

FINAL REPORT

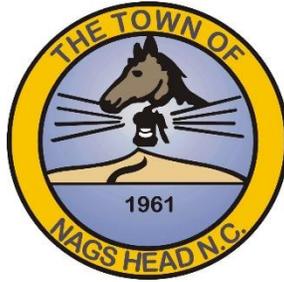
Produced for the Town of Nags Head, NC
January 2024



2023 ANNUAL BEACH MONITORING SURVEY EVALUATION

Town of Nags Head, NC





TOWN OF NAGS HEAD

**2023 ANNUAL MONITORING SURVEY
EVALUATION**

EXECUTIVE SUMMARY

The Town of Nags Head Beach Monitoring and Maintenance Plan is sponsored by the Town of Nags Head (Town) as a continuation of the 2011 monitoring program initiated for assessing beach conditions. The primary purpose of the program is to assess current and historical shoreline conditions, determine shoreline and volumetric changes and evaluate the performance of beach nourishment and other restoration efforts. Evaluating and documenting these changes consistently over successive years provides information necessary to plan for future beach nourishments and to support development of the Town's multi-decadal Beach Nourishment Master Plan.

The latest annual summer survey took place in June 2023 and was carried out by McKim & Creed. Furthermore, a fall survey, prompted by observed scarping along the Town's beachfront, was conducted by McKim & Creed in October 2023. This report outlines the data sources, methodologies, and findings of a survey evaluation conducted by Moffatt & Nichol. The evaluation compares the June 2023 survey to the data from June 2022 and assesses changes between the October 2023 and June 2023 surveys.

The survey data was used to compute shoreline change at Mean High Water (MHW), which is designated as +1.18 ft NAVD88 for Nags Head, and volume change above +6 ft NAVD88 (berm), MHW, -6 ft NAVD88 (wading depth), -14 ft NAVD88 (outer bar), -19 ft NAVD88 (approximate depth of closure), and -30 ft NAVD88 (offshore).

During the 2019 Beach Nourishment Project approximately 4.0 million cy of material was placed along approximately 10 miles of shoreline. The shoreline position and volume changes above six elevations relative to pre-nourishment conditions (April 2019) along the Nourished Oceanfront (Station 495+00 – 1025+00) were also analyzed.

Figure ES-1 illustrates the shoreline changes relative to pre-nourishment condition (April 2019) along the Nourished Oceanfront. As can be seen from the figure, a significant landward recession occurred along the Nourished Oceanfront since the completion of the 2019 nourishment project. The majority of this recession, noted before the post-Dorian survey, can be attributed to Hurricane Dorian. However, a portion of it was also due to profile equilibration, a natural occurrence during the stabilization of the nourishment profile. Similarly, while the August 2022 Post-Dorian Renourishment project mitigated part of the shoreline recession, by June 2023, the shoreline had significantly receded, likely due to profile equilibration.

Figure ES-2 illustrates that the overall changes in sand volume vary with the depth above which volumes are assessed. Notably, the Nourished Oceanfront exhibited material gains along the upper elevation (+6 ft NAVD88) and the lower elevations (-14 ft NAVD88 and -19 ft NAVD88) of the profiles. Conversely, material losses were observed MHW and -6 ft NAVD88. The results show large-scale shifts of sand cross-shore, across different elevations. Most notably, about 140% of the volume present in August 2019 above -19 ft NAVD88 has remained within the system through the October 2023 survey. It's important

to note that the 614,106 cubic yards of material placed during the 2022 Post-Dorian Renourishment project contribute to a 15% increase in the overall volume gain above -19 ft NAVD88.

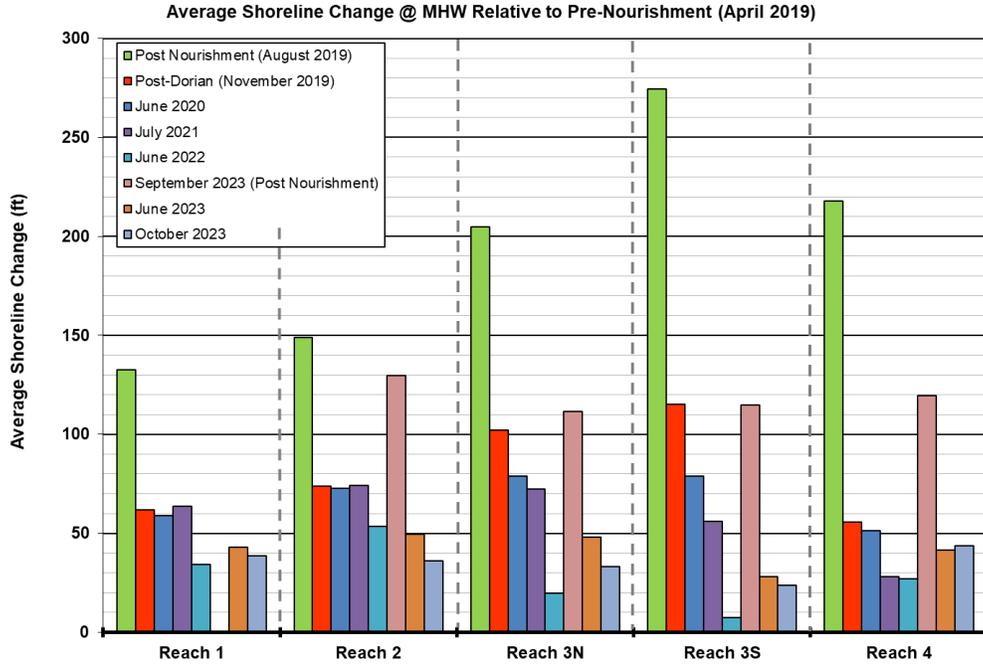


Figure ES-1. Nourished Oceanfront Average Shoreline Change Relative to Pre-Nourishment Conditions

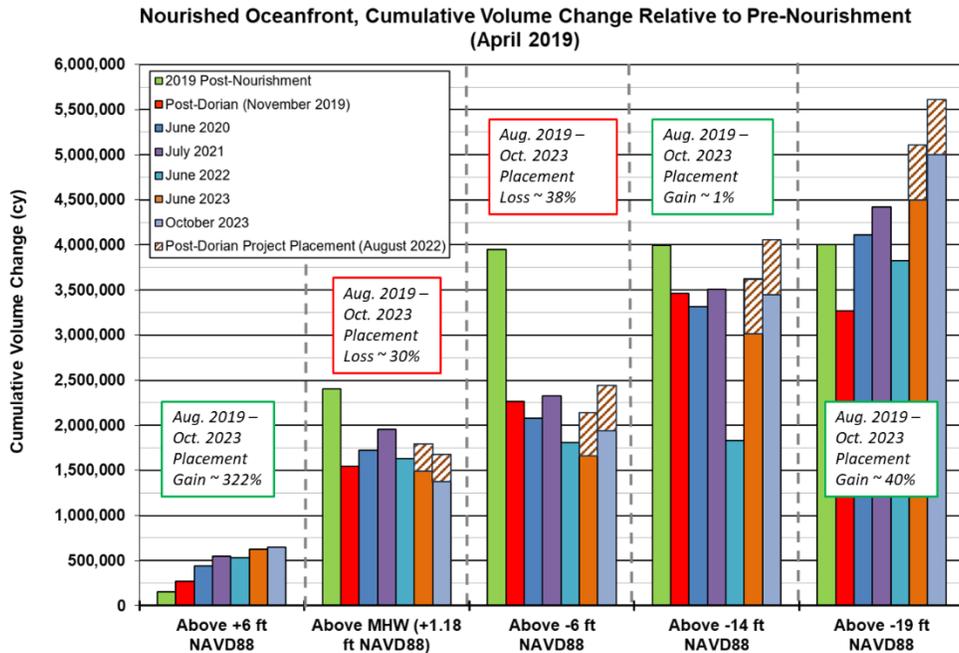


Figure ES-2. Nourished Oceanfront Cumulative Volume Change Relative to Pre-Nourishment

Figure ES-3 presents the volume changes relative to pre-nourishment conditions (April 2019) above -19 ft NAVD88 along the Nourished Oceanfront. In this figure, Reach 1, Reach 2, and Reach 3N display volume gains above -19 ft NAVD88 relative to the pre-nourishment conditions. Conversely, the remaining reaches show percent losses, but even with these losses, more than 50% of the material still remains in the system. It's important to note that without the 2022 Post-Dorian Project, the reported loss percentages at Reaches 3N, 3S, and 4 would have been 8%, 75%, and 72%, respectively.

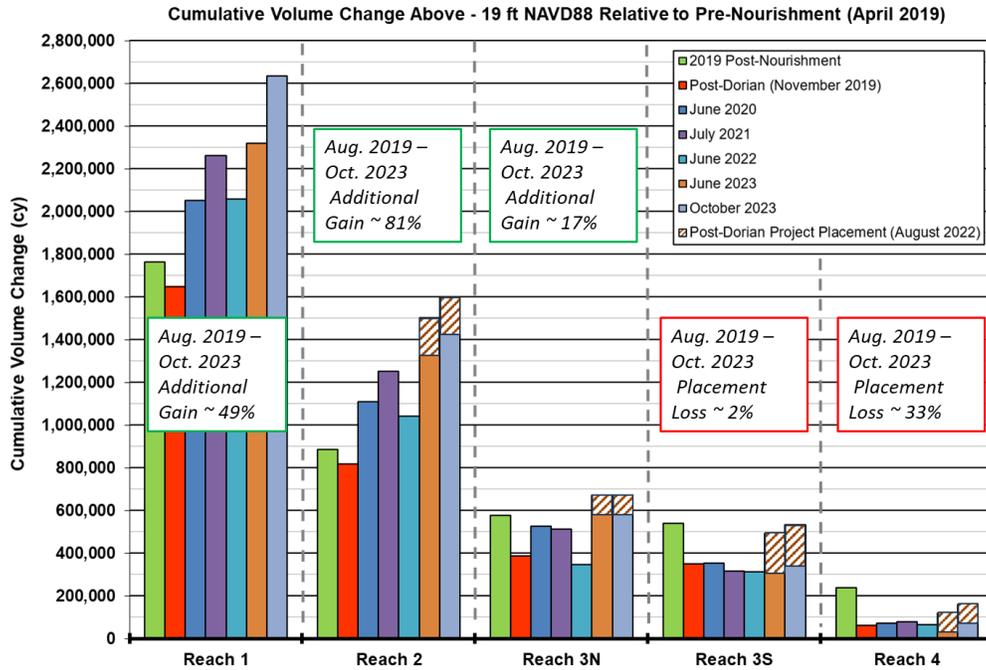


Figure ES-3. Cumulative Volume Change Above -19 ft NAVD88 Relative to Pre-Nourishment

Volume changes during the annual monitoring period indicated that the Nourished Oceanfront and Total Monitored Oceanfront both experienced gains in material between June 2022 and June 2023 along all the analyzed elevations. Key statistics for individual reaches along Nags Head along with the entire oceanfront shoreline were as follows:

Table ES-1. Nags Head Shoreline and Average Unit Volume Change Statistics (June 2022 – June 2023)

June 2022 vs. June 2023	Transects	Reach Length	avg shoreline change @ +1.18 ft NAVD88	avg volume change above +6 ft NAVD88	avg volume change above +1.18 ft NAVD88	avg volume change above -6 ft NAVD88	avg volume change above -14 ft NAVD88	avg volume change above -19 ft NAVD88	avg volume change above -30 ft NAVD88
Reach	#	ft	ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft
Nags Head - North	430+00 - 495+00	6,500	8.8	0.5	1.8	7.6	15.0	26.2	9.9
Nags Head - Reach 1	495+00 - 790+00	29,500	-3.8	0.3	-0.6	0.8	17.8	8.8	-8.0
Nags Head - Reach 2	790+00 - 920+00	13,000	28.2	3.0	6.5	12.3	47.6	35.5	15.9
Nags Head - Reach 3N	920+00 - 975+00	5,500	20.8	3.9	9.2	18.1	75.5	57.0	33.0
Nags Head - Reach 3S	975+00 - 1010+00	3,500	14.4	4.7	9.4	13.1	49.5	51.4	26.5
Nags Head - Reach 4	1010+00 - 1025+00	1,500	-4.0	1.3	1.8	2.7	21.1	31.2	3.0
National Seashore North	1025+00 - 1200+00	17,500	-16.6	0.8	-1.0	-2.6	21.2	28.6	-7.0
	Transects	Reach Length	weighted avg	weighted avg	weighted avg	weighted avg	weighted avg	weighted avg	weighted avg
Nourished Oceanfront	495+00 - 1025+00	53,000	7.8	1.7	2.9	6.3	33.3	23.8	4.7
Total Monitored Oceanfront*	430+00 - 1200+00	77,000	2.3	1.4	1.9	4.4	29.0	25.1	2.5

*National Seashore South Reach not included in the Total Monitored Oceanfront

Table ES-2. Nags Head Cumulative Volume Change Statistics (June 2022 – June 2023)

June 2022 vs. June 2023	Transects	Reach Length	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above -6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88	cumulative volume change above 30 ft NAVD88
Reach	#	ft	cy	cy	cy	cy	cy	cy
Nags Head - North	430+00 - 495+00	6,500	2,728	10,873	45,455	90,173	156,991	59,278
Nags Head - Reach 1	495+00 - 790+00	29,500	9,424	-17,101	23,090	524,899	259,165	-235,846
Nags Head - Reach 2	790+00 - 920+00	13,000	39,468	84,979	160,527	618,664	461,067	207,046
Nags Head - Reach 3N	920+00 - 975+00	5,500	22,669	52,897	104,129	434,344	327,560	189,758
Nags Head - Reach 3S	975+00 - 1010+00	3,500	16,465	32,955	45,820	173,425	179,797	92,894
Nags Head - Reach 4	1010+00 - 1025+00	1,500	2,335	3,218	4,697	36,988	54,562	5,242
National Seashore - North	1025+00 - 1200+00	17,500	13,543	-16,706	-45,322	371,445	500,960	-122,115
	Transects	Reach Length	total	total	total	total	total	total
Nourished Oceanfront	495+00 - 1025+00	53,000	90,361	156,947	338,263	1,788,319	1,282,153	259,094
Total Monitored Oceanfront*	430+00 - 1200+00	77,000	106,632	151,114	338,396	2,249,937	1,940,103	196,257

*National Seashore South Reach not included in the Total Monitored Oceanfront

During the June 2022-June 2023 monitoring period, among the nourished reaches, Reach 1 and Reach 4 were the only ones to observe shoreline recession. It's important to note that material was placed at all of the nourished oceanfront reaches during the 2022 Post-Dorian

Renourishment project, except for Reach 1, which helped mitigate recession rates in those reaches. Therefore, the seaward advancement observed in Reaches 2, 3N, and 3S can be attributed to the material placed during the nourishment project. The National Seashore-North reach, situated to the south of the Nourished Oceanfront, also observed seaward advancement, potentially attributed to southward material transport

Both the Nourished Oceanfront and Total Monitored Oceanfront exhibited material gains across all analyzed elevations, with the majority of the gain observed above -14 ft NAVD88. Slightly smaller volume gains were present above the depth of closure at -19 ft NAVD88. Specifically, the Nourished Oceanfront gained 1,282,153 cy (23.8 cy/ft) above -19 ft NAVD88, and the Total Monitored Oceanfront gained 1,940,103 cy (25.1 cy/ft) above -19 ft NAVD88. This material gain is primarily attributed to the 2022 Post Dorian Renourishment project. However, it's noteworthy that the observed material gain exceeds the amount placed during the nourishment project, suggesting additional material sources.

Volume changes during the fall monitoring period indicated that the Nourished Oceanfront experienced gains in material between June 2023 and October 2023 along all the analyzed elevations. Key statistics for individual reaches along Nags Head along with the entire oceanfront shoreline were as follows:

Table ES-3. Nags Head Shoreline and Average Unit Volume Change Statistics (June 2023 – October 2023)

June 2023 vs. October 2023 (Total Change)	Transects	Reach Length	avg shoreline change @ +1.18 ft NAVD88	avg volume change above +6 ft NAVD88	avg volume change above +1.18 ft NAVD88	avg volume change above -6 ft NAVD88	avg volume change above -14 ft NAVD88	avg volume change above -19 ft NAVD88	avg volume change above -30 ft NAVD88
Reach	#	ft	ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft
Nags Head - Reach 1	495+00 - 790+00	29,500	-4.4	-0.3	-2.7	6.1	8.1	10.9	12.0
Nags Head - Reach 2	790+00 - 920+00	13,000	-13.5	0.6	-3.0	7.3	9.1	7.6	7.7
Nags Head - Reach 3N	920+00 - 975+00	5,500	-14.8	2.2	-1.1	0.2	-0.7	0.1	-2.2
Nags Head - Reach 3S	975+00 - 1010+00	3,500	-4.3	2.9	1.4	5.2	12.5	11.2	13.3
Nags Head - Reach 4	1010+00 - 1025+00	1,500	2.4	0.9	0.6	3.4	17.9	20.8	15.8
	Transects	Reach Length	weighted avg	weighted avg	weighted avg	weighted avg	weighted avg	weighted avg	weighted avg
Nourished Oceanfront	495+00 - 1025+00	53,000	-7.5	0.4	-2.2	5.6	8.0	9.3	9.7

Table ES-4. Nags Head Shoreline and Average Unit Volume Change Statistics (June 2023 – October 2023)

June 2023 vs. October 2023 (Total Change)	Transects	Reach Length	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above -6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88	cumulative volume change above -30 ft NAVD88
Reach	#	ft	cy	cy	cy	cy	cy	cy
Nags Head - Reach 1	495+00 - 790+00	29,500	-10,004	-78,257	177,029	235,219	315,744	347,626
Nags Head - Reach 2	790+00 - 920+00	13,000	7,197	-39,527	94,591	118,082	98,797	100,524
Nags Head - Reach 3N	920+00 - 975+00	5,500	11,888	-5,916	896	-3,962	380	-12,229
Nags Head - Reach 3S	975+00 - 1010+00	3,500	10,134	5,059	18,290	43,859	39,179	46,462
Nags Head - Reach 4	1010+00 - 1025+00	1,500	1,769	1,291	6,778	35,815	41,518	31,585
	Transects	Reach Length	total	total	total	total	total	total
Nourished Oceanfront	495+00 - 1025+00	53,000	20,984	-117,350	297,583	429,014	495,619	513,968

Between June and October 2023, recession was observed in the shorelines of all reaches except for Reach 4. This trend can be attributed, in part, to the movement of material from the berm and beachface to the offshore bar and, conversely, onshore to the dune. Furthermore, at reaches that received material during the 2022 Post-Dorian renourishment project, the continuing profile equilibrium may have contributed to this shift. Notably, among the nourished reaches, both Reach 2 and Reach 3-North exhibited higher recession rates.

The volume changes observed during the monitoring period revealed that the Nourished Oceanfront saw material gains between July 2023 and October 2023 along all the analyzed reaches above -19 ft NAVD88, indicating an overall material gain in the system. However, at Reaches 1, 2, and 3-North, material loss occurred above MHW (1.18 ft NAVD88). At Reaches 1 and 2, this loss was primarily due to the offshore shifting of material, subsequently captured in the offshore bar.

During the current observation period, there has been notable dune growth in all reaches except for Reach 1. The growth is most evident in the areas that received material as part of the 2022 Post-Dorian nourishment project. Despite not placing material above the berm (+6 ft NAVD88) during this project, the expanded beach width resulted in increased sediment supply for aeolian transport, consequently contributing to dune growth.

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1.0 OBJECTIVE

The Town of Nags Head Beach Monitoring and Maintenance Plan is sponsored by the Town of Nags Head (Town) as a continuation of the 2011 monitoring program initiated for assessing beach conditions. The primary purpose of the program is to assess current and historical shoreline conditions, determine shoreline and volumetric changes and evaluate the performance of beach nourishment and other restoration efforts. Evaluating and documenting these changes consistently over successive years provides information necessary to plan for future beach nourishments and to support development of the Town's multi-decadal Beach Nourishment Master Plan.

The latest annual summer survey took place in June 2023 and was carried out by McKim & Creed. Furthermore, a fall survey, prompted by observed scarping along the Town's beachfront, was conducted by McKim & Creed in October 2023. This report outlines the data sources, methodologies, and findings of a survey evaluation conducted by Moffatt & Nichol. The evaluation compares the June 2023 survey to the data from June 2022 and assesses changes observed between the October 2023 and June 2023 surveys.

Table 2-1. Long-term Volume Change (Previous Studies: 2010-2018)

		Nov 2010- Nov 2011	Nov 2010- Jun 2012	Nov 2010- Nov 2012	Nov 2010- Jun 2013	Nov 2010- Jun 2014	Nov 2010- Jun 2015	Nov 2010- Jun 2016	Nov 2010- July 2017	Nov 2010- May 2018
		cy	cy							
Dune to +6 ft NAVD88	Reach 1 (495- 790)	135,789	213,713	124,589	344,963	456,407	466,904	505,144	551,781	526,825
	Reach 2 (790-920)	117,999	164,846	145,705	254,009	287,513	281,663	302,382	328,262	293,650
	Reach 3 (920-1010)	85,345	100,273	144,338	243,163	221,848	211,574	221,481	237,733	227,253
	Reach 4 (1010-1025)	10,824	17,767	13,678	26,771	35,216	18,915	5,486	9,292	2,746
	Project Oceanfront	349,957	496,599	428,310	868,906	1,000,984	979,056	1,034,493	1,127,068	1,050,474
Dune to -6 ft NAVD88	Reach 1 (495- 790)	1,138,026	1,032,425	1,014,648	1,219,411	1,085,981	1,079,356	1,086,961	1,194,858	985,588
	Reach 2 (790-920)	967,742	902,188	883,008	1,002,007	844,702	809,453	783,717	721,915	599,858
	Reach 3 (920-1010)	1,026,681	904,870	789,190	823,748	669,903	658,157	579,130	604,978	420,428
	Reach 4 (1010-1025)	110,880	118,284	93,392	90,268	77,033	31,752	29,024	22,168	-14,344
	Project Oceanfront	3,243,329	2,957,767	2,780,238	3,135,434	2,677,619	2,578,718	2,478,832	2,543,919	1,991,530
Dune to -19 ft NAVD88	Reach 1 (495- 790)	1,700,982	2,101,133	1,713,410	1,911,609	1,908,360	1,790,705	2,088,642	1,699,296	1,053,383
	Reach 2 (790-920)	1,297,082	1,373,586	1,141,685	1,292,398	1,346,691	1,268,412	1,305,026	888,118	573,200
	Reach 3 (920-1010)	1,281,379	1,296,493	1,003,944	1,137,586	1,025,817	799,182	760,191	408,100	157,253
	Reach 4 (1010-1025)	173,344	207,830	176,447	137,614	114,850	61,492	16,051	-59,743	-114,154
	Project Oceanfront	4,452,787	4,979,042	4,035,486	4,479,207	4,395,718	3,919,791	4,169,910	2,935,771	1,669,682

3.0 SURVEY PROCEDURES AND DATA PROCESSING

3.1 Survey Transects and Reaches

The present monitoring survey and evaluation continue to use the existing transect lines and origins established by CSE in monitoring periods prior to 2020. Additional monitoring transects were added in 2020 as recommended by Moffatt & Nichol to better understand sand movement and trends at hotspots and along the National Seashore shoreline south of the Town limits. McKim & Creed conducted the summer 2023 survey in June 2023, including both the additional transects and the previously established transect lines. **Figure 3-1** shows the location of the original and additional survey lines and origins applied by McKim & Creed and Moffatt & Nichol. **Figure 3-2** shows the survey lines used in the fall monitoring survey. As shown, survey transect lines were stationed from north to south along Nags Head. A summary of streets/landmarks present at the start and end of each reach are provided in **Table 3-1**.

Table 3-1. Reach Start and End Points

Reach	Stations	Length (ft)	Start Point	End Point
Nags Head - North	430+00-495+00	6,750	E 8 th Street	Bonnett Street
Reach 1	495+00-790+00	29,000	Bonnett Street	Governor Street
Reach 2	790+00-920+00	13,000	Governor Street	James Street
Reach 3 - North	920+00-975+00	5,500	James Street	Limulus Drive
Reach 3 - South	975+00-1010+00	3,500	Limulus Drive	Loon Court
Reach 4	1010+00-1025+00	2,000	Loon Court	McCall Court
National Seashore - North	1025+00-1200+00	17,250	McCall Court	North of Oregon Inlet Campground
National Seashore - South	1200+00-1290+00	9,000	North of Oregon Inlet Campground	Oregon Inlet

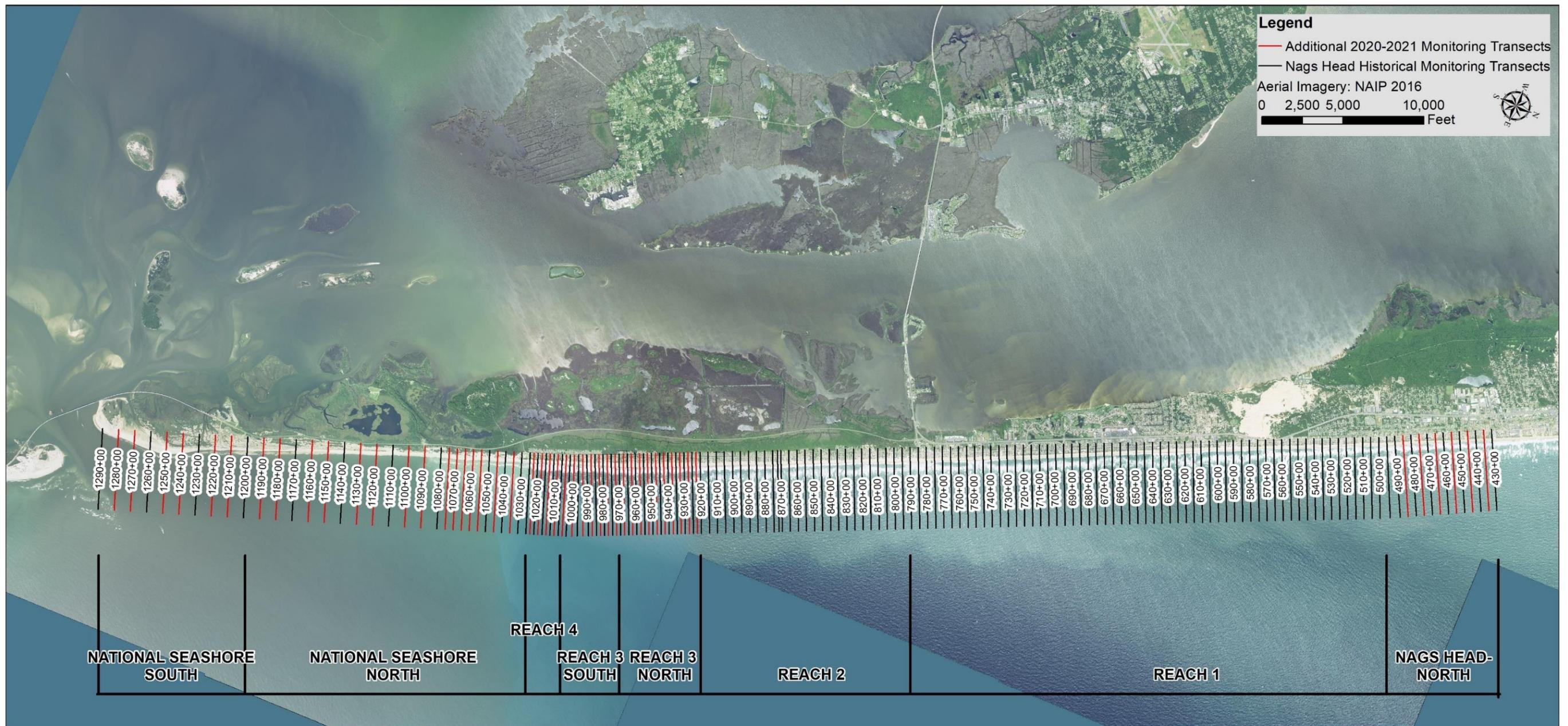


Figure 3-1. Nags Head Annual Monitoring Profile Line Locations

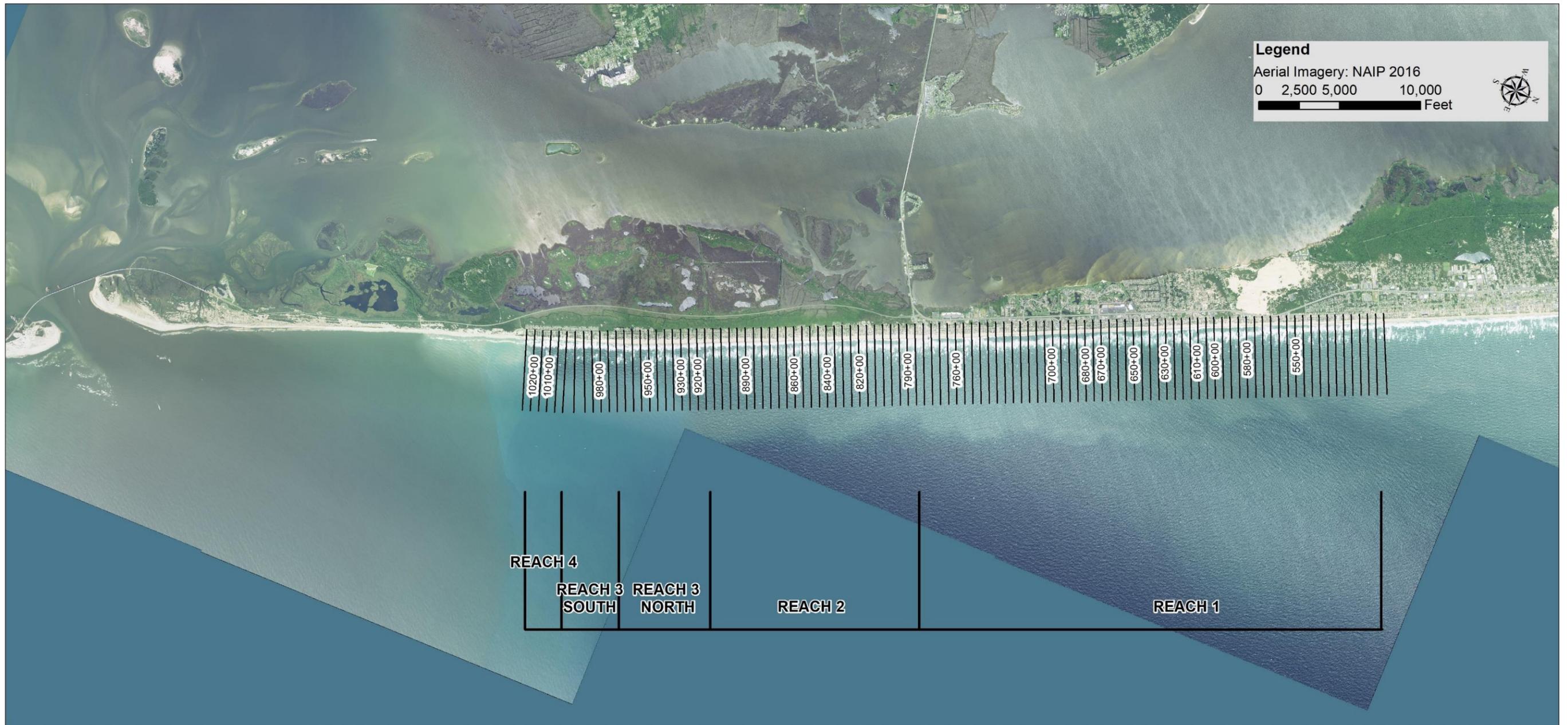


Figure 3-2. Nags Head Fall Monitoring Profile Line Locations

3.2 Survey Data Acquisition

To enable a reproducible and consistent result for the monitoring analysis, the survey events for each shoreline segment are assigned a single date for their completion. Assigning the survey date allows the determination of a consistent timeframe for each monitoring period between survey events for use in calculating shoreline and volumetric change rates. Surveys referenced during the current monitoring analysis include:

2023 Fall Survey

The present fall survey was conducted from October 17-19. The date used for the 2023 Fall survey is October 19, 2023, when the surveying was completed.

2023 Annual Survey

The most recent set of annual survey data was collected by McKim & Creed on June 11-July 1. The date used for the 2023 Nags Head profiles for this report is June 30, 2023, when the majority of the surveying was completed.

2022 Post-Dorian Renourishment Project Pre and Post Construction Surveys

The Post-Dorian beach nourishment project was completed between July 2022 and August 2022. During the project, pre- and post-nourishment profiles were surveyed at 100 ft spacing, immediately before and after filling by Gahagan & Bryant Associates. Volume placed during the renourishment effort was determined using these surveys.

2022 Annual Survey

The previous set of annual survey data was by McKim & Creed June 20-29. The date used for the 2022 Nags Head profiles for this report is June 29, 2022, when the majority of the surveying was completed.

2019 Pre – Nourishment Survey

Before the 2019 Beach Nourishment Project, CSE conducted a pre-nourishment survey in April 2019. The date used for the 2019 Nags Head profiles for this report is April 8, 2019.

McKim & Creed provided the processed survey data to Moffatt & Nichol in ASCII (xyz), Excel (xyz), BMAP (free format), and GIS (shapefile, grid) formats allowing for compatibility with multiple programs. The data referenced the horizontal North American Datum 1983 (NAD83) State Plane North Carolina (U.S. survey feet) and elevations were provided in feet relative to the North American Vertical Datum of 1988 (NAVD88). A copy of the survey data files is included on the attached USB also containing an electronic copy of the report.

Appendix A contains the McKim & Creed 2023 Field Report which discusses, in detail, the singlebeam (bathymetric) and topographic data acquisition. The field report also provides the associated equipment and quality control procedures (QA/QC) utilized in the data collection and processing tasks.

4.0 SURVEY EVALUATION METHODS

4.1 Shoreline Change

Shoreline change designated at the MHW contour, defined as +1.18 ft NAVD88, was calculated at each transect between the June 2022 and June 2023 surveys as well as between the June 2023 and October 2023 surveys. The MHW elevation is based on a National Oceanic and Atmospheric Administration (NOAA) tidal benchmark at Duck, NC shown in **Figure 4-1**. The resulting values represent the shoreline change (ft) over the time between surveys.

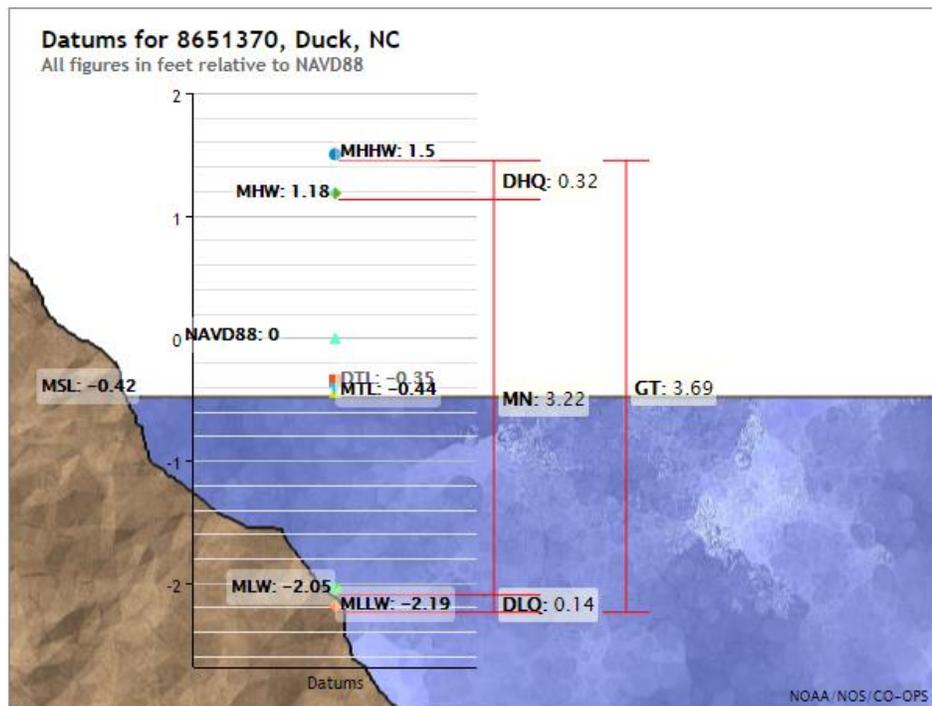


Figure 4-1. Tidal Datum for Duck, NC Station 8651370

4.2 Volume Change

Representative volume changes were calculated at each transect between the June 2022 and June 2023 surveys as well as between the June 2023 and October 2023 surveys. Volume changes were calculated for six different elevation extents to better understand the processes occurring onshore and offshore of Nags Head. Calculations included volume change above the following elevations:

- above +6 ft NAVD88 (berm),
- above +1.18 ft NAVD88 (MHW),
- above -6 ft NAVD88 (wading depth/recreational beach),
- above -14 ft NAVD88 (outer bar),

- above -19 ft NAVD88 (depth of closure), and
- above -30 ft NAVD88.

For those profiles which did not extend to -30 ft NAVD88, volume calculations were performed above -30 ft NAVD88 out to the extent of the shortest survey. **Figure 4-2** presents a graphical display of the various elevations for which volume change calculations were made.

As with the shoreline change, the results represent volume change (cy/ft) over the period of time between surveys. In addition, the volume changes were converted to cumulative changes over each of the management reaches and for the entire shoreline. This was done by applying the average end area method to the unit volume changes (cy/ft) computed at each transect and summing the total volume changes between each neighboring pair of transects. The resulting value indicated the total loss or gain of material between survey periods based on the applicable profile extents.

It should be noted that the uncertainty in the hydrographic portion of the survey can result in a significant volumetric change in offshore areas where the slope of the seafloor declines gradually. If an uncertainty of ± 0.11 ft is applied along the portion of the profile between the seaward side of the depth of closure (approximately 2,050 ft offshore) and a depth of -30 ft NAVD88 (approximately 2,950 ft offshore) along all 77,000 ft of oceanfront shoreline, this lends itself to an uncertainty of approximately $\pm 282,300$ cy. For this reason, more attention is given to the volume change calculations at -19 ft NAVD88 and above.

The profile volume calculation lenses (see **Figure 4-2**) were strategically chosen to help understand and track the movement of sand onshore and offshore. Volume changes calculated for portions of the profiles above +6 ft NAVD88 and above MHW are representative of changes in the amount of material in the dune system and on the subaerial beach. These areas of the profile are highly influenced by storm activity, and they are both very significant in the ability of the beach and dune to mitigate storm surge and wave impacts on landward structures and infrastructure. Volume comparisons for portions of the profiles above -6 ft NAVD88, an approximate wading depth, represent changes in the recreational beach area. Volume comparisons above -14 ft NAVD88 help to track sand movement to and from the outer sand bar and are valuable in decision making for future beach nourishment projects. Volume comparisons above -19 ft NAVD88 provide general estimates of the total volumetric change along the respective profile out to the depth of closure. Finally, volume comparisons above -30 ft NAVD88 allow the complete tracking of sand movement offshore. However, hydrographic survey measurement accuracy may impact these calculations. This is a proven, comprehensive way to assess the impact of storm activity on the subaerial beach and dune system as well as track the movement of sand offshore and quantify total gains and losses in the entire system.

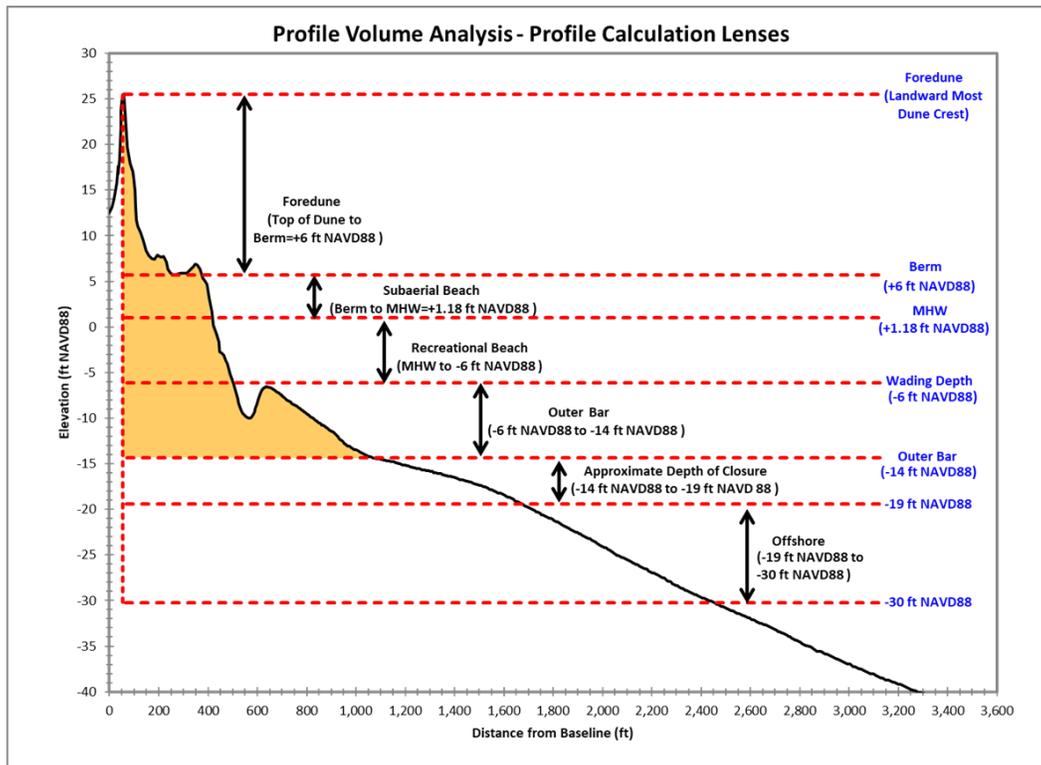


Figure 4-2. Profile Volume Calculation Lenses

5.0 DISCUSSION OF ANNUAL SURVEYING EVALUATION

This section discusses key events in the past year which influence the results of the annual analysis (i.e. nourishment projects, storms, etc.), development of background erosion rates, annual shoreline and volume change trends (June 2022 – June 2023), insight into summer/fall 2023 shoreline and volume change trends (June 2023 – October 2023), and analysis of long-term trends (2011 – 2023).

5.1 Key Events During the Reporting Period

Beach changes are greatly influenced by natural and engineered processes. This section describes key events that occurred during the reporting period that likely had an impact on shoreline change as well as profile volume gains and losses.

5.1.1 Sand Placement Events

The Town of Nags Head recently underwent a successful beach renourishment project to mitigate the effects of Hurricane Dorian which impacted the area on 6 September 2019. The construction of the 2022 Post-Dorian Project commenced on July 22, 2022, right at the onset of the 2022 - 2023 monitoring period, and was successfully completed by August 29, 2022. The entire project spanned approximately six weeks, during which a total of 614,106 cubic yards of material was placed along the four reaches of Nags Head.

The primary goal of the project was to restore the berm lost during Hurricane Dorian and provide additional berm to ensure an economically feasible fill density. The specific placement volumes are presented in **Table 5-1**. The geographical extents and reaches of the Post-Dorian Beach Renourishment Project design are shown in **Figure 5-1**.

Table 5-1. Project Volume Summary

Reach	Length	Final Volume (cy)	Final Density (cy/ft)
Reach 2	13,000	179,355	13.8
Reach 3N	5,500	142,137	25.8
Reach 3S	3,500	198,441	56.7
Reach 4	2,000	94,173	47.1
Total	24,000	614,106	

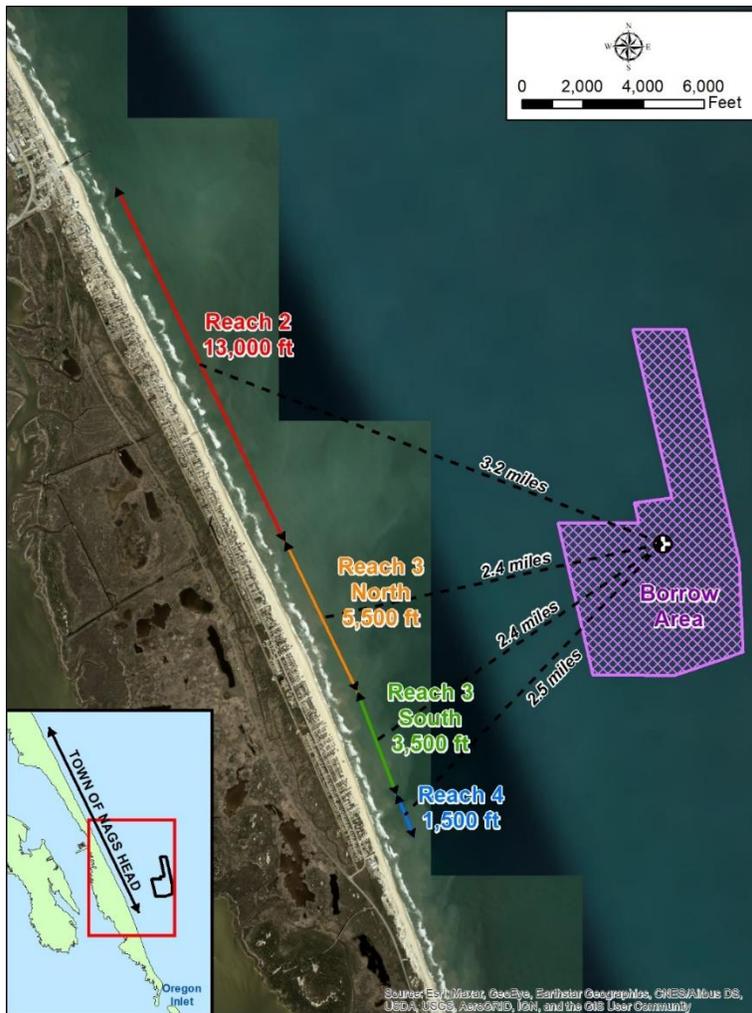


Figure 5-1. Post-Dorian Beach Renourishment Project Map

5.1.2 Wave Climate and Storm Events

Wave data from the National Data Buoy Center (NDBC) Station 44056 (USACE Field Research Facility (FRF)), located approximately 15 miles north of the Town, was downloaded for July 2022 through October 2023. The wave data was then plotted to analyze wave activity which may have impacted the Town. **Figure 5-2** shows the location of the buoy while **Figure 5-3** presents a plot of the wave heights during the reporting period. The blue line delineates the wave heights during the annual monitoring period (June 2022 – June 2023), and the black line indicates the fall monitoring period (June 2023 – October 2023).

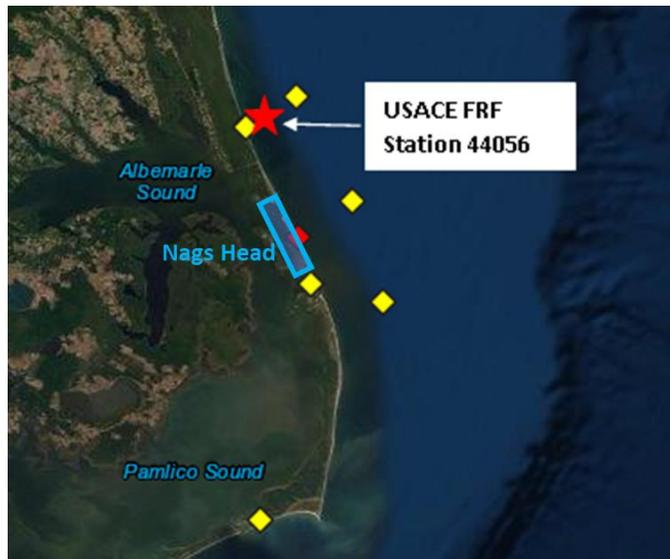


Figure 5-2. USACE FRF -51 ft Depth Waverider Buoy Location

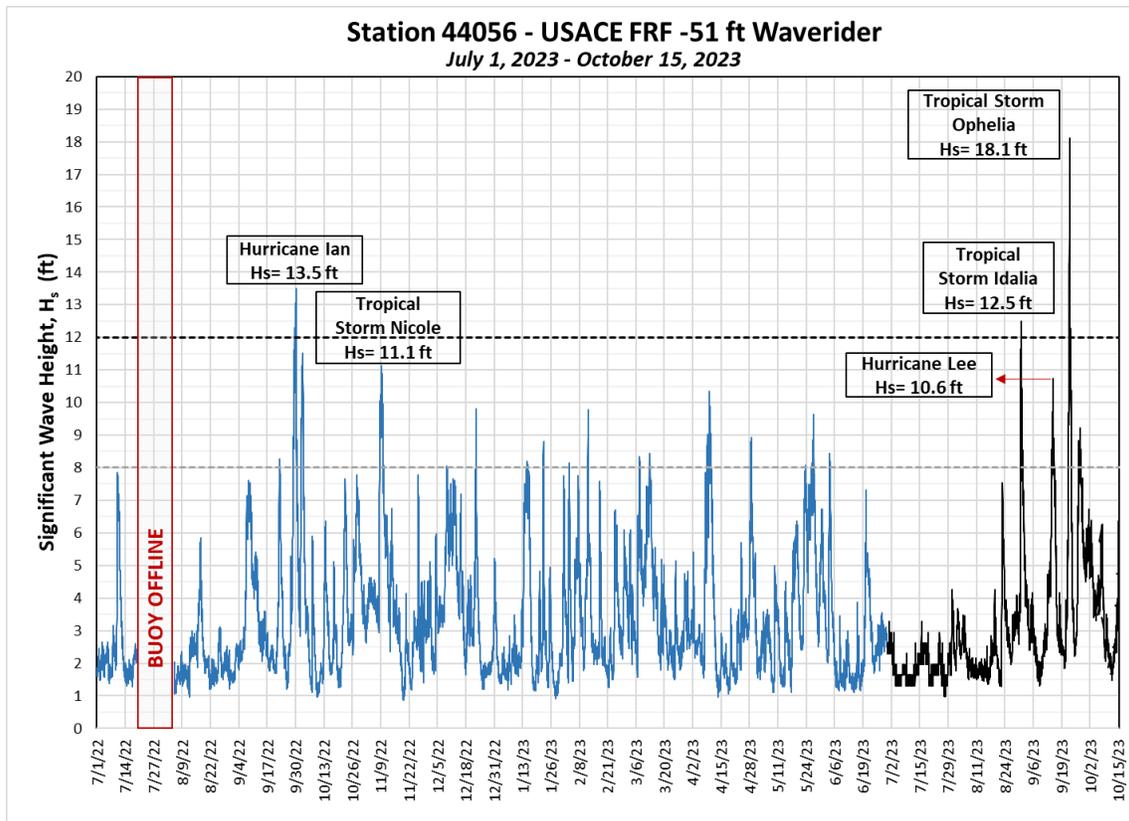


Figure 5-3. USACE FRF Station 44056 Wave Height

During the observation period the station 44056 buoy was unmoored between July 17-August 5, 2022. The data reveals a relatively calm wave climate during the annual monitoring period (June 2022 – June 2023). In the fall/winter season of 2022 (October

2022 – December 2022), four events occurred with wave heights surpassing 8 ft. Among these events, Hurricane Ian recorded the highest waves at 13.5 ft. Subsequently, during the winter storm season (January 2023 – May 2023), five events were observed with wave heights ranging between 8 ft and 11 ft. The subdued storm season between the summer 2022 and summer 2023 surveys may contribute to more favorable erosion rates compared to average annual background erosion rates.

In contrast, late August 2023 through early October 2023 experienced multiple high wave events. Two of these events registered total water levels exceeding 12 ft. Notably, during Tropical Storm Ophelia, recorded wave heights reached 18.1 ft. The heightened wave activity during this active fall season reportedly led to scarping along the Town's beachfront, a topic further discussed in Section 5.4.7.

Figure 5-4 and **Figure 5-5** depict the directional wave roses for the annual monitoring period (June 2022 - June 2023) and the period from January 1997 to June 2023, respectively. Statistical analysis reveals that for both time spans, prevailing waves originate from east-northeast to east-southeast directions. However, during the current annual monitoring period, a higher percentage of waves were observed from the east-northeast. In comparison to historical wave records, during the current annual monitoring, there was a significant increase (~6%) in the percentage of waves coming from the east-northeast, while waves from the east-southeast slightly decreased (~3%). Moreover, the percentage of waves higher than 5 ft from the east-northeast direction increased. This directional shift may have contributed to material from the north of the town shifting towards the Town's beachfront.

Figure 5-6 and **Figure 5-7** illustrate the directional wave roses for the fall monitoring period (June 2023 – October 2023) and historical fall wave climate, covering waves recorded in September, October, and November from 1997 to 2023. Comparing the current fall monitoring period to the historical fall wave climate, there's an approximate 6% increase in waves coming from the east and east-southeast directions. However, in all directions, the frequency of higher wave heights was smaller. The altered distribution in wave direction may lead to deviations from historical erosion trends during the observation period.

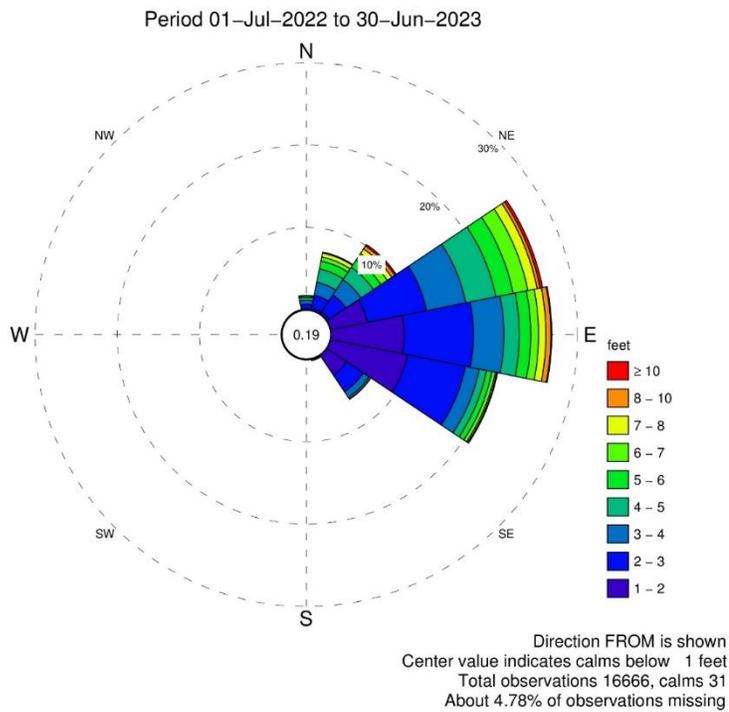


Figure 5-4. Station 44056 Significant Wave Height Rose from July 2022 – June 2023

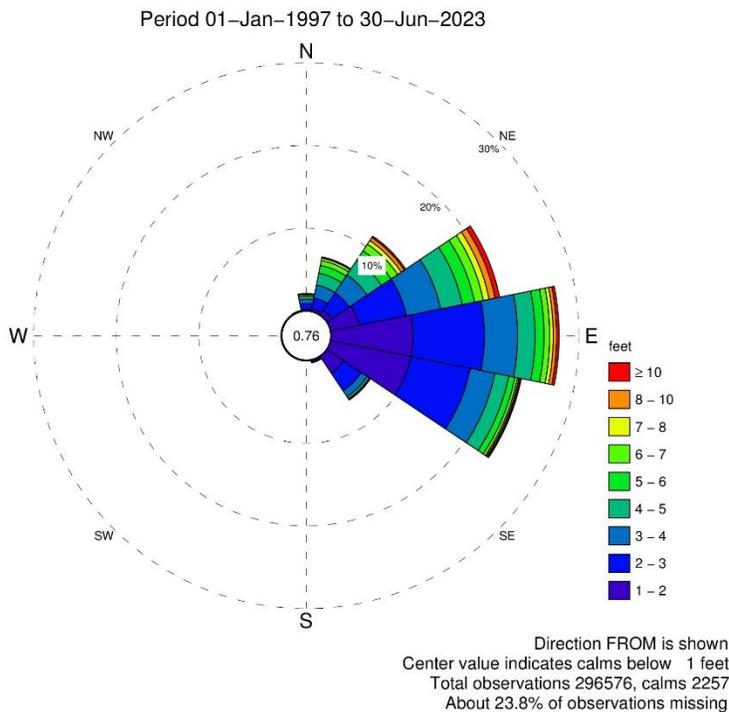


Figure 5-5. Station 44056 Significant Wave Height Rose from January 1997 – June 2023

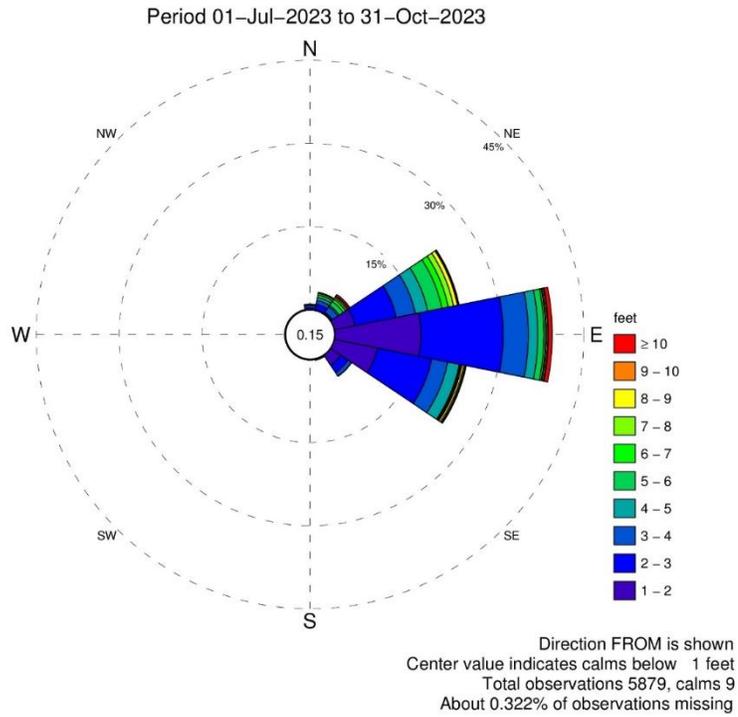


Figure 5-6. Station 44056 Significant Wave Height Rose from June 2023 – October 2023

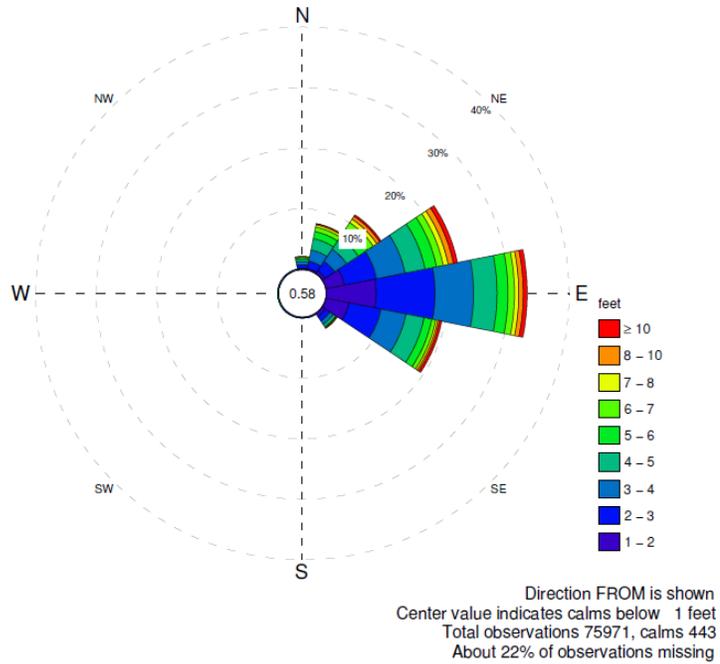


Figure 5-7. Station 44056 Significant Wave Height Rose for Sep.-Oct.-Nov. from January 1997– October 2023

5.2 Determination of Background Erosion Rates for Town of Nags Head (2011 – 2023)

To develop long-term trends in volume losses/gains, it is important to determine background erosion rates which do not include the volume gains from nourishment events. Since the establishment of the beach monitoring program immediately after the construction of the 2011 beach nourishment project, the Nags Head oceanfront has undergone one beach nourishment project in 2019 and another one in 2022.

Table 5-2 shows the nourishment volume placed at each reach within the monitoring program since the 2011 nourishment project.

Table 5-2. Nourishment Volumes Post-2011 by Management Reach

Reach	Nourishment Volume 2019 (cy)	Nourishment Volume 2022 (cy)	Total Nourishment Volume (cy)
Nags Head - North	0	0	0
Nags Head - Reach 1	1,762,213	0	1,762,213
Nags Head - Reach 2	885,587	179,355	1,064,942
Nags Head - Reach 3N	576,703	142,137	718,840
Nags Head - Reach 3S	540,833	198,441	739,274
Nags Head - Reach 4	239,298	94,173	333,471
National Seashore - North	0	0	0
Total	4,004,634	614,106	4,618,740

Historical volume changes above -19 ft NAVD88 were documented from 2011 through 2023. **Table 5-3** shows the computed volume change (including nourishments) above -19 ft NAVD88 from 2011-2023 for the defined monitoring reaches.

Table 5-3. Volume Change by Reach Above -19 ft NAVD88

Reach	Volume Change (cy) 2011-2012	Volume Change (cy) 2012-2013	Volume Change (cy) 2013-2014	Volume Change (cy) 2014-2015	Volume Change (cy) 2015-2016	Volume Change (cy) 2016-2017	Volume Change (cy) 2017-2018	Volume Change (cy) 2018-2019	Volume Change (cy) 2019-2020	Volume Change (cy) 2020-2021	Volume Change (cy) 2021-2022	Volume Change (cy) 2022-2023
Nags Head - North (430+00 - 495+00)	12,512	459	-61,997	42,855	-21,464	-107,963	-76,609	-273	14,451	82,466	-9,240	156,991
Nags Head - Reach 1 (495+00 - 790+00)	199,722	-210,804	16,718	-110,558	294,941	-418,152	-644,783	1,441,871	253,604	205,765	-210,748	259,165
Nags Head - Reach 2 (790+00 - 920+00)	117,215	-195,136	54,157	-81,138	33,499	-429,523	-328,626	696,896	156,913	143,886	-206,347	461,067
Nags Head - Reach 3N (920+00 - 975+00)	85,381	-144,828	-13,818	-133,901	15,540	-252,798	-168,797	423,513	21,457	10,346	-159,340	327,560
Nags Head - Reach 3S (975+00 - 1010+00)	-32,942	-48,873	-101,531	-89,412	-54,799	-104,590	-84,187	383,465	-106,581	-60,949	-12,855	179,797
Nags Head - Reach 4 (1010+00 - 1025+00)	71,930	-105,463	-14,079	-33,271	-42,050	-57,636	-31,569	136,047	-42,197	-11,624	-8,292	54,562
National Seashore - North (1025+00 - 1200+00)	107,833	-235,944	153,705	-442,192	3,220	-470,987	-520,298	-181,579	-93,041	610,231	284,283	500,960
Nourished Oceanfront (495+00 - 1025+00)	441,306	-705,102	-58,553	-448,280	247,132	-1,262,698	-1,257,961	3,081,792	283,196	287,425	-597,582	1,282,153
Total Monitored Oceanfront (430+00 - 1200+00)	561,651	-940,588	33,154	-847,616	228,887	-1,841,647	-1,854,868	2,899,940	204,606	980,122	-322,539	1,940,103

To calculate the background erosion rate, the documented nourishment volumes were subtracted from total volume changes above -19 ft NAVD88 between 2012 and 2023 and annualized over the 11-year time period. It should be noted that changes from 2011 to 2012

were omitted from the background erosion calculations. This exclusion was necessitated by the delayed survey date of the 2011 survey and the identification of atypical erosion trends during this specific observation period. **Table 5-4** shows the average annual background erosion rates for each management reach of the Nags Head oceanfront. The average background erosion rate for the Town’s Nourished Oceanfront and the Total Monitored Oceanfront shoreline is approximately -6.5 cy/ft/yr and -4.9 cy/ft/yr, respectively. Nags Head Reaches 3N, 3S, and 4 have considerably higher background erosion rates than the remainder of the oceanfront shoreline, signifying these areas need to be monitored closely and taken into special consideration during future planning and nourishment efforts.

Table 5-4. Average Annual Background Erosion Rates (2012 - 2023)

Reach (Transects)	Length	Volume Change Above -19 ft NAVD88 (cy) 2012-2023	Nourishment Volume (cy)	Background Erosion (cy)	Average Annual Background Erosion Rates (cy/ft/yr)
Nags Head - North (430+00 - 495+00)	6,500	19,677	0	19,677	0.3
Nags Head - Reach 1 (495+00 - 790+00)	29,500	877,020	1,762,213	-885,193	-2.7
Nags Head - Reach 2 (790+00 - 920+00)	13,000	305,649	1,064,942	-759,293	-5.3
Nags Head - Reach 3N (920+00 - 975+00)	5,500	-75,065	718,840	-793,905	-13.1
Nags Head - Reach 3S (975+00 - 1010+00)	3,500	-100,513	739,274	-839,787	-21.8
Nags Head - Reach 4 (1010+00 - 1025+00)	1,500	-155,571	333,471	-489,042	-29.6
National Seashore - North (1030+00 - 1200+00)	17,500	-391,642	0	-391,642	-2.0
Nourished Oceanfront (495+00 - 1025+00)	53,000	851,520	4,618,740	-3,767,220	-6.5
Total Monitored Oceanfront (430+00 - 1200+00)	77,000	479,555	4,618,740	-4,139,185	-4.9

5.3 Nags Head Annual Shoreline and Volume Change Analysis (June 2022 – June 2023)

This section discusses the results of the shoreline and volume change analysis for the defined monitoring reaches along Nags Head (see **Figure 3-1**). Key statistics were calculated to quantify average shoreline and volume changes for individual monitoring reaches as well as the entire oceanfront shoreline for Nags Head. The computed statistics include average shoreline change, average unit volume change, and cumulative volume change (e.g. total volume of material lost or gained along a section of shoreline). Evaluation of the computed statistics considers volume changes computed for portions of the profile above the berm (+6 ft NAVD88), above MHW (+1.18 ft NAVD88), above -6 ft NAVD88, above -14 ft NAVD88, above -19 ft NAVD88, and above -30 ft NAVD88 to better understand onshore and offshore processes.

Appendix B presents profile comparison plots for individual transects. These plots compare the summer 2022 and summer 2023 surveys, alongside the after-dredge (AD) surveys following the 2022 Post-Dorian Renourishment project. **Appendix C** provides the computed shoreline changes and volume changes measured at each transect between the summer 2022 and the summer 2023 surveys in tabular format.

5.3.1 Nags Head - North Reach (June 2022 – June 2023)

The Nags Head – North survey reach extends approximately 6,500 ft between E 8th Street and Bonnett Street, containing 13 survey transects (Station 430+00 – 495+00) at approximately 1000 ft spacing (see **Figure 3-1**). As a reminder, six transects were added to this reach during the 2020 surveying effort, creating 500 ft spacing for the whole reach. This reach did not receive any direct sand placement during the 2022 Post-Dorian Renourishment project. A summary of average shoreline and volume changes between June 2022 and June 2023 for Nags Head – North in comparison with the Total Monitored Oceanfront is presented in **Table 5-5** and **Table 5-6**.

Table 5-5. Average Shoreline and Average Unit Volume Change for Nags Head – North Reach (June 2022 – June 2023)

2022 vs. 2023 (Total Change)	Transects	Reach Length	avg shoreline change @ +1.18 ft NAVD88	avg volume change above +6 ft NAVD88	avg volume change above +1.18 ft NAVD88	avg volume change above -6 ft NAVD88	avg volume change above -14 ft NAVD88	avg volume change above -19 ft NAVD88	avg volume change above -30 ft NAVD88
Reach	#	ft	ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft
Nags Head - North	430+00 - 495+00	6,500	8.8	0.5	1.8	7.6	15.0	26.2	9.9
Total Monitored Oceanfront	430+00 - 1200+00	77,000	2.3	1.4	1.9	4.4	29.0	25.1	2.5

Table 5-6. Cumulative Volume Change for Nags Head – North Reach (June 2022 – June 2023)

2022 vs. 2023 (Total Change)	Transects	Reach Length	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above -6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88	cumulative volume change above -30 ft NAVD88
Reach	#	ft	cy	cy	cy	cy	cy	cy
Nags Head - North	430+00 - 495+00	6,500	2,728	10,873	45,455	90,173	156,991	59,278
Total Monitored Oceanfront	430+00 - 1200+00	77,000	106,632	151,114	338,396	2,249,937	1,940,103	196,257

Table 5-5 indicates that North Reach experienced a slight seaward advancement of the shoreline at MHW over the past year. **Figure 5-8** presents the shoreline changes at each transect, indicating widely varying shoreline movement patterns within the reach.

Table 5-5 and **Table 5-6** indicates that the Nags Head – North reach experienced volume gains at all analyzed elevations. Overall, North Reach experienced the largest volume gains above -19 ft NAVD88 (+156,991 cy or +26.2 cy/ft). These gains can be attributed to material placements both south and north of the reach during the summer of 2022, contributing to the transport of material to the reach.

Figure 5-9 displays the unit volume change at each transect for the Nags Head – North reach. The majority of transects experienced volume gains. Profile plots at **Appendix B** show onshore movement of the offshore sand bar. **Figure 5-10** presents an example of offshore bar adjustment.

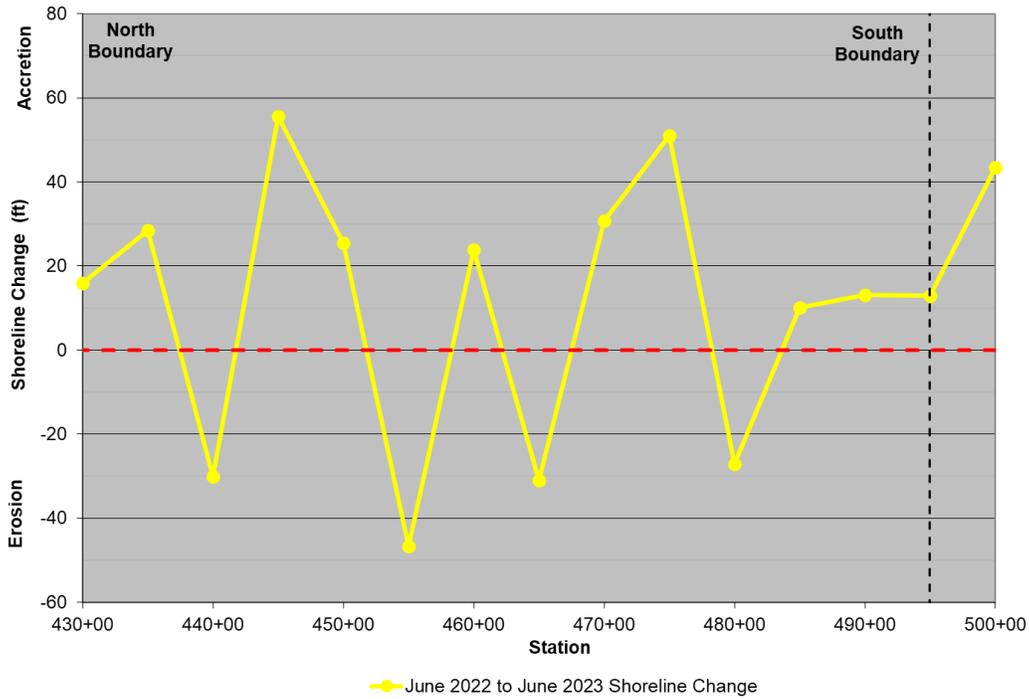


Figure 5-8. Nags Head – North Shoreline Change (June 2022 – June 2023)

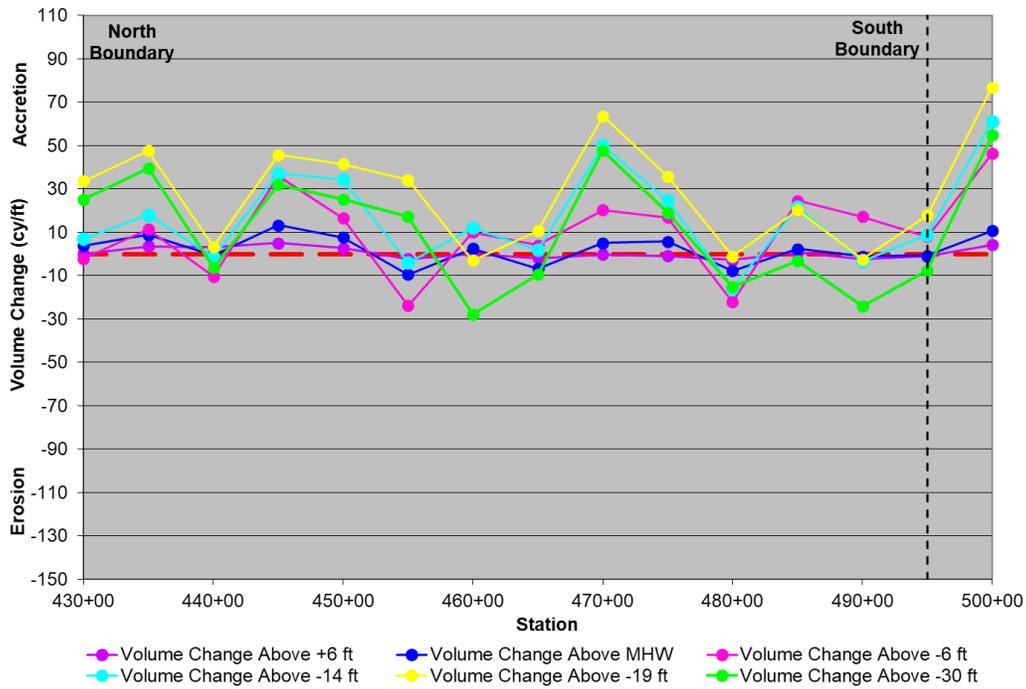


Figure 5-9. Nags Head – North Unit Volume Change (June 2022 – June 2023)

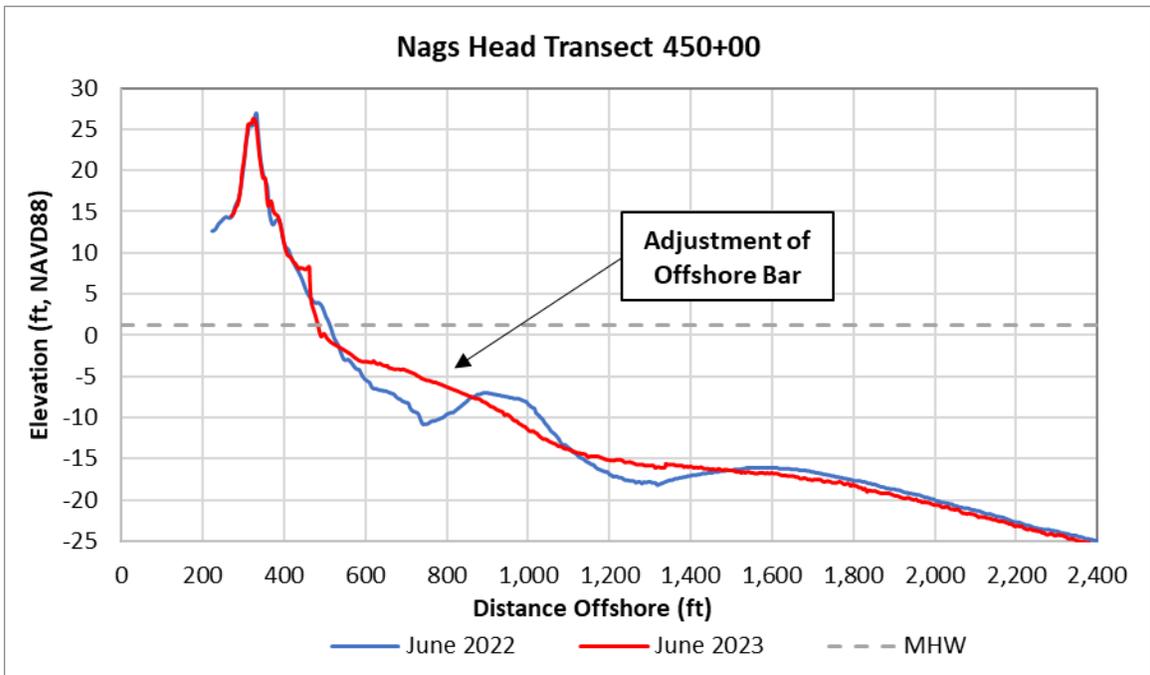


Figure 5-10. Example Nags Head – North Profile, Station 450+00 (E. Albatross St.)

5.3.2 Nags Head - Reach 1 (June 2022 – June 2023)

The Nags Head – Reach 1 survey reach extends approximately 29,500 ft between Bonnett Street and Governor Street, containing 59 survey transects (Station 495+00 – 790+00), at 500 ft spacing (see **Figure 3-1**). This reach did not receive any direct sand placement during the 2022 Post-Dorian Renourishment project. A summary of average shoreline and volume changes between June 2022 and June 2023 for Reach 1 in comparison with the Total Monitored Oceanfront is presented in **Table 5-7** and **Table 5-8**.

Table 5-7. Average Shoreline and Average Unit Volume Change for Reach 1 (June 2022 – June 2023)

June 2022 vs. June 2023	Transects	Reach Length	avg shoreline change @ +1.18 ft NAVD88	avg volume change above +6 ft NAVD88	avg volume change above +1.18 ft NAVD88	avg volume change above -6 ft NAVD88	avg volume change above -14 ft NAVD88	avg volume change above -19 ft NAVD88	avg volume change above -30 ft NAVD88
Reach	#	ft	ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft
Nags Head - Reach 1	495+00 - 790+00	29,500	-3.8	0.3	-0.6	0.8	17.8	8.8	-8.0
Total Monitored Oceanfront	430+00 - 1200+00	77,000	2.3	1.4	1.9	4.4	29.0	25.1	2.5

Table 5-8. Cumulative Volume Change for Reach 1 (June 2022 – June 2023)

June 2022 vs. June 2023	Transects	Reach Length	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above 6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88	cumulative volume change above 30 ft NAVD88
Reach	#	ft	cy	cy	cy	cy	cy	cy
Nags Head - Reach 1	495+00 - 790+00	29,500	9,424	-17,101	23,090	524,899	259,165	-235,846
Total Monitored Oceanfront	430+00 - 1200+00	77,000	106,632	151,114	338,396	2,249,937	1,940,103	196,257

Shoreline change at MHW showed a minor overall average landward recession of -3.8 ft. **Figure 5-11** presents the shoreline changes at each transect from June 2022 to June 2023. The figure indicates widely varying shoreline movement patterns within the reach, spanning from -56.4 ft at station 615+00 to +54.6 ft at station 745+00.

Table 5-7 and **Table 5-8** indicates that Reach 1 experienced volume gains above the analyzed elevations, except for MHW and -30 ft NAVD88. The occurrence of volume losses above MHW, coupled with gains observed at upper and lower elevations, suggests a steepening of the beachface profile. The most substantial volume gains occurred above -14 ft NAVD88 (+524,899 cy or +17.8 cy/ft). Profile plots in **Appendix B** show profile comparison plots for individual transects. Transects at the northern and southern ends of the reach experienced material gains as the offshore bar moved from lower elevations onshore to higher elevations. Simultaneously, the transects in the middle of the reach observed offshore bar adjustments, with the bar moving closer, although the bar elevation did not change significantly.

Figure 5-12 displays the unit volume change at each transect above the six elevations analyzed and further illustrate the trends observed in comparison plots. **Figure 5-13** presents an example profile from north of the reach where the sand bar moved onshore and

expanded. Additionally, **Figure 5-14** presents an example profile from the middle of the reach, showing the offshore bar moving onshore while maintaining a consistent elevation.

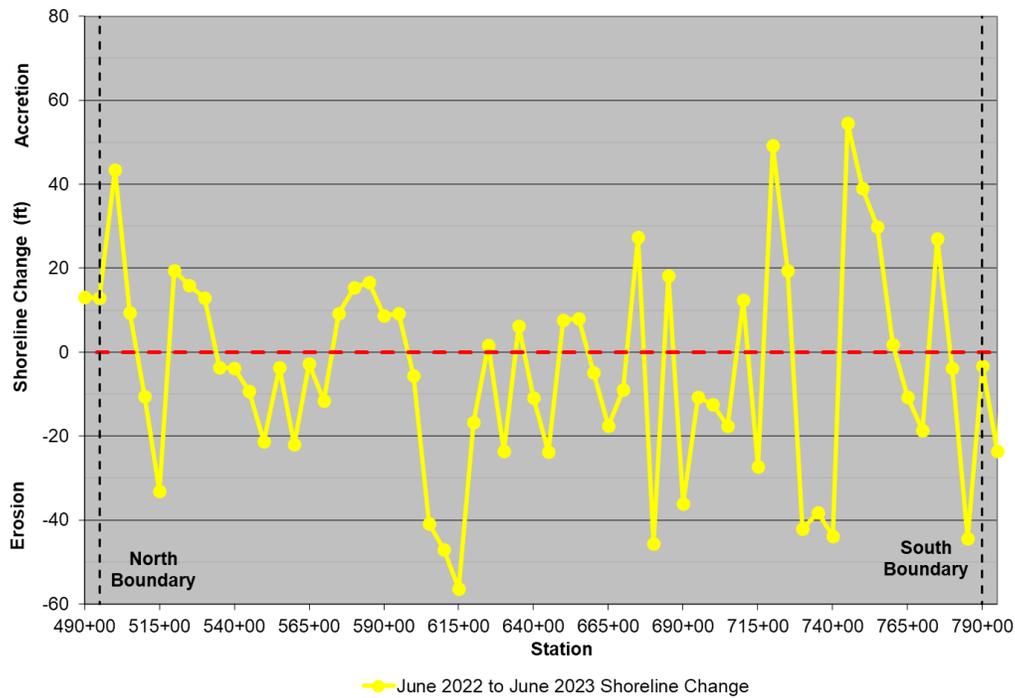


Figure 5-11. Nags Head – Reach 1 Shoreline Change (June 2022 – June 2023)

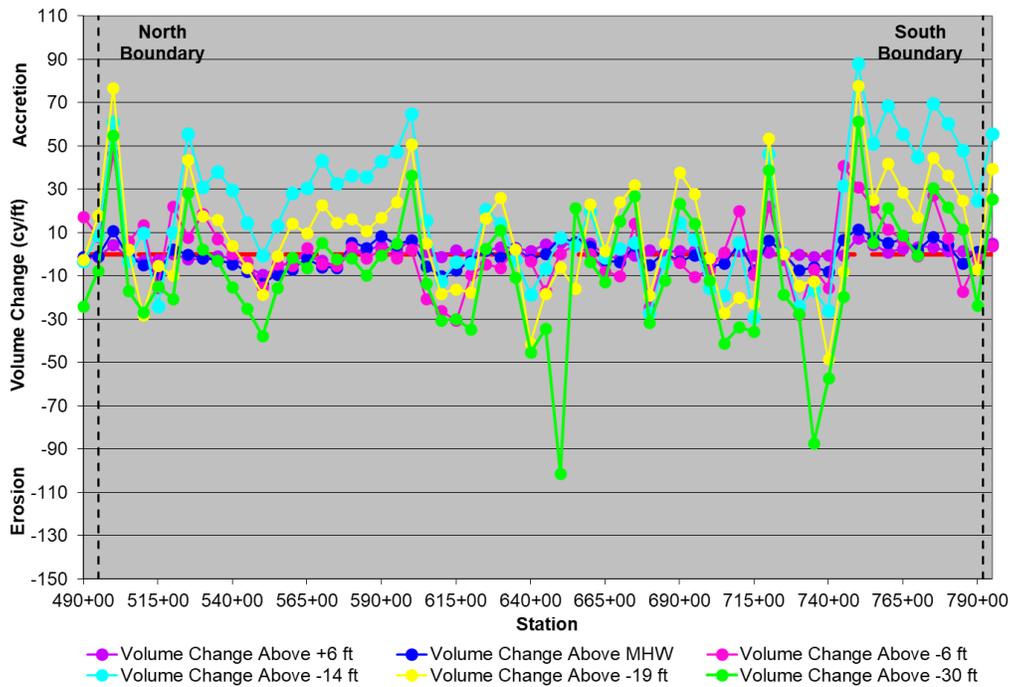


Figure 5-12. Nags Head – Reach 1 Unit Volume Change (June 2022 – June 2023)

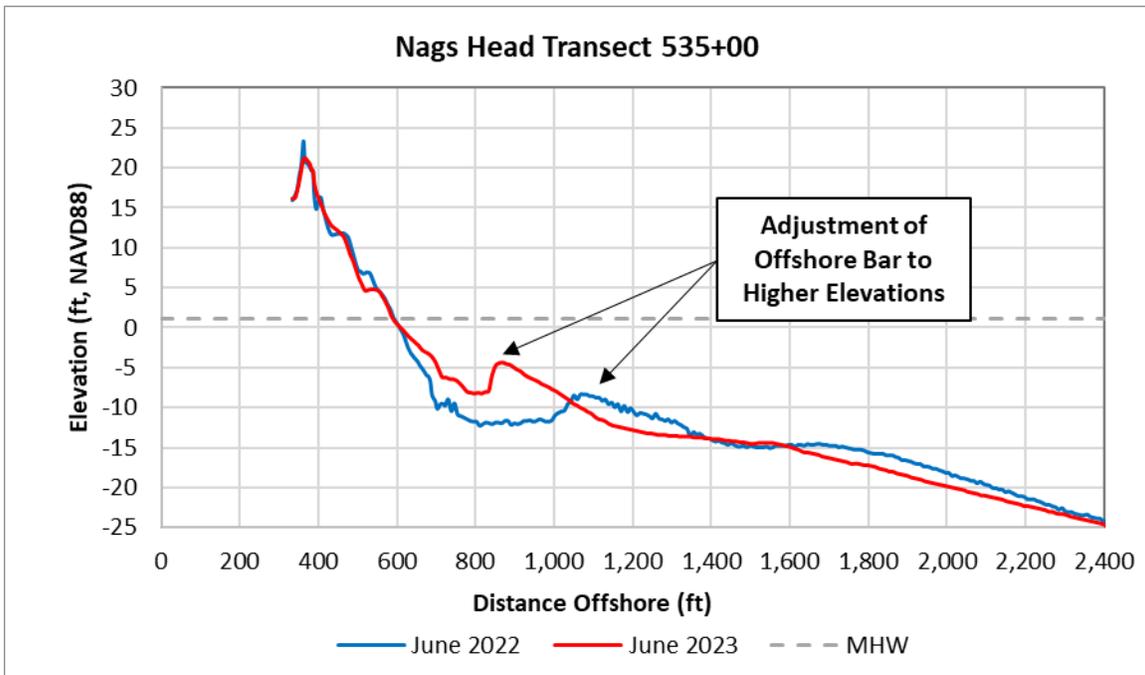


Figure 5-13. Example Reach 1 Profile, Station 535+00 (E Soundside Rd.)

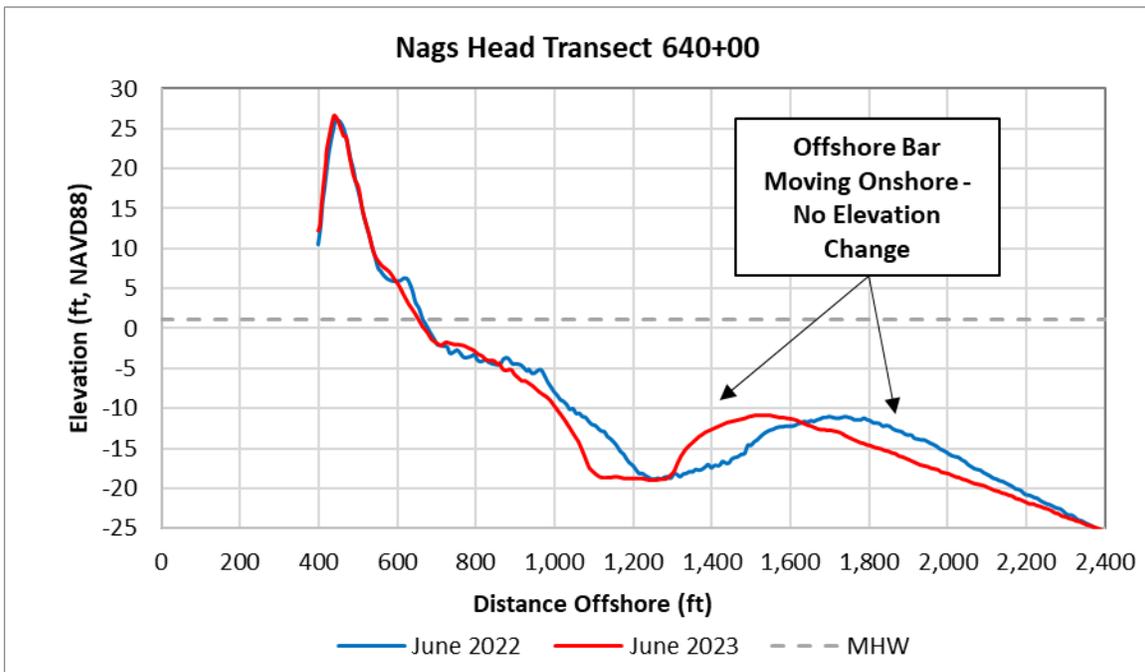


Figure 5-14. Example Reach 1 Profile, Station 640+00 (E Dunn St.)

5.3.3 *Nags Head - Reach 2 (June 2022 – June 2023)*

The Nags Head – Reach 2 survey reach extends approximately 13,000 ft between Governor Street and James Street, containing 26 survey transects (Station 790+00 – 920+00), at 500 ft spacing (see **Figure 3-1**). This reach received a total of 142,137 cy (25.8 cy/ft) of material during the 2022 Post-Dorian Renourishment Project. A summary of average shoreline and volume changes between June 2022 and June 2023 for Nags Head – Reach 2 in comparison with the Total Monitored Oceanfront is presented in **Table 5-9** and **Table 5-10**.

Table 5-9. Average Shoreline and Average Unit Volume Change for Reach 2 (June 2022 – June 2023)

2022 vs. 2023 (Total Change)	Transects	Reach Length	avg shoreline change @ +1.18 ft NAVD88	avg volume change above +6 ft NAVD88	avg volume change above +1.18 ft NAVD88	avg volume change above -6 ft NAVD88	avg volume change above -14 ft NAVD88	avg volume change above -19 ft NAVD88	avg volume change above -30 ft NAVD88
Reach	#	ft	ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft
Nags Head - Reach 2	790+00 - 920+00	13,000	28.2	3.0	6.5	12.3	47.6	35.5	15.9
Total Monitored Oceanfront	430+00 - 1200+00	77,000	2.3	1.4	1.9	4.4	29.0	25.1	2.5

Table 5-10. Cumulative Volume Change for Reach 2 (June 2022 – June 2023)

2022 vs. 2023 (Total Change)	Transects	Reach Length	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above -6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88	cumulative volume change above -30 ft NAVD88
Reach	#	ft	cy	cy	cy	cy	cy	cy
Nags Head - Reach 2	790+00 - 920+00	13,000	39,468	84,979	160,527	618,664	461,067	207,046
Total Monitored Oceanfront	430+00 - 1200+00	77,000	106,632	151,114	338,396	2,249,937	1,940,103	196,257

Shoreline change at MHW showed an overall average accretion of +28.2 ft. **Figure 5-15** illustrates the shoreline changes at each transect from June 2022 to June 2023, revealing that the majority of transects experienced accretion. The seaward advancement observed can be attributed to the material placement during the 2022 Post-Dorian Renourishment Project. It should be noted that the profile plots in **Appendix B** show numerous instances of shoreline recession occurring after the nourishment project.

Volumetrically, **Table 5-9** and **Table 5-10** indicates that Reach 2 experienced volume gains in this monitoring period above all the analyzed elevations. The most significant volume gains were observed above -14 ft NAVD88 (+618,664 cy or +47.6 cy/ft) and above -19 ft NAVD88 (+461,067 cy or +35.5 cy/ft). While some of this material gain can be attributed to the 2022 Post-Dorian Renourishment Project, the material gain is larger than the material placement, indicating additional volume gain. **Figure 5-16** displays the unit volume change at each transect above the six elevations analyzed. As can be seen, almost all transects experienced volume gains above all the analyzed elevations indicating a positive trend in volumetric changes across Reach 2.

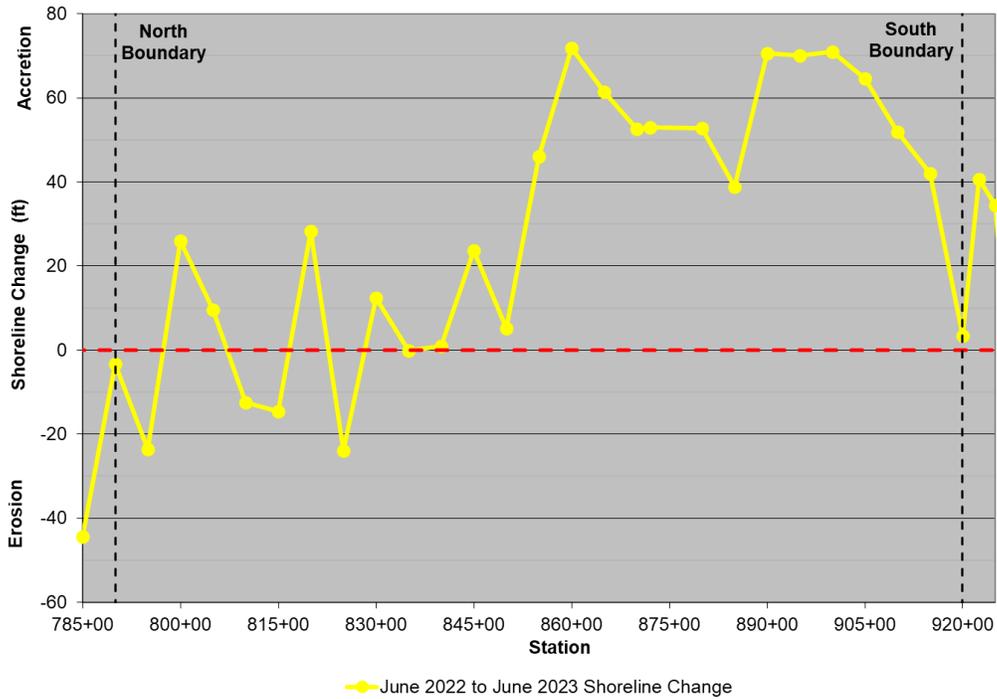


Figure 5-15. Nags Head – Reach 2 Shoreline Change (June 2022 – June 2023)

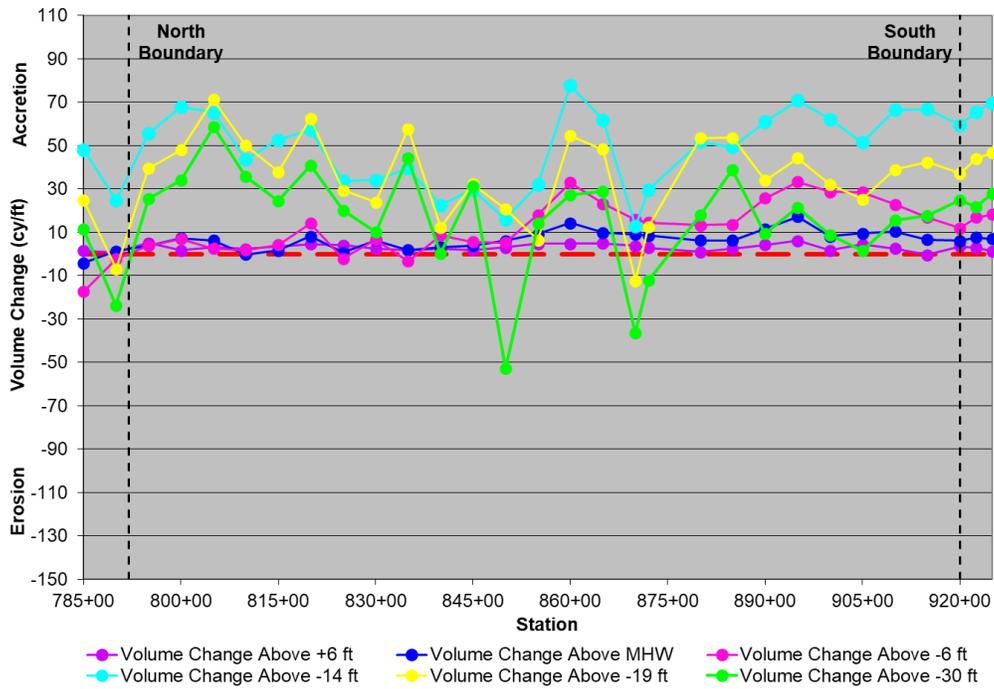


Figure 5-16. Nags Head – Reach 2 Unit Volume Change (June 2022 – June 2023)

Profile plots in **Appendix B** show many instances of offshore bar growth and adjustment, with it moving onshore and to higher elevations. Furthermore, the profiles demonstrate the movement of the 2022 Post-Dorian Renourishment Project placement to lower elevations as the profile equilibrates. **Figure 5-17** presents an example profile where nourishment profile has equilibrated, and offshore sand bar is adjusted to higher elevations.

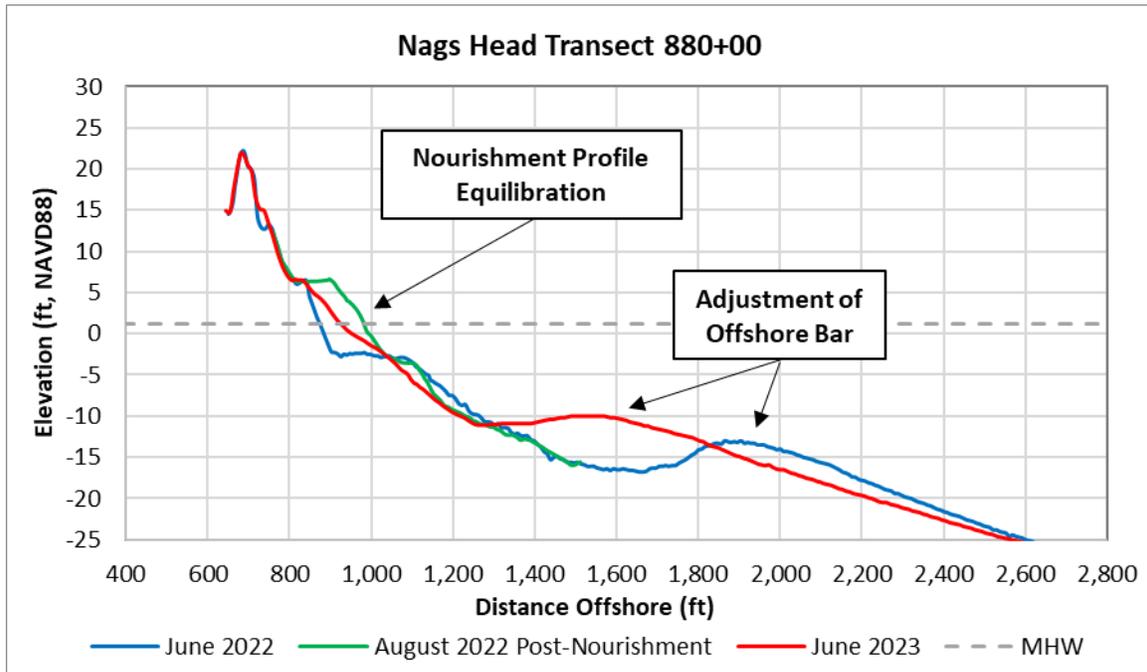


Figure 5-17. Example Reach 2 Profile, Station 880+00 (E Islington St.)

5.3.4 Nags Head - Reach 3 - North (June 2022 - June 2023)

The Nags Head – Reach 3 - North survey reach extends approximately 5,500 ft between James Street and Limulus Drive, containing 22 survey transects (Station 920+00 – 975+00), at 500 ft spacing (see **Figure 3-1**). As a reminder, 11 of the transects were added to this reach during the 2020 surveying effort, creating 250 ft spacing for the whole reach. In August 2022, as part of the 2022 Post-Dorian Renourishment Project (see **Table 5-2**), a total of 142,137 cy (25.8 cy/ft) of material was placed throughout the entire reach. A summary of average shoreline and volume changes between June 2022 and June 2023 for Nags Head – Reach 3 - North in comparison with the Total Monitored Oceanfront is presented in **Table 5-11** and **Table 5-12**.

Table 5-11. Average Shoreline and Average Unit Volume Change for Reach 3 - North (June 2022 – June 2023)

2022 vs. 2023 (Total Change)	Transects	Reach Length	avg shoreline change @ +1.18 ft NAVD88	avg volume change above +6 ft NAVD88	avg volume change above +1.18 ft NAVD88	avg volume change above -6 ft NAVD88	avg volume change above -14 ft NAVD88	avg volume change above -19 ft NAVD88	avg volume change above -30 ft NAVD88
Reach	#	ft	ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft
Nags Head - Reach 3 - North	920+00 - 975+00	5,500	20.8	3.9	9.2	18.1	75.5	57.0	33.0
Total Monitored Oceanfront	430+00 - 1200+00	77,000	2.3	1.4	1.9	4.4	29.0	25.1	2.5

Table 5-12. Cumulative Volume Change for Reach 3 - North (June 2022 – June 2023)

2022 vs. 2023 (Total Change)	Transects	Reach Length	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above -6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88	cumulative volume change above -30 ft NAVD88
Reach	#	ft	cy	cy	cy	cy	cy	cy
Nags Head - Reach 3 - North	920+00 - 975+00	5,500	22,669	52,897	104,129	434,344	327,560	189,758
Total Monitored Oceanfront	430+00 - 1200+00	77,000	106,632	151,114	338,396	2,249,937	1,940,103	196,257

Shoreline change at MHW showed a significant overall seaward advancement of +20.8 ft. **Figure 5-18** presents the shoreline changes at each transect from 2022 to 2023, showing up to +55 ft erosion (Station 972+50) along the transects. Similar to Reach 2, this seaward advancement can be attributed to the 2022 Post-Dorian Project Placement. The profile plots in **Appendix B** show receding shorelines at Reach 3N transects as the material from the nourishment project equilibrates to lower elevations.

Volumetrically, **Table 5-11** and **Table 5-12** indicates that Reach 3 - North experienced overall volume gains at all of the analyzed elevations. The most significant volume gains were observed above -14 ft NAVD88 (+434,344 cy or +75.5 cy/ft) and above -19 ft NAVD88 (+327,560 cy or +57.0 cy/ft). While some of this material gain can be attributed to the 2022 Post-Dorian Renourishment Project, the material gain is larger than the material placement, indicating additional volume gain of +185,423 cy (+33.7 cy/ft) above -19 ft NAVD88 from background processes. **Figure 5-19** displays the unit volume change at each transect above the six elevations analyzed. As can be seen, a majority of transects experienced volume gains at all the analyzed elevations.

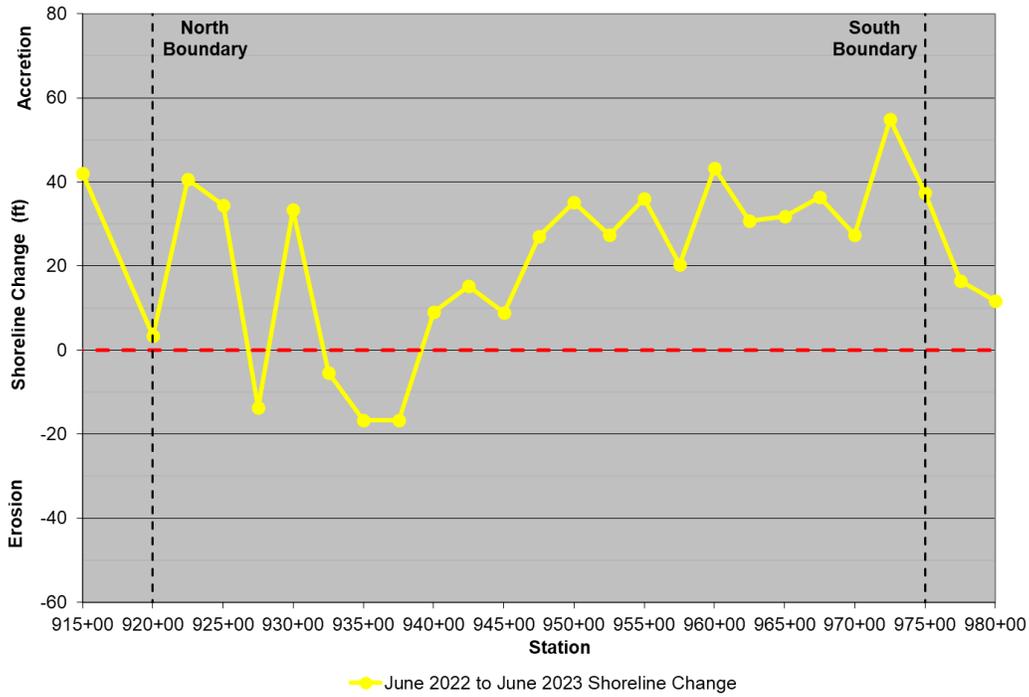


Figure 5-18. Nags Head – Reach 3 - N Shoreline Change (June 2022 – June 2023)

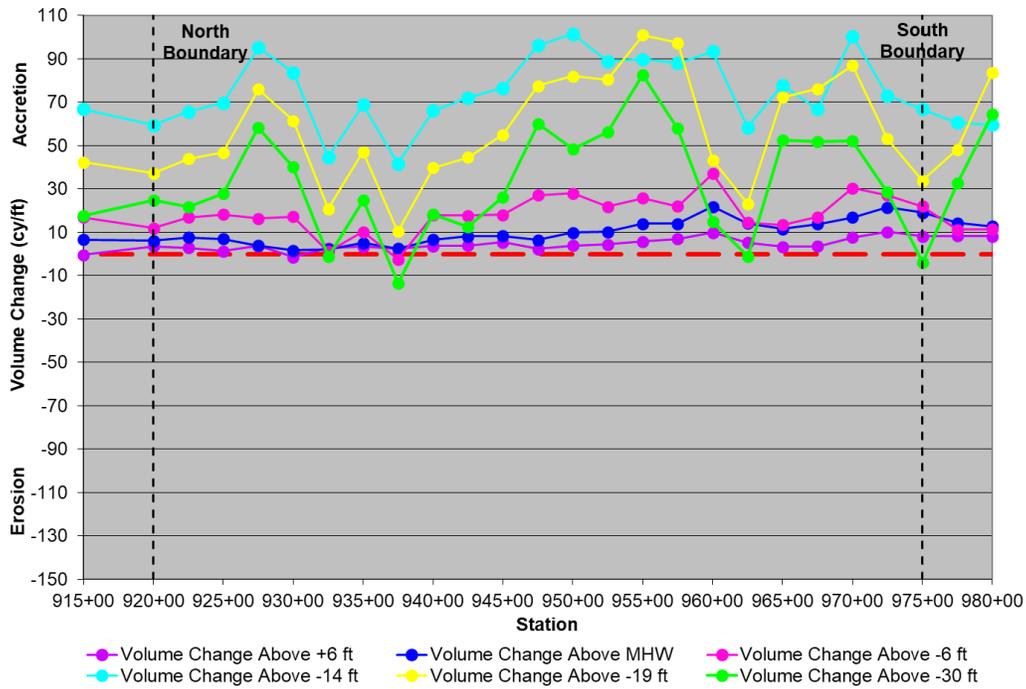


Figure 5-19. Nags Head – Reach 3 - N Unit Volume Change (June 2022 – June 2023)

Consistent with Reach 2, the profile plots in **Appendix B** depict numerous instances where the 2022 Post-Dorian Renourishment project profile has equilibrated, and the offshore bar has moved onshore and to higher elevations. **Figure 5-20** presents an example profile which shows profile equilibration and adjustment of the offshore sand bar.

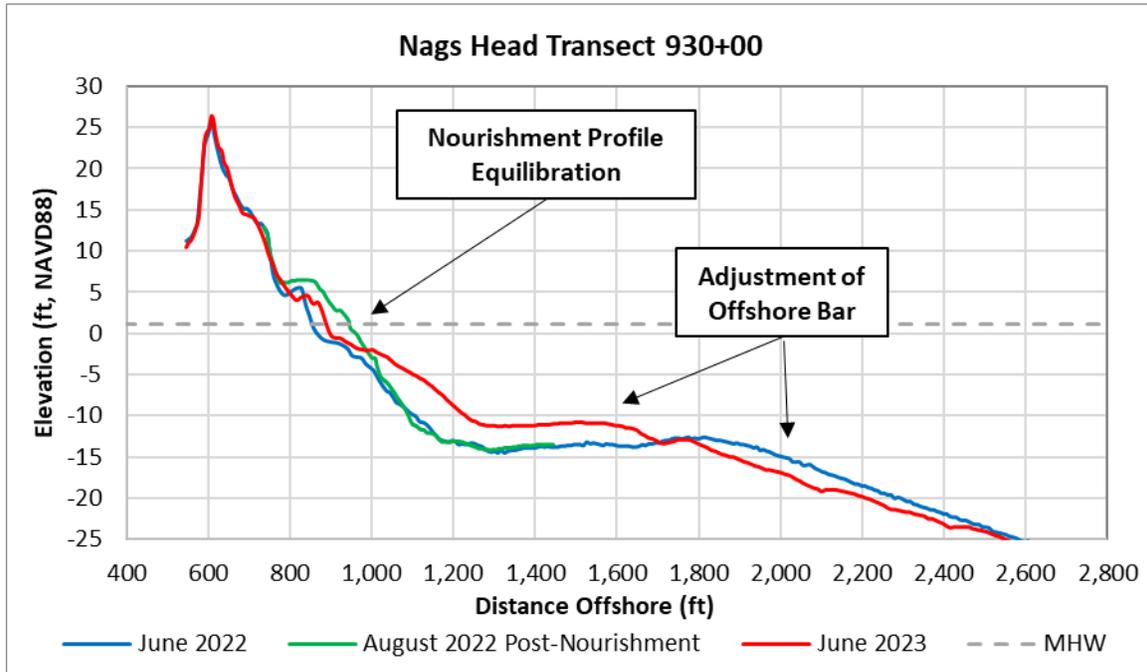


Figure 5-20. Example Reach 3 - North Profile, Station 930+00 (E Jacobs St.)

5.3.5 *Nags Head - Reach 3 - South (June 2022 – June 2023)*

The Nags Head – Reach 3 - South survey reach extends approximately 3,500 ft between Limulus Drive and Loon Court, containing 14 survey transects (Station 975+00 – 1010+00) (see **Figure 3-1**). Seven of these transects were added to this reach during the 2020 surveying effort, creating 250 ft spacing for the whole reach. In August 2022, as part of the 2022 Post-Dorian Renourishment Project (see

Table 5-2), a total of 198,441 cy (56.7 cy/ft) of material was placed throughout the reach. A summary of average shoreline and volume changes between June 2022 and June 2023 for Reach 3 – South in comparison with the Total Monitored Oceanfront is shown in **Table 5-13** and **Table 5-14**.

Table 5-13. Average Shoreline and Average Unit Volume Change for Reach 3 - South (June 2022 – June 2023)

2022 vs. 2023 (Total Change)	Transects	Reach Length	avg shoreline change @ +1.18 ft NAVD88	avg volume change above +6 ft NAVD88	avg volume change above +1.18 ft NAVD88	avg volume change above -6 ft NAVD88	avg volume change above -14 ft NAVD88	avg volume change above -19 ft NAVD88	avg volume change above -30 ft NAVD88
Reach	#	ft	ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft
Nags Head - Reach 3 - South	975+00 - 1010+00	3,500	14.4	4.7	9.4	13.1	49.5	51.4	26.5
Total Monitored Oceanfront	430+00 - 1200+00	77,000	2.3	1.4	1.9	4.4	29.0	25.1	2.5

Table 5-14. Cumulative Volume Change for Reach 3 - South (June 2022 – June 2023)

2022 vs. 2023 (Total Change)	Transects	Reach Length	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above -6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88	cumulative volume change above -30 ft NAVD88
Reach	#	ft	cy	cy	cy	cy	cy	cy
Nags Head - Reach 3 - South	975+00 - 1010+00	3,500	16,465	32,955	45,820	173,425	179,797	92,894
Total Monitored Oceanfront	430+00 - 1200+00	77,000	106,632	151,114	338,396	2,249,937	1,940,103	196,257

Shoreline change at MHW showed an overall seaward advancement of +14.4 ft. Similar to Reach 2 and Reach 3N, the profile plots in **Appendix B** illustrate that this seaward advancement can be attributed to the material placement during the 2022 Post-Dorian Renourishment Project. However, it's important to note that recession was observed after the nourishment project in the transects of this reach. **Figure 5-21** presents the shoreline changes at each transect from June 2022 to June 2023, highlighting the seaward advancement along most of the transects during this period.

Volumetrically, **Table 5-13** and **Table 5-14** indicates that Reach 3 - South experienced volume gains at all the analyzed elevations. Notably, the most substantial gains occurred above -14 ft NAVD88 (+173,425 cy or +49.5 cy/ft) and -19 ft NAVD88 (+179,797 cy or +51.4 cy/ft). However, it's worth noting that the material placed during the 2022 Post-Dorian Renourishment project slightly exceeded the observed volume gain, suggesting background volume losses of -18,644 cy (-5.3 cy/ft) above -19 ft NAVD88 throughout the monitoring period. Despite these losses, the annual background erosion rate remained significantly lower than the averaged background erosion rates from 2012-2023 (see **Table**

5-4), pointing to a favorable monitoring period overall. **Figure 5-22** displays the unit volume change at each transect above the six elevations analyzed, showing volume gains at all analyzed elevations at the majority of transects.

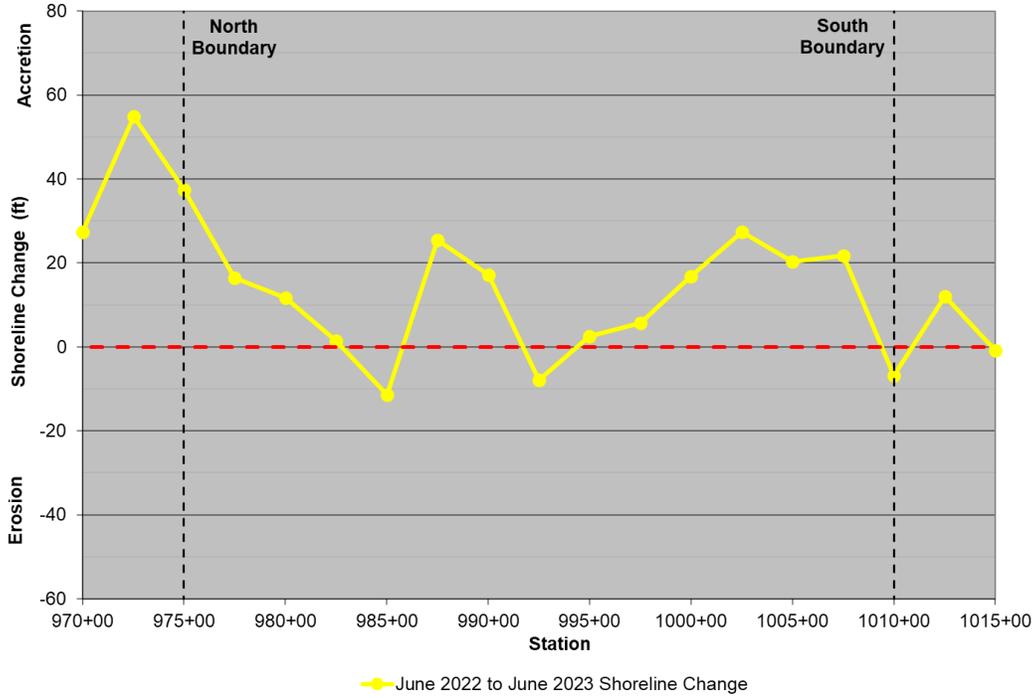


Figure 5-21. Nags Head – Reach 3 – S Shoreline Change (June 2022 – June 2023)

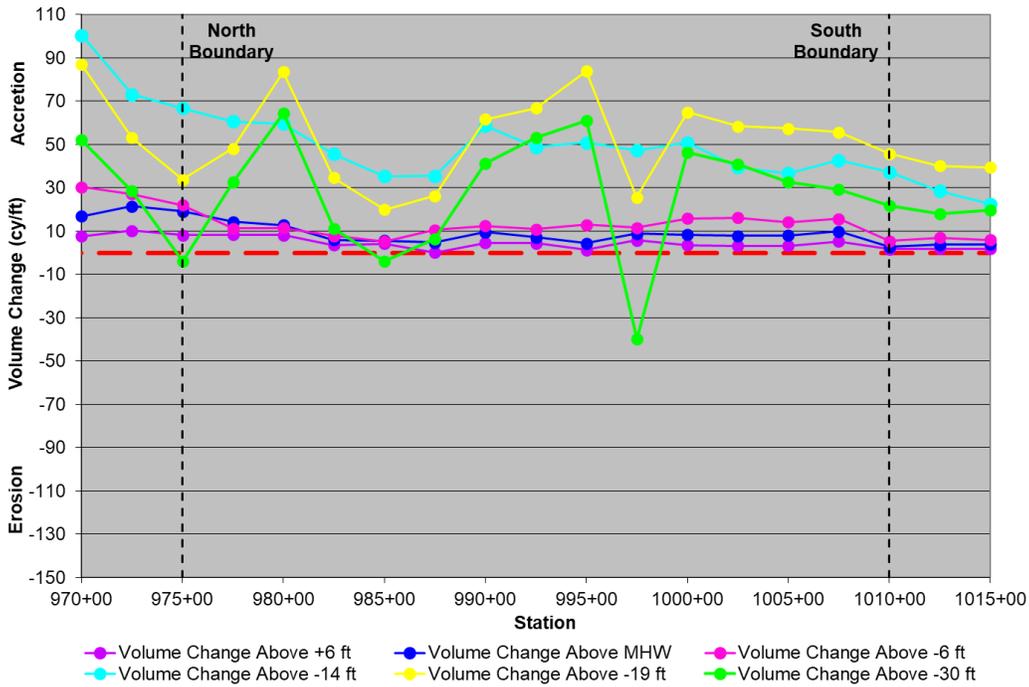


Figure 5-22. Nags Head – Reach 3 – S Unit Volume Change (June 2022 – June 2023)

The profile plots in **Appendix B** illustrate profile equilibration resulting from the 2022 nourishment project, accompanied by offshore bar adjustment. In these plots, the offshore bar is observed moving onshore, and there is noticeable material filling in the troughs observed in the 2022 profiles. **Figure 5-23** presents an example profile from Reach 3 - South that shows the equilibration of material from the 2022 Post-Dorian project to lower elevations as it fills in the trough before the offshore bar featured in the 2022 profile.

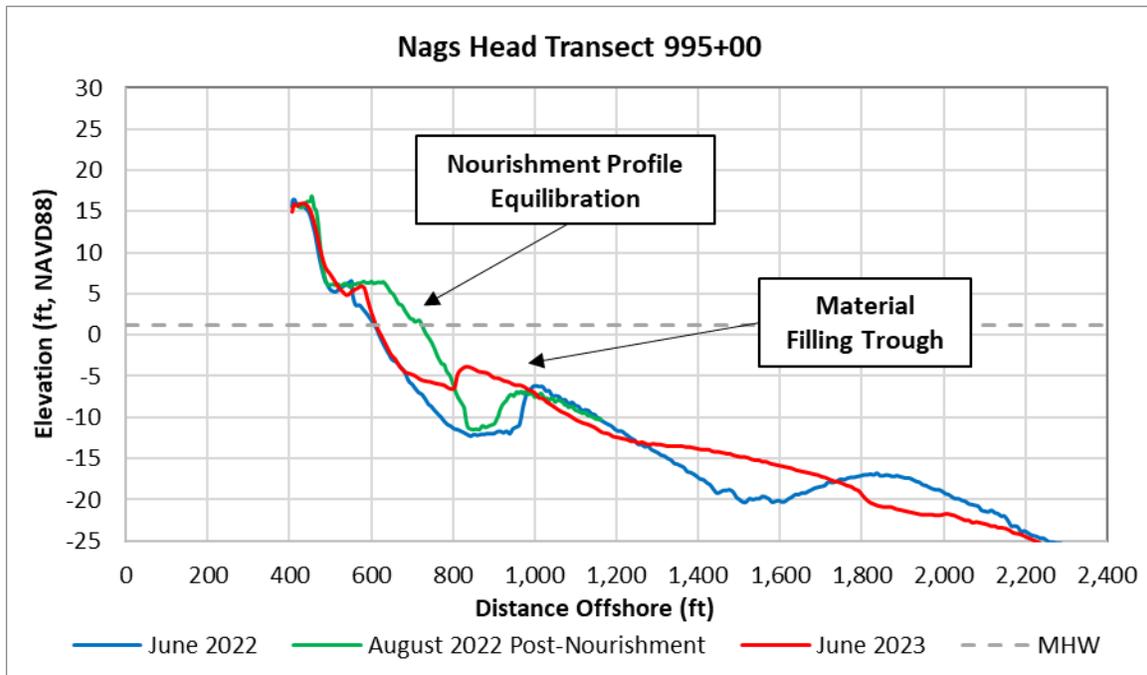


Figure 5-23. Example Reach 3 - South Profile, Station 995+00 (E Loon Ct.)

5.3.6 Nags Head - Reach 4 (June 2022 – June 2023)

The Nags Head – Reach 4 survey reach extends approximately 1,500 ft between Loon Court and McCall Court, containing seven survey transects (Station 1010+00 – 1025+00), at 500 ft spacing (see **Figure 3-1**). Three of these transects were added to this reach during the 2020 surveying effort, creating 250 ft spacing for the whole reach. A summary of average shoreline and volume changes between June 2022 and June 2023 for Nags Head – Reach 4 in comparison with the Total Monitored Oceanfront is presented in **Table 5-15** and **Table 5-16**.

Table 5-15. Average Shoreline and Average Unit Volume Change for Reach 4 (June 2022 – June 2023)

June 2022 vs. June 2023	Transects	Reach Length	avg shoreline change @ +1.18 ft NAVD88	avg volume change above +6 ft NAVD88	avg volume change above +1.18 ft NAVD88	avg volume change above -6 ft NAVD88	avg volume change above -14 ft NAVD88	avg volume change above -19 ft NAVD88	avg volume change above -30 ft NAVD88
Reach	#	ft	ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft
Nags Head - Reach 4	1010+00 - 1025+00	1,500	-4.0	1.3	1.8	2.7	21.1	31.2	3.0
Total Monitored Oceanfront	430+00 - 1200+00	77,000	2.3	1.4	1.9	4.4	29.0	25.1	2.5

Table 5-16. Cumulative Volume Change for Reach 4 (June 2022 – June 2023)

June 2022 vs. June 2023	Transects	Reach Length	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above -6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88	cumulative volume change above -30 ft NAVD88
Reach	#	ft	cy	cy	cy	cy	cy	cy
Nags Head - Reach 4	1010+00 - 1025+00	1,500	2,335	3,218	4,697	36,988	54,562	5,242
Total Monitored Oceanfront	430+00 - 1200+00	77,000	106,632	151,114	338,396	2,249,937	1,940,103	196,257

Shoreline change at MHW showed an overall average landward recession of 4.0 ft. **Figure 5-24** presents the shoreline changes at each transect from 2022 to 2023, showing recession at the majority of transects. It is noteworthy that this recession occurred despite the material placement during the 2022 Post-Dorian Project. As a result, the background erosion is more substantial than suggested by the difference between the 2022 and 2023 survey data.

Volumetrically, **Table 5-15** and **Table 5-16** indicates that Reach 4 experienced volume gains above all the analyzed elevations over the monitoring period. However, the volume gains, totaling +54,562 cubic yards (+31.2 cy/ft) above -19 ft NAVD88, were smaller than the material placement amount of 94,173 cubic yards during the Post-Dorian Renourishment Project. This indicates a net loss of approximately -39,611 cy (-26.4 cy/ft) above -19 ft NAVD88. **Figure 5-25** displays the unit volume change at each transect above the six elevations analyzed. Noticeably, the volume gains tend to increase as the elevations become lower. This trend is attributed to the capture of eroding material from the beachface of the nourishment profile in the offshore bar. Correspondingly, the profile plots in **Appendix B** show the removal of nourishment placement from the beachface, with the offshore bar moving seaward and growing in some transects.

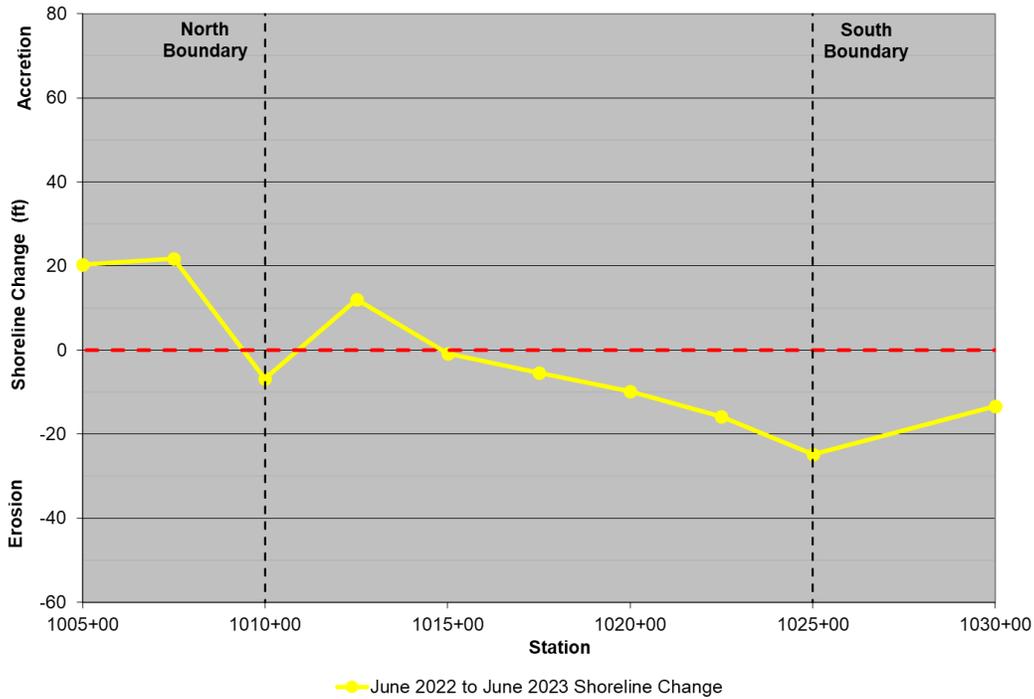


Figure 5-24. Nags Head – Reach 4 Shoreline Change (June 2022 – June 2023)

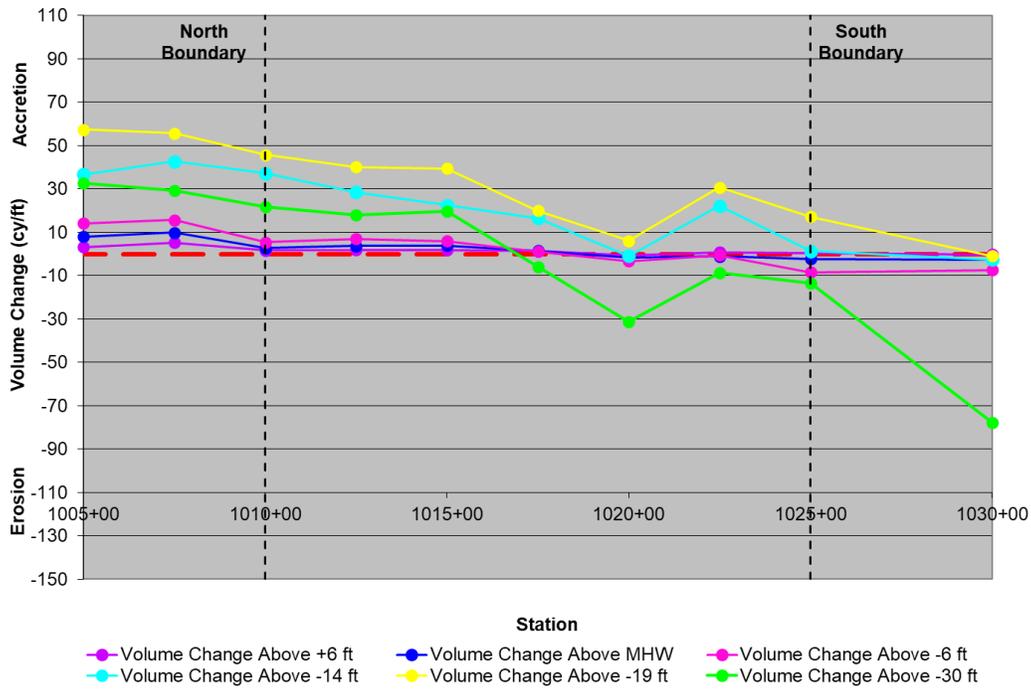


Figure 5-25. Nags Head – Reach 4 Unit Volume Change (June 2022 – June 2023)

Figure 5-26 presents an example profile displaying the volume placement in August 2022 and the subsequent removal of material throughout the remainder of the June 2022-June 2023 monitoring period.

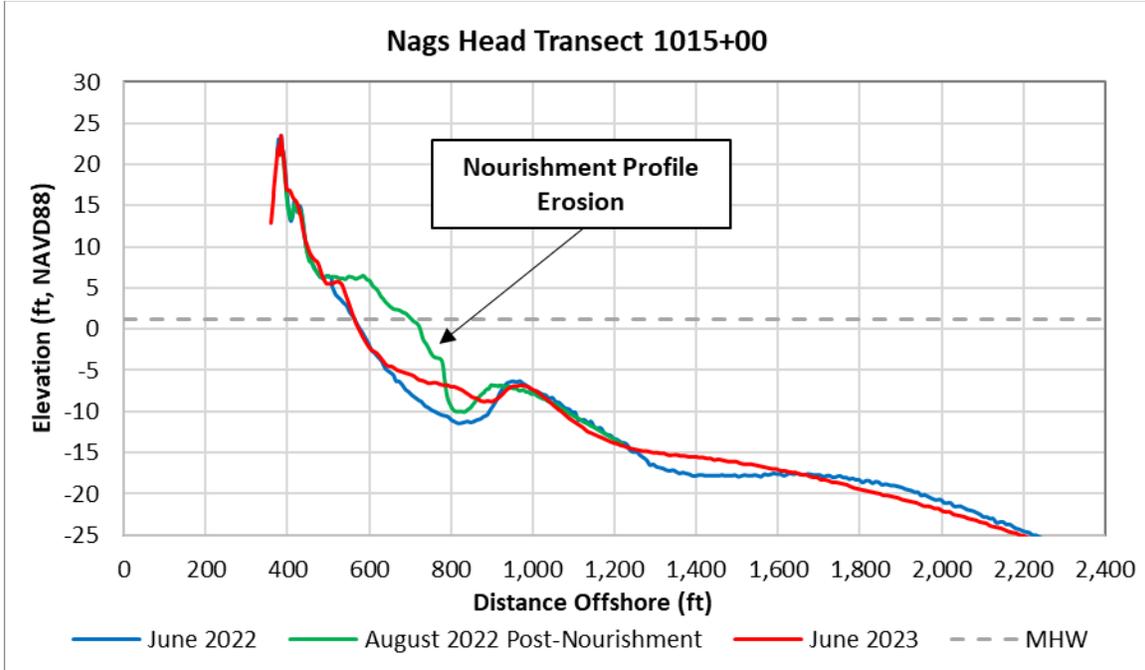


Figure 5-26. Example Reach 4 Profile, Station 1015+00 (Ehmann Beach Access)

5.3.7 National Seashore - North (June 2022 – June 2023)

The National Seashore - North survey reach extends approximately 17,500 ft between McCall Court and Oregon Inlet Campground. The National Seashore - North reach contains 23 survey transects (Station 1025+00 – 1200+00), varying in spacing between 500 ft and 1,000 ft (see **Figure 3-1**). A summary of average shoreline and volume changes between June 2022 and June 2023 for the National Seashore - North Reach is presented along with total oceanfront changes in **Table 5-17** and **Table 5-18**.

Table 5-17. Average Shoreline and Average Unit Volume Change for National Seashore - North (June 2022 – June 2023)

2022 vs. 2023 (Total Change)	Transects	Reach Length	avg shoreline change @ +1.18 ft NAVD88	avg volume change above +6 ft NAVD88	avg volume change above +1.18 ft NAVD88	avg volume change above -6 ft NAVD88	avg volume change above -14 ft NAVD88	avg volume change above -19 ft NAVD88	avg volume change above -30 ft NAVD88
Reach	#	ft	ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft
National Seashore - North	1025+00 - 1200+00	17,500	-16.6	0.8	-1.0	-2.6	21.2	28.6	-7.0
Total Monitored Oceanfront	430+00 - 1200+00	77,000	2.3	1.4	1.9	4.4	29.0	25.1	2.5

Table 5-18. Cumulative Volume Change for National Seashore - North (June 2022 – June 2023)

2022 vs. 2023 (Total Change)	Transects	Reach Length	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above -6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88	cumulative volume change above -30 ft NAVD88
Reach	#	ft	cy	cy	cy	cy	cy	cy
National Seashore - North	1025+00 - 1200+00	17,500	13,543	-16,706	-45,322	371,445	500,960	-122,115
Total Monitored Oceanfront	430+00 - 1200+00	77,000	106,632	151,114	338,396	2,249,937	1,940,103	196,257

Shoreline change at MHW showed an overall average recession of -16.6 ft. **Figure 5-27** presents the shoreline changes at each transect, showing recession along most of the transects.

Overall, the National Seashore - North reach experienced the largest volume gains above -19 ft NAVD88 of +500,960 cy (+28.6 cy/ft). **Figure 5-28** displays the unit volume change at each transect above the six elevations analyzed. As can be seen, a majority of transects experienced volume losses above -19 ft NAVD88. Profile plots in **Appendix B** highlight numerous instances of offshore bar growth. At the northernmost transects of the reach (1025+00-1080+00), the offshore bar moved onshore to higher elevations, while elsewhere in the reach, the offshore bar moved offshore, though without significant elevation differences. **Figure 5-29** shows an example profile that presents the offshore bar adjustment.

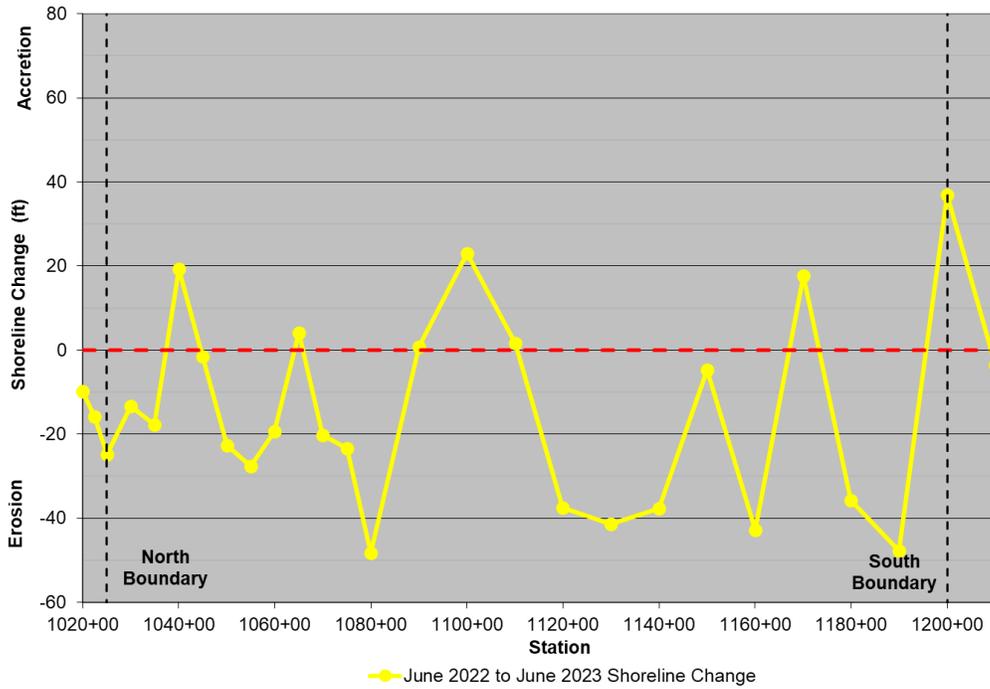


Figure 5-27. National Seashore - North Shoreline Change (June 2022 – June 2023)

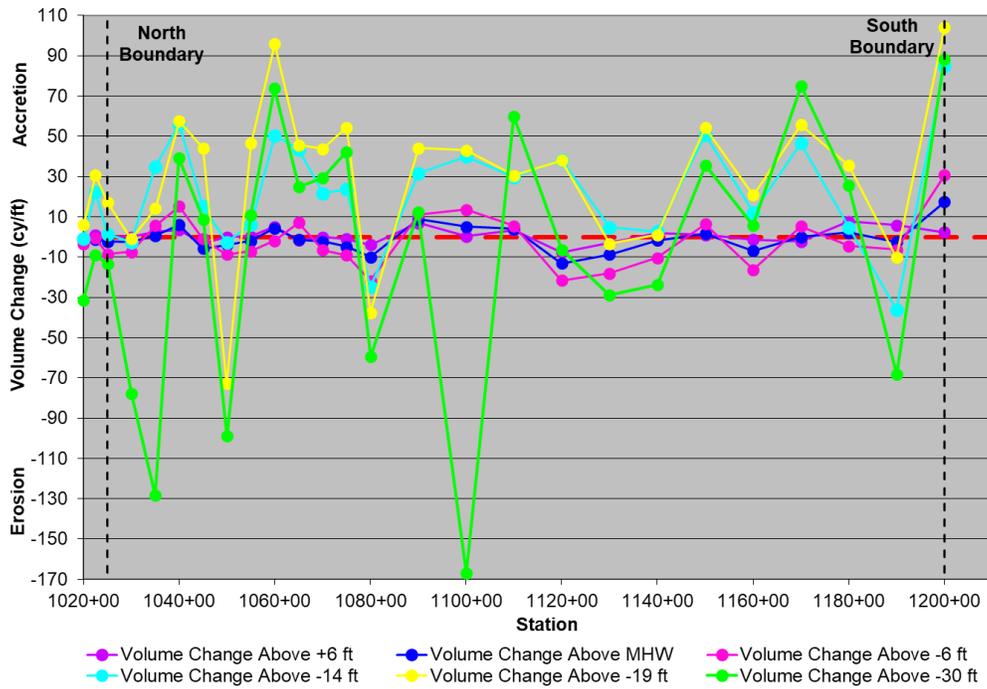


Figure 5-28. National Seashore - North Unit Volume Change (June 2022 – June 2023)

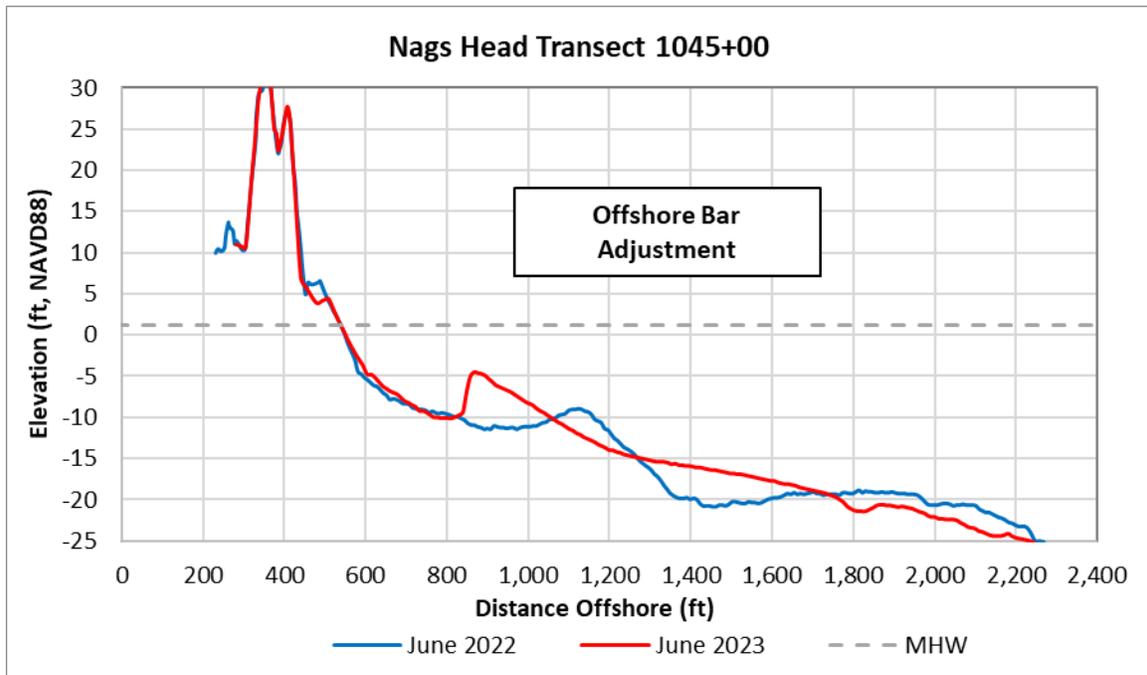


Figure 5-29. Example National Seashore - North Profile, Station 1045+00

5.3.8 National Seashore - South (June 2022 – June 2023)

The National Seashore - South survey reach extends approximately 9,000 ft north of Oregon Inlet, containing eight survey transects (Station 1200+00 – 1290+00), at 1,000 ft spacing (see **Figure 3-1**). Shorelines adjacent to an inlet are typically very active due to more complex hydrodynamics and often greater sediment transport rates, which can lead to more extreme profile changes from year to year. **Figure 5-30** presents the shoreline changes at each transect, revealing a predominant seaward advancement in transects to the north and recession in transects to the south. **Figure 5-31** shows the aerial image of Oregon Inlet from the beginning and end of the monitoring period. During the monitoring period, material from Station 1260+00 shifted southward into Bodie Island Spit (**Figure 5-31**), resulting in recession at the corresponding transect.

Due to the dynamic nature of Oregon Inlet, volume calculations were not meaningful. Instead, profile comparisons between June 2022 and June 2023 (**Appendix B**) were investigated to determine trends. At northern transects, material was deposited on the beachface, leading to the accretion of the shoreline, while transects next to the inlet experienced erosion. **Figure 5-32** provides an example profile illustrating the growth of the berm and the resulting accretion.

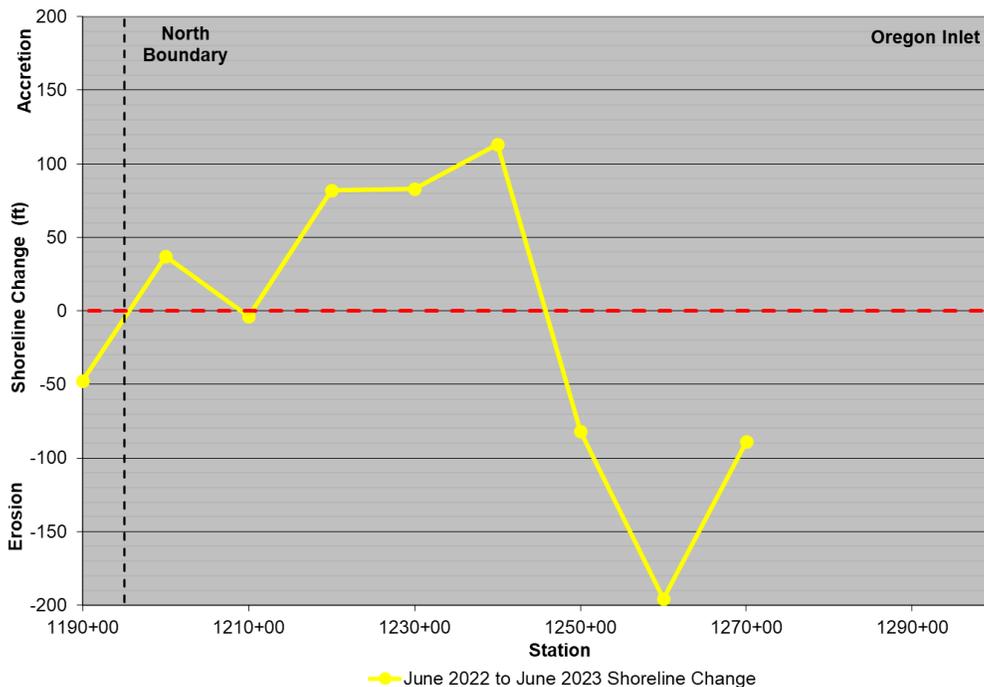


Figure 5-30. National Seashore - South Shoreline Change (2022 – 2023)

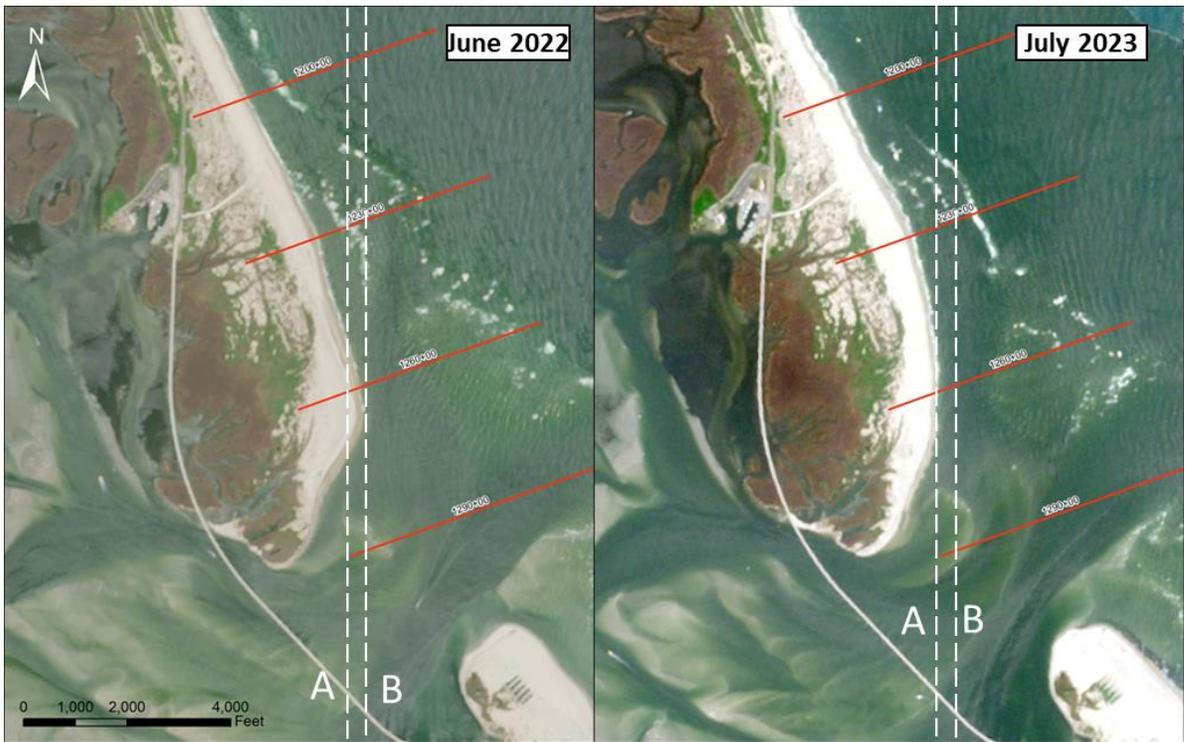


Figure 5-31. Oregon Inlet Change (06/26/2022 USGS Sentinel Imagery; 07/01/2023 USGS-Sentinel Imagery)

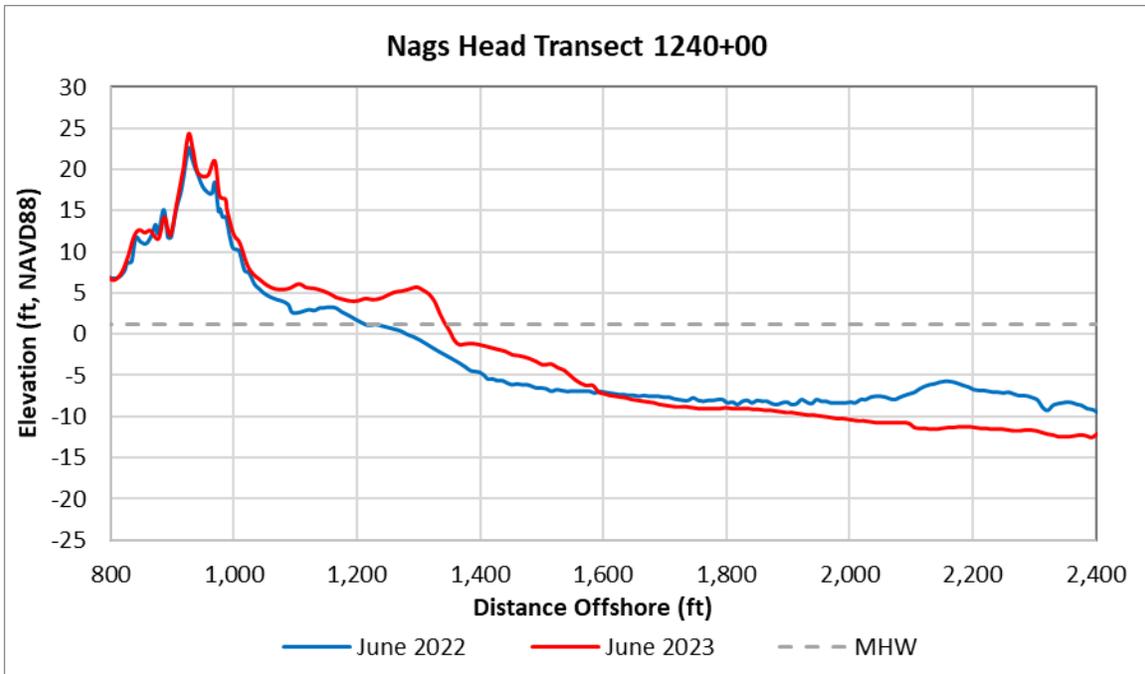


Figure 5-32. Example National Seashore - North Profile, Station 1240 (Bodie Island Spit)

5.3.9 Oceanfront Trends Summary for All Reaches (June 2022 – June 2023)

Table 5-19 and **Table 5-20** provides a summary of the shoreline and volume changes along Nags Head as presented in the previous sections along with average and total oceanfront values. For Nags Head, since each reach consists of a different length of shoreline, the calculations provide a weighted average for unit shoreline change (ft) and unit volume change (cy/ft) along the Nags Head oceanfront. The weighted average also accounts for differences in the shoreline length between each transect. **Appendix D** contains plots of the shoreline and volume changes between the June 2022 and the June 2023 surveys at each transect along Nags Head.

Table 5-19. Nags Head Shoreline and Average Unit Volume Change Statistics (June 2022 – June 2023)

June 2022 vs. June 2023	Transects	Reach Length	avg shoreline change @ +1.18 ft NAVD88	avg volume change above +6 ft NAVD88	avg volume change above +1.18 ft NAVD88	avg volume change above -6 ft NAVD88	avg volume change above -14 ft NAVD88	avg volume change above -19 ft NAVD88	avg volume change above -30 ft NAVD88
Reach	#	ft	ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft
Nags Head - North	430+00 - 495+00	6,500	8.8	0.5	1.8	7.6	15.0	26.2	9.9
Nags Head - Reach 1	495+00 - 790+00	29,500	-3.8	0.3	-0.6	0.8	17.8	8.8	-8.0
Nags Head - Reach 2	790+00 - 920+00	13,000	28.2	3.0	6.5	12.3	47.6	35.5	15.9
Nags Head - Reach 3N	920+00 - 975+00	5,500	20.8	3.9	9.2	18.1	75.5	57.0	33.0
Nags Head - Reach 3S	975+00 - 1010+00	3,500	14.4	4.7	9.4	13.1	49.5	51.4	26.5
Nags Head - Reach 4	1010+00 - 1025+00	1,500	-4.0	1.3	1.8	2.7	21.1	31.2	3.0
National Seashore North	1025+00 - 1200+00	17,500	-16.6	0.8	-1.0	-2.6	21.2	28.6	-7.0
	Transects	Reach Length	weighted avg	weighted avg	weighted avg	weighted avg	weighted avg	weighted avg	weighted avg
Nourished Oceanfront	495+00 - 1025+00	53,000	7.8	1.7	2.9	6.3	33.3	23.8	4.7
Total Monitored Oceanfront*	430+00 - 1200+00	77,000	2.3	1.4	1.9	4.4	29.0	25.1	2.5

*National Seashore South Reach not included in the Total Monitored Oceanfront

Table 5-20. Nags Head Cumulative Volume Change Statistics (June 2022 – June 2023)

June 2022 vs. June 2023	Transects	Reach Length	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above -6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88	cumulative volume change above 30 ft NAVD88
Reach	#	ft	cy	cy	cy	cy	cy	cy
Nags Head - North	430+00 - 495+00	6,500	2,728	10,873	45,455	90,173	156,991	59,278
Nags Head - Reach 1	495+00 - 790+00	29,500	9,424	-17,101	23,090	524,899	259,165	-235,846
Nags Head - Reach 2	790+00 - 920+00	13,000	39,468	84,979	160,527	618,664	461,067	207,046
Nags Head - Reach 3N	920+00 - 975+00	5,500	22,669	52,897	104,129	434,344	327,560	189,758
Nags Head - Reach 3S	975+00 - 1010+00	3,500	16,465	32,955	45,820	173,425	179,797	92,894
Nags Head - Reach 4	1010+00 - 1025+00	1,500	2,335	3,218	4,697	36,988	54,562	5,242
National Seashore - North	1025+00 - 1200+00	17,500	13,543	-16,706	-45,322	371,445	500,960	-122,115
	Transects	Reach Length	total	total	total	total	total	total
Nourished Oceanfront	495+00 - 1025+00	53,000	90,361	156,947	338,263	1,788,319	1,282,153	259,094
Total Monitored Oceanfront*	430+00 - 1200+00	77,000	106,632	151,114	338,396	2,249,937	1,940,103	196,257

*National Seashore South Reach not included in the Total Monitored Oceanfront

During the June 2022 - June 2023 monitoring period, among the nourished reaches, Reach 1 and Reach 4 were the only ones to observe shoreline recession. It's important to note that material was placed at all of the nourished oceanfront reaches during the 2022 Post-Dorian Renourishment project, except for Reach 1, which helped mitigate recession rates in those reaches. Therefore, the seaward advancement observed in Reaches 2, 3N, and 3S can be attributed to the material placed during the nourishment project. The National Seashore-North reach, situated to the south of the Nourished Oceanfront, also observed seaward advancement, potentially attributed to southward material transport

Both the Nourished Oceanfront and Total Monitored Oceanfront exhibited material gains across all analyzed elevations, with the majority of the gain observed above -14 ft NAVD88. Slightly smaller volume gains were present above the depth of closure at -19 ft NAVD88. Specifically, the Nourished Oceanfront gained 1,282,153 cy (23.8 cy/ft) above -19 ft NAVD88, and the Total Monitored Oceanfront gained 1,940,103 cy (25.1 cy/ft) above -19 ft NAVD88. This material gain is primarily attributed to the 2022 Post Dorian Renourishment project. However, it's noteworthy that the observed material gain exceeds the amount placed during the nourishment project, suggesting additional transport of material into the project area.

One potential cause for this excess gain is the shift of material placed during nourishment projects in northern towns (Town of Kill Devil Hills, Town of Kitty Hawk, and Town of Duck) southward into Nags Head. The increased frequency of waves coming from the east-northeast direction during the monitoring period (refer to Section 5.1.2) may have

facilitated this material transport. This phenomenon underscores the dynamic nature of coastal processes and the interconnectedness of nourishment projects across neighboring areas.

Figure 5-33 and **Figure 5-34** display the trends seen in **Table 5-19** and **Table 5-20** with bar plots of the average unit volume changes as well as total cumulative volume changes at each sub-reach to help visualize changes that occurred to the Nags Head monitoring area as a whole and how the magnitude of changes compares from one reach to the next. Both figures illustrate substantial volume gains above -14 ft NAVD88 and -19 ft NAVD88 along all monitored shoreline reaches. With the exception of Reach 1, the Nourished Oceanfront Reaches consistently experienced material gains at all analyzed elevations.

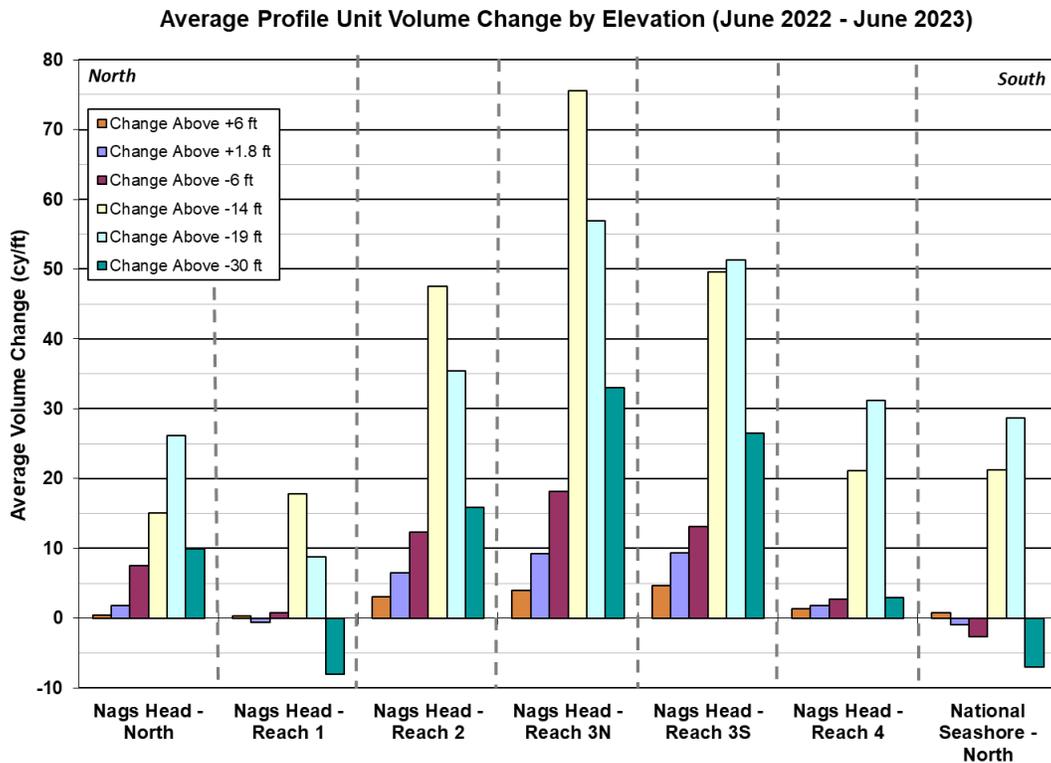


Figure 5-33. Average Unit Volume Change Within Each Reach (June 2022 – June 2023)

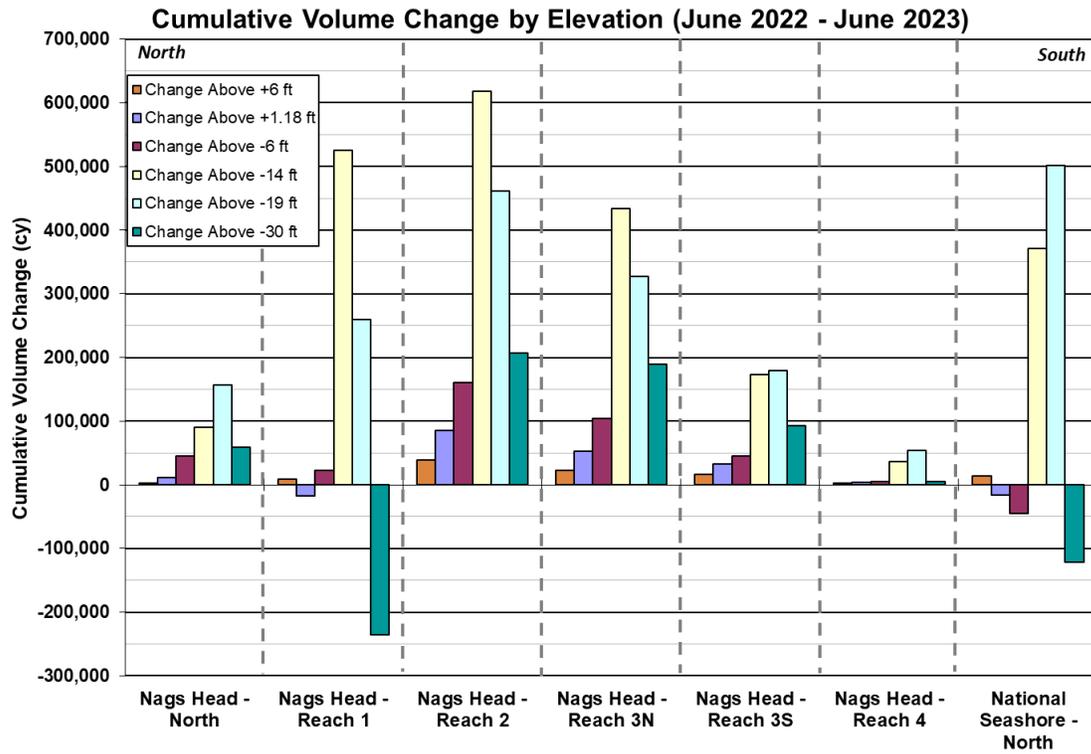


Figure 5-34. Cumulative Volume Change Within Each Reach (June 2022 – June 2023)

5.4 Nags Head Fall Shoreline and Volume Change Analysis (June 2023 – October 2023)

This section discusses the results of the shoreline and volume change analysis for the fall monitoring period along the defined monitoring reaches within the nourished oceanfront (Reaches 1 to 4) (see **Figure 3-2**). Key statistics were calculated to quantify average shoreline and volume changes for individual monitoring reaches as well as the total Nourished Oceanfront shoreline for Nags Head.

5.4.1 Nags Head - Reach 1 (June 2023 – October 2023)

The Nags Head – Reach 1 fall survey reach extends approximately 29,500 ft between Bonnett Street and Governor Street, containing 59 survey transects (Station 495+00 – 790+00), at 500 ft spacing (see **Figure 3-2**). A summary of average shoreline and volume changes between June 2023 and October 2023 for Reach 1 in comparison with the Nourished Oceanfront is presented in **Table 5-21** and **Table 5-22**.

Table 5-21. Average Shoreline and Average Unit Volume Change for Reach 1 (June 2023 – October 2023)

June 2023 vs. October 2023 (Total Change)	Transects	Reach Length	avg shoreline change @ +1.18 ft NAVD88	avg volume change above +6 ft NAVD88	avg volume change above +1.18 ft NAVD88	avg volume change above -6 ft NAVD88	avg volume change above -14 ft NAVD88	avg volume change above -19 ft NAVD88	avg volume change above -30 ft NAVD88
Reach	#	ft	ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft
Nags Head - Reach 1	495+00 - 790+00	29,500	-4.4	-0.3	-2.7	6.1	8.1	10.9	12.0
Nourished Oceanfront	495+00 - 1025+00	53,000	-7.5	0.4	-2.2	5.6	8.0	9.3	9.7

Table 5-22. Cumulative Volume Change for Reach 1 (June 2023 – October 2023)

June 2023 vs. October 2023 (Total Change)	Transects	Reach Length	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above -6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88	cumulative volume change above -30 ft NAVD88
Reach	#	ft	cy	cy	cy	cy	cy	cy
Nags Head - Reach 1	495+00 - 790+00	29,500	-10,004	-78,257	177,029	235,219	315,744	347,626
Nourished Oceanfront	430+00 - 1200+00	53,000	20,984	-117,350	297,583	429,014	495,619	513,968

Shoreline change at MHW in Reach 1 showed an overall average landward recession of -4.4 ft. **Figure 5-35** presents the shoreline changes at each transect from June 2023 to October 2023. While most of the transects experienced recession, the figure also indicates widely varying shoreline movement patterns within the reach ranging from a maximum recession of -81.4 ft at station 780+00 to a maximum shoreline advancement of +64.1 ft at the next station, 785+00.

Table 5-21 and **Table 5-22** indicate that Reach 1 experienced volume losses above +6 ft NAVD88 and MHW, whereas volume gains were evident in the lower analyzed elevations.

Figure 5-36 displays the unit volume change at each transect across the six elevations studied. Notably, the figure illustrates that, although the visible beach (above MHW) experienced volume losses, accumulations were noted at the lower elevations, resulting in an overall net volume gain. This trend was particularly prominent between stations 555+00 to 650+00. Profile plots in **Appendix B** show profile comparison plots for individual transects. The plots also show offshore sand bar moving onshore along with material moving from berm and beachface to lower elevations. **Figure 5-37** presents an example profile from the “historic district” where berm and beachface has eroded and created scarp. **Figure 5-38** presents an example profile from the north of the reach, showing the adjustment of the offshore bar.

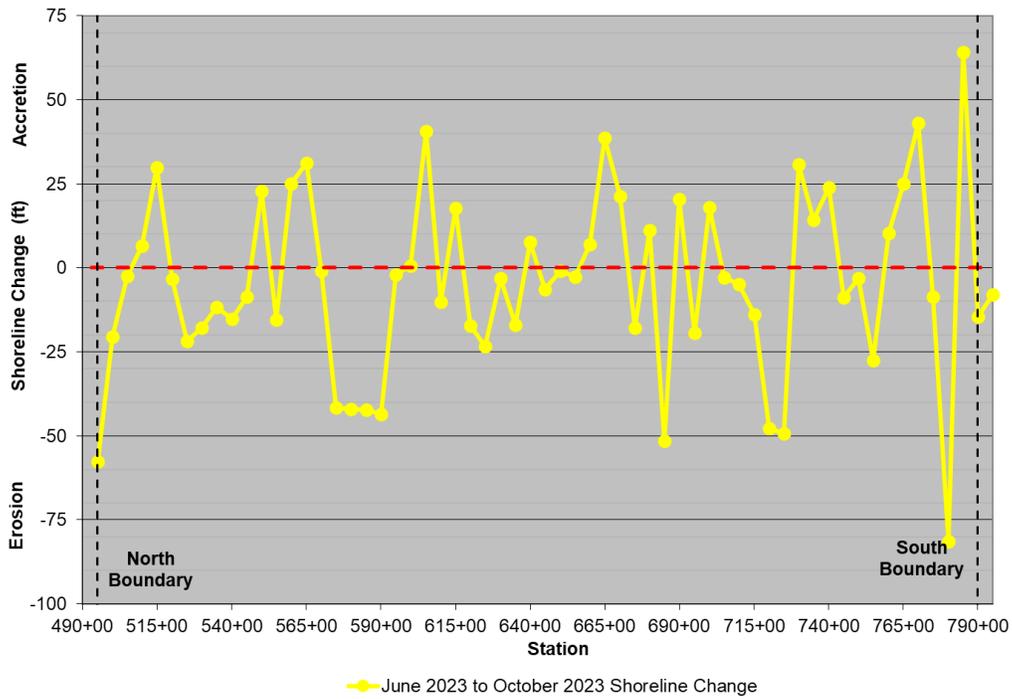


Figure 5-35. Nags Head – Reach 1 Shoreline Change (June 2023 – October 2023)

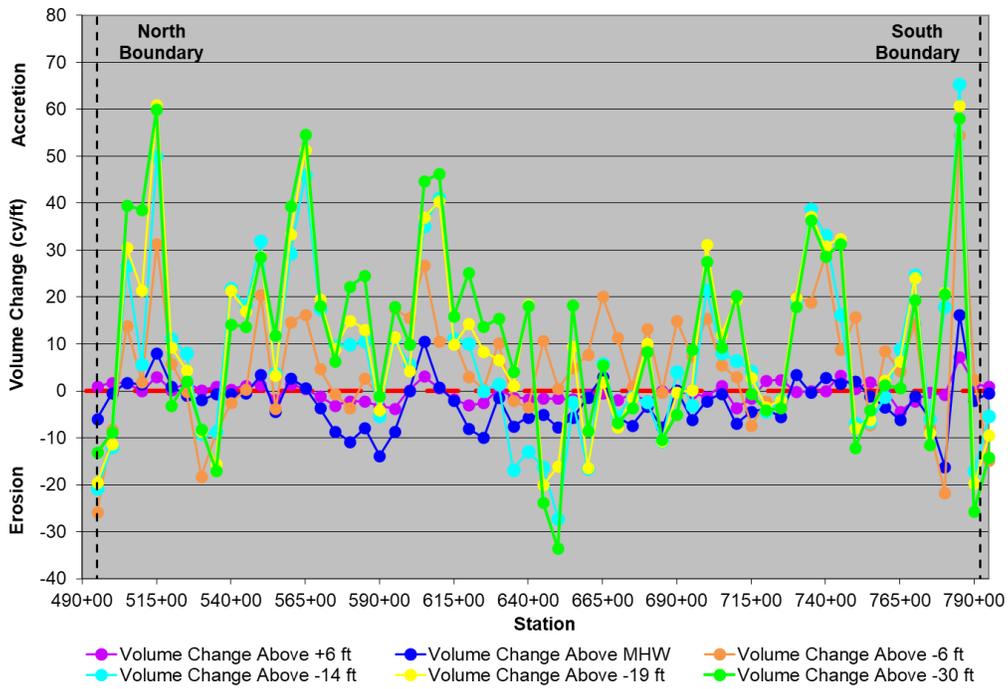


Figure 5-36. Nags Head – Reach 1 Unit Volume Change (June 2023 – October 2023)

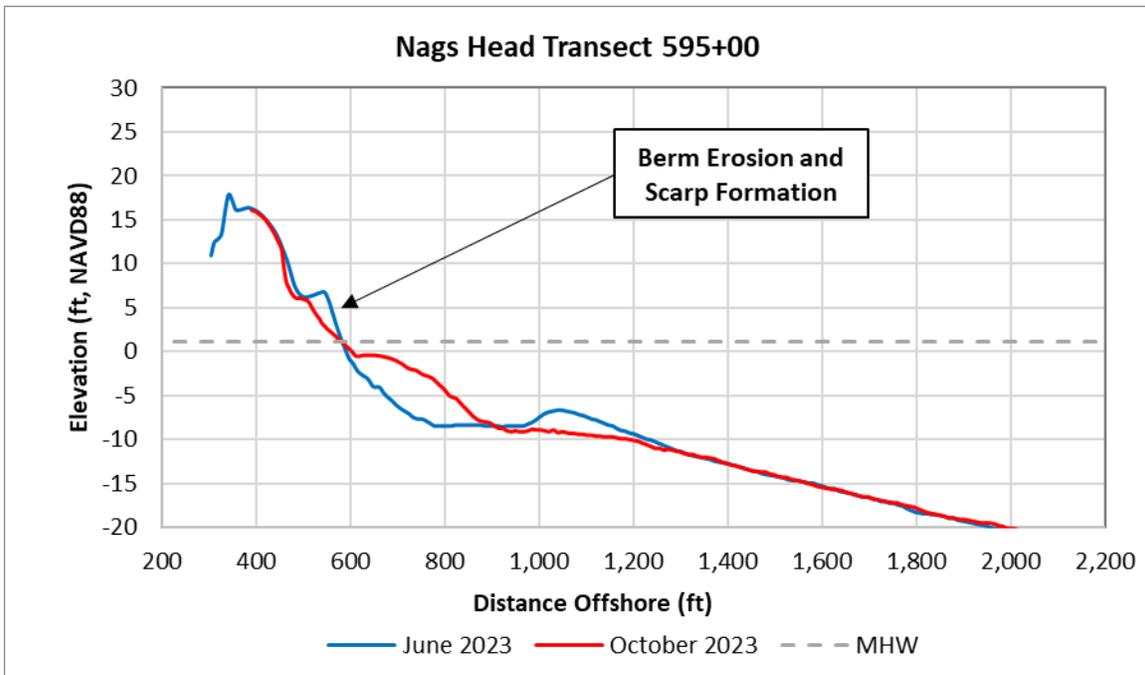


Figure 5-37. Example Reach 1 Profile, Station 595+00 (E Dune St)

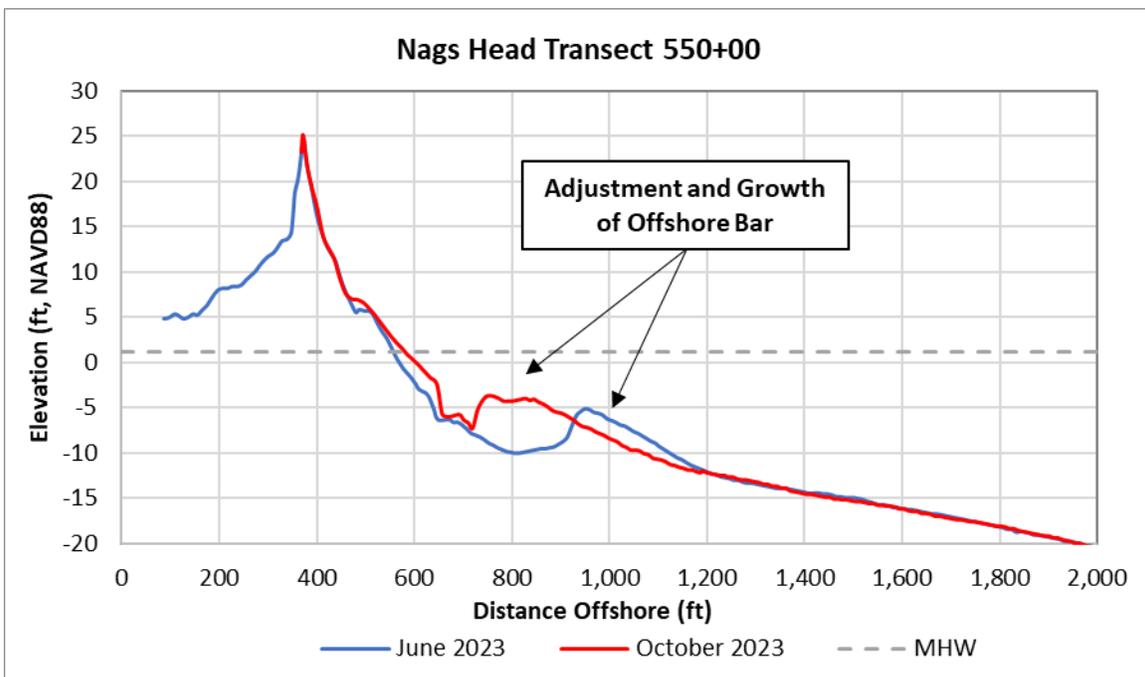


Figure 5-38. Example Reach 1 Profile, Station 550+00 (Curlew St.)

5.4.2 Nags Head - Reach 2 (June 2023 – October 2023)

The Nags Head – Reach 2 survey reach extends approximately 13,000 ft between Governor Street and James Street, containing 26 survey transects (Station 790+00 – 920+00), at 500 ft spacing (see **Figure 3-2**). A summary of average shoreline and volume changes between June 2023 and October 2023 for Nags Head – Reach 2 in comparison with the Nourished Oceanfront is presented in **Table 5-23** and **Table 5-24**.

Table 5-23. Average Shoreline and Average Unit Volume Change for Reach 2 (June 2023 – October 2023)

June 2023 vs. October 2023 (Total Change)	Transects	Reach Length	avg shoreline change @ +1.18 ft NAVD88	avg volume change above +6 ft NAVD88	avg volume change above +1.18 ft NAVD88	avg volume change above -6 ft NAVD88	avg volume change above -14 ft NAVD88	avg volume change above -19 ft NAVD88	avg volume change above -30 ft NAVD88
Reach	#	ft	ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft
Nags Head - Reach 2	790+00 - 920+00	13,000	-13.5	0.6	-3.0	7.3	9.1	7.6	7.7
Nourished Oceanfront	495+00 - 1025+00	53,000	-7.5	0.4	-2.2	5.6	8.0	9.3	9.7

Table 5-24. Cumulative Volume Change for Reach 2 (June 2023 – October 2023)

June 2023 vs. October 2023 (Total Change)	Transects	Reach Length	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above -6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88	cumulative volume change above -30 ft NAVD88
Reach	#	ft	cy	cy	cy	cy	cy	cy
Nags Head - Reach 2	790+00 - 920+00	13,000	7,197	-39,527	94,591	118,082	98,797	100,524
Nourished Oceanfront	430+00 - 1200+00	53,000	20,984	-117,350	297,583	429,014	495,619	513,968

Shoreline change at MHW within Reach 2 showed a significant overall average recession of 13.5 ft. **Figure 5-39** presents the shoreline changes at each transect from June 2023 to October 2023, showing recession along most of the transects. The severity of the recession intensified as the analysis moved south, reaching -54.6 ft at Station 905+00. This substantial landward recession can largely be attributed to the impact of storms occurring during the monitoring period from June 2023 to October 2023.

Volumetrically, **Table 5-23** and **Table 5-24** indicates that Reach 2 experienced volume gains above all the analyzed elevations except above MHW. The most substantial volume gains occurred above -14 ft NAVD88 (118,082 cy or 9.1 cy/ft). In **Figure 5-40**, the unit volume change at each transect across the six elevations is depicted. The figure illustrates that, for the majority of transects, there were volume gains above -14 ft NAVD88 and -19 ft NAVD88, with a few exceptions.

Similar to Reach 1, the profile plots in **Appendix B** showcase numerous instances of material from the visible beach (between MHW and +6 ft NAVD88) moving lower to be deposited nearshore between MHW and -10 ft NAVD88. Additionally, some material movement from offshore sandbar to onshore can be observed. **Figure 5-41** provides an example profile where berm erosion is evident, and volume gain at nearshore has been observed.

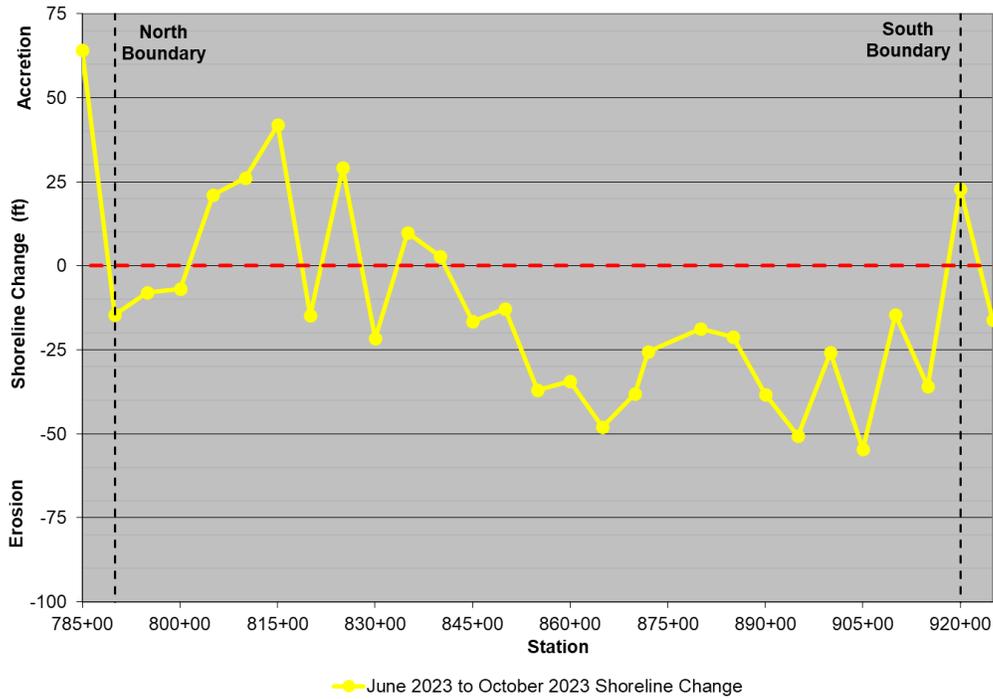


Figure 5-39. Nags Head – Reach 2 Shoreline Change (June 2023 – October 2023)

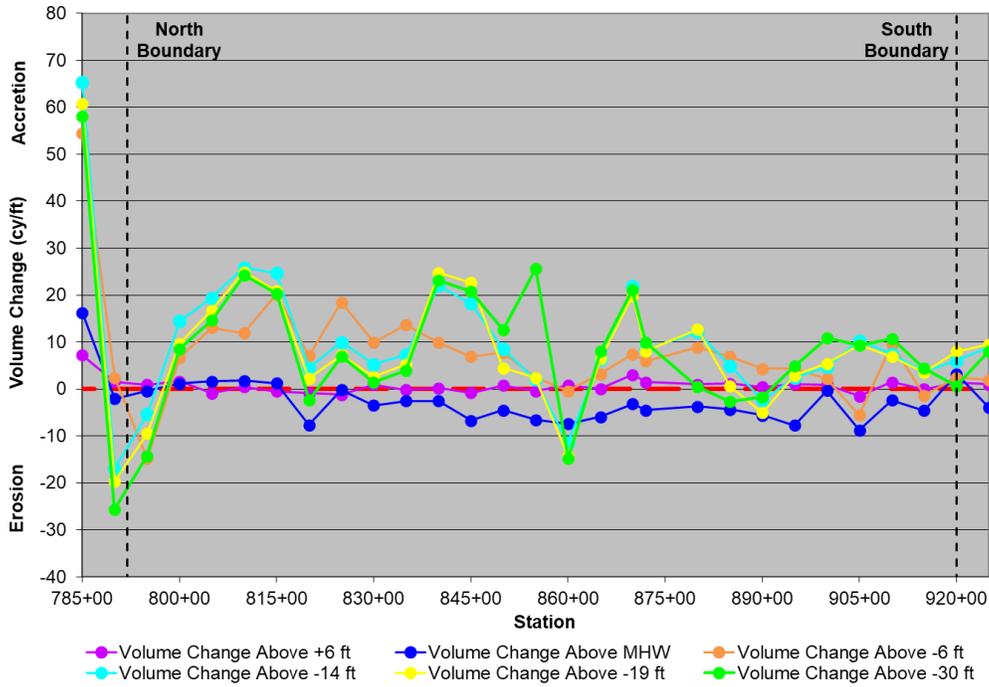


Figure 5-40. Nags Head – Reach 2 Unit Volume Change (June 2023 – October 2023)

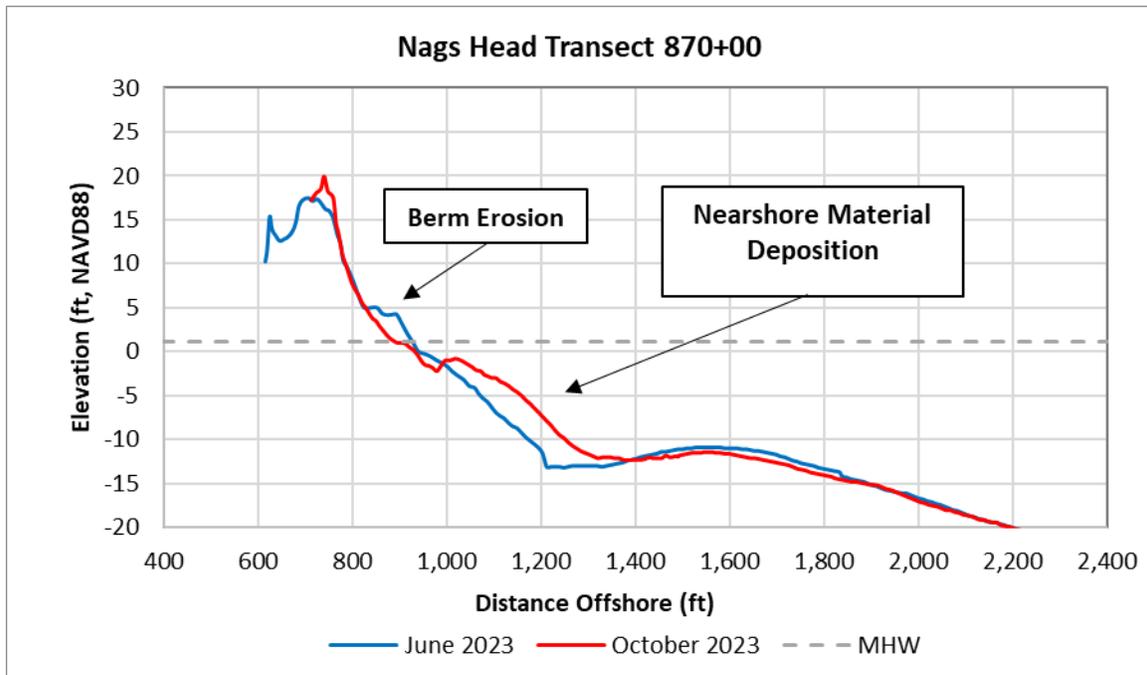


Figure 5-41. Example Reach 2 Profile, Station 870+00 (E Ida St.)

5.4.3 Nags Head - Reach 3 - North (June 2023 – October 2023)

The Nags Head – Reach 3 - North fall survey reach extends approximately 5,500 ft between James Street and Limulus Drive, containing 22 survey transects (Station 920+00 – 975+00), at 500 ft spacing (see **Figure 3-2**). A summary of average shoreline and volume changes between June 2023 and October 2023 for Nags Head – Reach 3 - North in comparison with the Nourished Oceanfront is presented in **Table 5-25** and **Table 5-26**.

Table 5-25. Average Shoreline and Average Unit Volume Change for Reach 3 - North (June 2023 – October 2023)

June 2023 vs. October 2023 (Total Change)	Transects	Reach Length	avg shoreline change @ +1.18 ft NAVD88	avg volume change above +6 ft NAVD88	avg volume change above +1.18 ft NAVD88	avg volume change above -6 ft NAVD88	avg volume change above -14 ft NAVD88	avg volume change above -19 ft NAVD88	avg volume change above -30 ft NAVD88
Reach	#	ft	ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft
Nags Head - Reach 3 - North	920+00 - 975+00	5,500	-14.8	2.2	-1.1	0.2	-0.7	0.1	-2.2
Nourished Oceanfront	495+00 - 1025+00	53,000	-7.5	0.4	-2.2	5.6	8.0	9.3	9.7

Table 5-26. Cumulative Volume Change for Reach 3 - North (June 2023 – October 2023)

June 2023 vs. October 2023 (Total Change)	Transects	Reach Length	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above -6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88	cumulative volume change above -30 ft NAVD88
Reach	#	ft	cy	cy	cy	cy	cy	cy
Nags Head - Reach 3 - North	920+00 - 975+00	5,500	11,888	-5,916	896	-3,962	380	-12,229
Nourished Oceanfront	430+00 - 1200+00	53,000	20,984	-117,350	297,583	429,014	495,619	513,968

Shoreline change at MHW in Reach 3 – North showed a significant overall landward recession of -14.8 ft. **Figure 5-42** presents the shoreline changes at each transect from June 2023 to October 2023, showing up to -32.6 ft erosion (Station 935+00) along the transects.

Volumetrically, **Table 5-25** and **Table 5-26** indicates that Reach 3 - North experienced minor volume changes across the analyzed elevations, with negligible volume gains above -19 ft NAVD88 (+380 cy or +0.1 cy/ft). This suggests minimal changes in the overall system.

Figure 5-43 shows the unit volume change at each transect above the six analyzed elevations in Reach 3 - North. The figure highlights that while volume change exhibited variation across the reach, it consistently remained minor among the transects.

The profile plots in **Appendix B** depict steepening of the beachface attributed to the movement of material from the berm to lower elevations. **Figure 5-44**, as an example profile, showcases berm erosion and the subsequent adjustment of the profile.

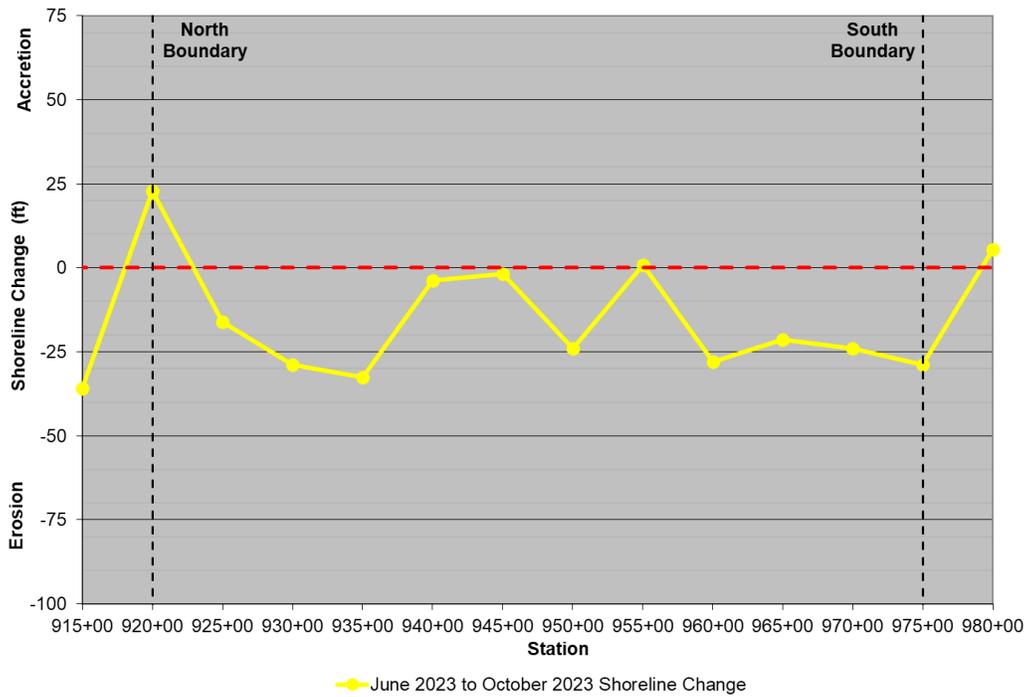


Figure 5-42. Nags Head – Reach 3 - North Shoreline Change (June 2023 – October 2023)

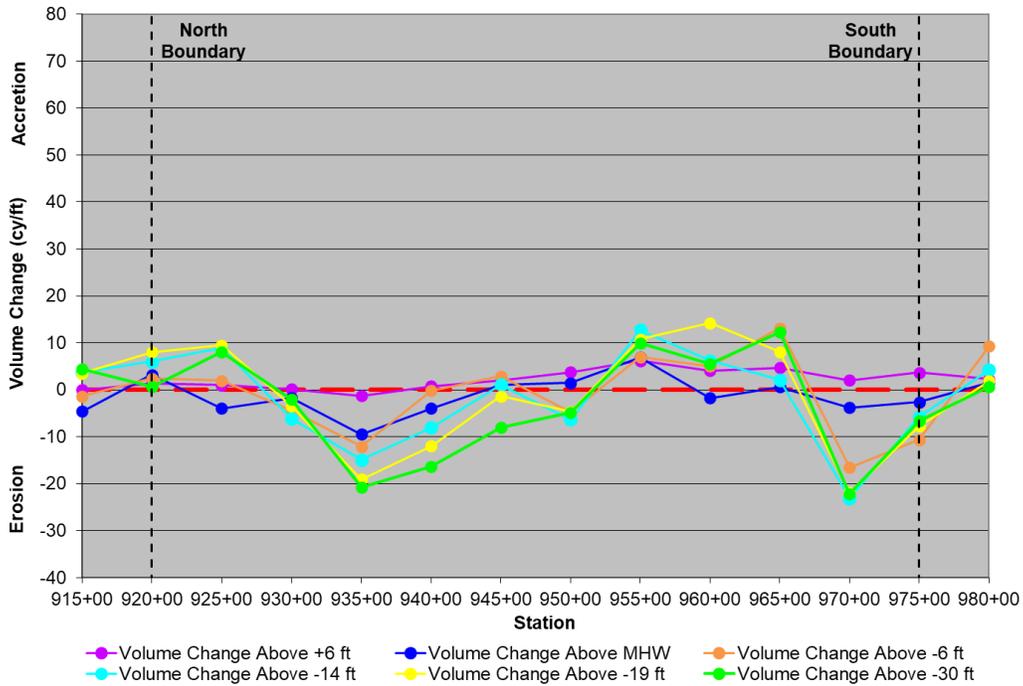


Figure 5-43. Nags Head – Reach 3 - North Unit Volume Change (June 2023 – October 2023)

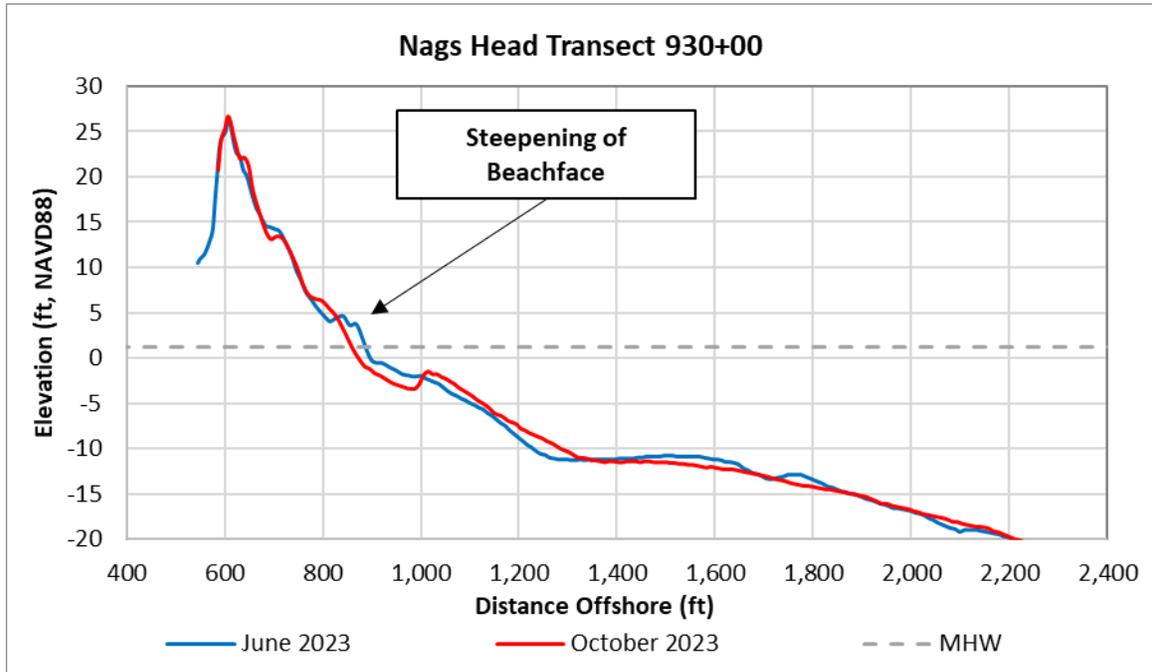


Figure 5-44. Example Reach 3 - North Profile, Station 930+00 (E Jacob St.)

5.4.4 Nags Head - Reach 3 - South (June 2023 – October 2023)

The Nags Head – Reach 3 - South fall survey reach extends approximately 3,500 ft between Limulus Drive and Loon Court, containing 7 survey transects (Station 975+00 – 1010+00), at 500 ft spacing (see **Figure 3-2**). A summary of average shoreline and volume changes between June 2023 and October 2023 for Reach 3 – South in comparison with the Nourished Oceanfront is presented in **Table 5-27** and **Table 5-28**.

Table 5-27. Average Shoreline and Average Unit Volume Change for Reach 3 - South (June 2023 – October 2023)

June 2023 vs. October 2023 (Total Change)	Transects	Reach Length	avg shoreline change @ +1.18 ft NAVD88	avg volume change above +6 ft NAVD88	avg volume change above +1.18 ft NAVD88	avg volume change above -6 ft NAVD88	avg volume change above -14 ft NAVD88	avg volume change above -19 ft NAVD88	avg volume change above -30 ft NAVD88
Reach	#	ft	ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft
Nags Head - Reach 3 - South	975+00 - 1010+00	3,500	-4.3	2.9	1.4	5.2	12.5	11.2	13.3
Nourished Oceanfront	495+00 - 1025+00	53,000	-7.5	0.4	-2.2	5.6	8.0	9.3	9.7

Table 5-28. Cumulative Volume Change for Reach 3 - South (June 2023 – October 2023)

June 2023 vs. October 2023 (Total Change)	Transects	Reach Length	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above -6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88	cumulative volume change above -30 ft NAVD88
Reach	#	ft	cy	cy	cy	cy	cy	cy
Nags Head - Reach 3 - South	975+00 - 1010+00	3,500	10,134	5,059	18,290	43,859	39,179	46,462
Nourished Oceanfront	430+00 - 1200+00	53,000	20,984	-117,350	297,583	429,014	495,619	513,968

Shoreline change at MHW within Reach 3 - South showed a minor overall average recession of -4.3 ft. **Figure 5-45** presents the shoreline changes at each transect from June 2023 to October 2023, illustrating a mix of erosion and accretion across the reach transects.

Volumetrically, **Table 5-27** and **Table 5-28** indicates that Reach 3 - South experienced volume gain at all the analyzed elevations. Overall, the most substantial gains occurred above -14 ft NAVD88 (+43,859 cy or +12.5 cy/ft) and -30 ft NAVD88 (+46,462 cy or +13.3 cy/ft). In **Figure 5-46**, the unit volume change at each transect across the six elevations is visually presented, demonstrating volume gains above all analyzed elevations at the majority of transects, with an exception noted at transect 1005+00.

The profile plots in **Appendix B** show material gain at the offshore bar, which, in turn, pushed the bar to higher elevations. **Figure 5-47** presents a profile from Reach 3 - South, highlighting accretion and adjustment of the offshore bar.

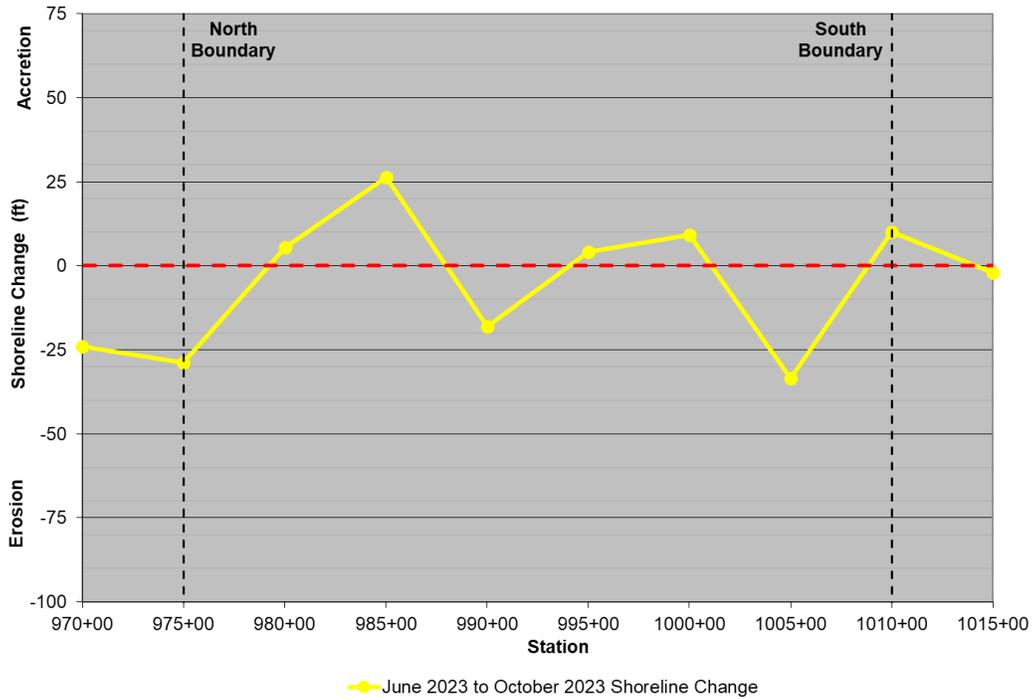


Figure 5-45. Nags Head – Reach 3S Shoreline Change (June 2023 – October 2023)

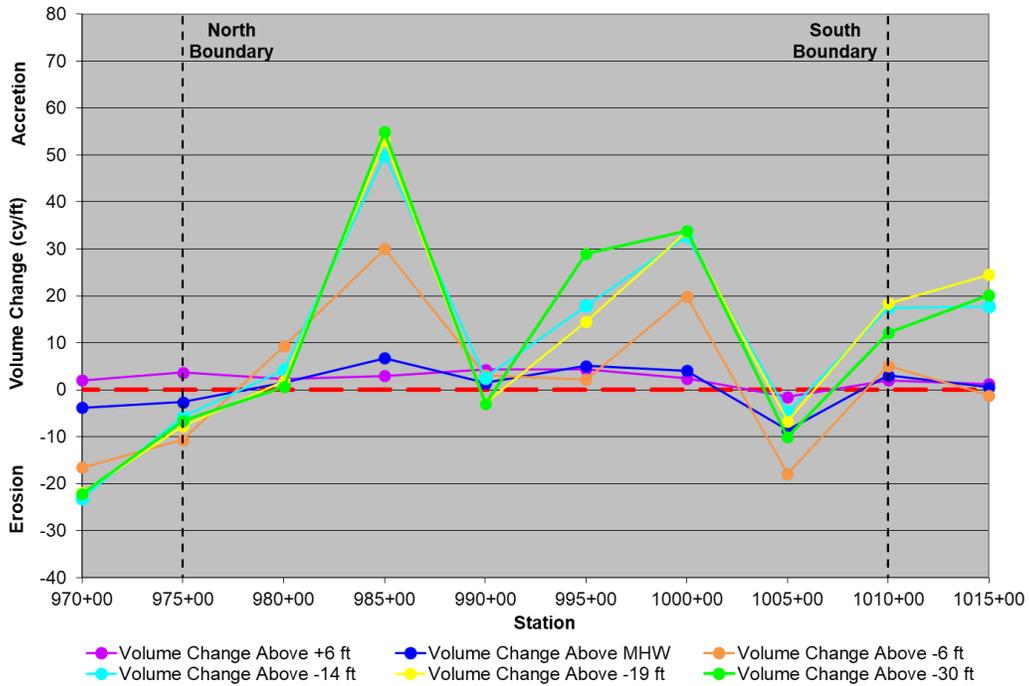


Figure 5-46. Nags Head – Reach 3S Unit Volume Change (June 2023 – October 2023)

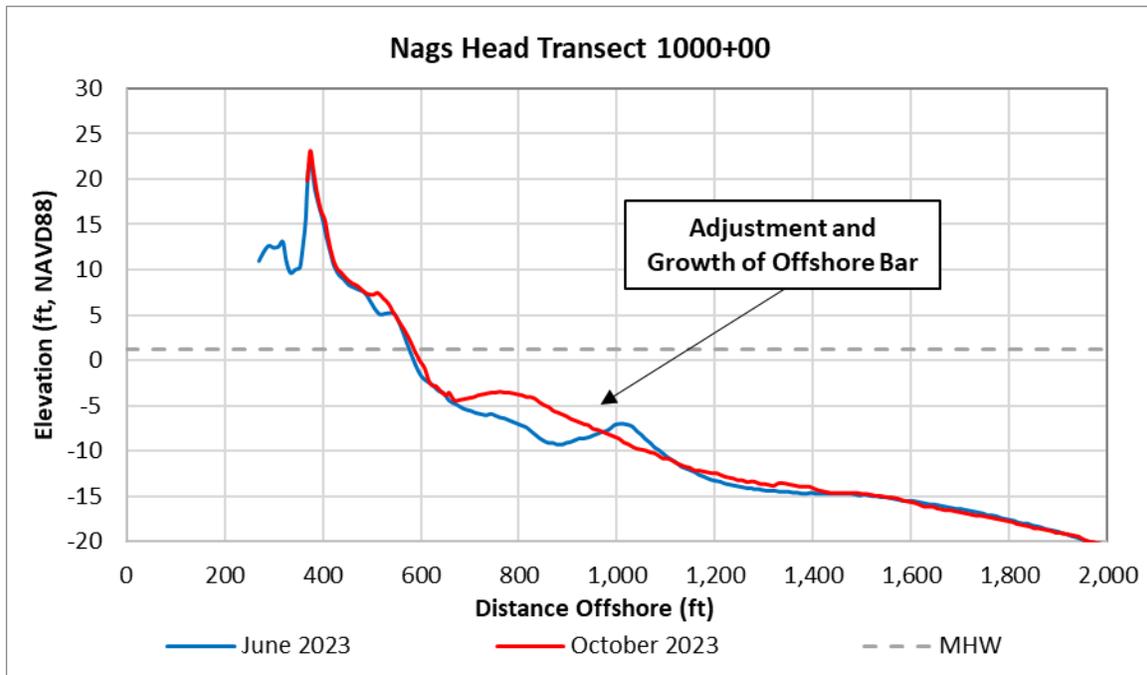


Figure 5-47. Example Reach 3 - South Profile, Station 1000+00 (E Loon Ct.)

5.4.5 Nags Head - Reach 4 (June 2023 – October 2023)

The Nags Head – Reach 4 fall survey reach extends approximately 1,500 ft between Loon Court and McCall Court, containing four survey transects (Station 1010+00 – 1025+00), at 500 ft spacing (see **Figure 3-2**). A summary of average shoreline and volume changes between June 2023 and October 2023 for Nags Head – Reach 4 in comparison with the Nourished Oceanfront is presented in **Table 5-29** and **Table 5-30**.

Table 5-29. Average Shoreline and Average Unit Volume Change for Reach 4 (June 2023 – October 2023)

June 2023 vs. October 2023 (Total Change)	Transects	Reach Length	avg shoreline change @ +1.18 ft NAVD88	avg volume change above +6 ft NAVD88	avg volume change above +1.18 ft NAVD88	avg volume change above -6 ft NAVD88	avg volume change above -14 ft NAVD88	avg volume change above -19 ft NAVD88	avg volume change above -30 ft NAVD88
Reach	#	ft	ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft
Nags Head - Reach 4	1010+00 - 1025+00	1,500	2.4	0.9	0.6	3.4	17.9	20.8	15.8
Nourished Oceanfront	495+00 - 1025+00	53,000	-7.5	0.4	-2.2	5.6	8.0	9.3	9.7

Table 5-30. Cumulative Volume Change for Reach 4 (June 2023 – October 2023)

June 2023 vs. October 2023 (Total Change)	Transects	Reach Length	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above -6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88	cumulative volume change above -30 ft NAVD88
Reach	#	ft	cy	cy	cy	cy	cy	cy
Nags Head - Reach 4	1010+00 - 1025+00	1,500	1,769	1,291	6,778	35,815	41,518	31,585
Nourished Oceanfront	430+00 - 1200+00	53,000	20,984	-117,350	297,583	429,014	495,619	513,968

Shoreline change at MHW within Reach 4 showed an overall average seaward advancement of 2.4 ft. **Figure 5-48** presents the shoreline changes at each transect from June 2023 to October 2023, showing seaward advancement at most of the transects.

Volumetrically, **Table 5-29** and **Table 5-30** indicates that Reach 4 experienced minor to moderate volume gains above all the analyzed elevations over the monitoring period. Overall, Reach 4 experienced the largest gains above -19 ft NAVD88 (41,518 cy or 20.8 cy/ft). **Figure 5-49** presents the unit volume changes at each transect across the six elevations analyzed, revealing a consistent pattern of volume gains above all analyzed elevations at the majority of transects. Profile plots in **Appendix B** show many instances of offshore bars accumulating material and migrating seaward. **Figure 5-50** presents a representative profile from Reach 4, highlighting the adjustments made to the offshore bar.

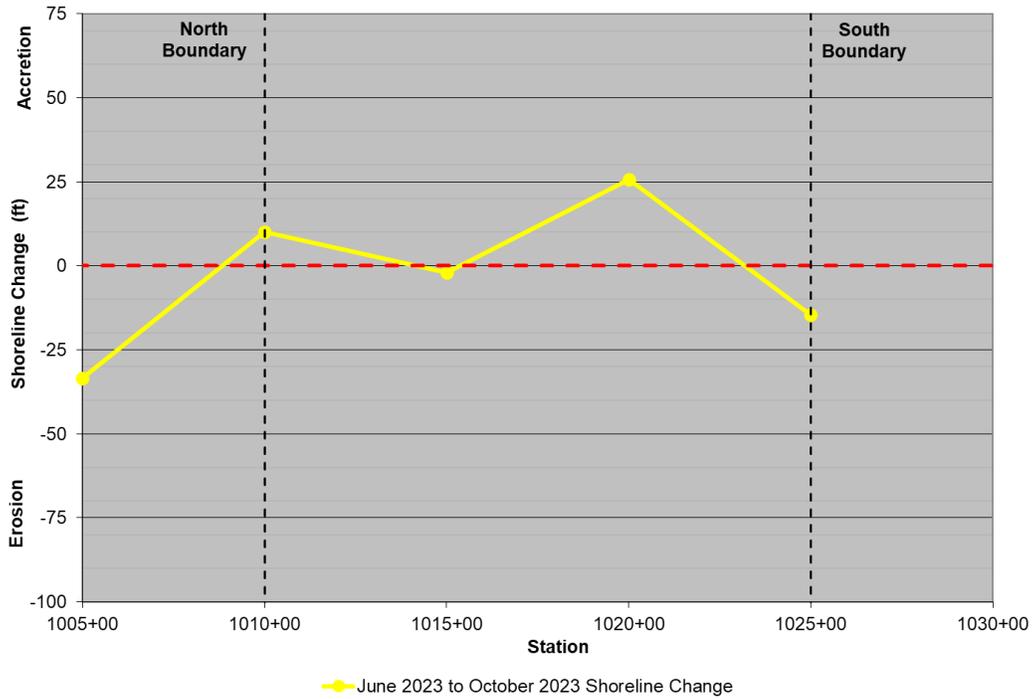


Figure 5-48. Nags Head – Reach 4 Shoreline Change (June 2023 – October 2023)

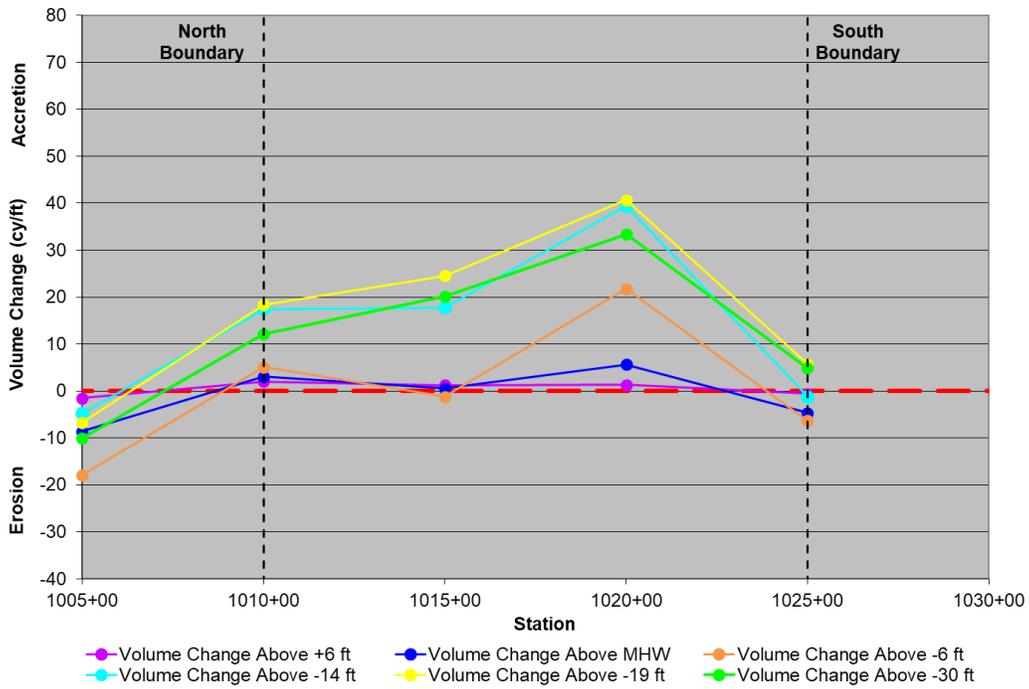


Figure 5-49. Nags Head – Reach 4 Unit Volume Change (June 2023 - October 2023)

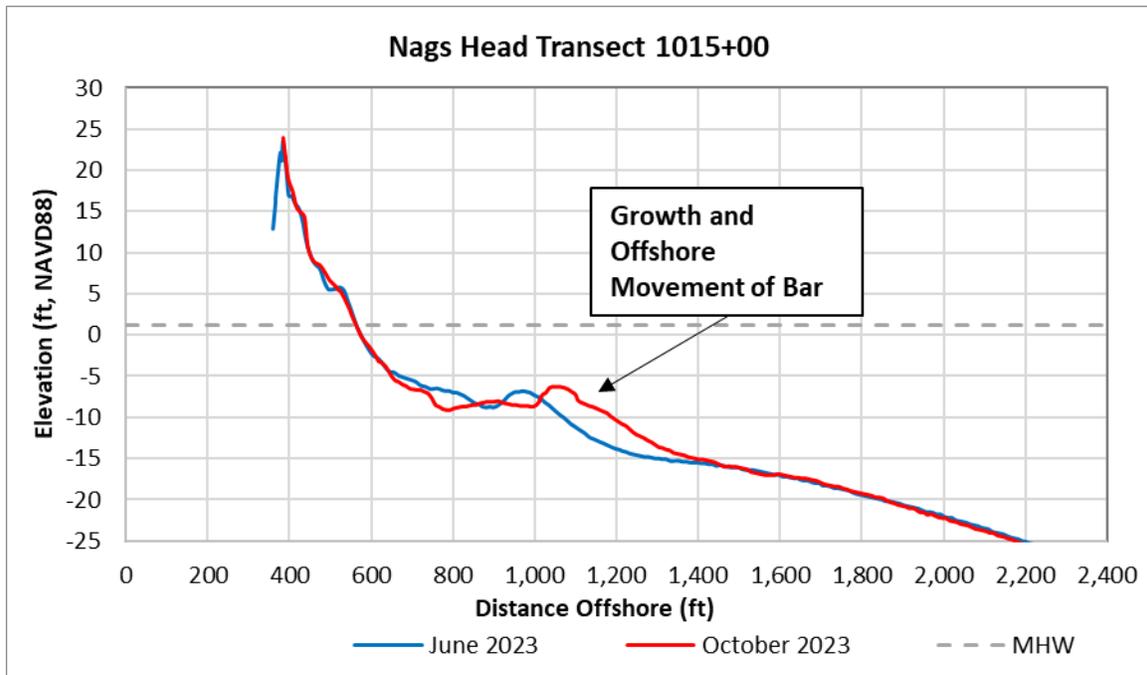


Figure 5-50. Example Reach 4 Profile, Station 1015+00 (S McCall Ct.)

5.4.6 Oceanfront Trends Summary for All Reaches (June 2023 - October 2023)

Table 5-31 and **Table 5-32** provides a summary of the shoreline and volume changes along Nags Head as presented in the previous sections along with average and total oceanfront values. **Appendix D** contains plots of the shoreline and volume changes between the June 2023 and October 2023 surveys at each transect along Nags Head.

Table 5-31. Nags Head Shoreline and Average Unit Volume Change Statistics (June 2023 – October 2023)

June 2023 vs. October 2023 (Total Change)	Transects	Reach Length	avg shoreline change @ +1.18 ft NAVD88	avg volume change above +6 ft NAVD88	avg volume change above +1.18 ft NAVD88	avg volume change above -6 ft NAVD88	avg volume change above -14 ft NAVD88	avg volume change above -19 ft NAVD88	avg volume change above -30 ft NAVD88
Reach	#	ft	ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft
Nags Head - Reach 1	495+00 - 790+00	29,500	-4.4	-0.3	-2.7	6.1	8.1	10.9	12.0
Nags Head - Reach 2	790+00 - 920+00	13,000	-13.5	0.6	-3.0	7.3	9.1	7.6	7.7
Nags Head - Reach 3N	920+00 - 975+00	5,500	-14.8	2.2	-1.1	0.2	-0.7	0.1	-2.2
Nags Head - Reach 3S	975+00 - 1010+00	3,500	-4.3	2.9	1.4	5.2	12.5	11.2	13.3
Nags Head - Reach 4	1010+00 - 1025+00	1,500	2.4	0.9	0.6	3.4	17.9	20.8	15.8
	Transects	Reach Length	weighted avg	weighted avg	weighted avg	weighted avg	weighted avg	weighted avg	weighted avg
Nourished Oceanfront	495+00 - 1025+00	53,000	-7.5	0.4	-2.2	5.6	8.0	9.3	9.7

Table 5-32. Nags Head Cumulative Volume Change Statistics (June 2023 – October 2023)

June 2023 vs. October 2023 (Total Change)	Transects	Reach Length	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above -6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88	cumulative volume change above -30 ft NAVD88
Reach	#	ft	cy	cy	cy	cy	cy	cy
Nags Head - Reach 1	495+00 - 790+00	29,500	-10,004	-78,257	177,029	235,219	315,744	347,626
Nags Head - Reach 2	790+00 - 920+00	13,000	7,197	-39,527	94,591	118,082	98,797	100,524
Nags Head - Reach 3N	920+00 - 975+00	5,500	11,888	-5,916	896	-3,962	380	-12,229
Nags Head - Reach 3S	975+00 - 1010+00	3,500	10,134	5,059	18,290	43,859	39,179	46,462
Nags Head - Reach 4	1010+00 - 1025+00	1,500	1,769	1,291	6,778	35,815	41,518	31,585
	Transects	Reach Length	total	total	total	total	total	total
Nourished Oceanfront	495+00 - 1025+00	53,000	20,984	-117,350	297,583	429,014	495,619	513,968

Between June and October 2023, recession was observed in the shorelines of all reaches except for Reach 4. This trend can be attributed, in part, to the movement of material from the berm and beachface to the offshore bar and, conversely, onshore to the dune. Furthermore, at reaches that received material during the 2022 Post-Dorian renourishment project, the continuing profile equilibrium may have contributed to this shift. Notably,

among the nourished reaches, both Reach 2 and Reach 3-North exhibited higher recession rates.

The volume changes observed during the monitoring period revealed that despite the overall shoreline recession the Nourished Oceanfront saw material gains between July 2023 and October 2023 along all the analyzed reaches above -19 ft NAVD88, indicating an overall material gain in the system. However, at Reaches 1, 2, and 3-North, material loss occurred above MHW (1.18 ft NAVD88). At Reaches 1 and 2, this loss was primarily due to the offshore shifting of material, subsequently captured in the offshore bar.

Figure 5-51 and **Figure 5-52** display the trends seen in **Table 5-31** and **Table 5-32** with bar plots of the average unit volume changes as well as total cumulative volume changes at each sub-reach to help visualize changes that occurred to the Nags Head monitoring area as a whole and how the magnitude of changes compares from one reach to the next. Both figures indicate volume losses above -6 ft NAVD88 in Reaches 1 through Reach 3N. The plots in **Appendix B** reveal visible scarping and loss of material at the beach, particularly in Reach 1 and Reach 2, where these losses were captured above -6 ft NAVD88. Reach 3N showed minor volume losses and gains, varying across elevations analyzed, indicating insignificant overall volume change. Reach 3S and Reach 4 exhibited net volume gains across all elevations, despite the reported scarping in Reach 4. This volume gain is likely due to a combination of longshore transport from the reaches to the north and wind-blown sand accumulation in the dunes.

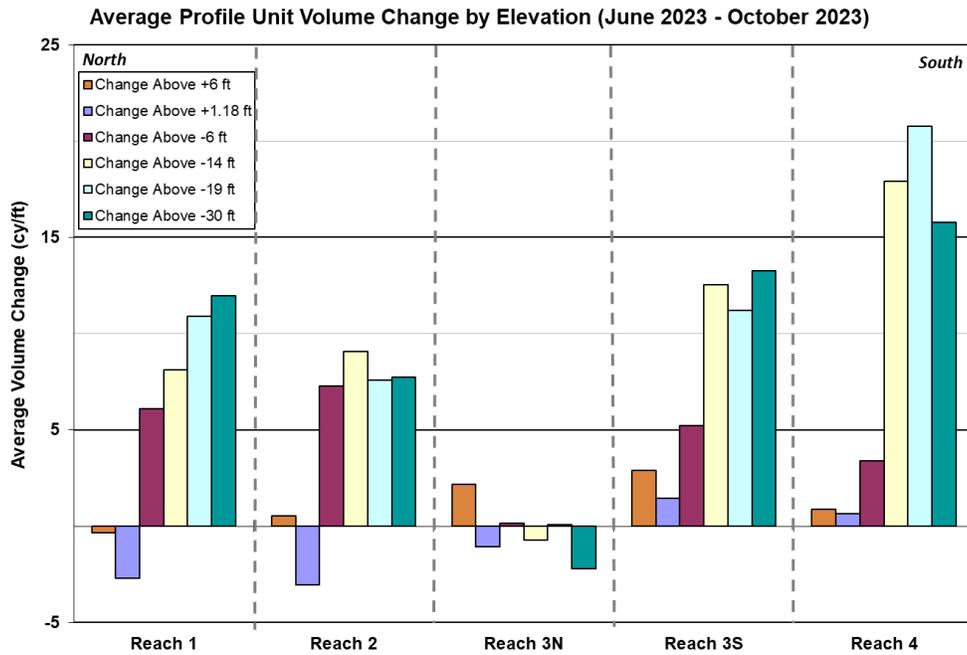


Figure 5-51. Average Unit Volume Change Within Each Reach (June 2023 – October 2023)

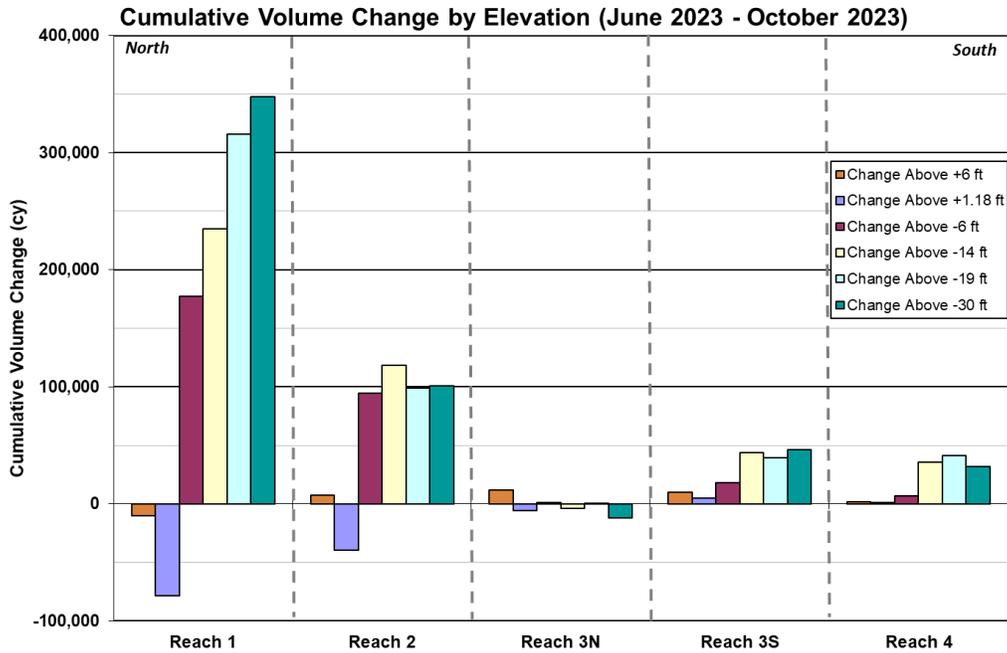


Figure 5-52. Cumulative Volume Change Within Each Reach (June 2023 – October 2023)

5.4.7 Fall 2023 Subaerial Beach and Dune Volume Loss and Scarping Discussion

The Fall 2023 monitoring survey was conducted after observed scarping along the Town’s “Historic District” within Reach 1 between Conch Street and E. Danube Street. The most significant escarpments were observed near the 4200 block of South Virginia Dare Trail (see **Figure 5-53**). There were also some escarpments observed near the south end of the Town in Reach 4 between McCall Ct. and the National Park Service property to the south. **Figure 5-54** shows a typical surveyed profile near the location shown in **Figure 5-53**, illustrating scarping, volume loss in the subaerial beach (above MHW), and accumulation in the nearshore.



Figure 5-53. Scarping Observed October 2, 2023 Near the 4200 Block Of Virginia Dare Trail (D. Ryan photo)

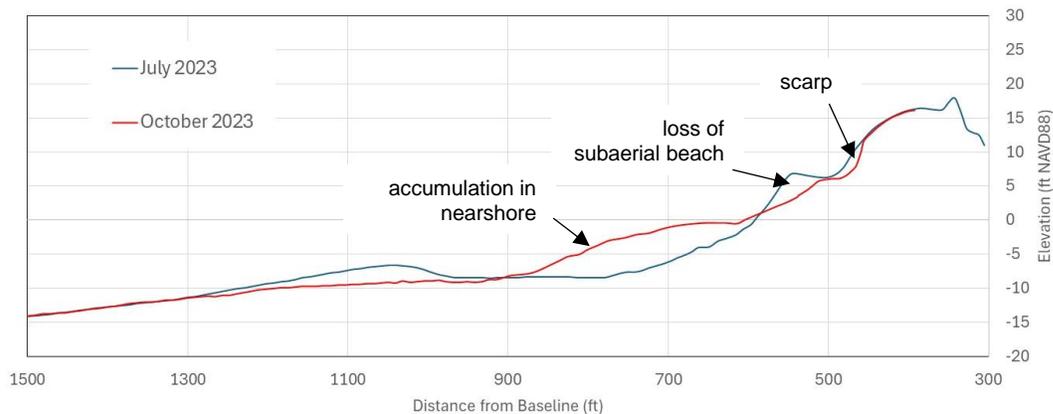


Figure 5-54. Station 595+00 (E Dune St), Near the 4200 Block of Virginia Dare Trail

Dune scarping occurs when high water levels accompanied by wave action reach the dune toe and the combination of wave impact, reflection, and turbulence remove sediment from the dune resulting in net seaward sediment transport (Davidson et al. 2020). This is referred to as the “collision regime” by Sallenger (2000) in the Storm Impact Scale. The primary controls on scarping of dunes according to the literature include water level, beach width, and beach slope (which is correlated with sand grain size [Dean 1991]). Secondary factors include vegetation cover, dune size/volume, degree of compaction, and presence of beach

wrack or woody debris (Davidson *et al.* 2020). Additionally, some investigations have attributed alongshore variability in dune scarping to features in the offshore including variations in shelf geometry (Cohn *et al.* 2019). It is likely that a combination of these factors contributed to the observed scarp formation in the fall of 2023.

To investigate the development of these scarp features as well as the observed loss of volume in the subaerial beach above MHW described in the preceding sections, an analysis of the total water levels occurring during the summer and fall of 2023 was performed. The total water level is the sum of the tide, storm surge, wave and/or wind set-up, and wave runup. Hourly water level data were obtained from NOAA station 8651370 (Duck, NC), and wave data were obtained from NDBC station 44056 (Duck buoy) as described in Section 5.1.2. Wave runup was computed using the formulation of Stockdon *et al.* (2006), which parameterizes the 2% exceedance runup value (exceeded by only 2% of the waves). In the Stockdon *et al.* (2006) formulation, the runup is dependent upon the offshore wave conditions and the slope of the beach foreshore. To assess pre-storm conditions, the foreshore beach slope was computed using the 2023 annual monitoring survey beach profiles (June-July 2023) according to the methods described in Doran *et al.* (2015). The results are presented in **Table 5-33**. A milder and a steeper typical representative slope were chosen to compute a range of runup values: 0.06 (approximately 1V:17H), and 0.09 (approximately 1V:11H), because the average beach slopes in all reaches fell within this range.

Table 5-33. Foreshore Beach Slopes by Reach (June 2023 Survey Data)

Reach	Average	Minimum	Maximum
Reach 1	0.09	0.04	0.19
Reach 2	0.06	0.04	0.14
Reach 3N	0.09	0.04	0.22
Reach 3S	0.07	0.05	0.18
Reach 4	0.06	0.05	0.07

Results of the total water level analysis for the steeper foreshore slope of 0.09 (1H:11V) are presented in **Figure 5-55**. Elevation +6 ft NAVD88 is also indicated by a horizontal black line, and the date of the photo in **Figure 5-53** is indicated as well. As evident in the figure, there were multiple high wave and water level events in late August and through the month of September into early October. Four of these events had total water levels (measured water levels including tide, surge, and wave setup plus computed runup, shown in orange) exceeding the +6 ft NAVD88 elevation, which is the approximate average dune toe elevation. This approximate dune toe elevation was exceeded for a total of 70 hours during the August to October time period considering the steeper beach slope. In local areas where slopes may have been steeper than 0.09, the total water levels would be expected to exceed the dune toe elevation for even longer.

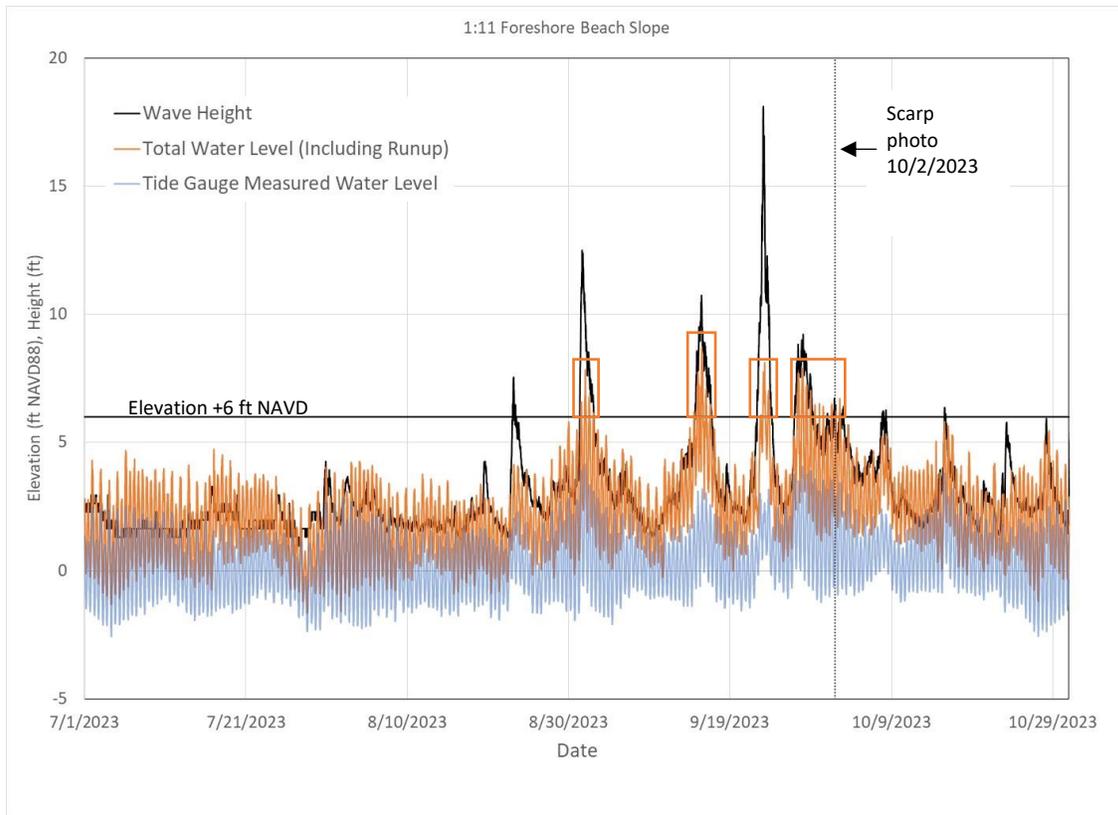


Figure 5-55. Measured Water Elevation, Computed Total Water Level Elevation (Foreshore Beach Slope 0.09), and Wave Height Observed at Duck from July to October 2023

For the milder beach slope of 0.06 (approximately 1V:17H), the total water level analysis is presented in **Figure 5-56**. Because a milder beach slope leads to less wave runup, in this case the time when total water levels exceeded the approximate dune toe elevation of +6 ft NAVD88 was reduced to 36 hours during the August to October time period. Additionally, the maximum total water elevation was also reduced. In local areas where slopes may have been milder than 0.06, the time of exceedance would be reduced even further. In general, where the foreshore slopes were steeper prior to the storms, more dune impacts would be expected.

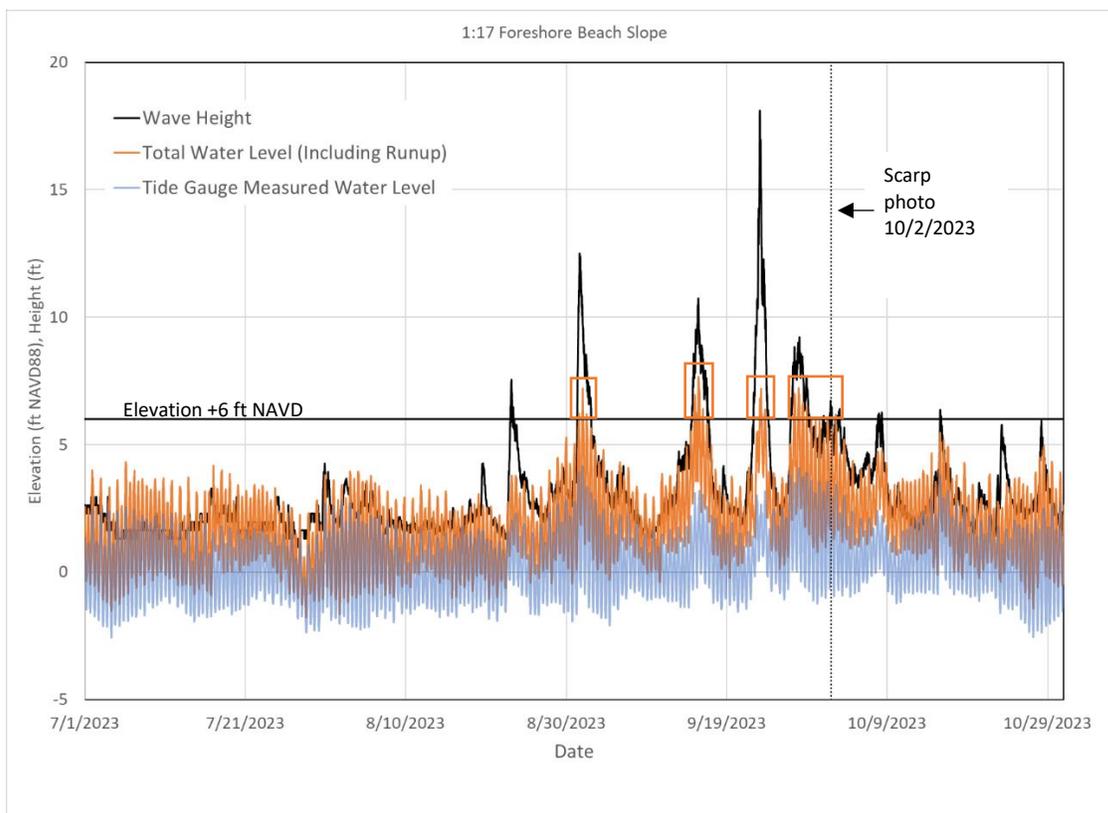


Figure 5-56. Measured Water Elevation, Computed Total Water Level Elevation (Foreshore Beach Slope 0.06), and Wave Height Observed at Duck from July to October 2023

In addition to the observed dune scarping, a substantial volume of material in the subaerial beach above MHW was transported to the nearshore (e.g. **Figure 5-54**). This was likely also a result of the higher wave events impacting the berm at lower elevations causing more turbulence, wave reflection, and net seaward transport. Berm impacts would be expected at lower total water levels, which occurred even more frequently throughout late August, September, and early October.

The natural recovery process includes dune recovery from scarping and net onshore movement of sediment during lower wave conditions. As the dune recovers from the scarping event, in the short term, the result of the event is that the dune toe is translated landward and generally increases in elevation. Sand slumps from the incline to the base of the dune and avalanching occurs as the moisture content of the sand decreases. In a healthy beach system with adequate sand, material removed from the dune is generally eventually returned to the slope face as part of the beach-dune recovery cycle (Carter *et al.* 1990). This occurs as wind-blown sand is deposited along the seaward face of the dune and vegetation becomes more established. This process has been shown to take anywhere from two to ten years on barrier islands (Houser *et al.* 2015). Sediment transport from the nearshore to the berm can occur more quickly, with beach width recovery observed in timescales on the order of several months to a year (e.g. Phillips *et al.* 2015, Sexton and

Hayes 1991, Lee *et al.* 1998). Depending on the wave and water level conditions through the winter and spring of 2024, some recovery of the subaerial beach and dune is expected prior to the 2024 annual survey. It is noted that repeated occurrence of nor'easter storms and high wave/water level conditions in the upcoming winter/spring season would be expected to interrupt the recovery process and potentially remove even more sediment from the subaerial portion of the profile.

5.5 Nourished Oceanfront Performance Relative to Pre-Nourishment

Construction of the 2019 Nags Head Beach Nourishment Project was carried out between May 1, 2019 and August 18, 2019. During the project, a total of 4 million cy of material was placed along approximately 10 miles of shoreline. CSE conducted a pre-construction survey in April 2019. To quantify the performance of the nourishment project, the volume changes between the pre-nourishment survey and the subsequent monitoring surveys were analyzed.

Figure 5-57 illustrates the shoreline changes relative to pre-nourishment condition (April 2019) along the Nourished Oceanfront. As can be seen from the figure, a significant landward recession occurred along the Nourished Oceanfront since the completion of the 2019 nourishment project. The majority of this recession, noted before the post-Dorian survey, can be attributed to Hurricane Dorian. However, a portion of it was also due to profile equilibration, a natural occurrence during the stabilization of the nourishment profile. Similarly, while the August 2022 Post-Dorian Renourishment project mitigated part of the shoreline recession, by June 2023, the shoreline had receded, likely due to profile equilibration.

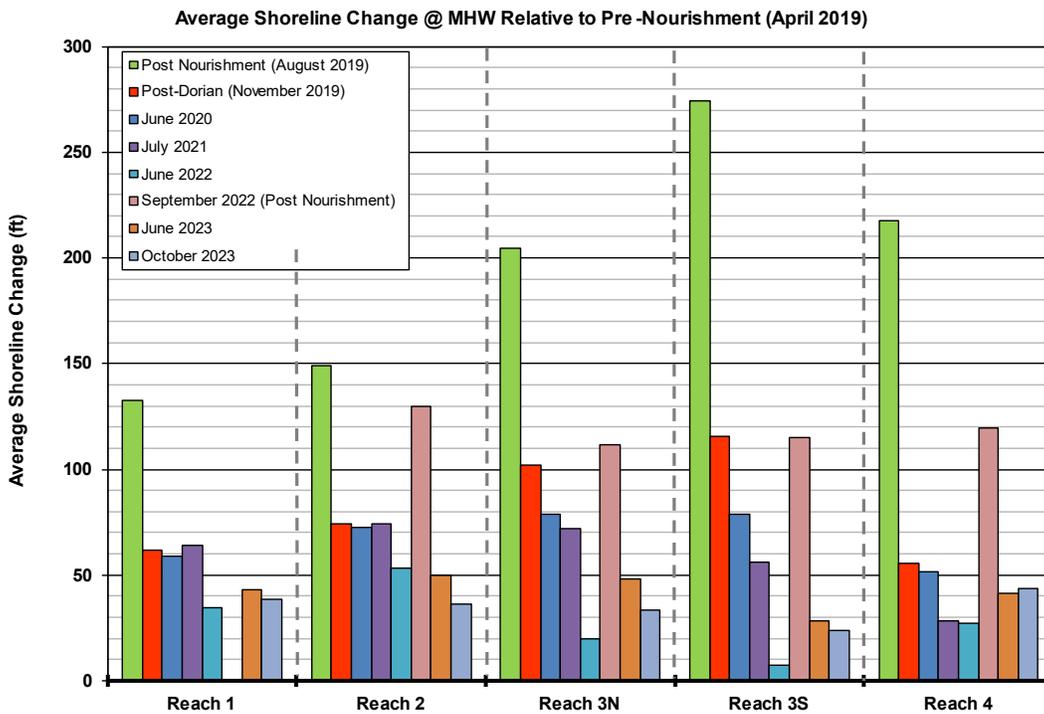


Figure 5-57. Nourished Oceanfront Average Shoreline Change Relative to Pre-Nourishment Conditions

Figure 5-58 and **Table 5-34** presents the volume changes relative to pre-nourishment conditions (April 2019) above six elevations along the Nourished Oceanfront. The volume

gains resulting from the 2022 Post-Dorian Renourishment project are visually highlighted as the shaded area in **Figure 5-58**. Notably, the Nourished Oceanfront exhibited material gains along the upper elevation (+6 ft NAVD88) and the lower elevations (-14 ft NAVD88 and -19 ft NAVD88) of the profiles. Conversely, material losses were observed MHW and -6 ft NAVD88.

Table 5-34 confirms that since the completion of the 2019 nourishment project approximately 1,595,755 cy (30.1 cy/ft) of volume gain was observed above -19 ft NAVD88 along the Nourished Oceanfront. However, the results show large-scale shifts of sand cross-shore, across different elevations. Most notably, about 140% of the volume present in August 2019 above -19 ft NAVD88 has remained within the system through the October 2023 survey. It's important to note that the 614,106 cubic yards of material placed during the 2022 Post-Dorian Renourishment project contribute to a 15% increase in the overall volume gain above -19 ft NAVD88.

Table 5-34. Nourished Oceanfront Cumulative Volume Change Relative to Pre-Nourishment Conditions

	Reaches	Stations	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above -6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88
Pre-Nourishment (April 2019) -Post Nourishment (August 2019)	Reach 1	495+00 - 790+00	47,918	1,258,165	1,693,618	1,755,354	1,762,213
	Reach 2	790+00 - 920+00	15,959	568,190	861,317	883,160	885,587
	Reach 3N	920+00 - 975+00	45,018	447,070	602,835	579,316	576,703
	Reach 3S	975+00 - 1010+00	24,590	94,184	521,783	538,928	540,833
	Reach 4	1010+00 - 1025+00	19,612	37,063	270,325	242,401	239,298
	Nourished Oceanfront	495+00 - 1025+00	153,098	2,404,672	3,949,879	3,999,158	4,004,634
Pre-Nourishment (April 2019) -Post Dorian (November 2019)	Reach 1	495+00 - 790+00	122,742	890,211	1,043,259	1,670,583	1,649,959
	Reach 2	790+00 - 920+00	53,589	441,740	550,539	906,718	817,193
	Reach 3N	920+00 - 975+00	53,200	273,200	304,616	414,929	388,407
	Reach 3S	975+00 - 1010+00	29,753	-14,098	295,230	387,901	350,928
	Reach 4	1010+00 - 1025+00	10,924	-47,450	67,788	85,461	62,951
	Nourished Oceanfront	495+00 - 1025+00	270,208	1,543,604	2,261,432	3,465,591	3,269,438
Pre-Nourishment (April 2019) - June 2020)	Reach 1	495+00 - 790+00	193,057	964,264	991,610	1,633,023	2,052,621
	Reach 2	790+00 - 920+00	110,115	502,260	554,438	935,933	1,109,539
	Reach 3N	920+00 - 975+00	72,432	288,994	261,920	383,133	526,039
	Reach 3S	975+00 - 1010+00	41,649	-4,082	235,215	316,084	354,188
	Reach 4	1010+00 - 1025+00	21,996	-28,740	33,984	45,101	71,796
	Nourished Oceanfront	495+00 - 1025+00	439,248	1,722,697	2,077,167	3,313,273	4,114,183
Pre-Nourishment (April 2019) - July 2021)	Reach 1	495+00 - 790+00	272,387	1,144,705	1,177,224	1,849,575	2,263,667
	Reach 2	790+00 - 920+00	139,655	559,446	705,370	1,035,767	1,250,047
	Reach 3N	920+00 - 975+00	75,007	303,408	242,005	349,588	511,176
	Reach 3S	975+00 - 1010+00	39,685	-14,715	184,822	252,470	316,292
	Reach 4	1010+00 - 1025+00	18,948	-35,699	15,219	22,910	79,520
	Nourished Oceanfront	495+00 - 1025+00	545,682	1,957,146	2,324,639	3,510,310	4,420,702
Pre-Nourishment (April 2019) - June 2022)	Reach 1	495+00 - 790+00	326,493	1,076,208	983,159	1,188,310	2,059,260
	Reach 2	790+00 - 920+00	124,552	437,580	512,104	498,138	1,039,949
	Reach 3N	920+00 - 975+00	46,334	206,727	156,733	11,292	344,958
	Reach 3S	975+00 - 1010+00	22,972	-45,066	153,151	142,466	313,583
	Reach 4	1010+00 - 1025+00	14,154	-43,008	-523	-5,248	64,869
	Nourished Oceanfront	495+00 - 1025+00	534,504	1,632,442	1,804,624	1,834,958	3,822,618
Pre-Nourishment (April 2019) - June 2023)	Reach 1	495+00 - 790+00	335,917	1,059,107	1,006,248	1,713,208	2,318,425
	Reach 2	790+00 - 920+00	164,020	522,559	672,631	1,116,802	1,501,016
	Reach 3N	920+00 - 975+00	69,003	259,624	260,863	445,635	672,518
	Reach 3S	975+00 - 1010+00	39,437	-12,111	198,971	315,891	493,380
	Reach 4	1010+00 - 1025+00	16,489	-39,790	4,174	31,740	119,431
	Nourished Oceanfront	495+00 - 1025+00	624,865	1,789,389	2,142,887	3,623,277	5,104,771
Pre-Nourishment (April 2019) - October 2023)	Reach 1	495+00 - 790+00	325,914	980,850	1,183,278	1,948,428	2,634,169
	Reach 2	790+00 - 920+00	171,216	483,032	767,222	1,234,884	1,599,814
	Reach 3N	920+00 - 975+00	80,891	253,708	261,759	441,674	672,898
	Reach 3S	975+00 - 1010+00	49,571	-7,052	217,261	359,750	532,559
	Reach 4	1010+00 - 1025+00	18,257	-38,499	10,952	67,555	160,949
	Nourished Oceanfront	495+00 - 1025+00	645,849	1,672,039	2,440,471	4,052,290	5,600,389

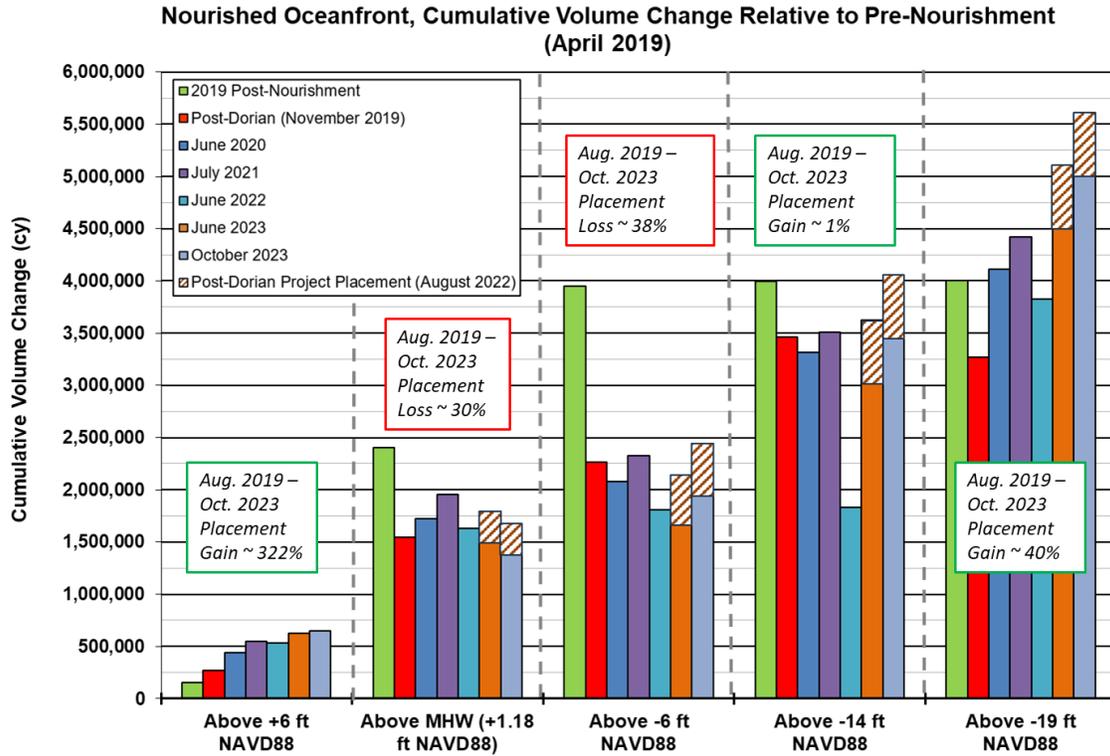


Figure 5-58. Nourished Oceanfront Cumulative Volume Change Relative to Pre-Nourishment

Figure 5-59 illustrates the volume changes relative to pre-nourishment conditions (April 2019) above +6 ft NAVD88 along the Nourished Oceanfront. All the reaches, excluding Reach 4, experienced a gain in material above +6 ft NAVD88. However, Reach 4 incurred a loss of approximately 7% of the material that was originally placed above +6 ft NAVD88 during the 2019 Nourishment Project.

Figure 5-60 shows the volume changes relative to pre-nourishment conditions (April 2019) above MHW (+1.18 ft NAVD88) along the Nourished Oceanfront. Notably, all reaches experienced material losses above MHW following the completion of the nourishment project. Similar to shoreline changes (see **Figure 5-57**), the majority of these losses were observed during the Post-Dorian survey, encompassing both the erosion caused by Hurricane Dorian and the equilibrium of the nourishment profile.

In the monitoring period from June 2022 to June 2023, the reaches that received sand during the 2022 Post-Dorian Renourishment project encountered volume losses above MHW, primarily attributed to profile equilibration. Subsequently, during the Fall monitoring period (June 2023-October 2023), Reach 1 and Reach 2 experienced further volume losses due to material shifting to the nearshore, influenced by active fall wave activities (see Section 5.4.7). By the conclusion of the October 2023 monitoring period, despite the material received during the 2022 Post-Dorian Renourishment project, Reaches

3S and Reach 4 experienced a complete loss of all material that was originally placed above MHW during the 2019 nourishment project.

Figure 5-61 presents the volume changes relative to pre-nourishment conditions (April 2019) above -19 ft NAVD88 along the Nourished Oceanfront. In this figure, Reach 1, Reach 2, and Reach 3N display volume gains above -19 ft NAVD88 relative to the pre-nourishment conditions. Conversely, the remaining reaches show percent losses, but even with these losses, more than 50% of the material still remains in the system. It's important to note that without the 2022 Post-Dorian Project, the reported loss percentages at Reaches 3N, 3S, and 4 would have been 8%, 75%, and 72%, respectively.

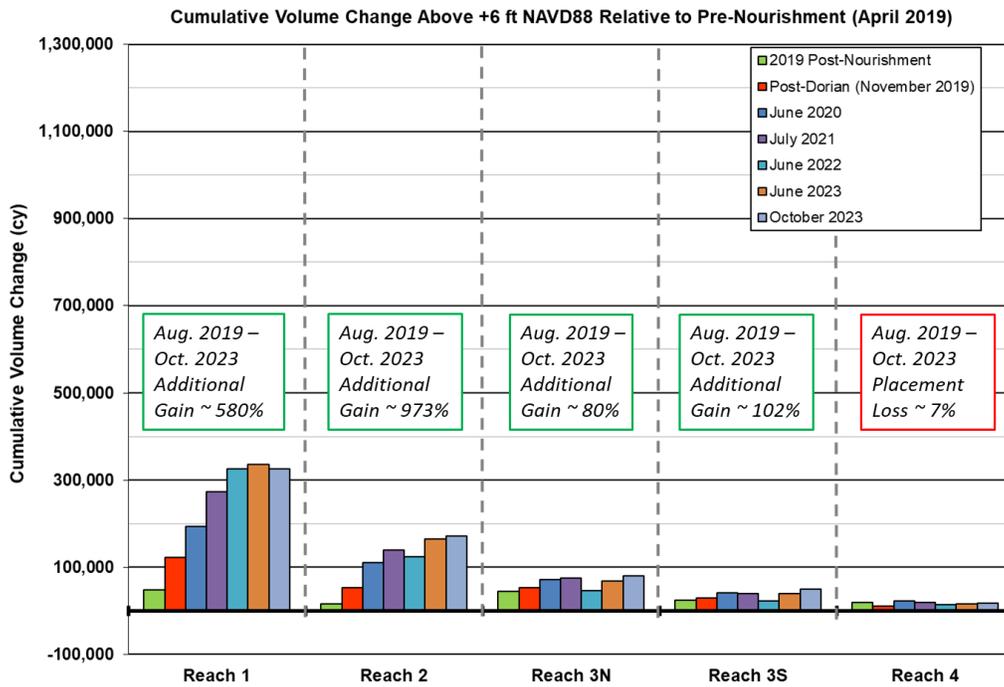


Figure 5-59. Cumulative Volume Change Above +6 ft NAVD88 Relative to Pre-Nourishment

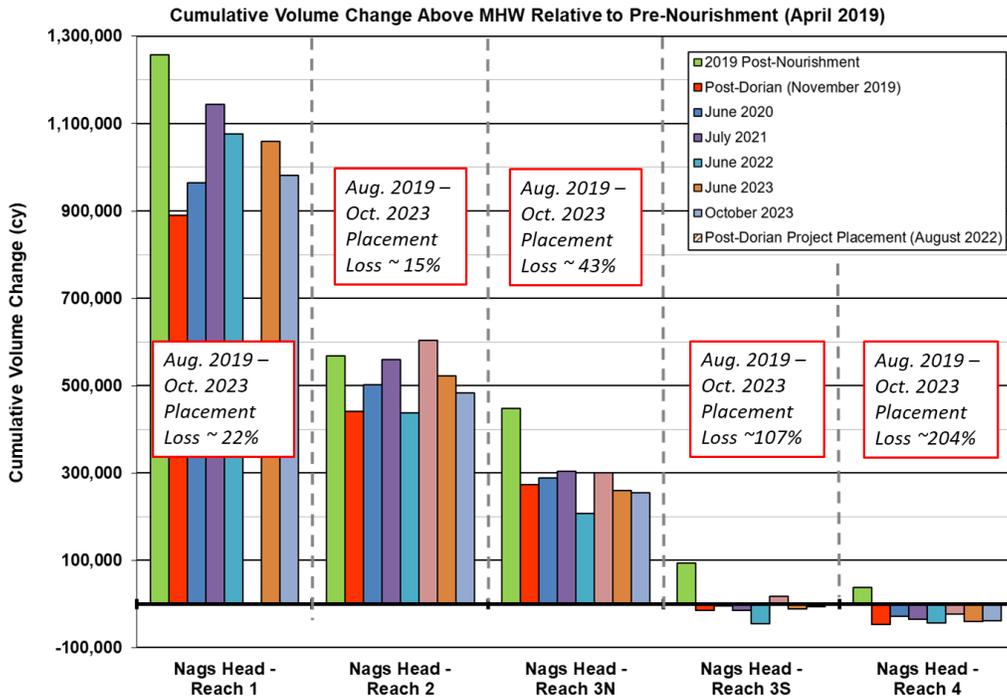


Figure 5-60. Cumulative Volume Change Above MHW Relative to Pre-Nourishment

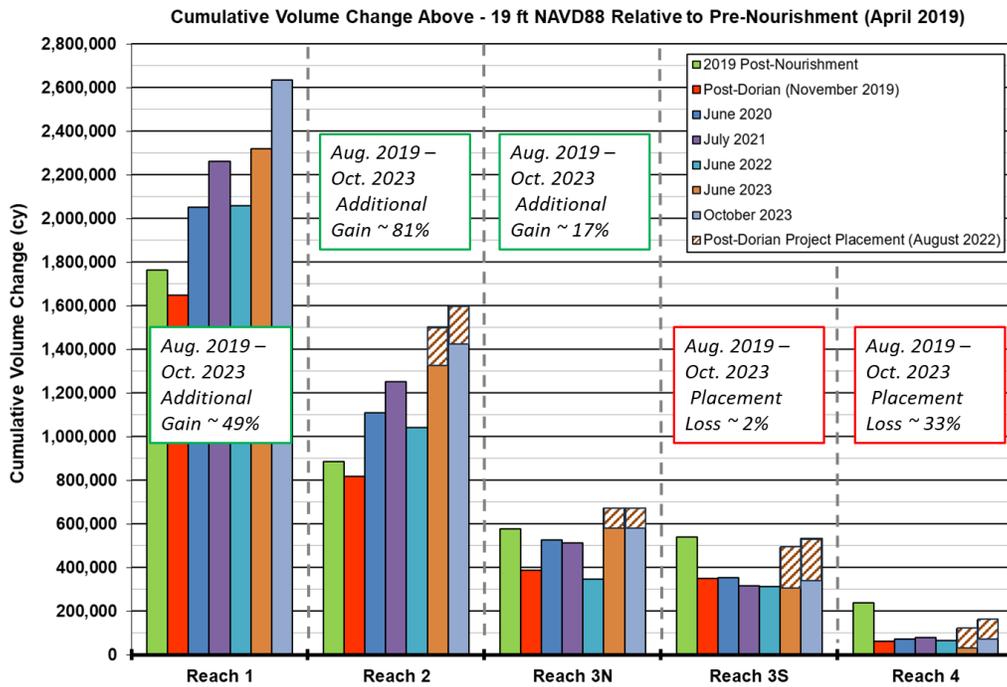


Figure 5-61. Cumulative Volume Change Above -19 ft NAVD88 Relative to Pre-Nourishment

5.6 Long-Term Volume Change Trends (2011 – 2023)

To determine the long-term trends along Nags Head, annual volume changes from the present and previous monitoring reports were averaged at each transect. Material placed during the 2019 and 2022 beach nourishment projects was subtracted out of the total volume change at each transect in order to determine the background erosion rate. **Figure 5-62** shows the mean volume change from 2011 to 2023 with nourishment, and **Figure 5-63** shows the mean volume change over the same years with the nourishment subtracted out. In comparison of the two figures, the hotspot at Reach 3-South (in the center of the red circle on each figure) is very visible when nourishment effects are subtracted out. In both figures increases in volume losses from north to south can be observed. The majority of profiles to the south of Reach 2 experience volume losses above all elevations analyzed when the nourishment material is subtracted.

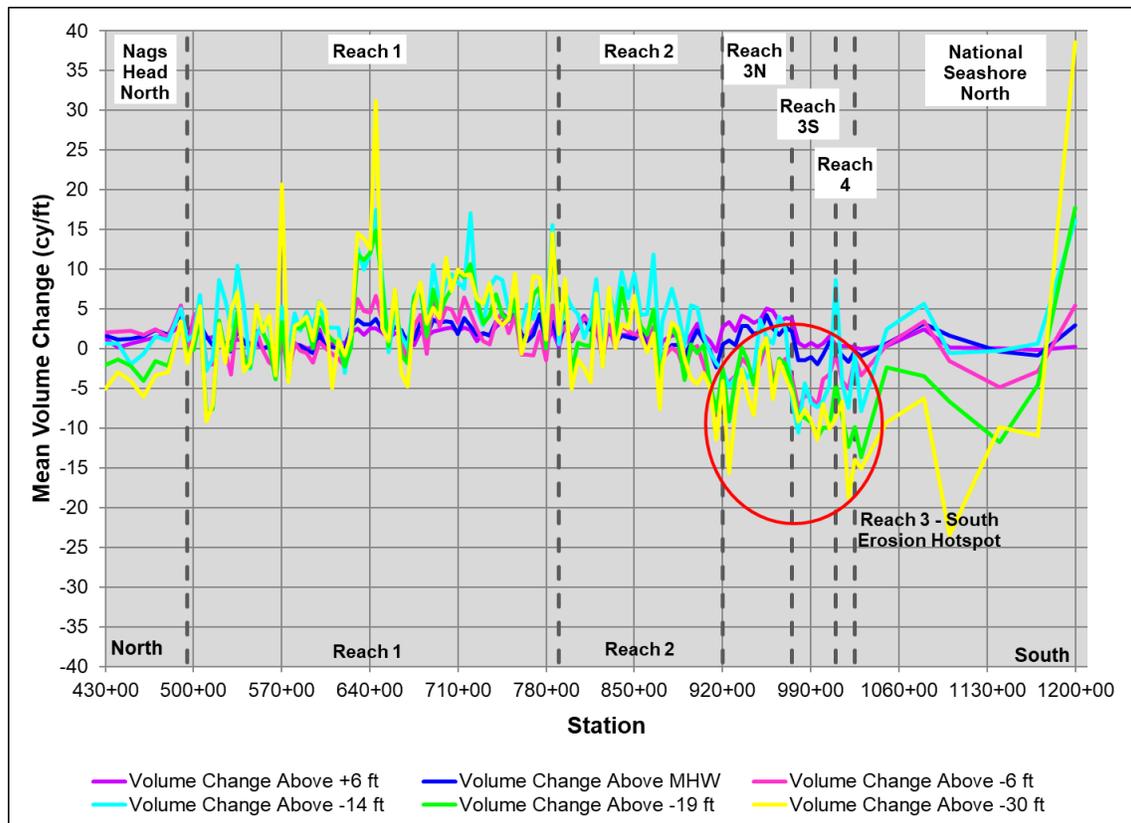


Figure 5-62. Mean Volume Change per year (2011 – 2023) (With Nourishment)

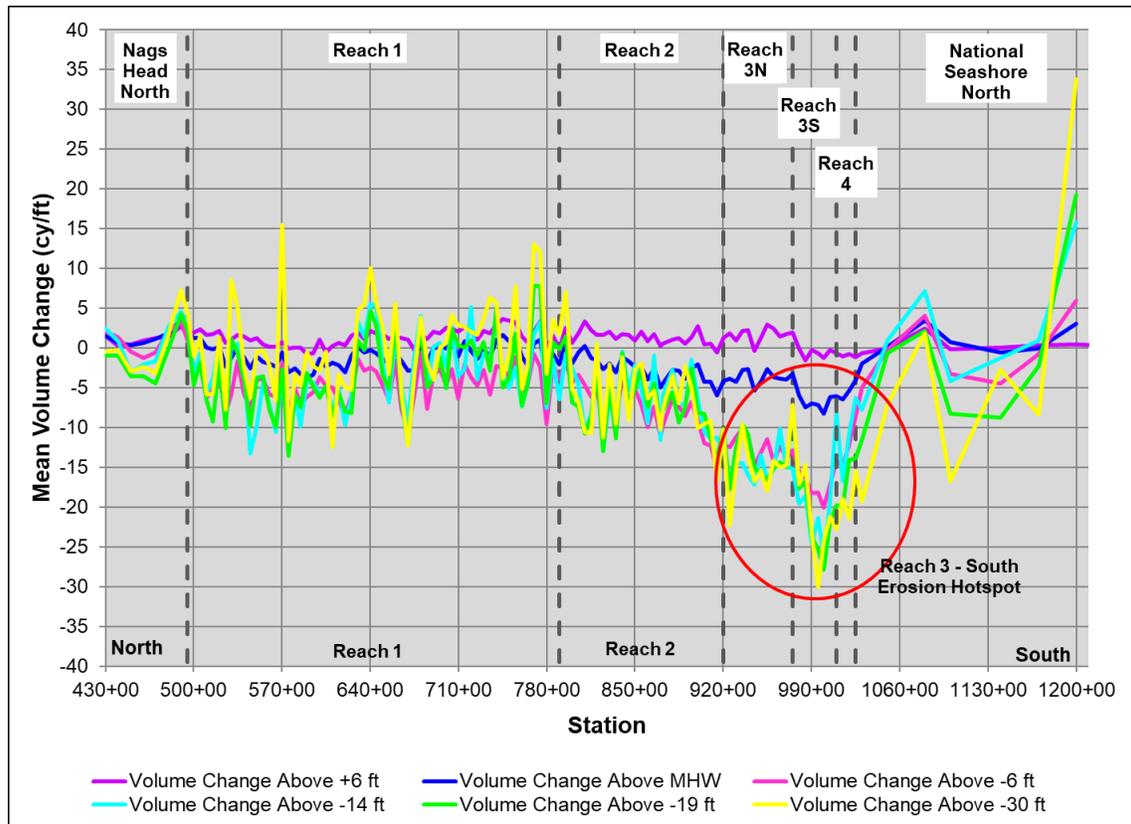


Figure 5-63. Mean Volume Change per year (2011 – 2023) (Without Nourishment)

5.7 Long-Term Dune Volume Trends

After the 2011 Beach Nourishment study it was noted (CSE 2018) that sand fencing has managed to capture the wind-blown sand and caused steady dune growth until 2014. The dune growth rates declined after 2014 as the available sand for aeolian transport decreased. Shoreline recession and reduction in dry beach width for aeolian transport caused dunes to lose sand from 2016 to 2018. The wider beaches created by the 2019 Beach Nourishment Project allowed for aeolian transport, and during the next two monitoring periods (2019 - 2020 and 2020 - 2021) dune growth was observed above +6 ft NAVD88. During the June 2022 - June 2023 monitoring period dune growth was observed throughout the oceanfront with most significant growth being observed in Reach 3S (+ 16,465 cy or +4.7 cy/ft) (**Table 5-19**).

In an attempt to determine the vulnerable locations, the mean volume change above +6 ft NAVD88 in between 2011 and 2019 beach nourishment projects was examined. **Figure 5-64** shows the mean volume change above +6 ft NAVD88, indicating two erosional locations. The first location is observed at Reach 1, in front of the Jockey's Ridge State Park, between E Hollowell Street and E Soundside Road. The second area covers the south part of the monitoring area starting from the hotspot location at Reach 3-South and extending south to National Seashore – North reach. The rest of the dunes across the Nags Head Oceanfront display either volume gain or no overall change.

To investigate how the volume changes occurred over time a moving average analysis was done by averaging the unit volume of a profile with profiles within 1,000 ft distance to it. Using moving average helps visualize the trends by displaying the localized trends while smoothing the instantaneous changes of volume between profiles. **Figure 5-65** presents the moving average analysis of unit volumes above +6 NAVD88 ft along the monitoring shoreline from 2019 to 2023, displaying the same dune erosion locations.

During the current observation period, there has been notable dune growth in all reaches except for Reach 1. The growth is most evident in the areas that received material as part of the 2022 Post-Dorian nourishment project. Despite not placing material above the berm (+6 ft NAVD88) during this project, the expanded beach width resulted in increased sediment supply for aeolian transport, consequently contributing to dune growth. As a result, the southern area between transects 970+00 and 1050+00, which historically showed long-term erosion trends, exhibited dune growth or minimal erosion during the observation period. While Reach 1 showed dune erosion in the historical erosion area and around station 510+00, the erosion at these locations was not significant. Following the 2019 Nourishment project dune growth is observed south of transect 1130+00 along the National Park Service (NPS) managed area. This is likely due to material shifting south and providing more material to boost aeolian transport.

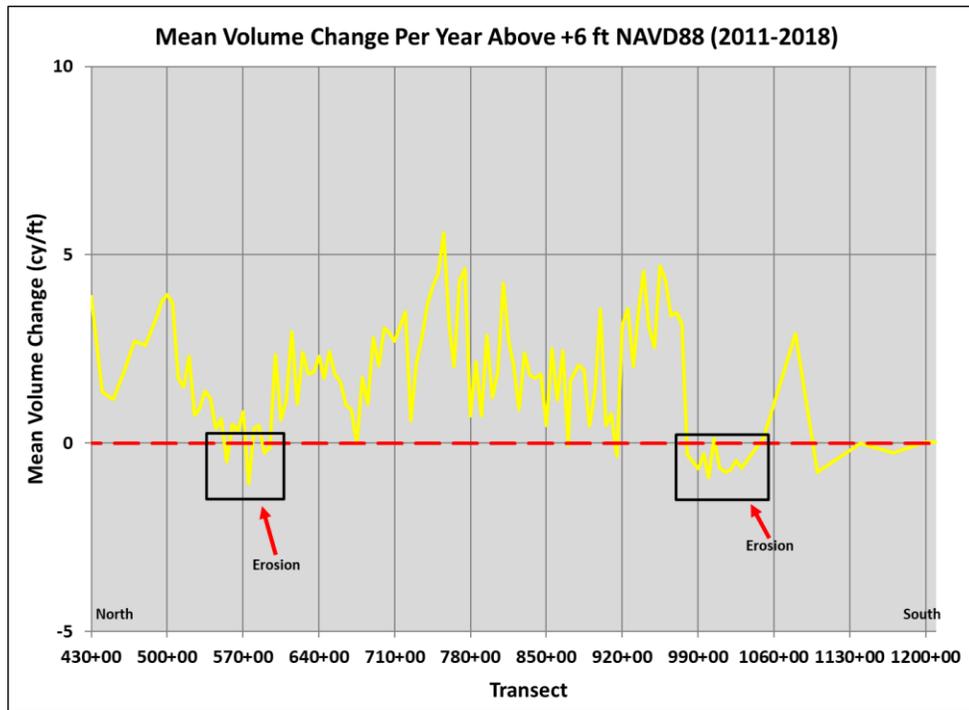


Figure 5-64. Unit Dune Volume Change from 2011 to 2018 (Moving Average Trend Above +6 ft NAVD88)

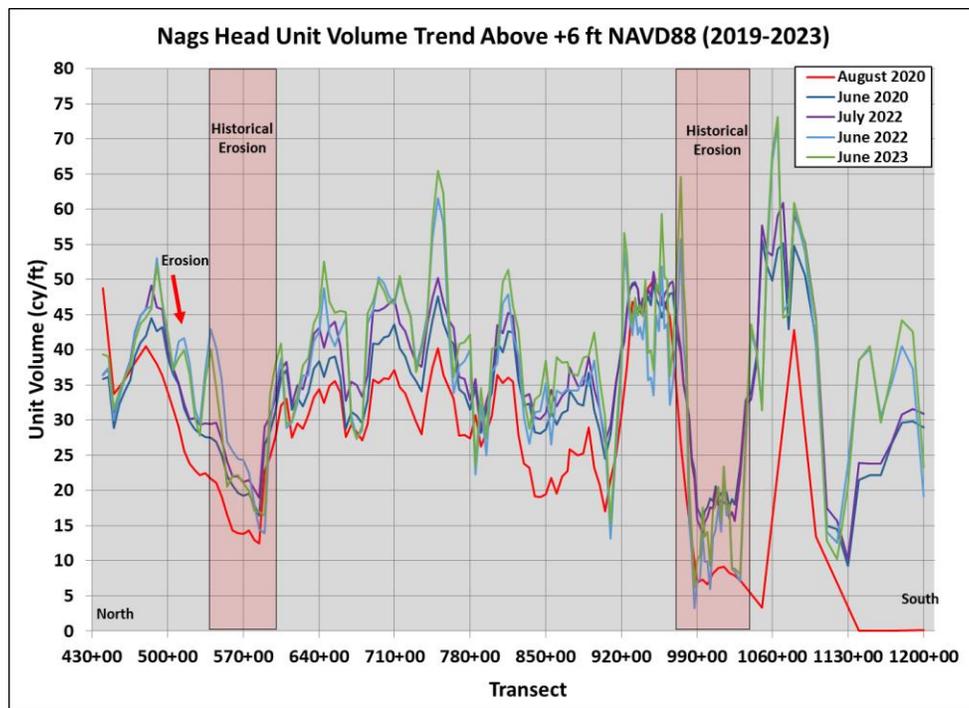


Figure 5-65. Unit Dune Volume by Year (Moving Average Trend Above +6 ft NAVD88)

6.0 SUMMARY

The Town of Nags Head Beach Monitoring and Maintenance Plan is sponsored by the Town of Nags Head (Town) as a continuation of the 2011 monitoring program initiated for assessing beach conditions. The primary purpose of the program is to assess current and historical shoreline conditions, determine shoreline and volumetric changes and evaluate the performance of beach nourishment and other restoration efforts. Evaluating and documenting these changes consistently over successive years provides information necessary to plan for future beach nourishments and to support development of the Town's multi-decadal Beach Nourishment Master Plan.

The latest annual summer survey took place in June 2023 and was carried out by McKim & Creed. Furthermore, a fall survey, prompted by observed scarping along the Town's beachfront, was conducted by McKim & Creed in October 2023. This report outlines the data sources, methodologies, and findings of a survey evaluation conducted by Moffatt & Nichol. The evaluation compares the June 2023 survey to the data from June 2022 and assesses changes between the October 2023 and June 2023 surveys.

The survey data was used to compute shoreline change at Mean High Water (MHW), which is designated as +1.18 ft NAVD88 for Nags Head, and volume change above +6 ft NAVD88 (berm), MHW, -6 ft NAVD88 (wading depth), -14 ft NAVD88 (outer bar), -19 ft NAVD88 (approximate depth of closure), and -30 ft NAVD88 (offshore).

During the 2019 Beach Nourishment Project approximately 4.0 million cy of material was placed along approximately 10 miles of shoreline. The shoreline position and volume changes above six elevations relative to pre-nourishment conditions (April 2019) along the Nourished Oceanfront (Station 495+00 – 1025+00) was also analyzed.

Figure 6-1 illustrates the shoreline changes relative to the pre-nourishment condition (April 2019) along the Nourished Oceanfront. As can be seen, a significant landward recession occurred along the Nourished Oceanfront since the completion of the 2019 nourishment project. Most of this recession, noted before the post-Dorian survey, can be attributed to Hurricane Dorian. However, a portion of it was also due to profile equilibration, a natural occurrence during the stabilization of the nourishment profile. Similarly, while the August 2022 Post-Dorian Renourishment project mitigated part of the shoreline recession, by June 2023, the shoreline had significantly receded, likely due to profile equilibration.

Figure 6-2 illustrates that the overall changes in sand volume vary with the depth above which volumes are assessed. Notably, the Nourished Oceanfront exhibited material gains along the upper elevation (+6 ft NAVD88) and the lower elevations (-14 ft NAVD88 and -19 ft NAVD88) of the profiles. Conversely, material losses were observed MHW and -6 ft NAVD88. Most notably, about 140% of the volume present in August 2019 above -19 ft NAVD88 has remained within the system through the October 2023 survey. It's important to note that the 614,106 cubic yards of material placed during the 2022 Post-Dorian

Renourishment project contribute to a 15% increase in the overall volume gain above -19 ft NAVD88.

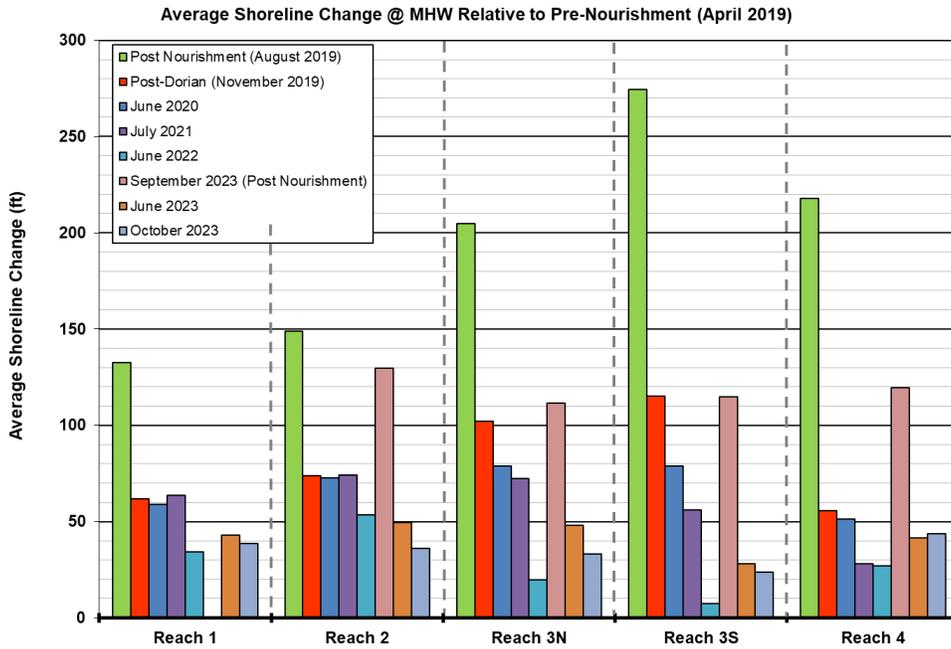


Figure 6-1. Nourished Oceanfront Average Shoreline Change Relative to April 2019 Pre-Nourishment Conditions

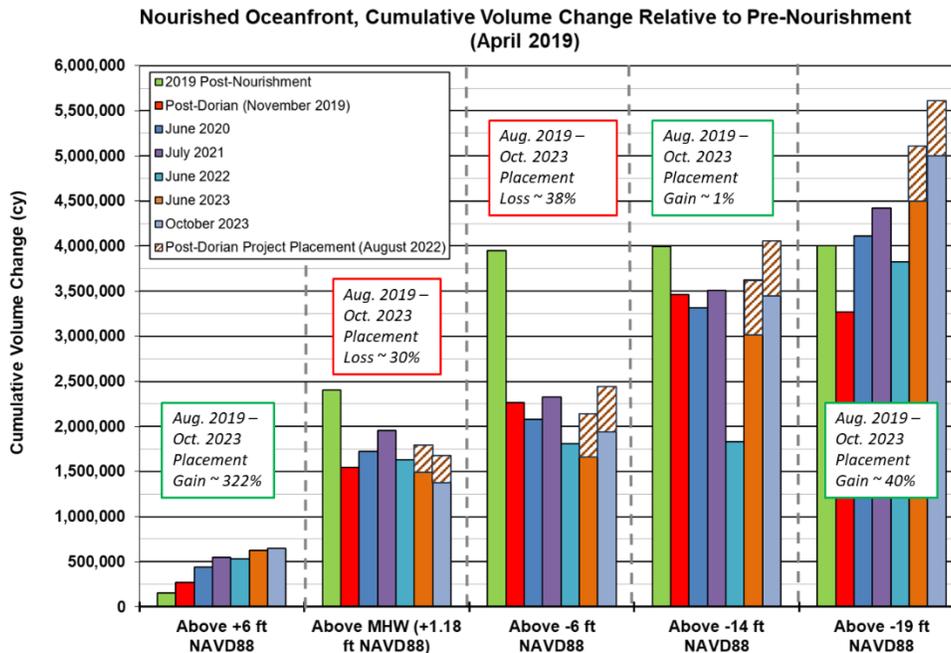


Figure 6-2. Nourished Oceanfront Cumulative Volume Change Relative to April 2019 Pre-Nourishment Conditions

Figure 6-3 presents the volume changes relative to pre-nourishment conditions (April 2019) above -19 ft NAVD88 along the Nourished Oceanfront. In this figure, Reach 1, Reach 2, and Reach 3N display volume gains above -19 ft NAVD88 relative to the pre-nourishment conditions. Conversely, the remaining reaches show percent losses, but even with these losses, more than 50% of the material still remains in the system. It's important to note that without the 2022 Post-Dorian Project, the reported loss percentages at Reaches 3N, 3S, and 4 would have been 8%, 75%, and 72%, respectively.

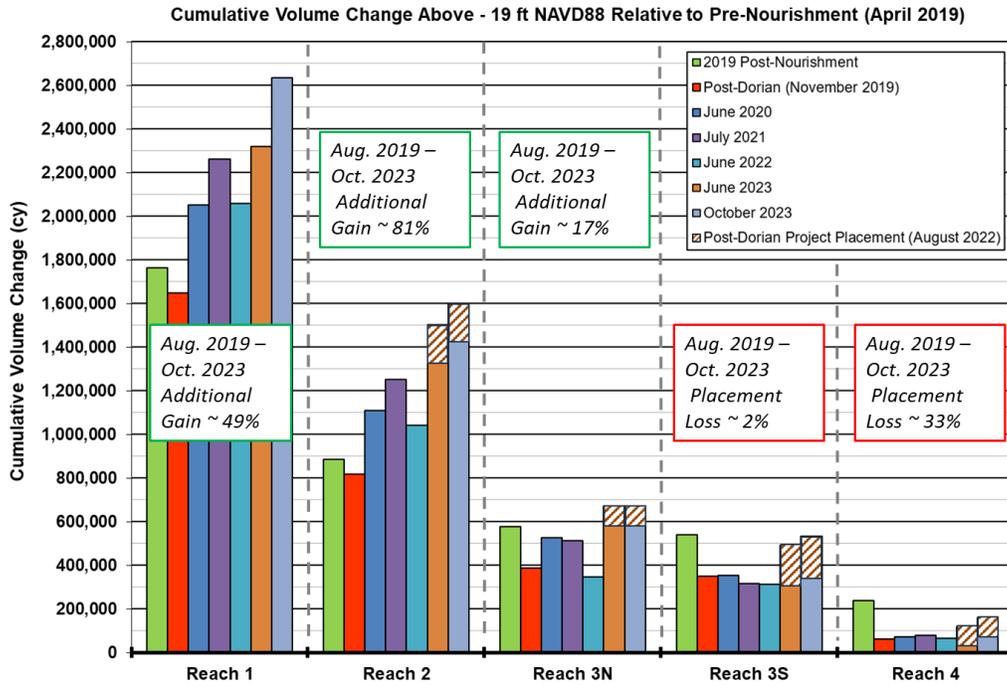


Figure 6-3. Cumulative Volume Change Above -19 ft NAVD88 Relative to Pre-Nourishment

Volume changes during the annual monitoring period indicated that the Nourished Oceanfront and Total Monitored Oceanfront both experienced gains in material between June 2022 and June 2023 along all the analyzed elevations. Key statistics for individual reaches along Nags Head along with the entire oceanfront shoreline were as follows:

Table 6-1. Nags Head Shoreline and Average Unit Volume Change Statistics (June 2022 – June 2023)

June 2022 vs. June 2023	Transects	Reach Length	avg shoreline change @ +1.18 ft NAVD88	avg volume change above +6 ft NAVD88	avg volume change above +1.18 ft NAVD88	avg volume change above -6 ft NAVD88	avg volume change above -14 ft NAVD88	avg volume change above -19 ft NAVD88	avg volume change above -30 ft NAVD88
Reach	#	ft	ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft
Nags Head - North	430+00 - 495+00	6,500	8.8	0.5	1.8	7.6	15.0	26.2	9.9
Nags Head - Reach 1	495+00 - 790+00	29,500	-3.8	0.3	-0.6	0.8	17.8	8.8	-8.0
Nags Head - Reach 2	790+00 - 920+00	13,000	28.2	3.0	6.5	12.3	47.6	35.5	15.9
Nags Head - Reach 3N	920+00 - 975+00	5,500	20.8	3.9	9.2	18.1	75.5	57.0	33.0
Nags Head - Reach 3S	975+00 - 1010+00	3,500	14.4	4.7	9.4	13.1	49.5	51.4	26.5
Nags Head - Reach 4	1010+00 - 1025+00	1,500	-4.0	1.3	1.8	2.7	21.1	31.2	3.0
National Seashore North	1025+00 - 1200+00	17,500	-16.6	0.8	-1.0	-2.6	21.2	28.6	-7.0
	Transects	Reach Length	weighted avg	weighted avg	weighted avg	weighted avg	weighted avg	weighted avg	weighted avg
Nourished Oceanfront	495+00 - 1025+00	53,000	7.8	1.7	2.9	6.3	33.3	23.8	4.7
Total Monitored Oceanfront*	430+00 - 1200+00	77,000	2.3	1.4	1.9	4.4	29.0	25.1	2.5

*National Seashore South Reach not included in the Total Monitored Oceanfront

Table 6-2. Nags Head Cumulative Volume Change Statistics (June 2022 – June 2023)

June 2022 vs. June 2023	Transects	Reach Length	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above -6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88	cumulative volume change above 30 ft NAVD88
Reach	#	ft	cy	cy	cy	cy	cy	cy
Nags Head - North	430+00 - 495+00	6,500	2,728	10,873	45,455	90,173	156,991	59,278
Nags Head - Reach 1	495+00 - 790+00	29,500	9,424	-17,101	23,090	524,899	259,165	-235,846
Nags Head - Reach 2	790+00 - 920+00	13,000	39,468	84,979	160,527	618,664	461,067	207,046
Nags Head - Reach 3N	920+00 - 975+00	5,500	22,669	52,897	104,129	434,344	327,560	189,758
Nags Head - Reach 3S	975+00 - 1010+00	3,500	16,465	32,955	45,820	173,425	179,797	92,894
Nags Head - Reach 4	1010+00 - 1025+00	1,500	2,335	3,218	4,697	36,988	54,562	5,242
National Seashore - North	1025+00 - 1200+00	17,500	13,543	-16,706	-45,322	371,445	500,960	-122,115
	Transects	Reach Length	total	total	total	total	total	total
Nourished Oceanfront	495+00 - 1025+00	53,000	90,361	156,947	338,263	1,788,319	1,282,153	259,094
Total Monitored Oceanfront*	430+00 - 1200+00	77,000	106,632	151,114	338,396	2,249,937	1,940,103	196,257

*National Seashore South Reach not included in the Total Monitored Oceanfront

During the June 2022-June 2023 monitoring period, among the nourished reaches, Reach 1 and Reach 4 were the only ones to observe shoreline recession. It's important to note that material was placed at all of the nourished oceanfront reaches during the 2022 Post-Dorian

Renourishment project, except for Reach 1, which helped mitigate recession rates in those reaches. Therefore, the seaward advancement observed in Reaches 2, 3N, and 3S can be attributed to the material placed during the nourishment project. The National Seashore-North reach, situated to the south of the Nourished Oceanfront, also observed seaward advancement, potentially attributed to southward material transport

Both the Nourished Oceanfront and Total Monitored Oceanfront exhibited material gains across all analyzed elevations, with the majority of the gain observed above -14 ft NAVD88. Slightly smaller volume gains were present above the depth of closure at -19 ft NAVD88. Specifically, the Nourished Oceanfront gained 1,282,153 cy (23.8 cy/ft) above -19 ft NAVD88, and the Total Monitored Oceanfront gained 1,940,103 cy (25.1 cy/ft) above -19 ft NAVD88. This material gain is primarily attributed to the 2022 Post Dorian Renourishment project. However, it's noteworthy that the observed material gain exceeds the amount placed during the nourishment project, suggesting additional material sources.

Volume changes during the fall monitoring period indicated that the Nourished Oceanfront experienced gains in material between June 2023 and October 2023 along all the analyzed elevations. Key statistics for individual reaches along Nags Head along with the entire oceanfront shoreline were as follows:

Table 6-3. Nags Head Shoreline and Average Unit Volume Change Statistics (June 2023 – October 2023)

June 2023 vs. October 2023 (Total Change)	Transects	Reach Length	avg shoreline change @ +1.18 ft NAVD88	avg volume change above +6 ft NAVD88	avg volume change above +1.18 ft NAVD88	avg volume change above -6 ft NAVD88	avg volume change above -14 ft NAVD88	avg volume change above -19 ft NAVD88	avg volume change above -30 ft NAVD88
Reach	#	ft	ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft
Nags Head - Reach 1	495+00 - 790+00	29,500	-4.4	-0.3	-2.7	6.1	8.1	10.9	12.0
Nags Head - Reach 2	790+00 - 920+00	13,000	-13.5	0.6	-3.0	7.3	9.1	7.6	7.7
Nags Head - Reach 3N	920+00 - 975+00	5,500	-14.8	2.2	-1.1	0.2	-0.7	0.1	-2.2
Nags Head - Reach 3S	975+00 - 1010+00	3,500	-4.3	2.9	1.4	5.2	12.5	11.2	13.3
Nags Head - Reach 4	1010+00 - 1025+00	1,500	2.4	0.9	0.6	3.4	17.9	20.8	15.8
	Transects	Reach Length	weighted avg	weighted avg	weighted avg	weighted avg	weighted avg	weighted avg	weighted avg
Nourished Oceanfront	495+00 - 1025+00	53,000	-7.5	0.4	-2.2	5.6	8.0	9.3	9.7

Table 6-4. Nags Head Shoreline and Average Unit Volume Change Statistics (June 2023 – October 2023)

June 2023 vs. October 2023 (Total Change)	Transects	Reach Length	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above -6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88	cumulative volume change above -30 ft NAVD88
Reach	#	ft	cy	cy	cy	cy	cy	cy
Nags Head - Reach 1	495+00 - 790+00	29,500	-10,004	-78,257	177,029	235,219	315,744	347,626
Nags Head - Reach 2	790+00 - 920+00	13,000	7,197	-39,527	94,591	118,082	98,797	100,524
Nags Head - Reach 3N	920+00 - 975+00	5,500	11,888	-5,916	896	-3,962	380	-12,229
Nags Head - Reach 3S	975+00 - 1010+00	3,500	10,134	5,059	18,290	43,859	39,179	46,462
Nags Head - Reach 4	1010+00 - 1025+00	1,500	1,769	1,291	6,778	35,815	41,518	31,585
	Transects	Reach Length	total	total	total	total	total	total
Nourished Oceanfront	495+00 - 1025+00	53,000	20,984	-117,350	297,583	429,014	495,619	513,968

Between June and October 2023, recession was observed in the shorelines of all reaches except for Reach 4. This trend can be attributed, in part, to the movement of material from the berm and beachface to the offshore bar and, conversely, onshore to the dune. Furthermore, at reaches that received material during the 2022 Post-Dorian renourishment project, the continuing profile equilibrium may have contributed to this shift. Notably, among the nourished reaches, both Reach 2 and Reach 3-North exhibited higher recession rates.

The volume changes observed during the monitoring period revealed that the Nourished Oceanfront saw material gains between July 2023 and October 2023 along all the analyzed reaches above -19 ft NAVD88, indicating an overall material gain in the system. However, at Reaches 1, 2, and 3-North, material loss occurred above MHW (1.18 ft NAVD88). At Reaches 1 and 2, this loss was primarily due to the offshore shifting of material, subsequently captured in the offshore bar.

During the current observation period, there has been notable dune growth in all reaches except for Reach 1. The growth is most evident in the areas that received material as part of the 2022 Post-Dorian nourishment project. Despite not placing material above the berm (+6 ft NAVD88) during this project, the expanded beach width resulted in increased sediment supply for aeolian transport, consequently contributing to dune growth.

7.0 REFERENCES

- Carter, R. Hesp, P.A., and Nordstrom, K.F. (1990). “Erosional landforms in coastal dunes”, in: Nordstrom, K.F., Psuty, N.P., and Carter, R. (eds) *Coastal Dunes: Form and Process*. London: Wiley, 217-249.
- Coastal Science & Engineering Inc. (CSE), 2018. Monitoring and Analyses of the 2011 Nags Head Beach Nourishment Project. Year 7 (2018) Beach Monitoring Report for Town of Nags Head., NC. Columbia, SC. October 2018.
- Cohn, N., Ruggiero, P., Garcia-Medina, G., Anderson, D., Serafin, K.A., and Biel, R. (2019). “Environmental and morphologic controls on wave-induced dune response”, *Geomorphology*, 329, 108-129.
- Davidson, S.G., Hesp, P.A. and Miot da Silva, G. (2020). “Controls on dune scarping”, *Progress in Physical Geography*, 44(6) 923-947.
- Dean, R.G. (1991). “Equilibrium beach profiles: Characteristics and applications”, *Journal of Coastal Research*, 7(1), 53-84.
- Doran, K.S., Long, J.W. and Overbeck, J.R. (2015). “A method for determining average beach slope and beach slope variability for U.S. sandy coastlines”, USGS Open-File Report 2015-1053.
- Houser, C., Wernette, P., Rentschlar, E., Jones, H., Hammond, B., and Trimble, S. (2015), “Post-storm beach and dune recovery: Implications for barrier island resilience”, *Geomorphology*, 234, 54-63.
- Lee, G., Nicholls, R.J., and Birekemeier, W.A. (1998). “Storm-driven variability of the beach-nearshore profile at Duck, North Carolina, USA, 1981-1991”, *Marine Geology* 148, 163-177.
- Moffatt & Nichol (MN), 2020. Town of Nags Head Beach Monitoring Analysis Program. 2020 Summer Annual Monitoring Survey Evaluation. Raleigh, NC. October 2020.
- Phillips, M.S., Turner, I.L., Cox, R.J., Splinter, K.D., and Harley, M.D. (2015). “Will the sand come back? Observations and characteristics of beach recovery”, *Australasian Coasts & Ports Conference 2015 Proceedings*. Auckland, New Zealand.
- Sallenger, A. (2000). “Storm impact scale for barrier islands”, *Journal of Coastal Research*, 16(3), 890-895.
- Sexton, W.J. and Hayes, M.O. (1991). “The geologic impact of Hurricane Hugo and post-storm shoreline recovery along the undeveloped coastline of South Carolina, Dewees Island to the Santee Delta”, *Journal of Coastal Research*, 8, 275-290.

Stockdon, H.F., Holman, R.A., Howd, P.A. and Sallenger, A. (2006). “Empirical parameterization of setup, swash, and runup”, *Coastal Engineering*, 53, 573-588.

APPENDIX A MCKIM & CREED SURVEY REPORT





2023 Nags Head Beach Monitoring Data Acquisition Survey Report

2023 Town of Nags Head Data Acquisition Survey Report

Dare County, North Carolina

Prepared for:

Town of Nags Head
PO Box 99
Nags Head, NC 27959

Prepared by:

McKim & Creed, Inc.
243 North Front Street
Wilmington, NC 28401



2023 Nags Head Beach Monitoring Data Acquisition Survey Report

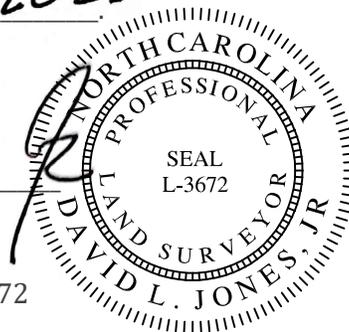
I, David L. Jones Jr., NC-PLS L-3672, certify that this project was completed under my direct and responsible charge from an actual survey made under my supervision; that this hydrographic and topographic survey was performed at the 95% percent confidence level to meet Federal Geographic Data Committee Standards; that this survey was performed to meet the requirements for a topographic/planimetric survey to the accuracy of Class III and vertical accuracy to the Class III standard, and that the original data was obtained on 11 June 2023; 01 July 2023; and all coordinates are based on North Carolina State Plane Coordinates (NAD83 2011) and all elevations are based on North American Vertical Datum of 1988 (NAVD88).

THIS 31st DAY OF July, AD 2023.

David L. Jones

DAVID L. JONES, JR.

PROFESSIONAL LAND SURVEYOR L-3672





INTRODUCTION

General scope of work

The work under the Task Order shall consist of performing topographic and hydrographic surveys along 174 beach profile lines in the City of Nags Head.

Survey area

The study area starts on the North between the Town of Nags Head and Kill Devil Hills and ends South at Oregon Inlet. This area has total linear distance of approximately 18 statute miles.

Planning

On June 5th, 2023, McKim & Creed Field Manager held a meeting with field and office crews to discuss the scope of work entailing the 173 beach monitoring profiles survey to be conducted in Dare County, North Carolina. In the two weeks prior to the meeting, preparations started to get the boat ready, arrange accommodations, create HYPACK project, gather control point information, line files, etc.

FIELD METHODOLOGY

The surveys were conducted in accordance with the Minimum Performance Standards for the U.S. Army Corps of Engineers (USACE), Engineering and Design Hydrographic Surveying Manual (EM 1110-2-1003).

This survey is in accordance with Chapter 56.1606 of the North Carolina Administrative Code (NCAC) specifications established by The North Carolina Engineering and Land Surveying Act (GS89C). In addition, all hydrographic surveying was conducted under the direct supervision of an NSPS-THSOA Certified Hydrographer (CH). Included in the deliverables are 61 cross-section profiles; one (1) plan view map; ground photos in .jpeg; one processed easting, northing, and elevation (xyz) in ASCII file format; and field notes. The plan view maps show reduced true position elevation data collected during the survey, and the location of published control monuments.

Vertical data was collected in the North American Vertical Datum of 1988 (NAVD88) using geoid 18. All Horizontal data is provided in the North Carolina State Plane Coordinate System, North American Datum (NAD) of 1983(2011).

The field survey and data collection activities encompassed four (4) phases. Brief descriptions of each survey phase, including methodologies and quality control/quality assurance procedures, are described below.

Control Reconnaissance/Establishment/Verification

Prior to surveying beach profiles, reconnaissance of the monuments was conducted to confirm that survey control was in place and undisturbed. Real Time Kinematic Global Positioning System (RTK GNSS) was used within the North Carolina virtual reference station (NCVRS) network to locate and confirm survey control for this project using a 3-minute observation at each monument (Table 1,2, and 3). The horizontal and vertical accuracy of control data meets the accuracy requirements as set forth in the Engineering and Design Hydrographic Surveying Manual (EM 1110-2-1003). To achieve required accuracy, the surveys were controlled using 2nd order monuments, specifically W 168 and CAHA 2, both from the National Geodetic Survey (NGS) (Datasheets can be found in appendix A). Horizontal and vertical positioning checks were conducted at the beginning and end of each day using at least two 2nd order monuments in the project area. The control check shots were acquired using a minimum of five (5) epochs which results in a high accuracy location (Tables 7 and 8).

Beach Profiles

Upon completion of the control reconnaissance survey, beach/upland and nearshore operations were initiated. Cross-sections of the beach in the project area were surveyed using extended rod RTK GNSS rovers, and standard RTK GNSS rovers. Extended rod RTK GNSS rovers were used to augment RTK GNSS survey capability into the nearshore.

Profiles commenced from the baseline and extended seaward overlapping the nearshore/wade data. Nearshore portions of the profiles were surveyed by two (2) surveyors with an Extended Rod Trimble R8 or R10 RTK GNSS rovers who entered the water wearing Personal Floatation Devices (PFD). The nearshore survey extended seaward to a point overlapping the offshore portion of the profiles.

Elevations were taken at a maximum of twenty-five (25) foot intervals along each profile line and at all grade breaks. To maintain online accuracy, surveyors utilized the RTK GNSS feature stakeout point. Stakeout point allows surveyors to maintain the profile azimuth without relying on a survey lathe or conventional compass bearings.



Nearshore/Offshore Profiles

The Nearshore/Offshore profiles were conducted at each required profile station. The profiles were obtained 2,500 feet beyond the shoreline or to the -30 NAVD88 contour, whichever is more landward. The landward limits of the nearshore profiles were based on a minimum overlap of fifty (50) feet beyond the seaward extent of beach profiles. Soundings were collected at 200kHz with an Odom Echotrac E20 single beam echosounder, hull-mounted transducer on McKim & Creed's twenty-five (25) foot survey vessel, the S/V Cawood. These soundings were then reduced to 9' spacing, sufficient to provide a smooth and accurate depiction of the seafloor.

Data was digitally stored using HYPACK 2022/2023 Software. An Applanix POSMV Inertia Navigation System was used onboard the survey vessel to provide pitch, roll, heave, and tide corrections. Tide (Table 4), echosounder (Table 5), sound velocity (Table 6), and bar checks were performed daily and as needed to check and calibrate the system. To maintain the vessel navigation along the profile lines, HYPACK navigation software was used.

Data Processing/Submittals

Upon completion of the field work, data was edited using Trimble Business Center, and HYPACK 2022/2023. The upland and nearshore portions of the beach profile were viewed and edited in Trimble Business Center and a comma delimited XYZ file was created. The raw bathymetry digital data was viewed and edited in HYPACK Single Beam Editor. The collected tide data was compared to NOAA measured tide for Duck, NC (NOAA Station ID: 8651370) and corrected as needed. Tide corrected offshore data was exported and a comma delimited XYZ file was created. All overlapping profile data was compared in cross section to ensure system accuracy. The edited beach profile data and offshore profile data were merged to create a representative cross-section for each profile line. The cross-sections were developed using HYPACK Cross-section software.

The final plots were edited and reviewed with comparisons to previous years; discrepancies were noted and resolved. Digital data is provided in the vertical datum NAVD88.

Map Preparation



2023 Nags Head Beach Monitoring Data Acquisition Survey Report

Upon completion of the surveys and data reduction, the plan view map was prepared in Autodesk Civil 3D. Elevations are displayed in NAVD88 and were sorted for display for better visualization. GIS parcel lines were used for background reference.

FIELD WORK

Control monuments were recovered on June 11th, 2023, and all profile lines were surveyed from June 11th to July 1st, 2023. The hydrographic survey crew used Oregon Inlet in Nags Head to access the beach profiles. Below is the timeline for the field work:

DATE	ACTIVITIES
06/05/2023	Scope Meeting at the office.
06/10/2023	First mobilization to job site.
06/11/2023	Control points were checked into to ensure horizontal and vertical tolerances were within standard. Land – 430+00 to 525+00
06/12/2023	Survey was performed on lines: Land – 530+00 to 775+00 No hydro or wade was surveyed.
06/13/2023	Survey was performed on lines: Land – 780+00 to 995+00 No hydro or wade was surveyed.
06/14/2023	Survey was performed on lines: Hydro Nearshore – 977+50 to 1025+00 Hydro Offshore – 977+50 to 982+50 Land – 997+50 to 1025+00 Wade – 997+50 to 977+50
06/15/2023	Survey was performed on lines: Hydro Offshore – 927+50 to 1025+00 Wade – 927+50 to 975+00 No land was surveyed.
06/16/2023	First Demobilization from job site
06/26/2023	Second mobilization to job site



2023 Nags Head Beach Monitoring Data Acquisition Survey Report

06/27/2023	Survey was performed on lines: Hydro Nearshore – 1030+00 to 1290+00 Hydro Offshore – 1280+00 to 1090+00 Land – 1030+00 to 1200+00 No wade was surveyed.
06/28/2023	Survey was performed on lines: Hydro Offshore – 435+00 to 515+00, and 1030+00 to 1240+00 Hydro Nearshore – 430+00 to 515+00 Land – 430+00 to 460+00, 1030+00 to 1070+00, 1140+00 to 1270+00 Wade – 1030+00 to 1180+00
06/29/2023	Survey was performed on lines: Hydro Offshore – 525+00 to 750+00 Hydro Nearshore – 495+00 to 625+00 Wade – 450+00 to 560+00 No land was surveyed.
06/30/2023	Survey was performed on lines: Hydro Offshore – 925+00 to 755+00 Hydro Nearshore – 630+00 to 925+00 Wade – 565+00 to 760+00 Land Gap Fills – 435+00 to 495+00
07/01/2023	Survey was performed on lines: Wade – 770+00 to 922+50 No land or hydro was surveyed Second demobilization from job site

Special comments:

- Line 872+00 was surveyed instead of line 875+00 due to Jennette’s pier proximity.
- Object in line for land survey on lines: 440+00, 470+00, 500+00, 520+00, 525+00, 545+00, 555+00, 610+00, 670+00, 700+00, 770+00, 620+00, 625+00, 660+00, 780+00, 880+00, 915+00, 987+50, 245+00, 885+00, 890+00, 945+00, 972+50, 1015+00, 1025+00, 490+00.
- Obstructions for hydro: 1025+00 has wooden jetty on line, 525+00 pier in way of line.



2023 Nags Head Beach Monitoring Data Acquisition Survey Report

- Could not locate monuments Loggerhead, Brooke and Eden.

CONTROL

NAGS HEAD, NC – NGS CONTROL MONUMENTS					
Station	Northing	Easting	Elevation	Comment	Station Description
BREW	823218.51	2997818.79	16.93	NOT FOUND	NOT USED
BROOKE	774768.51	3020429.10	19.38	NOT FOUND	NOT USED
EDEN	799346.34	3009247.87	32.66	NOT ACCESSIBLE	NOT USED
LOGGERHEAD	814705.66	3009247.87	15.49	NOT FOUND	NOT USED
W168	806503.64	3005850.14	7.54	FOUND	GOOD CONDITION AS DESCRIBED
CAHA2	801455.42	3007349.70	4.12	FOUND	GOOD CONDITION AS DESCRIBED
U168	816655.22	3000721.01	6.81	FOUND	OUTSIDE OF VERTICAL TOLERANCE/NOT USED FOR CHECKS

Table 1. List of Control Monuments

Using RTK GNSS, a 3-minute observation was performed for all monuments accessible.

Table 2. 3-minute observation values on NGS control monuments.

Measured			
July 2023 - RTK GPS (NCVRS) - 3 min. Obs.			
Station	Northing	Easting	Elevation
W168	806503.65	3005850.17	7.40
CAHA2	801455.44	3007349.71	4.02
U168	816655.23	3000720.98	6.50

Upon comparing the published NGS control monuments values and the data measured in the field, the variations (deltas) were determined in Table 3.

Table 3. Difference between published and control verification.

Variations from Client Provided Control to McKim & Creed			
Station	Northing	Easting	Elevation
W168	-0.01	-0.03	0.14
CAHA2	-0.02	-0.01	0.10
U168	-0.01	0.03	0.31

VESSEL CALIBRATIONS

The Survey Vessel Cawood (a 25' safe boat) was used for this survey. Offsets were measured and calculated on May 15th, 2023.

Daily vessel calibrations were performed in the survey area:

Table 4. Tide Checks

Tide Checks (in feet)	Trimble Receiver (in elevation)	Vessel System/Hypack
06/14/2023	0.94	-0.95
06/15/2023	0.84	-0.85
06/27/2023	1.25'	-1.23
06/28/2023	0.87	-0.88
06/29/2023	0.62	-0.62
06/30/2023	0.72	-0.72

Table 5. Echosounder Checks using rod reading.

Bar Checks (in feet)	Bar Check	Vessel Echosounder
06/14/2023	25, 20, 15, 10, 5	25, 20, 15, 10, 5
06/15/2023	6.40	6.41
06/27/2023	6.75	6.70
06/28/2023	5.92	5.95
06/29/2023	7.70	7.60
06/30/2023	7.00	7.10

Table 6. Sound Velocity Values

	Average Sound Velocity (in feet/second)
06/14/2023	4962
06/15/2023	4966
06/27/2023	5003
06/28/2023	4990
06/29/2023	4987
06/30/2023	5000

GPS CALIBRATION CHECKS

Table 7. GNSS calibration checks for Trimble R8 unit.

TRIMBLE R8 UNIT	CONTROL POINT	Δ Horizontal (in US Survey feet)	Δ Vertical (in US Survey feet)
06/11/2023 BEGIN	U168	0.041	0.293
06/11/2023 END	U168	0.026	0.264
06/11/2023 END	W168	0.040	0.188
06/11/2023 END	CAHA2	0.024	0.096
06/12/2023 BEGIN	CAHA2	0.043	0.096
06/12/2023 END	W168	0.019	0.089
06/13/2023 BEGIN	W168	0.013	0.096
06/13/2023 END	W168	0.056	0.103
06/14/2023 BEGIN	W168	0.010	0.154
06/14/2023 END	W168	0.048	0.159
06/15/2023 BEGIN	W168	0.025	0.324
06/15/2023 END	W168	0.038	-0.037
06/27/2023 BEGIN	CAHA2	0.039	-0.080
06/27/2023 END	CAHA2	0.021	-0.088
06/28/2023 BEGIN	CAHA2	0.054	-0.027
06/28/2023 END	CAHA2	0.093	-0.178
06/29/2023 BEGIN	W168	0.006	-0.035
06/29/2023 END	W168	0.019	-0.021
06/30/2023 BEGIN	W168	0.306	-0.036
06/30/2023 END	W168	0.089	-0.034

Table 8. GNSS calibration checks for Trimble R10 unit.

TRIMBLE R10 UNIT	CONTROL POINT	Δ Horizontal (in US Survey feet)	Δ Vertical (in US Survey feet)
06/11/2023 BEGIN	W168	0.071	0.284
06/11/2023 END	W168	0.048	0.190
06/11/2023 END	CAHA2	0.029	0.115
06/12/2023 BEGIN	CAHA2	0.027	0.105
06/12/2023 END	W168	0.047	0.081
06/13/2023 BEGIN	W168	0.034	0.041
06/13/2023 END	W168	0.022	0.058
06/14/2023 BEGIN	W168	0.036	0.141
06/14/2023 END	W168	0.059	0.190
06/15/2023 BEGIN	W168	0.072	0.183
06/15/2023 END	W168	0.034	-0.010
06/27/2023 BEGIN	CAHA2	0.105	-0.017
06/27/2023 END	NA	NA	NA
06/28/2023 BEGIN	CAHA2	0.020	0.042
06/28/2023 END	NA	NA	NA
06/29/2023 BEGIN	W168	0.074	0.109
06/29/2023 END	W168	0.045	0.005
06/30/2023 BEGIN	W168	0.021	0.062
06/30/2023 END	W168	0.064	0.077
07/01/2023 BEGIN	CAHA2	0.059	-0.065
07/01/2023 END	W168	0.114	-0.112

LIST OF EQUIPMENT USED DURING THE SURVEY

Below is a list of equipment used during the survey:

- 25' Survey Vessel "Cawood"
- Teledyne ECHOTRAC E20 transducer 200 kHz
- Applanix Pos-MV Inertia Navigation System I2NS
- Sound Velocity Profiler AML CTD Base X Profiler
- Hypack 2022/2023 for hydrographic data collection and processing
- Trimble R8 GNSS Receivers/ TSC3 data collectors
- Trimble R10 GNSS Receivers/ TSC5 data collectors
- Trimble Business Center
- AutoDesk Civil 3D



APPENDIX A. CONTROL DATASHEETS

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

```

PROGRAM = datasheet95, VERSION = 8.12.5.15
Starting Datasheet Retrieval...
1 National Geodetic Survey, Retrieval Date = JULY 25, 2023
EX0112 *****
EX0112 DESIGNATION - W 168
EX0112 PID - EX0112
EX0112 STATE/COUNTY- NC/DARE
EX0112 COUNTRY - US
EX0112 USGS QUAD - ROANOKE ISLAND NE (2019)
EX0112
EX0112 *CURRENT SURVEY CONTROL
EX0112
EX0112* NAD 83(2011) POSITION- 35 55 07.16930(N) 075 36 08.34047(W) ADJUSTED
EX0112* NAD 83(2011) ELLIP HT- -36.679 (meters) (06/27/12) ADJUSTED
EX0112* NAD 83(2011) EPOCH - 2010.00
EX0112* NAVD 88 ORTHO HEIGHT - 2.296 (meters) 7.53 (feet) ADJUSTED
EX0112
EX0112 GEOID HEIGHT - -38.978 (meters) GEOID18
EX0112 NAD 83(2011) X - 1,285,839.762 (meters) COMP
EX0112 NAD 83(2011) Y - -5,008,856.047 (meters) COMP
EX0112 NAD 83(2011) Z - 3,720,864.572 (meters) COMP
EX0112 LAPLACE CORR - 1.37 (seconds) DEFLEC18
EX0112 DYNAMIC HEIGHT - 2.294 (meters) 7.53 (feet) COMP
EX0112 MODELED GRAVITY - 979,770.6 (mgal) NAVD 88
EX0112
EX0112 VERT ORDER - FIRST CLASS II
EX0112
EX0112 Network accuracy estimates per FGDC Geospatial Positioning Accuracy
EX0112 Standards:
EX0112 FGDC (95% conf, cm) Standard deviation (cm) CorrNE
EX0112 Horiz Ellip SD_N SD_E SD_h (unitless)
EX0112 -----
EX0112 NETWORK 0.89 1.10 0.40 0.32 0.56 -0.13113158
EX0112 -----
EX0112 Click here for local accuracies and other accuracy information.
EX0112
EX0112.The horizontal coordinates were established by GPS observations
EX0112.and adjusted by the National Geodetic Survey in June 2012.
EX0112
EX0112.NAD 83(2011) refers to NAD 83 coordinates where the reference frame has
EX0112.been affixed to the stable North American tectonic plate. See
EX0112.NA2011 for more information.
EX0112
EX0112.The horizontal coordinates are valid at the epoch date displayed above
EX0112.which is a decimal equivalence of Year/Month/Day.
EX0112
EX0112.The orthometric height was determined by differential leveling and
EX0112.adjusted by the NATIONAL GEODETIC SURVEY
EX0112.in June 1991.
EX0112
EX0112.Significant digits in the geoid height do not necessarily reflect accuracy.
EX0112.GEOID18 height accuracy estimate available here.
EX0112
EX0112.Click photographs - Photos may exist for this station.
EX0112
EX0112.The X, Y, and Z were computed from the position and the ellipsoidal ht.
EX0112
EX0112.The Laplace correction was computed from DEFLEC18 derived deflections.

```




2023 Nags Head Beach Monitoring Data Acquisition Survey Report

EX0112'STATION MARK IS A STANDARD USC AND GS BENCH MARK DISK STAMPED
EX0112'W-168 1963, SET IN THE TOP OF A CONCRETE CYLINDER, THE TOP OF
EX0112'WHICH IS PROJECTING 2 INCHES ABOVE THE GROUND.
EX0112'
EX0112'MARK IS 29.0 FT ENE OF C/L OF U.S. 158 BUSINESS
EX0112'
EX0112'14.4 FT SSE OF C/L OF CONCRETE DRIVEWAY
EX0112'
EX0112'2.9 FT SSW OF NORTHERNMOST FENCE CORNER
EX0112'
EX0112'66.5 FT ESE OF FIRE HYDRANT TOP
EX0112'
EX0112'2.5 FT NNW OF WOODEN WITNESS POST
EX0112
EX0112 STATION RECOVERY (1974)
EX0112
EX0112'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1974
EX0112'RECOVERED IN GOOD CONDITION.
EX0112
EX0112 STATION RECOVERY (1981)
EX0112
EX0112'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1981
EX0112'1.4 KILOMETERS (0.9 MILE) NORTH ALONG U.S. HIGHWAY 158 BUSINESS FROM
EX0112'ITS JUNCTION WITH U.S. HIGHWAYS 64, 264 AND STATE HIGHWAY 12 IN NAGS
EX0112'HEAD, TO THE MARK ON THE RIGHT, ON THE SOUTH SIDE OF THE CONCRETE
EX0112'ENTRANCE DRIVEWAY OF CARE FREE COTTAGES, 8.83 METERS (29.0 FEET) EAST
EX0112'OF THE CENTER LINE OF THE HIGHWAY, 1.40 METERS (4.6 FEET) SOUTH OF THE
EX0112'SOUTH EDGE OF THE CONCRETE ENTRANCE DRIVEWAY OF CARE FREE COTTAGES,
EX0112'0.30 METER (1.0 FOOT) WEST OF A WOODEN FENCE.
EX0112'THE MARK IS 1.52 METERS NW FROM A WITNESS POST.
EX0112'THE MARK IS 0.18 M ABOVE HIGHWAY.
EX0112
EX0112 STATION RECOVERY (1990)
EX0112
EX0112'RECOVERY NOTE BY US POWER SQUADRON 1990 (PEM)
EX0112'RECOVERED IN GOOD CONDITION.
EX0112
EX0112 STATION RECOVERY (2005)
EX0112
EX0112'RECOVERY NOTE BY GEOCACHING 2005 (LWB)
EX0112'FOUND IN GOOD CONDITION NEAR A FENCE CORNER. CARE FREE COTTAGES HAS
EX0112'NO SIGN, AND IS LOOKING PRETTY SAD. MARK IS SSE OF THE FIRST COLONY
EX0112'INN ACROSS THE STREET.
EX0112
EX0112 STATION RECOVERY (2005)
EX0112
EX0112'RECOVERY NOTE BY NORTH CAROLINA GEODETIC SURVEY 2005 (EJH)
EX0112'RECOVERED IN GOOD CONDITION WITH THE FOLLOWING CORRECTION, MARK IS
EX0112'PROJECTING 10 INCHES (25 CM) ABOVE THE GROUND.
EX0112
EX0112 STATION RECOVERY (2006)
EX0112
EX0112'RECOVERY NOTE BY GEOCACHING 2006 (DEB)
EX0112'RECOVERED IN GOOD CONDITION.
EX0112
EX0112 STATION RECOVERY (2010)
EX0112
EX0112'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 2010 (DRD)
EX0112'RECOVERED IN GOOD CONDITION.
EX0112
EX0112 STATION RECOVERY (2020)
EX0112
EX0112'RECOVERY NOTE BY US POWER SQUADRON 2020 (CAC)
EX0112'RECOVERED IN GOOD CONDITION.



The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.15

Starting Datasheet Retrieval...

1 National Geodetic Survey, Retrieval Date = JULY 25, 2023

DN6292 *****

DN6292 HT_MOD - This is a Height Modernization Survey Station.

DN6292 DESIGNATION - CAHA 2

DN6292 PID - DN6292

DN6292 STATE/COUNTY- NC/DARE

DN6292 COUNTRY - US

DN6292 USGS QUAD - ROANOKE ISLAND NE (2019)

DN6292

DN6292 *CURRENT SURVEY CONTROL

DN6292

DN6292* NAD 83(2011) POSITION- 35 54 16.76469(N) 075 35 52.22233(W) ADJUSTED

DN6292* NAD 83(2011) ELLIP HT- -37.723 (meters) (06/27/12) ADJUSTED

DN6292* NAD 83(2011) EPOCH - 2010.00

DN6292* [NAVD 88](#) ORTHO HEIGHT - 1.28 (meters) 4.2 (feet) GPS OBS

DN6292

DN6292 NAVD 88 orthometric height was determined with geoid model GEOID09

DN6292 GEOID HEIGHT - -38.953 (meters) GEOID09

DN6292 GEOID HEIGHT - -38.979 (meters) GEOID18

DN6292 NAD 83(2011) X - 1,286,457.595 (meters) COMP

DN6292 NAD 83(2011) Y - -5,009,637.305 (meters) COMP

DN6292 NAD 83(2011) Z - 3,719,605.716 (meters) COMP

DN6292 LAPLACE CORR - 1.33 (seconds) DEFLEC18

DN6292

DN6292 Network accuracy estimates per FGDC Geospatial Positioning Accuracy

DN6292 Standards:

DN6292 FGDC (95% conf, cm) Standard deviation (cm) CorrNE

DN6292 Horiz Ellip SD_N SD_E SD_h (unitless)

DN6292 NETWORK 0.89 1.04 0.40 0.31 0.53 -0.22594700

DN6292 -----

DN6292 Click [here](#) for local accuracies and other accuracy information.

DN6292

DN6292.The horizontal coordinates were established by GPS observations

DN6292.and adjusted by the National Geodetic Survey in June 2012.

DN6292

DN6292.NAD 83(2011) refers to NAD 83 coordinates where the reference frame has

DN6292.been affixed to the stable North American tectonic plate. See

DN6292.[NA2011](#) for more information.

DN6292

DN6292.The horizontal coordinates are valid at the epoch date displayed above

DN6292.which is a decimal equivalence of Year/Month/Day.

DN6292

DN6292.The orthometric height was determined by GPS observations and a

DN6292.high-resolution geoid model using precise GPS observation and

DN6292.processing techniques.

DN6292

DN6292.Significant digits in the geoid height do not necessarily reflect accuracy.

DN6292.GEOID18 height accuracy estimate available [here](#).

DN6292

DN6292.Click [photographs](#) - Photos may exist for this station.

DN6292

DN6292.The X, Y, and Z were computed from the position and the ellipsoidal ht.

DN6292

DN6292.The Laplace correction was computed from DEFLEC18 derived deflections.

DN6292

DN6292.The ellipsoidal height was determined by GPS observations



2023 Nags Head Beach Monitoring Data Acquisition Survey Report

DN6292.The ellipsoidal height was determined by GPS observations
DN6292.and is referenced to NAD 83.

DN6292

DN6292. The following values were computed from the NAD 83(2011) position.

DN6292

DN6292;		North	East	Units	Scale Factor	Converg.
DN6292;SPC NC	-	244,284.101	916,642.023	MT	0.99993740	+1 57 49.1
DN6292;SPC NC	-	801,455.42	3,007,349.70	sFT	0.99993740	+1 57 49.1
DN6292;UTM 18	-	3,973,538.645	446,053.053	MT	0.99963586	-0 21 02.2

DN6292

DN6292! - Elev Factor x Scale Factor = Combined Factor

DN6292!SPC NC - 1.00000592 x 0.99993740 = 0.99994332

DN6292!UTM 18 - 1.00000592 x 0.99963586 = 0.99964178

DN6292

DN6292_U.S. NATIONAL GRID SPATIAL ADDRESS: 18SVE4605373538(NAD 83)

DN6292

SUPERSEDED SURVEY CONTROL

DN6292

DN6292 NAD 83(2007)- 35 54 16.76468(N) 075 35 52.22336(W) AD(2002.00) 1
 DN6292 ELLIP H (02/27/12) -37.703 (m) GP(2002.00) 3 1

DN6292

DN6292.Superseded values are not recommended for survey control.

DN6292

DN6292.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

DN6292.See file [dsdata.pdf](#) to determine how the superseded data were derived.

DN6292

DN6292_MARKER: F = FLANGE-ENCASED ROD

DN6292_SETTING: 59 = STAINLESS STEEL ROD IN SLEEVE (10 FT.+)

DN6292_STAMPING: CAHA 2 2010

DN6292_MARK LOGO: NPS

DN6292_PROJECTION: RECESSED 3 CENTIMETERS

DN6292_MAGNETIC: T = STEEL SPIKE ADJACENT TO MONUMENT

DN6292_STABILITY: B = PROBABLY HOLD POSITION/ELEVATION WELL

DN6292_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR

DN6292+SATELLITE: SATELLITE OBSERVATIONS - October 07, 2020

DN6292_ROD/PIPE-DEPTH: 30.5 meters

DN6292_SLEEVE-DEPTH : 0.6 meters

DN6292

DN6292 HISTORY	- Date	Condition	Report By
DN6292 HISTORY	- 20100302	MONUMENTED	NCGS
DN6292 HISTORY	- 20201007	GOOD	USPSQD

DN6292

STATION DESCRIPTION

DN6292

DN6292'DESCRIBED BY NORTH CAROLINA GEODETIC SURVEY 2010 (EJH)

DN6292'THE MARK IS LOCATED ABOUT 8.1 MI (13.0 KM) SOUTH-SOUTHEAST OF KILL

DN6292'DEVIL HILLS, 4.0 MI (6.4 KM) EAST OF MANTEO AND 3.9 MI (6.3 KM)

DN6292'SOUTH-SOUTHEAST OF NAGS HEAD.

DN6292'

DN6292'IN WHALEBONE, AT THE NATIONAL PARK SERVICE INFORMATION CENTER. ALONG

DN6292'NC 12 FOR 0.2 MI (0.3 KM) SOUTH FROM THE INTERSECTION WITH US 158, IN

DN6292'WHALEBONE JUNCTION, TO THE NATIONAL PARK SERVICE INFORMATION CENTER

DN6292'AND STATION NEAR FLAG POLE.

DN6292'

DN6292'MARK IS ABOUT LEVEL WITH THE ASPHALT PARKING LOT AND IS RECESSED 1

DN6292'INCH (3 CM) WITH THE GROUND. LOCATED 86.3 FT (26.3 M) WEST OF THE

DN6292'CENTERLINE OF NC 12, 49 FT (14.9 M) EAST OF THE CENTER OF ENTRANCE

DN6292'ROAD, 30.5 FT (9.3 M) NORTH-NORTHEAST OF THE METAL FLAG POLE---AND

DN6292'96.0 FT (29.3 M) NORTH-NORTHWEST OF THE NORTHWEST CORNER OF PORCH OF

DN6292'INFORMATION CENTER.

DN6292

STATION RECOVERY (2020)

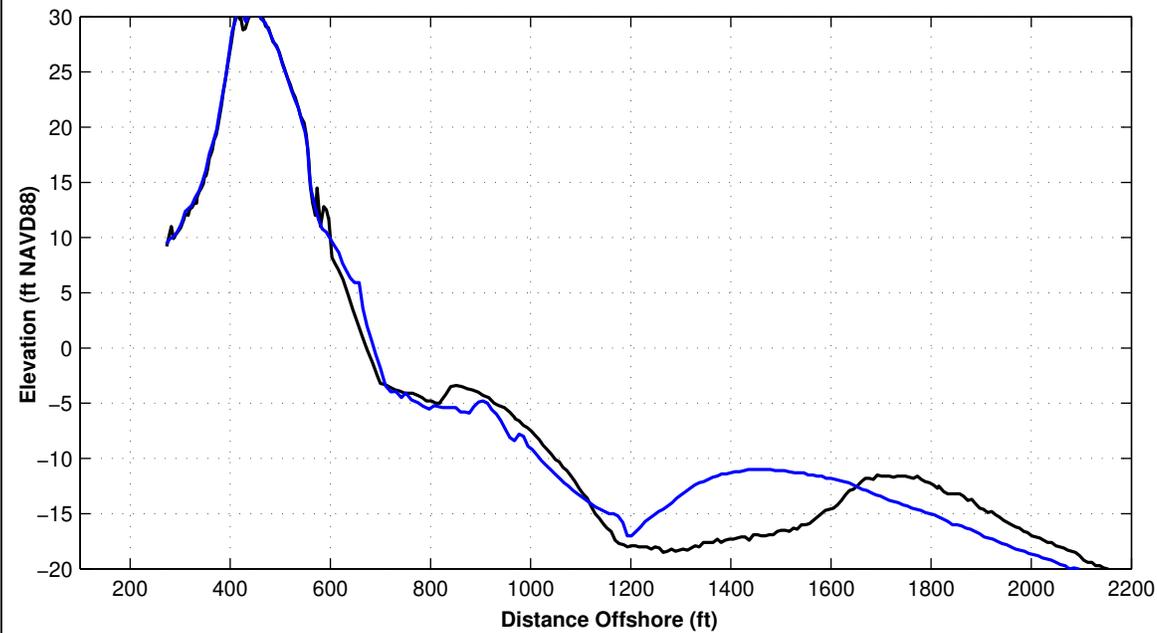
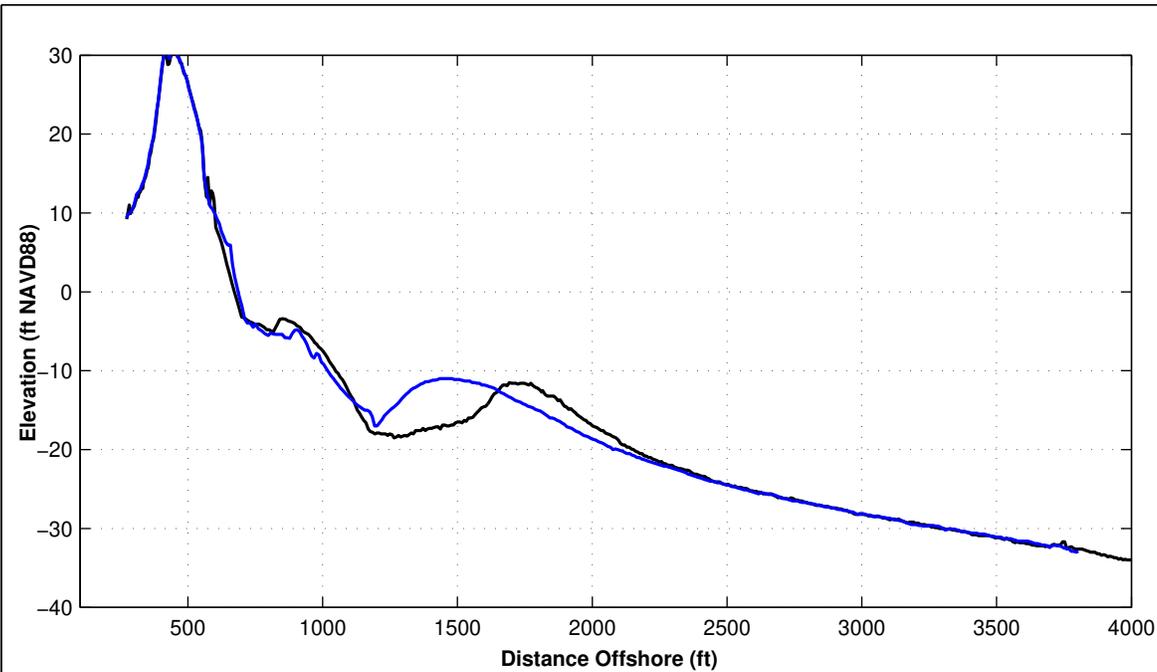
DN6292

DN6292'RECOVERY NOTE BY US POWER SQUADRON 2020 (CAC)

DN6292'RECOVERED IN GOOD CONDITION.

APPENDIX B SURVEY PROFILE COMPARISON PLOTS

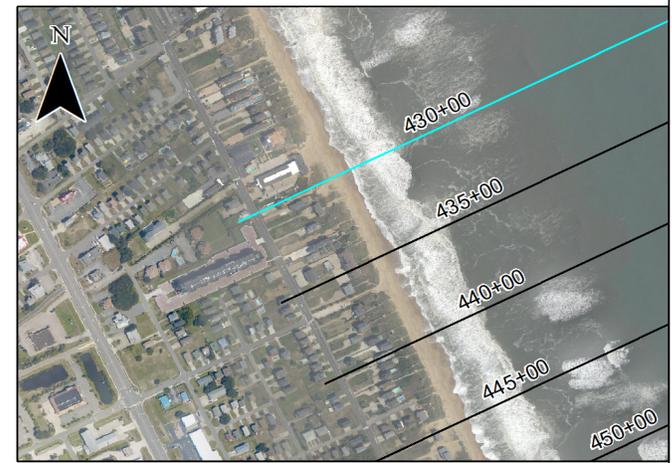


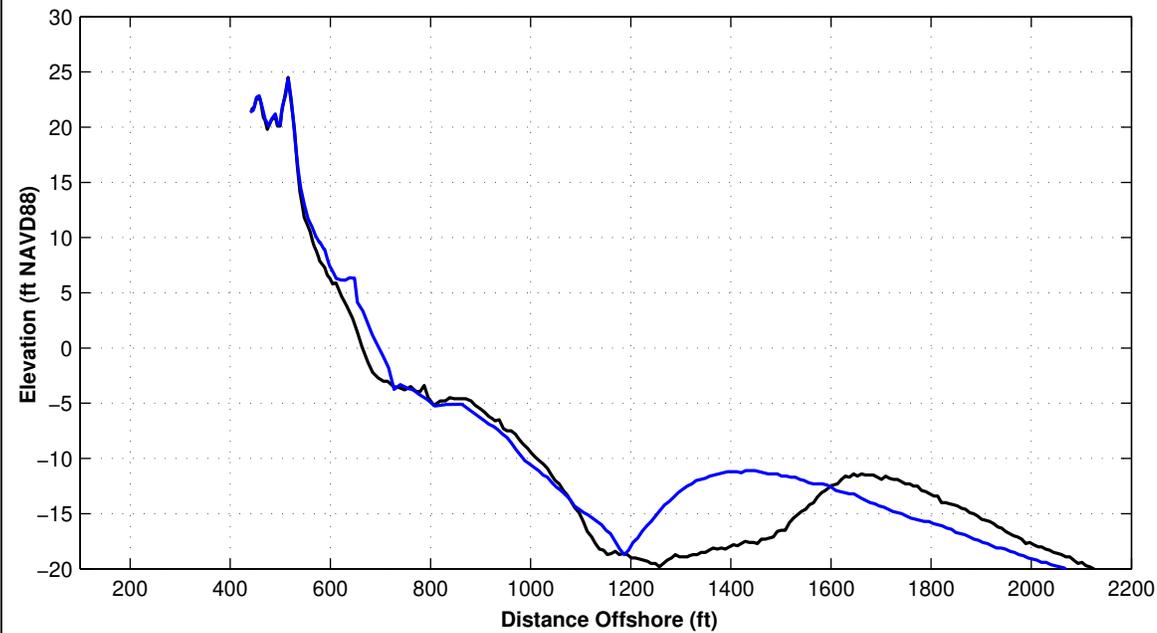
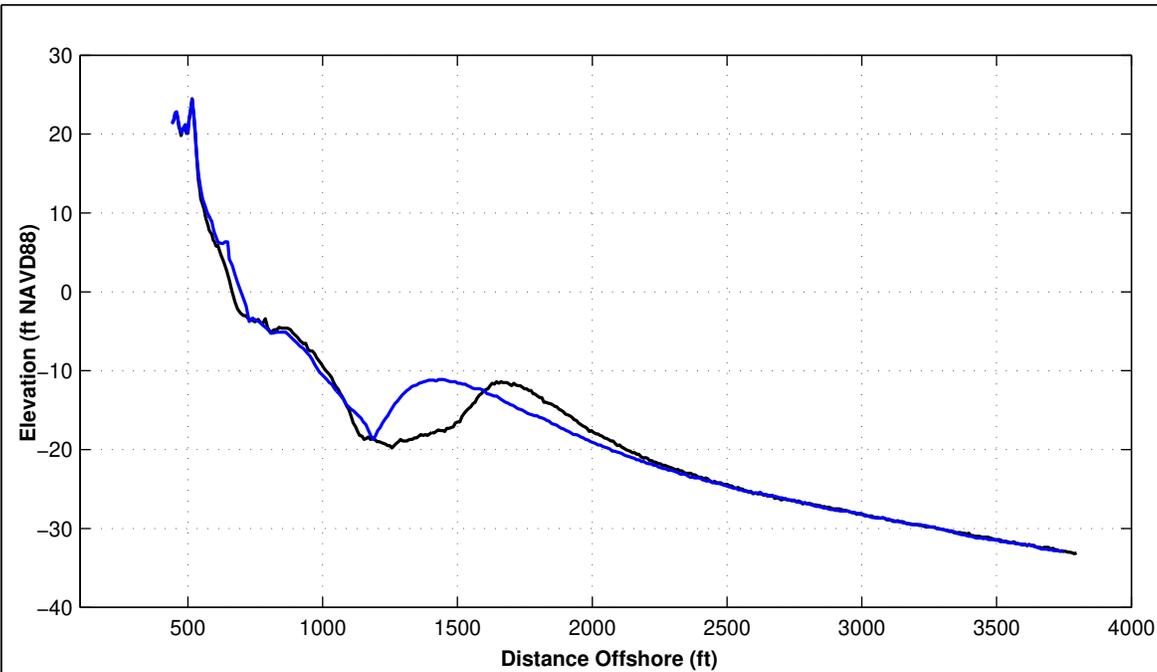


Survey Transect 430+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	15.93 ft	– ft
Volume Change Above +6 ft NAVD88	0.06 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	3.92 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	–2.05 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	6.88 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	33.60 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	25.01 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

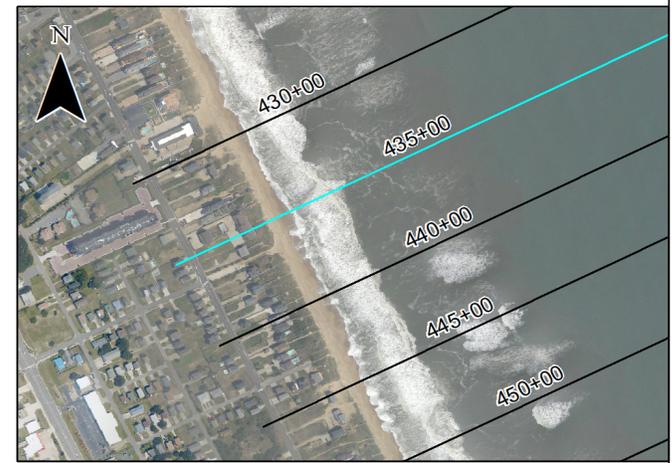


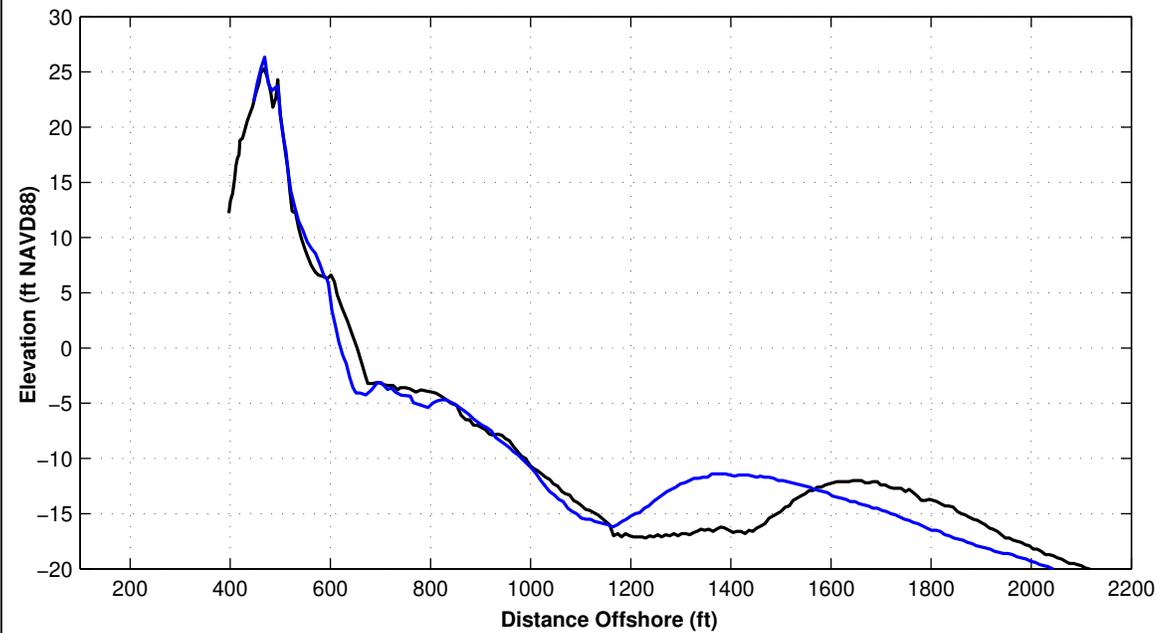
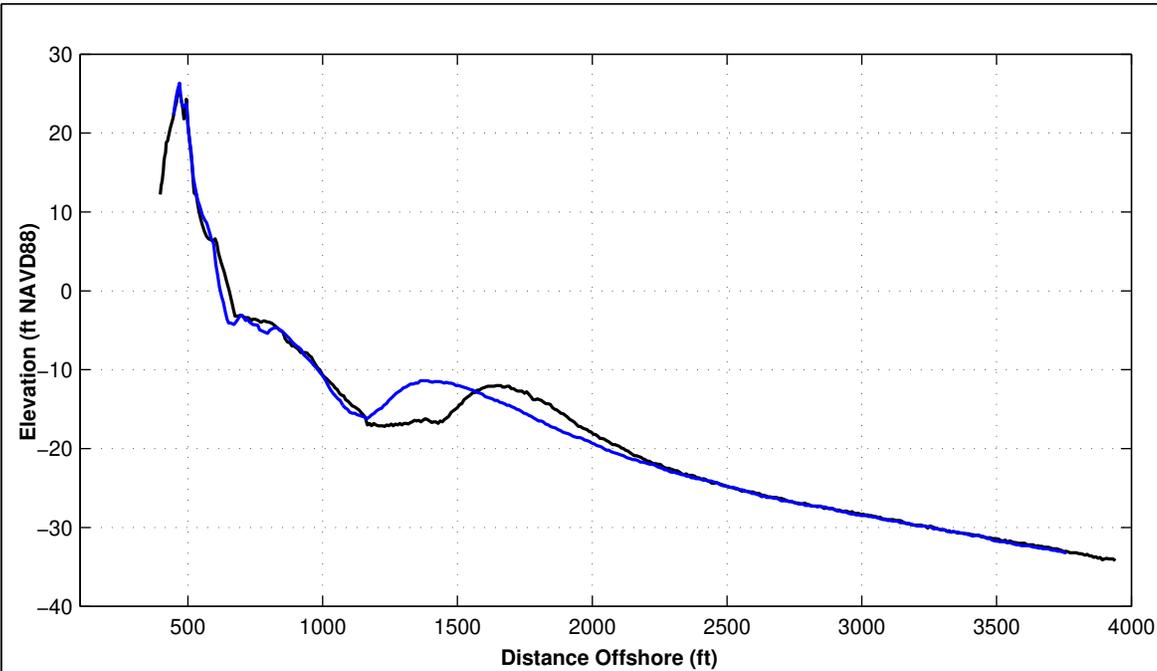


Survey Transect 435+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	28.40 ft	– ft
Volume Change Above +6 ft NAVD88	3.58 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	8.80 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	11.46 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	18.07 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	47.65 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	39.35 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

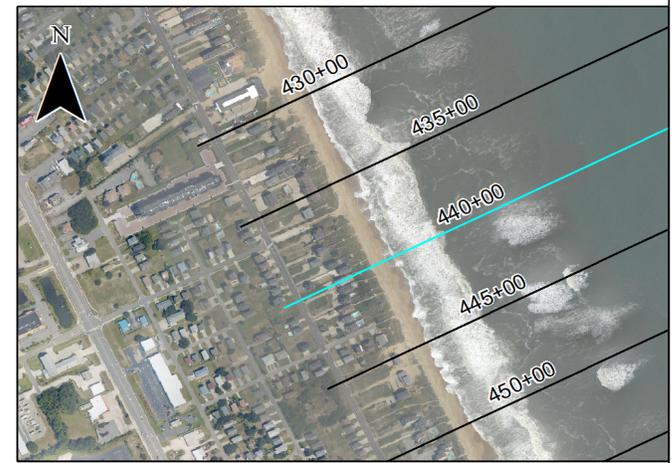


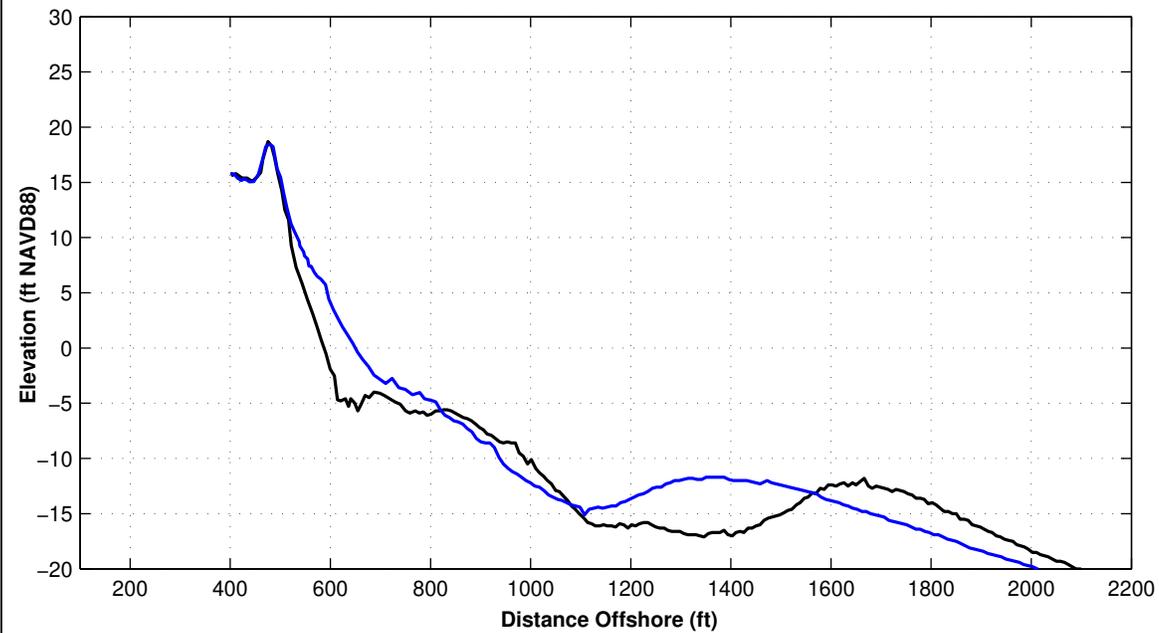
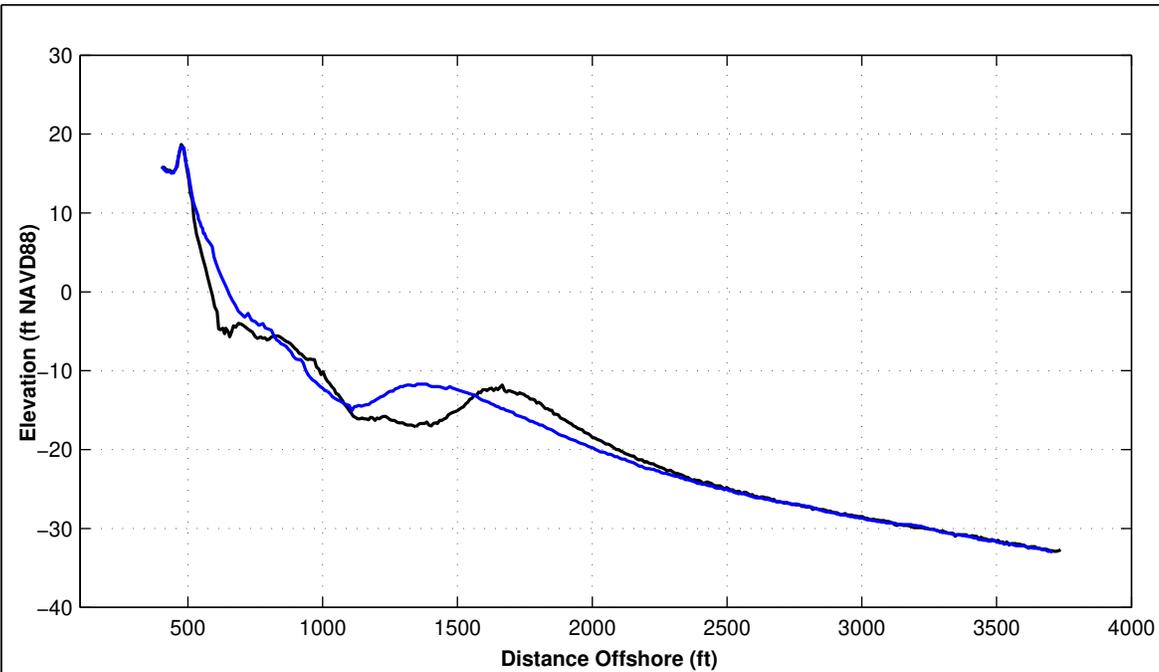


Survey Transect 440+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-30.02 ft	- ft
Volume Change Above +6 ft NAVD88	3.04 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	-0.67 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	-10.31 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	-1.44 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	3.29 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	-6.36 cy/ft	- cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

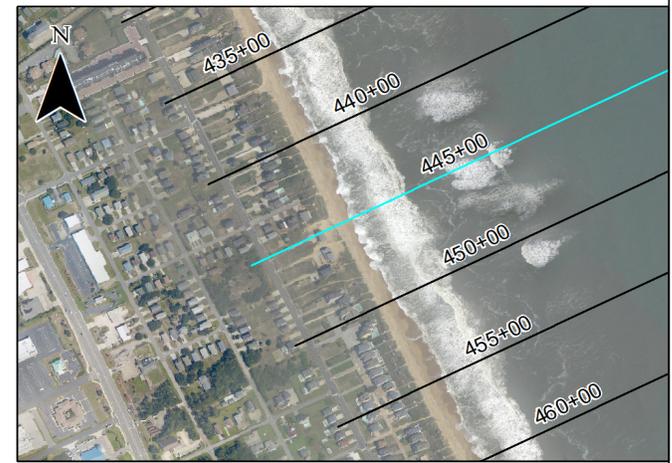


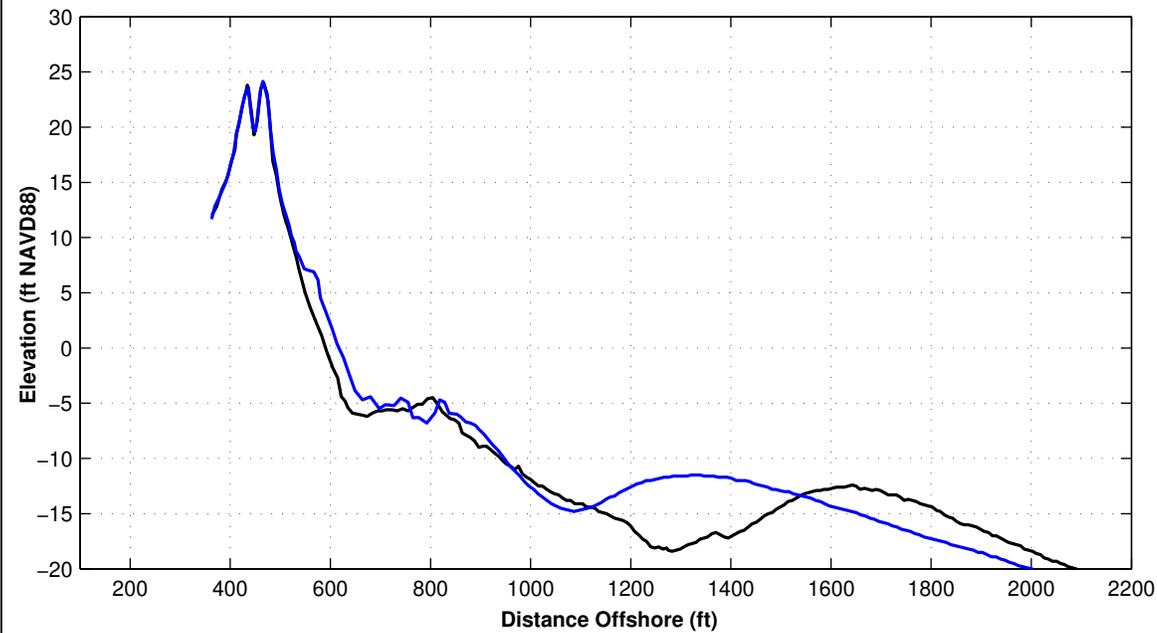
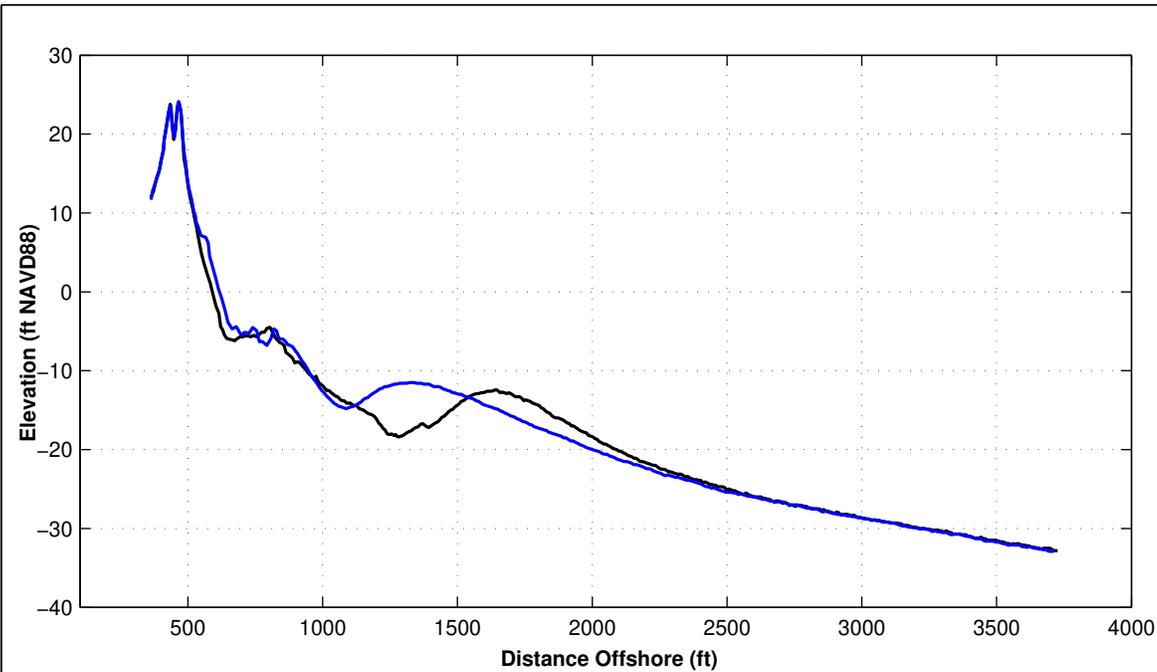


Survey Transect 445+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	55.68 ft	– ft
Volume Change Above +6 ft NAVD88	4.99 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	13.30 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	35.79 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	37.19 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	45.65 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	31.92 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

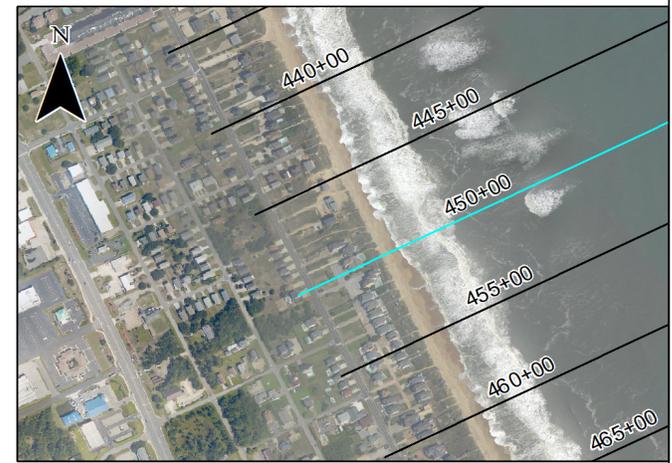


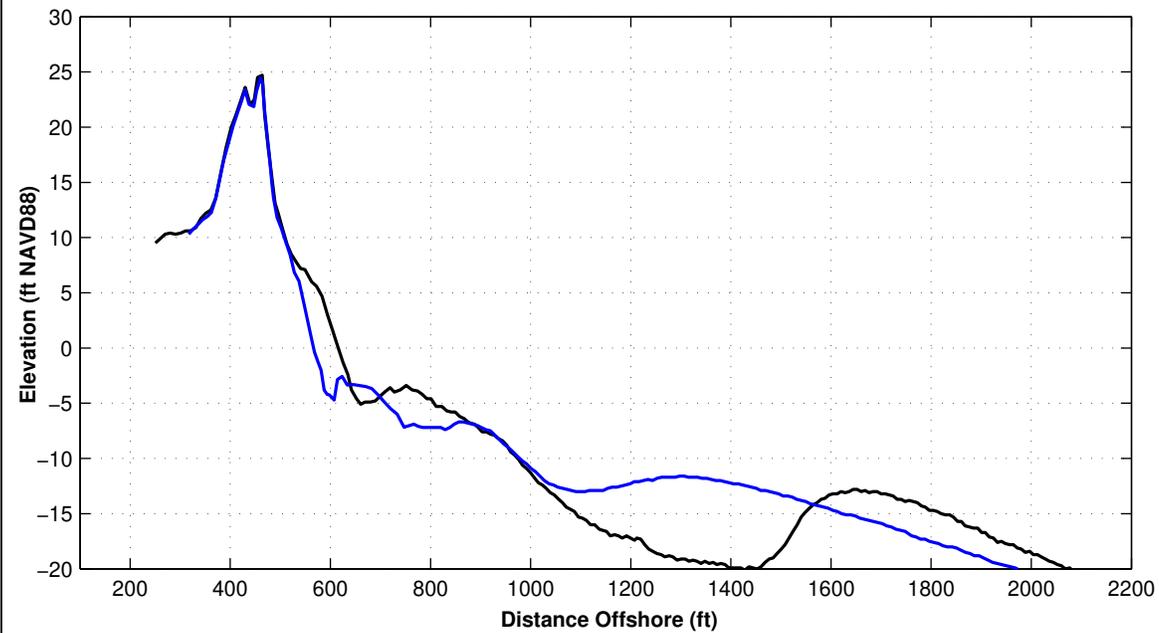
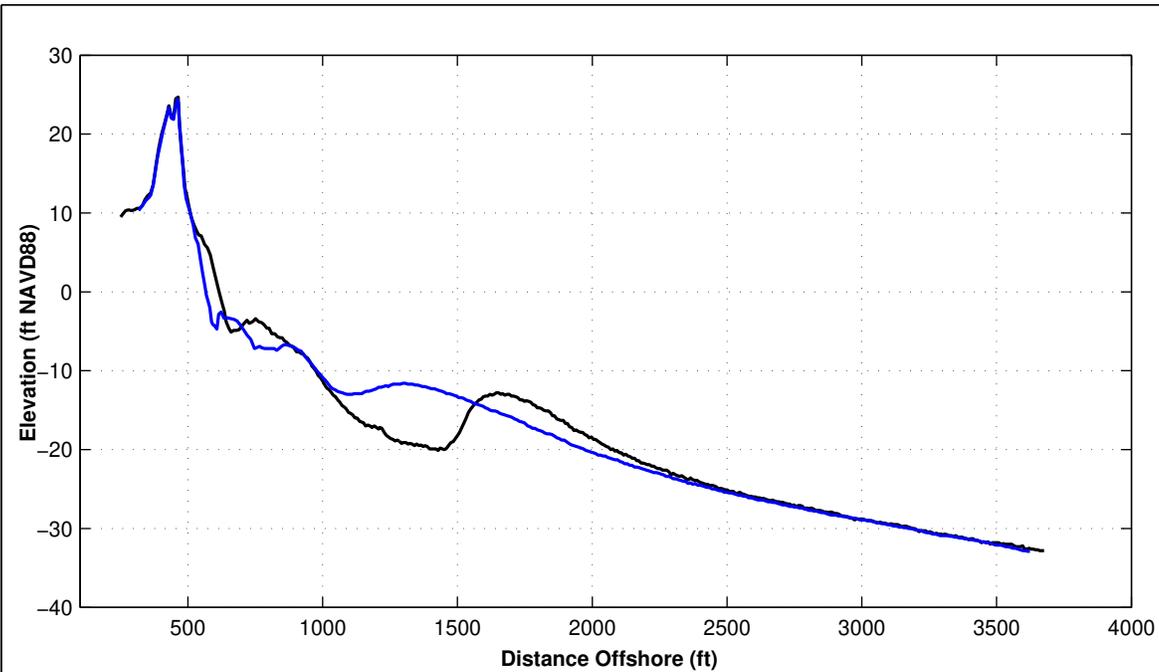


Survey Transect 450+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	25.52 ft	– ft
Volume Change Above +6 ft NAVD88	2.63 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	7.63 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	16.52 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	34.22 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	41.48 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	25.01 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

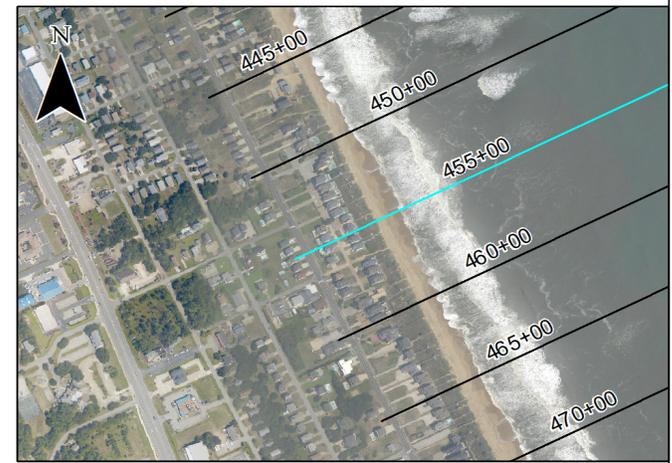


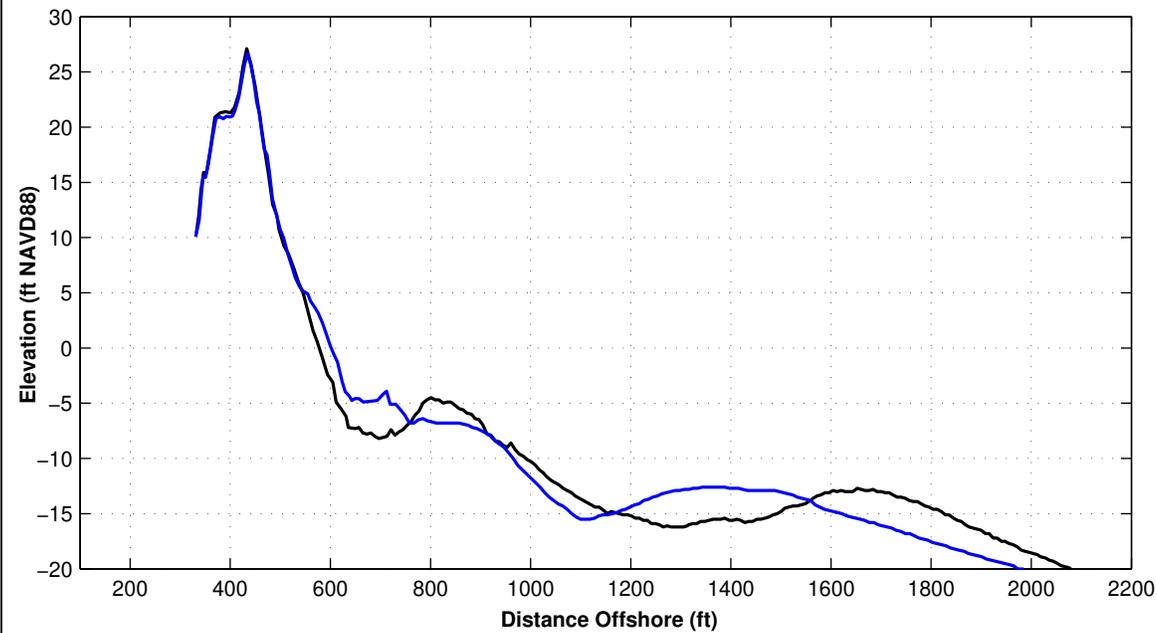
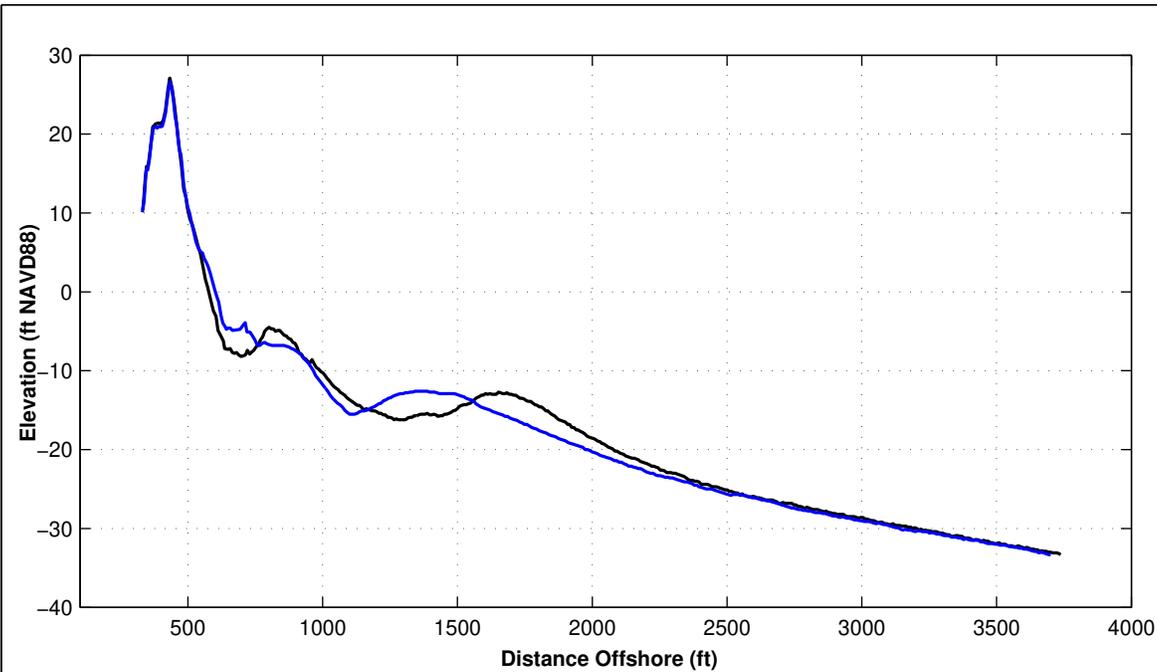


Survey Transect 455+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-46.61 ft	- ft
Volume Change Above +6 ft NAVD88	-2.30 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	-9.48 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	-23.83 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	-3.94 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	34.11 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	17.27 cy/ft	- cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

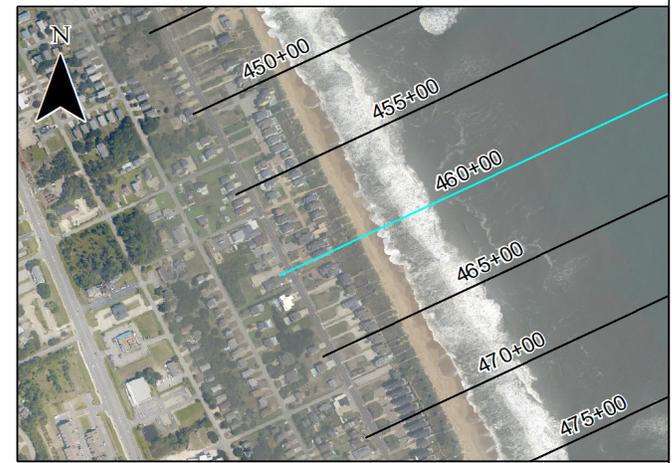


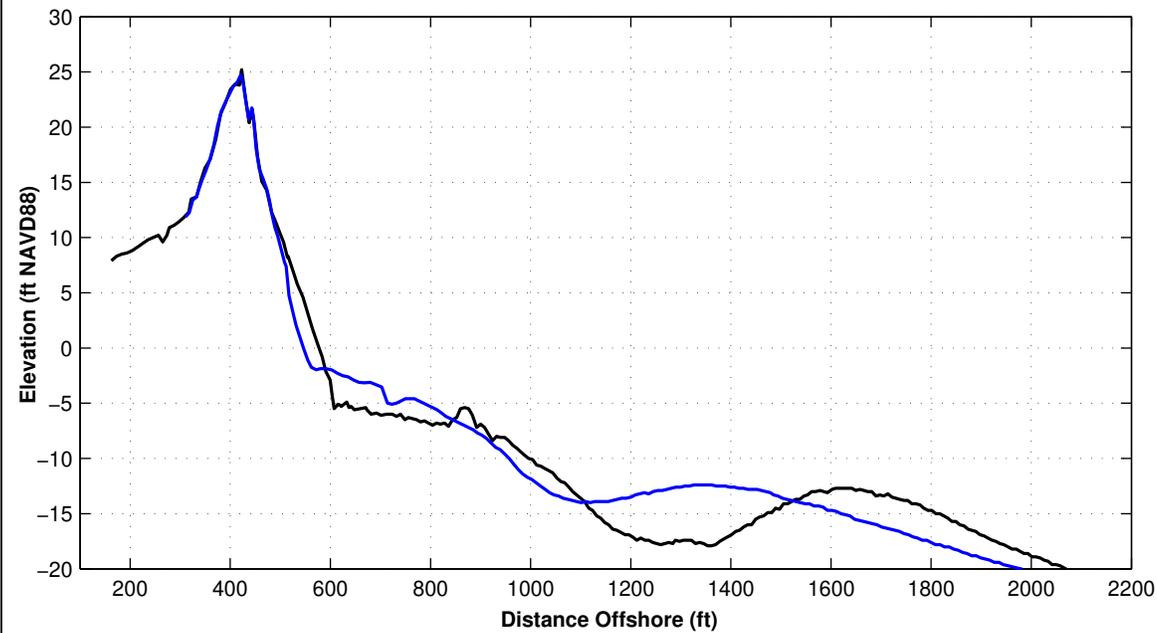
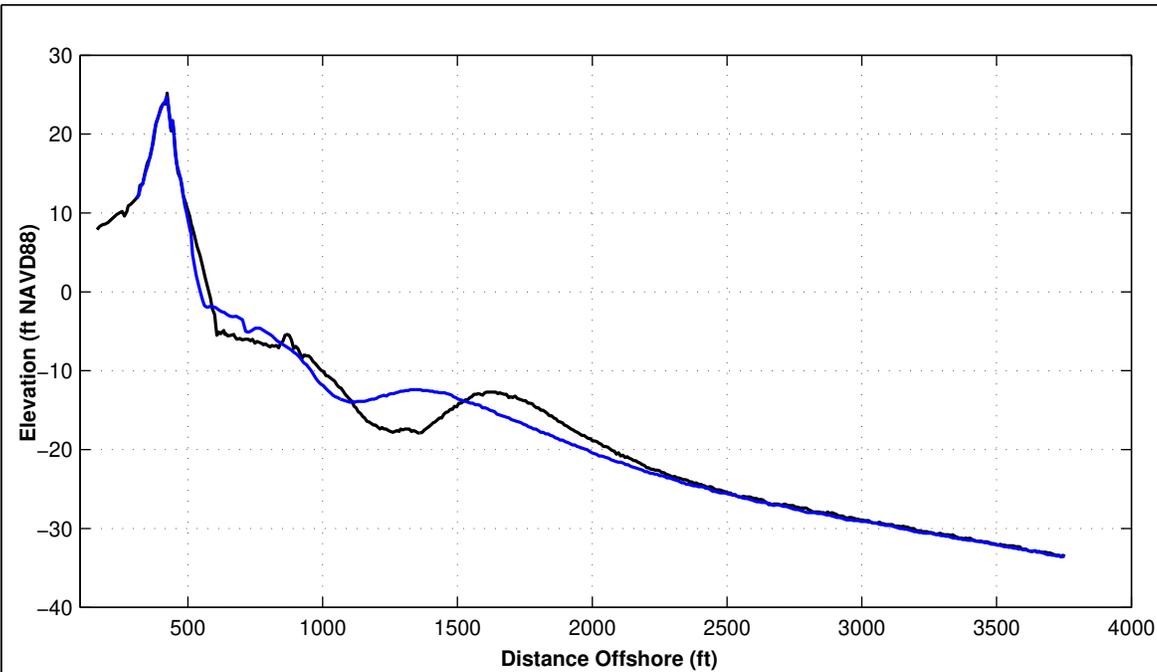


Survey Transect 460+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	23.84 ft	– ft
Volume Change Above +6 ft NAVD88	–0.06 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	2.44 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	10.05 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	12.09 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	–3.00 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	–27.98 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

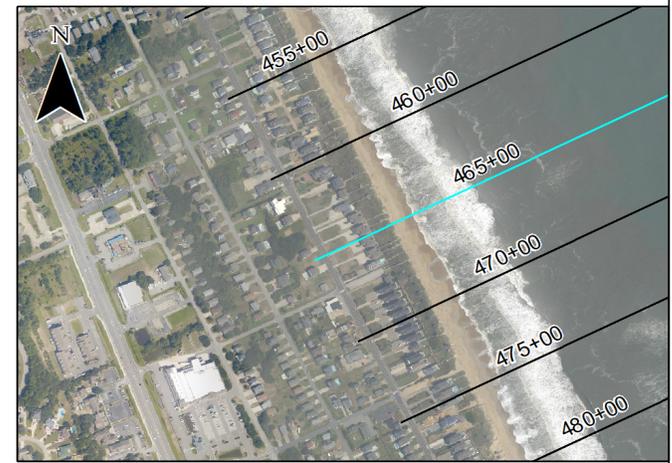


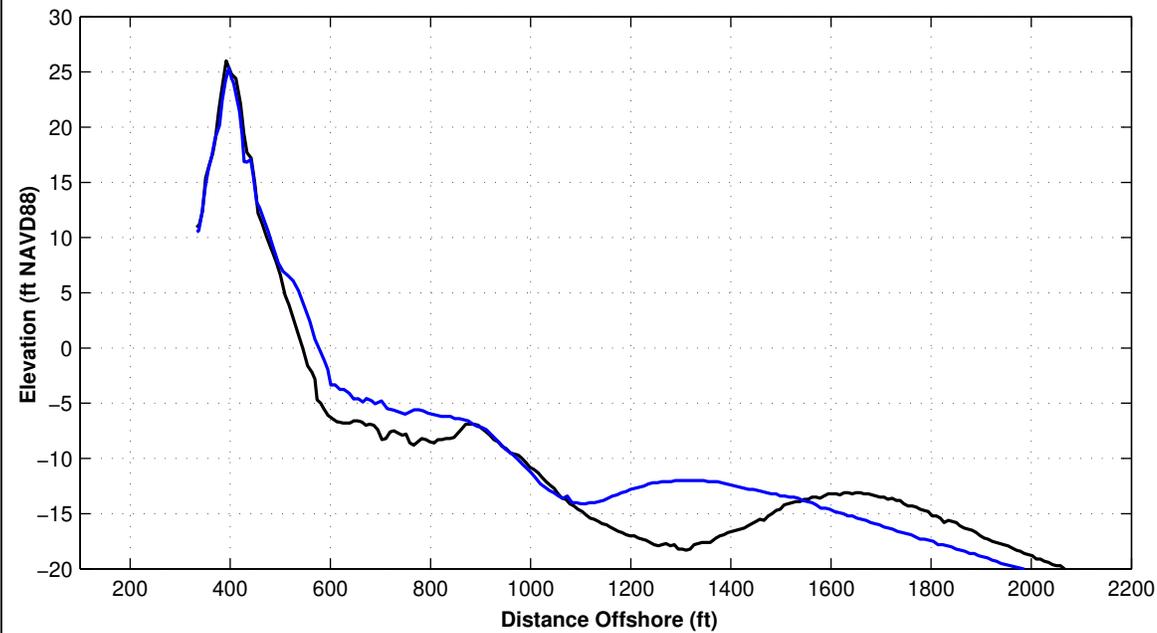
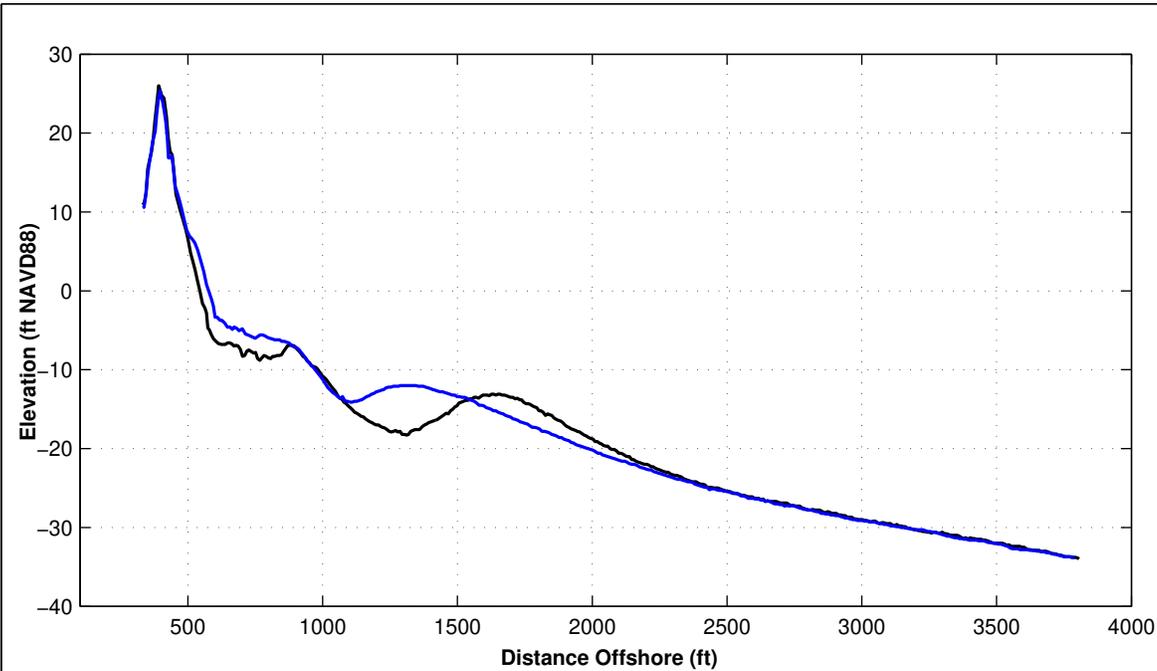


Survey Transect 465+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-30.97 ft	- ft
Volume Change Above +6 ft NAVD88	-1.92 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	-6.81 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	4.05 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	1.81 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	10.67 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	-9.22 cy/ft	- cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

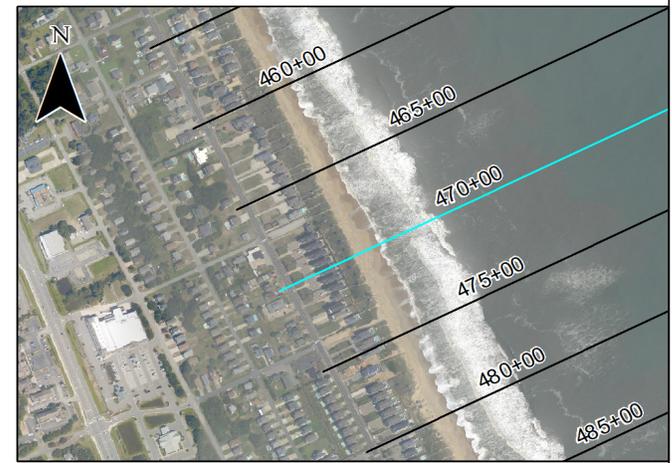


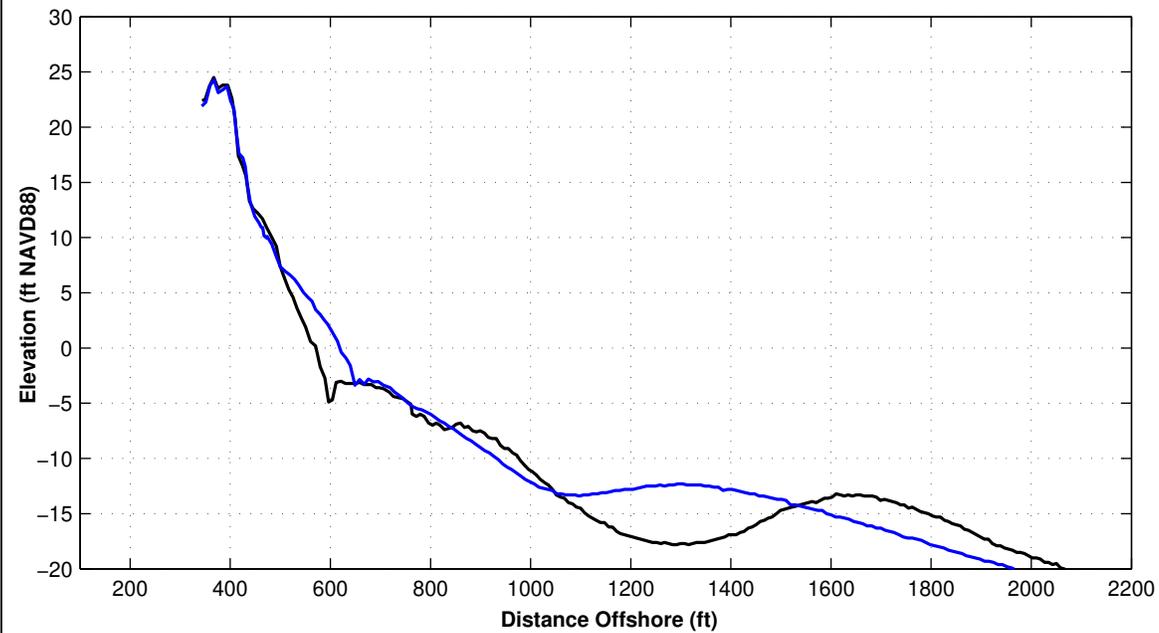
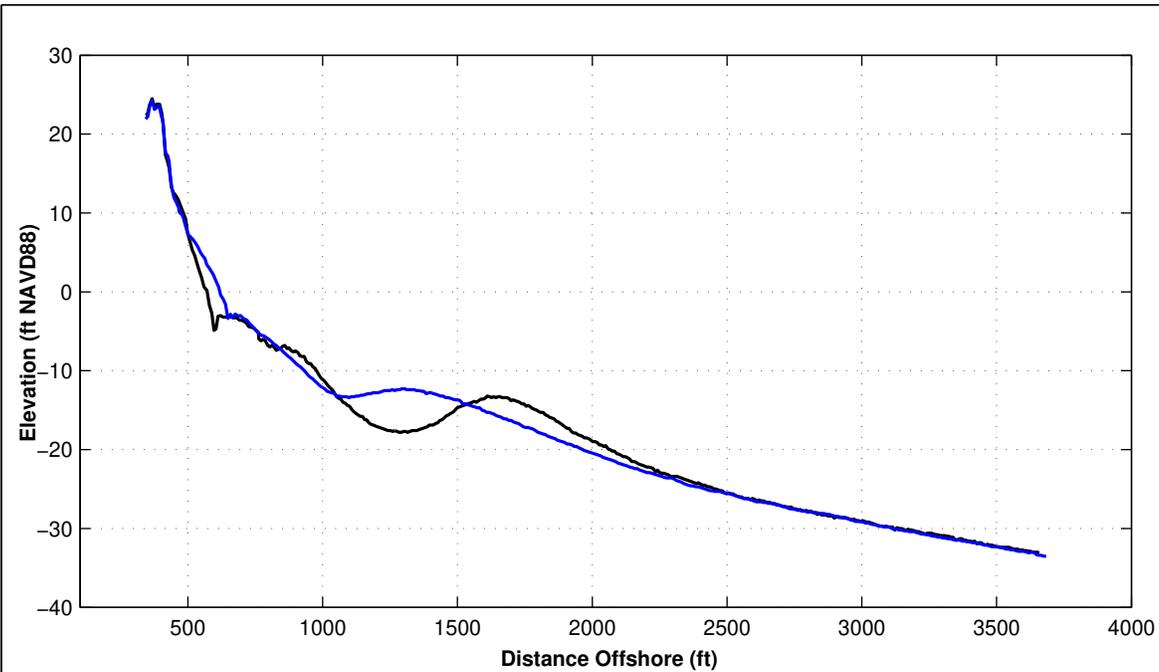


Survey Transect 470+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	30.69 ft	– ft
Volume Change Above +6 ft NAVD88	–0.28 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	5.00 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	20.21 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	50.02 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	63.54 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	47.76 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

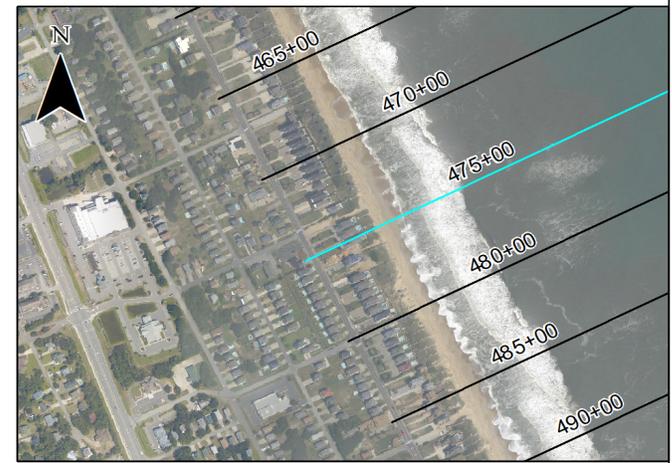


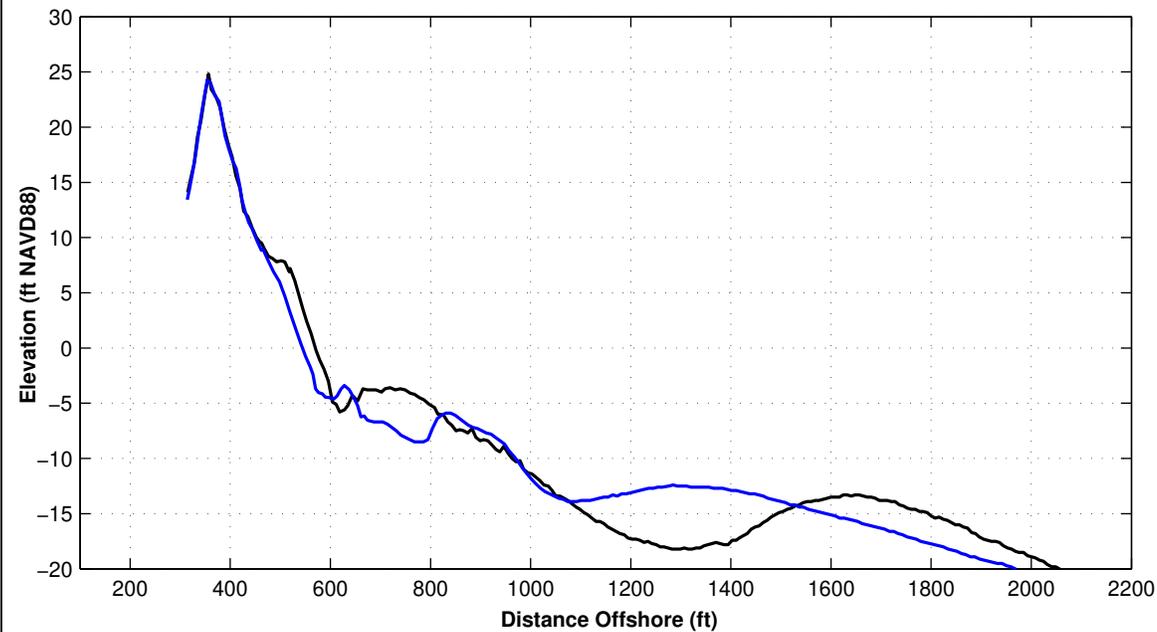
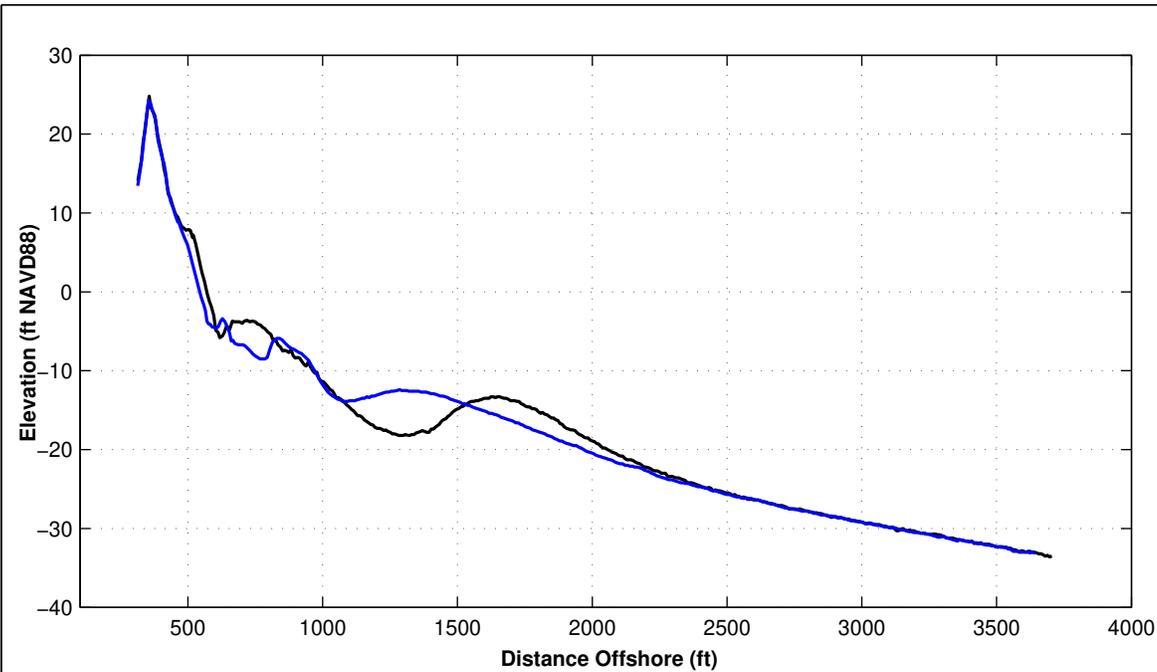


Survey Transect 475+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	51.02 ft	– ft
Volume Change Above +6 ft NAVD88	–0.88 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	5.67 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	16.90 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	24.75 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	35.75 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	18.83 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

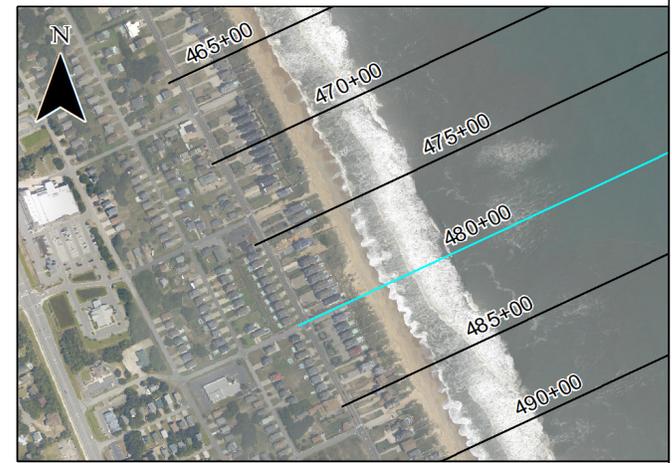


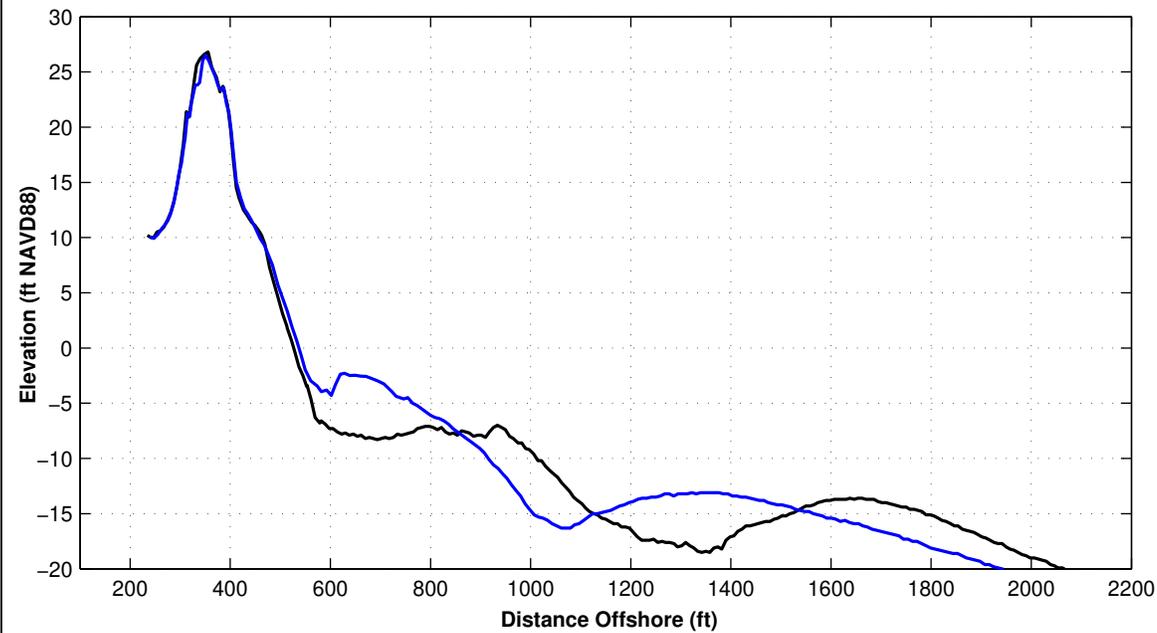
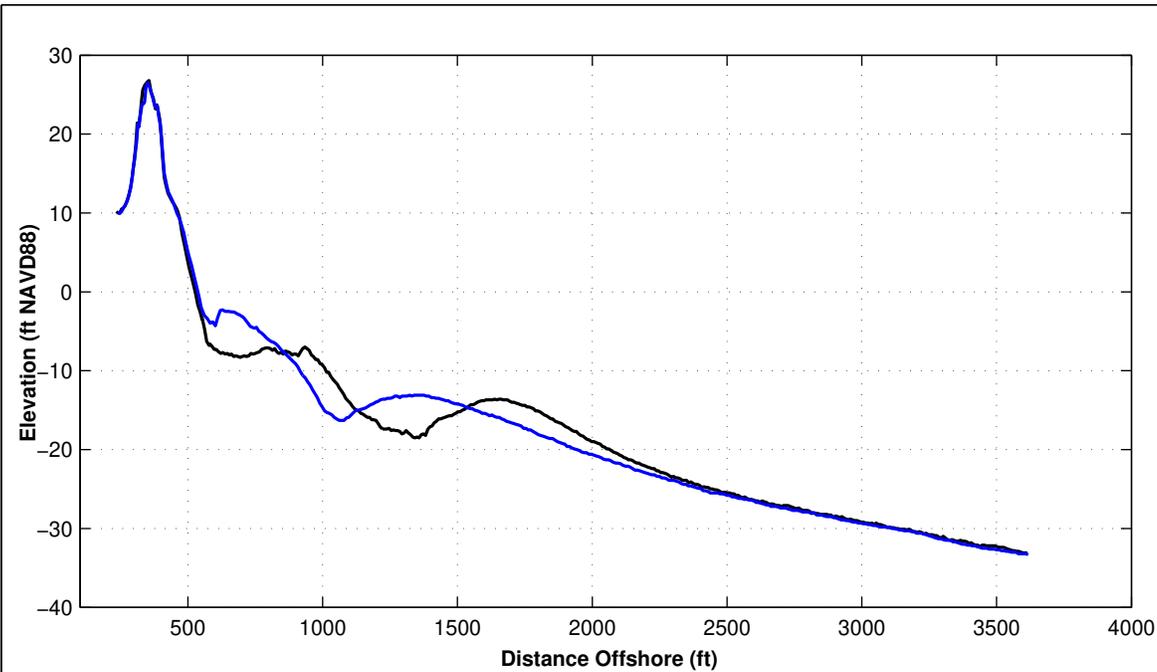


Survey Transect 480+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-27.14 ft	- ft
Volume Change Above +6 ft NAVD88	-2.74 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	-7.81 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	-22.05 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	-15.84 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	-1.06 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	-15.28 cy/ft	- cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

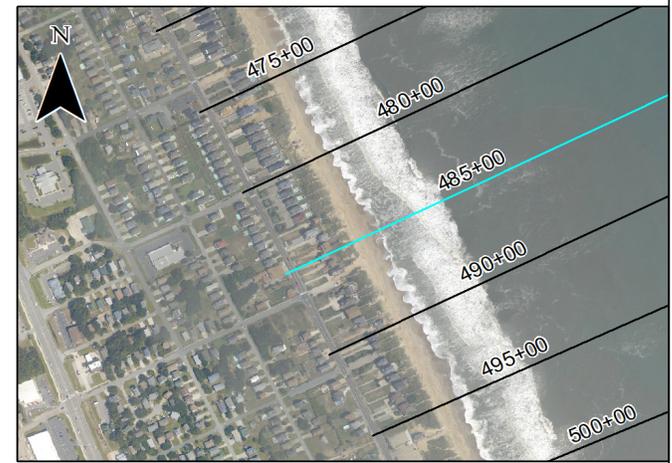


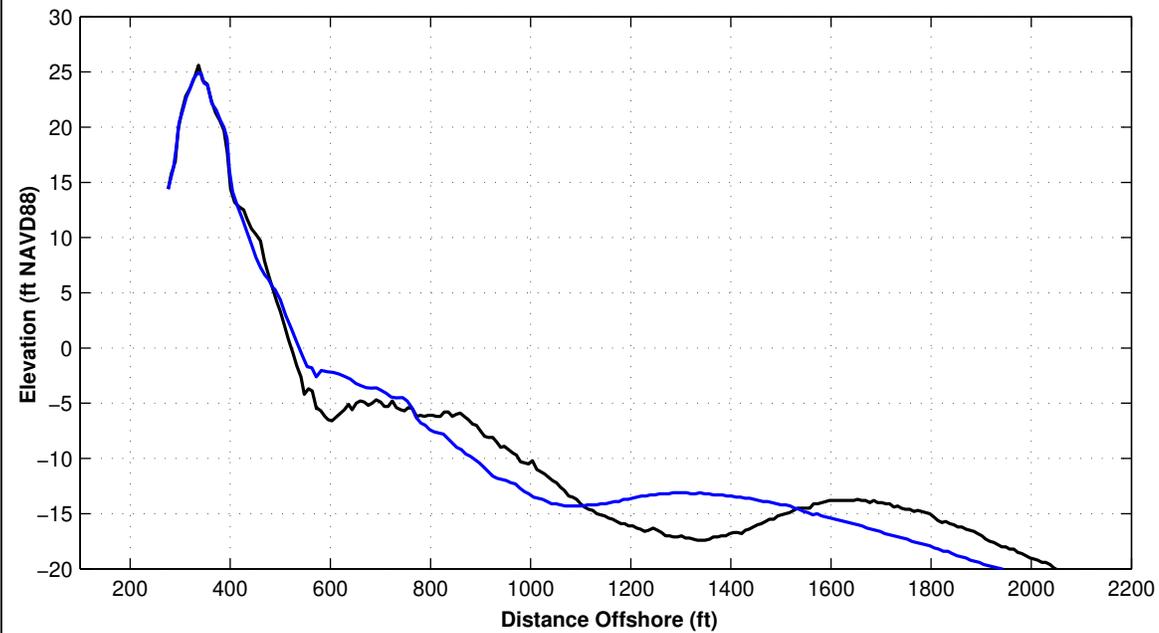
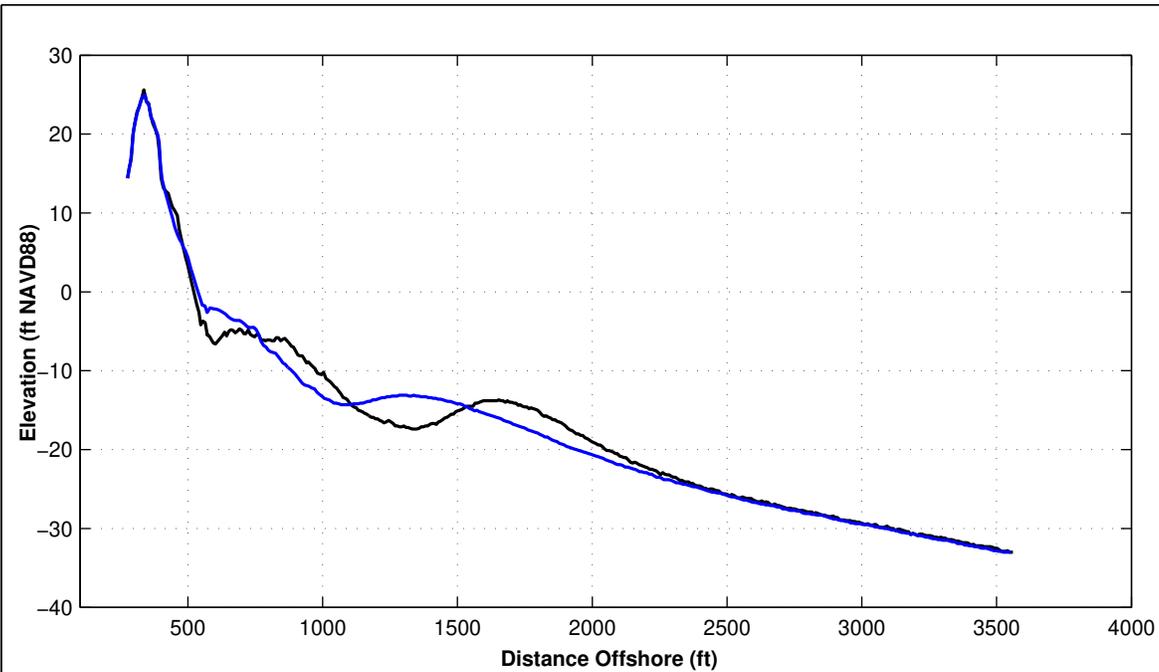


Survey Transect 485+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	10.12 ft	– ft
Volume Change Above +6 ft NAVD88	0.63 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	2.27 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	24.56 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	21.63 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	20.31 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	–3.26 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

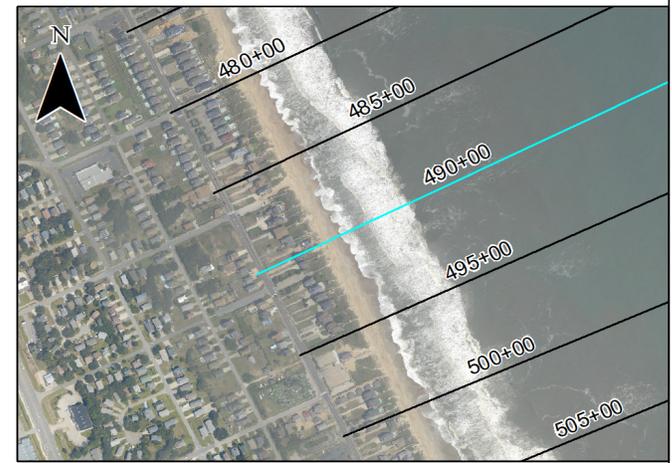


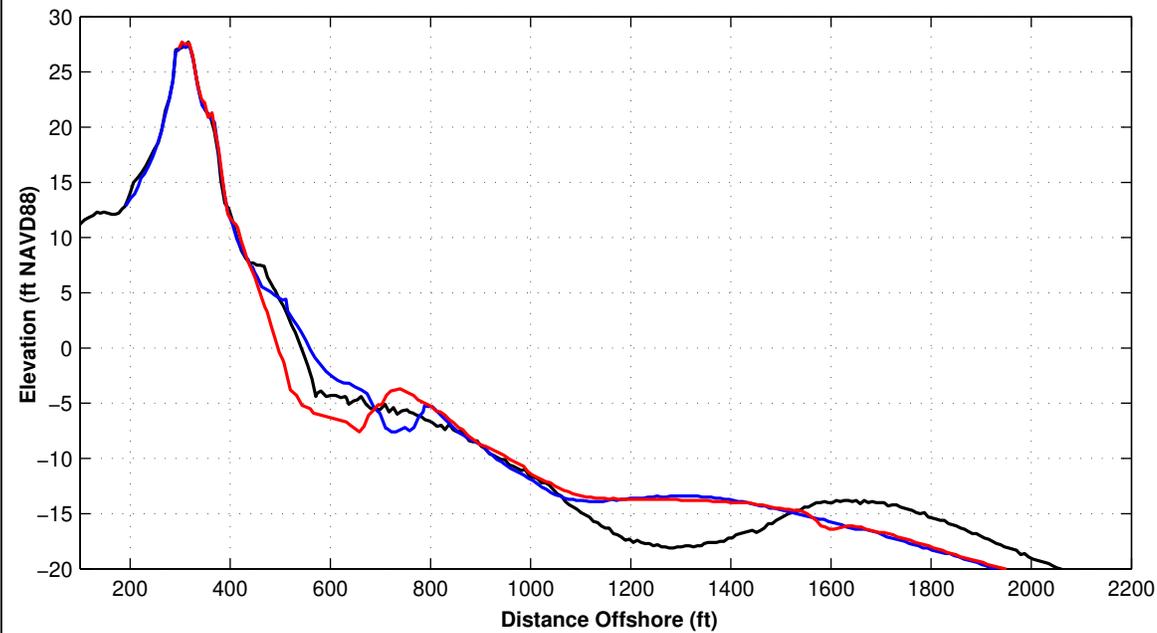
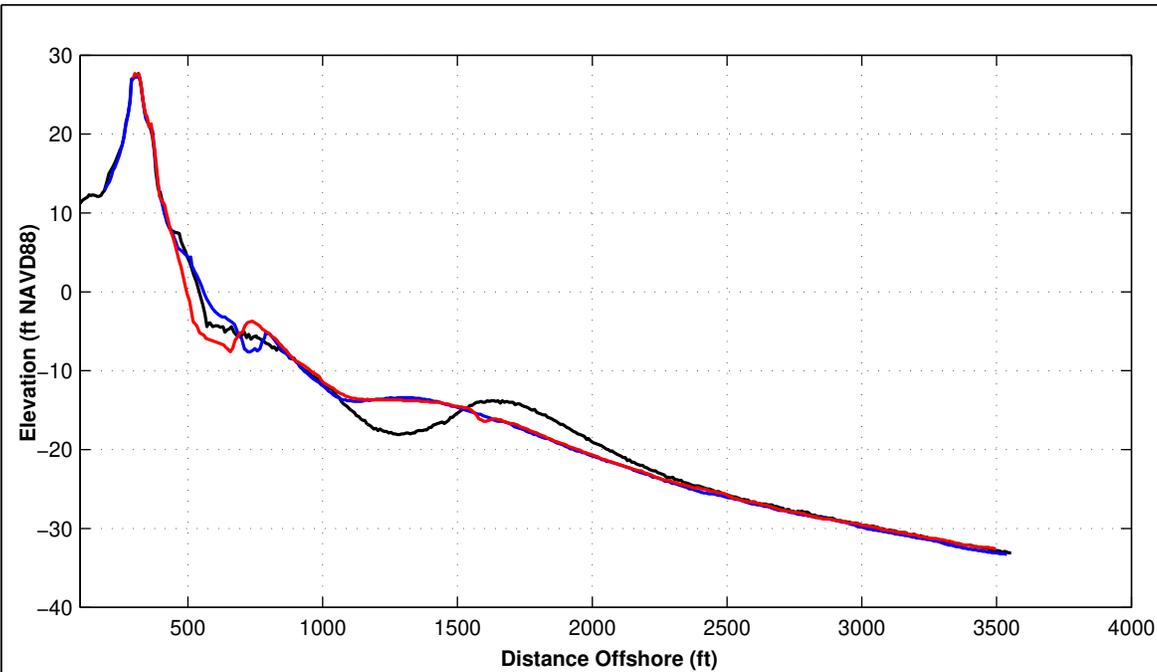


Survey Transect 490+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	13.14 ft	– ft
Volume Change Above +6 ft NAVD88	–2.52 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	–1.14 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	17.19 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	–3.31 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	–2.42 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	–23.98 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

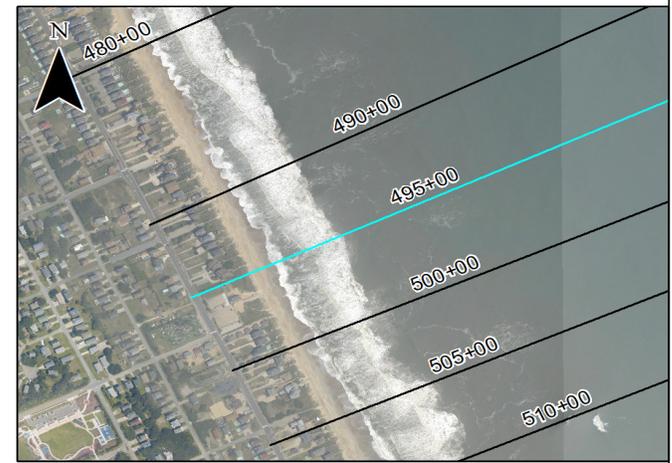


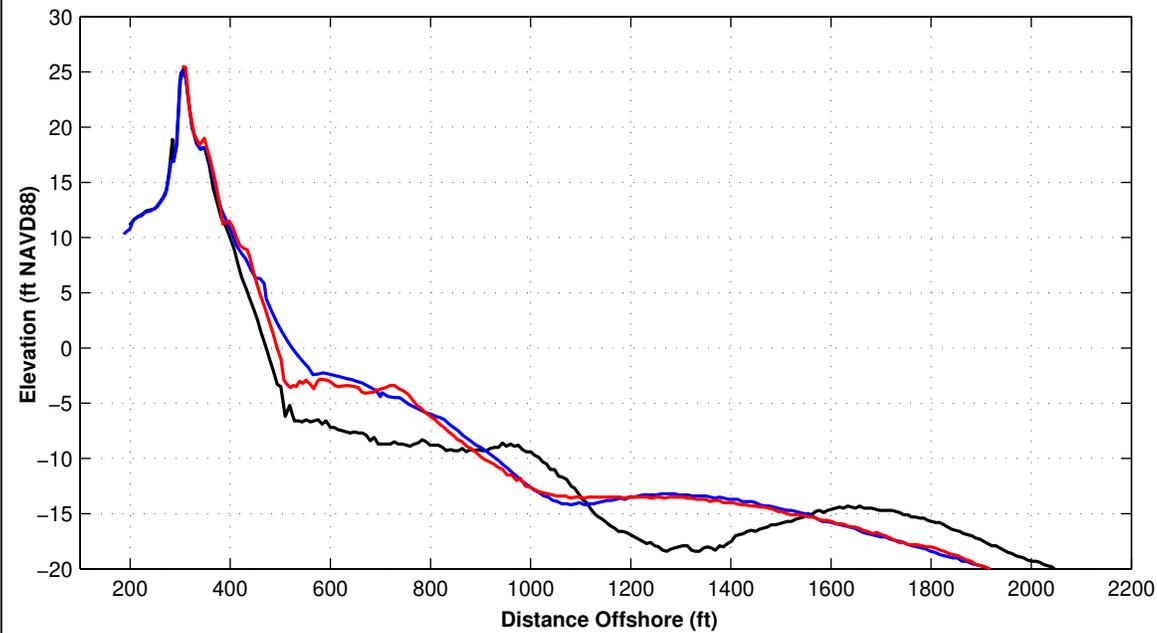
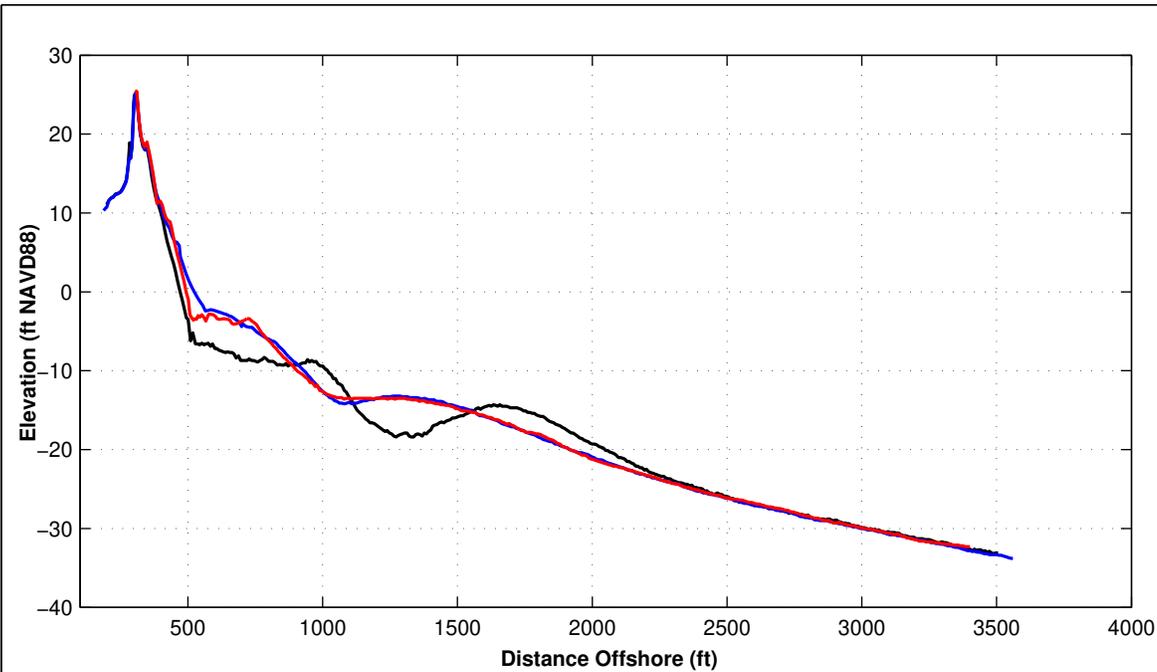


Survey Transect 495+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	12.90 ft	-57.69 ft
Volume Change Above +6 ft NAVD88	-1.04 cy/ft	0.92 cy/ft
Volume Change Above 1.18 ft NAVD88	-0.77 cy/ft	-5.93 cy/ft
Volume Change Above -6 ft NAVD88	7.95 cy/ft	-25.85 cy/ft
Volume Change Above -14 ft NAVD88	8.81 cy/ft	-20.76 cy/ft
Volume Change Above -19 ft NAVD88	17.88 cy/ft	-19.45 cy/ft
Volume Change Above -30 ft NAVD88	-7.54 cy/ft	-13.12 cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

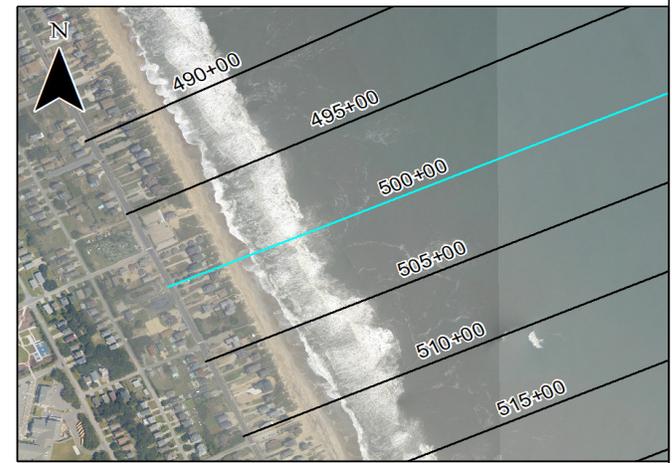


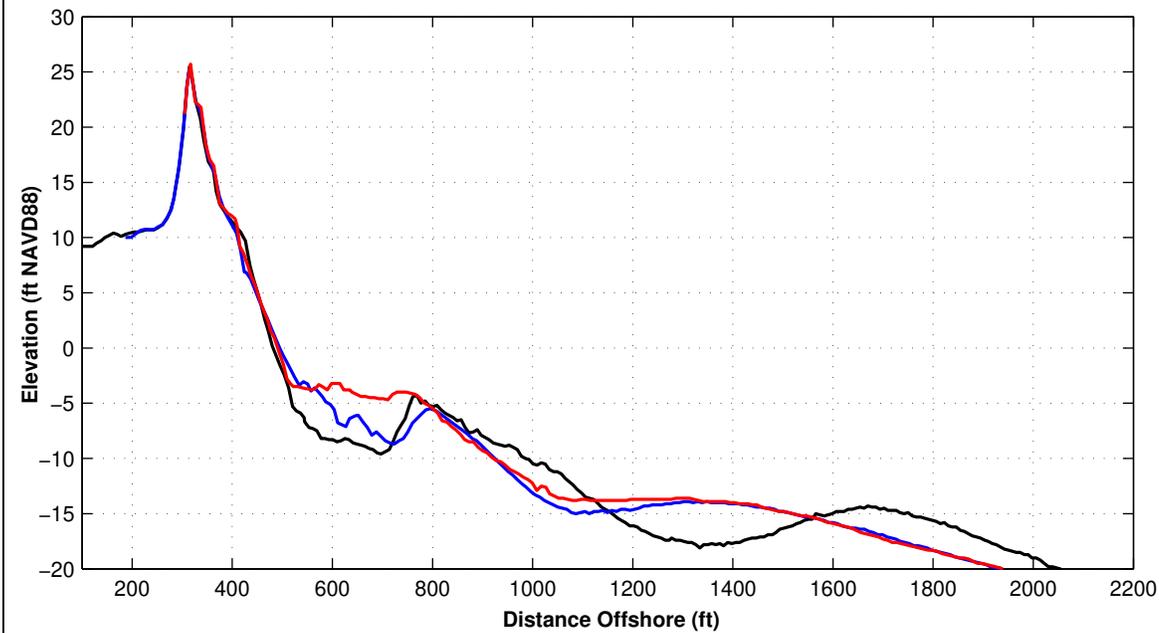
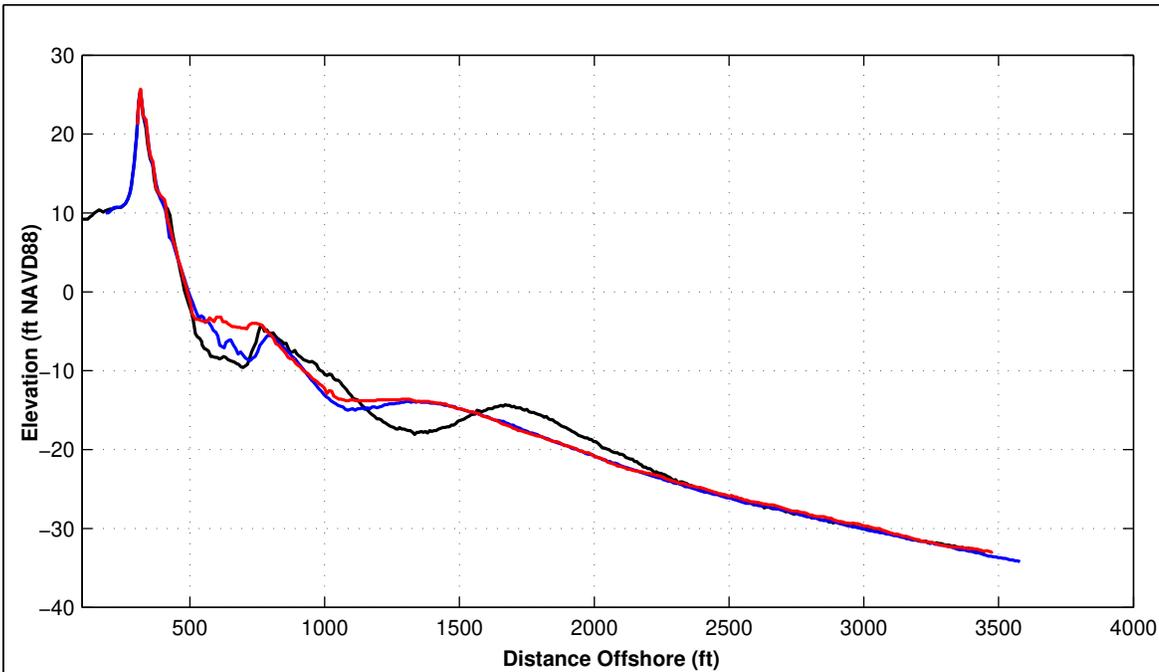


Survey Transect 500+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	43.45 ft	-20.51 ft
Volume Change Above +6 ft NAVD88	4.22 cy/ft	1.81 cy/ft
Volume Change Above 1.18 ft NAVD88	10.75 cy/ft	-0.53 cy/ft
Volume Change Above -6 ft NAVD88	46.23 cy/ft	-8.19 cy/ft
Volume Change Above -14 ft NAVD88	61.17 cy/ft	-12.01 cy/ft
Volume Change Above -19 ft NAVD88	76.80 cy/ft	-11.32 cy/ft
Volume Change Above -30 ft NAVD88	54.98 cy/ft	-8.88 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

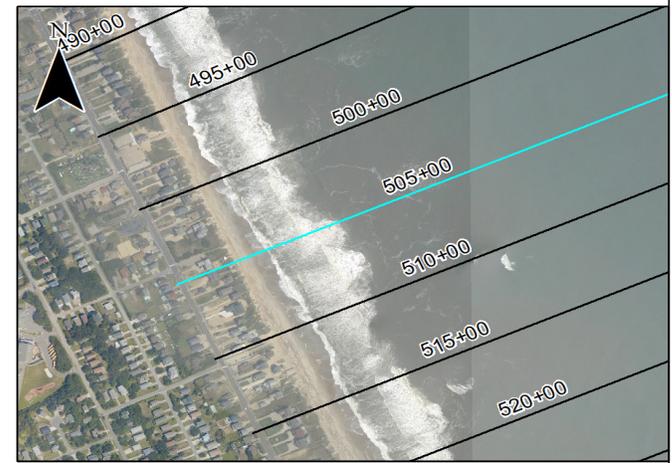


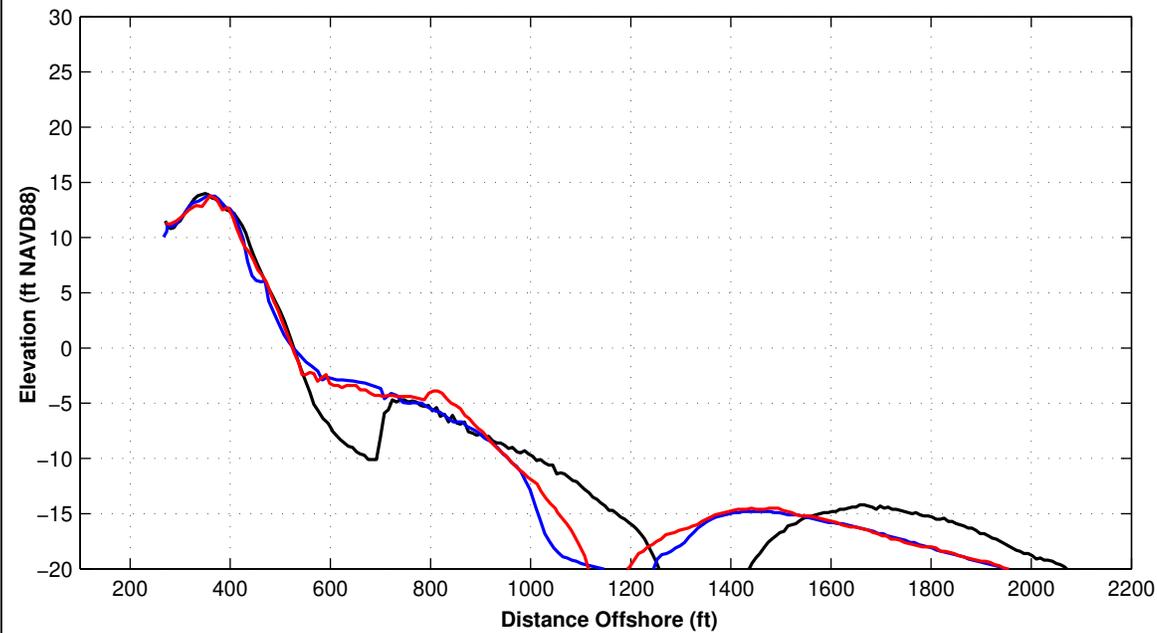
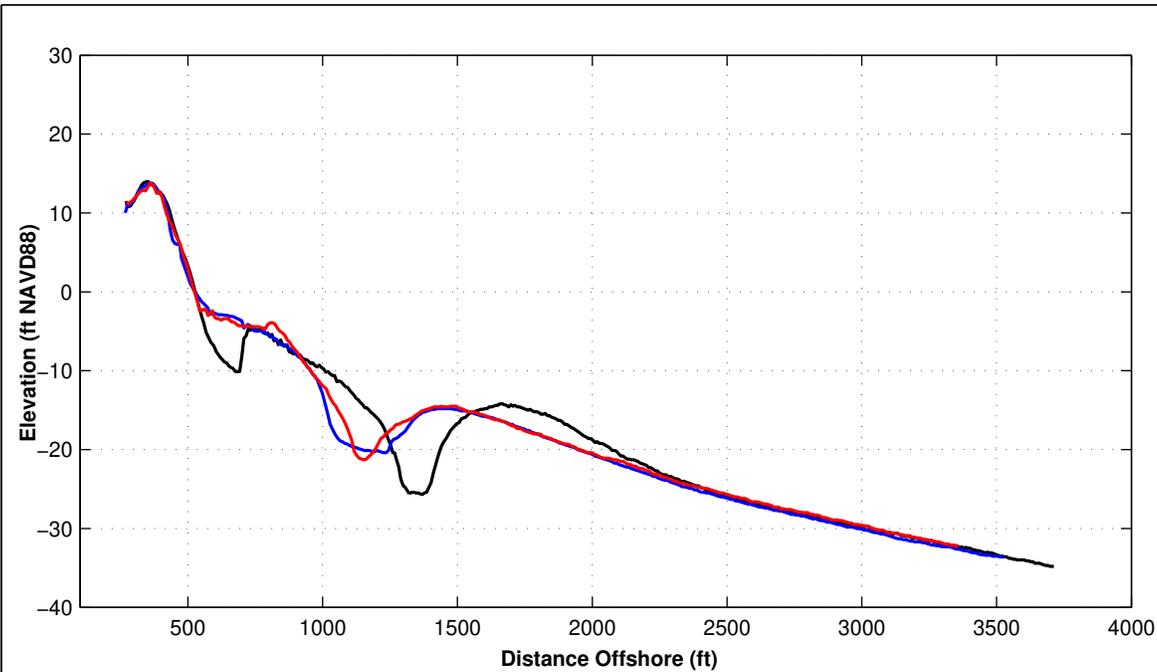


Survey Transect 505+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	9.37 ft	-2.41 ft
Volume Change Above +6 ft NAVD88	-1.33 cy/ft	1.72 cy/ft
Volume Change Above 1.18 ft NAVD88	-1.00 cy/ft	1.80 cy/ft
Volume Change Above -6 ft NAVD88	5.87 cy/ft	13.83 cy/ft
Volume Change Above -14 ft NAVD88	-3.38 cy/ft	26.61 cy/ft
Volume Change Above -19 ft NAVD88	2.27 cy/ft	30.52 cy/ft
Volume Change Above -30 ft NAVD88	-16.90 cy/ft	39.48 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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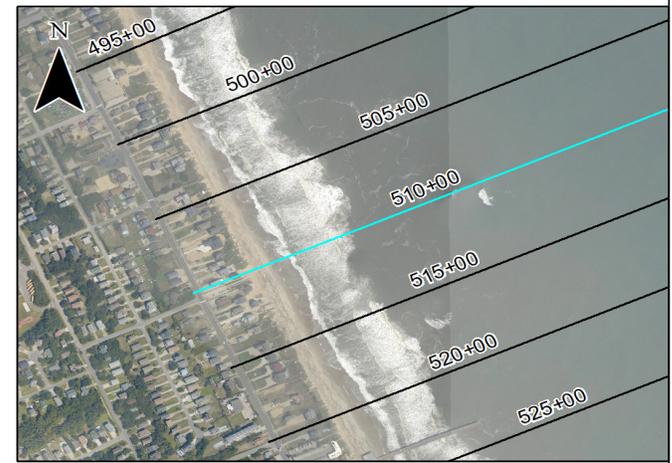


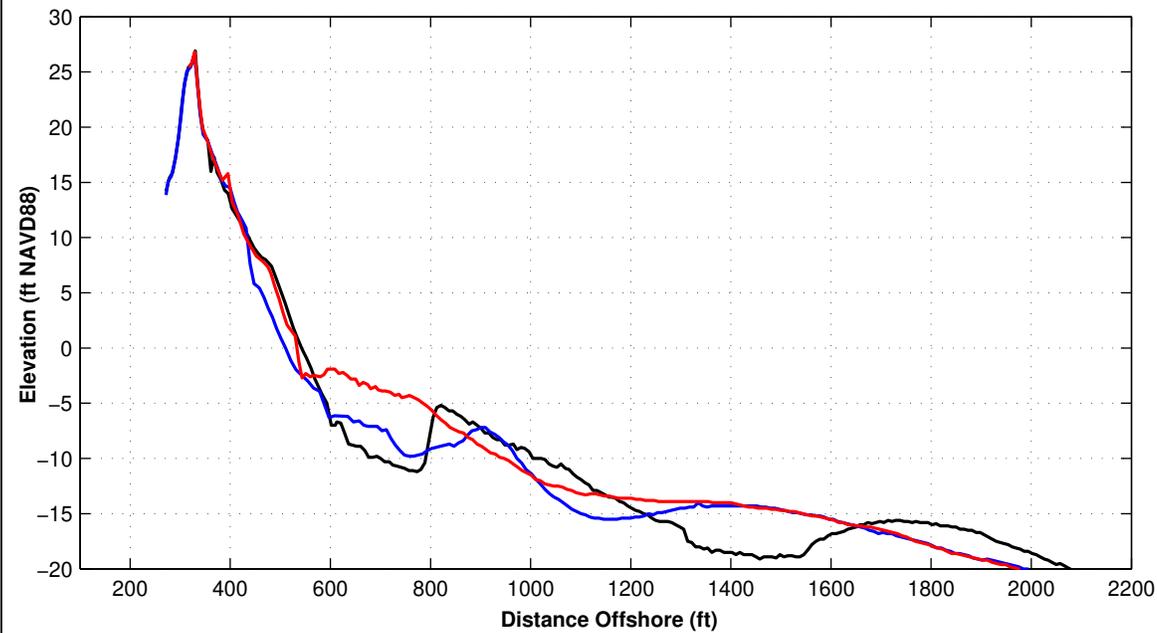
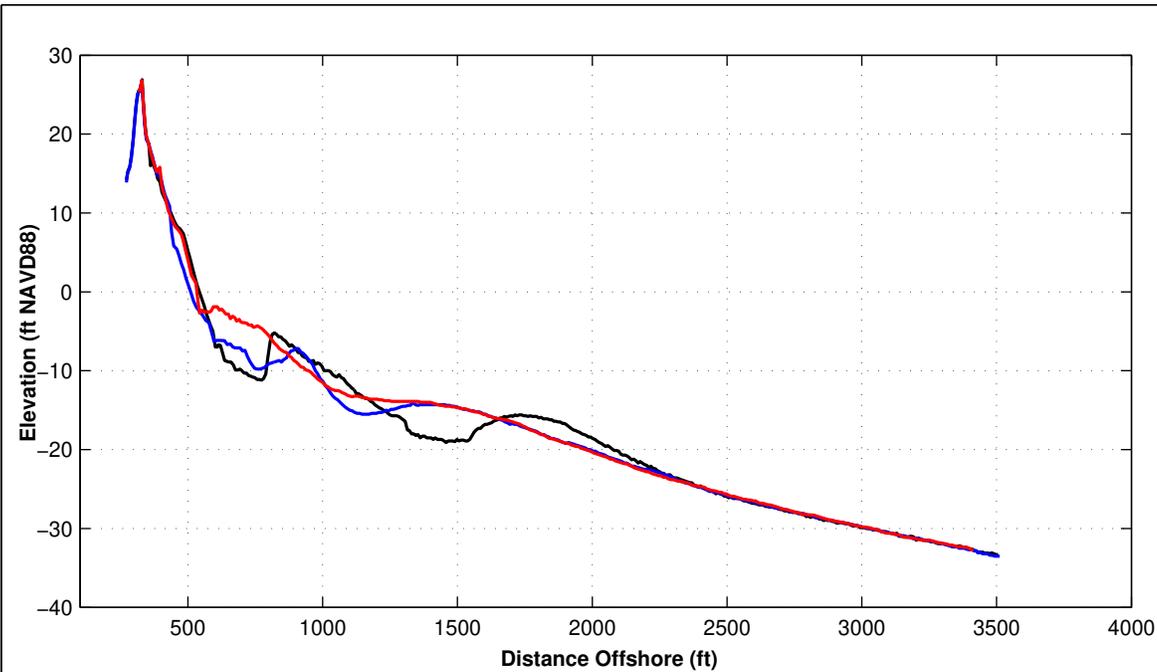


Survey Transect 510+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-10.46 ft	6.66 ft
Volume Change Above +6 ft NAVD88	-2.90 cy/ft	-0.06 cy/ft
Volume Change Above 1.18 ft NAVD88	-4.81 cy/ft	1.37 cy/ft
Volume Change Above -6 ft NAVD88	13.45 cy/ft	1.95 cy/ft
Volume Change Above -14 ft NAVD88	9.78 cy/ft	5.62 cy/ft
Volume Change Above -19 ft NAVD88	-28.19 cy/ft	21.41 cy/ft
Volume Change Above -30 ft NAVD88	-26.68 cy/ft	38.62 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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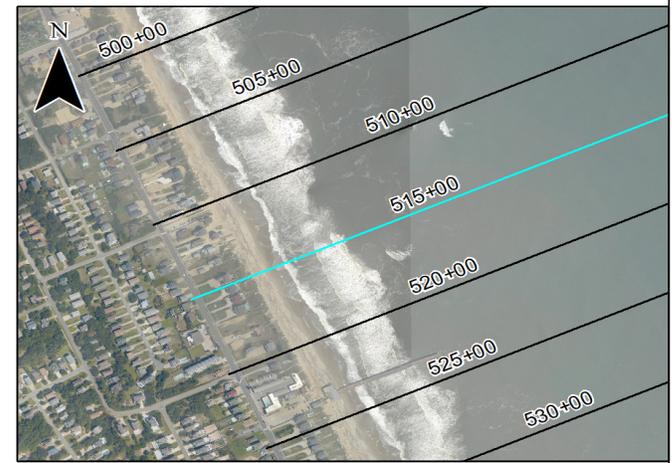


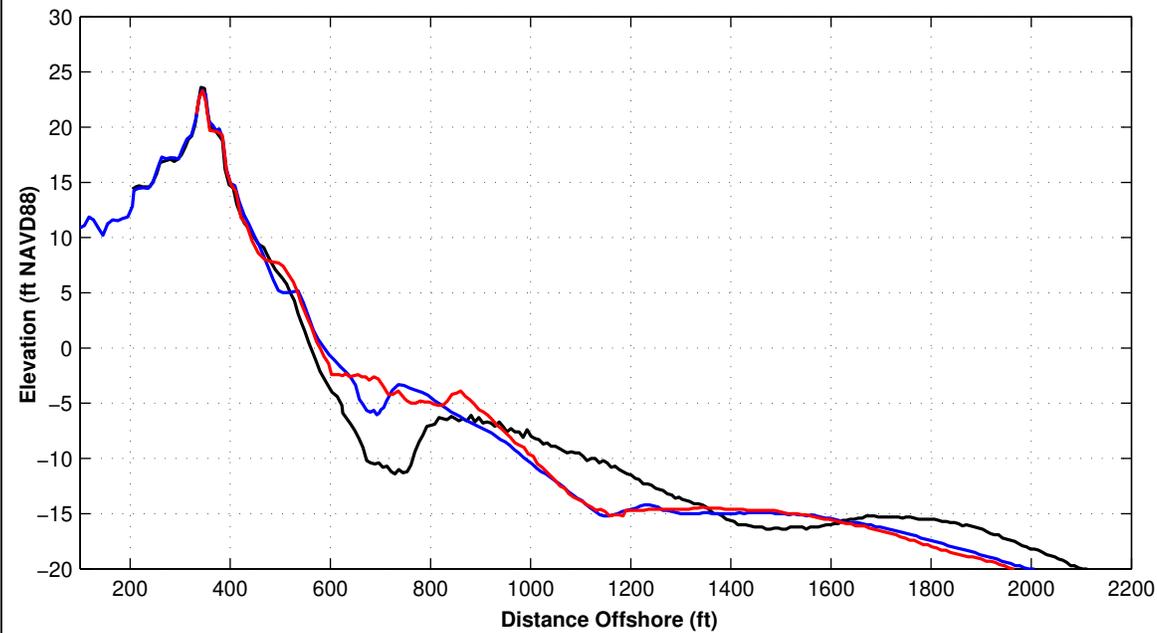
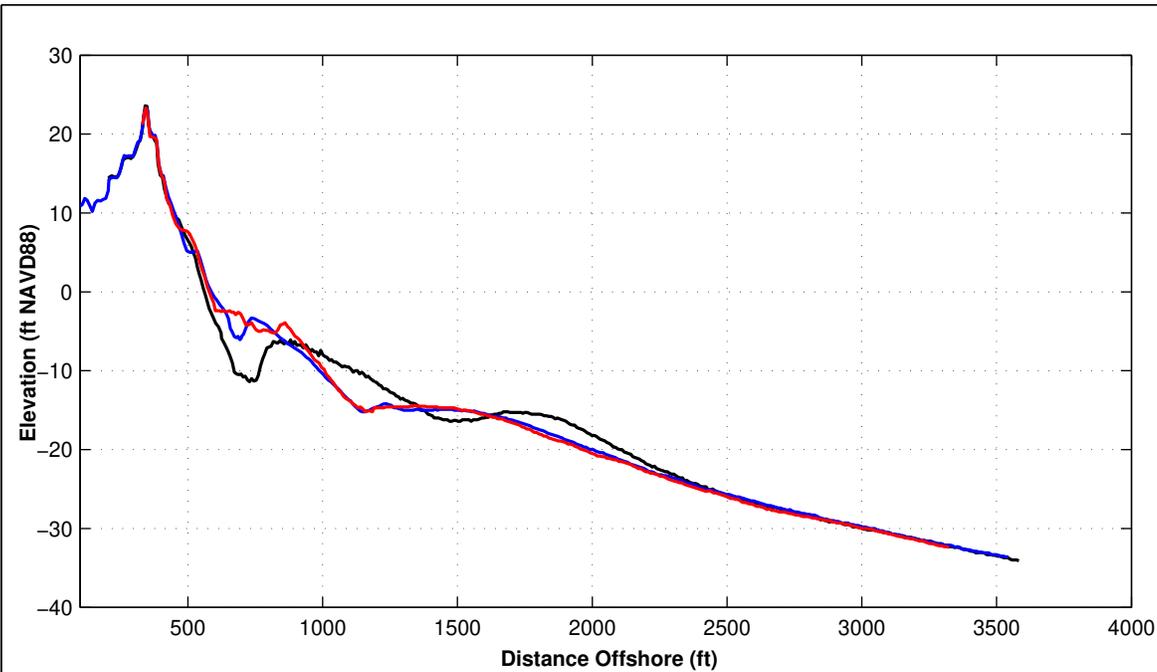


Survey Transect 515+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-33.16 ft	29.91 ft
Volume Change Above +6 ft NAVD88	-2.72 cy/ft	3.03 cy/ft
Volume Change Above 1.18 ft NAVD88	-9.37 cy/ft	8.08 cy/ft
Volume Change Above -6 ft NAVD88	-15.50 cy/ft	31.29 cy/ft
Volume Change Above -14 ft NAVD88	-24.13 cy/ft	49.98 cy/ft
Volume Change Above -19 ft NAVD88	-5.14 cy/ft	60.92 cy/ft
Volume Change Above -30 ft NAVD88	-14.79 cy/ft	59.96 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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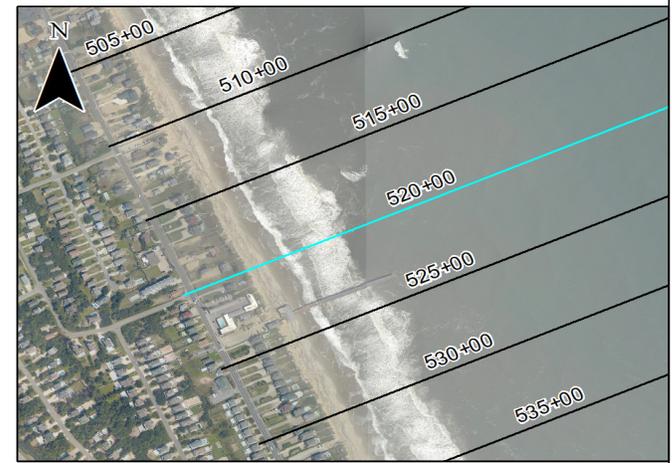


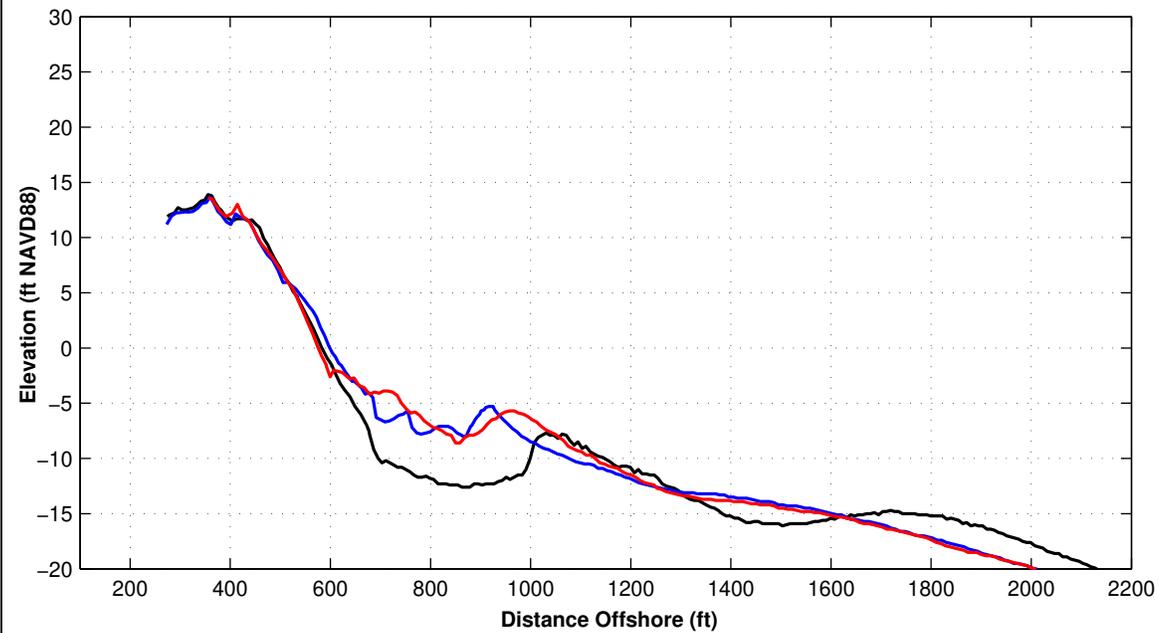
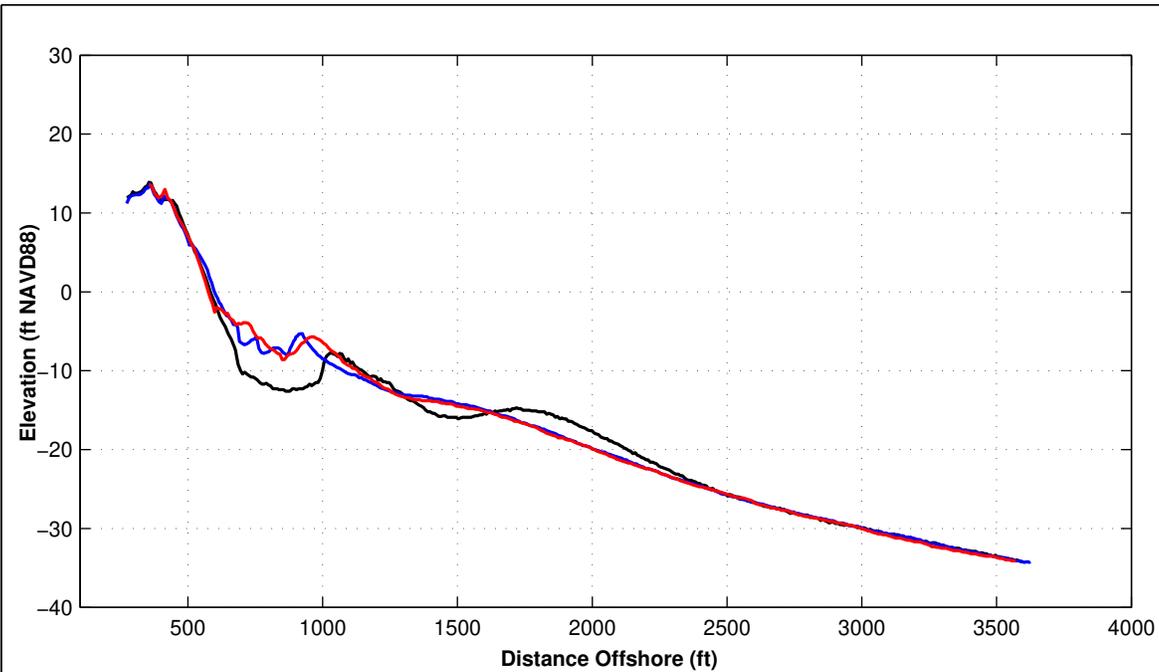


Survey Transect 520+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	19.46 ft	-3.38 ft
Volume Change Above +6 ft NAVD88	0.32 cy/ft	0.17 cy/ft
Volume Change Above 1.18 ft NAVD88	2.16 cy/ft	0.97 cy/ft
Volume Change Above -6 ft NAVD88	22.06 cy/ft	5.87 cy/ft
Volume Change Above -14 ft NAVD88	10.02 cy/ft	11.17 cy/ft
Volume Change Above -19 ft NAVD88	-9.82 cy/ft	9.25 cy/ft
Volume Change Above -30 ft NAVD88	-20.75 cy/ft	-3.13 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

Notes:
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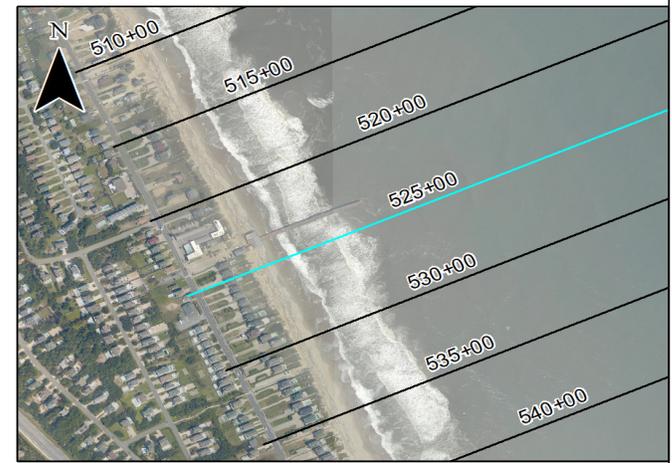
Survey Transect 525+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	15.93 ft	-21.92 ft
Volume Change Above +6 ft NAVD88	-2.26 cy/ft	1.72 cy/ft
Volume Change Above 1.18 ft NAVD88	0.00 cy/ft	-1.01 cy/ft
Volume Change Above -6 ft NAVD88	7.70 cy/ft	-0.10 cy/ft
Volume Change Above -14 ft NAVD88	55.64 cy/ft	8.02 cy/ft
Volume Change Above -19 ft NAVD88	43.45 cy/ft	4.46 cy/ft
Volume Change Above -30 ft NAVD88	28.09 cy/ft	2.12 cy/ft

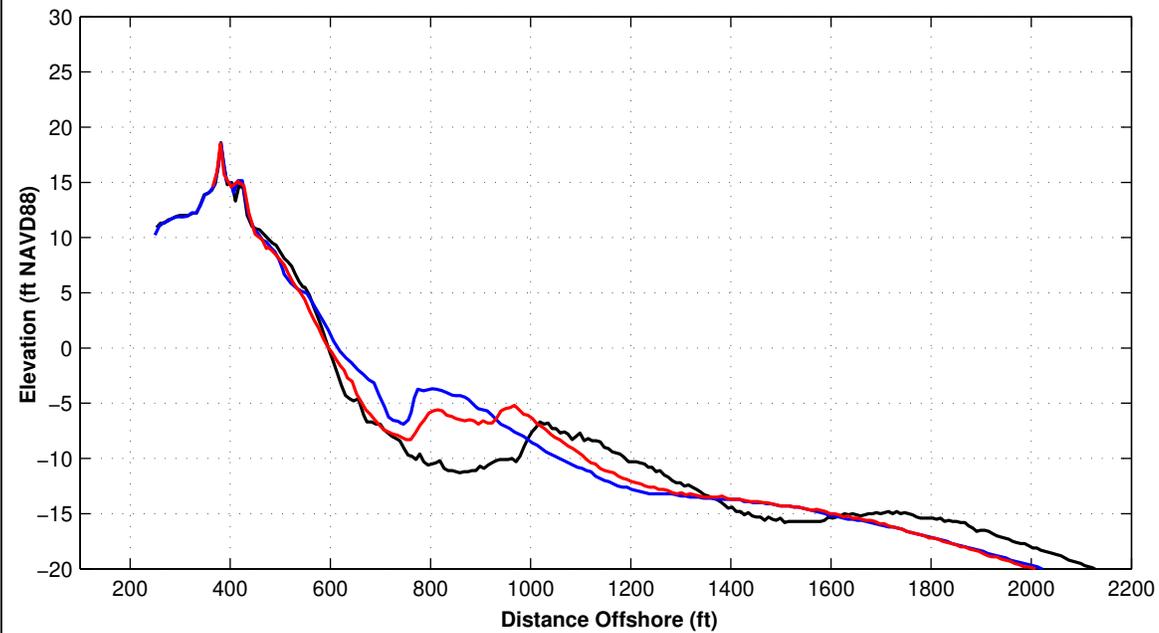
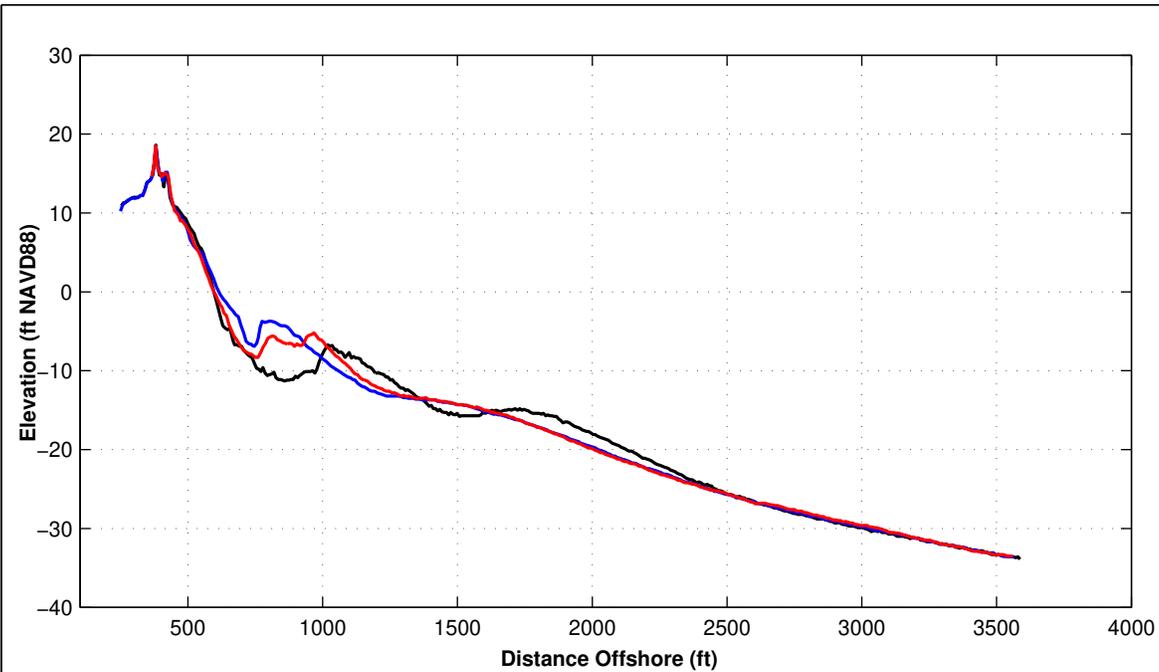
LEGEND:

OCTOBER 2023 — POST-DORIAN AD —

JUNE 2023 — JUNE 2022 —

- Notes:
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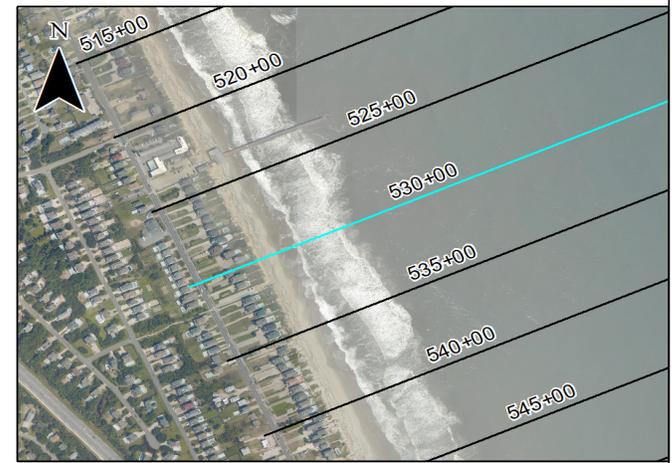


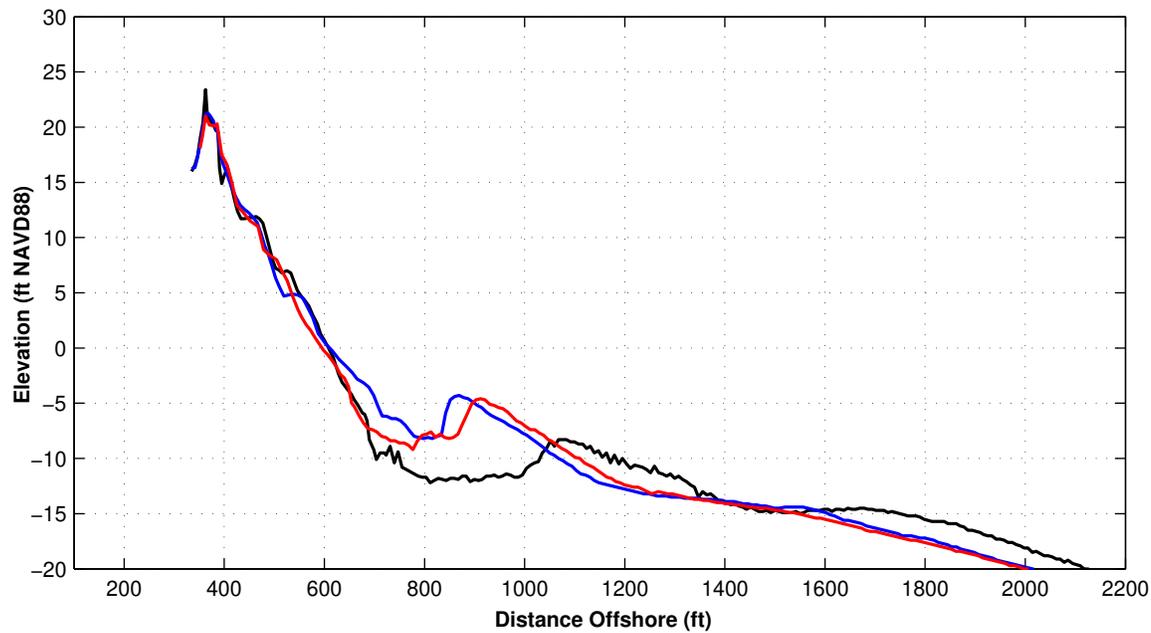
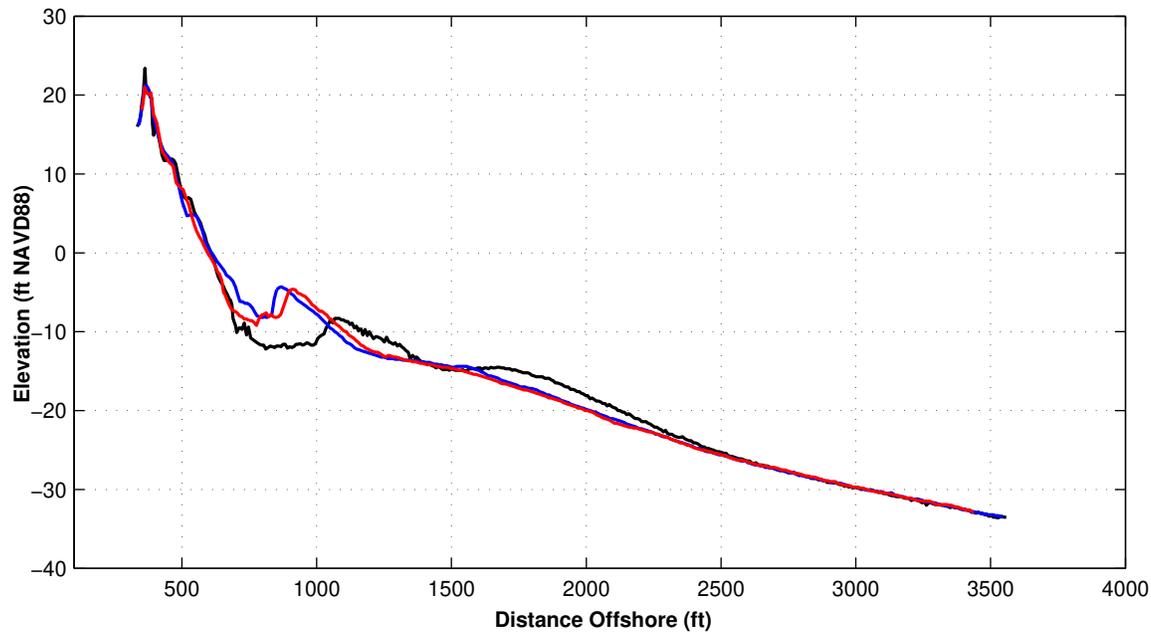


Survey Transect 530+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	12.98 ft	-17.90 ft
Volume Change Above +6 ft NAVD88	-1.91 cy/ft	0.18 cy/ft
Volume Change Above 1.18 ft NAVD88	-1.78 cy/ft	-1.94 cy/ft
Volume Change Above -6 ft NAVD88	18.59 cy/ft	-18.24 cy/ft
Volume Change Above -14 ft NAVD88	30.95 cy/ft	-9.17 cy/ft
Volume Change Above -19 ft NAVD88	17.45 cy/ft	-8.69 cy/ft
Volume Change Above -30 ft NAVD88	2.17 cy/ft	-8.25 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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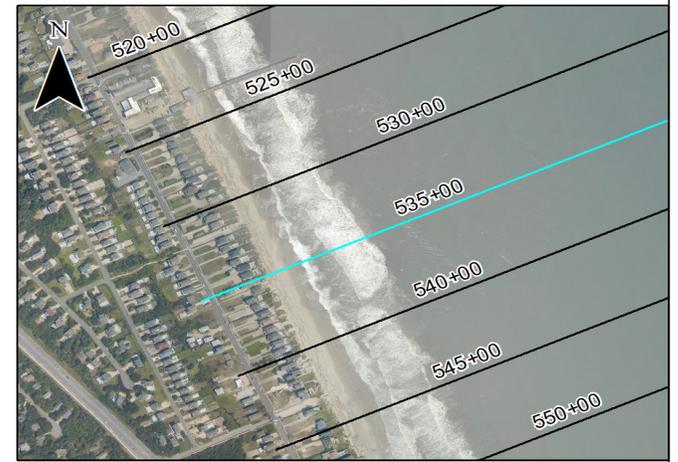
Survey Transect 535+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-3.60 ft	-11.73 ft
Volume Change Above +6 ft NAVD88	-0.90 cy/ft	0.94 cy/ft
Volume Change Above 1.18 ft NAVD88	-2.83 cy/ft	-0.66 cy/ft
Volume Change Above -6 ft NAVD88	7.13 cy/ft	-9.19 cy/ft
Volume Change Above -14 ft NAVD88	38.06 cy/ft	-8.72 cy/ft
Volume Change Above -19 ft NAVD88	15.77 cy/ft	-15.53 cy/ft
Volume Change Above -30 ft NAVD88	-2.88 cy/ft	-17.04 cy/ft

LEGEND:

OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

Notes:

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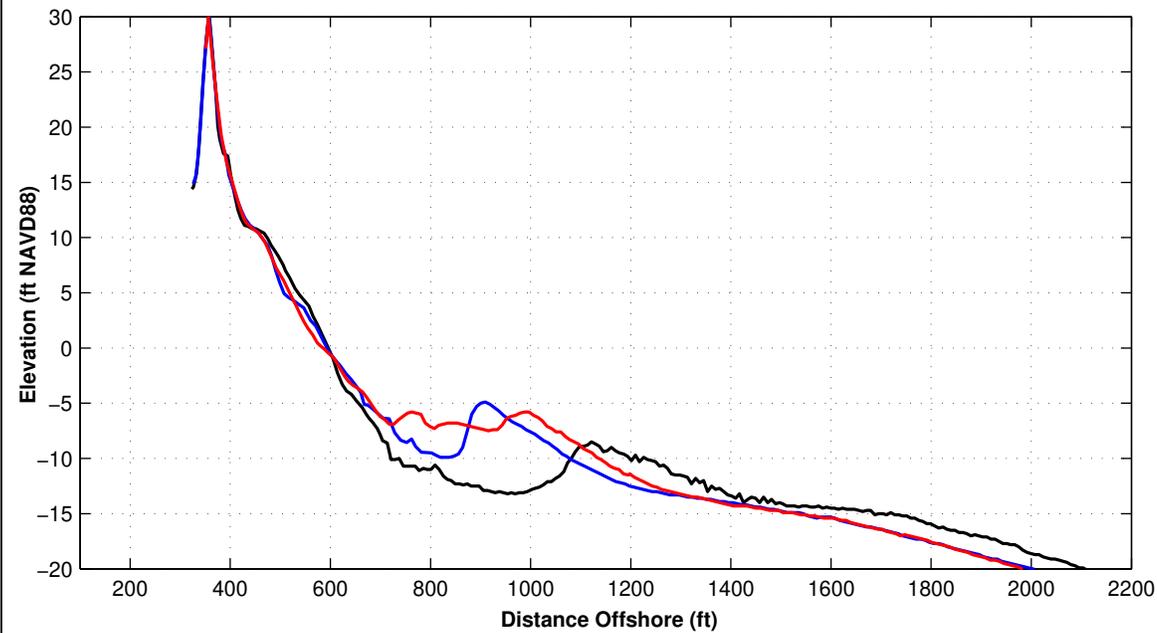
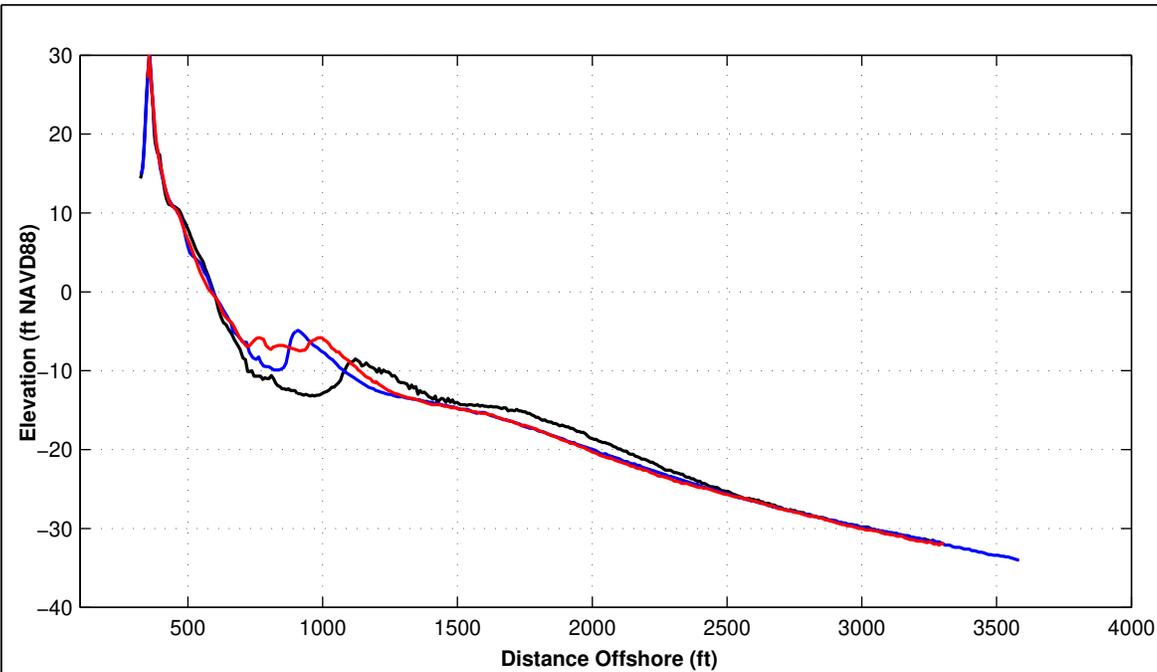


Town of Nags Head Periodic Surveying Data Analysis

ST 535+00

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2023



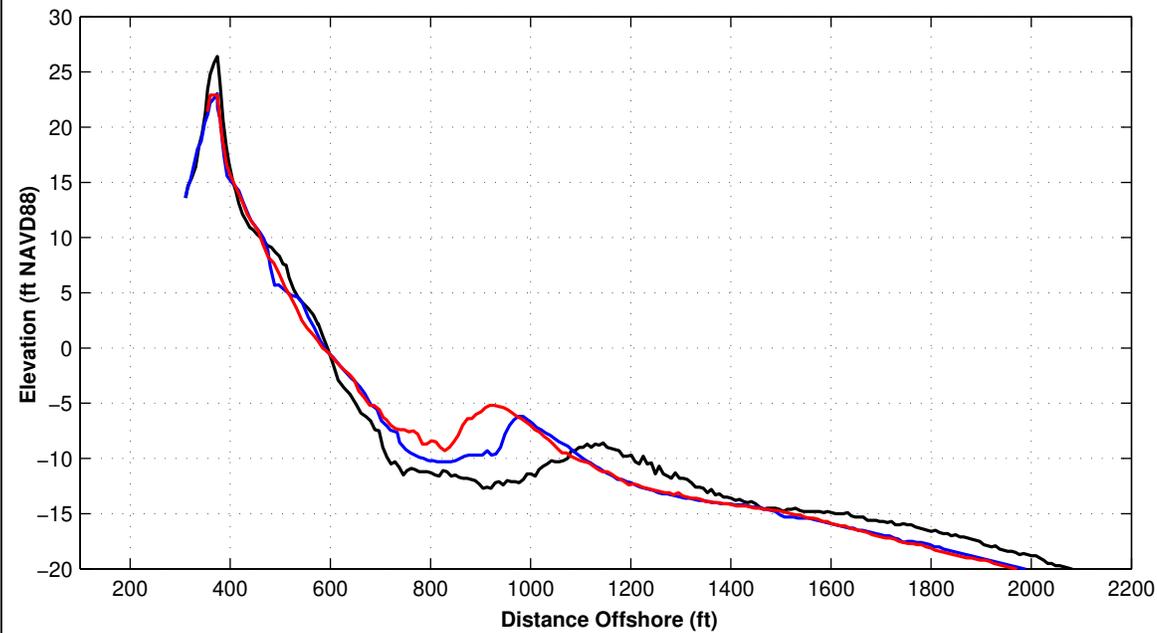
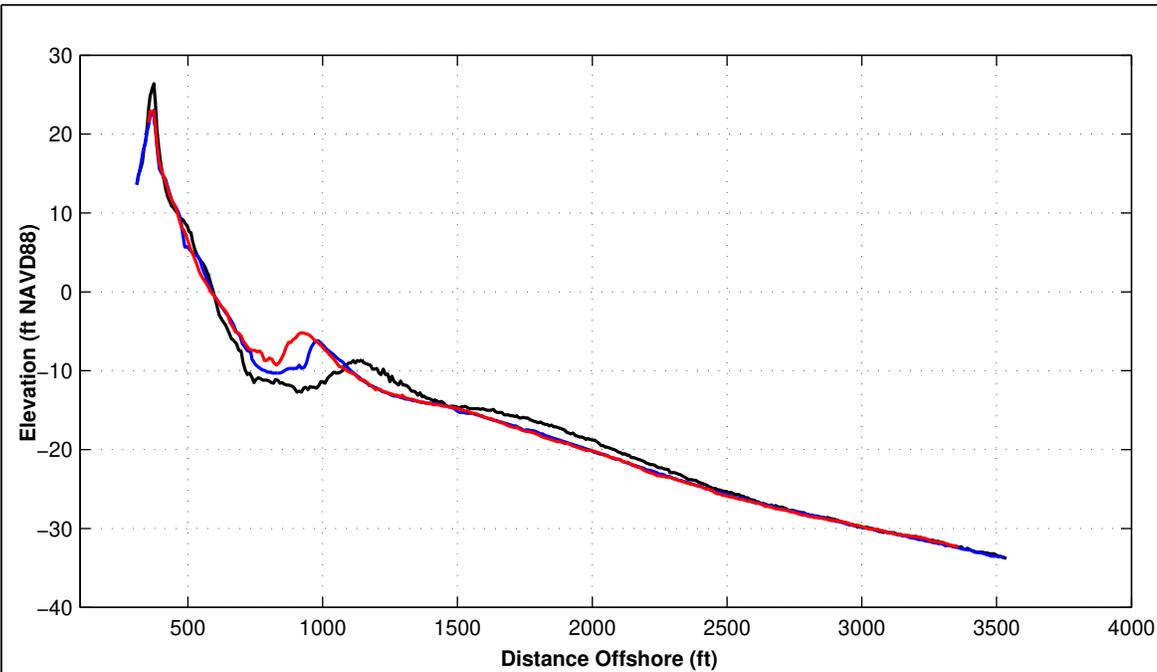
Survey Transect 540+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-3.90 ft	-15.14 ft
Volume Change Above +6 ft NAVD88	-1.72 cy/ft	0.34 cy/ft
Volume Change Above 1.18 ft NAVD88	-4.49 cy/ft	-0.65 cy/ft
Volume Change Above -6 ft NAVD88	0.11 cy/ft	-2.52 cy/ft
Volume Change Above -14 ft NAVD88	29.71 cy/ft	21.95 cy/ft
Volume Change Above -19 ft NAVD88	3.83 cy/ft	21.39 cy/ft
Volume Change Above -30 ft NAVD88	-15.12 cy/ft	14.11 cy/ft

LEGEND:

OCTOBER 2023		POST-DORIAN AD	
JUNE 2023		JUNE 2022	

- Notes:
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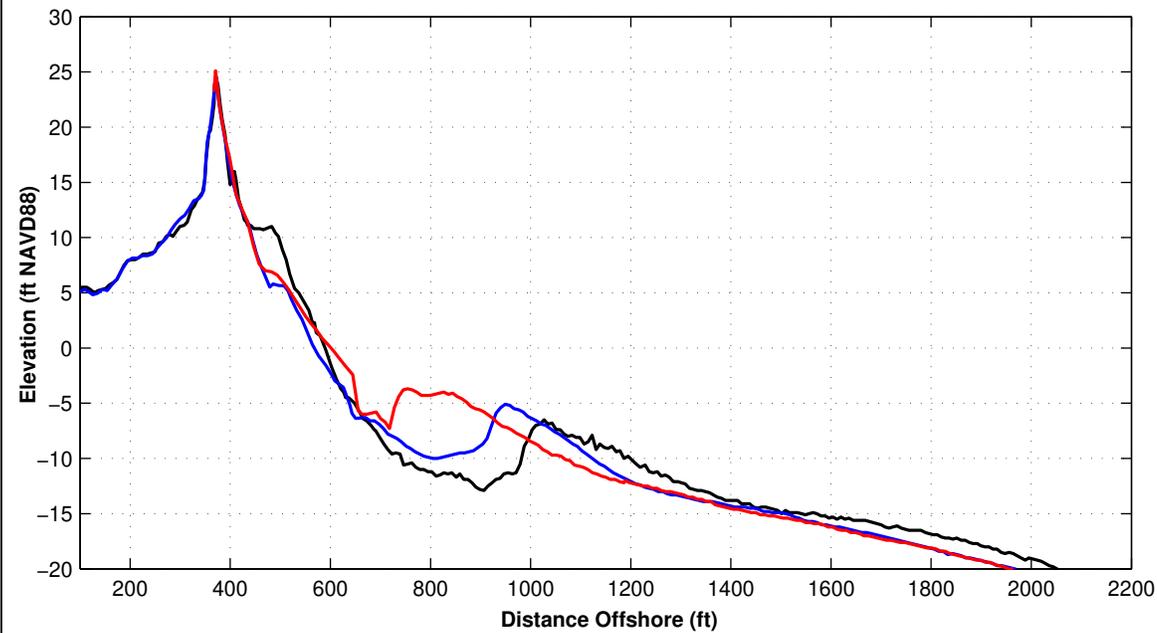
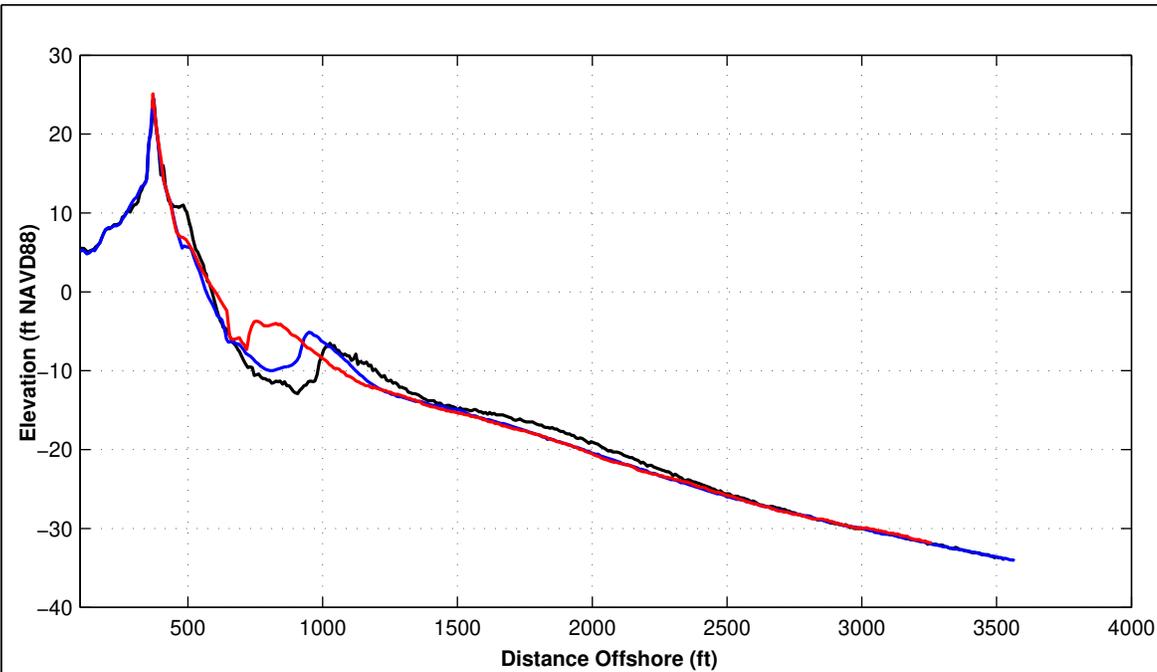


Survey Transect 545+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-9.31 ft	-8.67 ft
Volume Change Above +6 ft NAVD88	-5.91 cy/ft	1.12 cy/ft
Volume Change Above 1.18 ft NAVD88	-8.01 cy/ft	-0.54 cy/ft
Volume Change Above -6 ft NAVD88	-3.48 cy/ft	0.36 cy/ft
Volume Change Above -14 ft NAVD88	14.48 cy/ft	18.19 cy/ft
Volume Change Above -19 ft NAVD88	-6.47 cy/ft	17.06 cy/ft
Volume Change Above -30 ft NAVD88	-25.20 cy/ft	13.75 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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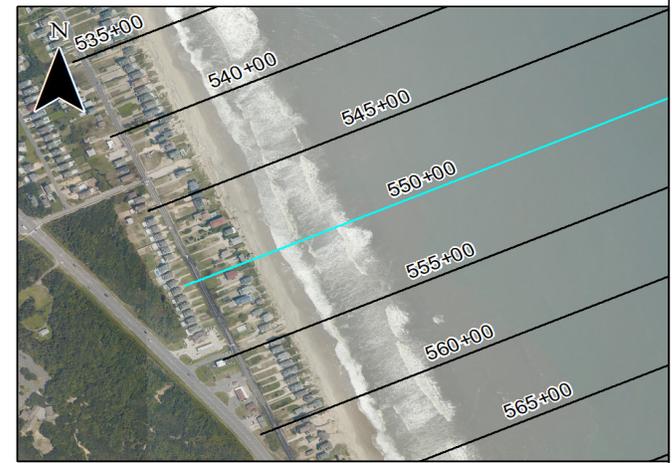


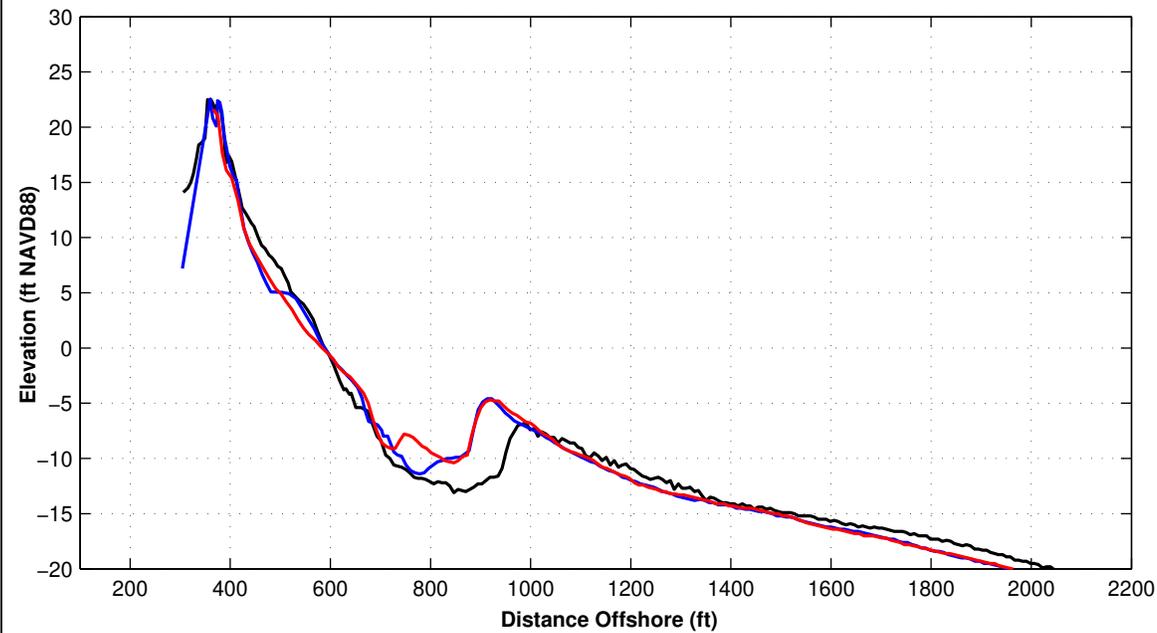
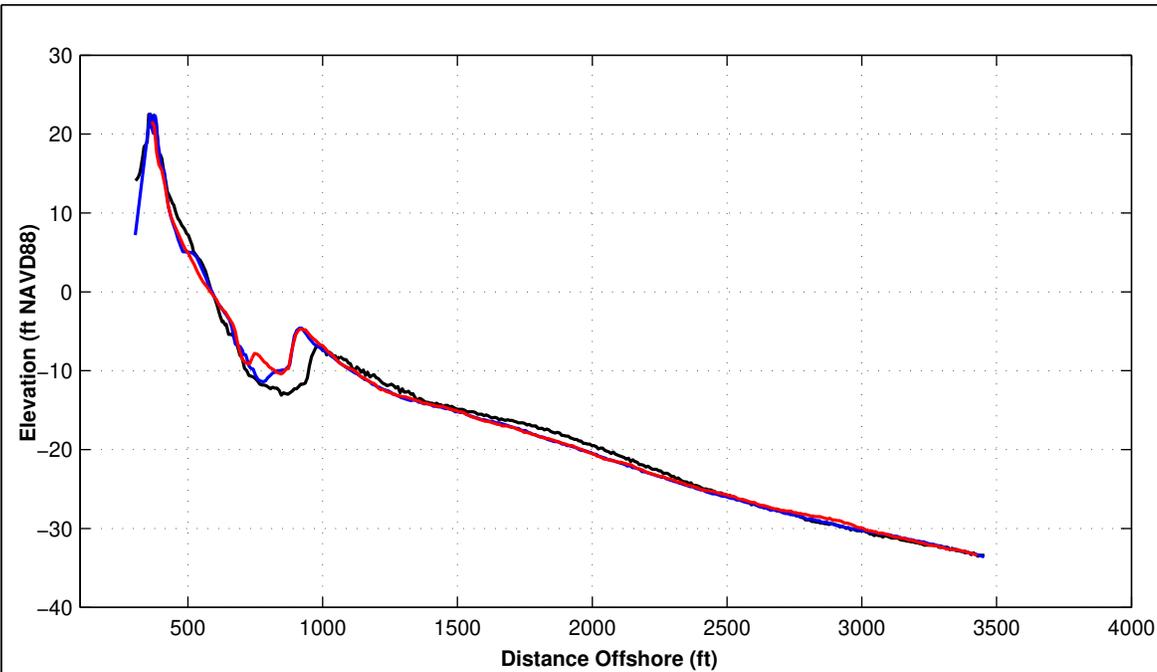
Survey Transect 550+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-21.25 ft	22.75 ft
Volume Change Above +6 ft NAVD88	-9.55 cy/ft	1.28 cy/ft
Volume Change Above 1.18 ft NAVD88	-13.59 cy/ft	3.40 cy/ft
Volume Change Above -6 ft NAVD88	-15.25 cy/ft	20.41 cy/ft
Volume Change Above -14 ft NAVD88	-0.55 cy/ft	31.97 cy/ft
Volume Change Above -19 ft NAVD88	-18.56 cy/ft	28.62 cy/ft
Volume Change Above -30 ft NAVD88	-37.88 cy/ft	28.44 cy/ft

LEGEND:

OCTOBER 2023	—	POST-DORIAN AD	—
JUNE 2023	—	JUNE 2022	—

- Notes:
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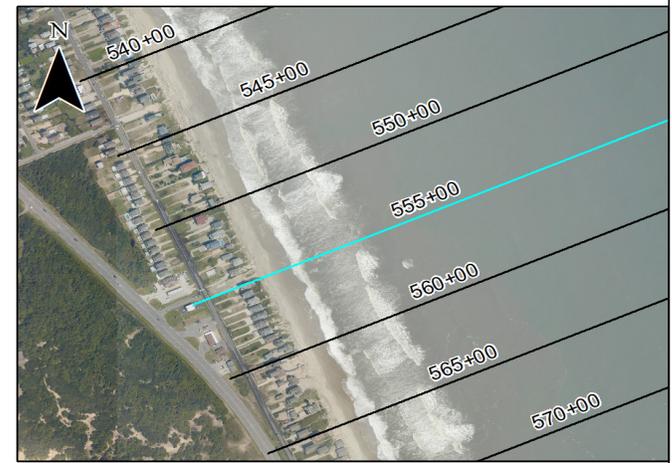


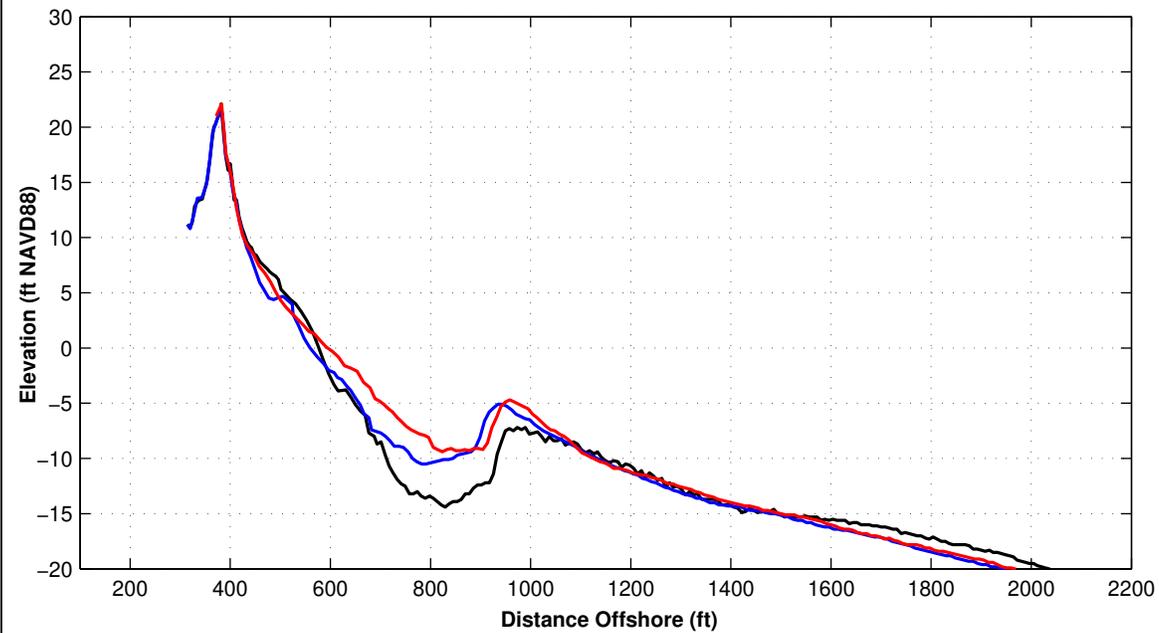
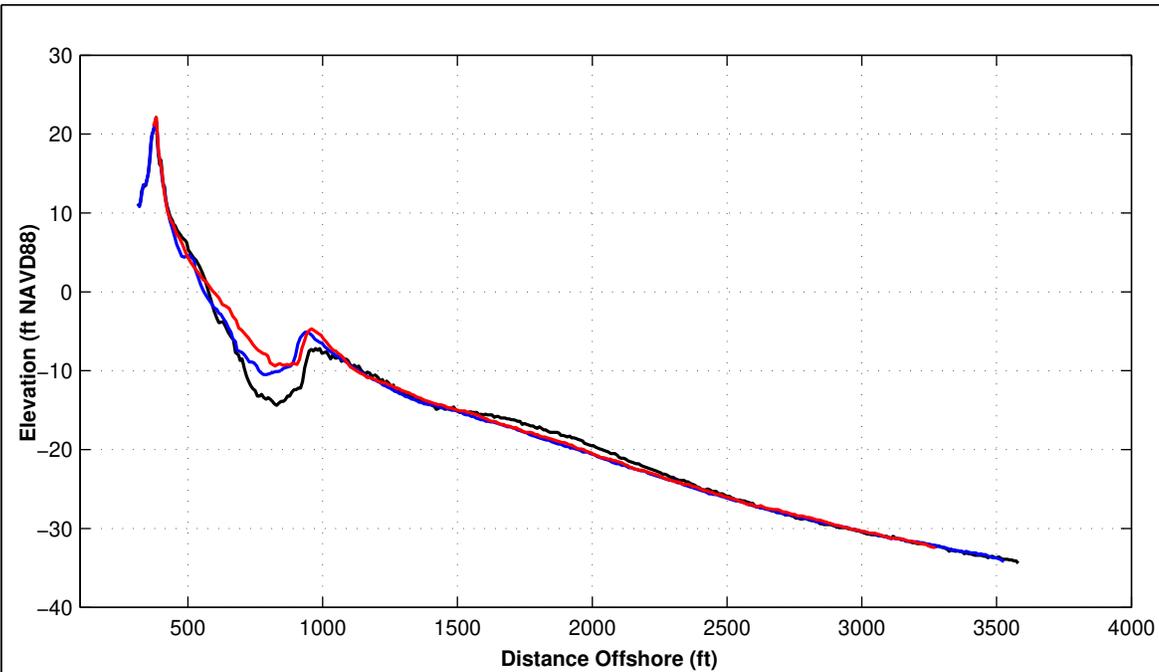


Survey Transect 555+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-3.71 ft	-15.44 ft
Volume Change Above +6 ft NAVD88	-6.77 cy/ft	-1.89 cy/ft
Volume Change Above 1.18 ft NAVD88	-9.25 cy/ft	-4.36 cy/ft
Volume Change Above -6 ft NAVD88	-4.44 cy/ft	-3.76 cy/ft
Volume Change Above -14 ft NAVD88	13.08 cy/ft	3.71 cy/ft
Volume Change Above -19 ft NAVD88	-0.68 cy/ft	3.36 cy/ft
Volume Change Above -30 ft NAVD88	-15.58 cy/ft	11.79 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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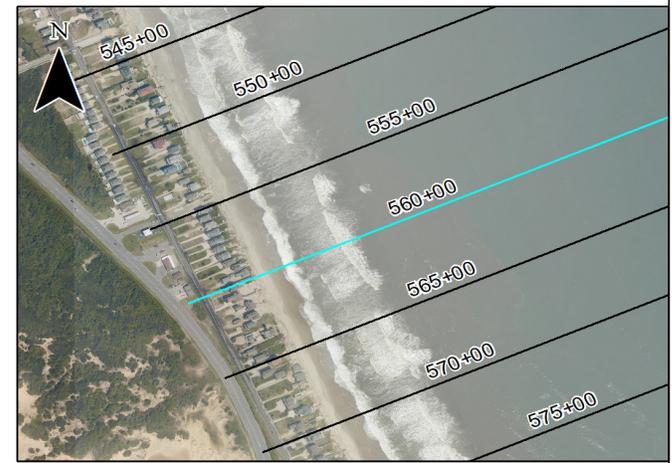


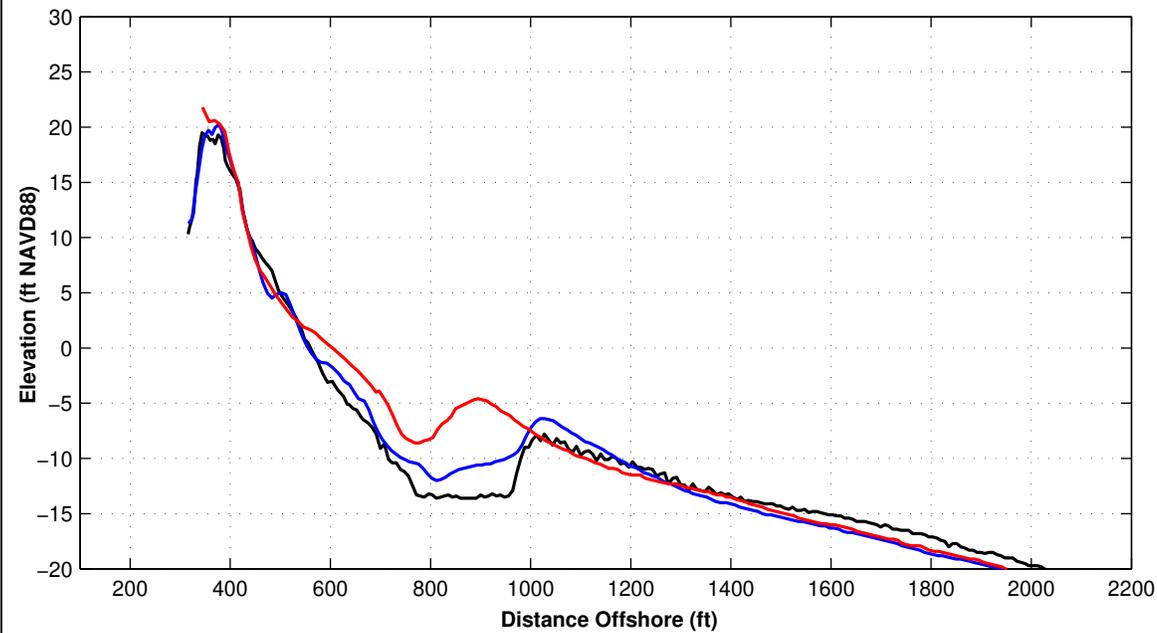
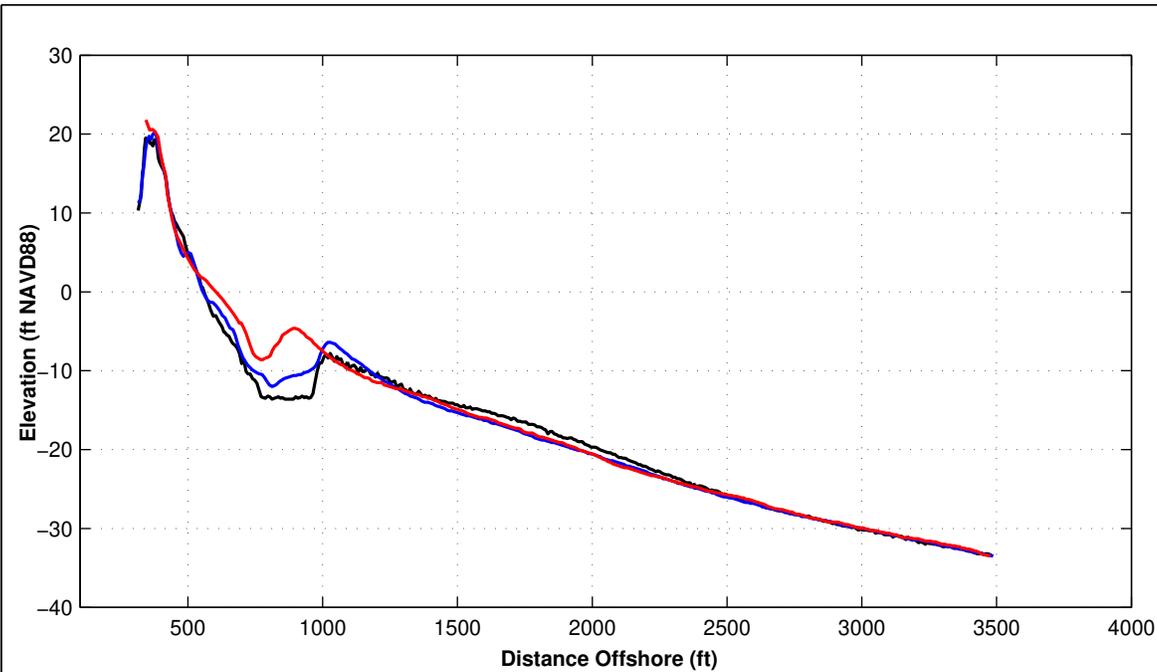


Survey Transect 560+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-22.00 ft	25.13 ft
Volume Change Above +6 ft NAVD88	-2.78 cy/ft	1.49 cy/ft
Volume Change Above 1.18 ft NAVD88	-6.90 cy/ft	2.73 cy/ft
Volume Change Above -6 ft NAVD88	-5.26 cy/ft	14.68 cy/ft
Volume Change Above -14 ft NAVD88	28.06 cy/ft	29.34 cy/ft
Volume Change Above -19 ft NAVD88	14.12 cy/ft	33.40 cy/ft
Volume Change Above -30 ft NAVD88	-1.40 cy/ft	39.31 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

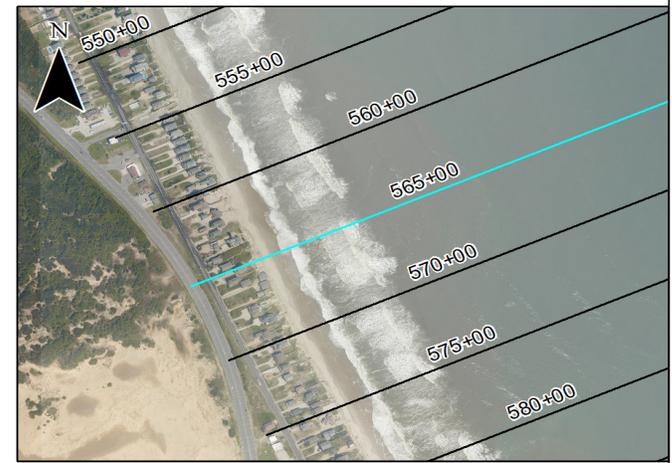


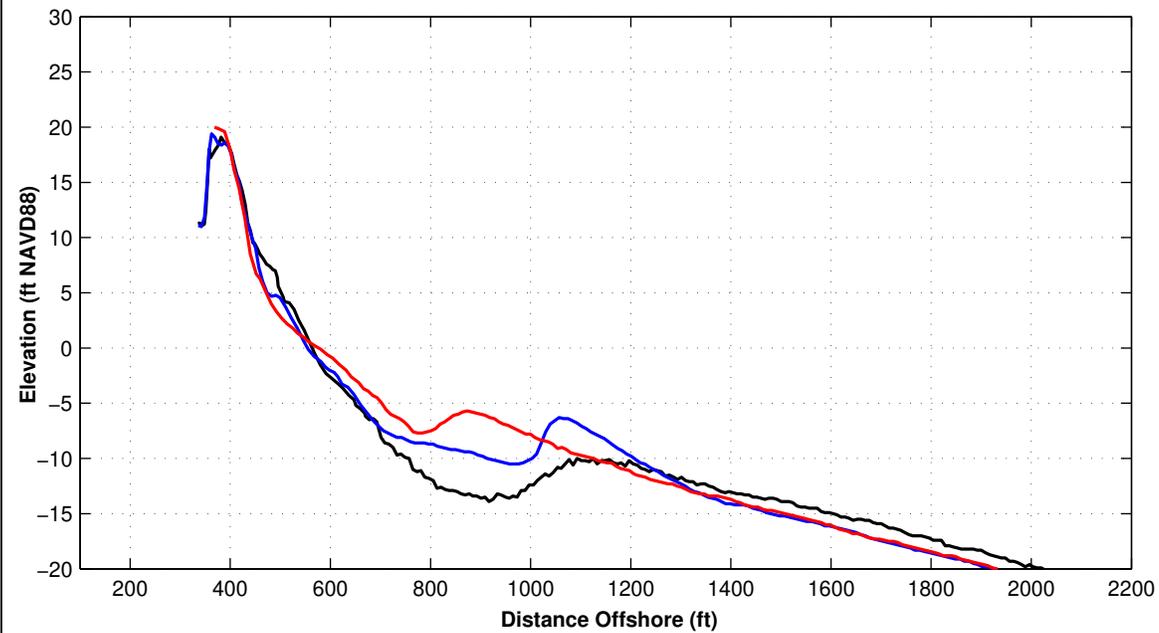
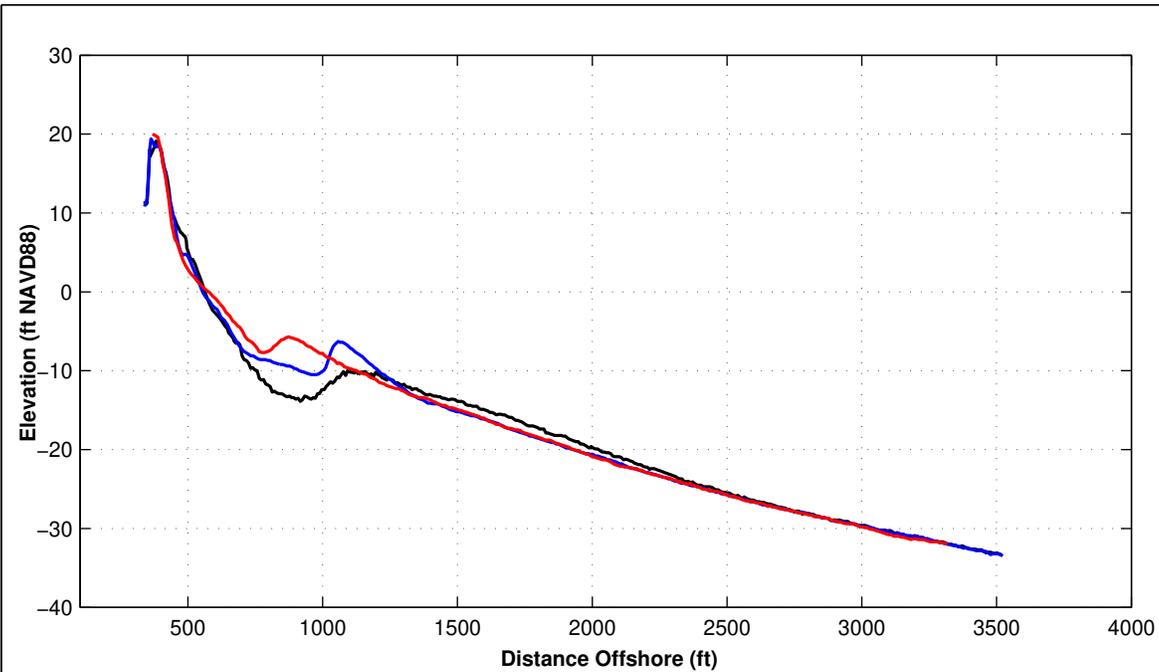


Survey Transect 565+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-2.68 ft	31.12 ft
Volume Change Above +6 ft NAVD88	-0.99 cy/ft	0.43 cy/ft
Volume Change Above 1.18 ft NAVD88	-1.94 cy/ft	0.70 cy/ft
Volume Change Above -6 ft NAVD88	2.89 cy/ft	16.24 cy/ft
Volume Change Above -14 ft NAVD88	30.53 cy/ft	45.93 cy/ft
Volume Change Above -19 ft NAVD88	9.60 cy/ft	51.38 cy/ft
Volume Change Above -30 ft NAVD88	-6.16 cy/ft	54.55 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.





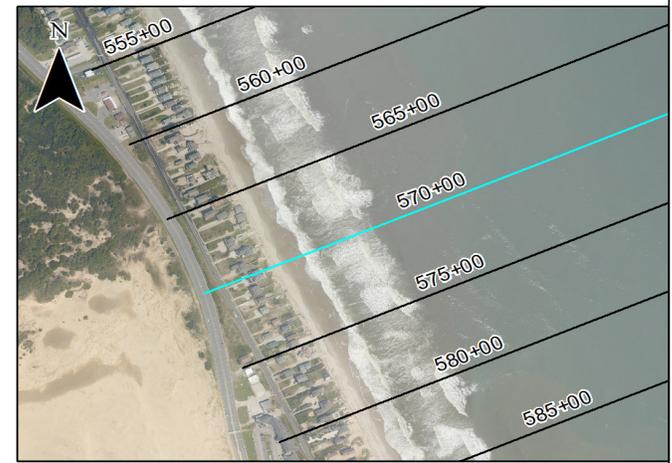
Survey Transect 570+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-11.51 ft	-0.95 ft
Volume Change Above +6 ft NAVD88	-3.04 cy/ft	-1.15 cy/ft
Volume Change Above 1.18 ft NAVD88	-5.86 cy/ft	-3.64 cy/ft
Volume Change Above -6 ft NAVD88	-4.76 cy/ft	4.73 cy/ft
Volume Change Above -14 ft NAVD88	43.38 cy/ft	17.47 cy/ft
Volume Change Above -19 ft NAVD88	22.82 cy/ft	19.51 cy/ft
Volume Change Above -30 ft NAVD88	5.42 cy/ft	18.12 cy/ft

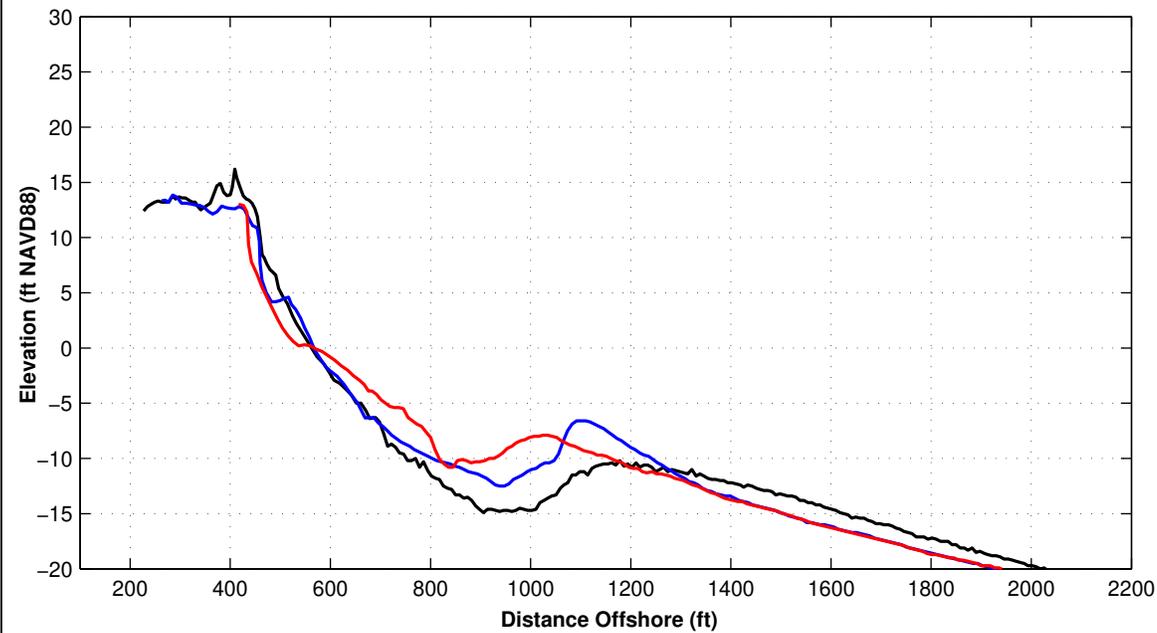
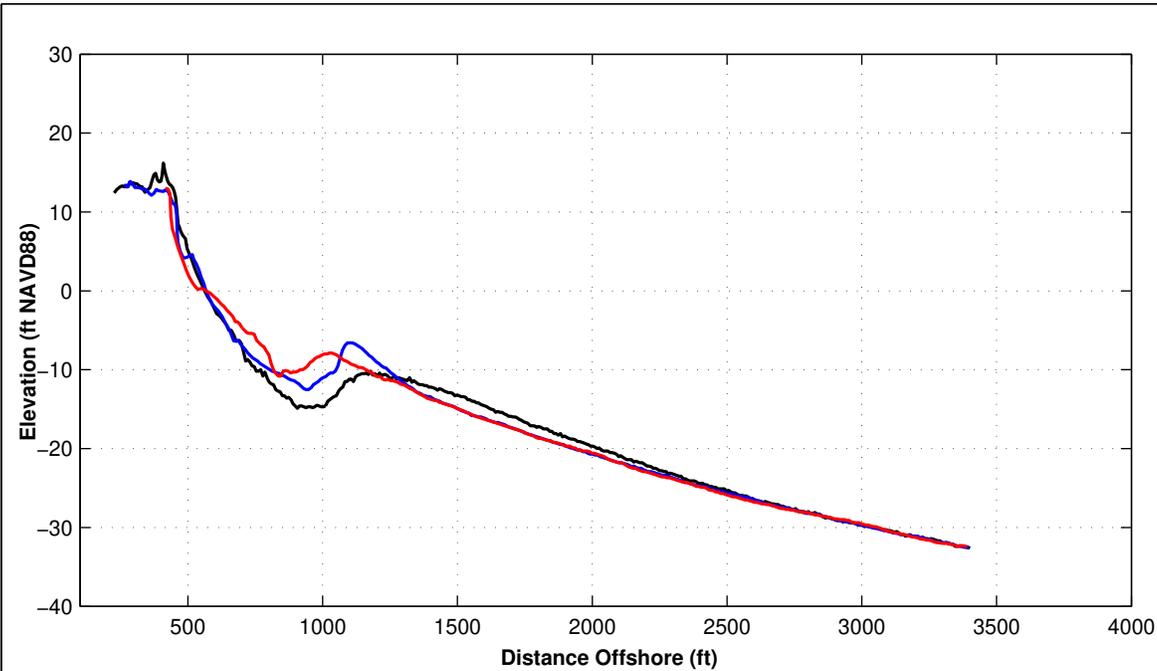
LEGEND:

OCTOBER 2023 — POST-DORIAN AD —

JUNE 2023 — JUNE 2022 —

- Notes:
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 2. All Survey Elevations In Feet Referenced to NAVD88.

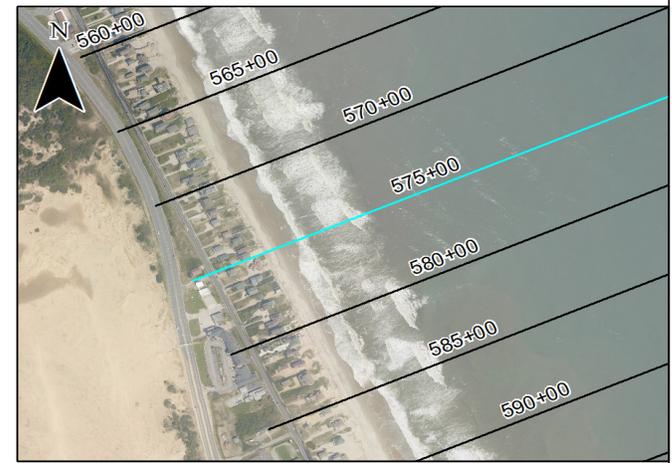


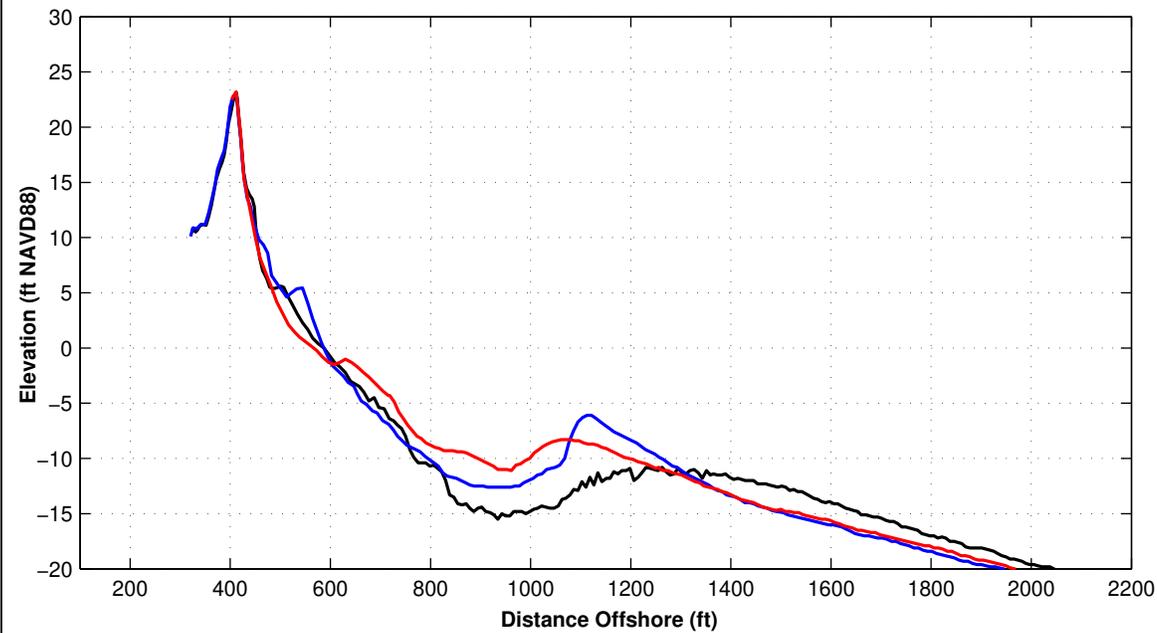
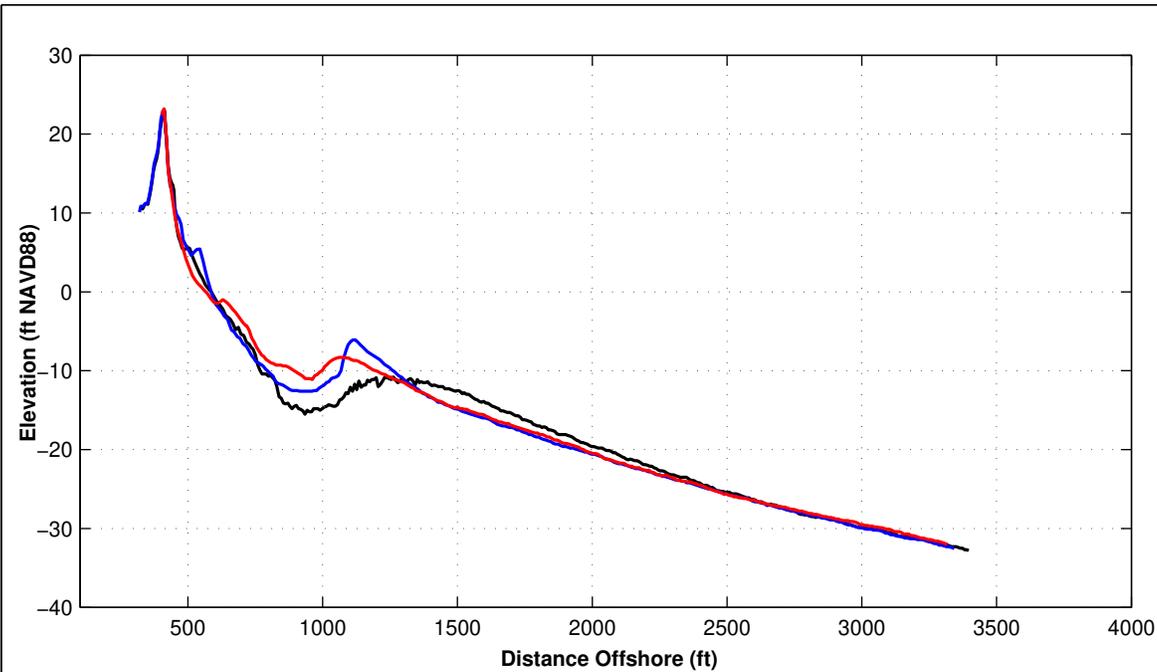


Survey Transect 575+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	9.31 ft	-41.51 ft
Volume Change Above +6 ft NAVD88	-5.73 cy/ft	-3.14 cy/ft
Volume Change Above 1.18 ft NAVD88	-6.17 cy/ft	-8.64 cy/ft
Volume Change Above -6 ft NAVD88	-5.41 cy/ft	-0.69 cy/ft
Volume Change Above -14 ft NAVD88	32.65 cy/ft	9.64 cy/ft
Volume Change Above -19 ft NAVD88	14.45 cy/ft	9.03 cy/ft
Volume Change Above -30 ft NAVD88	-2.08 cy/ft	6.29 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

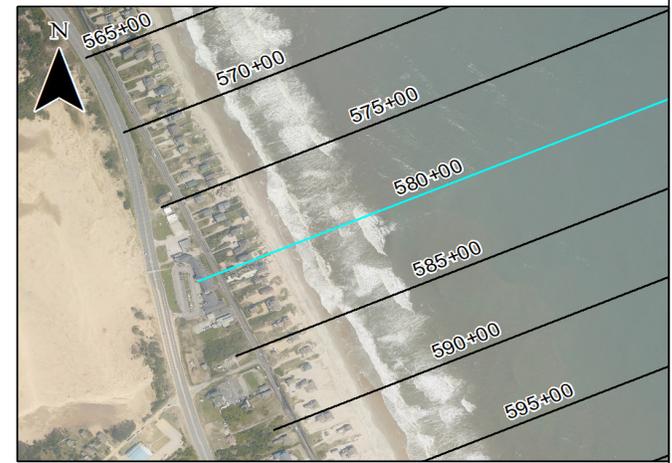


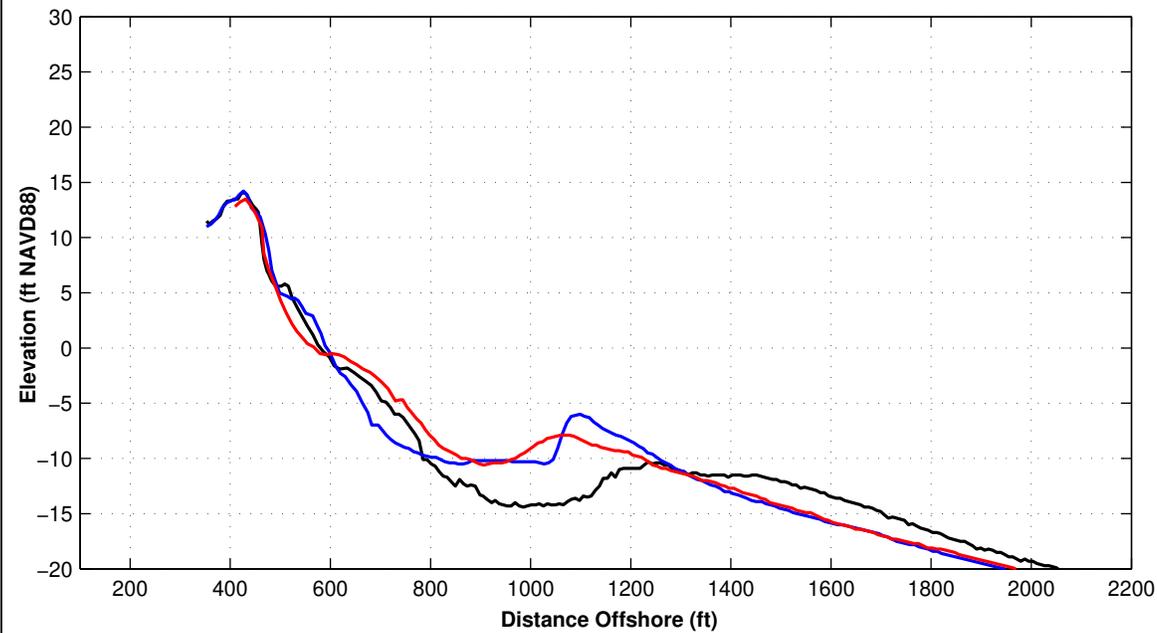
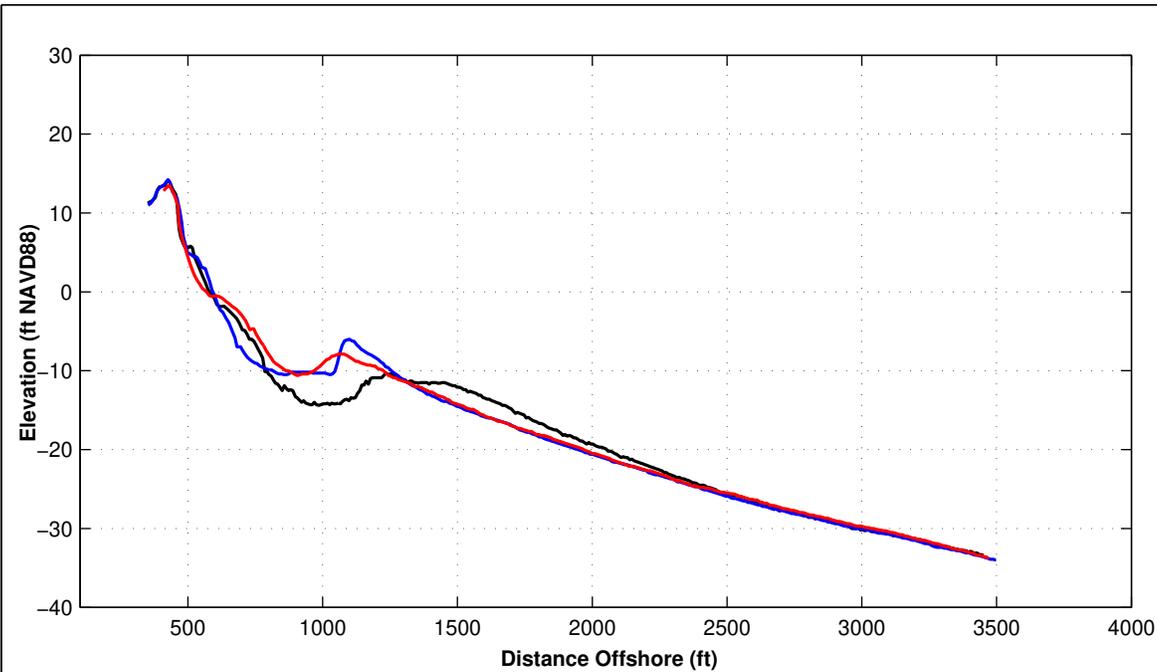


Survey Transect 580+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	15.43 ft	-42.07 ft
Volume Change Above +6 ft NAVD88	1.25 cy/ft	-2.13 cy/ft
Volume Change Above 1.18 ft NAVD88	5.47 cy/ft	-10.78 cy/ft
Volume Change Above -6 ft NAVD88	3.10 cy/ft	-3.54 cy/ft
Volume Change Above -14 ft NAVD88	36.45 cy/ft	9.89 cy/ft
Volume Change Above -19 ft NAVD88	16.21 cy/ft	15.04 cy/ft
Volume Change Above -30 ft NAVD88	-1.84 cy/ft	22.17 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

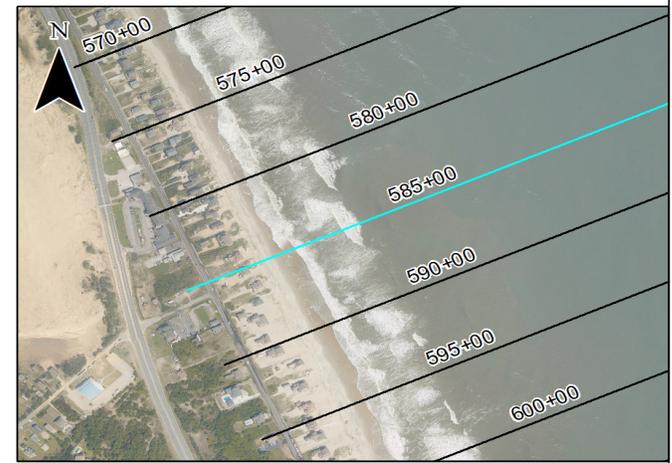


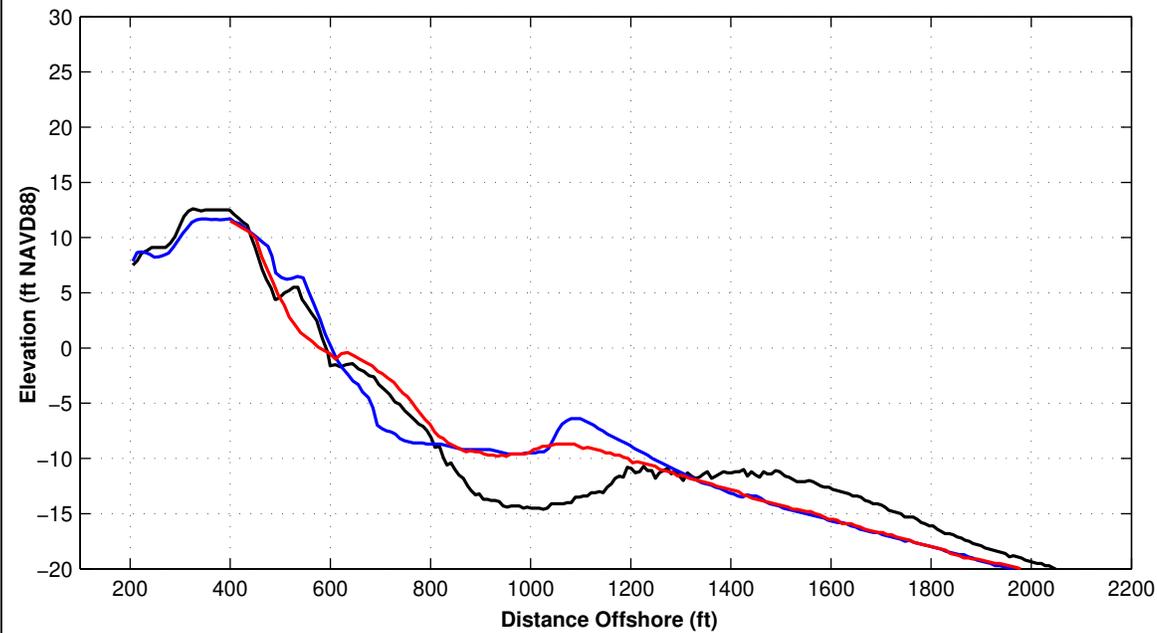
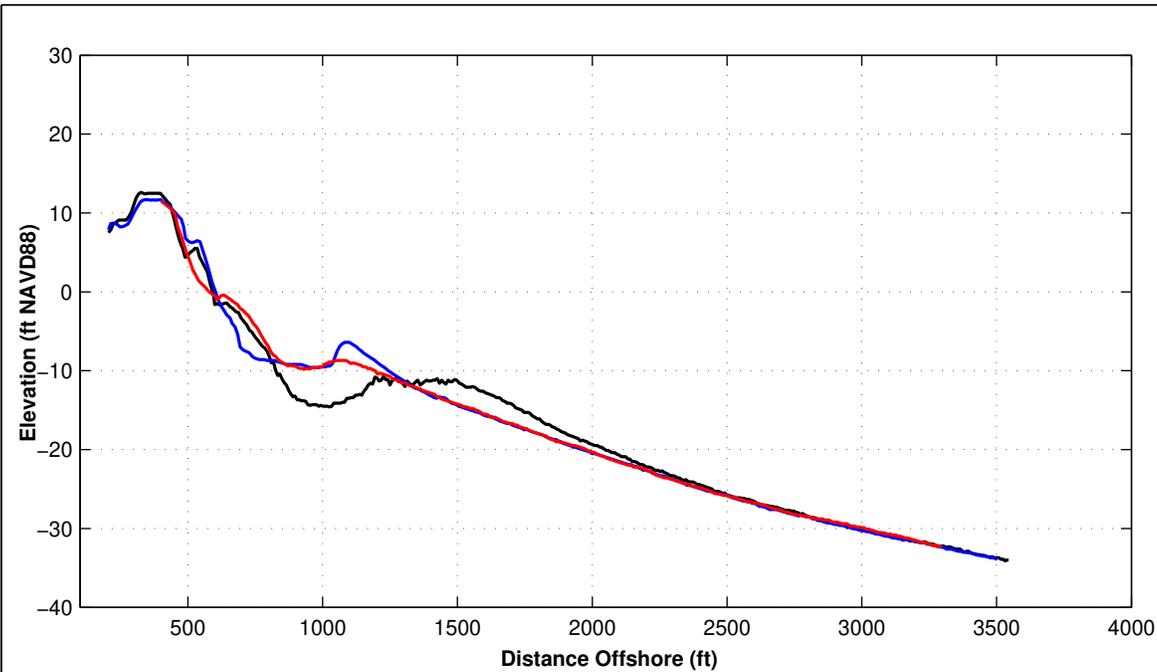


Survey Transect 585+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	16.59 ft	-42.29 ft
Volume Change Above +6 ft NAVD88	1.84 cy/ft	-2.25 cy/ft
Volume Change Above 1.18 ft NAVD88	3.00 cy/ft	-7.88 cy/ft
Volume Change Above -6 ft NAVD88	-1.95 cy/ft	2.64 cy/ft
Volume Change Above -14 ft NAVD88	35.75 cy/ft	10.63 cy/ft
Volume Change Above -19 ft NAVD88	10.81 cy/ft	13.12 cy/ft
Volume Change Above -30 ft NAVD88	-9.60 cy/ft	24.52 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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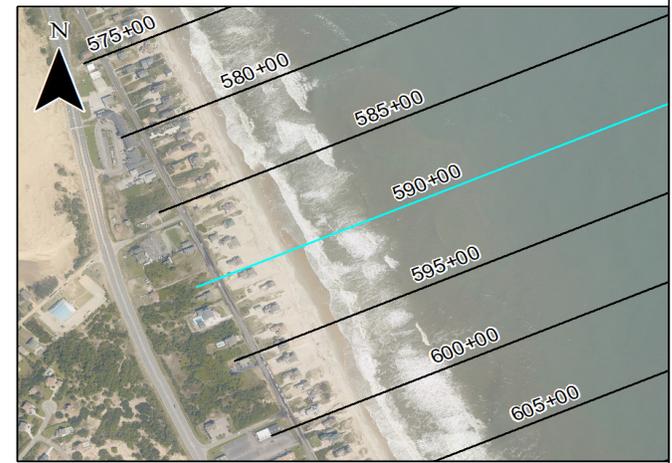


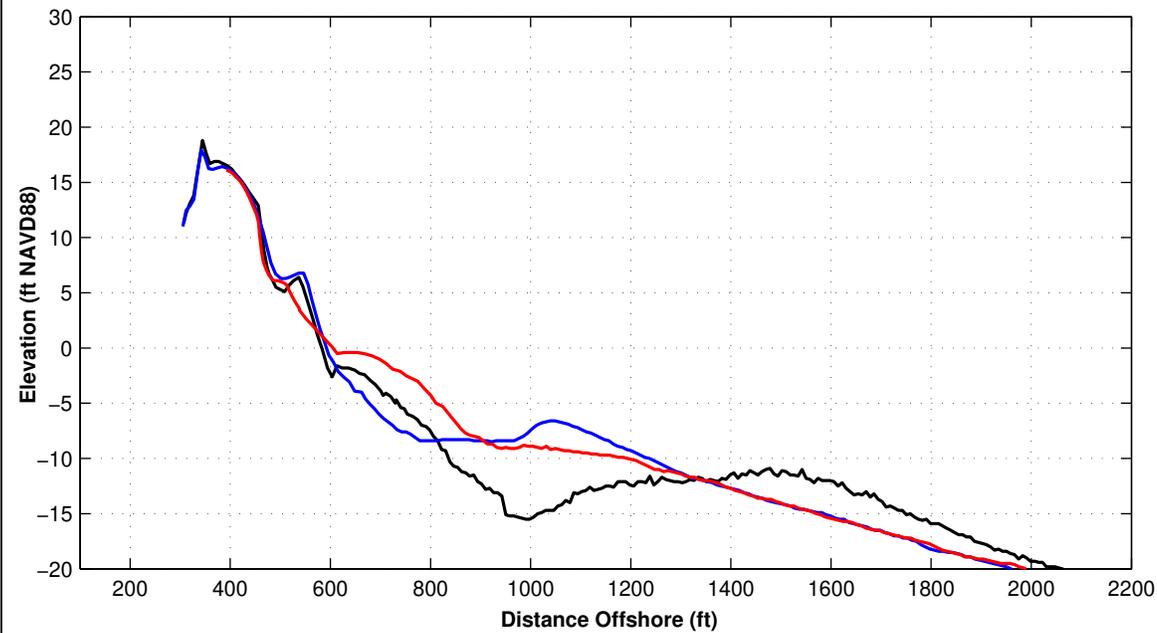
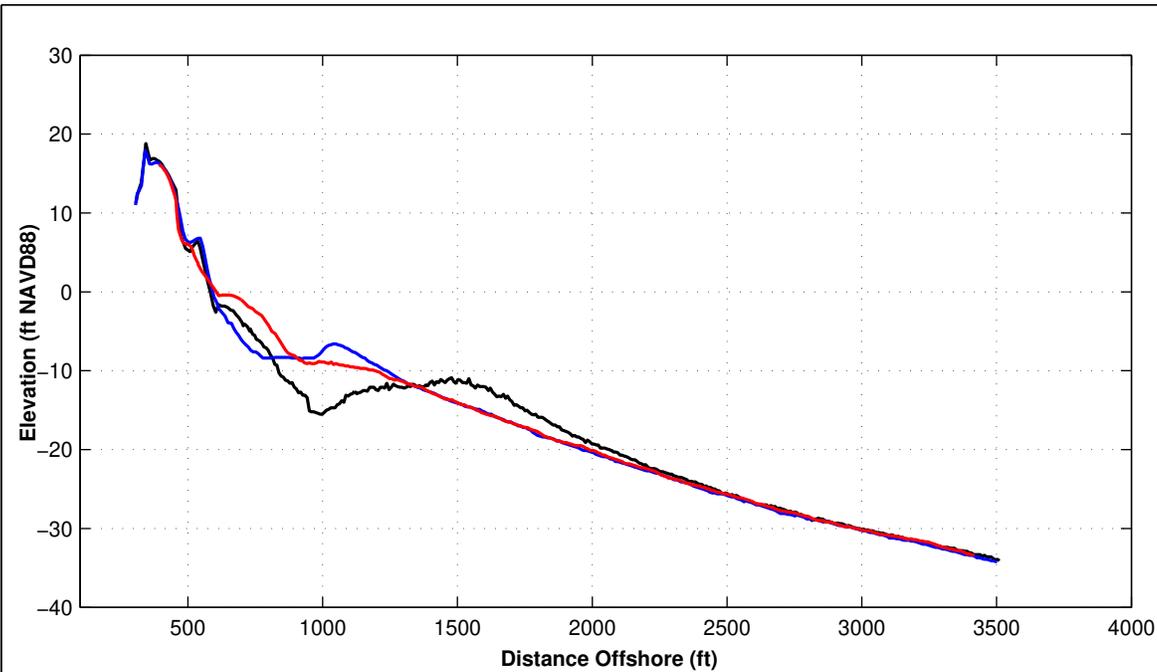


Survey Transect 590+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	8.63 ft	-43.60 ft
Volume Change Above +6 ft NAVD88	4.05 cy/ft	-3.28 cy/ft
Volume Change Above 1.18 ft NAVD88	8.50 cy/ft	-13.79 cy/ft
Volume Change Above -6 ft NAVD88	1.97 cy/ft	-1.17 cy/ft
Volume Change Above -14 ft NAVD88	42.87 cy/ft	-5.38 cy/ft
Volume Change Above -19 ft NAVD88	17.09 cy/ft	-4.04 cy/ft
Volume Change Above -30 ft NAVD88	-0.40 cy/ft	-1.10 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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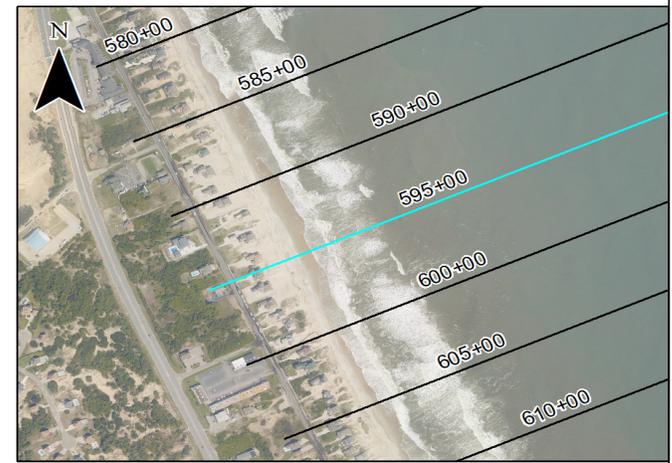


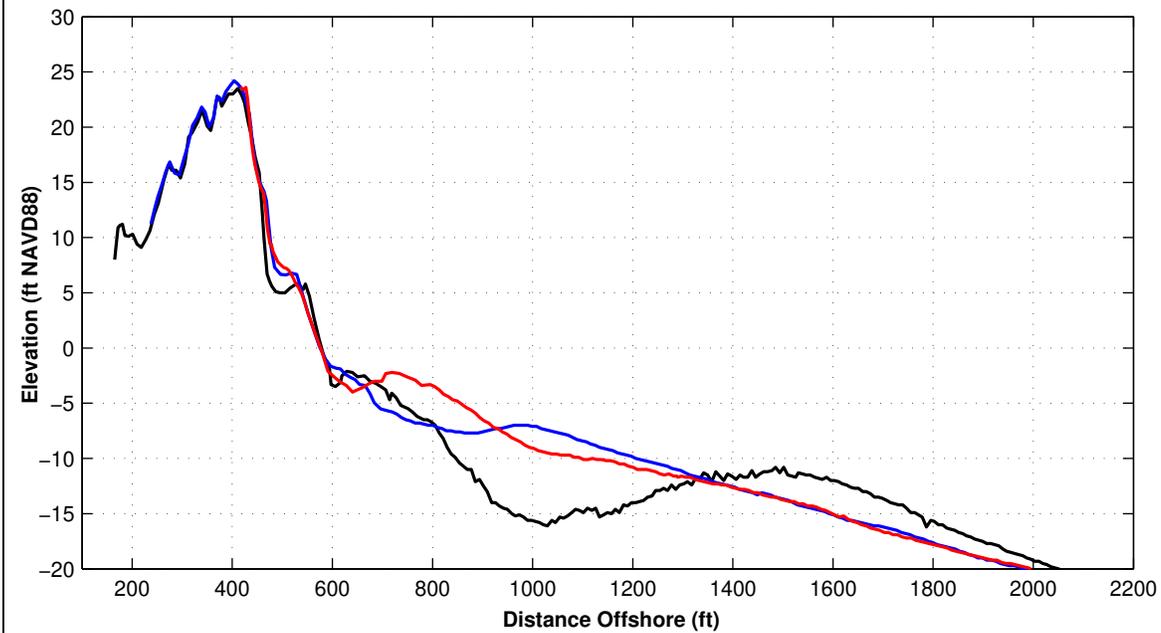
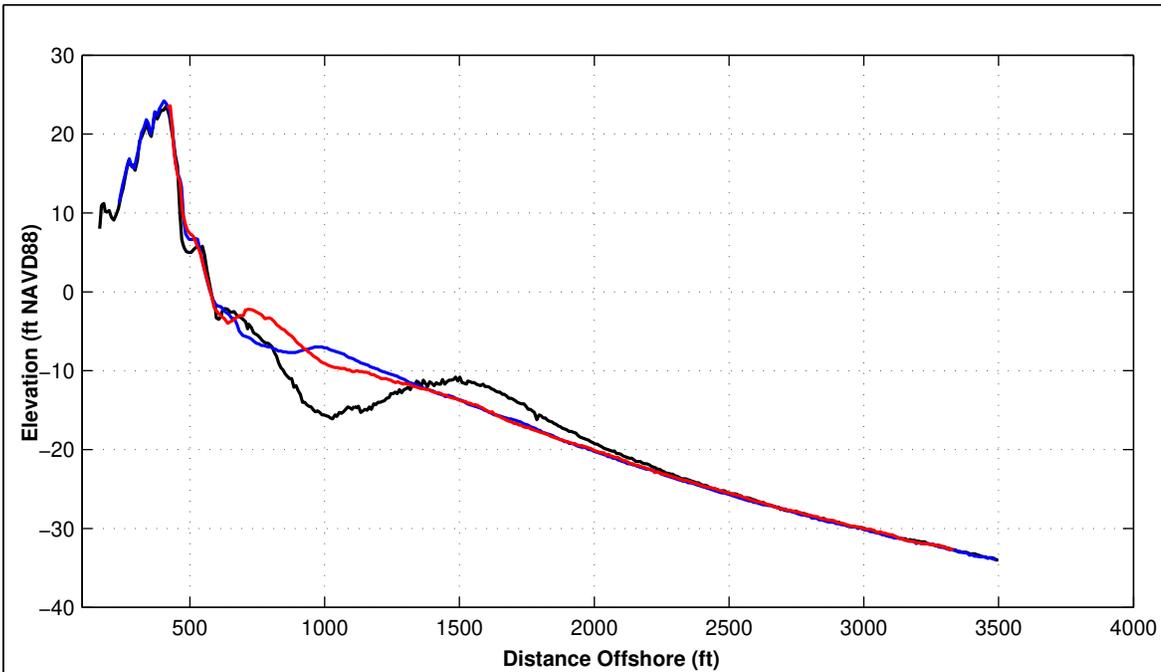


Survey Transect 595+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	9.16 ft	-1.94 ft
Volume Change Above +6 ft NAVD88	1.86 cy/ft	-3.71 cy/ft
Volume Change Above 1.18 ft NAVD88	4.31 cy/ft	-8.71 cy/ft
Volume Change Above -6 ft NAVD88	-1.91 cy/ft	17.56 cy/ft
Volume Change Above -14 ft NAVD88	47.26 cy/ft	11.20 cy/ft
Volume Change Above -19 ft NAVD88	24.05 cy/ft	11.52 cy/ft
Volume Change Above -30 ft NAVD88	5.12 cy/ft	17.98 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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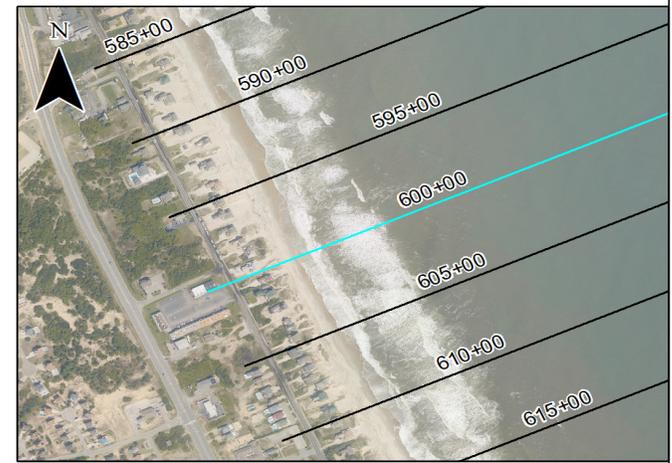


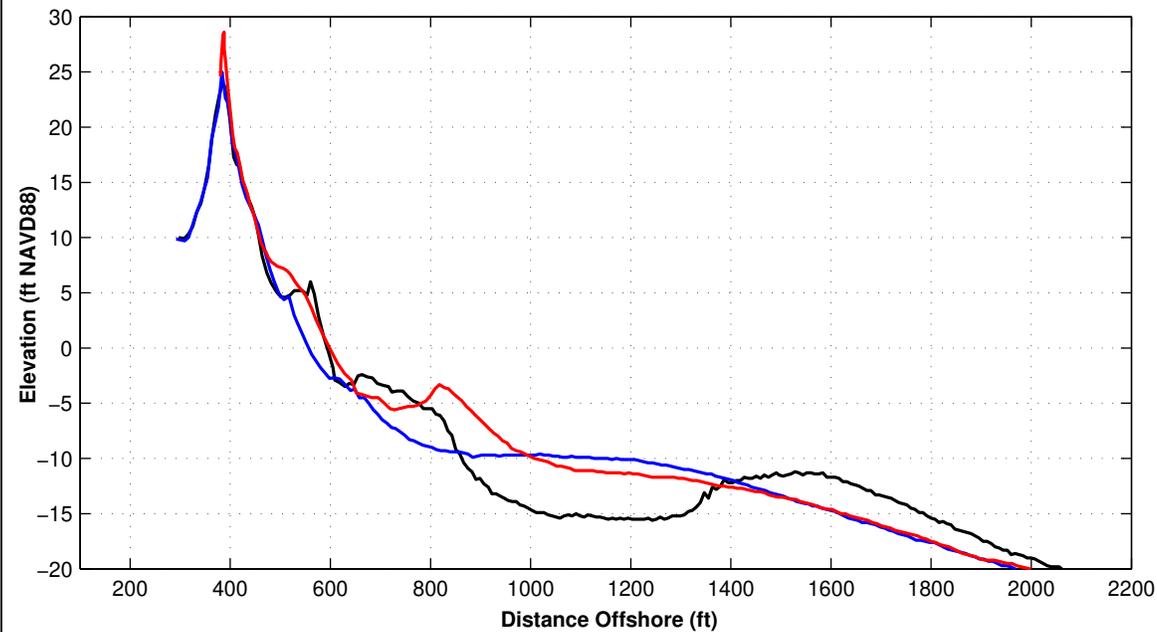
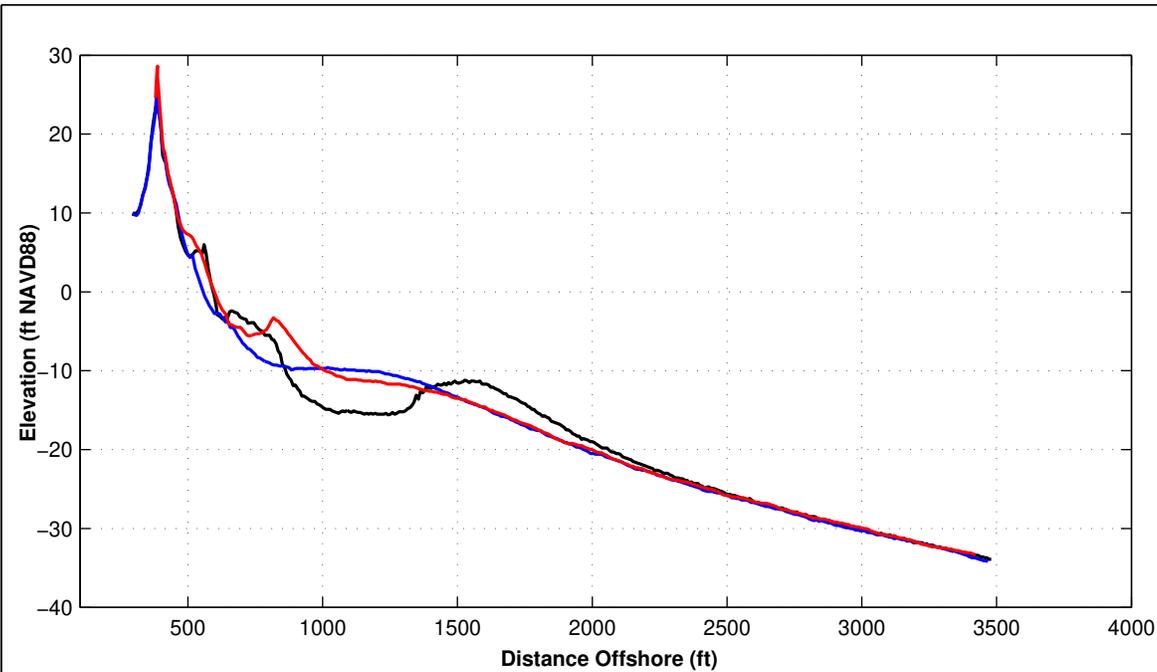


Survey Transect 600+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-5.62 ft	0.65 ft
Volume Change Above +6 ft NAVD88	6.56 cy/ft	0.20 cy/ft
Volume Change Above 1.18 ft NAVD88	6.40 cy/ft	-0.01 cy/ft
Volume Change Above -6 ft NAVD88	2.26 cy/ft	15.59 cy/ft
Volume Change Above -14 ft NAVD88	64.88 cy/ft	5.60 cy/ft
Volume Change Above -19 ft NAVD88	50.62 cy/ft	4.23 cy/ft
Volume Change Above -30 ft NAVD88	36.49 cy/ft	9.94 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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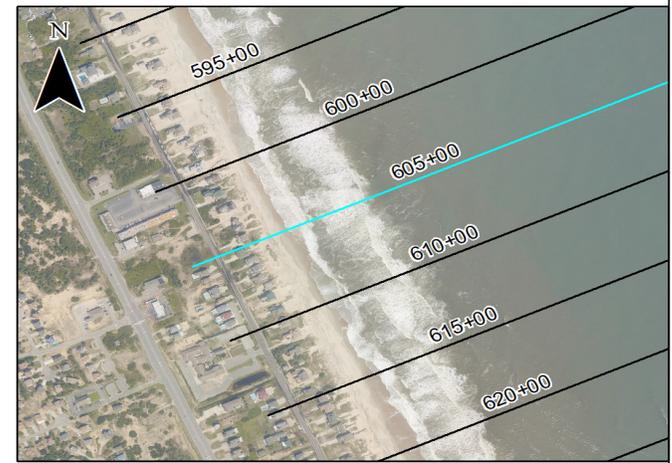


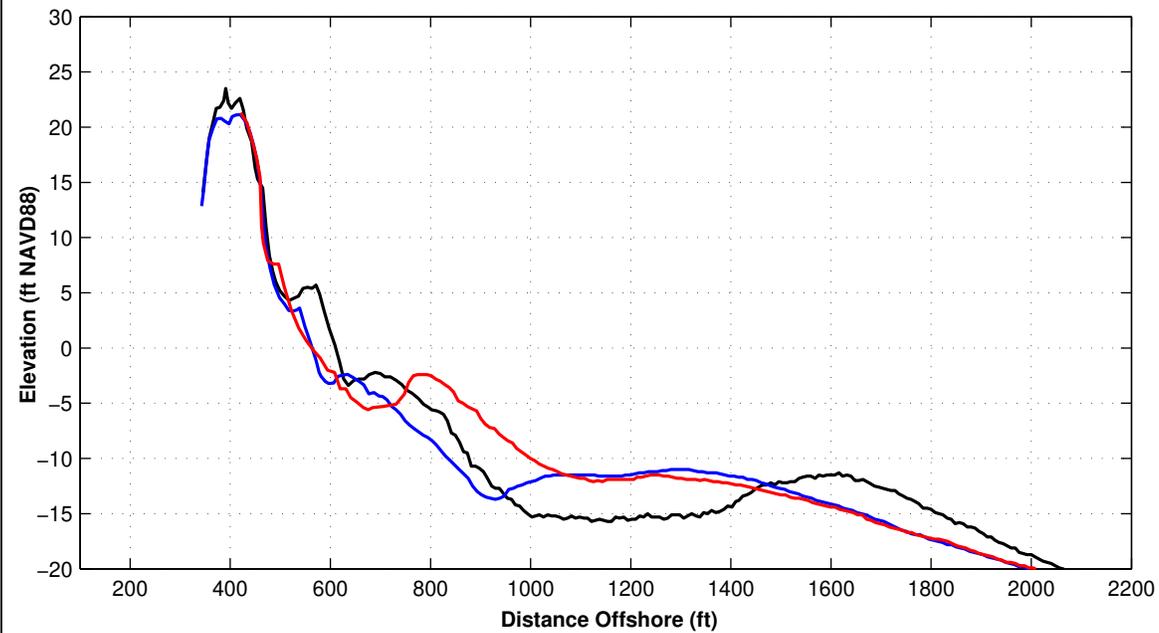
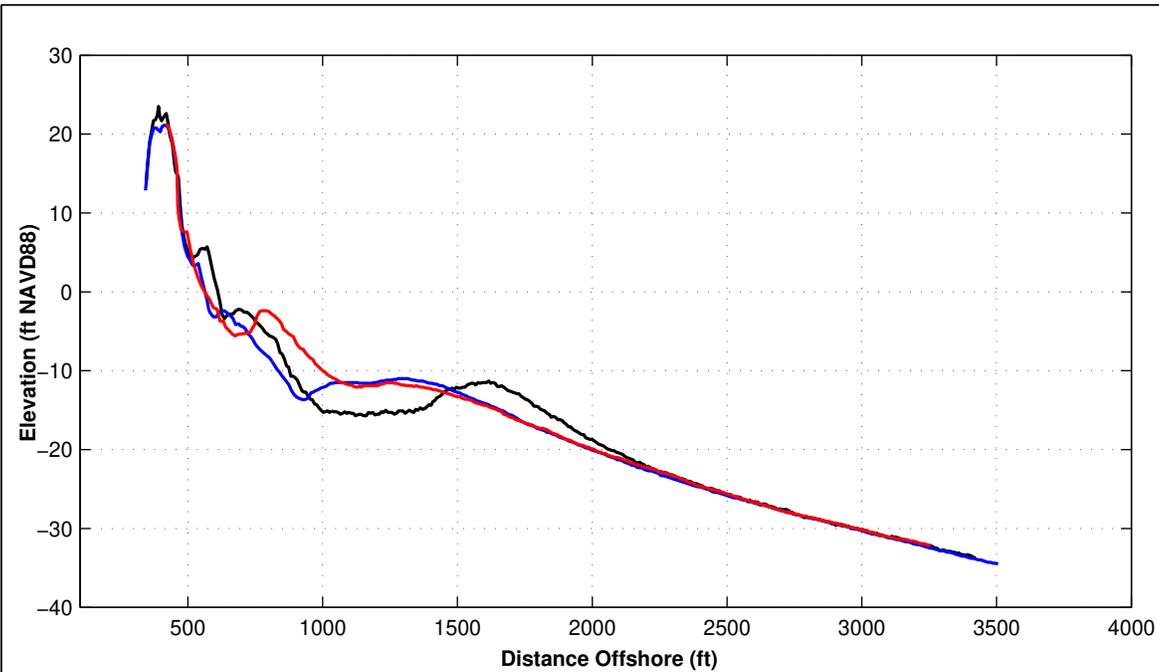
Survey Transect 605+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-40.84 ft	40.72 ft
Volume Change Above +6 ft NAVD88	1.23 cy/ft	3.13 cy/ft
Volume Change Above 1.18 ft NAVD88	-5.65 cy/ft	10.54 cy/ft
Volume Change Above -6 ft NAVD88	-20.58 cy/ft	26.72 cy/ft
Volume Change Above -14 ft NAVD88	15.47 cy/ft	35.06 cy/ft
Volume Change Above -19 ft NAVD88	4.99 cy/ft	36.93 cy/ft
Volume Change Above -30 ft NAVD88	-13.61 cy/ft	44.73 cy/ft

LEGEND:

OCTOBER 2023	—	POST-DORIAN AD	—
JUNE 2023	—	JUNE 2022	—

- Notes:
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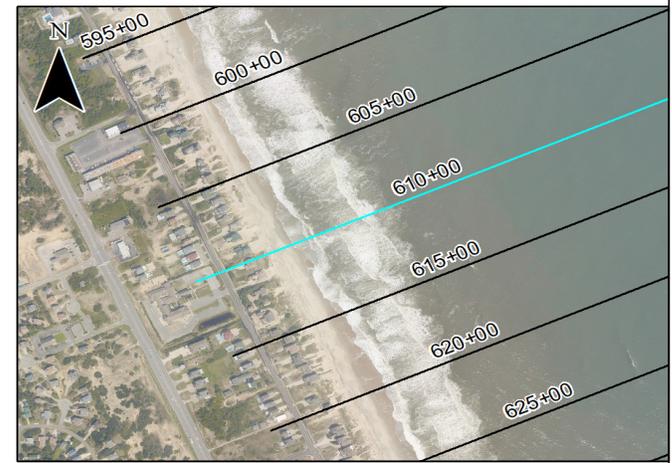


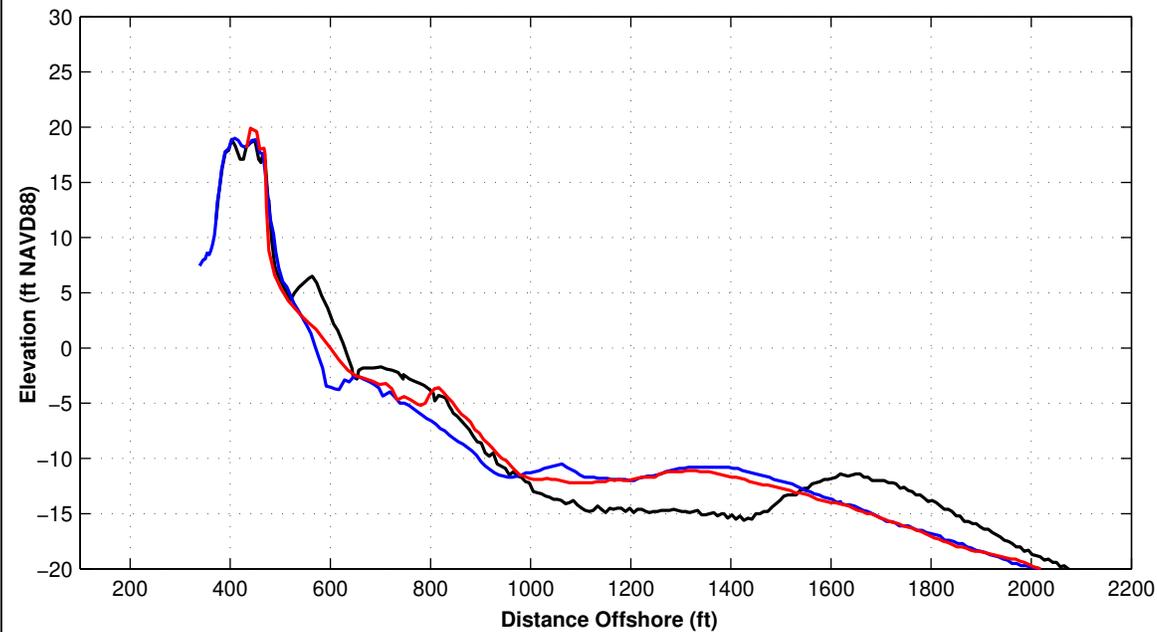
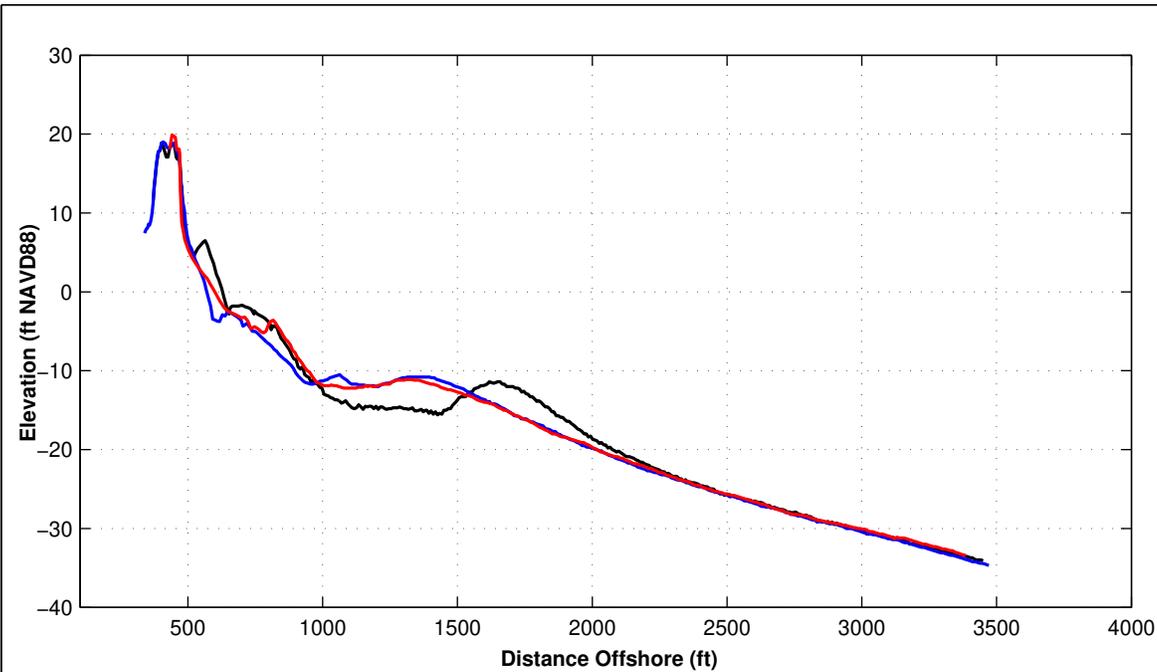


Survey Transect 610+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-46.98 ft	-10.06 ft
Volume Change Above +6 ft NAVD88	-1.34 cy/ft	0.61 cy/ft
Volume Change Above 1.18 ft NAVD88	-10.03 cy/ft	0.81 cy/ft
Volume Change Above -6 ft NAVD88	-26.01 cy/ft	10.61 cy/ft
Volume Change Above -14 ft NAVD88	-12.53 cy/ft	41.12 cy/ft
Volume Change Above -19 ft NAVD88	-18.23 cy/ft	40.41 cy/ft
Volume Change Above -30 ft NAVD88	-30.75 cy/ft	46.28 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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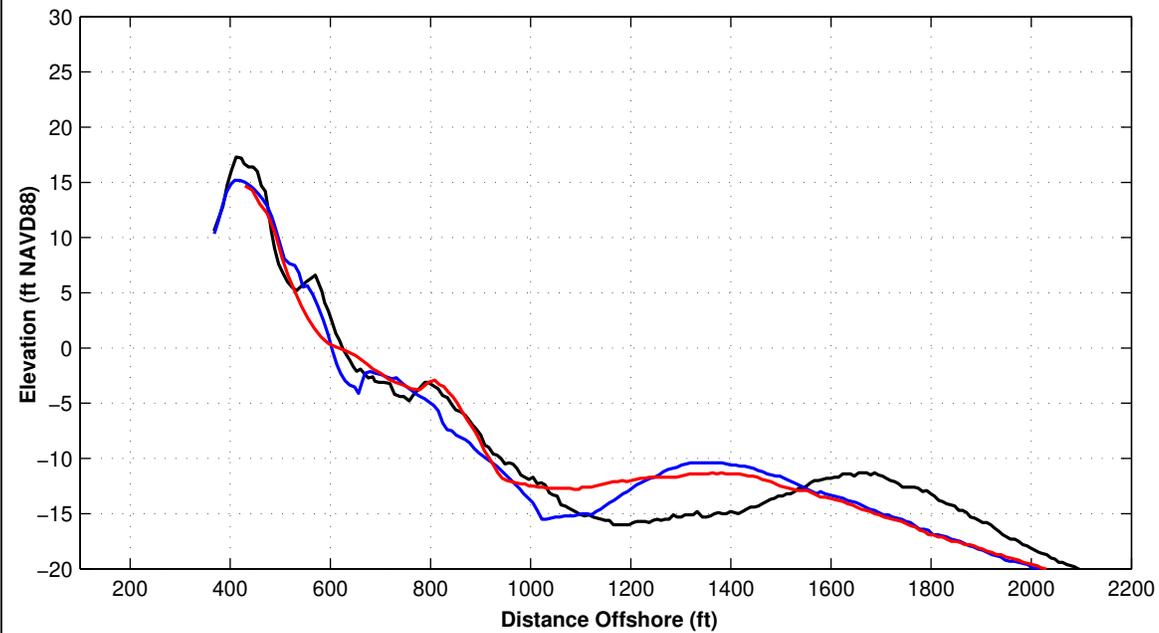
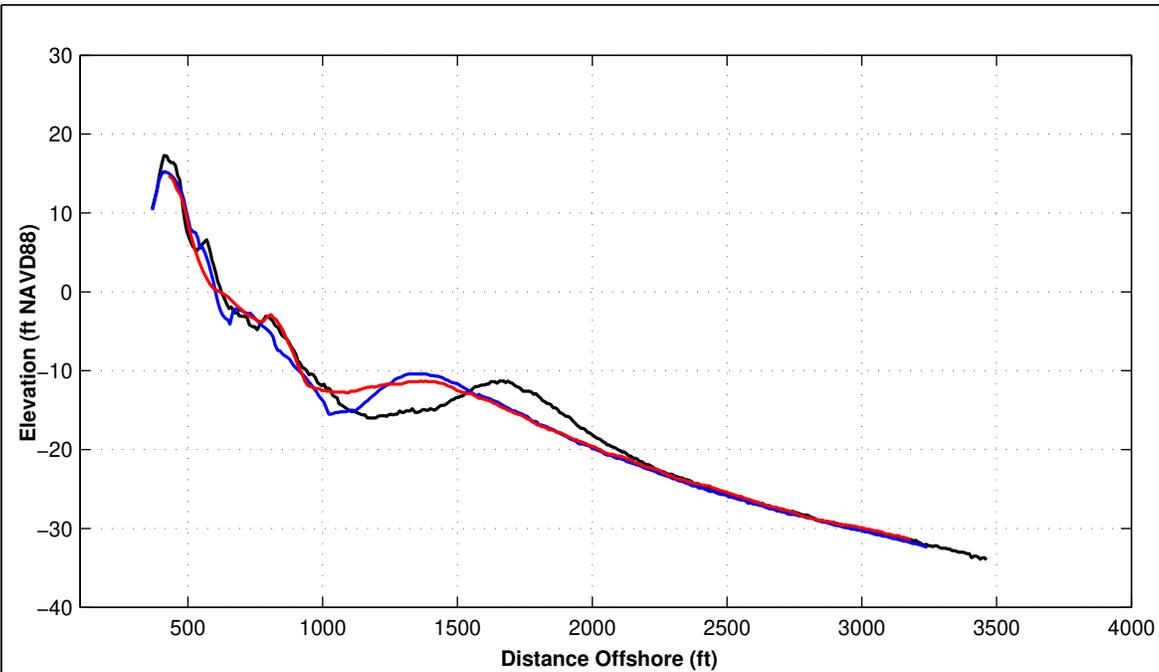


Survey Transect 615+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-56.41 ft	17.84 ft
Volume Change Above +6 ft NAVD88	1.89 cy/ft	-1.79 cy/ft
Volume Change Above 1.18 ft NAVD88	-7.47 cy/ft	-2.12 cy/ft
Volume Change Above -6 ft NAVD88	-30.60 cy/ft	11.02 cy/ft
Volume Change Above -14 ft NAVD88	-3.59 cy/ft	11.21 cy/ft
Volume Change Above -19 ft NAVD88	-16.12 cy/ft	9.91 cy/ft
Volume Change Above -30 ft NAVD88	-29.91 cy/ft	15.87 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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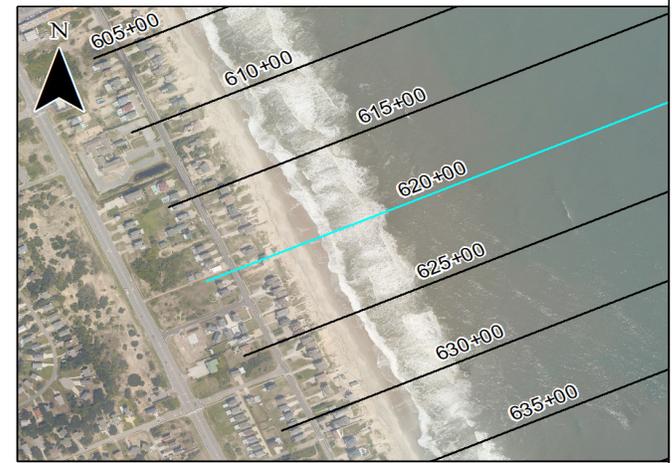


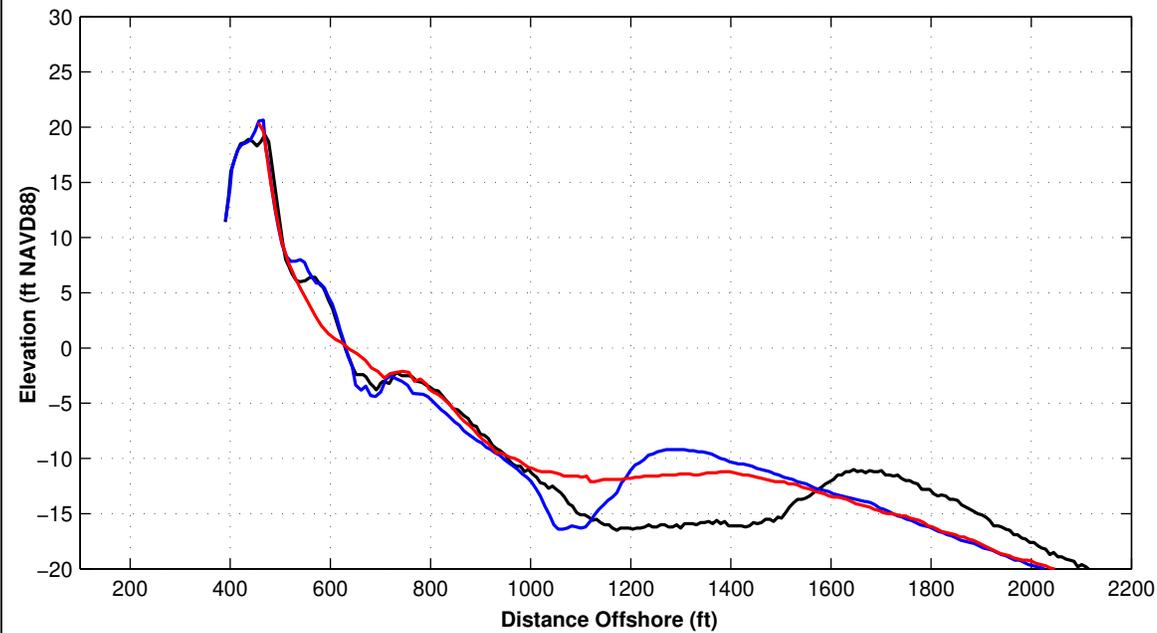
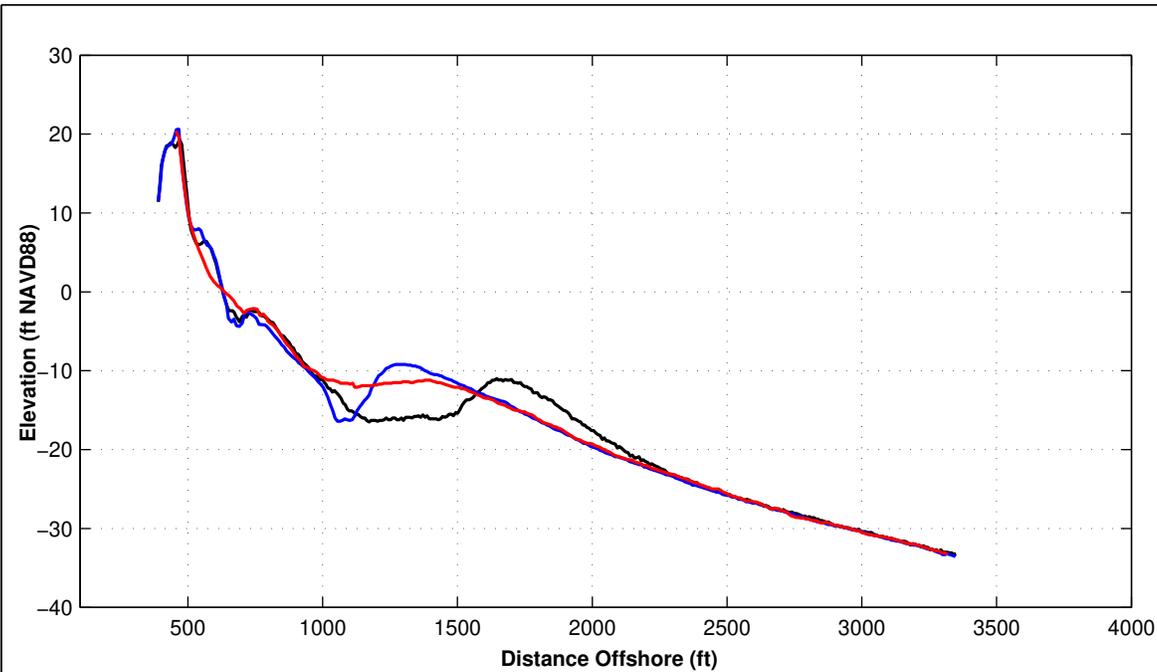


Survey Transect 620+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-16.76 ft	-17.14 ft
Volume Change Above +6 ft NAVD88	-0.32 cy/ft	-3.04 cy/ft
Volume Change Above 1.18 ft NAVD88	-3.16 cy/ft	-8.09 cy/ft
Volume Change Above -6 ft NAVD88	-9.48 cy/ft	3.08 cy/ft
Volume Change Above -14 ft NAVD88	-4.17 cy/ft	10.03 cy/ft
Volume Change Above -19 ft NAVD88	-17.75 cy/ft	14.41 cy/ft
Volume Change Above -30 ft NAVD88	-34.56 cy/ft	25.22 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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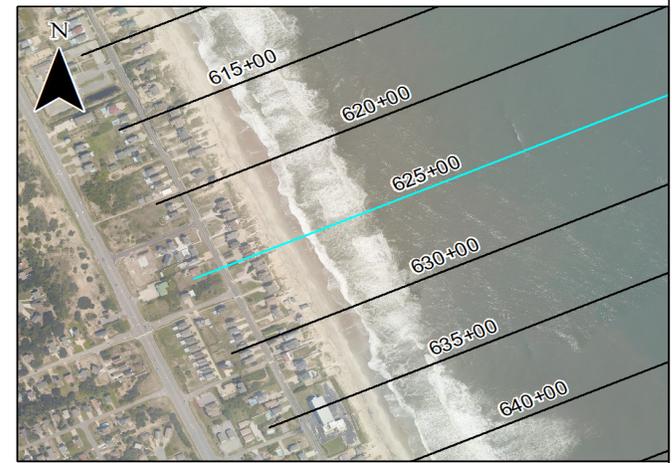


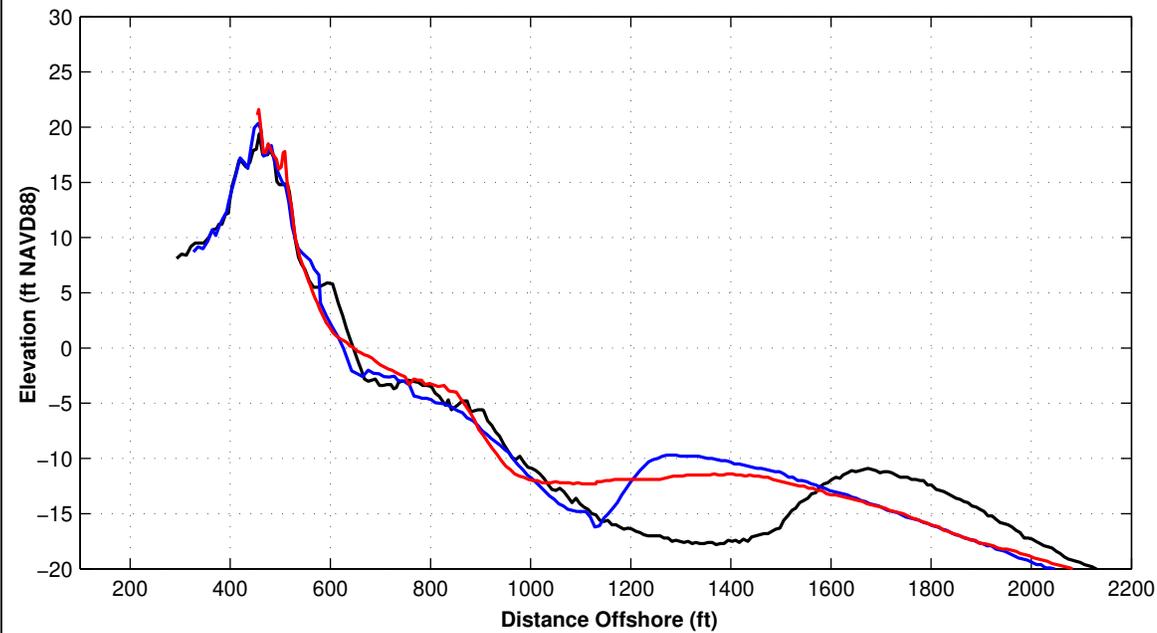
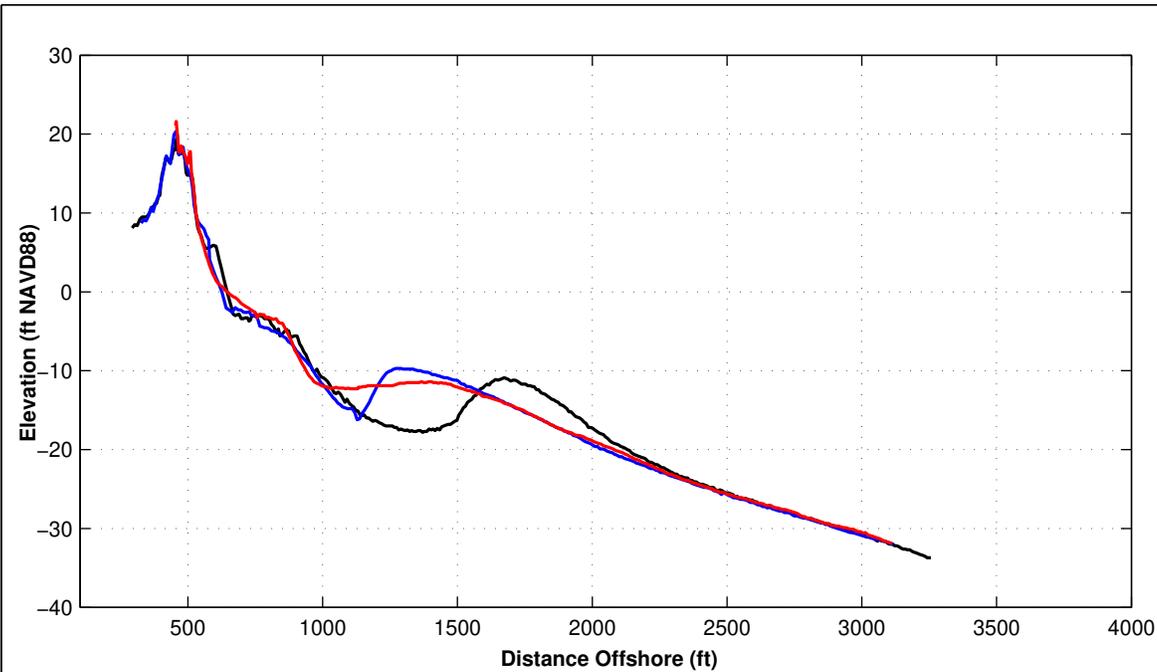


Survey Transect 625+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	1.58 ft	-23.44 ft
Volume Change Above +6 ft NAVD88	1.44 cy/ft	-2.55 cy/ft
Volume Change Above 1.18 ft NAVD88	1.83 cy/ft	-9.94 cy/ft
Volume Change Above -6 ft NAVD88	-4.64 cy/ft	0.37 cy/ft
Volume Change Above -14 ft NAVD88	20.59 cy/ft	0.01 cy/ft
Volume Change Above -19 ft NAVD88	16.63 cy/ft	8.42 cy/ft
Volume Change Above -30 ft NAVD88	2.55 cy/ft	13.73 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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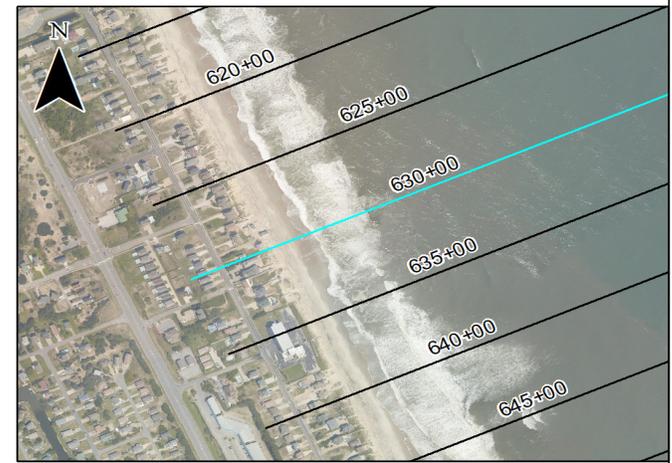


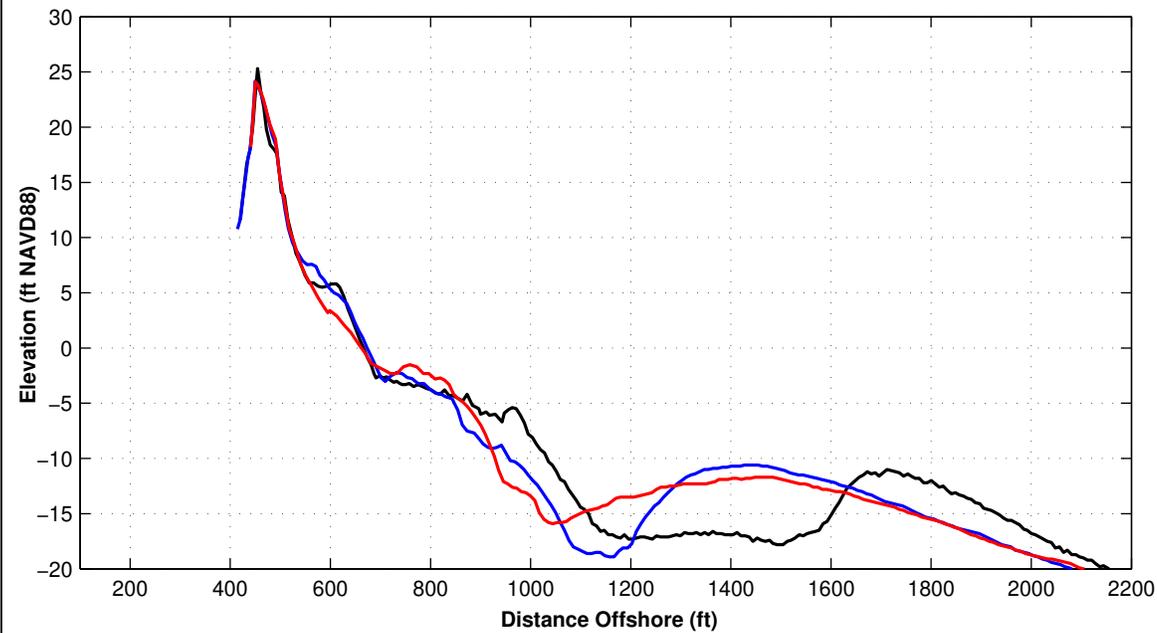
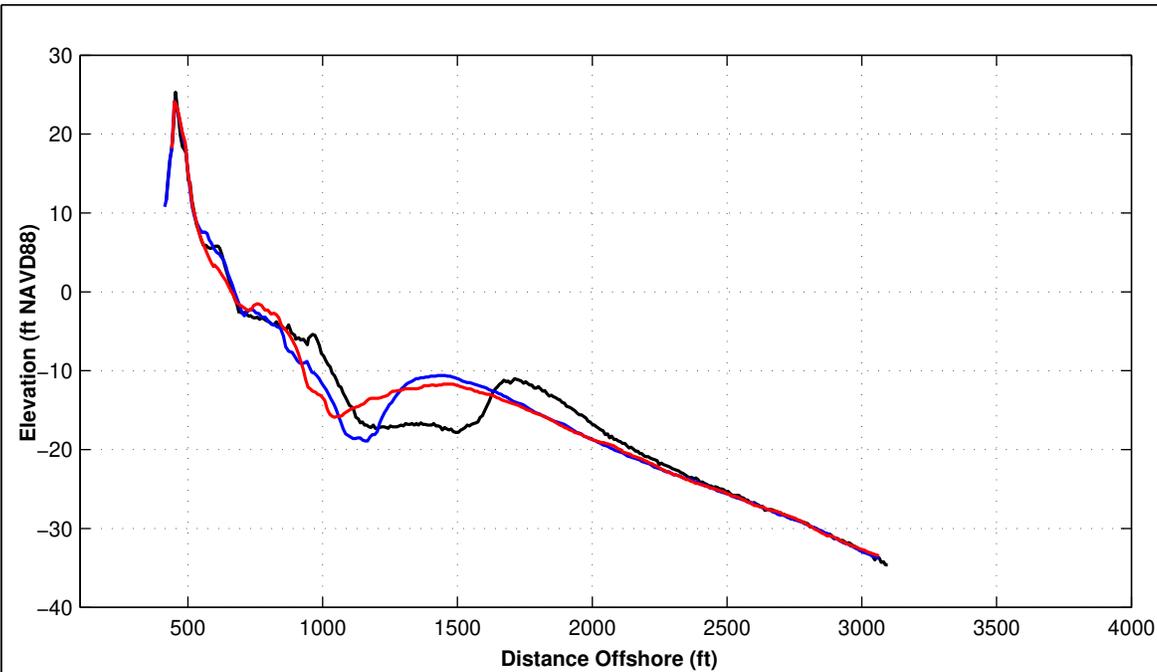


Survey Transect 630+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-23.60 ft	-3.13 ft
Volume Change Above +6 ft NAVD88	3.29 cy/ft	0.33 cy/ft
Volume Change Above 1.18 ft NAVD88	-1.67 cy/ft	-1.33 cy/ft
Volume Change Above -6 ft NAVD88	-6.26 cy/ft	10.25 cy/ft
Volume Change Above -14 ft NAVD88	14.10 cy/ft	1.43 cy/ft
Volume Change Above -19 ft NAVD88	26.31 cy/ft	6.67 cy/ft
Volume Change Above -30 ft NAVD88	11.19 cy/ft	15.50 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.



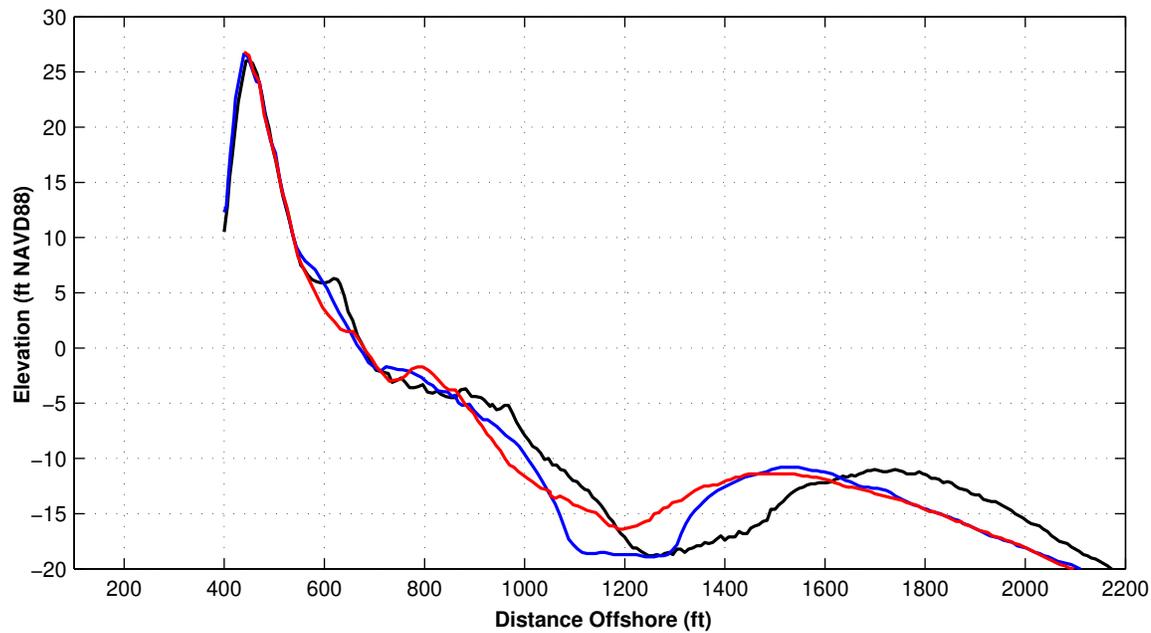
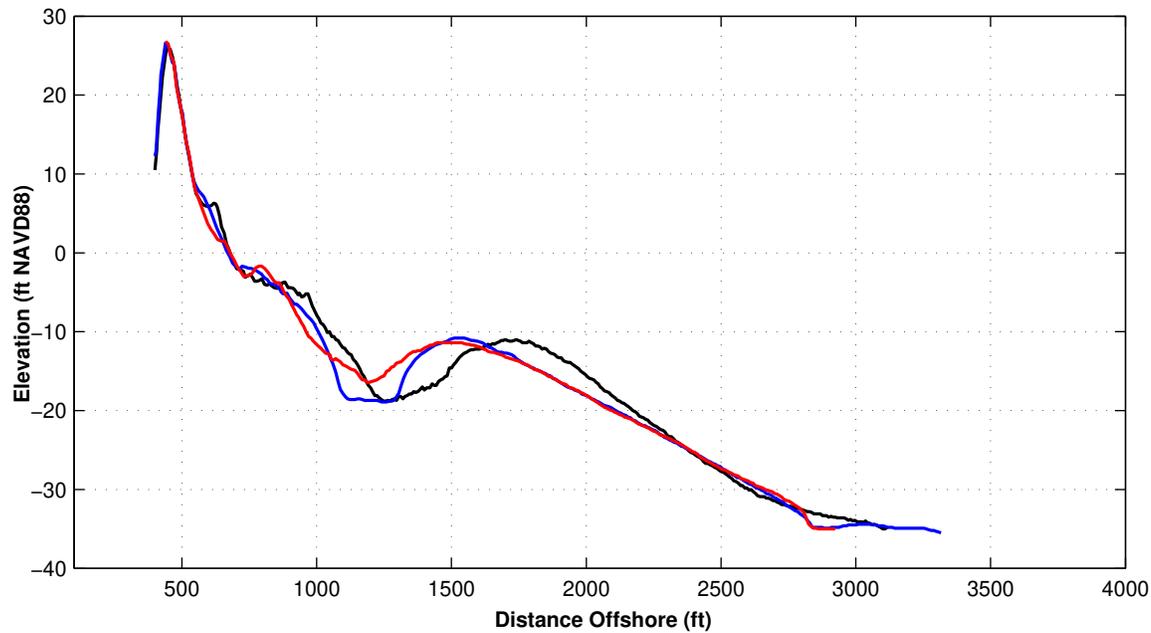


Survey Transect 635+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	6.29 ft	-17.05 ft
Volume Change Above +6 ft NAVD88	2.83 cy/ft	-1.37 cy/ft
Volume Change Above 1.18 ft NAVD88	2.80 cy/ft	-7.54 cy/ft
Volume Change Above -6 ft NAVD88	2.51 cy/ft	-2.08 cy/ft
Volume Change Above -14 ft NAVD88	-2.46 cy/ft	-16.83 cy/ft
Volume Change Above -19 ft NAVD88	2.13 cy/ft	1.18 cy/ft
Volume Change Above -30 ft NAVD88	-10.92 cy/ft	4.11 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.





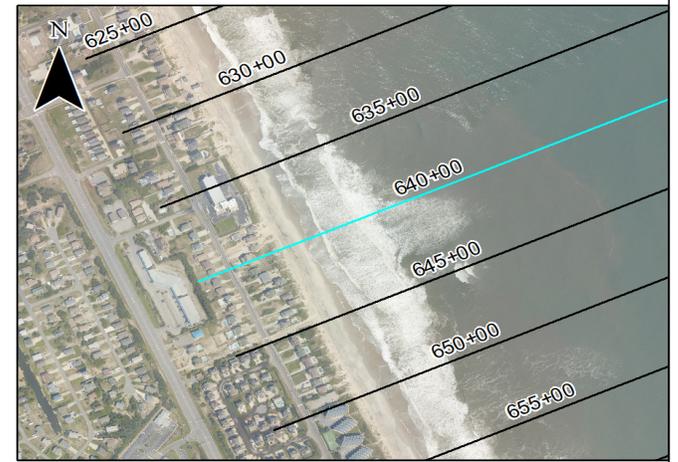
Survey Transect 640+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-10.79 ft	7.60 ft
Volume Change Above +6 ft NAVD88	1.44 cy/ft	-1.69 cy/ft
Volume Change Above 1.18 ft NAVD88	-2.38 cy/ft	-5.63 cy/ft
Volume Change Above -6 ft NAVD88	-3.27 cy/ft	-3.53 cy/ft
Volume Change Above -14 ft NAVD88	-18.54 cy/ft	-12.88 cy/ft
Volume Change Above -19 ft NAVD88	-41.16 cy/ft	18.41 cy/ft
Volume Change Above -30 ft NAVD88	-45.31 cy/ft	18.07 cy/ft

LEGEND:

OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

Notes:

1. Station From North To South At Varying Intervals.
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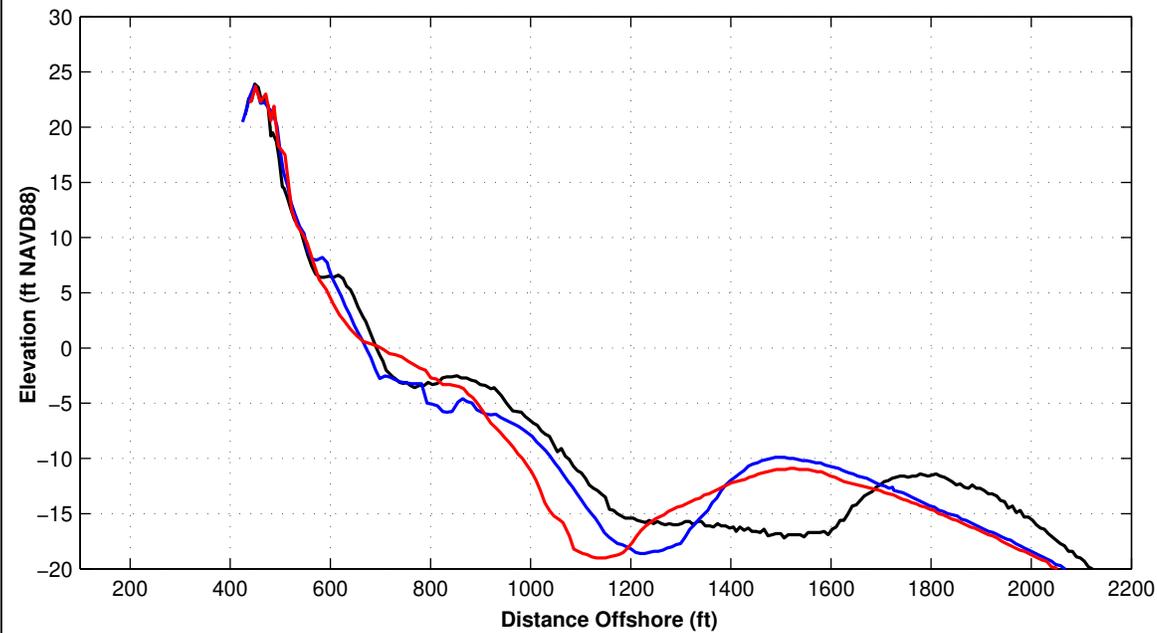
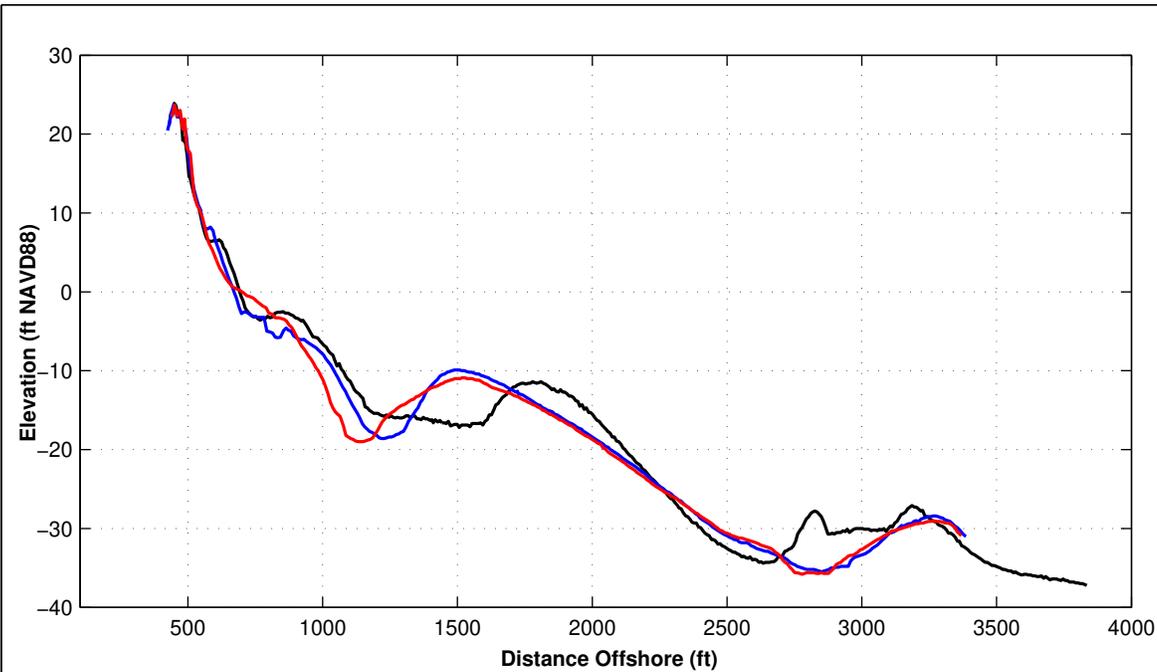


Town of Nags Head Periodic Surveying Data Analysis

ST 640+00

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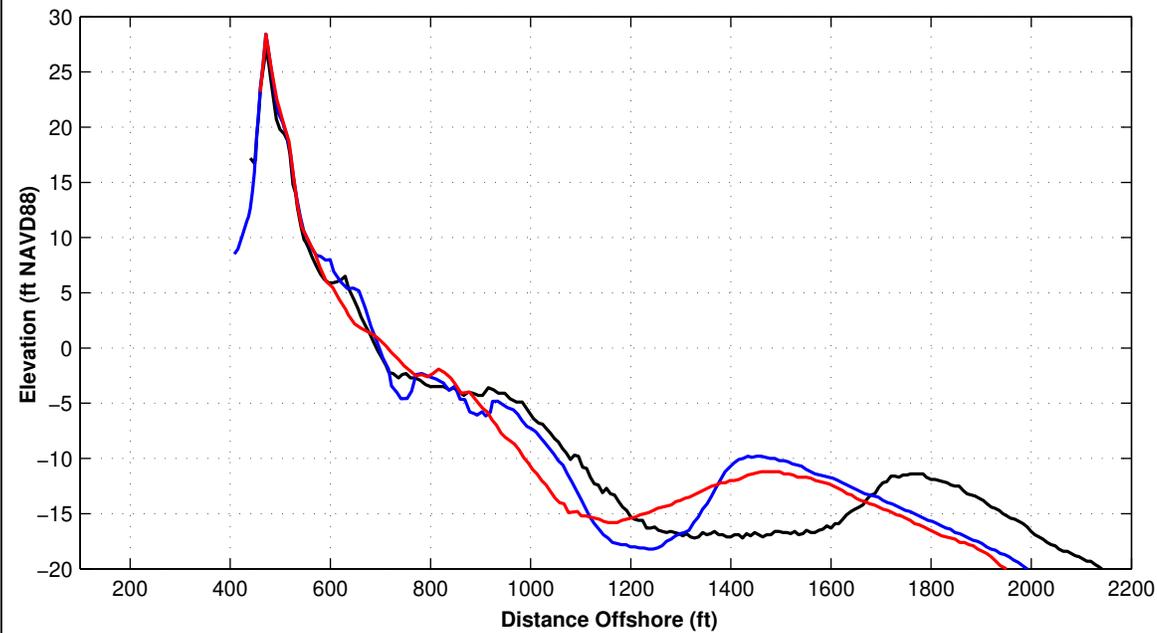
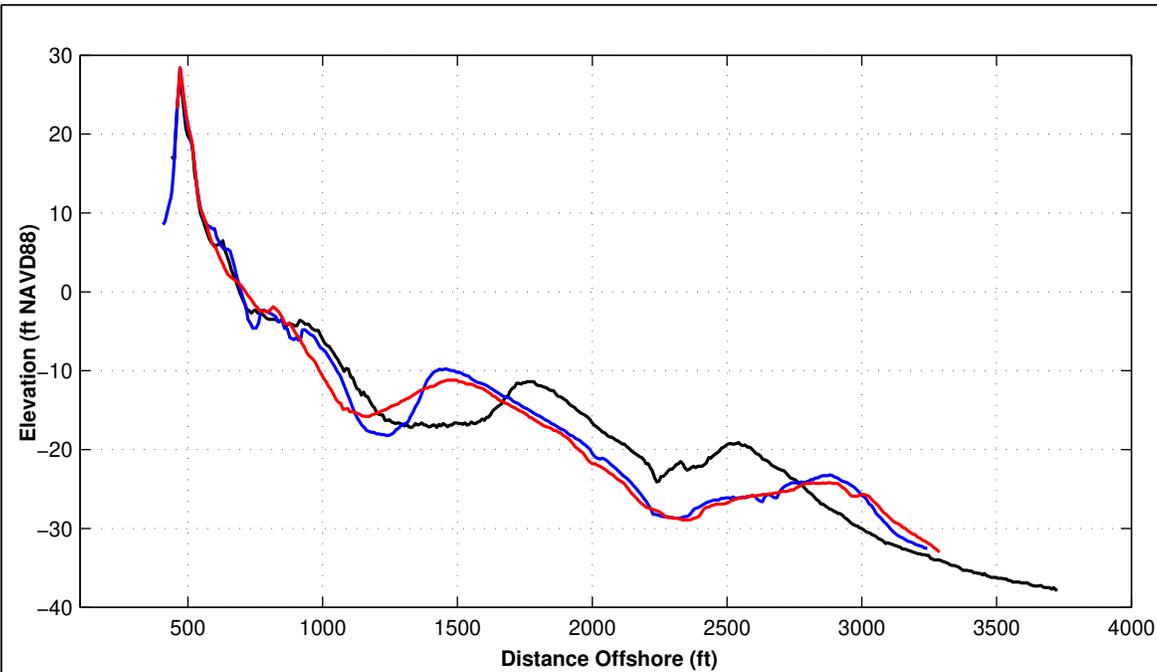


Survey Transect 645+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-23.76 ft	-6.45 ft
Volume Change Above +6 ft NAVD88	4.49 cy/ft	-1.60 cy/ft
Volume Change Above 1.18 ft NAVD88	0.11 cy/ft	-5.05 cy/ft
Volume Change Above -6 ft NAVD88	-17.06 cy/ft	10.66 cy/ft
Volume Change Above -14 ft NAVD88	-6.49 cy/ft	-16.26 cy/ft
Volume Change Above -19 ft NAVD88	-18.43 cy/ft	-20.03 cy/ft
Volume Change Above -30 ft NAVD88	-34.30 cy/ft	-23.81 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

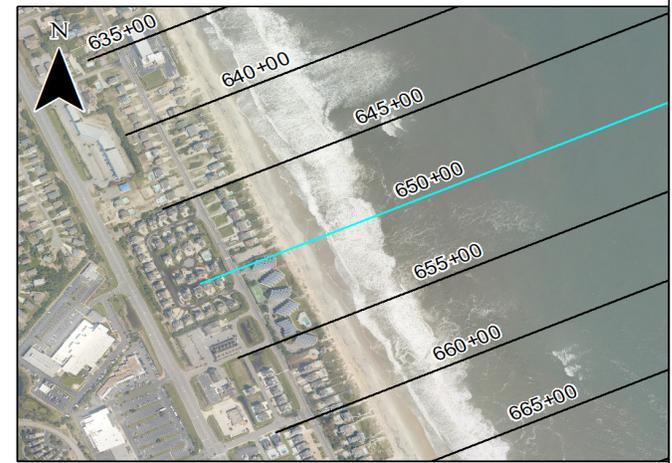


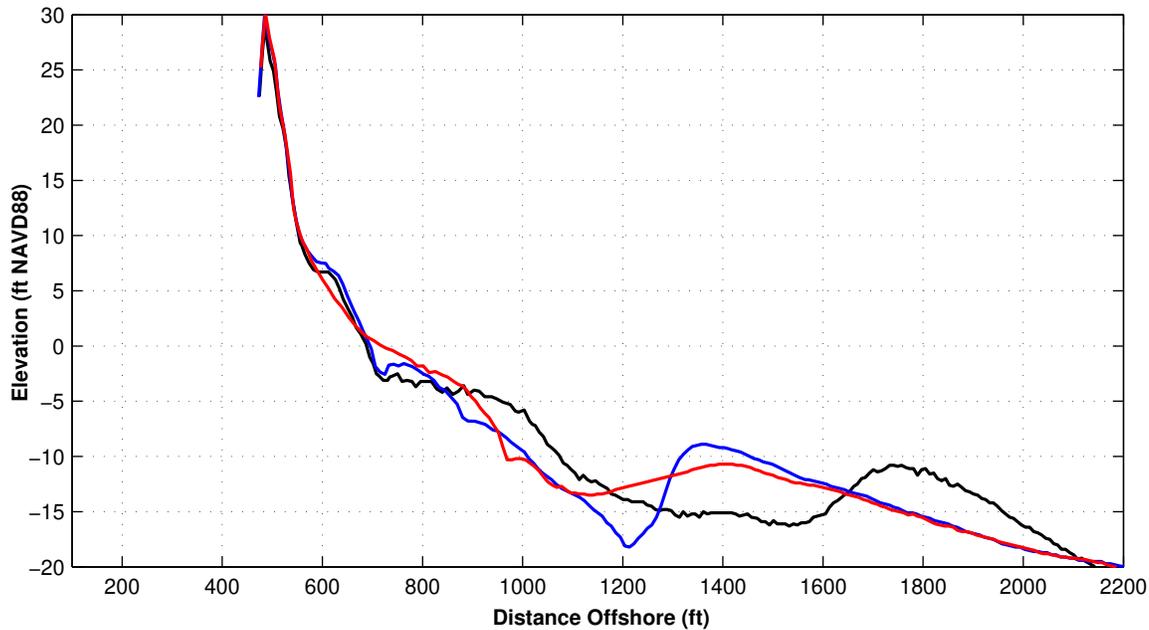
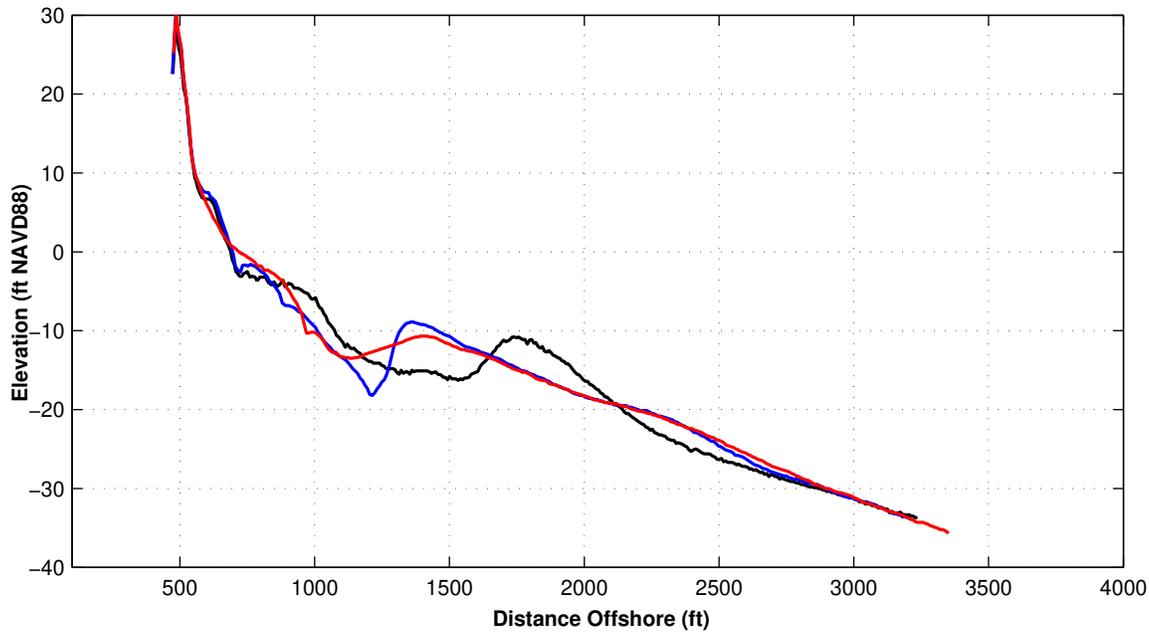


Survey Transect 650+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	7.71 ft	-0.86 ft
Volume Change Above +6 ft NAVD88	5.40 cy/ft	-1.62 cy/ft
Volume Change Above 1.18 ft NAVD88	7.44 cy/ft	-7.77 cy/ft
Volume Change Above -6 ft NAVD88	0.33 cy/ft	0.49 cy/ft
Volume Change Above -14 ft NAVD88	7.67 cy/ft	-27.28 cy/ft
Volume Change Above -19 ft NAVD88	-6.04 cy/ft	-16.03 cy/ft
Volume Change Above -30 ft NAVD88	-101.22 cy/ft	-33.60 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.





Survey Transect 655+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	8.06 ft	-2.61 ft
Volume Change Above +6 ft NAVD88	3.83 cy/ft	-1.79 cy/ft
Volume Change Above 1.18 ft NAVD88	5.65 cy/ft	-5.69 cy/ft
Volume Change Above -6 ft NAVD88	4.11 cy/ft	4.88 cy/ft
Volume Change Above -14 ft NAVD88	4.03 cy/ft	-2.37 cy/ft
Volume Change Above -19 ft NAVD88	-15.81 cy/ft	9.39 cy/ft
Volume Change Above -30 ft NAVD88	21.22 cy/ft	18.20 cy/ft

LEGEND:

OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.

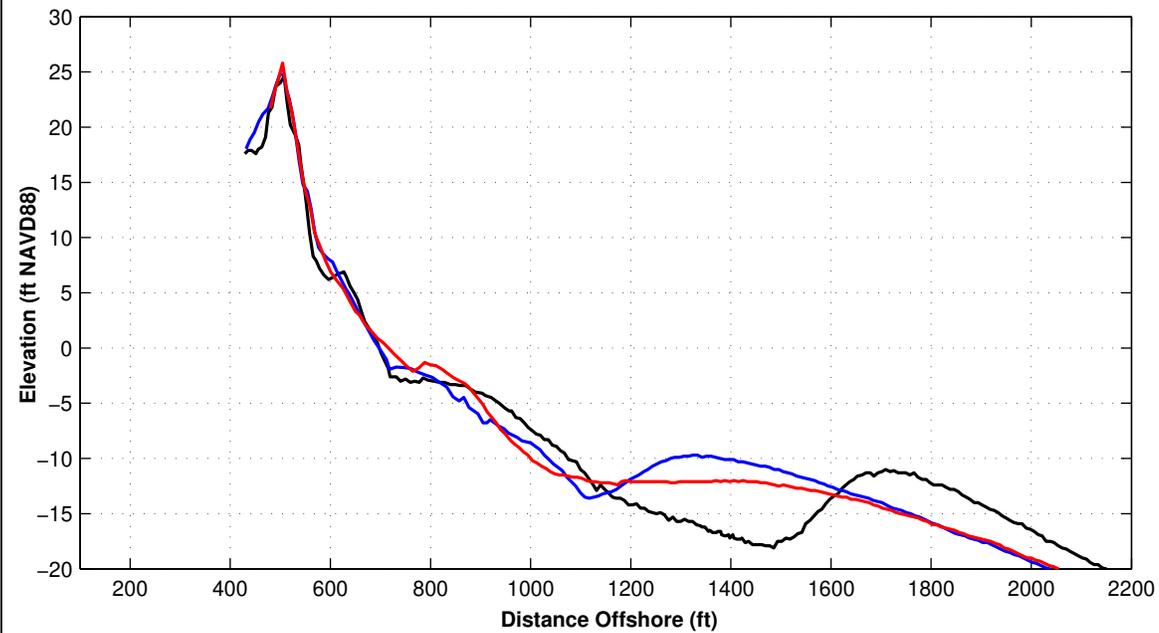
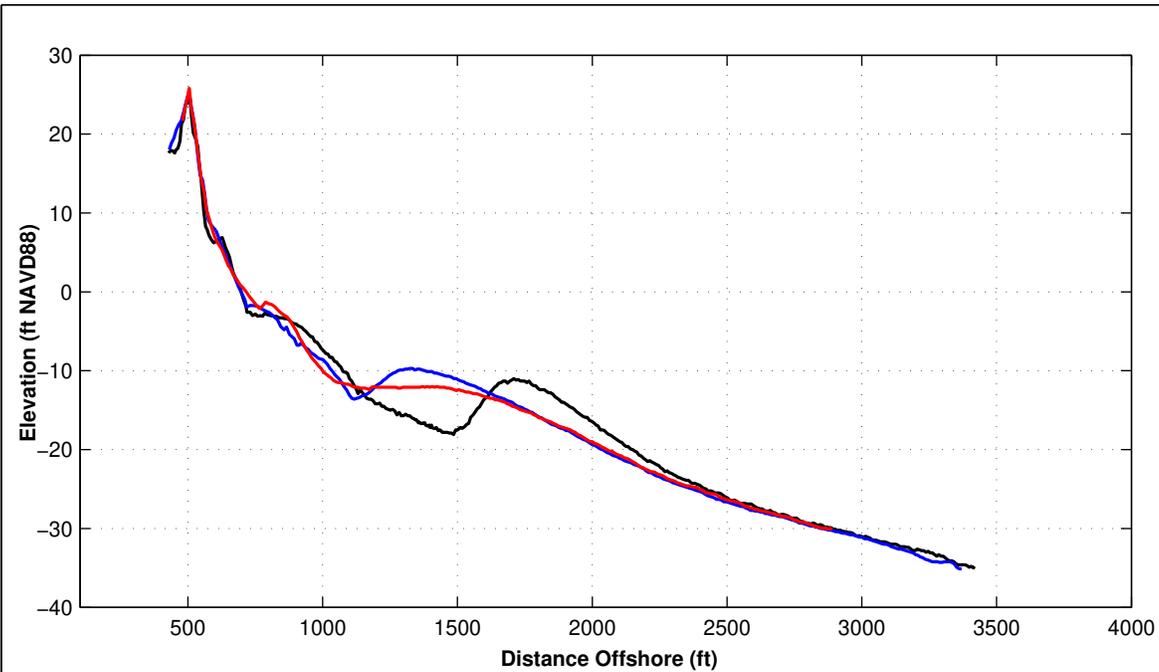


Town of Nags Head Periodic Surveying Data Analysis

ST 655+00

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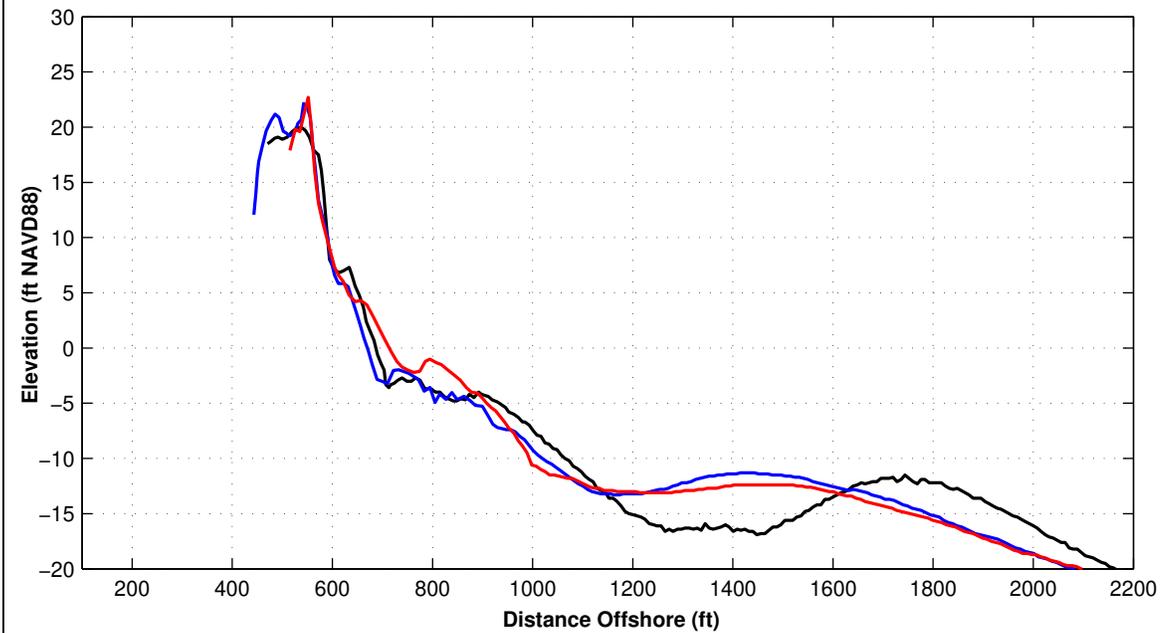
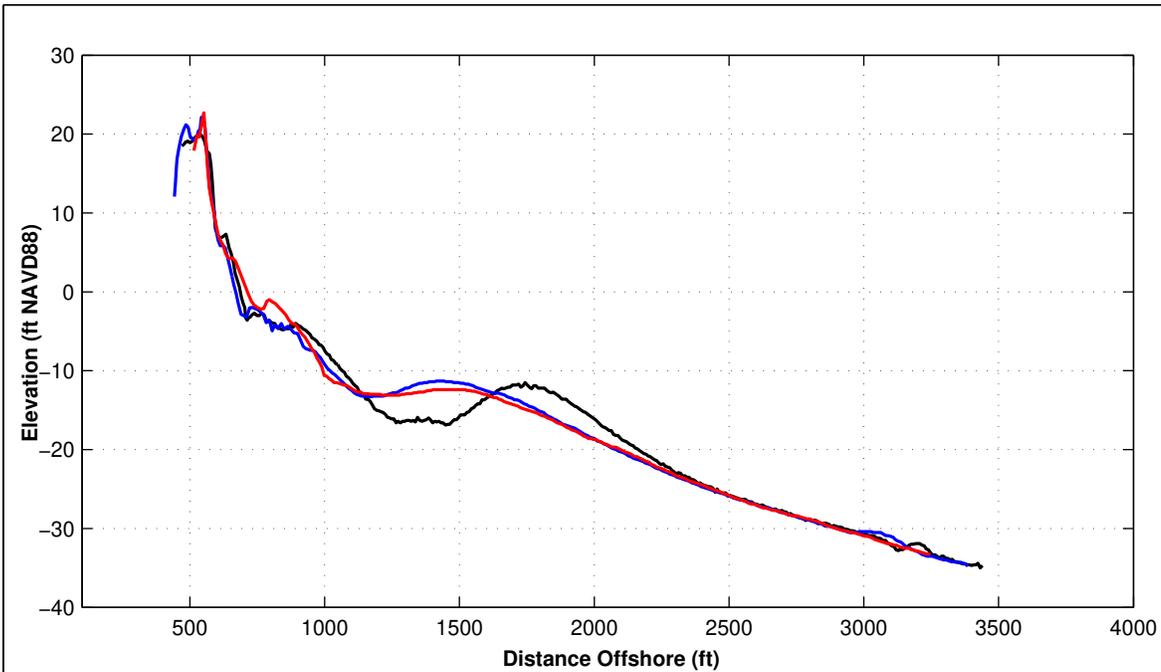


Survey Transect 660+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-4.86 ft	7.08 ft
Volume Change Above +6 ft NAVD88	5.06 cy/ft	-0.81 cy/ft
Volume Change Above 1.18 ft NAVD88	3.70 cy/ft	-1.34 cy/ft
Volume Change Above -6 ft NAVD88	0.28 cy/ft	7.77 cy/ft
Volume Change Above -14 ft NAVD88	19.54 cy/ft	-16.49 cy/ft
Volume Change Above -19 ft NAVD88	22.94 cy/ft	-16.35 cy/ft
Volume Change Above -30 ft NAVD88	-3.73 cy/ft	-8.46 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.



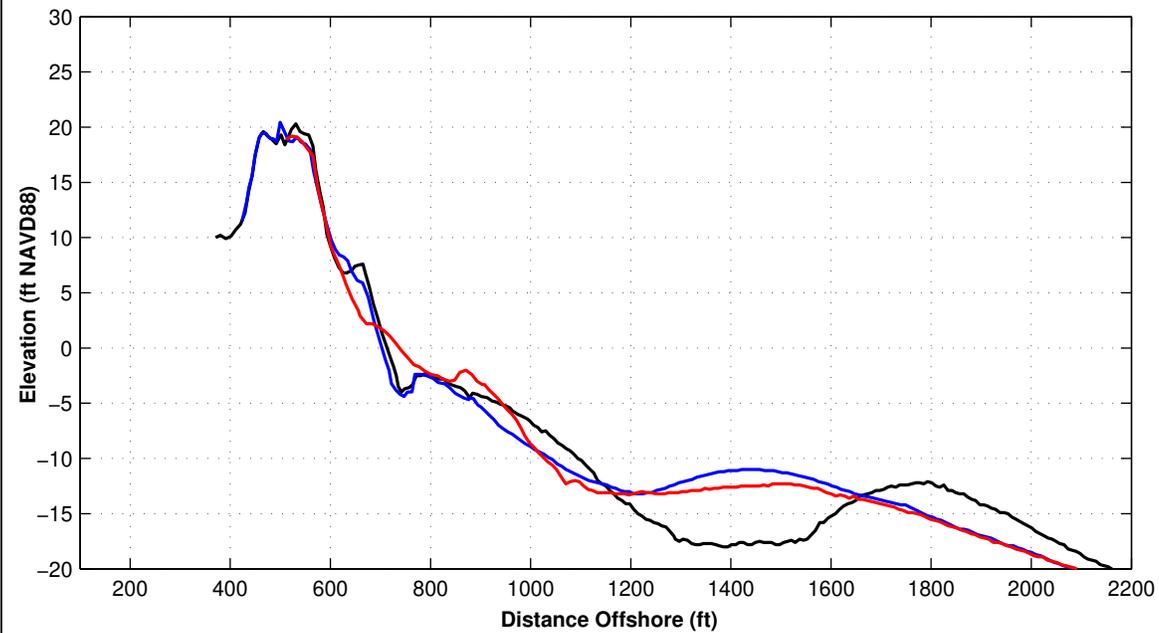
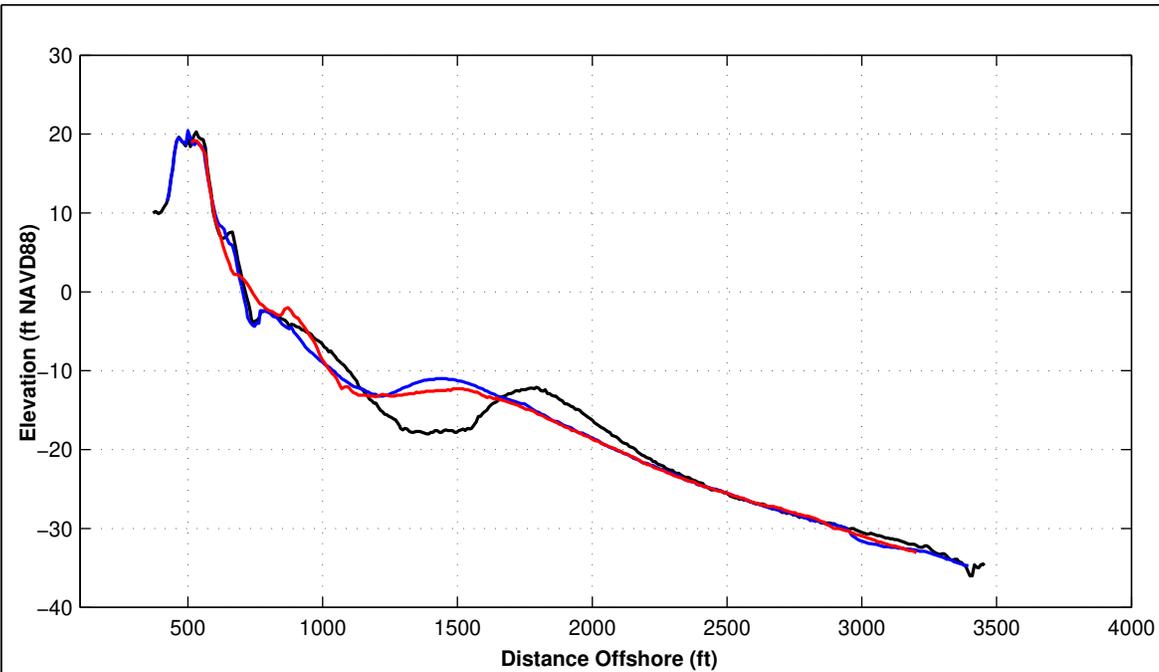


Survey Transect 665+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-17.50 ft	38.70 ft
Volume Change Above +6 ft NAVD88	-0.53 cy/ft	-0.42 cy/ft
Volume Change Above 1.18 ft NAVD88	-3.51 cy/ft	3.07 cy/ft
Volume Change Above -6 ft NAVD88	-7.92 cy/ft	20.13 cy/ft
Volume Change Above -14 ft NAVD88	-1.61 cy/ft	5.86 cy/ft
Volume Change Above -19 ft NAVD88	1.50 cy/ft	1.85 cy/ft
Volume Change Above -30 ft NAVD88	-12.79 cy/ft	5.45 cy/ft

LEGEND:
 OCTOBER 2023 ———— POST-DORIAN AD ————
 JUNE 2023 ———— JUNE 2022 ————

- Notes:
 1. Station From North To South At Varying Intervals.
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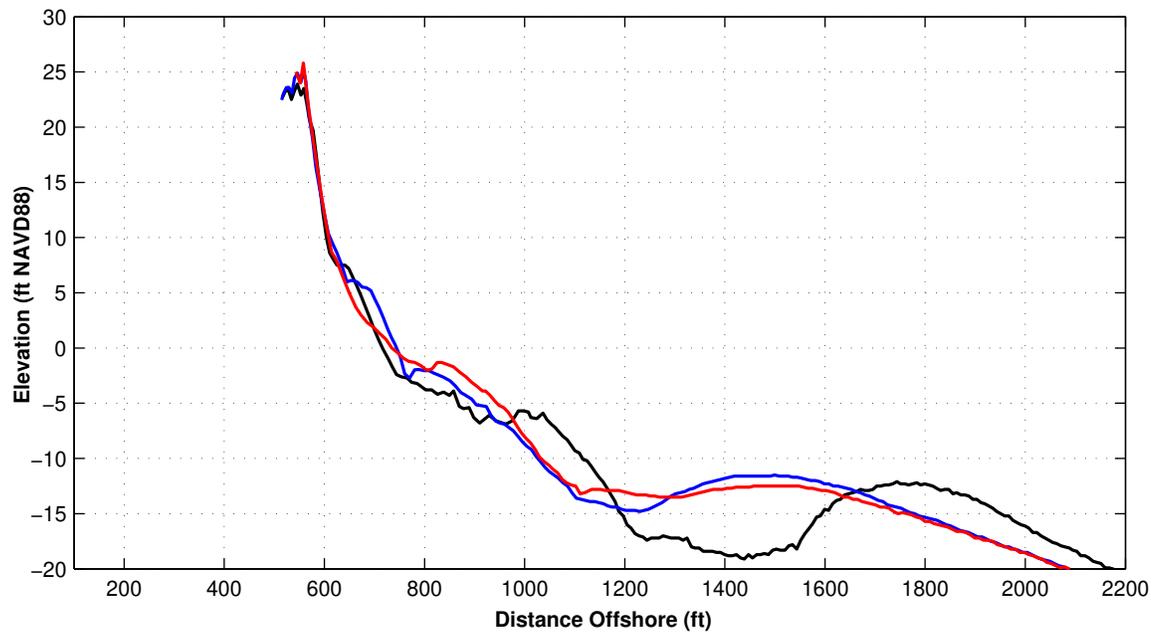
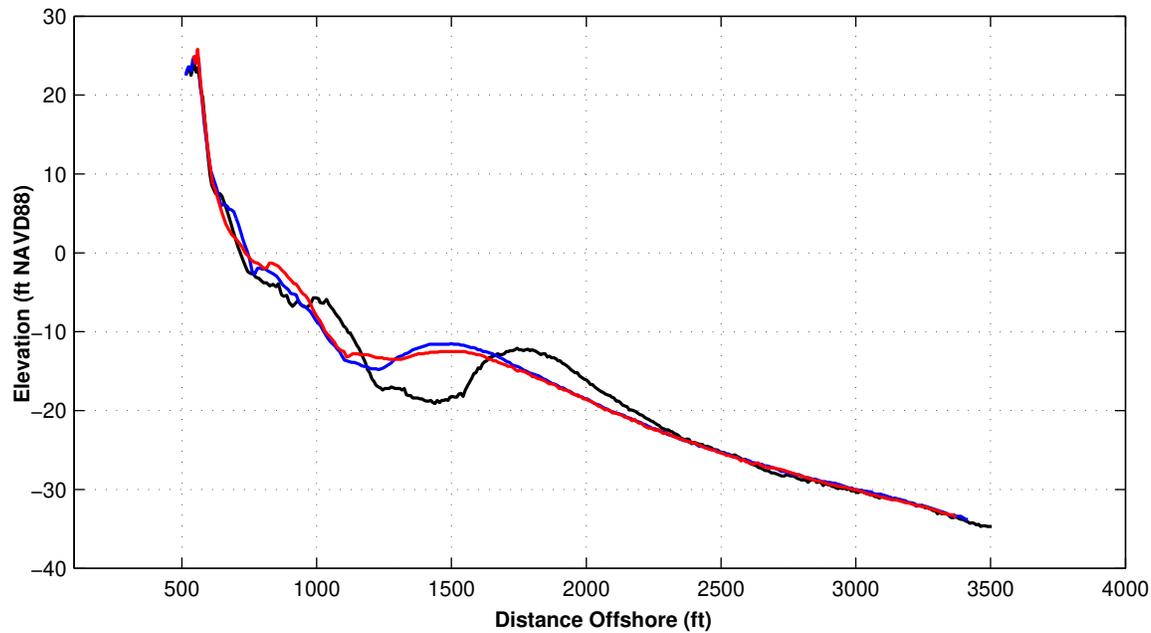


Survey Transect 670+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-8.97 ft	21.36 ft
Volume Change Above +6 ft NAVD88	-1.92 cy/ft	-1.89 cy/ft
Volume Change Above 1.18 ft NAVD88	-3.43 cy/ft	-5.63 cy/ft
Volume Change Above -6 ft NAVD88	-10.15 cy/ft	11.39 cy/ft
Volume Change Above -14 ft NAVD88	2.69 cy/ft	-5.31 cy/ft
Volume Change Above -19 ft NAVD88	24.01 cy/ft	-7.66 cy/ft
Volume Change Above -30 ft NAVD88	15.08 cy/ft	-6.72 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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Survey Transect 675+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	27.40 ft	-17.92 ft
Volume Change Above +6 ft NAVD88	-0.34 cy/ft	-0.63 cy/ft
Volume Change Above 1.18 ft NAVD88	3.94 cy/ft	-7.38 cy/ft
Volume Change Above -6 ft NAVD88	14.32 cy/ft	0.89 cy/ft
Volume Change Above -14 ft NAVD88	5.22 cy/ft	-1.26 cy/ft
Volume Change Above -19 ft NAVD88	32.08 cy/ft	-1.41 cy/ft
Volume Change Above -30 ft NAVD88	26.95 cy/ft	-3.60 cy/ft

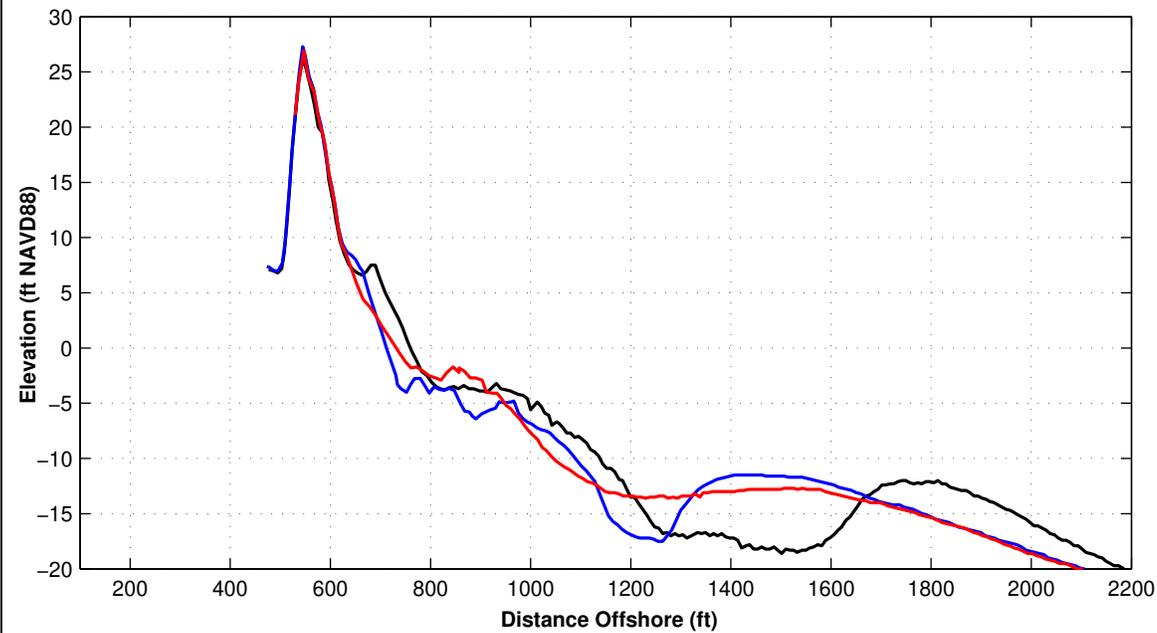
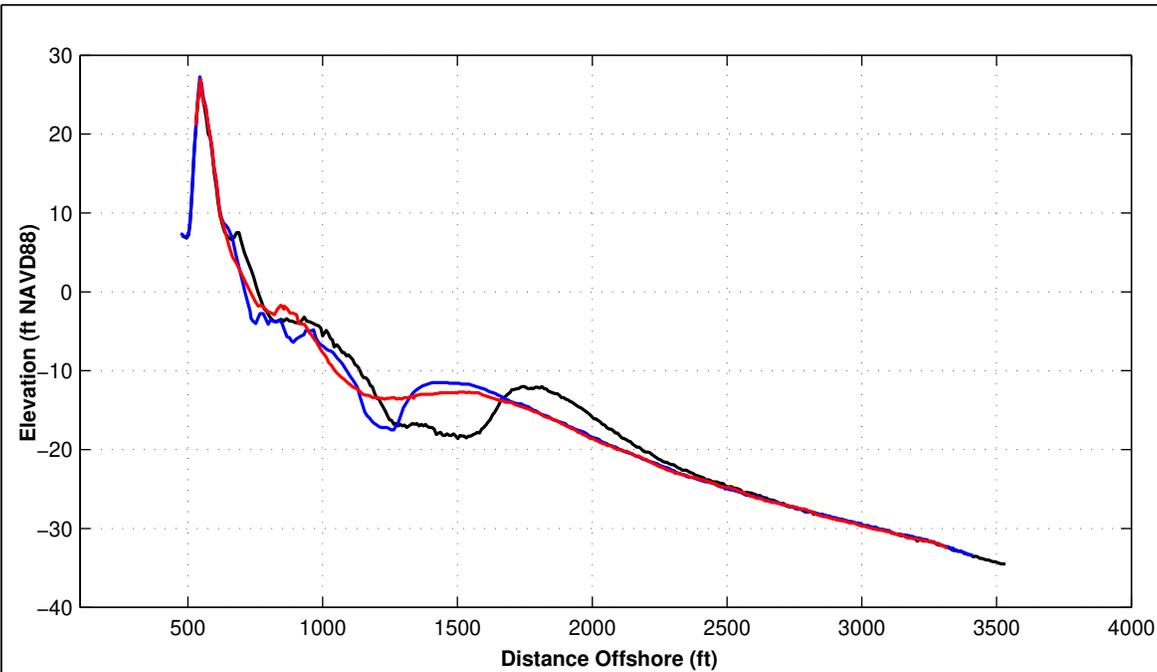
LEGEND:

OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.





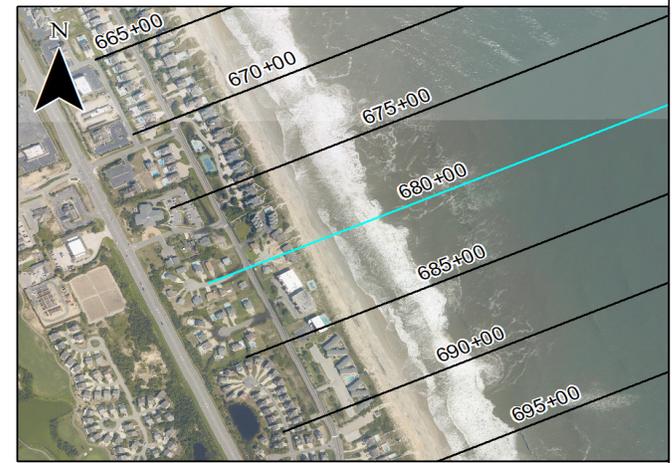
Survey Transect 680+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-45.68 ft	11.08 ft
Volume Change Above +6 ft NAVD88	1.85 cy/ft	-2.19 cy/ft
Volume Change Above 1.18 ft NAVD88	-5.08 cy/ft	-3.29 cy/ft
Volume Change Above -6 ft NAVD88	-24.31 cy/ft	13.24 cy/ft
Volume Change Above -14 ft NAVD88	-27.28 cy/ft	-2.42 cy/ft
Volume Change Above -19 ft NAVD88	-18.95 cy/ft	10.11 cy/ft
Volume Change Above -30 ft NAVD88	-31.74 cy/ft	8.43 cy/ft

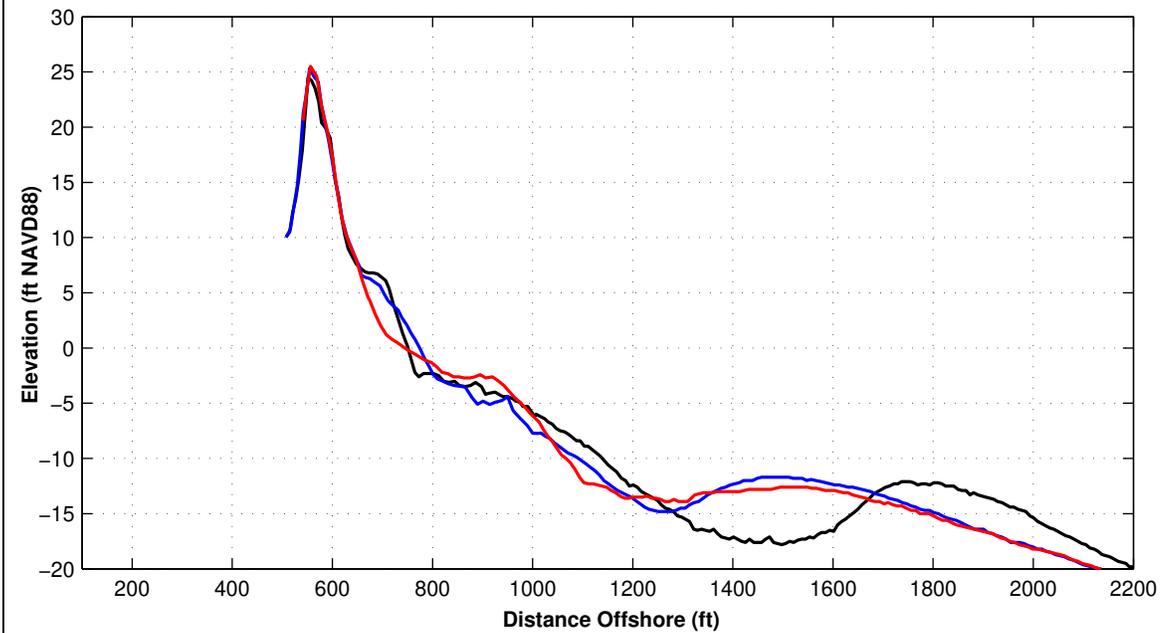
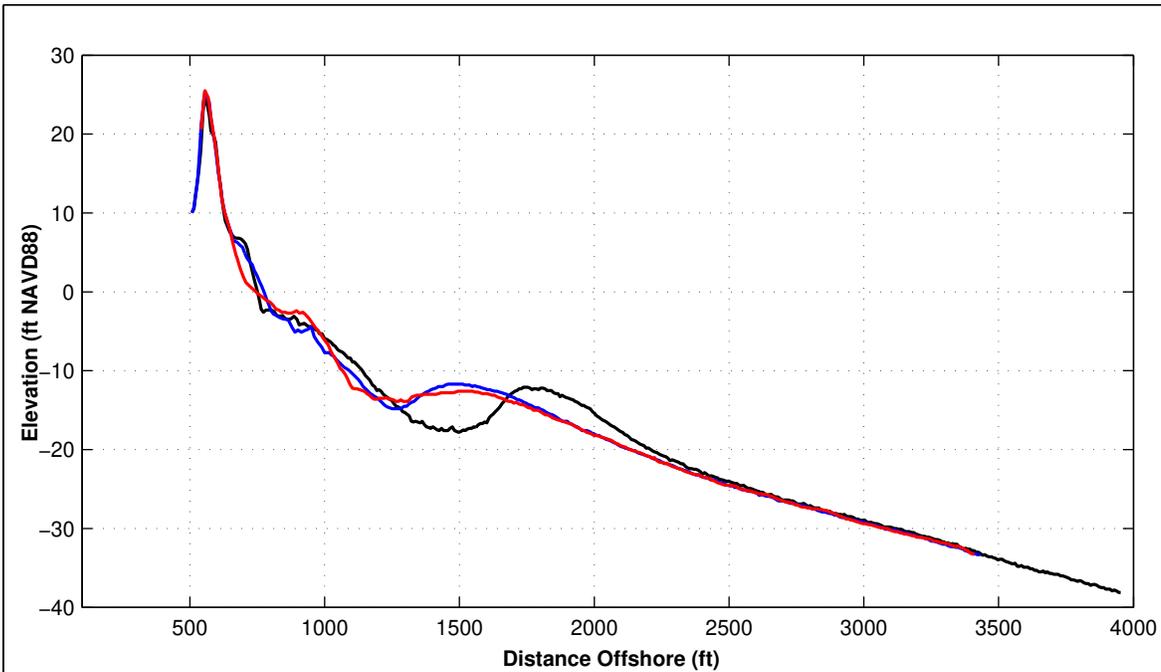
LEGEND:

OCTOBER 2023 — POST-DORIAN AD —

JUNE 2023 — JUNE 2022 —

- Notes:
1. Station From North To South At Varying Intervals.
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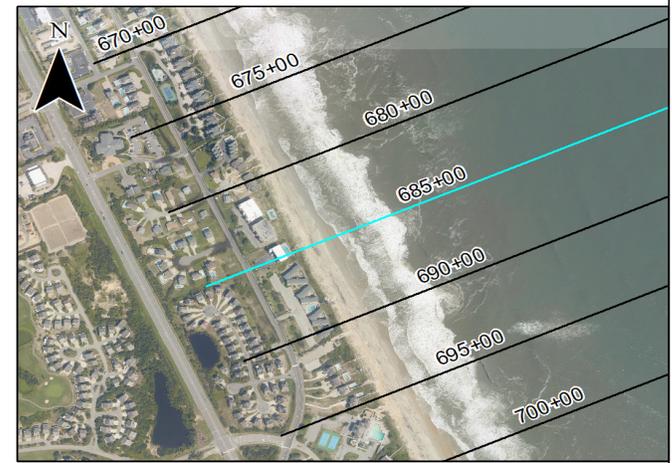


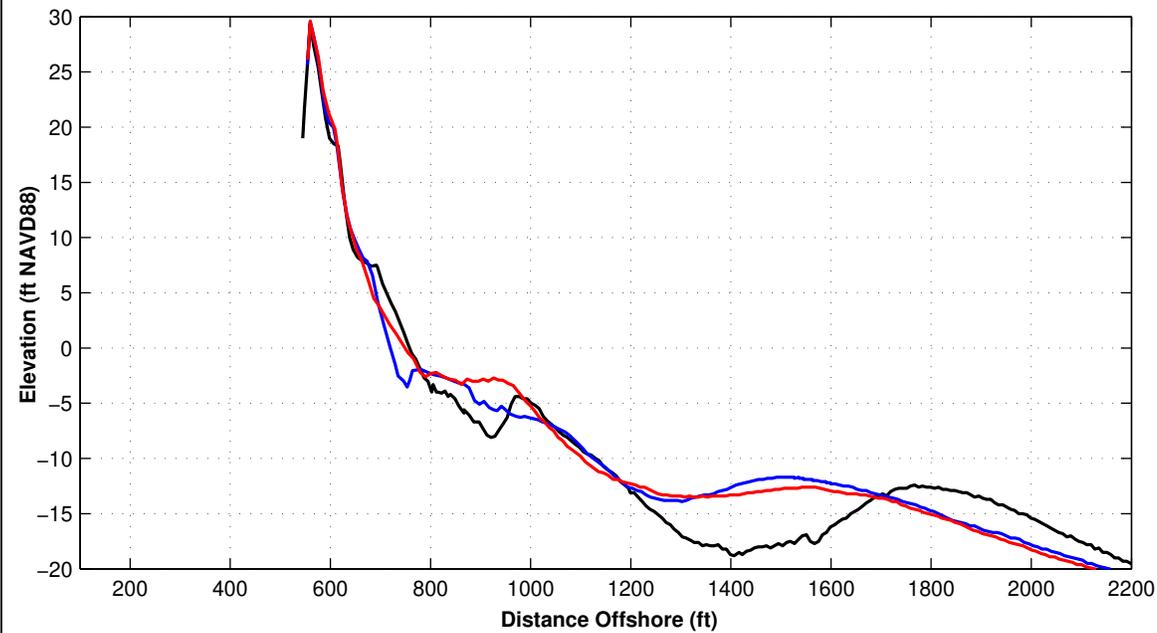
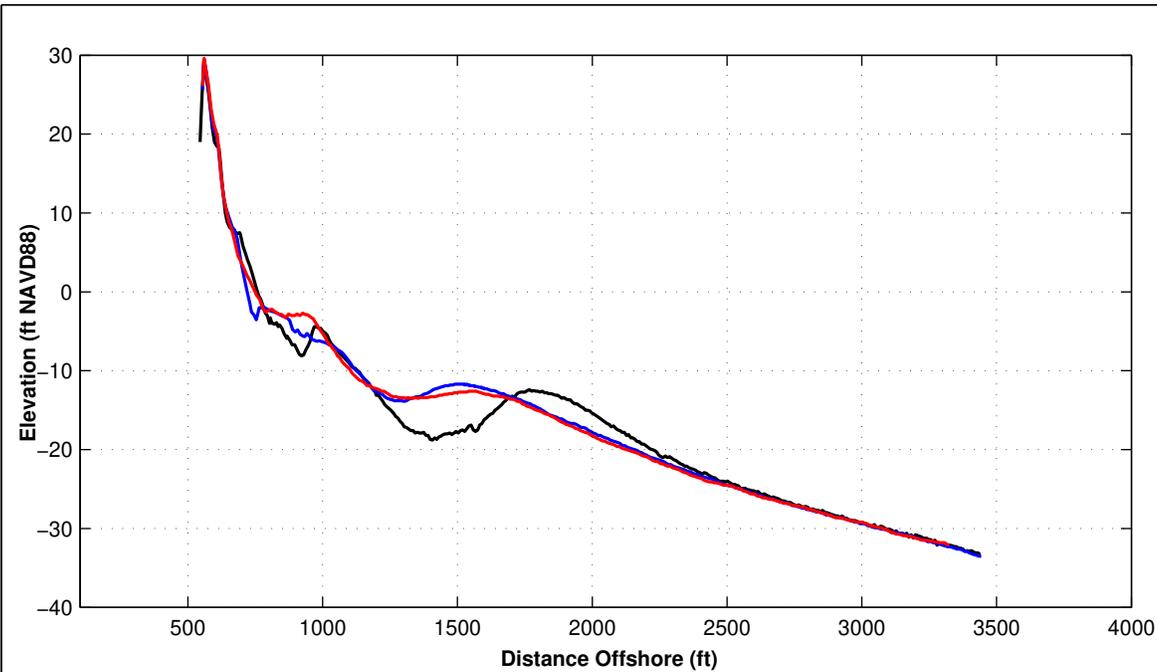


Survey Transect 685+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	18.28 ft	-51.46 ft
Volume Change Above +6 ft NAVD88	0.62 cy/ft	-0.04 cy/ft
Volume Change Above 1.18 ft NAVD88	0.63 cy/ft	-7.73 cy/ft
Volume Change Above -6 ft NAVD88	-0.49 cy/ft	-0.27 cy/ft
Volume Change Above -14 ft NAVD88	-3.76 cy/ft	-10.68 cy/ft
Volume Change Above -19 ft NAVD88	4.88 cy/ft	-10.62 cy/ft
Volume Change Above -30 ft NAVD88	-12.29 cy/ft	-10.39 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
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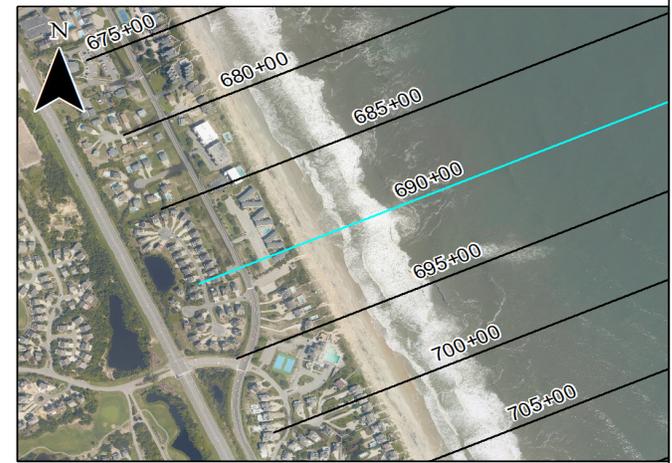


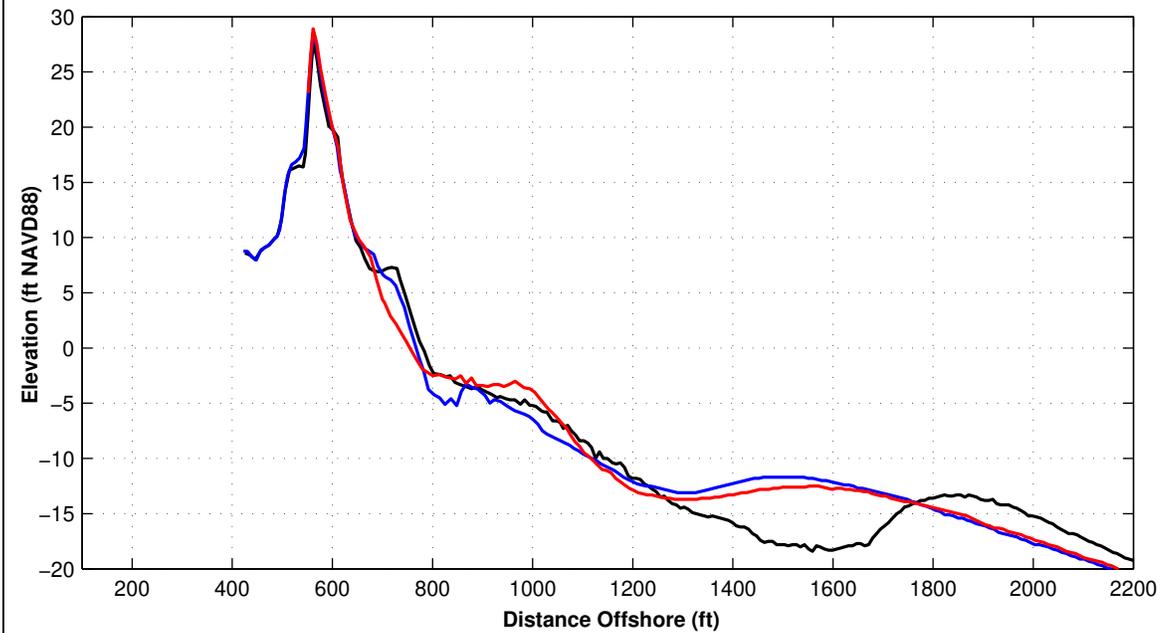
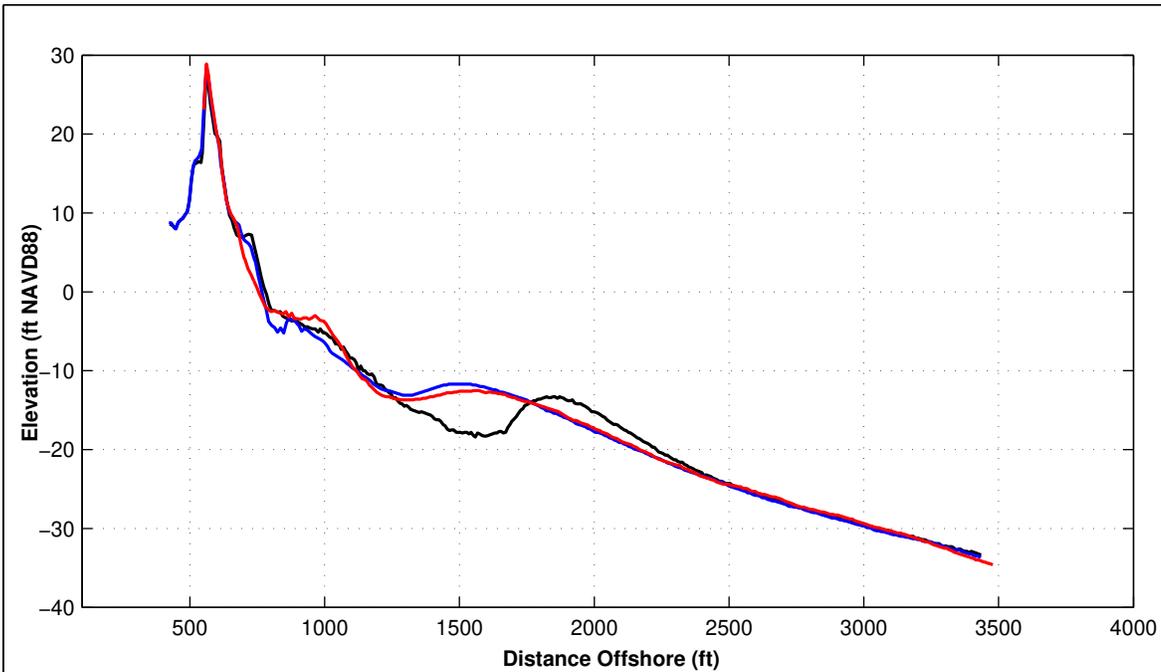


Survey Transect 690+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-36.03 ft	20.32 ft
Volume Change Above +6 ft NAVD88	1.57 cy/ft	-0.27 cy/ft
Volume Change Above 1.18 ft NAVD88	-3.33 cy/ft	0.14 cy/ft
Volume Change Above -6 ft NAVD88	-3.96 cy/ft	14.94 cy/ft
Volume Change Above -14 ft NAVD88	14.47 cy/ft	4.11 cy/ft
Volume Change Above -19 ft NAVD88	37.83 cy/ft	-0.31 cy/ft
Volume Change Above -30 ft NAVD88	23.37 cy/ft	-5.01 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
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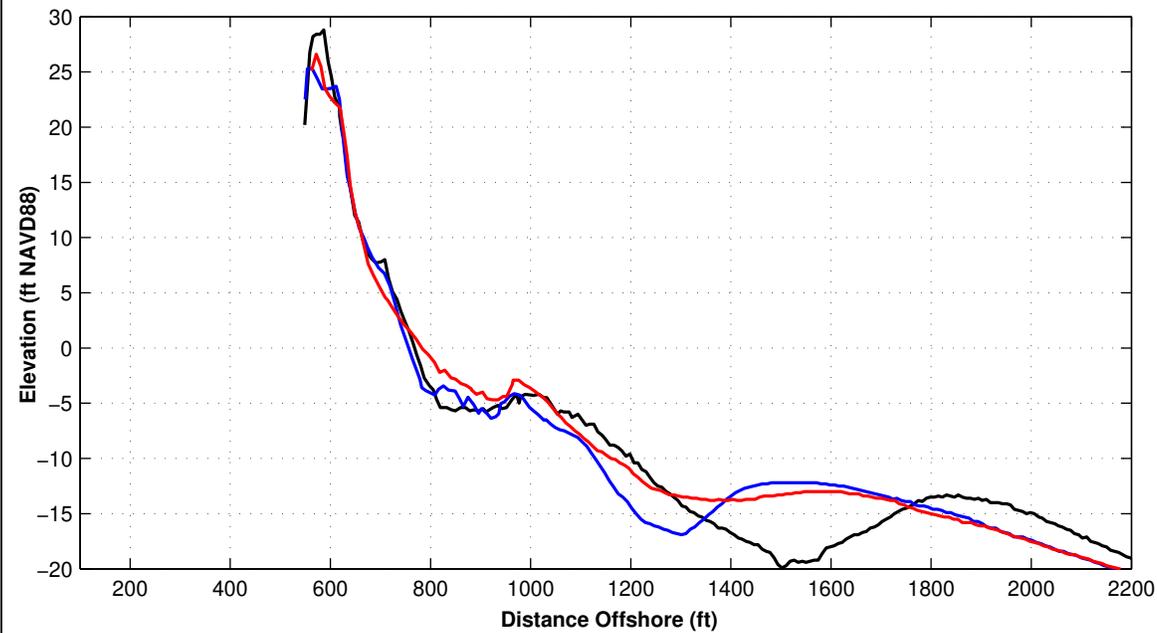
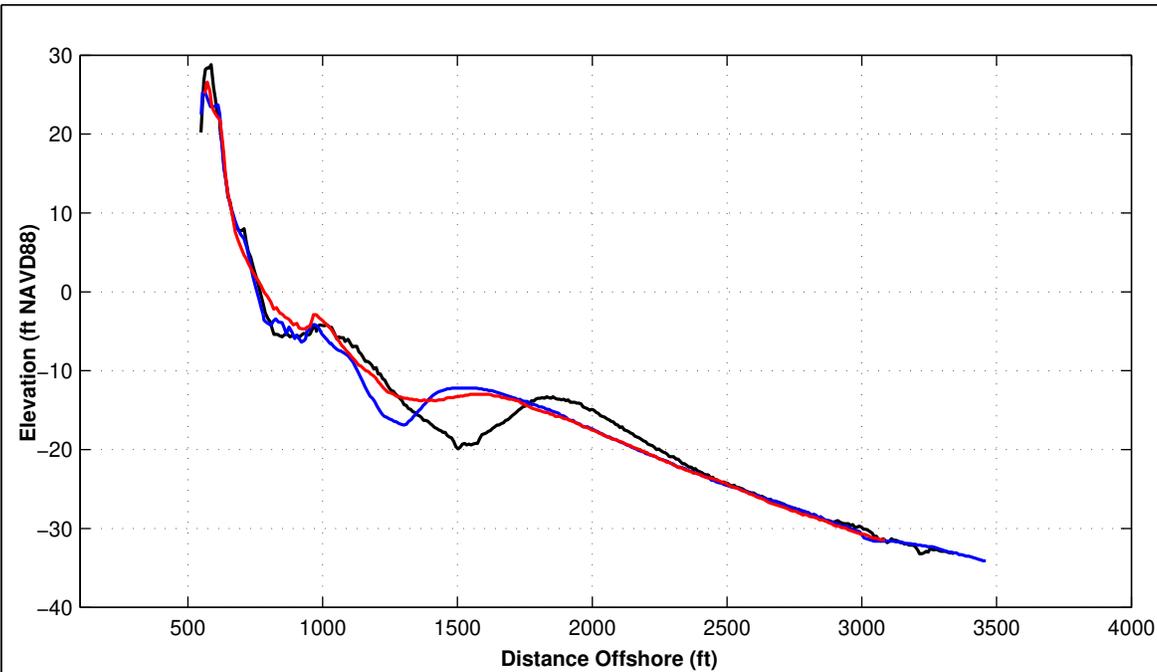


Survey Transect 695+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-10.66 ft	-19.40 ft
Volume Change Above +6 ft NAVD88	1.39 cy/ft	-0.48 cy/ft
Volume Change Above 1.18 ft NAVD88	-0.56 cy/ft	-6.09 cy/ft
Volume Change Above -6 ft NAVD88	-10.54 cy/ft	7.46 cy/ft
Volume Change Above -14 ft NAVD88	6.80 cy/ft	-3.07 cy/ft
Volume Change Above -19 ft NAVD88	27.77 cy/ft	0.17 cy/ft
Volume Change Above -30 ft NAVD88	14.16 cy/ft	8.80 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.



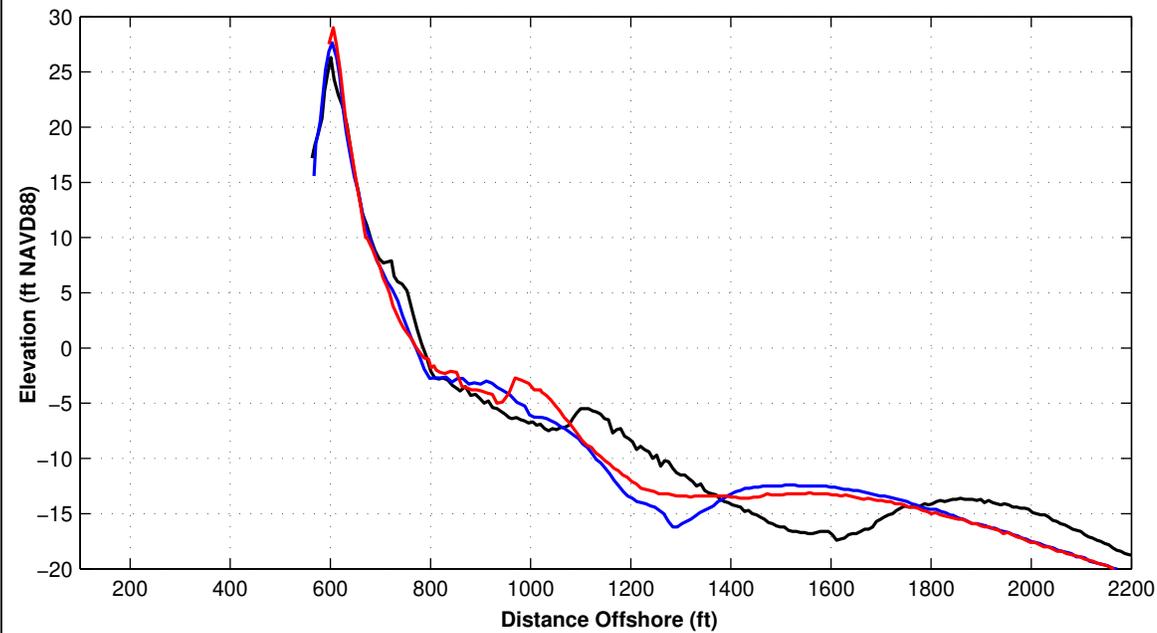
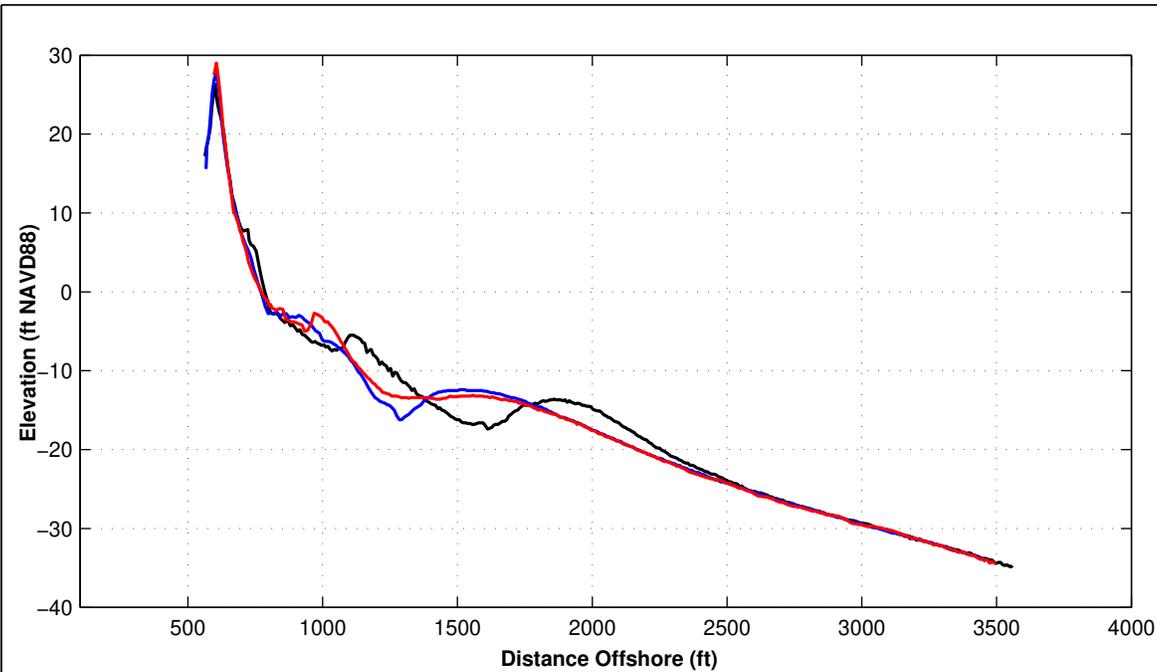


Survey Transect 700+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-12.45 ft	17.91 ft
Volume Change Above +6 ft NAVD88	-4.48 cy/ft	-1.18 cy/ft
Volume Change Above 1.18 ft NAVD88	-5.80 cy/ft	-2.17 cy/ft
Volume Change Above -6 ft NAVD88	-7.64 cy/ft	15.44 cy/ft
Volume Change Above -14 ft NAVD88	-15.63 cy/ft	21.58 cy/ft
Volume Change Above -19 ft NAVD88	-2.03 cy/ft	31.12 cy/ft
Volume Change Above -30 ft NAVD88	-12.14 cy/ft	27.55 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
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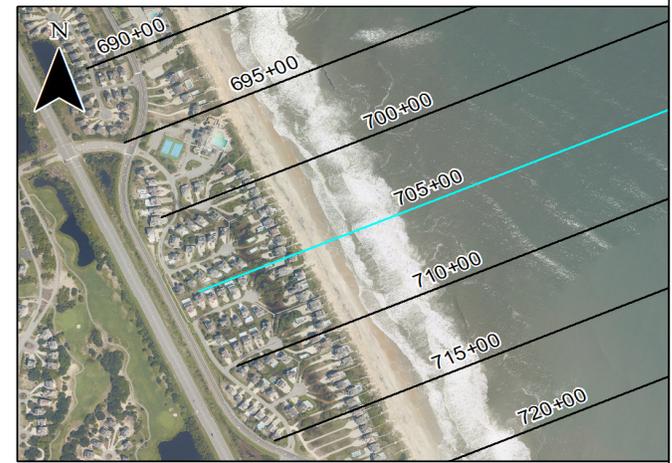


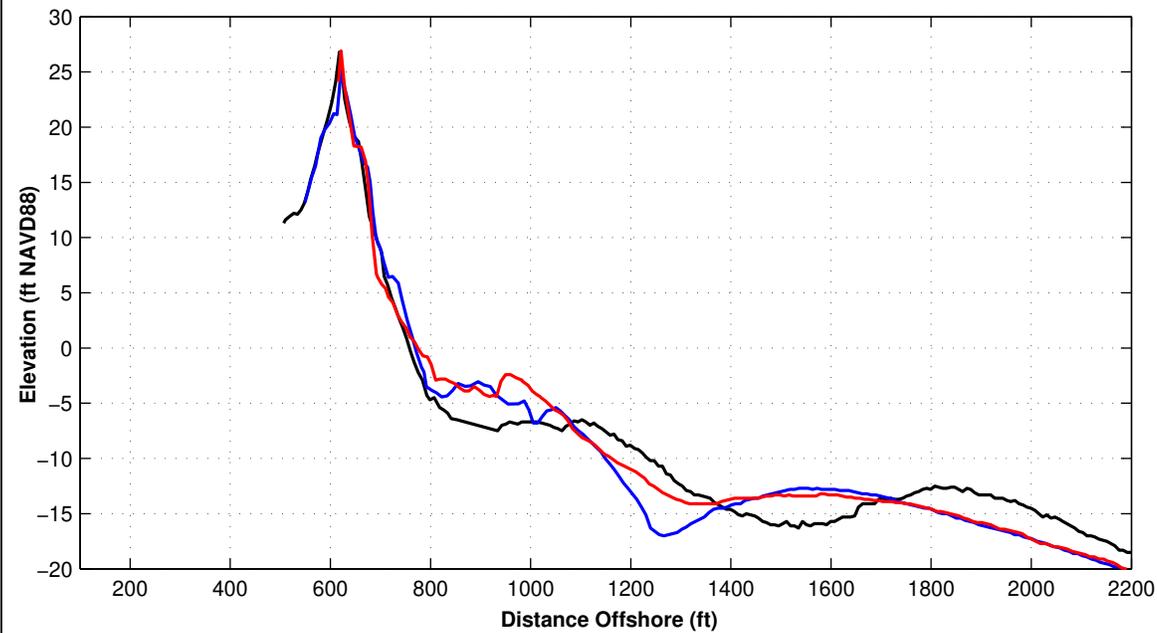
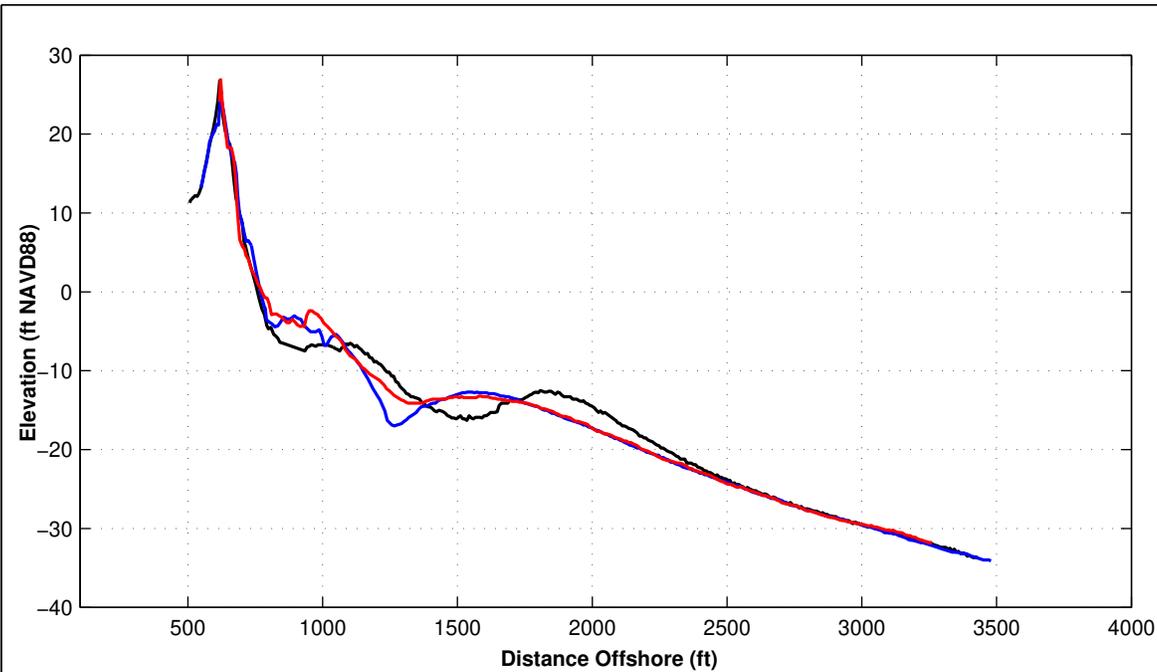


Survey Transect 705+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-17.61 ft	-2.99 ft
Volume Change Above +6 ft NAVD88	-0.25 cy/ft	1.09 cy/ft
Volume Change Above 1.18 ft NAVD88	-4.35 cy/ft	-0.55 cy/ft
Volume Change Above -6 ft NAVD88	0.71 cy/ft	5.51 cy/ft
Volume Change Above -14 ft NAVD88	-18.98 cy/ft	7.98 cy/ft
Volume Change Above -19 ft NAVD88	-27.07 cy/ft	11.94 cy/ft
Volume Change Above -30 ft NAVD88	-41.09 cy/ft	9.27 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
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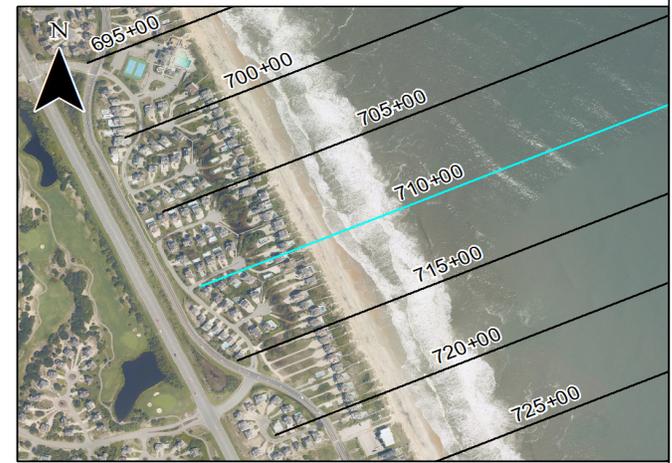


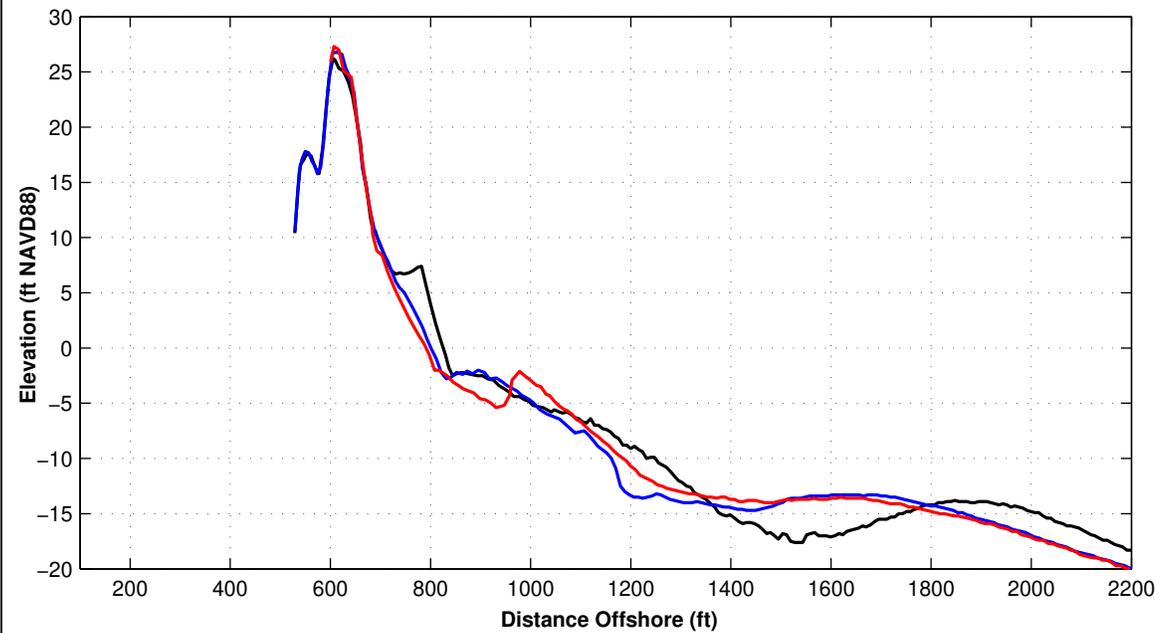
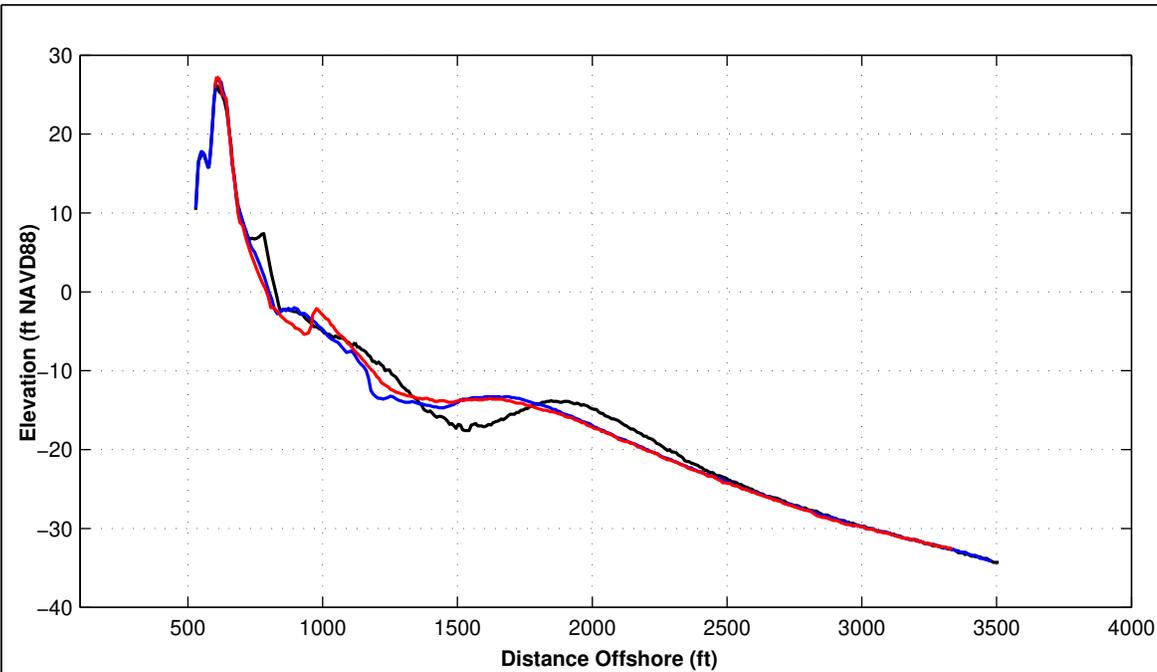


Survey Transect 710+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	12.46 ft	-4.90 ft
Volume Change Above +6 ft NAVD88	1.44 cy/ft	-3.58 cy/ft
Volume Change Above 1.18 ft NAVD88	4.58 cy/ft	-6.92 cy/ft
Volume Change Above -6 ft NAVD88	20.08 cy/ft	2.99 cy/ft
Volume Change Above -14 ft NAVD88	5.25 cy/ft	6.46 cy/ft
Volume Change Above -19 ft NAVD88	-20.00 cy/ft	19.38 cy/ft
Volume Change Above -30 ft NAVD88	-33.63 cy/ft	20.33 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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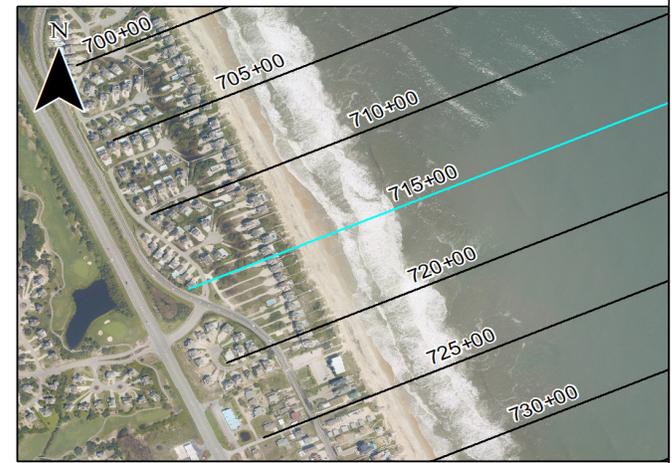


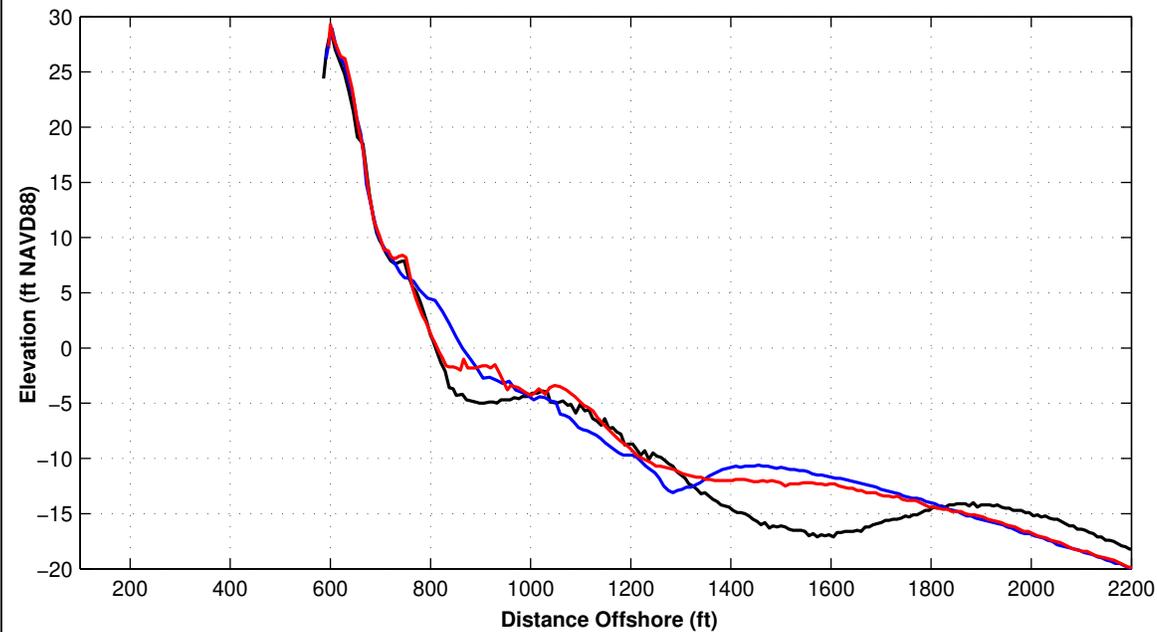
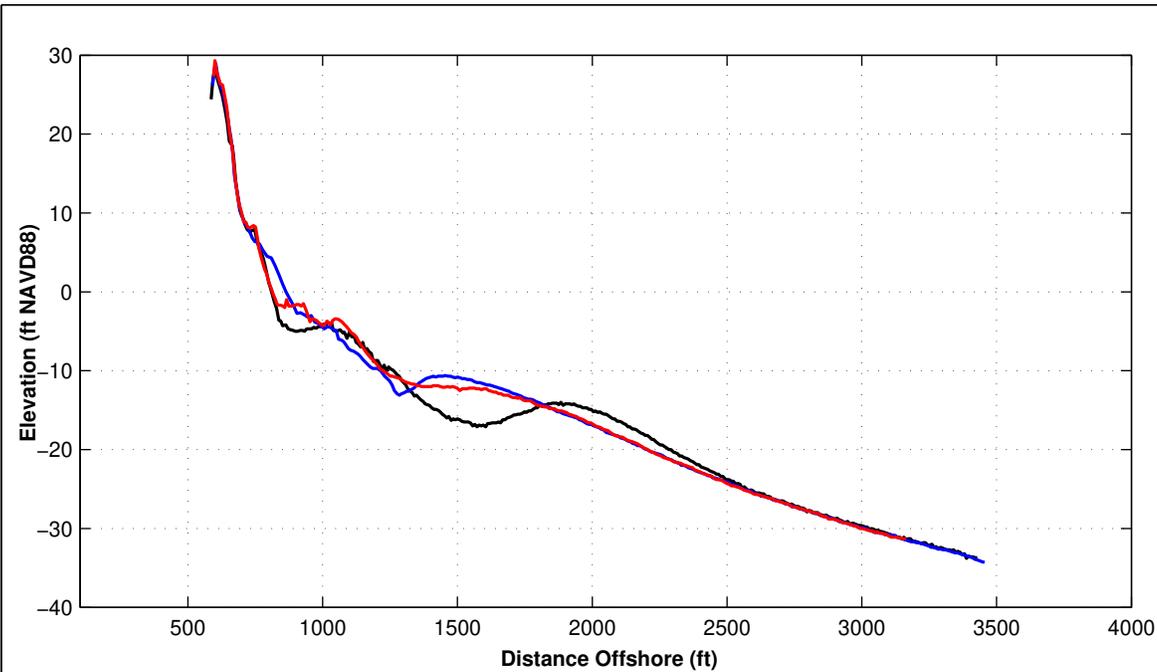
Survey Transect 715+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-27.25 ft	-13.91 ft
Volume Change Above +6 ft NAVD88	-0.34 cy/ft	-1.57 cy/ft
Volume Change Above 1.18 ft NAVD88	-7.29 cy/ft	-4.36 cy/ft
Volume Change Above -6 ft NAVD88	-9.31 cy/ft	-7.38 cy/ft
Volume Change Above -14 ft NAVD88	-29.17 cy/ft	4.33 cy/ft
Volume Change Above -19 ft NAVD88	-22.72 cy/ft	2.83 cy/ft
Volume Change Above -30 ft NAVD88	-35.79 cy/ft	-0.65 cy/ft

LEGEND:

OCTOBER 2023	—	POST-DORIAN AD	—
JUNE 2023	—	JUNE 2022	—

- Notes:
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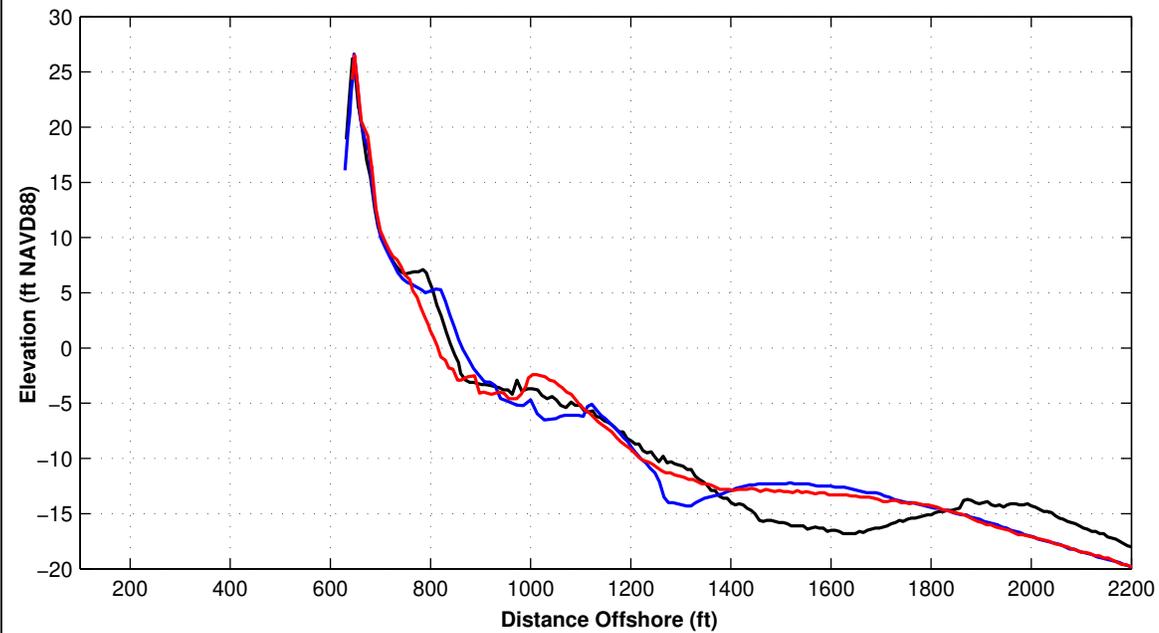
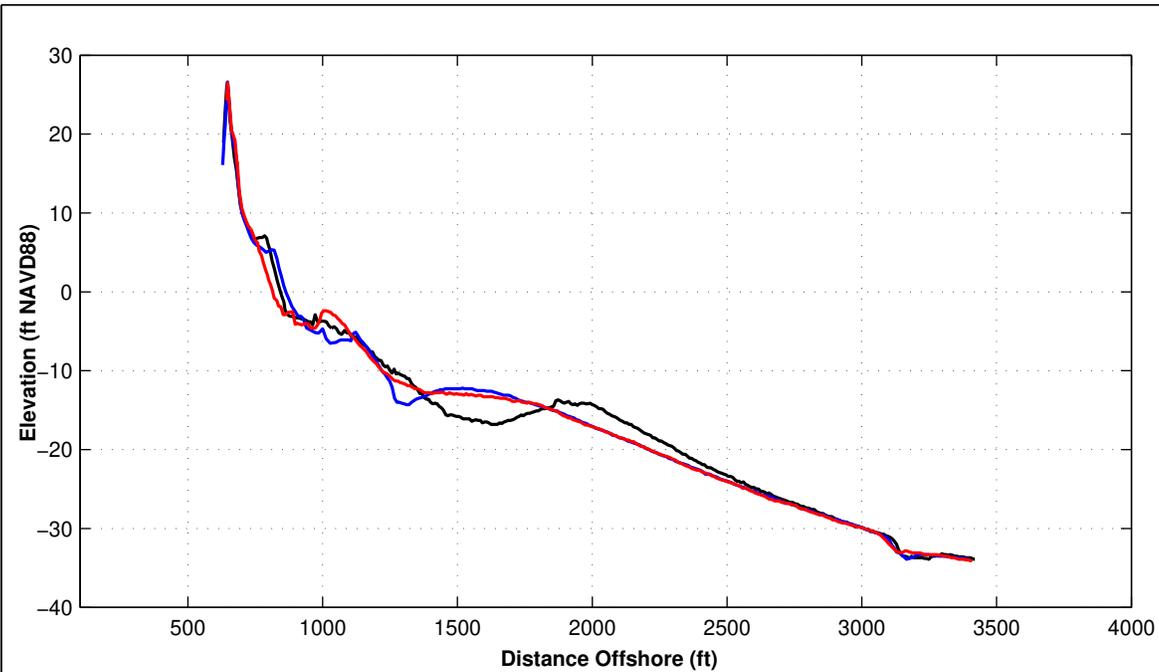
Survey Transect 720+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	49.23 ft	-47.85 ft
Volume Change Above +6 ft NAVD88	1.01 cy/ft	2.17 cy/ft
Volume Change Above 1.18 ft NAVD88	6.48 cy/ft	-3.89 cy/ft
Volume Change Above -6 ft NAVD88	22.03 cy/ft	-2.17 cy/ft
Volume Change Above -14 ft NAVD88	46.22 cy/ft	-4.48 cy/ft
Volume Change Above -19 ft NAVD88	53.66 cy/ft	-3.49 cy/ft
Volume Change Above -30 ft NAVD88	38.69 cy/ft	-4.01 cy/ft

LEGEND:

OCTOBER 2023		POST-DORIAN AD	
JUNE 2023		JUNE 2022	

- Notes:
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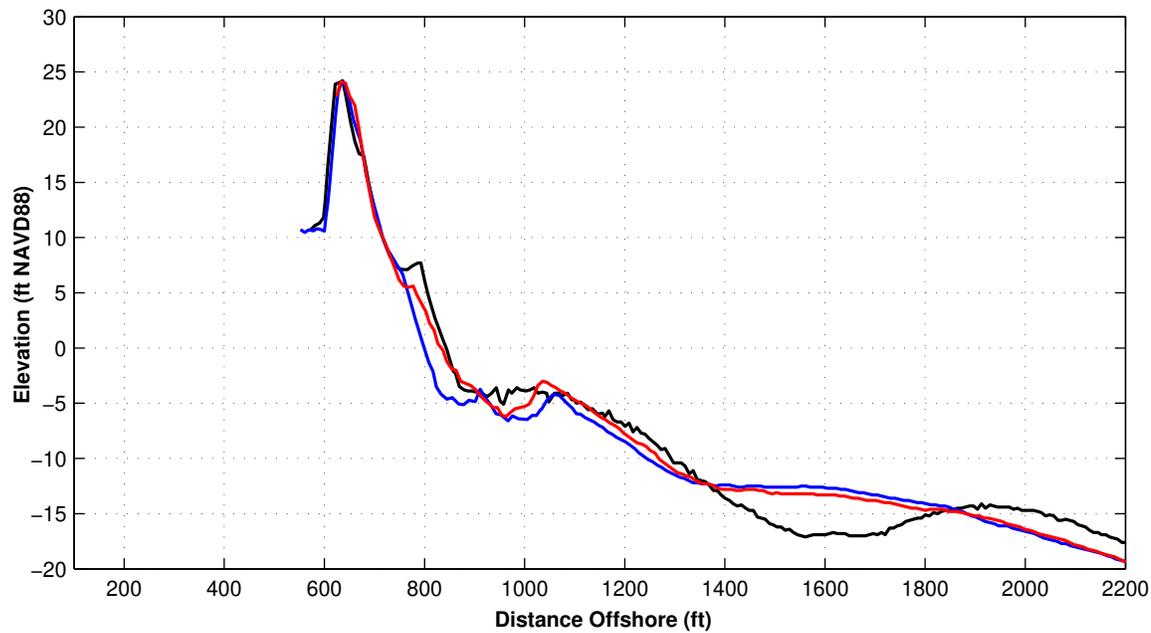
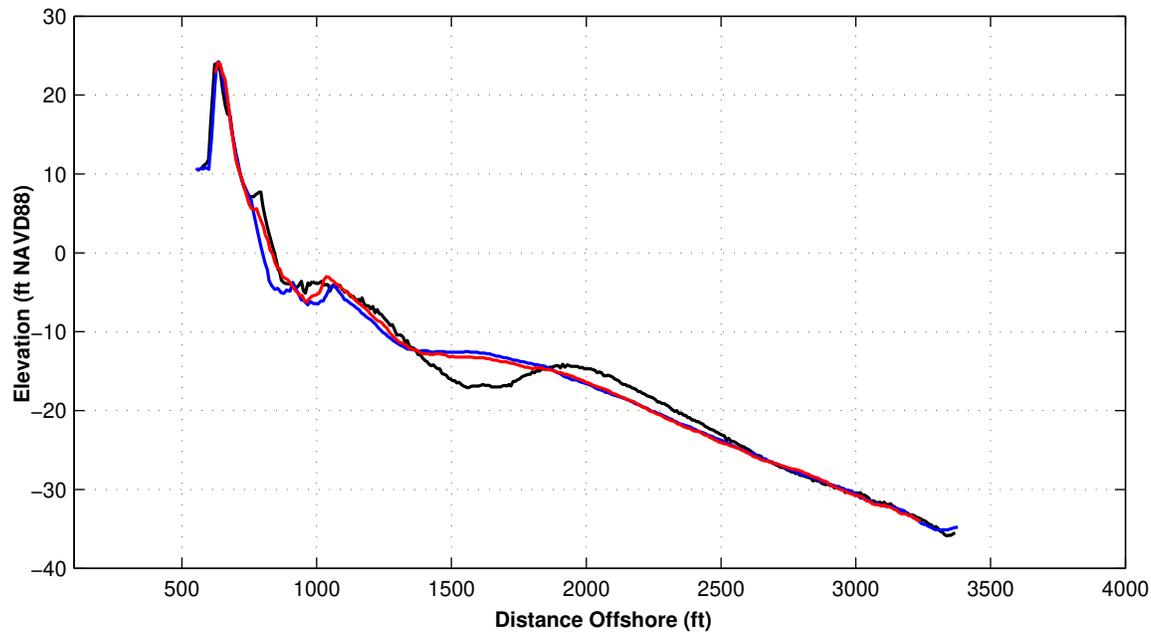


Survey Transect 725+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	19.44 ft	-49.31 ft
Volume Change Above +6 ft NAVD88	-1.30 cy/ft	2.41 cy/ft
Volume Change Above 1.18 ft NAVD88	0.50 cy/ft	-5.58 cy/ft
Volume Change Above -6 ft NAVD88	-2.53 cy/ft	-2.92 cy/ft
Volume Change Above -14 ft NAVD88	0.62 cy/ft	-1.73 cy/ft
Volume Change Above -19 ft NAVD88	0.21 cy/ft	-1.84 cy/ft
Volume Change Above -30 ft NAVD88	-18.45 cy/ft	-3.61 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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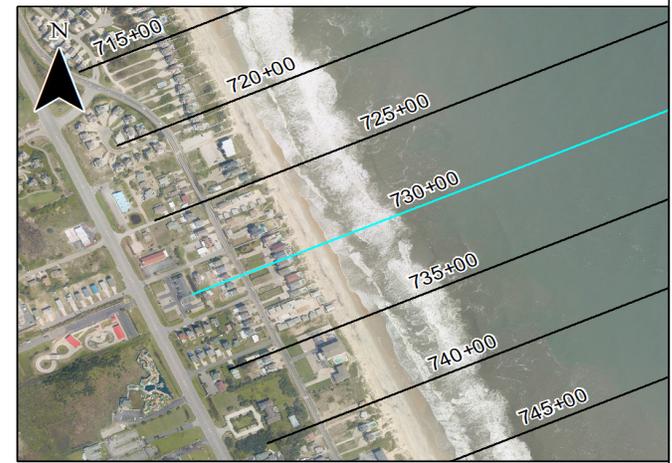


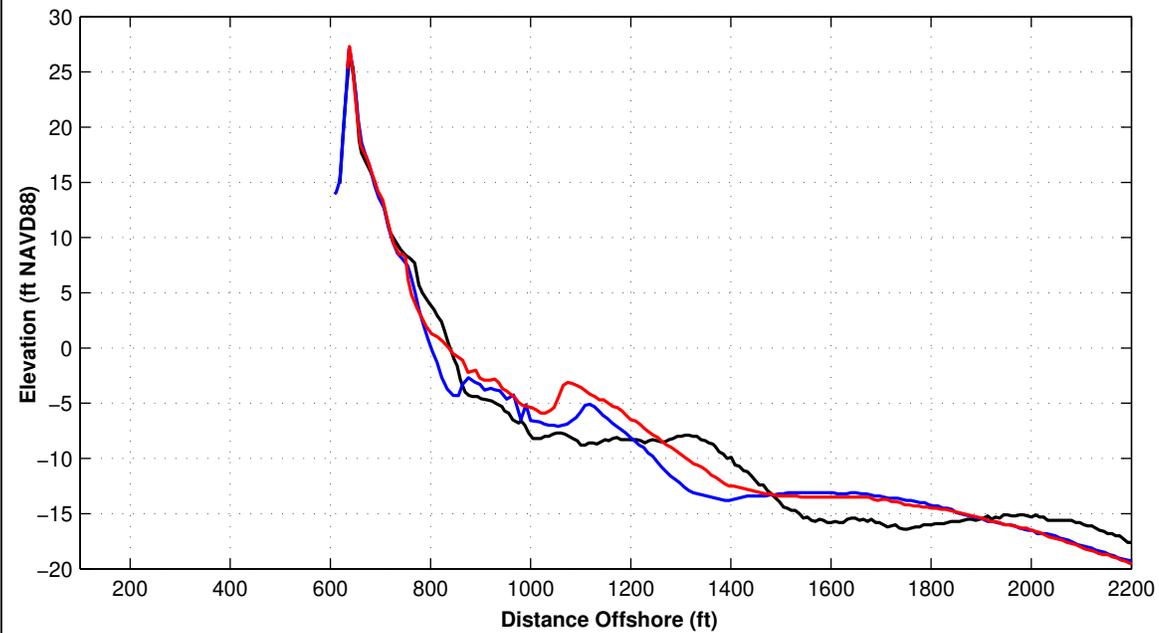
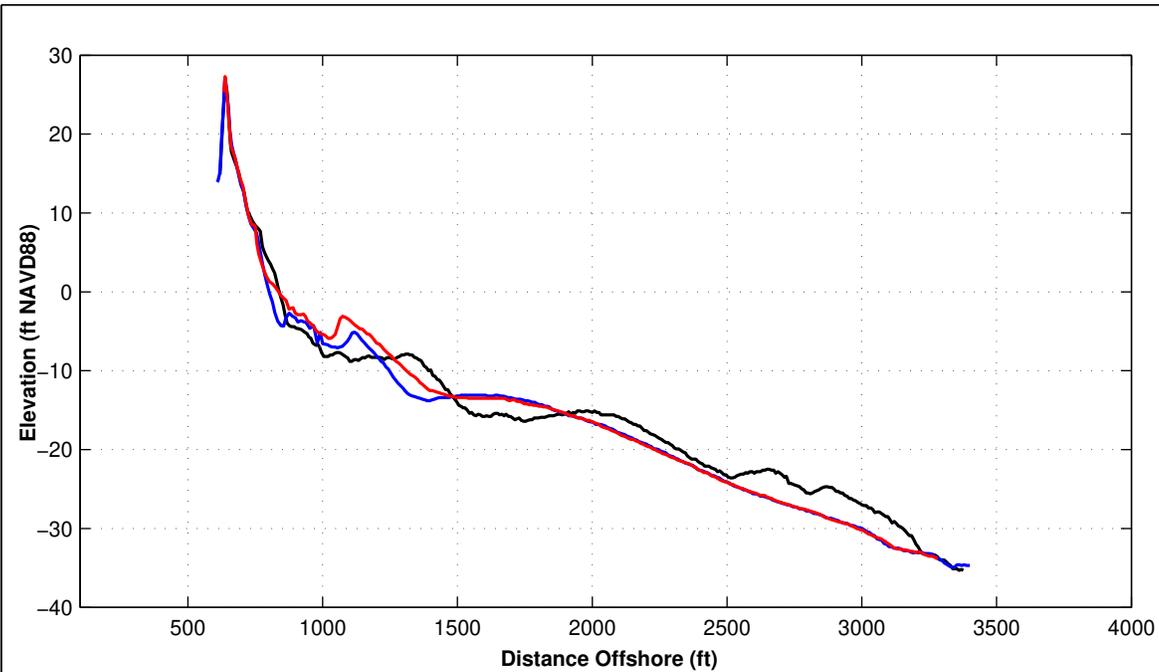


Survey Transect 730+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-42.05 ft	30.76 ft
Volume Change Above +6 ft NAVD88	-0.24 cy/ft	-0.21 cy/ft
Volume Change Above 1.18 ft NAVD88	-7.39 cy/ft	3.43 cy/ft
Volume Change Above -6 ft NAVD88	-27.70 cy/ft	20.07 cy/ft
Volume Change Above -14 ft NAVD88	-23.99 cy/ft	19.37 cy/ft
Volume Change Above -19 ft NAVD88	-14.50 cy/ft	19.78 cy/ft
Volume Change Above -30 ft NAVD88	-27.59 cy/ft	18.00 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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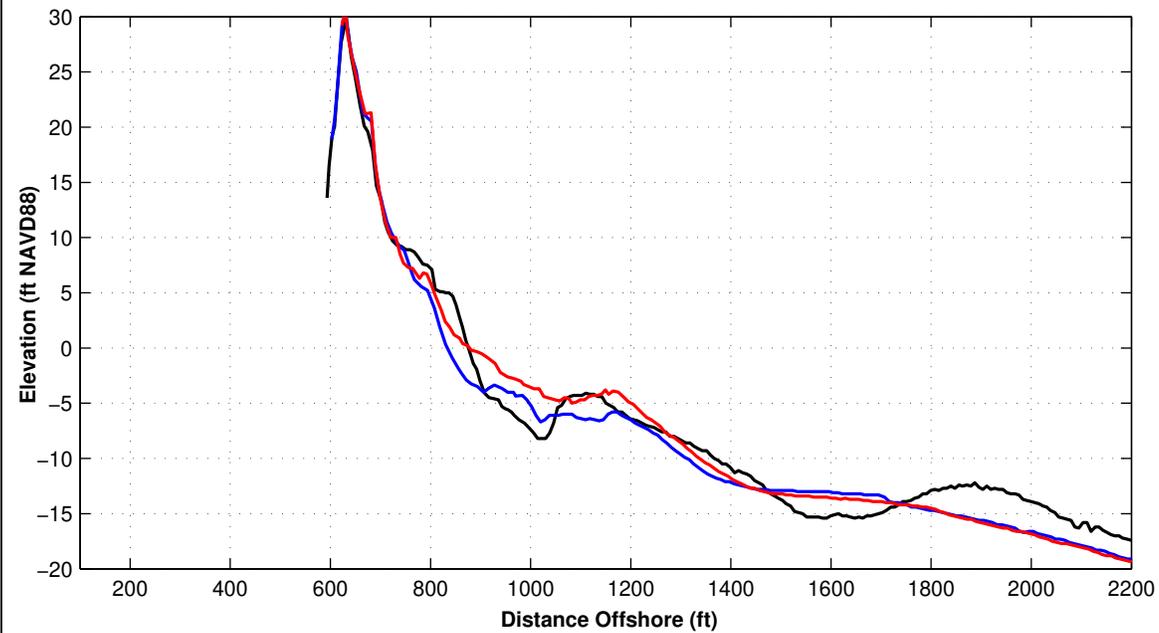
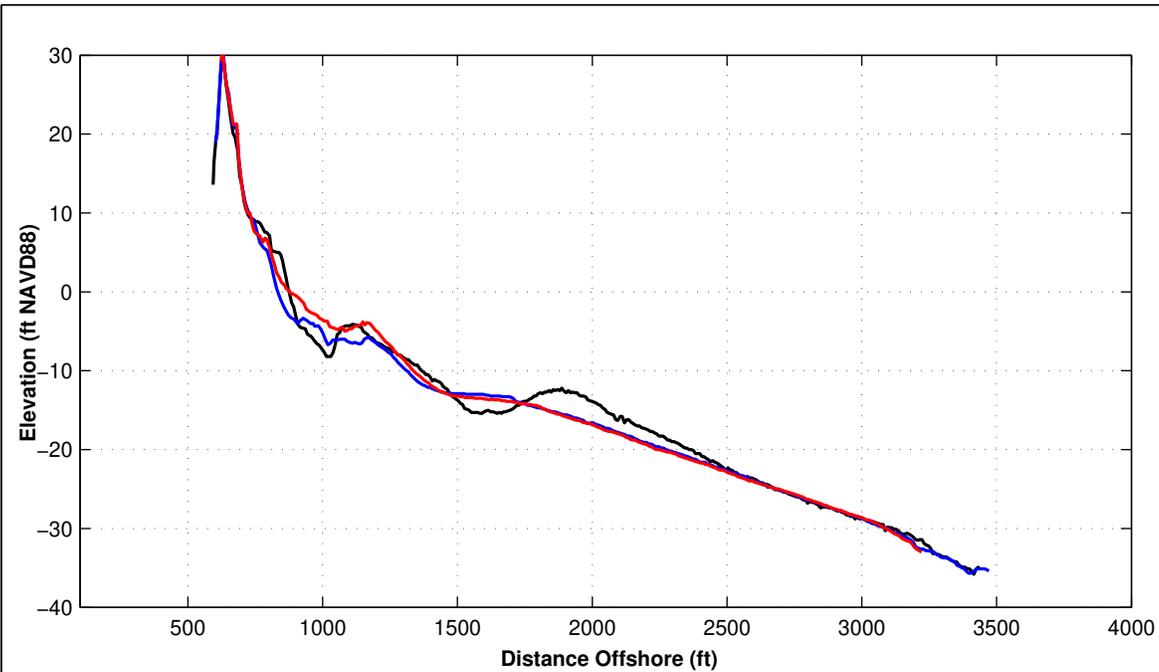


Survey Transect 735+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-38.15 ft	14.35 ft
Volume Change Above +6 ft NAVD88	-1.31 cy/ft	-0.01 cy/ft
Volume Change Above 1.18 ft NAVD88	-6.06 cy/ft	-0.32 cy/ft
Volume Change Above -6 ft NAVD88	-6.99 cy/ft	18.89 cy/ft
Volume Change Above -14 ft NAVD88	-16.58 cy/ft	38.68 cy/ft
Volume Change Above -19 ft NAVD88	-12.36 cy/ft	37.18 cy/ft
Volume Change Above -30 ft NAVD88	-87.48 cy/ft	36.37 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
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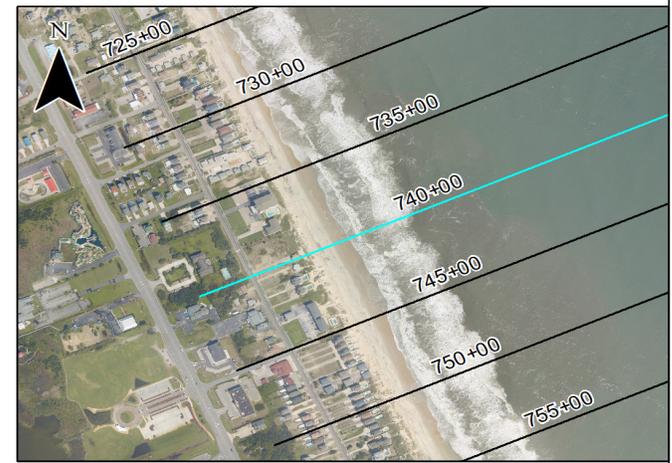
Survey Transect 740+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-43.79 ft	23.86 ft
Volume Change Above +6 ft NAVD88	-0.64 cy/ft	0.04 cy/ft
Volume Change Above 1.18 ft NAVD88	-8.00 cy/ft	2.84 cy/ft
Volume Change Above -6 ft NAVD88	-15.49 cy/ft	28.74 cy/ft
Volume Change Above -14 ft NAVD88	-26.00 cy/ft	33.26 cy/ft
Volume Change Above -19 ft NAVD88	-48.41 cy/ft	30.87 cy/ft
Volume Change Above -30 ft NAVD88	-57.10 cy/ft	28.66 cy/ft

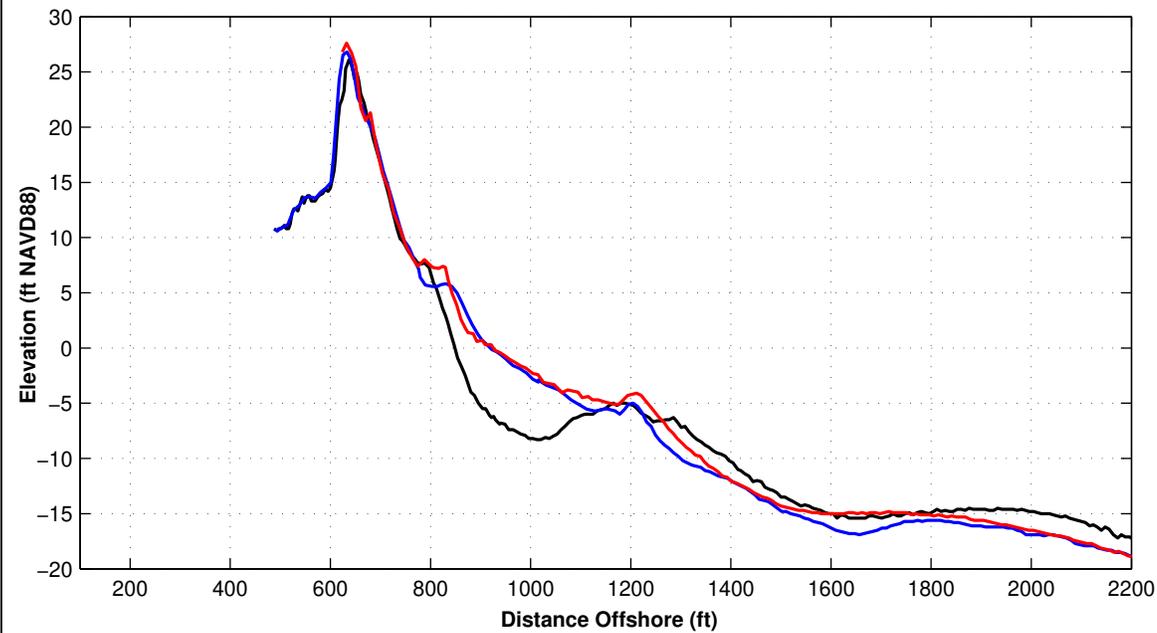
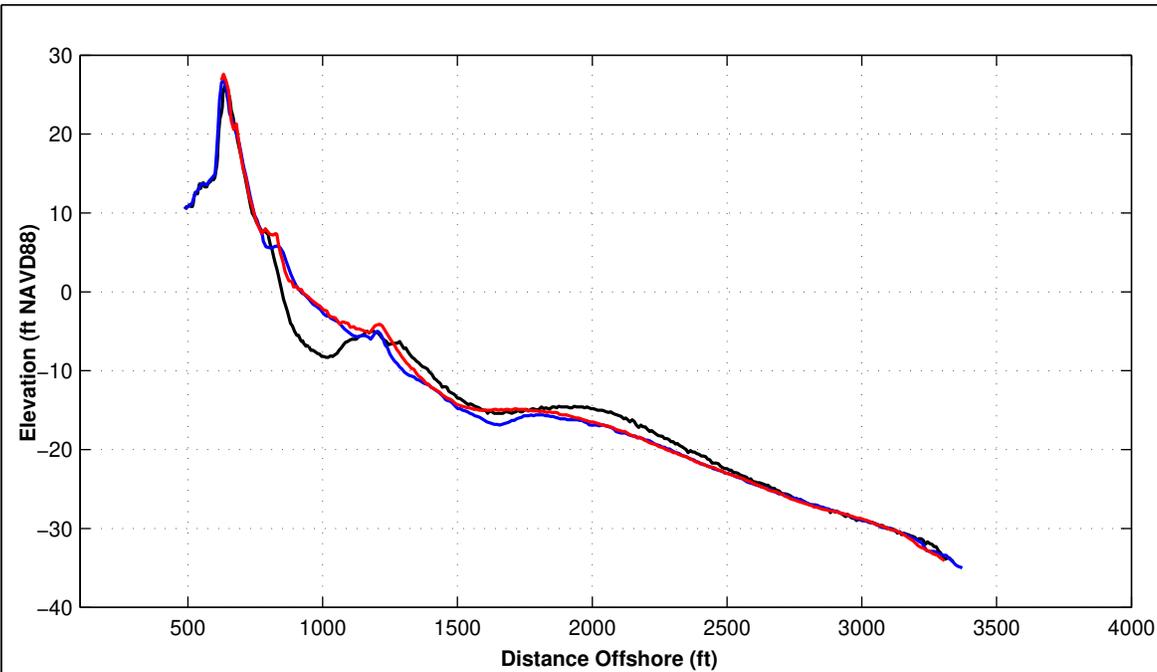
LEGEND:

OCTOBER 2023 — POST-DORIAN AD —

JUNE 2023 — JUNE 2022 —

- Notes:
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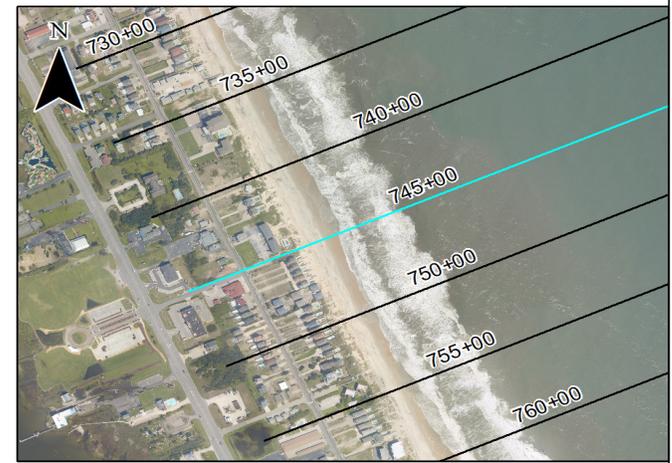


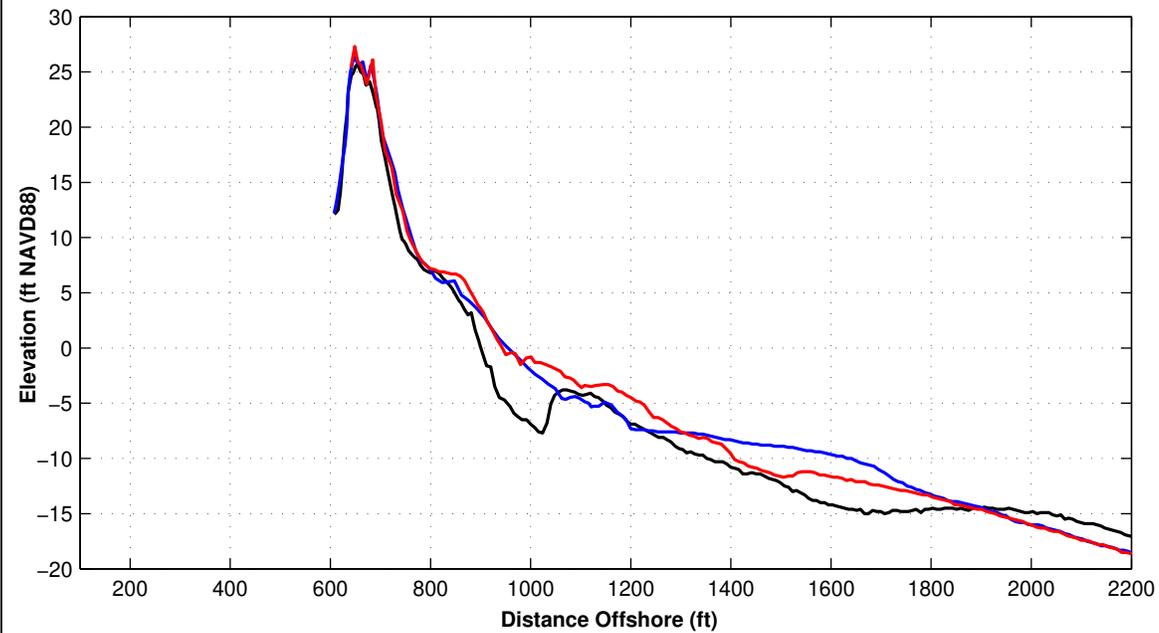
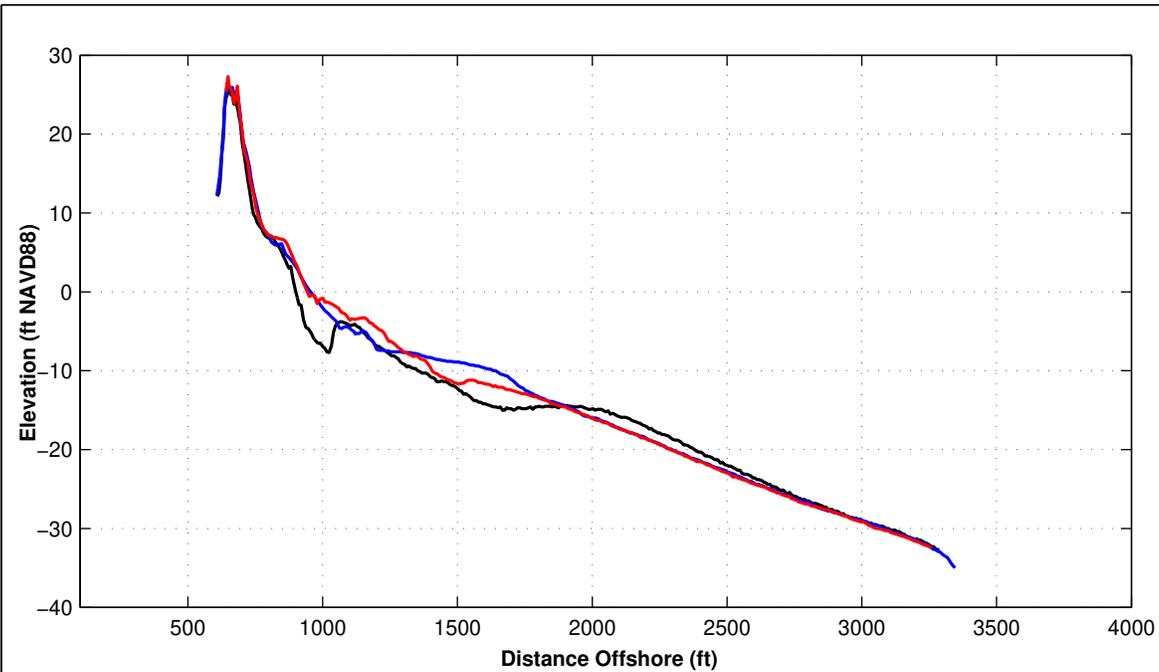


Survey Transect 745+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	54.64 ft	-8.90 ft
Volume Change Above +6 ft NAVD88	-0.35 cy/ft	3.24 cy/ft
Volume Change Above 1.18 ft NAVD88	6.69 cy/ft	1.63 cy/ft
Volume Change Above -6 ft NAVD88	40.98 cy/ft	8.86 cy/ft
Volume Change Above -14 ft NAVD88	31.59 cy/ft	16.23 cy/ft
Volume Change Above -19 ft NAVD88	-8.04 cy/ft	32.44 cy/ft
Volume Change Above -30 ft NAVD88	-19.56 cy/ft	31.27 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

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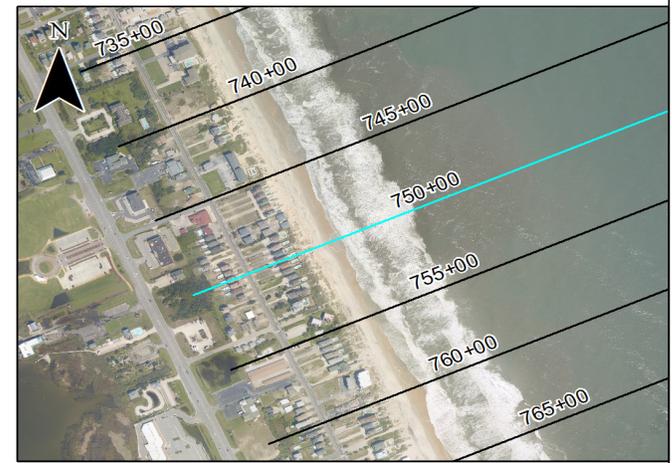


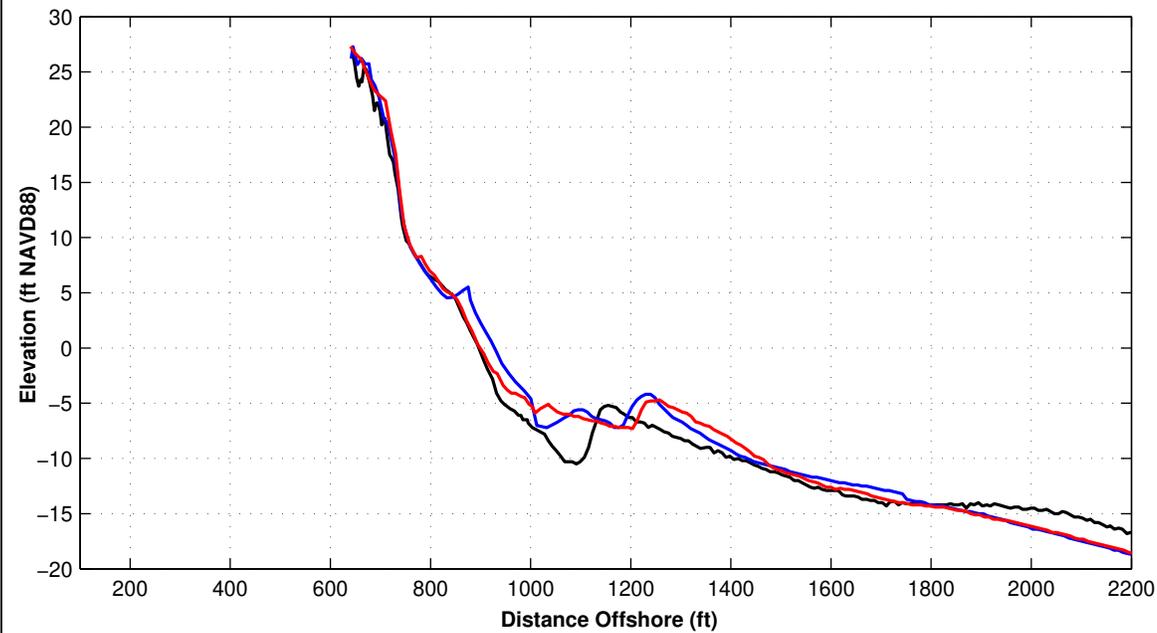
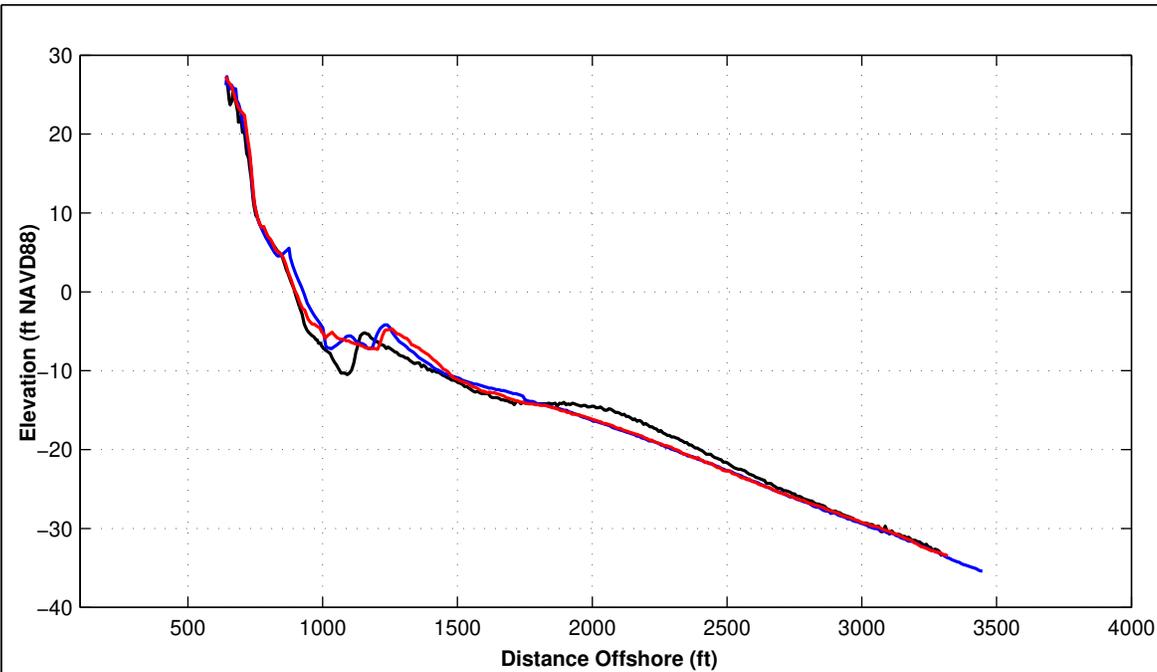


Survey Transect 750+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	38.99 ft	-3.18 ft
Volume Change Above +6 ft NAVD88	7.53 cy/ft	0.41 cy/ft
Volume Change Above 1.18 ft NAVD88	11.58 cy/ft	2.10 cy/ft
Volume Change Above -6 ft NAVD88	31.06 cy/ft	15.68 cy/ft
Volume Change Above -14 ft NAVD88	88.18 cy/ft	-6.73 cy/ft
Volume Change Above -19 ft NAVD88	77.74 cy/ft	-7.93 cy/ft
Volume Change Above -30 ft NAVD88	61.32 cy/ft	-12.16 cy/ft

LEGEND:
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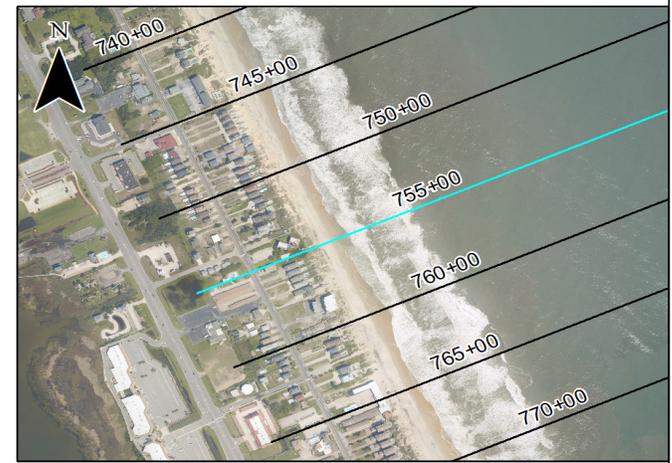
Survey Transect 755+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	29.91 ft	-27.52 ft
Volume Change Above +6 ft NAVD88	4.34 cy/ft	1.95 cy/ft
Volume Change Above 1.18 ft NAVD88	7.71 cy/ft	-1.11 cy/ft
Volume Change Above -6 ft NAVD88	21.61 cy/ft	-7.23 cy/ft
Volume Change Above -14 ft NAVD88	51.19 cy/ft	-6.60 cy/ft
Volume Change Above -19 ft NAVD88	25.24 cy/ft	-6.08 cy/ft
Volume Change Above -30 ft NAVD88	5.28 cy/ft	-4.12 cy/ft

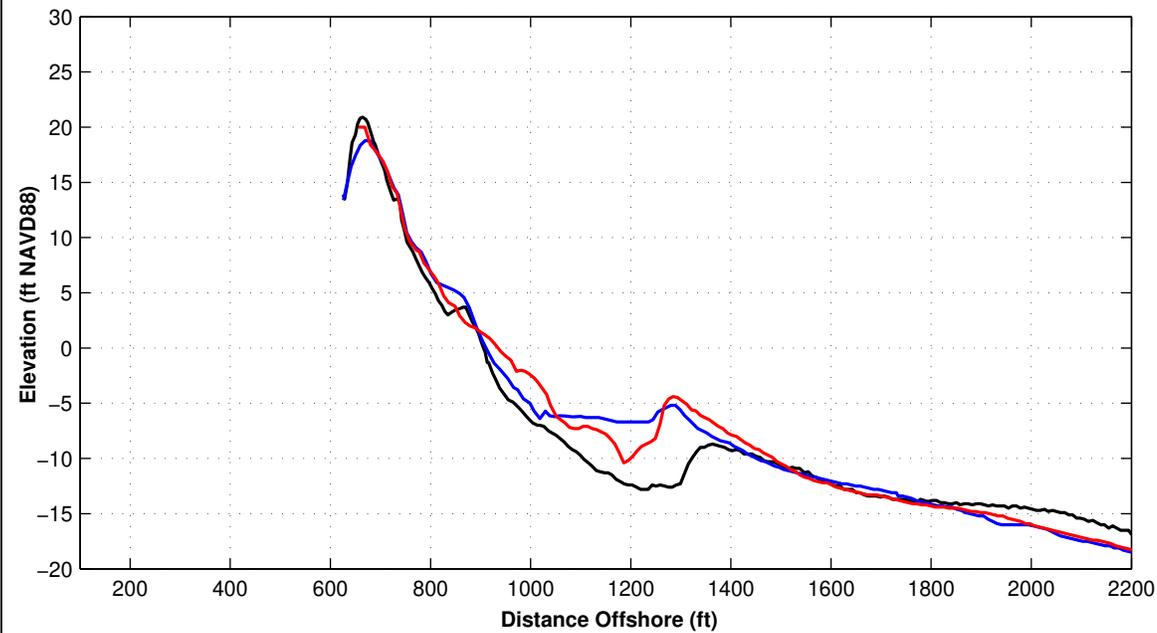
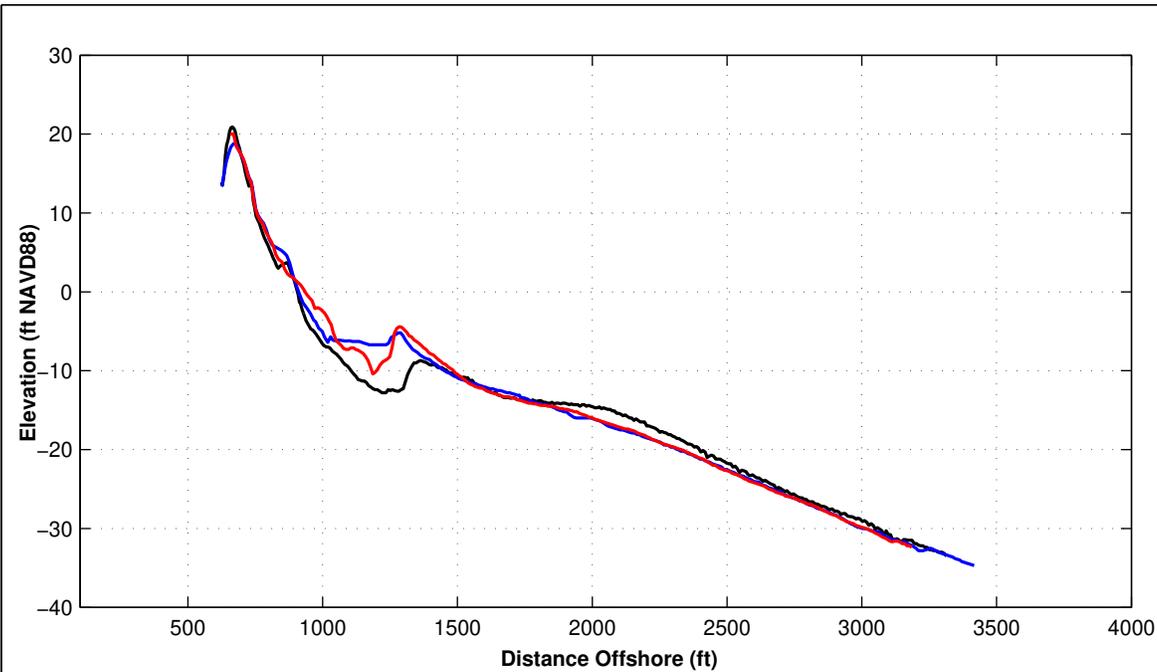
LEGEND:

OCTOBER 2023 — POST-DORIAN AD —

JUNE 2023 — JUNE 2022 —

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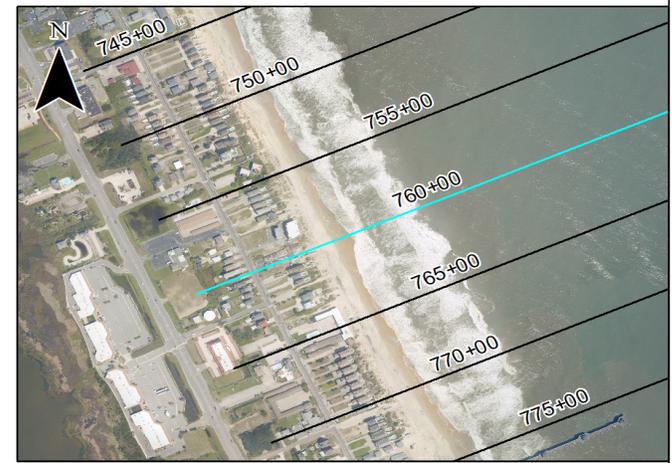


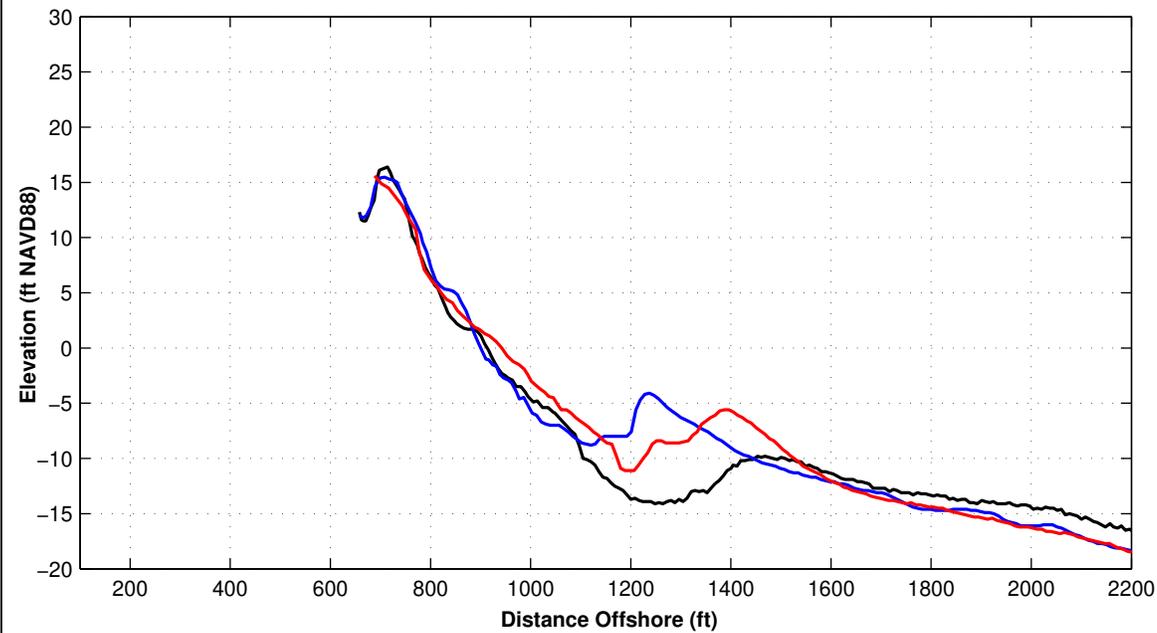
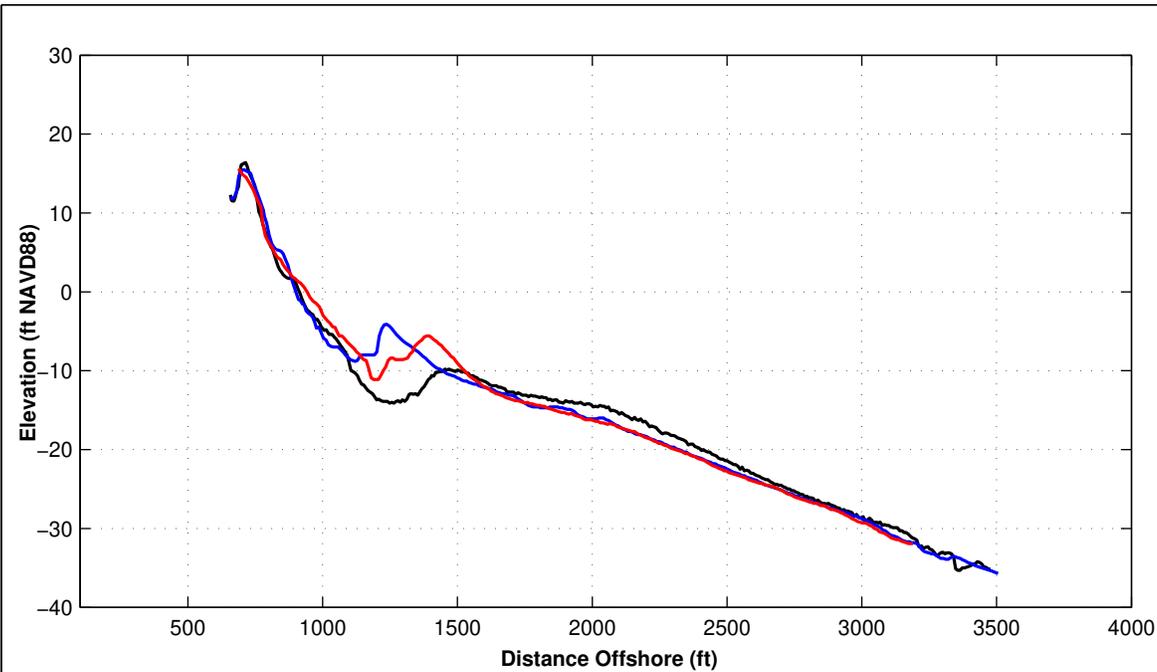


Survey Transect 760+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	1.86 ft	10.26 ft
Volume Change Above +6 ft NAVD88	0.70 cy/ft	0.23 cy/ft
Volume Change Above 1.18 ft NAVD88	5.28 cy/ft	-3.38 cy/ft
Volume Change Above -6 ft NAVD88	11.36 cy/ft	8.43 cy/ft
Volume Change Above -14 ft NAVD88	68.69 cy/ft	-1.32 cy/ft
Volume Change Above -19 ft NAVD88	41.85 cy/ft	2.22 cy/ft
Volume Change Above -30 ft NAVD88	21.22 cy/ft	1.30 cy/ft

LEGEND:
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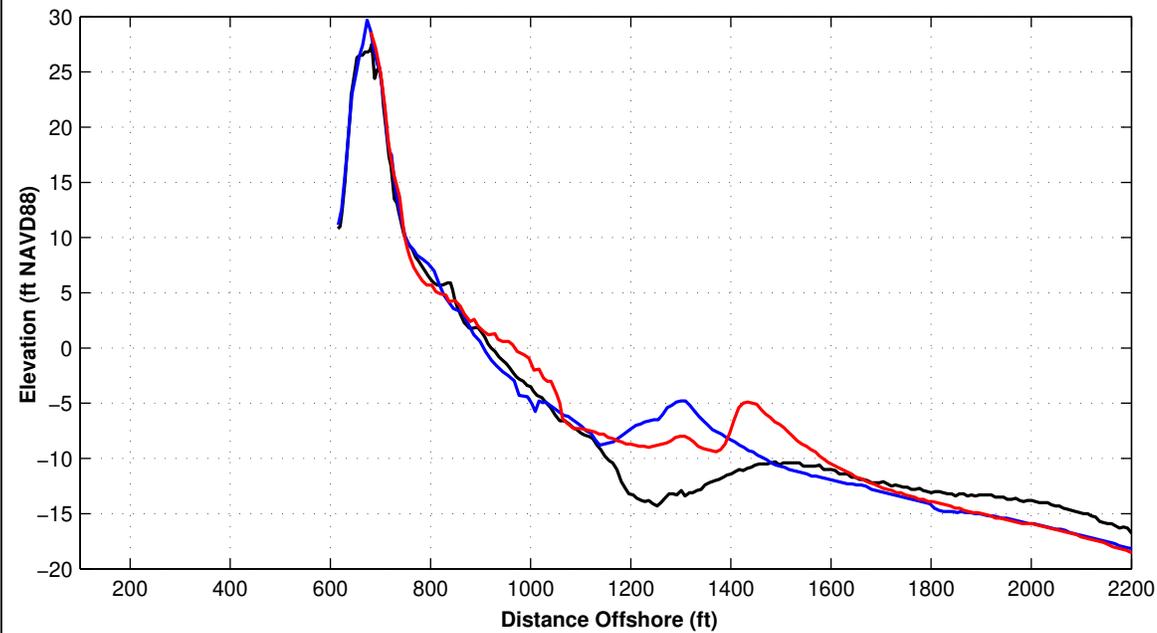
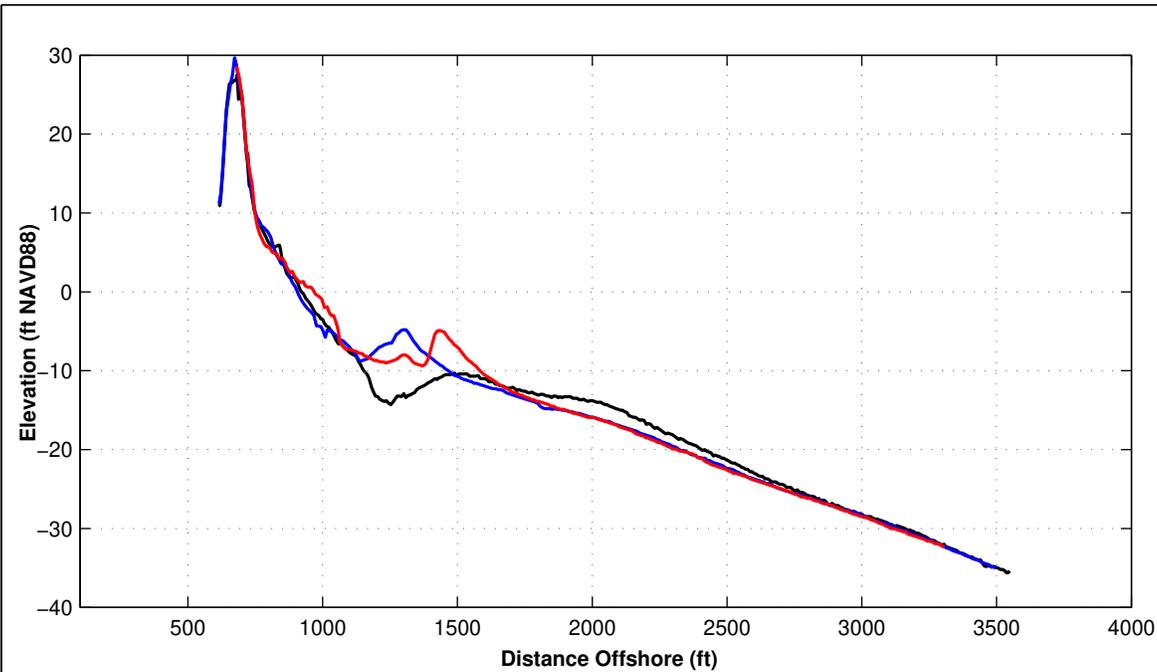


Survey Transect 765+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-10.61 ft	25.12 ft
Volume Change Above +6 ft NAVD88	2.58 cy/ft	-4.37 cy/ft
Volume Change Above 1.18 ft NAVD88	7.00 cy/ft	-6.14 cy/ft
Volume Change Above -6 ft NAVD88	6.62 cy/ft	4.31 cy/ft
Volume Change Above -14 ft NAVD88	55.45 cy/ft	8.98 cy/ft
Volume Change Above -19 ft NAVD88	28.67 cy/ft	6.32 cy/ft
Volume Change Above -30 ft NAVD88	8.61 cy/ft	0.67 cy/ft

LEGEND:
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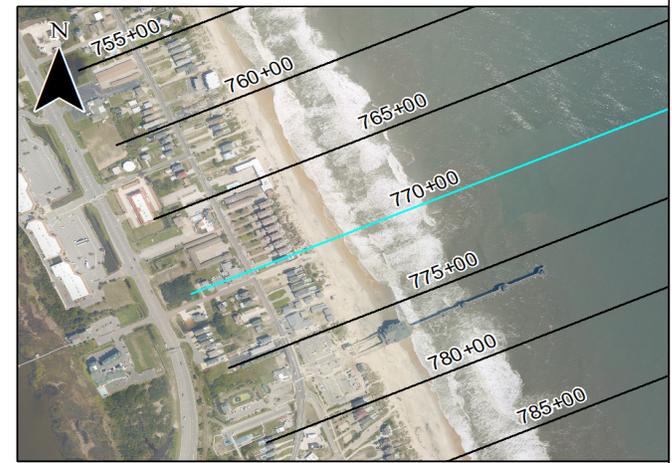


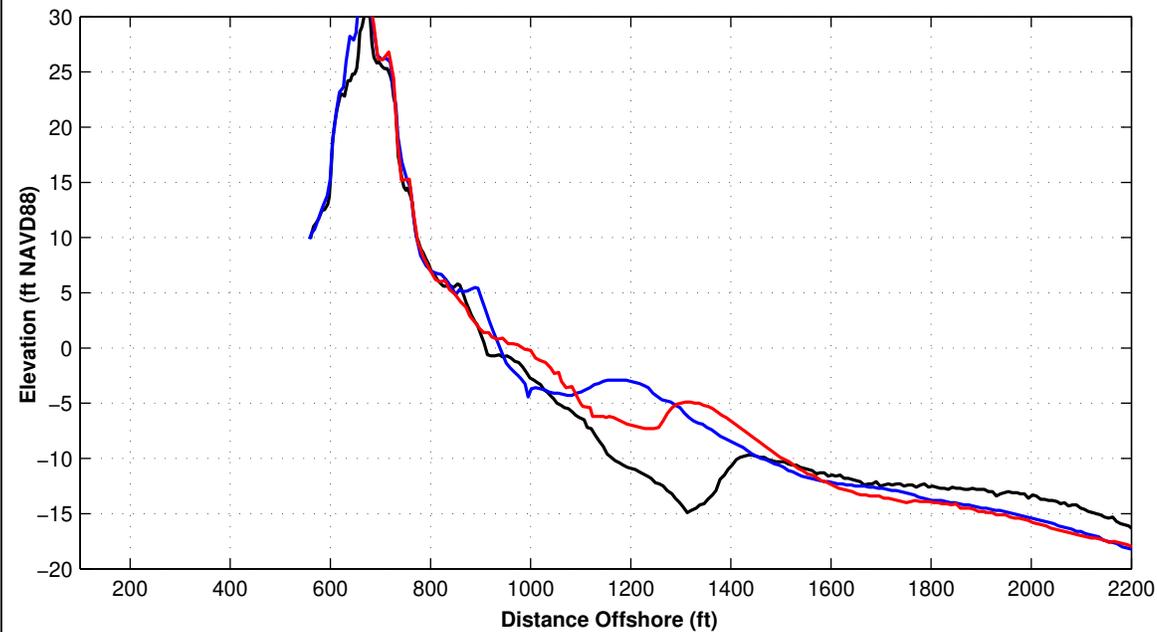
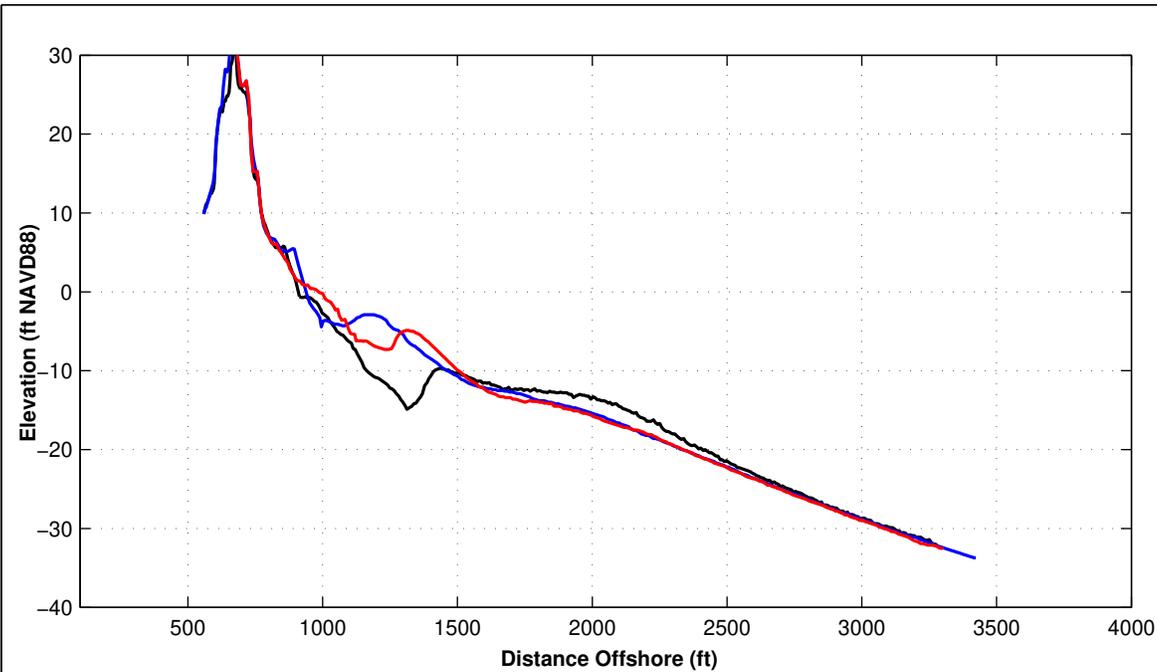


Survey Transect 770+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-18.63 ft	43.14 ft
Volume Change Above +6 ft NAVD88	3.26 cy/ft	-2.16 cy/ft
Volume Change Above 1.18 ft NAVD88	1.74 cy/ft	-1.12 cy/ft
Volume Change Above -6 ft NAVD88	-0.99 cy/ft	14.30 cy/ft
Volume Change Above -14 ft NAVD88	45.00 cy/ft	24.66 cy/ft
Volume Change Above -19 ft NAVD88	17.07 cy/ft	24.07 cy/ft
Volume Change Above -30 ft NAVD88	-0.65 cy/ft	19.36 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
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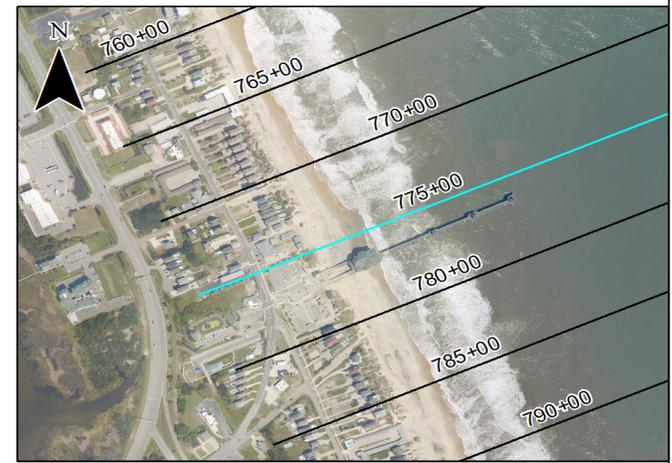


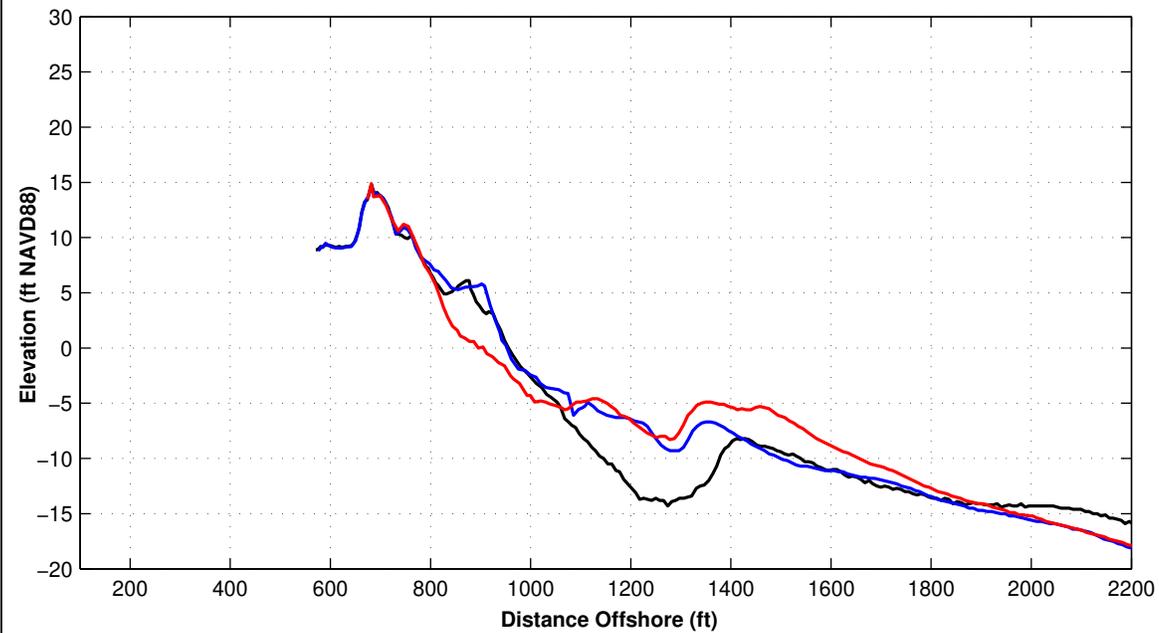
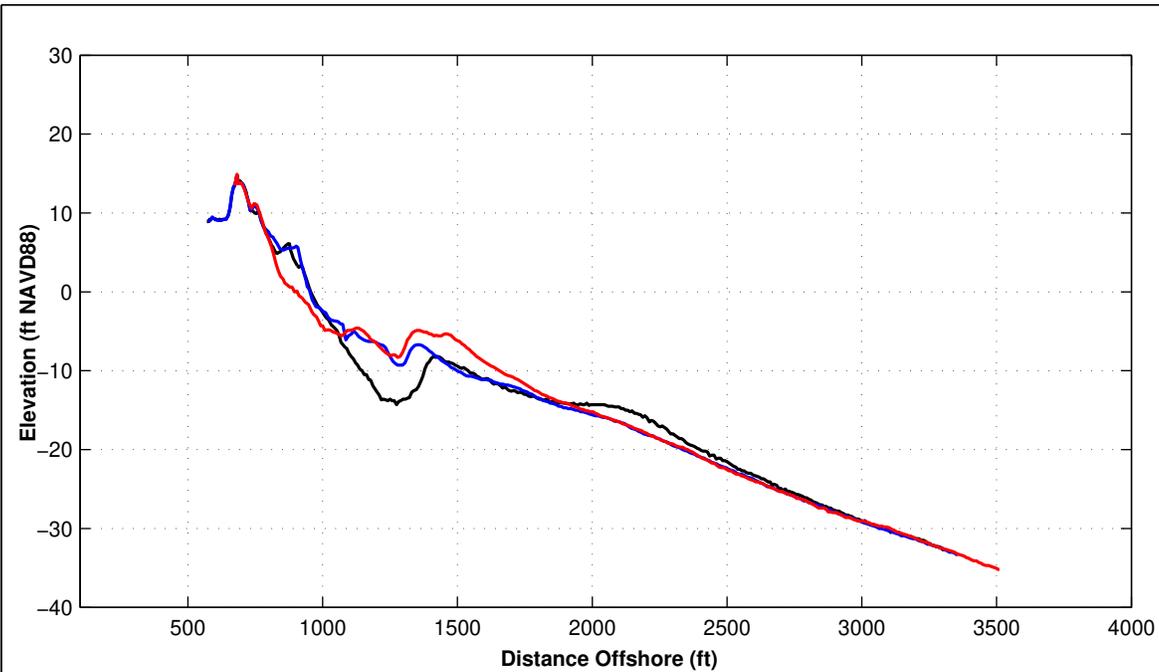


Survey Transect 775+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	27.12 ft	-8.57 ft
Volume Change Above +6 ft NAVD88	3.41 cy/ft	-0.35 cy/ft
Volume Change Above 1.18 ft NAVD88	7.97 cy/ft	-5.81 cy/ft
Volume Change Above -6 ft NAVD88	27.28 cy/ft	-7.78 cy/ft
Volume Change Above -14 ft NAVD88	69.58 cy/ft	-6.01 cy/ft
Volume Change Above -19 ft NAVD88	44.63 cy/ft	-8.94 cy/ft
Volume Change Above -30 ft NAVD88	30.48 cy/ft	-11.56 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
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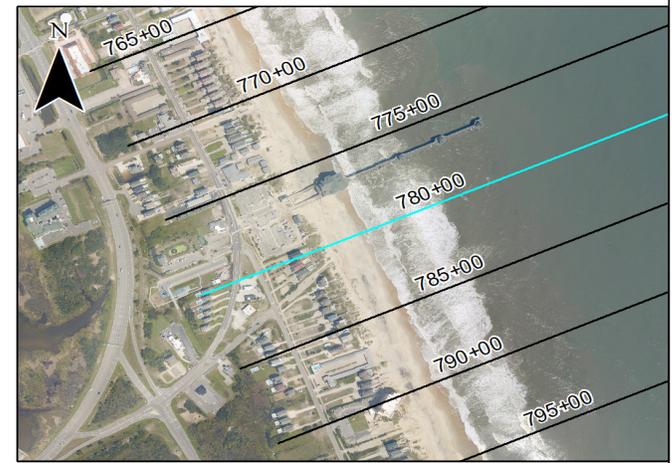


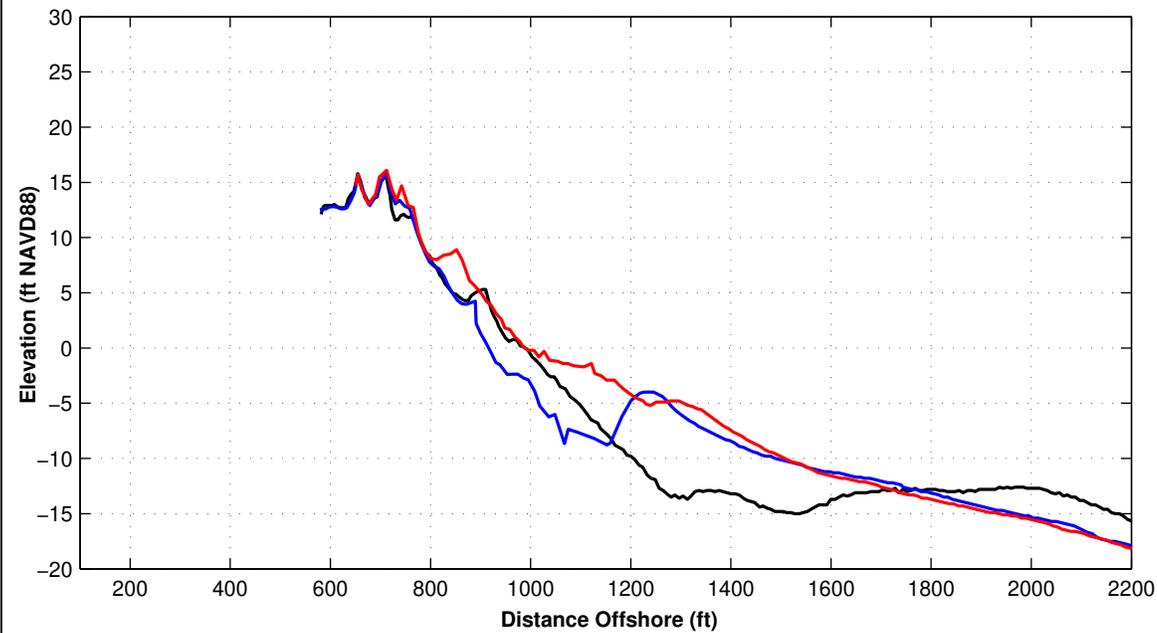
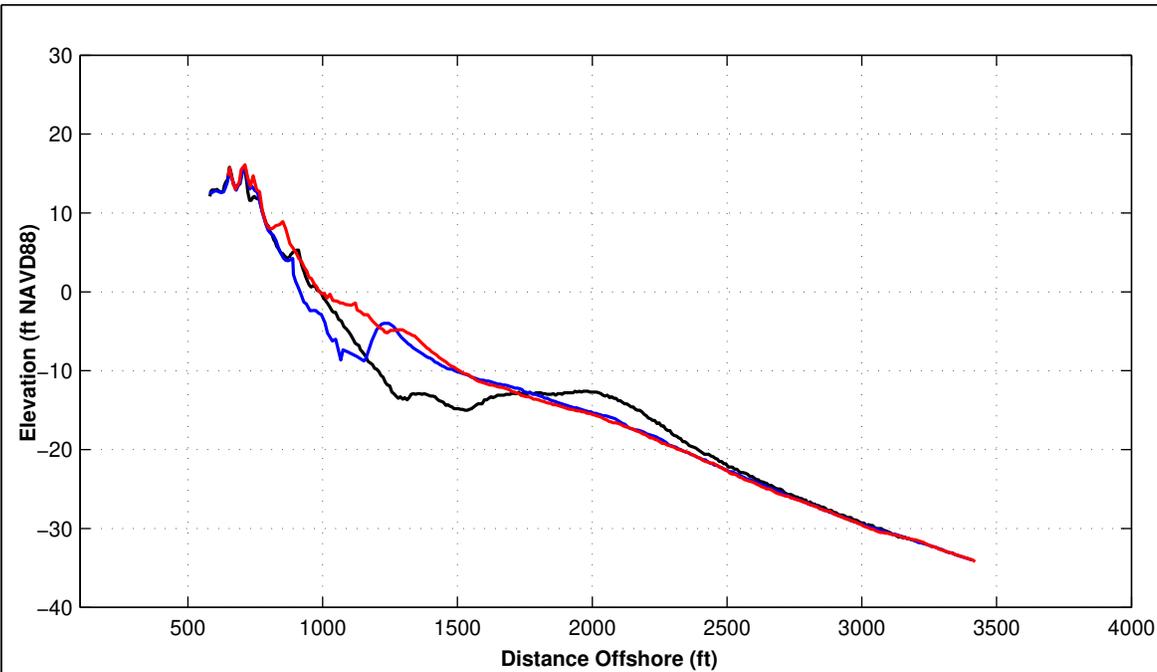


Survey Transect 780+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-3.79 ft	-81.40 ft
Volume Change Above +6 ft NAVD88	1.54 cy/ft	-0.85 cy/ft
Volume Change Above 1.18 ft NAVD88	4.11 cy/ft	-16.16 cy/ft
Volume Change Above -6 ft NAVD88	7.51 cy/ft	-21.69 cy/ft
Volume Change Above -14 ft NAVD88	60.39 cy/ft	17.89 cy/ft
Volume Change Above -19 ft NAVD88	36.30 cy/ft	20.88 cy/ft
Volume Change Above -30 ft NAVD88	21.62 cy/ft	20.56 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.





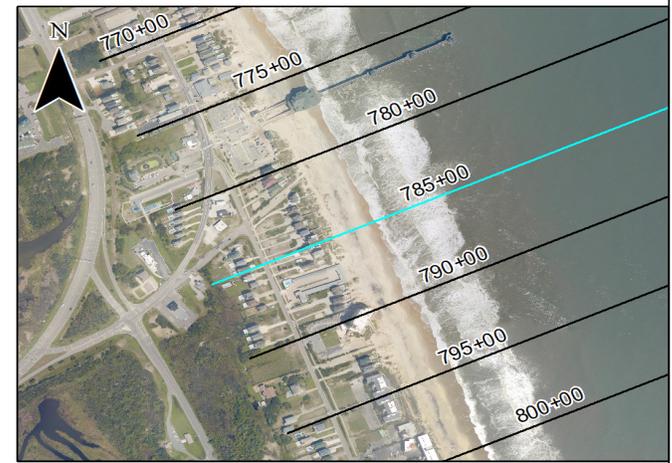
Survey Transect 785+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-44.38 ft	64.08 ft
Volume Change Above +6 ft NAVD88	1.53 cy/ft	7.19 cy/ft
Volume Change Above 1.18 ft NAVD88	-4.15 cy/ft	16.23 cy/ft
Volume Change Above -6 ft NAVD88	-17.26 cy/ft	54.43 cy/ft
Volume Change Above -14 ft NAVD88	48.05 cy/ft	65.29 cy/ft
Volume Change Above -19 ft NAVD88	24.70 cy/ft	60.72 cy/ft
Volume Change Above -30 ft NAVD88	11.46 cy/ft	58.05 cy/ft

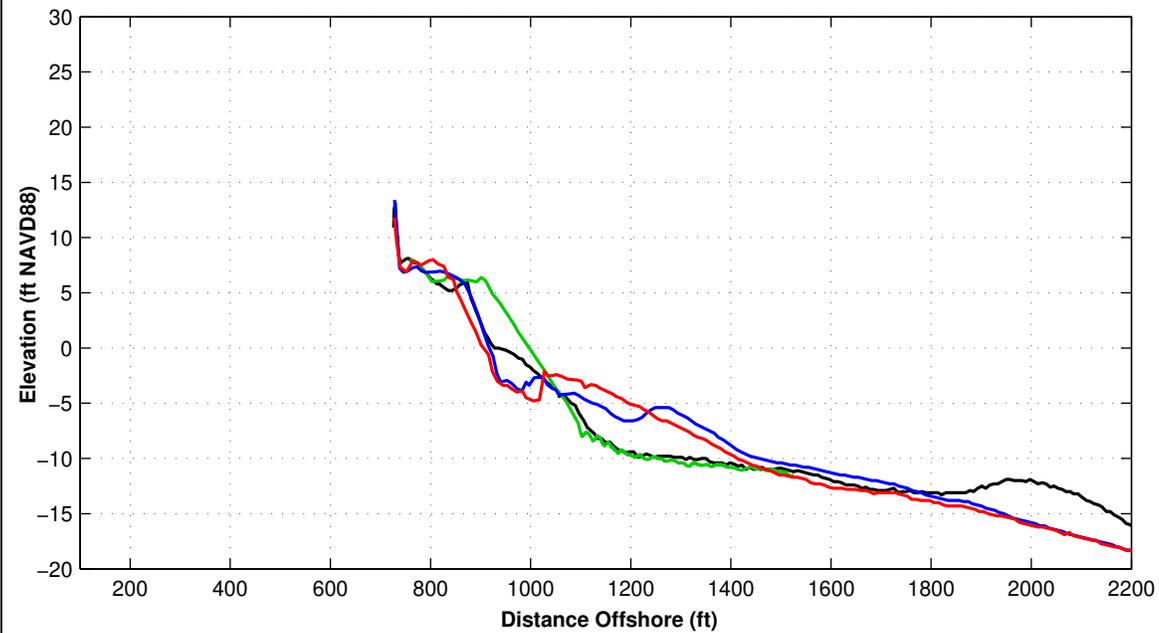
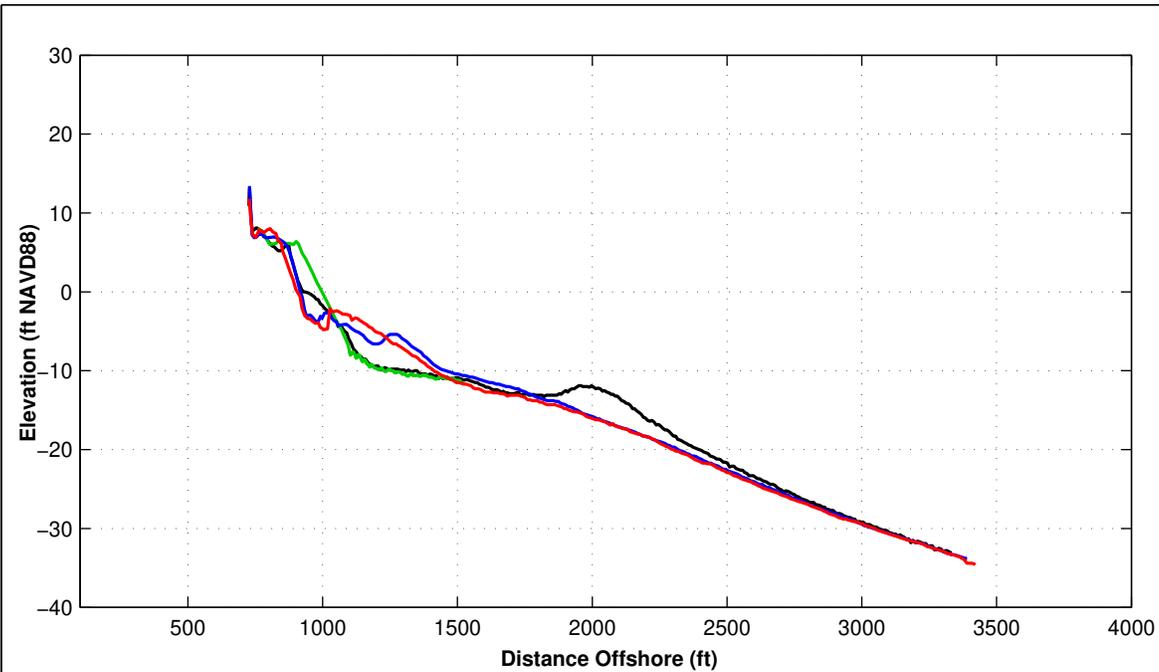
LEGEND:

OCTOBER 2023 — POST-DORIAN AD —

JUNE 2023 — JUNE 2022 —

- Notes:
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 2. All Survey Elevations In Feet Referenced to NAVD88.

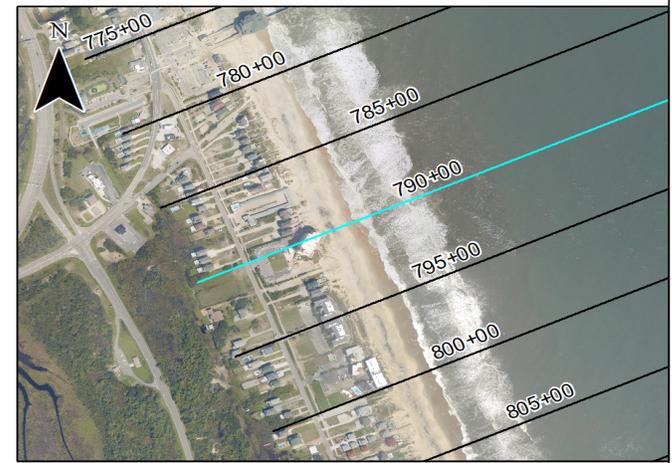


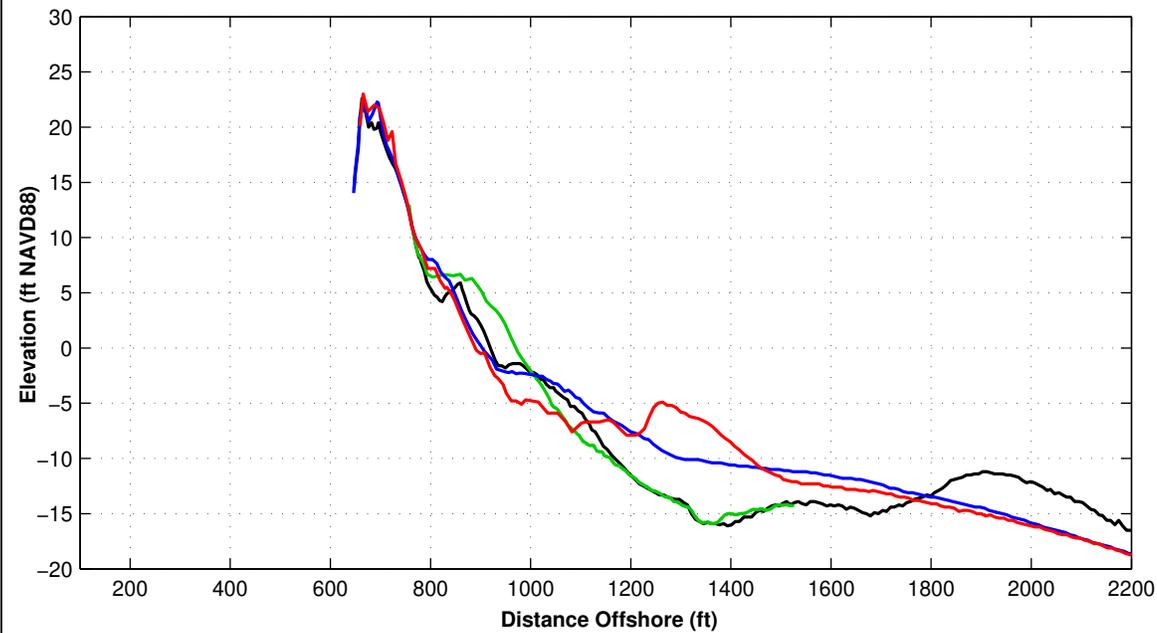
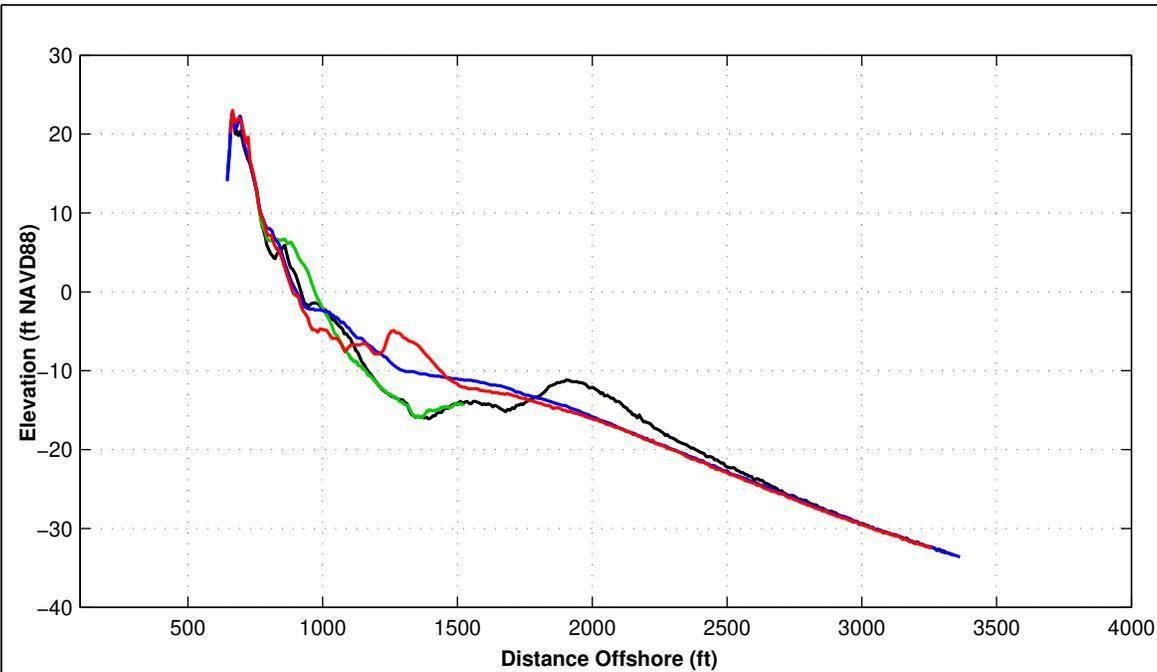


Survey Transect 790+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-3.31 ft	-14.55 ft
Volume Change Above +6 ft NAVD88	0.53 cy/ft	1.58 cy/ft
Volume Change Above 1.18 ft NAVD88	1.37 cy/ft	-2.05 cy/ft
Volume Change Above -6 ft NAVD88	-2.23 cy/ft	2.44 cy/ft
Volume Change Above -14 ft NAVD88	24.64 cy/ft	-16.96 cy/ft
Volume Change Above -19 ft NAVD88	-6.86 cy/ft	-19.62 cy/ft
Volume Change Above -30 ft NAVD88	-23.78 cy/ft	-25.61 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.



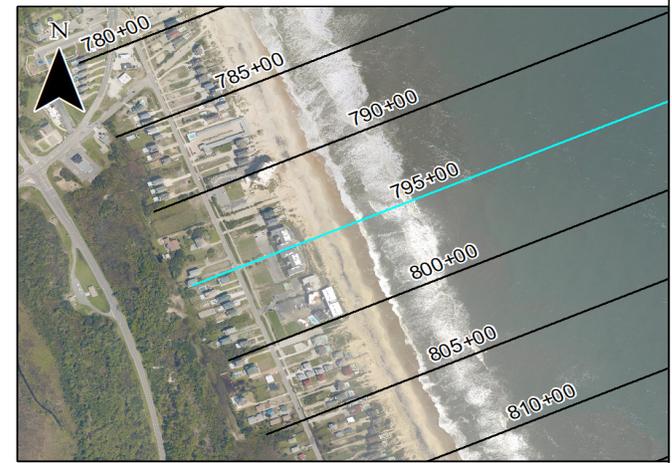


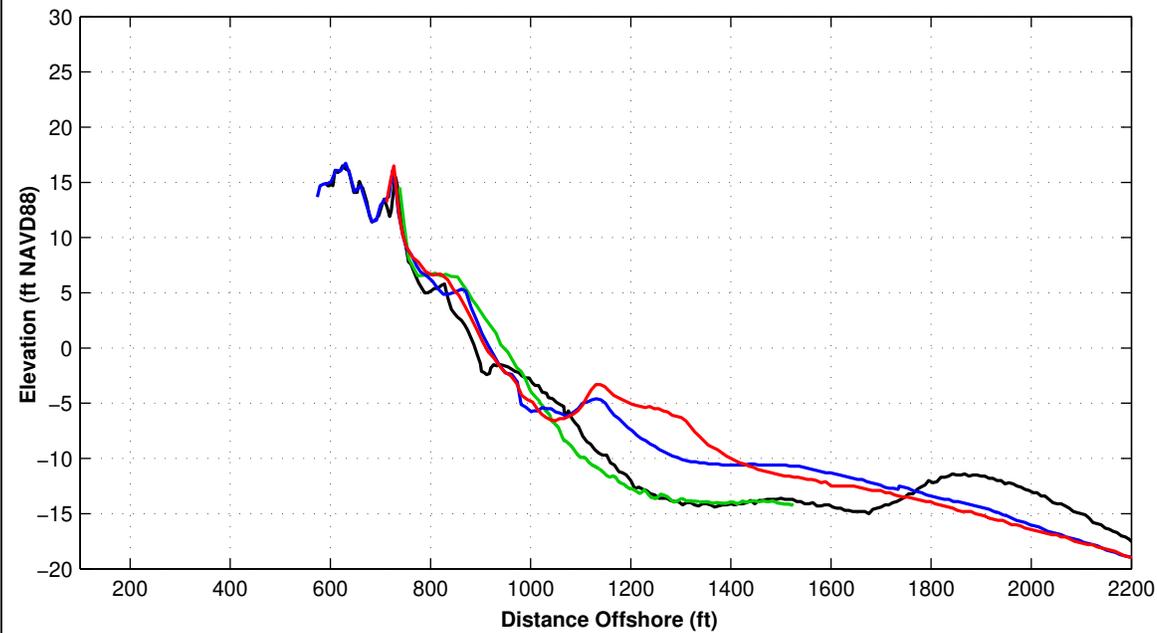
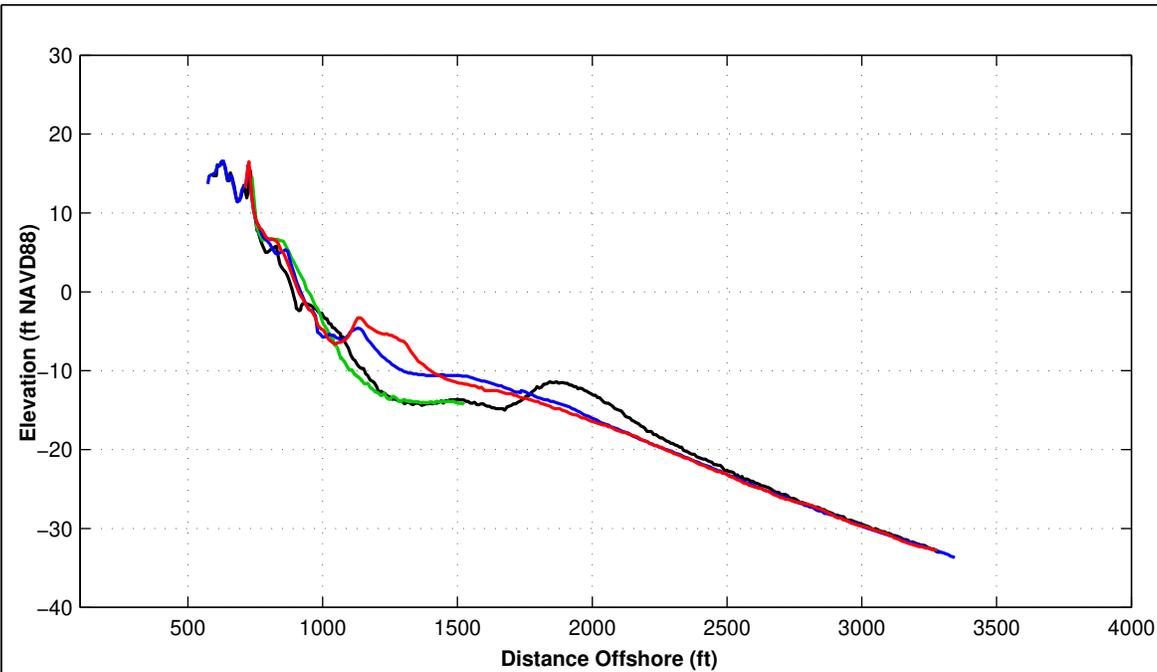
Survey Transect 795+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-23.57 ft	-8.02 ft
Volume Change Above +6 ft NAVD88	5.07 cy/ft	0.94 cy/ft
Volume Change Above 1.18 ft NAVD88	3.86 cy/ft	-0.40 cy/ft
Volume Change Above -6 ft NAVD88	3.82 cy/ft	-14.85 cy/ft
Volume Change Above -14 ft NAVD88	55.46 cy/ft	-5.41 cy/ft
Volume Change Above -19 ft NAVD88	39.44 cy/ft	-9.48 cy/ft
Volume Change Above -30 ft NAVD88	25.50 cy/ft	-14.23 cy/ft

LEGEND:

OCTOBER 2023	—	POST-DORIAN AD	—
JUNE 2023	—	JUNE 2022	—

- Notes:
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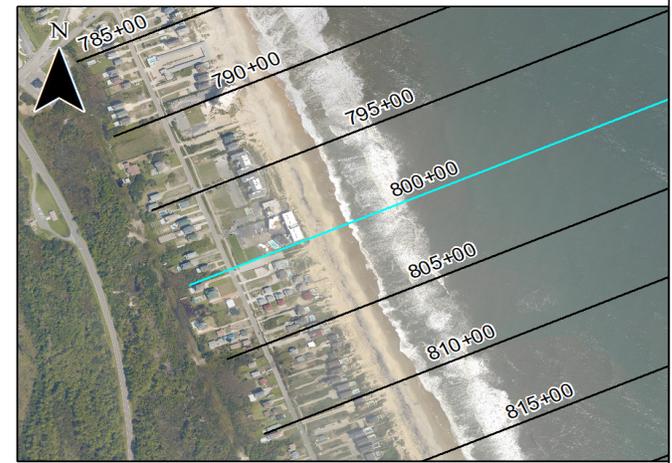


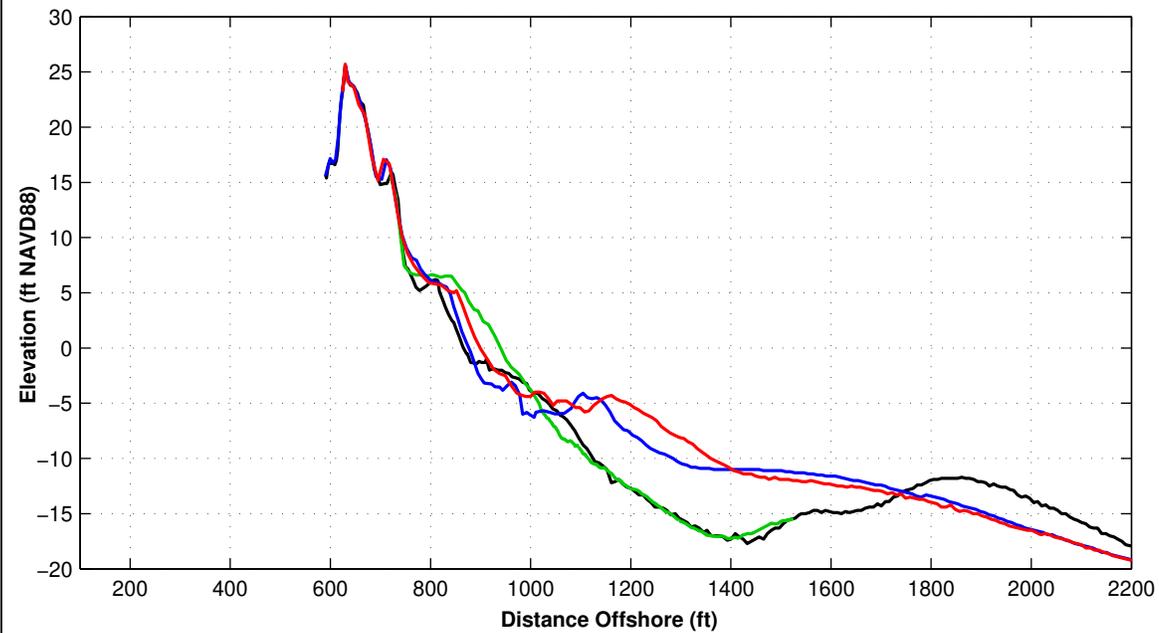
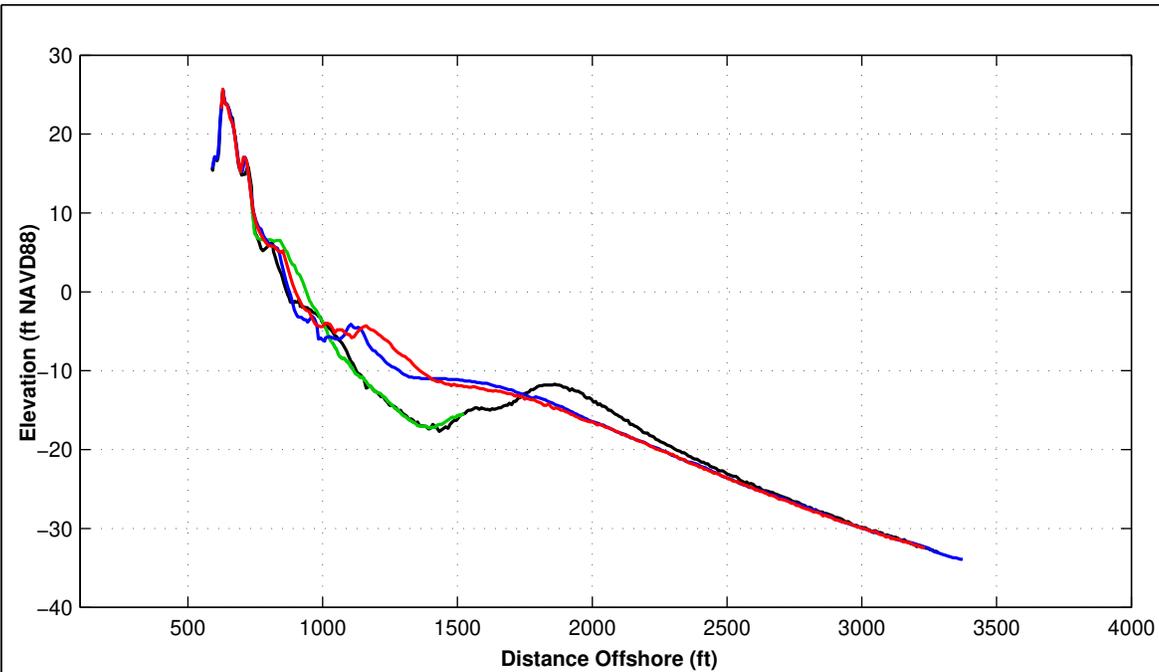


Survey Transect 800+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	25.96 ft	-6.84 ft
Volume Change Above +6 ft NAVD88	1.68 cy/ft	1.63 cy/ft
Volume Change Above 1.18 ft NAVD88	7.30 cy/ft	1.15 cy/ft
Volume Change Above -6 ft NAVD88	6.88 cy/ft	6.63 cy/ft
Volume Change Above -14 ft NAVD88	67.77 cy/ft	14.46 cy/ft
Volume Change Above -19 ft NAVD88	47.88 cy/ft	9.63 cy/ft
Volume Change Above -30 ft NAVD88	33.94 cy/ft	8.47 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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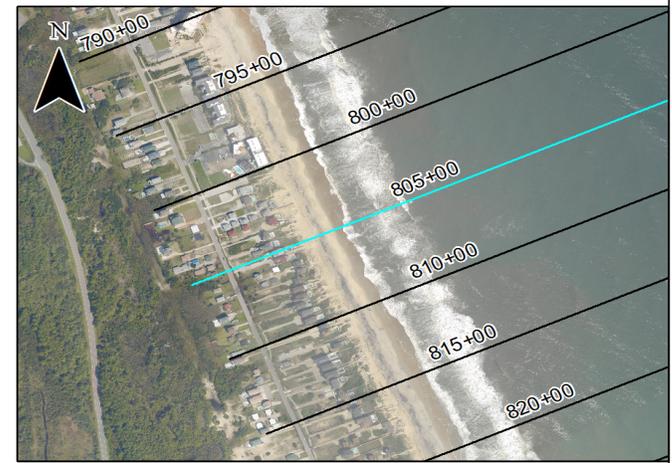


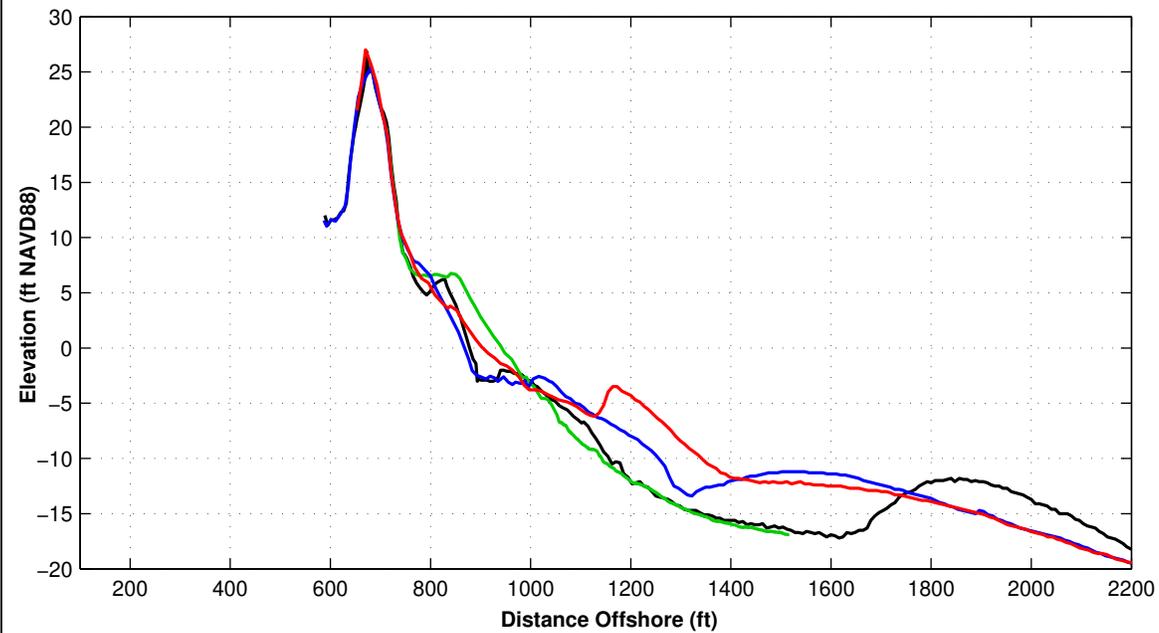
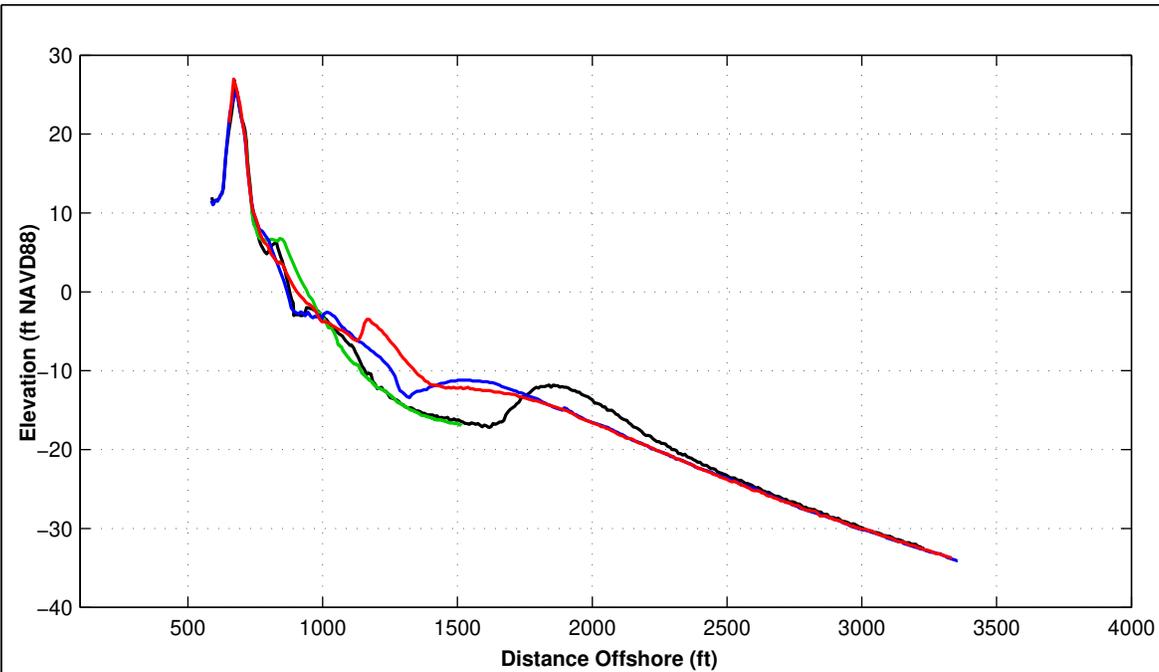


Survey Transect 805+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	9.65 ft	21.09 ft
Volume Change Above +6 ft NAVD88	3.14 cy/ft	-0.87 cy/ft
Volume Change Above 1.18 ft NAVD88	6.22 cy/ft	1.62 cy/ft
Volume Change Above -6 ft NAVD88	2.51 cy/ft	13.00 cy/ft
Volume Change Above -14 ft NAVD88	65.28 cy/ft	19.41 cy/ft
Volume Change Above -19 ft NAVD88	71.24 cy/ft	16.71 cy/ft
Volume Change Above -30 ft NAVD88	58.56 cy/ft	14.62 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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 2. All Survey Elevations In Feet Referenced to NAVD88.

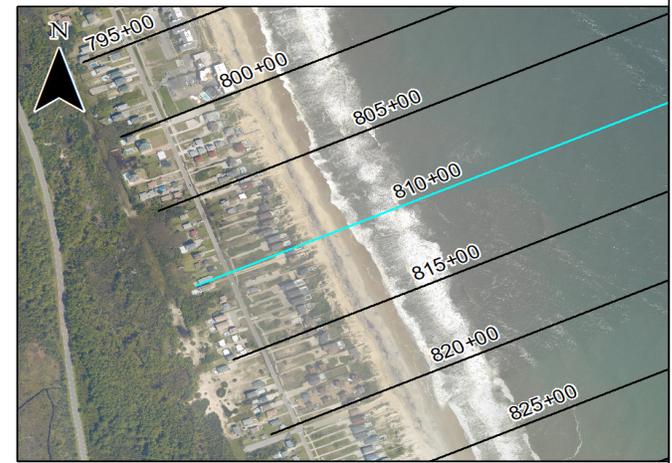


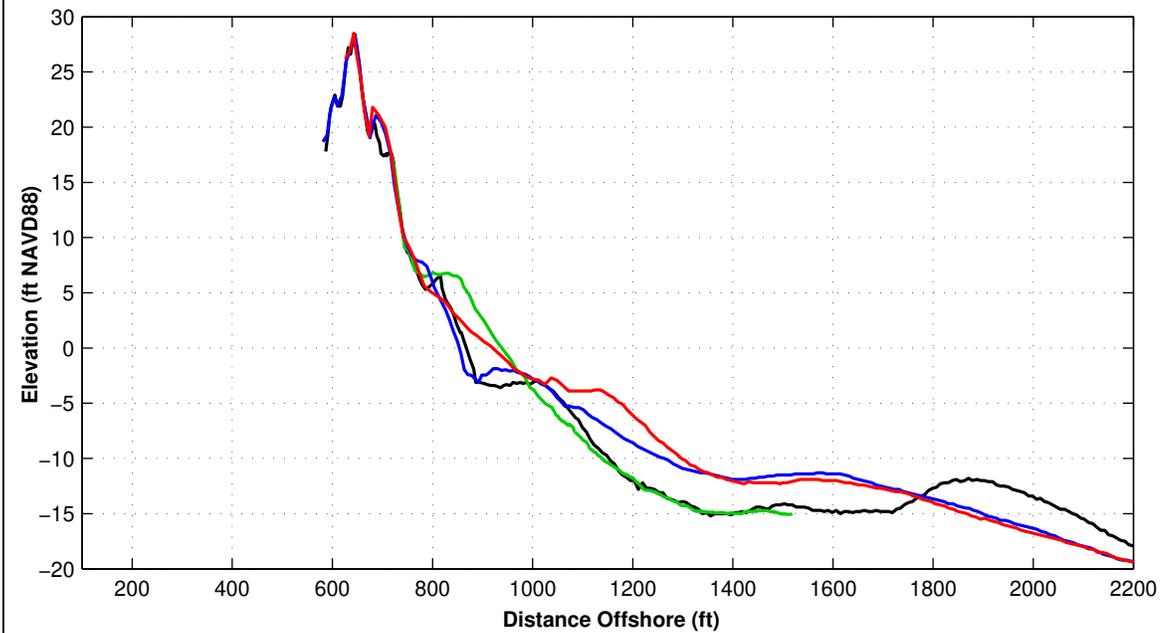
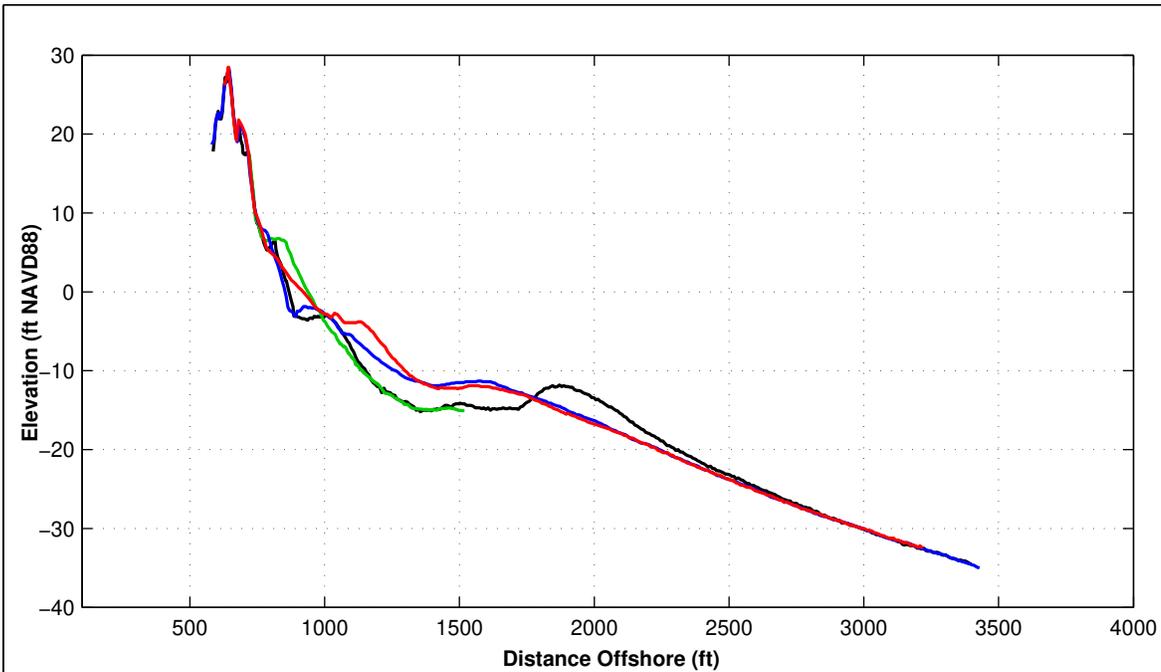


Survey Transect 810+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-12.43 ft	26.18 ft
Volume Change Above +6 ft NAVD88	2.35 cy/ft	0.42 cy/ft
Volume Change Above 1.18 ft NAVD88	-0.23 cy/ft	1.79 cy/ft
Volume Change Above -6 ft NAVD88	1.75 cy/ft	11.93 cy/ft
Volume Change Above -14 ft NAVD88	43.71 cy/ft	25.90 cy/ft
Volume Change Above -19 ft NAVD88	49.97 cy/ft	24.95 cy/ft
Volume Change Above -30 ft NAVD88	35.89 cy/ft	24.21 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
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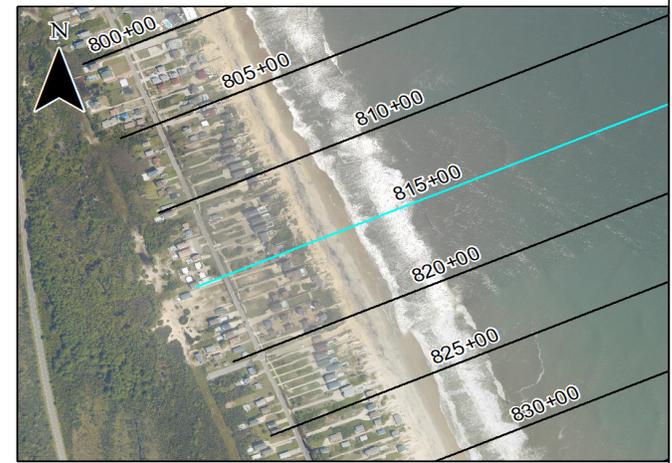


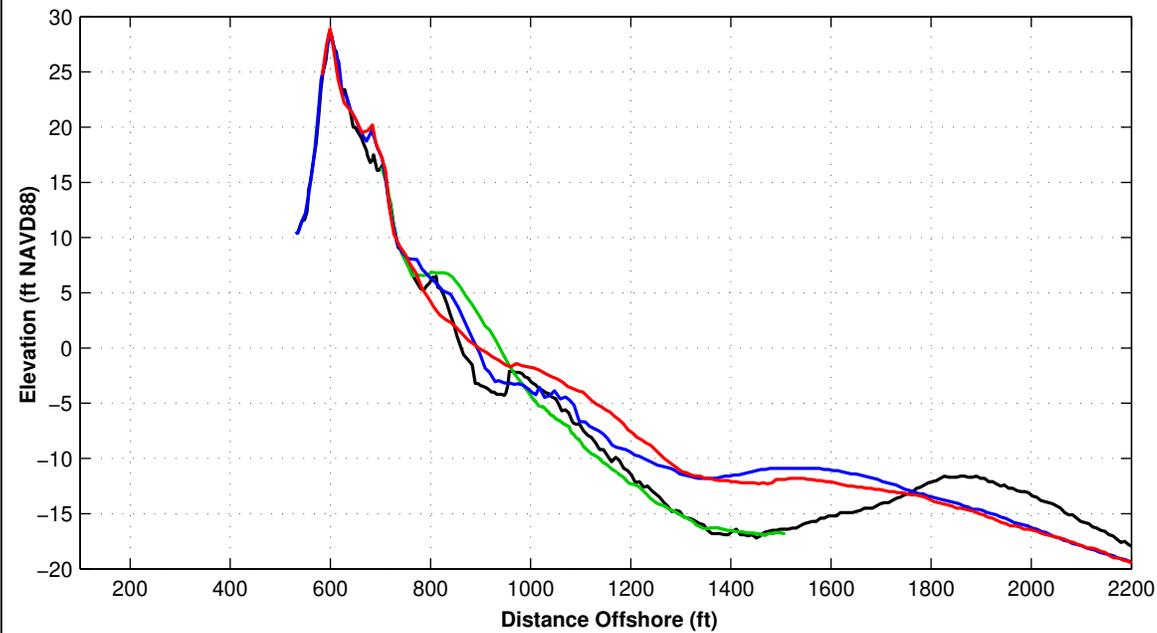
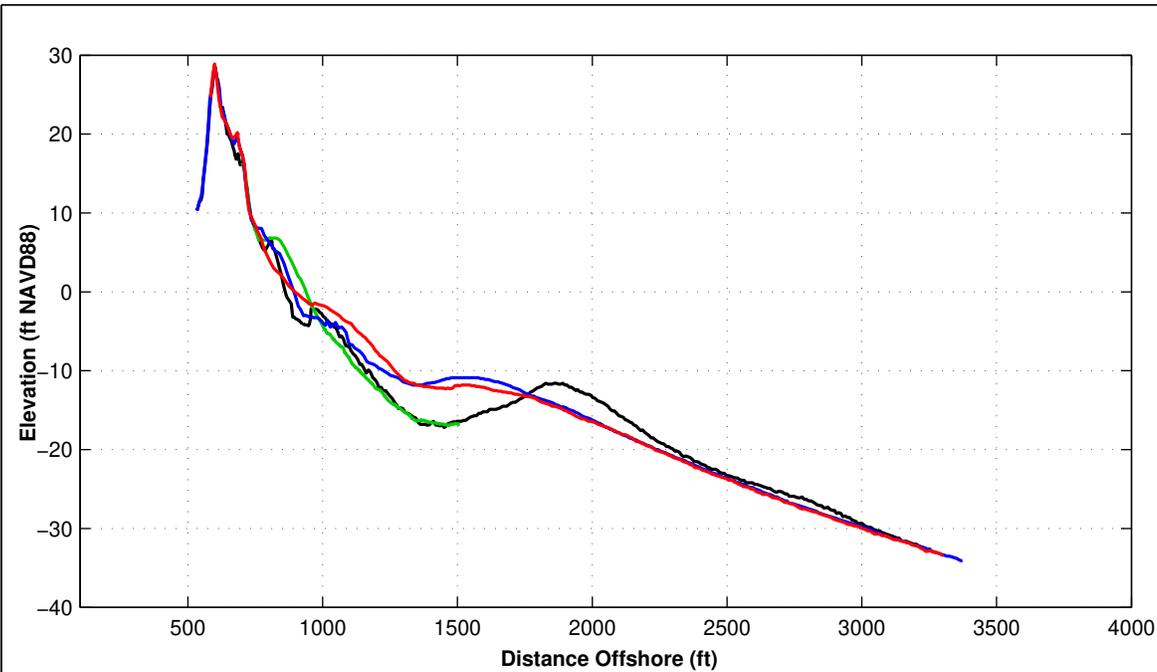
Survey Transect 815+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-14.60 ft	42.04 ft
Volume Change Above +6 ft NAVD88	3.50 cy/ft	-0.50 cy/ft
Volume Change Above 1.18 ft NAVD88	1.62 cy/ft	1.20 cy/ft
Volume Change Above -6 ft NAVD88	4.27 cy/ft	20.22 cy/ft
Volume Change Above -14 ft NAVD88	52.61 cy/ft	24.66 cy/ft
Volume Change Above -19 ft NAVD88	37.85 cy/ft	20.94 cy/ft
Volume Change Above -30 ft NAVD88	24.36 cy/ft	20.26 cy/ft

LEGEND:

OCTOBER 2023	—	POST-DORIAN AD	—
JUNE 2023	—	JUNE 2022	—

- Notes:
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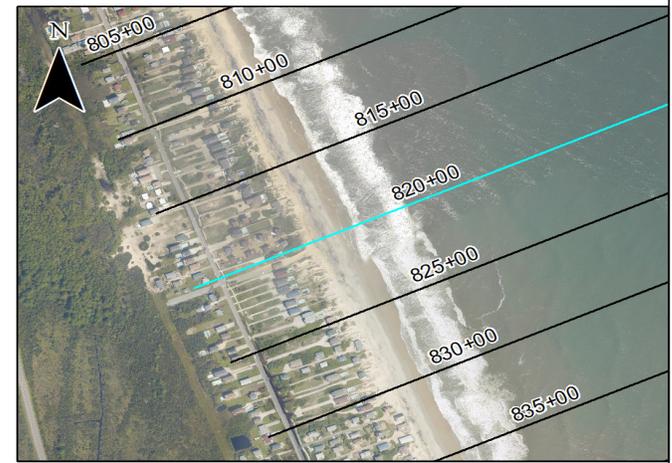


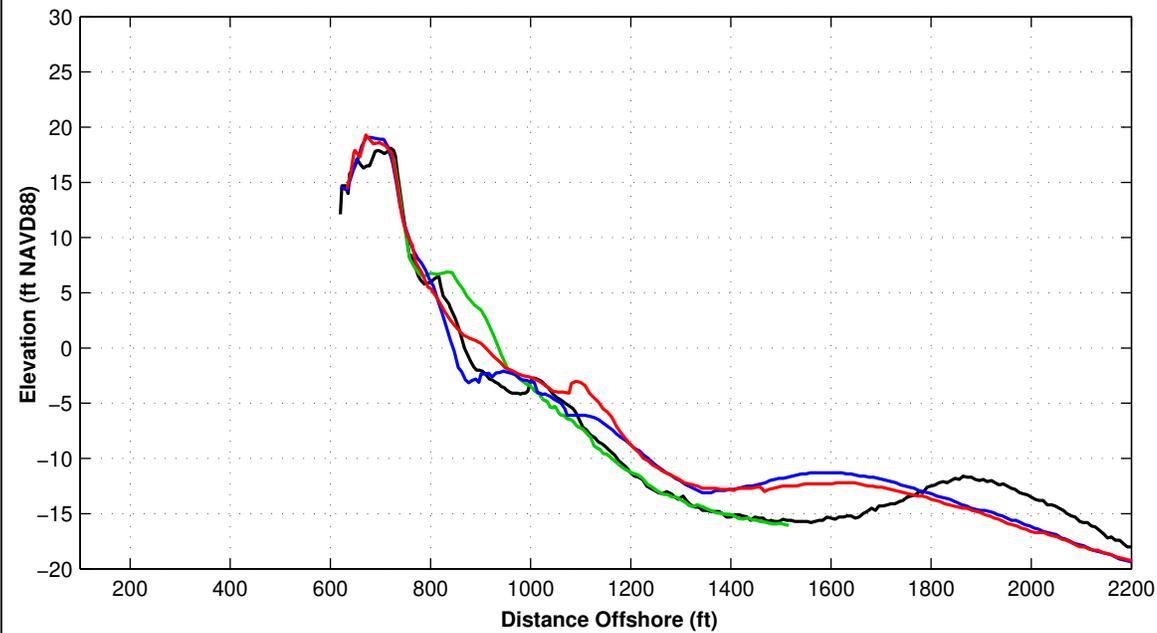
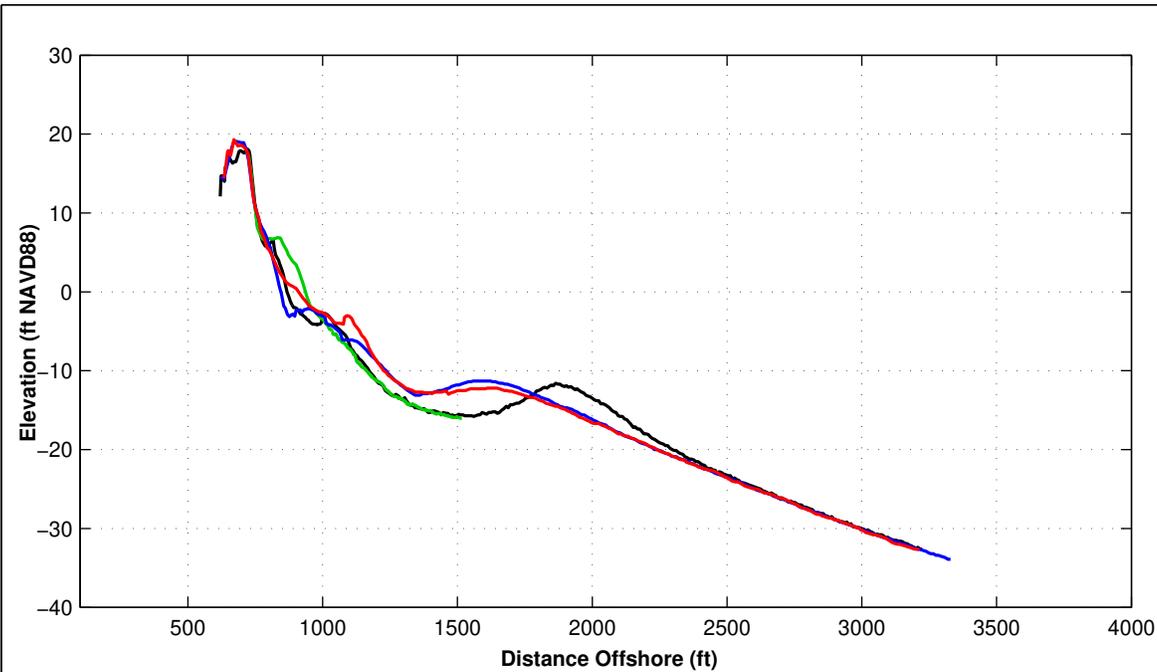


Survey Transect 820+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	28.24 ft	-14.79 ft
Volume Change Above +6 ft NAVD88	4.62 cy/ft	-0.92 cy/ft
Volume Change Above 1.18 ft NAVD88	8.18 cy/ft	-7.65 cy/ft
Volume Change Above -6 ft NAVD88	14.16 cy/ft	7.07 cy/ft
Volume Change Above -14 ft NAVD88	57.19 cy/ft	4.50 cy/ft
Volume Change Above -19 ft NAVD88	62.54 cy/ft	2.23 cy/ft
Volume Change Above -30 ft NAVD88	40.95 cy/ft	-2.33 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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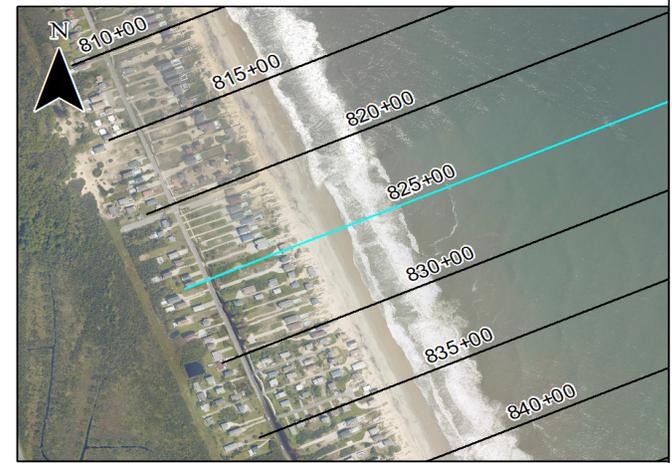


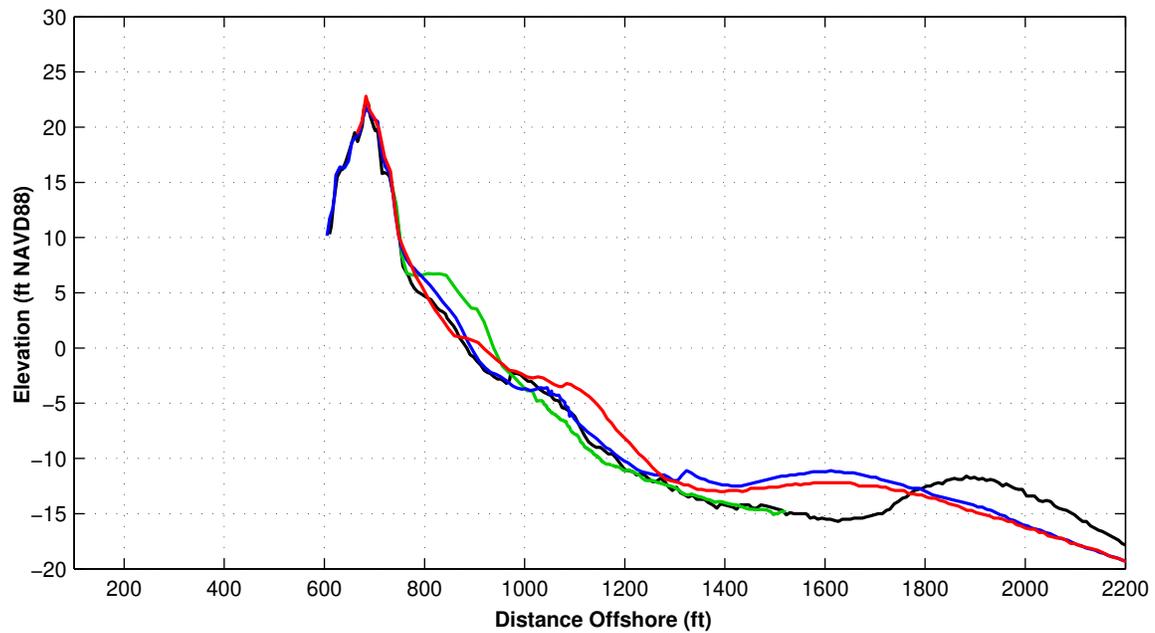
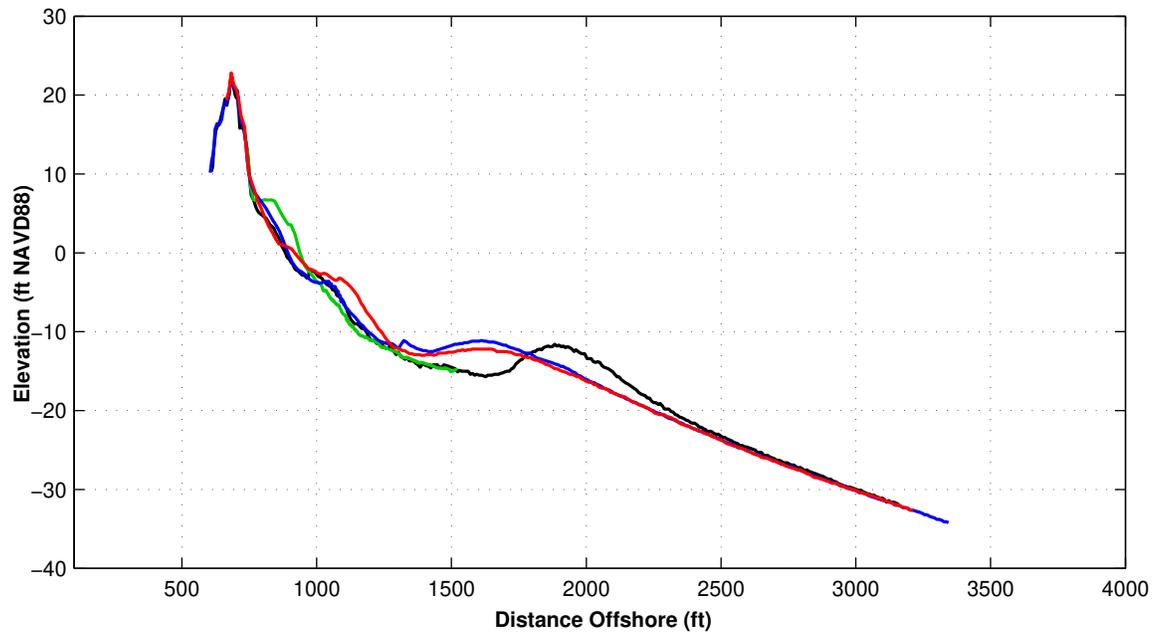


Survey Transect 825+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-23.85 ft	29.28 ft
Volume Change Above +6 ft NAVD88	3.97 cy/ft	-1.23 cy/ft
Volume Change Above 1.18 ft NAVD88	0.56 cy/ft	-0.18 cy/ft
Volume Change Above -6 ft NAVD88	-2.05 cy/ft	18.44 cy/ft
Volume Change Above -14 ft NAVD88	33.61 cy/ft	10.01 cy/ft
Volume Change Above -19 ft NAVD88	29.33 cy/ft	7.23 cy/ft
Volume Change Above -30 ft NAVD88	20.10 cy/ft	6.88 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
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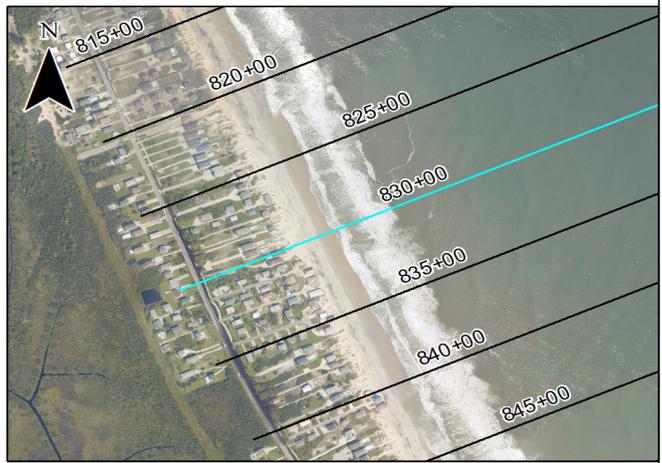


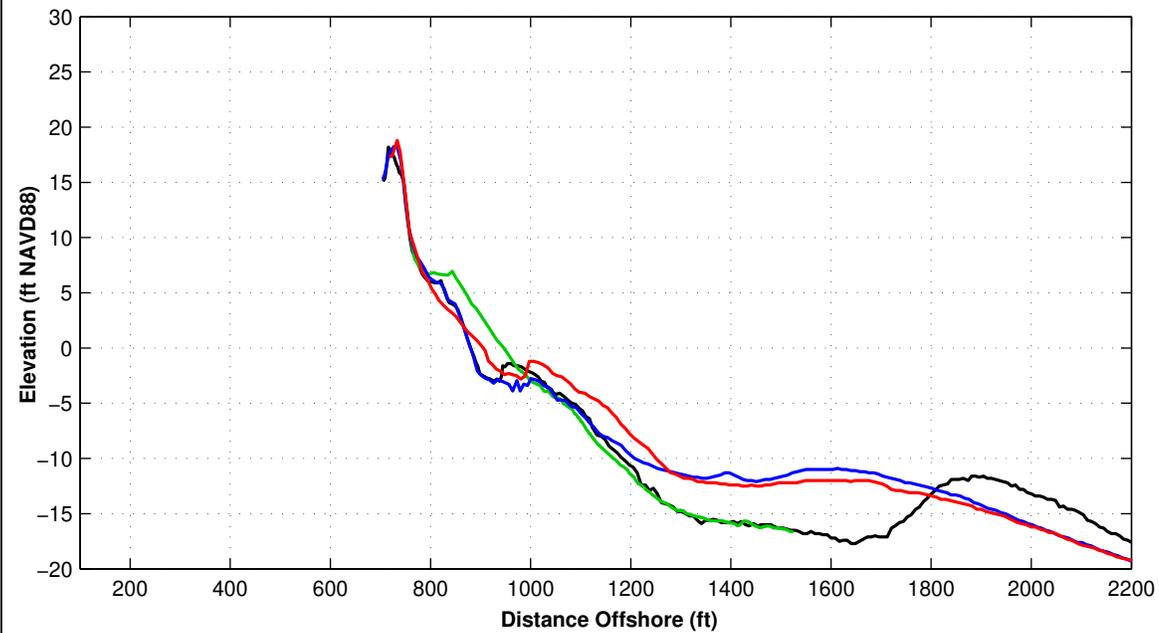
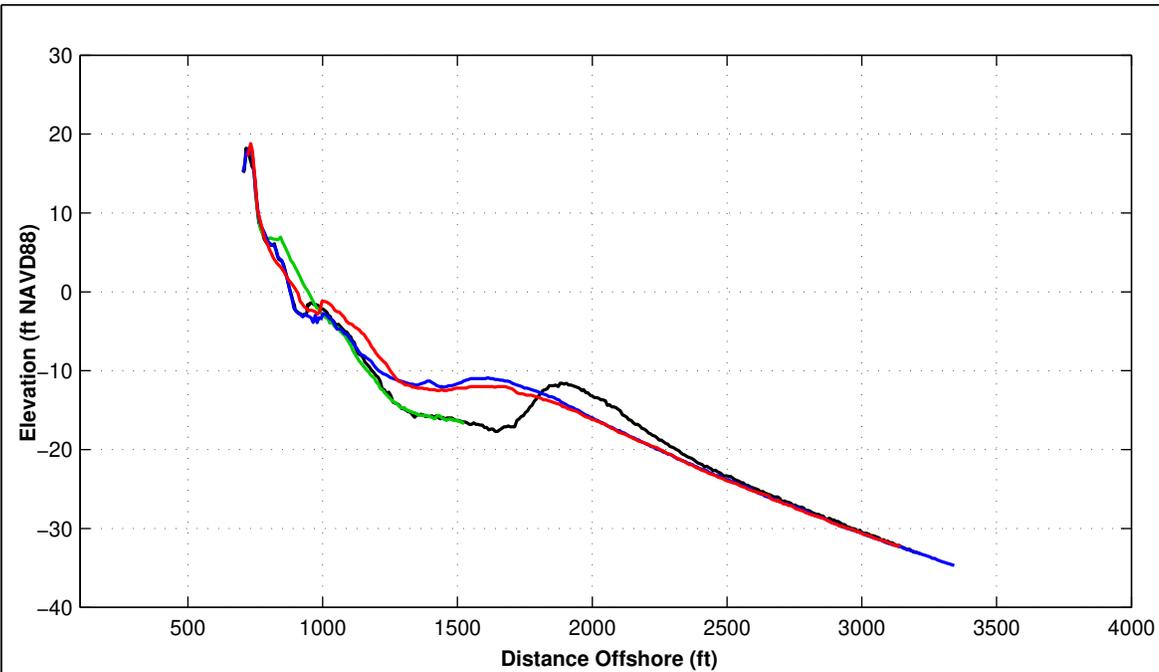


Survey Transect 830+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	12.49 ft	-21.56 ft
Volume Change Above +6 ft NAVD88	2.43 cy/ft	0.89 cy/ft
Volume Change Above 1.18 ft NAVD88	6.30 cy/ft	-3.51 cy/ft
Volume Change Above -6 ft NAVD88	6.53 cy/ft	9.98 cy/ft
Volume Change Above -14 ft NAVD88	34.15 cy/ft	5.22 cy/ft
Volume Change Above -19 ft NAVD88	23.89 cy/ft	2.57 cy/ft
Volume Change Above -30 ft NAVD88	10.16 cy/ft	1.42 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
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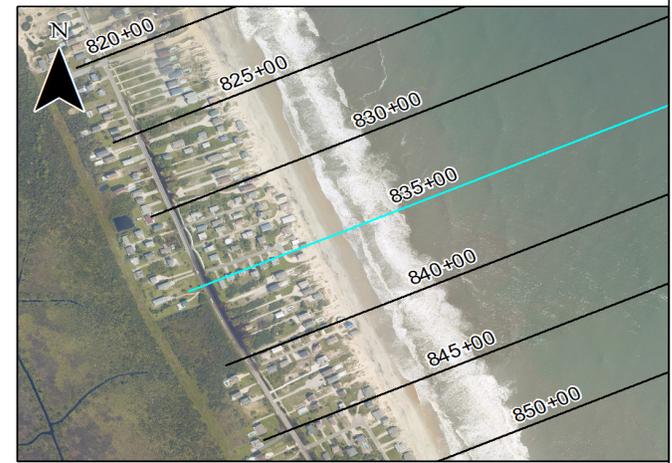


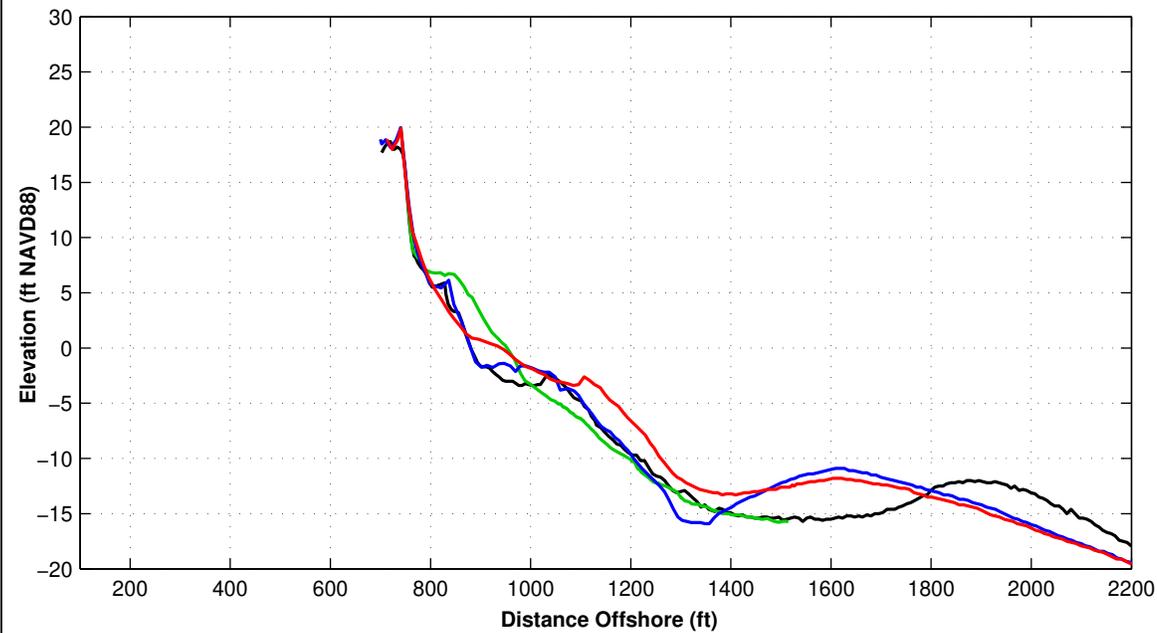
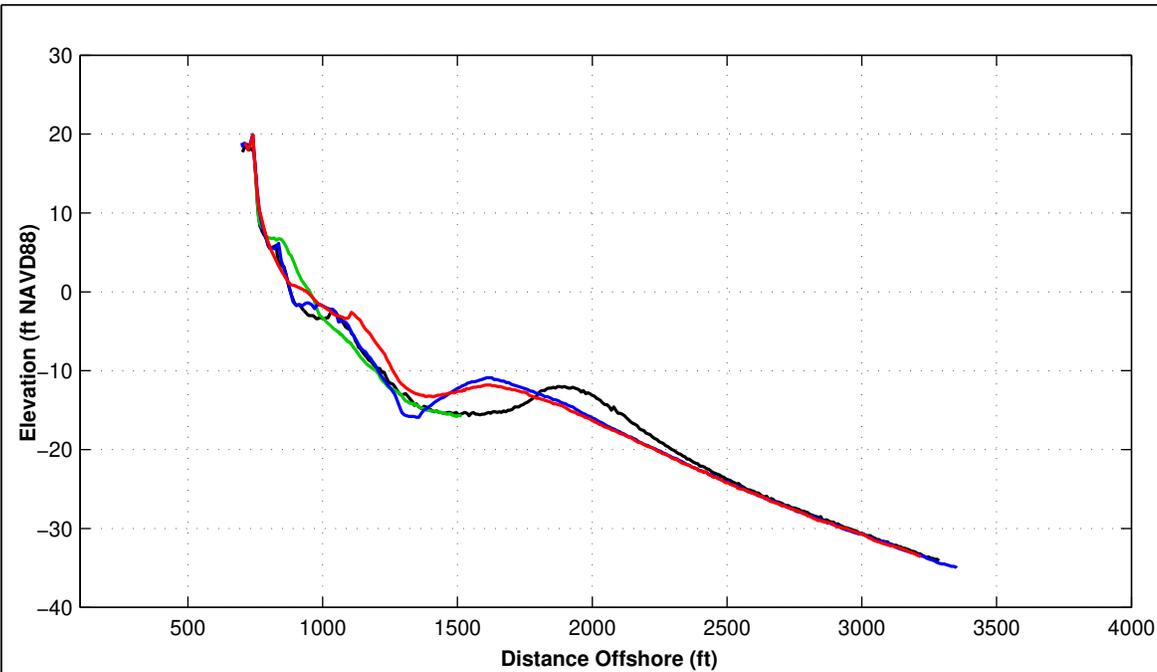


Survey Transect 835+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-0.08 ft	9.85 ft
Volume Change Above +6 ft NAVD88	1.77 cy/ft	-0.16 cy/ft
Volume Change Above 1.18 ft NAVD88	1.80 cy/ft	-2.53 cy/ft
Volume Change Above -6 ft NAVD88	-3.26 cy/ft	13.70 cy/ft
Volume Change Above -14 ft NAVD88	39.39 cy/ft	7.27 cy/ft
Volume Change Above -19 ft NAVD88	57.76 cy/ft	5.26 cy/ft
Volume Change Above -30 ft NAVD88	44.20 cy/ft	3.92 cy/ft

LEGEND:
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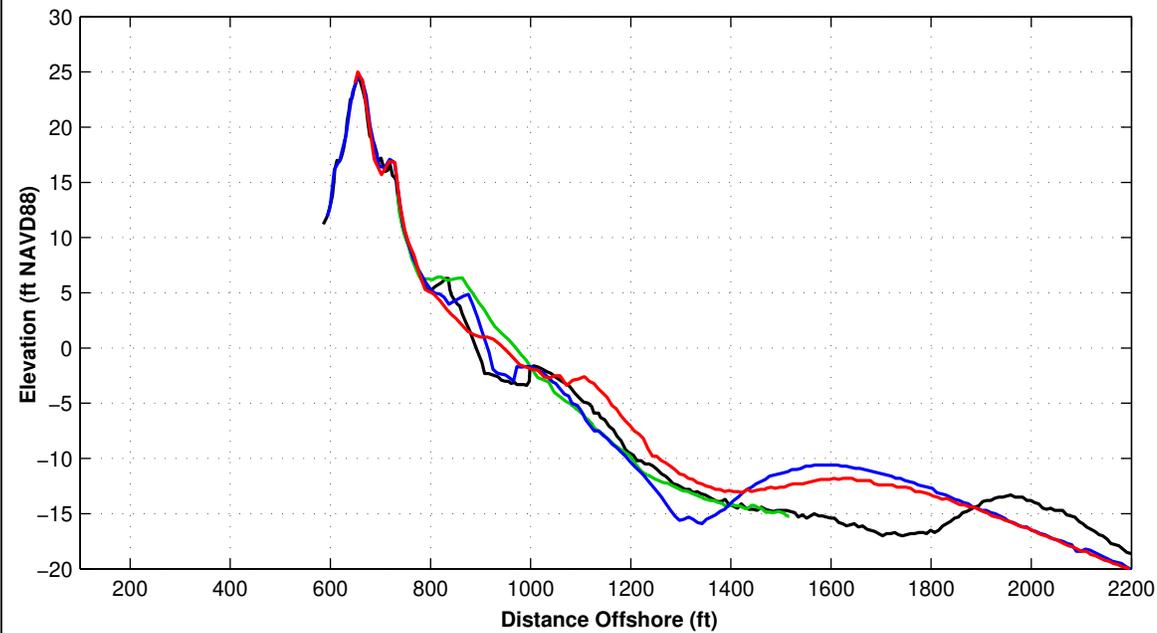
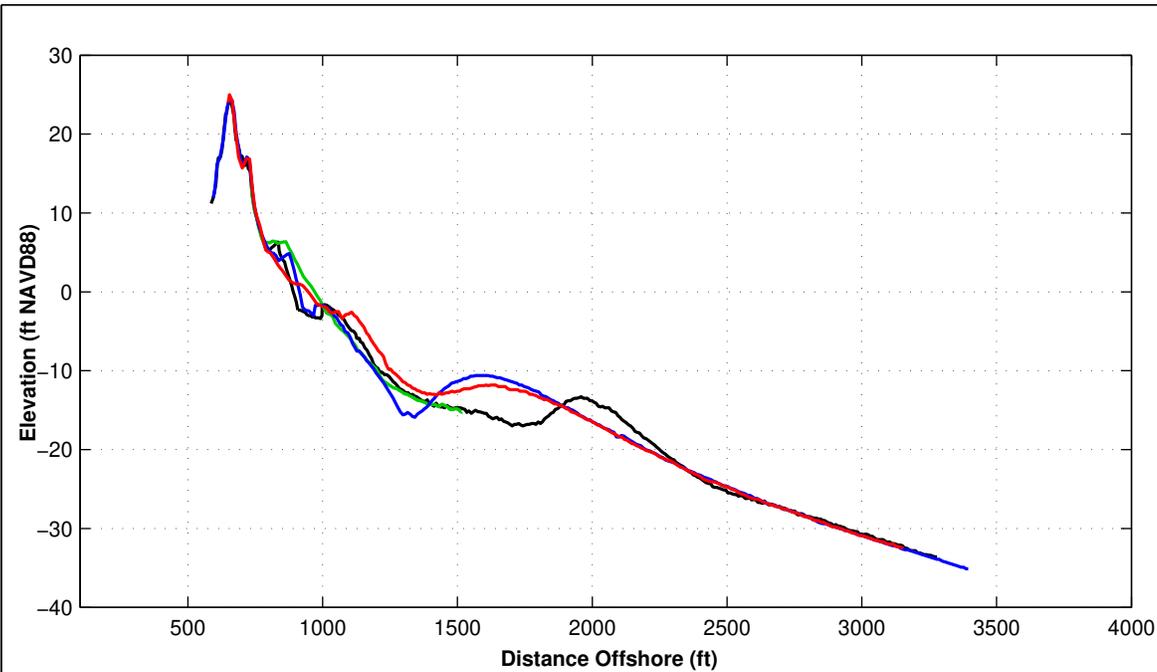
Survey Transect 840+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	0.98 ft	2.73 ft
Volume Change Above +6 ft NAVD88	2.25 cy/ft	0.20 cy/ft
Volume Change Above 1.18 ft NAVD88	3.15 cy/ft	-2.56 cy/ft
Volume Change Above -6 ft NAVD88	8.65 cy/ft	9.92 cy/ft
Volume Change Above -14 ft NAVD88	22.50 cy/ft	22.04 cy/ft
Volume Change Above -19 ft NAVD88	12.16 cy/ft	24.76 cy/ft
Volume Change Above -30 ft NAVD88	0.06 cy/ft	23.18 cy/ft

LEGEND:

OCTOBER 2023	—	POST-DORIAN AD	—
JUNE 2023	—	JUNE 2022	—

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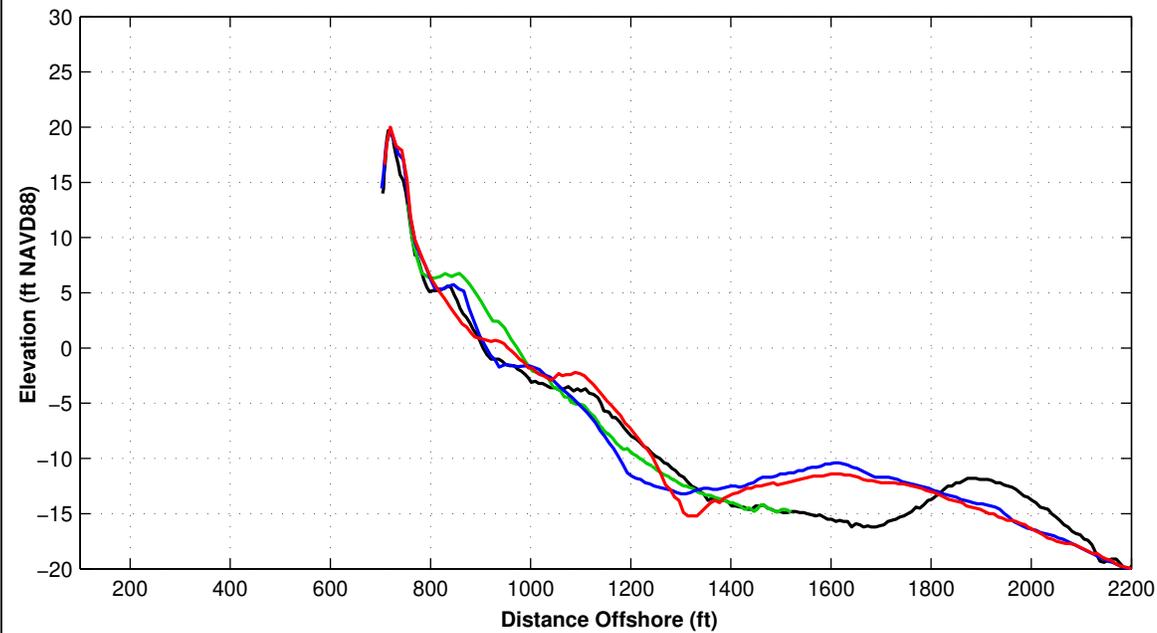
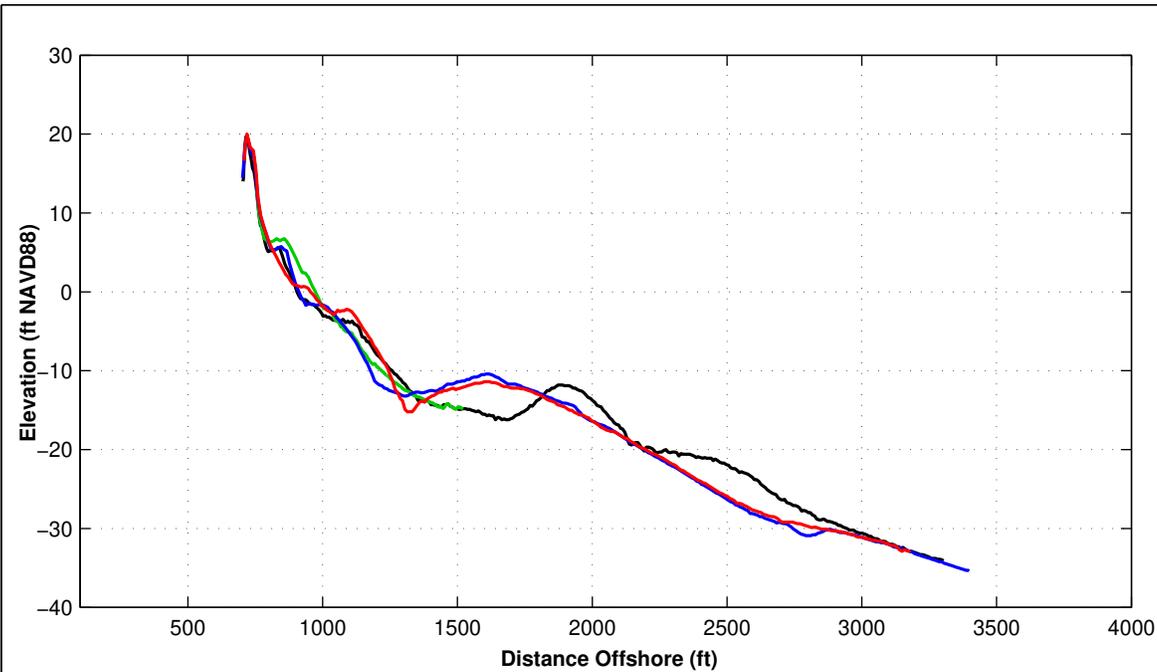


Survey Transect 845+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	23.78 ft	-16.53 ft
Volume Change Above +6 ft NAVD88	1.78 cy/ft	-0.77 cy/ft
Volume Change Above 1.18 ft NAVD88	3.78 cy/ft	-6.75 cy/ft
Volume Change Above -6 ft NAVD88	5.54 cy/ft	6.90 cy/ft
Volume Change Above -14 ft NAVD88	29.66 cy/ft	18.20 cy/ft
Volume Change Above -19 ft NAVD88	32.24 cy/ft	22.68 cy/ft
Volume Change Above -30 ft NAVD88	31.27 cy/ft	20.84 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

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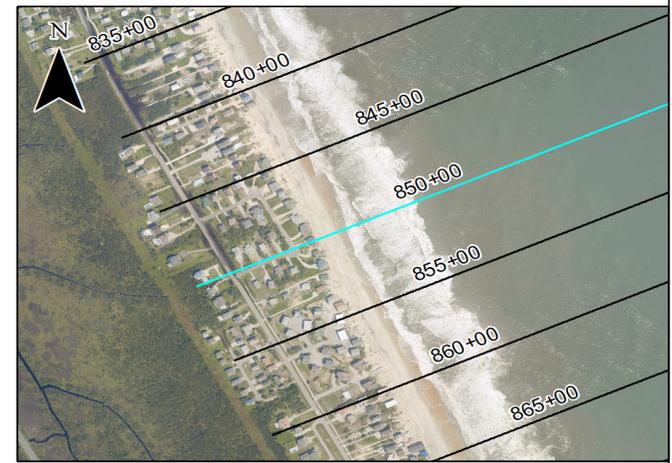


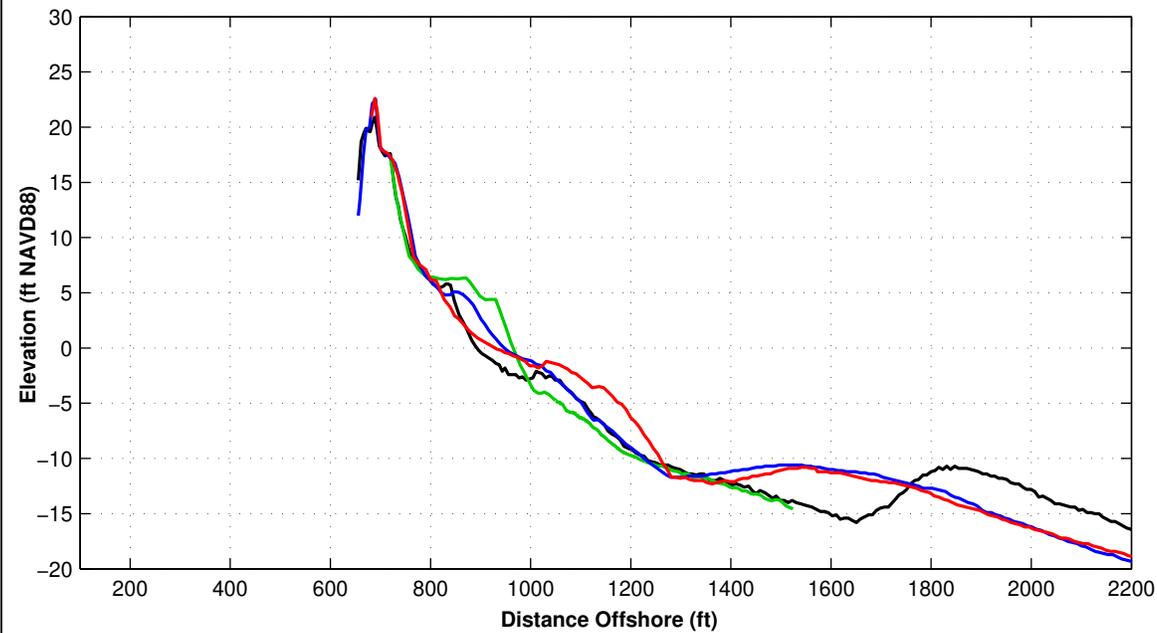
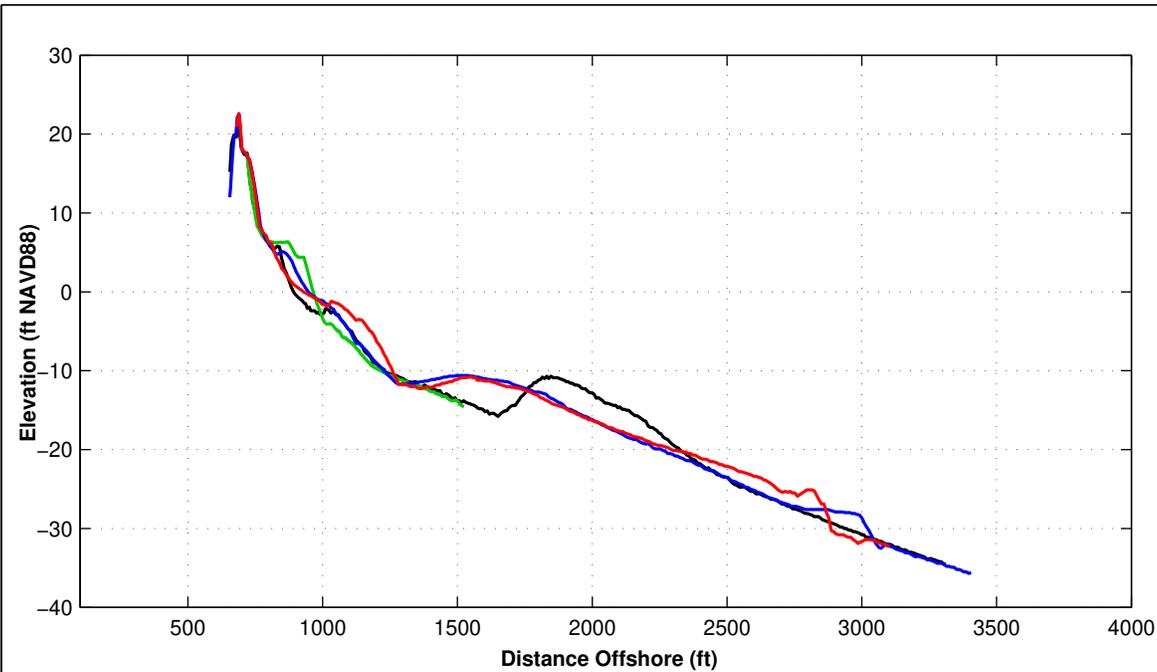
Survey Transect 850+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	5.12 ft	-12.82 ft
Volume Change Above +6 ft NAVD88	3.05 cy/ft	0.77 cy/ft
Volume Change Above 1.18 ft NAVD88	6.00 cy/ft	-4.49 cy/ft
Volume Change Above -6 ft NAVD88	5.17 cy/ft	7.78 cy/ft
Volume Change Above -14 ft NAVD88	16.00 cy/ft	8.55 cy/ft
Volume Change Above -19 ft NAVD88	20.71 cy/ft	4.50 cy/ft
Volume Change Above -30 ft NAVD88	-52.84 cy/ft	12.58 cy/ft

LEGEND:

OCTOBER 2023	—	POST-DORIAN AD	—
JUNE 2023	—	JUNE 2022	—

- Notes:
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 2. All Survey Elevations In Feet Referenced to NAVD88.



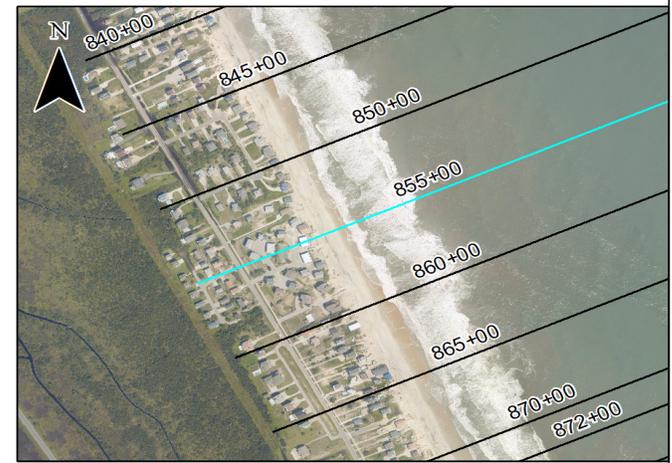


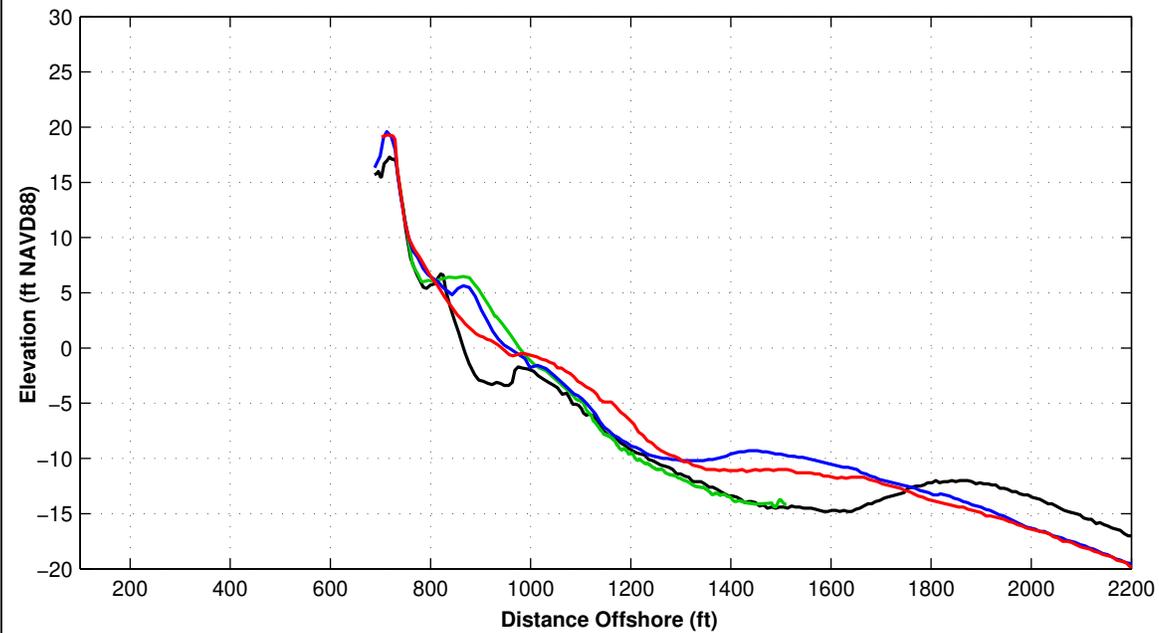
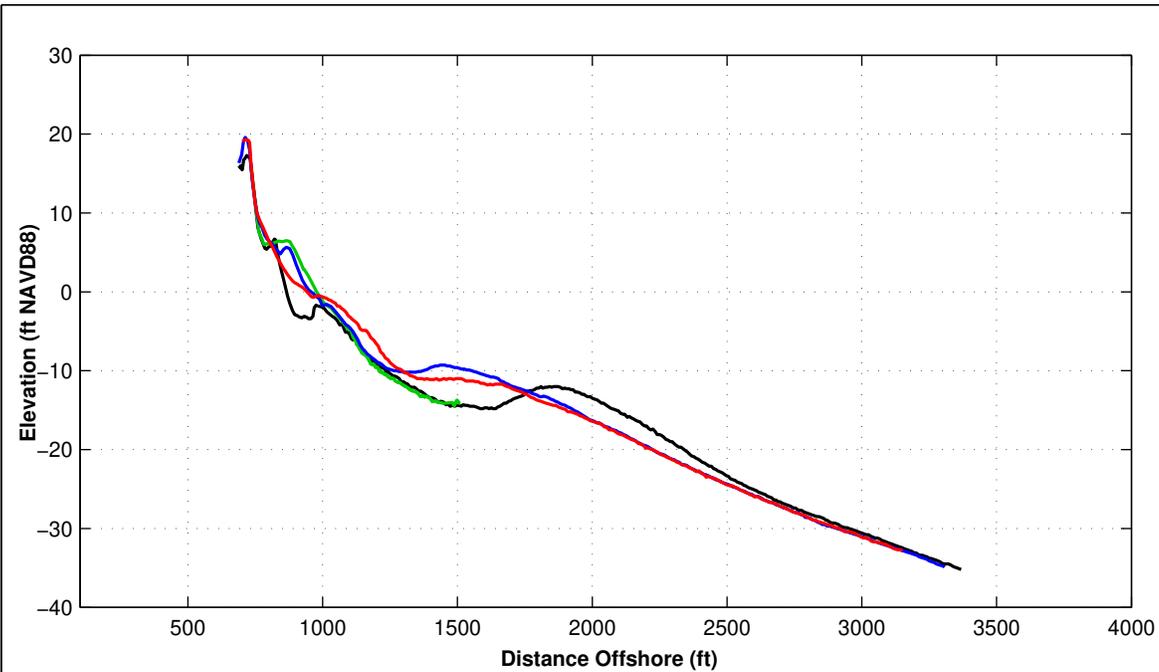
Survey Transect 855+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	46.11 ft	-36.98 ft
Volume Change Above +6 ft NAVD88	4.79 cy/ft	-0.42 cy/ft
Volume Change Above 1.18 ft NAVD88	9.23 cy/ft	-6.52 cy/ft
Volume Change Above -6 ft NAVD88	18.01 cy/ft	2.42 cy/ft
Volume Change Above -14 ft NAVD88	31.84 cy/ft	2.04 cy/ft
Volume Change Above -19 ft NAVD88	6.46 cy/ft	2.40 cy/ft
Volume Change Above -30 ft NAVD88	14.15 cy/ft	25.72 cy/ft

LEGEND:

OCTOBER 2023		POST-DORIAN AD	
JUNE 2023		JUNE 2022	

- Notes:
1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

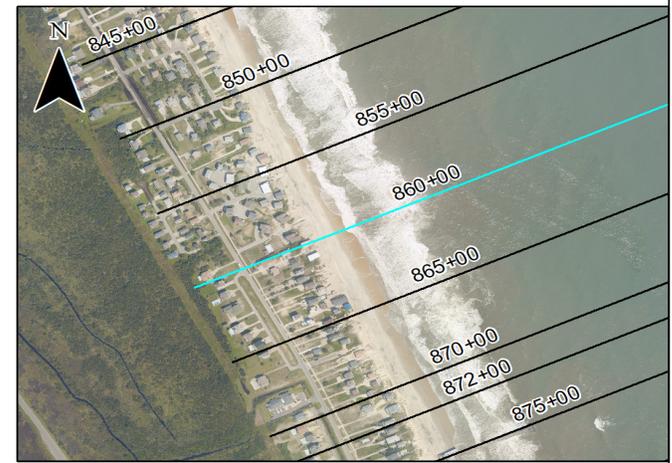


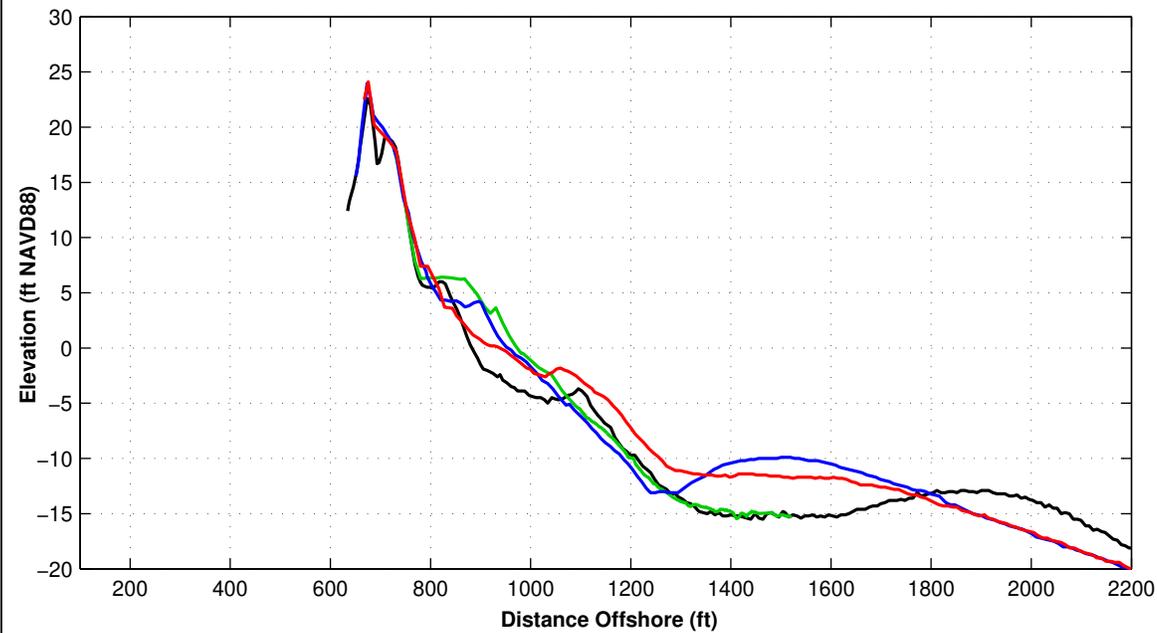
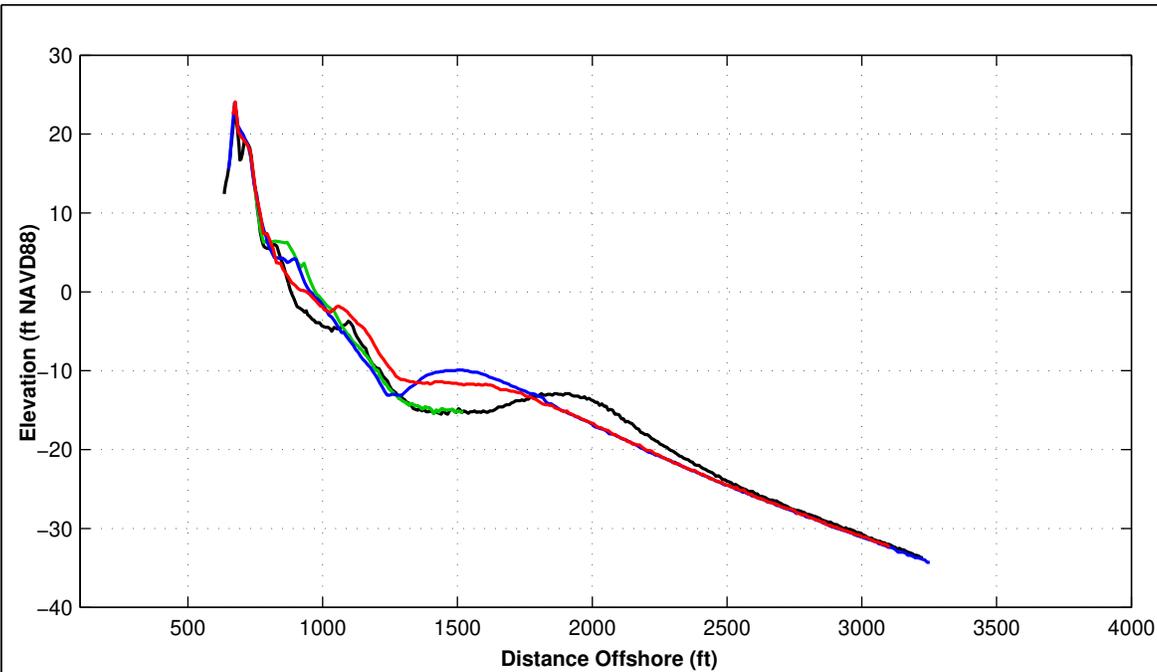


Survey Transect 860+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	71.84 ft	-34.38 ft
Volume Change Above +6 ft NAVD88	4.66 cy/ft	0.77 cy/ft
Volume Change Above 1.18 ft NAVD88	14.25 cy/ft	-7.45 cy/ft
Volume Change Above -6 ft NAVD88	32.97 cy/ft	-0.42 cy/ft
Volume Change Above -14 ft NAVD88	77.63 cy/ft	-11.48 cy/ft
Volume Change Above -19 ft NAVD88	54.49 cy/ft	-14.25 cy/ft
Volume Change Above -30 ft NAVD88	27.31 cy/ft	-14.71 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

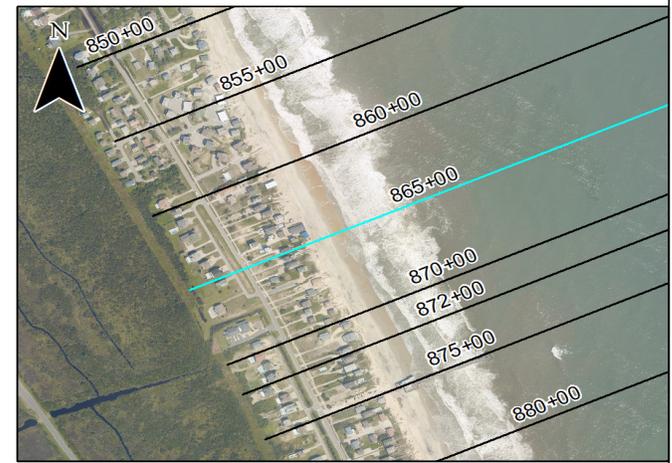


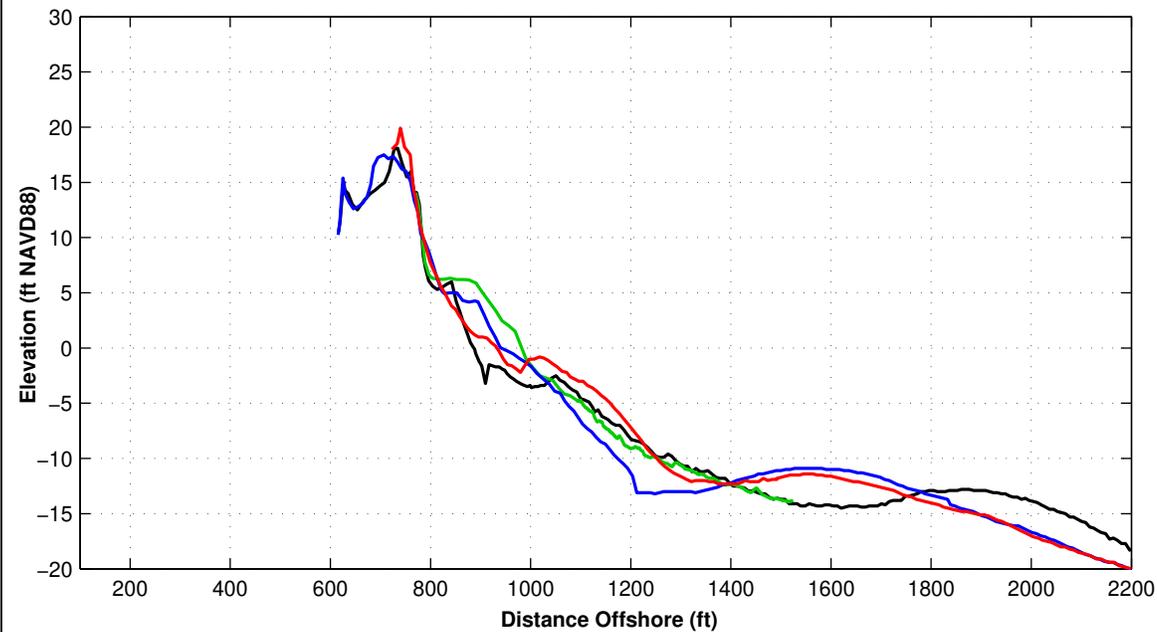
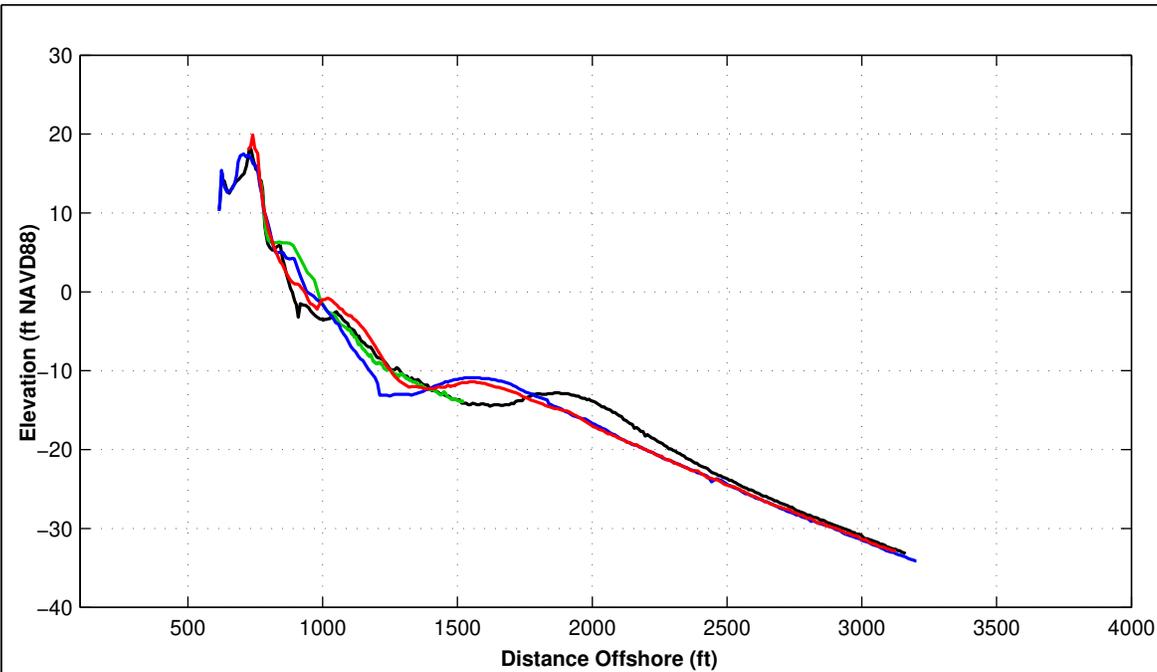


Survey Transect 865+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	61.45 ft	-47.90 ft
Volume Change Above +6 ft NAVD88	4.85 cy/ft	0.05 cy/ft
Volume Change Above 1.18 ft NAVD88	9.80 cy/ft	-5.91 cy/ft
Volume Change Above -6 ft NAVD88	23.19 cy/ft	3.18 cy/ft
Volume Change Above -14 ft NAVD88	61.81 cy/ft	6.26 cy/ft
Volume Change Above -19 ft NAVD88	48.30 cy/ft	6.40 cy/ft
Volume Change Above -30 ft NAVD88	28.73 cy/ft	7.99 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.



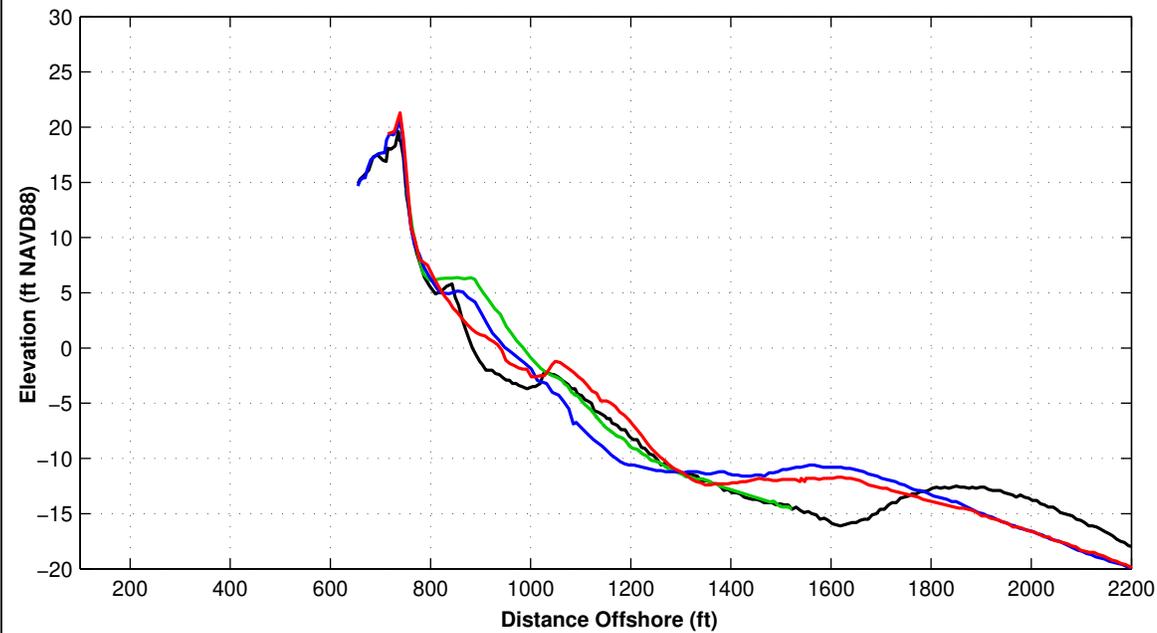
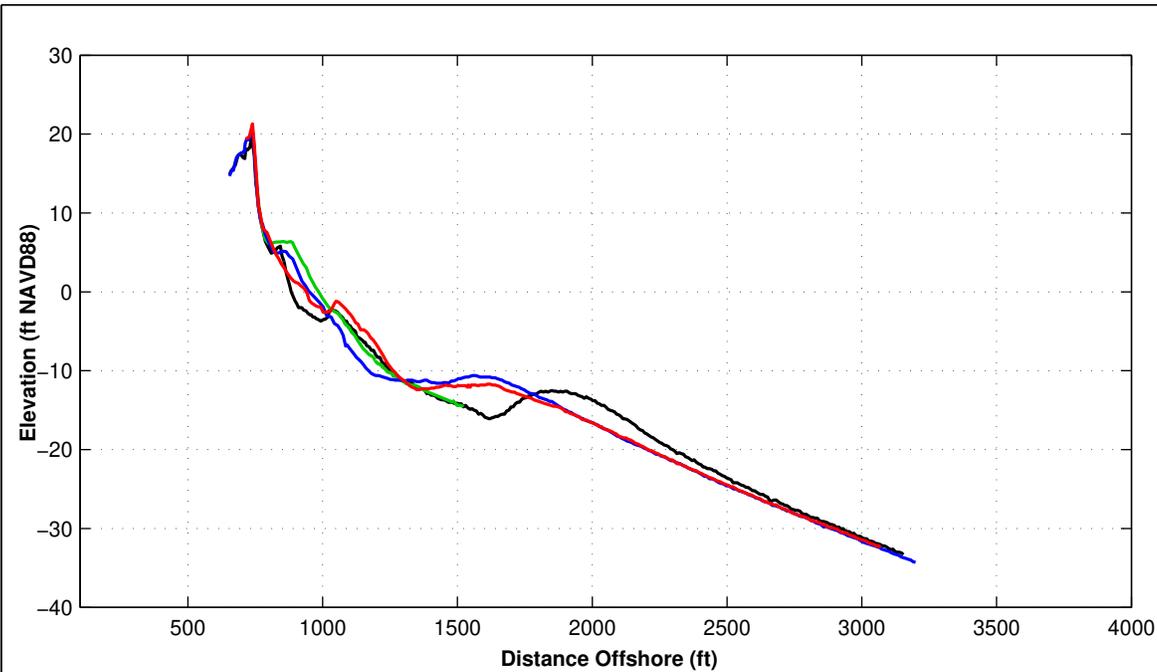


Survey Transect 870+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	52.68 ft	-38.13 ft
Volume Change Above +6 ft NAVD88	3.73 cy/ft	3.03 cy/ft
Volume Change Above 1.18 ft NAVD88	9.03 cy/ft	-3.17 cy/ft
Volume Change Above -6 ft NAVD88	15.87 cy/ft	7.44 cy/ft
Volume Change Above -14 ft NAVD88	12.75 cy/ft	21.88 cy/ft
Volume Change Above -19 ft NAVD88	-12.33 cy/ft	19.92 cy/ft
Volume Change Above -30 ft NAVD88	-36.29 cy/ft	21.11 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.



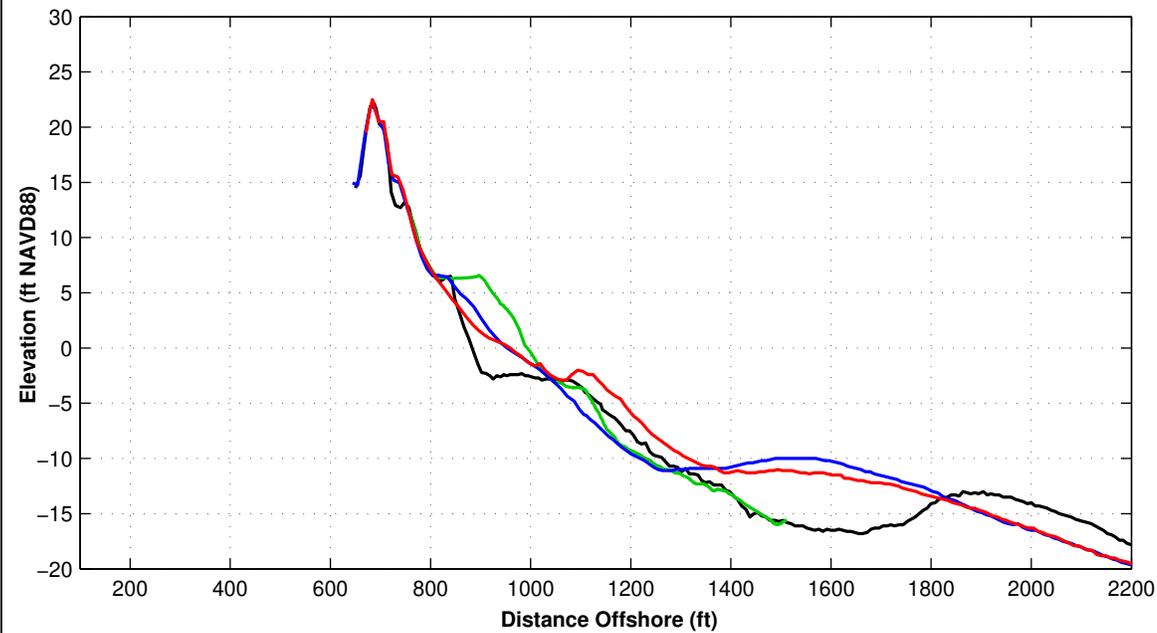
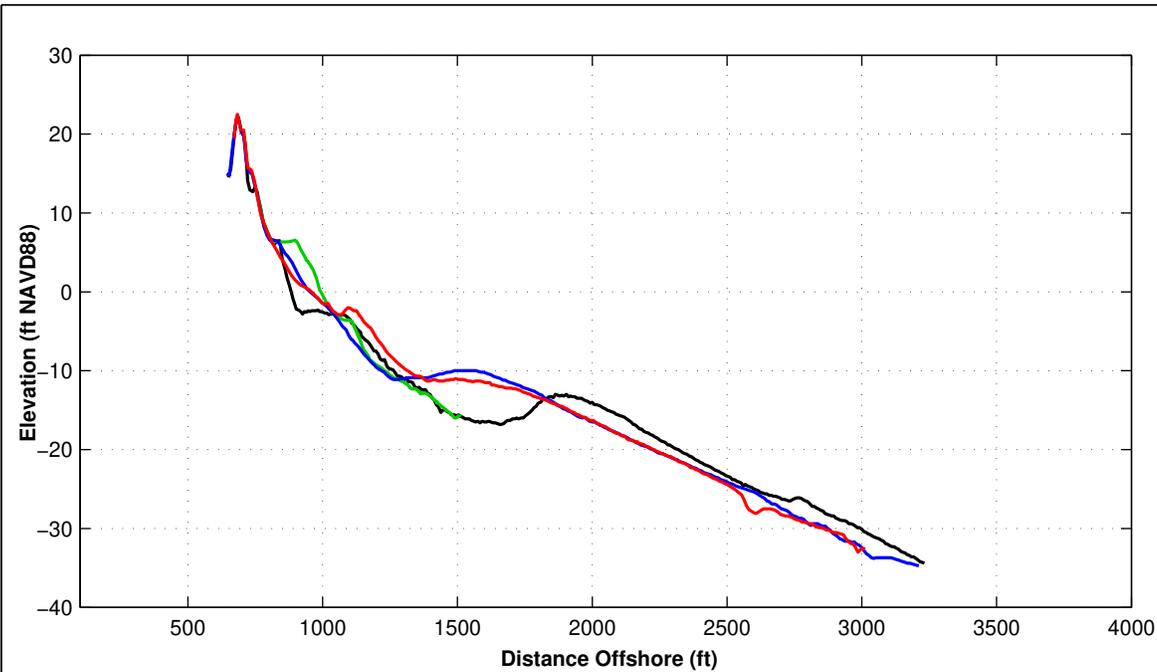


Survey Transect 872+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	52.93 ft	-25.49 ft
Volume Change Above +6 ft NAVD88	2.78 cy/ft	1.49 cy/ft
Volume Change Above 1.18 ft NAVD88	8.41 cy/ft	-4.51 cy/ft
Volume Change Above -6 ft NAVD88	14.40 cy/ft	5.97 cy/ft
Volume Change Above -14 ft NAVD88	29.50 cy/ft	8.41 cy/ft
Volume Change Above -19 ft NAVD88	12.35 cy/ft	8.09 cy/ft
Volume Change Above -30 ft NAVD88	-12.26 cy/ft	9.94 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

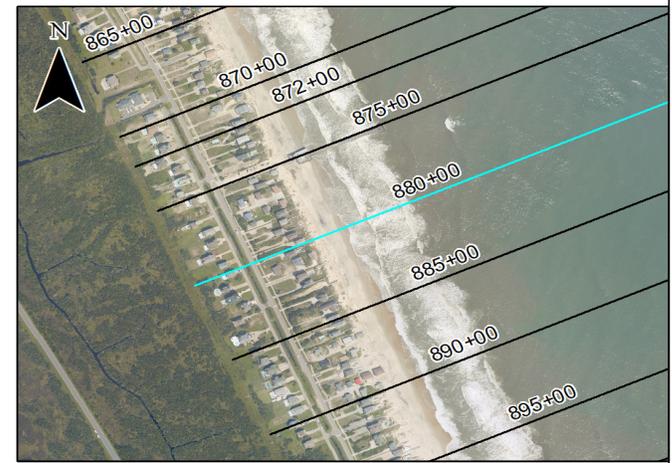


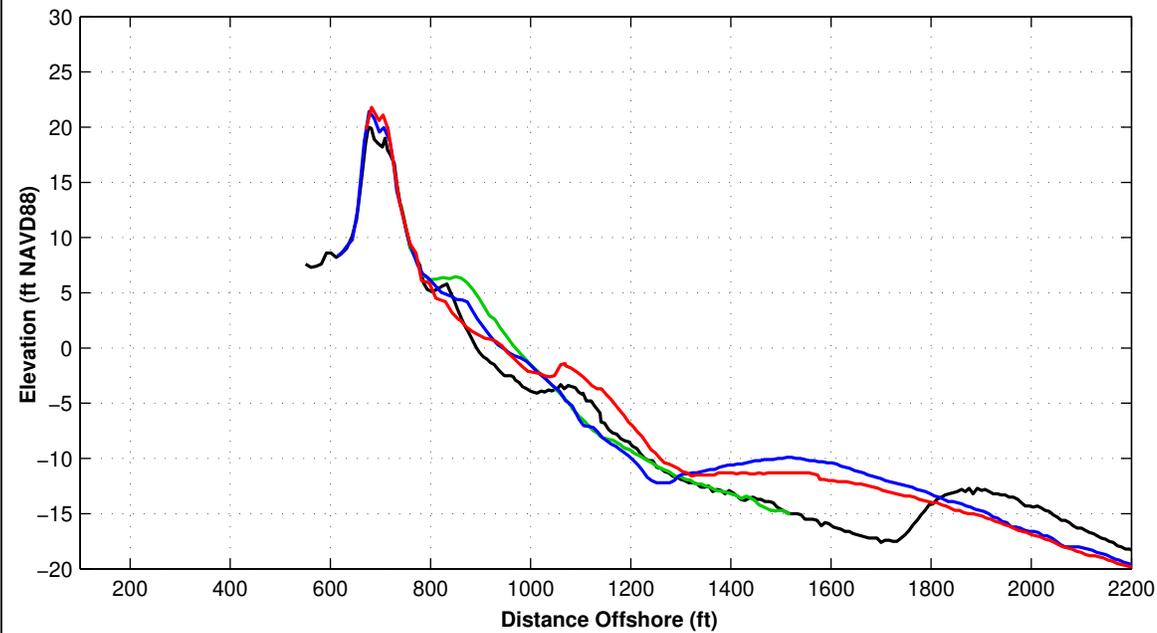
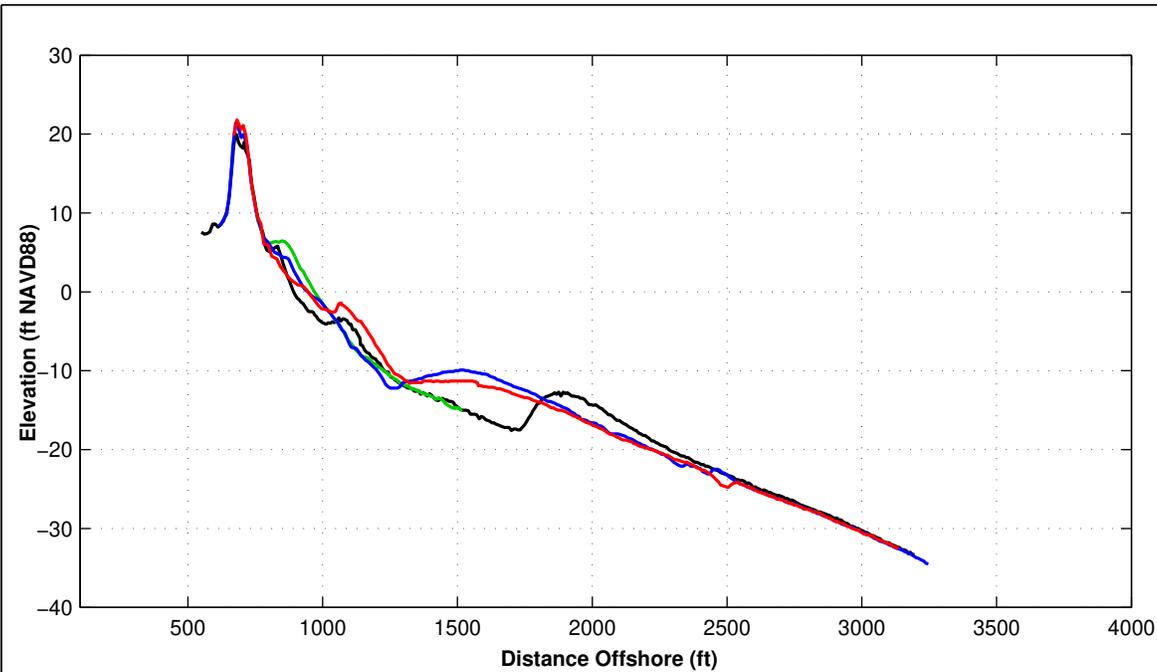


Survey Transect 880+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	52.83 ft	-18.75 ft
Volume Change Above +6 ft NAVD88	1.01 cy/ft	0.99 cy/ft
Volume Change Above 1.18 ft NAVD88	6.24 cy/ft	-3.69 cy/ft
Volume Change Above -6 ft NAVD88	13.27 cy/ft	8.90 cy/ft
Volume Change Above -14 ft NAVD88	51.73 cy/ft	12.11 cy/ft
Volume Change Above -19 ft NAVD88	53.51 cy/ft	12.76 cy/ft
Volume Change Above -30 ft NAVD88	17.87 cy/ft	0.45 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

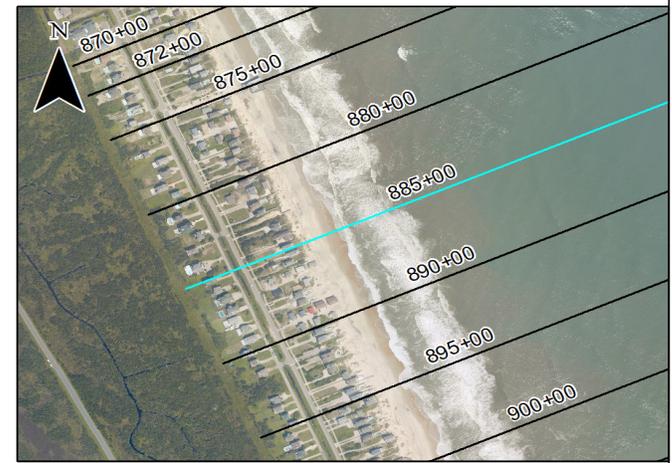


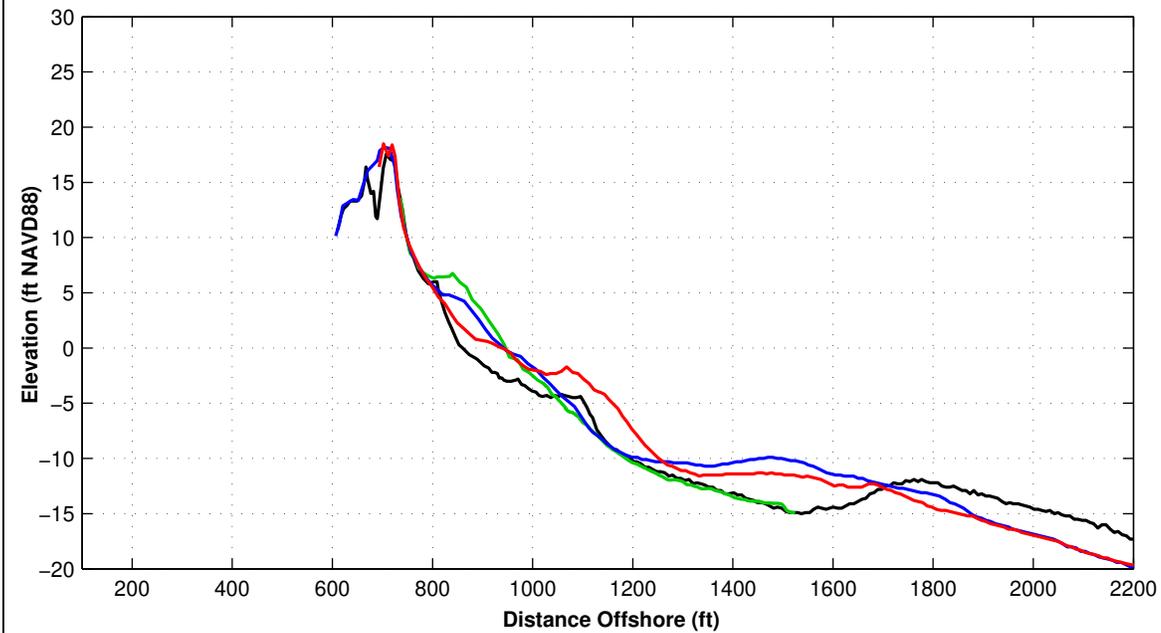
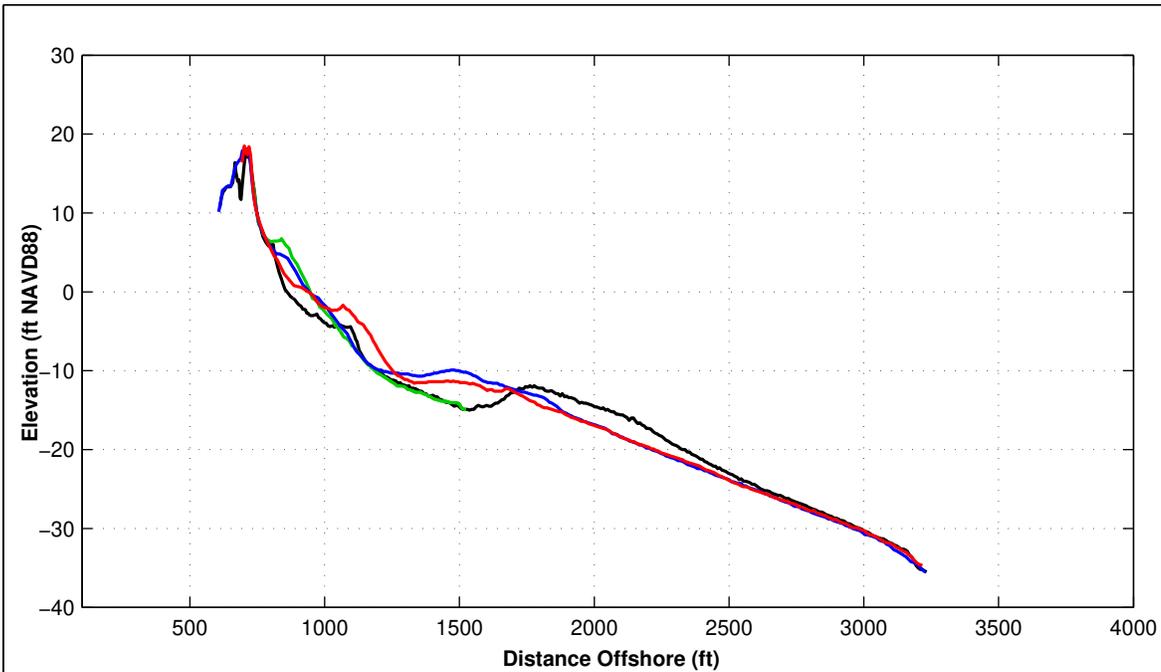


Survey Transect 885+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	38.81 ft	-21.14 ft
Volume Change Above +6 ft NAVD88	2.49 cy/ft	1.16 cy/ft
Volume Change Above 1.18 ft NAVD88	6.18 cy/ft	-4.38 cy/ft
Volume Change Above -6 ft NAVD88	13.61 cy/ft	6.89 cy/ft
Volume Change Above -14 ft NAVD88	49.32 cy/ft	4.95 cy/ft
Volume Change Above -19 ft NAVD88	53.53 cy/ft	0.57 cy/ft
Volume Change Above -30 ft NAVD88	38.70 cy/ft	-2.69 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

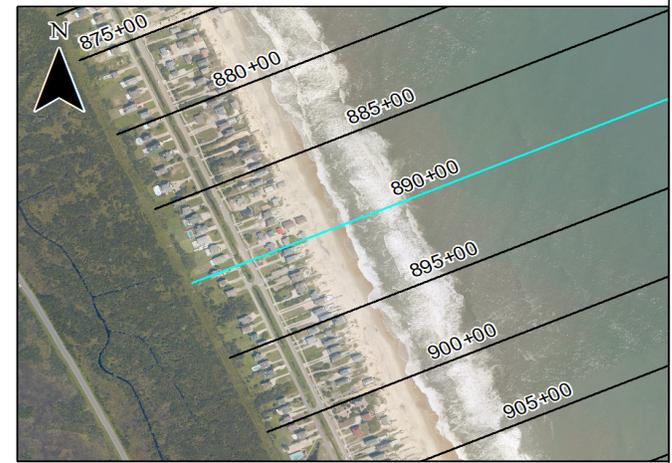


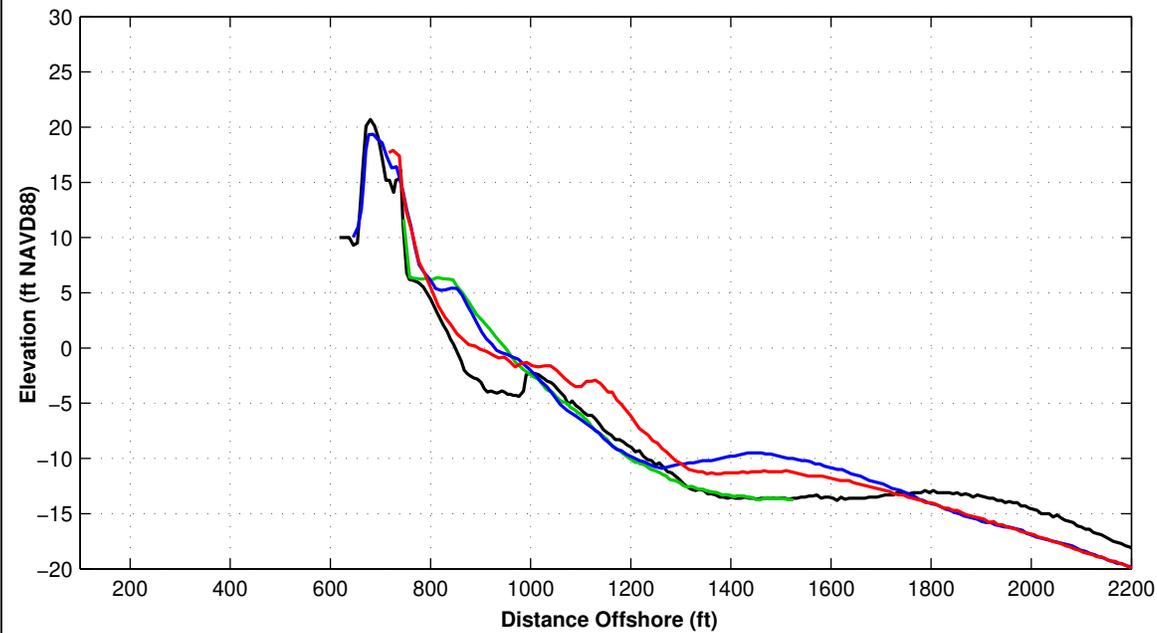
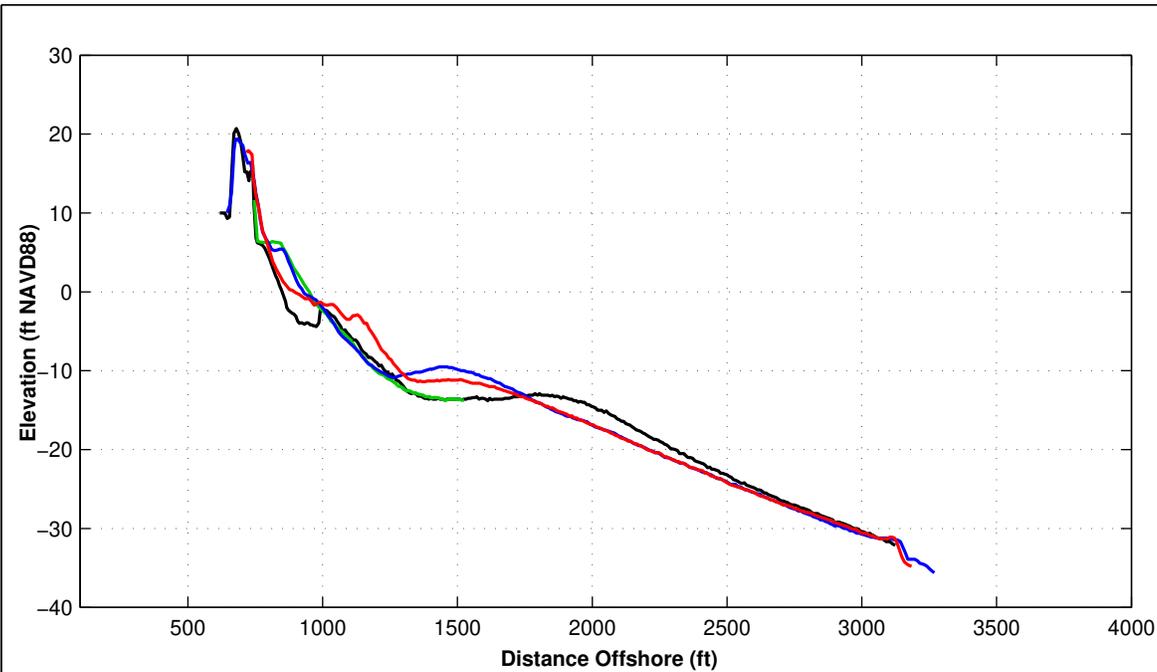


Survey Transect 890+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	70.66 ft	-38.20 ft
Volume Change Above +6 ft NAVD88	4.18 cy/ft	0.42 cy/ft
Volume Change Above 1.18 ft NAVD88	11.47 cy/ft	-5.59 cy/ft
Volume Change Above -6 ft NAVD88	25.69 cy/ft	4.29 cy/ft
Volume Change Above -14 ft NAVD88	60.93 cy/ft	-2.38 cy/ft
Volume Change Above -19 ft NAVD88	33.96 cy/ft	-5.07 cy/ft
Volume Change Above -30 ft NAVD88	9.44 cy/ft	-1.68 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

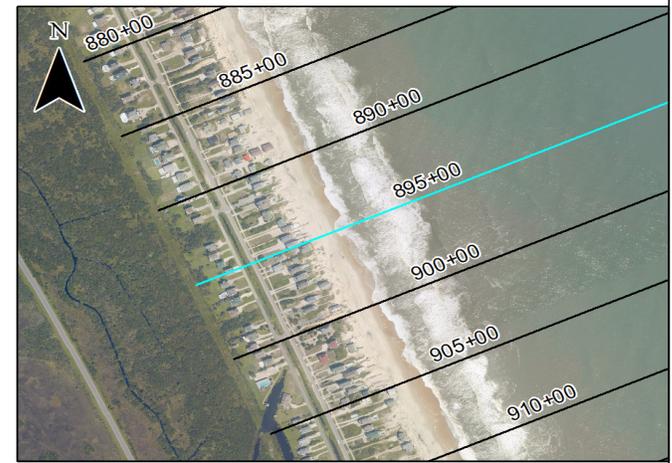


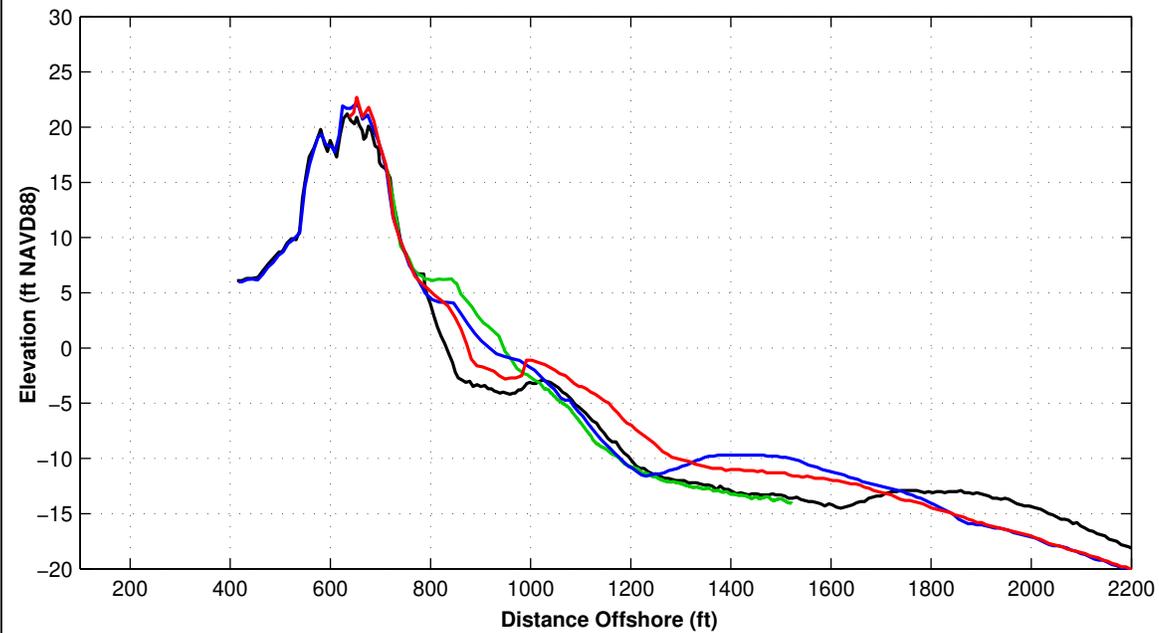
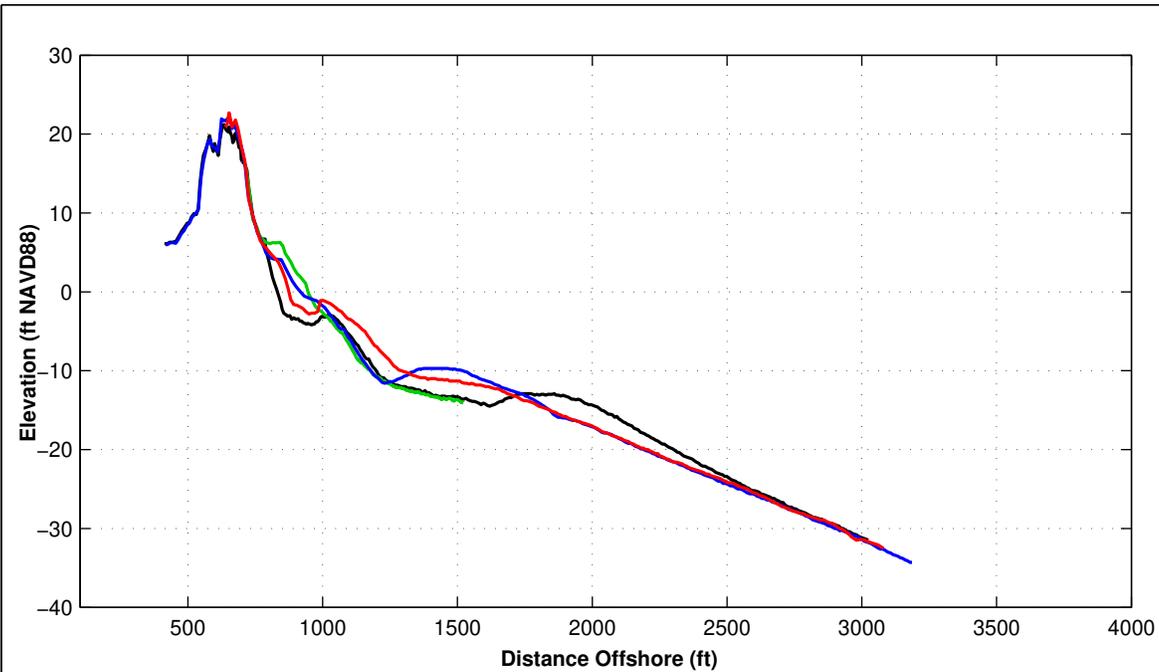


Survey Transect 895+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	70.01 ft	-50.55 ft
Volume Change Above +6 ft NAVD88	6.05 cy/ft	1.08 cy/ft
Volume Change Above 1.18 ft NAVD88	17.15 cy/ft	-7.72 cy/ft
Volume Change Above -6 ft NAVD88	33.28 cy/ft	4.30 cy/ft
Volume Change Above -14 ft NAVD88	70.84 cy/ft	2.44 cy/ft
Volume Change Above -19 ft NAVD88	44.24 cy/ft	2.88 cy/ft
Volume Change Above -30 ft NAVD88	21.36 cy/ft	4.88 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

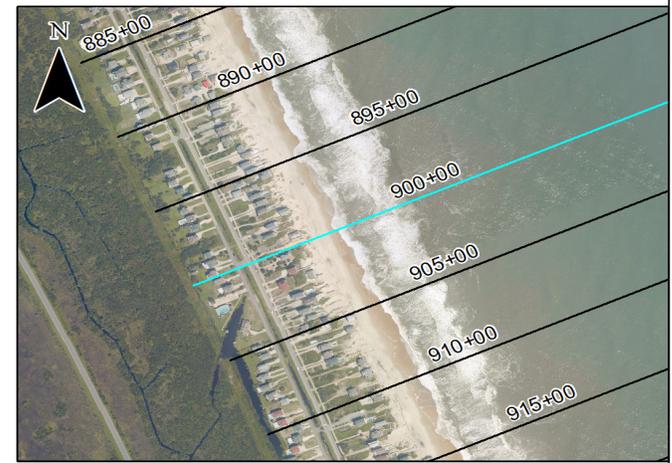


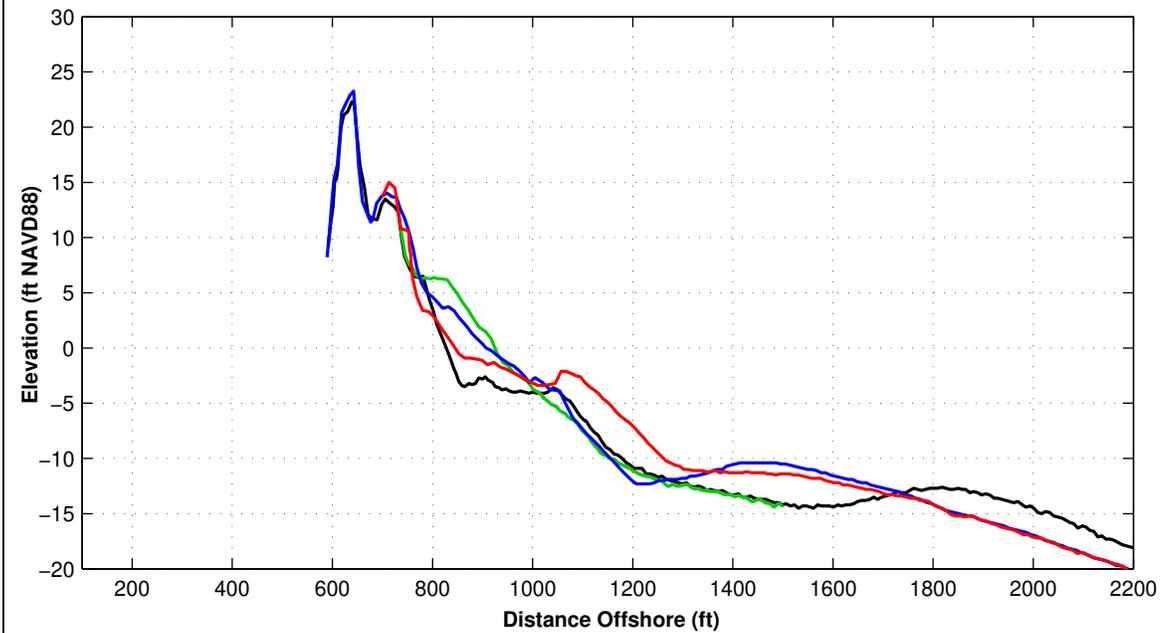
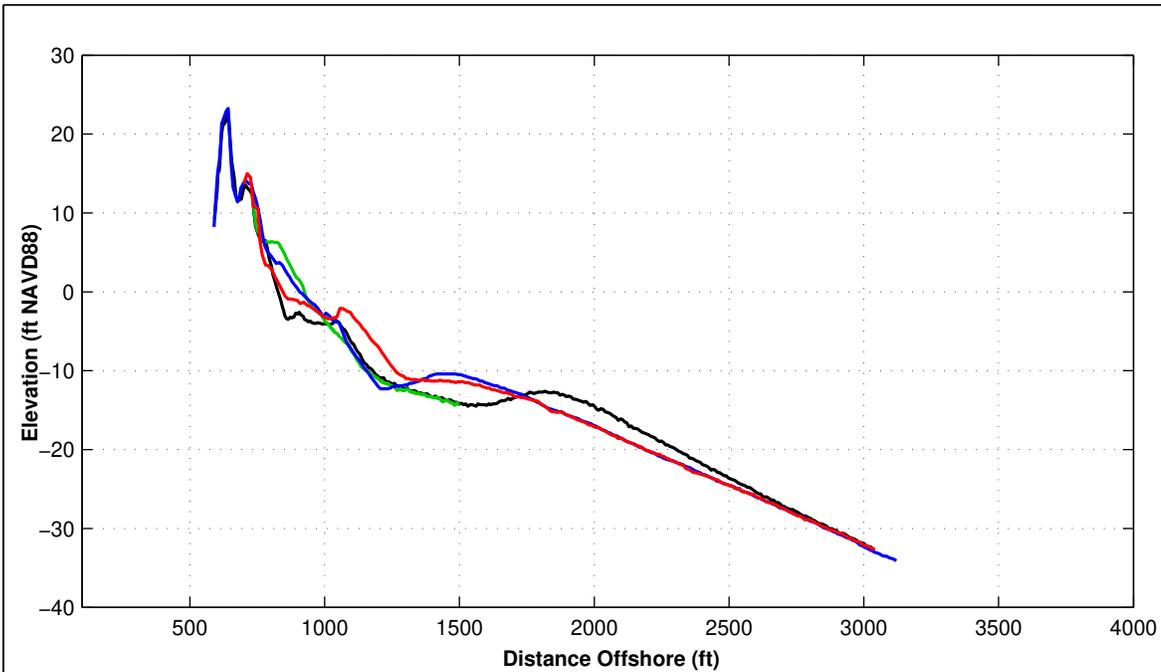


Survey Transect 900+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	70.90 ft	-25.79 ft
Volume Change Above +6 ft NAVD88	1.70 cy/ft	0.93 cy/ft
Volume Change Above 1.18 ft NAVD88	8.06 cy/ft	-0.32 cy/ft
Volume Change Above -6 ft NAVD88	28.68 cy/ft	2.16 cy/ft
Volume Change Above -14 ft NAVD88	62.22 cy/ft	4.72 cy/ft
Volume Change Above -19 ft NAVD88	32.11 cy/ft	5.37 cy/ft
Volume Change Above -30 ft NAVD88	8.79 cy/ft	10.86 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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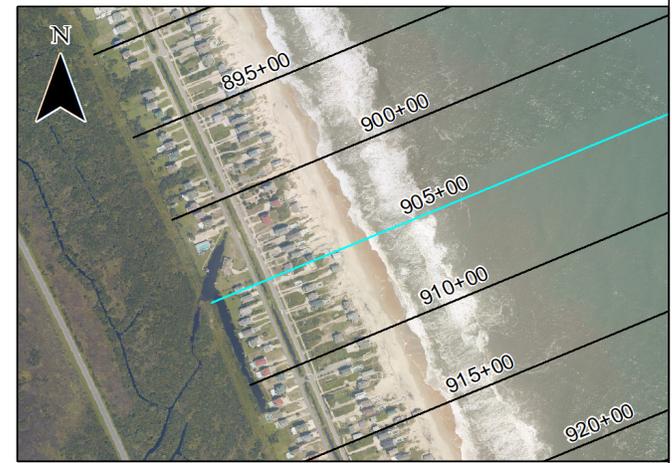


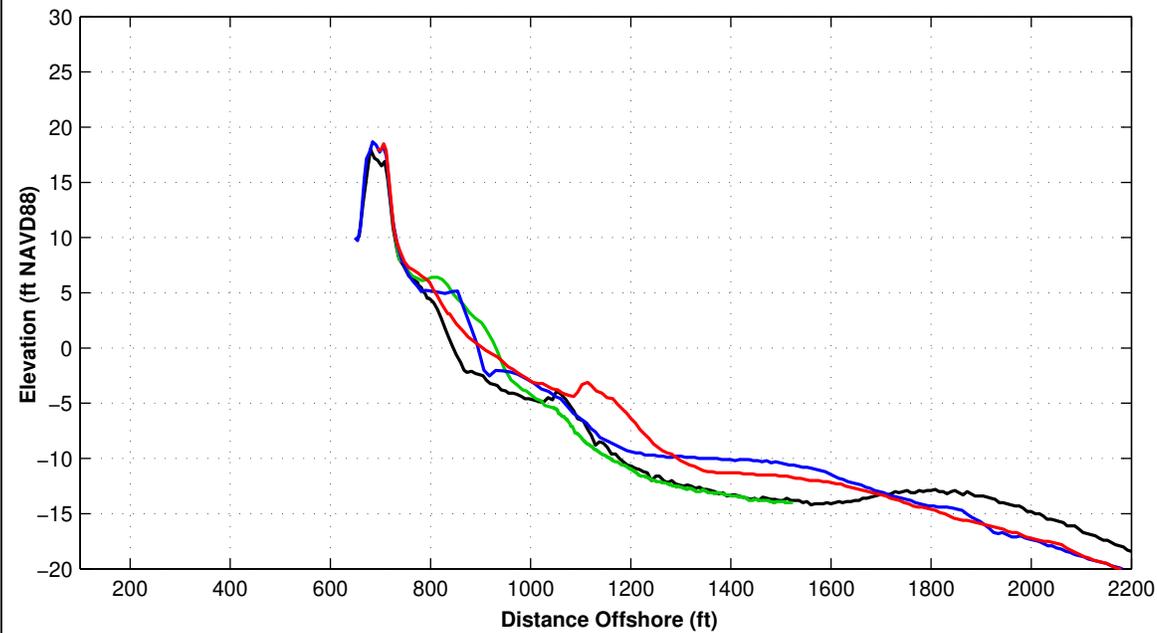
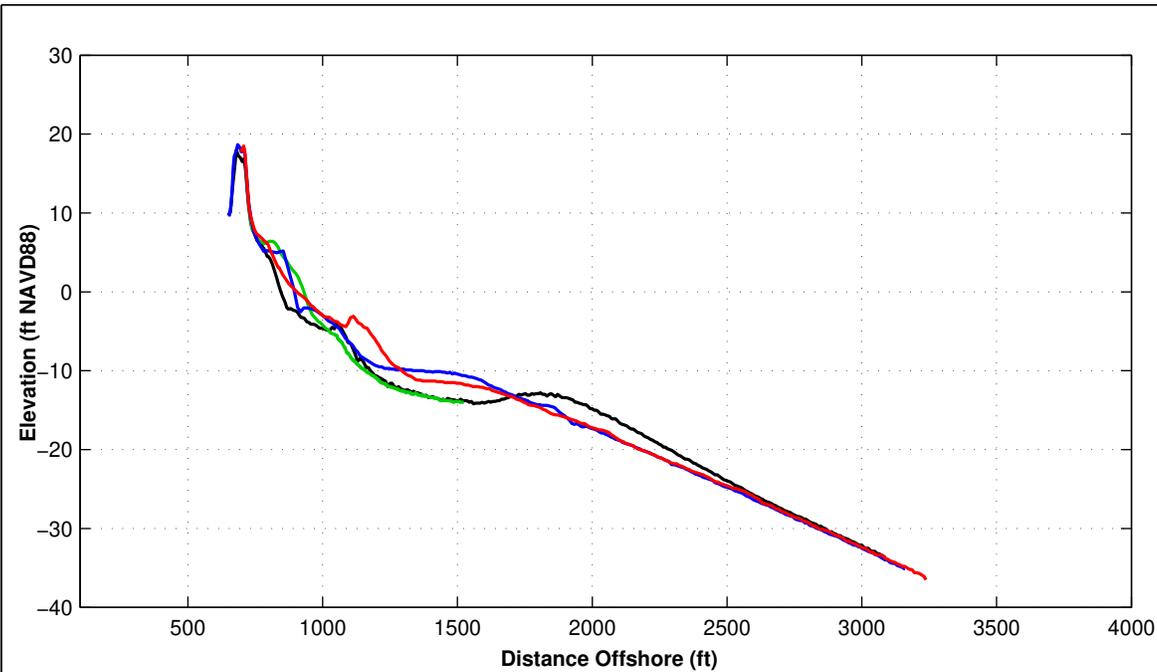


Survey Transect 905+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	64.68 ft	-54.58 ft
Volume Change Above +6 ft NAVD88	4.32 cy/ft	-1.54 cy/ft
Volume Change Above 1.18 ft NAVD88	9.50 cy/ft	-8.74 cy/ft
Volume Change Above -6 ft NAVD88	28.48 cy/ft	-5.55 cy/ft
Volume Change Above -14 ft NAVD88	51.32 cy/ft	10.30 cy/ft
Volume Change Above -19 ft NAVD88	25.26 cy/ft	9.30 cy/ft
Volume Change Above -30 ft NAVD88	1.63 cy/ft	9.23 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

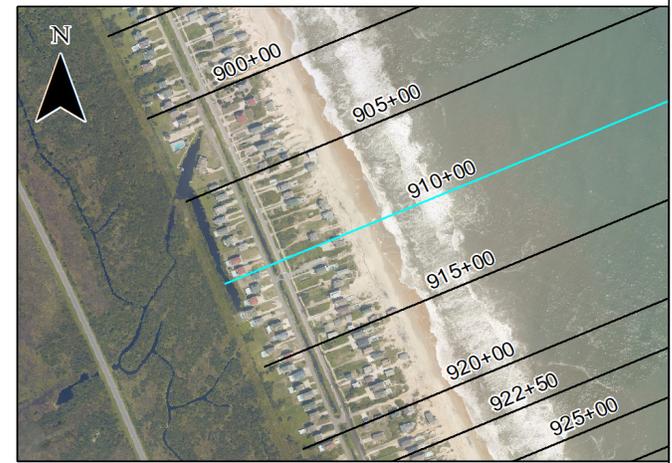


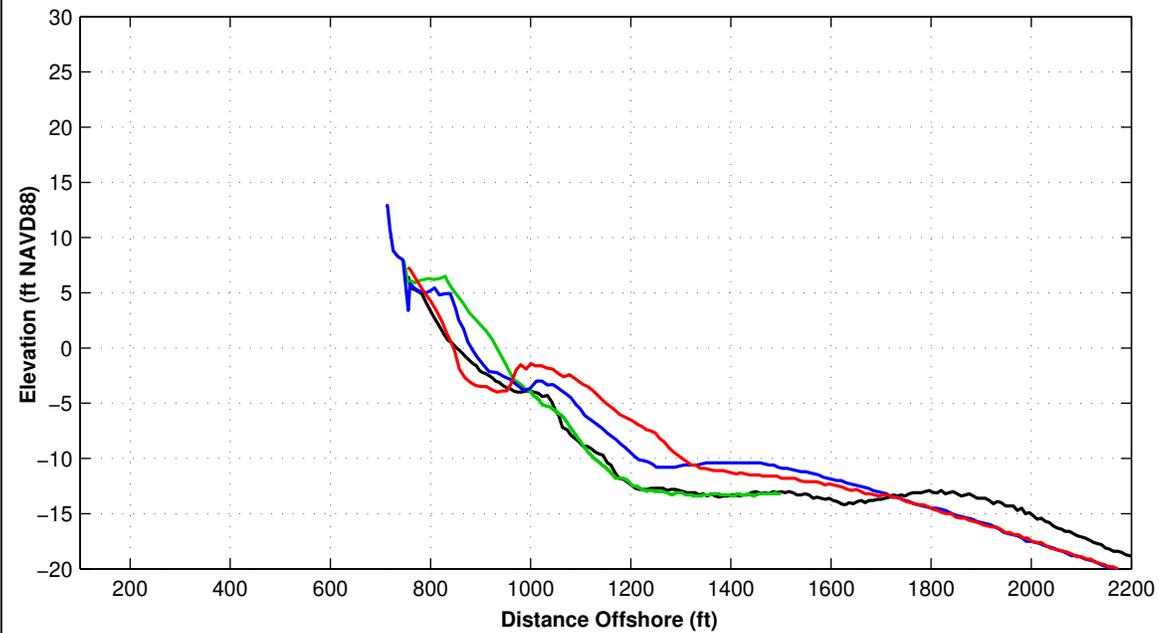
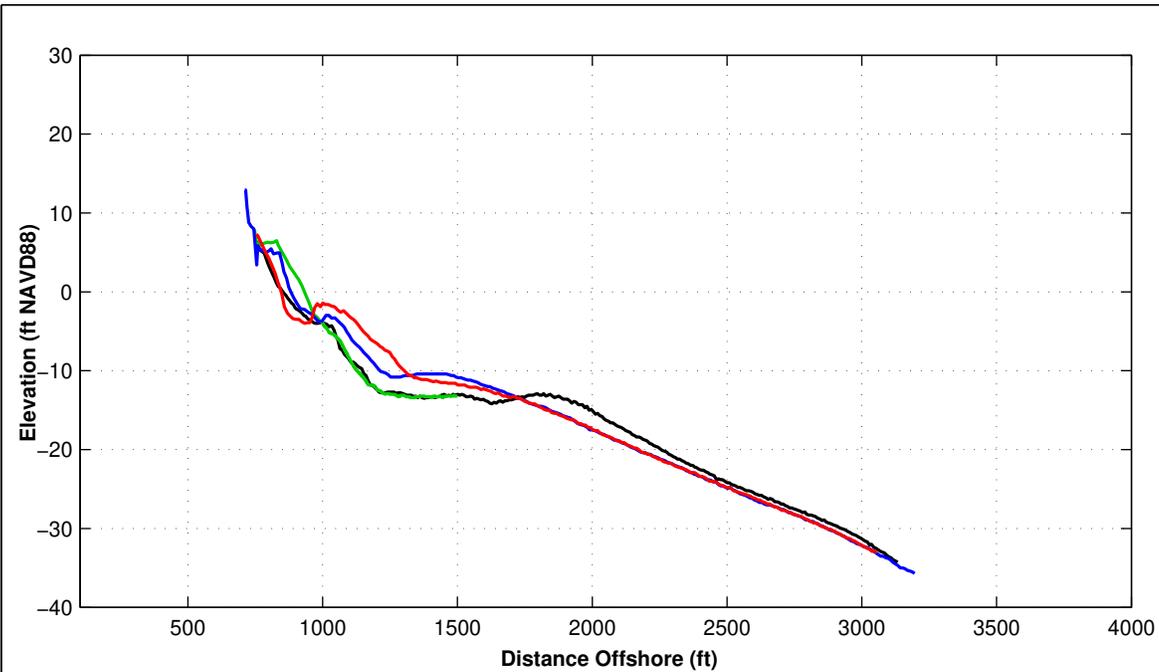


Survey Transect 910+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	51.91 ft	-14.50 ft
Volume Change Above +6 ft NAVD88	2.46 cy/ft	1.48 cy/ft
Volume Change Above 1.18 ft NAVD88	10.38 cy/ft	-2.39 cy/ft
Volume Change Above -6 ft NAVD88	22.85 cy/ft	9.46 cy/ft
Volume Change Above -14 ft NAVD88	66.40 cy/ft	7.49 cy/ft
Volume Change Above -19 ft NAVD88	38.83 cy/ft	6.90 cy/ft
Volume Change Above -30 ft NAVD88	15.60 cy/ft	10.75 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

Notes:
 1. Station From North To South At Varying Intervals.
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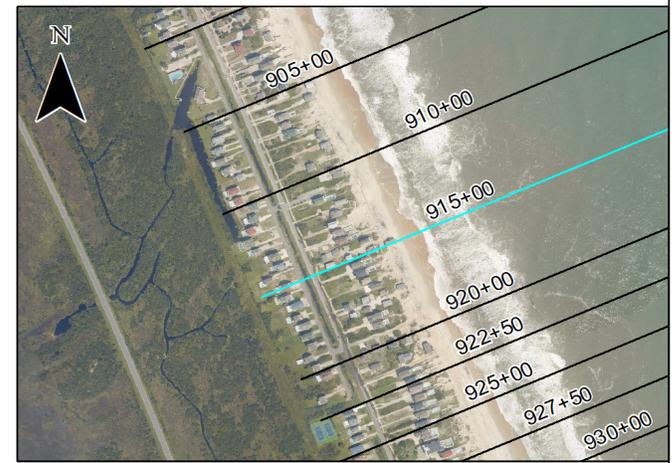


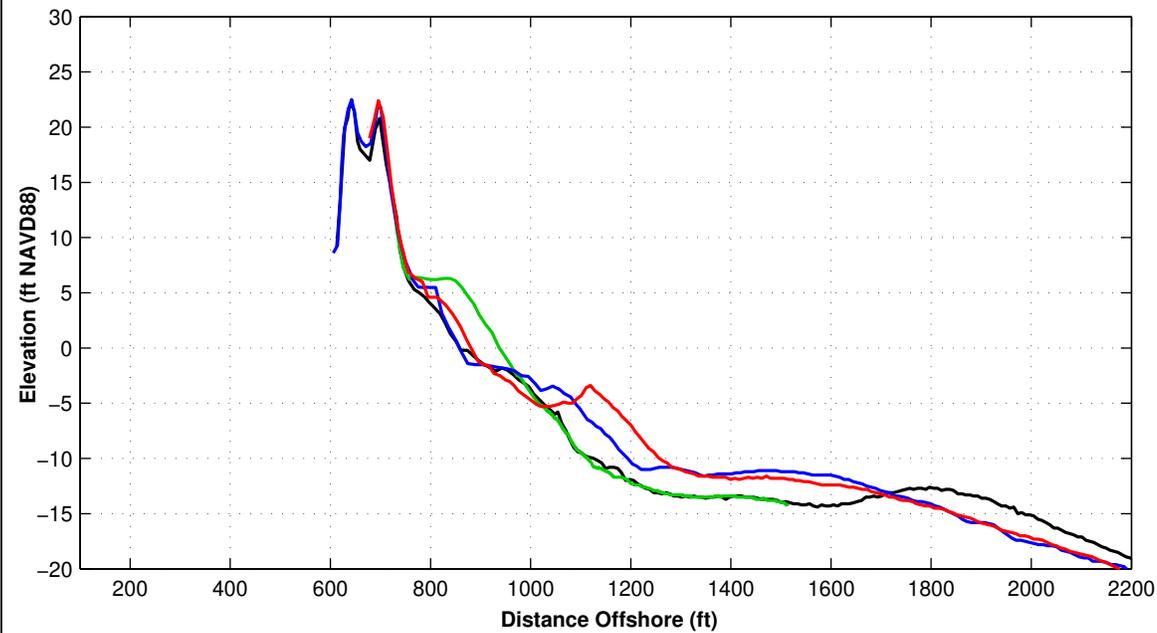
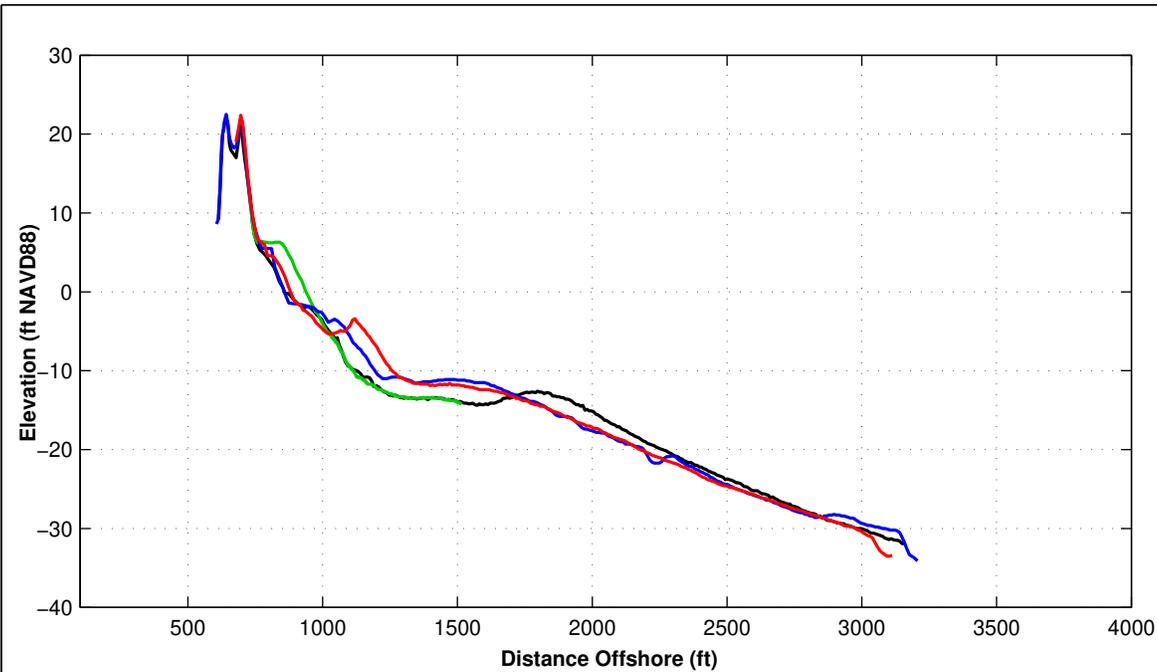


Survey Transect 915+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	42.02 ft	-35.92 ft
Volume Change Above +6 ft NAVD88	-0.35 cy/ft	0.00 cy/ft
Volume Change Above 1.18 ft NAVD88	6.53 cy/ft	-4.56 cy/ft
Volume Change Above -6 ft NAVD88	16.89 cy/ft	-1.36 cy/ft
Volume Change Above -14 ft NAVD88	66.70 cy/ft	3.69 cy/ft
Volume Change Above -19 ft NAVD88	42.37 cy/ft	3.48 cy/ft
Volume Change Above -30 ft NAVD88	17.48 cy/ft	4.36 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

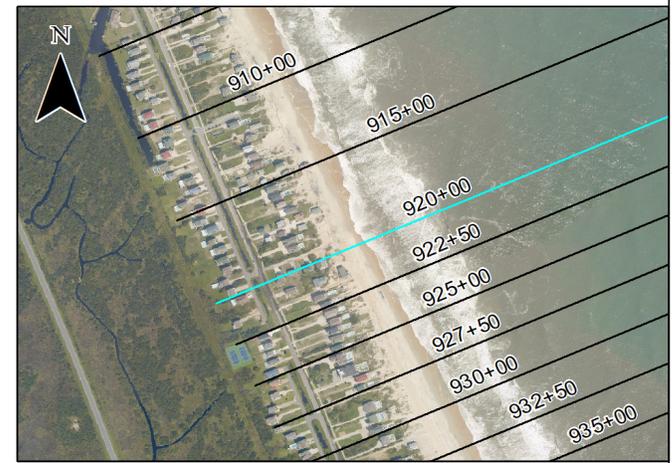


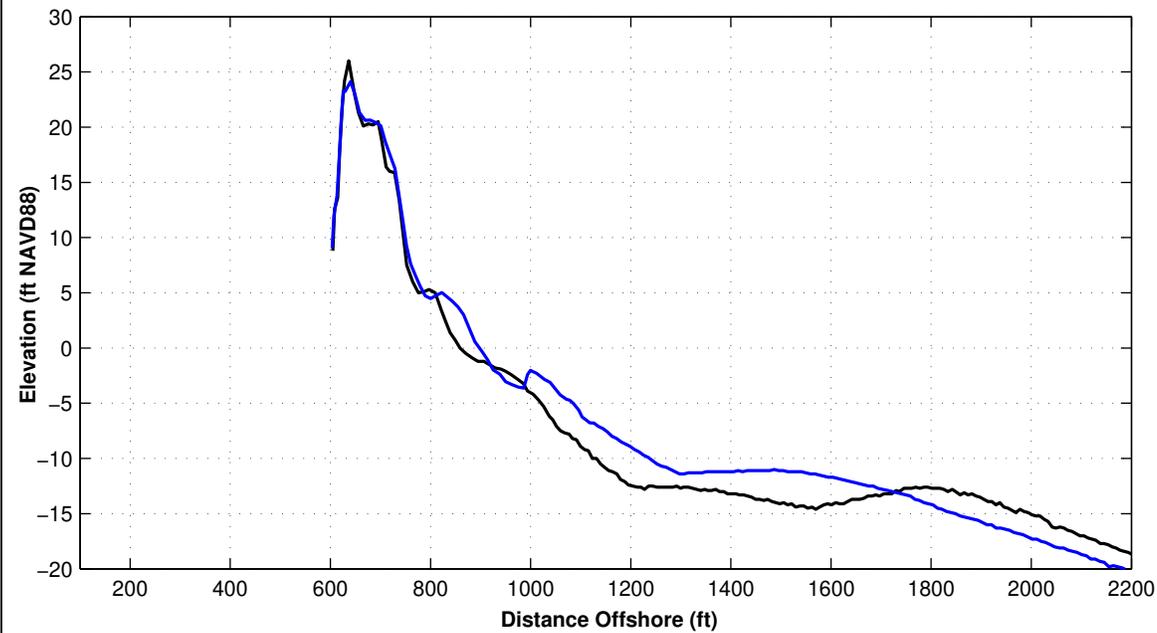
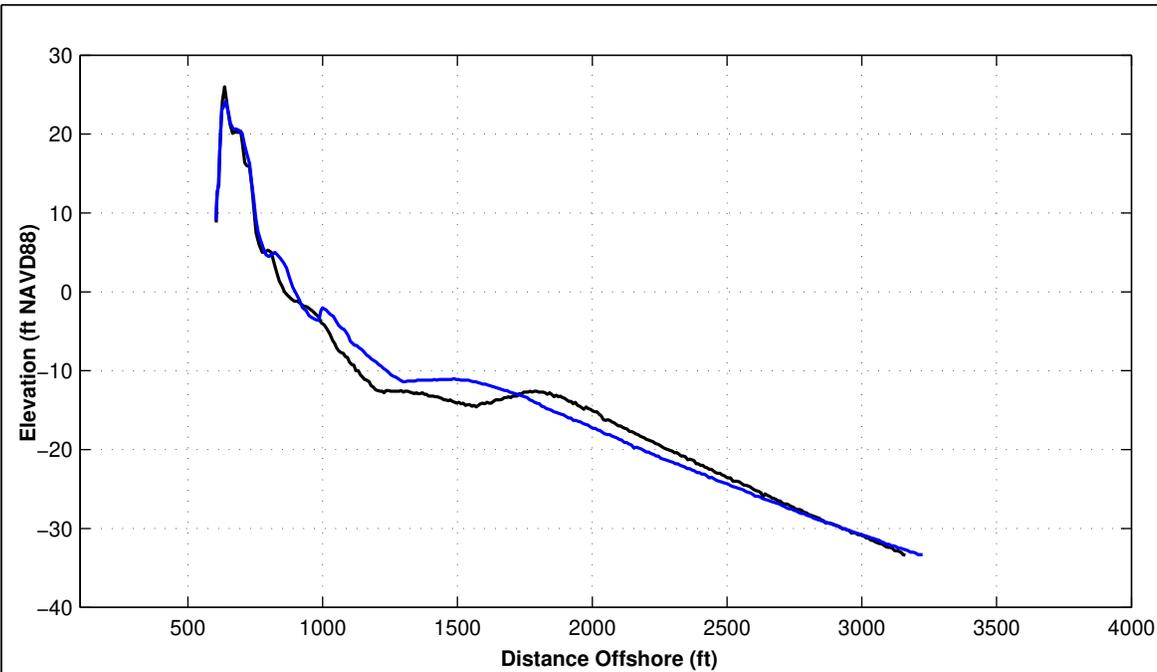


Survey Transect 920+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	3.42 ft	22.85 ft
Volume Change Above +6 ft NAVD88	3.56 cy/ft	1.41 cy/ft
Volume Change Above 1.18 ft NAVD88	6.07 cy/ft	3.22 cy/ft
Volume Change Above -6 ft NAVD88	11.94 cy/ft	2.40 cy/ft
Volume Change Above -14 ft NAVD88	59.33 cy/ft	6.05 cy/ft
Volume Change Above -19 ft NAVD88	37.15 cy/ft	7.97 cy/ft
Volume Change Above -30 ft NAVD88	24.79 cy/ft	0.69 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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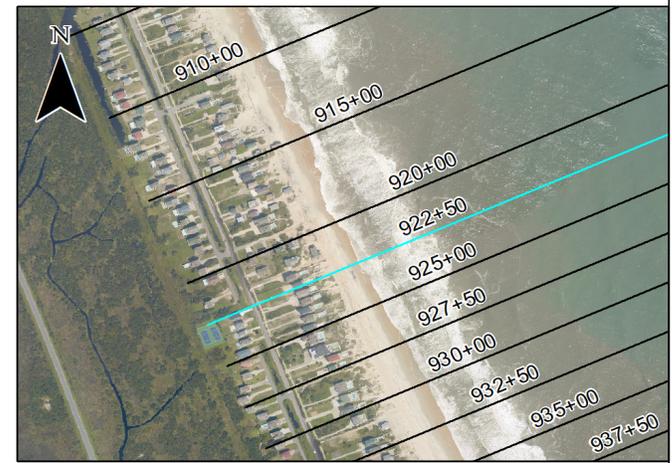


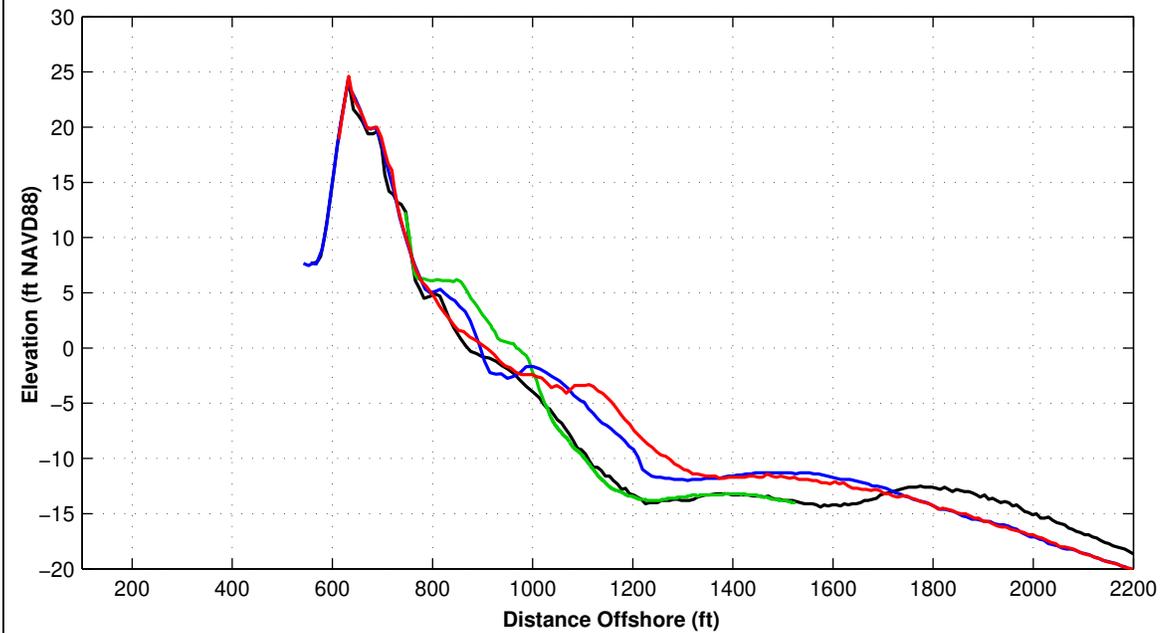
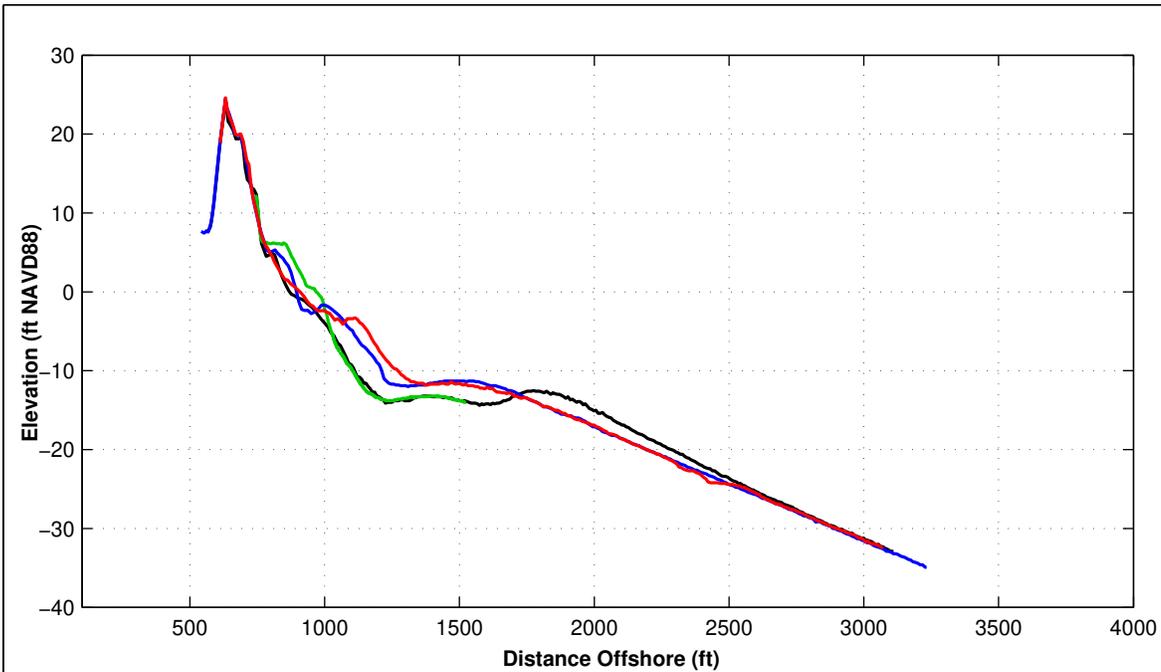


Survey Transect 922+50	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	40.65 ft	– ft
Volume Change Above +6 ft NAVD88	2.84 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	7.70 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	16.80 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	65.59 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	43.89 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	21.73 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

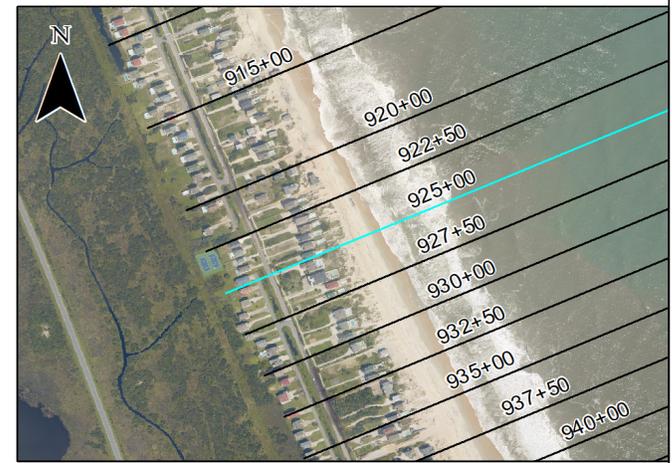


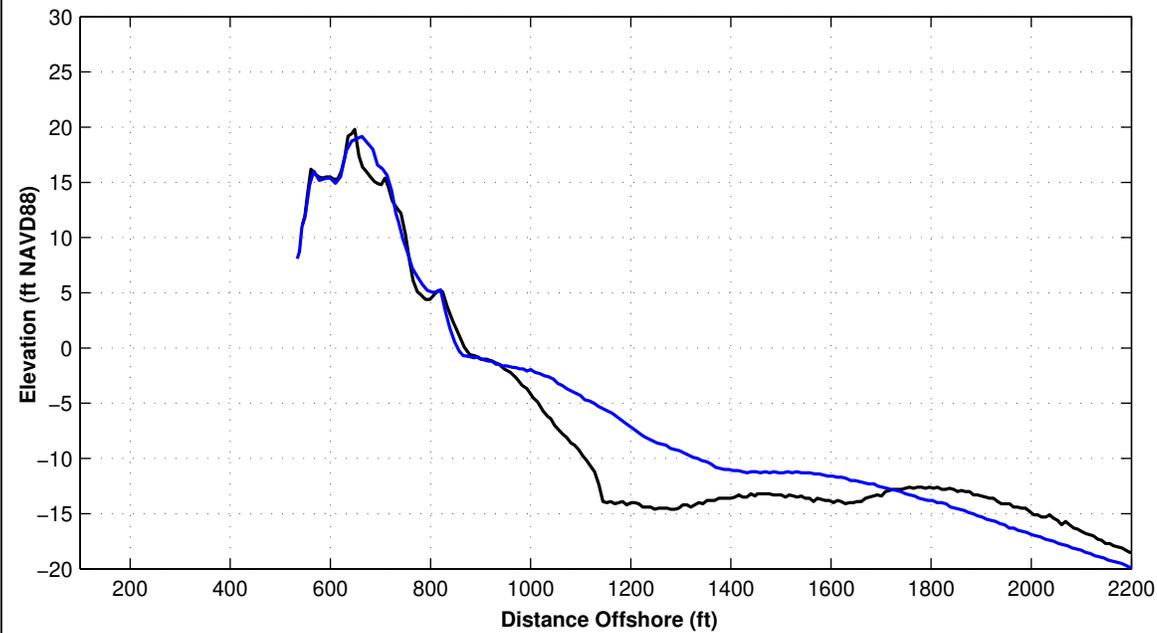
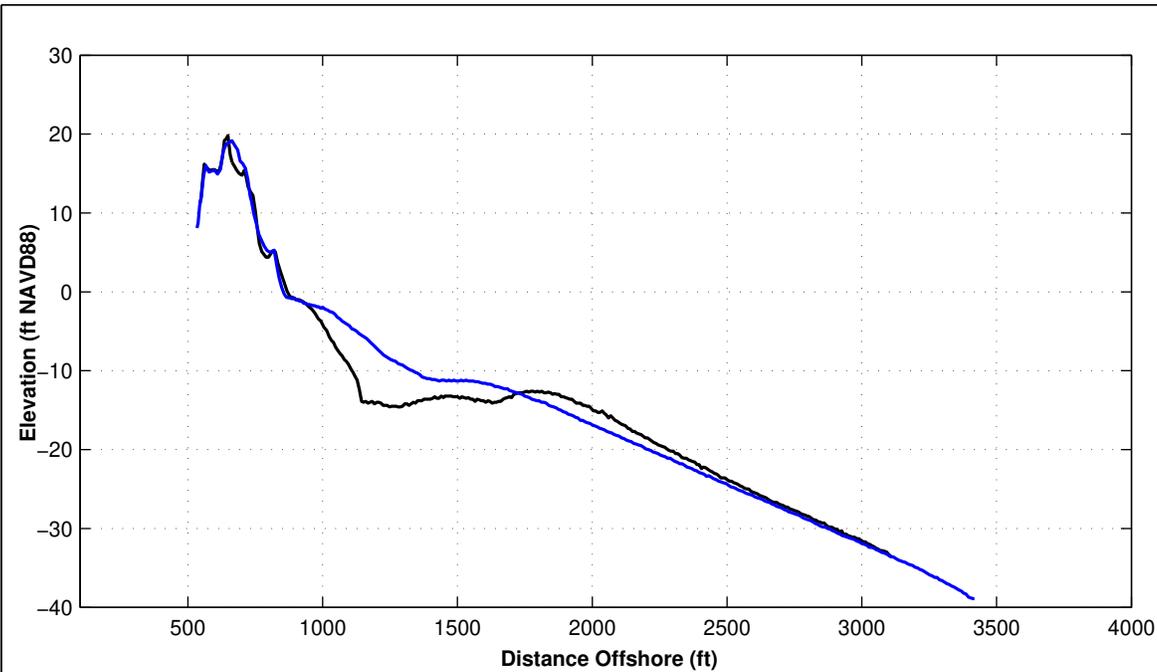


Survey Transect 925+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	34.49 ft	-16.17 ft
Volume Change Above +6 ft NAVD88	1.36 cy/ft	1.04 cy/ft
Volume Change Above 1.18 ft NAVD88	6.94 cy/ft	-3.95 cy/ft
Volume Change Above -6 ft NAVD88	18.25 cy/ft	1.91 cy/ft
Volume Change Above -14 ft NAVD88	69.62 cy/ft	8.97 cy/ft
Volume Change Above -19 ft NAVD88	46.82 cy/ft	9.49 cy/ft
Volume Change Above -30 ft NAVD88	28.00 cy/ft	8.00 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

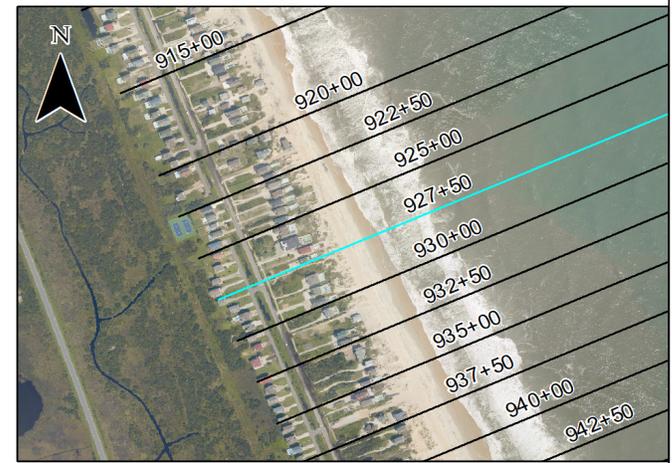


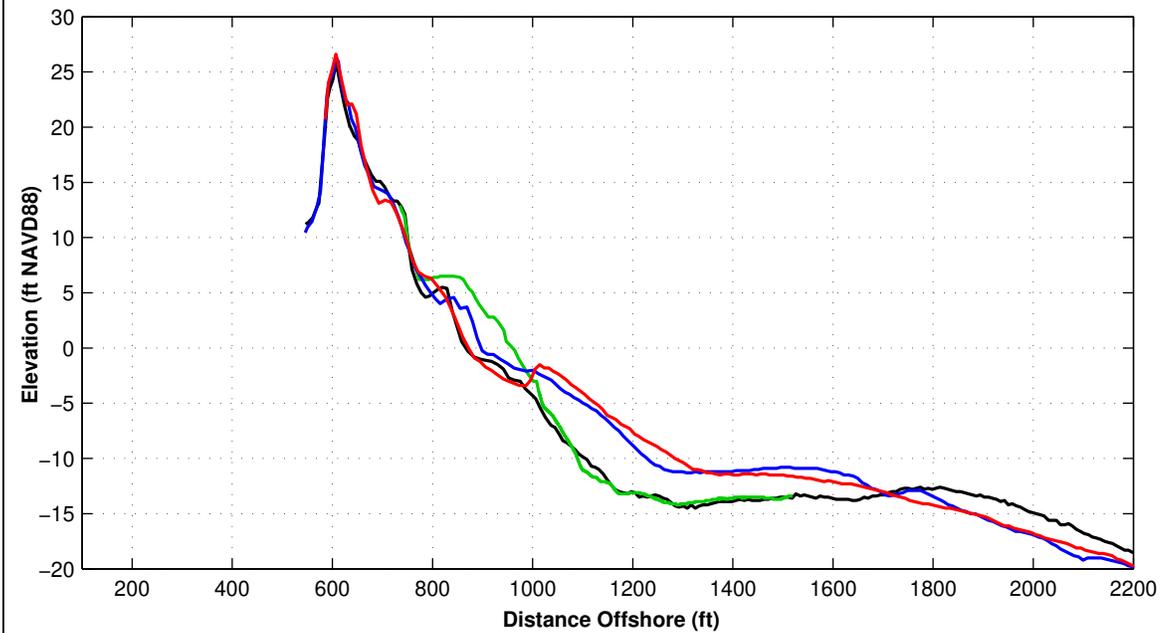
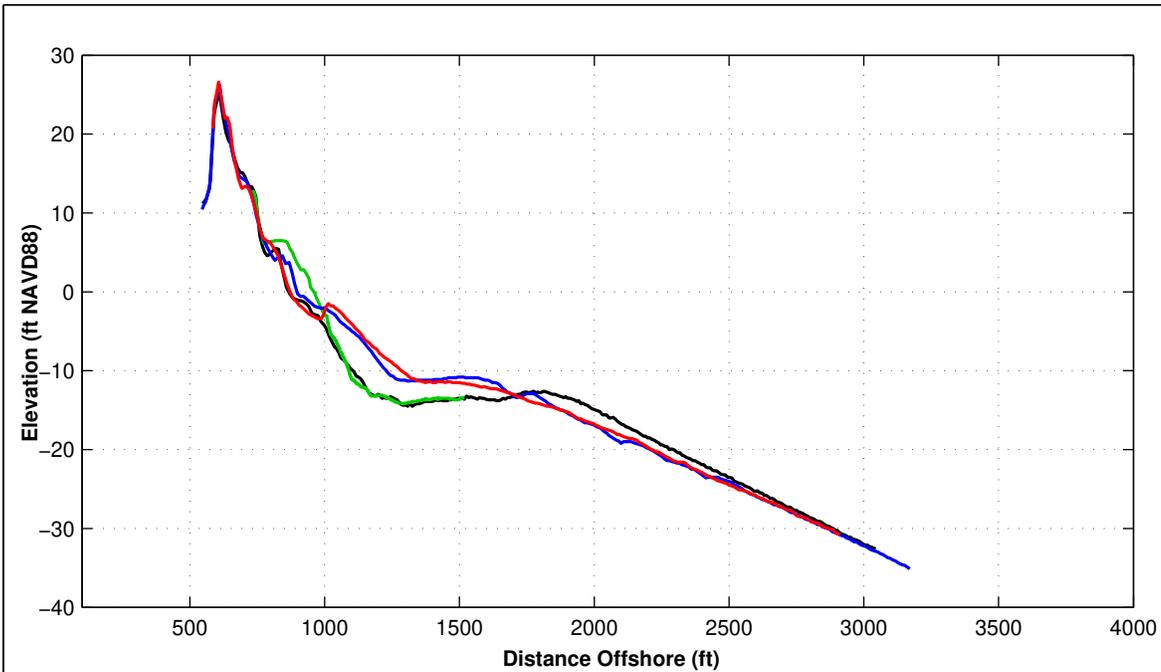


Survey Transect 927+50	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-13.77 ft	- ft
Volume Change Above +6 ft NAVD88	3.76 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	3.81 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	16.42 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	95.19 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	76.01 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	58.28 cy/ft	- cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

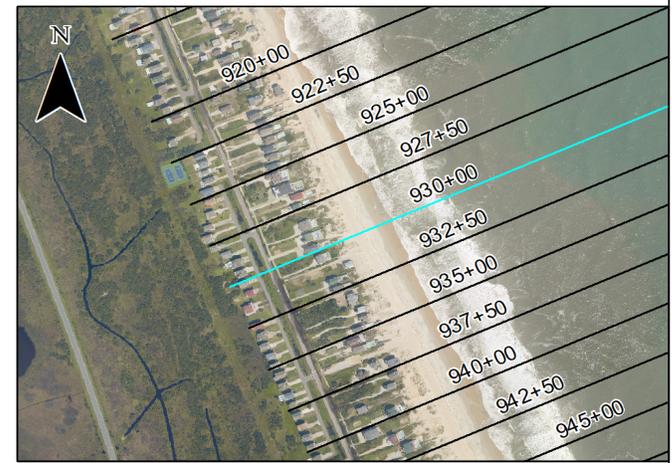


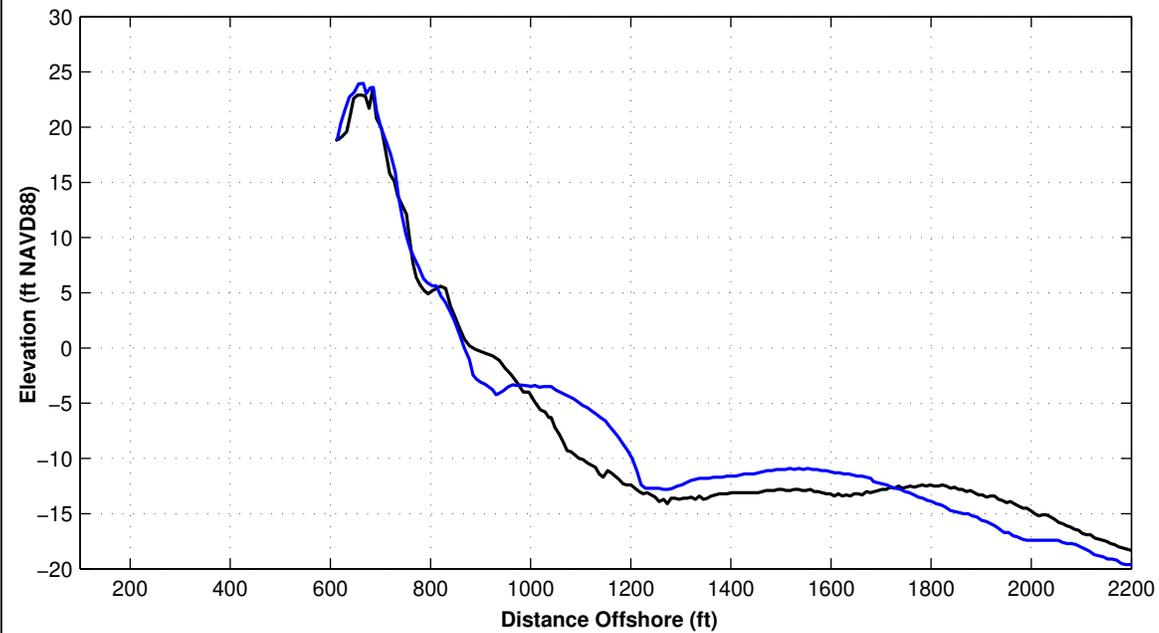
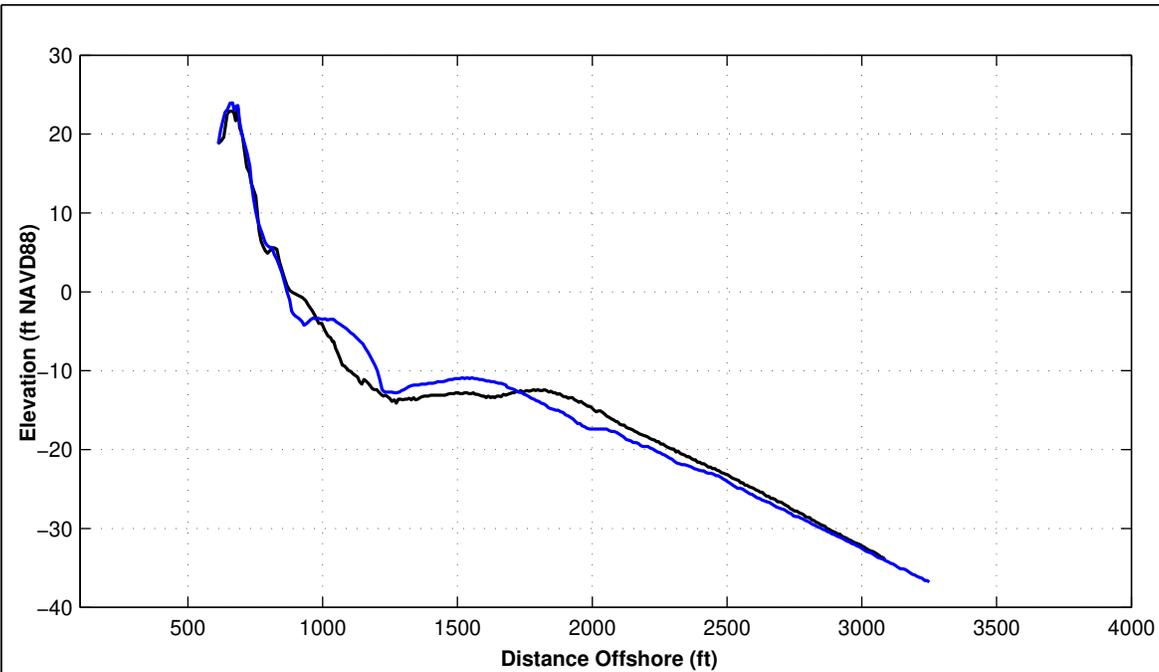


Survey Transect 930+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	33.35 ft	-28.75 ft
Volume Change Above +6 ft NAVD88	-1.46 cy/ft	0.16 cy/ft
Volume Change Above 1.18 ft NAVD88	1.65 cy/ft	-1.76 cy/ft
Volume Change Above -6 ft NAVD88	17.24 cy/ft	-4.47 cy/ft
Volume Change Above -14 ft NAVD88	83.74 cy/ft	-6.16 cy/ft
Volume Change Above -19 ft NAVD88	61.43 cy/ft	-3.46 cy/ft
Volume Change Above -30 ft NAVD88	40.17 cy/ft	-1.97 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

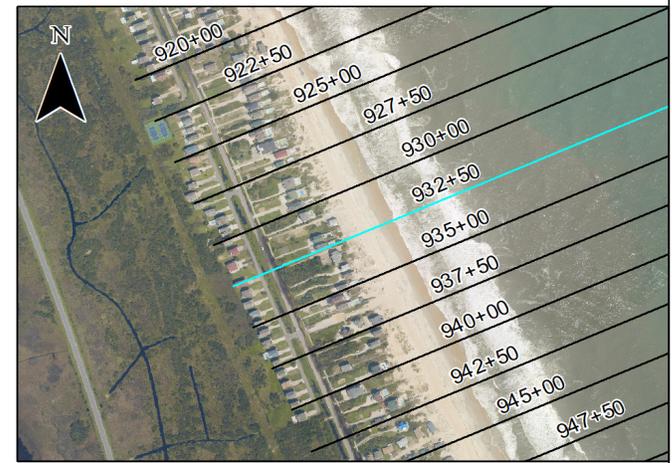


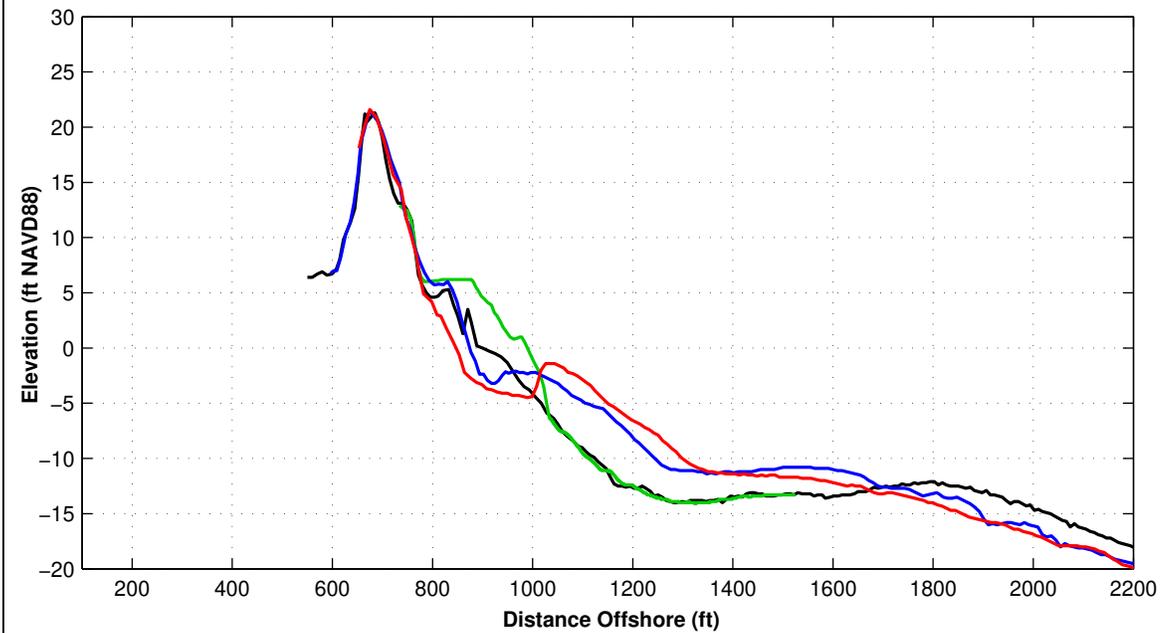
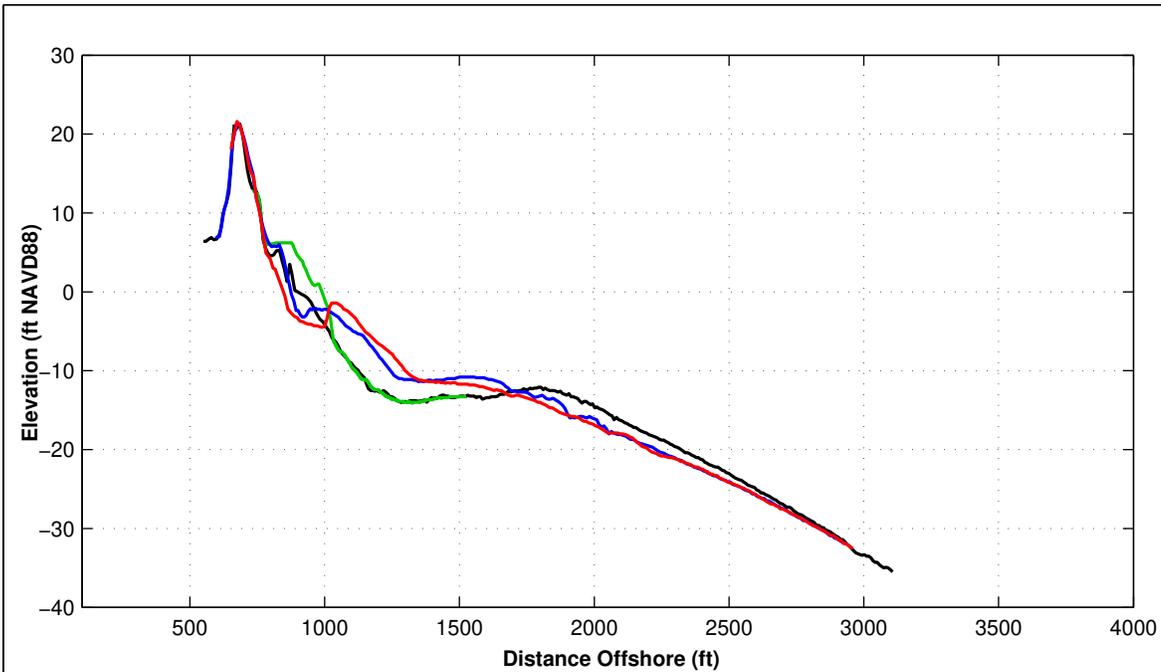


Survey Transect 932+50	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-5.48 ft	- ft
Volume Change Above +6 ft NAVD88	2.61 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	2.15 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	1.20 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	44.78 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	20.80 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	-1.06 cy/ft	- cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

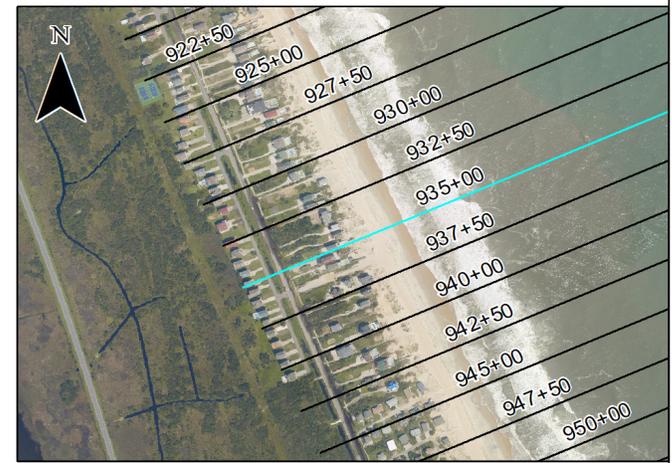


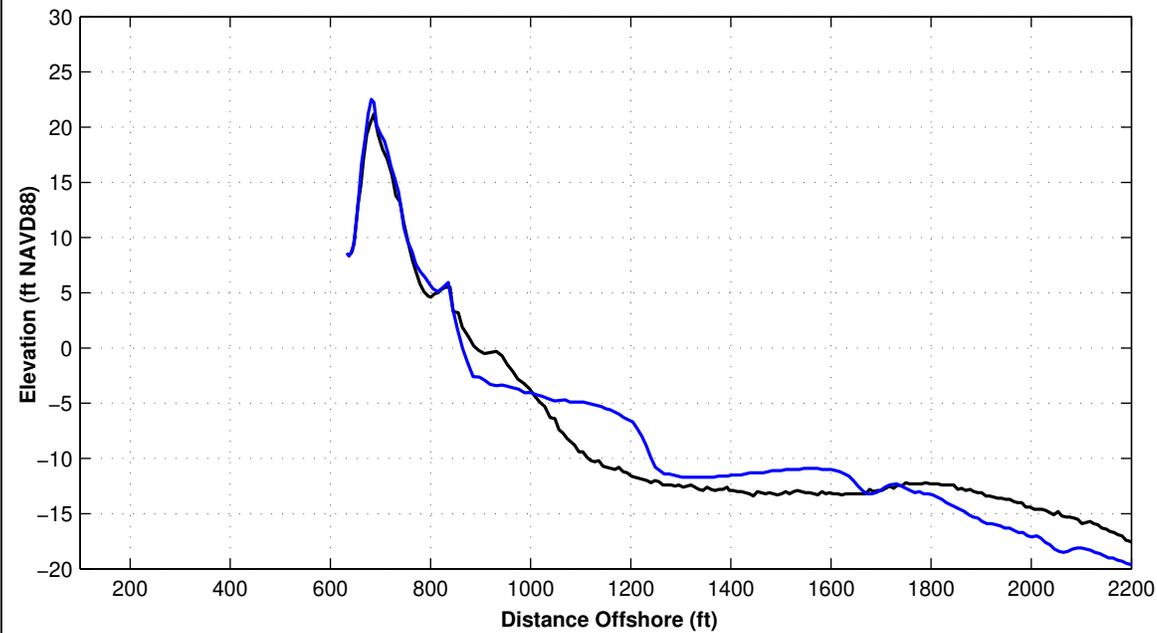
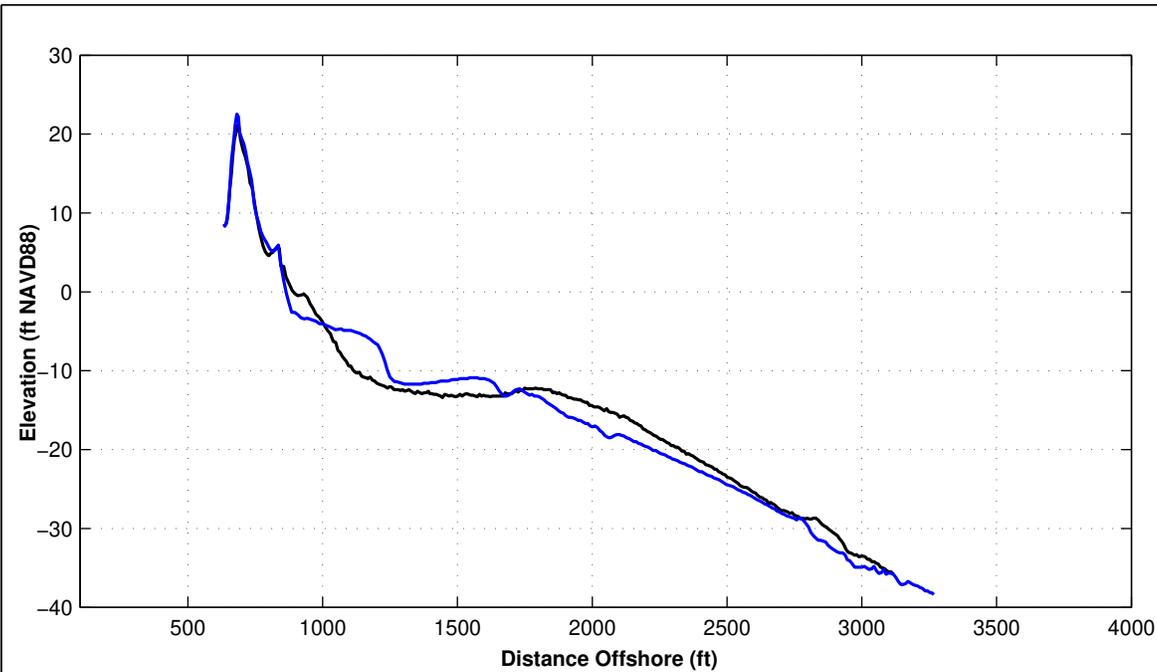


Survey Transect 935+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-16.61 ft	-32.57 ft
Volume Change Above +6 ft NAVD88	3.28 cy/ft	-1.28 cy/ft
Volume Change Above 1.18 ft NAVD88	5.11 cy/ft	-9.44 cy/ft
Volume Change Above -6 ft NAVD88	10.14 cy/ft	-12.07 cy/ft
Volume Change Above -14 ft NAVD88	68.75 cy/ft	-14.91 cy/ft
Volume Change Above -19 ft NAVD88	47.16 cy/ft	-19.10 cy/ft
Volume Change Above -30 ft NAVD88	24.73 cy/ft	-20.75 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

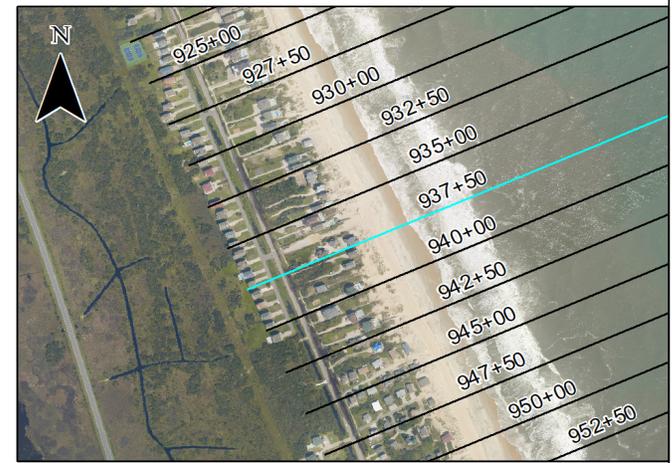


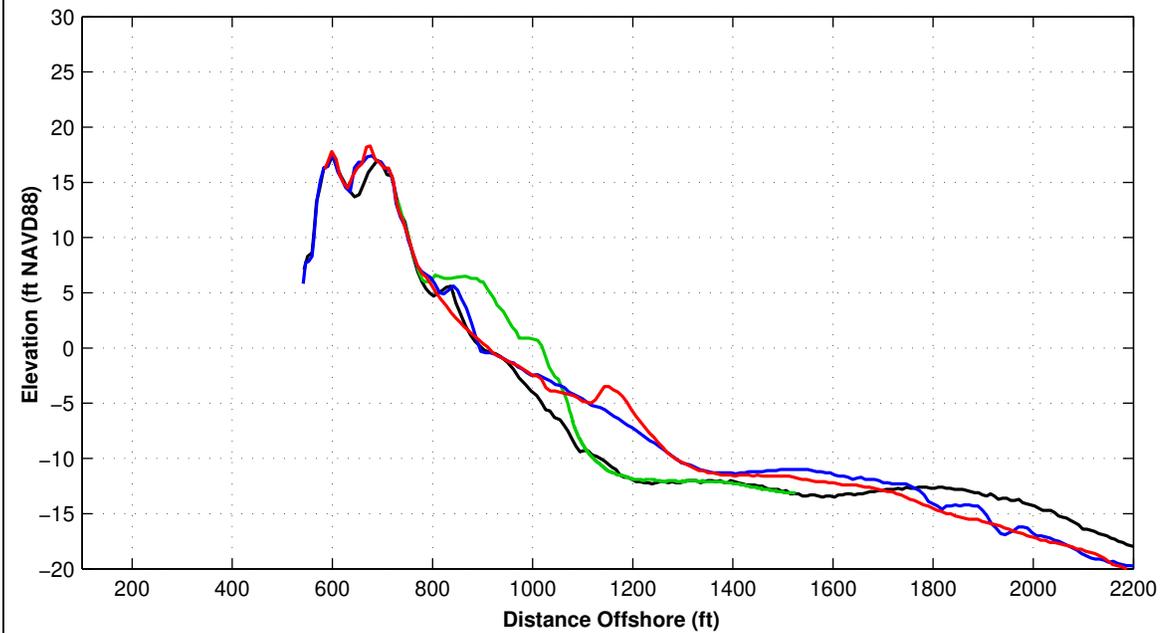
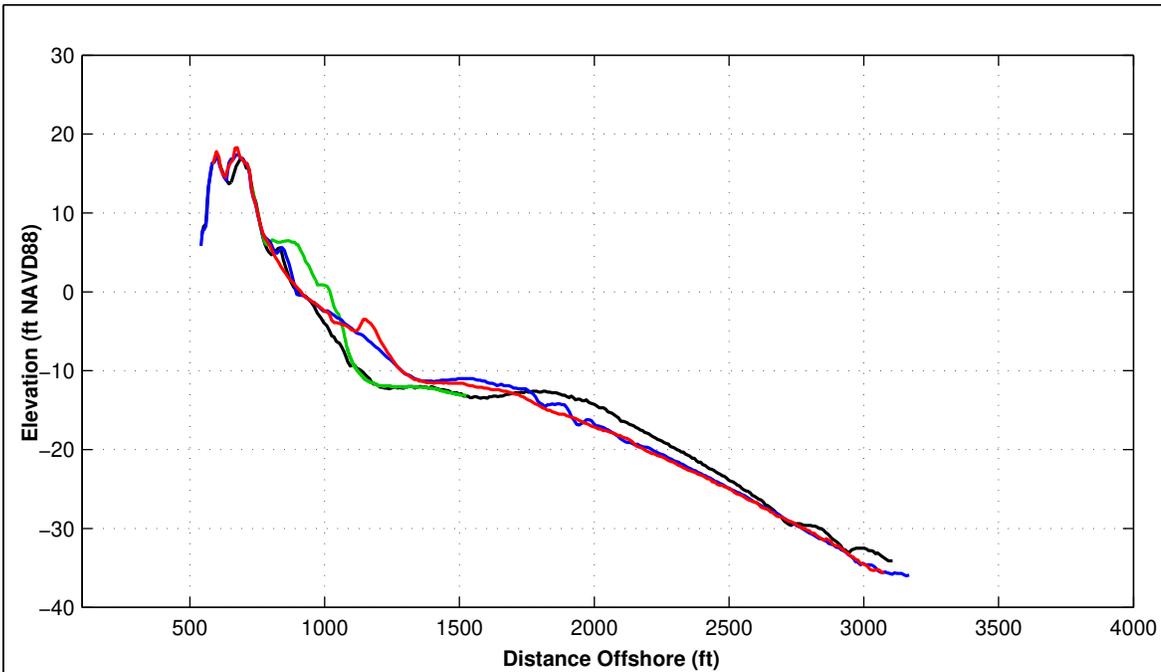


Survey Transect 937+50	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-16.61 ft	- ft
Volume Change Above +6 ft NAVD88	2.36 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	2.55 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	-2.43 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	41.64 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	10.32 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	-13.65 cy/ft	- cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

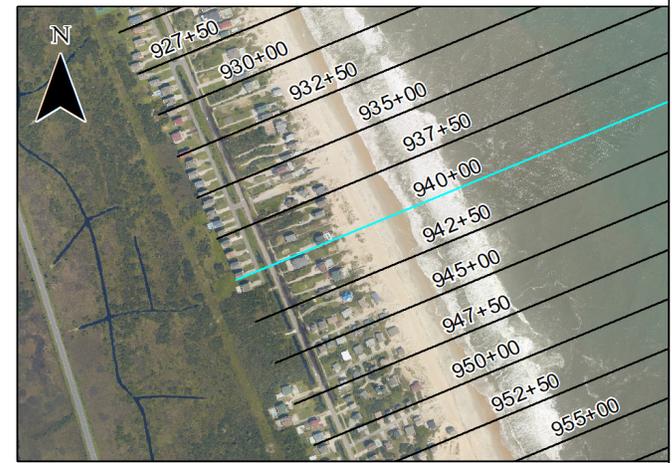


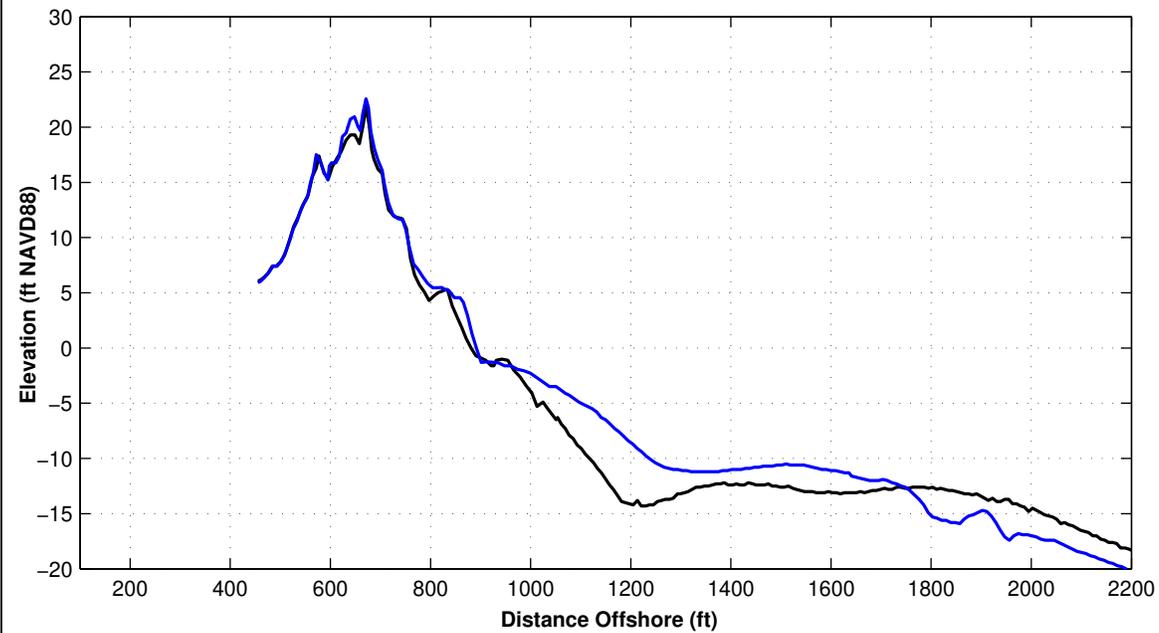
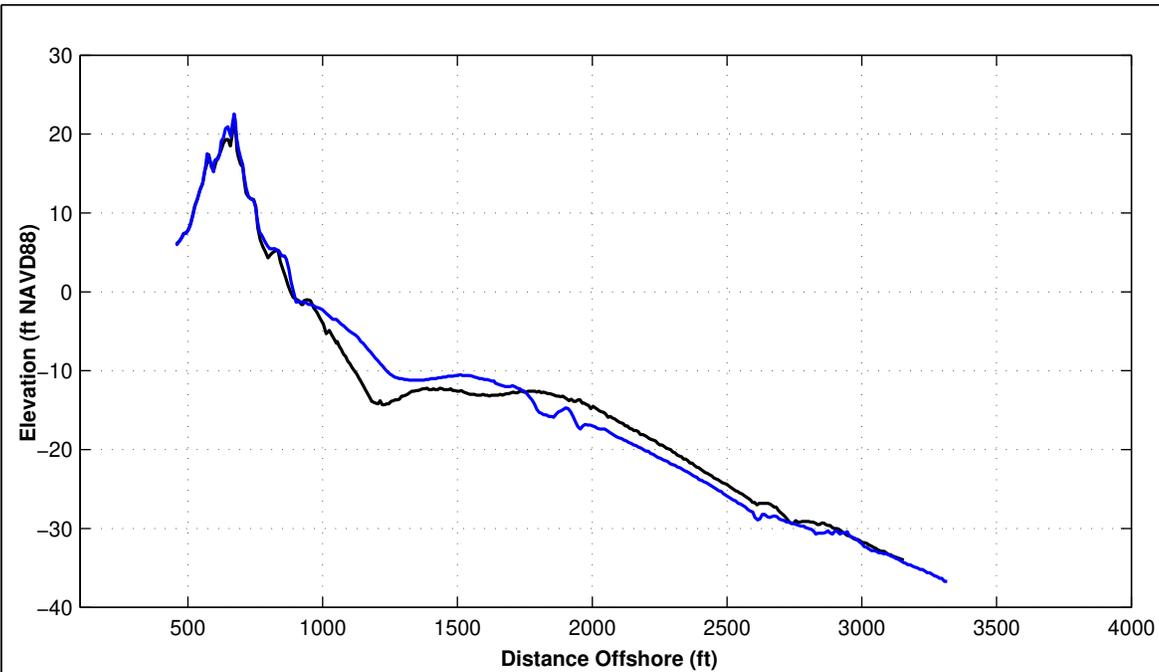


Survey Transect 940+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	9.07 ft	-3.78 ft
Volume Change Above +6 ft NAVD88	3.66 cy/ft	0.73 cy/ft
Volume Change Above 1.18 ft NAVD88	6.51 cy/ft	-3.95 cy/ft
Volume Change Above -6 ft NAVD88	17.87 cy/ft	-0.19 cy/ft
Volume Change Above -14 ft NAVD88	66.03 cy/ft	-8.04 cy/ft
Volume Change Above -19 ft NAVD88	39.71 cy/ft	-12.00 cy/ft
Volume Change Above -30 ft NAVD88	18.29 cy/ft	-16.31 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

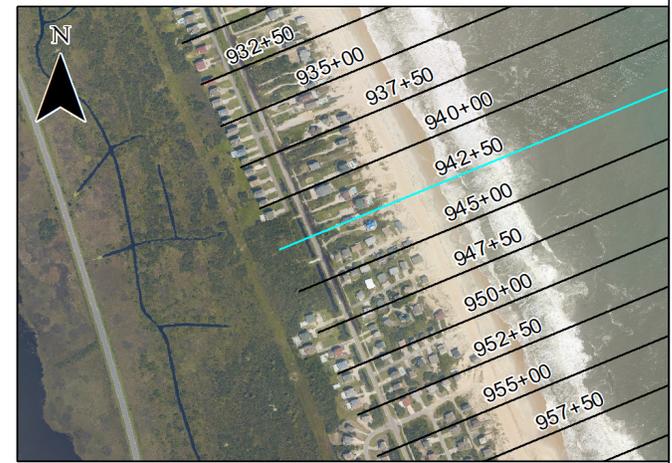


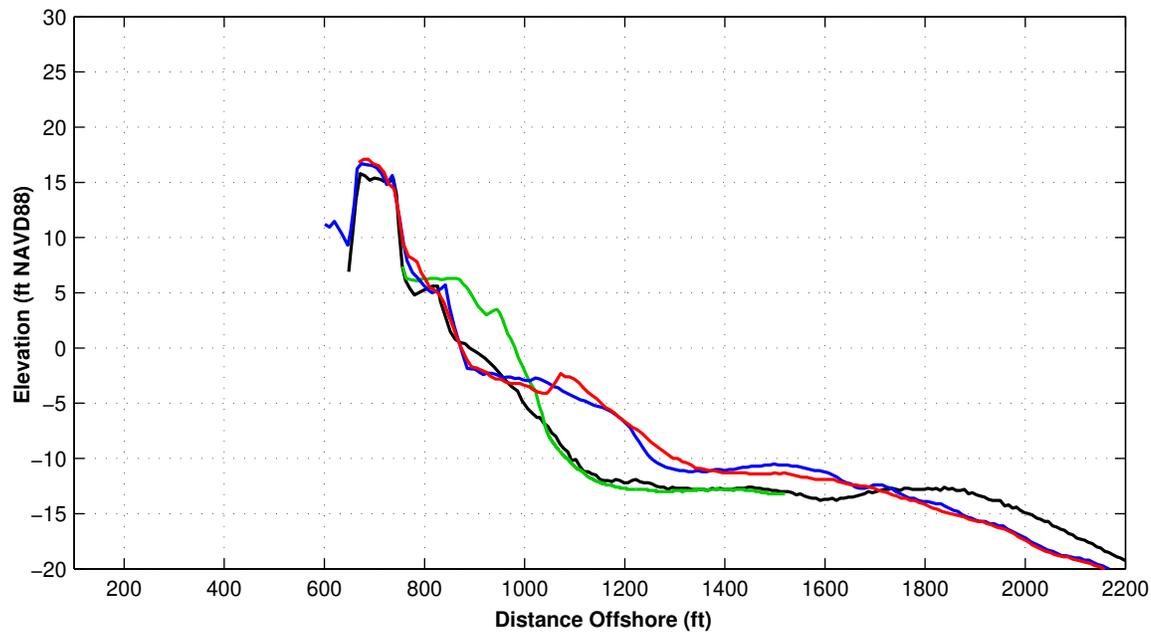
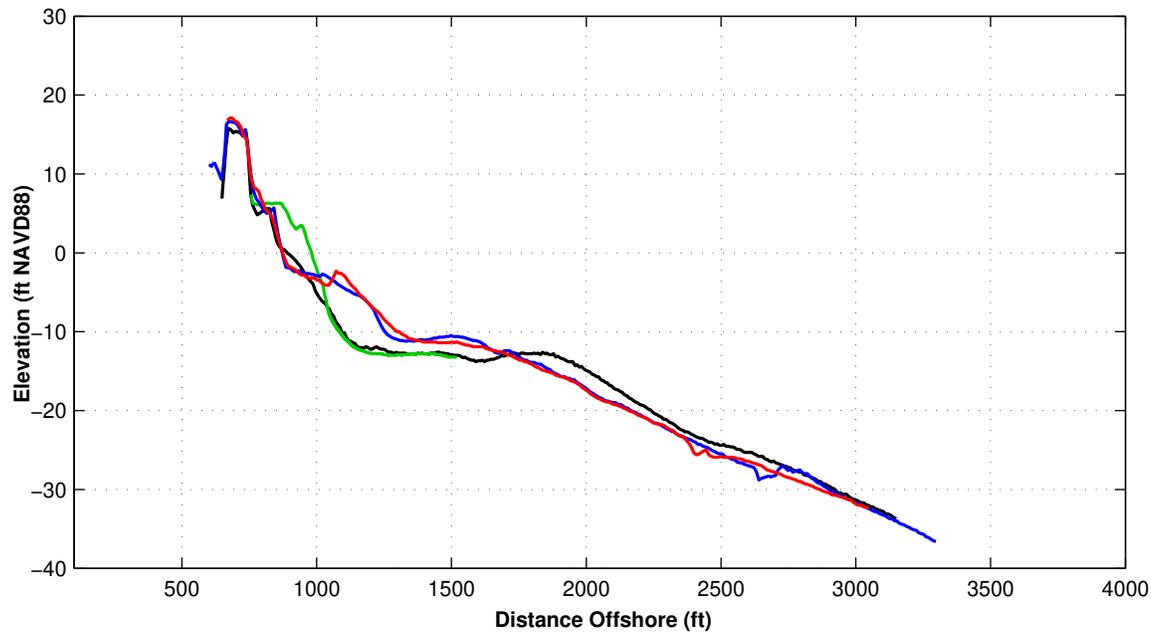


Survey Transect 942+50	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	15.15 ft	– ft
Volume Change Above +6 ft NAVD88	3.92 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	8.05 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	17.62 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	72.10 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	44.59 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	12.52 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

Notes:
 1. Station From North To South At Varying Intervals.
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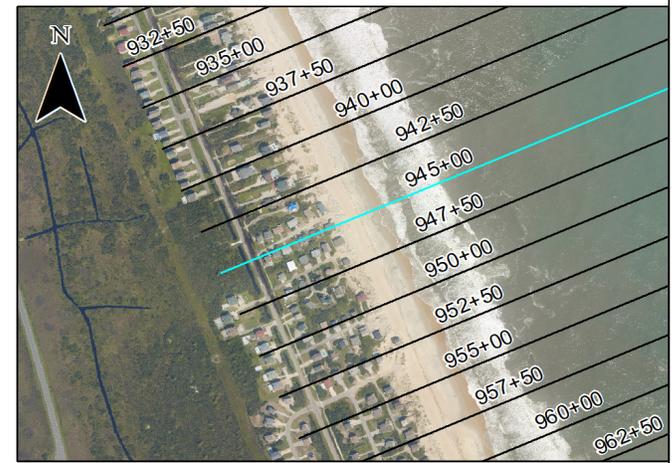


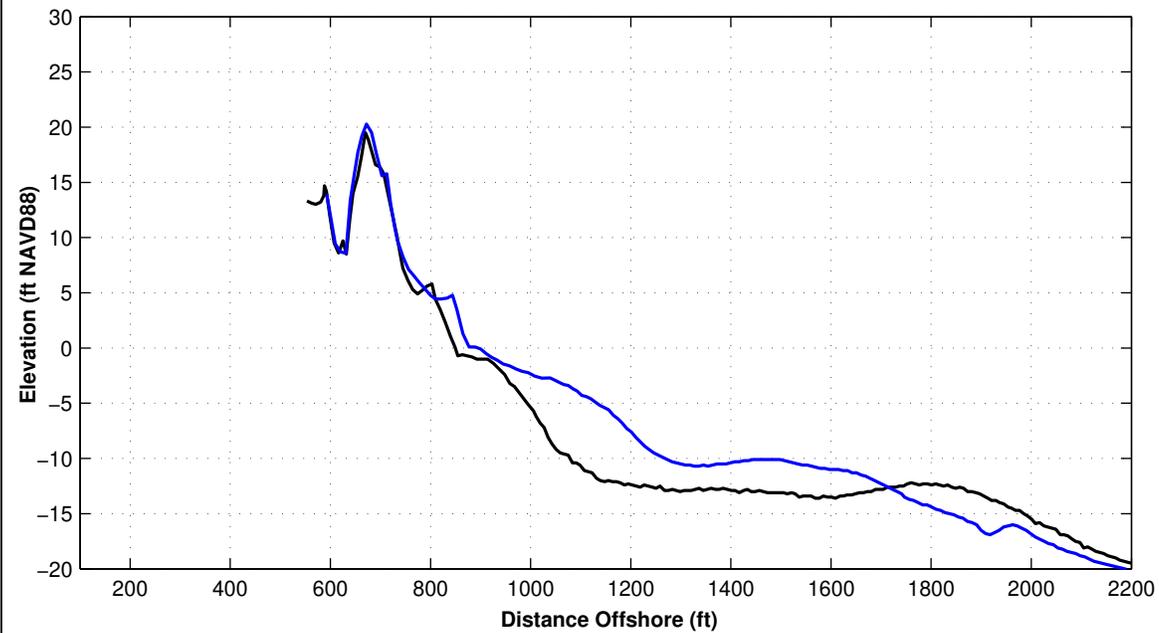
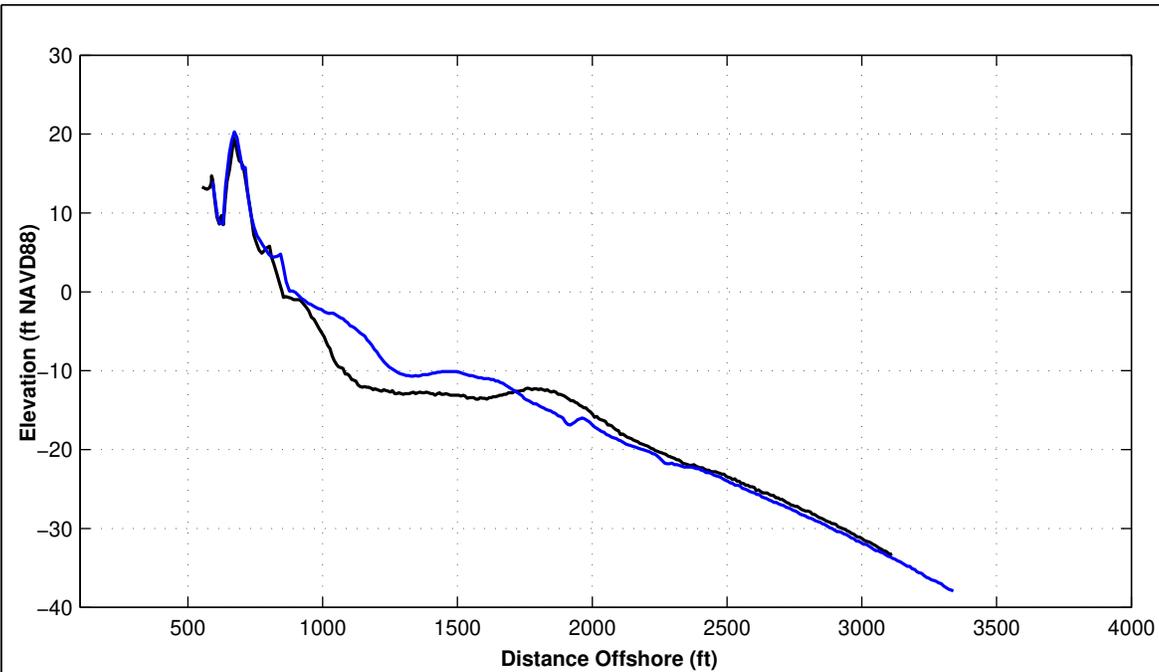


Survey Transect 945+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	8.81 ft	-1.89 ft
Volume Change Above +6 ft NAVD88	5.41 cy/ft	1.93 cy/ft
Volume Change Above 1.18 ft NAVD88	8.30 cy/ft	1.02 cy/ft
Volume Change Above -6 ft NAVD88	18.13 cy/ft	2.85 cy/ft
Volume Change Above -14 ft NAVD88	76.47 cy/ft	1.11 cy/ft
Volume Change Above -19 ft NAVD88	54.92 cy/ft	-1.36 cy/ft
Volume Change Above -30 ft NAVD88	26.12 cy/ft	-8.05 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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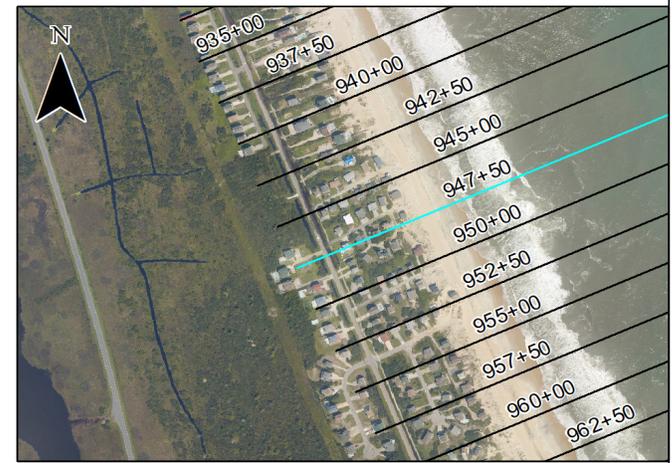


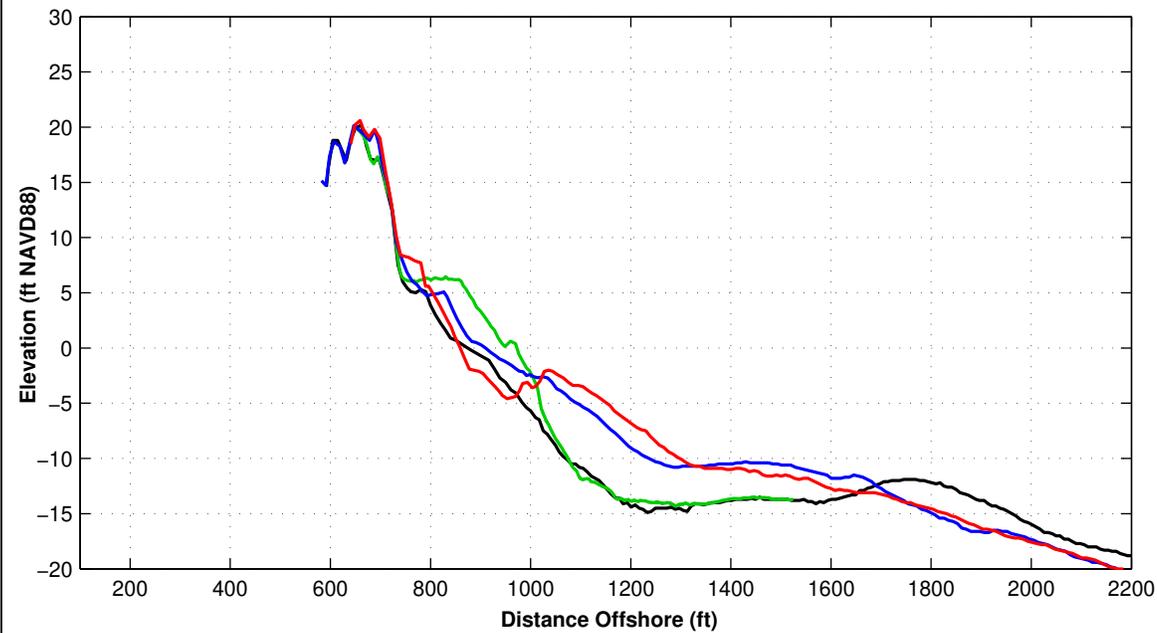
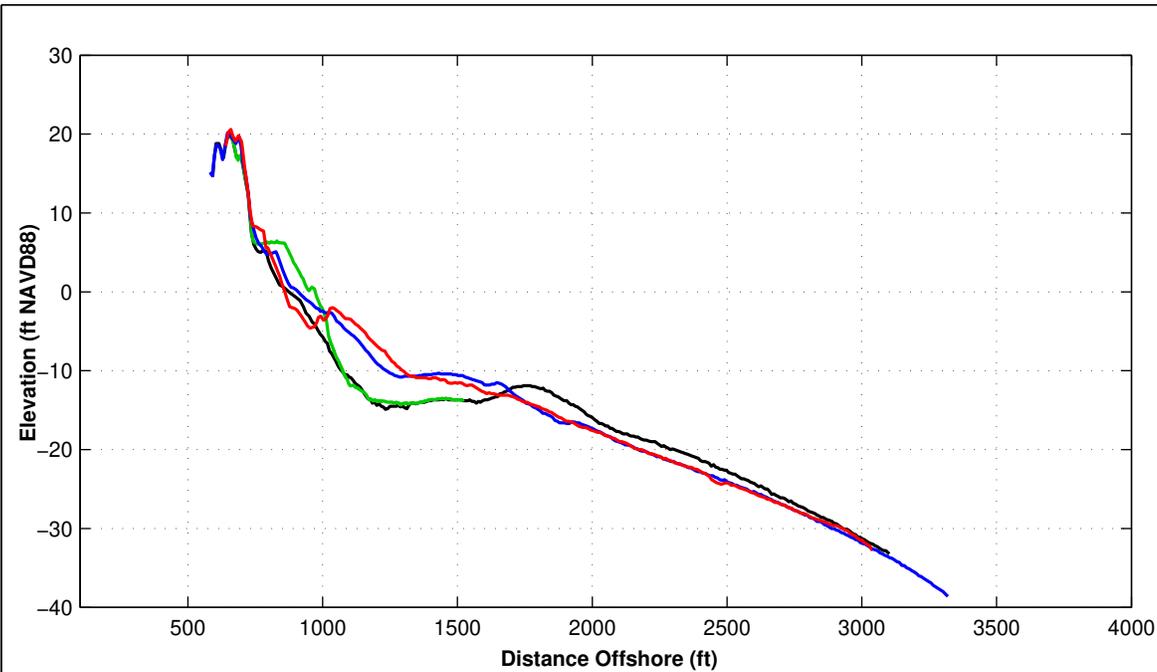


Survey Transect 947+50	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	27.06 ft	– ft
Volume Change Above +6 ft NAVD88	2.35 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	6.48 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	27.14 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	96.16 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	77.47 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	60.16 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

- Notes:
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 2. All Survey Elevations In Feet Referenced to NAVD88.

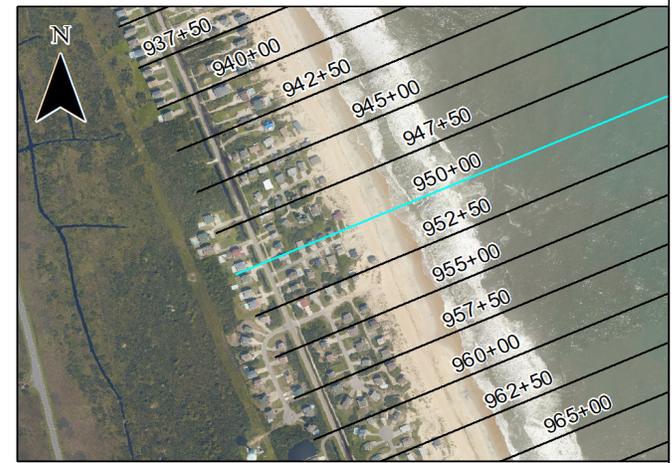


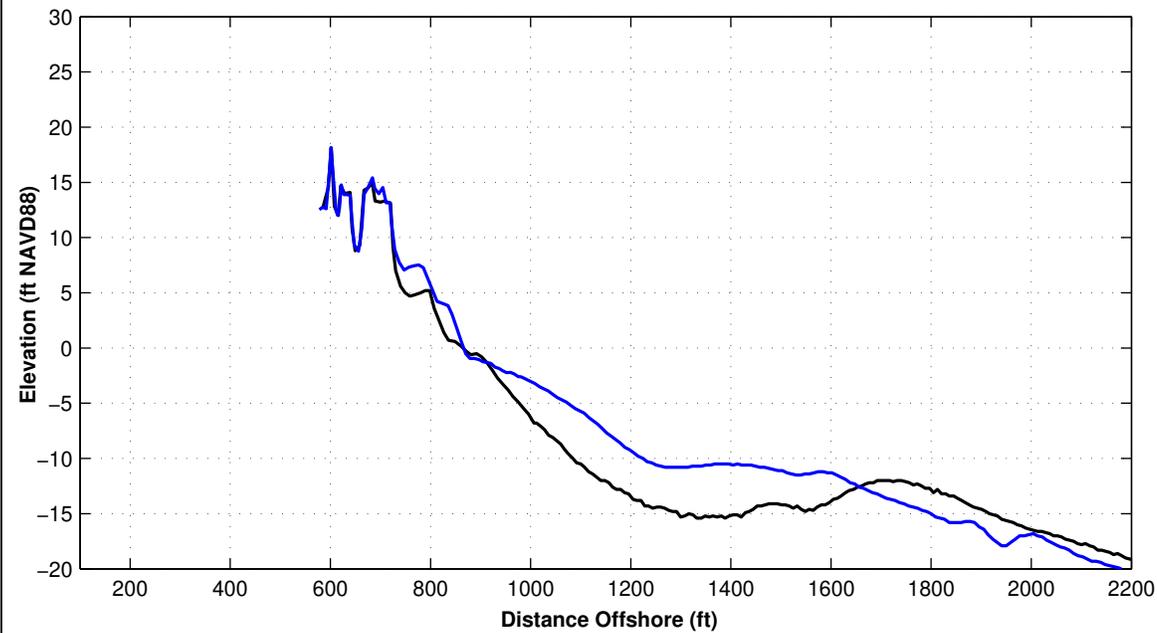
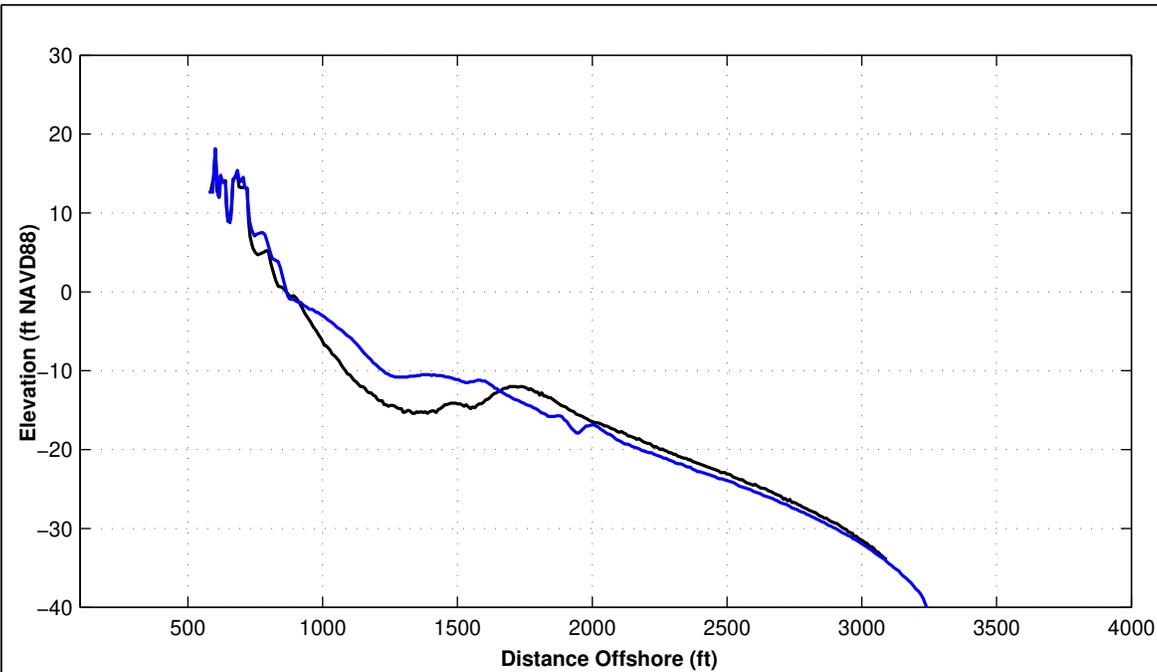


Survey Transect 950+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	35.24 ft	-23.94 ft
Volume Change Above +6 ft NAVD88	3.84 cy/ft	3.74 cy/ft
Volume Change Above 1.18 ft NAVD88	9.85 cy/ft	1.48 cy/ft
Volume Change Above -6 ft NAVD88	27.91 cy/ft	-4.77 cy/ft
Volume Change Above -14 ft NAVD88	101.52 cy/ft	-6.32 cy/ft
Volume Change Above -19 ft NAVD88	81.93 cy/ft	-4.64 cy/ft
Volume Change Above -30 ft NAVD88	48.33 cy/ft	-4.86 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

Notes:
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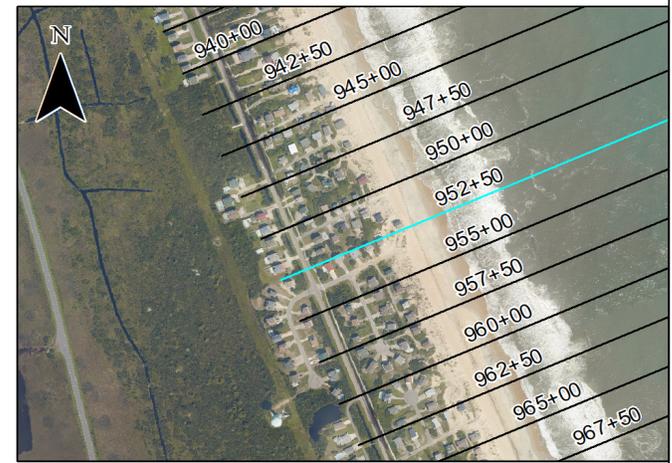


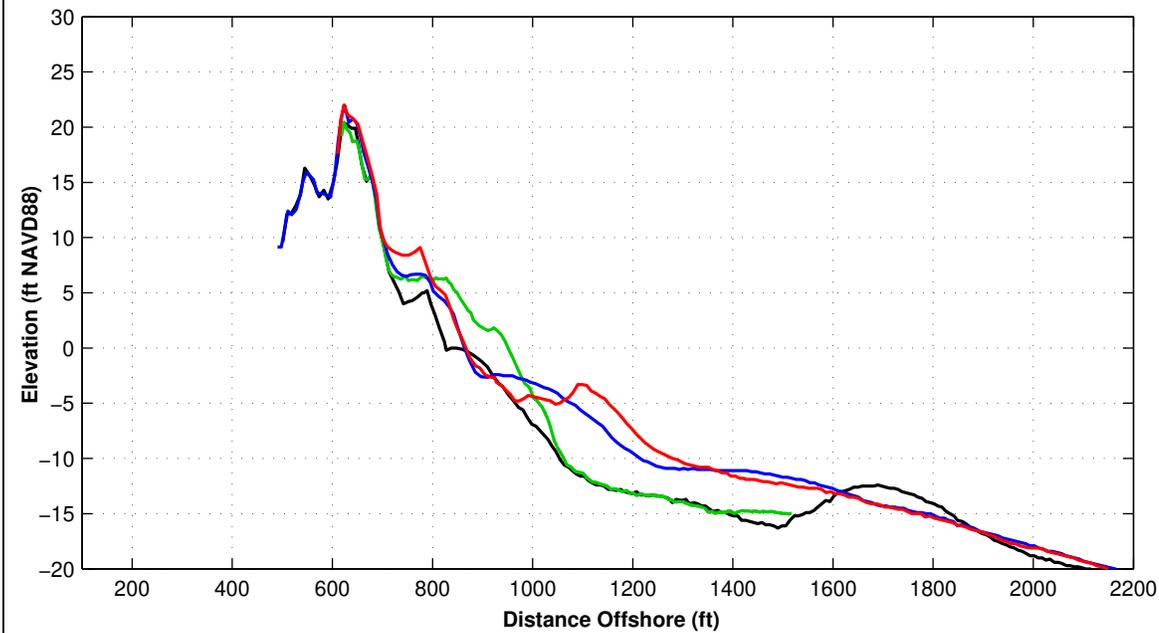
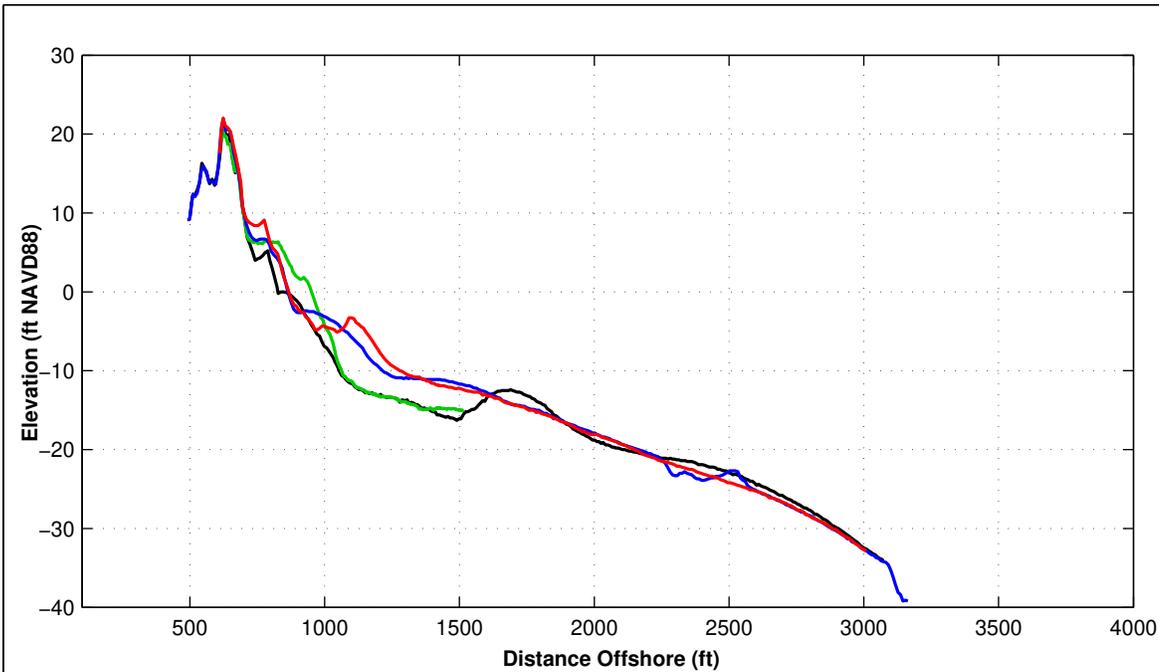


Survey Transect 952+50	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	27.36 ft	– ft
Volume Change Above +6 ft NAVD88	4.41 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	10.10 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	21.76 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	88.84 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	80.48 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	56.13 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.



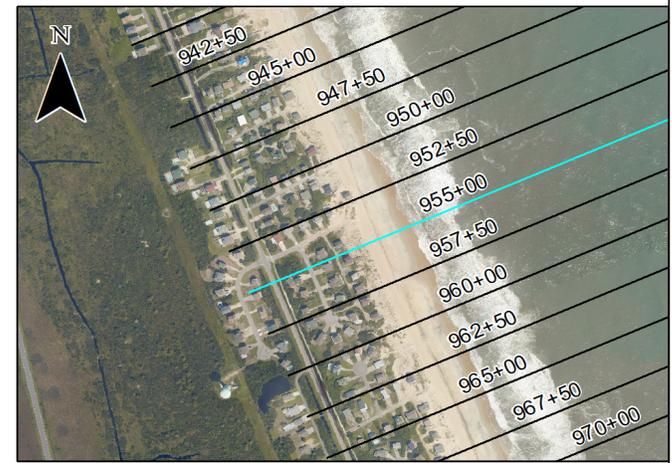


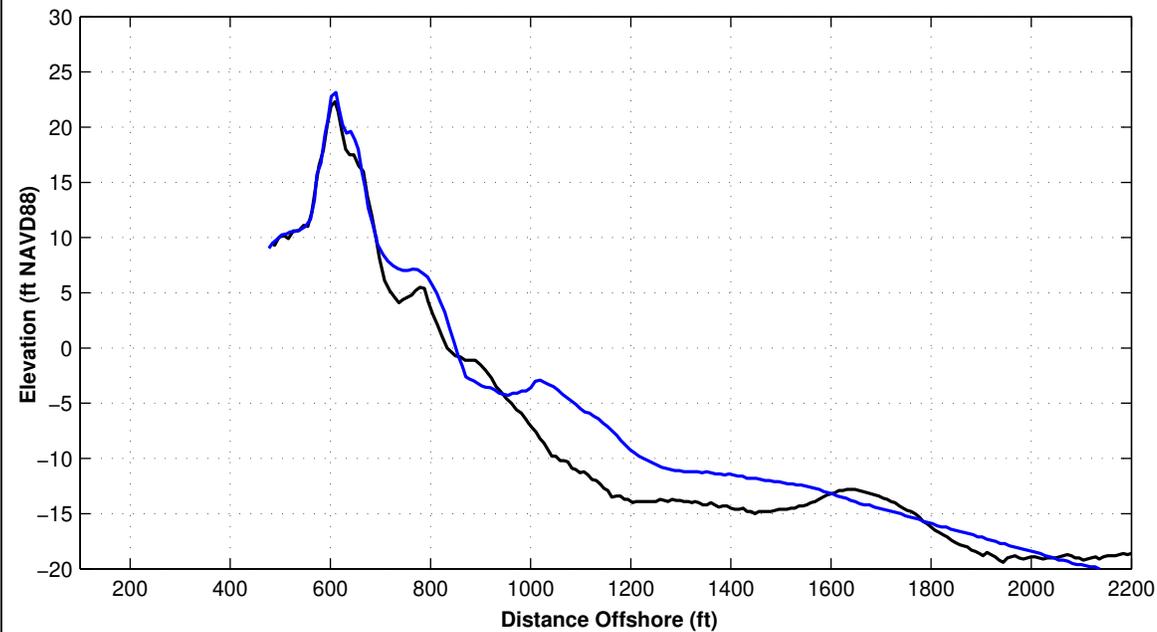
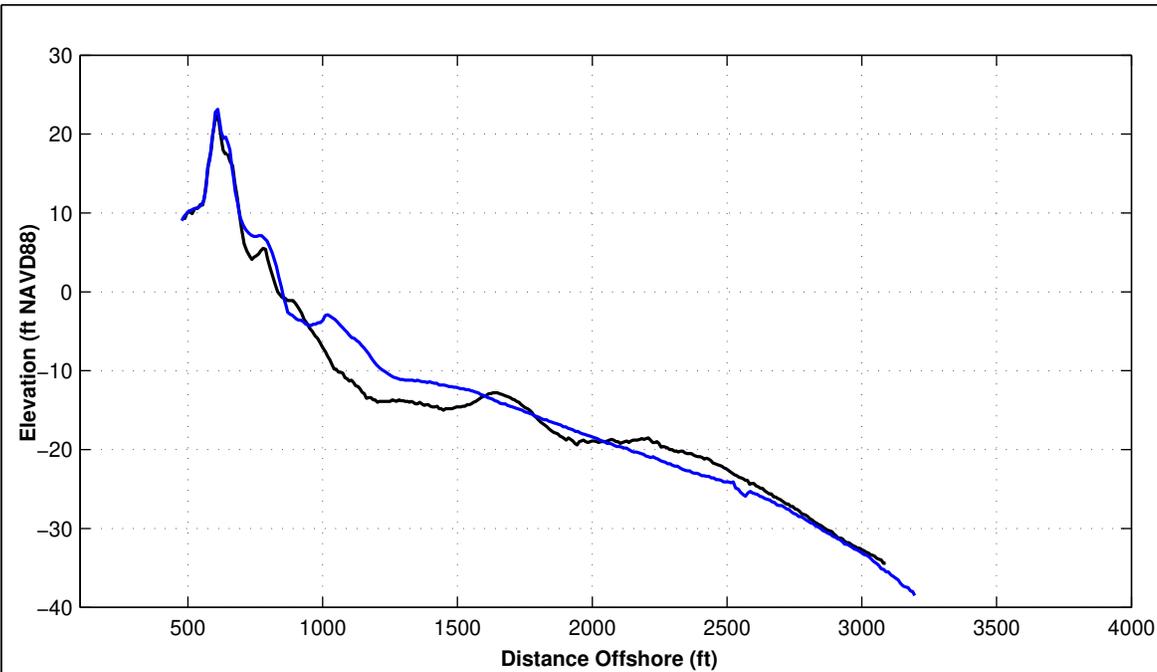
Survey Transect 955+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	36.11 ft	0.76 ft
Volume Change Above +6 ft NAVD88	5.74 cy/ft	6.23 cy/ft
Volume Change Above 1.18 ft NAVD88	13.98 cy/ft	6.92 cy/ft
Volume Change Above -6 ft NAVD88	25.82 cy/ft	6.97 cy/ft
Volume Change Above -14 ft NAVD88	89.84 cy/ft	12.71 cy/ft
Volume Change Above -19 ft NAVD88	100.96 cy/ft	10.79 cy/ft
Volume Change Above -30 ft NAVD88	82.58 cy/ft	9.99 cy/ft

LEGEND:

OCTOBER 2023	—	POST-DORIAN AD	—
JUNE 2023	—	JUNE 2022	—

- Notes:
1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

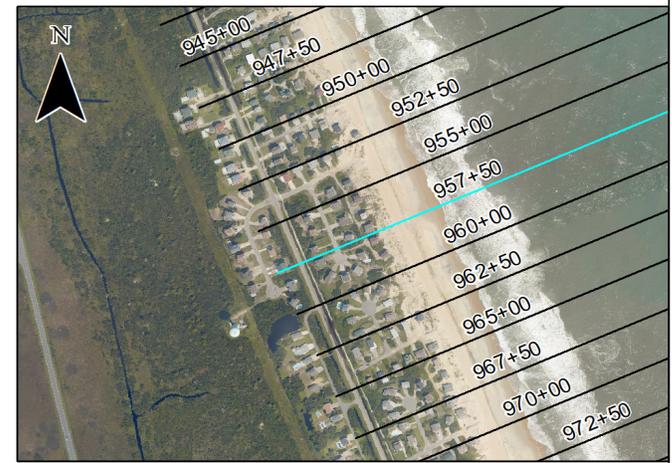


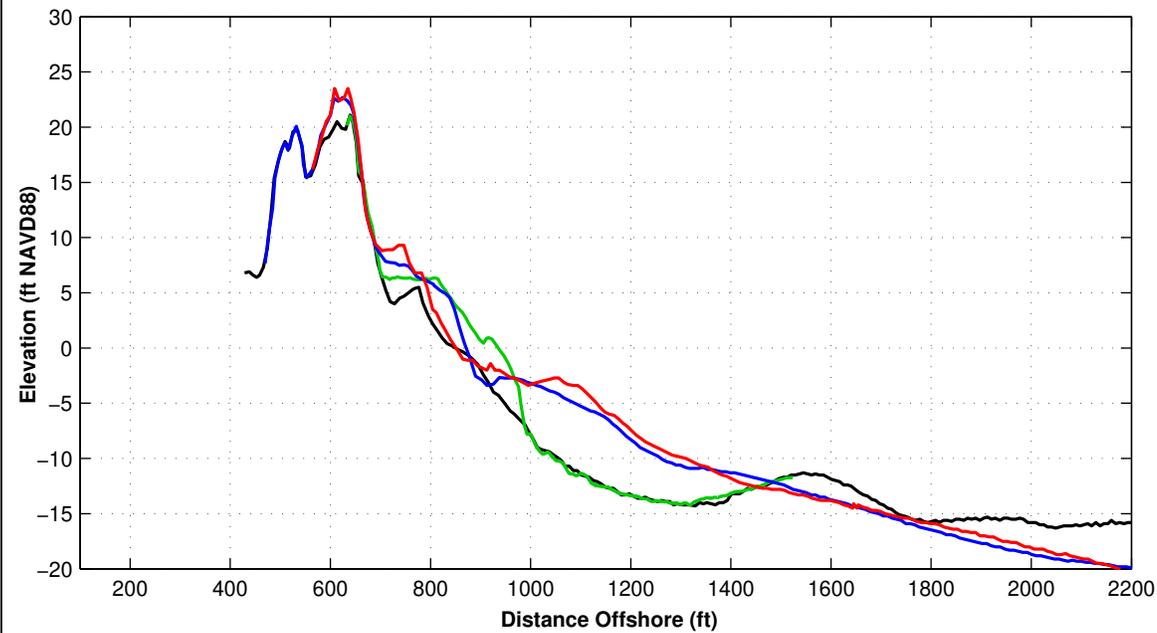
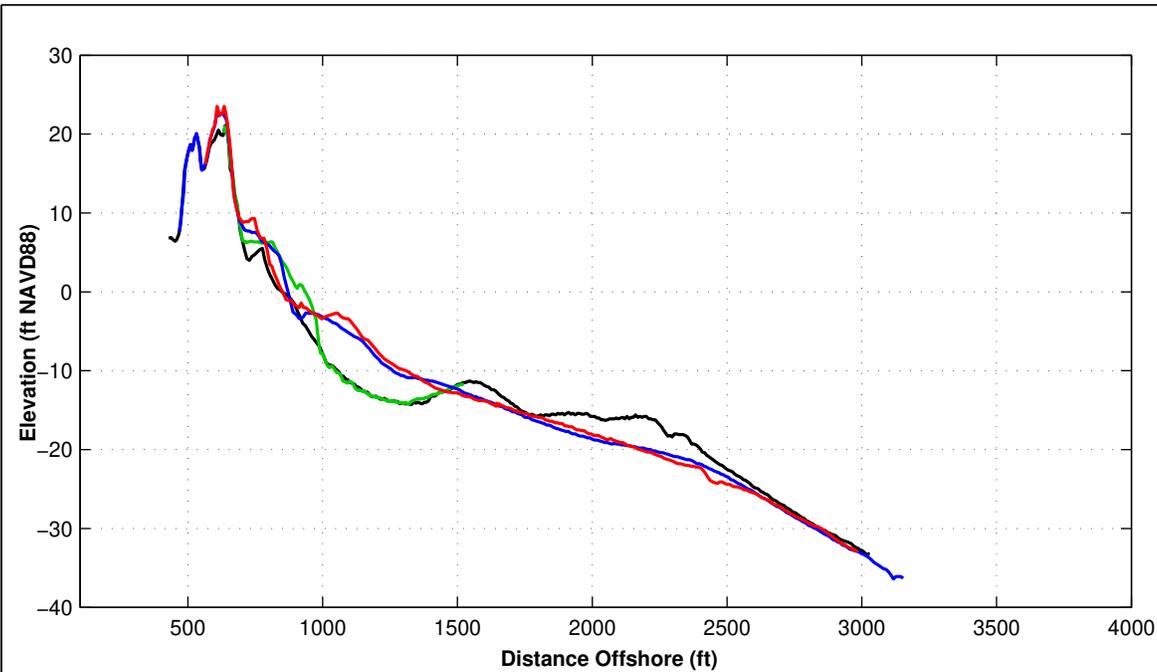


Survey Transect 957+50	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	20.37 ft	– ft
Volume Change Above +6 ft NAVD88	6.86 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	13.98 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	22.02 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	88.03 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	97.32 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	57.97 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

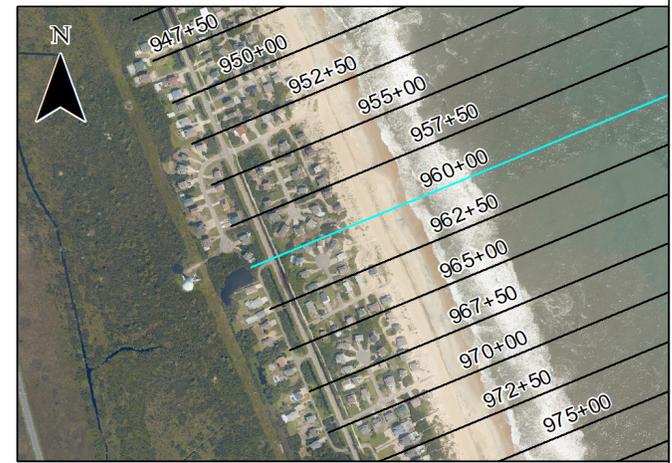


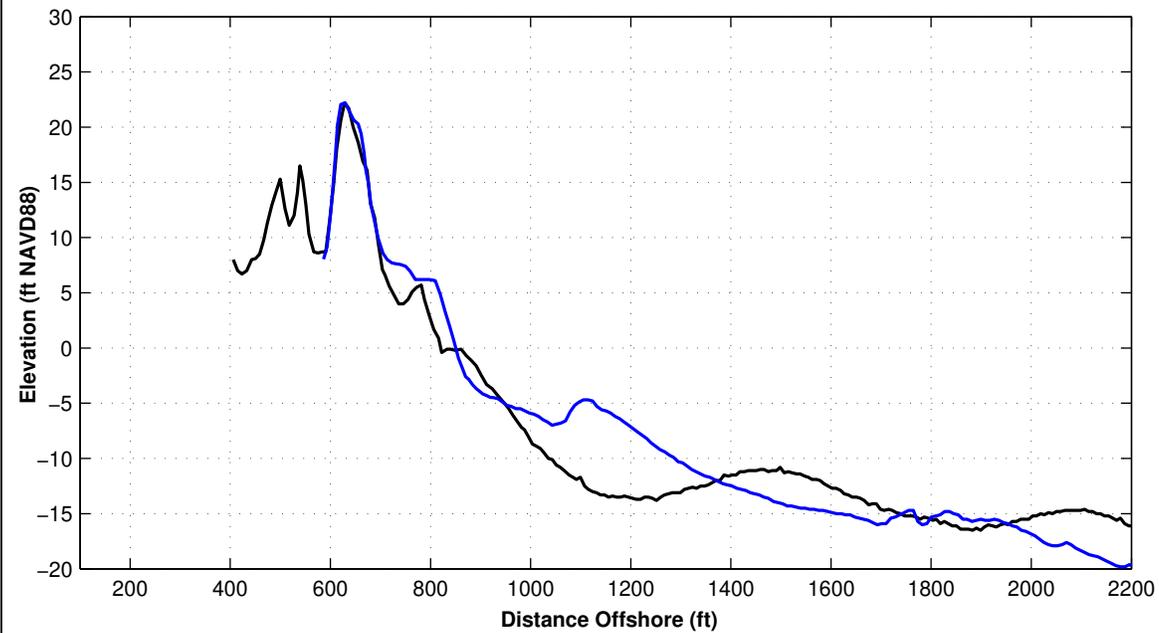
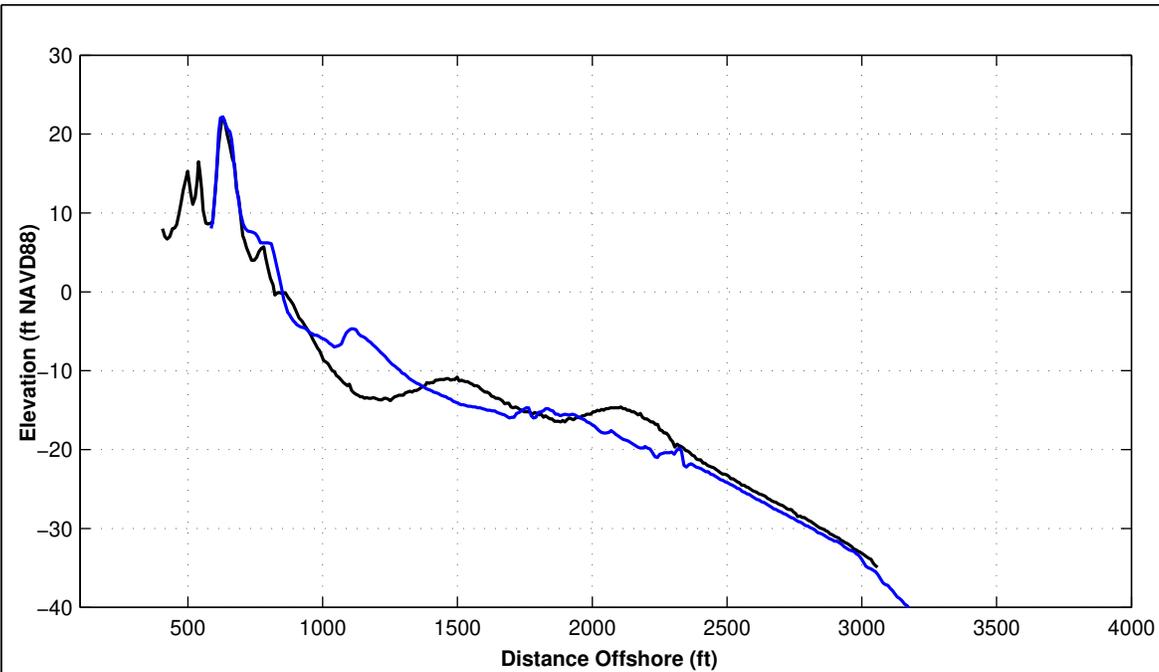


Survey Transect 960+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	43.26 ft	-27.87 ft
Volume Change Above +6 ft NAVD88	9.87 cy/ft	4.08 cy/ft
Volume Change Above 1.18 ft NAVD88	21.82 cy/ft	-1.78 cy/ft
Volume Change Above -6 ft NAVD88	37.04 cy/ft	5.01 cy/ft
Volume Change Above -14 ft NAVD88	93.40 cy/ft	6.22 cy/ft
Volume Change Above -19 ft NAVD88	43.34 cy/ft	14.19 cy/ft
Volume Change Above -30 ft NAVD88	14.81 cy/ft	5.46 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

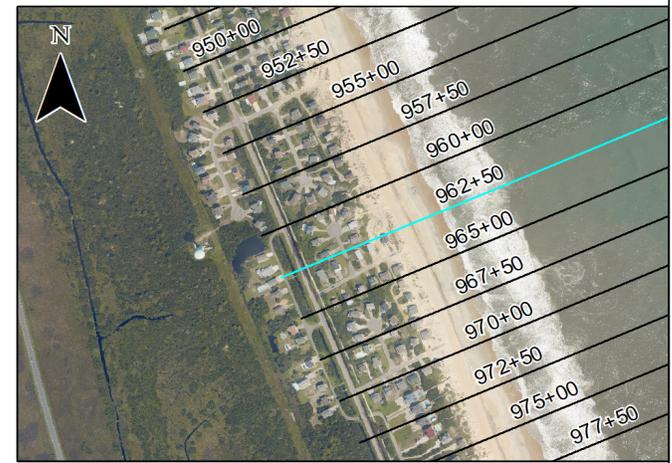


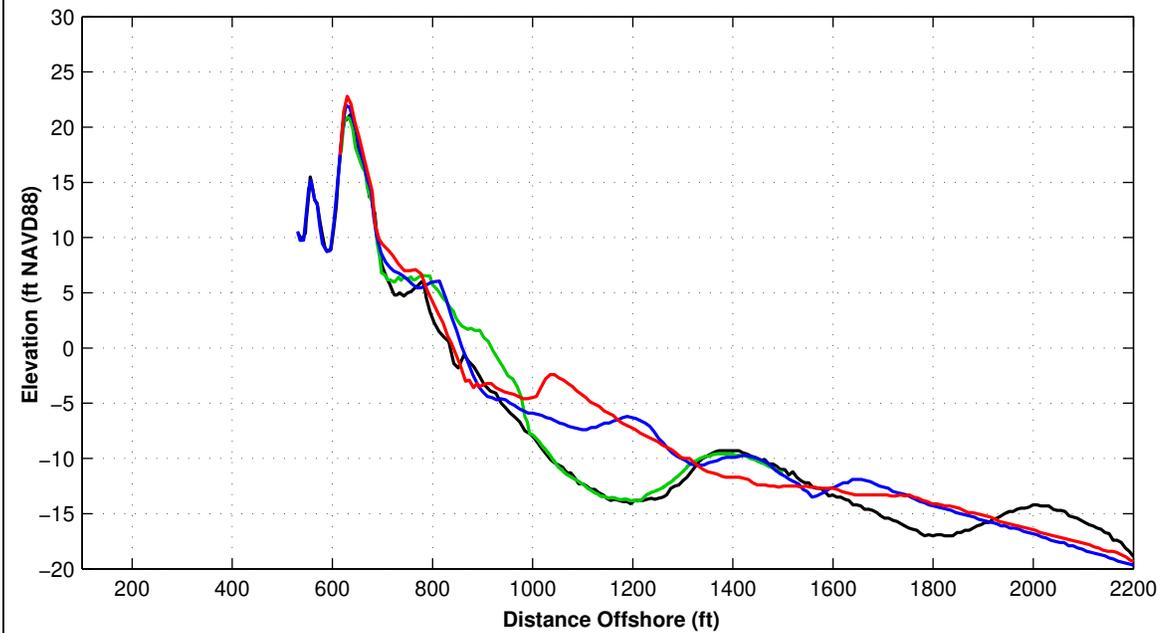
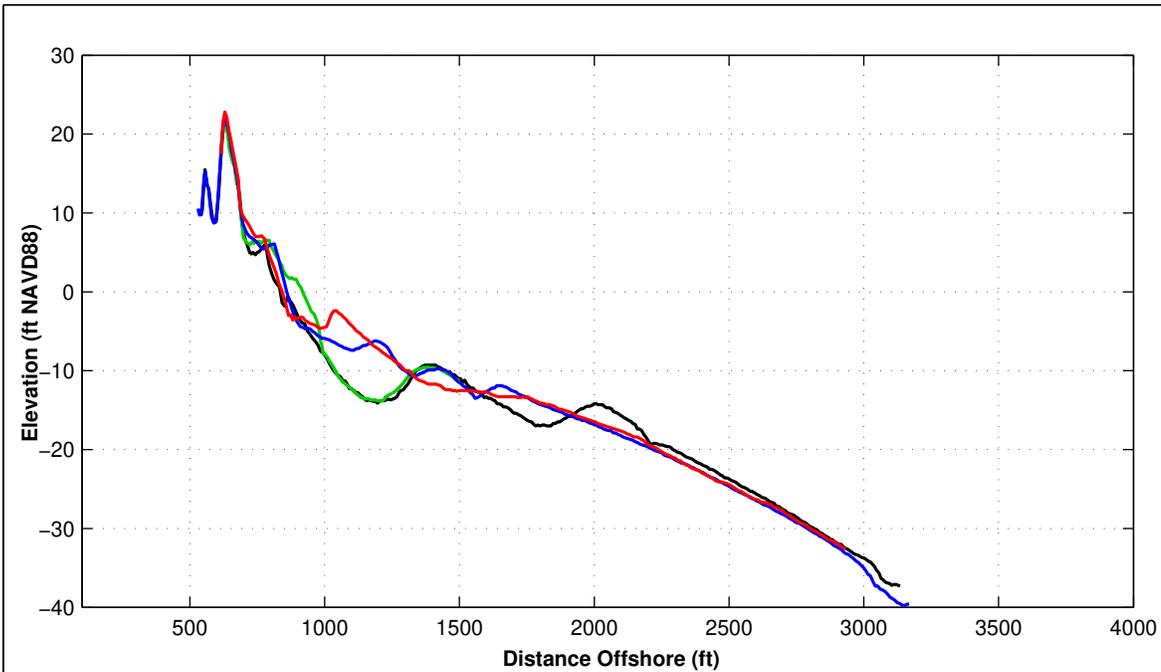


Survey Transect 962+50	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	30.71 ft	– ft
Volume Change Above +6 ft NAVD88	5.28 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	14.16 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	14.48 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	58.30 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	23.15 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	–1.30 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

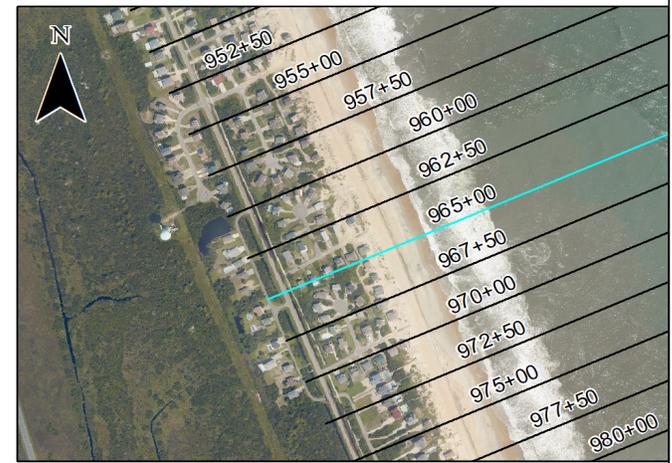


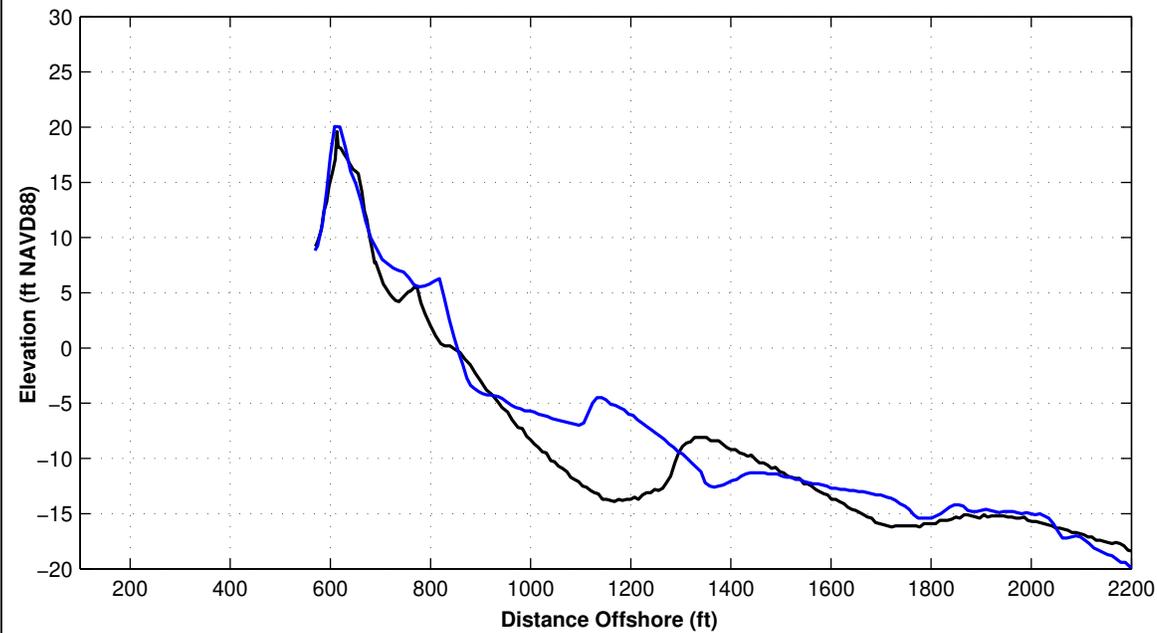
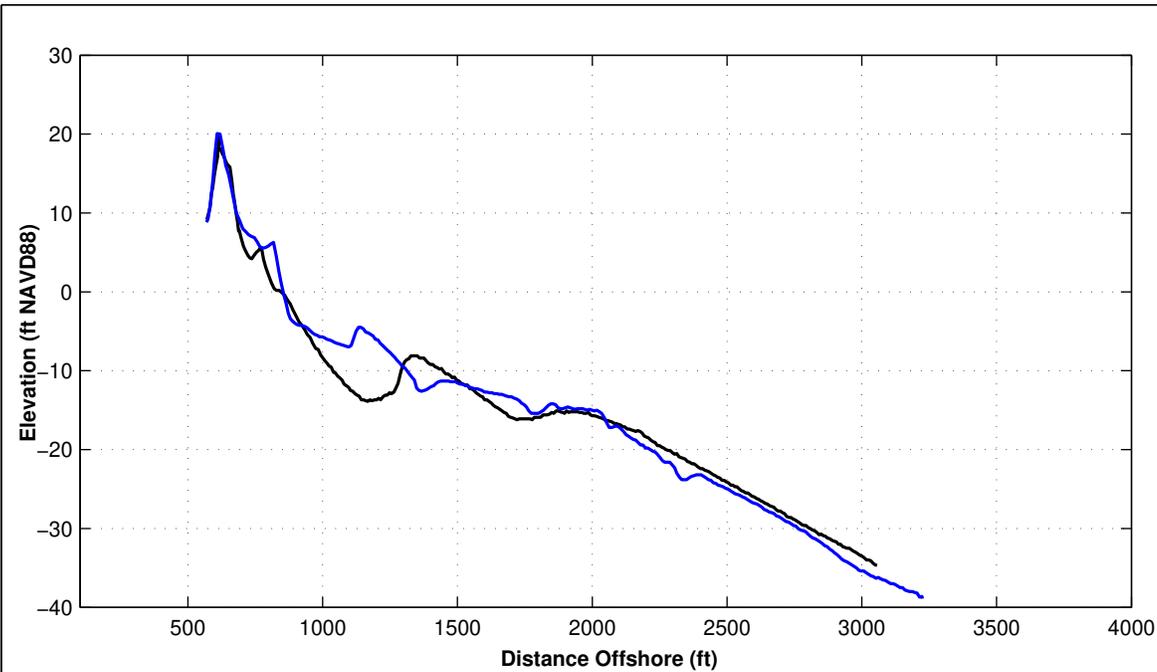


Survey Transect 965+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	31.77 ft	-21.35 ft
Volume Change Above +6 ft NAVD88	3.41 cy/ft	4.72 cy/ft
Volume Change Above 1.18 ft NAVD88	11.53 cy/ft	0.58 cy/ft
Volume Change Above -6 ft NAVD88	13.46 cy/ft	13.12 cy/ft
Volume Change Above -14 ft NAVD88	77.89 cy/ft	2.13 cy/ft
Volume Change Above -19 ft NAVD88	72.31 cy/ft	8.12 cy/ft
Volume Change Above -30 ft NAVD88	52.33 cy/ft	12.26 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

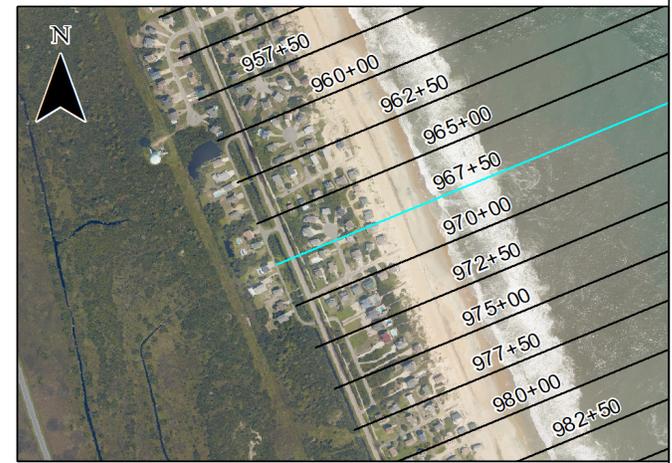


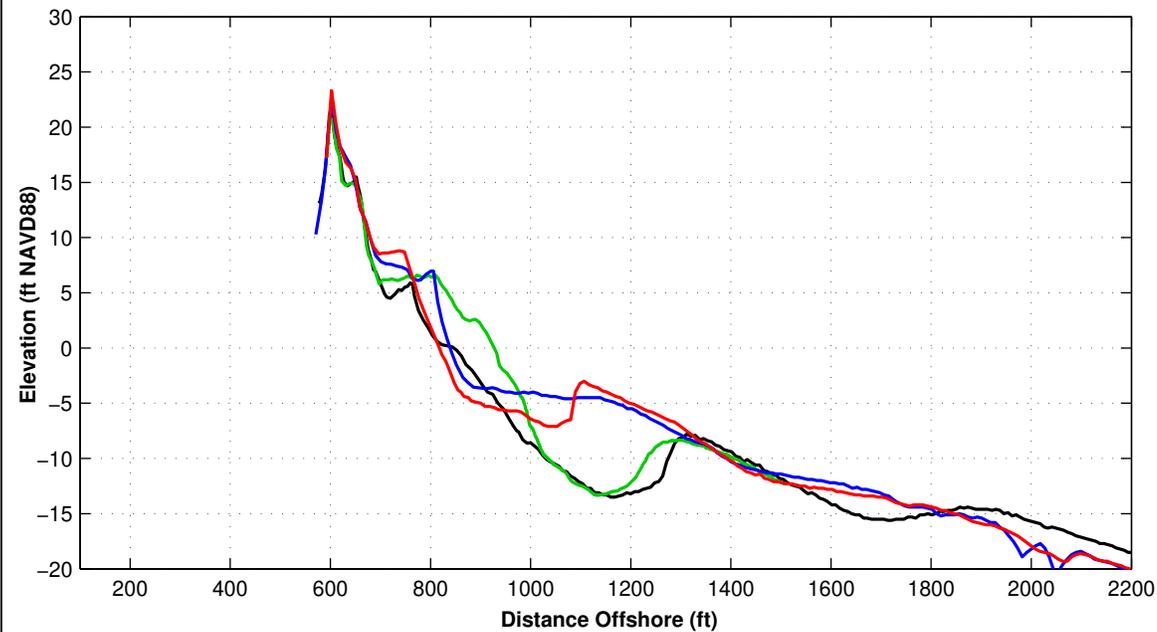
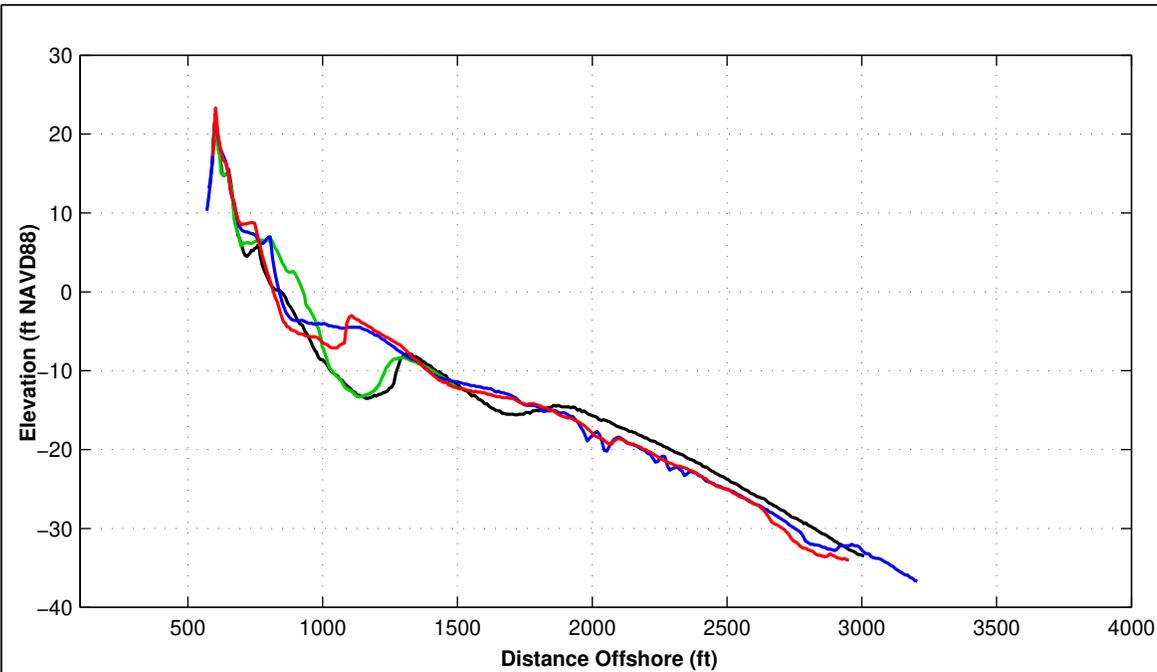


Survey Transect 967+50	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	36.42 ft	– ft
Volume Change Above +6 ft NAVD88	3.43 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	13.80 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	17.01 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	66.83 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	76.19 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	51.73 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 —— POST-DORIAN AD ——
 JUNE 2023 —— JUNE 2022 ——

Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.



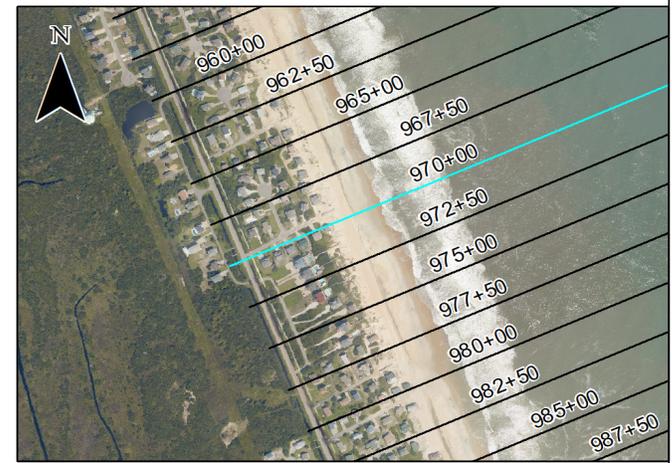


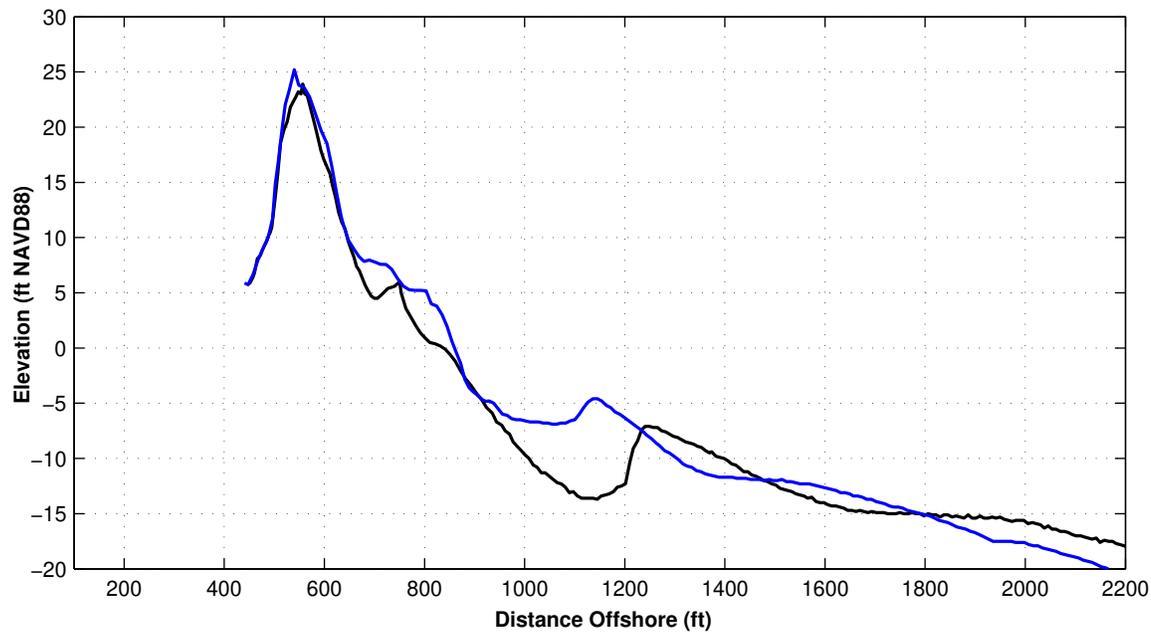
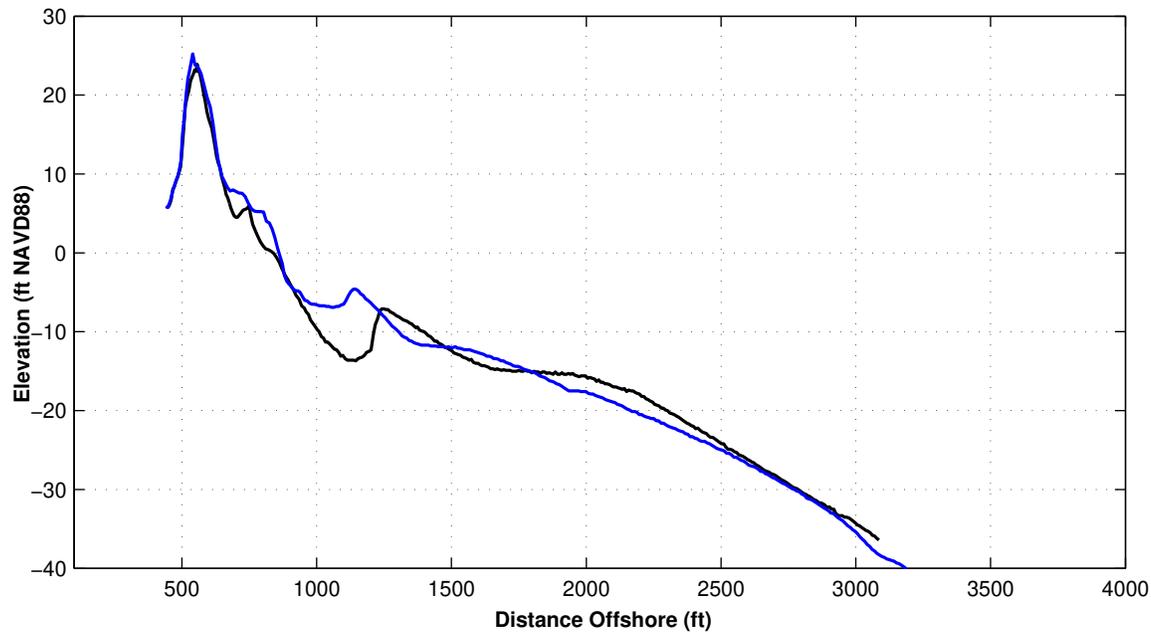
Survey Transect 970+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	27.33 ft	-23.92 ft
Volume Change Above +6 ft NAVD88	7.68 cy/ft	2.04 cy/ft
Volume Change Above 1.18 ft NAVD88	16.77 cy/ft	-3.80 cy/ft
Volume Change Above -6 ft NAVD88	30.27 cy/ft	-16.57 cy/ft
Volume Change Above -14 ft NAVD88	100.43 cy/ft	-23.09 cy/ft
Volume Change Above -19 ft NAVD88	86.85 cy/ft	-21.94 cy/ft
Volume Change Above -30 ft NAVD88	52.18 cy/ft	-22.23 cy/ft

LEGEND:

OCTOBER 2023		POST-DORIAN AD	
JUNE 2023		JUNE 2022	

- Notes:
1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.





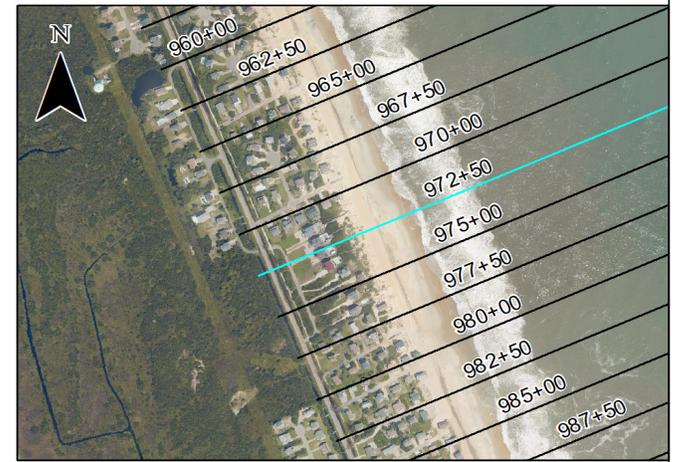
Survey Transect 972+50	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	54.91 ft	– ft
Volume Change Above +6 ft NAVD88	10.14 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	21.41 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	27.15 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	73.03 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	53.02 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	28.66 cy/ft	– cy/ft

LEGEND:

OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.

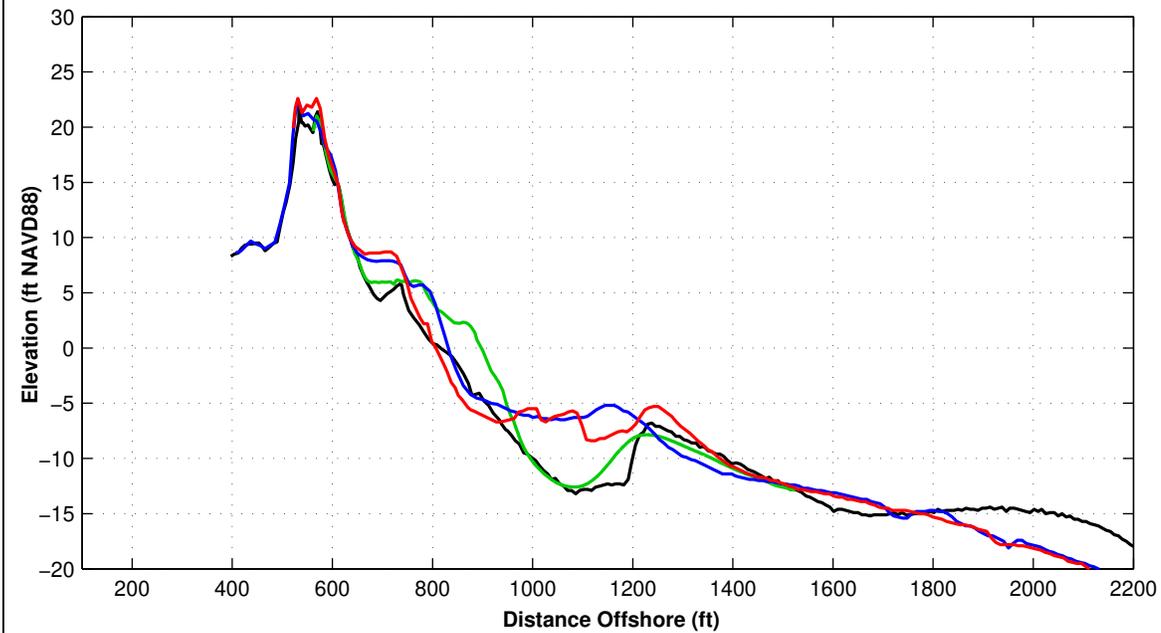
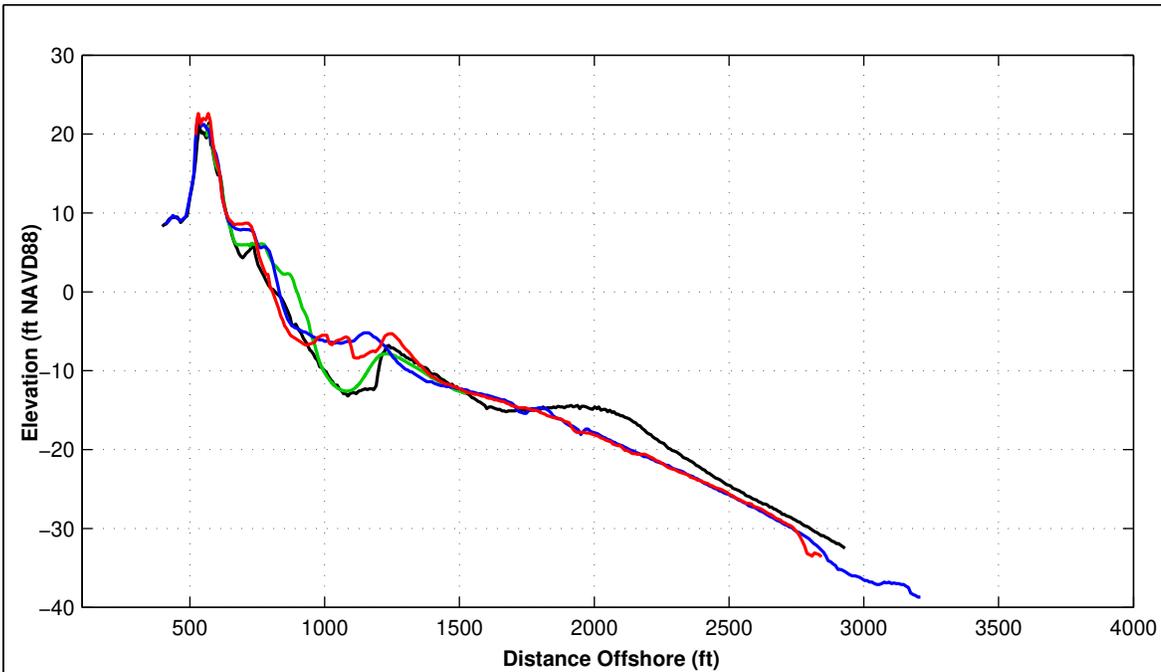


Town of Nags Head Periodic Surveying Data Analysis

ST 972+50

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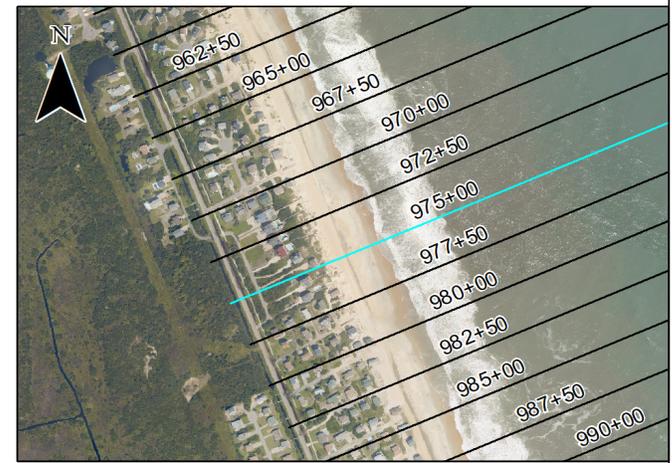


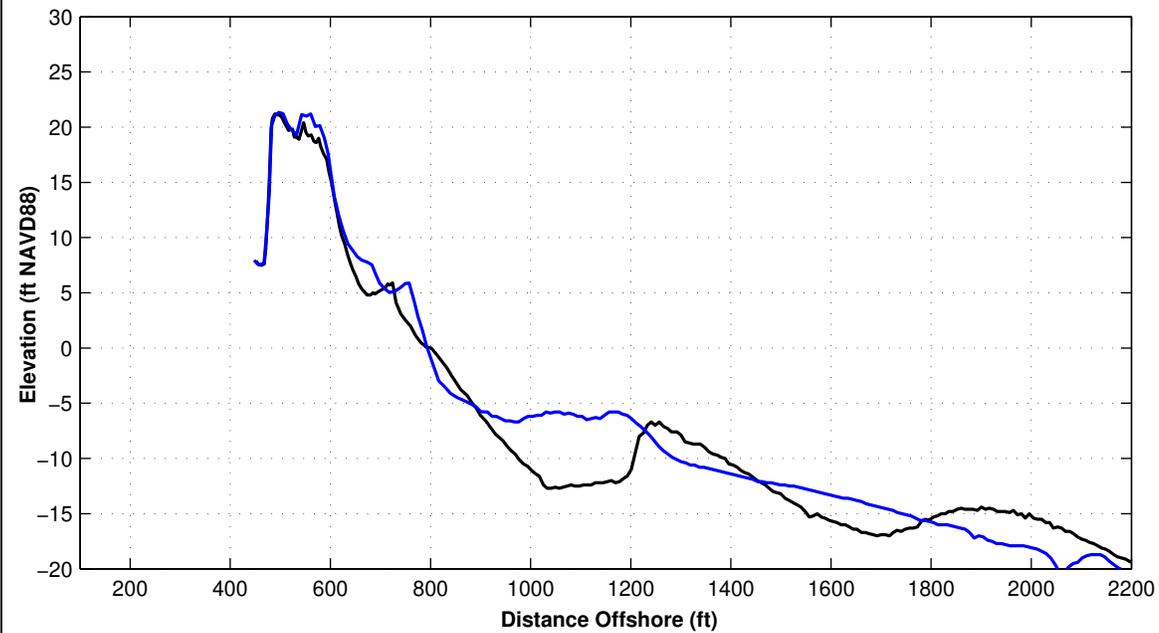
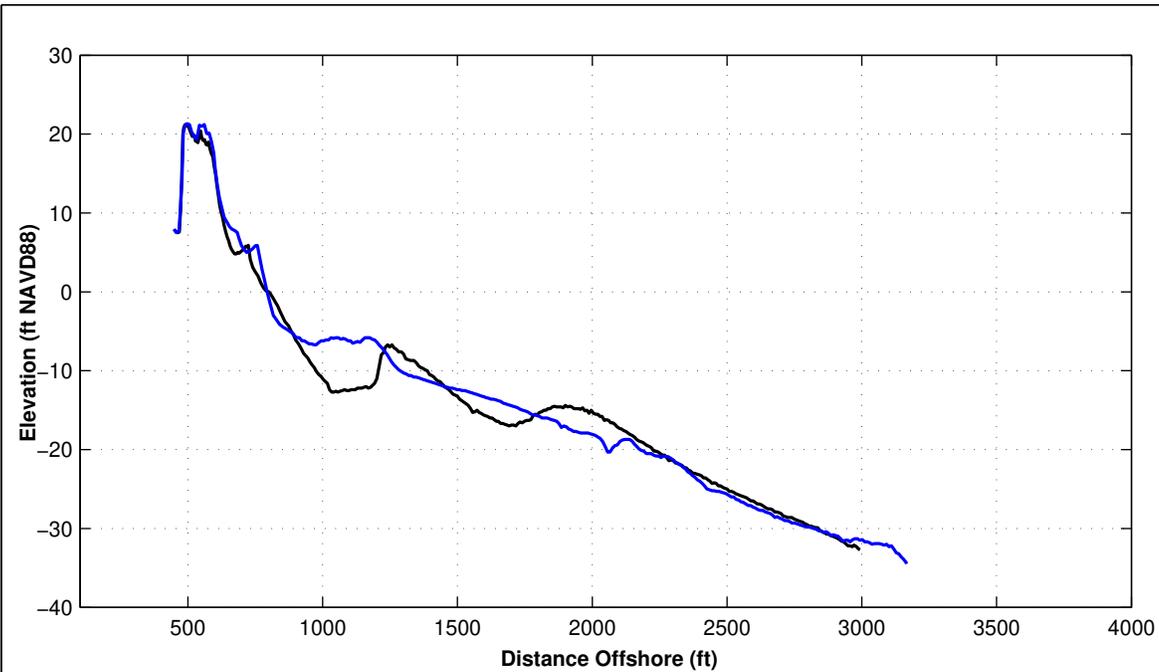
Survey Transect 975+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	37.48 ft	-28.75 ft
Volume Change Above +6 ft NAVD88	8.15 cy/ft	3.68 cy/ft
Volume Change Above 1.18 ft NAVD88	19.13 cy/ft	-2.59 cy/ft
Volume Change Above -6 ft NAVD88	22.00 cy/ft	-10.68 cy/ft
Volume Change Above -14 ft NAVD88	66.76 cy/ft	-5.77 cy/ft
Volume Change Above -19 ft NAVD88	33.74 cy/ft	-7.74 cy/ft
Volume Change Above -30 ft NAVD88	-4.02 cy/ft	-6.53 cy/ft

LEGEND:

OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
1. Station From North To South At Varying Intervals.
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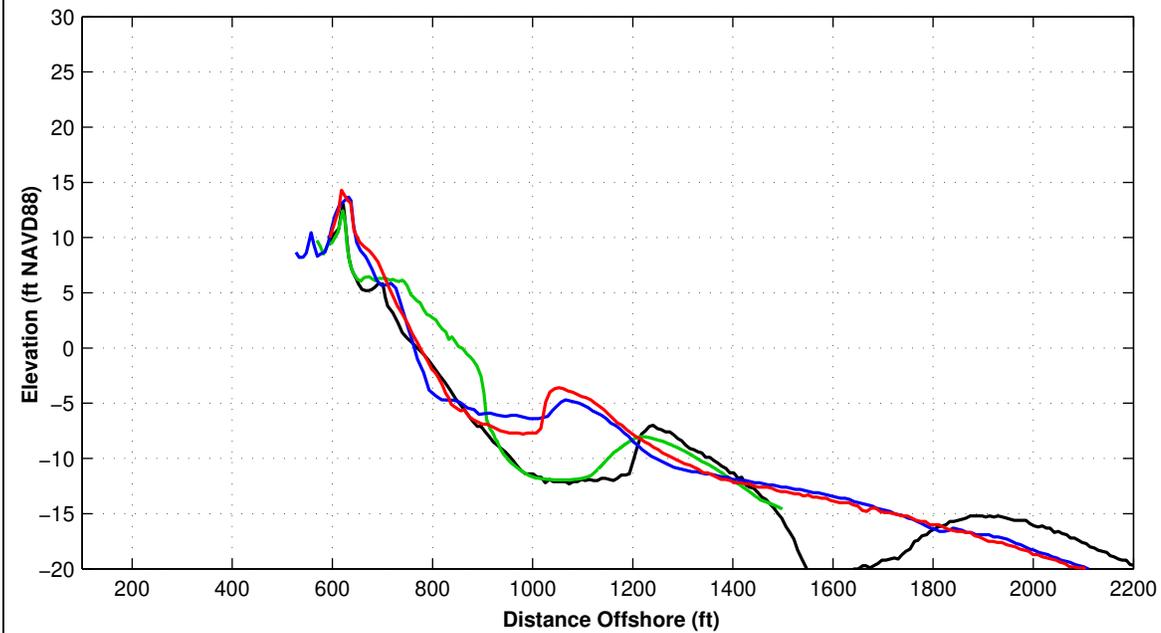
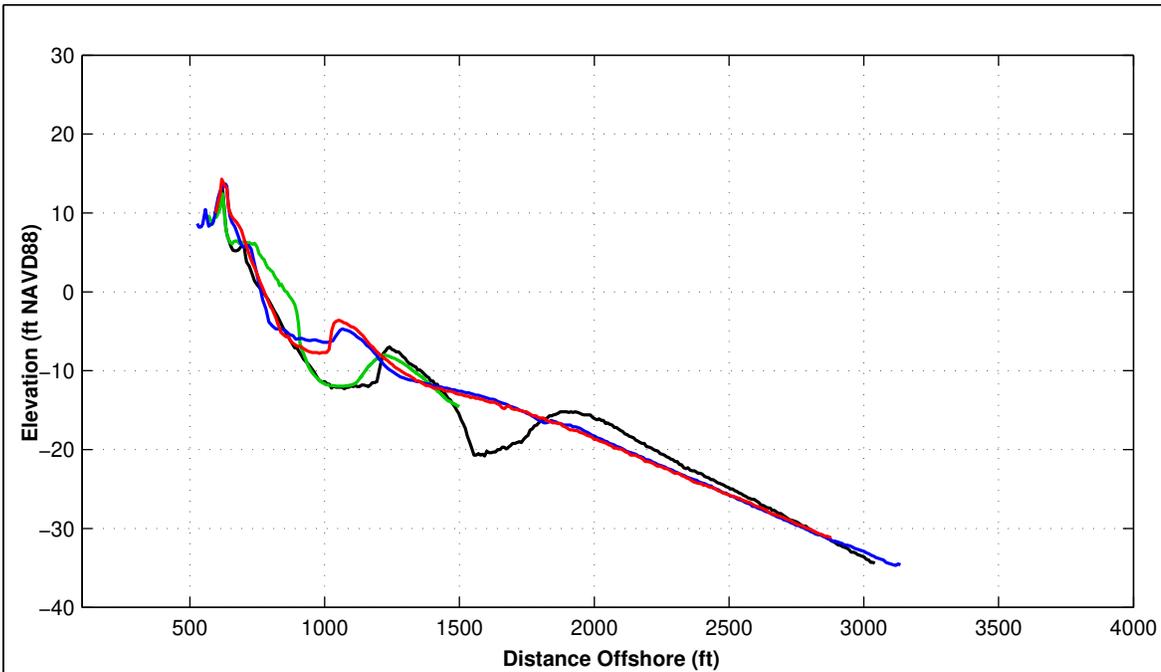


Survey Transect 977+50	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	16.55 ft	– ft
Volume Change Above +6 ft NAVD88	8.28 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	14.35 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	11.14 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	60.65 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	48.21 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	32.73 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

Notes:
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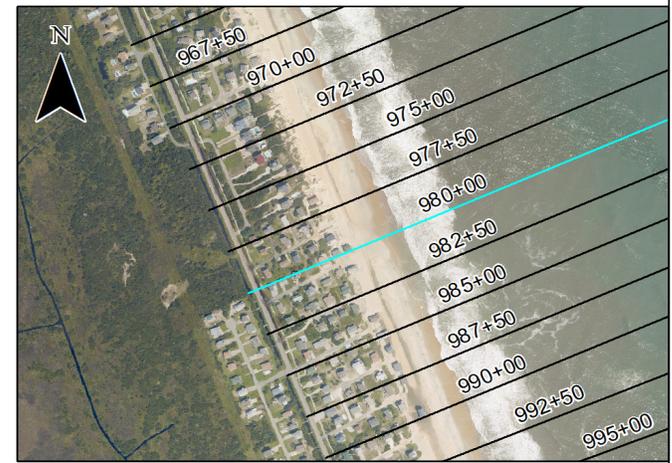


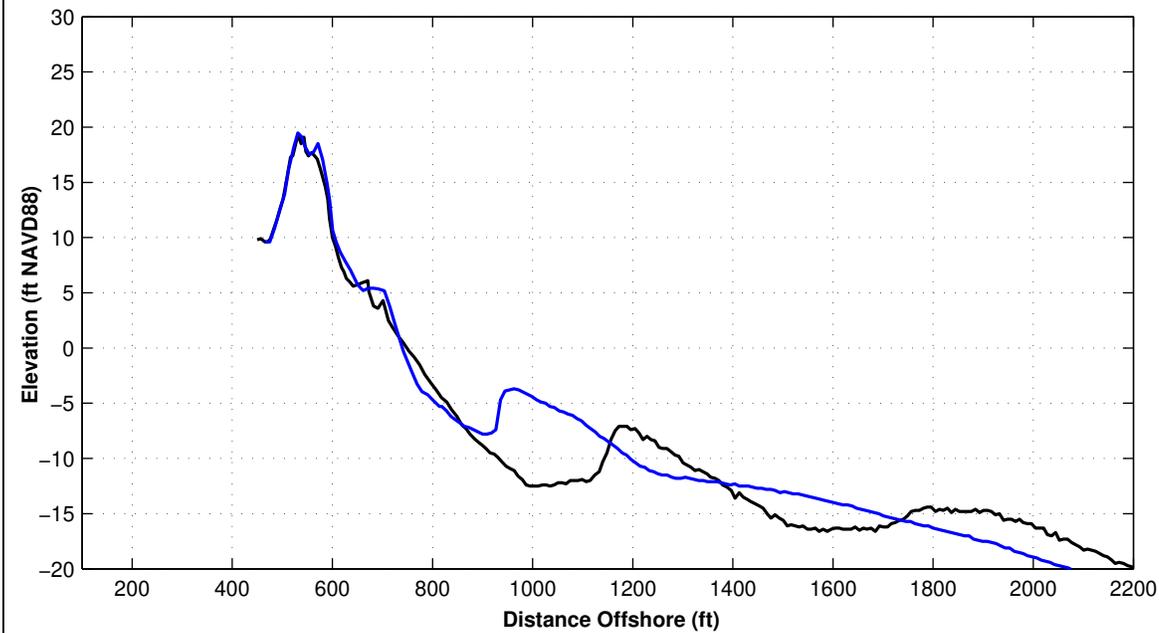
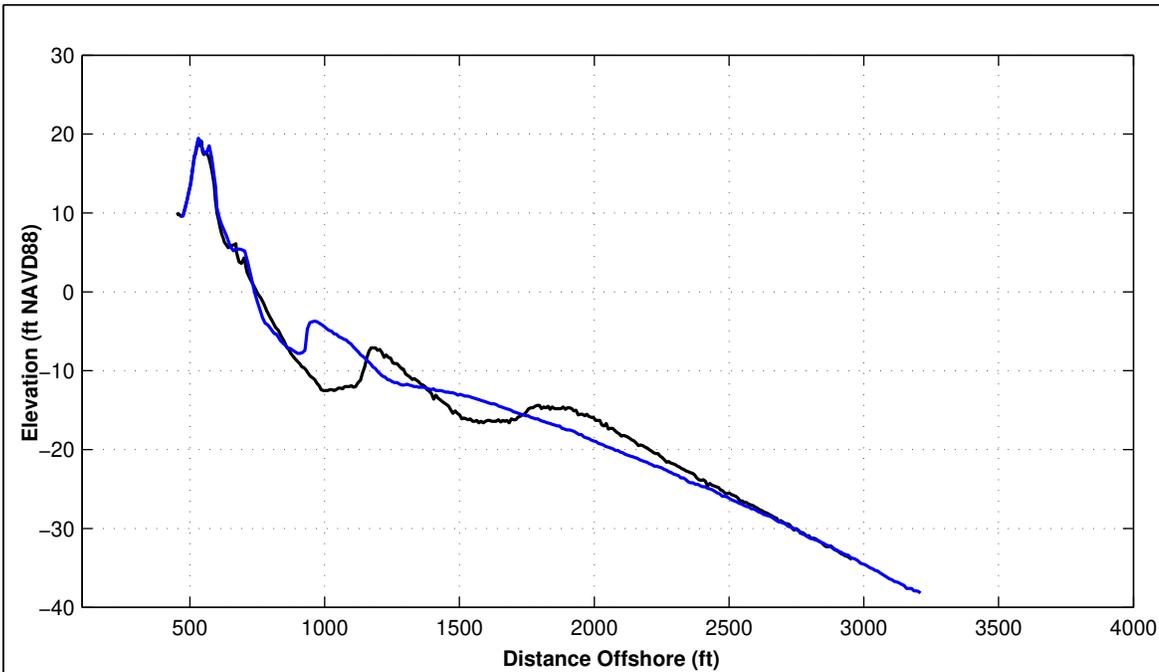


Survey Transect 980+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	11.69 ft	5.47 ft
Volume Change Above +6 ft NAVD88	8.10 cy/ft	2.25 cy/ft
Volume Change Above 1.18 ft NAVD88	12.68 cy/ft	1.57 cy/ft
Volume Change Above -6 ft NAVD88	11.30 cy/ft	9.29 cy/ft
Volume Change Above -14 ft NAVD88	59.51 cy/ft	4.21 cy/ft
Volume Change Above -19 ft NAVD88	83.58 cy/ft	1.87 cy/ft
Volume Change Above -30 ft NAVD88	64.57 cy/ft	0.68 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
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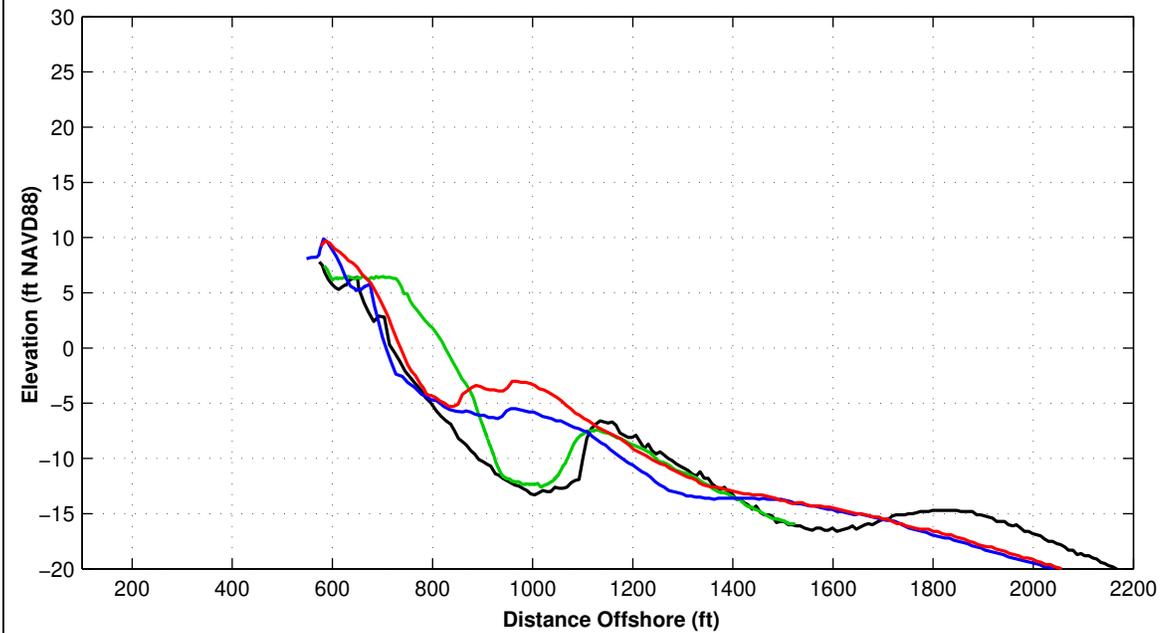
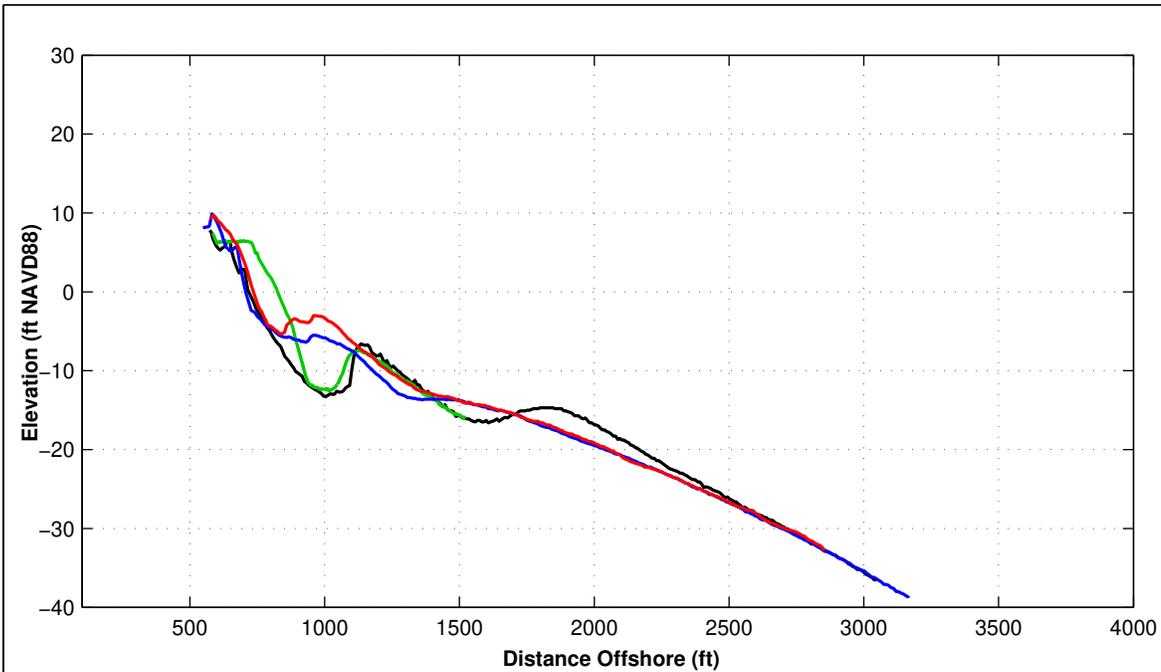
Survey Transect 982+50	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	1.44 ft	– ft
Volume Change Above +6 ft NAVD88	3.58 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	5.92 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	7.80 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	45.64 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	34.62 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	11.18 cy/ft	– cy/ft

LEGEND:

OCTOBER 2023	—	POST-DORIAN AD	—
JUNE 2023	—	JUNE 2022	—

- Notes:
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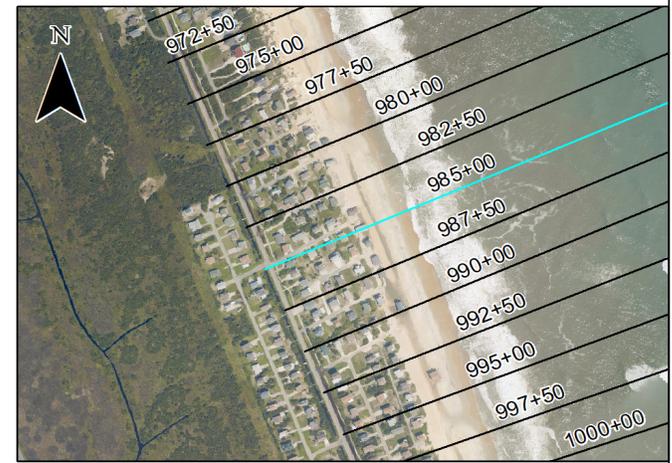


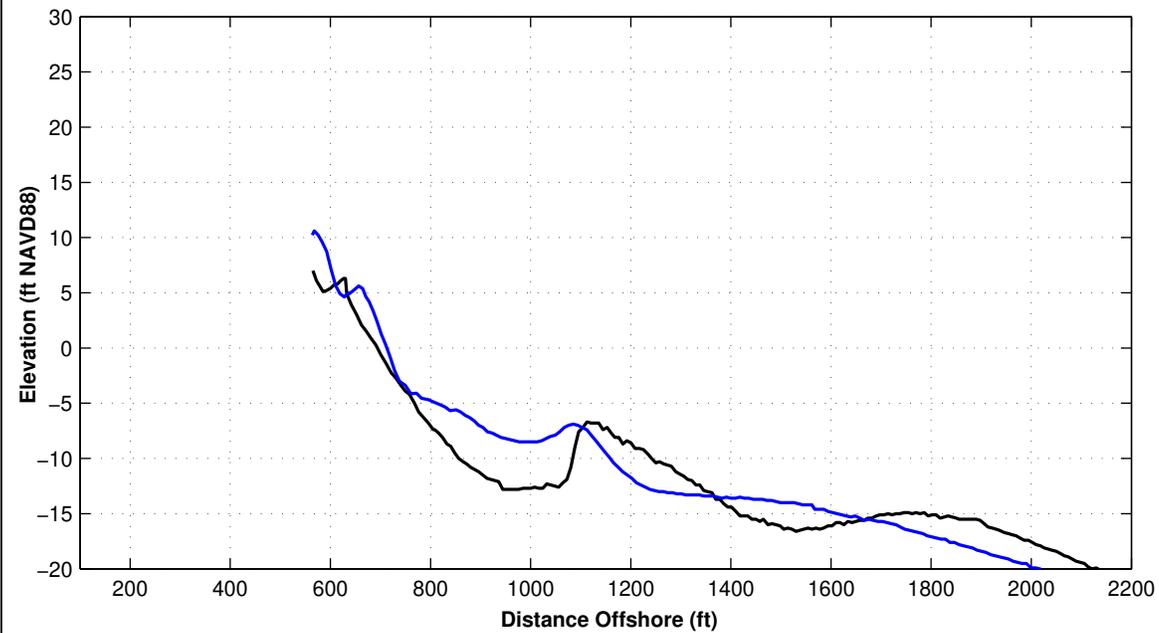
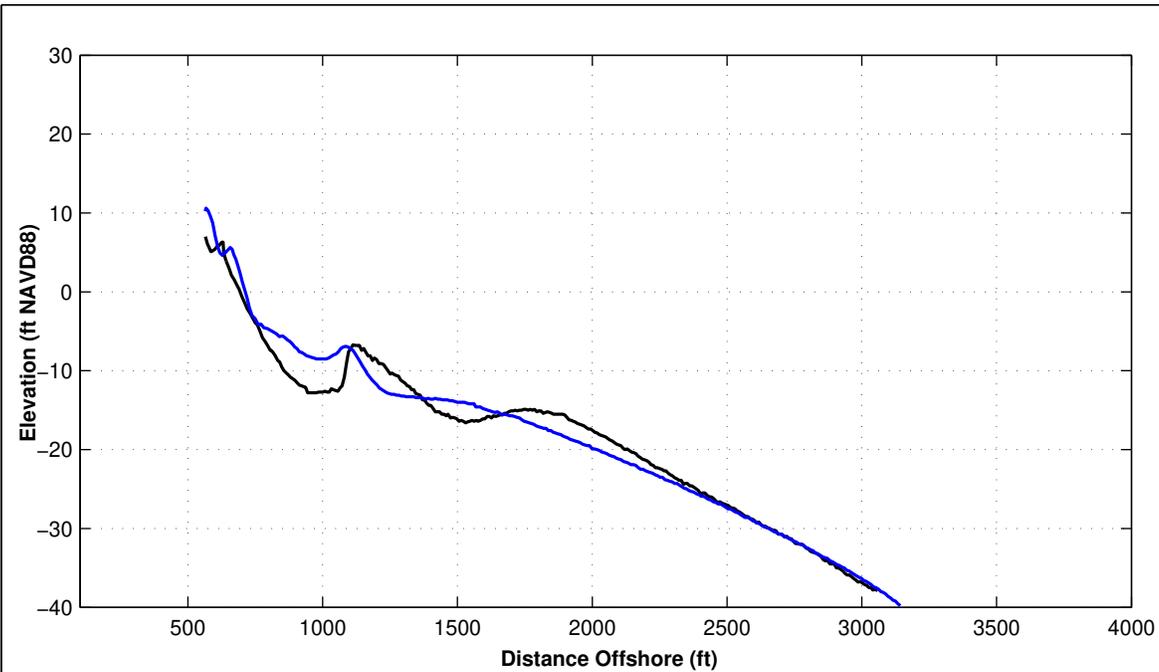


Survey Transect 985+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-11.46 ft	26.26 ft
Volume Change Above +6 ft NAVD88	4.19 cy/ft	2.97 cy/ft
Volume Change Above 1.18 ft NAVD88	5.56 cy/ft	6.73 cy/ft
Volume Change Above -6 ft NAVD88	5.18 cy/ft	30.03 cy/ft
Volume Change Above -14 ft NAVD88	35.36 cy/ft	49.98 cy/ft
Volume Change Above -19 ft NAVD88	19.97 cy/ft	53.18 cy/ft
Volume Change Above -30 ft NAVD88	-3.85 cy/ft	54.95 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

Notes:
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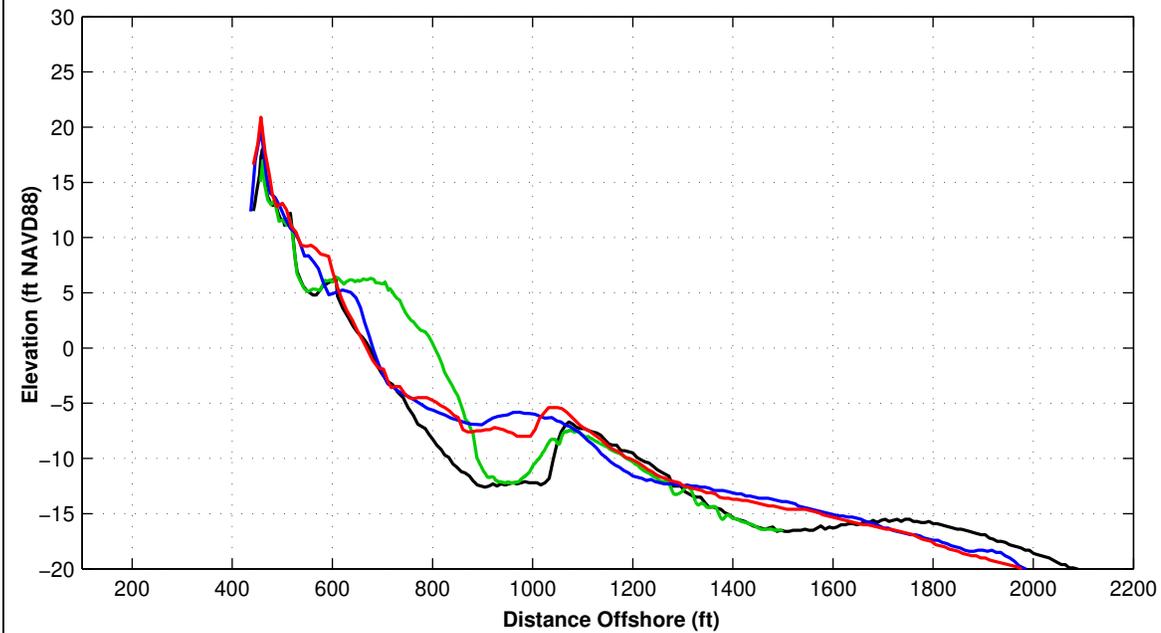
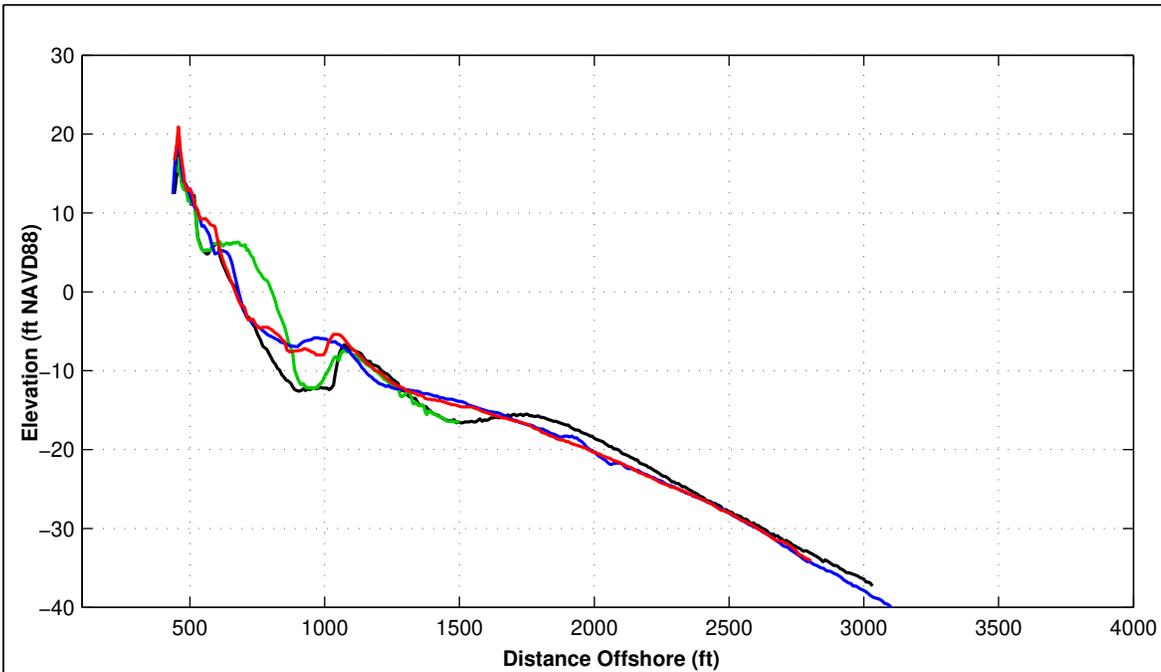


Survey Transect 987+50	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	25.45 ft	– ft
Volume Change Above +6 ft NAVD88	0.12 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	4.72 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	10.58 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	35.53 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	26.25 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	6.24 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

- Notes:
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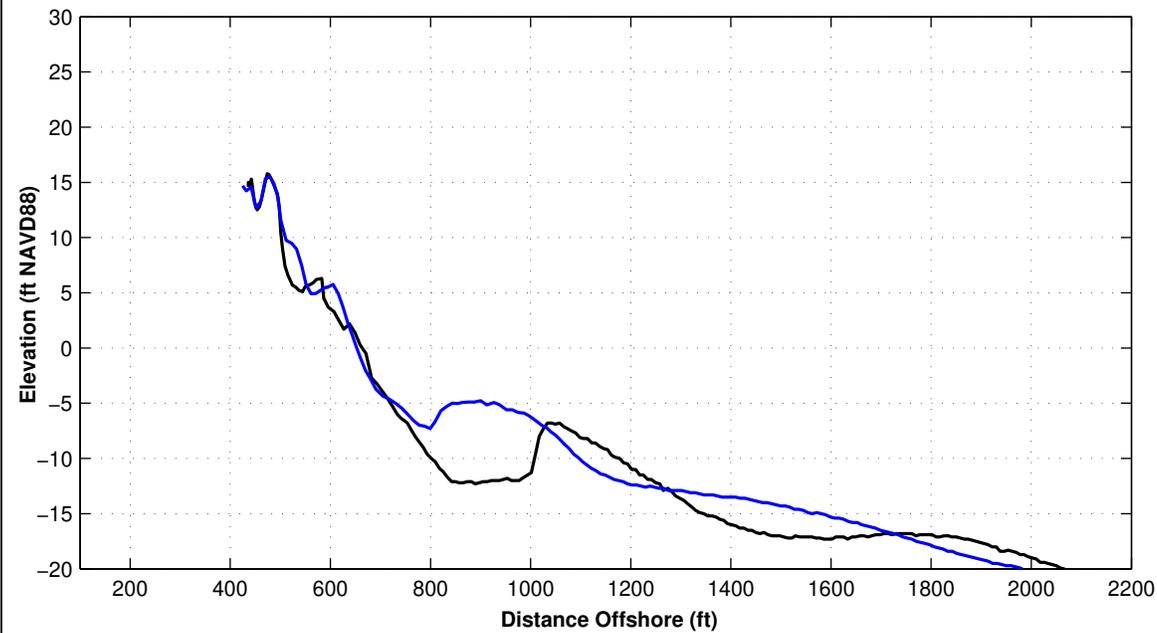
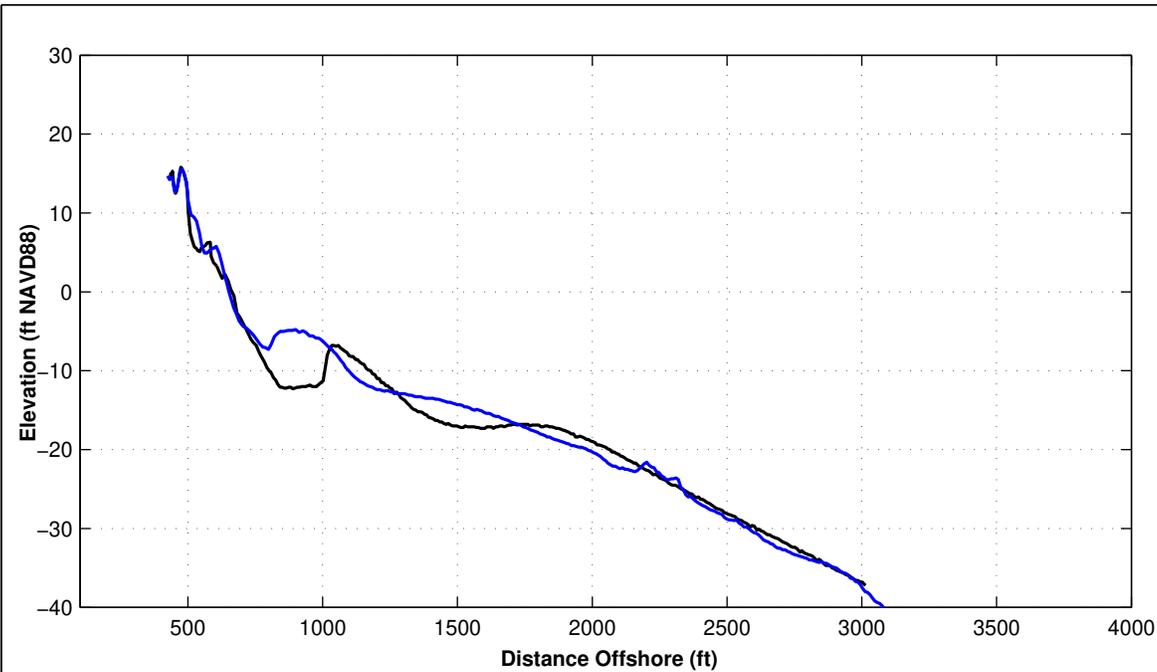


Survey Transect 990+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	17.24 ft	-18.01 ft
Volume Change Above +6 ft NAVD88	4.54 cy/ft	4.28 cy/ft
Volume Change Above 1.18 ft NAVD88	9.48 cy/ft	1.48 cy/ft
Volume Change Above -6 ft NAVD88	12.48 cy/ft	3.14 cy/ft
Volume Change Above -14 ft NAVD88	58.51 cy/ft	2.55 cy/ft
Volume Change Above -19 ft NAVD88	61.68 cy/ft	-2.84 cy/ft
Volume Change Above -30 ft NAVD88	41.15 cy/ft	-2.90 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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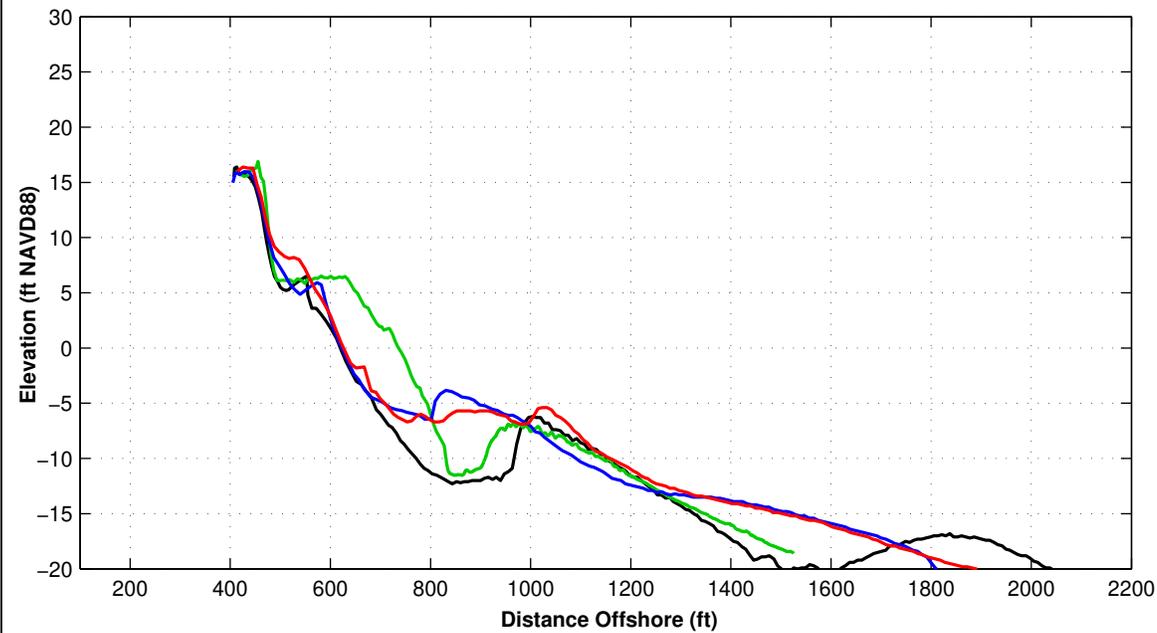
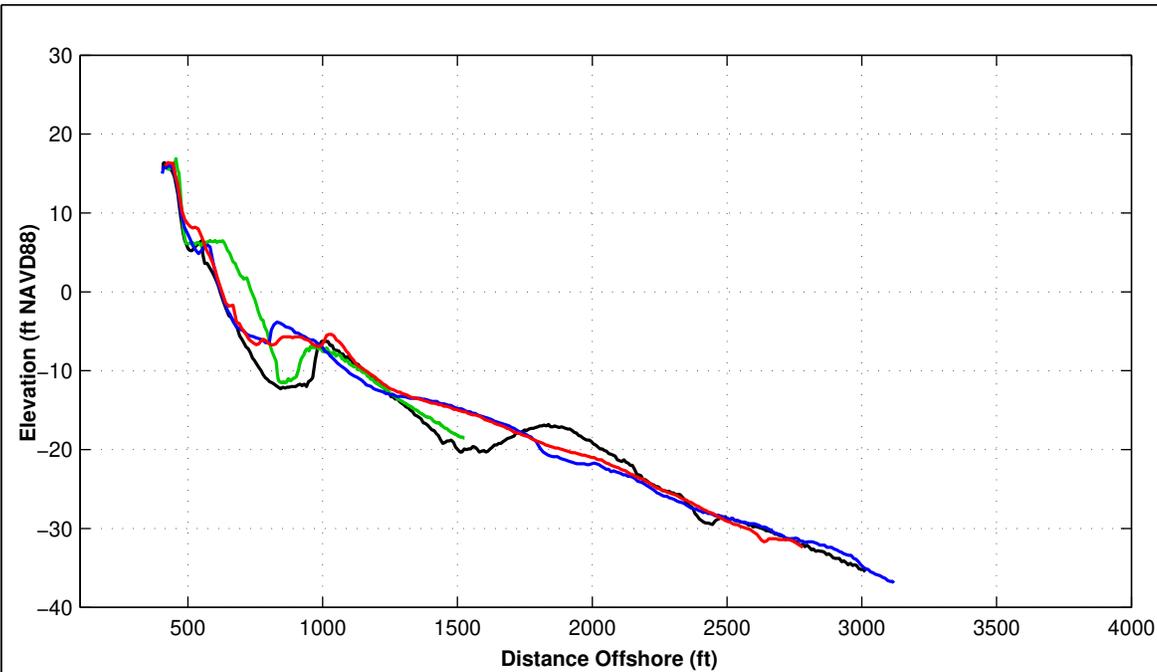


Survey Transect 992+50	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-7.82 ft	- ft
Volume Change Above +6 ft NAVD88	4.33 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	7.14 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	10.82 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	48.85 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	66.73 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	53.16 cy/ft	- cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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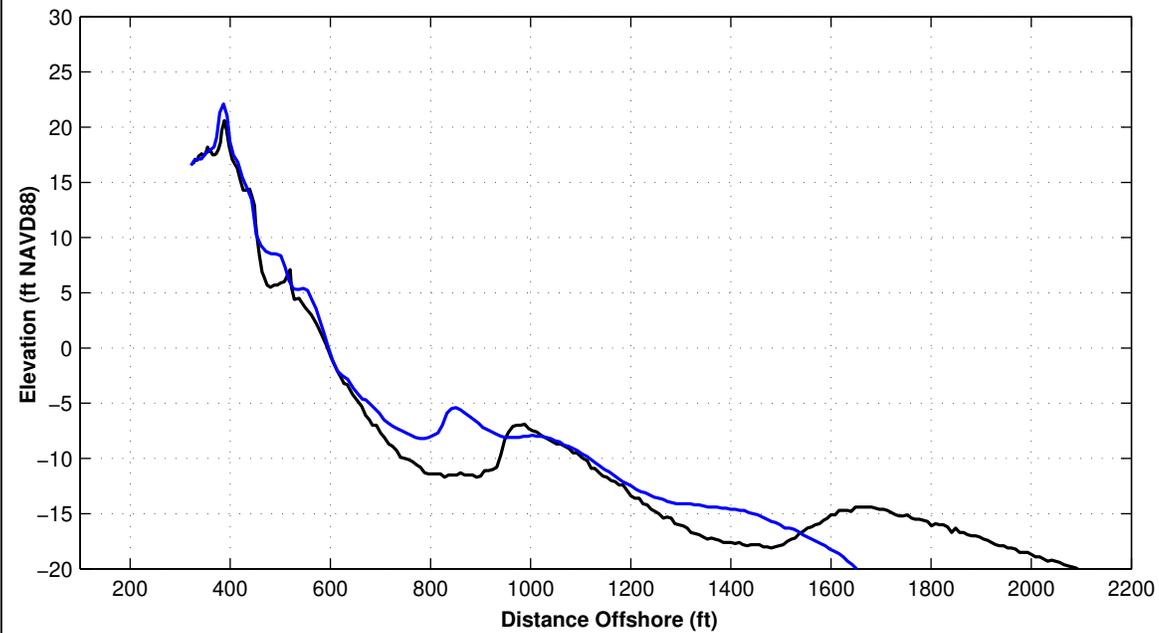
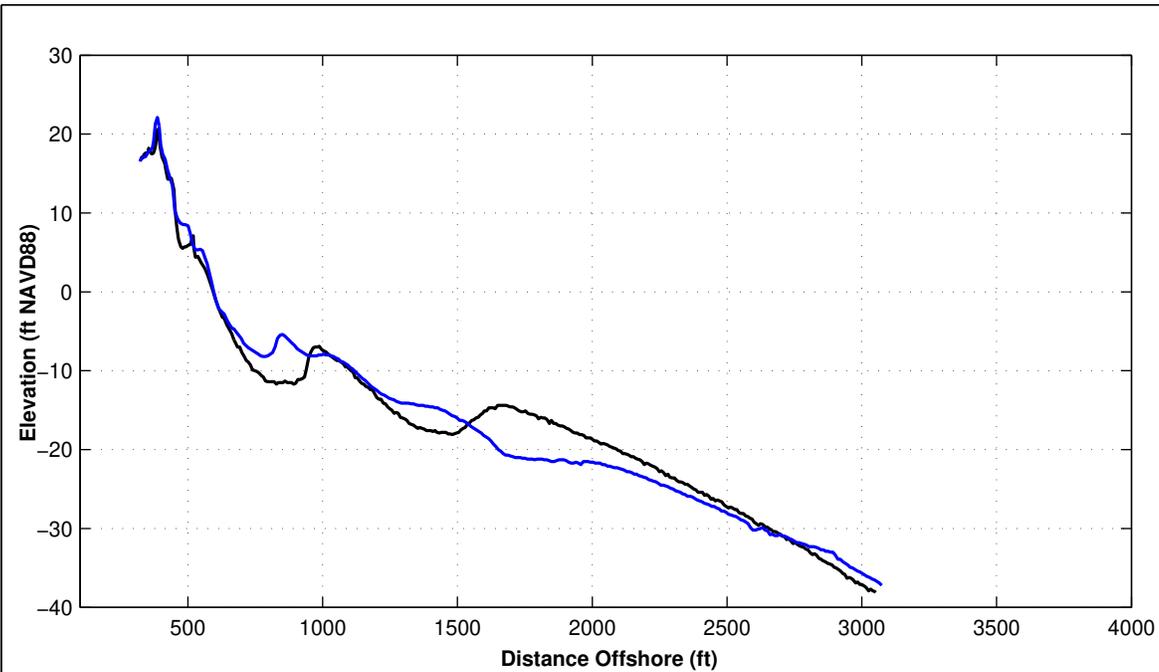


Survey Transect 995+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	2.60 ft	4.23 ft
Volume Change Above +6 ft NAVD88	1.29 cy/ft	4.42 cy/ft
Volume Change Above 1.18 ft NAVD88	4.36 cy/ft	5.06 cy/ft
Volume Change Above -6 ft NAVD88	12.96 cy/ft	2.15 cy/ft
Volume Change Above -14 ft NAVD88	50.81 cy/ft	17.93 cy/ft
Volume Change Above -19 ft NAVD88	83.85 cy/ft	14.53 cy/ft
Volume Change Above -30 ft NAVD88	61.03 cy/ft	28.95 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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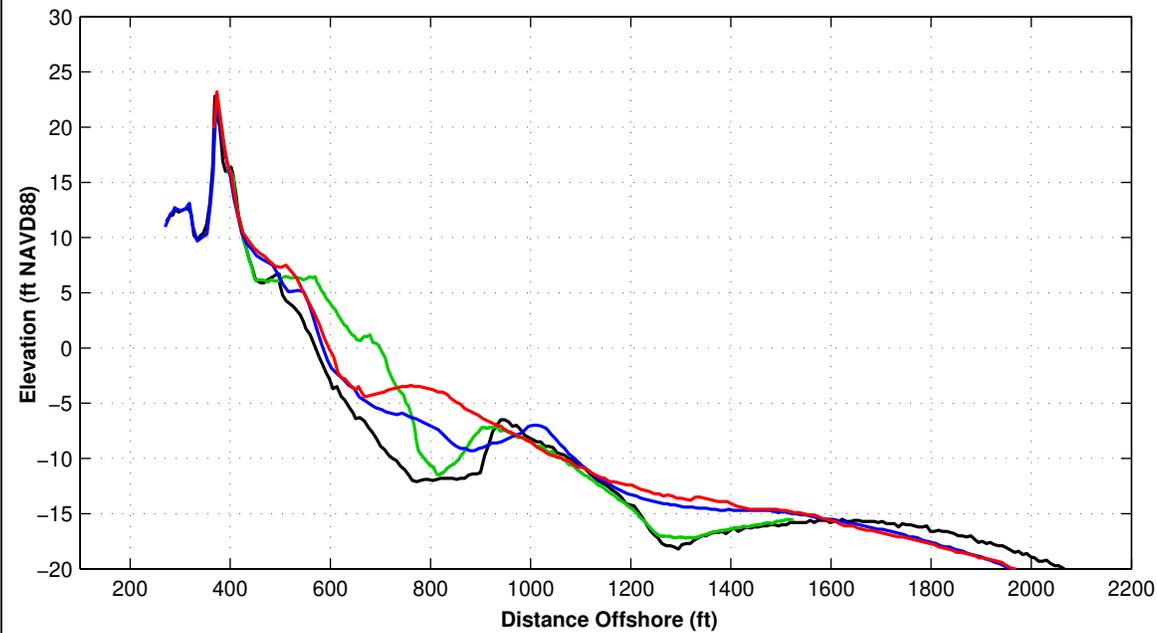
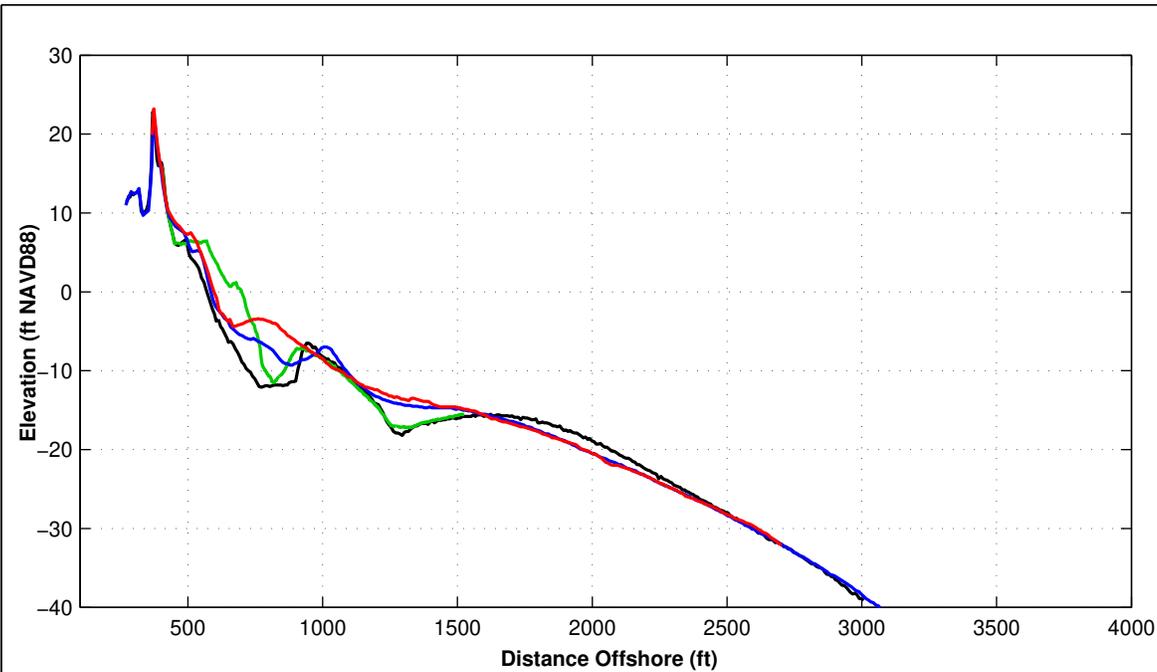


Survey Transect 997+50	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	5.63 ft	– ft
Volume Change Above +6 ft NAVD88	5.74 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	8.85 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	11.61 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	47.21 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	25.54 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	–39.67 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.



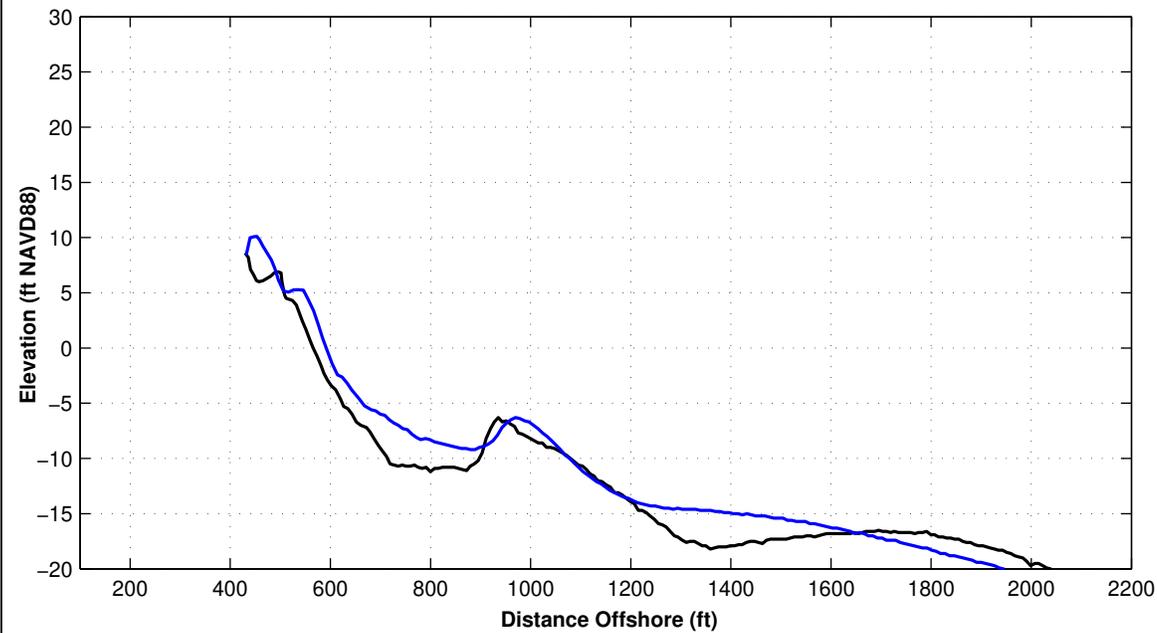
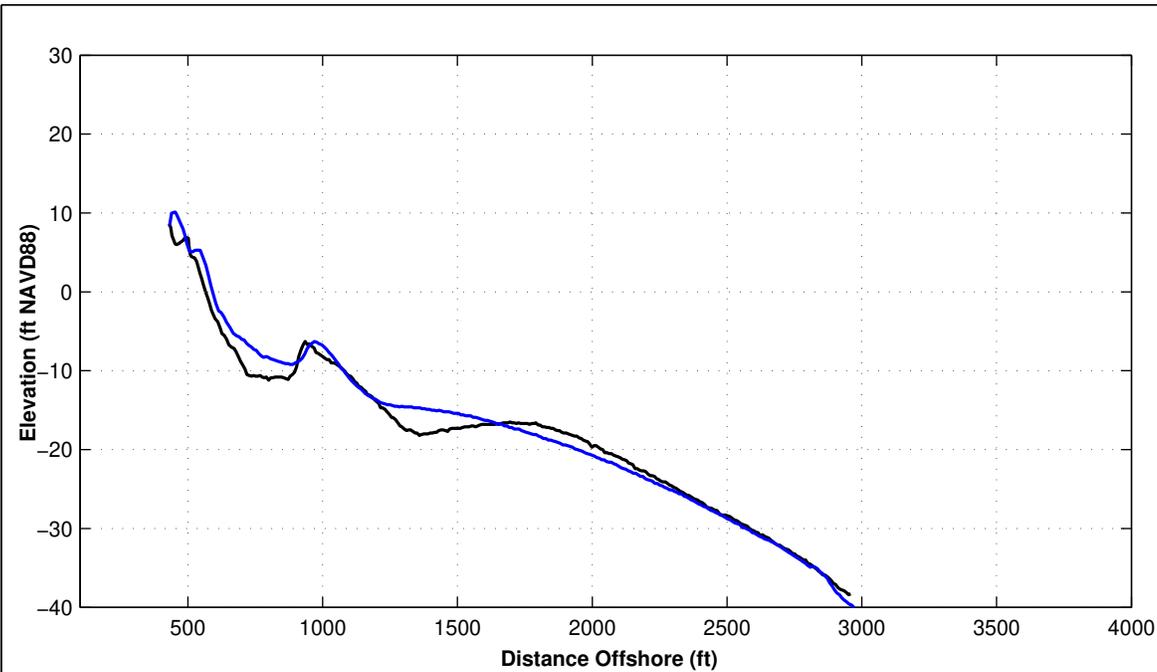


Survey Transect 1000+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	16.89 ft	9.17 ft
Volume Change Above +6 ft NAVD88	3.58 cy/ft	2.43 cy/ft
Volume Change Above 1.18 ft NAVD88	8.30 cy/ft	4.08 cy/ft
Volume Change Above -6 ft NAVD88	15.78 cy/ft	19.87 cy/ft
Volume Change Above -14 ft NAVD88	50.82 cy/ft	32.73 cy/ft
Volume Change Above -19 ft NAVD88	64.94 cy/ft	33.67 cy/ft
Volume Change Above -30 ft NAVD88	46.46 cy/ft	33.88 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.





Survey Transect 1002+50	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	27.32 ft	– ft
Volume Change Above +6 ft NAVD88	3.09 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	7.72 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	16.15 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	39.44 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	58.30 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	40.92 cy/ft	– cy/ft

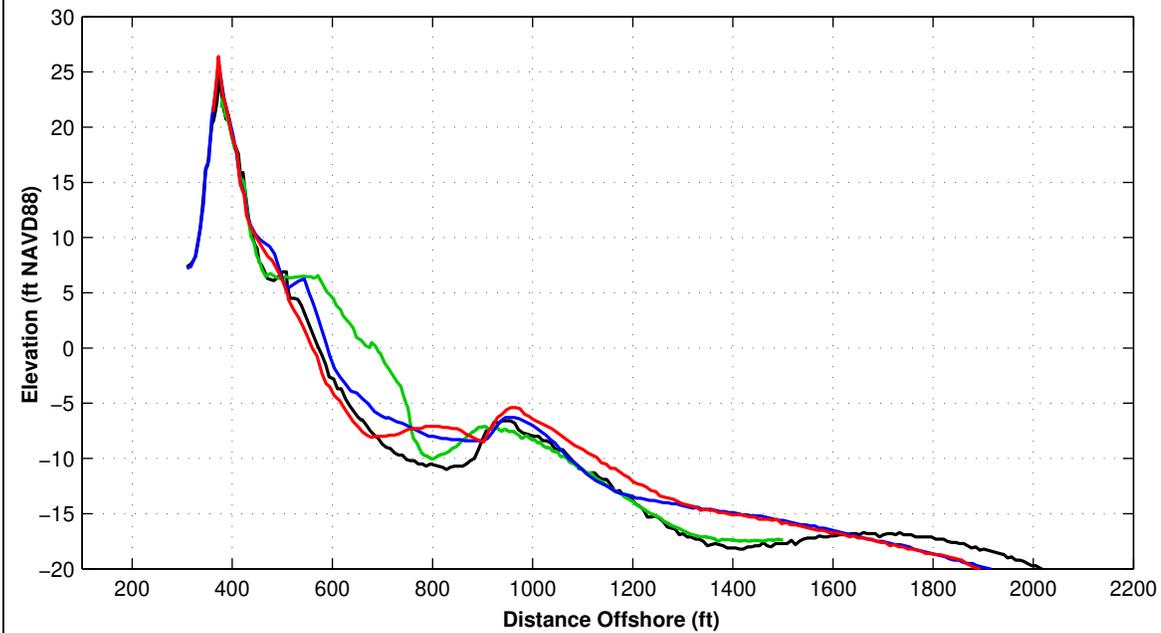
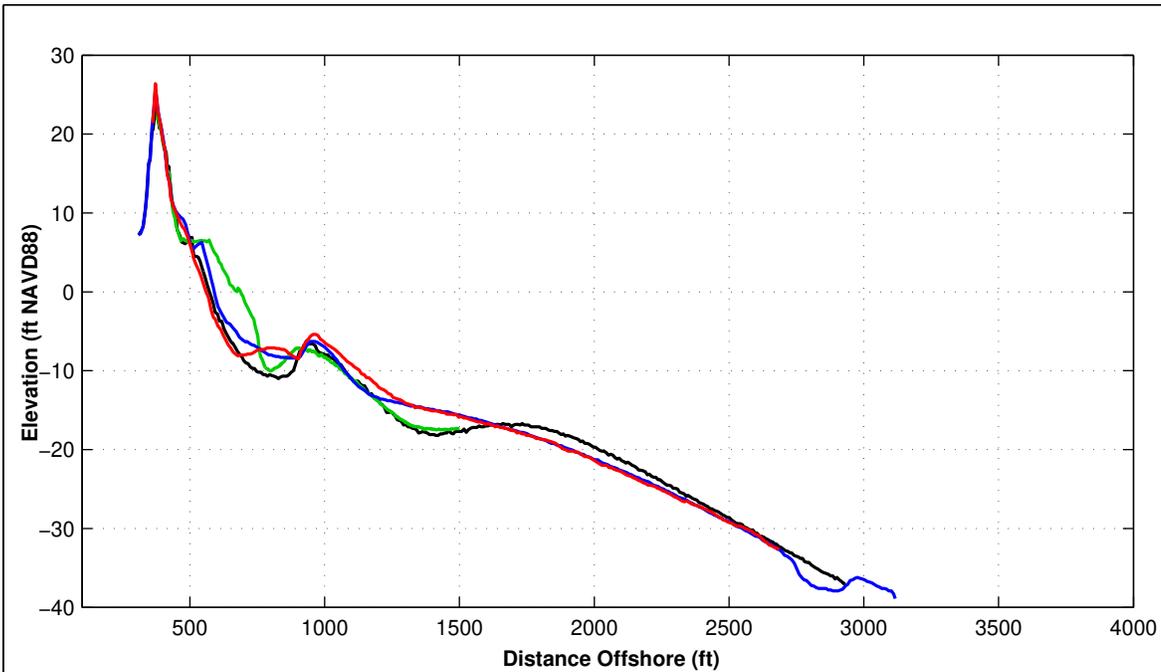
LEGEND:

OCTOBER 2023 — POST-DORIAN AD —

JUNE 2023 — JUNE 2022 —

- Notes:
1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.



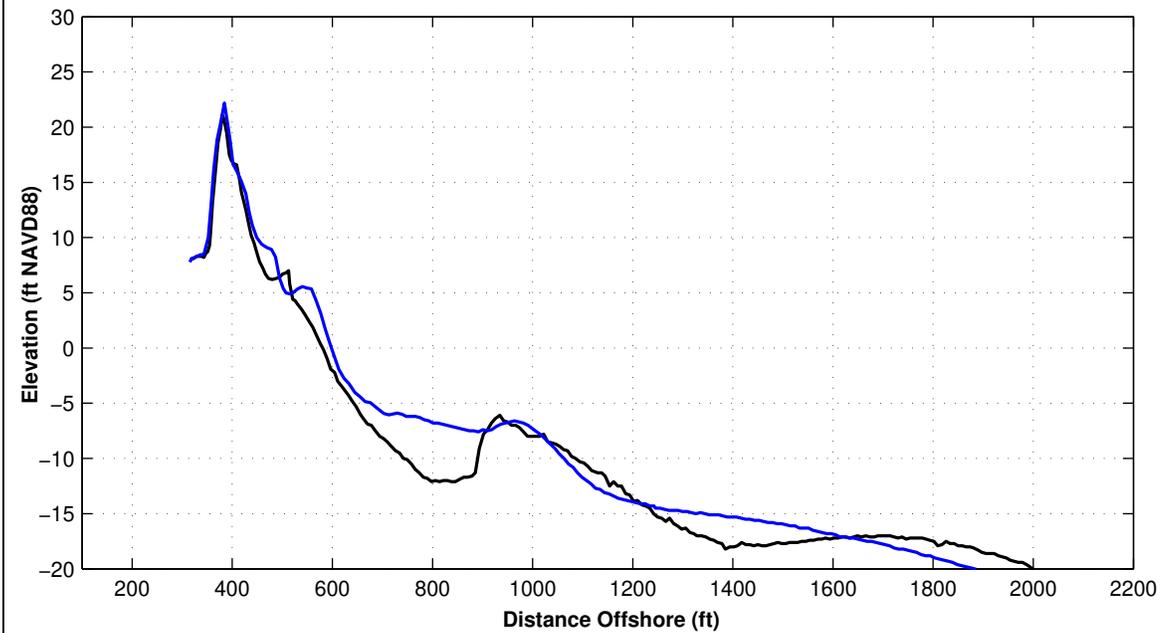
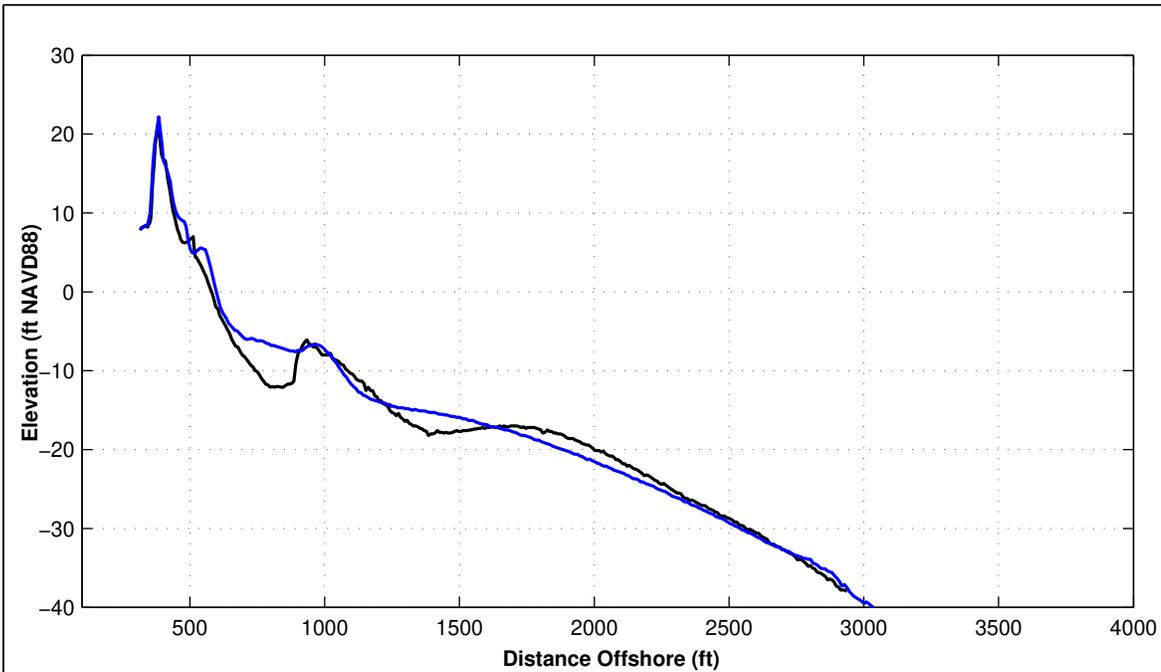


Survey Transect 1005+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	20.37 ft	-33.47 ft
Volume Change Above +6 ft NAVD88	3.17 cy/ft	-1.55 cy/ft
Volume Change Above 1.18 ft NAVD88	7.95 cy/ft	-8.60 cy/ft
Volume Change Above -6 ft NAVD88	14.10 cy/ft	-17.87 cy/ft
Volume Change Above -14 ft NAVD88	36.75 cy/ft	-4.76 cy/ft
Volume Change Above -19 ft NAVD88	57.44 cy/ft	-6.69 cy/ft
Volume Change Above -30 ft NAVD88	32.72 cy/ft	-10.01 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.



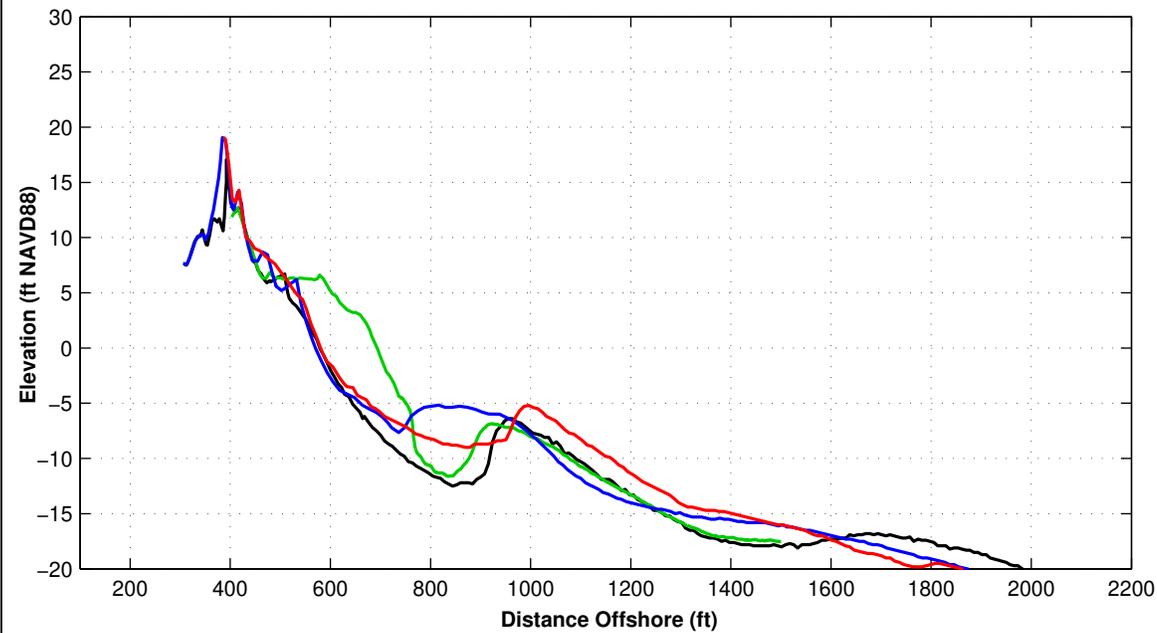
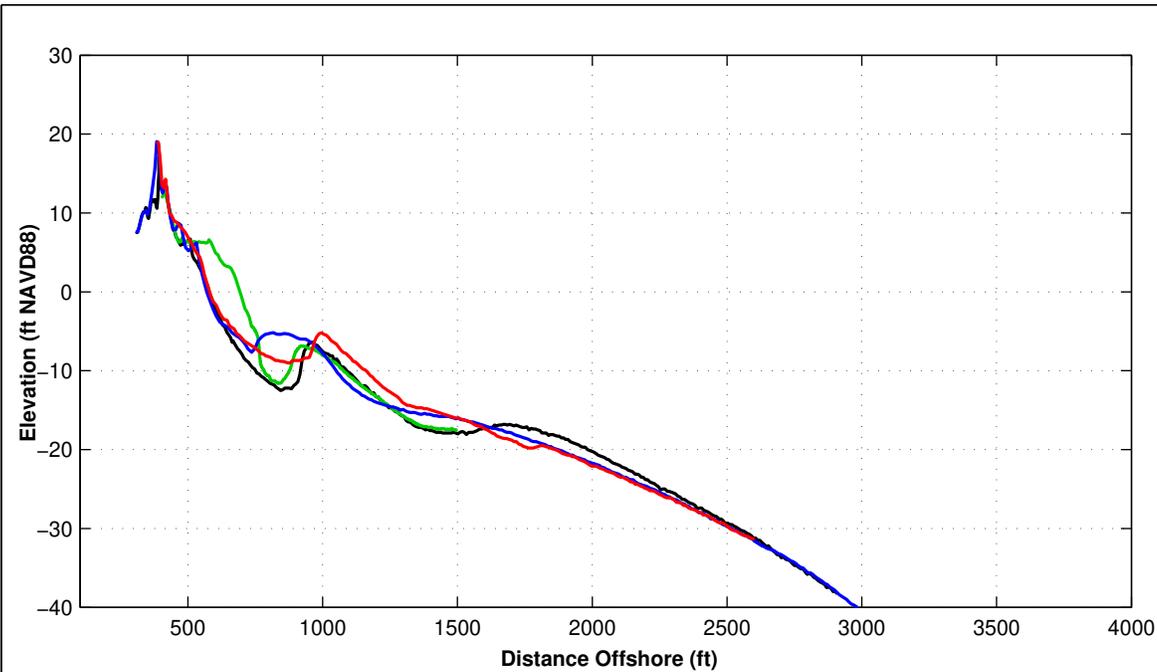


Survey Transect 1007+50	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	21.70 ft	– ft
Volume Change Above +6 ft NAVD88	5.26 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	9.90 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	15.58 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	42.70 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	55.64 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	29.25 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.



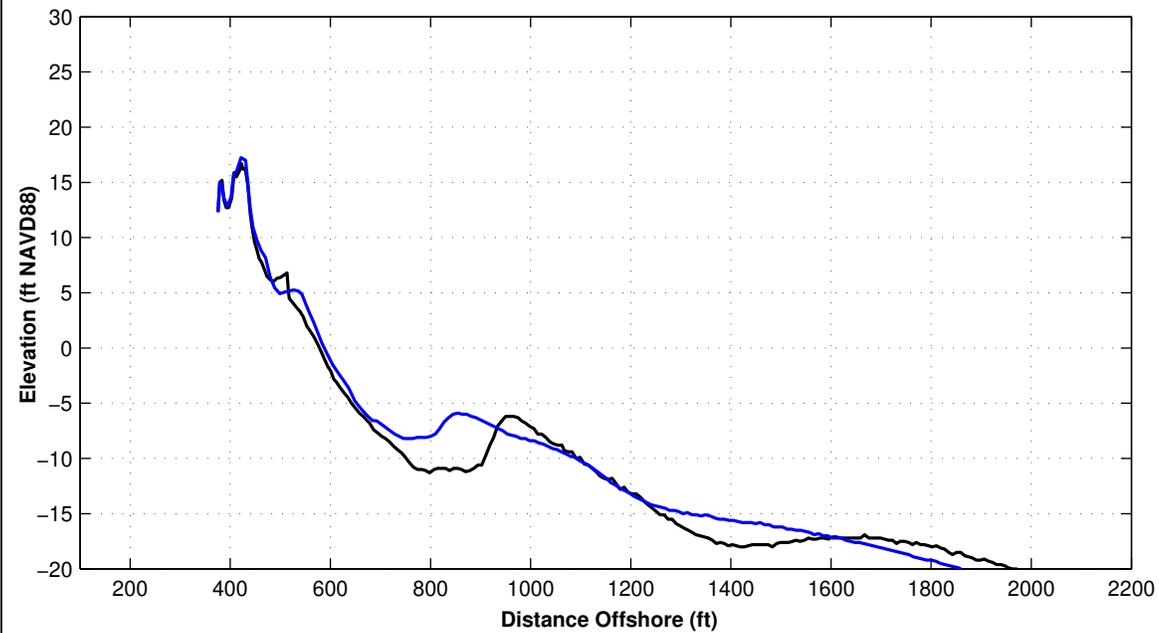
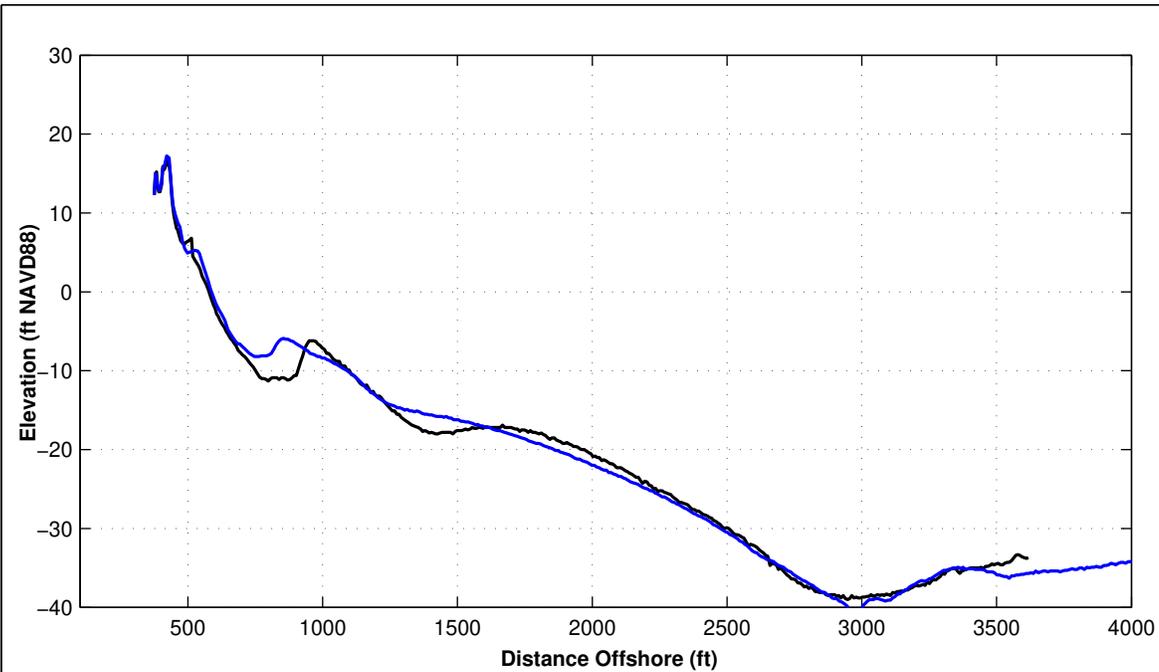


Survey Transect 1010+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-6.90 ft	10.03 ft
Volume Change Above +6 ft NAVD88	1.60 cy/ft	2.01 cy/ft
Volume Change Above 1.18 ft NAVD88	2.72 cy/ft	3.06 cy/ft
Volume Change Above -6 ft NAVD88	5.32 cy/ft	5.05 cy/ft
Volume Change Above -14 ft NAVD88	37.20 cy/ft	17.48 cy/ft
Volume Change Above -19 ft NAVD88	45.81 cy/ft	18.36 cy/ft
Volume Change Above -30 ft NAVD88	21.60 cy/ft	12.14 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.



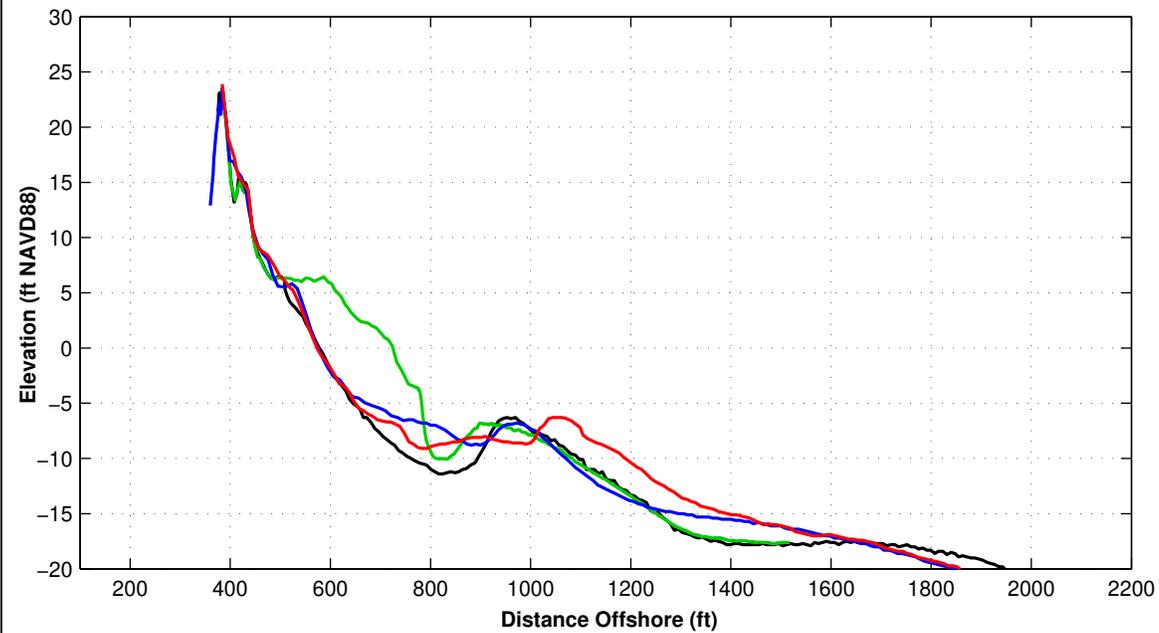
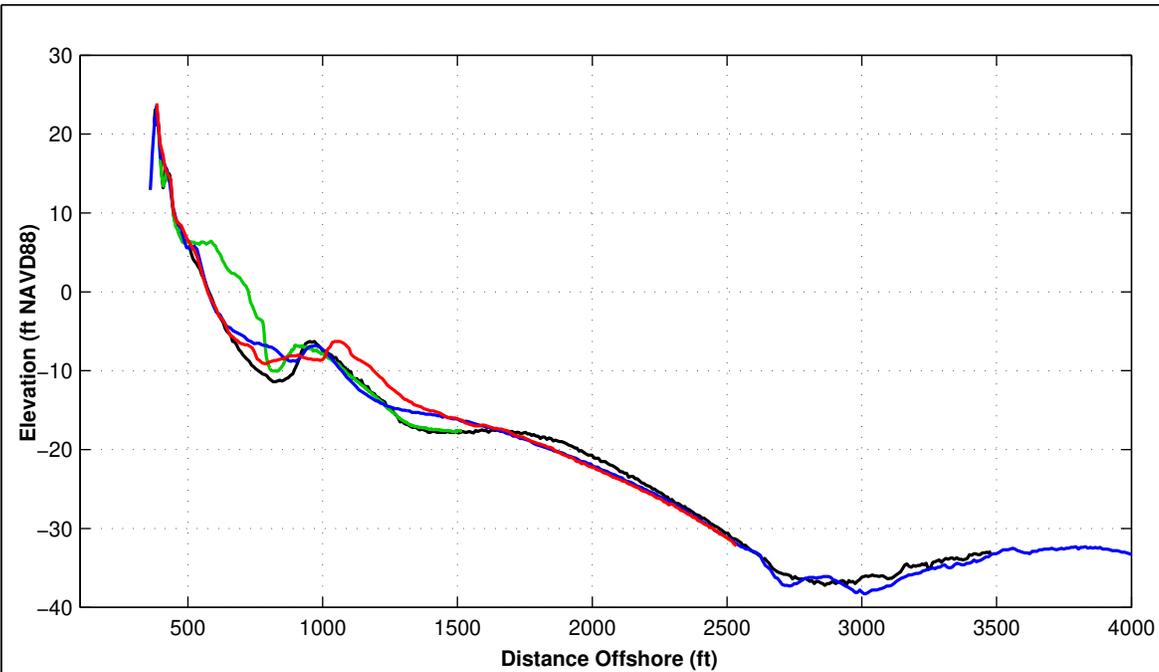


Survey Transect 1012+50	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	12.07 ft	– ft
Volume Change Above +6 ft NAVD88	1.77 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	3.75 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	6.97 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	28.41 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	40.04 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	18.07 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

- Notes:
1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

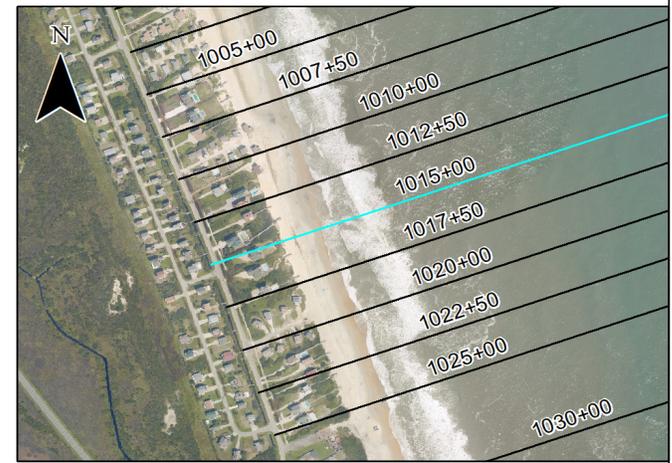


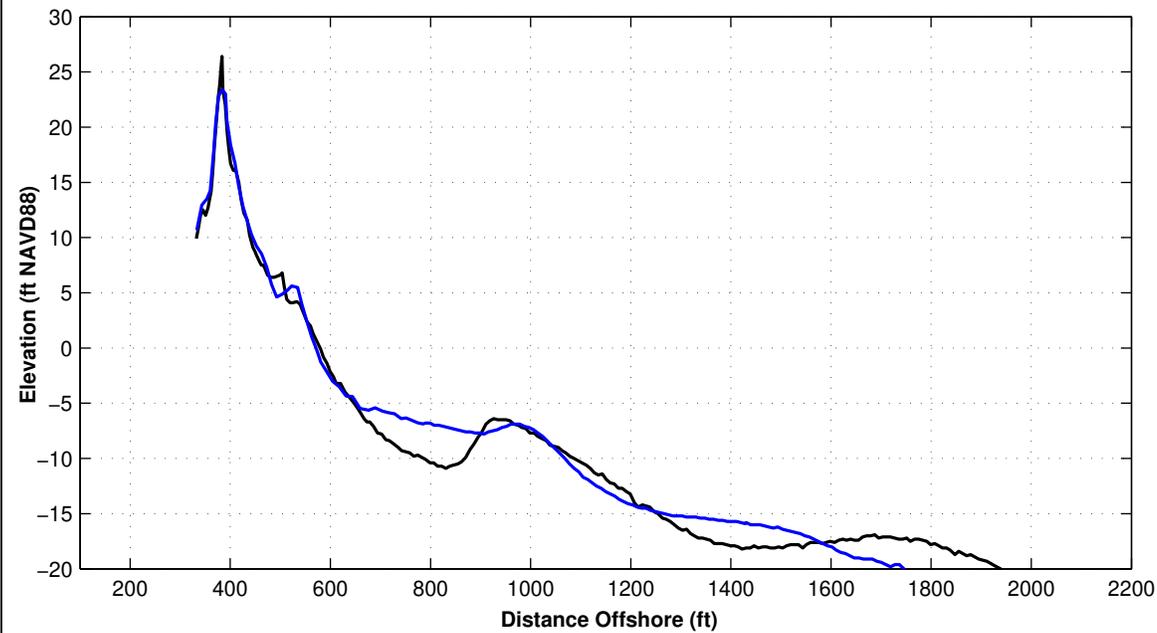
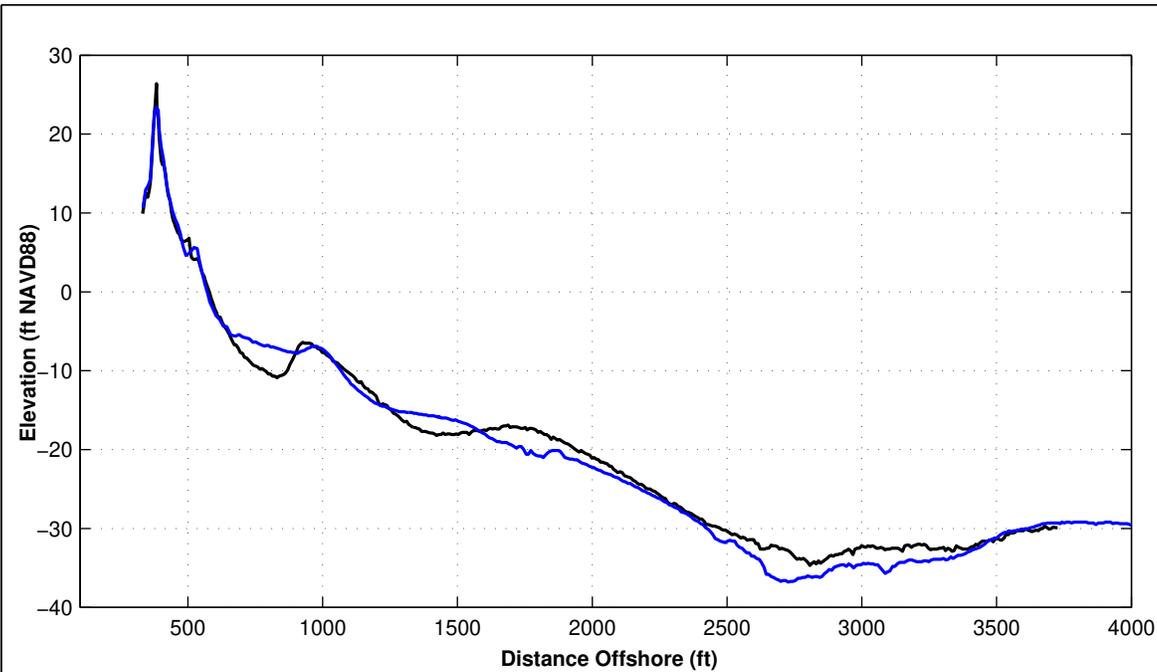


Survey Transect 1015+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-0.74 ft	-2.09 ft
Volume Change Above +6 ft NAVD88	1.79 cy/ft	1.26 cy/ft
Volume Change Above 1.18 ft NAVD88	3.93 cy/ft	0.55 cy/ft
Volume Change Above -6 ft NAVD88	5.85 cy/ft	-1.17 cy/ft
Volume Change Above -14 ft NAVD88	22.44 cy/ft	17.72 cy/ft
Volume Change Above -19 ft NAVD88	39.33 cy/ft	24.51 cy/ft
Volume Change Above -30 ft NAVD88	19.60 cy/ft	20.16 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.



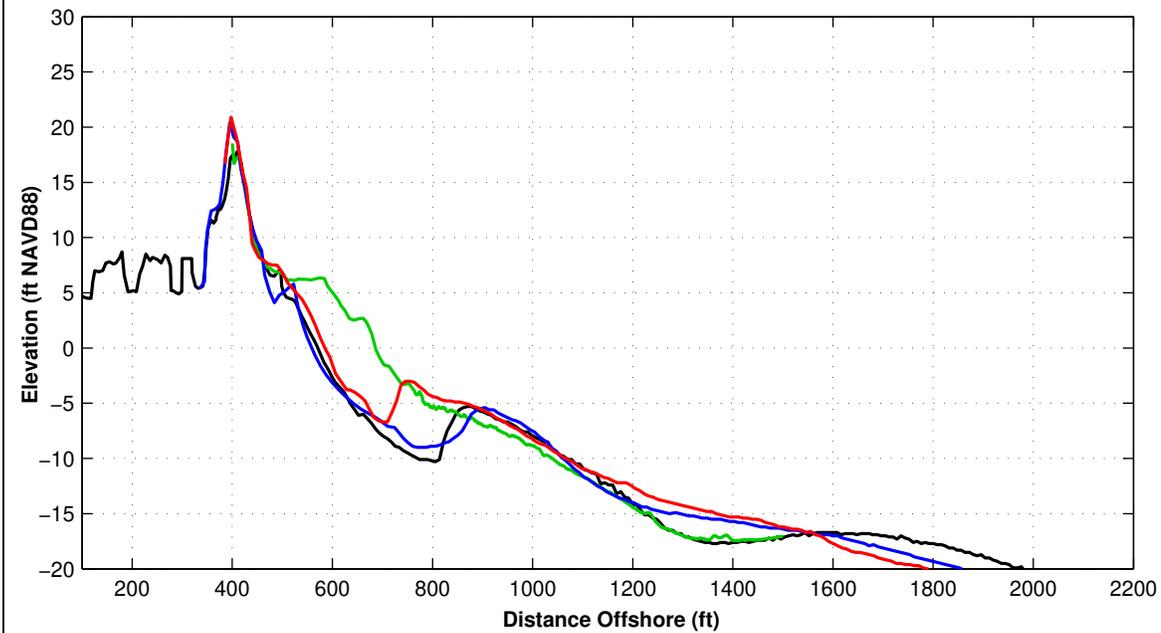
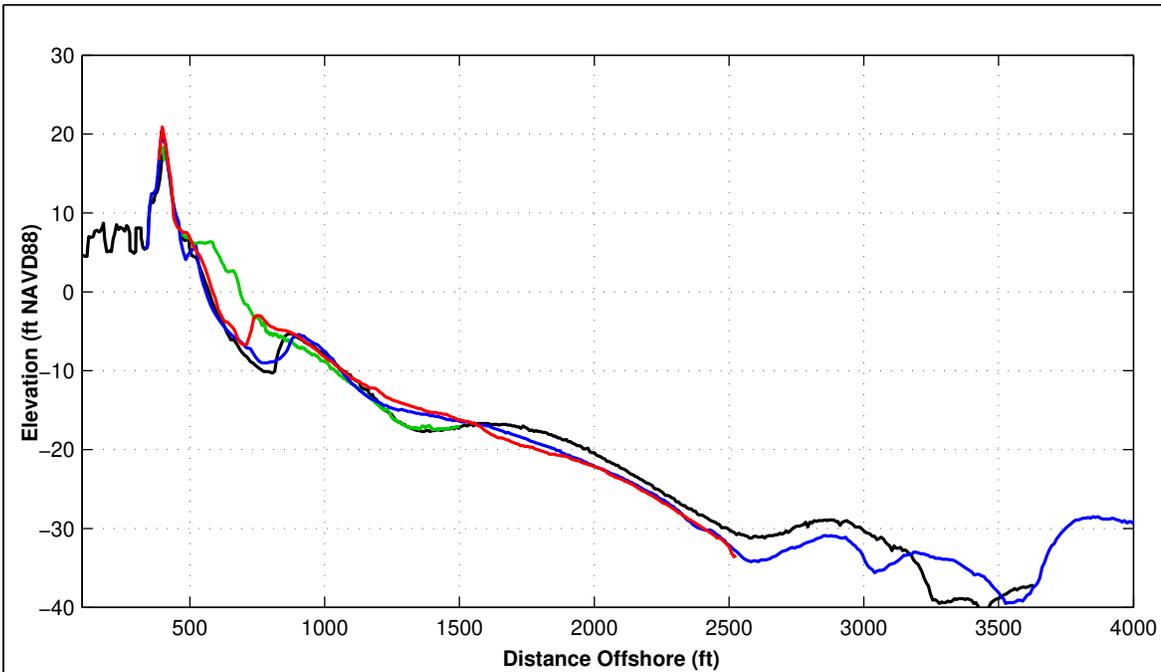


Survey Transect 1017+50	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-5.38 ft	- ft
Volume Change Above +6 ft NAVD88	1.24 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	1.48 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	1.15 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	16.49 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	19.95 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	-6.07 cy/ft	- cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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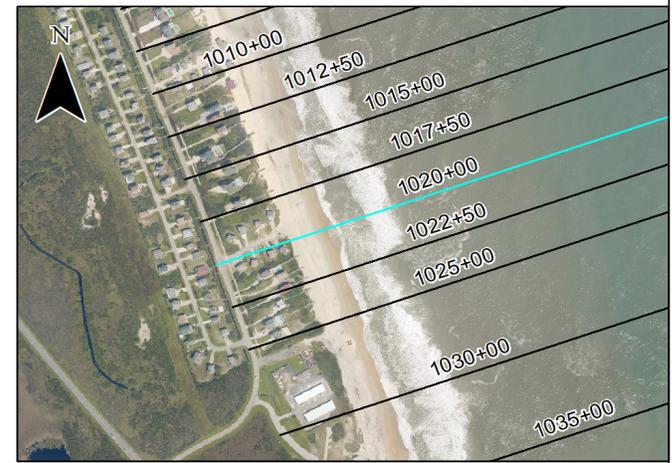


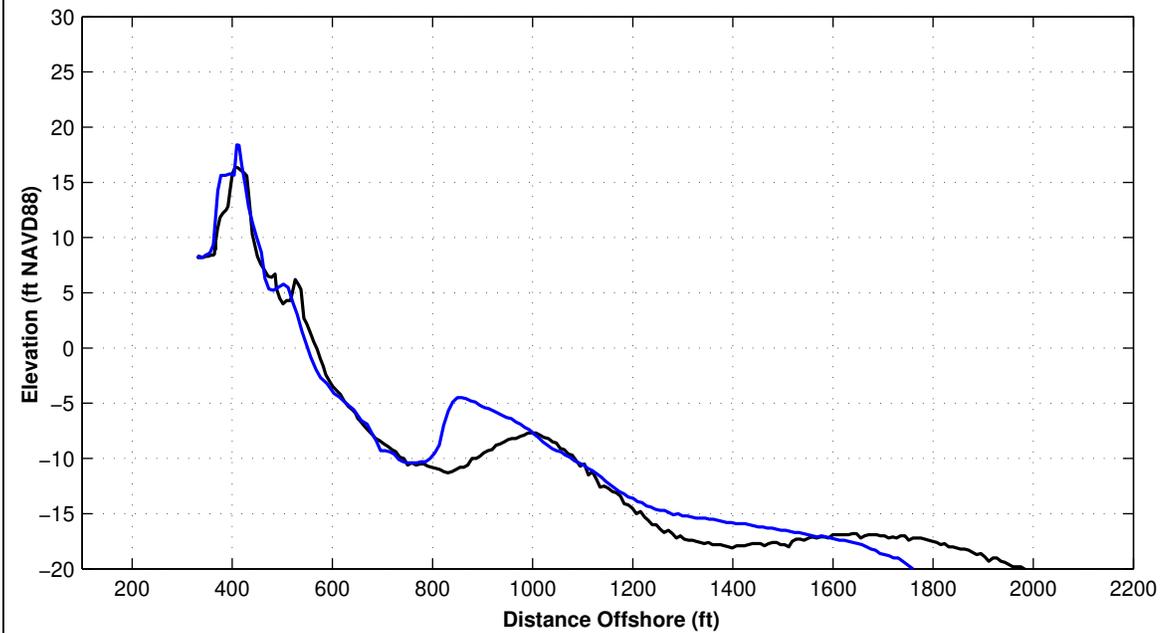
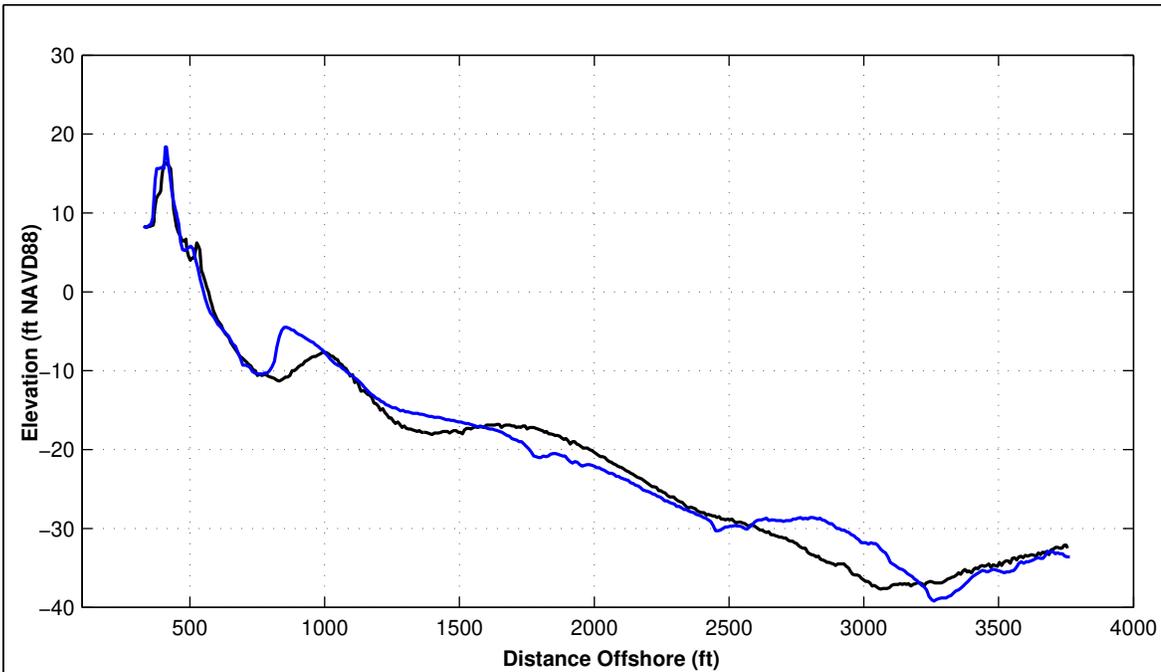


Survey Transect 1020+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-9.77 ft	25.65 ft
Volume Change Above +6 ft NAVD88	-0.77 cy/ft	1.31 cy/ft
Volume Change Above 1.18 ft NAVD88	-1.73 cy/ft	5.62 cy/ft
Volume Change Above -6 ft NAVD88	-3.39 cy/ft	21.77 cy/ft
Volume Change Above -14 ft NAVD88	-0.85 cy/ft	39.41 cy/ft
Volume Change Above -19 ft NAVD88	6.01 cy/ft	40.66 cy/ft
Volume Change Above -30 ft NAVD88	-31.33 cy/ft	33.40 cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.



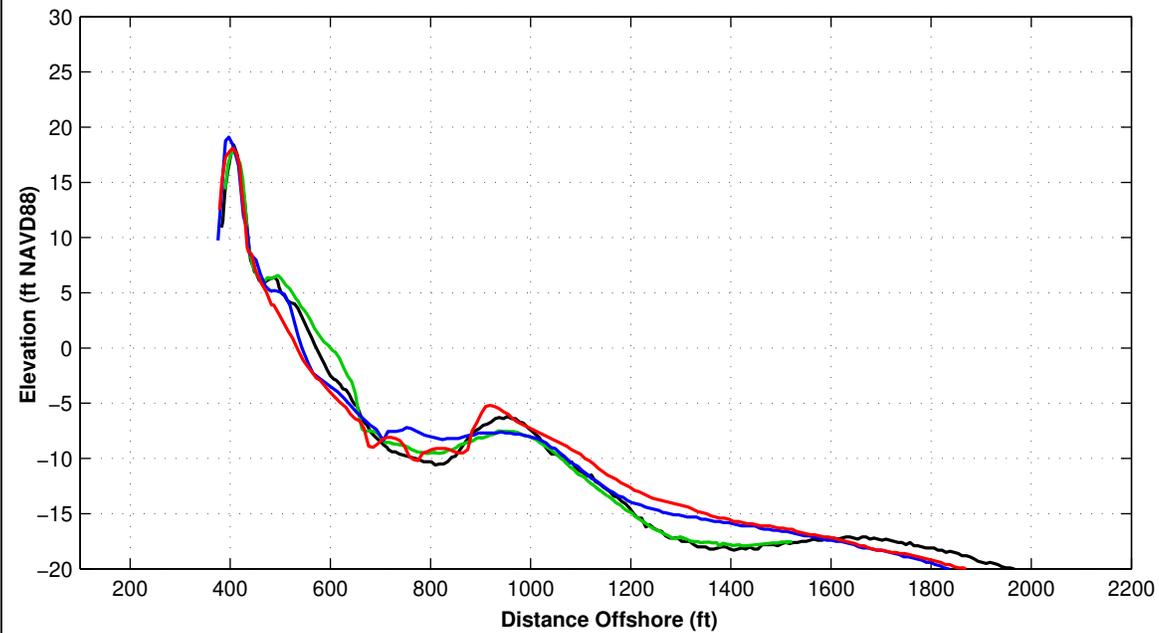
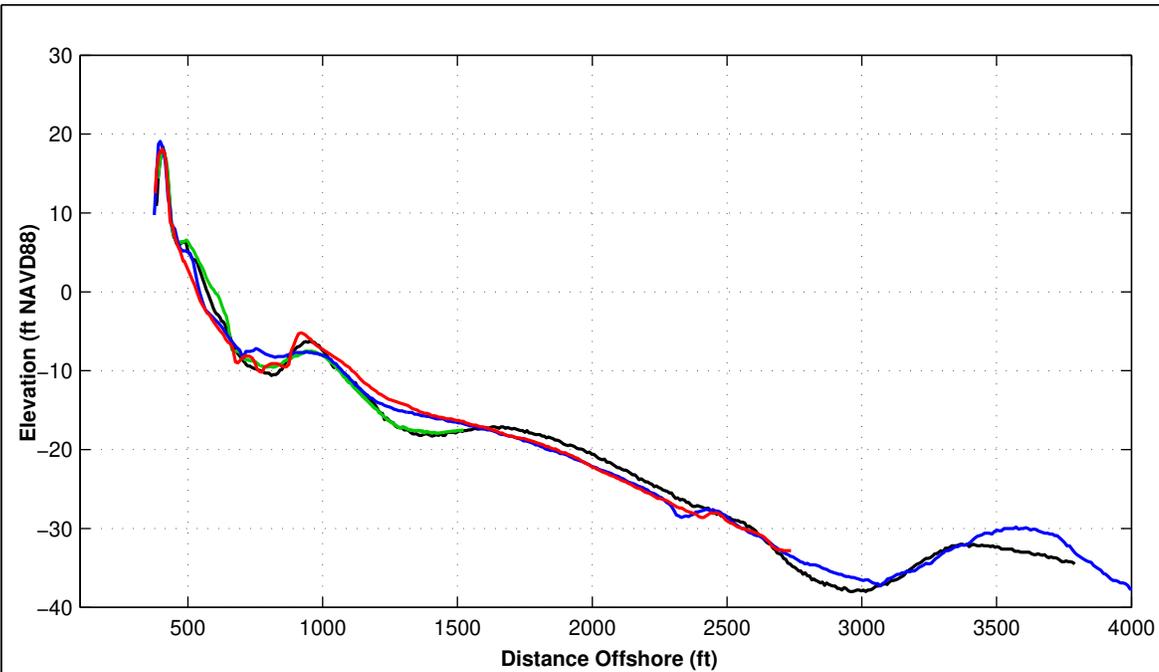


Survey Transect 1022+50	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-15.80 ft	- ft
Volume Change Above +6 ft NAVD88	0.82 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	-1.11 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	-0.67 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	22.21 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	30.65 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	-8.84 cy/ft	- cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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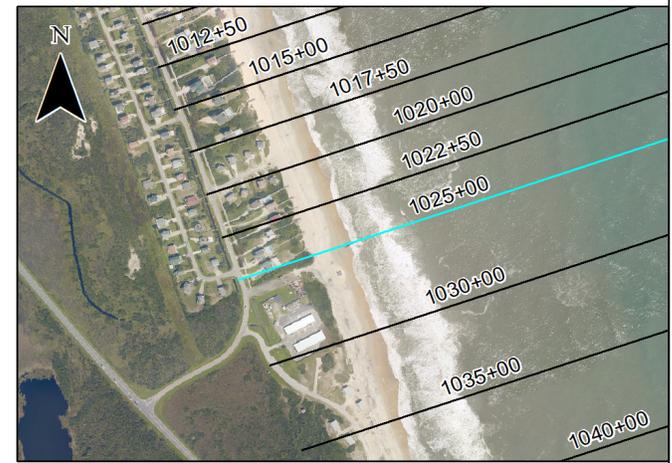


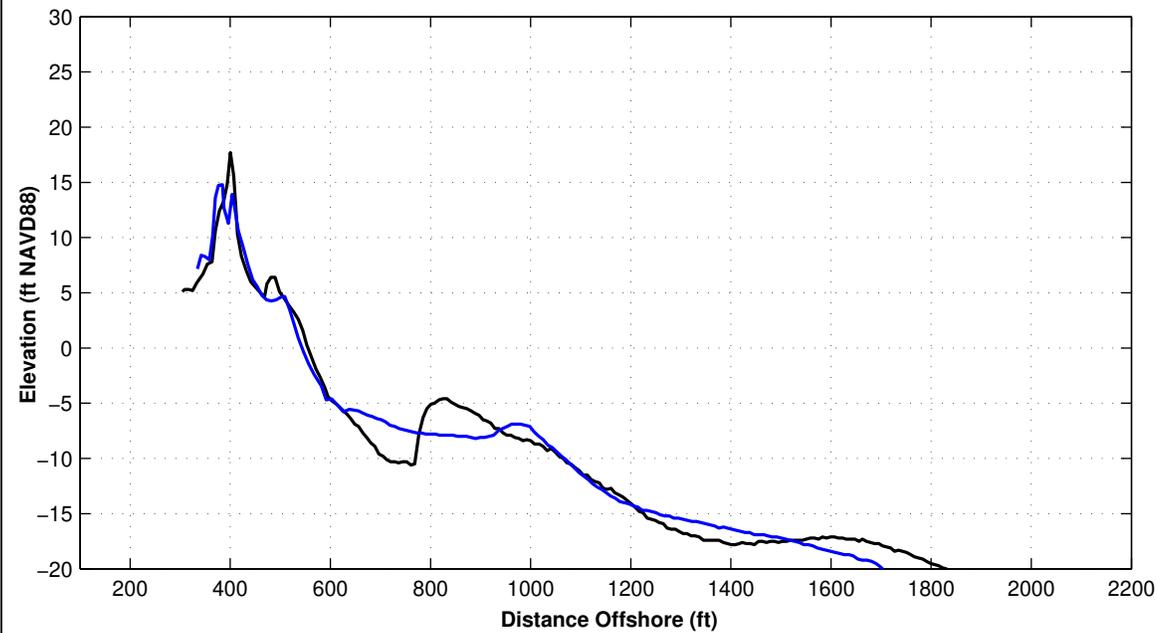
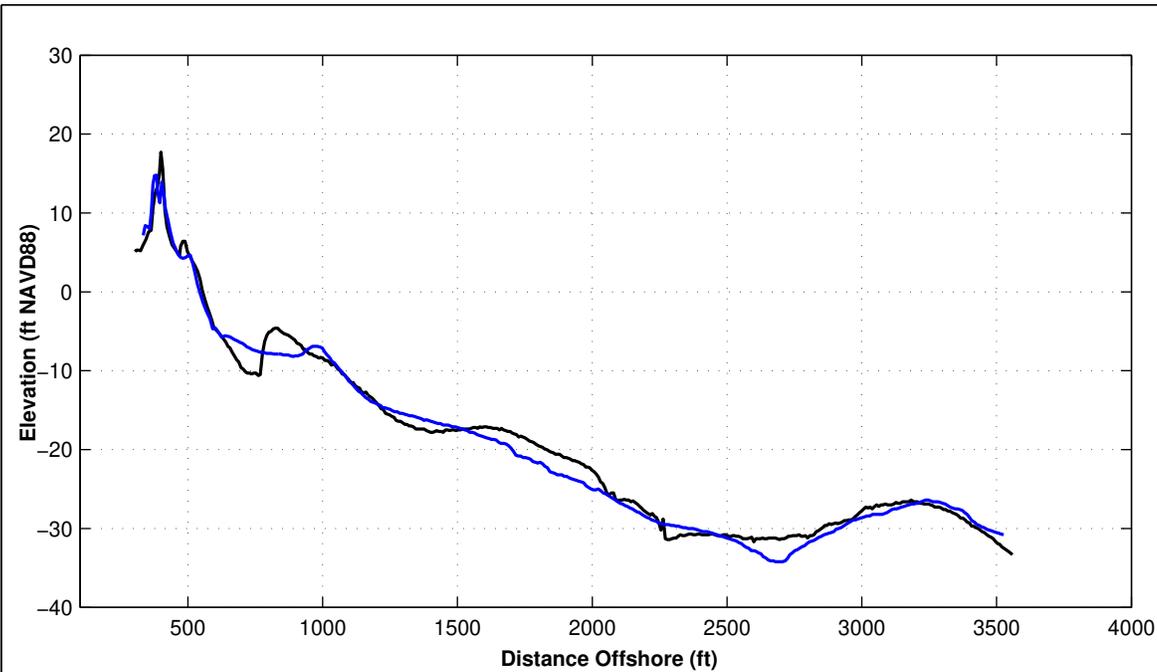


Survey Transect 1025+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-24.85 ft	-14.65 ft
Volume Change Above +6 ft NAVD88	0.50 cy/ft	-0.55 cy/ft
Volume Change Above 1.18 ft NAVD88	-2.24 cy/ft	-4.69 cy/ft
Volume Change Above -6 ft NAVD88	-8.48 cy/ft	-6.31 cy/ft
Volume Change Above -14 ft NAVD88	1.37 cy/ft	-1.21 cy/ft
Volume Change Above -19 ft NAVD88	17.26 cy/ft	5.70 cy/ft
Volume Change Above -30 ft NAVD88	-13.37 cy/ft	4.97 cy/ft

LEGEND:
 OCTOBER 2023 ———— POST-DORIAN AD ————
 JUNE 2023 ———— JUNE 2022 ————

- Notes:
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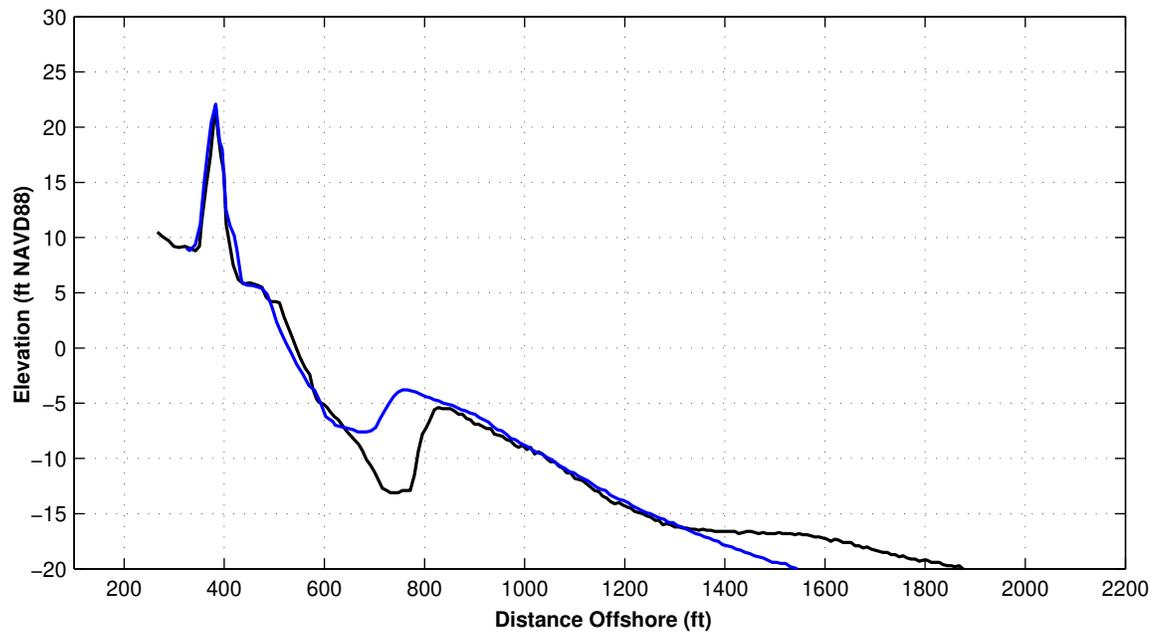
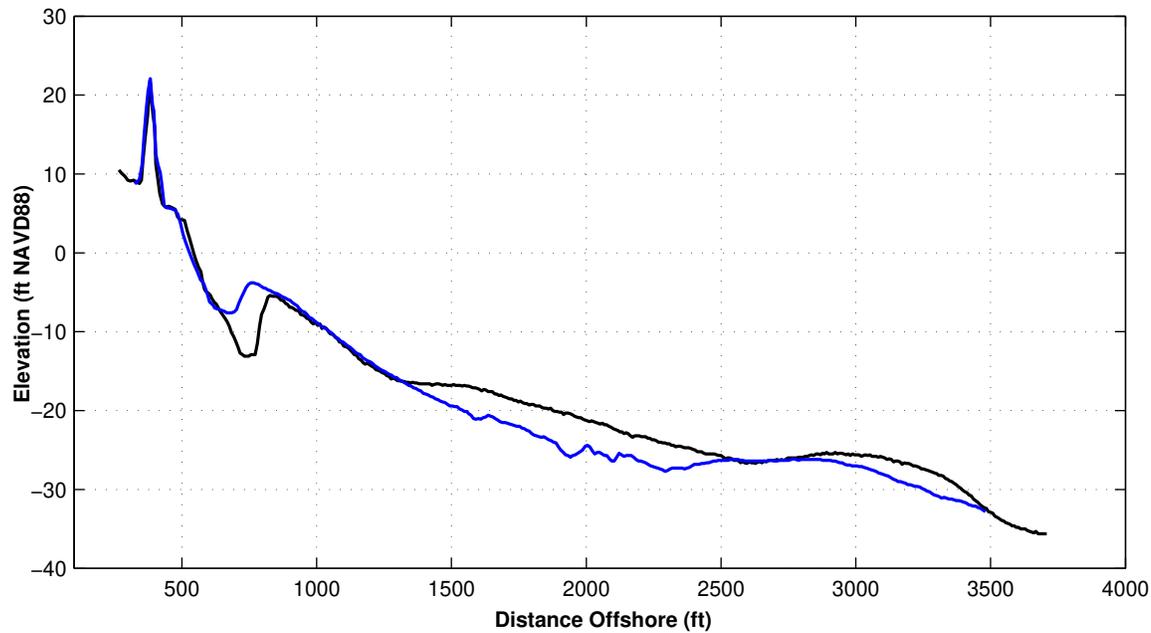


Survey Transect 1030+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-13.32 ft	- ft
Volume Change Above +6 ft NAVD88	-0.16 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	-2.65 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	-7.36 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	-2.61 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	-1.01 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	-77.90 cy/ft	- cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

- Notes:
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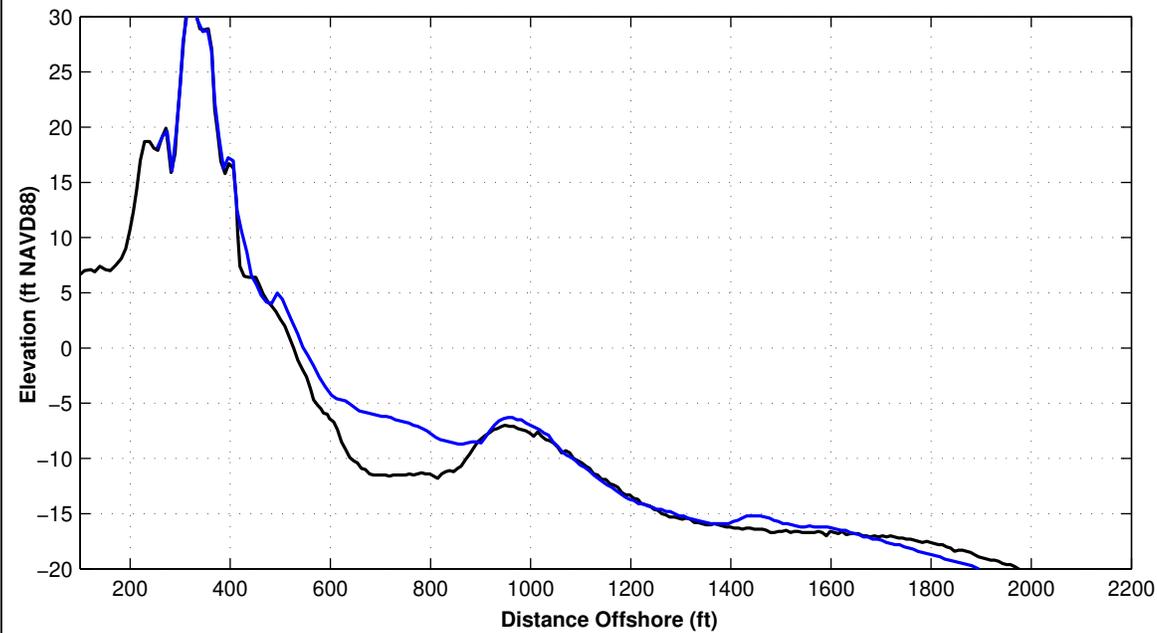
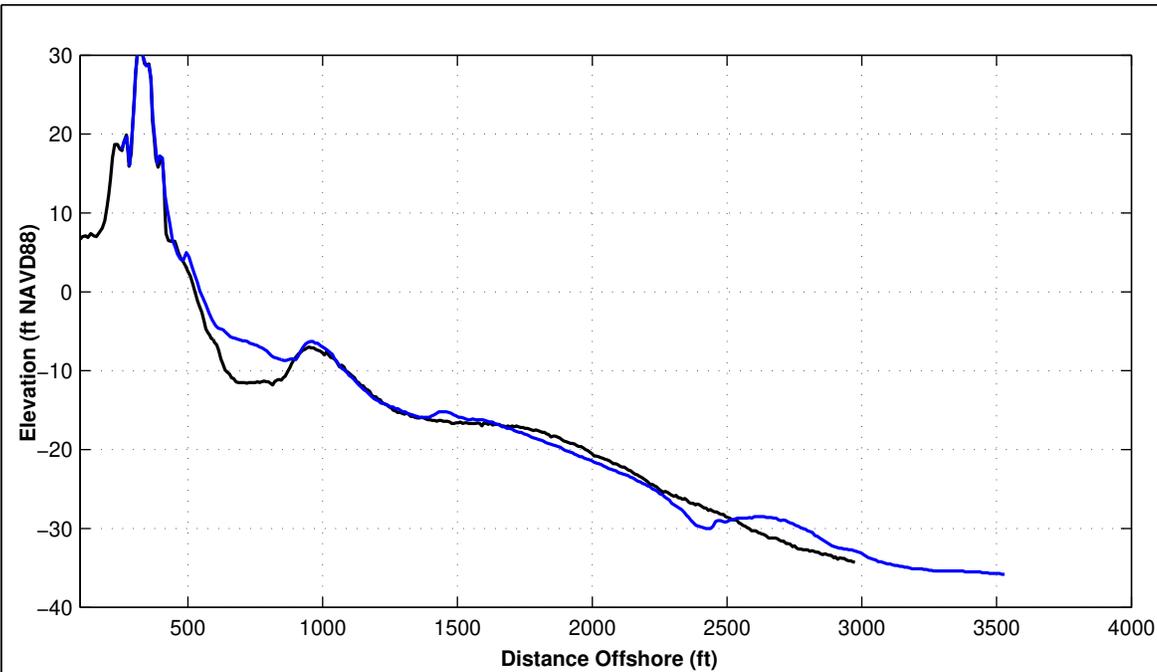


Survey Transect 1035+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-17.70 ft	- ft
Volume Change Above +6 ft NAVD88	2.76 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	0.65 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	5.59 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	34.81 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	14.12 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	-128.11 cy/ft	- cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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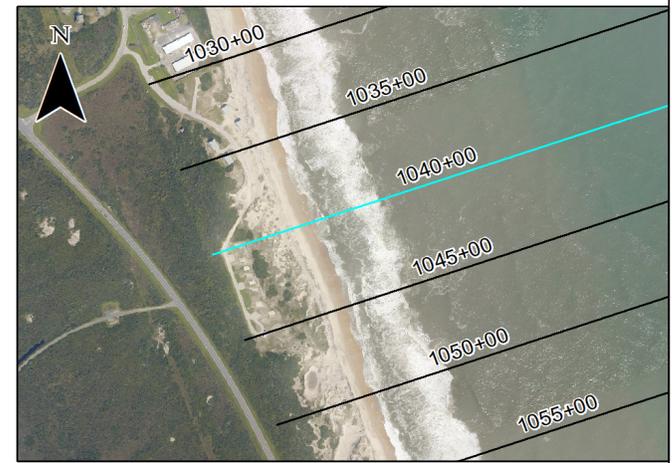


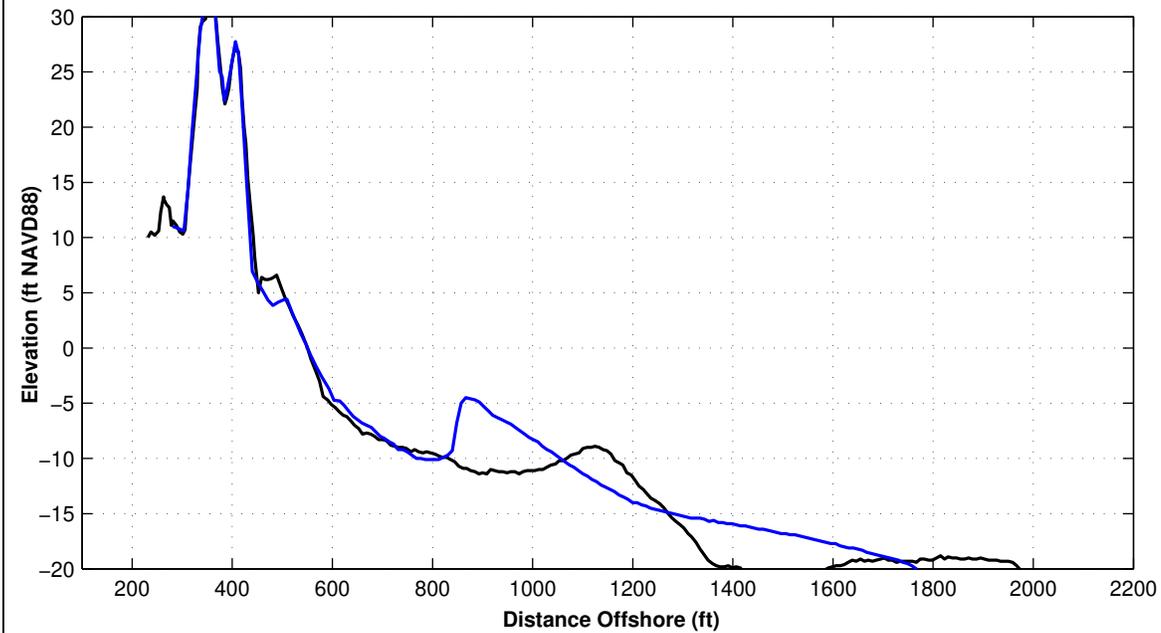
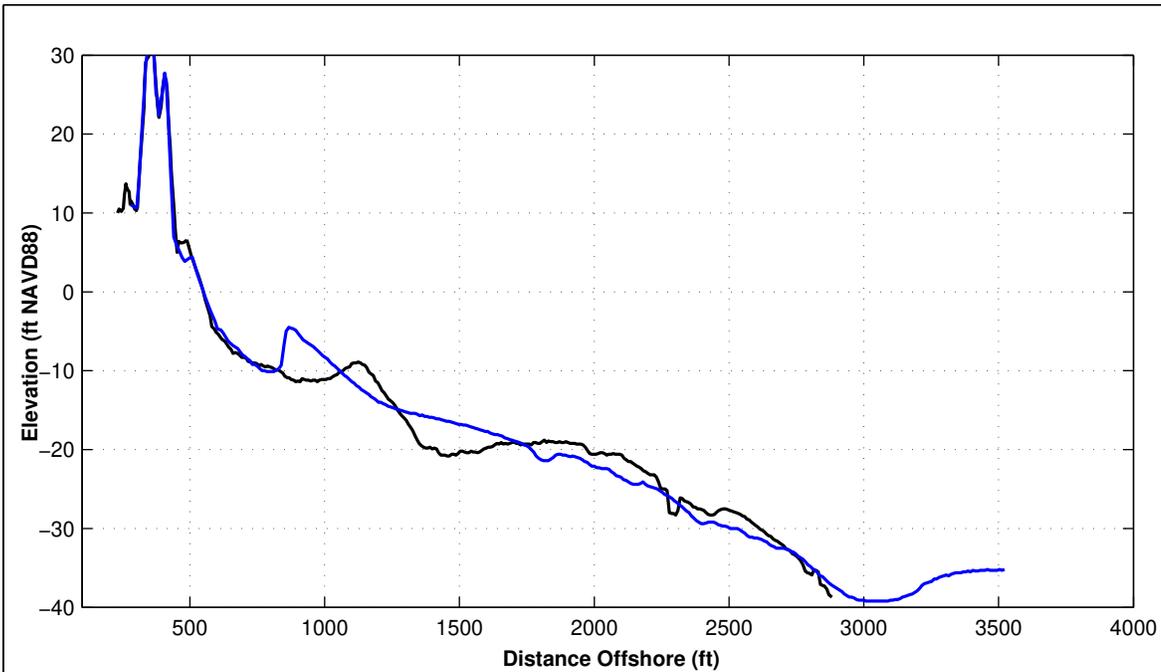


Survey Transect 1040+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	19.22 ft	– ft
Volume Change Above +6 ft NAVD88	3.50 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	5.91 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	15.13 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	55.81 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	57.45 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	39.26 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

Notes:
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 2. All Survey Elevations In Feet Referenced to NAVD88.

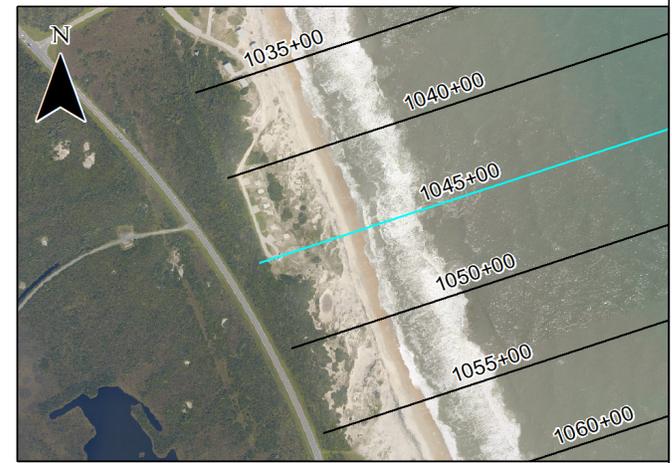


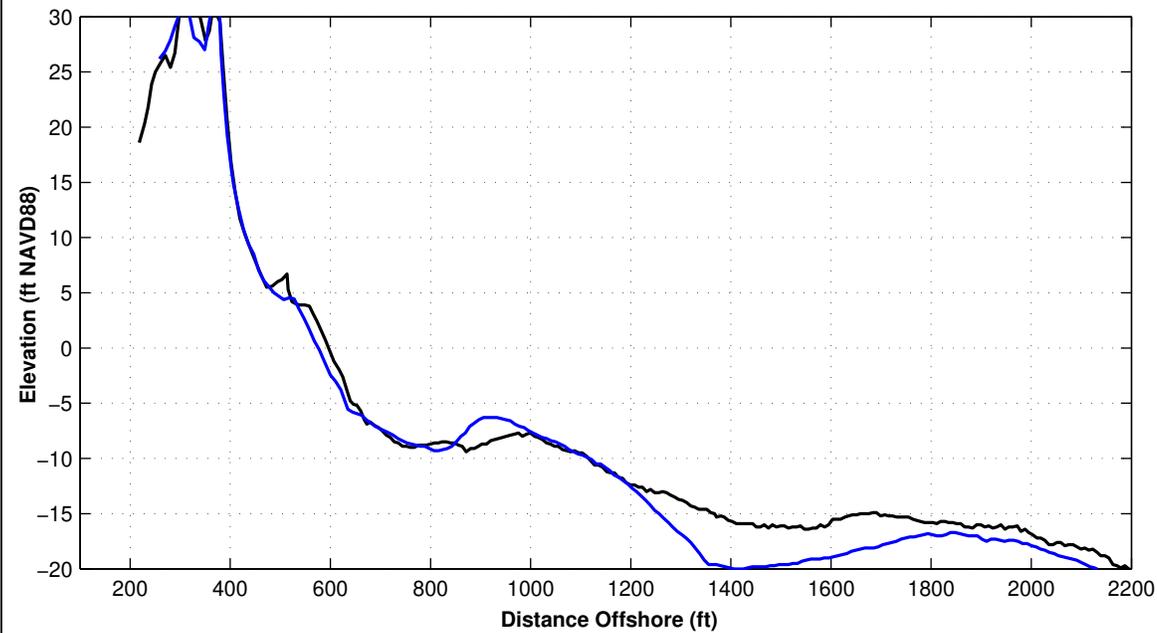
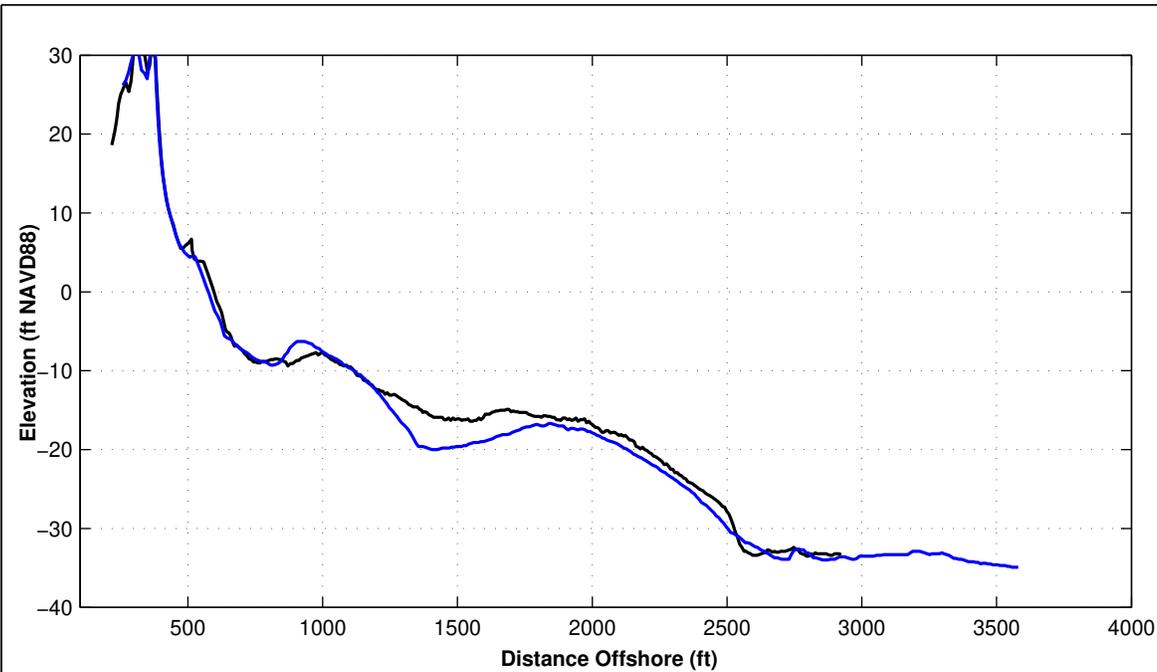


Survey Transect 1045+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-1.50 ft	- ft
Volume Change Above +6 ft NAVD88	-3.13 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	-5.70 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	-0.93 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	15.23 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	44.16 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	8.70 cy/ft	- cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
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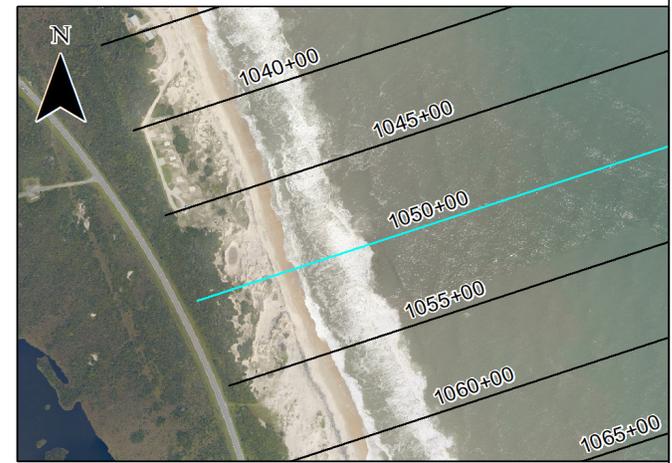
Survey Transect 1050+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-22.65 ft	- ft
Volume Change Above +6 ft NAVD88	-0.10 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	-3.88 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	-8.77 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	-2.58 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	-72.85 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	-98.92 cy/ft	- cy/ft

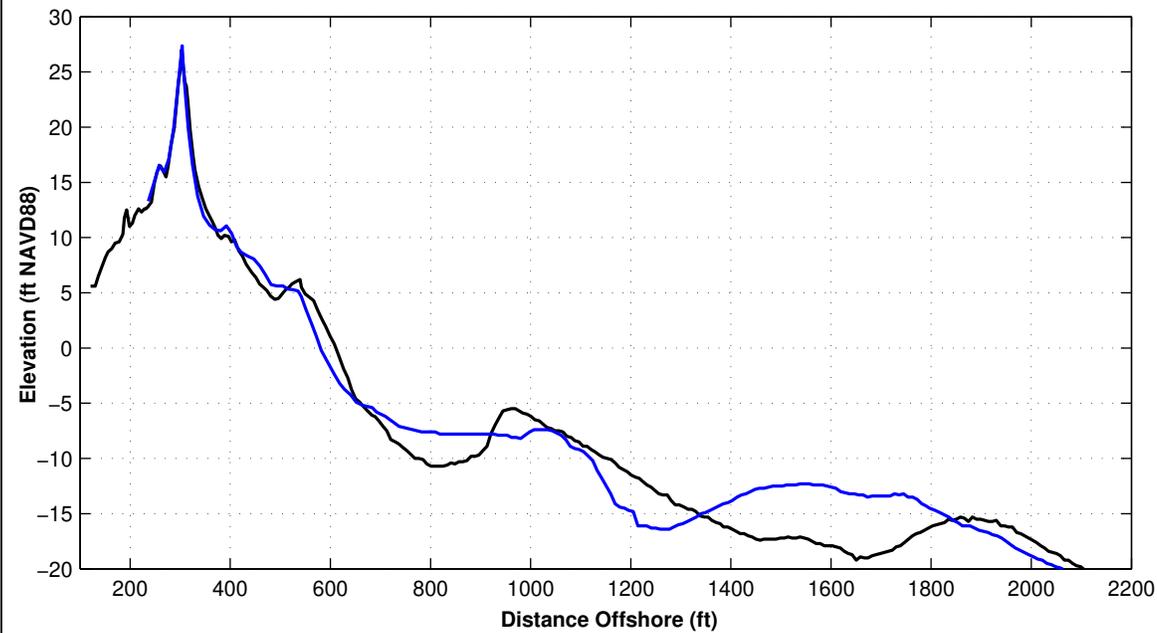
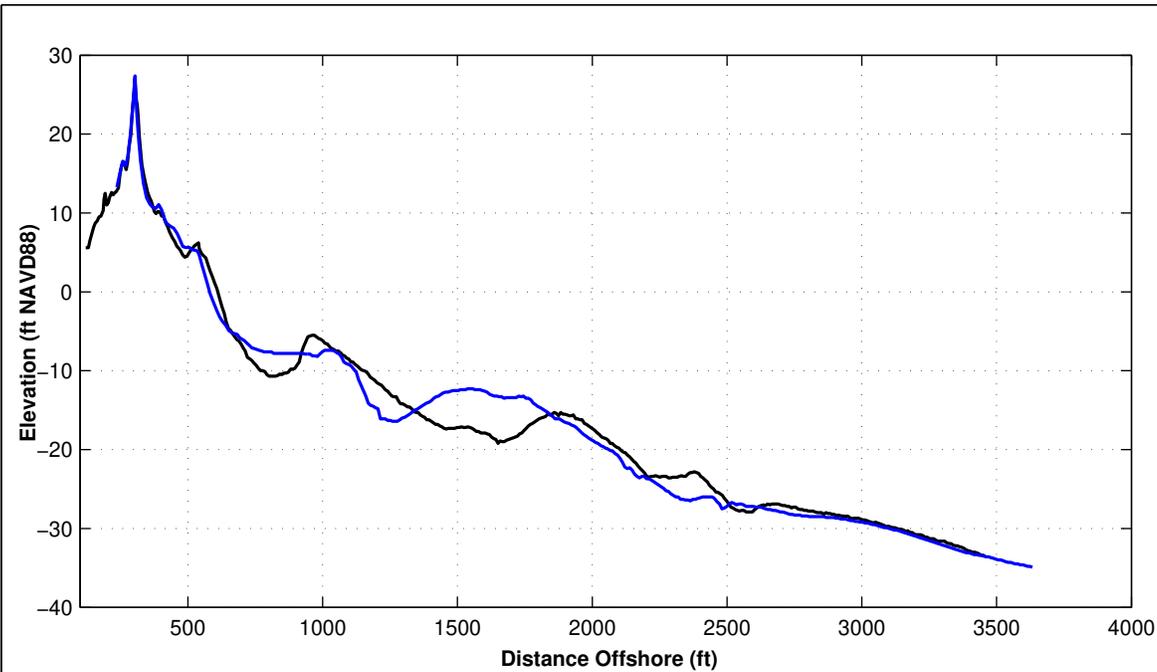
LEGEND:

OCTOBER 2023 — POST-DORIAN AD —

JUNE 2023 — JUNE 2022 —

- Notes:
1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

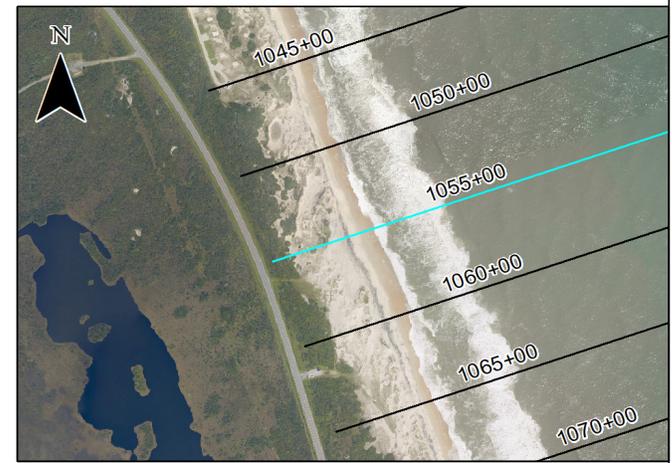


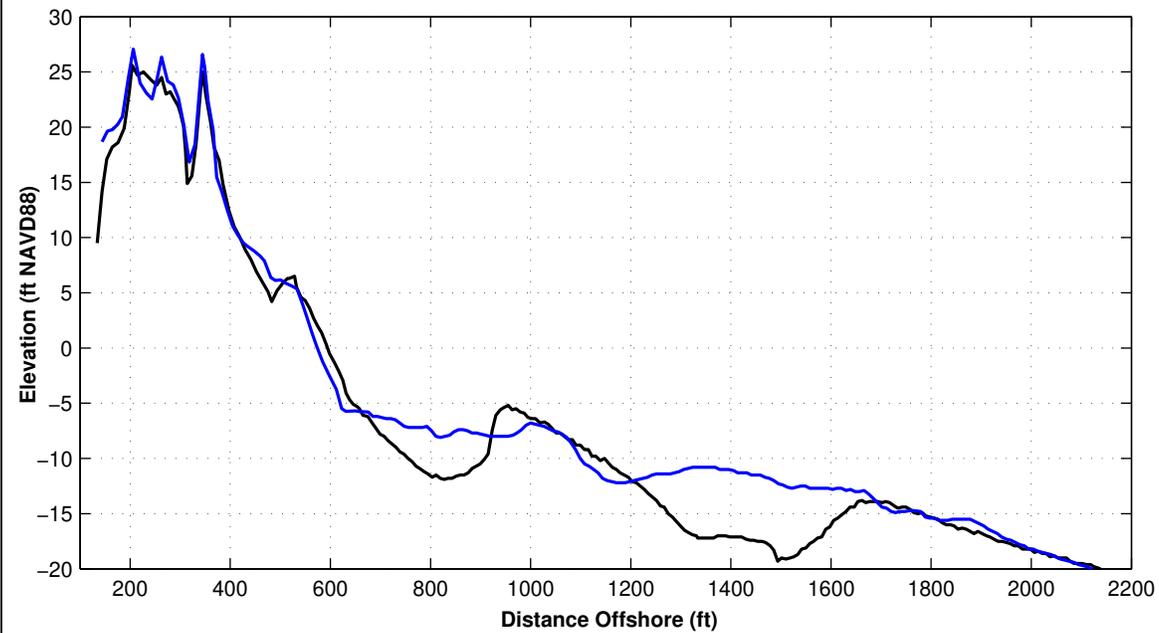
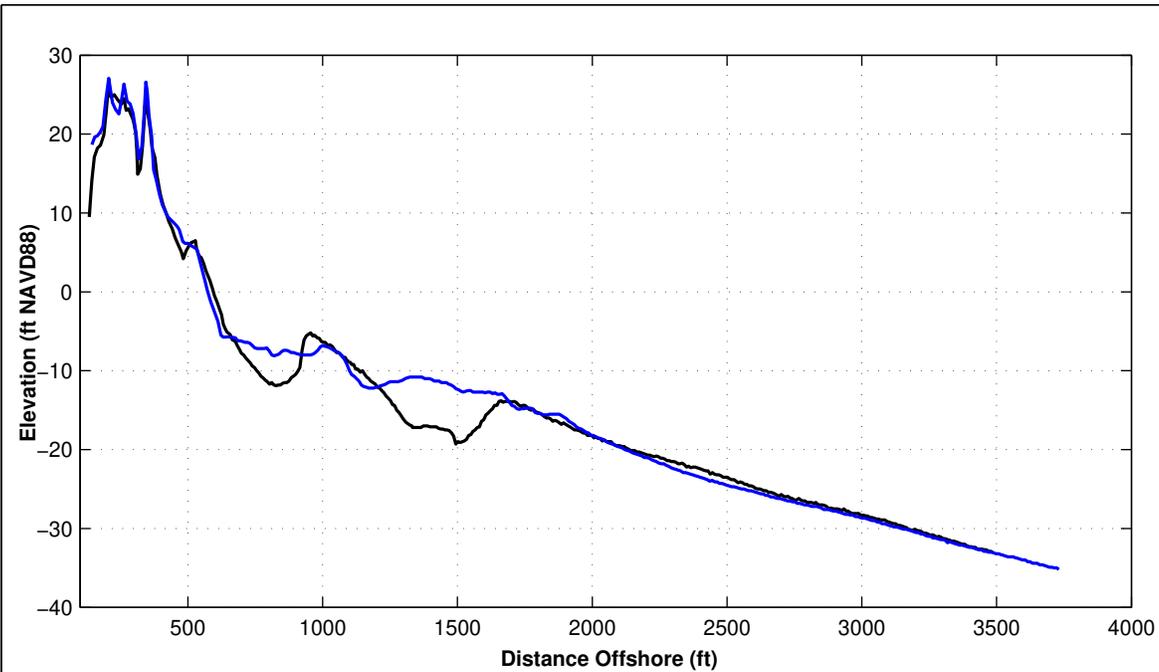


Survey Transect 1055+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-27.55 ft	- ft
Volume Change Above +6 ft NAVD88	0.38 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	-1.90 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	-7.12 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	6.19 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	46.44 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	10.81 cy/ft	- cy/ft

LEGEND:
 OCTOBER 2023 —— POST-DORIAN AD ——
 JUNE 2023 —— JUNE 2022 ——

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

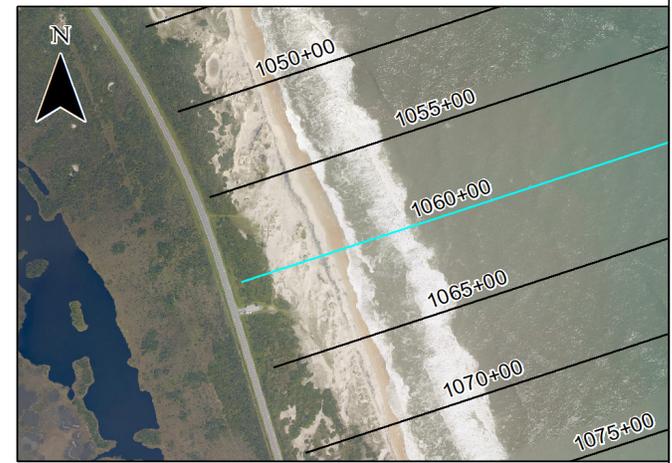


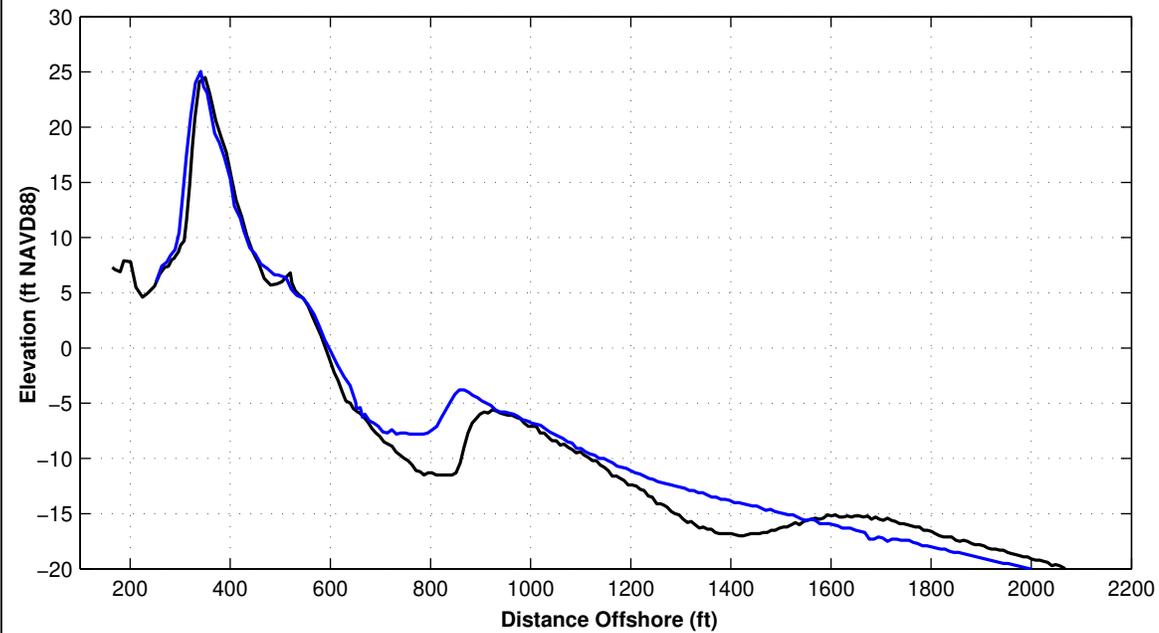
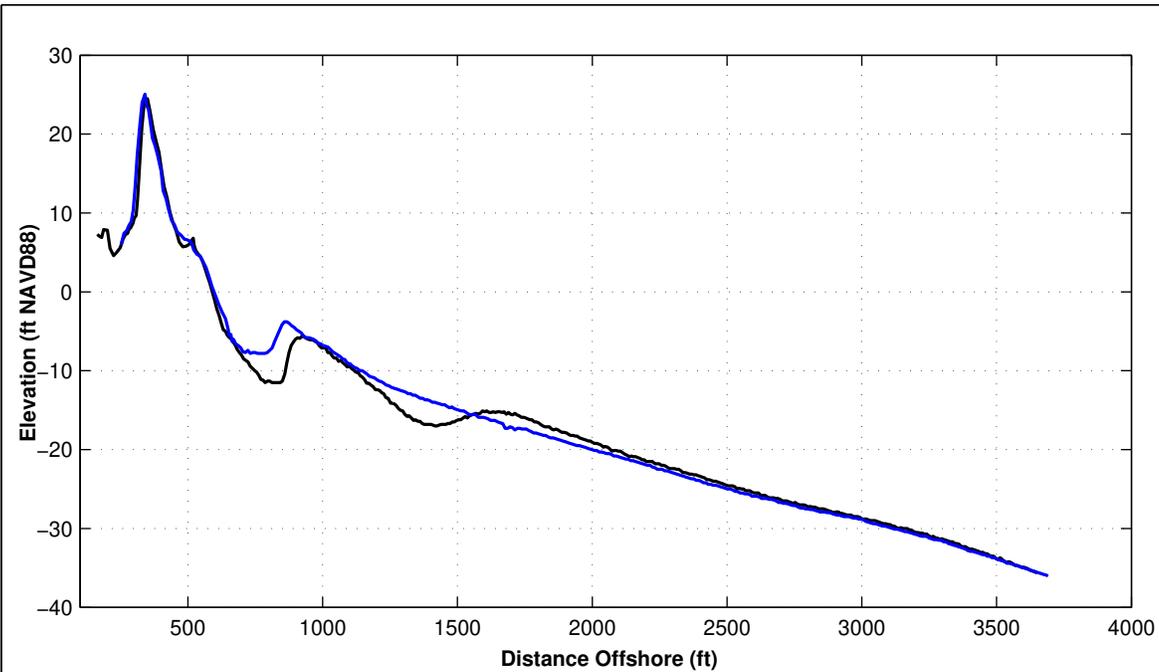


Survey Transect 1060+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-19.39 ft	- ft
Volume Change Above +6 ft NAVD88	4.99 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	4.35 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	-1.96 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	50.34 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	95.84 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	73.92 cy/ft	- cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

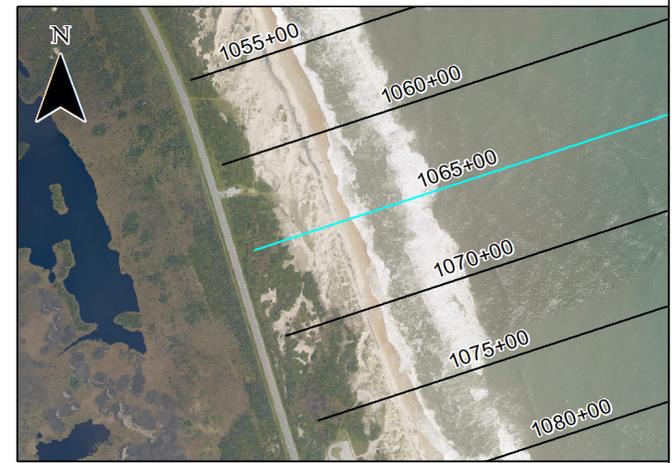


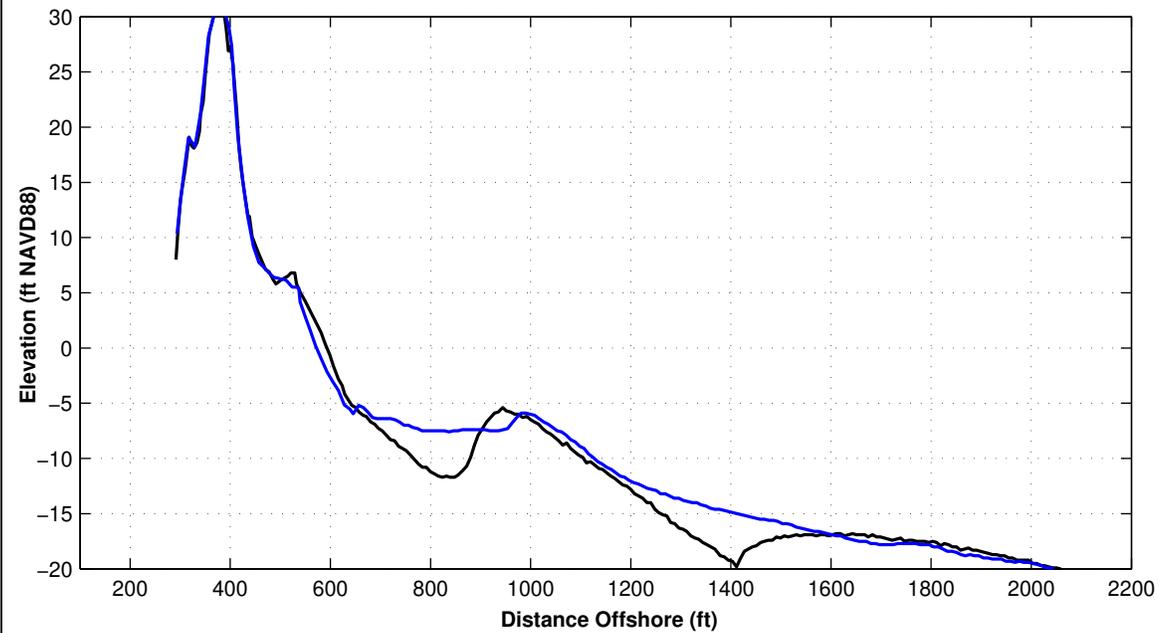
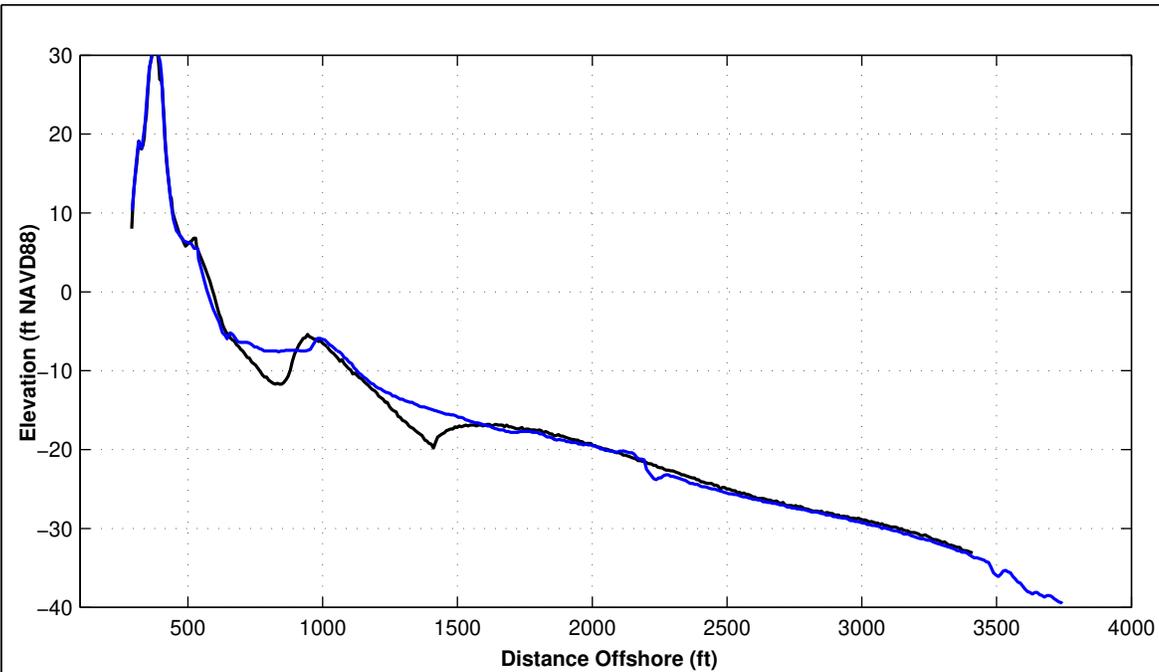


Survey Transect 1065+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	4.07 ft	– ft
Volume Change Above +6 ft NAVD88	–1.66 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	–1.35 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	7.17 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	43.44 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	45.50 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	24.75 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

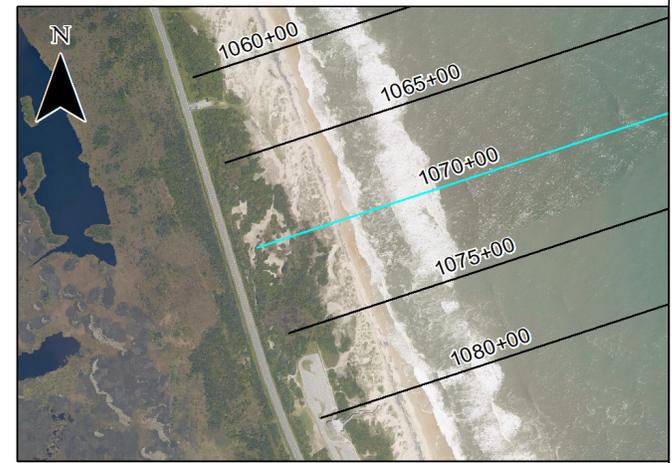


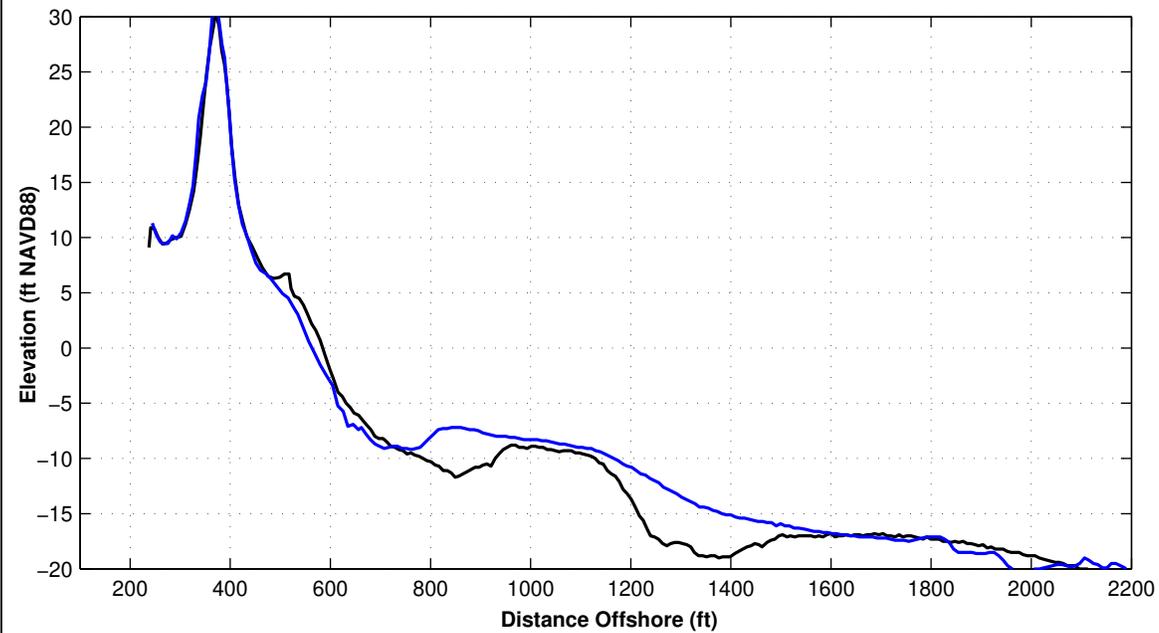
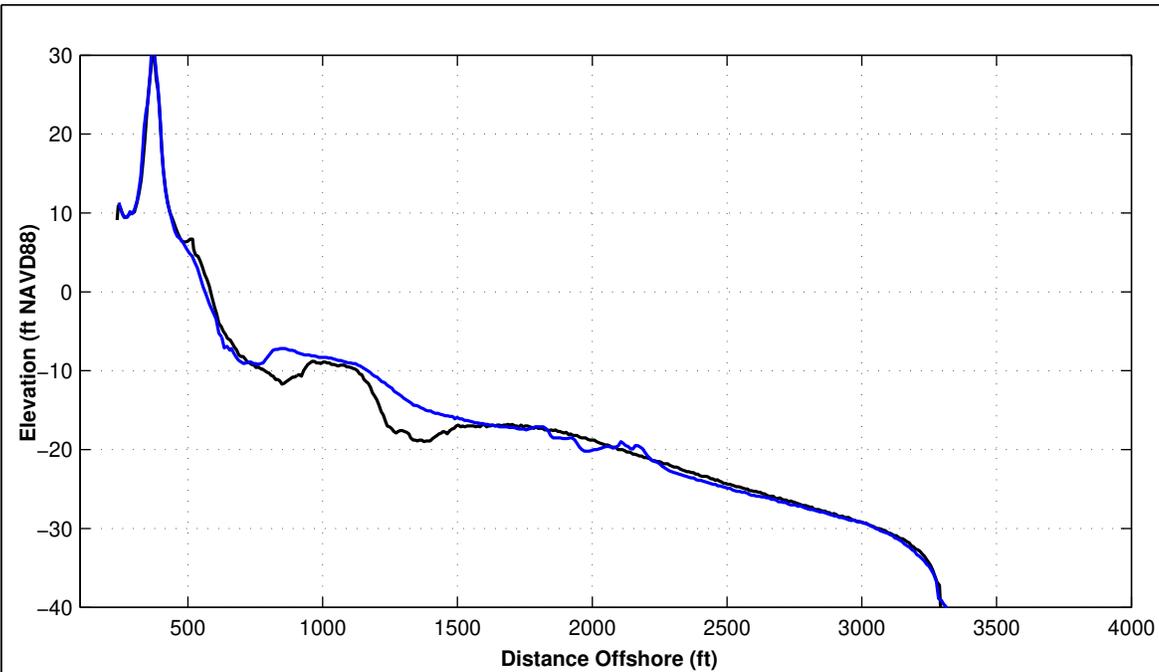


Survey Transect 1070+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-20.16 ft	- ft
Volume Change Above +6 ft NAVD88	-0.12 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	-2.36 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	-6.47 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	21.57 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	43.78 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	29.38 cy/ft	- cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

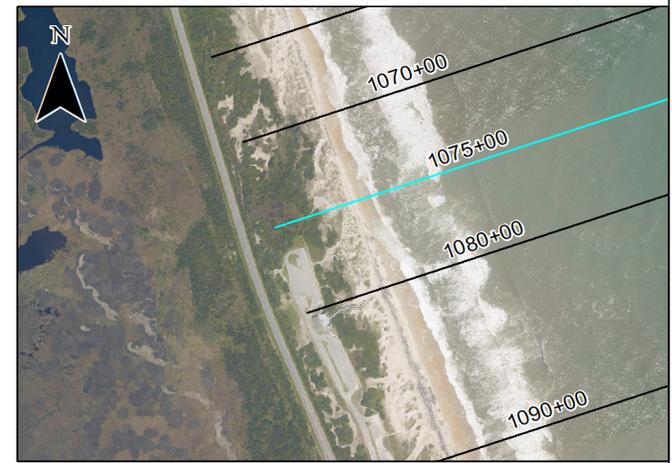


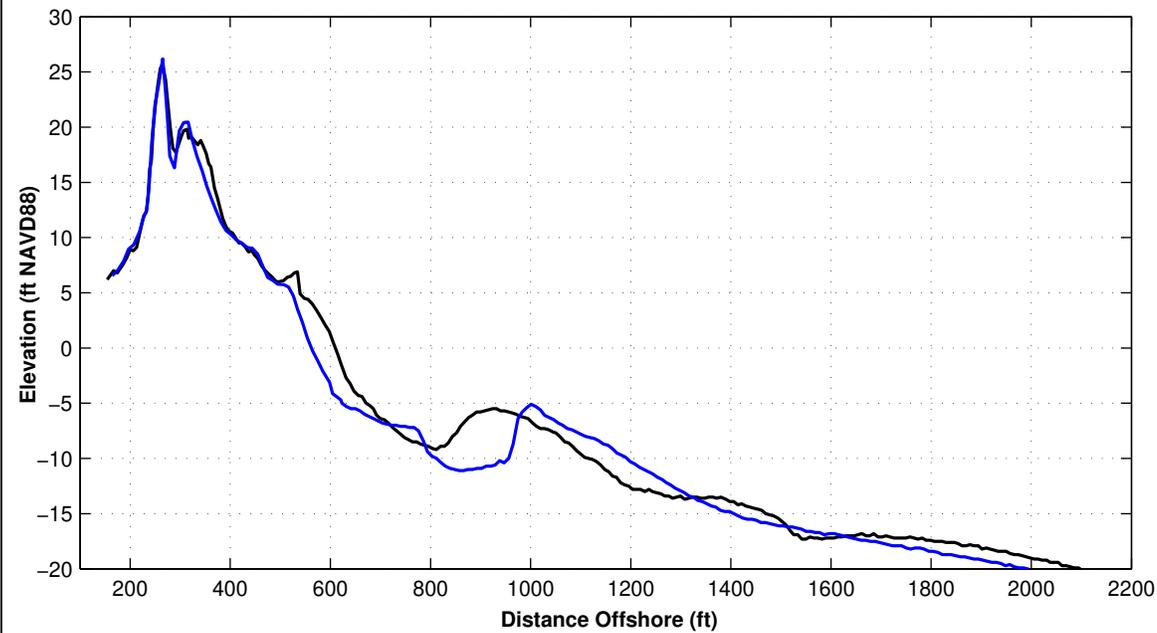
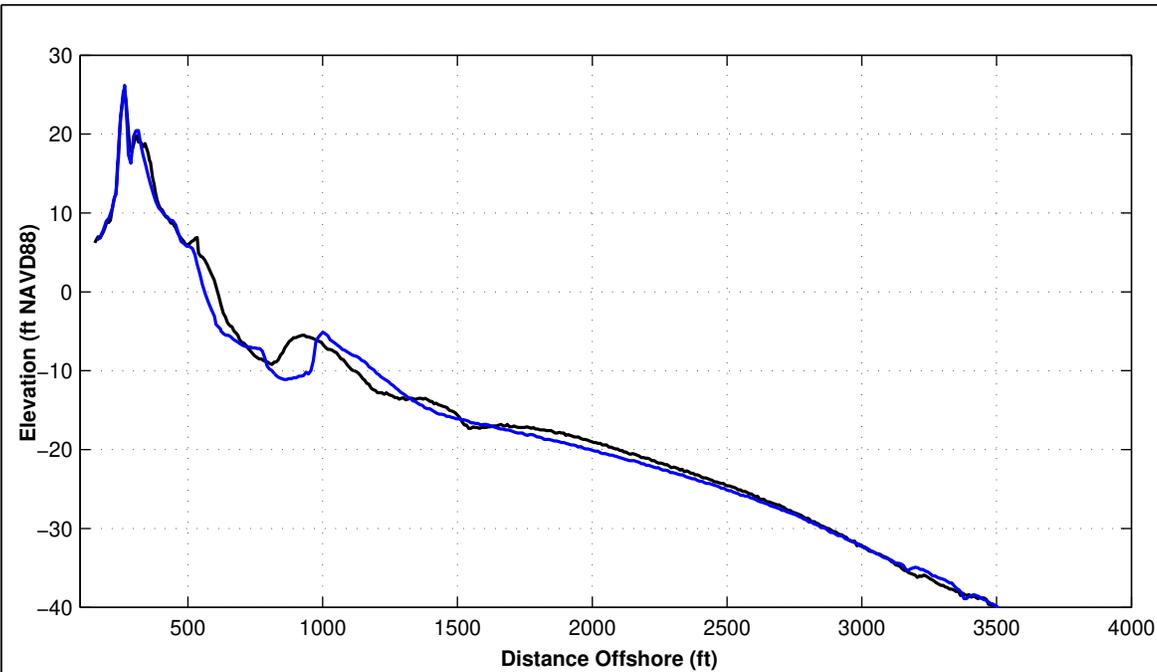


Survey Transect 1075+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-23.41 ft	- ft
Volume Change Above +6 ft NAVD88	-0.92 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	-4.91 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	-9.17 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	23.59 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	54.42 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	42.27 cy/ft	- cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

- Notes:
 1. Station From North To South At Varying Intervals.
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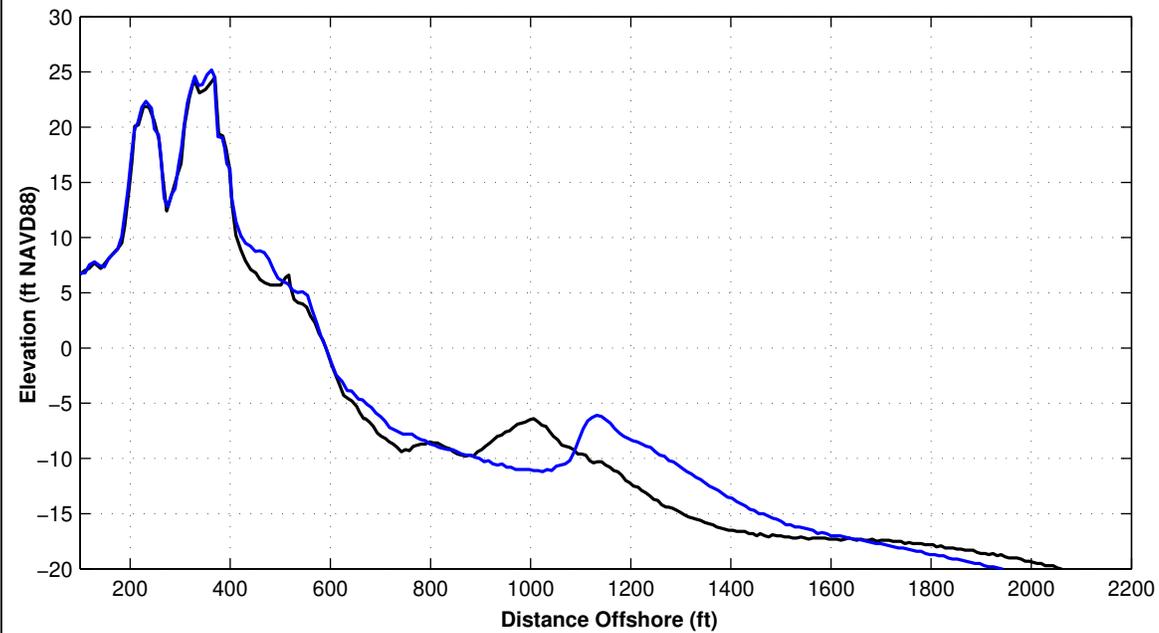
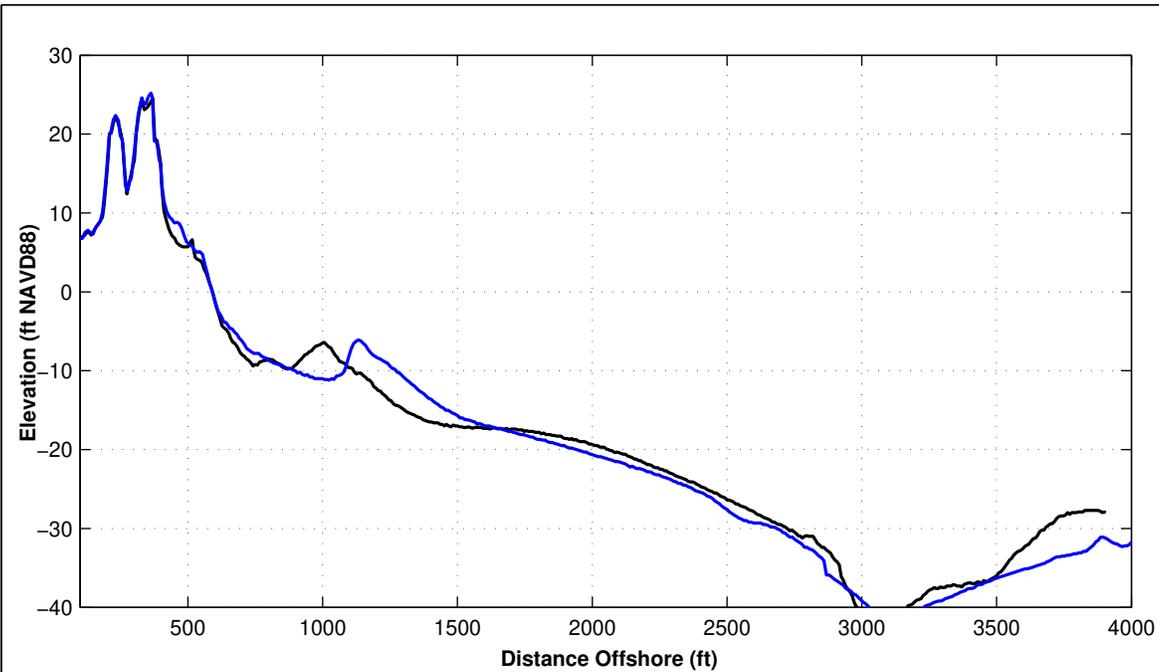


Survey Transect 1080+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-48.23 ft	- ft
Volume Change Above +6 ft NAVD88	-3.91 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	-10.09 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	-21.73 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	-24.99 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	-37.68 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	-59.43 cy/ft	- cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

- Notes:
 1. Station From North To South At Varying Intervals.
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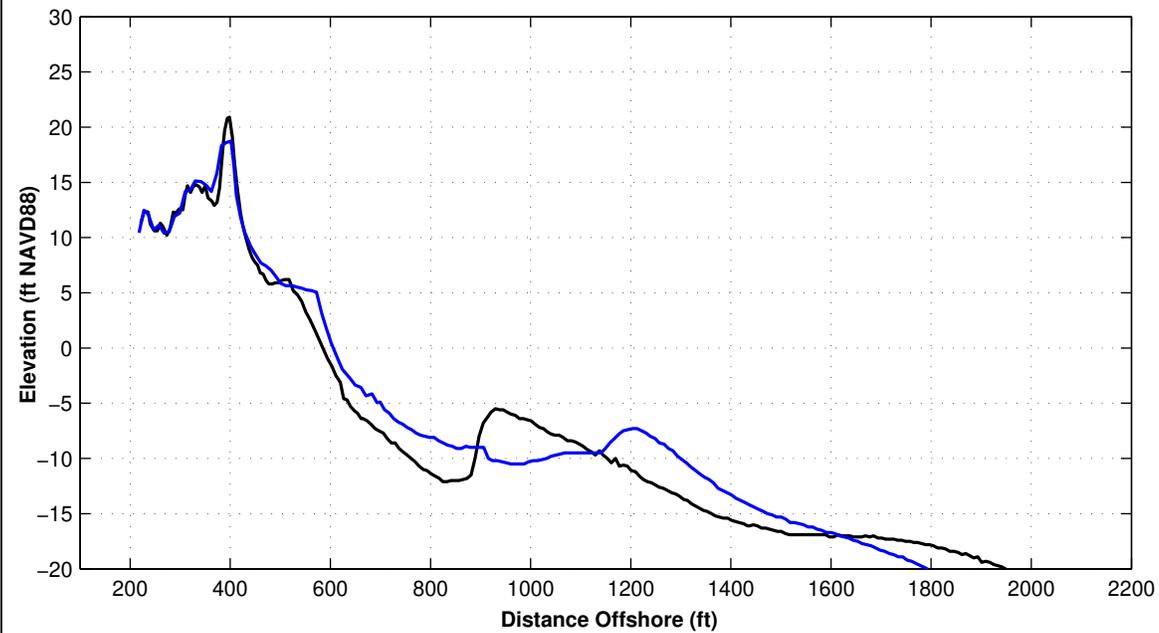
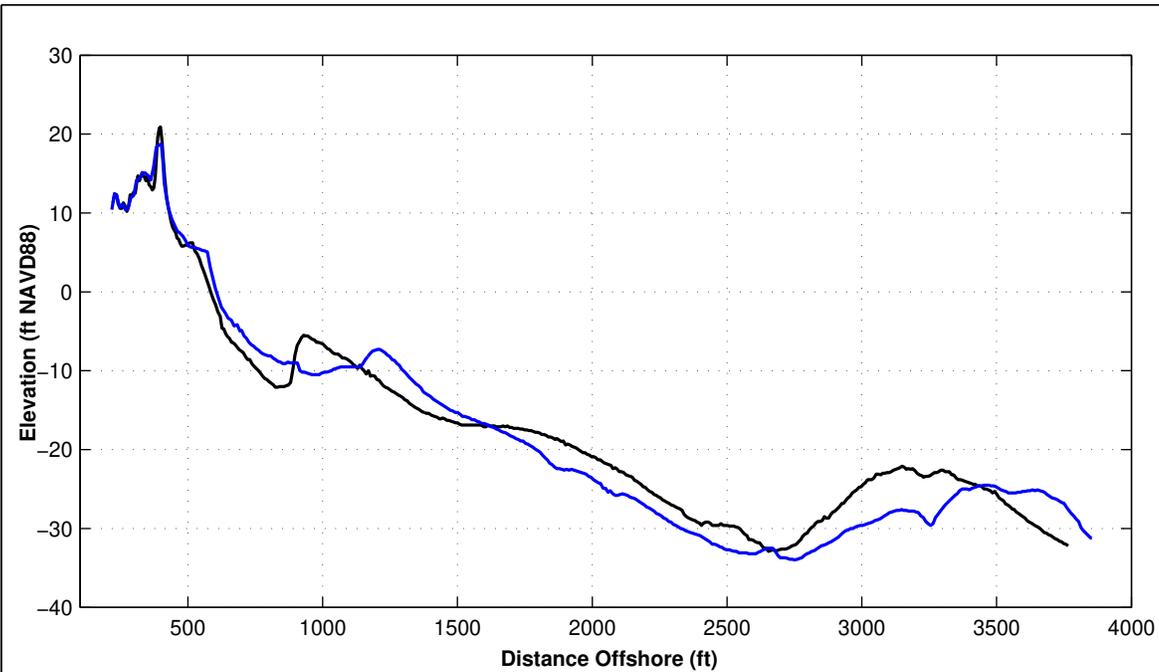


Survey Transect 1090+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	0.84 ft	– ft
Volume Change Above +6 ft NAVD88	6.86 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	8.81 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	11.21 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	31.61 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	44.15 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	12.20 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

- Notes:
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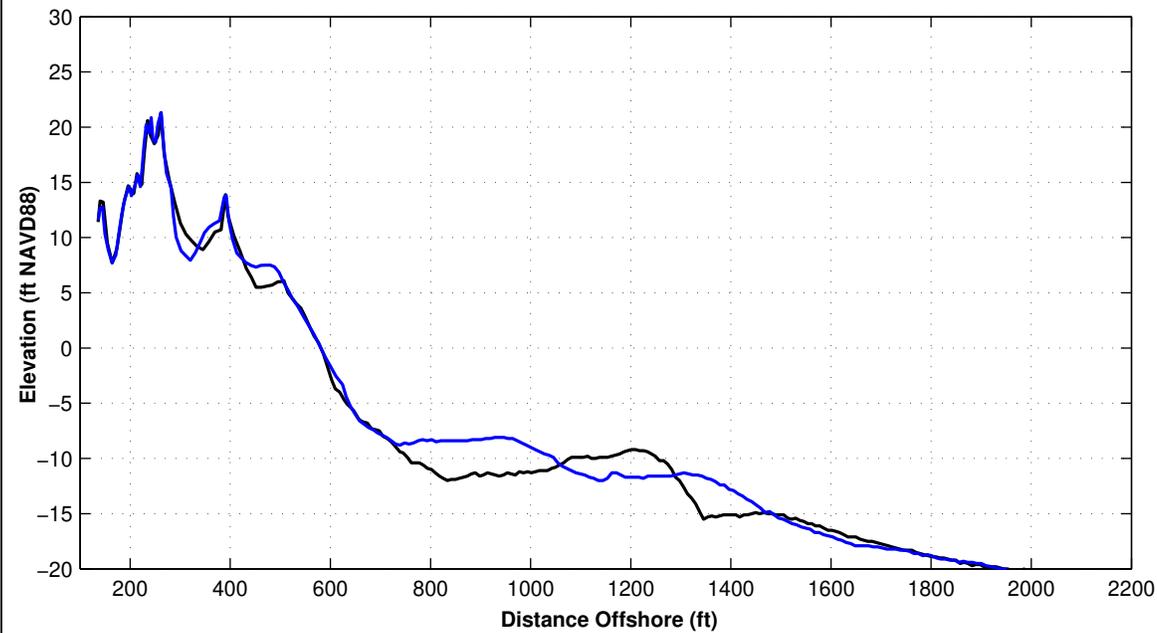
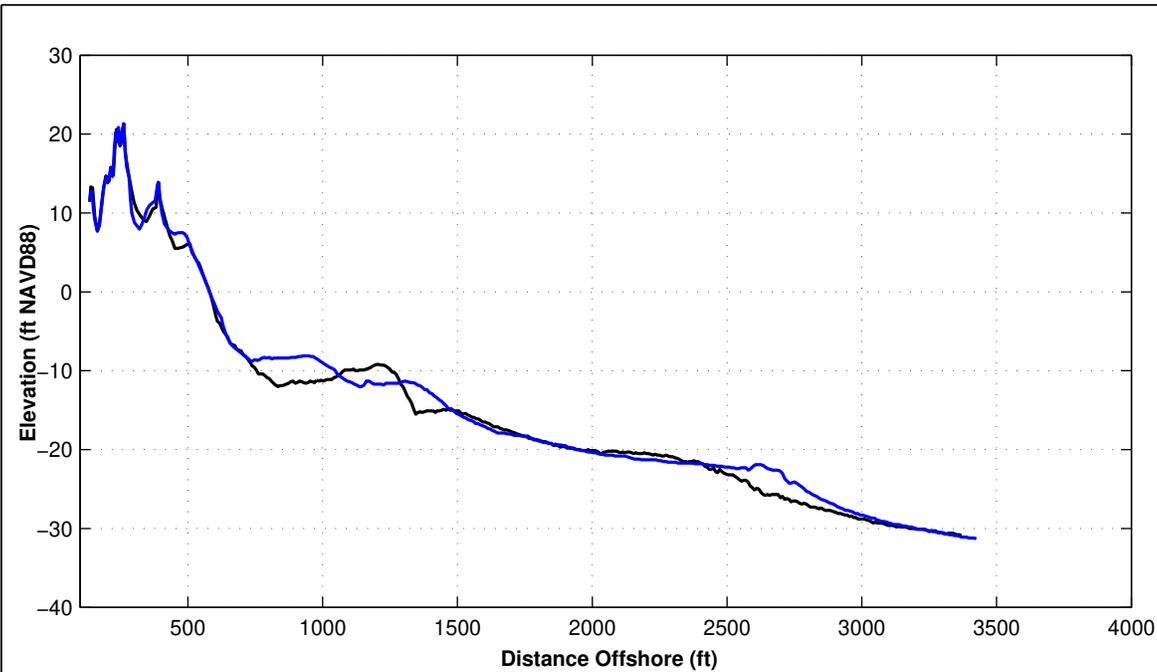


Survey Transect 1100+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	22.94 ft	– ft
Volume Change Above +6 ft NAVD88	0.32 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	5.11 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	13.57 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	39.82 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	42.94 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	–167.04 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

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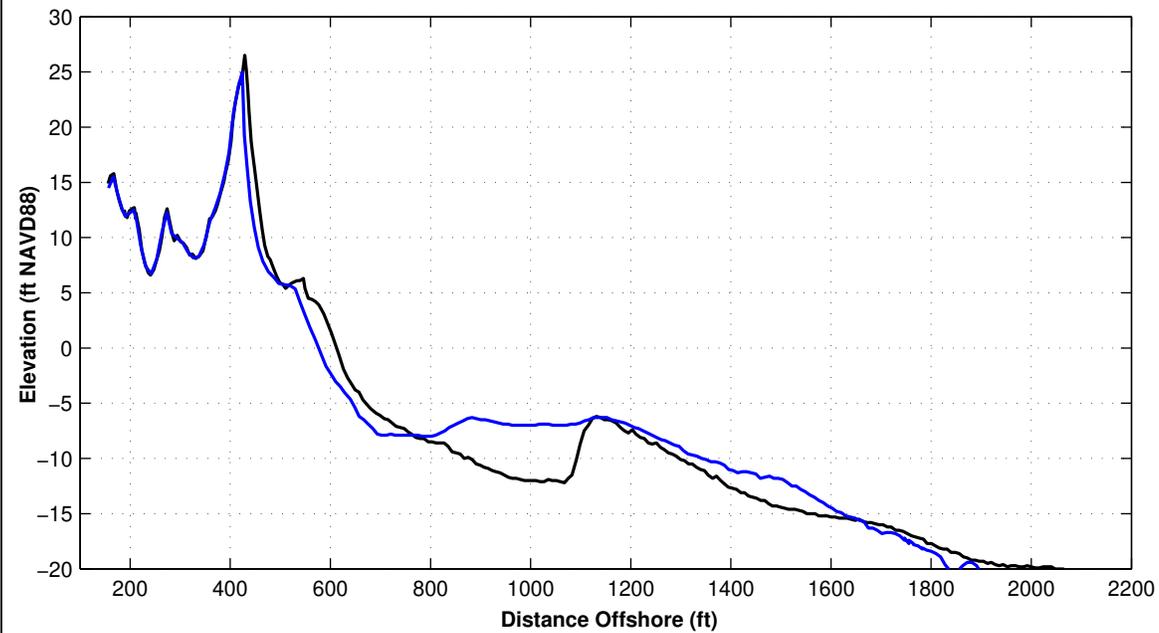
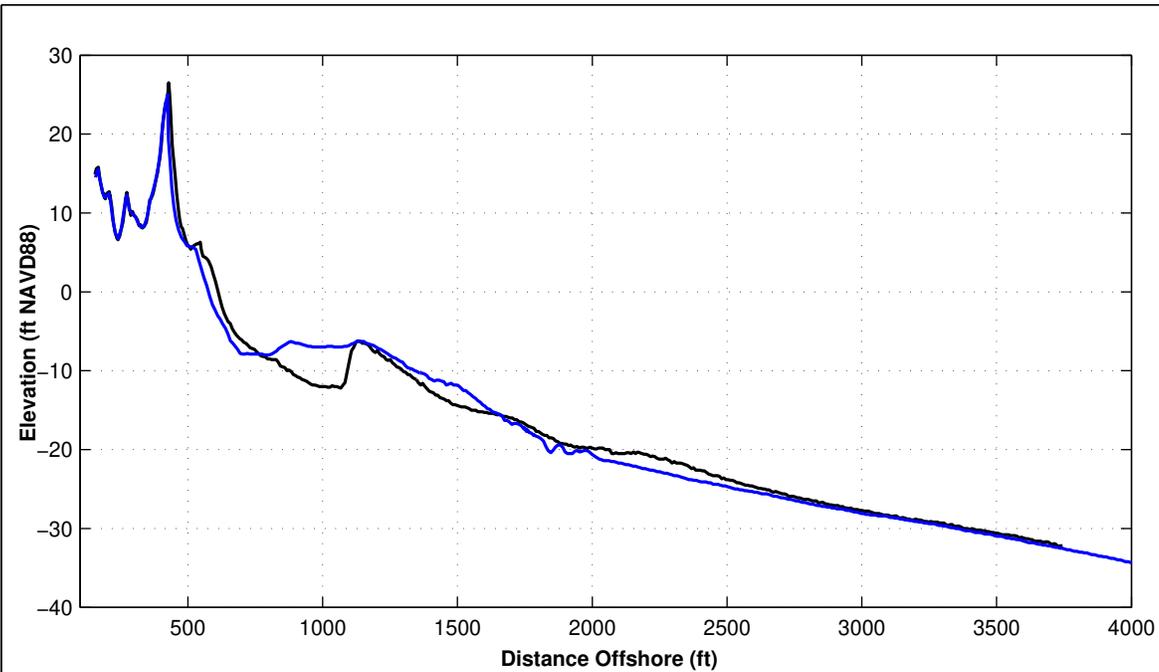


Survey Transect 1110+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	1.57 ft	– ft
Volume Change Above +6 ft NAVD88	3.45 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	3.94 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	5.50 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	29.72 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	30.52 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	59.91 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
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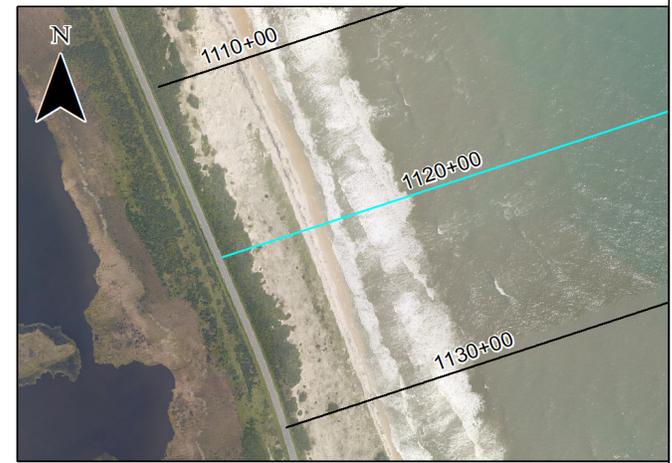


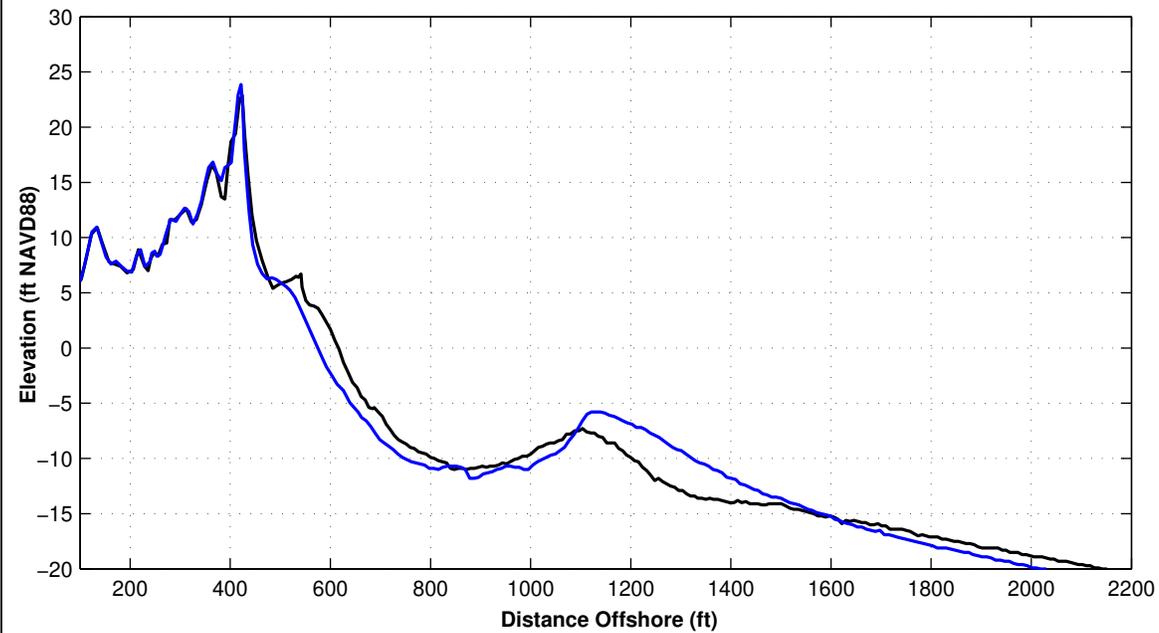
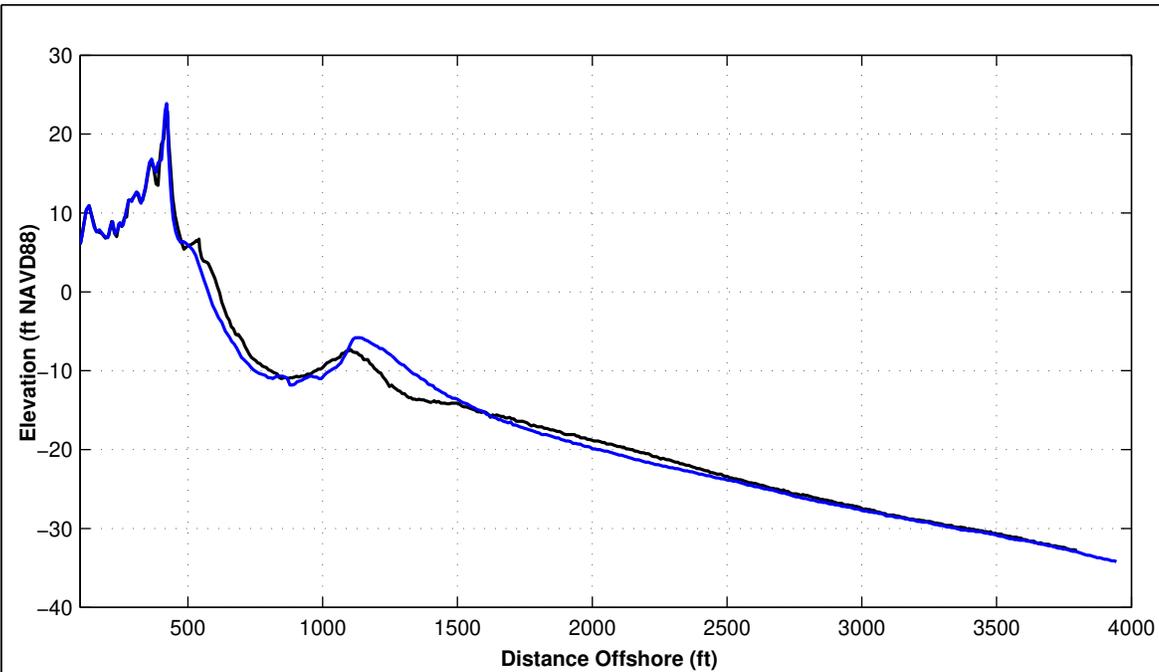


Survey Transect 1120+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-37.51 ft	- ft
Volume Change Above +6 ft NAVD88	-7.57 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	-13.21 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	-21.53 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	38.27 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	38.02 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	-6.39 cy/ft	- cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

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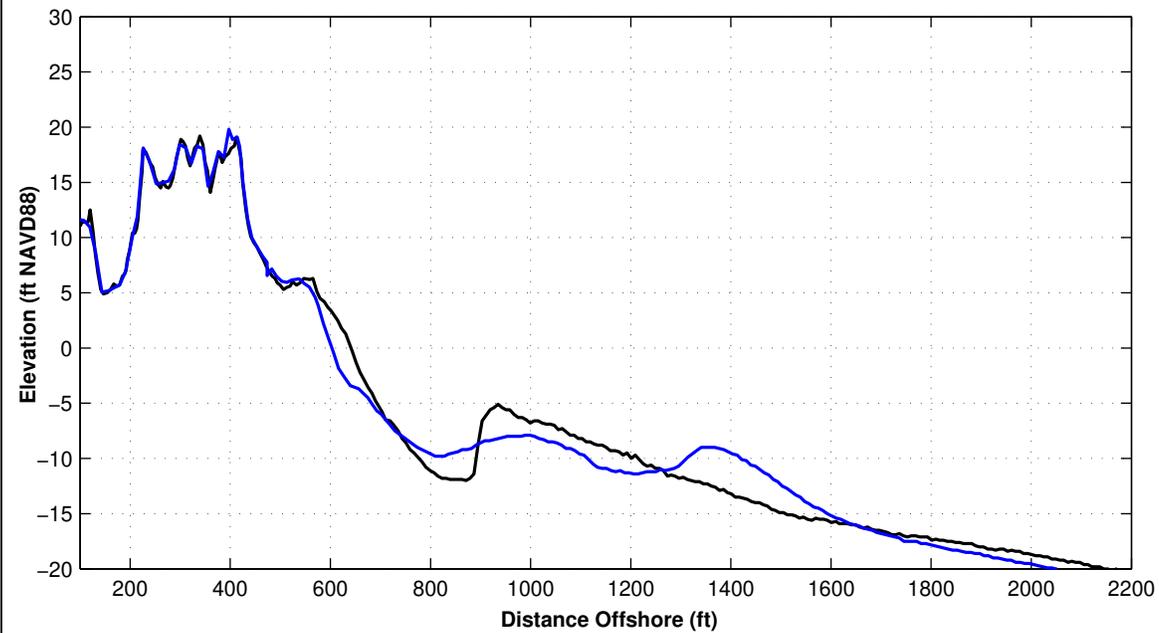
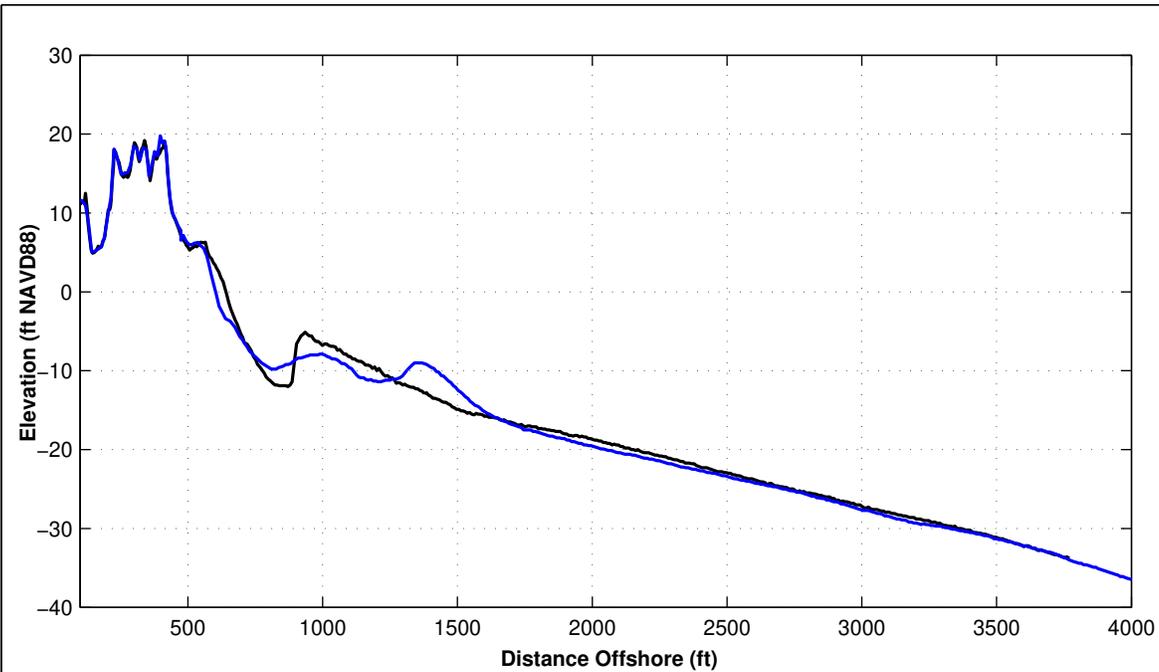


Survey Transect 1130+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-41.45 ft	- ft
Volume Change Above +6 ft NAVD88	-3.04 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	-8.65 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	-18.12 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	4.63 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	-3.42 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	-28.84 cy/ft	- cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
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Survey Transect 1140+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-37.63 ft	- ft
Volume Change Above +6 ft NAVD88	1.68 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	-1.65 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	-10.36 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	2.59 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	0.99 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	-23.81 cy/ft	- cy/ft

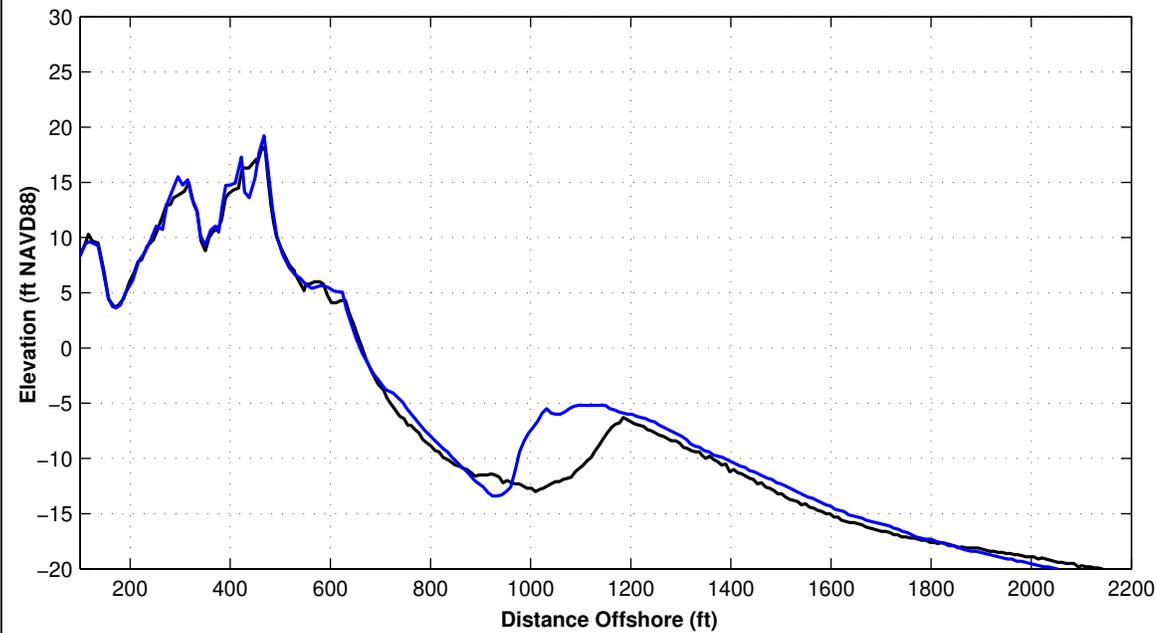
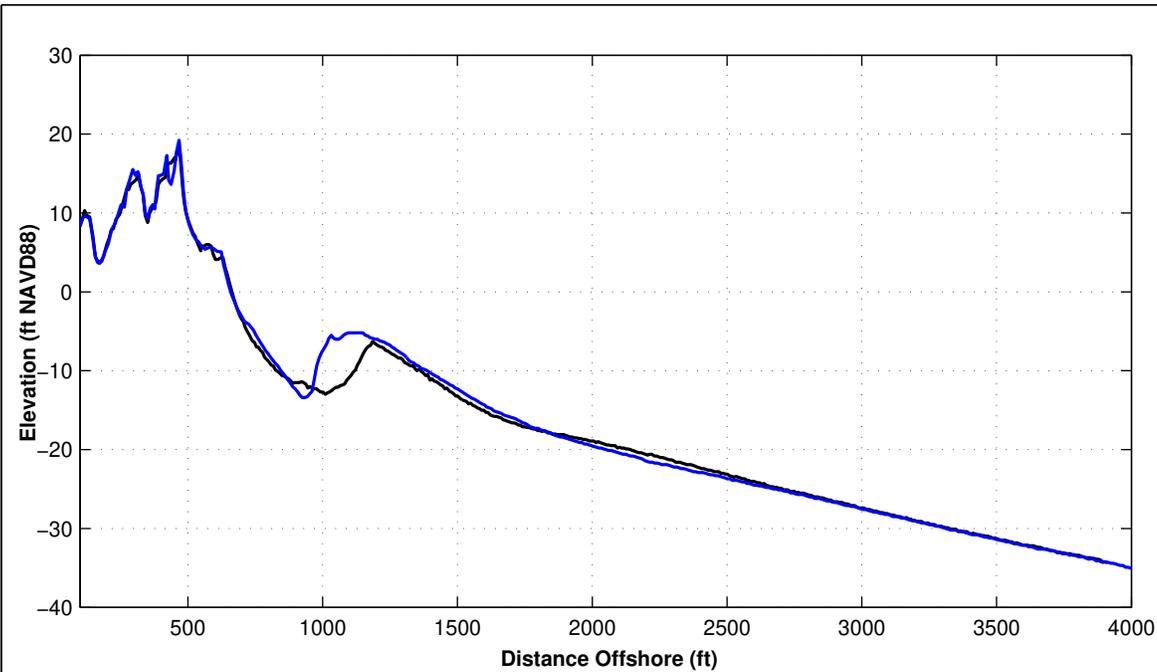
LEGEND:

OCTOBER 2023 — POST-DORIAN AD —

JUNE 2023 — JUNE 2022 —

- Notes:
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 2. All Survey Elevations In Feet Referenced to NAVD88.

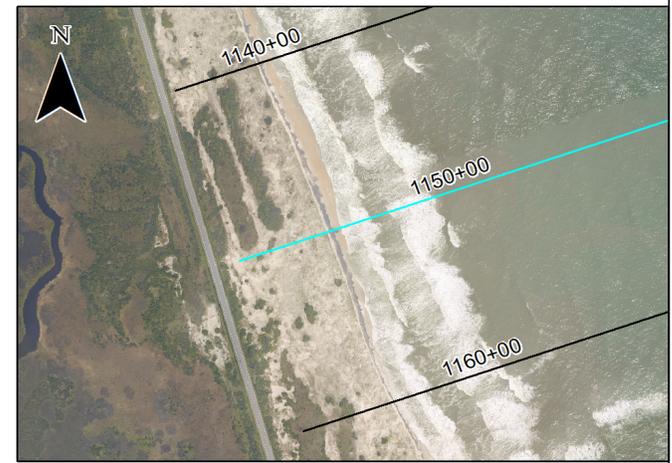


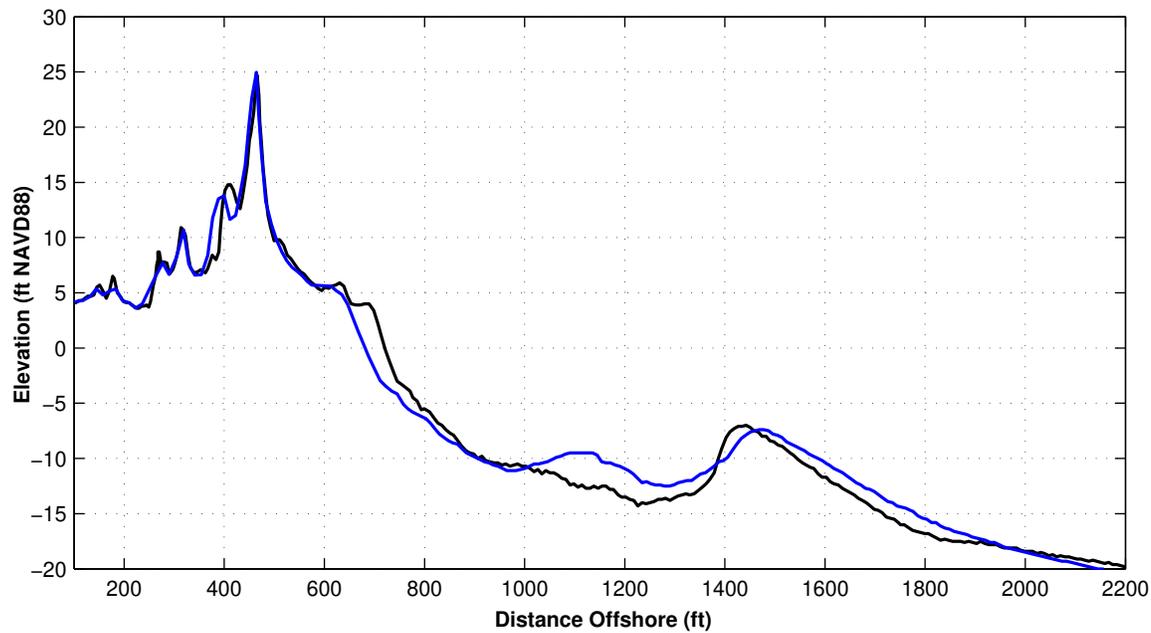
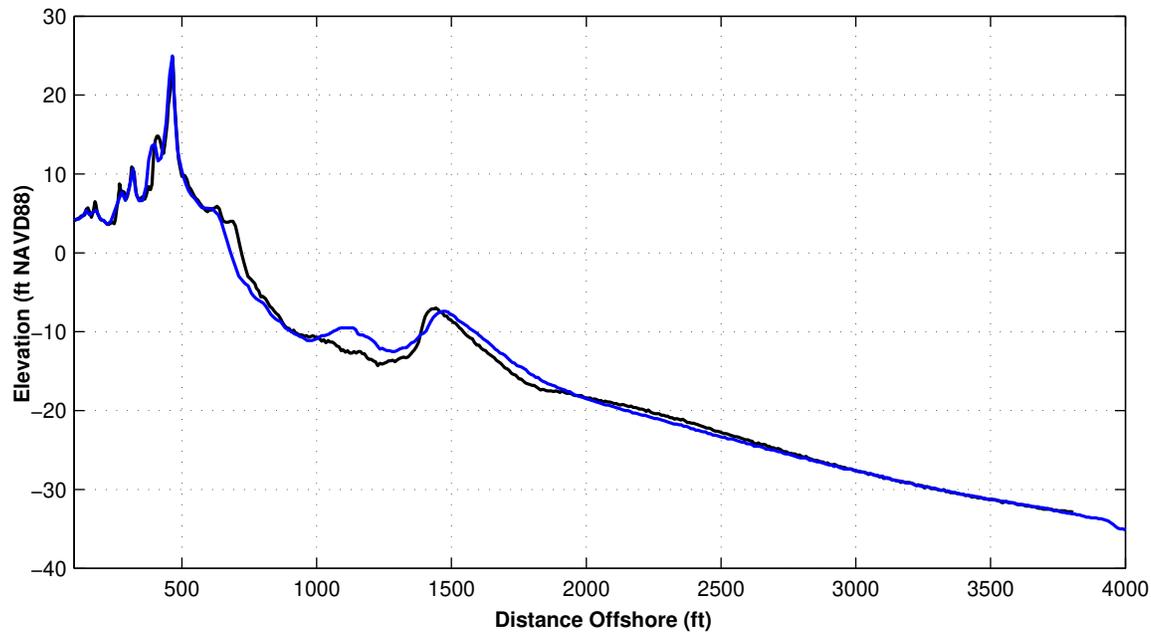


Survey Transect 1150+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-4.64 ft	- ft
Volume Change Above +6 ft NAVD88	1.08 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	1.62 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	6.35 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	50.69 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	54.30 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	35.54 cy/ft	- cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

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Survey Transect 1160+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-42.81 ft	- ft
Volume Change Above +6 ft NAVD88	-1.43 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	-6.82 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	-16.19 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	12.03 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	20.65 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	5.68 cy/ft	- cy/ft

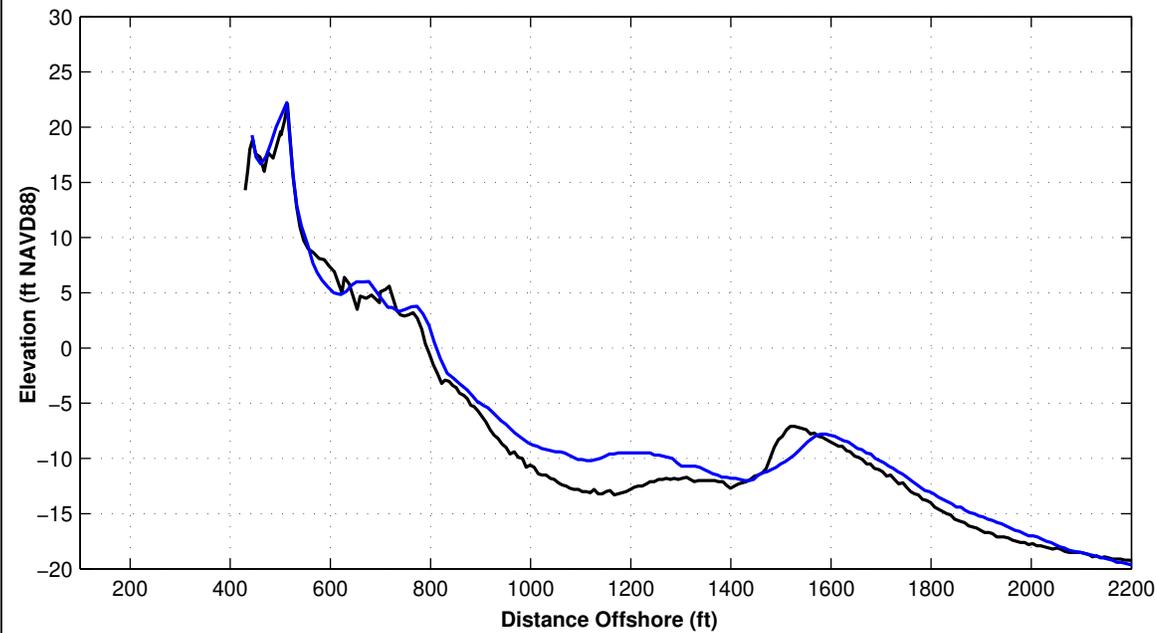
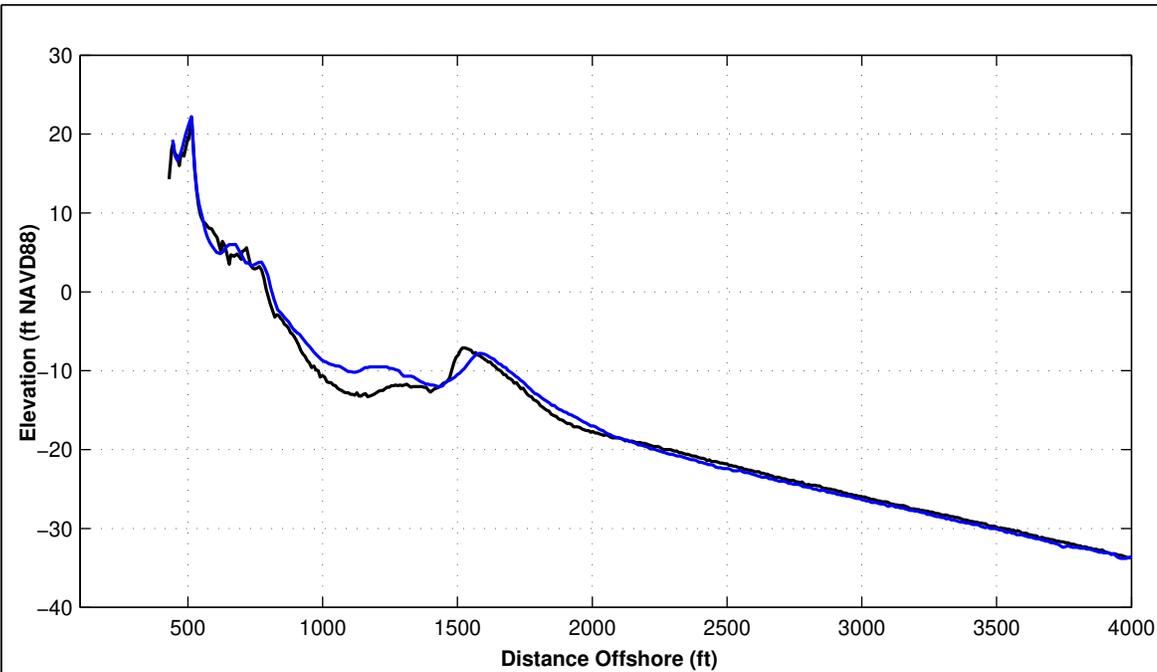
LEGEND:

OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

Notes:

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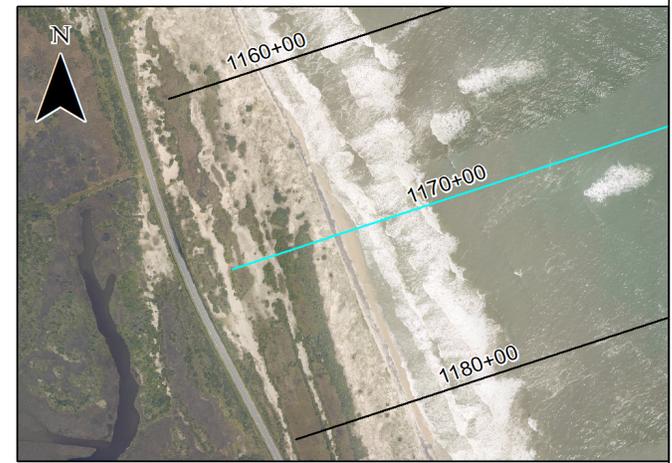


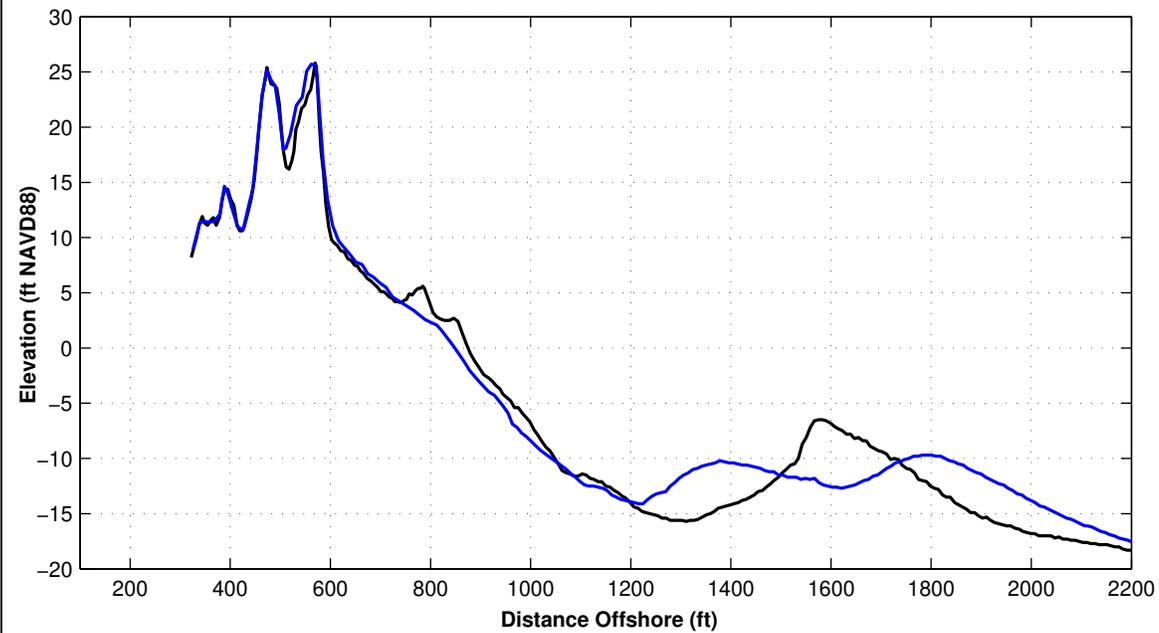
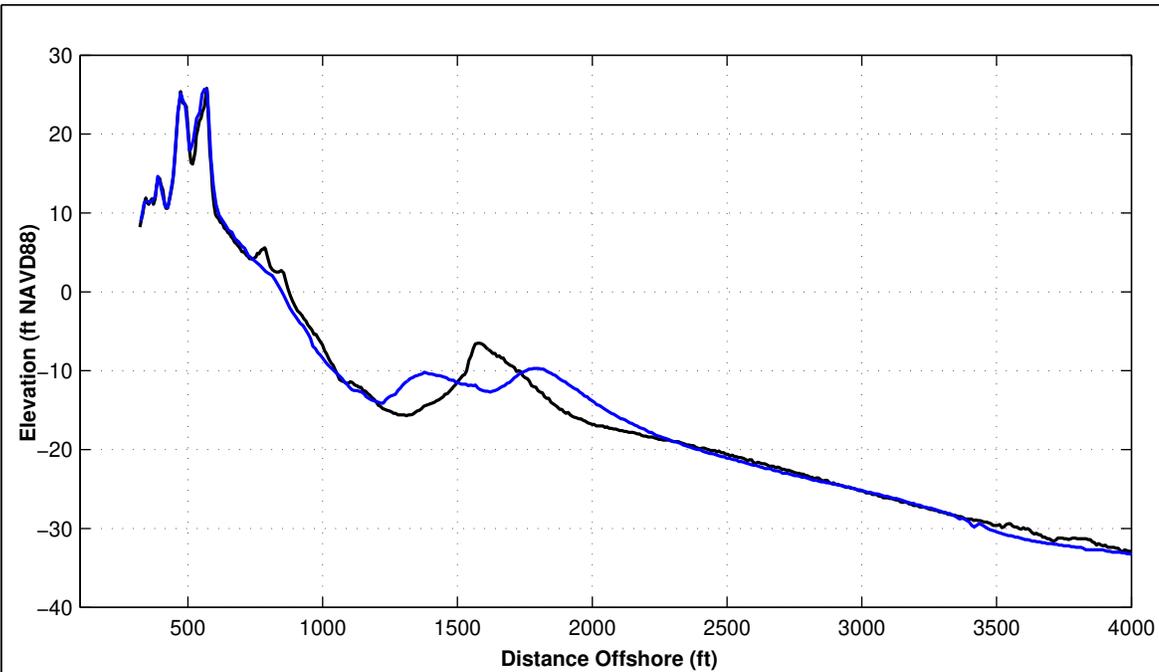


Survey Transect 1170+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	17.61 ft	– ft
Volume Change Above +6 ft NAVD88	–2.28 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	–0.14 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	5.21 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	46.51 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	55.63 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	75.02 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

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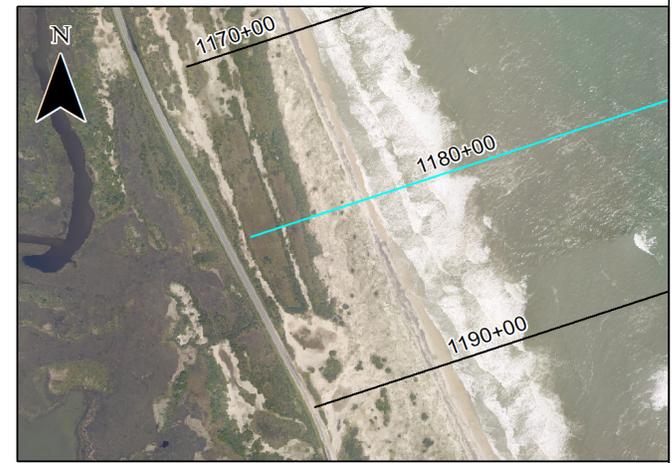


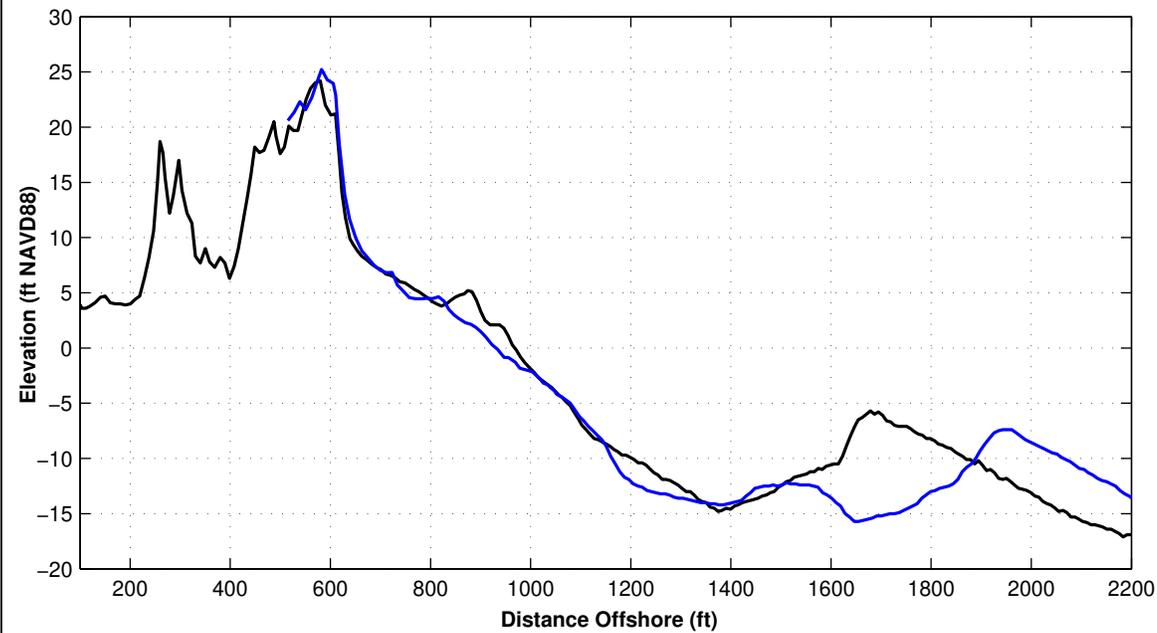
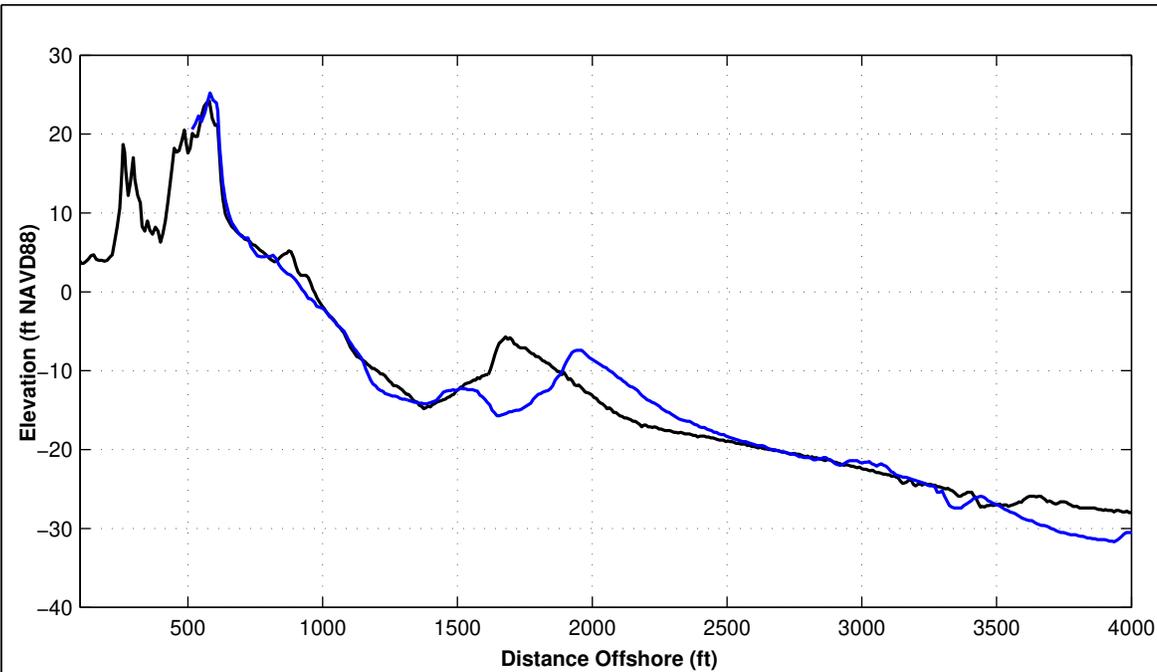


Survey Transect 1180+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-35.77 ft	- ft
Volume Change Above +6 ft NAVD88	7.57 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	2.14 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	-4.53 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	4.75 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	35.46 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	25.61 cy/ft	- cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.



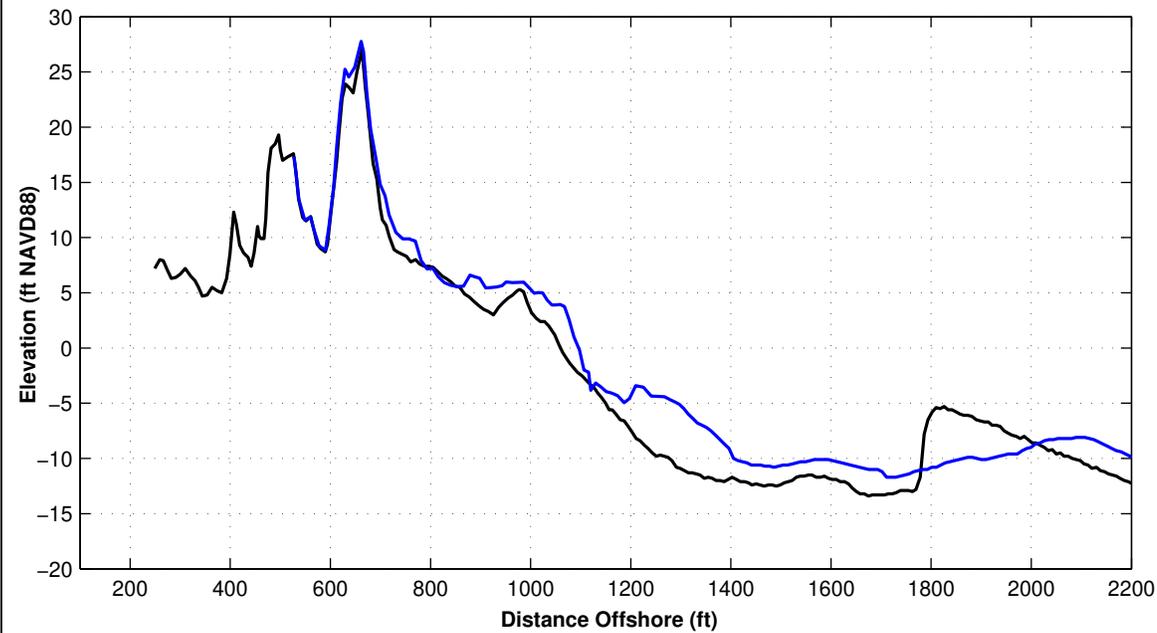
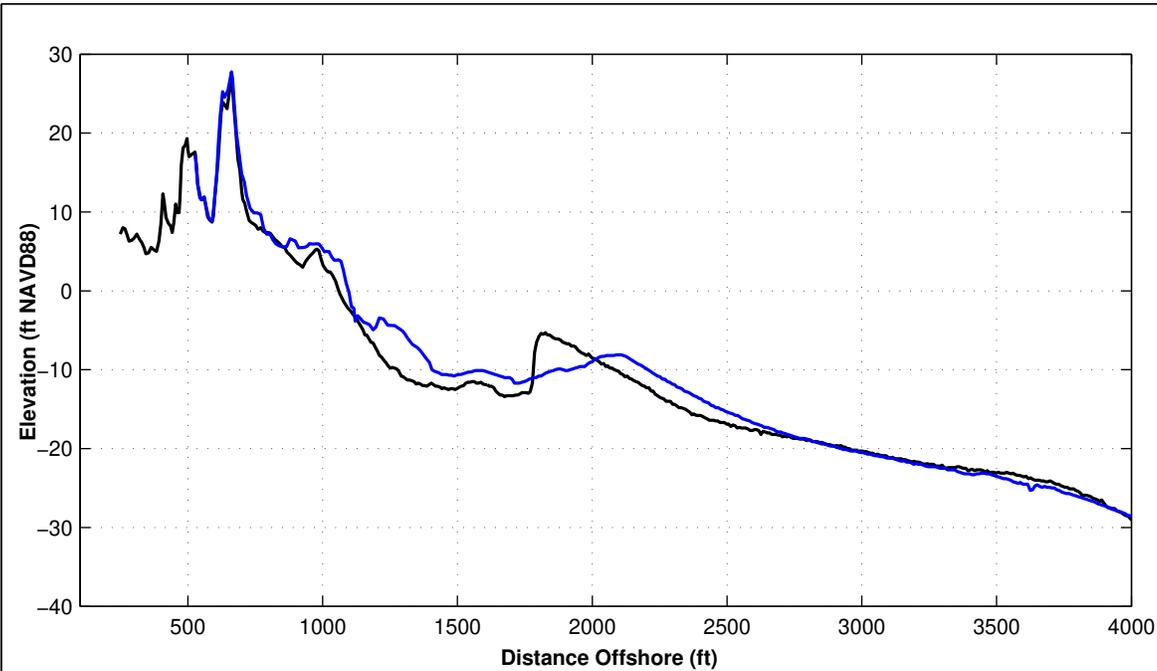


Survey Transect 1190+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-47.71 ft	- ft
Volume Change Above +6 ft NAVD88	5.77 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	-2.47 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	-6.40 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	-36.09 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	-10.20 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	-68.27 cy/ft	- cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.



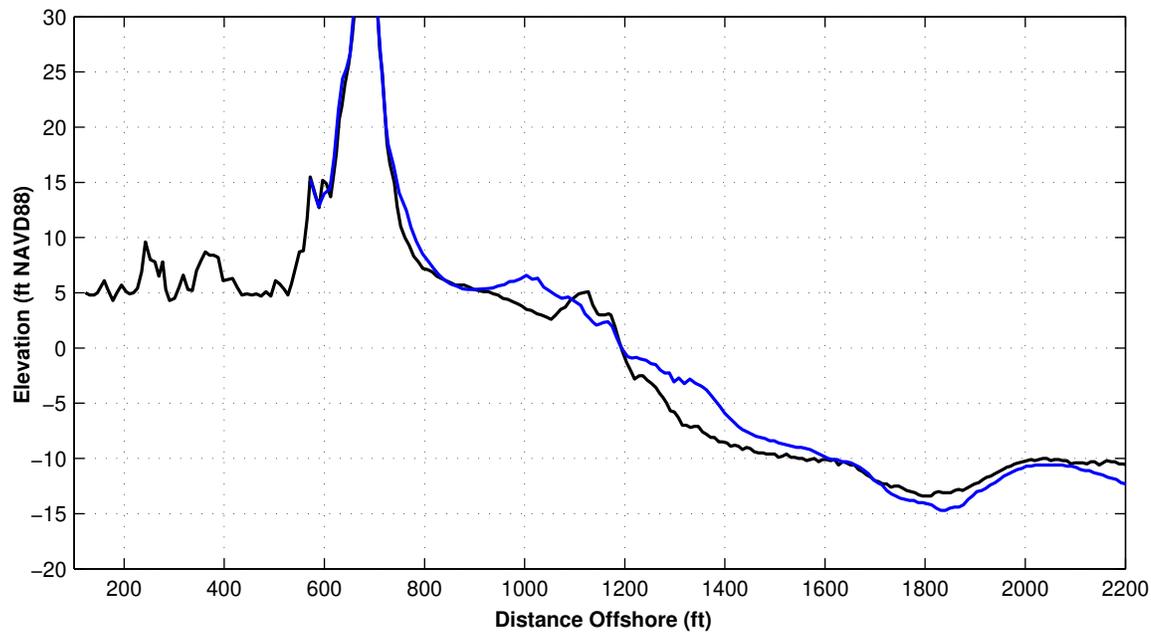
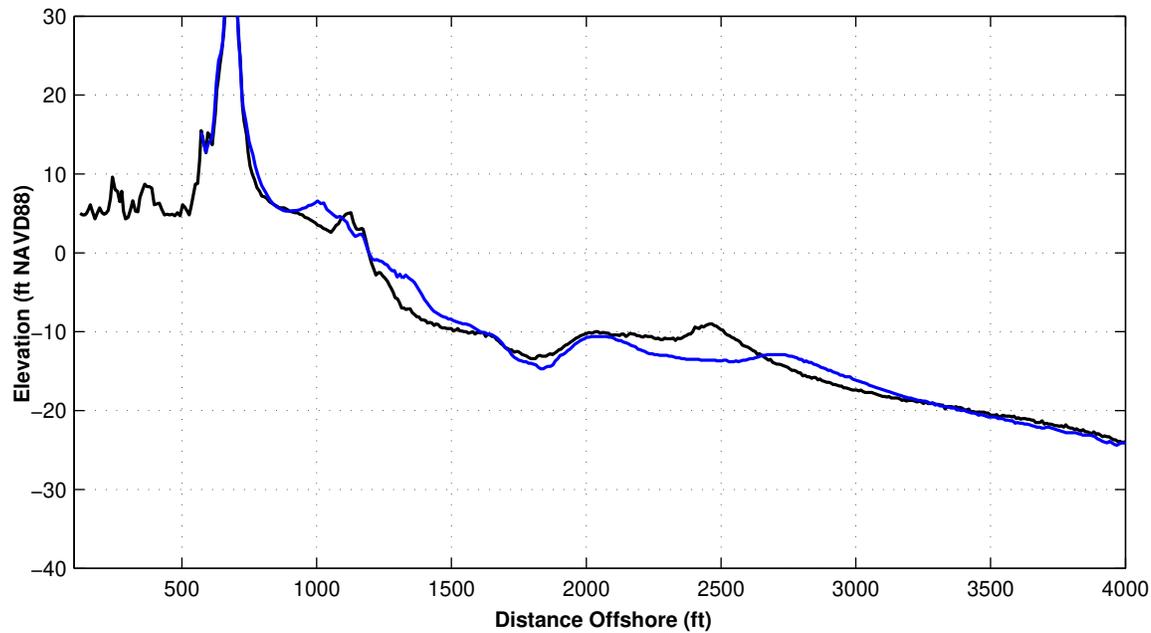


Survey Transect 1200+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	36.91 ft	– ft
Volume Change Above +6 ft NAVD88	2.35 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	17.33 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	30.66 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	84.85 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	103.88 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	88.22 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.





Survey Transect 1210+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-3.47 ft	- ft
Volume Change Above +6 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	99999.00 cy/ft	- cy/ft

LEGEND:

OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.

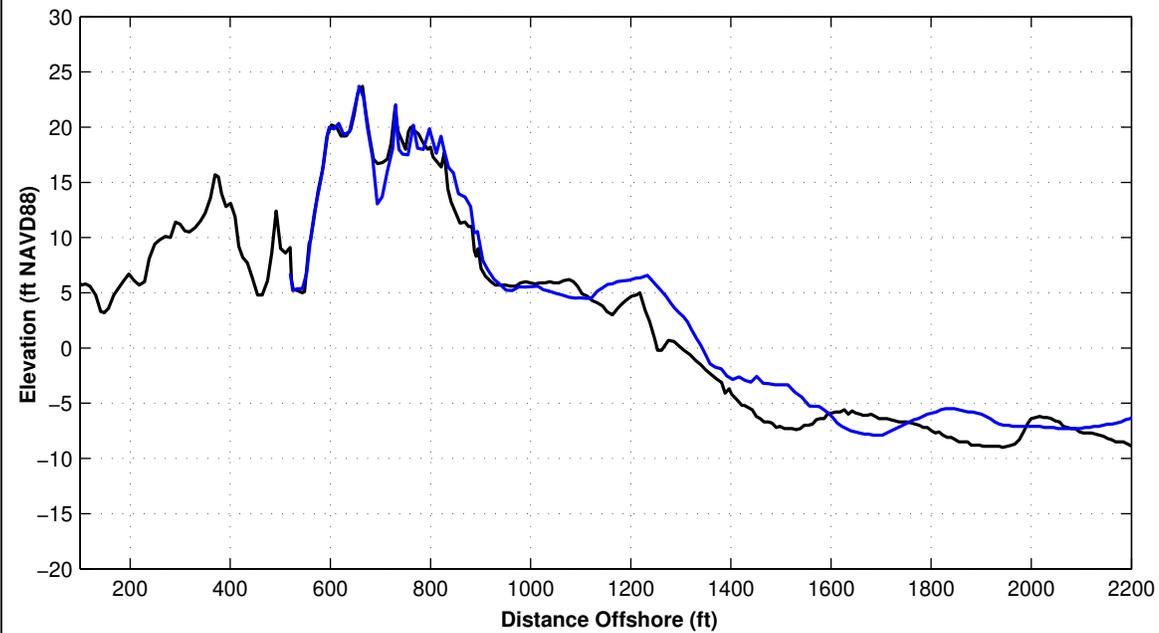
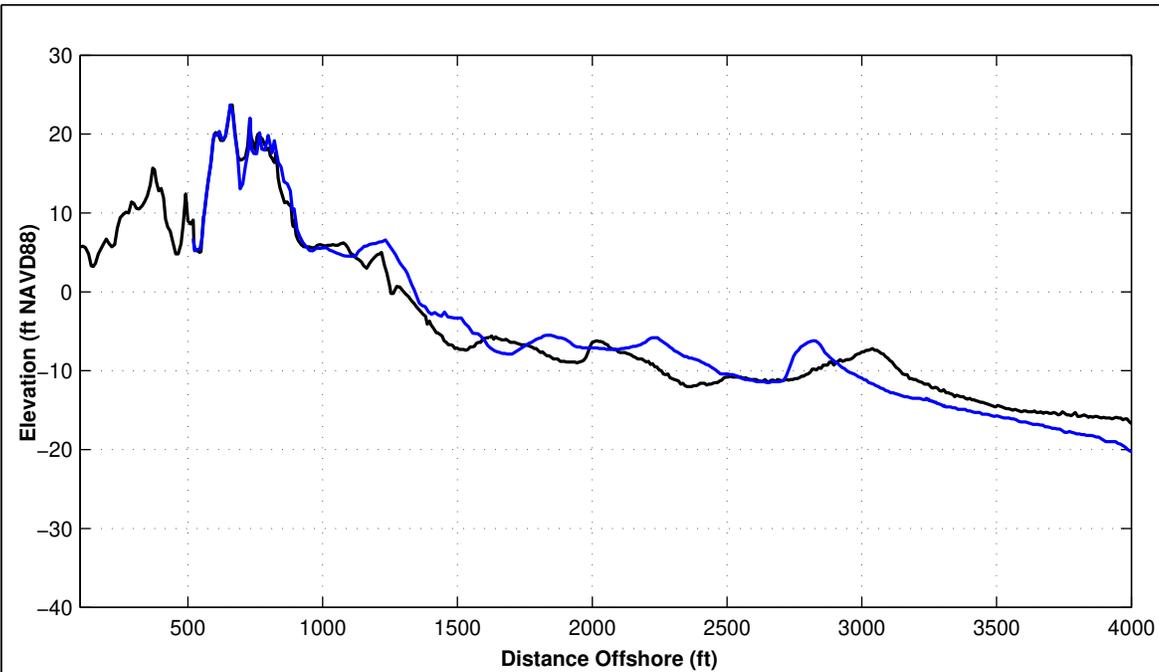


Town of Nags Head Periodic Surveying Data Analysis

ST 1210+00

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2023

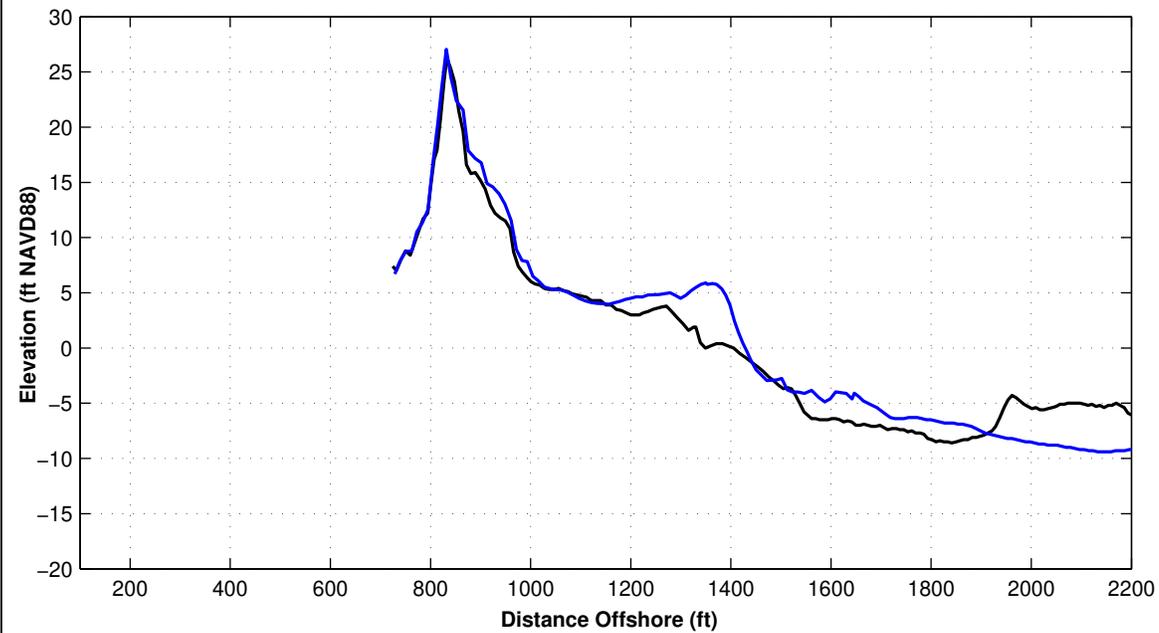
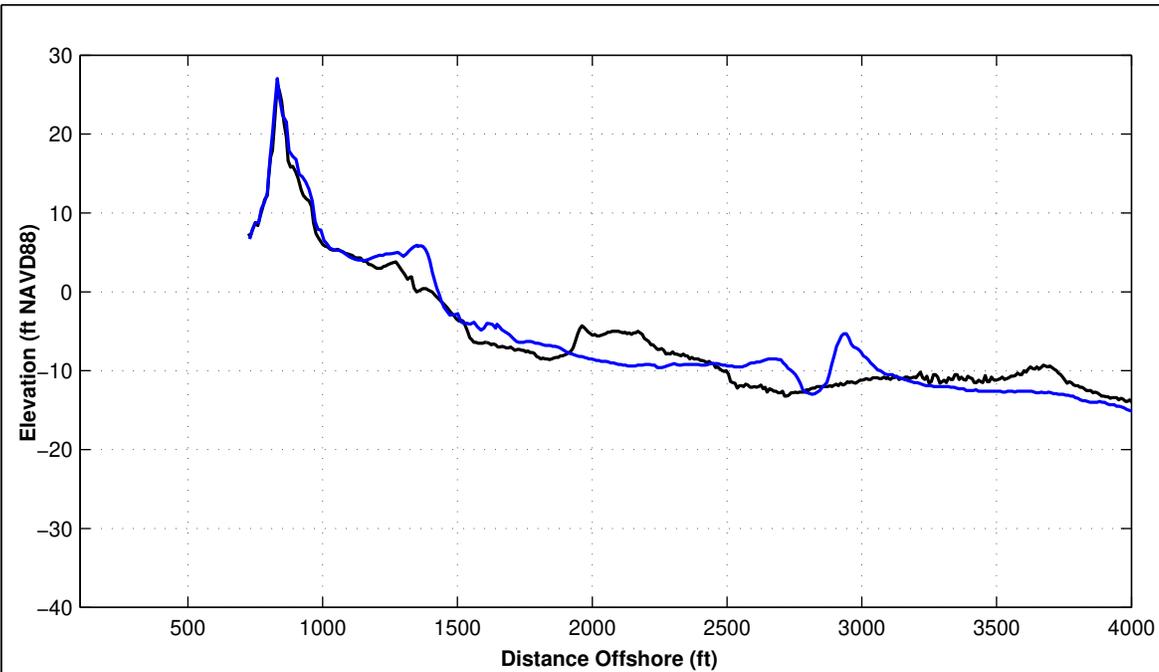


Survey Transect 1220+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	81.80 ft	– ft
Volume Change Above +6 ft NAVD88	99999.00 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	99999.00 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	99999.00 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	99999.00 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	99999.00 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	99999.00 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.

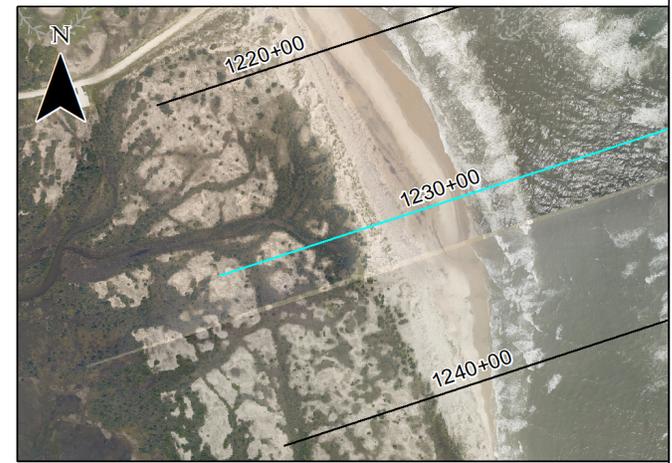


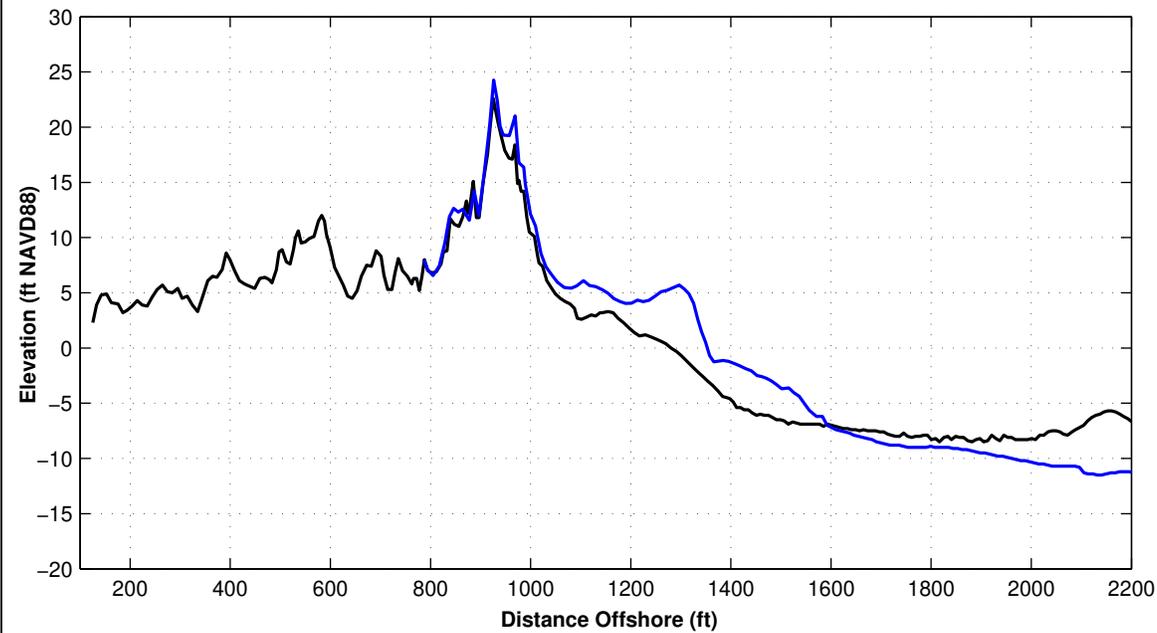
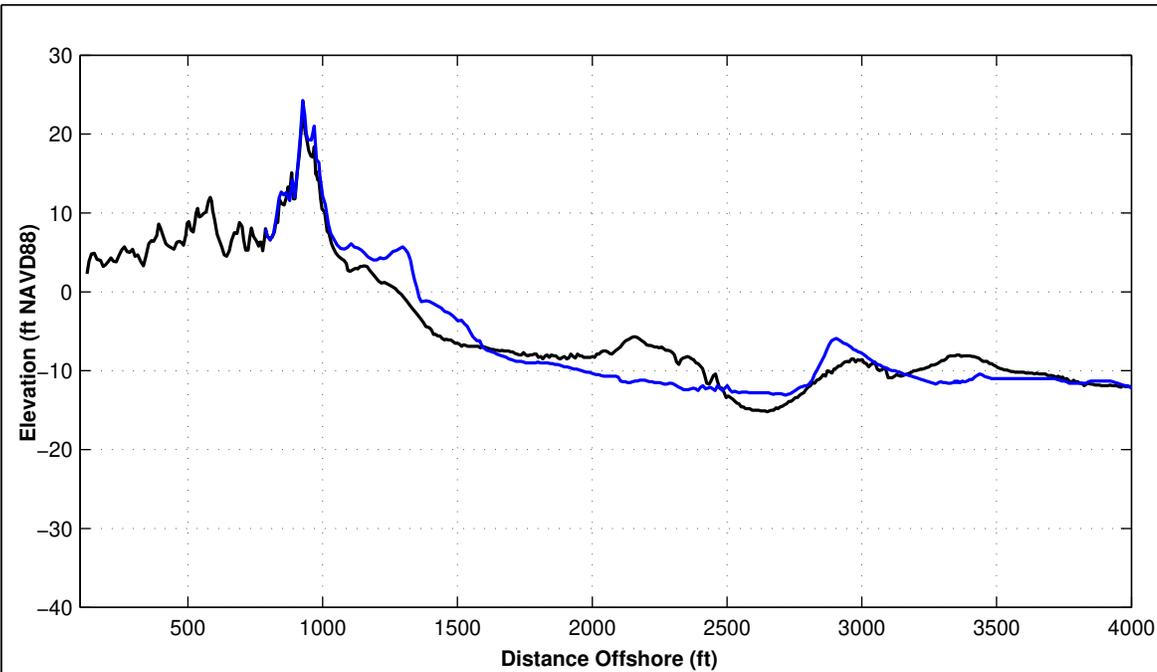


Survey Transect 1230+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	82.78 ft	– ft
Volume Change Above +6 ft NAVD88	99999.00 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	99999.00 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	99999.00 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	99999.00 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	99999.00 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	99999.00 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.



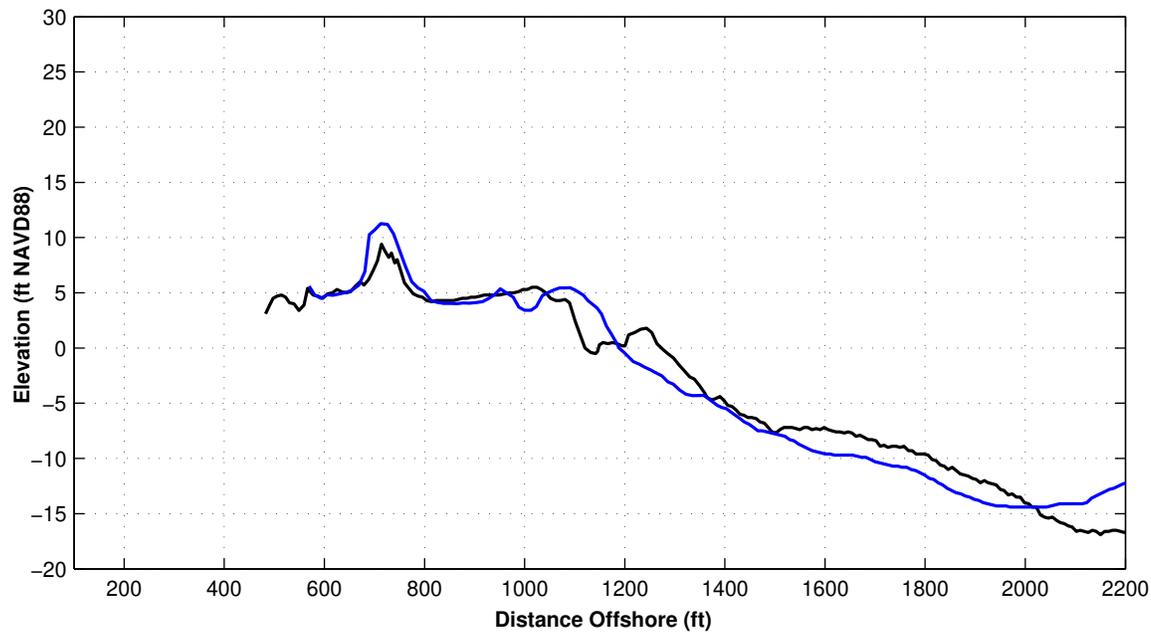
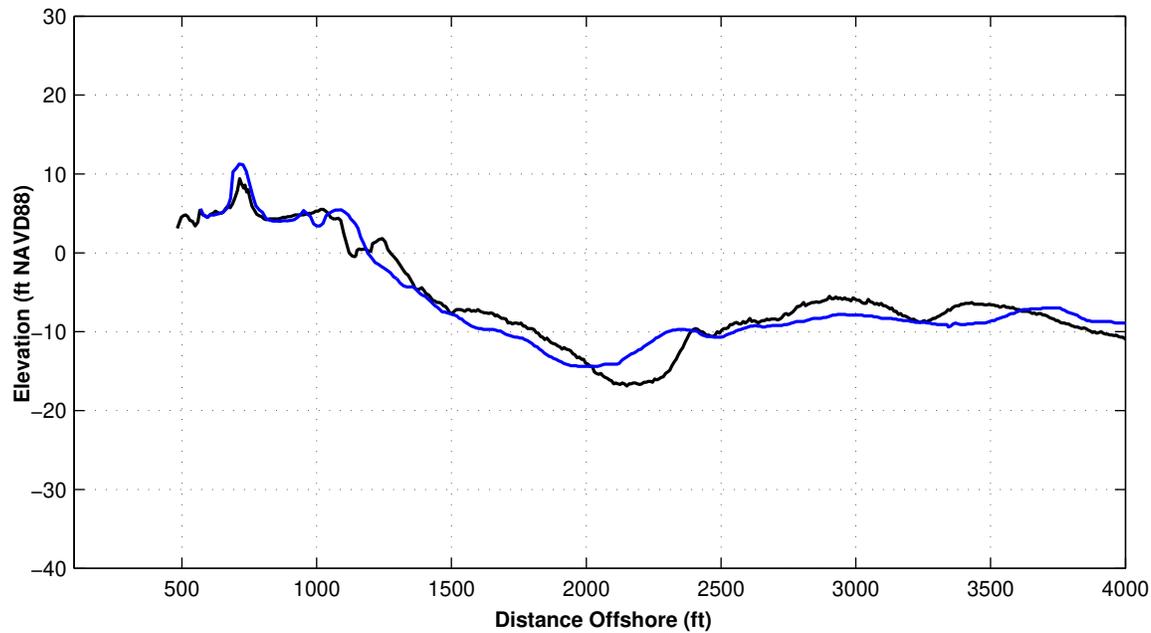


Survey Transect 1240+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	113.32 ft	– ft
Volume Change Above +6 ft NAVD88	99999.00 cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	99999.00 cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	99999.00 cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	99999.00 cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	99999.00 cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	99999.00 cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.





Survey Transect 1250+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-81.93 ft	- ft
Volume Change Above +6 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	99999.00 cy/ft	- cy/ft

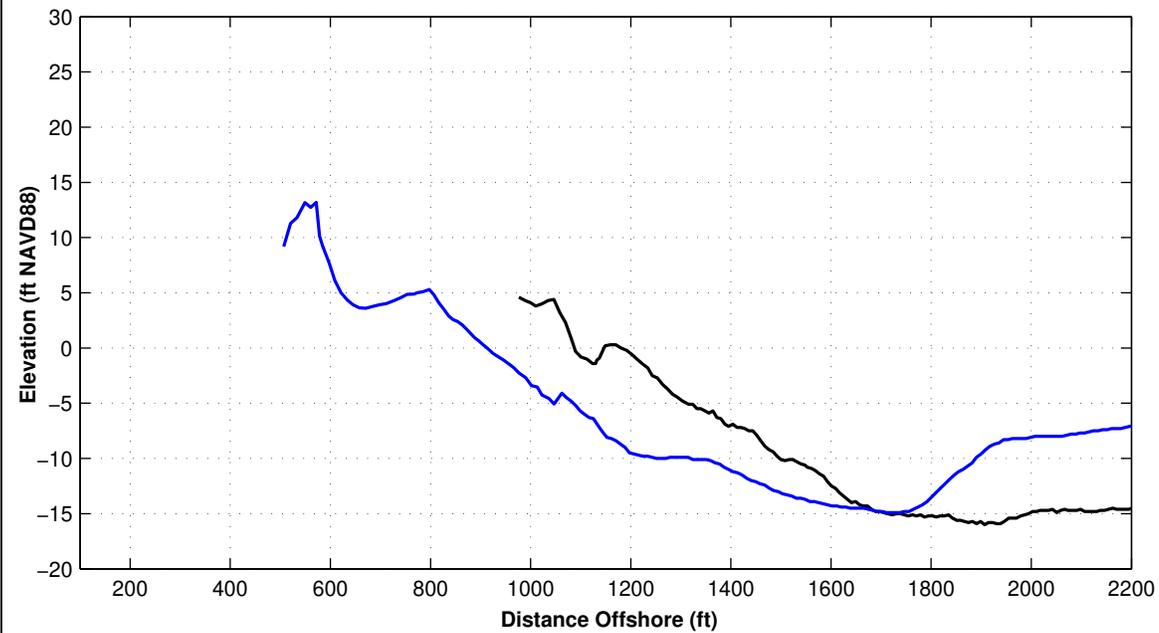
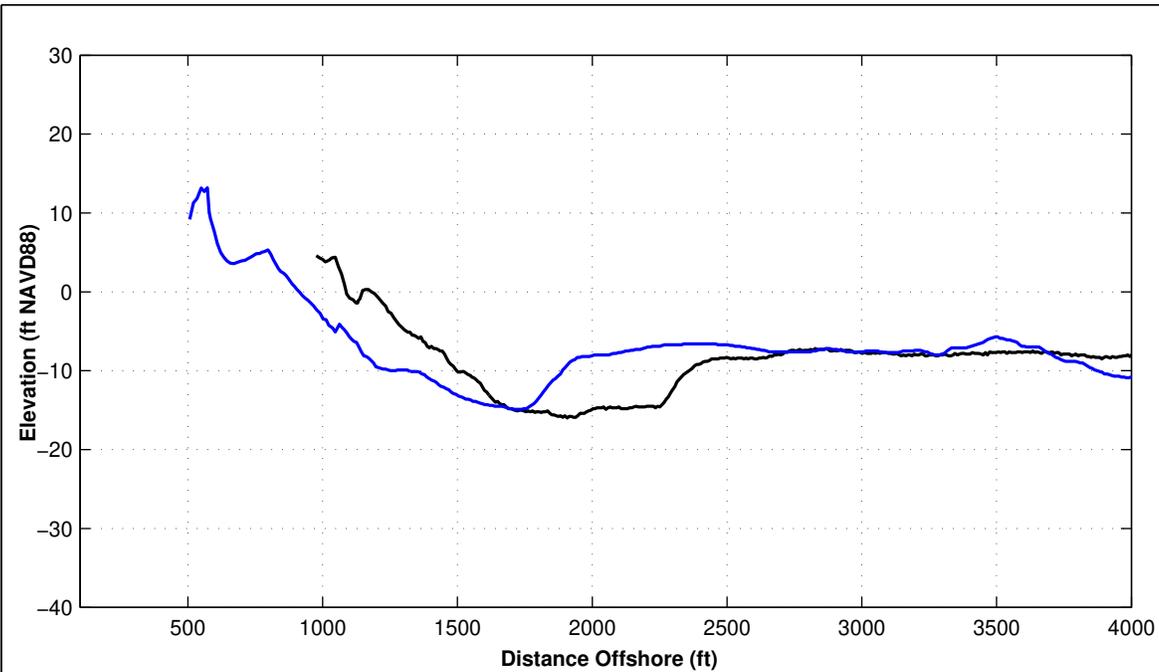
LEGEND:

OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

Notes:

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.



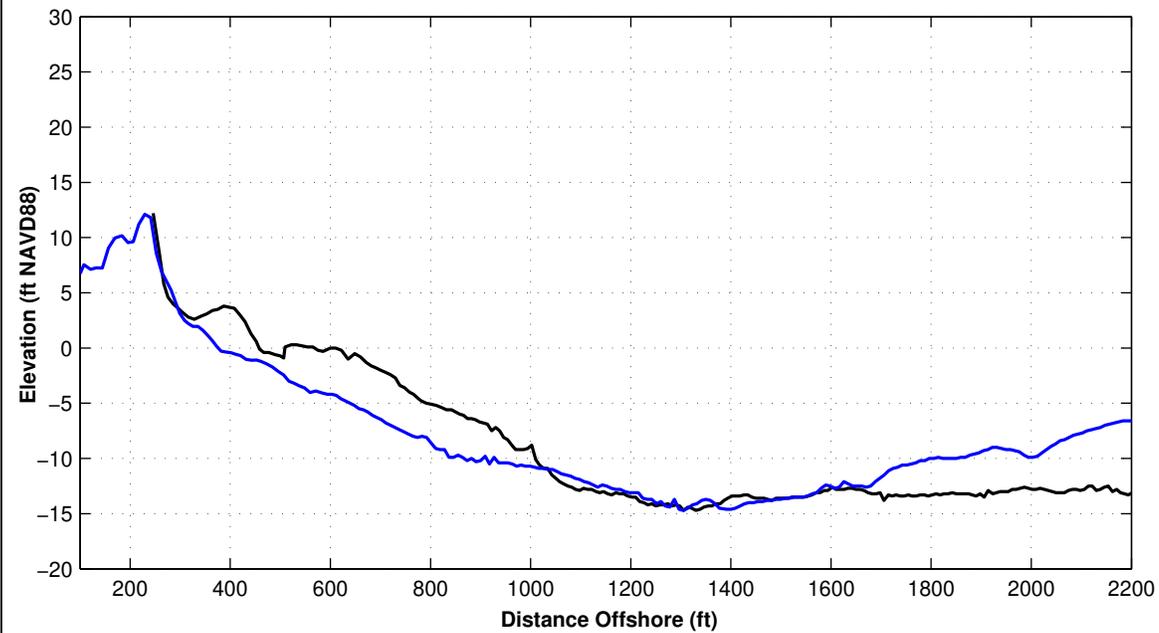
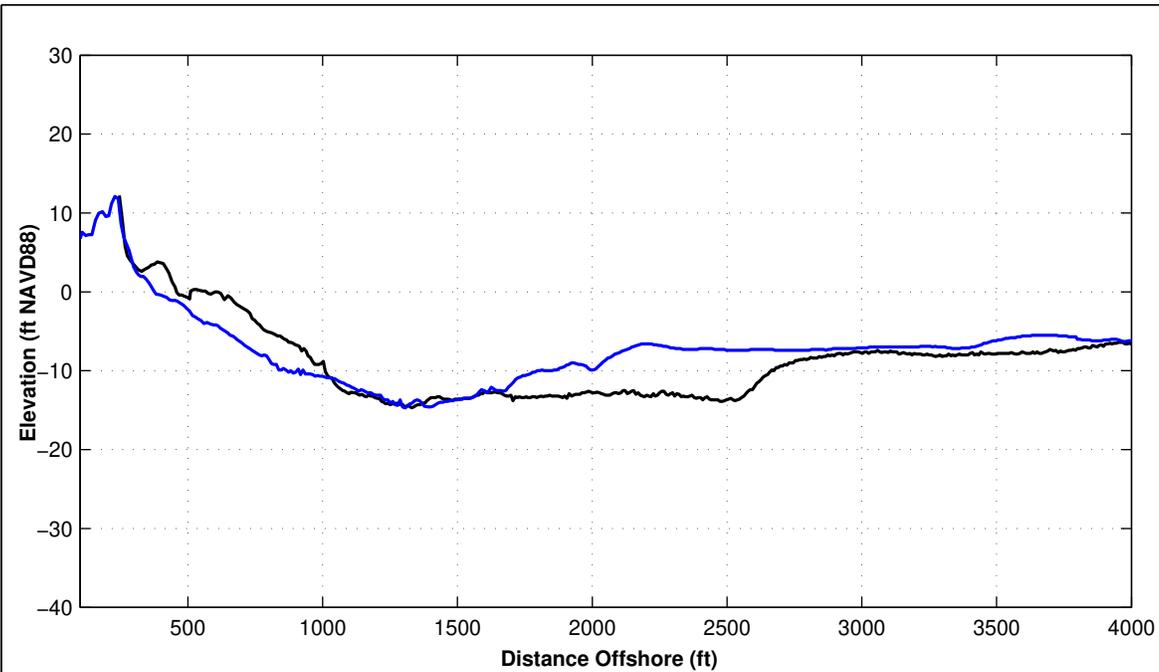


Survey Transect 1260+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-195.47 ft	- ft
Volume Change Above +6 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	99999.00 cy/ft	- cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

- Notes:
 1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.



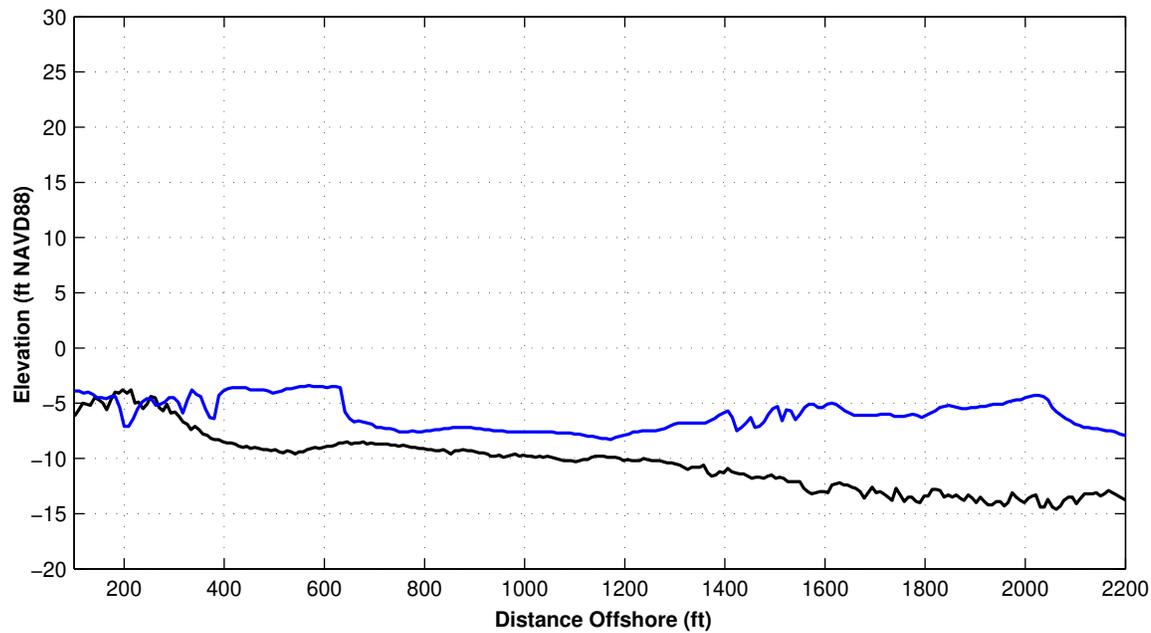
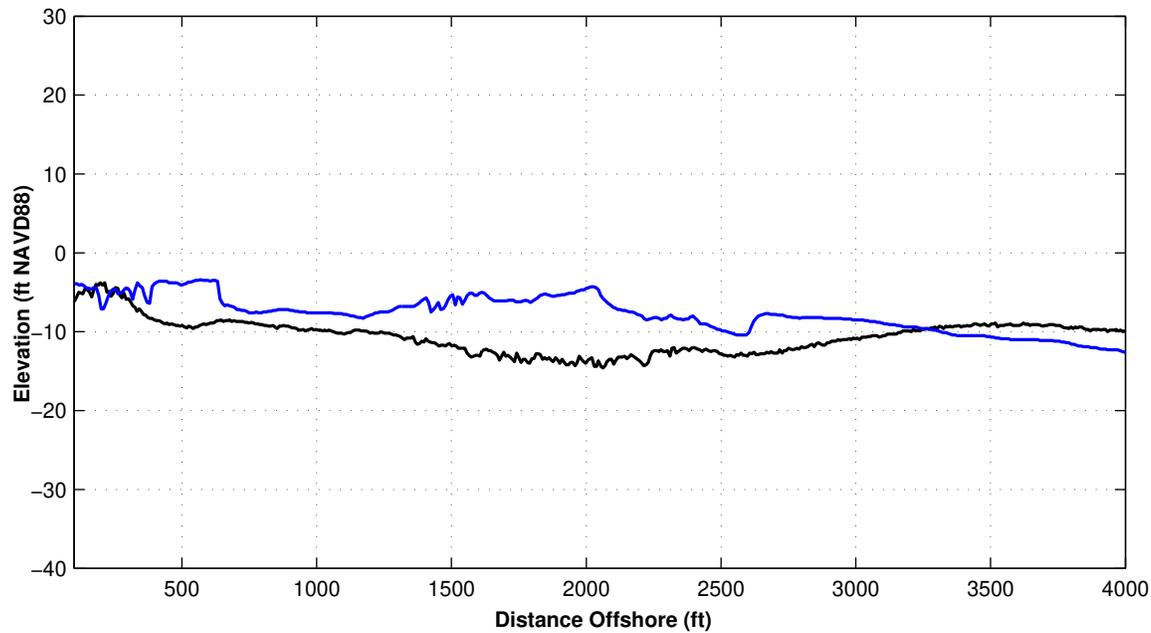


Survey Transect 1270+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	-88.70 ft	- ft
Volume Change Above +6 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	99999.00 cy/ft	- cy/ft

LEGEND:
 OCTOBER 2023 ——— POST-DORIAN AD ———
 JUNE 2023 ——— JUNE 2022 ———

- Notes:
 1. Station From North To South At Varying Intervals.
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Survey Transect 1280+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	– ft	– ft
Volume Change Above +6 ft NAVD88	– cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	– cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	– cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	– cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	– cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	– cy/ft	– cy/ft

LEGEND:

OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

Notes:

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2. All Survey Elevations In Feet Referenced to NAVD88.

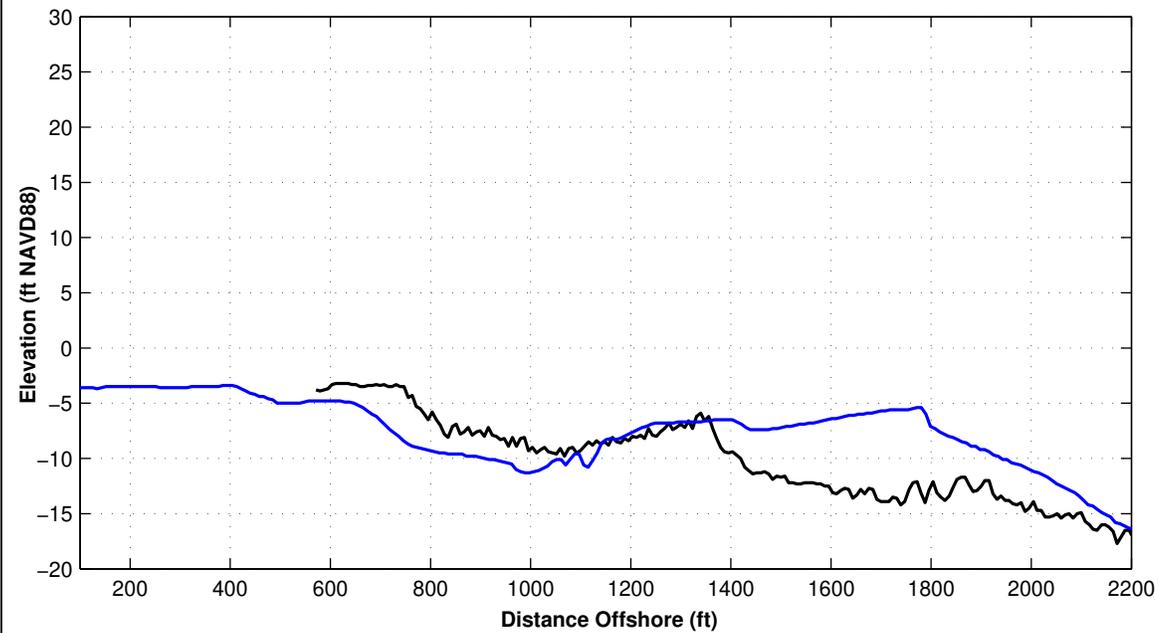
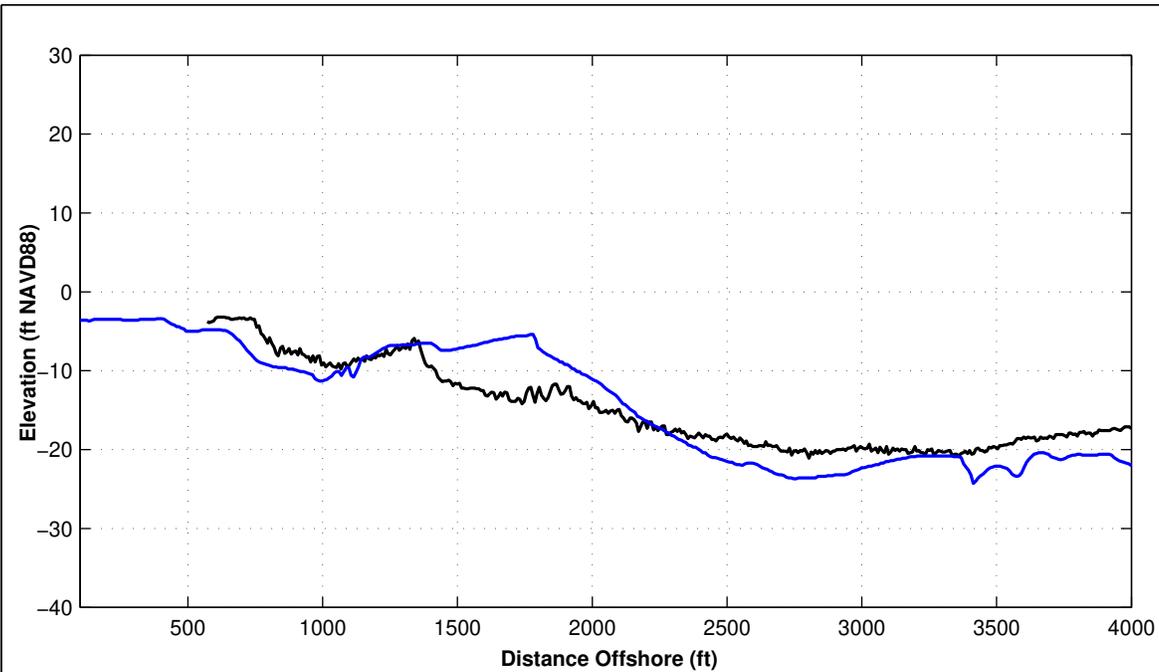


Town of Nags Head Periodic Surveying Data Analysis

ST 1280+00

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2023



Survey Transect 1290+00	JUNE 2022 – JUNE 2023	JUNE 2023 – OCTOBER 2023
Shoreline Change at MHW (1.18 ft NAVD88)	– ft	– ft
Volume Change Above +6 ft NAVD88	– cy/ft	– cy/ft
Volume Change Above 1.18 ft NAVD88	– cy/ft	– cy/ft
Volume Change Above –6 ft NAVD88	– cy/ft	– cy/ft
Volume Change Above –14 ft NAVD88	– cy/ft	– cy/ft
Volume Change Above –19 ft NAVD88	– cy/ft	– cy/ft
Volume Change Above –30 ft NAVD88	– cy/ft	– cy/ft

LEGEND:
 OCTOBER 2023 — POST-DORIAN AD —
 JUNE 2023 — JUNE 2022 —

- Notes:
1. Station From North To South At Varying Intervals.
 2. All Survey Elevations In Feet Referenced to NAVD88.



APPENDIX C TABULATED SHORELINE AND VOLUME CHANGE DATA



NOTES:

1. Positive changes indicate accretion or gain in volume along the profile and negative changes indicate erosion or loss of volume along the profile.
2. Shoreline Change and Volume Change is calculated for the period between surveys from June 29, 2022 to June 30, 2023.

Reach	Station	Shoreline Change @ MHW (+1.18 ft NAVD)	Above Berm (+6 ft NAVD88)		Above MHW (+1.18 ft NAVD88)		Above -6 ft NAVD88		Above -14 ft NAVD88		Above -19 ft NAVD88		Above -30 ft NAVD88	
			June 2023 Measured Volume (cy/ft)	June 2022- June 2023 Volume Change (cy/ft)	June 2023 Measured Volume (cy/ft)	June 2022- June 2023 Volume Change (cy/ft)	June 2023 Measured Volume (cy/ft)	June 2022- June 2023 Volume Change (cy/ft)	June 2023 Measured Volume (cy/ft)	June 2022- June 2023 Volume Change (cy/ft)	June 2023 Measured Volume (cy/ft)	June 2022- June 2023 Volume Change (cy/ft)	June 2023 Measured Volume (cy/ft)	June 2022- June 2023 Volume Change (cy/ft)
Nags Head - North	430+00	-662.81	84.93	0.06	122.61	3.92	195.62	-2.05	395.89	6.88	651.64	33.60	1509.28	25.01
	435+00	-655.62	22.84	3.58	49.09	8.80	109.92	11.46	278.69	18.07	508.38	47.65	1333.19	39.35
	440+00	-644.06	35.02	3.04	57.98	-0.67	113.31	-10.31	286.81	-1.44	525.60	3.29	1356.67	-6.36
	445+00	-578.56	23.86	4.99	48.35	13.30	113.16	35.79	276.96	37.19	517.81	45.65	1337.72	31.92
	450+00	-582.15	30.07	2.63	53.52	7.63	106.18	16.52	276.66	34.22	514.78	41.48	1334.79	25.01
	455+00	-607.40	36.44	-2.30	57.19	-9.49	106.87	-23.83	290.47	-3.94	531.23	34.11	1350.89	17.27
	460+00	-568.66	40.47	-0.06	65.87	2.44	122.42	10.05	290.27	12.09	526.24	-3.00	1345.57	-27.98
	465+00	-568.58	31.76	-1.92	49.98	-6.81	108.25	4.05	280.43	1.81	521.65	10.67	1337.72	-9.22
	470+00	-536.18	41.06	-0.28	69.43	5.00	130.47	20.21	321.58	50.02	569.72	63.54	1402.83	47.76
	475+00	-555.94	49.48	-0.88	85.82	5.67	168.23	16.90	354.19	24.75	602.05	35.75	1438.52	18.83
	480+00	-562.19	33.71	-2.74	59.91	-7.81	116.16	-22.05	298.21	-15.84	545.71	-1.06	1380.83	-15.28
	485+00	-518.68	56.18	0.63	85.86	2.27	161.13	24.56	334.52	21.63	573.04	20.31	1410.69	-3.26
	490+00	-513.76	53.06	-2.52	84.33	-1.14	163.63	17.19	335.59	-3.31	585.54	-2.42	1426.77	-23.98
	Reach 1	495+00	-532.17	46.85	-1.04	80.52	-0.77	159.56	7.95	343.94	8.81	591.84	17.88	1427.40
500+00		-463.44	40.34	4.22	71.12	10.75	154.30	46.23	342.79	61.17	591.39	76.80	1424.42	54.98
505+00		-474.25	40.10	-1.33	66.54	-1.00	126.24	5.87	298.75	-3.38	540.97	2.27	1375.85	-16.90
510+00		-518.12	30.79	-2.90	62.06	-4.81	146.68	13.45	334.27	9.78	525.65	-28.19	1356.49	-26.68
515+00		-531.59	45.59	-2.72	73.01	-9.37	132.53	-15.50	302.98	-24.13	542.75	-5.14	1391.88	-14.79
520+00		-551.65	43.30	0.32	78.68	2.16	163.19	22.06	353.62	10.02	593.30	-9.82	1436.85	-20.75
525+00		-571.80	20.73	-2.26	53.64	0.00	125.12	7.70	336.51	55.64	588.10	43.45	1420.54	28.09
530+00		-587.57	26.87	-1.91	59.84	-1.78	143.07	18.59	349.31	30.95	599.02	17.45	1429.88	2.16
535+00		-593.58	35.90	-0.90	69.18	-2.83	148.85	7.13	355.18	38.06	605.12	15.77	1441.93	-2.88
540+00		-583.80	44.07	-1.72	77.27	-4.49	152.93	0.11	356.54	29.71	603.62	3.83	1444.86	-15.12
545+00		-584.06	40.38	-5.91	73.53	-8.01	147.74	-3.48	342.52	14.48	583.10	-6.47	1420.31	-25.20
550+00		-577.47	19.25	-9.55	44.83	-13.59	103.55	-15.25	299.40	-0.55	531.52	-18.56	1346.78	-37.88
555+00		-577.28	25.68	-6.77	54.44	-9.25	124.33	-4.44	317.19	13.08	549.59	-0.68	1364.03	-15.58
560+00		-566.82	16.60	-2.78	39.35	-6.90	100.41	-5.26	298.28	28.06	527.56	14.12	1333.70	-1.40
565+00		-545.93	23.88	-0.99	48.25	-1.94	110.82	2.89	299.81	30.53	528.97	9.60	1342.70	-6.16
570+00		-552.07	26.10	-3.04	49.77	-5.86	111.64	-4.76	319.11	43.38	550.03	22.82	1372.29	5.42
575+00		-546.58	13.15	-5.73	33.74	-6.17	89.30	-5.41	277.83	32.65	505.43	14.45	1319.78	-2.08
580+00		-561.10	20.47	1.25	45.96	5.47	104.07	3.10	288.60	36.45	516.31	16.21	1327.76	-1.84
585+00		-565.42	17.62	1.84	41.50	3.00	99.98	-1.95	300.29	35.75	532.12	10.81	1336.64	-9.60
590+00		-581.82	12.68	4.05	41.28	8.50	102.05	1.97	312.92	42.87	546.98	17.09	1351.46	-0.40
595+00		-574.25	19.14	1.86	47.33	4.31	105.81	-1.91	327.89	47.26	564.76	24.05	1369.28	5.12
600+00		-571.66	69.02	6.56	104.73	6.40	179.59	2.26	425.75	64.88	678.15	50.62	1513.87	36.49
605+00		-585.60	25.73	1.23	48.43	-5.65	106.06	-20.58	311.26	15.47	556.97	4.99	1369.60	-13.61
610+00		-602.10	28.07	-1.34	47.95	-10.03	105.51	-26.01	281.57	-12.53	530.20	-18.23	1340.39	-30.75
615+00		-618.46	34.51	1.89	57.39	-7.47	119.21	-30.60	321.44	-3.59	575.37	-16.12	1387.64	-29.92
620+00		-612.40	26.86	-0.32	55.89	-3.16	128.51	-9.48	315.55	-4.17	565.65	-17.75	1375.23	-34.56
625+00		-621.23	38.76	1.44	71.82	1.83	145.09	-4.64	352.75	20.59	603.25	16.63	1412.97	2.55
630+00		-636.62	47.86	3.29	78.57	-1.67	156.09	-6.26	367.32	14.10	624.33	26.31	1436.79	11.18
635+00		-655.16	30.05	2.83	60.63	2.80	136.79	2.51	319.75	-2.46	554.72	2.13	1351.40	-10.92
640+00		-665.65	53.28	1.44	86.58	-2.38	174.16	-3.27	370.35	-18.54	601.45	-41.16	1381.06	-45.31
645+00		-681.69	53.05	4.49	87.57	0.11	166.90	-17.06	383.28	-6.49	626.56	-18.43	1362.54	-34.30
650+00		-679.92	51.37	5.40	88.11	7.44	170.76	0.33	378.69	7.67	607.10	-6.04	1415.08	-101.22
655+00		-675.06	35.99	3.83	65.90	5.65	141.76	4.11	338.10	4.03	580.74	-15.81	1398.81	21.22
660+00		-686.12	48.44	5.06	79.21	3.70	158.93	0.28	374.33	19.54	626.36	22.94	1391.70	-3.73
665+00		-678.82	52.26	-0.53	81.59	-3.51	153.49	-7.92	350.67	-1.61	609.04	1.50	1396.79	-12.79
670+00		-704.35	35.35	-1.92	64.55	-3.43	132.60	-10.15	325.72	2.69	577.14	24.01	1357.50	15.08
675+00		-704.28	1.39	-0.34	16.57	3.94	68.54	14.32	215.94	5.22	445.35	32.08	1193.26	26.95
680+00		-749.56	45.24	1.85	71.60	-5.08	134.42	-24.31	320.10	-27.28	553.68	-18.95	1349.35	-31.74
685+00		-741.52	41.22	0.62	72.61	0.63	148.17	-0.49	330.16	-3.76	578.08	4.88	1384.01	-12.29
690+00		-748.50	49.02	1.57	74.31	-3.33	140.15	-3.96	332.35	14.47	583.55	37.83	1386.52	23.37
695+00		-769.91	50.43	1.39	83.72	-0.56	153.36	-10.54	349.52	6.80	603.19	27.77	1401.77	14.16
700+00		-759.57	49.99	-4.48	78.81	-5.80	143.09	-7.64	322.91	-15.63	563.58	-2.03	1355.34	-12.14
705+00		-776.86	44.65	-0.25	70.83	-4.35	141.24	0.71	314.89	-18.98	557.48	-27.07	1351.37	-41.09
710+00		-749.89	45.17	1.44	71.04	4.58	134.00	20.08	304.28	5.25	539.67	-20.00	1329.87	-33.63
715+00		-817.25	50.37	-0.34	78.86	-7.29	155.92	-9.31	322.71	-29.17	572.41	-22.72	1363.47	-35.79
720+00		-799.89	55.96	1.01	93.88	6.48	182.67	22.03	398.41	46.22	651.85	53.66	1442.22	38.69
725+00		-833.60	33.98	-1.30	68.09	0.50	142.00	-2.53	331.93	0.62	577.06	0.21	1357.70	-18.45
730+00		-833.26	43.76	-0.24	70.49	-7.39	129.34	-27.70	331.50	-23.99	584.20	-14.50	1369.35	-27.59
735+00	-830.54	32.62	-1.31	56.41	-6.06	115.51	-6.99	300.88	-16.58	550.05	-12.36	1327.29	-87.48	
740+00	-867.66	43.57	-0.64	73.22	-8.00	141.51	-15.49	350.78	-26.00	598.08	-48.42	1415.86	-57.10	
745+00	-841.13	55.81	-0.35	97.20	6.69	197.35	40.98	402.37	31.59	627.46	-8.04	1441.09	-19.56	
750+00	-892.64	74.71	7.53	122.15	11.58	228.98	31.06	503.70	88.18	766.71	77.74	1585.83	61.32	
755+00	-884.02	65.83	4.34	107.36	7.71	196.21	21.61	439.93	51.19	694.59	25.24	1505.89	5.28	
760+00	-896.80	46.16	0.70	86.56	5.28	168.72	11.36	415.24	68.69	669.65	41.85	1479.30	21.22	
765+00	-899.52	22.19	2.58	49.61	7.00	115.44	6.62	330.96	55.45	575.79	28.67	1370.33	8.61	
770+00	-905.74	39.69	3.26	70.07	1.74	145.40	-0.99	378.91	45.00	631.01	17.07	1445.75	-0.65	
775+00	-901.18	60.50	3.41	100.70	7.97	203.77	27.28	448.20	69.58	707.79	44.63	1520.52	30.48	
780+00	-943.69	23.16	1.54	65.08	4.11	153.51	7.51	399.60	60.39	657.95	36.30	1462.08	21.62	
785+00	-946.24	42.83	1.53	84.96	-4.15	178.29	-17.26	434.31	48.05	703.34	24.70	1518.94	11.46	

Reach	Station	Shoreline Change @ MHW (+1.18 ft NAVD)	Above Berm (+6 ft NAVD88)		Above MHW (+1.18 ft NAVD88)		Above -6 ft NAVD88		Above -14 ft NAVD88		Above -19 ft NAVD88		Above -30 ft NAVD88	
			June 2023 Measured Volume (cy/ft)	June 2022 Volume Change (cy/ft)	June 2023 Measured Volume (cy/ft)	June 2022 Volume Change (cy/ft)	June 2023 Measured Volume (cy/ft)	June 2022 Volume Change (cy/ft)	June 2023 Measured Volume (cy/ft)	June 2022 Volume Change (cy/ft)	June 2023 Measured Volume (cy/ft)	June 2022 Volume Change (cy/ft)	June 2023 Measured Volume (cy/ft)	June 2022 Volume Change (cy/ft)
Reach 2	790+00	-911.17	4.29	0.53	31.77	1.37	101.64	-2.23	333.73	24.64	578.48	-6.86	1353.19	-23.78
	795+00	-909.41	56.68	5.07	94.34	3.86	186.99	3.82	415.19	55.46	673.91	39.44	1480.84	25.50
	800+00	-878.53	21.36	1.68	56.58	7.30	134.13	6.88	357.87	67.77	609.57	47.88	1395.33	33.94
	805+00	-855.93	42.25	3.14	77.38	6.22	153.35	2.51	376.28	65.28	628.22	71.24	1414.38	58.56
	810+00	-870.34	57.67	2.35	91.85	-0.23	177.68	1.75	391.22	43.71	642.88	49.97	1427.15	35.89
	815+00	-859.24	48.98	3.50	80.06	1.62	161.05	4.27	374.55	52.61	625.22	37.85	1404.25	24.36
	820+00	-852.31	47.40	4.62	86.32	8.18	173.44	14.16	391.34	57.19	646.62	62.54	1437.40	40.95
	825+00	-860.37	42.41	3.97	71.30	0.56	145.74	-2.05	350.48	33.61	602.17	29.33	1382.34	20.10
	830+00	-867.56	38.53	2.43	70.13	6.30	149.97	6.53	349.63	34.15	601.77	23.89	1374.81	10.16
	835+00	-871.46	18.49	1.77	41.87	1.80	105.59	-3.26	300.84	39.39	544.43	57.76	1293.00	44.20
	840+00	-870.85	29.40	2.25	56.12	3.15	135.40	8.65	315.39	22.50	555.56	12.16	1303.40	0.06
	845+00	-881.42	51.05	1.78	90.31	3.78	184.02	5.54	383.15	29.67	629.35	32.24	1385.53	31.27
	850+00	-892.76	20.36	3.05	47.64	6.00	124.12	5.17	306.47	16.00	546.79	20.71	1239.80	-52.84
	855+00	-877.60	43.90	4.79	82.49	9.23	180.50	18.01	399.85	31.84	651.01	6.46	1436.44	14.15
	860+00	-857.81	27.89	4.66	63.72	14.25	154.76	32.97	380.39	77.63	626.05	54.49	1369.73	27.31
	865+00	-871.75	45.15	4.85	81.96	9.80	173.46	23.19	380.86	61.81	623.88	48.30	1372.76	28.73
	870+00	-874.43	41.34	3.73	78.32	9.03	167.60	15.87	356.73	12.75	599.12	-12.33	1343.43	-36.29
	872+00	-874.30	28.36	2.78	60.20	8.41	141.17	14.40	335.27	29.50	573.77	12.35	1306.80	-12.26
	880+00	-873.58	40.56	1.01	78.07	6.24	170.57	13.27	391.35	51.73	637.12	53.51	1388.08	17.87
	885+00	-878.85	40.09	2.49	76.15	6.18	168.30	13.61	382.47	49.32	629.08	53.53	1400.92	38.70
890+00	-844.03	35.81	4.18	72.80	11.47	166.84	25.69	384.89	60.93	629.37	33.96	1400.37	9.44	
895+00	-836.31	41.58	6.05	79.01	17.15	169.09	33.28	389.53	70.84	631.89	44.24	1394.14	21.36	
900+00	-820.28	49.89	1.70	86.31	8.06	184.64	28.68	407.33	62.22	650.83	32.11	1415.78	8.79	
905+00	-817.26	15.73	4.32	38.69	9.50	114.90	28.48	299.70	51.32	533.27	25.26	1265.43	1.63	
910+00	-834.29	25.63	2.46	58.20	10.38	138.21	22.85	351.10	66.40	587.42	38.83	1324.28	15.60	
915+00	-828.09	4.60	-0.35	26.59	6.53	95.63	16.89	290.59	66.70	517.88	42.37	1239.36	17.48	
Reach 3 - North	920+00	-841.42	53.30	3.56	87.53	6.07	178.70	11.94	391.33	59.33	634.37	37.15	1411.09	24.79
	922+50	-842.51	59.93	2.84	97.53	7.70	190.12	16.80	406.22	65.59	650.79	43.89	1417.63	21.73
	925+00	-851.60	56.73	1.36	96.08	6.94	193.90	18.25	405.47	69.62	651.86	46.82	1419.01	28.00
	927+50	-856.99	43.77	3.76	77.02	3.81	172.66	16.42	403.41	95.19	651.87	76.01	1413.75	58.28
	930+00	-854.23	36.94	-1.46	73.65	1.65	169.86	17.24	389.25	83.74	634.46	61.43	1393.83	40.17
	932+50	-864.04	50.45	2.61	82.53	2.15	161.29	1.20	366.58	44.78	609.59	20.80	1367.04	-1.06
	935+00	-883.68	54.71	3.28	96.63	5.11	193.81	10.14	426.83	68.75	682.62	47.16	1455.98	24.73
	937+50	-873.58	29.59	2.36	57.58	2.55	127.08	-2.43	336.35	41.64	574.51	10.32	1314.46	-13.65
	940+00	-876.11	54.64	3.66	100.58	6.51	208.10	17.87	448.33	66.03	702.93	39.71	1464.57	18.29
	942+50	-868.51	50.02	3.92	90.29	8.05	186.30	17.62	412.77	72.10	656.74	44.59	1391.54	12.52
	945+00	-855.94	45.21	5.41	88.59	8.30	190.11	18.13	428.48	76.47	679.60	54.92	1439.11	26.12
	947+50	-839.03	23.46	2.35	52.19	6.48	141.04	27.14	363.79	96.16	599.23	77.47	1349.76	60.16
	950+00	-836.14	51.00	3.84	89.59	9.85	191.23	27.91	419.86	101.52	660.80	81.93	1435.12	48.33
	952+50	-829.79	36.60	4.41	77.22	10.10	174.42	21.76	400.08	88.84	644.13	80.48	1427.96	56.14
	955+00	-819.01	60.78	5.74	109.74	13.98	216.30	25.82	443.75	89.84	691.05	100.96	1487.75	82.58
	957+50	-821.98	47.50	6.86	87.97	13.98	177.72	22.02	389.30	88.03	621.44	97.32	1392.31	57.97
	960+00	-819.35	69.66	9.87	122.05	21.82	231.01	37.04	460.61	93.40	694.73	43.34	1499.99	14.81
	962+50	-812.61	33.93	5.28	69.51	14.16	140.92	14.48	339.11	58.30	574.38	23.15	1339.57	-1.30
	965+00	-819.24	46.25	3.41	94.23	11.53	182.85	13.46	429.99	77.89	690.94	72.31	1475.17	52.33
	967+50	-809.60	28.50	3.43	67.22	13.80	143.75	17.01	368.84	66.83	630.31	76.19	1381.92	51.73
970+00	-803.61	45.23	7.68	89.36	16.77	186.70	30.27	443.50	100.43	693.98	86.85	1459.72	52.18	
Reach 3 - South	972+50	-795.78	67.16	10.14	119.23	21.41	217.85	27.15	463.96	73.03	718.06	53.02	1504.91	28.66
	975+00	-786.63	54.24	8.15	103.16	19.13	193.73	22.00	438.76	66.76	690.04	33.74	1458.68	-4.02
	977+50	-769.76	72.37	8.28	122.03	14.35	212.75	11.14	467.15	60.65	721.90	48.21	1519.21	32.73
	980+00	-744.07	21.79	8.10	57.62	12.68	129.17	11.30	357.36	59.51	600.62	83.58	1365.37	64.57
	982+50	-730.31	34.15	3.58	66.57	5.92	137.54	7.80	347.46	45.64	585.89	34.62	1342.57	11.18
	985+00	-710.45	7.01	4.19	30.45	5.56	84.59	5.18	273.33	35.36	498.12	19.67	1230.74	-3.85
	987+50	-676.90	0.21	0.12	13.15	4.72	53.00	10.58	211.09	35.53	423.85	26.25	1121.61	6.24
	990+00	-655.50	11.30	4.54	38.30	9.48	98.04	12.48	301.44	58.51	530.18	61.68	1254.89	41.15
	992+50	-651.26	18.91	4.33	47.32	7.14	112.17	10.82	310.78	48.85	539.44	66.73	1278.63	53.16
	995+00	-608.30	1.83	1.29	20.79	4.36	74.35	12.96	261.70	50.81	475.86	83.85	1168.25	61.03
	997+50	-582.86	31.93	5.74	64.17	8.85	130.05	11.61	331.07	47.21	539.68	25.54	1274.83	-39.67
	1000+00	-559.79	6.40	3.58	29.62	8.30	83.59	15.78	264.67	50.82	494.95	64.94	1244.21	46.46
1002+50	-555.22	3.91	3.09	22.24	7.72	67.92	16.15	233.95	39.44	445.45	58.30	1174.37	40.92	
1005+00	-561.93	17.36	3.17	45.54	7.95	103.39	14.10	288.56	36.75	506.11	57.44	1241.92	32.72	
Reach 4	1007+50	-568.01	30.05	5.26	63.01	9.90	129.61	15.58	325.04	42.70	539.46	55.64	1279.32	29.25
	1010+00	-567.25	6.25	1.60	27.44	2.72	79.50	5.32	264.85	37.20	467.42	45.81	1182.31	21.60
	1012+50	-564.64	25.33	1.77	55.11	3.75	119.02	6.97	314.23	28.41	524.33	40.04	1249.03	18.07
	1015+00	-565.31	15.85	1.79	40.35	3.93	96.24	5.85	280.40	22.44	484.57	39.33	1192.96	19.60
	1017+50	-566.90	29.08	1.24	57.51	1.48	118.62	1.15	313.50	16.49	513.50	19.95	1222.25	-6.07
	1020+00	-557.69	6.73	-0.77	24.13	-1.73	70.18	-3.39	245.10	-0.85	444.02	6.01	1138.39	-31.33
	1022+50	-557.52	18.11	0.82	40.21	-1.11	93.01	-0.67	274.07	22.21	475.15	30.65	1179.66	-8.84
1025+00	-560.00	2.01	0.50	15.97	-2.24	55.30	-8.48	223.58	1.37	417.02	17.26	1119.64	-13.37	

NOTES:

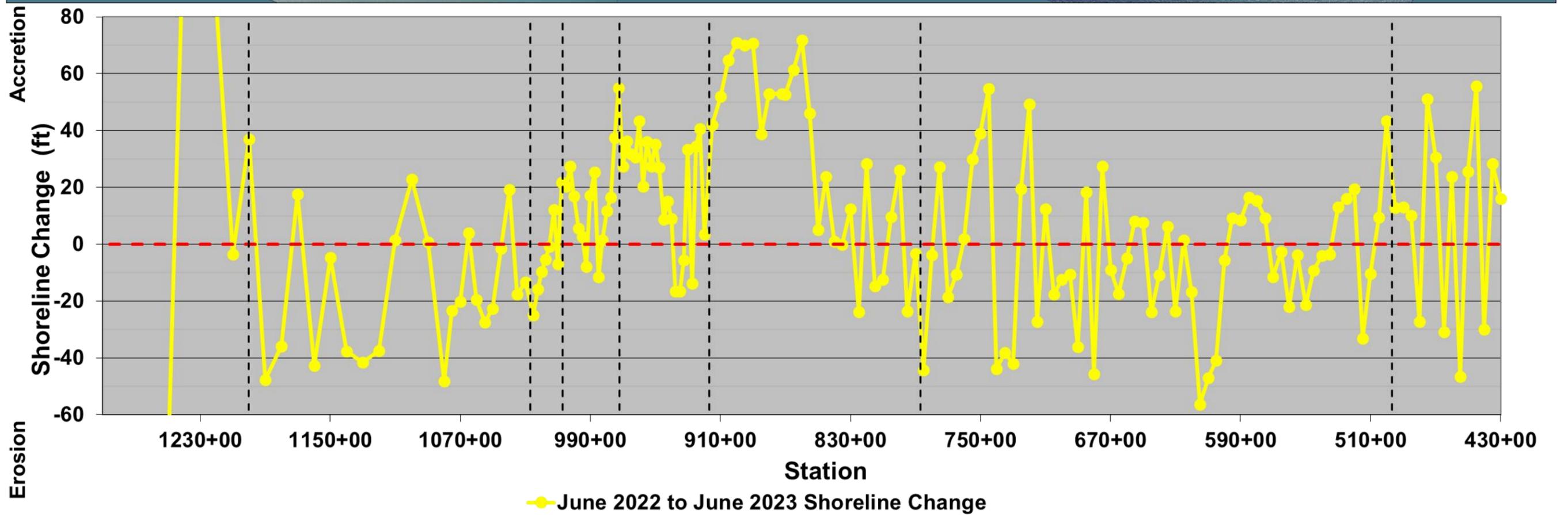
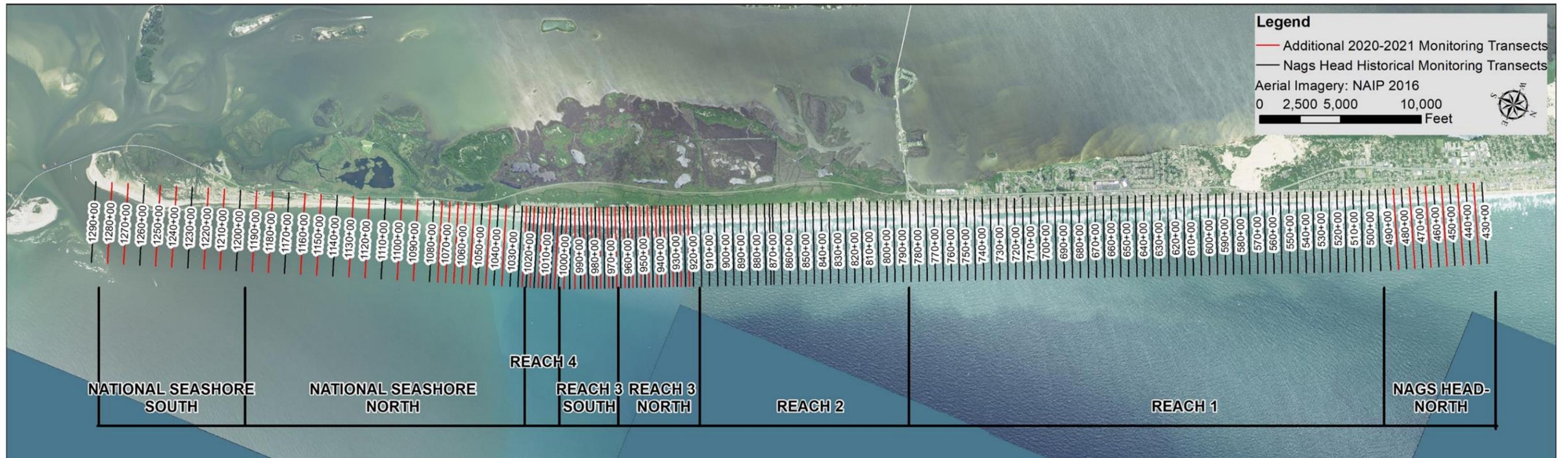
1. Positive changes indicate accretion or gain in volume along the profile and negative changes indicate erosion or loss of volume along the profile.
2. Shoreline Change and Volume Change is calculated for the period between surveys from June 30, 2023 to October 15, 2023.

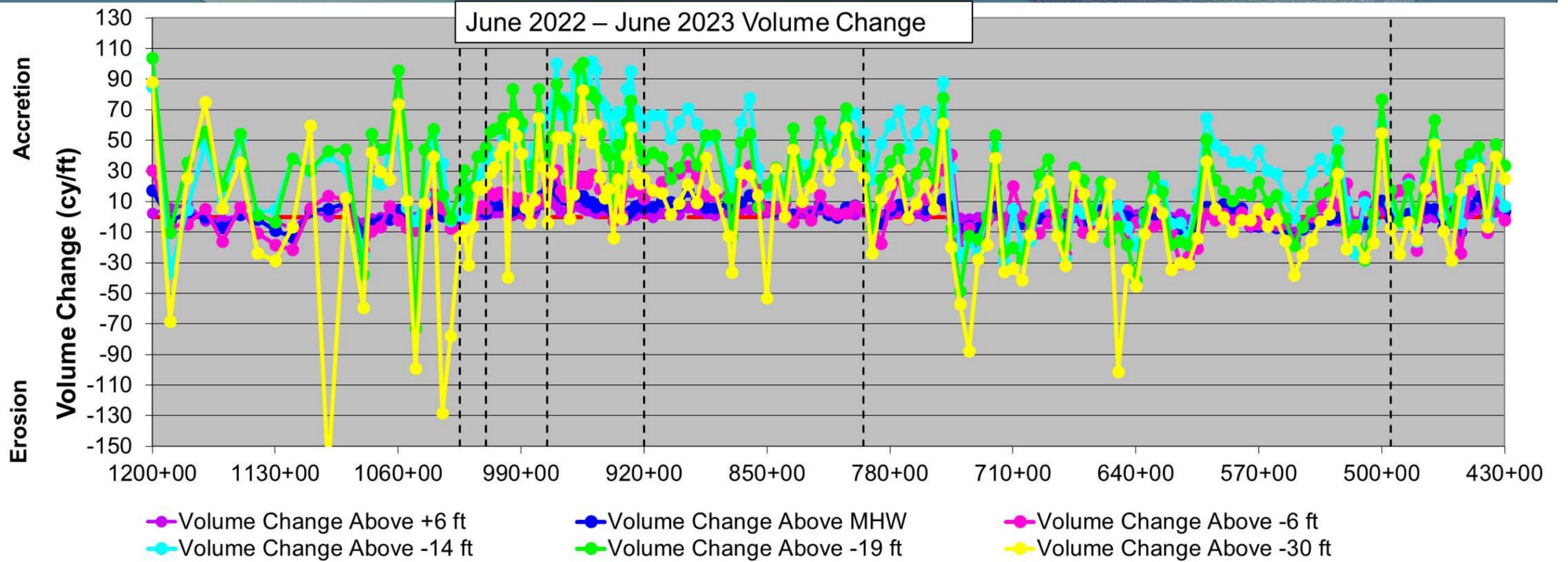
Reach	Station	Shoreline Change @ MHW (+1.18 ft NAVD)	Above Berm (+6 ft NAVD88)		Above MHW (+1.18 ft NAVD88)		Above -6 ft NAVD88		Above -14 ft NAVD88		Above -19 ft NAVD88		Above -30 ft NAVD88			
			Oct. 2023 Measured Volume (cy/ft)	June 2023-Oct. 2023 Volume Change (cy/ft)	Oct. 2023 Measured Volume (cy/ft)	June 2023-Oct. 2023 Volume Change (cy/ft)	Oct. 2023 Measured Volume (cy/ft)	June 2023-Oct. 2023 Volume Change (cy/ft)	Oct. 2023 Measured Volume (cy/ft)	June 2023-Oct. 2023 Volume Change (cy/ft)	Oct. 2023 Measured Volume (cy/ft)	June 2023-Oct. 2023 Volume Change (cy/ft)	Oct. 2023 Measured Volume (cy/ft)	June 2023-Oct. 2023 Volume Change (cy/ft)	Oct. 2023 Measured Volume (cy/ft)	June 2023-Oct. 2023 Volume Change (cy/ft)
			495+00	-57.69	47.77	0.92	74.59	-5.93	133.71	-25.85	323.18	-20.76	572.39	-19.45	1414.28	-13.12
500+00	-20.51	42.15	1.81	70.58	-0.53	146.11	-8.19	330.78	-12.01	580.07	-11.32	1415.53	-8.88			
505+00	-2.41	41.81	1.72	68.34	1.80	140.08	13.83	325.36	26.61	571.48	30.52	1415.32	39.48			
510+00	6.66	30.73	-0.06	63.43	1.37	148.63	1.95	339.89	5.62	547.06	21.41	1395.10	38.62			
515+00	29.91	48.62	3.03	81.10	8.08	163.82	31.29	352.96	49.98	603.67	60.92	1451.84	59.96			
520+00	-3.38	43.48	0.17	79.65	0.97	169.06	5.87	364.79	11.17	602.55	9.25	1433.72	-3.13			
525+00	-21.92	22.44	1.72	52.63	-1.01	125.01	-0.10	344.52	8.02	592.56	4.46	1422.66	2.12			
530+00	-17.90	27.05	0.18	57.90	-1.94	124.83	-18.24	340.14	-9.17	590.33	-8.69	1421.62	-8.25			
535+00	-11.73	36.83	0.94	68.52	-0.66	139.66	-9.19	346.46	-8.72	589.59	-15.53	1424.89	-17.04			
540+00	-15.14	44.41	0.34	76.62	-0.65	150.41	-2.52	378.49	21.95	625.01	21.39	1458.97	14.11			
545+00	-8.67	41.50	1.12	72.99	-0.54	148.10	0.36	360.71	18.19	600.16	17.06	1434.06	13.75			
550+00	22.75	20.53	1.28	48.24	3.40	123.96	20.41	331.37	31.97	560.14	28.62	1375.22	28.44			
555+00	-15.44	23.79	-1.89	50.07	-4.36	120.57	-3.76	320.90	3.71	552.95	3.36	1375.82	11.79			
560+00	25.13	18.09	1.49	42.08	2.73	115.09	14.68	327.62	29.34	560.96	33.40	1373.01	39.31			
565+00	31.12	24.30	0.43	48.95	0.70	127.06	16.24	345.74	45.93	580.35	51.38	1397.25	54.55			
570+00	-0.95	24.95	-1.15	46.13	-3.64	116.37	4.73	336.58	17.47	569.54	19.51	1390.41	18.12			
575+00	-41.51	5.83	-3.14	17.88	-8.64	76.87	-0.69	270.69	9.64	494.54	9.03	1299.22	6.29			
580+00	-42.07	18.34	-2.13	35.18	-10.78	100.53	-3.54	298.50	9.89	531.35	15.04	1349.93	22.17			
585+00	-42.29	14.55	-2.25	32.26	-7.88	100.47	2.64	307.87	10.63	541.63	13.12	1356.34	24.52			
590+00	-43.60	9.40	-3.28	27.48	-13.79	100.87	-1.17	307.54	-5.38	542.94	-4.04	1350.36	-1.10			
595+00	-1.94	15.42	-3.71	38.63	-8.71	123.37	17.56	339.09	11.20	576.28	11.52	1387.26	17.98			
600+00	0.65	27.32	0.20	50.67	-0.01	123.05	15.59	339.07	5.60	577.51	4.23	1391.23	9.94			
605+00	40.72	28.86	3.13	58.97	10.54	132.77	26.72	346.32	35.06	593.90	36.93	1414.33	44.73			
610+00	-10.06	21.97	0.61	39.90	0.81	104.07	10.61	307.09	41.12	552.79	40.41	1363.95	46.28			
615+00	17.84	20.14	-1.79	37.88	-2.12	105.66	11.02	300.09	11.21	547.71	9.91	1354.94	15.87			
620+00	-17.14	17.74	-3.04	38.50	-8.09	117.50	3.08	306.16	10.03	557.30	14.41	1370.37	25.22			
625+00	-23.44	17.89	-2.55	36.77	-9.94	110.26	0.37	306.30	0.01	558.17	8.42	1357.71	13.73			
630+00	-3.13	31.50	0.33	53.77	-1.33	132.77	10.25	323.91	1.43	579.13	6.67	1384.93	15.50			
635+00	-17.05	28.67	-1.37	53.08	-7.54	134.71	-2.08	302.92	-16.83	555.89	1.18	1355.51	4.11			
640+00	7.60	50.83	-1.69	80.01	-5.63	169.43	-3.53	355.97	-12.88	618.17	18.41	1397.03	18.07			
645+00	-6.45	50.83	-1.60	81.72	-5.05	176.49	10.66	365.65	-16.26	604.98	-20.03	1336.78	-23.81			
650+00	-0.86	49.09	-1.62	79.51	-7.77	170.15	0.49	350.02	-27.28	589.49	-16.03	1379.50	-33.60			
655+00	-2.61	34.19	-1.79	60.21	-5.69	146.64	4.88	335.73	-2.37	590.12	9.39	1417.01	18.20			
660+00	7.08	47.03	-0.81	77.09	-1.34	165.65	7.77	356.49	-16.49	608.49	-16.35	1381.29	-8.46			
665+00	38.70	32.90	-0.42	59.29	3.07	138.68	20.13	310.92	5.86	558.62	1.85	1335.30	5.45			
670+00	21.36	33.46	-1.89	58.92	-5.63	143.99	11.39	320.41	-5.31	569.48	-7.66	1350.78	-6.72			
675+00	-17.92	0.76	-0.63	9.19	-7.38	69.42	0.89	214.68	-1.26	443.93	-1.41	1189.66	-3.60			
680+00	11.08	43.05	-2.19	68.31	-3.29	147.66	13.24	317.68	-2.42	563.78	10.11	1357.78	8.43			
685+00	-51.46	41.18	-0.04	64.88	-7.73	147.90	-0.27	319.48	-10.68	567.46	-10.62	1373.61	-10.39			
690+00	20.32	48.75	-0.27	74.45	0.14	155.09	14.94	336.45	4.11	583.24	-0.31	1381.51	-5.01			
695+00	-19.40	49.95	-0.48	77.62	-6.09	160.82	7.46	346.45	-3.07	603.36	0.17	1410.56	8.80			
700+00	17.91	48.81	-1.18	76.64	-2.17	158.52	15.44	344.49	21.58	594.70	31.12	1382.89	27.55			
705+00	-2.99	41.99	1.09	65.63	-0.55	140.78	5.51	315.42	7.98	561.05	11.94	1350.22	9.27			
710+00	-4.90	33.62	-3.58	53.65	-6.92	122.80	2.99	292.40	6.46	538.11	19.38	1323.57	20.33			
715+00	-13.91	48.80	-1.57	74.51	-4.36	148.53	-7.38	327.04	4.33	575.24	2.83	1362.82	-0.65			
720+00	-47.85	58.12	2.17	89.99	-3.89	180.50	-2.17	393.94	-4.48	648.36	-3.49	1438.21	-4.01			
725+00	-49.31	28.98	2.41	52.96	-5.58	126.34	-2.92	313.91	-1.73	556.70	-1.84	1330.68	-3.61			
730+00	30.76	43.55	-0.21	73.92	3.43	149.41	20.07	350.87	19.37	603.98	19.78	1387.34	18.00			
735+00	14.35	32.62	-0.01	56.09	-0.32	134.40	18.89	339.56	38.68	587.23	37.18	1363.66	36.37			
740+00	23.86	43.61	0.04	76.06	2.84	170.25	28.74	384.04	33.26	628.95	30.87	1444.52	28.66			
745+00	-8.90	59.04	3.24	98.82	1.63	206.20	8.86	418.59	16.23	659.90	32.44	1472.37	31.27			
750+00	-3.18	65.13	0.41	111.05	2.10	226.68	15.68	473.65	-6.73	732.12	-7.93	1539.68	-12.16			
755+00	-27.52	67.79	1.95	106.25	-1.11	188.98	-7.23	433.32	-6.60	688.51	-6.08	1501.77	-4.12			
760+00	10.26	41.28	0.23	75.92	-3.38	166.71	8.43	399.93	-1.32	655.65	2.22	1459.49	1.30			
765+00	25.12	17.82	-4.37	43.48	-6.14	119.74	4.31	339.94	8.98	582.12	6.32	1371.00	0.67			
770+00	43.14	36.68	-2.16	67.93	-1.12	158.42	14.30	401.99	24.66	653.32	24.07	1462.93	19.36			
775+00	-8.57	60.15	-0.35	94.89	-5.81	195.99	-7.78	442.19	-6.01	698.85	-8.94	1508.96	-11.56			
780+00	-81.40	22.31	-0.85	48.93	-16.16	131.82	-21.69	417.49	17.89	678.83	20.88	1482.64	20.56			
785+00	64.08	46.33	7.19	95.18	16.23	223.26	54.43	486.28	65.29	748.34	60.72	1555.96	58.05			

Reach	Station	Shoreline Change @ MHW (+1.18 ft NAVD)	Above Berm (+6 ft NAVD88)		Above MHW (+1.18 ft NAVD88)		Above -6 ft NAVD88		Above -14 ft NAVD88		Above -19 ft NAVD88		Above -30 ft NAVD88	
			Oct. 2023 Measured Volume (cy/ft)	June 2023-Oct. 2023 Volume Change (cy/ft)	Oct. 2023 Measured Volume (cy/ft)	June 2023-Oct. 2023 Volume Change (cy/ft)	Oct. 2023 Measured Volume (cy/ft)	June 2023-Oct. 2023 Volume Change (cy/ft)	Oct. 2023 Measured Volume (cy/ft)	June 2023-Oct. 2023 Volume Change (cy/ft)	Oct. 2023 Measured Volume (cy/ft)	June 2023-Oct. 2023 Volume Change (cy/ft)	Oct. 2023 Measured Volume (cy/ft)	June 2023-Oct. 2023 Volume Change (cy/ft)
Reach 2	790+00	-14.55	5.86	1.58	29.72	-2.05	104.08	2.44	316.77	-16.96	558.86	-19.62	1327.58	-25.61
	795+00	-8.02	52.99	0.94	87.52	-0.40	163.08	-14.85	397.76	-5.41	650.55	-9.48	1448.65	-14.23
	800+00	-6.84	14.03	1.63	41.99	1.15	114.91	6.63	335.23	14.46	575.06	9.63	1344.18	8.47
	805+00	21.09	41.38	-0.87	79.00	1.62	166.36	13.00	395.69	19.41	644.93	16.71	1429.00	14.62
	810+00	26.18	51.01	0.42	84.06	1.79	176.30	11.93	399.67	25.90	647.78	24.95	1425.60	24.21
	815+00	42.04	48.48	-0.50	81.26	1.20	181.27	20.22	399.20	24.66	646.16	20.94	1424.51	20.26
	820+00	-14.79	46.48	-0.92	78.68	-7.65	180.50	7.07	395.84	4.50	648.85	2.23	1435.07	-2.33
	825+00	29.28	41.19	-1.23	71.12	-0.18	164.18	18.44	360.48	10.01	609.40	7.23	1389.22	6.88
	830+00	-21.56	39.43	0.89	66.62	-3.51	159.95	9.98	354.85	5.22	604.35	2.57	1376.23	1.42
	835+00	9.85	17.47	-0.16	38.12	-2.53	117.54	13.70	305.77	7.27	546.98	5.26	1293.39	3.92
	840+00	2.73	23.49	0.20	45.13	-2.56	133.43	9.92	321.69	22.04	562.18	24.76	1303.14	23.18
	845+00	-16.53	47.02	-0.77	79.41	-6.75	185.45	6.90	394.39	18.20	644.14	22.68	1396.46	20.84
	850+00	-12.82	21.13	0.77	43.15	-4.49	131.90	7.78	315.03	8.55	551.28	4.50	1252.38	12.58
	855+00	-36.98	33.54	-0.42	62.28	-6.52	163.64	2.42	376.39	2.04	624.03	2.40	1424.22	25.72
	860+00	-34.38	24.08	0.77	49.72	-7.45	144.86	-0.42	356.18	-11.48	597.03	-14.25	1335.76	-14.71
	865+00	-47.90	45.21	0.05	76.06	-5.91	176.64	3.18	387.12	6.26	630.29	6.40	1380.75	7.99
	870+00	-38.13	25.26	3.03	47.47	-3.17	134.59	7.44	323.94	21.88	555.48	19.92	1281.43	21.11
	872+00	-25.49	24.88	1.49	48.75	-4.51	137.28	5.97	330.57	8.41	566.70	8.09	1297.10	9.94
	880+00	-18.75	41.54	0.99	74.38	-3.69	179.47	8.90	403.46	12.11	649.88	12.76	1388.53	0.45
	885+00	-21.14	38.82	1.16	68.44	-4.38	170.53	6.89	381.29	4.95	622.58	0.57	1389.14	-2.69
890+00	-38.20	22.39	0.42	46.77	-5.59	140.85	4.29	341.27	-2.38	576.21	-5.07	1335.52	-1.68	
895+00	-50.55	17.85	1.08	36.48	-7.72	123.69	4.30	325.68	2.44	558.10	2.88	1299.55	4.88	
900+00	-25.79	48.49	0.93	82.96	-0.32	182.70	2.16	406.76	4.72	650.17	5.37	1418.98	10.86	
905+00	-54.58	14.19	-1.54	29.95	-8.74	109.35	-5.55	310.00	10.30	542.57	9.30	1274.65	9.23	
910+00	-14.50	16.46	1.48	40.88	-2.39	126.35	9.46	330.16	7.49	561.46	6.90	1292.38	10.75	
915+00	-35.92	NaN	0.00	9.82	-4.56	70.35	-1.36	257.33	3.69	476.26	3.48	1180.68	4.36	
Reach 3 - North	920+00	22.85	27.82	1.41	54.58	3.22	131.10	2.40	331.98	6.05	567.31	7.97	1315.57	0.69
	925+00	-16.17	57.76	1.04	92.13	-3.95	195.81	1.91	414.44	8.97	661.35	9.49	1427.01	8.00
	930+00	-28.75	37.10	0.16	71.90	-1.76	165.39	-4.47	383.09	-6.16	631.00	-3.46	1391.86	-1.97
	935+00	-32.57	45.12	-1.28	71.92	-9.44	156.09	-12.07	374.72	-14.91	619.09	-19.10	1374.92	-20.75
	940+00	-3.78	55.37	0.73	96.63	-3.95	207.91	-0.19	440.29	-8.04	690.93	-12.00	1448.26	-16.31
	945+00	-1.89	33.73	1.93	64.24	1.02	149.78	2.85	366.55	1.11	602.80	-1.36	1328.32	-8.05
	950+00	-23.94	44.27	3.74	76.32	1.48	165.33	-4.77	385.30	-6.32	623.47	-4.64	1387.80	-4.86
	955+00	0.76	49.03	6.23	88.68	6.92	180.41	6.97	397.01	12.71	632.01	10.79	1405.10	9.99
	960+00	-27.87	67.56	4.08	111.05	-1.78	222.28	5.01	448.06	6.22	686.99	14.19	1476.60	5.46
	965+00	-21.35	39.72	4.72	73.74	0.58	160.28	13.12	380.13	2.13	636.88	8.12	1402.85	12.26
970+00	-23.92	41.07	2.04	75.43	-3.80	154.14	-16.57	397.91	-23.09	645.46	-21.94	1401.95	-22.23	
Reach 3 - South	975+00	-28.75	57.91	3.68	100.57	-2.59	183.05	-10.68	433.00	-5.77	682.30	-7.74	1452.15	-6.53
	980+00	5.47	17.51	2.25	42.13	1.57	105.70	9.29	311.34	4.21	541.33	1.87	1280.85	0.68
	985+00	26.26	7.55	2.97	29.75	6.73	99.75	30.03	300.14	49.98	522.95	53.18	1245.94	54.95
	990+00	-18.01	15.58	4.28	39.77	1.48	101.18	3.14	303.99	2.55	527.34	-2.84	1251.99	-2.90
	995+00	4.23	6.25	4.42	25.85	5.06	76.50	2.15	279.64	17.93	490.39	14.53	1197.20	28.95
	1000+00	9.17	8.83	2.43	33.70	4.08	103.47	19.87	297.41	32.73	528.62	33.67	1278.09	33.88
1005+00	-33.47	15.81	-1.55	36.93	-8.60	85.51	-17.87	283.80	-4.76	499.42	-6.69	1231.91	-10.01	
Reach 4	1010+00	10.03	8.26	2.01	30.50	3.06	84.55	5.05	282.34	17.48	485.78	18.36	1194.45	12.14
	1015+00	-2.09	17.11	1.26	40.90	0.55	95.06	-1.17	298.12	17.72	509.07	24.51	1213.12	20.16
	1020+00	25.65	8.04	1.31	29.75	5.62	91.95	21.77	284.51	39.41	484.69	40.66	1171.79	33.40
	1025+00	-14.65	1.46	-0.55	11.28	-4.69	48.99	-6.31	222.36	-1.21	422.72	5.70	1124.61	4.97

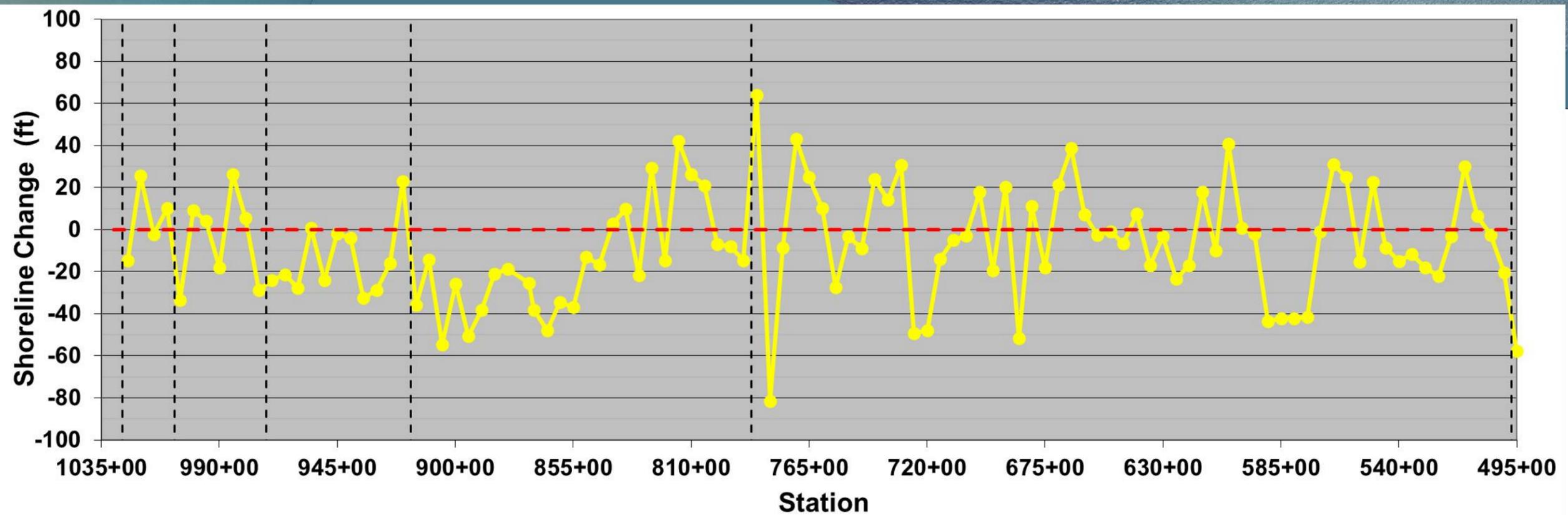
APPENDIX D SHORELINE AND VOLUME CHANGE PLOTS



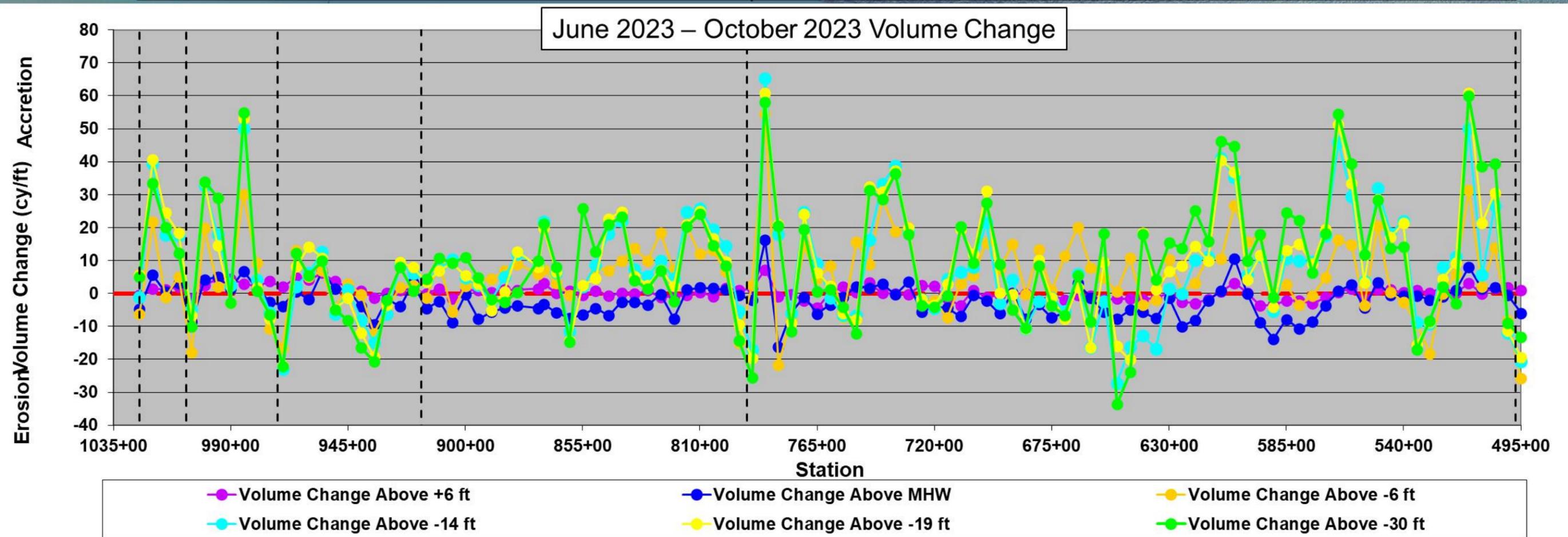




- Volume Change Above +6 ft
- Volume Change Above MHW
- Volume Change Above -6 ft
- Volume Change Above -14 ft
- Volume Change Above -19 ft
- Volume Change Above -30 ft



—●— June 2023 to October 2023 Shoreline Change





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