

Photo Date: 8 April 2024



Bald Head Island, N.C. Beach Monitoring Program

Monitoring Report No. 22 (May 2023 to April 2024)

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Village of Bald Head Island

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September 2024

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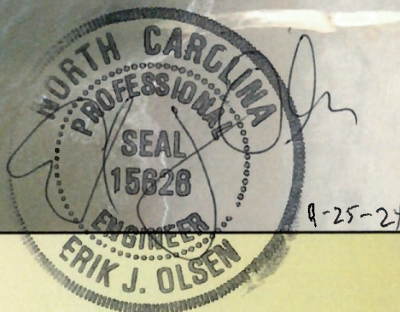
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EXECUTIVE SUMMARY

The most recent Wilmington Harbor Inner Ocean Bar maintenance dredging of Bald Head Shoal Channel Ranges 1 and 2, and the Smith Island Channel range was performed in the months of December 2022 – March 2023. Federal surveys show approximately 1.3 Mcy of sand during that operation were dredged with placement along South Beach pursuant to the terms of the Wilmington Harbor Sand Management Plan (WHSMP). Oak Island will be the recipient of the next tentatively scheduled 2024/25 beach federal disposal operation in accordance with the continued implementation of the present day WHSMP. As a result, the Village will contract for a locally constructed beach renourishment project in the winter of 24/25

It is presently proposed that the next Village sponsored project (in 2024/2025) will seek to place up to 1.0 Mcy of sand along two (2) sections of shoreline located at the opposite ends of South Beach. The final Contract amount will depend upon Bid costs and conditions at the time of construction. The easternmost segment of approximately 0.5 Mcy (Bid as an Option) is intended to briefly address the chronic erosion that’s been occurring for a number of years in the vicinity of the Shoals Club at Cape Fear. On the western end of South Beach an estimated 0.5 Mcy fill (Base Bid) will address the filling of the terminal groin template, as well as the section of shoreline extending throughout the limits of the sand tube groinfield. Subsequent to fill placement at that location, the Village will contract to remove and replace thirteen sandtube groins which have reached the end of their effective life. The groinfield was last replaced in its entirety in 2019 concurrent with a Village renourishment project. For purposes of constructing both the Base Bid and a potential Option (totaling up to 1.0 Mcy), a pre-existing (but depleted) borrow site at Jay Bird Shoals has been expanded to the north. As of March 2024, all Permitting had been completed for the proposed project.

Between November 2000 and April 2024, Bald Head Island had received up to 9.9 Mcy, mol of sand from the initial widening/deepening and six (6) subsequent maintenance dredging operations for the Wilmington Harbor Navigation Project entrance channel. Including the 2019 project, the Village has placed another 3.2 Mcy of sand along the West Beach and South Beach shorelines. Accordingly, in the net Bald Head Island has experienced a total *estimated* sand placement volume of approximately 13.1 Mcy since 2000 at those two locations – with South Beach todate receiving 97% or more of the total.

Conversely, the *gross* volumetric sediment *loss* over a November 2000 to April 2024 monitoring timeframe is conservatively computed at -9,166,800 cy, or approximately -398,600 cy per year – on “average”. This annualized “loss” addresses the continuous section of Bald Head Island shorefront extending from the marina entrance to the Cape Fear spit. The

assignment of an *average annual* long-term rate of sand loss at Bald Head Island however, has *not* necessarily been a meaningful indicator of navigation project impact. Such an average rate is often temporally biased by periods of beach fill equilibration, groinfield “effectiveness due to gradual deterioration,” major storm events (such as Hurricanes Florence, Dorian and Isaias), the occurrence of episodic destabilization dredging events in close proximity to the island, as well as other physiographic phenomena temporally affecting annualized quantities of alongshore sediment transport – from Bald Head Island. In addition, the westernmost segment of the island’s littoral system has had to adjust to the quasi-stabilizing effect of the terminal groin at that location in existence only since 2015. Along South Beach per se, there has historically existed a “nodal point” some 7,000 ft. eastward of the terminal groin (approx. STA 116+00). At or close to the nodal point, the directionality of *net littoral transport* on an annual basis changes from West (toward the groin) to East (toward Cape Fear). *Note* – depending on wave climatology, the condition and exposure of the sand tube groinfield, as well as other factors, the effective location of the nodal point can vary slightly along South Beach from year to year. As of April, 2024, within the 22,755 ft of shoreline influenced by sand episodically placed since 2000, up to +3,717,000 cy remain in the littoral system (measured above elevation -16 ft. NGVD 29). This *includes* the most recent 1.3 Mcy beach disposal project completed in early 2023 by the Wilmington District, USACE which beneficially affects this total.

Although not directly impacted by long-term navigation channel improvements and maintenance of the Cape Fear River entrance, the Village Council elected to initiate monitoring of the East Beach shorefront at Bald Head Island beginning in November 2008. Since that time, it is documented that East Beach can undergo strong seasonal variations of beach width and profile volume to a large degree dependent upon storm frequency and intensity, as well as the ever-changing configuration of the Cape Fear spit. For example, the most recent April 2024 survey data show a net shoreline volumetric loss of approximately -87,300 cy (above elevation -16 ft NGVD). throughout the 6,000 ft East Beach shoreline lying northward of Cape Fear over the last 12 months. In the prior year, this reach gained about +18,400 cy. Between November 2008 and April 2024, the shoreline gained +293,800 cy. Most of the East Beach volume increase had been caused by post-storm accretion of the portion of the Cape Fear spit shoreline which fronts Onslow Bay.

Typically, periods of episodic accretional configurations of the Cape Fear spit deemed beneficial to East Beach have corresponded to a high rate of erosion and duneline recession along the easternmost section of South Beach – directly seaward and westward of the Shoals Club facility. For example, between 2000 and 2020, the average MHWL erosion rate at that general location has been over -20 ft/yr – due to sand losses either directly or indirectly associated with the configuration of the Cape Fear spit formation. Although a 2021 federal beach disposal project placed fill within 2,000 ft. mol. of the Shoals Club and Cape Fear, erosion has continued to the point that the Club was required to install a sandbag revetment seaward of the property in May/June 2022. That revetment requires continuing maintenance due to episodic beach profile lowering at that location and the effects of storms.

In 2024, the Village performed monitoring of the Jay Bird Shoals borrow site utilized to construct the non-federal 1.85 Mcy beach fill sponsored by the Village in 2009/10 and the 1.10 Mcy beach constructed in 2018/19. During the monitoring period (May 2023 to April 2024), the fifth year following the 2018/19 project excavation, the entire permitted borrow site lost -27,400 cy (inclusive of the exclusion and buffer zones). As of April 2024, there is theoretically 1,360,400 Mcy of material located within the originally *permitted borrow site limits* above the permitted design cut elevation (-22 ft-NGVD). Most of that material is *not* however practically available for dredging at this time. Hence, an extension of the original JBS borrow site limits was required to act as a fill source for the upcoming Village beach fill project to be constructed in 24/25.

After an extension of the two marina entrance channel jetties in 2015, temporarily reduced shoaling within the navigation channel resulted in a corresponding reduced volume of disposal sand being placed along the Row Boat Row shoreline. Although the Village had planned to continue to proactively bypass sand from the south jetty fillet (located at the distal end of West Beach) to the Row Boat Row shorefront, it became clear that the existing four (4) low level timber groins were not capable of providing an acceptable level of shoreline stabilization at that location.

Hence, near the end of the 2017 monitoring period, the Village initiated construction of two (2) shore parallel detached rock breakwaters located north of the marina entrance seaward of the Row Boat Row shoreline. The placement of breakwaters between existing groins northward of the marina entrance was intended to combine the attributes of each of the two types of stabilization structure so as to reduce the rate of sediment transport from the eroding shoreline caused principally by ferry/barge generated waves. The subject expanded shore stabilization project (detached breakwaters *and* existing groinfield) was designed to have a sand fill prior to construction. Since construction multiple channel maintenance/sand bypass operations have occurred – most with increasing volumes dredged. Typically, dredging is required twice a year on average. This is primarily due to an increasing northerly rate of sediment transport along West Beach caused by a continuing reconfiguration of the Point

In the spring of 2019, the Village resubmitted permit applications accompanied by indepth geotechnical studies and environmental analyses intended to develop a long term (and large scale) supplementary borrow site located within Frying Pan Shoals. The purpose of such a borrow site would be to both ensure compliance with Permit conditions necessitating the maintenance of the updrift fillet associated with the 2015 terminal groin project and to provide an interim source of beach quality material sufficient to meet future South Beach renourishment requirements – when pursuant to the existing tenets of the Wilmington Harbor Sand Management Plan, beach quality channel maintenance material excavated would be placed at Oak Island. In 2021, a pre-project fisheries monitoring plan was submitted for purposes of addressing regulatory agency concerns. In April 2022, the Village acknowledged certain regulatory “concerns” may not be resolved in the near future. Subsequently, the Village authorized work intended to expand the Jay Bird Shoals borrow site for purposes of providing a sand source for the next Village sponsored fill event – when federal beach disposal is contractually redirected to Oak Island.

The original Permits for construction of the terminal groin at Bald Head Island stipulated that *if* the permittee elected to dredge more than 250,000 cy from the Jay Bird Shoals borrow site after 2015, limited monitoring of the eastern end of Oak Island must be performed. Accordingly, in November 2018, the Village initiated the requisite monitoring at Oak Island (Caswell Beach). The first report of findings for Oak Island followed a November 2019 monitoring survey. A second-year monitoring report was issued in December 2020. In early 2021 it was formally agreed by DCM and the USACE that based upon the results of the Year 2 report, the *Village's responsibility for continued monitoring of Oak Island has terminated*. It is important to note that a specific Permit term associated with the northern extension of the Jay Bird Shoals borrow site has included a requirement that the Village reinstate its monitoring program for Caswell Beach for some indeterminate period of time. Said monitoring will begin at/or after the proposed beach renourishment project scheduled for completion prior to 1 April 2025.

It should be noted that exacerbated sand losses throughout a portion of the sand tube groin field occurred over the 1-year monitoring period addressed herein. Although not specifically quantified by this report, coincident degradation and failure of several sand tube groins has occurred (as of September 2024). Surveys show that the measured sand loss throughout the proposed limits of beach fill in 2024/2025 within the westernmost segment of the South Beach project exceeds 400,000 cy – through April 2024. Visual observation of shoreline sand losses since that date indicate that the proposed 500,000 cy Segment A beach fill at the location may not be sufficient to allow for coverage of existing groins required for successful sand-tube replacement. As a result, it may be necessary for the Village to consider increasing the placement sand volume within Segment A (west end of South Beach) and coincidentally reduce the contracted Segment B sand volume proposed for placement updrift of Cape Fear (east end of South Beach).

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1.0 INTRODUCTION

1.1 Overview

This engineering report presents measured physical changes along the South Beach, West Beach, East Beach and Row Boat Row shorelines of Bald Head Island (BHI) based principally upon both historical and updated monitoring surveys performed annually on behalf of the Village of Bald Head Island (Village). It likewise addresses actions taken by the Village or others which have or could affect shoreline conditions. More, specifically, this report addresses:

- (1) An overview of Bald Head Island’s physical setting including a discussion of the Federal Navigation Channel and the status of the implementation for the Wilmington Harbor Sand Management Plan (WHSMP).
- (2) Recent volume and shoreline position changes measured between monitoring surveys of May 2023, November 2023 and April 2024 along the West Beach, "the Point" and South Beach shorelines, as well as *long-term changes* since November 2000. Updates of East Beach and the Cape Fear Spit conditions are likewise provided, as well as nearterm changes for the Row Boat Row shoreline which receives episodic sand placement associated with routine marina entrance channel sand bypass operations.
- (3) A discussion of the most recent Federal Beach Disposal Project constructed along the majority of S. Beach between December 2022 and March 2023 which has been subject to equilibration over the past year, mol.
- (4) An update on the implementation of the Wilmington Harbor Sand Management Plan and its required beach disposal at Caswell Beach.
- (5) Recent work including the receipt of permits to expand the Jay Bird Shoals borrow site for purposes of a 2024/2025 Village beach renourishment project.

1.2 Physical Setting

Bald Head Island is located in Brunswick County, North Carolina at approximately 33°51' N, 78°00' W (**Figure 1.1**). It is roughly 25 miles south of the City of Wilmington and 32 miles east of the South Carolina/North Carolina state line. It is the southernmost of the coastal barrier islands which form the Smith Island complex at the mouth of the Cape Fear River. The southeastern tip of the island is Cape Fear (also referred to as Cape Fear Point) from which Frying Pan Shoals extend seaward over 20 miles to the southeast.

The island's east and south shorelines, "East Beach" and "South Beach", front the Atlantic shoreline. The west shoreline, or "West Beach", fronts the Cape Fear River. The north side of the island is bounded by the Bald Head Creek estuary, Middle Island and Bluff Island. The Cape Fear River entrance, over one mile in width, separates Bald Head Island from Oak Island (or Caswell Beach).

The astronomical tides in the vicinity of Bald Head Island are semi-diurnal and have average mean and spring ranges of approximately 4.3 ft and 5.0 ft, respectively. Tidal datums for Bald Head Island are listed in **Table 1.1** and the predicted astronomical tides during the May 2022 to May 2023 monitoring period are plotted as **Figure 1.2**.

Table 1.1: Tidal datums for Bald Head Island, North Carolina¹.

Datum	Elevation (ft-NGVD29 ²)
Mean Higher High Water (MHHW)	+2.82
Mean High Water (MHW)	+2.51
NAVD 1988	+1.10
Mean Tide Level (MTL)	+0.35
NGVD 1929	0.00
Mean Low Water (MLW)	-1.81
Mean Lower Low Water (MLLW)	-1.98

¹ Approximations based upon extrapolation from Southport, N.C.

² NGVD 1929: National Geodetic Vertical Datum of 1929 (1929 Mean Seas Level). Horizontal coordinates are referenced to the North Carolina State Plane Coordinate System, North American Datum of 1983.

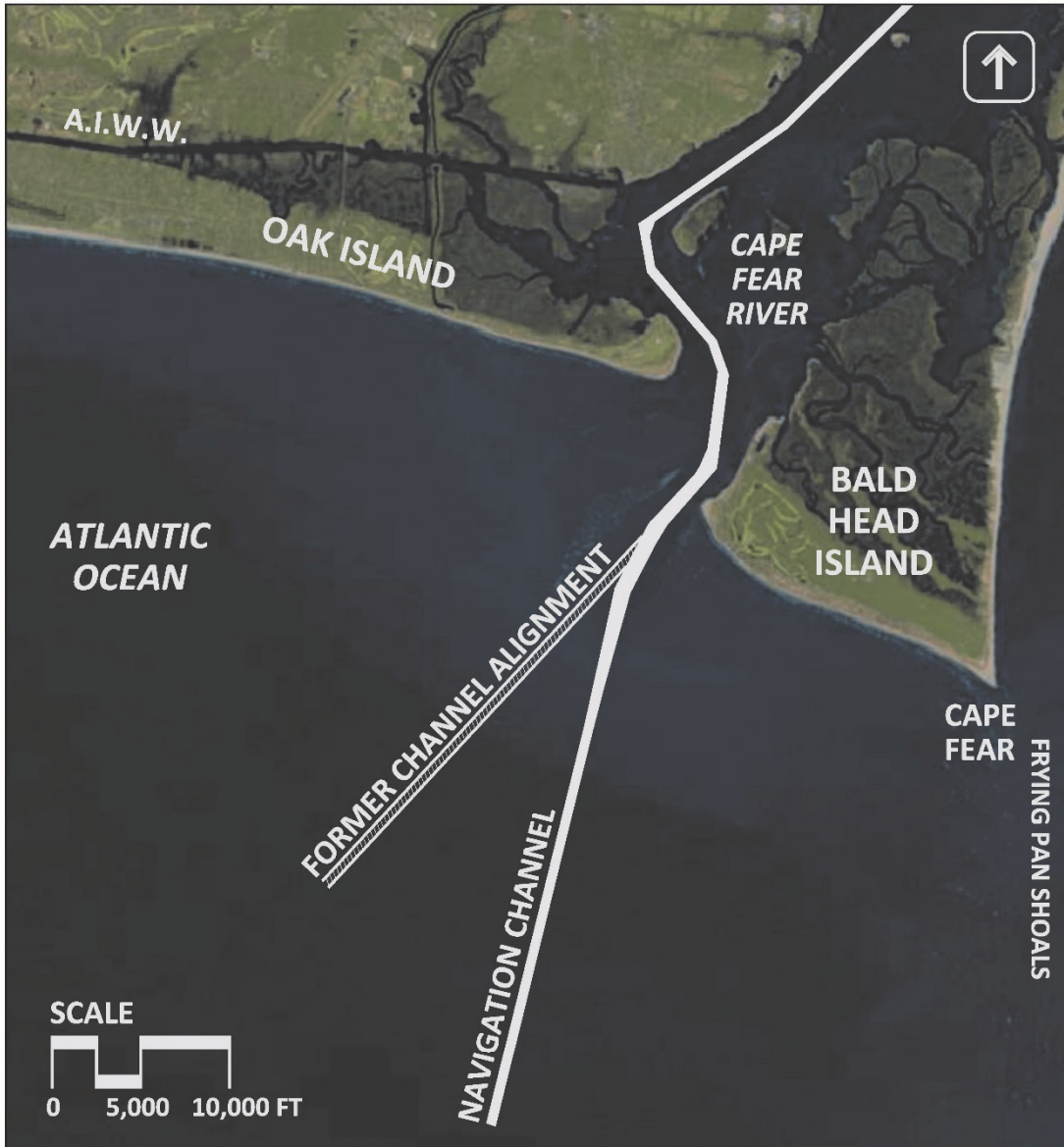
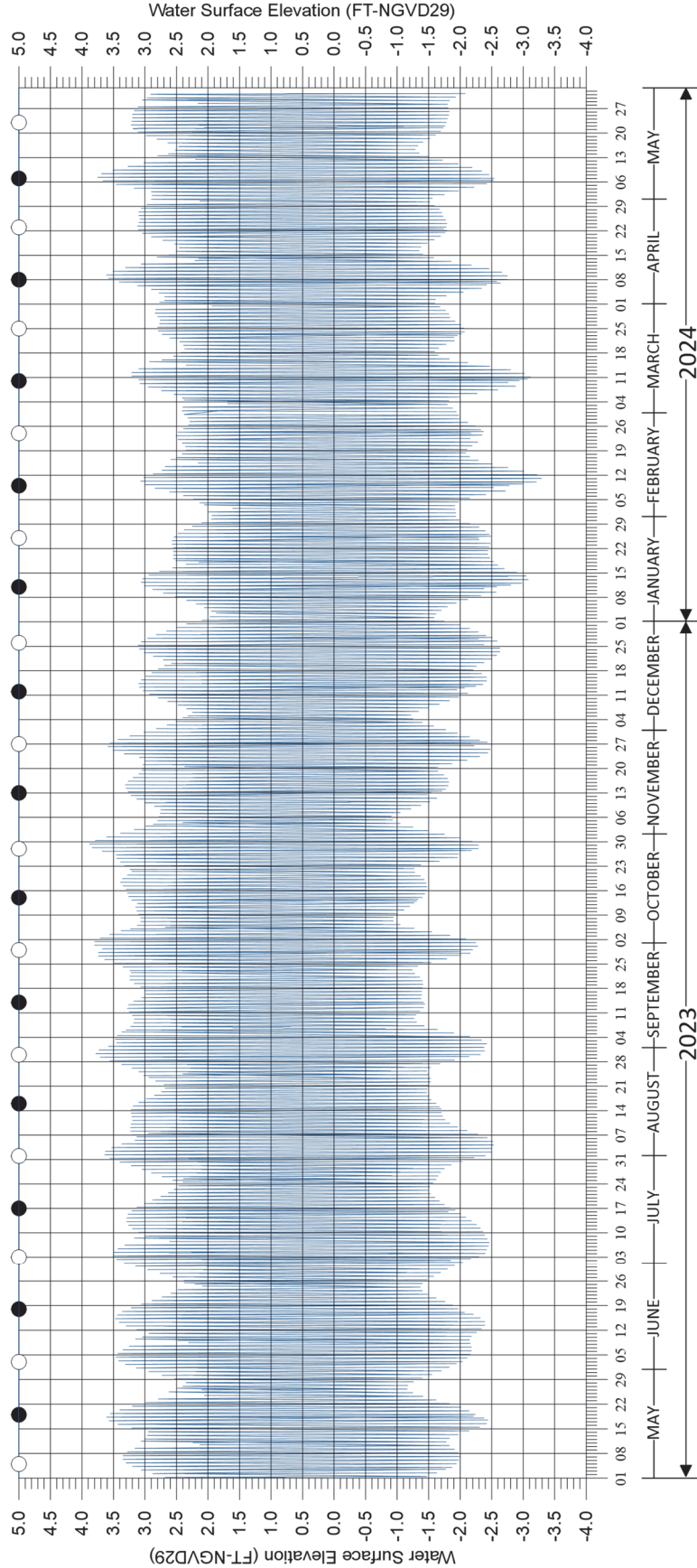


Figure 1.1: Location of Bald Head Island, N.C. and Federal Navigation Channel.

May 2023 through May 2024 Predicted Astronomical Tides Bald Head Island, North Carolina



Reference: NOAA, Station ID: 8658120
 Bald Head Island, Cape Fear River, NC
 Latitude: 33° 52.8 N, Longitude: 78° 0.1 W
 Epoch: 1983-2001
 Elevations relative to FEET-NGVD29
 NOT FOR PURPOSES OF NAVIGATION

LEGEND
 ● NEW MOON ○ FULL MOON

Datum Elevations
 MHHW = +2.82 FT-NGVD
 MHW = +2.51 FT-NGVD
 MTL = +0.35 FT-NGVD
 MLW = -1.81 FT-NGVD
 MLLW = -1.98 FT-NGVD



1.3 Monitoring Period Wave Climate (May 2023 to April 2024)

Figure 1.3 displays a time series of significant wave heights measured at NOAA Buoy 41108 from May 2023 through April 2024. NOAA Buoy 41108 is located roughly 9 miles south of Bald Head Island in approximately 42 feet of water. The buoy was deployed in March 1988 and has been collecting data nearly continuously for 35+ years except for an approximate five year period between April 1992 and May 1997 and several other periods lasting a few weeks or less in duration. The data collected by the buoy includes significant wave height (average of the highest one-third of all waves in a 20-minute sampling period), wave period, wave direction, wind speed and other standard meteorological data.

The average significant wave height³ at NOAA Buoy 41108 during the Year 23 monitoring period (May 21, 2023 to April 10, 2024⁴) was 3.41 feet with a maximum wave height of 16.24 ft measured on December 17, 2022 during a Nor'easter. The Year 23 average value is approximately 6 percent higher than the full record average significant wave height of 3.22 feet (March 1988 through April 2024) and 4 percent higher than the Year 22 average wave height (3.27 feet).

During the Year 23 monitoring period, roughly 5.8 percent of the recorded wave heights were above 6 feet, compared to 5.6 percent for the full record average. That is, there were roughly 4 percent fewer wave events recorded above 6 feet during the Year 23 monitoring period than would be expected during a typical similar period of time. During Year 23 monitoring period, the occurrence of waves above 10 feet was also slightly higher than the full record average (0.5 percent for Year 23 compared to 0.3 percent for the long-term average).

³ These measurements reflect the significant wave height, or the average of the highest 1/3rd of waves passing the buoy during a 20 minute sampling period.

⁴ The May 2023 beach profile survey was completed May 21, 2023, the November 2023 survey on November 28, 2023 and the April 2024 survey completed on April 10, 2024.

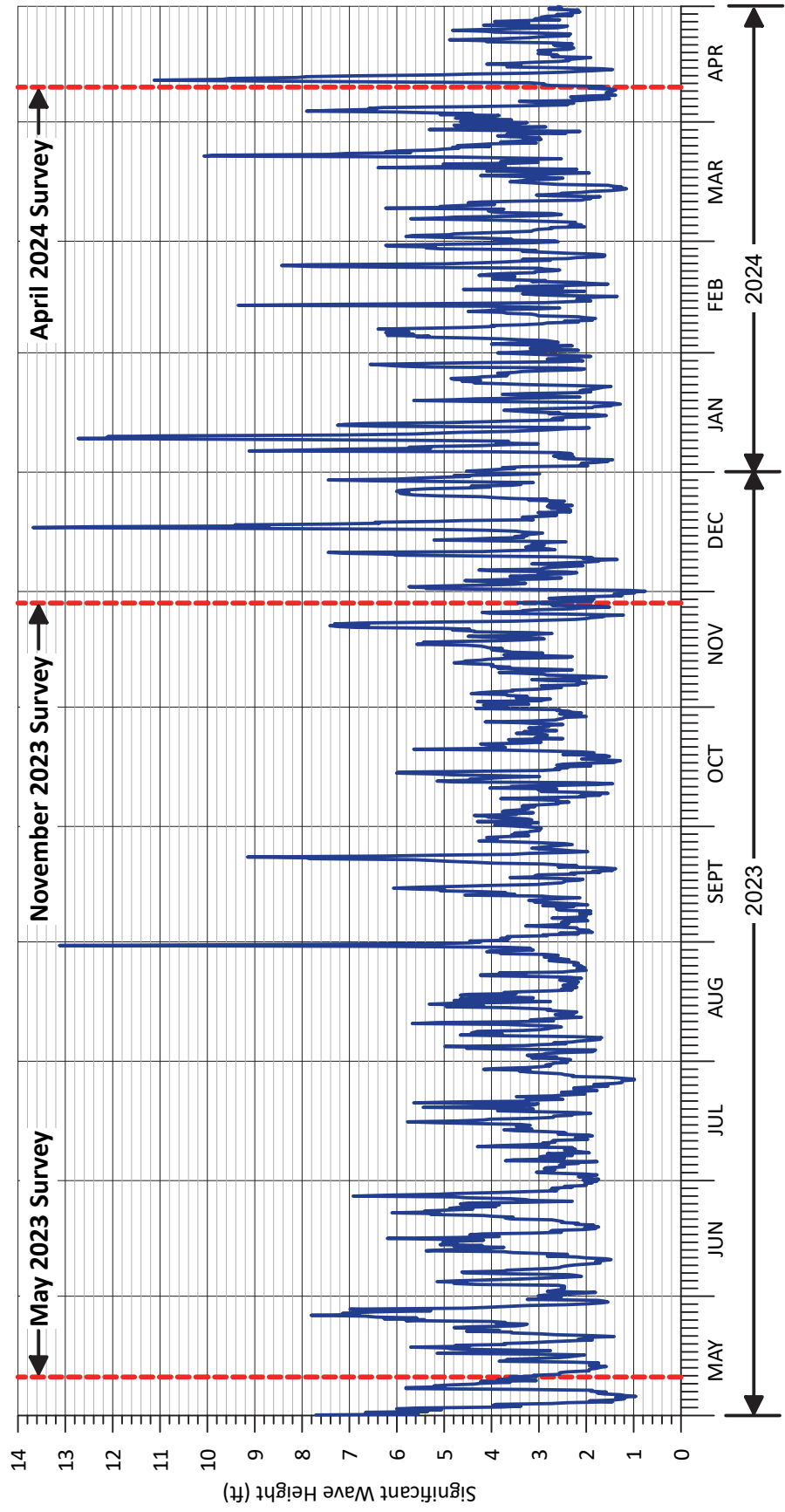


Figure 1.3: Significant wave heights recorded by NOAA Buoy 41108 during the 2023-24 monitoring period (Wilmington Harbor, NC).

1.4 Wilmington Harbor Federal Navigation Channel and Sand Management Plan

A detailed discussion of the history of the navigation channel and the Wilmington Harbor Sand Management Plan (WHSMP) is provided in Monitoring Report No. 15 (Olsen 2017).

The Wilmington Harbor Federal Navigation Project extends up the Cape Fear River from a point seven statute miles seaward of the Bald Head Island Marina, upstream 30.4 miles to a location just north of the City of Wilmington, N.C. The Wilmington District, U.S. Army Corps of Engineers (USACE) is responsible for maintaining the project at its congressionally authorized depths and widths.

The Wilmington Harbor Sand Management Plan (USACOE 2000) was formulated as a specific action element of the deepening project for Wilmington Harbor. For the most part, the Plan was in direct response to the stated concerns of the Village of Bald Head Island regarding the historical harbor maintenance impacts and potential new impacts of the deepening project to both the regional sediment budget and Bald Head Island. The Plan's stated purpose was to reverse the practice of placing beach quality sand in the off-shore disposal area by calling for placement of this sand onto adjacent beaches. Over a theoretical six-year biennial maintenance cycle, the initial Wilmington Harbor Sand Management Plan (WHSMP) stipulated that approximately 1.0 Mcy of sand was to be placed on the beaches of Bald Head Island in years two and four (*after* initial construction) and on Oak Island/Caswell Beach during year six. The six-year disposal cycle was proposed for the life of the project but, accordingly to its terms, could be altered based upon documentation of impacts to adjacent beaches, changes in conditions and other relevant factors. The first six-year (3 maintenance event) cycle was completed in April 2009. In early 2011, the Wilmington District issued a draft report-of-findings both summarizing approximately 10-years of monitoring and readdressing the tenets of the original (2000) Sand Management Plan based upon their interpretation of monitoring results, related analyses and other salient factors or considerations. Subsequently the District solicited public comments from the two (2) principal stakeholders – the Village of Bald Head Island and Caswell Beach.

It has been OAI's continuing opinion that the division of sand between the two (2) abutting shorefronts of Oak Island and Bald Head Island should be based upon the cumulative quantities of sediment *lost* from each shoreline over the prior dredging cycle(s) as documented by survey, as well as identifiable impacts which exceed the November 2000 (pre-project) benchmark survey. Alternatively, it should be based upon the ratio of documented littoral transport rates for each island toward the Cape Fear River. Pursuant to the existing Plan however, the most recent disposal operation at South Beach occurred in the winter/spring months of 2022/2023. A subsequent tentatively scheduled disposal event will address the eastern end of Oak Island at Caswell Beach between Nov 2024 and April 2025.

1.5 Historical Erosion Control Activities (1991 to 2024)

1.5.1 Channel Maintenance Beach Disposal and Beach Restorations – Chronology

Beach fill placement activities constructed at Bald Head Island since 1991 are summarized in **Table 1.2**. Not including disposal operations after 2018/19, a detailed discussion of the history of channel maintenance beach disposal and beach restoration activities is provided in Monitoring Report No. 15 (Olsen 2017).

Table 1.2: Beach disposal or sand placement activities at Bald Head Island since 1991.

Year	Volume	Sponsor	Location
1991	0.35 ± Mcy	VBHI	(Sta. 24+00 to 138+00)
1996	0.65 ± Mcy	VBHI	(Sta. 24+00 to 142+00)
1997	0.45 ± Mcy	VBHI	(Sta. 24+00 to 128+00)
2001	1.849 ± Mcy	USACE*	South Beach (Sta. 41+60 to 205+50)
2005	1.217 ± Mcy	USACE*	South Beach (Sta. 46+00 to 126+00)
2006	47,800 cy	VBHI	West Beach (Sta. 16+00 to 34+00)
2007	0.9785 ± Mcy	USACE*	South Beach (Sta. 46+00 to 174+00)
2009/10	1.850 ± Mcy	VBHI	West Beach (Sta. 8+00 to 32+00) South Beach (Sta. 40+00 to 190+00)
2012	137,990 cy	FEMA/VBHI	West Beach & Western South Beach
2013	1.566 ± Mcy	USACE*	South Beach (Sta. 44+00 to 150+00)
	92,500 cy		West Beach (Sta. 8+00 to 27+00)
2015	1.33 ± Mcy	USACE*	South Beach (Sta. 41+50 to 154+00)
2016/17	50,000 cy	VBHI	West Beach and Row Boat Row
2018/19	1.1 Mcy	VBHI	South Beach (Sta. 49+00 to Sta. 146+00)
2021	1.61 Mcy	USACE	South Beach (Sta. 60+00 to Sta. 212+00)
2023	1.3 Mcy	USACE	South Beach (Sta. 60+00 to Sta. 165+00)

* Disposal pursuant to the WHSMP. Dredge volume estimate (pre-losses).

1.5.2 Erosion Control Structures (1996 to 2024) - Chronology

Erosion control structures constructed at Bald Head Island since 1996 are summarized in **Table 1.3**. A detailed discussion of the (pre-2021) history of erosion control structures is provided in Monitoring Report No. 15 (Olsen 2017).

Table 1.3: History of erosion control structures at Bald Head Island since 1994.

Year	Location	Description
1994	Western South Beach	Sand bag revetment located along 645 feet of the back-beach berm
1996 (March)	Western South Beach	Sixteen (16) soft groins (geotube-type structures) were constructed of geotextile material and sand fill
2003/2004	Western South Beach	Rehabilitation of 1994 constructed sand bag revetment. Revetment lengthened by approximately 200 feet and base width increased to 40 ft and crest elevation raised to +12 ft-NGVD).
2005 (January to March)	Western South Beach	Replacement of 1996 constructed sand tube groin field. Minor changes in groin location were made in an effort to improve performance. Similarly, experimental “tapered” tubes were deployed in an attempt to better accommodate beach profile recession over time.
2009	Western South Beach	Complete rehabilitation of the sand tube groin field. Some adjustment of groin lengths, and the westward relocation of groin no. 16 were made in an attempt to refine the project design.
2011	Western South Beach	300 ft sand bag revetment was constructed on the downdrift (western side) of the last sand tube groin in order to protect several endangered residential structures.
2013	Western South Beach	In the spring of 2013, the westernmost five (5) sand tube groins were replaced in their entirety. This work was co-funded by FEMA as part of a post-Irene damage mitigation effort. The project P.W. was BHGJS04 in accordance with FEMA declaration 4019 DR NC.
2015	Western South Beach	In the spring of 2015, construction was initiated on a single 1,300 ft. long rock terminal groin designed to complement future placement of beach fill at South Beach. At that time, the westernmost three (3) geotube groins were removed in their entirety. A detailed description of the project is provided in Monitoring Report No. 15 (Olsen 2017).
2015	Bald Head Marina	The two marina entrance channel structures seaward of Row-Boat-Row originally constructed by Bald Head Island, Ltd., were modified through the addition of rock extensions.
2017	Row Boat Row	Two (2) detached breakwaters were constructed just north of the Marina Entrance. Construction details are provided in Monitoring Report No. 16 (Olsen, 2018).
2019	Western South Beach	All remaining 13 sand tube groins were removed and replaced coincident with the 2019 beach fill.
2022	Eastern South Beach	A major sand tube revetment was constructed seaward of the Shoals Club property.

2.0 PHYSICAL MONITORING PROGRAM

2.1 Monitoring Baseline & Beach Profiles

MONITORING BASELINE The present day Bald Head Island monitoring baseline extends roughly 31,400 ft from the northern end of Row Boat Row (Sta. -014+72), southward along West Beach, around “the Point”, then eastward along South Beach to Cape Fear and finally northward along East Beach (Sta, 284+00). The individual profile stationing and coordinates are listed in **Table 2.1** and graphically depicted in **Figure 2.1**.

BEACH PROFILES In order to document and assess any potential adverse effects of the Wilmington Harbor Navigation Channel Navigation project to Bald Head Island, the Village Council initiated a comprehensive beach monitoring program which commenced in 1999. As part of the present-day program onshore and offshore profiles are measured annually at seventy-nine (79) stations spaced approximately 400 ft apart along the roughly 31,400 ft of Bald Head Island’s shoreline. Since October 2003 profiles have been surveyed at 6 month intervals (i.e. fall and spring). The primary focus of this monitoring report (No. 22) is beach profile and shoreline changes occurring over the latest set of surveys (May 2023 to November 2023 to April 2024).

Typically, survey transects extend across the upland berm or from the dune line seaward a distance of up to 3,000 ft. Depending upon the location of the survey profile, this distance corresponds to offshore waters depths of at least -40 ft relative to NGVD within the Cape Fear River Channel and -16 ft-NGVD along the Atlantic Ocean shoreline. In **Chapter 5.0**, these surveys are intra-compared in order to determine trends in the condition of the beaches of Bald Head Island. Plots of selected historical comparative beach profile data (through April 2024) are provided in **Appendix A**.

Prior to October 2003, fifty-five (55) stations were surveyed as part of the monitoring program. Five (5) additional intermediate stations were added at the Point, commencing with the October 2003 survey. These profile stations were added to more accurately capture the extreme changes that occur at the Point. Seven (7) profiles were added along East Beach (EB-01 to EB-07) beginning with the November 2008 survey. Beginning with the November 2015 survey five (5) profiles were added along Row Boat Row and four (4) were added at the Point, as part of the terminal groin monitoring requirement. Finally, in November 2016, three (3) additional profiles were added along West Beach.

Table 2.1: Bald Head Island baseline stationing and beach monitoring profile locations.

Station (Monument)	Station Location		Grid Azi. (Deg.)	Station	Station Location		Grid Azi. (Deg.)
	Easting (FT-NAD83)	Northing (FT-NAD83)			Easting (FT-NAD83)	Northing (FT-NAD83)	
Row Boat Row				084+16 (B-22)	2,303,032.1	40,924.5	219
-014+72 (RB-01)	2,304,277.9	49,117.4	302	088+23 (B-23)	2,303,372.1	40,705.0	214
-012+00 (RB-02)	2,304,068.6	48,776.5	302	092+15 (B-24)	2,303,714.1	40,513.9	209
-008+00 (RB-03)	2,303,937.2	48,538.1	302	097+10 (B-25)	2,304,146.1	40,272.5	206
-004+00 (RB-04)	2,303,728.0	48,197.2	302	102+08 (B-26)	2,304,592.1	40,057.6	204
-003+00 (RB-05)	2,303,518.7	47,856.3	302	106+00 (B-27)	2,304,960.4	39,915.3	201
West Beach				110+00 (B-28)	2,305,333.5	39,771.1	201
000+00 (B-01)	2,303,309.3	47,515.5	302	114+00 (B-29)	2,305,708.5	39,626.3	202
004+00 (B-02)	2,303,100.4	47,174.4	301	118+00 (B-30)	2,306,080.6	39,482.5	202
008+00 (B-03)	2,302,891.5	46,833.3	301	122+00 (B-31)	2,306,451.7	39,339.2	201
010+00 (I-03)	2,302,788.1	46,662.0	301	126+00 (B-32)	2,306,824.0	39,195.3	200
012+00 (B-04)	2,302,682.5	46,492.2	301	130+00 (B-33)	2,307,196.5	39,051.4	200
014+00 (I-04)	2,302,578.8	46,321.1	301	134+00 (B-34)	2,307,569.6	38,907.3	200
016+00 (B-05)	2,302,473.6	46,151.1	301	138+00 (B-35)	2,307,943.9	38,767.8	200
018+00 (I-05)	2,302,369.5	45,980.3	301	142+00 (B-36)	2,308,320.5	38,633.0	200
020+00 (B-06)	2,302,264.7	45,810.0	301	146+00 (B-37)	2,308,697.1	38,498.2	200
024+00 (B-07)	2,302,055.2	45,468.8	302	150+00 (B-38)	2,309,073.8	38,363.4	200
"the Point"				154+00 (B-39)	2,309,452.4	38,228.0	201
028+00 (B-08)	2,301,845.1	45,126.6	303	158+00 (B-40)	2,309,818.8	38,074.6	202
032+00 (B-09)	2,301,566.1	44,843.7	301	162+00 (B-41)	2,310,179.1	37,895.6	203
034+00 (I-09)	2,301,394.4	44,742.0	301	166+00 (B-42)	2,310,539.0	37,716.9	204
036+00 (B-10)	2,301,220.2	44,647.1	299	170+00 (B-43)	2,310,903.5	37,552.0	204
038+00 (I-10)	2,301,043.1	44,550.6	296	174+00 (B-44)	2,311,267.9	37,387.2	204
039+60 (B-11)	2,300,902.6	44,473.9	291	178+00 (B-45)	2,311,632.4	37,222.3	204
041+50 (I-11)	2,300,765.0	44,365.0	287	182+00 (B-46)	2,311,996.9	37,057.4	204
043+47 (B-12)	2,300,757.5	44,167.6	284	186+00 (B-47)	2,312,361.3	36,892.6	204
044+25 (I-12)	2,300,754.6	44,090.2	276	190+00 (B-48)	2,312,725.8	36,727.8	204
045+07 (B-13)	2,300,751.4	44,007.0	268	194+00 (B-49)	2,313,090.2	36,562.9	204
046+00 (I-13)	2,300,784.9	43,920.7	260	198+00 (B-50)	2,313,454.7	36,398.1	204
046+89 (B-14)	2,300,813.7	43,836.0	251	202+00 (B-51)	2,313,819.2	36,233.2	204
049+00 (H-13)	2,300,881.5	43,636.5	247	206+00 (B-52)	2,314,183.6	36,068.4	204
050+50 (I-14)	2,300,913.5	43,541.9	247	210+00 (B-53)	2,314,548.1	35,903.5	204
051+00 (J-14)	2,300,945.8	43,447.1	247	214+00 (B-54)	2,314,912.5	35,738.7	204
052+64 (B-15)	2,300,998.3	43,292.1	243	218+00 (B-55)	2,315,277.0	35,573.8	204
054+00 (I-15)	2,301,042.2	43,163.0	243	East Beach			
South Beach				224+80 (EB-01)	2,315,748.8	36,063.3	90
056+56 (B-16)	2,301,148.7	42,933.8	233	234+80 (EB-02)	2,315,748.8	37,063.3	90
060+51 (B-17)	2,301,399.6	42,628.3	230	244+80 (EB-03)	2,315,748.8	38,063.3	90
065+50 (B-18)	2,301,716.0	42,243.2	229	254+80 (EB-04)	2,315,748.8	39,063.3	90
069+46 (B-19)	2,301,967.6	41,937.0	227	264+80 (EB-05)	2,315,748.8	40,063.3	90
073+39 (B-20)	2,302,246.1	41,660.5	223	274+80 (EB-06)	2,315,748.8	41,063.3	90
076+37 (B-21)	2,302,609.2	41,320.5	222	284+80 (EB-07)	2,315,748.8	42,063.3	90



Figure 2.1:
Island-wide beach monitoring baseline.

MHWL SURVEYS As part of the permit required monitoring for the terminal groin project completed in late 2015, post-construction MHWL surveys were initiated in November 2015. Each survey was specified to begin at the Marina entrance (Sta. 0+00) and extend to St. 75+00, about 3,000 ft eastward of the terminal groin head. On an annual basis, surveys are to be intercompared to assess both updrift fillet conditions and the location of the downdrift shoreline fronting the Cape Fear River.

2.2 Bald Head Creek Borrow Site Surveys

The Bald Head Creek borrow site and adjacent areas utilized for the 2017 Shore Stabilization Project constructed by Marcol Dredging were monitored at 6 months and thereafter annually for the following 3 years. **Table 2.2** summarizes selected surveys collected to date. *No survey was required or conducted during the current monitoring year.* The purpose of the monitoring is to document hydrographic changes throughout the borrow site and in particular areas which were “over-dredged” by the Contractor. Of specific interest to State and Federal regulatory agencies has been the rate of recovery and the composition of the material that infills the area(s) excavated by hydraulic dredge below that addressed by permit. In addition to annual surveys, limited grab samples and sediment analysis are performed by the firm LMG. The Marcol March 2017 AD Survey is considered as the “baseline condition”. As of May 2019, physical monitoring was deemed complete. Subsequent monitoring has not occurred.

Table 2.2: Selected Bald Head Creek borrow site surveys collected as of May 2023.

Borrow Site Survey Date	Comment
March 2012	After Dredge (AD) Survey (11/12 Project)
January 2013	10 Months Post-Dredge (11/12 Project)
December 2013	21 Months Post-Dredge (11/12 Project)
April 2015	37 Months Post-Dredge (11/12 Project)
April 2016	49 Months Post-Dredge (11/12 Project)
November 2016	Before Dredge (BD) Survey (16/17 Project)
March 2017	After Dredge (AD) Survey (16/17 Project)
November 2017	7 Months Post-Dredge (11/12 Project)
May 2018	14 Months Post-Dredge (11/12 Project)
May 2019 ⁽¹⁾	26 Months Post-Dredge (11/12 Project)

(1) Last monitoring survey required.

2.3 Jay Bird Shoal Borrow Site Surveys

Permits for the last beach renourishment project constructed by the Village in 2019 necessitate the resurveying of the Jay Bird Shoal borrow site as part of the annual island-wide monitoring program. **Table 2.3** summarizes the borrow site surveys conducted to date. Specifically, borrow site surveys are required both pre- and post-excavation, as well as at 12-, 24- and 36-months and biennially thereafter. The area typically surveyed is 400-acres ± which includes a buffer area outside the original “permitted” limits of work.

Table 2.3: Jay Bird Shoal borrow site surveys collected as of April 2024.

Borrow Site Survey Date	Comment
October 2009	Before Dredge (BD) Survey (09/10 Project)
March 2010	After Dredge (AD) Survey (09/10 Project)
May 2011	14 Months Post-Dredge (09/10 Project)
May 2012	26 Months Post-Dredge (09/10 Project)
May 2013	38 Months Post-Dredge (09/10 Project)
April 2015	61 Months Post-Dredge (09/10 Project)
May 2017	86 Months Post-Dredge (09/10 Project)
November 2017	92 Months Post-Dredge (09/10 Project)
May 2018	98 Months Post-Dredge (09/10 Project)
September 2018	98 Months Post-Dredge (09/10 Project)
December 2018	Before Dredge (BD) Survey (19 Project)
March 2019	After Dredge (AD) Survey (19 Project)
May 2020	14 Months Post Project (19 Project)
May 2021	26 Months Post Project (19 Project)
May 2022	38 Months Post Project (19 Project)
May 2023	50 Months Post Project (19 Project)
April 2024	61 Months Post Project (19 Project)

2.4 Orthorectified Aerial Photography

In addition to the beach profile surveys, digital color aerial photography of the island’s shoreline has been acquired at a minimum, annually by Greenman-Pedersen, Inc.⁵ A complete listing of flights is being included in Monitoring Report 22. Reproductions of the three most recent aerial photography sets (May 2023, November 2023 and April 2024) are presented in **Appendices B, C and D**, respectively.

⁵ Greenman-Pederson, Inc.; 3909 Wrightsville Ave. Suite 200; Wilmington, NC 28403.

3.0 MONITORING (SURVEY) RESULTS

3.1 Methodology

For purposes of analysis and discussion, the Bald Head Island monitoring baseline is qualitatively broken into seven (7) shoreline segments, or zones of interest, with significantly varying physiographic characteristics as follows:

- Station -018+72 to -003+00 “Row Boat Row”
- Station -001+60 to 028+00 “West Beach”
- Station 028+00 to 046+00 “The Point” – North of Terminal Groin
- Station 046+00 to 056+56 “The Point” – South of Terminal Groin
- Station 056+56 to 214+00 “South Beach”⁶
- Station 214+00 to 224+80 “Cape Fear Point”⁷
- Station 224+80 to 284+80 "East Beach"

These zones differ slightly from the shoreline segments used monitoring reports prior to 2015 (OAI 2015). More specifically, “the Point” is now divided into two areas rather than one, based upon the location of the recently completed terminal groin. The update is intended to more accurately capture the influence of that structure on the physical processes along the Bald Head Island shoreline. Additionally, the “Row Boat Row” reach was added to the monitoring analysis with the initial monitoring surveys along this reach completed in November 2015.

Alongshore volume changes were calculated using an average end-area method, where the cross-sectional areas are determined by comparing beach profiles at each beach monitoring station above several different vertical datums. This approach allows evaluation of beach changes at different elevations along the project in addition to the total profile.

Average shoreline position changes were spatially weighted based upon the distance between stations due to the non-uniform alongshore spacing of survey monuments.

⁶ East of Sta. 214+00, the remaining 400 ft of surveyed Atlantic oceanfront shoreline becomes part of Cape Fear Point and is not included in the South Beach analysis due to its highly dynamic nature.

⁷ The general condition of the Cape Fear spit is qualitatively monitored primarily through controlled aerial photography as well as quarterly drone flights. This depositional feature is routinely subject to episodic periods of accretion and erosion resulting from eventual detachment via tidal channel breakthrough during storms. It is likewise influenced by beach fill activities and sediment added to the littoral system of South Beach as well as storm waves originating from the east or southeast.

3.2 Year 23: Monitoring Program (May 2023 – November 2023 – April 2024)

The May 2023 to April 2024 monitoring period represents the twenty-third year of measured shoreline change following completion of the initial 2001 Federal +1.849 Mcy beach disposal at Bald Head Island. For compliance purposes, the April 2024 survey represents the 5th year following completion of the +1.1 Mcy beach fill constructed by the Village of Bald Head Island in the winter of 2018/2019 at South Beach. This survey period also serves to document the first year following the March 2023 completion of a 1.1 Mcy Federal beach disposal project at S. Beach. Note – the contract dredge volume was 1.3 Mcy.

Volume changes between condition surveys were computed using the average end-area method above the mean high water line (MHWL; +2.51 ft-NGVD) and the assumed typical depth of closure (-16.0 ft-NGVD). **Tables 3.1** through **3.3** list the computed changes along the Bald Head Island shoreline for the May 2023 – November 2023 – April 2024 survey intervals. **Figures 3.1, 3.2** and **3.3** depict the cumulative and local volume changes for the same intervals. Changes in shoreline position at each station were computed at the MHWL and the seaward edge of berm (+6 ft-NGVD contour). The results are summarized in **Tables 3.4** and **3.5** and graphically depicted in **Figures 3.4** and **3.5** (relative to their *November 2000* pre-disposal locations).

3.3 West Beach, “The Point” and South Beach: Discussion

3.3.1 Survey Period: May 2023 to November 2023 (8 Months Post-Federal Beach Fill)

This survey period represents the first few months following a federal beach disposal project completed in March 2023.

As depicted in **Figure 3.1** and **Table 3.1**, the island-wide *net* shoreline volume change trend for this period was erosional with -469,400 cy (-20.6 cy/ft) of loss, mol. over the 6 month span above -16 ft-NGVD. Similarly, above the MHWL, the shoreline lost -25,400 cy

In the net, West Beach was accretional during this period gaining +1,300 cy above the MHWL and +8,400 cy between the MHWL and the -16 ft-NGVD contour. Overall West Beach gained roughly +9,700 cy above the -16 ft contour.

The entire 3,690 ft of “the Point” shoreline (Sta. 28+00 to 56+56) was net erosional during this monitoring period, losing -4,500 cy above -16 ft-NGVD. For purposes of evaluating the impacts of the terminal groin completed in November 2015, “the Point” shoreline is subdivided into two reaches with Sta. 46+00, the approximate location of the terminal groin, as the dividing station. North of the terminal groin (Sta. 28+00 to 46+00), the shoreline gained +17,000 cy above the MHWL and +10,500 above the -16 ft. NGVD contour. South of the

terminal groin (Sta. 46+00 to 56+56), the shoreline gained +8,800 cy above the MHWL and lost -15,000 cy above the -16 ft-NGVD.

South Beach was net erosional during the period, losing roughly -52,500 cy above the MHWL and -174,300 cy above -16 ft-NGVD.

3.3.2 Survey Period: November 2023 to April 2024 (13 Months Post-Federal Beach Fill)

As depicted in **Figure 3.2** and **Table 3.2**, the island-wide *net* shoreline volume change trend for this period was erosional with -396,400 cy (-17.4 cy/ft) of loss, mol. over the 5 month span above -16 ft-NGVD. Similarly, above the MHWL, the shoreline lost -257,300 cy

In the net, West Beach was accretional during this period with gains of +12,000 cy above the MHWL and +17,900 cy above the -16 ft contour.

Along “the Point” shoreline north of the terminal groin, the beach lost -9,800 cy above the MHWL and -17,000 cy above the -16 ft-NGVD contour. Along “the Point” shoreline south of the terminal groin, the beach lost -11,200 cy above the MHWL and -14,200 cy above -16 ft-NGVD.

South Beach was net erosional during this period, losing -248,300 cy above the MHWL and -383,100 cy above -16 ft-NGVD.

3.3.3 Year 23 Monitoring Results: May 2023 to April 2024 (Excluding East Beach & Row Boat Row)

During Year 23 in its entirety, the monitored portion of the island (excluding East Beach & Row Boat Row) experienced a net loss of -565,500 above the -16 ft contour (see **Table 3.3** and **Figure 3.3**). Above the MHWL, the island lost -282,700 cy.

Along West Beach, the shoreline gained approximately +13,300 cy above the MHWL and +27,600 cy above -16 ft-NGVD.

The entire Point shoreline (north and south of the terminal groin), experienced a net gain of roughly +4,800 cy above the MHWL and -35,700 cy above -16 ft-NGVD.

In the net, the South Beach shorefront lost -300,800 cy above the MHWL and -557,400 cy above -16 ft-NGVD.

Table 3.1: Bald Head Island shoreline volume change (May 2023 to November 2023).

	Start Station	End Station	Reach (FT)	Volume Change		Start Station	End Station	Reach (FT)	Volume Change			
				Above +2.51 (FT)	Above -16 (FT)				Above +2.51 (FT)	Above -16 (FT)		
West Beach	Jetty	000+00	160	-300	-500	056+56	060+51	423	-3,900	-10,300	South Beach	
	000+00	004+00	400	-600	-1,000	060+51	065+50	510	-6,100	-16,600		
	004+00	008+00	400	-200	-400	065+50	069+46	423	-4,000	-13,100		
	008+00	010+00	200	-100	0	069+46	073+39	442	-4,300	-14,800		
	010+00	012+00	200	-100	-100	073+39	076+37	516	-7,300	-21,000		
	012+00	014+00	200	-100	-100	076+37	084+16	611	-6,800	-12,100		
	014+00	016+00	200	-200	-100	084+16	088+23	471	-1,500	-700		
	016+00	018+00	200	-400	100	088+23	092+15	455	-800	-5,900		
	018+00	020+00	200	-500	-500	092+15	097+10	536	-1,200	-12,100		
	020+00	024+00	400	1,200	4,800	097+10	102+08	525	-2,400	-11,200		
	024+00	028+00	400	2,600	7,500	102+08	106+00	436	-3,600	-8,300		
Subtotal			2,960	+1,300	+9,700	106+00	110+00	400	-3,800	-7,300		
Point (North of Groin)	028+00	032+00	395	1,400	700	110+00	114+00	388	-3,700	-6,800		
	032+00	034+00	200	800	-100	114+00	118+00	407	-3,800	-6,200		
	034+00	036+00	210	1,700	2,400	118+00	122+00	413	-2,900	-4,400		
	036+00	038+00	230	2,600	6,400	122+00	126+00	405	-1,700	-3,300		
	038+00	039+60	230	3,400	11,100	126+00	130+00	405	-2,500	-4,500		
	039+60	041+50	220	3,600	12,700	130+00	134+00	398	-3,500	-5,100		
	041+50	043+47	220	2,300	4,500	134+00	138+00	401	-3,600	-5,300		
	043+47	044+25	190	1,100	-7,600	138+00	142+00	400	-3,400	-4,900		
	044+25	045+07	190	600	-10,800	142+00	146+00	400	-3,000	-4,200		
	045+07	046+00	200	-500	-8,800	146+00	150+00	399	-3,800	-7,900		
Subtotal			2,285	+17,000	+10,500	150+00	154+00	385	-3,500	-8,800		
Point (South of Groin)	046+00	046+89	200	-700	-8,700	154+00	158+00	383	-3,100	-8,000		
	046+89	049+00	250	1,400	-5,500	158+00	162+00	386	-3,800	-9,500		
	049+00	050+50	100	1,400	100	162+00	166+00	393	-2,100	-9,200		
	050+50	051+00	100	1,300	300	166+00	170+00	394	2,100	-3,400		
	051+00	052+64	240	3,400	1,900	170+00	174+00	400	5,000	2,900		
	052+64	054+00	135	1,500	700	174+00	178+00	400	5,200	8,000		
	054+00	056+56	380	500	-3,800	178+00	182+00	400	4,200	8,800		
	Subtotal			1,405	+8,800	-15,000	182+00	186+00	400	3,600	5,100	
Note: Elevations are referenced to NGVD 1929.												
						186+00	190+00	400	3,200	3,700		
						190+00	194+00	400	2,800	-1,700		
						194+00	198+00	400	1,800	-5,300		
						198+00	202+00	400	600	-3,100		
						202+00	206+00	400	1,400	4,300		
						206+00	210+00	400	3,800	12,300		
						210+00	214+00	400	3,900	15,600		
						Subtotal			16,105	-52,500	-174,300	
						Bald Head Total			22,755	-25,400	-169,100	

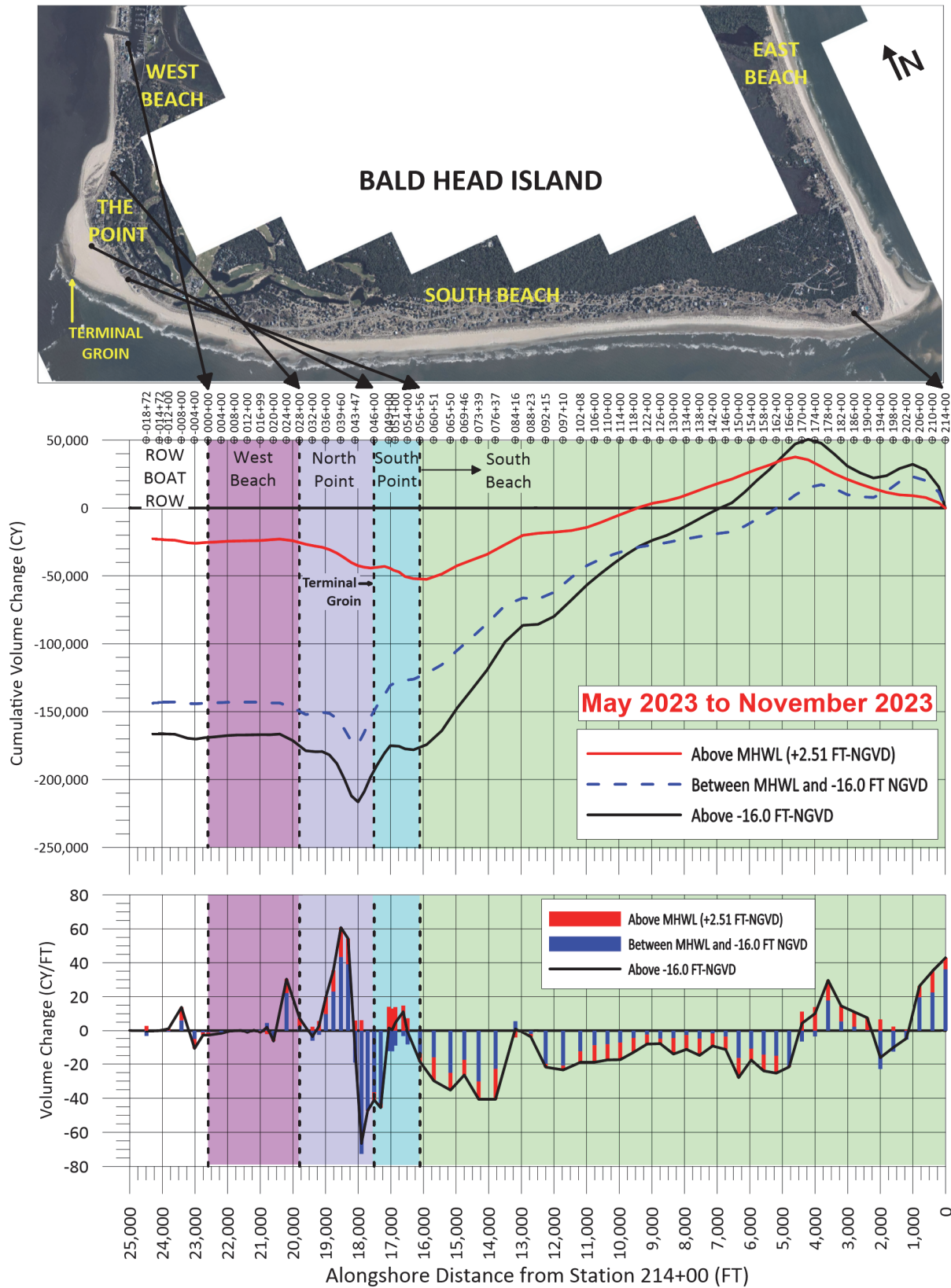


Figure 3.1: Volume change along the Bald Head Island shoreline between May 2023 & November 2023.

Table 3.2: Bald Head Island shoreline volume change (November 2023 to April 2024).

	Start Station	End Station	Reach (FT)	Volume Change		Start Station	End Station	Reach (FT)	Volume Change		
				Above +2.51 (FT)	Above -16 (FT)				Above +2.51 (FT)	Above -16 (FT)	
West Beach	Jetty	000+00	160	1,500	2,200	056+56	060+51	423	-6,100	-17,600	South Beach
	000+00	004+00	400	1,700	2,200	060+51	065+50	510	-8,200	-26,600	
	004+00	008+00	400	-100	-1,000	065+50	069+46	423	-8,900	-29,000	
	008+00	010+00	200	100	-400	069+46	073+39	442	-7,900	-24,300	
	010+00	012+00	200	200	-200	073+39	076+37	516	-4,700	-16,900	
	012+00	014+00	200	100	-200	076+37	084+16	611	-7,700	-23,400	
	014+00	016+00	200	200	-200	084+16	088+23	471	-7,800	-20,200	
	016+00	018+00	200	600	200	088+23	092+15	455	-7,800	-15,200	
	018+00	020+00	200	1,100	1,600	092+15	097+10	536	-10,600	-14,500	
	020+00	024+00	400	3,400	8,400	097+10	102+08	525	-9,900	-13,500	
024+00	028+00	400	3,200	5,300	102+08	106+00	436	-8,200	-12,500		
	Subtotal	2,960	+12,000	+17,900	106+00	110+00	400	-7,300	-11,800		
Point (North of Groin)	028+00	032+00	395	1,200	-3,400	110+00	114+00	388	-6,800	-9,700	
	032+00	034+00	200	200	-2,200	114+00	118+00	407	-7,200	-7,300	
	034+00	036+00	210	600	200	118+00	122+00	413	-7,600	-6,700	
	036+00	038+00	230	600	3,000	122+00	126+00	405	-7,100	-7,600	
	038+00	039+60	230	-300	-600	126+00	130+00	405	-6,700	-5,500	
	039+60	041+50	220	-1,200	-6,700	130+00	134+00	398	-6,700	-6,700	
	041+50	043+47	220	-2,400	-6,700	134+00	138+00	401	-6,800	-10,100	
	043+47	044+25	190	-3,100	500	138+00	142+00	400	-7,100	-10,300	
	044+25	045+07	190	-3,100	800	142+00	146+00	400	-7,800	-11,800	
	045+07	046+00	200	-2,300	-1,900	146+00	150+00	399	-8,200	-14,400	
	Subtotal	2,285	-9,800	-17,000	150+00	154+00	385	-7,800	-13,900		
Point (South of Groin)	046+00	046+89	200	-800	2,000	154+00	158+00	383	-7,900	-12,600	
	046+89	049+00	250	-600	3,100	158+00	162+00	386	-7,500	-12,300	
	049+00	050+50	100	-500	-100	162+00	166+00	393	-5,900	-8,500	
	050+50	051+00	100	-800	-600	166+00	170+00	394	-4,600	-2,500	
	051+00	052+64	240	-2,400	-3,800	170+00	174+00	400	-4,500	-500	
	052+64	054+00	135	-1,400	-3,100	174+00	178+00	400	-4,600	0	
	054+00	056+56	380	-4,700	-11,700	178+00	182+00	400	-4,400	-4,600	
		Subtotal	1,405	-11,200	-14,200	182+00	186+00	400	-4,100	-4,200	
Note: Elevations are referenced to NGVD 1929.											
						186+00	190+00	400	-4,500	-5,400	
						190+00	194+00	400	-4,900	-4,600	
						194+00	198+00	400	-4,700	1,600	
						198+00	202+00	400	-4,000	3,700	
						202+00	206+00	400	-3,900	0	
						206+00	210+00	400	-4,400	-4,400	
						210+00	214+00	400	-3,500	700	
						Subtotal	16,105	-248,300	-383,100		
						Bald Head Total	22,755	-257,300	-396,400		

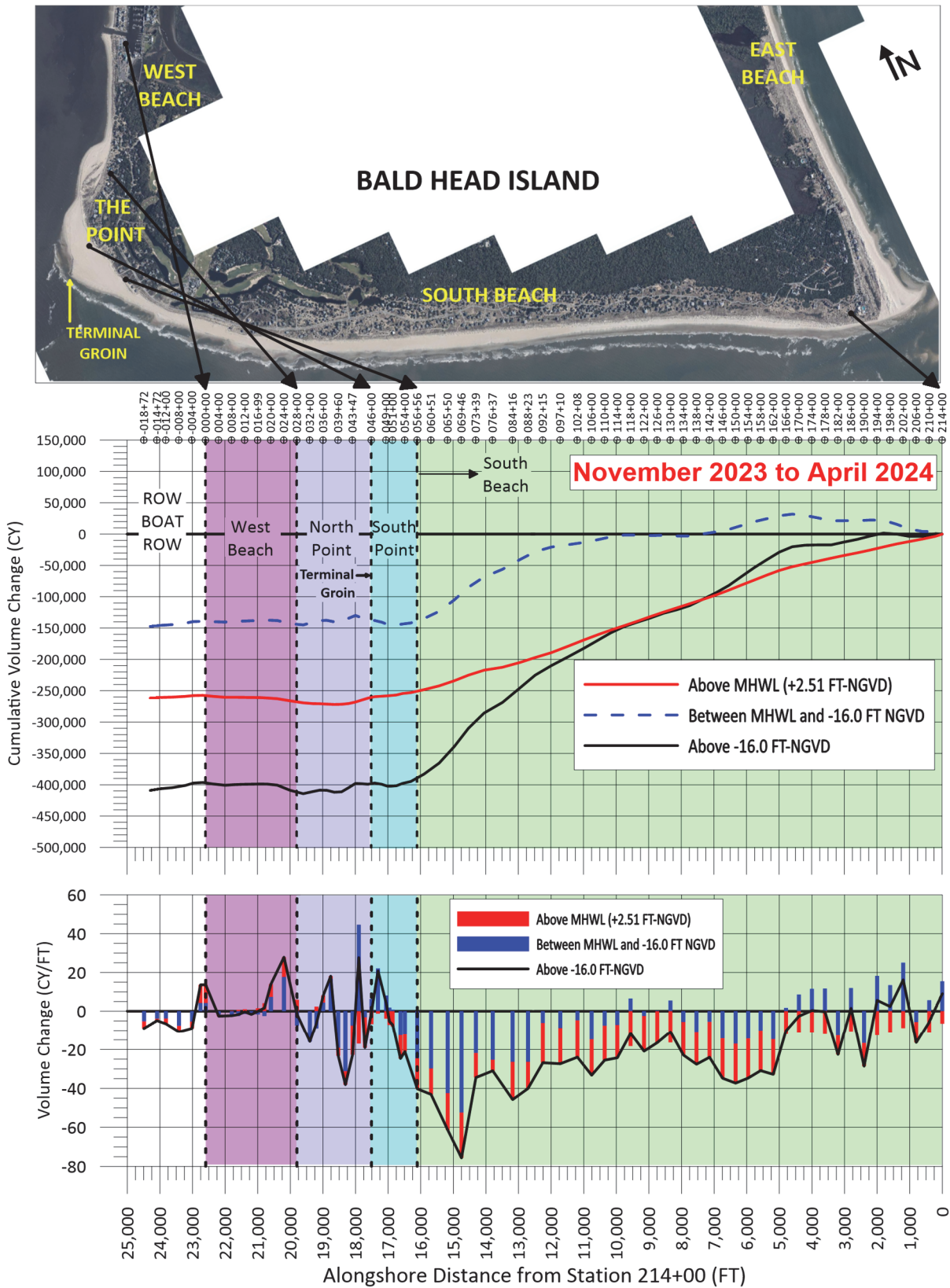


Figure 3.2: Volume change along the Bald Head Island shoreline between November 2023 & April 2024.

Table 3.3: Bald Head Island shoreline volume change (May 2023 to April 2024).

	Start Station	End Station	Reach (FT)	Volume Change		Start Station	End Station	Reach (FT)	Volume Change		
				Above +2.51 (FT)	Above -16 (FT)				Above +2.51 (FT)	Above -16 (FT)	
West Beach	Jetty	000+00	160	1,200	1,700	056+56	060+51	423	-10,000	-27,900	South Beach
	000+00	004+00	400	1,100	1,200	060+51	065+50	510	-14,300	-43,200	
	004+00	008+00	400	-300	-1,400	065+50	069+46	423	-12,900	-42,100	
	008+00	010+00	200	0	-400	069+46	073+39	442	-12,200	-39,100	
	010+00	012+00	200	100	-300	073+39	076+37	516	-12,000	-37,900	
	012+00	014+00	200	0	-300	076+37	084+16	611	-14,500	-35,500	
	014+00	016+00	200	0	-300	084+16	088+23	471	-9,300	-20,900	
	016+00	018+00	200	200	300	088+23	092+15	455	-8,600	-21,100	
	018+00	020+00	200	600	1,100	092+15	097+10	536	-11,800	-26,600	
	020+00	024+00	400	4,600	13,200	097+10	102+08	525	-12,300	-24,700	
	024+00	028+00	400	5,800	12,800	102+08	106+00	436	-11,800	-20,800	
	Subtotal	2,960	+13,300	+27,600	106+00	110+00	400	-11,100	-19,100		
Point (North of Groin)	028+00	032+00	395	2,600	-2,700	110+00	114+00	388	-10,500	-16,500	
	032+00	034+00	200	1,000	-2,300	114+00	118+00	407	-11,000	-13,500	
	034+00	036+00	210	2,300	2,600	118+00	122+00	413	-10,500	-11,100	
	036+00	038+00	230	3,200	9,400	122+00	126+00	405	-8,800	-10,900	
	038+00	039+60	230	3,100	10,500	126+00	130+00	405	-9,200	-10,000	
	039+60	041+50	220	2,400	6,000	130+00	134+00	398	-10,200	-11,800	
	041+50	043+47	220	-100	-2,200	134+00	138+00	401	-10,400	-15,400	
	043+47	044+25	190	-2,000	-7,100	138+00	142+00	400	-10,500	-15,200	
	044+25	045+07	190	-2,500	-10,000	142+00	146+00	400	-10,800	-16,000	
	045+07	046+00	200	-2,800	-10,700	146+00	150+00	399	-12,000	-22,300	
		Subtotal	2,285	+7,200	-6,500	150+00	154+00	385	-11,300	-22,700	
Point (South of Groin)	046+00	046+89	200	-1,500	-6,700	154+00	158+00	383	-11,000	-20,600	
	046+89	049+00	250	800	-2,400	158+00	162+00	386	-11,300	-21,800	
	049+00	050+50	100	900	0	162+00	166+00	393	-8,000	-17,700	
	050+50	051+00	100	500	-300	166+00	170+00	394	-2,500	-5,900	
	051+00	052+64	240	1,000	-1,900	170+00	174+00	400	500	2,400	
	052+64	054+00	135	100	-2,400	174+00	178+00	400	600	8,000	
	054+00	056+56	380	-4200	-15,500	178+00	182+00	400	-200	4,200	
		Subtotal	1,405	-2,400	-29,200	182+00	186+00	400	-500	900	
Note: Elevations are referenced to NGVD 1929.											
						186+00	190+00	400	-1,300	-1,700	
						190+00	194+00	400	-2,100	-6,300	
						194+00	198+00	400	-2,900	-3,700	
						198+00	202+00	400	-3,400	600	
						202+00	206+00	400	-2,500	4,300	
						206+00	210+00	400	-600	7,900	
						210+00	214+00	400	400	16,300	
						Subtotal		16,105	-300,800	-557,400	
						Bald Head Total		22,755	-282,700	-565,500	

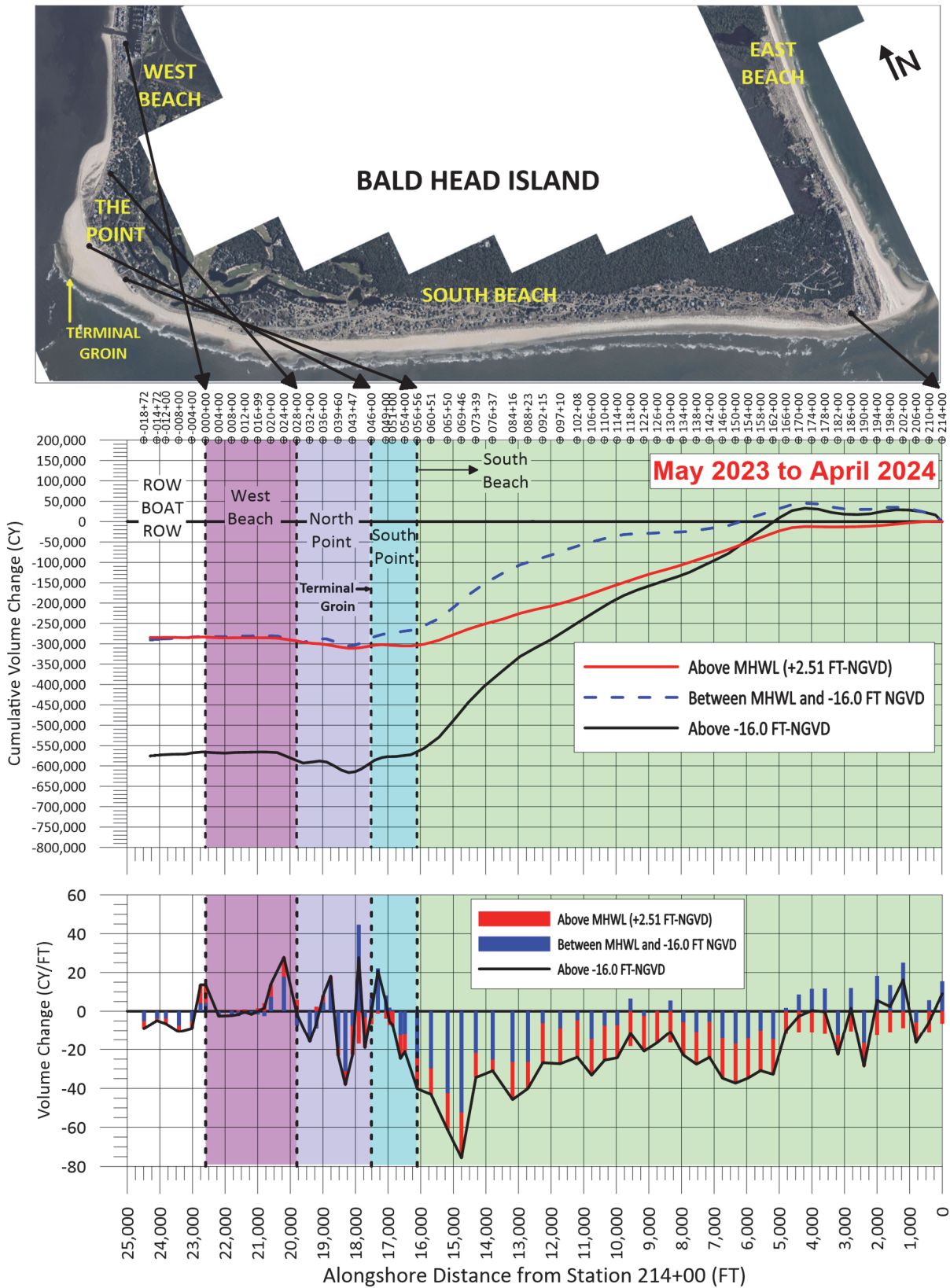


Figure 3.3: Volume change along the Bald Head Island shoreline between May 2023 and April 2024 (Year 23).

Table 3.4: Location of the **BERM** (+6.0 ft-NGVD) relative to the November 2000 (pre-2001 fill) location for selected monitoring surveys.

	Station	Location Relative to Nov. 2000				Station	Location Relative to Nov. 2000		
		May 2023	Nov. 2023	Apr. 2024			May 2023	Nov. 2023	Apr. 2024
West Beach	000+00	+67.5	+56.5	+102.0	South Beach	060+51	+156.7	+99.5	+28.6
	004+00	+10.3	+11.5	-2.3		065+50	+166.7	+128.3	+32.5
	008+00	-12.0	-11.6	-14.9		069+46	+212.8	+180.9	+65.2
	010+00	No November 2000 profile				073+39	+226.6	+181.5	+123.3
	012+00	+12.7	+12.0	+9.4		076+37	+291.3	+218.7	+187.8
	014+00	No November 2000 profile				084+16	+302.8	+288.7	+187.7
	016+00	+31.3	+22.2	+24.0		088+23	+298.4	+309.3	+247.0
	018+00	No November 2000 profile				092+15	+272.0	+274.1	+165.2
	020+00	+193.2	+172.5	+184.2		097+10	+238.1	+223.5	+117.8
	024+00	+205.8	+219.5	+304.2		102+08	+250.5	+225.1	+123.2
028+00	+144.3	+385.2	+381.7	106+00	+286.1	+247.4	+140.3		
Point (North of Groin)	032+00	+346.5	+324.6	+315.9	110+00	+295.4	+256.8	+155.5	
	034+00	No November 2000 profile			114+00	+306.3	+267.7	+174.8	
	036+00	+160.5	+184.5	+183.2	118+00	+321.5	+292.7	+198.9	
	038+00	No November 2000 profile			122+00	+360.1	+339.9	+236.2	
	039+60	+120.8	+221.1	+203.1	126+00	+362.9	+352.2	+265.7	
	041+50	No November 2000 profile			130+00	+391.3	+366.2	+276.9	
	043+47	+98.6	+117.4	+33.5	134+00	+406.1	+382.7	+295.4	
	044+25	No November 2000 profile			138+00	+429.2	+399.1	+313.4	
	045+07	+151.9	+153.3	+15.7	142+00	+428.4	+398.2	+309.0	
	046+00	No November 2000 profile			146+00	+424.8	+396.0	+290.5	
Point (South of Groin)	046+89	+269.0	+278.2	+248.3	150+00	+430.7	+397.8	+296.4	
	049+00	No November 2000 profile			154+00	+433.3	+392.8	+297.4	
	050+50	No November 2000 profile			158+00	+422.4	+382.4	+275.1	
	051+00	No November 2000 profile			162+00	+410.7	+360.1	+270.7	
	052+64	+257.5	+313.5	+245.8	166+00	+383.4	+352.6	+280.7	
	054+00	No November 2000 profile			170+00	+250.0	+313.5	+247.5	
	056+56	+227.1	+208.7	+129.0	174+00	+208.2	+282.1	+208.6	
	Positive values indicate shoreline advance relative to the pre-construction location. Negative values indicate shoreline erosion and are highlighted in red.				178+00	+215.3	+271.7	+199.6	
				182+00	+199.5	+241.7	+181.1		
				186+00	+160.5	+193.8	+136.5		
				190+00	+141.5	+156.6	+97.0		
				194+00	+100.2	+115.3	+63.1		
				198+00	+44.3	+49.3	-3.2		
				202+00	+7.6	-0.5	-41.7		
				206+00	-96.9	-81.6	-138.5		
				210+00	-222.2	-158.8	-216.4		
				214+00	-371.5	-289.1	-338.7		

Table 3.5: Location of the **MHWL** (+2.51 ft-NGVD) relative to the November 2000 (pre-2001 fill) location for selected monitoring surveys.

	Station	Location Relative to Nov. 2000				Station	Location Relative to Nov. 2000		
		May 2023	Nov. 2023	Apr. 2024			May 2023	Nov. 2023	Apr. 2024
West Beach	000+00	+52.5	+39.4	+109.8	South Beach	060+51	+161.7	+97.5	+18.3
	004+00	+8.2	+1.5	+1.9		065+50	+168.8	+130.5	+20.6
	008+00	-12.4	-16.0	-11.8		069+46	+200.7	+177.6	+54.5
	010+00	No November 2000 profile				073+39	+248.4	+179.5	+139.5
	012+00	-27.0	-32.4	-24.4		076+37	+300.6	+234.6	+199.3
	014+00	No November 2000 profile				084+16	+298.4	+311.2	+217.9
	016+00	+17.9	+7.2	+18.7		088+23	+308.2	+334.7	+243.6
	018+00	No November 2000 profile				092+15	+277.5	+285.2	+180.8
	020+00	+188.2	+164.8	+223.7		097+10	+237.7	+229.8	+133.2
	024+00	+187.6	+263.9	+367.5		102+08	+254.3	+230.2	+144.4
028+00	+319.0	+299.7	+333.8	106+00		+279.7	+258.6	+163.3	
Point (North of Groin)	032+00	+264.1	+253.7	+245.4		110+00	+279.9	+258.6	+179.8
	034+00	No November 2000 profile				114+00	+294.5	+282.5	+181.5
	036+00	+105.3	+163.3	+188.4		118+00	+314.6	+312.9	+206.9
	038+00	No November 2000 profile				122+00	+341.5	+341.4	+232.9
	039+60	+89.5	+208.1	+161.4		126+00	+360.5	+362.3	+263.5
	041+50	No November 2000 profile				130+00	+370.9	+374.5	+275.5
	043+47	+22.3	+65.9	-68.3		134+00	+391.6	+393.5	+297.2
	044+25	No November 2000 profile				138+00	+404.2	+403.2	+307.6
	045+07	+190.9	+148.7	-6.7		142+00	+408.3	+410.3	+318.8
	046+00	No November 2000 profile				146+00	+403.4	+403.0	+290.6
Point (South of Groin)	046+89	+322.4	+272.2	+272.2		150+00	+410.8	+409.5	+292.7
	049+00	No November 2000 profile				154+00	+409.0	+399.5	+294.2
	050+50	No November 2000 profile				158+00	+406.1	+388.7	+294.5
	051+00	No November 2000 profile				162+00	+387.3	+361.4	+262.8
	052+64	+261.4	+293.5	+232.4		166+00	+369.5	+341.5	+275.1
	054+00	No November 2000 profile				170+00	+281.0	+307.0	+236.2
	056+56	+237.7	+202.9	+113.5		174+00	+211.0	+283.9	+225.3
	Positive values indicate shoreline advance relative to the pre-construction location. Negative values indicate shoreline erosion and are highlighted in red.					178+00	+219.2	+283.0	+220.2
182+00						+200.2	+247.4	+184.4	
186+00						+155.9	+185.3	+139.9	
190+00						+128.3	+140.0	+83.1	
194+00						+94.5	+95.6	+47.2	
198+00						+52.4	+45.9	-5.6	
202+00						-6.6	-14.8	-57.6	
206+00						-119.3	-99.8	-152.8	
210+00						-249.4	-179.2	-239.8	
214+00						-359.9	-296.0	-342.3	

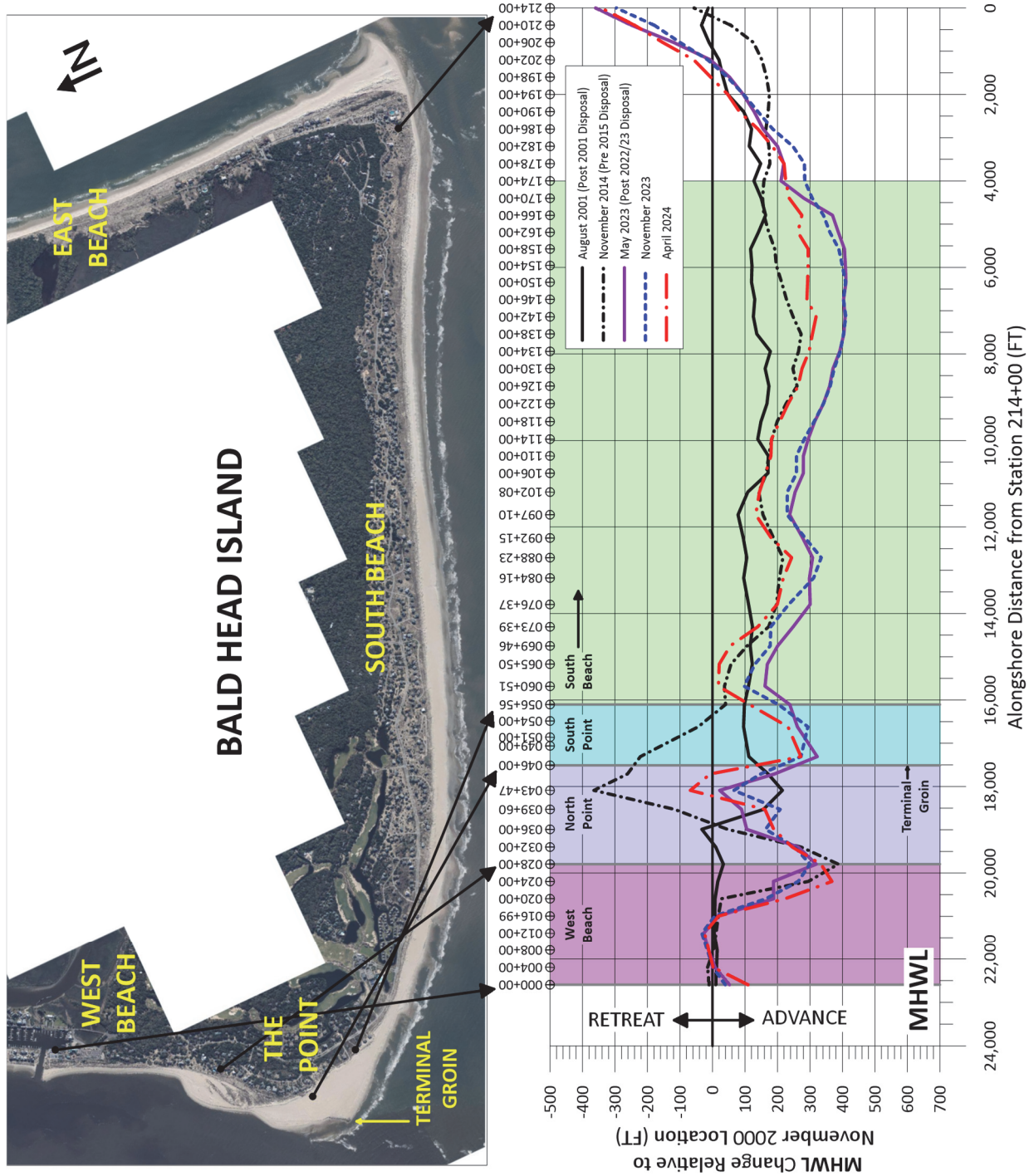


Figure 3.4: Location of the MHWL (+2.51 ft-NGVD) relative to the November 2000 (pre-2001 fill) location.

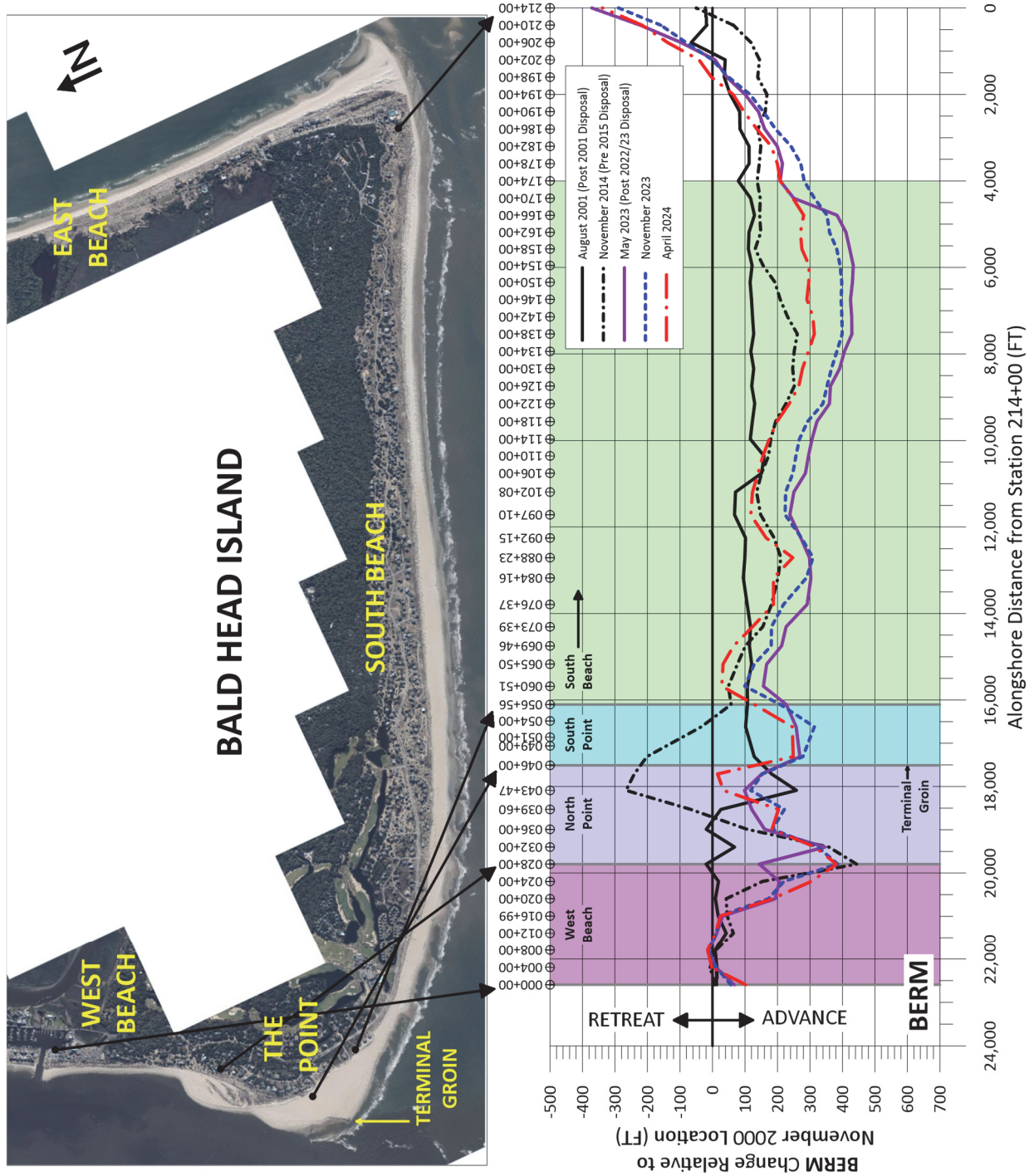


Figure 3.5: Location of the BERM (+6.00 ft-NGVD) relative to the November 2000 (pre-2001 fill) location.

3.3.4 Long-Term Beach Changes: November 2000 to April 2024

For purposes of tracking gross sand placement performance, **Figure 3.6** plots a time history of cumulative volume change relative to November 2000 conditions. **Figure 3.7** presents net volumetric change (alongshore above -16 ft NGVD) for the maximum period of comparison to date (*i.e.* November 2000 and April 2024). In both Figures the effects of direct South Beach sand placement over time are included. As with other similar analyses over the last decade, East Beach, Cape Fear and Row Boat Row are *excluded* from this analysis.

The classic “saw-tooth” effects of episodic sand placement (and subsequent sand losses over time), as reflected in **Figure 3.6**, are indicative of the periodic infusion of sand along South Beach at Bald Head Island associated with the placement of sand during initial construction of the channel deepening project, six (6) subsequent beach disposal operations pursuant to the WHSMP, the proactive beach renourishment project constructed by the Village in 2009/10 and to a smaller degree the emergency fill of 2012. The Village 1.85 Mcy fill was constructed with the knowledge gained through monitoring that certain irreparable large-scale impacts to Bald Head Island would predictably occur as a direct result of the proposed diversion of channel maintenance material in 2009 to Oak Island. *Note – a similar diversion of Federal maintenance sand occurred in the summer of 2018.* As a result of the 2018 federal sand disposal at Oak Island, the Village constructed a 1.1 Mcy interim beach fill at South Beach in the fall/winter of 2018/19. The most recent federal beach disposal project was completed in March 2023 along South Beach on Bald Head Island. Over the following 2 months, mol the fill berm had just begun to equilibrate. Similarly, a portion of that sand placed can be found as an accretional spit located immediately westward of the terminal groin. The episodic formation of that depositional feature was intended “by design” in order to maintain a sand supply to West Beach – subsequent to terminal groin construction.

Table 3.6 presents a chronology of sediment volumes (measured in-place) for the three (3) segments of shoreline noted between the benchmark survey of November 2000 and present (*i.e.* April 2024). Currently, within the **approximate** 22,755 ft of shoreline considered, there is a net gain of +3,717,000 cy. However, after removing the effects of the gross volume of sand artificially placed along the Bald Head Island shoreline since the 2000 deepening project, the net change in Island-wide volume (exclusive of East Beach and the Cape Fear Point) is a measured sediment *loss* of -9,166,800 cy. It is important to note that the chronology of sand volumes presented by this **Table** reflects the *actual volumes* of sand *measured in-place* by survey and therefore is not related to projections based upon *estimated* volumes dredged from the channel or borrow site, *estimated* sand volumes placed, contractual “net pay” volumes, etc.

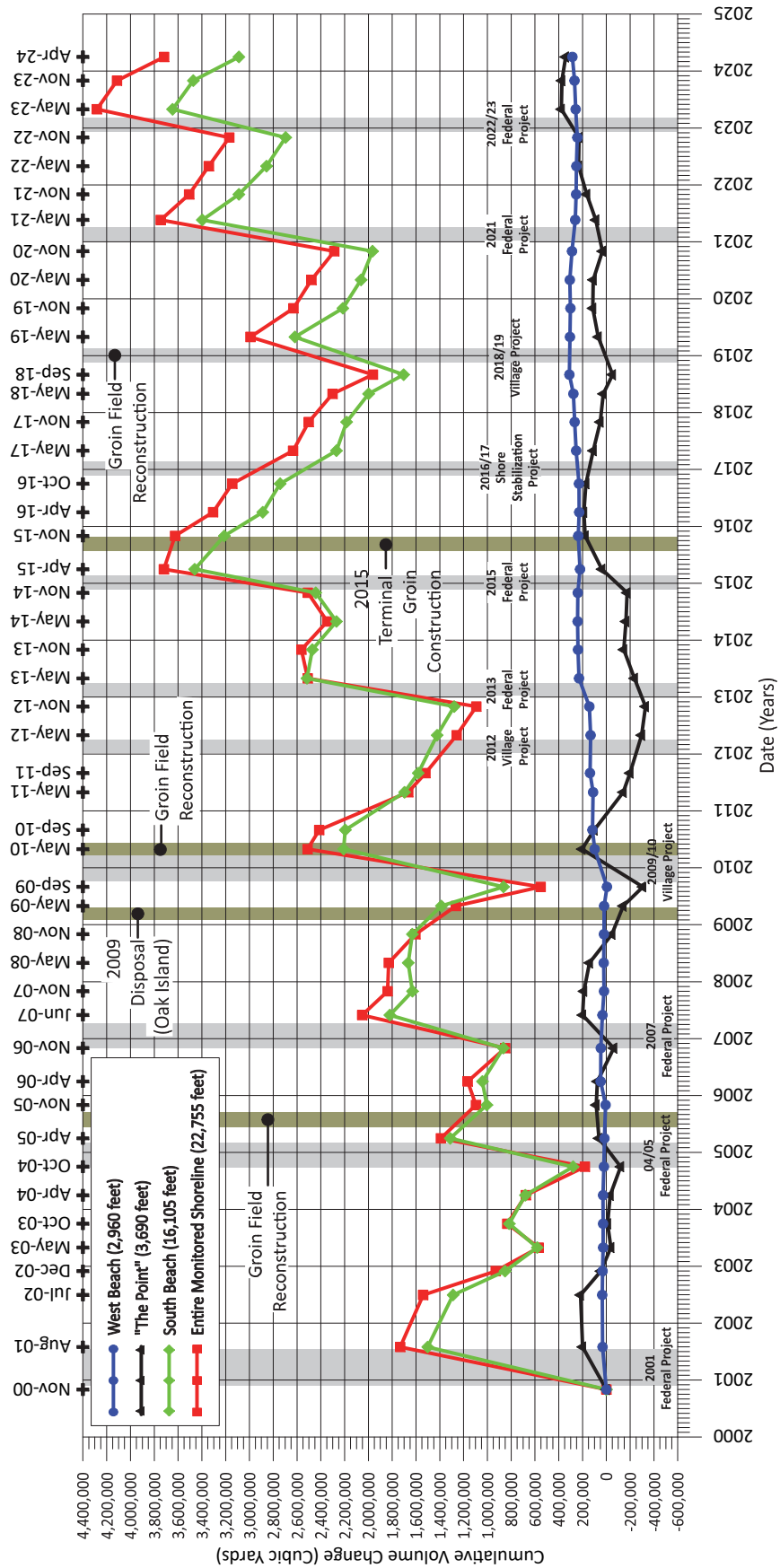


Figure 3.6: Cumulative volume change (above -16 ft-NGVD) relative to November 2000 conditions.

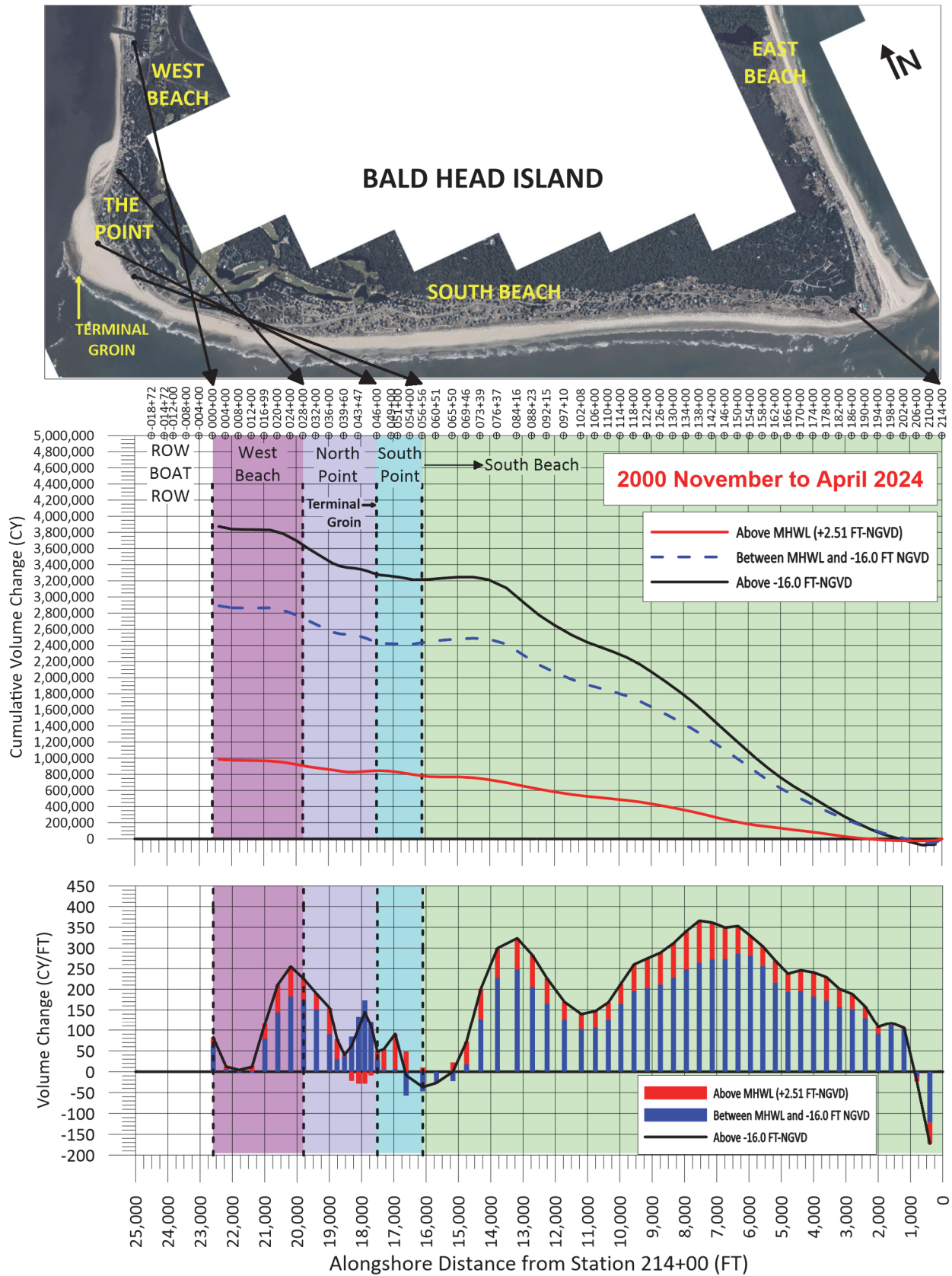


Figure 3.7: Volume change along the Bald Head Island shoreline between November 2000 and April 2024.

Table 3.6: Bald Head Island historic net volume change above -16 ft-NGVD (presumed closure depth).

Period	Start Date	End Date	Span (Months)	Volume Change Above -16 ft-NGVD (CY)			
				West Beach	The Point	South Beach	Total
Year 0 (Const.) ¹	Nov. 2000	Aug. 2001	9	+31,900	+199,500	+1,501,800	+1,733,200
Year 1	Aug. 2001	Jul. 2002	11	+2,900	+17,400	-213,300	-193,000
Year 2	Jul. 2002	May 2003	10	-8,000	-255,500	-707,400	-970,900
Year 3	May 2003	Apr. 2004	11	+1,000	+6,500	+99,900	+107,400
Year 4 (Project) ²	Apr. 2004	Apr. 2005	12	-11,800	+94,700	+631,200	+714,100
Year 5 (Project) ³	Apr. 2005	Apr. 2006	12	+32,000	+13,300	-270,200	-224,900
Year 6 (Project) ⁴	Apr. 2006	Jun. 2007	14	-15,400	+123,500	+778,100	+886,200
Year 7	Jun. 2007	May 2008	11	-10,300	-58,200	-154,600	-223,100
Year 8	May 2008	May 2009	12	-3,400	-282,800	-278,200	-564,400
Year 9 (Project) ⁵	May 2009	May 2010	12	+79,300	+346,000	+821,300	+1,246,600
Year 10	May 2010	May 2011	12	+13,200	-346,100	-512,700	-845,600
Year 11 (Fill) ⁶	May 2011	May 2012	12	+20,800	-154,600	-273,300	-407,100
Year 12 (Disposal) ⁷	May 2012	May 2013	12	+97,600	+59,800	+1,093,900	+1,251,300
Year 13	May 2013	May 2014	12	+11,600	+72,100	-247,500	-163,800
Year 14 (Disposal) ⁸	May 2014	Apr. 2015	11	-20,400	+201,800	+1,191,800	+1,373,200
Year 15	Apr. 2015	Apr. 2016	12	+7,200	+151,800	-572,500	-413,500
Year 16	Apr. 2016	May 2017	13	+25,500	-79,000	-619,000	-672,500
Year 17	May 2017	May 2018	12	+23,200	-84,600	-270,500	-331,900
Year 18 (Fill) ¹⁰	May 2018	May 2019	12	+29,000	+42,200	+619,500	+690,700
Year 19	May 2019	May 2020	12	+1,200	+42,200	-555,900	-512,500
Year 20 (Disposal) ¹¹	May 2020	May 2021	12	-45,300	-21,600	+1,334,400	+1,267,500
Year 21	May 2021	May 2022	12	-9,400	+144,500	-540,800	-405,700
Year 22 (Disposal) ¹²	May 2022	May 2023	12	+5,800	+145,400	+790,000	+941,200
Year 23	May 2023	Apr. 2024	11	+27,600	-35,700	-557,400	-565,500
Year 0 to Year 23	Nov. 2000	Apr. 2024	281	+285,800	+342,600	+3,088,600	+3,717,000
Year 0 to Year 23 (12,883,800 CY of Fill Removed)	Nov. 2000	Apr. 2024	281	NA	NA	NA	-9,166,800

¹ 2001 Initial Disposal (1,849,500± CY); ² 2005 Beach Disposal (1,217,000± CY); ³ 2006 West Beach Fill (47,800± CY)

⁴ 2007 Beach Disposal (978,500± CY); ⁵ 2009/10 Beach Fill (1,850,000± CY); ⁶ 2012 Beach Fill (138,000± CY)

⁷ 2013 Beach Disposal Fill (1,658,000± CY); ⁸ 2015 Beach Disposal (1,320,000± CY);

⁹ 2016/17 Beach Disposal (24,000± CY); ¹⁰ 2018/19 Beach Fill (1,100,000± CY); ¹¹ 2021 Beach Disposal (1,601,000± CY)

¹² 2022/23 Beach Disposal (1,100,000± CY)

The estimated *average* annual loss of sand from the monitored section of Bald Head Island shorefront (excluding East Beach and Row Boat Row) since November 2000, is approximately -398,600 cy per year including the impacts of numerous major storm events. The assignment of an “average” annual long-term rate of sand loss at Bald Head Island however, is *not* necessarily a meaningful indicator of navigation project impact. Such an “average rate” is temporally biased by periods of beach fill placement and equilibration, groin field effectiveness, the occurrence of episodic destabilizing dredging events in close proximity to the island, as well as other physiographic phenomena temporally affecting annualized quantities of alongshore sediment transport – from Bald Head Island – to the navigation channel, -- including meteorological effects – such as Hurricanes Florence, Dorian and Isaias.

3.3.5 MHWL Shoreline Position

As part of the permit required monitoring for the terminal groin project completed in late 2015, the MHWL was surveyed in December 2015 (post-construction), April 2016 (5 months post-construction), June 2017 (19 months post-construction), May 2018 (30 months post-construction), September 2018 (post-Florence), May 2019 (post-fill), November 2019 (post-Dorian), May 2020, May 2021, May 2022, May 2023, and April 2024. Various selected surveys are plotted in **Figure 3.8**. The purpose of the surveys is to be able to intercompare and assess both updrift fillet conditions and the location of the downdrift shoreline immediately fronting the Cape Fear River. Through April 2024, terminal groin project performance – based upon monitoring – has been both as intended and as predicted.

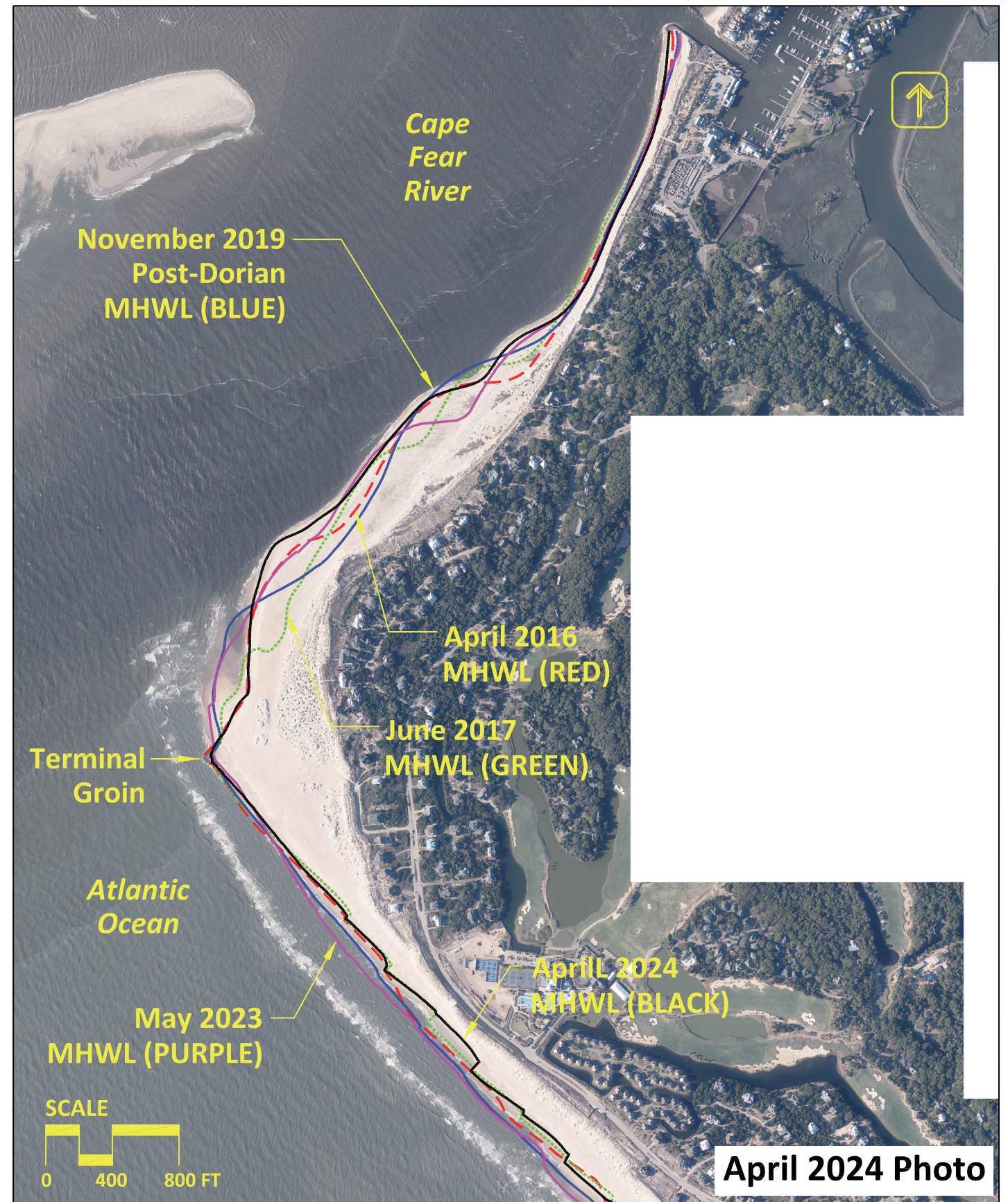
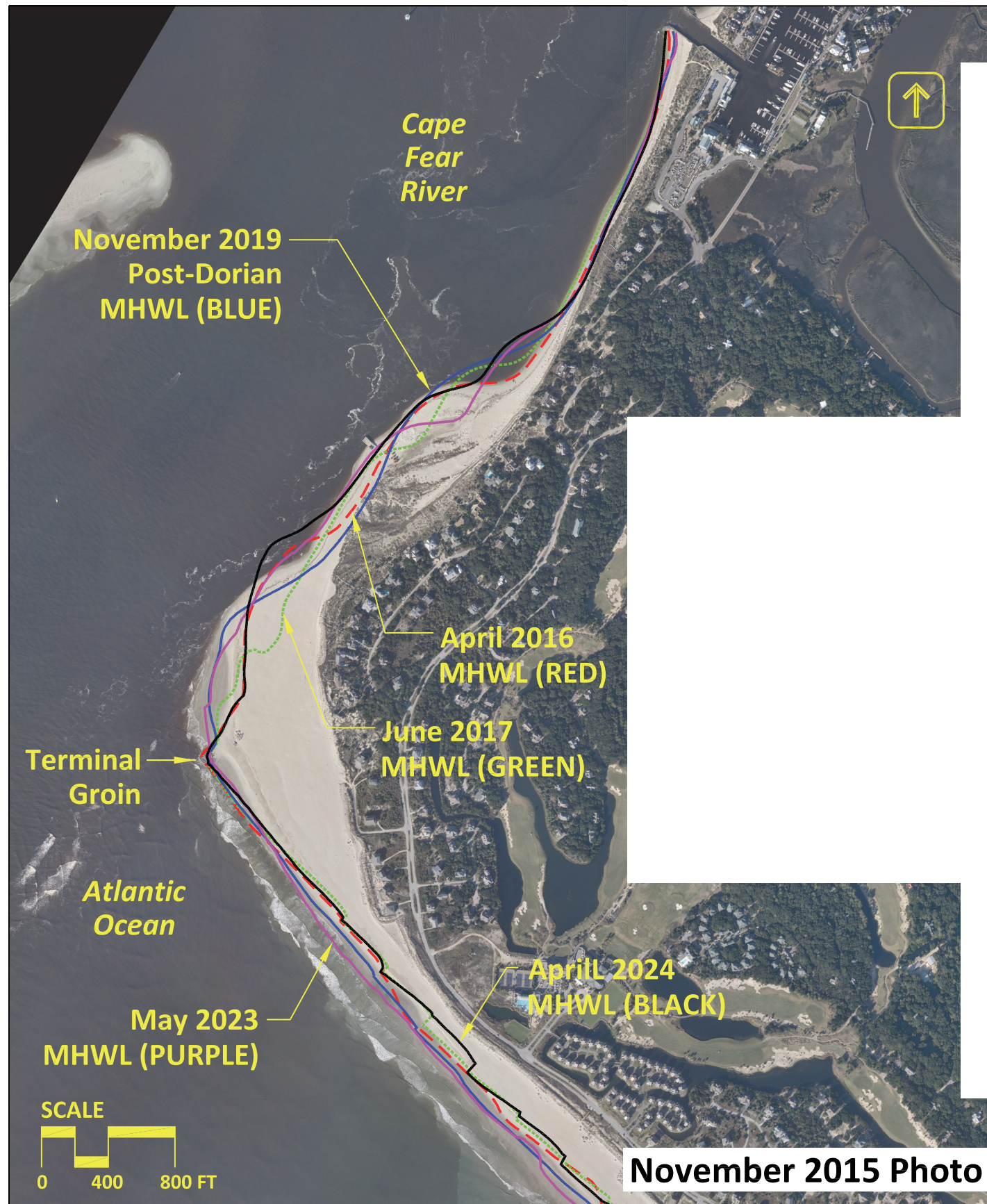


Figure 3.8: MHWL positions in the vicinity of the terminal groin Bald Head Island, NC

3.3.6 Chronology of the Point

Since the construction of the Wilmington Harbor Channel Deepening Project – in about 2001, the spatial configuration of the spit feature (known as the “Point”) located at the juncture of South Beach and the entrance channel, has been a focal point of the Village’s monitoring program. Accordingly, the chronology of the Point’s condition and evolution over time is indicative of the dynamic interaction between the ever increasing rate of sand transport westward along South Beach and the man-altered inlet hydrodynamics, as well as episodic dredging operations which result in sand removal from the island’s littoral system. In its simplest sense, the Point has historically been to a large degree, a visual indicator of the processes involved and a potential “bellwether” as to direct and indirect impacts associated with the Navigation Project – irrespective of proactive or remedial actions specified within the Wilmington Harbor Sand Management Plan. The latter take the form of alongshore sand placement events intended to mitigate adverse impacts associated with both project construction in 2000 and episodic channel maintenance required to ensure navigability.

Appendix E includes a high resolution visual chronology of the Point from 1998 to April 2024. Demarcated on each photo panel are the approximate September 2001 (blue line) and April 2024 (red line) apparent vegetation lines. Also placed on each photo are two reference marks (green dots). The variation in spit configuration from the before navigation improvement project photos (1998 and 1999) throughout the last approximate twenty-one years for pre- and post-fill timeframes can be easily visualized. Similarly, the advance and recession of the Point, as well as its consistent *net northerly migration* are self-evident. An additional perspective can be gained by an assessment of the locations of the pre-project and present day “vegetation lines” over the 1998 through 2021 timeframe. As had been concluded throughout the numerous years of comprehensive beach monitoring funded by the Village of Bald Head Island – improved conditions along the westernmost segment of South Beach and the Point were documented to last only about 2 years after each federal disposal event – *prior* to terminal groin construction in 2015.

Both long term monitoring, as well as numerical modeling of the Cape Fear River Entrance by Olsen Associates, Inc. (Olsen 2013a), and the abutting Bald Head Island shoreline, indicated that additional structural measures were warranted. As the westernmost segment of South Beach shoreline had “rolled back,” the annualized rate of littoral transport at that location had correspondingly increased. Hence, in 2012 the Village initiated the permitting for a 1,300 ft terminal structure intended to both reorient the effective updrift shoreline alignment (so as to reduce annual sediment losses) and to allow for the reconstruction of a protective beach where one now could not be reliably established through sand placement alone. That project was constructed during the summer of 2015. Subsequently, monitoring reports now document a “new dynamic” predicted to result from the implementation of the terminal groin structure. Analytical predictions of shoreline change to both the updrift and downdrift shorelines abutting

the structure – via DELFT 3D modeling – were discussed in a detailed report formulated for purposes of both design and permitting of the terminal groin (Olsen 2013a). Additional monitoring data required by Permit are intended to assist in the quantification of the terminal groin effects on littoral processes and resultant shoreline reconfiguration. These include additional transects in the vicinity of the structure as well as an approximate MHWL delineation performed by survey every 6-months.

During the May 2023 to April 2024 monitoring period, the inlet facing shoreline adjacent to the terminal groin continues to realign (as predicted) and adjust to a new equilibrium condition. An intertidal spit formation continues to form on the inlet side of the structure as a result of sediment transported from South Beach through or across the structure. The footprint of the spit varies throughout the year depending on the seasonal wave climate. Updrift thereof, portions of the historical Point continue to migrate northward as they did prior to terminal groin construction. This is best represented by the surveyed MHWL locations depicted in **Figure 3.8**. The configuration of the sand fillet updrift of the terminal groin continues to be influenced by the sand tube groin field as fill berms recede and the formerly buried groins become “activated”. The most recent Jan – March 2023 federal beach disposal project placed approximately 1.1 Mcy along South Beach. The mobilization of a portion of that fill westward directly affected the volume of material directed toward, over and through the terminal structure at the Point.

3.4 East Beach Shoreline Conditions

In November 2008, East Beach was added to the island-wide beach monitoring program⁸. Profiles along the East Beach shoreline are collected at seven (7) monitoring stations starting just north of Cape Fear and extending approximately 6,000 feet northward along the Onslow Bay facing shoreline (see **Figure 2.1**). Plots of these profiles are provided at the end of **Appendix A (Figures A-70 to A-76)**. **Tables 3.7 and 3.8** summarize the shoreline and volume changes measured during the May 2023 to November 2023 to April 2024 monitoring periods. **Figure 3.9** presents drone images of East Beach flown in July 2023. **Figure 3.10** depicts the May 2023, November 2023 and April 2024 aerial photographs along southern East Beach.

During the May 2023 to November 2023 period, the East Beach shoreline gained approximately +1,900 cy above the MHWL and +7,400 cy below the MHWL for a net gain above -16 ft-NGVD of +9,300 cy. During this same period the backshore berm (at elevation +6 ft-NGVD) receded by an average of -34.0 ft and the MHWL receded by an average of -31.3 ft. These averages are skewed by the relatively large recession at STA 224+80, the southernmost station along East Beach. At this station, the berm and MHWL receded by -116.9 ft and -234.7 ft, respectively. After removing STA 224+80, the average shoreline along East Beach was -20.2 ft (recession) at the berm and +2.6 ft (advance) at the MHWL.

During the November 2023 to April 2024 winter period, the East Beach shoreline lost approximately -1,600 cy above the MHWL and -95,000 cy below the MHWL for a net loss above -16 ft-NGVD of -96,600 cy. During this same period the berm advanced by an average of +7.8 ft while the MHWL receded by an average of -3.5 ft.

Table 3.9 summarizes the volume changes measured over the entire period of survey record (November 2008 – April 2024). Over the 186-month period, the East Beach shoreline gained approximately +73,100 cy above the MHWL and +293,800 cy above the -16 ft-NGVD contour.



Figure 3.9:
Southward looking view of East Beach.
(April 2024 Photo).

Table 3.7: East Beach shoreline and volume changes between May 2023 and November 2023.

Station	Reach (FT)	Volume Change (CY)		Shoreline Change (FT)	
		Above MHWL (+2.51 FT)	Above -16 FT	Berm (+6 FT)	MHWL (+2.51 FT)
224+80				-116.9	-234.7
	1,000	-8,300	-54,400		
234+80				-5.3	-14.5
	1,000	+2,800	+11,600		
244+80				-15.5	+8.7
	1,000	+4,600	+17,000		
254+80				+3.6	+8.8
	1,000	+3,500	+23,500		
264+80				-13.3	+5.4
	1,000	+500	+11,000		
274+80				-44.1	+1.7
	1,000	-1,200	+600		
284+80				-46.5	+5.6
Total	6,000	+1,900	+9,300	-34.0 (AVG)	-31.3 (AVG)

Table 3.8: East Beach shoreline and volume changes between November 2023 and April 2024.

Station	Reach (FT)	Volume Change		Shoreline Change (FT)	
		Above MHWL (+2.51 FT)	Above -16 FT	Berm (+6 FT)	MHWL (+2.51 FT)
224+80				+8.6	+3.7
	1,000	-700	-17,100		
234+80				+1.2	-0.3
	1,000	+1,300	-19,900		
244+80				+24.2	+5.4
	1,000	+300	-22,900		
254+80				+2.1	+4.9
	1,000	-600	-28,300		
264+80				+10.0	-5.5
	1,000	-1,200	-12,400		
274+80				-7.0	-18.1
	1,000	-700	+4,000		
284+80				+16.5	-14.3
Total	6,000	-1,600	-96,600	+7.8 (AVG)	-3.5 (AVG)

Table 3.9: Volume changes along East Beach (Sta. 224+80 to 284+80).

Survey Period	Volume Change Above Datum (CY)		
	Above MHWL (+2.51 ft-NGVD)	Below MHWL to -16 ft-NGVD	Total Change Above -16 ft-NGVD
November 2008 to May 2009	+700	-65,600	-64,900
May 2009 to May 2010	-23,300	-8,600	-31,900
May 2010 to May 2011	+10,600	+18,000	+28,600
May 2011 to May 2012	+5,700	+87,700	+93,400
May 2012 to May 2013	+20,000	-41,600	-21,600
May 2013 to May 2014	+17,700	+105,200	+122,900
May 2014 to April 2015	-900	+44,100	+43,200
April 2015 to April 2016	+20,800	-400	+20,400
April 2016 to May 2017	+4,500	+38,200	+42,700
May 2017 to May 2018	+31,400	+25,000	+56,400
May 2018 to May 2019	+9,600	+140,300	+149,900
May 2019 to May 2020	-12,500	-76,100	-88,600
May 2020 to May 2021	-7,800	+7,400	-400
May 2021 to May 2022	-1,700	+14,300	+12,600
May 2022 to May 2023	-2,000	+20,400	+18,400
May 2023 to April 2024	+300	-87,600	-87,300
November 2008 to April 2024	+73,100	+220,700	+293,800

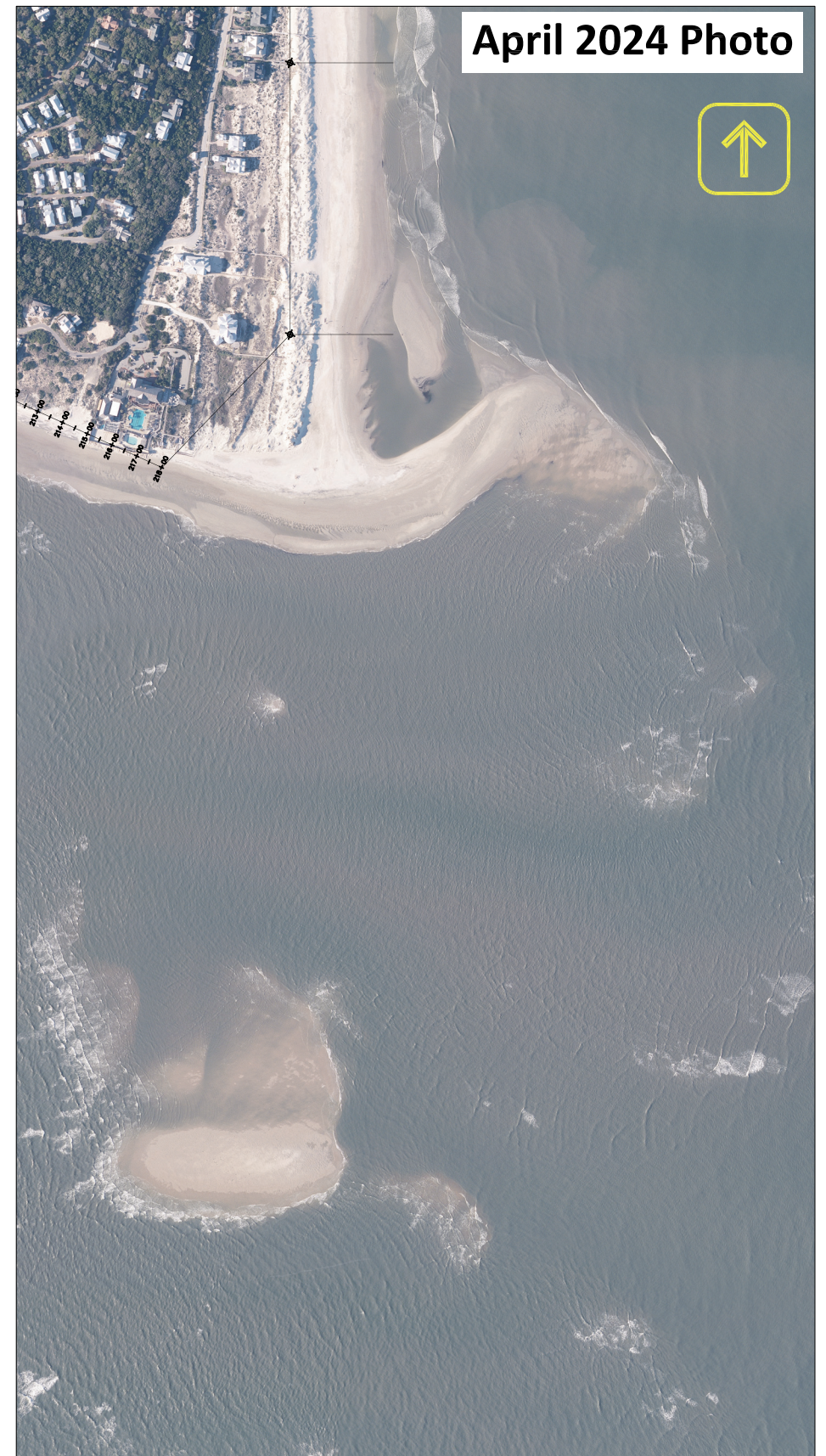
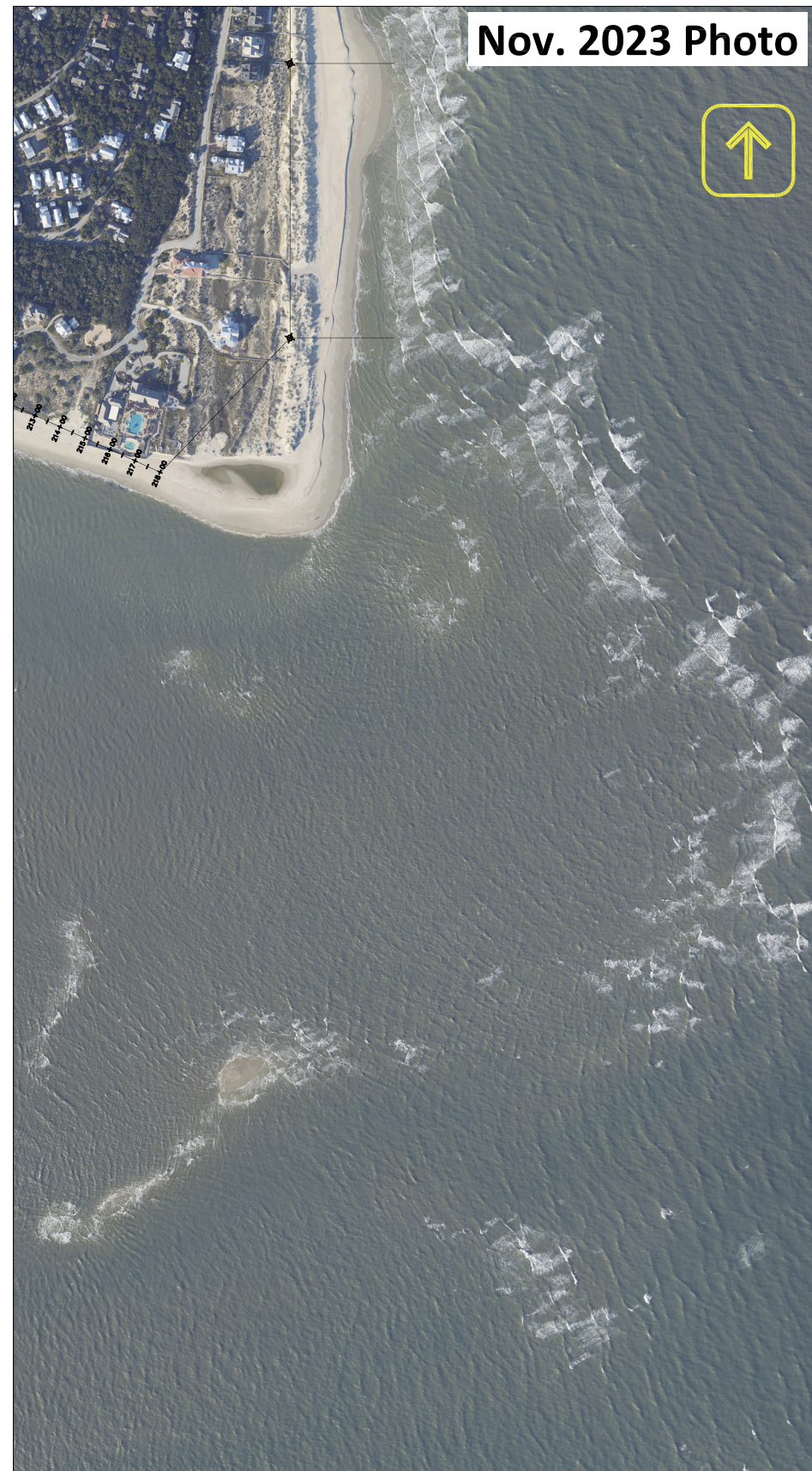


Figure 3.10:
Cape Fear aerial photography
Bald Head Island, NC

As demonstrated by the survey and photographic data (**Figure 3.10**), it can be reasonably assumed that the condition of East Beach at any one time is, has been and will continue to be not only seasonal but highly influenced by the configuration of the depositional spit and shoals associated with the “Cape Fear Point”. Of further interest are the variations in spit size and orientation over the 13 years (2008-2024) which are depicted by **Figure 3.12**. In its simplest sense, the Cape Fear spit is a highly dynamic feature which is influenced by sand supply originating from both the west (along South Beach) and the north (along East Beach). The Point is also highly susceptible to storm waves originating from *both* the west (Atlantic Ocean) and the east (Onslow Bay) and resultant tidal channels which episodically break through and subsequently influence localized patterns of sand deposition (or erosion).

Although the near-term locations of the Cape Fear spit have been beneficial to East Beach properties lying northward thereof, it has typically caused significant shoreline and dune recession seaward of the South Beach Shoals Club facility (see **Figure 3.11**). That section of shorefront is monitored via beach profiles B-54 and B-55 (Sta. 214+00 and 218+00). The Shoals Club lies approximately mid-way between these two survey stations. **Figure A-71** and **A-72** (**Appendix A**) depict some level of fill being placed by the Corps April 2021 disposal project. As shown by survey profiles for May 2022 to May 2023, however, virtually all of the fill material had been lost and that the location of the MHWL had receded even more landward than its pre-disposal project location. As a result, in the spring of 2022 the Shoals Club was required to construct a sand bag revetment along the existing scarp line seaward of the Club facility in order to preclude future losses of land and infrastructure. It is opined that the federal fill project failed to provide net benefit to this affected area due to the nature of very fine sand placed – which derives from material dredged from Bald Head Reach 2 of the navigation project channel.

Figure 3.11:
View of the South Beach
Shoals Club facility.
(July 2023 Photo).





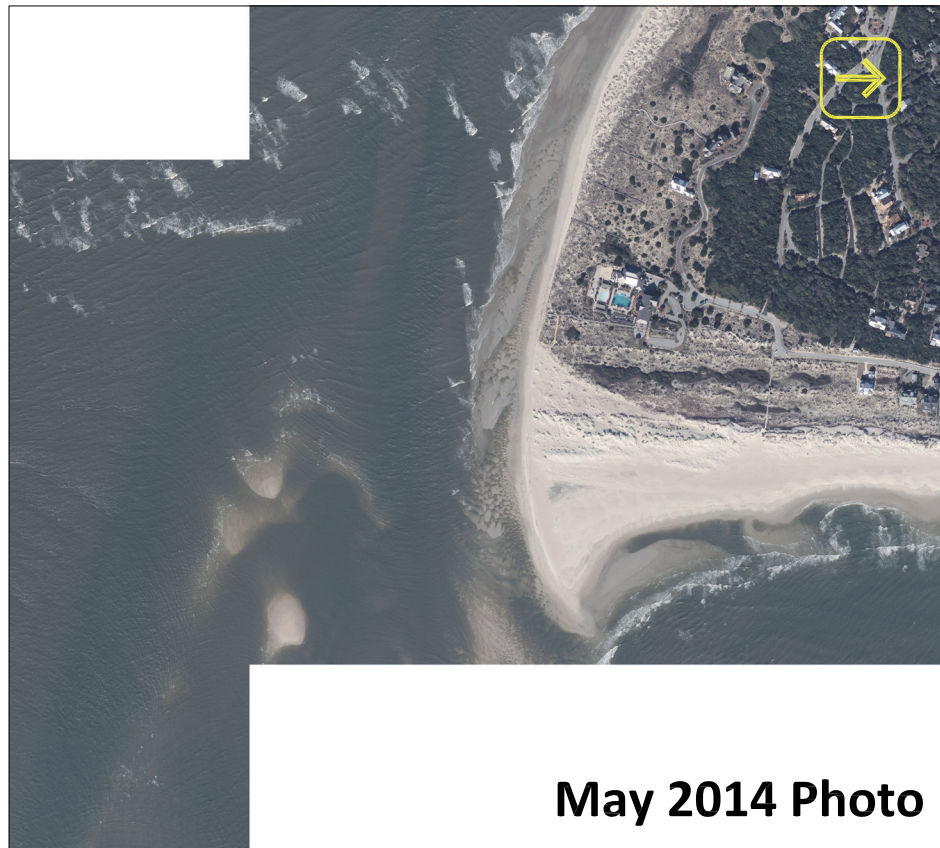
May 2008 Photo



April 2010 Photo



April 2011 Photo



May 2014 Photo



April 2017 Photo



April 2024 Photo

Figure 3.12:
Cape Fear aerial photography
Bald Head Island, NC

3.5 Row Boat Row Shoreline Conditions

In November 2015, the “Row Boat Row” shoreline was added to the island-wide beach monitoring program. Survey data are collected at five (5) monitoring stations starting just north of the marina entrance and extending approximately 1,500 feet northward along the Cape Fear River facing shoreline (see **Figure 2.1**). Plots of these profiles are provided at the beginning of **Appendix A (Figures A-1 to A-5)**. **Tables 3.10** and **3.11** summarize the shoreline and volume changes measured during the May 2023 to November 2023 to April 2024 monitoring period (11 months).

In early 2017, after completion of a 26,000 cy beach fill placed by Marcol Dredging along the Row Boat Row shoreline, two detached rock breakwaters were constructed by Intra Coastal Marine Construction. Final acceptance of the project occurred in July 2017. Subsequently, the shorefront within the influence of the two shore parallel structures has equilibrated into a series of discrete crenulate features between tombolos which extend from the center of each breakwater in a landward direction (**Figure 3.13**).

During the most recent monitoring year (May 2023 to April 2024), the shoreline showed a net loss of roughly -1,700 cy above the MHWL and -10,100 cy above -16 ft-NGVD. During this same period the berm receded by an average of -0.5 ft while the MHWL receded by an average of -21.8 ft.



Figure 3.12:
Northward looking view of the
Row-Boat-Row shoreline
detached breakwaters.
(April 2024 Photo).

Table 3.10: Row Boat Row shoreline and volume changes between May 2023 and November 2023.

Station	Reach (FT)	Volume Change (CY)		Shoreline Change (FT)	
		Above MHWL (+2.51 FT)	Above -16 FT	Berm (+6 FT)	MHWL (+2.51 FT)
-018+72				+37.8	-15.1
	400	+700	-100		
-014+72				+4.6	+1.7
	272	+300	+200		
-012+00				+1.4	+4.3
	400	+1,900	+3,000		
-008+00				+67.2	+47.7
	400	+400	+600		
-004+00				-33.3	-32.5
	100	-600	-1,100		
Marina					
Total	1,572	+2,700	+2,600	+14.6 (AVG)	+1.2 (AVG)

Table 3.11: Row Boat Row shoreline and volume changes between November 2023 and April 2024.

Station	Reach (FT)	Volume Change (CY)		Shoreline Change (FT)	
		Above MHWL (+2.51 FT)	Above -16 FT	Berm (+6 FT)	MHWL (+2.51 FT)
-018+72				-20.9	-26.7
	400	-1,000	-2,800		
-014+72				-2.3	-8.1
	272	-500	-1,600		
-012+00				-7.1	-13.1
	400	-1,200	-3,500		
-008+00				-30.2	-42.6
	400	-1,300	-3,900		
-004+00				-14.9	-24.3
	100	-400	-900		
Marina					
Total	1,572	-4,400	-12,700	-15.1 (AVG)	-23.0 (AVG)

Note – Volumes of sand associates with multiple sand bypass operations since 2017 have not been accounted for in these tables.

4.0 JAY BIRD SHOALS BORROW SITE MONITORING (SURVEY) RESULTS

Pursuant to permit requirements for the 2009/10 project, the Jay Bird Shoal borrow site has been surveyed for purposes of monitoring its recovery. Approximately 1.8 Mcy of material was excavated during the 2009/10 project and 1.1 Mcy during the 2018/19 project.

Figure 4.1 depicts the most recent borrow site (April 2024) seabed elevations. This plot represents conditions approximately 5 years post-2018/19 project and 14 years post-2009/10 project conditions. In the plot, the full permitted borrow area limits are shown. The permitted limits are further subdivided into three sub-areas. For the 2009/10 project, only portions of Area 1 and Area 3 were excavated. For the 2018/19 project, only portions of Area 2 and Area 3 were excavated. Also plotted in the figure are the locations of two dredging exclusion zones⁹ (both located in Area 3) and a 200 ft tide gage buffer zone (Area 1 & 2). No excavation was conducted within either the exclusion or buffer zones during the 2009/10 and 2018/19 projects.

Figure 4.2 depicts the seabed elevation change during the Year 5 monitoring period (May 2023 to April 2024). **Figure 4.3** depicts the seabed elevation changes during the 14 years (171 months) since 09/10 project construction to the most recent survey (March 2010 to April 2024).

Table 4.1 summarizes the volume changes within the permitted borrow site limits between the monitoring surveys conducted since construction of the 2009/10 project. During the Year 14 monitoring period (May 2022 to May 2023), the fifth year following the 2018/19 project excavation, the entire permitted borrow site lost -27,400 cy (inclusive of the exclusion and buffer zones). Within just the latest excavated areas (Areas 2 & 3), the borrow site lost -20,400 cy. Within just these areas, the average seabed elevation increased from -18.4 ft-NGVD to -18.5 ft-NGVD over this period.

Table 4.2 summarizes the volume of material theoretically remaining above the permitted cut elevation (-22 ft-NGVD) by survey date and sub-area. These volumes are exclusive of the exclusion and buffer zones shown in **Figure 4.1**. As of April 2024, there are approximately +1,360,400 cy of material theoretically available within the permitted borrow site limits above -22 ft-NGVD. A portion of this is undredged. Another portion is depositional. None of it is suitable in depth for purposes of excavation by an ocean certified dredge.

⁹ By permit, no work was allowed within 150 feet and 100 feet of two potential shipwreck sites located within the Jay Bird Shoals borrow site.

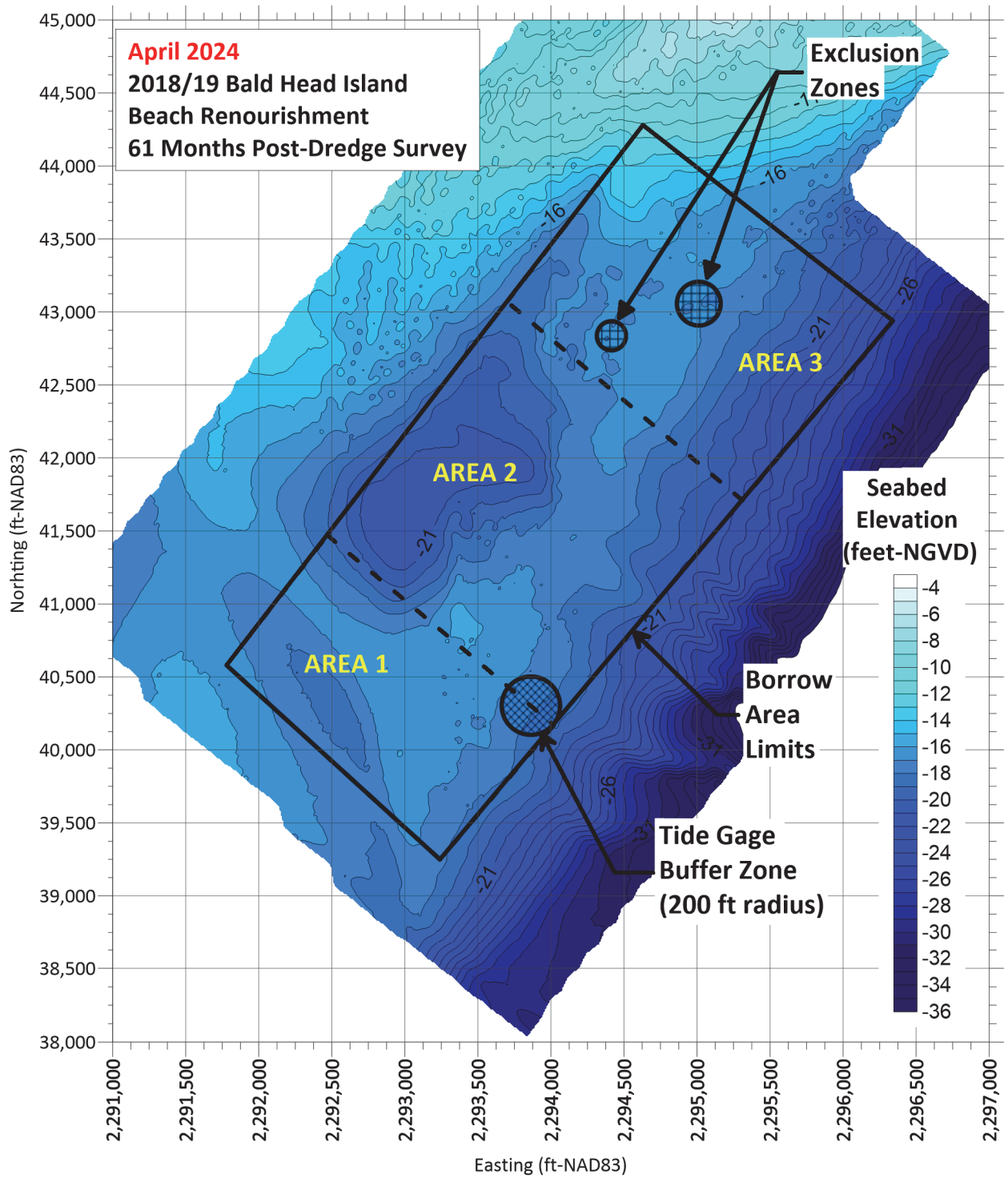


Figure 4.1: Jay Bird Shoals borrow site conditions in April 2024 (61 months post-dredge 2018/19 project).

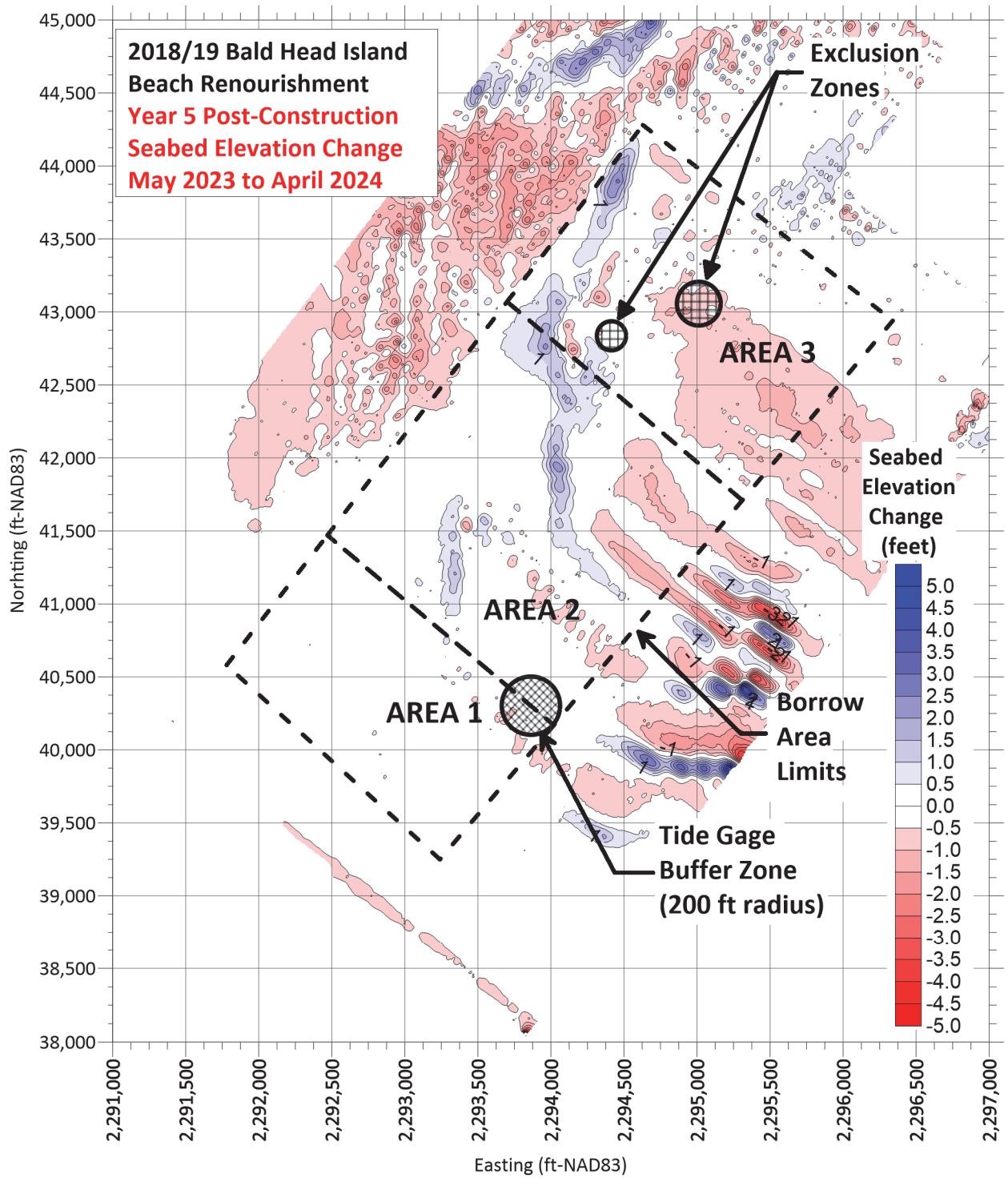


Figure 4.2: Jay Bird Shoals seabed elevation changes during the Year 5 Post-Construction for the 2018/19 project (May 2023 to April 2024).

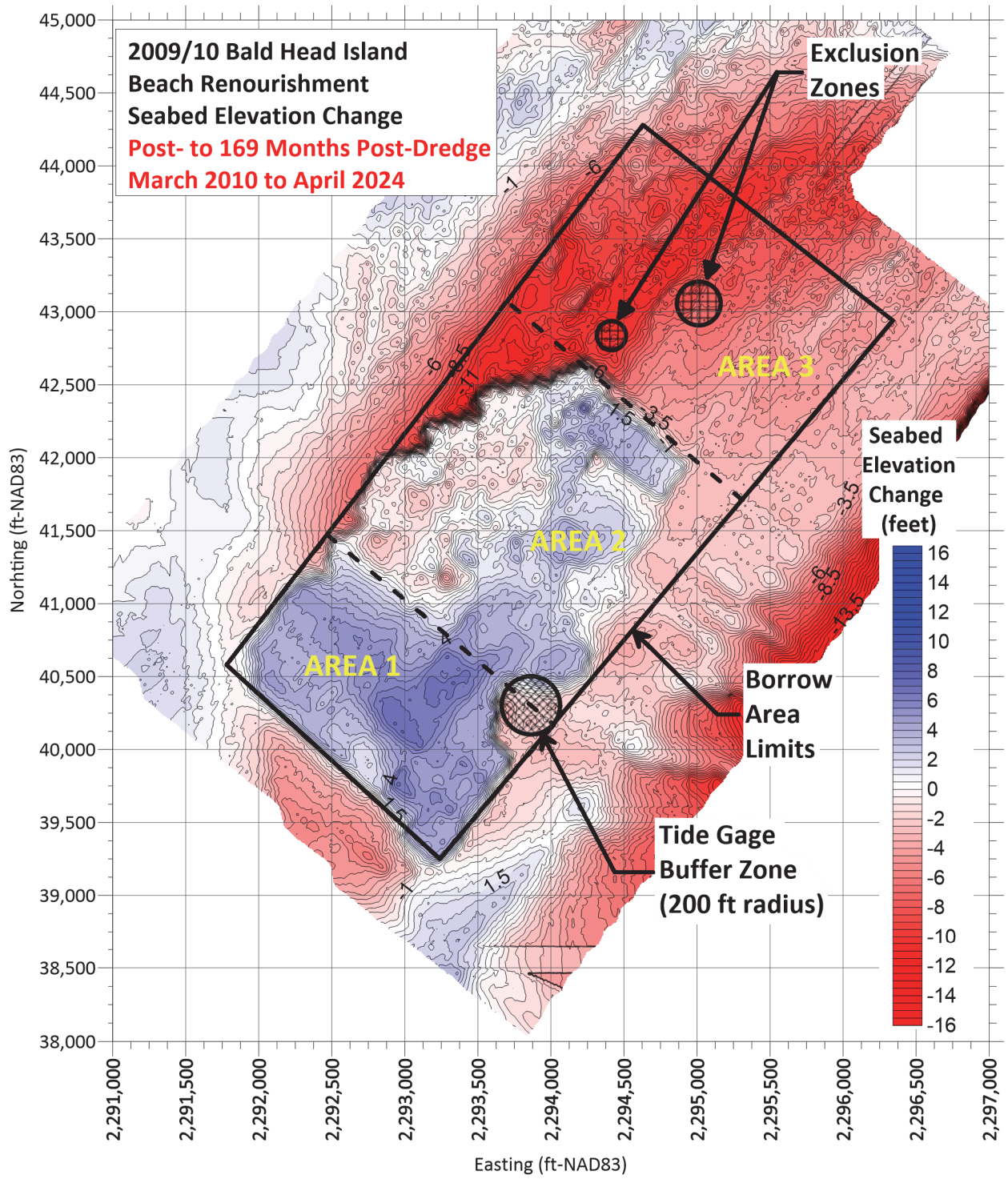


Figure 4.3: Jay Bird Shoals seabed elevation changes since the initial 2009/10 project completion (March 2010 to April 2024).

Table 4.1: Jay Bird Shoals borrow site volume changes (*PERMITTED LIMITS*).

Survey Period	Duration	Volume Change (CY)		
		Gross Gain	Gross Loss	Net Change
October 2009 to March 2010 (Construction)	5 months	+52,700	-1,888,400	-1,835,700
March 2010 to May 2011 (Year 1 Post-Construction)	14 months	+307,200	-104,800	+202,400
May 2011 to May 2012 (Year 2 Post-Construction)	12 months	+112,700	-107,200	+5,500
May 2012 to May 2013 (Year 3 Post-Construction)	12 months	+178,700	-77,600	+101,100
May 2013 to April 2015 (Years 4 & 5 Post-Construction)	23 months	+286,000	-217,100	+68,900
April 2015 to May 2017 (Years 6 & 7 Post-Construction)	25 months	+144,900	-328,500	-183,600
May 2017 to May 2018 (Year 8 Post-Construction)	12 months	+136,800	-71,400	+64,400
May 2018 to September 2018	4 months	+24,400	-246,300	-221,900
September 2018 to December 2018	3 months	+188,700	-5,400	+183,300
December 2018 to March 2019 (BD/AD 18/19 Project)	3 months	+63,700	-1,229,300	-1,165,600
March 2019 to May 2020 (Year 1 Post-2018/19)	14 months	+239,200	-105,600	+133,600
May 2020 to May 2021 (Year 2 Post-2018/19)	12 months	+199,000	-121,800	+77,300
May 2021 to May 2022 (Year 3 Post-2018/19)	12 months	+150,300	-11,800	+138,500
May 2022 to May 2023 (Year 4 Post-2018/19)	12 months	+56,000	-39,700	+16,300
May 2023 to April 2024 (Year 5 Post-2018/19)	11 Months	+47,800	-75,200	-27,400
Since 2009/10 Construction (March 2010 to April 2024)	171 months	+2,135,400	-2,741,700	-607,200
Since 2018/19 Construction (March 2019 to April 2024)	61 months	+692,300	-354,100	+338,300

Table 4.2: Jay Bird Shoals borrow site theoretical volume available above -22 ft-NGVD.

Survey	Volume above -22 ft-NGVD (CY)			
	Area 1	Area 2	Area 3	Total
October 2009 (Pre-2009/10 Excavation)	812,200	1,593,100	1,330,000	3,735,300
March 2010 (Post-2009/10 Excavation)	89,100	540,900	1,291,600	1,921,600
May 2011 (1 Year Post-2009/10)	157,900	685,600	1,275,500	2,119,000
May 2012 (2 Years Post-2009/10)	154,900	734,400	1,237,900	2,127,200
May 2013 (3 Years Post-2009/10)	186,300	844,000	1,200,200	2,230,500
April 2015 (5 Years Post-2009/10)	232,300	992,800	1,081,500	2,306,600
May 2017 (7 Years Post-2009/10)	289,300	942,100	898,800	2,130,200
November 2017 (7.5 Years Post-2009/10)	297,400	969,600	923,000	2,190,000
May 2018 (8 Years Post-2009/10)	315,200	966,400	912,800	2,194,400
September 2018 (8.5 Years Post-2009/10)	318,600	862,600	800,000	1,981,200
December 2018 (Pre-2018/19 Excavation)	355,000	945,200	858,900	2,159,100
March 2019 (Post-2018/19 Excavation)	398,700	332,900	286,200	1,017,800
May 2020 (1 Year Post-2018/19)	383,000	356,600	410,900	1,150,500
May 2021 (2 Year Post-2018/19)	387,700	379,000	464,000	1,230,700
May 2022 (3 Year Post-2018/19)	407,400	447,700	508,000	1,363,100
May 2023 (4 Year Post-2018/19)	406,500	464,200	509,300	1,380,000
April 2024 (5 Year Post-2018/19)	401,700	468,700	490,000	1,360,400

5.0 ONGOING PLANNED OR PROPOSED ACTIVITIES

5.1 Jay Bird Shoals Borrow Site Expansion Area

The Village of Bald Head Island is currently pursuing a modification to CAMA 91-14 and USACE No. SAW-2012-00040 to expand a portion of the previously developed Jay Bird Shoals borrow site. The intended project volume required is estimated at approximately 1 Mcy. Details of the proposed expansion area including geotechnical and cultural resource analyses are available in the Jay Bird Shoals Borrow Site Expansion Analysis (Olsen 2022). **Figure 4.4** depicts the location of the proposed expansion area located to the northwest of the original permitted site. As of the April 2024 survey, there are approximately +1,464,000 cy of material theoretically available within the expansion area above -22 ft-NGVD.

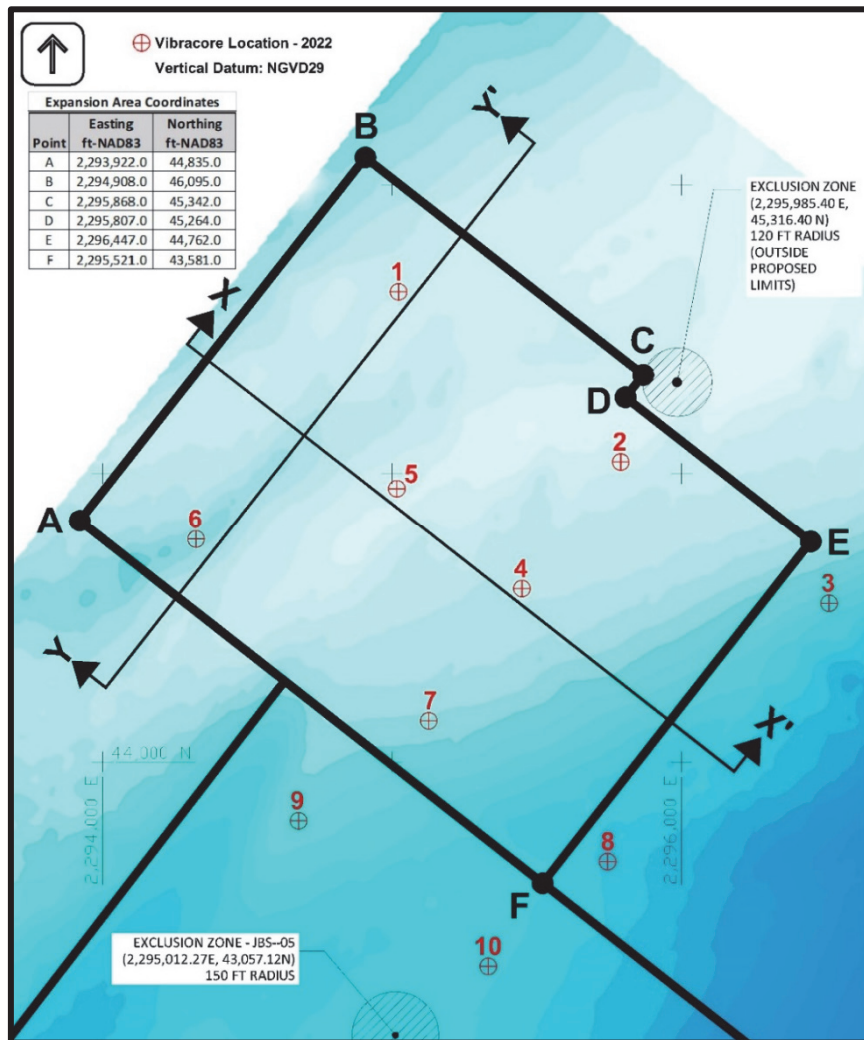


Figure 5.1: Jay Bird Shoals proposed expansion area.

5.2 Withdrawal of a Permit for a Frying Pan Shoals Borrow Site

In early 2017, the Village submitted permit applications with associated in-depth geotechnical studies and environmental analyses necessary to develop a long-term (and large scale) borrow site located within Frying Pan Shoals. The purpose of such a borrow site was to ensure compliance with Permit conditions necessitating the maintenance of the updrift fillet associated with the 2015 terminal groin project and to allow for large-scale beach renourishment of South Beach. Historically, sand placement from an alternate site has been required due to the scheduled hiatus in the disposal of channel maintenance sand on Bald Head Island by the Wilmington District, USACOE. To that end, pursuant to the existing tenets of the Wilmington Sand Management Plan, all beach quality channel maintenance material to be excavated in the spring of 2025 is to be placed at Oak Island. This action will necessitate a borrow site for excavation and fill placement by the Village during a 4 to 5 year hiatus.

In June 2017, the National Marine Fisheries Service (NMFS) issued concerns related to permits associated with the near-term use of the Frying Pan Shoals (FPS) borrow site *without first exploring and exhausting other viable sand source alternatives*. Realistically, the only alternate borrow area available for near-term sand placement at Bald Head Island (BHI) was sand remaining in the previously permitted Jay Bird Shoals (JBS) borrow site. Accordingly, in consideration of the NMFS request, the Village agreed to withdraw their application and prioritize the use of the previously authorized borrow site permitted at JBS (including both a partially “recovered” area dredged in 2009/10 and the remaining undredged portion of the borrow site). With the virtual depletion the Jay Bird Shoals borrow site, resulting from the 2018/19 renourishment project, the Village has reinitiated the permitting of a long-term borrow site located within Frying Pan Shoals in 2019. At the request of the Wilmington District, USACOE, Regulatory Branch, the permit request has been submitted as a modification of the 2015 Terminal Groin permit. By early 2022, the permit application continued to be in the RAI stage with fisheries “concerns” being a major hurdle to permit issuance. In April 2022, the Village acknowledged that the ongoing fisheries issue would not be readily resolved without seeking a Variance from the CRC. To that end, regulatory agencies recommended the prioritization of the use of Jay Bird Shoals over the use of Frying Pan Shoals for the next Village renourishment project. Accordingly, the Village authorized the necessary studies required to seek a Permit to expand the Jay Bird Shoals borrow site for purposes of providing sand for the next Village sponsored beach fill project.

5.3 Wilmington Harbor Navigation Project

In early 2023, the Wilmington District, USACE performed a routine navigation channel maintenance operation for the Smith Island Range as well as Bald Head Reaches 1 and 2. All beach compatible material excavated was placed on South Beach, Bald Head Island. The contract volume dredged was about 1.3 Mcy, mol. An estimate of the in-place volume at Bald Head Island was about 1.1 Mcy, mol. At the time of disposal, the sand tube groin field was again buried in its entirety below the beach disposal project berm. The District will schedule the next channel maintenance project disposal to be placed along Oak Island.

5.4 Wilmington Harbor Deepening Project

In 2019, the Port of Wilmington, NC both sponsored and formulated a Section 203 Report which proposes a plan to deepen and widen (in places), the Federal navigation project, which extends from the Atlantic Ocean up the Cape Fear River to the Port of Wilmington. The Village of Bald Head Island has formally submitted comments to the record which address deficiencies in the project analyses and which request clarification to impacts addressed or unaddressed by the consultant prepared report. No responses or additional information were received by the Village over the last 12 month period. In 2023, the Wilmington, USACE District has initiated the various environmental studies, E.I.S., and permitting. During the NEPA process the Village will again submit comments to that regard.

6.0 SUMMARY AND CONCLUSIONS

The most recent Wilmington Harbor Inner Ocean Bar maintenance dredging of Bald Head Shoal Channel Ranges 1 and 2, and the Smith Island Channel range was performed in the months of December 2022 – March 2023. Federal surveys show approximately 1.3 Mcy of sand during that operation were dredged with placement along South Beach pursuant to the terms of the Wilmington Harbor Sand Management Plan (WHSMP). Oak Island will be the recipient of the next tentatively scheduled 2024/25 beach federal disposal operation in accordance with the continued implementation of the present day WHSMP. As a result, the Village will contract for a locally constructed beach renourishment project in the winter of 24/25

It is presently proposed that the next Village sponsored project (in 2024/2025) will seek to place up to 1.0 Mcy of sand along two (2) sections of shoreline located at the opposite ends of South Beach. The final Contract amount will depend upon Bid costs and conditions at the time of construction. The easternmost segment of approximately 0.5 Mcy (Bid as an Option) is intended to briefly address the chronic erosion that’s been occurring for a number of years in the vicinity of the Shoals Club at Cape Fear. On the western end of South Beach an estimated 0.5 Mcy fill (Base Bid) will address the filling of the terminal groin template, as well as the section of shoreline extending throughout the limits of the sand tube groinfield. Subsequent to fill placement at that location, the Village will contract to remove and replace thirteen sandtube groins which have reached the end of their effective life. The groinfield was last replaced in its entirety in 2019 concurrent with a Village renourishment project. For purposes of constructing both the Base Bid and a potential Option (totaling up to 1.0 Mcy), a pre-existing (but depleted) borrow site at Jay Bird Shoals has been expanded to the north. As of March 2024, all Permitting had been completed for the proposed project.

Between November 2000 and April 2024, Bald Head Island had received up to 9.9 Mcy, mol of sand from the initial widening/deepening and six (6) subsequent maintenance dredging operations for the Wilmington Harbor Navigation Project entrance channel. Including the 2019 project, the Village has placed another 3.2 Mcy of sand along the West Beach and South Beach shorelines. Accordingly, in the net Bald Head Island has experienced a total *estimated* sand placement volume of approximately 13.1 Mcy since 2000 at those two locations – with South Beach todate receiving 97% or more of the total.

Conversely, the *gross* volumetric sediment *loss* over a November 2000 to April 2024 monitoring timeframe is conservatively computed at -9,166,800 cy, or approximately -398,600 cy per year – on “average”. This annualized “loss” addresses the continuous section of Bald Head Island shorefront extending from the marina entrance to the Cape Fear spit. The assignment of an *average annual* long-term rate of sand loss at Bald Head Island however, has *not* necessarily been a meaningful indicator of navigation project impact. Such an average rate is often temporally biased by periods of beach fill equilibration, groinfield “effectiveness due to

gradual deterioration,” major storm events (such as Hurricanes Florence, Dorian and Isaias), the occurrence of episodic destabilization dredging events in close proximity to the island, as well as other physiographic phenomena temporally affecting annualized quantities of alongshore sediment transport – from Bald Head Island. In addition, the westernmost segment of the island’s littoral system has had to adjust to the quasi-stabilizing effect of the terminal groin at that location in existence only since 2015. Along South Beach per se, there has historically existed a “nodal point” some 7,000 ft. eastward of the terminal groin (approx. STA 116+00). At or close to the nodal point, the directionality of *net littoral transport* on an annual basis changes from West (toward the groin) to East (toward Cape Fear). *Note* – depending on wave climatology, the condition and exposure of the sand tube groinfield, as well as other factors, the effective location of the nodal point can vary slightly along South Beach from year to year. As of April, 2024, within the 22,755 ft of shoreline influenced by sand episodically placed since 2000, up to +3,717,000 cy remain in the littoral system (measured above elevation -16 ft. NGVD 29). This *includes* the most recent 1.3 Mcy beach disposal project completed in early 2023 by the Wilmington District, USACE which beneficially affects this total.

Although not directly impacted by long-term navigation channel improvements and maintenance of the Cape Fear River entrance, the Village Council elected to initiate monitoring of the East Beach shorefront at Bald Head Island beginning in November 2008. Since that time, it is documented that East Beach can undergo strong seasonal variations of beach width and profile volume to a large degree dependent upon storm frequency and intensity, as well as the ever-changing configuration of the Cape Fear spit. For example, the most recent April 2024 survey data show a net shoreline volumetric loss of approximately -87,300 cy (above elevation -16 ft NGVD). throughout the 6,000 ft East Beach shoreline lying northward of Cape Fear over the last 12 months. In the prior year, this reach gained about +18,400 cy. Between November 2008 and April 2024, the shoreline gained +293,800 cy. Most of the East Beach volume increase had been caused by post-storm accretion of the portion of the Cape Fear spit shoreline which fronts Onslow Bay.

Typically, periods of episodic accretional configurations of the Cape Fear spit deemed beneficial to East Beach have corresponded to a high rate of erosion and duneline recession along the easternmost section of South Beach – directly seaward and westward of the Shoals Club facility. For example, between 2000 and 2020, the average MHWL erosion rate at that general location has been over -20 ft/yr – due to sand losses either directly or indirectly associated with the configuration of the Cape Fear spit formation. Although a 2021 federal beach disposal project placed fill within 2,000 ft. mol. of the Shoals Club and Cape Fear, erosion has continued to the point that the Club was required to install a sandbag revetment seaward of the property in May/June 2022. That revetment requires continuing maintenance due to episodic beach profile lowering at that location and the effects of storms.

In 2024, the Village performed monitoring of the Jay Bird Shoals borrow site utilized to construct the non-federal 1.85 Mcy beach fill sponsored by the Village in 2009/10 and the 1.10 Mcy beach constructed in 2018/19. During the monitoring period (May 2023 to April 2024), the fifth year following the 2018/19 project excavation, the entire permitted borrow site lost -27,400 cy (inclusive of the exclusion and buffer zones). As of April 2024, there is theoretically 1,360,400 Mcy of material located within the originally *permitted borrow site limits* above the permitted design cut elevation (-22 ft-NGVD). Most of that material is *not* however practically available for dredging at this time. Hence, an extension of the original JBS borrow site limits was required to act as a fill source for the upcoming Village beach fill project to be constructed in 24/25.

After an extension of the two marina entrance channel jetties in 2015, temporarily reduced shoaling within the navigation channel resulted in a corresponding reduced volume of disposal sand being placed along the Row Boat Row shoreline. Although the Village had planned to continue to proactively bypass sand from the south jetty fillet (located at the distal end of West Beach) to the Row Boat Row shorefront, it became clear that the existing four (4) low level timber groins were not capable of providing an acceptable level of shoreline stabilization at that location.

Hence, near the end of the 2017 monitoring period, the Village initiated construction of two (2) shore parallel detached rock breakwaters located north of the marina entrance seaward of the Row Boat Row shoreline. The placement of breakwaters between existing groins northward of the marina entrance was intended to combine the attributes of each of the two types of stabilization structure so as to reduce the rate of sediment transport from the eroding shoreline caused principally by ferry/barge generated waves. The subject expanded shore stabilization project (detached breakwaters *and* existing groinfield) was designed to have a sand fill prior to construction. Since construction multiple channel maintenance/sand bypass operations have occurred – most with increasing volumes dredged. Typically, dredging is required twice a year on average. This is primarily due to an increasing northerly rate of sediment transport along West Beach caused by a continuing reconfiguration of the Point

In the spring of 2019, the Village resubmitted permit applications accompanied by indepth geotechnical studies and environmental analyses intended to develop a long term (and large scale) supplementary borrow site located within Frying Pan Shoals. The purpose of such a borrow site would be to both ensure compliance with Permit conditions necessitating the maintenance of the updrift fillet associated with the 2015 terminal groin project and to provide an interim source of beach quality material sufficient to meet future South Beach renourishment requirements – when pursuant to the existing tenets of the Wilmington Harbor Sand Management Plan, beach quality channel maintenance material excavated would be placed at Oak Island. In 2021, a pre-project fisheries monitoring plan was submitted for purposes of addressing regulatory agency concerns. In April 2022, the Village acknowledged certain regulatory “concerns” may not be resolved in the near future. Subsequently, the Village authorized work intended to expand the Jay Bird Shoals borrow site for purposes of providing a

sand source for the next Village sponsored fill event – when federal beach disposal is contractually redirected to Oak Island.

The original Permits for construction of the terminal groin at Bald Head Island stipulated that *if* the permittee elected to dredge more than 250,000 cy from the Jay Bird Shoals borrow site after 2015, limited monitoring of the eastern end of Oak Island must be performed. Accordingly, in November 2018, the Village initiated the requisite monitoring at Oak Island (Caswell Beach). The first report of findings for Oak Island followed a November 2019 monitoring survey. A second-year monitoring report was issued in December 2020. In early 2021 it was formally agreed by DCM and the USACE that based upon the results of the Year 2 report, the *Village's responsibility for continued monitoring of Oak Island has terminated*. It is important to note that a specific Permit term associated with the northern extension of the Jay Bird Shoals borrow site has included a requirement that the Village reinstate its monitoring program for Caswell Beach for some indeterminate period of time. Said monitoring will begin at/or after the proposed beach renourishment project scheduled for completion prior to 1 April 2025.

It should be noted that exacerbated sand losses throughout a portion of the sand tube groin field occurred over the 1-year monitoring period addressed herein. Although not specifically quantified by this report, coincident degradation and failure of several sand tube groins has occurred (as of September 2024). Surveys show that the measured sand loss throughout the proposed limits of beach fill in 2024/2025 within the westernmost segment of the South Beach project exceeds 400,000 cy – through April 2024. Visual observation of shoreline sand losses since that date indicate that the proposed 500,000 cy Segment A beach fill at the location may not be sufficient to allow for coverage of existing groins required for successful sand-tube replacement. As a result, it may be necessary for the Village to consider increasing the placement sand volume within Segment A (west end of South Beach) and coincidentally reduce the contracted Segment B sand volume proposed for placement updrift of Cape Fear (east end of South Beach).

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