St. Johns County
Coastal Storm Risk Management Project

South Ponte Vedra and Vilano Beach
2021 Post-Construction Physical Monitoring Report

FDEP Permit File No. 0377120-001-JC
October 2021

US Army Corps of Engineers
Jacksonville District

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1.0 INTRODUCTION

This document is the first in a series of post-construction physical monitoring reports that details the St. Johns County Coastal Storm Risk Management (CSRM) Nourishment Project in South Ponte Vedra and Vilano Beach. The information in this report assesses the pre- and post-construction conditions of the most recent CSRM nourishment project that began on 08 October 2020 and completed on 05 February 2021 (denoted '2021 CSRM nourishment project' herein for brevity). This report was prepared for the project's non-Federal Sponsor, St. Johns County, and for the Florida Department of Environmental Protection (FDEP) in accordance with the physical monitoring requirements outlined in FDEP Permit File No. 0377120-001-JC and detailed in the associated Physical Monitoring Plan (PMP; USACE, 2020a).

1.1 Project and Physical Monitoring Overview

The project area is in St. Johns County, Florida, where sand nourishment was placed along South Ponte Vedra and Vilano Beach with sediment from borrow sources within the St. Augustine Inlet's flood tidal delta system. The Federal CSRM nourishment project's placement area spans 2.6 miles from the FDEP Reference Monument (R-Monument) R-103.5 south to R-116.5 plus 1,000-foot (foot or feet abbreviated ft herein) tapers to the north and south of the project area (to roughly R-102.5 to the north and R-117.5 to the south). Beach-compatible sediment was hydraulically dredged from five segments within three flood shoal borrow areas that span from the Tolomato River south to Salt Run within the St. Augustine Inlet's flood tidal delta: (1) North Flood Shoal A; (2) North Flood Shoal B; (3) the Intracoastal Waterway (IWW) Widener; (4) Davis Shoal A; and (5) Davis Shoal B. FDEP Permit File No. 0377120-001-JC authorizes dredging sediment from a portion of the Atlantic IWW Channel and a portion of the St. Augustine Inlet's Ebb Shoal. However, these sources are not documented in this report since they were not used in the 2021 CSRM nourishment project.

Table 1 summarizes the data collection efforts required by (and detailed in) the PMP. These include beach profile surveys from R-98 to R-122C, borrow area surveys encompassing the St. Augustine Inlet's tidal delta complex (including any portion of the IWW utilized as a sand source for the project), post-construction beach sand sampling and laboratory testing, and the production of reports detailing the findings of these efforts. Although the PMP only specifies collecting beach profile surveys within and north of the St. Augustine Inlet from R-98 to R-122C, this report analyzes pre- to post-construction physical beach changes from R-80 to T-157 for two main reasons: (1) applicable beach profile survey data was readily available (Table 3), and (2) to better understand the entire beach-inlet complex since there are now two 50-year Federal nourishment projects that take sand from the inlet shoals and place sediment to northern and southern beaches within these extents. Figure 1 shows this area segmented from north to south as follows: the north control area, the fill placement area, the south control area, Porpoise Point within the St. Augustine Inlet, St. Augustine Beach, and the St. Augustine Inlet's flood tidal delta borrow areas. Figure 2 displays the five segments within the three borrow areas and the fill placement area. For simplicity, this monitoring report considers R-103 to R-117 as the alongshore analysis range for the project area; and this report considers Anastasia State Park (southerly adjacent to the St. Augustine Inlet) within St. Augustine Beach for reporting brevity.

Table 1. Physical Monitoring Schedule (PMP, 2020a)

Monitoring Event	Beach Profile Surveys	Borrow Area Surveys	Beach Sand Sampling	Engineering Report
Pre-Construction	X	X		
Post-Construction	X	X	X	X
Year 1	X			X
Year 2	X	X		X
Year 3	X			X
Year 4				
Year 5	X			X

Note: This schedule continues biennially until the next beach nourishment event or the expiration of the project design life, whichever comes first. The biennial monitoring elements match those identified for Year 5.

Figure 1. St. Johns County CSRM Nourishment Project and Associated Monitoring Areas

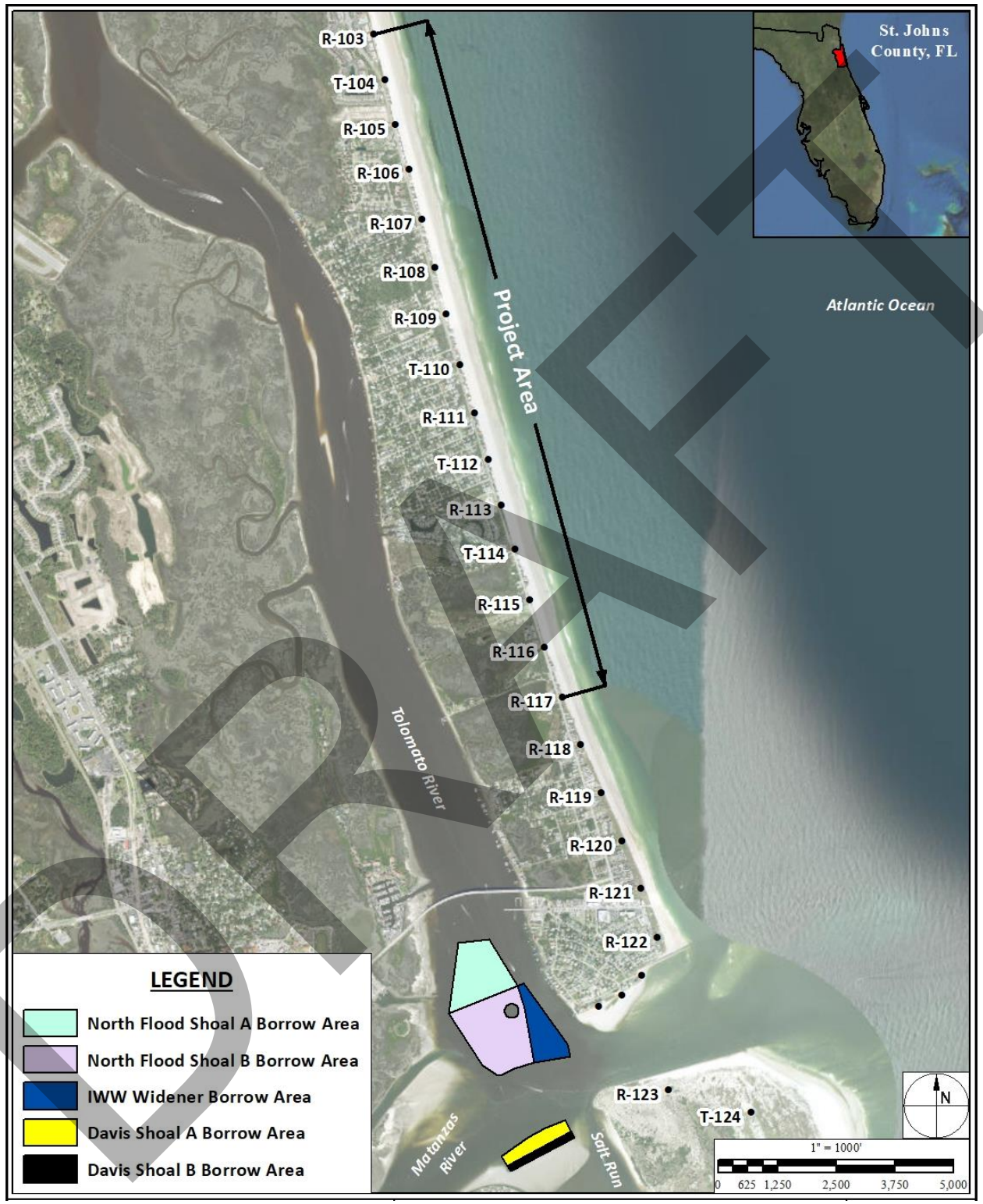

Figure 2. St. Johns County CSRM Nourishment Project's Borrow and Fill Locations

2.0 BACKGROUND INFORMATION AND RELEVANT MONITORING DATA

2.1 Brief Monitoring Area History

The 15.3-mile-long span of beach from South Ponte Vedra Beach at R-80 to St. Augustine Beach at T-157 has experienced drastic physical changes in the last century. This area's dynamics are significantly influenced by the St. Augustine Inlet, which is a stabilized navigation channel that was relocated in 1940 from roughly R-141/R-142 to its current location between R-122 and R-123. Once a naturally meandering channel that migrated along the open coast over time, the St. Augustine Inlet is now a mixed-energy, shallow-draft navigation channel with a terminal groin to the north and a jetty to the south. Since the inlet's relocation in 1940 (which is still the inlet's current location), the former ebb tidal shoal has migrated onshore and formed Anastasia Island (Taylor Engineering, 1994), and past US Army Corps of Engineers (USACE) studies (USACE, 1979 and USACE, 2017) estimate approximately 50% of beach erosion south of the inlet has occurred due to impacts from the 1940 Federal navigation channel's construction. USACE (2012a) documents how the inlet is currently acting as a sediment sink, and USACE (2017) reports that the shoreline from R-84 to R-122 eroded by an average of -1.8 ft per year from 1972 to 2015.

Multiple inlet maintenance dredging projects and four St. Johns County Shore Protection Project (SPP) nourishments have placed sand on the beach within the monitoring area with sand from St. Augustine Inlet's tidal delta shoals over the past two decades. The initial construction of the St. Johns County SPP was completed in 2003 and placed approximately 4.2 million cubic yards (mcy) of beach-compatible material along 3.7 miles of shoreline from T-132 to R-151 in St. Augustine Beach. The first SPP nourishment project concluded in 2005 and deposited approximately 2.8 mcy from R-137A to R-151. The second SPP nourishment project concluded in 2012 and put around 2.1 mcy of beach-compatible material on the beach from R-139 to R-147. Sediment from the inlet's interior navigation channel and IWW was placed in Anastasia State Park in fall 2012 and winter 2013. Approximately 280,000 cubic yards (cy) of sand from inlet maintenance dredging operations were placed in Vilano Beach from R-113 to R-117 in summer 2015 and summer 2017, and the most recent SPP nourishment project that concluded in 2018 deposited approximately 750,000 cy on St. Augustine Beach from R-139.7 to R-144.4 (Taylor Engineering, 2020). All these events, plus the initial construction of the St. Johns County CSRM nourishment project, aim to combat the St. Johns County shoreline retreat and provide sediment volume to the depleted coastline within the monitoring area.

2.2 Survey History

Topographic data (terrain elevation data above sea level) and bathymetric data (sea floor elevation data below sea level) are vital to understanding coastal processes. Beach profile survey data are collected along an azimuth, generally oriented perpendicular to the shoreline, and measured from a set benchmark within the upland portion of the coastal zone. Borrow area survey data are typically collected from a vessel that traverses along similar equidistance lines that tie-in to a set benchmark on dry land. These data help to provide an understanding of borrow area and beach morphodynamics, particularly after dredging and fill placement activities. Section 2.2.1 details the beach profile survey history for the monitoring area and Section 2.2.2 discusses the bathymetric surveys collected over the past two decades.

2.2.1 Beach Profile Surveys

Table 2 lists the R-monuments within the monitoring area from R-80 to T-157 that provide the basis for almost all beach profile survey data collected over the past two decades in this area. These surveys were collected or commissioned by various entities such as the FDEP, the USACE, and St. Johns County. Figure

1 displays this area, which includes South Ponte Vedra Beach and Vilano Beach north of the St. Augustine Inlet, Porpoise Point inside the St. Augustine Inlet, and St. Augustine Beach south of the St. Augustine Inlet. As mentioned in Section 1.1, the official project design extents range from R-103.5 to R-116.5 plus 1,000 ft tapers north and south of the design template extremes. However, this report uses R-103 to R-117 as the 'project area' for monitoring analyses. Thus, the northern extent of the beach monitoring area includes nearly all South Ponte Vedra Beach from R-80 south to R-102 (South Ponte Vedra Beach officially extends to T-104), which is denoted the 'north control area' for reporting purposes. The south control area spans roughly 1.1 miles from R-118 south to the terminal groin that stabilizes the north shore of the St. Augustine Inlet at R-122. Porpoise Point lies within the inlet on the south-facing shoreline from R-122A west to R-122C. Finally, the 6.4 miles of beach south of the St. Augustine Inlet from R-123 to T-157 includes Anastasia State Park and St. Augustine Beach. The monitoring area south of the inlet is simply represented as 'St. Augustine Beach' in this report for brevity.

Table 3 summarizes the beach profile data collected by various surveyors over the past 17 years within the monitoring area, but only beach profile survey data that encompassed some or all the St. Johns County CSRM nourishment project area are included in this table. The survey data that are compared in this report include the two most recent surveys: the August 2020 survey from R-80 to T-157 is considered the pre-construction survey and labeled '2021 pre-construction' throughout this report, and the March 2021 survey covering the same alongshore extent is represented as the post-construction survey and labeled '2021 post-construction' throughout this report.

Table 2. FDEP R-Monument Locations and Orientation

Area Description	FDEP R-Monument	Northing (ft)[1]	Easting (ft)[1]	Azimuth (°N)[2]	Elevation (ft-NAVD)
North Control Area	R-80	2,071,589.43	553,221.69	75	13.21
	R-81	2,070,504.14	553,451.43	75	15.71
	R-82	2,069,511.51	553,687.17	75	12.11
	R-83	2,068,459.47	553,869.00	75	16.81
	R-84	2,067,396.82	554,120.03	75	14.61
	R-85	2,066,379.28	554,356.02	75	15.61
	R-86	2,065,377.36	554,556.60	75	17.31
	R-87	2,064,355.48	554,819.38	75	18.91
	R-88	2,063,334.80	555,042.04	75	17.81
	R-89	2,062,398.22	555,233.72	75	17.01
	R-90	2,061,397.66	555,472.63	75	15.51
	R-91	2,060,368.98	555,664.56	75	18.21
	R-92	2,059,333.59	555,876.17	75	14.01
	R-93	2,058,361.01	556,112.12	75	13.51
	R-94	2,057,355.72	556,301.45	75	21.81
	R-95	2,056,383.43	556,495.90	75	19.11
	R-96	2,055,374.38	556,760.02	75	15.21
	R-97	2,054,378.39	557,002.40	75	23.51

	R-98	2,053,382.52	557,200.08	75	24.71
	R-99	2,052,355.00	557,425.03	75	23.61
	R-100	2,051,340.16	557,661.96	75	17.61
	R-101	2,050,324.66	557,879.74	75	18.31
	R-102	2,049,348.97	558,103.42	75	24.51
Project Area (South Ponte Vedra and Vilano Beach)[3]	R-103	2,048,381.47	558,321.91	75	18.11
	T-104	2,047,420.02	558,557.68	75	21.41
	R-105	2,046,454.35	558,792.65	75	15.31
	R-106	2,045,513.26	559,073.67	75	22.41
	R-107	2,044,435.73	559,357.88	75	24.71
	R-108	2,043,408.20	559,630.27	75	16.70
	R-109	2,042,423.61	559,870.56	75	21.90
	T-110	2,041,337.66	560,153.48	75	25.80
	R-111	2,040,320.32	560,466.29	75	26.50
	T-112	2,039,325.32	560,768.11	75	24.41
	R-113	2,038,355.17	561,043.54	75	20.31
	T-114	2,037,423.69	561,335.16	75	20.01
	R-115	2,036,348.78	561,648.28	75	13.71
	R-116	2,035,333.23	561,962.61	75	11.81
	R-117	2,034,275.87	562,336.86	75	12.81
South Control Area	R-118	2,033,255.76	562,719.89	75	15.61
	R-119	2,032,233.21	563,155.84	75	12.31
	R-120	2,031,206.45	563,598.70	75	10.82
	R-121	2,030,203.64	564,004.20	75	15.72
	R-122	2,029,152.76	564,352.72	75	6.92
Porpoise Point (Inside St. Augustine Inlet)	R-122A	2,028,353.18	564,027.90	155	9.52
	R-122B	2,027,938.21	563,605.44	155	5.72
	R-122C	2,027,699.52	563,116.29	155	7.32
St. Augustine Beach	R-123	2,025,910.03	564,595.34	75	9.32
	T-124	2,025,445.27	566,349.61	75	17.32
	R-125	2,024,572.17	566,521.02	75	11.23
	T-126	2,023,701.14	567,618.67	75	6.93
	R-127	2,022,440.60	567,880.30	75	5.13
	T-128	2,021,737.46	568,420.86	75	15.43
	T-129	2,020,672.22	568,634.55	75	14.43
	T-130	2,019,635.87	568,894.43	75	11.33
	R-131A	2,018,510.58	568,697.39	75	7.74
	T-132	2,017,594.10	569,375.67	75	10.44

R-133	2,016,587.52	569,449.82	75	4.84
R-134	2,016,245.15	569,858.77	75	15.74
R-135	2,014,709.78	569,926.01	75	3.44
R-136	2,013,703.17	570,154.23	75	3.25
R-137A	2,012,784.88	570,623.68	75	6.25
R-138	2,011,713.58	570,920.45	75	6.85
R-139	2,010,792.36	571,042.06	75	5.85
R-140	2,009,936.50	571,280.80	75	4.75
R-141	2,009,033.46	571,515.13	75	7.45
R-142	2,008,050.00	571,987.59	75	10.86
R-143T	2,006,967.50	571,758.65	75	8.08
R-144	2,006,002.22	571,810.73	75	9.96
R-145	2,004,974.90	571,833.50	75	9.06
R-146	2,003,979.99	571,909.69	75	11.36
R-147	2,002,934.98	571,810.82	75	10.96
R-148	2,001,996.63	572,107.69	75	8.16
R-149	2,000,990.32	572,163.42	75	11.06
R-150	2,000,010.09	572,297.74	75	10.75
R-151	1,999,005.19	572,276.20	75	7.95
R-152	1,998,020.29	572,344.51	75	9.55
R-153	1,997,017.89	572,421.62	75	7.95
R-154	1,996,029.08	572,459.64	75	8.65
R-155	1,995,031.45	572,571.16	75	10.35
T-156	1,994,028.53	572,628.97	75	8.95
T-157	1,993,096.49	572,704.97	75	12.55

[1]Florida State Plane East (0901), NAD 83 US ft.

[2]Degrees clockwise from north.

[3]Official project limits are R-103.5 to R-116.5 w/1,000 ft tapers. R-103 to R-117 used here for simplicity.

Table 3. Beach Profile Survey History

Survey Date	Profiles	Surveyor
Aug. 2005	R-109 to T-157	Arc Surveying & Mapping
Dec. 2005	R-109 to T-157	Arc Surveying & Mapping
May 2006	R-109 to T-157	Arc Surveying & Mapping
Aug. 2007	R-109 to T-157	Morgan & Eklund
Oct. 2009	R-116 to T-157	FDEP
Dec. 2009	R-109 to R-158	Morgan & Eklund
Oct. 2010	R-72 to R-157	Lowe Engineers
Dec. 2011	R-80 to T-157	USACE
Dec. 2012	R-80 to T-157	Morgan & Eklund
Jul. 2013	R-80 to T-157	Morgan & Eklund
Jul. 2014	R-80 to T-157	Morgan & Eklund
Aug. 2015	R-80 to T-157	Morgan & Eklund
Nov. 2016	T-114 to R-119	USACE
Dec. 2017	R-80 to T-157	Seaside Engineering and Surveying
Jul. 2018	R-80 to T-157	Seaside Engineering and Surveying
Aug. 2019	R-80 to T-157	Degrove Surveyors
Feb. 2019	R-101 to R-118	Seaside Engineering and Surveying
Nov. 2019	R-101 to R-118	Degrove Surveyors
Aug. 2020[1]	R-80 to T-157	Degrove Surveyors
Mar. 2021[2]	R-80 to T-157	Degrove Surveyors

[1]The Aug. 2020 survey is denoted 2021 Pre-Construction in this report for brevity.

[2]The Mar. 2021 survey is denoted 2021 Post-Construction in this report for brevity.

2.2.2 St. Augustine Inlet Tidal Delta Surveys

The same entities that have sponsored the beach profile surveys listed in Table 3 have also funded hydrographic borrow area surveys within the St. Augustine Inlet's tidal delta shoals and adjacent IWW maintenance cuts since 1998. Table 4 details the surveys collected within the inlet's tidal delta complex. Most of the surveys listed were collected to support the St. Johns County SPP monitoring requirements or for Federal navigation maintenance. The two most recent surveys in Table 4 are most relevant to this analysis, as they are the data used to document the effects of the 2021 CSRM nourishment project. A complete analysis of the bathymetric changes between the 2021 CSRM pre-dredge and 2021 CSRM post-dredge conditions is documented in Section 5.0. The pre-dredge survey collection dates ranged from July to October 2020, but all the flood tidal delta shoals were surveyed in July 2020; thus, the pre-dredge survey is denoted 'Jul. 2020' or '2021 CSRM pre-dredge' in this report since all the 2021 CSRM nourishment project's borrow areas reside within the inlet's flood shoal complex. The post-dredge survey collection dates ranged from February to May 2021, but the flood tidal delta survey was captured from March to April 2021; thus, the post-dredge survey is labeled 'Apr. 2021' or '2021 CSRM post-dredge' in this report for the same reason.

Table 4. St. Augustine Inlet Tidal Delta Survey History

Survey End Date	Project Affiliation[1,2]	Designation[3]	Surveyor
Dec. 1998	SPP	2002 SPP Pre-Dredge	Morgan & Eklund
Jun. 2003	SPP	2002 SPP Post-Dredge	Arc Surveying & Mapping
Nov. 2004	-	2004 Hurricane Monitoring	Bradley
Mar. 2006	SPP	2005 SPP Post-Dredge	Arc Surveying & Mapping
May 2006	SPP	2005 6-Month SPP Post-Dredge	Arc Surveying & Mapping
Dec. 2007	SPP	2005 Year 2 SPP Post-Dredge	Morgan & Eklund
Jan. 2009	SPP	2005 Year 3 SPP Post-Dredge	USACE
Oct. 2009	SPP	2005 Year 4 SPP Post-Dredge	FDEP
Oct. 2010	SPP	2005 Year 5 SPP Post-Dredge	Lowe Engineers
Dec. 2011	SPP	2012 SPP Pre-Dredge	USACE
Feb. 2013	SPP	2012 SPP Post-Dredge	USACE
Aug. 2013	SPP	2012 Year 1 SPP Post-Dredge	Morgan & Eklund
Aug. 2014	SPP	2012 Year 2 SPP Post-Dredge	Morgan & Eklund
Aug. 2015	SPP	2012 Year 3 SPP Post-Dredge	Morgan & Eklund
Jan. 2016	-	2016 IWW	USACE
Nov. 2016	-	2016 Delta Exam Survey	USACE
Jan. 2017	-	2017 Delta Exam Survey	USACE
Oct. 2017	SPP	2018 SPP Pre-Dredge	Seaside Engineering and Surveying
Feb. 2018	-	2018 Hurricane Monitoring	USACE
Jul. 2018	SPP	2018 SPP Post-Dredge	Seaside Engineering and Surveying
Oct. 2018	-	2018 IWW	USACE
Jan. 2019	-	2019 Davis Shoal	USACE
Mar. 2019	-	2019 Inlet Exam Survey	USACE
Aug. 2019	SPP	2018 Year 1 SPP Post-Dredge	Degrove Surveyors
Oct. 2019	-	2019 Delta Exam Survey	USACE
Oct. 2019	-	2019 Flood Delta Survey	USACE
Jul. 2020[4]	CSRM	2021 CSRM Pre-Dredge	USACE
Apr. 2021[5]	CSRM	2021 CSRM Post-Dredge	USACE

[1]SPP refers to the St. Johns County Federal Shore Protection Project in St. Augustine Beach.

[2]CSRM refers to the St. Johns County Federal Coastal Storm Risk Management nourishment project.

[3]IWW refers to the Intracoastal Waterway within or adjacent to the St. Augustine Inlet's tidal delta.

[4]The 2021 CSRM Pre-Dredge survey spanned from Jul. 2020 to Oct. 2020. Jul. 2020 reported for brevity.

[5]The 2021 CSRM Post-Dredge survey spanned from Feb. 2021 to May 2021. Apr. 2021 reported for brevity.

2.3 Astronomical Tides

Astronomical tides are the rise and fall of ocean water levels created by the gravitational pull of the moon and sun. Tide amplitudes and phases are easily predicted, and the National Oceanic and Atmospheric Administration (NOAA) frequently publishes future tide estimations and verified water levels from past gauge readings at selected coastal locations around the United States. NOAA also computes and publishes vertical benchmark water levels (or datums) at those same locations, which are based off historical water levels. Tidal datums are used as benchmark contours in nourishment analyses to help distinguish dry beach versus submerged nearshore evolution of fill material. Further, the Mean High Water (MHW) contour is used in this report to compute shoreline positions of the pre- and post-construction beach and overall shoreline changes within the monitoring area.

NOAA Station 8720587 is located at the end of the St. Johns County Fishing Pier in St. Augustine Beach near R-142. This gauge is the closest open-coast station to the project area, and it lies directly within the southern portion of the monitoring area. Station data shows that tides in St. Johns County are semidiurnal with two varying high and two varying low water levels each day. Table 5 presents datums referenced to the North American Vertical Datum of 1988 (NAVD) from an 8-year analysis period (June 1992 to May 2000) within the currently approved tidal epoch (1983 to 2001). The mean tide range is 4.61 ft, and the official MHW contour is listed at an elevation of 1.64 ft-NAVD.

Table 5. NOAA Tide Data for Station 8720587

Location: 29° 51.4' N, 81° 15.8' W Analysis Period: Jun. 1992 – May 2000	
Datum	**Elevation (ft-NAVD)**
Highest Observed Water Level (09/24/1992)	4.57
Mean Higher High Water (MHHW)	2.01
Mean High Water (MHW)	1.64
North American Vertical Datum of 1988 (NAVD)	0.00
Mean Tide Level (MTL)	-0.67
Mean Sea Level (MSL)	-0.70
Mean Low Water (MLW)	-2.97
Mean Lower Low Water (MLLW)	-3.13
Lowest Observed Water Level (03/13/1993)	-6.38

3.0 PROJECT DESIGN

The St. Johns County CSRM Integrated Feasibility Study (USACE, 2017) outlined the initial nourishment design template that would provide coastal storm risk management for 50 years in South Ponte Vedra and Vilano Beach. The Feasibility Study's selected plan recommended constructing a beach fill project consisting of a 60-ft seaward equilibrated berm extension along approximately 2.6 miles of beach (R-103.5 to R-116.5). The recommended plan also included a dune feature that reflects the average 2015 dune position and 1,000-ft beach fill tapers to the north and south that tie into the existing shoreline. Material from the St. Augustine Inlet tidal delta shoals was expected to fill four total nourishment events at an estimated initial volume of roughly 1.3 mcy and periodic nourishments on average every 12 years thereafter. The Feasibility Study recommended varying the dune width, dune height, and beach slopes along the placement area due to the natural variability of the coastline and the presence of coastal structures. The study also recommended a flat berm elevation of 8 ft-NAVD to match the natural 2015 berm contour.

3.1 Initial Geotechnical Assessment

Prior to project construction, staff from the USACE Geology and Explorations Section analyzed sediment from the five segments within three borrow sources briefly described in Section 1.1 and shown in Figure 2. The Geotechnical Data Report (GDR; USACE, 2019a) details the sediment sampling and testing procedures that the USACE conducted on 24 total samples (18 vibracore samples and six (6) surficial samples) from these borrow sources, which indicated approximately 1.7 mcy were available to adequately fill the project's design template. Section 4.0 details dredge cut extents for all borrow sources used in the 2021 CSRM nourishment project. Dredging beach-quality sediment from the IWW Widener is mutually beneficial for the periodic Federal Channel maintenance dredging projects since they have overlapping placement areas. The Sediment Quality Assurance/Quality Control (QA/QC) Plan (USACE, 2019b) that accompanies FDEP Permit File No. 0377120-001-JC outlines the sediment quality compliance specifications the borrow material must meet to construct the beach fill project in South Ponte Vedra and Vilano Beach. The general compliance specifications for the material placed on the beach are listed in Table 6.

Table 6. South Ponte Vedra and Vilano Beach Sediment Compliance Specifications (USACE, 2019b)

Sediment Parameter	Parameter Definition	Compliance Value
Max. Silt Content	Passing the #230 Sieve	≤ 5%
Max. Shell Content	Retained on the #4 sieve	≤ 5%
Munsell Color Value	Moist Value (Chroma = 1)	6 or Lighter
Note: Beach fill material shall not contain construction debris, toxic material, other foreign matter, coarse gravel, or rocks.		

3.2 Permitted Nourishment Design

Also prior to construction, the USACE conducted hydrodynamic modeling, collected hydrographic and topographic survey data, and finalized design drawings for the St. Johns County CSRM nourishment project. Borrow sources for the project included (but were not limited to) the North Flood Shoal, the IWW Widener, and Davis Shoal. The beach nourishment design as specified in FDEP Permit File No. 0377120-001-JC includes a full dune and berm construction from R-103.5 to R-116.5 and beach fill tapers 1,000 ft north and south of the full template alongshore extent. The dune comprises a varying crest width with

crest elevations varying from 15 to 18 ft-NAVD and seaward slopes of one (1) vertical ft for every three (3) horizontal ft (i.e., 1V:3H). The berm is segmented into two sections: a flat berm and a seaward-sloping berm. The flat berm comprises a varying crest width from 85 ft to 115 ft at an elevation of 8 ft-NAVD. The sloped berm comprises a width of 60 ft that ties into the steeper foreshore slope at an elevation of 7 ft-NAVD (i.e., a 1V:60H overall grade). The foreshore slope is permitted at a 1V:10H grade that ties into the existing sea floor. Table 7 summarizes the permitted design template by alongshore specification changes, and Figure 3 shows a general representation of the permitted design template.

Table 7. Permitted Design Template by R-Monument

R-Monuments	Dune Crest Elevation (ft-NAVD)[1,2]	Flat Berm Elevation (ft-NAVD)	Flat Berm Width (ft)	Sloped Berm Elevation (ft-NAVD)[3]	Sloped Berm Width (ft)[4]
R-102.5 to R-103.5	Taper[5]				
R-103.5 to T-114.0	18[6]	8	115	7	60
T-114 to R-115	Flat Berm Width Transitions from 115 ft to 85 ft				
R-115.0 to R-116.5	15[6]	8	85	7	60
R-116.5 to R-117.5	Taper[5]				

[1]The design dune crest width varies by property depending on structure location.

[2]The design dune's seaward slope is 1V:3H.

[3]The design sloped berm's grade is 1V:60H.

[4]The design foreshore slope's grade is 1V:10H.

[5]The design tapers mirror the adjacent placement design.

[6]The design dune crest elevation transitions from 18 (R-113.50) to 16 (R-113.95) to 15 (T-114.00).

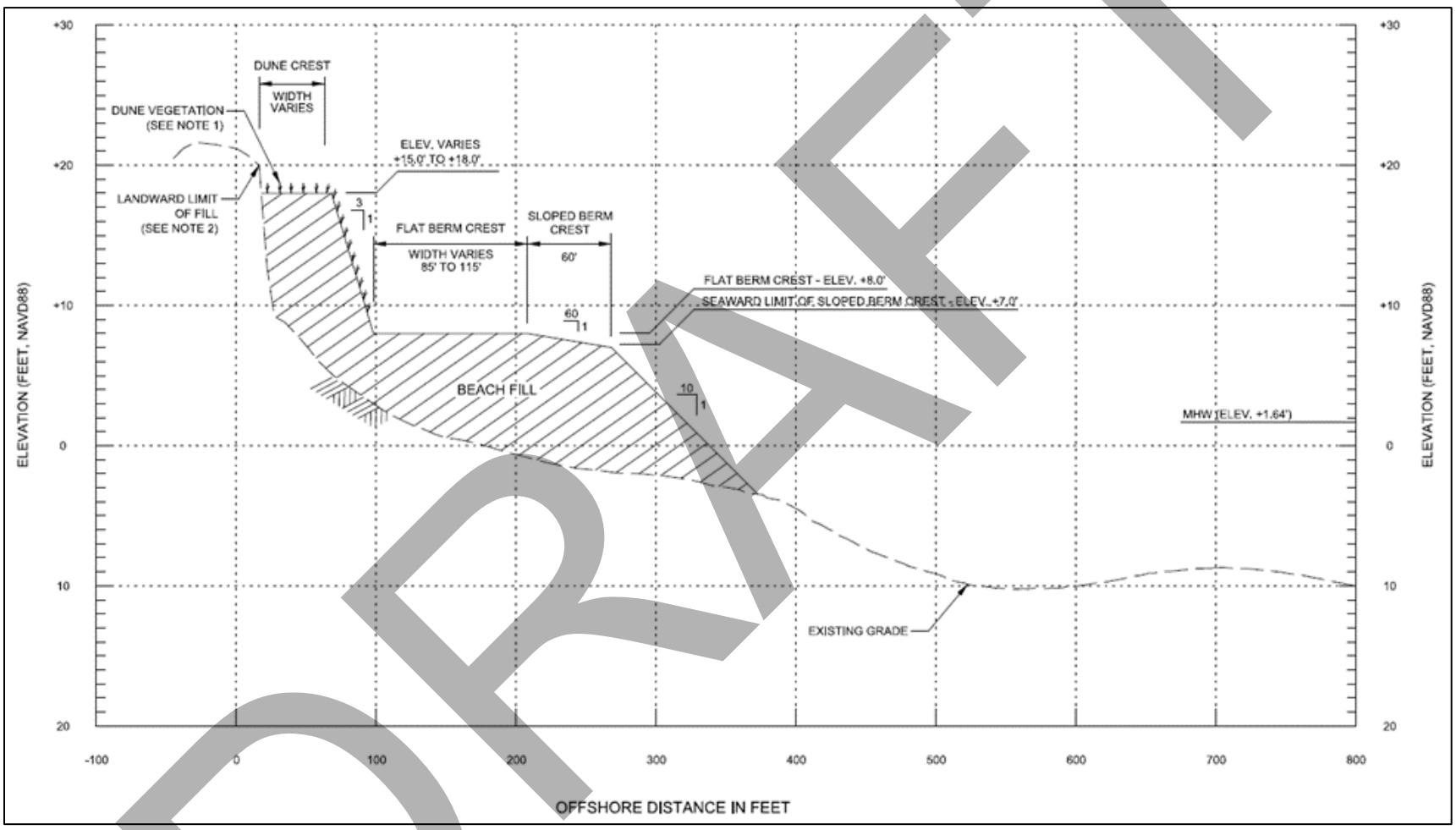

Figure 3. Typical Section of the Design Template

3.3 Constructed Nourishment Design

Multiple construction modifications were executed during construction, four of which are pertinent to physical monitoring efforts. The first modification important to this report was issued on 23 October 2020 due to unsuitable borrow material encountered in North Flood Shoal B, which resulted in reducing both the target and maximum allowable dredge depths in this area. The second modification important to this report was issued on 16 November 2020 due to fill losses from persistent nor'easters during construction, which resulted in reducing the construction berm width by 30 ft from approximately R-103.50 to roughly R-109.75 to maintain the target pay placement volume. The third and fourth modifications important to this report were issued on 24 November 2020 and 12 December 2020, respectively, and both pertained to St. Johns County acquiring additional easements for fill placement. Notably, other modifications not listed here may have been executed before, during, or after initial construction. However, they do not directly impact the physical monitoring analysis reported in this document, so they are not detailed herein.

The constructed beach project included both a dune and a berm, where dune heights, dune widths, and berm widths varied along the shoreline. The dune was constructed with a varying crest elevation that ranged from 15 ft-NAVD in the south to 18 ft-NAVD in the north. Dune crest elevation transitions occurred from approximately R-113.50 (18 ft-NAVD) to R-113.95 (16 ft-NAVD), then again to T-114.00 (15 ft-NAVD). The seaward dune slope included a 1V:3H grade to the 8 ft-NAVD flat berm elevation. Two distinct berm segments were constructed: a flat berm with a varying width at 8 ft-NAVD and a seaward-sloping, 80-ft-wide berm to 6 ft-NAVD (i.e., a 1V:40H grade). The flat berm width varied with a range from 65 ft to 95 ft, with the widest berm in the middle of the placement area spanning from roughly R-110 to T-114. The construction foreshore slope had a 1V:10H grade that tied into the existing nearshore profile, and there were two, 1,000 ft tapers that bounded the fill to the north and south. The geometry of the construction template is summarized in Table 8, and a typical section of the construction template is depicted in Figure 4.

Table 8. Construction Template by R-Monument

R-Monuments	Dune Crest Elevation (ft-NAVD)[1,2]	Flat Berm Elevation (ft-NAVD)	Flat Berm Width (ft)	Sloped Berm Seaward Elevation (ft-NAVD)[3]	Sloped Berm Width (ft)[4]
R-102.5 to R-103.5	Taper[5]				
R-103.50 to R-109.75[6]	18[7]	8	65	6	80
R-109.75 to R-109.85	Flat Berm Width Transitions from 65 ft to 95 ft				
R-109.85 to T-114.00	Varying	8	95	6	80
T-114 to R-115[6]	Flat Berm Width Transitions from 95 ft to 75 ft				
R-115.0[6] to R-116.5	15[7]	8	75	6	80
R-116.5 to R-117.5	Taper[5]				

[1]The construction dune crest width varies by property depending on structure location.

[2]The construction dune's seaward slope is 1V:3H.

[3]The construction sloped berm's grade is 1V:40H.

[4]The construction foreshore slope's grade is 1V:10H.

[5]The construction tapers mirror the adjacent placement design.

[6]A lack of easements in some of the fill area prevented full nourishment near R-108 and R-115.

[7]The design dune crest elevation transitions from 18 (R-113.50) to 16 (R-113.95) to 15 (T-114.00).

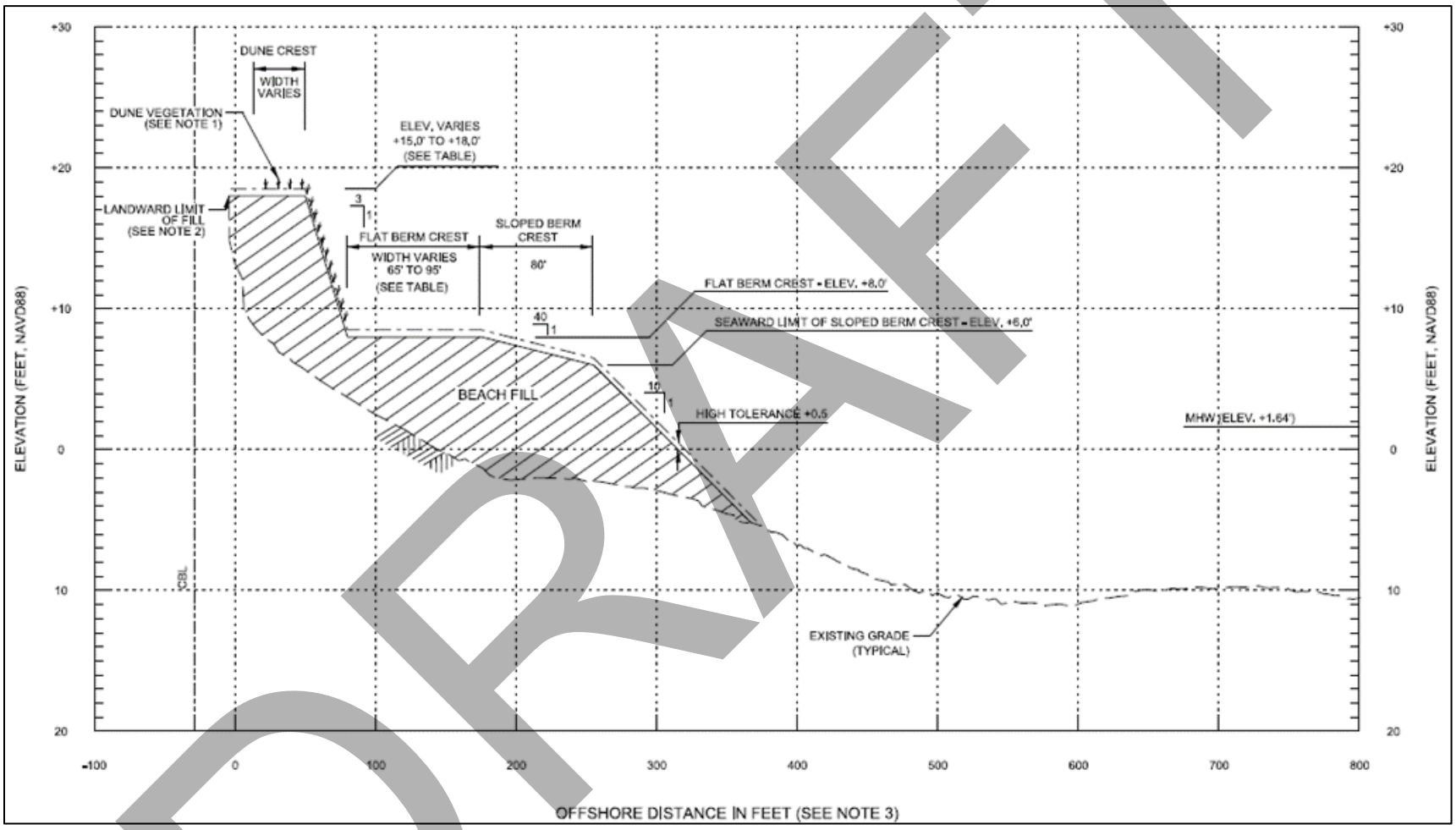

Figure 4. Typical Section of the Construction Template

4.0 FILL PLACEMENT ANALYSIS

The 2021 St. Johns County CSRM nourishment project's initial construction is the first 50-year Federal nourishment project authorized in South Ponte Vedra and Vilano Beach. Initial berm and dune sand placement commenced on 08 October 2020, where a total of 1,297,862 cy of sand were dredged from the St. Augustine Inlet's flood shoal complex and placed in the Project footprint. Grading, tilling, and dressing were completed on 05 February 2021, and pipeline and construction equipment were fully demobilized on 08 February 2021. Dune vegetation planting began on 22 March 2021 and concluded on 13 April 2021. The following sections analyze the beach conditions immediately prior to and just after the 2021 CSRM nourishment's construction template was built.

4.1 Analysis Overview

Beach fill monitoring is generally defined by tracking shoreline positions and volume changes over time. Consistent alongshore distances (R-monuments) and cross-shore (elevation contours) spatial controls allow homogeneous analyses within the monitoring area. Periodic surveys of the same area provide a historical perspective of beach fill evolution and monitoring area development. Shoreline positions are computed in this analysis (Section 4.2) by measuring the distance from R-monument benchmarks landward of the fill template to the MHW contour (along similar shore perpendicular azimuths). Position changes are calculated by comparing MHW contour locations over different periods within the monitoring area. The MHW contour for this analysis is reported in Table 5 at an elevation of 1.64 ft-NAVD.

Volume changes are best understood and analyzed by segmenting the beach into cross-shore domains. The volume change analysis presented here (Section 4.3) segments the cross-shore extent into three compartments: above MHW, MHW to -20 ft-NAVD, and below -20 ft-NAVD. Changes from the dune to the MHW contour (denoted 'above MHW' in this report) represent volume loss or gain in the dry beach, changes from MHW to -20 ft-NAVD constitute variations in the subaqueous nearshore zone, and changes below -20 ft-NAVD characterize the offshore volume fluctuations. The nearshore zone is typically the most dynamic compartment due to the presence of continuous breaking waves and strong alongshore and cross-shore currents; the offshore zone is generally less dynamic. Notably, like the Taylor Engineering (2020) SPP monitoring report, specifying a seaward limit for the deepest vertical compartment proved difficult due to the presence of the St. Augustine Inlet in the center of the monitoring area. Instead of computing the depth of closure – the depth along a beach profile where sediment transport is negligible – or using a set distance offshore, the following volume analyses apply the maximum offshore survey extents as the offshore limit.

Section 4.2 to Section **Error! Reference source not found.** analyze the 2021 CSRM nourishment project's overall evolution and performance. Section 4.2 and Section 4.3 document shoreline and volume comparisons over a 7-month period for the five alongshore monitoring areas detailed in Section 2.2.1 and shown in Figure 1. Section **Error! Reference source not found.** summarizes the cross-shore movement of the sloped berm's seaward-most position over the same period. Spatially, controlling distances – roughly equivalent to the length between the halfway points of adjacent monuments along the beach – are used to compute shoreline and volume changes on a comparative basis between alongshore beach segments (i.e., for weighted averaging). Temporally, the following analyses compare the 2021 pre-construction (August 2020) and the 2021 post-construction (March 2021) beach conditions to reveal the short-term effects of the project.

4.2 Shoreline Positions and Changes

Analyzing the position of the MHW contour over time generally indicates the alongshore and cross-shore progression of the beach monitoring area. A positive change in position indicates shoreline advance (MHW position movement offshore), while a negative change indicates shoreline retreat (MHW position movement onshore). This section details the short-term shoreline evolution within the monitoring area by comparing the 2021 pre-construction and 2021 post-construction surveys.

4.2.1 2021 Pre-Construction (Aug. 2020) to 2021 Post Construction (Mar. 2021)

The north control area is northerly-adjacent to the project area from R-80 to R-102 and experienced a slight average shoreline retreat of -0.7 ft with magnitudes ranging from -23.8 ft at R-86 to 19.8 ft at R-99. The shoreline generally retreated in the northern half of the north control area between R-80 and R-90 (an average of -5.4 ft), which is likely a direct result of natural seasonality (i.e., the post-construction survey was taken immediately after erosive winter nor'easters impacted the monitoring area). The shoreline generally advanced in the southern half of the north control area from R-91 to R-102 (an average of 3.6 ft), which may be a result of minor northerly spread of the 2021 CSRM nourishment project's fill material.

The shoreline change analysis within the project area (R-103 to R-117) reveals the direct effects of the 2021 CSRM nourishment project, which experienced an average shoreline advancement of 75.9 ft. T-110 to T-114 experienced the greatest gains within the project area with an average advance of 112.8 ft. This is expected since this stretch of beach received the largest constructed berm width. The shoreline change results in the project area generally follows a parabolic shape with increasing advancement from R-103 to T-112, maxing out at R-113 (121.3 ft), and decreasing advancement from T-114 to R-117. Section 3.3 and Table 8 fully detail the varying construction berm widths throughout the project area.

The south control area (R-118 to R-122) and Porpoise Point (R-122A to R-122C) both encountered significant overall shoreline retreat with an average movement of -32.6 ft and -108.9 ft, respectively. Shoreline losses in the south control area were generally less pronounced at the extremes (-28.8 ft at R-118 and -14.0 at R-122) and more pronounced centrally (an average of -37.0 ft from R-119 to R-121). However, there were no shoreline gains in the entire south control area over this analysis period. The highly dynamic shoreline of Porpoise Point lies within the St. Augustine Inlet, where major shoreline retreat to the east (-467.3 ft at R-122A) and notable advancement to the west (327.3 ft at R-122C) may indicate nearshore sediment moved west-northwest around the point from seasonal nor'easter wave action entering the inlet from the Atlantic Ocean.

Only two monuments encountered a shoreline advance south of the St. Augustine Inlet (24.4 ft at T-126 and 6.6 ft at R-148). The average shoreline retreat from R-123 to T-157 is -35.6 ft with the maximum retreat just south of the St. Augustine inlet at R-123 (-161.2 ft) and the maximum gain at T-126 (24.4 ft). Overall recession is generally greater to the north and smaller to the south within this monitoring area. Smaller overall recession south of R-151 (the southern extent of the St. Johns County SPP) may indicate cumulative effects of the Federal SPP's nourishments. St. Johns County SPP physical monitoring fully documents this area with respect to the SPP project.

Table 9 lists the MHW shoreline position ranging from each monument for the 2021 pre-construction and 2021 post-construction surveys. Table 9 also presents the overall MHW shoreline position changes at each profile for the same analysis periods, displayed graphically in Figure 5. Notably, Appendix C graphically

shows MHW shoreline positions over the 7-month period by overlaying these positions on 2016 plan-view satellite aerials.

Table 9. MHW Shoreline Positions and Changes

Area Details	FDEP Reference Monument	Controlling Distance (ft)	MHW Position (ft from R-monument)		MHW Position Change (ft)
			2021 Pre-Fill (Aug. 2020)	2021 Post-Fill (Mar. 2021)	2021 Pre-Fill to 2021 Post-Fill
North Control Area	R-80	1,066.3	138.5	145.9	7.3
	R-81	1,063.9	145.1	133.8	-11.4
	R-82	1,041.7	108.2	110.5	2.3
	R-83	1,077.5	158.0	152.5	-5.5
	R-84	1,067.8	137.5	130.0	-7.4
	R-85	1,032.0	140.8	118.3	-22.6
	R-86	1,037.5	153.3	129.5	-23.8
	R-87	1,049.4	82.3	90.0	7.7
	R-88	999.0	69.9	78.1	8.1
	R-89	991.4	74.0	76.7	2.7
	R-90	1,035.9	80.1	63.4	-16.6
	R-91	1,049.3	109.2	119.3	10.1
	R-92	1,027.8	116.3	120.5	4.2
	R-93	1,010.4	84.5	98.5	13.9
	R-94	1,004.9	112.3	110.0	-2.2
	R-95	1,016.3	124.5	126.8	2.4
	R-96	1,033.9	95.9	84.6	-11.3
	R-97	1,019.1	95.0	91.1	-3.9
	R-98	1,032.1	106.2	112.8	6.6
	R-99	1,046.3	113.1	132.9	19.8
	R-100	1,039.5	111.7	105.1	-6.7
	R-101	1,018.9	115.8	118.2	2.4
	R-102	995.8	110.4	118.7	8.3
Project Area (South Ponte Vedra and Vilano Beach)	R-103	990.5	127.4	171.5	44.1
	T-104	991.7	133.7	199.2	65.5
	R-105	987.6	136.5	209.8	73.3
	R-106	1,048.0	100.3	179.9	79.6
	R-107	1,088.7	112.4	174.6	62.3
	R-108	1,038.1	117.8	199.6	81.8
	R-109	1,067.7	144.6	215.9	71.3

	T-110	1,092.8	151.5	260.3	108.8
	R-111	1,051.3	124.9	235.0	110.1
	T-112	1,023.7	111.0	222.7	111.7
	R-113	991.7	113.9	235.2	121.3
	T-114	1,047.2	90.3	188.4	98.1
	R-115	1,090.7	147.7	197.6	50.0
	R-116	1,090.1	165.2	193.0	27.8
	R-117	1,101.1	138.2	175.4	37.3
South Control Area	R-118	1,092.2	201.1	172.3	-28.8
	R-119	1,103.0	220.7	167.1	-53.6
	R-120	1,089.6	208.4	205.8	-2.6
	R-121	1,089.2	228.3	173.6	-54.7
	R-122	552.6	318.6	304.5	-14.0
Porpoise Point (Inside St. Augustine Inlet)	R-122A	278.9	503.7	36.4	-467.3
	R-122B	551.0	410.4	267.6	-142.8
	R-122C	272.1	193.7	521.0	327.3
St. Augustine Beach	R-123	449.5	2,262.6	2,101.4	-161.2
	T-124	893.4	1,683.2	1,631.0	-52.2
	R-125	1,005.6	1,999.4	1,981.9	-17.5
	T-126	1,204.4	980.2	1,004.6	24.4
	R-127	1,051.8	912.0	849.3	-62.7
	T-128	951.3	472.6	419.5	-53.1
	T-129	1,076.4	446.9	404.1	-42.8
	T-130	1,052.7	430.0	383.9	-46.1
	R-131A	1,048.4	881.5	815.1	-66.4
	T-132	1,025.8	455.7	386.8	-68.8
	R-133	713.8	627.6	592.6	-35.1
	R-134	968.5	319.5	290.2	-29.3
	R-135	1,266.3	690.5	666.4	-24.1
	R-136	1,019.7	780.4	720.6	-59.9
	R-137A	1,059.8	546.6	498.6	-48.1
	R-138	1,016.6	490.8	470.8	-20.0
	R-139	905.0	583.0	550.9	-32.1
	R-140	910.7	551.2	483.8	-67.4
	R-141	1,002.3	472.5	431.1	-41.4
	R-142	1,029.6	165.2	83.8	-81.4
	R-143T	966.1	532.1	485.9	-46.2
	R-144	972.0	568.6	538.7	-29.8
	R-145	990.0	604.0	582.0	-21.9

	R-146	982.9	608.7	591.1	-17.5
	R-147	983.9	780.0	736.4	-43.6
	R-148	985.0	509.6	516.2	6.6
	R-149	984.4	516.4	488.6	-27.7
	R-150	973.8	444.3	415.6	-28.8
	R-151	967.6	545.0	505.6	-39.4
	R-152	979.0	517.5	516.9	-0.6
	R-153	977.0	509.8	498.6	-11.2
	R-154	979.1	533.2	509.7	-23.5
	R-155	988.5	488.0	470.5	-17.5
	T-156	952.2	502.8	485.1	-17.7
	T-157	976.6	521.0	502.2	-18.8
North Control Area Weighted Average	**R-80 to R-102**	**23,756.7**	**112.6**	**111.9**	**-0.7**
Project Area Weighted Average	**R-103 to R-117**	**15,700.9**	**128.0**	**203.8**	**75.9**
South Control Area Weighted Average	**R-118 to R-122**	**4,926.6**	**226.3**	**193.7**	**-32.6**
Porpoise Point Weighted Average	**R-122A to R-122C**	**1,102.0**	**380.5**	**271.6**	**-108.9**
St. Augustine Beach Weighted Average	**R-123 to T-157**	**34,309.7**	**659.4**	**623.8**	**-35.6**

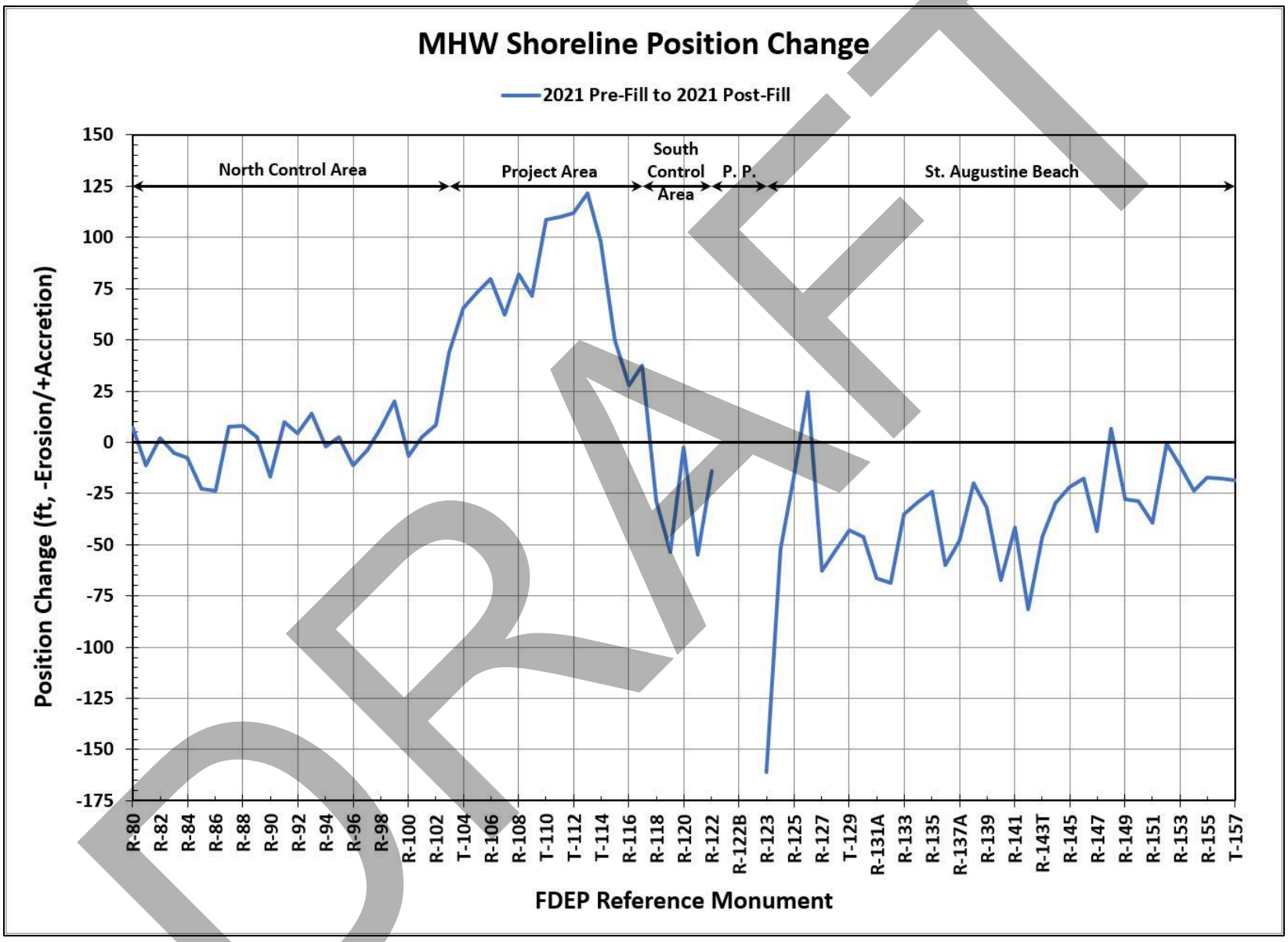

Figure 5. MHW Shoreline Change

4.3 Beach Volume Changes

Physical beach monitoring also includes analyzing volume changes throughout the study area. Computing 2021 pre-construction to 2021 post-construction beach volume changes within the monitoring area indicates overall beach evolution over a 7-month period and the 2021 CSRM nourishment project's performance immediately after construction. Compartmentalizing cross-shore profiles helps segment changes to the subaerial (i.e., dry) portion of the beach and the typically more dynamic subaqueous (i.e., wet) portion of the beach. Table 10 and Figure 6 to Figure 9 present the dry beach volume change densities (i.e., the volume changes per alongshore ft above MHW), the nearshore volume change densities (i.e., the volume changes per alongshore ft between MHW and -20 ft-NAVD), the offshore volume change densities (i.e., the volume changes per alongshore ft below -20 ft-NAVD), and the total volume change densities (i.e., the volume changes per alongshore ft from the dune to -20 ft-NAVD) for the specified period. Table 11 details the volume changes (cy) within each vertical compartment by R-monument, and Table 12 summarizes the beach volume changes (cy) in each focus area along the beach.

4.3.1 2021 Pre-Construction (Aug. 2020) to 2021 Post Construction (Mar. 2021)

The 7-month analysis period indicates the direct impact of the 2021 CSRM nourishment project in the fill area north of the St. Augustine Inlet and the general beach movement after the 2021 winter season within and south of the inlet. The area north of the inlet from R-80 to R-122 gained 1,616,402 cy (36.4 cy/ft on average), reflecting benefits of fill material (and contractor over-fill) and possibly experiencing net longshore sediment influx from the beaches north of the monitoring area, while areas south of R-122 experienced overall erosion. The north control area (R-80 to R-102) remained relatively stable with 91,508 cy (3.9 cy/ft) of overall volume gain. Volume gain was generally concentrated in the northern half of this area from R-80 to R-91 (181,852 cy; 14.5 cy/ft), and moderate losses were generally contained to the southern half of this area from R-92 to R-102 (-90,344 cy; -8.0 cy/ft). Losses were almost exclusively realized in the dry beach and offshore vertical compartments (excluding the minor loss from MHW to -20 ft-NAVD at R-83). Much of the volume gain in the nearshore vertical compartment appears to be from the formation of a nearshore bar above -10 ft-NAVD (see the profile plots in Appendix B).

The project area (R-103 to R-117) experienced an overall volume gain of 1,407,826 cy (89.7 cy/ft), with gains at every R-monument above -20 ft-NAVD and losses at every R-monument below -20 ft-NAVD. The beach above MHW gained 601,650 cy (38.3 cy/ft), the nearshore zone from MHW to -20 ft-NAVD gained 1,109,089 cy (70.6 cy/ft), and the offshore zone below -20 ft-NAVD lost -302,912 cy (-19.3 cy/ft). The largest accretion predictably occurred between R-108 and R-113 (726,981 cy; 116.0 cy/ft), reflecting the center of the 2021 CSRM placement area where the berm was constructed widest. Sediment eroded from the dry beach's constructed berm position appears to have settled into the nearshore zone, forming a nearshore bar around the -5 to -10 ft-NAVD contour along a portion of the beach (see Appendix B). The overall sediment gain (1,407,826 cy) is 7.8% greater than the fill volume placed (1,297,862 cy), likely reflecting contractor over-fill and possibly reflecting sediment flowing south into the project area via net longshore transport between survey dates.

Like the north control area, the south control area (R-118 to R-122) experienced volume losses above MHW and below -20 ft-NAVD but gained volume overall (117,068 cy; 23.8 cy/ft). Every monument within the nearshore vertical compartment between MHW and -20 ft-NAVD experienced volume gains except for R-121 (-20.1 cy/ft), which is roughly 1,600 ft north of the St. Augustine Inlet's terminal groin. This area may be an erosional hotspot under the influence of inlet and groin dynamics. Volume gain within the nearshore vertical compartment in the south control area is likely a benefit of the 2021 CSRM nourishment project acting as an updrift feeder beach.

Unlike areas north of the inlet, Porpoise Point (R-122A to R-122C) and St. Augustine Beach both experienced overall volume losses. Tracking MHW contour positions (Section 4.2 and Appendix C) and inlet hydrodynamics (Section 5.0) indicates natural sediment migration from eastern to western Porpoise Point during the more active winter nor'easter season. Volumes also indicate more accretion (or less erosion depending on the vertical compartment) east to west from R-122A to R-122C over the analysis period, with an overall net loss of -57,300 cy (-52.0 cy/ft) in this area. St. Augustine Beach (R-123 to T-157) incurred an overall volume loss of -206,165 cy (-6.0 cy/ft), likely resulting from persistent seasonal nor'easters between survey dates. Change was highly variable with mixed accretion and erosion occurring throughout this area. Areas with the highest concentrated erosion were just south of the inlet at R-123 to T-124 (-97,332 cy; -72.5 cy/ft) and in the middle of the St. Johns County SPP placement area from R-139 to R-144 (-192,586 cy; -33.3 cy/ft). Notably, the performance of the SPP is further detailed in Taylor Engineering (2020).

Table 10. Beach Volume Change Densities by Compartment

Area Details	FDEP Reference Monument	Controlling Distance (ft)	2021 Pre-Fill to 2021 Post-Fill Volume Change Densities (cy/ft)			
			Above MHW	MHW to -20 ft-NAVD	Below -20 ft-NAVD	Total
North Control Area	R-80	1,066.3	0.9	21.1	0.8	22.9
	R-81	1,063.9	0.5	18.0	-4.4	14.1
	R-82	1,041.7	0.8	2.8	-7.5	-3.9
	R-83	1,077.5	-0.9	-4.4	-10.0	-15.2
	R-84	1,067.8	1.6	3.0	3.7	8.4
	R-85	1,032.0	-1.1	24.8	-12.9	10.8
	R-86	1,037.5	-3.4	21.1	12.3	30.1
	R-87	1,049.4	-1.6	13.3	4.0	15.7
	R-88	999.0	-0.2	38.8	17.2	55.8
	R-89	991.4	0.5	23.4	-0.7	23.3
	R-90	1,035.9	-7.3	21.4	-7.4	6.7
	R-91	1,049.3	0.6	14.8	-6.5	8.9
	R-92	1,027.8	-0.8	11.0	-13.5	-3.3
	R-93	1,010.4	2.2	3.5	-13.2	-7.6
	R-94	1,004.9	-0.4	5.9	-12.6	-7.1
	R-95	1,016.3	-0.4	8.5	-30.1	-22.0
	R-96	1,033.9	-4.5	5.1	-19.1	-18.5
	R-97	1,019.1	0.7	1.6	-26.9	-24.6
	R-98	1,032.1	-2.0	9.2	-9.2	-2.0
	R-99	1,046.3	0.8	13.7	-11.5	3.1
	R-100	1,039.5	-6.6	14.2	-19.8	-12.1
	R-101	1,018.9	-3.9	16.2	-14.2	-1.9
	R-102	995.8	-1.6	26.5	-17.1	7.7
Project Area (South Ponte Vedra and Vilano Beach)	R-103	990.5	30.7	56.6	-7.4	79.9
	T-104	991.7	41.5	67.8	-43.7	65.6
	R-105	987.6	38.8	66.4	-34.4	70.8
	R-106	1,048.0	38.3	69.4	-25.1	82.6
	R-107	1,088.7	41.0	67.7	-15.5	93.1
	R-108	1,038.1	54.4	75.0	-16.4	112.9
	R-109	1,067.7	44.2	73.9	-13.4	104.6
	T-110	1,092.8	54.5	72.1	-13.0	113.6
	R-111	1,051.3	43.1	98.1	-27.0	114.2
	T-112	1,023.7	53.6	100.1	-16.1	137.6

	R-113	991.7	46.8	85.5	-18.4	113.9
	T-114	1,047.2	43.1	75.4	-20.8	97.7
	R-115	1,090.7	20.7	63.8	-16.7	67.8
	R-116	1,090.1	12.8	42.8	-14.5	41.2
	R-117	1,101.1	14.1	47.8	-9.6	52.3
South Control Area	R-118	1,092.2	1.7	39.5	-8.9	32.4
	R-119	1,103.0	-5.1	29.2	-7.9	16.2
	R-120	1,089.6	-1.0	31.9	0.0	30.9
	R-121	1,089.2	-6.2	-20.1	-0.2	-26.5
	R-122	552.6	5.6	101.3	0.0	106.8
Porpoise Point (Inside St. Augustine Inlet)	R-122A	278.9	0.2	-103.6	-53.9	-157.3
	R-122B	551.0	19.1	-61.3	22.7	-19.5
	R-122C	272.1	117.8	16.5	-144.1	-9.8
St. Augustine Beach	R-123	449.5	-7.0	-109.5	-0.1	-116.6
	T-124	893.4	-4.8	-45.5	0.0	-50.3
	R-125	1,005.6	7.9	-1.7	-0.1	6.1
	T-126	1,204.4	12.9	14.6	0.5	28.1
	R-127	1,051.8	-3.1	56.5	0.2	53.6
	T-128	951.3	-2.3	25.5	-0.3	23.0
	T-129	1,076.4	1.6	11.7	2.8	16.1
	T-130	1,052.7	-0.1	0.3	-6.6	-6.4
	R-131A	1,048.4	-1.9	12.3	1.3	11.7
	T-132	1,025.8	-2.8	5.4	-22.1	-19.6
	R-133	713.8	-3.6	10.5	-0.1	6.8
	R-134	968.5	-4.2	2.3	26.0	24.1
	R-135	1,266.3	5.5	2.4	-7.5	0.3
	R-136	1,019.7	3.8	2.8	-0.5	6.2
	R-137A	1,059.8	-0.1	2.2	-8.5	-6.4
	R-138	1,016.6	1.4	2.0	-3.0	0.3
	R-139	905.0	-2.6	-4.0	-11.4	-18.0
	R-140	910.7	-8.0	-16.1	-10.5	-34.6
	R-141	1,002.3	-13.4	-22.5	2.9	-33.0
	R-142	1,029.6	-7.8	-13.0	-15.1	-36.0
	R-143T	966.1	-12.0	-21.4	-12.7	-46.0
	R-144	972.0	-4.3	-12.8	-13.9	-31.0
	R-145	990.0	2.3	25.8	-8.9	19.2
	R-146	982.9	3.4	0.5	5.6	9.6
	R-147	983.9	-2.9	-7.2	11.5	1.4
	R-148	985.0	-0.3	13.4	-0.1	13.0

	R-149	984.4	-5.6	2.1	-2.3	-5.8
	R-150	973.8	-1.5	-11.5	-16.7	-29.7
	R-151	967.6	-1.8	-4.0	-29.8	-35.6
	R-152	979.0	1.0	-16.6	-9.1	-24.7
	R-153	977.0	0.9	22.7	-4.3	19.3
	R-154	979.1	0.2	-0.1	-6.9	-6.8
	R-155	988.5	2.2	-12.9	-1.4	-12.1
	T-156	952.2	0.4	12.1	-15.5	-3.0
	T-157	976.6	0.5	9.3	-22.6	-12.7
North Control Area Weighted Average	**R-80 to R-102**	**23,756.7**	**-1.1**	**13.6**	**-8.6**	**3.9**
Project Area Weighted Average	**R-103 to R-117**	**15,700.9**	**38.3**	**70.6**	**-19.3**	**89.7**
South Control Area Weighted Average	**R-118 to R-122**	**4,926.6**	**-1.7**	**29.3**	**-3.8**	**23.8**
Porpoise Point Weighted Average	**R-122A to R-122C**	**1,102.0**	**38.7**	**-52.8**	**-37.9**	**-52.0**
St. Augustine Beach Weighted Average	**R-123 to T-157**	**34,309.7**	**-1.0**	**0.2**	**-5.2**	**-6.0**

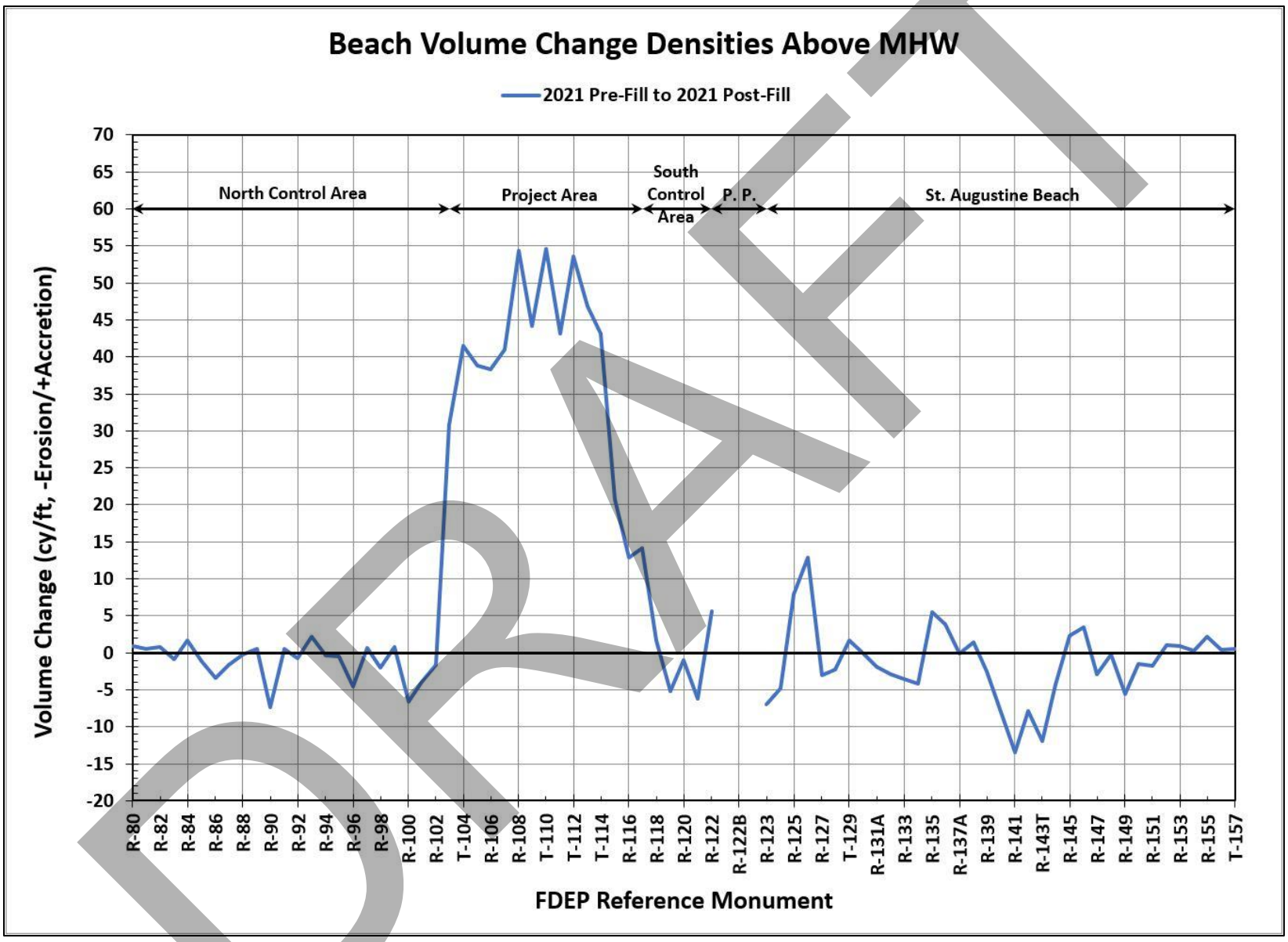

Figure 6. Beach Volume Change Densities Above MHW

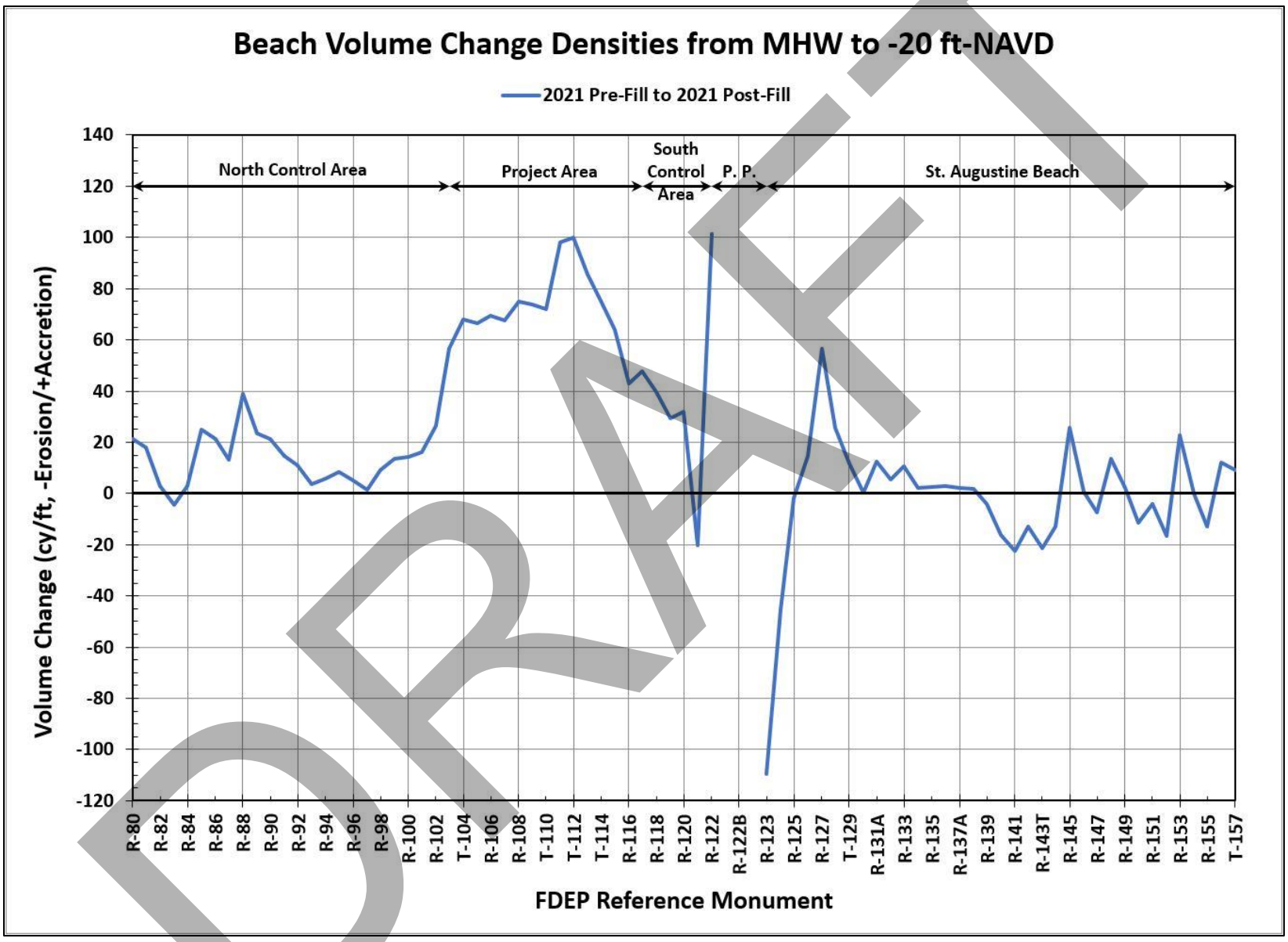

Figure 7. Beach Volume Change Densities from MHW to -20 ft-NAVD

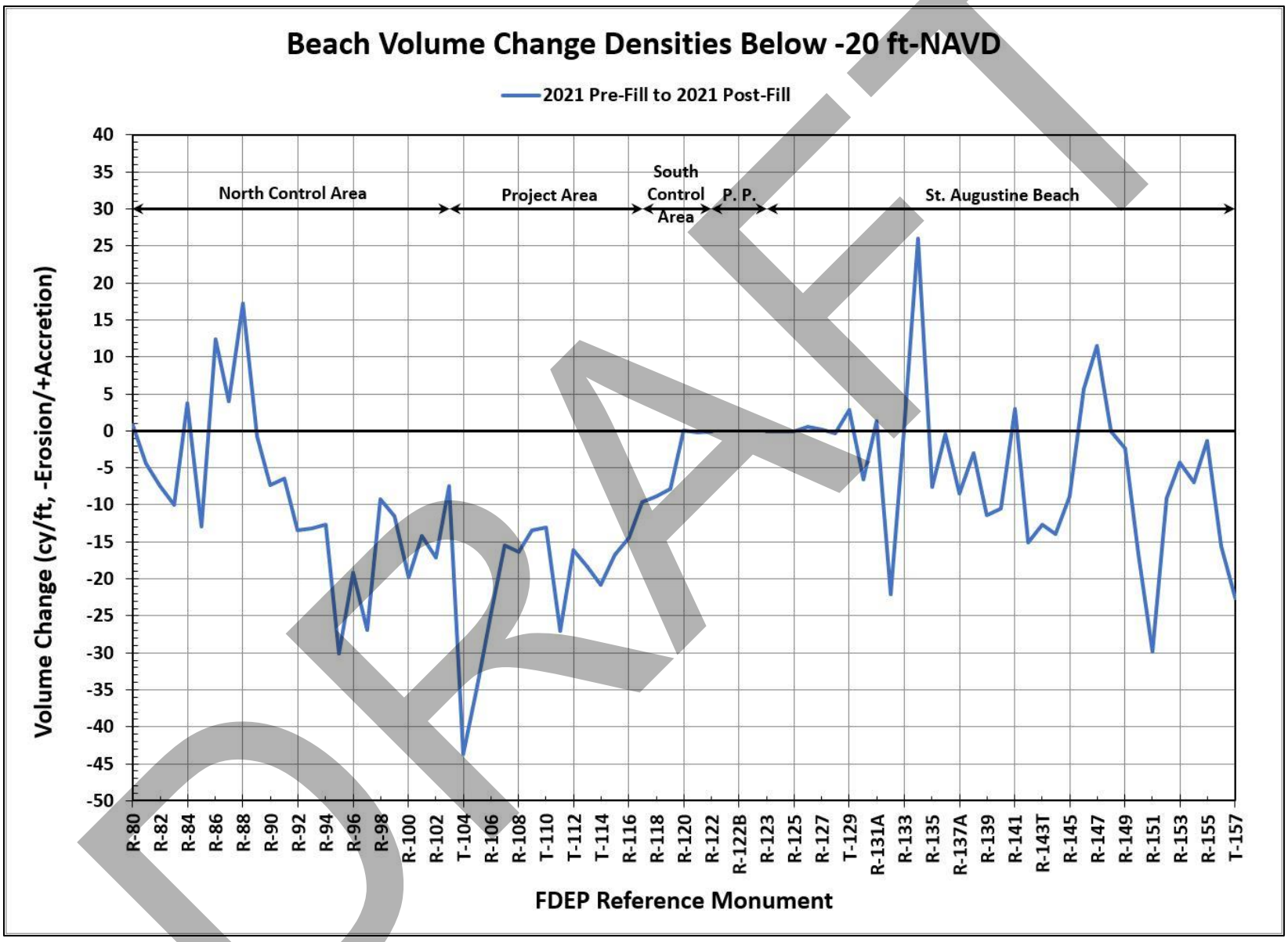

Figure 8. Beach Volume Change Densities Below -20 ft-NAVD

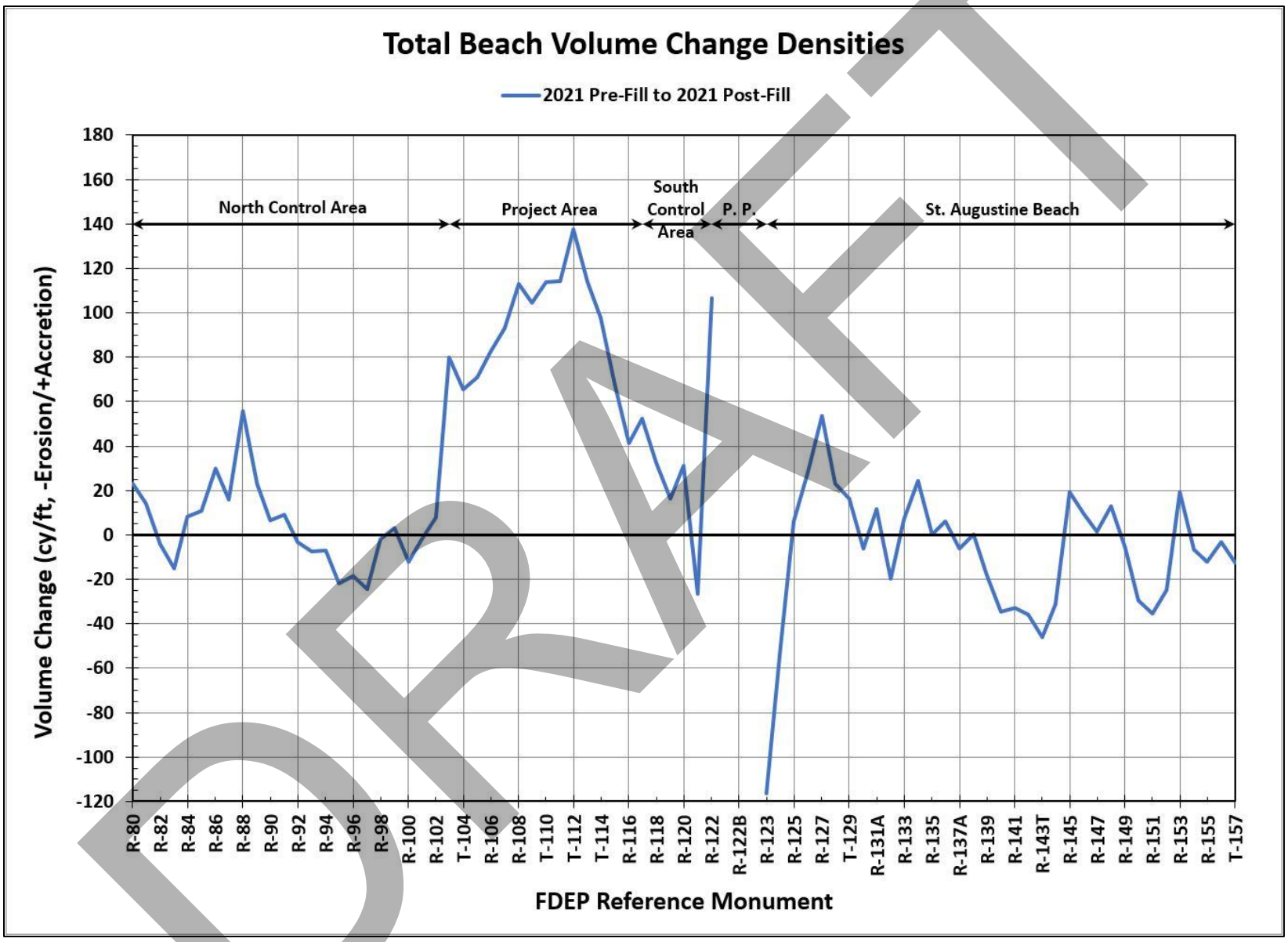

Figure 9. Total Beach Volume Change Densities

Table 11. Beach Volume Changes by Compartment

Area Details	FDEP Reference Monument	Controlling Distance (ft)	2021 Pre-Fill to 2021 Post-Fill Volume Changes (cy)			
			Above MHW	MHW to -20 ft-NAVD	Below -20 ft-NAVD	Total
North Control Area	R-80	1,066.3	1,008	22,533	837	24,378
	R-81	1,063.9	542	19,176	-4,664	15,053
	R-82	1,041.7	846	2,943	-7,815	-4,026
	R-83	1,077.5	-927	-4,721	-10,732	-16,379
	R-84	1,067.8	1,734	3,229	3,986	8,949
	R-85	1,032.0	-1,105	25,576	-13,308	11,163
	R-86	1,037.5	-3,535	21,927	12,806	31,198
	R-87	1,049.4	-1,693	13,911	4,244	16,462
	R-88	999.0	-225	38,723	17,207	55,705
	R-89	991.4	539	23,206	-665	23,080
	R-90	1,035.9	-7,594	22,202	-7,662	6,947
	R-91	1,049.3	622	15,508	-6,807	9,323
	R-92	1,027.8	-814	11,346	-13,877	-3,345
	R-93	1,010.4	2,173	3,507	-13,325	-7,645
	R-94	1,004.9	-412	5,934	-12,692	-7,170
	R-95	1,016.3	-432	8,671	-30,553	-22,314
	R-96	1,033.9	-4,647	5,285	-19,775	-19,137
	R-97	1,019.1	713	1,605	-27,381	-25,063
	R-98	1,032.1	-2,113	9,546	-9,514	-2,081
	R-99	1,046.3	885	14,351	-12,008	3,228
	R-100	1,039.5	-6,824	14,746	-20,531	-12,609
	R-101	1,018.9	-3,957	16,482	-14,426	-1,901
	R-102	995.8	-1,641	26,411	-17,076	7,694
Project Area (South Ponte Vedra and Vilano Beach)	R-103	990.5	30,454	56,072	-7,373	79,153
	T-104	991.7	41,153	67,241	-43,315	65,078
	R-105	987.6	38,285	65,622	-33,997	69,910
	R-106	1,048.0	40,102	72,742	-26,281	86,563
	R-107	1,088.7	44,607	73,691	-16,893	101,405
	R-108	1,038.1	56,445	77,834	-17,052	117,226
	R-109	1,067.7	47,139	78,860	-14,334	111,665
	T-110	1,092.8	59,605	78,808	-14,228	124,185
	R-111	1,051.3	45,343	103,130	-28,380	120,093
	T-112	1,023.7	54,870	102,458	-16,496	140,832

	R-113	991.7	46,417	84,764	-18,202	112,978
	T-114	1,047.2	45,133	78,945	-21,767	102,311
	R-115	1,090.7	22,583	69,620	-18,266	73,937
	R-116	1,090.1	13,975	46,704	-15,753	44,926
	R-117	1,101.1	15,540	52,596	-10,575	57,561
South Control Area	R-118	1,092.2	1,879	43,186	-9,694	35,370
	R-119	1,103.0	-5,668	32,194	-8,695	17,831
	R-120	1,089.6	-1,074	34,775	-10	33,690
	R-121	1,089.2	-6,756	-21,906	-181	-28,843
	R-122	552.6	3,092	55,955	-27	59,020
Porpoise Point (Inside St. Augustine Inlet)	R-122A	278.9	58	-28,896	-15,036	-43,874
	R-122B	551.0	10,503	-33,775	12,503	-10,769
	R-122C	272.1	32,065	4,490	-39,213	-2,657
St. Augustine Beach	R-123	449.5	-3,154	-49,208	-61	-52,423
	T-124	893.4	-4,281	-40,605	-23	-44,909
	R-125	1,005.6	7,928	-1,755	-51	6,122
	T-126	1,204.4	15,573	17,643	649	33,865
	R-127	1,051.8	-3,247	59,475	195	56,423
	T-128	951.3	-2,158	24,288	-265	21,865
	T-129	1,076.4	1,761	12,573	2,996	17,330
	T-130	1,052.7	-113	351	-6,965	-6,727
	R-131A	1,048.4	-2,040	12,929	1,331	12,220
	T-132	1,025.8	-2,913	5,520	-22,689	-20,082
	R-133	713.8	-2,563	7,462	-46	4,853
	R-134	968.5	-4,056	2,253	25,179	23,376
	R-135	1,266.3	6,918	3,000	-9,531	386
	R-136	1,019.7	3,855	2,898	-476	6,277
	R-137A	1,059.8	-144	2,351	-8,962	-6,755
	R-138	1,016.6	1,408	1,997	-3,072	332
	R-139	905.0	-2,308	-3,626	-10,358	-16,292
	R-140	910.7	-7,263	-14,688	-9,604	-31,555
	R-141	1,002.3	-13,477	-22,523	2,916	-33,084
	R-142	1,029.6	-8,055	-13,403	-15,559	-37,017
	R-143T	966.1	-11,560	-20,633	-12,274	-44,468
	R-144	972.0	-4,211	-12,418	-13,542	-30,171
	R-145	990.0	2,250	25,520	-8,771	18,999
	R-146	982.9	3,346	531	5,538	9,414
	R-147	983.9	-2,819	-7,122	11,322	1,380
	R-148	985.0	-284	13,213	-119	12,810

	R-149	984.4	-5,539	2,111	-2,294	-5,722
	R-150	973.8	-1,452	-11,203	-16,225	-28,880
	R-151	967.6	-1,726	-3,910	-28,847	-34,483
	R-152	979.0	1,017	-16,273	-8,955	-24,211
	R-153	977.0	897	22,160	-4,155	18,902
	R-154	979.1	220	-101	-6,746	-6,627
	R-155	988.5	2,158	-12,742	-1,393	-11,977
	T-156	952.2	369	11,541	-14,802	-2,892
	T-157	976.6	489	9,089	-22,025	-12,447
North Control Area Weighted Average	**R-80 to R-102**	**23,756.7**	**-1,166**	**13,930**	**-8,813**	**3,951**
Project Area Weighted Average	**R-103 to R-117**	**15,700.9**	**39,969**	**73,844**	**-20,039**	**93,774**
South Control Area Weighted Average	**R-118 to R-122**	**4,926.6**	**-2,237**	**25,906**	**-4,141**	**19,528**
Porpoise Point Weighted Average	**R-122A to R-122C**	**1,102.0**	**13,183**	**-23,092**	**-7,236**	**-17,144**
St. Augustine Beach Weighted Average	**R-123 to T-157**	**34,309.7**	**-755**	**1,332**	**-5,159**	**-4,583**

Table 12. Summary of Beach Volume Changes by Focus Area

Area Details	2021 Pre-Fill to 2021 Post-Fill Volume Changes (cy)			
	Above MHW	MHW to -20 ft-NAVD	Below -20 ft-NAVD	Total
North Control Area	-26,857	322,096	-203,732	91,508
Project Area (South Ponte Vedra and Vilano Beach)	601,650	1,109,089	-302,912	1,407,826
South Control Area	-8,528	144,203	-18,607	117,068
Porpoise Point (Inside St. Augustine Inlet)	42,626	-58,180	-41,745	-57,300
St. Augustine Beach	-35,172	6,693	-177,687	-206,165

4.4 Constructed Berm Position Over Time

This report analyzes the seaward-most position of the construction template's sloped berm to indicate the 2021 CSRM nourishment project's berm performance. Table 13 details the project performance based on the 6 ft-NAVD contour position measured cross-shore from each R-monument within the placement area. Notably, the R-103 and R-117 transect measurements lie within the beach fill tapers, and the R-108 and R-115 transect measurements reside immediately adjacent or within areas where easements were not obtained; thus, these monuments were omitted from the project performance assessment.

Comparing the 2021 pre-construction data to the constructed berm position shows the relative berm width conditions prior to the 2021 CSRM nourishment project. The average 2021 pre-construction berm position was -158.7 ft from the constructed berm position. The widest part of the 2021 CSRM construction template (T-110 to T-114; average 252.5 ft) predictably yielded the largest relative position difference before construction (-181.9 ft on average).

Associating the 2021 post-construction data with the constructed berm position shows the relative berm width conditions immediately following the 2021 CSRM nourishment project. The 6 ft-NAVD post-construction position migrated an average of -81.6 ft landward from the constructed position. 2021 post-construction berm position losses generally decreased in magnitude from north to south, where the fill south of R-113 experienced an average loss of -123.1 ft. As discussed in Section 4.3 and shown graphically in Appendix B, much of the berm fill appears to have migrated into the nearshore zone from MHW to -10 ft-NAVD. Persistent nor'easters during and immediately following fill placement may be responsible for eroding dry beach volume and depositing the sediment within the subaqueous profile.

Assessing the difference between the 2021 pre-construction and 2021 post-construction data indicates the project's direct impacts on the relative berm position. The project resulted in advancing the average berm position by 77.2 ft from T-104 to R-116. The northern half of the project area from T-104 to R-109 gained 73.3 ft on average, and the center of the project area benefited most with an average seaward berm position shift of 95.9 ft from T-110 to T-114.

Table 13. Constructed Berm Position and Relative Change

FDEP Reference Monument (Project Area)	Controlling Distance (ft)	6 ft-NAVD Constructed Berm Position (ft from Monument)	Distance from Constructed Berm (ft, +seaward/-landward)		Berm Position Change (ft)
			2021 Pre-Fill	2021 Post-Fill	2021 Pre-Fill to 2021 Post-Fill
R-103[1]	-	-	-	-	-
T-104	991.7	226.0	-122.4	-53.4	69.0
R-105	987.6	224.0	-126.2	-48.5	77.7
R-106	1,048.0	213.0	-168.7	-74.6	94.1
R-107	1,620.2	214.0	-139.3	-79.3	60.0
R-108[2]	-	-	-	-	-
R-109	1,574.3	243.0	-141.6	-68.7	72.9
T-110	1,092.8	278.0	-166.2	-60.8	105.4
R-111	1,051.3	264.0	-169.8	-72.1	97.7
T-112	1,023.7	249.0	-194.3	-78.3	116.0
R-113	991.7	236.0	-168.6	-75.3	93.3
T-114	1,606.8	240.0	-200.9	-123.8	77.1
R-115[2]	-	-	-	-	-
R-116	1,621.2	245.0	-147.8	-122.4	25.4
R-117[1]	-	-	-	-	-
Weighted Average:	**13,609.3**	**238.9**	**-158.7**	**-81.6**	**77.2**

[1]This R-monument resides within in the tapered fill.

[2]A lack of easement prevented full nourishment near R-108 and R-115.

5.0 ST. AUGUSTINE INLET TIDAL DELTA BATHYMETRIC ANALYSIS

The St. Augustine Inlet complex is a coast-parallel lagoon estuary that feeds a small tidal salt marsh, as much of the estuary is brackish to fully marine (from tidal oscillations). Tides in the project area are semi-diurnal with a mean tidal range of around 4.6 ft and spring high tides of roughly 6.5 ft (Section 0). The wind and wave conditions are seasonal, where the greatest wave energy is generally experienced during the months of October to April with high-wind nor'easter events, notwithstanding tropical cyclones that also impact the area over summer and fall months. Nor'easters generate wind-driven waves averaging 4.0 to 6.0 ft in height with longer mean wave periods than that of summer events (9 to 12 seconds versus 5 to 8 seconds). The summer season typically experiences mild wind and wave conditions that yield average wave heights of approximately 1.0 to 3.5 ft in height and shorter mean wave periods. These conditions (a relatively large tidal range and persistent fall-to-spring nor'easter events) result in a highly dynamic inlet complex with swift ebb-flood currents and southerly net longshore sediment transport.

Although the St. Augustine Inlet ebb-tidal morphology consists of relatively comparable forcing from both tides and waves (the inlet is nearly mesotidal with moderate wave action), the St. Augustine Inlet's flood-tidal morphology is dependent on the geological boundaries that limit hydraulic pathways and the forcing mechanisms that transport and deposit sediment. The combination of tide and wave energy results in spatial sediment transport patterns, where the northern up-drift portion of the inlet's ebb experiences greater wave forcing and operates as a wave-dominated shoal, and the flood shoal complex is significantly influenced by flood tidal currents (USACE, 2012b). Notably, ebb-tidal sediment transport in this region is comprehensively described in USACE (2012c), the Sediment Compatibility Analysis and QA/QC Plan detail the area's sediment characteristics and compliance measures for this project, and Section 3.1 and Appendix A summarize the 2021 post-construction geotechnical findings from flood shoal dredging operations.

5.1 2021 CSRM Pre-Dredge (Jul 2020) to 2021 CSRM Post-Dredge (Apr. 2021) Bathymetric Survey Comparison

Authorized dredge depths for the 2021 CSRM nourishment project varied across the five segments in the three borrow areas detailed in Section 1.1 and shown in Figure 2, where target and maximum dredge depths differed by 1 ft. The maximum dredge depth for the IWW Widener was set to an elevation of -16.9 ft-NAVD. The North Flood Shoal (both A and B) was authorized for maximum dredging to an elevation of -20.0 ft-NAVD. Maximum dredge depths for Davis Shoal varied by section; Davis Shoal A was authorized to be dredged to an elevation of -20.0 ft-NAVD, and Davis Shoal B was authorized to be dredged to an elevation of -16.0 ft-NAVD. Notably, the permit modification issued on 23 October 2020 changed the North Flood Shoal B borrow area maximum dredge depth from an elevation of -24.0 ft-NAVD to -20.0 ft-NAVD during dredging operations.

The 2021 CSRM nourishment project placed 1,297,862 cy of beach-compatible material within the project area. A comparison of the 2021 pre- and post-dredge bathymetric conditions across these five segments shows a total loss of approximately -1,369,887 cy, or roughly 5.5% more than the placed volume. Further, approximately 56.6% of the total borrow area volume loss was encompassed within the North Flood Shoal B segment (-774,786 cy). The entire survey extent lost around -1,091,624 cy, indicating roughly 278,262 cy accumulated outside the borrow area boundaries. Most of this accretion appears to occur in the central portion of the ebb shoal, the southeastern portion of the ebb shoal's seaward extreme, parts of the Federal navigation channel, and in the nearshore zone of eastern Porpoise Point. Table 14 summarizes the volume changes in the 2021 CSRM nourishment project's borrow areas and the overall volume changes across the entire inlet complex within the common survey boundary domain. Figure 10 shows

the 2021 CSRM pre-dredge bathymetric condition, Figure 11 presents the 2021 CSRM post-dredge bathymetric condition, and Figure 12 displays the 2021 pre-dredge to 2021 post-dredge bathymetric changes.

Table 14. Borrow Area Volume Changes

Computation	2021 CSRM Pre-Dredge to 2021 CSRM Post-Dredge Bathymetric Changes (cy)						
	Full Survey Extent	Borrow Area Segment					
		North Flood Shoal A	North Flood Shoal B	IWW Widener	Davis Shoal A	Davis Shoal B	
Cut:	-3,155,230	-293,732	-774,876	-98,993	-128,748	-91,655	
Fill:	2,063,606	16,395	90	1,583	49	0	
Net:	**-1,091,624**	**-277,337**	**-774,786**	**-97,410**	**-128,699**	**-91,655**	
Total Borrow Area Net:		**-1,369,887**					

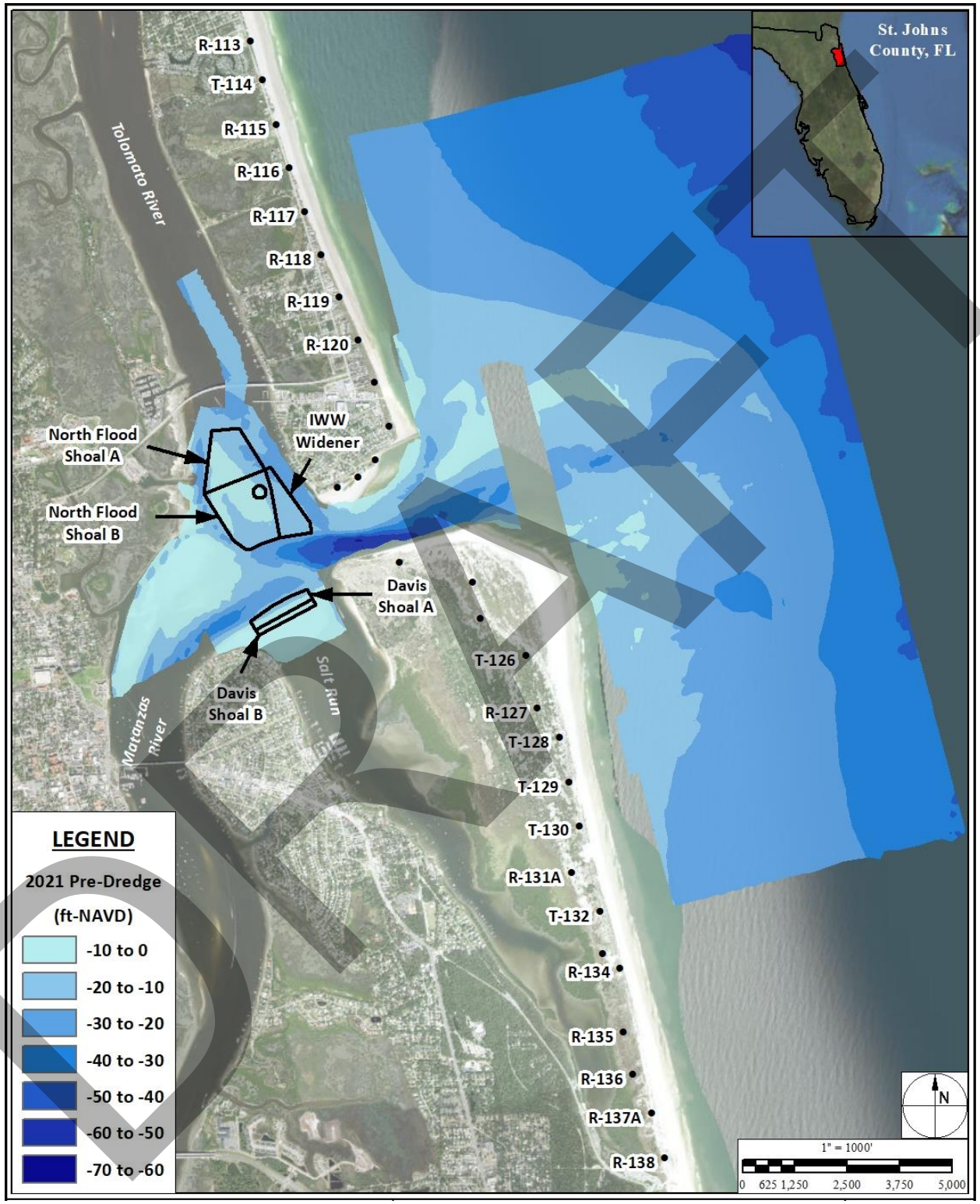

Figure 10. 2021 CSRM Pre-Dredge Bathymetric Conditions

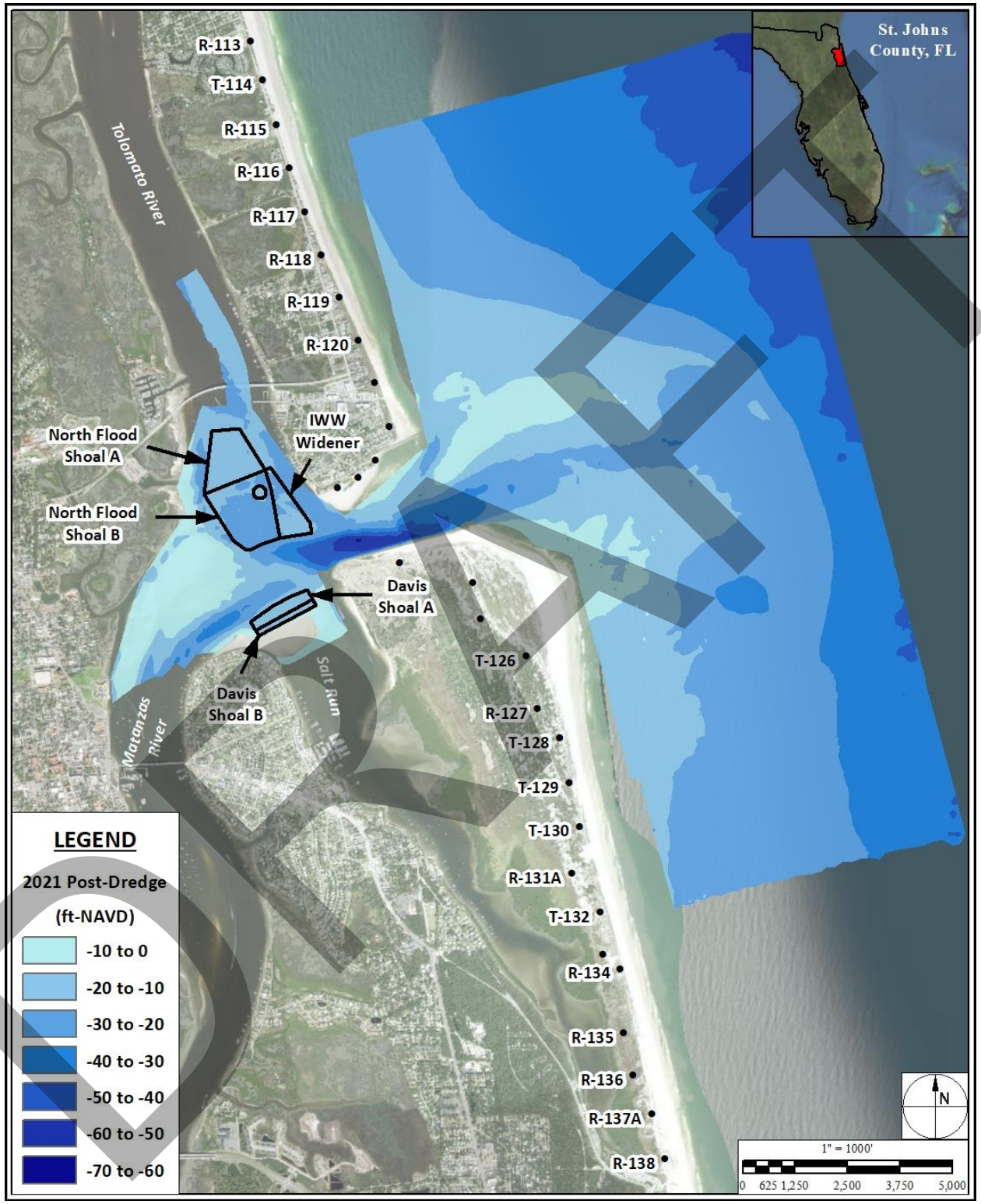

Figure 11. 2021 CSRM Post-Dredge Bathymetric Conditions

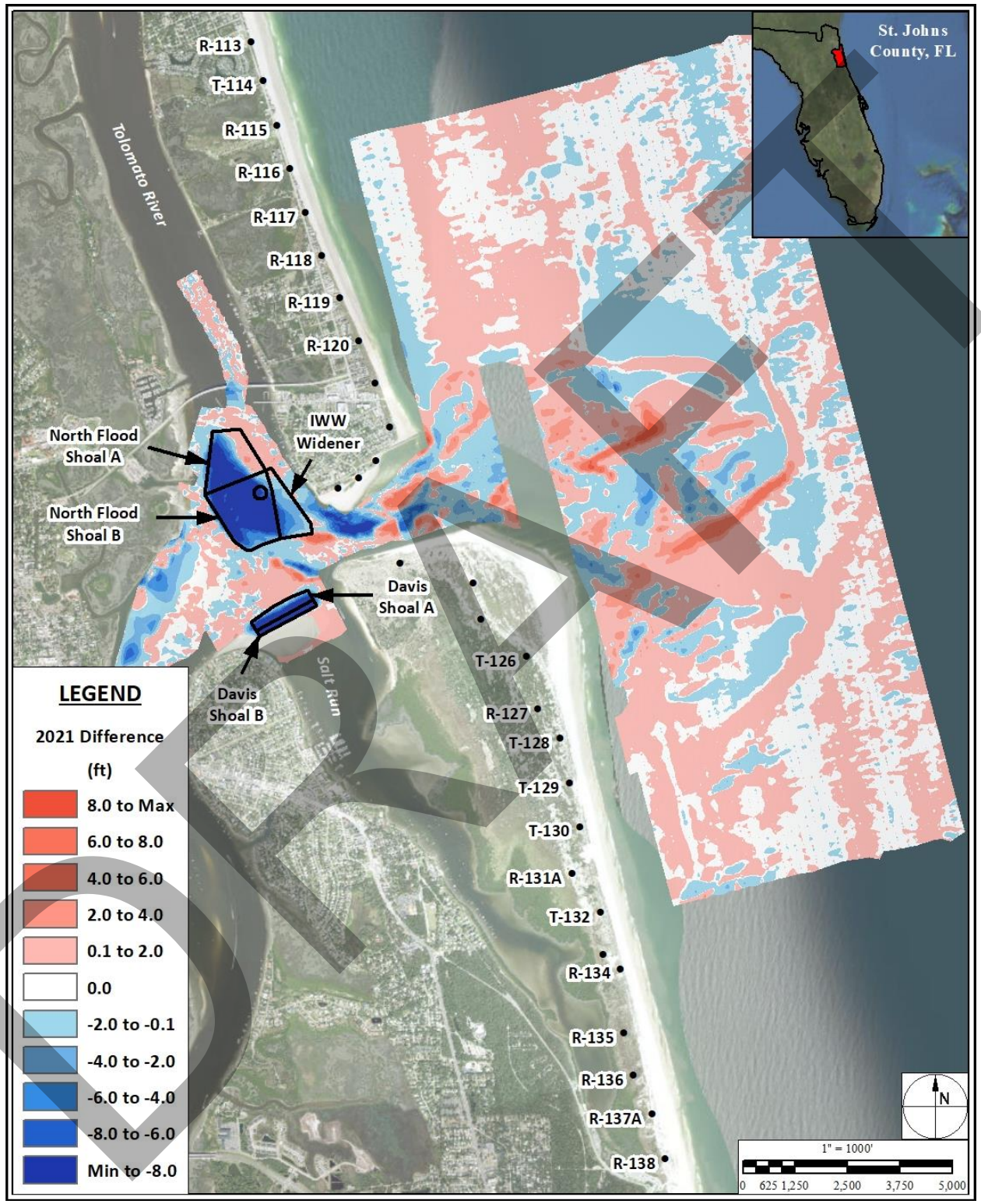

Figure 12. 2021 CSRM Pre-Dredge to 2021 CSRM Post-Dredge Bathymetric Changes

6.0 POST-CONSTRUCTION BEACH SEDIMENT COMPLIANCE VERIFICATION

Post-construction sediment sampling and analyses were conducted by the USACE in April 2021 in accordance with FDEP Permit File No. 0377120-002-JC requirements. The St. Johns County CSRM nourishment project complied with the FDEP's 'Sand Rule' guidelines (Florida Administration Code 62B-41.007(2)(j)) and FDEP Permit requirements detailed in the QA/QC plan. Fifteen (15) post-construction beach samples were collected from South Ponte Vedra and Vilano Beach on 02 March 2021 from R-103 to R-117. The samples were collected within the design template's berm area and taken at approximately 1,000-ft increments adjacent to FDEP R-monuments. Surficial sediment samples were collected from a depth of approximately 1.0- to 1.5-ft below the ground's surface.

One sediment sample contained shell retained on the #4 sieve above the Sediment QA/QC Plan's 5% shell content compliance threshold. However, the composite percent shell for all samples was well below the threshold at 1.67%, as shown in Table 15. All other post-construction sample values were below the compliance values, and the outlier mentioned previously is believed to be due to natural variation within the sand source. The USACE believes the percent shell compliance violation is minor and does not warrant the Sediment QA/QC Plan's remediation activities. Full documentation of the St. Johns County CSRM Post-Construction Sampling Report is detailed in Appendix A.

Table 15. South Ponte Vedra and Vilano Beach Composite Sediment Compliance Values

Sediment Parameter	Compliance Value	Post-Construction Composite Value
	QA/QC Plan	South Ponte Vedra and Vilano Beach
Percent Silt Passing the #230 Sieve	5.00%	0.22%
Percent Shell retained on the #4 Sieve	5.00%	1.67%
Munsell Color Value (Chroma ≤ 2)	6 or Lighter	7

7.0 CONCLUSIONS

This report satisfies the 2021 post-construction physical monitoring requirements for the St. Johns County CSRM nourishment project as required by FDEP Permit File No. 0377120-001-JC. Physical monitoring of this project is necessary to assess project performance and to ensure that project functionality is maintained throughout the 50-year period of Federal participation. The PMP (USACE, 2020a) is directed primarily toward accomplishing systematic measurements of the beach profile shape. Profile surveys document beach and dune conditions, allowing the engineer to monitor project performance, observe seasonal and storm-induced variability in profile shape, and assess the need for design adjustments. Engineering analyses using these surveys is vital to understanding the effects of nourishment activities and the overall evolution of the project beach. Engineering analyses for beach monitoring include tracking of shoreline and berm position, volume change computations, and berm position assessments. Analyses for borrow area monitoring included a full inlet tidal delta bathymetric analysis.

A total of 1,297,862 cy of beach-compatible sediment was hydraulically dredged from five segments in three flood shoal borrow areas within the St. Augustine Inlet's flood tidal delta and placed onto the critically eroded shoreline in South Ponte Vedra and Vilano Beach in St. Johns County, Florida. The 15.3-mile-long span of beach from South Ponte Vedra Beach at R-80 to St. Augustine Beach at T-157 and the St. Augustine Inlet's tidal delta complex were analyzed in this report using 2021 pre-construction and 2021 post-construction survey data of the beach and borrow areas. The beach north of the St. Augustine Inlet experienced a shoreline advance of 75.9 ft on average and an average volume gain of 89.7 cy/ft (1,407,826 cy) within the active profile. The overall volume gain was around 7.8% greater than the fill volume placed, likely reflecting contractor over-fill and possibly indicating net longshore transport was flowing south into the project area from northerly-adjacent beaches. Volume analyses above MHW and below -20 ft-NAVD showed general erosion in the north and south control areas, whereas the nearshore zone between MHW and -20 ft-NAVD north of the inlet showed an average volume gain of 35.5 cy/ft. This likely indicates fill material placed on the dry beach migrated seaward and settled in a nearshore bar. Porpoise Point generally experienced shoreline retreat and volume loss to the east and shoreline advancement and a stable volume to the west. St. Augustine Beach south of the inlet experienced mixed overall erosion and accretion from R-125 to T-157, but moderate to major shoreline retreat in the center of the SPP nourishment area and just south of the inlet. Borrow area surveys reveal -1,369,887 cy were eroded from all borrow areas cumulatively, which was roughly 5.5% more than the total volume dredged for the nourishment project. The entire survey extent lost -1,091,624 cy, indicating roughly 278,262 cy accumulated outside the borrow area boundaries. Most of this accretion appears to occur in the central portion of the ebb shoal, the southeastern portion of the ebb shoal's seaward extreme, parts of the Federal navigation channel, and in the nearshore zone of eastern Porpoise Point.

The USACE recommends that St. Johns County continue collecting and analyzing periodic beach profile and borrow area bathymetry data in compliance with FDEP Permit File No. 0377120-001-JC. These data, and subsequent engineering analyses, help provide a better understanding of regional morphodynamics and assist in future project planning. Succeeding monitoring efforts and associated engineering analyses should continue to study the dry beach above MHW within the CSRM project area, the recent severe erosion at Porpoise Point, and erosional areas immediately south of the St. Augustine Inlet and in St. Augustine Beach to track beach erosion or recovery.

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