BCarbon Stakeholder Meeting

March 2nd, 2023

Where We Are and Where We Are Going

- March 2 full stakeholder briefing on protocol
- March 3 shoreline committee meeting
- By March 15 final written protocol sent to all stakeholders
- Comments Back by March 24
- Final action slated for April 6 stakeholders meeting

1,000 Mile Living Shoreline Project

April 20, 2022

A report by the Texas Coastal Exchange
Prepared by Sustainable Planning and Design

Research funded by The Meadows Foundation and John Teutsch

Jim Blackburn, Lalise Mason, Emily Fucile, Jace Hodder,
Camille Chenevert, David Valerio, and Melanie Martin

Texas Coastal Xchange

Sustainable Planning & Design

Research Funding Provided To Texas Coastal Exchange By:

Meadows Foundation
John Teutsch

With Earlier Assistance from:

Trull Foundation
Hershey Foundation

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Risk From Sea Level Rise

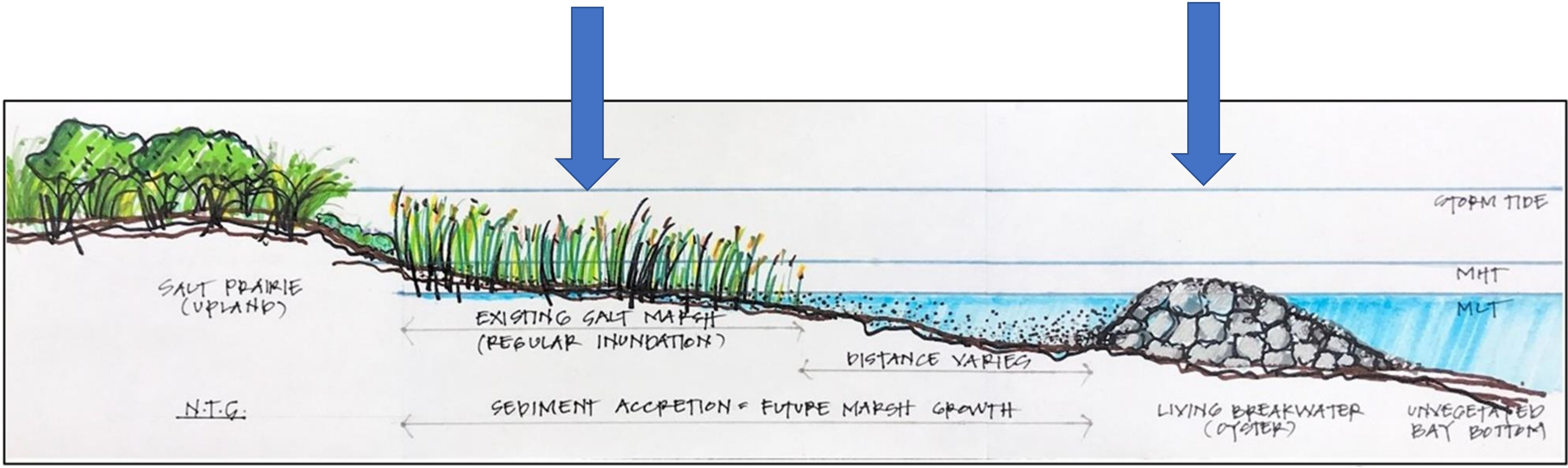
Innovative Coastal Blue Carbon Credit

Protected Wetland Credit

Protection Enables Yearly
Credit In The Future

Reef Construction Credit

Protection of Wetland Stored Carbon
Oyster Reef Sequestration
Associated Seagrass



Unanswered Questions Summer 2022

- How vulnerable are wetlands to SLR?
- What is the carbon potential of coastal wetlands?
- Will living shorelines protect the stored carbon?
- Will living shorelines protect the coastal wetland?
- What is a reasonable carbon yield from oysters?
- What is a reasonable carbon yield from seagrass?

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BCarbon Living Shorelines Carbon Protocol

BCarbon Living Shorelines Carbon Credits Concept

Draft October 5, 2022

This is a white paper describing BCarbon's approach to the certification of carbon credits generated by the construction of living shoreline barriers seaward of coastal wetlands. Specific research projects funded by Valero Energy Foundation.

Developed With Input From:

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- Dr. Joe Fox
- Dr. Rusty Feagin
- Dr. Rob Lane
- Dr. Rachel Hunter
- Dr. John Day
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- Ted Hollingsworth
- Tony Williams
- Mark Gagliano
- Chris Levitz
- Lalise Mason

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Living Shorelines Stakeholders

ExxonMobil

PALACIOS MARINE AGRICULTURAL RESEARCH, INC.

TEXAS A&M UNIVERSITY CORPUS CHRISTI
HARTE RESEARCH INSTITUTE FOR GULF OF MEXICO STUDIES

Hilcorp

POLLINATION

RS
RESTORATION SYSTEMS

AECOM

GHD

GALVESTON BAY FOUNDATION

Valero

TEXAS PARKS & WILDLIFE

U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

MATAGORDA BAY FOUNDATION

DUCKS UNLIMITED

USDA
NRCS

INTERNATIONAL CRANE FOUNDATION

TEXAS GENERAL LAND OFFICE
ESTABLISHED 1836

The Nature Conservancy

THE JOE W. AND DOROTHY DORSETT BROWN FOUNDATION

TETRA TECH

TEXAS
The University of Texas at Austin

TEXAS A&M UNIVERSITY

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Goals of the BCarbon Blue Carbon Protocol

- Goal: To protect Texas coastal marshlands from destruction by sea-level rise occurring due to climate change
    - May be only plan in the U.S. and perhaps the world to protect coastal wetlands from sea level rise
- Goal: To protect Texas Coastal Essential Fishery Habitat by protecting Texas coastal marshlands
- Goal: To develop living shorelines suitable for occupation by colonizing oysters along 1000 miles of Texas shoreline
- Goal: To prevent the release of 50+ million tons of carbon dioxide stored in coastal wetlands from the impacts of marsh erosion and release
- Goal: To allow the marsh to continue to sequester carbon dioxide for the next 50 years along with colonizing oysters and sea grass

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Key Concepts of BCarbon Coastal Blue Carbon Protocol – Consensus Items

- Wetlands are protected from toe erosion by construction of living shoreline/breakwater
- Living shoreline will enhance sedimentation in marsh as well as protecting against toe erosion
- Colonizing oysters provided by Palacios Marine Agricultural Research (PMAR) will supplement permanence of protection where feasible
- Carbon stored in the wetland soil will remain in place due to protection provided by the coastal living shoreline even with loss of marsh vegetation
- Insurance rather than a buffer pool is provided to ensure permanence of protection and carbon

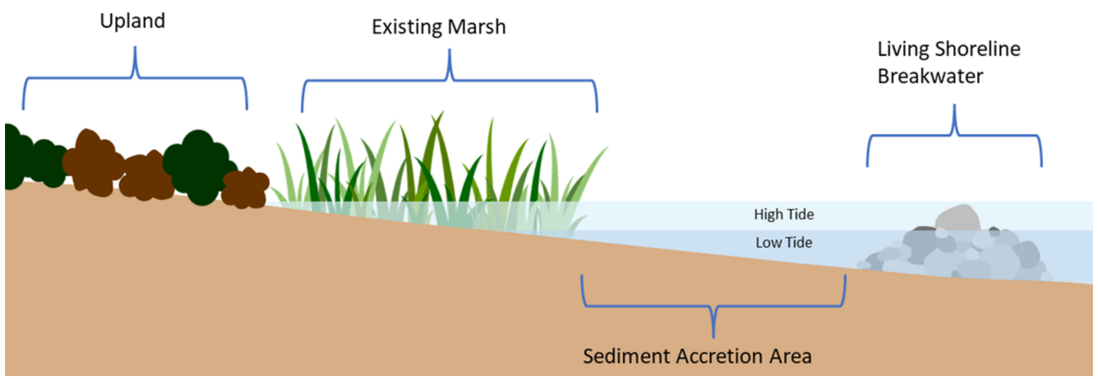
Key Concepts of BCarbon Coastal Blue Carbon Protocol

- Attempt will be made to enhance sedimentation by coordination with the U.S. Army Corps of Engineers
- Monitoring will be undertaken to confirm the following:
  - Progress of oyster colonization on breakwater
  - Status of toe erosion at project area interface with open water
  - Status of wetland vegetation within project area
  - Status of sedimentation within the project area

1.0 Context

The concept behind these credits is that by constructing “coastal regenerative and protective living shorelines” (“Living Shorelines”), the health and life span of existing wetlands will be regenerated and extended by the protection offered from regular and steady wave energy, increasing intensity of storm events, and the erosive wave action caused by future sea-level rise.

Living Shoreline Diagram



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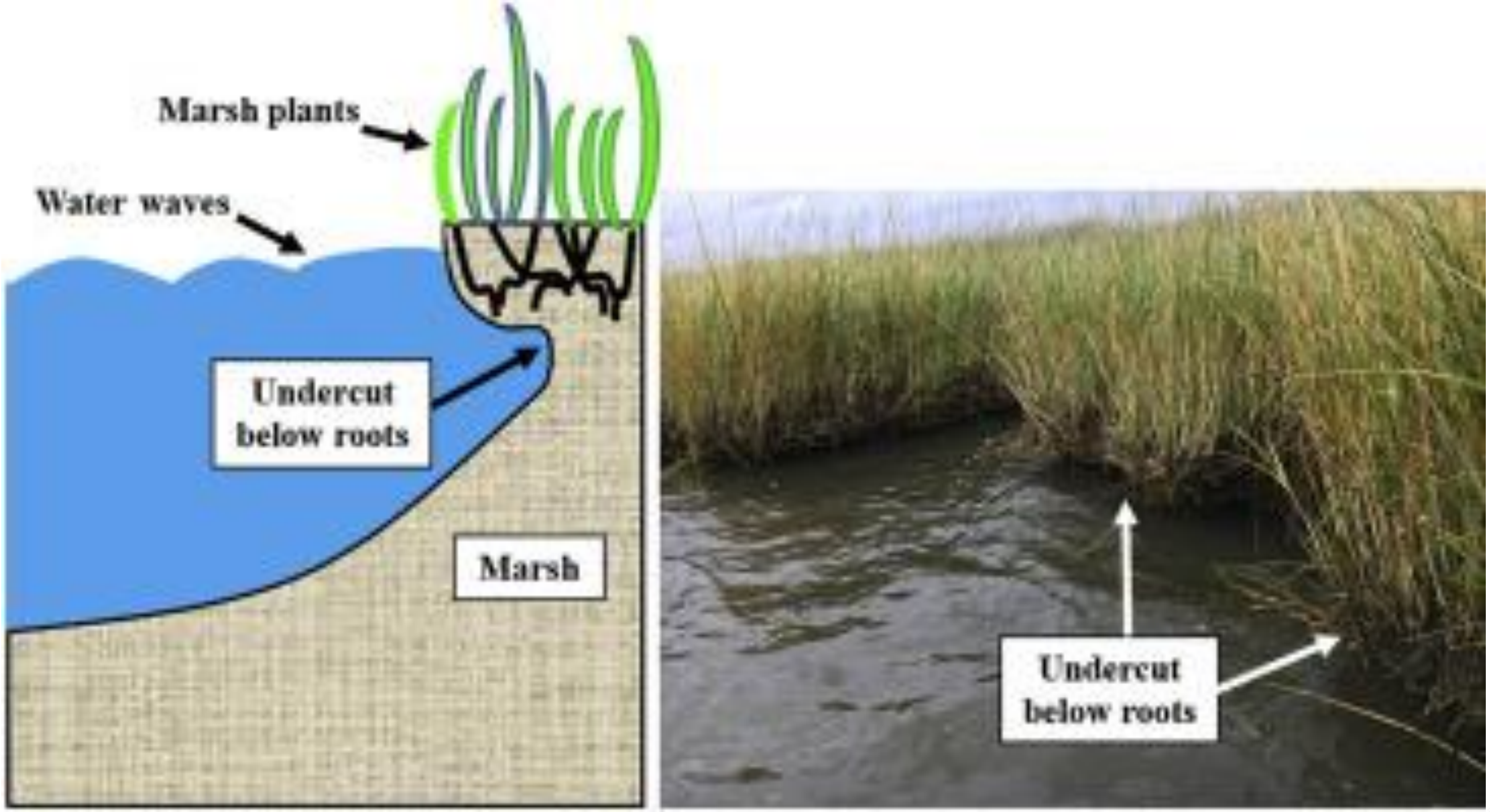
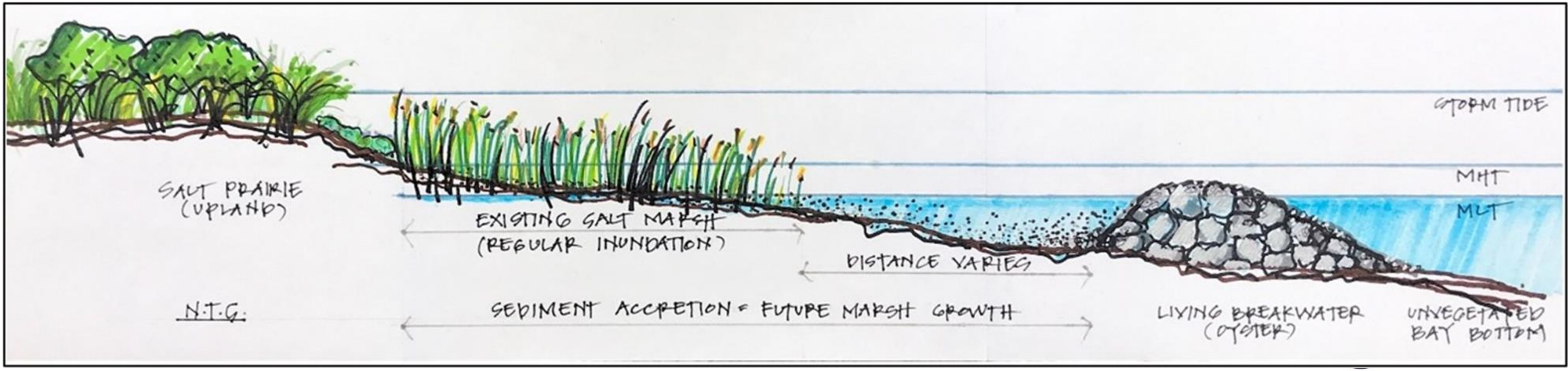
1.1 Wave Energy and Sea-level Rise Threatens Wetlands



1.2 Coastal Regenerative and Protective Living Shorelines Protect Stored Carbon

The Living Shorelines certified by this protocol will be designed and engineered to protect the toe of the wetlands at the water's edge, which is below the living root zone and is the most susceptible to erosion, and to regenerate and expand the existing wetlands. Evidence from existing coastal shoreline projects indicates that properly constructed shorelines can stop the erosion of the toe of the wetlands, thereby preventing the potential loss of large amounts of carbon stored in wetland soils.

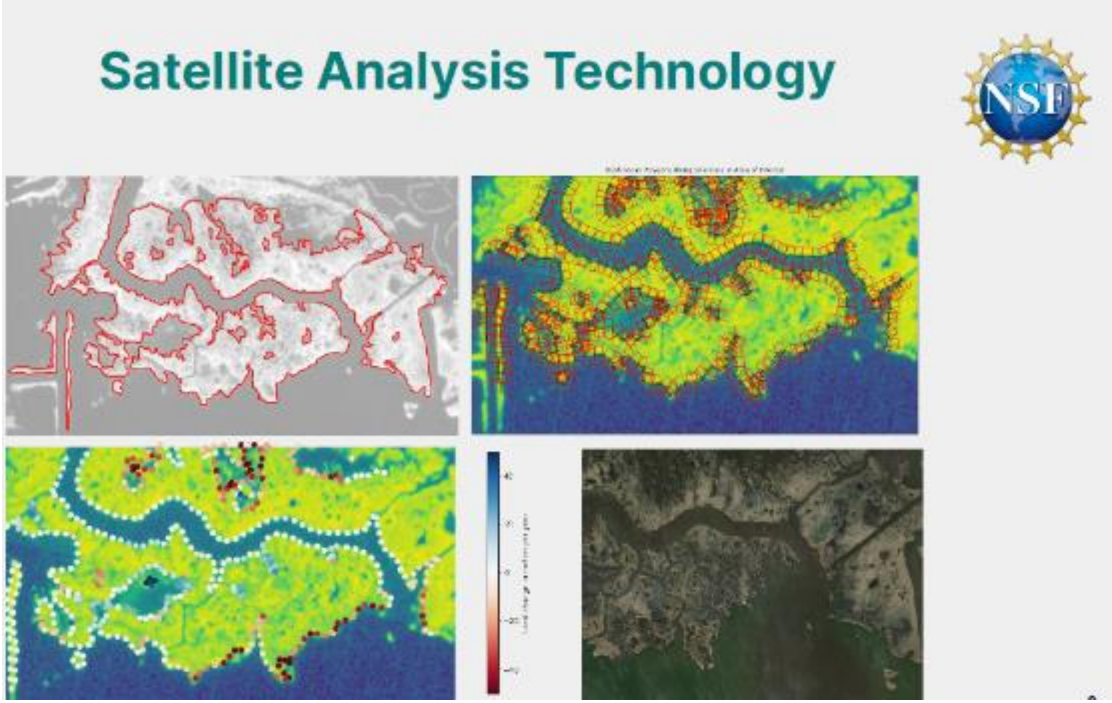


Permanence in the Protocol

2.1 Site Analysis

A full site analysis of the environmental conditions present at the proposed Living Shoreline is essential to inform the design of the project.

Site wetland description
Percent vegetative cover
Ortho-imagery - shoreline retreat
Buildability criteria
Bathymetry
Wave analysis
Alternatives analysis
Oyster reefs
Seagrass beds
Threatened and Endangered Species Assessment
Cultural Resources Assessment
LSLS Survey by Licensed State Land Surveyor
Geotechnical survey



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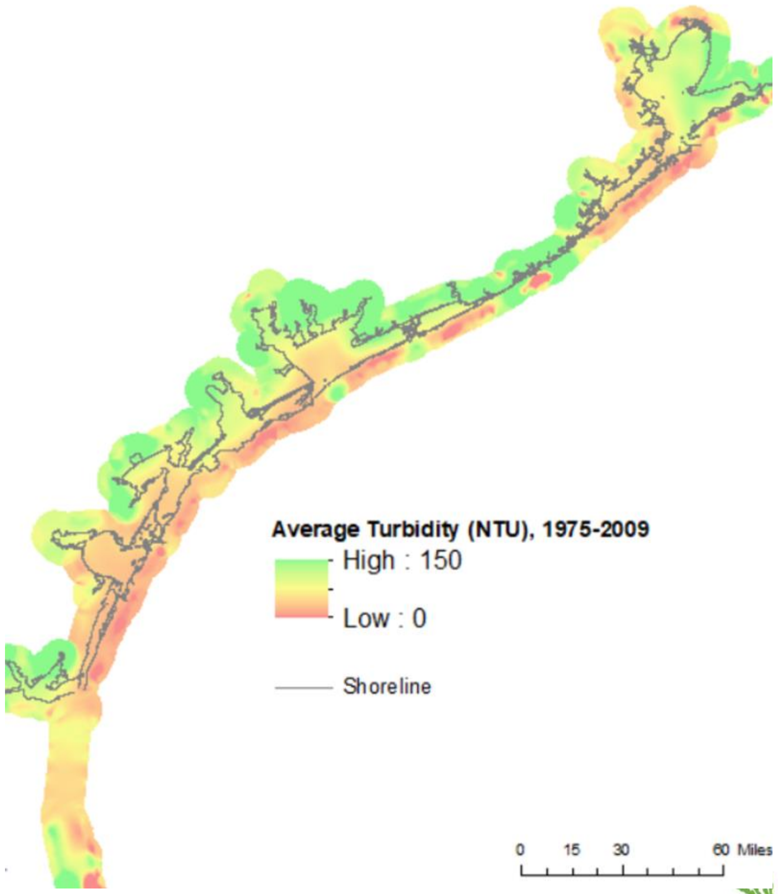
2.2 Living Shorelines Requirements

Designed to optimize sediment deposition behind the structure

The size, scale, and configuration of the Living Shoreline will be defined in the Signed Engineer's Statement, submitted to BCarbon, such that the Living Shoreline will achieve the objectives of this protocol, as described in Section 2.2.3.

Tidal interchange should be encouraged via the use of structural breaks and/or porous construction materials..



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2.2 Living Shorelines Requirements (cont.)

All projects should also be designed to encourage the recruitment of oysters, as oyster reefs may be able to outpace future rates of sea-level rise.

However, project specifications should not necessarily rely on oysters to function as coastal erosion protection at the completion of construction.

Construction design drawings must be submitted that identify the dimensions, placement, orientation, building materials, and construction methods used for the proposed Living Shoreline along the entire length of the shoreline to be protected.

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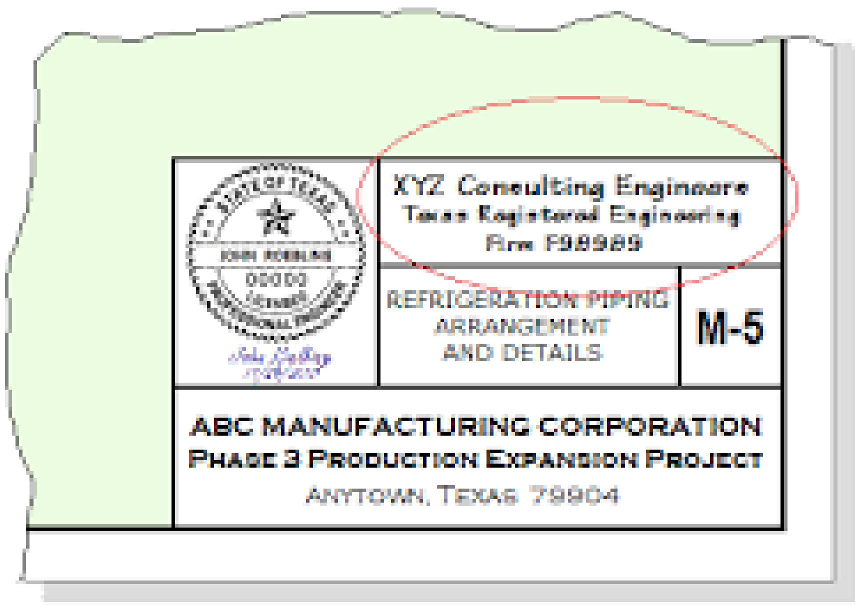
2.2.1 Signed Engineer’s Statement

An Engineer’s Statement must be submitted that states the proposed project is designed to be **efficacious and resilient.**

Efficacious means protecting the wetlands from edge erosion and optimizing for sedimentation behind the living shorelines for fifty years. The letter must also state that the project is resilient.

Resilient means the project has been designed to withstand future major storm events. The Engineer’s Statement should also certify that the project has been built as designed.

The Engineer’s Statement must provide estimates as defined in Section 2.2.3 “Insurance Requirements.”



2.2.2 Long-term Maintenance Requirement

The proposed arrangement for the monitoring and maintenance of the Living Shoreline over a **50-year term** must be submitted with the project application to BCarbon. A key reversal risk for the blue carbon credits issued under this protocol is the potential for the shoreline project itself to be destroyed in the future. Rather than buffer credits being taken from the total volume of credits certified under this protocol, an insurance policy ensuring the ongoing maintenance of the Living Shoreline must be established.

Who Owns Long Term?
How Is Structure Maintained?

2.2.3 Insurance Requirements

The owner of the Living Shoreline will be required to carry property insurance in an amount **sufficient to restore the Living Shoreline to an Efficacious and Resilient state** in the event the Living Shoreline experiences any of the 4 storm scenarios below (“Storm Scenarios”), as certified in the Engineer’s Statement.

Storm Scenarios	**1-minute Maximum Sustained Wind Speed and Central Pressure**
Category 2 Storm	96 miles per hour and 980 millibars
Category 3 Storm	111 miles per hour and 965 millibars
Category 4 Storm	130 miles per hour and 945 millibars
Category 5 Storm	157 miles per hour and 920 millibars

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2.2.3 Insurance Requirements (cont.)

The Engineer’s Statement to be submitted to BCarbon must include a schedule of cost estimates to restore (“Probable Maximum Loss” “PML”) the Efficacy and Resiliency of the Living Shoreline for each of the 4 Storm Scenarios and the amount of the insurance coverage required for each of the 4 Storm Scenarios will be the 4 corresponding PML levels listed in the Engineer’s Statement.

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2.2.4 Maintenance Specifics

The owner of the Living Shoreline will be required to meet specific maintenance and monitoring Standards.

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2.3 Application Submission and Approval Process

The BCarbon project proposal and acceptance process will be as follows:

- Prior to USACE application, developer submits “USACE Package” to BCarbon + proposal package (“BCarbon Package”) to BCarbon that will include Engineering Report, Proposed Insurance and deployment and construction timeline
- Within **30 days**, BCarbon responds on application completeness
- Within **60 days** of BCarbon acknowledging they have a complete Submission Package they will notify the Developer that they either have 1) a tentatively approved project pending USACE’s [feedback approval] or 2) they will notify the developer of the deficiencies in their Submission Package.
- If the Developer decides to address the deficiencies in the Submission Package, then they will resubmit their Submission Package as defined above.

2.3 Small Landowner Support

Source: Texas A&M Agrilife

Small landowners may apply for financial and logistical assistance to meet the above project requirements under BCarbon’s DEI principle.

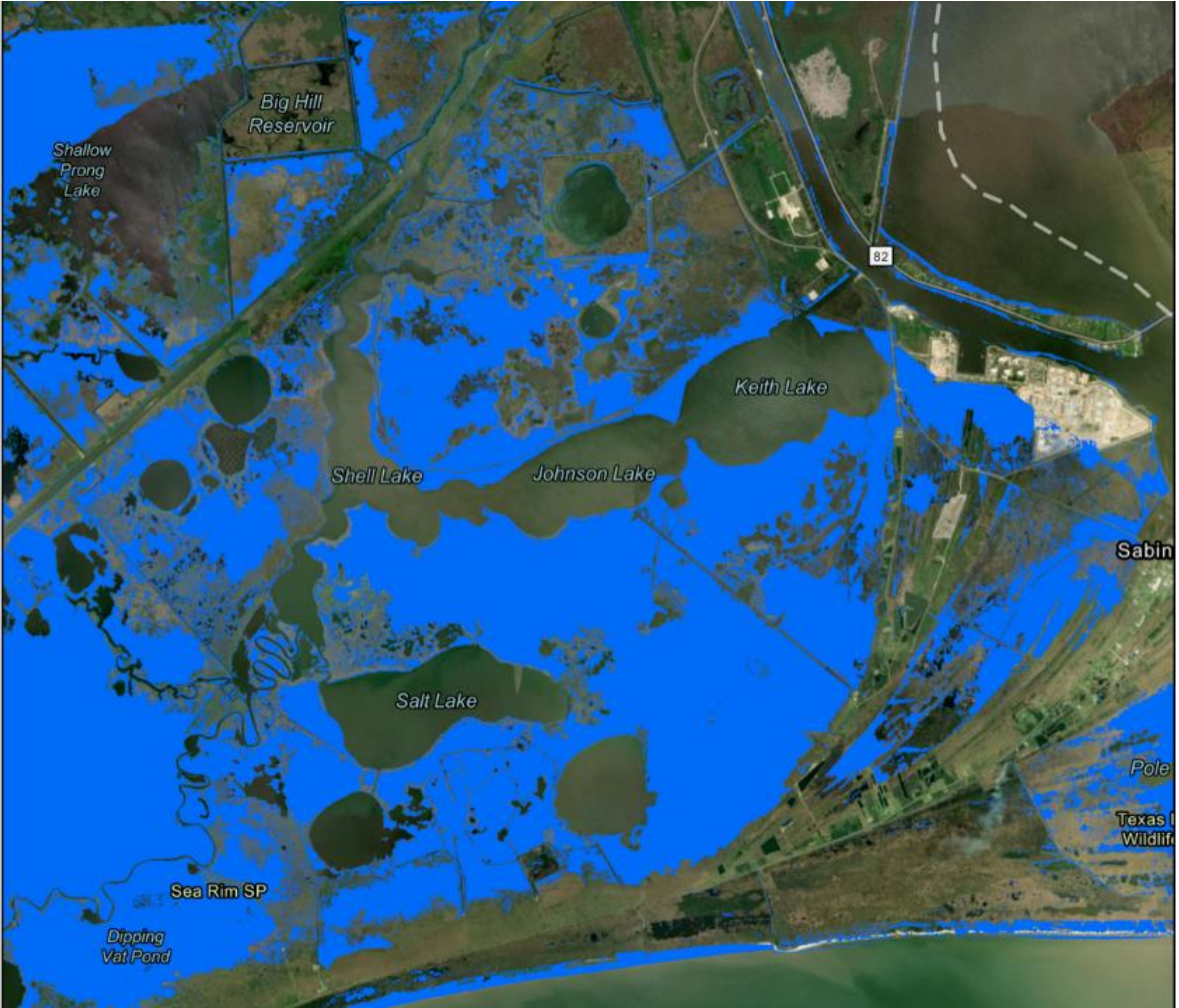
3.1 Determination of Protected Carbon Extent

3.1.1 SLAMM Description

SLAMM simulates the key processes involved in wetland change under different long-term sea level rise scenarios. The model uses geometric and qualitative relationships to represent material transfer among coastal classes. Each site is divided into cells of equal area, and each landcover class within a cell is simulated separately. SLAMM is flexible with regards to cell-size, cell widths typically range between 5 and 30 meters depending on the size of the site and data availability. Map distributions of wetlands are predicted under conditions of accelerated sea level rise, with results summarized in spreadsheets and graphs.

3.1.2 Maximum Inland Extent

Wetlands submerged, or in the process of fragmenting and being submerged, in the year 2075 as indicated by Sea Level Affecting Marshes Model (SLAMM) simulations conducted using the High sea-level rise scenario are considered to be the maximum inland extent of blue carbon credits potentially issued for Living Shorelines built seaward of them. This model run represents what would otherwise happen to the wetlands in question if a Living Shoreline project was not built to protect them (i.e., a “No Action” Scenario).



SLAMM Imagery

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3.1 Determination of Protected Carbon Extent

3.1.3 Living Shoreline Protection Mechanism

Living Shorelines protect against erosion at the toe of the marsh which keeps soil organic carbon stable in underlying sediments for decades into the future. **Even if wetland vegetation dies due to a rise in relative sea-level, most of the sediment behind the Living Shoreline will be held in place. In this scenario, the Living Shoreline creates a sill that reduces sediment loss and impounds it in bulk, as far landward as the SLAMM 2075 boundary line.** This can be contrasted with a scenario without shoreline protection, where the vegetation drowns and dies and the root system degrades, causing the underlying soil to become unstable and highly erodible.

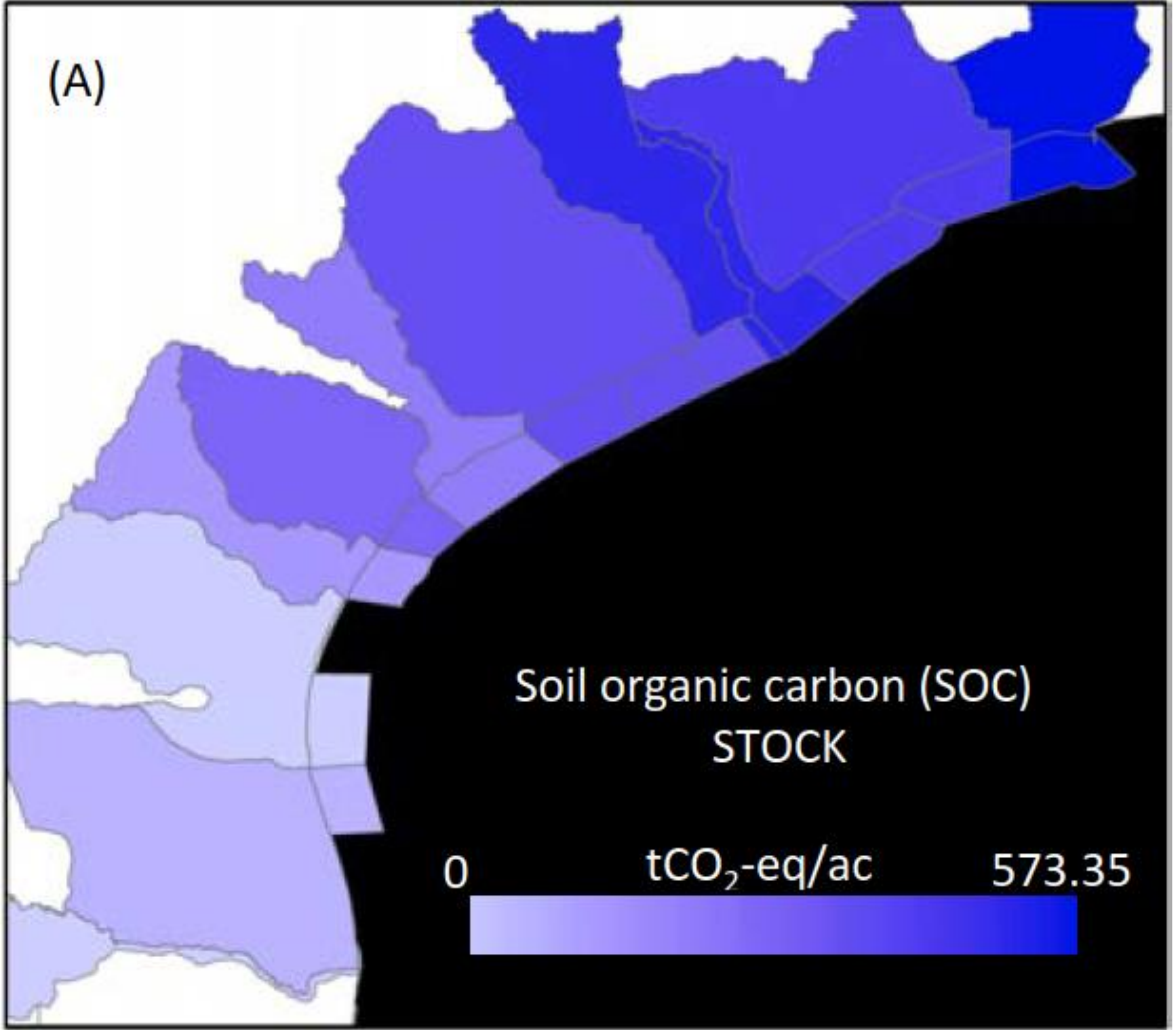
While the loss of some suspended sediment and organic matter by tidal action may continue through the gaps in the Living Shoreline, the Living Shoreline itself will reduce material movement into nearby bays and thereby reduce the release of CO_2 into the atmosphere due to aerobic decomposition. This bulk reduction in the export of soil organic carbon is another source of additionality offered by the shoreline project beyond the more immediate (and traditionally accounted for) wave protection provided to the eroding edge of the wetland by the Living Shoreline.

3.2 Determination of Wetland Carbon Stocks

3.2.1 Database

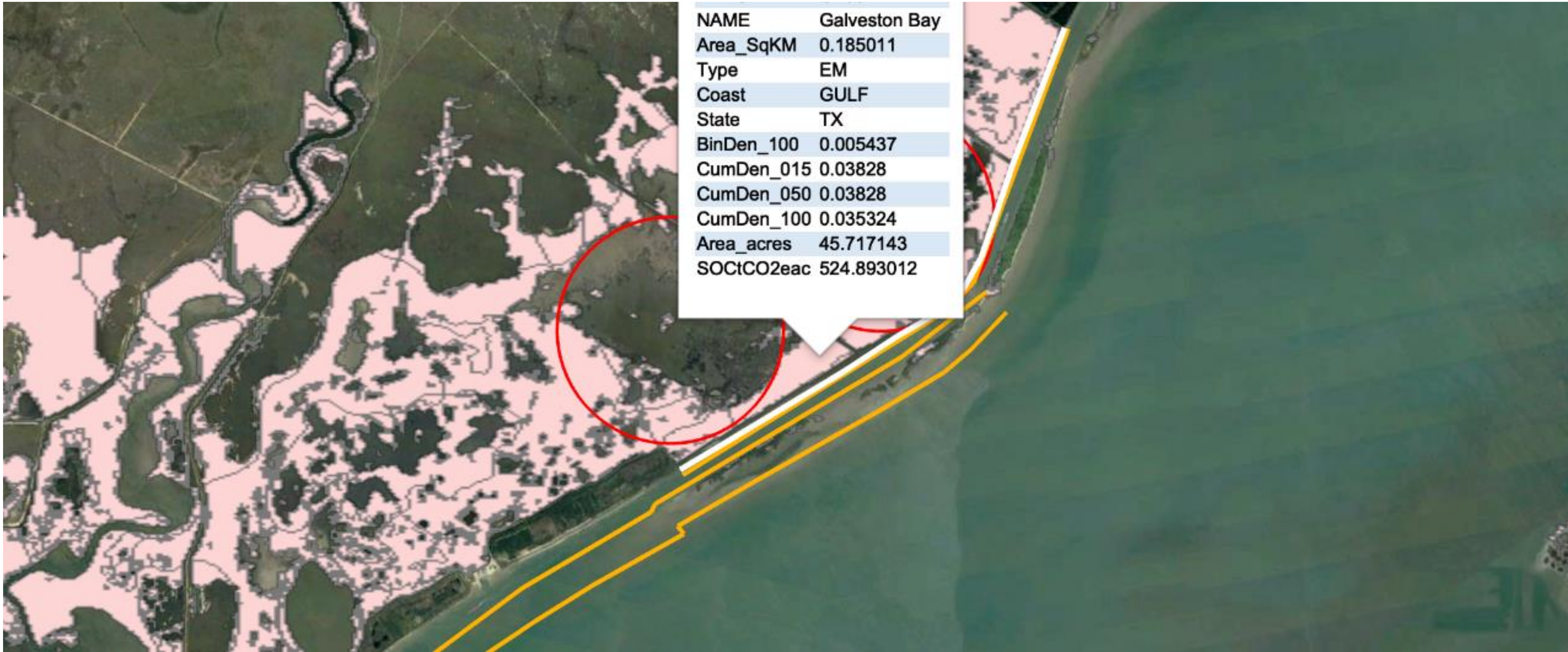
The carbon dioxide equivalent ($CO_{2\text{-eq}}$) content of wetlands can be determined using the Texas Blue Carbon Database created by Dr. Rusty Feagin of Texas A&M University. This database is a modified version of the US National Blue Carbon Database, the creation of which was funded by a grant from the National Aeronautics and Space Administration (NASA). The new database described below incorporates all Texas wetlands. Development of this database involved three main steps:

1) Tidal wetland locations and types were extracted from the National Wetland Inventory (NWI) database.
2) Measurements of organic matter fraction (OMF) and bulk density (BD) were extracted from the Soil Survey Geographic Database (SSURGO), and then used to compute the organic carbon density (OCD) and soil organic carbon stock, where possible, at 1-cm increments within individual SSURGO map units.
3) OCD and soil organic carbon stock were computed for individual wetland polygons by area-weighting map units within each wetland polygon.



Generalized Soil Carbon Content For The Texas Coast

ACOE GIWW Tract



3.2 Determination of Wetland Carbon Stocks

3.2.2 Field Measurements

Where the output of the database referred to in the previous section is a best estimate, field measurements of soil organic carbon must be conducted using the following steps from the BCarbon Soil Carbon Protocol, modified appropriately for wetlands:

Step 1: Stratification (Standard Procedure A)

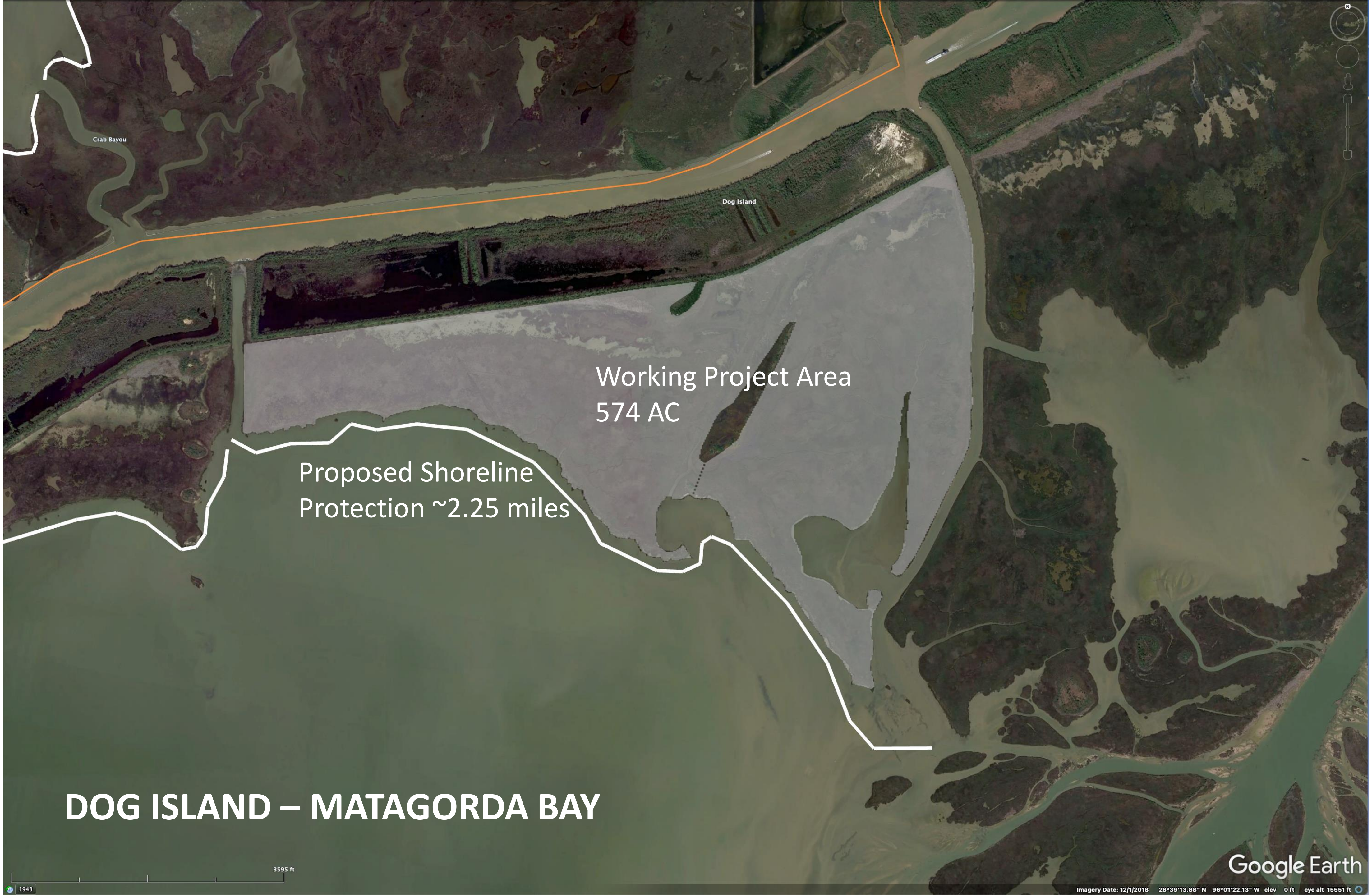
Step 2: Initial Measurement (Standard Procedure B)

DOG ISLAND – MATAGORDA BAY

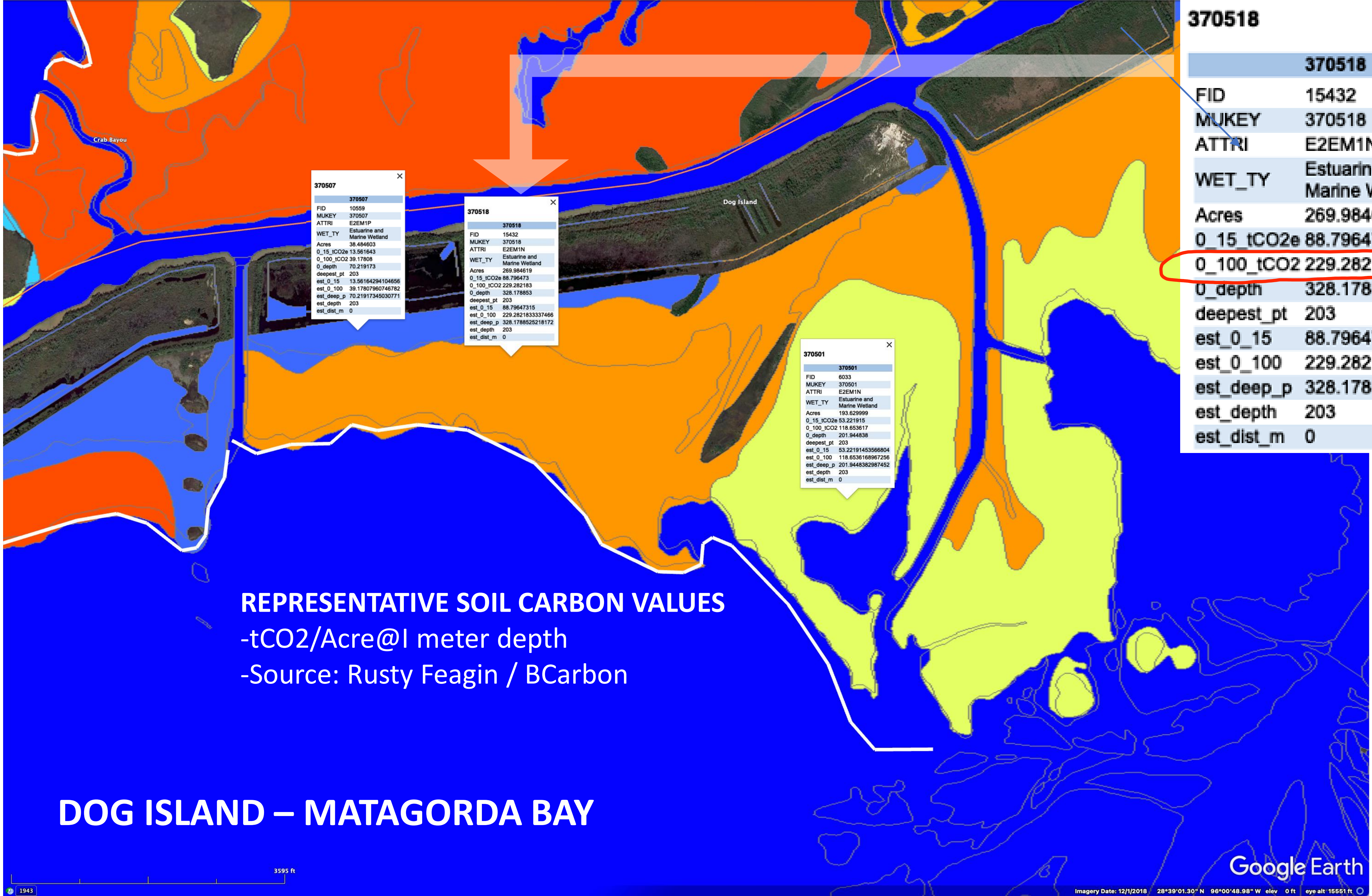
Matagorda Bay Foundation

DOG ISLAND – MATAGORDA BAY

National Wetlands Inventory (NWI) 2019


Crab Bayou
Dog Island
Working Project Area
574 AC
Proposed Shoreline
Protection ~2.25 miles
DOG ISLAND – MATAGORDA BAY
3595 ft
Imagery Date: 12/1/2018
Google Earth


2/1995
Crab Bayou
Dog Island
Shoreline Retreat
1995-present (approx.)
DOG ISLAND – MATAGORDA BAY
Image U.S. Geological Survey
3595 ft
1943
Google Earth



370518

370518	
FID	15432
MUKEY	370518
ATTRI	E2EM1N
WET_TY	Estuarine and Marine Wetland
Acres	269.984619
0_15_tCO2e	88.796473
0_100_tCO2	229.282183
0_depth	328.178853
deepest_pt	203
est_0_15	88.79647315
est_0_100	229.2821833337466
est_deep_p	328.1788525218172
est_depth	203
est_dist_m	0

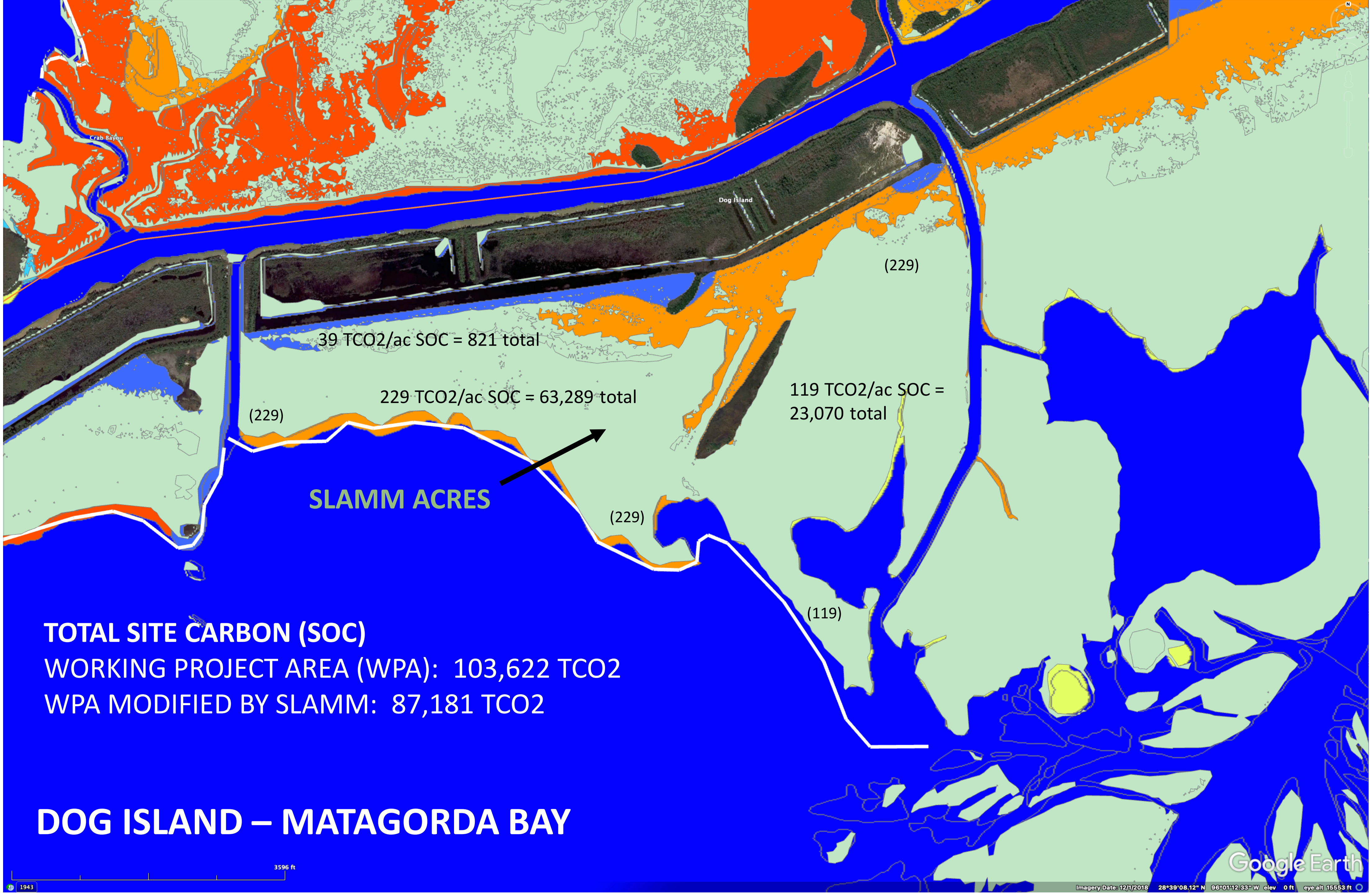
REPRESENTATIVE SOIL CARBON VALUES

-tCO2/Acre@I meter depth

-Source: Rusty Feagin / BCarbon

DOG ISLAND – MATAGORDA BAY


Crab Bayou
Dog Island
WORKING PROJECT AREA
574 Acres
SLAMM ACRES OVERLAP
496 Acres
DOG ISLAND – MATAGORDA BAY
Sea Level Affecting Marshes Model (SLAMM)
3596 ft
1943
Imagery Date: 12/1/2018 28°39'56.07" N 96°01'32.58" W elev 0 ft eye alt 15553 ft
Google Earth



Crab Bayou
Dog Island
(229)
39 TCO2/ac SOC = 821 total
229 TCO2/ac SOC = 63,289 total
119 TCO2/ac SOC =
23,070 total
(229)
SLAMM ACRES
(229)
(119)
TOTAL SITE CARBON (SOC)
WORKING PROJECT AREA (WPA): 103,622 TCO2
WPA MODIFIED BY SLAMM: 87,181 TCO2
DOG ISLAND – MATAGORDA BAY
3596 ft
Google Earth
Imagery Date: 12/1/2018

3.3 Monitoring Durability of Wetland Carbon Stocks

3.3.1 Shoreline Change Observations

The shoreline being protected shall be monitored to determine the effectiveness of Living Shoreline projects in limiting the erosion of the targeted wetlands over time. The total change in shoreline boundary, as well as the rate of change, shall be calculated as follows:

(1) Identify the shoreline position in the year the Living Shoreline project is completed using remote sensing and/or aerial imagery sources such as National Agricultural Imagery Program (NAIP) georeferenced aerial photographs, Texas General Land Office imagery, or others and import the data into a GIS database.

(2) Create shore-parallel baselines in order to cast shore-perpendicular transects at 50-m intervals along the shoreline using the GIS-based extension software Digital Shoreline Analysis System (DSAS) version 5.0.

(3) Determine the intersection of the transect lines with the initial and five-year interval shorelines to create GIS shape files containing (a) the total change, rates of change, and associated statistics of shoreline measurements and (b) the measurement transects bounded by the most landward and seaward historical shoreline position for each measurement site.

(4) Repeat steps 1 through 3 at five-year intervals over the duration of the fifty-year Living Shoreline project period.

(5) Calculate the total change in shoreline, rate of shoreline change, and their associated statistics over the fifty-year Living Shoreline project period.

4.1.1 Measuring Wetlands Carbon Sequestration

4.1.1.1 Default Value

A default carbon sequestration rate of 2.0 tons of carbon dioxide equivalent per acre per year may be applied.

4.1.1.2 Field Measurements

For blue carbon credits to be issued at a rate higher than the default value laid out in Section 4.1.1.1, the following measurement steps from the BCarbon Soil Carbon Protocol must be conducted, modified appropriately for wetlands:

Step 1: Stratification (Standard Procedure A)

Step 2: Initial Measurement (Standard Procedure B)

Step 3: True-up Measurements (Standard Procedure D)

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4.1.1 Measuring Salt Marsh Sequestration

- Vertical Accretion Using Feldspar Markers
  - Plots
  - Measurement Timing
  - Sample Collection
  - Accretion Calculations
  - Comparison
- Inland Expansion
- Marsh Health

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4.1.2 Monitoring Salt Marsh Sequestration

- Surface Elevation using Rod Surface Elevation Table (rSETs)
  - Stable Benchmark
  - Attaching the SET
  - Measuring Using the SET
  - Calculating Change in Elevation
- Surface Accretion
  - Plots
  - Measurement Timing
  - Sample Collection
  - Accretion Calculation
  - Comparison

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4.2.2 Monitoring Oyster Reef Carbon Sequestration

- Setting Efficiency
- Live vs. Dead
- Natural vs. Artificial
- Oyster Size
- Oyster Density
- Aerial Dimensions of Reef
- Reef Height

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4.3 Seagrasses

- 4.3.1 Measuring Seagrass Carbon Sequestration
- 4.3.2 Monitoring Seagrass Carbon Sequestration
  - Tier 1 Monitoring Program
  - Tier 2 Monitoring Program

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5.0 Co-benefits

- Biodiversity Benefits
  - Oyster Reef Biodiversity
  - Marshland Maintenance Biodiversity
  - Monitoring Biodiversity
- Community Benefits

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Texas Coast Wetlands Values

Ecosystem Service	Value
Aesthetic Value	$101
Bequest	$4,956
Carbon Sequestration	$290
Disaster Risk Reduction	$6,374
Food	$886
Habitat	$2,093
Recreation	$6,674
Soil Formation and Erosion Control	$2,662
Water Quality	$1,550
Total	**$25,586**

Possibility of Mangroves

- Research grant forthcoming to study potential of mangrove introduction in South Texas and elsewhere

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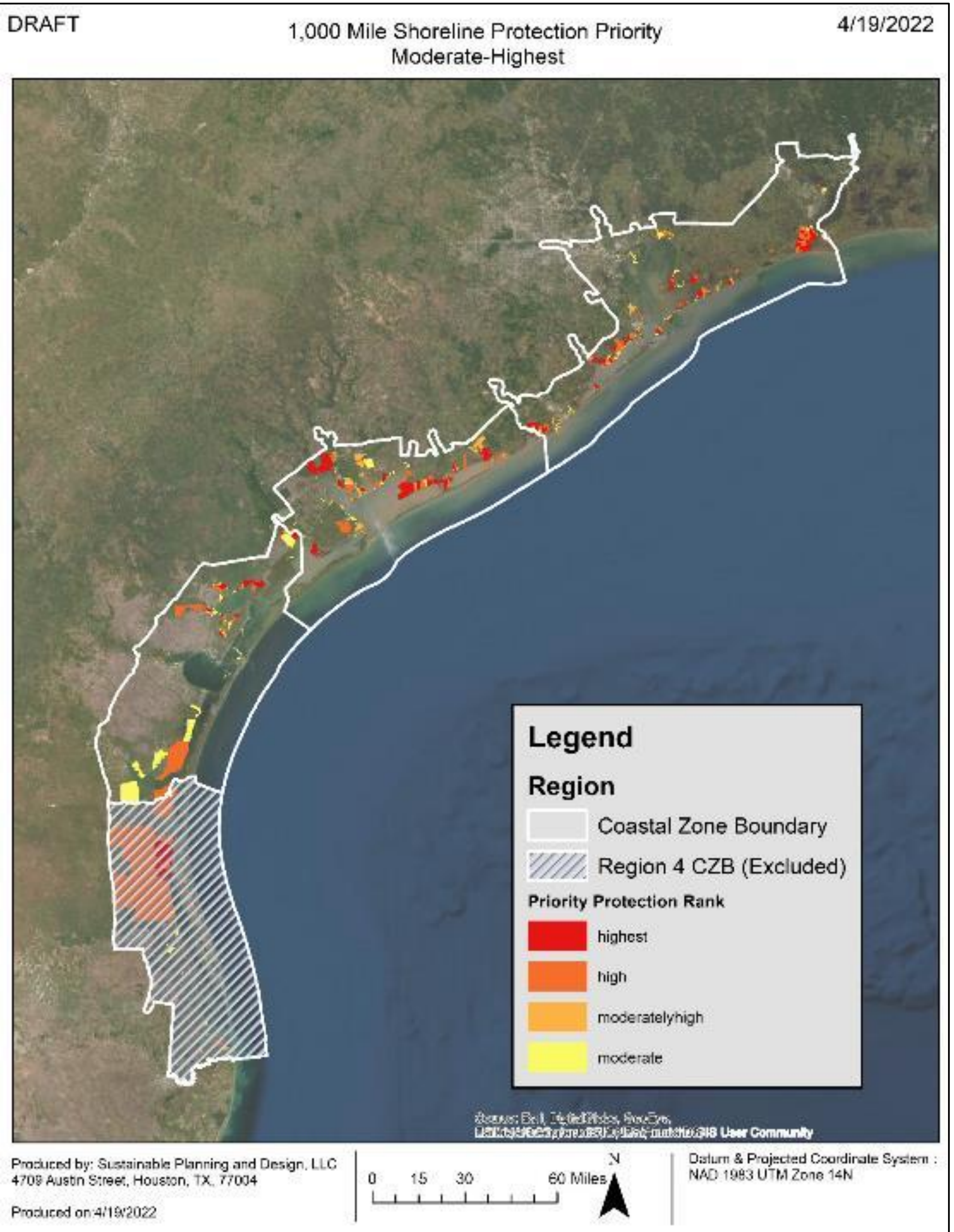

Agreement Has Been Signed for Construction of 250 Miles of Living Shoreline at Cost Not to Exceed $500 Million

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Questions?