

HOLISTIC COASTAL RESILIENCY IN THE GALVESTON BAY AREA

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BACKGROUND and MOTIVATION

The Houston-Galveston area is conceptualizing some of the largest flood defense systems on the planet. The Coastal Texas Study and the Harris County Flood Control District's proposed tunneling program are both estimated to be in the +\$30 billion, first cost, range. Solutions of this large a scale are desperately needed, and we are at the point where we have the political resolve and now need to obtain the financial investment to construct "Texas sized" coastal resilience solutions prior to another devastating event. Advancing the science and keeping these needed projects in the forefront is critical to implementing these projects and protecting those that have less resources and typically live in more vulnerable areas, while also preserving the environment for future generations. In our view, coastal flood risk reduction and equity across resiliency efforts are inherently tied to improved sediment management and other practices plus innovations that can adapt to changing climate threats.

Numerous studies have been performed in the Galveston Bay Region that have identified features that will make the region more resilient to climate change, flooding, surge, erosion impacts, and ecosystem functionality degradation.

There is a need to develop a comprehensive collaborative resiliency plan taking the best features/concepts from each plan and putting them together to improve our coastal resiliency and environmental quality. This hybridized approach would allow stakeholders to ultimately advocate for others' plans as they are part of a holistic approach where the gaps and overlaps have been identified and resolved.

Here, we explore a focused series of demonstration projects combined with technical research and development to grow scientific knowledge, awareness, community support, and lower coastal risk by aiding the implementation of billions of dollars in investment already studied and recommended for design and construction. Below is a subset of the existing or ongoing Coastal Storm Surge and Resiliency Studies in the region.

ONGOING STUDIES

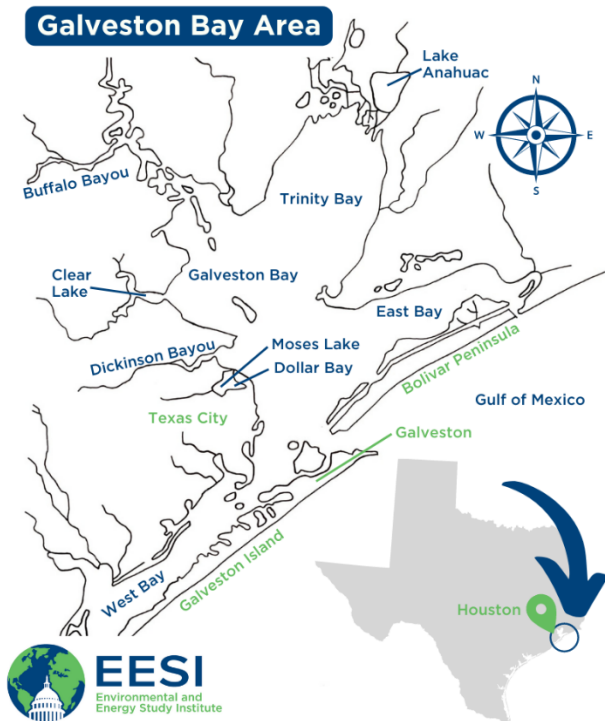
U.S. Army Corps of Engineers (USACE) Coastal Texas Protection and Restoration Study - \$35B federal recommendation. Along the Texas coast, vital resources critical to the social, economic, and environmental welfare of the nation are at risk. When storms damage homes, businesses, infrastructure, and the natural environments of the Texas coast, the immediate fallout and the continued aftermath affect not only the people who live in these coastal counties, but also the entire nation. Due to the importance of the Texas coast, the United States Army Corps of Engineers (USACE) has partnered with the State of Texas General Land Office (GLO) to identify and recommend solutions. The goals are to reduce risks to communities, public health, and the economy; to restore critical ecosystems; and to advance coastal resiliency.

GLO Texas Coastal Resiliency Master Plan - \$5.4B state recommended cost.

A statewide plan to protect and promote a vibrant and resilient Texas coast that supports and sustains a strong economy and healthy environment for all who live, work, play or otherwise benefit from the natural resources and infrastructure along the Texas coast.

GLO Texas Sediment Management Plan - \$5m - ongoing. The goals of this plan are to identify and develop sediment resources, permit the use of these sediment resources, monitor sediment budgets, develop or modify policy, and define state priorities for coastal erosion response. This is to include riverine and coastal systems to holistically address data and long-term planning.

USACE Galveston Bay Regional Sediment Management (RSM) Plan - ongoing. This study is a programmatic approach with the goal of better managing sediment across multiple projects, both federal and non-federal, through improved interagency cooperation, science, and engineering practices. As part of the implementation of the RSM for the Galveston Bay region, the Programmatic Sediment Management (PSM) Plan is a comprehensive guidance and policy implementation document that identifies how RSM can be implemented in an



Graphic by: Alison Davis
Figure 1. Galveston Bay Area map.
(courtesy of S. Bertrand).

expeditious, cost-effective, and resource protective manner.

Galveston Bay Plan - Texas Commission on Environmental Quality (TCEQ). The National Estuary Programs were charged with developing and implementing a comprehensive conservation and management plan that establishes priorities for activities, research, and funding for the estuary. Area stakeholders developed the Galveston Bay Plan to ensure long-term preservation of the bay's health. The Galveston Bay Council, a 41-member advisory committee to the TCEQ, oversees The Plan's implementation.

Galveston Bay Park Plan - SSPEED Center, Rice University. The plan includes a regional multi-functional facility providing flood surge protection, recreational opportunities, enhanced environmental conditions, improved operational safety for the Houston Ship Channel, and improved fish and wildlife conditions. The project works in collaboration with the Coastal Spine (see next item).

Ike Dike Coastal Spine Plan - Texas A&M University (TAMU), Institute for a Disaster Resilient Texas (IDRT).

Following Hurricane Ike, scientists, policy makers, and elected officials have been calling for a comprehensive coastal storm surge protection system for the Galveston Bay region. To date, several efforts have estimated benefit/cost ratios of multiple protection solutions, which have focused primarily on the direct economic impacts of a surge-related event on Galveston Bay. Although these results have been critical in demonstrating the effectiveness of a coastal spine from the perspective of avoided damages, other secondary, indirect benefits need yet to be evaluated.

USACE Dredge Material Management Plan for the Houston Ship Channel. This is a 20-year plan for the maintenance of the dredging material to keep the proper navigational depth of the Houston Ship channel as well as channels for adjacent private facility operators.

PURPOSE

The intention of this activity is to work closely with all the entities involved in coastal resiliency in the region, particularly those with programmed investments in the near future. Our regional partners include: USACE, FEMA, USGS, NOAA, EPA, GLO, Texas Department of Transportation (TxDOT), Texas Water Development Board (TWDB), Texas Institute for a Disaster Resilient Texas (IDRT), Harris County Flood Control (HCFCD), Port Houston, Port of Galveston, City of Houston, City of Galveston, and numerous NGO's.

PROPOSED ACTIVITIES AND OUTCOMES

This project will accomplish two critical objectives:

(1) Develop a comprehensive collaborative resiliency plan "knowledge gap" assessment incorporating all the various plans for the Houston-Galveston area. Develop and implement recommended research and development efforts to fill identified "knowledge gaps". Identify "Multiple lines of defense" features for the protection and coastal resiliency in Galveston Bay including nature-based features (NBF) such as: beach-dune systems, marsh creation, and archipelagos.

(2) In parallel to the "knowledge gap" identification, a

series of previously identified coastal flood and erosion risk reduction demonstration pilots will be completed to drive down future implementation efforts and cost. Projects cover innovative sediment management and include:

Sediment transport studies at the Galveston Bay/Bolivar Roads Inlet. There are millions of cubic yards of proposed beach placement in the littoral system that includes the inlet to Galveston Bay (i.e., Bolivar Roads). Combining this new material being injected into the highly dynamic coastal system of the area with the world's largest proposed gate system for storm surge suppression, creates opportunities to improve the design of the nourishments and gate systems to be mutually beneficial.

Sediment bypassing and backpassing - bedload collector study. There are technologies that can greatly reduce the amount of sediment lost in littoral cells. These systems can also allow for the capture and recycling of sediments for beneficial use projects. This can lead to lower dredging and renourishment requirements. It would also be a highly valuable maintenance asset to any future large storm surge suppression gate as shoaling would likely be a significant factor influencing the ultimate design.

Sediment Separation Demonstration - 100% Beneficial Use. Traditional dredging practices for building beaches or maintaining navigation channels release significant quantities of suspended sediment back into adjacent waterbodies. This is a lost opportunity as all uncontaminated sediment can be useful. In a hydraulic pipeline, the ability to separate the component of a slurry as an example, would allow the sand to be used for beach nourishment and the fines to nourish marshes. If properly designed, it could virtually eliminate water quality concerns typically associated with dredging activities.

Multi-Purpose Resilient Structures. Investigate adding surge gates to existing and new bridges. There are numerous bridges in our region that could be retro-fit or when they are replaced, turned into a storm surge gate barrier.

Educational material on coastal resiliency and surge gate systems. The largest hurdle to the implementation of the Coastal Texas Study is the design selection and the public apprehension of implementing the world's largest storm surge gate suppression system. Our intention is to produce 3-D printed scale models of the existing large storm surge suppression gate systems from around the world and the most likely designs to be used at the entrance to Galveston Bay.

Full-scale Dune Demonstrations Resiliency Project. The intent is to construct engineered dunes over a total length of approximately half a mile along the Galveston Island coastline and integrate them into the local beach-dune system. Individual sections will include regular sand dunes as well as hybrid systems with different core structures such as rubble mounds, vertical walls, clay dikes, combinations, etc. to test core alternatives and constructability, and monitor performance. Additional items for consideration are bio-cementation techniques such as microbially-induced calcium carbonate precipitation (MICP) processes to enhance the dune's resistance against wave-induced erosion.

The presentation will be an overview of activities and projects delivering holistic coastal resiliency in Texas.