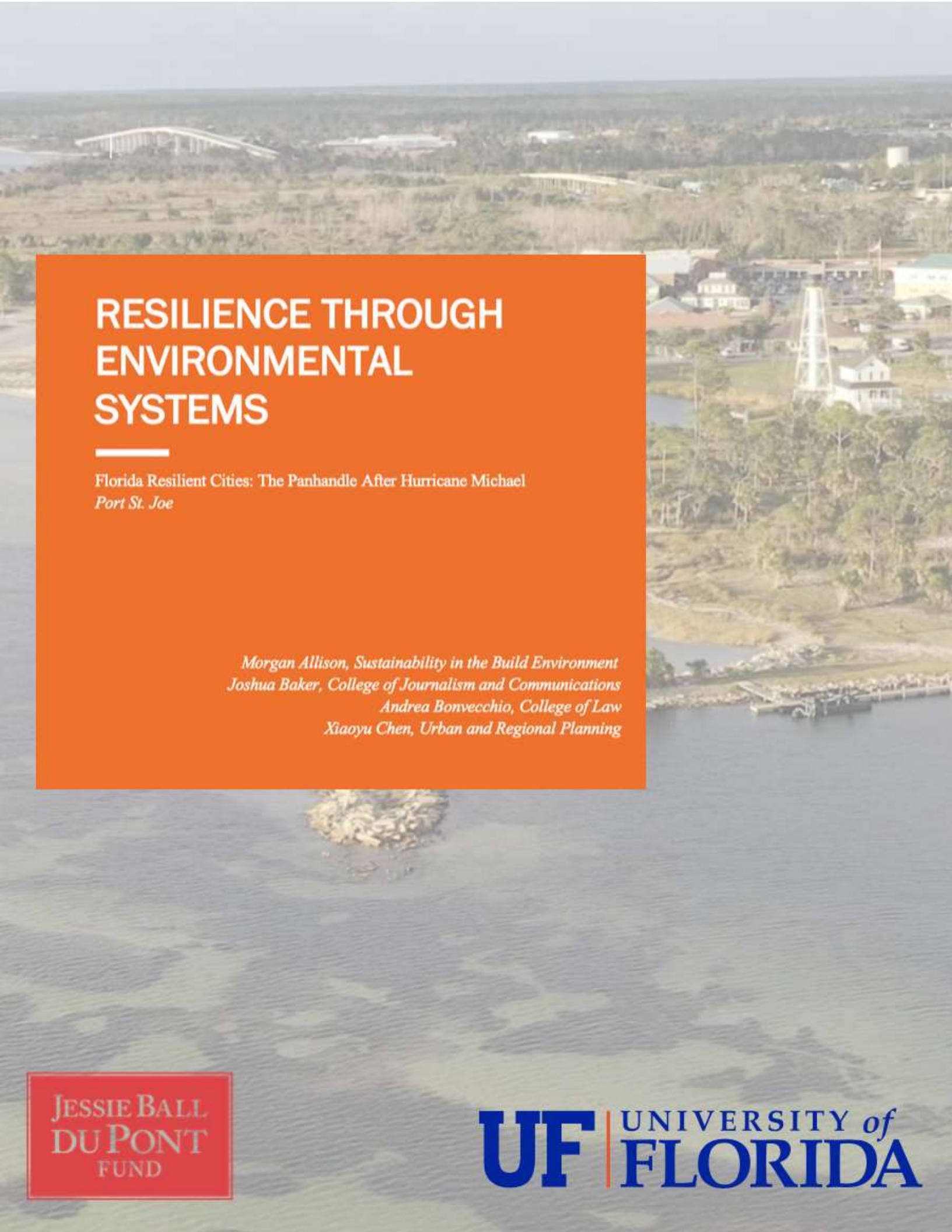

RESILIENCE THROUGH ENVIRONMENTAL SYSTEMS

Florida Resilient Cities: The Panhandle After Hurricane Michael
Port St. Joe

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Executive Summary

The city of Port St. Joe and the surrounding region rely on the natural resources and environment that make the area unique. These natural systems are currently threatened by water quality issues and inland shifts in agricultural production. The region relies on vacation rentals, ecotourism, recreational fishing, and other amenities directly related to the quality of environmental features to sustain the economy. With these resources being the primary draw of tourists and residents to the area, the health of the environment is vital to the future resiliency of Port St. Joe and the surrounding region.

This proposal explores the current environmental problems in the region by examining potential solutions to water quality and increases in cattle ranching, as well as looking at future implications of a growing population and rising sea levels.

Through research and interviews with stakeholders and residents, this paper will examine how the region benefits from environmental economic drivers as well how St. Joseph Bay is increasingly at risk from pollution runoff, septic tank leaching, and other issues affecting water quality. This paper will examine the effects of the Gulf County Canal draining into St. Joseph Bay, as well as the canal's impact on other regional waterways.

By focusing on environmental concerns, particularly on the water quality of St. Joseph Bay, regional problems can be placed into context based on the scope of their impact. This paper shows that resiliency in the area is dependent on regional and local changes in wastewater treatment, pollution management, and water quality control.

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Introduction and Background

Introduction

The purpose of this proposal is to resolve issues surrounding the economy and environmental resiliency of Port St. Joe, Florida. This paper and its findings focus on how the natural resources in and around the town are vital to not only the town itself but also Gulf County. Despite this, there are threats and vulnerabilities to the region that need to be assessed in order to preserve the area.

Context Analysis

Nestled within the intersection of Florida State Road 71 and US-98 sits the historic town of Port Saint Joe, Florida. The town was established as a permanent settlement in 1829, shortly after the land was purchased from Spain. By the 1920s, the economy and land were being developed for pine, timber, and paper production due to Alfred DuPont's purchase of over 300,000 acres of land across the Florida panhandle region. The land acquirement led to the birth of the St. Joe Paper Company, a company that worked in paper mills until its closure in 1999. With the closing of this industry, the town witnessed an unemployment rate of 14%, and within the following year, the population dropped to 3,644. By 2014, the St. Joe Paper Company had sold off pieces of its land to AgReserves, Inc. (AgReserves), also known as Deseret Ranches, which is a tax-paying company owned by the Church of Jesus Christ of Latter-Day Saints. The 1990s also brought a change in landscape, as in 1990, the St. Joe Bay Buffer project was added to the Conservation and Recreation Lands list. Five years later, the first piece of land was obtained by the state of Florida. Since that first purchase, 5,019 acres of land are protected by the Florida Coastal Office (FCO), and the project has since been marked as completed. Still, there

are pieces of the land that remain as significant cultural and natural resources (Florida Department of Environmental Protection, 2016).

Community Narrative

The economy of Port St. Joe has transitioned from an industrial town to a tourism and vacation destination. Still, the entire history of the city revolves around St. Joseph Bay and its amenities. The use of the port became obsolete when the paper mill shutdown and the need for a railroad line and intracoastal canal for shipping purposes soon followed. The economic narrative seems to be addressed in two aptly named categories: the “old” and “new.” While many people in Port St. Joe would like to see a revitalization of the old economy, which would be accomplished by bringing in new industries like shipbuilding into the port, others want to lean into the new economy of ecotourism and vacation rentals.

No matter the direction of the economy in Port St. Joe, there will still be a heavy reliance on the natural features of Cape San Blas, St. Joseph Bay and the surrounding land and water systems in Gulf County and beyond. Tourists and locals use these natural amenities for fishing, boating, scalloping, beachgoing, and other forms of recreation that are important to the life of the city of Port St. Joe. The region’s natural resources are the primary attractant to the area, as well as the primary economic driver. Protection of these resources in a way that is both sustainable to the environment and the economy is the foundation for forming a region that is resilient to changes in climate, land use, and population growth.

Issues of water quality and land use have developed as possible threats to the health of natural resources in the region, and residents are concerned about potential environmental damages. Gulf County has had a shift in primary agricultural production from timber to cattle ranching in recent years, and there are concerns about pollution from inland runoff affecting

natural habitat and water quality. In addition, septic tank usage and wastewater management also present threats to the hydrological health of the region. Residents want to see these potential environmental threats studied and addressed in order to protect the basis of the economy and to sustain the natural resources that make the region unique.

Benchmark Analysis

Destin, FL

Located just under 100 miles west from the town of Port St. Joe, the town of Destin is no stranger to the destructive nature of hurricanes. While it did not suffer much from Hurricane Michael, it did face repercussion from Hurricane Dennis on July 10, 2005. When Hurricane Dennis made landfall, it was a category 3 with 70 mph sustained winds (Barry & Shepherd, 2016). Like Hurricane Michael, the Air Force Base at Eglin suffered damage of over a half a billion dollars. Another hurricane that left a lasting scar on the town was Hurricane Ivan. With a storm surge between 6 to 9 ft, Hurricane Ivan hit on September 16, 2004. As a result of this direct hit, major dune and beach erosion occurred as well as vast structural damage.

Years later, and now a tourist-filled town, Destin provides an example of what the future could look like for Port St. Joe. There is the possibility of focusing less on industry and instead looking towards tourism. It is economically viable, yet it is not what most residents wish for.

Mobile, AL

Despite being located more inland than Port St. Joe, the town of Mobile, Alabama, has had its own fair share of hurricane damage. Two examples of this include Hurricane Ivan in 2004 and Hurricane Katrina in 2005. Hurricane Ivan landed as a category 3 on September 16, 2004. It maintained 120 mph winds per Mobile's National Weather Service. Like Hurricane Michael in Port St. Joe, the region witnessed the destruction of multiple parks, including the Poarch Creek

Indian Reservation. Hurricane Katrina affected the area almost a year later on August 29, 2005. With Hurricane Katrina came the city's worst flooding in 90 years as it peaked in Downtown Mobile with 11 feet.

After both storm events, both Mobile and its surrounding Mobile County suffered significant structural damage. With Hurricane Ivan, both the U.S. Department of Homeland Security's Federal Emergency Management Agency (FEMA) and the Alabama Emergency Management Agency (AEMA) provided resources to help with recovery efforts. A total of $735 million was spread across various contexts, such as assistance to residents and restoration funds for infrastructure (FEMA, 2005). Hurricane Katrina dealt its own damage to the town, such as causing a floating habitat used by oil platforms to crash into the Cochrane—Africatown USA Bridge: a site that was later placed on the National Register of Historic Places. The events that transpired in Mobile, Alabama, are relevant to this research project as it provides a source of vision; both the city and county's recovery from hurricane damage can be examples of what other locations should, or should not, do.

Problem Statement, Challenges, and Concerns

This section will involve data collection and research, to better understand the issues on and around the project site.

Sources and types of current flooding, areas flooded, future flooding projections.

Port St. Joe has already experienced about 3 inches of sea level rise over the last 34 years. Due to climate change, sea levels are projected to rise even further during this century. Due to this phenomenon, the starting point for storm surges and high tides will make coastal flooding more

severe and more frequent. Although St. Joseph Bay reduces the amount of tidal surge to some extent, the community could be affected by the coastal flooding in this area.

Severe coastal flooding and storms have occurred in Port St. Joe, including Hurricane Eloise in 1975, Hurricane Elena and Kate in 1985, Hurricane Opal in 1995, Hurricane Dennis in 2005, and Hurricane Ivan in 2006. The most recent, Hurricane Michael, hit the area in October 2018. According to data from the National Weather Service, Hurricane Michael is the strongest hurricane in Panhandle history with a maximum sustained wind speed of 160 mph and a minimum pressure of 919 millibars. Michael registered as a Category 5 storm according to the National Hurricane Center. This disaster caused 16 deaths and $25 billion in losses in the United States.

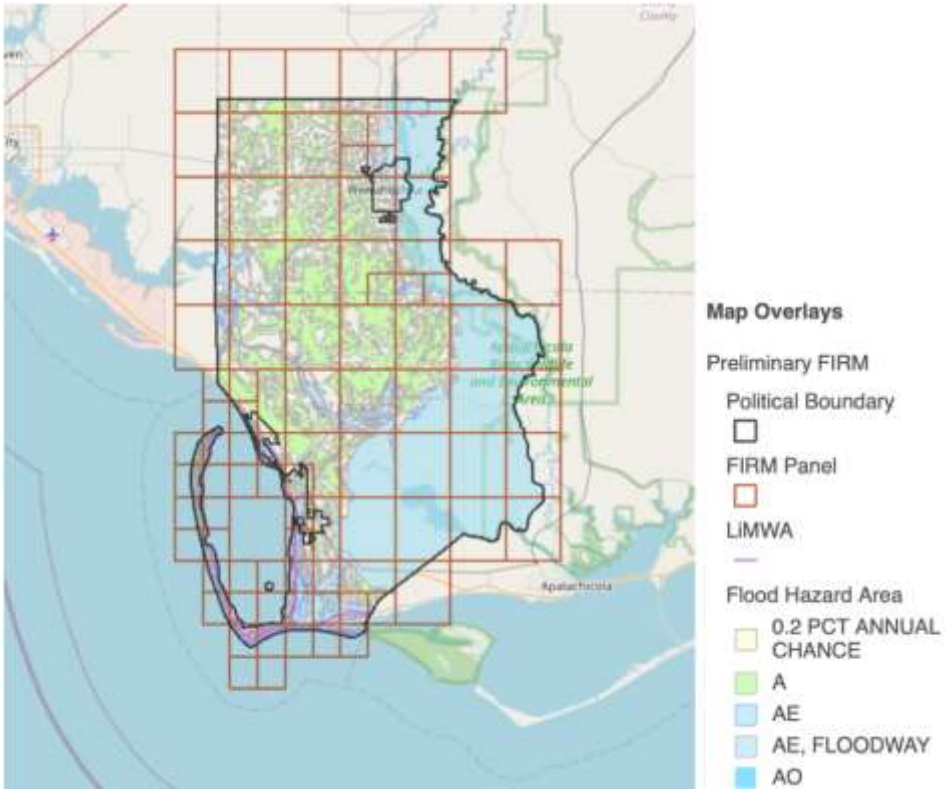


Figure 2.1. FEMA Flood Zones (Revised 08/09/2019)

Figure 2.1 shows the flood zones in Gulf County. The 1% annual chance of flooding area boundary every year corresponds to the boundary of special flood hazards (e.g. Zones A, AE, V, VE, etc.), while the 0.2% chance of annual flooding area boundary corresponds to the boundary of other flooding hazards.

Flooding Area

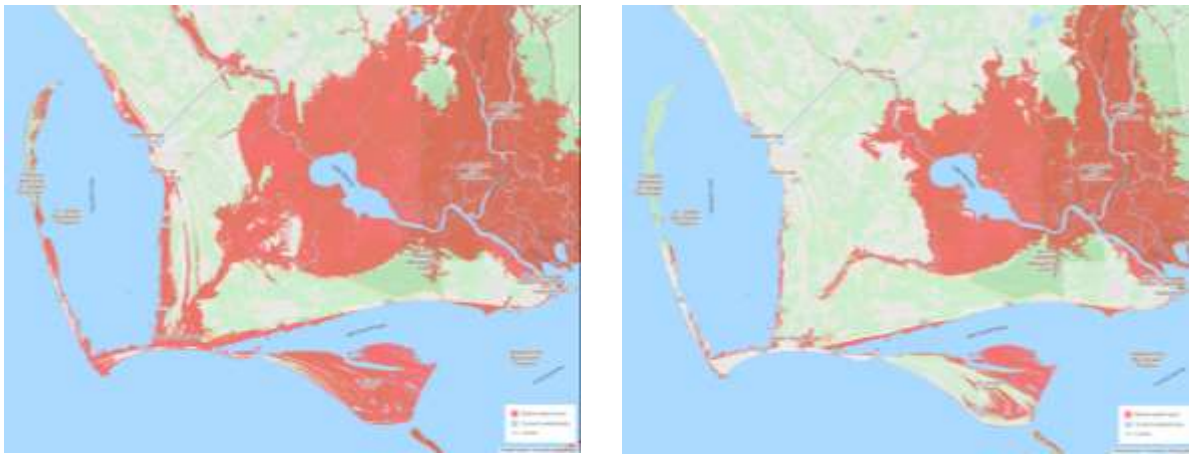
The main flooding sources in Gulf County were concluded by FEMA in 2019. Table 2.1 shows the water sources for each community in Gulf county, a brief description, and its drainage area. Besides Apalachicola, St. Joseph bay has the largest flooding area, reaching 230 square miles.

Table 2.1. Flooding Area Characteristics

Name	Primary Flooding Source	Description of Affected Area	Flooding Area (square miles)
Apalachicola	Apalachicola River	The Apalachicola River is one of four alluvial rivers in the Florida Panhandle. Its discharge accounts for 35 percent of the total freshwater runoff from Florida's west coast. Its floodplain is the largest in Florida.	260
Apalachicola Bay	Gulf of Mexico	Apalachicola Bay is one of the most productive bays in the nation, providing approximately 90 percent of oysters consumed in Florida.	11
Chipola	Chipola River	The Chipola River originates in southern Alabama and goes underground for a short distance at Marianna, Florida. The Chipola watershed provides habitat for a number of threatened and endangered animal and plant species.	79
St. Andrew-St. Joseph Bays	Intracoastal Waterway	The St. Andrew Bay watershed covers about 750,000 acres in Walton, Washington, Jackson, Calhoun, Gulf, and Bay Counties, with 61 percent in Bay County alone. It is the only major watershed in the Florida Panhandle that lies entirely in Florida.	230

Future Flooding Projections

Kopp et. al (2017) examined flooding projections by considering factors such as thermal expansion of the ocean, melting of ice sheets, and land movement when simulating future sea level scenarios. The Coastal Risk Screening Tool provided by Climate Central identifies flood risk areas that require deeper investigation. The shaded red areas shown below in Figure 2.2 exclude potentially protected areas.



(a) (b)

Figure 2.2 Future Flooding Projection in (a) Land Below 7.0 Feet of Water, (b) Land Projected to be blow annual flood level in 2050

Even with a small rise in sea level, tides and storms can make rare flood events more frequent and intense. Studies indicate that floods above 7 feet may cause significant damages. Areas within Port St. Joe that would be vulnerable to reoccurring intensive flooding of 7 feet (Figure 2.2 (a)) include 1 hazardous waste site, 5 wastewater sites, 15 miles of road, 1 hospital and 2 sq. miles of land. Figure 2.2 (b) shows the flooding risk area projection in 2050 under the condition of sea level rise and annual flood. Coastal areas along the St Joseph Bay are most likely to be below the annual flood level, which represents the level of coastal flooding on average occurring more than once a year.

Vulnerable structures, infrastructure, and natural areas.

Water quality in St. Joseph Bay and the surrounding region is a significant area of concern as human usage, and agricultural production will most likely continue to increase. Threats to the quality of water in the region include pollutants flushing out of the Gulf County Canal, the flow of freshwater and saltwater in and out of St. Joseph Bay, and discharge from septic tanks.

The Gulf County Canal was constructed to connect St. Joseph Bay to the Gulf Intracoastal Waterway, which allowed ships to enter and navigate the inland waterway that stretches along the Gulf Coast of the United States. The canal, however, created an unnatural connection between the Apalachicola River system and St. Joseph Bay. This introduced saltwater into the Apalachicola system and freshwater intrusion into the St. Joseph Bay system. Literature currently states that St. Joseph Bay is the only saltwater bay in the eastern Gulf that is not influenced by freshwater inflow (Florida Department of Environmental Protection), but polluted sediment found in the Gulf County Canal and St. Joseph Bay would suggest that this is not entirely correct (Florida Department of Environmental Protection). Projected increases in stormwater runoff and agricultural production along the Apalachicola River system could increase interactions between inland freshwater and the saltwater bay. In addition, saltwater inflow to the Apalachicola system results in harmful effects to natural wetlands and inland aquatic environments, such as Lake Wimico. The saltwater being displaced into the Apalachicola River also harms oyster production, which has already been strained by a decrease of upstream freshwater flow due to agricultural production and human use by Georgia, Alabama and Florida.

Studies have shown an increase in the presence of nitrogen and bacteria originating from human waste that is discharged into the Bay via septic tank nitrification. (Florida Department of

Environmental Protection, 2008) Although Port St. Joe has sewer lines running through the city and out to the Cape San Blas area, septic tanks usually provide an alternative to the cost of hooking up to a sewer system and do not require recurring service fees. Residents of Port St. Joe expressed that the sewer system is indeed expensive to connect to and that many homeowners choose septic over sewer for a more cost-effective waste management solution. Septic discharge provides nutrients for algal blooms to grow and thrive (Mallin, 2013), which can damage ecosystems that are vital to the economy and ecology of Port St. Joe, such as seagrass, scallops, turtles and fish and ecology of Port St. Joe, such as seagrass, scallops, turtles and fish.

Seagrass beds are prone to eutrophication (nutrition load) and decline in the Bay. A study compared nitrogen consumption and outflow pathways in and near the seagrass bed (Thalassia testudinum) in St. Joseph Bay, Florida. The sediment oxygen demand and total ammonium (NH_4^+) outflow in vegetation and non-vegetation sediments were larger ($p < 0.001$), indicating that seagrass enhanced the remineralization of organic matter. This research shows that unstable organic matter can help regulate the balance between nitrogen removal and internal circulation pathways in the seagrass system, which has an impact on coastal areas and is one of the management strategies to solve eutrophication.

All the previously mentioned threats to water quality can have a devastating effect on the health of the environment of Port St. Joe, as well as the people who use the water. With the health of St. Joseph Bay and surrounding water systems being so vulnerable, it is important to seek solutions to water quality issues in order to establish a resilient ecosystem for humans, plants, and animals.

In addition to water quality issues, the entire Gulf County is susceptible to wind and water damages from tropical cyclones. The effects of hurricanes and tropical storms include

strong winds, heavy rains, storm surges, coastal and inland floods, and tornadoes. Floods caused by hurricanes are a major problem in the county. Given the amount of tree cover in the county, all areas could be affected by debris related to high winds and tornado activity. The wind impact of a major hurricane may cause major damage to the county, destroy buildings and property. Sometimes, flooding can cause buildings to collapse and electrical wires to be knocked down. In severe cases, flooding can also lead to fires caused by rupture of natural gas pipelines, and even death or injury.

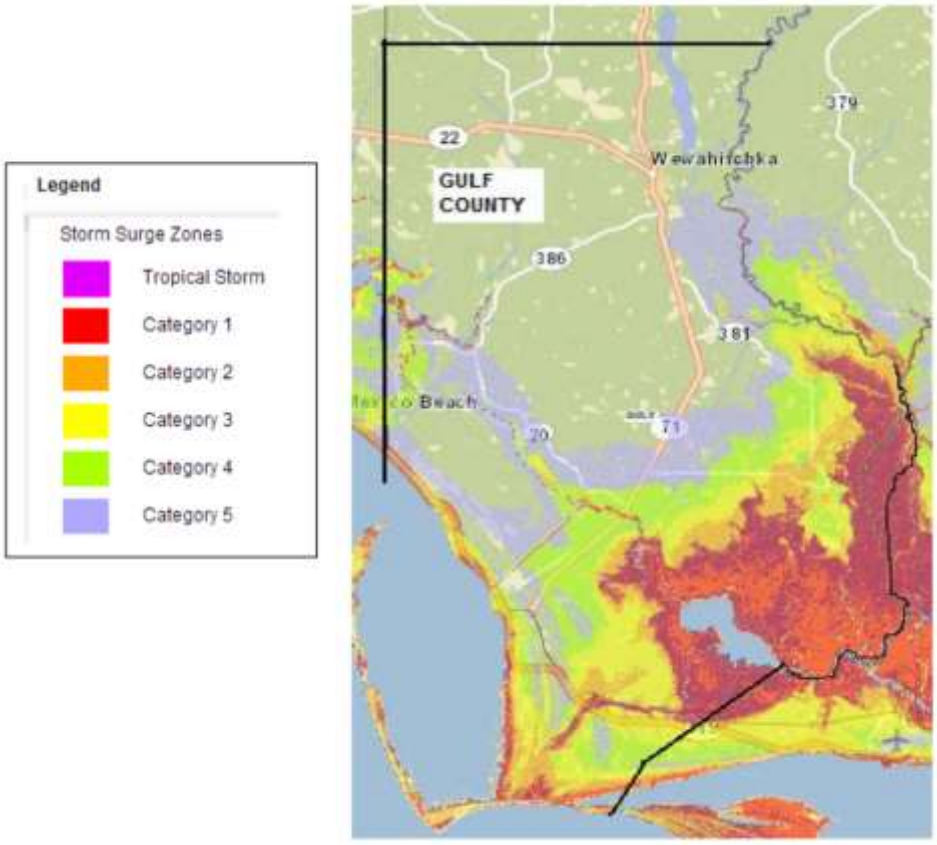


Figure 2.3 Gulf County Hurricane Storm Surge Zones

Policy and Legal Constraints

Private Land Ownership v. Local and State Environmental Enforcement

In terms of regional water quality management, private land ownership in the region poses one of the biggest hurdles for the implementation and enforcement of agricultural Best Management Practices (BMPs). AgReserves is a multinational agricultural for-profit and private company that owns nearly 383,000 acres in northwest Florida. After one of the most massive private land sales in Florida history, their landownership spreads across Bay, Calhoun, Franklin, Gadsden, Gulf, Jefferson, Leon, Liberty and Wakulla counties. (Proctor, 2017) Since the 2014 purchase, AgReserves, which presently operates one of the nation's most extensive cow-calf operations at Deseret Cattle & Timber in Central Florida, has been steadily converting its Panhandle properties from timberland to pasture. (Proctor, 2017) Due to the large amount of pasture acreage, improperly managed pasture runoff has the potential to adversely affect the quality of surrounding waterways, such as St. Joseph Bay. (Florida Department of Agriculture and Consumer Services, 2008) Therefore, the question becomes, how can the City of Port St. Joe, Gulf County, or the State of Florida regulate cattle operations on private property to reduce water pollution?

The Federal Clean Water Act (CWA) requires states to assess the impacts of nonpoint sources of pollution on surface and ground waters and establish programs to minimize these impacts. (Federal Water Pollution Control Act, 1972) With this authorization, Florida established a Nonpoint Source Management Program, which includes the use of BMPs to minimize nonpoint source pollution. (Florida Department of Environmental Protection, 2015) Section 303(d) of the CWA requires states to identify impaired waters and establish total maximum daily loads (TMDLs) for pollutants entering these waters. (Federal Water Pollution Control Act, 1972)

TMDLs establish the maximum amount of pollutants that can be discharged to a waterbody while still meeting designated uses such as swimming, fishing, or as potable water sources. (Environmental Protection Agency, 2018)

In Florida, the Florida Watershed Restoration Act (FWRA) provides the framework for Florida's TMDL program. Under the FWRA, once the Florida Department of Environmental Protection (FDEP) establishes a TMDL, the agency may develop and adopt a Basin Management Action Plan (BMAP) that specifies the activities that watershed users will undertake to reduce point and nonpoint source pollutant loadings. (Olexa, Borisova, & Davis, 2018) Pursuant to § 403.067(7)(c), and § 570.085, F.S., implementation, in accordance with the Florida Department of Agriculture and Consumer Services (FDACS) rule, of FDEP-verified and FDACS-adopted BMPs give agricultural landowners the following advantages: (1) a presumption of compliance with state water quality standards; (2) a release from the provisions of § 376.307(5), F.S., for those pollutants addressed by the BMPs; and assistance with BMP implementation. (Presumption of Compliance, 2014)

Due to the private nature of AgReserves' land ownership, there are few options for implementing and enforcing mandatory sustainable practices to deter harmful impacts on the surrounding environment due to these agricultural operations. For example, a review of the most recent Verified List of Impaired Waters from October 2019 reveals that St. Joseph Bay was in the process of being delisted from the state's CWA § 303(d) list of impaired waters. (Florida Department of Environmental Protection, "Comprehensive Delist List", 2019) According to Figure 2.4, however, St. Joseph Bay is shown as a "Waters Not Attaining Standards" and thus is still considered an impaired waterbody. Figure 2.4 also shows that there are no areas in the

vicinity of St. Joseph Bay that are currently involved in a BMAP. Despite this, according to Figure 2.5, as of January 23, 2020, there are no state adopted TMDLs for St. Joseph Bay.

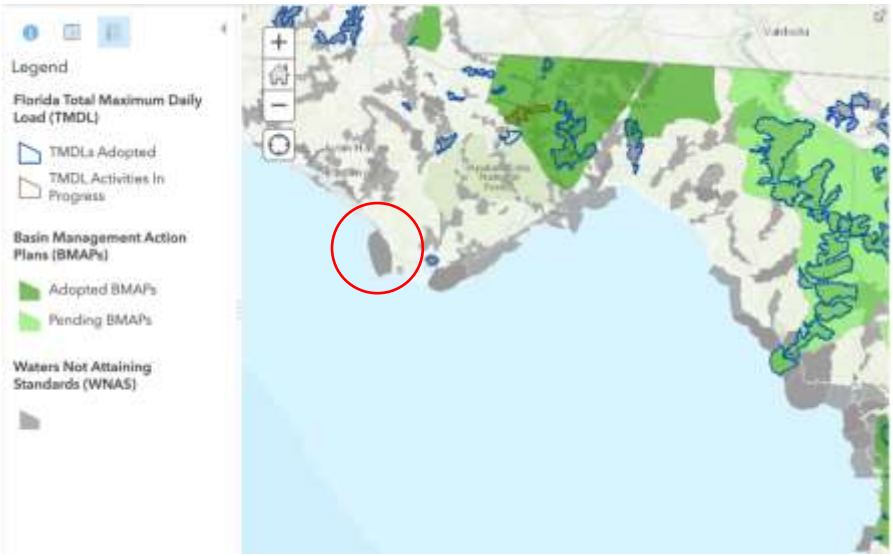


Figure 2.4 Water Quality Assessments, TMDLs, and BMAPs

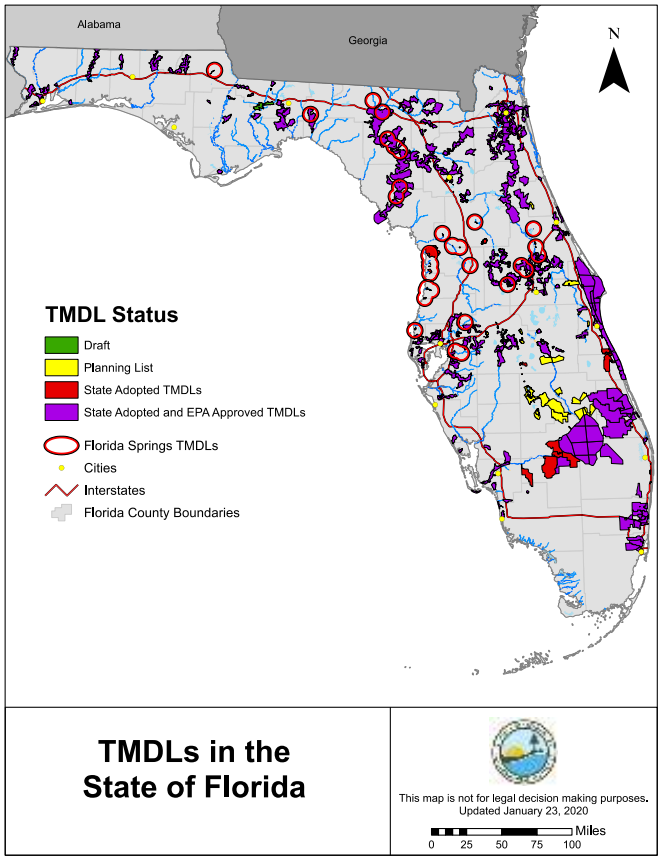


Figure 2.5 TMDLs in the State of Florida

As emphasized before, in watersheds with adopted BMAPs, agricultural producers are statutorily required to either implement FDACs-adopted BMPs or conduct water quality monitoring prescribed by FDEP or the water management district. Without these particular classifications, there is minimal authority available to specify the activities that watershed polluters would have to undertake to reduce point and nonpoint source pollutant loadings. As a result, AgReserves would have to enroll in BMPs with FDACS voluntarily. Therefore, the question becomes whether AgReserves has adopted Agricultural BMPs that are designed to benefit water quality and water conservation while maintaining or enhancing agricultural production. According to Figure 2.6, the area that corresponds with AgReserves' land ownership in the regional project site does not show any acreage enrolled in FDACS BMP programs. It is important to note, however, that land owned by Deseret Cattle & Timber in Central Florida, which operates a cow-calf operation, has adopted BMPs for these practices. This disconnection should be addressed to provide more insight as to why BMPs are not adopted in AgReserves' panhandle properties.

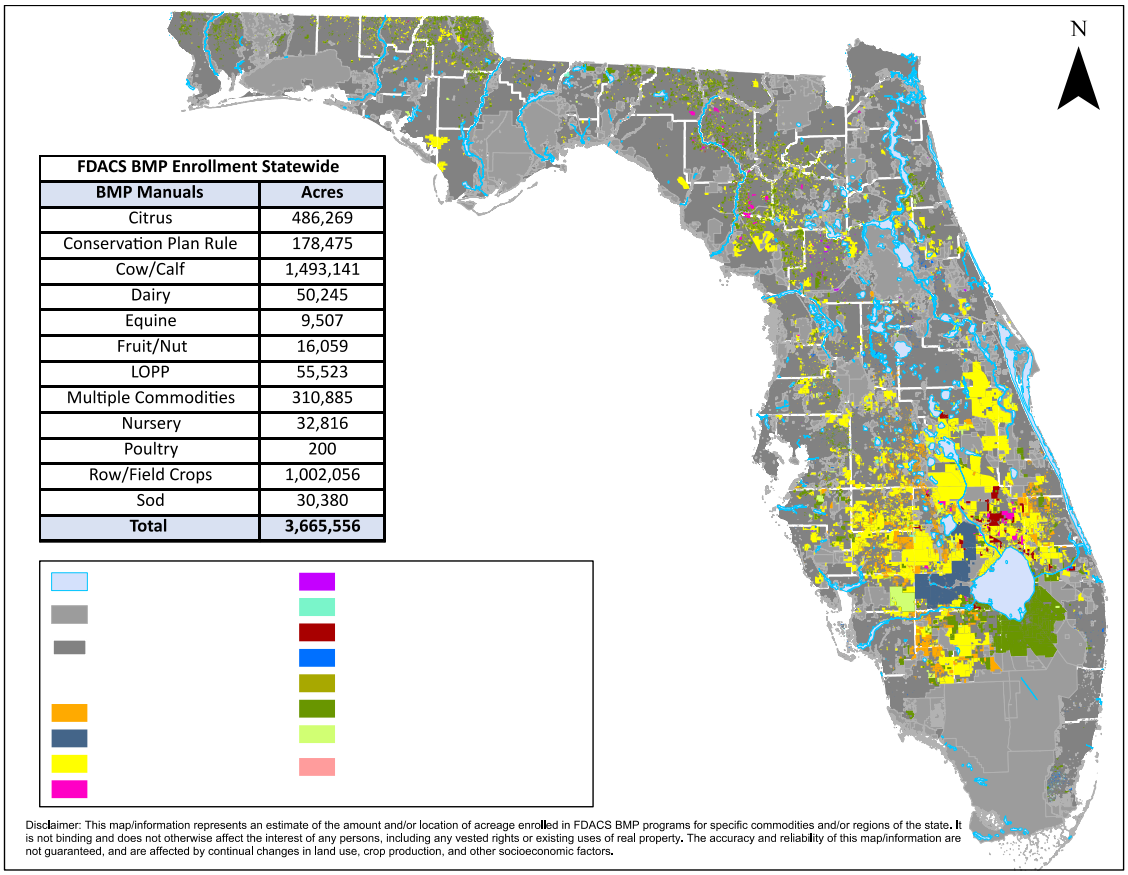


Figure 2.6 (Florida Department of Agriculture and Consumer Services)

Residents' Concerns and Public Input.

Residents have expressed concern surrounding the involvement of AgReserves in the region and their purchase of former timberland for its conversion to cattle pastures. The company has a mysterious presence in the county, according to several people who were interviewed for this project, but there is little to mild concern about the looming presence of their cattle operations. Residents are concerned with making sure that the AgReserves ranches operate in a way that is minimally invasive on natural resources and to their lifestyles. The people of Port St. Joe are concerned with the amount of dialogue that exists between AgReserves, Gulf County and the city, and would like to know that there are communicative efforts between the involved

parties to ensure that the land is used in ways that aren't detrimental to people's lives or the ecology of St. Joseph Bay and surrounding areas.

Another commonly expressed concern was the number of houses that rely on septic tanks for sewage treatment. According to residents, it is cheaper to install a septic tank than it is to hook up to the city's current sewer lines. There is also community concern about current wastewater infrastructure in the area, primarily with the proximity of Port St. Joe's current treatment site being located adjacent to the canal. There are concerns about leeching from this retention system into the water systems of the region.

While residents have expressed interest in placing some type of water control structure to restore balance to the freshwater and saltwater systems of the region, there is still a desire to maintain access to both Lake Wimico and Apalachicola Bay via the Gulf Intracoastal Waterway. A structure, such as a lock, would allow residents to navigate the Intracoastal Waterway, but would also control the amount of freshwater and saltwater flow into and out of St. Joseph Bay and Apalachicola Bay. This idea was expressed both by commercial tourism interests, such as fishing charters, as well as recreational boaters.

While many residents would like to see some type of industry return to Port St. Joe, there is environmental concern about oil companies and other types of chemical refineries moving in, which could result in harmful effects on the natural resources of the area.

Adaptation Objectives

To establish environmental resiliency in the region surrounding Port St. Joe, threats to the hydrological and ecological systems must be studied and addressed. Keeping the Apalachicola River freshwater system and the St. Joseph Bay saltwater system separate is a primary concern.

Residents have expressed the desire for the United States Army Corps of Engineers to find a solution in the form of a water control structure, such as a lock or a dam, that would restructure the flow along the Gulf Intracoastal Waterway.

Current data collected from the Gulf County Canal and St. Joseph Bay shows evidence of runoff pollution and sediment intrusion from the Apalachicola River freshwater system (Cardno Tec. 2014), but the state still considers St. Joseph Bay to be independent of freshwater influence (Florida Department of Environmental Protection). Although most of the data showing sediment and pollutants in St. Joseph Bay is considered below the Florida Department of Health's thresholds (Cardno Tec. 2014), there is a need for the state to conduct further research in order to determine how much freshwater is entering St. Joseph Bay and how much saltwater is leaving. Evidence that shows the detrimental effects of septic tanks and wastewater must also be addressed by officials that are charged with implementing environmental protection measures. This can be done through specific state abatement programs in order to ease the costs of connecting the region to sewer lines. Ultimately, reducing the effects of human waste is vital to preventing harmful algal blooms that currently affect the region.

To prevent adverse effects from increases in cattle ranching, certain best management practices, or BMPs, must be considered and applied to ensure that environmental harm from livestock production is kept to a minimum. There also needs to be an increase in communication between private landowners, Gulf County, and the city of Port St. Joe in order to ensure that all parties involved are informed and aware of environmental threats and possible solutions to problems that affect the area. This communication should also trickle-down through a public information and communications strategy in order to educate residents about what they can do to ensure the health of the regional environmental systems.

While considering the wildlife in St. Joseph Bay and the economic potential brought by fisheries, ecosystem-based fisheries management can be used (EBFM) (Keith et al., 2013). Based on ecosystem-based fisheries management, we can understand the impact of species dynamics and nutritional interactions on the environment, thereby realizing fishery management strategies (Link 2010; Patrick and Link 2015). Existing studies have conducted single-species population assessments (for example, SEDAR2014b, 2015), using ecosystem modeling platforms for simulations, such as Ecopath and Ecosim (EwE), to understand the potential impacts of fishery policies on ecosystems (Chagaris et al., 2015b), and to prepare for mitigating the invasion of large Pteridium species (McCreedy et al. 2012).

In addition, several studies have delineated 12 Biologically Important Areas (BIA) in the Gulf for for Bryde's whales and bottlenose dolphins (Figure 3.1). BIAs were developed to enhance the existing information that scientists, managers, policy makers, and the public already have. The size of the BIAs ranges from approximately 117 to 23,000 square kilometers. We can use the information provided by BIAs for analysis and planning according to US regulations that require characterization and minimization of the impact of human activities on marine mammals.

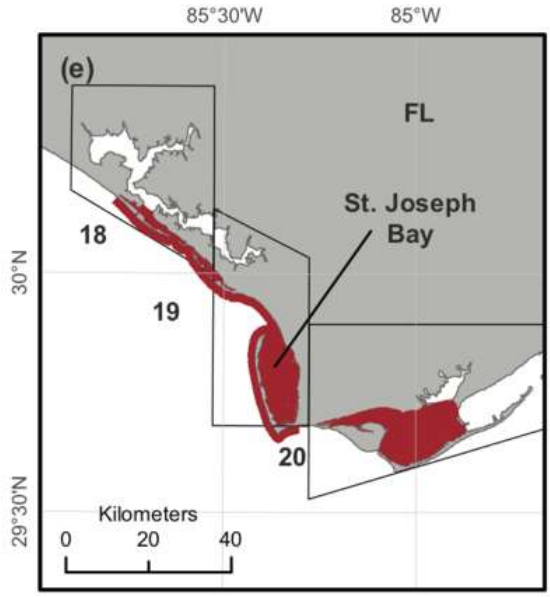


Figure 3.1 – Eleven year-round BIAs for small and resident bottlenose dolphins in St. Joseph Bay, St. Vincent Sound and Apalachicola Bay

Recovery and Adaptation Opportunities and Design Solutions

Physical Design Solutions

A group called "BAYSAVERS" has taken on the initiative of generating public interest and funding for a potential water control structure to be placed on the Gulf Intracoastal Waterway to prevent the flow of freshwater and saltwater between Apalachicola Bay and St. Joseph Bay. BAYSAVERS argues that the two water systems were naturally separated before industrial operations in the region required a shipping canal to connect St. Joseph Bay to the Gulf Intracoastal Waterway. Since there is no longer a need for the infrastructure of the canal to support the passage of large ships, BAYSAVERS is asking the United States Army Corps of Engineers to find a solution in order to protect the Bay from harmful regional impacts. Figure 4.1 shows the connection of the two mentioned water systems, as well as a proposed water control site by BAYSAVERS.

Figure 4.1 Regional View and Proposed Water Control Site (BAYSAVERS)

A water control structure would need to be constructed by the United States Army Corps of Engineers as they are responsible for maintaining the Gulf Intracoastal Waterway. A program within the Army Corps of Engineers called “Engineering with Nature” could be used to solve the water control problem that the region is facing. The Engineering with Nature initiative focuses on solving engineering problems by integrating social, environmental, and economic components. (Engineering With Nature) Since the residents of the region want to maintain the natural resources of the area while also finding a sustainable solution to water quality issues, the Engineering with Nature initiative might serve as an effective solution to regional concerns.

Flow control is not the only problem that water quality in the region faces, as septic tank leeching and wastewater treatment continues to be a growing threat to the area. (Northwest Florida Water Management District, 2017). In order to remedy this problem, a septic tank abatement program should be implemented in order to ease the financial stresses associated with connecting the region to sewer lines.

Proposed Policies & Legal Analysis

To effectively monitor the natural resources that affect the Bay and to be able to document and determine the health of the Bay system as well as accomplish the goal of this project, a variety of projects and efforts must be utilized and implemented. Since implementing agricultural BMPs is at the discretion of AgReserves, the city of Port St. Joe, Gulf County officials, and AgReserves should enter into a memorandum of agreement (MOA) to establish and maintain sound, responsible BMPs that foster agricultural land use and promote natural resource conservation. This MOA would allow all parties to agree on voluntary agricultural BMPs for AgReserves to adopt for their continued operations in the area. Prioritization of issues, objectives, and strategies can lead to a cohesive management program that, in the long-term, produce positive environmental results. Such BMPs can include co-locating renewable energy infrastructure—such as solar panels—on agricultural land.

Throughout the United States, agricultural landowners are implementing this practice because of the many benefits associated with it. (Macknick, Beatty, & Hill, 2013) For example, dedicating a portion of land for solar energy infrastructure reduces the scale of cattle operations, which reduces negative impacts on the land and surrounding waterbodies. Also, landowners can self-generate electricity that can be used on-site to run cattle operations and reduce their energy bills. Landowners can also install solar-powered livestock watering systems that can provide fresh and clean water and eliminate the risk of cattle congregating around surface water that typically leads to nutrient runoff. Lastly, the elevated solar infrastructure can also provide shade and cover for livestock during days with high temperatures.

Communications Strategies for Public Education & Engagement

Strategies that can be used to communicate, engage, and educate the public include partnering with the University of Florida's Institute of Food and Agricultural Sciences (IFAS) to coordinate a citizen science initiative. Such an initiative can start to prioritize the discussion of environmentally friendly actions that can feasibly take place throughout the region to support the health of both the Bay and the overall water systems that feed into it. Other methods of public awareness can include creating surveys or forums for citizens to learn more about their immediate environment. Through these public forums, citizens can provide locally driven perspectives and feedback as to what direction environmental policies should go in. A volunteer program may also be established to teach residents environmental best practices such as a rain garden workshop, spring break restoration projects, oyster gardening techniques, storm drain labeling, and using public service announcements, social media, and events to spread awareness throughout the community (Northwest Florida Water Management District , 2000).

Not only could IFAS partner with the general public, but a program that bridges high school students with the surrounding environment and community could also be implemented. In Alachua County, for example, the University of Florida has partnered with various schools in the district to help prepare students for their futures. Titled the Florida 4-H Life Ready program, it's available in Panama City and Southport, but Bay County does not have its own club. One can be established in order to educate anyone between the ages of 5 and 18. A 4-H club can be held at a church, a school, or any public facility. The 4-H club is free and designed to teach individuals a variety of skills, ranging from artistic to environmental. Members could be hands-on at the Bay and surrounding areas to teach them ecological systems and operations. Overall, a 4-H program

would encourage involvement at a young age as well as encourage individuals to return home after receiving trade skills or college degrees elsewhere.

Statement of Economic Viability

The BAYSAVERS group has made a pitch for a federal feasibility study to be conducted by the United States Army Corps of Engineers to determine if a need for intervention exists. BAYSAVERS is currently seeking community help and a non-federal sponsor in order to meet the 50/50 requirement of payment for the feasibility study. In order to move forward with the study, BAYSAVERS must raise $1.5 million to meet cost-sharing requirements with the Army Corps of Engineers. (BAYSAVERS)

The state of Florida is currently conducting studies and implementation plans. The Northwest Florida Water Management District is looking into a Stormwater Planning and Retrofit project and a Septic Tank Abatement program. (Northwest Florida Water Management District, 2017) The stormwater project is estimated to cost over $60 million and will serve to gather and analyze data to develop projects that are location specific in the region. These projects will include retrofitting current stormwater management facilities, creating regional master plans for future management, and developing public communication and education programs. (Northwest Florida Water Management District, 2017) These projects will be prioritized based on need, and there is a possibility that the problems of St. Joseph Bay could be overlooked in order to serve more populated areas in the region, such as those surrounding Panama City.

The septic tank abatement project is estimated to cost over $50 million. It will include sewer line extension programs with cities, public outreach programs, and a study to identify areas that are at risk of affecting vulnerable water systems. (Northwest Florida Water

Management District, 2017) This project will primarily focus on converting areas with a high volume of septic tanks to sewer lines and will include plans to eliminate connection costs for residents in the area. The abatement of septic tanks is essential to prevent massive economic loss from algal blooms affecting the tourism and recreation economies of the area.

Implementation

Management & Organization

For Port St. Joe and the surrounding region to implement sustainable solutions to establish environmental resiliency, the current state of ecological and hydrological systems must be examined at both the state and federal level. State agencies, including FDEP, FDACS, Florida Department of Health, and the Northwest Florida Water Management District, must be proactive in obtaining scientific data to guarantee the health of residents and wildlife when environmental decisions are made. Federally, the United States Army Corps of Engineers must also work with state and local governments, along with local stakeholders, to discuss the implementation of a cost and environmentally effective water control method between the Apalachicola and St. Joseph Bay water systems.

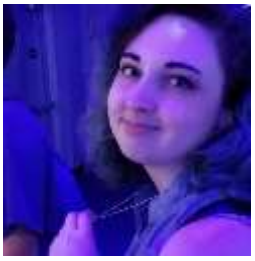
The city of Port St. Joe relies on ecotourism, vacation rentals, and recreational activities to sustain its economy, and the natural resources of the area are directly related to businesses in the region. Residential input should be taken into consideration, especially from local stakeholders, regarding any potential solutions to environmental problems. However, scientific and engineering experts should develop proper communication strategies with the public to ensure that there is no miscommunication about environmental decision making.

Budget Summary

Since there are many different routes that the region could take regarding environmental issues, there is no exact budget or specific timeline for developing an environmental resiliency program. Ultimately, which decisions are made or not will rely on the stakeholders, state officials, and federal government to decide. Budget for projects that are currently being worked and discussed include; a $3 million cost-split between BAYSAVERS sponsors and the United States Army Corps of Engineers for a water control structure feasibility study, and over $100 million toward wastewater and septic management programs. Funding would also be required for educational programs and communication initiatives, which could come either from the state or local stakeholders.

Team Bios

Morgan Allison, Sustainability in the Built Environment



Morgan Allison is a fourth-year student enrolled in the University of Florida's Sustainability in the Built Environment program. Her concentration is on sustainability in tourism and she plans on furthering this via a research project dedicated to sustainable practices in the Greater Orlando Region. Future plans include either working in a firm or at Disney's Imagineering, as well as pursuing a master's in architecture. If she is not studying, she enjoys curling up with her sketchbook and listening to music.

Joshua Baker, College of Journalism and Communications

Joshua Baker is a first-year graduate student with a background in journalism and multimedia storytelling. He is interested in the complex relationships that exist between humans and the natural world, such as environmental system adaptability and cultural impacts on nature.

Andrea Bonvecchio, College of Law

Andrea is a third-year law student at the University of Florida Levin College of Law and a soon to be double gator. She is pursuing a concentration in environmental law through the Environmental and Land Use Law Program with an emphasis on environmental justice issues. She hopes that by pursuing a law degree, she is able to ensure that everyone's right to a clean and healthy environment is protected through the development of equity-based policies. Andrea is fluent in Spanish, plays music, and enjoys exploring trails with her dog, Arrow.

Xiaoyu Chen, Urban and Regional Planning

Xiaoyu is a first-year Ph. D student at the University of Florida College of Design, Construction and Planning. She is motivated to contribute to design studies such as minimal human vulnerability, diverse livelihood and effective safeguards for human health. Her dream is to provide more scientific suggestions for improving our living environment in the future. In addition to her research time, Xiaoyu likes playing volleyball, painting and cooking traditional Chinese food.

Conclusion

Port St. Joe and the surrounding region rely on the environmental assets that are provided by natural resources. Still, a growing population and increase in land used for agricultural and recreational purposes are threatening the health of water quality resulting in impacts on the area's economy, ecology, and residential well-being. There is growing concern that the health of St. Joseph Bay is at risk from freshwater pollution and sediment runoff via the Gulf County Canal, and that Apalachicola Bay is at risk from saltwater flushing coming from the Gulf Intracoastal Waterway. To increase environmental resiliency, the region is currently seeking to address concerns such as increases in agricultural production of cattle, water flow between saltwater and

freshwater systems, and several issues affecting water quality. These issues must be addressed to maintain economic and environmental resilience in the region.

Appendix

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We extend our thanks to the residents of Port St. Joe and our community partners in the area. The scope of this project wouldn't have been possible to cover without their help, and we are grateful that they welcomed us into their community and provided us with the help and expertise that we needed.

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