RESTORE ACT Direct Component Multiyear Plan Matrix — Department of the Treasury										OMB Approval No. 1505-0250
Applicant Name:	Franklin County Florida, Board of County Commissioners									
1. MULTIYEAR PLAN VERSION (INITIAL OR AMENDMENT NUMBER):		Amendment #02	2a. DATE OF INITIAL MULTIYEAR PLAN ACCEPTANCE (mm/dd/yyyy):			1/22/2020	2b. DATE OF LAST MULTIYEAR PLAN ACCEPTANCE:			4/21/2023
3. CUMULATIVE DIRECT COMPONENT ALLOCATION AVAILABLE FOR DISTRIBUTION TO APPLICANT:			$12,527,373.74	4. TOTAL ALLOCATIONS PLUS KNOWN FUNDS NOT YET DEPOSITED IN TRUST FUND FOR DIRECT COMPONENT:						$23,598,703.30
5. Primary Direct Component Eligible Activity Further Described in Application (Static Field)	6. Activity Title (Static Field)	7. Location (Static Field)	8. Estimated Total Funding Contributions For Proposed Activity(ies)(refer to Instructions)				9. Proposed Start Date mm/dd/yyyy	10. Proposed End Date mm/dd/yyyy	11. Status (refer to Instructions)	
			8a. Direct Component Contribution	8b. Other RESTORE Act Contribution	8c. Other Third Party Contribution	8d. Total Contribution				
Restoration and protection of the natural resources, ecosystems, fisheries, marine and wildlife habitats, beaches, and coastal wetlands of the Gulf Coast Region	County-wide Dune Restoration	Approximately 11 miles of Franklin County coastline. St. George Island (4.0 miles), Alligator Point (5.0 miles), Bald Point (1.2 miles) and Carrabelle Beach (0.8	$2,100,826.00			$2,100,826.00	02-2024	07-2026	Grant Award RDCGR090518-01-00 issued on 02/01/2024 in the amount of $1,625,278.00 for dune construction and vegetation planting	
Coastal flood protection and related infrastructure	St. George Island Storm Water Drainage Improvements	The commercial district on St. George Island, which runs from 3rd St. East to 3rd St. West, from Gorrie Drive to Bayshore Drive, and covers approximately 70	$4,500,000.00			$4,500,000.00	08-2024	07-2026	Grant Application in the amount of $4,144,265.14 submitted for Treasury Review on 3/15/2024	
Infrastructure projects benefitting the economy or ecological resources, including port infrastructure	Franklin County Municipal Solid Waste Transfer Station	255 FL-65, Eastpoint, FL 32328 (County-wide)	$6,755,606.00			$6,755,606.00	10-2024	09-2026	Feasibility Study, including cost estimates for construction, completed May 15, 2023	
						$0.00				
						$0.00				
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						$0.00			
						$0.00			
						$0.00			
						$0.00			
						$0.00			
	12. ESTIMATED TOTAL FUNDING CONTRIBUTIONS FOR ACTIVITY(IES) (refer to Instructions)		$13,356,432.00	$0.00	$0.00	$13,356,432.00	**Please note: Grant awards may reflect non-material changes in proposed dates and estimated funding.**		

According to the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 1505-0250. Comments concerning the time required to complete this information collection, including the time to review instructions, search existing data resources, gathering and maintaining the data needed, and completing and reviewing the collection of information, should be directed to the Department of the Treasury, Office of Gulf Coast Restoration, 1500 Pennsylvania Ave., NW, Washington, DC 20220.

RESTORE ACT Direct Component Multiyear Plan Narrative

Department of the Treasury

OMB Approval No. 1505-0250

Directions: Use this form for the Initial Multiyear Plan and any subsequent amendments to an accepted Multiyear Plan. For amendments, include only new and/or materially modified activities.

Multiyear Plan Version (Initial or Amendment Number):	Amendment #02
Date of Initial Multiyear Plan Acceptance:	1/22/2020
Date of Last Multiyear Plan Acceptance:	4/21/2023

Eligible Applicant Name:	Franklin County Florida, Board of County Commissioners
Name and Contact Information of the Person to be contacted (POC) on matters concerning this Multiyear Implementation Plan:	
POC Name:	Erin Griffith
POC Title:	Fiscal Manager/Grants Coordinator (Authorizing Official)
POC Email:	erin@franklincountyflorida.com
POC Phone:	(850) 653-9783 Ext. 158

NARRATIVE DESCRIPTION:
1. A description of each activity, including the need, purpose, objective(s), milestones and location. Include map showing the location of each activity.

Project #1: County-wide Dune Restoration

Need: In Franklin County's coastal communities including, St. George Island, Alligator Point, Bald Point, and Carrabelle Beach, the beach and dune system are the first line of defense from storms and in many places need re-building. This area, approximately 16 miles in length, has been damaged by several recent hurricanes in which most of the dune system was leveled in certain areas. The beach dune community on Alligator Point is generally in poor condition and/or completely absent of dune stabilizing sea oats in certain areas . The typical shoreline habitat on Alligator Point has been completely compromised to a relatively low elevation primary dune and narrow berm. In addition, there is a documented need for the construction of a new ADA accessible dune walkover and new ADA accessible parking spots at St. George Island Lighthouse Park. These two (2) new activities are being added to the overall County-wide Dune Restoration project and are included in the County-wide Dune Restoration Study completed by MRD Associates, Inc. in April 2022.

Purpose: In April 2022, MRD Associates, Inc. completed a County-wide Dune Restoration Study funded with Planning Assistance dollars provided by the RESTORE Act Direct Component Program. This study identified four (4) shoreline segments along approximately 11 miles of coastline in need of restoration and provided cost-effective solutions to rebuild and increase the stability of the dunes. Based upon the findings and recommendations of this study, the County intends to pursue the construction template dune and coastal hammock restoration at the two county beach park locations: St. George Island's Lighthouse Park (Current Cost Estimate: $215,782) and Carrabelle Beach Park (Current Cost Estimate: $228,944) and implement a county-wide dune vegetation project (Current Cost Estimate: $257,250). A varied vegetation footprint of between 6 and 7.5 feet could be installed along the toe of the dune areas along 11 miles of public beaches (the four project segments shown in figure 27, page 34, of the attached report consisting of four miles of St. George Island, .8 miles of Carrabelle Beach, 5 miles of Alligator Point and 1.2 miles of Bald Point). Native coastal vegetation would be placed on 18" centers in staggered rows for a natural look. Approximately 171,500 plants would be needed for the county-wide effort at an estimated installed cost per plant of $1.25. Franklin County would obtain written consent from interested private property owners for the plants to be installed along the dune line. As cited in the study 'Native dune vegetation provides significant benefits to beaches, dunes, uplands and wildlife (FDEP, 2022). Salt tolerant dune plants: build protective dunes by trapping and stabilizing wind-blown beach sand, reduce erosion losses by wind and storms, provide a buffer against storm surges and salt spray, provide shelter for wildlife, and block light pollution for nesting and hatchling sea turtles.' In addition, Franklin County received multiple public comments regarding the lack of ADA accessibility to St. George Island Lighthouse Park and need for additional ADA accessible parking spots to accommodate persons with disabilities, so the County is proposing to add two (2) new activities to the overall County-wide Dune Restoration project in this Amendment #02 including the construction of a new ADA accessible dune walkover and additional ADA accessible parking spots at the adjacent County parking lot. More information regarding these planned improvements can be found in Figure 10.9 Dune Walkover Guidelines on Page 40 of the County-wide Dune Restoration Study attached. The estimated cost for these improvements is $475,548.00 and the project elements are further described in an attached memo provided by MRD Associates, Inc. titled *Preliminary Opinion of Probable Construction Costs* dated August 11, 2023.

Objectives: 1) Improve existing dune structures at public park facilities by increasing crest elevations, crest widths, and side slopes utilizing template dune restoration methods; 2) Improve existing dune structures by assisting beach-front property owners by planting vegetation to assist in the development and growth of the dunes on private property. 3) Provide ADA accessibility by constructing a new wooden ADA accessible dune walkover and the installation of a wide ADA accessibility mat which will also serve as beach access for emergency and first responder vehicle adjacent to the County beach parking area. 4) Increase the number of ADA accessible parking spots and improve the layout/design for accessibility in the County beach parking lot.

Milestones: 1) Prepare a final Scope of Work and Budget for Construction activities; 2) Prepare bid package meeting U.S. Treasury specifications and solicit bids for Construction Contractor; 3) Obtain permits for Construction from FDEP; 4) Select Construction Contractor and award Contract Agreement; 5) Notice to Proceed and Mobilization; 6) Complete Construction Scope of Work; 7) De-Mobilization; 8) Periodic Reports to Grantor; and 9) File Final Reports and complete Closeout of Grant Award Agreement

Location: Approximately 11 miles of shoreline in Franklin County, including the municipalities and shoreline segments of 1) St. George Island (R-73 to R-94), 2) Alligator Point (R-195 to R-222), 3) Bald Point (R-229 to R-235), 4) Carrabelle Beach, and 5) St. George Island Lighthouse Park.

Project #2: St. George Island Storm Water Improvements

Need: The commercial district on St. George Island, which runs from 3rd Street East to 3rd Street West, from Gorrie Drive to Bayshore Drive, has an existing storm water pond that provides treatment to approximately 25% of the commercial area. The appeal of the quaint coastal community has led to the increased desirability of the commercial area of St. George Island and there are several proposed developments underway that will increase the population, increase demand for commercial development, and therefore potentially increase storm water runoff as spaces that had previously been undeveloped become developed. Expanding storm water drainage capacity is necessary as the current storm water drainage facility is near capacity. Similarly, the commercial area is near sea-level which adds additional layers of difficulty with construction of storm water infrastructure. The County anticipates further development in the commercial district of St. George in the near future thus necessitating additional storm water drainage capacity and improvements.

Purpose: Franklin County contracted with Dewberry Engineers for the planning and design phase of the St. George Island Storm Water Improvements project. This phase was complete in September 2023 with the submission of final design plans and an approval for an Environmental Resource Permit by the Northwest Florida Water Management District and was funded with Planning Assistance dollars provided by the RESTORE Act Direct Component Program which determined the need for the installation of approximately 1,489 linear feet of 18" piping and 3,186 linear feet of 24" piping, and 3,270 square yards of asphalt patching and resurfacing, sod improvements, other required piping and restoration activities to complete the overall objectives of the St. George Island Stormwater Improvements project. The purpose of this project is to fund the construction phase of the St. George Island Stormwater Improvements project, which includes mentioned above to extend, enhance and construct storm water drainage facilities in order to increase the capacity for the commercial district of St. George Island. A grant application for $4,144,265.14 was submitted to Treasury on March 15, 2024.

Objective(s): 1) Increase storm water drainage capacity

Milestones: 1) Prepare a final Scope of Work and Budget for Construction activities; 2) Prepare bid package meeting U.S. Treasury specifications and solicit bids for Construction Contractor; 3) Obtain permits for Construction from FDEP; 4) Select Construction Contractor and award Contract Agreement; 5) Notice to Proceed and Mobilization; 6) Complete Construction Scope of Work; 7) De-Mobilization; 8) Periodic Reports to Grantor; and 9) File Final Reports and complete Closeout of Grant Award Agreement

Location: Zone 1: W Gorrie Drive, 1st Street W, W Gulf Beach Drive; Zone 2: W Pine Street to Franklin Blvd; Zone 3: W Bay Shore Drive to Franklin Blvd; Zone 4: 1st Street E; Zone 5: 2nd Street E to E Pine Street; Zone 6: E Pine Street to 3rd Street E [See attached map]

Project #3: Franklin County Municipal Solid Waste Transfer Station

Need: The existing 16.98 acre Franklin County Municipal Solid Waste Facility, permitted in 1995, serves all Franklin County municipalities and unincorporated areas, and approximately 8,452 housing units. On October 10, 2018, Hurricane Michael made landfall approximately 45 miles NW of Franklin County resulting in unprecedented damage to the Florida Panhandle, including Franklin County cities Apalachicola and Carrabelle, and coastal unincorporated areas of the County including Eastpoint, St. George Island, Lanark Village and Alligator Point. Debris left behind in the wake of Hurricane Michael took years of capacity off of the estimated useful life of the landfill. Franklin County estimates that within the next 7-9 years, the landfill will reach its full capacity which elevates this project to a community urgent need. Furthermore, due to Franklin County's proximity to the Gulf of Mexico, additional storms will further reduce capacity and lead to the closure of the landfill and eliminate the County's ability to process solid waste locally.

Purpose: Franklin County is coming to a crossroads whereas there are only two options to extend the capacity of the landfill: 1) the County will have to acquire or purchase a large tract of suitable land, permit and build a new landfill at an estimated construction cost of $10 to $15 million; OR 2) the County will construct a 'County Transfer Station' operation in lieu of a new landfill to dispose of waste at a private facility inland at an estimated cost of $6.75 million. Franklin County proposes pursuing option #2 to construct a transfer station operation with RESTORE Act Direct Component Program dollars. In July 2022, Franklin County contracted with Dewberry Engineers to conduct a Franklin County Municipal Solid Waste Transfer Station Feasibility Study in order to produce pre-construction design services. The Feasibility Study was completed in May 2023 and includes estimated costs to permit and construct a Municipal Solid Waste transfer station and administrative building utilizing capacity, intended size and level of service of the proposed facility based on current and future tonnages; estimate the manpower and equipment operations costs to properly operate and maintain the proposed transfer station; purchase equipment (i.e., wheel loader, tamping crane), and determine the estimated cost to transfer municipal solid waste to a selected disposal facility. Franklin County used the results of the Feasibility Study to formulate a scope of work and budget for construction costs.

Objective: 1) Construct Municipal Solid Waste Transfer Station operation and administrative building; and 2) Extend current capacity (remaining useful life) of existing landfill

Milestones: 1) Prepare a final Scope of Work and Budget for Construction activities; 2) Prepare bid package meeting U.S. Treasury specifications and solicit bids for Construction Contractor; 3) Obtain permits for Construction; 4) Select Construction Contractor and award Contract Agreement; 5) Notice to Proceed and Mobilization; 6) Complete Construction Scope of Work; 7) De-Mobilization; 8) Periodic Reports to Grantor; and 9) File Final Reports and complete Closeout of Grant Award Agreement

Location: All construction activities will take place at the existing Central Landfill location at 210 Highway 65, Eastpoint, FL 32328. Please see attached the final Site Plan included in the final Feasibility Study conducted by Dewberry Engineers. Should the location change after the approval of this MYP Amendment, the final location maps and approved Site Plan will be included in the construction grant application for RESTORE Act Direct Component funding.

2. How the applicant made the multiyear plan available for 45 days for public review and comment, in a manner calculated to obtain broad-based participation from individuals, businesses, Indian tribes, and non-profit organizations, such as through public meetings, presentations in languages other than English, and postings on the Internet. The applicant will need to submit documentation (e.g., a copy of public notices) to demonstrate that it made its multiyear plan available to the public for at least 45 days. In addition, describe how each activity in the multiyear plan was approved after consideration of all meaningful input from the public and submit documentation (e.g., a letter from the applicant's leadership approving submission of the multiyear plan to Treasury or a resolution approving the applicant's multiyear plan).

The Franklin County Multi-Year Implementation Plan, Amendment #02 was posted to the County's website on Thursday, April 25, 2024 and remained available until Monday, June 10, 2024 [45 days required]. It was also available in hard copy format at the Franklin County Courthouse and Courthouse Annex buildings during the public comment period. In addition, the Multi-Year Implementation Plan, Amendment #02 was advertised in The Apalachicola Times newspaper on Thursday, April 25, 2024 and Thursday, May 2, 2024 and the Panama City News Herald newspaper on Wednesday, April 24, 2024 and Wednesday, May 1, 2024.

[Include the description of any public comments received, how they were addressed and whether or not any changes were made as a result of the public comment period.] – Will be completed after the 45 day public comment period .

3. How each activity included in the applicant's multiyear plan narrative meets all the requirements under the RESTORE Act, including a description of how each activity is eligible for funding based on the geographic location of each activity and how each activity qualifies for at least one of the eligible activities under the RESTORE Act.

Project #1: County-Wide Dune Restoration

Geographic Requirement: This proposed project location includes approximately 11 miles of Franklin County coastline along the Gulf of Mexico, including St. George Island, Alligator Point, Bald Point and Carrabelle Beach. In addition, it includes the address of the St. George Island Lighthouse Park where the ADA accessible dune walkover and parking spot construction will take place.

Primary Eligible Activity: This proposed project was previously approved in the initial and Amendment #01 to the Multi-Year Implementation Plan as planning assistance for the RESTORE eligible activity of coastal flood protection and related infrastructure. However, after the completion of the County-Wide Dune Restoration Study, and the proposed construction elements and perceived benefits to the wildlife habitats within the proposed project area, we are re-classifying this project under the Restoration and protection of the natural resources, ecosystems, fisheries, marine and wildlife habitats, beaches, and coastal wetlands of the Gulf Coast Region eligible activity. Please see figure 27, page 34 of the completed County-Wide Dune Restoration study, provided by MRD Associates, attached as ‘Exhibit 1’ for more detail on the proposed project scope and location.

Project #2: St. George Island Storm Water Drainage Improvements

Geographic Requirement: This proposed project location is St. George Island, which is an island and Census-designated place in Franklin County, FL. It is within walking distance to the coastline of the Gulf of Mexico.

Primary Eligible Activity: This proposed project was previously approved in the initial and Amendment #01 to the Multi-Year Implementation Plan as planning assistance for the RESTORE eligible activity of infrastructure projects benefitting the economy or ecological resources, including port infrastructure. However, after the planning and design work was completed on the St. George Island Storm Water Drainage Improvements we are re-classifying this project under the coastal flood protection and related infrastructure eligible activity. Please see the St. George Island Storm Water Drainage Improvements planning and design documents, provide by Dewberry Engineers, attached as ‘Exhibit 2’ for more detail on the proposed project scope and location.

Project #3: Franklin County Municipal Solid Waste Transfer Station

Geographic Requirement: This proposed project location is Eastpoint, FL, located in Franklin County, and services households located along or near the coastline of the Gulf of Mexico.

Primary Eligible Activity: This proposed project was previously approved in in Amendment #01 of the Multi-Year Implementation Plan, and has been updated to include findings from the completed Feasibility Study. It was determined by Franklin County, and confirmed by U.S. Department of Treasury, that this proposed project should be classified under the infrastructure projects benefitting the economy or ecological resources, including port infrastructure eligible activity.

4. Criteria the applicant will use to evaluate the success of the activities included in the multiyear plan narrative in helping to restore and protect the Gulf Coast Region impacted by the Deepwater Horizon oil spill.

Project #1 County-Wide Dune Restoration:

Project success will be measured by:

1. The template dune restoration project construction at the county-owned beach parks will help protect the coastline from erosion and added flood protection of critical public tourism infrastructure in areas prone to Gulf Coast storms;
2. The sand fencing and planting of new vegetation’s ability to create new wildlife habitats and protect existing habitats along the coastline; and
3. An increase to accessibility of St. George Lighthouse Park for persons with disabilities.

Project #2: St. George Storm Water Drainage Improvements

Project success will be measured by:

1. The ability to re-route storm water to existing storm water facilities; and
2. The ability to extend the capacity of the existing storm water facilities.

Project #3: Franklin County Municipal Solid Waste Transfer Station

Project success will be measured by:

1. The transfer station operation's ability to extend the capacity and estimated useful life of the existing landfill site.

5. How the activities included in the multiyear plan narrative were prioritized and list the criteria used to establish the priorities.

Project #1: County-Wide Dune Restoration and Project #2: St. George Storm Water Drainage Improvements were prioritized based on their readiness to proceed forward to construction. The planning and design phases for the County-Wide Dune Restoration and St. George Island Storm Water Drainage Improvements project are complete. Final engineering plans have been reviewed and approved by both the County and State regulatory agencies, such as Florida Department of Transportation (FDOT) and Florida Department of Environmental Protection (FDEP).

Criteria used: 1) Readiness to proceed to construction; and 2) Prevention of further damage or capacity reduction from Gulf Coast storm events.

Project #3: A Feasibility Study to determine a proposed Scope of Work and estimated construction costs to achieve project objectives for the Franklin County Municipal Solid Waste Transfer Station is complete and included in this Amendment #02 to the Multi-Year Implementation Plan for review. This project was prioritized because of its community urgent need status.

Criteria used: 1) Preliminary engineering and design is complete; and 2) Prevention of further capacity reduction from Gulf Coast storm events.

6. If applicable, describe the amount and current status of funding from other sources (e.g., other RESTORE Act contribution, other third party contribution) and provide a description of the specific portion of the project to be funded by the RESTORE Act Direct Component.

Project #1 County-Wide Dune Restoration – The construction of this project is estimated to cost $2,100,826.00 and will be funded 100% with RESTORE Act Direct Component funding. A grant application in the amount of $1,625,728.00 was awarded in February 2024 for dune restoration construction and vegetation planting. An Amendment to this Grant Award Agreement will be submitted for an additional $475,548.00 to cover the estimated costs of construction of a new ADA accessible dune walkover, the installation of a wide ADA beach access mat and addition of ADA accessible parking spots/ADA design improvement in the County parking lot adjacent to the dune walkover.

Project #2 St. George Storm Water Drainage Improvements – The construction of this project is estimated to cost $4,500,000.00 and will be funded 100% with RESTORE Act Direct Component funding. A grant application in the amount of $4,144,265.14 was submitted to Treasury on March 15, 2024. Due to the fact that a Construction Contractor has not been selected, we are keeping the estimated budget of $4,500,000.00 for construction costs in case bids come back higher than expected.

Project #3: Franklin County Municipal Solid Waste Transfer Station and Administrative Building– The construction of this project is estimated to cost $6,755,606.00 based on the completed Feasibility Study and will be funded 100% with RESTORE Act Direct Component funding.

EXHIBIT 1

County-wide Dune Restoration Study

Franklin County, Florida
County-Wide Dune Restoration Study

Source: MRD Associates

PREPARED FOR:

Franklin County Board of County Commissioners
33 Market Street, Suite 203
Apalachicola, Florida 32320

PREPARED BY:

mrd associates, inc.
Coastal, Marina & Water Resources Engineering
543 Harbor Boulevard, Suite 204
Destin, Florida USA 32541
850.654.1555 • (fax) 850.654.0550
www.mrd-associates.com

April 28, 2022
MRD Project No. 21-495.001

Executive Summary

The purpose of this investigation was to identify cost-effective solutions to rebuild and increase the stability of the dunes throughout the Franklin County study shoreline. There are four (4) shoreline segments included in this study 1) St. George Island shoreline between R-73 to R-94, 2) Alligator Point between R-195 to R-222, 3) Bald Point between R-229 to R-235, and 4) Carrabelle Beach.

The primary constraints that determine the types of dune enhancement or restoration possible for a particular stretch of shoreline were: 1) the height of the existing dune system, 2) the width of the existing dry beach berm, 3) the location of upland structures and infrastructure relative to the shoreline, and 4) the level of storm protection provided by the existing beach and dune system. The greatest benefit of constructing a continuous, contiguous dune feature is to provide a barrier to storm events, reduce overtopping and flooding to the back dune areas, mitigating for historic dune erosion and creating wildlife habitat.

Three conceptual dune types (A, B and C) were developed through an iterative process by revising the crest height and width to optimize the level of storm protection while maintaining a minimum berm width. A fourth option consists of vegetation and sand fence where there is not an adequate amount of room to construct a dune feature. The conceptual dune designs included location, crest elevations, crest widths, and side slopes.

There are some shoreline segments where there is not adequate room between the existing structures and the shoreline to construct a dune feature. In these locations vegetation and sand fencing can be placed to assist in the development and growth of dunes. It should be noted that the sand fence requires periodic maintenance to ensure the optimal long-term performance to capture wind-blown sediments. The fencing must be pulled up before it is buried by 2 feet of sand. Otherwise, it will be difficult to impossible to remove the fence and be completely covered making the fence ineffective at trapping sand. Post and rope fencing is used to direct pedestrian traffic away from the dune and to dune walkovers, beach and vehicular accesses and paths. “Keep Off the Dunes” signs should also be installed at the toe of the dune to inform and educate beach goes on the ecological importance of dunes systems.

The conceptual construction templates may need to be refined to fit along a particular beach segment depending on the specific conditions existing at the time of final design. Updated surveys will document the existing grades that will be used to develop the construction templates and update construction volumes. The preliminary opinion of probable construction costs in 2022 dollars were $7,546,557 for St. George Island, $5,032,130 for Alligator Point, $1,199,884 for Bald Point, and $228,944 for Carrabelle Beach. A price escalation was applied to these unit costs to account for the increased fuel costs since these projects were bid. The preparation of a budget for grant applications or construction should include an adjustment in the unit costs based on the anticipated design, permitting and construction schedule.

The proposed activities seaward of the CCCL will require a CCCL permit from FDEP. FDEP encourages the placement of beach quality sand and native dune vegetation to restore and enhance dune systems, therefore permitting is relatively straight forward. A USACE permit should not be required provided the proposed activity will occur upland of the High Tide line. Construction may be limited to outside of sea turtle nesting season which extends from May 1 to October 30. Permits and authorization from FDEP can be obtained in approximately 6-months or less from submitting a complete permit application that will also identify the borrow area(s) and sand quality.

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mrd associates, inc.

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1.0 Introduction

In June 2021, the Franklin County Board of County Commissioners retained the services of MRD Associates, Inc. (MRD) to prepare a County-Wide Dune Restoration Study along the Franklin County shoreline. This work has been performed under Agreement for Professional Services, executed on June 6, 2021, and commenced on August 2, 2021, upon receipt of the Notice to Proceed.

Sand dunes are naturally occurring dynamic coastal features which are formed by the accumulation of wind-blown sand and beach over wash. Damaged sand dunes resulting from severe storms or human activity can be repaired or rebuilt to restore ecological habitat, increase storm protection and provide a source of sand to replenish the beach. A dune restoration project should be designed to mimic the existing or historic natural dune patterns along the shoreline. Sand fences and dune plants can be used to stabilize the dune and trap sand more rapidly.

Franklin County, Florida is located in the eastern portion of the Florida Panhandle along the Gulf of Mexico *(Figure 1)*. There are four (4) shoreline segments included in this study 1) St. George Island shoreline between the Florida Department of Environmental Protection (FDEP) Reference Monument R-73.5 to R-93.8 (4.0 miles, 21,100 feet), 2) Alligator Point between R-195 to R-222 (5.0 miles, 25,950 feet), 3) Bald Point between R-229 to R-235 (1.1 miles, 5,950 feet), and 4) Carrabelle Beach (0.15 miles, 800 feet). The purpose of this investigation is to identify cost-effective options rebuilding and increasing the stability of the dunes throughout the identified 10.25-miles of Franklin County shoreline.

One valuable set of information that is mentioned frequently throughout this document are the FDEP "R-Monuments" which are reference points spaced approximately 1,000 feet apart along the gulf shoreline. They are used to correlate survey data over time to monitor and are also used to reference the location of coastal features and projects.

2.0 Oceanographic Data

Beach and dune changes are dependent on tides, storm surge and storm events, and are described in the following sections.

2.1 Tidal Datums

The tides along the Gulf of Mexico are primarily diurnal, becoming mixed during the 1/4 and 3/4 moon phases. Tidal datums in Franklin County were obtained from the NOAA Tides and Current Station 8728669 located at Sikes Cut near R-52 on the south-western edge of St. George Island, Station 8728488 located at South Carrabelle Beach, and Station 8728261 located on Alligator Point near R-207 which provides the tidal datums for both Alligator and Bald Point. This data is summarized in ***Table 1***.

2.2 Storm Surge

Predicted storm surge elevations along the Gulf of Mexico were obtained from the reports entitled, "*Design Storm Surge Hydrographs for the Florida Coast*" (FDOT, 2003) and "*SBEACH High-Frequency Storm Erosion Model Study for Franklin County*" (FDEP, 2016). The range of Storm surge elevations for various return periods in Franklin Count are listed in ***Table 2***. The combined total storm tide includes the effects of wave and wind set-up, astronomical tides and pressure.

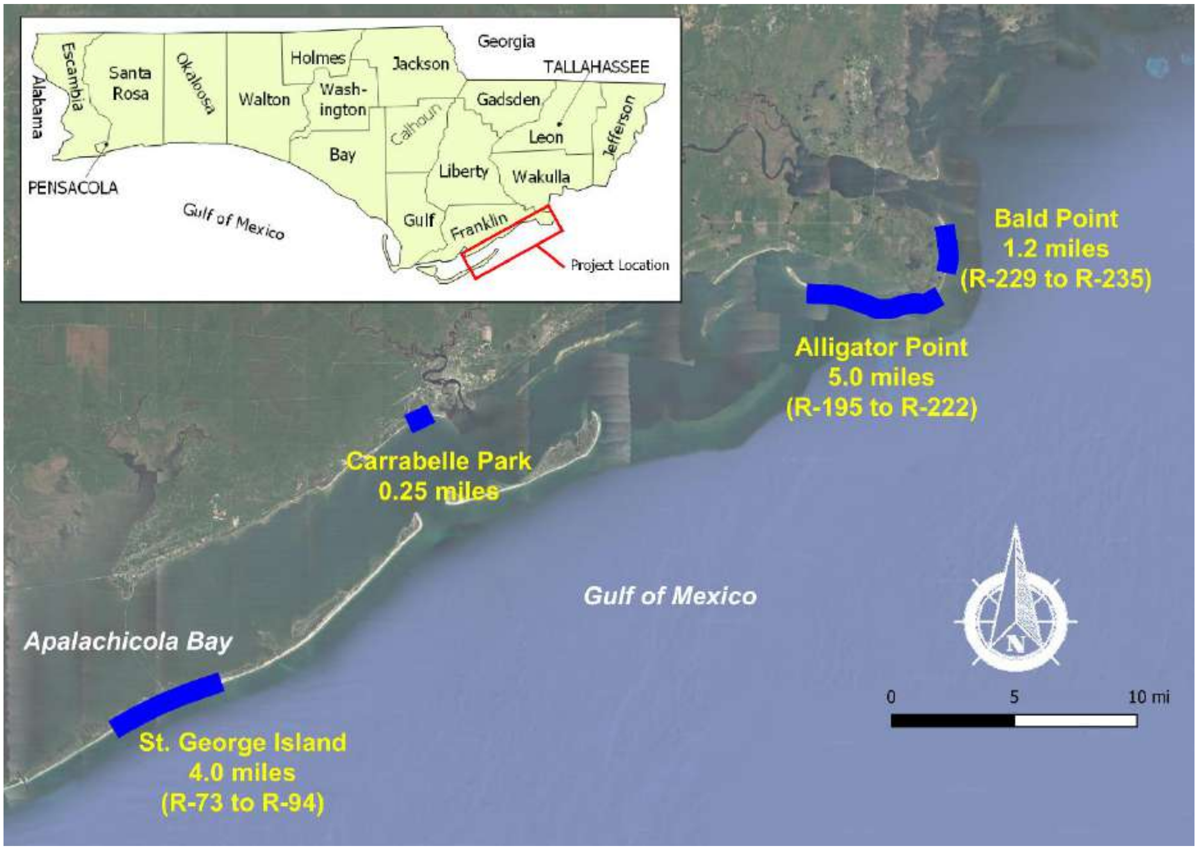

Figure 1. *Location map and project limits.*

Table 1. *Tidal datums along Franklin County, Florida . (feet, NAVD88).*

Datum	Sike's Cut	Carrabelle Beach	Alligator & Bald Point
Mean Higher High Water (MHHW)	+0.62	+0.99	+1.27
Mean High Water (MHW)	+0.39	+0.80	+1.05
Mean Tide Level (MTL)	-0.22	-0.03	0.07
Mean Low Water (MLW)	-0.83	-0.86	-0.92
Mean Lower Low Water (MLLW)	-1.35	-1.47	-1.50
Mean Tide Range	**1.22**	**1.66**	**1.97**

It should also be noted that there is an undefined correlation between return periods and hurricane categories. Return periods for a defined storm event is given as the probability of being equaled or exceeded in any one year (i.e., exceedance = 1/return period = 1/50 year = 0.02 or 2% chance per year) compared to a hurricane category which are based on the measured "Sustained Winds" in accordance with the Saffir-Simpson Hurricane Wind Scale.

***Table 2**. Combined total storm tide level (feet, NAVD88) for various Return Periods.*

Return Period (years)	**R-90 (St. George Island)** (feet, NAVD88)	**R-210 (Alligator Point, Bald Point)**
50	+9.7	+10.6
30	+8.6	+8.8
25	+8.1	+8.4
20	+7.6	+7.7
15	+6.9	+6.9
10	+5.9	+5.8

2.3 Storm Events

Historical storm events (Tropical Storms to Category 5 Hurricanes) that passed within 150 nautical miles (NM) of Franklin County since 1996 were assessed for the two distinct time frames (1996 to 2008, 2008 to 2018), which also correspond to available survey dates. The purpose is to correlate the effects of storm events on the beach and dune system and trends in shoreline position and volume changes in Section 4.0. The following sections describe those storm events.

2.3.1 July 1996 to October 2008

Over this 12-year period, 20 named storms and one tropical depression passed within 150NM of Franklin County (NOS, 2021). Of the 20 named storms, four reached hurricane strengths: Danny in 1997 (Category 1), Earl in 1998 (Category 1-2), Gordon in 2000 (Category 1), and Dennis in 2005 (Category 2-3) (***Figure 2***). This was one of the most active storm periods over the last 40-years. This period also included Hurricane's Ivan (2004), Katrina (2005), Gustav (2008), and Ike (2008), while their tracks where not within 150NM's of the studies shoreline, their effects were still felt along the beaches of the Gulf of Mexico.

Hurricane Earl made landfall as a Category 1 hurricane near Panama City on September 5, 1998, located approximately 60-miles to the northwest of Franklin County. There was no storm tide data, but it was estimated that Hurricane Earl's conditions were typical of that of a 15- to 20-year storm tide (FDEP, 2006a). Hurricane Dennis was a Category 3 hurricane that made landfall over Santa Rosa Island (Navarre Beach) on July 10, 2005. Even though Franklin County was over 150 miles east of the center of the eye of Hurricane Dennis, gulf storm tides were around 8 to 10 feet (FDEP, 2006a) and 7 feet in Apalachicola, Florida (Beven, J., 2005). A storm tide line of +11.7 feet, NAVD88 was found on St. George Island. The storm had a major effect on the shoreline, with FDEP categorizing the erosion as Category IV, meaning major dune erosion with dunes receding greater than 10 feet or the dunes being completely removed (FDEP, 2006b).

In addition, five of the 16 Tropical Storms passed within 65 miles of Franklin County resulting in minor beach and dune erosion. These included Josephine (1996), Alberto (2002), Bonnie (2004), and Fay (2008). Frances (2004) crossed the Florida peninsula, emerging in the Gulf of Mexico as a tropical storm, where it made a second landfall near St. Marks on September 6, 2004. FDEP classified the effects of the storm as Erosion Condition I (minor beach erosion), resulting in a small scarp on the beach (FDEP, 2004).

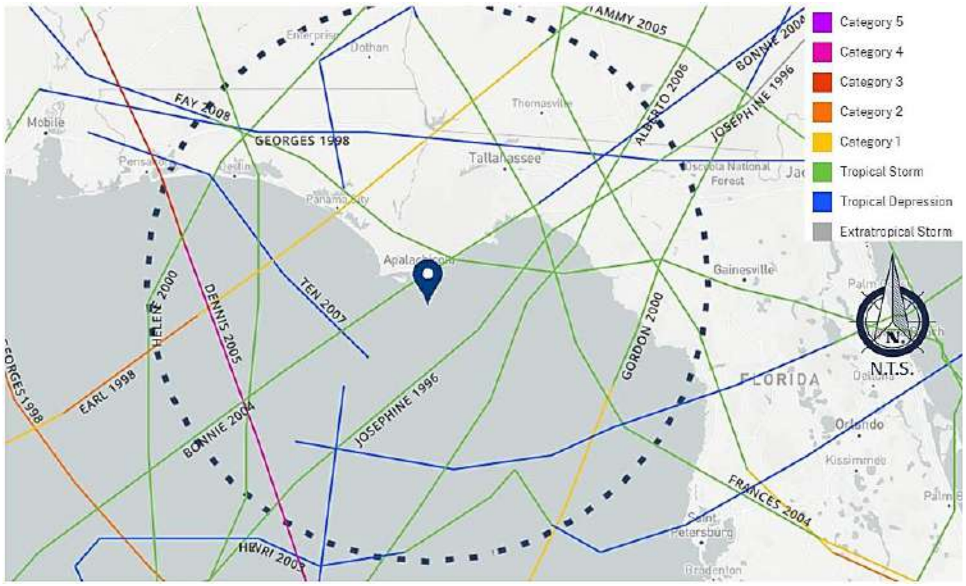

Figure 2. *Major storms within 150NM of Franklin County, Florida – 1996 to 2008.*

2.3.2 October 2008 to October 2018

Over this ten-year period, 12 named storms and two tropical storms passed within 150NM of St. George Island (NOS, 2021). Of the 12 storms, 2 reached hurricane strength: Hermine in 2016 (Category 1), and Michael (Category 5+) in 2018 (***Figure 4***).

Hurricane Hermine made landfall on September 2, 2016, near St. Marks as a Category 1 hurricane. The estimated storm surge was +5 feet, NAVD88. The coastal damage in Franklin County was most pronounced between Southwest Cape and Bald Point with road, rock revetment, and armoring damage (FDEP, 2017). Minor beach and dune erosion occurred as well along Alligator Point and St. George Island. Hurricane Michael made landfall 45-miles to the northwest of St. George Island near Tyndall Air Force Base on October 10, 2018, as a Category 5+ hurricane. FDEP categorized the erosion along St. George Island as Erosion Condition IV (major beach and dune erosion), along Alligator Point as Erosion Conditions II (minor beach and dune erosion) and III (moderate beach and dune erosion), and along Bald Point as Erosion Condition II (minor beach and dune erosion) (***Figure 3***). The storm tides from Hurricane Michael ranged from +8 ft to +10.6 feet, NAVD88 along St. George Island and from +8.8 ft to +10.7 feet along Alligator and Bald Points (FDEP, 2019). FDEP did not classify the erosion condition at Carrabelle Park but storm tides of 9 to 10 feet above sea level were measured which would have over washed the park. Extensive storm surge flooding and substantial over wash deposit occurred over the length of St. George Island. In addition, one (Colin in 2016) of the eight Tropical Storms passed within 65 miles of Franklin County resulting in only minor beach erosion.

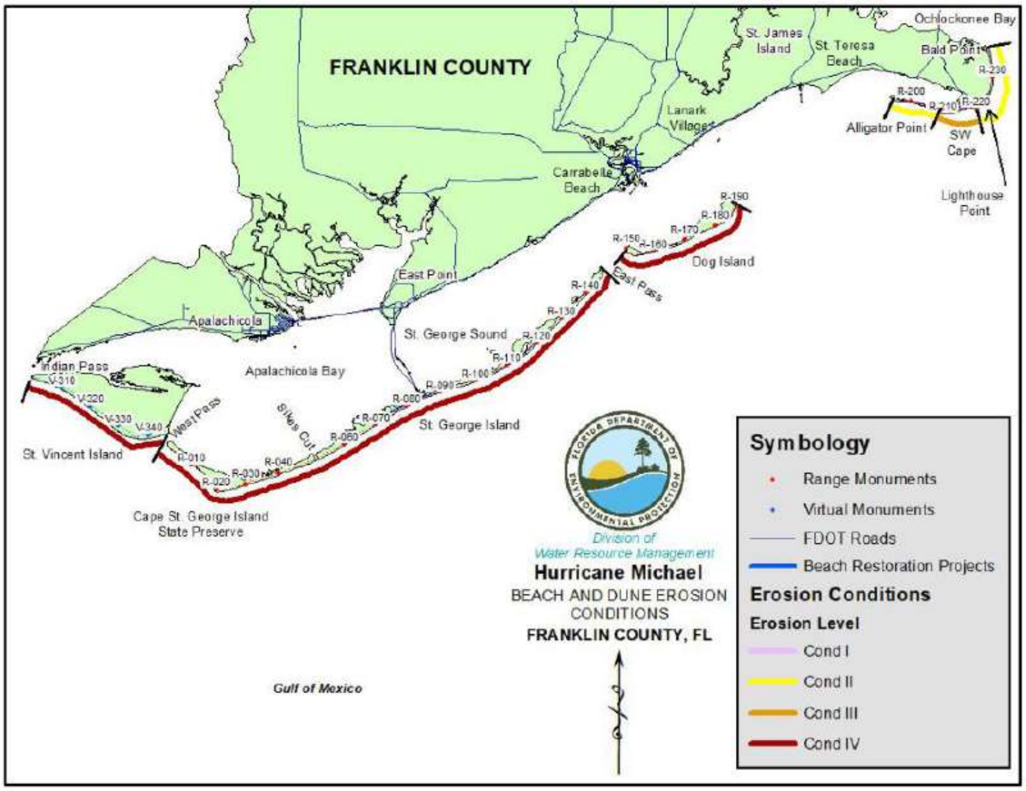

Figure 3. *Franklin County beach and dune erosion conditions from Hurricane Michael.*

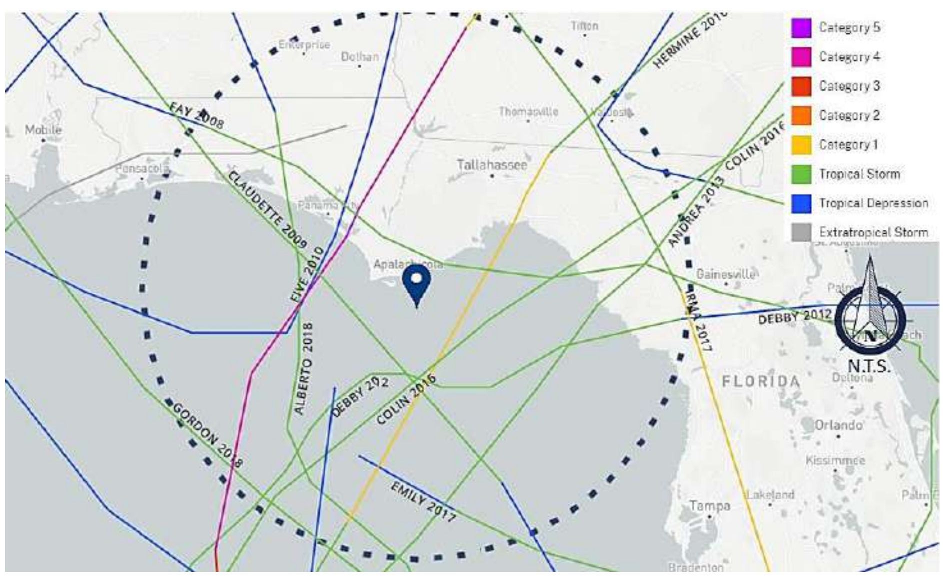

Figure 4. *Major storms within 150NM of Franklin County, Florida – 2008 to 2018.*

3.0 FDEP Shoreline and Profile Data

Historical and recent beach survey data at FDEP R-Monuments are used in this study to document and analyze shoreline position changes along three of the four separate study areas: 1) the St. George Island residential area (R-73 to R-94), 2) Alligator Point (R-195 to R-222) and 3) Bald Point (R-229 to R-235). These data sets are based on the FDEP R-Monuments which are reference points spaced approximately 1,000 feet apart along the gulf shoreline. These FDEP maintained monuments which are either physical monuments set into the ground or virtual locations are referenced to vertical and horizontal datums. They are used to correlate survey data over time to monitor various shoreline changes within the littoral zone and upland topography and are also used to reference the location of coastal features. This data is available from DEP's website: https://floridadep.gov/rcp/beaches-inlets-ports/content/historic-shoreline-database. The shoreline changes along the 1,500-foot Carrabelle Beach Park maintained by the County were based on historic aerials and LIDAR. The topography obtained in September 2021 by a drone did not delineate the MHW contour and was not used in this analysis.

3.1 Shoreline (MHW Line) Position Data

A historic shoreline position documents the horizontal location of the MHW elevation at one point in time. A comparison of such shoreline positions can suggest erosional (landward movement) or accretional (seaward movement) trends. For this investigation, the shoreline position was taken where the plane of the MHW elevation intersects the beach. FDEP provides a MHW line database which tabulates shoreline position based on historic beach profile surveys performed at DEP R-Monuments and covers the years selected in this study. These historic surveys have an accuracy in shoreline position within one (1) foot. Shoreline positions were analyzed for July 1996, Winter of 2008/2009, and May 2019. DEP does not have reference monuments nor shoreline position data for Carrabelle Beach. An analysis was done using LIDAR data from USGS and FDEM from the NOAA data access viewer over a 10-year period from July 2007 to May 2018 to achieve an understanding of the shoreline changes along the Park.

3.2 Historic Beach and Offshore Profiles

Historic beach and offshore survey data used in this analysis are used to document the dune volume changes above the MHW line to provide a reasonable estimate of episodic and long-term changes along the study limits. These vertical slices through the beach perpendicular to the shoreline are plotted in profile form at FDEP R-Monuments for shoreline and volume change analysis. Historic beach profiles include surveys from July 1996, Winter 2008/2009, October/November 2018, and May 2019. This study relied on existing survey data and no additional beach and offshore surveys were performed.

4.0 Shoreline Position and Volume Changes

This section presents the changes to the shoreline (MHW) position over the 22+ year period between 1996 and 2019, and dune volume changes between 2008 and 2019.

4.1 Shoreline Position Changes

The shoreline changes presented reflect the actual measured positions and rates based on the location of the MHW line at the time of the survey. The shoreline change at each R-Monument was measured as the difference between the distance from the R-Monument to the MHW for the July 1996, Winter of 2008/2009, and May 2019 surveys. The survey over the winter of 2008/2009 completed St. George Island in October 2008, Bald Point in December 2008 and Alligator Point in January of 2009. ***Table 3*** through ***6*** list the total shoreline change, and yearly shoreline change rate during the three time periods (July 1996 to Winter of 2008/09, Winter of 2008/09 to May 2019, and July 1996 to May 2019) and ***Figure 5*** through ***7*** plot the shoreline changes rates in feet per year for 2008/09 to May 2019 (left axis).

The two LIDAR data sets (July 2007, May 2018) for Carrabelle Beach were used to calculate the shoreline changes at three shore perpendicular profiles: The Eastern and Western edge of the park and a central profile going through the existing restroom. This data is presented in ***Table 6***.

4.2 Dune Volume Changes

The dune volume changes are based on the measured loss or gain of sand measured from the estimated toe of the dune to the landward limits of observed change. The volume changes at each R-Monument were measured by comparing the Winter 2008/2009, and May 2019 surveys. ***Table 3*** through ***6*** lists the dune volume change rate (in cubic yards/linear foot/year) and ***Figure 5*** through 7 plot the volume change rates in cubic yards per linear foot per year over the 2008/2009 to 2019 time period (right axis). The LIDAR data was used to determine the volume change rate above the MHW line in Carrabelle Beach shown in ***Table 6***.

4.1 Critically Eroded Shoreline

The Florida Department of Environmental Protection, Office of Resilience and Coastal Protection (aka Beaches) has long recognized the erosive condition of the shoreline and as a result has designated certain beach segments of the Franklin County shoreline as “Critically Eroded” and “Non-Critically Eroded” (FDEP, 2021a). A “Critically Eroded” shoreline is “*where natural processes or human activity have caused or contributed to erosion and recession of the beach or dune system to such a degree that upland development, recreational interests, wildlife habitat, or important cultural resources are threatened or lost.*” A “Non-Critically Eroded” shoreline is where “*many areas have significant historic or contemporary erosion conditions, yet the erosion processes do not currently threaten public or private interests. These areas are therefore designated as non-critically eroded beaches and require close monitoring in case the conditions become critical*”. The R-Monument ranges of critical erosion within the study area are listed in ***Table 7***.

The State of Florida may participate in erosion control projects as prescribed by Chapter 161 of the Florida Statutes and 62B-36 of the Florida Administrative Codes. According to Section 161.101(8), DEP *is authorized to pay from legislative appropriations specifically provided for these purposes an amount up to 50% of the actual costs of the approved project …*State funding is limited to projects located within Critically Eroded shoreline and the cost-share percentage is dependent on the spacing of beach accesses and number of parking spaces open to the general public.

Table 3. *St. George Island - Annualized shoreline (MHW line) position change (ft) and rates (ft/yr) and dune volume change rate (yds³/lf yr).*

DEP Monument	1996 to 2008		1996 to 2019		2008 to 2019		
	Total Shoreline Change (ft)	Shoreline Change Rate (ft/yr)	Total Shoreline Change (ft)	Shoreline Change Rate (ft/yr)	Total Shoreline Change (ft)	Shoreline Change Rate (ft/yr)	Dune Volume Change Rate (yds³/yr)
R-73	-36.50	-2.98	-36.50	-1.60	0.00	0.00	-7.68
R-74	-31.67	-2.59	-30.33	-1.33	1.33	0.13	-11.39
R-75	-25.33	-2.07	-32.00	-1.40	-6.67	-0.63	-13.47
R-76	-11.33	-0.93	-9.00	-0.39	2.33	0.22	-12.74
R-77	-1.67	-0.14	-7.67	-0.34	-6.00	-0.57	-7.98
R-78	8.67	0.71	8.00	0.35	-0.67	-0.06	-4.88
R-79	18.67	1.52	10.33	0.45	-8.33	-0.79	-1.98
R-80	7.00	0.57	4.67	0.20	-2.33	-0.22	-0.92
R-81	-3.67	-0.30	1.67	0.07	5.33	0.50	-0.75
R-82	-10.00	-0.82	5.00	0.22	15.00	1.42	-4.75
R-83	6.33	0.52	18.67	0.82	12.33	1.17	-2.10
R-84	8.00	0.65	12.67	0.55	4.67	0.44	0.01
R-85	-4.67	-0.38	-10.67	-0.47	-6.00	-0.57	0.65
R-86	6.67	0.54	0.67	0.03	-6.00	-0.57	-0.54
R-87	36.33	2.97	15.67	0.69	-20.67	-1.95	-0.97
R-88	44.33	3.62	18.00	0.79	-26.33	-2.49	-0.02
R-89	35.33	2.88	8.33	0.36	-27.00	-2.55	-2.15
R-90	29.67	2.42	8.67	0.38	-21.00	-1.98	-4.57
R-91	31.33	2.56	22.67	0.99	-8.67	-0.82	-3.41
R-92	21.33	1.74	15.00	0.66	-6.33	-0.60	-3.08
R-93	17.67	1.44	21.67	0.95	4.00	0.38	-1.02
R-94	12.50	1.02	18.50	0.81	6.00	0.57	-0.28
Average	7.23	0.59	2.91	0.13	-4.32	-0.41	-3.82

Table 4 *Alligator Point - Annualized shoreline (MHW line) position change (ft) and rates (ft/yr) and dune volume change rate (yds^3/lf/yr).*

DEP Monument	1996 to 2008		1996 to 2019		2008 to 2019		
	Total Shoreline Change (ft)	Shoreline Change Rate (ft/yr)	Total Shoreline Change (ft)	Shoreline Change Rate (ft/yr)	Total Shoreline Change (ft)	Shoreline Change Rate (ft/yr)	Dune Volume Change Rate (yds3/lf/yr)
R-195	126.00	10.08	111.00	4.86	-15.00	-1.45	(1)
R-196	66.67	5.33	58.00	2.54	-8.67	-0.84	-1.34
R-197	-21.33	-1.71	-10.67	-0.47	10.67	1.03	-0.22
R-198	-15.00	-1.20	2.67	0.12	17.67	1.71	1.18
R-199	7.00	0.56	20.67	0.91	13.67	1.32	2.41
R-200	22.00	1.76	25.33	1.11	3.33	0.32	3.95
R-201	21.33	1.71	21.33	0.93	0.00	0.00	2.17
R-202	11.67	0.93	17.33	0.76	5.67	0.55	-2.51
R-203	3.33	0.27	-2.00	-0.09	-5.33	-0.52	-7.36
R-204	6.67	0.53	-6.00	-0.26	-12.67	-1.23	-7.59
R-205	5.33	0.43	-6.67	-0.29	-12.00	-1.16	-2.14
R-206	11.33	0.91	18.33	0.80	7.00	0.68	2.47
R-207	11.00	0.88	29.67	1.30	18.67	1.81	4.99
R-208	38.00	3.04	56.33	2.47	18.33	1.77	5.07
R-209	-12.00	-0.96	-5.00	-0.22	7.00	0.68	-5.98
R-210	-29.00	-2.32	-32.00	-1.40	-3.00	-0.29	-11.68
R-211	-50.33	-4.03	-57.67	-2.53	-7.33	-0.71	(2)
R-212	-12.00	-0.96	-12.33	-0.54	-0.33	-0.03	(2)
R-213	-20.33	-1.63	-18.67	-0.82	1.67	0.16	(2)
R-214	-23.33	-1.87	-26.67	-1.17	-3.33	-0.32	(2)
R-215	-28.00	-2.24	-44.00	-1.93	-16.00	-1.55	(2)
R-216	-18.33	-1.47	-37.67	-1.65	-19.33	-1.87	-7.66
R-217	-21.67	-1.73	-26.00	-1.14	-4.33	-0.42	-1.96
R-218	-41.33	-3.31	-29.00	-1.27	12.33	1.19	4.30
R-219	-19.00	-1.52	-0.67	-0.03	18.33	1.77	5.15
R-220	-38.00	-3.04	-66.67	-2.92	-28.67	-2.77	3.00
R-221	-26.33	-2.11	-82.33	-3.61	-56.00	-5.42	(3)
R-222	-65.00	-5.20	-155.00	-6.79	-90.00	-8.71	(3)
Average	-3.95	-0.32	-9.23	-0.40	-5.27	-0.51	-0.69

(1) End of Alligator Drive, insufficient data
(2) Alligator Drive Revetment, insufficient data
(3) End of Gulfshore Boulevard, insufficient data

Table 5. *Bald Point - Annualized shoreline (MHW line) position change (ft) and rates (ft/yr)and dune volume change rate (yds^3/lf/yr).*

DEP Monument	1996 to 2008		1996 to 2019		2008 to 2019		
	Total Shoreline Change (ft)	Shoreline Change Rate (ft/yr)	Total Shoreline Change (ft)	Shoreline Change Rate (ft/yr)	Total Shoreline Change (ft)	Shoreline Change Rate (ft/yr)	Dune Volume Change Rate (yds^3/lf/yr)
R-229	-11.00	-0.89	-43.50	-3.12	-32.50	-3.12	-10.41
R-230	-17.67	-1.42	-39.67	-2.11	-22.00	-2.11	-2.04
R-231	-21.00	-1.69	-39.00	-1.73	-18.00	-1.73	1.06
R-232	-48.00	-3.87	-53.33	-0.51	-5.33	-0.51	2.21
R-233	-39.00	-3.14	-55.00	-1.54	-16.00	-1.54	-0.12
R-234	-11.33	-0.91	-12.33	-0.10	-1.00	-0.10	2.14
R-235	22.50	1.81	15.00	-0.72	-7.50	-0.72	2.60
Average	-17.93	-1.44	-32.55	-1.43	-14.62	-1.40	-0.65

Table 6. *Carrabelle - Annualized shoreline (MHW line) position change (ft) and rates (ft/yr)and dune volume change rate (yd^3/lf/yr).*

Profile	2007 to 2018		
	Total Shoreline Change (ft)	Shoreline Change Rate (ft/yr)	Dune Volume Change Rate (yds^3/lf/yr)
West	-23.43	-2.16	0.15
Central	-15.18	-1.40	0.13
East	-11.72	-1.08	0.21
Average	-16.78	-1.55	0.17

Table 7. *"Critically Eroded" shoreline within study area.*

R-Monument Range	Type of Erosion
R-194 to R-196	Non-Critically Eroded Beach
R-210 to R-216	Critically Eroded Beach
R-220 to R-222	Critically Eroded Beach
R-222 to R-232	Non-Critically Eroded Beach

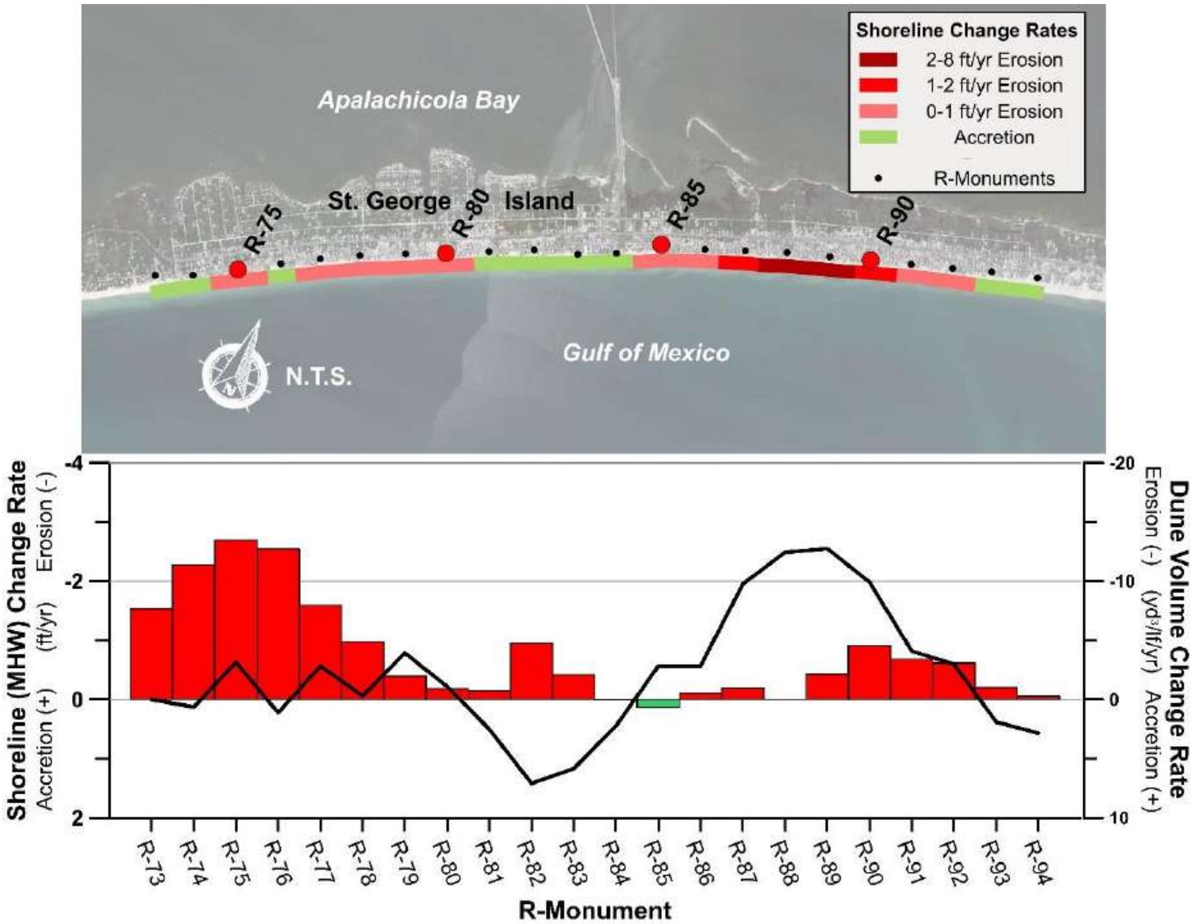

Figure 5. *St. George Island - Annualized shoreline (left axis, line) and dune volume (right axis, bar) change rate 2008 to 2019 in ft/yr.*

5.0 Sea Level Rise

Sea Level Rise (SLR) plays an important role in long-term shoreline position and volumetric change trends. This also has a potential impact on the design and longevity of the beach and dune system. A general "Rule of Thumb" is for every-one (1) foot in sea level rise for a beach with an average slope of 1 vertical to 100 horizontal (1V:100H) would equate to 100 feet of shoreline erosion.

5.1 Local Trends

The National Oceanic and Atmospheric Administration (NOAA) Center for Operational Oceanographic Products and Services (NOAA 2017) has been measuring the sea level for over 150 years, with tide stations of the National Water Level Observation Network (NWLON) operating on all U.S. coasts. Changes in Mean Sea Level (MSL), either a sea level rise or sea level fall, have been computed at 142 long-term water level stations using a minimum span of 30 years of observations at each location. NOAA provides estimates based upon monthly averages and a linear trend analysis for Apalachicola, Florida (NOAA Station 8728690). The measured mean sea level trend is currently +2.7 millimeters/year (mm/yr) or 0.1063 inch/year with a 95% confidence interval of +/-

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0.61 mm/yr based on monthly mean sea level data from 1967 to 2020 which is equivalent to a change of 0.89 feet in 100 years (***Figure 8***).

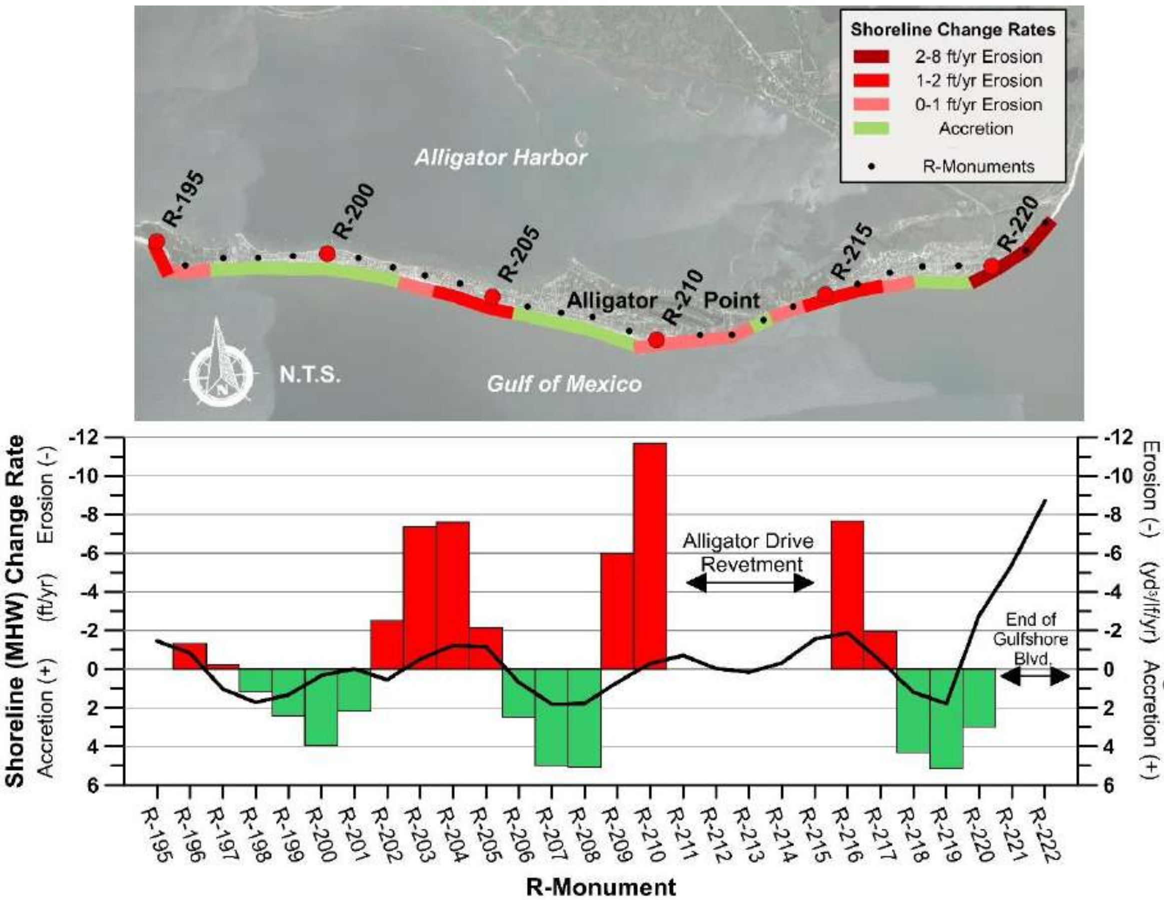

Figure 6. *Alligator Point - Annualized shoreline (left axis, line) and dune volume (right axis, bar) change rate 2008 to 2019 in ft/yr.*

NOAA (2017) assessed global, regional, and local sea level rise estimates under various future climate scenarios ultimately producing a gridded model for localized sea level estimates for the coastal shorelines of the United States. They determined that along almost all U.S. coasts outside Alaska, relative sea level (RSL) is projected to be higher than the global average under the Intermediate-High, High and Extreme scenarios (i.e., 0.3 to 1 meter or more RSL rise by the year 2100 than global mean sea level (GMSL) rise under the High scenario).

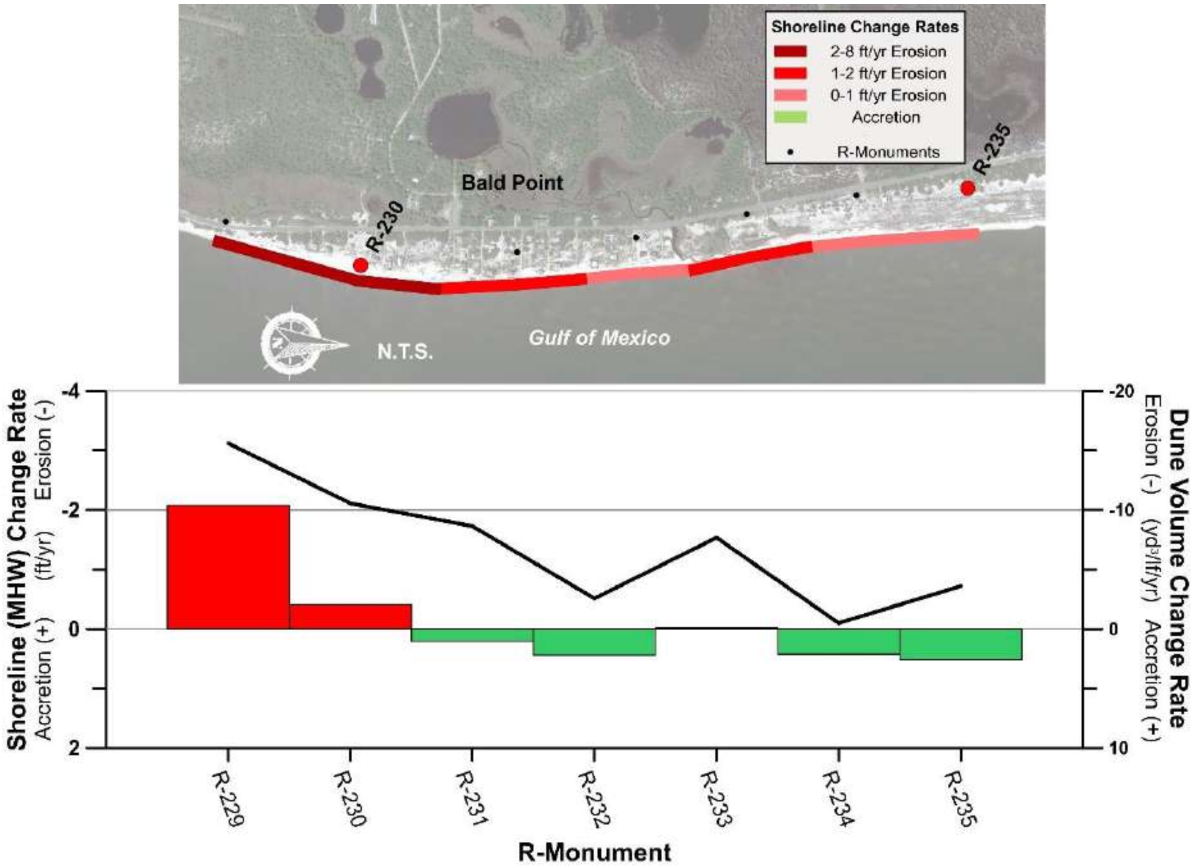

Figure 7. *Bald Point – Annualized shoreline (left axis, line) and dune volume (right axis, bar) change rate 2008 to 2019 in ft/yr.*

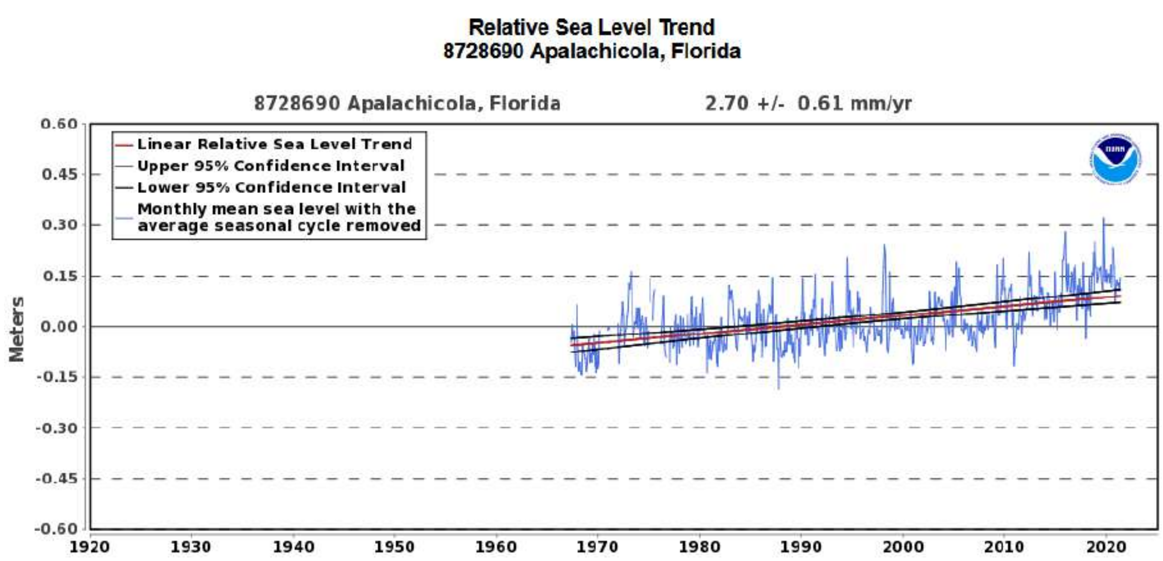

Figure 8. *Measured sea level trends from 1967 to 2020 at Apalachicola, Florida.*

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5.2 Regional Trends

Analyzing relative sea level rise for the Gulf of Mexico region, Boon (2018) provides a summary of measured trends and a quadratic statistical model of future trends. All measured regional trends in the northern Gulf of Mexico show an increase in sea level rise. The quadratic statistical model analyzed sea level change rate or acceleration, as well as sea level change for various stations across the United States. ***Figure 9*** shows the estimated sea level trends for an analysis area centered on Pensacola, which includes Apalachicola and St. George Island. The analysis shows that within the next 30 years sea level rise could increase between 0.4 and 0.5 meters (1.3 and 1.6 feet) above the existing mean sea level elevation as of 2020. NOAA (2017) determined factors influencing regional sea level rise in the Gulf of Mexico included shifts in oceanographic factors such as circulation patterns, changes in Earth's gravitational field, and vertical land movement such as subsidence or uplift, sediment compaction, groundwater, and fossil fuel withdrawals and other non-climatic factors.

The potential impacts of sea level rise include the loss of recreational beaches and dunes due to accelerated erosion, loss of waterfront property through erosion and inundation of low-lying areas, and the loss of and changes to natural habitats, and other low-lying natural areas. This may result in the loss or required relocation of gulf front structures. A general rule of thumb is for every 1-foot of sea level rise equals 100 feet of additional coastal erosion.

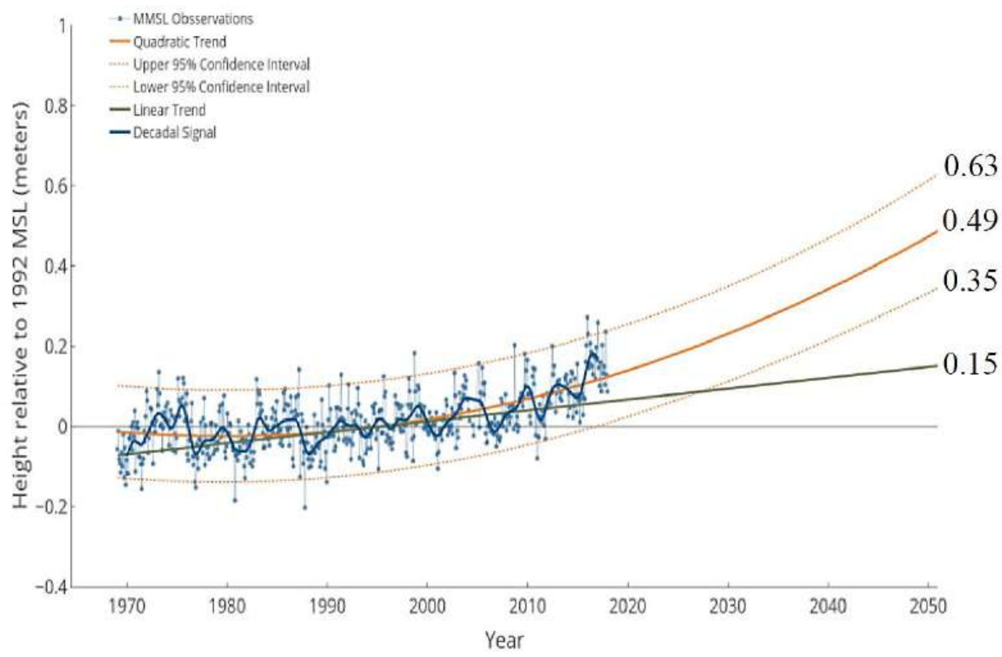

Figure 9. *Measured and predicted sea level change for Pensacola, Florida (Boon, 2018).*

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6.0. Existing Storm Capacity

Existing dune performance was evaluated by applying the cross-shore model SBEACH (Storm-induced BEAch CHange). The 2018 upland FDEP beach profile data was combined with 2008 offshore FDEP profile data to develop a complete profile as the initial conditions, and subjected to 20-, 30-, and 50-year return period storms. The storm tide levels used to calibrate the model are displayed in ***Table 2***. It should also be noted that there is an undefined correlation between return periods and hurricane categories. Return periods for a defined storm event is given as the probability of being equaled or exceeded in any one year (I.e., exceedance = 1/return period = 1/50 year = 0.02 or 2% chance per year) compared to a hurricane category which are based on the measured "Sustained Winds" in accordance with the Saffir-Simpson Hurricane Wind Scale.

Representative profiles were used for the four segments: 1) St. George Island at R-76, R-84, and R-91; 2) Alligator Point at R-201, R-209, R-217; 3) Bald Point at R-232; and 4) Carrabelle Beach. The Carrabelle beach profile was compiled by combining a transect of the photogrammetry taken in September 2021 with an equilibrium beach profile concluding at a depth of -11.5 feet. The qualitative risk to upland structures is divided into three levels: High, Medium, and Low. High is when a hypothetical storm event captures a majority the structure along a continuous beach section, Medium when the landward limit of the storm captures the seaward limit of the structures, and, Low when the storm limits are seaward of the structures. ***Table 8*** summarizes the risk along Franklin County.

Table 8. *Structures at risk for 20-year, 30-year, and 50-year storm events.*

Beach Segment	R-Monument	20-year Level of Risk	30-year Level of Risk	50-year Level of Risk
St. George Island	R-76	Low	Medium	High
	R-84	Low	Medium	High
	R-91	Low	Medium	High
Alligator Point	R-201	Low	High	High
	R-209	Low	Medium	High
	R-217	High	High	High
Bald Point	R-232	High	High	High
Carrabelle Beach		High	High	High

7.0. Native Beach Sand

Native beach sand data for St. George Island, Alligator Point, and Bald Point was found from the report "A Sedimentological and Granulometric Atlas of the Beach Sediments of Florida's Northwest Coast and Big Bend", dated July 2011 and prepared by the Florida Geological Survey (FGS). Samples FK-27 to FK-30 were collected within the study limits of St. George Island, with FK-27 at the western end of the study area and FK-30 at the eastern end. FK-57 to FK-60 were collected within the limits of Alligator Point, and FK-63 and FK-64 were collected on Bald Point. The sediment characteristics are presented in ***Table 9*** and ***Figure 10***, ***Figure 11***, and ***Figure 12*** show the sample collection sites with the R-Monuments. Additionally, sand samples were gathered by MRD Associates on March 8, 2022 at the County Park on St. George Island (near R-84) and Carrabelle Beach.

Table 9. *Franklin County sand characteristics.*

Sample ID	Description	Mean Grain Size, d_{50} (mm)	Sorting (phi)	Percent Silt (%)	Munsell Color Value	Percent Carbonate (%)
St. George Island						
Native FK-27-BB	Mid-berm R-77	0.37	0.421	0.03	10YR 8/3	1.75
Native FK-28-BB	Mid-berm R-82	0.37	0.466	0.01	10YR 8/3	2.55
Native FK-29-BB	Mid-berm R-87	0.37	0.965	0.06	10YR 8/3	8.62
Native FK-30-BB	Mid-berm R-92	0.32	0.533	0.08	10YR 8/2	1.35
County Park - 1	Mid-berm	0.32	0.49	0.32	10YR 8/3	1.80
County Park - 2	Seaward dune Toe	0.35	0.5	0.87	10YR 8/3	-
Alligator Point						
Native FK-57-BB	Mid-berm R-199	0.21	0.435	0.26	2.5Y 8.5/2	0.11
Native FK-58-BB	Mid-berm R-204	0.20	0.429	0.11	2.5Y 8.5/2	2.18
Native FK-59-BB	Mid-berm R-209	0.30	0.466	0.10	2.5Y 8.5/2	0.38
Native FK-60	Near R-215	0.28	0.667	0.48	2.5Y 8/2	0.51
Bald Point						
Native FK-63	Near R-229	0.51	0.726	0.38	10YR 7/2	0.52
Native FK-64	Near R-234	0.60	0.484	0.41	10YR 8/2	0.27
Carrabelle Beach						
Carrabelle - 1	Mid-berm	0.29	0.52	0.63	10YR 8/2	0.04
Carrabelle - 2	Seaward dune Toe	0.24	0.37	0.39	10YR 8/1	-

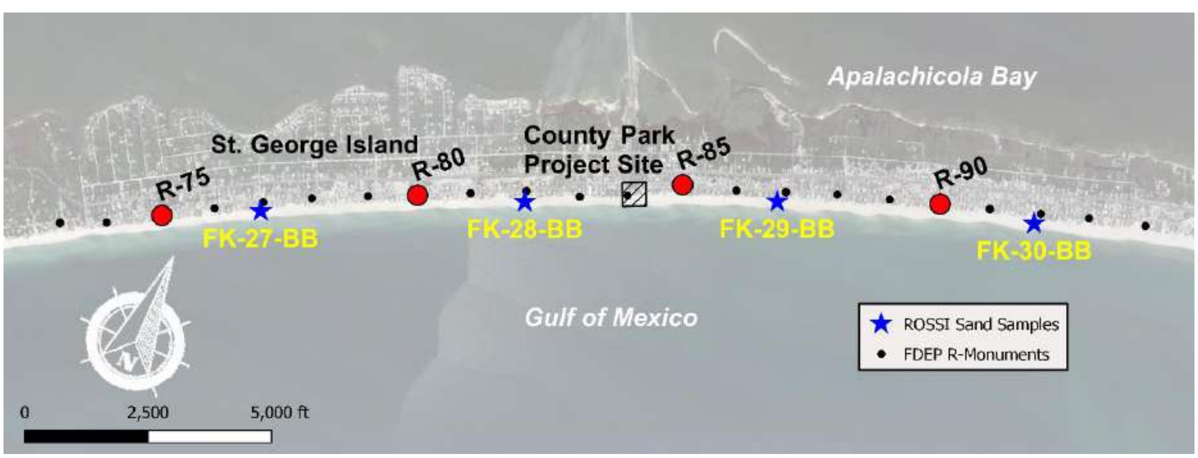

Figure 10. *St. George Island - Sediment sampling sites.*

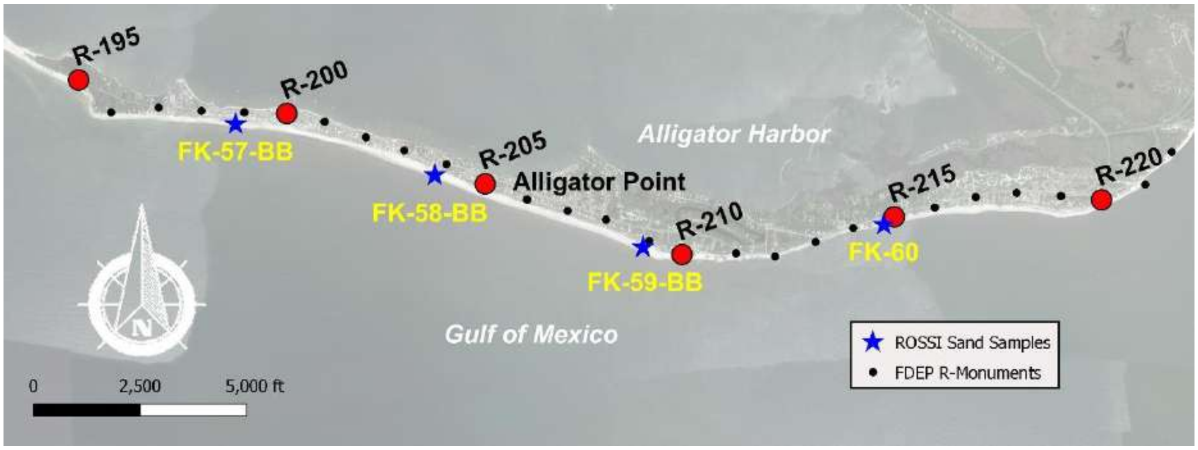

Figure 11. *Alligator Point - Sediment sampling sites.*

Figure 12. *Bald Point - Sediment sampling sites.*

8.0. Potential Sand Sources

Sand pits in Gulf, Franklin, and Wakulla counties were identified as potential sources of sand for dune projects in Franklin County. The sand mine locations were found from the "Mandatory Non-Phosphate (mannon) Mine Boundaries" database provided by DEP on Map Direct (FDEP, 2021b). There are 6 mines in Gulf, Franklin, and Wakulla counties that contain sand, shown in ***Figure 13***. Google maps was used to estimate the driving distance and drive time to the four project sites (***Table 10***).

Table 10. *Driving distances and times (one-way) from sand pits to the project sites.*

Sand Mine	St. George Island		Alligator Point		Bald Point		Carrabelle Park	
	Miles	Minutes	Miles	Minutes	Miles	Minutes	Miles	Minutes
Honeyville	53.7	63	92.3	113	90.1	107	62.1	73
Taunton	53.9	63	92.5	114	90.3	107	62.2	73
110-Acre pit	13.0	17	36.3	46	34.1	41	6.0	8
Rouse-Pigot	54.6	65	24.2	34	21.8	29	35.4	42

The distance from the sand mines to the project site will influence the cost of the project. Whenever an individual dune project is started, it is in the interest of the stakeholders to find a mine with the required sand that provides the lowest cost. This may not be the same sand mine for projects on St. George Island versus Alligator or Bald Point.

MRD have previously used the Honeyville Sand Mine and had completed a geotechnical analysis. Four (4) samples were collected from the upland borrow pit at the Honeyville Sand Mine in 2017 and 2018 and were analyzed (***Table 11***). Sediment characteristics for the Taunton Sand Mine were also provided by the operator.

Fill material should be placed in accordance with the guidelines provided under the Florida Department of Environmental Protection pursuant to the following conditions:

8.1. All fill material shall be sand that is similar to the native beach sand in both coloration and grain size and be free of debris, rocks, clay, organic matter or other foreign matter. In general, beach-compatible fill material will be predominantly quartz sand of a mean grain size diameter between 0.20mm and 0.45mm and a moist Munsell color-value/chroma of 7/1 or lighter with similar quantity of shell as the existing beach. No sand may be obtained from the beach, near shore, or below MHW seaward of the Coastal Construction Control Line (CCCL) without specific written authorization from FDEP.

8.2. During visual inspection of sand material upon arrival to the beach access site, physical samples will be taken for later quantitative analysis (sieving, color, etc) if the suitability of the material is uncertain at delivery time.

8.3. Any single or cumulative placement of greater than 15 cubic yards of material determined not to meet the benchmark beach sand sample quality shall be remediated. Upon discovery of such an occurrence, all sand placements shall cease, and the incompatible material removed and disposed of in an upland site. Sand that does not meet the beach compatibility requirements must be removed immediately.

Table 11. *Available sand mine characteristics.*

Sample ID	Description	Mean Grain Size, d_{50} (mm)	Sorting (phi)	Percent Silt (%)	Munsell Color Value	Percent Carbonate (%)
Honeyville Sand Mine						
Sample 1	Berm near weir	0.34	1.10	4.78	10YR 8/1	0.3
Sample 2	Berm near discharge	0.26	0.96	2.08	10YR 8/1	0.3
Sample 3	At discharge	0.29	0.95	1.68	10YR 8/1	0.2
Sample 5	North Stockpile	0.44	0.73	2.47	10YR 8/1	0.1
Taunton Sand Mine						
GS-1	Composite	0.67	0.96	-	2.5Y 8/1	0

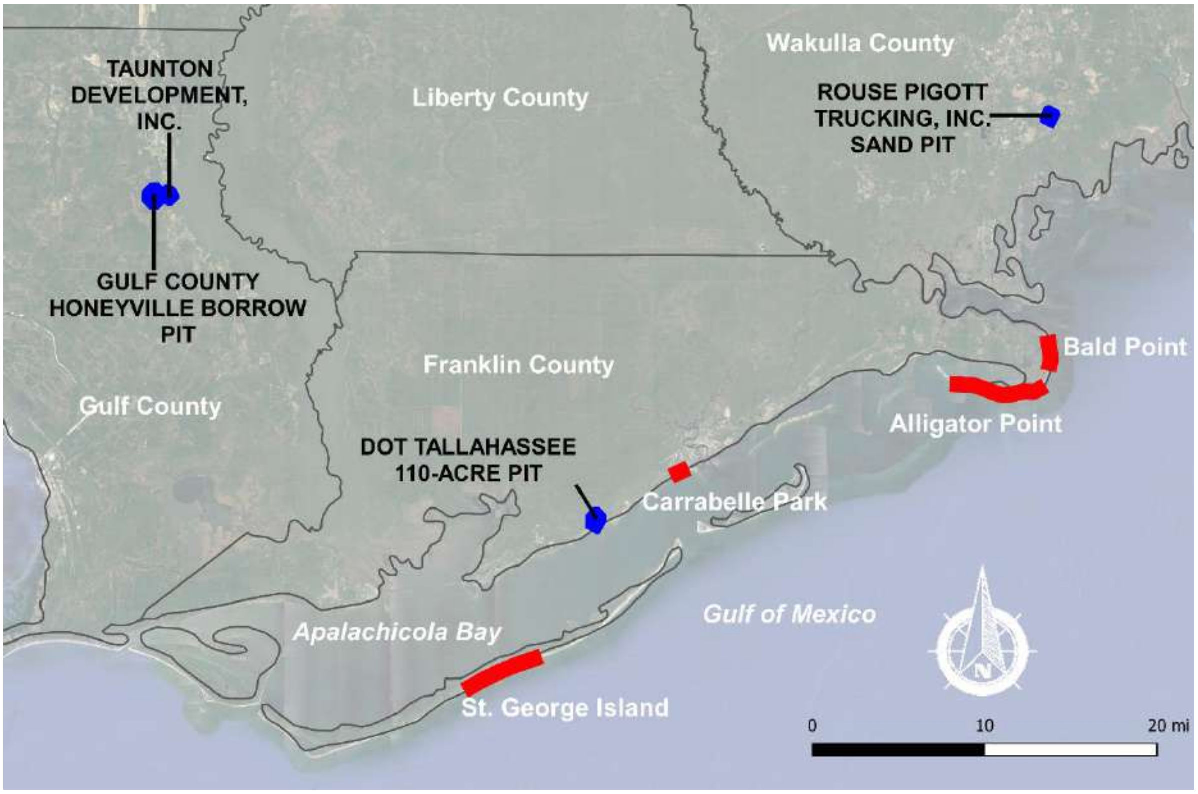

Figure 13. *Sand pit locations in vicinity of Franklin County.*

9.0. Alternative Designs Assessment

The primary objective of the alternative design assessment is to develop feasible dune alternatives that meet the design goals of the study. Additionally, this section provides an assessment of the existing beach conditions along the four project sites (St. George Island, Alligator Point, Bald Point, and Carrabelle Beach Park) The topography and geo-refenced aerial obtained in 2021 by a drone documented the seaward limits of vegetation and structures, dune topography, and beach berm width. The primary constraints that determine the types of dunes possible for a particular stretch of shoreline are: 1) the height (or lack) of the existing dune system, 2) the width of the existing dry beach berm, 3) the location of upland structures and infrastructure relative to the shoreline, and 4) the level of storm protection (level of risk) provided by the existing beach and dune system. The greatest benefits of constructing a continuous and contiguous dune feature along the Franklin County beaches are to provide a barrier to storm events, reduce overtopping and flooding to the back dune area, mitigate for historic dune erosion and create wildlife habitat.

These conceptual dunes were developed through an iterative process by revising the crest height and width to optimize the level of storm protection through SBEACH modeling while maintaining a minimum berm width of 80-feet, where possible. The typical sections provided within may need to be refined to fit along a particular beach segment depending on the specific conditions existing at the time of final design. In addition, planting native dune vegetation is recommended after placement of the sand to increase the stability of the dune, capture wind-blown sediments to further grow the dune feature and mitigate for any vegetation covered by the dune construction.

9.1. Type A Dune

Portions of Alligator Point and Bald Point are typically characterized by wide berms greater than 100 ft, low flat dune features with elevations typically less than +8 feet, NAVD88 and significant structural setbacks of approximately 175 feet from the Gulf of Mexico (***Figure 14*** left). ***Figure 15*** plots the historic profiles at R-198 on Alligator Point used to compare the profiles between 1996 and 2019 to a conceptual dune. Type A Dune will have a crest elevation of +10-foot, NAVD88 so not to impede views, crest width from 20 to 30-feet and side slopes from 1V:4H to 1V:3H. The footprint for this style dune can range from approximately 55 to 65 feet depending on the existing dune topography. This dune type is suitable for an existing berm width of 100-feet or greater. ***Figure 14*** shows an example beach on Alligator Point at R-198 that would be suitable for the Type A Dune. The wider dune crest and more gradual slope of this dune type (1V:4H) allows for greater storm protection and a more natural transition from dune to the beach berm (***Figure 16***).

Figure 14. *Typical beach condition to support a Type A Dune at Alligator Point near R-198 (left, view to the East, taken August 23, 2021) and a Type B Dune on St. George Island near R-90 (right, view to the southwest, taken August 24, 2021).*

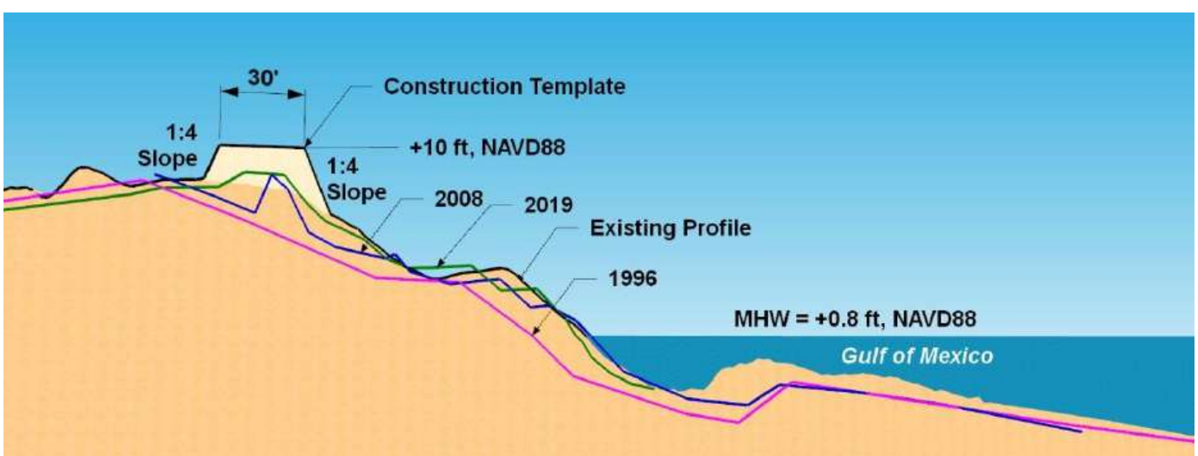

Figure 15. *Conceptual Type A Dune comparison to historical profiles on Alligator Point (R-198).*

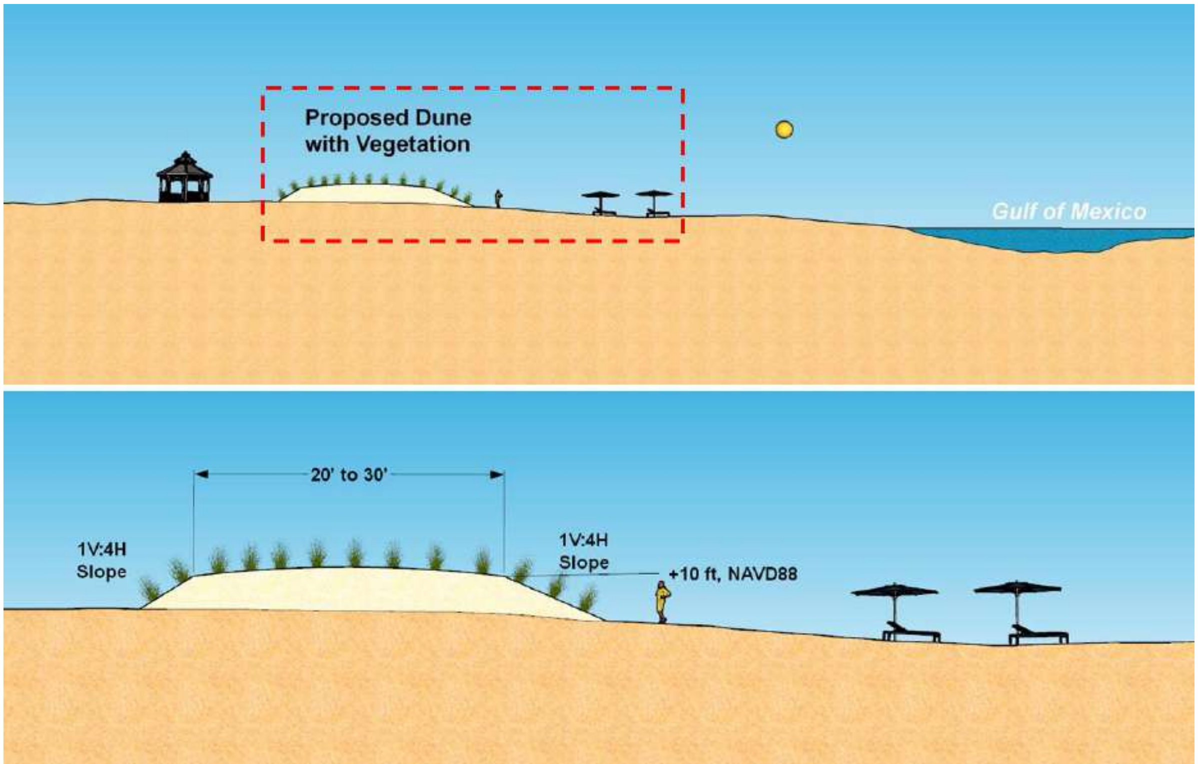

Figure 16. *Typical Type A Dune overview (top) and detailed view (bottom).*

9.2. Type B Dune

The entire St. George Island beach segment between R-73.5 and R-93.8 along with portions of Alligator Point and Bald Point are typically characterized by wide beach berms, eroded dune faces with peaks from +10 to +13 feet, NAVD88 and fairly significant structural setbacks of approximately 200 feet from the Gulf of Mexico (***Figure 14*,** right). ***Figure 17*** plots the historic dune profiles between 1996 and 2019 at R-90 on St. George Island compared to a conceptual Type B dune. The Type B Dune alternative extends from the existing dune crest elevation of +10 ft, NAVD88 so not to impede views to the Gulf of Mexico from the upland structures and can be placed in locations with narrow or wide existing beach berm widths by varying the crest width from 20 to 30 feet and side slopes from 1V:3H to 1V:4H. It has a dune footprint ranging from 40 to 65 feet, depending on the crest and slope (***Figure 18***). ***Figure 14*** shows an example of a typical beach condition for a Type B Dune placement on St. George Island.

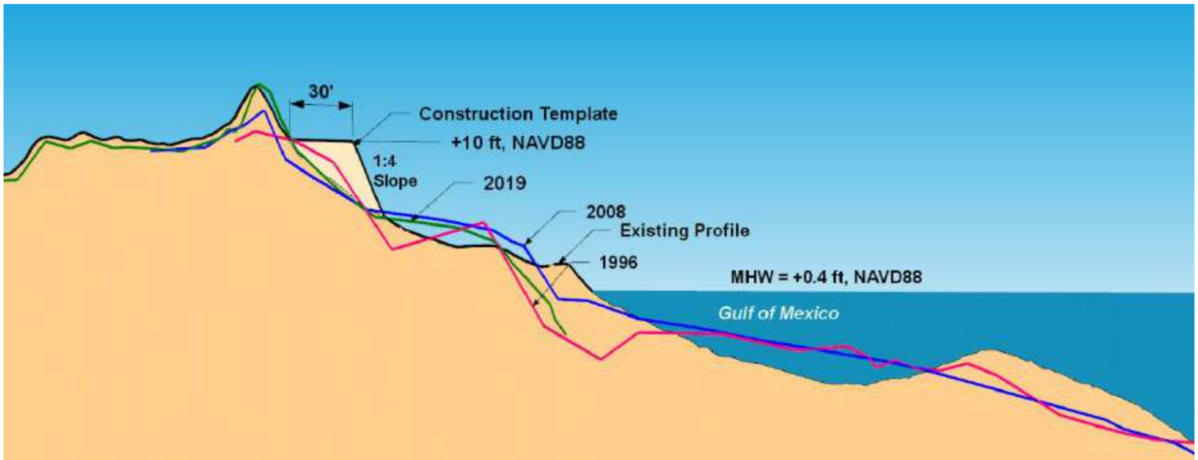

Figure 17. *Conceptual Type B Dune on St. George Island compared to historical profiles (R-90).*

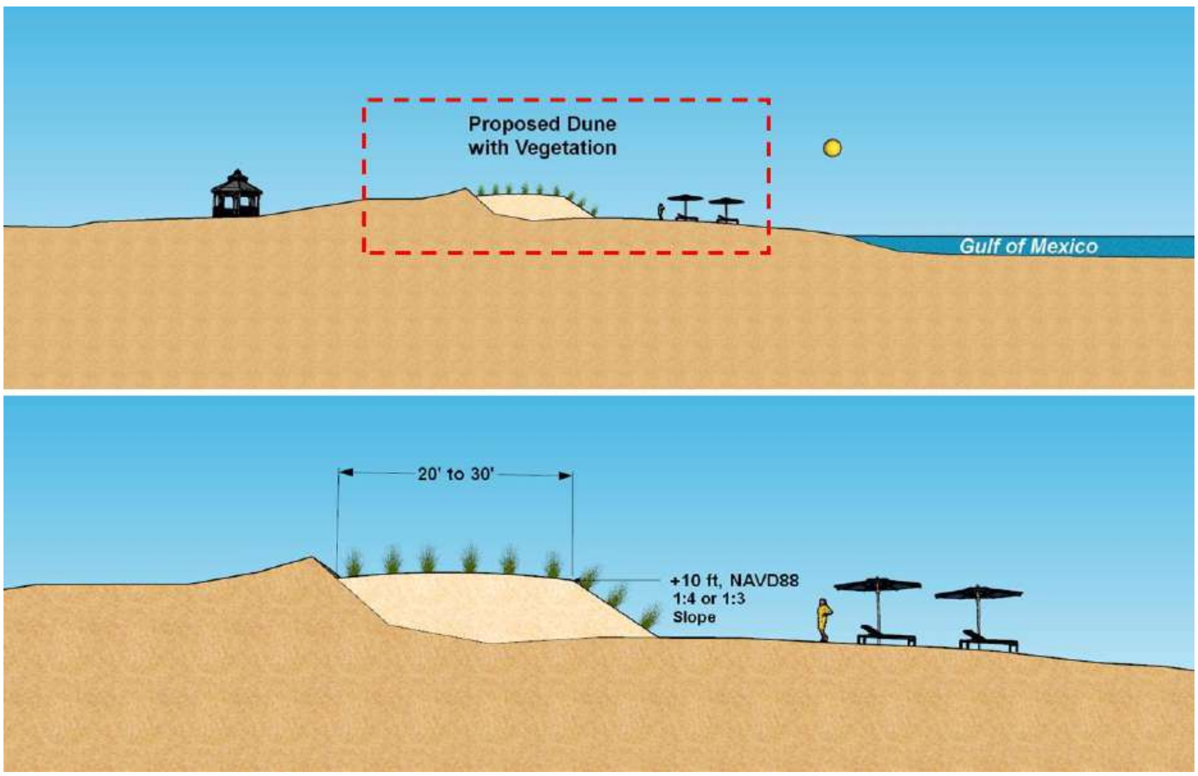

Figure 18. *Typical Type B Dune overview (above) and detail view (below).*

9.3. Type C Dune

Portions of Alligator Point are typically characterized by narrow berm widths less than 80 feet with eroded dune peaks to +7 to +8 feet, NAVD88 and constrained structural setbacks of less than 125 feet from the Gulf of Mexico (***Figure 19***, left). ***Figure 20*** plots the historic dune profiles between 1996 and 2019 at R-221 on Alligator Point compared to a conceptual dune. The Type C Dune is similar to the Type A Dune in that it extends further landward along the existing profile. Also, the Type C Dune is for locations with narrower and lower beach berms than the beaches a Type A Dune is suitable for. The Type C Dune would have a crest elevation of +10 feet NAVD 1988 so not to impede views, narrow crest width of 10 to 20 feet (depending on the available beach width), and front and back slopes of 1V:3H. This dune style has a footprint of approximately 20 to 30 feet depending on the existing topography and is suitable for sections of Franklin County beaches where the existing dune elevations are less than +8 feet, NAVD88 and the berm is less than 100-feet wide. ***Figure 19*** shows a shoreline on Alligator Point where the Type C Dune would be appropriate.

Figure 19. *Typical beach condition to support a Type C Dune at end of Gulf Shore Boulevard near R-221 (left, view to the southwest, taken August 23, 2021) and vegetation only at Bald Point near R-231 (right, view to the southwest, taken August 24, 2021).*

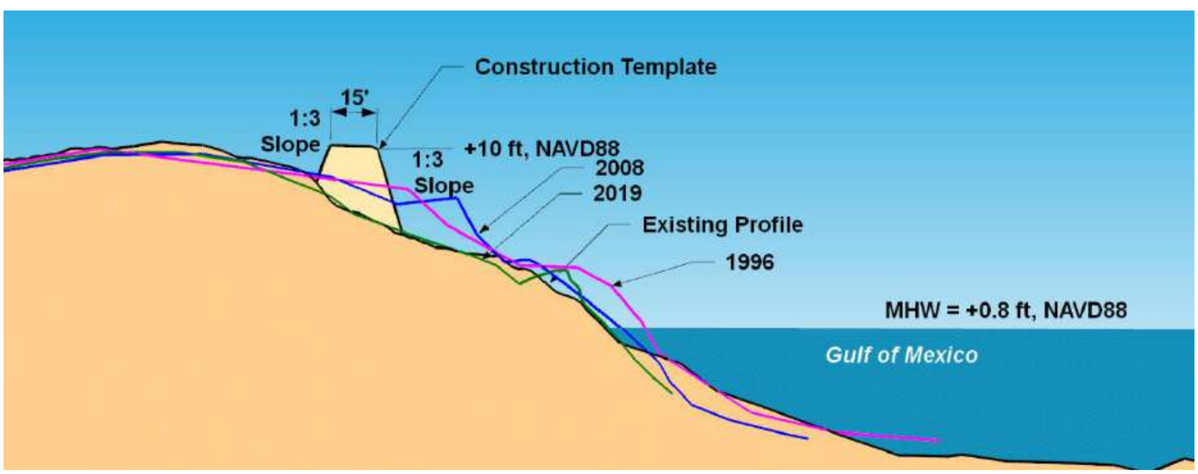

Figure 20. *Conceptual Type C Dune comparison to historical profiles on Alligator Point (R-221).*

9.4. Vegetation Only

There are some areas on Alligator Point and Bald Point where there is not adequate room between the existing structures and the shoreline to construct a dune feature. In these locations vegetation and sand fence can be placed to assist in the development and growth of dunes naturally. Initially this option would not provide any storm protection but over time the storm protection offered by the dune may increase as the dune grows naturally. ***Figure 19*** shows a shoreline on Bald Point where the vegetation only option would be recommended to be placed seaward of the existing structures. It should be noted that sand fencing requires periodic maintenance to ensure the optimal long-term performance is achieved with respect to capturing wind-blown sediments. It is recommended that the fencing be pulled up and reinstalled before it is buried by 2 feet of sand. Otherwise, it will be difficult or impossible to remove the fence and may eventually be completely covered becoming ineffective at trapping sand.

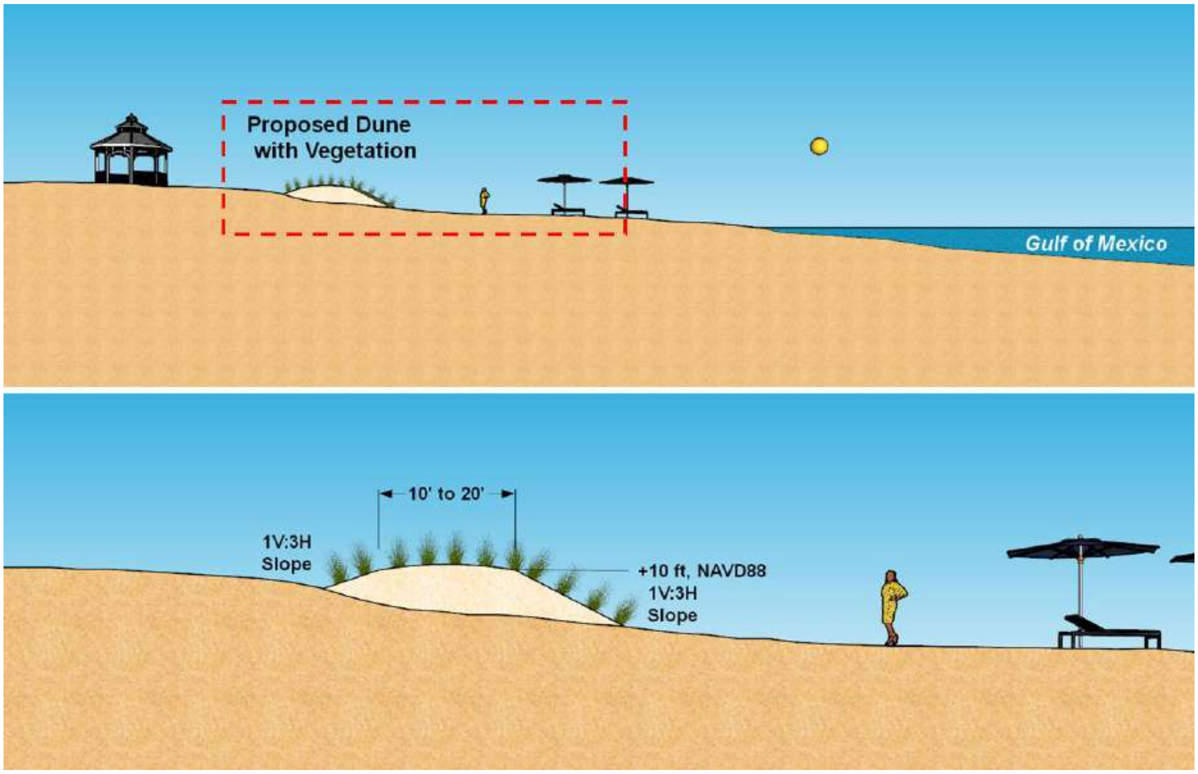

Figure 21. *Typical Type C Dune overview (above) and detail view (below).*

10.0. Conceptual Design

The typical dune types discussed in Section 9.0 are summarized in ***Table 12*** below. The following section presents the four project sites (St. George Island, Alligator Point, Bald Point, and Carrabelle Beach Park) and the dune type for each beach segment. The preliminary opinion of probable construction costs associated with each beach segment are also presented which include sand placement, vegetation, sand fences, post and rope fence and Engineering, Design, and Permitting (2022 dollars). Sand placement costs will vary due to transport distances from the mine to the project site. The 10-foot-long sand fencing shall be spaced at the DEP recommended 10-feet centers in the alongshore direction and at an angle to the shoreline will be placed at select beach sites where construction of a dune is not feasible. This generally includes areas that need assistance in starting a dune or dune enhancement of an existing dune. Sand fencing could also be utilized to reduce wind-blown sediment in problem areas. Vegetating the dune typically will have a greater effect on growing and stabilizing the sand than installing fencing. Post and rope fencing is used to direct pedestrian traffic away from the dune around dune walkovers, beach and vehicular accesses and paths. This investigation does not include the costs for dune walkovers.

Table 12. *Typical Dune types per shoreline segment summary.*

Dune Type	R-Monument Range	Length (feet)
St. George Island		
Type B	R-73.5 to R-93.8	21,100
Alligator Point		
Type C	R-195.8 to R-197.5	1,500
Type A	R-197.5 to R-203.5	6,000
Type B	R-203.5 to R-210	6,500
Alligator Point Revetment	R-210 to R-216	6,050
Type C	R-216 to R-217.2	1,100
Type B	R-217.2 to R-219.9	2,700
Vegetation and Sand Fence	R-219.9 to R-220.7	800
Type C	R-220.7 to R-221.5	800
Vegetation and Sand Fence	R-221.5 to R-222	500
Bald Point		
Type B	R-229.5 to R-230.5	1,200
Vegetation and Sand Fence	R-230.5 to R-232.5	2,150
Type A	R-232.5 to R-235	2,600
Carrabelle Beach Park		
Specific to Carrabelle		800

10.1. St. George Island

The Type B Dune concept is suitable for the entirety of St. George Island (R-73.5 to R-93.8 shown in ***Figure 22***) as the existing dunes have varying elevations up to and great than +10 feet, NAVD88. The proposed dune would extend seaward from the existing dune (shown in ***Figure 16***). Comparing FDEP historical profiles, the Type B Dune would extend the +10-foot contour seaward of where it was located in 1996 (***Figure 17***). Performance of the Type B Dune along St. George Island was modeled in SBEACH with the same storm parameters used in Section 6.0. The SBEACH analysis showed a slight increase in the level of storm protection for a 20+ year storm event to a 30-year storm event. The Type B Dune would not protect the upland structures from a 50-year storm and would be completely eroded during this level of storm.

The average construction volume rate of the proposed dune construction template for St. George Island is 4.91 cubic yards per linear foot (yd^3/lf). Over the 21,100 feet of the shoreline on St. George Island from R-73.5 to R-93.7 the total in-place volume is estimated at 103,545 cubic yards (yd^3) (***Table 13***). The estimated cost to construct the dune is $52 per cubic yard ($yd^3$) in place (2022 dollars). Approximately 558,750 dune plants spaced at 12-inch to 18-inch on-center will be installed on the constructed dune. Ten-foot-long sections of sand fencing would be installed at 10-foot spacing along 20% of the project length (21,100 x 0.20 = 4,220 feet) and post and rope

mrd associates, inc.

will be installed along 10% of the project length (21,250 x 0.1 = 2,110 feet). ***Table 13*** summarizes the probable costs of construction for a dune restoration project on St. George Island.

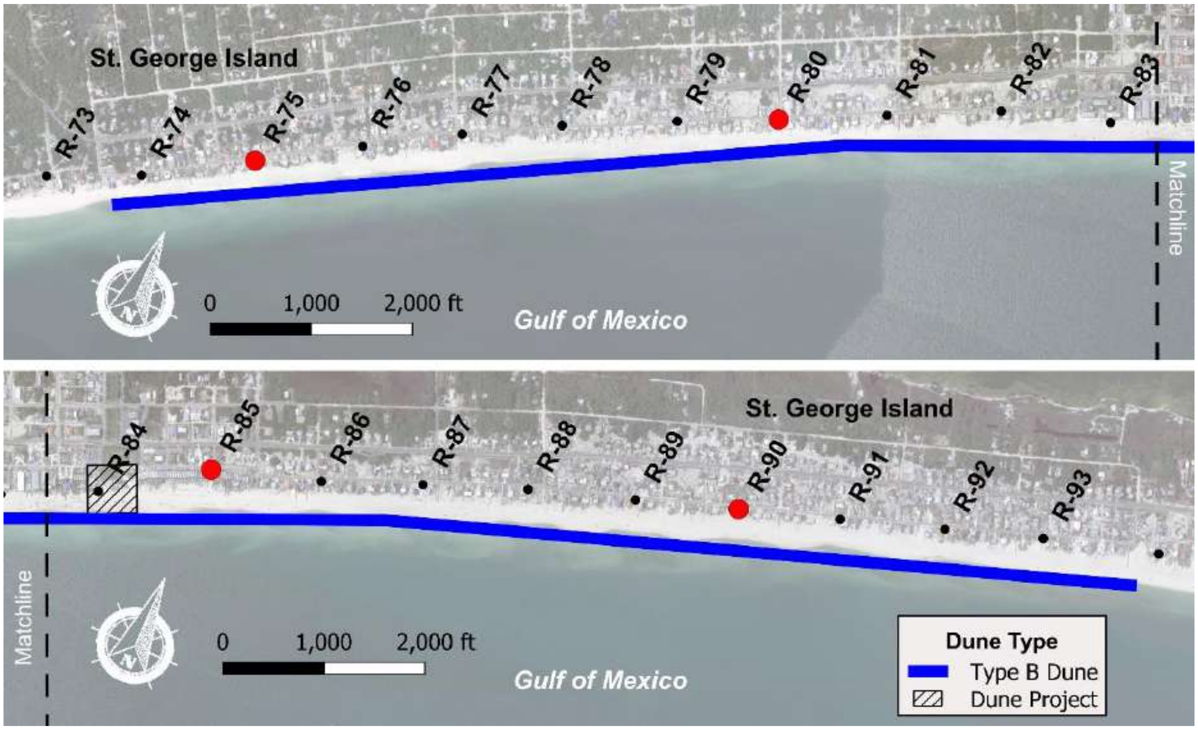

Figure 22. *Locations of the Conceptual St. George Island dune project and the St. George Island Park dune project.*

Table 13. *St. George Island Conceptual Dune Project - Preliminary Opinion of Probable Construction Costs.*

Description	Quantities	Unit Cost	Costs in 2021 Dollars
Type B Dune			
Sand Placement	103,545 yd^3	\$52/yd^3	\$5,384,326
Native Dune Vegetation	554,777	\$1.25/plant	\$693,471
Sand Fence	422	\$250/fence	\$105,500
Post and Rope Fence	2,110 feet	\$50/lf	\$105,500
Engineering, Design, Permitting		20% of total	\$1,257,760
Totals:			**\$7,546,557**

10.2. St. George Island County Park

The existing beach at the St. George Island County Park near R-84 is relatively wide (less than 200 feet) and is comprised of a dune system with elevations greater than +10 ft, NAVD88. A dune with a +10 ft, NAVD 88 crest height and a crest width ranging from 15 to 30 feet was determined to be the optimum design for the park. The proposed dune would leave an 80-to-100 foot berm width seaward of the proposed dune. The dune would be vegetated with native coastal vegetation to help stabilize the dune. Native vegetation will also be placed landward of the dune to fill in areas of the county park currently lacking vegetation. Coastal hammock plant species consisting of Scrub Oak, Saw Palmetto, Cabbage Palms, Slash Pine, Sand Live Oak, and Florida Rosemary will be placed between the existing gazebos and the CCCL line along the existing dune walkover. The project would also include 1,727 feet of post and rope fencing around the dune and throughout the county park to protect the native coastal vegetation. The dune would have a fill rate of 2.99 yd^3/lf over 452 feet of shoreline for a total volume of 1,353 yd^3 (***Table 17***). MRD Associates, Inc has submitted a CCCL permit application to FDEP for this dune project.

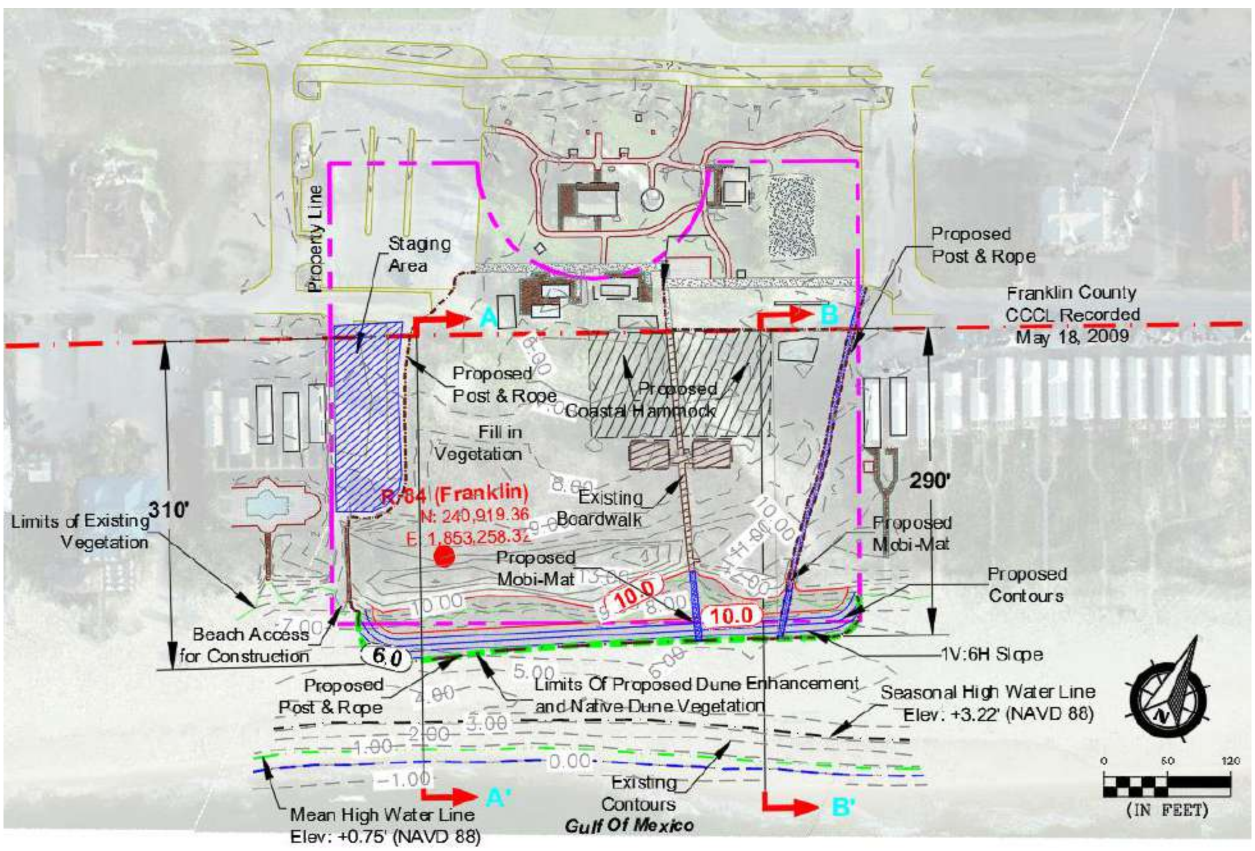

Figure 23. Proposed Dune Dimensions excerpted from FDEP CCCL permit application.

Table 14. *St. George Island County Park - Preliminary Opinion of Probable Construction Costs.*

Description	Quantities	Unit Cost	Costs in 2021 Dollars
Sand Placement	1,353 yd^3	$52/$yd^3$	$70,376
Native Dune Vegetation	13,958	$1.25/plant	$17,448
Hammock Vegetation	82	$40-90/plant	$5,595
Post and Rope Fence	1,728	$50/ft	$86,400
Engineering, Design, Permitting		20% of Total	$35,964
Totals:			**$215,782**

10.3. Alligator Point

The shoreline between R-197.5 and R-203.5 (***Figure 24***) has a large beach width of greater than 120 feet and low elevations suitable for a Type A Dune which will generally provide an 80-foot beach berm if constructed. A SBEACH model run was conducted at R-198 and simulated 30- and 50-year storm events with the conceptual Type A dune constructed. The results found that the 30-year storm would likely not capture the upland structures along this beach segment. A 50-year storm event is predicted to cause significant beach and dune erosion, potentially capture all the structures within the erosion profile and over wash Alligator Drive. The conceptual Type A Dune would have 1V:4H slopes and a fill rate of 3.77 yd^3/lf for a total volume of 22,614 yd^3. The revetment shoreline (R-210 and R-216) is not suitable for construction of a dune. However, a beach and dune restoration project are in the planning stages for construction in 2025-2026.

The conceptual Type B Dune is the optimal alternative for R-203.5 to R-210 and R-217.2 to R-219.9. These beach sections have a significant distance between the seaward structures and shoreline, and existing dune elevations of +10 feet, NAVD88 or greater providing storm protection greater than a 20-year storm event. Similar to the Type B Dunes on St. George Island, the proposed dune would mitigate for dune erosion, enhance the existing dune system, and increase the level of storm protection up to a 30-year storm event. The construction template has an estimated average construction volume rate of 3.25 yd^3/lf for a total volume of 29,734 yd^3. The preliminary opinion of probable construction costs for Alligator Point is found in ***Table 15***.

There are three shoreline sections on Alligator Point where a Type C Dune is most-appropriate due to the narrow beach and low existing dune elevations: R-195.8 to R-197.5, R-216.5 to R-217.2 and R-220.7 to R-221.5. Type C Dune would provide minimal storm protection for up to a 20-year storm event. This is an increase over the existing conditions of no storm protection for a 20-year storm. An analysis of the historical profiles provided by DEP shows the dune extending above the historic 1996 profile (***Figure 20***). The average construction volume rate of this type of dune on Alligator Point would be 3.19 yd^3/lf for a total volume of 10,856 yd^3.

A proposed project along the shoreline segment of Alligator Point from R-220 to 220.7 and R-221.5 to R-222 would be Vegetation and Sand Fence Only due to the narrow beach widths of 40 to 60 feet and proximity of the shoreline to the structures. Approximately 13,000 square feet of beach would be vegetated with 17,333 native dune plants using various species with 26 sections of 10-foot-long sand fence.

Table 15 summarizes the construction volumes for each of the dune types and estimated costs associated with the design, permitting, and construction of a project on Alligator Point. Due to Alligator Point being further from the sand mines, we estimated the construction cost for the dune to be \$55/yd^3 in place (2022 dollars).

10.4. Bald Point

At the northern shoreline of Bald Point just north of the outfall from R-232.5 to R-235 (***Figure 25***), the Type A Dune along this section is suitable due to the structural setbacks of over 200 ft. The maximum dune elevations seaward of the structures range between +7 to +9 feet, NAVD88 and a proposed +10-foot dune would extend seaward of the existing dunes and provide protection up to a 30-year storm. The construction volume rate for a proposed construction template is estimated to be 3.77 yd^3/lf over the 2,600 feet of shoreline or 9,799 yd^3.

The landward end of the Type B Dune between R-229.5 and R-230.5 would taper into the existing dune system and would provide storm protection up to a 30-year event along the southern end of Bald Point (***Figure 25***). The historical profiles on Bald Point indicate that implementing a conceptual Type B dune would restore the dune system to the 1996 profile. The average construction volume rate of sand for this dune is 3.19 yd^3/lf over the 1,200-foot shoreline or a total volume of 3,829 yd^3 (***Table 16***).

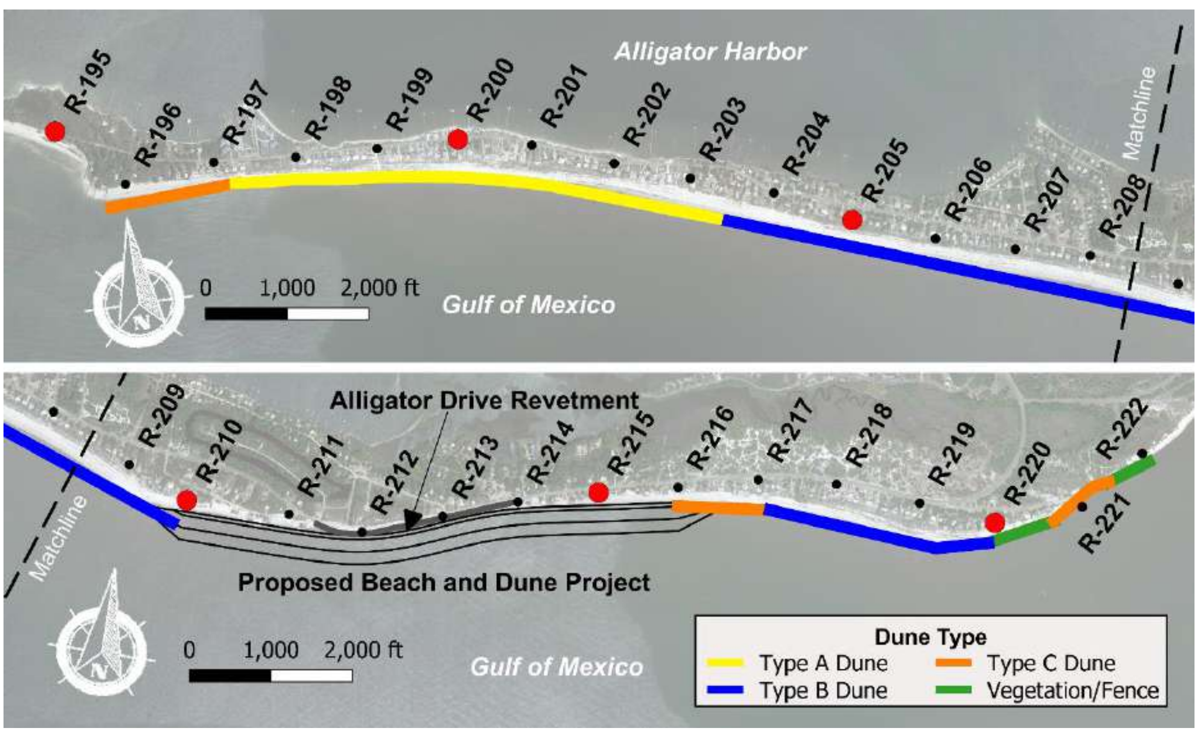

Figure 24. *Alligator Point dune type and the proposed Beach and Dune Restoration Project.*

Multiple structures in the middle of Bald Point (R-230.5 to R-232.5) are directly on the water or within 100 feet of the shoreline. It is unlikely that any dune or vegetation can be placed in front of these structures and not encroach the existing dry beach. Further inland are areas where an estimated 64,500 plants can be placed to help enhance and build dunes from captured wind-blown sand, as well as sand fences every 10 feet and post and rope where necessary. Vegetation planting can be completed within existing bare spots.

Table 16 summarizes the volumes for each of the dune types and the preliminary opinion of probable construction costs associated with the design, permitting, and construction of a project on Bald Point. Due to the greater distance between the sand mines and fill area, the cost of sand will be approximately $55/yd^3 (2022 dollars).

10.5. Carrabelle Beach

The existing beach at the Carrabelle Beach Park is both relatively wide (less than 200 feet) and is comprised of a low-profile dune system. ***Figure 26*** shows the existing beach conditions at Carrabelle Park. A small dune with an +8 ft, NAVD 88 crest height and a 10-foot crest width was determined to be the optimum design for the park based on SBEACH modeling. For reference, the elevation of the parking lot is approximately +8 feet, NAVD 88. The proposed dune would leave a 75-to-100-foot berm width seaward of the proposed dune. This design would also provide storm protection between a 20- and 30-year storm event. The dune would have a fill rate of 2.45 yd^3/lf, for a total volume of 1,954 yd^3 (***Table 17***).

Table 15. *Alligator Point - Preliminary Opinion of Probable Construction Costs.*

Description	Quantities	Unit Cost	Costs in 2021 Dollars
Type A Dune			
Sand Placement	22,614 yd^3	\$55/yd^3	\$1,243,770
Native Dune Vegetation	149,408	\$1.25/plant	\$186,759
Sand Fence	120	\$250/fence	\$30,000
Post and Rope Fence	600 feet	\$50/ft	\$30,000
Type B Dune			
Sand Placement	29,734 yd^3	\$55/yd^3	\$1,635,381
Native Dune Vegetation	177,817	\$1.25/plant	\$222,271
Sand Fence	184	\$250/fence	\$46,000
Post and Rope Fence	920	\$50/ft	\$46,000
Type C Dune			
Sand Placement	10,856 yd^3	\$55/yd^3	\$597,091
Native Dune Vegetation	70,002	\$1.25/plant	\$87,501
Sand Fence	68	\$250/fence	\$17,000
Post and Rope Fence	340	\$50/ft	\$17,000
Vegetation and Sand Fence Only			
Native Dune Vegetation	17,333	\$1.25/plant	\$21,667
Sand Fence	26	\$250/fence	\$6,500
Post and Rope Fence	130	\$50/ft	\$6,500
Engineering, Design, Permitting		20% of Total	\$838,688
Totals:			**\$5,032,130**

Figure 25. *Bald Point dune type locations.*

Table 16. *Bald Point - Preliminary Opinion of Probable Construction Costs.*

Description	Quantities	Unit Cost	Costs in 2021 Dollars
Type A Dune			
Sand Placement	9,799 yd³	$55/yd³	$538,5967
Native Dune Vegetation	64,743	$1.25/plant	$80,929
Sand Fence	52	$250/fence	$13,000
Post and Rope Fence	260 feet	$50/ft	$13,000
Type B Dune			
Sand Placement	3,829 yd³	$55/yd³	$210,606
Native Dune Vegetation	23,421	$1.25/plant	$29,276
Sand Fence	24	$250/fence	$6,000
Post and Rope Fence	120 feet	$50/ft	$6,000
Vegetation Only			
Native Dune Vegetation	64,500	$1.25/plant	$80,625
Sand Fence	43	$250/fence	$10,750
Post and Rope Fence	215 feet	$50/ft	$10,750
Engineering, Design, Permitting		20% of Total	$199,981
Totals:			**$1,199,884**

Table 17. *Carrabelle Park - Preliminary Opinion of Probable Construction Costs.*

Description	Quantities	Unit Cost	Costs in 2021 Dollars
Sand Placement	1,954 yd^3	$52/$yd^3$	$101,632
Native Dune Vegetation	18,396	$1.25/plant	$22,995
Sand Fence	16	$250/fence	$4,000
Post and Rope Fence	1,240	$50/ft	$62,160
Engineering, Design, Permitting		20% of Total	$38,157
Totals:			**$228,944**

Figure 26. *Existing conditions of Carrabelle Beach*

10.6. County Wide Dune Vegetation

Coastal vegetation can be planted at the toe of the dune along the county's shoreline as an alternative to provide some dune stabilization and enhancement to the existing dune system. A varied vegetation footprint of between 6 and 7.5 feet wide could be installed along the toe of the dune. The vegetation would be placed along the approximately 11 miles of the 4 project segments shown in ***Figure 27***. The native coastal vegetation would be placed on 18" centers in staggered rows to help achieve a natural look. The cost is estimated at $1.25 per plant, including the installation. The total number of plants to be installed is estimated at 171,500 with the final number to be determined during a design phase (***Table 18***).

Table 18. *County wide dune vegetation project - Preliminary Opinion of Probable Construction Costs.*

Description	Quantities	Unit Cost	Costs in 2021 Dollars
Native Dune Vegetation	171,500	$1.25/plant	$214,375
Engineering, Design, Permitting		20% of Total	$42,875
Totals:			**$257,250**

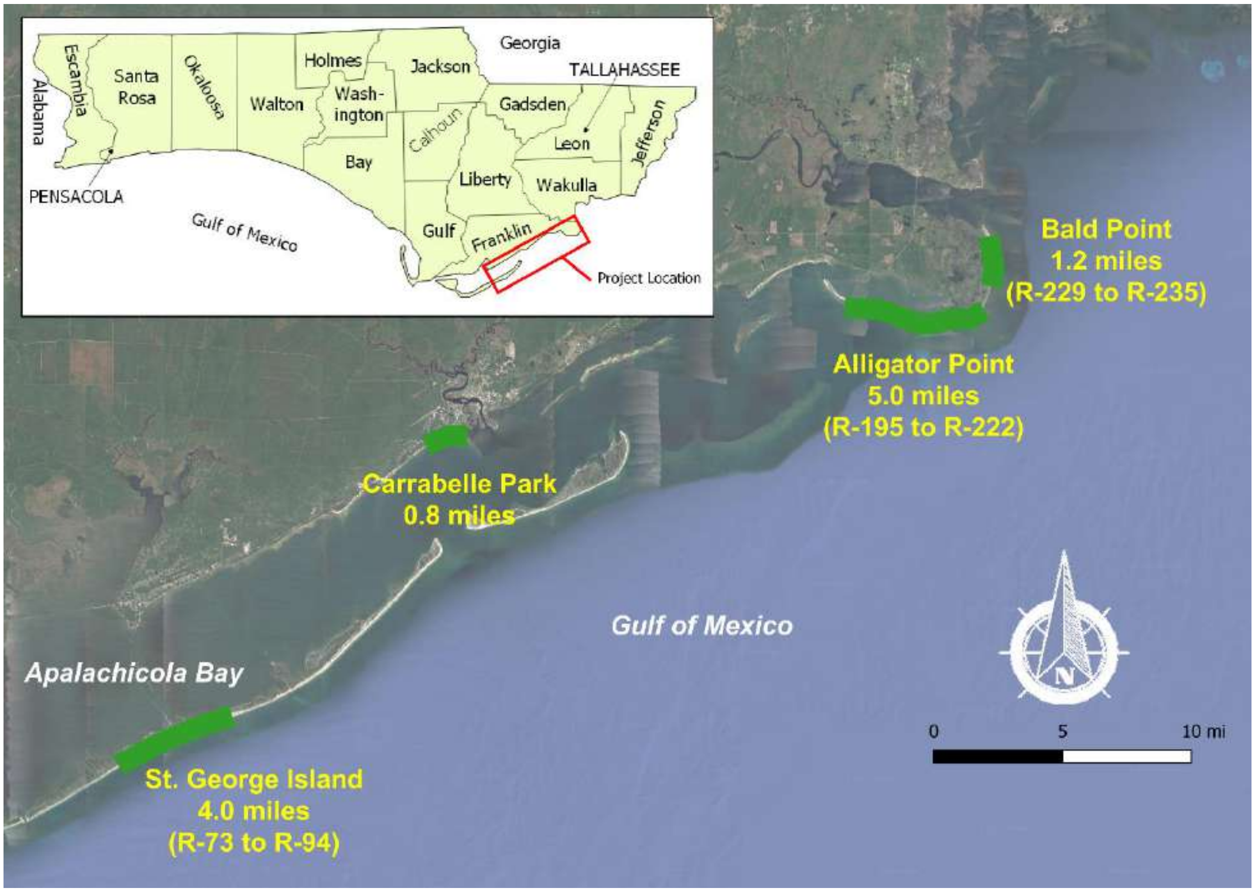

Figure 27. *County wide dune vegetation project limits*

10.7. Native Beach and Dune Vegetation

Native dune vegetation provides significant benefits to beaches, dunes, uplands and wildlife (FDEP, 2022). *Salt tolerant dune plants:*

- *build protective dunes by trapping and stabilizing wind-blown beach sand,*
- *reduce erosion losses by wind and storms,*
- *provide a buffer against storm surges and salt spray,*
- *provide shelter for wildlife, and*
- *block light pollution for nesting and hatchling sea turtles.*

Restored dunes should be planted with native vegetation within 14-days of project completion. However, there are shoreline segments on Alligator Point and Bald Point that do not have adequate space to fit any of the three dune types ("A", "B" and "C"). The placement of dunes within these areas may significantly decrease dry beach berm width or the dune feature may be eroded during small storm events if the dune is too close to the MHWL. In these locations, vegetation can be used to start, grow, and stabilize existing sand features. Planting native dune vegetation is typically appropriate for any type of beach and dune system. Even though this alternative may provide negligible storm protection, the establishment of resilient vegetation will grow dunes through the accumulation of wind-blown sediments. Sea oats (*Uniola paniculata*) typically cover 60-80% of the total area but will vary per project location and distance from the

MHWL. Bitter panicum (*Panicum amarum*), Beach Morning Glory (*Ipomoea imperati*) and Silver Sea Oxeye Daisy (*Borrichia frutescens*) are other typical native dune vegetation among others found along the NW Florida beaches that can be planted in the remaining areas. Some additional species provided by FDEP are listed below. Further guidance on the dune planting and suggested recommendations is provided within the *Dune Restoration and Enhancement for the Florida Panhandle* guide (https://edis.ifas.ufl.edu/sg156)

Figure 28. Sea oats (*Uniola paniculata*) (top left), Bitter panicum (*Panicum amarum*) (top right), Beach Morning Glory (*Ipomoea imperati*) (bottom left) and Silver Sea Oxeye Daisy (*Borrichia frutescens*) (bottom right).

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(850) 245-2094

Recommended Florida Native Beach and Dune Plants for Beachfront Properties and Dune Restoration

Description

This plant list has been compiled by Coastal Construction Control Line (CCCL) staff to inform homeowners and professionals on attractive native plants expected to grow well on Florida dunes and to be available for sale in Florida nurseries. Beach dune plants are adapted to harsh environments, yet require a moderate level of protection from drought, saltspray, wind, sunburn and being eaten before the newly planted plants "harden off" and start growing on their own.

Notes:

1. Salt tolerance: high (tolerant of heavy and frequent salt spray, salt water flooding); moderate (tolerant of salt spray but subject to leaf burn from heavy salt spray or root damage from flooding); low (tolerant of salt laden air and short duration, infrequent salt water flooding but usually in protected areas).
2. Region: NW = northwest Florida Panhandle; SW = Pinellas to Collier counties; NE = Nassau to Volusia counties; SE = Brevard to Dade counties; Keys = restricted to the Florida Keys and adjacent Dade and Monroe County islands. Regions have primarily been determined by the historic distribution of the plant in Florida's coastal upland natural communities, not necessarily by the range of areas or habitats where the plant could survive.
3. Soil Moisture: moist (subject to flooding as within low dune swales); moderate (not subject to frequent flooding but not adapted to deepest sands or driest conditions; dry (adapted to deep sands, dune ridges, or well drained rocky soils); and variations for plants adapted across a range of conditions.
4. The native status of plants noted with an asterisk "*" has been questioned due to use of cultivars or artificial introduction of plant populations in Fla.

References:

1. Nelson, Gil. 2003. Florida's Best Native Landscape Plants: 200 readily available species for homeowners and professionals. Florida Association of Native Nurseries. University Presses of Florida.
2. Williams, M.J. 2007. Native Plants for Coastal Dune Restoration: what, when and how for Florida. USDA, NRCS, Brooksville Plant Materials Center, Brooksville, Florida.
3. Wunderlin, Richard P., et.al. Plant Atlas. University of South Florida.

Dune Grasses

Scientific Name	Common Name	Salt tolerance	NW/SW/NE/SE/Keys	Soil Moisture
Distichlis spicata	salt grass	high	all	moist
Muhlenbergia capillaris var. filipes	Gulf hairawn muhly grass	moderate	all	moderate
Panicum amarum	bitter panic grass	high	all	dry
Paspalum vaginatum	seashore paspalum*(not sod)	high	all	moderate
Schizachyrium scoparium	coastal bluestem	high	all	moderate
Spartina patens	marshhay	high	all	moderate
Sporobolus virginicus	seashore dropseed	high	all	moist
Uniola paniculata	sea oats	high	all	dry

Groundcovers

Scientific Name	Common Name	Salt tolerance	NW/SW/NE/SE/Keys	Soil Moisture
Borrichia arborescens	sea oxeye	high	SW, SE, Keys	moist
Borrichia frutescens	sea oxeye	high	all	moist
Conradina canescens	beach rosemary	moderate	NW	dry
Ernodea littoralis	golden beach creeper	high	SW, SE, Keys	moderate - dry
Gaillardia pulchella*	blanket flower	moderate	all	dry
Helianthus debilis	East Coast dune sunflower	high	NE, SE, Keys	dry
Helianthus debilis spp. cucumerifolius	cucumber leaf dune sunflower	high	NW, SW	dry
Helianthus debilis ssp. vestitus	West Coast dune sunflower	high	SW	dry
Hymenocallis latifolia	beach spider lily	high	SW, NE, SE, Keys	moist - dry
Ipomoea imperati	beach morning glory	high	all	moderate, dry
Ipomoea pes-caprae	railroad vine	high	all	moderate, dry
Iva imbricata	beach elder	high	all	moist – dry
Sesuvium portulacastrum	sea purslane	high	all	moist - moderate
Solidago sempervirens	seaside goldenrod	high	NW, SW, NE, SE	moist – moderate
Yucca filamentosa	Adam's needle	moderate	NW, SW, NE, SE	dry

Recommended Florida Native Beach and Dune Plants (continued)

Vines

Scientific Name	Common Name	Salt tolerance	NW/SW/NE/SE/Keys	Soil Moisture
Bignonia capreolata	cross vine	moderate	NW, SW, NE, SE	moderate
Gelsemium sempervirens	Carolina jessamine	moderate	NW, SW, NE, SE	moderate – dry
Ipomoea alba	moonflower	high	SW, SE, Keys	moist – dry
Pentalinon luteum	wild allamanda	high	SW, SE, Keys	dry
Vitis rotundifolia	muscadine	moderate	NW, SW, NE, SE	moderate – dry

Shrubs

Scientific Name	Common Name	Salt tolerance	NW/SW/NE/SE/Keys	Soil Moisture
Ardisia escallonioides	marlberry	moderate	SW, SE, Keys	moderate
Argusia gnaphalodes	sea lavender	high	SE, Keys	dry
Chrysobalanus icaco	coco plum	moderate	SW, SE, Keys	moderate - dry
Erythrina herbacea	coral bean	low	all	moderate - dry
Eugenia axillaris	white stopper	low	SW, SE, Keys	moderate
Eugenia foetida	Spanish stopper	low	SW, SE, Keys	moderate
Forestiera segregata	Florida privet	low	SW, NE, SE, Keys	moist -moderate
Ilex vomitoria	yaupon	moderate	NW/SW, NE, SE	moderate - dry
Myrica cerifera	wax myrtle	moderate	all	moist - moderate
Quercus geminata	sand live oak	moderate	NW, SW, NE, SE	dry
Quercus myrtifolia	myrtle oak	moderate	NW, SW, NE, SE	dry
Rapanea punctata	myrsine	moderate	SW, SE, Keys	moist - dry
Serenoa repens	saw palmetto	high	all	moist - dry
Suriana maritima	bay cedar	high	SW, SE, Keys	dry
Zamia pumila	coontie	moderate	SW, NE, SE, Keys	dry

Thorn/Scrub Plants

Scientific Name	Common Name	Salt tolerance	NW/SW/NE/SE/Keys	Soil Moisture
Agave decipiens	false sisal	high	SW, SE, Keys	dry
Guilandina bonduc	gray nickerbean	moderate	SW, SE, Keys	moderate - dry

Scientific Name	Common Name	Salt tolerance	NW/SW/NE/SE/Keys	Soil Moisture
Erythrina herbacea	coral bean	low	all	dry
Opuntia spp.	prickly pears	high	all	moderate - dry
Serenoa repens	saw palmetto	high	all	moist - dry
Sideroxylon tenax	tough bully	low	NE, SE	dry
Smilax auriculata	earleaf catbrier	moderate	all	dry
Ximenia americana	hog plum	low	NE, SE	dry
Yucca aloifolia	Spanish bayonet	high	all	dry
Yucca filamentosa	Adam's needle	moderate	NW, SW, NE, SE	dry
Yucca gloriosa	moundlily yucca	moderate	NW, SW, NE	dry
Zanthoxylum clava-hercules	Hercules' club	moderate	NW, SW, NE, SE	dry
Zanthoxylum fagara	wild lime	moderate	SW, NE, SE, Keys	moderate - dry

Trees

Scientific Name	Common Name	Salt tolerance	NW/SW/NE/SE/Keys	Soil Moisture
Acacia farnesiana	sweet acacia	moderate	all	moist - dry
Baccharis halimifolia	salt bush	high	all	moist - moderate
Bursera simaruba	gumbo limbo	moderate	SW, SE, Keys	moderate - dry
Capparis cynophallophora	Jamaica caper	moderate	SW, SE, Keys	dry
Celtis laevigata	hackberry	low	NW, SW, NE, SE	moist - moderate
Chrysophyllum oliviforme	satinleaf	moderate	SE, Keys	moderate - dry
Citharexylum spinosum	fiddleleaf	moderate	SE, Keys	dry
Coccoloba diversifolia	pigeon plum	high	SW, SE, Keys	moderate - dry
Coccoloba uvifera	sea grape	high	SW, SE, Keys	moderate - dry
Conocarpus erectus	buttonwood	high	SW, SE, Keys	moist - moderate
Cordia sebestena	Geiger tree	moderate	SW, SE, Keys	moderate - dry
Ficus aurea	golden fig	moderate	SW, SE, Keys	moderate
Ilex x. attenuata	East Palatka holly	low	NW, SW, NE, SE	moderate
Ilex cassine	dahoon holly	low	NW, SW, NE, SE	moist - moderate
Ilex opaca	American holly	low	NW, SW, NE, SE	moderate
Ilex vomitoria	yaupon holly	moderate	NW, SW, NE, SE	moderate - dry

Recommended Florida Native Beach and Dune Plants (continued)

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Scientific Name	Common Name	Salt tolerance	NW/SW/NE/SE/Keys	Soil Moisture
Juniperus silicicola	southern red cedar	moderate	NW, SW, NE, SE	moderate
Laguncularia racemosa	white mangrove	high	SW, SE, Keys	moist - moderate
Magnolia grandiflora	southern magnolia	moderate	NW, SW, NE	moderate
Pinus clausa	sand pine	moderate	NW, SW, NE, SE	dry
Pinus elliottii (S. Fla = var. densa)	slash pine	moderate	NW, SW, NE, SE , Keys	moist - moderate
Quercus geminata	sand live oak	moderate	NW, SW, NE, SE	moderate - dry
Quercus virginiana	live oak	moderate	NW, SW, NE, SE, Keys	moderate - dry
Sideroxylon foetidissimum	False mastic	moderate	SW, SE, Keys	moderate

Palms

Scientific Name	Common Name	Salt tolerance	NW/SW/NE/SE/Keys	Soil Moisture
Acoelorraphe wrightii	Everglades palm	moderate	SW, SE, Keys	moist - moderate
Coccothrinax argentata	silver palm	high	SE, Keys	dry
Sabal palmetto	cabbage palm	high	all	moist - moderate
Serenoa repens	saw palmetto	high	all	moist - dry
Leucothrinax morrisii	brittle thatch palm	moderate	Keys	dry
Thrinax radiata	Florida thatch palm	moderate	Keys	dry

For more information call Fritz Wettstein at 850/245-8020 or email fritz.wettstein@floridadep.gov.

Coastal Construction Control Line Program, Office of Resilience and Coastal Protection,
Florida Department of Environmental Protection, 2600 Blair Stone Road, Mail Station 3522, Tallahassee, Florida 32399-2400
850/245-8336 voice 850/245-8499 fax, cccl@dep.state.fl.us.

10.8. Sand Fencing Guidelines

Wind-blown sand is transported along the beach and may be trapped and collected by sand fences to assist in building sand dunes. Fences should be raised before the sand accumulates to a depth of 18 inches and can no longer trap sand. The installation of sand fencing may be restricted along high density marine turtle nesting beaches or where the dry beach area is too narrow to supply wind-blown sand to be effective or the shoreline is subjected to frequent erosion. The U.S. Fish and Wildlife Service also discourages the installation of long segments of sand fencing along marine turtle nesting beaches and should be installed along selective shorelines where sand fencing would be the most effective. The following Sand Fence Guidelines (FDEP, 2020) are provided below:

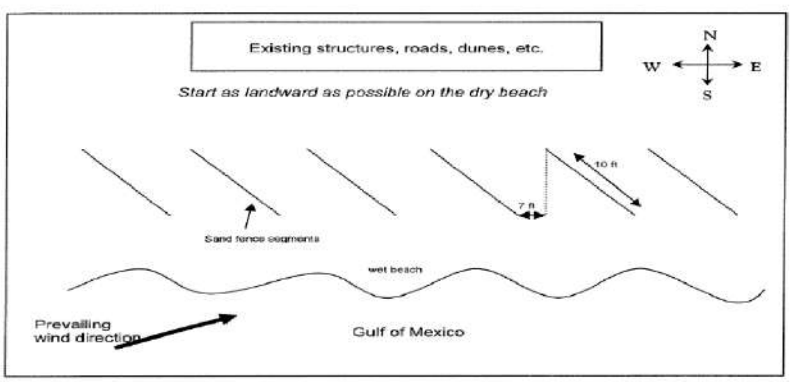
Sand Fencing Guidelines

Florida Department of Environmental Protection
Office of Resilience and Coastal Protection
Coastal Construction Control Line Program
2600 Blair Stone Road, MS 3522
Tallahassee, Florida 32399-2400
cccl@dep.state.fl.us
(850) 245-8336

Sand fences can assist dune vegetation and placement of beach compatible sand in rebuilding sand dunes by trapping windblown sand. Standard fencing used in dune restoration projects consists of wooden slats wired together with space between the slats as originally designed for snow fences. Sand fence designs with woven fabric type fencing have also been successful. Whatever the material being used, the fence is recommended to have a 40% open space to 60% closed space ratio for most effective sand trapping. Fabric-type fences might not hold up as well as the wooden slats since they are more susceptible to ultraviolet degradation.

Sand fences are usually 2 to 4 feet high and recommended to be lifted and repositioned prior to becoming 50% buried. If completely buried in sand, the fence loses the ability to collect more sand and the fence materials become difficult to remove and potential safety hazards.

Sand fences require Coastal Construction Control Line permits and must be installed outside of sea turtle nesting season with minimal risk to nesting sea turtles. Sand fences are best located seaward of the crest of the primary dune and for sea turtle protection must be configured as follows: a maximum of ten (10) foot long spurs of sand fencing spaced at a minimum of seven (7) feet on a diagonal alignment (facing the predominate wind direction) along the shoreline. Only one row is allowed within sea turtle nesting habitat.



If the primary reason for sand fencing is to control pedestrian access, a post and rope fence with a single strand of rope a minimum of three feet in height is preferred to reduce the amount of material in the dune system.

Florida Fish and Wildlife Conservation Commission
Contact: Imperiled Species Management (850) 922-4330 or marineturtle@myfwc.com

10.9. Dune Walkover Guidelines

Dune Walkovers and designated Beach Access Points should be used to cross the dunes from the uplands to the beach and direct foot and vehicular traffic. Continual on-grade traffic will damage dune vegetation and cause the sand dunes to erode and become more susceptible to storm damage. A dune system with well-established vegetation will provide a strong defense against storms. The following Dune Walkover Guidelines (FDEP, 2021d) are provided below:

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www.FloridaDEP.gov/CCCL
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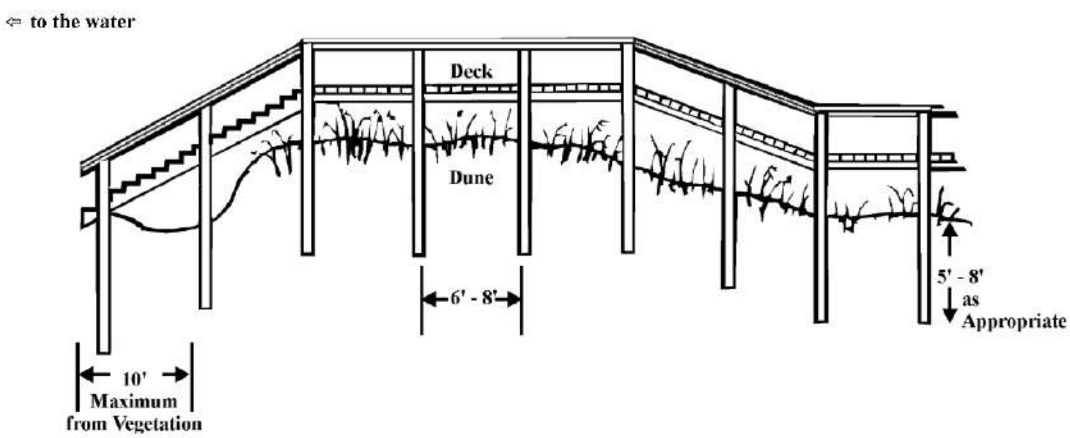
COASTAL CONSTRUCTION CONTROL LINE
DUNE WALKOVER GUIDELINES

On many of Florida's beaches, coastal dunes provide significant protection to upland property, wildlife habitat, and the beach dune system. The Florida Department of Environmental Protection (DEP) encourages coastal resilience design features for beach access and dune walkovers to protect dune topography, dune plants and coastal wildlife from construction impacts, damaging foot traffic and to allow for the natural recovery of damaged or eroded dunes.

TYPICAL DUNE WALKOVER PROFILE



PERMIT REQUIREMENTS

A permit from DEP is required for construction of walkovers on most sandy beaches fronting on the open waters of the Atlantic Ocean or Gulf of Mexico. In areas where a Coastal Construction Control Line (CCCL) has been established pursuant to provisions of Section 161.053, Florida Statutes (F.S.), a permit is required for all excavation, construction, or other activities with the potential to cause beach erosion or damage coastal vegetation. On sandy shorelines where a CCCL line has not been established, a permit is required for construction activities within 50 feet of the mean high water line (see Section 161.052, F.S.).

Permits for walkovers contain standard conditions that require construction to be conducted in a manner that minimizes short-term disturbance to the dune system and existing vegetation. Replacing vegetation destroyed during construction with similar plants suitable for beach and dune stabilization is required. Only limited excavation for the placement of support posts is allowed, and walkovers cannot be constructed during the marine turtle-nesting season, which extends May 1 through October 31 (except for Brevard through Broward counties, which extends March 1 through October 31).

Dune Walkover Guidelines (continued)

GENERAL SITING GUIDELINES

The walkover must be located and designed to protect dune features, to minimize disturbance of native vegetation, to not obstruct lateral beach access and to minimize the amount of construction material that may become debris during a storm. Elevated walkovers are not required for all beach accesses, such as in sparsely vegetated, low profile dune areas where on-grade sand or shell paths are suitable for controlling foot traffic. Note that on-grade beach mats are considered to be structures that require CCCL permits. Walkovers are generally constructed over the frontal dune and perpendicular to the shoreline. Dune walkovers are designed to extend at least to the seaward toe of the frontal dune or the existing line of vegetation and are allowed no farther than 10 feet seaward of the vegetation. The optimum siting of the walkover structure can be determined by contacting a CCCL field inspector.

GENERAL DESIGN GUIDELINES

Walkovers are designed to be minor, expendable structures that pose only minimal interference with coastal processes and generate minimal amounts of debris. Walkovers constructed across native beach and dune vegetation need to be post-supported and elevated a sufficient distance above the existing or proposed vegetation to allow for sand build-up and clearance above the vegetation. Stairways and ramps leading from the dune bluff or crest down to the beach need to completely span the seaward slope of the dune without installing posts into unstable slopes steeper than approximately 30 degrees. The structure must be designed to minimize the quantity of material used in construction, such as avoiding the use of vertical wood pickets, and reducing the length and width of construction on the beach.

Single family walkovers are not to exceed 4 feet in overall width and the support posts are not to be greater than 4-inch wide posts. Multi-family walkovers are not to exceed 6 feet in overall width and the support posts are not to be greater than 6-inch wide posts. Round posts are preferred to square posts. Support posts cannot be encased in concrete nor installed into dune slopes that are steeper than approximately 30 degrees. Support posts are to have a minimum 5 feet of soil penetration or embedment. Cross bracing is not required for most structures when following the designs in the document "*Beach/Dune Walkover Structures*," referenced at the end of this document. Local governments and property owners are advised to consult with a CCCL Permit Manager prior to requesting a permit for a walkover that contains switchbacks, long ramps or other features required to comply with the Americans with Disabilities Act Accessibility Guidelines.

WALKOVER ELEVATION GUIDELINES

Walkover heights vary as the structure crosses the beach/dune system. The ground cover changes from the uplands, commonly covered with woody scrub or coastal strand vegetation (saw palmetto/sea grape/scrub oaks),over a dune bluff or one or several dune crest(s), covered with either coastal strand or coastal grassland (sea oats/bitter panicum/marsh hay), down the slope to the dry sand beach, either uncovered bare escarpment or partially covered with beach/dune vegetation (railroad vine/sea rocket/sea oats). Design of the structure and height of the deck from the dune bluff or crest down to the beach also must be considered in setting the walkover elevation with the goal of minimizing the amount of material on the beach.

Walkover Elevations in Uplands. The upland environment of coastal scrub/coastal strand habitat is characterized by more stable soil conditions with less blowing sands and infrequent storm overwash events. The stable conditions allow for the development of a mature woody vegetation and saw palmetto dominated plant community. In addition to thick above ground stem and leaf vegetation between 5 and 15 feet in height, this plant community has an extensive below ground woody root mat. Walkovers in these upland habitats need be elevated only a sufficient distance above the ground to avoid disturbance of the soil and root systems or cutting of low tree and palmetto trunks. An elevation of the stringers from 6" to 2'-0" above existing grade is expected to be sufficient in many cases. Walkover elevations crossing coastal wetlands within upland areas may require increased elevations. Elevation of the walkover above the leaf canopy is in most cases impractical in coastal

Dune Walkover Guidelines (continued)

scrub or coastal strand habitats where careful pruning needs to be limited to removal of only those aerial branches to create an open passage. Deck elevations need to be no higher than five feet above grade to provide clearance for vegetation, and the movement of sand, water and sea turtles underneath the structure.

Walkover Elevations over Bluffs. The low stringer elevation recommended for uplands can be carried to the landward side of the bluff line. This will reduce the length of a ramp or walkover from the crest down to the beach. Again the objective the walkover elevation is to reduce damage to coastal scrub soils and root systems.

Walkover Elevations over Dune Crests. Dune environments are characterized by mobile sands subject to storm effects (which lower grade elevations) and wind effects (which can raise elevation as sand is trapped). Dunes are dominated by coastal grassland plants adapted to the dynamic environment. These include sea oats, bitter panicum, and little bluestem. Walkovers sited within active dune systems are required to be elevated sufficiently to allow for sand movement and growth of vegetation. Walkover designs published in "Beach/Dune Walkover Structures" referenced below specify a 3'-10" minimum clearance from existing grade to the bottom of the stringers of an up to 6-foot wide (overall dimension) multi-family or public beach access structures, and a 3'-0" minimum clearance to the top of the deck for 4-foot wide single family walkovers.

Walkover Elevations on Seaward Dune or Bluff Slopes. The elevation of the walkover at the dune crest and the distance of the seaward terminus from the water's edge determine the height of the steps or ramps crossing the seaward slope. The design objective is to get the structure down to the beach in as short a shore-normal (perpendicular to the shoreline) distance as possible while reducing the shore-parallel coverage of the slope. Department guidelines require that the seaward terminus of the structure be no farther seaward than 10 feet from the line of permanent beach dune vegetation or the toe of the frontal dune. Reducing the seaward encroachment and shore-parallel width decreases the potential for storms interacting with the structure, occupation of sea turtle nesting habitat by the structure, and interference with lateral public beach access. Walkovers designed for the Americans with Disabilities Act often increase the length of walkover ramps on the beach. This requires the need for a site specific review for environmental impacts. The burial of the ramp or step terminus a minimum amount (0.5 to 1.0 feet)-foot below grade may allow for use of the walkover after some lowering of the beach elevation from minor storms. However, placement of this terminus below the depth of a post storm beach profile is discouraged as this portion of the walkover will most likely have been damaged by larger storms and to have interfered with coastal processes.

On Grade Walkovers. Elevated walkovers are not necessary in all site conditions and use situations. Where dune development is minimal, beach dune vegetation is sparse and the use infrequent, on-grade footpaths may be preferred. The Department discourages solid concrete walks and footpath surfaces such as stepping stones that create debris or missiles. Other surfaces such as geotextile fabrics, cabled wood planks, or shell require a case by case review. No permanent path surfaces are allowed farther seaward than 10-feet from the dune or vegetation line or within sea turtle nesting habitat.

Reference

Beach/Dune Walkover Structures, SUSF-SG-76 by Todd L. Walton, Jr., and Thomas C. Skinner. Published by the Marine Advisory Program of the Florida Cooperative Extension Service and the Florida Sea Grant, March, 1983.

11.0. Permit Feasibility

Any activity seaward of the CCCL and the MHW line will require a CCCL permit from FDEP which would likely be necessary for any of the proposed projects discussed within. FDEP encourages the placement of beach quality sand and native dune vegetation to restore and enhance dune systems, therefore permitting is relatively straight forward. The establishment of an Erosion Control Line (ECL) or a Joint Coastal Permit (JCP) would not be required provided sand is not placed below the MHW line that would extend the shoreline seaward. A USACE permit or Biological Opinion from the U.S. Fish and Wildlife or National Marine Fisheries Service should not be required because the proposed activities will occur upland of the High Tide line. These sections of beach do not contain "critical beach mouse habitat", however it is within critical nesting habitat for loggerhead sea turtles so construction may be limited to outside of sea turtle nesting season which extends from May 1 to October 30. Florida Fish and Wildlife Conservation Commission (FWC) will also provide comments during the permitting process. Permits and authorization from FDEP can be obtained in approximately 6-months or less from submitting a complete permit application that will also identify the borrow area(s) and sand quality.

12.0. Summary

The purpose of this investigation was to identify cost-effective solutions to rebuild and increase the stability of the dunes throughout the Franklin County study shoreline. There are four (4) shoreline segments included in this study 1) St. George Island shoreline between R-73 to R-94, 2) Alligator Point between R-195 to R-222, 3) Bald Point between R-229 to R-235, and 4) Carrabelle Beach.

The primary constraints that determined the types of dunes possible for a particular stretch of shoreline were: 1) the height (or lack) of the existing dune system, 2) the width of the existing dry beach berm, 3) the location of upland structures and infrastructure relative to the shoreline, and 4) the level of storm protection (level of risk) provided by the existing beach and dune system. The greatest benefit of constructing a continuous, contiguous dune feature along the Franklin County beaches is to provide a barrier to storm events, reduce overtopping and flooding to the back dune areas, mitigating for historic dune erosion and creating wildlife habitat.

Three conceptual dune types (A, B and C) were developed through an iterative process by revising the crest height and width to optimize the level of storm protection through SBEACH modeling while maintaining a minimum berm width of 80-feet, where possible. A fourth option consists solely of vegetation and sand fencing where there is not an adequate amount of room to construct a dune feature.

1) Portions of Alligator Point and Bald Point are typically characterized by having wide berms, low flat dune features with elevations typically less than +8 feet, NAVD88 and significant structural setbacks from the Gulf of Mexico. The conceptual Type A Dune would have a crest elevation of +10-foot, NAVD88 so not to impede views, crest width varying between 20 to 30-feet and side slopes from 1V:4H to 1V:3H. This dune type is suitable for areas having an existing berm width of a 100-feet or greater. The wider dune crest and more gradual slope of this dune type (1V:4H) allows for greater storm protection and a more natural transition from the dune to the beach berm.

2) The entire beach segment of St. George Island between R-73 and R-94 and portions of Alligator Point and Bald Point are typically characterized by wide beach berms, eroded dune faces with and fairly significant structural setbacks from the Gulf of Mexico. The Type B Dune concept extends from an existing dune crest elevation of +10 ft, NAVD88 so not to impede views to the Gulf from the upland structures and can be placed in locations with narrow or wide existing beach berm widths by varying the crest width between 20 to 30 feet and side slopes from 1V:3H to 1V:4H.

3) Portions of Alligator Point are typically characterized by narrow berm widths, eroded dune peaks and smaller structural setbacks from the Gulf of Mexico. The Type C Dune concept is similar to the Type A Dune and is suitable for existing dune elevations that are less than +8 feet, NAVD88, and consist of narrower and lower elevation beach berms than beaches suitable for a Type A Dune. The conceptual Type C Dune would have a crest elevation at +10 feet NAVD 1988 so not to impede views, narrow crest width of 10 to 20 feet, and steeper front and back slopes of 1V:3H.

4) There are some areas on Alligator Point and Bald Point where there is not adequate room between the existing structures and the shoreline to construct a dune feature. In these locations vegetation and sand fence can be placed to assist in the development and growth of dunes. Initially this option would not provide any storm protection but may increase with the growth of the dune naturally. It should be noted that the sand fence requires periodic maintenance to ensure the optimal long-term performance to capture wind-blown sediments. It is recommended that the fencing be pulled up and reinstalled before it is buried by 2 feet of sand. Otherwise, it will be difficult to impossible to remove the fence and may eventually completely covered becoming ineffective to trap sand.

Post and rope fencing is used to direct pedestrian traffic away from the dunes and to dune walkovers, beach and vehicular accesses and paths. “Keep Off the Dunes” signs should also be installed at the toe of the dune to inform and educate beach goes on the ecological importance of dunes systems.

The conceptual construction templates may need to be refined to fit along a particular beach segment depending on the specific conditions existing at the time of final design. Updated surveys will document the existing grades that will be used to develop the construction templates and update construction volumes. The preliminary opinion of probable construction costs in 2022 dollars are found in ***Table 13***, ***14***, ***15***, and ***16*** and were based on Gulf County dune projects that were bid and constructed in 2020 and 2021-2022. A price escalation was applied to these unit costs to account for the increased fuel costs since these projects were bid. The preparation of a budget for grant applications or construction should include an adjustment in the unit costs based on the anticipated design, permitting and construction schedule.

The proposed activities seaward of the CCCL will require a CCCL permit from FDEP. FDEP encourages the placement of beach quality sand and native dune vegetation to restore and enhance dune systems, therefore permitting is relatively straight forward. A USACE permit should not be required provided the proposed activity will occur upland of the High Tide line. Construction may be limited to outside of sea turtle nesting season which extends from May 1 to October 30. Permits and authorization from FDEP can be obtained in approximately 6-months or less from submitting a complete permit application that will also identify the borrow area(s) and sand quality.

13.0. Glossary of Coastal Engineering Terminology

The following terms were obtained from a number of sources and refined for use in this report. The majority of these terms were obtained from the Coastal Engineering Manual (USACE, 2002), www.Beachapedia.org, and Chapter 62B-33, Florida Administrative Code (FAC).

ACCRETION

The accumulation of (beach) sediment, deposited by natural fluid flow processes. Growth (vertical and/or horizontal) of morphological structures (beach, bar, dune, sand bank, tidal flat, salt marsh, tidal channel, etc.) by sedimentation. May be either natural or artificial. Natural accretion is the buildup of land, solely by the action of the forces of nature, on a beach by deposition of water-borne or airborne material. Artificial accretion is a similar buildup of land by reason of an act of man, such as the accretion formed by a groin, breakwater, or beach fill deposited by mechanical means.

BACKSHORE

That zone of the shore or beach lying between the foreshore and the dunes comprising the BERM or BERMS and acted upon by waves only during severe storms, especially when combined with exceptionally high water. Generally referred to as the landward portion of the dry recreational beach area. The backshore is dry under normal conditions and only exposed to waves under extreme events with high tide and storm surge. Vegetation is generally sparse or absent.

BACK BARRIER

Sandy region in the lee of a coastal barrier island, barrier spit, or baymouth barrier, often containing significant coarse sediment that has washed in from the seaward side.

BACKRUSH

The seaward return of water following the uprush of the waves. For any given tide stage, the point of farthest return seaward of the backrush is known as the limit of backrush.

BACKSHORE

That zone of shore or beach lying between the foreshore and the dunes and acted upon by waves only during severe storms, especially when combined with exceptionally high water. It includes the berm or groins.

BACKSLOPE

The part of the profile of a hillslope that forms the steepest, typically linear portion of the slope, generally located in the middle and bounded by a convex shoulder above and a concave foot slope below. The backslope may or may not include vertical or near-vertical cliffs.

BAR

A submerged or emerged embankment of sand, gravel, or other unconsolidated material built on the sea floor in shallow water by waves and currents.

BARRIER ISLAND

A coastal landform that runs parallel to the coastline, often created when offshore bars are driven onshore by rising sea levels.

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BATHYMETRY

The measurement of depths of water in oceans, seas, and lakes, and also the information derived from such measurements.

BEACH

A zone of unconsolidated material that extends landward from the low water line to the place where there is marked change in material or physiographic form such as the toe of the dune, or to the line of permanent vegetation (usually the effective limit of storm waves).

BEACH BERM

A nearly horizontal shore parallel ridge formed on the beach formed by the landward transport of the coarsest fraction of the beach material by the wave uprush. Some beaches have no berms, others have one or several. Under normal conditions a beach berm is formed on the upper part of the beach face, and over the backshore during severe events. Beach berms are sometimes artificially reinforced as coastal protection measure.

BEACH CUSPS

One of a series of short scallop-like ridges on the foreshore separated by crescent-shaped troughs or depressions spaced at more or less regular intervals along the beach. Typically, these are spaced between a few meters and a few tens of meters consisting of small embayment between protruding horns.

BEACH FACE

Is the zone between the mean low water (MLW) and the seaward beach berm, which is equivalent to the upper limit of wave run-up at high tide. The beach face is the part of the beach which is wetted due to the varying tide and swash under normal conditions.

BEACH FILL

Material placed on a beach to nourish eroding shorelines, usually pumped and placed by a dredge but sometimes delivered by trucks. The supply of beach sand for the construction of an artificial beach.

BEACH NOURISHMENT

Beach nourishment is the supply of sand to the beach to increase the recreational value and/or to compensate for the effect of shore erosion by feeding sand on the beach.

BEACH WIDTH

The horizontal dimension for the beach measured normal to the shoreline and landward of the higher-high tide line.

BERM

In a barrier beach system, the relatively flat, sandy area between the berm crest and the dunes formed by the deposit of material by wave action. Some beaches have no berm, others have one or several.

BERM CREST

The seaward limit of a berm.

BEACH COMPATIBILITY MATERIAL OR BEACH QUALITY SAND

In general, fill material shall be sand that is similar in coloration and grain size as the existing natural sands. It shall be free of debris, rock, clay, organic matter or other foreign matter and shall not result in cementation of the beach. Beach-compatible fill material will be predominantly quartz sand of a mean grain size diameter between 0.20mm and 0.45mm, with a moist Munsell color value/chroma of 7/1 or lighter and a similar quantity of shell as the existing natural beach.

BEACH AND OFFSHORE PROFILES

Survey measurement of the elevations of the beach surface taken along a line that runs from the dune across the beach to the Depth of Closure. A profile is the shape of the beach and offshore if one had taken a vertical cut from the dune to the offshore and looked at from the side. Profiles taken at different dates can be compared to illustrate and quantify storm, seasonal, and longer-term changes in beach width, height, volume, and shape.

BORROW AREA OR SITES

Located offshore in the form of drowned barrier islands, oblique sand bodies and longshore sand bars, near to shore in the form of flood and ebb tidal deltas, or on land. This sand is used for beach and dune nourishment by excavating the material from these features, transporting, placing and forming to the specified construction template. Sand may also come from navigation channel maintenance dredging activity.

BRUUN RULE

A linear relationship between sea level rise and shoreline recession based on equilibrium profile theory, which asserts that shore face profile maintains an equilibrium shape, and as sea level rises the increasing accommodation space forces this equilibrium profile landward and upward to preserve its shape relative to the new sea level.

COAST

A strip of land of indefinite width that extends from the shoreline inland to the first major change in terrain features. Coastal zones are regions where the interaction of terrestrial and marine processes occurs.

COASTAL CONSTRUCTION CONTROL LINE (CCCL) OR CONTROL LINE

Is the line established pursuant to the provisions of Section 161.053, F.S., and recorded in the official records of the county, which defines that portion of the beach-dune system subject to severe fluctuations based on a 100-year storm surge, storm waves, or other predictable weather conditions.

COASTAL ZONE

The transition zone where the land meets the water, the region that is directly influenced by marine and lacustrine hydrodynamic processes. Extends offshore to the continental shelf break and onshore to the first major change in topography above the reach of major storm waves. On barrier coasts, includes the bays and lagoons between the barrier island and the mainland.

CONSTRUCTION TEMPLATE

The specified grade, elevations, slope that sand will be placed and shaped to nourish a beach.

CONTOUR

A line marked on a topographic map or chart which connects points of equal elevation above or below a specified reference datum. Multiple contour lines, each representing a different elevation, are depicted together to show the shape of the terrain within the map area.

CRITICALLY ERODED SHORELINE

Pursuant to Rule 62B-36.002(5), Florida Administrative Code (FAC), *where natural processes or human activity have caused or contributed to erosion and recession of the beach or dune system to such a degree that upland development, recreational interests, wildlife habitat, or important cultural resources are threatened or lost*.

CROSS-SHORE

Perpendicular to the shoreline.

CUTTERHEAD DREDGE

A hydraulic dredge that uses a rotating steel head consisting of hardened cutting blades and backing ring to dislodge bottom material. The head is mounted at the suction entrance of the hydraulic pipeline, and fluidized material is picked up by suction and carried away through the pipeline.

DATUM

Any permanent line, plane or surface used as a reference datum to which elevations are referred. The National Geodetic Vertical Datum of 1929 (NGVD29) was the official vertical datum established for vertical control surveying in the lower 48 states and Alaska. The datum was used to measure the elevation of a point above and depression below mean sea level (MSL). NGVD29 was superseded by the North American Vertical Datum of 1988 (NAVD 88) in 1993.

DEPTH OF CLOSURE

The theoretical depth along a beach profile where sediment transport is very small or non-existent, dependent on wave height and period, and occasionally, sediment grain size." Based on this definition, there should be no or very little volume changes seaward of the Depth of Closure.

DESIGN STORM

A hypothetical extreme storm whose waves coastal protection structures and/or beaches will often be designed to withstand. The severity of the storm (return period) is chosen in view of the acceptable level of risk of damage or failure. A design storm consists of a design wave conditions, a design water level and a duration.

DOWNDRIFT

The direction of predominant movement of littoral materials.

DUNE

Ridges or mounds of loose sediment (fine to medium) landward of a coastal berm deposited by wind or by storm overwash. Sediment deposited by artificial means serves the purpose of storm-damage prevention and flood control. These coastal features are somewhat parallel to the shoreline and are more or less vegetated. Dunes are an active coastal form acting as a sand reservoir and providing flexible natural protection against erosion and flooding.

DUNE CREST

Top of the natural of artificial created dune feature.

DUNE, TOE

Occurs at a point where there is a distinct change from a relatively steep slope to a relatively mild slope either on the seaward or landward side of the dune feature.

DREDGING

The removal of sediment or the excavation of tidal or subtidal bottom to provide sufficient depths for navigation or anchorage, or to obtain material for construction or for beach nourishment.

EROSION, RECESSION

The wearing away of land by the action of natural forces. On a beach, the carrying away of beach material by wave action, tidal currents, littoral currents, or by deflation. A continuing net landward movement of the shoreline over a specified time.

EROSION CONTROL LINE (ECL)

In accordance with Rule 62B-41.002(15), FAC … *in connection with beach restoration projects. Where established, an erosion control line represents the landward extent of the claims of the state in its capacity as sovereign title holder of the submerged bottoms and shores of the … the Gulf of Mexico …* The ECL establishes the boundary between upland private property and the State of Florida and is delineated along the MHW line at the time of the pre-construction survey. Any dry beach created seaward of the ECL will be public property and can be passively used by the public including activities such as sunbathing, fishing, etc.

ESCARPMENT OR SCARP

An almost vertical slope along the beach caused by erosion by wave action. It may vary in height from a few inches to several feet, depending on wave action and the nature and composition of the beach.

EQUILIBRIUM PROFILE

For sediment of a given size, there will be a unique beach profile shape in equilibrium with the specified wave and tidal characteristics of the beach where the constructive and destructive forces on the sand grains are in balance. If the forces change, a new equilibrium profile will evolve and form.

FEEDER BEACH

An artificially widened beach serving to nourish downdrift beaches by natural littoral currents or forces.

FOREDUNE

The front dune immediately behind the backshore.

FORESHORE

The part of the shore, lying between the crest of the seaward berm (or upper limit of wave wash at high tide) and the ordinary low water mark, that is ordinarily traversed by the uprush and backrush of the waves as the tides rise and fall.

HIGH TIDE, HIGH WATER (HW)

The maximum elevation reached by each rising tide. The height may be solely due to the periodic tidal forces, or it may have superimposed upon it the effects of prevailing meteorological conditions.

HOPPER DREDGE

Self-propelled floating plant, which is capable of dredging material, storing it onboard, and transporting and placing the material at a specified disposal site. Often used to dredge inlets and deposit the along the open coast or offshore.

HURRICANE

An intense tropical cyclone with winds that move counterclockwise around a low-pressure system. Maximum sustained winds of 74 miles per hour or greater.

JETTY

On open seacoasts, a structure extending into a body of water, which is designed to prevent shoaling of a channel by littoral materials and to direct and confine the stream or tidal flow. Jetties are built at the mouths of rivers or tidal inlet to help deepen and stabilize a channel.

LEE

Shelter, or the part or side sheltered or turned away from the wind or waves. The quarter or region toward which the wind blows.

LEEWARD

The direction toward which the wind is blowing; the direction toward which waves are traveling.

LEVEL OF STORM PROTECTION OR PROTECTIVE VALUE

The measurable protection level afforded by the dune system to upland property and structures from the predictable erosion and storm surge levels associated with coastal storm events.

LITTORAL

Pertaining to a shore, especially of the sea. Often used as a general term for the coastal zone influenced by wave action, or, more specifically, the shore zone between the high and low water marks.

LONGSHORE

Parallel to and near the shoreline.

LOW TIDE, LOW WATER (LW)

The minimum elevation reached by each falling tide.

MUNSELL COLOR

A color system is a color space that specifies colors based on three properties of color: hue (basic color), chroma (color intensity), and value (lightness). The Munsell Chart is used to compare beach sand color and compatibility.

NATIVE SAND

The sand that occurs naturally on the beach.

NAUTICAL MILE

Generally, one minute of latitude is considered equal to one nautical mile. The accepted United States value as of 1 July 1959 is 1,852 meters (6,076.115 feet), approximately 1.15 times as long as the U.S. statute mile of 5,280 feet.

NEARSHORE

In beach terminology an indefinite zone extending seaward from the shoreline well beyond the breaker zone.

NON-CRITICALLY ERODED SHORELINE

Pursuant to Rule 62B-36.002(5), FAC, *Where many areas have significant historic or contemporary erosion conditions, yet the erosion processes do not currently threaten public or private interests. These areas are therefore designated as non-critically eroded beaches and require close monitoring in case the conditions become critical.*

NOURISHMENT

The placement of sediment on a beach or dunes by mechanical means. Sand is extracted (generally by dredging) from nearby sources and applied to the beach, the shoreface or the dunes. The costs highly depend on the location of available sand sources, which should be situated outside (seaward of) the active coastal zone. Dune nourishment is usually meant for safety against flooding, beach nourishment for restoration of the beach and shoreface nourishment for stabilizing the shoreline.

OVERWASH

The uprush and overtopping of a coastal dune by storm waters. Sediment is usually carried with the overwashing water and deposited, usually in a fan shape, on the landward side of the dune or barrier.

PLANFORM EVOLUTION

The changes in the outline or shape of a body of water as determined by the still-water line over a period of time.

REFERENCE MONUMENT

"R-Monuments" are reference points spaced approximately 1,000 feet apart along the gulf shoreline. These FDEP maintained monuments which are either physical monuments driven into the ground or virtual locations are referenced to vertical and horizontal datums. They are used to correlate survey data over time to monitor various shoreline changes within the littoral zone and upland topography and are also used to reference the location of coastal features.

REVETMENT

A sloped, facing structure made of an armoring material designed to protect an escarpment or embankment or an upland structure from erosion by wave or current action. Designed to dissipate the force of storm waves and prevent undermining of a seawall, dune or placed fill.

RUBBLE-MOUND STRUCTURE

A mound of random-shaped and random-placed stones protected with a cover layer of selected stones or specially shaped concrete armor units. Armor units in a primary cover layer may be placed in an orderly manner or dumped at random.

SAND

Sediment particles, often largely composed of quartz, with diameter between 0.062mm and 2mm, generally classified as fine, medium, coarse or very coarse. Beach sand may sometimes be composed of organic sediments such as calcareous reef debris or shell fragments.

SEA LEVEL RISE (SLR)

The so-called greenhouse effect or global warming causes a rise of the mean sea level, which will have a great impact on long-term coastal morphology, see Sea level rise. The long-term gradual sea-level rise will cause a general coastline retreat and an increased flooding risk depending on local conditions. An estimate of coastline retreat due to relative sea-level rise can be derived from the so-called Bruun rule, which is valid under certain rather restrictive conditions.

SEAWALL

A vertical, wall-like coastal-engineering structure built parallel to the beach or dune line and usually located at the back of the beach or the seaward edge of the dune to prevent erosion and other damage due to wave or current action.

SEDIMENT

Loose, fragments of rocks, minerals or organic material which are transported form their source for varying distances and deposited by air, wind, ice and water. Other sediments are precipitated from the overlying water or form chemically, in place. Sediment includes all the unconsolidated materials on the sea floor.

SETUP, WAVE

Superelevation of the water surface over normal surge elevation due to onshore mass transport of the water by wave action alone.

SHORE

The fringe of land at the edge of a large body of water, such as an ocean, sea, or lake.

SHORELINE

The intersection between the water line and the shore. The line delineating the shoreline on Nautical Charts approximates the Mean High Water (MHW) Line.

SHORELINE CHANGE RATE

The average annual horizontal shift of the intersection of the foreshore slope of the beach with the referenced water plane, based on recorded historical measurements.

SPRING TIDE

A tide that occurs at or near the time of new or full moon (syzygy) and that rises highest and falls lowest from the mean sea level.

STORM RETURN PERIOD

The inverse of probability (generally expressed in %), it gives the estimated time interval between events of a similar size or intensity. Return periods for a defined storm event is given as the probability of being equaled or exceeded in any one year (i.e., for a 100-year event, exceedance = 1/return period = 1/100 year = 0.01 or 1% chance per year) compared to a hurricane category which are based on the measured "Sustained Winds" in accordance with the Saffir-Simpson Hurricane Wind Scale.

STORM SURGE
: The rise in water-level on an open coast as a result of the combined impact of the wind stress on the water surface, the atmospheric pressure reduction and local topographic features. The storm surge does not include the effect of the astronomical tide.

SURF ZONE
: The area between the outermost breaker and the limit of wave uprush.

TIDE
: The periodic rising and falling of the water that results from gravitational attraction of the moon, the sun and other astronomical bodies acting upon the rotating earth.

UPDRIFT
: The direction opposite that of the predominant movement of sediment along the shore. The side of a groin, jetty or other structure where sand accumulates.

UPLAND
: A general term for land or ground that is higher than the floodplain or shoreline.

UPRUSH
: The landward flow of water up onto the beach that occurs when a wave breaks.

VOLUME CHANGE RATE
: The average annual volume changes along a beach profile and along the shoreline, based on recorded historical measurements.

14.0. References

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EXHIBIT 2

Construction Cost Estimate and Scope of Work for St. George Island Stormwater Improvements

SGI STORMWATER IMPROVEMENTS - FRANKLIN COUNTY, FL
ENGINEER'S ESTIMATE OF PROBABLE CONSTRUCTION COSTS (100%)
DEI PROJECT NO. 50141160

ITEM	DESCRIPTION	QTY.	UNIT	UNIT BID PRICE	BID PRICE
	GENERAL				
1	MOBILIZATION (5% OF BID MAX)	1	LS	$156,304.85	$156,304.85
2	BONDS AND INSURANCE (2.5% OF BID MAX)	1	LS	$78,152.43	$78,152.43
3	NPDES PERMIT	1	LS	$8,000.00	$8,000.00
4	CONSTRUCTION LAYOUT	1	LS	$14,000.00	$14,000.00
5	EROSION CONTROL (INCLUDES SILT FENCE, TURBIDITY BARRIER, INLET PROTECTION, ETC.)	1	LS	$16,000.00	$16,000.00
6	MAINTENANCE OF TRAFFIC	1	LS	$35,000.00	$35,000.00
7	TESTING	1	LS	$10,000.00	$10,000.00
8	AS-BUILTS	1	LS	$10,000.00	$10,000.00
				SUBTOTAL	$327,457.28
	BASE BID				
9	DEMOLITION	1	LS	$80,000.00	$80,000.00
10	REMOVE AND REPLACE TREES	29	EA	$2,500.00	$72,500.00
11	MISCELLANEOUS RESTORATION	1	LS	$100,000.00	$100,000.00
12	UTILITY CONFLICTS	1	LS	$50,000.00	$50,000.00
13	REGULAR EXCAVATION	5,500	CY	$30.00	$165,000.00
14	BORROW EXCAVATION	1,600	CY	$40.00	$64,000.00
15	TYPE B STABILIZATION	1,020	SY	$8.00	$8,160.00
16	OPTIONAL BASE, BASE GROUP 09	1,521	SY	$38.00	$57,798.00
17	SUPERPAVE ASPHALTIC CONCRETE, TRAFFIC B	170	TN	$205.00	$34,850.00
18	6" CONCRETE DRIVEWAY	783	SY	$95.00	$74,385.00
19	BRICK PAVERS	6	SY	$195.00	$1,170.00
20	6" OF 57 STONE OR APPROVED EQUAL	237	SY	$35.00	$8,295.00
21	TYPE D INLET	44	EA	$9,600.00	$422,400.00
22	TYPE E INLET	1	EA	$12,200.00	$12,200.00
23	TYPE H INLET	1	EA	$20,000.00	$20,000.00
24	TYPE J MANHOLE	1	EA	$16,000.00	$16,000.00
25	18" RCP	2732	LF	$200.00	$546,400.00
26	24" RCP	2345	LF	$250.00	$586,250.00
27	18" MES	2	EA	$3,600.00	$7,200.00
28	24" MES	11	EA	$4,200.00	$46,200.00
29	MAIMI CURB	270	LF	$75.00	$20,250.00
30	DETECTABLE WARNINGS	140	SF	$40.00	$5,600.00
31	PERFORMANCE TURF	1200	SY	$2.00	$2,400.00
32	PERFORMANCE TURF, SOD	2,800	SY	$4.50	$12,600.00
33	THERMOPLASTIC, STANDARD, WHITE, SOLID, 12"	75	LF	$10.00	$750.00
34	THERMOPLASTIC, STANDARD, WHITE, SOLID, 24"	108	LF	$15.00	$1,620.00
				SUBTOTAL	$2,416,028.00
				TOTAL BASE BID	$2,743,485.28
	BID ALTERNATES				
	BID ALTERNATE 1: WEST GORRIE DRIVE				
35	CLEARING AND GRUBBING	1	LS	$17,000.00	$17,000.00
36	REGULAR EXCAVATION	230	CY	$30.00	$6,900.00
37	BORROW EXCAVATION	62	CY	$40.00	$2,480.00
38	OPTIONAL BASE, BASE GROUP 04 (LIMEROCK ONLY)	190	SY	$25.00	$4,750.00
39	OPTIONAL BASE, BASE GROUP 09 (LIMEROCK ONLY)	490	SY	$38.00	$18,620.00
40	SUPERPAVE ASPHALTIC CONCRETE, TRAFFIC B	246	TN	$205.00	$50,430.00
41	PERFORMANCE TURF	100	SY	$2.00	$200.00
42	PERFORMANCE TURF, SOD	400	SY	$4.50	$1,800.00
43	PAINTED PAVEMENT MARKINGS, FINAL SURFACE	1	LS	$2,000.00	$2,000.00
*	PAINTED PAVEMENT MARKINGS, STANDARD, YELLOW, SOLID, 6"	0.230	GM	*	*
44	THERMOPLASTIC, STANDARD, YELLOW, SOLID, 6"	0.230	GM	$5,500.00	$1,265.00
				SUBTOTAL	$105,445.00
	BID ALTERNATE 2: WEST PINE STREET				
45	CLEARING AND GRUBBING	1	LS	$10,000.00	$10,000.00
46	REGULAR EXCAVATION	224	CY	$30.00	$6,720.00
47	BORROW EXCAVATION	57	CY	$40.00	$2,280.00
48	OPTIONAL BASE, BASE GROUP 04 (LIMEROCK ONLY)	300	SY	$25.00	$7,500.00
49	OPTIONAL BASE, BASE GROUP 09 (LIMEROCK ONLY)	372	SY	$38.00	$14,136.00

50	SUPERPAVE ASPHALTIC CONCRETE, TRAFFIC B	233	TN	$205.00	$47,765.00
51	PERFORMANCE TURF	100	SY	$2.00	$200.00
52	PERFORMANCE TURF, SOD	300	SY	$4.50	$1,350.00
53	PAINTED PAVEMENT MARKINGS, FINAL SURFACE	1	LS	$1,000.00	$1,000.00
*	PAINTED PAVEMENT MARKINGS, STANDARD, WHITE, SOLID, 24"	41	LF	*	*
*	PAINTED PAVEMENT MARKINGS, STANDARD, YELLOW, SOLID, 6"	0.160	GM	*	*
54	THERMOPLASTIC, STANDARD, WHITE, SOLID, 24"	41	LF	$15.00	$615.00
55	THERMOPLASTIC, STANDARD, WHITE, MESSAGE OR SYMBOL	1.000	EA	$300.00	$300.00
56	THERMOPLASTIC, STANDARD, YELLOW, SOLID, 6"	0.160	GM	$5,500.00	$880.00
				SUBTOTAL	$92,746.00
	BID ALTERNATE 3: GULF BEACH DRIVE				
57	CLEARING AND GRUBBING	1	LS	$20,000.00	$20,000.00
58	REMOVAL OF EXISTING CONCRETE	3	SY	$50.00	$150.00
59	REGULAR EXCAVATION	213	CY	$30.00	$6,390.00
60	BORROW EXCAVATION	64	CY	$40.00	$2,560.00
61	OPTIONAL BASE, BASE GROUP 04 (LIMEROCK ONLY)	328	SY	$25.00	$8,200.00
62	OPTIONAL BASE, BASE GROUP 09 (LIMEROCK ONLY)	422	SY	$38.00	$16,036.00
63	SUPERPAVE ASPHALTIC CONCRETE, TRAFFIC B	393	TN	$205.00	$80,565.00
64	CONCRETE SIDEWALK AND DRIVEWAYS, 4" THICK	3	SY	$45.00	$135.00
65	PERFORMANCE TURF	200	SY	$2.00	$400.00
66	PERFORMANCE TURF, SOD	700	SY	$4.50	$3,150.00
67	RAISED PAVEMENT MARKER, TYPE B	1	LS	$300.00	$300.00
**	RAISED PAVEMENT MARKERS, BI-DIRECTIONAL YELLOW	40	EA	**	**
68	PAINTED PAVEMENT MARKINGS, FINAL SURFACE	1	LS	$2,500.00	$2,500.00
*	PAINTED PAVEMENT MARKINGS, STANDARD, WHITE, SOLID, 12"	240	LF	*	*
*	PAINTED PAVEMENT MARKINGS, STANDARD, WHITE, SOLID, 24"	180	LF	*	*
*	PAINTED PAVEMENT MARKINGS, STANDARD, YELLOW, SOLID, 6"	0.310	GM	*	*
69	THERMOPLASTIC, STANDARD, WHITE, SOLID, 12"	240	LF	$10.00	$2,400.00
70	THERMOPLASTIC, STANDARD, WHITE, SOLID, 24"	180	LF	$15.00	$2,700.00
71	THERMOPLASTIC, STANDARD, WHITE, MESSAGE OR SYMBOL	4.000	EA	$300.00	$1,200.00
72	THERMOPLASTIC, STANDARD, YELLOW, SOLID, 6"	0.310	GM	$5,500.00	$1,705.00
				SUBTOTAL	$148,391.00
	BID ALTERNATE 4: EAST GORRIE DRIVE				
73	CLEARING AND GRUBBING	1	LS	$9,000.00	$9,000.00
74	REGULAR EXCAVATION	83	CY	$30.00	$2,490.00
75	BORROW EXCAVATION	20	CY	$40.00	$800.00
76	OPTIONAL BASE, BASE GROUP 04 (LIMEROCK ONLY)	65	SY	$25.00	$1,625.00
77	OPTIONAL BASE, BASE GROUP 09 (LIMEROCK ONLY)	182	SY	$38.00	$6,916.00
78	SUPERPAVE ASPHALTIC CONCRETE, TRAFFIC B	101	TN	$205.00	$20,705.00
79	PERFORMANCE TURF	25	SY	$2.00	$50.00
80	PERFORMANCE TURF, SOD	70	SY	$4.50	$315.00
81	12" RIBBON CURB (INCLUDES REINFORCEMENT BAR)	200	LF	$75.00	$15,000.00
82	PAINTED PAVEMENT MARKINGS, FINAL SURFACE	1	LS	$700.00	$700.00
*	PAINTED PAVEMENT MARKINGS, STANDARD, YELLOW, SOLID, 6"	0.100	GM	*	*
83	THERMOPLASTIC, STANDARD, YELLOW, SOLID, 6"	0.100	GM	$5,500.00	$550.00
				SUBTOTAL	$58,151.00
	BID ALTERNATE 5: EAST PINE STREET				
84	CLEARING AND GRUBBING	1	LS	$10,000.00	$10,000.00
85	REGULAR EXCAVATION	133	CY	$30.00	$3,990.00
86	BORROW EXCAVATION	50	CY	$40.00	$2,000.00
87	OPTIONAL BASE, BASE GROUP 04 (LIMEROCK ONLY)	111	SY	$25.00	$2,775.00
88	OPTIONAL BASE, BASE GROUP 09 (LIMEROCK ONLY)	287	SY	$38.00	$10,906.00
89	SUPERPAVE ASPHALTIC CONCRETE, TRAFFIC B	215	TN	$205.00	$44,075.00
90	PERFORMANCE TURF	100	SY	$2.00	$200.00
91	PERFORMANCE TURF, SOD	400	SY	$4.50	$1,800.00
92	PAINTED PAVEMENT MARKINGS, FINAL SURFACE	1	LS	$1,800.00	$1,800.00
*	PAINTED PAVEMENT MARKINGS, STANDARD, WHITE, SOLID, 12"	40	LF	*	*
*	PAINTED PAVEMENT MARKINGS, STANDARD, WHITE, SOLID, 24"	65	LF	*	*
*	PAINTED PAVEMENT MARKINGS, STANDARD, YELLOW, SOLID, 6"	0.230	GM	*	*
93	THERMOPLASTIC, STANDARD, WHITE, SOLID, 12"	40	LF	$10.00	$400.00
94	THERMOPLASTIC, STANDARD, WHITE, SOLID, 24"	65	LF	$15.00	$975.00
95	THERMOPLASTIC, STANDARD, WHITE, MESSAGE OR SYMBOL	1.000	EA	$300.00	$300.00
96	THERMOPLASTIC, STANDARD, YELLOW, SOLID, 6"	0.230	GM	$5,500.00	$1,265.00
				SUBTOTAL	$80,486.00
	BID ALTERNATE 6: EAST CHILI BOULEVARD				

97	CLEARING AND GRUBBING	1	LS	$12,000.00	$12,000.00
98	REGULAR EXCAVATION	321	CY	$30.00	$9,630.00
99	BORROW EXCAVATION	96	CY	$40.00	$3,840.00
100	OPTIONAL BASE, BASE GROUP 04 (LIMEROCK ONLY)	117	SY	$25.00	$2,925.00
101	OPTIONAL BASE, BASE GROUP 09 (LIMEROCK ONLY)	886	SY	$38.00	$33,668.00
102	SUPERPAVE ASPHALTIC CONCRETE, TRAFFIC B	250	TN	$205.00	$51,250.00
103	DETECTABLE WARNINGS	10	SF	$40.00	$400.00
104	PERFORMANCE TURF	25	SY	$2.00	$50.00
105	PERFORMANCE TURF, SOD	75	SY	$4.50	$337.50
106	SINGLE POST SIGN, F&I GROUND MOUNT, UP TO 12 SF	3	EA	$450.00	$1,350.00
107	PAINTED PAVEMENT MARKINGS, FINAL SURFACE	1	LS	$1,500.00	$1,500.00
*	PAINTED PAVEMENT MARKING, STANDARD, BLUE, SOLID,6"	140	LF	*	*
*	PAINTED PAVEMENT MARKINGS, STANDARD, WHITE, SOLID, 6"	476	LF	*	*
*	PAINTED PAVEMENT MARKINGS, STANDARD, WHITE, SOLID, 12"	65	LF	*	*
*	PAINTED PAVEMENT MARKINGS, STANDARD, WHITE, SOLID, 24"	62	LF	*	*
*	PAINTED PAVEMENT MARKINGS, STANDARD, YELLOW, SOLID, 6"	0.090	GM	*	*
108	THERMOPLASTIC, STANDARD, WHITE, SOLID, 12"	65	LF	$10.00	$650.00
109	THERMOPLASTIC, STANDARD, WHITE, SOLID, 24"	62	LF	$15.00	$930.00
110	THERMOPLASTIC, STANDARD, WHITE, MESSAGE OR SYMBOL	4	EA	$300.00	$1,200.00
111	THERMOPLASTIC, STANDARD, BLUE, SOLID,6"	140	LF	$2.00	$280.00
112	THERMOPLASTIC, STANDARD, WHITE, SOLID, 6"	476	LF	$1.50	$714.00
113	THERMOPLASTIC, STANDARD, YELLOW, SOLID, 6"	0.090	GM	$5,500.00	$495.00
				SUBTOTAL	$121,219.50
	BID ALTERNATE 7: WEST 1ST STREET				
114	CLEARING AND GRUBBING	1	LS	$9,000.00	$9,000.00
115	REGULAR EXCAVATION	10	CY	$30.00	$300.00
116	BORROW EXCAVATION	25	CY	$40.00	$1,000.00
117	OPTIONAL BASE, BASE GROUP 04 (LIMEROCK ONLY)	27	SY	$25.00	$675.00
118	SUPERPAVE ASPHALTIC CONCRETE, TRAFFIC B	67	TN	$205.00	$13,735.00
119	PERFORMANCE TURF	50	SY	$2.00	$100.00
120	PERFORMANCE TURF, SOD	145	SY	$4.50	$652.50
121	PAINTED PAVEMENT MARKINGS, FINAL SURFACE	1	LS	$1,500.00	$1,500.00
*	PAINTED PAVEMENT MARKINGS, STANDARD, WHITE, SOLID, 12"	50	LF	*	*
*	PAINTED PAVEMENT MARKINGS, STANDARD, WHITE, SOLID, 24"	74	LF	*	*
*	PAINTED PAVEMENT MARKINGS, STANDARD, YELLOW, SOLID, 6"	0.080	GM	*	*
122	THERMOPLASTIC, STANDARD, WHITE, SOLID, 12"	50	LF	$10.00	$500.00
123	THERMOPLASTIC, STANDARD, WHITE, SOLID, 24"	74	LF	$15.00	$1,110.00
124	THERMOPLASTIC, STANDARD, WHITE, MESSAGE OR SYMBOL	2.000	EA	$300.00	$600.00
125	THERMOPLASTIC, STANDARD, YELLOW, SOLID, 6"	0.080	GM	$5,500.00	$440.00
				SUBTOTAL	$29,612.50
	BID ALTERNATE 8: EAST 2ND STREET				
126	CLEARING AND GRUBBING	1	LS	$12,000.00	$12,000.00
127	REGULAR EXCAVATION	93	CY	$30.00	$2,790.00
128	BORROW EXCAVATION	50	CY	$40.00	$2,000.00
129	OPTIONAL BASE, BASE GROUP 04 (LIMEROCK ONLY)	193	SY	$25.00	$4,825.00
130	OPTIONAL BASE, BASE GROUP 09 (LIMEROCK ONLY)	151	SY	$38.00	$5,738.00
131	SUPERPAVE ASPHALTIC CONCRETE, TRAFFIC B	192	TN	$205.00	$39,360.00
132	PERFORMANCE TURF	50	SY	$2.00	$100.00
133	PERFORMANCE TURF, SOD	350	SY	$4.50	$1,575.00
134	PAINTED PAVEMENT MARKINGS, FINAL SURFACE	1	LS	$1,500.00	$1,500.00
*	PAINTED PAVEMENT MARKINGS, STANDARD, WHITE, SOLID, 12"	46	LF	*	*
*	PAINTED PAVEMENT MARKINGS, STANDARD, WHITE, SOLID, 24"	95	LF	*	*
*	PAINTED PAVEMENT MARKINGS, STANDARD, YELLOW, SOLID, 6"	0.190	GM	*	*
135	THERMOPLASTIC, STANDARD, WHITE, SOLID, 12"	46	LF	$10.00	$460.00
136	THERMOPLASTIC, STANDARD, WHITE, SOLID, 24"	95	LF	$15.00	$1,425.00
137	THERMOPLASTIC, STANDARD, WHITE, MESSAGE OR SYMBOL	4.000	EA	$300.00	$1,200.00
138	THERMOPLASTIC, STANDARD, YELLOW, SOLID, 6"	0.190	GM	$5,500.00	$1,045.00
				SUBTOTAL	$74,018.00
				PROJECT SUBTOTAL	$3,453,554.28
				CONTINGENCY (10%)	$345,355.43
				CEI (10%)	$345,355.43
				PROJECT TOTAL	**$4,144,265.13**

EXHIBIT 5

Feasibility Study

Franklin County Municipal Solid Waste Transfer Station

Memo

Date:	Monday, May 15, 2023	Revised:
Project:	Franklin County Solid Waste System Feasibility Study	
To:	Caleb Brown, Joshua Baxley - Dewberry	
From:	Mark Roberts, Kelsey Heller - HDR	
Subject:	Franklin County MSW Transfer Station Feasibility Study	

The Franklin County Solid Waste Management System (System) is primarily comprised of the Franklin County Central Landfill Facility (Facility) for the County's solid waste management operations which includes disposal, transfer, and recycling. The Facility successfully manages the Class I municipal solid waste (MSW), Class III (non-putrescible commercial and household) waste and the construction and demolition (C&D) waste generated in Franklin County. The Facility has three primary operating waste management functions: solid waste landfill, solid waste transfer station, and recycling facility. A site plan is included as Attachment 1.

Currently, the solid waste landfill is used to dispose of Class III waste and C&D waste. The solid waste transfer station is currently used to transfer MSW waste out of the county for disposal at a permitted Class I landfill. The recycling facility is used to separate and store a limited range of recyclables— consisting of plastics, paper, and metals. The County currently generates approximately 60 tons of Class I waste per day which is transferred at the Facility to an out-of-county landfill. The County generates approximately 50 tons of Class III and C&D waste per day that is disposed of in the Facility landfill.

The Franklin County Central Landfill Solid Waste Facility has an operating Class III Waste Cell which was constructed in 1980 and is unlined. The County currently operates this landfill primarily for the disposal of Class III and C&D waste. On site there is also a Closed Class I Cell which was closed in 1992, in addition to the "New" Class I (Phase I) Landfill which was temporarily closed in 1992. Although the "New" Class I Landfill is lined, it has never been used to dispose of MSW and it is assumed that the liner/leachate collection system is non-functionable. It is currently being used as a composting area.

The purpose of this memo is to examine the feasibility to permit, construct, and operate a MSW transfer station that would be located at the current Facility. The memo also compares the estimated MSW transfer station cost with an alternative cost of permitting, constructing, and operating a new landfill that is located offsite from the Franklin County Central Landfill Facility.

1. Proposed MSW Transfer Station Construction and Equipment Costs

Table 1 provides a breakdown of the cost to design, permit and construct a MSW transfer station sized to process approximately 150 tons per day (40,000 tons per year). The estimated covered area needed for a transfer station of this capacity is approximately 8,400 square feet. Figure 1 illustrates typical transfer station operation where waste on the tipping floor is loaded through a hopper down into a transfer trailer.

Figure 1 – MSW Transfer Station Tipping Floor, Hopper, and Wheel Loader

An approximate 4-acre area would be needed to provide the necessary roadway, apron, turnaround areas, and stormwater management systems. For costing purposes, it is assumed that structural fill material can be found on-site at the Facility. Figure 2 illustrates the type of roadway and apron areas required for a MSW transfer station.

Figure 2 – Aerial photo of a MSW Transfer Station

Equipment necessary for the operations of a new transfer station include the cost of a wheel loader, with an estimated cost of approximately $75,000. The wheel loader is used to move the waste within the transfer station into the transfer trailers via a hopper to a lower area where the trailer is parked. A tamping crane, which can be used to make sure the waste is efficiently packed into the transfer trailers, has a cost of approximately $175,000. It is assumed the County would utilize the current Facility operations staff to operate the new transfer station.

Figure 3 - Tamping Crane

Table 1 indicates that the facility and equipment cost is approximately $3.57 million in 2023 dollars. With the addition of a 20% contingency, the cost to perform engineering design and permitting estimated at 10% of the subtotal, and construction administration at 8% of the subtotal, the total estimated probable cost to design, permit, construct and provide equipment is approximately $5.05 million.

TABLE 1

ESTIMATED TRANSFER STATION DESIGN, PERMITTING AND CONSTRUCTION COSTS

	ITEM DESCRIPTION	QUANTITY	UNIT	ESTIMATED COST UNIT PRICE	TOTAL PRICE
	Transfer Building				
1	Bonds, Mobilization and Insurance	7%	of WORK	$3,316,800	$249,700
2	Clearing and Grubbing	4	AC	$4,000	$16,000
3	Earthwork/Structural Fill	20,000	CY	$15.00	$300,000
4	Concrete:				
	Apron	150	CY	$350	$52,500
	Retaining Wall (1.5cy/LF)	210	CY	$600	$126,000
	Foundations	40	CY	$600	$24,000
	Tipping Floor	350	CY	$350	$122,500
	Tunnel Exterior Wall	150	CY	$600	$90,000
5	Roadway Paving	6,000	SY	$130	$780,000
6	Pre-engineered Building (70x120)	8,625	SF	$90	$776,300
7	Mechanical & Fire Protection	8,625	SF	$16	$138,000
8	Electrical	8,625	SF	$20	$172,500
10	Steel Hoppers/Chutes/Liners	1	LS	$125,000	$125,000
11	Utilities	1	LS	$200,000	$200,000
12	Surveying	1	LS	$20,000	$20,000
13	Geotech	1	LS	$40,000	$40,000
14	Erosion and Stormwater Control	1	LS	$60,000	$60,000
15	Yard Lighting	8	EA	$1,500	$12,000
16	Roll-up doors	4	EA	$3,000	$12,000
17	Tamping Crane	1	EA	$175,000	$175,000
18	Wheel Loader	1	EA	$75,000	$75,000
				SUBTOTAL	**$3,566,500**
				Contingency (20%)	**$713,300**
				Subtotal	**$4,279,800**
				Permitting, Engineering & Design (10%)	**$427,980**
				Construction Administration (8%)	**$342,384**
				TOTAL	**$5,050,164**

2. Proposed Office Building Costs

Table 2 provides a breakdown of the cost to design, permit and construct a 1,500 square foot office building on site at the Franklin County Landfill Facility.

The estimated area needed for the office building is approximately one-acre for the building, driveway and parking. It assumes that the building is independent of the other structures currently on site and requires independent stormwater, wastewater, and electrical services. The office building itself consists of three offices, a bathroom, dining area, reception area and storage areas. The pricing is typical of other recent landfill office buildings for similar sized facilities. The total estimated probable cost to design, permit and construct is approximately $1.46 million, which includes a 20% contingency, engineering, and construction administration. The cost of the office building may be less if it is combined with an enlarged transfer station structure to incorporate offices.

TABLE 2

ESTIMATED OFFICE BUILDING DESIGN AND CONSTRUCTION COSTS

	ITEM DESCRIPTION	QUANTITY	UNIT	ESTIMATED COST UNIT PRICE	ESTIMATED COST TOTAL PRICE
	Office Building				
1	Bonds, Mobilization and Insurance	7%	of WORK	$969,900	$73,000
2	Clearing and Grubbing	1	AC	$2,000	$2,000
3	Earthwork	5,000	CY	$15	$75,000
4	Stormwater Management Channels and Pond	5,000	CY	$15	$75,000
5	Driveway and Parking Area Paving	2,000	SY	$130	$260,000
6	Building (30x50)	1,500	SF	$150	$225,000
7	Mechanical & Fire Protection	1,500	SF	$16	$24,000
8	Interior Electrical	1,500	SF	$25	$37,500
10	Potable Water Pipe Extension	400	LF	$26	$10,400
11	Sanitary Lift Station and Piping	1	LS	$70,000	$70,000
12	Surveying	1	LS	$20,000	$20,000
13	Geotech	1	LS	$40,000	$40,000
14	Utilities	1	LS	$5,000	$5,000
15	Exterior Electrical and Lighting	1	LS	$11,000	$11,000
16	Foundation and Building Wall Footings	1	LS	$60,000	$60,000
17	Air Conditioning	1	LS	$25,000	$25,000
18	Furniture	1	LS	$30,000	$30,000
				SUBTOTAL	**$1,042,900**
				Contingency (20%)	**$208,580**
				Subtotal	**$1,251,480**
				Engineering & Design (7%)	**$87,604**
				Construction Administration (10%)	**$125,148**
				TOTAL	**$1,464,232**

Proposed MSW Transfer Station and Office Building Operations Costs

Operation costs associated with the proposed transfer station and office building include the facility utilities, as well as operations and maintenance (O&M). Overall, the facility utilities include the costs of electricity usage, water, and sanitary service. Other costs include the estimated cost for equipment fuel, equipment O&M, insurance, building and site maintenance and equipment replacement services. The annual estimated total including overhead, and a 10% contingency is approximately $241,210.

It is assumed that the county's waste hauler will provide the roll-off container and roll-off transfer trucks. If recycling operations are also intended in the transfer building, then an additional cost would need to be projected for that effort.

In 2021/2022 the county paid $579,286 for transfer station charges (See Attachment 2 for annual transfer station charges). Based on the current average disposal rates, the county is expected to pay $752,700 in 2023 to transfer 60 tons of waste per day. At the generation rate of 150 tons per day, the future annual cost to haul and dispose of the waste through the new transfer station would be $1,881,750 (see Attachment 3 for calculations).

TABLE 3

O&M COSTS FOR TRANSFER STATION AND OFFICE BUILDING

UTILITIES - TRANSFER STATION BUILDING and OFFICE BUILDING					
Item	**Annual Quantity**		**Unit Price**		**Total**
Electricity Usage	129,900 kwh		$0.16	$	20,800
TS Washdown for Industrial - Leachate	500 gal per day		$10.66/1000 gal +40%	$	2,724
Sanitary Service	12 months		$200 /month	$	2,400
Notes/Assumptions:					
	0.5 watts/sf		***Subtotal***	***$***	***25,924***
	8400 square feet, Transfer Station				
	1500 square feet, Office Building				
Stationary Tamping Crane	75 hp	780 hours/year		(est.3 hrs/day)	
	55.93 kw				
Water use - domestic and washdown	200 gpd (domestic)	5 gpd/100 SF		(washdown)	
Eastpoint Water & Sewer District	$10.66 per 1,000 gallons + 40% Outside-the-District Surcharge				

MOBILE EQUIPMENT FUEL						
Item	**Qty**	**Rate**	**Hrs/Day**	**Unit Price**		**Total**
Wheel Loader	1	3 gal/hr	5 hrs	$5.28	$	20,573
				Subtotal	***$***	***20,573***

EQUIPMENT O&M					
Item	**Qty**	**Units/Yr**	**Unit Price**		**Total**
Stationary Tamping Crane - electric	1	780 hrs	$3	$	2,300
Wheel Loader (Volvo L 1103)	1	1300 hrs	$10	$	13,000
			Subtotal	***$***	***15,300***

INSURANCE						
Item		**Quantity**		**Unit Price**		**Total**
General, Liability, Fire, Etc.	0.5%	$5,531,280	bldgs/equipment value		***$***	***28,000***

BUILDING AND SITE MAINTENANCE						
Item		**Quantity**		**Unit Price**		**Total**
General Maintenance	1.5%	$5,531,280	bldgs/equipment value		***$***	***83,000***

EQUIPMENT REPLACEMENT RESERVES					
Item	**Qty**	**Equip Life**	**Price (2022$)**		**Total - Annual**
Stationary Tamping Crane	1	10 yrs	$175,000		$17,500
Wheel Loader (Volvo L 1103)	1	7 yrs	$75,000		$10,714
			Subtotal	***$***	***28,214***

ANNUAL SUBTOTAL	**$**	**201,010**
Overhead(10%)	$	20,100
Contingency (10%)	$	20,100
ANNUAL TOTAL	**$**	**241,210**

3. Landfill Development Costs

HDR reviewed the cost of designing, permitting and constructing a new 15-acre landfill cell. This estimate is based on recent landfill development cost data from other Florida counties to provide a cost to develop a new landfill on a generic upland site (i.e., no wetland mitigation costs or extensive dewatering costs during construction). The cost of purchasing this generic upland site is outside the scope of this memo.

TABLE 4

ESTIMATED MSW LANDFILL DESIGN, FDEP PERMITTING AND CONSTRUCTION COSTS

				ESTIMATED COST	
	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
	15-Acre Landfill				
1	Bonds, Mobilization and Insurance	7%	of WORK	12,239,400.00	$856,758
2	Erosion and Sediment Control	15	AC	3,200.00	$48,000
3	Surveying	15	AC	5,800.00	$87,000
4	Clearing and Grading	15	AC	3,730.00	$56,000
5	Installation of Stormwater Conveyance System, Berms, Culverts	4,000	LF	95.00	$380,000
6	Stormwater Pond and Outlet Structure	150,000	CY	6.50	$975,000
7	Subgrade	653,400	SF	0.42	$274,400
8	Subbase	653,400	SF	0.52	$339,800
9	Anchor Trenches and Low Permeability Soil	3,233	LF	45.00	$145,500
10	GCL	653,400	SF	0.92	$601,100
11	Secondary HDPE Liner	653,400	SF	0.71	$463,900
12	Leak Detection Geocomposite	653,400	SF	1.06	$692,600
13	Primary HDPE Liner	653,400	SF	0.71	$463,900
14	Leachate Collection Geocomposite	653,400	SF	1.06	$692,600
15	Protective Cover Layer	48,400	CY	50.00	$2,420,000
16	Leachate Collection/Leak Detection Pipe Trench and Piping	1,000	LF	250.00	$250,000
17	Leachate Collection and Leak Detection Sump	2	LS	300,000.00	$600,000
18	Leachate Holding Tank and Piping	1	LS	650,000.00	$650,000
19	Leachate Lift Station and Conveyance System	1	LS	350,000.00	$350,000
20	Electrical System Installation + Electrical Utility Extension	1	LS	75,000.00	$75,000
21	Gravel Perimeter Road	3,667	SY	25.00	$91,700
22	Monitoring Systems - Gas Probes (20)	20	EA	1,000.00	$20,000
23	Monitoring Systems - GWM Wells Install (4)	4	EA	10,000.00	$40,000
24	Scales	2	EA	85,000.00	$170,000
25	Office Building	1	EA	1,042,900.00	$1,042,900
26	Bulldozer	1	EA	165,000.00	$165,000
27	Excavator	1	EA	250,000.00	$250,000
28	Dump Truck	1	EA	120,000.00	$120,000
29	Wheel Loader	1	EA	75,000.00	$75,000
30	Landfill Compactor	1	EA	700,000.00	$700,000
				SUBTOTAL	**$13,096,158**
				Contingency (20%)	**$2,619,232**
				Subtotal	**$15,715,390**
				Engineering, Permitting & Design (10%)	**$1,571,539**
				Construction Administration (10%)	**$1,571,539**
				TOTAL	**$18,858,468**

Proposed MSW Landfill Operation and Maintenance Costs

The operation and maintenance cost for a new 15-acre landfill was estimated to be $935,714 annually (See Table 5 for cost breakdown). This equates to approximately $24/ton. This estimate is supported by information provided by the Solid Waste Association of North America in their benchmark report for the average cost of MSW Landfill operations (Attachment 3).

TABLE 5

O&M COSTS FOR 15-ACRE LANDFILL

UTILITIES - LANDFILL					
Item		**Annual Quantity**	**Unit Price**		**Total**
Electricity Usage		1,960 kwh	$0.16	$	300
Leachate Treatment		7,391,250 gal	$14.93 per 1000 gal	$	110,351
			Subtotal	***$***	***110,651***
Notes/Assumptions:					
	149.14	watts/pump			
	2	Leachate Collection and Detection Layer Pumps			
	1	Leachate Tank Pumps			
Leachate Pumps	200	hp	4380 hours/year	(est.4 hrs/day)	
Leachate Generation	1350	gallons per acre per day			
Eastpoint Water & Sewer District	$10.66	per 1,000 gallons + 40% Outside-the-District Surcharge			

MOBILE EQUIPMENT FUEL						
Item	**Qty**	**Rate**	**Hrs/Day**	**Unit Price**		**Total**
Wheel Loader	1	3 gal/hr	5 hrs	$5.28	$	20,573
Compactor	1	4 gal/hr	5 hrs	$5.28	$	27,430
Excavator	1	3 gal/hr	5 hrs	$5.28	$	20,573
Bulldozer	1	3 gal/hr	5 hrs	$5.28	$	20,573
Dump Trucks	1	3 gal/hr	5 hrs	$5.28	$	20,573
				Subtotal	***$***	***109,720***

EQUIPMENT O&M					
Item	**Qty**	**Units/Yr**	**Unit Price**		**Total**
Wheel Loader (Volvo L 1103)	1	1300 hrs	$10	$	13,000
Compactor (Cat 836H)	1	1300 hrs	$12	$	15,600
Excavator	1	1300 hrs	$10	$	13,000
Bulldozer	1	1300 hrs	$8	$	10,400
Dump Truck	1	1300 hrs	$4	$	5,200
			Subtotal	***$***	***57,200***

INSURANCE					
Item		**Quantity**	**Unit Price**		**Total**
General, Liability, Fire, Etc.	0.5%	$15,715,390	bldgs/equipment value	***$***	***79,000***

BUILDING AND SITE MAINTENANCE					
Item		**Quantity**	**Unit Price**		**Total**
General Maintenance	1.5%	$15,715,390	bldgs/equipment value	***$***	***236,000***

EQUIPMENT REPLACEMENT RESERVES					
Item	**Qty**	**Equip Life**	**Price (2022$)**		**Total - Annual**
Wheel Loader (Volvo L 1103)	1	7 yrs	$75,000		$10,714
Compactor (Cat 836H)	1	7 yrs	$700,000		$100,000
Excavator	1	7 yrs	$250,000		$35,714
Bulldozer	1	7 yrs	$165,000		$23,571
Dump Truck	1	7 yrs	$120,000		$17,143
			Subtotal	***$***	***187,143***

ANNUAL SUBTOTAL	**$**	**779,714**
Overhead(10%)	$	78,000
Contingency (10%)	$	78,000
ANNUAL TOTAL	**$**	**935,714**

4. Observations and Conclusions

a. Proposed locations for the projected solid waste management facilities are shown in the Site Plan (See Attachment 1)

b. Utilizing the "New Class I" Landfill area shown in the Site Plan, currently proposed for future Class III disposal, may provide a benefit to the County if the County selects to construct a new transfer station by utilizing it to continuing Class III disposal and thereby reducing the amount of waste and cost to transfer and dispose a mix of Class I and Class III waste at the Springhill Class I LF.

c. The cost to develop and permit the "New Class I Landfill" as a Class III landfill, and to also the cost to develop and permit a new transfer station, will require additional capital for the County to develop both a new Class III landfill and a transfer station. It is most feasible to operate the current Class III landfill and address the grading issues to realize the optimum permitted remaining airspace.

d. Once the transfer station is operating, and the current Class III landfill has reached capacity, the County will be paying to haul and dispose of Class III waste at Class I tipping rates at the Springhill Landfill.

e. A stand-alone office building could cost as much as $1.46 million to design and construct. Savings may be realized if the new transfer station building, and the new administration building could be combined.

f. Developing a transfer station ($6.5 million) is more feasible than developing a new Class I 15-acre landfill ($18.9 million). However, the cost to operate the transfer station and haul and dispose of 150 tons per day of waste is over $2.1 million annually, whereas the cost to operate the new Class I landfill is less than $1 million annually.

g. Assuming a 3:1 side slope and 40,000 tons of waste disposal annually, the approximate lifespan of the new 15-acre landfill is projected to be 13 years. In comparison, the new transfer station building is estimated to have a lifespan of at least 20 years. The lifespan of the equipment is shorter and will need to be replaced roughly every seven years. Those costs are accounted for in the Landfill O&M Table 5.

h. Once the landfill reaches its end of life after 13 years, the County would then have to pay a $3,085,500 landfill closure cost.

i. In addition to the landfill closure cost, it is expected for the County to pay a post-closure care cost of $60,300/year for 30 years. This cost is factored into the annual expenses in Table 6 but will not reach the full amount needed before reaching its end of life. This means the County will have to pay an additional $1 million, resulting in over $4.1 million in closure fees.

j. The cost estimate of the landfill does not include the purchase of land. This is an important factor to consider since the landfill is intended to be constructed offsite from the current Facility.

k. Although the annual net revenue of the proposed landfill is significantly higher than the annual net revenue for the transfer station, the initial cost of construction and the estimated closure costs, combined with a shorter lifespan, indicate that the transfer station is the more economically feasible option.

l. Based on the annual expense report, the current facility operations are costing the County, on average, $831,268 per year (see Table 7 and Attachment 2). Neither one of the proposed options is predicted to offset those expenses enough to generate a profit, but the proposed new transfer station is expected to contribute less to the annual net cost of operations than the new Class I landfill.

TABLE 6: SUMMARY OF PROPOSED COSTS

Cost	Transfer Station	15-Acre Landfill
Construction Cost	$ 6,514,396	$ 18,858,468
Annual Operating Cost	$ 241,210	$ 935,714
Annual Post-Closure Care Cost for 30 Years	-	$ 60,300
Annual Cost to Transfer Waste	$ 1,881,750	$ -
Annual Tipping Fee Revenue	$ 2,535,000	$ 2,535,000
Net Annual Revenue	**$ 412,040**	**$ 1,538,986**
Payoff Length (Years)	**15.81**	**12.25**
Lifespan (Years)	20	13
Closure Cost	-	$ 3,085,500
Remaining Post-Closure Care Cost	-	$ 1,025,100

Note: This assumes a 5-day work week at 150 tons per day.
The payoff length is the time it takes for the net annual revenue to offset the initial construction cost.

TABLE 7: FINANCIAL RECORDS

Year	Total Revenue	Total Expenses	Net Cost of Operation	Transfer Fees (Included in Total Expenses)
2021/2022	$ 1,296,270	$ 2,084,507	$ (788,238)	$ 579,286
2020/2021	$ 1,265,367	$ 2,520,773	$ (1,255,406)	$ 519,747
2019/2020	$ 1,271,153	$ 1,721,314	$ (450,161)	$ 449,294
Average	**$ 1,277,597**	**$ 2,108,865**	**$ (831,268)**	**$ 516,109**

Note: These values are taken from the Facility’s Financial Records (Attachment 2).

Attachment 1: Site Plan

PROJECT MANAGER M. ROBERTS, P.E.
DRAWN BY J. RAYMOND
PROJECT NUMBER 10358127

ISSUE	DATE	DESCRIPTION

PROPOSED SITE PLAN

FRANKLIN COUNTY CENTRAL LANDFILL
TRANSFER STATION FEASIBILITY STUDY
FRANKLIN COUNTY, FLORIDA

FILENAME Site Plan.dwg
SCALE 1" = 100'
SHEET 1

HDR

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER M. ROBERTS, P.E.
DRAWN BY J. RAYMOND
PROJECT NUMBER 10358127

FRANKLIN COUNTY CENTRAL LANDFILL
TRANSFER STATION FEASIBILITY STUDY
FRANKLIN COUNTY, FLORIDA

ENLARGED SITE PLAN

FILENAME Site Plan.dwg
SCALE 1" = 50'
SHEET 2

Attachment 2: Revenue Information

2021/2022	FUND	GENERAL LEDGER NUMBER	DESCRIPTION	FISCAL TOTAL
	TIPPING FEE FUND	304.334.400	TIPPING FEE REVENUES	$ 1,198,855.29
	TIPPING FEE FUND	304.343.401	TIPPING FEE LATE FEES CHARGE CCOUNTS	$ 891.40
	TIPPING FEE FUND	304.343.100	TIPPING FEE FUND INTEREST	$ 2,754.12
	TIPPING FEE FUND	304.343.100	TIPPING FEE SALE OF CAPITAL ASSET	$ -
	TIPPING FEE FUND	304.369.000	TIPPING FEE - MISCELLANEOUS REVENUE	$ 30.00
	GENERAL FUND - CONS SW GRT	001.334.396	CONSOLIDATED SOLID WASTE GRANT REVENUES	$ 93,738.97
			TOTAL REVENUES	$ 1,296,269.78
	GENERAL FUND - SW	001.40.534.1200	SALARIES	$ 491,897.22
	GENERAL FUND - SW	001.40.534.1300	OTHER SALARIES AND WAGES	$ 27,548.02
	GENERAL FUND - SW	001.40.534.1400	OVERTIME	$ 1,320.00
	GENERAL FUND - SW	001.40.534.2100	FICA TAXES	$ 37,988.46
	GENERAL FUND - SW	001.40.534.2200	RETIREMENT	$ 65,230.91
	GENERAL FUND - SW	001.40.534.2300	HEALTH, LIFE, DENTAL INS	$ 103,756.80
	GENERAL FUND - SW	001.40.534.2400	WORKERS COMP	$ 24,594.45
	GENERAL FUND - SW	001.40.534.3100	PROFESSIONAL SVCS	$ 4,440.00
	GENERAL FUND - SW	001.40.534.3400	OTHER CONTRACT SERVICES	$ 2,447.04
	GENERAL FUND - SW	001.40.534.4000	TRAVEL & PER DIEM	$ 2,545.13
	GENERAL FUND - SW	001.40.534.4100	COMMUNICATION SERVICES	$ 7,983.08
	GENERAL FUND - SW	001.40.534.4200	TRANSPORTATION	$ 300.00
	GENERAL FUND - SW	001.40.534.4300	UTILITY SERVICE	$ 36,783.09
	GENERAL FUND - SW	001.40.534.4400	RENTALS & LEASES	$ 3,732.22
	GENERAL FUND - SW	001.40.534.4500	INSURANCE	$ 52,612.86
	GENERAL FUND - SW	001.40.534.4600	REPAIR & MAINTENANCE	$ 164,290.32
	GENERAL FUND - SW	001.40.534.4800	PROMOTIONAL ACTIVITIES	$ 55.00
	GENERAL FUND - SW	001.40.534.4900	OTHER CURRENT CHARGES	$ 8,810.77
	GENERAL FUND - SW	001.40.534.5100	OFFICE SUPPLIES	$ 1,533.93
	GENERAL FUND - SW	001.40.534.5200	OPERATING SUPPLIES	$ 64,216.57
	GENERAL FUND - SW	001.40.534.5400	BOOKS, PUBLICATIONS, SUBSCRIPTIONS, MEMBERSHIPS	$ 781.00
	GENERAL FUND - SW	001.40.534.5500	TRAINING	$ 1,980.00
	GENERAL FUND - SW	001.40.534.6400	MACHINERY & EQUIPMENT	$ 2,704.13
	GENERAL FUND - SW	001.40.534.6401	MACHINERY & EQUIPMENT OVER 5K	$ 7,499.00
	GENERAL FUND - SW	001.40.534.7100	PRINICPAL	$ -
	GENERAL FUND - SW	001.40.534.7200	INTEREST	$ -
	GENERAL FUND - SW	001.40.581.9100	TRANSFER TO CAPITAL OUTLAY	$ 52,810.00
	GENERAL FUND - CONS	001.59.534.3100	CONS SW GRT - PROFESSIONAL SVCS	$ 21,338.00
	GENERAL FUND - CONS	001.59.534.3400	CONS SW GRT - OTHER CONTRACT SVCS	$ 13,435.12
	GENERAL FUND - CONS	001.59.534.4600	CONS SW GRT - REPAIR & MAINT	$ 3,624.46
	GENERAL FUND - CONS	001.59.534.5200	CONS SW GRT -OPERATING SUPPLIES	$ 58,194.65
	TIPPING FEE FUND	304.40.534.3100	PROFESSIONAL SVCS - TRANSFER STN CHGS	$ 579,285.53
	TIPPING FEE FUND	304.40.534.4600	REPAIR & MAINTENANCE	$ 92,423.15
	TIPPING FEE FUND	304.40.534.6401	CAPITAL OUTLAY OVER 5K	$ -
	TIPPING FEE FUND	304.40.534.7100	PRINCIPAL	$ 129,414.72
	TIPPING FEE FUND	304.40.534.7200	INTEREST	$ 18,931.77
			TOTAL EXPENSES	$ 2,084,507.40
			NET COST OF OPERATIONS	$ (788,237.62)

2020/2021

FUND	GENERAL LEDGER NUMBER	DESCRIPTION	FISCAL TOTAL
TIPPING FEE FUND	304.334.400	TIPPING FEE REVENUES	$ 1,145,322.15
TIPPING FEE FUND	304.343.401	TIPPING FEE LATE FEES CHARGE CCOUNTS	$ 13.47
TIPPING FEE FUND	304.343.100	TIPPING FEE FUND INTEREST	$ 1,827.02
TIPPING FEE FUND	304.343.100	TIPPING FEE SALE OF CAPITAL ASSET	$ 20,000.00
GENERAL FUND - CONS SW GRT	001.334.396	CONSOLIDATED SOLID WASTE GRANT REVENUES	$ 98,204.60
		TOTAL REVENUES	$ 1,265,367.24
GENERAL FUND - SW	001.40.534.1200	SALARIES	$ 455,094.20
GENERAL FUND - SW	001.40.534.1300	OTHER SALARIES AND WAGES	$ 497.92
GENERAL FUND - SW	001.40.534.1400	OVERTIME	$ 18,442.82
GENERAL FUND - SW	001.40.534.2100	FICA TAXES	$ 34,631.51
GENERAL FUND - SW	001.40.534.2200	RETIREMENT	$ 45,259.15
GENERAL FUND - SW	001.40.534.2300	HEALTH, LIFE, DENTAL INS	$ 105,694.18
GENERAL FUND - SW	001.40.534.2400	WORKERS COMP	$ 19,485.16
GENERAL FUND - SW	001.40.534.3100	PROFESSIONAL SVCS	$ 6,900.00
GENERAL FUND - SW	001.40.534.3400	OTHER CONTRACT SERVICES	$ 4,245.75
GENERAL FUND - SW	001.40.534.4000	TRAVEL & PER DIEM	$ 960.66
GENERAL FUND - SW	001.40.534.4100	COMMUNICATION SERVICES	$ 7,377.57
GENERAL FUND - SW	001.40.534.4200	TRANSPORTATION	$ 52.70
GENERAL FUND - SW	001.40.534.4300	UTILITY SERVICE	$ 72,608.99
GENERAL FUND - SW	001.40.534.4400	RENTALS & LEASES	$ 3,923.18
GENERAL FUND - SW	001.40.534.4500	INSURANCE	$ 51,949.65
GENERAL FUND - SW	001.40.534.4600	REPAIR & MAINTENANCE	$ 156,565.32
GENERAL FUND - SW	001.40.534.4800	PROMOTIONAL ACTIVITIES	$ -
GENERAL FUND - SW	001.40.534.4900	OTHER CURRENT CHARGES	$ 6,360.43
GENERAL FUND - SW	001.40.534.5100	OFFICE SUPPLIES	$ 4,327.59
GENERAL FUND - SW	001.40.534.5200	OPERATING SUPPLIES	$ 27,014.33
GENERAL FUND - SW	001.40.534.5400	BOOKS, PUBLICATIONS, SUBSCRIPTIONS, MEMBERSHIPS	$ 3,417.91
GENERAL FUND - SW	001.40.534.6400	MACHINERY & EQUIPMENT	$ 6,003.52
GENERAL FUND - SW	001.40.534.6401	MACHINERY & EQUIPMENT OVER 5K	$ 6,499.00
GENERAL FUND - SW	001.40.534.7100	PRINICPAL	$ -
GENERAL FUND - SW	001.40.534.7200	INTEREST	$ -
GENERAL FUND - SW	001.40.581.9100	TRANSFER TO CAPITAL OUTLAY	$ 52,810.00
GENERAL FUND - CONS	001.59.534.3100	CONS SW GRT - PROFESSIONAL SVCS	$ 19,394.00
GENERAL FUND - CONS	001.59.534.3400	CONS SW GRT - OTHER CONTRACT SVCS	$ 18,935.30
GENERAL FUND - CONS	001.59.534.4600	CONS SW GRT - REPAIR & MAINT	$ 1,665.20
GENERAL FUND - CONS	001.59.534.5200	CONS SW GRT -OPERATING SUPPLIES	$ 58,210.10
TIPPING FEE FUND	304.40.534.3100	PROFESSIONAL SVCS - TRANSFER STN CHGS	$ 519,747.48
TIPPING FEE FUND	304.40.534.4600	REPAIR & MAINTENANCE	$ -
TIPPING FEE FUND	304.40.534.6401	CAPITAL OUTLAY OVER 5K	$ 664,353.18
TIPPING FEE FUND	304.40.534.7100	PRINCIPAL	$ 137,889.68
TIPPING FEE FUND	304.40.534.7200	INTEREST	$ 10,456.81
		TOTAL EXPENSES	$ 2,520,773.29
		NET COST OF OPERATIONS	$ (1,255,406.05)

2019/2020

FUND	GENERAL LEDGER NUMBER	DESCRIPTION	FISCAL TOTAL
TIPPING FEE FUND	304.334.400	TIPPING FEE REVENUES	$ 1,173,572.42
TIPPING FEE FUND	304.343.401	TIPPING FEE LATE FEES CHARGE CCOUNTS	$ 2,812.97
TIPPING FEE FUND	304.343.100	TIPPING FEE FUND INTEREST	$ 3,140.76
GENERAL FUND -	001.334.396	CONSOLIDATED SOLID WASTE GRANT REVENUES	$ 91,627.10
		TOTAL REVENUES	$ 1,271,153.25
GENERAL FUND - SW	001.40.534.1200	SALARIES	$ 435,439.12
GENERAL FUND - SW	001.40.534.1400	OVERTIME	$ 16,773.83
GENERAL FUND - SW	001.40.534.2100	FICA TAXES	$ 32,995.68
GENERAL FUND - SW	001.40.534.2200	RETIREMENT	$ 37,904.92
GENERAL FUND - SW	001.40.534.2300	HEALTH, LIFE, DENTAL INS	$ 100,561.47
GENERAL FUND - SW	001.40.534.2400	WORKERS COMP	$ 20,516.10
GENERAL FUND - SW	001.40.534.3400	OTHER CONTRACT SERVICES	$ 1,625.70
GENERAL FUND - SW	001.40.534.4000	TRAVEL & PER DIEM	$ (0.01)
GENERAL FUND - SW	001.40.534.4100	COMMUNICATION SERVICES	$ 6,964.99
GENERAL FUND - SW	001.40.534.4200	TRANSPORTATION	$ 1,500.00
GENERAL FUND - SW	001.40.534.4300	UTILITY SERVICE	$ 41,104.76
GENERAL FUND - SW	001.40.534.4400	RENTALS & LEASES	$ 3,858.88
GENERAL FUND - SW	001.40.534.4500	INSURANCE	$ 35,943.37
GENERAL FUND - SW	001.40.534.4600	REPAIR & MAINTENANCE	$ 180,461.88
GENERAL FUND - SW	001.40.534.4800	PROMOTIONAL ACTIVITIES	$ 801.33
GENERAL FUND - SW	001.40.534.4900	OTHER CURRENT CHARGES	$ 7,000.45
GENERAL FUND - SW	001.40.534.5100	OFFICE SUPPLIES	$ 3,503.13
GENERAL FUND - SW	001.40.534.5200	OPERATING SUPPLIES	$ 20,414.24
GENERAL FUND - SW	001.40.534.5400	BOOKS, PUBLICATIONS, SUBSCRIPTIONS, MEMBERSHIPS	$ 1,624.00
GENERAL FUND - SW	001.40.534.6400	MACHINERY & EQUIPMENT	$ 2,345.43
GENERAL FUND - SW	001.40.534.7100	PRINICPAL	$ 25,266.95
GENERAL FUND - SW	001.40.534.7200	INTEREST	$ 730.70
GENERAL FUND - SW	001.40.581.9100	TRANSFER TO CAPITAL OUTLAY	$ 52,810.00
GENERAL FUND - CONS	001.59.534.3100	CONS SW GRT - PROFESSIONAL SVCS	$ 19,378.00
GENERAL FUND - CONS	001.59.534.3400	CONS SW GRT - OTHER CONTRACT SVCS	$ 15,604.00
GENERAL FUND - CONS	001.59.534.4600	CONS SW GRT - REPAIR & MAINT	$ 2,497.80
GENERAL FUND - CONS	001.59.534.5200	CONS SW GRT -OPERATING SUPPLIES	$ 54,147.30
TIPPING FEE FUND	304.40.534.3100	PROFESSIONAL SVCS - TRANSFER STN CHGS	$ 449,294.02
TIPPING FEE FUND	304.40.534.4600	REPAIR & MAINTENANCE	$ 59,038.34
TIPPING FEE FUND	304.40.534.6401	CAPITAL OUTLAY OVER 5K	$ 38,400.00
TIPPING FEE FUND	304.40.534.7100	PRINCIPAL	$ 47,112.38
TIPPING FEE FUND	304.40.534.7200	INTEREST	$ 5,694.99
		TOTAL EXPENSES	$ 1,721,313.75
		NET COST OF OPERATIONS	$ (450,160.50)

***TRANSFERS TO LANDFILL MGMT ESCROW AND TRANSFERS TO GENERAL FUND ARE EXCLUDED, TRANSFERS TO CAPITAL OUTLAY ARE INCLUDED BECAUSE THAT IS FOR PAYMENTS ON LANDFILL EQUIPMENT, LANDFILL MANAGEMENT ESCROW FUND IS EXCLUDED, EXCLUDE BOOKING OF INSTALLMENT PURCHASE PROCEEDS IN REVENUES

Attachment 3: Calculations

Current Cost to Transfer 60 tons per day:

(3 boxes * $385/box) + (60 tons * $29/ton) = $2,895/ day

($2,895/day) (5 days a week) (52 weeks per year) = **$752,700 annually**

Note: Based on information provided via e-mail by the Fiscal Manager at Franklin County

Predicted Annual Cost to Transfer 150 tons based on the current cost to transfer 60 tons:

($752,700) (150 tons / 60 tons) = **$1,881,750**

Annual Tipping Fee Revenue based on the current price of $65 per ton, assuming a 5-day work week

(150 tons)* ($65/ton) *(5 days/week) *(52 weeks/year) = **$2,535,000**

Annual Post-Closure Care Cost based on current Market Rates:

15 Acres * ($4,020 per Acre) = **$60,300**

Net Annual Revenue for New Transfer Station:

Tipping Fee Revenue – Annual Operating Cost – Annual Cost to Transfer Waste

Net Annual Revenue for New 15-Acre Landfill:

Tipping Fee Revenue – Annual Operating Cost – Annual Post-Closure Care Cost

Estimated Closure Cost of the new 15-Acre Landfill based on current Market Rates:

($205,700/Acre) * (15 Acres) = **$3,085,500**

Estimated Post-Closure Care Cost based on current Market Rates:

($4,020/Acre) * (15 Acres) = **$60,300/Year for 30 Years**

Attachment 4:

SWANA 2017 Update for Benchmarking the Performance and Costs of MSW Landfills

May 2018

BENCHMARKING THE PERFORMANCE AND COSTS OF MSW LANDFILLS

2017 Update

SWANA APPLIED RESEARCH FOUNDATION

Prepared for:
SWANA Applied Research Foundation
FY2017 Disposal Group Subscribers

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APPLIED RESEARCH FOUNDATION
SWANA

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INTRODUCTION

The SWANA Applied Research Foundation's (ARF) Fiscal Year 2017 (FY2017) Disposal Group identified the need for an updated version of the 2008 ARF report on *Benchmarking the Performance and Costs of MSW Landfills*.

This topic, submitted by the City of Winston-Salem, was described as follows:

> "The 2008 ARF report on Benchmarking the Performance and Costs of Landfills is a valuable resource for landfill owners/operators interested in analyzing operational metrics such as equipment, staffing, airspace utilization, waste-to-cover ratios, etc. Given the period of time that has passed since that data was compiled, an updated version of this report would support facility operators in ongoing efforts to increase efficiency and effectiveness. A shared database could be created to accompany the report, allowing operators to access information and provide updates to keep the data current."

The 2008 ARF report presented the results of a two-year effort to develop a Municipal Solid Waste (MSW) Landfills Benchmark database as well as an analysis of the database information. During that effort, SWANA ARF staff developed a "MSW Landfill Benchmarking Survey" that was distributed to ARF subscribers and members of the SWANA Landfill Management Technical Division. Eight ARF subscribers and sixteen Technical Division members provided responses.

The purpose of this report is to present the findings of the 2017 landfill benchmarking research project.

A listing of the FY2018 Disposal Group Subscribers is provided in Table 1.

Table 1: SWANA Applied Research Foundation - FY2018 Disposal Group Subscribers		
Jurisdiction	**Representative**	**Title**
Chester County Solid Waste Authority (PA)	Robert Watts	Executive Director
Delaware County Solid Waste Authority (PA)	Joseph Vasturia, PE	Chief Executive Officer
Delaware Solid Waste Authority (DE)	Jason Munyon, PE, BCEE	Manager of Engineering
City of Denton (TX)	Scott Lebsack	Development and Administration Manager
Illinois SWANA Chapter	Steven Schilling, P.E.	SWANA Land of Lincoln Chapter Representative
Iowa SWANA Chapter	Mike Classen	Solid Waste Engineer (HDR)
King County (WA)	Laura Belt	Special Projects Manager
Lancaster County Solid Waste Management Authority (PA)	Erin Saylor	Business Development Manager
Los Angeles County Sanitation Districts (CA)	Frank Caponi	Division Engineer
Mecklenburg County (NC)	Jeff Smithberger	Director, Solid Waste Management
Metro Waste Authority (IA)	Michael McCoy	Executive Director
New Jersey SWANA Chapter	Gary Conover	Solid Waste Director - Atlantic County (NJ) Utilities Authority
New River Resource Authority (VA)	Joseph Levine, PE	Executive Director
New River Solid Waste Association (FL)	Darrel O'Neal	Executive Director
North Carolina SWANA Chapter	Joe Readling, PE	Vice President - HDR Engineering, Inc.
Prince William County, VA	Tom Smith	Solid Waste Division Chief
San Joaquin County, CA	Jim Stone	Deputy Director of Public Works
SCS Engineers	Robert Gardner, PE, DEE	Senior Vice President
Smith Gardner, Inc.	Mike Brinchek	Senior Project Manager
Solid Waste Authority of Central Ohio (OH)	Scott Perry	Director of Operations and Maintenance
Solid Waste Authority of Palm Beach County (FL)	Mark Hammond	Executive Director
City of Tucson (AZ)	Martin Bey	Landfill Manager
Waste Commission of Scott County (IA)	Kathy Morris	Director
Winston-Salem City/County Utilities (NC)	Jan McHargue, PE	Solid Waste Administrator
Wisconsin SWANA Chapter	Chris Anderson	Foth Infrastructure and Environment, LLC

BENCHMARKING MSW LANDFILLS

Introduction

Benchmarking is the systematic process of searching for best practices, innovative ideas, and highly-effective operating procedures that lead to superior performance – and then adapting those practices, ideas, and procedures to improve the performance of one's own organization.

Benchmarking has been widely embraced by both the private and public sectors as an essential business practice for continuous performance improvement. MSW landfill managers rely on benchmarking data to:

- Objectively measure the quality and levels of the services they provide;
- Identify and implement best practices that will enable them to reduce costs and improve services.

The need to benchmark MSW landfill operations has long been recognized by disposal system managers. Historically, this need has been met through the conduct of periodic, regional benchmarking studies by MSW landfill owners and their consultants.

By revisiting this benchmarking effort on a recurring basis going forward, SWANA intends to develop and maintain a SWANA *MSW Landfill Benchmarks* Database that can be made available to landfill owners and their consultants. By serving as the repository of accurate, consistent, and timely performance and cost data for MSW landfills, this database will minimize the efforts and costs for landfill owners and managers to access benchmark data. It will also enable the development of well-defined and meaningful performance and cost parameters.

The *SWANA MSW Landfill Benchmarks Database* is positioned to grow into the leading industry reference for MSW landfill owners and managers across the United States and Canada. SWANA is committed to seeing this database expand and invites visionary solid waste managers to participate in this ongoing effort.

Data Sources

To conduct the 2017 update, the "MSW Landfill Benchmarking Survey" was distributed to the 26 subscribers of the SWANA ARF Disposal Group. Completed survey questionnaires were received from ten subscribers representing twelve landfills, which are listed in Table 2.

Table 2: SWANA Landfill Benchmarking Survery Questionnaire — Respondent			
Jurisdiction	**Landfills**	**Contact**	**Title**
Charleston County, SC	County Landfill	Robert Lawing, P.E.	Solid Waste Engineer
Chester County Solid Waste Authority	Lanchester Facility	Robert Watts	Executive Director
City of Denton, TX	1590A	Randall Morris	Landfill Manager
Delaware Solid Waste Authority	Cherry Island Landfill	Lynsey Baer	Facility Manager
	Sandtown Landfill	Justin Wagner	Facility Manager
Prince William County, VA	Prince William County Sanitary Landfill	Thomas Smith	Solid Waste Division Chief
San Joaquin County, CA	Foothill Landfill	Charlie Yuon	Junior Admin. Asst.
	North County Landfill		
Solid Waste Authority of Central Ohio	Franklin County Sanitary Landfill	Scott Perry	Director of Operations and Maintenance
City of Tucson, AZ	Los Reales Landfill	Martin Bey	Landfill Manager
Waste Commission of Scott County, IA	Scott Area Landfill	Brian Seals	Operations Manager
City of Winston-Salem, NC	Hanes Mill Road Landfill	Jan McHargue, P.E.	Solid Waste Administrator

Each year, the State of North Carolina develops an estimate of the remaining MSW landfill capacity in the state by tracking the total tons disposed and airspace consumed at each permitted site in the state. These data are made available to the public via the State's web site.[1] The 2017 update incorporates landfill density data from the State's 37 active MSW landfills.

[1] *http://edocs.deq.nc.gov/WasteManagement/0/edoc/996954/NC_SWMMAR_FY2016-17_LandfillCapacity.pdf?searchid=b1697d-cf-7917-4c91-950e-fb192ed909de*

BENCHMARKING MSW LANDFILL PERFORMANCE

Introduction

Table 3 summarizes the parameters and number of data points from each source included in the database.

Table 3: SWANA MFW Landfill Benchmarks Database – Data Sources			
Parameter	No. Data Points	SWANA ARF Subscribers (12 Data Points - 2016)	North Carolina (37 Data Points – 2017)
Performance Parameters			
Airspace Utilization Density (AUD)	49	X	X
AUD Versus Landfill Age	12	X	
AUD Versus Annual Rainfall	12	X	
AUD Versus Landfill Height	9	X	
Average Cell Life	11	X	
Cover Soil Utilization	8	X	
No. Compactors	11	X	
No. Personnel	12	X	
No. Heavy Equipment	10	X	
Cost Parameters			
Personnel Costs	10	X	
Operating Costs	11	X	
Total Costs	8	X	
Cell Construction and Closure Costs	7	X	

The results of the benchmarking analysis of the MSW landfills with respect to productivity, efficiency, and effectiveness are presented below.

Landfill Airspace Utilization Density

The primary measure of landfill performance is the efficient use of landfill airspace. Landfill airspace can be defined as the volume of space on a landfill site which is permitted for the disposal of MSW. This space is initially occupied by air that is eventually displaced by the disposed waste — hence the term "landfill airspace."

Landfill airspace is depleted by being filled with waste or required cover material. In this regard, two points are true, though to varying degrees, about both privately and publicly owned landfills:

- Landfill managers sell airspace and are more cost effective as they increase the portion of the airspace available for waste and lessen the amount used by cover.
- Landfill airspace represents a resource to be wisely and economically used.

In a research report published in 2006, the SWANA ARF proposed that the following terms be used to characterize landfill densities:

- ***Landfilled Waste Density*** – refers to the density of the waste itself. This is calculated as the weight of the waste divided by the volume occupied by the waste and is reported in units of pounds per cubic yard (lbs/cy) or tons per cubic yard (tons/cy).
- ***Airspace Utilization Density*** – refers to the weight of the landfilled waste divided by the volume of airspace occupied by the landfilled waste as well as cover materials.[2]

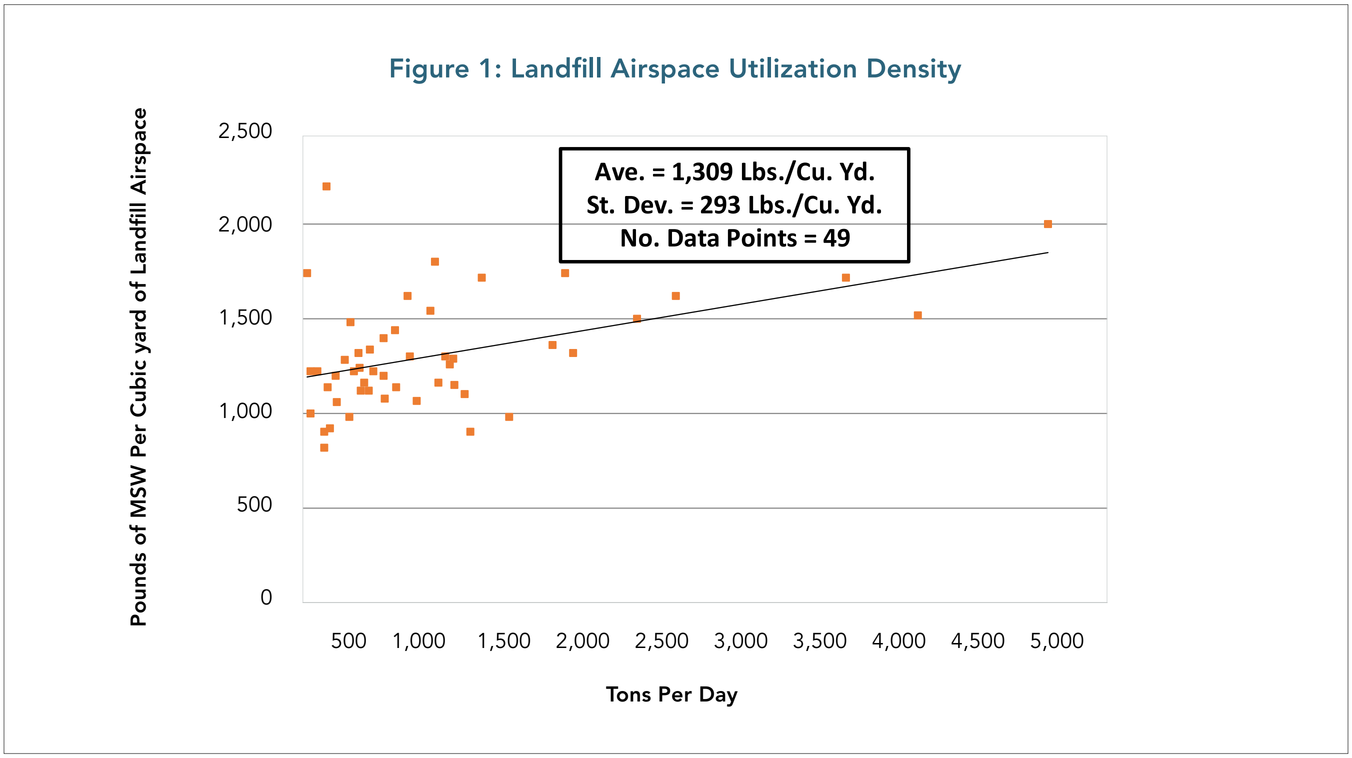
Of these terms, **Airspace Utilization Density (AUD)** is the primary parameter of landfill performance used in this report. AUD is determined by dividing the weight of the waste landfilled by the volume of the total airspace utilized—that is, the volume of airspace occupied by the landfilled waste as well as the cover materials used to meet regulatory requirements.

The AUD can be measured after the waste has been in the landfill for either a short or a long period of time. Determining the AUD over different time periods is important since the volume of landfill airspace utilized changes over time due to waste decomposition, waste compression from overburden, settlement and subsidence into voids, and similar mechanisms.

During this project, AUD data were analyzed for the 49 MSW landfills in the 2017 *Database*. As shown in Figure 1, the average long-term AUD achieved at these landfills is 1,309 pounds per cubic yard. This represents an 11% increase over the average long-term AUD of 1,181 pounds per cubic yard reported for the 63 landfills in the 2008 report.

Figure 1 appears to indicate a relationship between the AUD and the average daily disposal rates.[3] Landfill with higher average daily disposal rates (presumably larger landfills) appear to be able to achieve higher AUDs.

[2]It should be noted that the volumes occupied by the bottom liner system and final cover system of the landfill are not included in this term.
[3]Average daily disposal rates were calculated based on recent or average annual disposal rates assuming a 5.5-day work week.



Cover Soil Usage

The amount of cover material used has a direct relationship to the AUD achieved for a landfill operation. Decreasing the amount of cover material used automatically increases the AUD.

For landfills that use soil or similar cover material for daily cover, one of the landfill operator's primary jobs at the working face is to minimize the amount of airspace used for daily cover. This includes both applying as little cover as needed to meet regulatory requirements and removing as much of the cover soil as possible before continuing waste placement in that area.

Despite the importance of cover soil management to landfill airspace utilization, not all landfill managers keep accurate records of cover material usage. Additionally, those that track cover soil usage generally report such usage on a volume-to-volume basis (i.e., 1 part cover soil to 4 parts waste). This metric may not represent the best way to track cover material usage.

Instead, the SWANA ARF recommends landfill managers consider using a metric that compares the volume of cover soil used to the weight of the waste covered – i.e., Cover Material Volume Usage Per Ton of Waste Disposed – as calculated by the following equation:

$$\text{Cover Material Volume Usage per Ton} = \frac{\text{Cover Material Used (cubic yards)}}{\text{Tons of Waste Disposed}}$$

The value of using this proposed metric is illustrated in the following example.

Assume that a landfill manager has determined that a waste-to-daily cover material ratio of 5.8 to 1 is being consistently achieved at his or her site. This means that – for every 500 cubic yards of airspace used for waste disposal - 86 cubic yards of cover material are used to cover the waste.[4]

If a landfill operator achieves a waste density at the landfill working face of 1,000 pounds per cubic yard at this site, 250 tons can be disposed in a 500-cubic yard daily cell and 0.34 cubic yards of cover material (86 cy of cover soil divided by 250 tons of waste) will be used per ton of waste landfilled. Alternately, if another operator achieves a density of 1,200 pounds per cubic yard at the working face, 300 tons could be disposed in the same cell and only 0.29 cubic yards of cover material per ton disposed would have been used. In both cases, the volumetric ratio that is traditionally used to report cover soil usage is the same.

By using the "cover material volume usage per ton of waste disposed" metric proposed by the SWANA ARF, the landfill manager can identify and reward operators and practices that minimize the use of cover soil used per ton of waste disposed.

The new metric relies on data that is readily available at most sites. The amount of cover material used can be estimated based on the number of truck loads pulled over a given time frame, multiplied by the capacity of the truck (in cubic yards), and the percentage of the truck volume that is filled (on average) with cover material. Waste disposal tonnage data are available from scale house records.

The cover soil utilization for eight landfills owned by SWANA ARF members is graphically illustrated in Figure 2. As shown, an average of 0.39 cubic yards of cover soil was utilized per ton of waste disposed. This is very close to the average of 0.42 cubic yards of cover soil per ton of waste disposed reported in 2008 for eleven landfills. As the graph indicates, there appears to be a modest relationship between the amount of cover soil used and the size of the landfill (i.e., the disposal rate).

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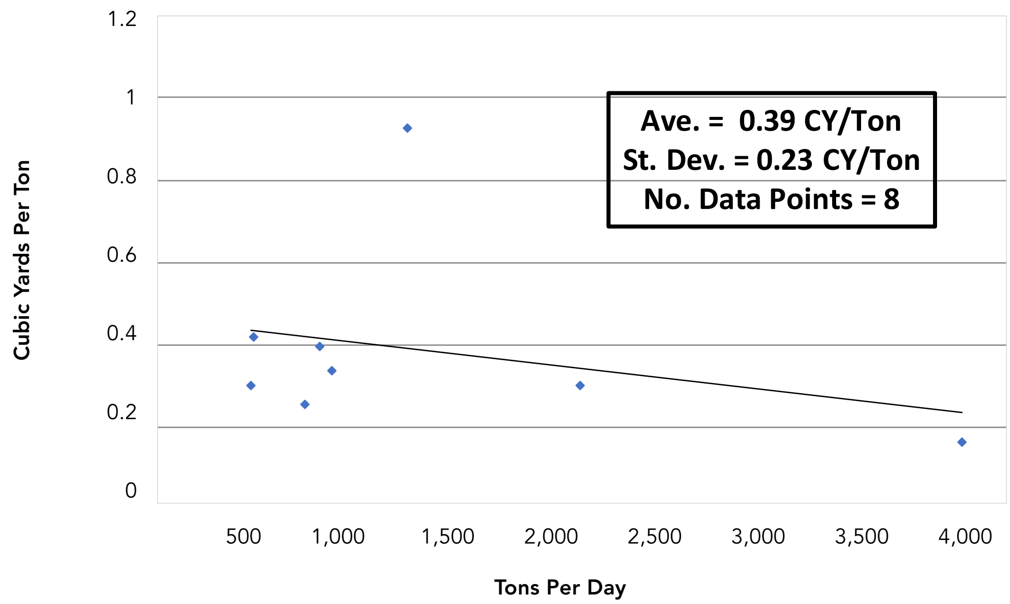
[4]*The daily waste cell is assumed to have the following dimensions: cell height – 10 feet.; cell width – 100 feet.; cell "advance" (length) – 13.5 feet.; for a total airspace available for waste disposal of 500 cubic yards ((10 x 13.5 x 100)/ 27).*

Figure 2: Cover Soil Usage Per Ton of Waste Landfilled



Other Factors Impacting Landfill Airspace Utilization Densities

Introduction

A 2005 SWANA ARF project on landfill airspace utilization identified a number of factors that impact AUD.[5] As indicated in Table 4, these factors vary in the degree of impact they have on waste density. As the table also indicates, some of these factors are outside of the control of the landfill manager and/or operator. Four factors that are known to have a major effect on the AUD achieved at MSW landfills are:

- Landfill Age.
- Landfill Height.
- Annual Rainfall.

The purpose of this section is to present data from the *SWANA MSW Landfill Benchmarks Database* that quantifies these impacts.

[5] *SWANA Applied Research Foundation.* Landfill Airspace Utilization: Measurement and Management. *Silver Spring, Maryland: SWANA, 2005.*

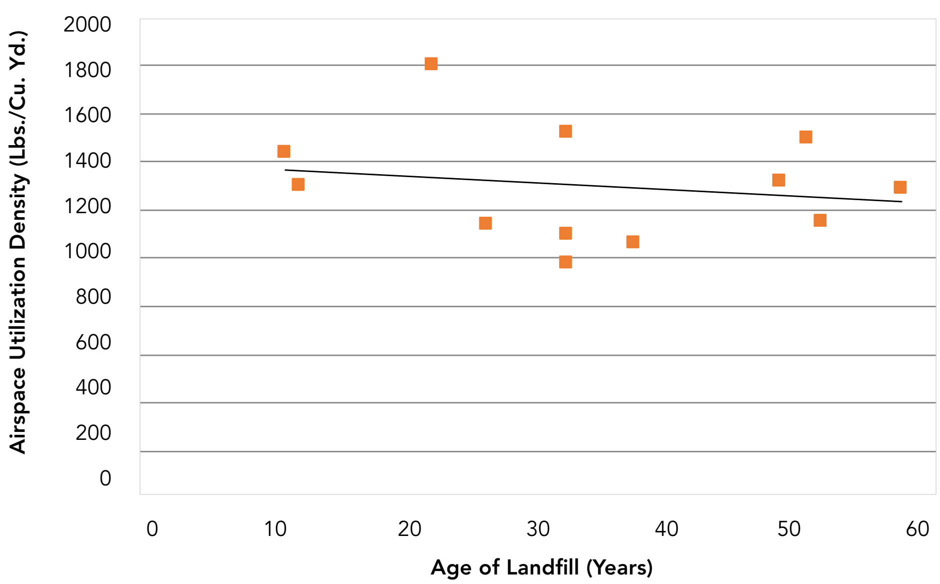
Table 4: Landfill Airspace Utilization – Factors Impacting Waste Density					
Waste Density Measurement Parameter	**Factors Impacting Waste Density**	**Impact**	**Under Manager's Control**	**Under Operator's Control**	**Under Operator's Control**
Airspace Utilization Long-Term Density	Landfill Age	Major			X
	Landfill Height	Major			X
	Waste Stream Mix	Major			X
	Annual Rainfall	Major			X
	Landfill Surcharging with Cover Soil	Moderate		X	
	Stripping and Reclamation of Intermediate Cover Soil	Moderate		X	
	Leachate Recirculation/ Moisture Addition	Major	X	X	

Landfill Age

Figure 3 shows the variation of AUD by age for the 12 landfills for which these data were provided. Theoretically, older landfills should have higher AUDs because the landfilled wastes have had a longer time to decompose. However, as shown by the responses in Figure 3, that is not always the case and in fact, sometimes higher AUDs are associated with younger landfills.

It can be concluded from this figure that the AUDs for these landfills are more highly influenced by other factors such as the types of wastes landfilled and annual precipitation at the landfill rather than landfill age.

Figure 3: Airspace Utilization Density Versus Landfill Age

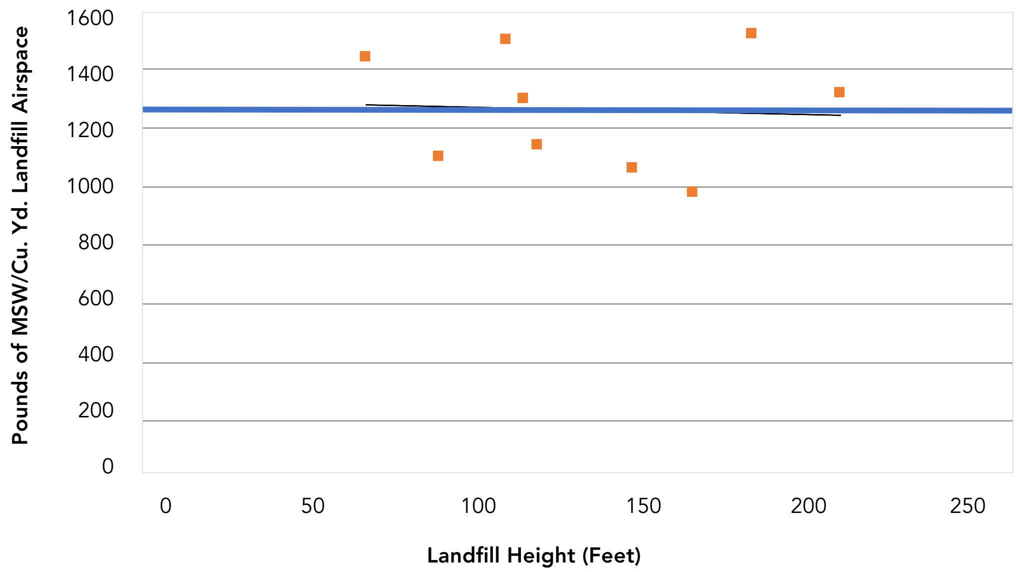


Landfill Height

Another factor that can have a significant impact on the long-term AUD achieved at an MSW landfill is the height of the landfill. Higher lifts place more weight and pressure on the lower, underlying lifts, thereby increasing the density of the landfilled wastes in the lower sections of the landfill.

Figure 4 presents a graph depicting the relationship between long-term AUD and landfill height. The graph does not show a significant correlation between landfill height and increased AUD for the nine landfills that supplied height data.

Figure 4: Airspace Utilization Density Versus Landfill Height

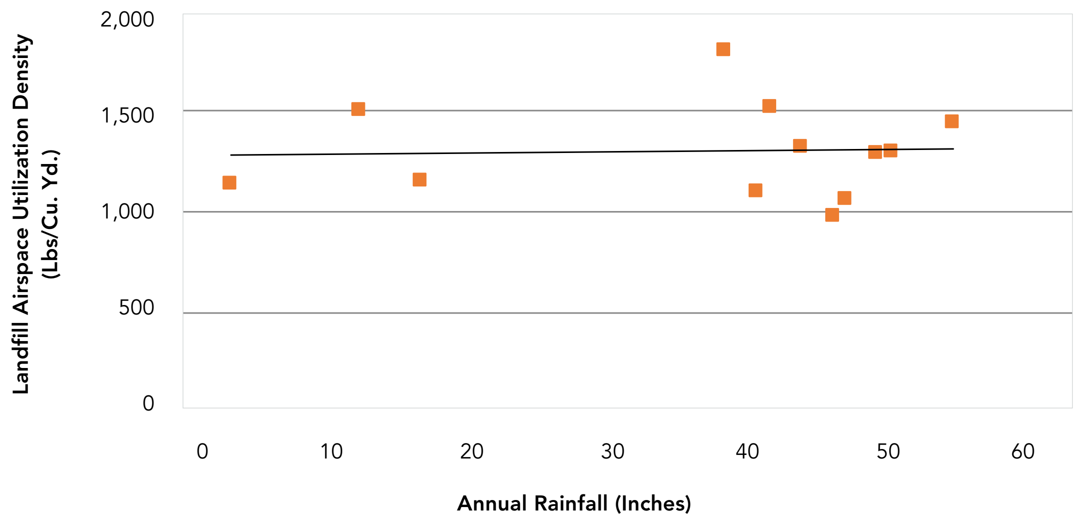


Annual Rainfall

The amount of waste decomposition in landfills is directly related to the amount of available moisture which, in most landfills (except for bioreactors and those that recirculate leachate), depends on precipitation. As decomposed waste is denser than non-decomposed waste, the logical conclusion is that MSW landfills located in climates with higher precipitation should achieve higher AUDs.

As Figure 5 illustrates, AUD data from the SWANA MSW Landfill Benchmarks Database appears to support this conclusion.

Figure 5: Airspace Utilization Density Versus Rainfall



BENCHMARKING MSW LANDFILL COSTS

Introduction

A major goal of the SWANA MSW Landfill Benchmarks Database is to collect, analyze, and present accurate and comparable cost data for MSW landfills. In this regard, the goal of the database is to collect and compile full-cost information including:

- Landfill Capital Costs, including Site Development Costs and Cell Construction and Closure Costs.
- Personnel Costs, including Direct Labor and Fringe Costs.
- Amortized Equipment Capital Costs.
- Equipment Maintenance Costs.
- Other Operating Costs.
- Indirect and Overhead Costs.

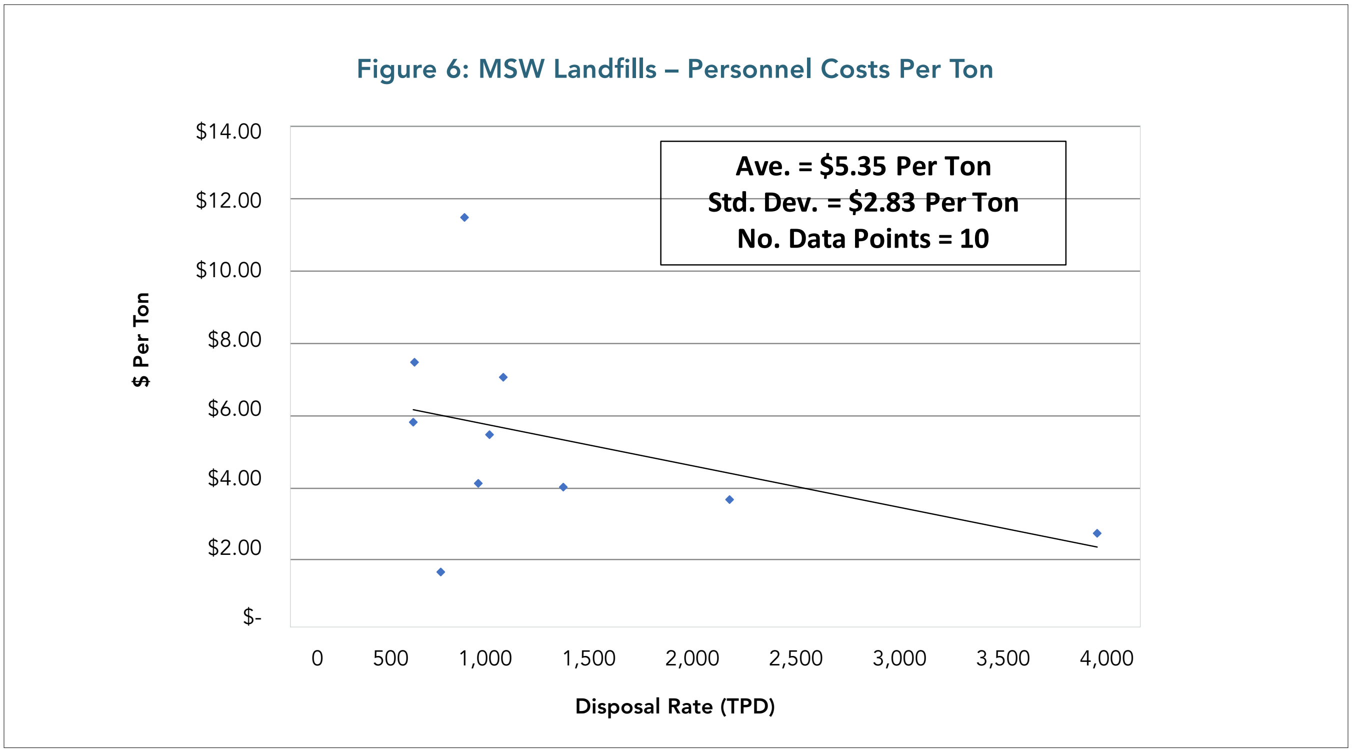
Complete cost information was provided for most of the landfills providing responses. This information is summarized in Table 5 and discussed below.

Table 5: Benchmarking MSW Landfills – Summary of Cost Data

Parameter	No. of Data Points	Units	Mean	Standard Deviation
Disposal Rate				
Tons Per Year	12	TPY	386,880	259,369
Tons Per Day (5.5 day work week assumed)	12	TPD5.5	1,272	907
Landfill Costs				
Personnel Costs	10	$/Ton	$5.35	$2.83
Operating Costs	11	$/Ton	$15.94	$5.44
Total Costs	8	$/Ton	$22.27	$5.99

Personnel Costs

The average personnel costs for MSW landfill operations are presented in Figure 6. These costs include both direct labor costs as well as fringe benefits. As indicated, the average personnel costs for the ten landfills, which submitted cost information, are $5.35 per ton. The data in Figure 7 also indicate that personnel costs per ton tend to decrease as the size of the landfill increases, confirming that there are economies of scale associated with landfill personnel costs.

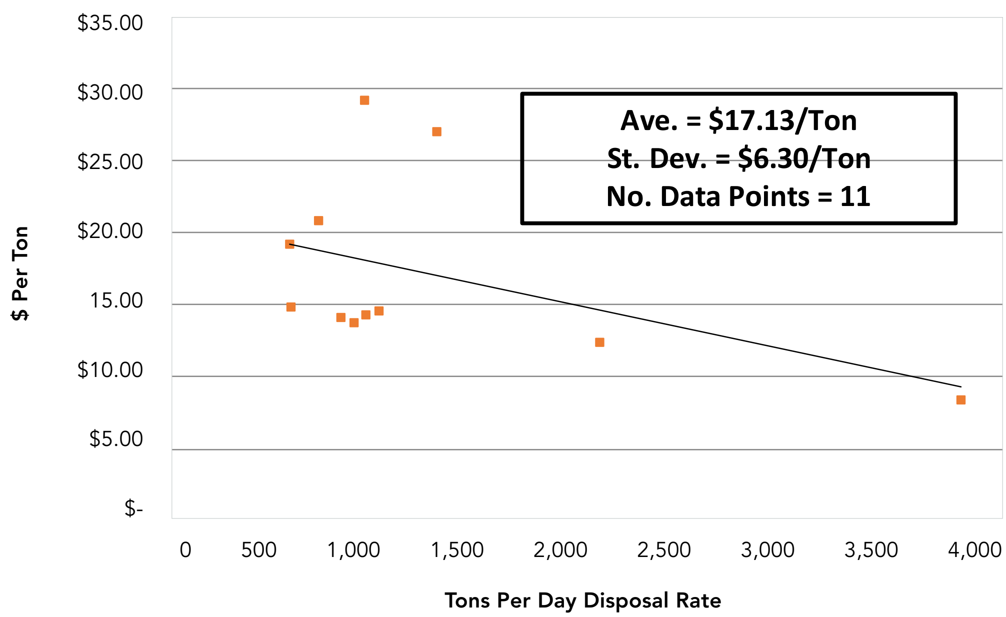


Operating Costs

The average operating costs for MSW landfill operations are presented in Figure 7. These costs include personnel costs, equipment operation and maintenance costs, consulting and professional services costs, and miscellaneous operating costs. State landfill taxes, landfill host fees, and landfill post-closure costs are not included.

As indicated, the average operating costs for the eleven landfills which submitted this cost data are $17.13 per ton. This average is slightly higher than the average of $13.93 per ton presented in the 2008 report for nine landfills. The data in Figure 7 indicate that operating costs per ton tend to decrease as the size of the landfill increases, confirming again that there are significant economies of scale associated with landfill operations.

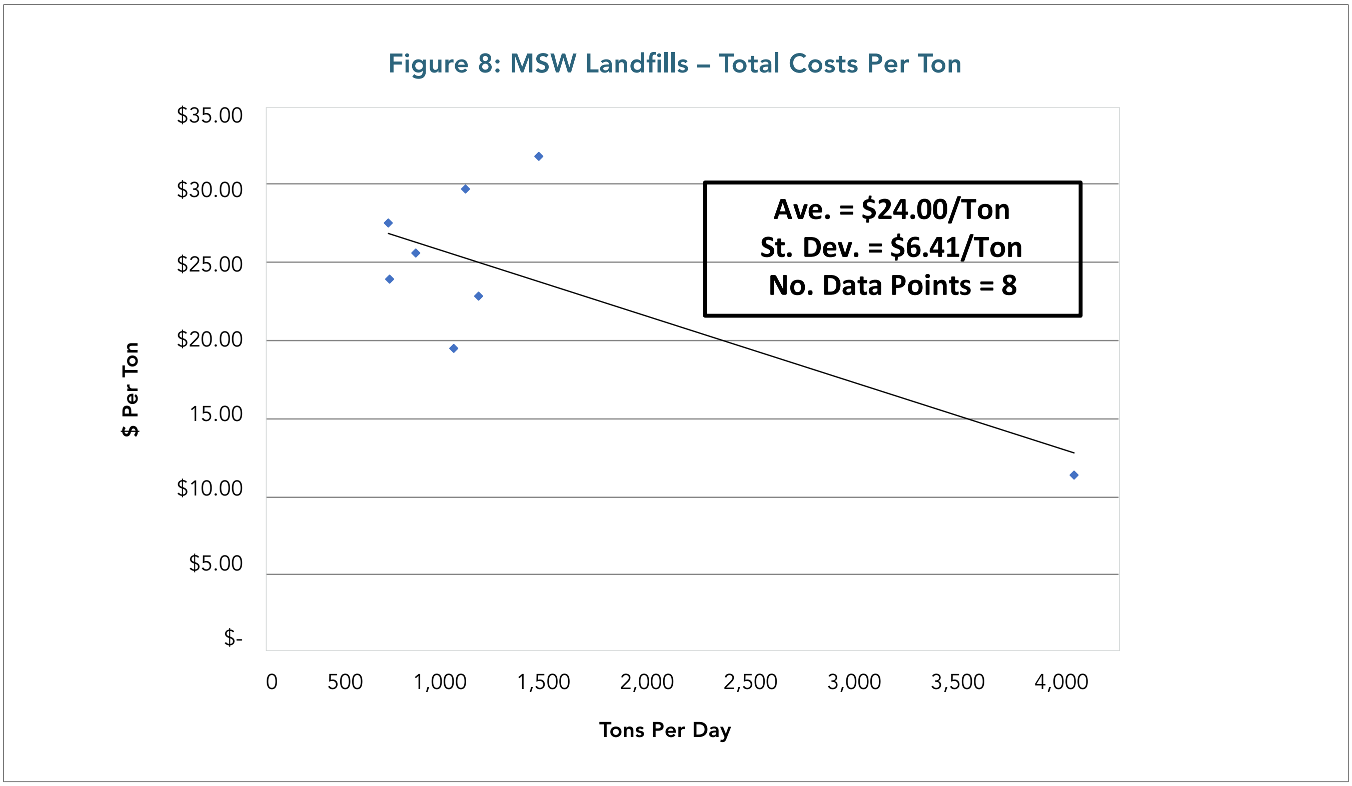
Figure 7: MSW Landfills – Operating Costs Per Ton



Total Costs

The total costs associated with the provision of MSW landfill disposal services are presented in Figure 8. These costs include landfill capital costs (equipment purchase, cell construction, and closure) and landfill operating costs (including personnel and equipment costs). State landfill taxes, post-closure costs and landfill host fees are not included.

As indicated, the average total cost for the eight landfills, which submitted cost information, is $24.00 per ton which is almost identical to the average total costs of $22.41 per ton presented for five landfills in the 2008 report. The data in Figure 8 also indicate that the total costs per ton tend to decrease as the size of the landfill increases due to economies of scale.



Cell Construction and Closure Costs

Cell construction and closure costs for the seven MSW landfills which submitted this cost data are summarized in Table 6. As shown, construction costs for Subtitle D landfill cells averaged $297,587 per acre in FY2016 for these landfills which is slightly lower than $304,479 per acre average presented in the 2008 report. Closure costs average $122,539 per acre which is slightly higher than the $117,762 per acre average presented in the 2008 report.

Table 6: Landfill Cell Constrcution and Closure Costs (FY2016)				
Parameter	No. of Data Points	Units	Mean	Standard Deviation
Cell Construction Costs	7	$/Acre	$297,587	$100,269
Cell Closure Costs	7	$/Acre	$122,539	$68,758

ADDITIONAL DATABASE INFORMATION OF INTEREST TO MSW LANDFILL MANAGERS

Introduction

The primary purpose of the SWANA MSW Landfill Benchmarks Database is to serve the benchmarking information needs of SWANA landfill managers. In addition to generating data that can be used to evaluate and compare service delivery performance and costs, the database can provide managers with data and information on numerous subjects of interest and importance to disposal services manager. The information that can be gleaned from the SWANA MSW Landfill Benchmarks Database on a number of these topics is presented below.

Average Cell Life

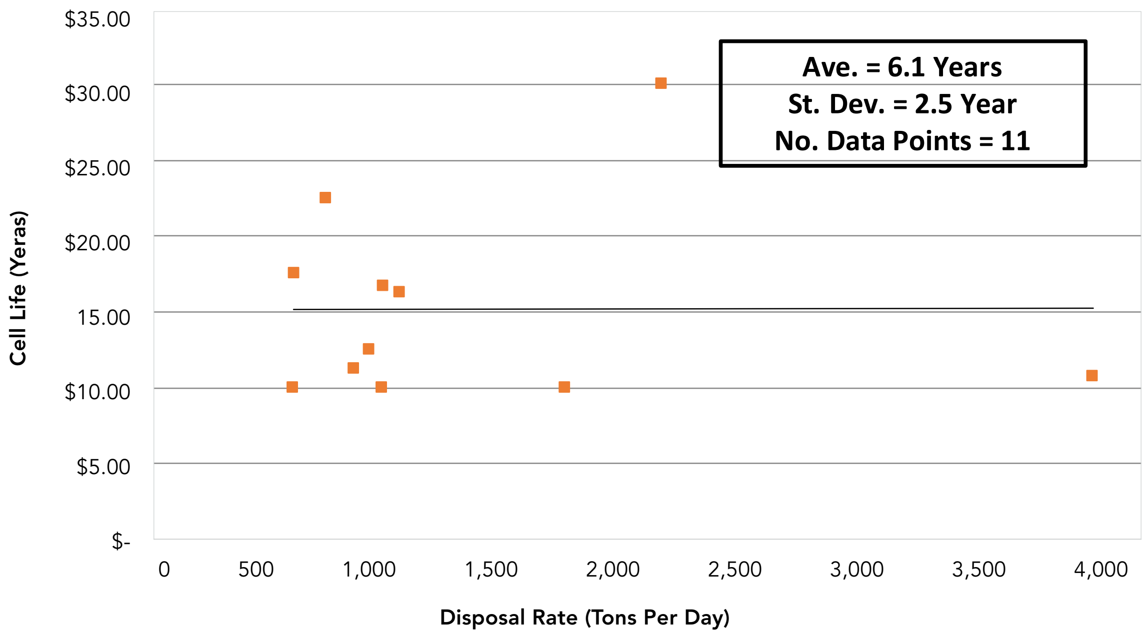
MSW landfills are typically designed as a series of contiguous lined areas called cells. Each cell typically consists of several acres which are built with Subtitle D liner systems that include a composite liner (composed of compacted clay or geosynthetic clay covered by a geomembrane liner), gas collection system, leachate collection system, and drainage layer.

The construction of landfill cells represents a major ongoing capital investment to MSW landfill owners. As indicated in Table 7, cell construction costs averaged $298,000 per acre for the seven landfills which provided this cost information for the database.

Once constructed, unused landfill cell capacity represents an investment which is recouped over the life of the cell. For this reason, landfill managers must balance the need for future capacity with the cost of having unused constructed cell capacity sitting around waiting to be filled. In view of this balance, the goal is similar to that of manufacturing or retail organizations – that is, to minimize the amount of unused inventory— in this case constructed cell acreage—while at the same time having the capacity needed to meet present and near-term future needs.

As shown in Figure 9, the average life of cells for the eleven MSW landfills reporting this data is 6.1 years. Interestingly, longer cell lives are associated with the smaller landfills.

Figure 9: Cell Life Versus Disposal Rate (TPD)



Number of Landfill Personnel

How many full-time employees (FTEs) are required to operate an MSW landfill? As shown in Figure 10, the twelve landfills, which reported this data, employ 9 to 54 FTEs.

As indicated in Figure 11, these landfills average 1.92 FTEs per 100 tons per day of MSW dis-posed. The number of required operating personnel appears to exhibit significant economies of scale.

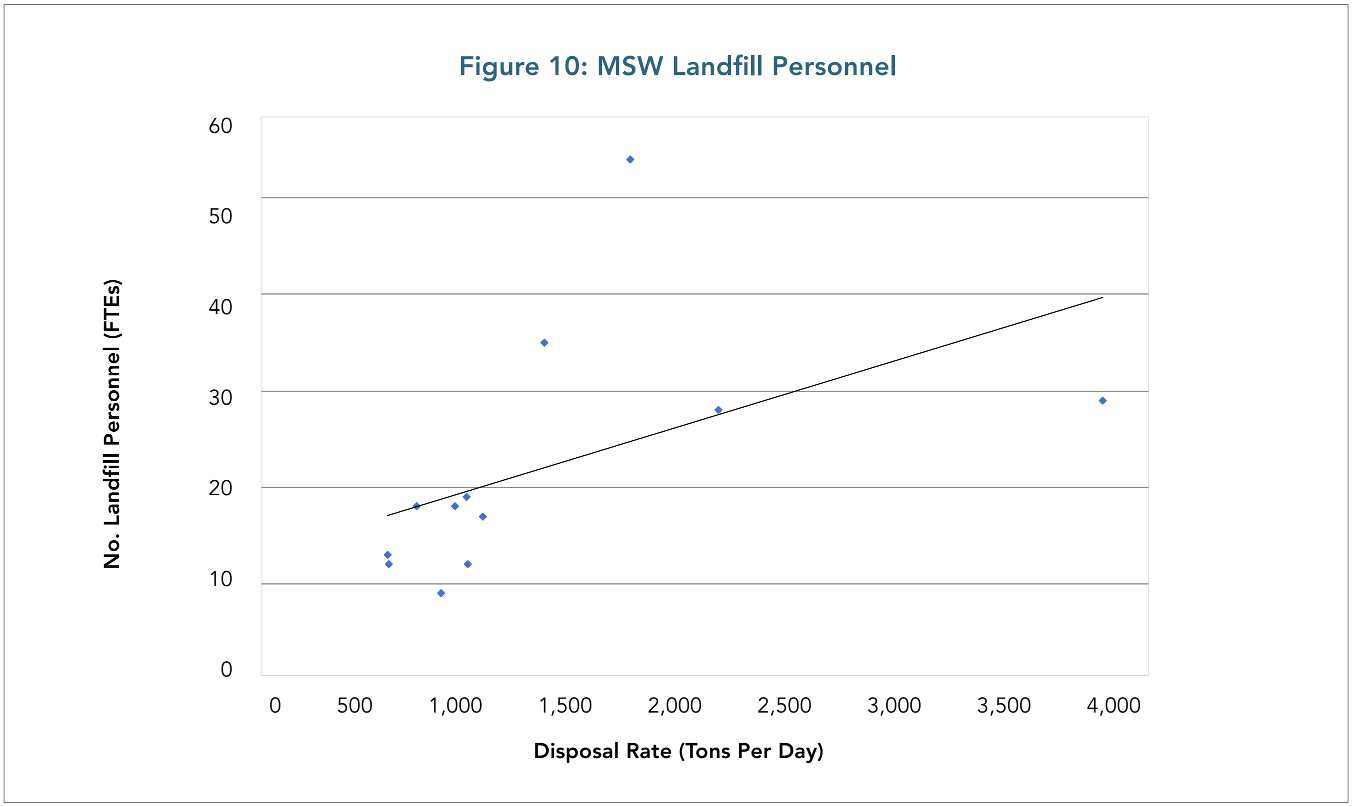


Figure 10: MSW Landfill Personnel
No. Landfill Personnel (FTEs)
60
50
40
30
20
10
0
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
Disposal Rate (Tons Per Day)

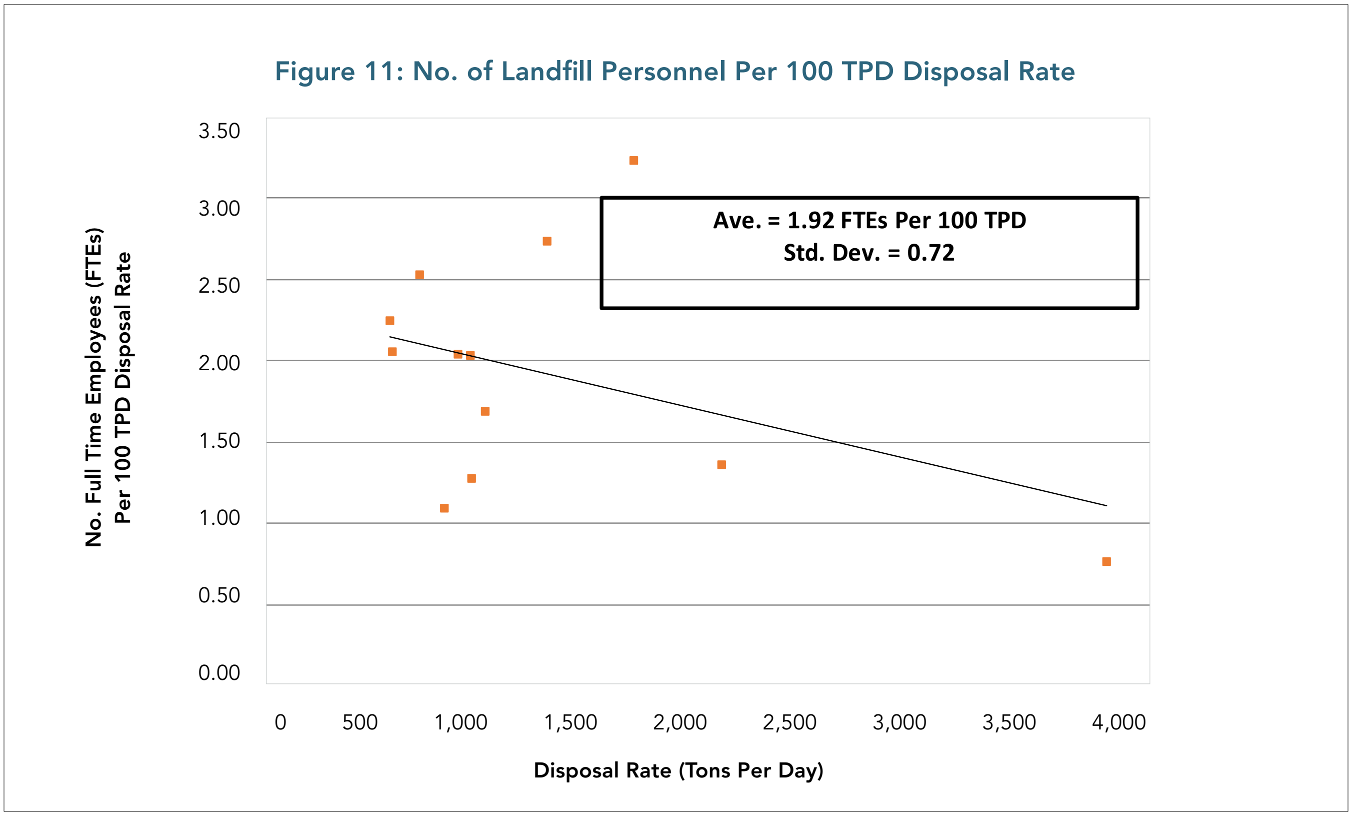
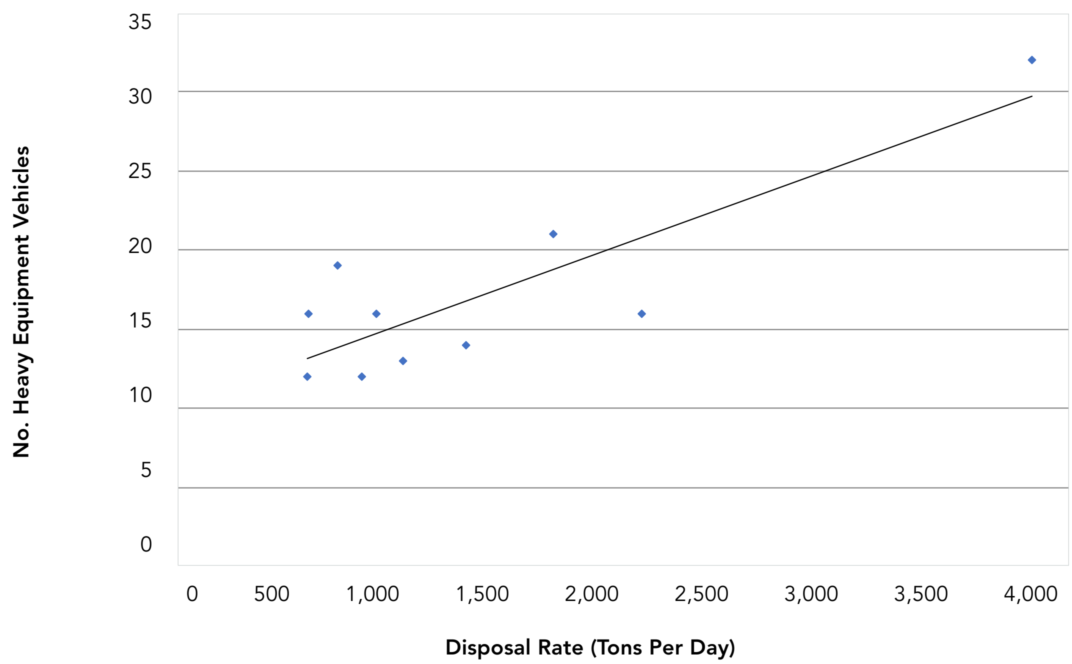


Figure 11: No. of Landfill Personnel Per 100 TPD Disposal Rate
No. Full Time Employees (FTEs) Per 100 TPD Disposal Rate
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Ave. = 1.92 FTEs Per 100 TPD
Std. Dev. = 0.72
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
Disposal Rate (Tons Per Day)

Number of Heavy Equipment

Ten MSW landfills in the *SWANA MSW Landfill Benchmarks Database* provided data on the number and types of heavy equipment used at their sites.[6] As shown in Figure 12, these landfills utilize 12 to 32 pieces of heavy equipment to operate their sites.

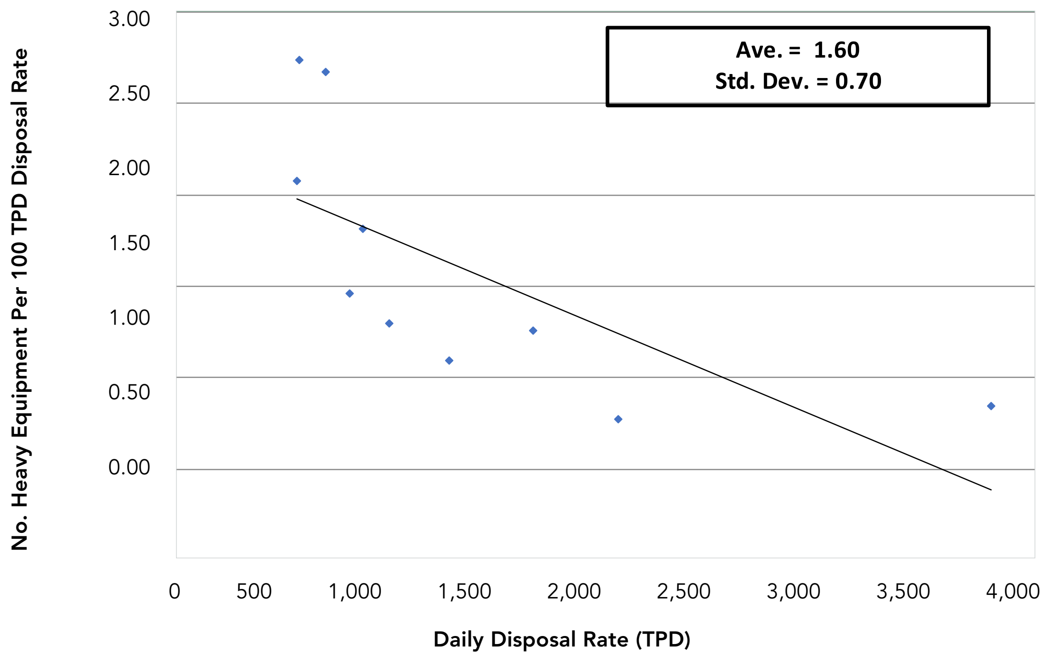
Figure 12: MSW Landfills – Heavy Equipment Vehicles



This data is also presented from the perspective of the number of pieces of heavy equipment utilized per 100 tons of MSW disposed daily in Figure 13. As indicated, these landfills average 1.6 pieces of heavy equipment per 100 tons per day (TPD) of MSW disposed. As with the number of required operating personnel, the number of required pieces of heavy equipment appears to exhibit significant economies of scale with respect to increased daily disposal rates.

[6]*A list of the equipment defined as "heavy equipment" in the* SWANA MSW Landfill Benchmarks Database *is presented in Section 4.6.*

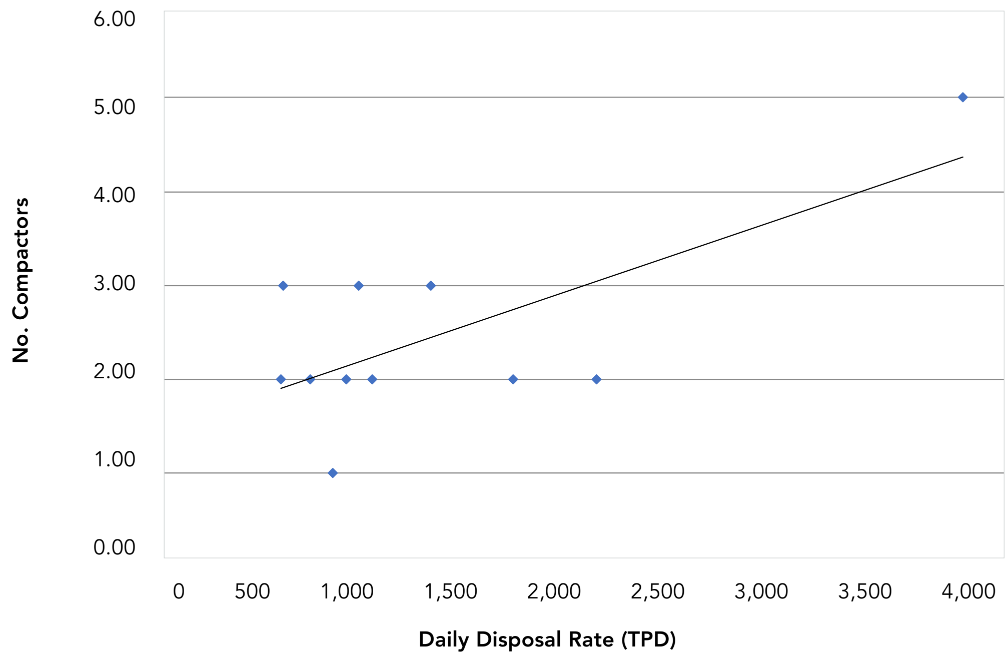
Figure 13: No. Heavy Equipment Per 100 TPD Daily Disposal Rate



Number of Compactors

The most expensive piece of heavy equipment that is utilized at MSW landfills is the landfill compactor. The number of compactors utilized at the eleven MSW landfills in the SWANA MSW Landfill Benchmarks Database, which reported this data, is presented in Figure 14.

Figure 14: No. of Compactors



NEXT STEPS

Over the last ten years, the *SWANA MSW Landfill Benchmarks Database* has transitioned from concept to reality. SWANA sincerely appreciates the vision and commitment of the ARF Disposal Group Subscribers who have worked diligently to make this database a reality.

SWANA is committed to growing and expanding this database in future years.

SWANA will continue to protect the privacy of the landfill owners, who provide database information, by not allowing user access to data from individual landfills.

For more information on becoming a subscriber to the SWANA Applied Research Foundation, please contact Jeremy O'Brien, PE, SWANA's Director of Applied Research, via email at jobrien@swana.org.

APPLIED RESEARCH FOUNDATION

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