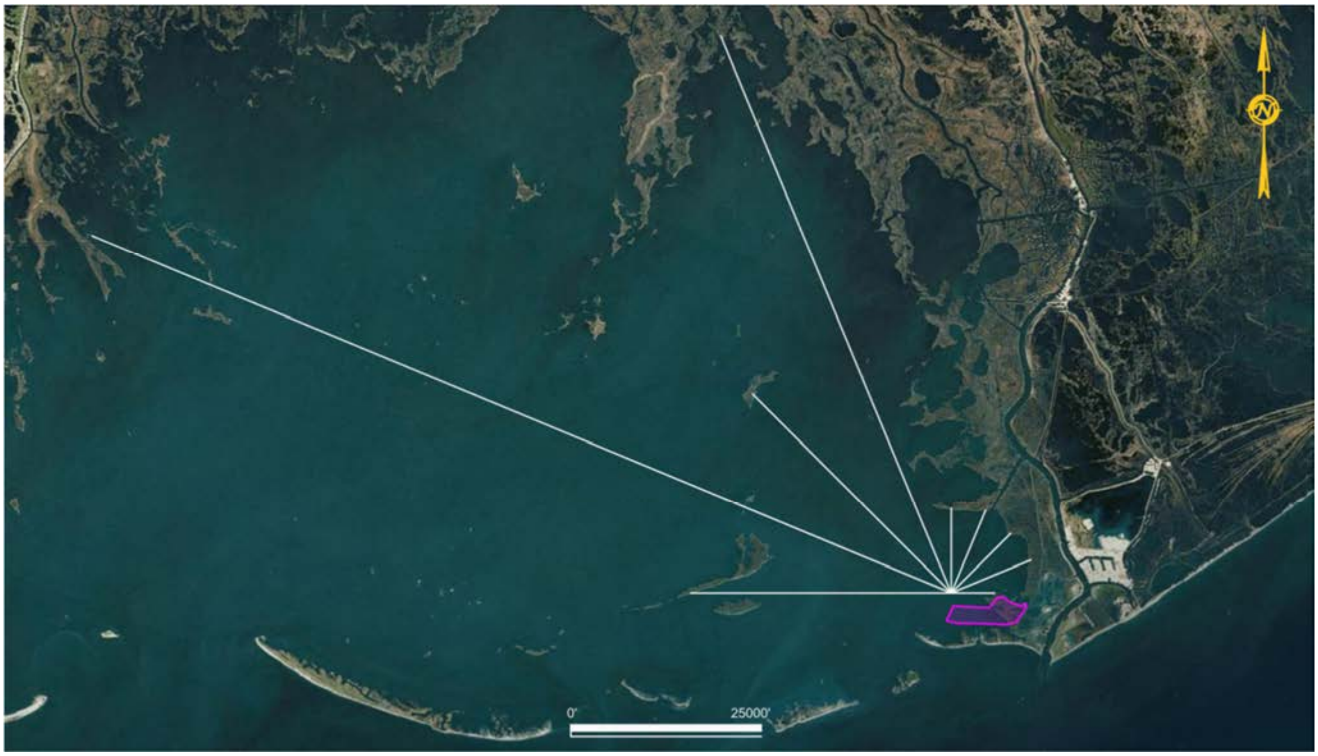

Figure 20: Directional Maximum Fetch Distances

5.11.1 Average Wave Scenario

When utilizing the average wind speeds, all waves were determined to be fetch limited. The average wave height was modeled to be 0.75 ft with a 1.86 second (s) period. When broken out into cardinal directions- average wave heights varied from 0.27 ft to 1.48 ft with wave periods ranging from 1.04 s to 3.07 s. Figure 21 shows the average wave period and height per cardinal direction and is complemented by Table 13 which shows additional pertinent information.

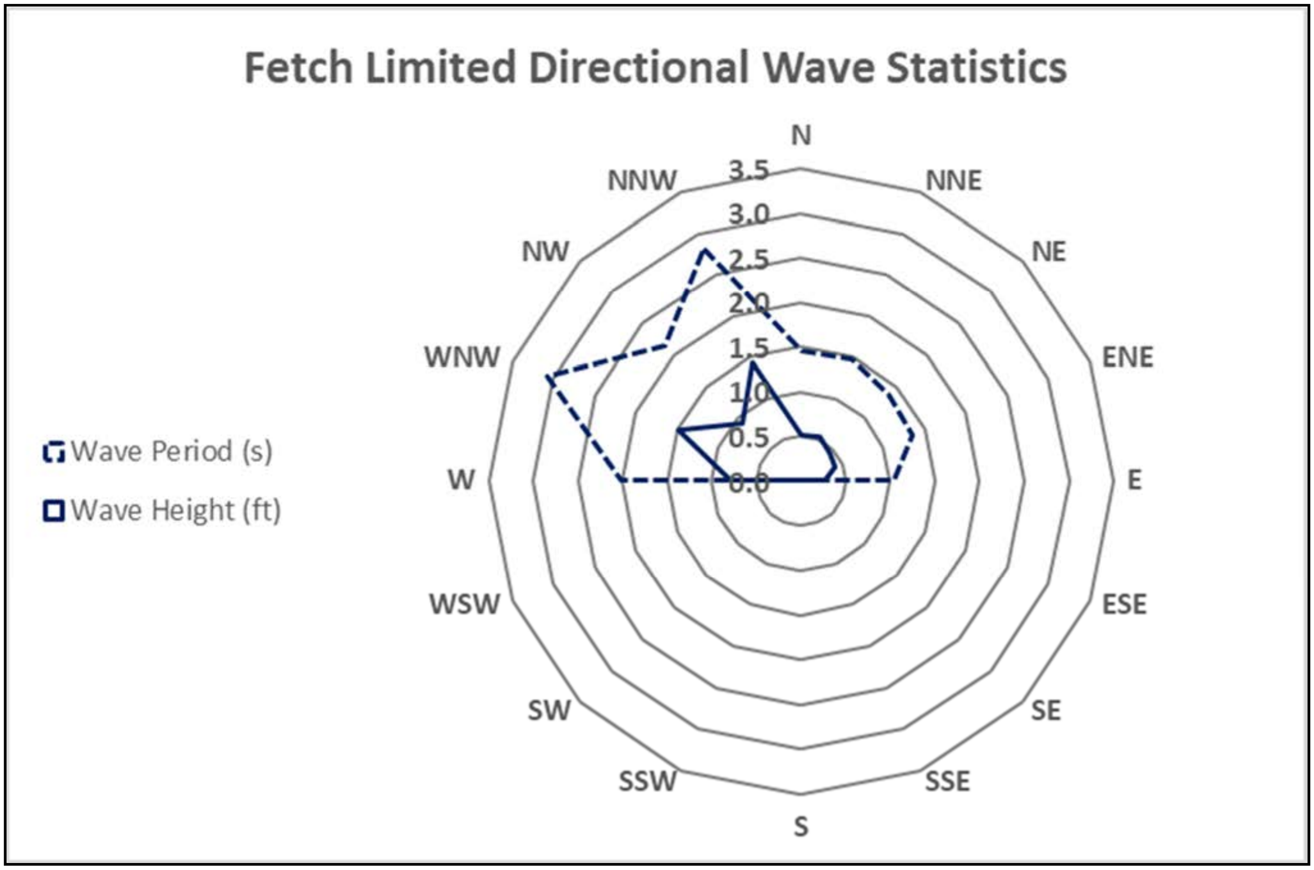

Figure 21: Calculated Normalized Directional Wave Periods and Wave Heights

Table 13: Hindcasted Directional Wave Heights and Wave Periods

Cardinal Direction	Fetch Length (ft)	Average Wind Speed (mph)	Percent Occurrence (%)	Wave Height (ft)	Wave Period (s)
N	11139	12.9	6.9	0.53	1.46
NNE	11733	12.7	6.5	0.53	1.48
NE	11042	11.2	7.6	0.45	1.38
ENE	11309	10.3	7.2	0.41	1.35
E	5678	9.4	8.3	0.27	1.04
ESE	-	8.6	8.9	-	-
SE	-	8.4	9.5	-	-
SSE	-	8.1	7.6	-	-
S	-	8.0	7.1	-	-
SSW	-	7.7	5.8	-	-
SW	-	8.0	5.0	-	-
WSW	-	10.1	4.3	-	-
W	34188	11.1	3.8	0.78	2.01
WNW	122052	11.1	3.0	1.48	3.07
NW	36898	12.4	3.9	0.91	2.14
NNW	78995	13.2	4.6	1.43	2.83
Averages	35893	10.2	-	0.75	1.86

5.11.2 High Wind Wave Scenarios

The 90th, 95th, and 99th percentile wind data were utilized to determine the corresponding 90th, 95th, and 99th percentile wave heights. As illustrated in Figure 22, it is expected that winds from the N to E directions will result in waves under 1.50 ft even when evaluating the 99th percentile waves from that direction. However, waves in the W to NNW direction showed higher wave heights. The 99th percentile waves in the WNW and NNW direction reached a depth limited scenario due to the high wind energy and large fetch length. These high wave scenarios lead to an ECD armoring evaluation to best ensure the ECDs would not fail during construction due to the high wind and wave energies (see Section 8.1.3, Section 11.1.2, and Appendix F).

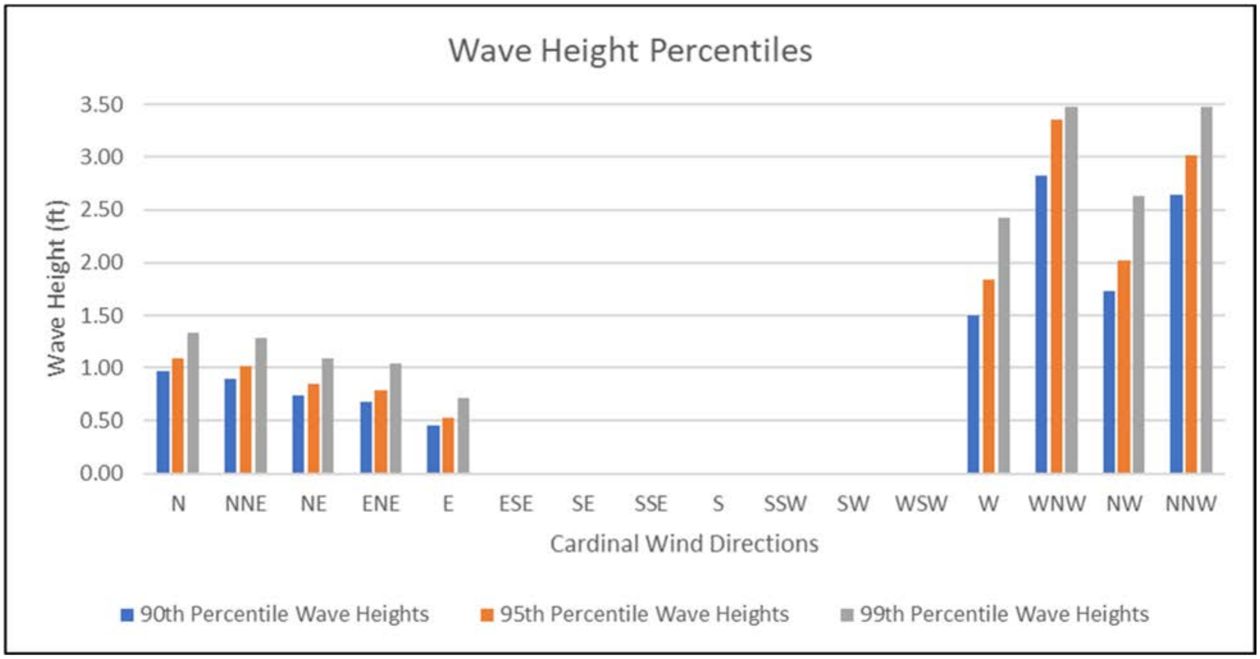

Figure 22: 90th, 95th, and 99th Wave Heights

6.0 SURVEY

A full survey deliverable package can be found in Appendix C.

Topographic, bathymetric, and magnetometer survey data were collected in the MCA, BA, and DPC. The alternative BA (BA B) was also surveyed, though not discussed in this report as it is no longer being considered as a BA alternative. Surveying commenced on December 4, 2023, and concluded on April 12, 2024. All surveying was completed by GISE's surveying team.

Additional surveying was completed in August of 2024. These efforts consisted of further investigating areas identified to warrant further magnetic evaluation based on the results of the magnetometer survey performed earlier in 2024, including undetermined anomalies or anomalies identified to be pipelines. Pipeline locations near major project features were probed when able.

Additional hydrographic and magnetometer surveys were performed along the proposed Timbalier EAC and southwest of the MCA footprint.

The Louisiana State Plane Coordinate System South Zone (1702), North American Datum of 1983 (NAD 83) was used for all horizontal coordinate references. Elevations use NAVD 88 Geoid 12A for all vertical references.

6.1 Marsh Creation Area Surveys

Topographic and bathymetric surveys were collected in a 500 ft by 500 ft grid in the MCA area. Transects extended approximately 500 ft past the originally proposed ECD locations in the south and east sides of the MCA. Transects extended 1,500 ft past the originally proposed ECD on the north and west sides of the MCA. Additional topographic survey data were collected every 25 ft when the change in elevation was greater than 0.5 ft as well as at locations where obvious features were observed.

Topographic data were taken with a Real-time Kinematic (RTK) Global Positioning System (GPS) with a 2 m rover pole with a 6 in attached flatfoot. Bathymetric surveys used a single beam dual frequency echo sounder in correlation with Hypack 2021 survey data collection software. Vessel positioning was recorded with RTK GPS.

Magnetometer survey was run along the planned centerline of the ECD in three (3) passes. An additional grid of 500 ft was surveyed and extended 100 ft beyond both the ECD. Magnetometer survey was performed using a Geometrics G882 Cesium magnetometer at a frequency of 1 Hz. Data were recorded using the Hypack 2021 survey data collection software.

A total of 32 anomalies were detected in the vicinity of the fill area. The only anomalies deemed necessary to be further investigated were those located near the 16” Kinetica pipeline, which was probed accordingly. Probing results indicated a minimum depth of cover of 5.8 ft. Additional information on this pipeline can be found in Section 5.2.1.

6.2 Borrow Area Survey

Bathymetric transects were taken every 500 ft along the centerline to the end of the BA channel. Data were collected using a single beam dual frequency echo sounder and Hypack 2021 survey data collection software. Positioning was recorded with RTK GPS.

Magnetometer data were also collected along the centerline of the borrow area and on parallel lines offset by 150 ft. Additional perpendicular lines were run every 500 ft and extended 100 ft past the BA footprint. Magnetometer survey was performed using a Geometrics G882 Cesium magnetometer at a frequency of one (1) Hz. Data were recorded using the Hypack 2021 survey data collection software. Probing, when necessary and available, will occur during the final design phase. Magnetometer hits that were determined to be pipelines can be found in Section 4.2.

A total of 169 anomalies were detected in the BA. While this is a significant number of anomalies, the borrow site’s location inside an active Port increases the likelihood of encountering debris and trash from typical Port activities. Anomalies that were not able to be confirmed as debris were probed in the final design stages of this project.

Furthermore, side scan and sub-bottom profiler data collected for cultural resources purposes (see Appendix C and Appendix D for further details) showed existing debris within the Belle Pass navigation channel along the following stations:

- Sta. 160+00 to Sta. 170+00
- Sta. 300+00 to Sta. 320+00
- Sta. 368+00

GLPC will coordinate cleanup efforts of this debris. Dredging activity at these locations is expected before the construction of TE-0171 (see Section 4.0 for more details on overlapping projects in this area). Therefore, no conflicts with TE-0171 are expected.

6.3 Dredge Pipeline Corridor Surveys

The DPC was surveyed in 500 ft transects for topographic and bathymetric surveys. Additional topographic survey data were collected every 25 ft when the change in elevation was greater than 0.5 ft. Topographic data were taken using an RTK GPS with a two (2) m rover pole with a six (6) in attached flatfoot. Bathymetric surveys used a single beam duel frequency echo sounder in correlation with Hypack 2021 survey data collection software. Vessel positioning was recorded with RTK GPS.

Magnetometer survey data were collected along the planned centerline of the DPC with additional perpendicular surveying being taken every 500 ft. Survey continued approximately 100 ft past the footprint of the corridor. Magnetometer survey data can be found in Appendix C.

6.4 Equipment Access Survey

EAC surveys were completed for the proposed Timbalier EAC as well as for the Headland EAC (in conjunction with the DPC survey across the beach). The EACs were surveyed in 500 ft transects for topographic and bathymetric surveys. Additional topographic survey data were collected every 25 ft when the change in elevation was greater than 0.5 ft. Topographic data were taken using an RTK GPS with a two (2) m rover pole with a six (6) in attached flatfoot. Bathymetric surveys used a single beam dual frequency echo sounder in correlation with Hypack 2021 survey data collection software. Vessel positioning was recorded with RTK GPS.

Magnetometer survey data were collected along the planned centerline of the EACs with additional perpendicular transects being taken every 500 ft. Survey continued approximately 100 ft past the footprint of the corridor. Further details on magnetometer hits that were determined to be pipelines can be found in Section 5.2. Magnetometer survey data can be found in Appendix C.

6.5 Additional Magnetometer and Probing Survey

Collected magnetometer data were evaluated to determine the nature of the anomalies detected. Due to the location of this project (close proximity to an active port and within the confines of a federal navigation channel) many anomalies were recorded that were determined to be debris or trash from typical port activities. Anomalies that were either identified to be pipelines or undetermined were probed when able. However, due to the deep-water depths in the area not all pipelines were able to be probed due to equipment limitations. As-built information from pipeline companies in the project area were used to supplement this data gap.

7.0 GEOTECHNICAL EXPLORATION AND ENGINEERING ANALYSIS

Eustis commenced a geotechnical field investigation on January 13, 2024. Fieldwork concluded on March 20, 2024. Laboratory testing was completed on June 3, 2024. Eustis collected a total of twenty-four (24) borings and fifteen (15) Cone Penetration Tests (CPTs) within the TE-0171 Project area.

In addition to newly collected data, Eustis evaluated existing geotechnical data that were collected for previous projects in the area. The usage of this data is explained in the two (2) previously issued technical memorandums included under Appendix F as well as referenced throughout Eustis' geotechnical reports. Geotechnical Data and Engineering Reports can be found under Appendix G.

7.1 Marsh Creation Area Soil Investigation

The MCA soil investigation consisted of eleven (11) borings that were taken between 30 ft and 40 ft below the mudline. Undisturbed samples of cohesive or semi-cohesive subsoils were obtained continuously for the first 20 ft and then at 5 ft intervals, or changes in stratum. Samples were obtained using a 3-in diameter thin wall Shelby tube sampler. Cohesionless soils, when encountered, were sampled during the performance of Standard Penetration Tests. Additionally, fourteen (14) CPTs were taken at the MCA. All CPTs encountered refusal within the initial 20 ft. Figure 23 shows where these borings were taken in the MCA.

ECD borings were chosen to be as close to the 30% design ECD centerline as possible. Though the MCA shape has evolved, all CPRA guidelines have still been met to ensure sufficient data is available in the MCA for the required engineering analyses.

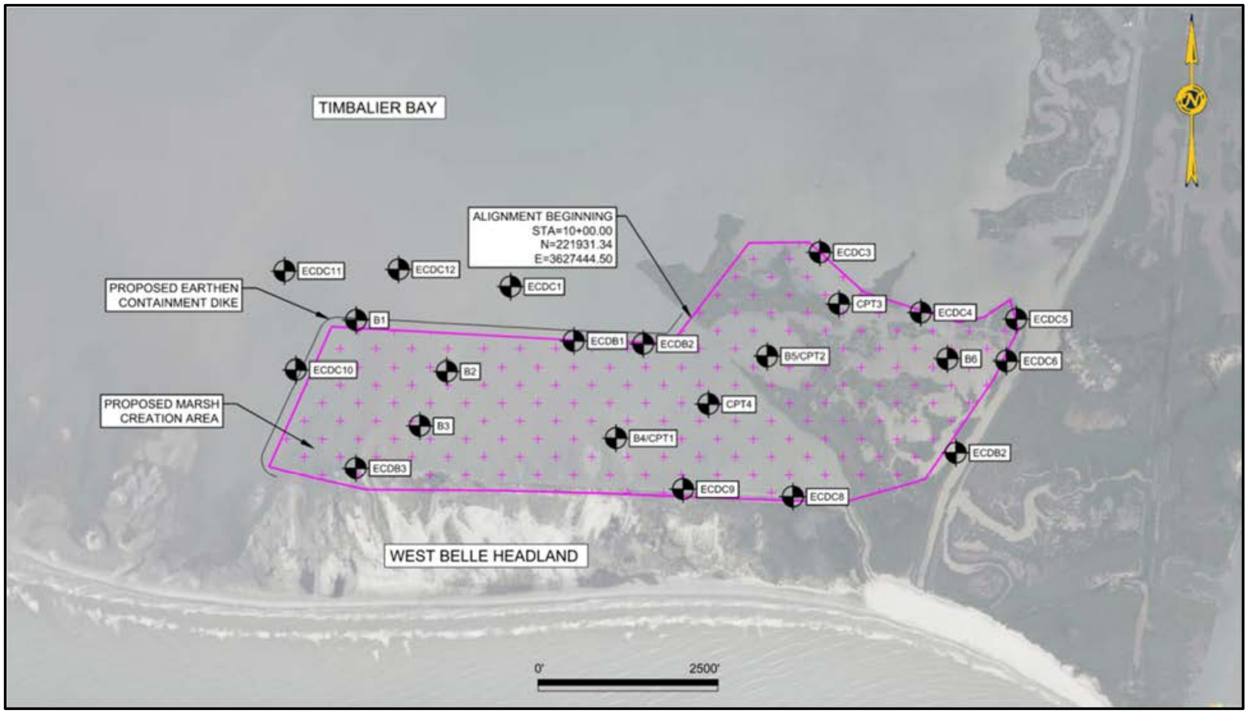

Figure 23: MCA Soil Boring and CPT Locations

Figure 24 shows simplified soil classification resulting from of the MCA soil boring exploration. The Unified Soil Classification System (USCS) abbreviations are shown for the one (1) ft depth intervals of each soil boring. The near-surface soils at the site are predominantly organic clays/peat/humus underlain primarily by medium dense sands. Therefore, relatively low estimates of consolidation of the foundation soils are anticipated. Continuing settlement will occur over long periods of time at a diminishing rate.

Full geotechnical results of the collected soil borings and CPTs are included in Appendix G.

Depth	MCA-B1	MCA-B2	MCA-B3	MCA-B4	MCA-B5	MCA-B6	ECDB-1	ECDB-2	ECDB-3	ECDB-4
-1	CL	SM	SP	SP	OH	OH	SM	CH	SM	CL
-2	CL	SM	SP	SP	OH	OH	SM	OH	SM	CL
-3	CL	ML	ML	SP	CH	OH	CL	OH	SM	CL
-4	CL	ML	ML	SP	CH	OH	CL	OH	SM	CL
-5	CL	ML	ML	SP	SP	SM	CL	OH	SM	SM
-6	CL	SM	ML	CL	SP	SM	CH	OH	SM	SM
-7	CL	SM	ML	CL	SM	SM	CH	ML	SM	ML
-8	CL	SM	ML	CL	SM	SM	CH	ML	SM	ML
-9	ML	SP	ML	SM	SM	SM	CH	ML	SM	ML
-10	ML	SP	ML	SM	SM	SM	SM	ML	SM	ML
-11	ML	SP	ML	SM	SM	SM	SM	ML	SM	ML
-12	ML	SP-SM	SM	SM	SM	SM	SM	ML	ML	ML
-13	ML	SP-SM	SM	SM	SM	SM	SM	ML	ML	SM
-14	ML	SP-SM	ML	SM	SM	SM	SM	ML	ML	SM
-15	ML	CL	ML	SM	SM	SM	SM	SM	ML	SM
-16	ML	CL	ML	SM	SM	SM	SM	SM	ML	SM
-17	ML	CL	ML	SM	SM	SM	ML	SM	ML	SM
-18	ML	SM	ML	SM	SM	SM	ML	ML	ML	SM
-19	ML	SM	ML	SM	ML	SM	ML	ML	ML	SM
-20	CH	SM	ML	SM	ML	SM	SP	ML	ML	SM
-21	CH	SP	CH	SM	ML	SM	SP	ML	ML	SM
-22	CH	SP	CH	SM	ML	ML	ML	ML	ML	SM
-23	CH	SP	CH	SM	ML	ML	ML	ML	ML	CH
-24	CH	SP	CH	SM	ML	ML	ML	ML	ML	CH
-25	CH	SP	CH	SM	ML	ML	ML	ML	ML	CH
-26	CL	CH	CH	SM	ML	CH	CH	CL	CH	CH
-27	CL	CH	CH	SM	ML	CH	CH	CL	CH	CH
-28	CL	CH	CH	SM	ML	CH	CH	CL	CH	CH
-29	CL	CH	CH	SM	ML	CH	CH	CL	CH	CH
-30	CL	CH	CH	SM	ML	CH	CH	CL	CH	CH
-31							CH	ML	CH	ML
-32							CH	ML	CH	ML
-33							CH	ML	CH	ML
-34							CH	ML	CH	ML
-35							CH	ML	CH	ML
-36							CH	ML	CH	ML
-37							CH	ML	CH	ML
-38							CH	ML	CH	ML
-39							CH	ML	CH	ML
-40							CH	ML	CH	ML

SP - Poorly graded sands
SP-SM - Poorly graded sands and silty sands
SM - Silty sands
ML - Inorganic silts and very fine sands
CL - Inorganic clays of low to medium plasticity
OH – Organic clays of medium to high plasticity
CH - Inorganic clays of high plasticity

Figure 24: MCA Soil Boring Soil Classification Results

7.2 Borrow Area Soil Investigation

Due to available existing data in the area, only four (4) soil borings were collected to supplement the existing geotechnical data in the BA. At the time of collection, the BA was projected to the -50 ft NAVD 88 contour. This resulted in the final boring (BA4) being outside the final BA footprint. However, due to the similarities in sediment between BA4 and the other three borings, there were no concerns with utilizing this boring for testing. Figure 25 shows the boring locations both collected for TE-0171 and already existing in the BA. Figure 26 shows simplified soil classification results of all BA soil borings. A majority of both the collected and existing borings consist of clay. The USCS abbreviations are shown for the one (1) ft depth intervals of each soil boring. Full geotechnical results of the collected soil borings and CPTs are included in Appendix G.

In addition to the collected borings in Belle Pass, ten (10) borings were collected in the alternative borrow area. Field boring logs, CPT results, laboratory test summaries and results, final settlement curves, ECD borrow area stability analyses, and overall construction recommendations for the MCA, BA, and alternative BA can be found under Appendix G.

Figure 25: BA Soil Boring Locations

Depth	OW-3*	F-09	BC-1*	F-10	F-11	F-12	BC-2*	F-13	BA-1	BA-2	BC-3 *	BA-3	BA-4
-1	OH	CH	OH	CH	CH	CH	SM	OH	CH	CH	CH	CH	CH
-2	OH	CH	OH	CH	CH	SC	SM	OH	CH	SM	CH	CH	CH
-3	OH	CH	CL	CH	CH	CH	SP-SC	OH	CH	SM	CH	CH	CH
-4	OH	CH	CL	CH	CH	CH	SP-SC	OH	CH	SM	CH	CH	CH
-5	OH	CH	CL	CH	CH	CH	SP-SC	OH	ML	SM	CH	ML	CH
-6	OH	CH	CL	SP-SM	CH	CH	SP-SC	CH	ML	SM	CH	ML	CH
-7	OH	CH	CL	SP-SM	CH	CH	SP-SC	CH	ML	SM	CH	ML	CH
-8	CL	CH	CL	SP-SM	CH	CH	ML	SC	CH	CH	CH	ML	CH
-9	CL	CH	CL	SP-SM	CH	CH	ML	SC	CH	CH	CH	ML	CH
-10	CL	CH	CL	CH	CH	CH	ML	CH	CH	CH	CH	ML	CH
-11	CL	CH	CL	CH	CH	CH	CH	SC	CL	CH	CH	CH	CH
-12	CL	CH	CL	CH	CH	CH	CH	CH	CH	CH	CH	CH	CH
-13	CL		CL	CL	CH	CH	SC	CH	ML	CH	CH	CH	CH
-14	CL		CL	CH	CH	CH	SC	CH	CH	CH	CH	CH	CH
-15	CL		CL	CH	CH	CH	SC	CH	CH	CH	SM	CH	CH
-16	CL		CL	CL	CH	CH	SC	CH	CH	CH	SM	CH	CH
-17	CL		CL	CL	CH	CH	SC	CH	CH	CH	SM	CH	CH
-18	CH		CH	CL	CH	CH	CH	CH	CH	SM	SM	ML	CH
-19	CH		CH	CL	CH	CH	CH	CH	CH	SM	SM	CH	CH
-20	CH		CH	CL	CH	CH	CH	CH	CH	SM	SM	CH	CH
-21	CH		CH				CH				SM		
-22	CH		CH				CH				CH		
-23	CH		CH				CH				CH		
-24	CH		CH				CH				CH		
-25	CH		CH				CH				CH		
-26	CH		CH				CH				CH		
-27	CH		CH				CH				CH		
-28	CH		CH				CH				CH		
-29	CH		CH				CH				CH		
-30	CH		CH				CH				CH		

* Deeper data is available

SM - Silty sands
SC- Clayey Sands
SP-SM- Poorly graded sands and silty sands
SP-SC- Poorly Graded Sands and Clayey Sands
ML - Inorganic silts and very fine sands
OH – Organic clays of medium to high plasticity
CL - Inorganic clays of low to medium plasticity
CH - Inorganic clays of high plasticity

Figure 26: BA Soil Boring Clasification Results

8.0 ENGINEERING AND DESIGN

The goals of the TE-0171 Port Fourchon Marsh Creation Project as presented in Phase 0 are to:

- Creating/nourishing 605 acres of marsh
- Evaluating the use of Belle Pass sediment for coastal restoration
- Demonstrating cost-sharing opportunities with local stakeholders
- Improving local community resilience, protecting critical infrastructure
- Supporting stakeholder priorities

In order to meet the above goals, the following engineering and design tasks were established as objectives for the MCA design based on the selected BA.

- Determine the tidal datum and optimal inundation range for the MCA (Section 5.7 and Section 5.9).
- Determine the Constructed Marsh Fill Elevation (CMFE) by utilizing geotechnical settlement curves based on the computed inundation ranges (Section 8.1.1).
- Determine and optimize cross sectional design for ECDs (Section 8.1.3).
- Evaluate the usage of ECD armoring to withstand design wave heights (Appendix F).
- Determine the Target Marsh Fill Elevation (TMFE) for volume calculation purposes (Section 8.2.1).
- Estimate the cut and fill volumes required to fill the MCA (Section 8.3).
- Design the BA to meet the required cut volume to fill the MCA (Section 8.4).
- Evaluate the need for and design of additional features including:
    - General layout for the equipment EACs and DPC (Section 8.5.1)
    - Settlement plates (Section 8.5.2)
    - Grade stakes (Section 8.5.3)
    - Bird abatement (Section 8.5.4).

The 95% Design Drawings have been included under Appendix O.

8.1 Marsh Creation Area Design

During Phase 0 of TE-0171, the marsh creation area transformed from three (3) cells totaling 528 acres located on the west bank of Bayou Lafourche to a single cell located west of Belle Pass and to the South of Timbalier Bay. The Phase 0 report concluded that the project would aim to create/nourish 605 acres of marsh. After the completion of surveying efforts during the preliminary phase of the project, the MCA was slightly altered to avoid areas of deeper water along the ECDs due to constructability concerns. After the completion of the 30% design phase, the MCA was further reduced to a singular 543-acre MCA to ensure the project stays competitive ahead of requesting construction funds (Phase II) later in 2024.

8.1.1 MCA Elevation Distribution

A typical mudline elevation across the MCA must be defined in order to properly determine the expected settlement of the dredged material to be placed in the MCA. The average mudline elevation in the MCA is approximately -1.24 ft NAVD 88. However, the elevation distribution chart, as seen in Figure 27, shows that 69% of the MCA existing mudline falls in the range of -1.0 ft NAVD 88 and -3 ft NAVD 88. Therefore, two (2) mudline elevations were considered for settlement testing purposes. A mudline elevation of -2 ft NAVD 88 was considered to better represent and evaluate the open water areas on the western side of the MCA. A mudline elevation of -1 ft NAVD 88 was considered to better represent and evaluate the marsh nourishment areas towards the eastern side of the MCA.

It is acknowledged that areas of lower existing elevation will experience more consolidation than areas of existing higher elevations. This is due to the greater self-weight settlement and (to a lesser extent) foundation settlement that occurs when a greater volume of fill is needed to achieve a similar final marsh surface elevation. Therefore, settlement will vary across the site depending on the thickness of compressible foundation soils, and composition and thickness of dredge fill. A target CMFE with an approximate construction tolerance of ±0.25 ft can be determined during construction, based on the contractor's means and methods. Additionally, different target CMFEs may be determined across the MCA to address the variance in existing mudline elevations. It is advised that the shallower eastern side of the MCA be filled to a lower target CMFE than the western deeper side.

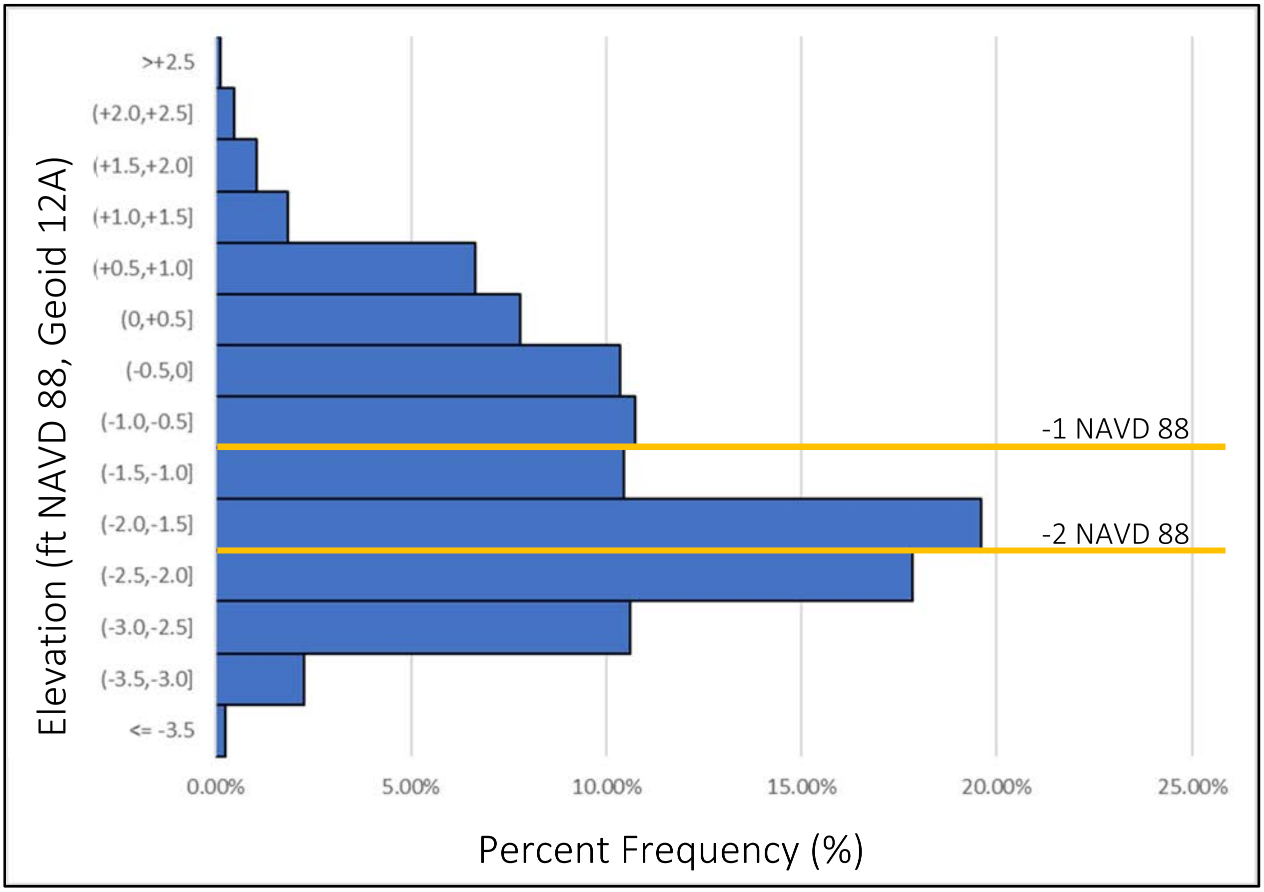

Figure 27: Mudline Elevation Distribution of TE-0171's MCA

8.1.2 Constructed Marsh Fill Elevation

A self-weight consolidation test was performed utilizing collected soil samples from the BA. Soil samples for testing were carefully selected to ensure that the samples represented the material that would be dredged and eventually placed in the MCA. Sediment in Belle Pass consists mainly of clay. Therefore, composite clay samples from Belle Pass, within or near the proposed BA limits, were used for this testing.

Consolidation testing was performed utilizing borings from the MCA. This testing allowed for the settling parameters of the underlying soils to be estimated.

A target CMFE is greatly dependent on the means and methods of the construction contractor and decisions made in the field such as pumping rate, cell size, and drainage of the slurry at the site. Therefore, for the purpose of this 95% design report, a maximum CMFE was determined and is reflected in the design plan set (Appendix O).

Consolidation testing results were used to develop settlement curves to determine a maximum CMFE. Assumptions included a fast dredge pumping rate, that the construction contractor would break the MCA into 100-acre cells, and poor soil foundation drainage at the MCA. A concentration of 250-300 grams (g)/ liter (L) was used with an assumed -2 ft NAVD 88 mudline elevation. The resulting curve can be found in Figure 28 and shows a TY 0 elevation of +3.20 ft NAVD 88.

Therefore, the maximum CMFE has been determined to be +3.20 ft NAVD 88 with a +0.25 tolerance to account for any slurry swelling that may occur during construction. Lower CMFEs may be anticipated in conditions such as lower dredge filling rates or if a higher concentration is used by the construction contractor.

A target CMFE will be provided during construction in order to best reflect the volume necessary to maximize the duration in which the project's elevation is within the 20% to 80% inundation range over the project's 20-yr life (as described in Section 8.3). Different target CMFEs may be determined across the MCA to address the variance in existing mudline elevations. It is advised that the shallower eastern side of the MCA be filled to a lower target CMFE than the western deeper side. Target CMFE(s) will be determined based on the means and methods of the construction contractor and the behavior of the slurry and will include 0.5 ft of tolerance. Additional settlement curves (which can be found in Appendix G) that were created and evaluated during the design phase may be used to help determine the target CMFE during construction.

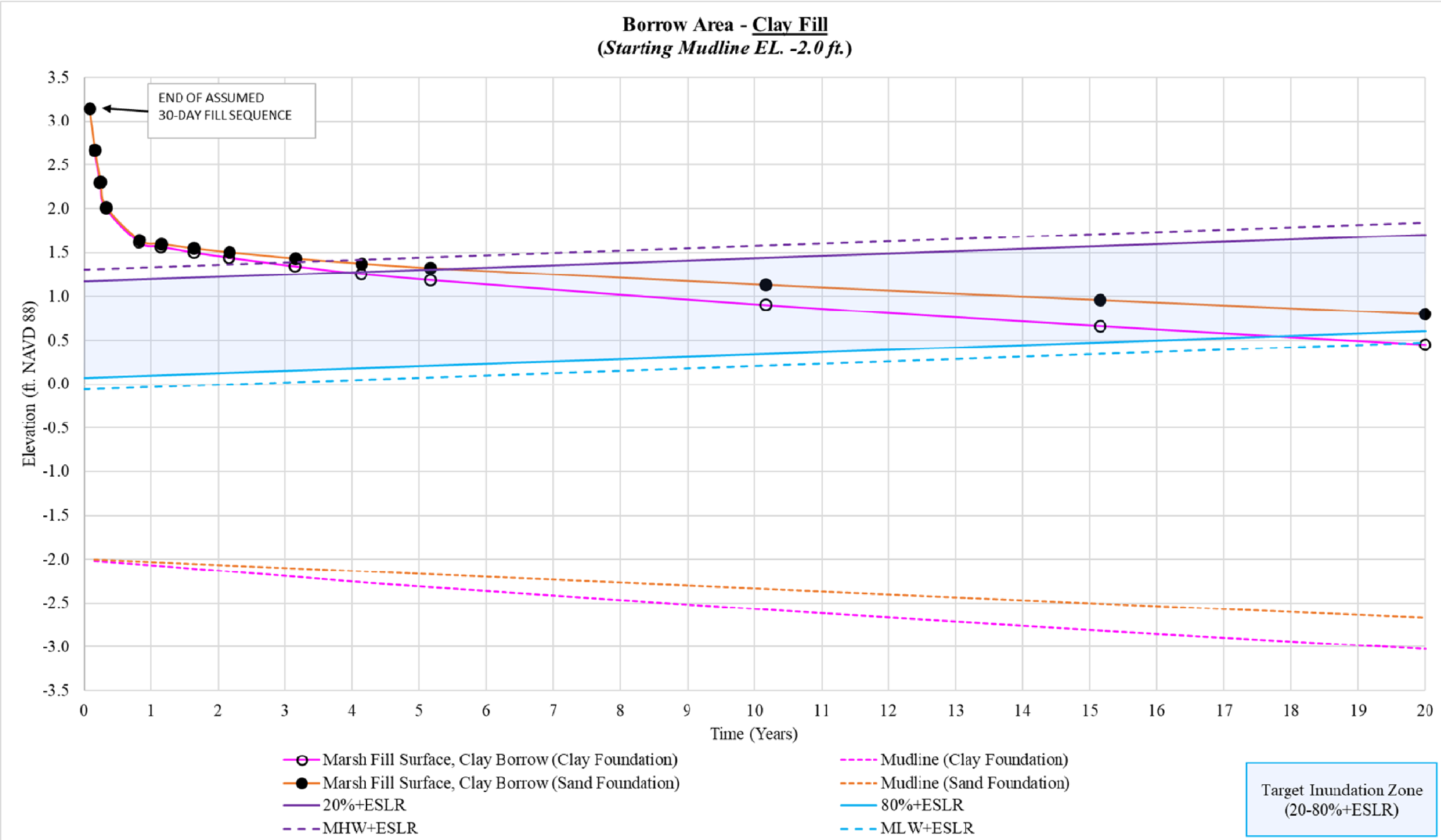

Figure 28: MCA Settlement Curve with EL -2 ft Mudline

8.1.3 Earthen Containment Dike Design

ECD design requires defining the dimensions of crown elevation, crown width, and side slopes. While CPRA guidelines were used as a base for these designs, field experience and specific site conditions lead the Project Team to modify the guidelines to best fit the needs of TE-0171.

In order to mitigate high wind and wave energies in this location, “enhanced ECDs” were designed to be used on the Timbalier Bay side of the MCA. Due to the large fetch of open water, the area of these enhanced ECDs is expected to experience more wave energy than the remaining project area. The enhanced ECD will allow for additional erosion to take place during construction without compromising the stability of the ECDs. The remaining areas of the MCA are not expected to experience these high wave conditions and therefore “standard ECDs” will be used.

ECDs were evaluated for stability assuming they are built to the +0.5’ construction tolerance. All stability cases evaluated achieved the minimum required factor of safety (FOS) of 1.2 as per CPRA’s Marsh Creation Design Guidelines. The results of these ECD slope stability analyses are included in the geotechnical report found in Appendix G.

Standard ECD

The standard ECDs (see below) will be located along the MCA where enhanced ECDs were not deemed necessary. These ECDs were designed with a 5 ft crown width and 5H:1V side slopes. The crown elevation was determined to be +4.5 ft NAVD 88 with a +0.5 ft construction tolerance. This elevation was determined by adding a one (1) ft of freeboard to the maximum expected CMFE.

A typical cross-section of the standard ECD and standard ECD borrow pit (design described below) is shown in Figure 29. Table 14 below summarizes all ECD design dimensions as well as estimated fill and cut volumes.

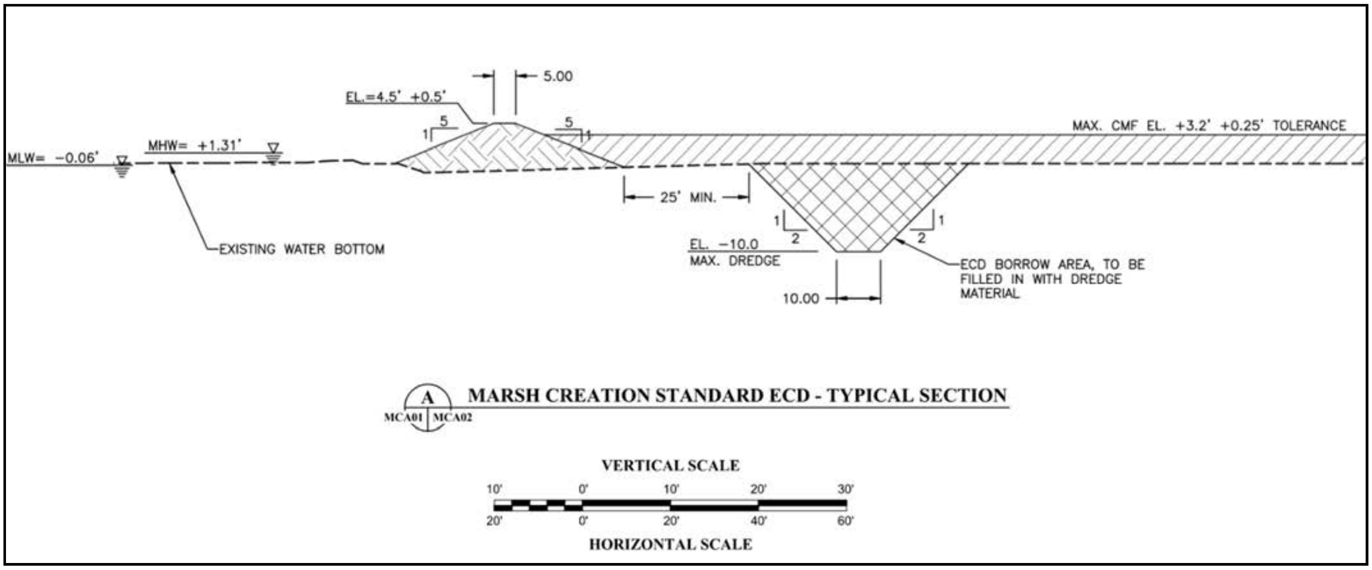

Figure 29: Typical MCA Cross Section with Standard ECD

Enhanced ECDs

During 30% design, the Project Team assumed the need of ECD armoring in order to protect the dikes from severe erosion during construction. In this preliminary phase of design, articulated concrete mats (ACMs) were recommended to be used on the north and west ECD alignments of the MCA. However, this assumption was believed to be conservative and would require further evaluation.

During this 95% design phase, the Project Team evaluated past projects in this area (TE-0052 and TE-0143/TE-0118) and concluded that utilizing enhanced ECDs along the north and west side of the MCA (Figure 30) would be the most cost-effective way to successfully build the dikes amid the expected site conditions. GISE developed a technical memorandum detailing this evaluation, which can be found in Appendix F.

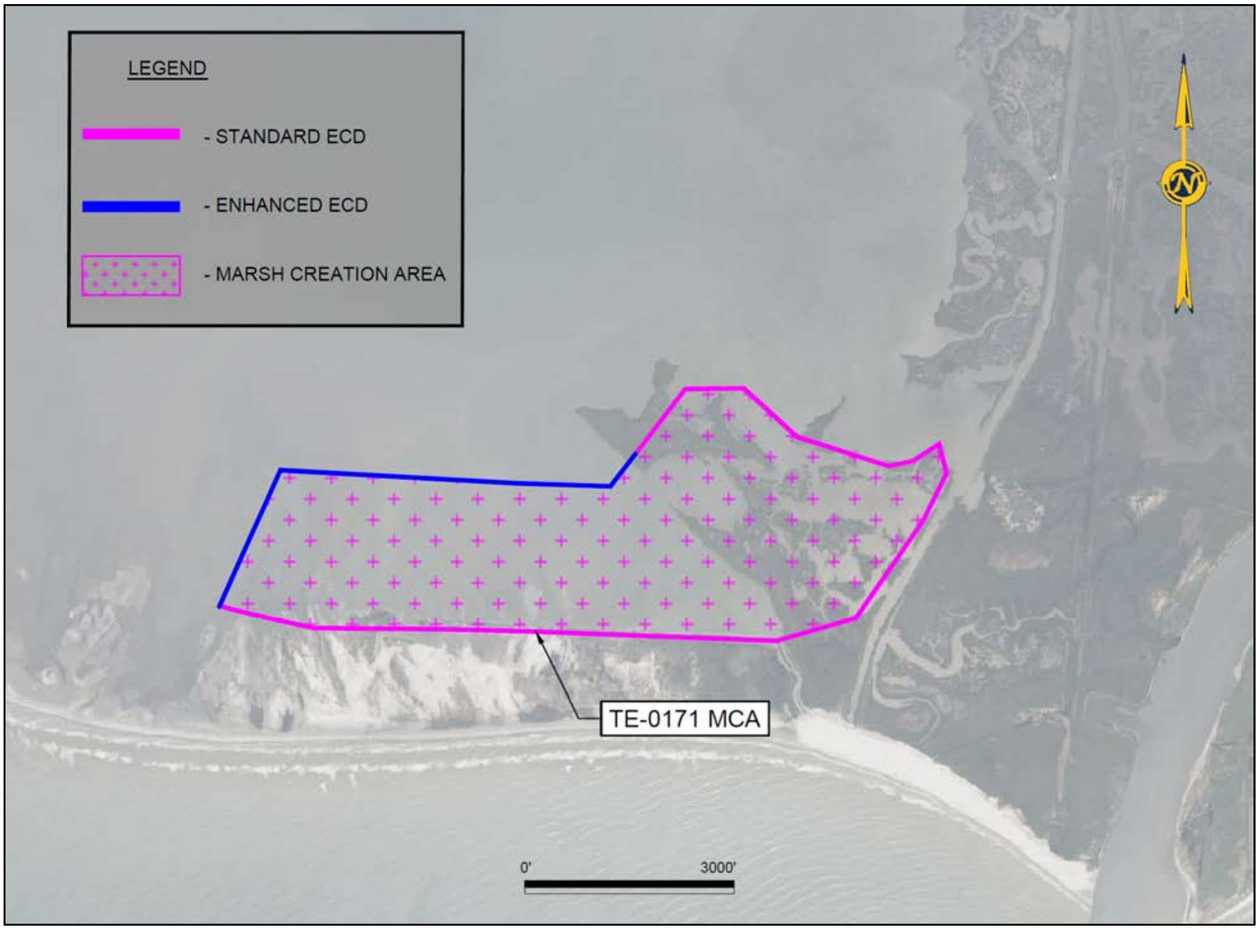

Figure 30: Location of Enhanced ECDs

For TE-0171, the enhanced ECDs will have an interior side slope of 5H:1V and an exterior side slope of 8H:1V. The crown width will be 10 ft with an elevation of +4.5 ft NAVD 88 with a +0.5 ft tolerance. Both an internal and external borrow pit will be required to produce the amount of earthen material anticipated for these enhanced ECDs. Borrow pit design is described below.

Due to the increased size of these ECDs, contractors may decide to utilize larger equipment such as clamshell bucket dredges in comparison to smaller equipment such as marsh buggies. Larger equipment may require the dredging of an EAC (further described in Section 11.1.4). However, the means and methods of equipment access is up to the discretion of the contractor.

A typical cross-section of the enhanced ECD and enhanced ECD borrow pits is shown in Figure 31. Table 14 summarizes all ECD design dimensions as well as estimated fill and cut volumes.

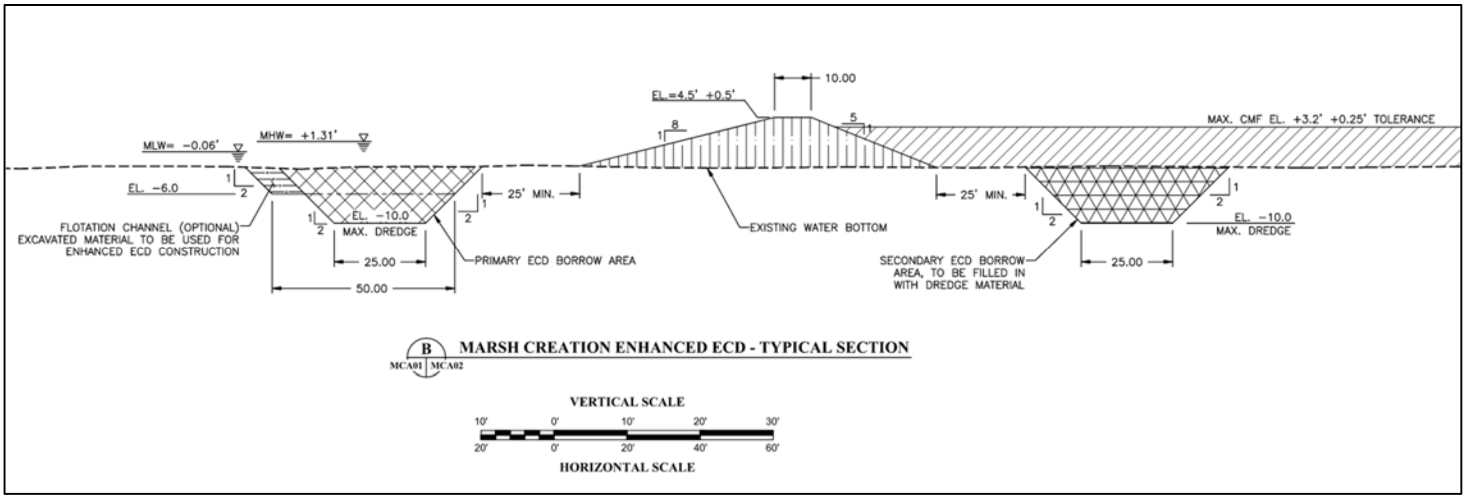

Figure 31: Typical MCA Cross Section with Enhanced ECD

Table 14: Earthen Containment Dike Design

ECD type	Crown Elevation (ft NAVD 88)	Tolerance (ft)	Interior Side Slope	Exterior Side Slope	Crown Width (ft)	Length (ft)	Volume of ECD Fill (CY)	Cut to Fill Ratio	Volume of ECD Cut (CY)
Standard	+4.5	0.5	5H:1V	5H:1V	5	17,174	84,581	1.5	126,872
Enhanced	+4.5	0.5	5H:1V	8H:1V	10	7,422	101,433	1.5	152,149

Borrow Pits

ECD borrow pits will be used to obtain the necessary earthen material for both the standard and enhanced ECDs. Hydraulically dredged material from Belle Pass will backfill internal borrow pits. Borrow pits were designed to reach the ECD cut volumes, which includes a 1.5 cut-to-fill (CTF) ratio. This ratio not only considers the geotechnical properties of the material but also the additional material needed in the construction and maintenance of the ECDs.

For the enhanced ECDs, an external borrow pit has been added to obtain the necessary material to build the ECDs. The exterior borrow pit will be utilized as the primary borrow source and will not be backfilled after use. Additionally, an optional flotation channel has been designed to an elevation of -6 ft NAVD 88 around the enhanced ECD. This flotation channel would allow for larger equipment, such as clamshell buckets, to reach the site if it is deemed necessary by the construction contractor. If constructed, the material from the flotation channel will be utilized for ECD construction. Similar to the exterior borrow pit for enhanced ECDs, the flotation channel will not require backfill after use. After the external borrow pit and flotation channel (if constructed) are exhausted, the construction contractor will utilize interior borrow for the remaining material necessary to build the enhanced ECDs. The interior borrow pit will be backfilled with hydraulically dredged material.

Double handling should be avoided, as much as possible, by the contractor in all ECD construction in order to supply the least expensive and most stable dikes.

Table 15 shows the design dimensions for the interior borrow pit for standard ECDs as well as both the interior and exterior borrow pits for enhanced ECDs. All ECDs and borrow pits were evaluated for stability by Eustis.

Table 15: ECD Borrow Pit Design

Borrow Pit	Bottom Elevation (ft NAVD 88)	Bottom Width (ft)	Side Slope	Bench (ft)	Available Borrow (CY)	Volume Estimated to be Removed (CY)	Backfill Volume (CY)
Standard Interior	-10	10	2H:1V	25	178,325	126,872	126,872
Enhanced Exterior (Primary)	-10	25	2H:1V	25	88,223	88,223	0
Flotation Channel (Optional)	-6	50	2H:1V	25	45,656	8,403	0
Enhanced Interior (Secondary)	-10	25	2H:1V	25	83,183	63,926 (maximum) 55,524 (minimum)	63,926 (maximum)* 55,524 (minimum)

*maximum backfill volume was assumed in volume calculations, to be conservative

Degradation/Gapping of ECDs

ECDs may be gapped or degraded post dredging and prior to construction demobilization at the discretion of the sponsors with locations to be field determined by the Engineer. Use of available elevation survey data and an interagency on-site investigation will be used to refine gapping and siting needs. In general, gapping and degradation of the enhanced ECDs and northern ECDs will be limited due to possible wind/wave impacts affecting retention of the sediments prior to their stabilization. An adaptive management approach to facilitate tidal wetland functions will be taken. For cost estimate purposes, it was assumed that ECDs would be gapped every 1000’, up to 20% of the entire ECD alignment. Cost for gapping ECDs post-construction of the MCA has been included within the project construction cost and ECD unit prices.

8.2 Volume Calculations

The following section describes how the MCA fill volumes were estimated. A more detailed volume calculation summary can be found in Appendix H.

8.2.1 Target Marsh Fill Elevation

The settlement curves for TE-0171 were used to determine the TMFE at TY 20 (2047). This TMFE was then applied in Equation 1 below to calculate the Marsh Fill Elevation (MFE), which is used to compute the cut volumes required to fill the MCA to the CMFE at TY 0 (2027). This calculation approach is standard practice for CPRA and assumes that most solid soil particles have settled in place by the end of the project’s 20-year life. Anticipated values for foundation settlement and subsidence over the project's lifespan are added to the TMFE to estimate the necessary amount of cut volume at TY 0 to achieve the TMFE at TY 20.

The TMFE at TY 20 was assumed to be +0.65 ft NAVD 88, as indicated by the settlement curves shown in Figure 27. Since both clay and sand soil foundations are present at the MCA, a TMFE value in between the clay and sand foundation curves was selected. A subsidence rate of 0.67 ft over 20 years (10.21 mm/yr) was used for both borrow areas as per CPRA's most recent data.[17] The foundation settlement estimate, as recommended by Eustis, is 0.25 ft.

This comes to an equivalent MFE, at TY 0, of +1.57 ft NAVD 88. This was rounded to +1.6 ft NAVD 88. This number was used for volume estimating purposes along with the CTF Ratio of 1 selected for the design of this project (further described in Section 8.2.2).

Equation 1: Marsh Fill Elevation at TY 0

$$MFE\ at\ TY\ 0 = TMFE + Foundation\ settlement + Subsidence\ Over\ 20\ Years$$

$$1.6\ (ft\ NAVD\ 88) = 0.65' + 0.25' + 0.67'$$

8.2.2 Cut-to-Fill Ratio

Bulking factors for the BA were also estimated by Eustis to be between 1.3 and 1.7. These bulking factors are based on the estimated unit weight of the borrow material 20 years after placement in the MCA and the in-situ unit weight from soil borings at the BA. Greater bulking factors are anticipated for the borrow material immediately after dredging, but will depend on the dredge contractor's means and methods of placement.

The bulking factor is considered to determine a CTF ratio to be used on material taken from the BA and placed in the MCA. CPRA typically recommends using a cut-to-fill ratio between 1.0 and 1.3.[11] Based on this recommendation and the bulking factors estimated by Eustis, a conservative CTF ratio of 1.0 will be used for estimating cut volumes. This conservative CTF ratio was selected to take into consideration not only the estimated bulking factors but also the sediment losses that could occur during dredging operations and the possible need to rebuild the ECDs as needed during construction.

8.3 Cut Volume Estimation

Cut volumes were calculated following two (2) different methods.

The first method used AutoCAD Civil 3D[46] to calculate volumes. AutoCAD Civil 3D utilizes coordinate data collected during surveying in the X, Y, and Z dimensions. The XYZ coordinate data were used to create a surface known as a Triangulated Irregular Network (TIN) surface. The TIN surface was then used to estimate volumes given the MFE of +1.6 ft NAVD 88 (as defined in Section 8.2.1).

[46] Autodesk AutoCAD Civil 3D 2022 software

The second method used the coordinate transect data and the average end area method to calculate the volume required to fill the MCA to +1.6 ft NAVD 88. Microsoft Excel[47] was used for this process.

It should be noted that both of these methods include backfilling of the interior ECD borrow pit. Back fill volumes can be found in Table 15 within Section 8.1.3.

The average of these two (2) methods was utilized as the total cut volume for the construction cost estimate prepared for this report. However, the borrow area design that follows ensures an additional 20% contingency in borrow availability.

Table 16 summarizes the volumes (including ECD backfill) that can be found in Appendix H.

Table 16: Volume Calculations

Maximum CMFE (NAVD 88)	MFE at Year 0 (NAVD 88)	Cut Volume (with Backfill) Using MFE at Year 0 with CTF Ratio = 1.0			
		AutoCAD Surface	Average End Excel	Average Cut Volume	Average Cut Volume with 20% Contingency
+3.20 ft	+1.6 ft	2,562,460	2,710,248	2,636,354	3,163,625

8.4 Borrow Area Design

During the Phase 0 of TE-0171, Belle Pass was determined to be the preferred borrow area for TE-0171. The sediment has historically been used for marsh creation projects and is significantly closer to the placement area than other borrow alternatives, allowing for reduced costs. Additionally, the use of Belle Pass as the borrow area helps to support the vision of Port Fourchon expansion and support local stakeholder priorities and welcomes cost share opportunities. An alternative analysis completed as part of this 30% design effort (Section 1.6) deemed BA A to be the preferred BA for TE-0171. After the completion of the 30% design phase, Belle Pass was determined to be the final and singular BA for this project.

This BA was designed in order to achieve approximately 3.2 MCY of sediment availability. Dredging will commence at Sta. 140+00 in Belle Pass, and will continue south at a width of 300 ft and a proposed elevation of -43 ft NAVD 88. After the jetties, at Sta. 275+00, the width of the cut will widen to 475 ft wide over a 500 ft transition zone. The TMFE is estimated to be reached at Sta. 360+00. The borrow area side slopes will be constructed to a 3H:1V ratio.

GISE completed a Section 203 feasibility study (in 2019) in which they evaluated deepening Belle Pass up to -53.61 ft NAVD 88 (-53 ft MLLW) (and up to -56.61 ft NAVD 88 outside the jetties)

[47] Microsoft Office, Excel 2019 software

including advance maintenance. This study included the stability of the channel, hydrodynamic modeling (completed by the Water Institute), and a draft EIS.

The results of this study showed no environmental, stability, or any other engineering concerns through the maximum depths evaluated. However, due to the cost-to-benefit ratio at the time, a shallower elevation was selected for the deepening project (Port Fourchon Belle Pass Channel Deepening Project) and conditional authorization was granted by USACE Headquarters (further information can be found in Section 13). The results of this feasibility study can be utilized to alleviate any environmental and viability concerns with the temporary deepening of the channel that would be a result of the construction of TE-0171.

TE-0134, has an overlapping borrow area with TE-0171. TE-0134 is predicted to take the sediment from Sta. 140+00 to Sta. 330+00 at a cut of 300 ft wide and a mudline elevation of -33.61 ft NAVD 88 (-33 MLLW). Therefore, for the TE-0171 design, Sta. 140+00 to Sta. 330+00 assumes the mudline elevation is at an elevation of -33.61 ft NAVD 88 (-33 MLLW).

A potential overlap with the Port Fourchon Belle Pass Channel Deepening Project also exists. Due to USACE scheduling, it is assumed that TE-0171 construction will precede the Port Fourchon Belle Pass Channel Deepening Project dredging construction and will not be a conflict. A map that illustrates this overlap can be seen in Figure 7 in Section 4.2. Additionally, Table 17 shows the borrow dimensions for the BA as well as the available volume and expected volume to be removed from these overlapping projects.

Table 17: BA Design Dimensions and Volumes

Channel	Port Fourchon Marsh Creation Project (TE-0171) - Available Dredge Material at BA						
	Channel Width (Ft)	Channel Side Slopes	Dredge Depth (NAVD 88)	Survey Date	Volume from Survey (CY)	Volume Expected to be Removed by TE-0134 (CY)*	Volume Available (CY)
Sta. 140+00 to 275+00	300'	3H:1V	-43'	4/12/2024	2,604,387	905,222	1,699,165
Sta. 275+00 to 280+00	Varies	3H:1V	-43'	4/12/2024	114,815	19,409	95,406
Sta. 280+00 to 360+00	475'	3H:1V	-43'	4/12/2024	1,626,685	211,005	1,415,680
				Total CY:	**4,345,888**	**1,135,637**	**3,210,251**

Notes:

** The full removal of 1,135,637 CY from the TE-0134 project is expected and has been reflected in the design of the BA.*

Pipelines in the borrow area (as noted in Section 5.2) will be treated as “avoidance areas,” where no dredging will take place. Distance from the pipeline will follow all ROW regulations per each pipeline owner. A required offset of 100 ft in each direction of the pipeline crossing was assumed. An additional minimum of 100 ft in both directions was designed to slope back to the cut depth. Avoidance areas have been considered in the available volume calculations and can be seen in Figure 32 and Figure 33.

Two (2) pipeline crossings have been identified in the BA. The first crossing was identified at Sta. 199+27. While removal of pipelines is not in the scope of work for TE-0171, the 10-in Chevron pipeline is currently in the early stages of removal coordination for other projects in the area. This crossing, while currently listed as a conflict, is not expected to be a conflict when TE-0171 is approved for construction. Once this pipeline is removed, this avoidance area will be eliminated from plans.

The second pipeline is 12-in EnLink pipeline located at Sta. 335+00. While no coordination for the removal of this pipeline has commenced, this pipeline will also be removed during the Port Fourchon Deepening Project. Therefore, it is possible this line will be removed before the construction of TE-0171 and this avoidance area can be removed.

Since the BA involves dredging a federal channel, a Section 408 permit will be needed. The coastal use permit (CUP) and Section 408 permitting process has begun (see Section 10.1 and Appendix M). Typical cross sections can be found in Figure 34 and Figure 35.

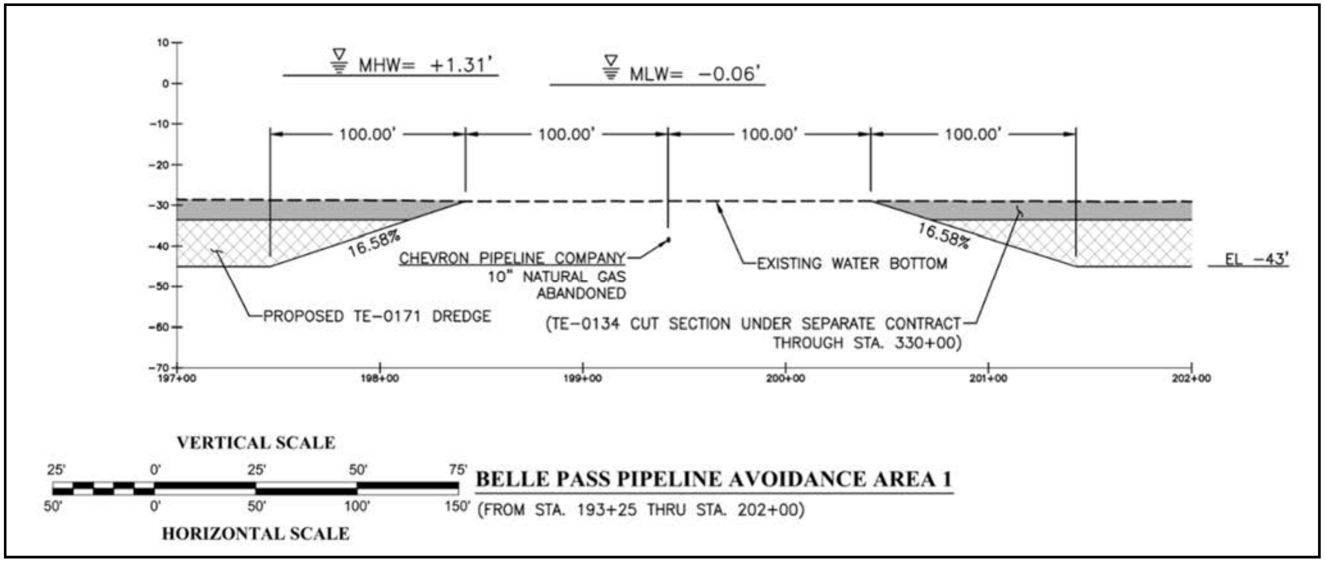

Figure 32: Chevron BA Pipeline Crossing Avoidance Area

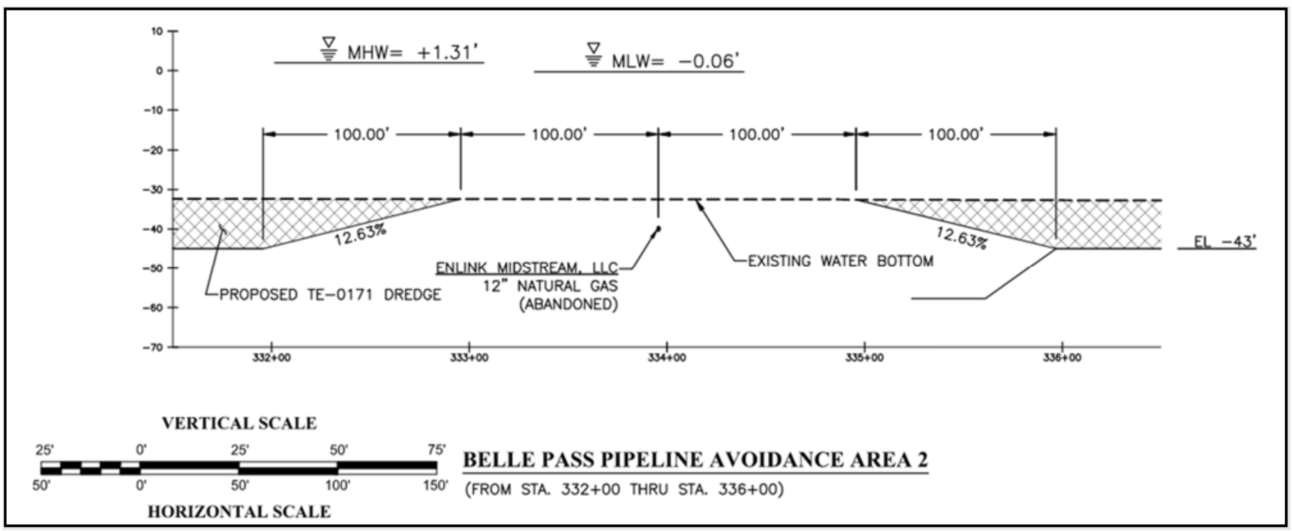

Figure 33: EnLink BA Pipeline Crossing Avoidance Area

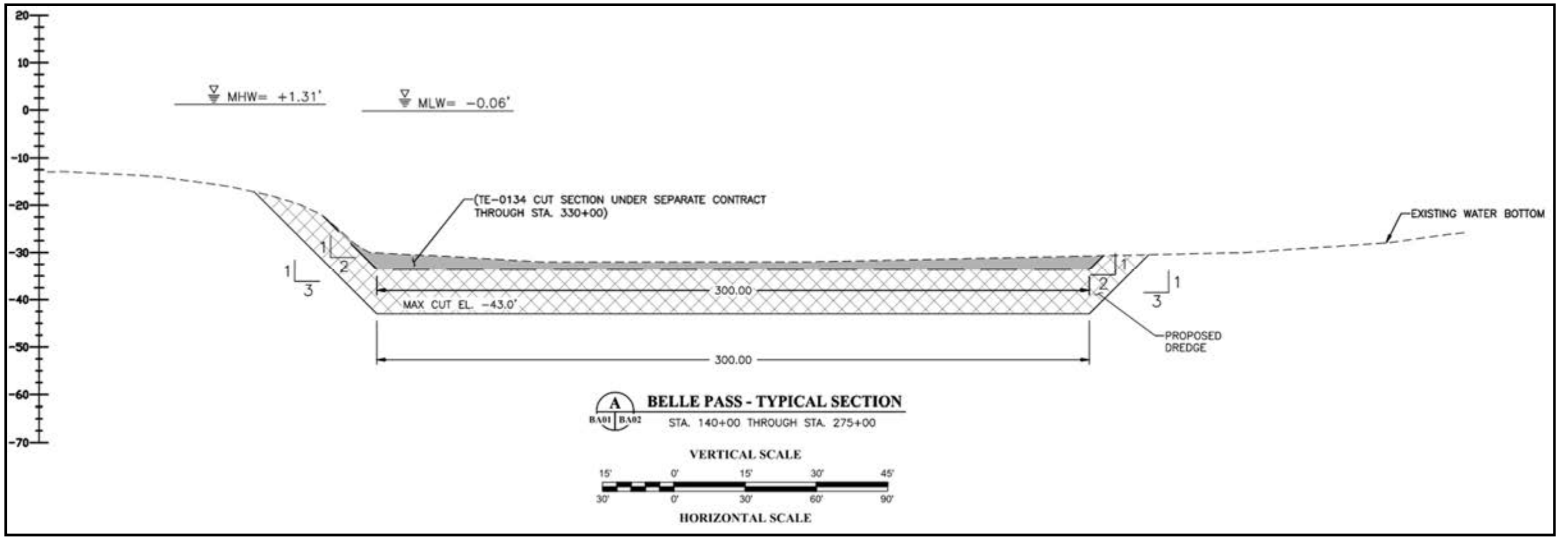

Figure 34: BA Typical Dredging Cross Section Sta. 140+00 to Sta. 275+00

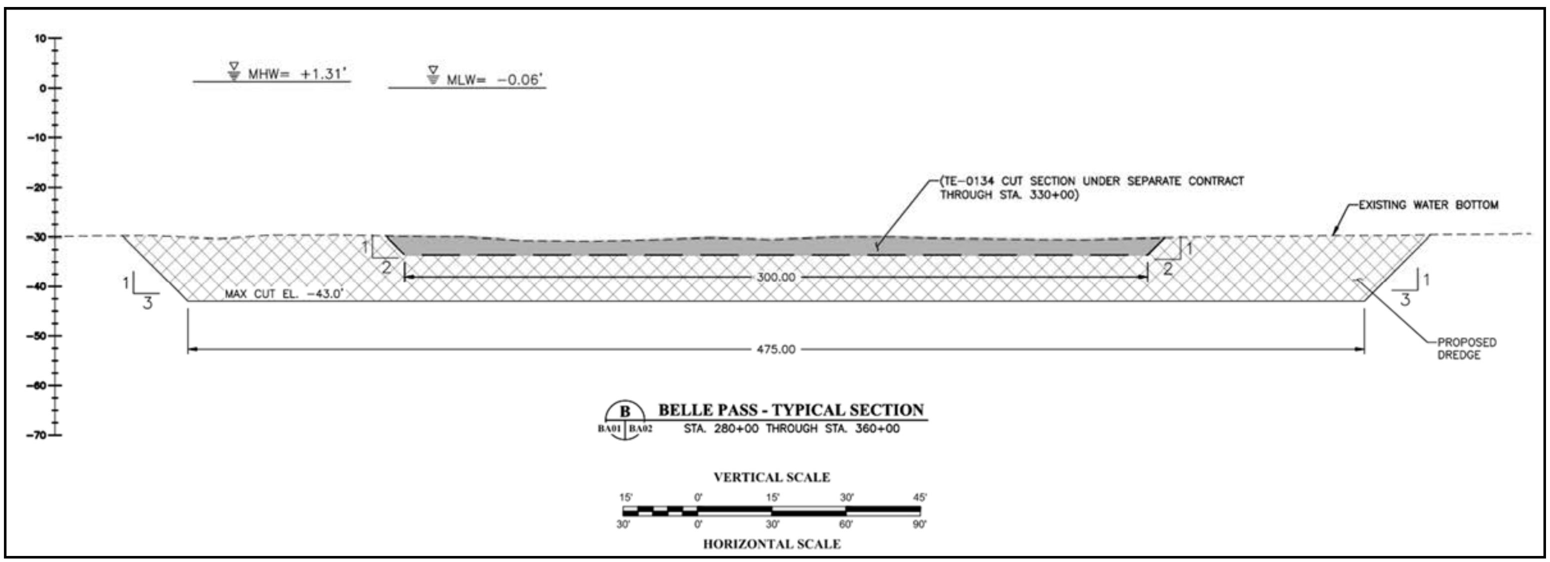

Figure 35: BA Typical Dredging Cross Section Sta. 280+00 to Sta. 360+00

8.5 Additional Features

Additional features include EACs, DPC, settlement plates, grade stakes, and bird abatement.

8.5.1 Equipment Access and Dredge Pipeline Corridor Design

In order for equipment to access the site, two (2) EACs have been proposed by the Project Team. The first of these access points is Timbalier EAC. This channel will run across Timbalier Bay and into the MCA. This access channel will be permitted to a -6 ft NAVD 88 elevation and will turn into a flotation channel around the enhanced ECDs. The access and flotation channels will be 50 ft wide with 2H:1V side slopes. Dredging these channels will be optional and is left to the discretion of the construction contractor. However, they serve the purpose of allowing larger equipment to be brought into the MCA. A temporary spoil bank will be permitted on either side of the EAC. The construction contractor should bring this area to its original condition before demobilizing. The Timbalier EAC design is summarized in Table 18.

Table 18: Timbalier EAC Design

Maximum Elevation (ft NAVD 88)	Maximum Bottom Width (ft)	Length (LF)	Side Slope	Bench (ft)	Maximum Spoil Bank Height (ft)	Volume (CY)
-6	50	9,227	2H:1V	25	5	47,273

The second EAC for this project is the Headland EAC, which allows for access through the West Belle Headland beach into the placement area. To cross the beach, equipment will utilize the existing TE-0052 ECDs in order to minimize impacts to existing marsh. Access is ultimately left to the discretion of the construction contractor and alternative routes may be utilized.

The proposed DPC will follow the BA along the west bank line of Belle Pass, go around the west Belle Pass jetties, and cross the beach just south of the MCA, following the Headland EAC. The dredge pipeline will float from the BA to the MCA, except where it crosses the beach. The ultimate decision on the utilization of floating pipeline is up to the discretion of the construction contractor with the exception of areas delineated in the specifications.

The two proposed EACs and DPC can be seen in Figure 36.

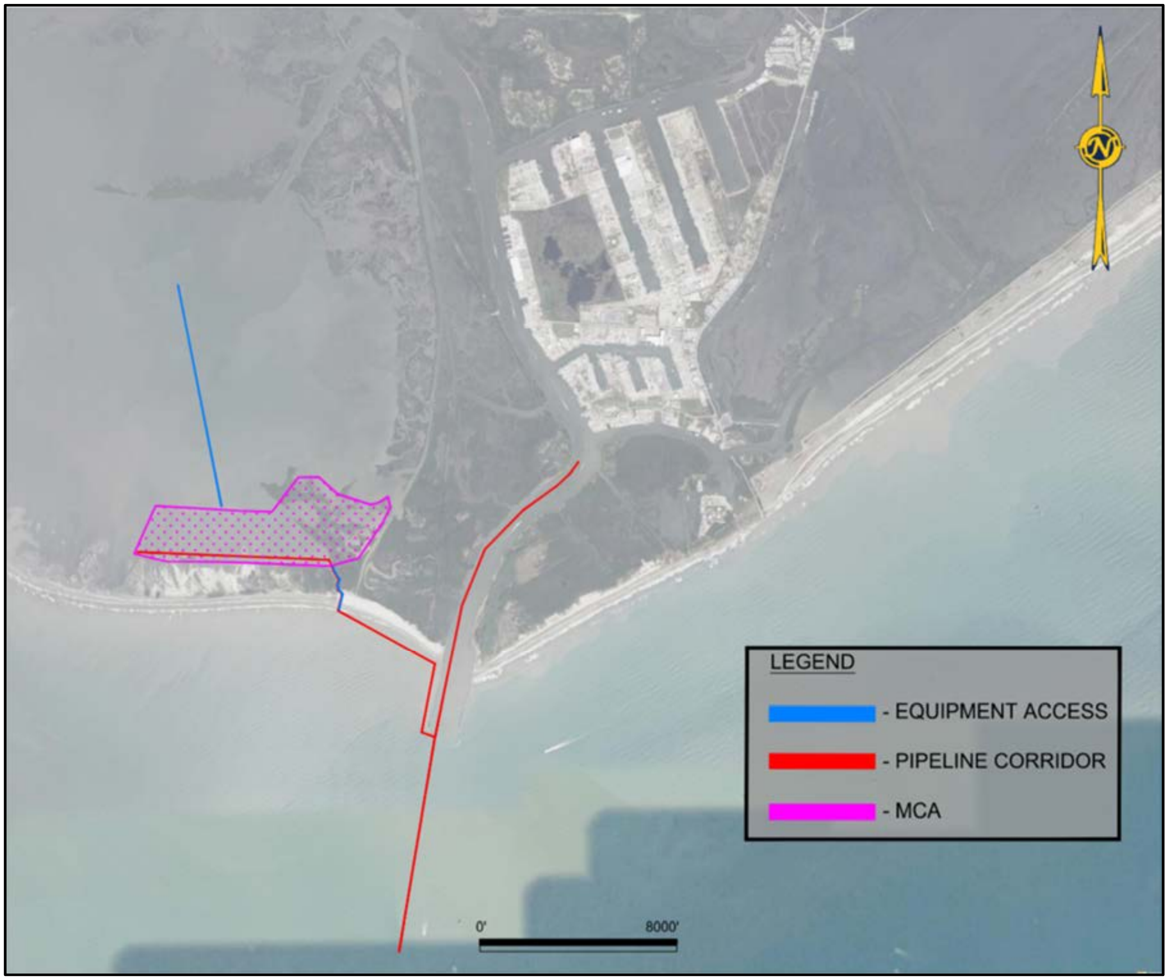

Figure 36: TE-0171's Two EACs and Dredging Pipeline Corridor

8.5.2 Settlement Plates

One (1) settlement plate will be utilized in the MCA for every 50 acres. In total, 11 settlement plates will be utilized approximately equidistant from each other. The locations for the settlement plates have been included in Appendix O. Construction specifications will also be developed to allow for relocation during construction as deemed necessary.

8.5.3 Grade Stakes

One (1) grade stake will be utilized in the MCA at a spacing of 300 ft. In total, approximately 261 grade stakes will be utilized approximately equidistant from each other. Construction specifications can also be developed to allow for relocation during construction as deemed necessary.

8.5.4 Bird Abatement

Due to the likelihood of presence of birds in this area, bird abatement is currently assumed to be necessary. The nesting season spans from February to September, totaling 226 days of nesting bird season a year. While a conservative amount of bird abatement days of 317 is currently assumed, the final estimation will be further evaluated in Phase II and will be based on the anticipated starting construction date.

8.5.5 Vegetative Plantings

Vegetative plantings will be handled under a CPRA specific contract. The current plan is to plant the ECDs shortly after heavy construction is complete with Seashore Paspalum (*Paspalum distichum*) on the top of the ECDs and Smooth Cordgrass (*Spartina alterniflora* 'Vermilion') on the outside of the north facing ECD. Vegetative planting will occur under a separate contract.

9.0 CONSTRUCTION

9.1 Duration

A construction duration estimate was completed using the CWPPRA PPL 34 spreadsheet. The construction duration will continue to be evaluated through design. A 10% contingency was added for the total construction durations. This 10% contingency was designed to capture weather delays over the year. If funded, this contingency will be reevaluated to more accurately represent the average weather delays typical for the specific months in which construction will occur.

It was estimated that it would take 176 days to fill the MCA including the ECD backfill after the completion of containment dikes using a 30-in dredge. Mobilization/demobilization was estimated to be 60 days. A construction duration of the entire project, including contingency, was estimated to be 485 days (approximately 16 months). A detailed breakdown of the construction duration estimate can be found in Appendix I. 95% Project Specifications are found in Appendix N.

9.2 Cost Estimate

Cost estimates have been completed using the CWPPRA PPL 34 spreadsheet format and submitted to the CWPPRA Engineering workgroup along with this report.

10.0 STEPS FORWARD

Due to the uniqueness of this project which includes dredging a navigable channel, GISE has already begun coordination for a CUP permit which will include Section 408 review. Coordination will continue and, once funded for Phase II, the final tasks can be finished to bring the project design up to 100%.

10.1 Section 408 Permit

While a Section 408 permit will need to be obtained for this project due to the federal channel borrow area, GISE does not see this as a major risk for the project or the project's schedule.

First, GLPC (with the assistance of GISE) has experience in obtaining Section 408 authorization for CWPRRA Project TE-0134. TE-0134 required Section 408 compliance for both Belle Pass and Bayou Lafourche outside the currently authorized dredge limits. The Section 408 compliance was successfully achieved and had no impact on the project schedule. To best ensure the same result for the TE-0171 project, GLPC has already begun conversations with the USACE on this Section 408 review effort. GISE estimates obtaining Section 408 compliance to take from six (6) to eighteen (18) months. Coordination for this permit with USACE began in August of 2024 (following the completion of the 30% Design CWPPRA Review period). Compliance should be achieved by February 2026, approximately a full year before TE-0171 is anticipated to commence construction (Q1 2027).

Secondly, GISE expects the stability of the channel, specifically the jetties, to be the main focus of obtaining a Section 408 Permit. However, in January of 2020 GLPC, with the assistance of GISE, submitted a Section 203 Feasibility study to deepen Belle Pass to an elevation of -50.61 ft NAVD 88 (-50 ft MLLW) with three (3) ft of advance maintenance inside the jetties and -52.61 NAVD 88 (-52 ft MLLW) with four (4) ft of advance maintenance outside the jetties. While this project has not yet been authorized, the engineering analysis supporting the stability of the channel and surrounding infrastructure for the proposed channel dimensions has already been completed. Little to no additional data is expected to be needed to support the stability of the channel. Though TE-0171 will temporarily modify the depth of Belle Pass, it does not adversely impact any currently proposed USACE project.

Finally, GLPC has agreed to absorb the costs for any coordination needed to obtain Section 408 compliance.

10.2 Additional Coordination & Possible Participation from the USACE

Due to the potential overlap between TE-0171 and the Port Fourchon Belle Pass Channel Deepening Project, additional funding participation with the USACE may be available for approximately three (3) ft of material from Sta. 140+00 to 330+00 (approximately 300,000 CY). This possibility has already been raised with the USACE. The complementary relationship between TE-0171 and the deepening project will highlight CWPPRA's determination to create a synergetic and sustainable project benefitting the local, state, and national project goals.

11.0 MODIFICATIONS

As TE-0171 has progressed during the Phase I process, it has undergone many changes from both the 30% design phase and the approved Phase 0.

11.1 Modifications from 30% Design

Many modifications have happened over the 95% design of TE-0171. Changes to the MCA, ECDs and ECD armoring, BA, EACs, and general assumptions have all been made to not only refine but best reflect the project's environment but also to decrease the project cost. The following explains the major changes that have been made to the design of this project and the reasoning behind the updated design.

11.1.1 Changes to the MCA

After the completion of the 30% design, an overall concern for the project's funding ability was held by the CWPPRA community due to the high project cost. This was a driving factor to redesign multiple aspects of the MCA.

In the 95% stage of design, the MCA shifted from a 595-acre cell to the final 543-acre cell reflected in this report. The new design was chosen in order to both maximize acreage of the MCA while still greatly decreasing Engineer's Estimates of the project cost. The following changes were made to the MCA to achieve this task:

- The northwestern corner of the MCA was shifted south so that the northern open water area of the cell was straight across. This greatly decreased the cost of the project by decreasing the acreage in a deeper area of the MCA.
- The southern border of the MCA was shifted south to the old containment dike for TE-0052 in order to increase stability of the ECD by decreasing the ECD's overall height.
- The southwestern corner of the MCA was 'kicked out' to maximize acreage, take advantage of shallow water depths, and provide increased synergy with TE-0176. Additionally, this change in design helped to alleviate a concern that was discussed by the Project Team. The original footprint would have resulted in an acute angle where TE-0176, TE-0052, and TE-0171 would have met. This could have resulted in focused wave energy at the corner, which could increase erosion. It is believed that this change in design will help to contribute to the longevity of all three (3) of these projects.
- The eastern side of the MCA was shifted westward. While this was not specifically to reduce costs, this boundary was shifted to ensure that a buffer was available between the eastern ECD and the active pipeline located directly east of the MCA in the pipeline canal.

All these changes worked together, decreasing the MCA acreage, shifting ECD alignment to higher existing mudline elevations, increasing the synergy with other projects, and helping to increase the stability and longevity of the project.

11.1.2 ECDs and ECD Armoring

Another major change to the project from the original 30% design was the design of the ECDs. Not only was the ECD height changed, but the original ECD armoring recommendation was replaced with an enhanced ECD design.

ECD Height

The ECD height was changed from +3.25 ft NAVD 88 to +4.5 ft NAVD 88, with an additional +0.5 ft of construction tolerance for both cases. In CPRA's experience, many projects that have required a high marsh fill amount due to existing deep mudlines, have resulted in ECD crown elevations designed too low when utilizing CPRA's marsh creation guidelines, which recommend one (1) ft of freeboard above the target CMFE to determine the height of ECDs. With this amount of marsh fill, there are multiple variables that can affect the height of the slurry once inside the MCA. The

Project Team, assisted by Eustis, evaluated pumping rates and sediment profiles to determine the maximum CMFE, which allowed for the calculation of a new ECD height to prevent potential overtopping of material as it expands during construction. One (1) ft above the maximum CMFE was used to determine the new height of the ECDs.

ECD Armoring

In the original 30% design report, ACMs were recommended to be used along the north and west ECD alignments of the MCA. However, this was always considered to be a preliminary and conservative assumption that would be revisited in final design. GISE completed an evaluation of past projects in direct connection to TE-0171 (TE-0052 and TE-0143/TE-0118) to evaluate the need of armoring the ECDs. The conclusion of this evaluation (which can be found in Appendix F) was the ECD armoring would not be needed for the successful completion of TE-0171. However, enhanced ECDs were recommended.

Therefore, in the 95% design of TE-0171, the north and west ECDs consist of 8H:1V exterior side slopes in order to provide greater resistance against the high wind and wave energies in this area. The interior borrow pit design was updated to accommodate these enhanced ECDs along with the addition of exterior borrow pits.

Not only did this design update alleviate concerns from some in the CWPPRA community about the success of ACMs, but it also greatly helped in decreasing the overall project cost.

11.1.3 Changes to the Borrow Area

While a majority of the BA design stayed consistent from the 30% to 95% design, some small changes were made. The ending station changed from Sta. 365+00 to Sta. 360+00 in order to allow additional buffer distance between the end of the project and a pipeline located at Sta. 367+00. Secondly, the borrow side slopes changed from 2H:1V to 3H:1V in order to follow Eustis' recommendation for channel stability. Finally, the cut elevation changed from -45 ft NAVD 88 to -43 ft NAVD 88. This was due to a decrease in required cut volume after the MCA was redesigned as explained in this section.

11.1.4 Changes to Equipment Access

The EAC for this project changed from following the shoreline to two (2) possible EACs. The first EAC goes straight across Timbalier Bay to the MCA (Timbalier EAC), and the second goes over the beach (Headland EAC). This change was made to avoid the need for oyster lease assessments and acquisitions, as well as to reduce costs by decreasing the distance needed to excavate an optional access channel. The ultimate choice for accessing the project area and need for excavation is left to the discretion of the contractor.

11.1.5 Changes to General Assumptions

After re-evaluating the geotechnical properties of both the BA and MCA sediment, the CTF ratio changed from 1.1 to 1.0.

11.1.6 Changes to Cost

The combination of the above changes helped to greatly decrease the project cost. When comparing the 30% Design and 95% Design Fully Funded Cost, there was a 18% decrease in cost for the total without GLPC cost share (22% decrease in cost including GLPC cost share). Note the Total Phase II Cost in this comparison does not include O&M costs.

11.2 Modifications from Approved Phase 0

During the Phase 0 process, the goal of the Port Fourchon Marsh Creation project was to create and nourish 605 acres of wetlands with sediment from Belle Pass in order to restore degraded wetland habitat and provide increased protection to the area from factors such as storm surge and flooding.

The initial candidate (Phase 0) project footprint consisted of three (3) small MCAs along Timbalier Bay west of Port Fourchon. During the Phase 0 process, a new configuration was proposed due to constructability concerns with marsh creation areas deeper than expected. The approved Phase I project consists of one (1) MCA still to the west of Belle Pass and directly north of the previously completed TE-0052 CWPPRA project. GISE evaluated both of these options in a desktop alternative analysis process and determined the singular MCA would be a better choice for this project. This MCA was selected for several reasons, including better synergy with other projects, more manageable ECD constructability, and maximum utilization of State Lands of Louisiana acquired for coastal restoration purposes.

Further changes to the MCA during Phase I include refining the project footprint to reduce costs. This revision is a 10% decrease from the approved Phase I acreage of 605 acres. Changes to the MCA throughout the design process can be seen in Figure 37.

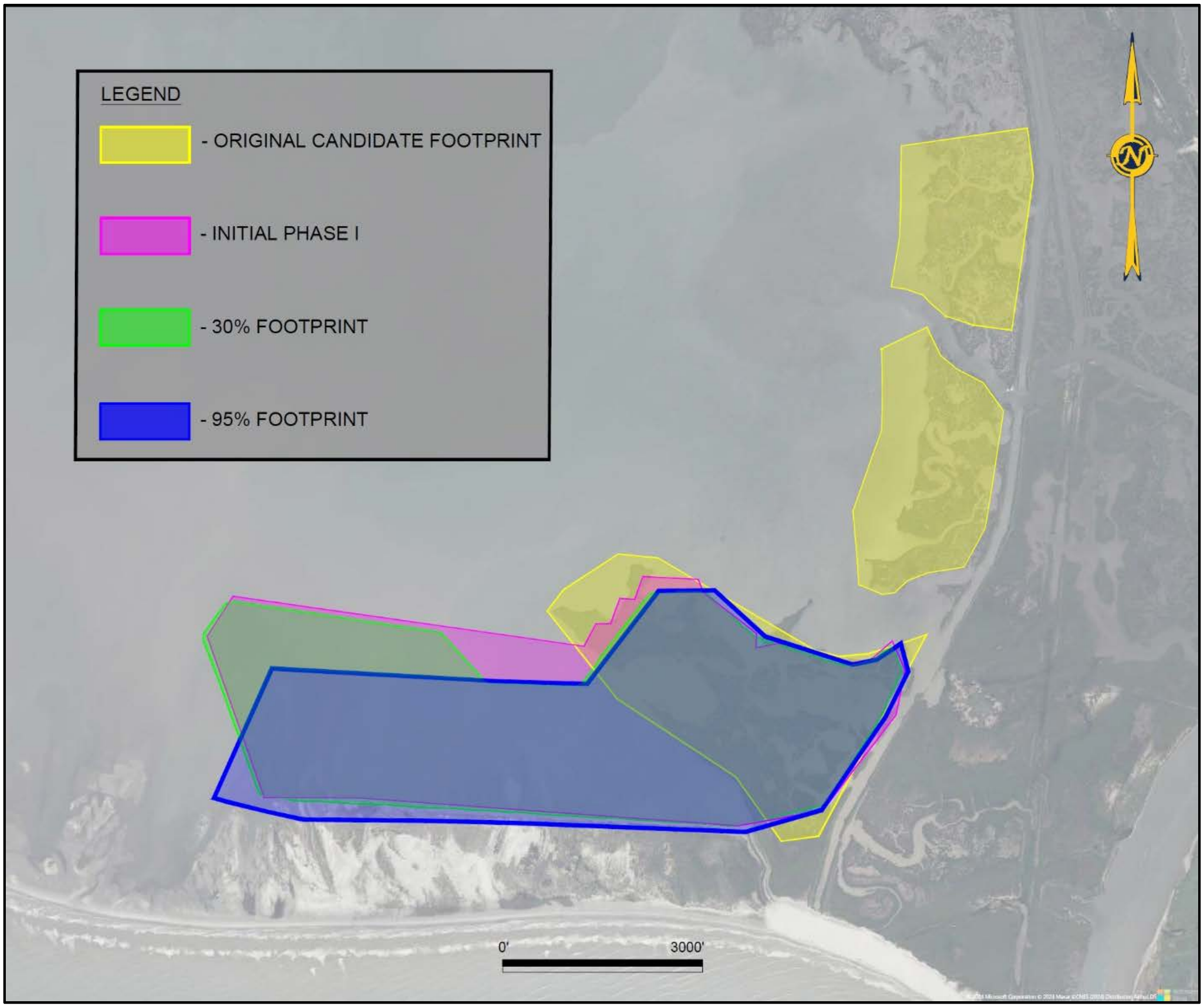

Figure 37: Design Changes to MCA Footprint

The January 2022 CWPPRA Task Force approved TE-0171 Phase I engineering and design costs of $3,484,176 with a fully funded estimated project cost of $37,075,992. On September 5, 2024 the CWPPRA Technical Committee approved a scope change request lead by EPA. The new approved scope has an acreage of 543 and a Fully Funded Cost of $49,976,390.

Major changes since Phase 0 have been summarized in Table 19.

Table 19: Cost Changes from Phase 0 to 95% Design

Phase	Marsh Creation (Acres)	Total Net Acres	Total "Fully Funded" Cost without GLPC Contribution		Total "Fully Funded" Cost with GLPC Contribution	
			Cost with 25% Contingency	Cost per Net Acre	Cost with 25% Contingency	Cost per Net Acre
Phase 0	605	450	$37,075,992	$82,391	$29,696,971	$65,993
30% Design	595	443	$59,474,275	$134,253	$49,474,275	$111,680
95% Design*	543	412	$48,709,094	$118,226	$38,709,094	$93,954
Change from Phase 0 to 95%	-10%	-8%	31%	43%	30%	42%
Changes from 30% to 95%	-9%	-7%	-18%	-12%	-22%	-16%

** 95% Design is approximately equal to the approved rescoping efforts approved by the CWPPRA Technical Committee on Thursday, September 5, 2024.*

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