Louisiana's RESTORE Center of Excellence Research Grants Program
FY2020 Annual Report to the RESTORE Council

Executive Summary

On April 8, 2014, the Coastal Protection and Restoration Authority (CPRA) of Louisiana named The Water Institute of the Gulf as the State of Louisiana's Center of Excellence. On November 1, 2015, the U.S. Department of the Treasury awarded CPRA a grant to begin its research program. The mission of the RESTORE Act Center of Excellence for Louisiana (LA-COE) is to support research directly relevant to implementation of Louisiana's Coastal Master Plan by administering a competitive grants program and providing the appropriate coordination and oversight support to ensure that success metrics are achieved and assessed.

The LA-COE has been managing research subrecipients that were executed in March 2018 under the first request for proposals (RFP1). A total of 13 awards were granted including six graduate studentship awards, two collaborative awards, and five research awards, one of which was terminated in the fall 2018. The LA-COE has been continuously reviewing the quarterly performance progress reports and their final deliverables for technical content (via the Technical Point of Contact (TPOC)) and to ensure research results will help implement the Louisiana Coastal Master Plan (via CPRA Liaisons). During this reporting period, eight out of 12 subawardees completed their research projects before September 2020 (Q11); their final reports and other deliverables have all been compiled and provided to CPRA. The four remaining subawardees requested no cost extensions (due to COVID-related challenges at virtual learning and impacts from Tropical Storm Marco and Hurricane Laura), and completed their projects before September 18, 2020.

A Technical Memorandum (Tech Memo) for tracking RFP1 success metrics and federal reporting requirements, including reports to the U.S. Department of the Treasury, is being developed. LA-COE has been working on the Tech Memo for tracking the success metrics defined in Standard Operation Procedure Version 1 (SOP V1) to assess RFP1 project progress and performance based on information collected from proposals, final reports, and other deliverables. Success metrics were categorized into the following: (1) Competitive Grants Process, (2) Research Progress, (3) Research Accomplishments, and (4) Outcomes, and have been comprehensively evaluated using the methodology developed at the start of RFP1 grant. Further, key accomplishments and milestones (publications, presentations, and data published) from RPF1 projects are also summarized in this Tech Memo and are being prepared to be posted on LA-COE website. A table of accomplishments and outcomes from RFP1 projects during this reporting period is included in the next section. RFP1 survey questions were designed and sent to principle investigators (PIs), TPOCs, and CPRA liaisons on September 18, 2020 to evaluate the performance of LA-COE operation during CEA1/RFP1, and their responses are also included in the Tech Memo.

The grant for CEA2/RFP2 was approved by the U.S. Department of the Treasury on May 4, 2020, and was executed on October 13, 2020. Correspondingly, the SOP V3 was revised, finalized, and posted online on June 12,

2020 (https://cims.coastal.louisiana.gov/RecordDetail.aspx?Root=0&sid=22460) to prepare for the release of RFP2. Meanwhile, rotating off RFP1 Executive Committee members and inviting new members of the Executive Committee for RFP2 is in process.

LA-COE has had regular meetings with CPRA (monthly and/or bi-monthly depending on schedules and quarantine), and phone calls as needed, and continues to be operated according to the standard operating procedures (SOPs) including website maintenance, data management, coordination with other Centers of Excellence, and federal reporting requirements, including reports to the U.S. Department of the Treasury and other dissemination of information.

LA-COE is working on disseminating or publicizing results of the program: 1) the LA-COE website is being revamped by designing new pages for the dissemination of RFP1 results (e.g., final reports, publications, success metrics Tech Memo, and link for dataset) and for the upcoming RFP2; 2) as papers continue to emerge from the research, these are posted on social media (Twitter) and on the LA-COE website.

Key highlights in 2020 include 1) Managing and closing 12 research subawards. A summary of key accomplishments and outcomes for the 12 RFP1 projects is provided in the following section "Programmatic Elements". 2) SOP V3 has been finalized and released. 3) A Tech Memo for tracking RFP1 success metrics and federal reporting requirements, including reports to the U.S. Department of the Treasury was developed. 4) The LA-COE collaborated with several other RESTORE Act Centers of Excellence and the Sea Grant Oil Spill Science Outreach Program on a conference session entitled "New insights in the Gulf of Mexico nine years after the *Deepwater Horizon* oil spill". This session was accepted for the Coastal and Estuarine Research Federation (CERF) conference in November 2019 in Mobile, Alabama and the LA-COE Director served as a panelist. 5) A conference session entitled, "RESTORE Act Centers of Excellence Research Grant Programs – Filling Gaps in Gulf Research to Inform Policy and Management" was conducted with the Centers of Excellence Research Grant Program at the Gulf of Mexico Oil Spill and Ecosystem Science Conference (GoMOSES) conference held on February 05, 2020 in Tampa, Florida. LA-COE presented about the progress of the program and how applied research conducted helps to inform policy and management decisions that are important to the state and the region. 6) LA-COE submitted a session proposal entitled, "RESTORE Act Center of Excellence for Louisiana: Research to support Louisiana's Coastal Master Plan" with the Coastal and Protection Restoration Authority and was accepted for the State of the Coast conference to be held in New Orleans, LA in September 2020, which has been postponed to June 2021, with six of the research subrecipients agreeing to present their research; 7) potential co-host of a science workshop with NOAA RESTORE Science Program.

Programmatic Elements

Summary of CEA1 RFP1 projects:

The Water Institute of the Gulf was selected by the Louisiana Coastal Protection and Restoration Authority (CPRA) to serve as the State's RESTORE Act Center of Excellence (LA-COE), and on Nov. 1, 2015, the U.S. Department of the Treasury awarded CPRA a grant to begin its research program. Funding for the research program comes from fines and penalties in the wake

of the 2010 Deepwater Horizon oil spill. Announced on June 22, 2017, 13 projects were awarded with a total near $3 million that included research and collaborative awards as well as graduate studentships. Since the first All-Hands meeting held by LA-COE in cooperation with CPRA on August 17, 2018, one researcher, Dr. Sanjay Tewari, moved out of state and left the program. As we approach the completion of CEA1 RFP1, summaries of each awardees' research are presented below.

1. Louisiana State University, Dr. Kehui Xu
    - Researcher role: Help implement Louisiana's Coastal Master Plan
    - Eligible discipline: Coastal and deltaic sustainability, restoration and protection, including solutions and technology that allow citizens to live in a safe and sustainable manner in a coastal delta in the Gulf Coast
    - Research project undertaken: Integrating High-Fidelity Models with New Remote Sensing Techniques to Predict Storm Impacts on Louisiana Coastal and Deltaic Systems
    - The project was executed in March 2018 and closed out in April 2020. Deliverables included 2 publications and 3 presentations, and 6 datasets will be shared by May 30, 2020. See project final summary below:

    "The successful implementation of the Louisiana Coastal Master Plan depends on (1) a thorough understanding of the deltaic system dynamics of barrier islands, shallow estuaries, and coastal wetlands as well as their connection in order to manage sediment budgets, and (2) the development of the modeling capability to quantify the effectiveness of these natural landscapes in mitigating storm-induced waves and surges, and thus reduce hydraulic loads on flood defenses. The effectiveness of the deltaic system in flood risk reduction has thus far been difficult to quantify accurately. An outstanding issue is that state-of-the-art numerical models need spatially- and temporally-varying input parameters of vegetation biophysical properties, that are not easily obtained in-situ for large areas and at regular time intervals, and both remotely-sensed parameters and numerical models require validation by field measurements in coastal Louisiana. Moreover, the sediment fluxes during storms between the barrier islands, back-barrier wetlands, shallow lakes and open bays, and the marshes are not well understood. To address both issues, this project has developed an innovative model system, which integrates state-of-the-art numerical modeling of physical processes, in-situ measurements, and satellite-sensed vegetation properties. Caminada Headland Complex serves as a testbed. These products will have direct applicability and utility in support of the implementation of the Coastal Master Plan."

2. Louisiana State University, Dr. Scott Hagen
    - Researcher role: Help implement Louisiana's Coastal Master Plan
    - Eligible discipline: Coastal and deltaic sustainability, restoration and protection, including solutions and technology that allow citizens to live in a safe and sustainable manner in a coastal delta in the Gulf Coast
    - Title: Coupling Hydrologic, Tide and Surge Processes to Enhance Flood Risk Assessments for the Louisiana Coastal Master Plan

- The project was executed in March 2018 and closed out in September 2020. Deliverables included 7 presentations and 3 datasets, which are available online. See project final summary below:

"Traditional coastal flood hazard studies do not typically account for rainfall runoff processes in the quantification of flood hazard and related cascading risks. This study addresses the potential impacts of antecedent rainfall-runoff, tropical cyclone (TC)-driven rainfall, and TC-driven surge on total water levels and its influence in delineating a coastal flood transition zone for two distinct coastal basins in southeastern Louisiana. Rainfall-runoff from antecedent and TC-driven rainfall along with storm surge was simulated using a new rain-on-mesh module incorporated into the ADCIRC code. Antecedent rainfall conditions were obtained for 21 landfalling TC events spanning 1948-2008 via rain stations. A parametric, TC-driven, rainfall model was used for precipitation associated with the TC. Twelve synthetic storms of varying meteorological intensity (low, medium, and high) and total rainfall were utilized for each watershed (Barataria and Lake Maurepas) and provided model forcing for simulations of coastal inundation. First, it was found that antecedent rainfall (pre-TC landfall) is influential up to three days pre-landfall. Second, results show that antecedent and TC-driven rainfall increase simulated peak water levels within each basin, with antecedent rainfall dominating inundation across upper portions of the basin. Third, the delineated flood zones of coastal, transition, and hydrologic show stark differences between the two basins."

3. University of New Orleans, Dr. Mark Kulp
    - Researcher role: Help implement Louisiana's Coastal Master Plan
    - Eligible discipline: Coastal and deltaic sustainability, restoration and protection, including solutions and technology that allow citizens to live in a safe and sustainable manner in a coastal delta in the Gulf Coast
    - Title: An Evaluation of Faulting in Holocene Mississippi River Delta Strata through the Merger of Deep 3-D and 2-D Seismic Data with Near Surface Imaging and Measurements of Vertical Motion at Three Study Areas
    - The project was executed in March 2018 and closed out in September 2020. Deliverables included 7 presentations and 3 datasets, which are available online. See project final summary below:

"The focus was to map the geographic extent and history of displacement on Cenozoic fault systems that trend across the Holocene Mississippi River delta plain. The work was concentrated in Terrebonne-Timbalier Bay, Bayou Lafourche near Golden Meadow, and Lake Pontchartrain/Lake Borgne. Each of three Louisiana universities involved in this project hold license agreements with energy companies, who have provided access to high-quality, industry-standard 3-D and 2-D seismic reflection data that image Cenozoic strata in the study areas. These data allow for an assessment of whether deep-seated faults are present and if these faults extend upward into overlying strata. These seismic datasets are essential for the success of any study attempting to document the potential impact of faults on geomorphology, deltaic geology, and the stability of Holocene sedimentary units of the north central

Gulf coast. Louisiana Master Plan efforts strongly rely upon an understanding of vertical elevation changes and if modern fault motion is occurring Master Plan efforts could be jeopardized. The research unites industry seismic reflection data (3-D, 2-D) with additional methods of data analysis including high-resolution seismic imaging, construction of near-surface stratigraphic sections, geochronology, GPS surveys and quantification of sediment accumulation rates. Primary research questions included: 1) Do geologic structures influence modern Mississippi River delta plain evolution?, 2) Are fault slip rates variable across the delta plain because of proximity to major late Pleistocene and Holocene depocenters and interaction with underlying ductile salt bodies?, 3) Can Holocene motion be detected using shallow, high-resolution seismic imaging, radiocarbon stratigraphic horizons, GPS surveys, and sediment accretion rates. All three of the industry seismic datasets image an array of faults, with variable lengths and geometries. The depth to which the faults can be projected upward varies between the datasets because of the quality of the industry seismic data but maps of suspected shallow faults can guide decision making and an assessment of potential fault impacts to Holocene strata and geomorphology. Only locally does high resolution seismic data clearly image the subsurface of the study areas because of shallow water and gas-charged sediments. Radiocarbon dated horizons locally indicate offset of Holocene strata as do geomorphologic features at the surface. Continued efforts to fully document the exact location and overall extent of latest Quaternary fault offsets across all of the delta plain should include the acquisition of additional industry seismic data, shallow seismic data, sediment cores, GPS surveys and radiocarbon dated strata."

4. University of Louisiana at Lafayette, Dr. Paul Leberg
    - Researcher role: Help implement Louisiana's Coastal Master Plan
    - Eligible discipline: Coastal fisheries and wildlife ecosystem research and monitoring in the Gulf Coast Region
    - Title: Assessment of Coastal Island Restoration Practices for the Creation of Brown Pelican Nesting Habitat.
    - The project was executed in March 2018 and closed out in September 2020. Deliverables included 2 publications, 6 presentations, and 3 datasets, which are available online. See project final summary below:

    "There is limited understanding of the success of the most common restoration approaches in providing seabird habitat. In light of the threats coastal Louisiana faces, and the region's importance for seabirds, our goal was to address a suite of questions including how birds and colonies respond to a shifting mosaic of available islands and fisheries, how far they travel to provision nestlings, and the extent to which birds move between breeding and foraging areas in our dynamic coastal landscape. By tapping into the opportunities provided by numerous habitat restoration efforts in coastal Louisiana, this research increases understanding of which outcomes are due to the restoration, the location of the restoration in relation to marine and wetland resources, or the level of predation threat.

Because many coastal islands in Louisiana have experienced some level of restoration, this research employed a space for time substitution approach comparing restoration sites of varying ages, focusing on use by brown pelicans. To quantify the spatial extent of habitats, we gathered existing satellite and aerial imagery for nesting sites as well as unused islands. The extent of each habitat type and its change over time was determined. We quantified how factors altered by restoration such as vegetation type, predator communities, and site characteristics affect bird use of barrier islands as nesting habitat. Cameras and other survey techniques were used to monitor nests to determine nest success, the causes of nest failure, and the abundance of nest predators. We found evidence that seabirds readily used restored islands and that restoration created vegetation conditions that favored use by brown pelicans and other birds. However, restoration actions can also increase conditions that favor mammalian predators, so a balance must be struck in project planning.

The role of island location on nest success, movement and habitat is being characterized using GPS-based tracking devices. This research is ongoing as we are affected by delays in funding and by the pandemic. When completed, this information will be related to physiological condition, foraging ecology, breeding success, and survival. Telemetry data will be used to quantify foraging ecology (frequency, distance, and duration of foraging trips) and parental care (trips to their nests coupled with direct observations of food delivery to nestlings per visit). The research will quantify how connectivity and position of restoration and other potential colony sites, relative to hypoxic zones and salinity gradients, affect their use as nesting habitat."

5. University of New Orleans, Dr. Marla Nelson
    - Researcher role: Help implement Louisiana's Coastal Master Plan
    - Eligible discipline: Sustainable and resilient growth, economic and commercial development in the Gulf Coast Region
    - Title: From Adapting in Place to Adaptive Migration: Designing and Facilitating an Equitable Relocation Strategy
    - The project was executed in March 2018 and closed out in September 2020. Deliverables included 1 working paper and 4 presentations, and 5 datasets will also be shared. See project final summary below:

    "In vulnerable areas across coastal Louisiana, nonstructural interventions are necessary to reduce risk and potential harm to residents and property. While nonstructural mitigation has primarily focused on helping people adapt in place, resident relocation will become increasingly necessary. This project responds to the need for effective programs that help people move away from risky areas in the face of ongoing environmental change and increasing disasters. The primary objective of these recommendations is to assist in implementation of nonstructural mitigation measures in Louisiana's 2017 Comprehensive Master Plan for a Sustainable Coast to shape equitable relocation assistance that helps enable people to preserve their coastal cultures. The project addresses two questions and interrelated sub-questions: Research Question 1: How do residents respond to threats from immediate and long-term environmental change? What factors drive decisions of whether, when and

where to relocate? What factors drive decisions to stay in place? Research Question 2: How do public officials and land managers respond to threats from immediate and long-term environmental change? How can local officials facilitate equitable relocation for residents in at risk areas? How can communities develop low risk residential land use that accommodate relocating residents?

To answer the first question we conducted interviews with 58 residents who live in Terrebonne Parish's bayou communities or who have relocated within or outside the parish. In answering the second question we interviewed 29 local officials, planners, nonprofit and business leaders and university researchers. We coded and analyzed the transcribed interviews for key themes using Dedoose qualitative analysis software. Additionally, we analyzed buyout and relocation programs in the US to identify useful lessons, promising practices and pitfalls to avoid during the relocation process. Results address the conditions associated with long term environmental change, the relationships among land loss and increased flooding and larger economic and population shifts, the diverse and changing circumstances of people living in at-risk communities, and their priorities when participating in initiatives to reduce risk and property damage. Based upon our results we present recommendations to inform relocation policies and programs that move beyond merely acquiring at risk properties and lead to just outcomes for communities and residents on the frontline of dealing with disasters from both extreme weather events and ongoing environmental change. Just and equitable policies and programs must be flexible, inclusive and transparent, and work beyond disaster recovery to ensure long term, inclusive and just adaptation."

6. Louisiana State University, Dr. Kehui Xu
    - Researcher role: Help implement Louisiana's Coastal Master Plan
    - Eligible discipline: Coastal and deltaic sustainability, restoration and protection, including solutions and technology that allow citizens to live in a safe and sustainable manner in a coastal delta in the Gulf Coast
    - Title: Enhancing Sediment Retention Rates of Receiving Basins of Louisiana Sediment Diversions
    - The project was executed in March 2018 and closed out in April 2020. Deliverables included 1 publication and 3 presentations, and 5 datasets will be shared by May 30, 2022. See project summary below:

    "Mud and sand represent >80% and <20% of sediment load in the Mississippi/Atchafalaya Rivers, respectively, so the loss of mud represents a substantial issue in the land-building process. Muddy sediment dynamics, however, is complicated and has widely been recognized to be controlled by multiple nonlinear processes. Operation strategies, based on results of this project, can be considered that allow sediment consolidation and reduce sediment loss/bypass. This can be used in rotations in multiple receiving basins to maximize total land gaining. A new hydrodynamics and sediment dynamics study was conducted to quantify: (1) cohesive muddy sediment characteristics in a receiving basin, (2) mud retention rate in a receiving basin, (3) settling and compaction of dredged sediment to be used to build

marsh and Sediment Retention Enhancement Device (SRED), (4) the impact of SREDs on wave-induced shear stress, and (5) the impact of SREDs on sediment retention rate. This project helps evaluate the interaction and interdependence between sediment diversion and marsh creation; dredged materials for marsh creation, either from river channels or wetland canals, can be placed in the receiving basin as SREDs to enhance the retention of sediment diversion. This project also helps the design and implementation of engineering structures like wave attenuation and sediment collection devices in near future."

7. Louisiana State University, Dr. Tracy Quirk
    - Researcher role: Help implement Louisiana's Coastal Master Plan
    - Eligible discipline: Coastal and deltaic sustainability, restoration and protection, including solutions and technology that allow citizens to live in a safe and sustainable manner in a coastal delta in the Gulf Coast
    - Title: Plant and Soil Response to the Interactive Effects of Nutrient and Sediment Availability: Enhancing Predictive Capabilities for the Use of Sediment Diversions and Dredge Sediment for Marsh Creation
    - The project was executed in March 2018 and closed out in October 2020. Deliverables included 6 presentations, and 5 datasets will be shared by Nov 01, 2022. See project final summary below:

    "Marshes in the Mississippi River Delta are rapidly deteriorating due partly to inadequate sediment supply to equilibrate to a high rate of relative sea-level rise. Restoration strategies include sediment diversions and marsh creation. However, high nutrient loading into existing and newly created marshes may have potential negative impacts on belowground biomass and soil organic matter accumulation. The goal of this research is to provide critical information on the interactive effects of nutrient- and sediment availability on marsh nutrient cycling, plant productivity, decomposition and soil organic matter accumulation and accretion. In a field study across three marsh types, low nutrient-enrichment stimulated both the accumulation and decomposition of dead roots across marsh types. Intermediate marsh plugs in a greenhouse had lower species richness, stem density, aboveground biomass, root productivity at lower elevations. Nutrient-enrichment tended to negatively affect plant structure at low elevations without sedimentation and positively affect plant processes at high elevations and/or with sediment deposition. Spartina patens in a greenhouse had greater aboveground biomass and root productivity in mineral rather than organic soils. Overall, these results show that the effects of nutrient-enrichment on plant productivity and soil processes are strongly dependent on elevation and sediment availability, which have a greater influence on the vegetation and soil."

8. Louisiana Tech University, Dr. Sanjay Tewari
    - Researcher role: Help implement Louisiana's Coastal Master Plan
    - Eligible discipline: Coastal and deltaic sustainability, restoration and protection, including solutions and technology that allow citizens to live in a safe and sustainable manner in a coastal delta in the Gulf Coast & Comprehensive observation, monitoring, and mapping of the Gulf of Mexico
    - Title: Electrokinetic Barrier for Seawater Intrusion

- Summary: The project investigates electrokinetic barriers against seawater intrusion in the coastal region of Louisiana. Efforts will be made to compare the efficacy of this electrokinetic barrier against other techniques that are being used, which is important for many coastal areas that have freshwater crises due to saltwater intrusion. Tewari and his graduate student both left Louisiana Tech University and moved to separate universities. LA-COE terminated this subaward in the fall 2018.

9. Louisiana State University, Dr. Robert Twilley
    - Researcher role: Help implement Louisiana's Coastal Master Plan
    - Eligible discipline: Coastal and deltaic sustainability, restoration and protection, including solutions and technology that allow citizens to live in a safe and sustainable manner in a coastal delta in the Gulf Coast
    - Title: Multiple Tools for Determining the Fate of Nitrate
    - The project was executed in March 2018 and closed out in January 2020. Deliverables included 1 publication and 3 presentations, and 2 datasets will be shared by Feb 01, 2022. See project final summary below:

    "Coastal deltaic floodplains provide important ecosystem services of land building and water quality improvement. Wetland plants, soils, and microbes within these floodplains functionally remove nitrate through uptake, burial, and denitrification, thereby reducing algal blooms and hypoxia in the Gulf of Mexico (GOM). This study was part of larger effort to understand nitrate removal capacity by measuring factors that control denitrification rates and other nitrogen pathways in a developing delta. Our study area, Wax Lake Delta (WLD), is a young (<40 years) and actively prograding delta located within the Atchafalaya Bay, in southeastern Louisiana. The objective of this project was to quantify transformation of nitrate by wetland plants, soil, and microbes of deltaic floodplains of WLD. To determine nitrate uptake rates across WLD, we conducted several field incubation tracer experiments using 15NO3. These experiments measured nitrate uptake, denitrification, dissimilatory nitrate reduction to ammonium, and estimated assimilation of nitrate by plants and microbial communities in surface sediments. Total nitrate uptake rates, as well as denitrification rates, increased with soil organic matter content. Plant and soil assimilation of nitrogen was limited due to disturbance caused by Hurricane Barry, which killed vegetation and reworked surface sediments across the delta. Total nitrate uptake rates were incorporated into a Delft-3D Water Quality model."

10. Louisiana State University, Dr. George Xue
    - Researcher role: Help implement Louisiana's Coastal Master Plan
    - Eligible discipline: Coastal and deltaic sustainability, restoration and protection, including solutions and technology that allow citizens to live in a safe and sustainable manner in a coastal delta in the Gulf Coast.
    - Title: Project Louisiana Rivers' Sediment Flux to the Coastal Ocean
    - The project was executed in March 2018 and closed out in April 2020. Deliverables included 2 publications and 2 presentations, and 2 datasets will be shared by May 30, 2022. See project final summary below:

"In this study we propose to incorporate sediment modules and oceanside boundary conditions to a newly developed hydrologic model (WRF-Hydro). Our long-term objectives are to: 1) Quantify water and sediment flux from Louisiana rivers to the Chenier Plain; 2) Project possible changes in water and sediment flux regarding future climate and ongoing/planned restoration activities of the Louisiana Coastal Master Plan. For this 2yr fellowship project we further developed and validated a SW Louisiana WRF-Hydro model and performed a 35-yr model hindcast. Our model detected a possible change-point around the year 2004, after which the monthly precipitation decreased from 140 to 120 mm, evapotranspiration slightly increased from 80 to 83 mm, and water surplus decreased from 60 to 38 mm. In addition, we successfully adapted a new sediment module to WRF-Hydro and applied the coupled hydrological-sediment model in a small test watershed in Mississippi. We also applied ocean boundary condition to drive the WRF-Hydro model and performed another test study for a hurricane event along the US east coast. Development and application of the sediment module and oceanside boundary condition confirmed WRF-Hydro's potential as a toolbox to assess the changes of water and sediment flux regarding future climate and ongoing/planned restoration activities along the Louisiana coast. Further improvement of model parameterization, parallelization, and the fully coupling with an ocean model is needed."

11. University of Louisiana at Lafayette, Dr. Emad Habib
    - Researcher role: Help implement Louisiana's Coastal Master Plan
    - Eligible discipline: Coastal and deltaic sustainability, restoration and protection, including solutions and technology that allow citizens to live in a safe and sustainable manner in a coastal delta in the Gulf Coast & Comprehensive observation, monitoring, and mapping of the Gulf of Mexico
    - Title: Evaluation of Radar-Based Precipitation Datasets
    - The project was executed in March 2018 and closed out in April 2020. Deliverables included 1 publication, 2 presentations, and 1dataset, which has been incorporated into the 2023 Coastal Master Plan modeling. See project summary below:

    "Despite the potential advantages of using the spatially-continuous, high-resolution radar rainfall products in hydro-ecological modeling and ecosystem applications, only few studies assessed the quality of these products over coastal regions that lack adequate in-situ rainfall observations. This study evaluates two radar rainfall products, the National Center for Environmental Prediction (NCEP) Multi-sensor Stage IV and the National Severe Storms Laboratory (NSSL) Multi-Radar Multi-Sensor (MRMS), over the Louisiana coastal region in the United States. Surface reference rainfall observations from two independent rain gage networks were used in the evaluation analysis."

12. Louisiana State University, Dr. Frank Tsai
    - Researcher role: Help implement Louisiana's Coastal Master Plan

- Eligible discipline: Coastal and deltaic sustainability, restoration and protection, including solutions and technology that allow citizens to live in a safe and sustainable manner in a coastal delta in the Gulf Coast
- Title: Constructing Mississippi River Delta Plain Soil Stratigraphy
- The project was executed in March 2018 and closed out in December 2019. Deliverables included 3 publications and 7 presentations, and 2 out of 7 datasets have been made available online. See project final summary below:

"The Mississippi River Delta (MRD) is socioeconomically important to the state of Louisiana and the United States. Various types of land-water system data have been collected in the MRD. However, very few efforts have been made to utilize these datasets in modeling regional stratigraphy and groundwater dynamics in the MRD, especially for the upper 50 m of the depth. In this interval of depth, the Mississippi River and surrounding interdistributary bays intensively interact with the groundwater system. The lack of knowledge in regional stratigraphy and groundwater dynamics hinder an understanding of how hydrogeological setting affects processes such as surface- groundwater interaction, subsidence, and sediment erosion. In this study, topobathymetric, geological/geotechnical, and hydrological data were used to construct multiple 3-D stratigraphy models and a groundwater flow model in the MRD. Ordinary kriging, compositional kriging, and multiple indicator methods were found to be efficient in regionalizing different types of geological/geotechnical data. The stratigraphy models and groundwater model reveal a complex hydrogeologic setting in the MRD. Mississippi River channel cut through clayey delta plain deposits into buried sands between -10 m and -35 m. Sands deposited at depth and near the surface provide pathways for groundwater to interact with surface waters. Groundwater flow rate is 3-4 orders of magnitude smaller than the river discharge rate. The groundwater system actively interacts with surface water system in the Mississippi River and in the surrounding bays, especially during flood, storm, and hurricane events. Dramatic increase in pore water pressure and sharp groundwater recharge-to-discharge reversion are estimated to occur during hurricane and right after hurricanes respectively. High pore water pressure during and after hurricanes may destabilize sediments and compromise safety of coastal infrastructures such as the ring levees. Groundwater activities may contribute to vertical movement in the delta."

13. Louisiana State University, Dr. John White
    - Researcher role: Help implement Louisiana's Coastal Master Plan
    - Eligible discipline: Coastal and deltaic sustainability, restoration and protection, including solutions and technology that allow citizens to live in a safe and sustainable manner in a coastal delta in the Gulf Coast
    - Title: Determining the Influence of Surface Water Diversions
    - The project was executed in March 2018 and closed out in October 2019. Deliverables included 2 presentations, and 1 dataset will be shared by Dec 01, 2020. See project final summary below:

> "Sediment and nutrient deprivation as well as salt water intrusion are driving widespread organic soil erosion and coastal marsh loss in the Mississippi River Delta. Freshwater diversions were designed to reintroduce river water and dissolved nutrients into the adjacent basins to manage salinity and slow land loss by maintaining marsh vegetation and nutrient cycling. In this study, a soil characterization is presented for the receiving marsh of the Davis Pond diversion in 2007 and again in 2018 after 11 years of operation. Data for the top 0-10 cm of soil from the same 140 stations were used in spatial analysis to model soil properties. As a result of diversion operation, there has been a significant increase in soil mineral content and consequently soil bulk density. Elevated δ15N isotope values and increased inorganic soil P stocks delineated areas of diversion influence and nutrient enrichment of the wetland. These conditions led to an increased organic matter and carbon sequestrations in diversion influenced regions of the wetland. Multivariate methods demonstrate the effectiveness of certain parameters for monitoring impacts of river diversions on wetlands. The δ15N is an important indicator of the exposure to dissolved river water N and changes in inorganic soil P can identify areas of river sediment subsidy. Results have implication for continued freshwater diversion operation as well as far field effects of large sediment diversions on wetland soil properties."

Assessment of RFP1 Success Metrics:

The assessment of the LA-COE success metrics refers to the process of summarizing the performance of LA-COE funded RFP1 projects based on the pre-defined success metrics and information collected from proposals, final reports, and other deliverables. For the RFP1 grant, LA-COE received a total of 76 proposals including 15 for graduate studentships, 10 for collaborative awards, and 51 for research awards, from which a total of six graduate studentship, five research awards, and two collaborative awards were funded. Results for 1) Competitive Grant Process, 2) Research Progress, 3) Research Accomplishments, and 4) Outcomes, are provided in Table 1. First, success metrics in Competitive Grants Process were fully evaluated and indicate that overall performance was better relative to the target with exception of two success metrics, "percent of topical areas identified in the Research Strategy addressed by the proposals" and "maximum time from initiation of the contract to execution". Second, the success metrics in Research Progress and Accomplishment were partially determined based on completed RFP1 projects. Given the time it takes to publish in the peer-reviewed literature, summarize applied results, and apply it to Louisiana Coastal Master Plan, LA-COE will determine long-term tracking methods of metrics, such as "on-time adherence to data management procedures", "number of publications per funded project within one year of project completion" and the assessment in the Outcomes category

Table 1. Success metrics (from SOP V1), assessment criteria, targets, and RFP1 results. Some results have not been calculated because the assessment is still on going.

Success Metric	Metric Assessment	Metric Target	RFP1 Results
Competitive Grants Process	Percent of submitted proposals including more than one Louisiana-based institution [1]	>50%	33%
	Percent of submitted proposals including collaborations between colleges/universities and industry/non-profits/agencies	>25%	34%
	Percent of proposals that provide training opportunities for graduate/undergraduate students or postdocs at Louisiana-based colleges/universities	>90%	95%
	Percent of topical areas identified in the Research Strategy addressed by the proposals	100%	100%
	Maximum time from initiation of the contract to execution	10 weeks	32 weeks
Research Progress	On-time reporting	100%	58%
	On-time completion of deliverables	100%	62%
	On-time adherence to data management procedures	100%	On going
	Percent of proposals for which no-cost extensions are requested	<20%	100%
Research Accomplishments	Number of publications per funded project within one year of project completion	1–3	On going
	Percent of funded projects that train graduate/undergraduate students or postdocs at Louisiana-based colleges/universities	>90%	100%
Outcomes	Number of Coastal Master Plan projects and programs that directly utilize research findings within one year of project completion	>10	On going

[1] Louisiana-based institutions are defined as those institutions with their main office based in Louisiana.

Financial Elements

Award Recipient

The RESTORE Act Center of Excellence Research Grant Program amended award to CPRA was issued on May 25, 2017 and is funded for $4,202,509.00. A Cooperative Endeavor Agreement dated June 9, 2017 was executed between CPRA and The Water Institute of the Gulf (The Water Institute) to administer the award with a current contract value of $4,036,238. Invoices from The

Water Institute total $3,489,601.93 through the period ending August 31, 2020, including subaward expenditures.

Award Subrecipient(s)

As a result of a competitive and peer-reviewed request for proposal process, subrecipients of research awards were selected. Subawards were executed in March & April 2018. The subrecipients and associated subaward amounts are provided below:

Number	Subrecipient	Subaward Amount
1	Louisiana State University	$501,270.00
2	Louisiana State University	$499,882.00
3	University of New Orleans	$349,173.52
4	University of Louisiana at Lafayette	$299,733.16
5	University of New Orleans	$295,338.00
6	Louisiana State University	$292,495.00
7	Louisiana State University	$292,914.80
8	Louisiana Tech University	$57,519.00
9	Louisiana State University	$63,100.00
10	Louisiana State University	$77,015.26
11	University of Louisiana at Lafayette	$71,148.00
12	Louisiana State University	$70,070.00
13	Louisiana State University	$83,328.00

Gulf Coast Ecosystem Restoration Council Elements

Leveraging Multipliers

The LA-COE and CPRA participate in bimonthly conference calls of the Gulf of Mexico Restoration and Science Programs Coordination Forum that allows for funding organizations in the Gulf region to discuss their programs, share ideas, and promote collaborations.