APPENDIX A

Dauphin Island Fiscal Analysis

FISCAL IMPACT ANALYSIS

DAUPHIN ISLAND, AL

PREPARED FOR THE MOBILE BAY NATIONAL ESTUARY PROGRAM

March 18, 2022

PREPARED BY:

PHILIP G. KING, PH.D.

Professor of Economics, San Francisco State University

SARAH JENKINS, B.S. B.A.

Research Associate in Economics

With Assistance from Kiersten Patsch, Ph.D.

Professor of Environmental Science and Resource Management, California State University Channel Islands

Table of Contents

Introduction

This fiscal impact assessment examines the relative costs and benefits generated by the West End of Dauphin Island. The western four-fifths of the island is considered a simple barrier island, indicating a low and narrow sandy landform dominated by overwash and alongshore transport. This part of the Island is highly susceptible to storm impacts due to its low elevation (around 5 feet above sea level), narrow width, and lack of substantial dune features. For example, when Hurricane Katrina made landfall in August 2005, 450 of the 500 homes on the West End were damaged when the West End was completely covered with water [7]. Sea-level rise is projected to make the Island more susceptible to storm events, flooding, overtopping, and erosion, and threatens the sustainability of infrastructure on the West End.

The purpose of this fiscal impact assessment is to determine if the West End properties represent a net benefit to the Island—that is to say, if they bring in more in tax revenues than they cost to maintain. A better understanding of these costs and benefits is necessary in order to make recommendations for the Island's long-term sustainability. The analysis focuses on the Town's revenues in terms of property taxes, lodging taxes, and sales taxes, in comparison to the costs of providing local services and storm cleanup. In addition, we evaluated the future costs in the face of projected storm and flooding damages. The fiscal impact analysis examined property classification and ownership on the Island to better understand the short-term rental market at the heart of the Island's economy.

Project Background

Dauphin Island is a small island off the coast of Southern Alabama, connected to the mainland by a 3.4-mile bridge. It is approximately a 45-minute drive from Mobile and is also accessible by ferry. Like many Gulf Coast communities, Dauphin Island boasts miles of pristine coastline. Unlike nearby Gulf Shores, however, Dauphin Island is less developed commercially.

As a barrier island, Dauphin Island has a naturally changing landscape. A barrier island forms as waves deposit sediment parallel to the shoreline, forming an elongated strip of unconsolidated sediment[1], constantly changing in response to wave and storm action [6][16]. Their dynamic structures allow them to buffer and protect the ecological systems on their landward side and the mainland beyond. Beaches and sand dune systems will form facing the ocean, while the landward side often includes ecological habitats such as marshland, tidal flats, and maritime forests[2]. However, barrier islands are unstable and depend heavily on the dunes for protection and longevity[3]. Dauphin Island demonstrates the dynamic, shifting nature[4] of these lands, as it has migrated landward in recent history, been cut and reformed by major storms, and yet sustains a small population and settlement despite these conditions.

[1] https://www.floridaocean.org/sites/default/files/documents/PDFS/barrier-islands.pdf

[2] https://oceanservice.noaa.gov/facts/barrier-islands.html

[3] https://oceanservice.noaa.gov/facts/barrier-islands.html

[4] https://www.floridaocean.org/sites/default/files/documents/PDFS/barrier-islands.pdf

Dauphin Island is a small community with just over 1,700 full-time residents in 2021[5]. This small population, however, is steadily growing (7% growth from 2010 to 2019), especially in comparison to Mobile County at large (1% growth from 2010 to 2019)[6]. According to the recent Aloe Bay Master Plan [8], Island residents are also older than those of Mobile County and enjoy a higher median income. Basic demographic trends for the Island are presented in Table 1 below.

Table 1: Demographic Trends for Mobile County and Dauphin Island, 2019. Source: Randal Gross Development Economics, collected for the Aloe Bay Master Plan, 2021

Trends (2019 data)	Mobile County	Dauphin Island
Population (Full-time residents)	413,210	1,324
Population Growth 2010 to 2019	1%	7%
Percentage of Residents over Age 65	17%	36% (up 71% since 2010)
Households	155,946	585
Median Household Income	$49,639	$87,596 (up 32% since 2010)

Home prices on the Island are also higher than in the County. According to Zillow, the average price for a home on Dauphin Island is $405,423—almost three times the median home value of Mobile County ($163,031). In addition, Island home values rose 23.7% in the past year[7]. According to data from the mayor's office, there has been a recent building surge on the Island, with an average of 61 new homes permitted each year. On an island with just over 2,000 homes total, this represents a significant growth.

Development on the Island has shifted significantly through its history. The first homes on the Island were built on the East End behind the protection of the sand dunes and maritime forest [20]. In the 1950s, the Island had approximately 250 residents [17]. However, with the construction of the original bridge in 1954-55 and the platting of the Island into marketable parcels (both efforts undertaken by the Mobile Chamber of Commerce), the Island began to see increased development, including development of the narrow, low lying West End [17].

In 1979, Hurricane Frederic destroyed many of the West End homes and the bridge. The newly created Federal Emergency Management Agency (FEMA) used Alabama as a test in the wake of this 1979 hurricane [7]. The new Agency pledged $200 million (1979 dollars) to Alabama's recovery—including spending $40 million (approximately $135 million in today's dollars) on the construction of a new bridge to Dauphin Island [7]. Since then, building on the Island has steadily increased, with homes on the West End becoming increasingly larger and more extravagant [20]. In the wake of the decimating effects of Hurricane Katrina in 2005, which destroyed 90% of the West End, rebuilding resumed [20].

West End properties are largely second homes and rental properties and, even without hurricanes and major storms, cost the Town a significant amount to maintain. The purpose of this fiscal impact assessment is to determine if the West End properties represent a net benefit or cost to the Island. This

[5] According to Town officials

[6] Randall Gross / Development Economics from the Aloe Bay Master Plan 2021

[7] https://www.zillow.com/dauphin-island-al/home-values/

analysis aims to examine not only the patterns of land use, development, and ownership on the Island but also the fiscal impacts of that development.

Fiscal Impact Assessment (FIA)

Local governments, planners, and residents often use a fiscal impact analysis (FIA) to determine the impacts of local policy decisions [8,11,5]. FIAs can be used for multiple purposes; however, one primary purpose is to help local communities with development and land use decisions [10]. FIAs are typically applied to land use issues such as developing new properties (e.g., for residential or commercial development), rezoning existing properties, or conserving land. [3, 13,] These assessments were originally developed to determine tax and spending impacts to local governments and economies [21]. For example, a town considering whether to develop a new shopping center or apartment complex will want to weigh the fiscal benefits of a development (e.g., increased sales and property taxes) with the costs of providing local services (e.g., police, fire, road maintenance) [10,11, 5].

Unlike other economic reports, FIAs focus on the fiscal (revenue minus cost) impacts of any local decision.

***Revenues*:** The primary sources of local revenues are typically taxes and user fees related to the new development or change in land usage. For example, a new shopping center would generate sales taxes as well as property taxes for the local community.

***Costs*:** New policies and development also typically have service costs associated with them. A new shopping center may require alterations to existing traffic or require additional police and fire services. New residential developments generally lead to new residents, which require additional Town services (schools, fire, etc.).

***Intergovernmental Transfers*:** Most FIAs also consider intergovernmental transfers in one way or another (e.g., if school fees are paid by State government). For this study the primary intergovernmental transfer examined are federal funds (from FEMA, USACE, NOAA, and other sources) related to storm resilience and disaster recovery efforts.

Economists and planners incorporate models and assumptions into FIAs to most accurately predict local impacts given the available data. As with any economic or planning model, data is limited, and the assumptions applied in any FIA should accurately reflect the key tradeoffs in the community. The analysis conducted for the Dauphin Island Watershed Management Plan contains a number of standard assumptions, some based on experts' insights on the Island, which will be discussed in more detail below.

Although FIAs have been used for many decades [10], scientists, economists, and planners have incorporated more detailed geospatial modelling in the past decade as availability of computer software and geospatial databases have increased dramatically [13]. Geospatial planning models have several advantages:

- Property tax revenues are one of the main sources of revenue for most local communities. Since property taxes are levied on land (and improvements to the land, such as home construction) a geospatial analysis can help improve understanding of this revenue source.

- Many local decisions involve zoning or other ordinances with a geographic component.
- Certain impacts (e.g., hurricanes and other storms) have a strong geospatial element.

This study incorporates the latest geospatial methods to provide an analysis of geographical development patterns on the Island and the impacts of that development on Dauphin Island's fiscal sustainability. Specifically, it attempts to examine the relative costs and contributions of different areas of the Island, including consideration of high costs of storm prevention measures as well as maintenance of roads and other infrastructure after sustaining storm damages. As detailed later, these costs are not distributed evenly across the Island but tend to be focused on specific areas subject to severe storms.

In part, this study seeks to help the Island determine how best to spend its limited tax revenues particularly concerning storm maintenance and adaptation across the Island. Allocating their limited resources is a critical issue for local officials, especially in regards to preparing for storm events. This FIA will address several issues for the Town of Dauphin Island, including:

a) Does the Town have sufficient revenues to sustain the Island given future expected storms?

b) What impacts of current land use policies affect the Island's fiscal situation?

c) Can current land-use policies on Dauphin Island be sustained?

d) How can the Town increase local revenues considering answers to questions a and b above?

Some FIAs also include an analysis of how tax burdens are distributed across residents of varying income levels (vertical equity) or how taxes are distributed among residents with similar incomes (horizontal equity). While the scope of this study does not include this consideration, the analysis does include an in-depth assessment of property ownership on the Island, including a significant portion of parcels belonging to out-of-state owners.

Data Sources

Table 2 summarizes the data sources which are described in more detail in the following sections.

Table 2: Data Sources for Fiscal Impact Analysis

Estimate	Data Source
Residential Property	Mobile County Parcel Data
Vacant Land	Mobile County Parcel Data
Property Tax Revenue	Mobile County Parcel Data
Property Classification	Mobile County Parcel Data
Rental Property	Mobile County Parcel Data, Expert Input, Sensitivity Analysis
Town Revenues	Town Budget, Expert Input
Town Expenditures	Town Budget, Expert Input on Town Budget
Federal Expenditures	Past Reports, FEMA data unavailable for this FIA
Storm Impacts (Economic Damages)	NOAA Economic Impact Assessment, FEMA Hazus Model, Parcel Data

Parcel data

This FIA began with an analysis of parcel data, collected from the Mobile County Department of Revenue. Figure 1 below presents a sample image of parcel data (not on Dauphin Island). In the diagram below, each area delineated by dark lines represent a distinct parcel.

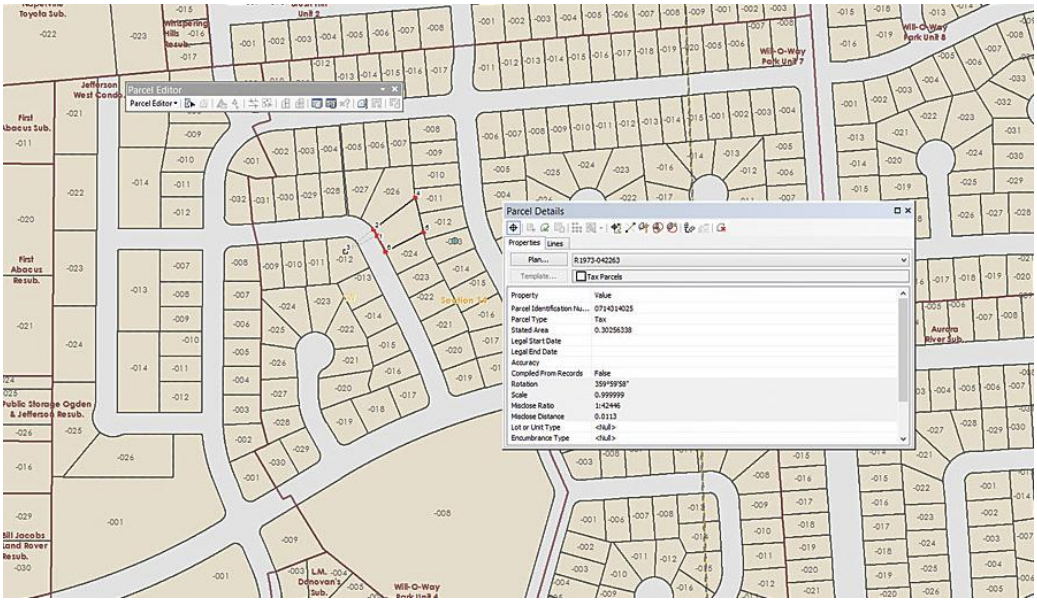


Figure 1: Typical Parcel Data Map (https://www.esri.com/about/newsroom/arcnews/making-local-parcel-data-open-at-state-national-levels/)

In the United States, these parcels are typically owned by either private citizens (e.g., residential property or business), a public agency (e.g., national or local parks, police stations), or a non-profit organization (e.g., church) often not subject to property taxes. The parcels denote the ownership and lot line boundaries.

Private residences and businesses are generally assessed on the value of both land and "improvements" to property—typically structures (e.g., a home or business)[8]. County Assessor's offices, including the Mobile County assessor's office, base this assessment on the value of the land and its improvements. Aside from levying property taxes, assessor's offices track current property values, creating parcel data. As the housing market fluctuates or properties are developed, these values change. Coastal properties in the U.S. have seen higher price appreciation than more inland properties [11]. This study, however, does not use temporal parcel data, as predictions of future home values are highly unstable and historical data is not relevant to the goals of this FIA.

By using state of the art geospatial modeling to render parcel data, one can incorporate the following:

- The specific geospatial location of every parcel including land boundaries. Given sufficient resources, the location of specific buildings can also be incorporated (e.g., to examine vulnerability to flooding).
- The property tax classification, and the assessed value of land and improvements.
- FEMA flood modeling.
- Other relevant data (e.g., Zillow for home prices).
- Regional designations.

Since property taxes have traditionally been a source of local revenue, the County Assessor's data allow one to easily analyze the geospatial distribution of property tax revenues alongside these additional components

Town Budget Data

Revenues

We obtained data from the Town of Dauphin Island's current budget (available online). In 2020-2021, the total budget was just under $4 million. Dauphin Island's chief sources of revenue (discussed in more detail below) are sales taxes (32.5% of the Island's budget at $1.3 million), lodging taxes ($1.1 million) and ad valorem (property) taxes ($500,000). Updated 2020-21 budget data was obtained from Town officials in October of 2021, and indicated total revenues of $4,032,647, sales tax collection of $1,617,242, and lodging tax revenues of $1,500,771[9].

As noted above, data on each parcel on Dauphin Island and the property taxes garnered to the County and Town were obtained. This rich dataset included not only the assessed value, but also the property value, the property tax classification (discussed in more detail below), and detailed ownership information. Using geospatial software (ArcGIS from ESRI), the geospatial distribution of property taxes across the Island were mapped, and property tax revenues from specific areas were estimated.

[8] For the purposes of this study, any parcel with "improvements" is considered developed. Developed parcels, for this analysis, are treated as "homes."

[9] Obtained via correspondence with the Town Clerk and members of Council.

Although exact breakdown of lodging taxes was not obtained, several people associated with the local real estate industry offered perceptions. As discussed in detail below, this analysis followed common practice in obtaining expert information to inform the assumptions and alleviate gaps in available data.

The Town's budget information was limited but provided us year-end numbers for total revenues and expenditures. In particular, this data illustrated the relatively high importance of the Island's rental market and lack of other significant revenue sources.

Expenses

The annual budget data included the full year of expenses as projected. For expenses, Dauphin Island's budget is focused on categories such as "salaries" and "insurance" rather than specific service sectors. While this data provided initial estimates, it did not contain the detail necessary for a full analysis. Furthermore, the annual budgets for specific departments within the Town—such as Public Works or the Police—were not available. To obtain more detail, Town officials were consulted and provided a breakdown of Town services by type and location

Storm Modeling Data—NOAA and FEMA's HAZUS Model

In addition to the analysis of the current fiscal situation on the Island, this FIA endeavors to provide insight into the Island's fiscal sustainability, particularly in the case of storm resilience. In order to do so, researchers from the Harte Research Institute for Gulf of Mexico Studies at Texas A&M and the National Centers for Coastal Ocean Science/NOAA National Ocean Service supplied modeling results of storm impacts in the Northern Gulf of Mexico. This research provided regional-scale Economic Impact Assessments.

Impact damages to specific features of the Northern Gulf of Mexico (NGOM) region were modeled under five scenarios. The features included buildings, vehicles, infrastructure, crops, and humans (in terms of shelter and displacement). For this FIA, only the data on building damage were used.

The model determines building damage costs based on FEMA's HAZUS model, a nationally standardized risk modelling methodology[10]. HAZUS does not, however, use precise building data. Rather, it determines damage at the census block level and uses estimates of what buildings within that block are likely to be worth. Thus, the model cannot be matched parcel for parcel but rather by census block. Damages within census blocks are determined using "depth damage curves," such that the percentage damaged in a particular storm event or sea-level rise scenario results in an associated cost [9,18]. In applying these curves, the HAZUS model operates under the assumption that building stock is consistently distributed throughout the census block [18].

For this analysis, geospatial data at the census block level were used. For two storm conditions—100-year and 500-year—and five sea-level rise scenarios, researchers projected the number of buildings exposed to damage, the number of "substantially damaged residential buildings[11]", and the percentage of buildings damaged, among other results.

[10] FEMA Hazus Factsheet

[11] Defined as greater than 50% damage, such that the structure would likely be replaced.

Data Limitations

As noted above, this study, like any other similar study, faces data limitations. Overall, fewer records were readily available than anticipated, and, as a result, models and assumptions were used to best capture the current and future fiscal situation on the Island. For each type of data obtained, this section discusses the limitations and possible improvements for future studies.

Parcel data: Of all the tax data used for this study, the parcel data were the most complete. However, the data obtained from the Mobile County Assessor's office presented numerous challenges (e.g., "Dauphin" misspelled or "deleted parcels" present in the dataset). The parcel data was "cleaned" to eliminate many of these discrepancies. One other feature common to parcel data is that the assessed value provided by the County is often very different from the actual market value. This discrepancy is particularly acute on older properties and in markets where prices have changed rapidly, as has been the case with Dauphin Island and other coastal areas. In such instances, commercially available services like Zillow can provide more up to date property price information.

In addition, the parcel data did not align with the storm damage data. The storm modeling was performed with what appeared to be 2010 census blocks, which did not accurately fit the 2021 shape of the Island, which had changed as is common with barrier islands. This is in part due to the shifting of sand on the Island, but also the differences in scale. The federal data was modeled on a regional scale, with the finest level being census blocks. While there are many small census blocks on Dauphin Island, it took considerable effort to realign these blocks with parcel boundaries and map the NOAA Environmental Impact Assessment (EIA) dataset onto the up-to-date parcel data. In the future, as geospatial models progress, federal data will hopefully come into better agreement with local data to more accurately reflect the realities at a community and parcel-specific level.

Sales tax data: Sales tax data was only available in the aggregate for one year. In many FIAs, it is common to assume new residents will spend, on average, the same as existing residents. However, a breakdown of sales tax data by sector, common in FIAs, is ideal. The Island's sales tax revenues are fairly substantial given its small population and very limited retail environment. Some on the Island expressed beliefs that sales taxes on boating (fuel) were a significant contributor to sales tax revenues for the Island. Any future studies should examine the role that boating/gas taxes play, since many boat owners do not live on Dauphin Island.

Lodging Tax Data: Lodging tax data was only available in the aggregate for one year. Furthermore, information on specific rental locations and permits was not available, only the overall lodging tax collection. However, these data were supplemented with interviews with real estate agents and other local experts on the Island. Public portals such as Airbnb and VRBO were examined to determine where short-term rentals (STRs) are advertised. Although many people on the Island perceive that most STRs are on the West End of the Island, a significant rental market throughout the Island was observed, as discussed below. It is also worth noting that everyone consulted observed the following: (1) the market for STRs has become increasingly popular on Dauphin Island with the COVID pandemic seeming to have

increased demand, and (2) the Island is becoming a year-round destination, although there is seasonality in rates (i.e., higher in summer).

This analysis and future FIAs would benefit from an investigation of the STR market on the Island. Specifically, detailed information on the number of rentals on the Island, the location of those rentals, characteristic or hedonic analyses, and the nightly rates or gross revenues would improve this analysis and greatly inform local adaptation policy. In addition, information on the number of overnight and day-trip visitors to the Island would be useful. Given the importance of tourism to the Island's economy, these data gaps are significant. It should be noted, however, that the STR market is inherently opaque and ever-changing [23]. Precise data is cumbersome, expensive, and often inaccurate [23]. Thus, as a cost-effective form of monitoring and data-collection, the Town might benefit from focusing on rental business licenses[12] and requiring operators to report their earnings.

Expenditure Data: The Town's annual published budget data are insufficient for determining expenditures according to government function (e.g., police, road maintenance). However, reasonable estimates of Town expenditures across administrative units and by region (i.e., west, middle, east) were developed based on interviews with Town officials, including the mayor. In addition, the Town did not provide data on departmental expenditures for routine or emergency/storm costs, which would have better informed estimates of area-specific expenditures and whether the West End is a fiscal liability.

Historical Data: This analysis was performed exclusively with data from 2021. Historical budget information may improve future estimates, particularly given that according to many experts, the COVID-19 pandemic has altered the rental market on the Island and may have impacted the annual budget.

Federal Expenditure Data: FEMA expenditures on the Island, either through the National Flood Insurance Program (NFIP) or direct assistance to the Town and individual households, were not considered in this analysis. FEMA records may benefit a future FIA and provide improved understanding of the true costs of living on Dauphin Island and its West End especially. Federal expenditures were beyond the scope of this analysis, but public records for past storm costs, although not specific to Dauphin Island, were examined.

Methods

Parcel Data Analysis

The first step in this FIA was an in-depth parcel data analysis. Parcel data for 2021 were provided by the Mobile County Revenue Commission Office. The dataset was restricted to include only properties on Dauphin Island, erroneous entries were eliminated, and the data were cleaned. The parcel data were

[12] Requiring a business license of all rental property owners has been proposed to the Town Council but has not passed.

then combined with a separate parcel set from the Mobile Bay National Estuary Program and building footprint data[13]. This compiled dataset was overlaid with 2020 and 2010 census blocks, which had to be manually fit to many parcels, as they did not align with parcel boundaries, due to erosion and movement of the boundaries of the Island. Finally, each parcel was tagged with a specific area on the Island: East, West, or Middle. These areas were chosen based on their unique geographic and demographic features, as well as local perspectives. For the purposes of this analysis, Dauphin Island was divided into the following areas:

- **The West End:** defined as the area west of Pirate's Cove Street. Primarily built on less solid ground and at lower elevations. Some residents have defined it as the point where homes are built on fill.
- **The Middle:** the area west of Salt Creek and east of Pirate's Cove Street. The area houses the large condominium blocks comprising approximately 300 units, with an estimated 50% of those units serving as STRs. This area generates a considerable amount of economic activity heavily related to tourism. It is much less vulnerable than the West End, with less risk of erosion and flooding, and overall, less storm exposure.
- **The East End:** The area east of Salt Creek (Omega Street). This is the portion of the Island built on the most solid land and with the oldest structures. It is commonly thought of as more "local," with most full-time residents residing here.

With this dataset, summary statistics for the Island were developed, and a variety of tests were run to determine the fiscal impact of each region in terms of property tax generation for the Town. The impact of ownership (on-island, State of Alabama, or out-of-state) and *classification* on revenues was also examined. In the Mobile County parcel data, properties are designated as either Class 2 or Class 3. Table 3 provides an official explanation of Class from the County. For the purposes of this FIA, Class 2 properties were treated as rental or investment properties, while Class 3 properties were treated as personal or owner-occupied properties (not registered as a rental or STR).

Table 3: Explanation of Parcel Classification by Mobile County, as provided by the Mobile County Revenue Commission/ Assessor's Office.

Classification	Explanation of Property Use	Tax Rate (Annual rate on Assessed Value)
2	"Rental, vacant land and any property owned by a corporation/business"	20%
3	"Owner occupied, owner owned but not rented, can be classified as a second home if the utilities are in your name, and vacant land that is being used for agricultural purposes, if a current use application has been filed and approved"	10%

[13] From GMC for the Aloe Bay Plan.

Expert Interviews

Unfortunately, detailed budget data were not available beyond the Town's posted budget. To fill in the gaps, expert interviews were conducted. In the social sciences, expert interviews are often used either as data or to inform estimates [2]. Residents involved primarily in local government and real estate/property management were interviewed. These interviews informed assumptions surrounding (1) the proportion of Town spending allocated to the West End, (2) the STR market and tourist behavior, and (3) sales tax and tourist expenditures on the Island. For expenditure allocation, department heads provided an estimate of the proportion of their work devoted to the West End. Expert insight into tourism and the rental market informed sensitivity analyses of lodging and sales tax revenues. Although Dauphin Island does have some hotel accommodations, the primary source of lodging revenue (according to everyone consulted) are STRs. Further, these rentals have become increasingly popular.

Storm Damage

To calculate the potential fiscal impact of storm damage, the NGOM EIA model was fit onto the parcel dataset. As the NGOM predictions and the FEMA Hazus model are based on a regional scale, fitting those predictions to Dauphin Island required matching individual parcels to census blocks manually. This was especially difficult since the 2010 census blocks, due to the erosion and movement of the Island [6,15], did not match either the parcels or the physical shape of the Island in 2021.

Once the parcels were matched to the appropriate census block, the percentage of residential buildings damaged for each block was applied to the 2021 count of buildings, resulting in updated estimates of the number of substantially damaged buildings. From these estimates, the expected replacement cost was determined using the average developed parcel value for each census block. This method adheres to the assumptions of the Hazus model and the EIA, that the distribution of structures in a given area is standard. It applies percentage prediction in an identical manner to the Hazus method and original model but with updated and parcel-level (more granular) data.

For this FIA, estimates of substantial damage were used. The model does not provide sufficient granularity to determine the potential repair costs. However, given historical damage [20] and the high percentage of structures substantially damaged during major storm events, it is likely that many impacted homes would need to be replaced rather than repaired. Estimates of repair costs require specific information as to the damage percentage for the structure, the square footage of the structure, and a host of building characteristics beyond the scope of this FIA and the available model data [22].

Results

Parcel Data Results

Figure 2. Geospatial analysis of parcel development and classification shows Class 2 homes concentrated on the West End and in the Middle, while vacant parcels are more prevalent on the East End.

After checking for discrepancies and anomalies in the data ("cleaning"), the parcel data with property tax information from Mobile County were input into ArcGIS (ESRI). The geospatial visualization allowed examination of development patterns on Dauphin Island, in particular how development varied geographically on the Island from east to west. To understand settlement patterns on the Island, "developed" parcels were first examined and defined as those with improvements assessed in the parcel data[14]. In the parcel data, the County records the added value of "improvements" to a property. Improvements are work on a property that increases its value, typically construction of a structure, such as a home.

As shown in Table 4 and Figure 2, the Middle area has the highest percentage of developed parcels (73%), closely followed by the West End (69%), and the East End (58%). The West and Middle areas are similarly much more built out than the East End.

[14] For this FIA all parcels with an improvement value greater than $0 were considered "developed."

Table 4: Distribution of "developed" parcels on Dauphin Island, 2021. Developed parcels are defined as those with improvements made to the property, as documented in the Mobile County parcel data.

Area	*Number of Parcels*	*Number of Developed Parcels*	*Number of Undeveloped Parcels*
East End	2,349	1,384	965
Middle	559	410	149
West End	1,023	711	312
Total	**3,931**	**2,505**	**1,426**

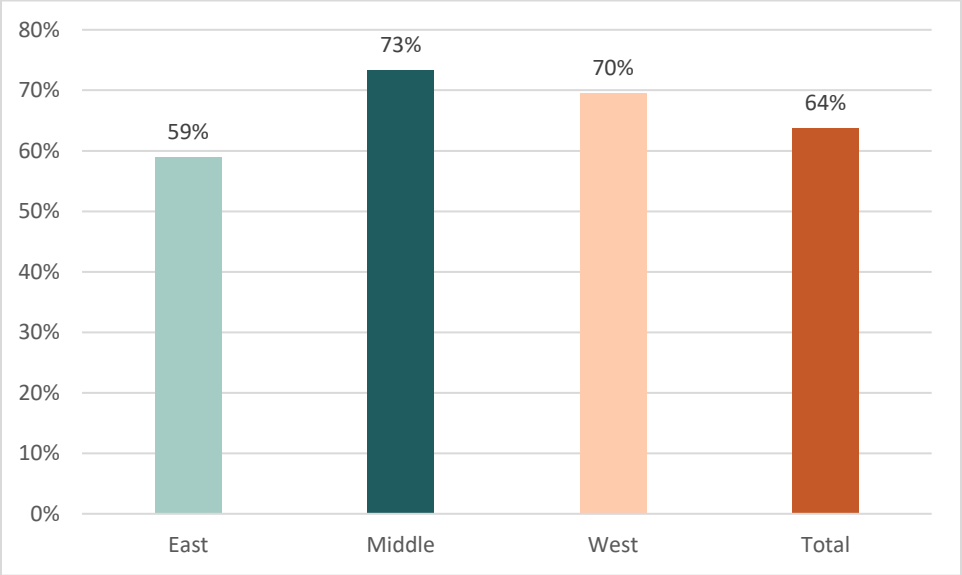


Figure 3. Examination of the Mobile County parcel data for 2021/22 shows that while the developed proportion of area parcels is relatively consistent, the Middle and West End are more developed than the East End.

Parcels were separated into areas and the average value of parcels and the average appraisal value of developed parcels[15] in each area were determined. Developed parcels serve as a proxy for homes or residential units, whereas undeveloped or unimproved parcels are assumed to be vacant lots. As shown in Table 5, both the highest value parcels and developed lots (homes) are found in the West End. While the East End has significantly lower values for parcels overall, the value of homes is comparable to the Middle area of the Island. However, West End homes are still significantly more valuable.

[15] The parcel data contained several values for parcels. We used the total value from the Mobile Bay NEP data which was the most up to date data with the fewest erroneous entries. This value is equivalent to the appraisal value as recorded in the Mobile County parcel data.

Table 5: Average appraisal values on Dauphin Island by area, according to Mobile County parcel data for 2021/22.

Area	*Average Value, All Parcels*	*Average Developed Parcel Value*
East End	$175,463.43	$290,822.00
Middle	$206,785.23	$291,825.51
West End	$263,638.42	$352,973.32
Island Average	**$213,914.37**	**$306,284.91**

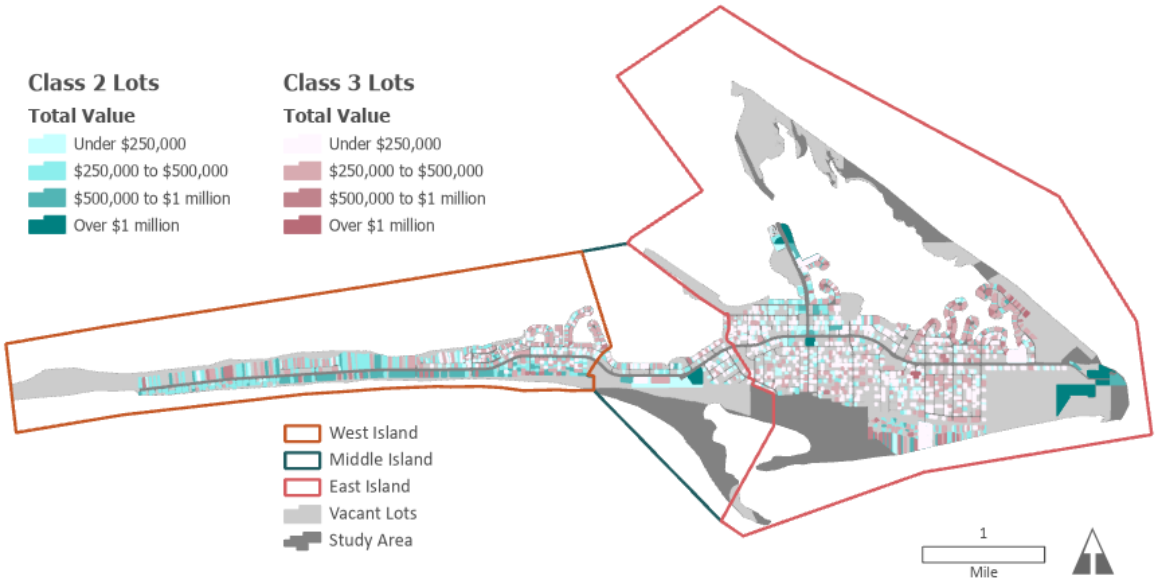


Figure 4. Geospatial analysis of parcel value for developed properties shows (a) Class 2 (blue) lots are more valuable, and (b) there are more Class 2 lots and higher value lots on the West End than other areas of the Island.

Land Use Analysis: Parcel Classification

Crucial to this FIA was an analysis of parcel classifications as provided in the Mobile County data. All parcels in the dataset were either Class 2 or Class 3 parcels. As described previously, Class 2 properties include the following: rental property, vacation rentals, vacant land, and any property owned by a corporation or business; Class 3 property is owner occupied or owned but not rented, or a second home if the utilities are in owner's name. Class 2 property is taxed at twice the rate of Class 3 property. Table 6 shows the breakdown of developed and undeveloped parcels on the Island by classification and area. Most parcels are Class 2. There are almost no undeveloped parcels registered as Class 3 on the Island.

However, this classification could change if a property owner constructs a home for full-time or personal use.

Table 6: Breakdown of parcel classification for each area, as recorded in the 2021 Mobile County parcel data.

Region	*Number of Parcels*	*Number of Developed Parcels*	*Number of Class 2 Developed Parcels*	*Number of Class 3 developed Parcels*	*Percentage of Developed Parcels that are Class 2*	*Number of Undeveloped Parcels*	*Number of Class 2 undeveloped Parcels*	*Number of Class 3 undeveloped Parcels*	*Percentage of Undeveloped Parcels that are Class 2*
East	2,349	800	261	539	33%	1,549	1,193	356	77%
Middle	559	102	51	51	50%	457	368	89	81%
West	1,023	371	166	205	45%	652	545	107	84%
Total	3,931	1,273	478	795	38%	2,658	2,106	552	79%

Distribution of developed property varies between the three areas of the Island, as shown in Figure 5. While almost all undeveloped parcels are Class 2, homes in the Middle and West are predominantly Class 2, while the East has only 36% of homes registered as Class 2. Given that Class 2 homes are most likely to be rental properties, this shows the relative importance of rentals in the areas of the Island.

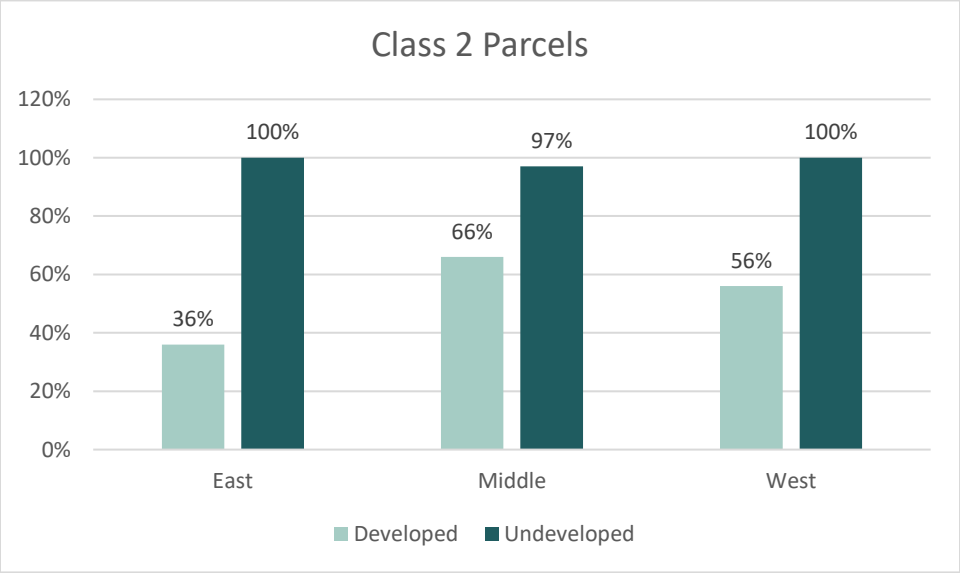


Figure 5: A comparison of parcel classification between developed and undeveloped parcels, by area, shows that almost all undeveloped parcels are Class 2, regardless of area. In the Middle and on the West End, most developed parcels are Class 2, whereas on the East End only 36% of developed parcels are Class 2.

Apart from distribution, the parcel data also revealed that on the West End and in the Middle areas of the Island, Class 2 homes (developed parcels) are significantly more valuable than Class 3 homes, as shown in Table 7. In the East End, however, Class 3 homes are more valuable. This finding supports the local consensus that the East End is more "local," with less of a focus on tourism. On the East End, the most valuable homes are not rentals, but primary residences or second homes.

Table 7: Average Developed Parcel (Home) Appraisal Values by Area, According to 2021 Parcel data.

Region	*Class 3 Developed Parcel, Average Value*	*Class 2 Developed Parcel, Average Value*
East	$264,802.91	$257,019.51
Middle	$218,815.11	$277,359.93
West	$312,675.64	$388,222.06
Total	$271,164.78	$306,916.49

Fiscal Impact – Property Taxes

As discussed previously, Class 2 parcels are taxed at twice the rate of Class 3 parcels. Furthermore, given that Class 2 parcels on the West and Middle areas are more valuable than those on the East End, it follows that the West End and Middle region generate higher average Town property tax revenues for the Town. For all properties, the average Town property tax collection for class 2 parcels on the West End is more than twice that of the East End. For Class 3 parcels, there are significantly more developed, high value parcels on the East End, therefore, the average tax collection is higher than Class 2 parcels.

Table 8: Average per-parcel Town tax collection for Class 2 and Class 3 parcels, as recorded in the County parcel data, shows higher tax collection for Class 2 properties in the Middle and West End, whereas on the East End, Class 3 homes generate higher property tax revenues.

	Non-Primary Residences/Investment Parcels (Class 2)			*Primary Residences, Personal Use Parcels (Class 3)*		
Area	*Number of Parcels*	*Average Value*	*Average Town Tax Collection*	*Number of Parcels*	*Average Value*	*Average Town Tax Collection*
East End	1,454	$120,912.45	$92.00	895	$264,085.92	$127.94
Middle	415	$203,145.78	$175.48	140	$217,573.57	$107.66
West End	711	$242,119.97	$229.42	312	$312,675.64	$152.25

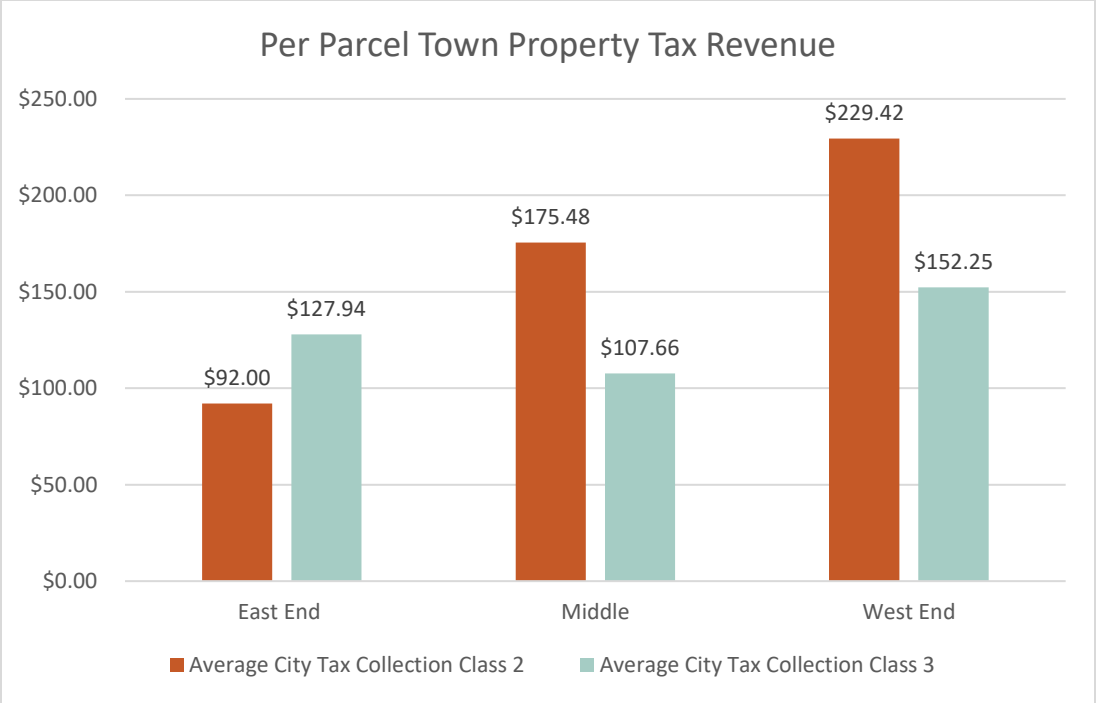


Figure 6: Town parcel tax collection per-parcel for each area of the Island, based on the average value of Town property tax revenue in the 2021 parcel data for Class 2 and Class 3 properties, shows significantly higher tax revenues for Class 2 Properties, except on the East End, and that the West End generates the greatest revenue per-parcel.

Parcel Ownership

The Mobile County tax data include the taxpayers' billing addresses[16]. Table 9 shows that many parcels on Dauphin Island are owned by off-island residents, either from the State of Alabama or out of state. Even on the East End, which is widely considered to be more local, only 39% of parcels and 22% of Class 3 parcels are registered to an owner on the Island. Figure 7 shows only 9% and 11% of parcels on the West End and Middle, respectively, are Class 3 homes registered to a local owner. These data reveal not only the importance of tourism on the Island but also how much of the Island's land is controlled by non-residents. Since only residents are generally allowed to participate in Island governance, the fact that much of the property is owned by non-islanders is potentially important for future adaptation policies, as discussed in depth later.

Furthermore, many homes are classified as Class 3, yet are registered to taxpayers who live off the Island, implying that the Island and Mobile County may not be collecting the property taxes they should be. It is possible that some of these homes are second homes that are *not* rented out, and therefore correctly classified as Class 3. However, some are potentially operated as STRs, especially as 168 developed parcels are registered to out-of-state taxpayers. Based on conversations with long-term

[16] Billing address was used as a proxy for home or primary address for this FIA. Even if the homeowner does not live at the billing address, the fact that the addresses is out of state still shows non-local control.

residents and real estate agents, it is worth investigating the nature of these properties to determine whether they are being rented out.

Table 9: Analysis of Ownership on Dauphin Island by area shows that the majority of parcels are registered to Alabama or out-of-state owners, with the greatest proportion of local ownership on the East End.

	Owned by Dauphin Island Resident		***Non-Locally Owned, Class 3***		***Locally Owned, Class 3***	
Area	*Number of Parcels*	*Percent of Total*	*Number of Parcels*	*Percent of Total*	*Number of Parcels*	*Percent of Total*
East End	916	39%	375	16%	520	22%
Middle	142	25%	81	14%	59	11%
West End	221	22%	222	22%	90	9%

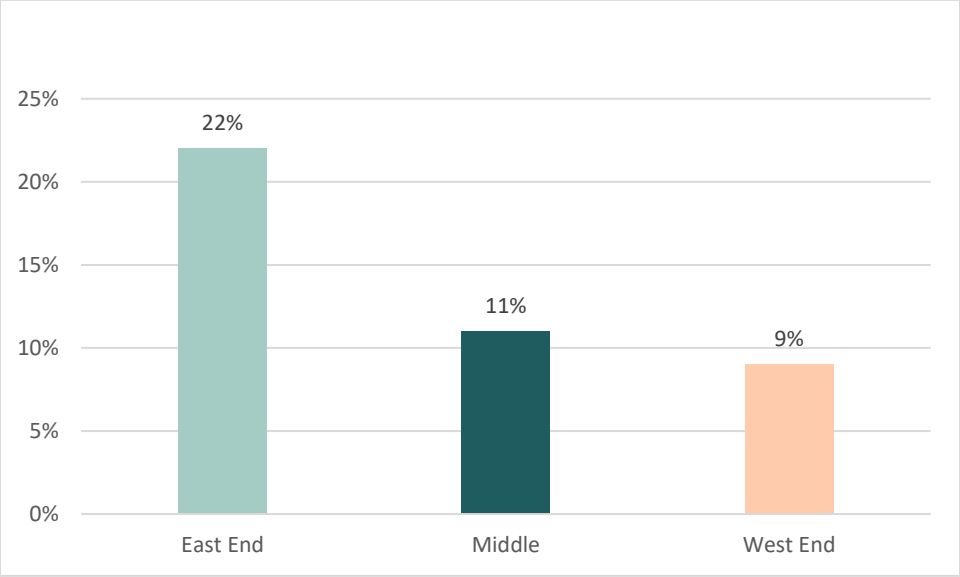


Figure 7: Analysis of the proportion of area parcels registered as Class 3 to Dauphin Island residents shows that very few parcels on the West End or in the Middle are locally owned and occupied.

The differences between areas are more apparent when considering only developed parcels (homes). Table 9 shows only 17% of homes on the West End are owned by a Dauphin Island resident, compared to 48% on the East End (Figure 8). Additionally, 31% of homes on the West End are registered as Class 3 to an off-island resident. These data show not only the prevalence of outside ownership across the different areas of the Island but also that West End (and Middle) Class 3 properties are predominantly owned by non-locals.

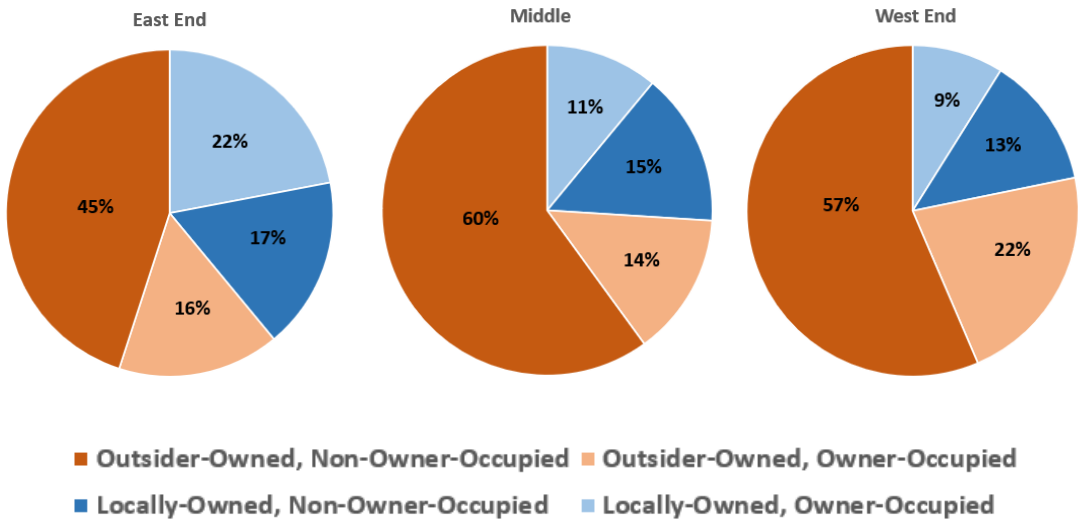


Figure 8: Analysis of classification and taxpayer addresses in the 2021 parcel data shows the predominance of non-locally owned, Class 2 properties on the West End and in the Middle, along with the overall lack of local ownership on the Island, especially in these two regions

The parcel data analysis also showed clear patterns of out-of-state ownership, as shown in Figure 9. The vast majority of homes (developed parcels) registered to an out-of-state taxpayer are on the West End and in particular the ocean-facing side.

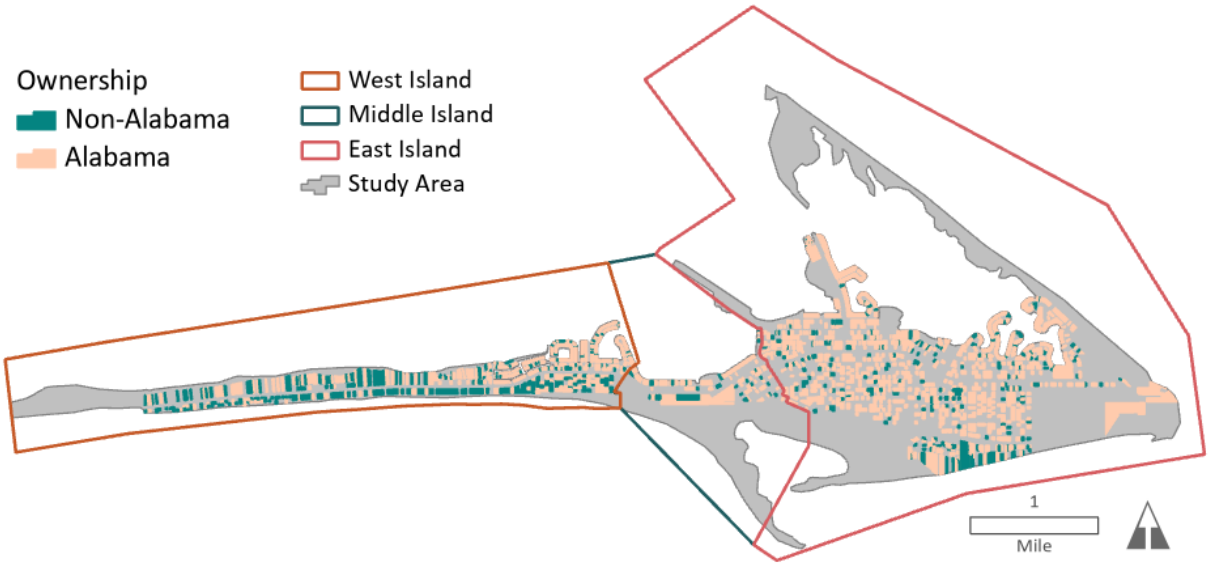


Figure 9: Geospatial visualization of ownership of developed parcels in ArcGIS shows that out-of-state homes are largely concentrated on the West End, particularly the ocean-facing side.

The value of parcels in the three areas of the Island varies based on ownership. While property values in the East and Middle areas are comparable between local owners, Alabama owners, and out-of-state

owners, on the West End homes registered to out-of-state owners are significantly more valuable. These homes have an average value of $412,000, compared to average values around $320,000 for other West End homes. Appendix C provides a breakdown of the property values by area. The highest value homes (developed parcels), irrespective of Class, on Dauphin Island are West End properties registered to taxpayers from out-of-state with an average value of $412,011 in 2021. Considering Class, homes registered as Class 2 to *both* local and out-of-state owners are most valuable at over $420,000. There are 222 Class 2 homes on the West End registered to an owner off the Island, compared to only 28 Class 2 homes registered to local owners. Overall, there are far fewer homes on the West End owned by local residents, while the highest percentage of locally owned homes are on the East End. Figure 10 shows the value of homes registered to out-of-state owners. As depicted, the most valuable of these properties are the ocean-facing homes on the West End.

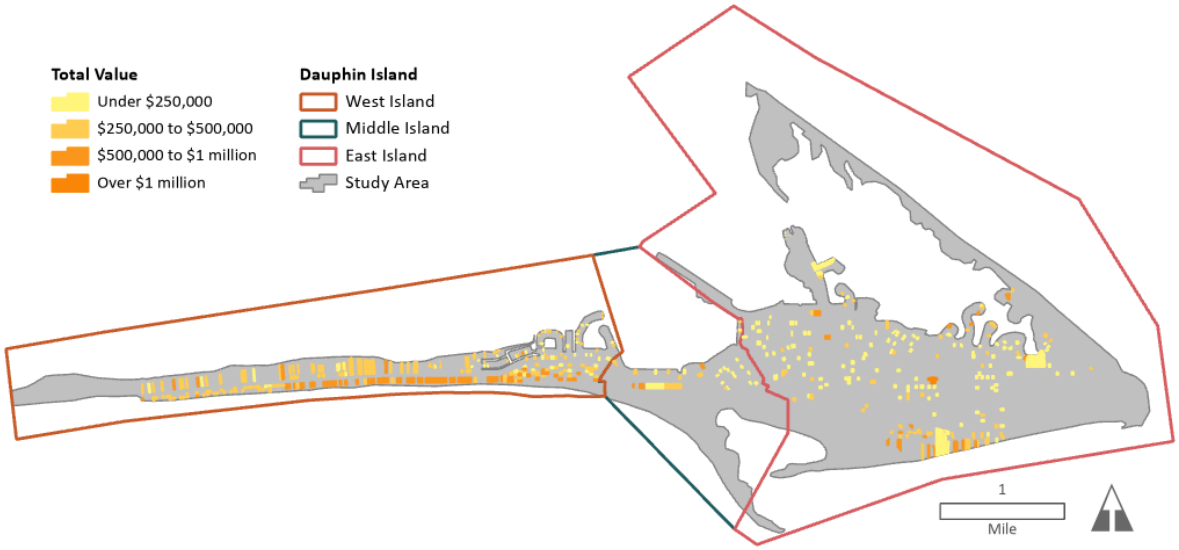


Figure 10: Geospatial analysis of the appraisal value of homes registered to out-of-state owners shows the highest value homes are on the West End, in particular the ocean-facing side.

Ownership & Tax Revenues

The parcel data indicate that the highest overall Town property taxes per parcel are collected from homes registered to out-of-state owners. As expected, given the higher tax rate for Class 2 properties, Town property tax revenues are much higher for these properties than for Class 3. It is important to note that for locally owned properties on the East End, Class 2 properties only generate 37% more revenue than Class 3 properties. For the Island's other areas, Class 2 homes generate more than twice the revenue of Class 3. Detailed information on property tax revenue is provided in Appendix C.

Interviews with homeowners and property managers/realtors on the Island provided insight into the ownership dynamics reflected in the data. According to locals, there are many property owners on the

Island who have second homes there—not for rental or investment purposes, but for their own use. According to local knowledge, most of these homeowners are from southern Alabama. Taxpayer (ownership) data from the County were examined to reveal 168 Class 3, developed parcels (homes) registered to an out-of-state owner. While it is possible that these homes are indeed for owner use and not rented out, if they are rental properties, they would be subject to the higher Class 2 tax rate. Table 10 shows the potential increase in Town property tax revenue if these homes were reclassified as Class 2. Reclassification would require an examination of the property use by the County and/or Town to determine whether each was, in fact, a rental property.

Table 10: Potentially misclassified parcels on Dauphin Island were determined by identifying the parcels in the 2021/22 parcel data registered as Class 3 (personal use) to out-of-state owners who are unlikely to use those homes themselves.

Area	Number of *developed* parcels registered as Class 3 to out of state payer	Potential Gain in Town Property Tax Collection
East End	101	$ 14,166.10
Middle	25	$ 3,273.50
West End	42	$ 7,500.70
Total	168	$ 24,940.30

Short-Term Rentals and Lodging Taxes

As the property tax data show, rentals make up most of Dauphin Island's properties, and, therefore, lodging taxes are a crucial part of the Town's economy. Lodging taxes are largely collected by the property management companies that manage most rentals on the Island. Vacasa is a major operator, along with local operators such as ACP, Beach Rentals, and Beach Rentals and Sales. Together, these management companies are estimated to manage over 700 rental properties[17]. The combined local lodging tax rate is 11%, with 5% going to the Town of Dauphin Island itself[18].

Due to the limited availability of rental and lodging data discussed in the data limitations section above, the overall number of STRs was estimated using several methods, given the limited data. The number of Class 3 properties indicated in the parcel data provided the most conservative estimate. This estimate of 478 is conservative for two main reasons. First, the parcel data undercount multi-unit properties (such as the large condominium blocks in the Middle area of the Island). Second, there are likely homes registered as Class 3 which are rented out as STRs, as discussed above.

To provide a more accurate estimate of STRs on the Island, the number of rentals were adjusted based on conversations with local experts including real estate agents and property managers (see Table 11 below), with the highest estimate being 700 rental units on the Island. This estimate factors in expert opinion that the condominium blocks have around 250 to 300 units.

[17] Estimated from conversation with local realtors.

[18] https://222868be-fcef-4d0f-961c-0e6d442d5caa.usrfiles.com/ugd/222868_1521bbc0fd1640fbbb14ff45d4e3fb3f.pdf

Table 11: median Short-Term Rental (STR) estimates

Estimate	Source
478	Number of Developed Class 2 Properties
700	Estimate from a long-term Island Real Estate agent and property manager
647	Number of developed Class 2 properties + 25% of the developed Class 3 Properties registered to an off-island owner

Fiscal Impact –

West End Lodging

A sensitivity analysis was conducted to estimate a range of possible lodging tax revenues generated by the West End. This analysis depended on (1) the proportion of total rentals on the West End and (2) the assumption of how much higher the average weekly rate for the West End rentals is compared to the rest of the Island. A full discussion of this analysis is provided in Appendix A. Based on this analysis, West End rental properties generate between $604,000 and $1.12 million in annual lodging tax revenue for the Town. We estimate that West End rental properties generate approximately 63% of lodging tax revenues.

West End Expenses

One key concern that several Town officials and other experts expressed was that the costs of providing some key public services, in particular road maintenance and post-storm damage repair to local infrastructure, is much higher on the West End. To estimate how these costs are distributed across the Island, estimates were obtained from Town officials about how costs are distributed between the West End and East End.

The results, shown in Table 13, indicate that, according to local officials, most departments spend a disproportionate amount of funds on the West End properties. The total expense estimate for 2021 is more than $1.3 million. Expenditures for the Water and Sewage authority were not estimated, as they are a distinct entity from the Town with their own budget and revenues and, therefore, beyond the scope of this FIA.

Table 12: Proportional spending between the West End and the rest of the Island, based on interviews with Town officials, indicates the West End costs the Island approximately $1.4 million annually (based on 2021 budget).

Service	*FY 20 -21 Budget*	*Proportion Attributed to West End*	*Est. West End Expense*
Administration (10)	$ 508,840.00	25%	$ 127,210.00
Council (20)	$ 121,754.00	25%	$ 30,438.50
Police (40)	$ 1,122,510.00	45%	$ 505,129.50
Public Works (30)	$ 712,428.00	40%	$ 284,971.20
Public Safety (45)	$ 492,712.00	40%	$ 197,084.80
Court (50)	$ 68,451.00	25%	$ 17,112.75
Chamber of Commerce (61)	$ 30,000.00	40%	$ 12,000.00
Building Dept. (70)	$ 167,197.00	30%	$ 50,159.10
Other (90)	$ 643,750.00	25%	$ 160,937.50
Town Subtotal of Operating Costs			**$ 1,385,043.35**
Other Impacts			
Water Department		60%	

Cost-Benefit Analysis

Using the estimates of West End proportional expenses (Table 12), we compared the relative costs and benefits of the West End properties to determine the fiscal impact of this area. Costs included routine maintenance costs and departmental costs but did *not* include storm-specific expenditures. Fiscal benefits included property, lodging, and sales tax revenues. A sensitivity analysis around both property and sales tax revenues were conducted and is discussed in detail in Appendix A. As shown in **Error! Reference source not found.**3, *without considering storm costs*, the revenue estimates for West End properties ranged from a $459,000 net deficit to a $151,000 net benefit.

Table 13: Lodging and Sales Tax Revenue estimates for the West End

Estimates of Net Fiscal Benefits of Lodging and Sales Tax Revenues for the West End	Most Conservative	Median Conservative	Least Conservative
Maintenance Cost Projections (not considering significant storms)/ Estimated Town Expenditure	$1,385,043.35	$1,385,043.35	$1,385,043.35
Property Tax Revenues	$209,470.00	$209,470.00	$209,470.00
Lodging Tax Revenues	$604,060.58	$900,462.98	$1,125,578.72
Sales Tax Revenue	$111,661.48	$159,516.40	$200,990.66
Total Net Fiscal Benefit	**-$459,851.29**	**-$115,593.97**	**$150,996.04**

Potential Storm Damage Fiscal Impacts

The analysis of storm damages in the NGOM, once adjusted for the discrepancies between the HAZUS model's 2010 census block data and the 2021 parcel data for the Island, yielded a range of estimates for residential property loss on Dauphin Island. As shown in Table 144, under almost all sea-level rise (SLR) scenarios, the model estimates the most severe impacts on the West End. However, in the Low SLR scenario (0.7 feet), storms are projected to have a relatively lower impact on the West End due to projections of sand motility in the wake of overwash. Essentially, the West End is expected to progress inland as sand is deposited from the ocean-facing side of the barrier island to the backshore, providing a temporary buffer against storm damage. This phenomenon is only sufficient to provide protection at the Low SLR level. The adjusted EIA data indicate the Town should be concerned about resource allocation as the model shows significant impacts (in terms of number and percent of homes and value) on both the west and east ends of the Island from both 100 and 500-year storms (Tables 13 and 14, respectively).

Table 14: Projected Storm Damages, 100-year storm under various SLR scenarios, as determined by the NOAA EIA modeling.

Area	*Percent of Homes Lost, Present SLR*	*Percent of Homes Lost, Low SLR*[19] *(0.7ft)*	*Percent of Homes Lost, Intermediate Low SLR (1.6ft)*	*Percent of Homes Lost, Intermediate High SLR (3.9ft)*	*Percent of Homes Lost, High SLR (6.6ft)*
East End	0%	3%	8%	21%	38%
Middle	4%	12%	17%	34%	46%
West End	11%	5%	26%	55%	71%

Table 15: Project Storm Damage in a 500-year storm in the NOAA EIA model.

Area	*Percent of Homes Lost, Present SLR*	*Percent of Homes Lost, Low SLR (0.7ft)*	*Percent of Homes Lost, IL SLR (1.6ft)*	*Percent of Homes Lost, IH SLR (3.9ft)*	*Percent of Homes Lost, High SLR (6.6ft)*
East End	14%	16%	23%	37%	50%
Middle	37%	34%	42%	47%	50%
West End	67%	16%	58%	73%	76%

[19] https://222868be-fcef-4d0f-961c-0e6d442d5caa.usrfiles.com/ugd/222868_1521bbc0fd1640fbbb14ff45d4e3fb3f.pdf

Fiscal Impacts of Future Storms

Based on the NOAA EIA estimates, the expected fiscal impact of potential storm damage on the Island was determined. As shown in Table 166, the Town will lose between $19,000 and $142,000 in property tax revenues at current sea levels, and up to $189,000 at higher sea levels. Table 17 shows the impacts on lodging tax revenues, with between $114,000 and $985,000 in lost annual revenue. The majority of lost lodging tax revenue, as estimated, comes from impacts on the West End.

Table 16: For this FIA, lost Town property tax revenue for 100 and 500-year storms was determined from the number of developed properties projected to be significantly damaged, and applying the average Town property tax revenue from developed properties for each region to the expected loss. The expected property tax losses are between $19,000 and $176,000 in the different scenarios.

Area	Present Sea Level		0.7ft of SLR		1.6ft of SLR		3.9ft of SLR		6.6ft of SLR	
	100-year storm	500-year storm	100-year storm	500-year storm	100-year storm	500-year storm	100-year storm	500-year storm	100-year storm	500-year storm
East End	$287.37	$20,654.94	$4,023.12	$26,396.30	$11,494.64	$38,604.59	$30,460.78	$62,196.28	$55,748.98	$84,468.16
Middle	$2,831.19	$24,222.41	$7,864.42	$17,055.80	$10,695.61	$20,954.27	$22,020.37	$23,634.47	$29,884.79	$25,096.39
West End	$16,458.72	$97,380.79	$7,772.18	$13,872.26	$37,489.32	$50,592.95	$80,922.06	$63,921.20	$104,238.59	$66,369.24
Total	$19,577.28	$142,258.14	$19,659.72	$57,324.36	$59,679.56	$110,151.80	$133,403.22	$149,751.94	$189,872.36	$175,933.79

Table 17: For this FIA, lost Town property tax revenue for 100 and 500-year storms was determined from the number of developed properties projected to be significantly damaged, and applying the estimated lodging tax revenue from for each region to the expected loss. The expected property tax losses are between $115,000 and $986,000 in the different scenarios.

Area	Present Sea Level		0.7ft of SLR		1.6ft of SLR		3.9ft of SLR		6.6ft of SLR	
	100-year storm	500-year storm	100-year storm	500-year storm	100-year storm	500-year storm	100-year storm	500-year storm	100-year storm	500-year storm
East End	$584.23	$42,356.38	$8,179.16	$46,738.07	$23,369.04	$68,354.43	$61,927.95	$110,126.58	$113,339.82	$149,561.83
Middle	$13,106.80	$112,135.92	$36,407.77	$101,941.75	$49,514.56	$125,242.72	$101,941.75	$141,262.14	$138,349.51	$150,000.00
West End	$101,250.00	$599,062.50	$47,812.50	$143,437.50	$230,625.00	$523,125.00	$497,812.50	$660,937.50	$641,250.00	$686,250.00
Total	$114,941.02	$753,554.80	$92,399.43	$292,117.32	$303,508.60	$716,722.15	$661,682.19	$912,326.22	$892,939.34	$985,811.83

Limitations of Results

The data limitations faced in this analysis reduce the certainty of the results. Estimates of the STR market—including the lodging tax revenue attributed to the West End—and sales taxes could be improved with better tax records from the Town, County, and/or State. Similarly, better records of Town revenues and expenditures (both day-to-day and around storm cleanup) would improve estimates of the portion of those revenues and expenditures attributed to the West End. In addition, Town budget data from previous years would enhance this analysis and further FIAs on the Island. Due to these limitations, a range of assumptions was used, all of which could be refined with improved data. Some of these assumptions and questions include:

- The percentage of STR revenue attributable to the West End.
    - What percentage of rentals are on the West End?
    - How do the prices of those rentals compare to others on the Island?
- The distribution of STR properties on the Island.
- Departmental expenditures or the percentage of departmental budget spent on the West End.
- Sales tax revenues attributable to (1) tourism and (2) the West End.

Additionally, while the estimates of the impacts of projected storms were made with the best science available, models of climate impacts, storms, and SLR are constantly evolving. Therefore, estimates of the fiscal impact of future storm events should be refined as new science and data become available.

Finally, not much is known about visitors to Dauphin Island or how future events and policies might influence tourists and the revenue they generate. Better understanding of tourist behavior might provide new inputs to the analyses used here, such as whether rentals in different parts of the Island are indeed substitutable or the role day-trippers might play in a Dauphin Island economy with more retail. At present, given that the Town does not track the number of visitors nor information about them or their spending habits, conclusions about their behavior cannot be inferred.

Discussion

An additional purpose of this FIA was to examine the Island's practices related to storm damages. Specifically, it sought to analyze the long-term sustainability of the Island given its susceptibility to future storms. Although the Island's economy is currently quite healthy in terms of real estate sales, its long-term resiliency to storm damages, especially on the West End of the Island where real estate has been booming, is questionable.

Storm Damages

This FIA examines the relative costs and benefits of the West End development in terms of local costs. It does not attempt to consider the impact of major storms, or federally declared disasters (most often hurricanes)[20]. These events drastically increase costs, although not exclusively for the West End. For example, while Katrina decimated the West End, it was reported by numerous residents and officials that Ivan had a severe impact on the East End. Given the precarious position of Dauphin Island in the Gulf's "hurricane alley" and its vulnerability to storms and wave action, it is necessary to understand the Town's ability to absorb the associated costs.

In the scope of this analysis, however, regional costs associated with storms and declared disasters were not fully examined. Officials estimate the costs of federally declared disasters around $500,000 to $600,000 per event. When a federal disaster is declared, the federal government—through FEMA—covers 85% of the repair and cleanup costs. In instances of a severe storm that is *not* declared a federal emergency, the Town is entirely responsible for these costs. One such event in 2021 resulted in $2.5 million in sand removal costs exclusively on the West End. Because of the lack of federal assistance, these storms are of greater concern for the Town's fiscal situation than declared disasters. For this FIA, however, records of recent storm expenses were unavailable. There is general indication from Town officials that the West End imposes greater costs in these instances.

Storm threats are of acute importance to the fiscal resilience of the Island. In part, this FIA was conducted to understand how the Island would fare if the West End was no longer viable. While we could not examine the costs for this area from past storms, analysis of the Town's revenues suggests that irrespective of storm costs the West End either costs the Town more to maintain than it generates in revenues or, at best, generates a very small net revenue (tax dollars generated minus costs) for the Town. Importantly, this revenue would not offset the cost of either a "non-event" storm, or even a federally declared disaster. While these results are preliminary pending more accurate data, they indicate that the West End has an overall net negative impact on the Town's fiscal situation.

[20] When a storm is not declared a federal emergency, it is considered a "non-event." Unlike the storms described above, the Town bears the full cost of these damages. Non-events range in severity from routine wind and wave uprush to coastal storms that are severe but not severe enough to reach federal emergency status. These all involve costs such as clean-up (debris removal, road clearing, sand removal), emergency services including the presence of police and fire, road repair, and the impact storms have on water and sewage systems

In regard to these findings, this FIA recommends both increasing the Town's sources of revenue *in other areas* and reducing the costs of at-risk properties.

Recommendations

Based on this analysis, Dauphin Island cannot offset the cost of storm damages. The Town, however, can shift its economic base from the more vulnerable lowest lying areas to less vulnerable properties and development. In doing so, they can offset the coming losses with new revenue sources. New policies are needed to incentivize this shift. Table 18 below provides a brief overview of some of the options available to the Town to increase revenues and decrease costs.

Table 18: Some of the options available to the Town which would either (a) increase revenues or (b) reduce costs. The impact of each recommendation is presented in terms of High, Medium, and Low. The timescale of each is also indicated, as a combination of short- and long-term strategies will likely be necessary.

	Description	Impact & Effort	Timescale
Tax Recommendations			
Increase STR Collection	Some rental properties likely do not collect taxes. Ensuring collection of all the taxes would increase revenues	Low impact, low effort (monitoring)	Immediate
Increased STR Rate	The combined tax rate for Dauphin Island is 11%, with 5% going to the Town. Some tourist areas have rates as high as 15%, with 7% collection for the Town.	Low to medium impact, medium effort (ordinance)	1 year
Verify Class 3 Homes/Exemption	The County should verify that the homes claiming Class 3 (lower property tax rate) are indeed Class 3 homes.[21]	Low impact, medium effort (enforcement)	Immediate – 1 year
Special Tax District for the West End Homes / other low-lying areas	Special Tax Districts can raise additional funds for properties. These funds can be used to mitigate against or recover from disaster. Low-lying areas of the East End identified as at-risk of severe damages should also be required to form a Special Tax District.	High impact, medium effort (ordinance)	1-3 years

[21] Analysis of property classification in the parcel data was especially important to this FIA. However, in the course of the analysis it became clear that not only is property classification an imprecise measure of property use, but many are confused about the meaning of those classifications. The definition of Class 3 property—assessed at the lower (10%) tax rate—may in fact leave ample room for short-term rental properties to be incorrectly classified as Class 3. It is recommended that, along with cleaning up the parcel data, the County consider investigating these properties in Dauphin Island and other popular coastal communities.

	Description	Impact & Effort	Timescale
Increase Tourism and Sales taxes	Market the Island more for short (1-3 night) stays and day-trippers.	Medium Impact, medium effort (ordinance)	1 -3 years
Non-Tax Recommendations			
Rebuilding Permit Fee	Require a significant fee to rebuild homes destroyed following major storms, as a preventative measure.	High impact, medium/high effort Would require discussion with Town. The fee should be *high.* The idea is not to increase revenues but rather encourage abandonment of those homes. Could be paired with another attempt at a buyback program (for parcel value).	1 year
Buyback Program	Offer buyouts to property owners whose homes are destroyed during storms, except reduce the value of the property to match the risk. Therefore, the buyout would be offered to homeowners in the wake of a storm as an alternative to a rebuilding fee. They could sell their parcel to the government and that parcel would be decommissioned for further development.	High impact, high effort Reduces burden following storms, reduces FEMA payouts to homeowners on the Island. Would potentially results in loss of property and lodging tax.	3-5 years
Toll on West End of Bienville Boulevard	Charge for access on West End of Bienville Blvd. to offset cleanup and maintenance costs. Could be a permit for full-time residents or full-time residents may be exempt. Weekly pass option should be available to tourists renting on that end of the Island	Low impact, medium-high effort	Immediate – 1 year
Parking Fees	Require a parking fee for day users and in the historic part of the Island	Low impact, low effort	Immediate
Marina Fees		Low impact, low effort	Immediate
STR Permit for 3rd Party Managed Rentals		Low to medium impact, low effort (ordinance)	Immediate
East End Growth			
Aloe Bay Plan	The Aloe Bay plan offers many opportunities to increase Town revenues and attract more visitors. It is discussed in detail below	Medium impact (See Table 20 below)	1- 5 years (phased)
Incentivize Rentals on East End		Medium impact Offset the loss of lodging tax revenue on the West End with more high-end East End rentals.	N/A

While many of these policies could generate several million in revenue, that increase does not begin to compare to the full cost of the threats the Island faces. These policies provide a way for the Town to offset routinely lost West End revenues (between $700,000 and $1.3 Million gross revenues, up to $150,000 considering costs), *not* as a way to recover from storms.

Additionally, it is recommended the Town pursue the creation of a special tax district[22] to shift the cost burden to the area where costs are generated. The purpose of such districts is to levy an additional tax on at-risk properties in response to the risks faced by that property's significant exposure to geological hazard. On Dauphin Island, certain properties are far greater risk due to (1) their low elevation, (2) the shifting nature of the sand, and (3) the lack of physical protection from storms and inundation. A special tax could be levied on these properties to increase Town revenues and offset the disproportionate expenses imposed in the wake of storms. The tax would be limited to at-risk homes, and those funds would have to be used to protect and repair this area, reducing the burden on the Town at large and helping promote resilience. The funds could also be used for adaptation efforts on the West End.

Projected storm damage makes it clear that Dauphin Island cannot afford to continue building as it has, placing high value homes in the path of hurricanes. Instead, the Island must adapt. The Town should be encouraged to create a "carrot and stick" style policy around at-risk homes. This two-pronged solution would only impact homes destroyed by hurricanes and tropical storms. In that event, a homeowner could either (a) pay the Town a *rebuilding fee* (recommended at $50,000 or more) or (b) sell the parcel to the Town for parcel value (an average of $53,000 according to Mobile County data for undeveloped parcels, although parcel value would need to be reappraised before the buyback). In the event they sell the property to the Town, that parcel would be precluded from further development.

Monitoring & Accounting

One issue identified in this study is that current fiscal record keeping, reporting, and the accuracy of local tax data creates serious limitations for the community in planning and preparing for future storms. This data is vital for assessing how communities can grow and adapt in the face of these changes. Community resilience requires financial resilience, and financial resilience requires transparency in fiscal accounting. Although these issues are often paid lip-service in reporting, this analysis revealed specific policies that could be implemented on Dauphin Island in the near future (1-10 years) to improve the Town's understanding of its own fiscal health. Accounting and monitoring of expenditures (and where they occur) would not only assist the Town and affiliated agencies in resource allocation, but also help make the public aware of the Island's financial sustainability.

Some specific examples:

- Accurate property tax rolls including indications where homeowners may not be paying their legally required share of taxes.
- Accounting for sales taxes and other taxes that allows planners to determine which sector and parts of the Island are generating taxes.
- More detailed accounting for how money is spent on the Island for government services, e.g., maintenance of roads.

[22] Sometimes referred to as a Geological Hazard Abatement District, or GHAD

- More detailed information on revenues generated by hotels, and short-term rentals on the Island, including a breakdown by area.

Federal Policy

Reducing the number of properties at high risk of storm damage brings the Island in alignment with federal policy. FEMA encourages communities to identify and mitigate the causes of repetitive losses [22]. Furthermore, the National Flood Insurance Program (NFIP) updated the guidelines and risk rating system in acknowledgement of climate change and its impact on flooding risk. Beginning in April 2022, these changes will lead to an up-to-18 percent annual increase in premiums per year for the next 20 years. The new system, Risk Rating 2.0, is meant not only to reflect costs more accurately, but also to discourage unsustainable building and rebuilding so prevalent on Dauphin Island. The previous method of calculating premiums, based on a static model, had been criticized for not accurately considering the effects of climate change and SLR (Batten).

Going forward, FEMA and other federal programs are likely to continue to make changes in response to the threat of climate change, SLR, and increasing severity of coastal storms. Between these changes and the increasing frequency and severity of emergency events, the status quo on Dauphin Island cannot last. It is worth undertaking efforts to adapt the Island in anticipation of losing federal subsidies rather than in reaction to the lack thereof.

While FEMA continues to intervene and assist the Island, the existence of a repetitive loss area[23] on the West End contradicts FEMA guidance, as directed by Congress[24]. Certain strategies aim to eliminate or reduce the damage to residential property and the disruption to life caused by repeated flooding and provide for mitigation measures against the continual loss of these properties[25].

After all, continual rebuilding in the path of hurricanes does not meet FEMA's requirements for cost effective mitigation efforts. The guidelines for Hazard Mitigation Assistance (HMA) require not only cost effectiveness but also that the intent is to "reduce the loss of life and property." The HMA program is distinct from the Individual and Households Program (IHP), and the IHP currently lacks the requirement for cost effectiveness. The IHP program, for which many homeowners on Dauphin Island have applied in the aftermath of previous storms, will be extremely overburdened in the coming years, as climate-related disasters worsen and increase in frequency. It is possible they may begin to look at the cost

[23]. A repetitive loss property is defined by the Federal Emergency Management Agency (FEMA) as a property for which two or more National Flood Insurance Program (NFIP) losses of at least $1,000 each have been paid within any 10-year rolling period since 1978 (FEMA 2017). From 1978 through 2017, about a quarter of all claims paid under the NFIP nationwide were for repetitive loss properties, even though such properties make up fewer than two percent of all NFIP insurance policies (FEMA 2017). A repetitive loss area is 50 or more contiguous repetitive loss properties. While the West End is specific as an LRA, this may in part be due the high value of the homes there, which exceed the value covered by NFIP. The pattern of damage and loss on the island, however, could meet the requirement for LRA.

[24] https://www.fema.gov/pdf/nfip/manual201205/content/20_srl.pdf

[25] https://www.fema.gov/pdf/nfip/manual201205/content/20_srl.pdf

effectiveness of the program and discontinue the practice of funding rebuilding efforts where homes are unlikely to last.

New Areas for Growth

Given the relative fiscal impact of the West End, it would benefit the Town to shift its tax base to the more protected East End or Middle areas. The Aloe Bay Plan [8] was conceived in the 5Es plan to shift the tax base from the West End and re-establish it in more secure and safer areas of the Island. It aims to develop a "town center," a planned community at the harbor area near the Dauphin Island bridge. The goal is to redevelop the area into a gateway for the Island with shops, a fish market, boutique dining, and lodging. It has been proposed as a three-phase development project incorporating significant local input. The eventual outcome is a multi-use space of several city blocks generating additional economic activity (and associated revenues) for the Town while retaining community character. More information on the project and plans can be found at https://www.aloebay.org/.

The Aloe Bay Plan includes 108,200 square feet of space for tax-generating businesses, including retail, restaurants, and event spaces. Applying national averages for sales per square feet, these spaces should generate on the order of $37 million in spending and economic activity, including $1.8 million in sales tax revenues for the Island. The Aloe Bay Plan also recommends 123 units for overnight lodging which are estimated to generate just over $6 million in revenues and $300,000 in hotel taxes for the Island. More specific fiscal impacts for the Plan are provided in Appendix B. The sales tax and lodging revenue generated by the Aloe Bay Plan would not offset the cost of repairs or damages. However, they would likely offset the lost lodging tax revenue from decommissioning at-risk vacation homes on the West End of the Island.

The Aloe Bay Plan crucially helps shift the focus of tourist and economic activity on Dauphin Island away from the vulnerable West End. Revitalizing and redeveloping the East End will be key for offsetting the lost revenues of the large vacation homes. Aloe Bay would also help draw short-term and day-use visitors to the Island. Going forward, Dauphin Island should prioritize projects which grow the East End (and perhaps the Middle as well) and increase the draw for tourists to that portion of the Island , so eventually tourism on more eastern portions of the Island can compensate for the loss on the west. We are not advocating an immediate condemnation of the West End homes, but sooner rather than later, a storm may necessitate this shift.

Conclusion

In many ways, Dauphin Island is a harbinger of the challenges facing coastal communities nationwide, and in fact worldwide.

Dauphin Island faces significant challenges to its long-term sustainability and possesses limited resources with which to meet these challenges. Understanding how best to maximize and allocate those resources is vital to the Island's survival. This FIA set out to determine if the West End was a net benefit to Dauphin Island. Careful assessment of the available data indicates that the West End is in fact a net negative, and a potential drain on the Town's resources. That isn't to say that this portion of the Island doesn't generate significant revenues—including most of the lodging tax revenues—but these revenues do not offset the cost of maintaining the West End area and providing public services to the properties. Furthermore, these revenues certainly do not offset the cost of storm damages. These findings are crucial for future planning, policymaking, and adaptation efforts on the Island.

Most property on the Island is (1) not owned by Island residents, and (2) not owned for personal use. This is especially apparent on the West End. Thus, a significant portion of the Town's expenditures benefits property owned by off-Island and out-of-state residents. While these properties generate revenues for the Town, most of the revenue they generate goes to owners and management companies off the Island entirely.

With the knowledge that the West End is not a fiscal benefit to the Island, Town officials and full-time residents, along with off-Island property owners, need to consider the future they envision for Dauphin Island. As the estimates of property damage from the NOAA model demonstrate, a major storm would impose massive losses on the Island. The Town needs to be prepared not only to absorb the costs of these physical damages, but also look for solutions to reduce the costs of future natural disasters.

Dauphin Island is becoming increasingly commercial, with more STRs each year. Without proper awareness of the costs and benefits of tourism and rentals, how can the Town plan sustainable growth? Of the many recommendations that resulted from this FIA, the most achievable and potentially the most impactful is to improve the accounting of revenue expenditures on the Island, both day-to-day and after storms.

Appendix A—Sensitivity Analysis

Sensitivity Analysis

Lodging Taxes

To estimate the fiscal benefits of the West End, it was necessary to determine the lodging taxes generated by rentals there. Lodging taxes are a major portion of the Town's budget, and many of the people consulted perceived that most of the rentals—and certainly the highest grossing rentals—are located on the West End. As mentioned earlier, precise data regarding the short-term rental (STR) market on the Island were unavailable. However, several Island real estate agents interviewed felt the Middle area also has a significant number of short-term rentals, and the East End has pockets with high rental rates. Based on interviews with real estate professionals and other local experts, a sensitivity analysis was conducted based on two assumptions. First, the proportion of rentals on the West End (either 60%, 50%, or 35%), and second, while it was clear from all our interviews (and observations) that West End STRs are priced higher than all others, this differential is uncertain, based on our interviews. We decided to assume that West End rentals are either 15%, 20%, or 25% greater.

Under the nine possible scenarios, we determined the proportion of 2021 fiscal year lodging tax revenues attributable to the West End and the dollar value of those revenues. The lodging tax revenue collection data was obtained from the Town's 2021 budget.

Sales Taxes

Determining the regional sales tax contribution, along with tourists' sales tax contribution, was an original goal of this analysis. However, service-sector-specific sales tax data was unavailable. As a result, this FIA does not include extensive estimates of sales tax impacts. However, in the analysis of the relative costs and benefits of the West End development, estimates of sales tax generated by those properties were included.

These estimates are based on standard assumptions and insights provided by local officials. First, several experts in the area noted the large volume of gas sales on the Island related to recreational boating (fishing). Due to these sales and the limited other retail transactions on the Island, we attributed 50% of total sales tax revenue to boating gas, unrelated to development. Second, following economic practice, we assumed that sales taxes would follow property taxes, and thus the proportion of sales taxes attributed to each area would reflect the same proportion as lodging taxes.

West End Additional Rental Rate	**Percentage on the West End**					
	35%[4]		**50%[6]**		**60%[5]**	
	Town Lodging Taxes Collected	*Percentage of Total Town Lodging Tax Revenue*	*Town Lodging Taxes Collected*	*Percentage of Total Town Lodging Tax Revenue*	*Town Lodging Taxes Collected*	*Percentage of Total Town Lodging Tax Revenue*
15%	$604,060.58	40%	$862,943.69	58%	$1,035,532.42	69%
20%	$630,324.08	42%	$900,462.98	60%	$1,080,555.57	72%
25%	$656,587.59	44%	$937,982.27	63%	$1,125,578.72	75%

Appendix B – Potential Sales Tax

Aloe Bay Sales Tax

Table 19: Estimated Sales Tax Revenue, Aloe Bay Master Plan

Business Type	*BFE Square Feet*	*Estimates Sales per Square Feet*	*Estimates Annual Sales*	*Estimated Sales Tax Revenues at 5%*
Ecotourism Center	8,500	$486.00	$4,131,000.00	$206,550.00
Fish Market	8,000	$389.00	$3,112,000.00	$155,600.00
Open Pavilion (Commercial)	3,750	$299.00	$1,121,250.00	$56,062.50
Hook-to Table Restaurants	8,000	$408.00	$3,264,000.00	$163,200.00
Mixed Use/Boutique Lodging	13,200	$299.00	$3,946,800.00	$197,340.00
Waterfront Use (Oysters)	3,000	$299.00	$897,000.00	$44,850.00
Mixed Use Space	29,600	$299.00	$8,850,400.00	$442,520.00
Restaurant/Snack Bar	3,000	$408.00	$1,224,000.00	$61,200.00
Waterfront Use (Charter/Marina)	2,800	$418.00	$1,170,400.00	$58,520.00
Personal Services	6,000	$418.00	$2,508,000.00	$125,400.00
Sporting Goods/Rentals	2,200	$299.00	$657,800.00	$32,890.00
Bait/Tackle Shops	3,675	$299.00	$1,098,825.00	$54,941.25
Restaurant	3,675	$408.00	$1,499,400.00	$74,970.00
Boat Shop	2,600	$299.00	$777,400.00	$38,870.00
Art Maker Gallery	2,100	$135.00	$283,500.00	$14,175.00
Books	2,100	$299.00	$627,900.00	$31,395.00
Health/Personal	3,500	$172.00	$602,000.00	$30,100.00
Restaurant	2,500	$408.00	$1,020,000.00	$51,000.00
Total	108,200	$6,042.00	$36,791,675.00	$1,839,583.75

Source: Philip King, sales tax analysis based on Randall Gross estimates of capacity at Aloe Bay and the Aloe Bay Master Plan.

Appendix C – Parcel Data Analysis Results

Ownership Analysis

Table 20: Parcel Value by Ownership

Area	*Parcels Owned by Dauphin Island Resident*	*Average Value*	*Locally Owned Parcels, Class 3, Average Value*	*Locally Owned Parcels, Class 2 Average Value*
East End	922	$ 264,344.58	$ 256,793.87	$ 290,447.02
Middle	142	$ 255,352.43	$ 220,396.61	$ 302,225.00
West End	221	$ 343,213.39	$ 316,094.74	$ 423,721.88

Area	*Alabama Owned Parcels*	*Average Value*	*Alabama Owned Parcels, Class 3, Average Value*	*Alabama Owned Parcels, Class 2 Average Value*
East End	468	$ 267,788.03	$ 278,804.03	$ 252,365.64
Middle	150	$ 256,042.00	$ 210,341.82	$ 282,500.00
West End	328	$ 314,447.56	$ 298,325.56	$ 334,055.41

Area	*Outside Alabama Owned Parcels*	*Average Value*	*Outside Alabama Owned Parcels, Class 3, Average Value*	*Outside Alabama Owned Parcels, Class 2 Average Value*
East End	250	$ 245,357.60	$ 271,782.18	$ 227,445.64
Middle	154	$ 260,405.19	$ 233,724.00	$ 265,575.97
West End	265	$ 412,011.70	$ 363,264.29	$ 421,192.83

Table 21: Property Tax to the Town, by Ownership

Area	*Parcels Owned by Dauphin Island Resident*	*Average Value*	*Locally Owned Parcels, Class 3, Average Value*	*Locally Owned Parcels, Class 2 Average Value*
East End	666	$ 124.44	$ 114.84	$ 158.20
Middle	102	$ 174.09	$ 101.30	$ 272.28
West End	118	$ 205.72	$ 146.15	$ 397.17

Area	*Alabama Owned Parcels*	*Average Value*	*Alabama Owned Parcels, Class 3, Average Value*	*Alabama Owned Parcels, Class 2 Average Value*
East End	468	$ 173.97	$ 148.94	$ 209.01
Middle	150	$ 181.63	$ 105.33	$ 231.58
West End	328	$ 221.96	$ 149.15	$ 310.51

Area	*Outside Alabama Owned Parcels*	*Average Value*	*Outside Alabama Owned Parcels, Class 3, Average Value*	*Outside Alabama Owned Parcels, Class 2 Average Value*
East End	250	$ 178.85	$ 141.66	$ 203.98
Middle	154	$ 231.49	$ 130.94	$ 251.12
West End	265	$ 363.76	$ 178.59	$ 398.63

References

1. Bilskie, M. V., S. C.Hagen, K. Alizad, S. C.Medeiros, D. L. Passeri, H. F. Needham,and A. Cox (2016), Dynamic simulation and numerical analysis of hurricane storm surge under sea level rise with geomorphologic changes along the northern Gulf of Mexico, Earth's Future, 4, 177–193, doi:10.1002/2015EF000347.
2. Bogner, A., Littig, B., Menz, W. (2009). Introduction: Expert Interviews — An Introduction to a New Methodological Debate. In: Bogner, A., Littig, B., Menz, W. (eds) Interviewing Experts. Research Methods Series. Palgrave Macmillan, London. https://doi.org/10.1057/9780230244276_1
3. Colie, Dennis G.; University of South Florida. Center for Economic Development Research; NAIOP of Florida Inc; and Fishkind & Associates, "Fiscal Impact Analysis Model (FIAM)" (2003). College of Business Publications. Paper 32. http://scholarcommons.usf.edu/business_pub/32
4. C.R. Berry, Ms. REASSESSING THE PROPERTY TAX. THE UNIVERSITY OF CHICAGO, N.d. https://propertytaxproject.uchicago.edu/.
5. F. Larry Leistritz (1994) ECONOMIC AND FISCAL IMPACT ASSESSMENT, Impact Assessment, 12:3, 305-317, DOI: 10.1080/07349165.1994.9725868
6. Florida Oceans. "Barrier Islands." https://www.floridaocean.org/sites/default/files/documents/PDFS/barrier-islands.pdf
7. Gaul, Gilbert M. 2019. "On the Alabama Coast, the Unluckiest Island in America." Yale Environment 360. https://e360.yale.edu/features/on-the-alabama-coast-the-unluckiest-island-in-america#:~:text=Dauphin%20Island%20has%20been%20battered,tropical%20storms%20in%20recent%20decades.
8. Goodwyn Mills Cawood, Dover Kohl and Partners, and Randall Gross Development Economics. (2021) *Aloe Bay Town Center Master Plan.*
9. Habete, Daniel., and Ferreira, Celso. M. 2017. "Potential Impacts of Sea-Level Rise and Land-Use Change on Special Flood Hazard Areas and Associates Risks." Natural Hazards Review Vol. 18:4. https://doi.org/10.1061/(ASCE)NH.1527-6996.0000262
10. Halstead, John M., Leistritz, F. Larry., and Thomas G. Johnson. 1991. "the Role of Fiscal Impact Models in Impact Assessment, impact assessment". 9:3,43-54, DOI: 10.1080/07349165.1991.9725717
11. Halstead, John M., and Thomas G. Johnson. 1986. "Fiscal Impact Models For Local Economies". Journal of Applied Business Research (JABR) 2 (2):90-101. https://doi.org/10.19030/jabr.v2i3.6574.

12. Justin Murfin, Matthew Spiegel, “Is the Risk of Sea Level Rise Capitalized in Residential Real Estate?”, The Review of Financial Studies, Volume 33, Issue 3, March 2020, Pages 1217–1255, https://doi.org/10.1093/rfs/hhz134

13. Lamie, David R., Campbell, Wallace., and Molnar, William E. 2012. “The Fiscal-Geographic Nexus: An Overview of Fiscal Impact Assessment in Local Policy Development.” Applied Geography, vol. 32, no. 1, pp. 54–60., https://doi.org/10.1016/j.apgeog.2010.07.007.

14. Mobile County Revenue Commission. Parcel Data. Mobile, Alabama. 2021

15. National Research Council 2007. NATIONAL LAND PARCEL DATA: A VISION FOR THE FUTURE. WASHINGTON, DC: THE NATIONAL ACADEMIES PRESS. https://doi.org/10.17226/11978.

16. NOAA. What is a Barrier Island? National Ocean Service website, https://oceanservice.noaa.gov/facts/barrier-islands.html, 03/05/2021.

17. Patterson, Bill. 1999. “How the Mobile Chamber of Commerce Bought, Sold and Forgot Dauphin Island.” Mobile, Alabama Harbinger. http://www.dauphinislandhistory.com/harbinger1.htm

18. Scawthorn, Charles., Blais, Neil., Sekigson, Hope., and Tate, Eric. 2006. “HAZUS-MH Flood Loss Estimation Methodology. I: Overview and Flood Hazard Characterization.” Natural Hazards Review. 7:2. https://doi.org/10.1061/(ASCE)1527-6988(2006)7:2(60)

19. South Alabama Regional Planning Commission In Cooperation With The Town Planning Commission. (November 18, 2014.) ZONING ORDINANCE DAUPHIN ISLAND, ALABAMA.

20. Swann, Roberta, Director. *Flight of the Frigate Bird: an Omen of Rising Seas.* Mobile Bay National Estuary Program, 2018. 32 min. https://www.mobilebaynep.com/watersheds/dauphin-island-watershed/the-flight-of-the-frigate-bird.

21. Taylor, Charles, and Molnar, William E. 2006. “Fiscal Impact Assessment: Jasper County, South Carolina, Hardeeville, South Carolina, and Ridgeland, South Carolina.” The Strom Thurmond Institute.

22. Tetra Tech. “Los Angeles County Repetitive Loss Area Analysis.” 2021.

23. Zhang, Zhihua., Chen, Rachel J.C., Han, Lee D., and Yang, Lu. 2017. “Kay Factors Affecting the Price of Airbnb Listings” A Geographically Weighted Approach.” Sustainability. 9: 1635. doi:10.3390/su9091635

APPENDIX B

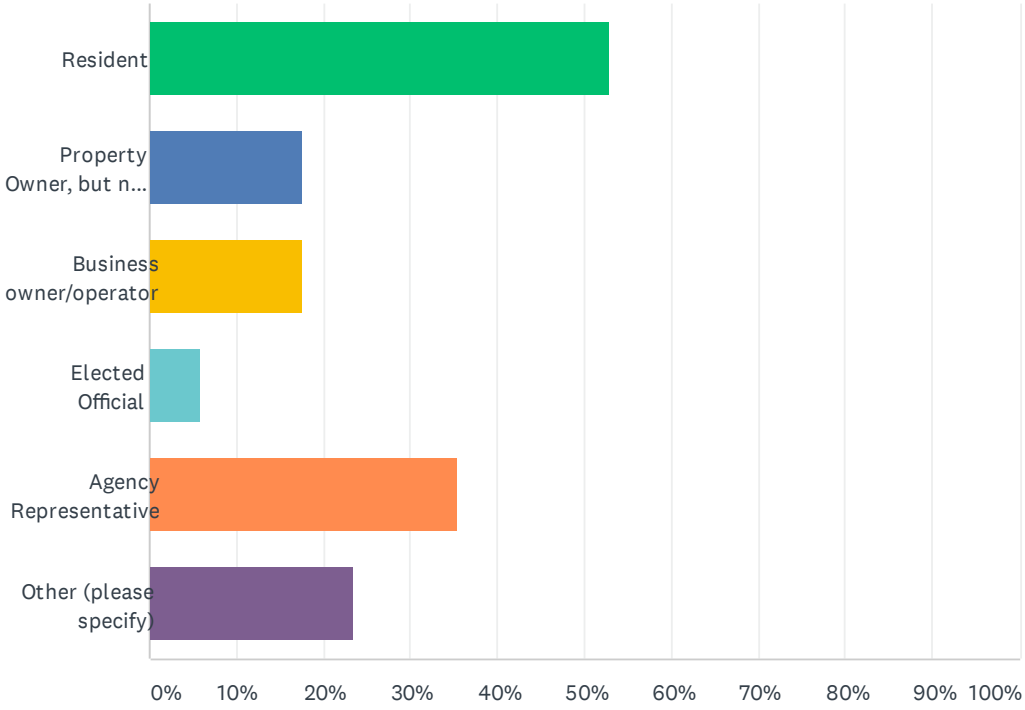
Community and Stakeholder Engagement Survey and Poll Results

APPENDIX B1

Steering Committee Survey

Q1 Which, if any, of these stakeholder groups do you represent (check all that apply)?

Answered: 17 Skipped: 0



ANSWER CHOICES	RESPONSES	
Resident	52.94%	9
Property Owner, but not a Resident	17.65%	3
Business owner/operator	17.65%	3
Elected Official	5.88%	1
Agency Representative	35.29%	6
Other (please specify)	23.53%	4
Total Respondents: 17		

#	OTHER (PLEASE SPECIFY)	DATE
1	Pres. Dauphin Island Bird Sanctuaries, Inc	3/30/2021 11:12 AM
2	Work on another project on the island and generally support the Town around SLR technical support when I can	3/30/2021 10:19 AM
3	Dauphin Island Heritage and Arts Council, Inc., 501(c) 3 entity	3/30/2021 8:24 AM
4	administrator - education dept at DISL, educator	3/29/2021 10:19 AM

Q2 Referring to the list of values above, what are the top three issues the Dauphin Island WMP should focus on?

Answered: 17 Skipped: 0

#	RESPONSES	DATE
1	Water Quality, Enviro Health & Resilience, Beach & Shoreline	4/5/2021 12:26 PM
2	Water Quality Beach and Shorelines Environmental Health and Resilience	4/2/2021 2:03 PM
3	Environmental Health and Resilience Fish and Wildlife Heritage and Culture	4/2/2021 12:00 PM
4	Water quality, environmental health and resilience, and beaches and shorelines	4/2/2021 8:08 AM
5	After reconciling the described purpose of WMP's with the NEP's values my top value is obviously water quality. All the others are sub-sets of water quality. However, if you are simply asking what I believe are the most issues facing DI under the NEP values then it would be fish and wildlife (birds), beaches and shorelines (access is part of this) and heritage and culture.	3/31/2021 11:34 AM
6	beaches and shorelines, fish and wildlife, heritage and culture	3/31/2021 9:57 AM
7	Habitat Acquisitions and protection Watershed protection, storm water runoff Promotion of ecotourism	3/30/2021 11:12 AM
8	1) Stormwater management - the stormwater system is continuing to lose functionality as seas rise. This is causing access, water quality, and environmental resilience issues. 2)Balanced development/growth - the east end is growing very fast, and I know we need to balance property rights and tax base needs with environmental and resilience concerns. Coupled with this is a need for growth that considers the individual and cumulative environmental impact of each new build (e.g., LID etc. I think there are already some good strides towards this with the tree ordinances etc.) Those are the two that I'm particularly concerned with that I don't feel like are being explicitly addressed there are other concerns affiliated with sea-level rise (e.g., salt water intrusion, erosion, etc.) and the impact of hurricanes; however, there is a lot of work on going in those areas right now so maybe we could simply highlight present those efforts?	3/30/2021 10:19 AM
9	Beaches and Shorelines Environmental Health and Resilience Water Quality	3/30/2021 8:39 AM
10	Environmental health and resilience Heritage and culture including fish and wildlife Water quality	3/30/2021 8:24 AM
11	beaches and shore line, resilience, access	3/29/2021 3:07 PM
12	Long term sustainability for the Island, the residents and the water Quality.	3/29/2021 2:53 PM
13	Water Quality, fish and wildlife, heritage and culture	3/29/2021 2:09 PM
14	water quality; environmental health and resilience, beaches and shorelines	3/29/2021 10:19 AM
15	Beaches and Shoreline Environmental Health and Resilience Heritage and Culture	3/29/2021 9:52 AM
16	beaches and shorelines fish and wildlife environmental health and resilience	3/29/2021 9:41 AM
17	Heritage, shorelines, environmental health	3/29/2021 9:30 AM

Q3 Are there certain cultural, historic, or environmental sites or resources that should be protected on the Island?

Answered: 17 Skipped: 0

#	RESPONSES	DATE
1	Audubon Bird Sanctuary and Goat Trees	4/5/2021 12:26 PM
2	Being a small island, all of the above should have great attention paid to them.	4/2/2021 2:03 PM
3	Dunes; Fort; Shell mounds; wildlife preserves	4/2/2021 12:00 PM
4	Fort Gaines, valuable east end habitats in bird sanctuary, Little Dauphin Island, Graveline marsh	4/2/2021 8:08 AM
5	All the DIBs properties, and Park and Beach Board properties. The bird sanctuary is already under a conservation easement which will make it very difficult for any of the property to be developed. The DI golf course should also be protected because it a large track of land that provides wildlife habitat and water storage.	3/31/2021 11:34 AM
6	yes, but too many to name here	3/31/2021 9:57 AM
7	Protection of as much Tupelo/mixed maritime forest habitat and invasive species removal and control. A Working Waterfront should reflect the unique history and culture of the island.	3/30/2021 11:12 AM
8	The fort, goat trees, and the shell mounds for cultural/historic. I also think the marshes around the north side of the island are an important environmental resource for recreation and protection. Also the dunes are critically important for protection.	3/30/2021 10:19 AM
9	Bird Sanctuary and Lake Shell Mounds Fort Gaines Goat Trees	3/30/2021 8:39 AM
10	Shell Mound Park Fort Gaines Sand Island Lighthouse Major birding sites	3/30/2021 8:24 AM
11	all need protecting	3/29/2021 3:07 PM
12	There are those type sites on the Island and I di think they need to be protected.	3/29/2021 2:53 PM
13	Many- shell mounds, fort gaines, bird sanctuary, wetlands on north side of island, all interior wetlands	3/29/2021 2:09 PM
14	Yes, 'airport' salt marsh, Shell Mounds, Audubon Bird Sanctuary, Fort Gaines, Cadillac Park, far west end, (Sea Lab), other areas for birds, birding and birders;	3/29/2021 10:19 AM
15	East End (Fort and Bird Sanctuary) West End (public access and shorebird habitat) Small town ambience	3/29/2021 9:52 AM
16	undeveloped lots which could be purchased and preserved bird sanctuary shell mounds	3/29/2021 9:41 AM
17	Yes	3/29/2021 9:30 AM

Q4 Do you think the condition of the Island is better or worse today compared to how you first remember it? If worse, what do you feel are the primary causes?

Answered: 17 Skipped: 0

#	RESPONSES	DATE
1	Lots of concern surrounding clear cutting of lots and impervious structure going in.	4/5/2021 12:26 PM
2	In regards to the physical health of the island, I feel it is worse due to erosion and lack of funding for restoration. Environmentally, the awareness has greatly improved.	4/2/2021 2:03 PM
3	The old Isle Dauphine due to neglect and lack of funds	4/2/2021 12:00 PM
4	Worse. Development, predominately on the west end, and storms are the causes.	4/2/2021 8:08 AM
5	My horizon is 20 yrs so I would say it worse from the standpoint of development on the south side of Bienville on the west end, fewer trees, less beach access and no improvement for boating access when considering there are more boats now than 20 yrs ago. The primary causes in my opinion is lack of commitment for addressing the problems.	3/31/2021 11:34 AM
6	better	3/31/2021 9:57 AM
7	Worse. Over development, clear-cutting of residential lots.	3/30/2021 11:12 AM
8	Worse - little dauphin island is getting very small very fast. To me that is a canary in the coal mine in terms of showing the pressures on the island. Additionally, as it continues to disappear it leaves a large portion of the north of the island vulnerable. I think little dauphin is worse in part because of rising seas and storms. I would imagine recreational boating may have had an impact and the inability (until recently) to do restoration. Also stormwater drainage has gotten so much worse and the stuff in it is gross. I think part of that is the system and I think part of that is sea-level rise. I think it's a good opportunity to start investigating NNBFs that could help with stormwater reduction.	3/30/2021 10:19 AM
9	Better from a standpoint of quality of life, cleanliness, services provided, amenities and more. Worse from an environmental and resiliency perspective caused in part by repeat storms/hurricanes, erosion, accelerated growth (new home construction) leading to deforestation, etc.	3/30/2021 8:39 AM
10	Better in many ways, but worse primarily because of erosion of west end, intense development and reconstruction	3/30/2021 8:24 AM
11	worse!!!!	3/29/2021 3:07 PM
12	I think worse. The Island seems to be much smaller than what I remember. I think when you dredge the ship channel that material should be utilized on the North ans South side of the Island	3/29/2021 2:53 PM
13	It is still a wonderful place but I am disheartened by the amount of continued development and denuding of the island...also- with new people moving in it is getting harder to sustain knowledge or traditional life, heritage and culture	3/29/2021 2:09 PM
14	I see examples of both. The recent rapid spec development of home and associated clearing of land along Bienville Blvd is worrisome, yet, recognition of the importance of and recent move to protect west end is a good sign (when I first moved here, the west end was being considered for development of additional housing). The focus on increasing ecotourism opportunities has been a positive thing. I recall water pressure and brown water being a common problem around the 4th of July holiday in my neighborhood 20 yrs ago. This has obviously improved. Many of the problems the island is experiencing come from increased development and associated human impact.	3/29/2021 10:19 AM
15	My first memories as a young child were of huge dunes and few people on Dauphin Island. I	3/29/2021 9:52 AM

	think it is generally better because of the people who love the island and work to protect it. However, over development and vulnerability to extreme events are worse.	
16	better	3/29/2021 9:41 AM
17	Worse, that stems from inevitable change and growth	3/29/2021 9:30 AM

Q5 In your opinion, does the environmental quality of the Island need to be improved? If yes, what are the key issues needing attention now?

Answered: 17 Skipped: 0

#	RESPONSES	DATE
1	Clear cutting of lots and invasive species management	4/5/2021 12:26 PM
2	As stated in Question 4, I feel we have improved environmentally yet still have a great amount of work to do. The construction boom is removing much of the trees and root systems which is concerning. I believe construction should also pay attention to permeability.	4/2/2021 2:03 PM
3	Recycling (island wide)	4/2/2021 12:00 PM
4	Yes. Key issue is a long term funding source to not only construct but maintatin/renourish the numerous restoration projects that have already been identified for the island.	4/2/2021 8:08 AM
5	Reforestation....if you can spend millions on putting sand back on the beaches then it stands to reason that resources should be devoted to planting more trees and wildlife friendly habitat.	3/31/2021 11:34 AM
6	Environmental quality of DI warrants continued protection. Shoreline erosion, coupled with subsidized re-development of vulnerable properties will remain a key issue, and related impacts will worsen with climate change.	3/31/2021 9:57 AM
7	Yes. Purchase properties for green space and essential habitat required for migratory and residents birds animals and plants.	3/30/2021 11:12 AM
8	Not necessarily improved - it's pretty great, but I feel like we're on the verge of a tipping point with the rate of development and rising seas. I want to make sure that these things are being balanced so that we don't start to see things degrade at a rapid pace.	3/30/2021 10:19 AM
9	Combat coastal erosion and degradation, address/mitigate tree loss, protect dunes and critical habitats. Mother Nature can only do so much on her own.	3/30/2021 8:39 AM
10	Recycling program Loss of land and marshes Loss of wildlife habitat and plants	3/30/2021 8:24 AM
11	sea level rise	3/29/2021 3:07 PM
12	Yes. I believe the roadside ditches should should be Piped and back filled and grassed.	3/29/2021 2:53 PM
13	Stormwater management, urban forestry, native species enhancements, wetland protections	3/29/2021 2:09 PM
14	In comparison to the shores of Baldwin County, we are doing well, but when compared to Dauphin Island 20 yrs ago, yes, there is a need for improvement. Water quality, trash on the beaches and in the marshes, and resilience to storm associated flooding are key issues.	3/29/2021 10:19 AM
15	Yes, the west end needs a management plan that develops and implements strategies to protect nearshore and dune habitats.	3/29/2021 9:52 AM
16	attention to shoreline issues; limiting bulkheads and structures destructive to the shoreline; restoring Little Dauphin Island	3/29/2021 9:41 AM
17	Not sure	3/29/2021 9:30 AM

Q6 What do you believe are the biggest threats to management, planning, and restoration on the Island?

Answered: 17 Skipped: 0

#	RESPONSES	DATE
1	Balancing economic growth with environmental conservation.	4/5/2021 12:26 PM
2	Funds and climate change.	4/2/2021 2:03 PM
3	Need a strong central entity like the town to control a public amenities	4/2/2021 12:00 PM
4	Long term funding	4/2/2021 8:08 AM
5	The town needs more staff with the expertise to work on the problems. For example, a full time forester and flood plane manager would benefit the residents and tourists who visit the Island.	3/31/2021 11:34 AM
6	Short-term, reactionary measures to "immediate" crises take priority, but may not reflect overall long-term needs.	3/31/2021 9:57 AM
7	Rapid development, clear-cutting of maritime forest.	3/30/2021 11:12 AM
8	Funding; challenges from those who have not yet built on their lots if the management/planning choices make it harder more expensive or limit when they can build. I also think that rising seas make all of this a bit more challenging - because we will need to get out of the box to think creatively about how to set ourselves up to live with water differently.	3/30/2021 10:19 AM
9	Hurricanes, sea level rise, development, costs, buy-in, ability to collaborate with various island entities.	3/30/2021 8:39 AM
10	Increased population Lack of resources - funds and personnel Indifference	3/30/2021 8:24 AM
11	cost	3/29/2021 3:07 PM
12	Government Bureaucracy.	3/29/2021 2:53 PM
13	I believe one of the biggest threats is residents who now live on the island but have yet to experience severe weather (hurricane hit). Their knowledge of how to maintain resilience is a bit different from those who have and their expectations of "what the island could be" aren't in sync with what it is and has been...loving it to death...	3/29/2021 2:09 PM
14	The need (and perhaps desire) for an increased tax base and the desire for access by an increasing number of visitors.	3/29/2021 10:19 AM
15	Poor communication between the different controlling entities on the island limits management and planning. I think the Town would benefit from establishing a department that manages the Parks and natural areas under its control.	3/29/2021 9:52 AM
16	no coordinating effort as too many entities in control of certain portions of land; Town, which should be the controlling entity is limited by properties controlled by the Park and Beach Board and the Property Owners Association	3/29/2021 9:41 AM
17	Unsure at this time	3/29/2021 9:30 AM

Q7 What is your ideal vision for Dauphin Island ten years from now?

Answered: 17 Skipped: 0

#	RESPONSES	DATE
1	Continued small town living with greater conservation	4/5/2021 12:26 PM
2	Smart growth needs to be taken into consideration to preserve the character of Dauphin Island and create a stronger sustainable framework.	4/2/2021 2:03 PM
3	like it is with better amenities and restaurants. Family friendly, retiree friendly	4/2/2021 12:00 PM
4	Many of the already identified restoration projects are implemented with a strategic plan to monitor their success and a funding source to maintain them for the long-term.	4/2/2021 8:08 AM
5	Aa viable working waterfront community that has more will have significantly more trees and residents and leaders work together instead of blaming other groups for the problems the the Island has.	3/31/2021 11:34 AM
6	A coastal community that remains a wonderful place to live and visit because its environmental attributes have been maintained and improved, not diminished by poor development choices.	3/31/2021 9:57 AM
7	Dauphin Island is rich in animal and plant species and procurement of important wildlife habitat, especially on the island's eastern is essential Dauphin Island must retain its biological diversity. The island has been designated a Globally Important Bird area, and significant habitat purchase, invasive species removal, primary dune protection, are are critical for Dauphin Island's long-term ecological future.	3/30/2021 11:12 AM
8	Still quiet, still a small town feel, still a place to go and feel close to nature in many different ways - I can paddle in a marsh, lounge on a beach, or stroll through a maritime forest. It's amazing diversity in such a small stretch of land.	3/30/2021 10:19 AM
9	That the community will be fiscally and physically sound and resilient. Maintaining the identity, charm and qualities that residents and visitors have come to enjoy.	3/30/2021 8:39 AM
10	- Pristine, undeveloped west end - bird / wildlife sanctuary - Thriving economy through completion of the Aloe Bay development and similar projects in keeping with the character of the Island -Increased public awareness, respect for, and interest in the Island's rich heritage and culture	3/30/2021 8:24 AM
11	return beaches and shorelines to 30 years age	3/29/2021 3:07 PM
12	An Island that my wife, children,grand children and friends can come and enjoy the quality of the air,water, fishing and environment.	3/29/2021 2:53 PM
13	An island paradise, not overcome by development demands- quiet, accessible, and an example of smart growth/management which aligns with the sensitive nature of its environment	3/29/2021 2:09 PM
14	A variety of healthy coastal habitats that support native wildlife (including birds), programs that support learning about AL's coastal areas that inculcate stewardship, and a working waterfront where one can participate in fishing trips, buy local area seafood and a few businesses that support local inhabitants while leaving large areas of the island undeveloped.	3/29/2021 10:19 AM
15	A community that has retained its small town charm while taking advantage of the available funding to improve experiences and protect the environment.	3/29/2021 9:52 AM
16	maintaining its unique character but developing some of the bays for cultural and entertainment venues	3/29/2021 9:41 AM
17	A continued belief that we can properly manage the island and its environment and maintain what draws all of to such an incredible place	3/29/2021 9:30 AM

#1

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Monday, March 29, 2021 9:15:57 AM
Last Modified:	Monday, March 29, 2021 9:29:58 AM
Time Spent:	00:14:01
IP Address:	174.203.35.191

Page 1

Q1

Which, if any, of these stakeholder groups do you represent (check all that apply)?

Agency Representative

Q2

Referring to the list of values above, what are the top three issues the Dauphin Island WMP should focus on?

Heritage, shorelines, environmental health

Q3

Are there certain cultural, historic, or environmental sites or resources that should be protected on the Island?

Yes

Q4

Do you think the condition of the Island is better or worse today compared to how you first remember it? If worse, what do you feel are the primary causes?

Worse, that stems from inevitable change and growth

Q5

In your opinion, does the environmental quality of the Island need to be improved? If yes, what are the key issues needing attention now?

Not sure

Q6

What do you believe are the biggest threats to management, planning, and restoration on the Island?

Unsure at this time

Q7

What is your ideal vision for Dauphin Island ten years from now?

A continued belief that we can properly manage the island and its environment and maintain what draws all of to such an incredible place

#2

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Monday, March 29, 2021 9:33:03 AM
Last Modified:	Monday, March 29, 2021 9:41:00 AM
Time Spent:	00:07:57
IP Address:	68.63.34.139

Page 1

Q1

Which, if any, of these stakeholder groups do you represent (check all that apply)?

Resident

Q2

Referring to the list of values above, what are the top three issues the Dauphin Island WMP should focus on?

beaches and shorelines
fish and wildlife
environmental health and resilience

Q3

Are there certain cultural, historic, or environmental sites or resources that should be protected on the Island?

undeveloped lots which could be purchased and preserved
bird sanctuary

shell mounds

Q4

Do you think the condition of the Island is better or worse today compared to how you first remember it? If worse, what do you feel are the primary causes?

better

Q5

In your opinion, does the environmental quality of the Island need to be improved? If yes, what are the key issues needing attention now?

attention to shoreline issues; limiting bulkheads and structures destructive to the shoreline; restoring Little Dauphin Island

Q6

What do you believe are the biggest threats to management, planning, and restoration on the Island?

no coordinating effort as too many entities in control of certain portions of land; Town, which should be the controlling entity is limited by properties controlled by the Park and Beach Board and the Property Owners Association

Q7

What is your ideal vision for Dauphin Island ten years from now?

maintaining its unique character but developing some of the bays for cultural and entertainment venues

#3

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Monday, March 29, 2021 9:37:23 AM
Last Modified:	Monday, March 29, 2021 9:51:51 AM
Time Spent:	00:14:27
IP Address:	198.185.254.2

Page 1

Q1

Which, if any, of these stakeholder groups do you represent (check all that apply)?

Property Owner, but not a Resident,

Agency Representative

Q2

Referring to the list of values above, what are the top three issues the Dauphin Island WMP should focus on?

Beaches and Shoreline
Environmental Health and Resilience
Heritage and Culture

Q3

Are there certain cultural, historic, or environmental sites or resources that should be protected on the Island?

East End (Fort and Bird Sanctuary)
West End (public access and shorebird habitat)
Small town ambience

Q4

Do you think the condition of the Island is better or worse today compared to how you first remember it? If worse, what do you feel are the primary causes?

My first memories as a young child were of huge dunes and few people on Dauphin Island. I think it is generally better because of the people who love the island and work to protect it. However, over development and vulnerability to extreme events are worse.

Q5

In your opinion, does the environmental quality of the Island need to be improved? If yes, what are the key issues needing attention now?

Yes, the west end needs a management plan that develops and implements strategies to protect nearshore and dune habitats.

Q6

What do you believe are the biggest threats to management, planning, and restoration on the Island?

Poor communication between the different controlling entities on the island limits management and planning. I think the Town would benefit from establishing a department that manages the Parks and natural areas under its control.

Q7

What is your ideal vision for Dauphin Island ten years from now?

A community that has retained its small town charm while taking advantage of the available funding to improve experiences and protect the environment.

#4

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Monday, March 29, 2021 9:55:18 AM
Last Modified:	Monday, March 29, 2021 10:18:54 AM
Time Spent:	00:23:36
IP Address:	216.109.15.157

Page 1

Q1

Which, if any, of these stakeholder groups do you represent (check all that apply)?

Property Owner, but not a Resident,

Other (please specify):

administrator - education dept at DISL, educator

Q2

Referring to the list of values above, what are the top three issues the Dauphin Island WMP should focus on?

water quality; environmental health and resilience, beaches and shorelines

Q3

Are there certain cultural, historic, or environmental sites or resources that should be protected on the Island?

Yes, 'airport' salt marsh, Shell Mounds, Audubon Bird Sanctuary, Fort Gaines, Cadillac Park, far west end, (Sea Lab), other areas for birds, birding and birders;

Q4

Do you think the condition of the Island is better or worse today compared to how you first remember it? If worse, what do you feel are the primary causes?

I see examples of both. The recent rapid spec development of home and associated clearing of land along Bienville Blvd is worrisome, yet, recognition of the importance of and recent move to protect west end is a good sign (when I first moved here, the west end was being considered for development of additional housing). The focus on increasing ecotourism opportunities has been a positive thing. I recall water pressure and brown water being a common problem around the 4th of July holiday in my neighborhood 20 yrs ago. This has obviously improved. Many of the problems the island is experiencing come from increased development and associated human impact.

Q5

In your opinion, does the environmental quality of the Island need to be improved? If yes, what are the key issues needing attention now?

In comparison to the shores of Baldwin County, we are doing well, but when compared to Dauphin Island 20 yrs ago, yes, there is a need for improvement. Water quality, trash on the beaches and in the marshes, and resilience to storm associated flooding are key issues.

Q6

What do you believe are the biggest threats to management, planning, and restoration on the Island?

The need (and perhaps desire) for an increased tax base and the desire for access by an increasing number of visitors.

Q7

What is your ideal vision for Dauphin Island ten years from now?

A variety of healthy coastal habitats that support native wildlife (including birds), programs that support learning about AL's coastal areas that inculcate stewardship, and a working waterfront where one can participate in fishing trips, buy local area seafood and a few businesses that support local inhabitants while leaving large areas of the island undeveloped.

#5

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Monday, March 29, 2021 1:58:44 PM
Last Modified:	Monday, March 29, 2021 2:09:17 PM
Time Spent:	00:10:33
IP Address:	69.85.254.50

Page 1

Q1

Which, if any, of these stakeholder groups do you represent (check all that apply)?

Agency Representative

Q2

Referring to the list of values above, what are the top three issues the Dauphin Island WMP should focus on?

Water Quality, fish and wildlife, heritage and culture

Q3

Are there certain cultural, historic, or environmental sites or resources that should be protected on the Island?

Many- shell mounds, fort gaines, bird sanctuary, wetlands on north side of island, all interior wetlands

Q4

Do you think the condition of the Island is better or worse today compared to how you first remember it? If worse, what do you feel are the primary causes?

It is still a wonderful place but I am disheartened by the amount of continued development and denuding of the island...also- with new people moving in it is getting harder to sustain knowledge or traditional life, heritage and culture

Q5

In your opinion, does the environmental quality of the Island need to be improved? If yes, what are the key issues needing attention now?

Stormwater management, urban forestry, native species enhancements, wetland protections

Q6

What do you believe are the biggest threats to management, planning, and restoration on the Island?

I believe one of the biggest threats is residents who now live on the island but have yet to experience severe weather (hurricane hit). Their knowledge of how to maintain resilience is a bit different from those who have and their expectations of "what the island could be" aren't in sync with what it is and has been...loving it to death...

Q7

What is your ideal vision for Dauphin Island ten years from now?

An island paradise, not overcome by development demands- quiet, accessible, and an example of smart growth/management which aligns with the sensitive nature of its environment

#6

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Monday, March 29, 2021 2:32:23 PM
Last Modified:	Monday, March 29, 2021 2:52:50 PM
Time Spent:	00:20:27
IP Address:	142.190.83.58

Page 1

Q1

Which, if any, of these stakeholder groups do you represent (check all that apply)?

Resident

Q2

Referring to the list of values above, what are the top three issues the Dauphin Island WMP should focus on?

Long term sustainability for the Island, the residents and the water Quality.

Q3

Are there certain cultural, historic, or environmental sites or resources that should be protected on the Island?

There are those type sites on the Island and I di think they need to be protected.

Q4

Do you think the condition of the Island is better or worse today compared to how you first remember it? If worse, what do you feel are the primary causes?

I think worse. The Island seems to be much smaller than what I remember. I think when you dredge the ship channel that material should be utilized on the North ans South side of the Island

Q5

In your opinion, does the environmental quality of the Island need to be improved? If yes, what are the key issues needing attention now?

Yes. I believe the roadside ditches should should be Piped and back filled and grassed.

Q6

What do you believe are the biggest threats to management, planning, and restoration on the Island?

Government Bureaucracy.

Q7

What is your ideal vision for Dauphin Island ten years from now?

An Island that my wife, children,grand children and friends can come and enjoy the quality of the air,water, fishing and environment.

#7

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Monday, March 29, 2021 3:03:27 PM
Last Modified:	Monday, March 29, 2021 3:07:20 PM
Time Spent:	00:03:52
IP Address:	170.249.179.138

Page 1

Q1

Which, if any, of these stakeholder groups do you represent (check all that apply)?

Resident

Q2

Referring to the list of values above, what are the top three issues the Dauphin Island WMP should focus on?

beaches and shore line, resilience, access

Q3

Are there certain cultural, historic, or environmental sites or resources that should be protected on the Island?

all need protecting

Q4

Do you think the condition of the Island is better or worse today compared to how you first remember it? If worse, what do you feel are the primary causes?

worse!!!!

Q5

In your opinion, does the environmental quality of the Island need to be improved? If yes, what are the key issues needing attention now?

sea level rise

Q6

What do you believe are the biggest threats to management, planning, and restoration on the Island?

cost

Q7

What is your ideal vision for Dauphin Island ten years from now?

return beaches and shorelines to 30 years age

#8

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Tuesday, March 30, 2021 7:52:00 AM
Last Modified:	Tuesday, March 30, 2021 8:24:21 AM
Time Spent:	00:32:20
IP Address:	199.187.143.130

Page 1

Q1

Which, if any, of these stakeholder groups do you represent (check all that apply)?

Business owner/operator,

Other (please specify):

Dauphin Island Heritage and Arts Council, Inc., 501(c) 3 entity

Q2

Referring to the list of values above, what are the top three issues the Dauphin Island WMP should focus on?

Environmental health and resilience
Heritage and culture including fish and wildlife
Water quality

Q3

Are there certain cultural, historic, or environmental sites or resources that should be protected on the Island?

Shell Mound Park
Fort Gaines
Sand Island Lighthouse
Major birding sites

Q4

Do you think the condition of the Island is better or worse today compared to how you first remember it? If worse, what do you feel are the primary causes?

Better in many ways, but worse primarily because of erosion of west end, intense development and reconstruction

Q5

In your opinion, does the environmental quality of the Island need to be improved? If yes, what are the key issues needing attention now?

Recycling program
Loss of land and marshes
Loss of wildlife habitat and plants

Q6

What do you believe are the biggest threats to management, planning, and restoration on the Island?

Increased population
Lack of resources - funds and personnel
Indifference

Q7

What is your ideal vision for Dauphin Island ten years from now?

- Pristine, undeveloped west end - bird / wildlife sanctuary
- Thriving economy through completion of the Aloe Bay development and similar projects in keeping with the character of the Island
-Increased public awareness, respect for, and interest in the Island's rich heritage and culture

#9

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Tuesday, March 30, 2021 8:17:04 AM
Last Modified:	Tuesday, March 30, 2021 8:38:49 AM
Time Spent:	00:21:45
IP Address:	107.77.233.189

Page 1

Q1

Which, if any, of these stakeholder groups do you represent (check all that apply)?

Resident,

Elected Official

Q2

Referring to the list of values above, what are the top three issues the Dauphin Island WMP should focus on?

Beaches and Shorelines
Environmental Health and Resilience
Water Quality

Q3

Are there certain cultural, historic, or environmental sites or resources that should be protected on the Island?

Bird Sanctuary and Lake
Shell Mounds
Fort Gaines
Goat Trees

Q4

Do you think the condition of the Island is better or worse today compared to how you first remember it? If worse, what do you feel are the primary causes?

Better from a standpoint of quality of life, cleanliness, services provided, amenities and more. Worse from an environmental and resiliency perspective caused in part by repeat storms/hurricanes, erosion, accelerated growth (new home construction) leading to deforestation, etc.

Q5

In your opinion, does the environmental quality of the Island need to be improved? If yes, what are the key issues needing attention now?

Combat coastal erosion and degradation, address/mitigate tree loss, protect dunes and critical habitats. Mother Nature can only do so much on her own.

Q6

What do you believe are the biggest threats to management, planning, and restoration on the Island?

Hurricanes, sea level rise, development, costs, buy-in, ability to collaborate with various island entities.

Q7

What is your ideal vision for Dauphin Island ten years from now?

That the community will be fiscally and physically sound and resilient. Maintaining the identity, charm and qualities that residents and visitors have come to enjoy.

#10

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Tuesday, March 30, 2021 10:01:15 AM
Last Modified:	Tuesday, March 30, 2021 10:19:11 AM
Time Spent:	00:17:56
IP Address:	192.208.140.68

Page 1

Q1

Which, if any, of these stakeholder groups do you represent (check all that apply)?

Property Owner, but not a Resident,

Other (please specify):

Work on another project on the island and generally support the Town around SLR technical support when I can

Q2

Referring to the list of values above, what are the top three issues the Dauphin Island WMP should focus on?

1) Stormwater management - the stormwater system is continuing to lose functionality as seas rise. This is causing access, water quality, and environmental resilience issues.

2)Balanced development/growth - the east end is growing very fast, and I know we need to balance property rights and tax base needs with environmental and resilience concerns. Coupled with this is a need for growth that considers the individual and cumulative environmental impact of each new build (e.g., LID etc. I think there are already some good strides towards this with the tree ordinances etc.)

Those are the two that I'm particularly concerned with that I don't feel like are being explicitly addressed there are other concerns affiliated with sea-level rise (e.g., salt water intrusion, erosion, etc.) and the impact of hurricanes; however, there is a lot of work on going in those areas right now so maybe we could simply highlight present those efforts?

Q3

Are there certain cultural, historic, or environmental sites or resources that should be protected on the Island?

The fort, goat trees, and the shell mounds for cultural/historic. I also think the marshes around the north side of the island are an important environmental resource for recreation and protection. Also the dunes are critically important for protection.

Q4

Do you think the condition of the Island is better or worse today compared to how you first remember it? If worse, what do you feel are the primary causes?

Worse - little dauphin island is getting very small very fast. To me that is a canary in the coal mine in terms of showing the pressures on the island. Additionally, as it continues to disappear it leaves a large portion of the north of the island vulnerable. I think little dauphin is worse in part because of rising seas and storms. I would imagine recreational boating may have had an impact and the inability (until recently) to do restoration.

Also stormwater drainage has gotten so much worse and the stuff in it is gross. I think part of that is the system and I think part of that is sea-level rise. I think it's a good opportunity to start investigating NNBFs that could help with stormwater reduction.

Q5

In your opinion, does the environmental quality of the Island need to be improved? If yes, what are the key issues needing attention now?

Not necessarily improved - it's pretty great, but I feel like we're on the verge of a tipping point with the rate of development and rising seas. I want to make sure that these things are being balanced so that we don't start to see things degrade at a rapid pace.

Q6

What do you believe are the biggest threats to management, planning, and restoration on the Island?

Funding; challenges from those who have not yet built on their lots if the management/planning choices make it harder more expensive or limit when they can build. I also think that rising seas make all of this a bit more challenging - because we will need to get out of the box to think creatively about how to set ourselves up to live with water differently.

Q7

What is your ideal vision for Dauphin Island ten years from now?

Still quiet, still a small town feel, still a place to go and feel close to nature in many different ways - I can paddle in a marsh, lounge on a beach, or stroll through a maritime forest. It's amazing diversity in such a small stretch of land.

#11

COMPLETE

Collector: Web Link 1 (Web Link)
Started: Tuesday, March 30, 2021 10:44:16 AM
Last Modified: Tuesday, March 30, 2021 11:12:22 AM
Time Spent: 00:28:06
IP Address: 170.249.179.138

Page 1

Q1

Which, if any, of these stakeholder groups do you represent (check all that apply)?

Resident,

Business owner/operator,

Other (please specify):

Pres. Dauphin Island Bird Sanctuaries, Inc

Q2

Referring to the list of values above, what are the top three issues the Dauphin Island WMP should focus on?

Habitat Acquisitions and protection
Watershed protection, storm water runoff
Promotion of ecotourism

Q3

Are there certain cultural, historic, or environmental sites or resources that should be protected on the Island?

Protection of as much Tupelo/mixed maritime forest habitat and invasive species removal and control. A Working Waterfront should reflect the unique history and culture of the island.

Q4

Do you think the condition of the Island is better or worse today compared to how you first remember it? If worse, what do you feel are the primary causes?

Worse. Over development, clear-cutting of residential lots.

Q5

In your opinion, does the environmental quality of the Island need to be improved? If yes, what are the key issues needing attention now?

Yes. Purchase properties for green space and essential habitat required for migratory and residents birds animals and plants.

Q6

What do you believe are the biggest threats to management, planning, and restoration on the Island?

Rapid development, clear-cutting of maritime forest.

Q7

What is your ideal vision for Dauphin Island ten years from now?

Dauphin Island is rich in animal and plant species and procurement of important wildlife habitat, especially on the island's eastern is essential Dauphin Island must retain its biological diversity. The island has been designated a Globally Important Bird area, and significant habitat purchase, invasive species removal, primary dune protection, are are critical for Dauphin Island's long-term ecological future.

#12

COMPLETE

Collector: Web Link 1 (Web Link)
Started: Wednesday, March 31, 2021 9:26:59 AM
Last Modified: Wednesday, March 31, 2021 9:57:00 AM
Time Spent: 00:30:00
IP Address: 170.249.179.138

Page 1

Q1

Which, if any, of these stakeholder groups do you represent (check all that apply)?

Resident

Q2

Referring to the list of values above, what are the top three issues the Dauphin Island WMP should focus on?

beaches and shorelines, fish and wildlife, heritage and culture

Q3

Are there certain cultural, historic, or environmental sites or resources that should be protected on the Island?

yes, but too many to name here

Q4

Do you think the condition of the Island is better or worse today compared to how you first remember it? If worse, what do you feel are the primary causes?

better

Q5

In your opinion, does the environmental quality of the Island need to be improved? If yes, what are the key issues needing attention now?

Environmental quality of DI warrants continued protection. Shoreline erosion, coupled with subsidized re-development of vulnerable properties will remain a key issue, and related impacts will worsen with climate change.

Q6

What do you believe are the biggest threats to management, planning, and restoration on the Island?

Short-term, reactionary measures to "immediate" crises take priority, but may not reflect overall long-term needs.

Q7

What is your ideal vision for Dauphin Island ten years from now?

A coastal community that remains a wonderful place to live and visit because its environmental attributes have been maintained and improved, not diminished by poor development choices.

#13

COMPLETE

Collector: Web Link 1 (Web Link)
Started: Wednesday, March 31, 2021 11:12:02 AM
Last Modified: Wednesday, March 31, 2021 11:34:14 AM
Time Spent: 00:22:12
IP Address: 107.77.233.59

Page 1

Q1

Which, if any, of these stakeholder groups do you represent (check all that apply)?

Agency Representative

Q2

Referring to the list of values above, what are the top three issues the Dauphin Island WMP should focus on?

After reconciling the described purpose of WMP's with the NEP's values my top value is obviously water quality. All the others are sub-sets of water quality. However, if you are simply asking what I believe are the most issues facing DI under the NEP values then it would be fish and wildlife (birds), beaches and shorelines (access is part of this) and heritage and culture.

Q3

Are there certain cultural, historic, or environmental sites or resources that should be protected on the Island?

All the DIBs properties, and Park and Beach Board properties. The bird sanctuary is already under a conservation easement which will make it very difficult for any of the property to be developed. The DI golf course should also be protected because it a large track of land that provides wildlife habitat and water storage.

Q4

Do you think the condition of the Island is better or worse today compared to how you first remember it? If worse, what do you feel are the primary causes?

My horizon is 20 yrs so I would say it worse from the standpoint of development on the south side of Bienville on the west end, fewer trees, less beach access and no improvement for boating access when considering there are more boats now than 20 yrs ago. The primary causes in my opinion is lack of commitment for addressing the problems.

Q5

In your opinion, does the environmental quality of the Island need to be improved? If yes, what are the key issues needing attention now?

Reforestation....if you can spend millions on putting sand back on the beaches then it stands to reason that resources should be devoted to planting more trees and wildlife friendly habitat.

Q6

What do you believe are the biggest threats to management, planning, and restoration on the Island?

The town needs more staff with the expertise to work on the problems. For example, a full time forester and flood plane manager would benefit the residents and tourists who visit the Island.

Q7

What is your ideal vision for Dauphin Island ten years from now?

Aa viable working waterfront community that has more will have significantly more trees and residents and leaders work together instead of blaming other groups for the problems the the Island has.

#14

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Friday, April 02, 2021 7:58:55 AM
Last Modified:	Friday, April 02, 2021 8:07:34 AM
Time Spent:	00:08:39
IP Address:	140.194.40.6

Page 1

Q1

Which, if any, of these stakeholder groups do you represent (check all that apply)?

Agency Representative

Q2

Referring to the list of values above, what are the top three issues the Dauphin Island WMP should focus on?

Water quality, environmental health and resilience, and beaches and shorelines

Q3

Are there certain cultural, historic, or environmental sites or resources that should be protected on the Island?

Fort Gaines, valuable east end habitats in bird sanctuary, Little Dauphin Island, Graveline marsh

Q4

Do you think the condition of the Island is better or worse today compared to how you first remember it? If worse, what do you feel are the primary causes?

Worse. Development, predominately on the west end, and storms are the causes.

Q5

In your opinion, does the environmental quality of the Island need to be improved? If yes, what are the key issues needing attention now?

Yes. Key issue is a long term funding source to not only construct but maintatin/renourish the numerous restoration projects that have already been identified for the island.

Q6

What do you believe are the biggest threats to management, planning, and restoration on the Island?

Long term funding

Q7

What is your ideal vision for Dauphin Island ten years from now?

Many of the already identified restoration projects are implemented with a strategic plan to monitor their success and a funding source to maintain them for the long-term.

#15

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Friday, April 02, 2021 11:45:18 AM
Last Modified:	Friday, April 02, 2021 11:59:42 AM
Time Spent:	00:14:24
IP Address:	23.167.96.227

Page 1

Q1

Which, if any, of these stakeholder groups do you represent (check all that apply)?

Resident

Q2

Referring to the list of values above, what are the top three issues the Dauphin Island WMP should focus on?

Environmental Health and Resilience
Fish and Wildlife
Heritage and Culture

Q3

Are there certain cultural, historic, or environmental sites or resources that should be protected on the Island?

Dunes; Fort; Shell mounds; wildlife preserves

Q4

Do you think the condition of the Island is better or worse today compared to how you first remember it? If worse, what do you feel are the primary causes?

The old Isle Dauphine due to neglect and lack of funds

Q5

In your opinion, does the environmental quality of the Island need to be improved? If yes, what are the key issues needing attention now?

Recycling (island wide)

Q6

What do you believe are the biggest threats to management, planning, and restoration on the Island?

Need a strong central entity like the town to control a public amenities

Q7

What is your ideal vision for Dauphin Island ten years from now?

like it is with better amenities and restaurants. Family friendly, retiree friendly

#16

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Thursday, April 01, 2021 5:02:43 PM
Last Modified:	Friday, April 02, 2021 2:03:28 PM
Time Spent:	21:00:44
IP Address:	69.29.167.38

Page 1

Q1

Which, if any, of these stakeholder groups do you represent (check all that apply)?

Resident,

Business owner/operator

Q2

Referring to the list of values above, what are the top three issues the Dauphin Island WMP should focus on?

Water Quality
Beach and Shorelines
Environmental Health and Resilience

Q3

Are there certain cultural, historic, or environmental sites or resources that should be protected on the Island?

Being a small island, all of the above should have great attention paid to them.

Q4

Do you think the condition of the Island is better or worse today compared to how you first remember it? If worse, what do you feel are the primary causes?

In regards to the physical health of the island, I feel it is worse due to erosion and lack of funding for restoration. Environmentally, the awareness has greatly improved.

Q5

In your opinion, does the environmental quality of the Island need to be improved? If yes, what are the key issues needing attention now?

As stated in Question 4, I feel we have improved environmentally yet still have a great amount of work to do. The construction boom is removing much of the trees and root systems which is concerning. I believe construction should also pay attention to permeability.

Q6

What do you believe are the biggest threats to management, planning, and restoration on the Island?

Funds and climate change.

Q7

What is your ideal vision for Dauphin Island ten years from now?

Smart growth needs to be taken into consideration to preserve the character of Dauphin Island and create a stronger sustainable framework.

#17

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Monday, April 05, 2021 12:20:42 PM
Last Modified:	Monday, April 05, 2021 12:26:20 PM
Time Spent:	00:05:38
IP Address:	75.120.82.29

Page 1

Q1

Which, if any, of these stakeholder groups do you represent (check all that apply)?

Resident,

Agency Representative

Q2

Referring to the list of values above, what are the top three issues the Dauphin Island WMP should focus on?

Water Quality, Enviro Health & Resilience, Beach & Shoreline

Q3

Are there certain cultural, historic, or environmental sites or resources that should be protected on the Island?

Audubon Bird Sanctuary and Goat Trees

Q4

Do you think the condition of the Island is better or worse today compared to how you first remember it? If worse, what do you feel are the primary causes?

Lots of concern surrounding clear cutting of lots and impervious structure going in.

Q5

In your opinion, does the environmental quality of the Island need to be improved? If yes, what are the key issues needing attention now?

Clear cutting of lots and invasive species management

Q6

What do you believe are the biggest threats to management, planning, and restoration on the Island?

Balancing economic growth with environmental conservation.

Q7

What is your ideal vision for Dauphin Island ten years from now?

Continued small town living with greater conservation

APPENDIX B2

Preliminary Public Outreach Survey, September 8, 2016

Mississippi Sound-Portersville Bay Watershed Complex

Dauphin Island Stakeholder Survey

The purpose of this survey is to help us better understand what you and other members of the community think about the current and future health of the Dauphin Island ecosystems in context to the greater **Mississippi-Sound-Portersville Bay Watershed Complex**. Your ideas and comments are very important. Use the extra sheets that are provided should you need additional space.

Which of the following Dauphin Island stakeholder group(s) do you represent?

____ Resident ____ Property owner but not a resident ____Business owner/operator
____ Other(s) (Specify) _____
____ Please identify your city/town of residence_____

TOPIC: Environmental Health and Resiliency, Fish, Habitats, Shorelines

1. In your opinion, are the different ecosystems that exist on **Dauphin Island** (marshes, dunes, pine stands, beaches, etc.) important to the ecological health, commercial vitality and community resiliency of the island? ___Yes ___No ___Don't Know
   If "yes", please explain_____
   _____
   _____

2. In your opinion, are these same ecosystems on **Dauphin Island** also important to the ecological health, commercial vitality and community resiliency **of the entire Mississippi Sound-Portersville Bay Watershed Complex?** ___Yes ___No ___Don't Know
   If "yes", please explain_____
   _____
   _____

3. Rank in order of importance *("1" being the most important*) the following features of Alabama's coastal marsh areas as found in the **Mississippi Sound-Portersville Bay Watershed Complex, including Dauphin Island.**

   ____ Serves as a nursery for young marine life *(shrimp, crabs and finfish)*
   ____ Provides for storm water runoff treatment *(removing organic matter and recycling important elements)*
   ____ Provides buffer protection from the impact of storms by temporarily dissipating rainwater discharge, tidal action and wave action
   ____ Provides a source of recreational fishing, boating, swimming, and bird watching, etc.
   ____ Provides transportation routes through the marsh areas for boaters & marine commerce.
   ____ Other _____

4. How would you describe the environmental condition and long-term stability of **Dauphin Island** today? _____
   _____

5. How would you describe the environmental condition of the **Mississippi Sound-Portersville Bay Watershed Complex, including Dauphin Island**, today compared to when you first remember it?
   ____ Better ____ About the same ____ Worse
   If "worse," please explain _____
   _____
   _____

6. In your opinion, what are the most important things we should consider doing RIGHT NOW that could help keep the **Mississippi Sound-Portersville Bay Watershed Complex, including Dauphin,** healthy in the future? *(i.e. property acquisition for preservation and restoration, etc.)*

_____

_____

TOPIC: Access

7. In your opinion, do recreational opportunities in the **Mississippi Sound-Portersville Bay Watershed Complex, including Dauphin Island**, need to be improved or expanded?
____Yes ____No ____Don't Know

TOPIC: Culture & Heritage

8. What are the cultural, historic or environmental sites or resources on Dauphin Island that deserve special protection? *(i.e. certain churches, cemeteries, etc.)* _____

_____

_____

TOPIC: Water Quality

9. In your opinion, does the water quality in the **Mississippi Sound-Portersville Bay Watershed Complex, including Dauphin Island,** need improvement? ____ Yes ____ No ____Don't know
If "Yes," what are the most important issues that need attention? _____

_____

_____

10. What do you think are the biggest threats to environmental management, planning and restoration on **Dauphin Island**? (*i.e. community awareness of problems, etc.)* _____

_____

_____

11. What do you think are the biggest threats to environmental management, planning and restoration of the combined **Mississippi Sound-Portersville Bay Complex, which includes Dauphin Island***?* _____

_____

_____

Other Comments

12. Please provide any other comments, concerns, or suggestions you feel would benefit the gathering of information relative to the **Mississippi Sound-Portersville Bay Watershed Complex and Dauphin Island.** _____

_____

_____

_____

_____

_____

_____

_____

_____

Dauphin Island Watershed Management Plan
Community Outreach Effort

Results of On-line Survey as of October 2, 2016

- ***Question 1. Do you live on Dauphin Island?***

RESPONSES

- Total Stakeholders ……..42
- Resident Stakeholders……25
- Non-Resident Stakeholders……17

- ***Question 2. If you marked "yes" How long have you lived on the island?***

RESPONSES

- 0-5 years……47 %
- 6-10 years……12 %
- 11-15 years……..12 %
- Over 16 years ……..29 %

- ***Question 3. What do you think are the top three things that are most important about the various natural environments of Dauphin Island? (Examples might include providing nurseries for young animals, public access, serving as a buffer during storms, etc.)***

RESPONSE AREA **RESPONSES**

- Buffer for storm protection for coastal communities in the Mississippi Sound ecosystems ……21
- Natural habitat/nurseries for fish, shrimp, crabs, etc. ……21
- Support for indigenous and migratory wildlife ……18
- Natural, unspoiled and replenished beaches ……15
- Public access …….. 8
- Protection for the Mississippi Sound fisheries …… 8
- Economic generator (recreation, fishing, tourism, etc.) ……..5
- Pine woods …… 3
- Keeping large corporate interest off the island to keep local control of the environment …… 3
- Turtles …… 3
- Protecting freshwater lake from saltwater encroachment …. 2
- Water quality ……..2
- Drainage issues that help breed mosquitos…….. 1
- Research conducted by DISL …… 1
- Eliminate airstrip …… 1
- Historical areas …….. 1

❖ ***Question 4. Are there certain cultural, historic or environmental sites or resources on Dauphin Island that you think deserve special protection? If so, please identify them. (Examples might include churches, schools, parks, cemeteries, birding areas, etc.)***

RESPONSE AREA **RESPONSES**

- Audubon Bird Sanctuary and Birding Areas …… 26
- Fort Gaines …….. 17
- Shell Mounds …… 10
- Public Beaches …….. 8
- Isle Dauphine Complex (Club) including golf course …… 7
- Cemeteries …… 5
- Turtle nesting dunes/natural dunes …… 4
- Marine life habitats …… 4
- All parks …….. 4
- Marshes …….. 4
- Living dune systems …….. 3
- Little Red School House …… 3
- Indigenous animals …… 3
- West end …….. 2
- Maritime forest …… 2
- Dauphin Island Sea Lab …… 2
- Shoreline restoration …….. 2
- Goat trees …….. 1
- Aloe Bay Landing Park ……..... 1
- Churches …….. 1
- Lighthouse …… 1

❖ ***Question 5. How would you describe the environmental condition of Dauphin Island TODAY compared to when you first remember it?***

RESPONSES

- It is Better……10%
- It is About the Same……..20%
- It is Worse……70%

❖ ***Question 6. if you marked "worse" to question #5, why do you think the environmental condition of Dauphin Island is worse today?***

RESPONSE AREA **RESPONSES**

- South side beach erosion caused by a) Corps of Engineers maintenance dredging, b) crabbers and jet skis, c) Sand Island infill, d) lack of Federal and state support for beach nourishment, e) economics of the State and Port Authority……..17
- West end system disrupted……... 9
- Increased human intervention and development/loss of trees……. .6
- Deepwater Horizon oil spill…… 5
- Litter…… 5
- Loss of wetlands…… 2
- Diminished habitat for sea turtles and other wildlife……2
- Oil Rigs…….. 1
- Poor water quality…… 1

❖ Question 7. In your opinion, does the environmental condition of Dauphin Island need to be improved?

RESPONSES

- Yes ……83 %
- No…… 5 %
- Don't Know ……..12 %

❖ ***Question 8. If you marked "yes" to question #7, what are the most important environmental issues that need attention? (Examples might include improved pollution controls, stakeholder education, surface water management, etc.)***

RESPONSE AREA **RESPONSES**

- Shoreline restoration/beach nourishment ……..……11
- Surface water management ……..... 6
- Acknowledgement that DI is a special environmental place that should be protected ……..…….. 5
- Pollution control …… 4
- Property owner education concerning environmental matters…….. 4
- Eliminate further loss of trees and natural vegetation/trees…….. 4
- Recycling and trash disposal control, anti-liter strategies…… 3
- Erosion management ……..... 2
- Protection for birding areas ……..……..…2
- Advanced Town Planning relative to demands on resources ……. 2
- Improve and enforce zoning ordinances …….. 2
- Eliminate sea walls ……... 2
- Better control of jet skis…… 1
- Education for Federal and State decision makers…….. 1
- Improve wastewater treatment facility…… . 1
- Reduce invasive vegetative species ……..… 1
- Aquifer protection …… 1
- Insect management …… 1
- Oil rigs ……..... 1
- Light pollution during turtle nesting season……..… 1
- Eliminate further sand -borrow sites……..… 1
- Replace rip-rap with marshes …….. 1
- Eliminate feral cats …… 1

❖ ***Question 9. What do you think are the biggest threats to successful environmental planning and restoration on Dauphin Island?***

RESPONSE AREA **RESPONSES**

- Corps of Engineers not revising its maintenance practices ……. 8
- Money …….. 8
- Unwillingness to put the environmental interests of the island ahead of tourist interests …….. 7
- Town of DI enforcing local ordinances …… 7
- Corps of Engineers not correcting historical sand deficit on south side …….. 6
- Lack of interest on the part of State and Federal decision Makers …….. 6
- Development/construction …….. 5
- Lack of education by property owners …….. 5
- Too many non-full time resident owners …….. 5
- Failure to plan ahead ……..... 4
- Lack of proper lobbying efforts …….. 3
- Shoreline destruction …… 3
- Litter …… 3
- Barrier island ignorance ……..... 2
- Unsustainable exploitation of resources …….. 2
- Large storms …….. 1
- Competing Interest ……..... 1
- Oil Rigs …… 1
- Armoring of personal properties …… 1
- Determination by some to bring large scale development to the island ……..1

❖ ***Question 10. Do you, your family or friends use the natural resources of Dauphin Island for any of the following recreational purposes?***

RESPONSES

- Fishing/Crabbing……80 %
- Walking/Hiking ……..95 %
- Canoeing/Kayaking……...60 %
- Boating……70 %
- Nature Observation……90 %
- Swimming……83 %
- Other……26 %
- No Recreational Use ……. 0 %

❖ ***Question 11. In your opinion, do recreational opportunities on Dauphin Island need to be improved or expanded?***

RESPONSES

- Yes …… 54 %
- No…….. 33 %
- Don't Know..,…… 13 %

❖ ***Question 12. Imagine Dauphin Island ten (10) years from now. What would you want it to look like?***

RESPONSE AREA	**RESPONSES**
Stable dune and beach structure of 250 – 300 ft. ……	7
Island restored to safe standards for humans and wildlife……	7
Emphasis on sustainability rather than growth ……..……	6
More marshes and protected areas……..……6	
Better beach access for public……	5
Looks like it did before Katrina ……..	5
World class nature preserve/better tree management ……	5
More public marinas and launches..……	4
Little commercialism ……...	4
No litter ……..	4
Town, Park and Beach Board and Property Owners' Association working together……..…	4
Protection for sea turtles and other wildlife ……	3
More access to beaches ……	3
No more cut throughs in dunes for development of subdivisions….	3
More permanent residents that appreciate the benefits of the Island ……...	3
Houses on west end slowly eliminated by natural processes and then no more rebuilding ……..…...	3
Quaint, small community like Fairhope but not Gulf Shores.……	3
No more development ……	2
Restored west end……..… …2	
Erosion from dredging corrected ……..	2
No oil rigs ……..2	
Not crowded ……	2
Minimal commercialism ……..	2
Less development on the west end ……..	2
No bulkheads……..…	2
West end vacated and made into a park..……1	
More successful small business enterprises……..……..1	
Removal of mosquito breeding surface water areas ……	1
Fishing pier over water……1	
Robust, well planned working waterfront……..1	

- Historic buildings protected……1
- West end converted to public beach …….. 1
- Better water drainage…….. 1
- Thriving tourist destination…….. 1
- No corporate hotels …….. 1

❖ ***Question 13. In your opinion, what are the most important things we should consider RIGHT NOW that could help protect the natural resources on Dauphin Island for the future?***

RESPONSE AREA **RESPONSES**

- Demand that the Corps of Engineers restore beach erosion caused by dredging/ shoreline restoration…… 19
- Enforce protection ordinances/ no litter policy …… 6
- Enact state laws to address Corps of Engineers dredging……. 4
- Stop or minimize all development …… 3
- Environmental awareness education especially with visitors ……. 3
- Protect the dunes/ Walkways to beaches to protect dunes …… 2
- Buy land for conservation ……..2
- Develop a restoration plan ……... 2
- Find somewhere else for the oil companies to go ……2
- Develop offshore jetties to protect coastline…….. 2
- Rezoning to protect fragile areas ……... 2
- Requite the Port Authority to fund beach nourishment…… 2
- Eliminate bulkheads ……..…2
- Create unbiased goals and objectives for the restoration of DI……1
- Create better drainage ……...1
- Find money for project of the beaches, lighthouse ……1
- Wastewater upgrades ……1
- Eliminate Erosion ……...1
- Buy out west end property owners ……..1

❖ ***Question 14. Please give us any other comments, concerns, or suggestions you may have concerning Dauphin Island.***

RESPONSE AREA	RESPONSES
• Need Federal and State governmental agencies to make DI a priority ……	1
• Surface water and its management are major factors …….....	1
• Need better protection for the causeway leading to the bridge ……	1
• Very hard to enjoy the island any more due to commercialization and visitors ……	1
• Dredging practices have destroyed the island's ability to regenerate itself ……	2
• Partner with Bellingrath Gardens or Auburn and use part of the island to grow native plants and shrubs ……	1
• Convert the golf course into an ecological sanctuary with walking trails ……....	1
• Protect rental properties on the west end because they generate much of the island's income ……	1
• More planting of natural grasses on west end to help with erosion…	1
• The POA is a barrier to economic development of the island ……..…	1
• Need to build more congressional support ……..	1
• The watershed study is a good start! …… …	1
• DISL rules ……..……..	1
• Need long-term solutions instead of short term solutions ..……..	1
• The island must be replenished and maintained to protect fishing and wildlife ……..	1

❖ ***Would you like to be kept informed as the Dauphin Island study moves forward?***

RESPONSES
• Yes ……..55 %

APPENDIX B3

Alabama Deep Sea Fishing Rodeo Poll, July 17, 2021

Where is your favorite place in the Dauphin Island area?	What do you like least about coming to Dauphin Island?
red snapper reefs	rain
Silver Pearl gift shop	golf carts
Estuarium	condos/development
Ship n Shore	mud/drainage
Beach east of golf course	pay for parking
east end beach	nothing
east end beach	nothing
east end	not finding a house
Bird Sanctuary beach	lack of restrooms
Aloe Bay	trash cans at beach overflow
home	hurricane protection south of Bienville
cruising to Sand Island	Ship n Shore prices - need competition
	less tourists - more restaurants
Estuarium	Fear of commercialization
house	Negativity on FB pages - not welcoming new folks
St. Stephens Rd.	drainage
West end beach	drainage
Nautica's rest	flooding
Pelican Point	more pet friendly beaches
public beach	more beach - erosion
airport marsh - fishing	no more houses on west end
fishing	feral cats
West end beach	less traffic
Pirates	parking
Creek of Little Dauphin Island	parking
Estuarium	travel time
Estuarium	travel time
north of Katrina Cut	crowded
north of Estuarium	rain
public beach	rain
far west end	boat ramp parking
east end	bathrooms on east end
east end	more small restaurants
Bird Sanctuary	restaurants
St. Stephens beach	restaurants
my house	boar ramp parking

Where is your favorite place in the Dauphin Island area?	What do you like least about coming to Dauphin Island?
Sealab boardwalk	bigger Estuarium
marina and west end	restaurants
east end water watching	better traffic flow during events
offshore fishing	signage
fishing	boat launch parking
Katrina Cut	climate change
home	behavior
beach	campground development improvements
Holiday Isle	more restaurant availability and open longer
east end pier	more restaurants
beach	ADA mats
Pelican Pub	Uber/taxi/transport service
Rodeo site	traffic
beach	mosquitos
Fishing Rodeo (misting booths)	more parking
Food	more parking
Pirates	lack of restaurants
my house	no grocery store
my condo	better restaurants
campground	more parking
ferry	hurricanes
bay	more boat rentals
swimming	more food options
my home	Rodeo-too many people
West end beach	lack of boat ramps and parking
Bird Sanctuary	lower prices for 4wheeler rentals
friends beach house - like not commercialized	NA
beach access	lack of trash cans
Fort Gaines pier	becoming commercialized a little - a lot of people
kayaking	lacking trash cans
Pirates Bar and beach	more restaurants
east end beach	ferry line too long
Sand Island	make Sand Island an island again
snacks at Circle K	NA
Bridge views	more restaurants
beach	traffic

Where is your favorite place in the Dauphin Island area?	What do you like least about coming to Dauphin Island?
Fort Gaines pier	the pier is land locked
our house	beach erosion
my house	NA
my home	more restaurants
Pirates Cove	flooding/drainage
Hippie Fish	more restaurants
east end beach	garbage/trash
Bird Sanctuary	use of single-use plastics
Rodeo	heat
west end beach	more restaurants
my house	better drainage on Bienville Blvd.
Fort Gaines	NA
Rodeo	travel/drive
Pirates Cove	parking for residents and visitors
water access at beach	politics
Rodeo	parking
my house	sewer system smell/plumbing
public beach/Sand Island	visitor parking
Fort Gaines	danger of water/rip currents
campground	campground staff/politics and flooding
West end beach	water clarity
stay home	more restaurants
my property/home	need more public access
Indian Bay	add another boat ramp
west end	more grocery shopping
west end beach	drainage
west end	erosion
east end beach	drainage
bike trail	more access to east end
beach walks	water clarity
offshore fishing	more restaurants
West end beach	more restaurants
DISL	paying for public beach
St. Stephens St.	no parking for surfers
Sand/Cedar Island	Traffic
My house	not bicycle friendly

Where is your favorite place in the Dauphin Island area?	What do you like least about coming to Dauphin Island?
my home	more restaurants
family's home	more boat ramps
Aloe Bay	more boat ramps
For Gaines	nothing
a friend's home	sewage smell near bridge
Pirate Cove grill and Estuarium	locals
Billy Goat Hole	mosquitos and gnats
Rainbows restaurant	parking
west end fishing	griping from locals
my house	more night life
parent's home	boat launch parking
house	need higher bulkhead
golf course beach	fire restrictions
east end pier	east end water restrictions signage and public restrooms
potential house	none needed
Rodeo visits only	none needed
west end beach	visitors can't park on side streets
Pirates bar	more restaurants
my condo	more restaurants but less people
east end fishing at jetties	more restaurants
west end beach	build it up/sea level
West end beach	less trash on beach
west end beach	the drive
east end beach jetties	side street parking for visitors
St. Stephens St.	too expensive, pier at public beach
East End beach	no restrooms at east end beach
Rodeo	traffic
Pelican Pub	drainage issues
golf course beach	dog friendly areas/movie night
campground	less traffic
beach area on east end	more trash cans/keep ditches clear
public beach (dogs welcome)	getting here, lack of restaurants
east end	drainage
west end	weather
Estuarium/ferry	travel time

Where is your favorite place in the Dauphin Island area?	What do you like least about coming to Dauphin Island?
Pirates	east end
Bineda St.	boat traffic (high speed), drainage
public beach board walk	trash on public beach
west end tip	more launches
Lighthouse Bakery	distance to get here/everything closed too early
Lighthouse Bakery	the rain today
Beach-Little Blue Motel	rain today
fishing	sewage overflows and trash
East End	Boat launch and parking
Fishing	less tourists
East beach	golf course
Sound side	restaurants, tourist activities
natural beauty	development/no grocery store
Sand Island fishing	no fishing pier
sound side west end beach fishing	gold course
restaurants and fishing	not enough boat launces/too much development
restaurants	development of west end
west end beach	east end beach (the smell)
fishing	Billy Goat Hole parking - need shuttle
Billy Goat Hole	mosquitos/dredging LDI Sound
my friends house	no rainy days
less populated areas (side streets)	traffic
Fort Gaines	Shorten walk to beach
walking beach and bike trail	trailer parking/boat launches
Her Shop?	Speed limits back to 40
Her Shop?	no golf carts after dark
Branch of Cottage Hill Baptist Church	more parking for surfers
Pirates Cove	get rid of the condos
Bird Sanctuary	dirty river water
west end beaches	water color (river water)
west end beaches	launch at west end
west end beaches	parking
west end beach	fishing pier in sand
Cedar Point/Fort/Campground	over crowded
Bird Sanctuary	too many people
Pirates	more access to public beaches

Where is your favorite place in the Dauphin Island area?	What do you like least about coming to Dauphin Island?
Circle K	not enough nice restaurants
Aloe Bay side	more restaurants and hotel
golf course	parking
Pelican Point	more places to eat
friends house	hurricanes
Fort Gaines launch	not enough live bait
public beach	water under pier
Rigs	water under pier
Pirate Cove (Islander)	the people
Lafitte Bay	too many people
Pirates Cove	restaurants
Fort Gaines	parking
Fort Gaines/Pirates	restaurants
beach	water color
Pirates/DISL	move sewage like away form entrance to DI
marina	all good
marina	too over populated
Ship n Shore	more convenience stores
Rodeo	less people speeding
my condo	drainage system
Sand Island	tourists
beach	litter and paying for access
Bird Sanctuary	paying to park
Bird Sanctuary	hurricanes/resilience
my house	lack of bike paths
Fort Gaines	lack of topless/nude beaches
Lighthouse fishing	water quality
Pirates Cove	tourists
Bird Sanctuary	turning lane
west end beach	new residents
my home	no adherence to speed limits
west end beach	replenish beaches/sand management
my house	parking-residential/no parking
my house	erosion of shoreline at end of Desoto and boat launch at Aloe Bay
east end boat launch	not enough restaurants

Where is your favorite place in the Dauphin Island area?	What do you like least about coming to Dauphin Island?
west end tip fishing	more boat launch parking
west end beach	more trash cans
west end beach	ADA parking
west end beach	west end being compromised
public beach	travel/drive
bars	police
public beach	litter
Pirates Cove Bar	water clarity
Fort Gaines	limited parking on east end beach
Fort Gaines	not enough shops
Sand Island	the bridge
	lack of boat launches
	places to lock bike
Billy Goat Hole	Privatization of West End
Lafitte Bay	food options/another public pool
Beach - Semmes	more trash cans on beach
Bird Sanctuary	monitor trash on beach more
west end	pet bags refilled
home	bring sand back
fishing opportunities	parking and reclaim the sand, need more economic opportunity, but not like Gulf Shores, designated sea turtle areas
east end	drainage on west end
BBQ restaurant	the bridge
Fort and east end beach	
our home	better restaurants
west end vacation home	
public pool	more restaurants

APPENDIX B4

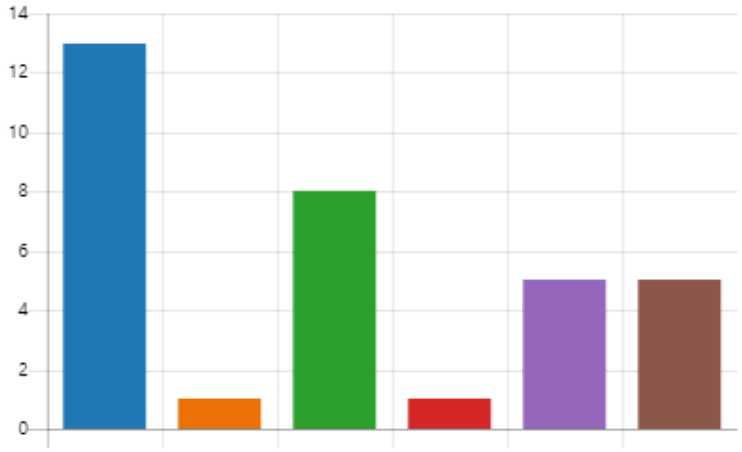
Dauphin Island Open House Meeting Poll, November 8, 2021

Dauphin Island Watershed Management Plan Open House

33 Responses 04:35 Average time to complete Active Status

1. Which stakeholder group do you represent?

Resident	13
Agency	1
Property owner, but not reside...	8
Business	1
Government	5
Other	5

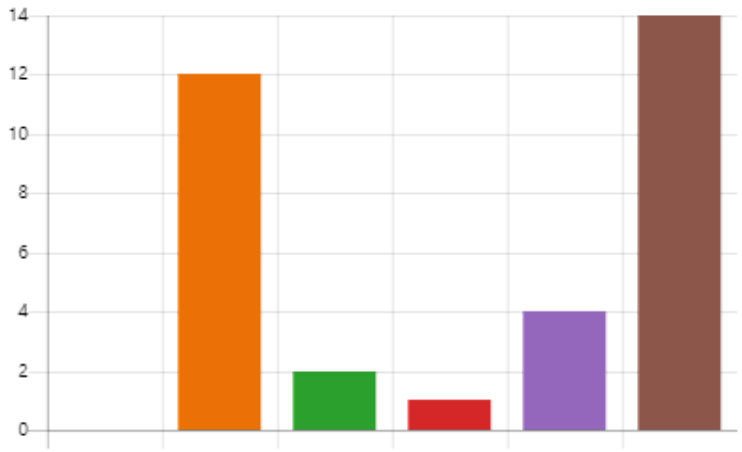


2. How long have you lived on or owned property on the Island?

<1 year	0
1-5 years	1
5-10 years	7
10-20 years	6
>20 years	7

3. In your opinion what is the most important issue on Dauphin Island?

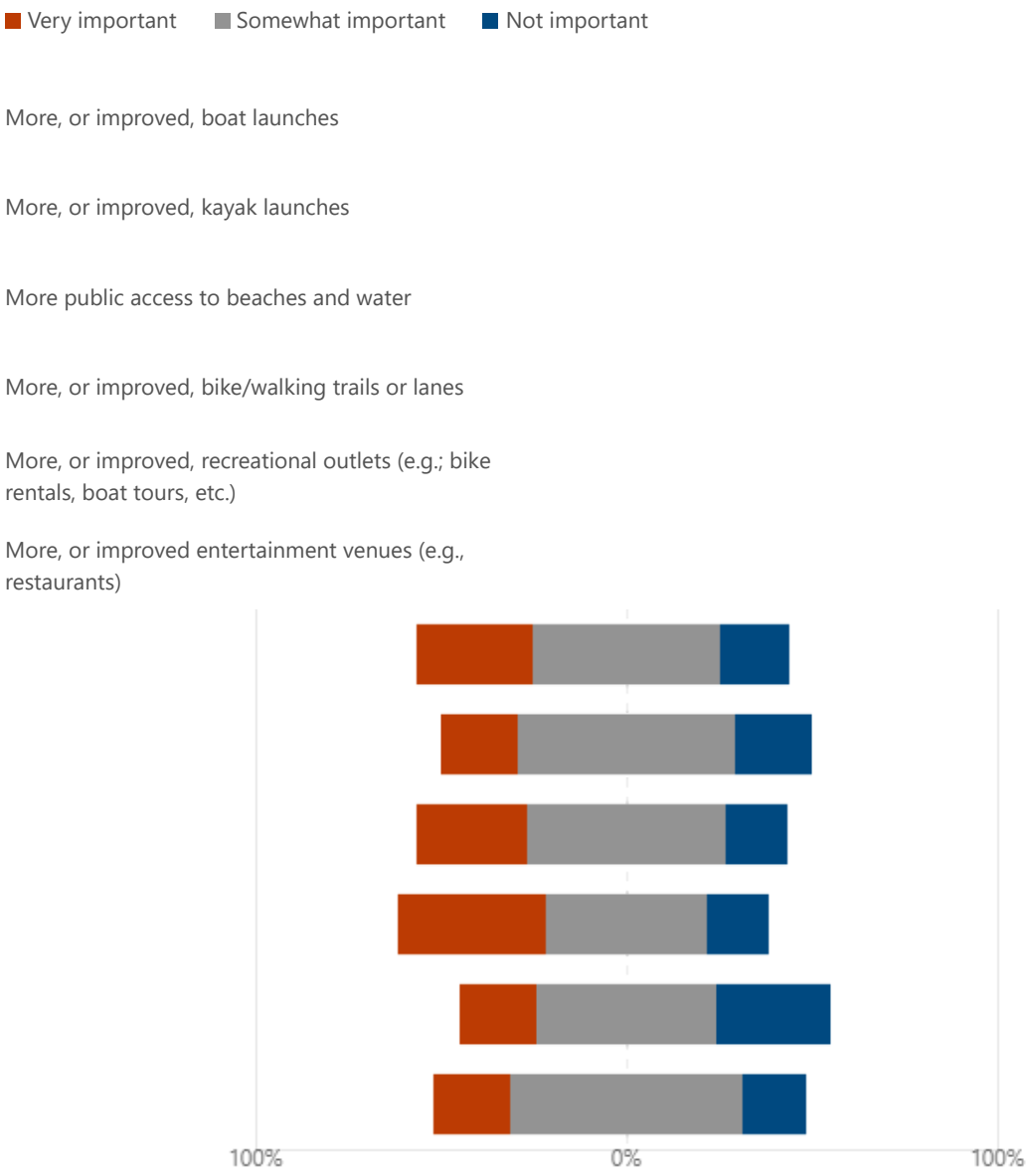
Water Quality	0
Environmental Health and Res...	12
Public Access	2
Culture and Heritage	1
Fish and Wildlife	4
Beaches and Shorelines	14



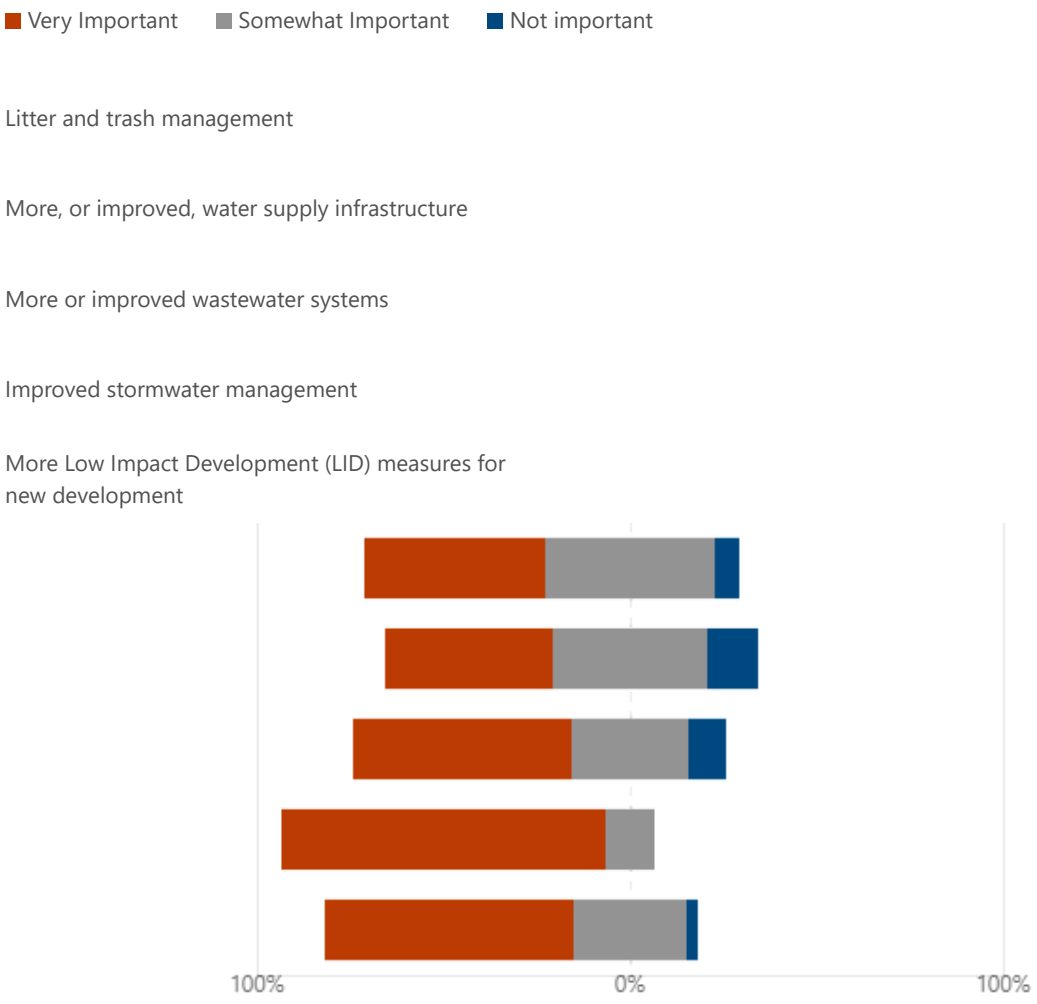
4. What do you determine as the dividing line between East End and West End

St. Stephens Street	5
Pelican Street	9
Water Tower	6
West End Public Beach	5
Perdido Street	7

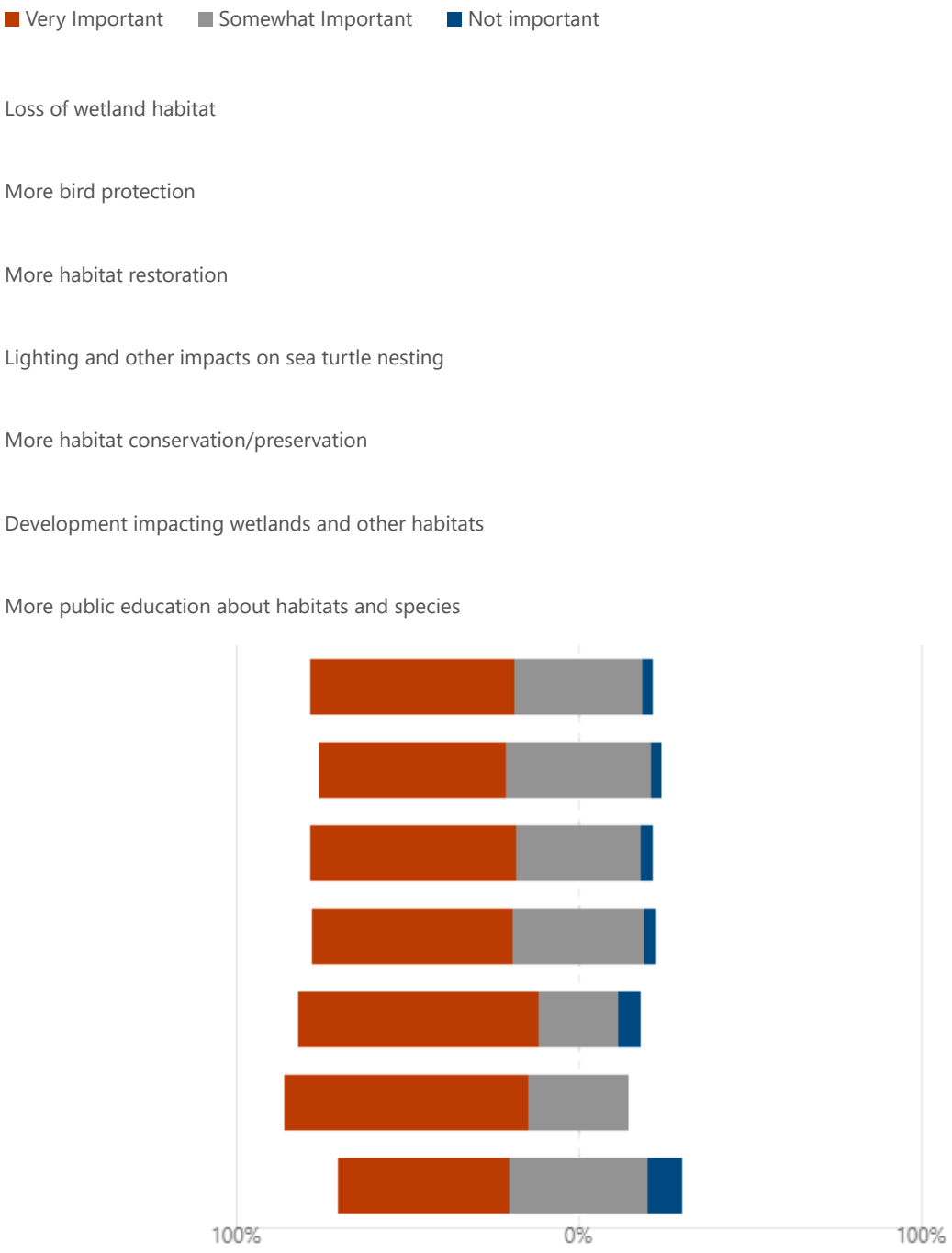
5. In your opinion, what are the most important issues affecting Public Access on DI?



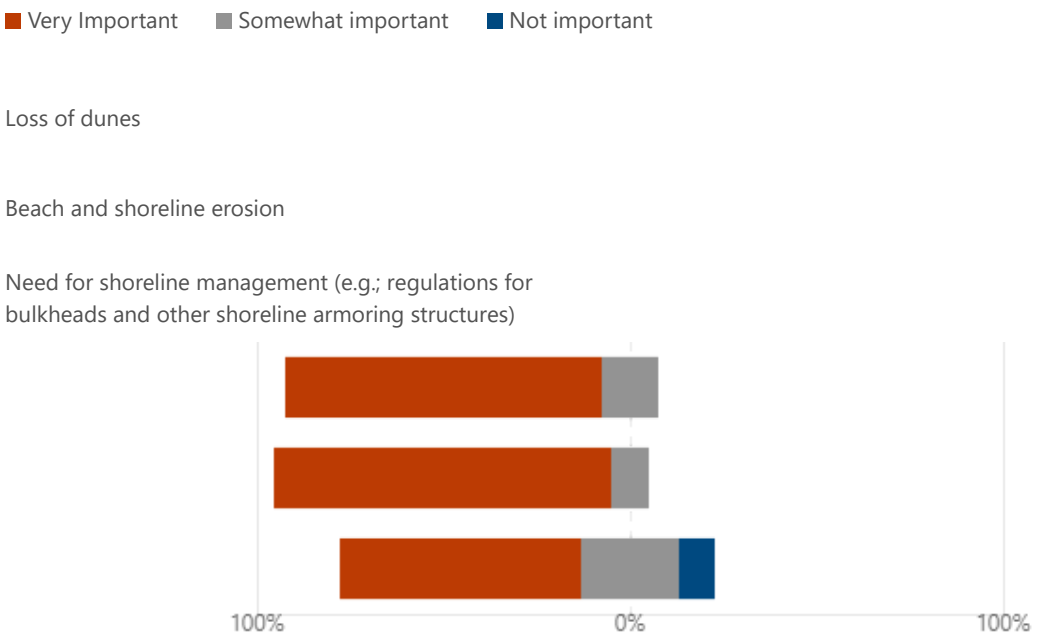
6. In your opinion, what are the most important issues affecting Water Quality?



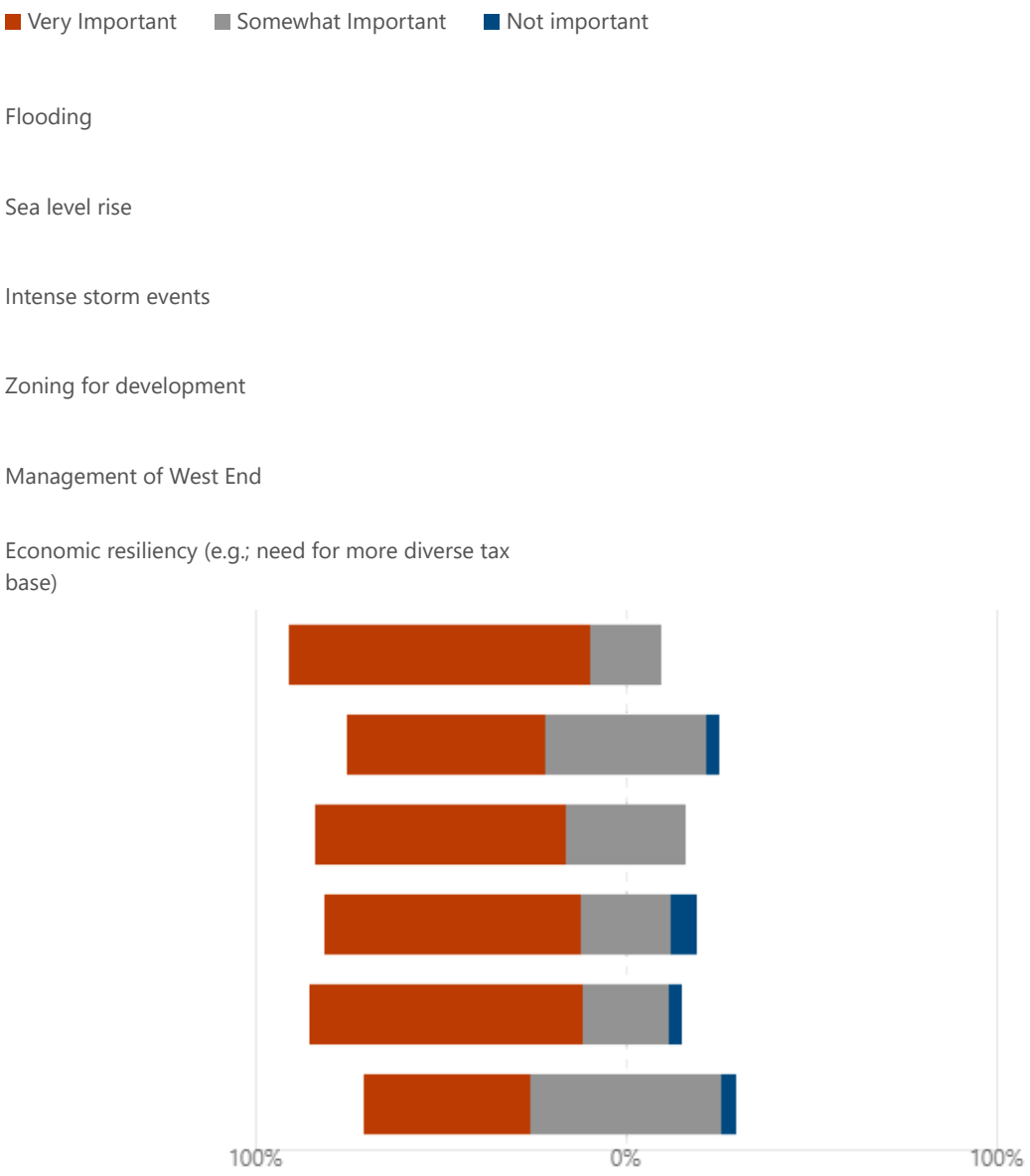
7. In your opinion, what are the most important issues affecting Fish and Wildlife?



8. In your opinion, what are the most important issues affecting Shorelines?



9. In your opinion, what are the most important issues affecting Environmental Health and Resiliency?



APPENDIX C

Hydrogeology of Dauphin Island

Professional Hydrogeologic Consulting
600 Bel Air Boulevard, Suite 130
Mobile, Alabama 36606

O'Donnell
& Associates, Inc.

Telephone 251-285-5945

19 April 2022

Mr. Steve O'Hearn
Thompson Engineering, Inc.
2970 Cottage Hill Road, Suite 190
Mobile, Alabama 36606

Re: Consulting Services
Hydrogeology of Dauphin Island, Alabama
OAI Project #470207

Dear Steve,

As requested and discussed with Chris Warn, I have put together this brief summary of the hydrogeology of Dauphin Island.

The hydrogeology of Dauphin Island is unique in that it is a barrier island composed of sand that overlies alternating layers of clay and sand. From the legendary shallow well that served as a hiding place for a jeweled cross to the deepest well completed on the island, wells completed in the sand making up the island and those sands under the island have proven to be a source of drinking water to the inhabitants of the island over the past centuries.

The first in depth study of Dauphin Island's hydrogeology was initiated in 1984 as a collaborative project between the United States Geological Survey (USGS) and the Dauphin Island Water and Sewer Authority (DIWSA). A summary of the hydrogeology presented in the report follows.

The primary focus of this effort, USGS's Water-Resources Investigation Report 87-4283, was the water table aquifer and its potential to serve as a source of drinking water. While focused on this shallow aquifer, identified in the report as the Water-Table Aquifer, the report identified two additional aquifers at depth. The deeper aquifers were named the Shallow Sand Aquifer and the Deep Sand Aquifer. Of these three aquifers, the USGS's study reported that only the Water-Table and the Shallow Sand Aquifers are potential sources of fresh water.

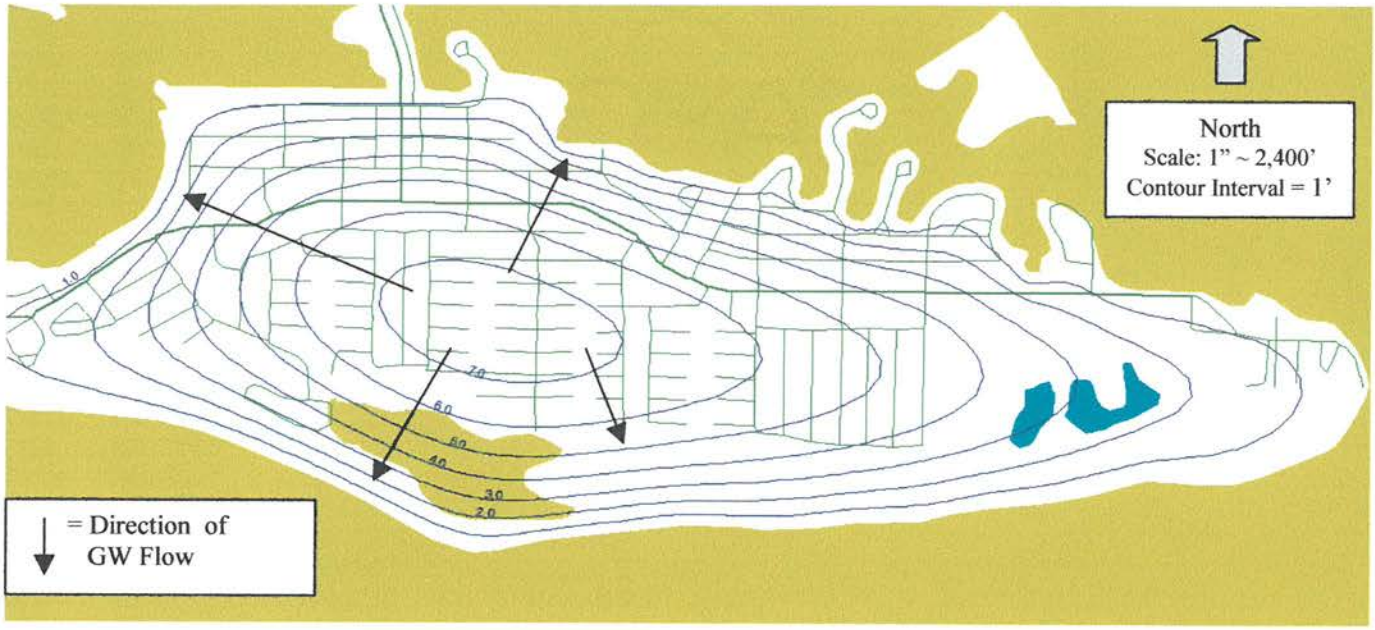
Water-Table Aquifer

The Water-Table Aquifer, the top of which is visible at ground level on Dauphin Island, extends from ground level to the clay hydraulically separating it from the Shallow Sand Aquifer. The base of the aquifer is typically found in the 40 foot depth range where a dense plastic clay is encountered. The aquifer consists of well to moderately sorted, white, medium to very fine grained quartz sand, lenses of dark brown humate, silt, limonite and streaks of semi-consolidated sands. Aquifer testing found the aquifer's hydraulic conductivity fell in the 45 to 56 feet per day range

The Water-Table Aquifer is recharged directly by precipitation (typically rain) falling on the island. As

rain enters the aquifer, it discharges to area water bodies such as Mississippi Sound to the north and the Gulf of Mexico to the south, Inset A. When the precipitation rate exceeds the discharge rate, the aquifer's potentiometric surface (water table) rises above ground level in low-lying areas giving the appearance of flooding. This phenomenon is known as groundwater flooding[1]. Groundwater flooding takes longer to dissipate than surface water flooding because groundwater moves much more slowly than surface water and will take time to flow away underground. As the aquifer slowly discharges to the surrounding water bodies, the water table drops and the "flooding" recedes.

Inset A
Typical Representation of the Potentiometric Surface of the Water-Table Aquifer



The study concluded that the Water-Table Aquifer could support production from eight wells in the main eastern end of the island with each well pumping 50 gpm/24 hours per day without causing saltwater intrusion. However, the aquifer can be adversely impacted by the salt content of dry fall and storm surge.

[1] See: https://dnr.wisconsin.gov/topic/WaterUse/gwLevels.html

Shallow Sand Aquifer
The Shallow Sand Aquifer was identified in the USGS report as Pleistocene sediments between 50 and 150 feet below sea level and Miocene sediments between 150 and 500 feet below sea level. It consists of very fine to very coarse grain, sub-angular to sub-rounded quartzose sand with some shell fragments, carbonized wood, silt and clay.

Test drilling completed during the USGS study found the Shallow Sand Aquifer to be confined by and separated from the Water-Table Aquifer by a 20-foot thick dense plastic clay. Aquifer testing saw no indication of hydraulic connection between the Shallow Sand Aquifer and the overlying Water-Table Aquifer.

Deep Sand Aquifer
The Deep Sand Aquifer is identified as Miocene sediments present at a depth of 500+ feet below sea level. It consists of very fine to very coarse grain sub-angular to sub-rounded quartzose sand with shell fragments and traces of dark minerals. Some clay and silt layers are present.

Additional Hydrogeologic Studies

Beginning in 2002, O'Donnell & Associates, Inc. (OAI) has worked with DIWSA on developing their groundwater supply. Over the years, OAI has refined the hydrogeology originally presented in USGS 87-4783 through research into historic "on island" drilling activity and drilling efforts completed by DIWSA both prior to and after the USGS's study was completed.

The deepest on island well was completed to a depth of 919 feet below ground level, Inset B. The log of the 919-foot boring indicates it was drilled at the "east-end of Dauphin Island, Fort Gaines" as a "US Government: Water Well". The log records alternating sequences of sand, clay, sandstone, limestone, gumbo and gravel. A second record on this 1903 well indicated the strainer was set in the sand present from 824 to 919 feet. A water sample attributed to the well had a chloride concentration of 193 parts per million (ppm). Antidotal information was that the well's artesian flow tasted good. The well was plugged and abandoned before OAI was able to obtain and submit a sample the deep aquifer's water for laboratory analysis.

Inset B
Log of U.S. Government's Deep Well

U. S. Government: Water Well

Located: Sec. 7, T. 9 S., R. 1 W.—East End of Dauphin Island, Fort Gaines

Began: ? Completed: 11-12-1903

Elevation: ? Casing Record: ?

0– 10	white sand
70	black sand
76	blue sand
171	white sand
191	blue clay
232	white sand
277	blue sand, very fine
312	blue clay
342	blue sand
352	blue clay
354	limestone
409	gray sand, salt water
414	sandstone, very hard
419	gravel
449	gumbo clay
559	gray sand
619	blue clay
669	blue sand
679	gravel
824	blue clay
919	water bearing sand
	TOTAL DEPTH

SUMMARY

Top Miocene ..... 679'

Additional deep subsurface lithologic and aquifer water quality information associated with Layne Central Company's drilling efforts on behalf of DIWSA between 1954 and 1979 was secured.

Using this information, OAI was able to identify five distinct sand units within the Shallow Sand Aquifer and at least three individual sand units within the Deep Sand Aquifer. Once identified, production from each DIWSA's wells or test well was tied to specific sand units for assessment of water quality and for additional future production possibilities.

Aquifer Water Quality

DIWSA's eight shallow wells were completed in the Water-Table Aquifer based in part on the findings of the USGS's report. Over the years, production from the shallow wells decreased while water quality issues associated with iron and dis-infection by-product formation increased resulting in the wells being taken out of service and abandoned.

DIWSA currently operates three wells completed in the brackish sands of the Shallow Sand Aquifer. The water produced by these three wells requires various treatment methods prior to distribution. The treatment for these wells may include blending, aeration, iron removal, filtering, pH adjustment, corrosion control, the addition of Pretreat 100+, reverse osmosis to remove salt, pH adjustment and chlorination.

DIWSA currently operates one well completed in a brackish water sand of the Deep Sand Aquifer. The aquifer's water is treated by reverse osmosis to remove chlorides prior to distribution.

Long Term Concerns

Due to the lack of a continuous and sustainable fresh drinking water source of supply, DIWSA invested in reverse osmosis as the primary treatment method to render the brackish water contained in sands of the Shallow and Deep Sand Aquifers potable. This treatment method is very expensive when compared to that required for aquifers containing fresh water that typically requires little or no significant post production treatment. To help protect the current treatable chloride levels in the aquifers with the existing reverse osmosis infrastructure, DIWSA would like to see the Town of Dauphin Island implement a total ban on all non-DIWSA operated public supply wells (i.e. private wells) drilled below a depth of 40 feet. In doing so, the Dauphin Island community would be open to developing fresh water wells in the Water-Table Aquifer and provide needed local protection to the brackish water aquifers currently serving citizens and visitors to Dauphin Island.

OAI appreciates the opportunity to assist Thompson Engineering on this project.

Sincerely,

Daniel J. O'Donnell, PG
O'Donnell & Associates, Inc.

APPENDIX D

Mobile Bay Subwatershed Restoration Monitoring Framework

MOBILE BAY NATIONAL ESTUARY PROGRAM

Mobile Bay Subwatershed Restoration Monitoring Framework

Science Advisory Committee: Monitoring Working Group, 2015

Mobile Bay Subwatershed Restoration Monitoring Framework

Vision: Comprehensive restoration monitoring that enables quantitative assessment of restoration success and assessment of overall ecosystem function

Goals: To answer three questions:

1. What, if any, changes are there in the water quality, sedimentation, flow, biology, and habitat quantity and quality as a result of restoration efforts and management plan implementation?
2. How are potential ecosystem health indicators related to stressors and ecosystem functions/services?
3. What is the long-term status of the biological condition in the Mobile Bay watershed?

▾ ▾ ▾

COMMENTS ON THE PROCESS AND RECOMMENDATIONS

This framework outlines recommended monitoring procedures in relation to watershed restoration and watershed management plan implementation to understand ensuing impacts on the entire subwatershed. Development and implementation of a standardized monitoring protocol across the larger Mobile Bay watershed in all subwatersheds is critical for understanding the current health and function of the Mobile Bay Estuary and any shifts due to restoration. Recognizing the existing gap and need for such a plan in Mobile and Baldwin Counties the Mobile Bay National Estuary Program (MBNEP) tasked their Science Advisory Committee with the development of a comprehensive monitoring framework. This plan contributes to the MBNEP's Five Year Comprehensive Conservation Management Plan and can be integrated with larger monitoring networks being developed by the Gulf of Mexico Alliance, the Gulf of Mexico Coastal Ocean Observing System, and other partners.

This plan was developed by a working group of the Mobile Bay National Estuary Program Science Advisory Committee (SAC) and then approved by the rest of the SAC. These are thought to be the best available practices necessary to answer the questions laid forth in our goals. Recommendations of best practices reflect the group's professional opinion.

Desired Outcomes:

The recommended protocols will result in standardized data collection for restoration efforts throughout Mobile and Baldwin Counties, allowing comparisons both temporally and spatially, improved decision making, and data preservation for future use. We recommend the monitoring program outlined within this framework be incorporated into all watershed management plans and restoration

proposals and contracts. Ensuring utilization of this framework uniformly across all restorations and watersheds in Mobile and Baldwin counties will allow an interconnected network of data that can improve understanding of the processes of Mobile Bay as a whole. This will also serve as a model for future efforts across the Gulf Coast in developing larger, regional networks, including those envisioned by the Gulf of Mexico Alliance, the National Oceanic and Atmospheric Administration, and the Gulf of Mexico Coastal Ocean Observing System. To achieve these goals we recommend:

1) The adoption of this framework in every restoration request for proposals (RFP) and restoration contracts for Mobile and Baldwin County
2) Long-term monitoring based on this framework in every watershed management plan for all watersheds in Mobile and Baldwin County
3) Data synthesis to develop tools and products for assessment of restoration success, adaptive resource management, and baseline establishment
4) Active engagement with county and municipality planners, resource managers, agencies working within the watershed, and other stakeholders to encourage implementation of monitoring and broad application of tools developed from data synthesis.

Efficiency:

These recommendations are not all inexpensive or new. Prior to design and implementation in specific watersheds we highly encourage an inventory of required and ongoing monitoring within the watershed to assess what resources are available and what can be leveraged. For example municipalities, businesses, and state and local agencies frequently must monitor to some degree to meet Clean Water Act MS4 requirements. Interagency cooperation will avoid redundancy and provide maximum success for the minimum investment for all partners.

Data Utilization and Storage:

In addition to the monitoring scheme laid forth here, we highly recommend implementation of a feedback mechanism in both developing and existing watershed management plans (WMP). Collection of data is not enough; synthesis and analysis is required to determine if restoration and management practices are successful. While this implementation will be different for each watershed, a set of essential minimum requirements need to be met. It is critical that a committee be composed of representatives from:

- The drafter of the WMP – to navigate any changes necessary to the plan
- The municipalities and counties within the watershed – to ensure buy in to the adaptive management process and to supplement their efforts
- Agencies that will derive use from these data – to encourage focus on the watershed and implementation of necessary regulation or status change (i.e. EPA or FDA)
- Those performing the restoration – to evaluate progress of the restoration and give context to observed outcomes

- The Mobile Bay National Estuary Program – to coordinate effort and outcomes between surrounding watersheds and leverage existing partnerships
- Expert researchers – to perform analyses and interpret results

It is imperative that this committee be afforded the power needed to influence or direct the actions in the WMP based on monitoring results. Suggestions include: annual review and restructuring of the WMP based on monitoring data, review of the effectiveness of the restoration, a mechanism to address, edit, or introduce local policy based on baseline and restoration results, and implement adaptive management measures.

We also recommend that these data be housed within a regional partner to facilitate consistency, development of metadata, and promote public access to the data. Establishing a regional data repository will encourage integration within larger monitoring programs, expanding the context of the restoration effort and subsequent monitoring. This will also promote more research and data analysis, thereby improving our understanding of system function and management capabilities. As part of these recommendations metadata should be in ISO 19115-2 standard format. Utilizing a nationally recognized metadata standard will encourage data utilization across Mobile Bay and within larger regional data analyses and inventories.

Incorporating historical datasets to obtain a longer time series for analysis of system status and trends is encouraged; however, such datasets should be utilized in context and not applied beyond the scope of the original sampling.

Final Remarks

This document was developed as a framework to guide individual subwatersheds in the Mobile Bay watershed in standardizing their restoration monitoring. This standardization encourages integration of data and assessment of health of the entire Mobile Bay Estuary. Commitment to these protocols ensures relevance of data and increases the capacity of our region to better manage our resources. This sampling regime will develop an understanding of what drives the successes and failures of restoration efforts. Applying this understanding to adaptive watershed management is critical to utilizing our scarce financial and ecological resources efficiently.

▼ ▼ ▼

SAMPLING PROTOCOLS

We recommend that all of these monitoring efforts begin at least one year prior to implementation of restoration efforts to establish baselines. Monitoring should continue after restoration to track both short-term and long-term impacts. The minimum length of monitoring post restoration should be 3-5

years. We strongly recommend, if at all possible, transition of this monitoring into a sustained, long-term program for each subwatershed to continue tracking response to restoration and overall shifts in subwatershed health and function.

Sedimentation and Flow

Reducing sedimentation and flow are often at the core of restoration aims. If the primary goal of the restoration is to reduce sedimentation and flow, we recommend development of performance metrics specific to each restoration project for assessing success. We recommend the following monitoring metrics:

	Timing and Frequency	**Location**	**Methodology**
Erosion Rates	• Begin in Nov/Dec • After every rainfall event ≥ 1 inch • Post catastrophic events related to flow but not precipitation (e.g., dam failure)	• Upstream of restoration • Downstream of restoration • At restoration	*Staley et al., 2006*
Continuous Monitoring - Sondes	Every 15 minutes	• Mouth of all 2nd order streams or strategically important locations • Receiving sub-basin • Prior to and after in-stream retention water bodies (e.g. small lakes or large retention ponds)	• Flow • Turbidity: *EPA, 2012*
Continuous Monitoring – Automatic Water Grabs	• Any rainfall event ≥ 0.1 inch preceded by 72 dry hours • Continue every 15 min there has been no precipitation for 72 hours *Citation: EPA, 1992*	• Mouth of all 2nd order streams or strategically important locations • Receiving sub-basin • Prior to and after in-stream retention water bodies (e.g. small lakes or larger retention ponds)	• Total Suspended Solids • Suspended Sediment Annual Loading: *Cook & Moss, 2008*
Soil/sediment characterization	• Annually, beginning prior to restoration.	• Upstream of restoration • At restoration site • Downstream	• Grain size • Fraction distribution • TOC

		depositional site	
Manual Monitoring – Develop Sediment Transport Model	• After any rainfall event ≥ 1 inch for 12 months	• Upstream of restoration • Downstream of restoration • Mouth of all 2nd order streams or strategically important locations	• *Cohn et al., 1992*
Manual Monitoring – Maintain Sediment Transport Model	• Two rainfall events annually: ○ Moderate flow event ○ High flow event	• Upstream of restoration • Downstream of restoration • Mouth of all 2nd order streams or strategically important locations	• Bed Sediment Transport Rates • Bed Sediment Annual Loading: *Cook & Moss, 2008*

The Geological Survey of Alabama (GSA) has extensive experience and historical data regarding sediment and flow in many of the subwatersheds around Mobile Bay. It is highly recommended to coordinate effort and standard methods with this agency to improve efficiency and standardization.

Water Quality

Improved water quality is desired outcome from all restoration efforts. Given that water quality is a direct link to biological condition and ecosystem health, impacts must be quantified. It is critical to the evaluation of a restoration project to measure baselines and changes of water quality over time. For accurate assessment of water quality baselines and quantified changes in response to restoration we recommend monitoring:

	Timing and Frequency	**Location**	**Method**
Continuous Monitoring – Sondes	Every 15 minutes (to sample first flush)	• Reference site • Upstream from restoration • Downstream from restoration ○ Combine with sediment and flow continuous monitoring • Receiving Sub-basin • In-stream retention water bodies	• Temperature • Dissolved Oxygen • pH • Conductivity • Photosythetically Active Radiation ○ Only in receiving sub-basin • NO3 • CDOM • Turbidity
Continuous Monitoring – Automatic Water	• Any rainfall event ≥ 1 inch • Continue every	• Reference Site • Upstream from restoration • Downstream from	• Nutrients ○ NO3 ○ NH4

Grabs	15 min until it has been dry for 3 days: *EPA, 1992*	restoration ○ Combine with sediment and flow continuous monitoring • Receiving sub-basin • In-stream retention water bodies	○ DON ○ PN ○ PO4 ○ DOP ○ POP ○ *Lehrter et al., 2013* • Total Suspended Solids • Dissolved Organic Carbon • Particulate Organic Carbon *Welschmeyer, 1994*
Manual Sampling – Monthly Water Grabs	Sample based on turnover in the receiving sub-basin	Receiving sub-basin • Determine sampling locations within the sub-basin based on size and dynamics of the system	• Nutrients ○ NO3 ○ NH4 ○ DON ○ PN ○ PO4 ○ DOP ○ POP • Chlorophyll-a • Dissolved Organic Carbon • Particulate Organic Carbon *Welschmeyer, 1994*
Other	• Consider additional 303d issues based on initial screening sampling with subsequent periodic reevaluations for both continuous and manual sampling • Any additional issues specific to a subwatershed should be addressed with a detailed monitoring protocol ▪ Protocols used should be submitted to the MBNEP SAC for integration into this framework to ensure consistency and standardization across the Mobile Bay Watershed		

Habitats

Habitats are the foundation of an ecosystem; shifts in habitat health and function directly impact the ecological and economic benefits of the watershed. To accurately assess the health of individual habitats we recommend the following monitoring for each habitat:

<u>Submerged Aquatic Vegetation</u>

	Timing and Frequency	**Location**	**Method**

Bed Boundaries	Annually at peak biomass	Receiving sub-basins	Aerial Photography; Tier 1, *Neckles et al., 2012*
Species Composition and Density	Annually at peak biomass	Receiving sub-basins – determine sampling locations depending on the size and dynamics of the system and the SAV beds	Percent Cover & Cores; Tier 2,3, *Neckles et al., 2012*

Wetlands

	Timing and Frequency	**Location**	**Methods**
Acreage*	Annually at peak biomass	• Reference Site • Restoration Site • Downstream of restoration site	Aerial imagery and existing spatial data with field verification. *USACE, 2010*
Floristic Quality Index (FQI)	Annually at peak biomass	• Reference Site • Restoration Site • Downstream of restoration (if applicable)	*Lopez & Fennessy, 2002*
Wetlands Rapid Assessment Protocol (WRAP)	Annually at peak biomass	• Same locations as the FQI	*Miller and Gunsalus, 1999*
Hydrogeomorphic (HGM) Model	Annually at peak biomass	• Receiving sub-basins	*Shafer et al., 2007*

* Mobile and Baldwin Counties will have detailed mapping of critical habitat including wetlands conducted in 2015. It is the recommendation of this team that such mapping occur annually as part of a comprehensive watershed management plan for each sub-watershed. If complete watershed mapping is not scheduled in the year prior to and at least 3 years after restoration then follow this recommendation.

Streams and Riparian Buffers

	Timing and Frequency	**Location**	**Method**
Rapid Stream Assessment for Riparian Buffers	Annually at peak biomass	Entire watershed	• *Barbour et al., 1999* • *Look to leverage effort with ADEM: ADEM conducts these around the state*
Stream Quality Score	Annually, during early spring, prior to adult insect emergence	• 100 m reach segments • Upstream from	• *Barbour et al., 1999* • *Be aware of agriculture, golf*

		restoration or a reference site • At restoration • Downstream from restoration	*courses, and other potential sources of insecticide that could artificially skew results*

Oyster Reefs

	Timing and Frequency	**Location**	**Method**
Reef Areal Dimension	Annually and after events that impact oyster survival (i.e. hurricanes)	Receiving sub-basins	*Bagget et al, 2014*
Reef Height *	Annually and after events that impact oyster survival (i.e. hurricanes)	Reference sites within receiving sub-basins	*Bagget et al, 2014*
Oyster Density	Annually after peak growing season	Receiving sub-basins	*Bagget et al, 2014*
Oyster Size-Frequency Distribution	Annually after peak growing season	Receiving sub-basins	*Bagget et al, 2014*
Other	Coordination with Alabama Department of Conservation and Natural Resources Marine Resources Division (ADCNR MRD) is highly recommended as ADCNR MRD have a long-term oyster data set and expertise in oyster sampling methodologies. Any additional concerns such as HABs or fecal coliforms should be considered and coordination with the Alabama Department of Public Health (ADPH) is highly recommended to reduce redundancy and incorporate experts in sampling and analysis of results. (*National Shellfish Sanitation Program*)		

*Monitoring oyster reef height provides understanding of how upstream or adjacent land-based activities that change rates of sedimentation, dissolved oxygen, or other water column attributes may, in turn, impact the overall function and productivity of reefs (which can change based on vertical distribution). Low height oyster reefs are naturally occurring in and around Mobile Bay, and a low reef height alone is not to be considered a sign of a poorly functioning reef.

Other Foundational Habitats

There are other habitats that may be critical within individual subwatersheds. For each of these habitats we recommend following a protocol based on published and standardized methods that details frequency and location. Protocols used should be submitted to the MBNEP SAC for integration into this framework to ensure consistency and standardization across the Mobile Bay Watershed

Biological Communities

Biological communities are a critical component of both ecological function and services including fisheries. Many of the native species are captured in the stream and marsh indices; however, specific species and their associated habitats should be considered. Targeted species differ for individual subwatershed. To ensure that no critical species are overlooked the following should be considered in detail for each subwatershed monitoring program:

- Sensitive habitats
    - Determine if there are any habitats (e.g. marine mammal feeding, resting, breeding habitats, nesting bird habitat etc.)
    - Develop a protocol based on published or standardized methods that details frequency and location
        - Developed protocol should be submitted to the MBNEP SAC for integration into this framework to ensure consistency and standardization across the Mobile Bay Watershed
- Invasive Species
    - Develop a protocol based on published and standardized methods that details frequency and location
- Endangered and Threatened Species
    - Determine if there are any endangered or threatened species
    - Develop a protocol based on published methods or standardized methods that details frequency and location

▼ ▼ ▼

REFERENCES

Baggett, L.P., S.P. Powers, R. Brumbaugh, L.D. Coen,B. DeAngelis, J. Greene, B. Hancock, and S. Morlock, 2014. Oyster Habitat restoration monitoring and assessment handbook. The Nature Conservancy, Arlington, VA, USA

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling, 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

Cohn, T.A., D.L. Caulder, E.J. Gilroy, L.D. Zynjuk, and R. M. Summers, 1992. The validity of a simple statistical model for estimating fluvial constituent loads: an impirical study involving nutrient loads entering Chesapeake Bay: Water Resources Research 28: 2353-2363

Cook, M. R., and N.E. Moss, 2008. Analysis of water quality, sediment loading, biological resources, and impacts of land-use change on the D'Olive and Tiawasee Creek watersheds, Baldwin County, Alabama, 2008. Geological Survey of Alabama open file report 0811, p. 20-31

Lehrter, J.C., D.S. Ko, M.C. Murrell, J.D. Hagy, B.A. Schaeffer, R.M. Greene, R.W. Gould, B. Penta, 2013. Nutrient distributions, transports, and budgets on the inner margin of a river-dominated continental shelf. Journal of Geophysical Research: Oceans 118: 1-17

Lopez, R.D. and M.S. Fennessy, 2002. Testing the floristic quality assessment index as an indicator of wetland condition. Ecological Applications 12(2):487-497

Miller, R.E., Jr. and B.E. Gunsalus, 1999. Wetland Rapid Assessment Procedure. Technical Publication REG-001. Natural Resource Management Division, Regulation Department, South Florida Water Management District, West Palm Beach, FL. 36 pp + appendices.

Neckles, H.A., B.S. Kopp, B.J. Peterson, P.S. Pooler, 2012. Integrating Scales of Seagrass Monitoring to Meet Conservation Needs. Estuaries and Coasts 35(1): 23-46

Shafer, D.J, T.H. Roberts, M.S. Peterson and Keil Schmid, 2007. A Regional Guidebook for Applying the Hydrogeomorphic Approach to Assessing the Functions of Tidal Fringe Wetlands Along the Mississippi and Alabama Gulf Coast. U.S. Army Corps of Engineers, Engineer Research and Development Center, Vicksburg, MS. 76 pp + appendices.

Staley, N. A., T. Wynn, B. Benham, G. Yagow, 2006. Modeling channel erosion at the watershed scale: model review and case study. Center for TMDL and Watershed Studies, Biological Systems Engineering, Virginia Tech University, BSE Document Number 2006-0009, Section 8.5, pp. 57-60.

U.S. Army Corps of Engineers (USACE), 2010. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region (Version 2.0), ed. J. S. Wakeley, R. W. Lichvar, and C. V. Noble. ERDC/EL TR-10-20. Vicksburg, MS: U.S. Army Engineer Research and Development Center

U.S. Environmental Protection Agency, 2012, Water: monitoring and assessment, Section 5.5 Turbidity, http://water.epa.gov/type/rsl/monitoring/vms55.cfm

Welschmeyer, N.A., 1994. Fluorometric analysis of cholorphyll a in the presence of chlorophyll b and pheopigments. Limnology and Oceanography 39 (8): 1985-1992

APPENDIX E

Alabama Barrier Island Restoration Assessment Monitoring and Adaptive Management Plan

ALABAMA BARRIER ISLAND RESTORATION ASSESSMENT

Monitoring and Adaptive Management Plan

April 20, 2020

Prepared by

Gregory D. Steyer[1], Michelle B Meyers[2] and Kathryn A. Spear[3]

[1]U.S. Geological Survey, Southeast Region
[2]U.S. Army Corps of Engineers, New Orleans District
[3]National Oceanic and Atmospheric Administration, Fisheries West Coast Region

Table of Contents

1.0 Introduction

Dauphin Island, Alabama, is a strategically important barrier island along the northern Gulf of Mexico. It serves as the only barrier island providing protection to much of the State of Alabama's coastal natural resources. With an average elevation of 7.2 feet, Dauphin Island is highly susceptible to rising sea levels. The size of the system spans over 3500 acres of barrier island habitat including beach, dune, overwash fans, intertidal flats, intertidal wetlands, maritime forest, and freshwater ponds. In addition, Dauphin Island provides protection to approximately one-third of the Mississippi Sound and estuarine habitats including oyster reefs, marshes and seagrasses. It serves as one of the most important bird sanctuaries in the Southeast and supports an important recreational and commercial fishing industry.

Dauphin Island and the remainder of the barrier islands fronting the Mississippi Sound have been historically losing surface area, and their capacity to protect mainland natural resources and infrastructure is diminishing (Byrnes et al., 2010). Rising sea level, severe and frequent storms, and engineering activities all threaten the sustained subaerial presence (Twichell et al., 2013, Byrnes et al., 2012, Morton et al., 2008). Moreover, loss of barrier island area threatens the estuarine ecosystem of the Mississippi Sound and its resources and exposes the mainland coast and its associated wetlands and coastal habitats to increasing saltwater intrusion and damage from future storms and storm surges (USACE 2009).

Dauphin Island has been severely impacted by repeated extreme events over the past several decades, most recently Hurricanes Ivan, Katrina, and Isaac, and by the Deepwater Horizon (DWH) oil spill. Hurricanes Frederic, Ivan, and Katrina caused some of the most substantial morphological changes since major residential development on the island. Changes from these storms include island lowering, rollover, and breaching along the western portion of Dauphin Island as well as the merging of the Pelican/Sand Island complex to Dauphin Island. This pattern of island breaching and rollover as a function of hurricane passage, as well as the merging of the Pelican/Sand Island complex to Dauphin Island, has been documented several times in the historical survey record (Morton et al., 2008, Byrnes et al., 2010, Byrnes et al., 2012, Park et al., 2013). Breaches along the island prior to the most recent ones in 2004 and 2005 have been documented as closing naturally in response to sediment supplied from the Mobile Pass ebb-tidal delta, with large breach closures occurring on the order of decades. In addition, published reports (Morton et al., 2008, Byrnes et al., 2010) indicate that, historically, the western portion of the island has generally maintained its form through time by migrating landward.

Efforts to mitigate the impacts of these coastal hazards on the island date from 1904 when a rock revetment was put in place to protect Fort Gaines at the far eastern end of the island. Over time, other efforts include rock groins on the southeastern shore, a series of bulkheads along the northeastern side of the island, limited beneficial use on the southeastern shore, riprap protection at the fishing pier to the west, and construction of two emergency protective berms on the west end funded by the Federal Emergency Management Agency (FEMA) following Hurricane Georges, Tropical Storm Isadore, and Hurricanes Ivan and Katrina. Most recent mitigation efforts include reorientation of the groin field into a breakwater configuration and pocket beach construction on the east end and dune construction along the western portion of the developed island. Furthermore, in response to the 2010 DWH oil spill, a major breach in the island, Katrina Cut, was closed with a temporary rubble mound structure to prevent oil migration into the Mississippi Sound.

Sea level rise, storms, oil spills, and development on the island and surrounding shorelines are primary stressors that continue to degrade and threaten further loss of the island habitats and threaten the ecological functioning of the Mississippi Sound and the Heron Bay wetlands on the mainland.

Restoration of Dauphin Island will help enhance, maintain, and protect important coastal habitat and living resources affected by these stressors. The goal of this work is to investigate viable options for the restoration of Dauphin Island as a sustainable barrier island to protect, enhance and restore resources on the island as well as the surrounding coastal resources the island supports. One of the main objectives for the Alabama Barrier Island Restoration Assessment is to evaluate potential restoration alternatives based on sound science, allowing science to guide development of sustainable restoration alternatives and exploring a range of restoration possibilities. The likelihood of restoration success can be maximized by ensuring that restoration plans include an understanding of the island's historical evolution, the island's physical topography and bathymetry, and geologic and oceanographic factors. These factors play an important role in understanding how the island has evolved over time to the existing island feature and how the island might respond to restoration actions.

This feasibility-level monitoring and adaptive management (MAM) plan describes a programmatic monitoring design to evaluate progress towards meeting project goals and objectives, describes the organizational structure for the MAM process, identifies key uncertainties, provides potential adaptive management (AM) actions, and provides cost estimates that can be used to guide project planning, implementation, and performance monitoring. Many factors such as ecosystem dynamics, engineering applications, institutional requirements, and other key uncertainties can change and/or evolve over a project's life. The MAM plan is a living document and will likely need to be revised upon availability of planning and engineering details regarding the suite of restoration measures included in the preferred restoration alternative. The revisions should consider updates to the goals and objectives, associated performance measures, monitoring design, and desired outcomes and specification of success criteria, interim targets, triggers, and adaptive management actions. Additionally, the plan should be regularly updated to reflect new monitoring and supporting information, as well as resolution of key uncertainties.

1.1 Introduction to Monitoring and Adaptive Management

Adaptive management is distinguished from traditional long-term monitoring in part through implementation of an organized, coherent, and documented decision process. Important aspects of the AM process lie in exploring alternative ways to meet management objectives, predicting the outcomes of alternatives based on the current state of knowledge, implementing one or more alternatives, and establishing a feedback mechanism whereby monitored conditions may be used to update the knowledge base and adjust management actions to refine and/or better achieve project goals and objectives. The definition of AM used for the Alabama Barrier Island Restoration Assessment is adopted from the National Research Council, Adaptive Management for Water Resources Project Planning, 2004:

> *"Adaptive management promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management also recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a "trial and error" process, but rather emphasizes learning while doing. Adaptive management does not represent an end in itself, but rather a means to more effective decisions and enhanced benefits. Its true measure is in how well it helps meet environmental, social, and economic goals, increases scientific knowledge, and reduces tensions among stakeholders."*

Learning from the AM experience is certainly not a new idea, but the purposeful and systematic pursuit of knowledge to address identified uncertainties has rarely been practiced. Adaptive management acknowledges the uncertainty about how ecological systems function and how they may respond to management actions. Nevertheless, AM is not a random trial-and-error process; it is not ad-hoc or simply reactionary. An essential element of AM is the development and execution of a monitoring and assessment program to analyze and understand responses of the system to implementation of the project.

The Alabama Barrier Island Restoration Assessment MAM program will be developed and used to:

- Allow scientists and managers to collaboratively design plans for managing complex and partially understood ecological systems.
- Reduce uncertainty over time.
    - Acknowledge, identify, and characterize risks and uncertainties.
    - Analyze uncertainties to identify key gaps in information and understanding.
- Implement systematic monitoring of outcomes and impacts.
    - Use scientific information obtained through continued monitoring to evaluate and manage uncertainties to achieve desired goals and objectives.
    - Explicitly state goals and measurable indicators of progress toward those goals.
    - Demonstrate to others that the project is meeting or exceeding performance goals and achieves "ecological success" (See Section 1.2).
    - Detect beneficial and detrimental system responses as early as possible to quantify the effects of these responses.
    - Evaluate hypotheses and performance measures and revise conceptual ecological models as appropriate.
- Incorporate an iterative approach to decision-making.
    - Develop feedback loops so that monitoring and assessment produce continuous and systematic learning that in turn is incorporated into subsequent decision-making.
    - Incorporate management flexibility in the design and implementation of programs or projects.
    - Implement projects and programs in phases to allow for course corrections based on new information.

- Provide a basis for identifying options for improvements in the design, construction and/or operation of Alabama Barrier Island Restoration Assessment projects and components through AM.
- Develop reports on the status and progress of the Alabama Barrier Island Restoration Assessment for the agencies involved, the public, and other stakeholders.
- Enhance predictive capability through improvements in simulation models before and after project construction.
- Provide information to summarize and develop lessons learned to optimize barrier island restoration strategies in the future.
- Ensure interagency collaboration and productive stakeholder participation. AM encourages defining agency objectives for stakeholder involvement, deciding upon a strategy for stakeholder involvement, clearly communicating this to the public, and maintaining long-term collaboration among stakeholders. Continued communication with key stakeholders helps identify and reduce socio-economic uncertainties, measure project progress towards objectives, and adaptively manage projects (Knight et al., 2008, Smith et al., 2009, Nkhata and Breen 2010).

Monitoring and Adaptive Management Process

The developed MAM program and process is complimentary to the U.S. Army Corps of Engineers (USACE) Project Life Cycle (planning, design, construction and operation and maintenance). The MAM process is not elaborate or duplicative and enhances activities that already take place. The basic process of MAM (Figure 1) was adapted from the DRAFT USACE Adaptive Management Technical Guide (USACE 2011) and includes:

Planning a program or project;

Designing the corresponding project;

Building the project (construction and implementation);

Operating and maintaining the project;

Monitoring and **assessing** the project performance;

Continue project implementation as originally designed or

Adjust the project if goals and objectives are not being achieved;

Complete project if goals and objectives and **success** criteria are achieved, or it is determined the project has **successfully** produced the desired outcomes

Project **termination** is possible if project goals and objectives are not being achieved and the decision is made to not adjust the project, or no adjustments are possible

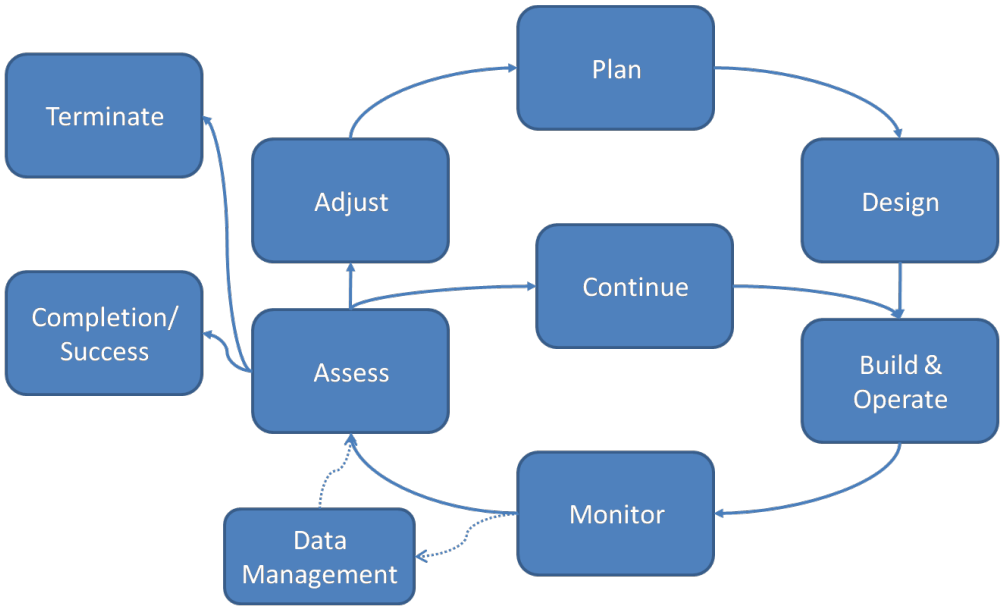


Figure 1. Monitoring and Adaptive Management process for the USACE Civil Works.

1.2 Authorization for Monitoring and Adaptive Management

This feasibility-level monitoring and adaptive management plan is consistent with National Fish and Wildlife Foundation, Gulf Environmental Benefit Fund Monitoring and Adaptive Management Plan guidelines and consistent with the Water Resources Development Act guidance for U.S. Army Corps of Engineers projects.

1.2.1 Monitoring Plan Guidelines

- The plan should specify nature, duration, and periodicity of monitoring, disposition of monitoring and analysis, costs, and responsibilities.
- Scope and duration should include the minimum monitoring actions necessary to evaluate success.
- Success is determined by an evaluation of predicted outcomes compared to actual results.
- Monitoring should be continued until "ecological success" is documented by the project sponsor in consultation with Federal and State resource agencies, as appropriate.
- Monitoring can end sooner than planned, if success is determined.
- Monitoring costs should be included as part of the project cost.

1.2.2 Adaptive Management/Contingency Plan

- Adaptive management plan should be appropriately scoped to project scale.
- The rationale and cost of AM and anticipated adjustments should be reviewed as part of the decision document.
- Major changes needed to achieve ecological success that cannot be addressed through operational changes or the AM plan may be examined under other funding authorities.

1.3 Monitoring and Adaptive Management Framework

The MAM plan includes a Set-up Phase (Figure 2) and an Implementation Phase (Figure 3). The Set-up phase proceeds concurrently with the planning process. While planners are identifying problems and opportunities, inventorying and forecasting resource conditions, evaluating and comparing alternative formulations, and selecting a plan, the MAM plan for the project should be developed. In addition to items developed during the planning process, a conceptual ecological model (CEM) will be developed, uncertainties identified, and performance measures, desired outcomes, and summary monitoring designs established as guidance to MAM plan development. Upon selection of an alternative for construction, additional MAM details on success and decision criteria (i.e., targets, triggers and thresholds) should be developed.

While the AM Set-up phase includes planning, the implementation phase puts the MAM plans into action (Figure 3). Projects will be designed, constructed, monitored, and assessed to understand responses of the system to implementation of the project alternative relative to stated goals, objectives, targets and success criteria. A Program Team should decide whether to alter the project and implement AM actions to improve plan performance based on assessment results.

Baseline monitoring should begin during or proceeding the design phase, prior to project construction. Monitoring should also be conducted during construction. Unexpected detrimental events may alter the project site, requiring consideration of corrective measures. For example, a tropical cyclone impacting a project site or invasion of an exotic species may necessitate management actions. Decisions may be required on how to address changes in conditions. In addition, projects that are phased-in over a long period of time present a greater potential for changing baseline conditions due to construction methods, deviations from selected methods, or development of new information. Using an AM strategy in this situation may increase the chances of overall project success. Design changes during construction may warrant changes to the MAM plan.

After construction, the project will enter the iterative cycle of AM where monitoring data are used to assess impacts and evaluate project performance. The results from the monitoring assessment should guide decision-making. An operation and maintenance, repair, replacement, and rehabilitation (OMRR&R) manual (or equivalent) should clearly communicate the MAM plans and process, including monitoring parameters, frequency and duration of monitoring and assessment, decision criteria, and options for adjustment (if necessary) to increase project success.

Engagement with stakeholders throughout project planning and implementation phases is critical to developing and maintaining common understandings of the goals and objectives, expectations of results, and potential commitment of resources. All phases of the MAM process should be open, transparent, and accessible to stakeholders. Such interaction fosters the mutual understanding of decisions and events and appreciation of the time and patience required to fully realize the benefits of restoration projects and to manage unrealized expectations. A strong effort should be made to identify and engage all appropriate stakeholders. Project teams should continually seek to identify governmental and non-governmental organizations, groups and other interested parties who could affect, be affected by, and/or be able to contribute knowledge, data, and/or resources to project-related activities (e.g., planning, design, implementation, and monitoring).

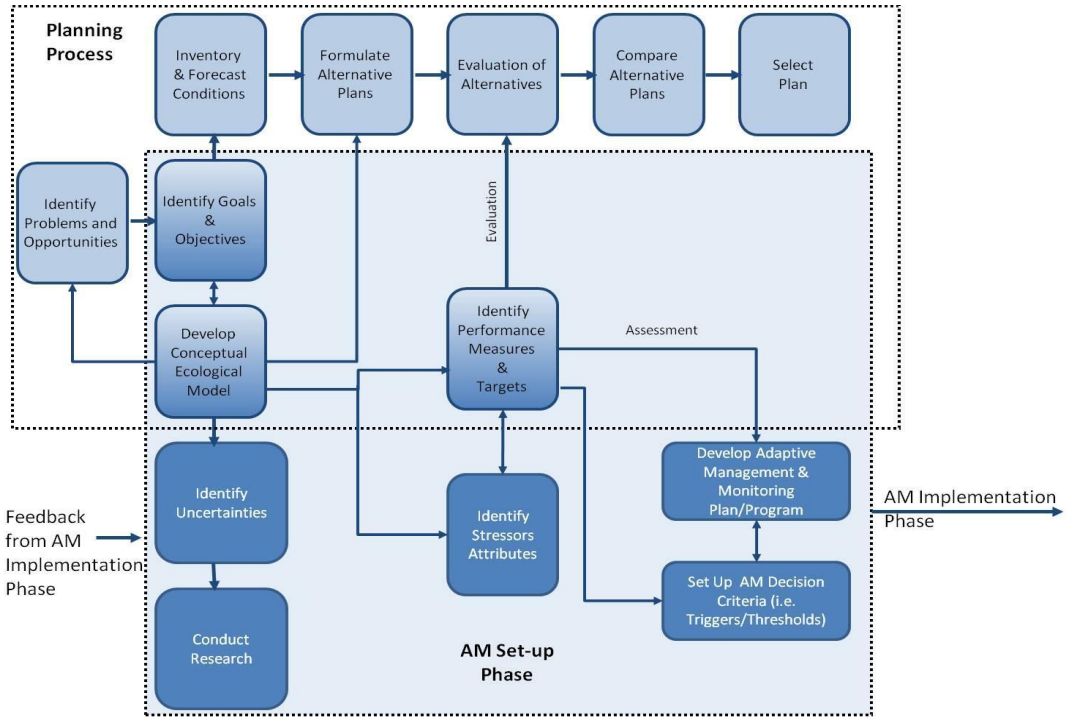


Figure 2. Monitoring and Adaptive Management Program Framework Set-up Phase.

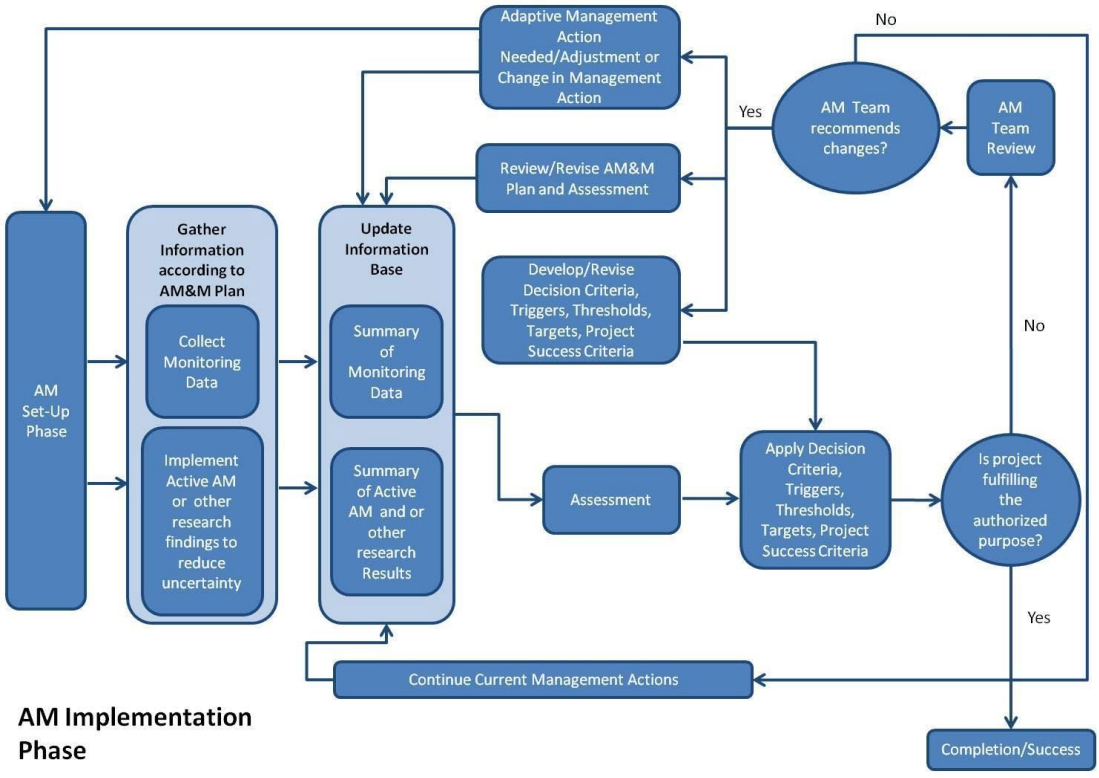


Figure 3. Implementation Phase of the Adaptive Management Program Framework.

2.0 Monitoring and Adaptive Management Planning

A feasibility-level MAM plan has been developed for the Alabama Barrier Island Restoration Assessment based on identified project goals and objectives, proposed restoration measures presented in the final report, and informed by a barrier island conceptual ecological model. The level of detail in the MAM plan is based on currently available programmatic project data and information developed as a part of this feasibility-level study of viable options for Dauphin Island restoration. Since this study is at the programmatic level, uncertainties remain concerning the exact project measures to be selected, project implementation, monitoring elements, and adaptive management opportunities. This MAM plan describes the types of monitoring and performance measures that could be used, but the MAM plan may need to be refined after an alternative is selected for construction. The MAM plan should then be implemented during pre-construction, project-construction, and post-construction phases and should be updated regularly to reflect new information, including important progress or resolution of recognized uncertainties, as well as any new uncertainties that might emerge during and following project construction. The actual scope of the final Alabama Barrier Island Restoration Assessment MAM plan should be based on project complexity, project uncertainties, the flexibility in potential management options, and the stage of project development. It is suggested that a MAM team be formed to develop the final MAM plan, including detailed cost estimates, monitoring protocols, and AM triggers, thresholds and actions.

2.1 Conceptual Ecological Model

As part of the MAM planning process, a CEM (Attachment 1) was developed to help explain the general functional relationships among the essential components of the barrier island ecosystem. CEMs are a means of:

(1) simplifying complex ecological relationships by organizing information and clearly depicting system components and interactions;
(2) integrating to more comprehensively implicit ecosystem dynamics;
(3) identifying which attributes will show ecosystem response;
(4) interpreting and tracking changes in restoration/management targets; and
(5) communicating these findings in multiple formats.

This CEM assists with identifying aspects of the ecosystem where restoration measures can effect change. Specifically, the CEM identifies those major stressors, ecosystem drivers, and critical ecological processes and attributes of the natural system likely to respond to restoration measures. The Dauphin Island CEM developed for the Alabama Barrier Island Restoration Assessment was used in the development of this MAM plan to help identify and confirm objectives, identify problems and opportunities, uncertainties, and select important system attributes and performance measures to be considered for monitoring. The CEM represents the current understanding of these factors and should be updated and modified, as necessary, as new information becomes available to assist with further refining this MAM plan during project planning and implementation.

Factors identified for the Alabama Barrier Island Restoration Assessment are listed below and further detailed in Attachment 1. The numbers associated with the performance measures align with the same number identified with the attributes.

Drivers

- D1: Coastal Geomorphic and Geological Processes
- D2: Oceanographic & Atmospheric Processes
- D3: Changing Global Climate Patterns
- D4: Human Development & Expansions

Stressors

- ES1: Relative Sea Level Rise
- ES2: Altered Sediment & Nutrient Availability
- ES3: Altered Hydrological Exchange & Circulation Patterns
- ES4: Island Morphological Changes
- ES5: Local Weather Disturbances & Storms
- ES6: Oil Spills
- ES7: Shoreline Protection Projects
- ES8: Commercial & Recreational Use
- ES9: Navigation & Dredging Activities
- ES10: Habitat Restoration

Effects

- ES1: Groundwater Exchange
- ES2: Land Area & Elevation Change
- ES3: Sediment Budget & Transport
- ES4: Buffer/Hazard Protection
- ES5: Water Quality Dynamics
- ES6: Habitat Diversity
- ES7: Benthic Communities
- ES8: Bird Communities
- ES9: Terrestrial Mammals
- ES10: Vegetation Types
- ES11: Upper Trophic Level Marine Communities
- ES12: Fish & Shellfish Communities
- ES13: Reptiles & Amphibians

Attributes

- A1: Social Considerations
- A2: Hydrological Processes
- A3: Water Quality Constituents
- A4: Island Morphology
- A5: Substrate Characteristics
- A6: Key Coastal & Marine Faunal Species
- A7: Key Coastal & Marine Habitats

Performance Measures

- PM 1: Access to Recreational/Cultural Activities, Impacts to Properties
- PM 2: Waves, Currents, Velocity, Tides, Groundwater
- PM 3: Salinity, Temperature, Turbidity, Nutrients
- PM 4: Elevation, Bathymetry, Slope, Width
- PM 5: Grain Size, Color, Texture, Porosity
- PM 6: Species Composition, Abundance, Biomass, Distribution
- PM 7: Habitat Composition, Vegetation Distribution, Land/Water

2.2 Goals and Objectives

The goal of the Alabama Barrier Island Restoration Assessment is to investigate viable options for the restoration of Dauphin Island as a sustainable barrier island to protect and restore island resources, including habitat and living coastal and marine resources, as well as protect the coastal resources of the Mississippi Sound/Mobile Bay and the southern portion of Mobile County, Alabama including the expansive Heron Bay wetlands. Some of the questions this study was designed to help answer include:

- Is restoration of Dauphin Island feasible? For example, can the habitats and living resources that depend on it be increased and sustained over a longer period of time (20 years) with the appropriate amount of financial resources invested in island restoration?
- Is there a feasible option to support beneficial use of dredged material to aid in restoration of Dauphin Island?
- Would natural processes (such as wave action and sand transport) support or degrade island resources over time?
- How should island restoration be configured (i.e., width, height) for resilience to winter and tropical storms?
- Would Dauphin Island withstand future storms if restored?
- Would restoration increase and/or conserve the habitats that support long-term living resources damaged by the DWH spill?
- Would successful restoration of the East End be different from the West End?
- What are the most feasible and cost-effective restoration alternatives that support a sustainable design?

The project objectives developed in this feasibility study were formulated by the State of Alabama Lands Division and the U.S. Army Corps of Engineers management team using scoping sessions with the public, directed stakeholder elicitations, and expert panels from academia, State and Federal partners, non-governmental organizations, and consultants. Objectives within existing natural resource management or restoration plans were also compiled and considered such as: the Dauphin Island Strategic Plan funded by the Town of Dauphin Island; the Alabama Coastal Comprehensive Plan; and plans prepared by the Mississippi-Alabama Sea Grant Consortium, the University of Southern Mississippi, the Alabama Department of Conservation and Natural Resources, the Dauphin Island Sea Lab and Mobile Bay National Estuary Program. The project objectives identified below were used to screen and select restoration measures for evaluation.

Project objectives

The overall planning objective of the project is to achieve long-term sustainability of Dauphin Island. In order to assess that fundamental objective, the following broad project objectives were identified:

Objective 1: Restore ecological function of Dauphin Island to support the coastal region by maximizing habitat and focal species.

Objective 2: Restore physical processes affecting morphology of Dauphin Island.

Objective 3: Minimize social impacts associated with impacted properties, infrastructure, human use, and cultural resources.

Objective 4: Minimize project costs.

These objectives may be refined upon the final identification of restoration actions to be included in the selected alternative.

2.3 Restoration Measures

The restoration measures considered for inclusion in a selected plan fall under four ecosystem restoration measure types: (1) Ebb Tidal Shoal; (2) Gulf Beach; (3) Back Barrier and Marsh Restoration; and (4) Land Acquisition. The details of individual measures are included in Table 1.

Table 1. Project Measures

Measure	Description	Benefits
Ebb Tidal Shoal		
Pelican Island Southeast Nourishment	Place 4.5 million cubic yards (cy) of sand SE of existing Pelican Island. Supply sand to nearshore littoral system.	Create 240 acres of intertidal beach and barrier flat. Reduce loss of managed lands and piping plover critical habitat. Reduce wave energy and shoreline erosion along East End of Dauphin Island
Sand Island Platform Nourishment	Place 4.3 million cy of sand along Sand Island (-8 to -6 ft North American Vertical Datum (NAVD88)). Build up shoal system around Sand Island Lighthouse and supply sand to nearshore littoral system.	Create 127 acres of submerged offshore sand along ebb tidal shoal system. Directly feed Pelican Island and Sand Island shoals. Reduce shoal loss around Sand Island Lighthouse.
Gulf Beach		
East End Beach and Dune Restoration	Place 1.2 million cy of sand along shoreline to construct a beach and frontal dune (7 ft height x 25 ft width) with native vegetation. Install 3,200 ft of sand fencing.	Restore 35 acres of beach and dune habitat. Reduce loss of managed lands. Reduce storm risk to an additional 50 acres of beach, dune, woody vegetation, and freshwater lake habitats.
West End Beach and Dune Restoration (No Buyouts)	Place 4.2 million cy of sand along shoreline. Construct frontal dune (7 ft height x 25 ft width) with native vegetation. Install 14,000 ft of sand fencing.	Restore 200 acres of beach and dune habitat. Reduce loss of piping plover critical habitat. Reduce storm risk to an additional 100+ acres of beach, dune, intertidal flat, and intertidal marsh habitats.
West End Beach and Dune	Remove 225 residential structures.	Restore 200 acres of beach and dune habitat.

Measure	Description	Benefits
Restoration (Voluntary Buyouts)	Place 3.1 million cy of sand along shoreline to construct a beach and frontal dune (5 ft height x 30 ft width) with native vegetation. Install 14,000 ft of sand fencing.	Reduce loss of piping plover critical habitat. Reduce storm risk to an additional 100+ acres of beach, dune, intertidal flat, and intertidal marsh habitats. Reduce storm damage to 225 residential structures.
West End Beach and Katrina Cut Beach and Dune Restoration (Voluntary Buyouts)	Remove 225 residential structures. Place 7.9 million cy of sand along shoreline to construct a beach and frontal dune (5 ft height x 30 ft width) with native vegetation. Install 14,000 ft of sand fencing.	Restore 450 acres of beach and dune habitat. Reduce loss of managed lands and piping plover critical habitat. Reduce storm risk to an additional 280+ acres of beach, dune, intertidal flat, and intertidal marsh habitats. Reduce storm damage to 225 residential structures.
Katrina Cut Structure Removal	Remove Katrina Cut Structure. Excavate 230,000 tons of stone.	Restore 27 acres of back barrier flat, intertidal flat, and intertidal beach. Restore piping plover critical habitat. Slight reduction to breaching at ends of structure. Allow breaching in a natural area per natural processes for maintaining barrier island.
Back Barrier and Marsh Restoration		
2010 Borrow Pits Restoration	Place 280,500 cy of material in the 31 abandoned 2010 borrow pits.	Restore intertidal and barrier flat habitat. Increase back barrier meadow and wetland habitats. Restore piping plover critical habitat. Provide platform for migration of intertidal marsh under rising sea level.
Marsh Habitat Restoration Behind Katrina Cut	Place 1.1 million cy of sand along lee of Katrina Cut Structure. Plant 1.6 million native marsh plants.	Restore 75 acres of intertidal marsh habitat. Reduce loss of managed lands and piping plover critical habitat.

Measure	Description	Benefits
		Reduce lee side damage to Katrina Cut Structure.
Aloe Bay Beneficial Marsh Restoration	Place 34,000 cy of sediment along lee of DI within Aloe Bay. Plant 105,000 native marsh plants. Construct 1,900 ft low crested rubble mound or bioengineered breakwater.	Restore 6 acres of intertidal marsh. Reduce lee side shoreline erosion in project area.
Graveline Bay Marsh Restoration	Place 162,000 cy of sediment along lee of DI within Graveline Bay. Plant 623,000 native marsh plants.	Restore 25 acres of intertidal marsh. Reduce lee side shoreline erosion in project area.
West End Back Barrier Herbaceous Dune Plant Restoration	Plant 120,000 native dune plants in historic vegetated dune footprint along developed West End. Install 19,000 ft of sand fencing.	Restore 21 acres of herbaceous dune habitat. Restore piping plover critical habitat. Rebuild island elevation.
Land Acquisition		
West End Land Acquisition	Acquire approximately 720 acres of habitat west of Katrina Cut.	Conserve 720 acres of beach, dune, shrub, flat, and tidal pool habitats for various resident and migratory birds. Conserve critical habitat for piping plovers.
Mid-Island Land Acquisition and Management Phase I	Acquire approximately 10 acres of undeveloped beach and dune habitat located west of the public fishing pier. Enhance control of public access.	Conserve 10 acres of critical wintering habitat for resident and migratory birds. Reduce development risk.
U.S. Coast Guard Property Acquisition	Acquire approximately 7.5 acres of habitat.	Conserve 7.5 acres of scrub/shrub, dune, maritime forest, and beach habitats. Conserve habitat for resident and migratory birds. Enhance education through open laboratory use by Dauphin Island Sea Lab.
Dauphin Island 39 Parcel Property Acquisition: Parcel A – West End	Acquire approximately 518 acres on the west end of Dauphin Island along the Mississippi Sound.	Conserve 518 acres of habitat for shorebirds, fish, and marine invertebrates. Reduce development risk.
Dauphin Island 39 Parcel Property Acquisition:	Acquire approximately 340 acres of wetland and open water habitat south and west of the southern edge of Dauphin Island.	Conserve 340 acres of habitat for wading birds, waterfowl, fish, and marine invertebrates. Reduce development risk.

Measure	Description	Benefits
Parcel B – Graveline Bay		
Dauphin Island 39 Parcel Property Acquisition: Parcel C – Aloe Bay	Acquire approximately 76 acres of shallow open water habitat in the Aloe Bay area of Mississippi Sound.	Conserve 76 acres of habitat for aquatic species.
Dauphin Island 39 Parcel Property Acquisition: Parcel D – Little Dauphin Island Bay	Acquire approximately 150 acres of shallow open water habitat in Little Dauphin Bay and Mississippi Sound.	Conserve 150 acres of habitat for aquatic species.
Dauphin Island 39 Acquisition: Parcel E – East End	Acquire approximately 4 acres of undeveloped land throughout the East End of Dauphin Island.	Conserve habitat for resident and migratory birds.
Tupelo Gum Swamp Land Acquisition	Acquire approximately 10 acres of gum swamp on Dauphin Island.	Conserve 10 acres of critical habitat for resident and migratory birds. Provide ecotourism opportunity by developing birding trails. Reduce development risk.
Gorgas Swamp Land Acquisition	Acquire approximately 10 acres of swamp.	Conserve 10 acres of critical habitat for resident and migratory birds. Provide ecotourism opportunity by developing birding trails. Reduce degradation from all-terrain vehicle traffic.
Steiner Property Acquisition	Acquire approximately 12 acres of undeveloped land.	Conserve 12 acres of critical habitat for migratory and wading birds and waterfowl. Provide ecotourism opportunity by developing birding trails. Reduce development risk.

2.4 Sources of Uncertainties

A fundamental tenet of AM is decision-making and achieving desired project outcomes in the face of uncertainties. The MAM program provides a framework for identifying, analyzing, and

managing uncertainties. Scientific uncertainties and technological challenges are inherent with any large-scale restoration project with the principal sources of uncertainty typically including (1) incomplete description and understanding of relevant ecosystem structure and function, (2) imprecise relationships between project management actions and corresponding outcomes, (3) engineering challenges in implementing project alternatives, and (4) ambiguous management and decision-making processes. It is important to determine the type of risk each uncertainty comprises and to discern what constitutes sufficient knowledge to proceed considering those risks.

Identified uncertainties associated with the restoration measures considered under this study include:

- Natural variability in ecological and physical processes (e.g., geomorphic variability and barrier island evolution).
- Life expectancy of the barrier island system without continued restoration and sand placement.
- The long-term fate of placed material.
- Climate-change variability, such as tropical cyclone frequency, intensity, and timing.
- Climate-change effects in redistributing sand placed as part of the project.
- Future rate of relative sea level rise (subsidence plus eustatic variability), how much sea level will rise at the barrier islands, whether the rate of rise will be relatively constant or accelerate and the island's response.
- Sediment utilization if storm impacts occur to historic and cultural resources.
- Borrow area impacts to sediment transport processes.
- Socio-economic and cultural, including effects on commercial and recreational activities, properties and infrastructure, and historic and cultural resources.

Climate change and rates of sea level rise are important scientific uncertainties for barrier island projects. These uncertainties were included in the forecast modeling of Dauphin Island by selecting three static sea-level increases (0.3 m, 0.5 m, and 1.0 m) derived from the USACE sea level change curve calculator ([version] 2017.55) for low, intermediate and high curves and the National Oceanic and Atmospheric Administration (NOAA) 1966 to 2017 local relative sea level trends that are reported for the Dauphin Island tide station 8735180. The future sea level rise scenarios provide understanding of potential effects that can be incorporated into the planning, engineering and design, construction, operation and maintenance, and monitoring of selected alternatives. Ultimately, identifying and analyzing uncertainties and their associated risks allows the project team to discern what constitutes sufficient knowledge to proceed with a proposed course of action or how best to adaptively manage.

2.5 Rationale for Monitoring & AM Risk and Uncertainty Management

The primary reason for implementing AM is to increase the likelihood of achieving desired project outcomes given the uncertainties identified in Section 2.4. Adaptive management works best when it is tailored to the specific problem(s), designed to ensure accountability and enforceability, used to promote useful learning, and supported by sufficient funding (Doremus et al., 2011). Although all restoration projects should consider AM, there may be some projects or increments of project for which AM may not be applicable. AM is warranted when there are consequential decisions to be made, when there is an opportunity to apply learning, when the objectives of management are

clear, when the value of reducing uncertainty is high, and when a monitoring design can be put in place to reduce uncertainty (Williams et al., 2009). Adaptive management should not be used where or when there is a lack of flexibility in project designs and mistakes may be irreversible, when learning is unlikely on the relevant time scale, or where no opportunity exists to revise or reevaluate decisions (Doremus et al., 2011).

Once a selected plan is identified through the Alabama Barrier Island Restoration Assessment, an evaluation should determine if AM is applicable and would better enable the project to meet stated goals and objectives. Several questions will be considered to determine if AM could be applied to the project or a portion of the project:

1) Are the ecosystems to be restored sufficiently understood in terms of hydrology and ecology, and can project outcomes be accurately predicted given recognized natural and anthropogenic stressors?
2) Can the most effective project design and operation for achieving project goals and objectives be readily identified?
3) Are the measures for this restoration project performance well understood and agreed upon by all parties?
4) Can project management actions be adjusted in relation to monitoring results?

A 'No' answer to questions 1-3 and a 'Yes' answer to question 4 qualifies the project as a candidate that could benefit from AM.

3.0 Monitoring Plan

An effective monitoring program is required to determine if project outcomes are consistent with original project goals and objectives. The strength of a monitoring program developed to support AM lies in the establishment of feedback between continued project monitoring and corresponding project management. Consistent with the USACE Civil Works (CECW-PB) Memo dated 31 August 2009, the monitoring plan: *"…includes the systemic collection and analysis of data that provides information useful for assessing project performance, determining whether ecological success has been achieved, or whether Adaptive Management may be needed to attain project benefits."*

The elements proposed in this section include the elements that are typical for barrier island restoration project in the Gulf region. It is recommended that monitoring data collection occurs pre-construction, during construction, and post-construction monitoring to determine barrier island restoration success. Any additional monitoring that will be collected during construction by contractors as required by project plans and specifications that may support the monitoring proposed in the MAM plan should also be included or referenced when that information becomes available. Monitoring should continue until the trajectory of ecological and/or physical process changes as defined by project-specific objectives in the selected alternative meet the success criteria. It is anticipated that a 10-year post-construction monitoring period will be needed to determine if success criteria have been met. No further monitoring needs to be performed once success has been achieved.

Monitoring activities should utilize and leverage all existing data and monitoring guidance pertinent to developing a project-level MAM plan and evaluating the project. Integrating with existing monitoring efforts underway improves consistency in collection efforts and commonly reduces costs. Monitoring and research programs that could provide leveraging opportunities include:

- RESTORE Council Monitoring and Assessment Program, Monitoring Inventory and Baseline Assessments Compilation
- Natural Resources Damage Assessment, Monitoring and Adaptive Management Manual
- Gulf of Mexico Avian Monitoring Network, Strategic Avian Monitoring Guidelines
- National Academy of Science, "Effective Monitoring to Evaluate Ecological Restoration in the Gulf of Mexico" Report
- Dauphin Island Sea Lab, Alabama Center for Ecological Resilience
- U.S. Geological Survey (USGS) Barrier Island Evolution Research Project
- USGS Mississippi Water Science Center Data Collection
- National Park Service Inventory and Monitoring Program at Gulf Islands National Seashore
- Mississippi Coastal Improvements Project
- Louisiana Barrier Island Comprehensive Monitoring Program
- USACE National Coastal Mapping Program

3.1 Monitoring Plan Elements

Defining and assessing progress towards meeting project objectives are crucial components of the MAM program. Table 2 outlines the proposed performance measures, desired outcomes and minimum monitoring design that may be needed to measure restoration progress, determine ecological success and support the AM program should changes need to be made to improve project performance. This section identifies the potential performance measures associated with the current project objectives. The performance measures should be refined, using the CEM, and finalized once a construction project or restoration alternative is selected.

Table 2. Proposed Performance Measures, Desired Outcomes, and Monitoring Design

Objective 1. **Restore ecological function of Dauphin Island to support the coastal region by maximizing habitat and focal species.**	
(1) Measure Type(s):	Ebb Tidal Shoal; Gulf Beach; Back Barrier and Marsh Restoration; Land Acquisition
Performance Measure(s):	Habitat Composition, Vegetation Distribution and Land/Water
Desired Outcome:	Increase the habitat diversity and acreage of emergent and submerged habitats including barrier flats, beach, dune, intertidal flats, intertidal beach, intertidal marsh, woody vegetation, and woody wetlands.
Monitoring Design Summary:	High-resolution orthophotography and light detection and ranging (lidar) should be collected annually before and during construction, and at two additional times within a 10-year monitoring effort. These data should be used to map habitats using the same methodology and classification scheme used to develop the 2015 habitat map (Enwright et al., 2017, Enwright et al., 2019) for Dauphin Island, Little Dauphin Island, and Pelican Island. Field

	investigations should be conducted to ground-truth various geomorphic and vegetation habitats in the field with corresponding signatures on orthophotography. Multitemporal satellite imagery (e.g., Sentinel-2 and Landsat 8) should be used to produce maps of water, sand, and vegetation for all available cloud-free available imagery for the entire MAM monitoring effort. These data should be used to understand changes in land/water and habitat dynamics before and after restoration measures are implemented.
(2) Measure Type(s):	Gulf Beach; Land Acquisition
Performance Measure:	Nesting Shorebirds Distribution and Abundance
Desired Outcome:	Improve nesting potential in newly created habitats.
Monitoring Design Summary:	Trained bird monitors (observers) should conduct bird identification, counts, habitat use, behavior observations, and locational assessments of all observed solitary and colonial nesters, and winter migrants following the USFWS, Ecological Services Office, Jackson, Mississippi, non-breeding season survey guidelines, National Park Service guidelines (Byrne et al. 2009), or Florida Shorebird Alliance breeding bird protocol, or equivalent. At a minimum, monitoring (counts or relative abundance) should be conducted weekly or bi-weekly 1 year pre-, during, and 2 years post-construction after project equilibrium. Sampling interval/frequency should be consistent over all years. Nests should be monitored to minimize nest loss during construction of Gulf beach measures and also to evaluate changes in nesting effort by species over time. Tracking of emergent and submerged habitat types over a 10-year post-construction monitoring period will be used with any available data as identified through the Gulf of Mexico Avian Monitoring Network to help access nesting potential over time.
Objective 2. **Restore physical processes of Dauphin Island**	
(1) Measure Type(s):	Ebb Tidal Shoal; Gulf Beach; Back Barrier and Marsh Restoration; Land Acquisition
Performance Measure(s):	Elevation and Derived Geomorphic Profiles (slope, width, shoreline change)
Desired Outcome:	Net loss of Dauphin Island area benefiting from the measure should not be greater than the long-term average identified in Smith et al. (2018) over the 10-year monitoring period.
Monitoring Design Summary:	To capture changes, simultaneous near-vertical aerial imagery and lidar surveys should be acquired before and after construction and at two additional times over a 10-year post-construction monitoring period. To evaluate the effectiveness of the restoration design, measurements should be compared with previous measurements of historic shoreline change rates, foreshore slopes, elevations and volumetric changes within the system when combined with bathymetric surveys following approaches outlined in Smith et al. (2018) or equivalent.
(2) Measure Type(s):	Ebb Tidal Shoal; Gulf Beach

Performance Measure:	Bathymetry
Desired Outcome:	Increase sediment availability for littoral transport along Dauphin Island.
Monitoring Design Summary:	Bathymetric surveys of the nearshore should be collected at similar time intervals to island morphology and shoreline change to track the subaqueous movement of sand transported from the subaerial beach during initial beach adjustments toward dynamic equilibrium and in response to storm events. Single and multi-beam approaches should be used as outlined in DeWitt et al. (2017) and Flocks et al. (2018) or equivalent.
Objective 3. **Minimize social impacts associated with impacted properties, infrastructure, human use, and cultural resources**	
(1) Measure Type(s):	Ebb Tidal Shoal; Gulf Beach; Back Barrier and Marsh Restoration; Land Acquisition
Performance Measure:	Land/Water
Desired Outcome:	Emergent beach, dunes, marshes as well as shoal platforms continue to buffer public infrastructure and/or significant cultural resources such as the Sand Island Lighthouse.
Monitoring Design Summary:	Aerial imagery and lidar surveys should be acquired before and after project construction, and at two additional times over a 10-year monitoring period. Bathymetric surveys should also be collected as described in objective 2.
(2) Measure Type(s):	Ebb Tidal Shoal; Gulf Beach; Back Barrier, Marsh and Tidal Flat Restoration; Land Acquisition
Performance Measure:	Access or Direct Impact to Properties Based on Existing Types of Use (e.g., hunting, fishing, or other recreational use)
Desired Outcome:	Minimize impacts to public and private properties.
Monitoring Design Summary:	To be determined upon selection of restoration alternative.
Objective 4. **Minimize project costs**	
Measure Type(s):	Ebb Tidal Shoal; Gulf Beach; Back Barrier and Marsh Restoration; Land Acquisition
Performance Measure:	Project costs
Desired Outcome:	Design, construct, and operate and maintain selected alternative within identified budget.
Monitoring Design Summary:	To be determined upon selection of restoration alternative.

4.0 Assessment

The assessment phase of the implementation framework (Figure 3) compares the results of the monitoring efforts to the Alabama Barrier Island Restoration Assessment performance measures that reflect the goals and objectives of the restoration action.

This assessment process measures the progress of barrier island restoration in relation to the stated project goals and objectives, performance measures, and desired outcomes. The assessments

should continue through the life of the project or until it is decided that the project has successfully achieved (or cannot achieve) its goals and objectives.

4.1 Assessment Process

The MAM team should identify a combination of qualitative and quantitative methods for comparing the values of the performance measures produced by monitoring with the selected values of those measures that define criteria for decision-making.

Appropriate statistical comparisons (e.g., hypothesis testing, ANOVA, multivariate methods) should be used to summarize monitoring data and compare these data with stated metrics. Assessments should be documented as part of the project reporting and data management system.

A MAM team should collaborate with project managers and decision-makers to define significant differences between the values of monitored performance measures and the desired values that will constitute variances. Variances should be used to recommend AM actions, including (1) continuation of the project without modification, (2) project modifications, (3) consideration of new project features, or (4) termination of the project.

The CEM (Attachment 1) helps describe the linkages between stressors and performance measures and may be used to further define management actions based on monitored results. Assessments will help determine if the observed responses are attributable to restoration actions, and are either undesirable (e.g., are moving away from restoration goals) or in accordance with specified success criteria. If performance measures are not responding as desired or the stressor has not changed enough in the desired trajectory (for example, there is a reduction in important habitat), then AM considerations should be identified by a MAM team. If the stressor has changed as expected/desired and the performance measure has not, additional research may be necessary to understand why.

At this time, it is proposed that an initial project assessment be completed using pre-construction baseline data. Assessments are recommended to occur every 3 years and after acute events (e.g., tropical events) as necessary. Ultimately the determination of the frequency of assessment should be based on: (1) relevant temporal scales of the performance measures; (2) time required to obtain sufficient monitoring results and analysis for meaningful comparisons with the decision criteria; (3) consequences (ecological, socioeconomic, political, stakeholder) of variances with decision criteria; (4) logistical requirements to perform the assessment; (5) availability of the AM personnel; (6) funding; and (7) occurrence of acute events.

4.2 Documentation and Reporting

The performed assessments will be documented, and assessment results communicated to restoration management. This includes production of periodic reports that should measure progress towards project goals and objectives as characterized by the selected performance measures and decision criteria. The detailed reporting of monitoring results and AM evaluations should be in the form of an Assessment Report.

5.0 Data Management

Data management is a vital component of any long-term monitoring plan and the overall AM process. To maintain hydrological, biological, and physical data, the data must be stored, organized, and archived in an efficient and intuitive structure. All data collected should be analyzed for sensitivity and protected accordingly. Using a public and/or password-protected web interface, spatial and temporal aspects of applicable data types should be available for accessing restoration project progress and for use in AM decision-making. Each distinct data type collected should comply with its specific data format, delivery, and metadata standard. These standards were developed as a part of this study and are described in a Data Management Plan (DMP; Appendix A). The DMP is a living document and can be refined once a selected alternative is identified. Any new data types that are identified as a part of the selected alternative can be added to this DMP as well as additional details as appropriate, including information on data access, standardization, archival, and public release.

6.0 Adaptive Management and Decision-Making Processes

Scientific, technological, socio-economic, engineering, and institutional uncertainties are challenges inherent with any large-scale ecosystem restoration project, and are commonly the reason many programs rely on AM. However, many AM programs lack formalized decision structures to integrate learning about effectiveness of management actions and system dynamics and often utilize a "trial and error" approach to implementing corrective actions (NRC 2004, Rist et al., 2013). Formal AM, on the other hand, necessitates decision analytic models that explicitly address uncertainties to inform the iterative adjustment of actions through time. Structured Decision Making (SDM) is a collaborative process that includes stakeholders, managers and scientists to define management objectives, alternative actions, external drivers, predictive models, and quantitative methods for optimization and tradeoff analysis, which is used to identify optimal decisions and key uncertainties to be addressed through further gathering of information (Conroy and Peterson 2012, Gregory et al., 2012). This process has been used effectively to develop decision analytic models that can then be used to inform AM programs (Nichols et al., 2007, Conroy and Peterson 2012, Moore et al., 2013).

Under this study, SDM was used to determine objectives (Section 2.2) associated with the long-term sustainability and resiliency of the barrier island, its habitats, and the living and coastal marine resources and estuarine conditions it supports and to investigate the consequences of various alternatives for restoration of Dauphin Island. The SDM framework (Appendix I) provided a formal, transparent and replicable process for assessing tradeoffs among various restoration measure types (Ebb Tidal Shoal, Gulf Beach, Back Barrier and Marsh Restoration, and Land Acquisition) in optimally addressing the objectives. It also used modeling output to evaluate the major uncertainties associated with barrier island restoration, namely coastal storm frequency and intensity and sea level rise, and how the Dauphin Island system would respond to changes in climate and sea level over time. For example, this analysis helped decision-makers determine that a potential adaptive management action to account for these identified risks and uncertainties would be regular maintenance of intertidal marsh under accelerated sea level rise, especially under conditions of infrequent storms and low overwash depth (i.e., minimal elevation gain through sedimentation from overwash). Additional actions should be evaluated once a selected alternative is identified.

The monitoring plan should also be adaptively managed and adjusted as necessary based on any changes in management and stakeholder values. As part of the SDM framework, investigators identified habitat preferences for 44 species of value that are known to occupy Dauphin Island using a literature review and a non-metric multi-dimensional scaling (NMDS) model. Based on results, 11 proxy species represent the fauna that have strong habitat affinities on Dauphin Island: Seaside Sparrow, Reddish Egret, Oyster Catcher, Least Tern, Swainson's Warbler, Loggerhead Shrike, Brown Pelican, Piping Plover, Loggerhead Sea Turtle, Bottlenose Dolphin, and Gulf Sturgeon. Once objectives are refined upon the final identification of restoration actions to be included in the selected alternative, additional proxy species other than nesting birds may be included in the monitoring plan.

Once the decision makers choose restoration measures or portfolios of measures, the iterative phase of AM will begin and monitoring of restoration outcomes will ensue to both determine if objectives are being met and/or if changes in restoration measures are needed. The monitoring design (previously described Section 3) provides data necessary to evaluate progress towards achieving project goals and objectives, and to compare against modeled sea level rise scenario outcomes. This should inform iterative decisions about future project adjustments that may be needed through AM. The assessment reports should be used by the project sponsors to evaluate project status and any potential adaptive management needs.

7.0 Lessons Learned

The MAM program should allow for lessons learned and provide information and or recommendations to other programs and or future projects. Monitoring results from the project should help refine modeling, design, and predictions of physical and ecological processes that may in turn inform design of future restoration projects.

The MAM program should compile lessons learned, best practices and experiences relevant to implementation of barrier island restoration, technical and organizational challenges, and monitoring and adaptive management approaches. Lessons and experiences should be clearly documented with recommendations so that they can be easily applied to future barrier island and ecosystem restoration programs and projects. Documenting the lessons learned ultimately aims to reduce recurring, technical or programmatic issues that negatively impact cost, schedule, restoration project performance and success.

Future potential projects that may benefit from lessons learned include operation and maintenance of Mobile Harbor Federal Navigation Channel and other state and local planning initiatives including the planning efforts in the State of Mississippi.

8.0 Costs

The MAM program establishes a feedback mechanism whereby monitored conditions should be used to adjust or refine construction and or maintenance actions to better achieve project goals and objectives. This MAM plan includes the minimum monitoring actions determined necessary to evaluate project success for the four restoration measure types and provide information to inform the AM program. For cost estimating purposes, a 10-year post-construction monitoring period was considered. Once ecological success has been established, monitoring would cease.

The budget estimate of 3% of total project cost was identified based on costs of similar programs, the risks and uncertainties of confronting climate change and sea level rise, and the potential need for adaptive management actions. The estimate includes the monitoring necessary to determine project success, data management, adaptive management, and overall MAM program management. Detailed cost estimates will need to be developed as additional information becomes available.

9.0 References

Byrne, M.W., J.C. DeVivo, J.M. Maxfield, C.J. Wright, and E. Thompson. 2009. Methods for monitoring migratory and wintering shorebirds in Southeast Coast Network Parks. Natural Resource Report NPS/SECN/NRR—2009/107. National Park Service, Fort Collins, Colorado.

Byrnes, M.R., S.F. Griffee, and M.S. Osler. 2010. Channel dredging on geomorphic response at and adjacent to Mobile Pass, Alabama, ERDC/CHL-TR-10-8, U.S. Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory, Vicksburg, MS, 309 p.

Byrnes, M.R., J.D. Rosati, S.F. Griffee, and J.L. Berlinghoff. 2012. Littoral sediment budget for the Mississippi Sound barrier islands, ERDC/CHL-TR-12-9, U.S. Army Engineer Research and Development Center, Vicksburg, MS, 106 p.

Conroy, M.J. and J.T. Peterson. 2012. Decision Making in Natural Resource Management: A Structured, Adaptive Approach. John Wiley & Sons.

Convertino, M, C.M. Foranc, J.M. Keislerd, L. Scarlette, A. LoSchiavo, G.A. Kikerb, and I. Linkov. 2013. Nature Scientific Reports 3: 2922. Enhanced Adaptive Management: Integrating Decision Analysis, Scenario Analysis and Environmental Modeling for the Everglades.

DeWitt, N.T., C.A. Stalk, J.G. Flocks, J.C. Bernier, K.W. Kelso, J.J. Fredericks, and T. Tuten. 2017. Single-beam bathymetry data collected in 2015 nearshore Dauphin Island, Alabama: U.S. Geological Survey data release, accessed May 30, 2017, at https://doi.org/10.5066/F7BZ648W.

Doremus, H., W. Andreen, A. Camacho, D. Farber, R. Glicksman, D. Goble, B. Karkkainen, R. Rohlf, A. Tarlock, S. Zellmer, S. Jones, and Yee Huang. 2011. Making good use of adaptive management. Center for Progressive Reform White Paper #1104.

Enwright, N.M., S.M. Borchert, R.H. Day, L.C. Feher, M.J. Osland, L. Wang, and H. Wang. 2017. Barrier island habitat map and vegetation survey—Dauphin Island, Alabama, 2015: U.S. Geological Survey Open-File Report 2017–1083, 17 p., https://doi.org/10.3133/ofr20171083.

Enwright, N.M., L. Wang, S.M. Borchert, R.H. Day, L.C. Feher, and M.J. Osland. 2019. Advancing barrier island habitat mapping using landscape position information. Progress in Physical Geography: Earth and Environment, v. 43, no. 3, p.425–450.

Flocks, J.G., N.T. DeWitt, and C.A. Stalk. 2018. Analysis of seafloor change around Dauphin Island, Alabama, 1987–2015 (ver. 1.1, February 2018): U.S. Geological Survey Open-File Report 2017–1112, 19 p., https://doi.org/10.3133/ofr20171112.

Gregory, R., L. Failing, M. Harstone, G. Long, T. McDaniels, and D. Ohlson. 2012. Structured decision making: a practical guide to environmental management choices. John Wiley & Sons.

Knight, A.T., R.M. Cowling, M. Rouge, A. Balmford, A.T. Lombard, and B.M. Campbell. 2008. Knowing but not doing: Selecting priority conservation areas and the research-implementation gap. Conservation Biology, 22:610-617.

Moore, C.T., T.L. Shaffer, and J.J. Gannon. 2013. Spatial Education: Improving Conservation Delivery Through Space-Structured Decision Making. Journal of Fish and Wildlife Management, 4(1):199-210.

Morton, R.A. 2008. Historical changes in the Mississippi-Alabama barrier island chain and the roles of extreme storms, sea level, and human activities, Journal of Coastal Research, 1587-1600.

National Research Council. 2004. Adaptive Management for water resource planning. Washington, DC: National Academies Press. http://www.nap.edu/openbook.php?record_id=10972

Nichols, J. D., M. C. Runge, F. A. Johnson, and B. K. Williams. 2007. Adaptive harvest management of North American waterfowl populations: a brief history and future prospects. Journal of Ornithology, 148:S, 343-S349.

Nkhata, B., and C. Breen. 2010. A framework for exploring integrated learning systems for the governance and management of public protected areas. Environmental Management, 45:403-413.

Park, K, S.P. Powers, G.S. Bosarge, and S-H Jung. 2013. Plugging the leak: Barrier island restoration following Hurricane Katrina enhances larval retention and improves salinity regime for oysters in Mobile Bay, Alabama. Marine Environmental Research, 1-8.

Rist, L., B.M. Campbell, and P. Frost. 2013. Adaptive management: where are we now? Environmental Conservation 40:5-18.

Smith, R.J., D. Verissimo, N. Leader-Williams, R.M. Cowling, and A.T. Knight. 2009. Let the locals lead. Nature, 462:280-281.

Smith, C.G., J.W. Long, R.E. Henderson, and P.R. Nelson. 2018. Assessing the impact of open-ocean and back-barrier shoreline change on Dauphin Island, Alabama, at multiple time scales over the last 75 years: U.S. Geological Survey Open-File Report 2018–1170, 20 p., https://doi.org/10.3133/ofr20181170.

Twitchell, D.C., J.C. Flocks, E.A. Pendleton, and W.G. Baldwin. 2013. Geologic controls on regional and local erosion rates of three northern Gulf of Mexico barrier-island systems. Journal of Coastal Research, 63(sp1):32-45.

U.S. Army Corps of Engineers. 2009. Comprehensive Plan and Integrated Programmatic Environmental Impact Statement, Mississippi Coastal Improvements Program (MsCIP) Hancock, Harrison, and Jackson Counties, Mississippi. Army Engineer District, Mobile. Volume 1, Main Report. 417 p.

U.S. Army Corps of Engineers (USACE) 2011. DRAFT U.S. Army Corps of Engineers: A Systems Approach to Adaptive Management USACE Technical Guide.

Williams, B.K., R.C. Szaro, and C.D. Shapiro. 2009. Adaptive Management: The U.S. Department of the Interior Technical Guide. Adaptive Management Working Group, U.S. Department of the Interior, Washington, D.C. http://www.doi.gov/initiatives/AdaptiveManagement/TechGuide.pdf

10.0 Attachment 1. Dauphin Island Conceptual Ecological Model