Partnership for Our Working Coast

Phase 1 Executive Summary

August 2018

INTEGRATING APPLIED RESEARCH | LINKING KNOWLEDGE TO ACTION | BUILDING PARTNERSHIPS

INTRODUCTION

The Greater Lafourche Port Commission (GLPC) operates Port Fourchon, the nation's premier oil and gas services port, services more than 90 percent of all U.S. Gulf of Mexico Deepwater oil and gas exploration and production activities. Port Fourchon is also home to the land booster pump station for the Louisiana Offshore Oil Platform (LOOP), which transfers both foreign and domestically-produced crude oil to large storage tanks and an underground storage facility adjacent to the South Lafourche Airport (GAO) in Galliano, Louisiana.

This same facility is also the land shore base through which both Chevron and Shell's major pipelines bring ashore domestically produced crude from the U.S. Gulf of Mexico for its journey to the marketplaces and refineries along the Mississippi River corridor and many points beyond. Port Fourchon is vital in the production of approximately 20 percent of the nation's oil supply, making it the single most critical costal piece of energy production infrastructure in the United States.

In 2016, the GLPC formally announced its plans to obtain Federal regulatory approval to deepen Belle Pass at the mouth of Bayou Lafourche in Port Fourchon to a target depth of -50 feet in order to provide an additional port facility capable of handling the heavy maintenance, refurbishment and/or decommissioning needs of the deepwater energy industry.

This large-scale dredging project will generate tens of millions of cubic yards of dredged material over its lifespan. The GLPC has made it clear that they intend to see this material used beneficially both for the project's development, environmental mitigation obligations, and as an integral and renewable borrow source for coastal restoration and protection initiatives locally.

Energy industry partners Chevron, Shell, and Danos along with GLPC and The Water Institute of the Gulf came together to form the Partnership for Our Working Coast which takes a science-based approach to maximizing the benefits of coastal restoration efforts to protect energy assets and critical infrastructure as a vital component of industry's risk management and sustainability business drivers. In close collaboration with companies to determine what areas in and around the port were most important from a critical infrastructure perspective, the group has focused its efforts on science and engineering to answer questions around the port concerning (a) options for optimizing the placement of beneficially-used dredged material to create nature-based defenses for critical infrastructure and communities; (b) land subsidence; (c) quantification of the potential for blue carbon capture and sequestration potential of the coastal ecosystems created using the dredged material; and (d) community resilience.

Phase one of this collaboration focused on data collection, characterization, and preliminary analysis for the first three of these issues. This executive summary and the associated technical reports detail the methods and findings for work completed in phase one and outline a potential path forward for phase two.

OPTIMIZING BENEFICIAL USE OF DREDGED MATERIAL

The need:

As part of the GLPC's work gaining federal approval to deepen Belle Pass, one component that needs to be answered is where the dredged material will be placed. The dredging project will provide millions of cubic yards of badly needed sediment that will need to be disposed of, likely in the nearby vicinity.

In order to use this material in the most beneficial way for industry, the port, communities, and the environment, the Partnership for Our Working Coast members engaged the Institute as a way to leverage the work which the GLPC had already directly engaged the Institute to do to support the development of its Environmental Impact Statement (EIS) and related analysis for the channel deepening project, which created a powerful leveraging opportunity.

The Institute undertook the first steps in delineating potential site locations that could accept the dredged material while also providing one or more benefits to industry, the community, and the environment.

What we did:

First, the Institute used numerical modeling to predict how much sediment could be removed from the channel at Port Fourchon over the life of the project including a series of alternative maintained channel bed elevations from -30 to -50 feet.

Second, the Institute analyzed potential locations for the beneficial use around Port Fourchon including developing a map of the current mean water depth.

The distance between dredge pump locations and the center of each potential fill location was determined and for each pump location, the potential fill sites were listed in order of increasing distance. Using an assumed dredging schedule, the closest sites to each dredge location were selected until all of the expected dredged material was accounted for.

The initial list of potential sites was discussed during a field visit with federal agency representatives including the U.S. Army Corps of Engineers and U.S. Fish and Wildlife Service.

For purposes of the EIS preparation, the federal agencies suggested that the material be placed in deep open water with depths greater than three feet; alternatively, it was suggested that the material be used as beach and dune nourishment along West Bell Pass and Caminada headlands. This rendered the vast majority of sites in the first list unsuitable.

A final update to the potential site list was made after GIS Engineering, (the port's primary contractor on the EIS development) conducted a grain size analysis on sediment cores taken at the off-shore dredge locations. This material had relatively low amounts of sand and so the barrier headland dune and beach restoration projects sites were removed from the list. Instead, the material would be placed in the deepwater in the near-shore area of the Gulf of Mexico to nourish the eroding beach and dune habitat of the West Bell Pass and Caminada Headlands.

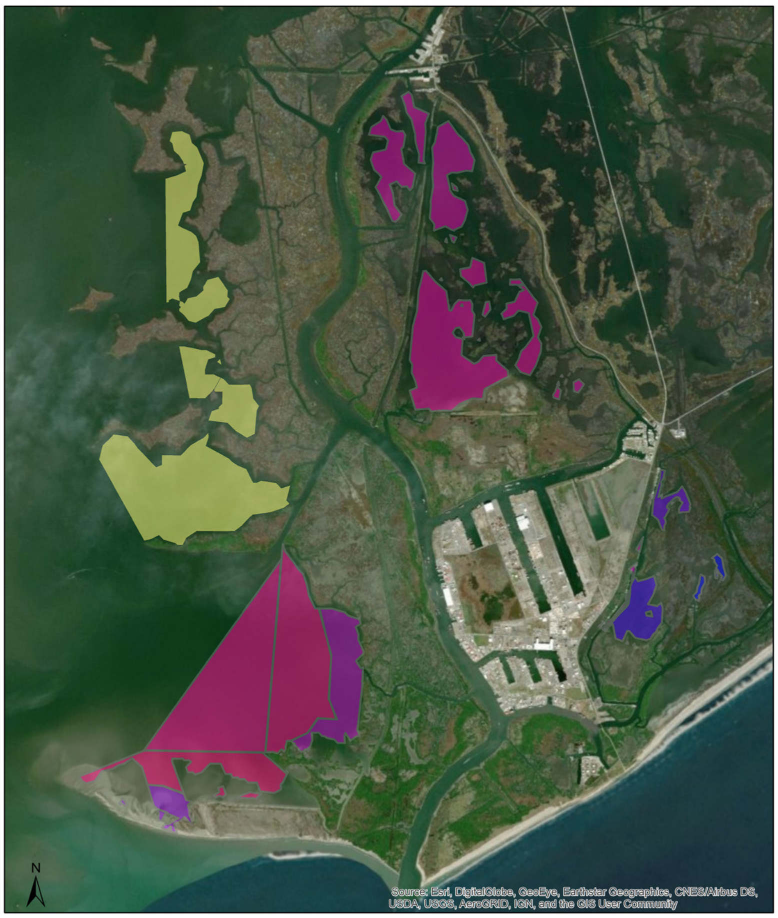
What we found:

Using this updated list of potential deposition sites, and using placement plans outlined by GIS, 13 remaining sites were examined to determine the volume in cubic yards needed to fill the deeper water areas to a four-foot elevation, the land area this could create, as well as the current maximum and average water depth in the area.

The two dredge placement plans provided by GIS, along with a future without action, were analyzed using three scenarios for sea level rise and subsidence.

Although these placement sites are greatly reduced from the initial list generated based on federal input, there are opportunities for the list to be expanded in the future as the project moves towards implementation.

Final deposition sites for beneficial use of dredged material



0 0.5 1 2 Miles

Water depths classifed into three bins:
deeper than 3-ft, shallower than 3-ft, and land with an elevation higher than the mean water surface elevation.

Mean water surface elevation determined from 4 closest CRMS sites: 0.43 ft NAVD88.
Bathymetric and topographic elevation data taken from the USGS dataset compiled for the 2017 Coastal Master Plan (30-m XY resolution).

Final deposition sites for beneficial use of dredged material from the construction and maintenance base plan and the tentatively selected plan/locally preferred plan dredge schedules.

SUBSIDENCE

The need:

Many areas of coastal Louisiana experience a higher risk of damage to ecosystems, communities, and infrastructure due in part to high rates of land sinking additive to rates of eustatic sea level rise. There are multiple causes for this "subsidence", mainly related to being located on top of a thick and young package of deltaic sediment. Many of the mechanisms causing subsidence cannot be mitigated, hence, formulating subsidence adaptation plans in coastal areas like Port Fourchon with dense human and industrial infrastructure at risk requires a precise knowledge of the spatial and temporal trends in subsidence rates. Developing adaptation strategies requires answering several main challenges.

First is to accurately measure and monitor where and how fast subsidence is causing land elevations to change.

A fuller understanding of the causes of subsidence and their respective contribution to the total subsidence rate would be helpful in (1) predicting subsidence rates between measured locations and (2) determining whether any of these contributing mechanisms would be predicted to change in magnitude in the future. However, this fuller understanding is more detailed than the Port currently needs to predict its own impact on sustainability of infrastructure and ecosystems. Instead, a well-developed understanding of the total land surface elevation change, regardless of causes, would be the most useful for future planning. Total land surface elevation change is the summation of the total subsidence rate plus the eustatic sea level rise rate minus the addition of any new sediment.

What we did:

In this first phase, the Institute focused on gathering what is currently known about relative sea level rise in south Louisiana (subsidence + eustatic), focusing on the areas around Port Fourchon and the Lafourche headland to as far north as Raceland, LA through a variety of existing data sources including:

- Holocene-Pleistocene subsurface thickness through soil borings
- Geotechnical data from soil-borings and cone penetrometer tests
- Location of salt domes in the subsurface
- Location of faults in the subsurface
- Geodetic levelling
- Tide gauge records
- Coastwide Reference Monitoring Stations (CRMS)
- Continuously Operating GPS Reference Stations (CORS)

• Satellite and airborne Light Detection and Ranging (LiDAR) land elevation surveys
• Coastal wetland extent change maps

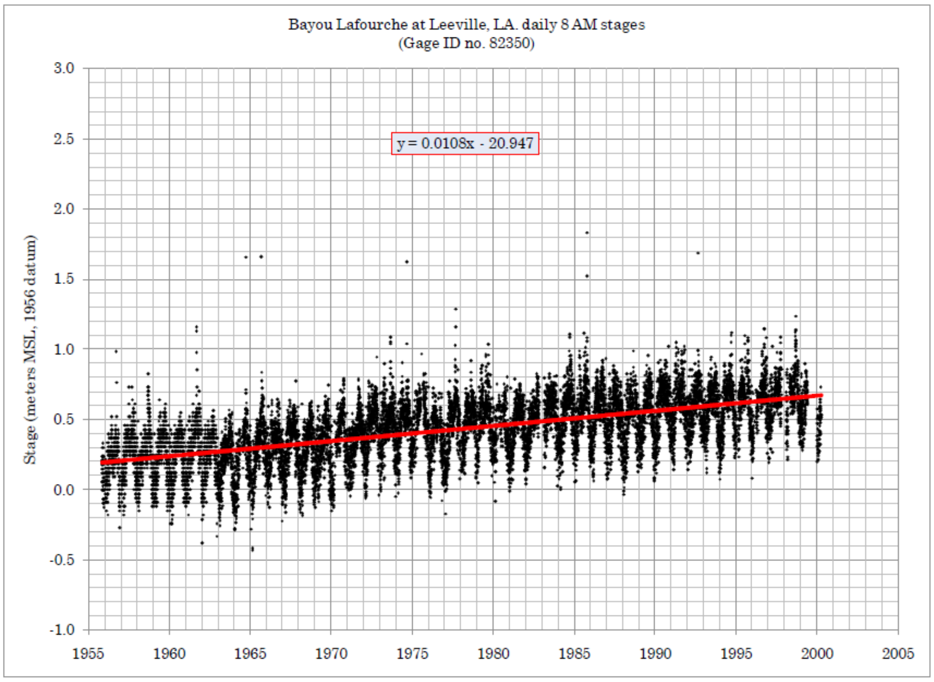
The goal was to populate a map with spatial information about subsidence rates as well as identifying knowledge gaps.

What we found:

In all, more than 100 subsidence rates have been calculated in the Port Fourchon area during the last 15 years using a wide variety of methods, each having its own strength and weakness. The one constant through all of these methods is that subsidence rates differ greatly in space and over time.

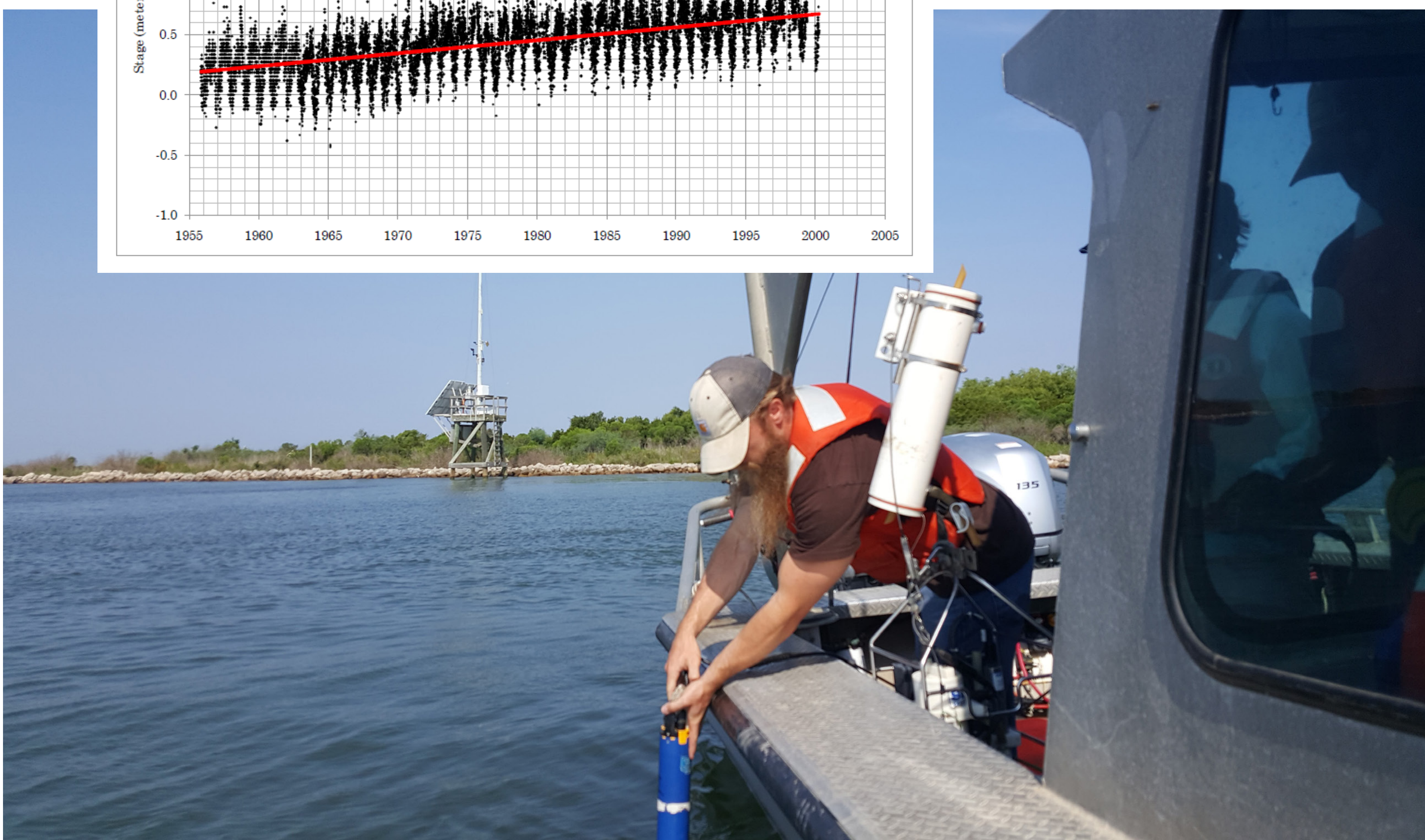
Future work will use the cumulated information gathered in this phase to build a subsidence and elevation loss "hazard map" to be used in assessing when, and at what elevation loss, areas around Port Fourchon can be expected to sink below mean sea level.

This information will be crucial as the site selection for future beneficial use of dredged material moves forward. There is a significant subsidence range in the Coastal Master Plan and zeroing in on it in Port Fourchon will help improve future decision making.



Left: Linear regression on daily stage measurements yield the long term relative sea level rise rate at Leeville tide gauge. Reproduced from U.S. Army Corps of Engineers, New Orleans District (2010)

Below: Nicholls State University student takes measurements in the Port Fourchon area.



BLUE CARBON

The need:

Blue carbon refers to the greenhouse gases (GHG), such as carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O) sequestered, stored, and released from seagrass, tidal wetlands, salt marshes and mangroves. Coastal wetland restoration is among the newest project types approved to generate carbon offsets on the voluntary carbon market.

With the Port Fourchon work, and anticipated creation and enhancement of coastal marshes, the possibilities for additional benefits coming from the calculation and potential sale of blue carbon were investigated.

The potential revenue generated through offset sales currently will not cover the full cost of restoration, but can provide support for project components such as long-term monitoring, management, and incentivizing additional restoration investors.

What we did:

The Institute team reviewed existing literature and site-specific data to provide foundational information and a list of items to be considered in developing a blue carbon project in Port Fourchon. This initial feasibility assessment examines the technical and financial feasibility for a project to generate carbon credits and is meant to guide project developers in the decision of whether or not to pursue carbon project development.

The team looked into per acre of carbon storage, per ton dollar value, the question of permanence of any wetlands created, carbon credit prices, the cost of monitoring, carbon net cash flows over a 30-year period, and net emission reductions over a 30-year period.

Blue carbon credits can be maximized through a number of means including using dredged material in shallow areas with less than three feet of water, use maintenance dredging as a source for thin-layer sediment application, and building large areas of marsh for maximum efficiency. A mix of marsh creation and marsh terrace creation may provide for both high amount of stored carbon, as well as greatest permanence of that carbon.

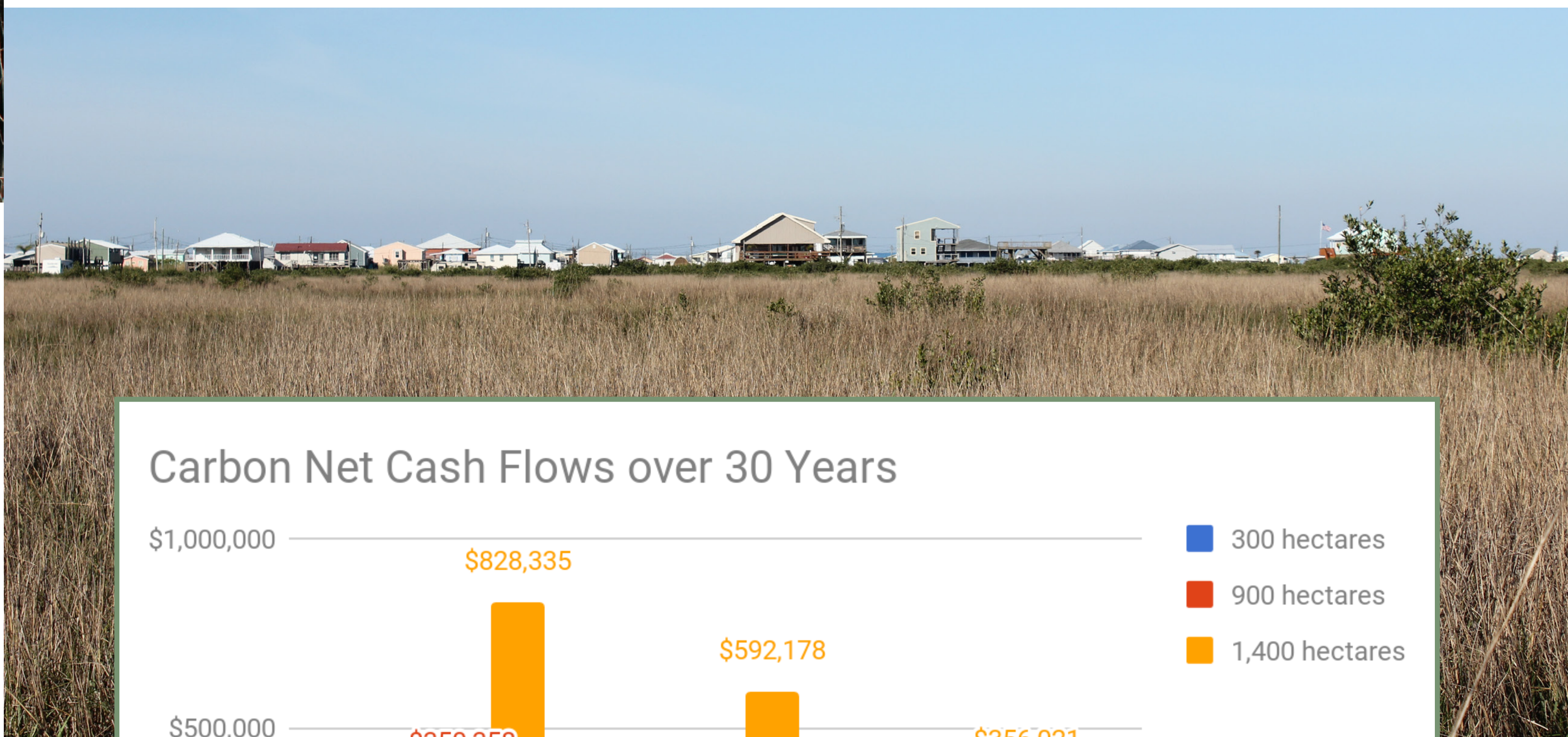
What we found:

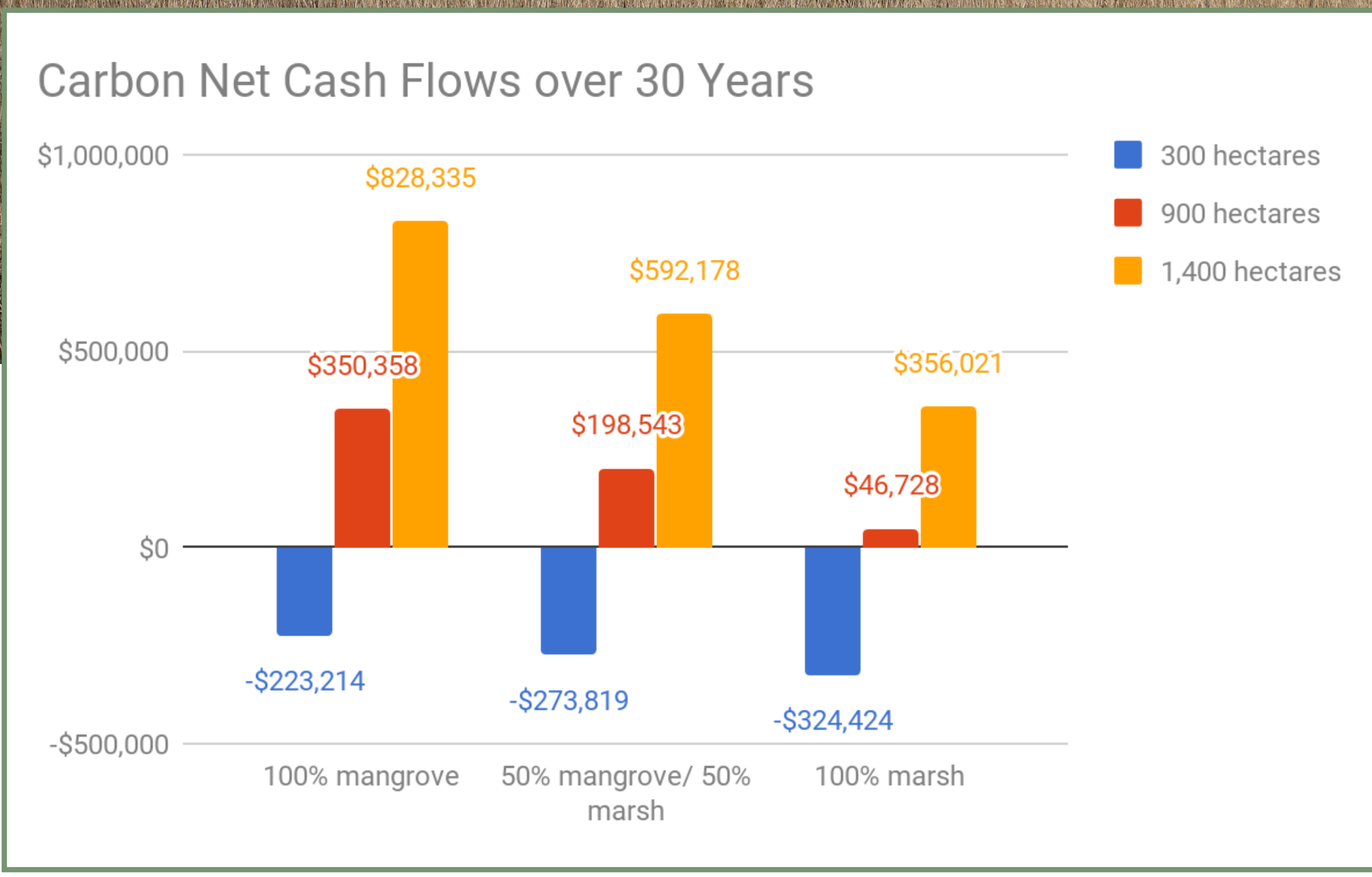
At the current time, if developed as a carbon offset project, the Port Fourchon tidal wetland restoration project would be able to sell offsets into the voluntary carbon market; compliance markets do not currently accept offsets from tidal wetland restoration projects.

Voluntary markets are made up of mostly consumer-facing industries looking to voluntarily become more carbon neutral and help combat climate change, especially in situations where emission reductions are cost prohibitive.

Project implementation is still in the planning and design stage.

However presuming each phase of dredging would be used to create some type of new land area, each of these smaller areas on their own would not sequester enough carbon to justify the cost of carbon monitoring, but the aggregation of all phases over time has potential to contribute substantively to the cost of monitoring required to qualify for Blue Carbon credits.





Net cash flow (income from offsets minus project monitoring costs) for the various project areas and for each of the saline wetland vegetation types.

PATH FORWARD

The phase one findings included in this executive summary and in the accompanying technical reports, provide the foundation for work in the Port Fourchon area that will better inform future, more specific efforts With a better understanding of factors influencing the area around the port, the stage is set to move the analysis beyond the feasibility level into the more operational aspects of gaining the most benefit possible for the port, industry, community, and environment as a result of the channel deepening.

In the next phase of the work, the Institute is recommending the following:

Beneficial Use of Dredged Material

Apply numerical predictive models developed at the Institute to optimize the placement and geometry of beneficial use dredge material from the Fourchon Ship Channel to 1) examine the performance of projects selected in Phase 1 for improving infrastructure protection from storms and relative sea level rise; and 2) provide insight into the location, orientation, and elevation needed for either marsh creation or ridge restoration projects.

Subsidence

To establish a subsidence monitoring program in the vicinity of the port, to refine both the quality and spatial resolution of subsidence work done in phase 1. This program will allow the port and industry stakeholders to make better informed decisions.

Blue Carbon

Use the ecosystem model to evaluate where to place dredged material beneficially and how long that built land can be sustained through modeling different methods such thin-layer placement for marsh renourishment. In addition, the team will be modeling vegetation with the dominant species in the area being black mangroves to understand potential for infrastructure risk reduction, wave attenuation, and carbon storage.

Community resilience

Use a Social Return on Investment framework to integrate community-based qualitative research, ecological site assessments, and economic valuation to calculate the social value of candidate projects. Potential costs and benefits of each proposed action on nearby communities will be assessed through qualitative research and stakeholder engagement including one-on-one interviews, workshops, and meetings to assess the potential social and economic and cultural outcomes of the candidate projects and to help assess and interpret the Phase 2 model results.

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