Mississippi River Valley Division,
Regional Planning and Environment Division South

South Central Coast Louisiana Study

Draft Feasibility Study with Integrated Environmental Impact Statement

Hurricane Ike flooding in Delcambre, Louisiana.

Appendix A-1 – Environmental Resources

November 2019

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Section 1
Introduction

1.1 PURPOSE

The District inventoried the applicable social, economic, and environmental factors for the study area (St. Martin, Iberia, and St. Mary Parishes, as well as the area of potential effect). The study area includes an array of private, local, state and federally-managed lands. The District used applicable social, economic, and environmental factors as the foundation of the analysis, to evaluate and compare alternatives and ultimately select the District's Tentatively Selected Plan (TSP). These factors establish a baseline to measure the project's impacts.

This appendix includes additional information referenced in the Main Report Section 2, Inventory and Forecasted Conditions (Affected Environment) such as maps and tables deemed too large for the main report. This appendix also includes a table outlining the District's risks specific to environmental planning throughout the planning process.

1.1.1 Ecoregions of Louisiana

Sub-Ecoregions to the Mississippi Alluvial Plain The Mississippi River watershed drains all or parts of 31 states, 2 Canadian provinces, and approximately 1,243,000 miles^2 before the river finally reaches the Gulf. The Mississippi Alluvial Plain is mostly a broad, flat alluvial plain with river terraces, swales, and levees providing the main elements of relief. Soils are typically finer-textured and more poorly drained than the upland soils of adjacent ecoregions. The widespread loss of forest and wetland habitat, however, has impacted wildlife and reduced bird populations, although it is still a major bird migration corridor. The batture lands are hydrologically connected to the Mississippi River, are flood-prone, and contain remnant habitat for "big river" species (e.g., pallid sturgeon) as well as riverfront plant communities. The study area has five sub-ecoregions to the Mississippi Alluvial Plain (Figure 1). This riverine ecoregion extends from southern Illinois, at the confluence of the Ohio River with the Mississippi River, south to the Gulf of Mexico.

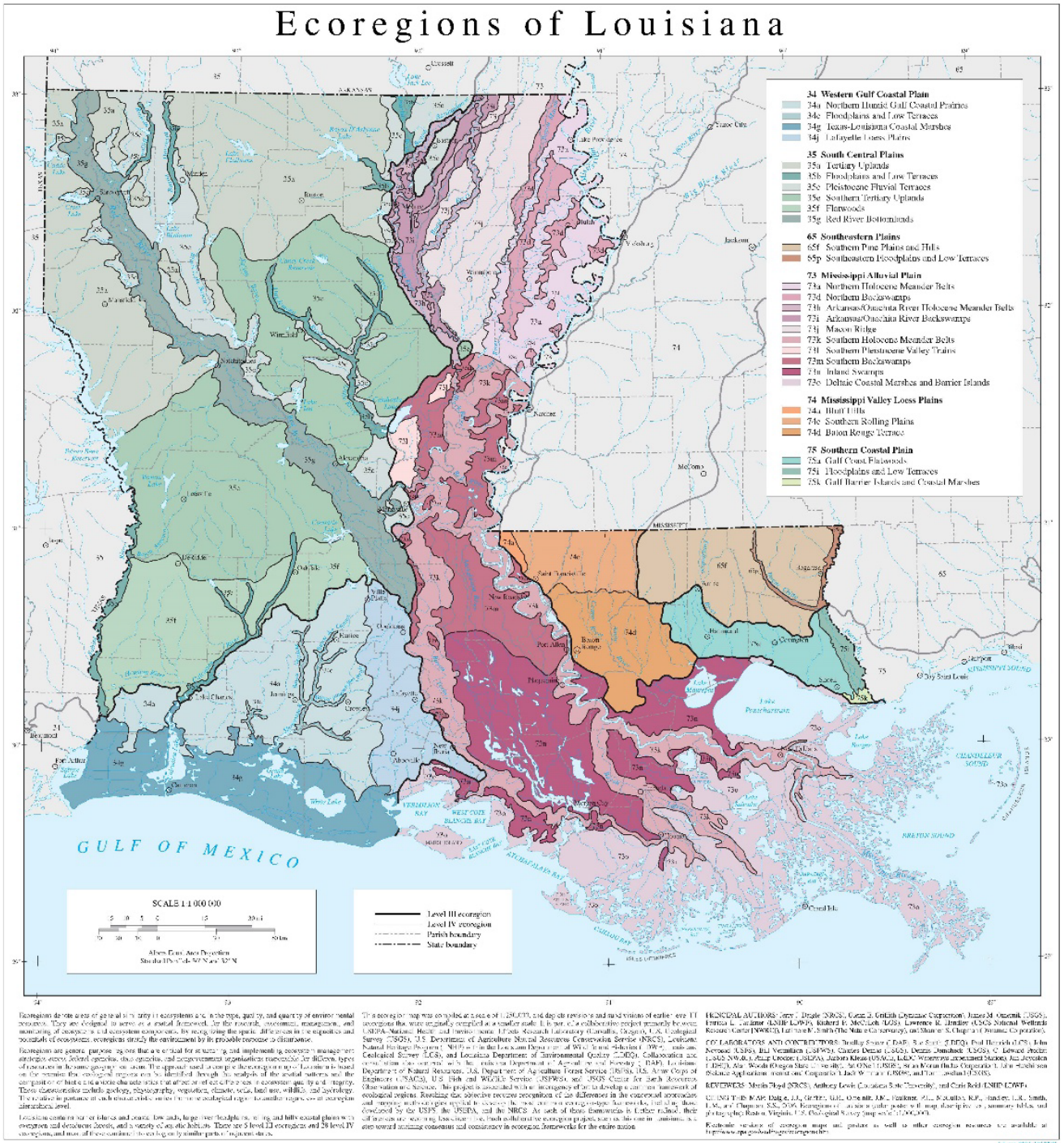

Figure 1. Ecoregions Of Louisiana

The five subecoregions to the Mississippi Alluvial Plain are:

1. **The *Southern Holocene Meander Belts* (73k) ecoregion** stretches from just north of Natchez, Mississippi south to New Orleans, Louisiana. Similar to the Northern Holocene Meander Belts (73a), point bars, oxbows, natural levees, and abandoned channels occur. The Bayou Teche now runs through this former Mississippi River valley. The ecoregion contains minor species such as live oak, laurel oak, and Spanish moss that are generally not found in the more northerly regions. The bottomland forests have been cleared and the region has been extensively modified for agriculture, flood control, and navigation.
2. **The *Southern Backswamps* (73m) ecoregion** soils are mostly poorly drained, clayey Vertisols, rich in organic matter. Wetlands are common and flooding occurs frequently. Bottomland hardwood forests are more prevalent in this region than in the adjacent Southern Holocene Meander Belts (73k), where cropland is common. Channelization and flood control systems modified this region and impacted many of the wetland habitats.
3. **The *Inland Swamps* ecoregion** marks a transition, ranging from the fresh waters of the Southern Backswamps (73m) at the northern extent of the intratidal basins to the fresh, brackish, and saline waters of the deltaic marshes of Ecoregion 73o. Soils are mostly poorly or very poorly drained, clayey Entisols and Vertisols. Swamp forest communities are dominated by bald cypress and water tupelo, which are generally intolerant of brackish water except for short periods. In areas where freshwater flooding is more prolonged, the vegetative community is dominated by grasses, sedges, and rushes. This region contains one of the largest bottomland hardwood forest swamps in North America. Deposits include organic clays and peats up to 20 feet thick, and inter-bedded fresh- and brackish-water carbonaceous clays. The levees in place on either side of the Mississippi River have diverted much of the river flow from its natural tendency to flow into the Atchafalaya Basin. Large concrete structures prevent diversion into the Atchafalaya River, and flow from the Red River is controlled. While this helps control flooding, it has also modified the region and contributed to the loss of wetland habitat.
4. **The *Deltaic Coastal Marshes and Barrier Islands* ecoregion** is dominated by brackish and saline marshes. The region supports vegetation tolerant of brackish or saline water including saltmarsh cordgrass, marshhay cordgrass, black needlerush, and coastal saltgrass. Black mangrove occurs in a few areas, and some live oak is found on Grand Isle and along old natural levees. Extensive organic deposits lie mainly below sea level in permanently flooded settings resulting in the development of mucky surfaced Histosols. Sediments of silts, clays, and

peats contain large amounts of methane, oil, and hydrogen sulfide gas. Inorganic sediments found within the ecoregion are soft and have high water contents. They will shrink dramatically upon draining. The wetlands and marshes act as a buffer to help moderate flooding and tidal inundation during storm events. Lack of sediment input, delta erosion, land subsidence, and rising sea levels threaten the region.

5. **The *Lafayette Loess Plains* (34j) ecoregion** historically had coastal prairie natural vegetation mostly tallgrass grasslands with gallery forests along streams. Little bluestem, big bluestem, yellow Indiangrass, brownseed paspalum, and switchgrass were dominant grasses, in a mixture with hundreds of other herbaceous species across these prairies. Almost all of the coastal prairies have been converted to cropland, pasture, crawfish aquaculture, or urban land uses. Some loblolly pines, and historically "islands" of longleaf pine, occur in the northern part of the region. Soils comprise a cap with a loess veneer associated with the Mississippi Valley. Well to poorly drained Alfisols and Mollisols with silt loam surface textures developed on the late Pleistocene-age terraces.

1.1.2 Hydrologic Basins

The study area intersects five hydrologic basins: Bayou Teche, Vermilion, Atchafalaya, Terrebonne, and Lower Grand. Bayou Teche and Vermilion can be considered two sub-basins in the combined Teche-Vermilion system. The Atchafalaya and Teche-Vermilion basins contain the dominant hydrologic features while the western portions of the Lower Grand and Terrebonne basins are peripherally relevant (Figure 2). Further details about these basins are provided below.

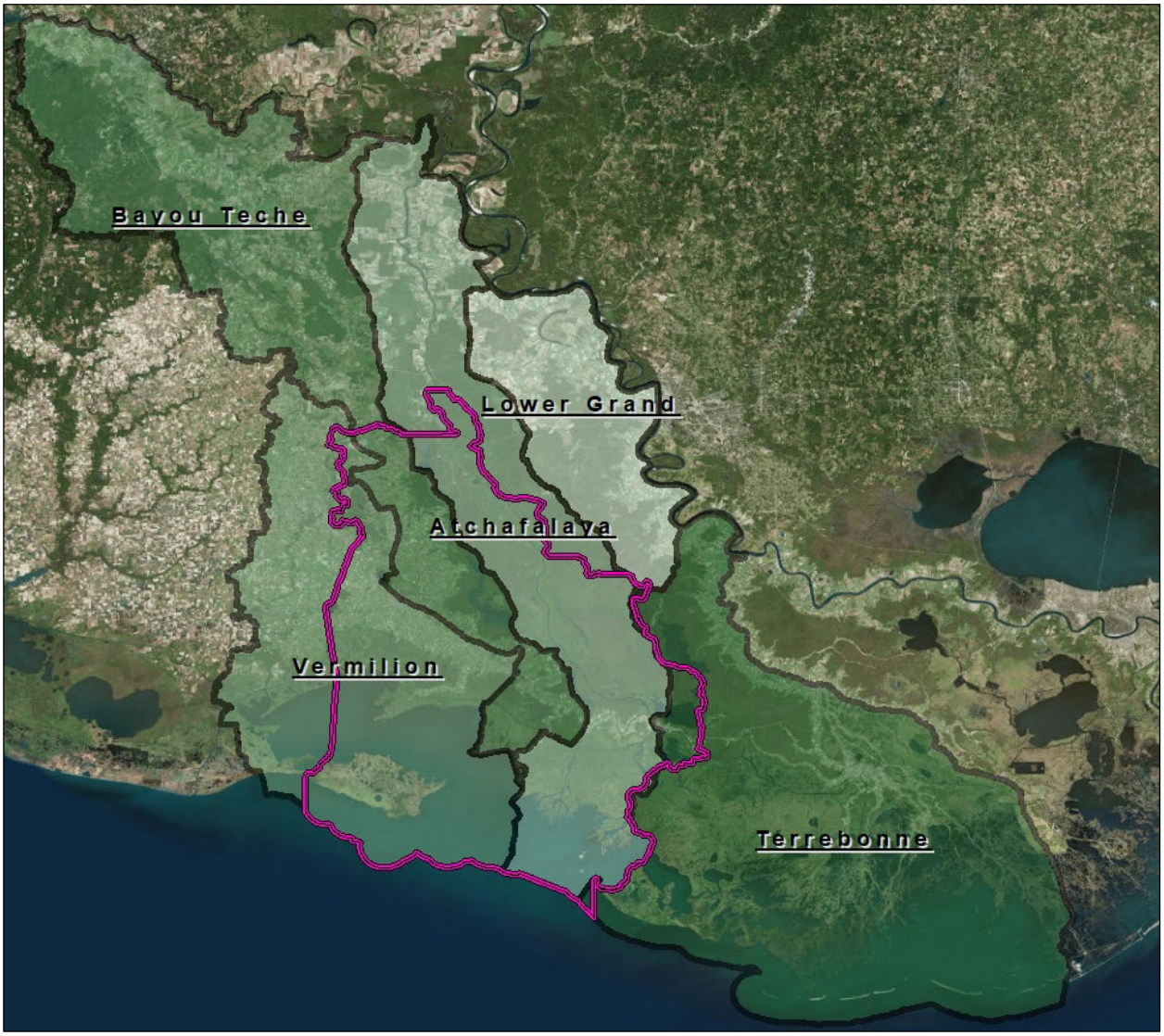

Figure 2. Schematic Delineating the Individual Basin Boundaries Overlaid with the Study Area

Teche-Vermilion Basin. The Teche-Vermilion Basin occupies over 50% of the study area. The Teche sub-basin has a drainage area of 2,200 square miles spanning from the west bank of the Red River to Cote Blanche Bay. Bayou Teche (125 miles long) begins in Port Barre and drains into the lower Atchafalaya. Since this is an ancient lobe of the Mississippi river, the banks are a natural ridge where many locals reside (Breaux Bridge, New Iberia, Franklin, etc.). Other inland features include Dauterive Lake and Lake Fausse Pointe, which are hydraulically connected to Bayou Teche via

the Loreauville Canal. The coastal boundary of this sub-basin includes the GIWW until the mouth Charenton Drainage and Navigation Canal. The Vermilion sub-basin has a total area of 2,100 square miles that includes the West Cote Blanche and Vermilion Bays, the Vermilion River, and Marsh Island. Much of the coastal area is made up of tidal wetlands transected by the GIWW. Unique to this sub-basin are exposed salt-dome deposits: Cote Blanche Island, Weeks Island, Avery Island, and partially Lake Peigneur.

Atchafalaya Basin. The Atchafalaya Basin contains the Atchafalaya River (137 miles long), a large freshwater feature that spans the entire study area (north to south). The basin begins at the Old River Control Structure located upstream of Simmesport and ultimately drains into the Gulf of Mexico. The Atchafalaya receives 30 percent of the longitudinal flow from the Mississippi river, as well as the entire Red River, averaging 225,000 cfs. The floodway, bordered by large Federal river levees, directs flow south towards the Atchafalaya Bay near Morgan City or via the Wax Lake outlet between Centerville and Calumet.

Terrebonne and Lower Grand. While the Terrebonne is a large basin, only the far western portion is considered in the authorization zone. The total area is 3,200 square miles and is made up of mainly tidal wetlands. These range from fresh near Bayou Lafourche to oligohaline towards the GOM. The Lower Grand basin is contained between the east Atchafalaya levees and the west bank Mississippi levees. The main channels in this basin are the Port Allen Lock waterway and the Avoca Island cutoff. Much of the upper basin is alluvial and heavily used for agriculture. The main hydrologic contribution of this area is as a catchment area for rainfall.

1.1.3 Storm Surge and Hurricane Events

Figure 3 shows the Storm Surge for the 25 year and 50 year Storm Events at Critical Infrastructure Locations.

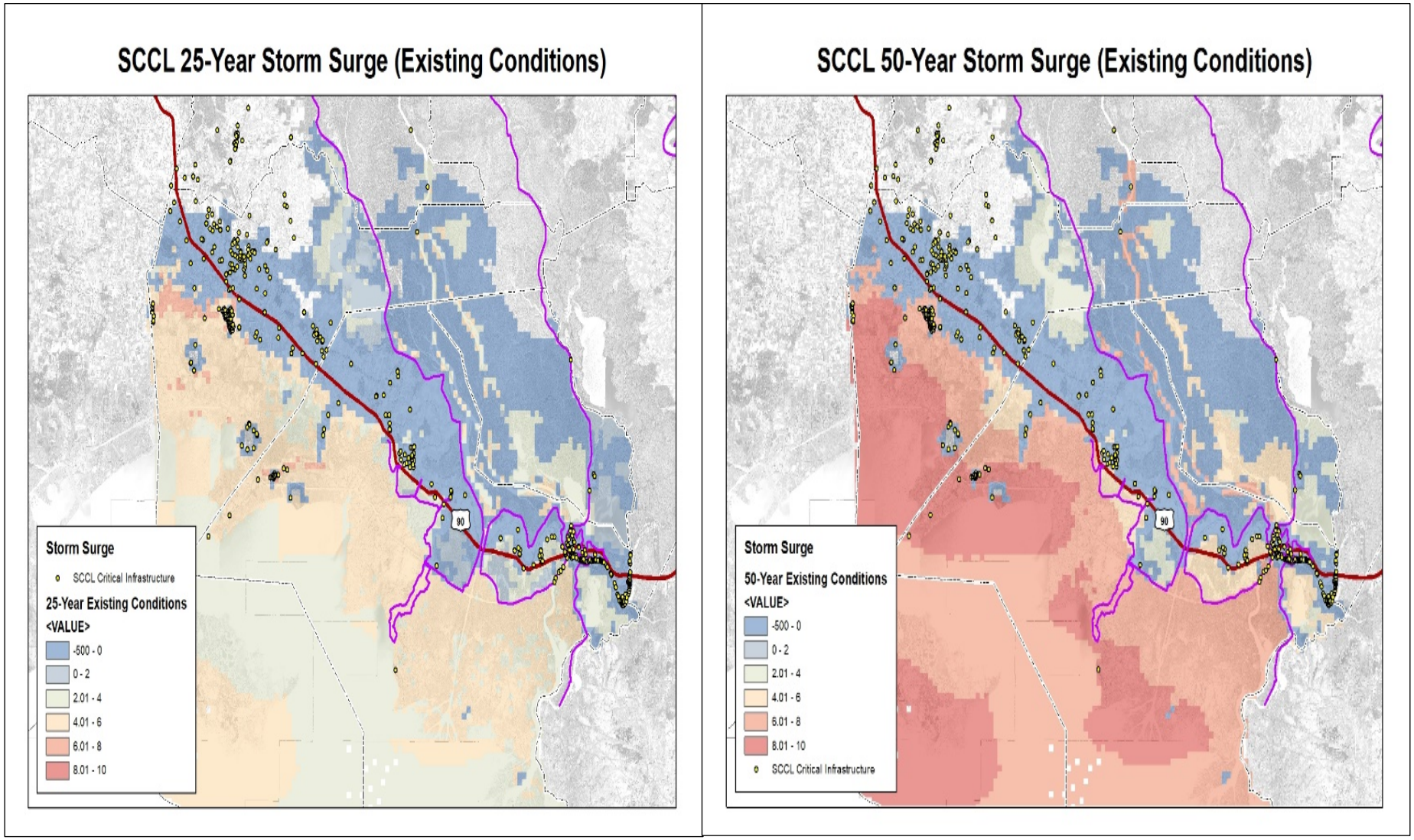

Figure 3. Storm Surge for the 25 Year and 50 Year Storm Surge Events at Critical Infrastructure Locations

1.1.4 Storms of Record

Hurricane Audrey (June 24-29 1957) was one of the deadliest tropical cyclones in U.S. history, as well as the strongest June hurricane ever recorded in the Atlantic basin, tied with Hurricane Alex in 2010. The rapidly developing storm struck southwestern Louisiana as a powerful Category 3 hurricane, destroying coastal communities with a powerful storm surge that penetrated as far as 20 mi (32 km) inland. Audrey caused $147 million in damages and resulted in at least 431 fatalities.

Hurricane Lili (September 23 - October 3, 2002) was originally a Category 4 hurricane and first made landfall near Marsh Island in Iberia Parish with maximum sustained winds of 92 mph. Highest recorded rainfall amount was about 9 inches in some parts of Louisiana. The highest storm surge was over 11 feet in St. Mary Parish (source: https://coast.noaa.gov/hes/docs/postStorm/Lili_%20final.pdf; accessed December 15, 2015).

Hurricane Rita (September 24 - 26, 2005) reaching its peak intensity southeast of the mouth of the Mississippi River as a Category 5, first made landfall just west of Johnson's Bayou and east of Sabine Pass at the Texas-Louisiana border as a Category 3 hurricane. Sensors recorded storm-surge water levels over 14 ft above NAVD 88 at Constance Beach (LC11), Creole (LA12), and Grand Chenier (LA11), La., about 20 miles, 48 miles, and 54 miles, respectively, east of Sabine Pass, Texas. In general, storm-surge water levels increased eastward from the Sabine River into southwest Louisiana. The magnitude of the storm surge was greatest near the coast and decreased inland through the approximate latitude of I-10, about 35 miles inland from the coast (source: http://pubs.usgs.gov/circ/1306/pdf/c1306_ch7_j.pdf; accessed December 15, 2015).

Hurricane Gustav (August 25 - September 4, 2008) made landfall near Cocodrie, Louisiana on September 1, 2008 as a strong category 2 (based on 110 mph sustained winds) and continued to move northwest, spreading hurricane force wind gusts across portions of Southeast and South Central Louisiana (http://www.srh.noaa.gov/lix/?n=gustavsummary; accessed January 26, 2016). Due to the storm-making landfall east of the study area, storm surge values were only 4-5 feet across St. Mary, Iberia, and Vermilion parishes (http://www.srh.noaa.gov/images/lch/tropical/HPW1-SUN.pdf; accessed January 26, 2016).

Hurricane Ike (September 1-14, 2008) first made landfall near Galveston, Texas on September 13, 2008 as a Category 2 hurricane with maximum sustained winds of 110 mph (http://www.srh.noaa.gov/hgx/?n=projects_ike08; accessed December 15, 2015). Ike was a large hurricane with tropical-storm-force and hurricane-force winds associated at the time of its landfall extending approximately 275 miles and 120 miles from the storm center, respectively. In Louisiana, estimated wind speeds ranged from 80 mph near the Texas-Louisiana border to 50 mph in Vermilion Parish. Storm surge caused flooding in Cameron, Vermilion, and many parishes to the east, with over 9-foot stillwater levels estimated for Lake Charles (http://www.fema.gov/media-library-data/20130726-1648-20490-1790/757_ch1_final.pdf; accessed December 15, 2015).

Hurricane Barry (July 4, 2019) was an unusually asymmetrical tropical cyclone that made landfall in Louisiana in July 2019, causing $600 million in damages. Barry was also the fourth recorded storm to make landfall at hurricane strength on the state of Louisiana in the month of July. Barry made landfall on Marsh Island and Intracoastal City, Louisiana as a Category 1 hurricane, subsequently weakening to tropical storm status. While Barry was in its formative stages, it dropped 6 to 9 in (150 to 230 mm) of rainfall across the New Orleans area, causing flooding. An expansive thunderstorm inundated streets and businesses over a six-hour period on the morning of July 10.

1.1.5 Floodplain Terminology Definitions

Flood Insurance Rate Map Zones (FIRM) are depicted in the floodplain terminology Table 1.

Terms	Measured Flood Event	Common Name	FIRM Zones
HIGH RISK AREAS Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these zones.	1% chance flood	100-year flood	Zone A
The base floodplain where base flood elevations are provided. AE Zones are now used on new format FIRMs instead of A1-A30 Zones.	0.2% chance flood	500-year flood	Zone AE
HIGH RISK COASTAL AREAS Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.			Zone VE
Areas with a 1% annual chance of shallow flooding, usually in the form of a pond, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.			Zone AH
River or stream flood hazard areas, and areas with a 1% or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Average flood depths derived from detailed analyses are shown within these zones.			Zone AO

Figure 4 shows the floodplain mapping for each of the three parishes.

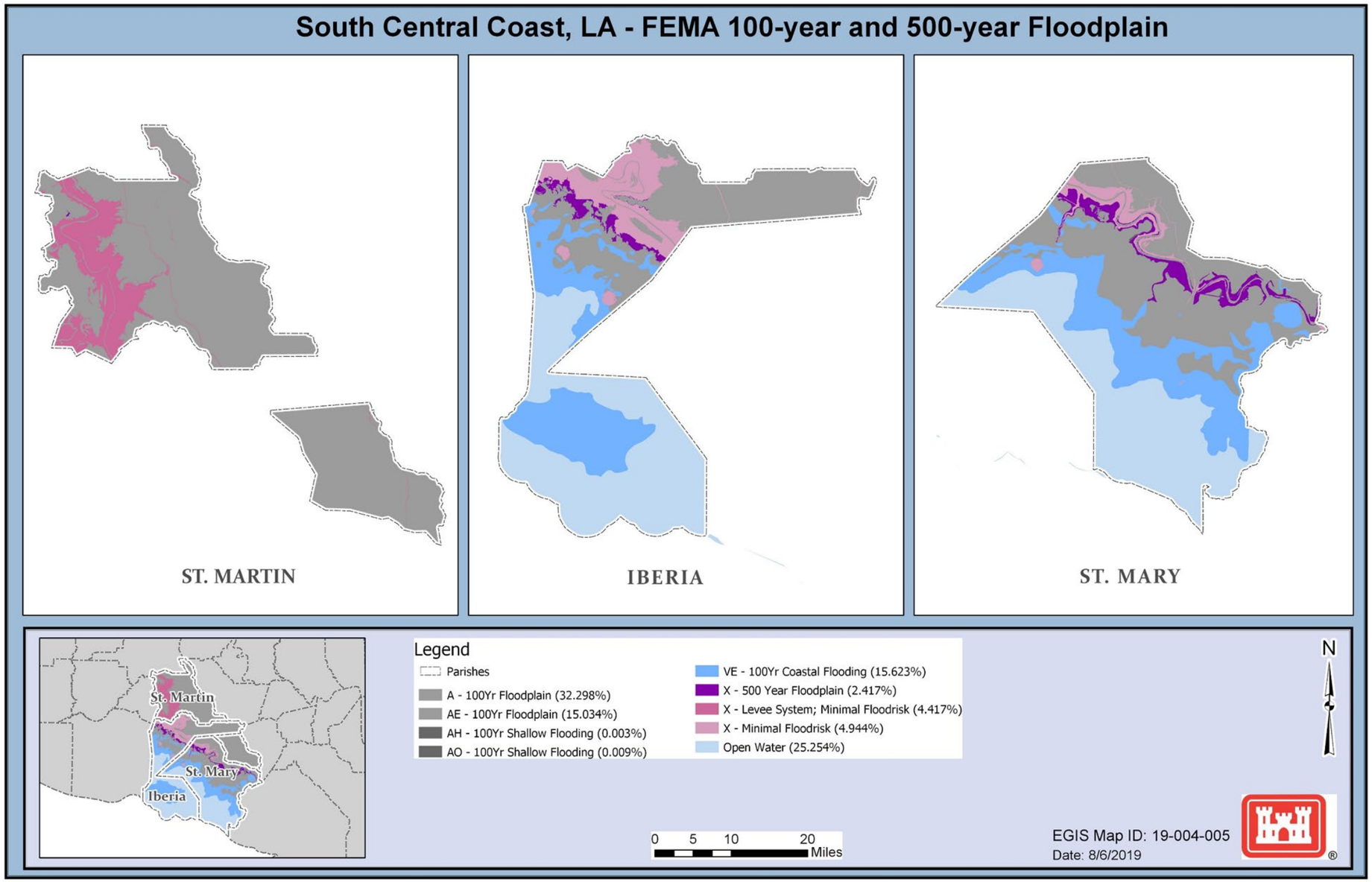

Figure 4. South Central Coast, LA – FEMA 100-year and 500-year Floodplains

1.1.6 Land Use and Land Use Plans

Figure 5 shows the land cover classification for the study area.

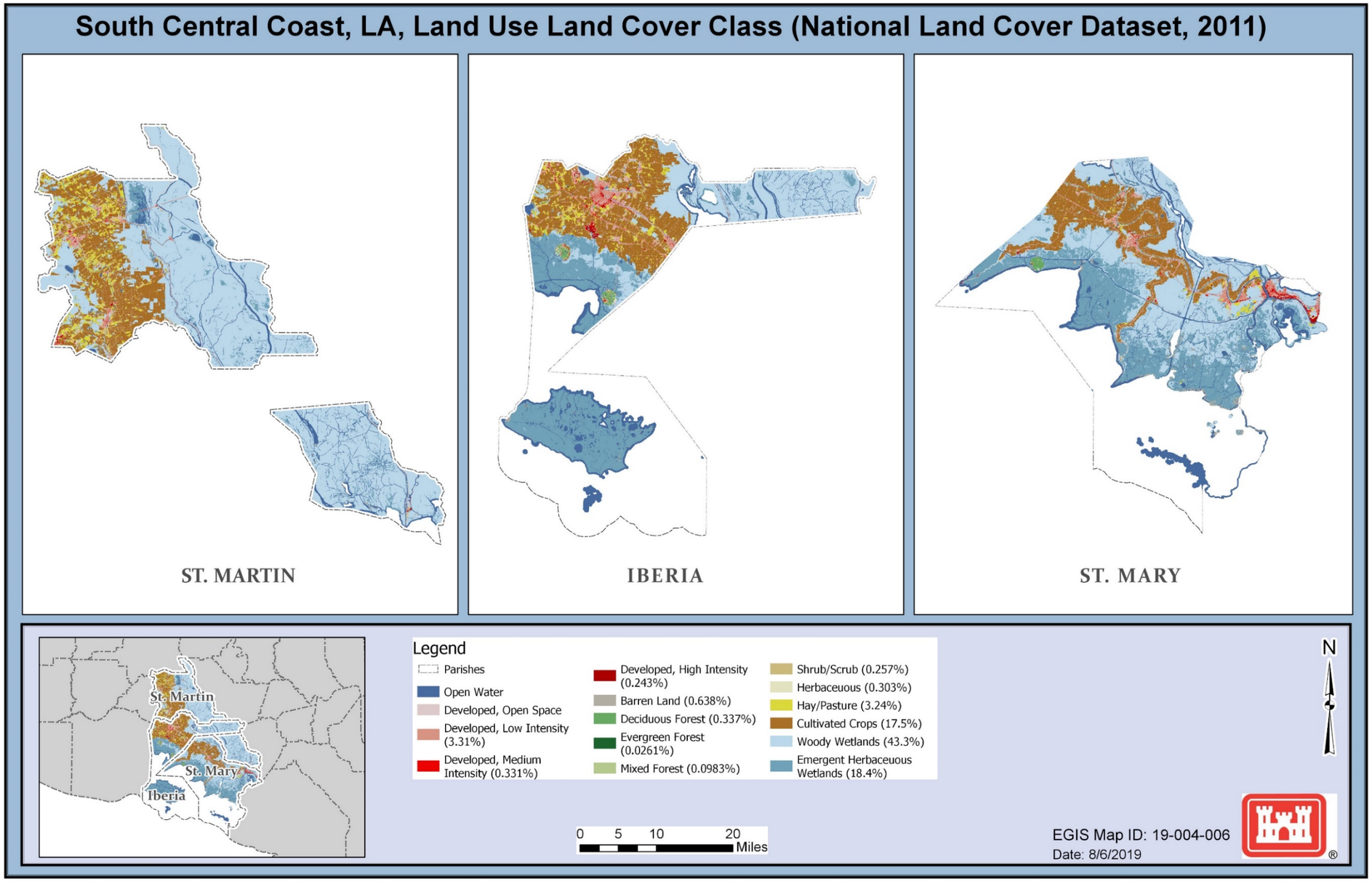

Figure 5. South Central Coast, LA, Land Use Land Cover Class (National Land Cover Dataset, 2011)

1.1.7 Land Use Plans and Emergency Operation Plans For Each Parish

Table 2. Master Plans In The Study Area

Title	Owner	Date	Purpose
Louisiana's Comprehensive Master Plan	Coastal Protection and Restoration Authority of Louisiana.	2017	Following Hurricanes Katrina and Rita in 2005, the Louisiana Legislature created the CPRAB and tasked it with coordinating the local, state, and Federal efforts to achieve comprehensive coastal protection and restoration. To accomplish these goals, CPRAB was charged with developing a master plan to guide our work toward a sustainable coast.
Breaux Bridge Comprehensive Long-Range Resiliency Plan	Breaux Bridge, LA	2012	A plan to use infill development in targeted areas to manage growth and ensure long-term resilience
Restoring the Mississippi River Delta	Restore the Mississippi River Delta	2018	Recommendations for Coastal Restoration Projects and Programs in Louisiana
Iberia Parish Hurricane Protection Master Plan	Iberia Parish	2012	Comprehensive plan to provide protection from flooding, saltwater intrusion, tidal and storm surges associated with tropical storms and hurricanes for the lands and residents of Iberia parish.
St. Mary Levee District Master Plan	St. Mary Parish	2010	The Plan identifies parish hurricane protection, backwater flooding, and related needs such as saltwater intrusion.

Iberia Parish Emergency Management Plan

2019 Emergency Operations Plan (http://iberiaparishgovernment.com/forms/dept-911-EOP.pdf)

Iberia Parish has an emergency management plan that aims to reduce the loss of life, suffering, and property damage from emergencies and/or disasters. All federal and state regulations, authorities, and other directives have been taken into account when creating the emergency operations plan (EOP). The EOP is intended to be broad enough to cover any disaster while also maintaining specific instructions for each individual disaster possibility.

Of note, the following possible disasters with accompanying probability, risks, and priorities are listed:

Table 3 *Iberia Parish Storm Risk Matrix*

Hazard	Probability	Risks	Priority
Flood & Storm Surge	Highly Likely	Lives, Property, Utilities, Etc	High
Hurricanes, Tropical Weather	Likely	Lives, Property, Comm, Etc	High
Severe Weather	Highly Likely	Lives, Property, Etc	High
Levee Failure	Possible	Lives, Property, Etc	High

Iberia Parish states three levels of evacuation; Shelter in place, Recommended Evacuation, and Mandatory Evacuation. To shelter in place means that it is recommended one hunker down in their own residence, place of work/business, or if outside to find a safe structure to hold up in for a period of hours to days. When a moderate risk is present to citizens, Iberia Parish may declare a recommended evacuation. The Iberia Parish government will describe the areas affected and include the location of shelters. In the event of a Mandatory Evacuation, the same procedures for the Recommended Evacuation will occur, in addition to transportation being provided to shelters if resources are available.

Communications during an emergency are varied and range from the use of the state of Louisiana standard 700 MHz interoperable radio system to several methods of public alert notifications distributed by means of local media, social media, OnSolve, and IPAWS. In the event that Iberia Parish 911 is disconnected, all incoming calls will be transferred to St. Marin Parish 911 center.

During the recovery and restoration phase, emergency management response activities will continue as long as they are needed. As soon as possible after an emergency or disaster, all agencies involved will conduct damage assessment activities. Damage assessments will be used to define the need for resources and strategies needed for recovery. The Disaster Recover Manual will be used to guide all damage assessment, analysis, documentation and report of damages. The OHSEP Director will work with local and Parish government agencies, private individuals and organizations in all recovery and restoration efforts.

St. Martin Parish Emergency Management

Emergency Operations website (http://www.stmartinohsep.org/) and 2009 St. Martin Storm Survival Guide (http://www.stmartinohsep.org/uploads/TRAC_ST_MARTIN_FINAL.pdf)

The mission of the St. Martin Parish Office of Homeland Security and Emergency Preparedness is listed as to coordinate response to natural and man-made disasters, including acts of terrorism; to plan and prepare responsible programs for the protection of life and property; to direct, mobilize, coordinate, and determine utilization of resources; and to coordinate and direct restoration and recovery operations in the disaster area.

St. Martin Parish is determined to be a “High Risk” Parish and as such is not suitable for sheltering. When disaster conditions present themselves, shelters will not be opened to the public. Emergency management will arrange for the public announcement of emergency shelters according to any potential threats. St. Martin Parish follows the plan established by the Louisiana Shelter Task Force and works in conjunction with the Acadiana Chapter of the American Red Cross.

If in need of an evacuation, St. Martin recommends having an emergency car kit, travel kit, and to leave your place of residence as early as possible. Evacuation plans are set forth with predetermined routes and Emergency Shelter Information Points along these routes are listed within the Storm Survival Guide.

St. Martin utilizes the Emergency Alert System (EAS) on all licensed broadcast stations in order to best disseminate information to the public immediately before, during, and after an emergency has occurred. The EAS radio stations will provide information on weather reports, road conditions, shelter locations, and re-entry information. As the storm comes closer to landfall, information will be distributed every 2 hours.

St. Mary Parish Emergency Management

Emergency operations website (http://stmaryohsep.org) and State of Louisiana Emergency Preparedness Guide (http://gohsep.la.gov/Portals/0/Documents/Prevent/2016EmergencyGuide_English.pdf)

The mission of the St. Mary Parish Government Office of Emergency Management is to maintain the highest possible level of preparedness to protect the lives and property of the citizens of St. Mary Parish before, during and after a natural or manmade disaster. St. Mary Parish Government Office of Emergency Preparedness works with all emergency responders, public and private agencies, business communities and volunteer organizations to meet this mission.

St. Mary Parish Hurricane Guides are located in the lobby of the St. Mary Parish Courthouse Building. St. Mary Parish will open shelters for storms up to Category 2 strength. Any storm that is Category 3 or great and St. Mary Parish will close all shelters and encourage its residents to evacuate.

When a local evacuation order is called, parish officials, will notify residents primarily using local media and the Emergency Alert System (EAS). All emergency information, including shelter openings, evacuation routes, and weather conditions will be given through the media. In case of an evacuation order St. Mary has the following pick-up points listed

Morgan City Jr. High
(985-384-5922)
(29'4218.93N / 91'1212.06W)
911 Marguerite St.
Morgan City, LA

Franklin Senior High
(337-828-0143)
(29'4815.91N / 91'3002.80W)
1401 Cynthia St.
Franklin, LA

1.1.8 State Wildlife Management Areas and Federal Wildlife Refuges

Atchafalaya Delta Wildlife Management Area. Located at the mouths of the Atchafalaya River and the Wax Lake Outlet, Atchafalaya Delta WMA mostly consists of open water in Atchafalaya Bay. Within the bay, two deltas (Main Delta and Wax Lake Delta) have formed from the accretion of sediments from the Atchafalaya River and from dredged material deposited by the U.S. Army Corps of Engineers. Main Delta has about 15,000 acres of marsh and scrubby habitat; Wax Lake Delta has about 12,000 acres of marsh.

Attakapas Island Wildlife Management Area. The state acquired Attakapas Island WMA in 1976. The U.S. Army Corps of Engineers also owns several tracts of land, including Shatters Bayou, which are managed as part of this WMA.

The WMA's terrain is characterized by flat swampland subject to periodic flooding and silt from the Atchafalaya River. Areas adjacent to the river and spoil banks from dredging activities provide upland habitat and refuge areas during periods of high

water. Many areas within the WMA have silted in; siltation will continue to increase the land-to-water ratio.

Marsh Island Wildlife Refuge. The Marsh Island Wildlife Refuge, operated by the LDWF, is located at the edge of the Gulf of Mexico, in Iberia Parish. Marsh Island Wildlife Refuge is located between Vermilion Bay and the Gulf of Mexico. When originally deeded to the state in 1920 by Mrs. Margaret Sage, the island was 76,664 acres. Today, however, Marsh Island is closer to 71,000 acres, primarily due to erosion and past storm damage. Marsh Island currently measures approximately 20 miles east to west and 11 miles north to south. Habitat on this refuge is mainly brackish to intermediate marsh and flat, with very few remaining trees.

Marsh Island is an extremely important refuge as it supports a wide array of animal species throughout the year. The island serves as crucial wintering habitat to numerous waterfowl, wading and shorebirds, and birds of prey. This refuge also serves as essential habitat for commercially important fish species, as well as alligators and furbearers. In the Vermilion Bay area, much of the recreational and commercial harvests of shrimp and blue crab depend on the nursery habitats provided by Marsh Island.

Cypremort Point State Park. Between Grand Isle and Cameron, Cypremort Point is one of the very few locations near the Gulf of Mexico that can be reached by car. The LDNR manages the park which is located in both Iberia and St Mary Parishes. A half-mile stretch of a man-made beach provides a delightful area for relaxing, picnicking and enjoying the water in this 185-acre park. It also affords an opportunity for fishing, crabbing, water skiing, windsurfing and, of course, sailing.

In addition to excellent sailing and swimming facilities, the park also holds a special attraction for nature enthusiasts. Located in the heart of a Louisiana marsh, the site contains an abundance of wildlife. The quiet observer may happen upon nutria, muskrat, alligator or a number of bird species native to the state. Deer, black bear, rabbits, opossum and red fox also make their home in this area

***Marsh Island/Rainey Unit LA-05P*.** The study area has one Coastal Barrier Resources Act (CBRA) unit, the John H. Chafee Coastal Barrier Resources System Marsh Island/Rainey Unit LA-05P. The CBRA of 1982 and subsequent amendments designated relatively undeveloped coastal barriers along the Atlantic, Gulf of Mexico, Great Lakes, U.S. Virgin Islands, and Puerto Rico coasts as part of the John H. Chafee Coastal Barrier Resources System (CBRS), and made these areas ineligible for most new Federal expenditures and financial assistance. The CBRA encourages the conservation of hurricane prone, biologically rich coastal barriers by restricting Federal

expenditures that encourage development, such as Federal flood insurance. Areas within the CBRS can be developed if private developers or other non-Federal parties bear the full cost. The USFWS administers the CBRA program.

This area is located on the west end of Marsh Island, Iberia Parish. The seaward side of the CBRS unit includes the entire sand-sharing system, including the beach and nearshore area. The sand-sharing system of coastal barriers is normally defined by the 30-ft bathymetric contour. In large coastal embayments and the Great Lakes, the sand-sharing system is defined by the 20-ft bathymetric contour or a line approximately 1 mile seaward of the shoreline, whichever is nearer the coastal barrier.

Bayou Teche National Wildlife Refuge. The Bayou Teche NWR is located within St. Mary Parish. Bayou Teche NWR is a 9,028-acre refuge situated along and on either side of Bayou Teche, an ancient channel of the Mississippi River. The refuge consists of 6 non-contiguous management units, ranging in size from 81 acres to 3,619 acres.

The Refuge consists mostly of back-swamp land located off the natural levees of the bayou. Habitats on the refuge include bottomland hardwood forests, cypress-tupelo swamps, bayous, and freshwater marshes. The Refuge's primary objective is to restore and manage bottomland hardwood forests, cypress-tupelo swamps, and marshes in order to provide high quality and diverse habitat to support the Louisiana black bear.

Shell Keys National Wildlife Refuge. Shell Keys was established by Executive Order on July 9, 1855, as a lighthouse reservation and subsequently as Shell Keys Reservation, and a breeding ground for native birds as established by Executive Order 682 on August 17, 1907. Shell Keys NWR is one of the oldest refuges in the Refuge System. Its boundary was and still is rather loosely described as "...a small group of unsurveyed islets located in the Gulf of Mexico about three and one-half miles south of Marsh Island, Louisiana..."

For a number of years, there has only been one islet at the location. This islet is composed almost entirely of shell fragments. It is extremely dynamic and builds or recedes with passing storms. Vegetation is almost entirely lacking.

Shell Keys NWR is managed as part of the Southwest Louisiana NWR Complex

1.1.9 AQUATIC RESOURCES AND WETLANDS

Gulf Coastal Shorelines

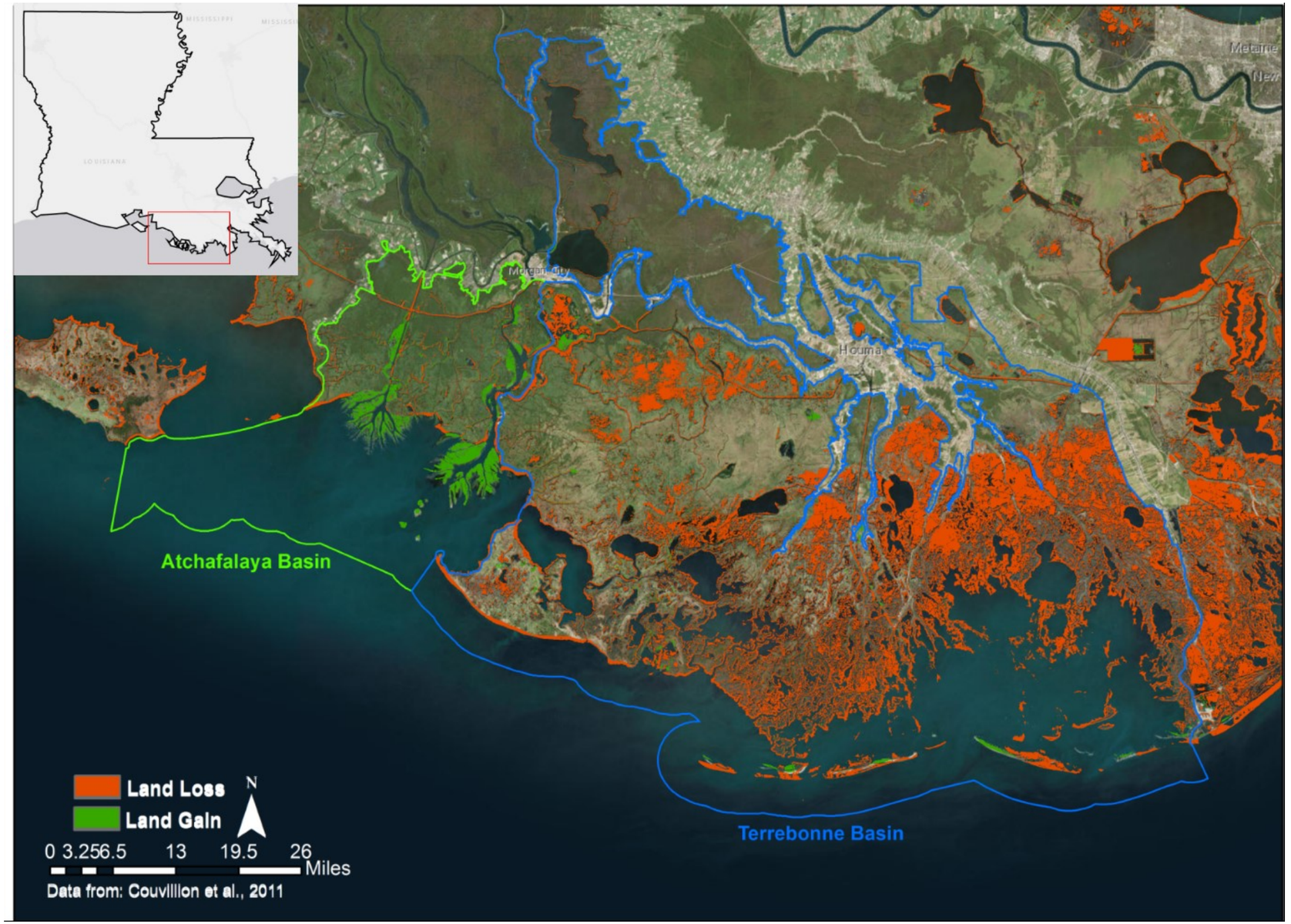

Figure 9. Gulf Shore and Land Area Change in Coastal Louisiana (Photo courtesy of USGS)

1.1.10 Vegetation and Estuary Resources. **The study area consists of open water ponds and lakes, Gulf shorelines, and freshwater, intermediate, brackish, and saline marsh (Figures 10 and 11)**

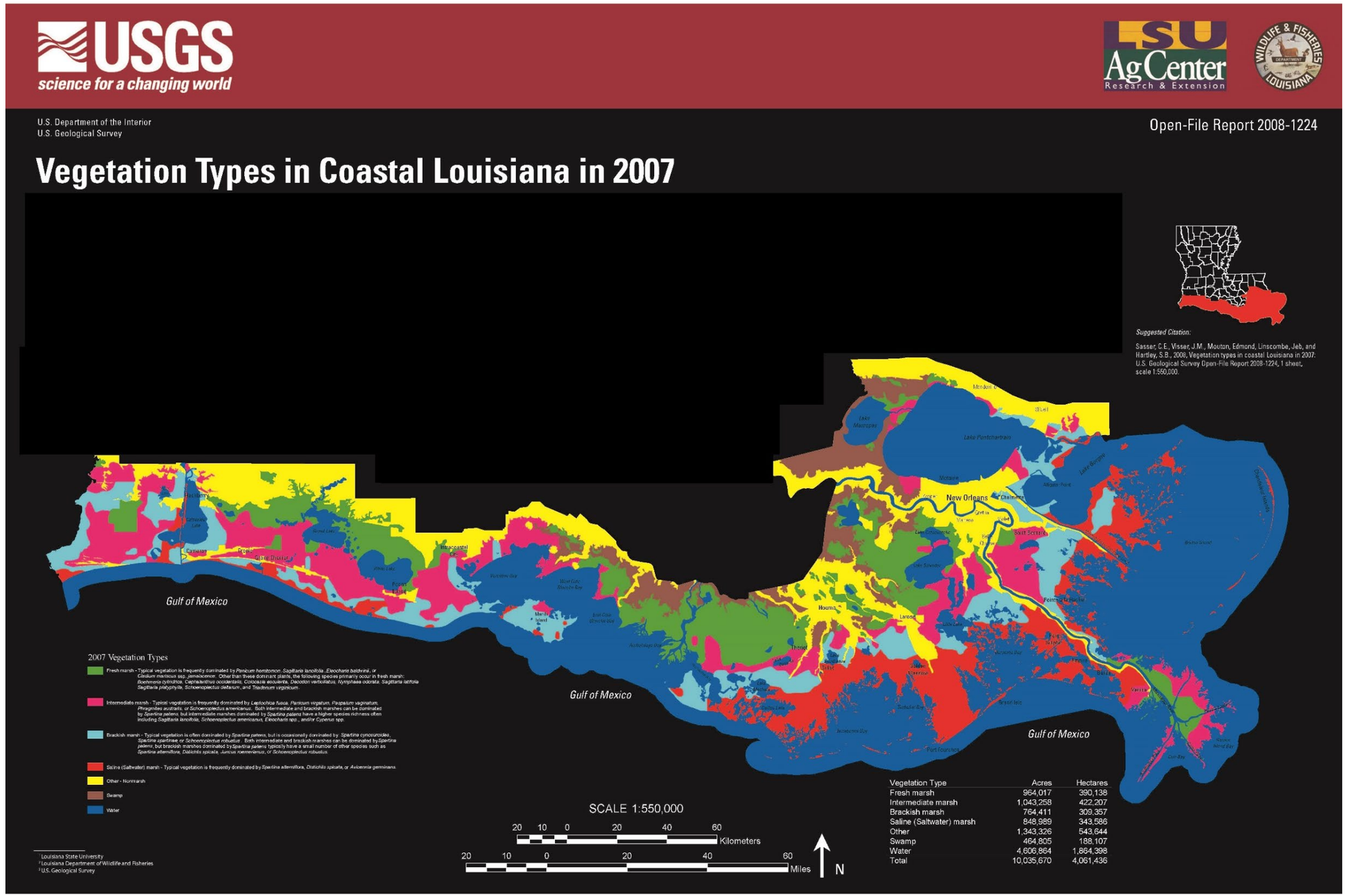

Figure 10. Vegetation Types on Coastal Louisiana in 2007

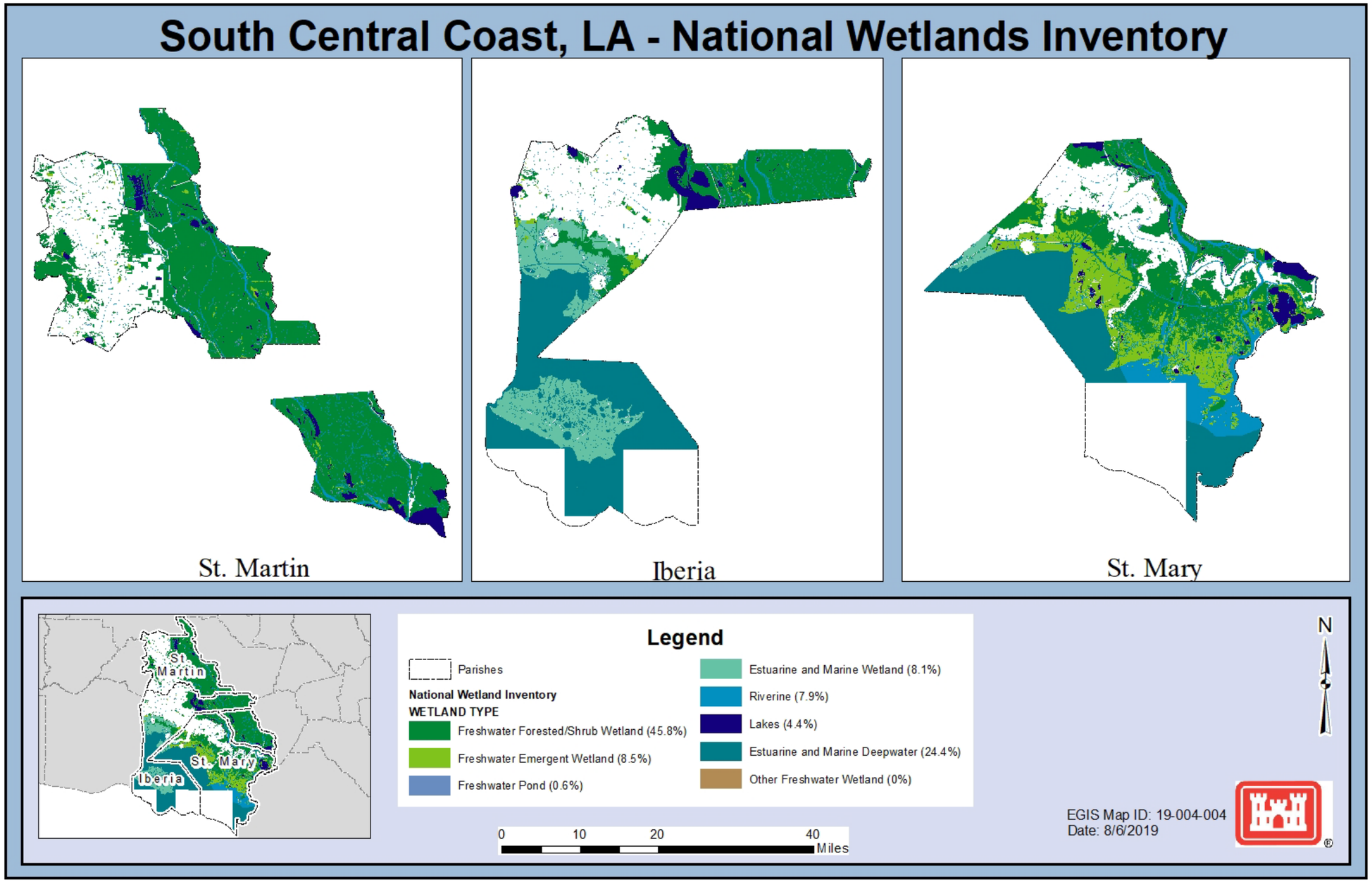

Figure 11. South Central Coast, LA, National Wetlands Inventory

1.1.11 Wetland Loss

The processes of wetland loss can result from the gradual decline of marsh vegetation due to inundation and saltwater intrusion, as well as from storm surge events, both of which can eventually lead to complete loss of marsh vegetation. As marsh vegetation is lost, underlying soils are more susceptible to erosion and are typically lost as well, leading to deeper water and precluding marsh regeneration. Significant accretion of sediments is then required in order for marsh habitat to reestablish.

Perhaps the most serious and complex problem in the study area is the rate of land and habitat loss. Coastal Louisiana wetlands are one of the most critically threatened environments in the United States. These wetlands are in peril because Louisiana currently experiences greater coastal wetland loss than all other States in the contiguous United States combined (Couvillion, et al., 2017). The Louisiana coastal plain accounts for 90 percent of the total coastal marsh loss in the nation (USACE 2004). Couvillion et al. (2011) analyses shows coastal Louisiana has undergone a net change in land area of about -1,883 square miles from 1932 to 2010. Trend analyses from 1985 to 2010 show a wetland loss rate of about 16.57 square miles per year.

Marsh Island is an important hydrologic feature because it separates Vermilion Bay and West Cote Branch Bay from saltier water in the Gulf of Mexico. Therefore, marshes in this basin are primarily fresh, intermediate, and brackish with relatively few salt marshes. The Vermilion Basin lost 42,293 acres (14.8 percent) of marsh since 1932, nearly half of which was lost between 1951 and 1974, which is a relatively low rate compared to rates in other basins. Marsh loss is relatively slow because the basin is in the later stages of the delta lobe cycle; the more delicate wetlands deteriorated centuries ago. In fact, the delta lobe cycle has proceeded to the point the basin should be experiencing rapid wetland creation in association with the emerging Atchafalaya River delta, but wetlands are not being built at maximum rates because the flow of fresh water and sediments down the Atchafalaya River is controlled at the Old River Control Structure. Fresh water and sediments from the Atchafalaya River benefit the basin nonetheless. Furthermore, numerous live and relic oyster reefs southeast of Marsh Island buffer water exchange between the big bays and the Gulf of Mexico, which also contributes stability.

Although the basin is geologically stable and benefits from the emerging Atchafalaya River delta, the dredging of navigation and petroleum access canals and the construction of spoil banks and levees have altered geomorphologic and hydrologic conditions. The effects of these alterations vary greatly from place to place, but generally they have created artificial barriers between wetlands and wetland maintenance processes, or removed natural barriers between wetlands and wetland

decay processes. Interior marshes, traditionally maintained by annual flooding with fresh water in the spring, may deteriorate when exposed to increasing marine conditions, particularly in marshes where the soils have low mineral content. However, marshes near the Gulf of Mexico benefit from linkage with the gulf because winter storms deliver sediments to those marshes. Many landowners have responded to changing conditions caused by large-scale alterations by managing hydrologic conditions on a small scale using marsh management techniques. It is possible some of these management efforts may not preserve marsh, particularly older ones. However, marsh management is an actively evolving field.

Some wetland loss might also be related to livestock grazing. Moderate grazing alone is not believed to cause wetland loss, but it may be the "final straw" in marshes experiencing additional stresses such as flooding or saltwater intrusion.

Most wetland loss in the basin occurs either as shoreline erosion or in isolated hot spots. Areas are classified as hot spots when they experience rapid loss relative to other marshes within this basin. Hot spots in this basin are smaller than in other basins; they presumably originate from hydrologic changes altering the balance between the marsh maintenance and deterioration processes, but the specific causes vary from place to place. Canals and spoil banks have impounded some areas and increased tidal energy in other areas. Thus, some areas have become isolated from sediment input, whereas water exchange removes more sediments than are introduced in other areas. Inadvertent impoundment also causes some areas to flood excessively.

Shoreline erosion on the large bays is caused primarily by natural wave energy. Wave energy has gradually increased over the centuries because the bays are naturally getting deeper due to the very slight but constant subsidence and global sea-level rise. Wave energy is also believed to have been increased because humans reduced the size of the oyster reefs between Marsh Island and Point Au Fer that shielded the large bays from wave and tidal energy in the Gulf of Mexico.

Shoreline erosion can dramatically affect wetland loss when it causes relatively isolated marsh drainage systems to become hydraulically connected with dynamic water bodies such as navigation canals and the large bays. In other areas, shoreline erosion is particularly rapid and causes the direct loss of significant wetland acreage. These may be classified as hot spots of erosion. Erosion caused by boat wakes and water surges associated with the passage of large vessels also causes wetland loss along the GIWW and other navigation canals.

The effects of recent hurricanes have accelerated marsh loss. Table 4 includes estimates of wetland loss attributed to the major hurricanes of 2004 to 2008 in the

throughout coastal Louisiana. It is expected the land loss with intermediate and brackish marshes experiencing the most land loss, while saline marshes were less impacted and fresh marshes showed evidence of vegetation seasonality change and regrowth, which concealed the hurricane impacts.

Table 4. Wetland Loss Estimates In Acres (Km^2) Following Hurricanes Katrina And Rita (2005) And Gustav And Ike (2008) By Geographic Province (Barras, 2009)

Period	Storms	Chenier Plain	Marginal Delta Plain	Delta Plain	Coastal Louisiana
2004-	Katrina and	-72,154 (-	-642 (-2.6)	-56,834 (-	-129,730 (-
2006-	Gustav and	-34,347 (-	-14,579 (-	-30,641 (-	-79,815 (-323)
2004-	All storms	-106,750 (-	-15,320 (-	-87,475 (-	-209,545 (-

Table 5. Predicted Acreage Loss of Different Wetland Types in Study Area

Region	Fresh Marsh Acres in 1990	Intermediate Marsh Acres in 1990	Brackish Marsh Acres in 1990	Saline Marsh Acres in 1990	Total Marsh Acres in 1990	Swamp Acres in 1990	Fresh Marsh Lost by 2050	Intermediate Marsh Lost by 2050
N. Wax Lake	2,770	0	0	0	2,770	2,340	460	0
Wax Lake Wetlands	43,61	0	0	0	43,610	10,255	5,860	0
Atchafalaya Bay	2430	0	0	0	2430	0	Gain	0
Atchafalaya Total	48,810	0	0	0	48,810	12,595	Gain	0
TECHE/VERMILION BASIN								
Cote Blanche	43,470	2,690	0	0	46,160	12,430	510	250
Vermilion Bay	6,610	29,970	36,660	0	73,240	5,960	0	3,950
Marsh Island	0	0	49,390	7,080	56,470	0	0	0
Rainey Marsh	245	7,770	47,990	2,410	58,415	0	0	780
Teche/Vermilion	50,325	40,430	134,040	9,490	234,285	18,390	510	4,980
Region 3 Total	298,330	92,680	240,750	140,155	771,915	183,384	5,975	23,590

Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority, 1999

1.1.12 FISH AND WILDLIFE RESOURCES

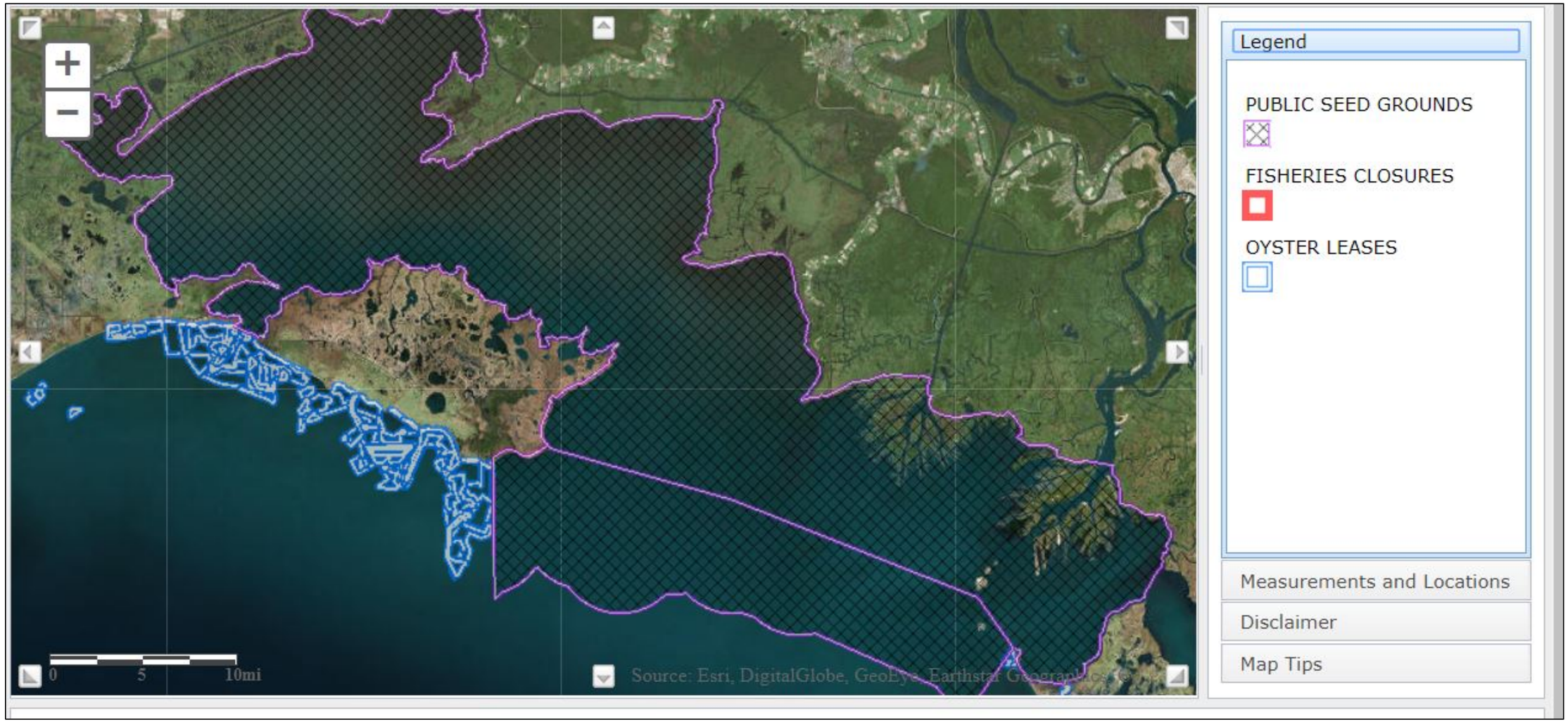

Figure 12. Oyster Lease, Seed Grounds, and Cultch Plant Maps (LDWF, 2018)

1.1.13 Environmental Risk Management

The District is managing the risk register, including uncertainty on the Institute for Water Resources- APT website: https://iwr-apt.planusace.us/. The District identified project risk associated with the project life cycle. Thirty-nine risks have been identified—thirty eight risk associated with the TSP milestone. Of these, there are thirteen environmental planning risks identified beyond what was described in the Main report, Section 6. Table 6 also describes the status of each risk.

Table 6. Environmental planning risks associated with the South Central Coast Louisiana Project

Milestone	Discipline	Scoping Choice or Event	Risk and Cause	Risk Rating	Resolution
Project Initiation	Environmental	Coordination with resource agencies may take additional time and delay meeting milestone schedules	The resource agencies (state and federal) are stretched thin with demanding workloads. Given their workloads and priorities, they may not be able to participate or reply back to the PDT with quality information and timely coordination.	H	Continual coordination with the resource agencies helped them stay on top of their responsibilities. They provided the PDT all necessary coordination on time and with high quality. No additional resolution is needed at this time.
Project Initiation	Environmental	Pre-NOI scoping and data gathering was not effective in collecting the right information or soliciting information from enough or the right stakeholders. Did the PDT identify the correct features/alternatives for the Alternatives Milestone during these meetings?	Due to such a short timeline to gather data, the PDT announced stakeholder and public meetings 2 weeks in advance. The meeting announcements were published in the paper and emails were sent to over 40 stakeholders. Lower than expect turnout occurred at each meeting.	L	The PDT conducted additional meetings after the Alternatives Milestone during the Scoping period. These meetings were well attended and well received from the public. No additional resolution needed is at this time.
PED Construction	Cultural Resources	For compliance with Section 106 of the National Historic Preservation Act (NHPA), as amended	At the feasibility study phase there may not be sufficient funding/time to complete the required Archaeological/Architectural/Historical surveys, consultation, and resolution of Adverse Effects. As an alternative to the standard Section 106	H	This risk remains applicable: To mitigate this risk the PDT is actively engaged in

		(54 U.S.C. § 300101 et seq.), this study will require the negotiation of a Section 106 agreement document (e.g., Programmatic Agreement) to stipulate roles and responsibilities of stakeholders, exempt certain actions from Section 106 review, establish protocols for continuing consultation, facilitate identification and evaluation of historic properties, and streamline the assessment and resolution of adverse effects (i.e., avoid, minimize, or mitigate). Although the successful execution of a Section 106 agreement document allows CEMVN to proceed with issuing a ROD, final NHPA compliance will be subject to the successful implementation of the conditions of the agreement (additional cultural compliance	process, the agency may also defer final identification and evaluation of historic properties if specifically provided for in a programmatic agreement (PA) executed pursuant to 36 CFR § 800.14(b). The process should establish the likely presence of historic properties within the Area of Potential Effects (APE) for each alternative, consultation, and an appropriate level of field investigation, taking into account the number of alternatives under consideration, the magnitude of the undertaking and its likely effects, and the views of the SHPO/THPO and any other consulting parties. Overall, it is likely that the District's Section 106 compliance requirements may be more effectively and efficiently implemented if a programmatic approach is used to stipulate roles and responsibilities, exempt certain actions from Section 106 review, establish protocols for continuing consultation, facilitate identification and evaluation of historic properties, and streamline the assessment and resolution of adverse effects.		developing a project-specific PA in furtherance of USACE's Section 106 responsibilities for this Undertaking. The PA would then govern the District's subsequent NHPA compliance efforts. Following the execution of the PA, USACE may proceed with issuing a ROD/FONSI in compliance with Section 106 of the NHPA; Also see: Table 6-1 (*Environmental Compliance Status*).

		measures). However, should this project be determined to not be feasible then the PA could be terminated without the implementation of additional cultural resource compliance measures.			
TSP	Cultural Resources	Any structural solution has the potential to increase the degradation of cultural resources both on the unprotected and protected sides of structural features (e.g., higher or re-directed wave action or increased erosion on the unprotected side of structural features, or, back-flooding on the protected side of structural features).	Additional impacts to cultural resources may occur beyond project footprint.	H	Since the TSP does not include structural measures, the PDT does anticipate this risk to be a concern at the planning process continues. No additional resolution is needed at this time.
Project Initiation Alternatives	Cultural Resources	Cultural resource assessment will utilize existing data and information only. Approximately 450 known cultural sites are within the project area. A significant amount of the project	Potentially select or screen measures and alternatives that have unknown impacts on cultural resources	H	This risk remains applicable: The present cultural resource assessment utilizes existing data only and a significant amount of the project area has not be surveyed.

		area has not be surveyed.			Additional Identification and Evaluation (survey) will be required. Additional cultural resources may be identified during PED that may have additional schedule and cost implications.
Agency Decision Senior Leaders Briefing/CWRB Chief's Report/Director's Report (HQUSACE Team)	Cultural Resources	Section 106 of the National Historic Preservation Act (NHPA), as amended (54 U.S.C. § 300101 et seq.), lays out 4 basic steps that must be carried out sequentially: 1) establish the undertaking; 2) identify and evaluate historic properties; 3) assess effects to historic properties; and 4) resolve any adverse effects (avoid, minimize, or mitigate). An agency cannot assess the effects of the undertaking on historic properties until it has identified and evaluated (ID & Eval.) historic properties	Based on a review of Louisiana Division of Archaeology (LDOA) records, approximately 449 archaeological sites have been previously recorded within the current study area that collectively span the entire spectrum of Pre-Contact and Post-Contact archaeological components; encompassing some 10,000 years or more. Nevertheless, as compared to other areas of the state, relatively little survey work has been conducted within the study area. Additionally, Iberia Parish has a total of 32 properties and districts listed on the NRHP including one (1) National Historic Landmark (NHL; Shadows-on-the-Teche), as well as the Downtown New Iberia Commercial Historic District and East Main Street Historic District. It is noteworthy to mention that Avery Island, located in Iberia Parish, was listed at all three (3) levels of significance (local, state and national) and for all four (4) NRHP criteria (history, association with significant individuals, architecture and archaeology) in September of 2018. St. Martin Parish has a total of 25 properties and districts listed on the NRHP including one (1) NHL (Acadian House) and the Breaux Bridge Historic District and St.	H	This risk remains applicable: This risk will be mitigated through the development of a PA that establishes procedures to satisfy the District's Section 106 responsibilities pursuant to 36 CFR Part 800.14(b); Also see: Table 6-1 (*Environmental Compliance Status*).

		within the APE. The federal agency must consult with external stakeholders in identifying historic properties, assessing effects, and resolving adverse effects, and provide for public involvement.	Martinville Historic District. St. Mary Parish has a total of 29 NRHP properties and districts listed on the NRHP including Morgan City Historic District, Franklin Historic District, and the Patterson Commercial District. The study area is also the setting of at least 23 terrestrial and naval Civil War battles ranging from small skirmishes to major decisive battles. Additionally, the National Park Service's American Battlefield Protection Program (ABPP; 54 U.S.C. 380101-380103), Civil War Sites Advisory Commission (Public Law 101-628), has assigned Preservation Priorities (https://www.nps.gov/abpp/battles/bystate.htm) for two (2) individual battlefields located in St. Mary Parish: Irish Bend and Fort Bisland		
PED Construction	Cultural Resources	At the feasibility level, there is insufficient time/funding to conduct required archaeological Phase I Survey and intensive records research.	Cultural Resources cost estimates only capture known marked cemeteries. Additional unmarked cemeteries may be identified during archaeological Phase I survey. Furthermore, all Cultural Resources cemetery cost estimates are based on current market research broken down to a per-foot cost rather than a per-individual cost. Because the number of individuals contained within each cemetery cannot be determined at the present time, Cultural Resources cost estimates do not include determination of descent for unmarked burials beyond records research, need for coroner, environmental justice issues, funeral directors, services for military, re-interment containers, plots, opening and closing of plots, resetting of grave markers at the re-interment cemetery, preliminary costs for legal aspects, such as obtaining permission from next-of-kin, petitioning courts, obtaining necessary permits, and any real estate cost for obtaining Tribal-	H	Since the TSP does not include structural measures, it is unanticipated that any known/ unmarked cemeteries will be impacted and the PDT does anticipate this risk to be a concern at the planning process continues. No additional resolution is needed at this time.

			trust lands for Native American reburials. Cultural Resources cost estimates can be refined once a Phase I Survey and intensive records search has been conducted and a Minimum Number of Individuals can be determined.		
TSP	Environment	Environmental Impacts are based on features designed with parametric methods. Environmental consequences documented in the report are generally considered maximum impact for each resource. Environmental Consequences and Mitigation Plans will be updated following results of feasibility level of design.	Impacts were estimated assuming borrow sites and wave attenuation structures will avoid environmental resources. Structural feature impacts were estimated based on similar types and design of structures within coastal environments. Following TSP study team will utilize additional modeling to validate and refine impact assessments.	L	Since the TSP does not include structural measures, the PDT does anticipate this risk to be a concern at the planning process continues. No additional resolution is needed at this time.
TSP	Environment	Water Quality impacts will be fully documented in the final report. The 401 Water Quality certification will require 30- days public comment period.	If water quality certification is delayed or significant comments are received during the public comment period final document may need to be modified resulting in impacts to the project schedule.	L	Since the TSP would not impact any water body (fresh or salt), the PDT willnot have to obtain a 401 Water Quality Certificate from the Sate of Louisiana. No additional resolution is needed at this time.
TSP	Environment	Coastal Zone Constancy determination impacts	Avoidance of impacts may result in change of design and or cost estimate. Significant public	L	Since the TSP would not impact any coastal zone

		are not complete will be fully documented in the final report. The Coastal Zone Constancy determination will require 45-day public comment period.	comments may take additional time and resources to address in the report.		resource, the PDT will not have to obtain a Coastal Zone Consistency Determination from the State of Louisiana. No additional resolution is needed at this time.
TSP	Environment	Wetland mitigation location was assumed for existing wetland mitigation banks. It is unclear at this time if sufficient acres will be available for mitigation requirements. Cost estimates for wetland mitigation were developed using known project costs on similar constructed projects in the region.	Location of wetland mitigation, cost, and amount will likely change and be refined following TSP identification. May results in change of cost estimates and impact preliminary B/C ratios.		Since the TSP would not impact any wetland resource, the PDT will not have to mitigate any wetland loss. No additional resolution is needed at this time.
TSP	Cultural Resources	Architectural History services Cost Estimates are for the number of structures in the larger study area.	These costs are likely to significantly change (-) following additional evaluation of non-structural measures as the proposed non-structural plan is refined and presently represent a high-level estimate.	H	This risk remains applicable: Architectural History services costs can be refined further as additional data regarding non-structural measures becomes available (i.e., # of eligible structures and their locations). However, it is anticipated that

					costs will remain within the present estimate.
TSP Agency Decision	Environmental Justice	If during PED, Real Estate (R.E.) uses a structure by structure justification to determine if a home is elevated, then there may be disproportionate impacts to EJ communities. If the majority of structures not meeting the criteria (value of home must be greater than cost to elevate) are predominately in Census block groups that are low-income, there could be a disproportionate burden on low-income homeowners. On the other hand, if half or more of the structures not meeting elevating criteria are in census block groups with majority of households above poverty, then there would probably not be a disproportionate impact. This needs to be discussed with	If R.E. uses an implementation criteria different from Economics planning criteria to determine eligibility, the EJ resource section does not correctly identify if the federal action causes high, adverse disproportionate impacts to EJ communities. Currently, the EJ analysis assumes the federal action causes no disproportionate impacts to EJ communities since ALL structures within the 25-, 50-, or 100-year flood zone are located in economically justified reaches and would be flood-proofed, elevated, or acquired; therefore, all residents within the reaches, irrespective of race, ethnicity, or income, would be expected to be similarly impacted.	M	This risk has been resolved. Real Estate. using their criteria is part of implementation and not part of the planning process.

		nonstructural policy expert to determine if R.E. can still use their traditional evaluation given the new EM or circular on nonstructural program policy.			