RESTORE Council Activity Description

## General Information

*Sponsor:*
Texas Commission on Environmental Quality

*Title:*
Chenier Plain Ecosystem Restoration Program

*Project Abstract:*
The RESTORE Council has approved $1.7M in planning activities as FPL Category 1 Council-Selected Restoration Component funding for the Chenier Plain Ecosystem Restoration Program, sponsored by Texas, through the Texas Commission on Environmental Quality. In addition, the Council has also identified a separate $18.3M implementation component as a FPL Category 2 priority for potential future funding. This program supports the primary RESTORE Comprehensive Plan goal to restore and conserve habitat through activities to restore and conserve coastal habitats within the Chenier Plain complex of Texas through a variety of methods including beneficial use of dredge material, construction of breakwaters to protect shoreline, and restoration of hydrology and wetlands. Targeted habitats will include freshwater to estuarine marsh, coastal prairie grasslands, tidal flats, creeks and basins, all of which creates a productive complex for diverse fish and wildlife resources and protects inland areas from storm surge.

Potential partners for the program may include the U.S. Army Corps of Engineers, Texas Parks and Wildlife Department, Ducks Unlimited, U.S. Fish and Wildlife Service, and local and regional governments. The program will utilize specified criteria for selecting projects that were identified earlier through public meetings and as part of a stakeholder process. Implementation of the program has the potential to restore degraded wetlands, reduce erosion, improve water quality, create habitat, provide land reclamation, and increase coastal resiliency in an effective and efficient manner. Program duration is 4 years.

*FPL Category:* Cat1: Planning/ Cat2: Implementation

*Activity Type:* Program

*Program:* Chenier Plain Ecosystem Restoration Program

*Co-sponsoring Agency(ies):* N/A

*Is this a construction project?:* Yes

*RESTORE Act Priority Criteria:*
(I) Projects that are projected to make the greatest contribution to restoring and protecting the natural resources, ecosystems, fisheries, marine and wildlife habitats, beaches, and coastal wetlands of the Gulf Coast region, without regard to geographic location within the Gulf Coast region.
(II) Large-scale projects and programs that are projected to substantially contribute to restoring and protecting the natural resources, ecosystems, fisheries, marine and wildlife habitats, beaches, and coastal wetlands of the Gulf Coast ecosystem.

(III) Projects contained in existing Gulf Coast State comprehensive plans for the restoration and protection of natural resources, ecosystems, fisheries, marine and wildlife habitats, beaches, and coastal wetlands of the Gulf Coast region.

*Priority Criteria Justification:*
This program meets three of the RESTORE Act Priority Criteria:

1. Projected to make the greatest contribution to restoring and protecting natural resources. This program aims to restore and protect the natural resources within the Chenier Plain. The Chenier Plain is a highly diverse and productive area, containing the largest contiguous estuarine marsh complex in Texas. The natural resources provided by this region are being diminished due to wetland degradation, erosion, and decreasing water quality. The benefits of this program are projected to restore, protect, and increase habitats, water quality, and coastal resiliency in the most effective and efficient manner.

2. Large-scale projects and programs. This program includes individual, large-scale ecosystem restoration projects which have the potential to provide a significant amount of habitat restoration. The benefits of these combined projects will restore hydrology in this large area, support natural diversity and productivity, and increase coastal resiliency.

3. Contained in existing Gulf Coast State Comprehensive Plans. Many of the components of prospective projects in this program were evaluated in the 2019 Texas Coastal Resiliency Master Plan (TCRMP), the state comprehensive coastal plan for Texas. Chenier Plain projects scored in the top tier of TCRMP projects (TGLO, 2019).

*Project Duration (in years):* 4

## Goals

*Primary Comprehensive Plan Goal:*
Restore and Conserve Habitat

*Primary Comprehensive Plan Objective:*
Restore, Enhance, and Protect Habitats

*Secondary Comprehensive Plan Objectives:*
N/A

*Secondary Comprehensive Plan Goals:*
N/A

*PF Restoration Technique(s):*
Create, restore, and enhance coastal wetlands, islands, shorelines and headlands: Protect natural shorelines
Create, restore, and enhance coastal wetlands, islands, shorelines and headlands: Sediment placement
Restore hydrology and natural processes: Restore natural salinity regimes

## Location

*Location:*
Chenier Plain of southeast Texas including locations in four upper coastal counties: Galveston, Orange, Jefferson, and Chambers.

*HUC8 Watershed(s):*
Texas-Gulf Region(Neches) - Neches(Lower Neches)
Texas-Gulf Region(Galveston Bay-San Jacinto) - Galveston Bay-Sabine Lake(East Galveston Bay)
Texas-Gulf Region(Galveston Bay-San Jacinto) - Galveston Bay-Sabine Lake(Sabine Lake)

*State(s):*
Texas

*County/Parish(es):*
TX - Chambers
TX - Galveston
TX - Jefferson
TX - Orange

*Congressional District(s):*
TX - 14
TX - 36

## Narratives

*Introduction and Overview:*

The Chenier Plain environment includes freshwater to estuarine marsh, coastal prairie grasslands, tidal flats, and creeks and basins, all of which creates an extremely productive complex with a diverse array of vegetation, fish, and wildlife resources (Johnson, Cairns, and Houser, 2013). This environment provides many benefits for surrounding communities. The gradual transition of freshwater marshes to estuarine marshes, punctuated by upland ridges, across the Chenier Plain creates a unique landscape of habitats which supports a wide variety of plants and animals. The vast resources provided by the Chenier Plain have been in decline due to both anthropogenic and natural processes, particularly in locations along the Gulf Intracoastal Waterway (GIWW). Continued degradation in this area may result in a decrease in the effectiveness of storm surge suppression, significant increase in the risks of storm damage, economic losses, and habitat destruction. The Texas portion of the Chenier Plain holds areas of environmental significance including, but not limited to, Salt Bayou Watershed, Sea Rim State Park, Texas Point National Wildlife Refuge, McFaddin National Wildlife Refuge, and J.D. Murphree Wildlife Management Area. These and similar locations will likely be the focus of specific project activities (See map in Figure 1).

The lower reach of the Salt Bayou Watershed within the Chenier Plain is the largest contiguous estuarine marsh complex in Texas and is a highly productive fishery and critical storm surge protection barrier for inland marshes and communities, including Sabine Pass, Port Arthur and Beaumont, with their critical petrochemical and military infrastructure (Texas Parks and Wildlife Department, 2013). Salt Bayou and the adjacent Chenier Plain watersheds support a mosaic of 139,000 acres of coastal wetlands. Natural diversity and productivity are dependent on sediment deposition and freshwater sheet flows to support these essential functions. This program would implement several components to restore hydrology and marsh elevations to enhance wetlands and stabilize shorelines within the Salt Bayou Watershed Ecosystem along the Upper Texas Coast.

Excavation of the GIWW in the early 20th century severed Gulfward sheet flow and freshwater inflows via bayous and tributaries, and initiated saltwater intrusion into the heart of this low-lying landscape, killing emergent brackish marsh vegetation, resulting in erosion and scouring. Relative sea level rise and human-induced subsidence and faulting has also caused fragmentation and loss of marsh and flats to open water (White and Tremblay, 1995). Vegetation coverage has been reduced in places from near 100% to 50% or less (Texas Parks and Wildlife Department, 2013; White et al., 2007). This program will work with local partners to increase the transport of freshwater from north of the GIWW into marshes south of the GIWW potentially through construction of additional siphons underneath the GIWW. It may also include construction of shore protection structures to slow or stop erosion of existing marshes, replacing water control structures to reduce saltwater intrusion, and modification and repair of existing levees to improve environmental land management.

The sponsor of Chenier Plain Ecosystem Restoration Programis the Texas Commission on Environmental Quality (TCEQ). The TCEQ administers RESTORE Act activities in Texas and has experience in implementing FPL 1 projects. Furthermore, TCEQ is a Natural Resource Trustee agency involved in the state's Natural Resource Damage Assessment (NRDA) program. Importantly, our NGO, state, and federal agency collaborators have significant experience in overseeing environmental restoration projects and addressing Chenier Plain problems. In fact, the effort to restore the Texas Chenier Plain has been ongoing since at least 1990. In 2013, the Salt Bayou Marsh Workgroup (Workgroup) published a restoration plan describing the status of the Texas Chenier Plain, a review of past and ongoing projects, and recommendations for future work. The Workgroup members include: (1) Ducks Unlimited (DU), (2) Jefferson County Engineering Department and Drainage District #6, (3) NOAA National Marine Fisheries

Service (NMFS) Habitat Conservation Division and the Restoration Center, (4) Texas General Land Office (GLO) Coastal Erosion Planning and Response Act and the Natural Resource Damage Assessment Programs, (5) Texas Parks and Wildlife Department Wildlife (TPWD) and Coastal Fisheries Divisions and the Environmental Assessment, Response, and Restoration Program, (6) Texas Water Development Board Coastal Water Resources Group, (7) U.S. Army Corps of Engineers (USACE) Galveston District, and (8) U.S. Fish and Wildlife Service (USFWS) McFaddin National Wildlife Refuge and the Coastal Program. The Chenier Plain Ecosystem Restoration Program will involve this Workgroup and other stakeholders to a great extent.

This program conforms to the RESTORE Council's FPL 3 Planning Framework by adhering to the priority to restore and conserve habitat, and to restore, enhance, and protect habitats and shorelines. This program will also advance the commitments set forth in the 2016 Comprehensive Plan Update by using the best available science for ecological restoration, developing a monitoring and data management framework, and defining metrics of success for the potential Chenier Plain projects. The total budget for this program is $20M over 4 years. Potential partners for the program include, but are not limited to, USACE, TPWD, DU, USFWS, and local and regional governments.

*Methods:*

This program aims to use a variety of methods, including beneficial use of dredge material, the construction of breakwaters to protect shoreline, levee regrading, and the restoration of hydrology and wetlands to enhance and restore the Chenier Plain complex. This program will develop a process for selecting activities that builds on Texas' stakeholder-driven process for developing the Planning Framework and selecting preliminary projects for FPL 3b consideration. Texas' process started with learning the public's concerns regarding coastal environmental problems, their causes, and the types of things we should do to address them. TCEQ initially held three public meetings in Brownsville, Corpus Christi, and Galveston. Following these meetings, 127 people filled out an online survey where they scored their levels of environmental concern and identified the types of activities needed to address them. The same survey was provided to NGO and state-federal working group partners, which provided 32 more responses. With the information from this survey, county governments, NGOs, and a workgroup made up of Texas NRDA/NFWF and Texas Coastal Resiliency Master Plan (TCRMP) representatives submitted 38 projects for FPL 3b consideration. Coastal experts, Harte Research Institute (HRI) staff, and TCEQ staff reviewed the projects and selected 23 for public comment. Once preliminary projects were selected, public meetings in Corpus Christi and Galveston were held to gather feedback. Among these 23 projects, there were 5 multicomponent projects that address the Chenier Plain and have many elements that scored in the top tier in the TCRMP (Texas General Land Office, 2019). These projects or project components plus additional activities, as they arise, will be considered in this program for implementation. This program will develop criteria for project funding that consider project efficacy in meeting objectives and improving the environment, resiliency, and its synergy with other projects on the Chenier Plain.

General steps to completing the program's project components will include:

1. Coordinating with local partners
2. Completing engineering and design
3. Applying for permits
4. Soliciting bids for construction
5. Overseeing construction
6. Conducting monitoring and adaptive management.

*Restoration methods*

Beneficial Use of Dredge Material (BUDM):
This program will include BUDM to restore wetlands and elevate marshes. This is a known and documented method of habitat creation when combined with restoration and conservation efforts, with well over 13,000 acres of wetlands benefitting from the practice of BUDM (Cluff, 1989; Parson, 2012). The degradation of coastal wetlands can be largely attributed to the breakup and lowering of marshes, transforming them to shallow-water habitat. Thus, reintroduction of sediment to restore substrate elevations is a fundamental step of marsh restoration (Ford, 1999). Dredge material can also be used to nourish beaches, specifically berms which provide a level of protection of landward environments from storm over wash and relative sea level rise.

This program will implement BUDM for habitat restoration to restore marshes at several potential priority sites with input from NRDA trustees and the DU Beneficial Use (BU) team. In 2018, 41 potential BU sites were selected for evaluation by DU, the USACE, state and federal resource agencies, and NGO groups. The geographic scope of those BU sites includes a large portion of the Texas coast and will consider sediments from the GIWW and other federal ship channels, private channels, berths, as well as the mining of dredge material placement areas currently used by the USACE and the Texas Department of Transportation (TxDOT). The potential BU project sites in the Chenier Plain complement the Salt Bayou Marsh Restoration Plan, an ongoing multi-agency effort to restore the Salt Bayou marsh complex in Jefferson County, that identifies BUDM as a major component of the long-term marsh restoration strategy (Texas Parks and Wildlife Department, 2013). Site investigations, geotechnical sampling and bathymetric surveys will be performed at potential sites to provide the necessary information for project selection and design.

Fresh Water Siphons:
This program will consider additional siphons to route freshwater underneath the GIWW and bring it south of the GIWW to the lower Chenier Plain. These siphons are designed to reconnect the natural flow of freshwater and flush saltwater from the coastal wetlands thereby improving wetland health (Pothina and Guthrie, 2009; Texas Parks and Wildlife Department, 2013). A similar siphon project is currently active as part of the Salt Bayou Restoration Plan and funded through the Gulf Environmental Benefit Fund administered by the National Fish and Wildlife Foundation.

Other successful siphon and freshwater diversion projects have been completed in similar locations in Louisiana. The West Pointe a la Hache Freshwater Diversion project was designed to restore the natural hydrology and offset the sinking of the marsh in the Barataria Estuary using eight 1.8-meter diameter siphons that divert freshwater from the Mississippi River into the wetlands of the estuary at a rate of 59 cubic meters of water per second (Good, 1993). When constructed, these siphons were expected to restore about 9,200 acres of marshland. As a result of the siphons, the land loss rate is estimated to have been reduced by 38 acres per year, from a rate of 1.29% to 0.89% post-construction (Boustany, 2010). The Caernarvon freshwater diversion, Naomi siphon, White's Ditch siphon, and Bohemia structure are other examples of siphon projects that have been completed, all with the goal of restoring hydrology and offsetting relative sea level rise in wetland areas of Breton Sound, Louisiana (Lane, 1999).

Breakwaters:
Installation of breakwaters will be considered to reduce shoreline erosion and protect coastal wetlands. Breakwaters have been used widely and in a variety of environmental settings to reduce wave energy.

This program will seek to gain additional benefit through their potential to promote oyster habitat when designed effectively and efficiently (Douglass, 2012).

Levee modification:
Levees may be regraded in several potential project sites, such as within the McFaddin and JD Murphee Wildlife Refuge Complexes. Natural or human induced damage to levees can cause significant damage to water quality, ecosystem productivity, and flood protection. Taking steps to repair these levees will support the mitigation of flood risk and help to restore coastal ecosystems in these areas, while increasing the productivity of the surrounding habitats (Olson 2015).

### *Environmental Benefits:*

The Chenier Plain Ecosystem Restoration program will provide habitat restoration and provide for the health and stability of the environment, enhancing the existing habitats and creating new ones. Project methods will include marsh restoration through the BUDM, construction of breakwaters along eroding shorelines, placement and distribution of rock materials, reparation and regrading of levees, and the use of best management practices to restore hydrological connections and marsh elevations. These practices have the potential to restore degraded wetlands, reduce erosion, improve water quality, create habitat (including oysters), provide land reclamation, and increase coastal resiliency in a large-scale, effective, and efficient manner.

Numerous factors such as channelization, subsidence, and erosion of critical shorelines in the Chenier Plain Ecosystem have degraded habitats (White et al., 2007; Paine, Mathew, and Caudle, 2012). This degradation increases the risk of storm surge impacts to economically important industries and nationally significant ports along the Upper Texas Coast. Restoration and protection of this marsh system will not only directly ensure long-term ecological benefits from the habitats, it will also reduce vulnerability of critical infrastructure to hurricanes and storm surges. In addition, this program will enhance coastal resiliency by restoring and protecting economically important fisheries and valuable recreation areas. This program combines several Tier 1 projects which are identified in the TCRMP (Project IDs R1-1, R1-2, R1-19, R1-25, R1-41 R1-42, R1-43) (Texas General Land Office, 2019) and will add to the previously funded work completed with Deepwater Horizon NRDA Texas Trustee funds and Gulf Environmental Benefit Fund grants.

The ecosystem services provided by the Chenier Plain system include storm surge buffering, water quality maintenance, sediment retention, nutrient regulation, recreation, and a wide variety of critical habitat. These services contribute to human wellbeing on the upper Texas coast and have both market and non-market value making them unreplaceable (Barbier et al., 2011). Implementation of this program will help preserve ecosystem services for the future.

### *Metrics:*

Metric Title: HR013: Wetland restoration - Acres restored
Target: TBD
Narrative: This program aims to restore wetland habitats within the Chenier Plain. Wetlands are a significant habitat in this geographic area, and activities including marsh elevation and hydrology restoration will be performed. Success will be measured by maximizing the wetland habitats that are restored through the program, which would have been otherwise lost or negatively impacted. This will be quantified through land surveys and by comparing rates of degradation or erosion. A reasonable estimate for acres being restored in this program will be made once specific projects are selected.

Metric Title: HR014: Habitat restoration - Acres of coastal habitat prevented from eroding
Target: TBD
Narrative: The goal of this program is to restore and conserve habitat within the Chenier Plain geographic area. This includes reducing or preventing the degradation and erosion of coastal environments. A measure of this program's long-term success will be the quantity of critical environments that would have been lost or negatively impacted if no restoration activities were performed. This will be quantified through land surveys and comparisons to past or future predicted rates of degradation. Project selection will inform a reasonable target for this metric.

Metric Title: HR009: Restoring hydrology - Acres with restored hydrology
Target: TBD
Narrative: This program will restore hydrology especially south of the GIWW to positively impact coastal wetlands that have been affected by saltwater intrusion and other altered hydrology. Success for this aspect of the program will be measured by improved hydrology in the proposed project locations. Project selection and design will inform a reasonable target for this metric.

Metric Title: HR002: Shoreline restoration - Miles of shoreline stabilized and restored
Target: TBD
Narrative: This program aims to restore shorelines within the Chenier Plain geographic area through various methods including the construction of breakwaters. The target is to provide the greatest benefit to reducing shoreline erosion and preserve a significant amount of critical environments given the funding provided. Success of the program will be measured by the length of shorelines that receive restoration activities. Texas will provide annual updates to the Council on the length of shoreline being restored and the features constructed.

*Risk and Uncertainties:*

Potential risks include the continuing increase of costs for construction and environmental permitting requirements. Additional long-term maintenance costs are also an uncertainty. Effective planning and design, including careful cost estimates and line item budgets for selected projects, will help to minimize these risks. In addition, adjacent landowners may object to the construction of hard structures that could potentially impact shoreline positions. Large-scale projects require planning for maintenance costs and coordination with program partners to identify a party to hold permits and be responsible for permit conditions. In addition, the uncertainty with dredging costs may impact the budgets for each component of the program. However, projects can be phased or scaled to accommodate the available funding and sediments. In addition, there could be several dredge cycles during a project period which may provide some cost savings through opportunities to cost-share with partners such as the USACE.

The process of habitat restoration through the utilization of sediments from maintenance dredging is a widely used restoration technique and has proven to be very cost effective and successful in application. Other techniques to be employed in this program also have successful track records. However, there are potential risks to the implementation of this program. The predominant risk is the rate of relative sea level rise. Due to risks from relative sea level rise and hurricane impacts, dredged materials will likely need to be replenished periodically, and the frequency will depend on changes in relative sea level rise and storm impacts. The upper Texas coast has the highest rate of subsidence in Texas, driven by groundwater withdrawal, oil and gas extraction, and compaction of Holocene sediments (Morton, 2003; Penland and Ramsey, 1990; White and Morton, 1997). The average rate of relative sea level rise in

nearby Galveston from 1909 to 2003 was 6.5 mm/year as measured from the tide gauge at Pier 21 on Galveston Island, which provides the longest continuous record of sea level variations along the Texas coast (Zervas, 2009). The impacts of relative sea level rise in this region are predicted to change rates and patterns of sedimentation, distribution of intertidal habitats, and exacerbate the effects of storm surge (TGLO, 2019). To alleviate this risk, projected future rates of relative sea level rise will be incorporated into the design of projects to ensure that elevations remain sufficient to support marsh vegetation or to protect shorelines.

The return period of storms of all magnitudes are also higher on the upper Texas coast – tropical storms strike the region on average every 3 years, hurricanes every 8 years, and major hurricanes every 26 years (Keim et al., 2007). The effects of relative sea level rise will enhance storm surges, driving inundation farther inland (TGLO, 2019). Storms also have the potential to move large quantities of offshore sediments inland thus majorly impacting the regional distribution of sediment, as evidenced by Hurricane Ike in 2008 moving an estimated sediment volume of 13.7 million m^3 (Williams, 2012). Frequent monitoring of shorelines through bathymetric surveys, ground surveys, and aerial lidar surveys plus offshore sediment sampling will assist in developing a regional sediment budget and help inform where additional sediment is needed (Campbell, 2005).

### *Monitoring and Adaptive Management:*

Project monitoring for this program will involve observations for ensuring (1) proper construction, (2) performance, and (3) to support adaptive management (NAS, 2017). Types of monitoring data will include biophysical observations (elevation, morphology, vegetation, hydrologic) of the project and of adjacent areas to serve as reference sites and to detect off site impacts (DWH-NRDA, 2017). Monitoring will occur on semiannual or annual bases for a minimum of two years following project completion. Project monitoring will be conducted on a project by project basis. Once specific projects are selected, a more detailed monitoring strategy will be put in place.

The Chenier Plain Ecosystem Restoration program will require long-term monitoring to ensure the goals and objectives are being fulfilled. Monitoring the area over the program duration and in the future will help determine if the areas are providing the expected benefits. Project monitoring for this program will involve observations to ensure proper construction, performance, and to support adaptive management (DWH-NRDA, 2017). Different biophysical observations will be performed within the geographic area of the Chenier Plain to report on the success of the program. Continuous non-destructive elevation, morphology, and hydrologic sampling of the project sites will verify the health of the wetland ecosystem being restored. These measurements can be compared to similar habitat types in the surrounding areas as reference sites to determine quantitative beneficial changes (Thayer et al., 2003). Water quality samples such as water temperature, dissolved oxygen, and salinity will be monitored as indicators of improvement. The frequency of monitoring may change over time as the projects develop and depending on the types of restoration activities.

### *Data Management:*

Data management for this program will be designed to make data publicly available thereby enhancing outcomes and future restoration efforts.

Planning data: During program planning, a variety of existing data and newly acquired data will be gathered. Data in this category includes mostly existing geospatial data on shoreline change rates, land cover, elevation, and ecological data describing past and current environmental conditions. Geotechnical and engineering data with construction specifications will also be included.

Project implementation data: These data are needed for determining as-built conditions. Detailed engineering survey data and photography will be included.

Post-project implementation data: These data are needed for monitoring performance, informing adaptive management actions, and for improving future projects. They include time-series of biophysical and engineering data plus hydrological data for understanding trends.

Program activities will identify data used. TCEQ and GRIIDC (Gibeaut, 2016) will work with data users to ensure data are shared when key activities end. GRIIDC is a well-known data repository designed to receive data from a variety of sources and from various scientific and engineering disciplines. GRIIDC will track, curate, and archive data in the GRIIDC repository and make it publicly discoverable and available. Metadata will follow the ISO 19115-2 standard and datasets will be reviewed for completeness and organization to enable reuse. This well-documented, accessible repository with metadata that enables interoperability with other datasets will facilitate data mining for performance monitoring and adaptive management.

### *Collaboration:*

Two Texas workgroups were established to provide input on coastal priorities: State & Federal Representatives and Non-Governmental Organizations. On-line and in-person meetings were held to discuss plans to develop Texas coastal priorities and to ensure the public's involvement. A survey was developed that asked for individual's coastal priorities. These surveys were available to the public and were also completed by members of the two work groups. Public meetings were conducted in three coastal cities for the public to present their issues and concerns. Information received from work group meetings, discussions with elected officials, public meetings and the surveys was used to develop a list of priorities to be included in the RESTORE Council's Planning Framework document. These efforts of collaboration will continue throughout the process to develop programs and projects. Work will continue with Texas representatives for NRDA/NFWF to consider leveraging opportunities.

### *Public Engagement, Outreach, and Education:*

The decision to submit this program was based on many months of discussions with workgroups and participation by the public. It began with discussions with the Texas representatives for NRDA & NFWF to identify programs/projects for FPL 3b. This identified list was shared with the two workgroups (State & Federal and NGOs) established for Bucket 2 planning purposes, for their review and comment. County judges in the coastal area also were given the opportunity to identify potential programs/projects for their areas. Using the information compiled as part of this process, a list of 23 projects was posted for public comment on the Texas RESTORE website. In addition, two public hearings were held in coastal cities. In reviewing the comments received, the timing to move forward with proposals, and in discussions with the Texas Governor's staff, it was determined that program, rather than project-specific, proposals would be submitted. The development of the program proposals was done to ensure that projects posted for public comment could be considered in at least one of the program submissions. Much of the work has already been done to identify projects that could be funded within this program. The process to select FPL 3b grant subrecipients will include the requirement that projects will have to already be vetted by this process or through other public processes such as the GLO's Coastal Resiliency Master Plan, NRDA or NFWF related activities. The criteria to select the specific projects will include, but are not limited to, the following: addresses issues presented in the program activity description; amounts of funds available for the program; readiness; leveraging opportunities;

scalability; risk/benefit ratio; and distribution of funds across the Texas coastline. Notification of the projects selected to receive grant funds will be posted on the Texas RESTORE website. This overall process, parts already completed and others to be completed after the program has been approved for FPL 3b funds, will ensure that the ultimate selection of projects for this program are not only consistent with the RESTORE Planning Framework document, but also reflect the ideas that were discussed by the workgroups, the elected officials, the public and the Office of the Governor.

*Leveraging:*

Funds: TBD
Type: TBD
Status: TBD
Source Type: TBD
Description: As part of the process to initially identify programs for FPL 3b, Texas held discussions with county judges, NGOs, NRDA and NFWF. Projects that are selected for funding in Texas could likely include partnerships leveraging various funds, including RESTORE, NRDA and NFWF monies. All parties have emphasized the need to leverage DWH Oil spill associated funds, as well as other funds, and it is Texas' intent to consider leveraging as a criteria in selecting projects, including the recognition of previous projects and the potential for a new project to add to the cumulative benefits. Over the years, NRDA and NFWF have invested in the Chenier Plains, and TCEQ looks forward to partnering with them in this geographic area.

*Environmental Compliance:*

The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component has been identified as a FPL Category 2 priority for future funding consideration.

*Bibliography:*

Barbier, E.B., Hacker, S.D., Kennedy, C., Koch, E.W., Stier, A.C. and Silliman, B.R., 2011. The value of estuarine and coastal ecosystem services. Ecological Monographs, 81: 169-193. doi:10.1890/10-1510.1

Boustany, Ronald G., 2010. Estimating the Benefits of Freshwater Introduction into Coastal Wetland Ecosystems in Louisiana: Nutrient and Sediment Analyses. Ecological Restoration, 28(2) 160-174. https://www.jstor.org/stable/pdf/43443227.pdf?refreqid=excelsior%3Af064f348b341d348d6faa150c82e7526

Campbell, T., Benedet, L., and Finkle, C.W., 2005. Regional Strategies for Coastal Restoration along the Louisiana Chenier Plain. Journal of Coastal Research 44, 268-283.

Cluff, Donald B., 1989. "Wildland Hydrology/Watershed Management Working Group – Technote :U.S. Army Corps of Engineers Wetland Programs and Activities." Hydata News and Views, vol. 8, no. 6, pp.1012. www.jstor.org/stable/43650497.

Douglass, S.L., Ferraro, C., Dixon, C.R., Oliver, L., Pitts, L., 2012. A Gulf of Mexico Marsh Restoration and Protection Project. Coastal Engineering. https://pdfs.semanticscholar.org/948d/8cd768d164d76571c09ac2974c5797ce643f.pdf

DWH-NRDA, 2017. Deepwater Horizon (DWH) Natural Resource Damage Assessment Trustees. 2017. Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0. Appendix to the Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the DWH Oil Spill. December. Available: http://www.gulfspillrestoration.noaa.gov/.

Esslinger, C.G., and B.C. Wilson. 2001. North American Waterfowl Management Plan, Gulf Coast Joint Venture: Chenier Plain Initiative. North American Waterfowl Management Plan, Albuquerque, NM. 28 pp. + appendix. (Revised 2003.) http://www.gcjv.org/docs/ChenierPlainpub.pdf

Ford, M.A., Cahoon, D.R., Lynch, J.C., 1999. Restoring marsh elevation in a rapidly subsiding salt marsh by thin-layer, 12(3-4):189-205. February 1999. https://www.sciencedirect.com/science/article/pii/S0925857498000615.

Gibeaut, J., 2016. Enabling data sharing through the Gulf of Mexico Research Initiative Information and Data Cooperative (GRIIDC). Oceanography 29(3):33–37, https://doi.org/10.5670/oceanog.2016.59.

Good, Bill. (1993). Louisiana's Wetlands: Combatting Erosion and Revitalizing Native Ecosystems. Restoration & Management Notes, (11)2, 125-133. https://www.jstor.org/stable/pdf/43440123.pdf

Johnson, J.S., Cairns, D.M., and Houser, C., 2013. Coastal marsh vegetation assemblages of Galveston Bay: insights for the east Texas chenier plain. Wetlands, v. 33, issue 5, p. 861 – 870.

Keim, B D., Muller, R A., and Stone, G.W., 2007. Spatiotemporal Patterns and Return Periods of Tropical Storm and Hurricane Strikes from Texas to Maine. J. Climate, 20, 3498–3509, https://doi.org/10.1175/JCLI4187.1.

Lane, R.R., Day Jr., J.W. and Thibodeaux, B., 1999. Water Quality Analysis of a Freshwater Diversion at Caernarvon, Louisiana. Estuaries, 22(2) 327-336. https://link.springer.com/article/10.2307/1352988

Morton, R.A., 2003. An overview of coastal land loss: with emphasis on the southeastern United States (Open-file Report). U.S. Geological Survey.

NAS, 2017. The National Academies of Sciences, Engineering, and Medicine (NAS). 2017. Effective Monitoring to Evaluate Ecological Restoration in the Gulf of Mexico. Washington, DC: The National Academies Press. doi: 10.17226/23476.

Olson, K., Matthews, J., Morton, L.W., Sloan, J., 2015. Impact of levee breaches, flooding, and land scouring on soil productivity. Journal of Soil and Water Conservation. Jan 2015. 70 (1) 5A-11A. DOI: 10.2489/jswc.70.1.5A.

Paine, J.G., Mathew, S. and Caudle, T., 2012. Historical shoreline change through 2007, Texas Gulf coast: rates, contributing causes, and Holocene context. Gulf Coast Association of Geological Sciences Journal, v. 1, p. 13-26.

Parson, L.E. and R. Swafford. 2012. "Beneficial use of sediments from dredging activities in the Gulf of Mexico." Technical Framework for the Gulf Regional Sediment Management Master Plan, Journal of Coastal Research, Special Issue No. 60, 45-50. https://www.jstor.org/stable/41508591.

Penland, S., Ramsey, K.E., 1990. Relative sea-level rise in Louisiana and the Gulf of Mexico: 1908-1988. J. Coast. Res. 6, 323–342.

Pothina, D. and C. Guthrie, 2009. Evaluating inverted siphons as a means of mitigating salinity intrusion in the Keith Lake/Salt Bayou System, Jefferson County, Texas: prepared by the Texas Water Development Board. Grant No. MX-96401704. U.S. Environmental Protection Agency, Gulf of Mexico Program.
http://www.twdb.texas.gov/surfacewater/bays/major_estuaries/sabine_neches/doc/TWDB_KeithLake2009_FinalReport.pdf

TGLO, 2019. Texas General Land Office , 2019. "Texas Coastal Resiliency Master Plan." Austin, Texas, March 2019. https://coastalstudy.texas.gov/resources/files/2019-coastal-master-plan.pdf.

Texas Parks and Wildlife Department. "Salt Bayou Watershed Restoration Plan." May 2013. https://tpwd.texas.gov/publications/pwdpubs/media/salt_bayou_plan.pdf.

Thayer, G.W., McTigue, T.A., Bellmer, R.J., Burrows, F.M., Merkey, D.H., Nickens, A.D., Lozano, S.J., Gayaldo, P.F., Polmateer, P.J., Pinit, P.T. 2003. "Science-Based Restoration Monitoring of Coastal Habitats." NOAA Coastal Ocean Program Devision Analysis Series. No. 23, Vol 1. 2003. https://repository.library.noaa.gov/view/noaa/439.

White, W.A., Morton, R.A., 1997. Wetland losses related to fault movement and hydrocarbon production, southeastern Texas coast. J. Coast. Res. 13, 1305–1320.

White, W.A. and Tremblay, T.A., 1995. Submergence of wetlands as a result of human-induced subsidence and faulting along the upper Texas Gulf coast. Journal of Coastal Research, v. 11, No. 3, p. 788 – 807.

White, W.A., Tremblay, T.A., Waldinger, R.L., and Calnan, T.R., 2007. Status and Trends of Wetland and

Aquatic Habitats on Texas Barriers: Upper Coast Strandplain-Chenier System and Southern Coast Padre Island National Seashore. Final Report prepared for Texas General Land Office and NOAA under GLO Contract No. 06-044 and NOAA Award No. NA05NOS4191064, 88 pp.
Williams, H.F., 2012. Magnitude of Hurricane Ike storm surge sedimentation: implications for coastal marsh aggradation. Earth Surf. Process. Landforms, 37: 901-906. doi:10.1002/esp.3252

Zervas, C., 2009. Sea level variations of the United States 1854-2006 (Tech. Report No. NOS CO-OPS 053). National Oceanic and Atmospheric Administration, Silver Spring, Maryland.

## Budget

*Project Budget Narrative:*
The total budget for this program is $20 million. Of that amount, approximately $18.9 million will be provided to subrecipients to implement projects selected for this program. TCEQ estimates that it will require approximately $1.1 million to support the following: administrative expenses (salary, indirect, travel, fringe, supplies, etc.); hosting & maintenance costs for the Texas RESTORE web site; and for a contract to provide technical assistance to TCEQ staff.

Category 1: $1,700,000

Planning Activities (3%) = $600,000
Project Management (5.5%) = $1,100,000

Category 2: $18,300,000

Implementation (81.5%) = $16,300,000
Contingency (10%) - $2,000,000

Data management and monitoring & adaptive management costs are included in the implementation costs.

Since some costs are uncertain depending on the type of individual project ultimately selected, contingency costs are included at this point and could be considered in a project specific budget as appropriate.

*Total FPL 3 Project/Program Budget:*
$ 20,000,000

*Estimated Percent Monitoring and Adaptive Management:* 0 %
*Estimated Percent Planning:* 3 %
*Estimated Percent Implementation:* 81.5 %
*Estimated Percent Project Management:* 5.5 %
*Estimated Percent Data Management:* 0 %
*Estimated Percent Contingency:* 10 %

## Environmental Compliance

| Environmental Requirement | Has the Requirement Been Addressed? | Compliance Notes (e.g., title and date of document, permit number, weblink etc.) |
|---|---|---|
| **National Environmental Policy Act** | Yes | The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is in Category 2. |
| **Endangered Species Act** | N/A | |
| **National Historic Preservation Act** | N/A | |
| **Magnuson-Stevens Act** | N/A | |
| **Fish and Wildlife Conservation Act** | N/A | |
| **Coastal Zone Management Act** | N/A | |
| **Coastal Barrier Resources Act** | N/A | |
| **Farmland Protection Policy Act** | N/A | |
| **Clean Water Act (Section 404)** | N/A | |
| **River and Harbors Act (Section 10)** | N/A | |
| **Marine Protection, Research and Sanctuaries Act** | N/A | |
| **Marine Mammal Protection Act** | N/A | |
| **National Marine Sanctuaries Act** | N/A | |
| **Migratory Bird Treaty Act** | N/A | |
| **Bald and Golden Eagle Protection Act** | N/A | |
| **Clean Air Act** | N/A | |
| **Other Applicable Environmental Compliance Laws or Regulations** | N/A | |

## Maps, Charts, Figures

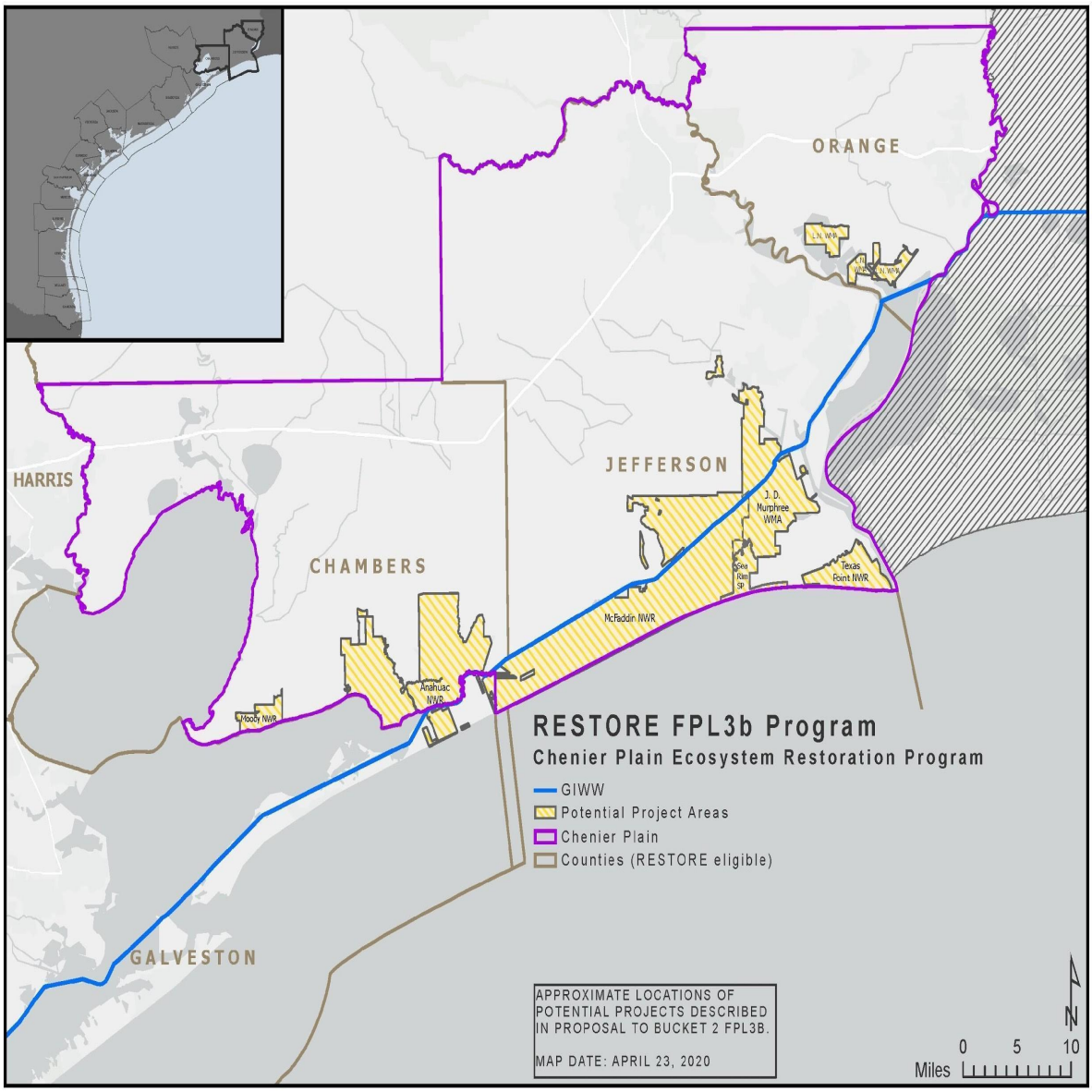


Figure 1: Approximate locations of Chenier Plain Ecosystem Restoration program activities.