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A look at the integration of wetlands and hazard mitigation planning in coastal Louisiana

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A LOOK AT THE INTEGRATION OF WETLANDS AND HAZARD MITIGATION PLANNING IN COASTAL LOUISIANA

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ABSTRACT

Due to the destruction of the damaging hurricanes of 2005, Katrina and Rita, more effort has gone into the rebuilding and prevention of future disasters along the Louisiana coast than ever before. This research focuses on the use of wetlands, in the ten coastal parishes of Louisiana, as a mitigation effort aiding in the protection of coastal communities. Using content analysis and decision support software, a wetland ranking was created that represents how wetlands are utilized and protected within each parish. Criteria gathered from the plans include how many times wetlands were mentioned, collaboration with the state and other agencies, and the occurrence of wetland mitigation projects within the plan or parish. This ranking shows Lafourche Parish having the highest wetland involvement and St. Bernard Parish the lowest.

The next objective was to determine what factors may influence the wetland ranking. Collected data included 2000 socioeconomic, 2005 wetland, and 46 year hazard data for the ten parishes which was run against the wetland ranking in the SPSS program. The number of hazards the parish experienced over a 46 year period was the only factor shown to significantly impact the wetland involvement. Other interesting relationships include the percentage of wetlands in the parish and number of hazards along with hazard data and voting percentages.

This research brings together protective and restorative measures in regards to wetlands along the coast. It is the first step in seeing how communities are adapting hazard mitigation plans to the specific needs of each area and opens the door to future research in which wetlands may be utilized as a way to decrease the vulnerability of coastal populations.

CHAPTER 1: INTRODUCTION

Each year, as summer approaches, the Gulf of Mexico inhabitants begin to prepare for another hurricane season, lasting until late November. This region has experienced over 70 hurricanes, tropical storms, and depressions in the 19th century with varying degrees of damage (NOAA Historical Hurricane Tracks Tool). These storms affected the 36 million people in the Gulf Coast (Godschalk, et al., 2000), including the 1.4 million[1] Louisiana residents living on the coast. Nature has not let up, starting out the 21st century with over 40 of these potential disasters (NOAA Historical Hurricane Tracks Tool).

The most devastating hurricane year turned out to be 2005. With this hurricane season came the most named storms in US history, the 3rd deadliest hurricane, and the most costly hurricane in the United States (Blake, et al., 2011; Knabb, et al., 2006). In August of 2005 over 1.2 million people in the Gulf Coast were advised to evacuate (Knabb, et al., 2006). The storm that has surpassed almost all others, Hurricane Katrina, directly caused 1200 deaths, along with an estimated $108 billion in damage. This storm easily doubles the $29.5 billion in damages Hurricane Ike caused in 2010 and Hurricane Andrew's damage of $26.5 billion in 1992 (Blake,et al., 2011). Many of these fatalities and damages were sustained by Louisiana residents (Knabb et al., 2006). Hurricane Rita gave Gulf Coast residents little recovery time as she hit the coast a month later, which merely added fuel to the fire. Rita caused another 7 deaths and $12 billion (Blake, et al., 2011) in damages, piling these losses and devastation on top of Katrina's destruction. Areas not affected by Katrina, such as Cameron Parish in Louisiana, had millions of

[1] This number was created by summing the population of the 10 Louisiana Parishes in 2000, found in Appendix B

dollars of damage and floodwaters at their back doors. After suffering massive flooding due to breaches and breakages of levees, the socially and physically vulnerable New Orleans took on more water due to Rita. This prolonged the cleanup, de-flooding, and recovery efforts of the city (Knabb et al. "Rita," 2006).

The Gulf Coast is known to be hit hard by storms physically, but these storms are also socially damaging. Cutter et al. (2003) created a social vulnerability index (SOVI) that assigned scores to all of the United States counties. Based on factors such as wealth, age, population density, economic dependency and race, the Louisiana coastal parishes' social vulnerability were categorized as middle to highly vulnerable. The 1990 SOVI ranks Orleans and Plaquemines parish as highly vulnerable. St. Mary and Cameron parish fell into the second highest category while the other six parishes ranked in the middle (Cutter et al., 2003). Social vulnerability can delay a society's recovery and regrowth due to a disaster. Of the parishes affected by Katrina in 2005, Orleans and St. Bernard ranked the highest in terms of the 2000 SOVI. Plaquemines, Jefferson, and Terrebonne also had higher scores with Lafourche containing a lower level of susceptibility (Cutter & Emrich, 2006). These scores are relevant to the events occurring in the coastal parishes, especially in Orleans Parish where 10,000 people were relocated due to Katrina (Colten et al., 2008).

Over 80% of the city of New Orleans was underwater for 6 weeks (Cigler, 2009) with floodwaters damaging 70% of residential housing (Colten et al., 2008). Louisiana residents have seen the hardships in the parish, the destruction and long recovery time. Nearly two-thirds of the population returned to New Orleans three years after the storm, but planned

reconstruction for the city was just beginning (Colten et al., 2008). In five years, many ministries, rebuilding agencies and other aiding organizations reconstructed over 1500 damaged homes and are still receiving requests for help. Unfortunately, funds are running low and many helping organizations will not be returning to rebuild more homes. Some agencies will be staying on and predict they will still be rebuilding in three years (Nolan, 2010). With over $40 billion in damages, slow reconstruction and the permanent loss of some communities (Colten et al., 2008), New Orleans still feels the aftermath of the storm and six years later has yet to fully recover.

Inherently, destruction comes with reconstruction. A community can be vulnerable but can also be resistant. The damages incurred will be repaired and measures taken to cope with future disasters. Hazards can come in many forms, not just hurricanes. Natural and man-made hazards can all eventually become disasters and must be prepared for correctly and in a timely manner. Tornadoes, thunderstorms, earthquakes, volcanoes, tsunamis, landslides, floods, droughts, wildfires, oil spills, and terrorist attacks, as well as coastal hazards must be planned for accordingly (Schwab et al., 2007). There are many actions and mitigation measures an individual, community, county, state, or country can take to plan for future problems. One way to prepare and mitigate for these hazards can come in the form of a hazard mitigation plan. A mitigation plan contains strategies and actions that, if followed, will help lessen a community's vulnerability to natural hazards in the future (Schwab et al., 2007).

In this study, there will be an intricate examination of these plans for the coastal parishes of Louisiana. There are three broad categories of mitigation measures, which include

coastal restoration, structural and nonstructural activities. While utilizing the natural environment is important, it is less used due to the large scale, scope, and estimated cost of the projects (Cigler, 2009). This research will focus on one specific natural hazard mitigation measure, the use of wetlands. The use of wetlands can include marshes, swamps, barrier islands, and mangrove forests. Wetlands are known for abating floods and storm surge (Mitch and Gosselink, 2000; Randolph, 2004; CPRA, 2007), but these ecosystems are disappearing at an alarming rate (Bernier et al., 2006; Bourne, 2000; Galloway et al., 2009). One model found that Katrina's storm surge would have been 3 to 6 ft higher in St. Bernard and NOLA East if wetlands east of MRGO had been open water (CPRA, 2007). Wetlands are precious resources and must be protected; but they are also a functioning part of the environment and should be utilized. This utilization could provoke "multi-tasking" within the plan and parish—protect and restore the environment while it helps to protect the human population as well. To further protect themselves, parishes should have multiple lines of defense strategies (Cigler, 2009); one of these strategies should include wetlands and the natural environment.

This research has two objectives—the first is to determine the integration, involvement, and overall inclusion of wetlands in the coastal parishes' hazard mitigation plans. The second objective is to try to determine the key influences or factors that may explain the degree of integration of wetlands in these documents. Gulf communities may be able to boost their resiliency to future storms and other hazards by using wetlands as one of their many hazard mitigation measures. Each area needs to mold their plans to the uniqueness of the surrounding area; one of these unique characteristics includes wetlands. The parishes may be able to create

a more uniquely tailored system of future protection by combining the functionality of wetlands into the local hazard mitigation plans. This study is looking into what is being done, locally, with Louisiana’s wetlands. The devastating Katrina and Rita storms give reasons to why these natural environments are critical for the protection of coastal residents.

CHAPTER 2: OVERVIEW OF PLANNING AND WETLANDS

2.1 Hazard Mitigation Plans

Mitigation is any step or process an individual, group, or community takes that will help to reduce, eliminate, or avoid damage and risk to a population from a natural hazard (Schwab et al., 2007; Wilkins et al., 2008; Randolph, 2004). Natural hazards that are the most prevalent in Louisiana include, but are not limited to, hurricanes, storm surge, flooding, subsidence, sea level rise, coastal erosion, tornadoes, and windstorms (Wilkins et al., 2008). Other natural hazards include wildfires, typhoons, thunderstorms, earthquakes, volcanoes, tsunamis, landslides, and drought (Schwab et al., 2007).

A hazard mitigation plan is a way to use mitigation to avoid the imminent danger of natural hazards that will constantly be a threat (Randolph, 2004). These plans summarize policies and strategies for a state, parish, or city to lessen the area's vulnerability to hazards when the mitigation approaches are followed. The strategies are formed from a risk and vulnerability assessment that is part of the planning process (Schwab et al., 2007). Hazard mitigation plans are meant to be an important aspect of a community as they are there to evaluate the area and any hazards that may pose a threat, but these plans also serve as a way to receive funding before or after a disaster.

The Federal Emergency Management Agency (FEMA) provides grants to States, Tribes, and Territories to create a FEMA approved plan. The grants can then be allocated to local governments and communities within the state to provide adequate support and funding while also aiding with hazard mitigation projects. Every mitigation plan, state or local, must be submitted and approved by FEMA. Mitigation funding is provided by FEMA's Hazard Mitigation

Assistance grant programs, which are: the Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM), Flood Mitigation Assistance (FMA), Repetitive Flood Claims (RFC), and Severe Repetitive Loss (SRL). To receive funding, certain requirements must be met, which can be found in the HMA guidance. Activities eligible for funding from all of the HMA programs include mitigation projects and management costs. Hazard mitigation planning is eligible for funding from the HMGP, PDM, and FMA programs. HMGP assists in hazard mitigation after a presidential disaster is declared while the PDM is an annual grant that helps with mitigation before a disaster. FMA is also an annual grant that aids in reducing flood damage to those insured under the National Flood Insurance Program (FEMA, 2011).

Many of the local plans, such as the Vermilion and Plaquemines updates, state that wetland construction and restoration is not eligible for HMGP funding (Shaw E&I, Inc, 2009). The Hazard Mitigation Grant Program Desk Reference (1999) and the Hazard Mitigation Assistance Unified Guidance (2010) state that wetland restoration is an allowable use of an open space. It is unclear whether this is indeed an action funded by FEMA. The HMA programs must be in compliance with the Environmental Planning and Historical Preservation Requirements (EHP); these requirements are usually in the best interest of wetlands. They are usually enforced through NEPA and EO 11990 along with other executive orders (FEMA, 1999) (FEMA, 2010). Even though they are acquired to do everything they can not to destroy wetlands, that does not assume that they are restoring, creating, or using these areas to their full potential.

Berke and Godschalk (2008), and the Division of Emergency Management in North Carolina (2000) provide two research initiatives involving evaluating comprehensive and hazard mitigation plans. Both of these evaluations aim to measure the degree of whether or not a plan is "good" or "successful." The broad criteria allow each method to be used on any plan, no matter the country, area, or situation. Many of the evaluations examine how the plan addresses the specific and unique problems prone to that region. The goal is to do what is best for a community not only in terms of protection from hazards but also adhering to the economic, political, and environmental issues the area may be facing.

Berke and Godschalk (2008) first address that a plan needs to be assessed to see the actual planning process and if the stated objectives are accomplished. They use two dimensions to evaluate plans: internal and external plan quality. Internal qualities include goals, policies and fact bases while external qualities address how the plan responds to the local situations. They examined criteria used in previous plan evaluations along with critiques of other research methods, which include cross-sectional and comparative research. An example of a cross-sectional review includes the "crosswalk" evaluation approach used by FEMA when examining a hazard mitigation plan. This detailed approach allows reviewers to score each section of the plan as "satisfactory" or "not met." There are detailed checklists containing specific questions that evaluate whether or not the applicant thoroughly and accurately assessed each section's specific goals. All of the sections must be "satisfactory" and meet all requirements before the plan can be approved; these sections include: prerequisites, planning process, risk assessment, mitigation strategy, coordination of local planning, and plan

maintenance (FEMA, 2008). One critique of the cross-sectional approach states that there is no true determination of any independent variables that may affect the plan's scores (Berke & Godschalk, 2008). This research is a helpful aid in determining what a plan should involve and how to test its overall quality.

The North Carolina Emergency Management Division (2000) describes how to not only measure a plan's effectiveness as a whole, but also using more specific methods, such as looking at the individual mitigation measures. The Division labels mitigation as containing many layers of involvement; one of these dimensions is the environmental factor. All of the layers are included in the seven criteria created to quantify the benefits of mitigation and assess the mitigation strategies within a plan. The seven criteria are: technical feasibility, losses avoided, cost of the strategy, compliance with federal, state, and local regulations, environmental impact, relation to other community goals, and political acceptability. Overall this study acts as a guideline to aid other hazard-prone areas that are striving to create a sustainable, hazard resistant community. Many of the concepts can be applied outside of North Carolina, as each mitigation strategy is different and should adhere to the community's unique needs and resources.

2.2 Wetlands

2.2.1 Defining a Wetland

Even though wetlands have existed long before humans, defining a wetland is still not an easy task. The exact definition is hard to pinpoint but wetlands will have a presence of water, unique soil conditions, and plants that are adapted to wet, flooded conditions (Mitsch &

Gosselink, 2000). Formal definitions of wetlands can be described by scientific and legal standpoints, but as Mitch & Gosselink (2000) state, there is not one definition of a wetland because the definition depends on the "objectives and field of interest of the user."

A wetland is a one of a kind environment with many distinctive functionalities. Wetlands are known for improving water quality (Randolph, 2004; Schwab et al., 2007), reducing damage from flooding and storm surge (Schwab et al., 2007; Randolph, 2004; CPRA, 2007; Mitsch & Gosselink, 2000), lessening shoreline erosion (Schwab et al., 2007; Randolph, 2004), along with many other qualities such as providing groundwater recharge, scientific research, healthy fisheries, and ecological benefits (Randolph, 2004). A study done by the USACE showed that 1 foot of storm surge is abated for every 2.75 miles of wetlands (USACE, 1963). There have been other studies showing storm surge reduction by wetlands but there is no concrete amount(Wilkins et al., 2008).; a USGS study in Calcasieu Lake showed an abatement rate of 1 foot for every 1.4 miles of marsh (McGee et al., 2006).

2.2.2 Valuing Wetlands

It may seem that these precious wetland areas are "priceless," but because they provide so many resources and protection, researchers want to quantify or "value" these ecosystems. Wetlands have been valued for flood and flow control, storm buffering, sediment retention, groundwater recharge, water quality maintenance, habitats and nurseries, biological diversity, micro-climate stabilization, carbon sequestrations, and as the natural environment (Brander et al., 2006). Farber (1987) and Costanza et al. (1989) looked at valuing wetlands in terms of hurricane protection. They found, on average, that every hectare of wetland provides $1000 of

hurricane protection services in Louisiana every year. A more recent study conducted by Costanza et al. (2008) concluded that every hectare of Louisiana's wetlands provide $1700 of hurricane protection value yearly. Due to the loss of over 500,000 ha of wetlands throughout the years in Louisiana, an estimated $28.3 billion was lost in storm protection with Katrina destroying $1.1 billion of these services in 2005 (Costanza et al., 2008). Other research suggests that over $37 billion has been lost in terms of wetlands not only as flood control and hurricane protection, but also in relation to public resources, fisheries, wildlife habitat and navigation (Bourne, 2000).

While valuing is an important tool in today's society in quantifying the environment, Mitsch and Gosselink (2000) identify eight problems associated with this system. Valuing comes from the anthropogenic world and usually mirrors what the human populations "sees" as being valuable. The relationships between wetlands, human populations, and marginal value are not easy to understand and therefore create a difficult situation in which to apply a cut-and-dry economic assessment. The value of these wetlands may change over time as wetlands provide numerous and infinitely continuous value and resources; short term and long term economic comparisons do not always agree. Overall, valuing is an important evaluation tool of these unique ecosystems but as with any other method, there are flaws to be overcome or dealt with.

Valuing a wetland is a complicated process, especially in regards to what a wetland means to a local individual or the community as a whole. The social, ecological, and economic aspects of a wetland are intertwined and depend upon each other. As seen in previous sections

and research, beneficial roles wetlands play ecologically include providing habitat, biodiversity, flood/storm protection, water quality, etc. (BenDor et al., 2008). But what role do wetlands play in the social aspect of a community? If the benefits of a wetland are removed, social and/or economic harm may occur to the local residents (BenDor et al., 2008). An example in Louisiana includes the effect wetland degradation or alteration would have on the shrimpers, trappers, and recreational hunters or fishermen that depend upon these areas for their livelihood. These are important connections between the wetland ecosystem and local communities, creating a social-ecological system (Adger et al., 2005).

Research conducted by Berke et al. (2008) suggests that coping capacity and social capital influence each other and are very similar within this system. This also indicates that social capital reflects on a community's ability to take action and work together so they are involved in local restoration efforts; enabling the community to adapt, change, and cope with whatever hazard or disaster that may hit next. If the community has the capacity to change then their resiliency factor and ability to bounce back from or deal with disasters is higher (Adger et al., 2005). Thus, social capital affects how the community interacts to acknowledge, protect, and restore their precious resources (Berke et al., 2008). By utilizing their social capital, assets and networks, a community can effectively manage and absorb any damages in a way that allows them to use a wide variety of adaptive management strategies (Adger et al., 2005). A document that contains many individual strategies is the parish hazard mitigation plan; these strategies would ideally involve wetlands as one of the many protective measures taken to boost the community's resiliency to hazards. The socio-ecological communities are

able to reduce their vulnerability and be better prepared for future hazard events because of these adaptive strategies (Adger et al., 2005).

An example of social capital in Louisiana can be seen in the tight-knit communities found in and around the coastal parishes. The National Wildlife Federation interviewed southern Louisiana residents who stated that southern Louisiana is full of irreplaceable communities, social networks, culture, and an overall way of living. Families have lived off of the land and in the same area for generations; this way of living and social connection cannot be reformed somewhere else. All of the interviewees state that the restoration of wetlands plays a big part in their livelihood and community. One person stated that he didn’t realize the importance of land loss and what it could eventually mean until after Katrina—with no protection and plans for mitigating future hazards, there will soon be no land or communities left (National Wildlife Federation, 2011). Wetlands are important in protecting a community and in supporting their economy. The presence of wetlands reduces a community’s vulnerability by abating storm surge and flooding; this prevention of destruction will keep a community together and increase their social capital. Increasing social capital can help the community learn from past hazards and aid in making adaptive decisions on where protective measures, such as wetlands, are needed the most.

Vulnerablity affects a community physcially and socially. Living on or near the Gulf Coast puts a population in harm’s way, especially in regards to coastal storms and flooding. These areas can also be socially vulnerable, in a not-so-obivous way. Other studies show that one aspect of society, social capital, plays a role in a communities’ resiliency and ability to react

and bounce back from these disasters (Adger et al., 2005; Berke et al., 2008). Cutter et al. (2003) quantified the social vulernability of counties within the United States by creating an index using known factors that can affect vulnerability. This type of vulnerability stems from social inequalities such as differences in income, education, knowledge, resources, political prowess, and population growth. Income and strong political affiliations allow a community to deal with the damages and bounce back quickly because they have the means to recover and garner political backup to lobby for clean-up programs. An important resource is knowledge, which can be measured through education. Higher education can aid in understanding warning or recovery directions and information. Population growth affects what where new residents can live in, especially in terms of availability, affordability, and location (Cutter et al., 2003).

The last aspect of wetlands within a socio-ecological role falls into how the community perceives these natural resources. Research dictates quantitative values of wetlands in terms of their services and protection benefits, how they fit into resiliency and vulnerability efforts, and finally their value according to the public. The public may not agree on the wetland's worth that the economists created, or may not be willing to pay that much in order to reap their future benefits. Petrolia and Kim (2011) conducted a survey along the Louisiana coast to see what people are willing to pay to receive and preserve future protection from potential disasters. The survey asked, in two different ways, what the public was willing to pay to prevent future land loss, including its resources, such as hurricane protection. The "willingness to pay" (WTP) scenario needed a majority vote to support the project and the "willingness to accept compensation" (WTA) needed a majority vote to abort the project. WTP could create a

tax to pay over “x amount of years” while WTA would receive a tax refund over “x amount of years” if the project was not supported. Significant factors affecting one or both of these scenarios include income, age, race, no confidence in government, and the respondent motivations for voting. Whites were more likely to vote yes but the motivations for voting remained highest, especially in regards to storm-protection benefits. Respondents whose highest concern involved storm protection were 48% more likely to vote yes for the WTP and 24% more likely to vote yes for the WTA scenario. Overall this study shows that citizens are willing to support preventative measures to curtail future land loss, especially since less land, and therefore wetlands, means less protection from hurricanes.

2.2.3 Wetland Loss in Louisiana

Louisiana is home to the seventh largest delta on earth (Couvillion et al., 2011), 37-40% of the wetlands found in the contiguous United States (Couvillion et al., 2011; Bourne, 2000), and receives drainage from 41% of the 48 states (Galloway et al., 2009). Louisiana is also responsible for 80-90% of the total coastal wetland loss in the continental U.S. (Tibbetts, 2006; Couvillion et al., 2011). Coastal Louisiana has lost over 1800 square miles of wetlands since 1932, averaging 16-34 square miles per year (Tibbetts, 2006; Couvillion et al., 2011; CPRA, 2007).

The rate of wetland loss in Louisiana cannot be filed under one specific reason. There are ten major navigation canals and 9,300 miles of pipeline along the coast that create land loss “hot spots” where further wetland loss occurs due to the excess amount of water overrunning the area. The fact that the water invading the wetlands may be saltwater is another ecosystem

changing situation (Tibbetts, 2006; Galloway et al., 2009) because saltwater degrades the wetlands by killing plants that are not adapted to high salinity levels (Mitsch & Gosselink, 2000; Schwab et al., 2007). These canals are a direct cause of 30% of wetland loss in Louisiana (Bourne, 2000). Extracting oil and gas from the coast has also been shown to increase subsidence in coastal Louisiana, allowing more water to fill up the wetland areas (Tibbetts, 2006). Thirty year historical subsidence rates in the Mississippi Delta average 12mm/yr with a 5000 yr geological rate of 2mm/year (Morton et al., 2005). Bernier et. al (2006) state that subsidence is the primary cause of wetland loss in south-central Louisiana with coastal erosion only bringing minor damage to the area.

Other wetland losses include drainage, destruction, and land conversion. Before the 1970's, drainage and destruction of these precious ecosystems was encouraged to create more land for agriculture and development (Mitsch & Gosselink, 2000). Over 50% of the original 221 million acres of wetlands in the United States have been converted to other uses with 80% of that conversion resulting in agricultural land (Randolph, 2004). Another big hit to wetlands occurs when tropical storms and hurricanes batter the Gulf Coast. Katrina and Rita, alone, destroyed over 200 square miles of marsh in 2005 (CPRA, 2007; America's Wetland; Environmental Defense Fund, 2006). The Chandeleur Islands were 5 meters high before Katrina hit and after that August only half of a meter of the islands were left (Tibbetts, 2006).

2.2.4 Protection and Restoration

After acres upon acres of wetlands were lost, research was conducted, and the realization of how many wetlands had been destroyed, a recovery, protection, and restoration

response began to form in the late 20th century. In 1990 the Coastal Wetlands Planning and Protection Act (CWPPRA), also known as the Breaux Act, was created in response to the devastating and alarming decrease in wetlands and coastal areas in Louisiana. This act is the first Federal program that provides steady monetary means so that the coast of Louisiana, along with its wetlands, can be restored over time. In 18 years, this act has created and carried out over seventy-seven projects. Projects include diversions, dredging, marsh creation, re-vegetation, shoreline protection, and many more (USGS, 2010). As of June 2010, CWPPRA has 180 active projects, 85 constructed, 12 under construction, and 26 de-authorized. Over 650,000 acres of wetlands along the Louisiana coast have been affected by 60 or more CWPPRA projects (Paul, 2010).

In 2007, the Louisiana State Legislature approved the Coastal Protection and Restoration Authority's (CPRA) Comprehensive Master Plan for a Sustainable Coast. Its purpose is to focus on the integration of coastal protection and restoration by lessening the impacts to economic assets, creating a more sustainable environment along the coast, preserving habitat diversity, and conserving the culture native only to Louisiana. Wetland projects include restoration using dredged material, protection by shoreline stabilization, and the closing of the Mississippi River Gulf Outlet, known as MRGO (CPRA, 2007). The Louisiana Coastal Protection and Restoration Plan (LACPR) complements the state master plan by examining it section by section and evaluating the components that are cohesive with the US Army Corps of Engineers' (USACE) mission. LACPR agrees with the multiple lines of defense strategy outlined in the master plan and provides a "delivery" of the state plan (USACE, 2007).

MRGO is a navigation channel that allows direct access from New Orleans to the Gulf of Mexico. In 2007 the US Congress acknowledged its imminent role in the flooding of New Olreans and St. Bernard parish. Storm waves generated in Lake Borgne reformed in the channel and eventually destroyed the earthen levee, allowing massive flooding to occur (Lopez et al., 2010). In January of 2009, the closure of the channel began. Rocks were dumped into MRGO, covering ten acres of the channel bottom and consisting of 430,000 tons of rock that will ultimately be 450 feet wide and 950 feet long (Warren, 2009). The MRGO Must Go Coalition created a report of recommendations to further reap the benefits from the closure of the channel. Their suggestions include reconnecting the Mississippi River to the surrounding wetlands, restoring central wetlands, banklines, and three land bridges along with a bayou ridge and barrier island chain. The goal is to mitigate the historical impacts of the channel, which include conversion of 27,600 acres of wetlands and lagoons into open water and extremely raising and/or changing the salinity in 38,000 acres of estuarine wetlands (Lopez et al., 2010).

Other efforts include Coast 2050, the Louisiana Coastal Ecosystem Restoration Study (LCA), and the Water Resources Development Act (WRDA). Coast 2050 is an initiative that was adopted in 1998-1999 and involves the CWPPRA Task Force, Coastal Zone Management Authority, and other state agencies along with local communities and residents. This act is supported by all the coastal parishes, the state, and five federal agencies. Coast 2050 currently serves as a blueprint for restoring coastal Louisiana (Coast 2050, 2001; Coast 2050, 2004). The goal of Coast 2050 is to “sustain a coastal ecosystem that supports and protects the

environment, economy and culture of southern Louisiana, and that contributes greatly to the economy and well-being of the nation" (Coalition to Restore Coastal Louisiana). The LCA is based on Coast 2050 and is the first step in the implementation of its restoration strategies. LCA will continue to build on the restoration approaches outlined in Coast 2050 using adaptive management to further address the issues with coastal wetlands (USACE, 2010).

WRDA bills are usually considered for amendment every two years due to the outstanding pressure to authorize new projects and funding within the USACE. The bills may contain provisions or regulations on how the Corps convey, review, and implement projects. WRDA requires the Corps to be held accountable for sound science, fair evaluation, fulfilling obligations and listening to local communities and the public; amending WRDA will effectively change the Corps behavior. Title VII of the 2007 WRDA addresses coastal land loss in Louisiana and is consistent with the 2005 WRDA, 2006 Hurricane Protection Study, and the Louisiana State Master Plan. This section of WRDA requires USACE to take action in regards to restoring coastal ecosystems along with flood and storm surge protection for the local communities. Title VII also created the Coastal Louisiana Ecosystem Protection and Restoration Task Force along with the Louisiana Water Resources Council (Heikkila, 2008; Carter, 2005).

Restoration efforts can be seen in the form of diversions and volunteer activities at the local community level. The Caernarvon Diversion and Davis Pond are two projects that, combined with the Breaux Act, are projected to prevent 22% of wetland loss by 2050 (Bourne, 2000). The Caernarvon Diversion delivers water into Breton Sound, which contains over 100,000 hectares of fresh, brackish, and saline wetlands (Engle, 2011). At the end of August,

2011 the Lake Pontchartrain Basin Foundation released a statement and photographs showing new wetlands expanding the Caernarvon delta in Big Mar Pond. Large sand bars and mud flats are becoming inhabitated with lush marsh plants, creating an extra protection level in front of the newly constructed levee (Lake Pontchartrain Basin Foundation, 2011). Davis Pond contains over 3,500 hectares of freshwater marsh-pond that drains into Barataria Bay (Engle, 2011). These diversions are a way to reroute the river water and create wetlands adjacent to the waterway; the Caenarvon delta is proof of this objective becoming successful. Other restoration efforts include wetland mitigation banks along with organizations, universities, and volunteers that donate their time to plant marsh vegetation in surrounding areas or help to cleanup any trash or debris that could be harmful to the ecosystem.

Wetlands are an important natural resource in places like coastal Louisiana. They are a source of significant economic value and a potential tool for hazard mitigation planning. This chapter has presented the background to key concepts that will be used in the analysis that follows. Chapter three presents a case study looking at specific coastal communities in Louisiana.

CHAPTER 3: STUDY AREA

This exploratory case study focuses on the historically and unique coastal area of Louisiana. The hazard mitigation plans collected for this study come from the ten coastal parishes of Louisiana, located along the Gulf of Mexico. These parishes can be found in Figure 3.1 and are known as Cameron, Vermilion, Iberia, St. Mary, Terrebonne, Lafourche, Jefferson, Plaquemines, St. Bernard, and Orleans Parish.

Louisiana boasts a population of 4,468,972[2] with 31.8% of these residents living in the ten coastal parishes. On average, the coast is about 71.73% white with nine of the ten parishes containing over a 60% white population; Orleans parish is the exception, having a 67% black/African American population. The Asian population in the coastal parishes is below the national average, but higher than the state's. The coast averages a per capita income of $15,900, slightly below Louisiana's income of $16,900 and well below the United States average of $21,600; none of the coastal parishes breach the $20,000 barrier. Louisiana and its coastal parishes are five to six percent higher than the national averages in regards to families below the poverty level and the percent of mobile homes found in the area. The ten parishes and the state of Louisiana do boast a lower unemployment rate than the rest of the country, at 1.65% and 1.2%. All of the 2000 Census data including the comparisons, state, county, and country values can be found in Appendix B.

With over 10 national wildlife refuges (US Fish & Wildlife Service, 2011), the coast of Louisiana is full of abundant bayous and marshes that are home to unique waterfowl, reptiles,

[2] The numbers found in this paragraph are collected from the 2000 US Census

Figure 3.1 Ten Coastal Parishes (Original picture from http://www.laparents.org/parishes.jpg)

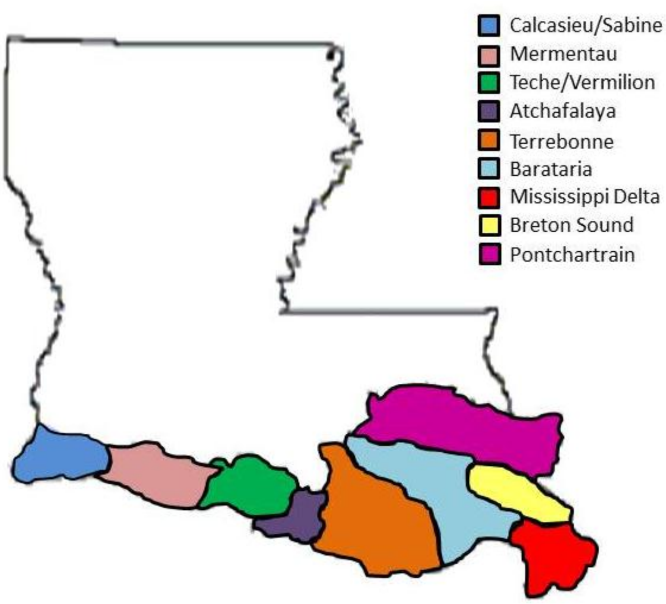


Figure 3.2 CWPPRA's nine Louisiana basins (original picture from www.lacoast.gov)

and other marine life that is an excellent place for wildlife protection and restoration, along with tourism. The abundance of these resources have led to Louisiana being known as the "Sportsman's Paradise." In 2001, a US Fish and Wildlife survey was conducted that inquired about hunting and fishing activities in the United States; of the 1000 Louisiana respondents, 30% said they had participated in some kind of hunting or fishing in that year (US Census, 2000[3]). The coast is also a support system and supplier for the oil and gas cooperation, with over 450 mining companies and 150 companies solely committed to oil and gas extraction (US Census, 2000[2]). The coast of Louisiana produces and supplies one-fifth of the oil and one-quarter of the natural gas used in the United States (Tibbetts, 2006). Other industries involved with the coast include farming rice and sugar cane, fishing, shrimping, and the crawfish business (Louisiana Speaks, 2006). The ten coastal parishes employ over 160 companies that support forestry, fishing, hunting, trapping, and logging (US Census, 2000[2]). Louisiana leads the country in shrimp production and is one of the top commercial fishing states (NSTATE, LLC, 2011) while south Louisiana contains salt domes and is home of the Louisiana pepper sauce, Tobasco (Louisiana Speaks, 2006).

The parishes examined in this study are all contained within the 9 Coastal Louisiana Basins (Figure 3.2), along with other inland parishes. The Basins are known as: Calcasieu/Sabine, Mermentau, Teche/Vermilion, Atchafalaya, Terrebonne, Barataria, Mississippi River Delta, Breton Sound, and Pontchartrain. These 9 basins contain over 3 million acres of wetlands (LaCoast, 2011). While the study area examined in this research does not

[3] This data was found using the US Census "DataFerret" (http://dataferrett.census.gov/about.html)

reflect the entire acreage of all the basins, it does consist of a majority of the wetland area found within these basins.

As mentioned previously, wetlands are an important natural resource, providing critical and unique habitat along with protection from coastal storms, floods, and erosion (CPRA, 2007; Mitsch & Gosselink, 2000; Randolph, 2004; Schwab et al., 2007; Wilkins et al., 2008). This study is focused on the coast of Louisiana because it is known as "America's Wetlands" and contains such a large amount of these fading ecosystems (America's Wetland Foundation, 2011). This is the area of Louisiana that takes the brunt of damage when disasters occur in the Gulf of Mexico, particularly hurricanes; we can see this from the amount of people affected and damage sustained during the 2005 hurricane season (Knabb et al., 2006; Knabb et al. "Hurricane Rita," 2006). In over 40 years, each of these 10 parishes has seen, on average, 117 hazards. The data collected from http://www.sheldus.org, which will be used later on in this research, is listed in Table 3.1 according to types of hazards. Severe thunderstorms make up the majority of the hazards experienced, some parishes dealing with upwards of 80 of these storms. According to SHELDUS™, a severe thunderstorm can include high winds, tornadoes, lightning, hail, and heavy or excessive rain. Hurricanes make up the second most dealt with hazard and some parishes have experienced over 30 hurricanes in the last 40 years.

Since most damage is occurring here, that also means that the wetlands are constantly exposed to these hazards, putting their survival in danger. Hurricane Katrina alone destroyed over 80 square miles of marshland; when combined with Rita's destruction, between 100-200 square miles of vegetated marsh were transformed into open water (America's Wetland;

Environmental Defense Fund, 2006; CPRA, 2007). The ten parishes examined in this study lost a net 30 square miles of wetland in 10 years. Table 3.2 breaks down the wetland losses and gains by parish with St. Mary gaining more than any other parish and Plaquemines losing the most (NOAA, 2011). Other detrimental factors to wetlands include sea level rise and subsidence (USGS, 1995; Bourne, 2000; Tibbetts, 2006). When combined, these two hazards are predicted to cause over 10,000 km^2 of land loss in the Mississippi Delta by the year 2100 (Blum & Roberts, 2009). With Louisiana containing about 40 percent of the wetlands in the continental United States and losing over 75 square kilometers a year, we now have to focus on the protection, restoration, and utilization of these precious resources (USGS, 1995; Bourne, 2000; Tibbetts, 2006).

Table 3.1 Hazards broken down by type

	Cameron	Iberia	Jefferson	Lafourche	Orleans	Plaquemines	St. Bernard	St. Mary	Terrebonne	Vermilion
Coastal Storms	3	2	12	11	9	12	10	3	9	2
Flooding	17	23	25	21	17	10	16	25	18	21
Severe Thunder-Storm	66	61	82	80	60	49	41	53	82	73
Hurricanes	20	16	31	31	26	30	30	22	31	19
Total	106	102	150	143	112	101	97	103	140	115

Table 3.2 Summary of Wetland Loss/Gain in 10 Parishes

Parish	**1996-2006 Wetland loss or gain (sq miles)**
Cameron	**-1.59**
Iberia	**+1.3**
Jefferson	**-5.47**
Lafourche	**-5.24**
Orleans	**-2.63**
Plaquemines	**-25.1**
St. Bernard	**-5.89**
St. Mary	**+30.04**
Terrebonne	**-10.37**
Vermilion	**-5.05**
Total Loss: 61.34	
Total Gain: 31.34	
Net Loss: 30.0	

Table compiled by author, data found in Appendix D

CHAPTER 4: DATA AND METHODS

4.1 Creating the Wetland Ranking

4.1.1 Hazard Mitigation Plans

Through email contact and personal acquisition, the most recent plans from each of the 10 Louisiana coastal parishes were collected from various contacts throughout the parishes. Most plans were contracted to specific companies to oversee and construct while others were created solely by the parish government. Seven parishes also gave access to previous plans that may provide a way to view the progress the plans have made, in terms of wetlands, over the years. Table 4.1 shows the most recent plans and if a previous plan was also collected.

Table 4.1 Updated and Previous Hazard Mitigation Plans

Parish	Updated Plan	Pages	Plan Author	Previous Plan	Pages	Plan Author
Cameron	2010	227	CSI	2006	173	CSI
Iberia	2009	134	Iberia Parish	2006	87	Iberia Parish
Jefferson	2010	410	Jefferson Parish	NA		
Lafourche	2010	201	Shaw	2006	170	Lafourche Parish
Orleans	2010	934	New Orleans OHSEP[4]	2005	147	New Orleans OHSPS[5]
Plaquemines	2009	157	Shaw	NA		
St. Bernard	2010	366	BKI	NA		
St. Mary	2009	244	Shaw	2004	246	LJC
Terrebonne	2009	242	Shaw	2005	248	Terrebonne Parish
Vermilion	2009	186	Shaw	2005	289	Vermilion Parish

NA= Not Available

[4] Office of Homeland Security Emergency Preparedness

[5] Office of Homeland Security and Public Safety

Questions and qualities indicative of wetland focus were used to evaluate the integration of wetlands into the plan. The criteria posed to each of the plans are as follows:

- How many times are wetlands and marshes mentioned?
- How many times is CWPPRA mentioned?
- Is there collaboration with CWPPRA?
- How many times is the Louisiana State Mitigation Plan or Comprehensive Master Plan for a Sustainable Coast mentioned?
- Are wetlands a focus or concern in each of the hazard identification/mitigation action sections?
- Is there a separate wetland section?
- Are there maps of wetlands within the parish?
- Are wetlands listed as assets?
- Are there wetland restoration or protection projects listed?

Using similar techniques to information retrieval and word frequencies as quantitative content analysis (List, 2007; Nie, 2011) a mere count of the keywords "wetland" and "marsh" in the entire plan will first determine if wetlands are of any concern and focus. To avoid vocabulary mismatching (Nie, 2011) and to gather a more collective idea of the wetland integration, the term "marsh" is included in this count. A marsh is a type of wetland that is covered in water most of the time, if not all the time. Marshes have emergent vegetation that can handle the constant inundation they are subjected to in that kind of ecosystem (US EPA, 2011). The same type of quantitative search was done for the Coastal Wetlands Planning, Protection, and Restoration Act along with its acronym (CWPPRA) and the mitigation plan for the state of Louisiana. Even if the funding for a wetland project is coming from CWPPRA and not FEMA or HGMP, one would assume that the plan should at least mention it, as it does

pertain to the parish and its overall protection. Acknowledging CWPPRA's work and providing any help, support, or local knowledge would indicate the parish's collaboration.

Another criterion involves an examination of the plan to see if there is any collaboration with other organizations. A search for the mention of the State of Louisiana's Hazard Mitigation Plan or Louisiana's Comprehensive Master Plan for a Sustainable Coast was conducted. These documents are essential to the protection of and planning for Louisiana along with the parishes that make up the state. The master plan is also mentioned and referenced in the State Mitigation Plan (Louisiana's Office of Homeland Security and Emergency Preparedness, 2008). Both of these plans show importance to wetlands, their protection and restoration. If either of these higher, comprehensive plans are mentioned within the parish plans it is believed that the parish is acknowledging what the state is doing in regards to wetlands and would ideally follow their example or plan.

One of the three steps in the hazard and risk assessment of a hazard mitigation plan is hazard identification (Randolph, 2004). The hazards examined in this analysis are hurricanes, storm surge, flooding, saltwater intrusion, coastal erosion, and land subsidence. These specific hazards were chosen due to their detrimental effects on wetlands and any hazards whose damage could be lowered by the presence of wetlands (CPRA, 2007; Louisiana's Office of Homeland Security and Emergency Preparedness, 2008; Mitsch & Gosselink, 2000; Randolph, 2004; Schwab et al., 2007; Wilkins et al., 2008; Bernier et al., 2006). The section containing any mitigation actions for each of these hazards was also included in this analysis; this is where the

goals and objectives of the plan should be, including any wetland restoration or protection projects and other actions meant to lessen the impact of these detrimental hazards.

The table of contents and the entire plan was searched to try and find a separate wetland section. If such a section is present, then this implies that the parish is appreciating wetlands and possibly realizing their importance. A specific section on wetlands is not required in a hazard mitigation plan but its presence could mean that the parish may be showing some attention to these diminishing ecosystems.

Maps are an important part of the hazard mitigation plan because they easily convey hazardous areas along with areas that are the most prone to hazards. Identifying vulnerable populations will aid the planners when they must focus on what areas will be hit the hardest by a disaster and have the hardest time recovering (Randolph, 2004; Schwab et al 2007; Berke & Smith, 2010; Burby, 2003; Morrow, 1999). Maps that are frequently seen in the plans include the location of levees, areas of subsidence and land loss, critical facilities, inundation from hurricanes, and much more. Each plan was searched for any maps pertaining to wetlands. If a map does exist then this gives evidence that the parish is aware of where these wetlands are located. Knowing the extent of their range could give a better idea of what areas could be protected because of wetlands, where floodwaters will collect, and where restoration and protection need to be created and enforced.

Another section located in the hazard mitigation plan consists of the assets and critical facilities located within the parish. Tables are usually constructed to quantify the value of these areas, damage they have ensued or are predicted to get, if they are subject to specific hazards, and determining the costs of repair. Residential, commercial, industrial, agricultural,

government, schools, and religious/non-profit areas are the most used classification of the assets. In some plans, recreational areas or the environment are considered as assets or critical areas as well. The environment can include national parks and wetlands. Each plan's asset section was scanned to see if any mention of wetlands occurred.

The last criteria concerns the wetland projects listed in the parish. The projects are normally listed under the mitigation actions towards the end of the plan. In this analysis, the number of projects occurring or predicted to be put into action are not being counted; the mere presence of such projects will merit a yes in the data recording. Ideally, this is the section where CWPPRA projects will be listed. When looking at the CWPPRA website (www.lacoast.gov), one can see how many projects are happening and what parishes are involved. This criterion will show what is happening in the parish in regards to wetlands and their protection or restoration, along with the probability of them being used as a hazard mitigation measure.

4.1.2 Word Clouds

Word clouds, also known as tag clouds, are a visual representation of a group of words, whether it is a speech, article, or hazard identification section. In the past they have mainly been used to summarize social tags corresponding to different URL's and documents on the internet. The purpose of these "clouds" is to highlight the most frequently used words and project them as physically larger than others, visually showing the subject matter of the document. The larger font draws the reader's attention quickly to the main topics while the layout has been shown to have no effect on the reader's ability to recognize and remember the larger tags. Inherently, the differences in font size will also provide indications of what words

are not present in bulk. Word clouds are not efficient at picking out the details and should not be the only tool used to evaluate the content of a document, but they can give an overall impression of the section (Hearst & Rosner, 2008; Kipp & Campbell, 2010; Rivadeneira et al., 2007; Sinclair & Cardew-Hall, 2008). As Sinclair and Cardew-Hall (2008) state, tag clouds are widely absent in academic literature and are mainly used for social purposes. In imploring this method, I am testing the usefulness of word clouds in scientific research. This is one method that could quickly aid scientists when trying to find the focus matter of an article or experiment.

The program used in this research is called "Tagxedo" (www.tagxedo.com). Using this program, I copied and pasted the hazard identification sections, with their corresponding mitigation actions, from each plan and created a word cloud in the shape of its parish. If it was available or relevant, I also pasted into each word cloud any vulnerabilities associated with that hazard. The specific sections used to generate the clouds were chosen based on what hazards are most likely to affect wetlands, or in which wetlands would be of use in mitigating their devastating destruction. Not every plan identified the same hazards and some plans grouped specific hazards together. The updated and old plans were both used in the word clouds, giving a visual representation of any change in wetland involvement. The goal of these word clouds is to identify the terms "wetland" or "marsh" after it is generated and to examine how large that word is compared to the others within the section. The word clouds for each section in each plan were examined in order to deduce whether or not wetlands were a focus for each specific hazard.

Veering from the traditional use of word clouds, they were also used to determine a wetland "focus" percentage, which is used as input data in the next analytical step. The word clouds were broken down into simple word frequencies; which helped to determine if that section showed any focus on wetlands. Each section (hurricanes, flooding, coastal erosion, etc) was evaluated separately. The number of times wetlands and marshes were mentioned were tallied; if the number was 0 then no other calculations were necessary as the involvement in that section would equal zero percent. When wetlands were mentioned, the common words within that section were removed (see Table 4.2).

Table 4.2 List of common words removed for word cloud analysis

A	The	And	Of	To	Is	At	Was
Were	In	It	That	For	On	Are	With
As	Be	Have	This	Or	From	Had	But

As Nie (2011) mentions, the removal of these non-essential words will improve the information retrieval effectiveness, therefore giving a more accurate assessment of the wetland involvement. The following calculation was then used to determine the final percentages:

$$\left(\frac{\text{(Number of times wetlands and marshes mentioned)}}{\text{(Total words in section} - \text{Total common words in section)}}\right) \times 100$$

Figure 4.1 Equation used to calculate word cloud percentages

4.1.3 Multi-Criteria Analysis

The Novel Approach to Imprecise Assessment and Decision Environments (NAIADE) is a decision support software (Munda, 1995). This method is very effective in aiding with any decision or policy making processes, including finding alternatives, concerning the previous

subjects. It has also been used to deal with sustainability issues. NAIADE can provide a ranking of alternatives according to the set of evaluation criteria, indications of the distance of the positions of various interest groups, or a ranking of the alternatives to the actors' impacts or preferences. When working with this program, alternatives and criteria are entered and then run according to a multi-criteria or equity analysis. When the matrix is created, alternatives are evaluated by the specific criteria. The alternatives are valued using a pair-wise comparison, then aggregated, and finally given a ranking. This program was chosen due to its ability to use not only quantitative data but also qualitative, including "fuzzy" measurements such as linguistic evaluations; the fact that no weight is given to the criteria—everything is compared as equals; and finally that it gives a ranking to the alternatives (Russi & Tabara; Munda 1995).

In this research the multi-criteria analysis was used. The parishes were listed as the "alternatives" while the "criteria" included the answers to alll of the questions that were posed to each of the hazard mitigation plans. Word counts and frequencies were used for the number of times wetlands/marshes were mentioned, how many times CWPPRA and the State Mitigation Plan were mentioned, and if any of the hazard sections focused on wetlands (percentage from the word clouds). The hazard section data was then grouped together and assigned a linguistic measurement ranging from extremely bad (zero) to very good. The same principle applied to the wetland/marsh numbers. The groupings were created by using the mean function in Excel. Linguistic measurements were also used for the rest of the criteria, consisting of a "yes," "somewhat," or "no." After inputting the ten parishes and their critera, the multi-criteria analysis was run—creating a linear ranking of the alternatives/parishes.

4.2 Evaluating Factors Affecting the Wetland Ranking

4.2.1 Census Data

Census data was collected for the ten parishes in Louisiana for the year 2000. Table 4.2 lists each census factor used in this analysis, along with the specific Census table that needs to be examined to locate the variable on the Census website. These factors were derived from Cutter et al. (2003) in regards to social vulnerability and resilience. Researchers have agreed that a lack of resources and knowledge, limited political power, population growth, and socioeconomic factors such as income have shown to influence vulnerability (Cutter et al., 2003). Bendor et al. (2008) also states that socioeconomic variables, such as income and population density, can affect how the population values wetlands. While there are many other variables to choose from, these five where chosen for this small study. The population growth percentage was calculated by subtracting the 1990 population from the 2000 population, dividing by the 1990 population and then multiplying by 100 (Parker, 2002).

Table 4.3 Census 2000 Variables

Variable/Factor	Census Table
Income (per capita income, 1999)	Income, Money
Government Spending	Local Area Government
Education (% population over 25 with Bachelor's degree)	Education
Voter participation	Elections (CQ Press)/Population Estimates
1990 Population	Population-Total and Selected Characteristics
2000 Population	Population-Total and Selected Characteristics

All census data was collected from: http://censtats.census.gov/usa/usa.shtml

4.2.2 Wetland Data

The acreage of wetlands was found using the NOAA Coastal Services Center's C-CAP Land Cover Atlas (NOAA, 2011). Once in the viewer, Louisiana was selected along with each individual parish. The percentage of wetland coverage in the parish during 2006 was recorded. The most recent wetland coverage was used, compared to 2001 and 1996, as this acreage should be reflected in the most updated plans. The wetland percentage recorded relates to how much of the parish's land area that is physically covered by wetlands. The wetland land cover categories include: palustrine forested, palustrine shrub/scrub, palustrine emergent, estuarine forested, estuarine shrub/scrub, estuarine emergent, and unconsolidated shore. These categories were not taken into account; the percentage of wetlands comes from measuring the categories of wetlands as a whole entity. Tables of all the wetland data from the C-CAP database can be found in Appendix D.

4.2.3 Hazard Data

The last factor included in this research is the frequency of hazards within each parish. This variable includes the number of severe storms/thunderstorms, floods, coastal storms, and hurricanes that have occurred in the parish from 1960 to 2006. These data were collected from http://www.sheldus.org for the ten study area parishes. Cutter et al. (2003) suggested using hazard event frequency data to continue examining factors that may influence vulnerability in communities. Her suggested time scale of hazards recorded from 1960 onwards was also followed.

The ten parishes and the four hazard types were used for data extraction. These hazards were selected due to the fact that they affect or interact with wetlands in some form.

Thunderstorms were not included in the evaluation of the hazards affecting the parish but were included in this data because they can be a cause of flooding in certain parishes (Shaw Environmental & Infrastructure, Inc, 2009). The frequencies of these hazards are mentioned alongside the hazard identification section in the parish plans. The plans usually recount only the hazard events causing major damage, not every single event. Utilizing the SHELDUS™ data removed this discrepancy.

4.2.2 Statistical Analysis

The Statistical Package for the Social Sciences (SPSS), version 15, was used to analyze the data collected during this research. Due to the small sample size, cross-tabulation and correlations was utilized in order to determine any relationships between the influencing factors mentioned in 4.2.1 and the resulting NAIADE analysis in 4.1.3 (the wetland ranking). The cross-tab analysis includes Chi Square, Spearman, Pearson, Kendall's tau-b, and Somer's D calculations where significance will be shown as .05 or lower. For the Somer's D calculation, the wetland index was used as the dependent variable and all of the influencing factors (census data, wetland area, hazard data) as the independent variables. A bivariate, two-tailed correlation was conducted using Spearman, Pearson, and Kendall's tau-b calculations. This test compared all of the variables to each other, not just the wetland index.

CHAPTER 5: RESULTS AND DISCUSSION

5.1 The Wetland Ranking

The wetland ranking is based on the analysis of ten hazard mitigation plans. Table 5.1 shows the results of the questions posed to the plans (found in section 4.1.1) and the word cloud frequencies calculated using the equation in Figure 4.1. The full calculations, including common word removal, can be found in Appendix B. The wetland/marsh section along with the word cloud frequencies are color coded according to the linguistic rating given to that range of numbers, as shown in Table 5.2. The word cloud frequencies (Table 5.1) served as input data to the multi-criteria analysis run in NAIADE.

After conducting a search for the wetland/marsh terms in the plan, frequencies ranged from 40 to 105 mentions. When assigning these numbers to the linguistic characteristic, no "bad" linguistic terms (extremely bad, very bad, bad, more or less bad) were used. These are objective assignments but the mere mention of wetland or marsh should be deemed as a positive aspect, not negative. If any plans had not mentioned these terms at all, then their score would be tallied as "extremely bad." Even though 40 mentions of wetlands/marshes is not a high count in a 157 page document, it should be considered moderate since any acknowledgement is positive progress.

CWPPRA was only mentioned a maximum of 4 times for each plan. While this number is not high, the mention of it shows the acknowledgement of the agency. These frequencies led to the next criteria: collaboration with CWPPRA. After locating the "CWPPRA" terms, the surrounding context was examined to see if the parish was notably working or collaborating

with the agency. *Yes*, *Somewhat*, or *No* were the terms used to describe the collaboration. A "no" was only given if CWPPRA was not found to be stated in the plan. Most of the plans received a yes based on the explanation of what CWPPRA was doing and how the parish would continue their goals or aid with the projects in any way possible. When a plan "somewhat" collaborated with CWPPRA, this usually meant that a CWPPRA project was found in the project section with no explanation of why CWPPRA was mentioned; none of the agency's goals were stated or how the parish would use this valuable resource and contact.

The same type of "term" search was conducted for the state's Hazard Mitigation Plan (LA HMP) or the Comprehensive Master Plan for a Sustainable Coast. The comprehensive plan could not be found referenced in any of the parish plans but the state plan was mentioned in all but one parish plan. As mentioned previously, the comprehensive plan is referenced in the state plan (Louisiana's Office of Homeland Security and Emergency Preparedness, 2008), therefore tying the two documents together. The HMP was mentioned a max of five times in one of the plans, with all the other ranging below five, but some plans had a separate section or page dedicated to the state plan. This distinction reflects an awareness of the events happening not only in their parish, but their state, thus giving an overall view of the wetland protection and restoration events. This could entice and allow future collaboration between the state and parishes, and even parish to parish.

Figures 5.1-5.5 show the content analysis, using word clouds, of the five wetland focus sections in some of the parishes' past and present plans. These images are a visual representation of the wetland involvement percentage found in Table 5.1. Each plan is unique

Table 5.1 Data inputted into the multi-criteria analysis

	Cameron	Iberia	Jefferson	Lafourche	Orleans	Plaquemines	St. Bernard	St. Mary	Terrebonne	Vermilion
W+M	70	44	105	45	84	40	59	44	57	47
CWPPRA	2	0	3	4	3	4	2	4	2	4
Collab w	Somewhat	No	Yes	Yes	Yes	Yes	Yes	Yes	Somewhat	Yes
LA HMP	0	2	5	2	3	3	2	3	2	3
Hurrican	.039%	.189%	.042%	0%	.145%	0%	.082%	.253%	0%	0%
C Erosion	1.79%	1.19%	2.82%	1.06%	2.41%	1.33%	0*	.993%	0*	1.07%
Subsiden	1.79%	0*	.383%	1.31%	.242%	0*	0%	0*	1.33%	0*
Flood	.063%	.064%	.034%	.758%	.223%	.955%	.062%	.53%	.615%	.864%
S-H2O	0*	0*	0*	1.23%	0*	0%	2.54%	0*	0%	0*
Wet Sect	No	No	No	No	No	No	No	No	No	No
Maps	No	No	No	Yes	No	Yes	No	Yes	Yes	Yes
Assets	Yes	Yes	No	No	No	No	No	No	No	No
Projects	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes

Table 5.2 Linguistic classifications of multi-criteria analysis data

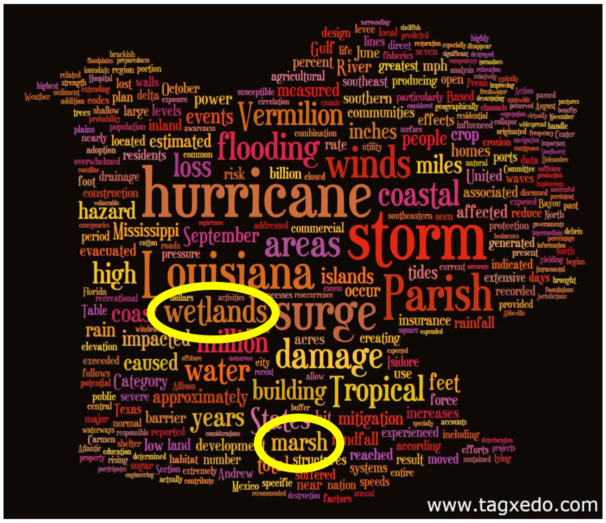
Linguistic Classification	Range of Percentage for Hazard ID	Range of Percentage for Wetland/Marsh
Extremely Bad	0	0
Very Bad	0.01% - 0.10%	
Bad	0.11% - 0.30%	
More or Less Bad	0.31% - 0.65%	
Moderate	0.66% - 1.0%	40-50
More or Less Good	1.01% - 1.25%	51-65
Good	1.26% - 1.80%	66-85
Very Good	1.81% upwards	86 onwards

* This parish did not have this specific hazard section, therefore the numbered entered into the analysis program was zero.

to the parish; this is seen in the lack of hazard identification for certain parishes and the process of combining two hazards into one section. The 2005 Vermilion plan included saltwater intrusion in the coastal erosion section; and the 2010 Cameron Parish plan combined coastal erosion and subsidence. Many of the parishes also merged storm surge into the hurricane section; if this was not done and two separate sections existed, then I physically combined the two sections together to try to keep some uniformity across the plans. The following figures and discussion depict a brief summary of the largest differences in the hurricane, coastal erosion, subsidence, flooding, and saltwater intrusion sections found when comparing the old and updated hazard mitigation plans.

The hurricane section in the 2010 Vermilion plan contained no wetland mentions, earning a score of 0% entered into the analysis. This is disheartening as previous research deems wetlands an important factor when dealing with storm surge and storm attenuation; the 0% can be seen in the constructed word cloud on the right (Figure 5.1). When compared to the 2005 word cloud on the left in Figure 5.1, the difference is highly noticeable. The terms wetland and marsh (circled in yellow) are clearly visible, indicating their prominent presence in 2005 and decline of involvement in five years.

In 2006, the coastal erosion section of Lafourche Parish contained over 50 combined mentions of wetland and marsh. Due to the large rate of usage, these terms are found in larger font in the left of Figure 5.2, circled in yellow. The right figure encompasses the 2010 updated section; one can see that the term “wetland” is not mentioned at all in this cloud, only marsh. The 2010 wetland inclusion rate is 1.06%, marking it as “more or less good.” This calculation,



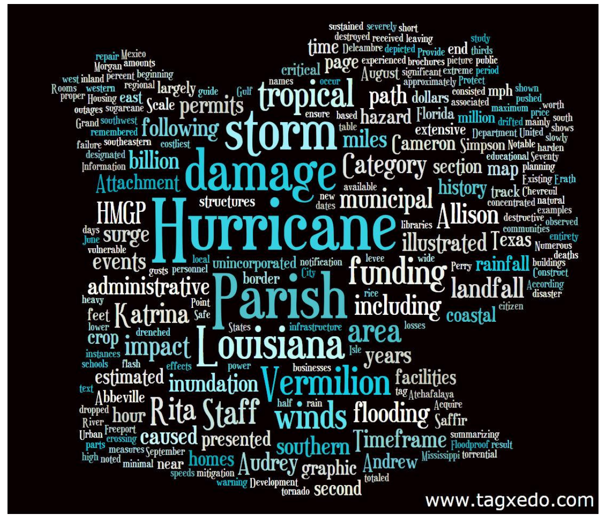


Figure 5.1 Comparison of 2005 (left) and 2010 (right) Hurricane section from Vermilion Parish

Figure 5.2 Comparison of 2006 (left) and 2010 (right) Coastal Erosion section from Lafourche Parish

Table 5.3 Common word removal and wetland focus percentages for 2010 Lafourche Parish

	wetland	marsh	wetland+marsh **(w+m)**	Total common words **(TCW)**	Total words **(TW)**	(w+m/TW-TCW)*100
Hurricane	0	0	0	[*]		0
Flooding	0	3	3	138	534	0.757576
Coastal Erosion	0	4	4	140	514	1.069519
Land Subsidence	5	2	7	220	756	1.30597
Saltwater Intrusion	2	8	10	358	1169	1.233046

highlighted in blue, can be seen in Table 5.3. This table also includes the percentages for every section examined in the Lafourche plan. Similar tables for every parish can be found in Appendix B. The word cloud comparison shows that while wetlands and marshes are still important in 2010, their presence has severely declined in four years. A quick calculation shows the 2006 coastal erosion section would merit a wetland/marsh rate of 3.79%, ranking it “very good” and the highest of any percentages used in the multi-criteria analysis.

The land subsidence sections for Terrebonne Parish’s 2005 and 2010 plans both incorporate wetlands into the section, but the words cloud yields a higher wetland usage in the 2010 update (Figure 5.3). Since the size of the term “wetland” has increased in five years, this also means that the wetland involvement rate has improved, resulting in a “good” score indicated by the percentage of 1.33. If the font size indicates importance then the improvement may have doubled. The Vermilion Parish plan includes another section showing great improvement in five years. The flooding section in 2005 has no clear signs of wetland or marsh stated in the hazard identification discussion. However, the 2010 plan shows a 0.86% wetland

[*] Gray boxes indicate that this number does not need to be tallied

involvement, visible in the yellow circle to the right in Figure 5.4. This discovery shows positive progress and that wetlands are becoming more involved in the fight against inundation in Vermilion Parish.

The last section, saltwater intrusion, shows another decrease in wetland importance over five years. The Terrebonne Parish plan solidifies this example, seen in Figure 5.5. Marshes and wetlands are highly integrated in the discussion, as they are easy to point on in the 2005 word cloud (circled in yellow), while the 2010 is severely lacking. The updated saltwater intrusion section contains no wetland mention, meaning it has a 0% score in the multi-criteria analysis. This is a severely drastic change from 2005 and merits concern over what is happening in the wetlands and if the parish is aware of saltwater intrusion consequences. These examples are just a sample of the parishes with drastic changes. Some parishes have changed for the better in four to five years, increasing the number of times wetlands/marshes are mentioned and possibly integrating or protecting these areas more efficiently. Parishes have also declined in their use of wetlands or extricated these terms completely while other parishes tend to have the same amount of wetland integration over the years. All of the word cloud comparisons can be found in Appendix A.

Each parish decides what specific hazards to identify as potentially harmful to their community. As seen in Table 5.1, only four parishes created an individual section for saltwater intrusion as a hazard affecting their area. Of these four, only two sections mentioned wetlands and marshes. A “0%” in the table indicates that the parish identified the specific hazard in their plan but there were no findings of marshes or wetlands. A “0^*” indicates that this plan did not

Figure 5.3 Comparison of 2005 (left) and 2010 (right) Land Subsidence section from Terrebonne Parish

Figure 5.4 Comparison of 2005 (left) and 2010 (right) Flood section from Vermilion Parish

Figure 5.5 Comparison of 2005 (left) and 2010 (right) Saltwater Intrusion section from Terrebonne Parish

contain an individual identification section concerning that hazard. Hurricanes and floods were identified in every plan as a potential hazard to the community, but the other hazards varied across the coast. After hurricanes and flooding, coastal erosion is talked about the most, followed by subsidence and lastly, saltwater intrusion. Every flooding section contained some mention of marshes and wetlands, as none of the calculations were ever zero. The highest percentages of wetland and marsh involvement can be seen in the saltwater intrusion and coastal erosion sections.

None of the updated hazard mitigation plans contained a separate wetland section; this criterion turned out to be unnecessary. The search for a wetland section was conducted to see the extent of wetland knowledge within the plans. A wetland section would, ideally, talk about what's going on with the wetlands within that parish—the acreage, where they are located, how much have been lost and under what circumstances, and what is being done to protect and restore these areas. Maps would also be another good inclusion in this section. Even though the plans lacked a section of this sort, wetlands and their attributes were described

elsewhere in the plan. Some plans had extreme detail about wetlands, such as the coastal erosion/subsidence section found in the 2010 Cameron Parish plan. The knowledge was scattered, mainly throughout the background and any history for the hazard identification sections. It would have been beneficial if this information was consolidated into one cohesive area.

Half of the plans lacked descriptive maps of wetlands found within the parish. Five plans contained at least one, maximum two, maps containing wetland area and portrayal. Due to the lack of difference between having one or two maps, the criteria entered into the analysis merely stated “yes” or “no” concerning the inclusion of maps. The wetland area was found to be an element in land use maps for the parish or community. Upon further investigation it was found that the five plans that contained maps were constructed by the same company: Shaw, Inc. This can be seen by comparing Table 4.1 and Table 5.1. Two plans were written by other contractors, and the remaining three were completed within the parish itself.

In order to find the assets listed for each parish, the vulnerability section of the risk assessment was examined. One purpose of the risk assessment is to identify vulnerable structures in the parish and estimate potential losses due to each hazard. The losses are tallied in monetary value, which can aid in determining what kind of mitigation actions may be needed or used in the future (FEMA, 2008). While wetlands are not a “structure,” they are still a valuable resource. Listing wetlands as an asset would mean the parish is acknowledging their benefits and any protection or restoration efforts. Ideally, describing the wetland as an asset

would include their acreage, past damage, future threats, along with past, current, and future efforts to utilize and protect their beneficial qualities.

Only two parishes, Cameron and Iberia, listed wetlands as assets. Cameron Parish contains a table listing types of land labeled "real property" that includes freshwater, brackish, and salt water marshes. Each asset lists the acres, taxable value, and total assessed value. While wetlands were listed as assets, there was a lack of focus on what kind of damage hazards could do to these ecosystems and what mitigation actions could be taken. Iberia Parish identified the Marsh Island Wildlife Refuge and Bayou Teche as assets, both containing some form of marshes. The Marsh Island Wildlife Refuge was not mentioned again, and therefore no history of damage or actions to protect it was stated. Bayou Teche is not just a "bayou" but also a settlement area/community, so it was mentioned numerous times. Many buildings, structures, and people are located in the Teche area so the plan covered more hazard history, but nothing was said in regards to wetlands.

The last element inputted into the multi-criteria analysis involved any wetland projects mentioned within the plan. These projects are usually found within the mitigation action section or among a table that lists all the projects occurring within the parish. In order to lessen the possible losses discussed in the risk assessment, the creation of mitigation strategies is required according to Section 201.6 (c)(3) of the mitigation planning regulation (FEMA, 2008). Examples of mitigation actions include raising buildings, creating warning systems, educating the public, improving drainage, restoring marshland, and many more. Many of the wetland mitigation actions can be found under the Coastal Wetlands Planning Protection and

Restoration Act (CWPPRA), Coastal Impact Assistance Program (CIAP), or Coastal Protection and Restoration Authority (CPRA). An example of this categorization can be seen in Figure 5.6; this format is not required but is seen most often from Shaw, Inc. Almost all of the projects involving wetlands or marshes are not available for HMGP funding; the project is most often funded and led by CWPPRA, CIAP, or CPRA. Sometimes the funding is not 100% secured, so the project may not be off the ground or paused to find more monetary back-up. Only two parishes, Cameron and St. Bernard, lacked projects involving wetlands or marshes. Due to the size of the mitigation action sections and time constraints, no difference was calculated if a parish only had one wetland project compared to another having 25; this led to a simple "yes" or "no" inputted into the analysis.

Attachment c3-1
Plaquemines Parish List of Projects

Plaquemines Parish Hazard Mitigation Plan Update
Initial List of Projects

Source	No.	Project
Coastal Wetlands Planning Protection & Restoration Act		
A	1	Chandeleur Islands marsh restoration overview
	2	Mississippi River sediment trap overview
	3	Pass-a-Loutre Crevasse overview
	4	Periodic introduction of sediment and nutrients at selected diversion sites demonstration overview
	5	Beneficial use of hopper dredged material demonstration overview
	6	Benneys Bay diversion overview
	7	Channel Armor Gap Crevasse overview
	8	Delta Wide Crevasses overview
	9	Dustpan maintenance dredging operations for marsh creation in the Mississippi River Delta demonstration
	10	West Bay sediment diversion overview
Coastal Impact Assistance Program		
B	1	Bayou Lamoque Floodgate Removal for new marsh creation
	2	East Grand Terre Island Restoration of breaches and tidal inlets of shoreline
	3	Fringe marsh repair program for restoring marsh lands
	4	Mississippi River long distance sediment pipeline for creation of marsh and ridge habitat
	5	Jump basin dredging and marsh creation
	6	Tidewater Road Flood Protection
	7	Beneficial use of dredged material program for restoring marshes
	8	Grand Bayou ridge restoration for marsh lands
	9	Bayou Grand Liard Ridge Restoration for the creation of marshes
Coastal Protection and Restoration Authority		
	1	Lake Pontchartrain Barrier Plan: Caernarvon to Pearl River Hurricane Protection
	2	Caernarvon to White Ditch Hurricane Protection
	3	Pointe a la Hache to Phoenix Hurricane Protection
	4	St. Bernard 40 Arpent Levee
	5	Raise/Maintain Evacuation Routes Located Outside the hurricane Protection Systems
	6	Mississippi River Diversion at Hope Canal
	7	Close MRGO at bayou La Loutre Ridge
	8	MRGO Shoreline Stabilization
	9	Central Wetlands Restoration
	10	Modify Authorization of Caernarvon Diversion
	11	Maintain and Restore the Breton Sound Marshes

Figure 5.6 Example of mitigation projects listed in a parish plan

After inputting the previous data into the multi-criteria analysis program, the wetland ranking was produced. A snapshot of the analysis output can be seen in Figure 5.7 along with simplified rankings in Figure 5.8. The multi-criteria results produce two rankings; one based on the "better and much better" preference relations, labeled ϕ+, along with one based on the "worse and much worse" preferences, labeled ϕ-. Both rankings give a value ranging from 0 to 1, indicating how '*a*' (in this case, the parish plan) is better or worse than the other alternatives. The ϕ+ ranking shows the alternative winning more pairwise comparisons while ϕ- shows the alternative losing less pairwise comparisons (Joint Research Centre, 1996). In both rankings Lafourche Parish comes out on top (1^{st}), and Terrebonne Parish is ranked 7^{th}. This means that Lafourche won the most comparisons and lost the least. The ϕ+ ranking can be verbalized by saying that Lafourche won more comparisons than Jefferson, Jefferson more than Plaquemines, and so on. The ϕ- ranking reads as Lafourche lost fewer comparisons than Plaquemines, Plaquemines less than Vermilion, and so on. The top parish (seen in green on Figure 5.8) is considered the best and therefore ranked 1^{st}, while the worst plan is seen in red and ranked 10^{th}.

5.2 Influencing the Ranking

The next section of this research tries to explain and discern why each plan received the wetland ranking determined by NAIADE. Different factors, including census, wetland, and hazard data, were examined to see if there are any trends between these datasets and the wetland ranking (Table 5.3). Table 5.3 contains the wetland ranking (ϕ+) along with the values for each influencing factor. Only the ϕ+ ranking was used since this research wants to focus on

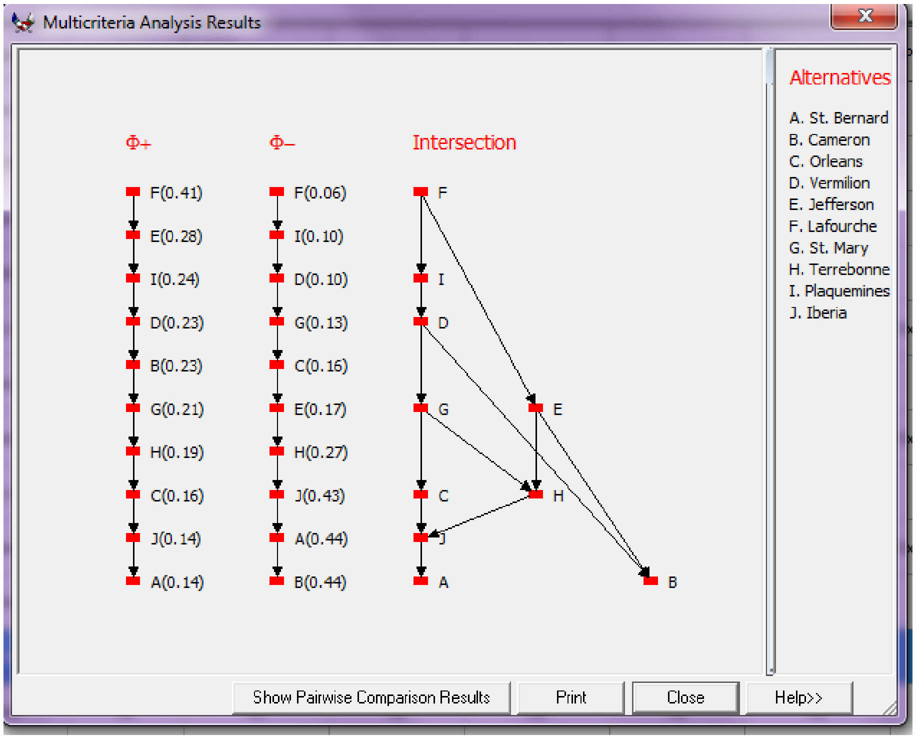


Figure 5.7 Snapshot of NAIADE ranking results

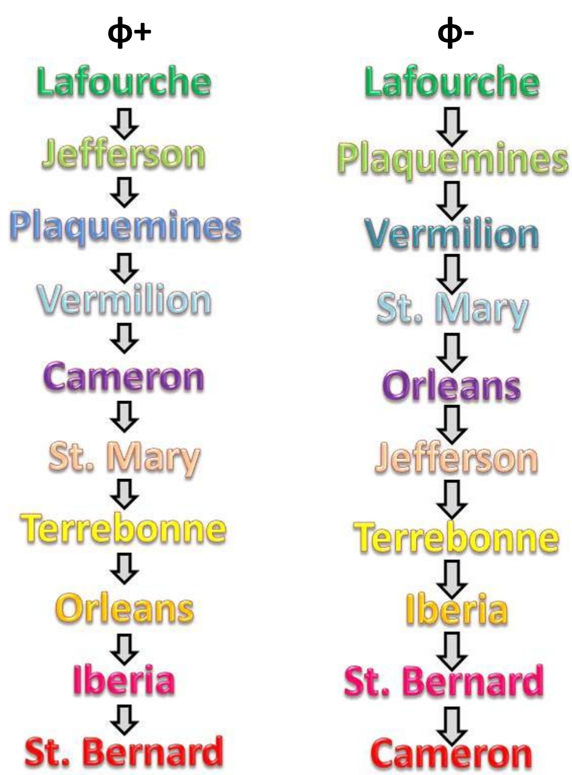


Figure 5.8 Final wetland ranking

the "better" plans that won more comparisons. The colored squares are meant to aid in the ease of visualizing any correlations and pertain to whether this value is in the high, medium, or low range. These ranges are only relative to this specific area's data and are not compared to any other parishes or states. The ranges were determined using the median function in Excel and grouping similar numbers together. Voting percentage is not colored due to the non-varying range between parishes.

After running the correlation and cross-tab analysis, only one of the influencing factors significantly affected the wetland ranking. The number of hazards occurring in the parish from 1960-2000 created a 0.049 significance rate using Somer's D and Kendall's tau-b, as seen in Tables 5.4 and 5.5. With a negative correlation, this means that the plans ranked higher, and therefore containing more wetland involvement, experienced more hazards over the 46 year period. No other factors were considered significant, but the parish budget was starting to trend with the ranking, having a significance of 0.126; this can be seen in Tables 5.6 and 5.7. This relation also gave a negative number, indicating a higher budget goes along with a higher ranking plan. All of the statistical results can be seen in Appendix C.

It is interesting and significant that none of the other factors correlated with the wetland ranking. At the start of this research, an area of curiosity involved the acreage of wetlands found within each parish and if this percentage would have any effect on how involved the protection, restoration, and utilization of wetlands was within the plan but with a p-value of only 0.334, there seems to be no connection. This was an area of interest due to the mass coverage of wetlands in many of the parishes; the percentages can be seen in Table 5.4.

Table 5.4 Wetland Ranking compared to Influencing Factors

	Cameron	Iberia	Jefferson	Lafourche	Orleans	Plaquemines	St. Bernard	St. Mary	Terrebonne	Vermilion
Wetland Index # (ϕ+)	**5th**	**9th**	**2nd**	**1st**	**8th**	**3rd**	**10th**	**6th**	**7th**	**4th**
Income	15,348	14,145	19,953	15,809	17,258	15,937	16,718	13,399	16,051	14,201
Wetland acreage (%)	55.55	33.58	27.54	50.71	25.16	25.08	20.92	44.49	45.80	35.10
% Population Growth (1990-2000)	7.89	7.28	2	4.79	-2.47	4.62	0.897	-7.895	7.75	7.495
Education (%)	7.9	11.2	21.5	12.4	25.8	10.8	8.9	9.4	12.3	10.7
Voting (%)	41.9	41	39.3	38.3	37.4	40.9	42.6	40.8	35.1	41.3
Budget	$4,794	$2,718	$3,193	$3,590	$3,253	$4,123	$1,983	$3,983	$3,816	$2,398
# hazards (1960-2006)	106	102	150	143	112	101	97	103	140	115

High	Medium	Low

As seen in Figures 5.9 and 5.12, wetlands cover half of Lafourche Parish. These figures, obtained from NOAA's C-CAP Land Cover Atlas, give a comprehensive picture of what's been happening with and to the parish's wetlands in the past 10 years. All of these figures for each parish can be found in Appendix D. Figure 5.9 shows the expansive coverage of wetlands within the parish; any shade of purple (most noticeable being bright purple) depicts a type of wetland; a full key can be found in the appendix. Figures 5.10, 5.11, and 5.13 show that wetlands in Lafourche Parish are not changing that much; only 5 square miles were lost in 10 years. Figures 5.13 and 5.14 break down the wetland losses and gains. Only palustrine emergent wetlands gained land while developed areas changed to wetlands.

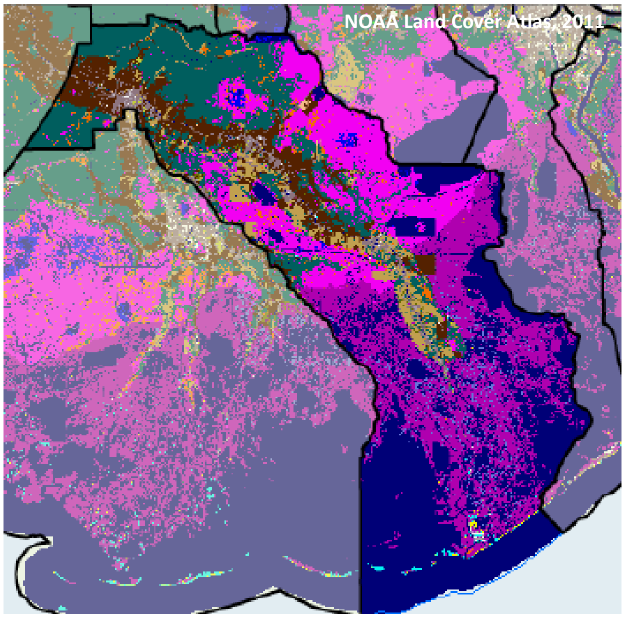
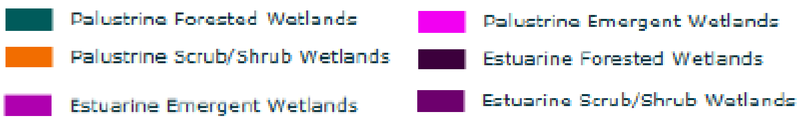


Figure 5.9 2006 Land cover map of Lafourche Parish



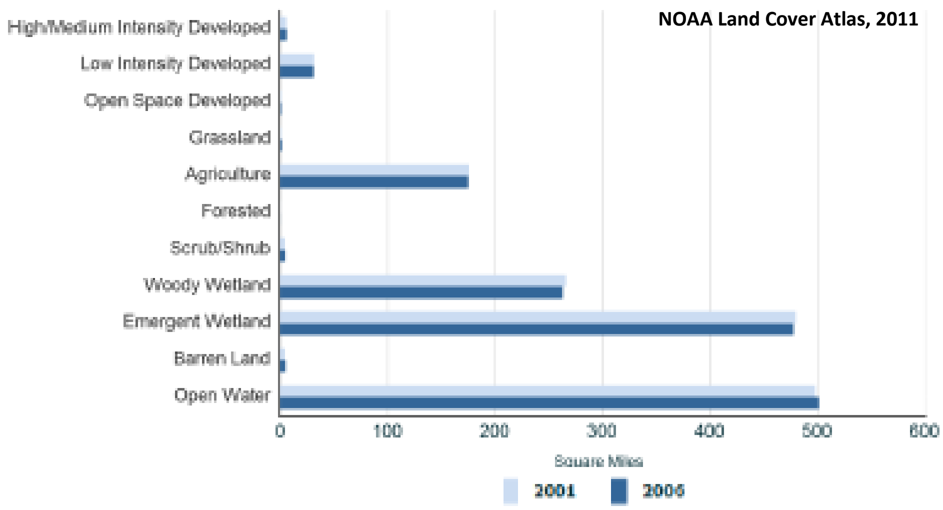


Figure 5.10 2001-2005 Land cover basics of Lafourche Parish

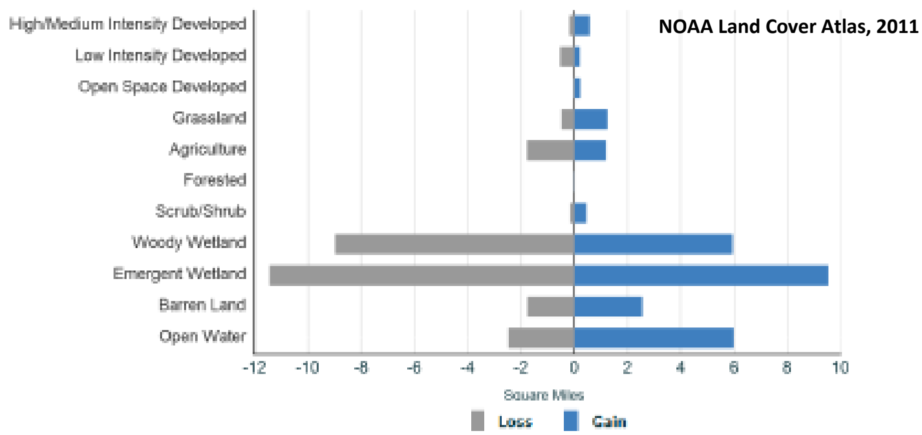


Figure 5.11 1996-2006 Net change in Lafourche Parish

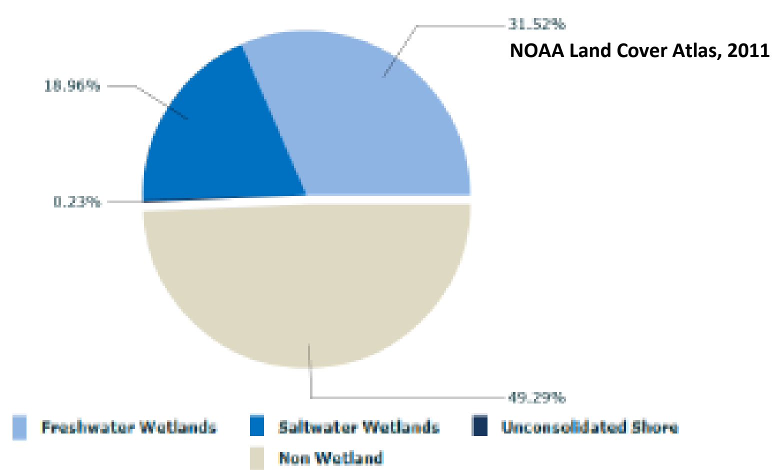


Figure 5.12 In 2006, 50.71% of Lafourche Parish is wetland.

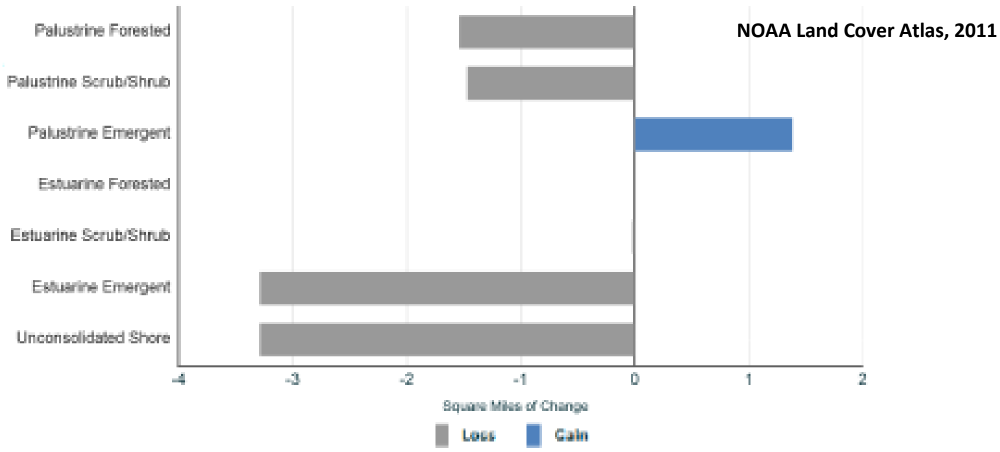


Figure 5.13 1996-2006 Wetland change in Lafourche Parish. 5.24 mi^2 were lost.

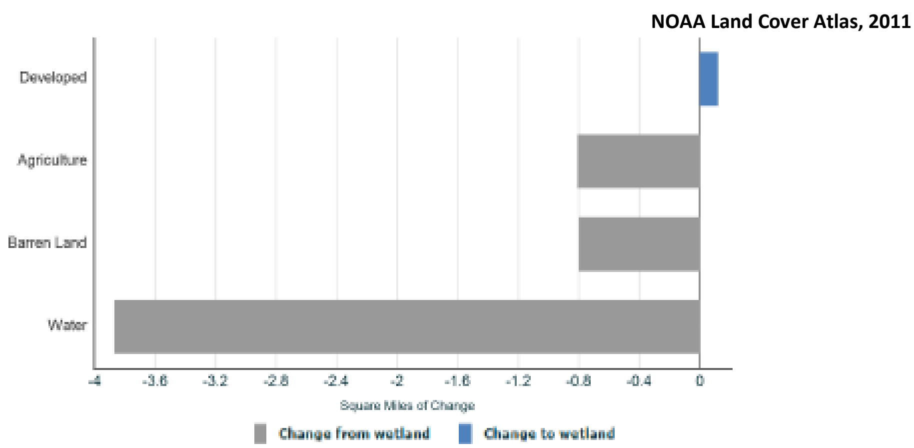


Figure 5.14 1996-2006 Change to or from wetland in Lafourche Parish

However, there may be some discrepancy in wetland acreage compared to other sources, especially within the plans. NOAA's parish boundaries also include a large amount of open water. As this particular field of data increases the land area within the parish it may also decrease the wetland percentage, possibly giving a false sense of coverage. One example of a discrepancy can be seen in Figure 5.15. As seen in the figure, the NOAA classification extends out into the Gulf, while the "typical" parish boundary (on right) found on most maps hugs closer

to the actual land area. This large difference in land area could increase Plaquemine's wetland acreage, possibly above 30%; this increase would move the parish into the "medium" category, as seen in Table 5.3.

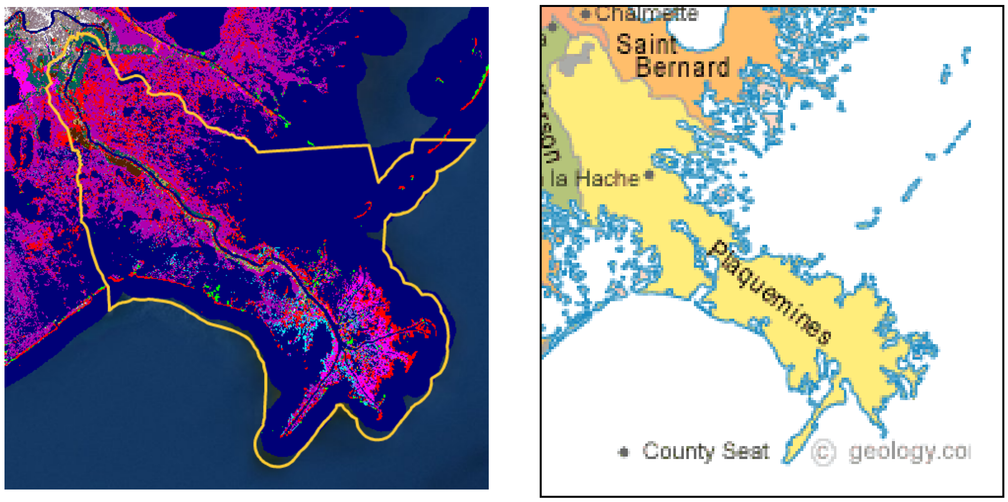


Figure 5.15 Comparison of Plaquemine's NOAA parish boundary on left (http://www.csc.noaa.gov/ccapatlas/#app=53cc&b8de-selectedIndex=3) and typical parish boundary on right (http://geology.com/county-map/louisiana.shtml)

Other interesting correlations can be seen in Table 5.8. This table lists other significant, or trending toward significant, values when comparing all of the influencing factors to each other, not just against the wetland ranking. The complete tables of these calculations can be found in Appendix C. Almost all of the pairings had at least two tests showing significance or trending toward a significant number. Of the three factor pairings that showed significance on all three tests, the most interesting includes the negative correlation between the number of hazards occurring in the parish and the percentage of the population that voted. If this correlation runs true, it would be intriguing to discover why areas being hit harder by nature

are not exercising their legislative rights. But, as mentioned before, the voting percentages did not differ greatly between these 10 parishes so this correlation may be misleading.

Many of the correlations that are interesting in terms of this research include anything to do with the number of hazards or wetland acreage in the parish. An oddity can be seen by the positive correlation between the amount of wetlands in the parish and the population growth over 10 years. One would assume that wetland area would be decreasing as the population increases due to the growing need of more land to support a larger population; but this assumption is not supported by the current numbers. An exciting and encouraging correlation appears between the number of hazards hitting the parish and the amount of wetlands found in that parish. This means that there are more wetlands available to be used as protection against the constant storms hitting the area; but this also conveys the danger these precious ecosystems are in since they are constantly exposed to damaging hazards.

Table 5.5 Directional Measures of the Wetland Ranking vs Number of Hazards.

			Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	-.467	.237	-1.970	.049
		Wetland_Index Dependent	-.467	.237	-1.970	.049
		# hazards 1960-2006 Dependent	-.467	.237	-1.970	.049

Table 5.6 Symmetric measures of the Wetland Ranking vs Number of Hazards.

		Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal	Kendall's tau-b	-.467	.237	-1.970	.049
	Spearman Correlation	-.600	.276	-2.121	.067(c)
Interval by Interval	Pearson's R	-.578	.219	-2.003	.080(c)
N of Valid Cases		10			

Table 5.7 Directional Measures of the Wetland Ranking vs Budget

			Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	-.333	.218	-1.531	.126
		Wetland_Index Dependent	-.333	.218	-1.531	.126
		Budget Dependent	-.333	.218	-1.531	.126

Table 5.8 Symmetric Measures of the Wetland Ranking vs Budget

		Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal	Kendall's tau-b	-.333	.218	-1.531	.126
	Spearman Correlation	-.358	.301	-1.083	.310(c)
Interval by Interval	Pearson's R	-.402	.220	-1.242	.250(c)
N of Valid Cases		10			

Table 5.9 Significant correlations among other influence variables.

Influencing Factors	Significant P-Value	(+) or (-)	Correlation
% Bachelor's & Per Capita Income	0.029	Positive	Pearson
	0.128	Positive	Kendall's Tau-b
	0.117	Positive	Spearman's
Wetland Acreage & Budget	0.050	Positive	Pearson
	0.150	Positive	Spearman's
% Voting & % Bachelor's	0.114	Negative	Pearson
	0.016	Negative	Kendall's Tau-b
	0.004	Negative	Spearman's
# Hazards & % Voting	0.029	Negative	Pearson
	0.089	Negative	Kendall's Tau-b
	0.054	Negative	Spearman's
Wetland Acreage & % Pop Growth	0.060	Positive	Kendall's Tau-b
	0.074	Positive	Spearman's
# Hazards & Wetland Acreage	0.089	Positive	Kendall's Tau-b
	0.150	Positive	Spearman's
# Hazards & % Bachelor's	0.060	Positive	Kendall's Tau-b
	0.060	Positive	Spearman's
Wetland Acreage & Per Capita Income	0.162	Negative	Spearman's

CHAPTER 6: CONCLUSIONS

This research utilizes a combination of qualitative and quantitative methods related to hazard mitigation and plan assessment along with other non-traditional methods that will help to further evaluate future hazard mitigation plans and mitigation measures. By combining the North Carolina Emergency Management Division's (2000) suggestion of examining individual mitigation measures, Berke and Godschalk's (2008) idea of internal plan quality, Munda's (1995) decision making software, and Cutter's (2003) notion of creating an index and determining its influencing factors, a new way to dissect, examine, and assess mitigation measures was explored. To create a new way of looking at the "internal plan quality," the less conventional method of content analysis and word count frequencies was used while also creating visual representations of these counts through word clouds. This research gives insight into how to take many methods and ideas from all aspects of science and put a new spin on them by merging the concepts into a uniquely coherent design.

According to the ranking, Lafourche and Jefferson parish incorporate wetlands into their plans more than any other parish while Iberia and St. Bernard fall short of utilizing wetlands as mitigation measures. Although the number hazards occurring in each parish was the only factor found to influence the wetland ranking, it was an important factor. Encouragingly, the parishes experiencing more hazards are, at the least, mentioning more wetlands in their hazard mitigation plans. While this wetland incorporation is not concrete evidence, it increases positive speculation that the hard hit parishes are utilizing wetlands as a natural means of protection. Wetlands should not be the *only* means of protection, other mitigation measures

outlined in the plans should also be followed, but they are a good starting point and as many researchers have said "wetlands are the first lines of defense against hurricanes."

Finding no other correlations with the wetland ranking is not disheartening, but a step toward the future of evaluating hazard mitigation measures, especially in terms of wetlands. The lack of correlations may be due to the small sample size of ten parishes; a larger sample size of other coastal parishes or counties along the Gulf of Mexico, including some "inland" regions may result in more pronounced relationships. Another discrepancy is found in the usage of only seven influencing factors; other interactions may be available when using more variables, as seen in Cutter's (2003) vulnerability index.

Interestingly, the amount of wetlands found in each parish did not seem to affect the wetland ranking and overall involvement of wetlands within each parish's plans. This is a significant finding and deserves further research with larger sampling sizes and more comparison variables. When examining the correlations of influencing factors to other influencing factors, it is observed that wetlands are connected with other variables, such as the number of hazards, per capita income, population growth and budget. These linkages can each be examined to determine and describe any further relationships. Future research should also involve the number of hazards a parish experiences and its correlation with the percentage of the population that is voting and the residents that have obtained a bachelor's degree. Some of these correlations cannot be explained easily and therefore deserve further examination. Additional research could focus on the connection of social capitol, wetlands, and local communities. As Berke et al. (2008) state, "social capitol is a key source of community capacity

for change;" this could bring about the idea of wetlands contributing to social capitol and the overall resiliency of the community. While no correlations were run against the results of the social vulnerability index created and explained by Cutter et al. (2003), there are obvious trends that run true and give way to further research. The 2000 SOVI results labeled Lafourche parish as a less vulnerable area and St. Bernard parish as highly vulnerable (Cutter & Emrich, 2006). These two parishes were at the highest and lowest tier in the wetland ranking created in this research, respectively. Not every parish followed this trend but these relationships should be tested; further research could indicate that wetlands do indeed reduce an area's vulnerability to disasters, physically and socially.

Further tweaking of this research approach could result in a more detailed outline and evaluation of a plan's mitigation measures in regards to wetlands. Different methods should be explored in regards to creating a ranking or index, such as factor analysis and weighted variables, along with a variety of more census and influencing variables. Word clouds and counts are only one way to determine what is in a plan; more focus should be put on the contents of the plan, such as the actual number of mitigation strategies, especially wetland projects, within the parish. The wetland projects need to be researched to determine where their funding is coming from and if the projects have been approved. Research should also include tracking the status of the wetland projects; this encompasses their progress, effectiveness, efficiency and overall completion. Another way to monitor wetlands within the parish includes examining the wetland restoration efforts along with the strategies proposed in the individual hazard mitigation plans. Following their progress will illuminate whether the

parish is improving each year, if they are meeting their strategic mitigation goals, and creating adaptive means to deal with future hazards. Overall, this will give a better summary of how wetlands are being utilized in the parish and state, and what agencies are working together towards the goal of a sustainable coast.

A confounding factor to consider when seeing the lack of wetland involvement in the plans is the political aspect. Mitigation plans must follow strict guidelines in order to receive approval from FEMA; while FEMA encourages other strategies and information not required in the plan, many planners may feel it costs too much time and energy to go the extra step. This extra or unique information may apply to wetlands used as a new mitigation measure. Stakeholders, local government, bureaucrats, site specific experts, and planners are all part of the planning process and therefore have a say in what the plan will include and cover. The idea of wetlands could become lost through all of the ideas, opinions, intent, and agendas put forth by the creators. Other aspects become more important and urgent, and therefore jump ahead of these precious and useful ecosystems.

This research is only the first step in evaluating individual mitigation measures that will ultimately help to reach the goal of restoring, protecting, and preserving our coast; this is not a "good" or "bad" evaluation, it does not show their success rate, only the presence of a mitigation measure as a plan component. Ideally, these smaller evaluations will eventually become part of the success measuring process used for the entire plan and help future communities become more resilient by using wetlands to overcome vulnerabilities due to coastal hazards.

There are continuing efforts going towards the restoration and protection of wetlands in Louisiana at the state and federal levels. This research gives rise to what is happening within the local level. Results show that while there is wetland involvement in the parish hazard mitigation plans, it is sparse and not well connected to the state goals. Wetlands are being recognized but not at the level they deserve, especially in the vulnerable coastal parishes. Many researchers (Mitsch & Gosselink, 2000; Wilkins J. G. et al., 2008; Galloway et al., 2009) and local residents (National Wildlife Federation, 2011) agree that wetlands are a vital step in protecting communities against hurricanes, yet the content analysis and word clouds created in this research show that there is little to no focus concerning wetlands within the hurricane sections. Hopefully this research will help future legislators and decision-makers collaborate with other agencies to fulfill wetland projects and go the extra mile to include wetlands as a new and adaptive way to mitigate against future hazards. As one of the National Wildlife Federation interviewees stated, “if we do nothing, then we will be left with nothing.” Wetlands must be a critical part of the arsenal used to preserve and protect coastal Louisiana against the relentless onslaught of coastal hazards.

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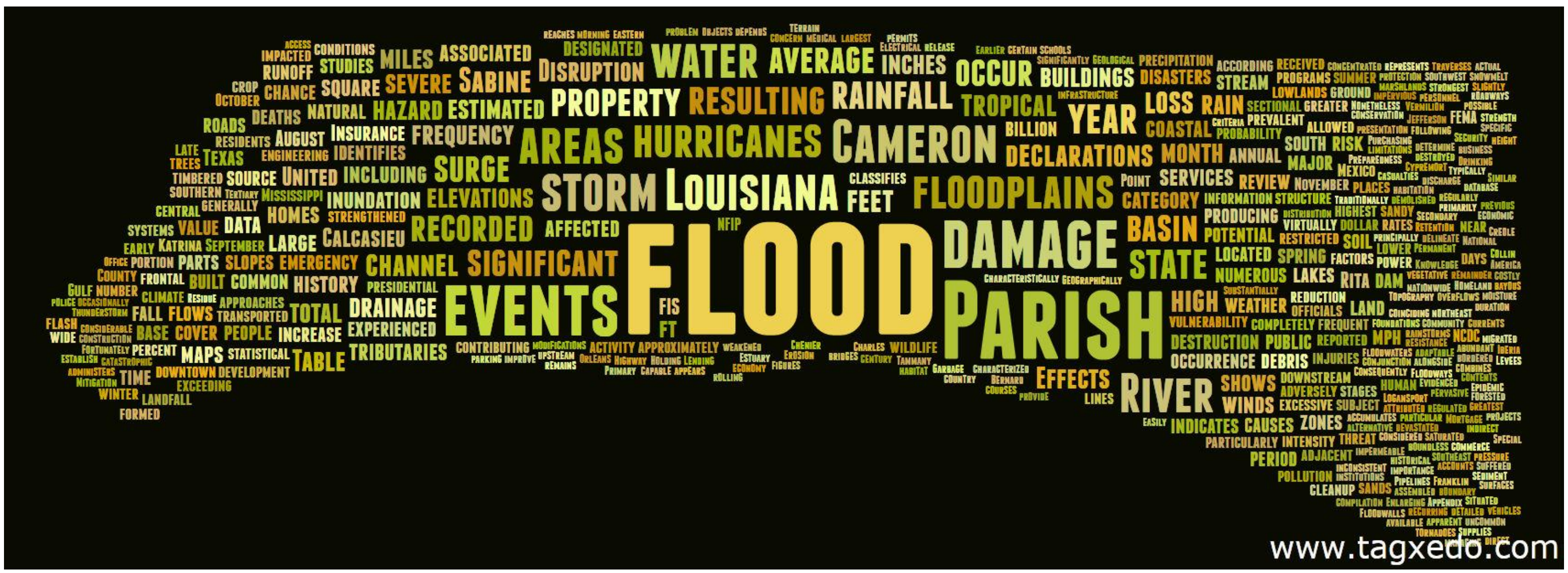
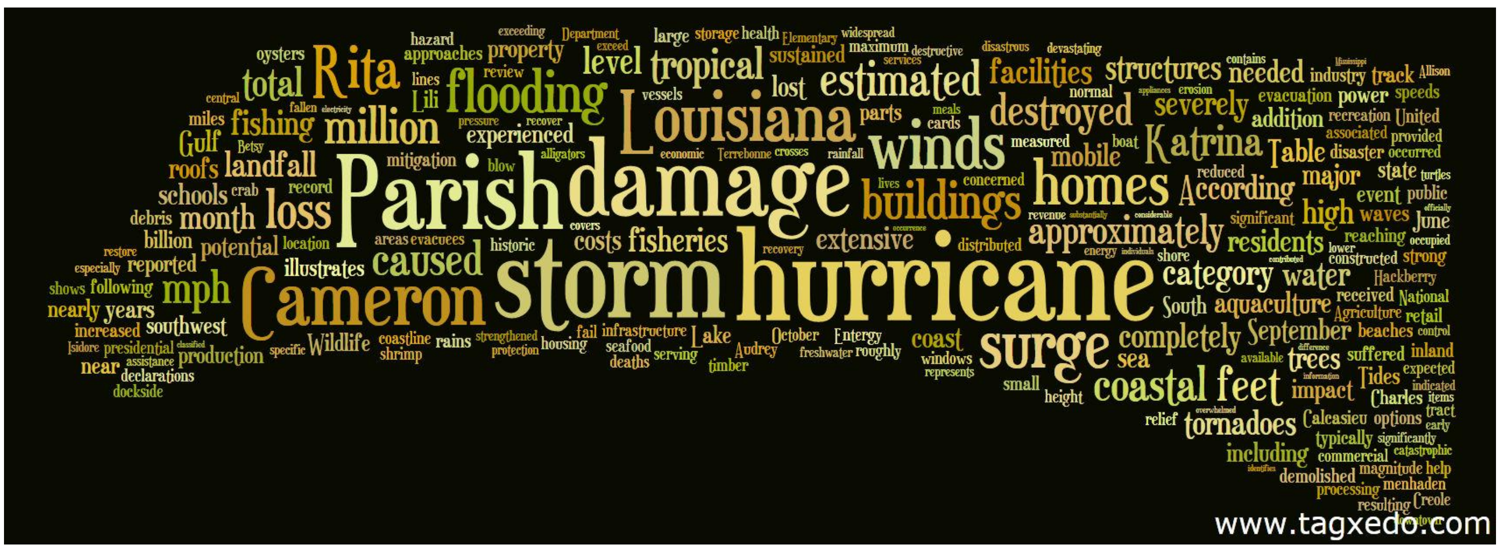
APPENDIX A: WORD CLOUDS

2006 Cameron Parish: Flooding

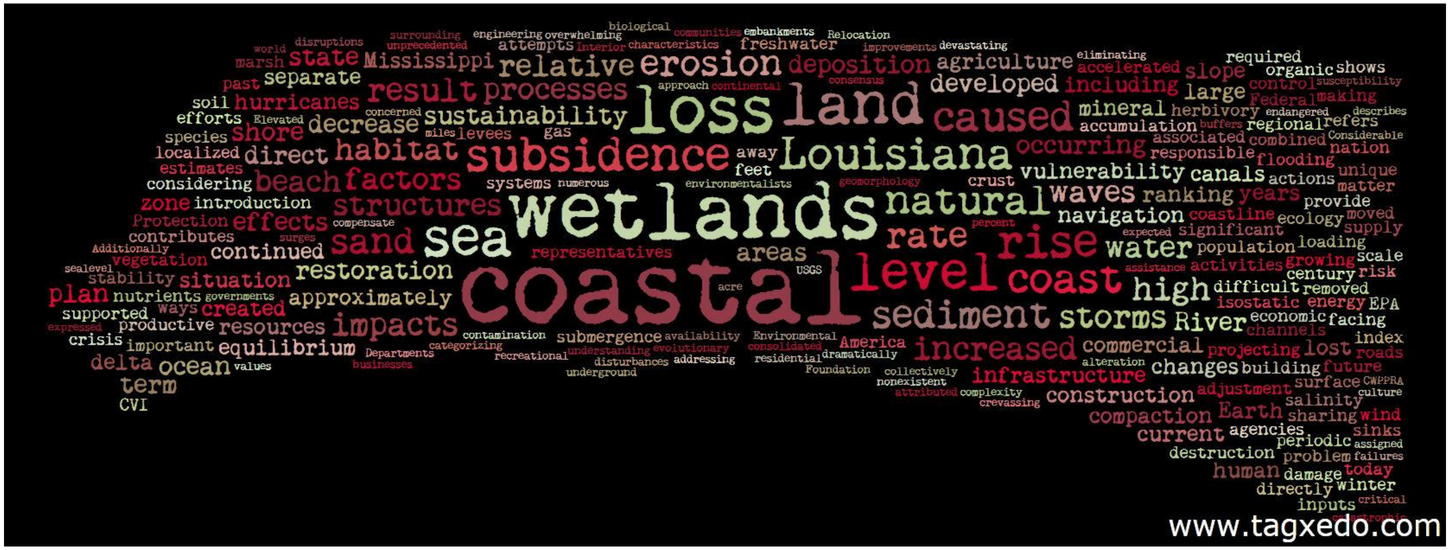


2010 Cameron Parish: Flooding

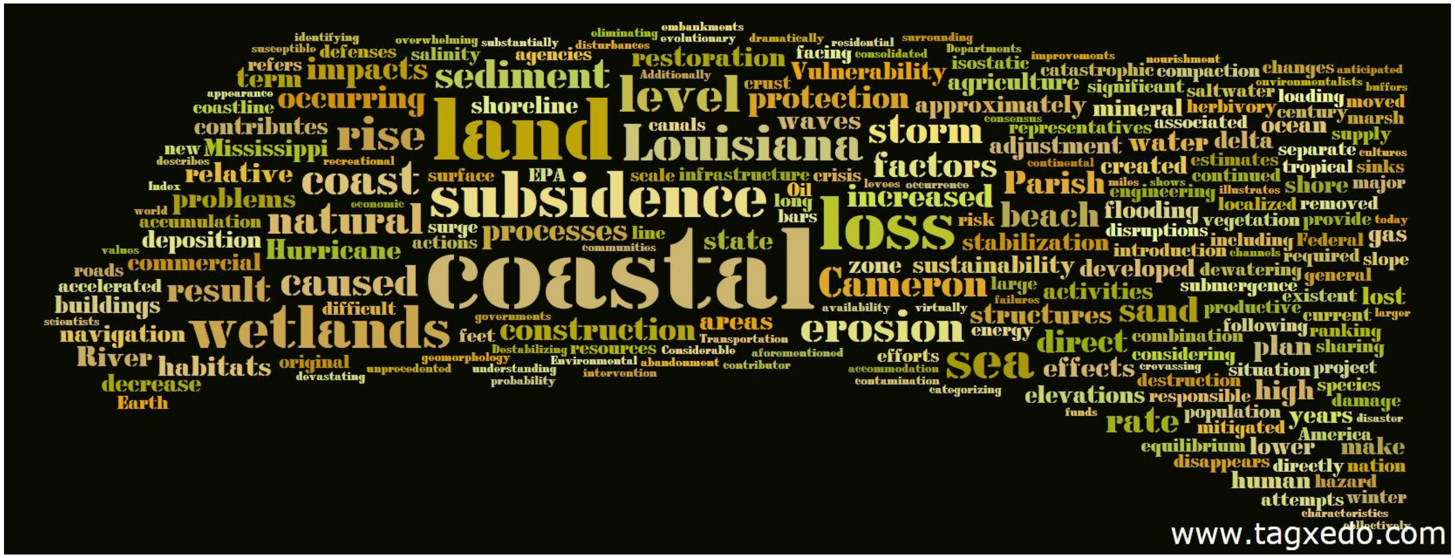
2006 Cameron Parish: Hurricanes



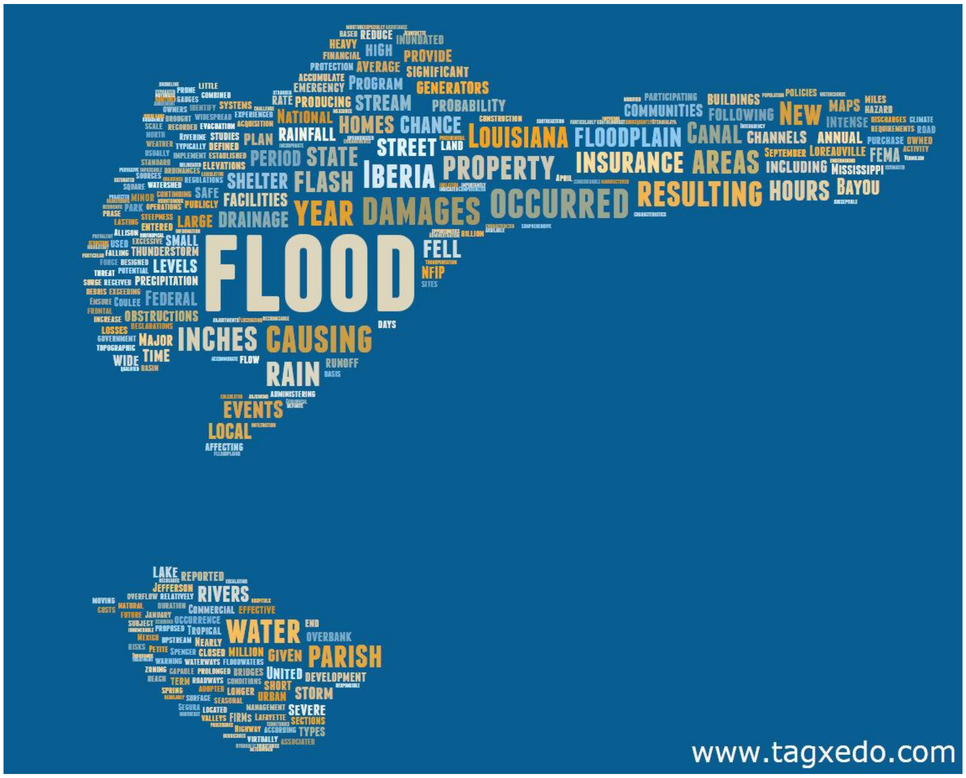
2010 Cameron Parish: Hurricanes



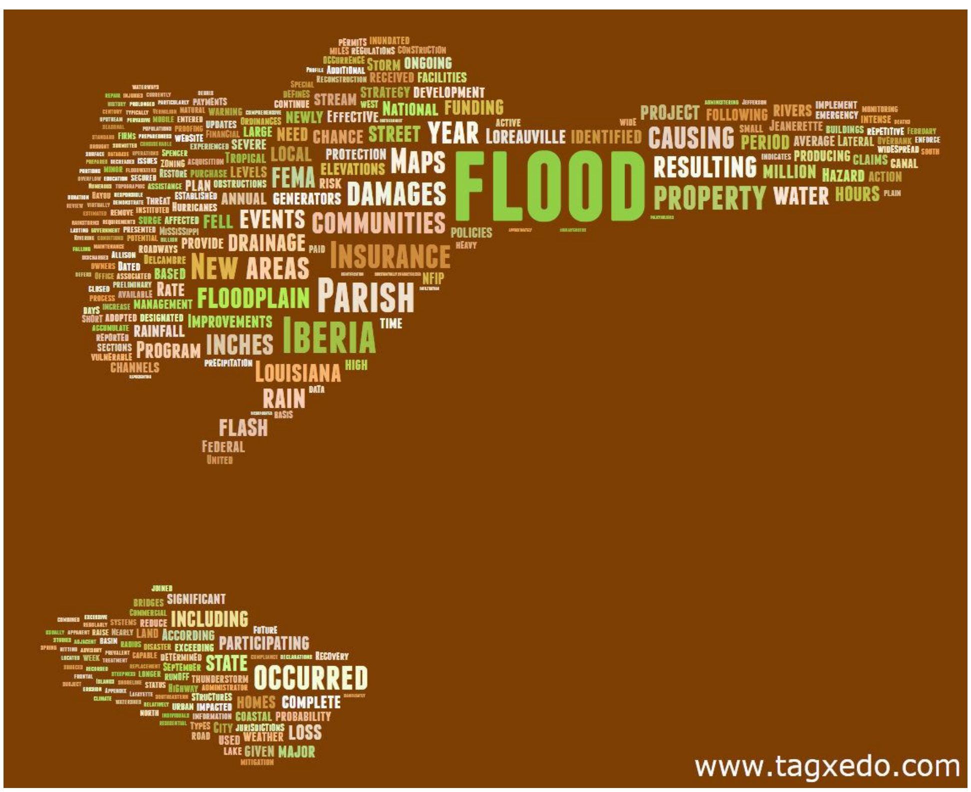
2006 Cameron Parish: Land Subsidence



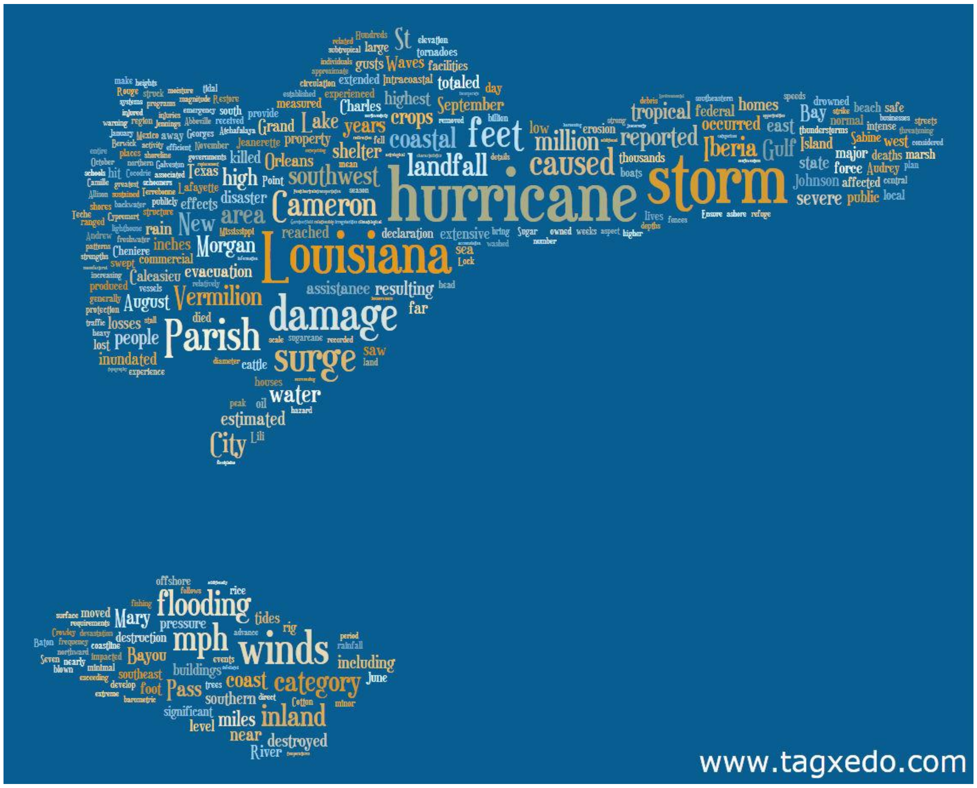
2010 Cameron Parish: Land Subsidence & Coastal Erosion



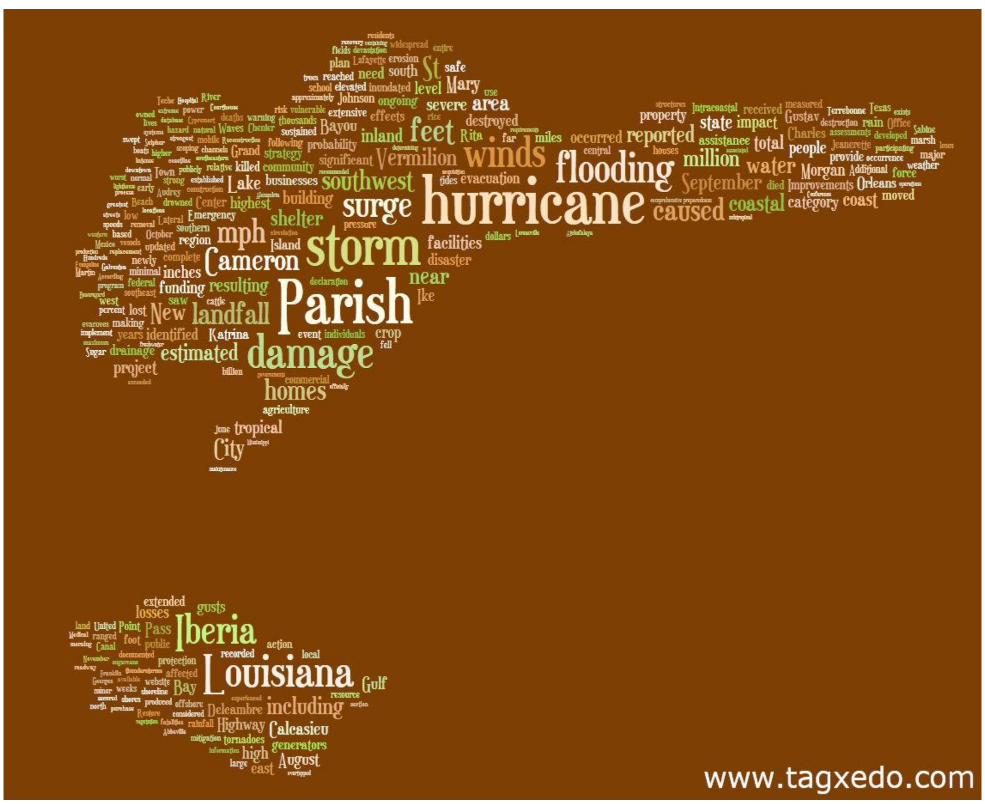
2006 Iberia Parish: Flooding



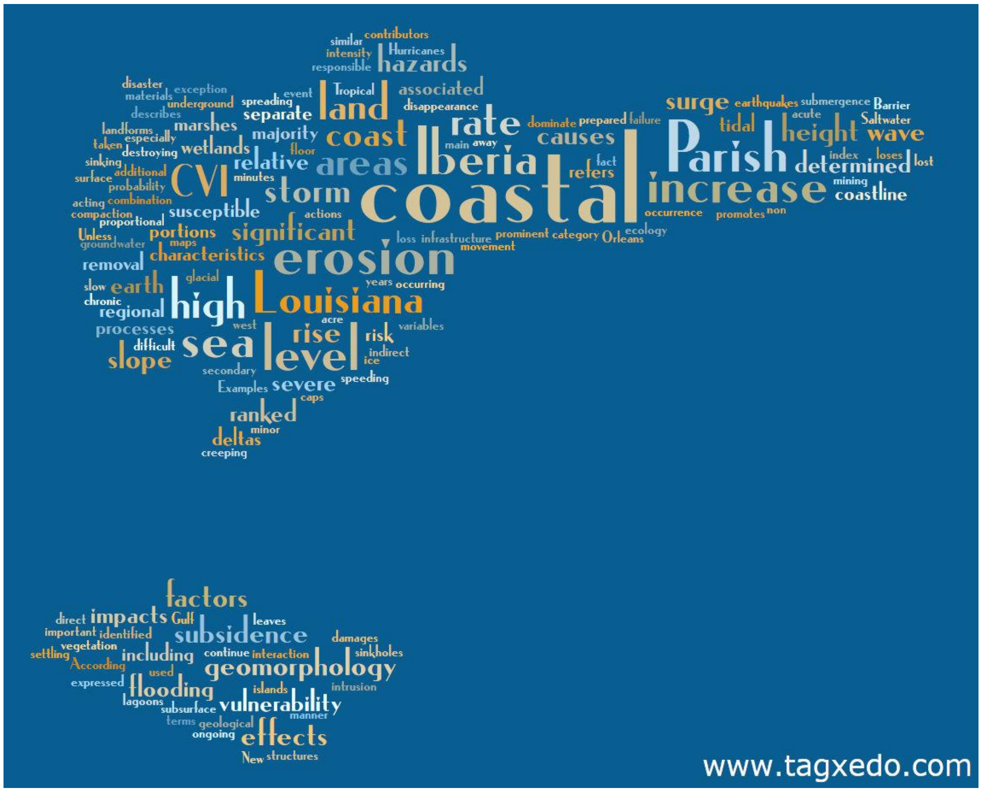
2009 Iberia Parish: Flooding



2006 Iberia Parish: Hurricanes

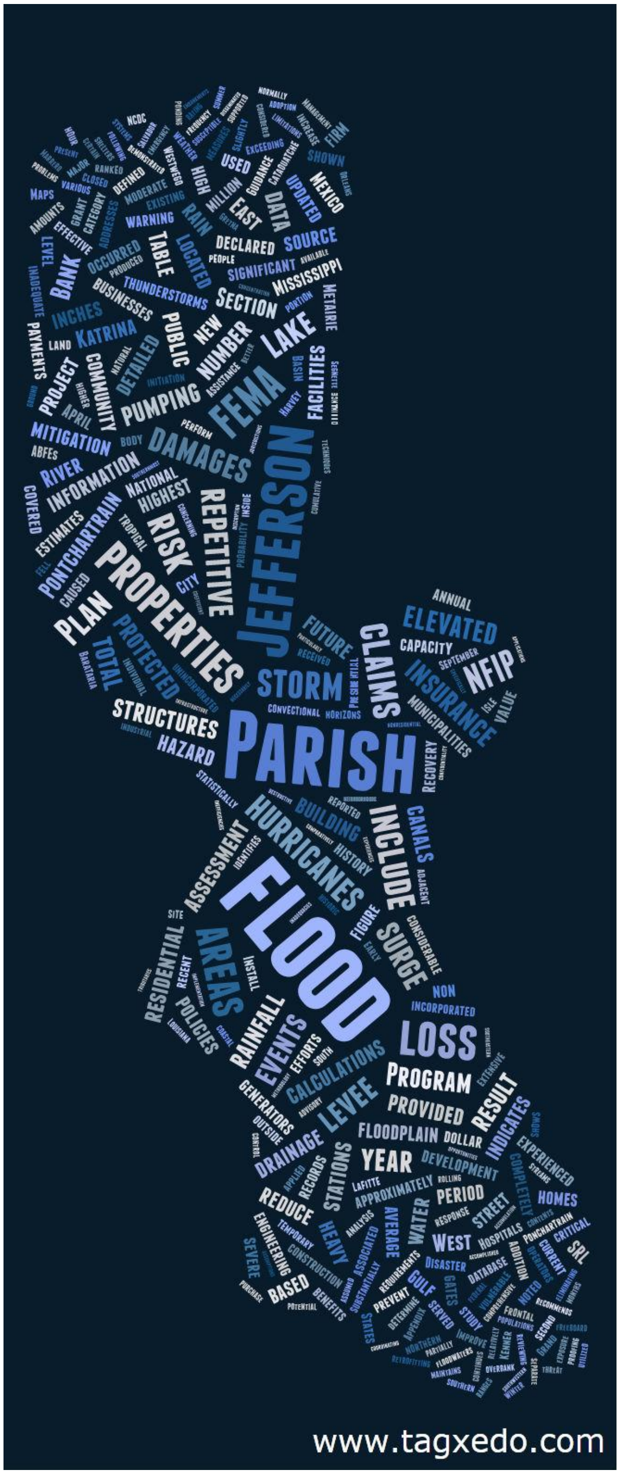


2009 Iberia Parish: Hurricanes

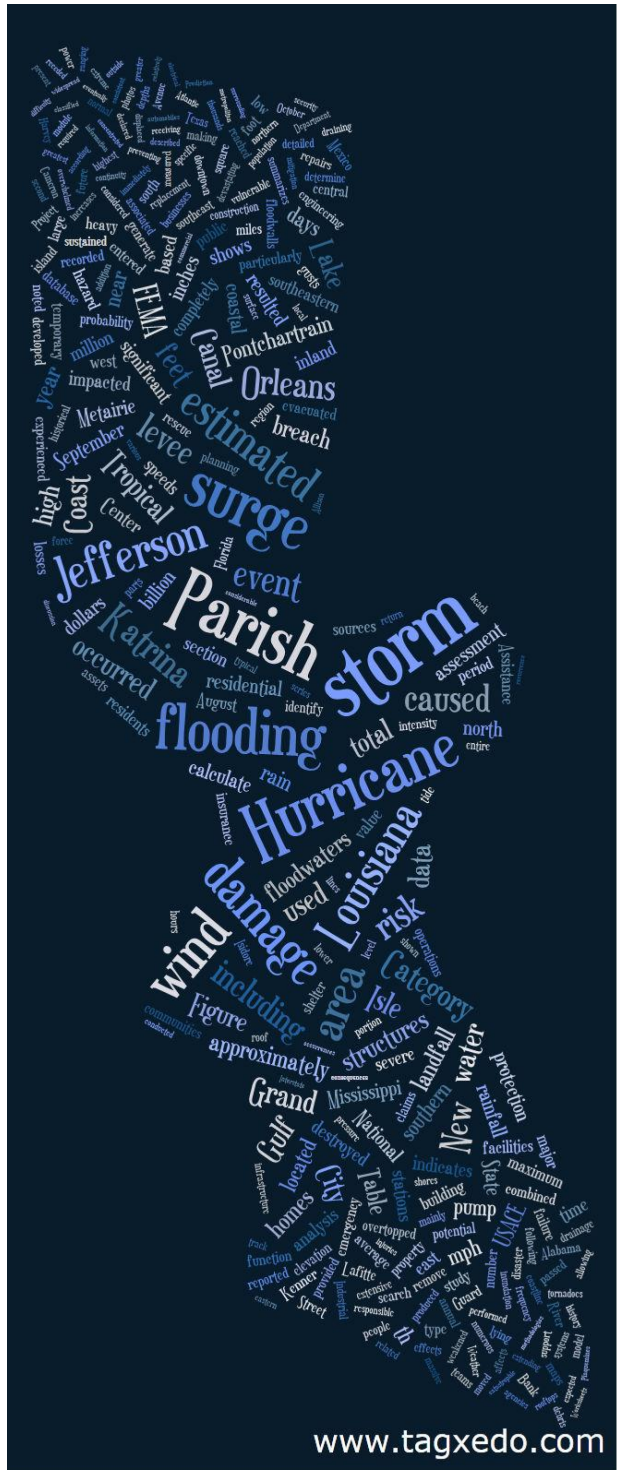


2006 Iberia Parish: Coastal Erosion

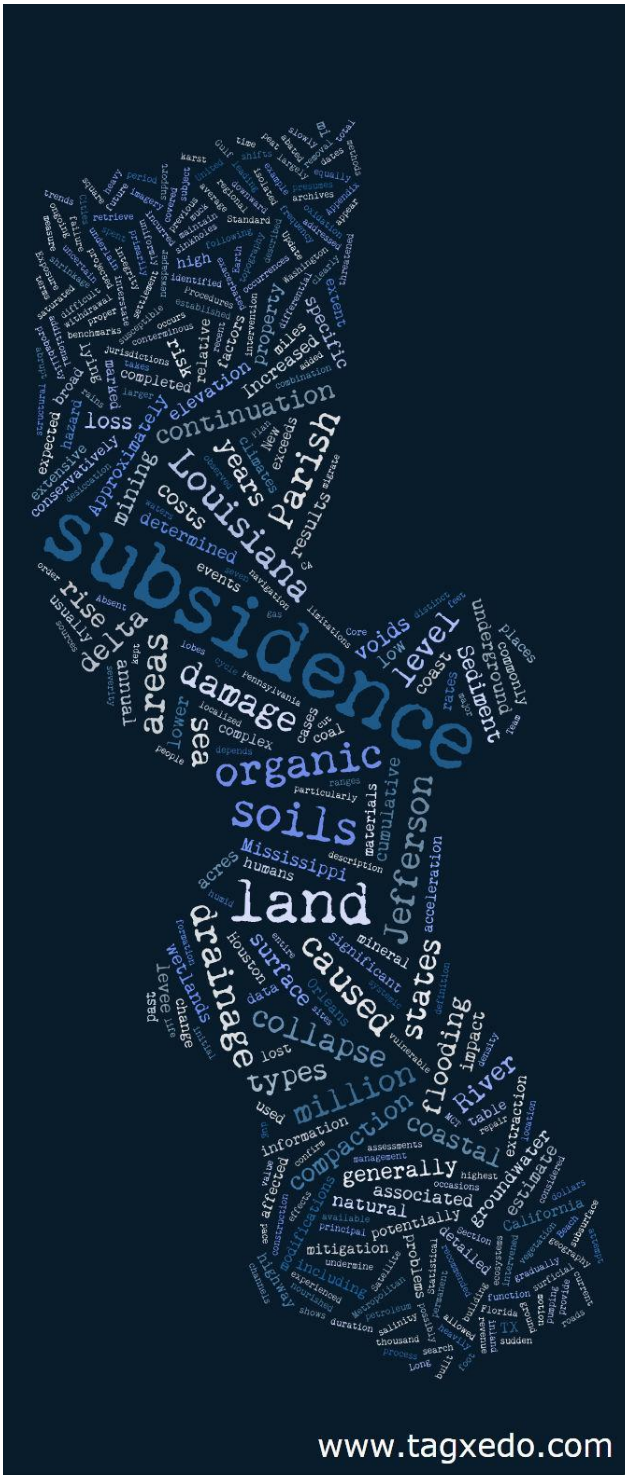
2009 Iberia Parish: Coastal Erosion



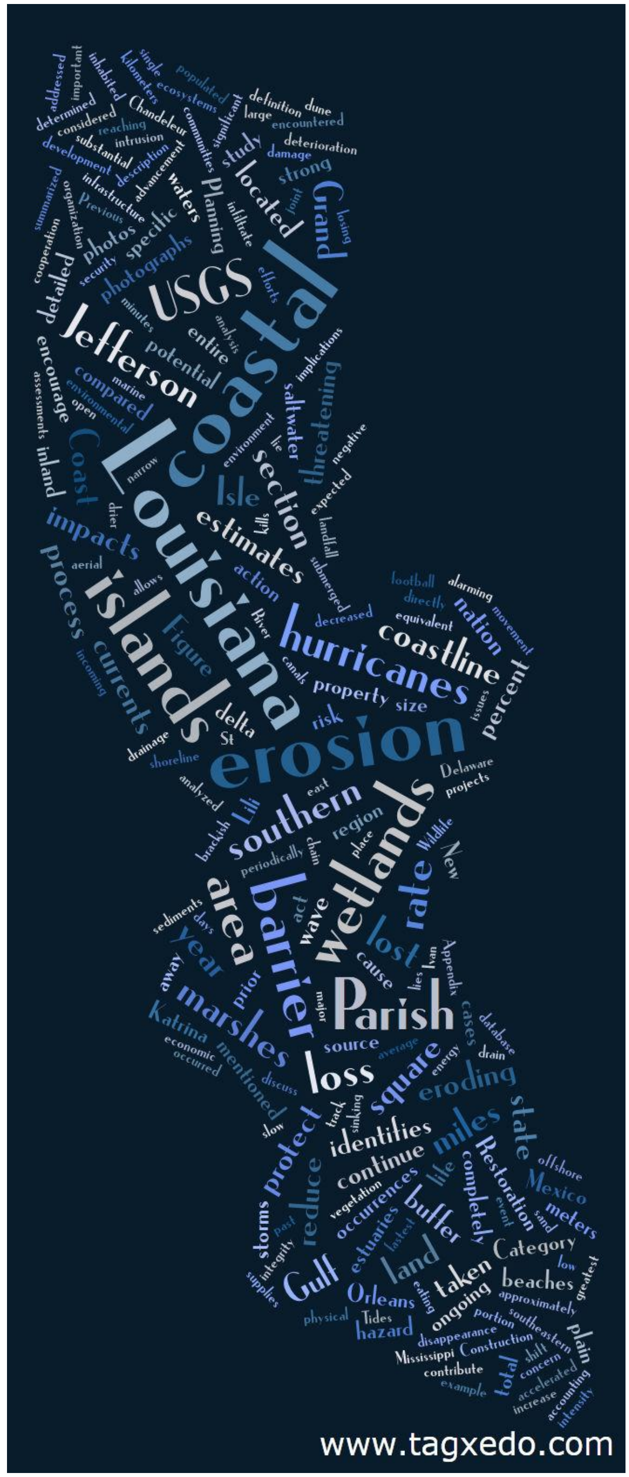
2010 Jefferson Parish: Flooding



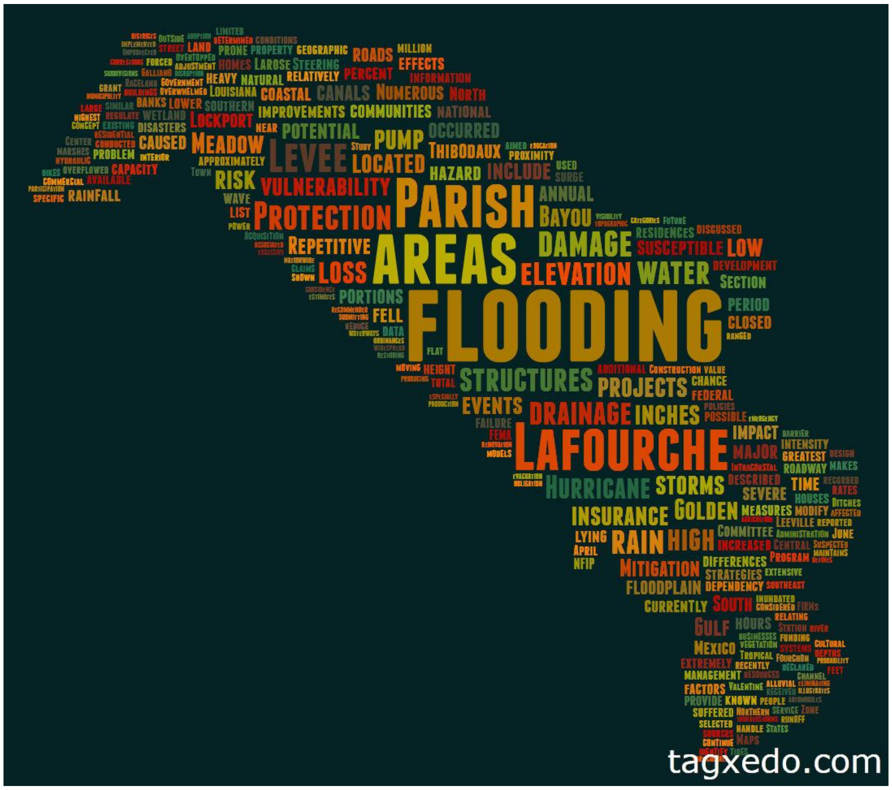
2010 Jefferson Parish: Hurricanes



2010 Jefferson Parish: Land Subsidence

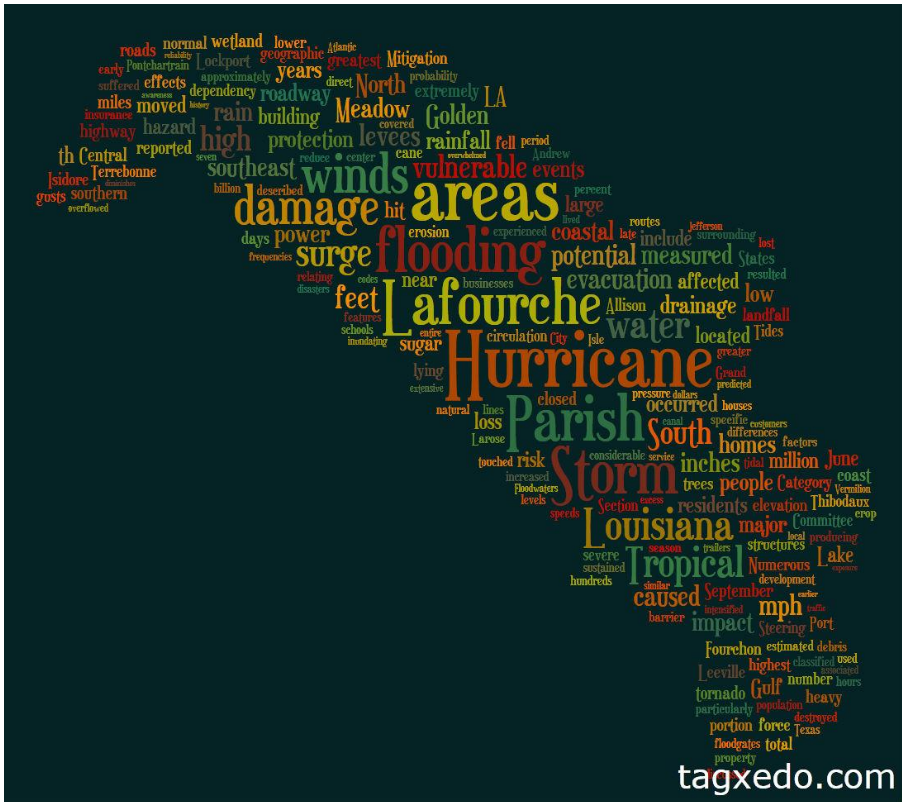


2010 Jefferson Parish: Coastal Erosion



2006 Lafourche Parish: Flooding

2010 Lafourche Parish: Flooding



2006 Lafourche Parish: Hurricanes

2010 Lafourche Parish: Hurricanes

2006 Lafourche Parish: Land Subsidence

2010 Lafourche Parish: Land Subsidence

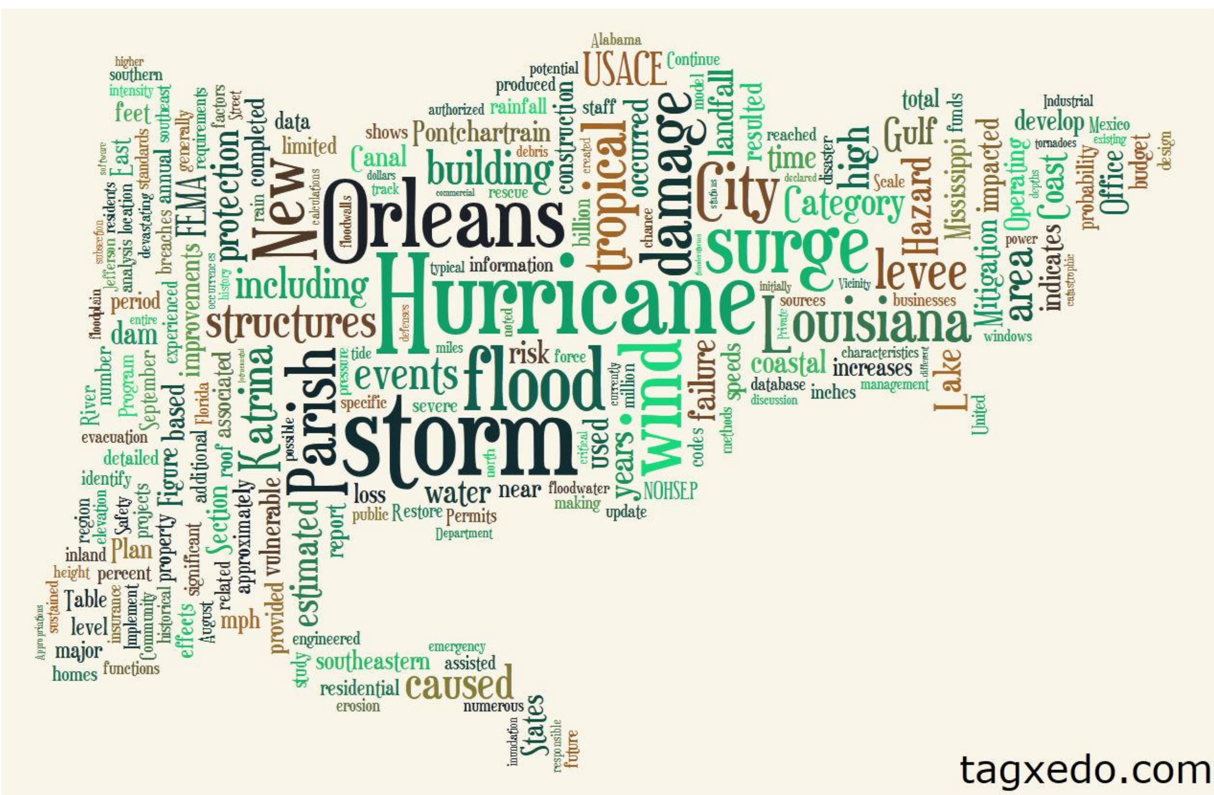
2006 Lafourche Parish: Coastal Erosion

2010 Lafourche Parish: Coastal Erosion

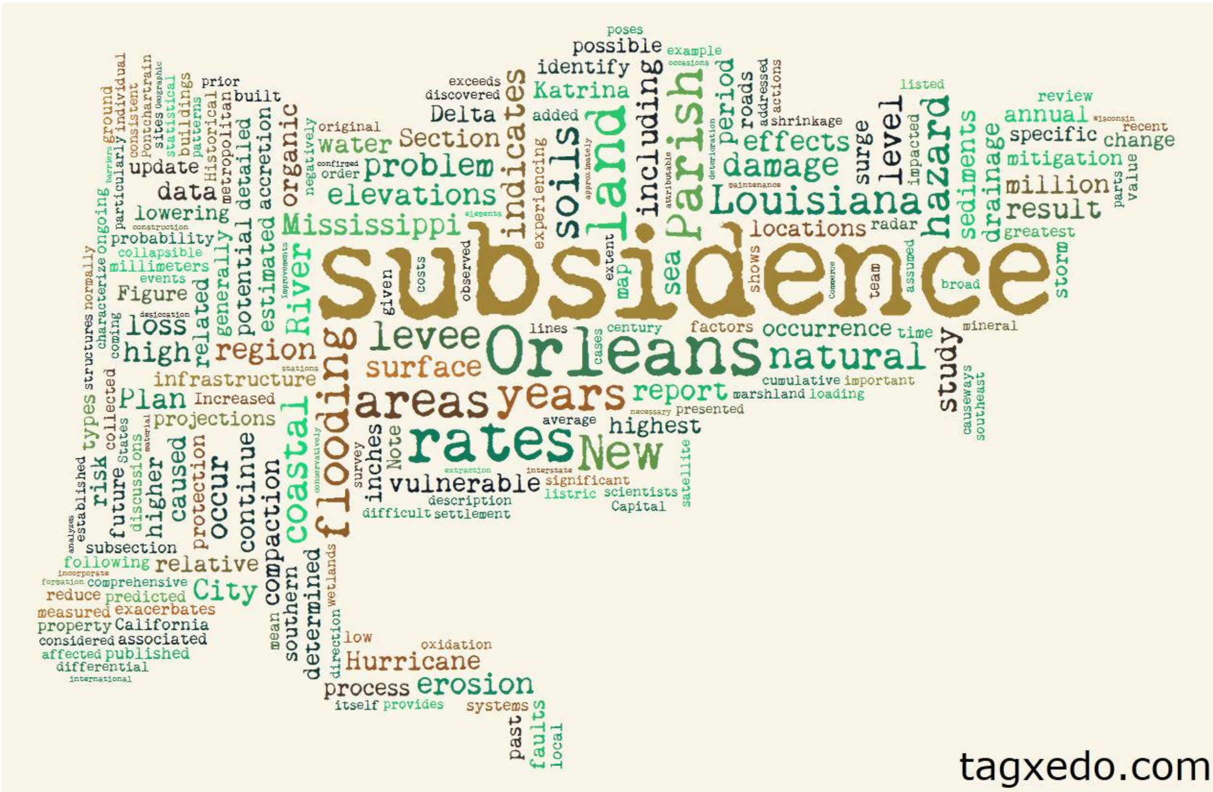
2006 Lafourche Parish: Saltwater Intrusion

2010 Lafourche Parish: Saltwater Intrusion

2010 Orleans Parish: Flooding

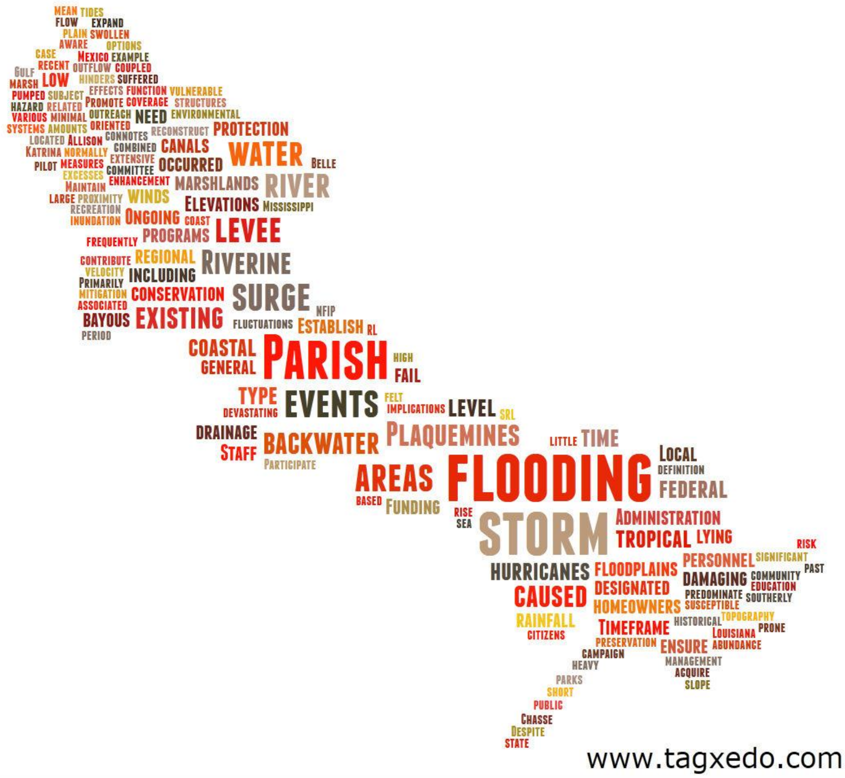


2010 Orleans Parish: Hurricanes



2010 Orleans Parish: Land Subsidence

2010 Orleans Parish: Coastal Erosion



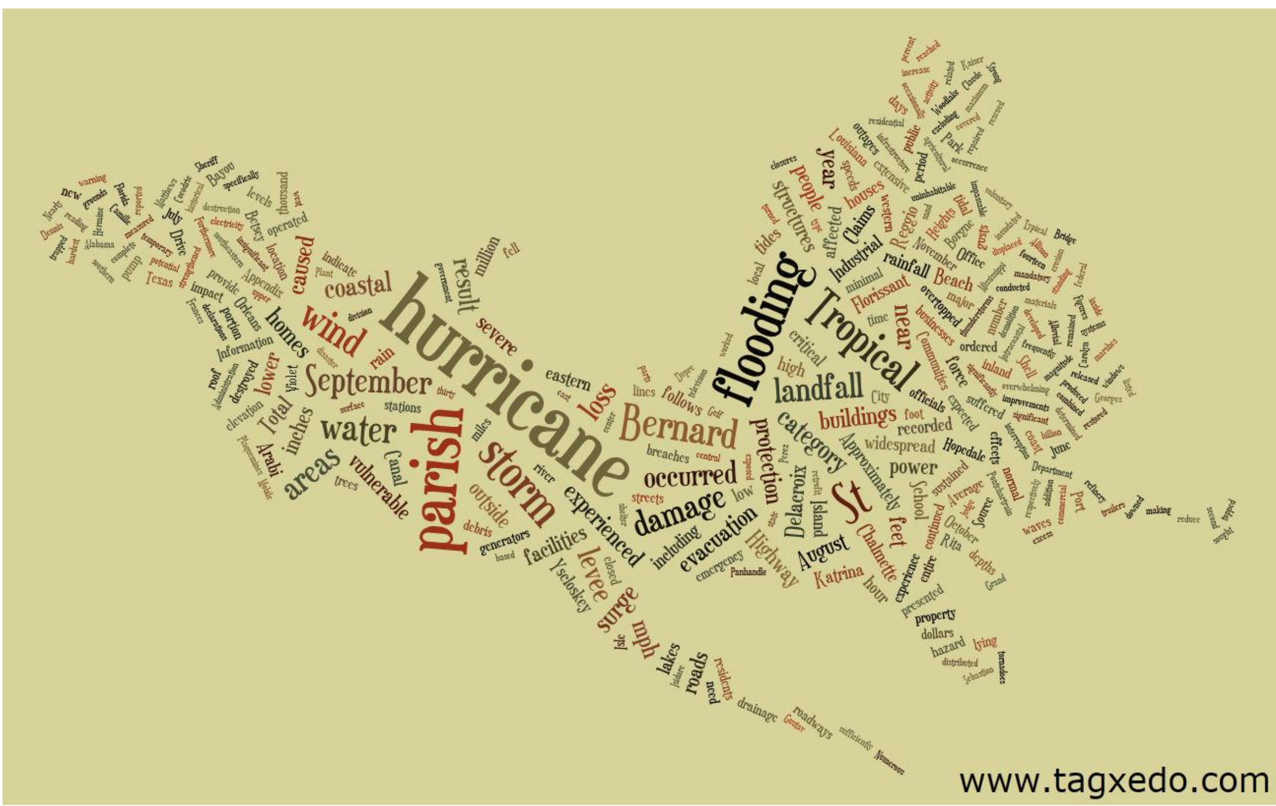
2009 Plaquemines Parish: Flooding

2009 Plaquemines Parish: Hurricanes

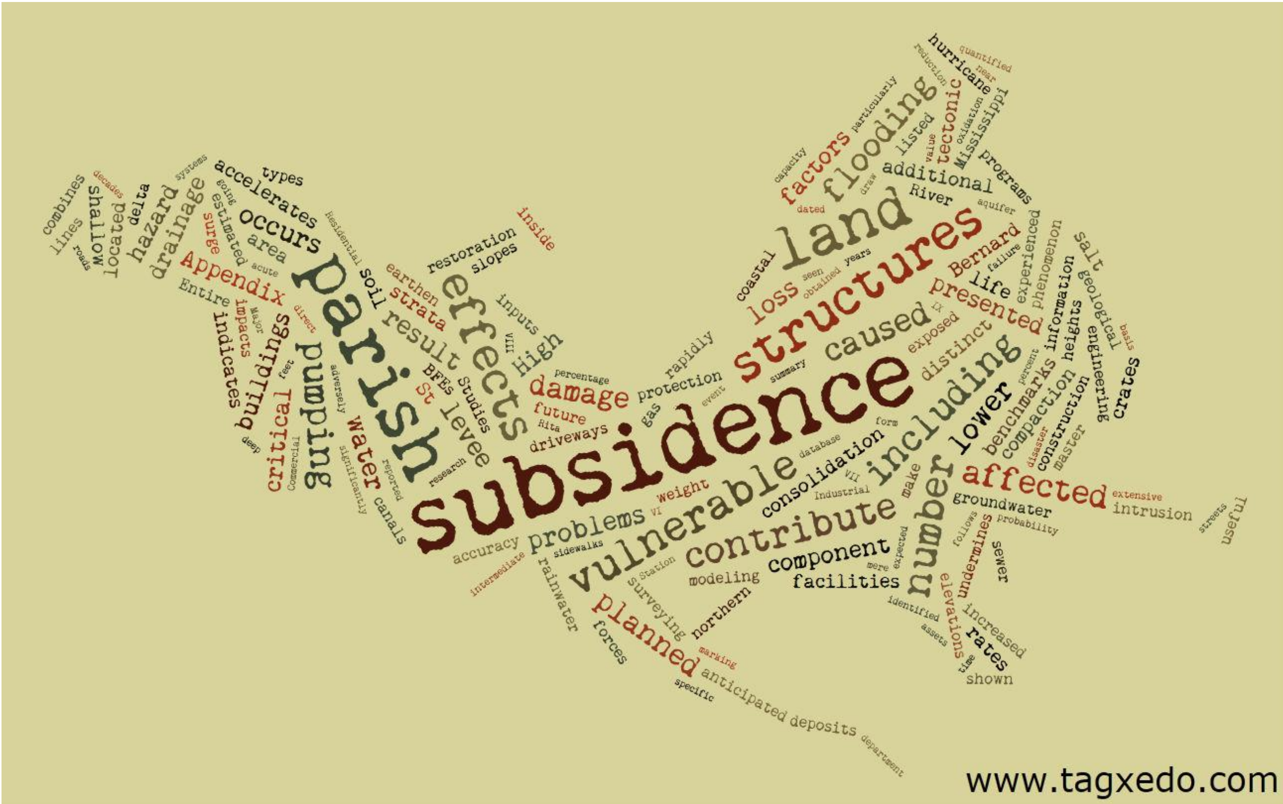
2009 Plaquemines Parish: Coastal Erosion

2009 Plaquemines Parish: Saltwater Intrusion

2010 St. Bernard Parish: Flooding



2010 St. Bernard Parish: Hurricanes

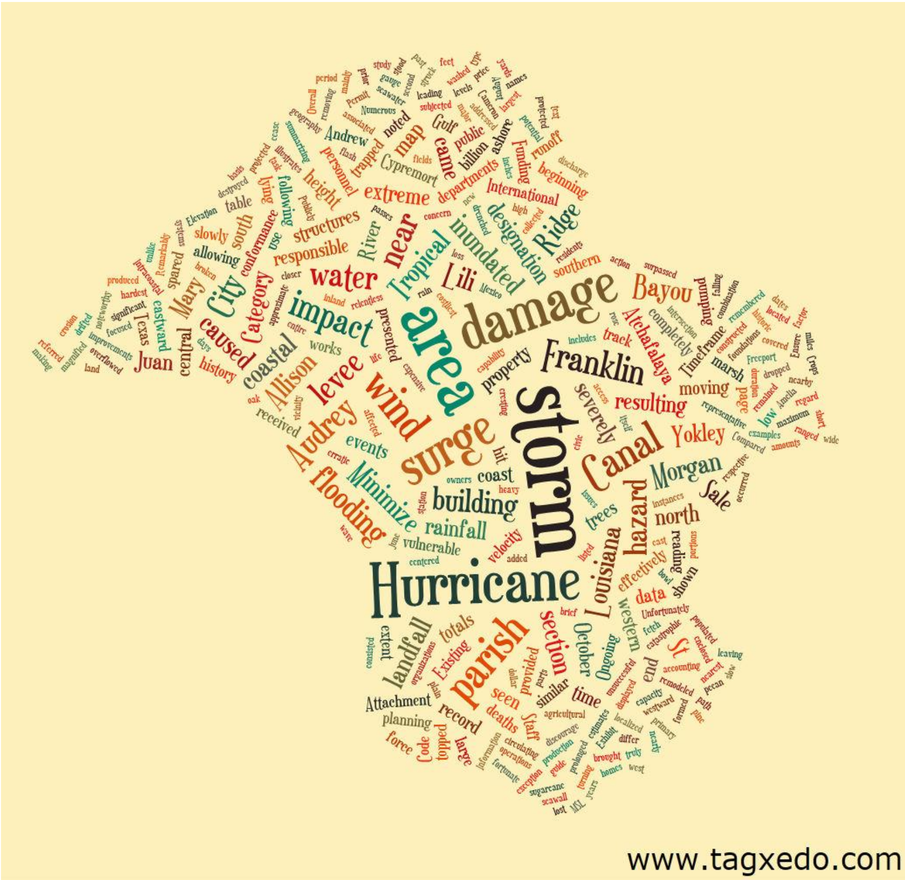


2010 St. Bernard Parish: Land Subsidence

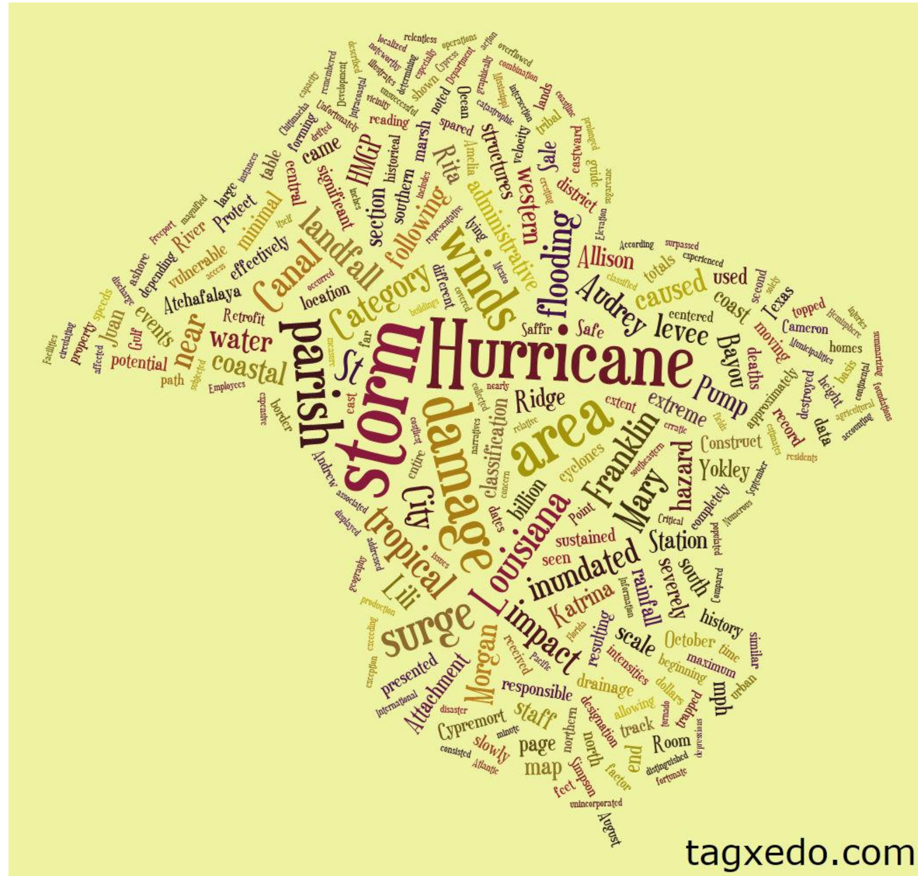
2010 St. Bernard Parish: Saltwater Intrusion

2004 St. Mary Parish: Flooding

2009 St. Mary Parish: Flooding



2004 St. Mary Parish: Hurricanes



2009 St. Mary Parish: Hurricanes

2004 St. Mary Parish: Coastal Erosion

2009 St. Mary Parish: Coastal Erosion

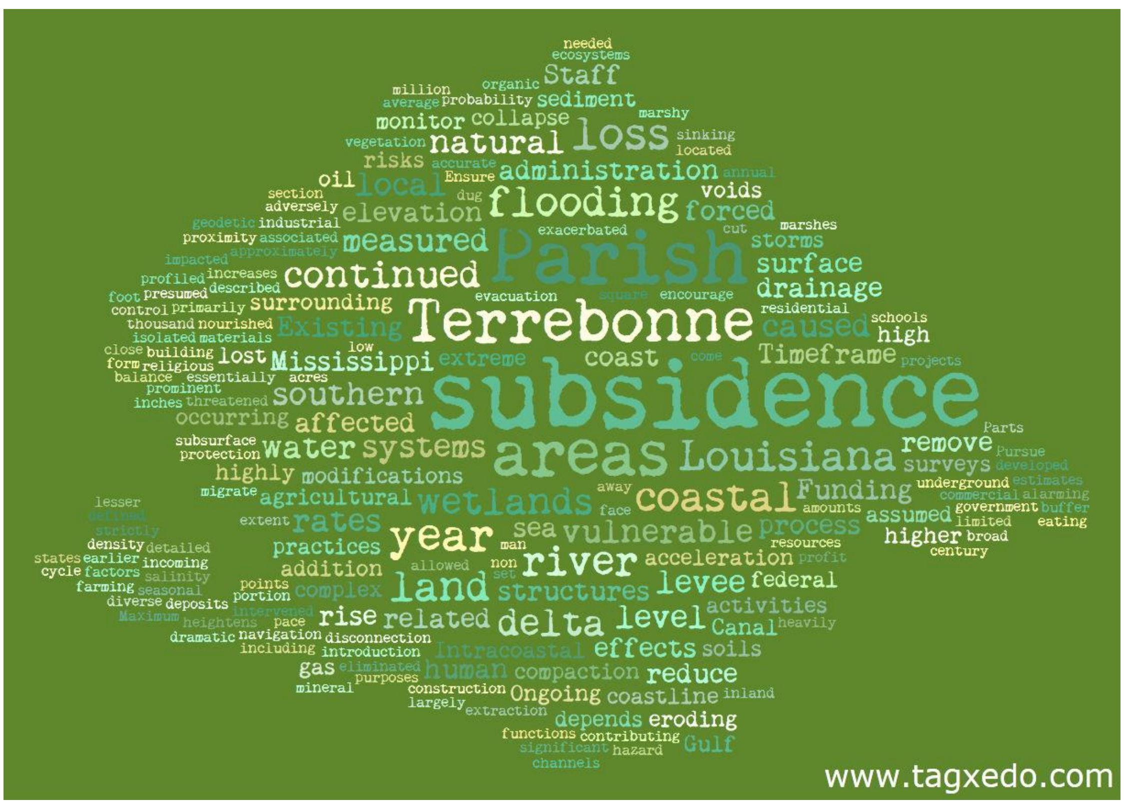
2005 Terrebonne Parish: Flooding

2010 Terrebonne Parish: Flooding

2005 Terrebonne Parish: Hurricanes

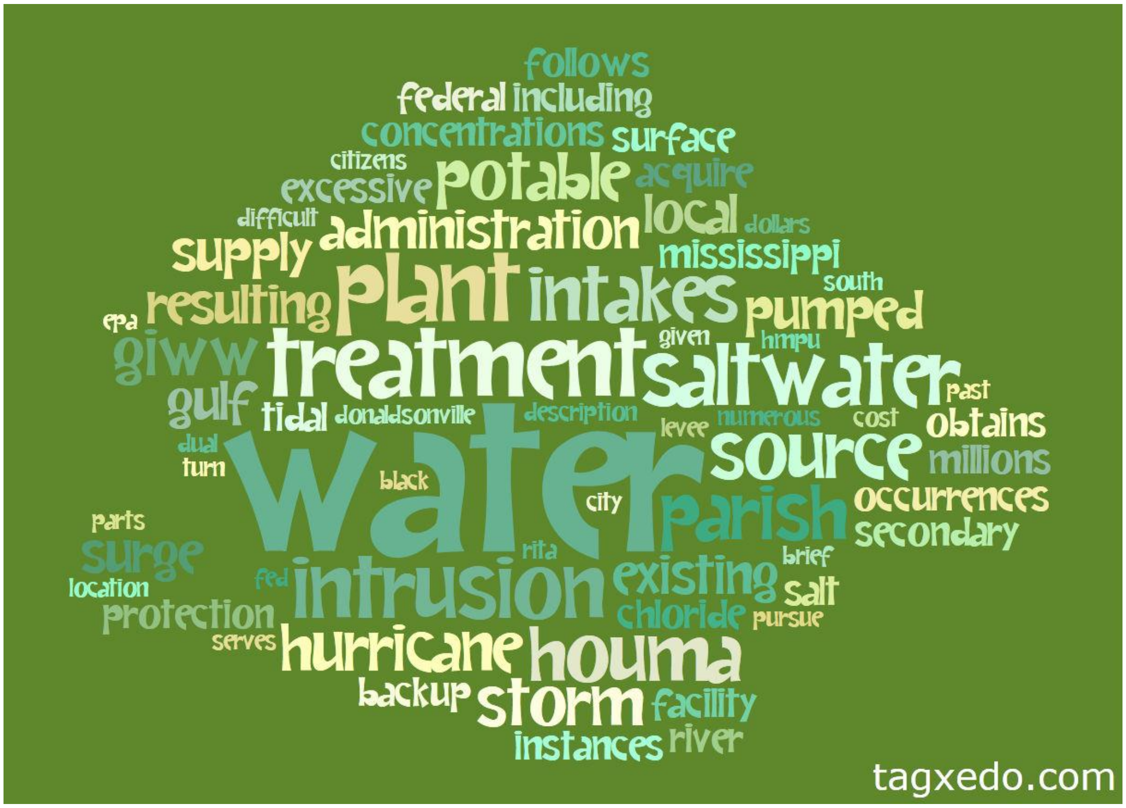
2010 Terrebonne Parish: Hurricanes

2005 Terrebonne Parish: Land Subsidence

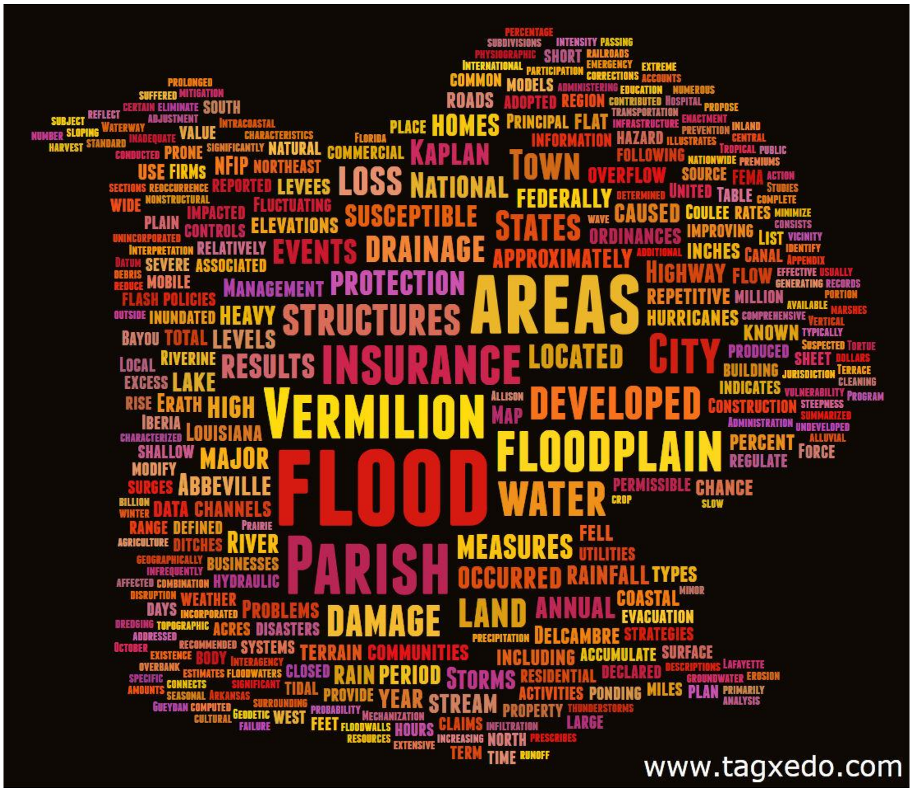


2010 Terrebonne Parish: Land Subsidence

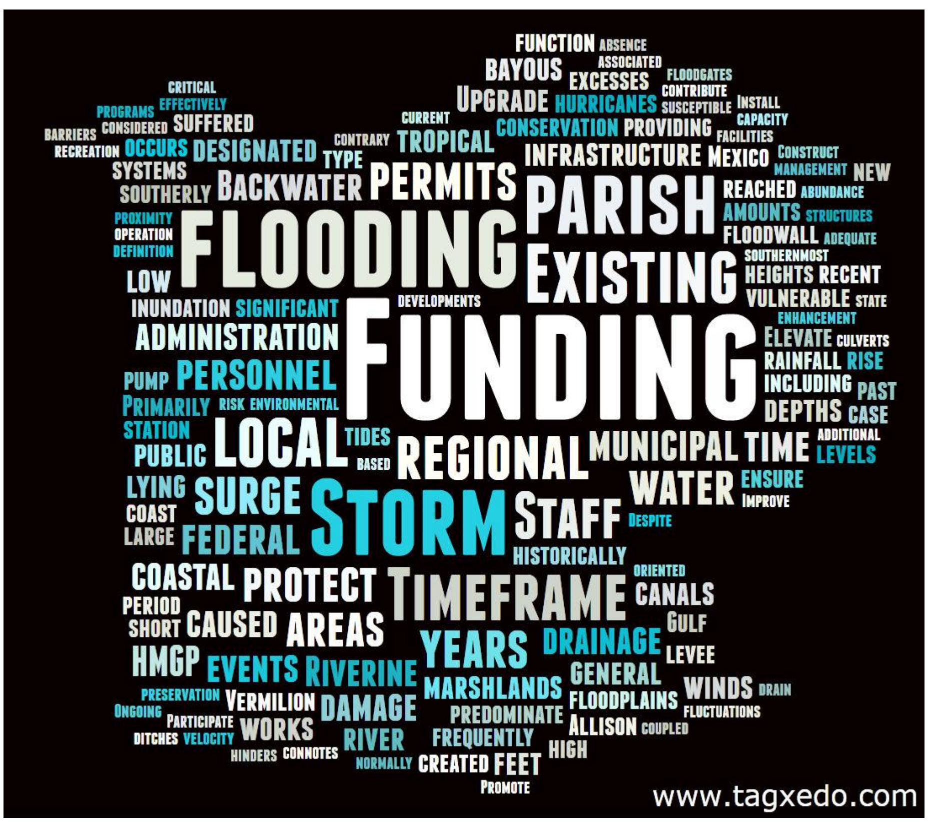
2005 Terrebonne Parish: Saltwater Intrusion



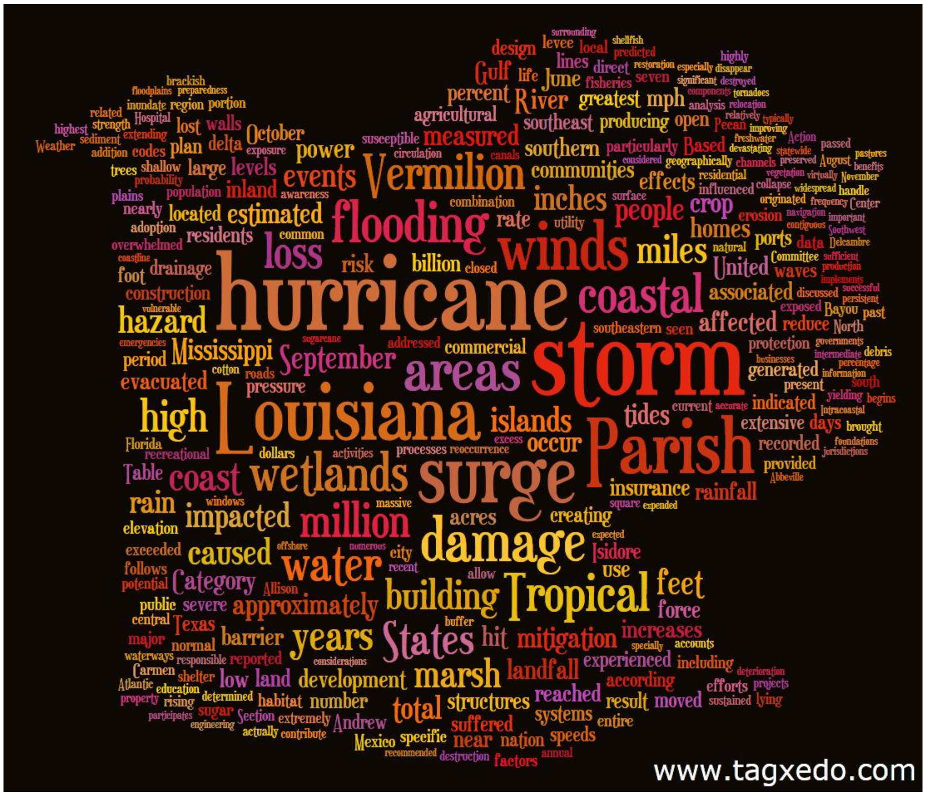
2010 Terrebonne Parish: Saltwater Intrusion



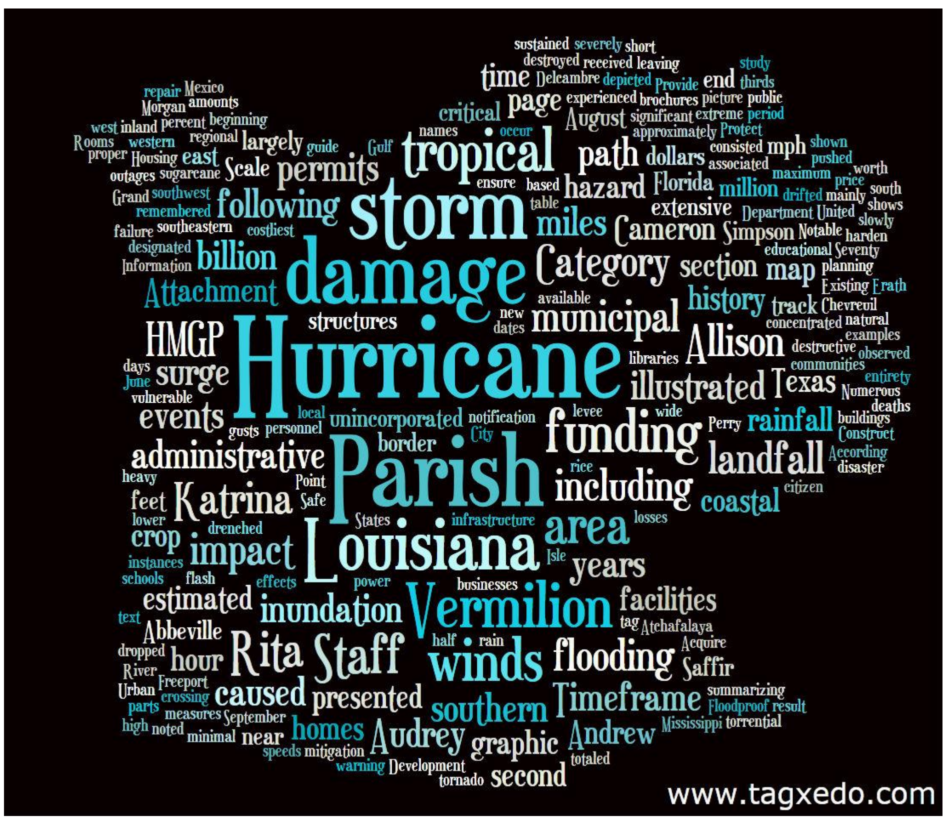
2005 Vermilion Parish: Flooding



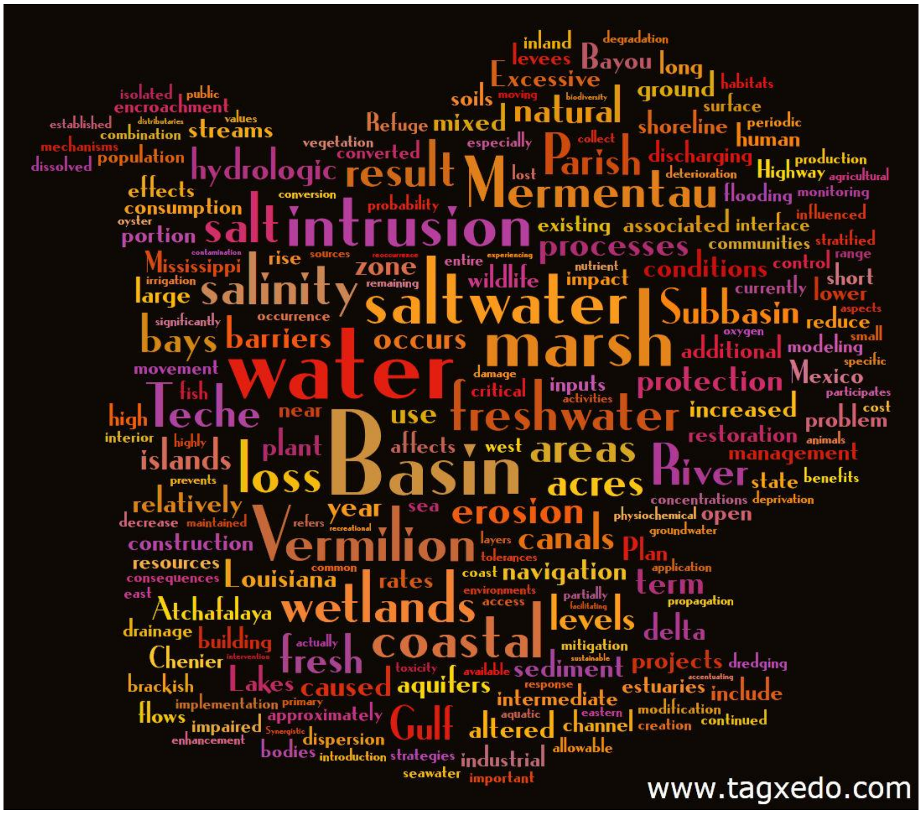
2010 Vermilion Parish: Flooding



2005 Vermilion Parish: Hurricanes

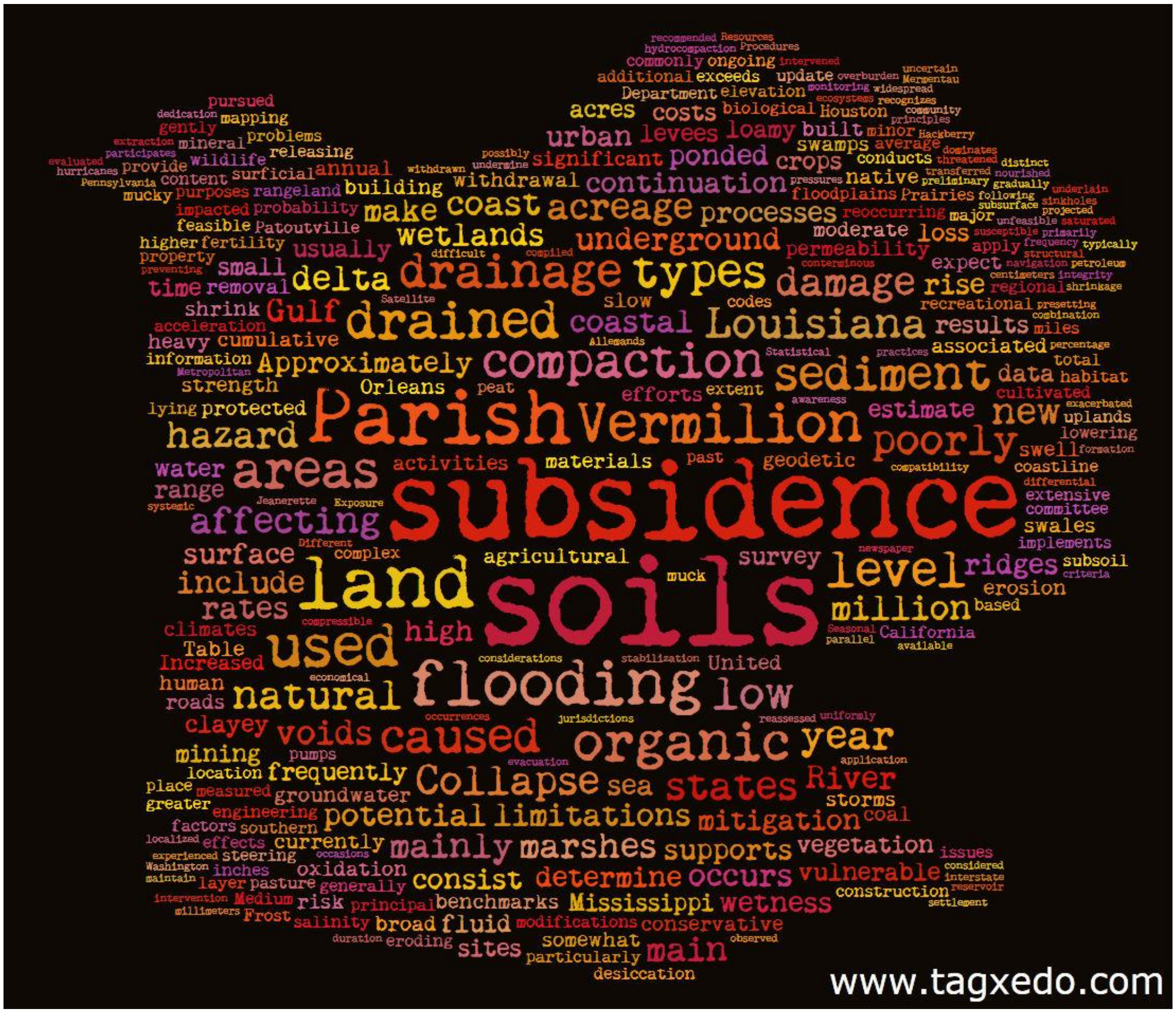


2010 Vermilion Parish: Hurricanes



2005 Vermilion Parish: Coastal Erosion

2010 Vermilion Parish: Coastal Erosion



2005 Vermilion Parish: Land Subsidence

APPENDIX B: WORD CLOUD AND CENSUS DATA

Common Words Removed from 2010 Cameron Parish

	wetland	marsh	wetland+marsh **(w+m)**	Total common words **(TCW)**	Total words **(TW)**	(w+m/TW-TCW)*100
Hurricane	0	1	1	994	3577	0.03871467
Flooding	0	1	1	634	2210	0.06345178
Land Subsidence + Coastal Erosion	27	2	29	716	2335	1.79122915

Common Words Removed from 2009 Iberia Parish

	wetland	marsh	wetland+marsh **(w+m)**	Total common words **(TCW)**	Total words **(TW)**	(w+m/TW-TCW)*100
Hurricane	2	7	9	1857	6622	0.188877
Flooding	0	2	2	1203	4312	0.064329
Coastal Erosion	5	4	9	319	1075	1.190476

Common Words Removed from 2010 Jefferson Parish

	wetland	marsh	wetland+marsh **(w+m)**	Total common words **(TCW)**	Total words **(TW)**	(w+m/TW-TCW)*100
Hurricane	1	2	3	3022	10243	0.041545
Flooding	0	1	1	1167	4124	0.033818
Coastal Erosion	12	7	19	304	977	2.82318
Land Subsidence	3	0	3	324	1108	0.382653

Common Words Removed from 2010 Lafourche Parish

	wetland	marsh	wetland+marsh **(w+m)**	Total common words **(TCW)**	Total words **(TW)**	(w+m/TW-TCW)*100
Hurricane	0	0	0	[*]		0
Flooding	0	3	3	138	534	0.757576
Coastal Erosion	0	4	4	140	514	1.069519
Land Subsidence	5	2	7	220	756	1.30597
Saltwater Intrusion	2	8	10	358	1169	1.233046

Common Words Removed from 2010 Orleans Parish

	wetland	marsh	wetland+marsh **(w+m)**	Total common words **(TCW)**	Total words **(TW)**	(w+m/TW-TCW)*100
Hurricane	7	6	13	3488	12432	0.145349
Flooding	6	4	10	1536	6012	0.223414
Coastal Erosion	23	12	35	601	2052	2.41213
Land Subsidence	2	2	4	714	2367	0.241984

Common Words Removed from 2009 Plaquemines Parish

	wetland	marsh	wetland+marsh **(w+m)**	Total common words **(TCW)**	Total words **(TW)**	(w+m/TW-TCW)*100
Hurricane	0	0	0			0
Flooding	0	3	3	113	427	0.955414
Saltwater Intrusion	0	0	0			0
Coastal Erosion	0	4	4	126	426	1.333333

[*] Gray boxes indicate that this number does not need to be tallied

Common Words Removed from 2010 St. Bernard

	wetland	marsh	wetland+marsh **(w+m)**	Total common words **(TCW)**	Total words **(TW)**	(w+m/TW-TCW)*100
Hurricane	1	2	3	1229	4877	0.082236842
Flooding	1	2	3	1644	6469	0.062176166
Land Subsidence	0	0	0			0
Saltwater Intrusion	18	26	44	598	2330	2.540415704

Common Words Removed from 2009 St. Mary

	wetland	marsh	wetland+marsh **(w+m)**	Total common words **(TCW)**	Total words **(TW)**	(w+m/TW-TCW)*100
Hurricane	0	3	3	541	1728	0.252738
Flooding	0	3	3	232	798	0.530035
Coastal Erosion	1	5	6	232	836	0.993377

Common Words Removed from 2010 Terrebonne Parish

	wetland	marsh	wetland+marsh **(w+m)**	Total common words **(TCW)**	Total words **(TW)**	(w+m/TW-TCW)*100
Hurricane	0	0	0			0
Flooding	0	3	3	165	653	0.614754
Saltwater Intrusion	0	0	0			0
Land Subsidence	5	2	7	223	749	1.330798

Common Words Removed from 2010 Vermilion Parish

	wetland	marsh	wetland+marsh **(w+m)**	Total common words **(TCW)**	Total words **(TW)**	(w+m/TW-TCW)*100
Hurricane	0	0	0			0
Flooding	0	4	4	139	602	0.86393089
Coastal Erosion	0	5	5	156	623	1.07066381

Comparison of background data of the ten parishes, Louisiana, and the United States

	Cameron	Iberia	Jefferson	Lafourche	Orleans	Plaquemines	St. Bernard	St. Mary	Terrebonne	Vermilion	**Avg**	Louisiana	United States
Population	9,991	73,266	455,466	89,974	484,674	26,757	67,229	53,500	104,503	53,807	**1,419,167 (Total)**	4,468,972	308,745,538
White	93.7%	65.1%	69.8%	82.9%	28.1%	69.8%	88.3%	62.8%	74.1%	82.7%	**71.73%**	63.9%	75.1%
Black-AA	3.9%	30.8%	22.9%	12.6%	67.3%	23.4%	7.6%	31.8%	17.8%	14.2%	**23.23%**	32.55%	12.3%
Asian	0.4%	1.9%	3.1%	0.7%	2.3%	2.6%	1.3%	1.6%	0.8%	1.8%	**1.65%**	1.2%	3.6%
Per capita income	$15,348	$14,145	$19,953	$15,809	$17,258	$15,937	$16,718	$13,399	$16,051	$14,201	**$15,882**	$16,912	$21,587
Unemployed	2.6%	5.2%	3.6%	3.4%	5.5%	3.6%	3.4%	4.8%	3.3%	3.9%	**3.93%**	4.3%	5.6%
Families Below Poverty	9.1%	20.2%	10.8%	13.2%	23.7%	15.4%	10.5%	20.6%	15.8%	17.4%	**15.67%**	15.8%	9.2%
Total Mobile Homes	29.7%	21.3%	1.9%	17.8%	0.3%	31.5%	7.9%	21.4%	17.6%	20.4%	**16.98%**	12.4%	7.0%

APPENDIX C: STATISTICAL OUTPUT

Crosstabs

[DataSet1] C:\DocumentsandSettings\kbower2\MyDocuments\Kbowers_Ranking_vs_Census.sav

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Wetland_Ranking * Per Capita Income	10	52.6%	9	47.4%	19	100.0%
Wetland_ Ranking * Percent area Wetland	10	52.6%	9	47.4%	19	100.0%
Wetland_ Ranking * Percent change Population	10	52.6%	9	47.4%	19	100.0%
Wetland_ Ranking * Percent Bachelor's	10	52.6%	9	47.4%	19	100.0%
Wetland_ Ranking * Percent Voting	10	52.6%	9	47.4%	19	100.0%
Wetland_ Ranking * Budget	10	52.6%	9	47.4%	19	100.0%
Wetland_ Ranking * # hazards 1960-2006	10	52.6%	9	47.4%	19	100.0%

Wetland Ranking * Per Capita Income

Crosstab

			Per Capita Income										
			13399.00	14145.00	14201.00	15348.00	15809.00	15937.00	16051.00	16718.00	17258.00	19953.00	Total
Wetland_Ranking	1.00	Count	0	0	0	0	1	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	2.00	Count	0	0	0	0	0	0	0	0	0	1	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	3.00	Count	0	0	0	0	0	1	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	4.00	Count	0	0	1	0	0	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	5.00	Count	0	0	0	1	0	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	6.00	Count	1	0	0	0	0	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	7.00	Count	0	0	0	0	0	0	1	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	8.00	Count	0	0	0	0	0	0	0	0	1	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	9.00	Count	0	1	0	0	0	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	10.00	Count	0	0	0	0	0	0	0	1	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
Total		Count	1	1	1	1	1	1	1	1	1	1	10
		Expected Count	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	90.000(a)	81	.231
Likelihood Ratio	46.052	81	.999
Linear-by-Linear Association	.429	1	.512
N of Valid Cases	10		

a 100 cells (100.0%) have expected count less than 5. The minimum expected count is .10.

Directional Measures

			Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	-.022	.261	-.085	.932
		Wetland_Ranking Dependent	-.022	.261	-.085	.932
		Per Capita Income Dependent	-.022	.261	-.085	.932

a Not assuming the null hypothesis.
b Using the asymptotic standard error assuming the null hypothesis.

Symmetric Measures

		Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal	Kendall's tau-b	-.022	.261	-.085	.932
	Spearman Correlation	-.030	.367	-.086	.934(c)
Interval by Interval	Pearson's R	-.218	.271	-.633	.544(c)
N of Valid Cases		10			

a Not assuming the null hypothesis.
b Using the asymptotic standard error assuming the null hypothesis.
c Based on normal approximation.

Wetland Ranking * Percent Area Wetland

Crosstab

			Percent area Wetland										Total
			20.92	25.08	25.16	27.54	33.58	35.10	44.49	45.80	50.71	55.55	
Wetland_Ranking	1.00	Count	0	0	0	0	0	0	0	0	1	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	2.00	Count	0	0	0	1	0	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	3.00	Count	0	1	0	0	0	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	4.00	Count	0	0	0	0	0	1	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	5.00	Count	0	0	0	0	0	0	0	0	0	1	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	6.00	Count	0	0	0	0	0	0	1	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	7.00	Count	0	0	0	0	0	0	0	1	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	8.00	Count	0	0	1	0	0	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	9.00	Count	0	0	0	0	1	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	10.00	Count	1	0	0	0	0	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
Total		Count	1	1	1	1	1	1	1	1	1	1	10
		Expected Count	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	90.000(a)	81	.231
Likelihood Ratio	46.052	81	.999
Linear-by-Linear Association	.871	1	.351
N of Valid Cases	10		

a 100 cells (100.0%) have expected count less than 5. The minimum expected count is .10.

Directional Measures

			Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	-.244	.253	-.966	.334
		Wetland_Ranking Dependent	-.244	.253	-.966	.334
		Percent area Wetland Dependent	-.244	.253	-.966	.334

a Not assuming the null hypothesis.
b Using the asymptotic standard error assuming the null hypothesis.

Symmetric Measures

		Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal	Kendall's tau-b	-.244	.253	-.966	.334
	Spearman Correlation	-.345	.336	-1.041	.328(c)
Interval by Interval	Pearson's R	-.311	.275	-.926	.382(c)
N of Valid Cases		10			

a Not assuming the null hypothesis.
b Using the asymptotic standard error assuming the null hypothesis.
c Based on normal approximation.

Wetland Ranking * Percent Population Growth

Crosstab

			Percent change Population										Total
			-7.90	-2.47	.90	2.00	4.62	4.79	7.28	7.50	7.76	7.89	
Wetland_Ranking	1.00	Count	0	0	0	0	0	1	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	2.00	Count	0	0	0	1	0	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	3.00	Count	0	0	0	0	1	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	4.00	Count	0	0	0	0	0	0	0	1	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	5.00	Count	0	0	0	0	0	0	0	0	0	1	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	6.00	Count	1	0	0	0	0	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	7.00	Count	0	0	0	0	0	0	0	0	1	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	8.00	Count	0	1	0	0	0	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	9.00	Count	0	0	0	0	0	0	1	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	10.00	Count	0	0	1	0	0	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
Total		Count	1	1	1	1	1	1	1	1	1	1	10
		Expected Count	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	90.000(a)	81	.231
Likelihood Ratio	46.052	81	.999
Linear-by-Linear Association	.263	1	.608
N of Valid Cases	10		

a 100 cells (100.0%) have expected count less than 5. The minimum expected count is .10.

Directional Measures

			Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	-.067	.138	-.484	.628
		Wetland_Ranking Dependent	-.067	.138	-.484	.628
		Percent Population Growth Dependent	-.067	.138	-.484	.628

a Not assuming the null hypothesis.
b Using the asymptotic standard error assuming the null hypothesis.

Symmetric Measures

		Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal	Kendall's tau-b	-.067	.138	-.484	.628
	Spearman Correlation	-.164	.253	-.469	.651(c)
Interval by Interval	Pearson's R	-.171	.176	-.491	.637(c)
N of Valid Cases		10			

a Not assuming the null hypothesis.
b Using the asymptotic standard error assuming the null hypothesis.
c Based on normal approximation.

Wetland Ranking * Percent Bachelor's

Crosstab

			Percent Bachelor's										Total
			7.90	8.90	9.40	10.70	10.80	11.20	12.30	12.40	21.50	25.80	
Wetland_Ranking	1.00	Count	0	0	0	0	0	0	0	1	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	2.00	Count	0	0	0	0	0	0	0	0	1	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	3.00	Count	0	0	0	0	1	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	4.00	Count	0	0	0	1	0	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	5.00	Count	1	0	0	0	0	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	6.00	Count	0	0	1	0	0	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	7.00	Count	0	0	0	0	0	0	1	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	8.00	Count	0	0	0	0	0	0	0	0	0	1	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	9.00	Count	0	0	0	0	0	1	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	10.00	Count	0	1	0	0	0	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
Total		Count	1	1	1	1	1	1	1	1	1	1	10
		Expected Count	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	90.000(a)	81	.231
Likelihood Ratio	46.052	81	.999
Linear-by-Linear Association	.044	1	.833
N of Valid Cases	10		

a 100 cells (100.0%) have expected count less than 5. The minimum expected count is .10.

Directional Measures

			Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	-.200	.237	-.844	.398
		Wetland_Ranking Dependent	-.200	.237	-.844	.398
		Percent Bachelor's Dependent	-.200	.237	-.844	.398

a Not assuming the null hypothesis.
b Using the asymptotic standard error assuming the null hypothesis.

Symmetric Measures

		Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal	Kendall's tau-b	-.200	.237	-.844	.398
	Spearman Correlation	-.236	.336	-.688	.511(c)
Interval by Interval	Pearson's R	-.070	.308	-.199	.847(c)
N of Valid Cases		10			

a Not assuming the null hypothesis.
b Using the asymptotic standard error assuming the null hypothesis.
c Based on normal approximation.

Wetland Ranking * Percent Voting

Crosstab

			Percent Voting										Total
			35.10	37.40	38.30	39.30	40.80	40.90	41.00	41.30	41.90	42.60	
Wetland_Ranking	1.00	Count	0	0	1	0	0	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	2.00	Count	0	0	0	1	0	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	3.00	Count	0	0	0	0	0	1	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	4.00	Count	0	0	0	0	0	0	0	1	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	5.00	Count	0	0	0	0	0	0	0	0	1	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	6.00	Count	0	0	0	0	1	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	7.00	Count	1	0	0	0	0	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	8.00	Count	0	1	0	0	0	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	9.00	Count	0	0	0	0	0	0	1	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	10.00	Count	0	0	0	0	0	0	0	0	0	1	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
Total		Count	1	1	1	1	1	1	1	1	1	1	10
		Expected Count	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	90.000(a)	81	.231
Likelihood Ratio	46.052	81	.999
Linear-by-Linear Association	.101	1	.751
N of Valid Cases	10		

a 100 cells (100.0%) have expected count less than 5. The minimum expected count is .10.

Directional Measures

			Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	.244	.261	.938	.348
		Wetland_Ranking Dependent	.244	.261	.938	.348
		Percent Voting Dependent	.244	.261	.938	.348

a Not assuming the null hypothesis.
b Using the asymptotic standard error assuming the null hypothesis.

Symmetric Measures

		Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal	Kendall's tau-b	.244	.261	.938	.348
	Spearman Correlation	.236	.360	.688	.511(c)
Interval by Interval	Pearson's R	.106	.279	.301	.771(c)
N of Valid Cases		10			

a Not assuming the null hypothesis.
b Using the asymptotic standard error assuming the null hypothesis.
c Based on normal approximation.

Wetland Ranking * Budget

Crosstab

			Budget										Total
			1983.00	2398.00	2718.00	3193.00	3253.00	3590.00	3816.00	3983.00	4123.00	4794.00	
Wetland_Ranking	1.00	Count	0	0	0	0	0	1	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	2.00	Count	0	0	0	1	0	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	3.00	Count	0	0	0	0	0	0	0	0	1	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	4.00	Count	0	1	0	0	0	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	5.00	Count	0	0	0	0	0	0	0	0	0	1	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	6.00	Count	0	0	0	0	0	0	0	1	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	7.00	Count	0	0	0	0	0	0	1	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	8.00	Count	0	0	0	0	1	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	9.00	Count	0	0	1	0	0	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	10.00	Count	1	0	0	0	0	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
Total		Count	1	1	1	1	1	1	1	1	1	1	10
		Expected Count	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	90.000(a)	81	.231
Likelihood Ratio	46.052	81	.999
Linear-by-Linear Association	1.454	1	.228
N of Valid Cases	10		

a 100 cells (100.0%) have expected count less than 5. The minimum expected count is .10.

Directional Measures

			Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	-.333	.218	-1.531	.126
		Wetland_Ranking Dependent	-.333	.218	-1.531	.126
		Budget Dependent	-.333	.218	-1.531	.126

a Not assuming the null hypothesis.
b Using the asymptotic standard error assuming the null hypothesis.

Symmetric Measures

		Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal	Kendall's tau-b	-.333	.218	-1.531	.126
	Spearman Correlation	-.358	.301	-1.083	.310(c)
Interval by Interval	Pearson's R	-.402	.220	-1.242	.250(c)
N of Valid Cases		10			

a Not assuming the null hypothesis.
b Using the asymptotic standard error assuming the null hypothesis.
c Based on normal approximation.

Wetland Ranking * # hazards 1960-2006

Crosstab

			# hazards 1960-2006										
			97.00	101.00	102.00	103.00	106.00	112.00	115.00	140.00	143.00	150.00	Total
Wetland_Ranking	1.00	Count	0	0	0	0	0	0	0	0	1	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	2.00	Count	0	0	0	0	0	0	0	0	0	1	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	3.00	Count	0	1	0	0	0	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	4.00	Count	0	0	0	0	0	0	1	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	5.00	Count	0	0	0	0	1	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	6.00	Count	0	0	0	1	0	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	7.00	Count	0	0	0	0	0	0	0	1	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	8.00	Count	0	0	0	0	0	1	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	9.00	Count	0	0	1	0	0	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
	10.00	Count	1	0	0	0	0	0	0	0	0	0	1
		Expected Count	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.0
Total		Count	1	1	1	1	1	1	1	1	1	1	10
		Expected Count	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	90.000(a)	81	.231
Likelihood Ratio	46.052	81	.999
Linear-by-Linear Association	3.006	1	.083
N of Valid Cases	10		

a 100 cells (100.0%) have expected count less than 5. The minimum expected count is .10.

Directional Measures

			Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	-.467	.237	-1.970	.049
		Wetland_Ranking Dependent	-.467	.237	-1.970	.049
		# hazards 1960-2006 Dependent	-.467	.237	-1.970	.049

a Not assuming the null hypothesis.
b Using the asymptotic standard error assuming the null hypothesis.

Symmetric Measures

		Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal	Kendall's tau-b	-.467	.237	-1.970	.049
	Spearman Correlation	-.600	.276	-2.121	.067(c)
Interval by Interval	Pearson's R	-.578	.219	-2.003	.080(c)
N of Valid Cases		10			

a Not assuming the null hypothesis.
b Using the asymptotic standard error assuming the null hypothesis.
c Based on normal approximation.

Correlations

Correlations

		Wetland Ranking	Per Capita Income	Percent area Wetland	Percent Population Growth	Percent Bachelor's	Percent Voting	Budget	# hazards 1960-2006
Wetland Ranking	Pearson Correlation	1	-.218	-.311	-.171	-.070	.106	-.402	-.578
	Sig. (2-tailed)		.544	.382	.637	.847	.771	.250	.080
	N	10	10	10	10	10	10	10	10
Per Capita Income	Pearson Correlation	-.218	1	-.433	-.036	.685(*)	-.303	-.101	.546
	Sig. (2-tailed)	.544		.212	.922	.029	.395	.781	.102
	N	10	10	10	10	10	10	10	10
Percent area Wetland	Pearson Correlation	-.311	-.433	1	.252	-.418	-.187	.632(*)	.263
	Sig. (2-tailed)	.382	.212		.482	.229	.605	.050	.463
	N	10	10	10	10	10	10	10	10
Percent Population Growth	Pearson Correlation	-.171	-.036	.252	1	-.299	-.040	.014	.207
	Sig. (2-tailed)	.637	.922	.482		.401	.912	.969	.566
	N	10	10	10	10	10	10	10	10
Percent Bachelor's	Pearson Correlation	-.070	.685(*)	-.418	-.299	1	-.531	-.123	.424
	Sig. (2-tailed)	.847	.029	.229	.401		.114	.736	.222
	N	10	10	10	10	10	10	10	10
Percent Voting	Pearson Correlation	.106	-.303	-.187	-.040	-.531	1	-.211	-.686(*)
	Sig. (2-tailed)	.771	.395	.605	.912	.114		.559	.029
	N	10	10	10	10	10	10	10	10
Budget	Pearson Correlation	-.402	-.101	.632(*)	.014	-.123	-.211	1	.092
	Sig. (2-tailed)	.250	.781	.050	.969	.736	.559		.801
	N	10	10	10	10	10	10	10	10
# hazards 1960-2006	Pearson Correlation	-.578	.546	.263	.207	.424	-.686(*)	.092	1
	Sig. (2-tailed)	.080	.102	.463	.566	.222	.029	.801	
	N	10	10	10	10	10	10	10	10

* Correlation is significant at the 0.05 level (2-tailed).

Nonparametric Correlations

Correlations

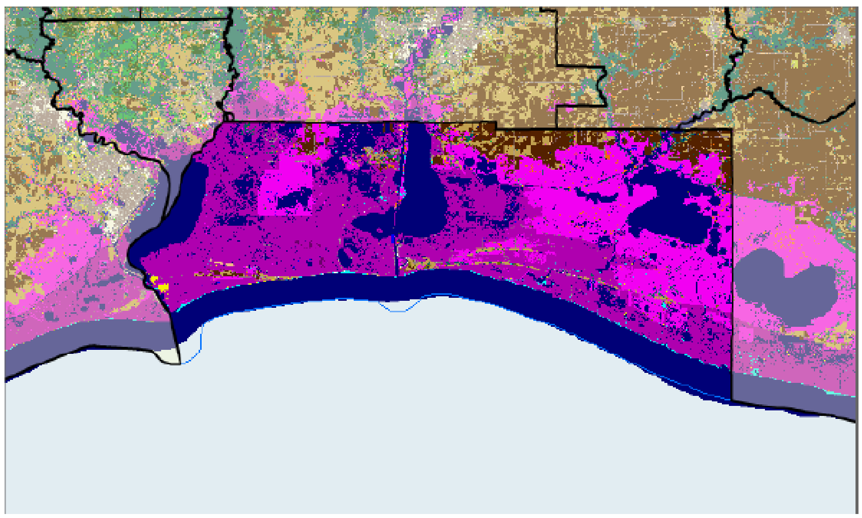
			Wetland Ranking	Per Capita Income	Percent area Wetland	Percent Population Growth	Percent Bachelor's	Percent Voting	Budget	# hazards 1960-2006
Kendall's tau_b	Wetland Ranking	Correlation Coefficient	1.000	-.022	-.244	-.067	-.200	.244	-.333	-.467
		Sig. (2-tailed)	.	.929	.325	.788	.421	.325	.180	.060
		N	10	10	10	10	10	10	10	10
	Per Capita Income	Correlation Coefficient	-.022	1.000	-.289	-.200	.378	-.156	-.200	.200
		Sig. (2-tailed)	.929	.	.245	.421	.128	.531	.421	.421
		N	10	10	10	10	10	10	10	10
	Percent area Wetland	Correlation Coefficient	-.244	-.289	1.000	.467	-.111	-.111	.289	.422
		Sig. (2-tailed)	.325	.245	.	.060	.655	.655	.245	.089
		N	10	10	10	10	10	10	10	10
	Percent growth Population	Correlation Coefficient	-.067	-.200	.467	1.000	-.200	.156	.111	.156
		Sig. (2-tailed)	.788	.421	.060	.	.421	.531	.655	.531
		N	10	10	10	10	10	10	10	10
	Percent Bachelor's	Correlation Coefficient	-.200	.378	-.111	-.200	1.000	-.600(*)	-.111	.467
		Sig. (2-tailed)	.421	.128	.655	.421	.	.016	.655	.060
		N	10	10	10	10	10	10	10	10
	Percent Voting	Correlation Coefficient	.244	-.156	-.111	.156	-.600(*)	1.000	-.200	-.422
		Sig. (2-tailed)	.325	.531	.655	.531	.016	.	.421	.089
		N	10	10	10	10	10	10	10	10
	Budget	Correlation Coefficient	-.333	-.200	.289	.111	-.111	-.200	1.000	-.022
		Sig. (2-tailed)	.180	.421	.245	.655	.655	.421	.	.929
		N	10	10	10	10	10	10	10	10
	# hazards 1960-2006	Correlation Coefficient	-.467	.200	.422	.156	.467	-.422	-.022	1.000
		Sig. (2-tailed)	.060	.421	.089	.531	.060	.089	.929	.
		N	10	10	10	10	10	10	10	10

Spearman's rho	Wetland Ranking	Correlation Coefficient	1.000	-.030	-.345	-.164	-.236	.236	-.358	-.600
		Sig. (2-tailed)	.	.934	.328	.651	.511	.511	.310	.067
		N	10	10	10	10	10	10	10	10
	Per Capita Income	Correlation Coefficient	-.030	1.000	-.479	-.224	.527	-.333	-.200	.285
		Sig. (2-tailed)	.934	.	.162	.533	.117	.347	.580	.425
		N	10	10	10	10	10	10	10	10
	Percent area Wetland	Correlation Coefficient	-.345	-.479	1.000	.588	-.139	-.188	.491	.491
		Sig. (2-tailed)	.328	.162	.	.074	.701	.603	.150	.150
		N	10	10	10	10	10	10	10	10
	Percent Population Growth	Correlation Coefficient	-.164	-.224	.588	1.000	-.212	.152	.188	.236
		Sig. (2-tailed)	.651	.533	.074	.	.556	.676	.603	.511
		N	10	10	10	10	10	10	10	10
	Percent Bachelor's	Correlation Coefficient	-.236	.527	-.139	-.212	1.000	-.818(**)	-.152	.612
		Sig. (2-tailed)	.511	.117	.701	.556	.	.004	.676	.060
		N	10	10	10	10	10	10	10	10
	Percent Voting	Correlation Coefficient	.236	-.333	-.188	.152	-.818(**)	1.000	-.248	-.624
		Sig. (2-tailed)	.511	.347	.603	.676	.004	.	.489	.054
		N	10	10	10	10	10	10	10	10
	Budget	Correlation Coefficient	-.358	-.200	.491	.188	-.152	-.248	1.000	.018
		Sig. (2-tailed)	.310	.580	.150	.603	.676	.489	.	.960
		N	10	10	10	10	10	10	10	10
	# hazards 1960-2006	Correlation Coefficient	-.600	.285	.491	.236	.612	-.624	.018	1.000
		Sig. (2-tailed)	.067	.425	.150	.511	.060	.054	.960	.
		N	10	10	10	10	10	10	10	10

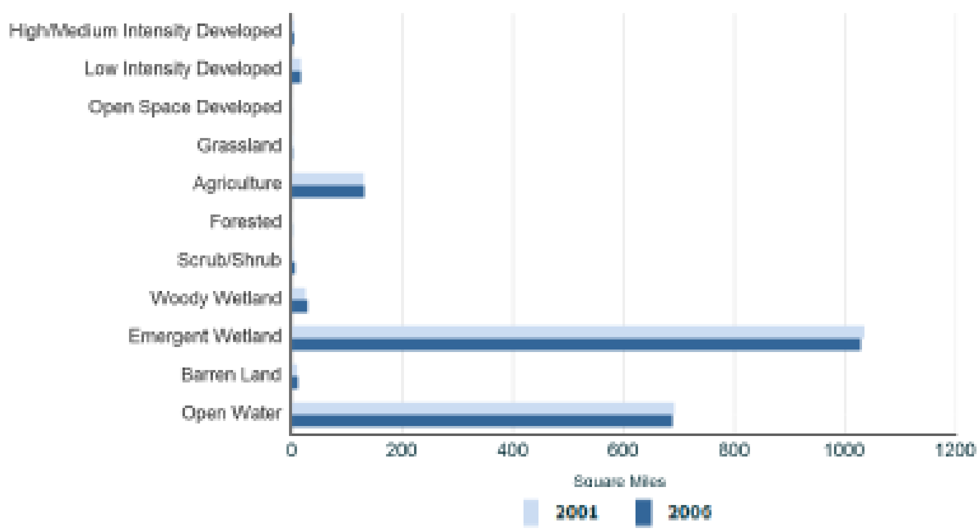
* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

APPENDIX D: NOAA C-CAP WETLAND DATA

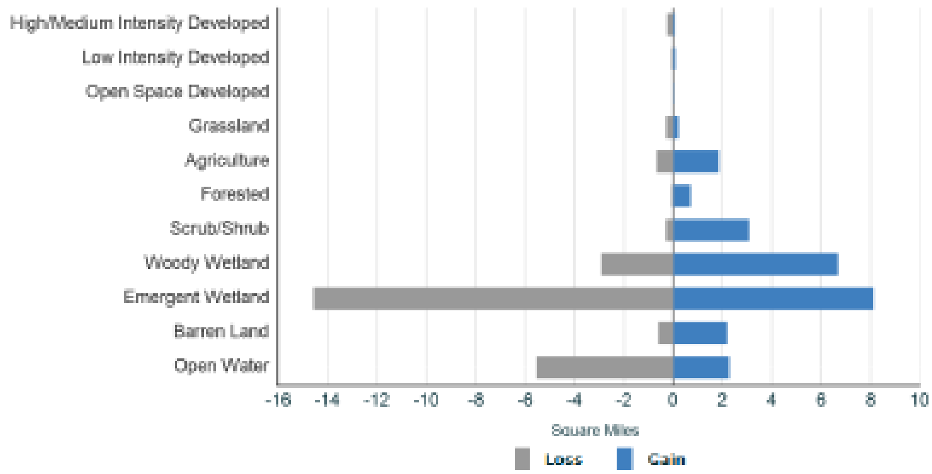
Key for all of the land types found within each parish



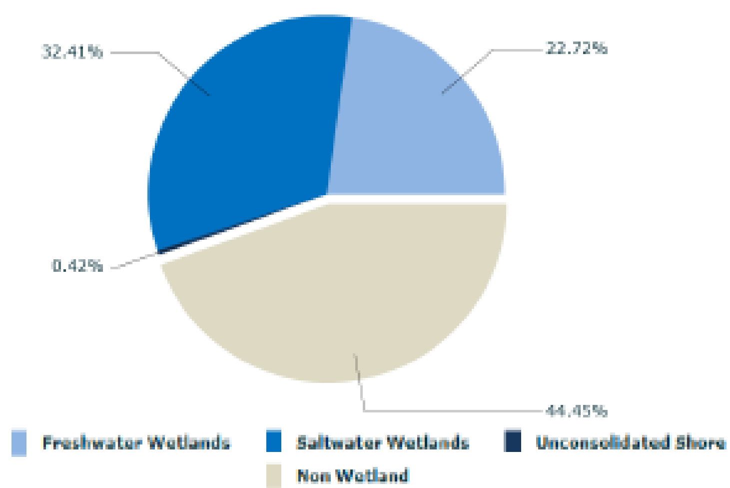
2006 Land cover map of Cameron Parish



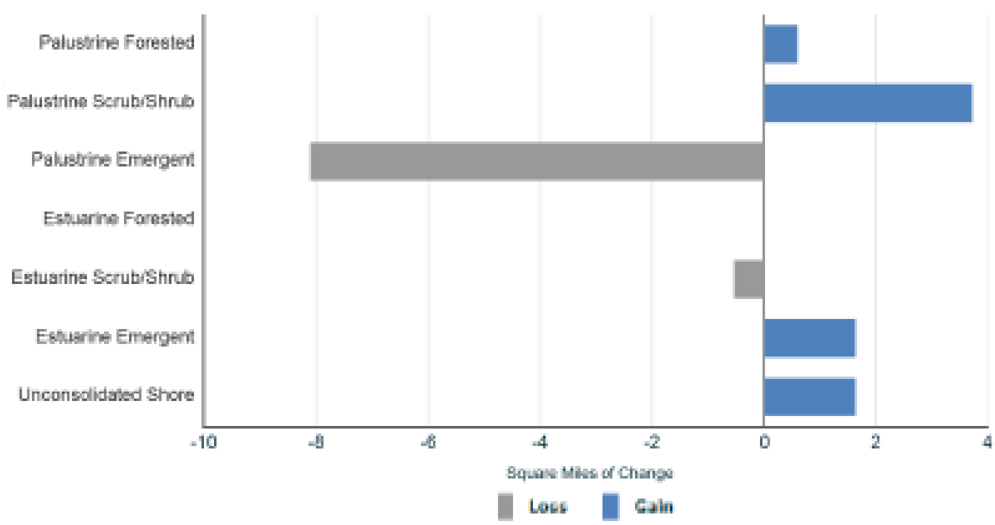
Land cover basics of Cameron Parish



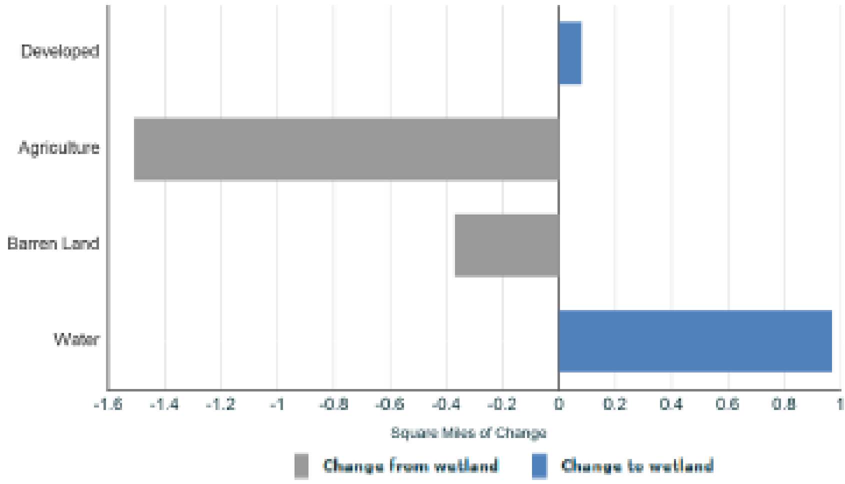
1996-2006 Net change in Cameron Parish



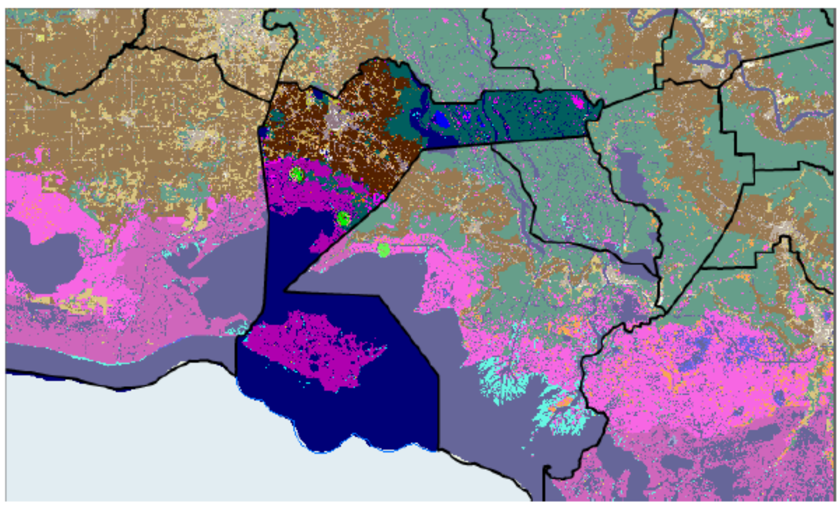
In 2006, 55.55% of Cameron Parish is wetland



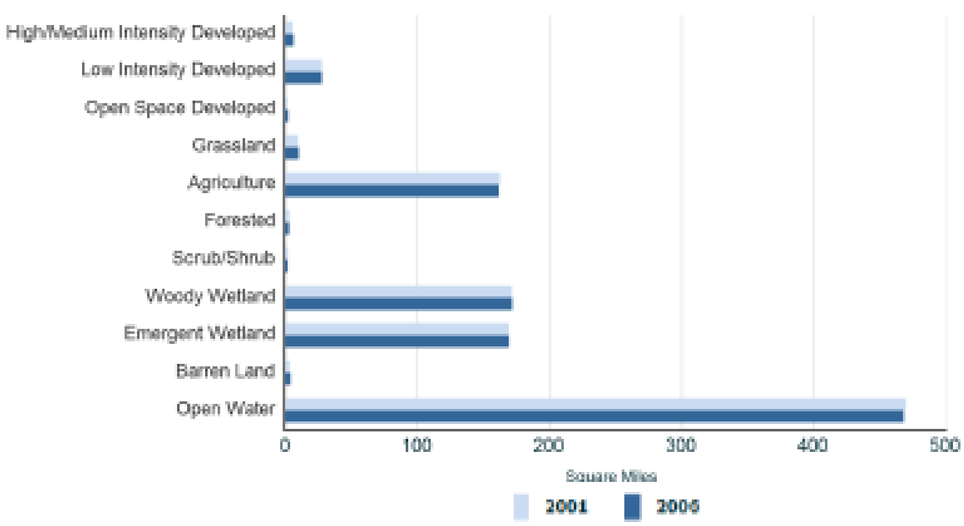
1996-2006 Wetland change in Cameron Parish. 1.59 mi^2 were lost.



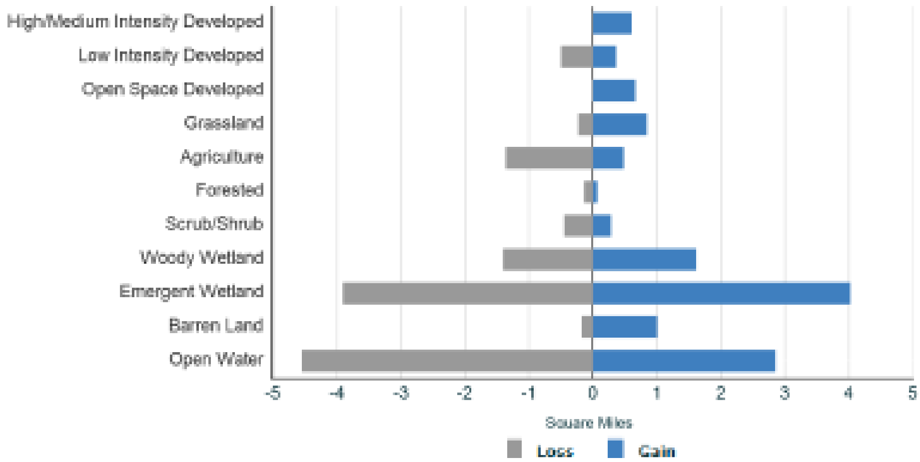
1996-2006 Change to or from wetland in Cameron Parish



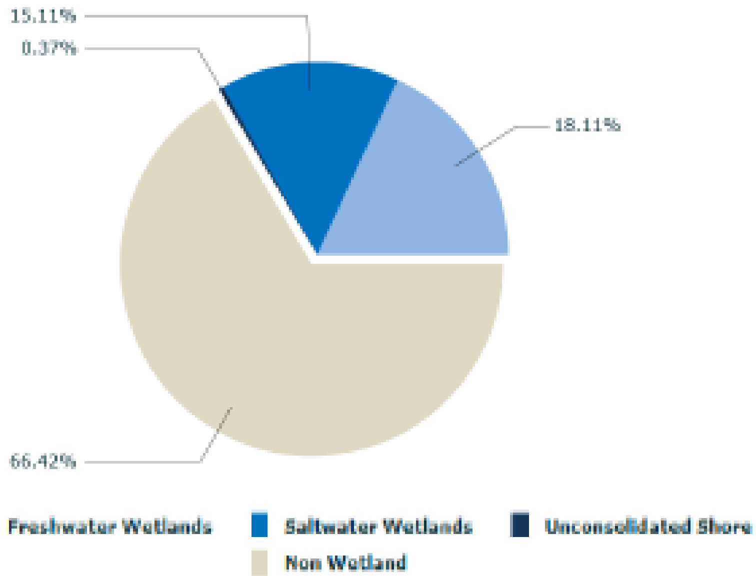
2006 Land cover map of Iberia Parish



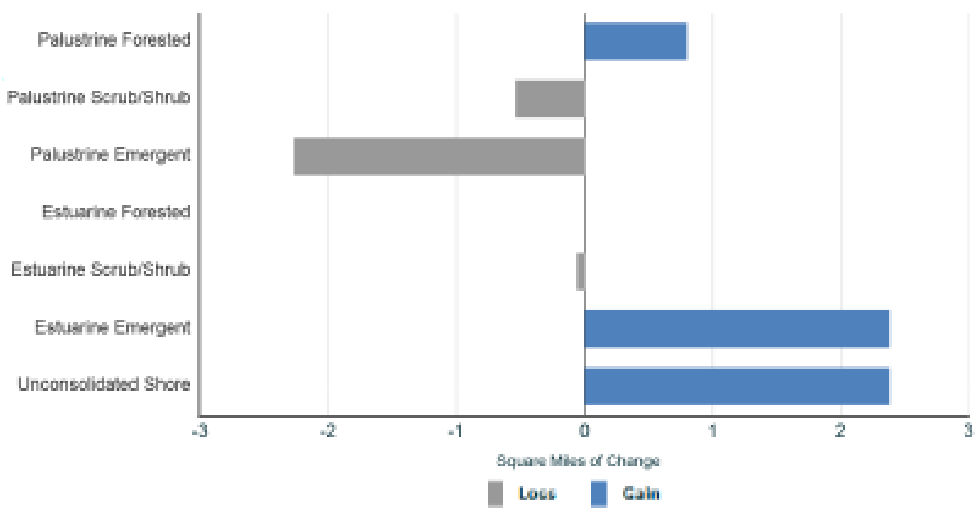
Land cover basics of Iberia Parish



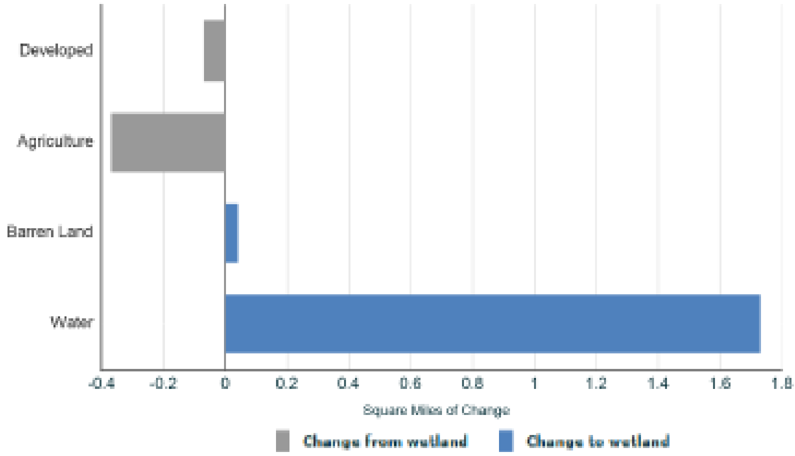
1996-2006 Net change in Iberia Parish



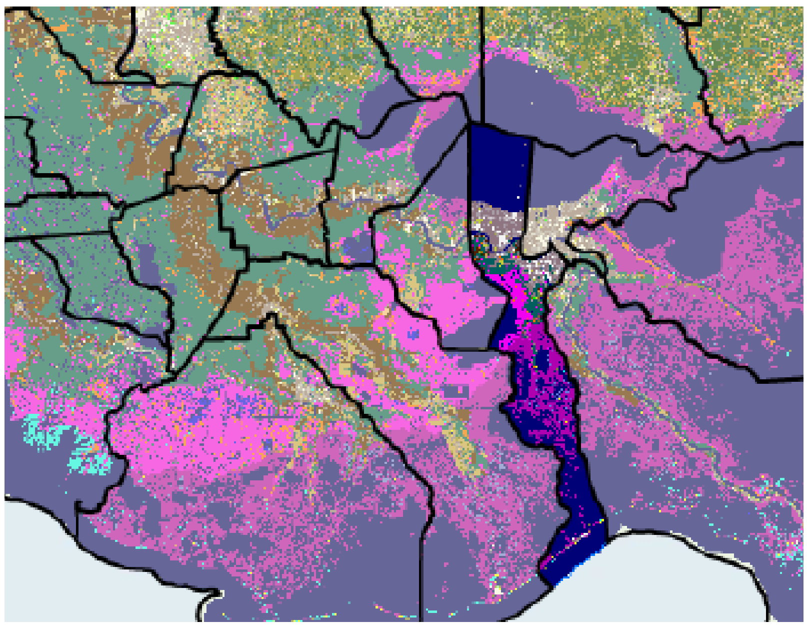
In 2006, 33.58% of Iberia Parish is wetland

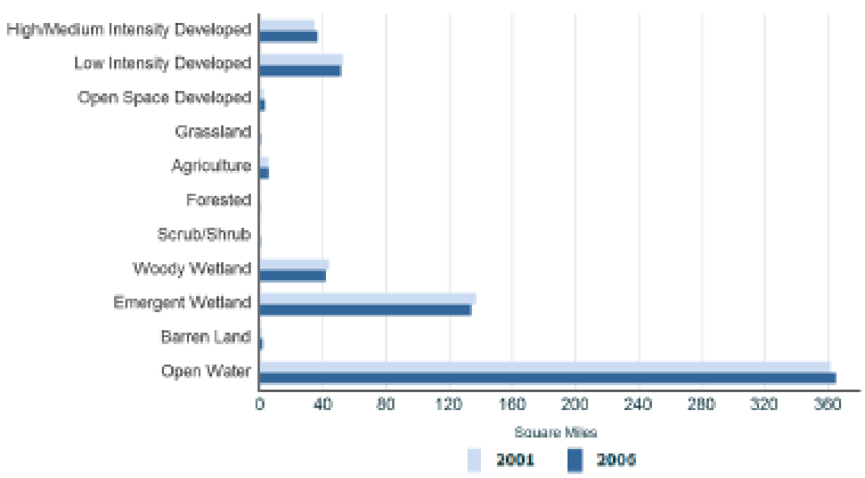


1996-2006 Wetland change in Iberia parish. 1.3 mi^2 were gained.

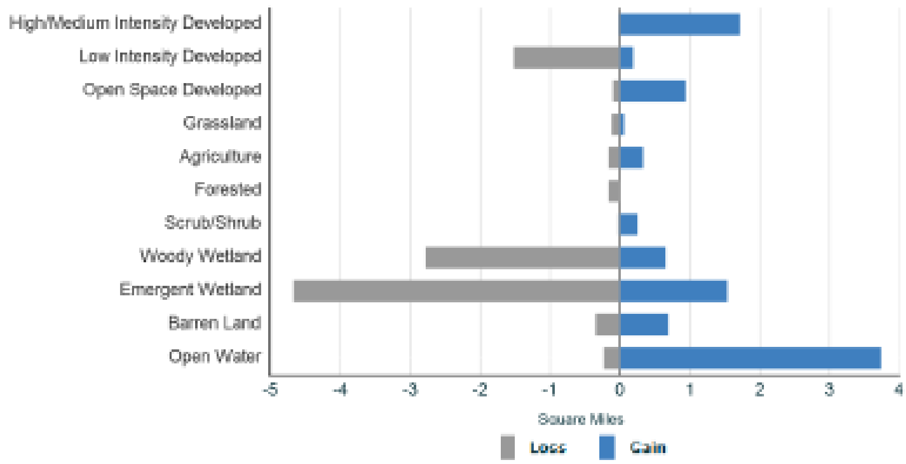


1996-2006 Change to or from wetland in Iberia Parish

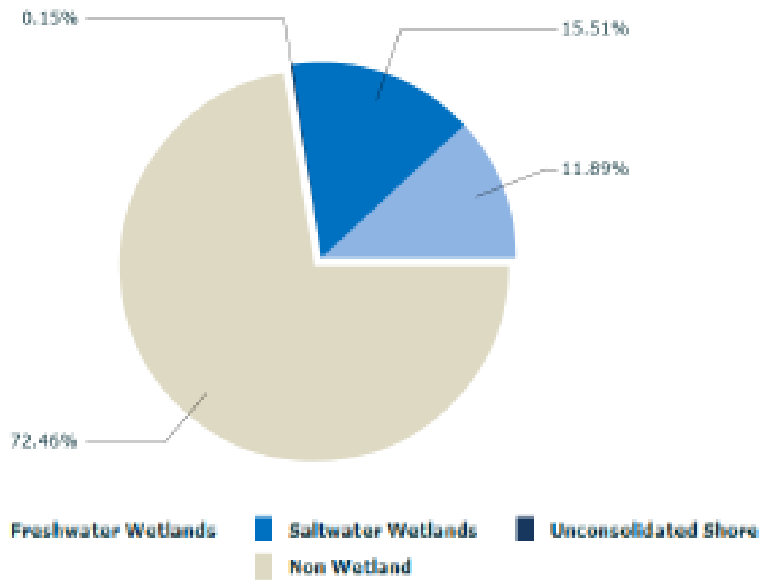

2006 Land cover map of Jefferson Parish



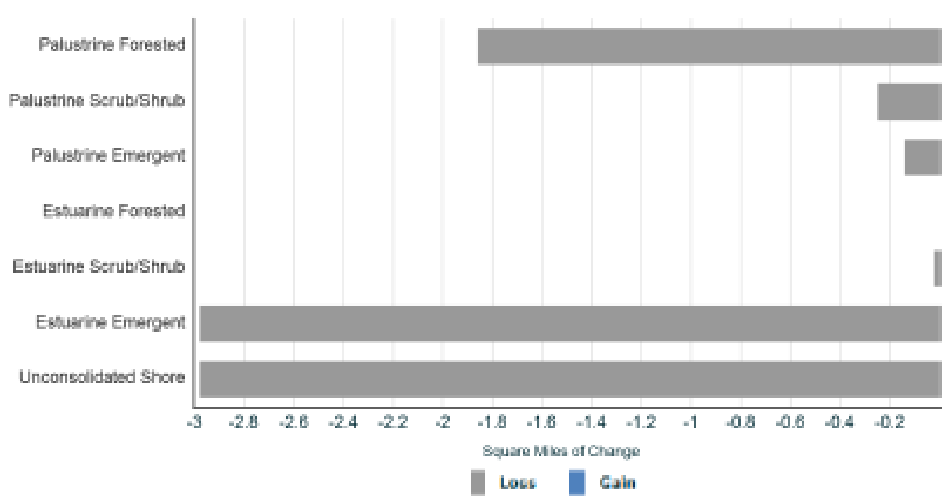
Land cover basics of Jefferson Parish



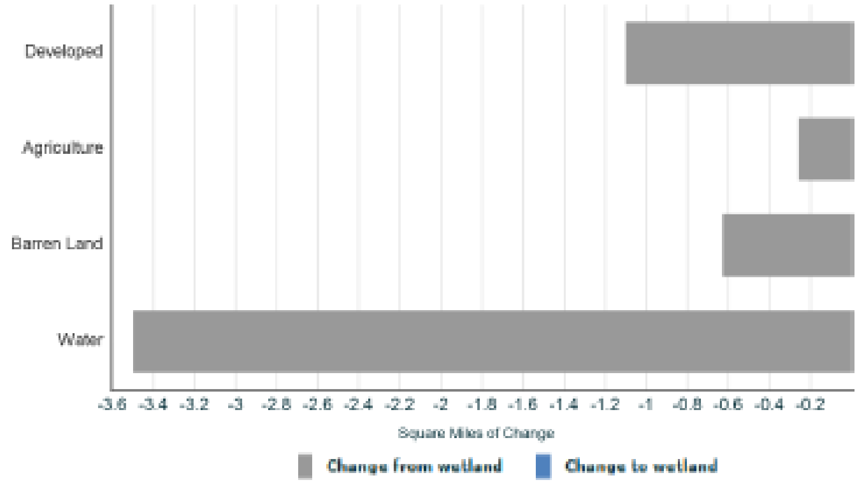
1996-2006 Net change in Jefferson Parish



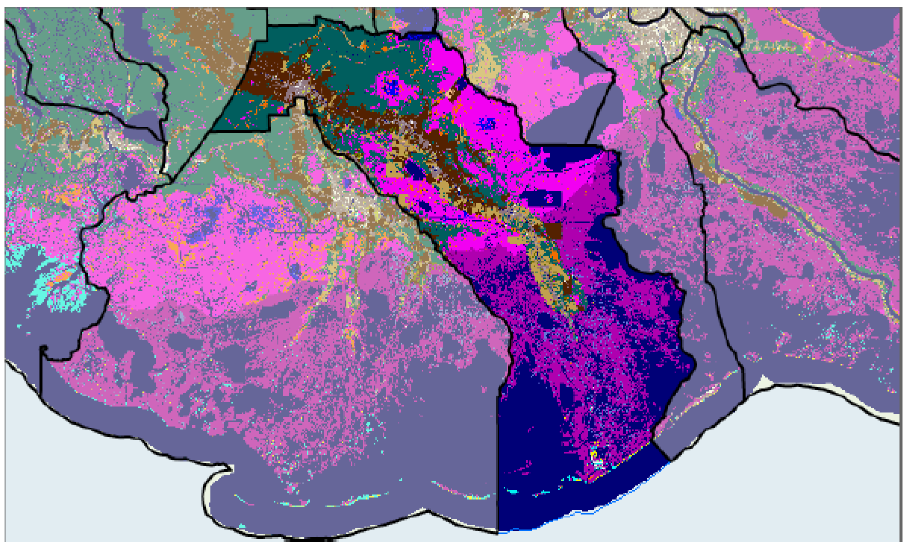
In 2006, 27.54% of Jefferson Parish is wetland



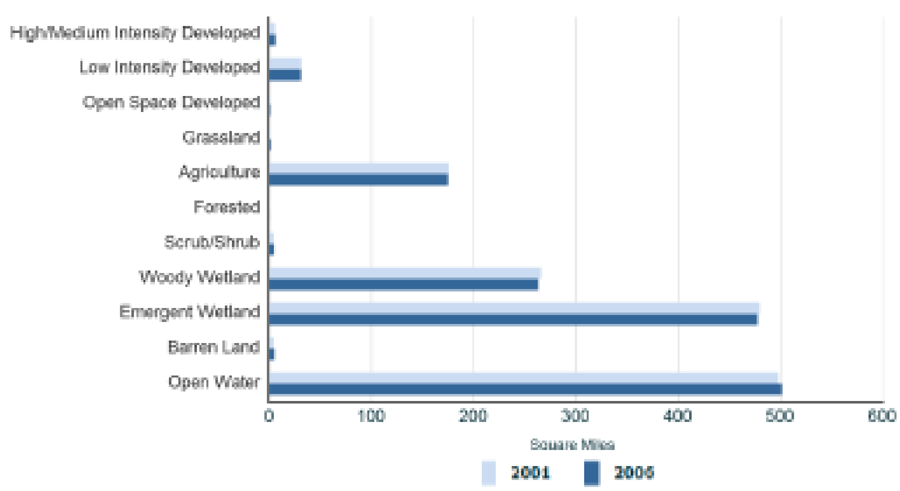
1996-2006 Wetland change in Jefferson Parish. 5.47 mi^2 were lost.



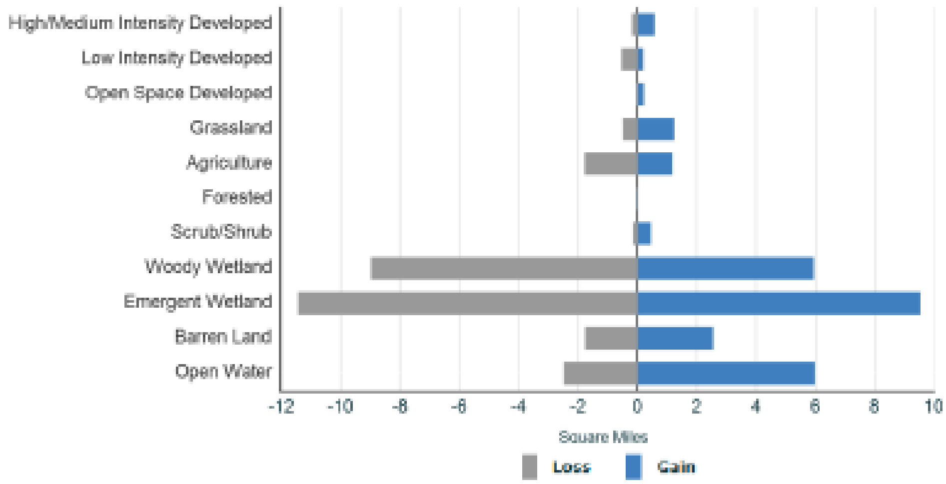
1996-2006 Change to or from wetland in Jefferson Parish



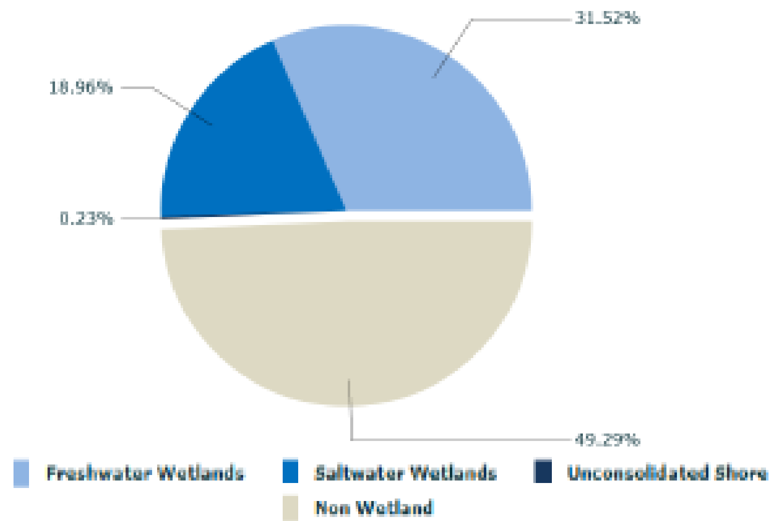
2006 Land cover map of Lafourche Parish



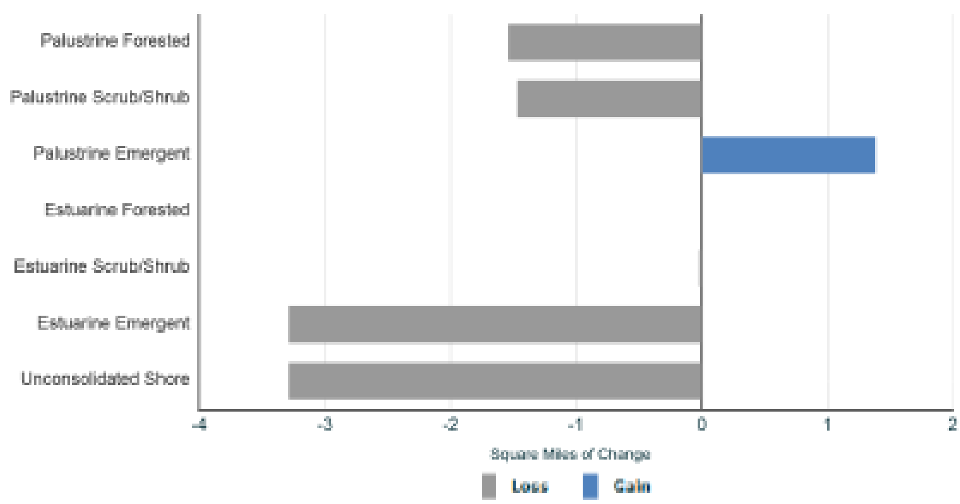
Land cover basics of Lafourche Parish



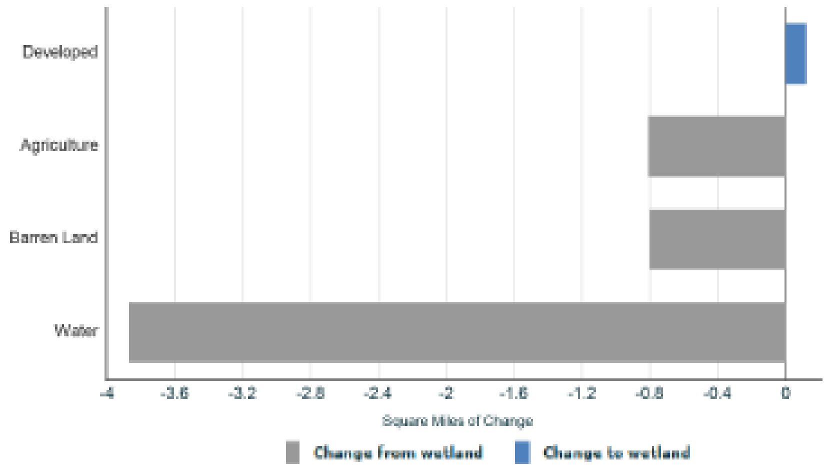
1996-2006 Net change in Lafourche Parish



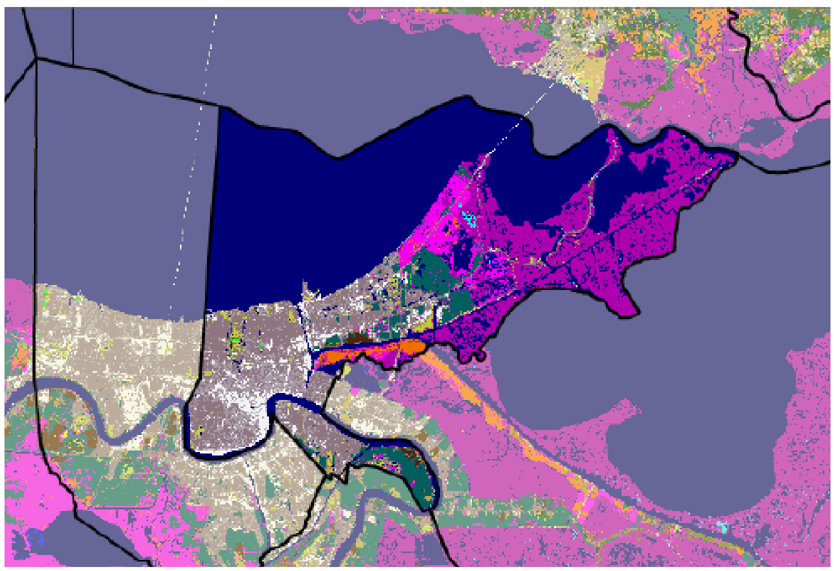
In 2006, 50.71% of Lafourche Parish is wetland



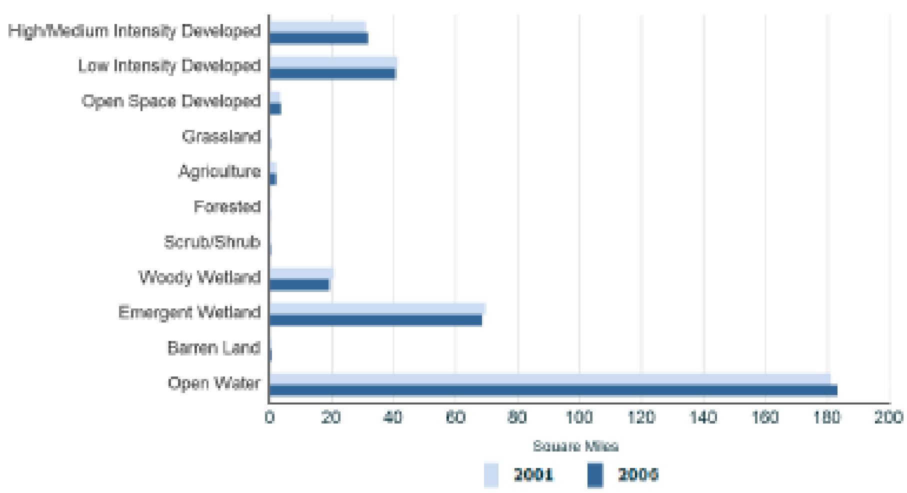
1996-2006 Wetland change in Lafourche Parish. 5.24 mi^2 were lost.



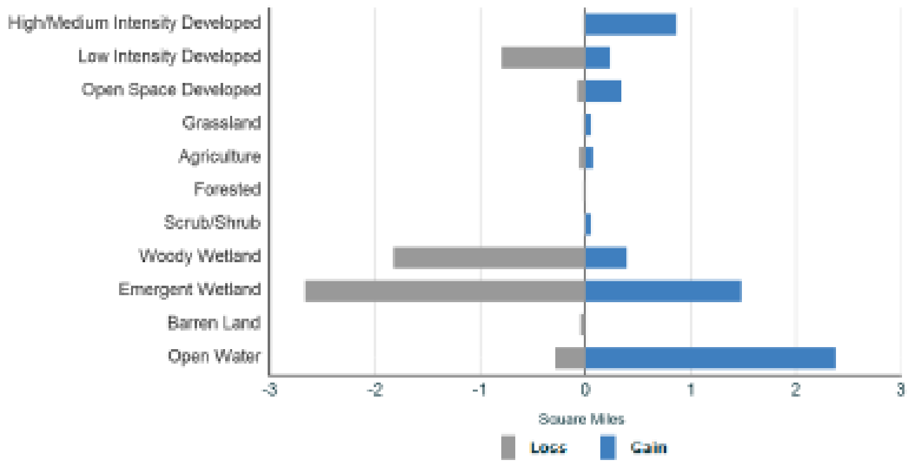
1996-2006 Change to or from wetland in Lafourche Parish



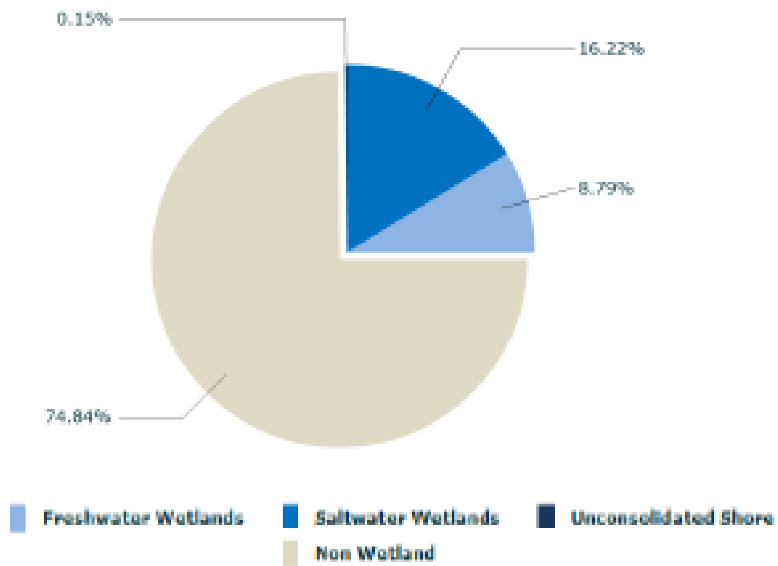
2006 Land cover map of Orleans Parish



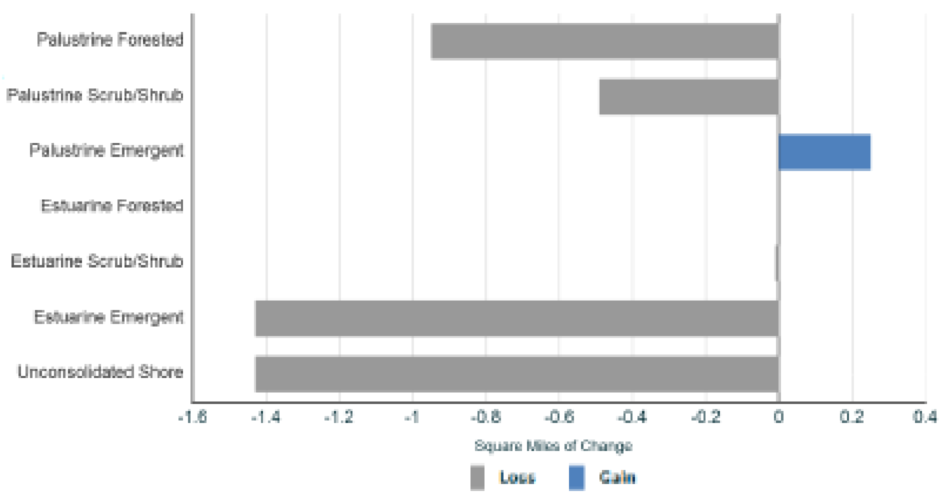
Land cover basics of Orleans Parish



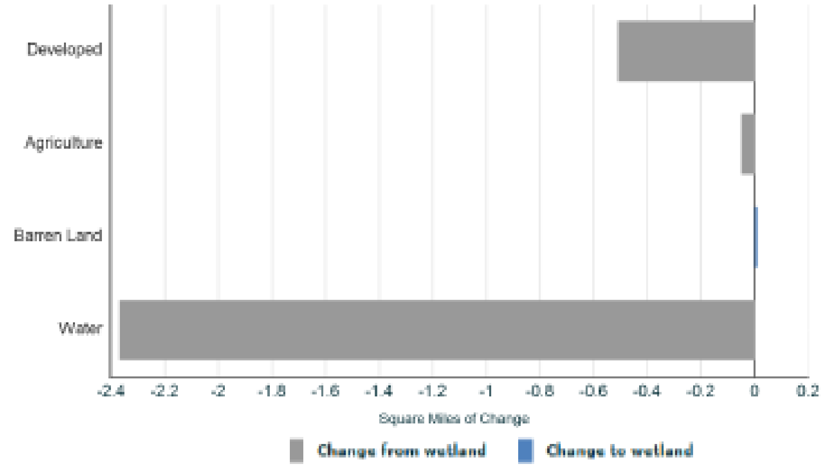
1996-2006 Net change in Orleans Parish



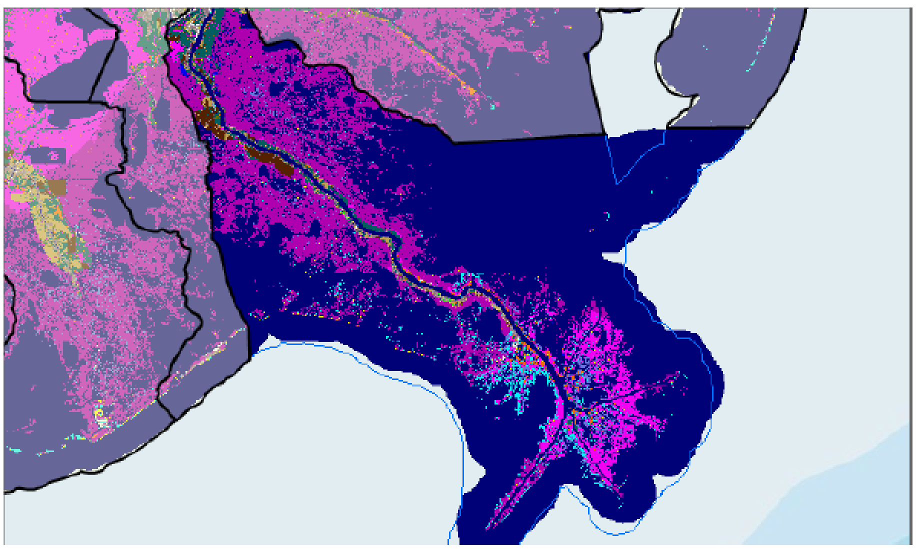
In 2006, 25.16% of Orleans Parish is wetland



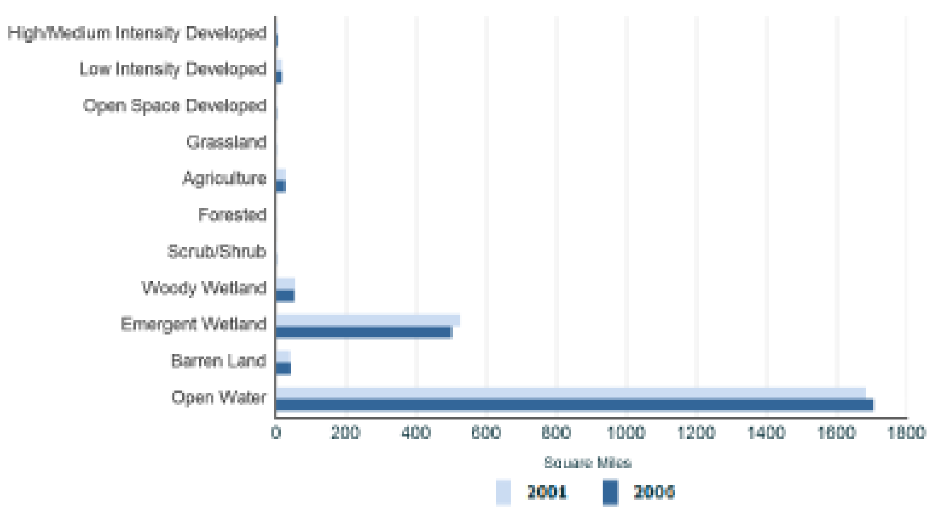
1996-2006 Wetland change in Orleans Parish. 2.63 mi^2 were lost.



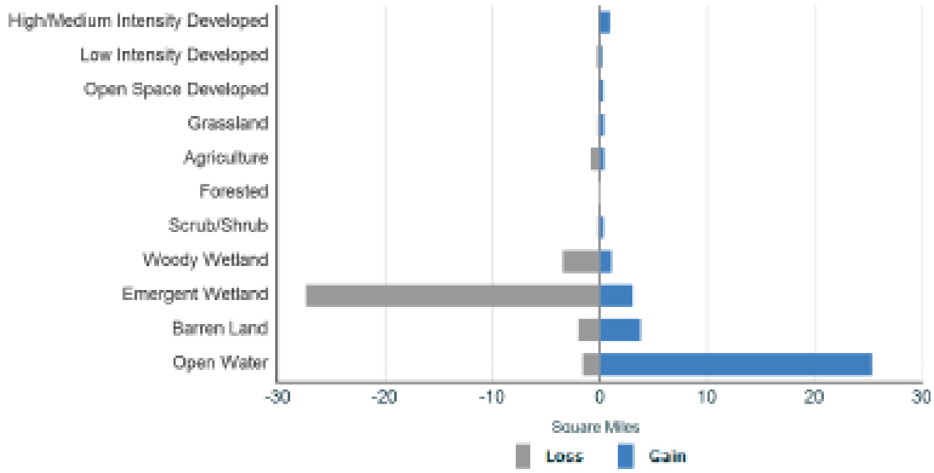
1996-2006 Change to or from wetland in Orleans Parish



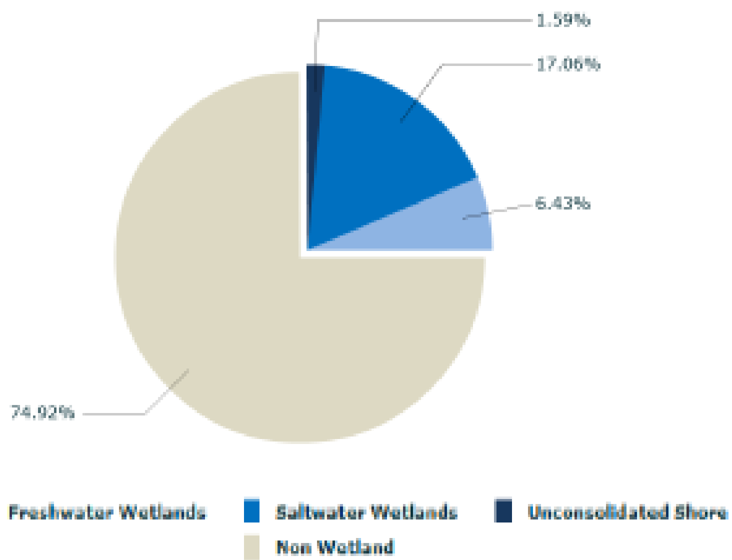
2006 Land cover map of Plaquemines Parish



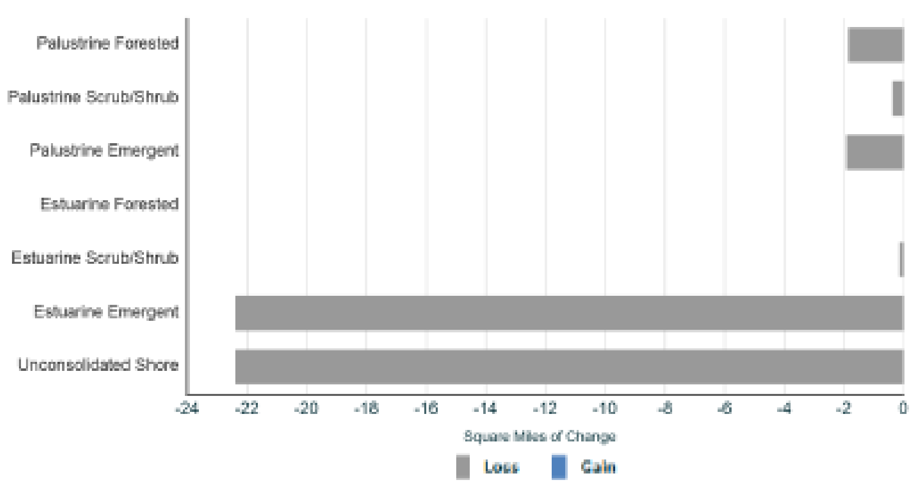
Land cover basics of Plaquemines Parish



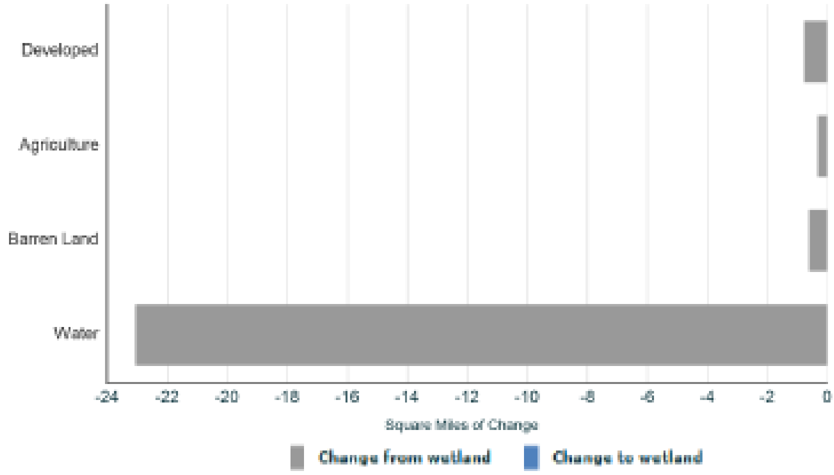
1996-2006 Net change in Plaquemines Parish



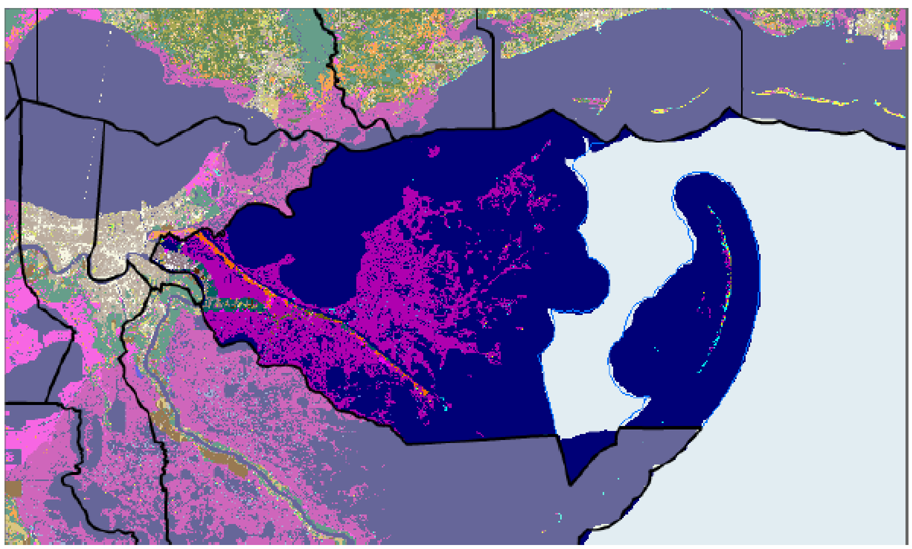
In 2006, 25.08% of Plaquemines Parish is wetland

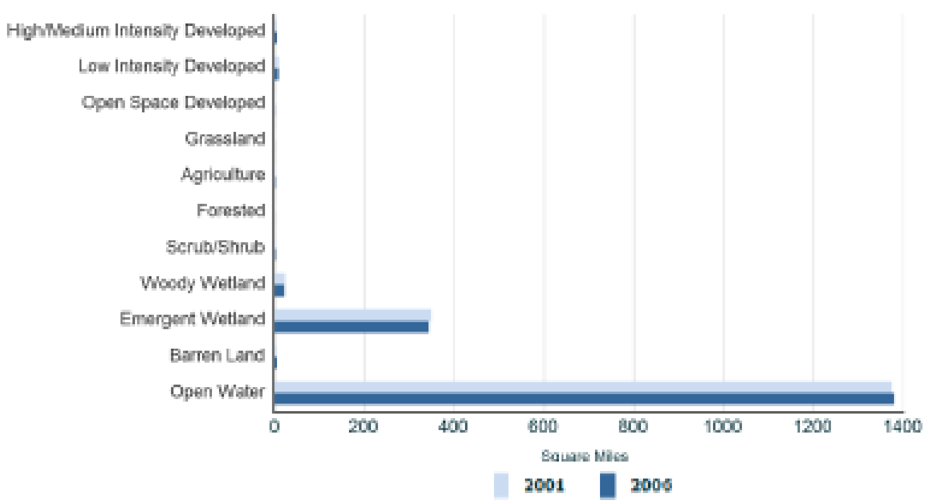


1996-2006 Wetland change in Plaquemines Parish. 25.1 mi^2 were lost.

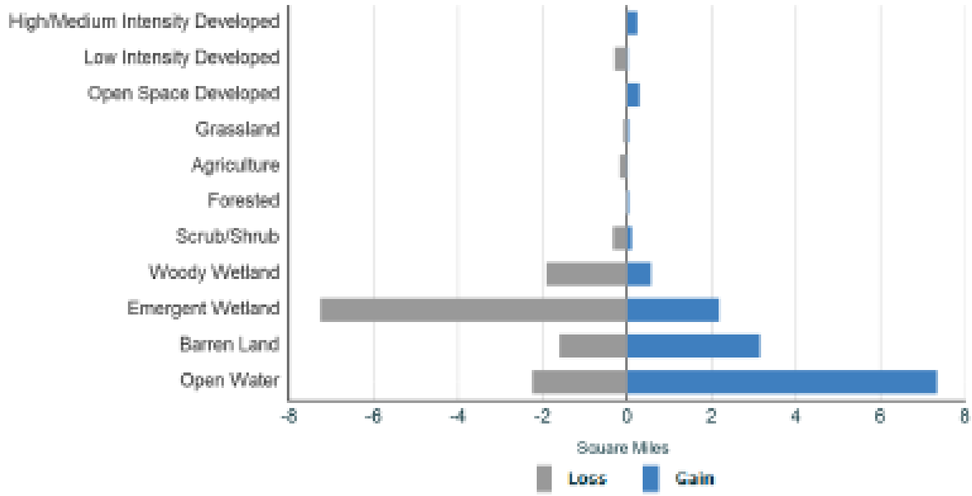


1996-2006 Change to or from wetland in Plaquemines Parish

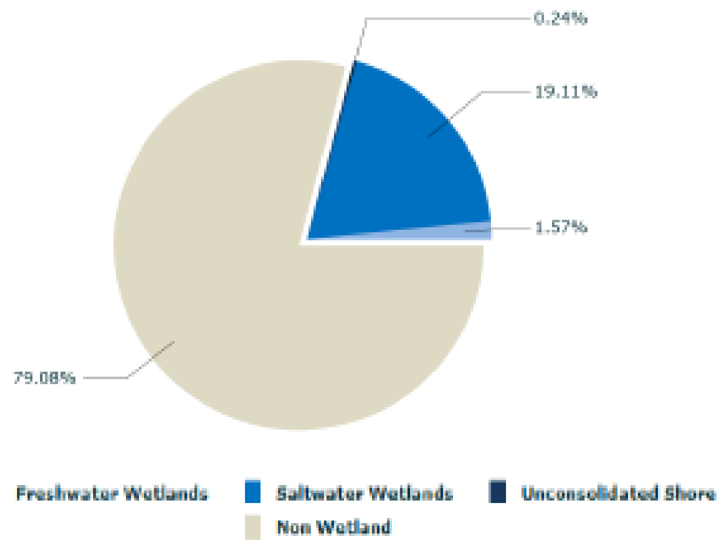

2006 Land cover map of St. Bernard Parish



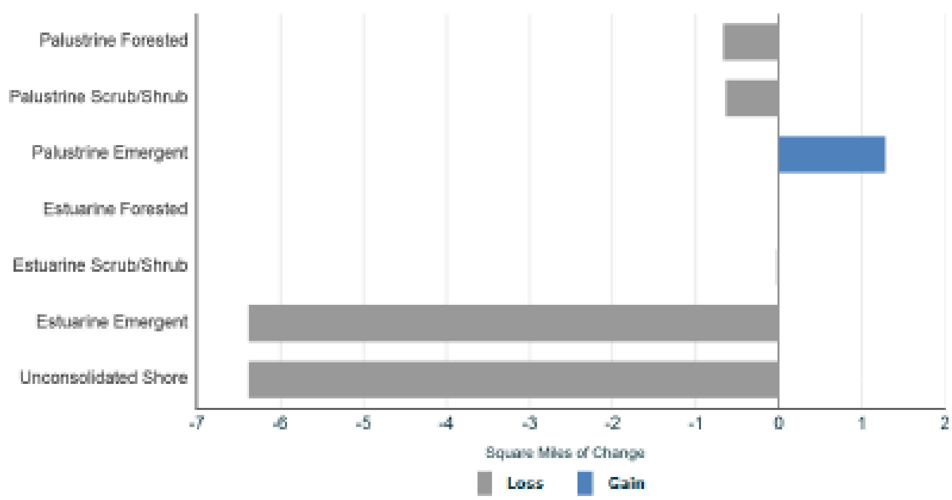
Land cover basics of St. Bernard Parish



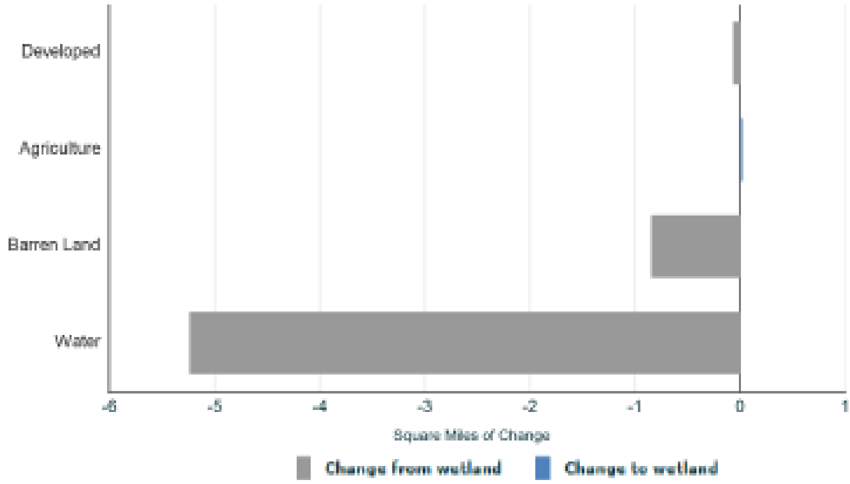
1996-2006 Net change in St. Bernard Parish



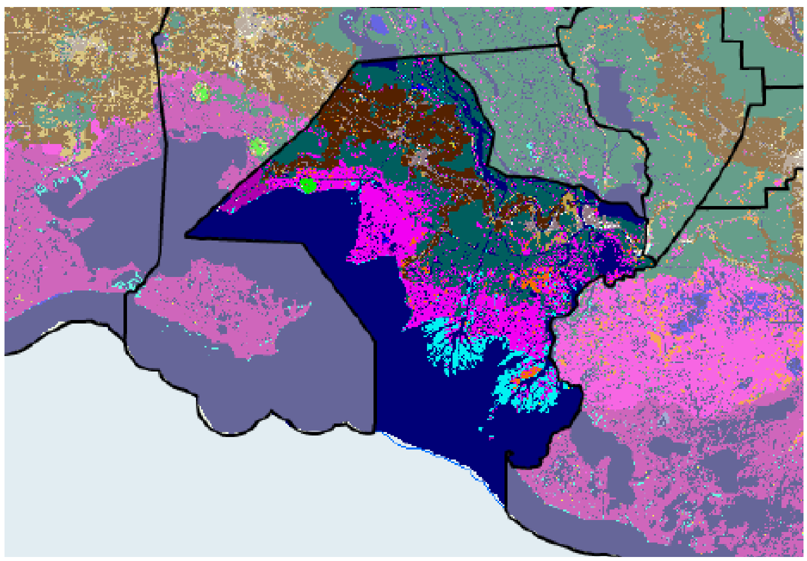
In 2006, 20.92% of St. Bernard Parish is wetland



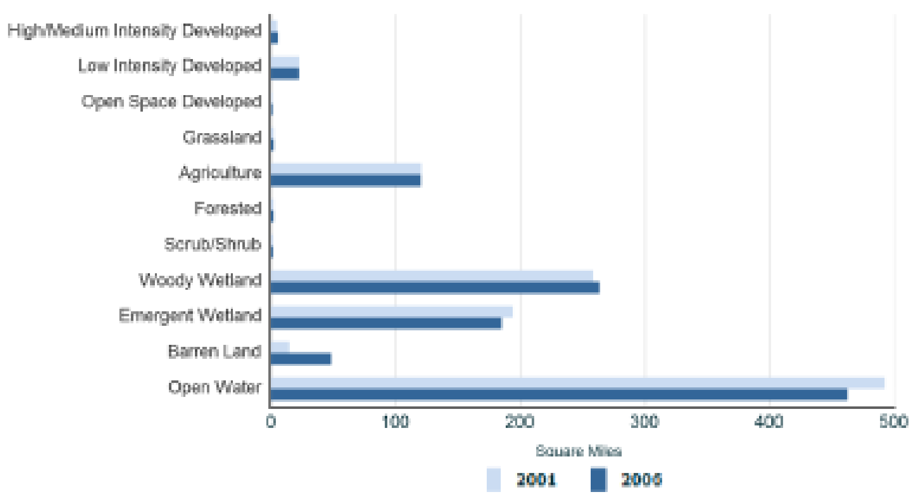
1996-2006 Wetland change in St. Bernard Parish. 5.89 mi^2 were lost.



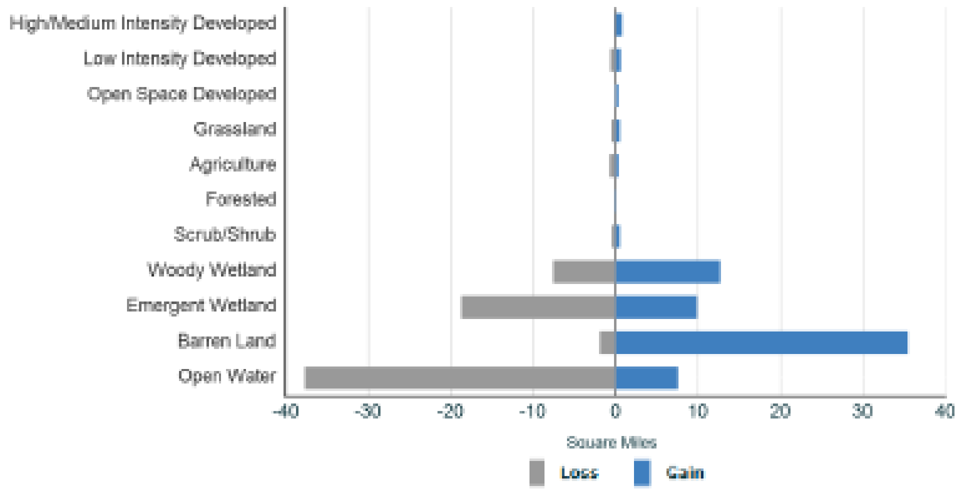
1996-2006 Change to or from wetland in St. Bernard Parish



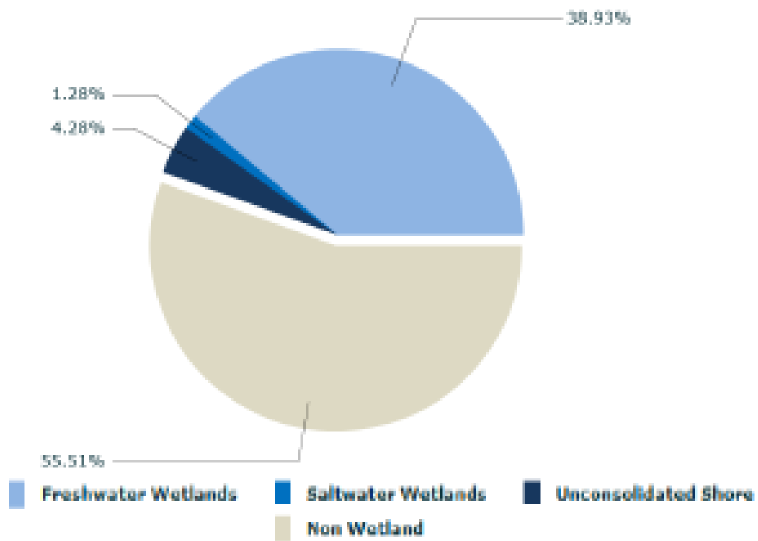
2006 Land cover map for St. Mary Parish



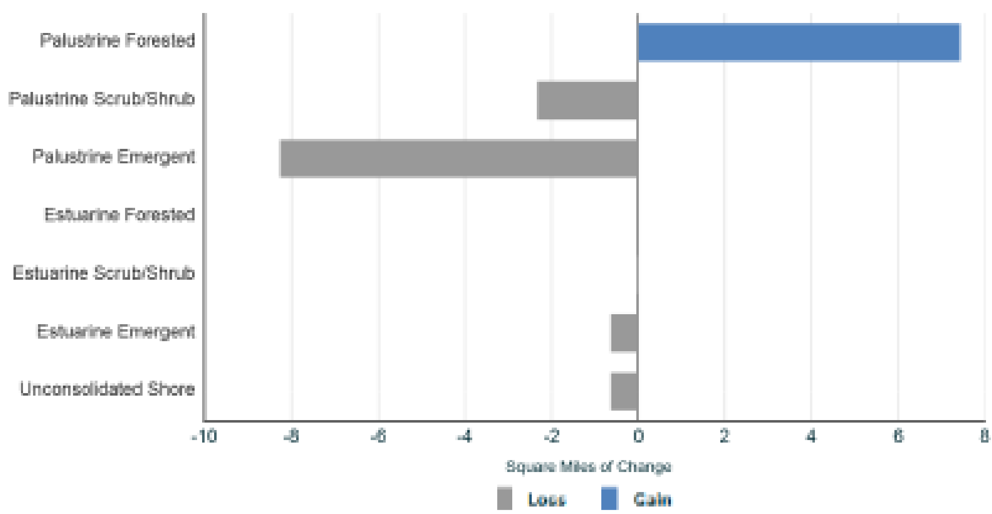
Land cover basics for St. Mary Parish



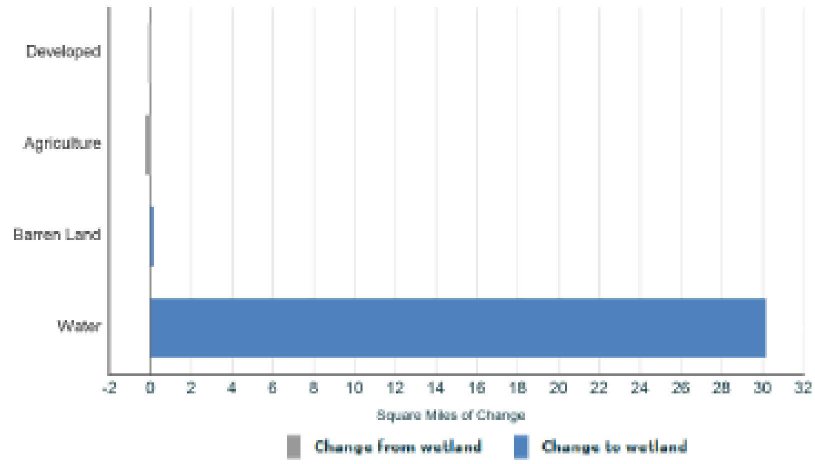
1996-2006 Net change in St. Mary Parish



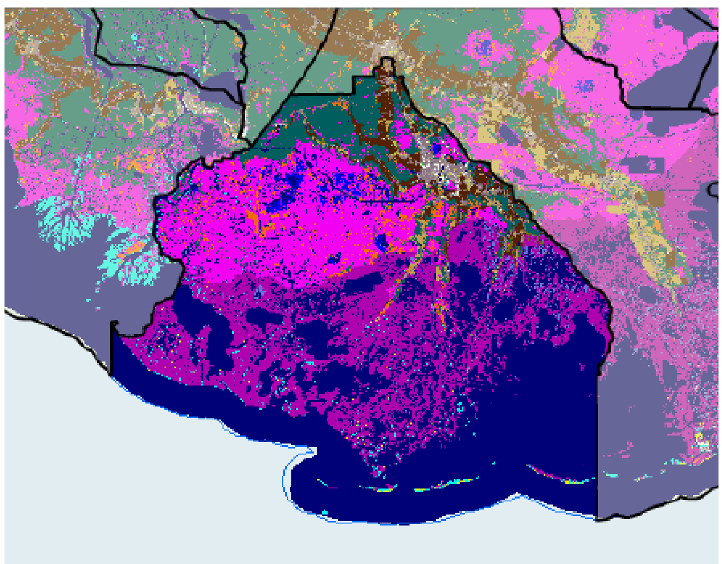
In 2006, 44.49% of St. Mary Parish is wetland



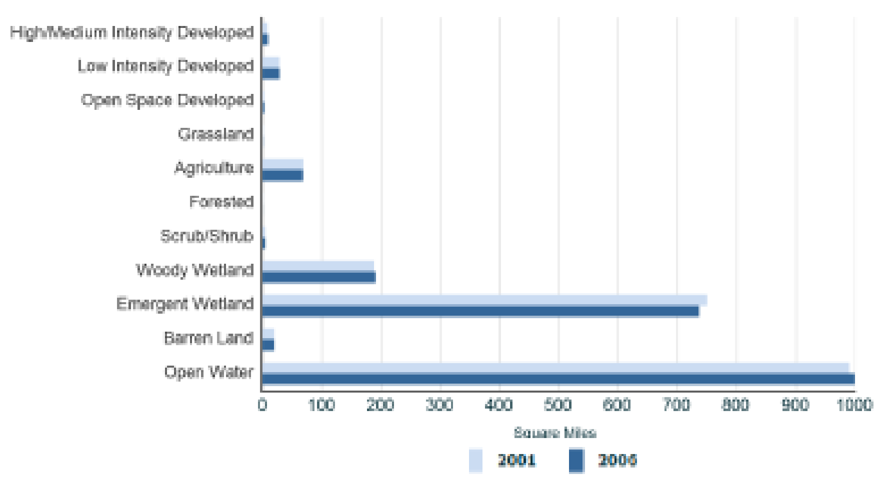
1996-2006 Wetland change in St. Mary Parish. 30.04 mi^2 were gained.



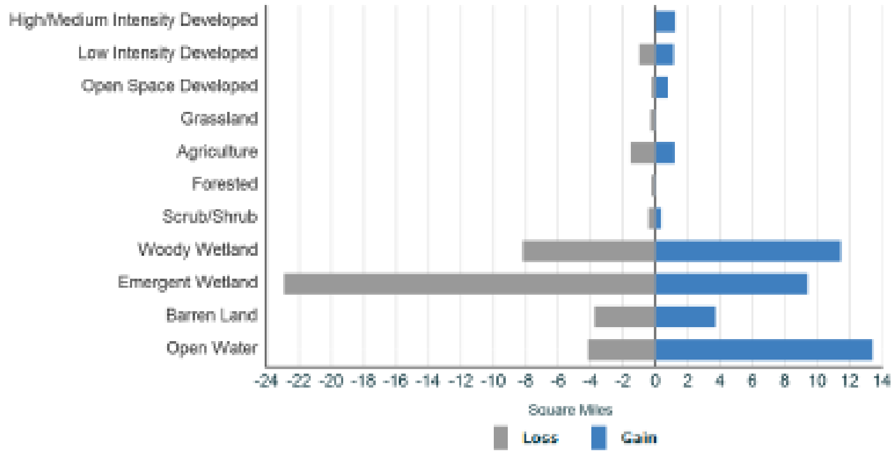
1996-2006 Change to or from wetland in St. Mary Parish



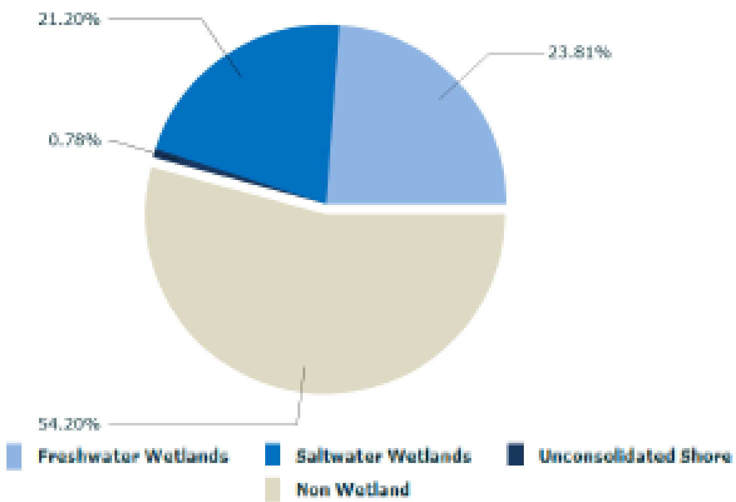
2006 Land cover map for Terrebonne Parish



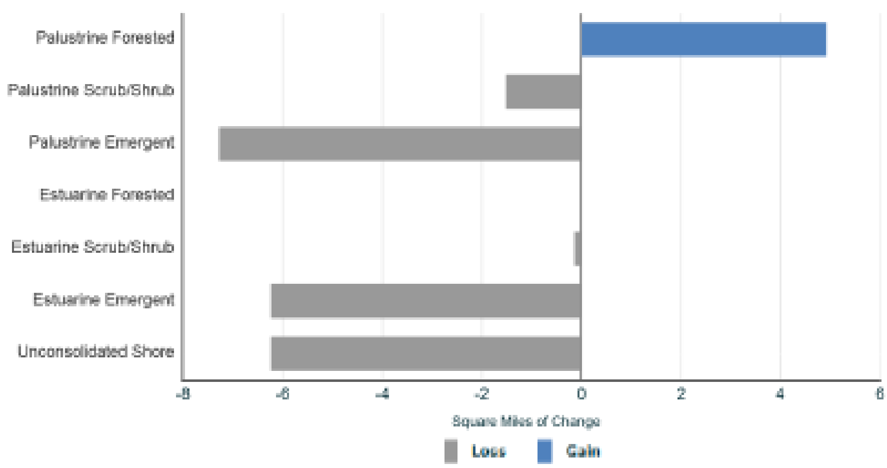
Land cover basics for Terrebonne Parish



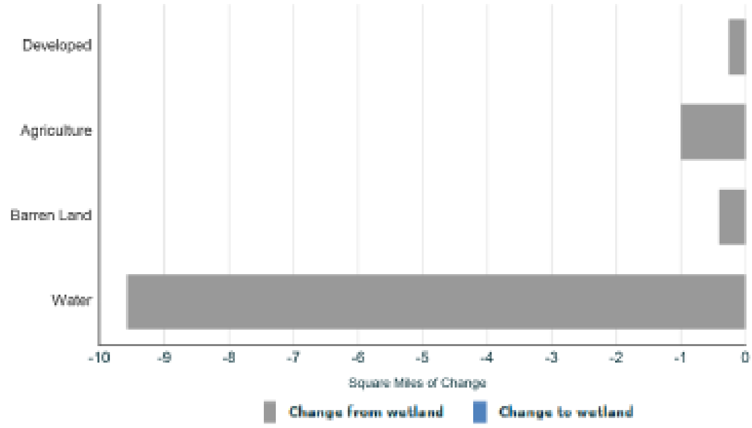
1996-2006 Net change in Terrebonne Parish



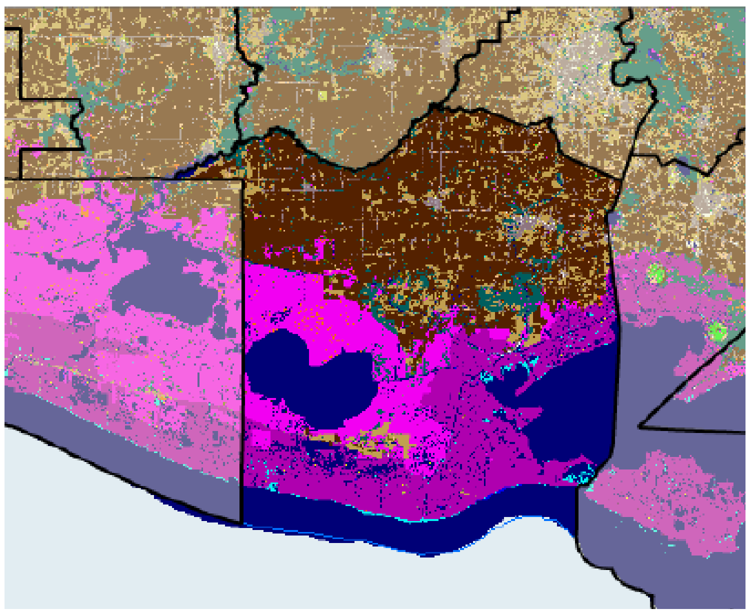
In 2006, 45.8% of Terrebonne Parish is wetland



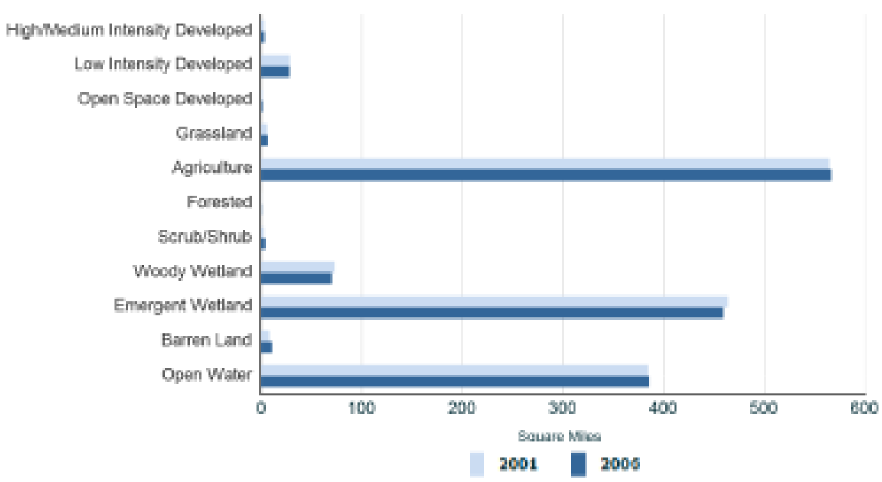
1996-2006 Wetland change in Terrebonne Parish. 10.37 mi^2 were lost.



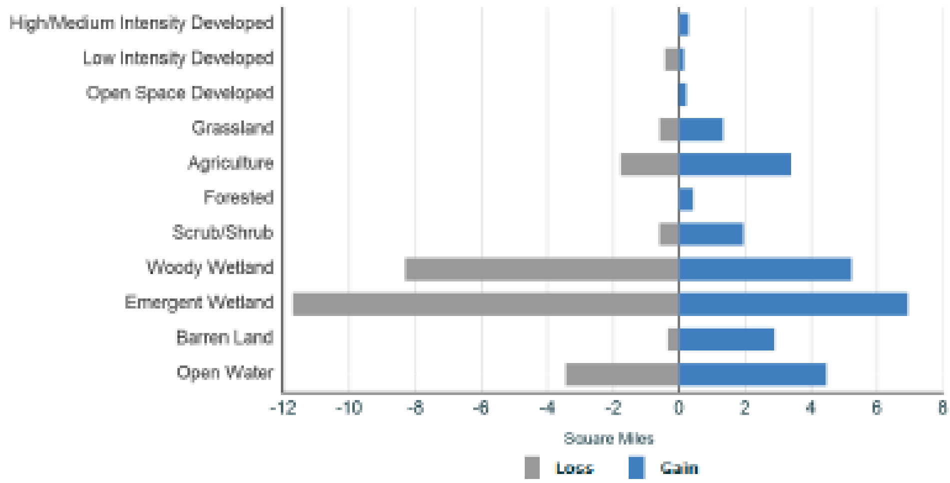
1996-2006 Change to or from wetland in Terrebonne Parish



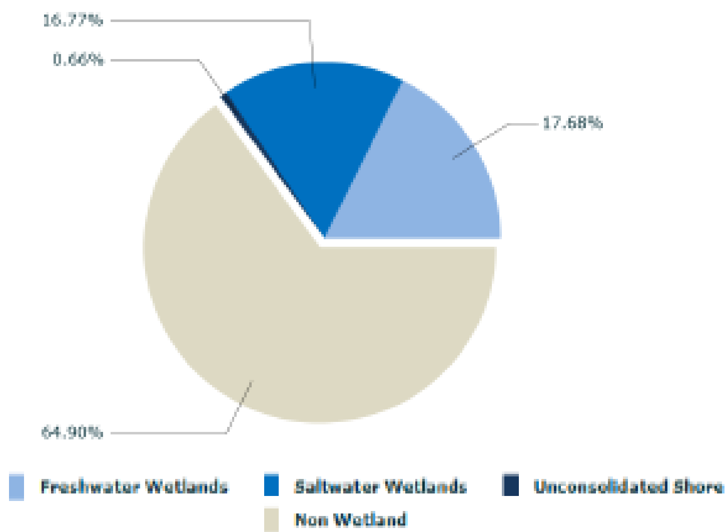
2006 Land cover map for Vermilion Parish



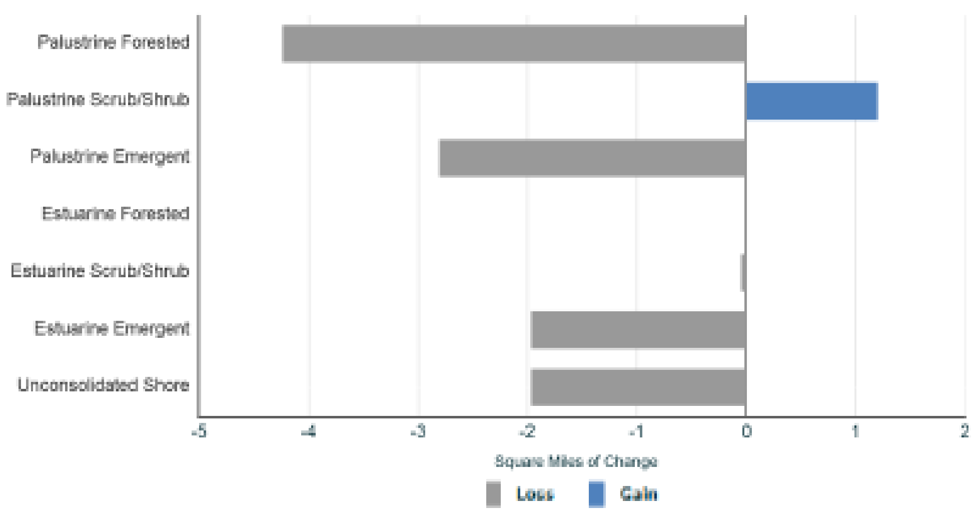
Land cover basics for Vermilion Parish



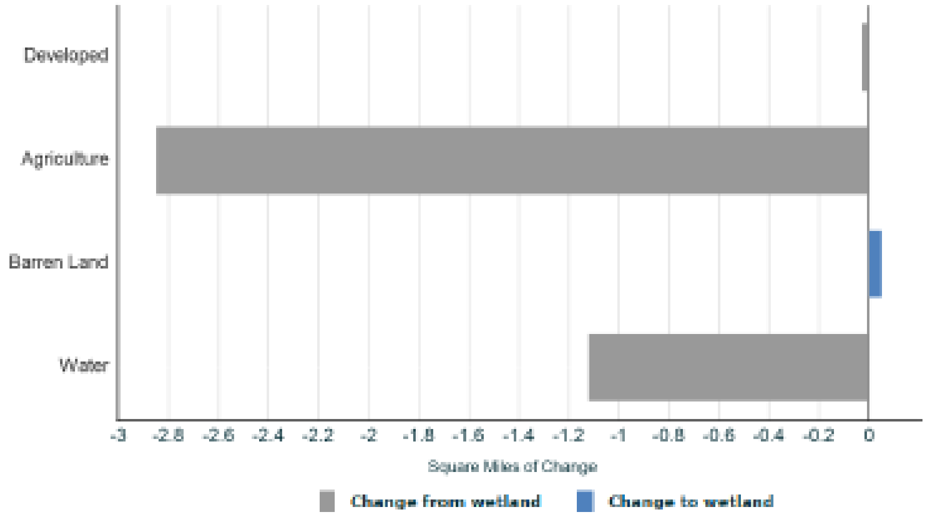
1996-2006 Net change in Vermilion Parish



In 2006, 35.1% of Vermilion Parish is wetland



1996-2006 Wetland change in Vermilion Parish. 5.05 mi^2 were lost.



1996-2006 Change to or from wetland in Vermilion Parish

VITA

Kathleen Bowers was born in 1986 to Frank and JoAnne Bowers of Loganville, Georgia. Preferring to be called Katie, she enjoyed playing many sports throughout her life but especially softball. Her other interests included reading as many books as possible, a love for animals, and drawing. After graduating high school in 2004, Katie continued her academic career at Georgia College and State University in Milledgeville, Georgia. Hesitantly she entered the science field as a biology major but soon discovered there was no other field for her; it was in her blood. After participating in intramural softball, flag football, environmental science and geology classes, Katie finally earned her Bachelor of Science degree in biology in August of 2008. Entering the looming science world Katie opted to earn more experience by electing to be a summer intern for the Environmental Protection Agency's Region 4 office in Atlanta, Georgia. Afterwards she also volunteered for the United States Fish and Wildlife Service's Ecological Field Office in Athens, Georgia, where she gained more field experience and made lifetime connections; her volunteer work earned her the 2009 Regional Volunteer's Award. But never far from her mind were her roots in Baton Rouge. Visiting Baton Rouge and LSU throughout her life, Katie never forgot the pull this town had towards her, so she decided to make a semi-permanent move and enrolled in the graduate program at LSU under Dr. Margaret Reams. Thanks to all the help she obtained, a little kickball, softball, flag football, and supportive friends and family, she is now a candidate for a Master of Science degree from LSU in December 2011. Katie still resides in Baton Rouge where she enjoys reading science fiction, playing sports, and volunteering with the local animal shelter.