TAYLOR ENGINEERING, INC.

Volusia County

Countywide Beach Profile Survey 2023

Volusia County, FL
January 2024

10199 Southside Boulevard, Suite 310
Jacksonville, Florida 32256
904-731-7040 | www.taylorengineering.com

Volusia County Interim Countywide Beach Profile Survey 2023
Volusia County, FL

Prepared for

Volusia County
Task Assignment No. 19, PC3280, RSQ No. 20-SQ-175IF

by

Nicole McClain, E.I.
Wendy K. Laurent, P.E.
Christopher Bender, Ph.D., P.E., BC.CE
James N. Marino, P.E., BC.CE

Taylor Engineering, Inc.
10199 Southside Blvd., Suite 310
Jacksonville, FL 32256
(904) 731-7040

January 2024

Taylor Project Number: C2023-065

TABLE OF CONTENTS

List of Figures

List of Tables

1.0 INTRODUCTION

This report presents the results of a countywide beach profile survey conducted during the late summer- early fall of 2023, to characterize the evolution of Volusia County's (County) beaches. Previous studies within the County focused on smaller project-specific sites such as surrounding the Ponce de Leon Inlet, Bethune Beach, and New Smyrna Beach. Example studies for the inlet include: Ponce De Leon Inlet Management Plan (Taylor and Yañez, 1994; FDEP, 2020a), Sediment Budget Update Ponce De Leon Inlet and Adjacent Beaches (Taylor Engineering, Inc., 2003), and Ponce de Leon Inlet Sediment Budget Update (Trudnak, Laurent, and Craig, 2018). Trudnak and Srinivas (2003) examined beach erosion south of the inlet, and Hall and Krecic (2007) documented a 2006 emergency dune construction project in New Smyrna Beach. The U.S. Army Corps of Engineers (USACE) authorized a federal feasibility study in 2006 for the Volusia County Shore Protection Project, although it has yet to be funded. Since 2021, the County has been actively engaged in their request for federal funding of the Coastal Storm Risk Management and Shore Protection Feasibility Study.

This report, prepared for the County, presents the 2023 beach profiles and shoreline positions with comparisons to the 2019 baseline condition, the 2022 interim condition, and the 2022 post-Hurricane Nicole condition. The 2019 survey collected data countywide to establish a baseline condition for future beach assessments and monitoring. The interim data collection efforts (2020, 2021, and 2022) surveyed beach profiles at all monuments in the Ponce de Leon Inlet area of influence (R-120 to R-170) and every third monument elsewhere throughout the County. The 2023 survey collected data countywide. Additionally, Taylor Engineering extracted profiles from the USACE Joint Airborne LiDAR Bathymetry Technical Center of Expertise (JALBTCX) post-event LiDAR data collected in November 2022, approximately 2-3 weeks following Hurricane Nicole. Historic shoreline comparisons for the 2019-2022 data are found in the following reports: Laurent and Trudnak, 2019; Laurent, Lamb, and Schedel, 2020; Laurent, Lamb, and Schedel, 2021; Laurent, Craig, McClain, and Lamb, 2022.

1.1 Overview

Volusia County is located south of Flagler County and north of Brevard County along the central-east coast of Florida. The County encompasses 47 miles of Atlantic Ocean shoreline. As of 2023, the Florida Department of Environmental Protection (FDEP) defined 27.2 miles of the County's shoreline as critically eroded, 2 miles as non-critically eroded, and 0.6 miles of critically eroded inlet shoreline (FDEP, 2023). FDEP, pursuant to rule 62B-36.002(5), Florida Administrative Code (F.A.C.), defines a critically eroded shoreline as:

> *A segment of the shoreline 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. Critically eroded shorelines may also include peripheral segments or gaps between identified critically eroded areas which, although they may be*

stable or slightly erosional now, their inclusion is necessary for continuity of management of the coastal system or for the design integrity of adjacent beach management projects.

Historically, the most erosive events within the County include Hurricane Dora (1964); the November and December Nor'easters of 1981; the Thanksgiving Day Storm of 1984; Hurricanes Floyd and Irene (1999); Tropical Storm Gabrielle (2001); Hurricanes Charley, Frances, and Jeanne (2004); Hurricanes Ophelia and Wilma (2005); Subtropical Storm Andrea, the October Nor'easters, and Tropical Storm Noel (2007); Hurricane Matthew (2016); Hurricane Irma (2017); Hurricane Dorian (2019); and numerous Nor'easters in 2020/2021 (FDEP, 2020b). Notably, in 2022 Hurricane Ian (September 2022) and Hurricane Nicole (November 2022) caused significant erosion along the County's shoreline; these events and their data are documented in the post-storm reports (Laurent, 2023; Taylor Engineering, 2023).

Figure 1.1 and **Table 1.1** present an overview of the County and its coastal municipalities—this breakdown of the coast is based on political boundaries and this study uses them to present community trends. It should be noted that the community trends could be defined based on coastal processes, but these boundaries would be dynamic and could change year to year, making comparisons challenging. Critically eroded shorelines encompass FDEP reference monuments R-0 to R-4, R-24 to R-33, R-51 to R-143, R-148 to R-149 (inlet north bank), and R-160.8 to R-207.8, spanning portions of North Peninsula, Ormond-By-The-Sea, Ormond Beach, Daytona Beach, Daytona Beach Shores, Ponce Inlet, New Smyrna Beach, Silver Sands, and Bethune Beach (FDEP, 2023). Currently, the only FDEP-approved beach management strategy within the County is the bypassing of sediment at Ponce de Leon Inlet (FDEP, 2020a), further discussed in Section 2.1. This 2023 beach profile survey is the fifth in a recent series of surveys conducted by the County. The County is taking a more proactive role in monitoring and managing its beaches on a countywide scale. Continued surveying and data analysis could lead to the development of additional beach management strategies and, at a minimum, a better understanding of the County's beach conditions.

Table 1.1 Volusia County Seaside Communities

Community	Bounding R-monuments
North Peninsula	R-0 to R-16
Ormond-by-the-Sea	R-16 to R-47
Ormond Beach	R-47 to T-67
Daytona Beach and Daytona Beach Shores	T-67 to R-122
Wilbur-by-the-Sea	R-122 to R-128
Ponce Inlet	R-128 to R-148
New Smyrna Beach	R-149 to R-185
Silver Sands and Bethune Beach	R-185 to T-208
Canaveral National Seashore Park	T-208 to R-234

1.2 Report Organization

Following this introduction, Chapter 2 reviews the countywide nourishment history, provides details (e.g., date and location) of available beach surveys, and presents the tidal datums defined by FDEP

for the County. Chapter 3 presents the results of the Mean High Water (MHW) shoreline change and volume change analyses by community. Chapter 4 summarizes this study, and a list of references completes the report.

Appendix A contains beach profile plots of the 2019, 2022, 2022 post-Nicole, and 2023 surveys from monuments R-0 to T-208. Appendix B presents a table of the FDEP reference monument coordinates, elevation, and associated profile azimuth. Appendix C contains 2023 aerial photos overlaid with surveyed MHW contours for 2019, 2022, 2022 post-Nicole, and 2023. Appendix D provides the MHW shoreline positions and changes in tabular and graphical formats while Appendix E illustrates volume changes in tabular and graphical formats. Appendix F presents the 2023 monitoring photographs.

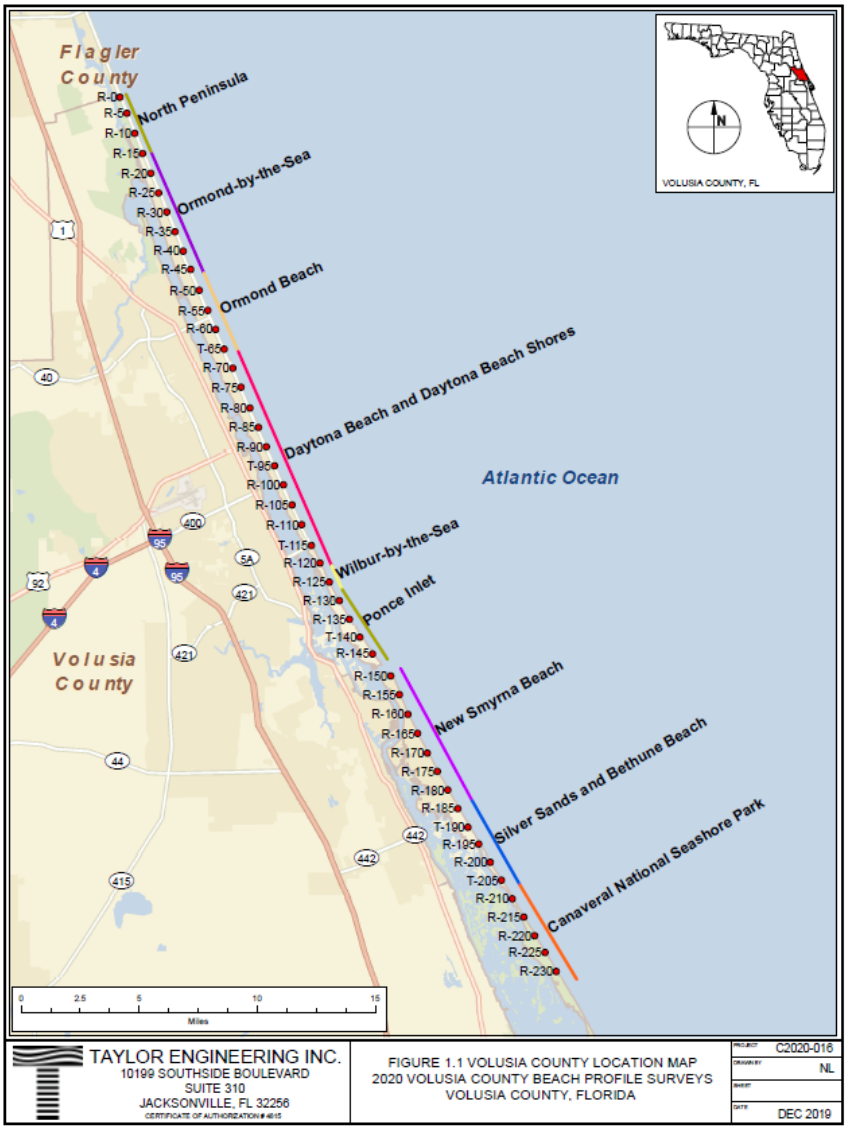

Figure 1.1 Volusia County Location Map

2.0 DATA COLLECTION

2.1 Nourishment History

Inlet bypassing efforts involving the beneficial use of dredge materials comprise the majority of the placement events that have occurred in Volusia County, aside from the 2006 and upcoming 2024 emergency dune restoration in New Smyrna Beach. Numerous regional sediment management (RSM) beach fill operations have placed material both north and south of Ponce de Leon Inlet, contributing to the management of the inlet and its adjacent beaches. **Table 2.1** documents the dredging history of the inlet since 1973, including projects that placed dredge material in the nearshore region as well as within the inlet itself. Historically, RSM projects have placed sediment on both the subaerial and subaqueous beaches to the north and south of the inlet (R-140 to R-148 and R-158 to R-177).

Since 2014, all bypassing has occurred to the south of the inlet; the County is currently re-permitting a placement area to the north of the inlet. The County is coordinating with FIND and the USACE to request placement of the 2024 dredge material in this location. The most recent project occurred in 2019, with the U.S. Army Corps of Engineers (USACE) placing sediment from Ponce de Leon Inlet in the nearshore area south of the inlet in the region of R-158 to R-166 (FDEP, 2020a). Of note, nearshore placement may indirectly nourish the beach, as cross-shore sediment transport could redistribute the placed materials towards or onto the subaerial beach; however, although trends may indicate the redistribution onto the subaerial beach the fate of the placed material and the effectiveness of this nourishment method has not been fully studied for Volusia County.

The 2006 dune restoration project occurred following erosive hurricanes (e.g., Hurricanes Frances and Jeanne both in 2004) and winter storms in 2004 and 2005. This project encompassed a 5.2-mile-long segment of beach, extending from R-161 to R-189 within New Smyrna Beach. The project placed approximately 745,000 cy sourced from the Florida Inland Navigation District (FIND) dredge material management areas (DMMA) MSA-434 and V-26 (Hall and Krecic, 2007). The County is currently in the permitting and design phases for a similar project which will restore the dune feature to +10 ft NAVD88 between R-160.3 and R-191.5 and is anticipated to place approximately 585,000 cy in 2024 (Trudnak, 2023).

Table 2.1 Volusia County Beach Fill Placement History (FDEP, 2020a)

Date	Volume (cubic yard)	Dredging Location	Placement Location
1973	120,204	Ponce de Leon Inlet	North Offshore
1974	433,751	Inlet/South Shoal	North Spit Breach Closure
1974	89,167	Ponce de Leon Inlet	North Beach
1975	138,009	Ponce de Leon Inlet	North Offshore
1976	12,515	Ponce de Leon Inlet	North Offshore
1976	137,936	Ponce de Leon Inlet	North Offshore
1978	40,821	Ponce de Leon Inlet	North Offshore
1978	434,558	Ponce de Leon Inlet	North Beach
1984	82,212	Ponce de Leon Inlet	North Beach
1985	899,996	Ponce de Leon Inlet	North Beach
1989	868,967	Ponce de Leon Inlet	North Beach
1994	214,700	IWW	North Bank
1999	32,000	IWW	South Beach Nearshore
2005	115,339	Ponce de Leon Inlet	North Beach
2006	745,000	DMMA (MSA 434/434C)	R-161 thru R-187 dunes
2008	432,073	IWW	South Beach Nearshore
2009	137,008	Ponce de Leon Inlet	North Beach
2011	30,000	Ponce de Leon Inlet	South Beach Nearshore
2012	51,160	Ponce de Leon Inlet	North Beach Nearshore
2013	141,600	Ponce de Leon Inlet	North Beach Nearshore
2014	46,170	Ponce de Leon Inlet	South Beach Nearshore
2015	130,215	Ponce de Leon Inlet	South Beach Nearshore
2017	34,850	Ponce de Leon Inlet	South Beach Nearshore
2018	16,080	Ponce de Leon Inlet	South Beach Nearshore
2019	410,047	Ponce de Leon Inlet and IWW	South Beach Nearshore
*2024**	*~585,000**	*DMMA (MSA 434/434C)*	*R-160.3 to R-191.5 dunes**
*2024**	*TBD**	*Ponce de Leon Inlet*	*North Beach**
Total *(excluding anticipated projects)*	**5,794,378**	-	-

**anticipated*

2.2 Survey History

2.2.1 Beach Profile Surveys

Volusia County, FDEP, and USACE sponsor the collection of beach profile data throughout the County. **Table 2.2** summarizes the timeline for the 24 beach profile datasets available through FDEP's Beach Profile Network; it should be noted that the survey extents vary, and some surveys are limited (every third monument, wading depth, etc.). The 2019 survey acts as the baseline for this and future analyses simply due to it being the first in this annual monitoring effort. Appendix A contains beach profile plots of the 2019, 2022, 2022 post-Nicole, and 2023 survey data for each monument throughout the study area.

Notably, the seaward extent of the USACE JALBTCX post-Nicole LiDAR data collected in November 2022 is limited due to the LiDAR's penetration below the water surface and averages -6.4 ft NAVD88 across the examined profiles; the extent for each individual profile can be found in Appendix B. Throughout the County, only seven of the profiles extend slightly beyond the -15 ft-NAVD88 contour with none extending below -16 ft-NAVD88. Additionally, sharp changes in elevation are not captured well due to the resolution of the LiDAR and its' grid size—an example of where this may occur is at the landward extent of a profile where a seawall or pool is located. The August 2022 data set also has data gaps in the nearshore extending approximately 1,000 ft at T-149 and R-150; the profile in this area is depicted as a straight line and the volume estimates may be skewed.

Appendix B lists the monument locations, associated profile azimuths, and alongshore distances for each beach profile used in this study, along with the extent for each individual profile for the November 2022 post-Nicole data. These monuments are part of an extensive network of survey control points that FDEP (formerly the Florida Department of Natural Resources) established and has maintained since the early 1970s. FDEP currently maintains these monuments, which serve as consistent base points to originate beach profile surveys. For consistency, the MHW shoreline position analysis references the monument locations in Appendix B.

Table 2.2 FDEP Beach Profile Survey History

Dates	Monuments
June 1972	R-1 to R-234
July 1984	R-1 to R-234
September 1987	R-1 to R-234
June 1988	R-0 to R-234
May 1989	R-1 to R-234
August 1993	R-1 to R-234
February 1997	R-57 to R-207
June 2001	R-130 to R-165
August 2003	R-1 to R-234
August 2003	R-2 to R-234
May 2004	R-161 to R-193
November 2004	R-161 to R-193
November 2005	R-155 to R-195
September 2006	R-155 to R-195
October 2007	R-149 to R-229
December 2007	R-1 to R-148
October 2011	R-1 to R-169
September 2014	R-1 to R-209
June 2016[1]	R-0 to R-234
November 2016[1]	R-0 to R-234
July 2017	R-0 to R-234
September 2017[1]	R-0 to R-234
July 2019	R-0 to R-208
July 2020[2]	R-0 to R-208
October 2021[2]	R-0 to R-208
August 2022[2]	R-0 to R-208
November 2022 (Post-Nicole)[1]	R-0 to R-208
October 2023	R-0 to R-208

[1]Extracted from LiDAR data, limited offshore extent
[2]Interim Survey- collected data at all monuments in the inlet area of influence and every 3rd monument elsewhere

2.2.2 Ponce de Leon Inlet Surveys

Historically, Volusia County and USACE sponsor the collection of inlet bathymetric data at Ponce de Leon Inlet. **Table 2.3** summarizes the timeline for the seven inlet datasets available; notably, some of the surveys only include certain inlet features. Laurent, Craig, McClain, and Lamb (2022) analyze the two most recent datasets—2017 and 2022. The 2019 Sediment Budget Update (Trudnak, Laurent, and Craig, 2020) documents the changes within the inlet complex for the period from north jetty weir closure (1984)

to 2001 and 2017. The study notes the data extents of other datasets limited the hydrographic analysis. Trudnak and Srinivas (2003) presented comparisons between the 1986, 1994, and 2001 surveys; the report documented deficiencies in the 1993 and 1994 beach profile surveys that prohibited an accurate representation of the conditions.

Table 2.3 Ponce de Leon Inlet Survey History

Dates	Description	Surveyor
September 1986	Inlet	U.S. Coast and Geodetic Survey and USACE
April 1990	Inlet	U.S. Coast and Geodetic Survey and USACE
January 1992	Inlet Channel	USACE
July 1994	Inlet Channel	USACE
June 2001	Inlet, Flood Shoal, Ebb Shoal	Morgan & Eklund
August 2017	Inlet, Flood Shoal, Ebb Shoal	Morgan & Eklund
September 2022	Inlet, Flood Shoal, Ebb Shoal	Morgan & Eklund
August 2023	Inlet Channel	USACE

2.3 Tidal Datums

This study applied the MHW elevations defined by FDEP for the County (obtained via FDEP mhwrequest, personal communications, 2019). Notably, multiple MHW elevations span the County's expansive length of shoreline. **Table 2.4** presents the MHW elevation, referenced to NAVD88, and the associated stretch of shoreline as defined by FDEP and applied in this study.

Table 2.4 FDEP MHW Elevations for Volusia County

R-monument	Elevation (ft-NAVD88)
R-0 to R-20	+1.4
R-21 to R-80	+1.3
R-81 to R-163	+1.2
R-164 to R-234	+1.1

3.0 BEACH PROFILE SURVEY RESULTS

3.1 Overview

Project monitoring generally includes analyses to determine the evolution of beach fill over time. This analysis investigates two common beach evolution parameters— changes to the shoreline position and profile volume within the study area. Calculating the distance from a given point (the reference monument) to a known elevation tracks the change in shoreline position.

This analysis uses the MHW elevation, which varies from +1.1 to +1.4 ft-NAVD88 as described in Section 2.3 from north to south across the study area, to track the shoreline position. Changes to the MHW position between reference monument locations indicate gross scale spatial evolution of the beach (i.e., alongshore), while changes to these shoreline positions over time determine the temporal evolution of the beach profile (i.e., cross-shore).

Tracking volumes between reference monuments (spatially) and surveys (temporally) provides a historic perspective of the project's evolution and performance. The volume analysis for this report segregates cross-shore volumes into the following vertical compartments: dune to MHW, MHW to -15 ft-NAVD88, and below -15 ft-NAVD88 to the profile extent. Changes above MHW represent variations to the subaerial or dry beach— the area the public typically considers as the beach. Changes below MHW, also called subaqueous changes, indicate the volume remaining below the water surface and within the active profile. The MHW to -15 ft-NAVD88 compartment represents the most dynamic area with significant changes in the position and elevation of the offshore bar. Below -15 ft-NAVD88, bathymetry changes are usually less pronounced and historic profiles typically converge to common elevations.

Notably, specifying a finite depth of closure applicable across the entire monitoring domain proved difficult for this countywide dataset. The profiles become steeper (deeper offshore depths for a finite distance offshore) as the distance from the ebb shoal increases. Thus, for a set distance offshore, a flatter profile (closer to the ebb shoal) extends to a shallower depth than one further away from the ebb shoal. The profiles at R-150 to R-153, just south of the inlet, do not extend deeper than -20 ft-NAVD88, whereas many of the profiles further to the north and south extended beyond -40 ft-NAVD88 (see profile plots in Appendix A). The following volume analysis used the full data extents, applying the maximum offshore survey extent at each profile as the offshore limit of volume calculations.

As mentioned in Section 1.1, the County's beaches are divided into nine coastal communities; this monitoring report analyzes eight of the nine regions spanning from R-0 to R-208 and excludes Canaveral National Seashore. A weighted average procedure incorporates the alongshore (controlling) distance between monuments. This weighted average, applied to the MHW and volume analyses, establishes a comparative basis between alongshore segments of beach. In general, a monument's controlling distance extends between the halfway points of adjacent monuments. Exceptions to this rule occur at the north and south ends of the monitoring area and at Ponce de Leon Inlet. At R-0 and R-208, the controlling distances extend only halfway towards the adjacent monument within the monitoring area. Surrounding Ponce de Leon Inlet, the controlling distances extend to the adjacent jetty. Due to the nature of the interim

survey, the controlling distance outside of the inlet area of influence extends to halfway between the surveyed monuments (every third monument) for the 2022 survey.

The following shoreline and beach volume analyses compare the 2019, 2022, and 2022 post-Nicole surveys to the 2023 monitoring survey. Appendix A contains beach profile plots of the survey data at each monument within the study area.

3.2 Shoreline Positions

Changes in the MHW shoreline position demonstrate the alongshore and cross-shore evolution of the beach monitoring area. Viewing MHW shoreline positions on recent aerial photographs of the monitoring area provides a convenient way to qualitatively evaluate the evolution and performance of the beach. As presented in Appendix C, Taylor Engineering overlaid the July 2019, August 2022, November 2022, and October 2023 MHW shorelines on aerial photography of the County. The MHW lines derive from the contour positions along the monument profiles; straight lines connect the contour positions between monuments. The figures also include the coastal construction control line (CCCL).

Appendix D presents the MHW shoreline positions as a function of distance from each monument for the July 2019, August 2022, November 2022, and October 2023 conditions and the MHW shoreline position changes between the three surveys. A positive value represents seaward shoreline advance while a negative value represents landward shoreline retreat.

Table 3.1 summarizes the weighted average shoreline change results for each Volusia County coastal community. A weighted average procedure incorporates the alongshore (controlling) distance between monuments. This weighted average, applied to the MHW shoreline analysis, establishes a comparative basis between alongshore segments of beach. In general, a monument's controlling distance extends between the halfway points of adjacent monuments—exceptions to this rule occur at the north and south ends of the project area and inlet as discussed above.

3.2.1 2019 Baseline Condition (July 2019) versus 2023 Condition (October 2023)

The comparison of the average 2019 MHW shoreline position and 2023 MHW shoreline position indicates significant shoreline retreat throughout Volusia County with extreme retreat occurring from Daytona Beach and Daytona Beach Shores to Ponce Inlet. Of note, Hurricane Ian (September 2022) and Hurricane Nicole (November 2022) induced catastrophic erosion throughout the County, including the loss of infrastructure and large portions of the existing protective dune system (Laurent, 2023; Taylor Engineering, 2023). Similar to what was reported for the 2019-2020, 2019-2021, and 2019-2022 comparisons (Laurent, Lamb, and Schedel, 2020; Laurent, Lamb, and Schedel, 2021; Laurent, Craig, McClain, and Lamb, 2022), Daytona Beach and Daytona Beach Shores experienced the greatest shoreline retreat since 2019, averaging 105 ft of retreat across these communities. To the south of Daytona Beach, extreme retreat is also observed at Wilbur-by-the Sea (-92 ft) and Ponce Inlet (-72 ft). Overall, the MHW shoreline position retreated an average of 57 ft across the County.

3.2.2 2022 Condition (August 2022) versus 2023 Condition (October 2023)

Similar to the comparison of the 2019 shoreline position to the 2023 shoreline position, the comparison of the 2022 MHW shoreline position and 2023 MHW shoreline position reveals net retreat occurred in all communities. Moderate shoreline retreat averaging 10 ft occurred at the County's northernmost community, North Peninsula. Significant to extreme shoreline retreat occurred in all communities south of and including Ormond-by-the-Sea. Again, the Daytona Beach and Daytona Beach Shores, Wilbur-by-the-Sea, and Ponce Inlet communities experienced the greatest shoreline retreat in the past year, averaging 92 ft, 125 ft, and 82 ft, respectively. Notably, these communities primarily consist of seawalls immediately upland from the beach, and many seawall failures occurred as a result of the 2022 hurricane season. Overall, the MHW shoreline position retreated an average of 63 ft across the County.

3.2.3 2022 Post-Nicole Condition (November 2022) versus 2023 Condition (October 2023)

Although the previous two comparisons reveal significant recession throughout the County due to the catastrophic erosion caused by Hurricanes Ian and Nicole, the comparison of the 2022 post-Nicole MHW shoreline position and 2023 MHW shoreline position shows that average community advancement occurred across all communities indicating seaward movement of the MHW contour and post-storm recovery of the beach. The largest average community advance observed occurred in Daytona Beach and Daytona Beach Shores (51 ft), Wilbur-by-the-Sea (56 ft), and Ponce Inlet (62 ft); however, evident in previous comparison periods, the shoreline retreat and storm-induced erosion of the beach outweighs the recent shoreline advance. Overall, the MHW shoreline position advanced an average of 37 ft across the entire County.

Table 3.1 Average MHW Shoreline Change by Community

Community	FDEP Reference Monuments	MHW Elevation Range (feet - NAVD88)	Average MHW Shoreline Change (feet) July 2019- October 2023	Average MHW Shoreline Change (feet) August 2022 – October 2023	Average MHW Shoreline Change (feet) November 2022 – October 2023
North Peninsula	R-0 to R-16	+1.4	-26	-10	20
Ormond-by-the-Sea	R-16 to R-47	+1.4 to +1.3	-31	-29	18
Ormond Beach	R-47 to T-67	+1.3	-44	-41	27
Daytona Beach and Daytona Beach Shores	T-67 to R-122	+1.3 to +1.2	-105	-92	51
Wilbur-by-the-Sea	R-122 to R-128	+1.2	-92	-125	56
Ponce Inlet	R-128 to R-148	+1.2	-72	-82	62
New Smyrna Beach	R-149 to R-185	+1.2 to +1.1	-35	-67	44
Silver Sands and Bethune Beach	R-185 to T-208	+1.1	-21	-58	10
Volusia County Study Area	**R-0 to T-208**	**+1.4 to +1.1**	**-57**	**-63**	**37**

3.3 Beach Volume Changes

As discussed in Section 3.1, beach volume changes indicate beach evolution and performance. Taylor Engineering calculated volume changes at each monument location within the following vertical compartments: dune to MHW, MHW to -15 ft-NAVD88, and below -15 ft-NAVD88 (extending offshore to the maximum common survey extent at each monument for each survey comparison). The total volume above MHW represents the subaerial or dry beach, while below MHW changes represent the subaqueous portion of the beach.

Appendix E presents beach volume changes (presented in cy and cy/ft units) on a monument-by-monument basis for each volume compartment. **Table 3.2** through **Table 3.4** provides an overview of the weighted average volume change by community presented in units of cubic yards per foot of shoreline (cy/ft), and **Table 3.5** through **Table 3.7** presents the values in cubic yards (cy). Of note, extending the volume calculations offshore to the maximum common survey extent at each monument for each survey comparison, as opposed to limiting the calculations to a consistent distance offshore (e.g., 3,000 ft offshore), results in volume changes that reflect the available data to the greatest degree possible.

Data shortcomings that should be noted include the offshore extent of the November 2022 post-Hurricane Nicole LiDAR data (Appendix B) and data gaps in the August 2022 monitoring data at T-149 and R-150 in the nearshore. Due to the limited extent of the November 2022 data, the volume changes are calculated between only above and below MHW. These data limitations are further detailed in Section 2.2.1.

3.3.1 2019 Baseline Condition (July 2019) versus 2023 Condition (October 2023)

The 2019 to 2023 volume change analysis documents the countywide beach volume changes over the past four years. Notably, and as previously discussed, Hurricane Ian and Hurricane Nicole induced catastrophic erosion to the beach and nearshore throughout the County during the 2022 hurricane season. Looking on a county-wide scale, the County experienced an average net accretion of 42.1 cy/ft. Significant sediment accretion occurred beyond the -15 ft-NAVD88 contour, averaging 59.9 cy/ft. Moderate erosion occurred above -15 ft-NAVD88 with the volume compartment above MHW eroding 8.2 cy/ft on average and between MHW and -15 ft-NAVD88 eroding 9.5 cy/ft on average.

Looking on a monument-by-monument basis indicates that the subaerial beach volumes fluctuate between minor to moderate erosion at nearly all monuments throughout the communities north of the inlet. Similar to the shoreline position changes, increased erosion occurred in portions of Daytona Beach and Daytona Beach Shores and throughout Wilbur-by-the-Sea and Ponce Inlet. Volume changes above MHW to the south of the inlet indicate minor to moderate erosion and accretion occurred throughout the communities. Below MHW and above -15 ft-NAVD88, mixed erosion and accretion occurred. The largest stretch of erosion occurred in the Wilbur-by-the-Sea and Ponce Inlet communities, while the largest stretch of accretion occurred in the New Smyrna Beach community. Beyond the -15 ft-NAVD88 contour accretion occurred at nearly all monuments; the most significant sediment gain is observed just north of

the Ponce de Leon Inlet in the Wilbur-by-the-Sea and Ponce Inlet communities. Evident in the profile plots (Appendix A), the sediment gain experienced beyond -15 ft-NAVD88 is likely a result of the shifting and redistribution of offshore sandbars and the redistribution of eroded material from the subaerial and nearshore beach as a result of the 2022 hurricane season.

Looking across the monitoring area for the 2019-2023 period, accretion controlled throughout the County. Minor to moderate erosion controlled the comparison period above the -15 ft-NAVD88 contour; however, significant accretion beyond the -15 ft-NAVD88 contour outweighed the erosion experienced in the subaerial and nearshore beach.

3.3.2 2022 Condition (August 2022) versus 2023 Condition (October 2023)

The 2022 to 2023 volume change analysis documents the countywide beach volume changes over the past year, including the impacts due to Hurricanes Ian and Nicole. On a county-wide scale, the County experienced a net erosion of 12.4 cy/ft. Much of the sediment loss occurred between MHW and the -15 ft-NAVD88 contour (-43.9 cy/ft). Above MHW erosion controlled averaging -10.6 cy/ft, while below the -15 ft-NAVD88 contour accretion controlled averaging 42.2 cy/ft.

Taking a closer look at the data reveals that above MHW erosion trends fluctuate between minor and moderate erosion throughout most of the County; again, increased erosion occurs in the southern portion of Daytona Beach and Daytona Beach Shores and south through New Smyrna Beach. Below MHW and above -15 ft-NAVD88, moderate to major erosion occurred at nearly all monuments, with the most significant erosion occurring in North Peninsula, Ormond Beach, and Wilbur-by-the-Sea. The erosion experienced above -15 ft-NAVD88 reflects the erosion experienced as a result of Hurricanes Ian and Nicole. Oppositely, beyond the -15 ft-NAVD88 contour moderate to major accretion occurred at nearly all monuments as the sediment was redistributed. The largest offshore accretion occurred in Wilbur-by-the-Sea and Ponce Inlet, two areas which experienced significant erosion above -15 ft-NAVD88.

Analyzing the profile extent for the 2022-2023 period, north of the inlet volumes fluctuate between erosion and accretion. Erosion controlled at the majority of the monuments from North Peninsula through Daytona Beach and Daytona Beach Shores while accretion dominated in Wilbur-by-the-Sea and Ponce Inlet. To the south of the inlet significant erosion controlled the comparison period.

3.3.3 2022 Post-Nicole Condition (November 2022) versus 2023 Condition (October 2023)

The 2022 post-Nicole to 2023 volume change analysis documents the countywide beach volume changes and recovery in the months following Hurricanes Ian and Nicole. During this time, the County experienced net accretion averaging 14.9 cy/ft. Notably, the volume analysis for this comparison period is limited to an average extent of -6.4 ft NAVD88 and does not include the significant offshore movement witnessed in the previous two comparisons. The seaward extent is limited due to the resolution of the USACE JALBTCX post-Nicole LiDAR data; the extent for each individual profile can be found in Appendix B. As previously mentioned, there are some locations where sharp elevation changes are not well captured

due to the resolution of the LiDAR data. Primarily accretion is witnessed across the profiles with the volume compartment above MHW gaining 6.3 cy/ft and the volume compartment between MHW and the profile extent gaining 8.6 cy/ft.

Taking a closer look at each community, the subaerial beach trends fluctuate between minor erosion and minor to moderate accretion throughout the County. The largest stretch of accretion occurs from R-86 in the Daytona Beach and Daytona Beach Shores community to R-191 in the Silver Sands and Bethune Beach community. Between MHW and the profile extents, accretion occurred throughout majority of the County with erosion at few monuments. Increased accretion occurred at the southernmost monuments in the Daytona Beach and Daytona Beach Shores community and to the south throughout the rest of the County. Due to the limited seaward extent of the post-Nicole LiDAR data, very few profiles extend to or beyond the -15 ft-NAVD88 contour and are not included within this summary. The total changes indicate minor to moderate accretion occurred in the past year following Hurricane Nicole within all communities suggesting post-storm natural recovery of the beach. Notably, the recovery observed since November 2022 compared to the losses observed since August 2022, indicate not all of the beach has recovered and we do not anticipate a full natural recovery of sediment due to the offshore redistribution of sediment.

Table 3.2 Average Volume Change by Community – July 2019-October 2023 (cubic yards/foot)

Community	FDEP Reference Monuments	July 2019-October 2023 Average Volume Change (cubic yards/foot) Dune to MHW	July 2019-October 2023 Average Volume Change (cubic yards/foot) MHW to -15 feet-NAVD88	July 2019-October 2023 Average Volume Change (cubic yards/foot) Below -15 feet-NAVD88	July 2019-October 2023 Average Volume Change (cubic yards/foot) Total
North Peninsula	R-0 to R-16	-6.1	-14.0	50.6	30.5
Ormond-by-the-Sea	R-16 to R-47	-5.1	-14.3	59.0	39.6
Ormond Beach	R-47 to T-67	-5.0	-17.0	61.8	39.8
Daytona Beach and Daytona Beach Shores	T-67 to R-122	-10.0	-6.1	63.8	47.7
Wilbur-by-the-Sea	R-122 to R-128	-13.5	-19.0	89.5	57.0
Ponce Inlet	R-128 to R-148	-21.0	-19.8	106.6	65.8
New Smyrna Beach	R-149 to R-185	-7.1	-0.6	26.5	18.7
Silver Sands and Bethune Beach	R-185 to T-208	-1.2	-3.8	59.1	54.1
Volusia County Study Area	R-0 to T-208	-8.2	-9.5	59.9	42.1

*profile extent varies by monument due to limited seaward extent of post-Nicole LiDAR data (see Appendix B)

Table 3.3 Average Volume Change by Community – August 2022-October 2023 (cubic yards/foot)

Community	FDEP Reference Monuments	August 2022-October 2023 Average Volume Change (cubic yards/foot) Dune to MHW	August 2022-October 2023 Average Volume Change (cubic yards/foot) MHW to -15 feet-NAVD88	August 2022-October 2023 Average Volume Change (cubic yards/foot) Below -15 feet-NAVD88	August 2022-October 2023 Average Volume Change (cubic yards/foot) Total
North Peninsula	R-0 to R-16	-5.0	-49.9	42.8	-12.0
Ormond-by-the-Sea	R-16 to R-47	-7.8	-42.2	43.2	-6.8
Ormond Beach	R-47 to T-67	-5.8	-51.2	56.4	-0.5
Daytona Beach and Daytona Beach Shores	T-67 to R-122	-11.7	-45.8	52.5	-4.9
Wilbur-by-the-Sea	R-122 to R-128	-15.9	-49.1	71.0	6.0
Ponce Inlet	R-128 to R-148	-18.6	-40.9	78.0	18.5
New Smyrna Beach	R-149 to R-185	-13.3	-34.4	4.6	-43.1
Silver Sands and Bethune Beach	R-185 to T-208	-7.5	-47.6	22.7	-32.4
Volusia County Study Area	R-0 to T-208	-10.6	-43.9	42.2	-12.4

*profile extent varies by monument due to limited seaward extent of post-Nicole LiDAR data (see Appendix B)

Table 3.4 Average Volume Change by Community – November 2022-October 2023 (cubic yards/foot)

Community	FDEP Reference Monuments	November 2022-October 2023 Average Volume Change (cubic yards/foot) Dune to MHW	November 2022-October 2023 Average Volume Change (cubic yards/foot) MHW to -15 feet-NAVD88	November 2022-October 2023 Average Volume Change (cubic yards/foot) Below -15 feet-NAVD88	November 2022-October 2023 Average Volume Change (cubic yards/foot) Total
North Peninsula	R-0 to R-16	4.4	3.0	-	7.4
Ormond-by-the-Sea	R-16 to R-47	2.9	5.0	-	7.9
Ormond Beach	R-47 to T-67	6.9	0.6	-	7.5
Daytona Beach and Daytona Beach Shores	T-67 to R-122	7.5	4.8	-	12.3
Wilbur-by-the-Sea	R-122 to R-128	7.1	22.9	-	29.9
Ponce Inlet	R-128 to R-148	10.9	14.1	-	25.0
New Smyrna Beach	R-149 to R-185	8.2	14.4	-	22.6
Silver Sands and Bethune Beach	R-185 to T-208	1.4	15.7	-	17.1
Volusia County Study Area	R-0 to T-208	6.3	8.6	-	14.9

*profile extent varies by monument due to limited seaward extent of post-Nicole LiDAR data (see Appendix B)

Table 3.5 Volume Change by Community- July 2019-October 2023 (cubic yards)

Community	FDEP Reference Monuments	July 2019-October 2023 Average Volume Change (cubic yards) Dune to MHW	July 2019-October 2023 Average Volume Change (cubic yards) MHW to -15 feet-NAVD88	July 2019-October 2023 Average Volume Change (cubic yards) Below -15 feet-NAVD88	July 2019-October 2023 Average Volume Change (cubic yards) Total
North Peninsula	R-0 to R-16	-90,500	-207,900	751,400	453,100
Ormond-by-the-Sea	R-16 to R-47	-148,900	-415,400	1,711,200	1,146,800
Ormond Beach	R-47 to T-67	-95,000	-323,900	1,174,100	755,200
Daytona Beach and Daytona Beach Shores	T-67 to R-122	-520,900	-316,400	3,316,300	2,479,000
Wilbur-by-the-Sea	R-122 to R-128	-77,800	-109,600	515,500	328,100
Ponce Inlet	R-128 to R-148	-402,500	-379,100	2,040,800	1,259,200
New Smyrna Beach	R-149 to R-185	-241,500	-20,800	897,600	635,400
Silver Sands and Bethune Beach	R-185 to T-208	-26,400	-81,600	1,280,900	1,172,900
Volusia County Study Area	R-0 to T-208	-1,603,500	-1,854,800	11,687,900	8,229,600

Table 3.6 Volume Change by Community- August 2022-October 2023 (cubic yards)

Community	FDEP Reference Monuments	August 2022-October 2023 Average Volume Change (cubic yards) Dune to MHW	August 2022-October 2023 Average Volume Change (cubic yards) MHW to -15 feet-NAVD88	August 2022-October 2023 Average Volume Change (cubic yards) Below -15 feet-NAVD88	August 2022-October 2023 Average Volume Change (cubic yards) Total
North Peninsula	R-0 to R-16	-73,600	-739,800	635,100	-178,300
Ormond-by-the-Sea	R-16 to R-47	-226,400	-1,221,800	1,251,200	-197,000
Ormond Beach	R-47 to T-67	-109,300	-971,800	1,071,200	-9,900
Daytona Beach and Daytona Beach Shores	T-67 to R-122	-606,600	-2,380,800	2,731,000	-256,400
Wilbur-by-the-Sea	R-122 to R-128	-91,700	-282,400	408,800	34,600
Ponce Inlet	R-128 to R-148	-356,500	-783,100	1,493,600	354,000
New Smyrna Beach	R-149 to R-185	-452,500	-1,165,300	155,400	-1,462,400
Silver Sands and Bethune Beach	R-185 to T-208	-162,900	-1,030,400	491,900	-701,400
Volusia County Study Area	R-0 to T-208	-2,079,600	-8,575,400	8,238,100	-2,416,900

Table 3.7 Volume Change by Community-November 2022-October 2023 (cubic yards)

Community	FDEP Reference Monuments	November 2022-October 2023 Average Volume Change (cubic yards) Dune to MHW	November 2022-October 2023 Average Volume Change (cubic yards) MHW to -15 feet-NAVD88	November 2022-October 2023 Average Volume Change (cubic yards) Below -15 feet-NAVD88	November 2022-October 2023 Average Volume Change (cubic yards) Total
North Peninsula	R-0 to R-16	65,000	44,600	-	109,600
Ormond-by-the-Sea	R-16 to R-47	84,600	144,300	-	228,900
Ormond Beach	R-47 to T-67	131,800	11,200	-	143,100
Daytona Beach and Daytona Beach Shores	T-67 to R-122	389,400	249,000	-	638,300
Wilbur-by-the-Sea	R-122 to R-128	40,700	131,700	-	172,400
Ponce Inlet	R-128 to R-148	208,800	269,000	-	477,900
New Smyrna Beach	R-149 to R-185	278,700	487,500	-	766,100
Silver Sands and Bethune Beach	R-185 to T-208	30,200	339,700	-	369,900
Volusia County Study Area	R-0 to T-208	1,229,200	1,677,100	-	2,906,300

4.0 SUMMARY

This monitoring report presents the results of a countywide beach profile analysis based on a survey conducted during late summer- early fall of 2023 to characterize Volusia County's beach evolution. Between November 2022 and October 2023, beach recovery following Hurricanes Ian and Nicole occurred throughout Volusia County, resulting in primarily minor to moderate shoreline advance and accretion of sediment across the subaerial and nearshore portions of the beach. Prior to the October 2023 survey, two major storm events, Hurricane Ian and Hurricane Nicole, impacted the County in 2022 and induced significant erosion to the County's shoreline. Comparison of the 2019 to 2023 and 2022 to 2023 survey data indicates significant storm-induced erosion above the -15 ft-NAVD88 contour, with accretion of sediment occurring beyond -15 ft-NAVD88. The post-Nicole to 2023 comparison indicated the beaches are recovering from the passing of Hurricanes Ian and Nicole, with shoreline advance and mild to moderate accretion on the subaerial and subaqueous beach controlling the trends.

Based on the analysis presented herein, the subaerial and subaqueous beaches throughout the County suffered significant erosion due to Hurricanes Ian and Nicole with increased erosion occurring in the communities in the vicinity of the inlet. Although post-storm recovery and onshore movement of sediment occurred in the past year, the 2022 storm season brought significant events which eroded the shoreline, and it is unlikely that all the material which was redistributed beyond -15 ft-NAVD88 will make its way back onshore. Taylor Engineering recommends the creation of robust beach management strategies and a coastal risk analysis for the Volusia County beachfront communities.

We recommend the County continue to monitor its beaches to establish a record of erosion and accretion trends, and to document the effects of storms. A longer monitoring period is recommended to better document the long-term changes to the County's beaches, monitor for future events, and help better understand the effects of nearshore placement events. Taylor Engineering suggests the County continue their beach and inlet monitoring plan which consists of a complete county-wide beach and inlet survey every five years and interim beach surveys annually.

REFERENCES

Florida Department of Environmental Protection (FDEP). 2020a. *Ponce de Leon Inlet Management Plan.* Tallahassee, FL.

Florida Department of Environmental Protection (FDEP). 2020b. *Strategic Beach Management Plan: Northeast Atlantic Coast Region*. Tallahassee, FL.

Florida Department of Environmental Protection (FDEP). 2023. *Critically Eroded Beaches in Florida*. FDEP, Office of Resilience and Coastal Protection. Tallahassee, FL.

Hall, J. and Krecic, M. 2007. *New Smyrna Beach Emergency Dune Restoration Project, Post-Construction Monitoring Report*. Taylor Engineering, Inc. Jacksonville, FL.

Laurent, W. K. and Trudnak, M.E. 2019. *Volusia County Countywide Beach Profile Survey 2019*. Taylor Engineering, Inc. Jacksonville, FL.

Laurent, W. K., Lamb, N., and Schedel, A. 2020. *Volusia County Interim Countywide Beach Profile Survey 2020*. Taylor Engineering, Inc. Jacksonville, FL.

Laurent, W. K., Lamb, N., and Schedel, A. 2021. *Volusia County Interim Countywide Beach Profile Survey 2021*. Taylor Engineering, Inc. Jacksonville, FL.

Laurent, W. K., Craig, K. R., McClain, N., and Lamb, N. 2022. *Volusia County Interim Countywide Beach Profile and Inlet Survey 2022*. Taylor Engineering, Inc. Jacksonville, FL.

Laurent, W. K. 2023. *Volusia County Beach Monitoring – 2022 Hurricane Season*. Taylor Engineering, Inc. Jacksonville, FL.

Taylor Engineering, Inc. 2003. *Sediment Budget Update Ponce DeLeon Inlet and Adjacent Beaches.* Taylor Engineering, Inc. Jacksonville, FL.

Taylor Engineering, Inc. 2023. *Volusia County Post Hurricane Nicole FEMA Analysis.* Taylor Engineering, Inc. Jacksonville, FL.

Taylor, R.B. and Yanez, M.A. 1994*. Ponce de Leon Inlet Management Plan*. Taylor Engineering, Inc. Jacksonville, FL.

Trudnak, M. 2023. *Permit 0428162-001-JC Modification Request – Rattlesnake Island Offloading*. INTERA – GEC. Gainesville, FL.

Trudnak, M.E., Laurent, W. K., and Craig, K. 2020. *Ponce de Leon Sediment Budget Update*. Taylor Engineering, Inc. Jacksonville, FL.

Trudnak, M.E. and Srinivas, R. 2003. *Volusia County Erosion Assessment Study for Shorelines South of Ponce De Leon Inlet to Canaveral National Seashore*. Taylor Engineering, Inc. Jacksonville, FL.