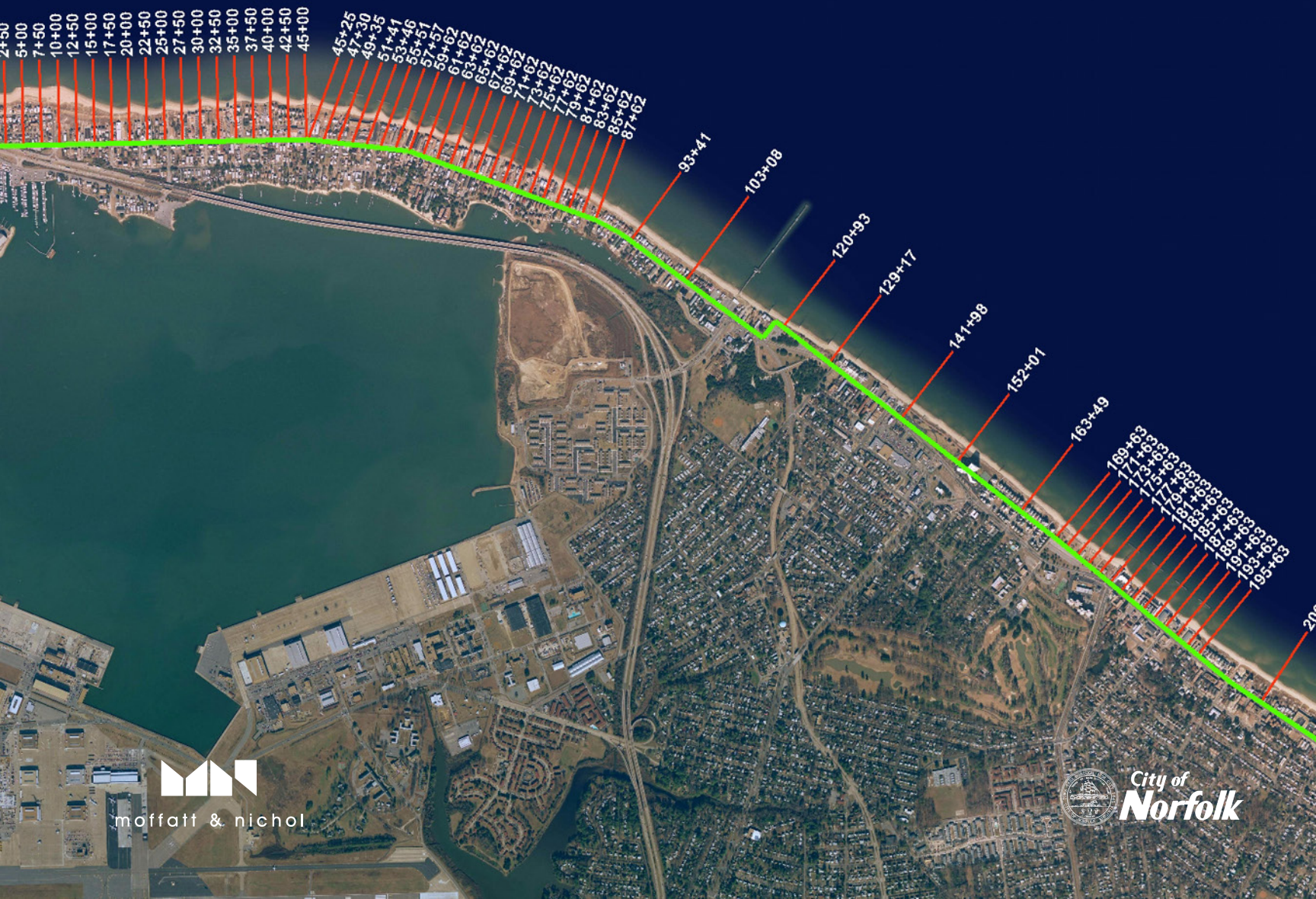
PERIODIC SURVEY EVALUATION:
OCEAN VIEW BEACH

City of Norfolk, Virginia | Spring 2018 | PN: 9169-25



moffatt & nichol

City of Norfolk

Periodic Survey Evaluation: Ocean View Beach Spring 2018

Presented to:

City of Norfolk

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Prepared by:

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1. Executive Summary

The twenty-sixth consecutive twice-yearly survey of the Ocean View shoreline was conducted on April 10 - 11, 2018. The study area extends from the western end of Willoughby Spit to the western edge of Little Creek Inlet in East Ocean View. The periodic surveys are typically collected bi-annually in March/April and September/October to monitor the condition of the shoreline and the state of existing shore protection projects. The Federal coastal storm damage reduction project was constructed by Norfolk District U.S. Army Corps of Engineers (USACE) in mid-May 2017. This report documents the second monitoring survey following the initial adjustment period of the Federal Project, illustrating changes in the Federal Project beach and nearshore conditions approximately one year post-construction.

A baseline and transect locations were established with the first survey in September 2005 and have been used for each subsequent survey. Shoreline changes at Mean High Water (MHW) and volumetric changes above 0 feet NAVD88 and -15 feet NAVD88 are calculated at each transect. Differences in the region above 0 feet NAVD88 are indicative of changes to the dune and subaerial beach berm, while the differences above -15 feet NAVD88 indicate changes in the nearshore zone. Comparison of yearly surveys (i.e. May 2017 to April 2018) eliminates seasonal variation of profiles in volumetric change analyses. Consecutive survey comparisons (fall to spring, and spring to fall) are useful to assess the direct impact of extreme events which have occurred during the six months between surveys. This report documents the data sources, methods, and results of a periodic surveying evaluation performed to compare the April 2018 survey data with previous surveys taken in May 2017 (spring to spring comparison) and October 2017 (most recent periodic survey comparison) in the Ocean View Beach area between Willoughby Spit and Little Creek Inlet.

Comparison	Parameter	Quantity
May 2017 vs. April 2018	Average Shoreline Change Rate at MHW (+0.98 ft NAVD88)	-22.91 ft/yr
	Cumulative Volume Change Rate Above 0 ft NAVD88	86,381 cy/yr
	Cumulative Volume Change Rate Above -15 ft NAVD88	10,097 cy/yr
October 2017 vs. April 2018	Average Shoreline Change at MHW (+0.98 ft NAVD88)	-3.91 ft
	Cumulative Volume Change Above 0 ft NAVD88	60,971 cy
	Cumulative Volume Change Above -15 ft NAVD88	-1,974 cy

The Federal Willoughby and Vicinity Coastal Storm Damage Reduction Project (Federal Project) was constructed in March, April and May 2017. The Federal Project placed approximately 1.2 million cubic yards material on the Ocean View Beach. The spring 2018 monitoring survey report is to evaluate the performance of the Federal Project and will help the City and USACE to track project conditions, document damage associated with specific storms, and effectively plan for future renourishment needs.

The behavior in each of the shoreline reaches for the May 2017 to April 2018, October 2017 to April 2018 periods are summarized in Table 1-1 and Table 1-2 respectively.

As illustrated in Table 1-1, the Ocean View shoreline has experienced overall retreat at MHW from May 2017 to April 2018 with a length-weighted average change rate of -22.91 ft/yr. The beach and dune above 0 feet NAVD88 gained sediment at a rate of 86,381 cy/yr from May 2017 to April 2018.

The beach and dune above -15 feet NAVD88 gained sediment at a rate of 10,097 cy/yr from May 2017 to April 2018.

From October 2017 to April 2018, the MHW shoreline retreated on average by -3.91 feet, as shown in Table 1-2. The volumetric change over the same period showed gain above 0 feet NAVD88 and loss above -15 feet NAVD88 of 60,971 cy and -1,974 cy, respectively.

Table 1-1: Regional Shoreline and Volume Change Statistics (May 2017 to April 2018)

Region	Average Shoreline Change	Average Volume Change Rate Above 0 ft NAVD88	Cumulative Volume Change Rate Above 0 ft NAVD88	Average Volume Change Rate Above -15 ft NAVD88	Cumulative Volume Change Rate Above -15 ft NAVD88
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
Willoughby Spit (0+00 to 45+00)	1.73	3.42	15,433	4.72	21,314
800 Block Breakwaters (45+25 to 87+62)	-29.20	0.21	971	-1.16	-5,258
West Ocean View (93+41 to 163+49)	-40.41	0.97	7,917	-3.06	-19,650
Central Ocean View Breakwaters (169+63 to 195+63)	-45.39	-1.17	-4,050	-3.12	-10,820
Central Ocean View (206+86 to 323+09)	-6.93	4.44	55,512	2.50	31,253
East Ocean View (329+63 to 383+58)	-35.43	1.85	10,598	-1.18	-6,742
OVERALL	Weighted Avg (ft/yr)	Weighted Avg (cy/ft/yr)	Total (cy/yr)	Weighted Avg (cy/ft/yr)	Total (cy/yr)
	-22.91	2.24	86,381	0.17	10,097

Table 1-2: Regional Shoreline and Volume Change Statistics (October 2017 to April 2018)

Region	Average Shoreline Change	Average Volume Change Above 0 ft NAVD88	Cumulative Volume Change Above 0 ft NAVD88	Average Volume Change Above -15 ft NAVD88	Cumulative Volume Change Above -15 ft NAVD88
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
Willoughby Spit (0+00 to 45+00)	-1.95	0.69	3,130	-0.35	-1,578
800 Block Breakwaters (45+25 to 87+62)	-12.39	0.66	3,010	-3.58	-16,229
West Ocean View (93+41 to 163+49)	-8.68	0.37	2,830	-3.38	-25,740
Central Ocean View Breakwaters (169+63 to 195+63)	-0.44	0.25	882	0.76	2,630
Central Ocean View (206+86 to 323+09)	1.25	3.18	39,796	2.29	28,607
East Ocean View (329+63 to 383+58)	-5.76	1.98	11,323	1.81	10,335
OVERALL	Weighted Avg (ft)	Weighted Avg (cy/ft)	Total (cy)	Weighted Avg (cy/ft)	Total (cy)
	-3.91	1.59	60,971	-0.05	-1,974

2. Objective

The City of Norfolk, Virginia has maintained a program of periodic surveying of the Ocean View shoreline since 2005. The periodic surveying data collection dates are shown in Table 2-1. This report documents the data sources, methods, and results of a periodic surveying evaluation performed to compare the April 2018 survey data with previous surveys taken in May 2017 (spring to spring comparison) and April 2018 (most recent periodic survey comparison) in the Ocean View Beach area between Willoughby Spit and Little Creek Inlet.

Table 2-1: Surveyors and Collection Dates

Data Collection Date	Surveyor
September 2005	McKim & Creed
March 2006	McKim & Creed
October 2006	McKim & Creed
March 2007	McKim & Creed
October 2007	McKim & Creed
March 2008	McKim & Creed
October 2008	McKim & Creed
April 2009	McKim & Creed
October 2009	Geodynamics, LLC
March 2010	Geodynamics, LLC
October 2010	Geodynamics, LLC
April 2011	Geodynamics, LLC
October 2011	Geodynamics, LLC
March 2012	Geodynamics, LLC
September 2012	Geodynamics, LLC
April 2013	Geodynamics, LLC
October 2013	Geodynamics, LLC
March 2014	Geodynamics, LLC
October 2014	Geodynamics, LLC
April 2015	Geodynamics, LLC
October 2015	Geodynamics, LLC
May 2016	Geodynamics, LLC
October 2016	Geodynamics, LLC
February 2017	USACE (Great Lakes Dredge & Dock)
May 2017	USACE (Great Lakes Dredge & Dock)
May 2017	Geodynamics, LLC
October 2017	Geodynamics, LLC
April 2018	Geodynamics, LLC

3. Data Sources

Geodynamics, LLC, conducted the most recent survey of Ocean View Beach on April 10-11, 2018. The baseline and transects established for the September 2005 survey were used for the most recent survey. Figure 3-1 shows the location of the baseline, transects and the stationing applied by Geodynamics for the surveying. As shown in Figure 3-1, transects were stationed from west to east along the Ocean View shoreline. The survey data were provided in xyz and shapefile formats allowing for compatibility with multiple programs.

Geodynamics noted that typical vertical survey accuracy along the hydrographic portions of the profiles is approximately ±1 cm. This 'margin of error', if applied over the entire length of the hydrographic profiles can potentially result in significant volumetric differences, in particular on the shallow-sloped and long profiles near Willoughby Spit. Therefore, volumetric changes discussed herein are analyzed with regard to potential volumetric margins of error.

On April 21, 2018, the Virginia Institute of Marine Science (VIMS) flew aerial photography of the Ocean View shoreline, georectified the images, and digitized the apparent MHW shoreline position from the images. The April 2018 aerial photos with the digitized shoreline positions from April 2018, October 2017, and June 2017 are shown in Appendix A. Since these photos cover a limited portion of area landward and seaward of the shoreline, a previous image (2009) is underlain for presentation purposes.

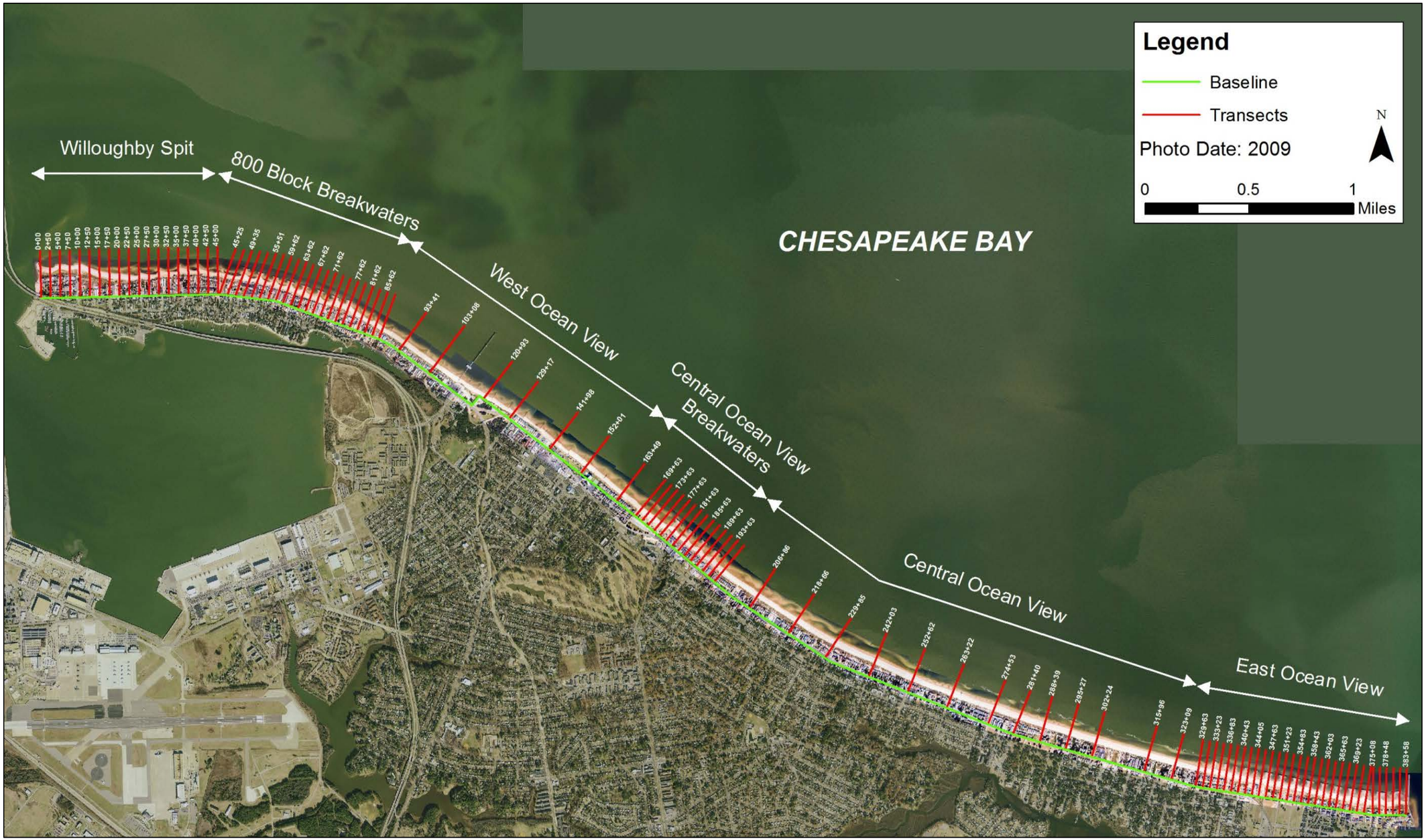


Figure 3-1: Survey Baseline and Transects

4. Methods

Survey comparisons and respective analysis were performed using a combination of Microsoft Excel, Golden Software Surfer, ESRI ArcGIS, and the USACE's Beach Morphology Analysis Package (BMAP). Surfer is a contouring and 3D surface mapping program utilized to create 3D surfaces for analysis. BMAP is a program developed by the USACE to analyze morphologic and dynamic properties of beach profiles.

The horizontal coordinate system used was Virginia South State Plane NAD 1983 (HARN), US Survey feet with a vertical datum of NAVD88. Individual profile plots showing the survey profile at each transect for each date are presented in Appendix B. From the profiles, shoreline changes and volumetric changes were then calculated at each transect for the following time periods:

1. May 2017 to April 2018 (Entire Shoreline)
2. October 2017 to April 2018 (Entire Shoreline)

First, the change in shoreline based on the survey profiles at mean high water (MHW) was calculated at each transect for each time period mentioned. MHW along Ocean View beaches is defined as +0.98 feet NAVD88 based on NOAA tidal benchmark at Sewells Point. The resulting value represents the shoreline change (feet) over the time period between surveys. The shoreline change rate (ft/yr) was then calculated by dividing by the amount of time between survey dates.

Representative volume changes were also calculated at each transect for all time periods. Volume changes were calculated for two different extents in order to better understand the processes occurring onshore and offshore of the Ocean View beach area. Calculations included volume changes above -15 feet NAVD88 and volume changes above 0 feet NAVD88. The results represent volume change per linear foot of shoreline (cy/ft) over the period of time between surveys. The volume change rate (cy/ft/yr) was then calculated by dividing by the amount of time between survey dates. In addition, the volume changes were converted to cumulative changes over the entire shoreline. This was done by applying the average end area method to the unit volume changes (cy/ft) and unit volume change rates (cy/ft/yr) computed at each transect and summing the total volume changes over the entire shoreline. The resulting value indicated the total loss or gain of material (cy) between surveys based on the applicable profile extents.

Volume changes calculated for portions of the profiles above 0 feet NAVD88 are representative of changes in the amount of material in the dune system and on the subaerial beach. These areas are highly influenced by the performance of coastal structures and the impact of storm activity. Volume changes calculated for portions of the profiles above -15 feet NAVD88 allow for the tracking of sand movement in the submerged active profile; removing profile data deeper than the -15 feet NAVD88 contour from the analysis reduces uncertainty that would be associated with hydrographic data beyond this depth.

5. Discussion of Periodic Surveying Evaluation

This section discusses differences observed between the noted surveys, overall shoreline trends, regional shoreline trends and comparison with the pre- and post-construction surveys of the Federal Project. The computed shoreline changes and volume changes at each individual transect for the time periods covered are tabulated in Appendix C.

5.1. Differences in Survey Coverage

Variation in profile positions between surveys taken as part of the ongoing program of periodic surveying of the Ocean View shoreline (May 2017, October 2017, and April 2018) were minimal in the topographic portion of the survey due to use of the same baseline and transects put in place for the initial survey in September 2005. Profile extents and alignment were virtually the same when comparing the survey data.

5.2. Key Events during the Reporting Period

Beach processes are greatly influenced by natural and engineering processes. This section describes key events that happened during the present reporting period which likely had an impact on shoreline position changes and profile volume gains and/or losses.

5.2.1. Storm Wave Events

Understanding of the wave climate immediately offshore of the Norfolk shoreline is vital for the design, monitoring, and understanding of projects along the shoreline and the behavior of the beach. The data used were collected from the City's AWAC (Acoustic Wave and Current) gage, which was deployed in 2006 directly offshore of the Norfolk Shoreline in approximately 23 feet of water. Wave data were collected throughout this survey period.

A summary of the observed conditions during this monitoring period yields the following general observations:

- The average significant wave height and peak period during this monitoring period (available wave data from October 20, 2017 to April 11, 2018) was approximately 1.4 feet and 4.7 seconds.
- The largest significant wave height observed during this monitoring period was approximately 5.2 feet with a corresponding peak period of approximately 6.1 seconds and mean direction of 13 degrees (January 4, 2018).
- Waves approach from the northwest to southeast, with more than 85% approaching from 0 to 120 degrees North.

Thirty-five storm events occurred during May 2017 and April 2018 for which the significant wave height at the wave gauge exceeded 3.3 feet (1.0 meter). These events are shown in Figure 5-1 through Figure 5-35.

The overall trends remained consistent with prior measurement periods with waves during calm periods being predominantly swell traveling into the bay from the ocean and having longer wave periods and lower wave heights. Typically, the larger wave height events are driven by northerly and northeasterly storm winds within the bay and tend to have shorter wave periods. There were 24 storm events identified during the Fall 2017 to Spring 2018 monitoring period, and, as observed in the prior measurement periods, the wind data indicate that for large and sustained wind events there is a corresponding increase in significant wave height. A summary of wave statistics by month from May 2017 through April 2018 is given in Table 5-1.

Table 5-1: Monthly Wave Statistics Summary

Wave Statistic	May-17	Jun-17	July-17	Aug-17	Sep-17	Oct-17	Nov-17
Average Significant Wave Height, H_s (ft)	1.2	0.9	0.9	1.3	1.7	1.3	1.4
Average Wave Period, T_m (s)	2.4	2.3	2.4	2.7	2.9	2.7	2.7
Average Peak Wave Period, T_p (s)	4.0	5.2	5.5	5.1	5.9	5.7	4.9
Maximum Observed Significant Wave Height, H_s (ft)	3.9	3.2	5.0	5.9	4.6	4.9	4.0
Maximum Observed Wave Height, H_{max} (ft)	6.3	5.7	7.7	10.5	7.9	8.3	7.1

Wave Statistic	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18		
Average Significant Wave Height, H_s (ft)	1.2	1.4	1.1	1.9	1.3		
Average Wave Period, T_m (s)	2.4	2.7	2.4	2.8	2.5		
Average Peak Wave Period, T_p (s)	4.0	4.4	4.5	5.7	4.2		
Maximum Observed Significant Wave Height, H_s (ft)	4.6	5.2	3.7	4.6	4.6		
Maximum Observed Wave Height, H_{max} (ft)	8.0	9.6	5.8	9.7	7.7		

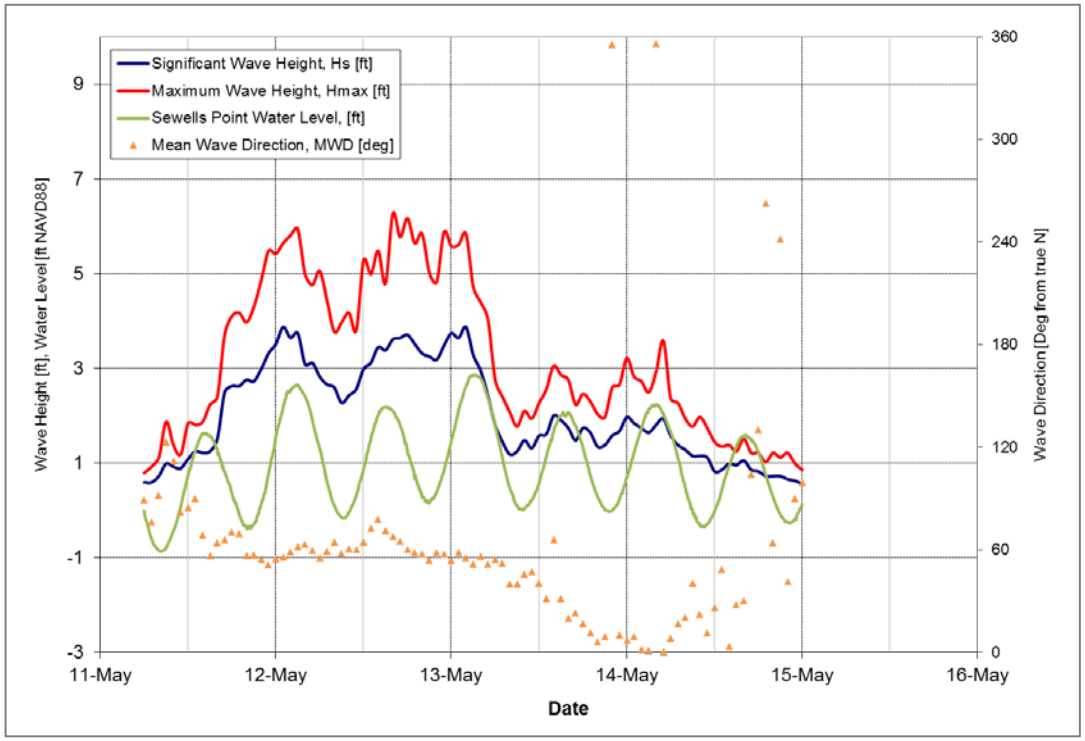


Figure 5-1: May 12, 2017 Storm

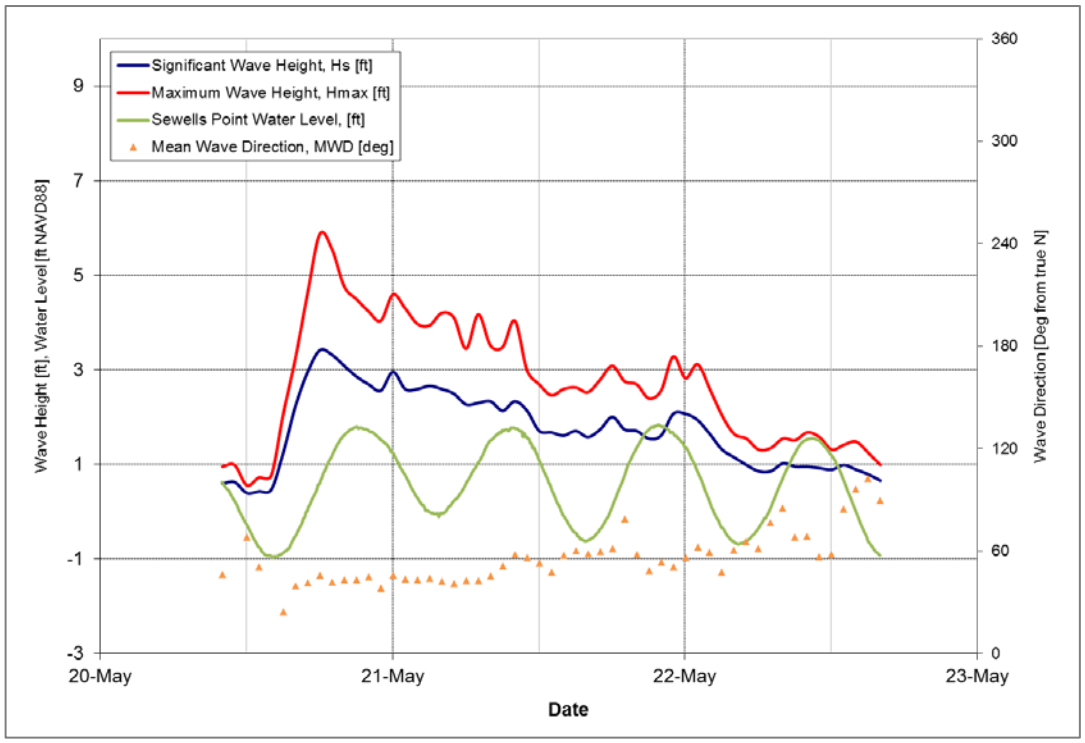


Figure 5-2: May 20, 2017 Storm

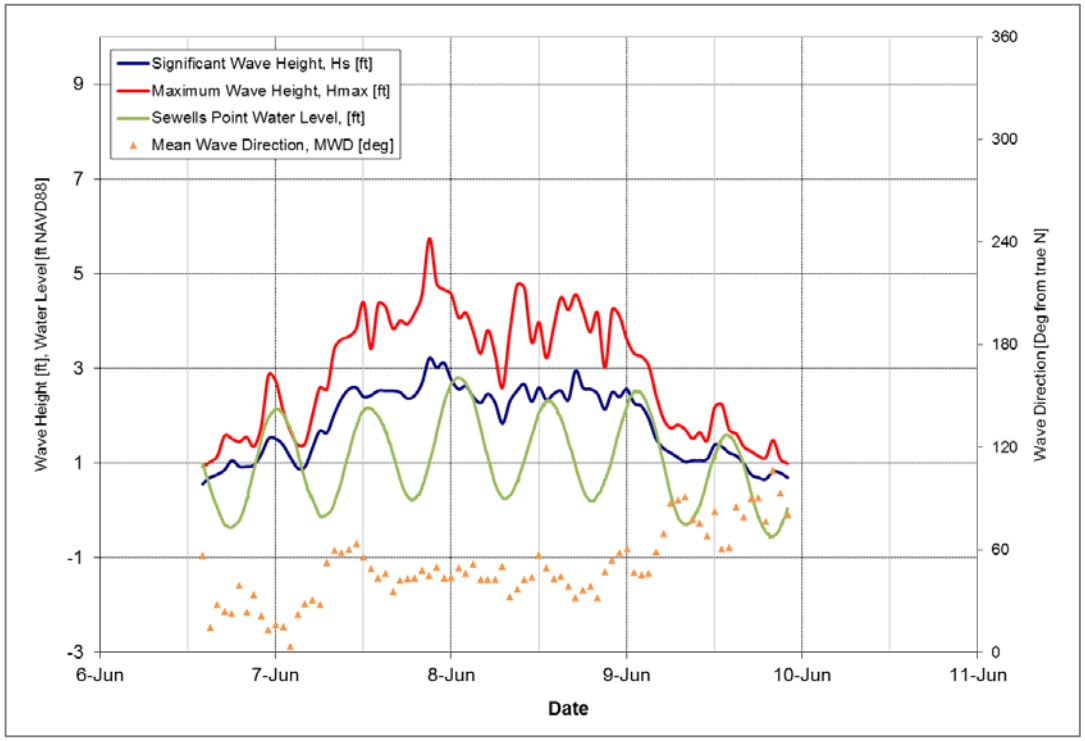


Figure 5-3: June 7, 2017 Storm

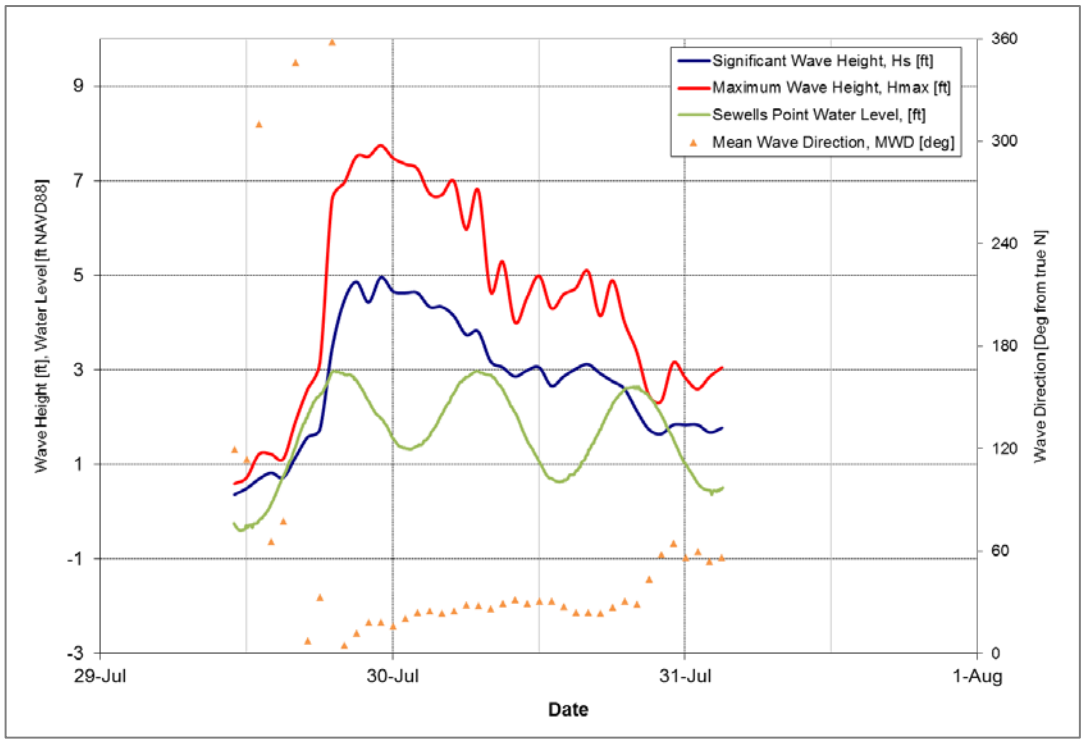


Figure 5-4: July 29, 2017 Storm

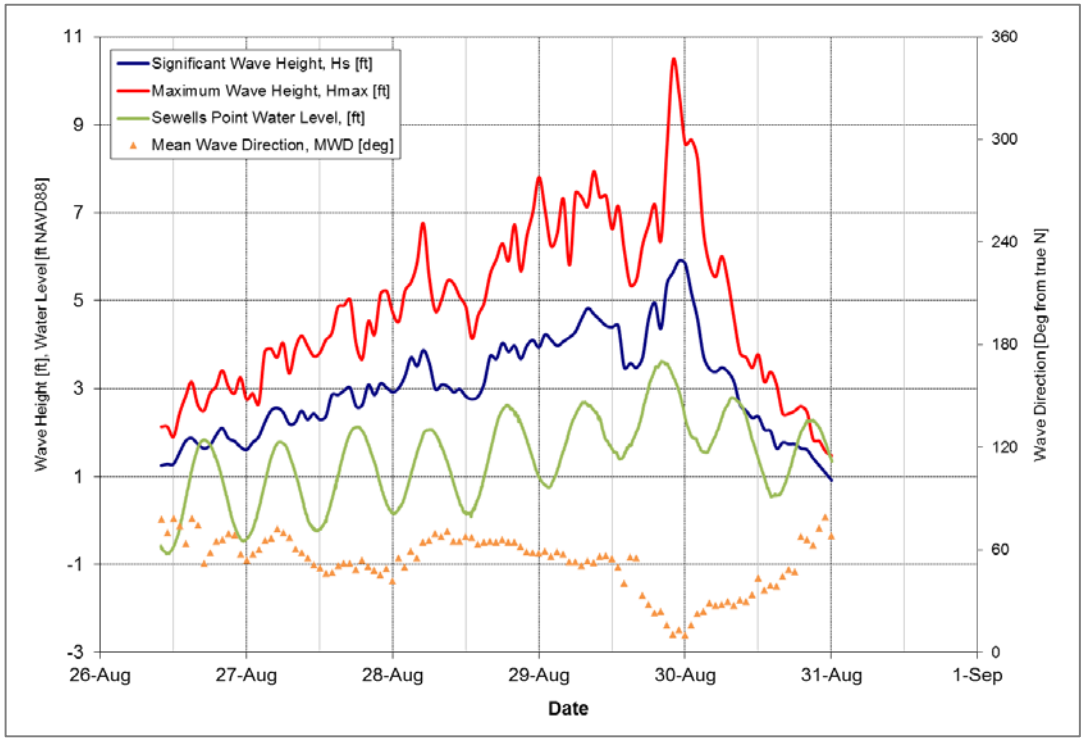


Figure 5-5: August 29, 2017 Storm

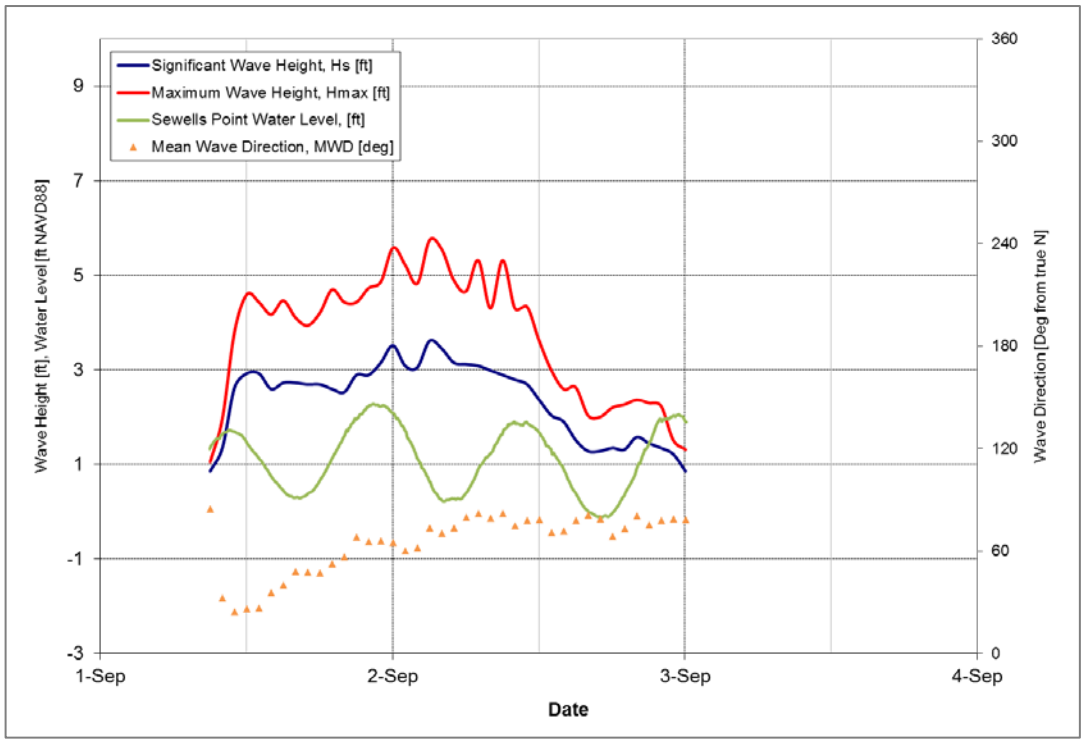


Figure 5-6: September 2, 2017 Storm

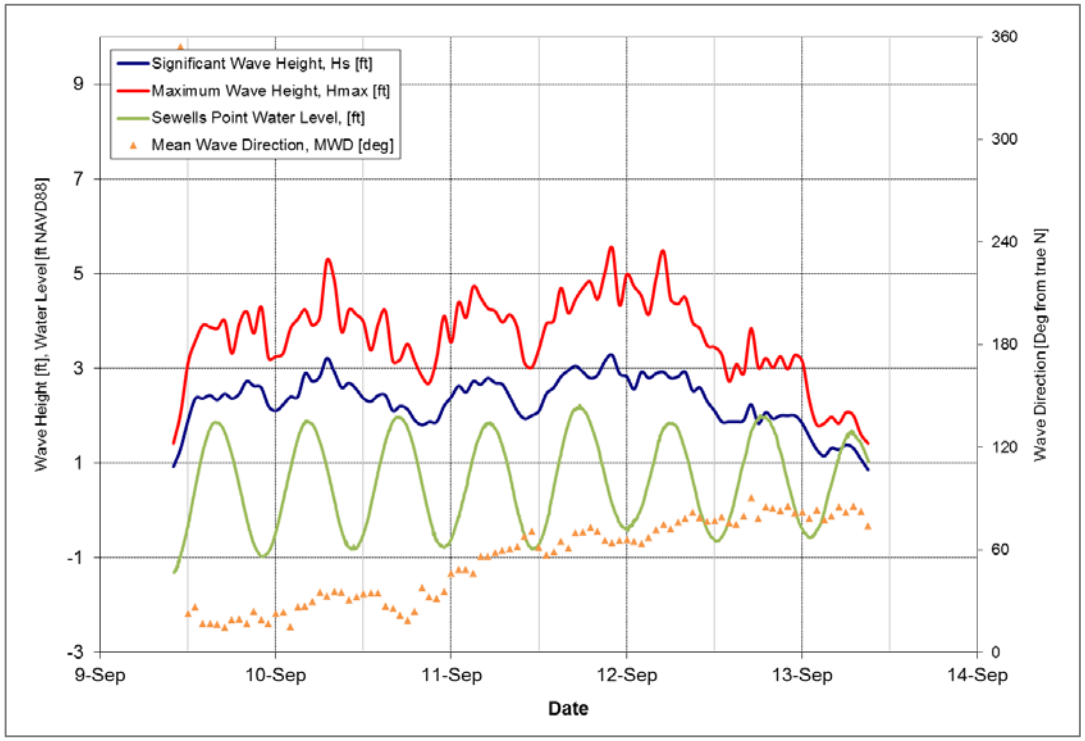


Figure 5-7: September 11, 2017 Storm

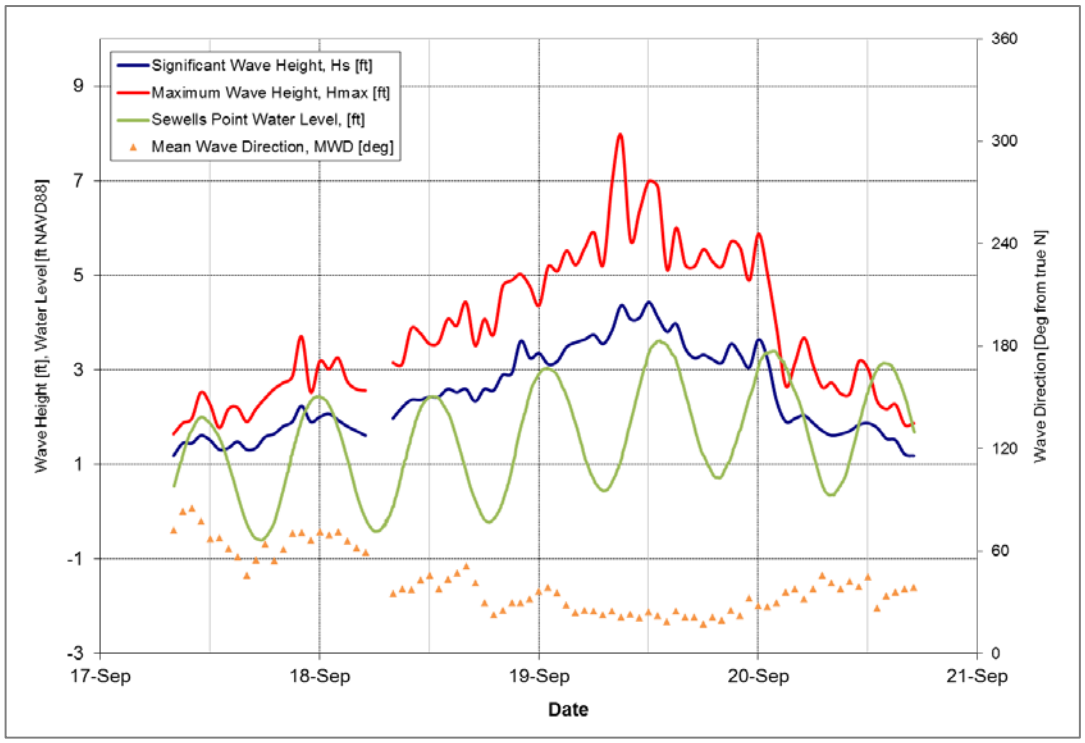


Figure 5-8: September 19, 2017 Storm

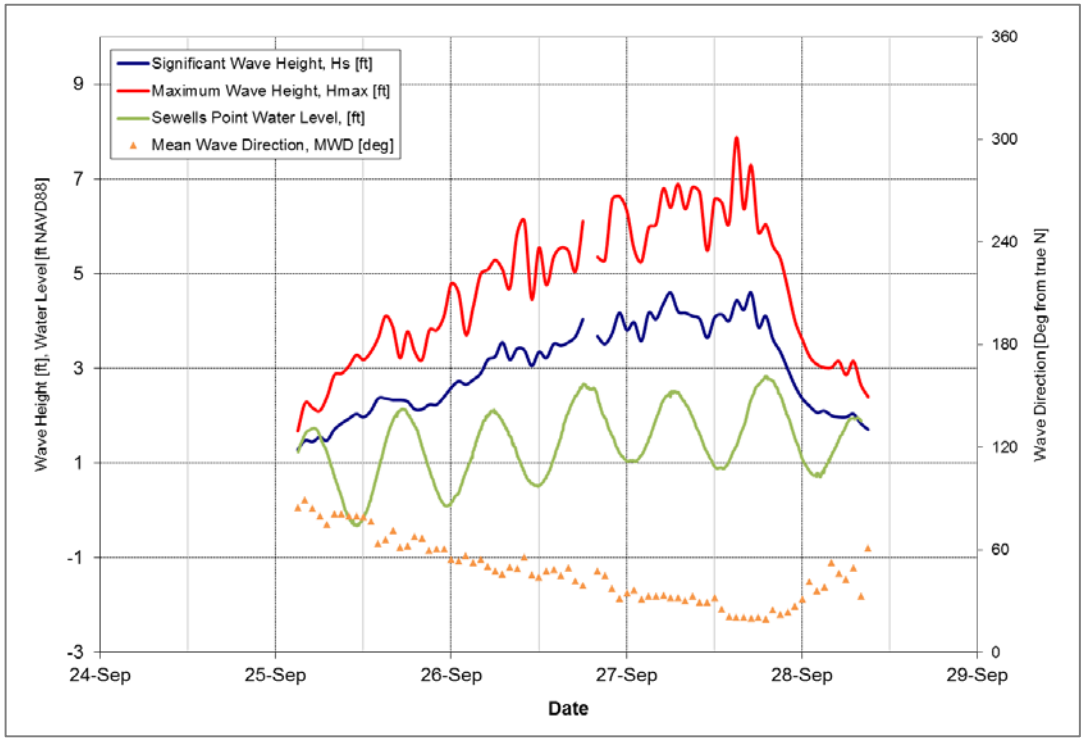


Figure 5-9: September 27, 2017 Storm

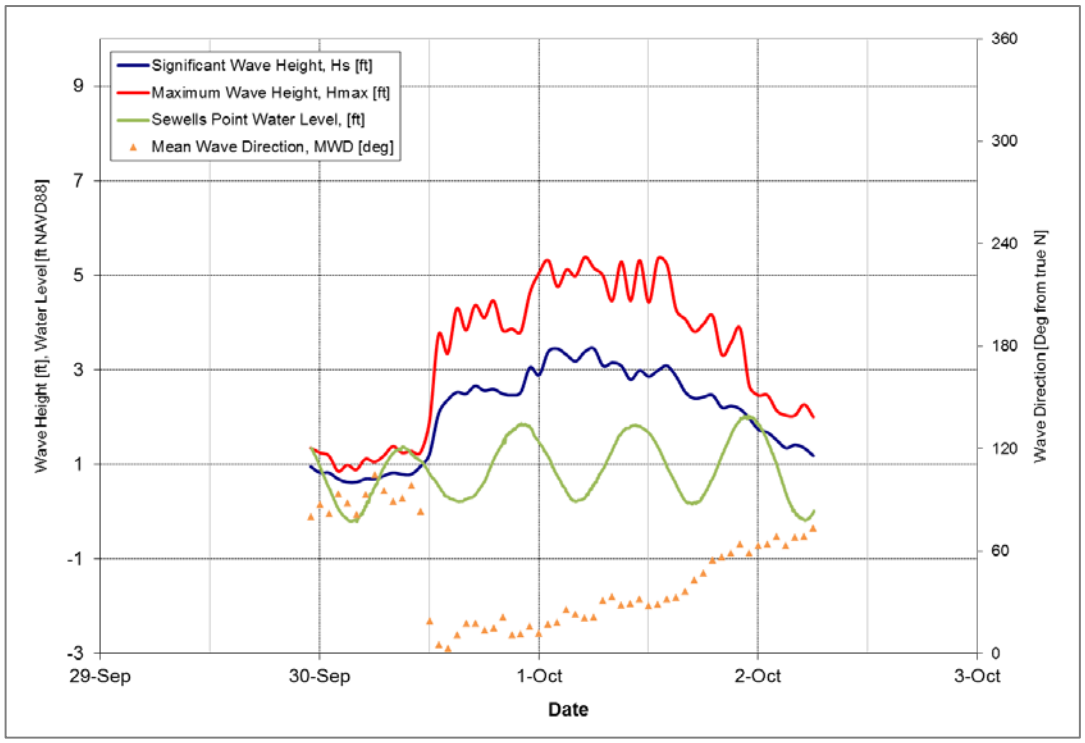


Figure 5-10: October 1, 2017 Storm

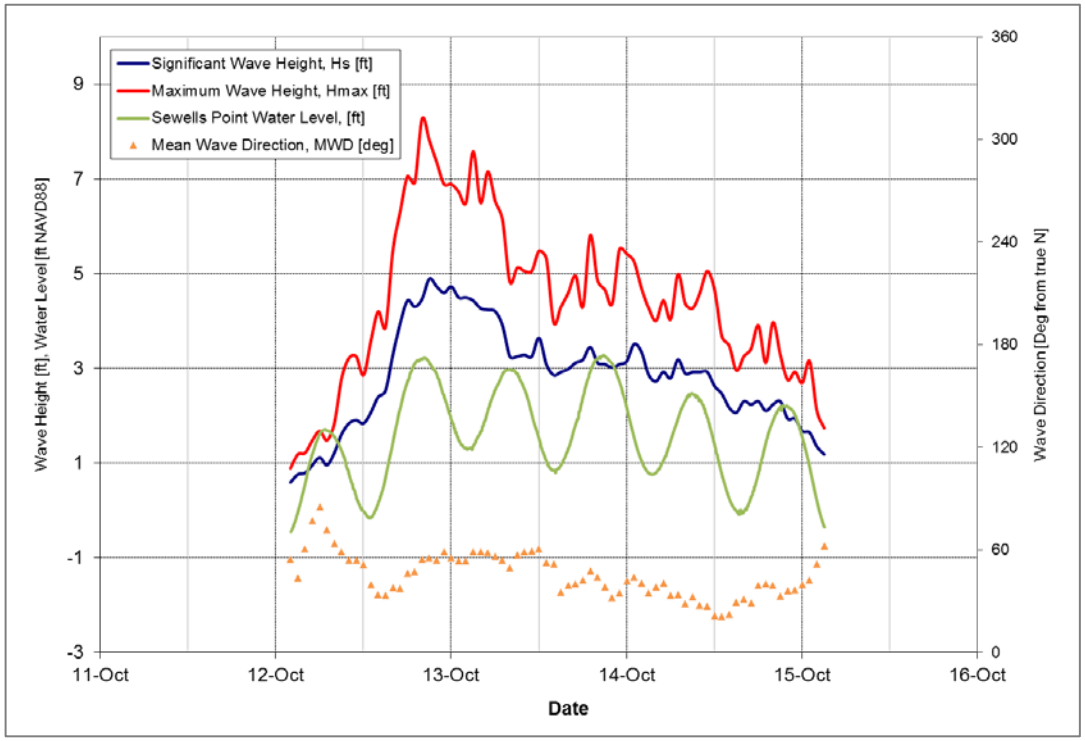


Figure 5-11: October 12, 2017 Storm

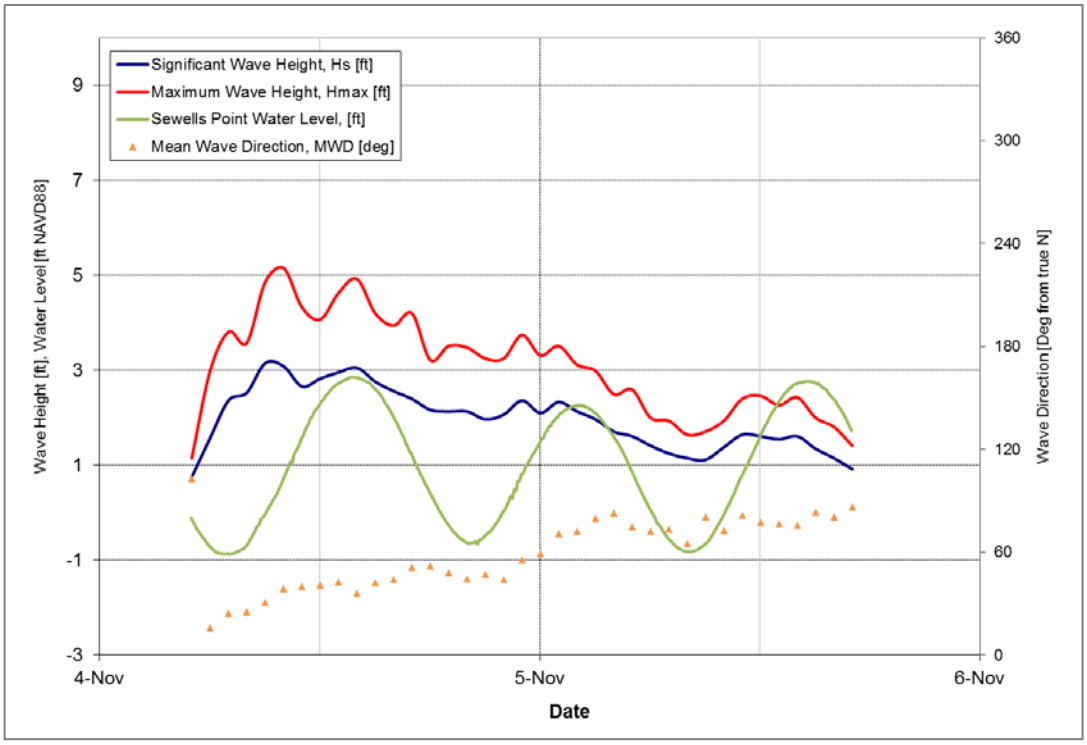


Figure 5-12: November 4, 2017 Storm

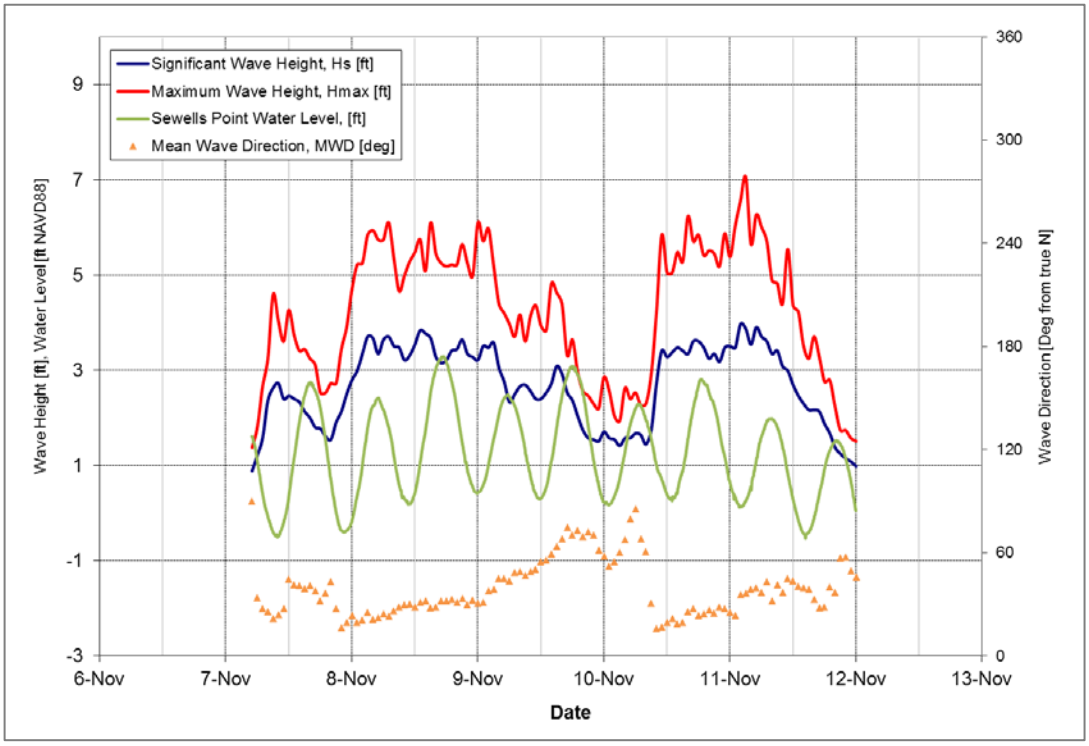


Figure 5-13: November 8, 2017 Storm

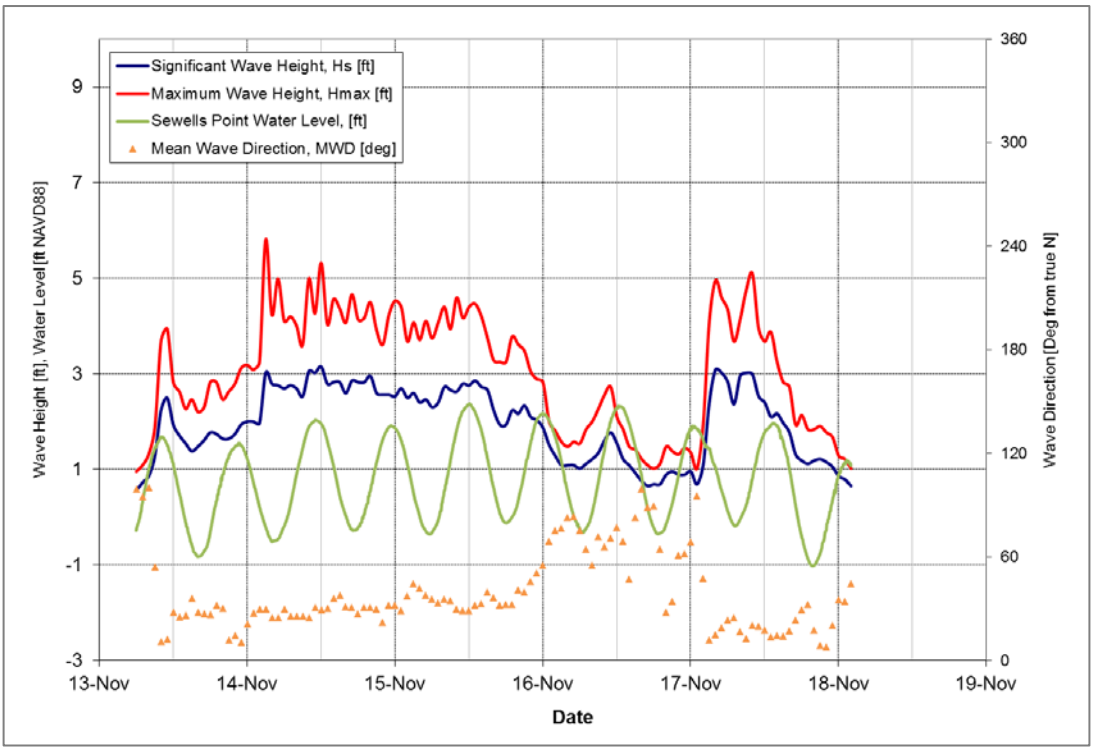


Figure 5-14: November 14, 2017 Storm

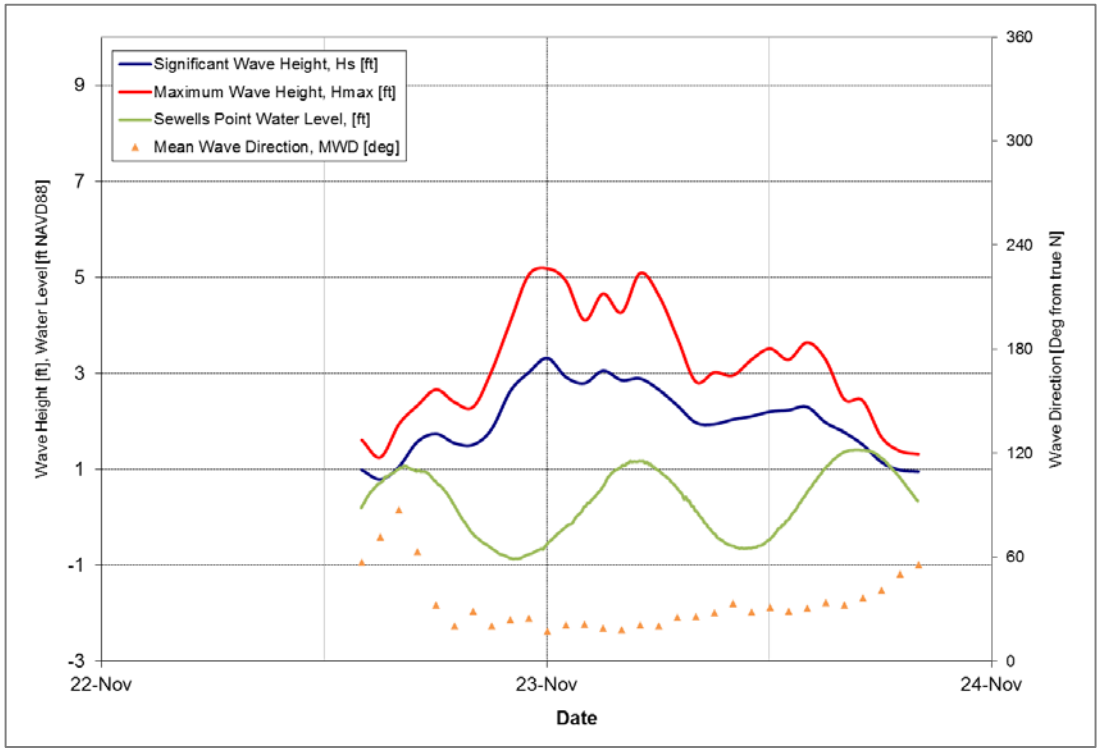


Figure 5-15: November 22, 2017 Storm

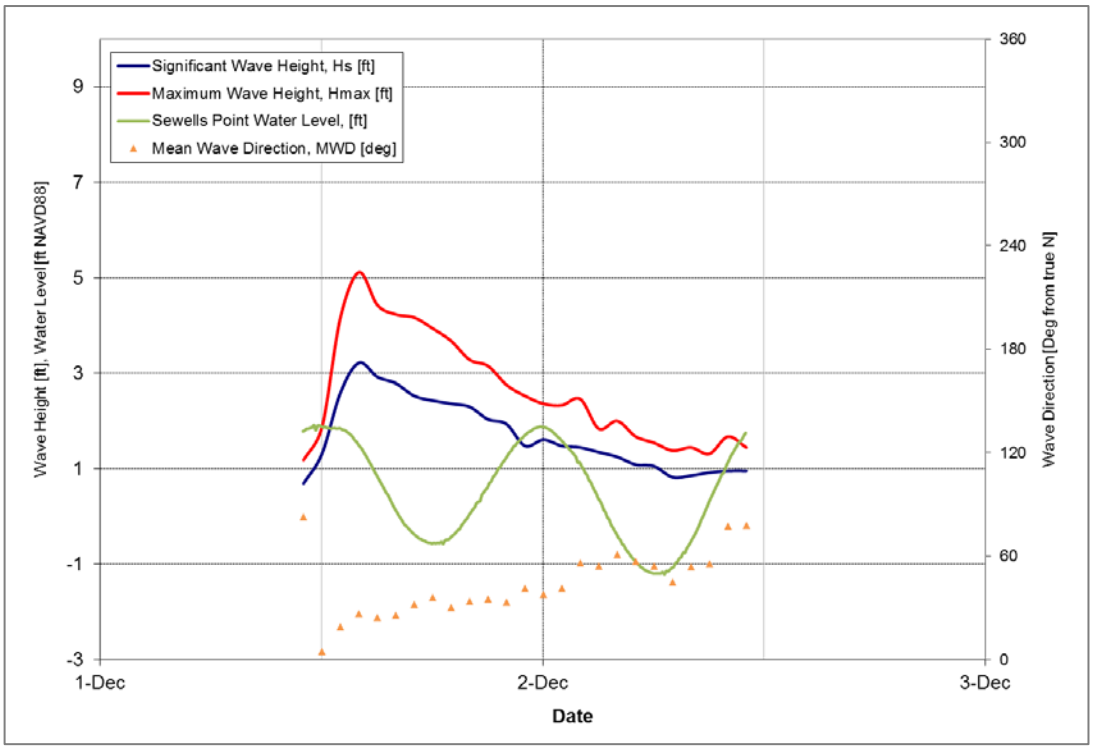


Figure 5-16: December 1, 2017 Storm

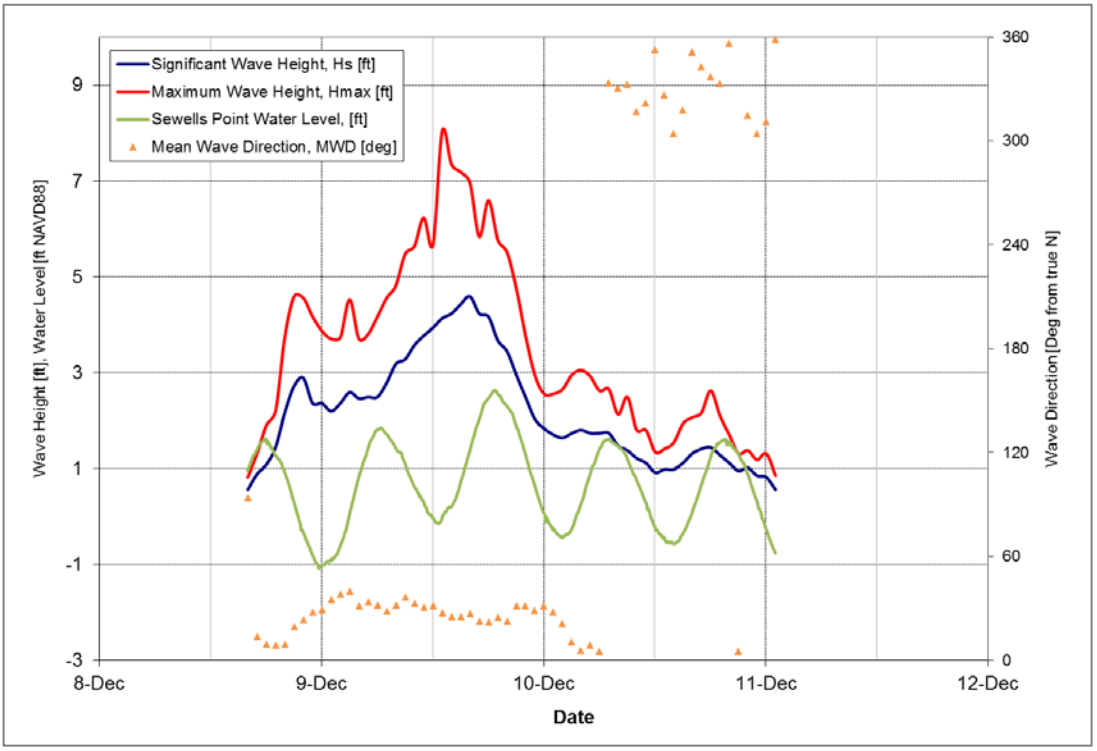


Figure 5-17: December 9, 2017 Storm

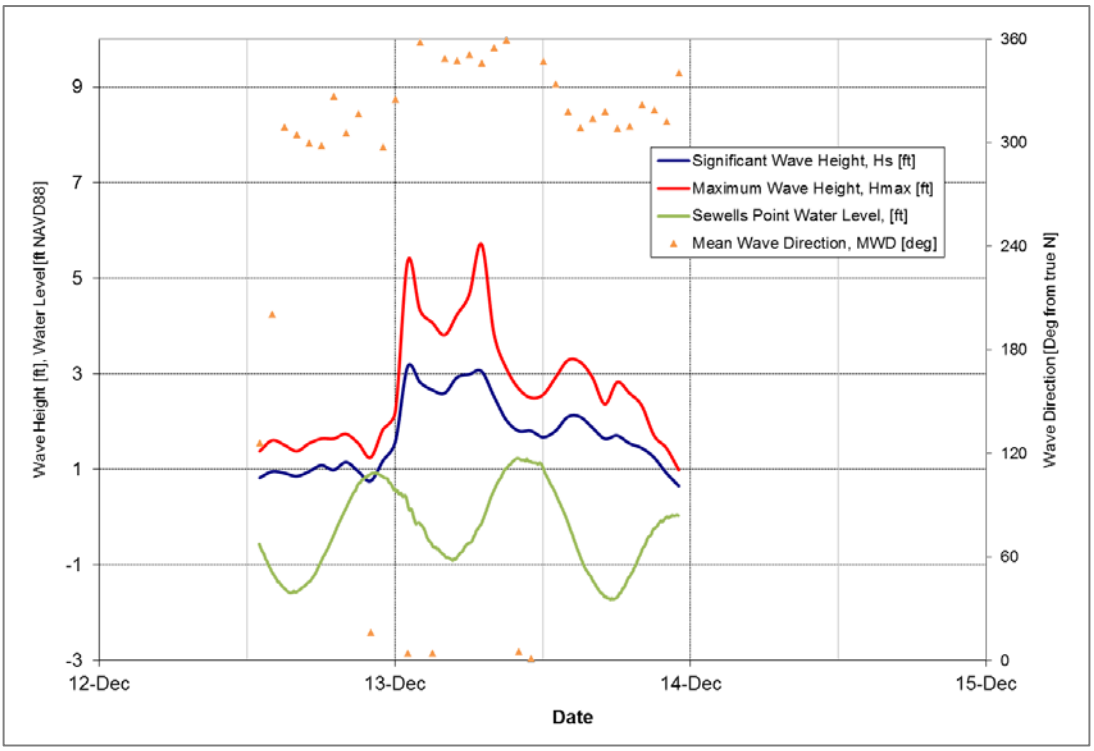


Figure 5-18: December 13, 2017 Storm

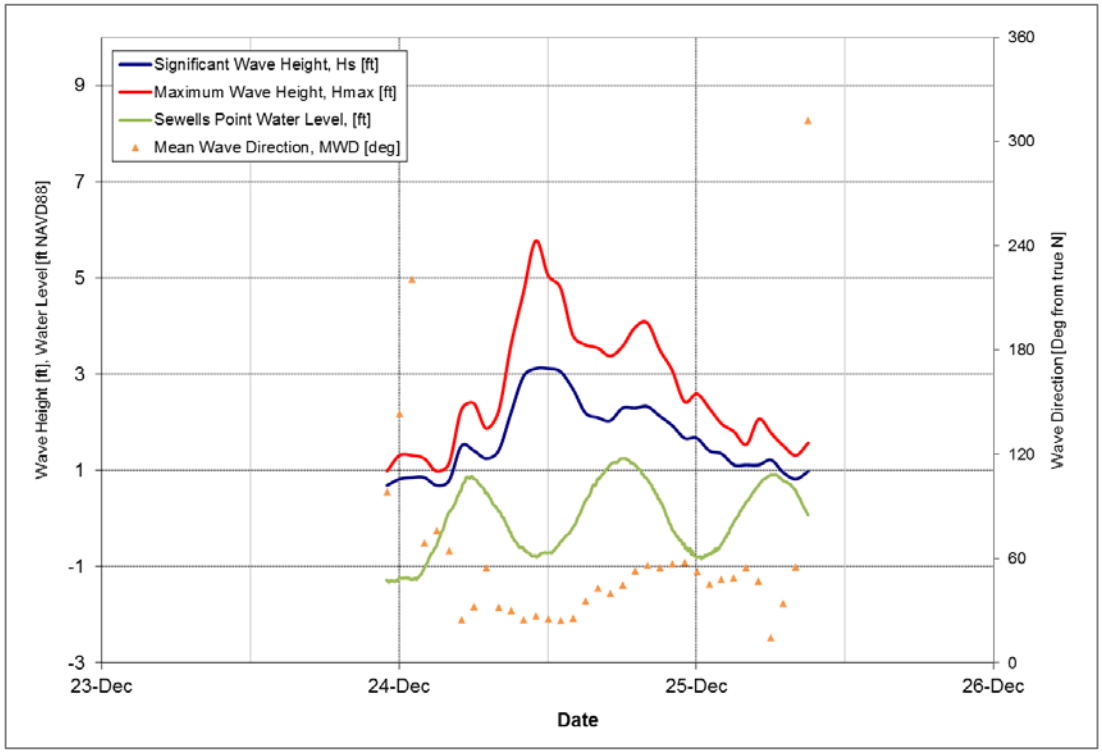


Figure 5-19: December 24, 2017 Storm

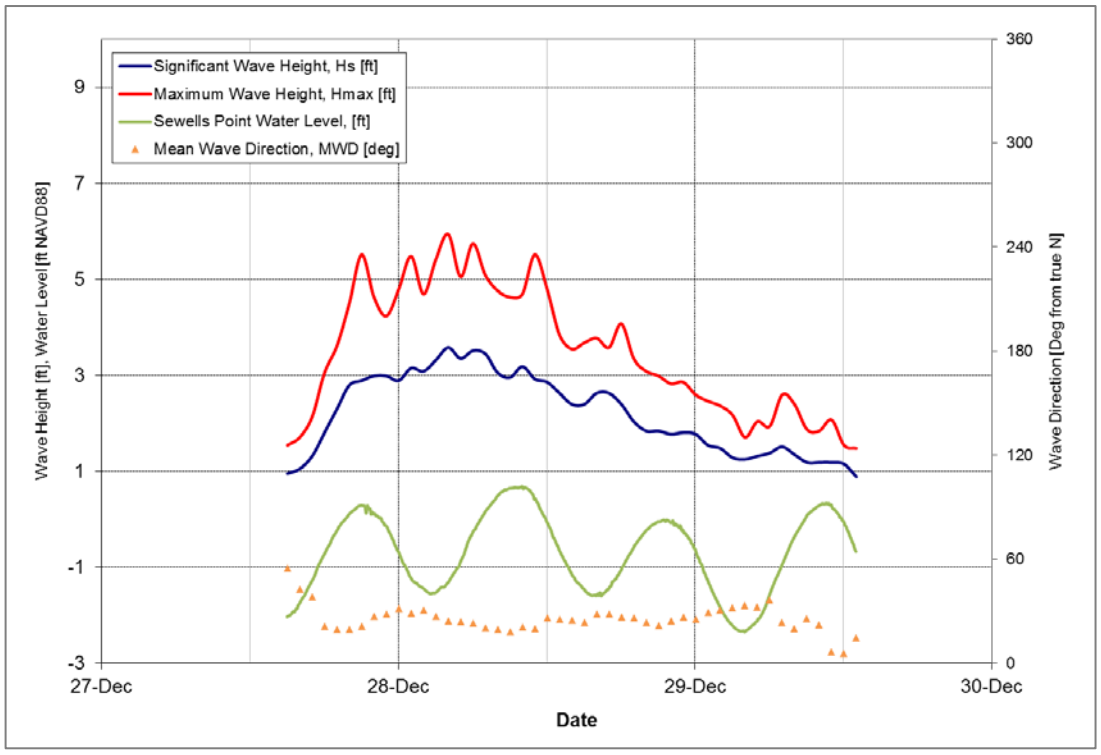


Figure 5-20: December 28, 2017 Storm

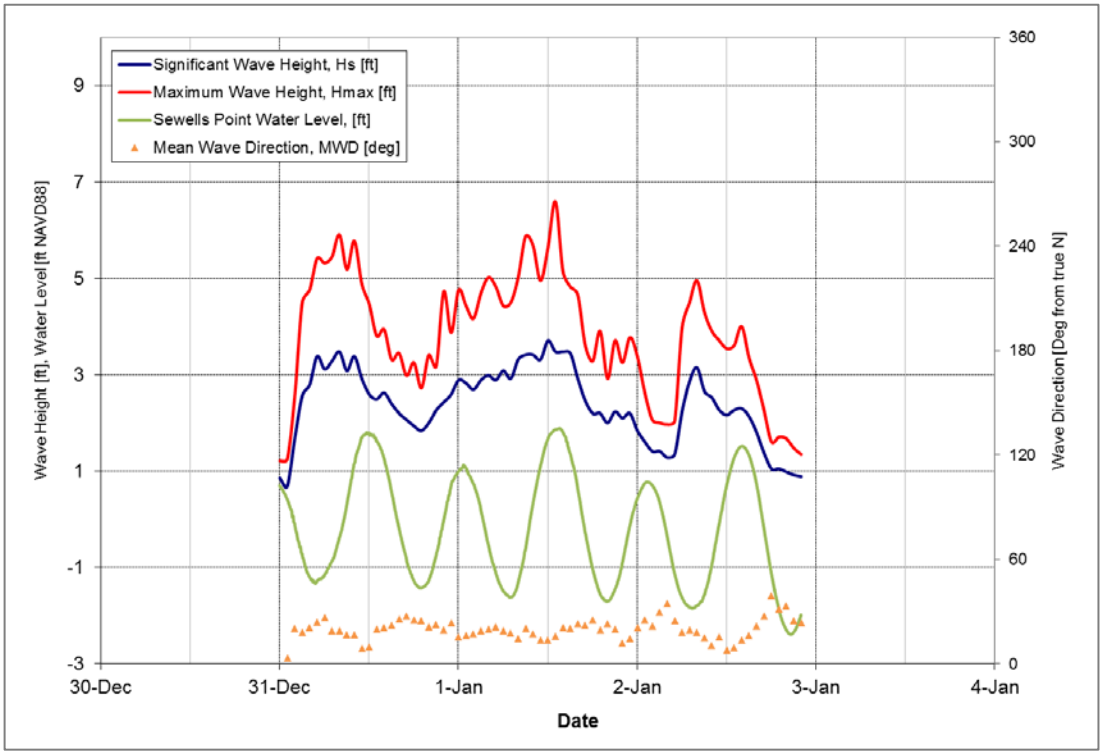


Figure 5-21: December 31, 2017 Storm

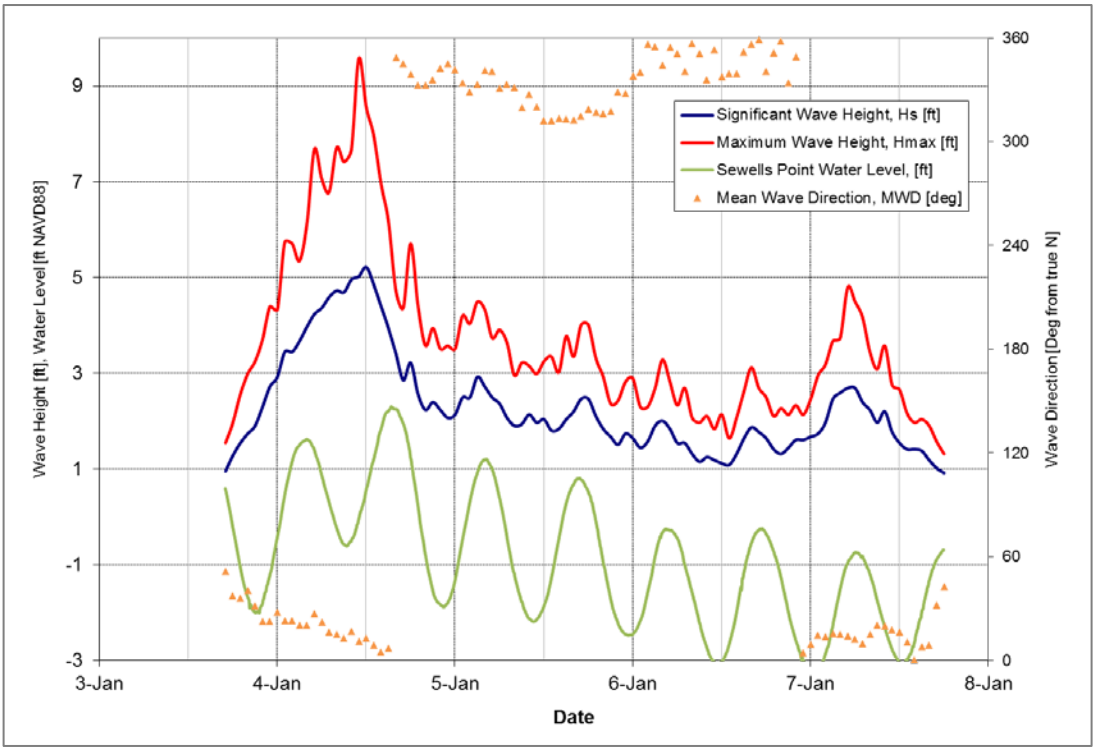


Figure 5-22: January 4, 2018 Storm

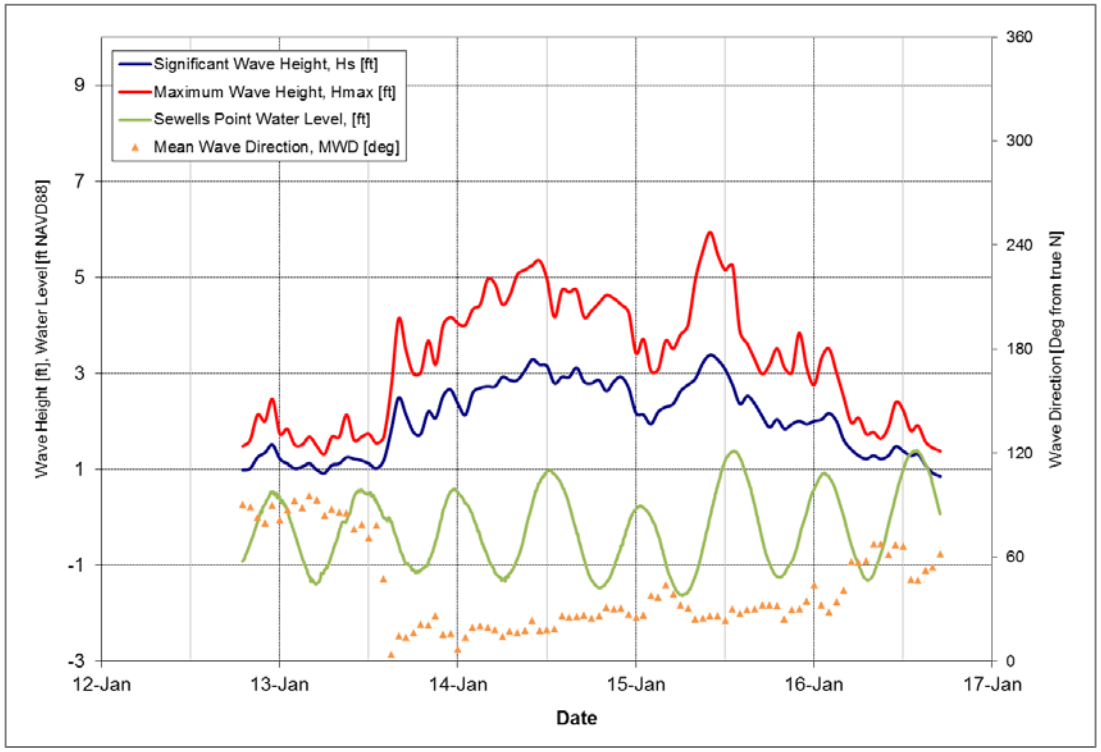


Figure 5-23: January 14, 2018 Storm

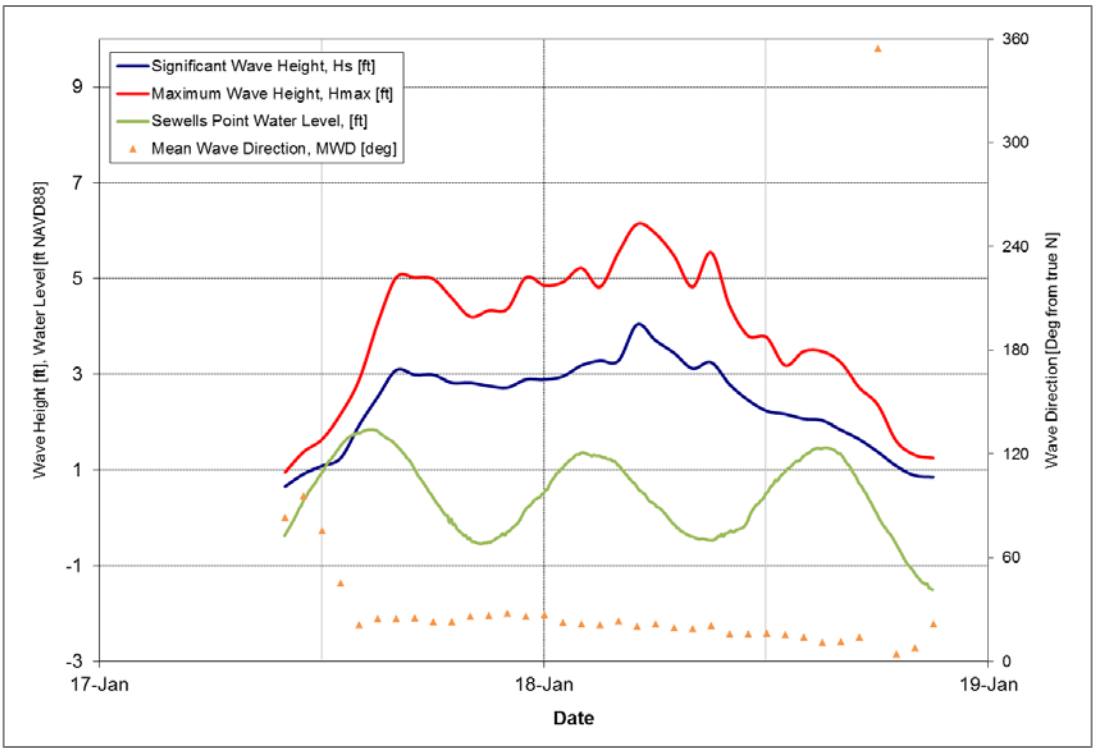


Figure 5-24: January 18, 2018 Storm

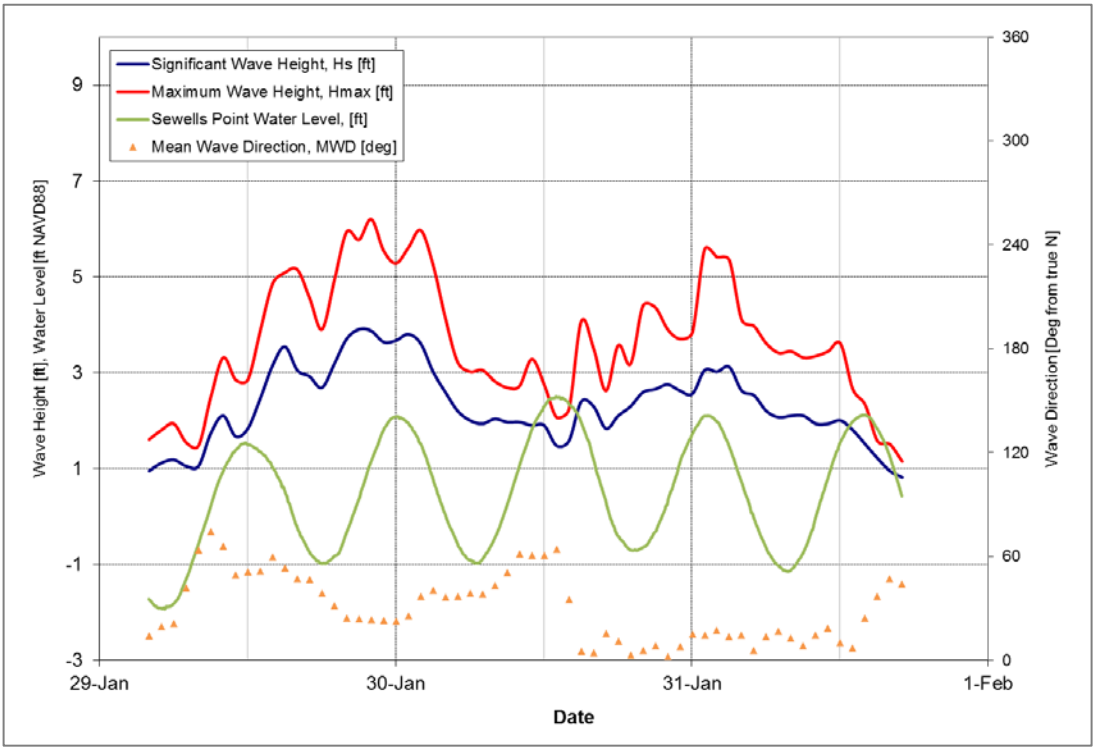


Figure 5-25: January 29, 2018 Storm

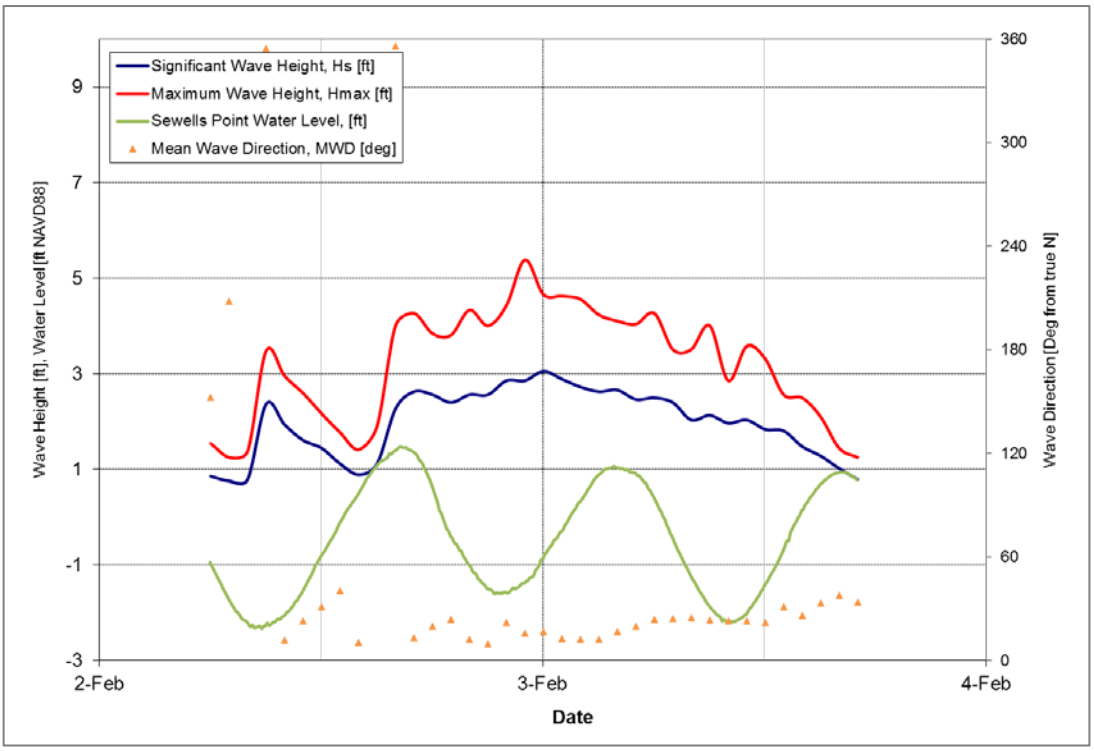


Figure 5-26: February 3, 2018 Storm

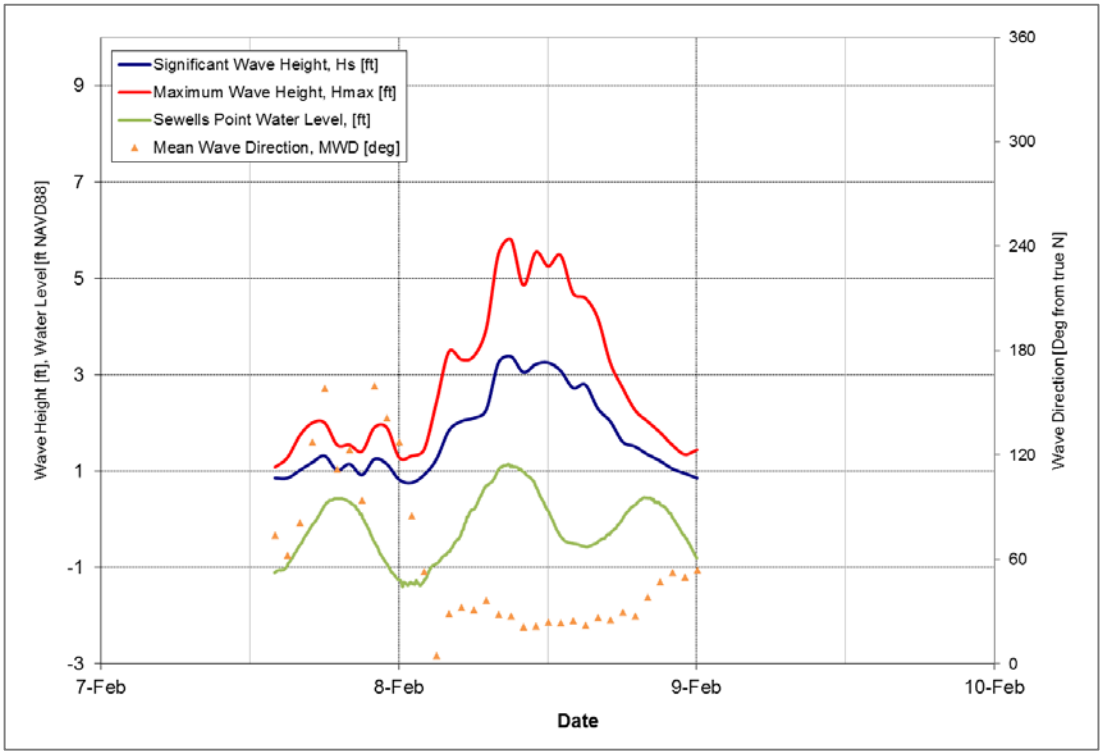


Figure 5-27: February 8, 2018 Storm

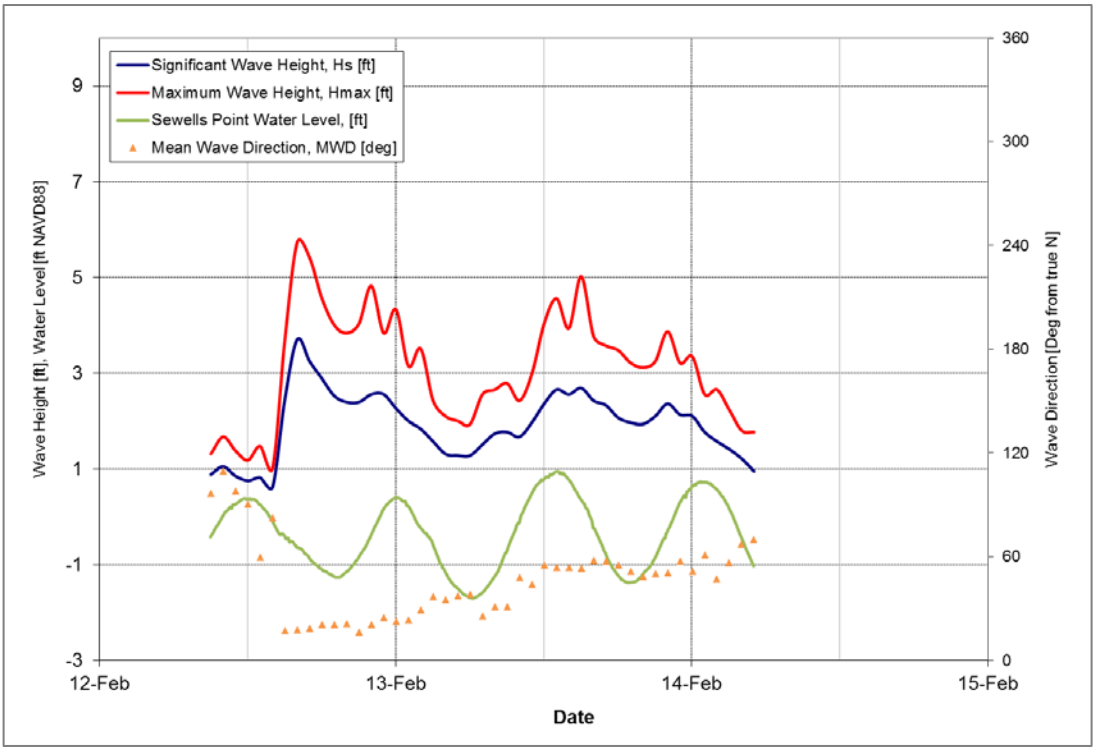


Figure 5-28: February 12, 2018 Storm

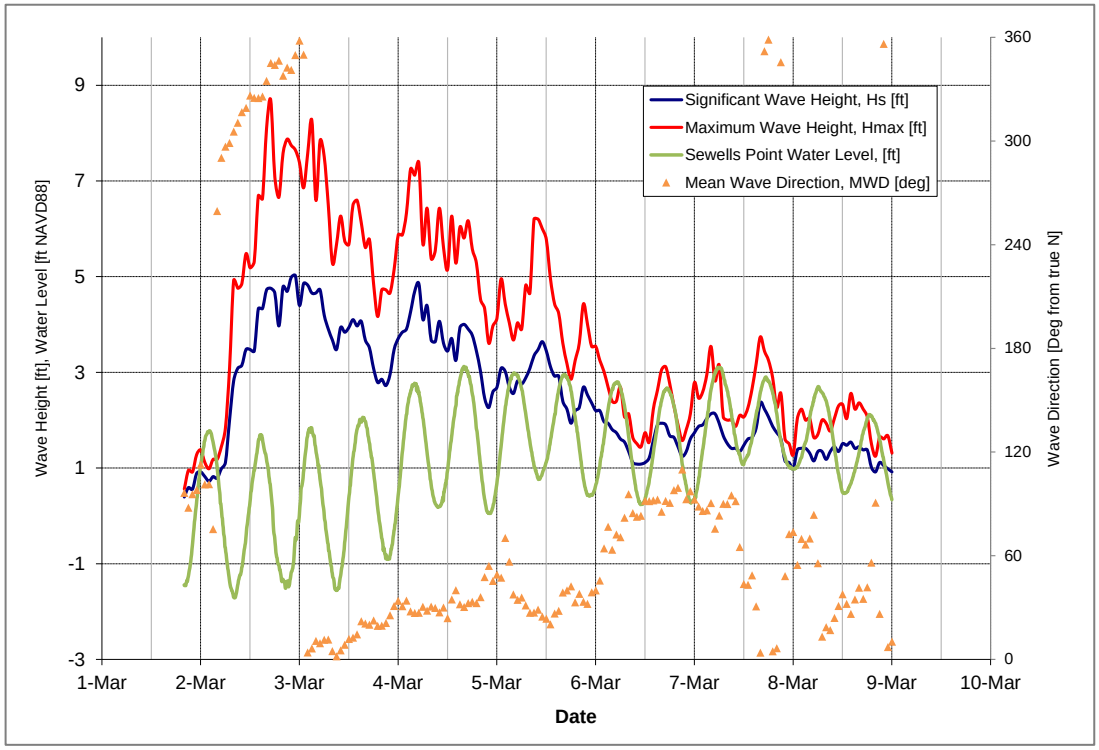


Figure 5-29: March 2, 2018 Storm

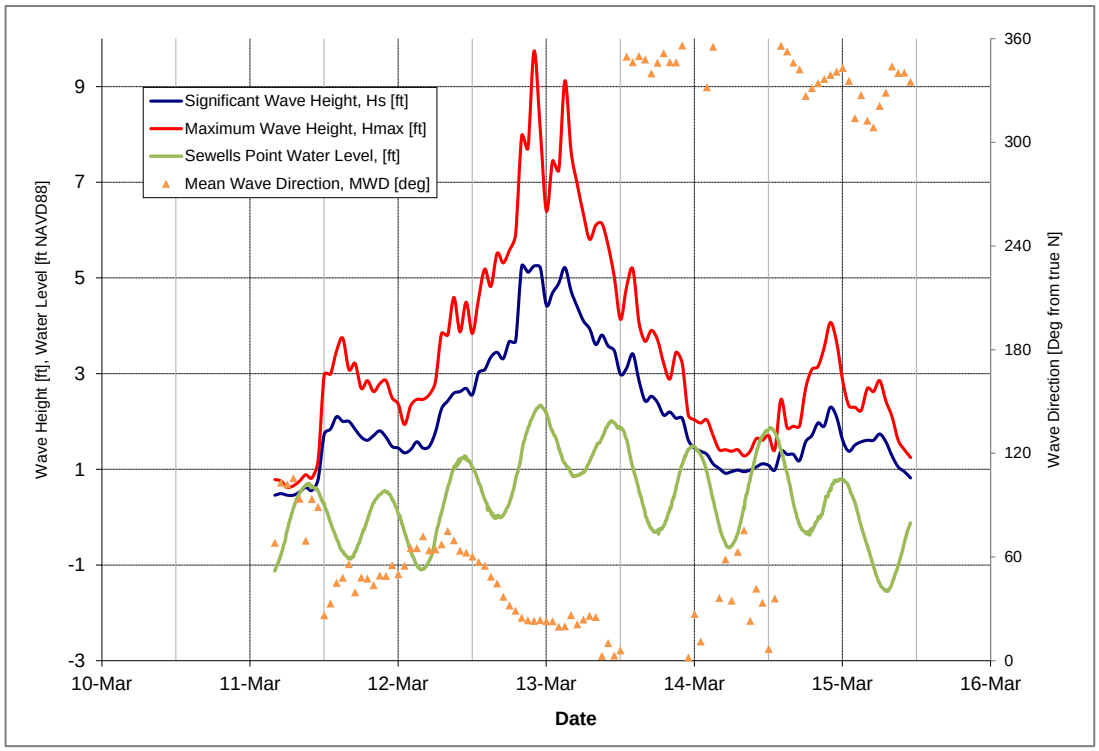


Figure 5-30: March 12, 2018 Storm

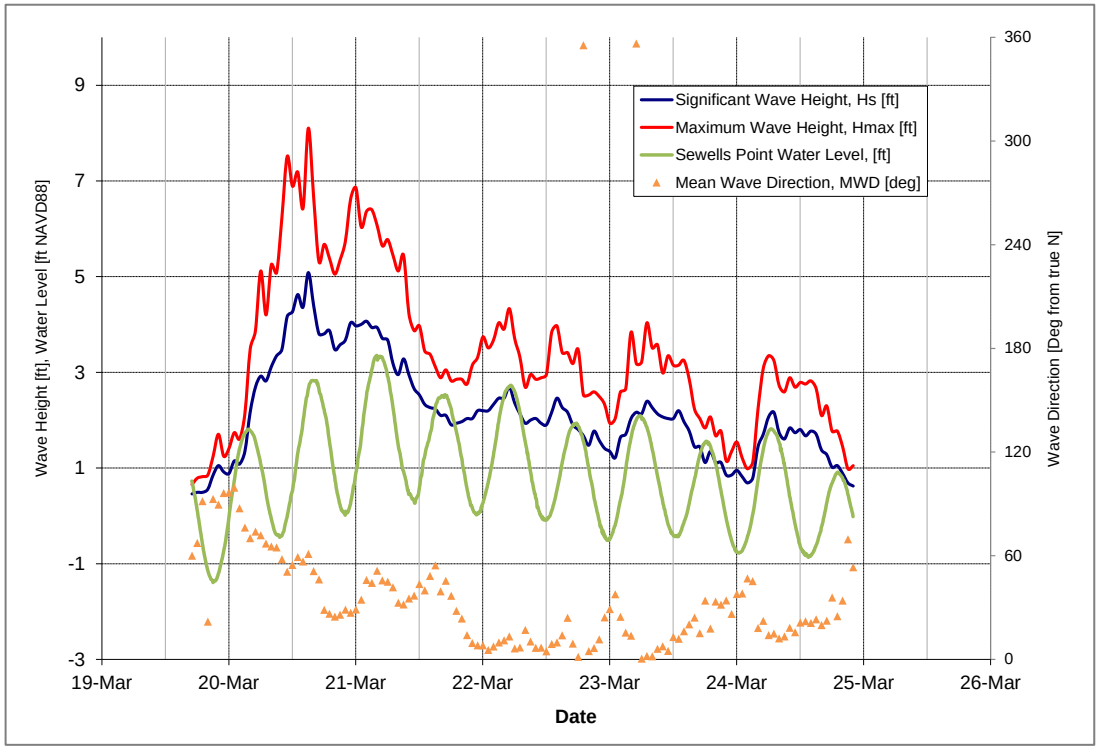


Figure 5-31: March 20, 2018 Storm

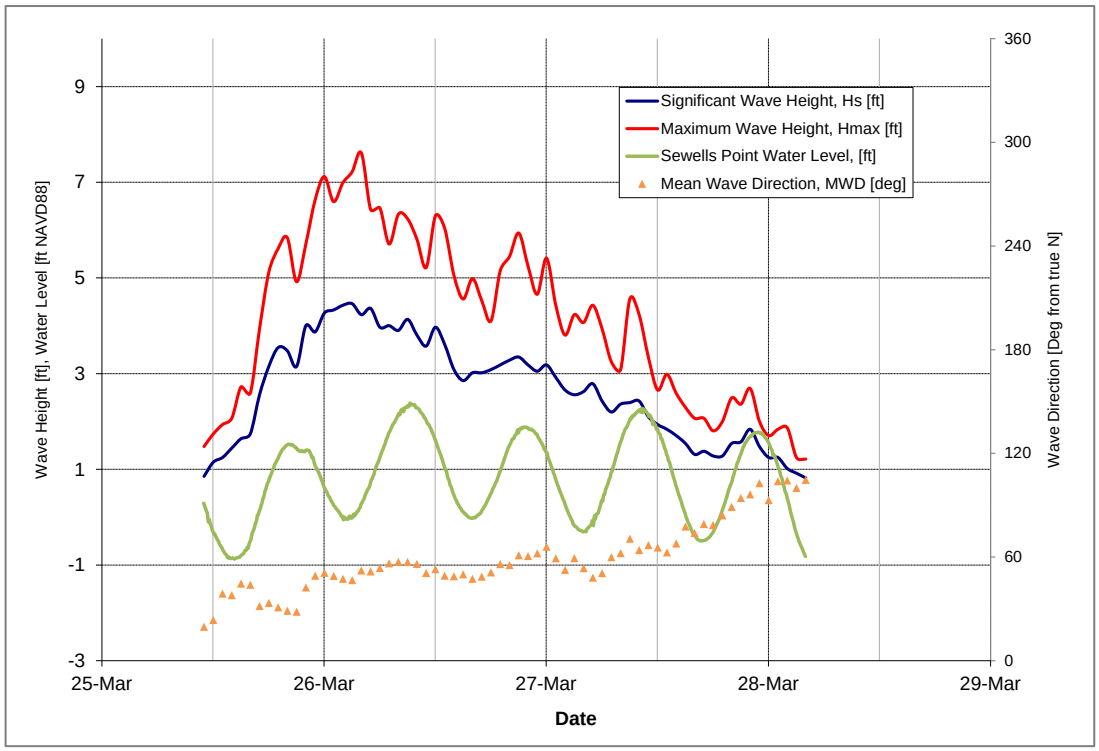


Figure 5-32: March 26, 2018 Storm

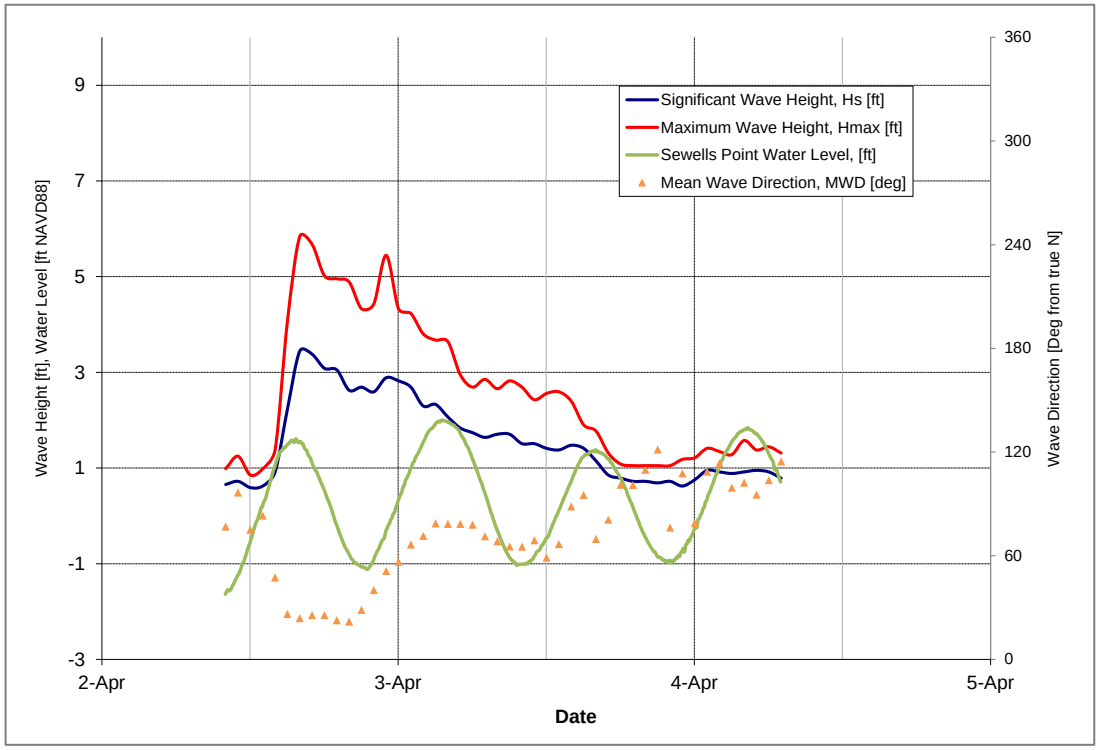


Figure 5-33: April 2, 2018 Storm

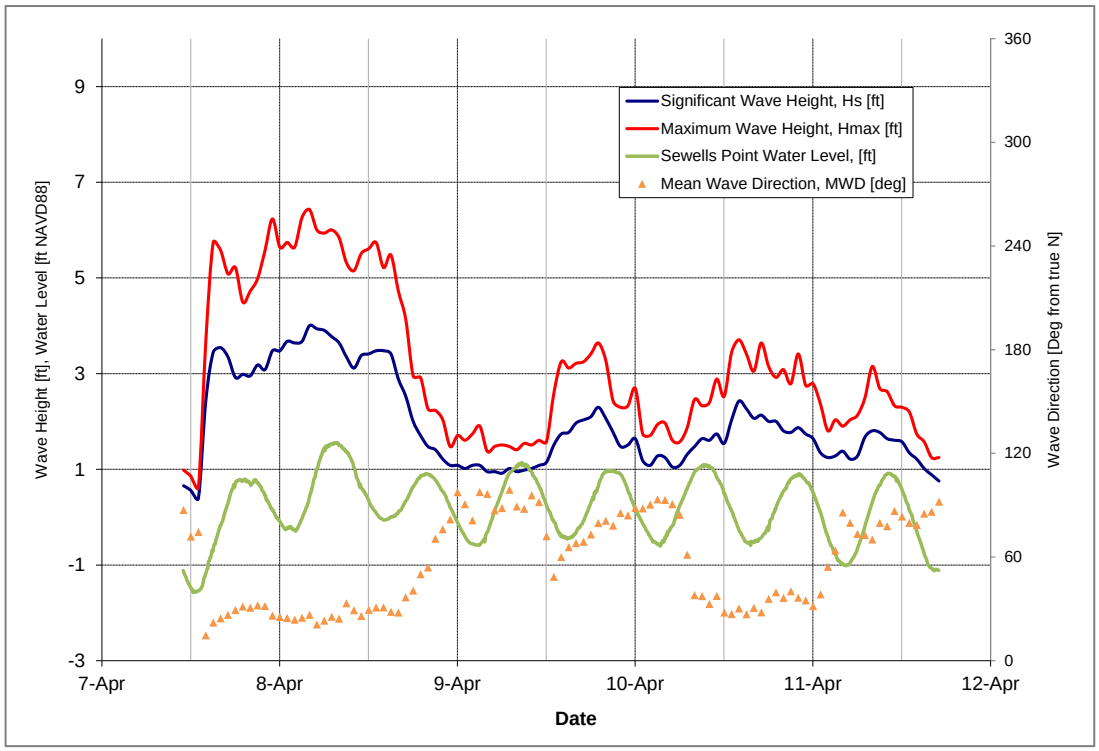


Figure 5-34: April 8, 2018 Storm

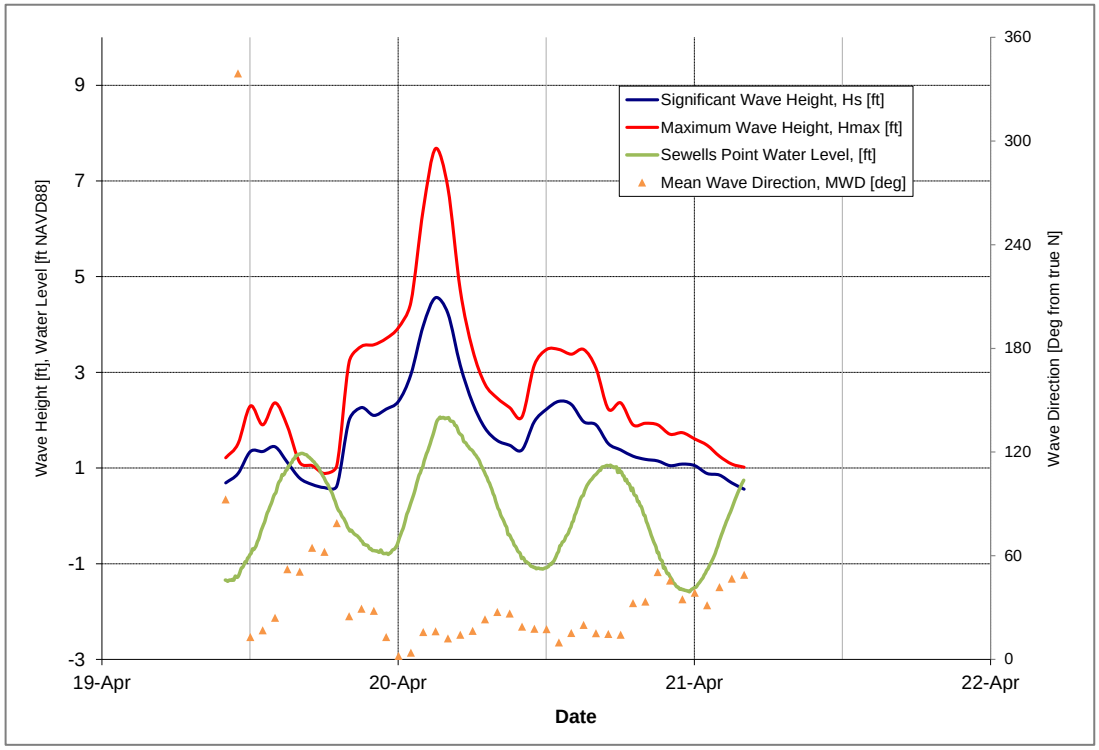


Figure 5-35: April 20, 2018 Storm

5.2.2. Engineering Activities

No significant coastal engineering activities occurred in the monitoring area during this six months' monitoring period.

The Federal Willoughby and Vicinity Coastal Storm Damage Reduction Project (Federal Project) was constructed in March, April and May 2017. The Federal Project placed approximately 1.2 million cubic yards of sand from the Thimble Shoals Auxiliary Channel along most of the Ocean View shoreline. An exception is that the Federal Project did not place sand between Warwick Avenue (station 206+86) and 1st Bay Street (station 274+53).

5.3. General Shoreline Trends

Key statistics were calculated to describe the shoreline and volume change trends over the entire shoreline as well as for each region of the shoreline as defined in Figure 3-1. The computed statistics include average shoreline change, average volume change, and cumulative volume change (e.g. total volume of material lost or gained along a section of shoreline). A summary of the resulting statistics for the May 2017 to April 2018 comparison are presented in Table 5-2. A summary of the resulting statistics for the October 2017 to April 2018 comparison are presented in Table 5-3.

As illustrated in Table 5-2, the Ocean View shoreline has experienced overall retreat at MHW during May 2017 and April 2018 with a length-weighted average change rate of -22.91 ft/yr after the Federal

Project construction. The beach and dune above 0 feet NAVD88 gained sediment at a rate of 86,381 cy/yr from May 2017 to April 2018. The beach and dune above -15 feet NAVD88 gained sediment at a rate of 10,097 cy/yr from May 2017 to April 2018.

From October 2017 to April 2018, the MHW shoreline retreated more slowly than in the first six months post-construction of the Federal Project, with an average shoreline change of -3.91 feet, as shown in Table 5-3. The volumetric change over the same period showed gains of 60,971 cy above 0 feet NAVD88, and loss of -1,974 cy above -15 feet NAVD88, respectively.

The Ocean View shoreline overall lost 1,974 cy above -15 feet NAVD88 between October 2017 and April 2018, and it had a net 10,097 cy gain of sand volume above -15 feet NAVD88 over the year between May 2017 and April 2018. These overall trends and the behavior of the system are better understood by looking at patterns of change on a reach-by-reach basis, as discussed in more detail in the following section.

Table 5-2: Regional Shoreline and Volume Change Statistics (May 2017 to April 2018)

Region	Average Shoreline Change	Average Volume Change Rate Above 0 ft NAVD88	Cumulative Volume Change Rate Above 0 ft NAVD88	Average Volume Change Rate Above -15 ft NAVD88	Cumulative Volume Change Rate Above -15 ft NAVD88
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
Willoughby Spit (0+00 to 45+00)	1.73	3.42	15,433	4.72	21,314
800 Block Breakwaters (45+25 to 87+62)	-29.20	0.21	971	-1.16	-5,258
West Ocean View (93+41 to 163+49)	-40.41	0.97	7,917	-3.06	-19,650
Central Ocean View Breakwaters (169+63 to 195+63)	-45.39	-1.17	-4,050	-3.12	-10,820
Central Ocean View (206+86 to 323+09)	-6.93	4.44	55,512	2.50	31,253
East Ocean View (329+63 to 383+58)	-35.43	1.85	10,598	-1.18	-6,742
OVERALL	Weighted Avg (ft/yr)	Weighted Avg (cy/ft/yr)	Total (cy/yr)	Weighted Avg (cy/ft/yr)	Total (cy/yr)
	-22.91	2.24	86,381	0.17	10,097

Table 5-3: Regional Shoreline and Volume Change Statistics (October 2017 to April 2018)

Region	Average Shoreline Change	Average Volume Change Above 0 ft NAVD88	Cumulative Volume Change Above 0 ft NAVD88	Average Volume Change Above -15 ft NAVD88	Cumulative Volume Change Above -15 ft NAVD88
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
Willoughby Spit (0+00 to 45+00)	-1.95	0.69	3,130	-0.35	-1,578
800 Block Breakwaters (45+25 to 87+62)	-12.39	0.66	3,010	-3.58	-16,229
West Ocean View (93+41 to 163+49)	-8.68	0.37	2,830	-3.38	-25,740
Central Ocean View Breakwaters (169+63 to 195+63)	-0.44	0.25	882	0.76	2,630
Central Ocean View (206+86 to 323+09)	1.25	3.18	39,796	2.29	28,607
East Ocean View (329+63 to 383+58)	-5.76	1.98	11,323	1.81	10,335
OVERALL	Weighted Avg (ft)	Weighted Avg (cy/ft)	Total (cy)	Weighted Avg (cy/ft)	Total (cy)
	-3.91	1.59	60,971	-0.05	-1,974

5.4. Regional Shoreline Trends

Regional shoreline trends are discussed below for the defined regions between Willoughby Spit and Little Creek Inlet (see Figure 3-1). A summary of the information in Table 5-2 and Table 5-3 has been created for each region of study.

Figure 5-36 through Figure 5-39, following the discussion of regional shoreline trends, present the shoreline and volume change at each transect within the defined regions.

5.4.1. Willoughby Spit

The western end of the Willoughby Spit region has, since regular monitoring started in 2005, been a relatively stable and accreting region. The eastern end of this region contained an erosional hot spot that was studied in 2010, and that study recommended improvements to manage erosion rates. Prior to December 2012, coastal structures in this region included two offshore breakwaters, a rock terminal groin, and several timber groins. Construction of the Willoughby Spit Shoreline Improvement Project was completed by December 2013, and it included sand nourishment, the removal of the existing timber groin field, relocation of a prior existing breakwater in the 800 Block breakwater field, and addition of seven new detached breakwaters connecting the 800 Block breakwaters with the two prior existing Willoughby Spit breakwaters. A summary of average shoreline and volume change rates for the Willoughby Spit region between May 2017 and April 2018 and between October 2017 and April 2018 are presented in Table 5-4.

Table 5-4: Average Shoreline and Volume Change Rates for Willoughby Spit

Region	Average Shoreline Change	Average Volume Change Above 0 ft NAVD88	Cumulative Volume Change Above 0 ft NAVD88	Average Volume Change Above -15 ft NAVD88	Cumulative Volume Change Above -15 ft NAVD88
May 2017 vs. April 2018 Comparison					
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
Willoughby Spit (0+00 to 45+00)	1.73	3.42	15,433	4.72	21,314
October 2017 vs. April 2018 Comparison					
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
Willoughby Spit (0+00 to 45+00)	-1.95	0.69	3,130	-0.35	-1,578

On average, this region gained volume in the beach and dune above 0 feet NAVD88 over the seasonal comparison (October 2017 - April 2018). Willoughby Spit gained volume in the beach above 0 feet NAVD88 over the yearly comparison (May 2017 - April 2018). This region lost volume in the subaerial beach and in the submerged profile over the seasonal comparison (October 2017 - April 2018) and gained volume over the yearly comparison (May 2017 – April 2018). For the yearly comparison, the MHW shoreline gained at a rate of 1.73 ft/yr while gaining volume above 0 feet and gaining volume above -15 feet NAVD88 at a rate of 15,433 cy/yr and 21,314 cy/yr, respectively. The seasonal comparison showed loss of the MHW shoreline of -1.95 feet on average and a cumulative sediment gain of 3,130 cy above 0 feet and loss of -1,578 cy above -15 feet NAVD88, respectively. The breakwaters that were part of the 2013 shoreline improvement project that connected to the previously existing 800 Block breakwaters have continued to provide stability to the majority of the Willoughby Spit reach as shown in Figure 5-36 and Figure 5-38. As an exception, the at the transition between the two sets of breakwaters, from approximately 11th View Street to 12th View Street along Toler Place, has experienced significantly greater shoreline retreat than adjacent areas in the Willoughby Spit segment.

5.4.2. 800 Block Breakwaters

The 800 Block Breakwaters region (Sta 45+25 to Sta 87+62) is characterized by a field of eight breakwaters. The easternmost breakwater was relocated in February 2006 along with removal of a pre-existing groin spur and toe extension. This relocated breakwater was placed further offshore to mitigate an excessive salient / tombolo formation, caused by the prior structural configuration that had impaired natural sediment transport to the west. In conjunction with the 2013 Willoughby Spit shoreline improvement project, the second easternmost breakwater in the 800 Block set was also relocated further offshore to enhance natural sediment transport in the region. A summary of average shoreline and volume change rates for the 800 Block Breakwaters region between May 2017 and April 2018 and between October 2017 and April 2018 are presented in Table 5-5.

Table 5-5: Average Shoreline and Volume Change Rates for 800 Block Breakwaters

Region	Average Shoreline Change	Average Volume Change Above 0 ft NAVD88	Cumulative Volume Change Above 0 ft NAVD88	Average Volume Change Above -15 ft NAVD88	Cumulative Volume Change Above -15 ft NAVD88
May 2017 vs. April 2018 Comparison					
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
800 Block Breakwaters (45+25 to 87+62)	-29.20	0.21	971	-1.16	-5,258
October 2017 vs. April 2018 Comparison					
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
800 Block Breakwaters (45+25 to 87+62)	-12.39	0.66	3,010	-3.58	-16,229

The 800 Block region lost volume over the seasonal comparison (October 2017 - April 2018) and over the yearly comparison (May 2017 - April 2018). Over the past year, there has been retreat of the MHW shoreline of -29.20 ft/yr as well as an overall volume gain above 0 feet NAVD88 of 971 cy/yr and overall volume loss above -15 ft NAVD88 of -5,258 cy/yr, respectively. The seasonal comparison showed there was retreat of the MHW shoreline of -12.39 feet with a gain of sediment volume above 0 feet NAVD88 and a loss of sediment volume above -15 feet NAVD88 of 3,010 cy and -16,229 cy, respectively.

5.4.3. West Ocean View

The West Ocean View area (Sta 93+41 to Sta 163+49), between the 800 Block and Central Ocean View breakwaters, was historically characterized by a series of timber groins. The 2013 West Ocean View Shoreline Improvement Project included the removal of all timber groins located between the Ocean View Fishing Pier and Station 141+98, the reconstruction of a rock groin at station 129+17, and 73,600 cy of sand nourishment placed in front of Sarah Constant Beach Park. A summary of average shoreline and volume change rates for the West Ocean View region between May 2017 and April 2018 and between October 2017 and April 2018 are presented in Table 5-6.

Table 5-6: Average Shoreline and Volume Change Rates for West Ocean View

Region	Average Shoreline Change	Average Volume Change Above 0 ft NAVD88	Cumulative Volume Change Above 0 ft NAVD88	Average Volume Change Above -15 ft NAVD88	Cumulative Volume Change Above -15 ft NAVD88
May 2017 vs. April 2018 Comparison					
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
West Ocean View (93+41 to 163+49)	-40.41	0.97	7,917	-3.06	-19,650
October 2017 vs. April 2018 Comparison					
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
West Ocean View (93+41 to 163+49)	-8.68	0.37	2,830	-3.38	-25,740

This region had loss over the yearly comparison (May 2017 - April 2018) with retreat of the MHW shoreline at a rate of -40.41 ft/yr, and a volume gain above 0 feet NAVD88 of 7,917 cy/yr and a volume loss above -15 feet NAVD88 of -19,650 cy/yr respectively. The seasonal comparison (October 2017 - April 2018) showed a retreat of the MHW shoreline of -8.68 feet, a gain of material above 0 feet NAVD88 of 2,830 cy and a loss of material above -15 feet NAVD88 of -25,740 cy.

5.4.4. Central Ocean View Breakwaters

The Central Ocean View Breakwaters region covers the four offshore breakwaters at Central Ocean View and approximately 800 feet westward (Sta 169+63 to Sta 195+63). A summary of average shoreline and volume change rates for the Central Ocean View Breakwaters region between May 2017 and April 2018 and between October 2017 and April 2018 are presented in Table 5-7.

Table 5-7: Average Shoreline and Volume Change Rates for Central Ocean View Breakwaters

Region	Average Shoreline Change	Average Volume Change Above 0 ft NAVD88	Cumulative Volume Change Above 0 ft NAVD88	Average Volume Change Above -15 ft NAVD88	Cumulative Volume Change Above -15 ft NAVD88
May 2017 vs. April 2018 Comparison					
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
Central Ocean View Breakwaters (169+63 to 195+63)	-45.39	-1.17	-4,050	-3.12	-10,820
October 2017 vs. April 2018 Comparison					
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
Central Ocean View Breakwaters (169+63 to 195+63)	-0.44	0.25	882	0.76	2,630

This region experienced overall volume loss over the yearly comparison (May 2017 - April 2018) and volume gain seasonal comparison (October 2017 – April 2018) above -15 feet NAVD88. The yearly comparison showed retreat of the MHW shoreline at an average rate of -45.39 ft/yr and an overall volume loss above 0 feet NAVD88 and above -15 feet NAVD88 at a rate of -4,050 cy/yr and -10,820 cy/yr, respectively. The seasonal comparison indicted relative shoreline stability over the most recent six months' period, with retreat of the MHW shoreline of -0.44 feet and a gain of material above 0 feet NAVD88 and -15 feet NAVD88 of 882 cy and 2,630 cy respectively.

5.4.5. Central Ocean View

Central Ocean View (Sta 206+86 to Sta 323+09) is historically a stable region with slight accretion despite the absence of engineering interventions (e.g. beach fill or structures). A summary of average shoreline and volume change rates for the Central Ocean View region between May 2017 and April 2018 and between October 2017 and April 2018 are presented in Table 5-8.

Table 5-8: Average Shoreline and Volume Change Rates for Central Ocean View

Region	Average Shoreline Change	Average Volume Change Above 0 ft NAVD88	Cumulative Volume Change Above 0 ft NAVD88	Average Volume Change Above -15 ft NAVD88	Cumulative Volume Change Above -15 ft NAVD88
May 2017 vs. April 2018 Comparison					
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
Central Ocean View (206+86 to 323+09)	-6.93	4.44	55,512	2.50	31,253
October 2017 vs. April 2018 Comparison					
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
Central Ocean View (206+86 to 323+09)	1.25	3.18	39,796	2.29	28,607

As shown in Table 5-8, the yearly comparison (May 2017 - April 2018) for the Central Ocean View region showed volume gain above 0 feet NAVD88 and above -15 feet NAVD88. The seasonal comparison (October 2017 - April 2018) also indicated volume gains above 0 feet NAVD88 and above -15 feet NAVD88 of 39,796 cy and 28,607 cy, respectively. The average yearly shoreline gain rate was 3.18 ft/yr with an average of 1.25 ft of gain occurring over the reach during the current survey period.

5.4.6. East Ocean View

The East Ocean View region (Sta 329+63 to Sta 383+58) is characterized by 15 breakwaters of which the 5 westernmost were built in August 2009. In March 2009, prior to the breakwater construction, a beach renourishment project added approximately 196,000 cy of material to the beach. Table 5-9 summarizes average shoreline and volume change rates for the East Ocean View region between May 2017 and April 2018 and between October 2017 and April 2018.

Table 5-9: Average Shoreline and Volume Change Rates for East Ocean View

Region	Average Shoreline Change	Average Volume Change Above 0 ft NAVD88	Cumulative Volume Change Above 0 ft NAVD88	Average Volume Change Above -15 ft NAVD88	Cumulative Volume Change Above -15 ft NAVD88
May 2017 vs. April 2018 Comparison					
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
East Ocean View (329+63 to 383+58)	-35.43	1.85	10,598	-1.18	-6,742
October 2017 vs. April 2018 Comparison					
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
East Ocean View (329+63 to 383+58)	-5.76	1.98	11,323	1.81	10,335

This region is normally characterized by a consistent erosional pattern due to sediment movement along the shoreline from east to west with no external sand source due to the terminal groin at Little Creek Inlet. East Ocean View experienced volume loss over the yearly (May 2017 - April 2018) comparison and volume gain over the seasonal (October 2017 – April 2018) comparison. The yearly comparison showed an overall retreat of the MHW shoreline at a rate of -35.43 ft/yr and an overall volume gain above 0 feet NAVD88 and overall volume loss above -15 feet NAVD88 at a rate of 10,598 cy/yr and -6,742 cy/yr respectively. However, while the seasonal comparison showed a MHW shoreline retreat of -5.76 feet, it also showed gains of material above 0 feet NAVD88 and -15 feet NAVD88 of 11,323 cy and 10,335 cy respectively.

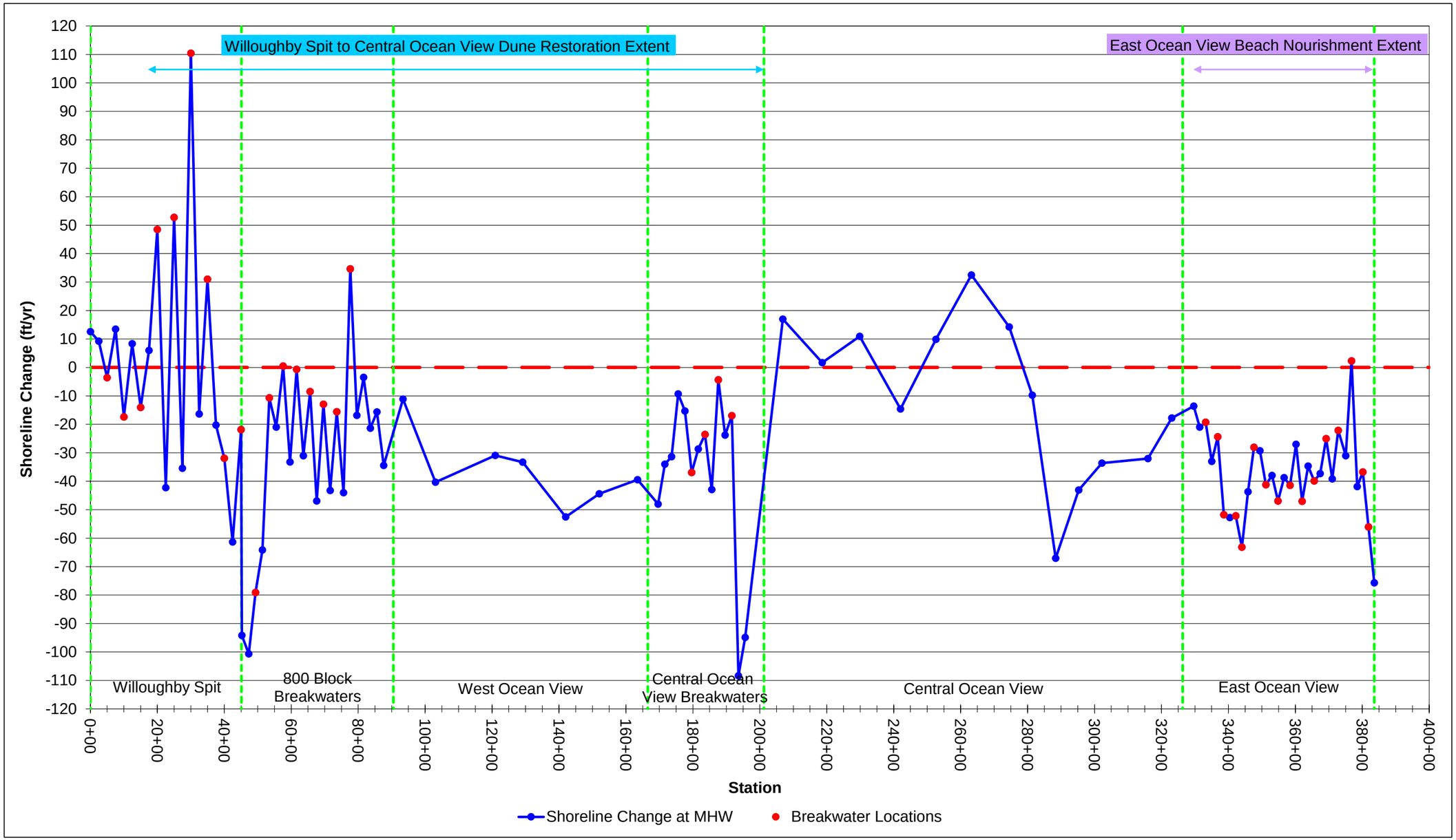


Figure 5-36: Shoreline Change Rate (ft/yr) at Mean High Water (+0.98 ft NAVD88) for May 2017 to April 2018 (Note: Positive = Accretion, Negative = Erosion)

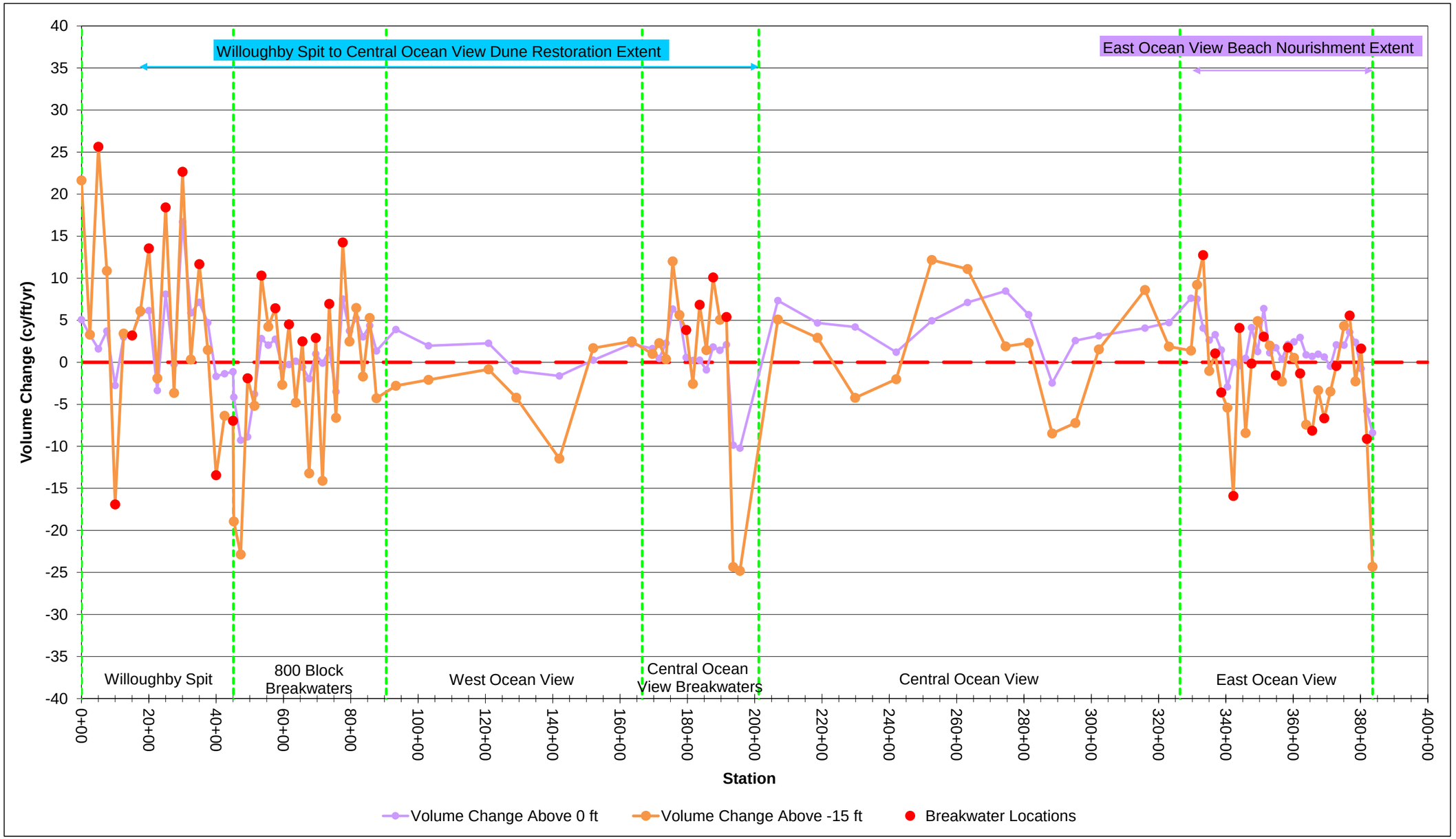


Figure 5-37: Volume Change Rate Above 0 ft NAVD88 and -15 ft NAVD88 (cy/ft/yr) for May 2017 to April 2018 (Note: Positive = Accretion, Negative = Erosion)

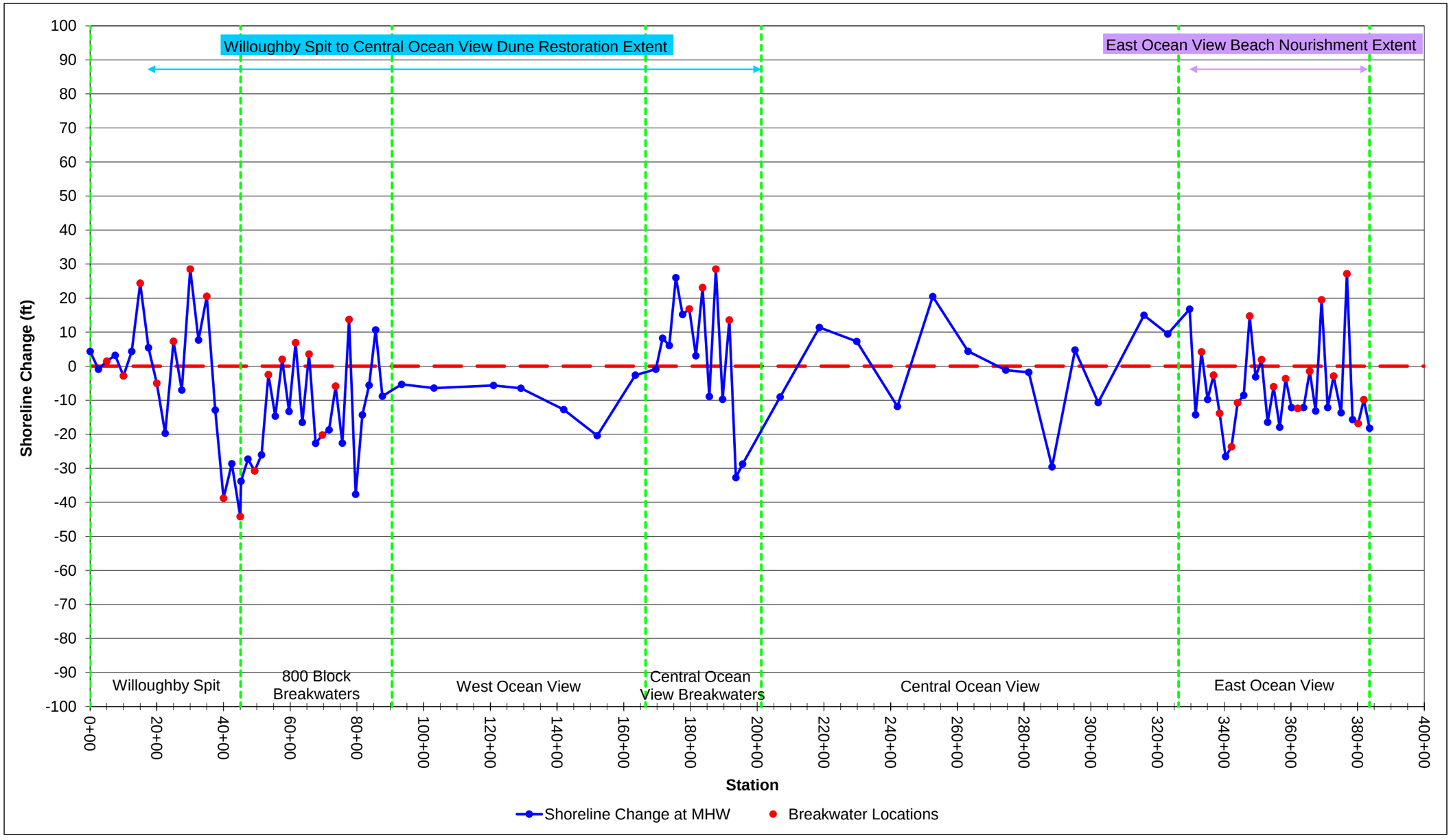


Figure 5-38: Shoreline Change (ft) at Mean High Water (+0.98 ft NAVD88) for October 2017 to April 2018 (Note: Positive = Accretion, Negative = Erosion)

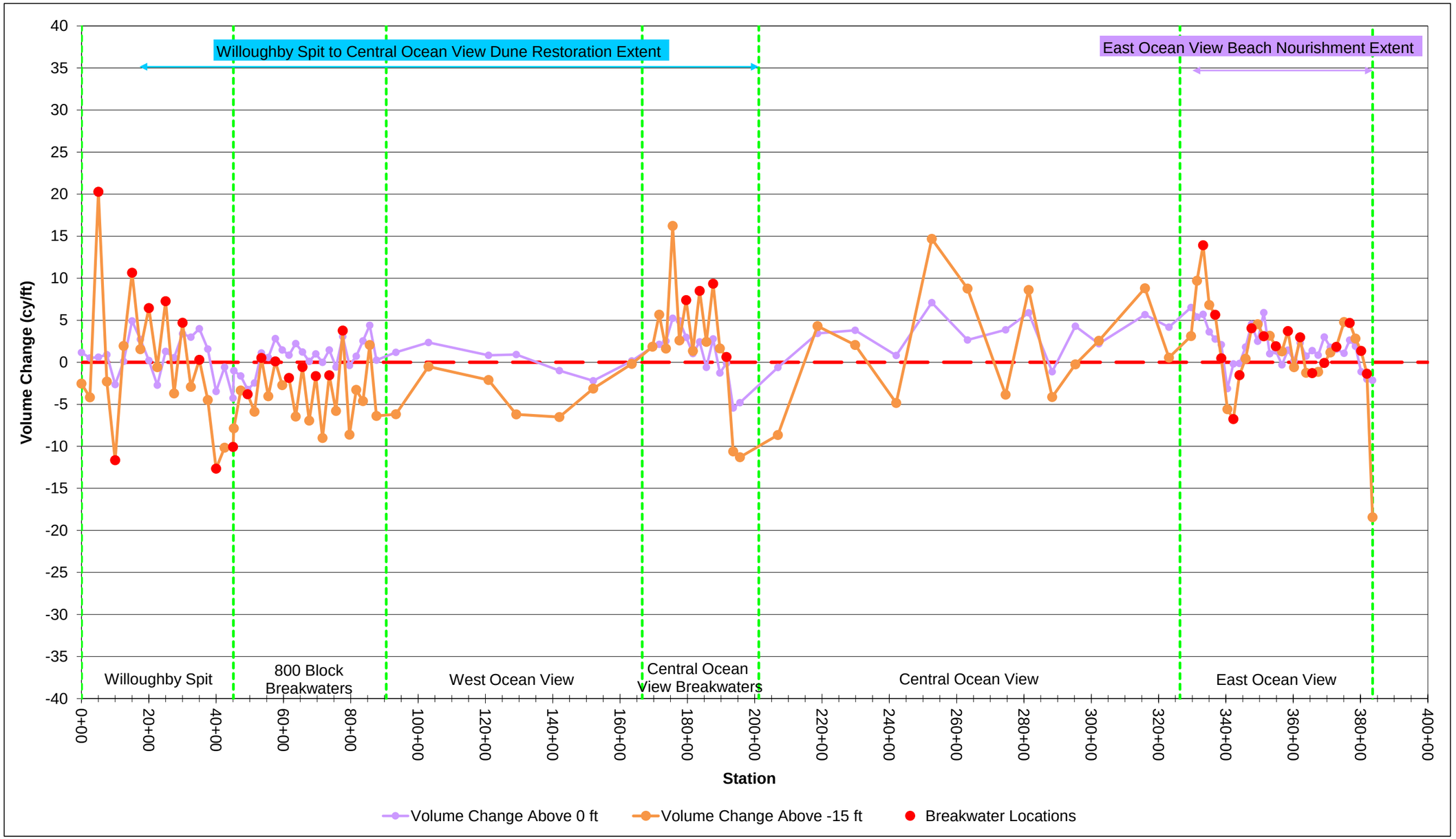


Figure 5-39: Volume Change Above 0 ft NAVD88 and -15 ft NAVD88 (cy/ft) for October 2017 to April 2018 (Note: Positive = Accretion, Negative = Erosion)

6. Federal Coastal Storm Damage Reduction Project

6.1. Initial Construction of the Federal Project

The initial nourishment of the Federal Willoughby and Vicinity Coastal Storm Damage Reduction Project (Federal Project) was constructed in March, April and May 2017. The Federal Project placed approximately 1.2 million cubic yards of sand from the Thimble Shoals Auxiliary Channel along most of the Ocean View shoreline. An exception is that the Federal Project did not place sand between Warwick Avenue (station 206+86) and 1st Bay Street (station 274+53). The Spring 2017 survey (done in late May 2017 after all of the Federal Project beach fill had been placed) captured the project's beach and nearshore condition very soon after construction was completed. The volume gain from October 2016 to May 2017 associated with Federal Project construction is illustrated by the last four map panels included in Appendix E.

6.2. Shoreline Beach Berm Contour Changes Relative to the May 2017 Post-Construction Condition of the Federal Project

The Fall 2017 periodic survey and the most recent Spring 2018 periodic survey together illustrate the evolution of the Federal Project through the typical rapid period of initial adjustment followed by additional background erosion / accretion due to coastal processes over its first year post-construction, from May 2017 through April 2018. Figure 6-1 shows the position of the Mean Higher High Water (MHHW) contour line extracted from Digital Elevation Models (DEMs) of surveys from October 2016 (approximately six months pre-construction), May 2017 (post-construction), October 2017 (approximately five months post-construction), and April 2018 (11 months post-construction).

The movement of the shoreline is consistent with the shoreline changes tabulated by Ocean View region earlier in this report (Table 1-2). The chart in Figure 6-1 shows shoreline position rather than shoreline change rate as a means of illustrating the beach planform remaining in the project relative to its construction design. The chart illustrates that the MHHW contour changed more slowly from October 2017 to April 2018 than it did in the first five months post-construction. This is consistent with the values tabulated and reported above, and is consistent with typical expectations of a beach nourishment project's evolution.

The amount of shoreline change post-construction of the Federal Project varied widely throughout the study area. The median shoreline change among the 106 transects (without any length-weighting) was approximately -20 feet, with 90% of transects having change between +10 and -40 feet. While this is a larger magnitude of change than is typically observed along Ocean View in a six-month period, it is typical and expected that the MHHW contour of a nourishment project changes in this way in the several months post-construction, as the beach profile and planform readjusts. Noticeable areas where the Federal Project's constructed shoreline retreated more quickly than in Ocean View as a whole included:

- At stations 45+25 to 49+35, between 11th View Street and the 800 Block Breakwaters, the MHHW contour retreated 60 to 90 feet in the first eleven months post-construction. The rate

of retreat from October 2017 to April 2018 decreased from the rate indicated between May 2017 and October 2017.

- At stations 163+49 to 173+63, immediately west of the Central Ocean View breakwaters, shoreline retreat averaged approximately 33 feet in the first eleven months post-construction. The rate of retreat from October 2017 to April 2018 was much slower than the rate indicated from May 2017 to October 2017. The localized erosion and shoreline retreat in this segment is most likely due to transport of sand eastward into the adjacent segment of Central Ocean View.

- At station 193+63 and station 195+63, immediately east of the of the Central Ocean View breakwaters, the shoreline retreated between 80 to 100 feet in the first eleven months post-construction. The rate of retreat from October 2017 to April 2018 decreased from the rate indicated between May 2017 and October 2017.

- From station 295+27 to 329+63 west of the Bay Oaks Breakwaters in East Ocean View, shoreline retreat averaged approximately 21 feet in the first eleven months post-construction. The rate of retreat from October 2017 to April 2018 decreased from the rate indicated between May 2017 and October 2017.

Significant shoreline advance occurred in Central Ocean View between stations 263+22 and 274+53 post-construction of the Federal Project. From May 2017 to April 2018, the shoreline in this reach advanced approximately 30 feet. This is most likely due to accretion of sand that was transported westward into this segment of Central Ocean View from the adjacent segment of East Ocean View.

The Federal Project authorized beach template is not defined by the shoreline position, but by the beach width (seaward of the dune toe) at or above a beach berm elevation of +3.5 feet NAVD88. Figure 6-2 shows the position of the most bayward +3.5 ft NAVD88 elevation contour (representing the authorized Federal beach berm elevation) as extracted from the October 2016, May 2017, October 2017 and April 2018 survey DEMs. Significant berm retreat is seen from stations 45+25 to 49+35, in the same area that greater shoreline retreat rates were noted east of 11th View Street. It is worth noting that the greater-than-typical MHHW and +3.5 ft contour retreat rates appear to be in the gap between the Willoughby Spit Breakwaters and the 800 Block Breakwaters, but do not extend, according to the data, into the adjacent Toler Place reach. Future monitoring events will continue to pay close attention to this area to track this trend. Noticeable retreat of the +3.5 ft contour also occurred within the 800 Block Breakwaters and adjacent to the east end of the Central Ocean View Breakwaters. The median +3.5 ft NAVD88 contour change rate was approximately -28 ft/yr, with 60% of the transects having rates between -13 and -40 ft/yr over the first eleven months post-construction.

Over the first five months post-construction the median +3.5 ft NAVD88 contour change rate was approximately -50 ft/yr, with 60% of the transects having rates between -30 and -80 ft/yr. Thus, the rate of beach berm retreat has decreased in the latter half of the first year post-construction, as is typical and expected for newly constructed beach nourishment projects.

In future monitoring reports, it is recommended to include the position of a line representing a threshold criteria for renourishment of the Federal Project. The published documents presently available relative to the Federal Project do not define a particular shoreline or beach berm position in physical space that

represents such a threshold condition. Instead, the threshold is discussed in the project's authorizing documents as a percentage of the authorized beach width at +3.5 feet NAVD88. Since the beach is not likely to hold a constant elevation across the berm from the dune toe bayward, it is difficult to choose a single contour representing the landward edge of the beach berm that can be consistently extracted from subsequent survey profiles and DEMs to calculate the remaining beach width. It is recommended that a fixed line in space be developed, in collaboration with USACE Norfolk District, that can be used to track the relative position of surveyed beach contours to the renourishment threshold.

6.3. Beach and Nearshore Elevation Changes Relative to the May 2017 Post-Construction Condition of the Federal Project

The map plots in Appendix E shows areas of elevation change between the dates indicated in the map Legends. Elevation gains (accretion) are shown in green shades, and elevation losses (erosion) are shown in yellow to red shades. The three sets of maps (four pages for each set) were prepared by subtracting elevations in each grid cell within survey Digital Elevation Models (DEMs) between survey dates October 2017 to April 2018; May 2017 to October 2017; and October 2016 to May 2017. Though it is outside of the annual monitoring period of this report, the October 2016 to May 2017 set is kept in the Appendix to illustrate the magnitude of the May 2017 Federal Project beach nourishment to give context to post-construction changes.

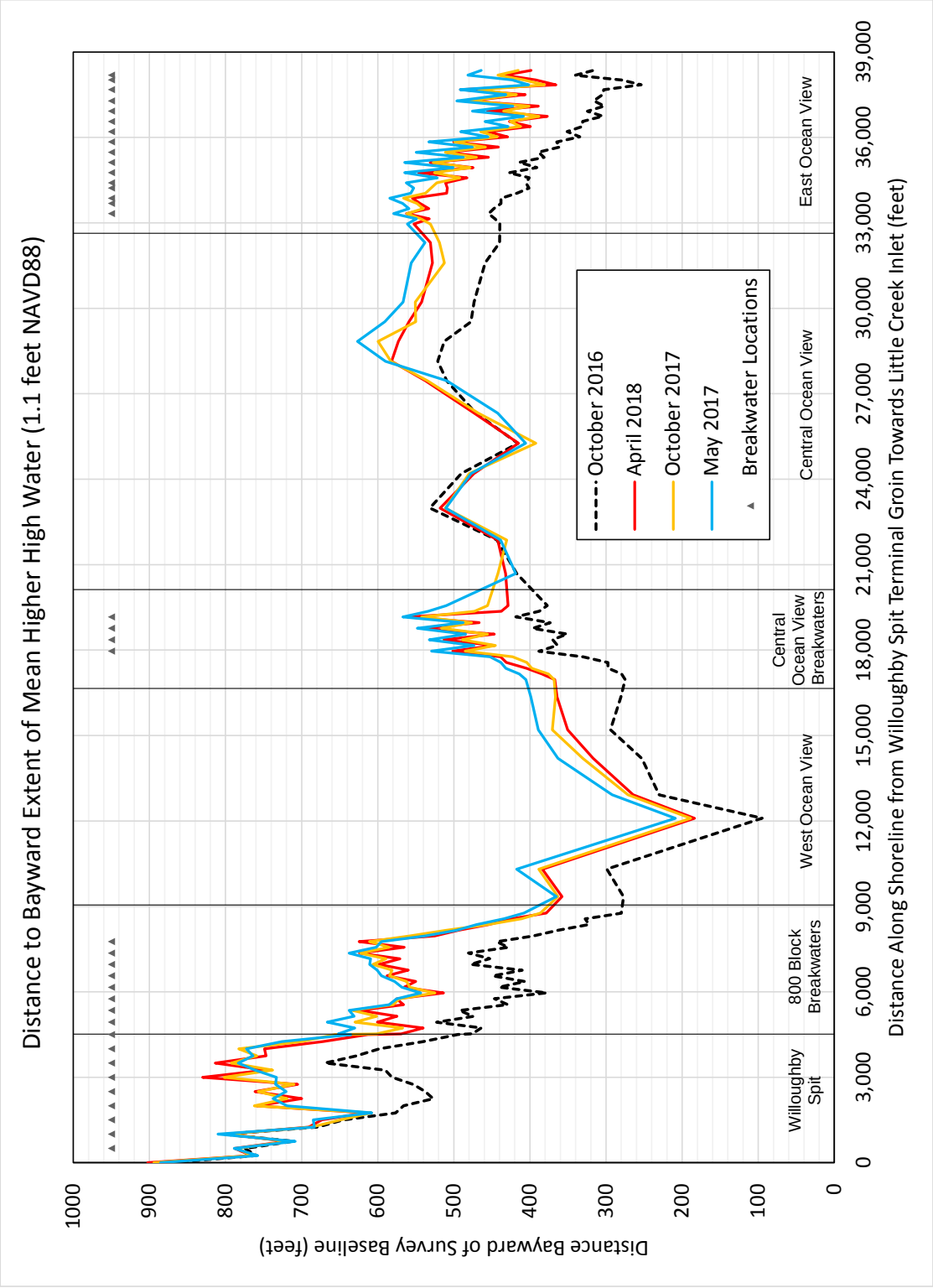


Figure 6-1: Position of the Mean Higher High Water (+1.1 ft NAVD88) Contour Relative to Pre- and Post-Construction of the Federal Project

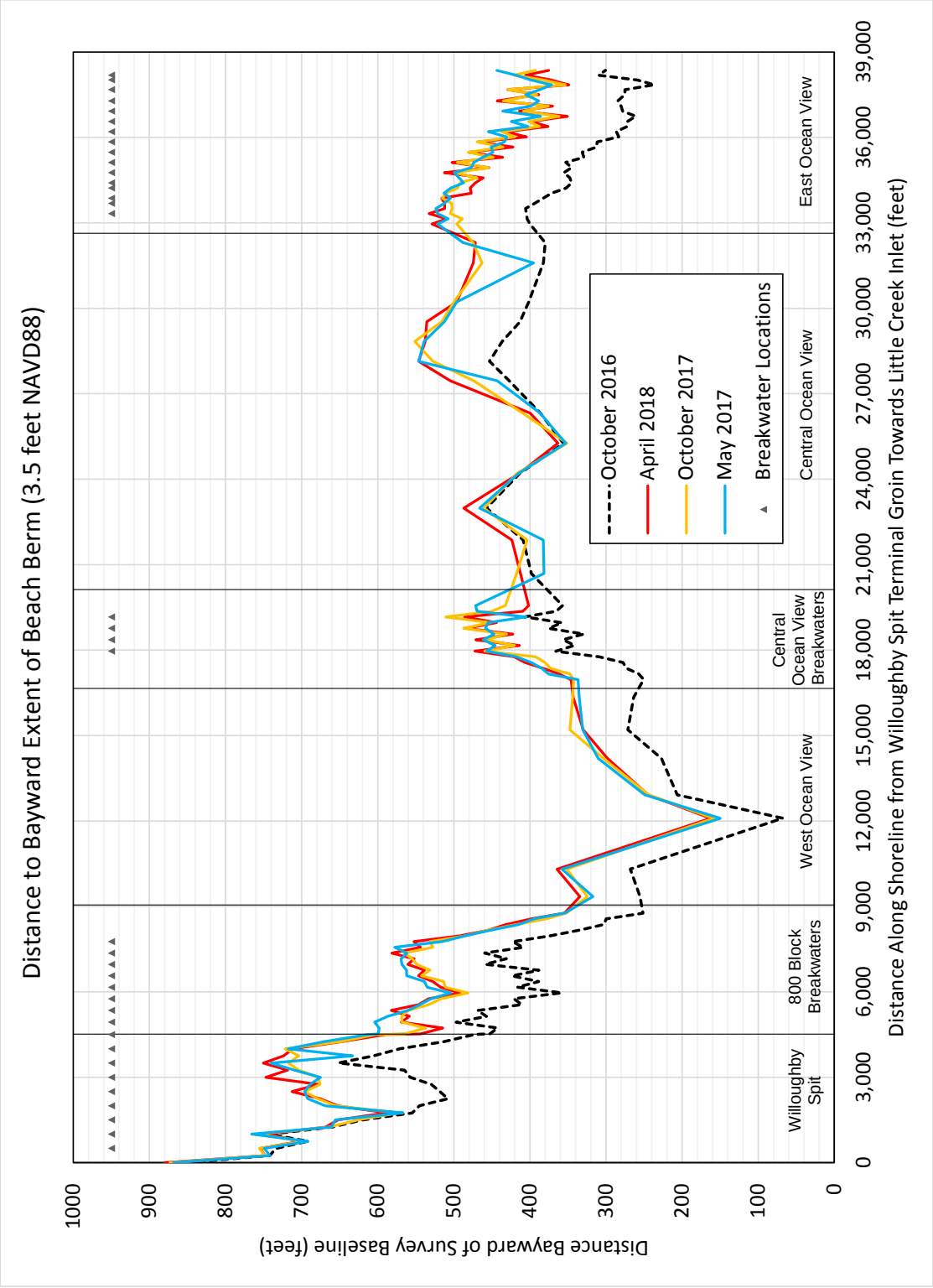


Figure 6-2: Position of the Bayward Extent of the +3.5 ft NAVD88 Beach Berm Contour Relative to Pre- and Post-Construction of the Federal Project

7. Summary

Comprehensive periodic surveying of the entire Ocean View shoreline began with an initial survey in September 2005. The most recent survey was completed in April 2018. The beach and bathymetric surveys performed by Geodynamics utilized baseline and transect positions established in September 2005 which are used for all periodic surveys. For this periodic evaluation, the April 2018 survey was compared with both the prior year and prior six months' surveys (April 2018 compared to May 2017 and October 2017, respectively). The surveys were used to compute shoreline change at MHW and volume change above 0 feet NAVD88 and above -15 feet NAVD88.

Key statistics were computed for defined regions along Ocean View and the entire shoreline for the time period between the May 2017 and April 2018 surveys and between the October 2017 and April 2018 surveys.

Comparison	Parameter	Quantity
May 2017 vs. April 2018	Average Shoreline Change Rate at MHW (+0.98 ft NAVD88)	-22.91 ft/yr
	Cumulative Volume Change Rate Above 0 ft NAVD88	86,381 cy/yr
	Cumulative Volume Change Rate Above -15 ft NAVD88	10,097 cy/yr
October 2017 vs. April 2018	Average Shoreline Change at MHW (+0.98 ft NAVD88)	-3.91 ft
	Cumulative Volume Change Above 0 ft NAVD88	60,971 cy
	Cumulative Volume Change Above -15 ft NAVD88	-1,974 cy

The average shoreline change rate for the entire shoreline at MHW between the May 2017 and April 2018 surveys was -22.91 ft/yr shoreline retreat, and the cumulative volume changes above 0 feet NAVD88 and -15 feet NAVD88 were approximately 86,381 cy/yr and 10,097 cy/yr, respectively.

The average shoreline change for the entire shoreline at MHW between the October 2017 and April 2018 surveys was -3.91 ft, and the cumulative volume changes above 0 feet NAVD88 and -15 feet NAVD88 were approximately 60,971 cy and -1,974 cy, respectively.

Areas of greater shoreline retreat (compared to average rates along Ocean View as a whole) include: between 11th View Street and the 800 Block Breakwaters; adjacent to the west and east ends of the Central Ocean View Breakwaters; and west of the Bay Oaks Breakwaters in East Ocean View. Shoreline change rates varied widely on a transect by transect basis. The median shoreline change among the 106 transects (without any length-weighting) was approximately -25 feet, with 90% of transects having change between +10 and -48 feet. For greater benefit in using future monitoring reports to track the performance and remaining "service life" of the Federal Project, it is recommended to establish a fixed line in space that can be plotted on charts similar to Figure 6-1 and Figure 6-2. This line should be developed in collaboration with USACE Norfolk District.

This is the twenty-sixth periodic survey report completed to date, and the twenty-sixth evaluation of a consistent survey period utilizing beach and bathymetric surveys. As noted, there are inevitable margins of error associated with the survey data that may reduce the accuracy of volumetric change analyses. Therefore, it is essential to thoroughly review the beach and bathymetric profiles using various analytical techniques and general engineering judgment to assure that results are not falsely interpreted. Comparison of surveys taken at the same season of the year (i.e. May 2017 to April 2018) mitigates seasonal variation of profiles in volumetric change analyses. Consecutive spring-fall or fall-

spring survey comparisons are useful to assess the direct impact of extreme events which may occur during the approximate six month period between surveys.

Future periodic survey evaluations will continue to improve on analysis techniques and will track changes in and the condition of the Federal Project, to assist the City to manage these beaches and coordinate with USACE regarding Federal Project maintenance.

CHESAPEAKE BAY

0+00
2+50
5+00
7+50
10+00
12+50
15+00
17+50
20+00
22+50
25+00
27+50
30+00
32+50
35+00
37+50
40+00
42+50
45+00

Legend

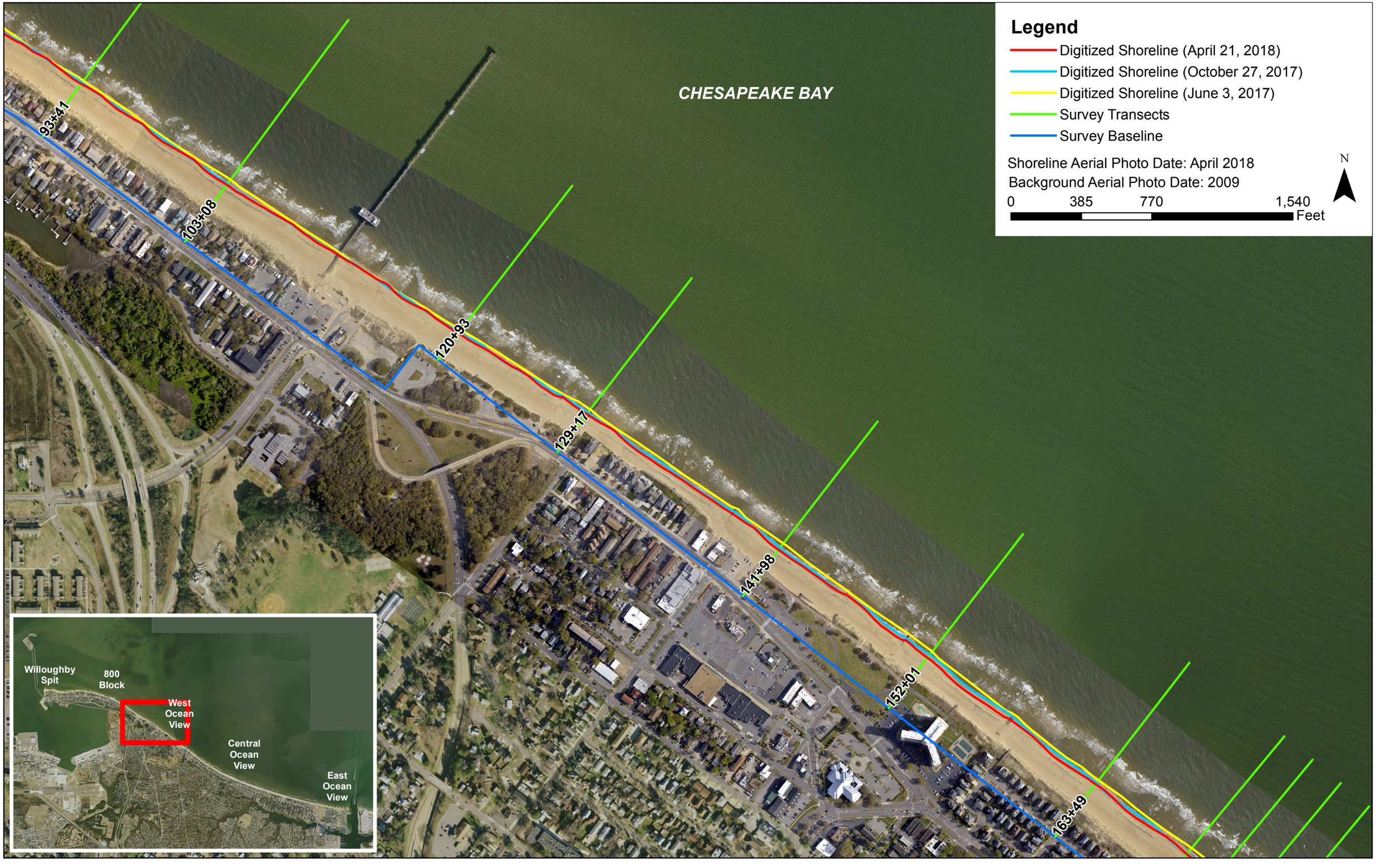
- Digitized Shoreline (April 21, 2018)
- Digitized Shoreline (October 27, 2017)
- Digitized Shoreline (June 3, 2017)
- Survey Transects
- Survey Baseline

Shoreline Aerial Photo Date: April 2018
Background Aerial Photo Date: 2009

0 275 550 1,100
Feet

N


CHESAPEAKE BAY
45+25
47+30
49+35
51+41
53+46
55+51
57+57
59+62
61+62
63+62
65+62
67+62
69+62
71+62
73+62
75+62
77+62
79+62
81+62
83+62
85+62
87+62
93+41
Legend
Digitized Shoreline (April 21, 2018)
Digitized Shoreline (October 27, 2017)
Digitized Shoreline (June 3, 2017)
Survey Transects
Survey Baseline
Shoreline Aerial Photo Date: April 2018
Background Aerial Photo Date: 2009
N
0
250
500
1,000
Feet
Willoughby Spit
800 Block
West Ocean View
Central Ocean View
East Ocean View


CHESAPEAKE BAY
93+41
103+08
120+93
129+17
141+98
152+01
163+49
Legend
Digitized Shoreline (April 21, 2018)
Digitized Shoreline (October 27, 2017)
Digitized Shoreline (June 3, 2017)
Survey Transects
Survey Baseline
Shoreline Aerial Photo Date: April 2018
Background Aerial Photo Date: 2009
0
385
770
1,540
Feet
N
Willoughby Spit
800 Block
West Ocean View
Central Ocean View
East Ocean View


CHESAPEAKE BAY
Legend
Digitized Shoreline (April 21, 2018)
Digitized Shoreline (October 27, 2017)
Digitized Shoreline (June 3, 2017)
Survey Transects
Survey Baseline
Shoreline Aerial Photo Date: April 2018
Background Aerial Photo Date: 2009
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250
500
1,000
Feet
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163+49
169+63
171+63
173+63
175+63
177+63
179+63
181+63
183+63
185+63
187+63
189+63
191+63
193+63
195+63
Willoughby Spit
800 Block
West Ocean View
Central Ocean View
East Ocean View


CHESAPEAKE BAY
206+86
218+66
229+85
242+03
252+62
263+22
274+53
281+40
288+39
295+27
302+24
315+96
323+09
329+63
331+43
Legend
Digitized Shoreline (April 21, 2018)
Digitized Shoreline (October 27, 2017)
Digitized Shoreline (June 3, 2017)
Survey Transects
Survey Baseline
Shoreline Aerial Photo Date: April 2018
Background Aerial Photo Date: 2009
0
600
1,200
2,400
Feet
N
Willoughby Spit
800 Block
West Ocean View
Central Ocean View
East Ocean View

CHESAPEAKE BAY

Legend

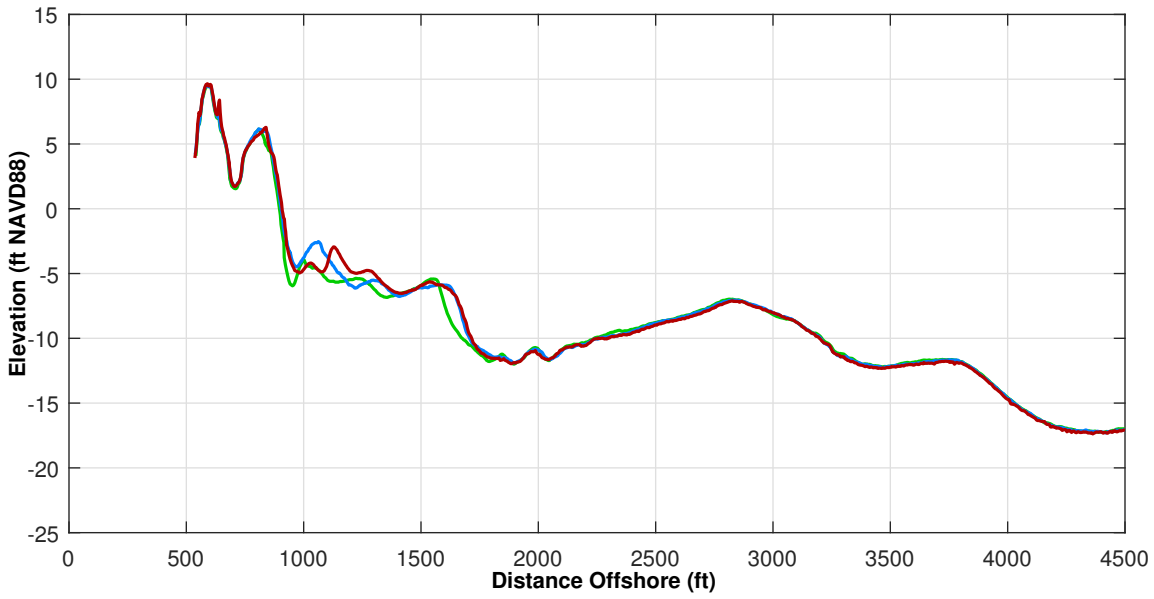
- Digitized Shoreline (April 21, 2018)
- Digitized Shoreline (October 27, 2017)
- Digitized Shoreline (June 3, 2017)
- Survey Transects
- Survey Baseline

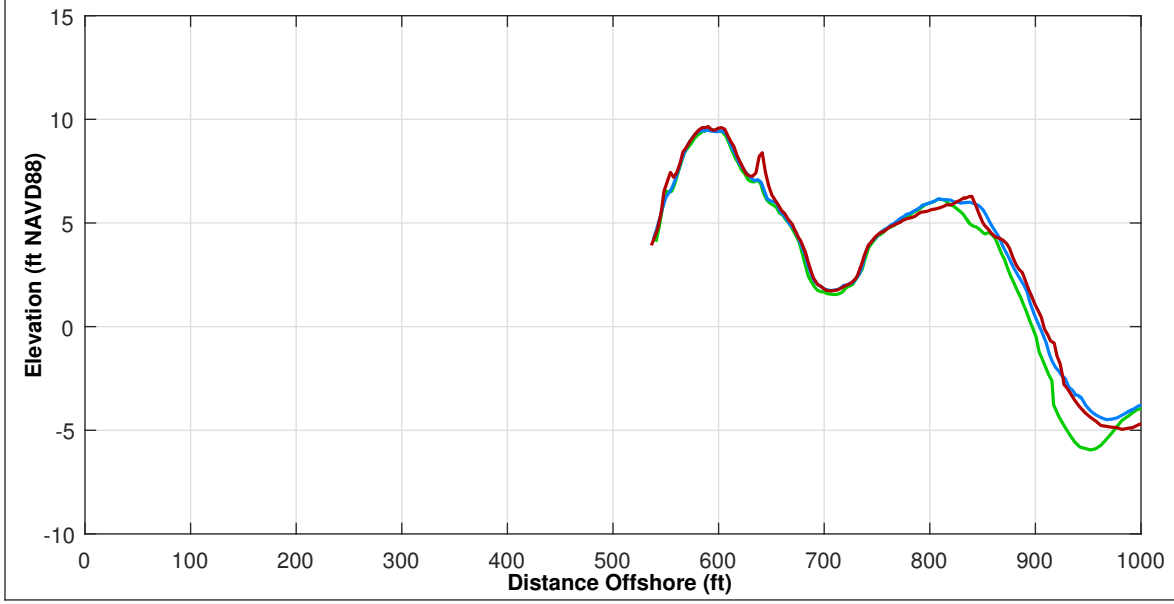
Shoreline Aerial Photo Date: April 2018
Background Aerial Photo Date: 2009

N

0 300 600 1,200 Feet

329+63 331+43 333+23 335+03 336+83 338+63 340+43 342+23 344+05 345+85 347+63 349+43 351+23 353+03 354+83 356+63 358+43 360+23 362+03 363+83 365+63 367+43 369+23 371+03 372+83 375+08 376+78 378+48 380+18 381+88 383+58





Survey Transect 0+00	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	12.60 ft/yr	4.33 ft
Volume Change Above -15 ft NAVD88	21.63 cy/ft/yr	-2.54 cy/ft
Volume Change Above 0 ft NAVD88	5.06 cy/ft/yr	1.16 cy/ft

LEGEND:
APR 2018
OCT 2017
MAY 2017

Notes:
1. Station From West To East At Varying Intervals.
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4. Survey Comparison Made to MAY 2017 and OCT 2017
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.

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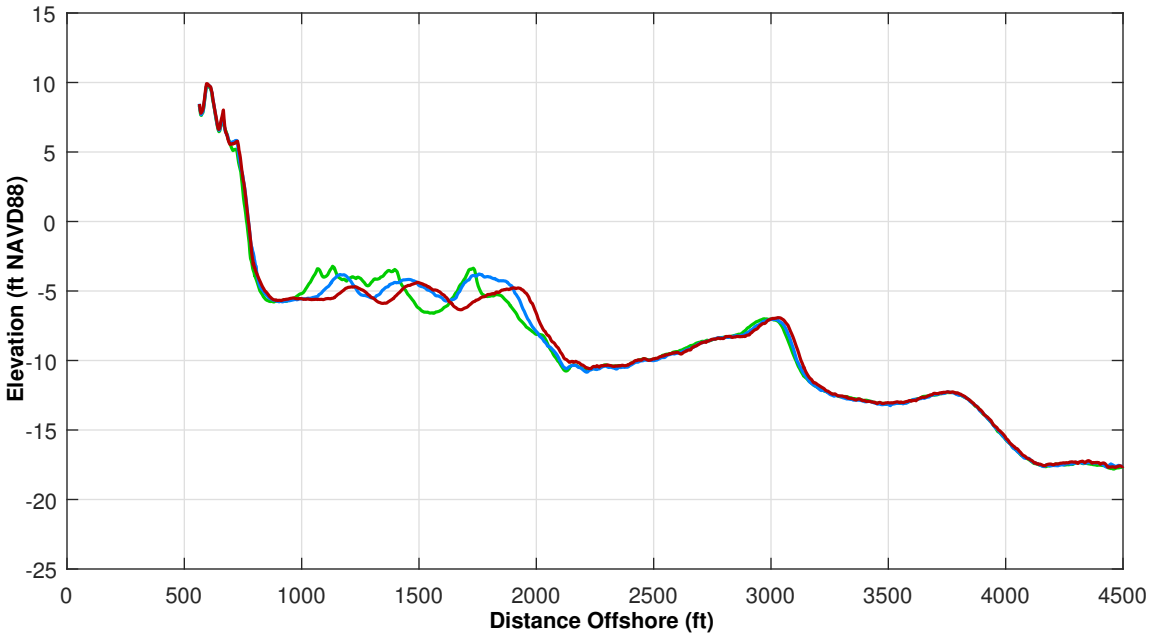
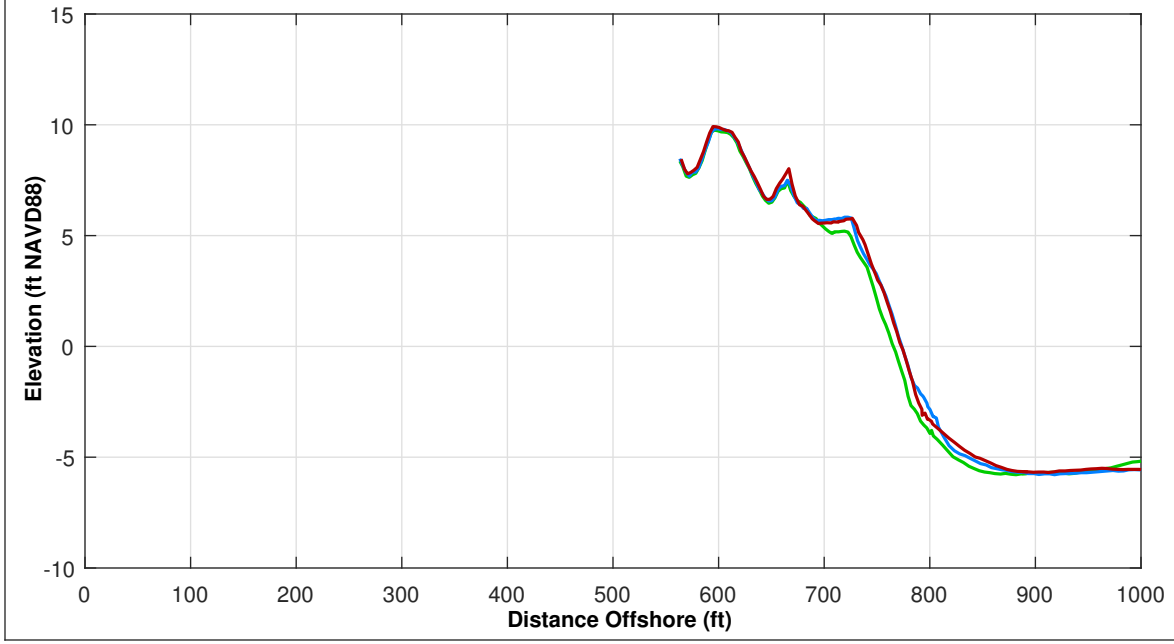
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS

ST 0+00	Pg 1 of 106	Spring 2018





Survey Transect 2+50	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	9.24 ft/yr	-0.89 ft
Volume Change Above -15 ft NAVD88	3.28 cy/ft/yr	-4.17 cy/ft
Volume Change Above 0 ft NAVD88	3.24 cy/ft/yr	0.50 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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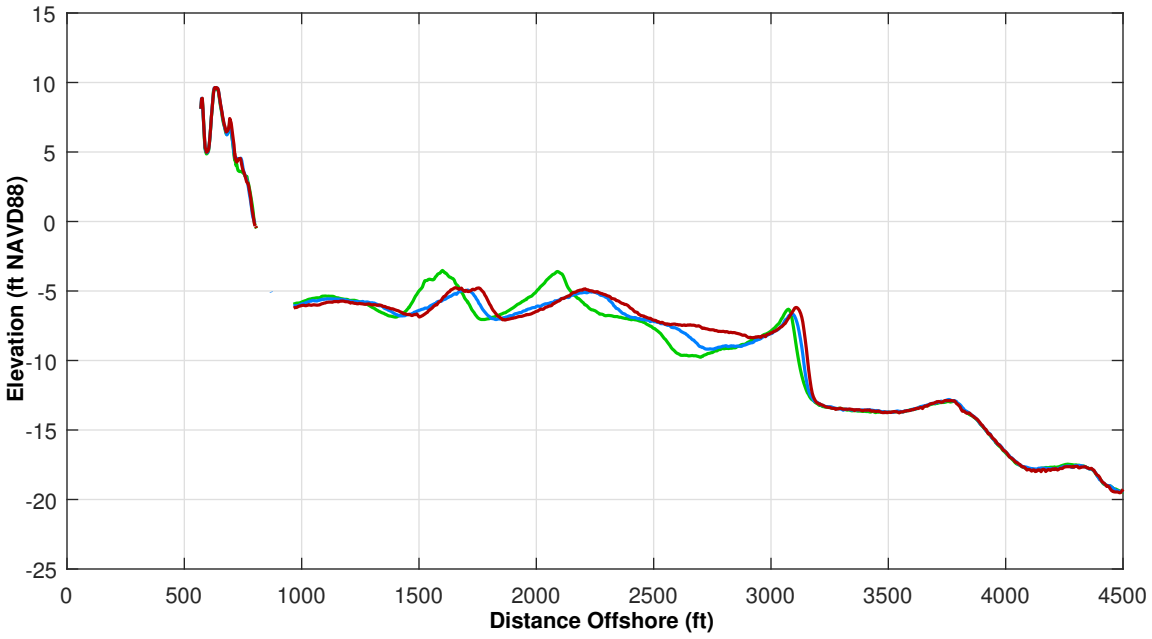
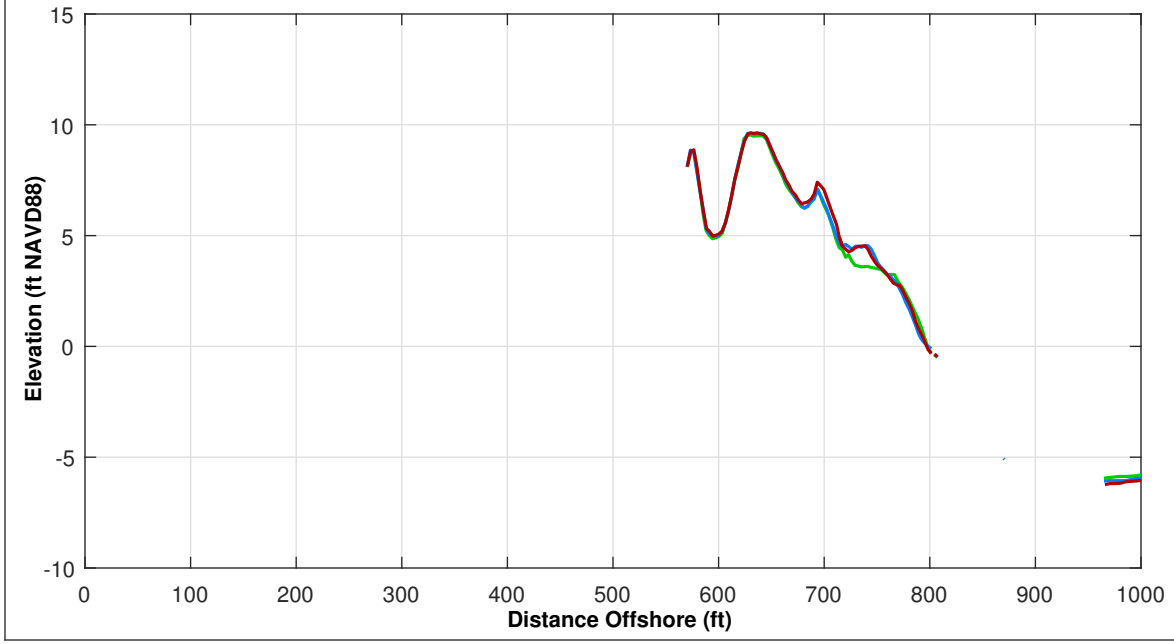
ST 2+50	Pg 2 of 106	Spring 2018





Survey Transect 5+00	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-3.59 ft/yr	1.45 ft
Volume Change Above -15 ft NAVD88	25.62 cy/ft/yr	20.27 cy/ft
Volume Change Above 0 ft NAVD88	1.59 cy/ft/yr	0.60 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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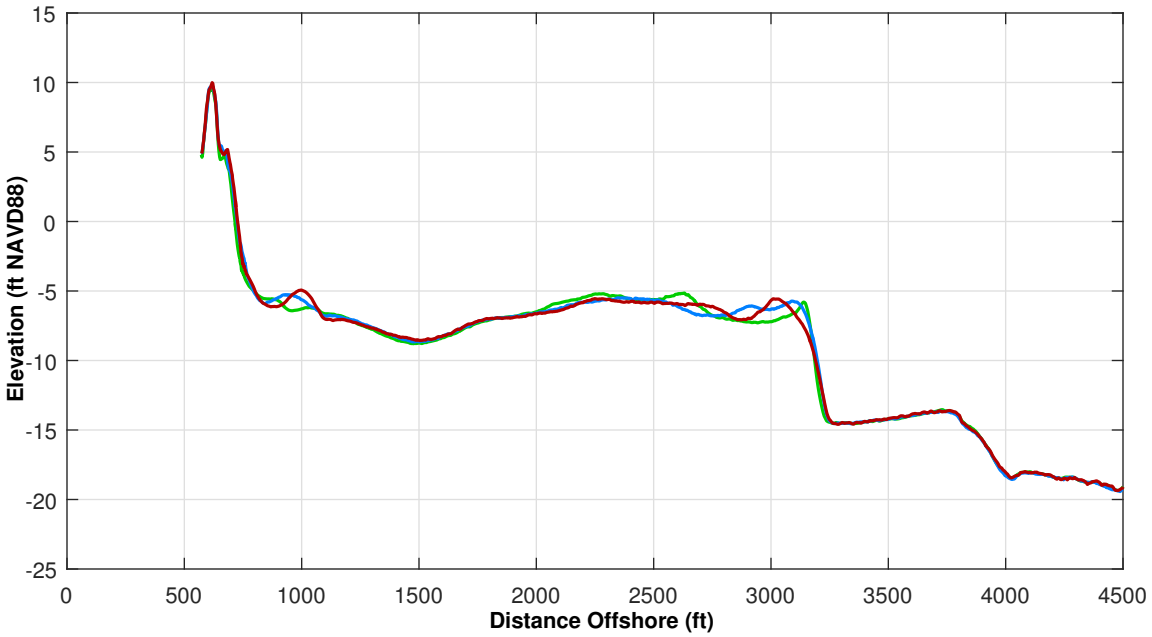
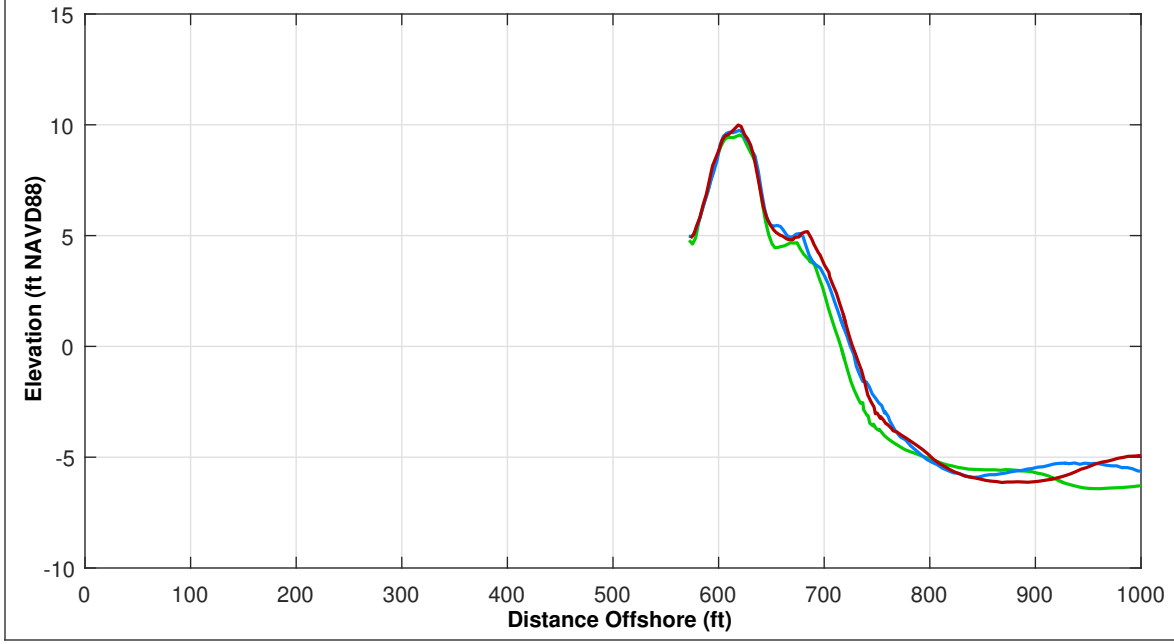
ST 5+00	Pg 3 of 106	Spring 2018





Survey Transect 7+50	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	13.45 ft/yr	3.20 ft
Volume Change Above -15 ft NAVD88	10.87 cy/ft/yr	-2.30 cy/ft
Volume Change Above 0 ft NAVD88	3.70 cy/ft/yr	0.90 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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4. Survey Comparison Made to MAY 2017 and OCT 2017
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.

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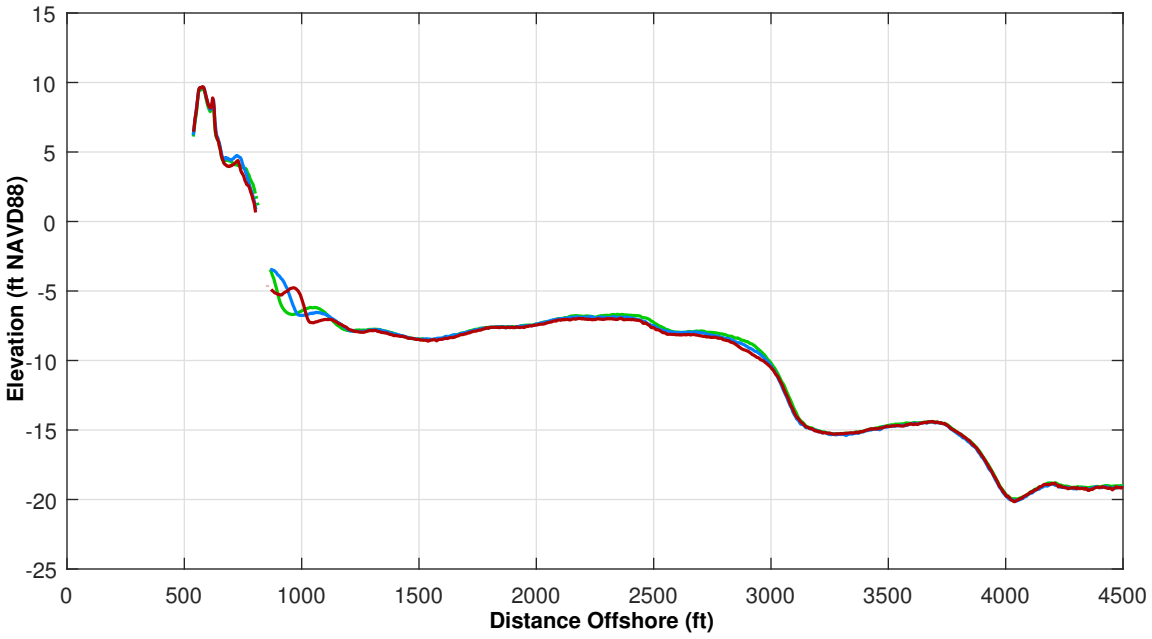

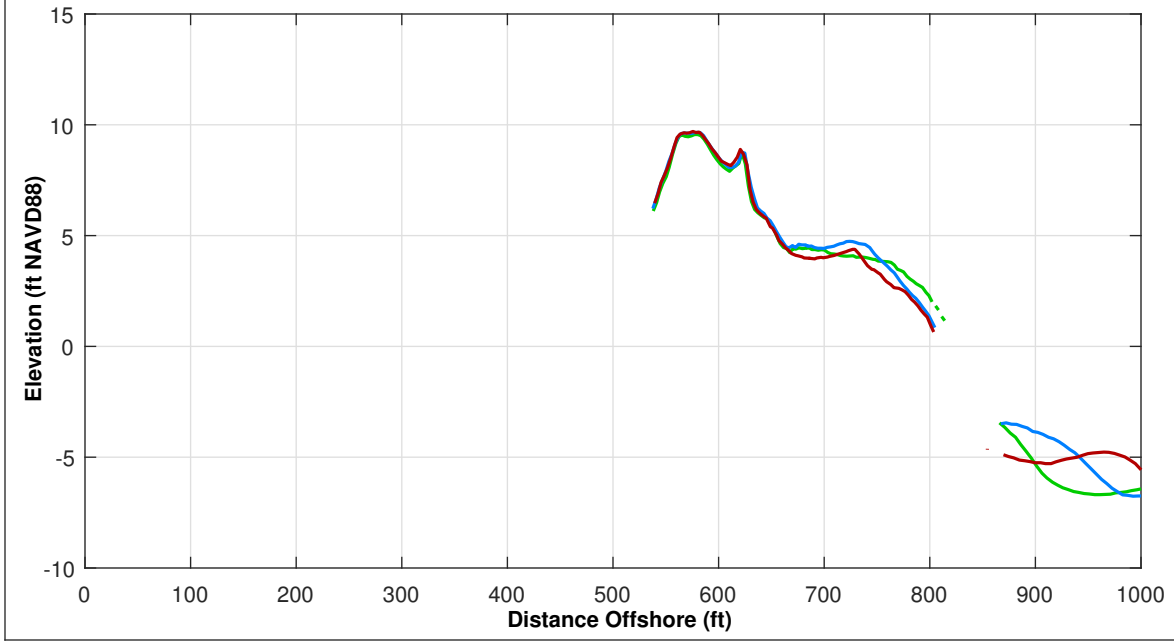

Survey Transect 10+00	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-17.41 ft/yr	-2.85 ft
Volume Change Above -15 ft NAVD88	-16.91 cy/ft/yr	-11.64 cy/ft
Volume Change Above 0 ft NAVD88	-2.76 cy/ft/yr	-2.66 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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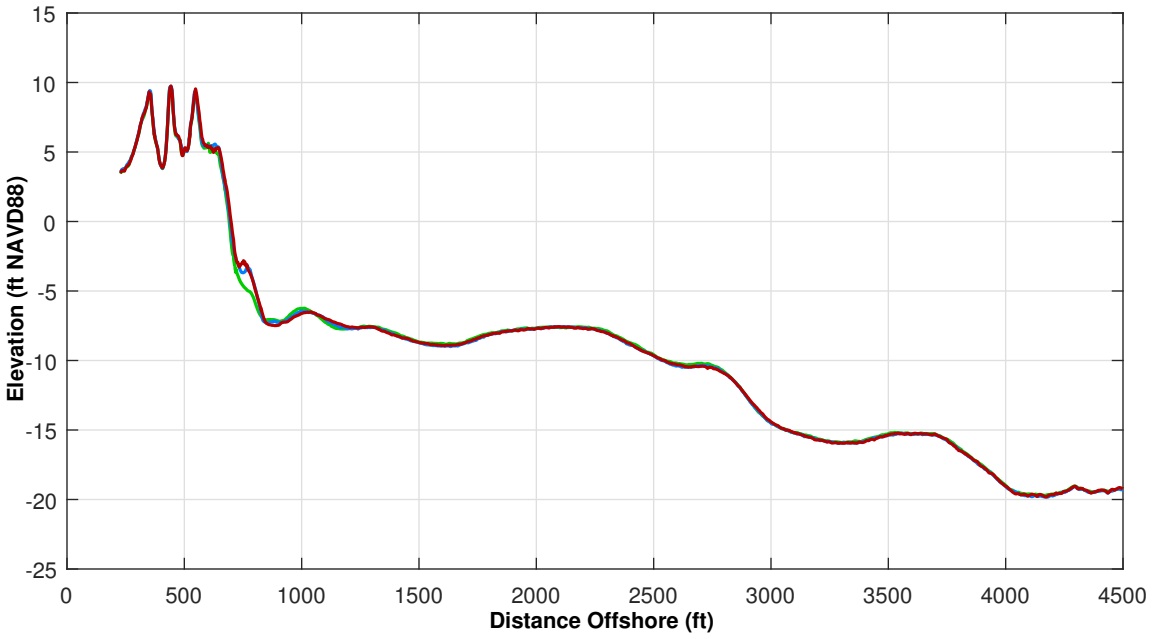

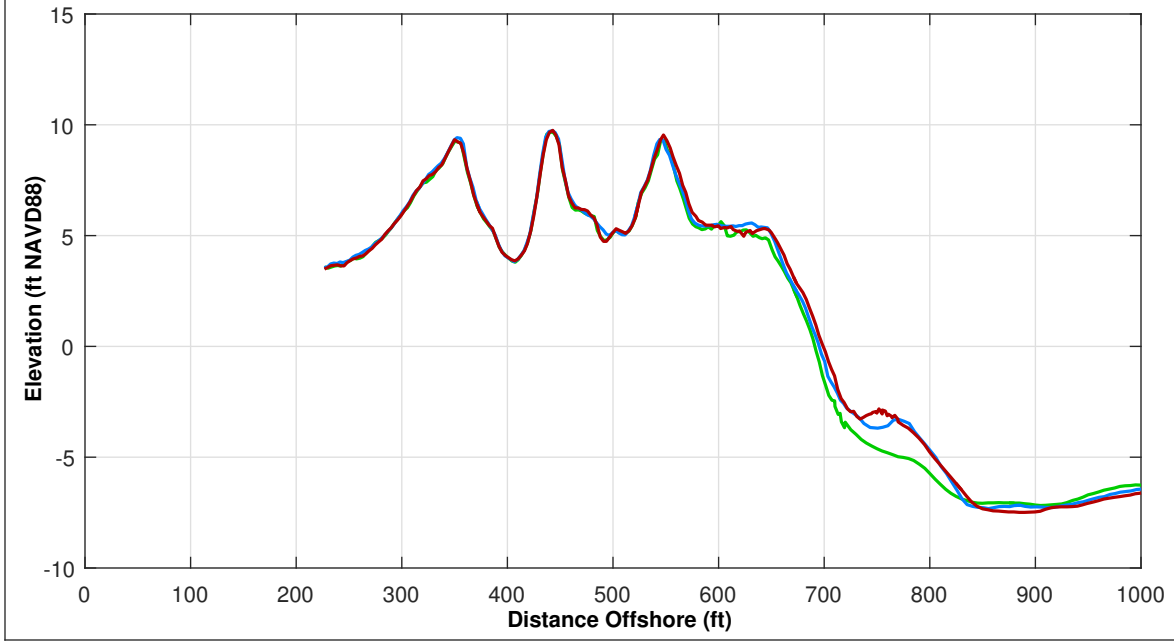

Survey Transect 12+50	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	8.33 ft/yr	4.32 ft
Volume Change Above -15 ft NAVD88	3.41 cy/ft/yr	1.94 cy/ft
Volume Change Above 0 ft NAVD88	2.98 cy/ft/yr	0.10 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2017 and OCT 2017
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.

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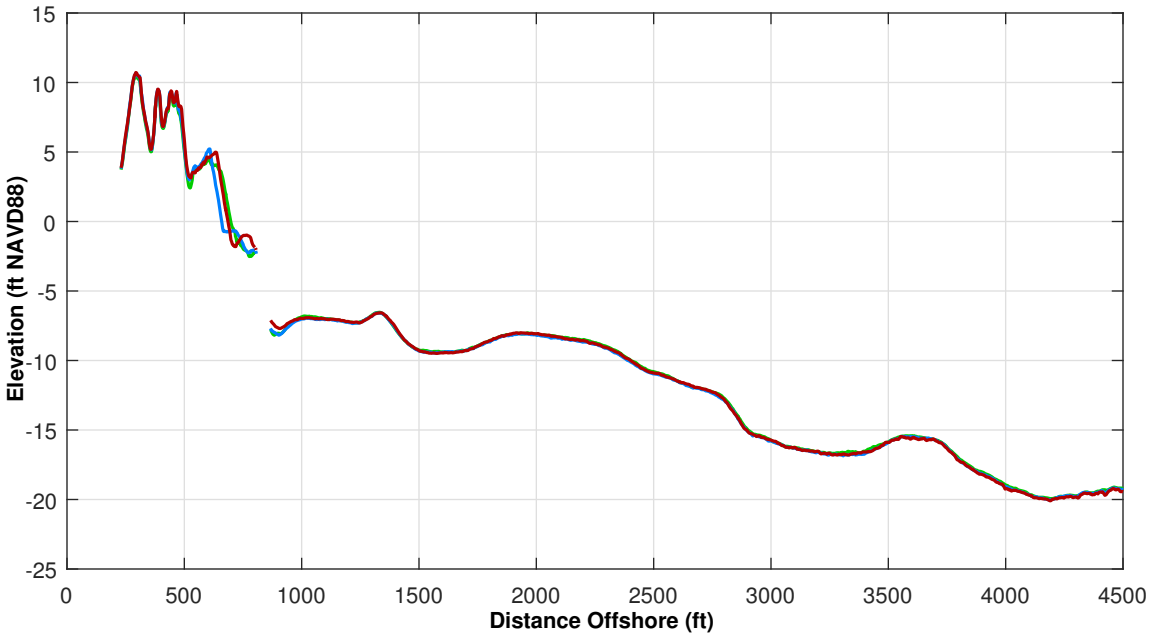

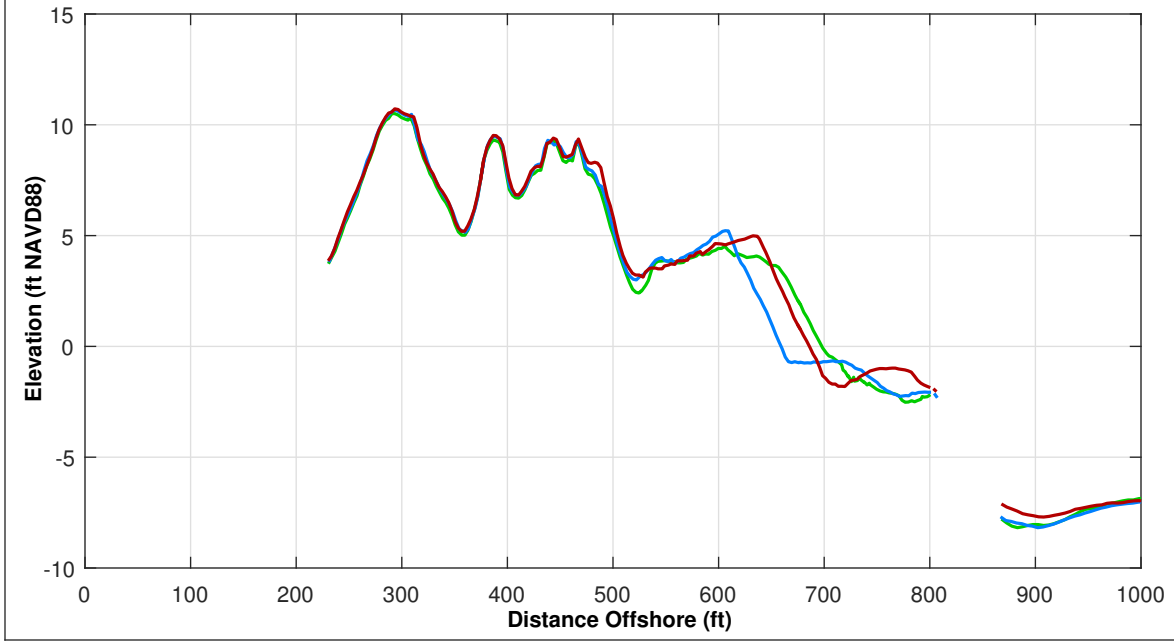

Survey Transect 15+00	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-14.07 ft/yr	24.36 ft
Volume Change Above -15 ft NAVD88	3.20 cy/ft/yr	10.65 cy/ft
Volume Change Above 0 ft NAVD88	3.20 cy/ft/yr	4.91 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2017 and OCT 2017
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.

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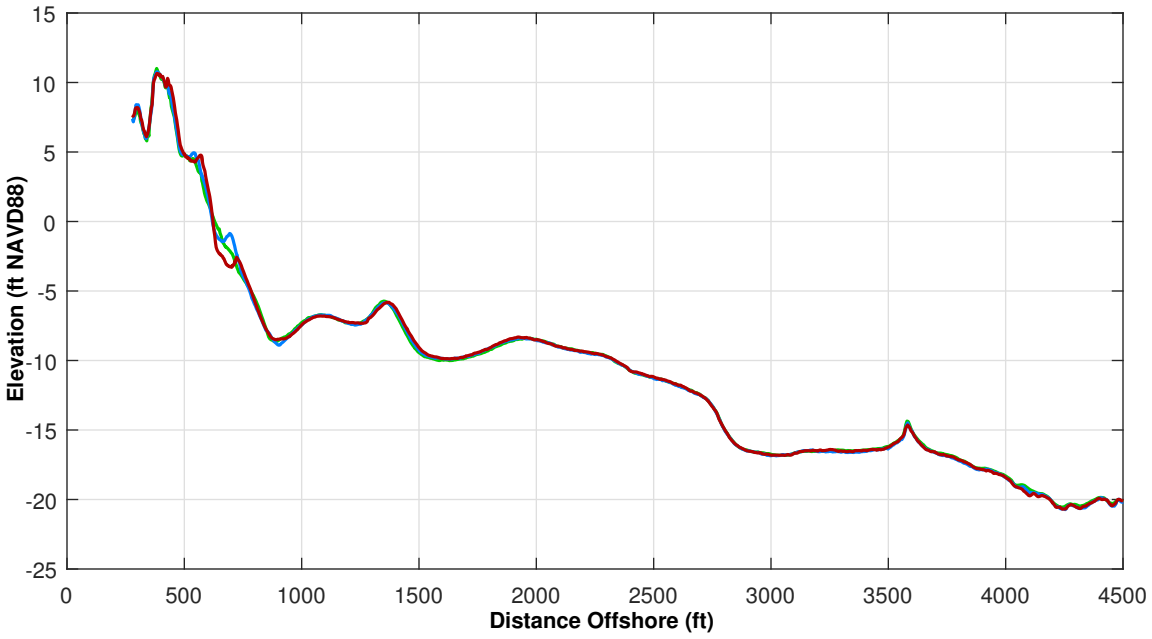

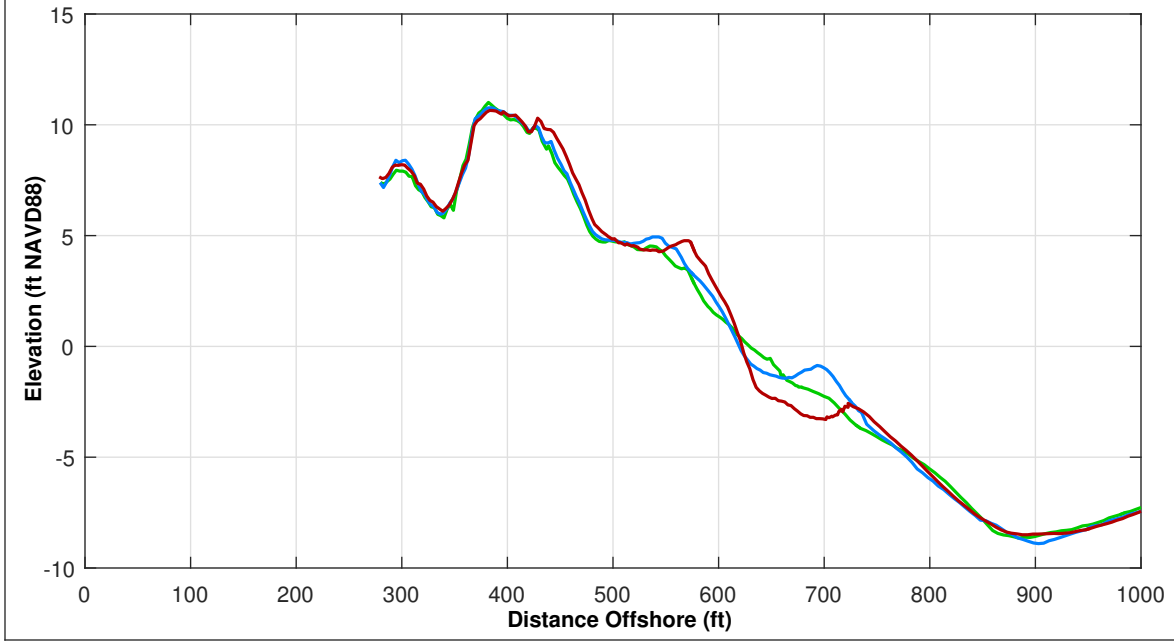

Survey Transect 17+50	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	5.99 ft/yr	5.46 ft
Volume Change Above -15 ft NAVD88	6.09 cy/ft/yr	1.56 cy/ft
Volume Change Above 0 ft NAVD88	5.85 cy/ft/yr	2.73 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2017 and OCT 2017
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.

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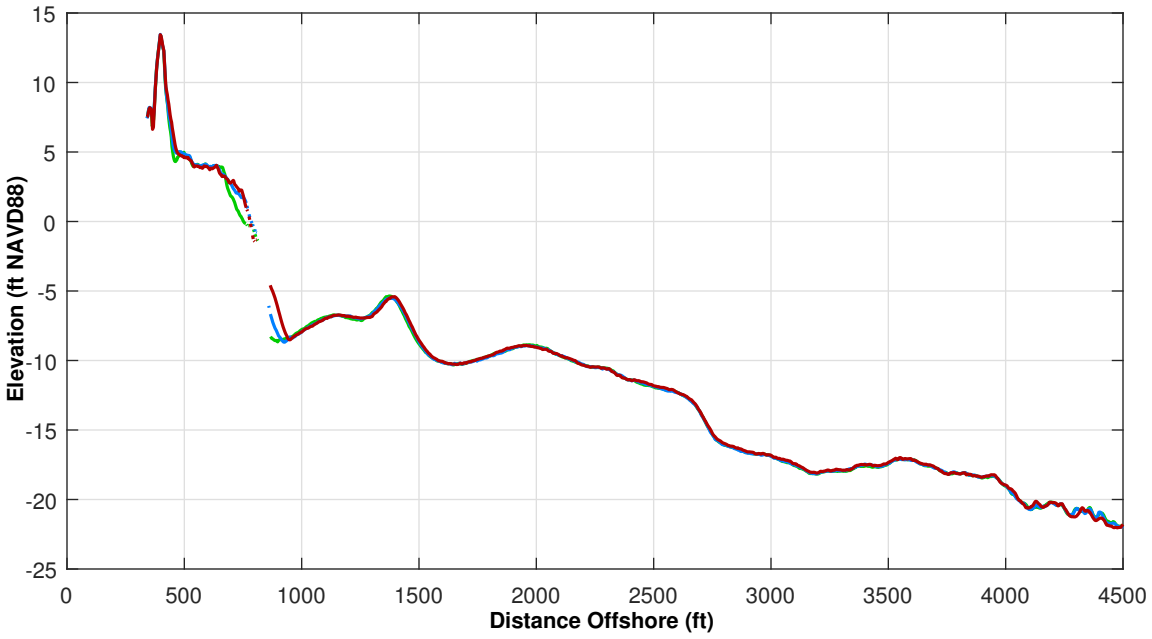

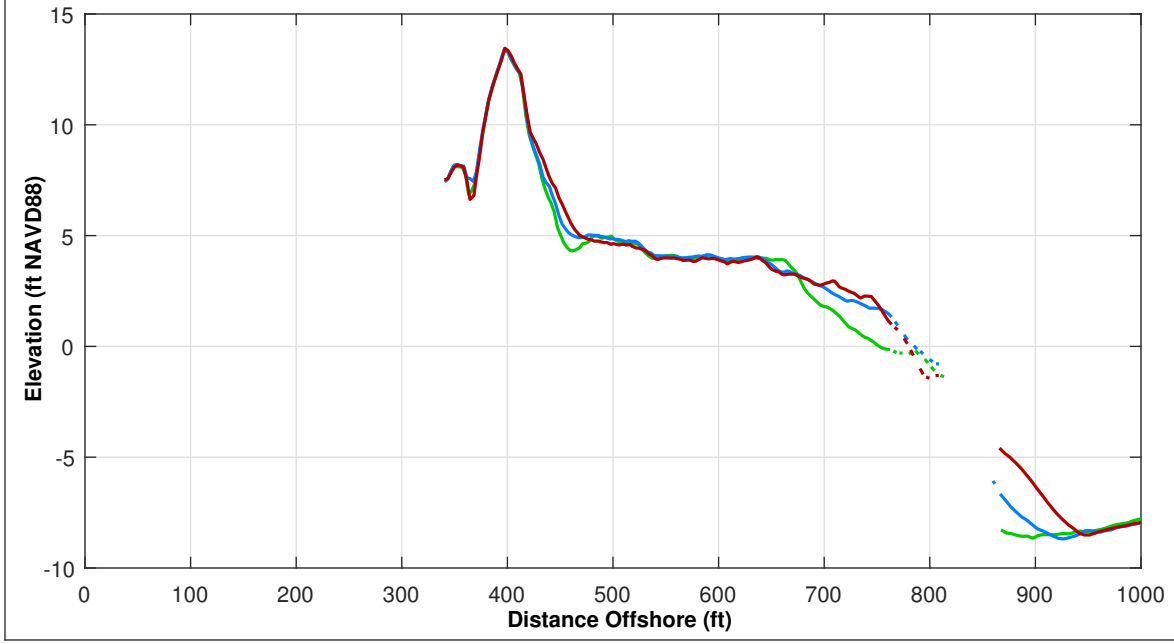

Survey Transect 20+00	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	48.50 ft/yr	-5.01 ft
Volume Change Above -15 ft NAVD88	13.54 cy/ft/yr	6.44 cy/ft
Volume Change Above 0 ft NAVD88	6.15 cy/ft/yr	0.21 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2017 and OCT 2017
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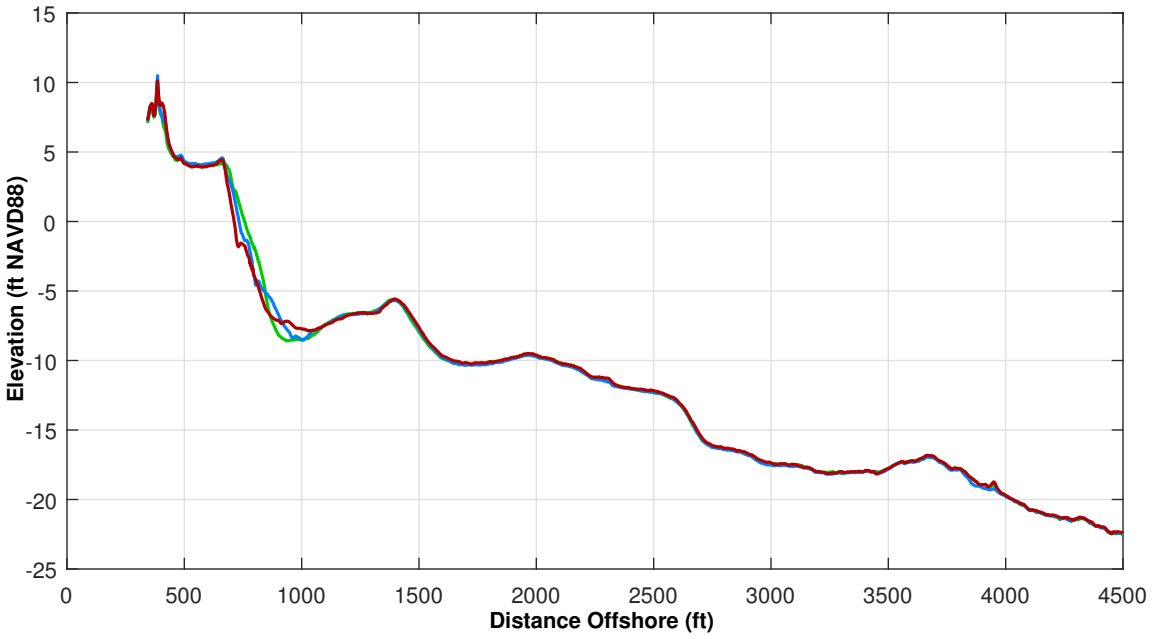
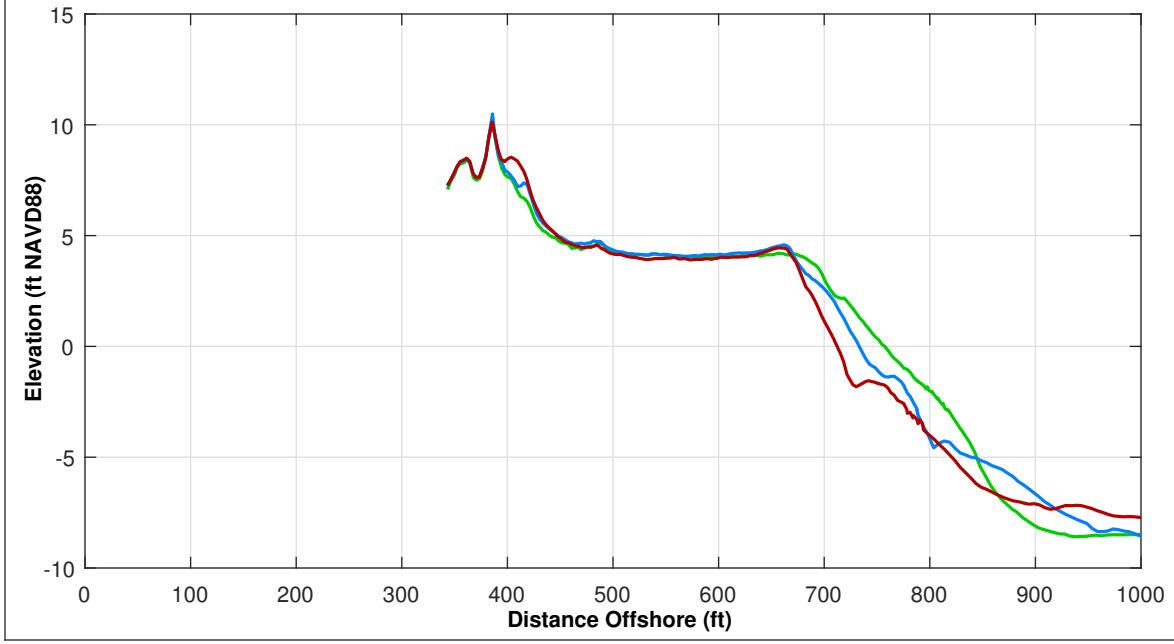
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS

ST 20+00	Pg 9 of 106	Spring 2018





Survey Transect 22+50	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-42.23 ft/yr	-19.73 ft
Volume Change Above -15 ft NAVD88	-1.90 cy/ft/yr	-0.58 cy/ft
Volume Change Above 0 ft NAVD88	-3.35 cy/ft/yr	-2.72 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2017 and OCT 2017
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.

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PUBLIC WORKS

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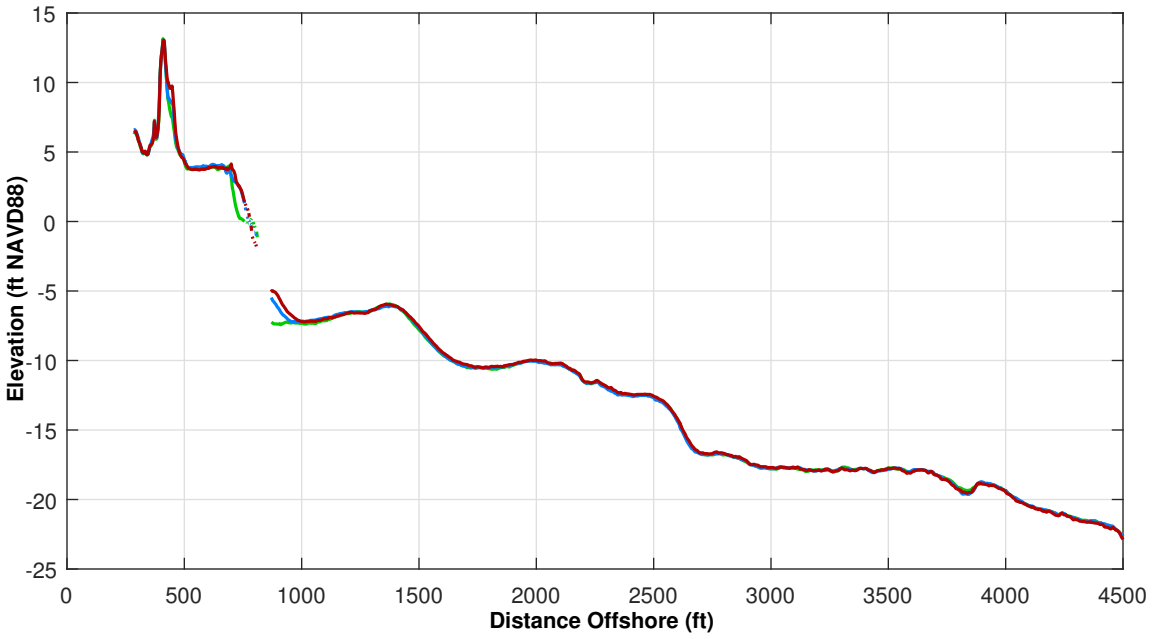

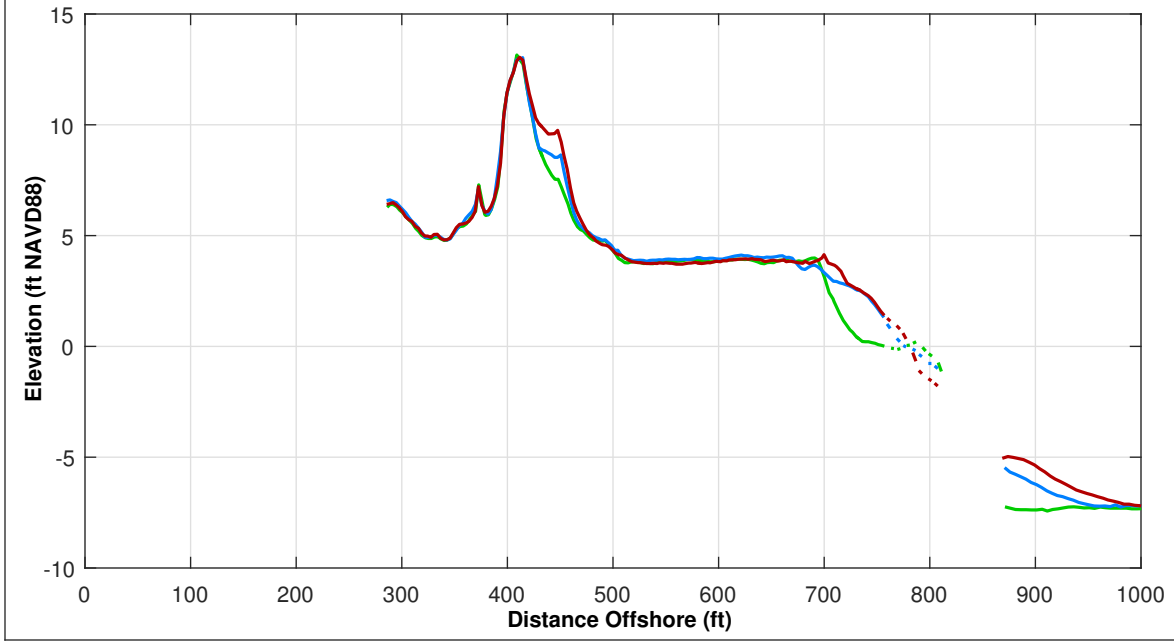

Survey Transect 25+00	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	52.70 ft/yr	7.33 ft
Volume Change Above -15 ft NAVD88	18.42 cy/ft/yr	7.25 cy/ft
Volume Change Above 0 ft NAVD88	8.10 cy/ft/yr	1.29 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

1. Station From West To East At Varying Intervals.
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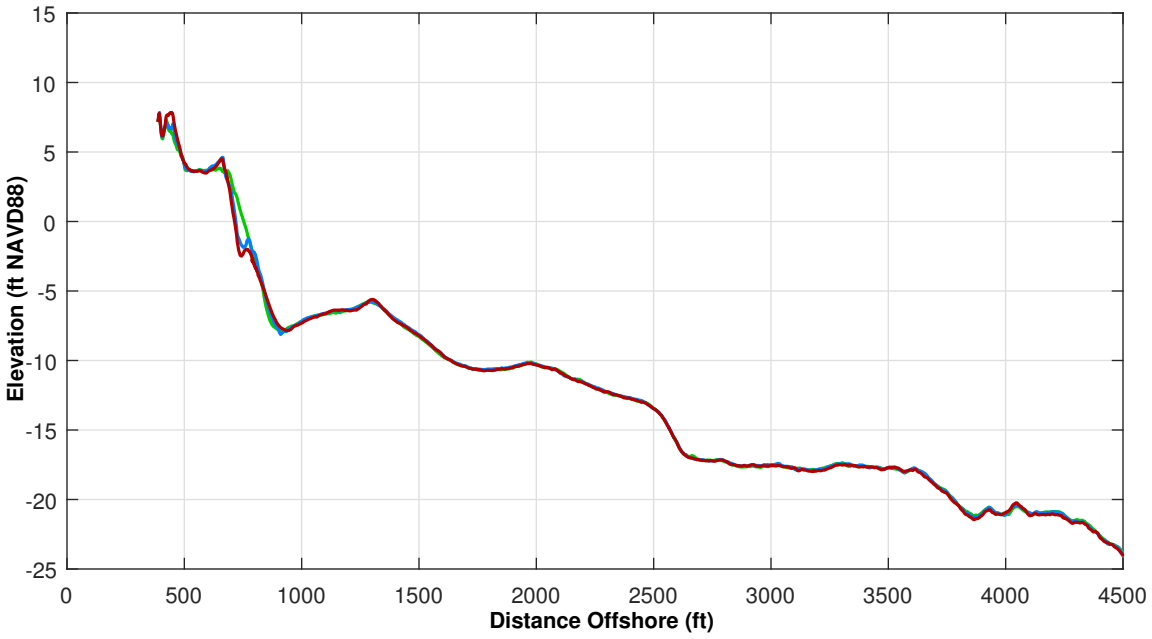
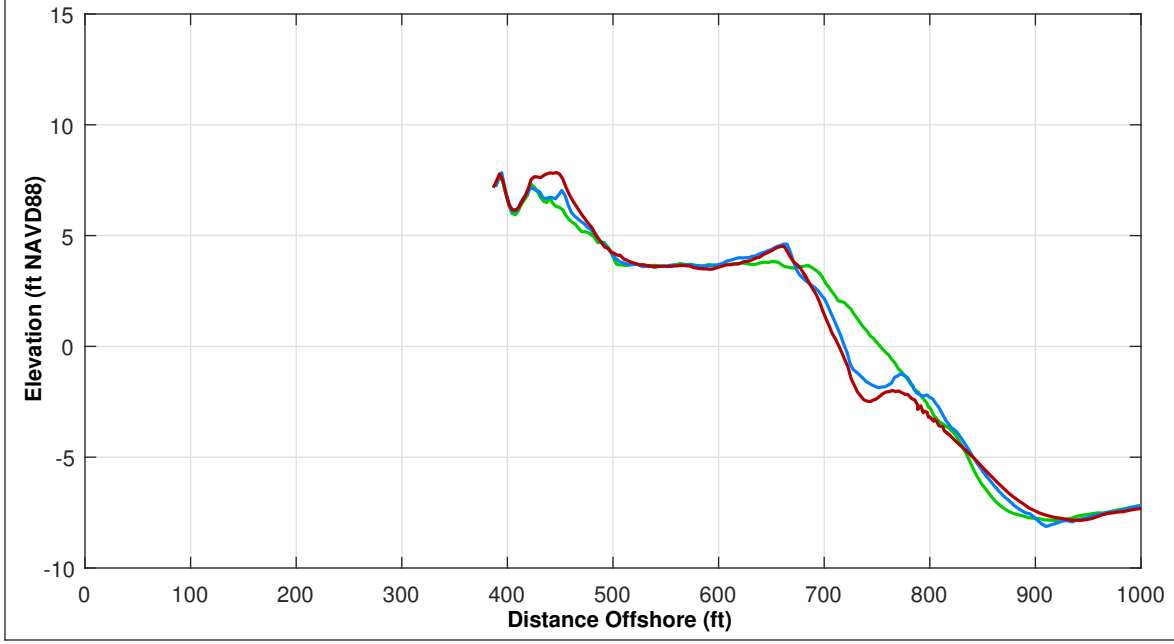
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 27+50	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-35.44 ft/yr	-7.03 ft
Volume Change Above -15 ft NAVD88	-3.65 cy/ft/yr	-3.71 cy/ft
Volume Change Above 0 ft NAVD88	-0.24 cy/ft/yr	0.55 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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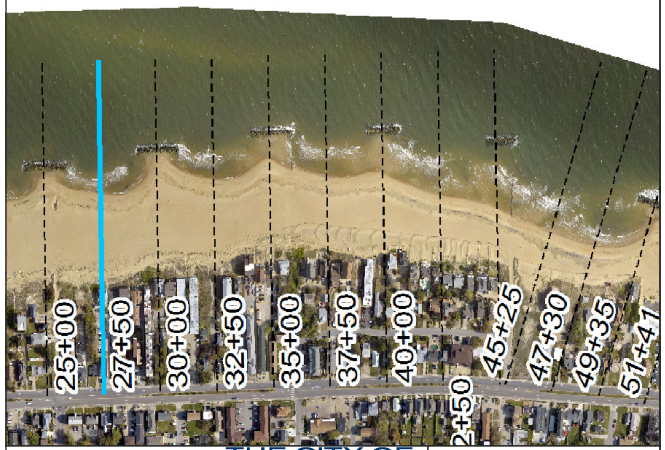

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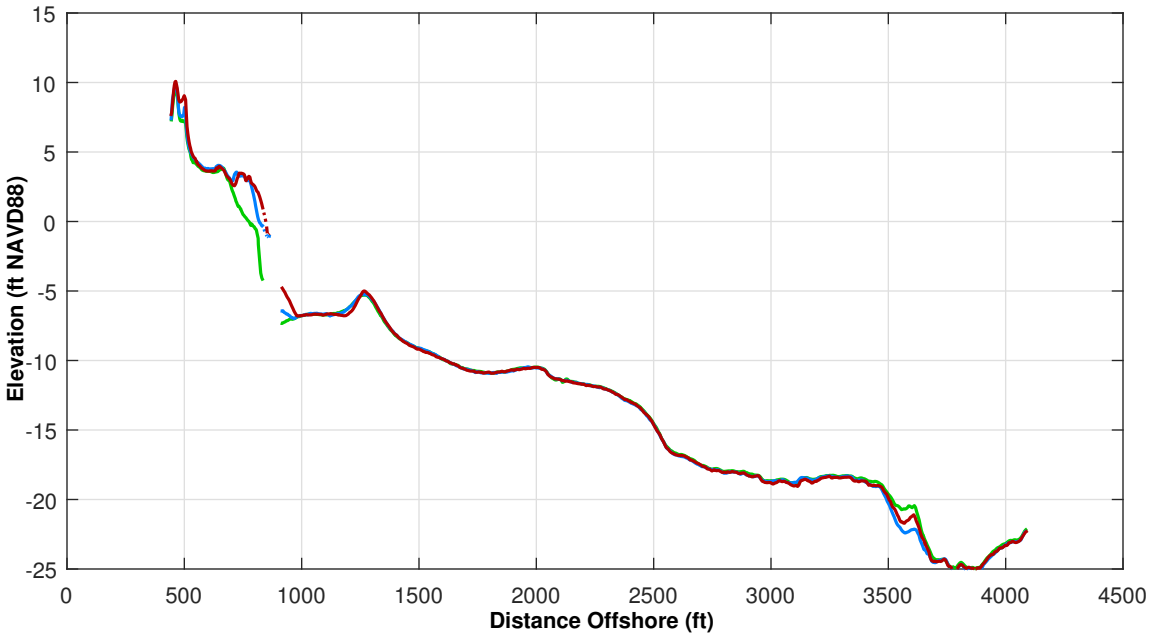
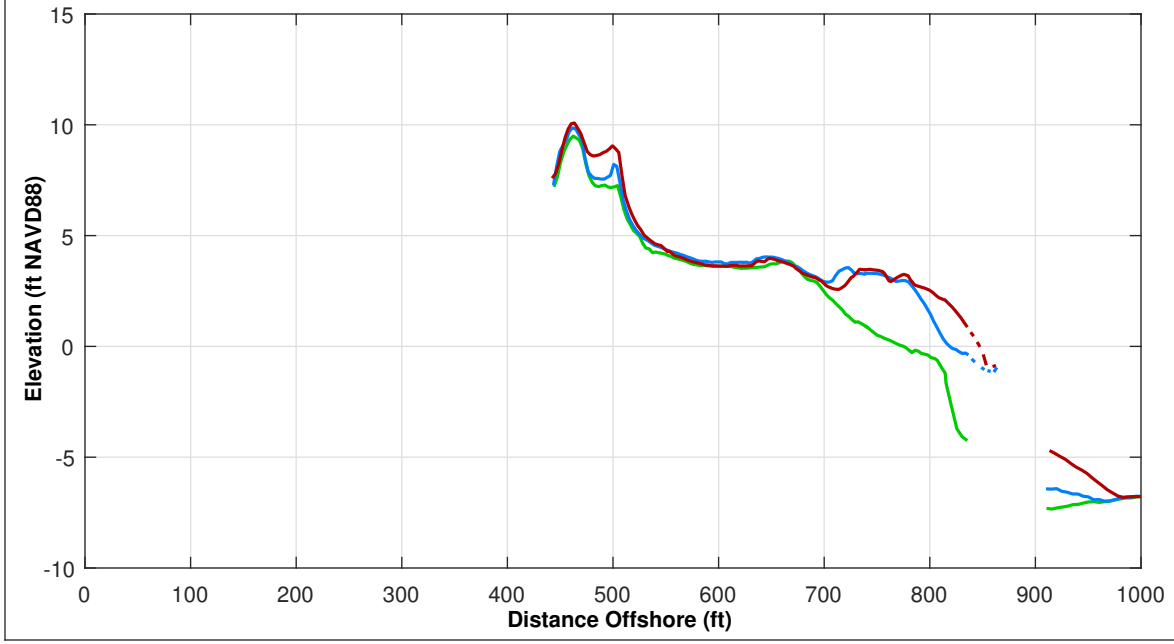
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 30+00	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	110.41 ft/yr	28.54 ft
Volume Change Above -15 ft NAVD88	22.66 cy/ft/yr	4.70 cy/ft
Volume Change Above 0 ft NAVD88	16.70 cy/ft/yr	3.39 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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3. All Survey Elevations In Feet Referenced to NAVD88.
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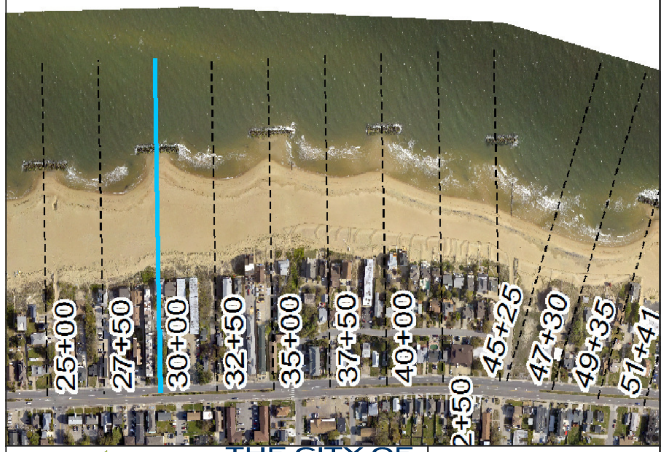
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.



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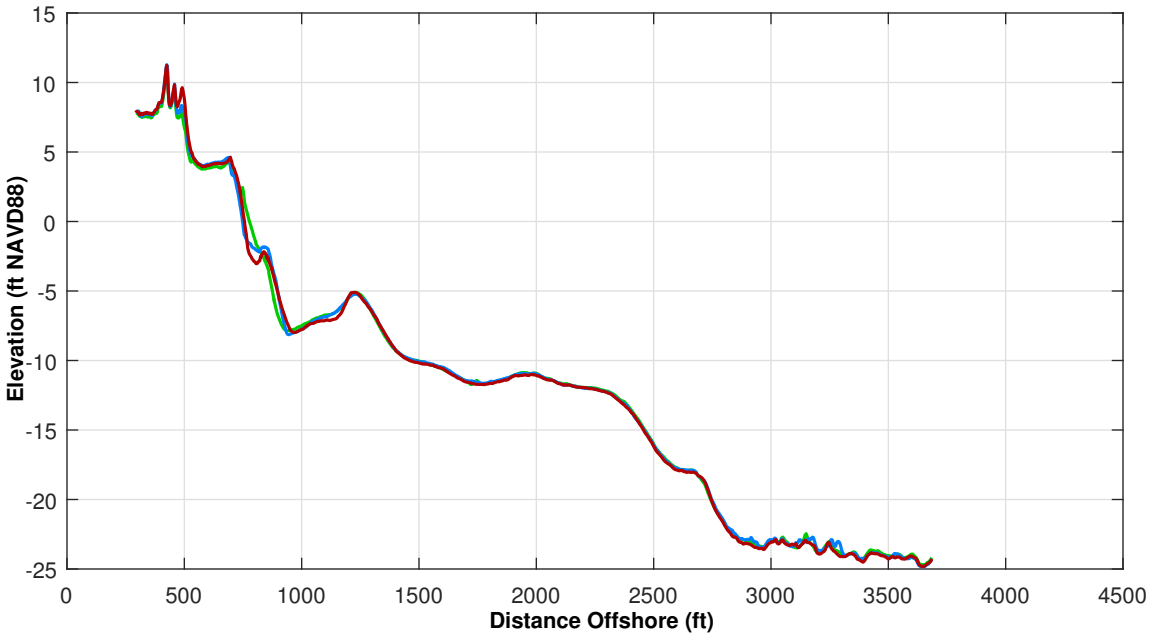

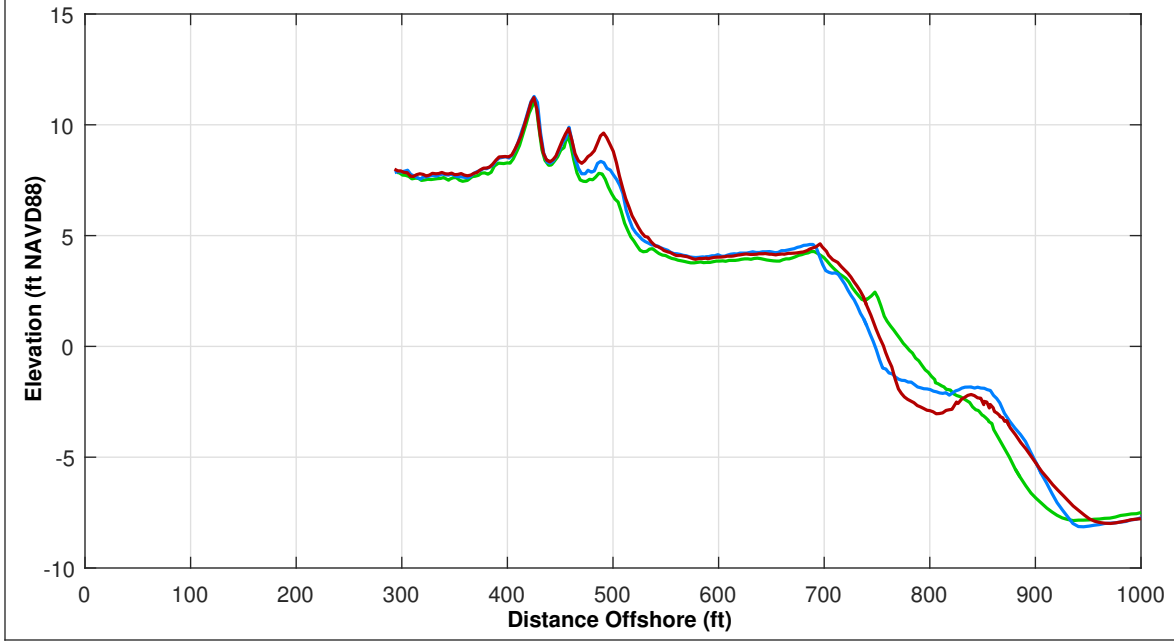

Survey Transect 32+50	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-16.33 ft/yr	7.70 ft
Volume Change Above -15 ft NAVD88	0.32 cy/ft/yr	-2.93 cy/ft
Volume Change Above 0 ft NAVD88	5.86 cy/ft/yr	2.98 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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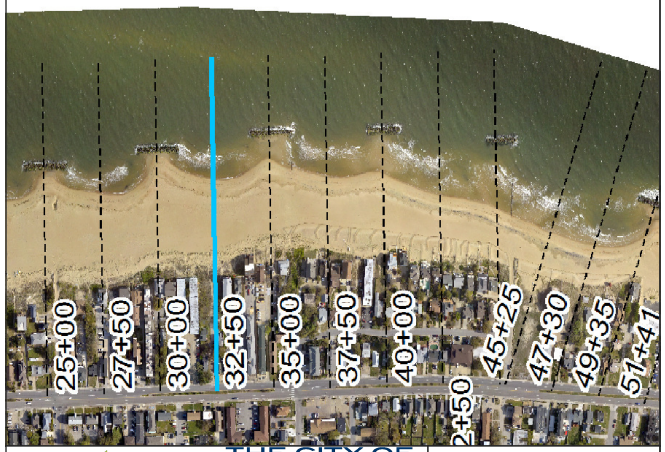

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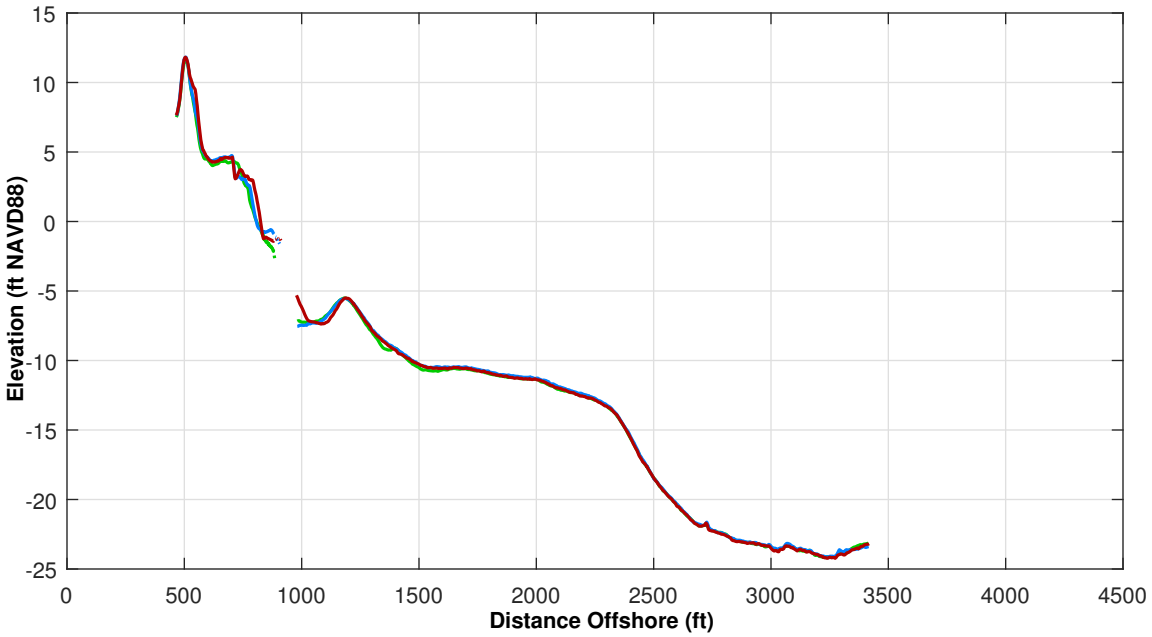

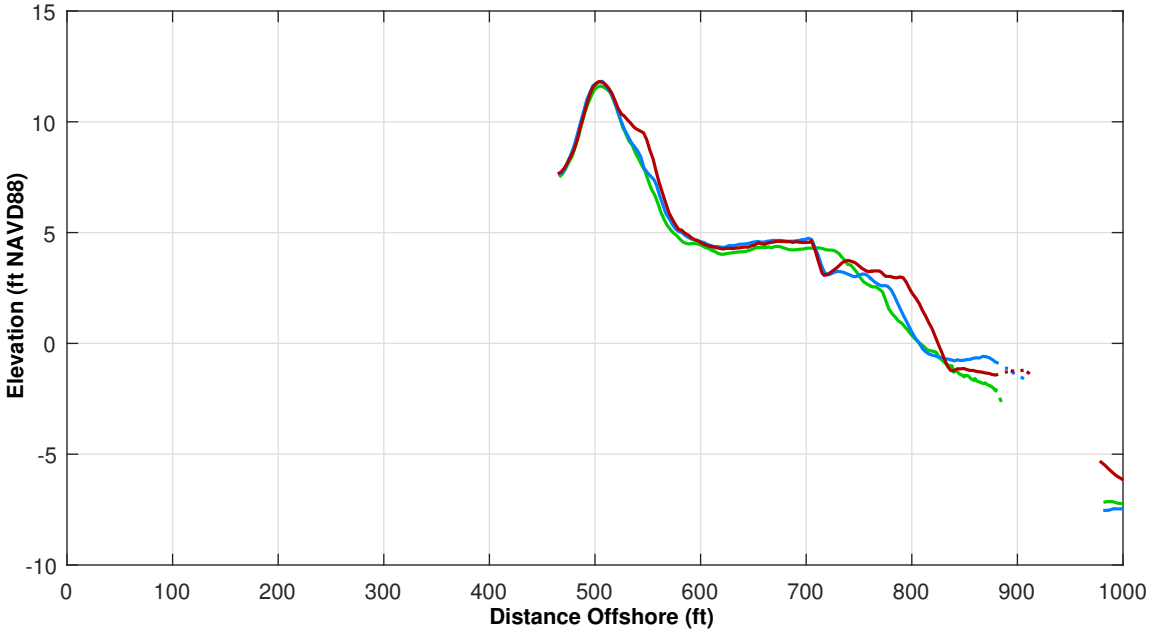

Survey Transect 35+00	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	31.01 ft/yr	20.52 ft
Volume Change Above -15 ft NAVD88	11.66 cy/ft/yr	0.29 cy/ft
Volume Change Above 0 ft NAVD88	7.14 cy/ft/yr	3.99 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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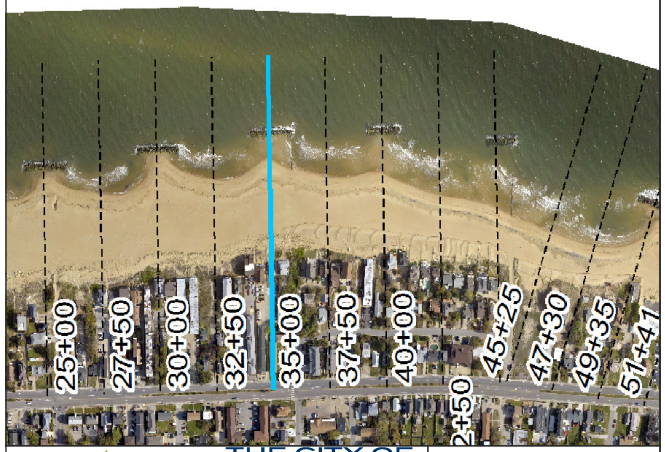
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.



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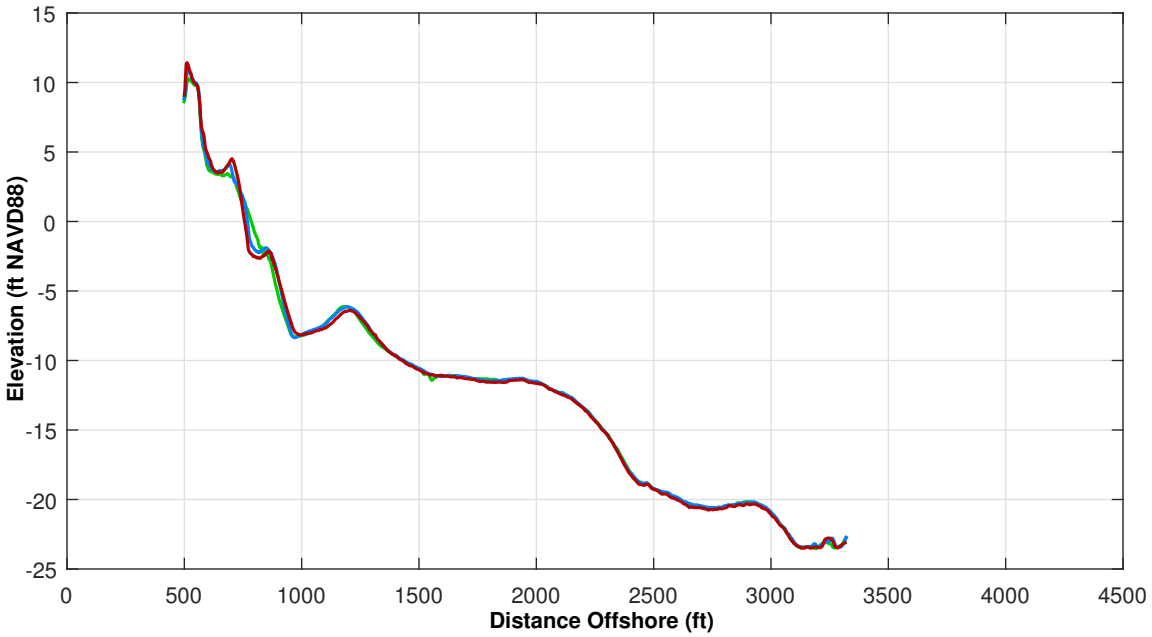
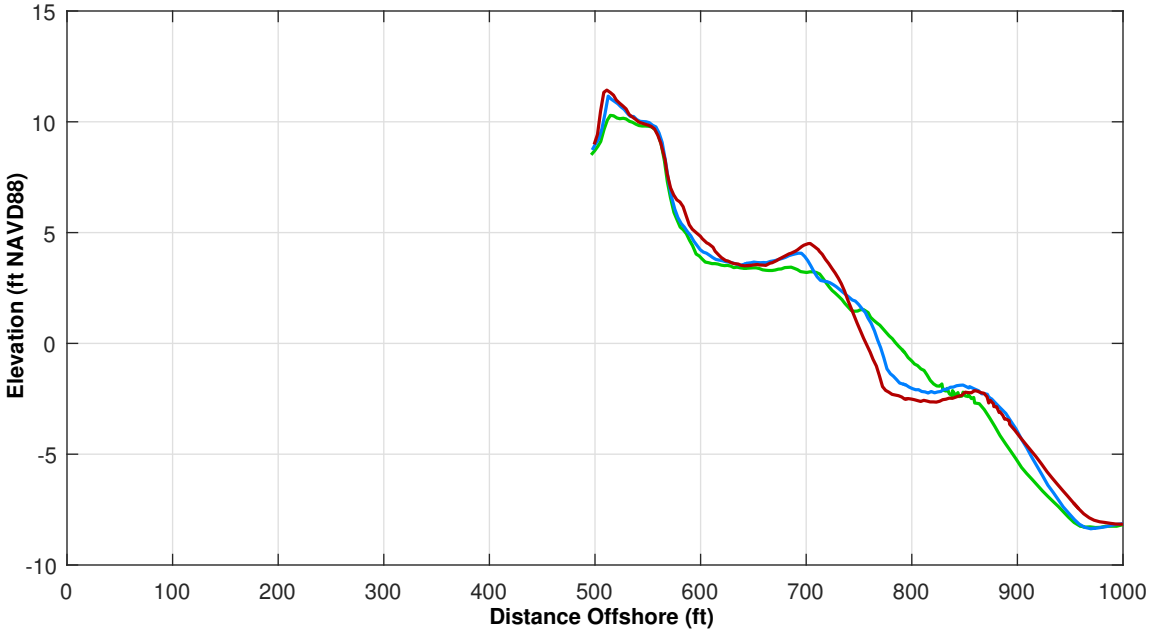
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 37+50	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-20.24 ft/yr	-12.91 ft
Volume Change Above -15 ft NAVD88	1.46 cy/ft/yr	-4.49 cy/ft
Volume Change Above 0 ft NAVD88	4.71 cy/ft/yr	1.57 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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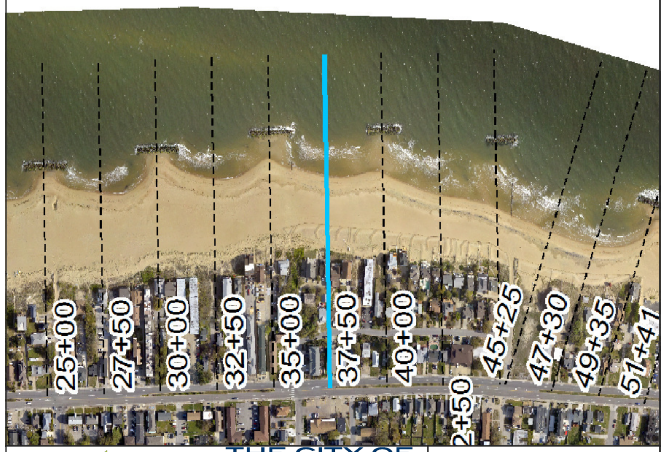
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.



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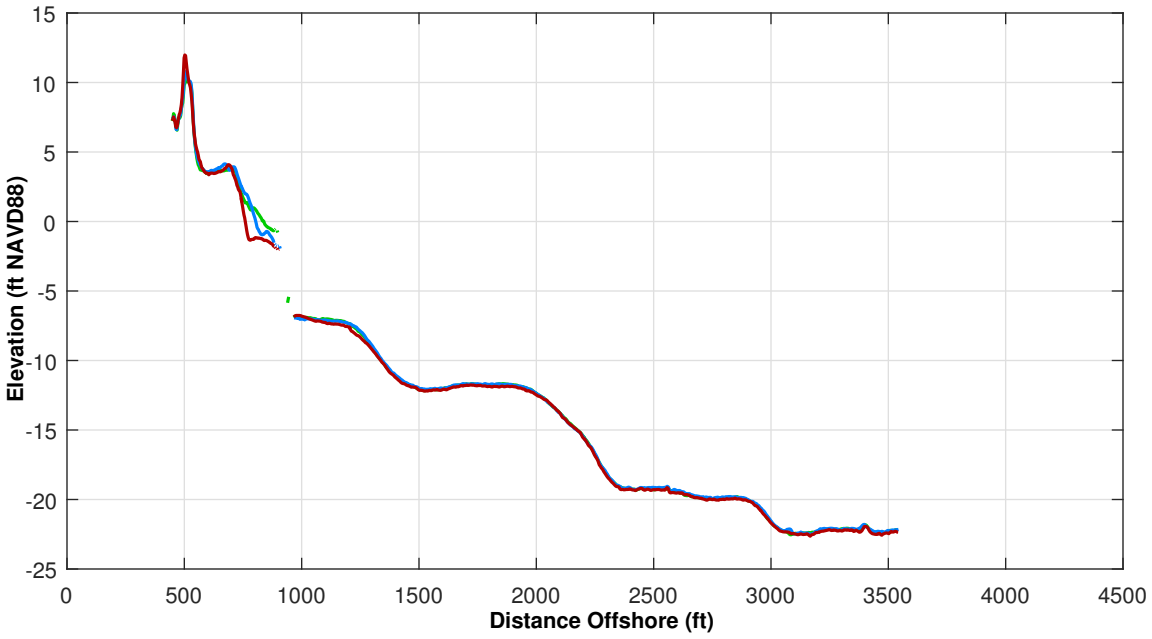
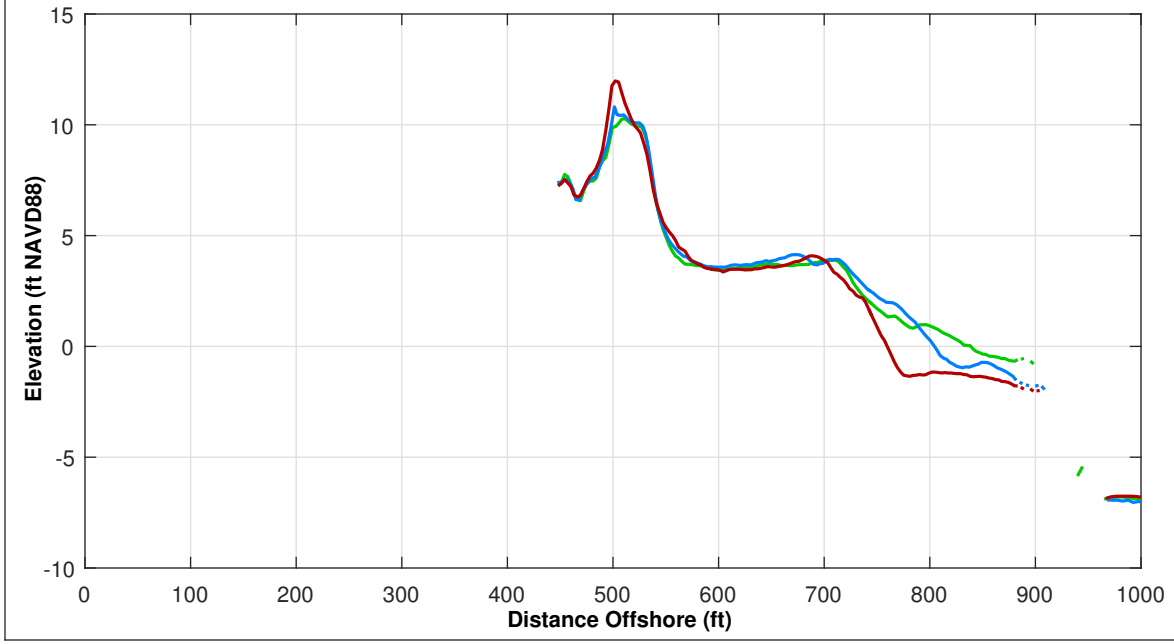
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 40+00	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-31.94 ft/yr	-38.77 ft
Volume Change Above -15 ft NAVD88	-13.43 cy/ft/yr	-12.65 cy/ft
Volume Change Above 0 ft NAVD88	-1.69 cy/ft/yr	-3.47 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

1. Station From West To East At Varying Intervals.
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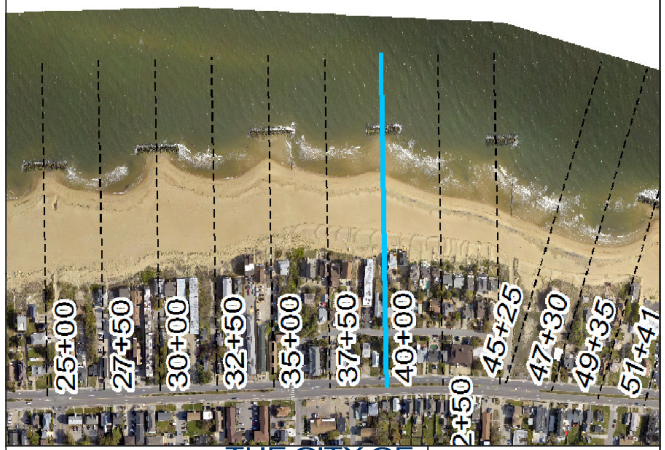
4. Survey Comparison Made to MAY 2017 and OCT 2017
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.



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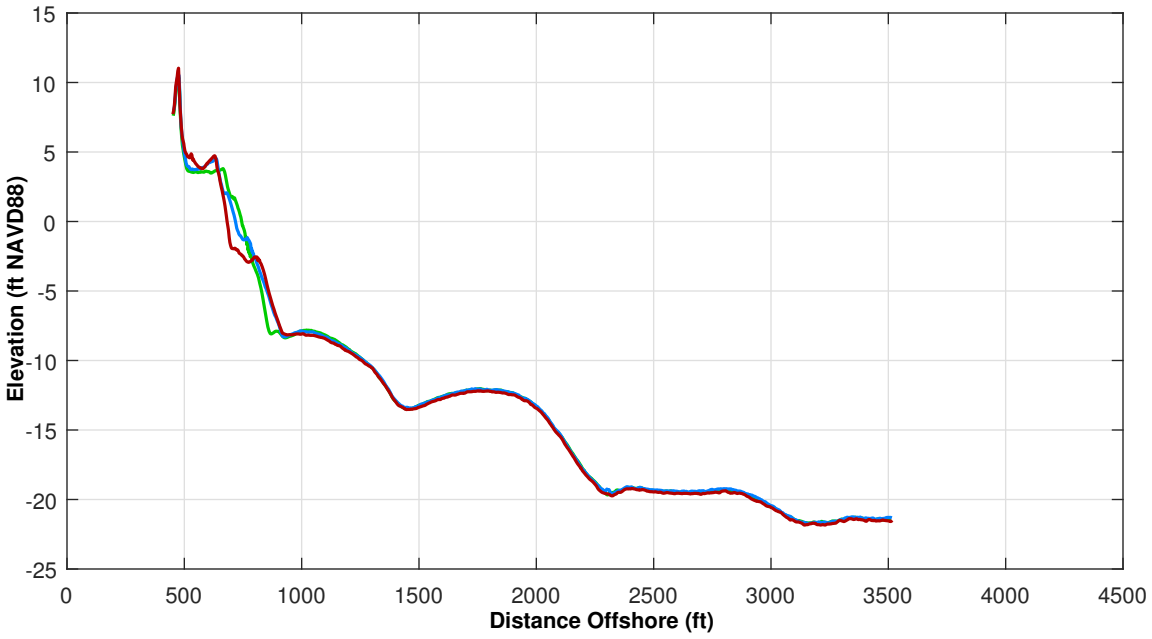
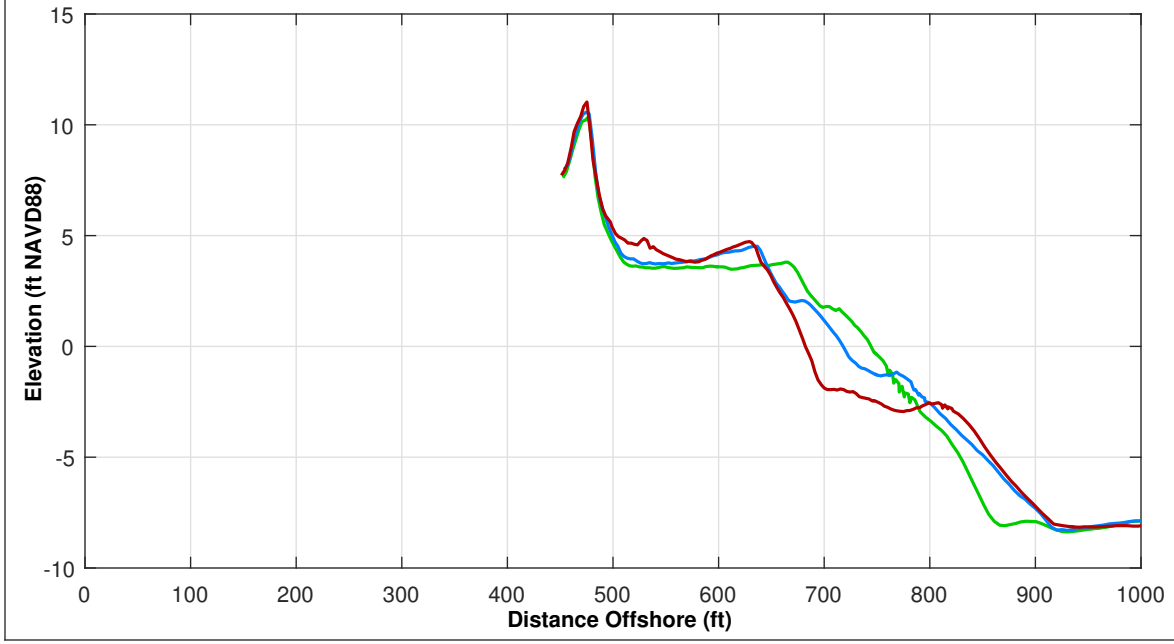
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 42+50	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-61.36 ft/yr	-28.67 ft
Volume Change Above -15 ft NAVD88	-6.37 cy/ft/yr	-10.15 cy/ft
Volume Change Above 0 ft NAVD88	-1.36 cy/ft/yr	-0.59 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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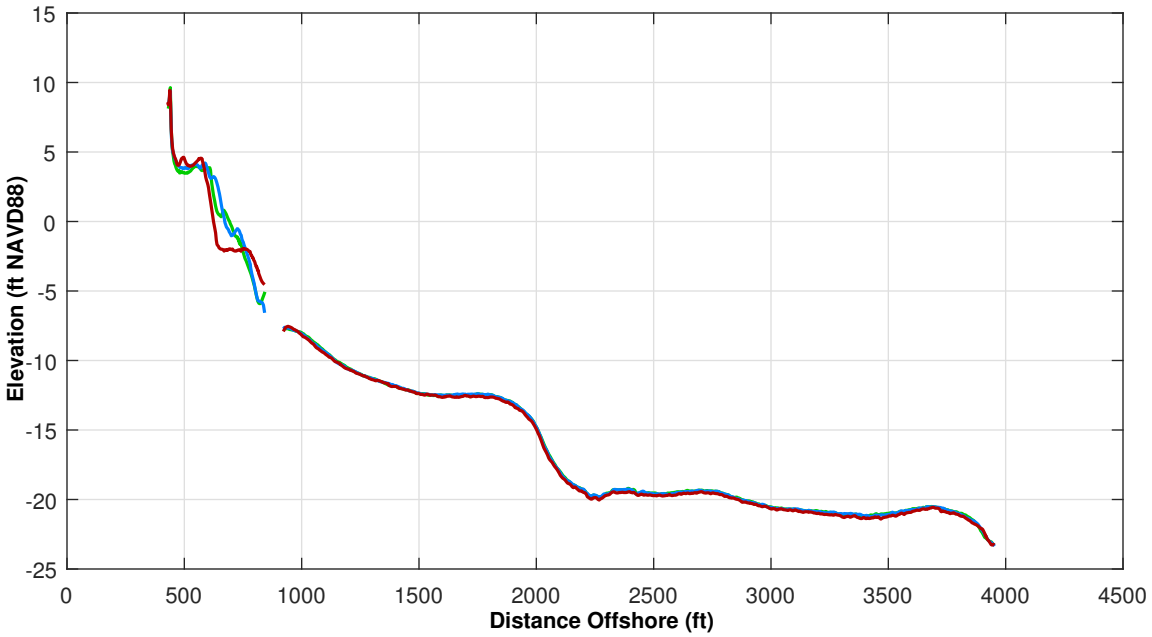

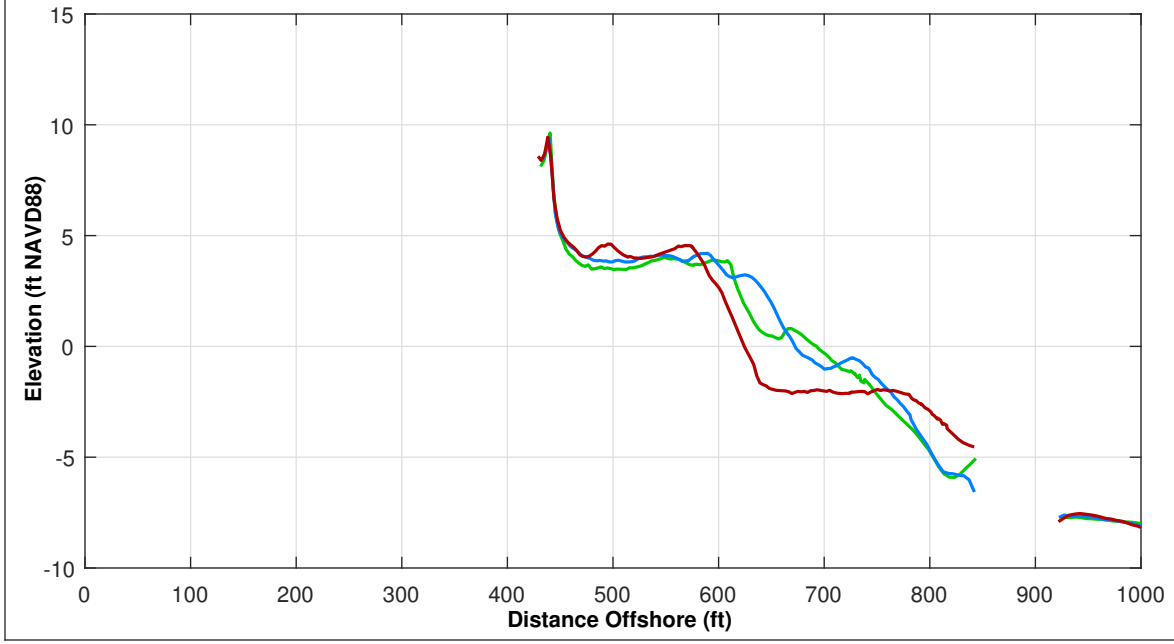

Survey Transect 45+00	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-21.87 ft/yr	-44.20 ft
Volume Change Above -15 ft NAVD88	-6.96 cy/ft/yr	-10.06 cy/ft
Volume Change Above 0 ft NAVD88	-1.12 cy/ft/yr	-4.27 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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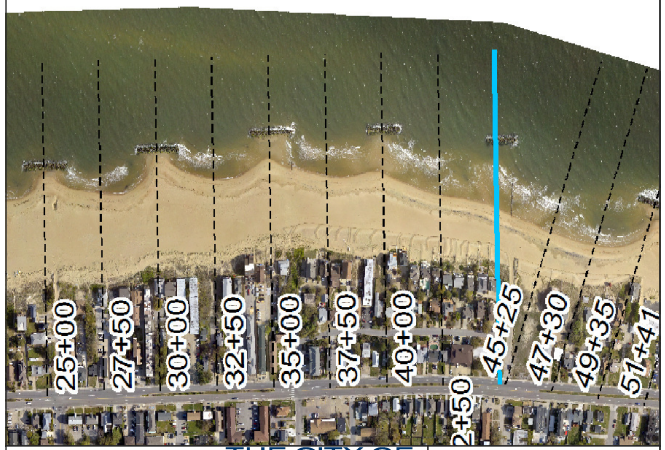

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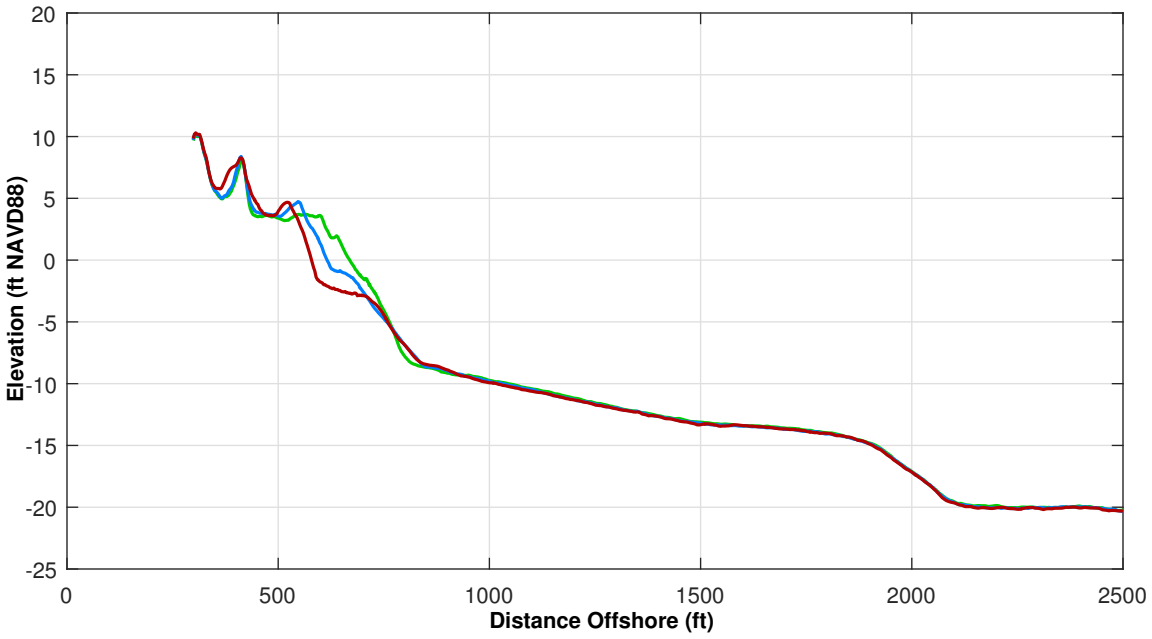

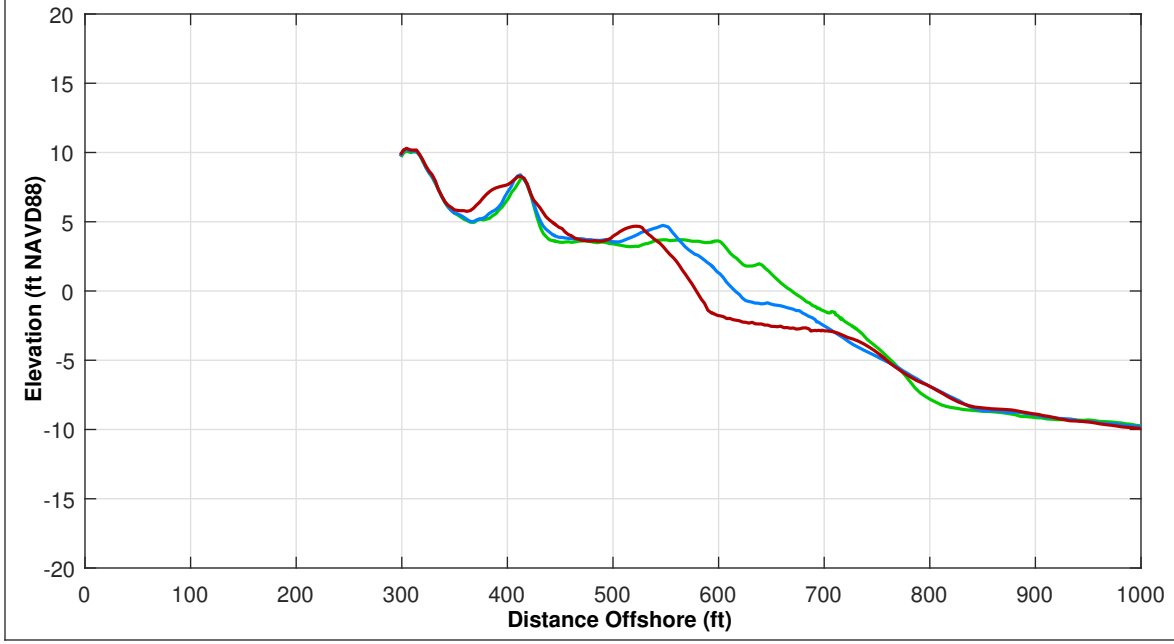

Survey Transect 45+25	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-94.17 ft/yr	-33.77 ft
Volume Change Above -15 ft NAVD88	-18.94 cy/ft/yr	-7.86 cy/ft
Volume Change Above 0 ft NAVD88	-4.16 cy/ft/yr	-1.00 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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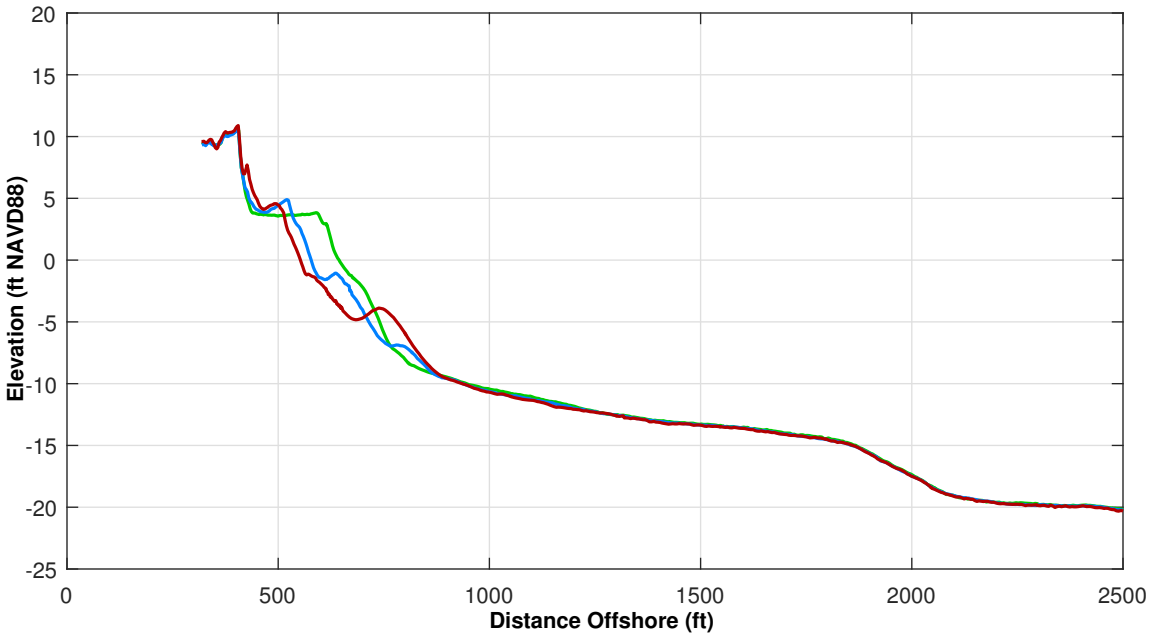

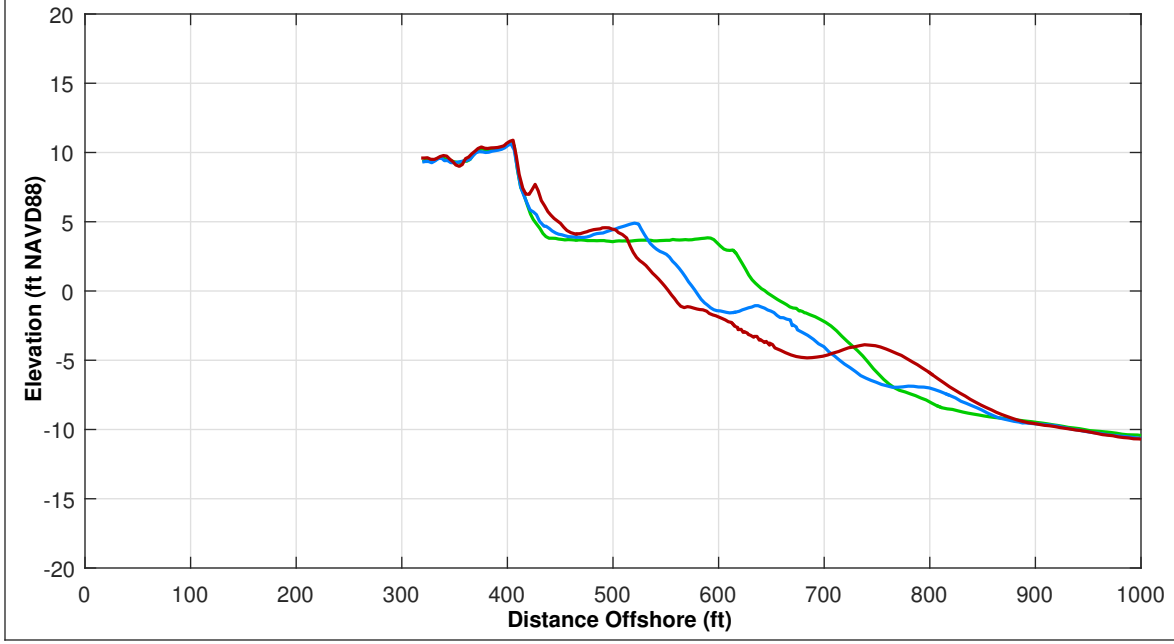

Survey Transect 47+30	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-100.65 ft/yr	-27.28 ft
Volume Change Above -15 ft NAVD88	-22.86 cy/ft/yr	-3.35 cy/ft
Volume Change Above 0 ft NAVD88	-9.27 cy/ft/yr	-1.63 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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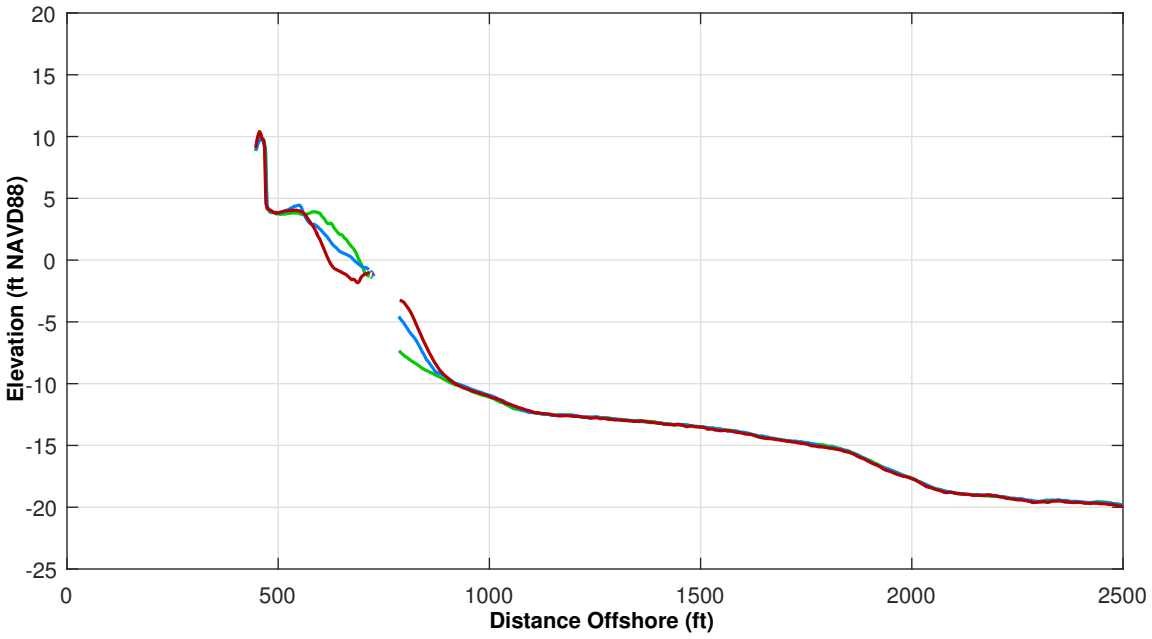

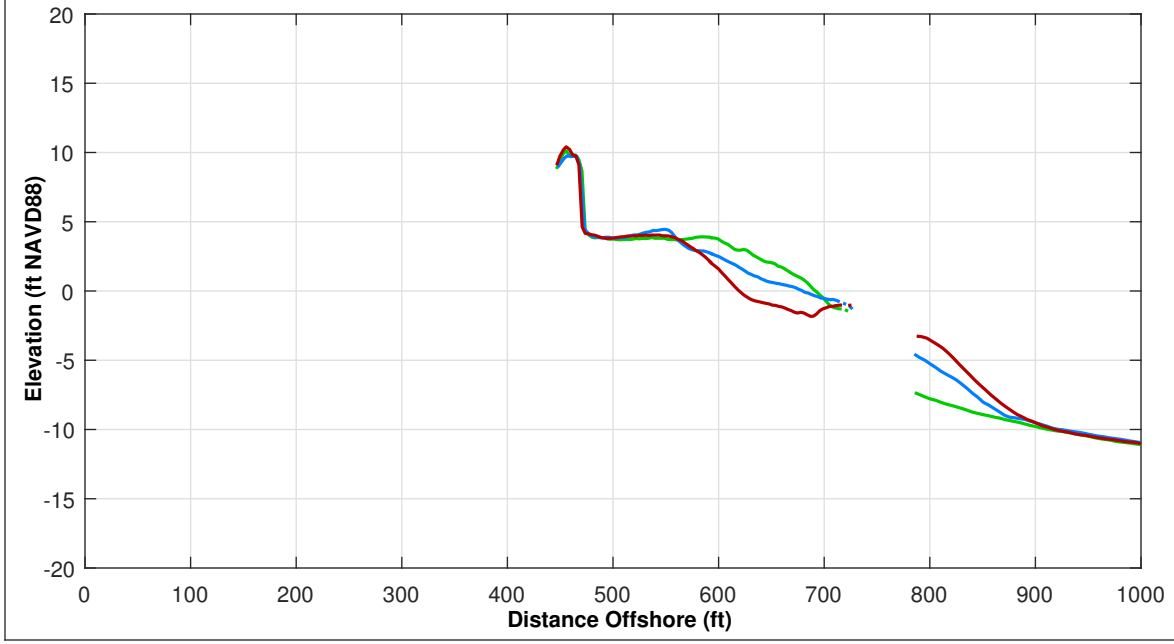

Survey Transect 49+35	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-79.12 ft/yr	-30.76 ft
Volume Change Above -15 ft NAVD88	-1.90 cy/ft/yr	-3.79 cy/ft
Volume Change Above 0 ft NAVD88	-8.88 cy/ft/yr	-3.25 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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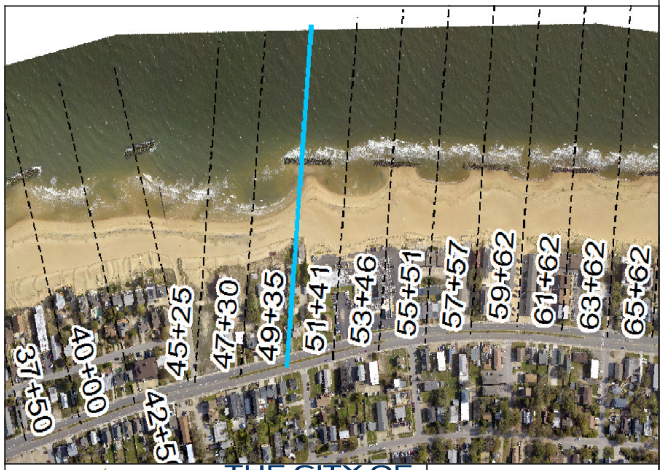

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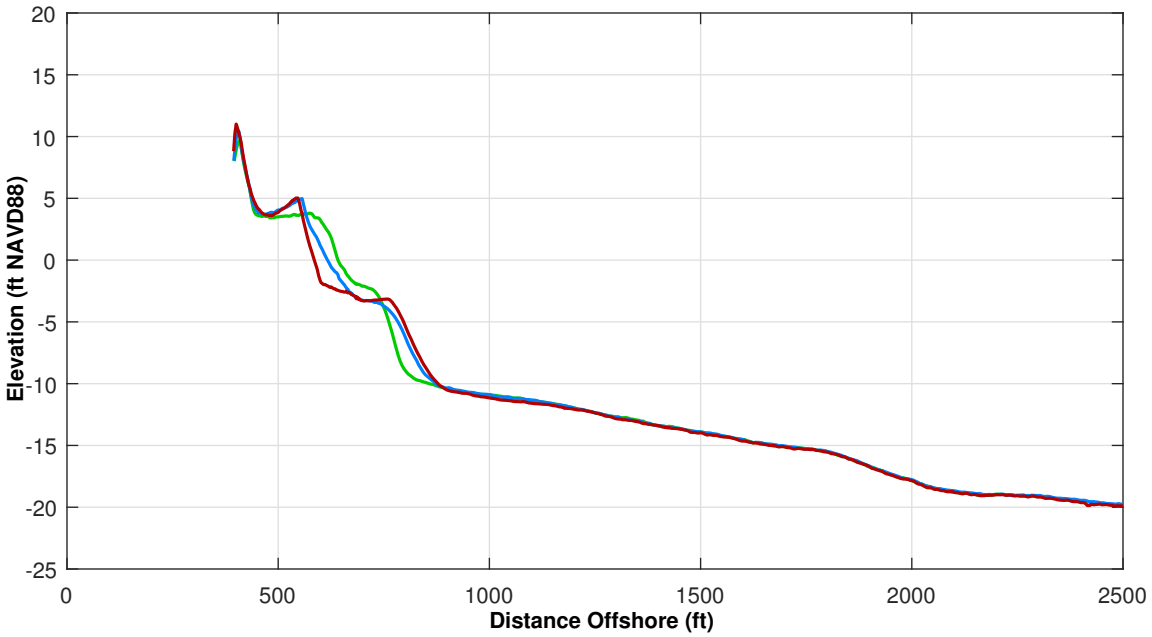
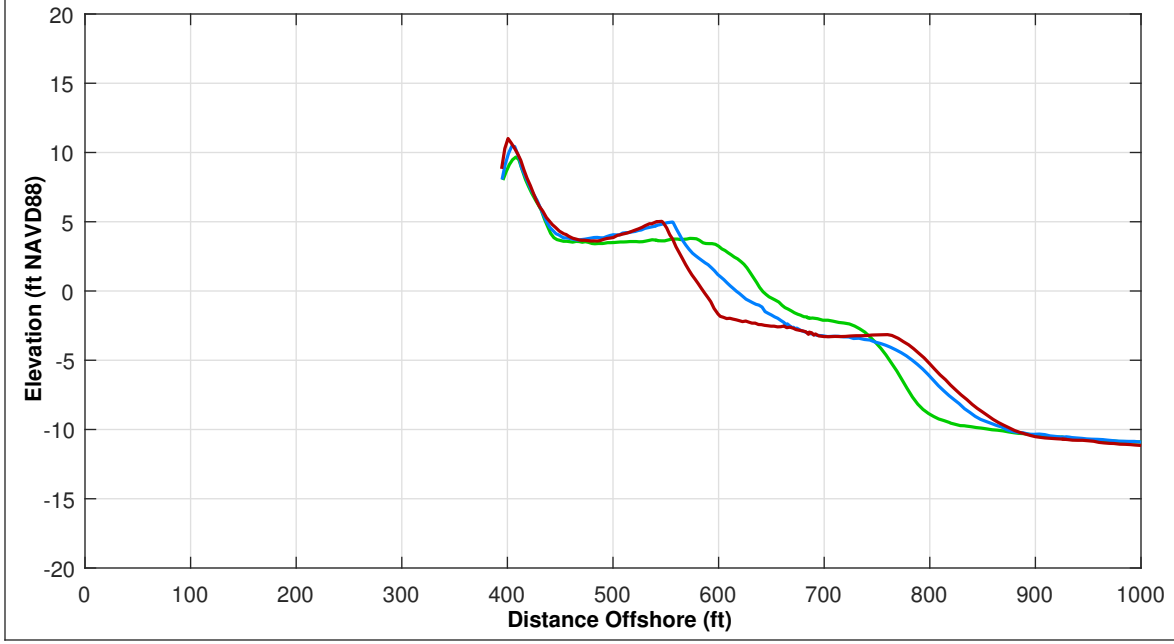




Survey Transect 51+41	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-64.14 ft/yr	-26.06 ft
Volume Change Above -15 ft NAVD88	-5.18 cy/ft/yr	-5.89 cy/ft
Volume Change Above 0 ft NAVD88	-3.78 cy/ft/yr	-2.46 cy/ft

LEGEND:

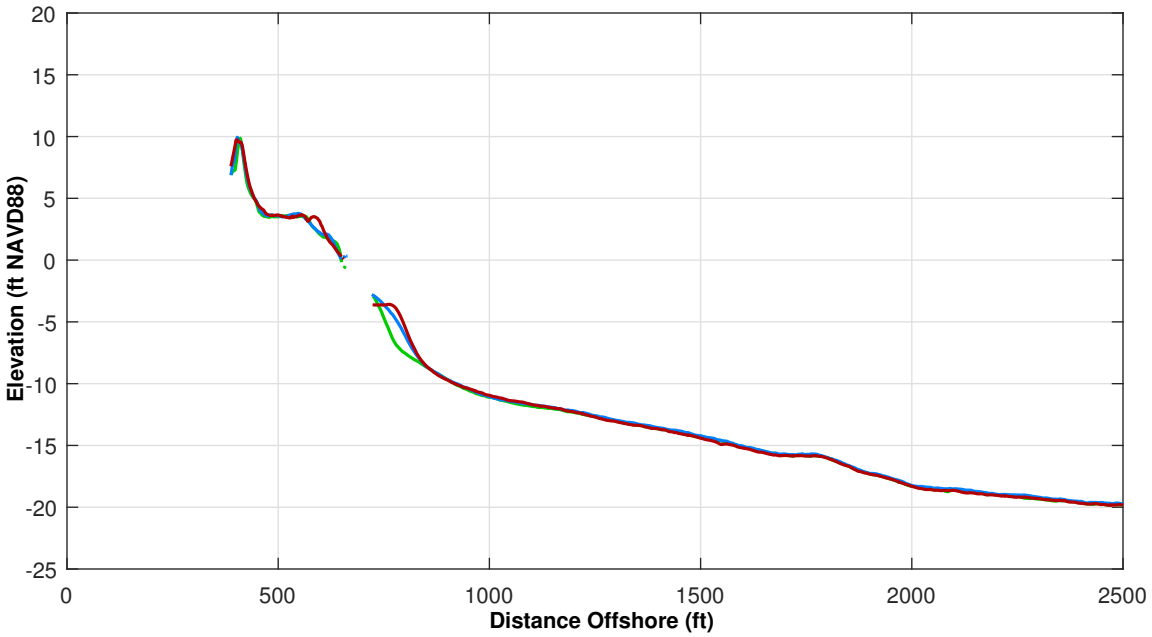
APR 2018
OCT 2017
MAY 2017

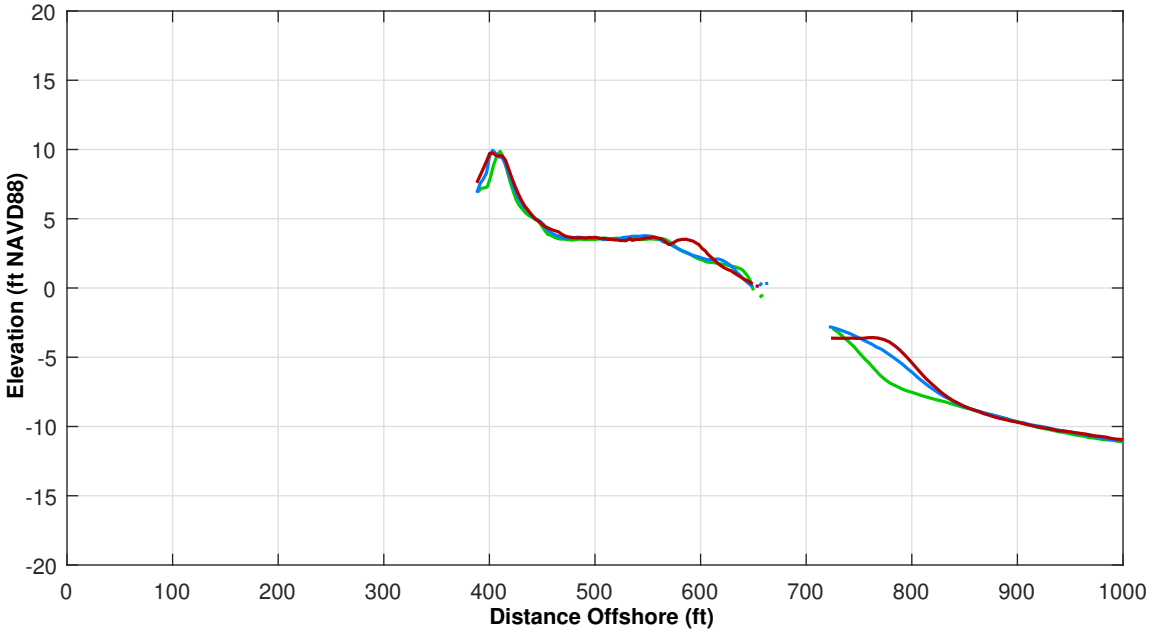
Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2017 and OCT 2017
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.

THE CITY OF NORFOLK
PUBLIC WORKS

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 53+46	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-10.67 ft/yr	-2.49 ft
Volume Change Above -15 ft NAVD88	10.30 cy/ft/yr	0.51 cy/ft
Volume Change Above 0 ft NAVD88	2.82 cy/ft/yr	1.11 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
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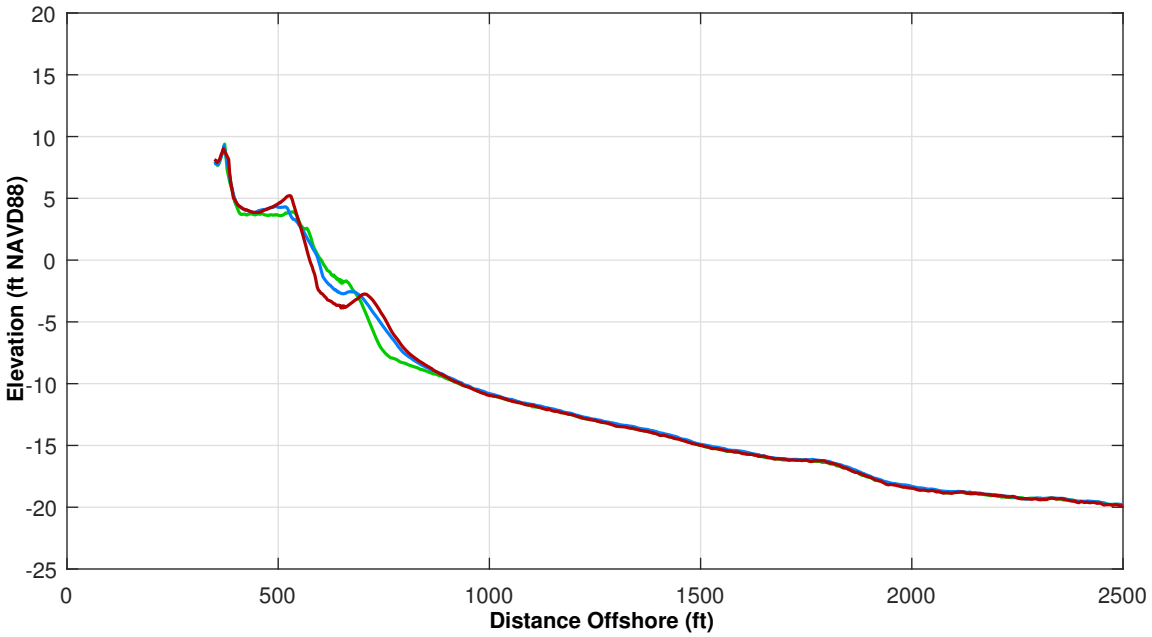
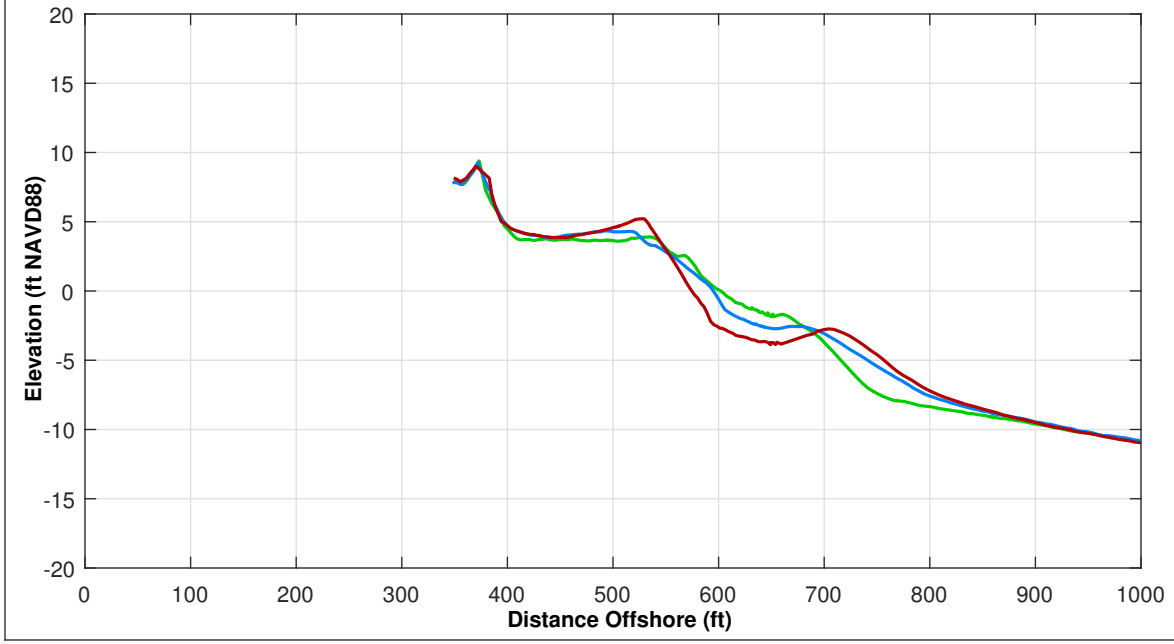
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.

THE CITY OF NORFOLK
PUBLIC WORKS

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 55+51	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-20.96 ft/yr	-14.67 ft
Volume Change Above -15 ft NAVD88	4.22 cy/ft/yr	-4.04 cy/ft
Volume Change Above 0 ft NAVD88	2.04 cy/ft/yr	0.57 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
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4. Survey Comparison Made to MAY 2017 and OCT 2017
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.

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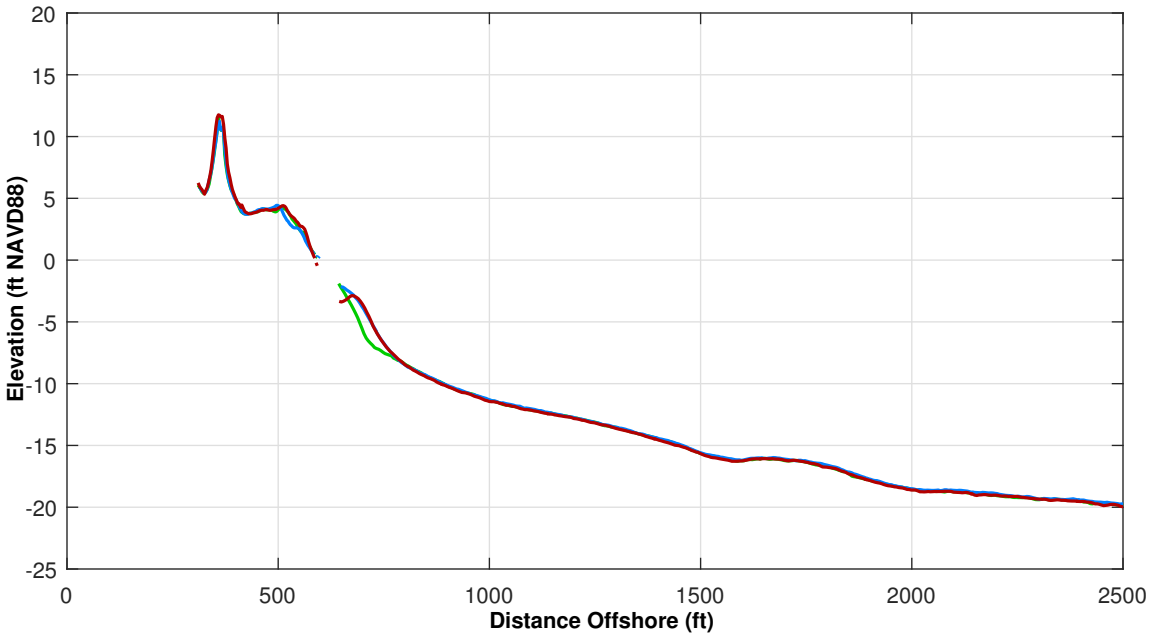

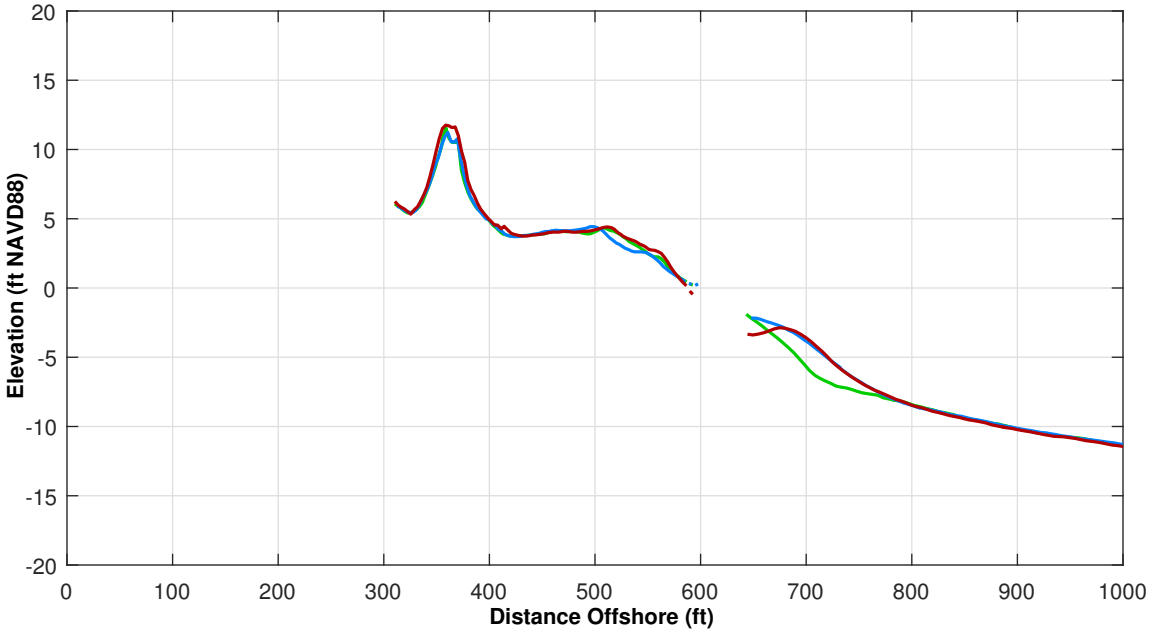

Survey Transect 57+57	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	0.47 ft/yr	2.01 ft
Volume Change Above -15 ft NAVD88	6.42 cy/ft/yr	0.10 cy/ft
Volume Change Above 0 ft NAVD88	2.73 cy/ft/yr	2.81 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
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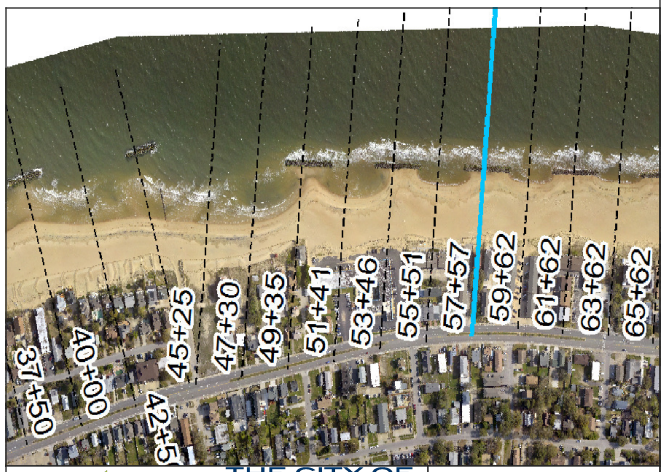
4. Survey Comparison Made to MAY 2017 and OCT 2017
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.



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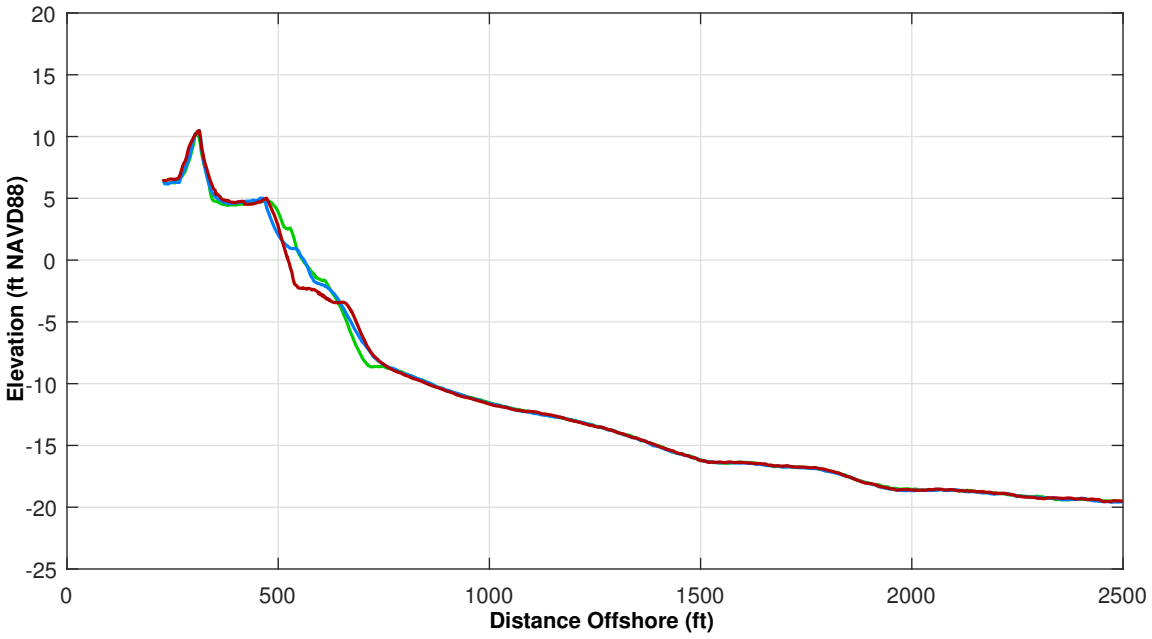

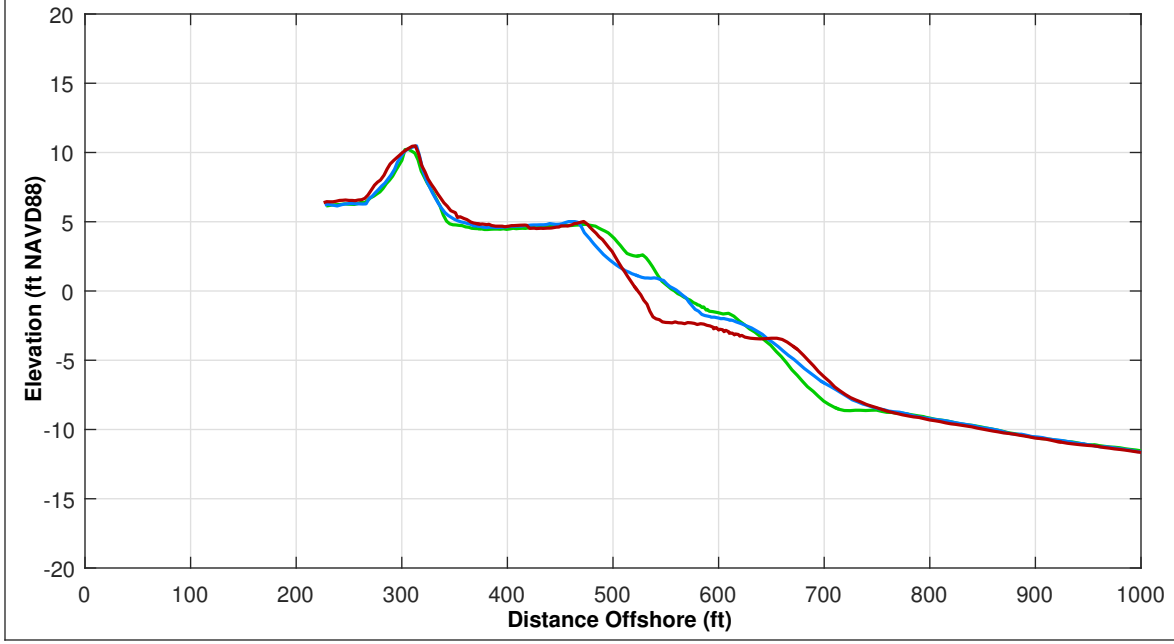

Survey Transect 59+62	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-33.25 ft/yr	-13.29 ft
Volume Change Above -15 ft NAVD88	-2.68 cy/ft/yr	-2.72 cy/ft
Volume Change Above 0 ft NAVD88	-0.63 cy/ft/yr	1.46 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
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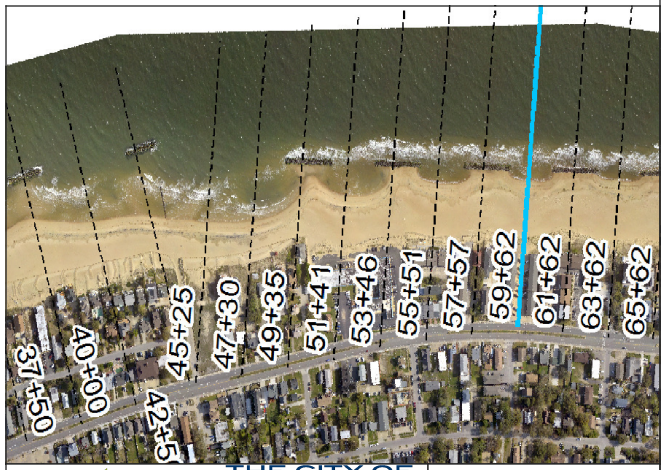
4. Survey Comparison Made to MAY 2017 and OCT 2017
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.



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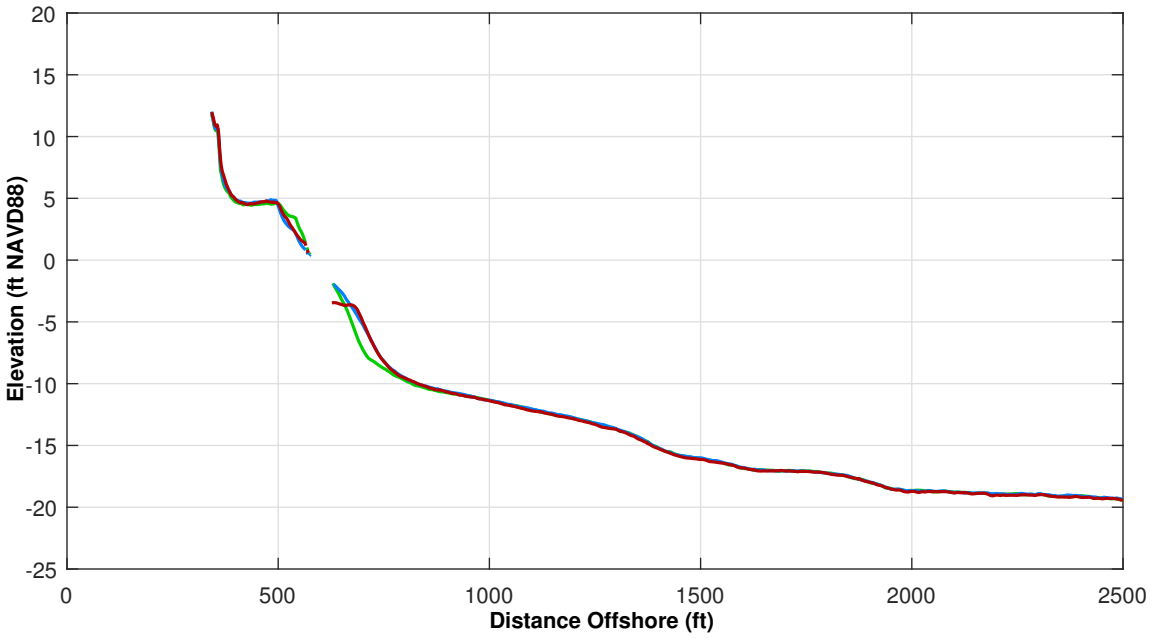

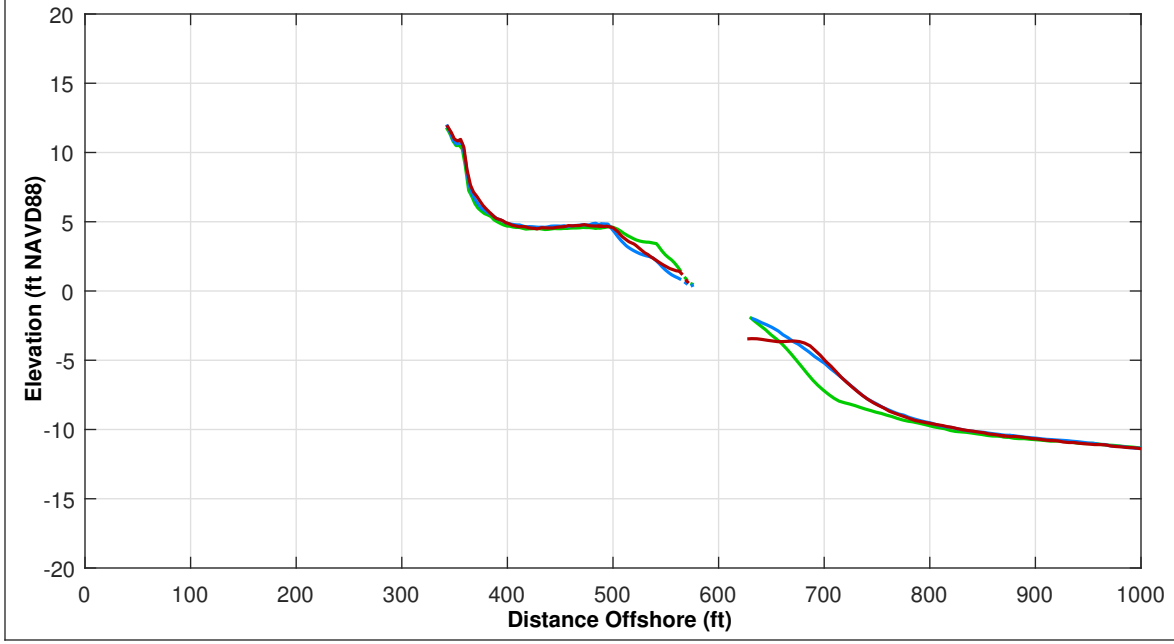

Survey Transect 61+62	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-0.70 ft/yr	6.92 ft
Volume Change Above -15 ft NAVD88	4.51 cy/ft/yr	-1.87 cy/ft
Volume Change Above 0 ft NAVD88	-0.27 cy/ft/yr	0.84 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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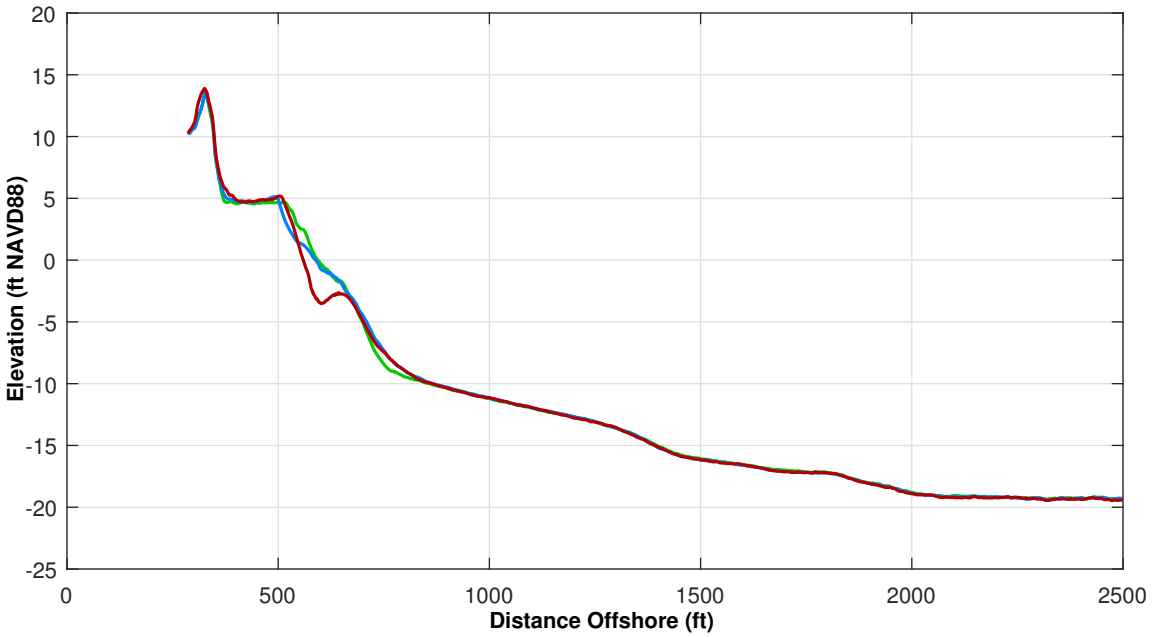

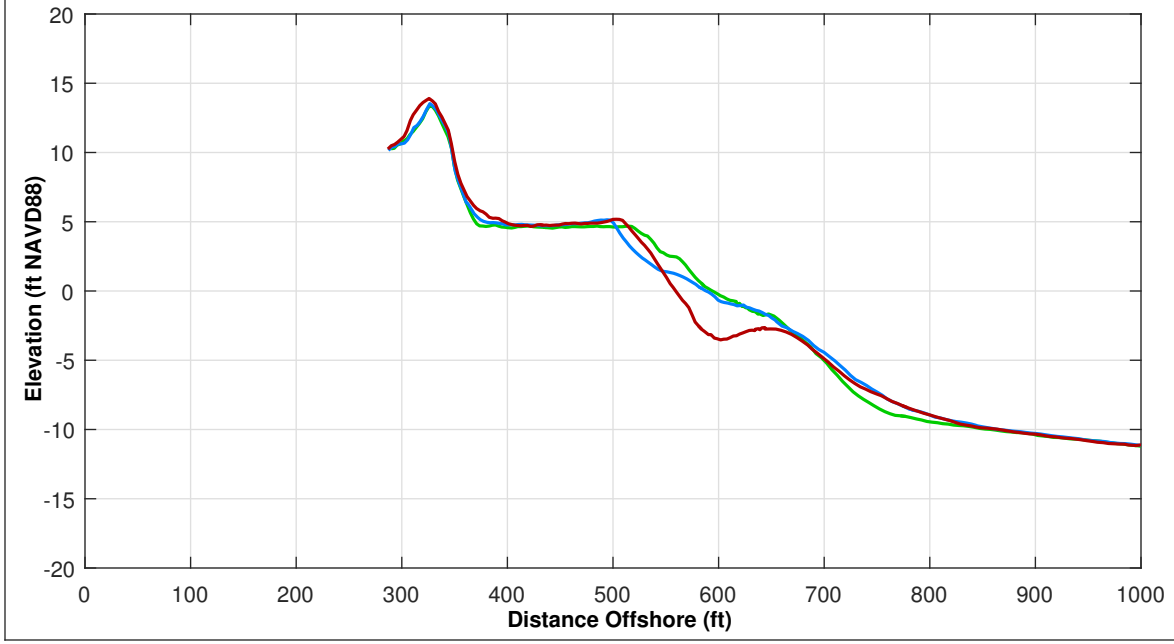

Survey Transect 63+62	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-31.03 ft/yr	-16.51 ft
Volume Change Above -15 ft NAVD88	-4.80 cy/ft/yr	-6.45 cy/ft
Volume Change Above 0 ft NAVD88	0.12 cy/ft/yr	2.22 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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3. All Survey Elevations In Feet Referenced to NAVD88.
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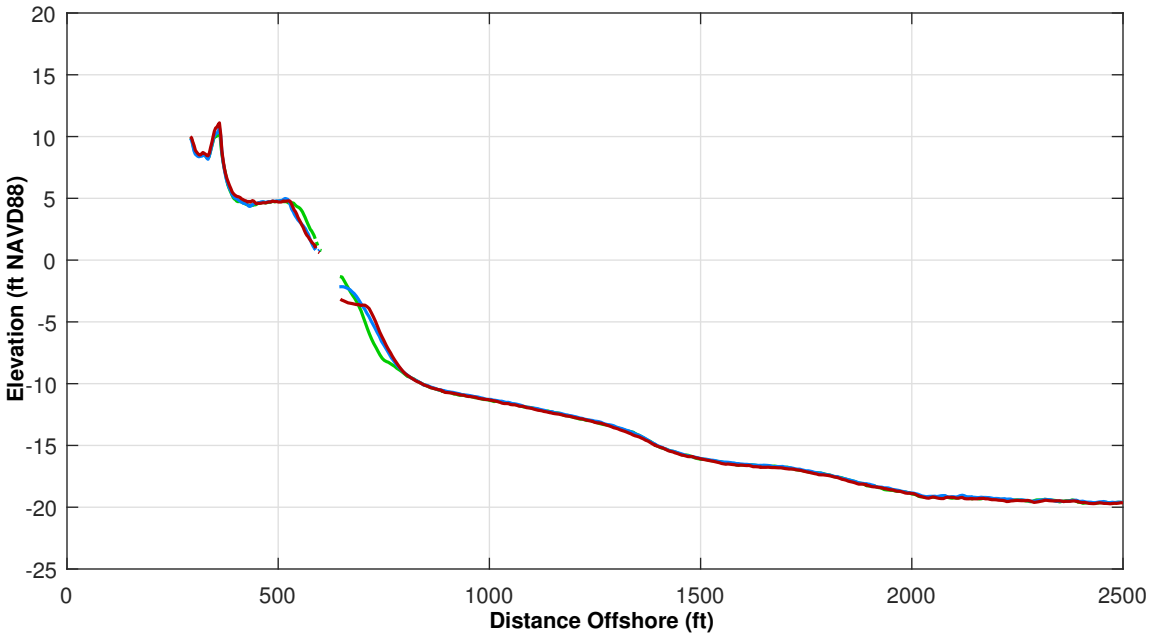

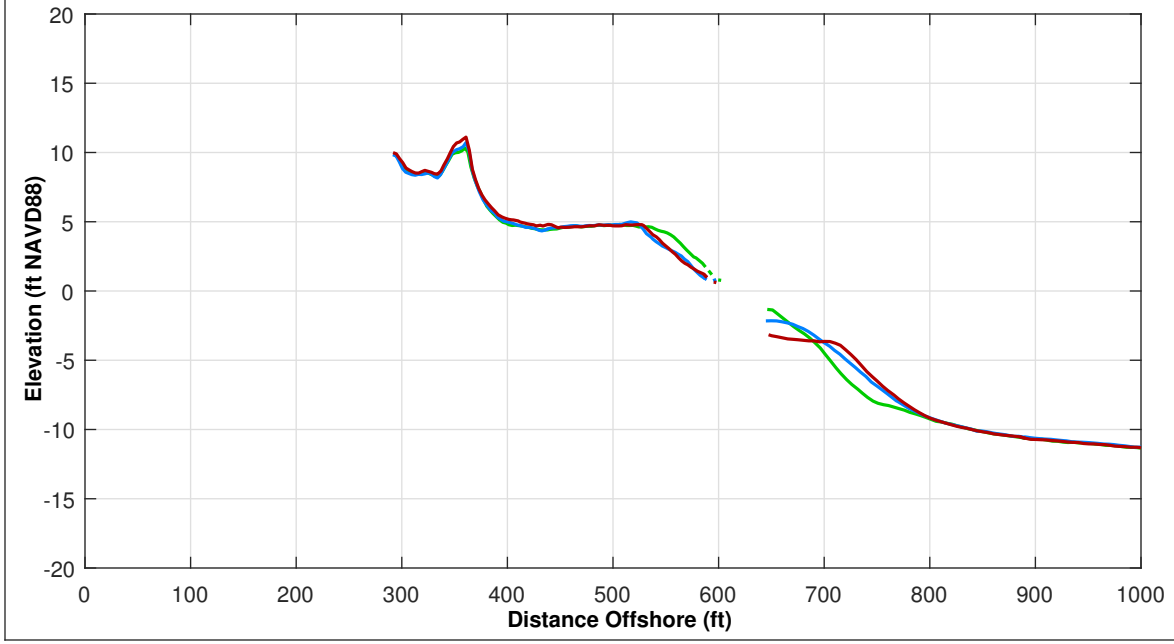

Survey Transect 65+62	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-8.46 ft/yr	3.58 ft
Volume Change Above -15 ft NAVD88	2.48 cy/ft/yr	-0.56 cy/ft
Volume Change Above 0 ft NAVD88	-0.58 cy/ft/yr	1.22 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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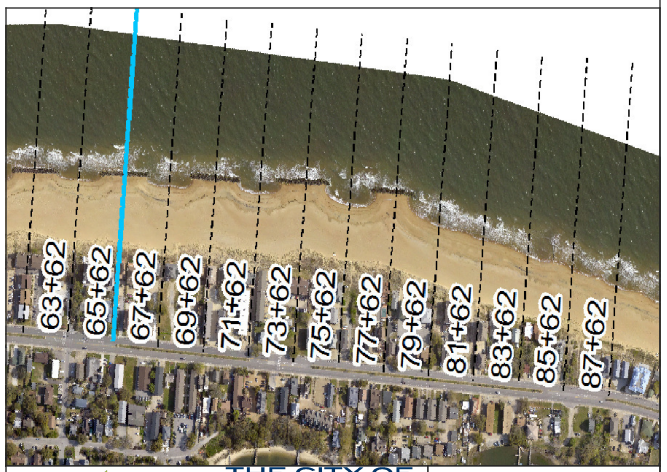

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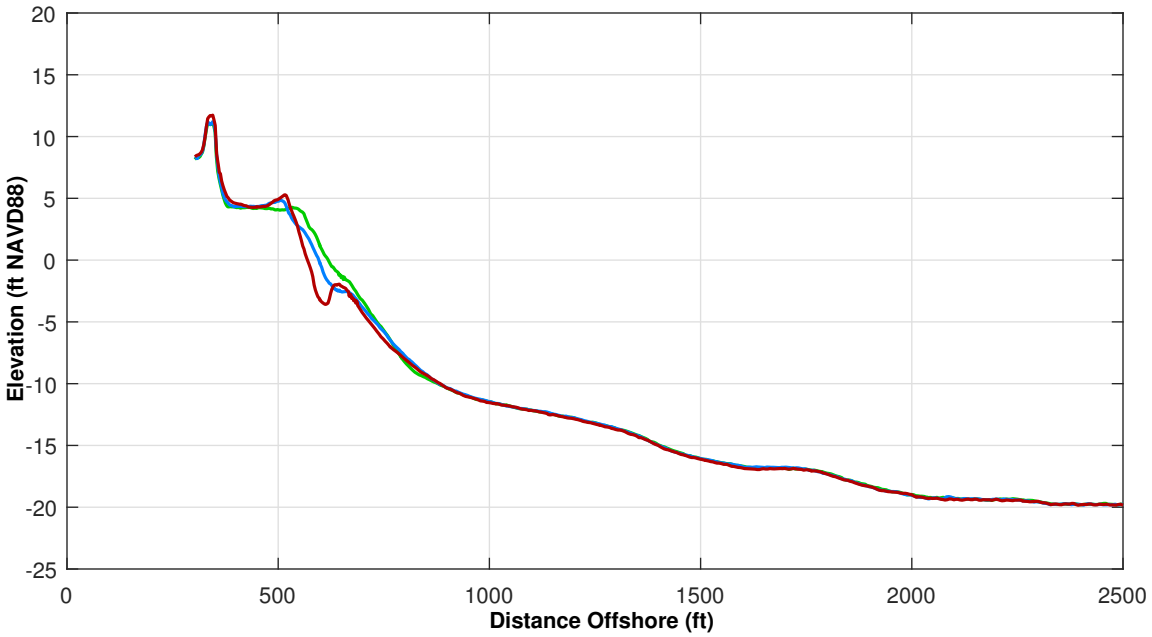
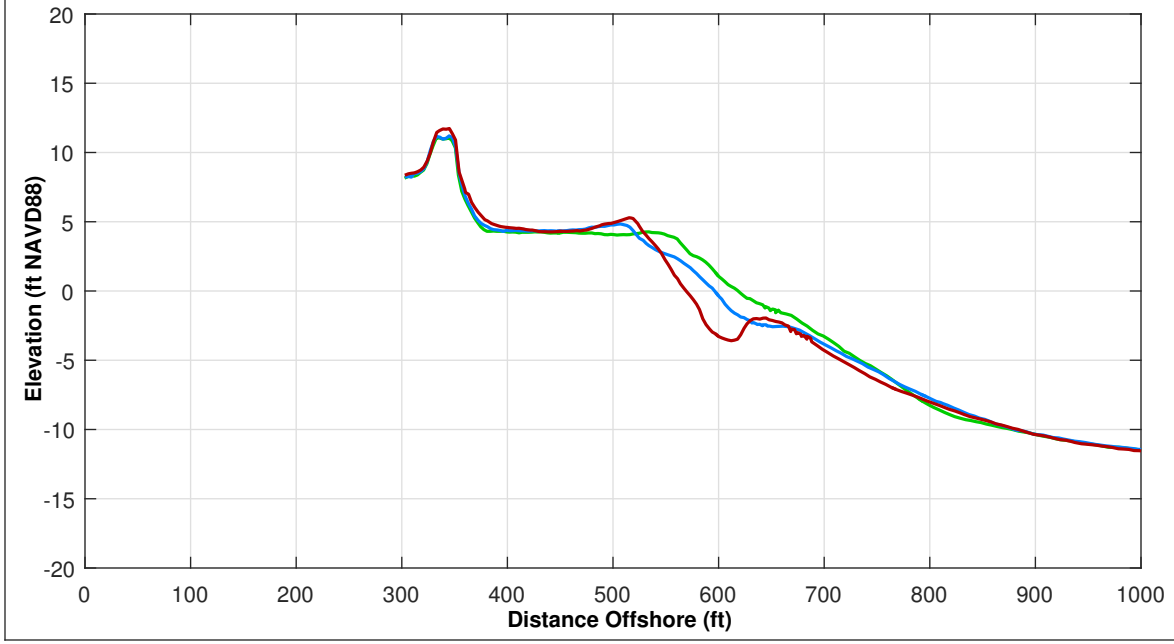
ST 65+62	Pg 30 of 106	Spring 2018





Survey Transect 67+62	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-46.90 ft/yr	-22.66 ft
Volume Change Above -15 ft NAVD88	-13.20 cy/ft/yr	-6.94 cy/ft
Volume Change Above 0 ft NAVD88	-1.96 cy/ft/yr	0.11 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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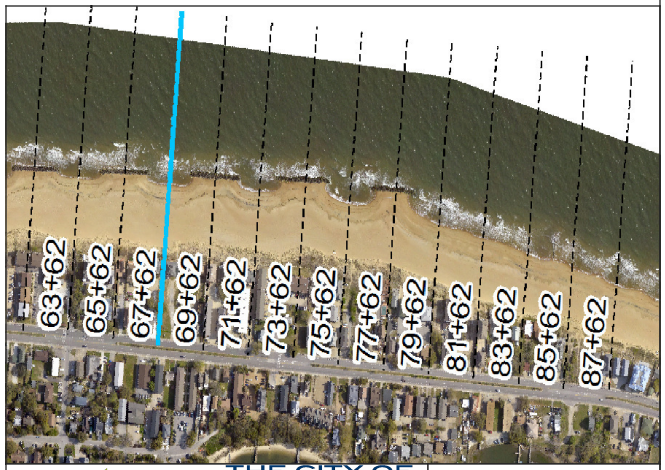

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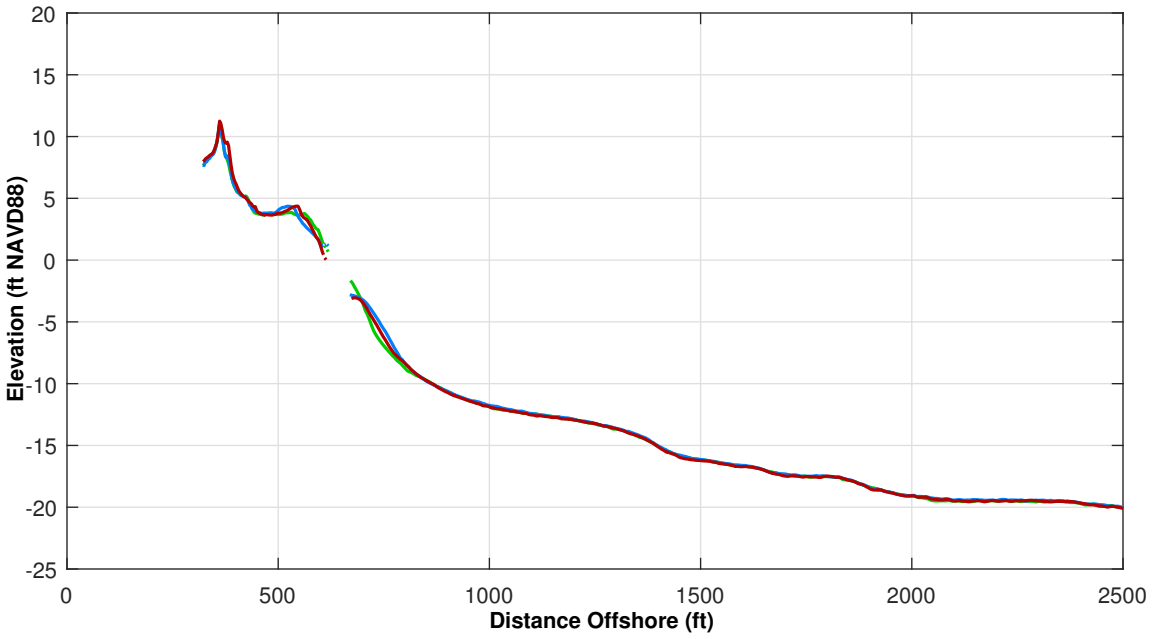
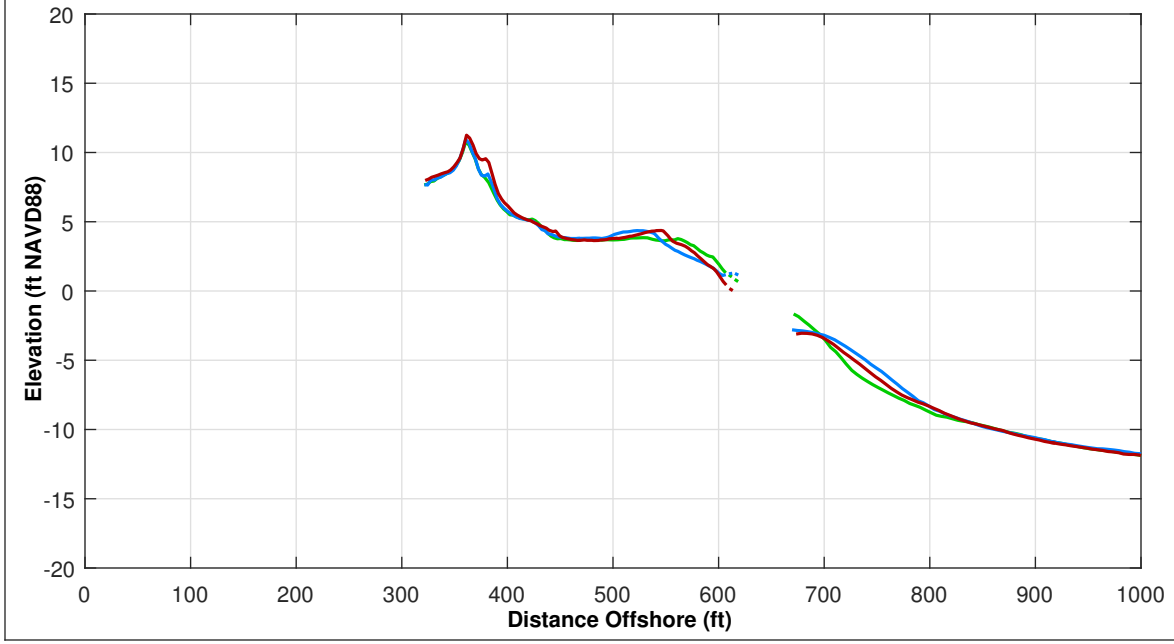
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 69+62	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-12.93 ft/yr	-20.22 ft
Volume Change Above -15 ft NAVD88	2.89 cy/ft/yr	-1.65 cy/ft
Volume Change Above 0 ft NAVD88	0.99 cy/ft/yr	0.99 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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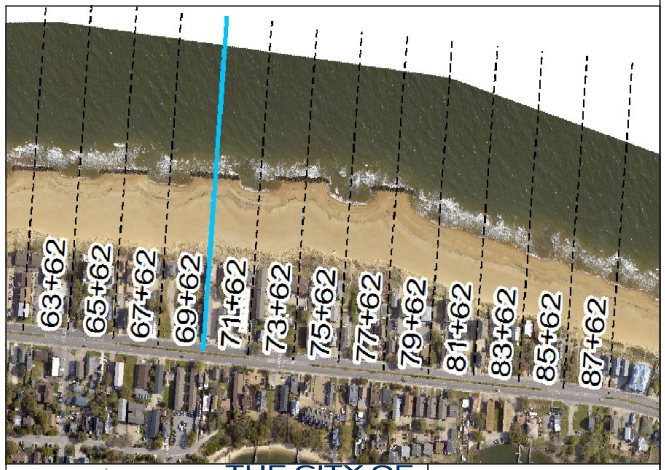

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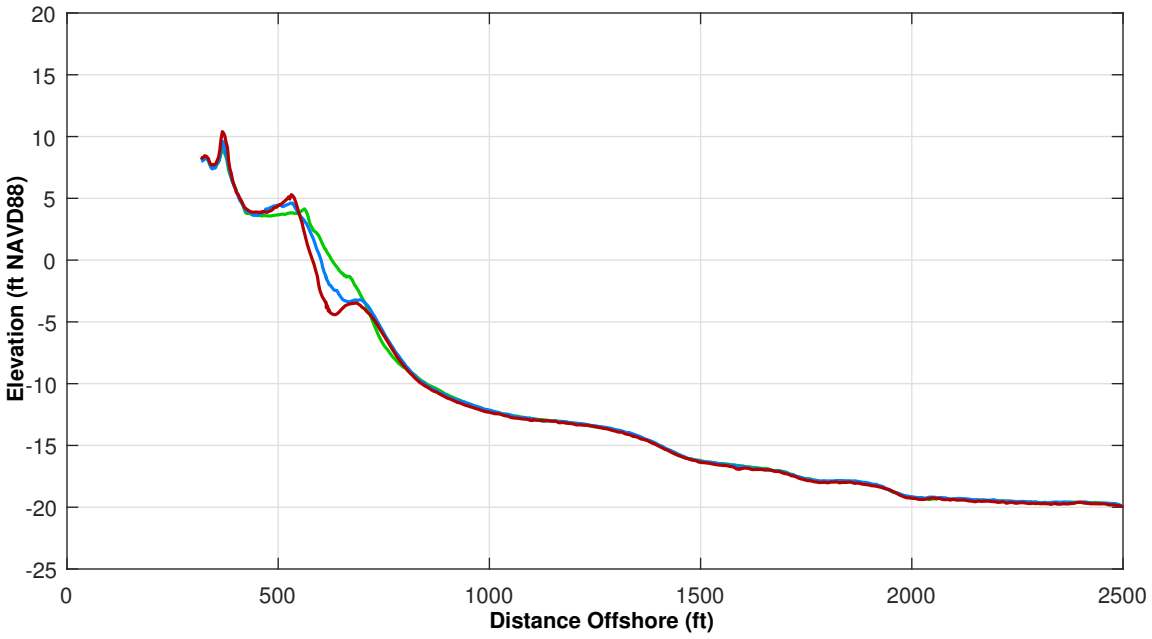
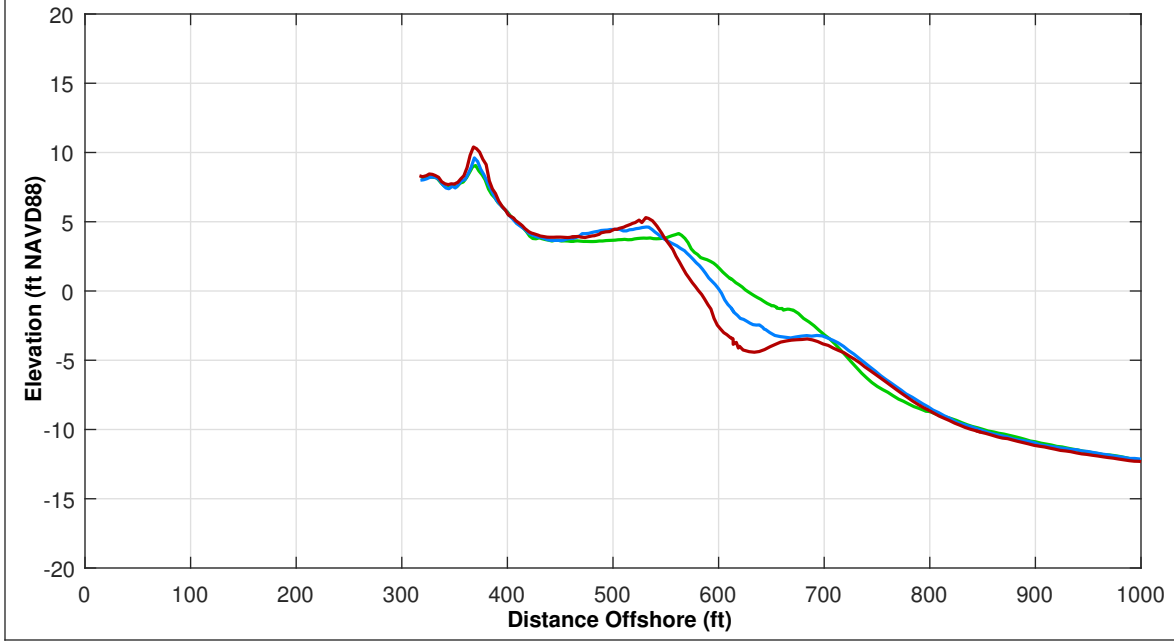
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 71+62	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-43.23 ft/yr	-18.70 ft
Volume Change Above -15 ft NAVD88	-14.10 cy/ft/yr	-9.00 cy/ft
Volume Change Above 0 ft NAVD88	-0.10 cy/ft/yr	-0.01 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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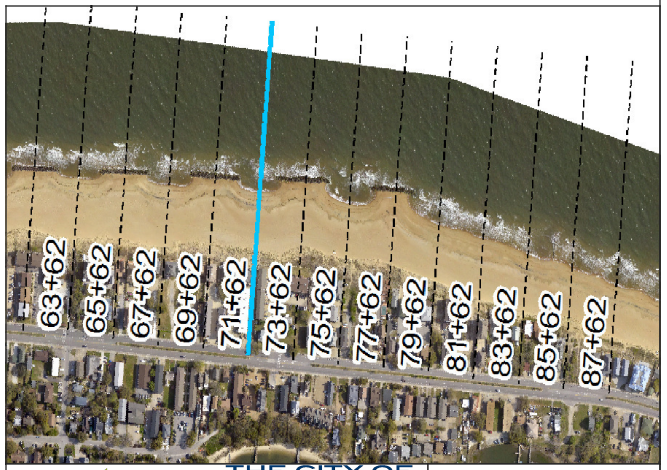

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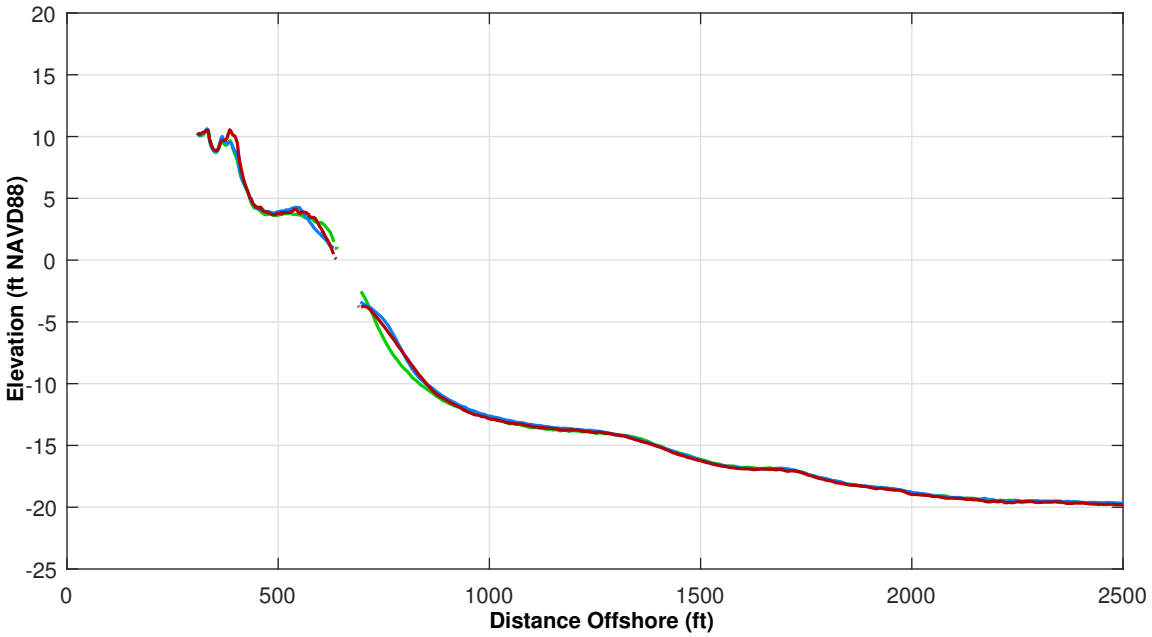

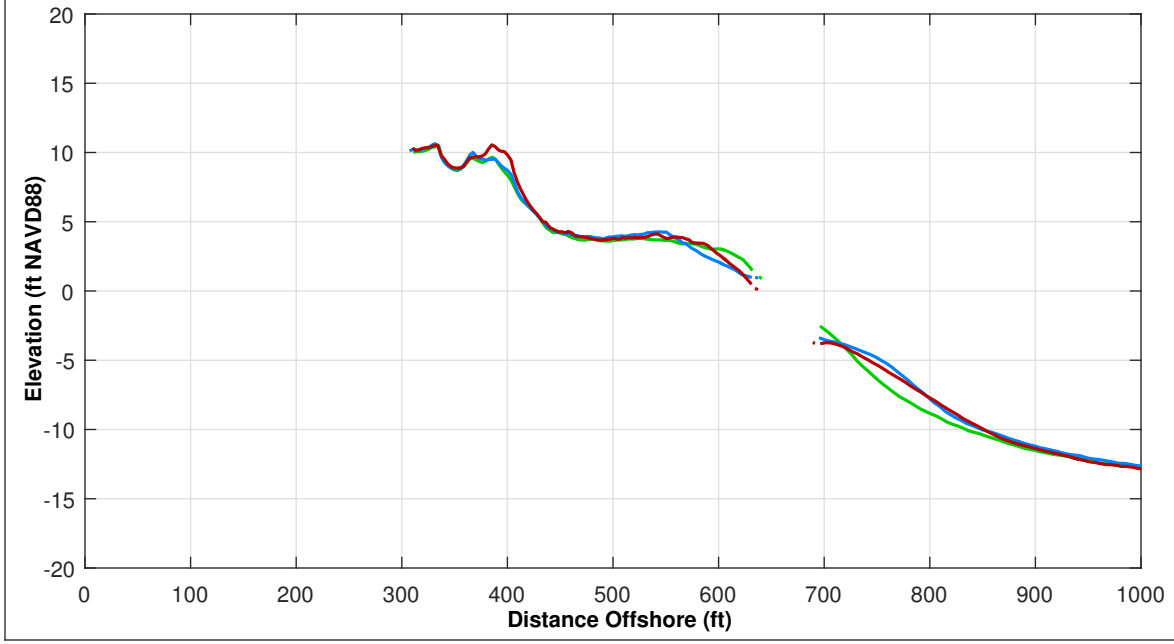

Survey Transect 73+62	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-15.56 ft/yr	-5.87 ft
Volume Change Above -15 ft NAVD88	6.94 cy/ft/yr	-1.56 cy/ft
Volume Change Above 0 ft NAVD88	1.45 cy/ft/yr	1.46 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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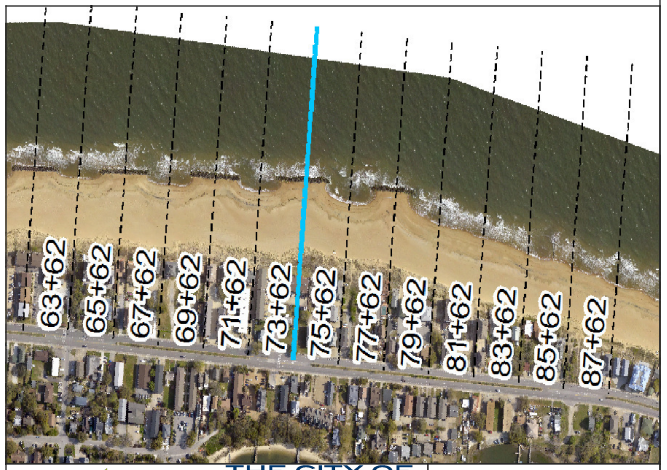
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.



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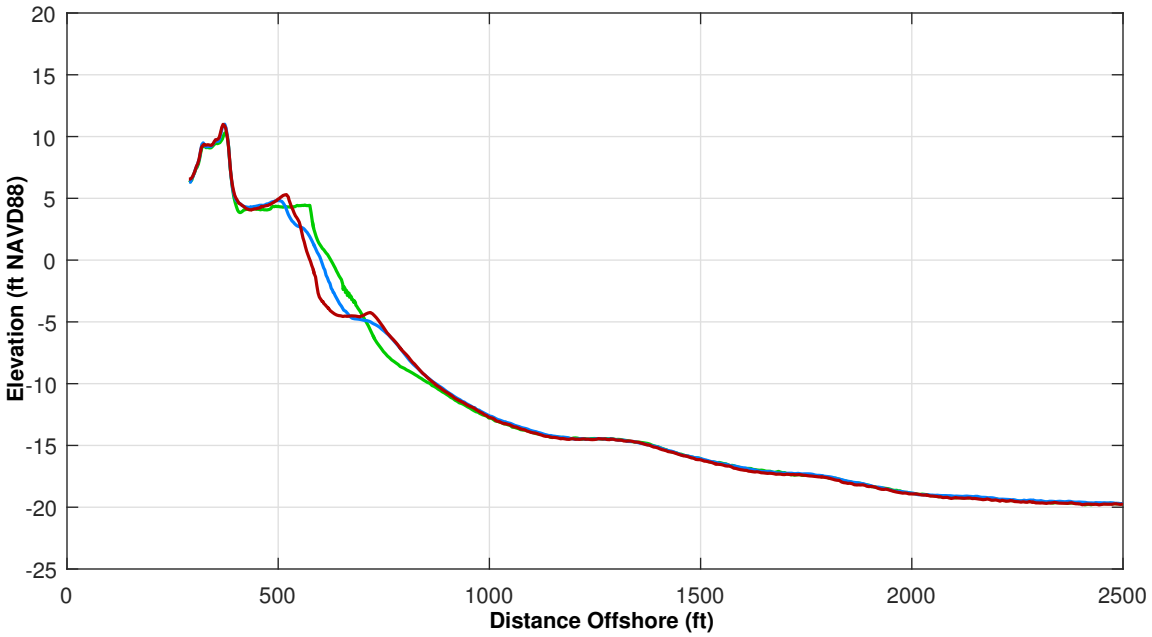

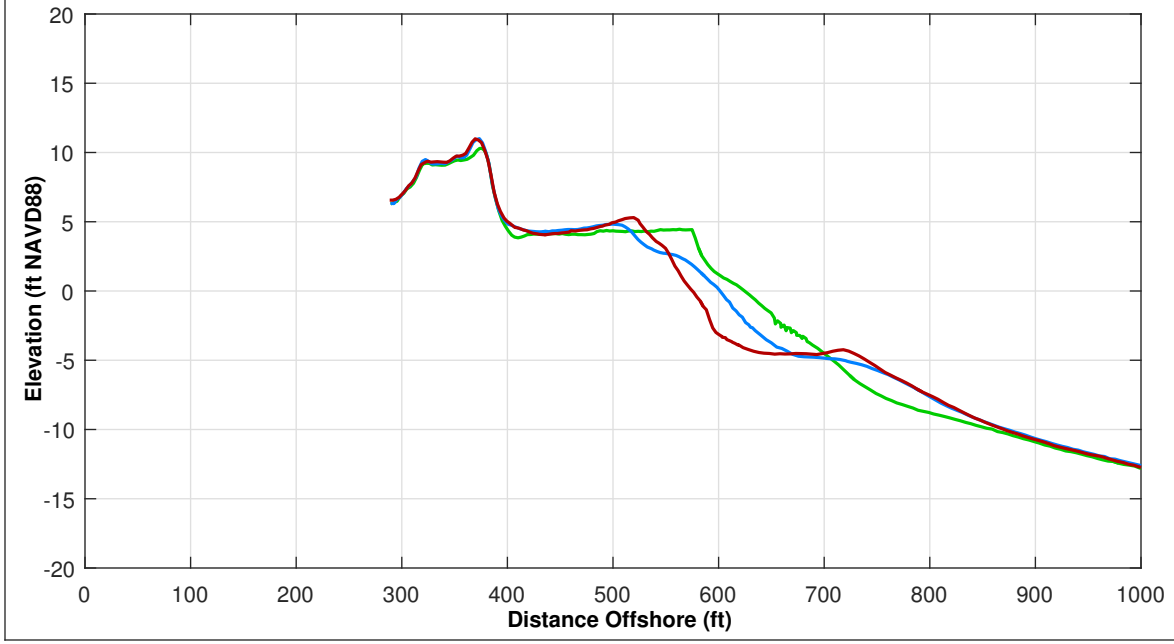

Survey Transect 75+62	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-44.03 ft/yr	-22.59 ft
Volume Change Above -15 ft NAVD88	-6.62 cy/ft/yr	-5.80 cy/ft
Volume Change Above 0 ft NAVD88	-3.51 cy/ft/yr	-0.57 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
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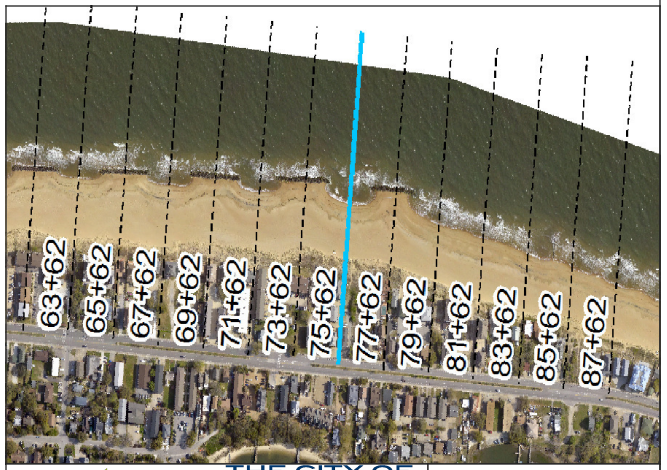
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.



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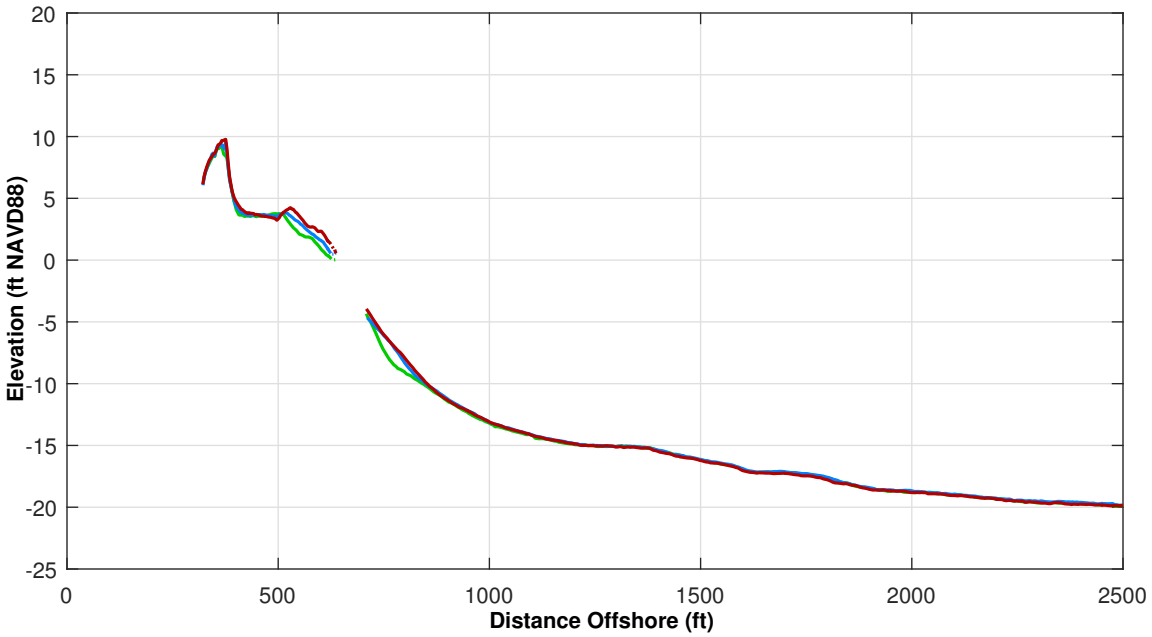

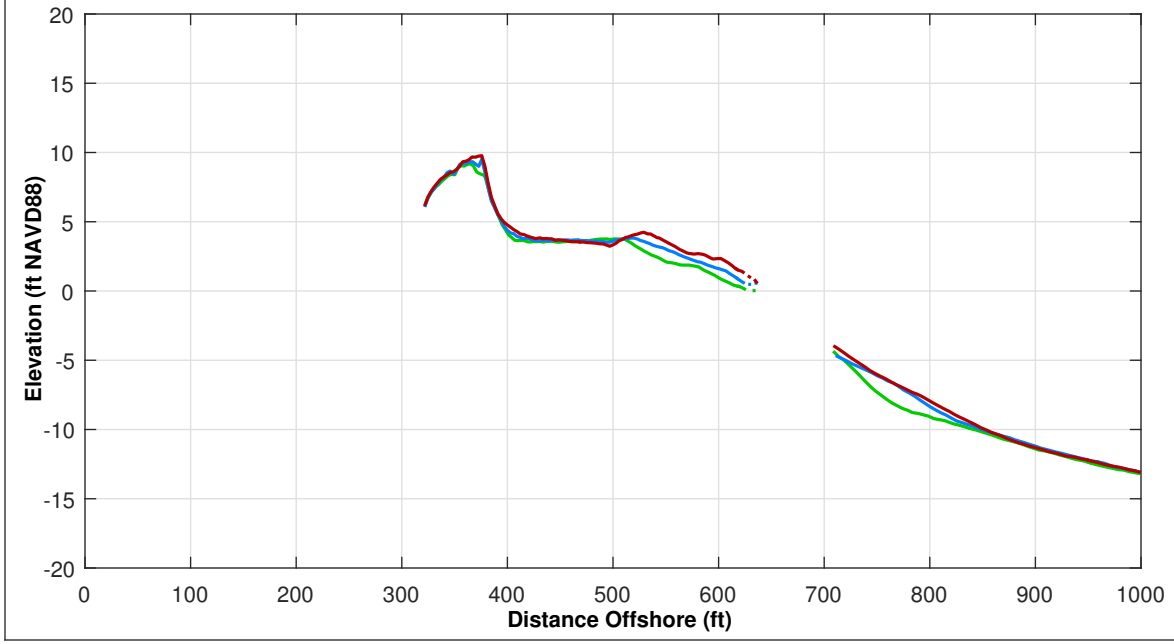

Survey Transect 77+62	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	34.64 ft/yr	13.74 ft
Volume Change Above -15 ft NAVD88	14.26 cy/ft/yr	3.76 cy/ft
Volume Change Above 0 ft NAVD88	7.51 cy/ft/yr	3.06 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

1. Station From West To East At Varying Intervals.
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3. All Survey Elevations In Feet Referenced to NAVD88.
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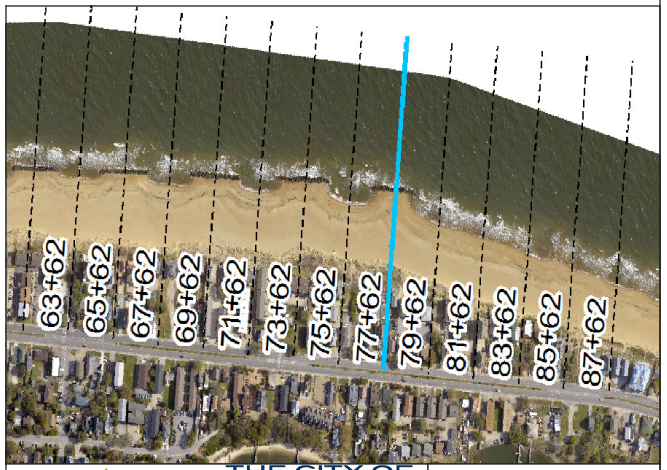

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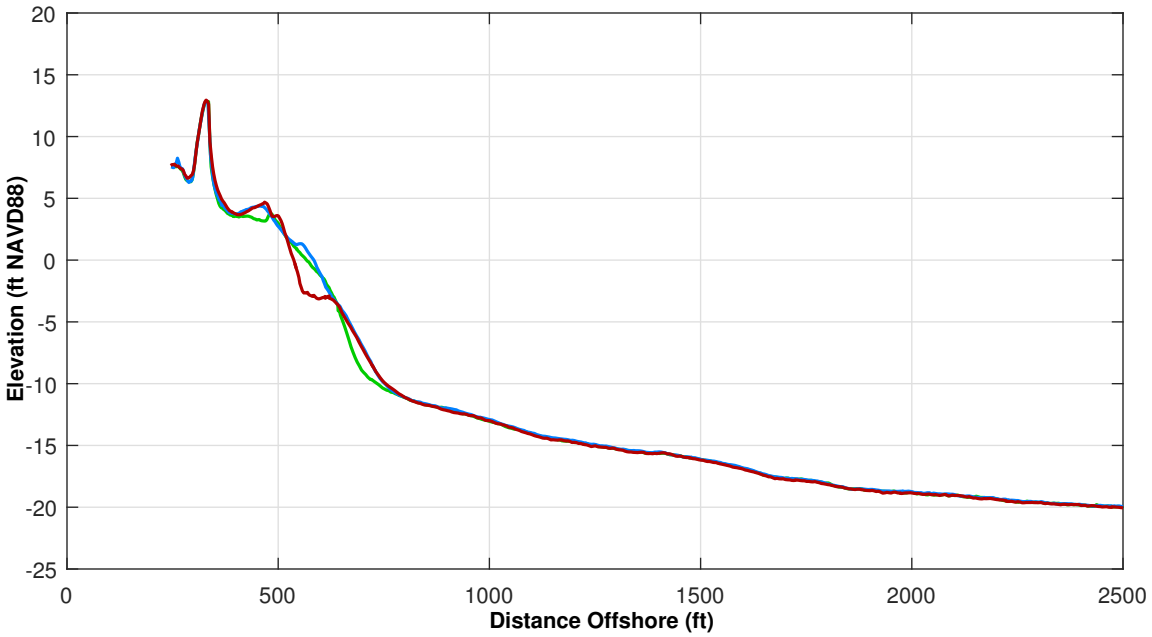
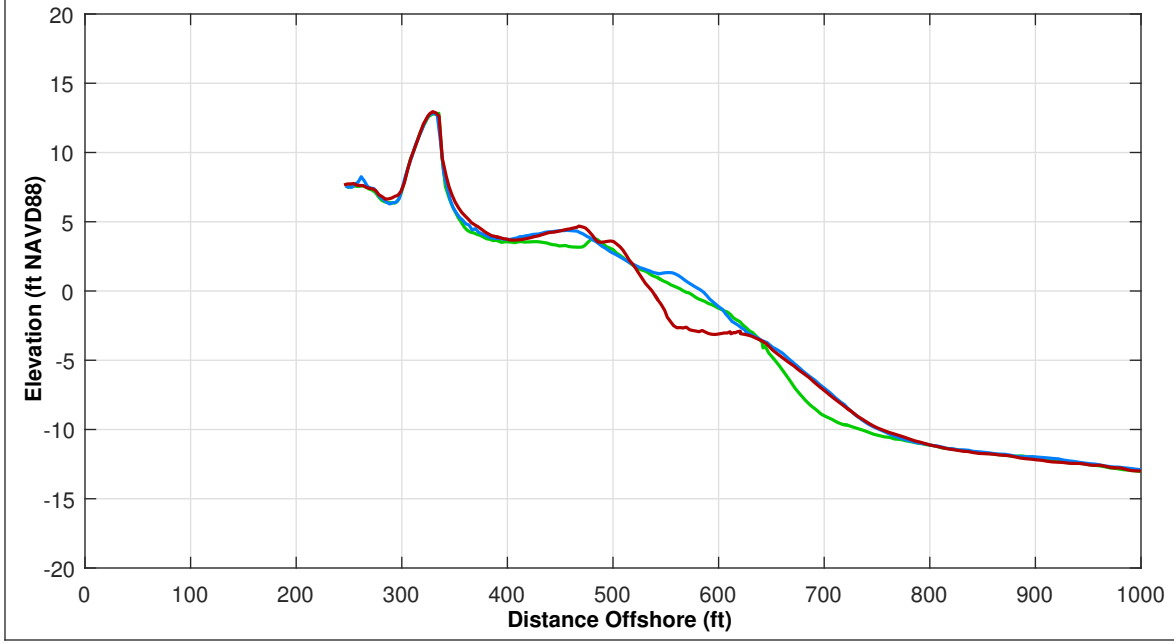
PUBLIC WORKS

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 79+62	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-16.85 ft/yr	-37.65 ft
Volume Change Above -15 ft NAVD88	2.46 cy/ft/yr	-8.61 cy/ft
Volume Change Above 0 ft NAVD88	3.73 cy/ft/yr	-0.38 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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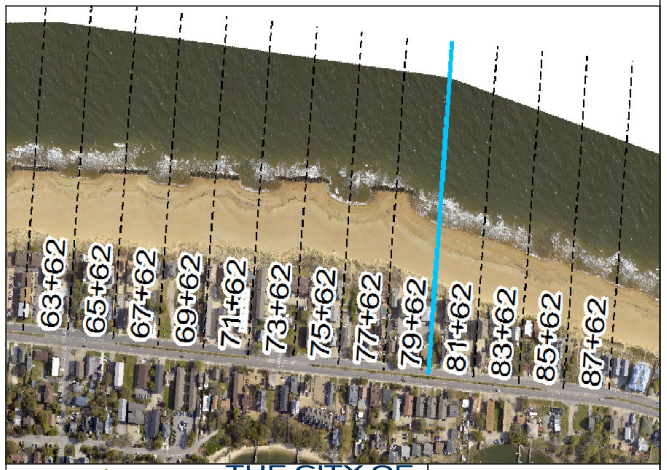

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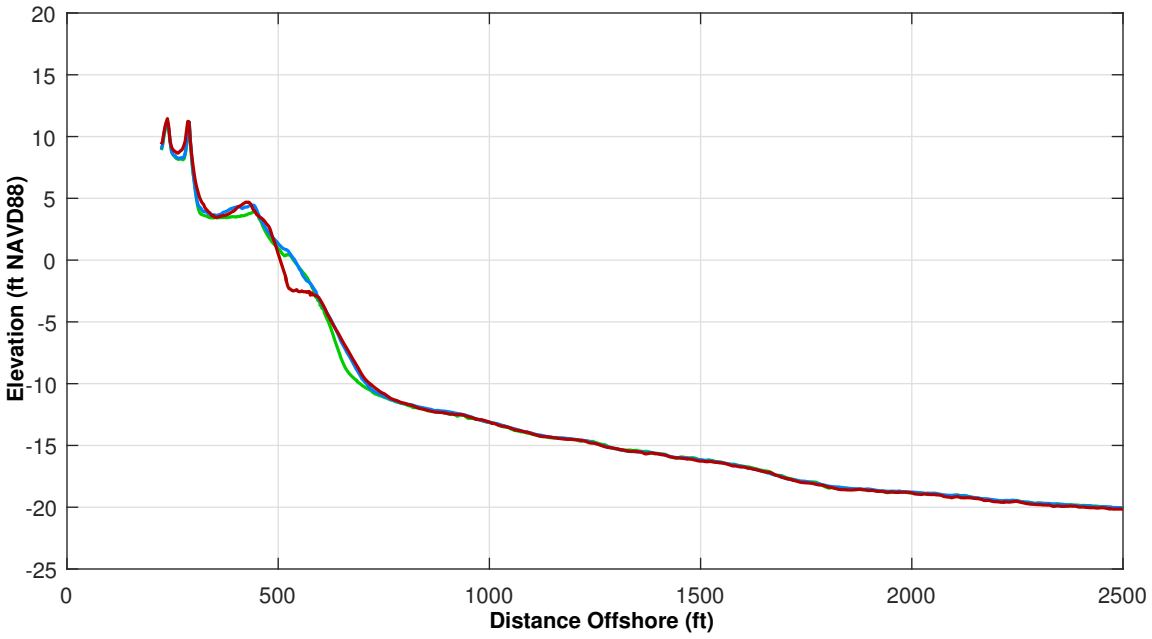
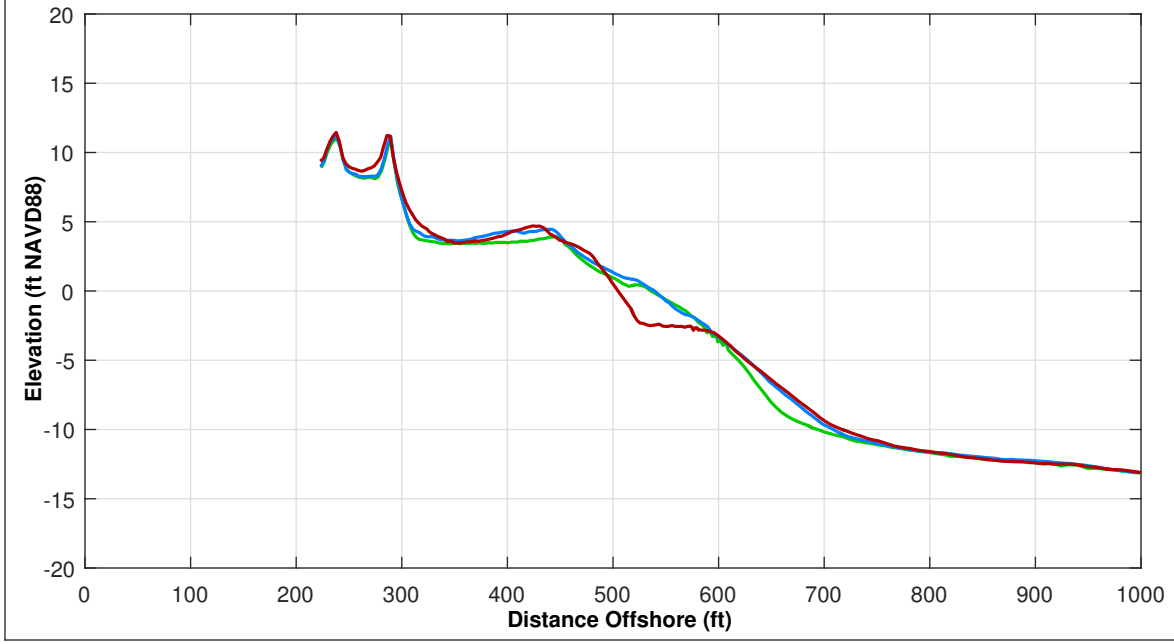
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 81+62	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-3.50 ft/yr	-14.33 ft
Volume Change Above -15 ft NAVD88	6.47 cy/ft/yr	-3.28 cy/ft
Volume Change Above 0 ft NAVD88	5.22 cy/ft/yr	0.71 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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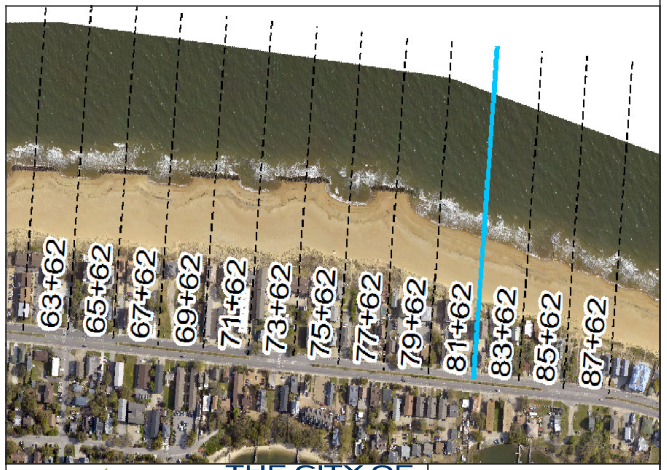

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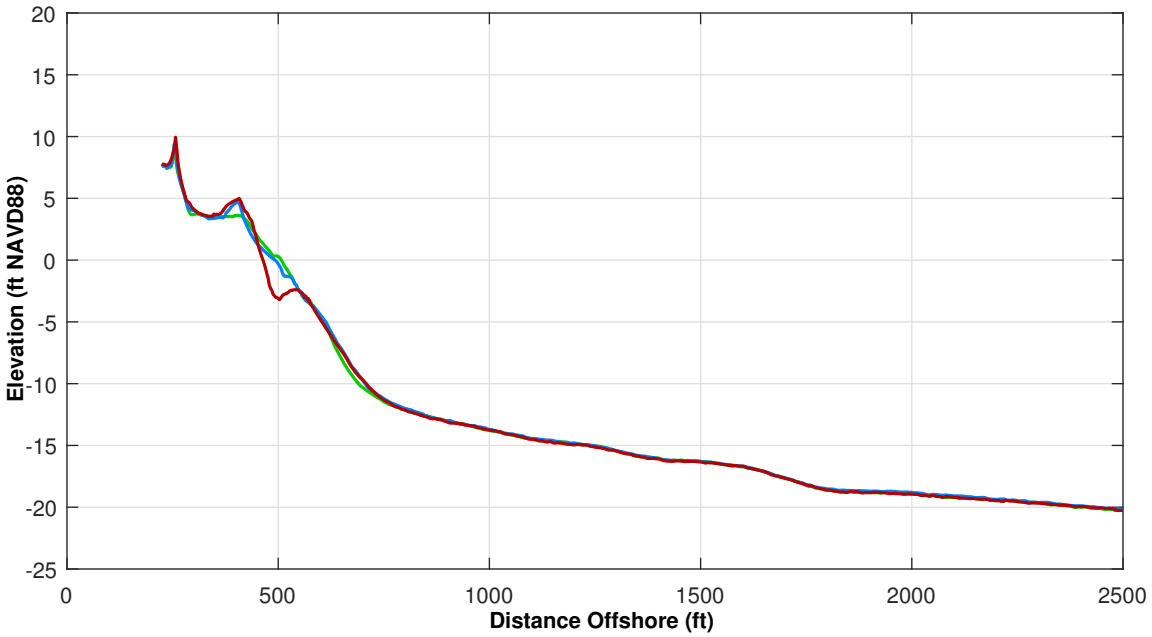
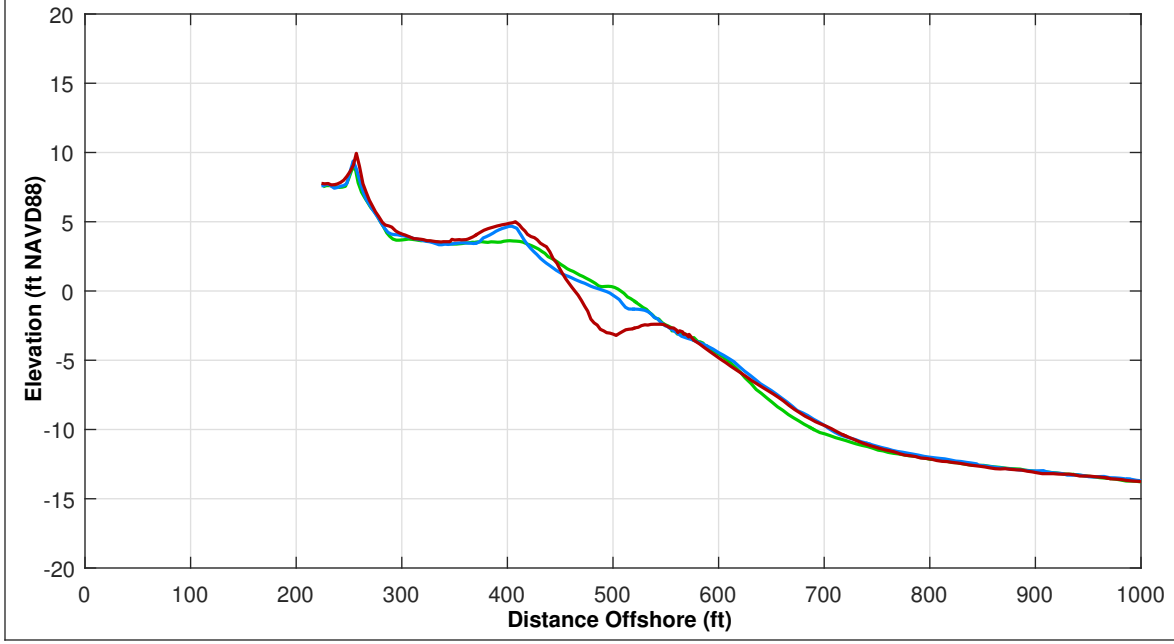
ST 81+62	Pg 38 of 106	Spring 2018





Survey Transect 83+62	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-21.33 ft/yr	-5.59 ft
Volume Change Above -15 ft NAVD88	-1.70 cy/ft/yr	-4.62 cy/ft
Volume Change Above 0 ft NAVD88	3.01 cy/ft/yr	2.54 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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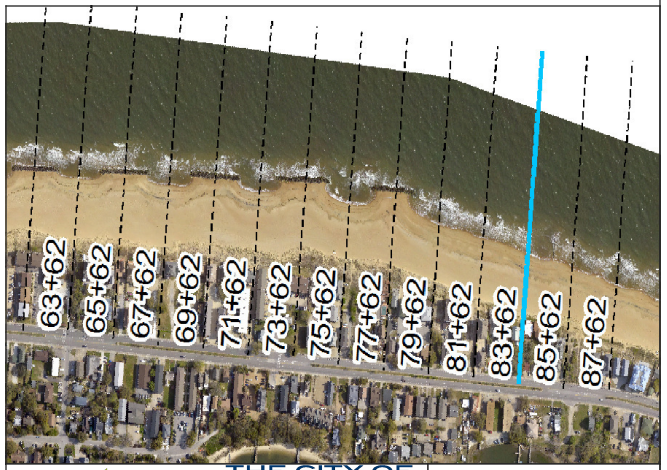

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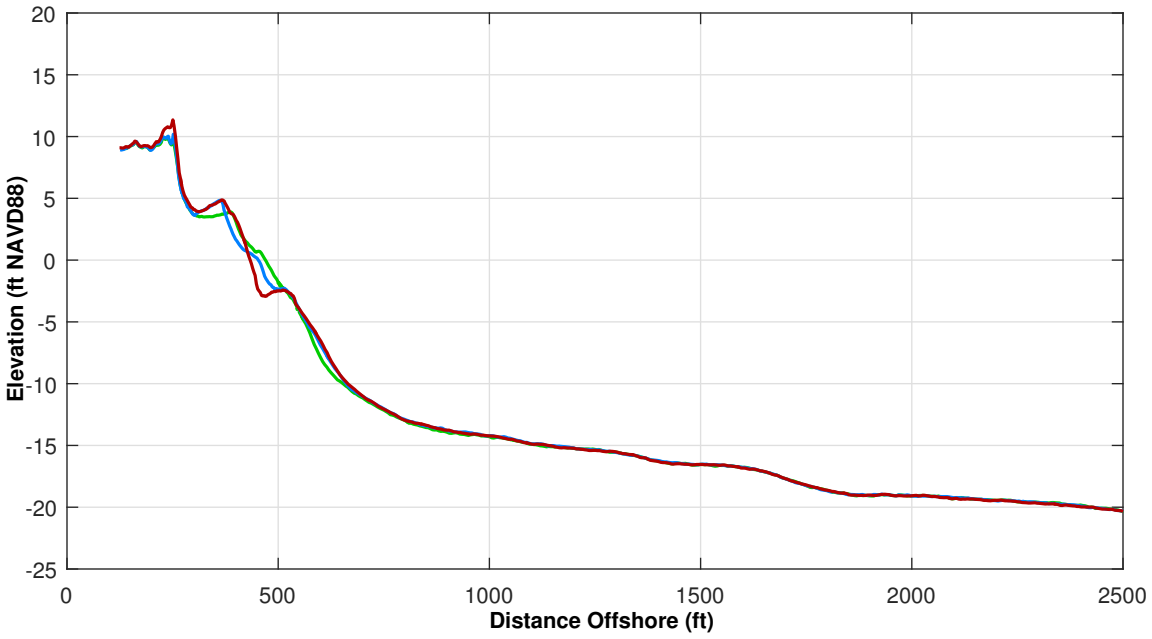
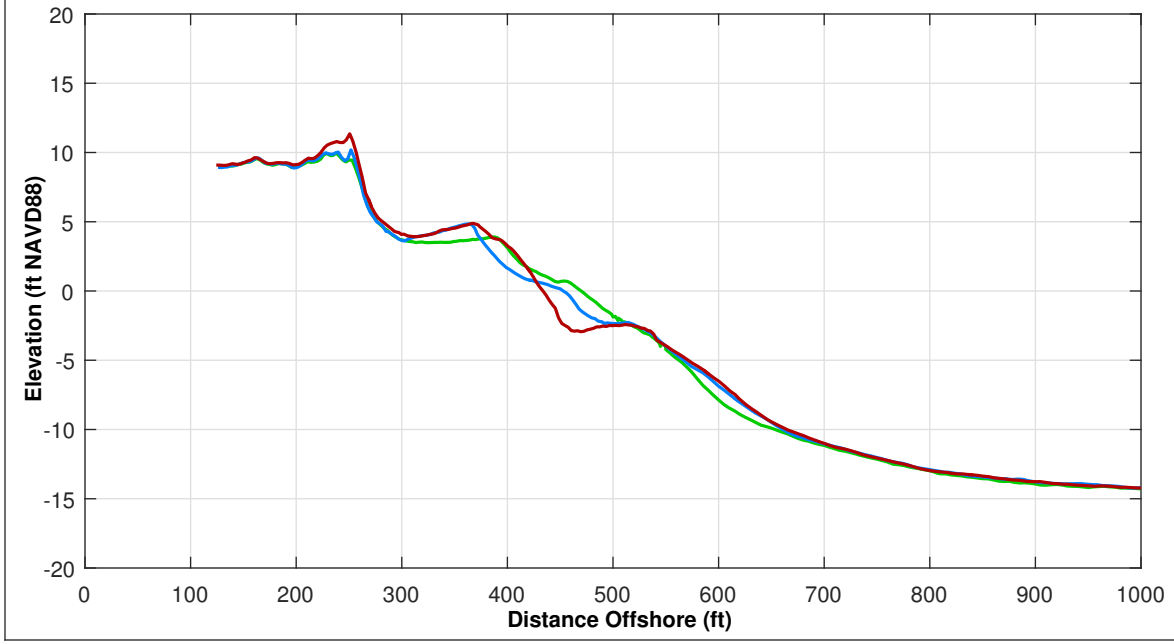
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 85+62	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-15.65 ft/yr	10.65 ft
Volume Change Above -15 ft NAVD88	5.26 cy/ft/yr	2.06 cy/ft
Volume Change Above 0 ft NAVD88	4.36 cy/ft/yr	4.40 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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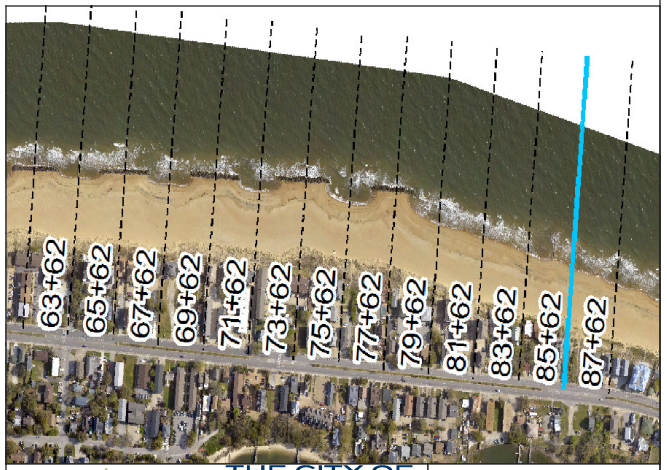

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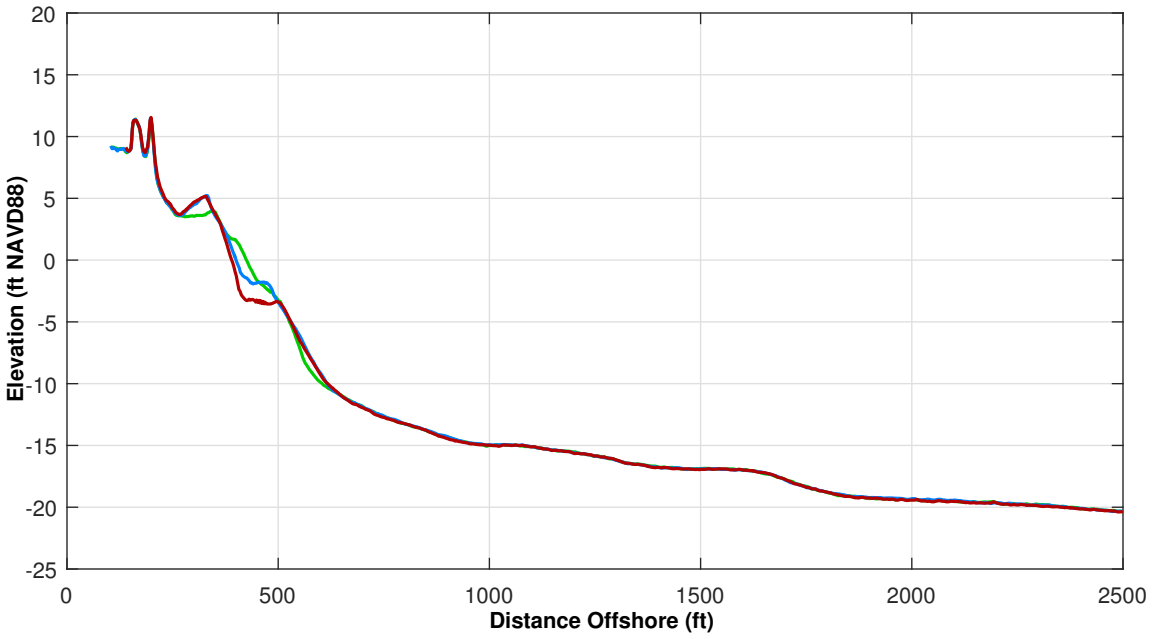

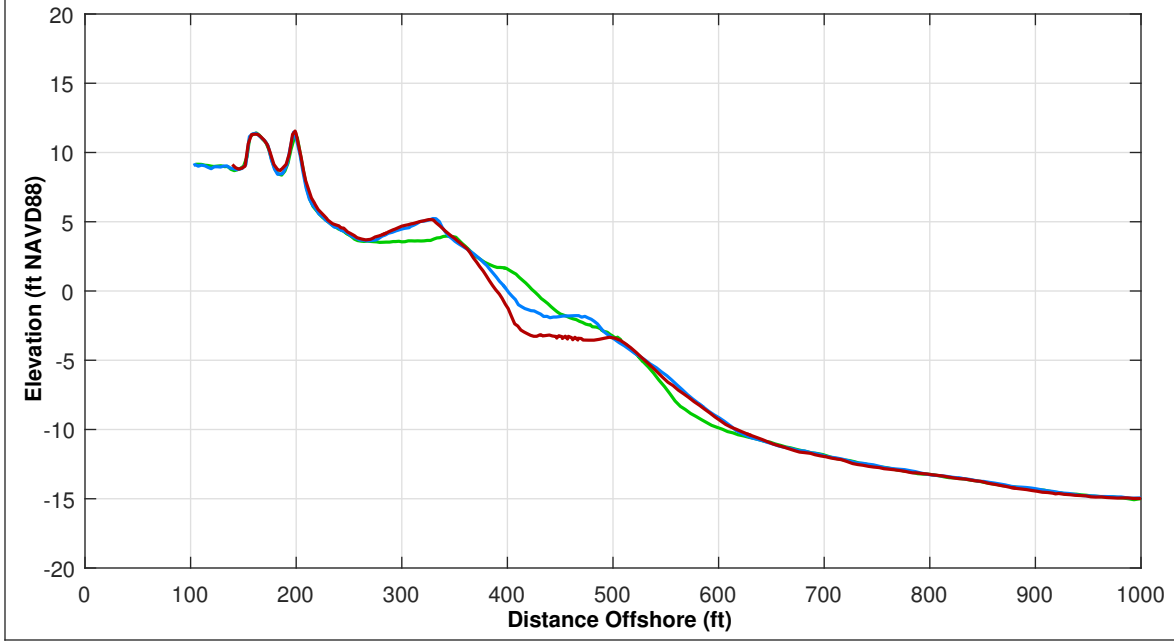

Survey Transect 87+62	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-34.45 ft/yr	-8.80 ft
Volume Change Above -15 ft NAVD88	-4.28 cy/ft/yr	-6.39 cy/ft
Volume Change Above 0 ft NAVD88	1.34 cy/ft/yr	0.25 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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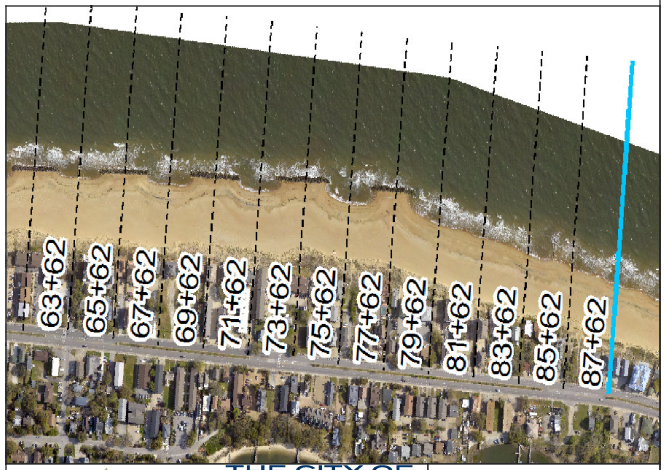

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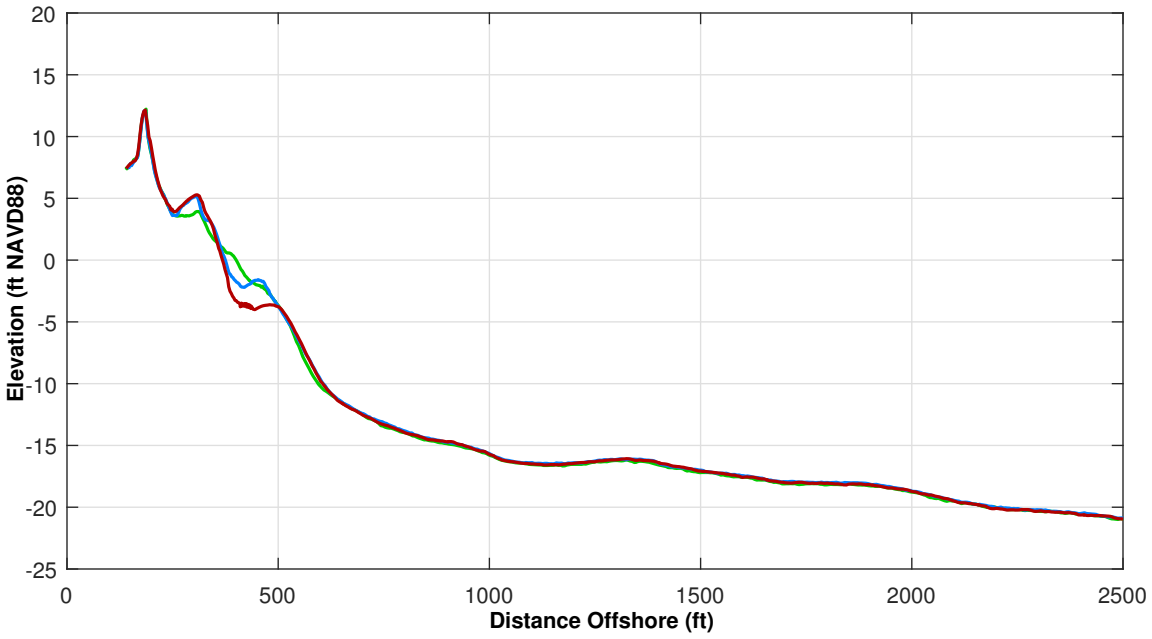

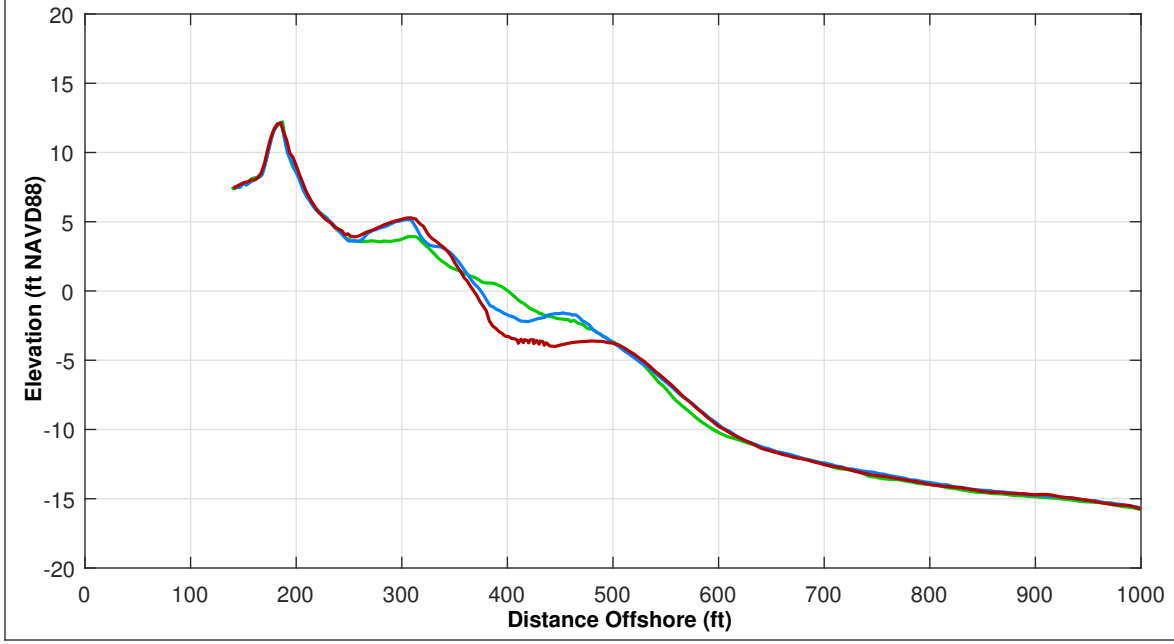

Survey Transect 93+41	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-11.11 ft/yr	-5.35 ft
Volume Change Above -15 ft NAVD88	-2.80 cy/ft/yr	-6.19 cy/ft
Volume Change Above 0 ft NAVD88	3.89 cy/ft/yr	1.18 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

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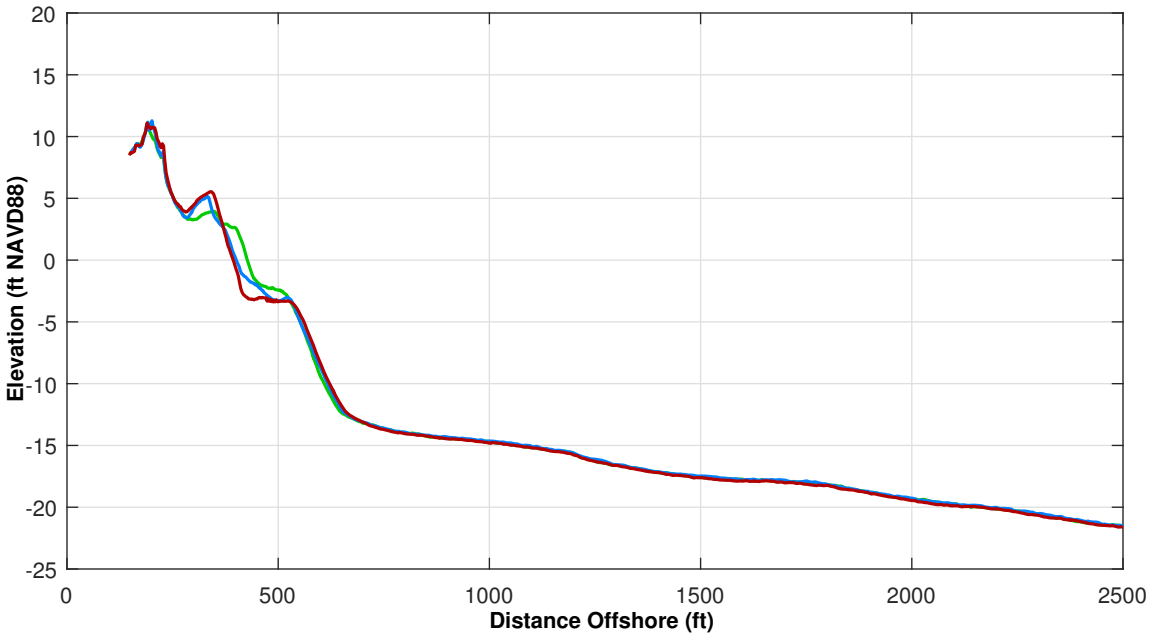

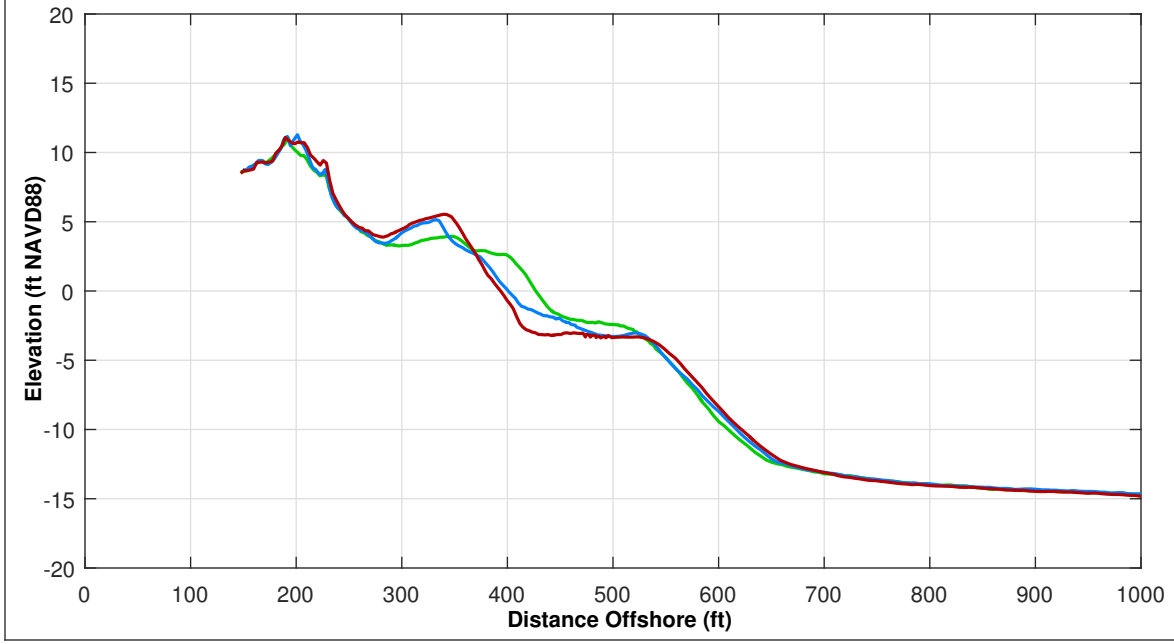

Survey Transect 103+08	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-40.33 ft/yr	-6.42 ft
Volume Change Above -15 ft NAVD88	-2.08 cy/ft/yr	-0.51 cy/ft
Volume Change Above 0 ft NAVD88	1.96 cy/ft/yr	2.35 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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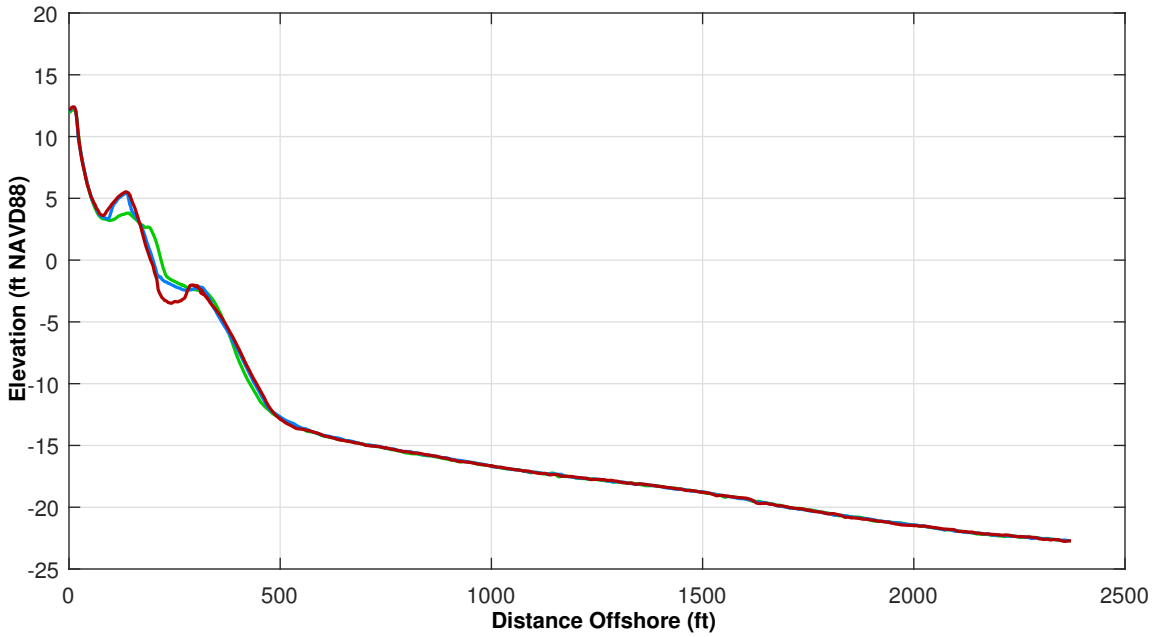

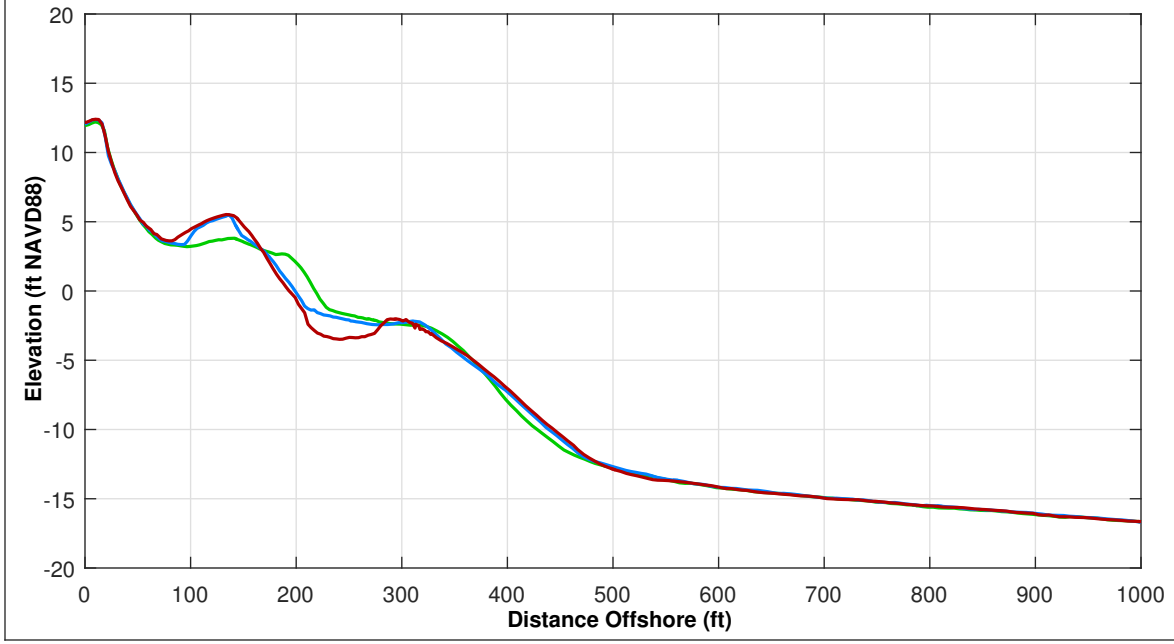

Survey Transect 120+93	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-30.94 ft/yr	-5.67 ft
Volume Change Above -15 ft NAVD88	-0.84 cy/ft/yr	-2.10 cy/ft
Volume Change Above 0 ft NAVD88	2.26 cy/ft/yr	0.83 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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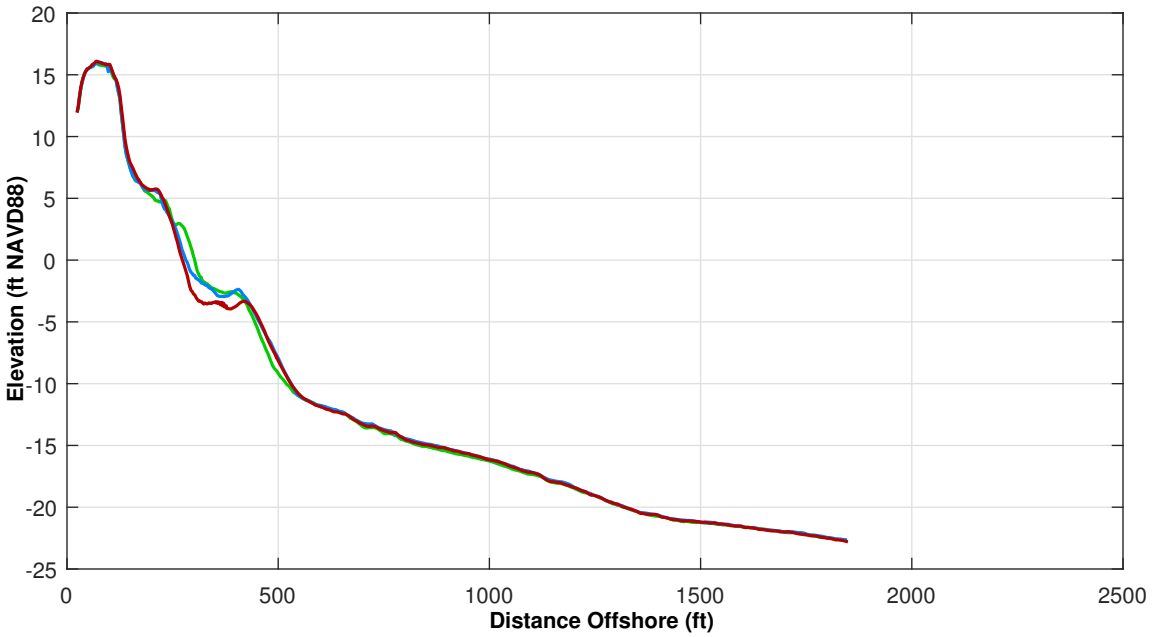
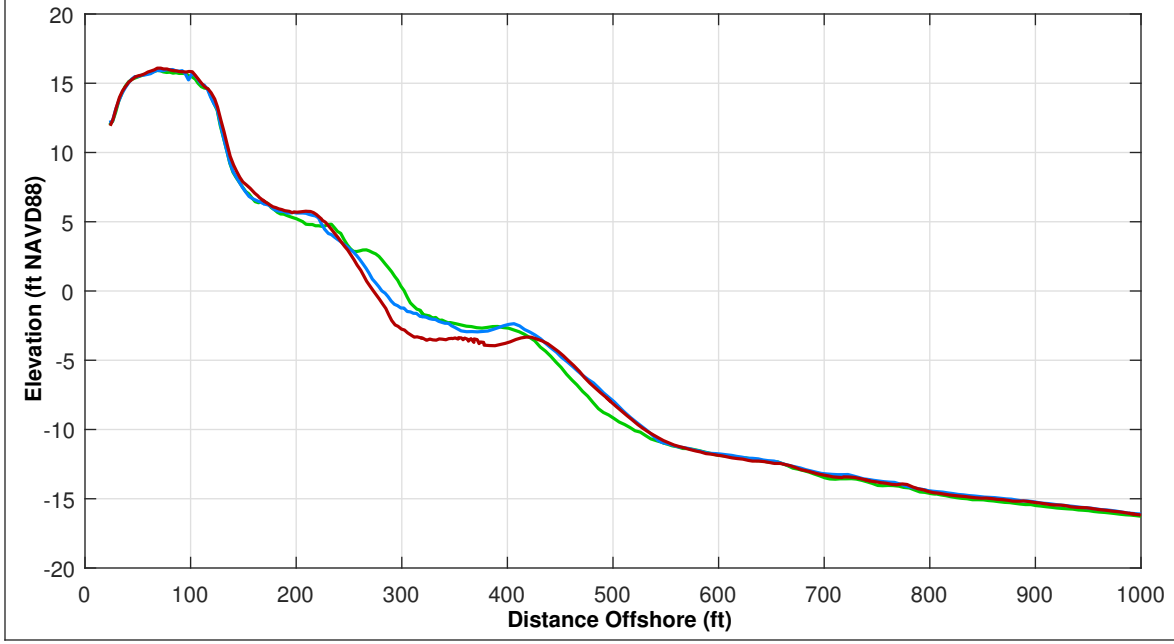
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 129+17	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-33.30 ft/yr	-6.47 ft
Volume Change Above -15 ft NAVD88	-4.21 cy/ft/yr	-6.21 cy/ft
Volume Change Above 0 ft NAVD88	-1.02 cy/ft/yr	0.92 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

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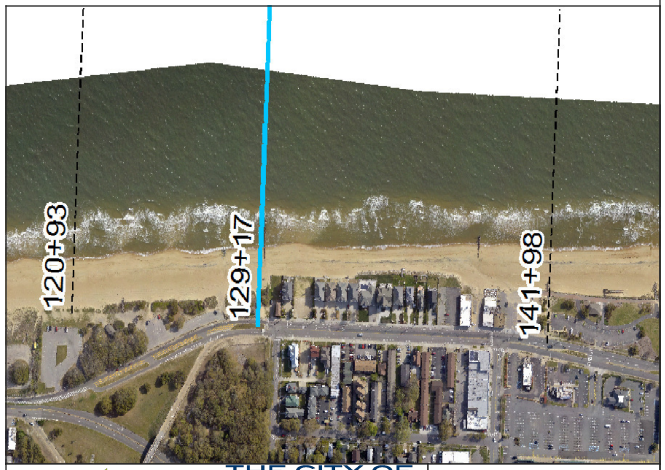

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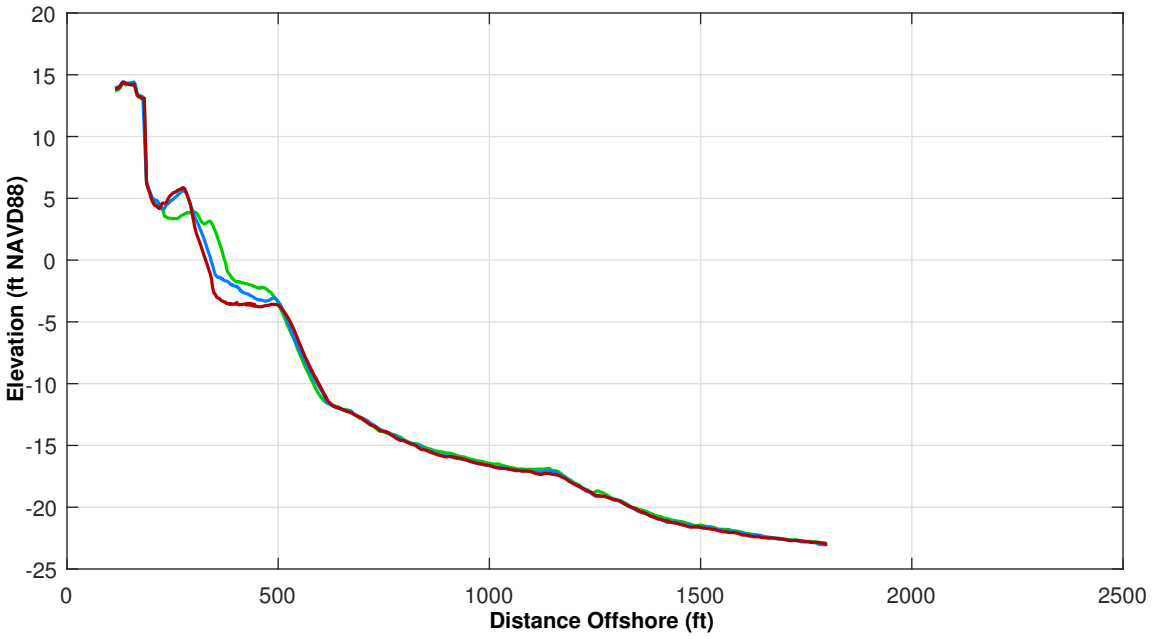

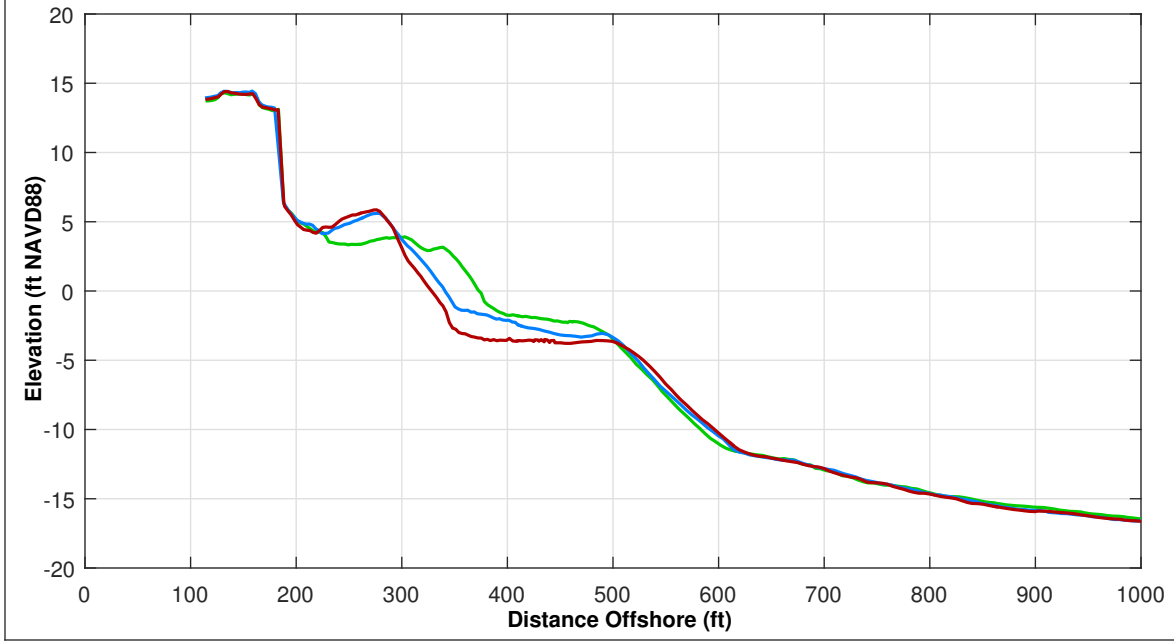

Survey Transect 141+98	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-52.54 ft/yr	-12.77 ft
Volume Change Above -15 ft NAVD88	-11.46 cy/ft/yr	-6.51 cy/ft
Volume Change Above 0 ft NAVD88	-1.63 cy/ft/yr	-1.00 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

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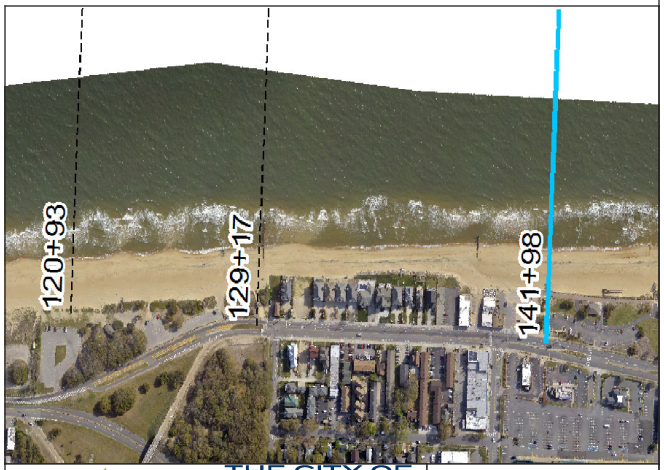

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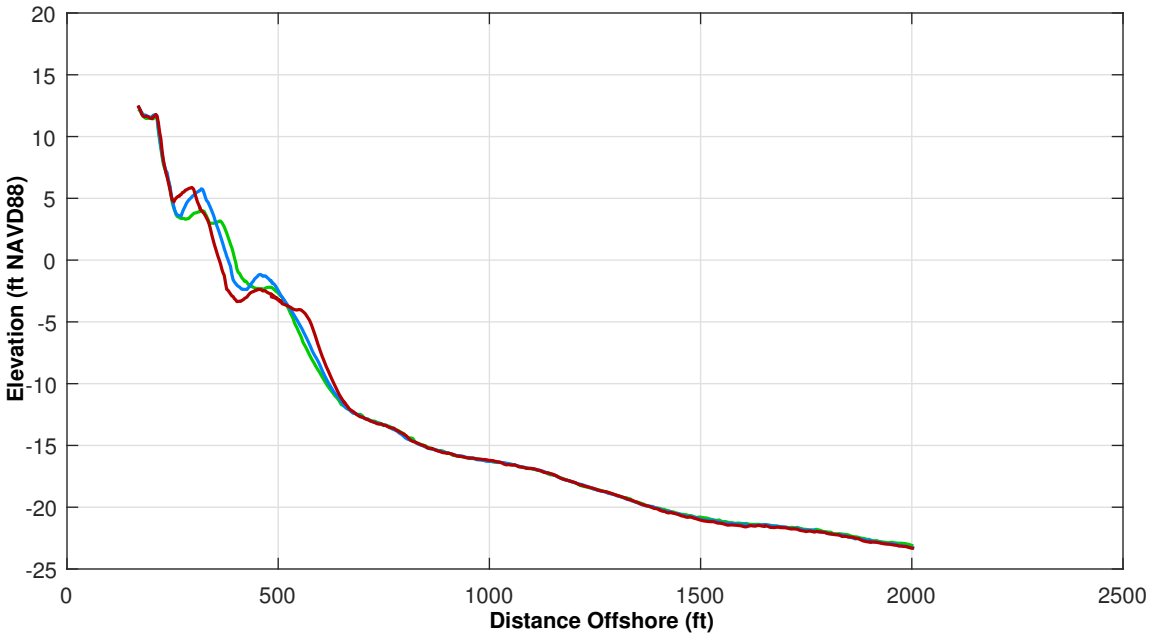

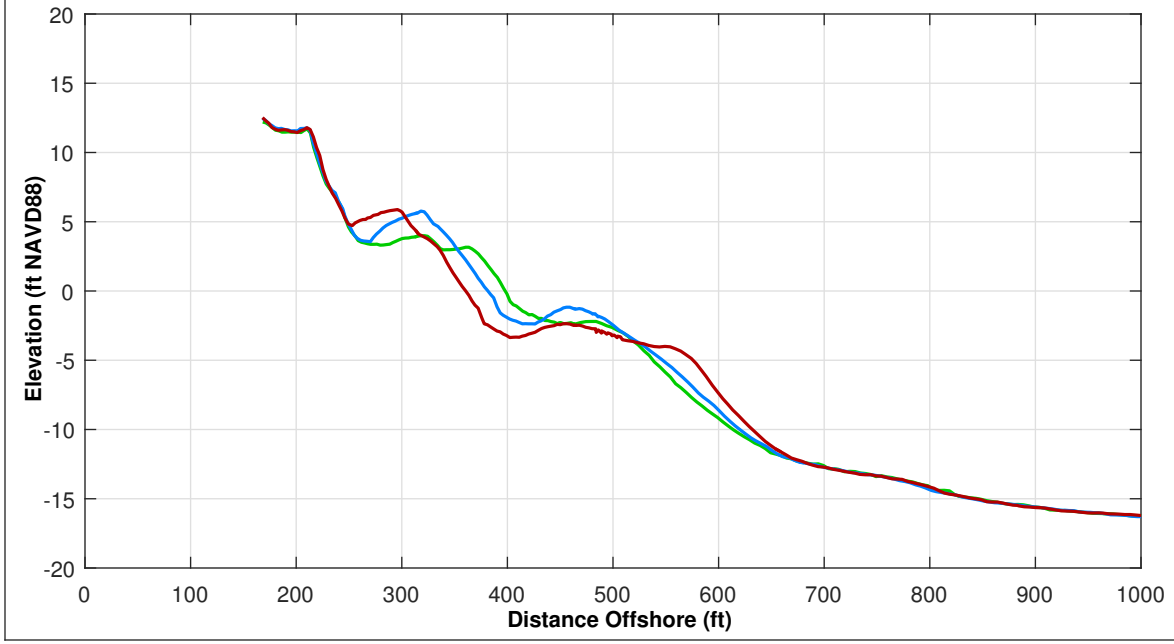

Survey Transect 152+01	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-44.41 ft/yr	-20.40 ft
Volume Change Above -15 ft NAVD88	1.69 cy/ft/yr	-3.14 cy/ft
Volume Change Above 0 ft NAVD88	0.25 cy/ft/yr	-2.21 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

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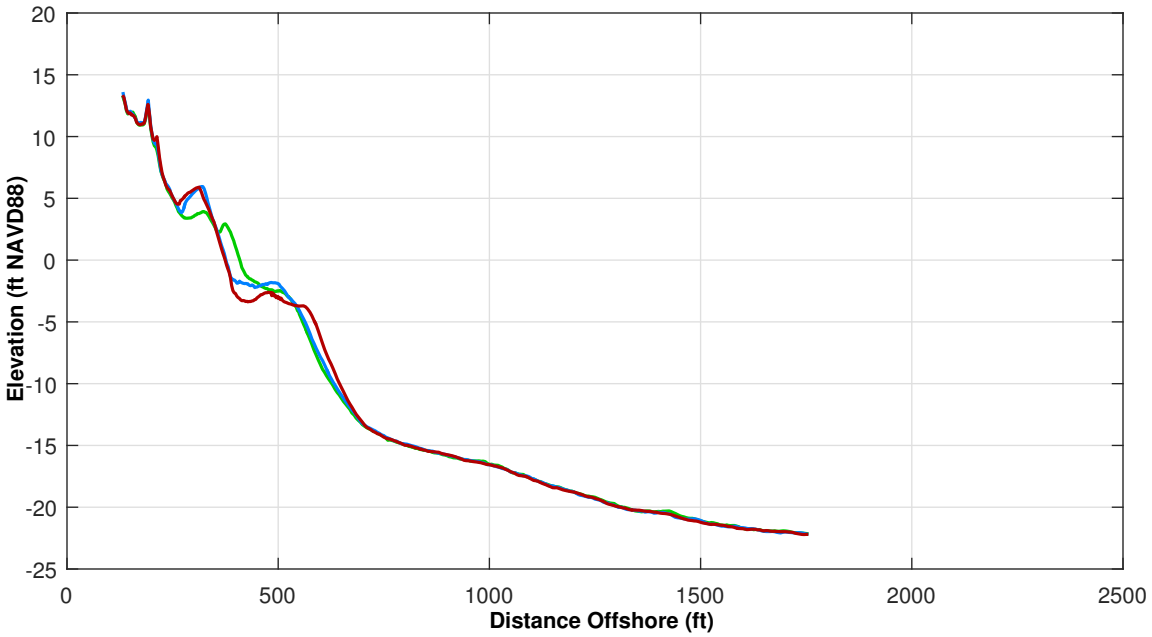

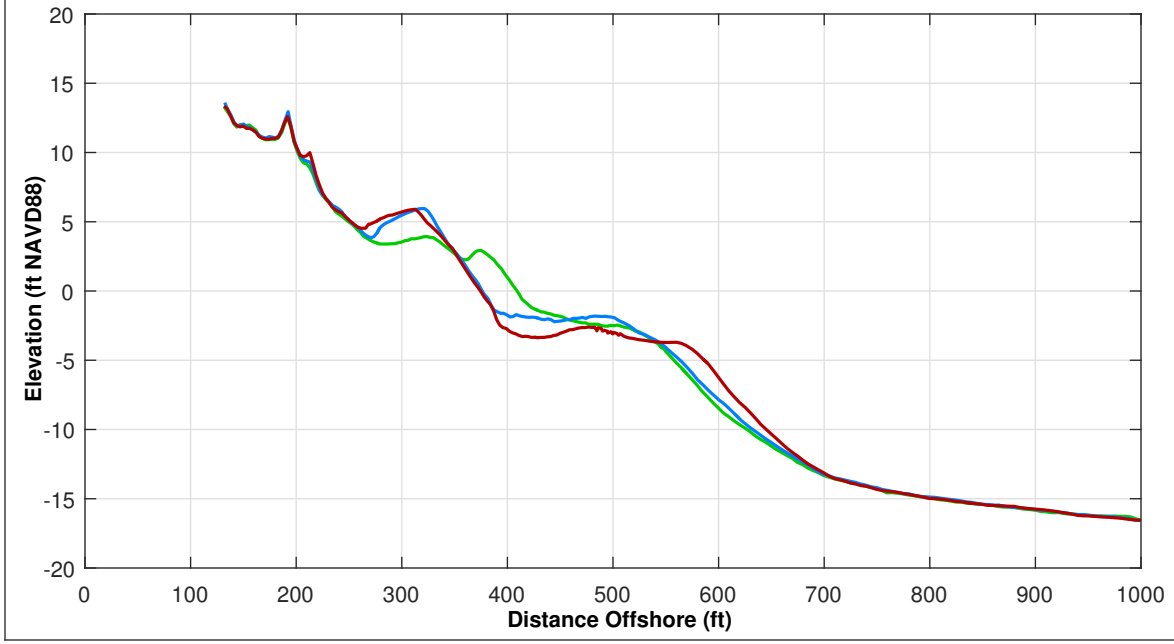

Survey Transect 163+49	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-39.45 ft/yr	-2.62 ft
Volume Change Above -15 ft NAVD88	2.48 cy/ft/yr	-0.19 cy/ft
Volume Change Above 0 ft NAVD88	2.19 cy/ft/yr	0.16 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

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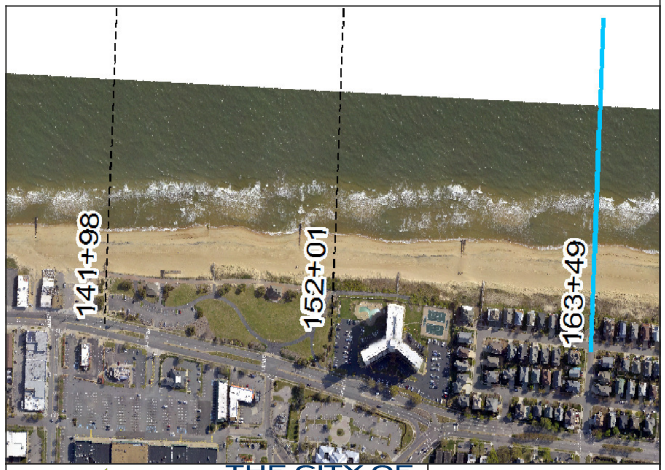

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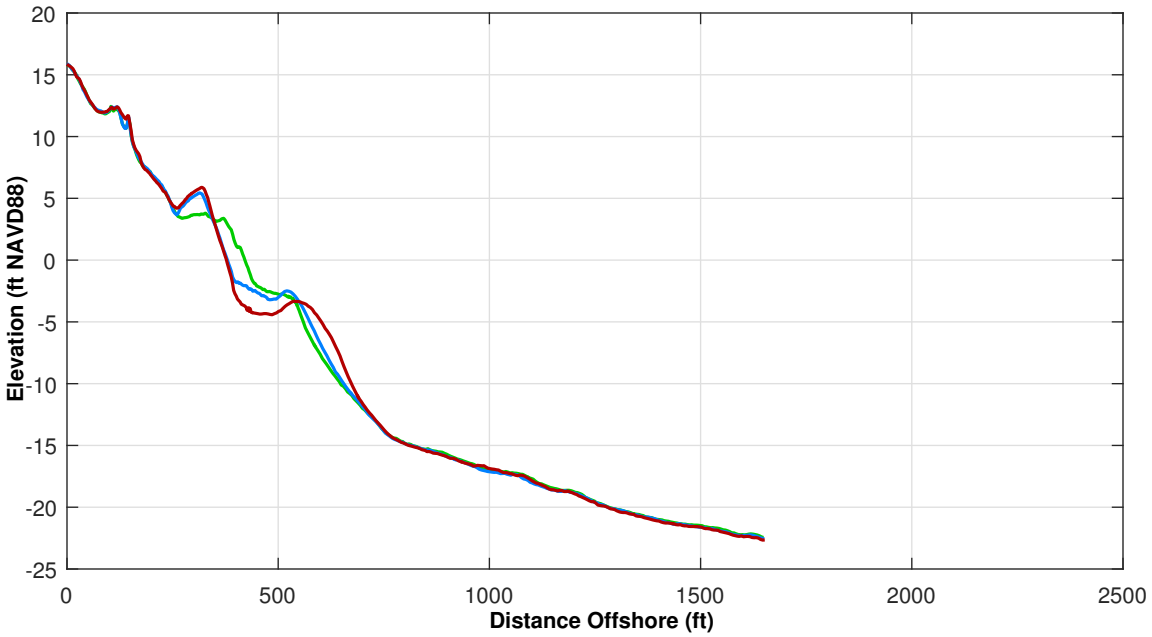

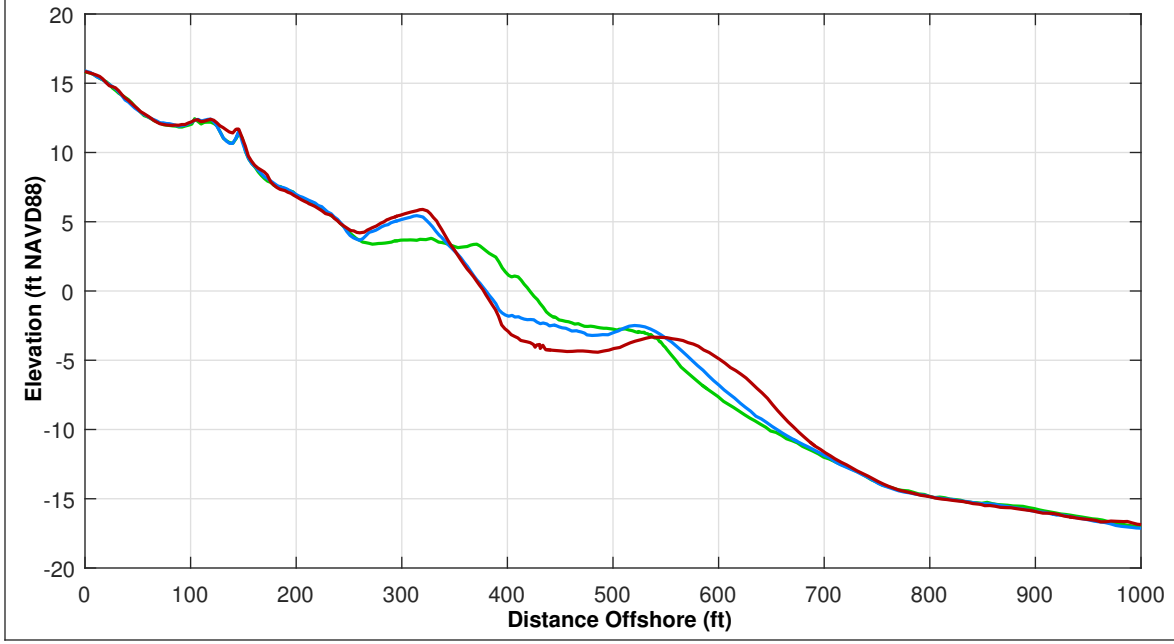

Survey Transect 169+63	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-48.04 ft/yr	-0.90 ft
Volume Change Above -15 ft NAVD88	0.99 cy/ft/yr	1.85 cy/ft
Volume Change Above 0 ft NAVD88	1.62 cy/ft/yr	1.82 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

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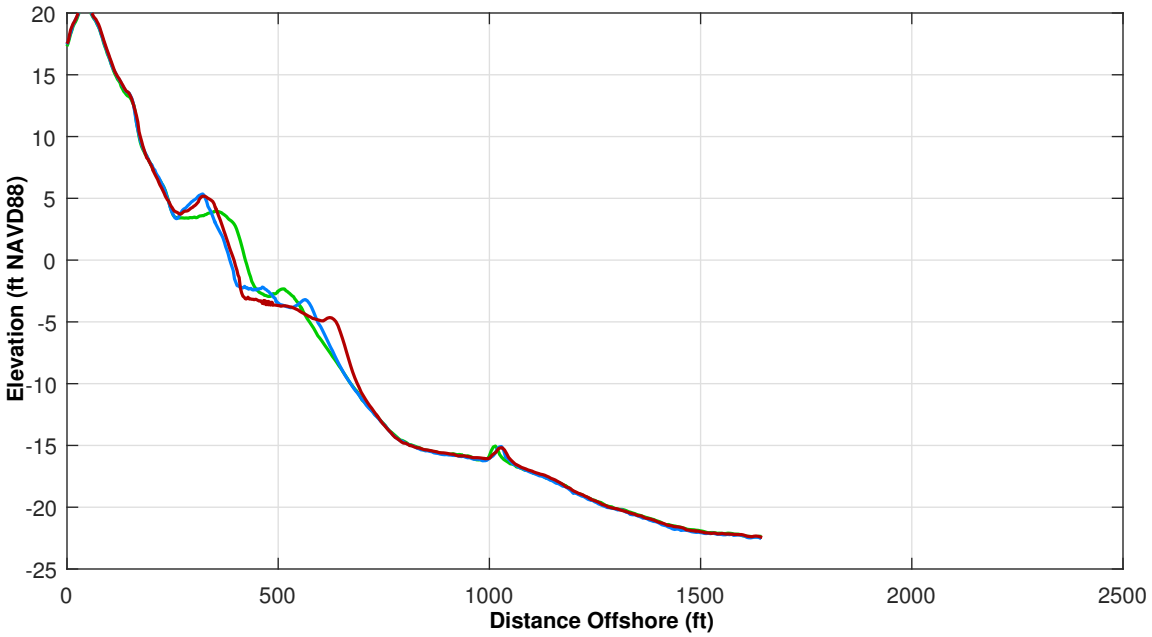

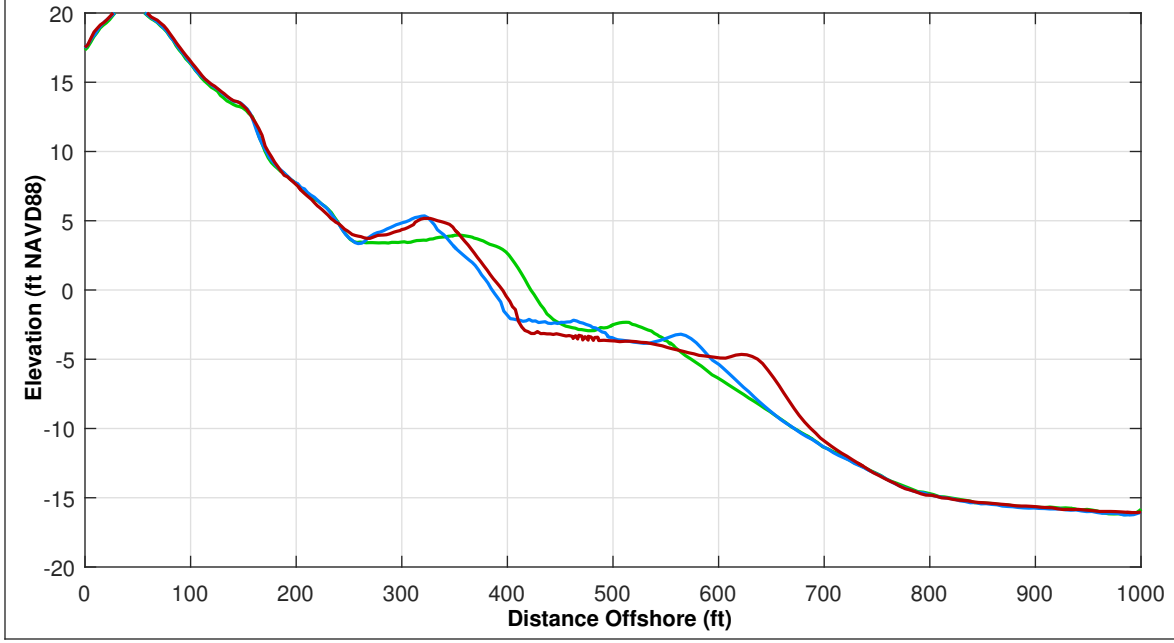

Survey Transect 171+63	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-34.00 ft/yr	8.24 ft
Volume Change Above -15 ft NAVD88	2.28 cy/ft/yr	5.67 cy/ft
Volume Change Above 0 ft NAVD88	0.46 cy/ft/yr	2.13 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2017 and OCT 2017
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.

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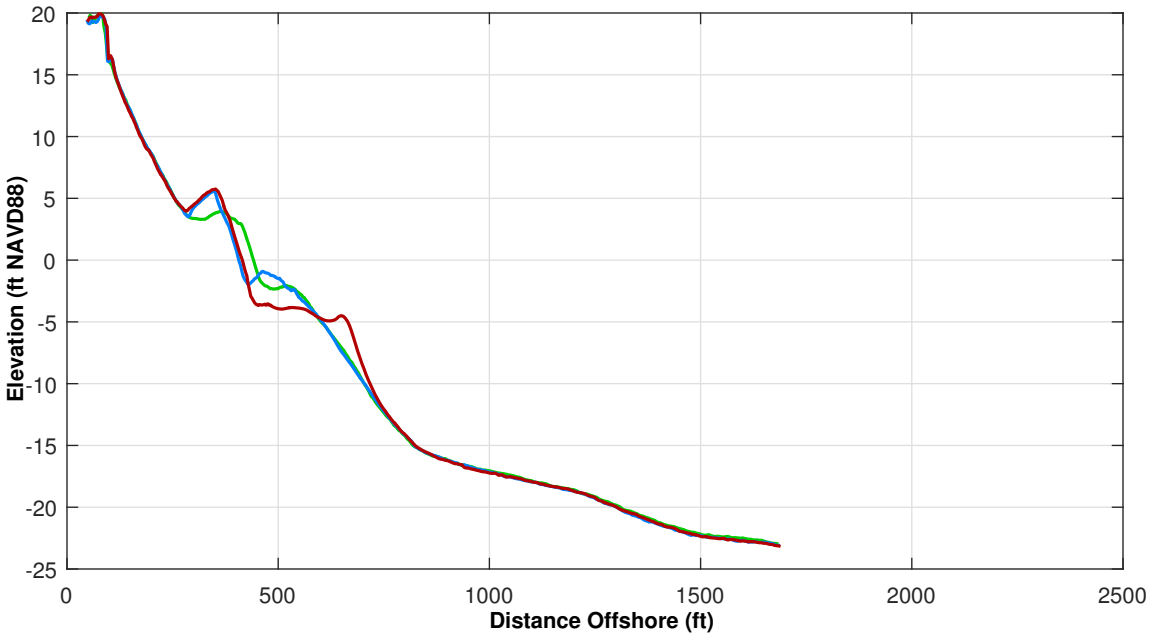

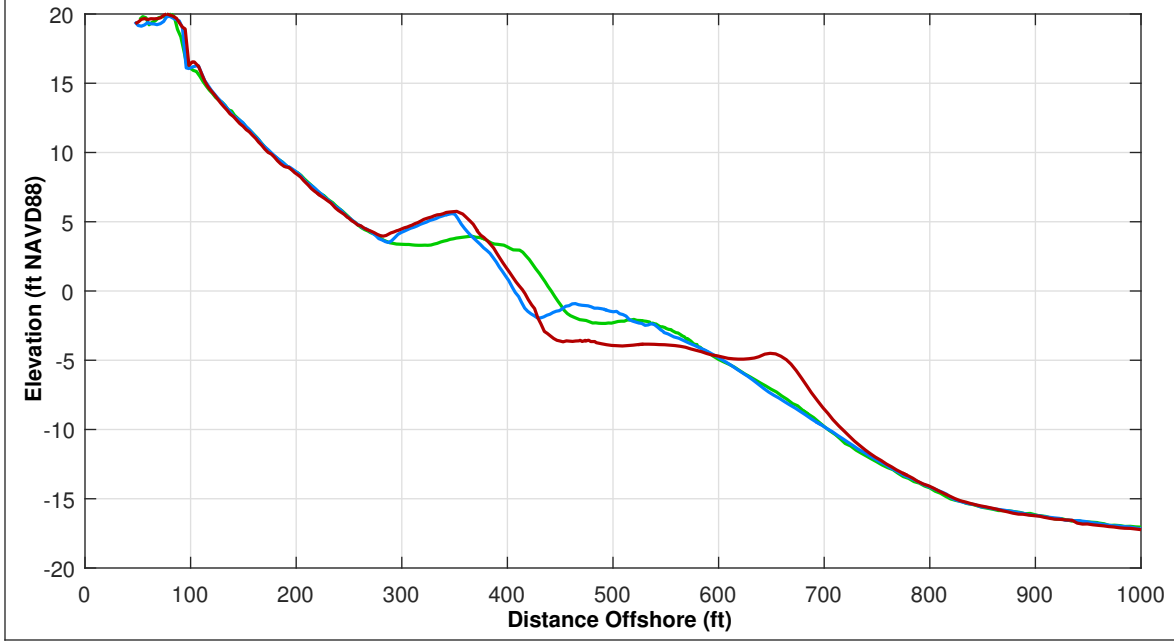

Survey Transect 173+63	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-31.37 ft/yr	6.10 ft
Volume Change Above -15 ft NAVD88	0.38 cy/ft/yr	1.62 cy/ft
Volume Change Above 0 ft NAVD88	2.26 cy/ft/yr	2.51 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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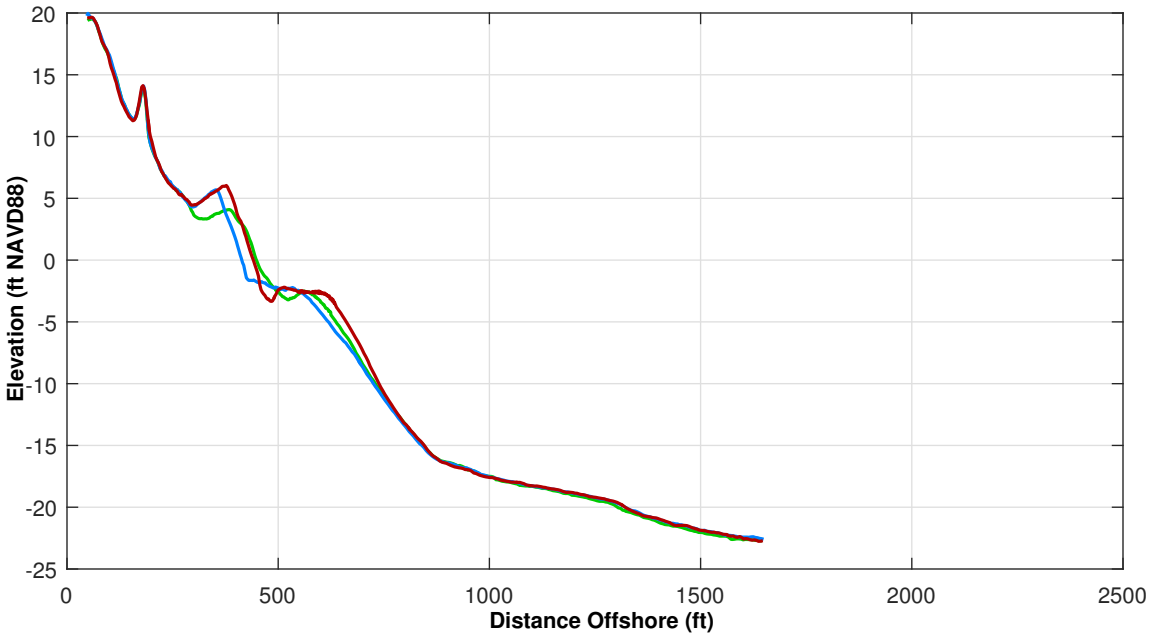

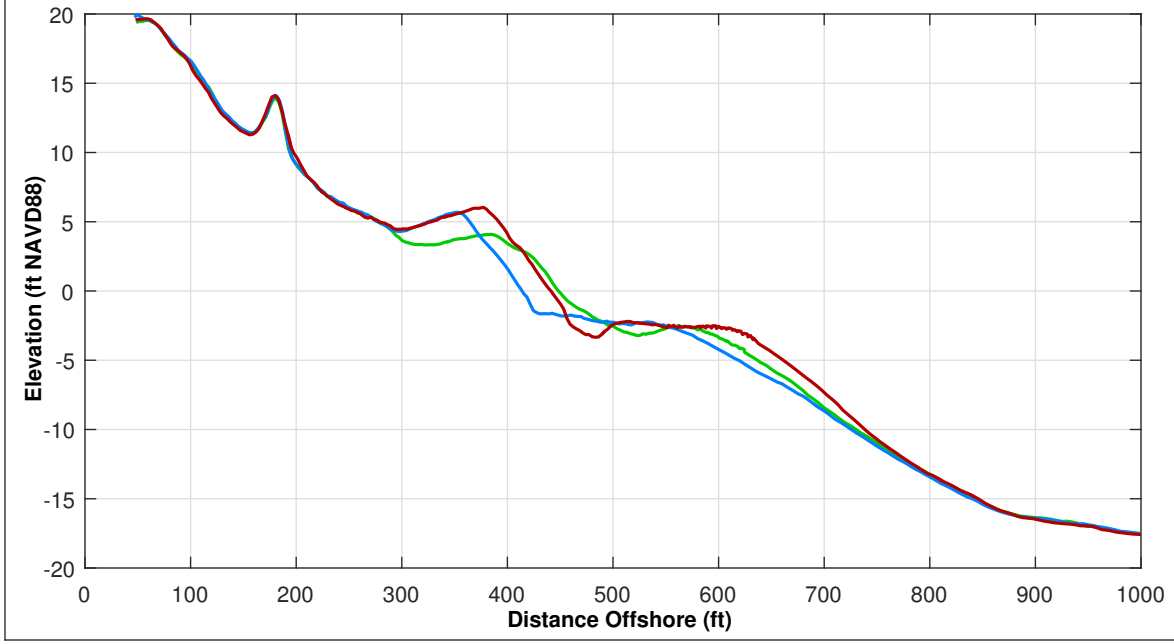

Survey Transect 175+63	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-9.30 ft/yr	26.01 ft
Volume Change Above -15 ft NAVD88	11.99 cy/ft/yr	16.23 cy/ft
Volume Change Above 0 ft NAVD88	6.32 cy/ft/yr	5.24 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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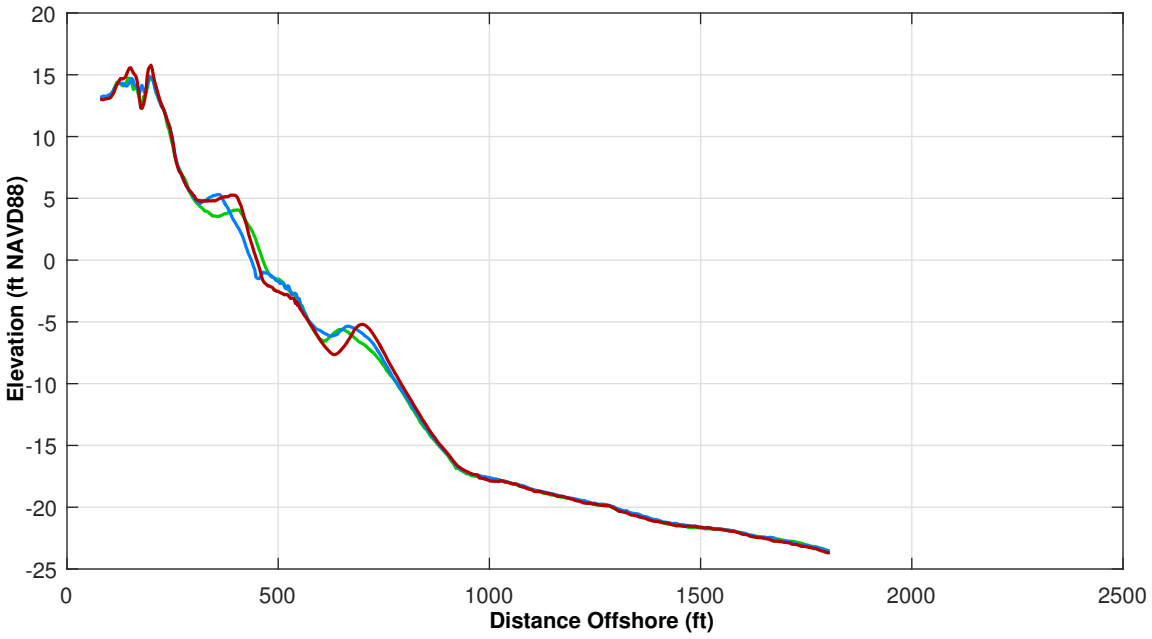

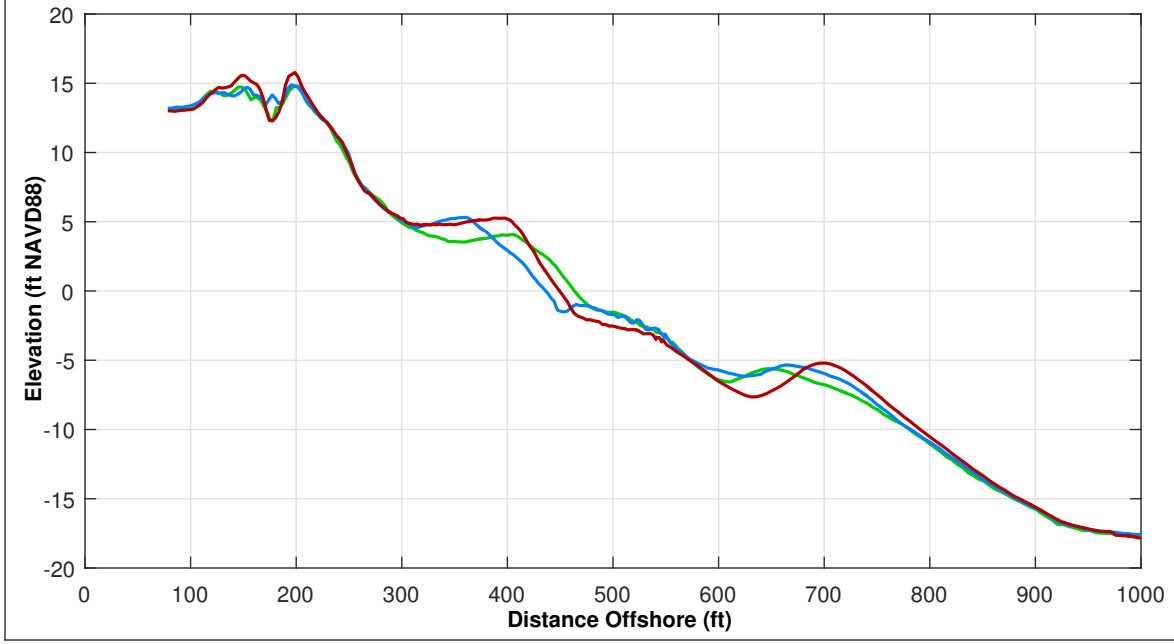

Survey Transect 177+63	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-15.32 ft/yr	15.19 ft
Volume Change Above -15 ft NAVD88	5.61 cy/ft/yr	2.59 cy/ft
Volume Change Above 0 ft NAVD88	5.58 cy/ft/yr	4.94 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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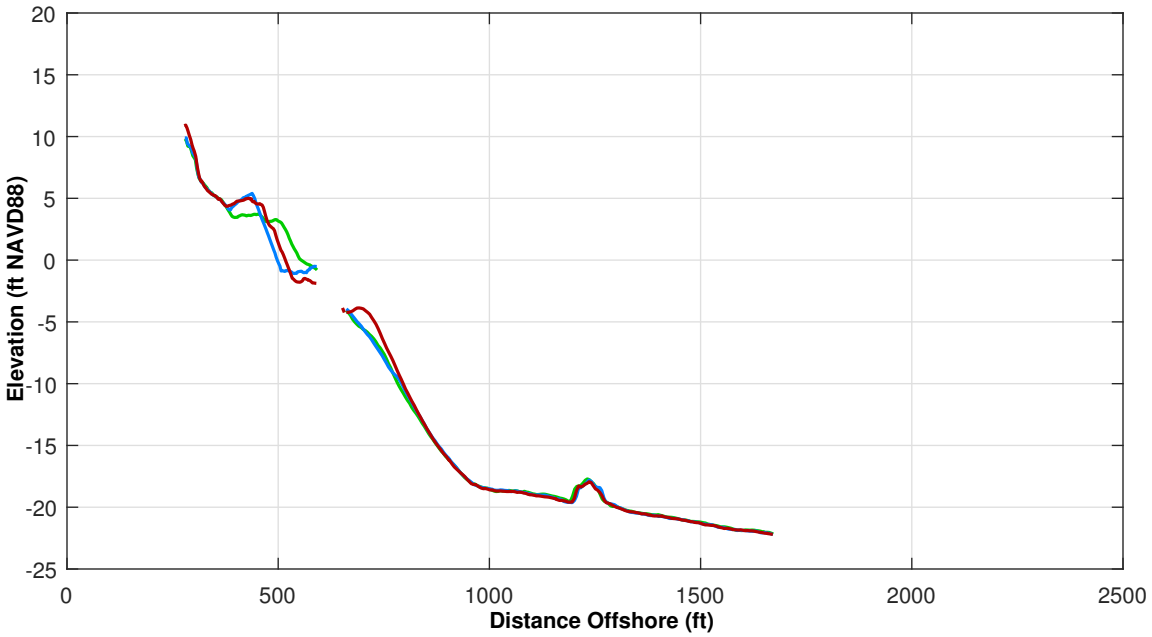

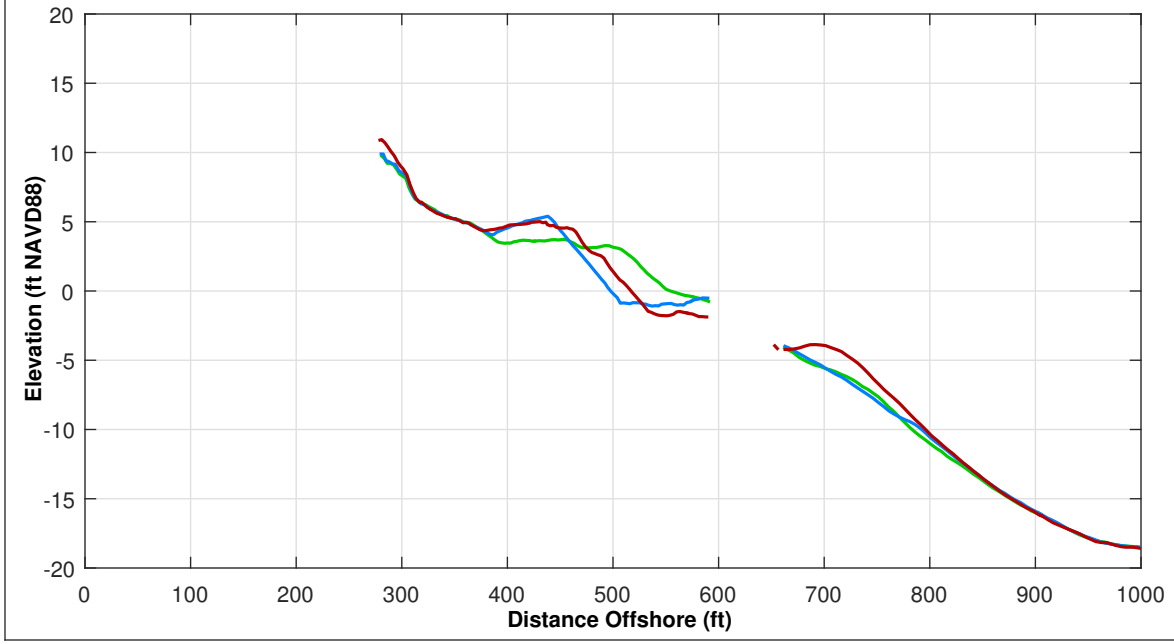

Survey Transect 179+63	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-36.94 ft/yr	16.80 ft
Volume Change Above -15 ft NAVD88	3.83 cy/ft/yr	7.39 cy/ft
Volume Change Above 0 ft NAVD88	0.58 cy/ft/yr	2.97 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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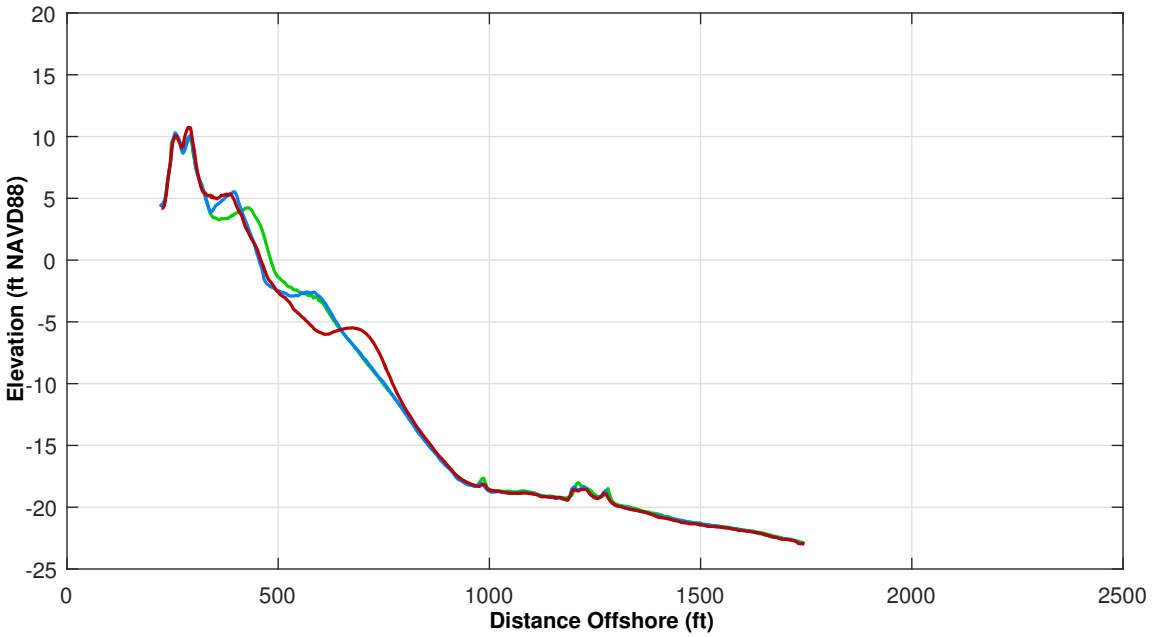

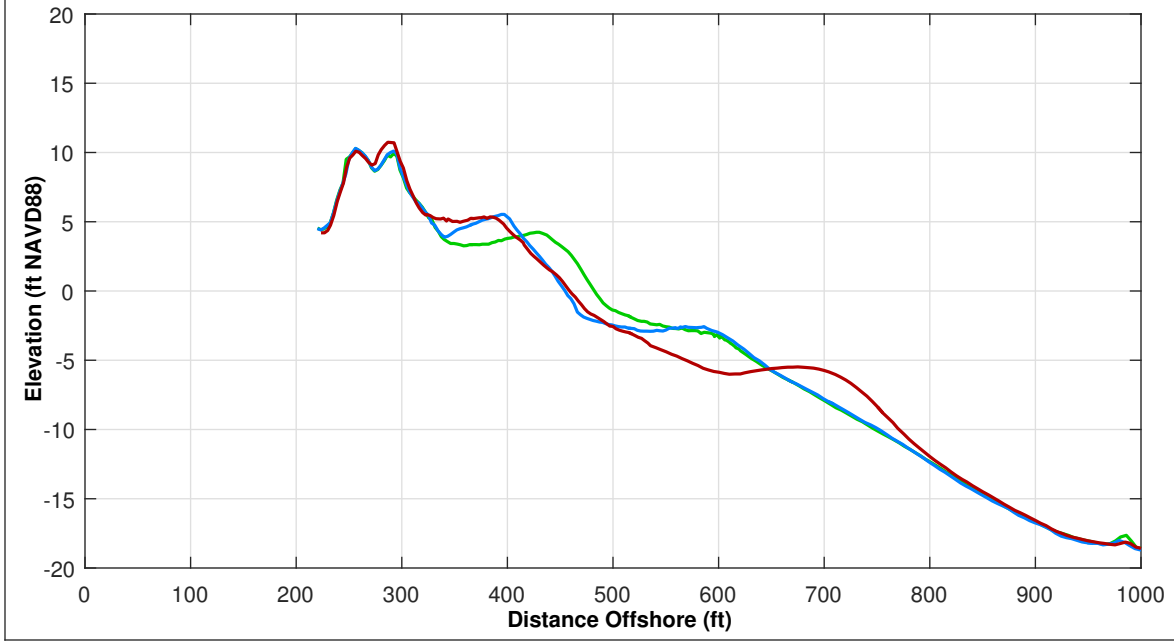

Survey Transect 181+63	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-28.64 ft/yr	3.07 ft
Volume Change Above -15 ft NAVD88	-2.57 cy/ft/yr	1.35 cy/ft
Volume Change Above 0 ft NAVD88	0.22 cy/ft/yr	1.03 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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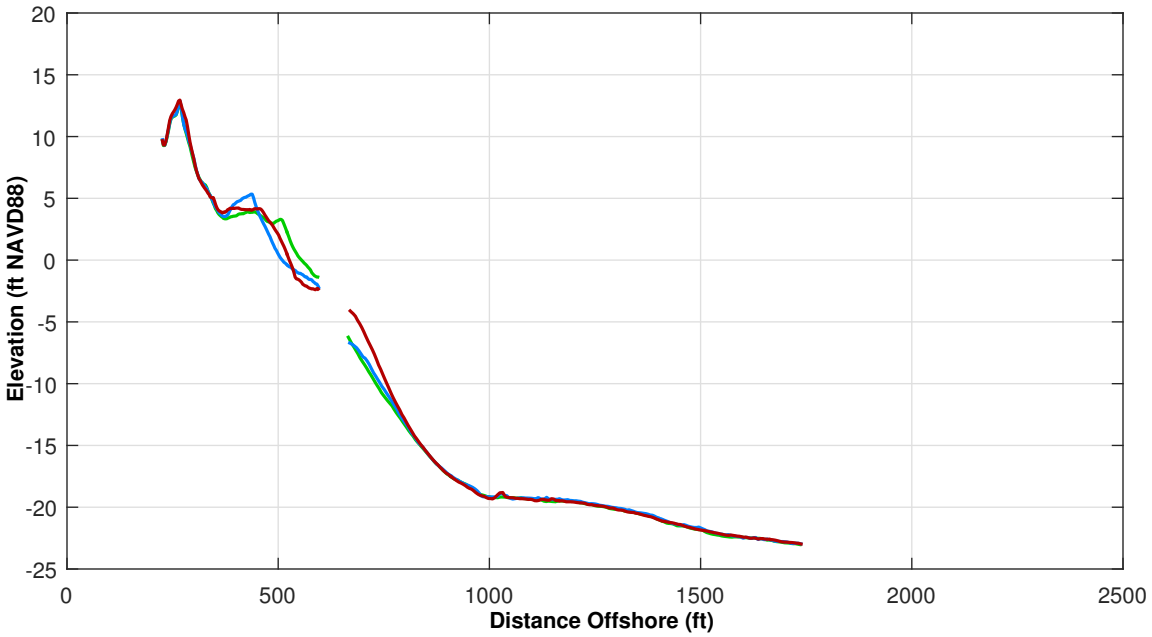

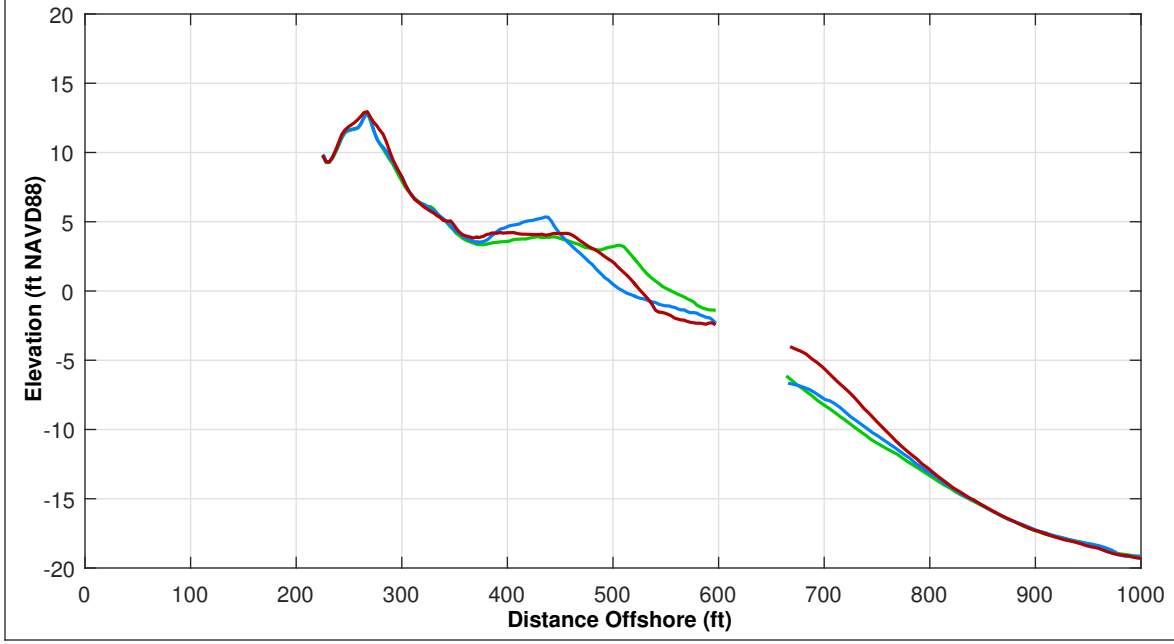

Survey Transect 183+63	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-23.58 ft/yr	23.09 ft
Volume Change Above -15 ft NAVD88	6.84 cy/ft/yr	8.48 cy/ft
Volume Change Above 0 ft NAVD88	0.26 cy/ft/yr	2.43 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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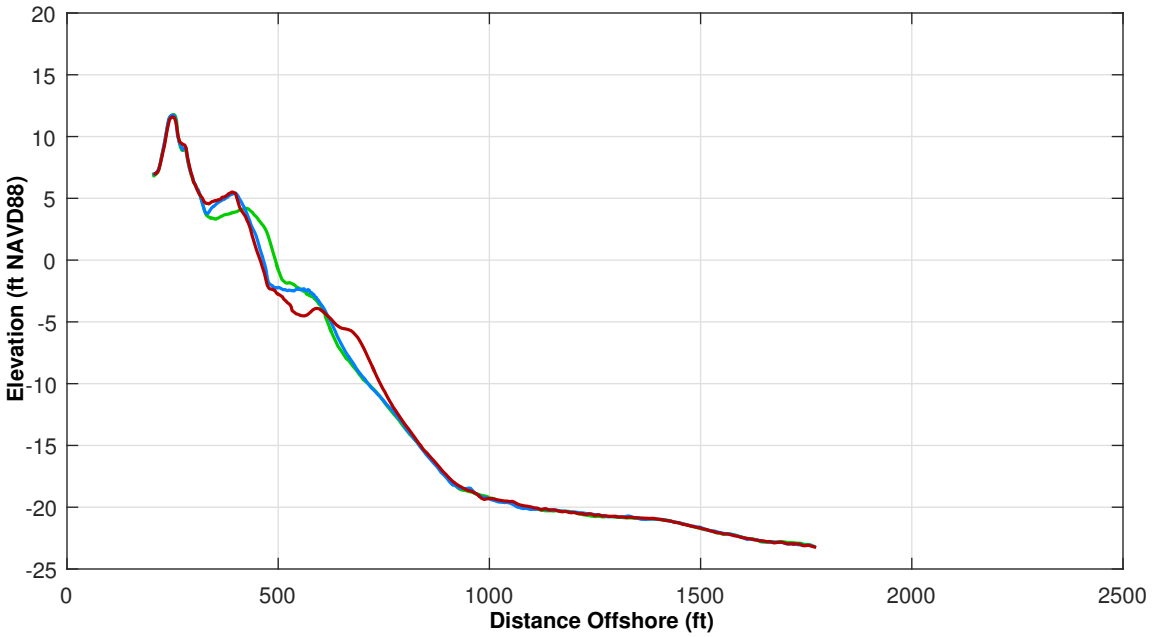

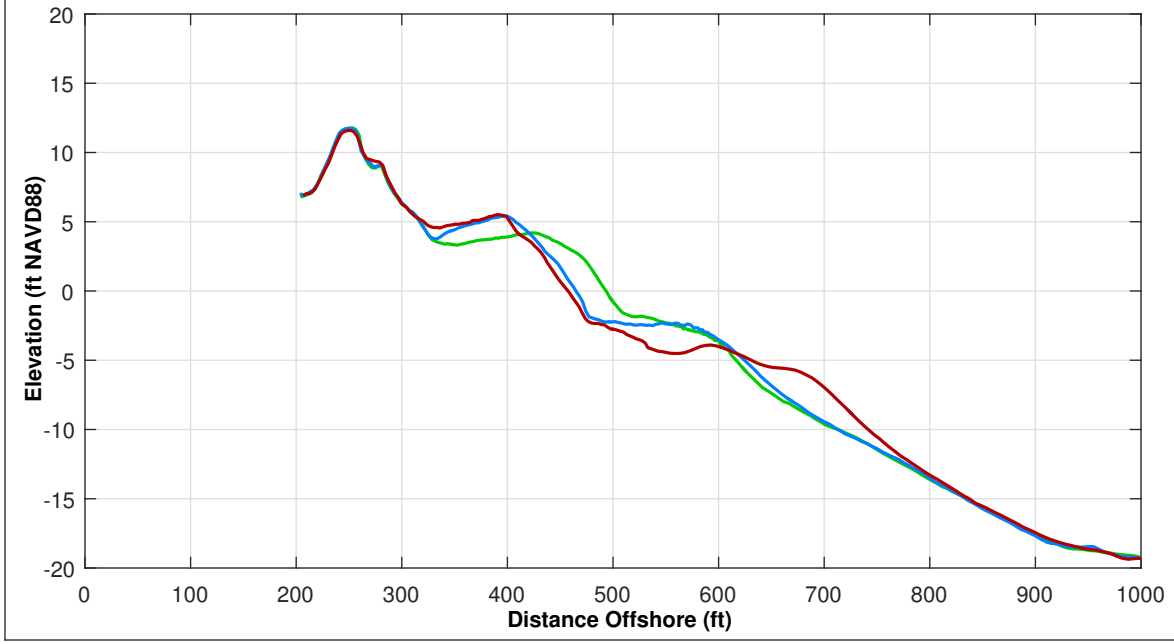

Survey Transect 185+63	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-42.91 ft/yr	-8.91 ft
Volume Change Above -15 ft NAVD88	1.43 cy/ft/yr	2.43 cy/ft
Volume Change Above 0 ft NAVD88	-0.90 cy/ft/yr	-0.60 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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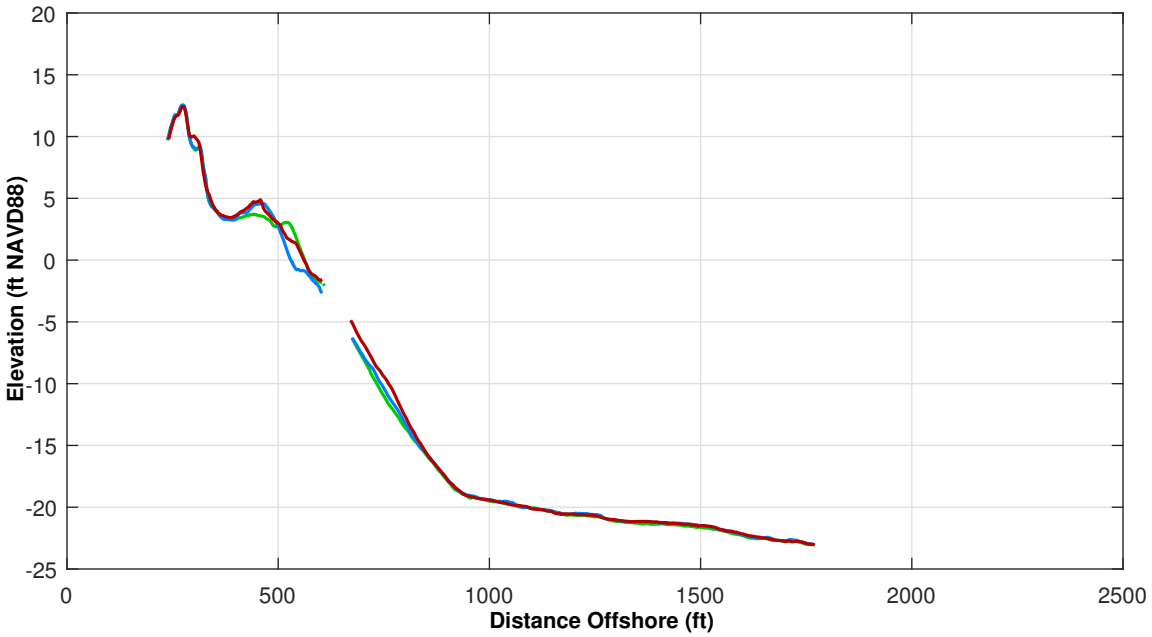
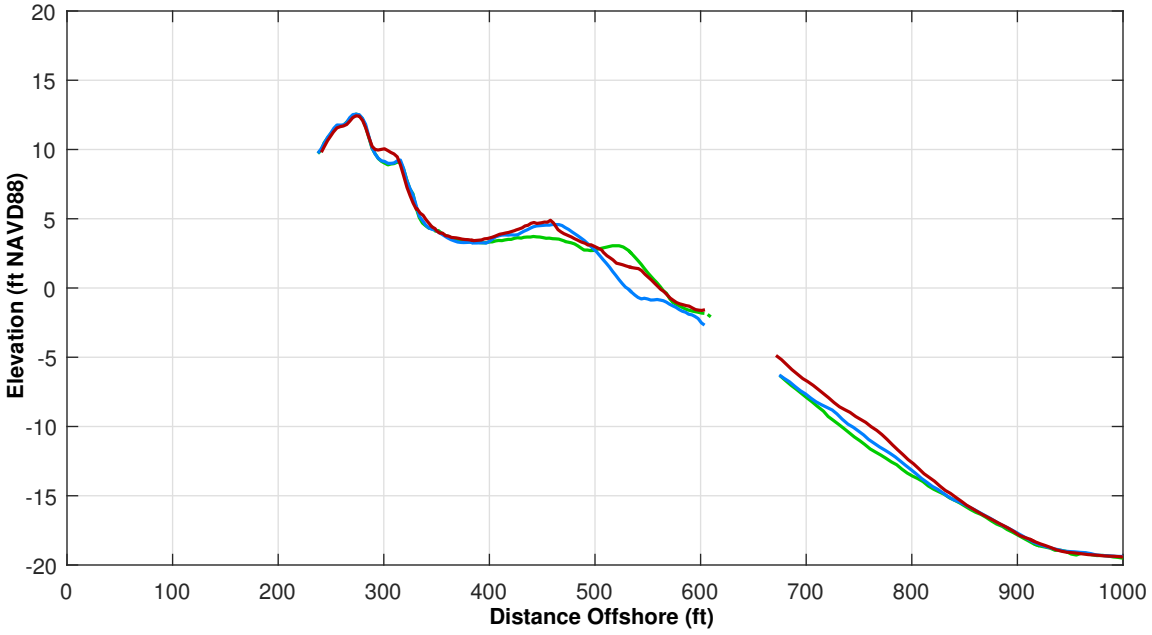
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 187+63	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-4.38 ft/yr	28.55 ft
Volume Change Above -15 ft NAVD88	10.08 cy/ft/yr	9.34 cy/ft
Volume Change Above 0 ft NAVD88	1.81 cy/ft/yr	2.78 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

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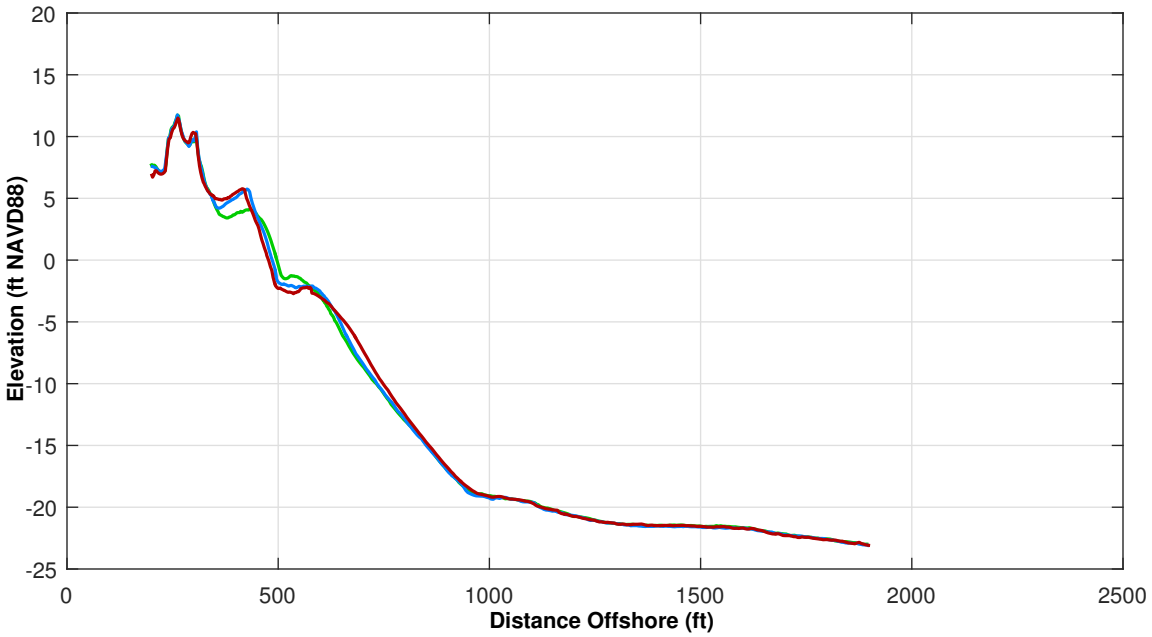
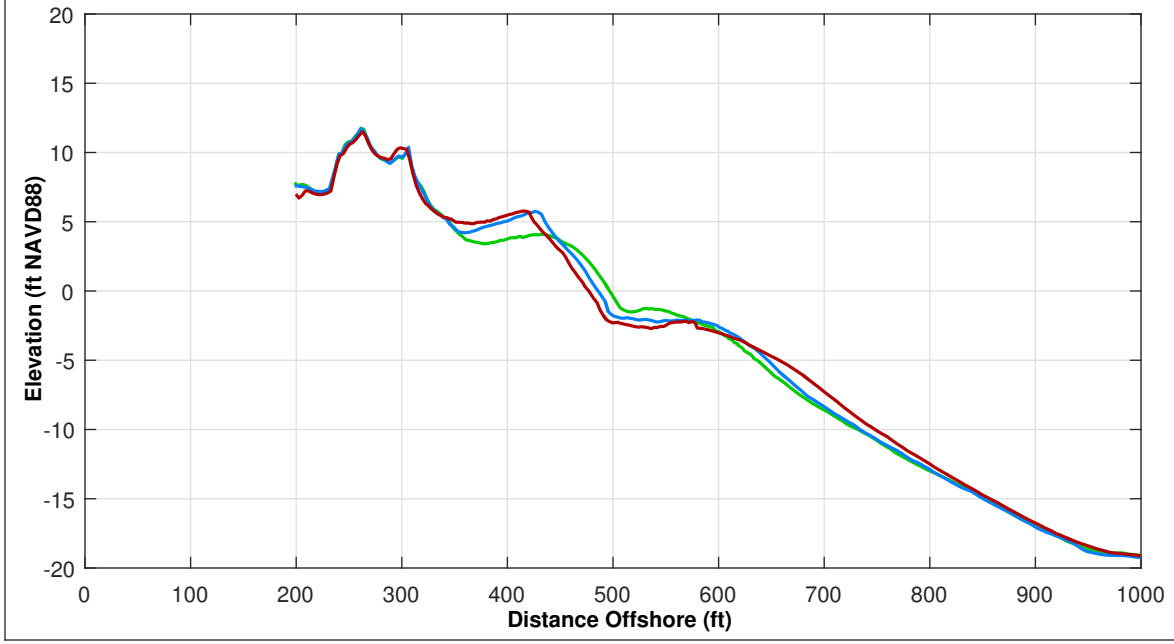
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 189+63	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-23.80 ft/yr	-9.72 ft
Volume Change Above -15 ft NAVD88	5.05 cy/ft/yr	1.65 cy/ft
Volume Change Above 0 ft NAVD88	1.41 cy/ft/yr	-1.28 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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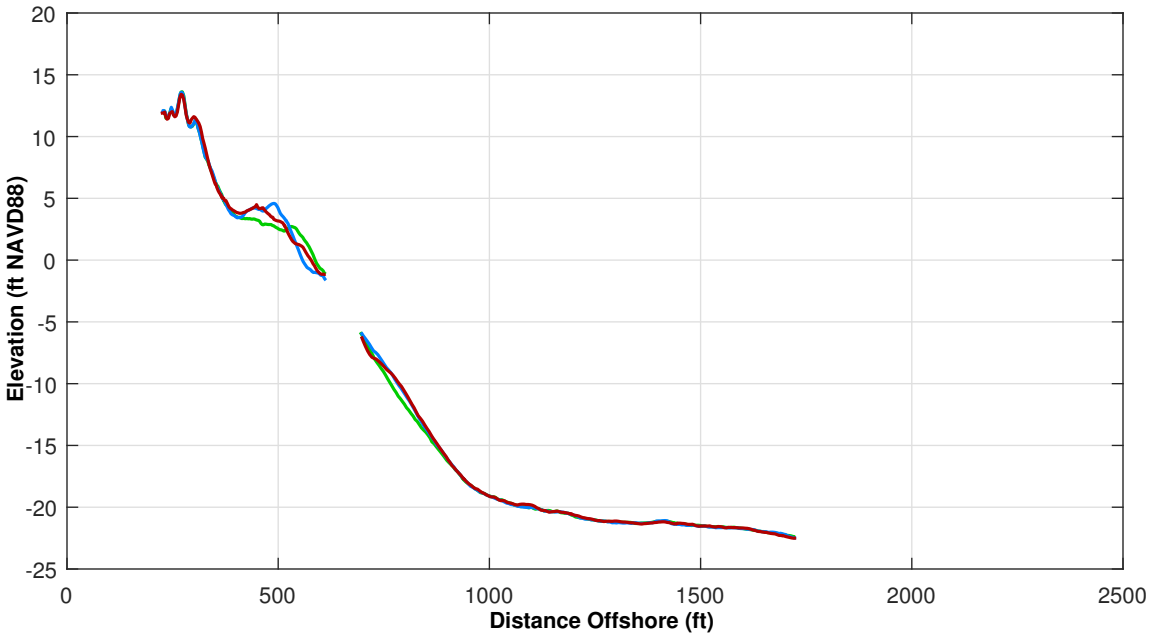

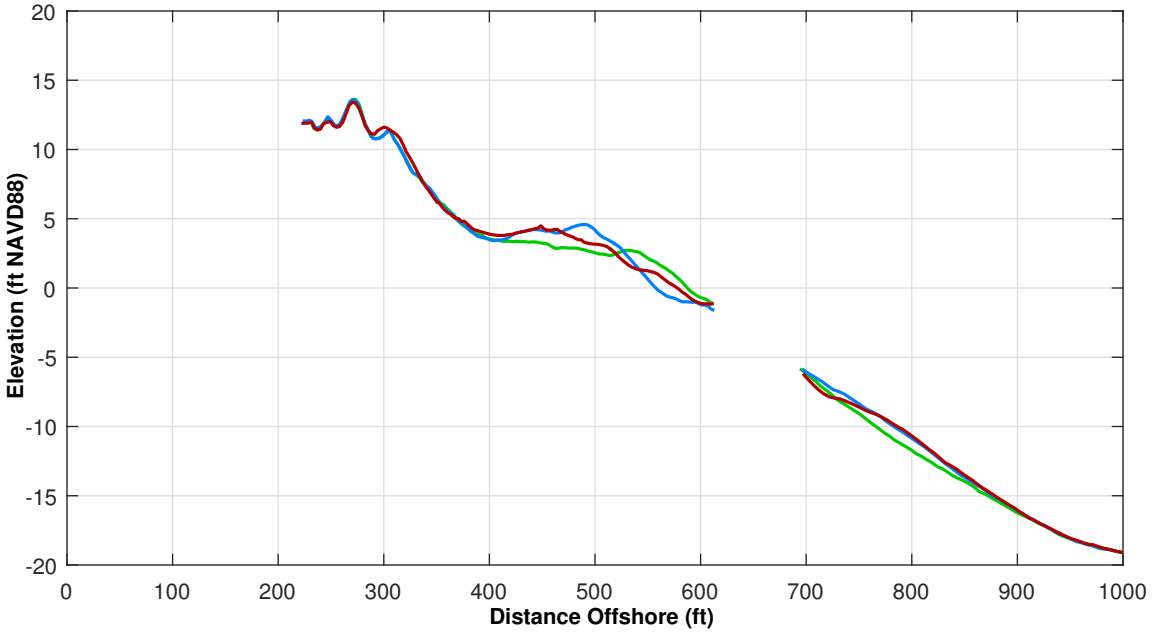

Survey Transect 191+63	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-16.93 ft/yr	13.55 ft
Volume Change Above -15 ft NAVD88	5.38 cy/ft/yr	0.63 cy/ft
Volume Change Above 0 ft NAVD88	2.09 cy/ft/yr	-0.13 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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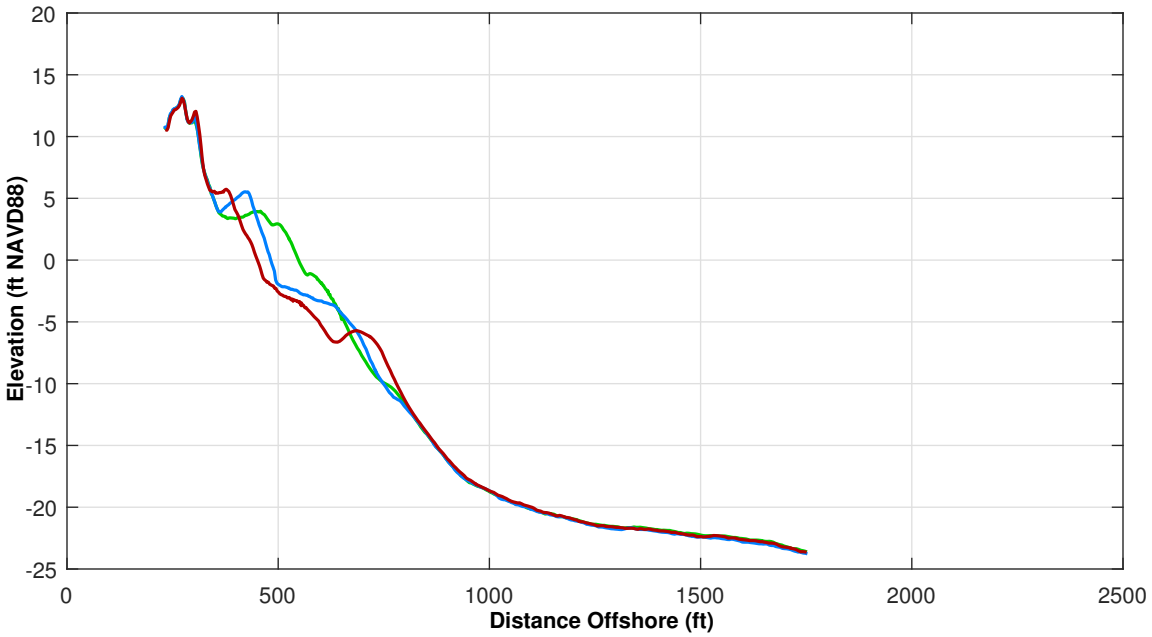

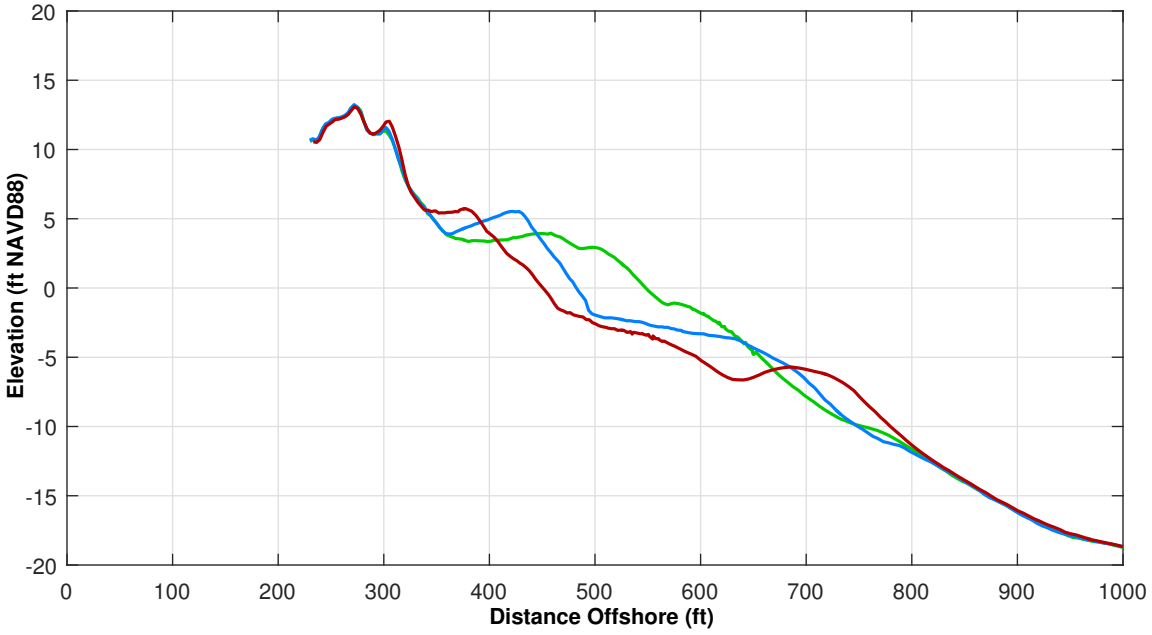

Survey Transect 193+63	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-108.37 ft/yr	-32.74 ft
Volume Change Above -15 ft NAVD88	-24.35 cy/ft/yr	-10.61 cy/ft
Volume Change Above 0 ft NAVD88	-9.86 cy/ft/yr	-5.44 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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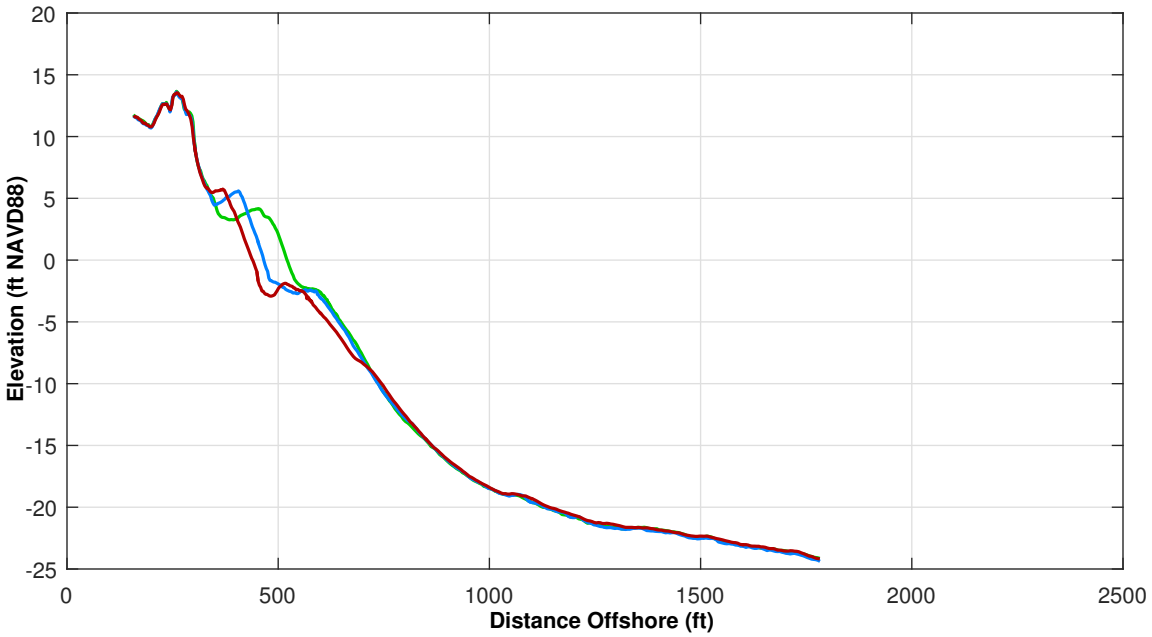

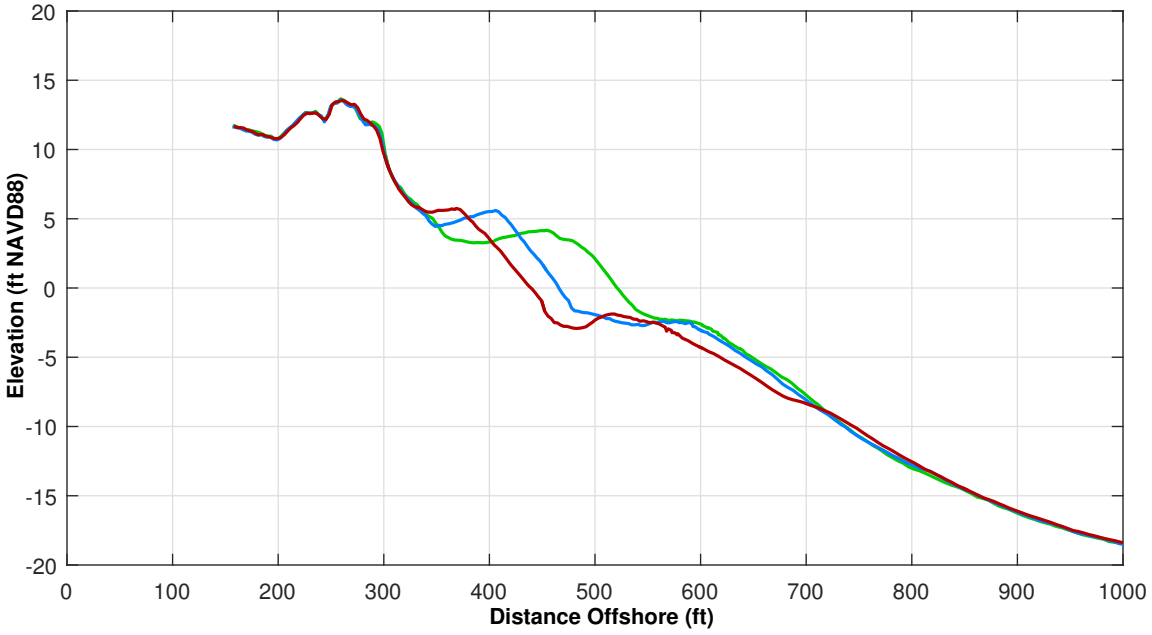

Survey Transect 195+63	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-94.89 ft/yr	-28.75 ft
Volume Change Above -15 ft NAVD88	-24.81 cy/ft/yr	-11.30 cy/ft
Volume Change Above 0 ft NAVD88	-10.22 cy/ft/yr	-4.80 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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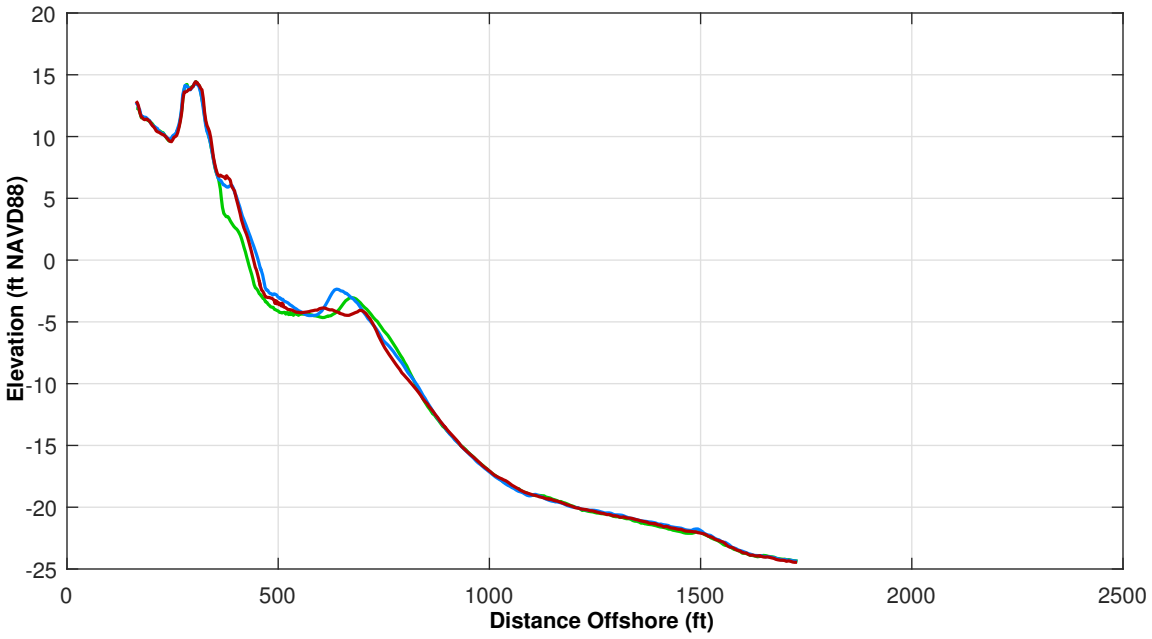

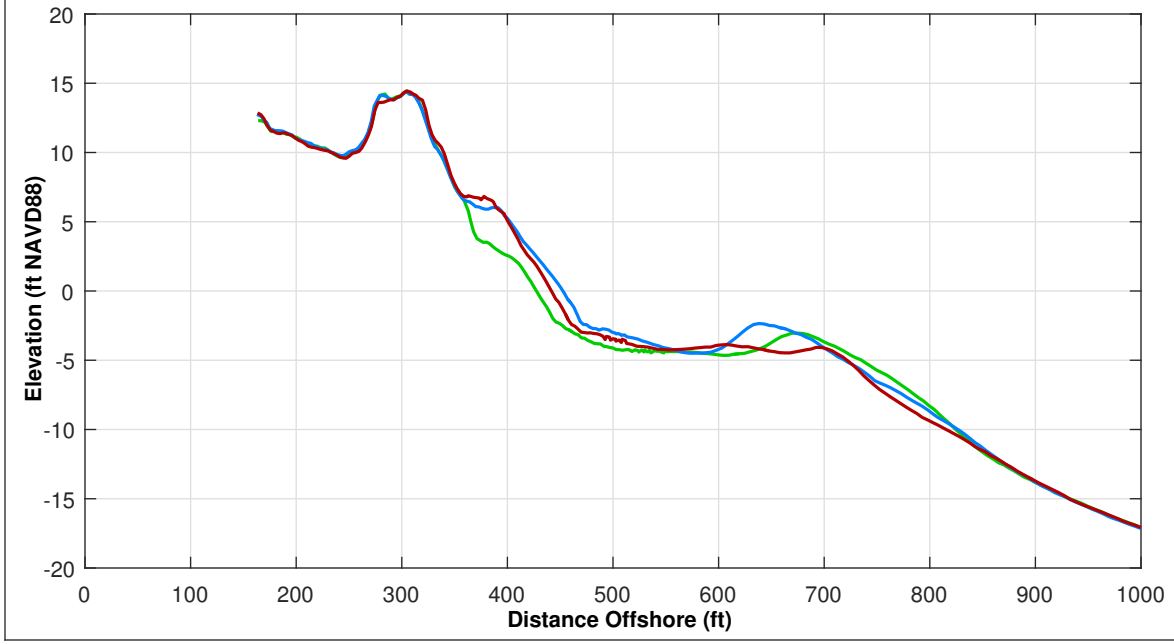

Survey Transect 206+86	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	16.97 ft/yr	-9.03 ft
Volume Change Above -15 ft NAVD88	5.08 cy/ft/yr	-8.65 cy/ft
Volume Change Above 0 ft NAVD88	7.33 cy/ft/yr	-0.63 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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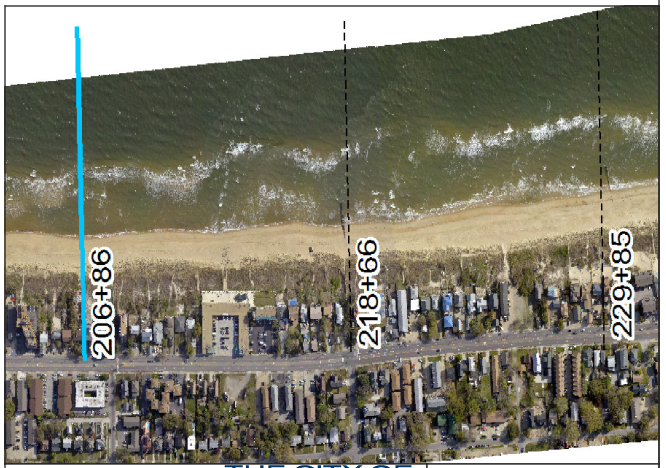

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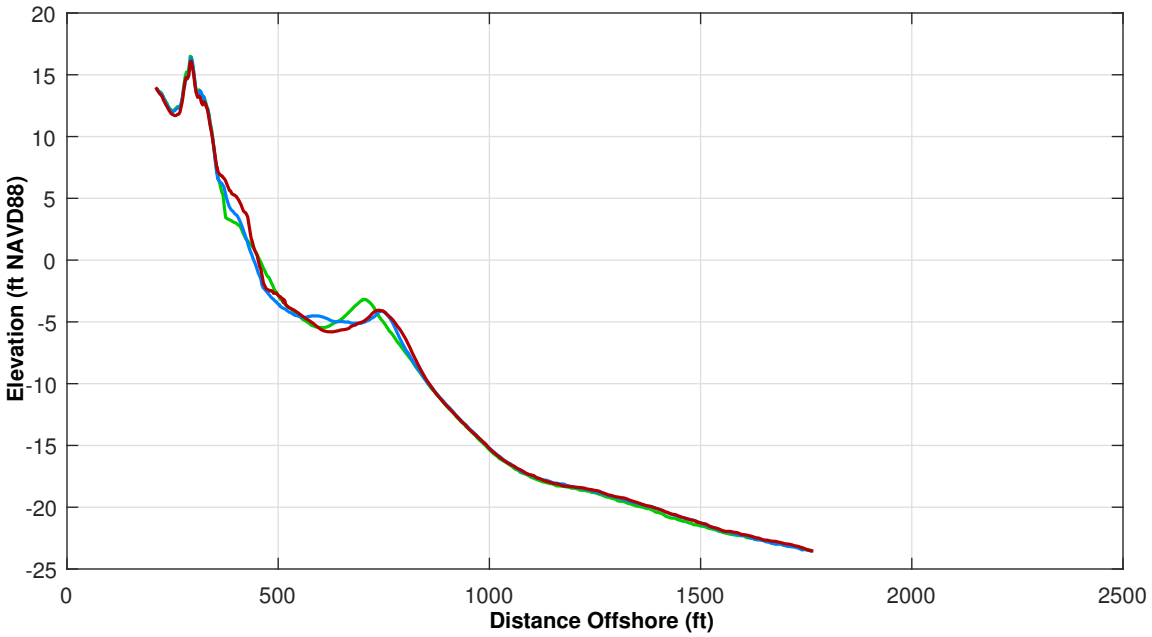

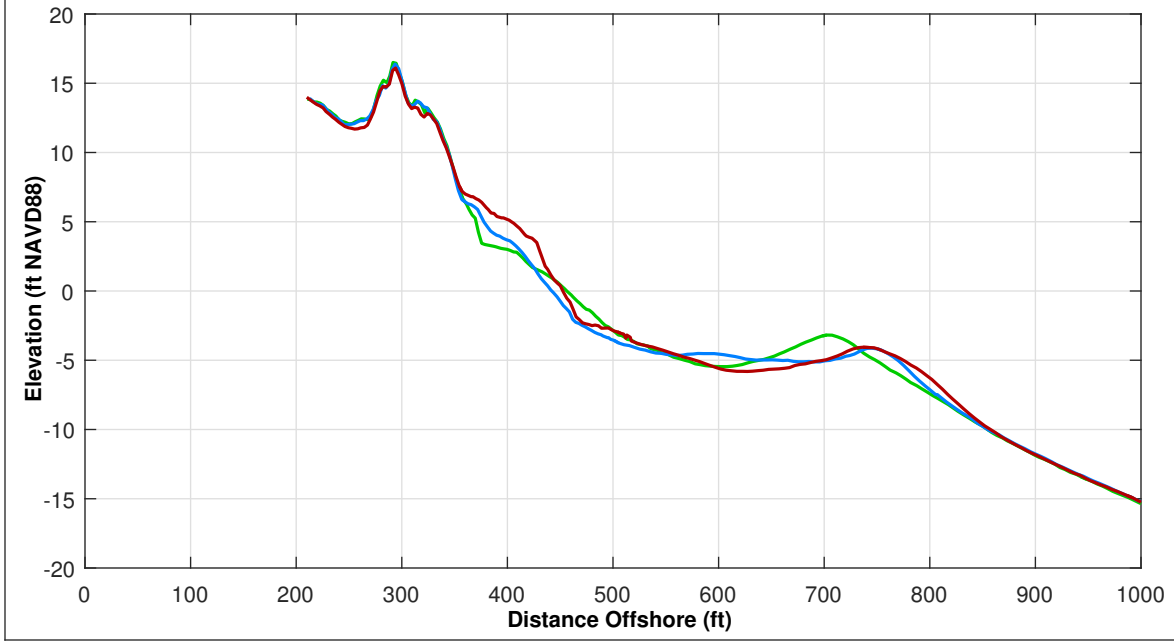

Survey Transect 218+66	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	1.71 ft/yr	11.40 ft
Volume Change Above -15 ft NAVD88	2.90 cy/ft/yr	4.31 cy/ft
Volume Change Above 0 ft NAVD88	4.68 cy/ft/yr	3.42 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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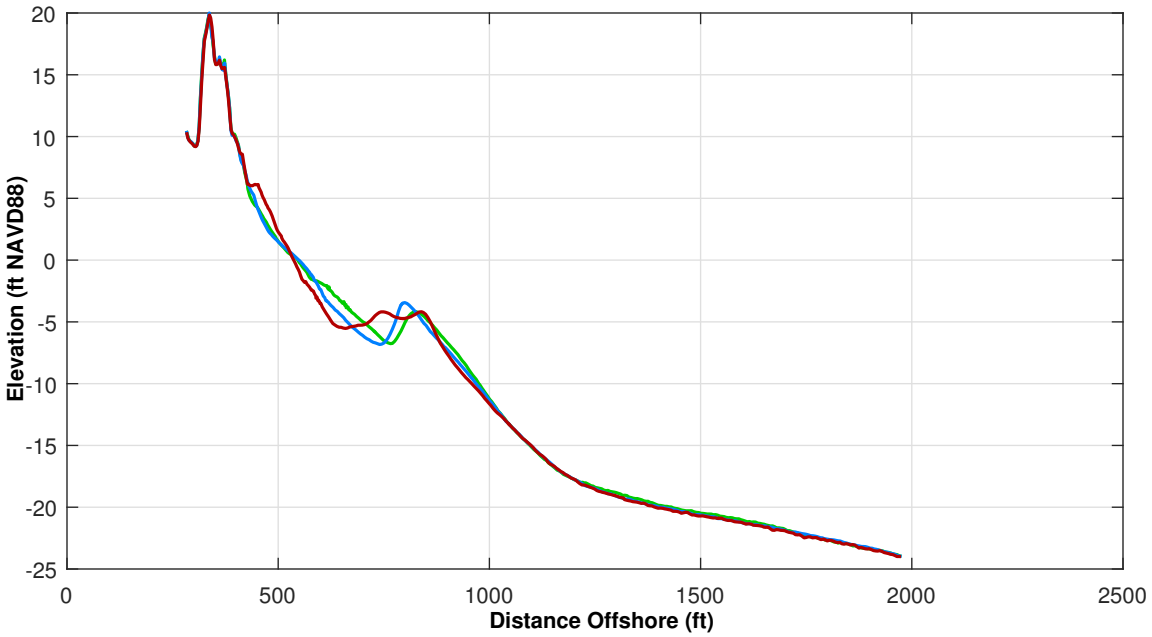

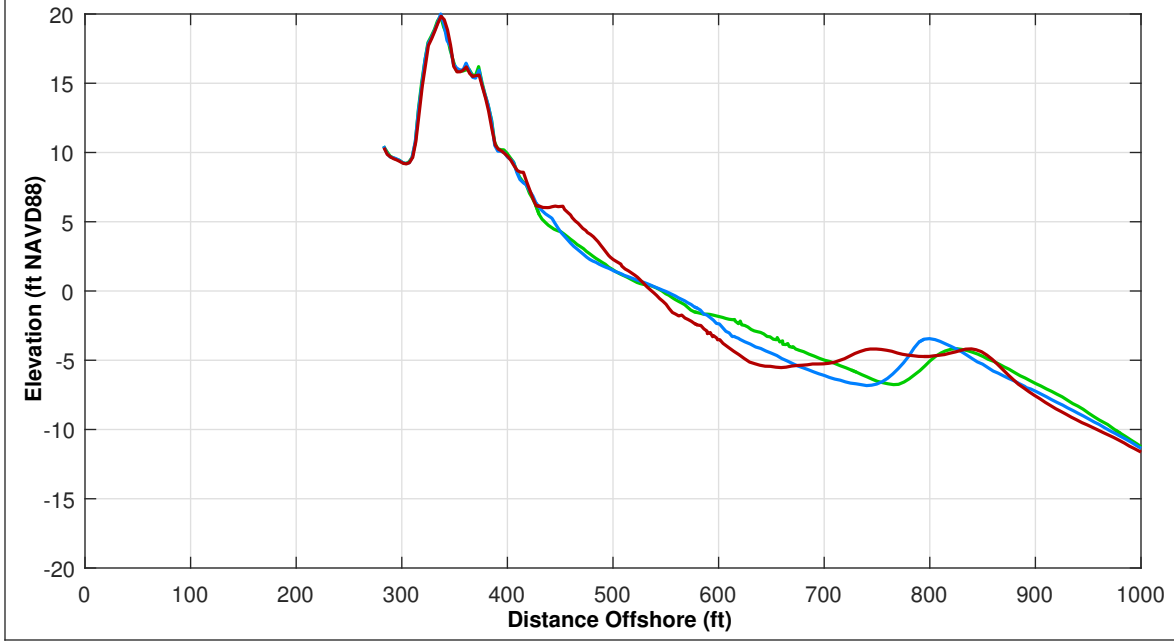

Survey Transect 229+85	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	10.95 ft/yr	7.27 ft
Volume Change Above -15 ft NAVD88	-4.22 cy/ft/yr	2.05 cy/ft
Volume Change Above 0 ft NAVD88	4.20 cy/ft/yr	3.81 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
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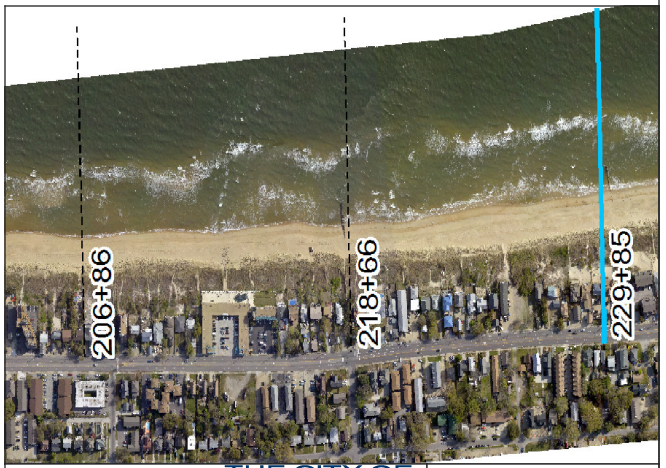
4. Survey Comparison Made to MAY 2017 and OCT 2017
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.



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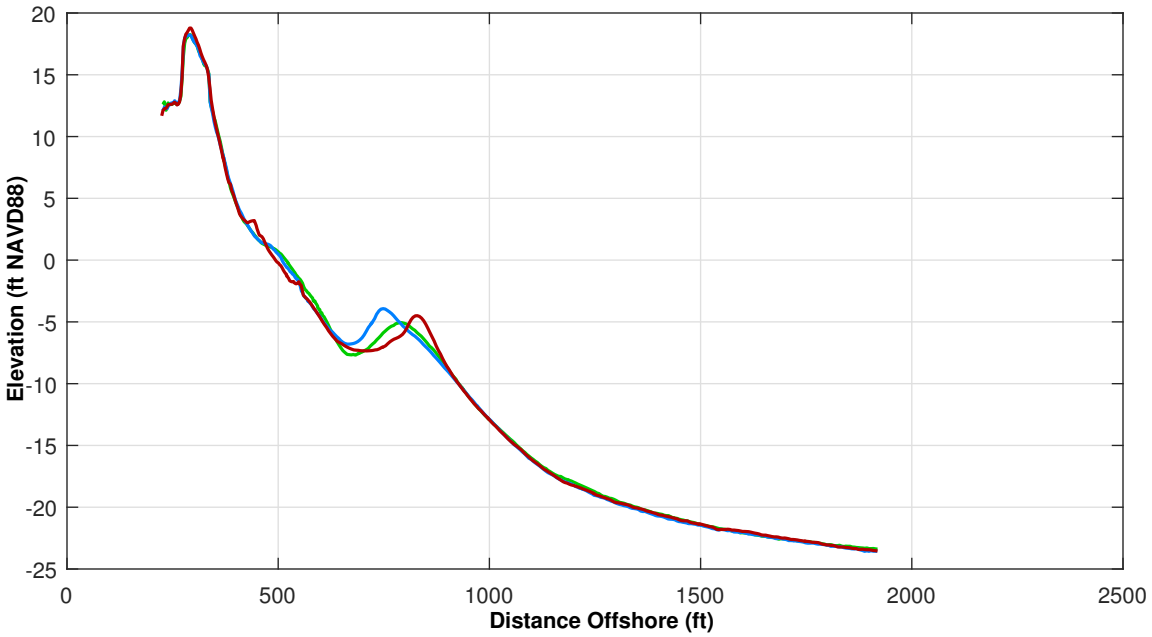
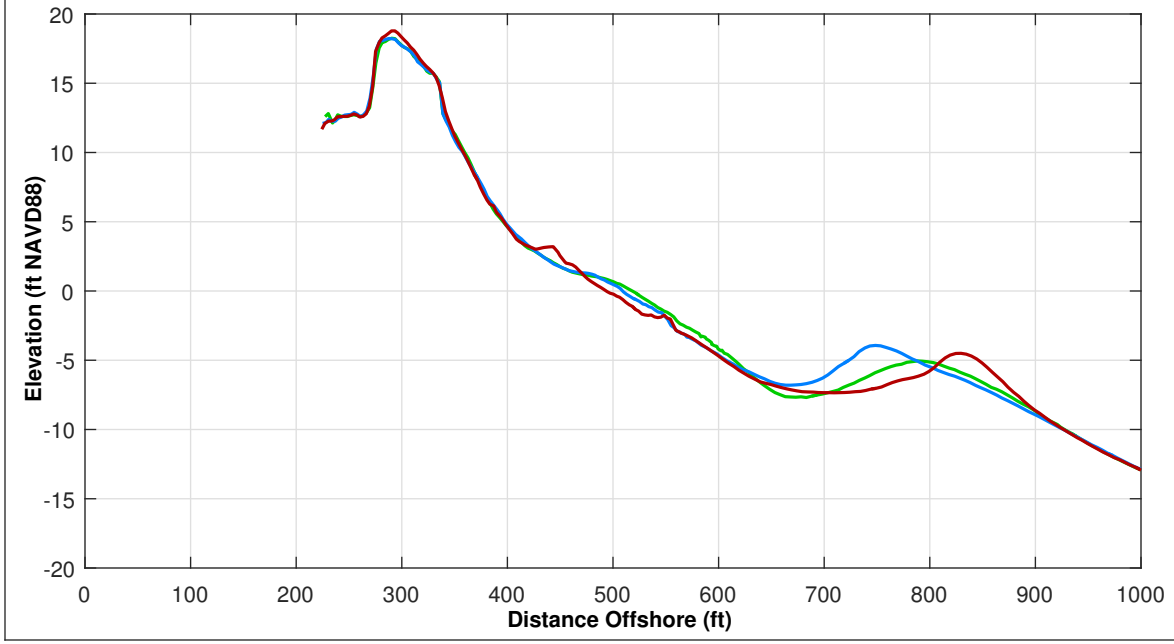
ST 229+85	Pg 65 of 106	Spring 2018





Survey Transect 242+03	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-14.57 ft/yr	-11.83 ft
Volume Change Above -15 ft NAVD88	-2.02 cy/ft/yr	-4.85 cy/ft
Volume Change Above 0 ft NAVD88	1.20 cy/ft/yr	0.81 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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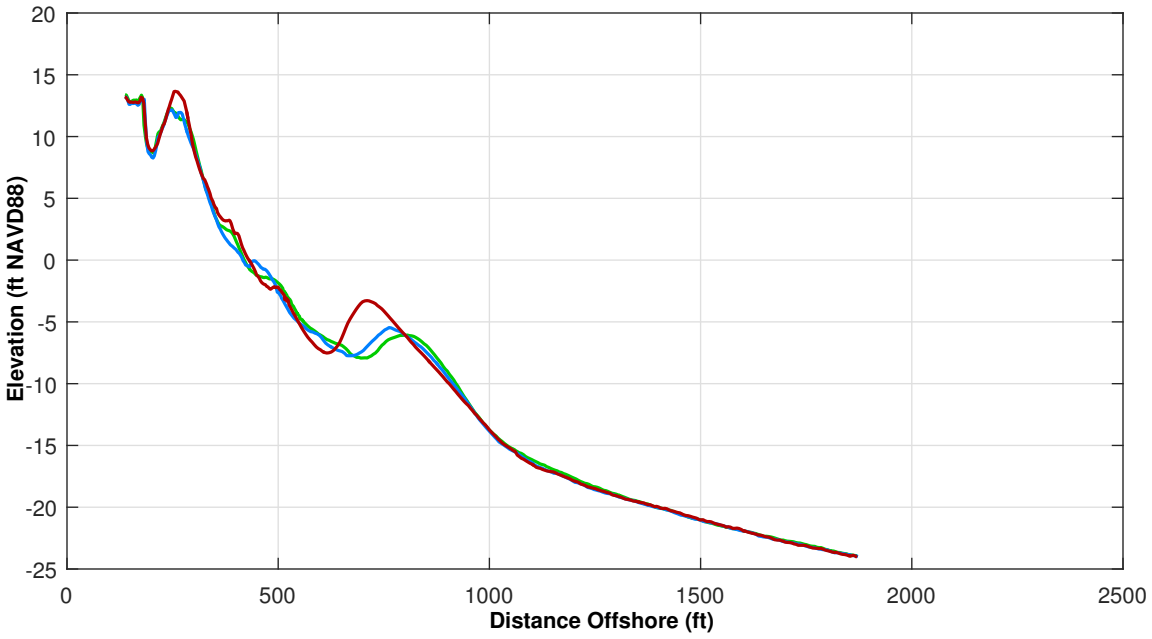

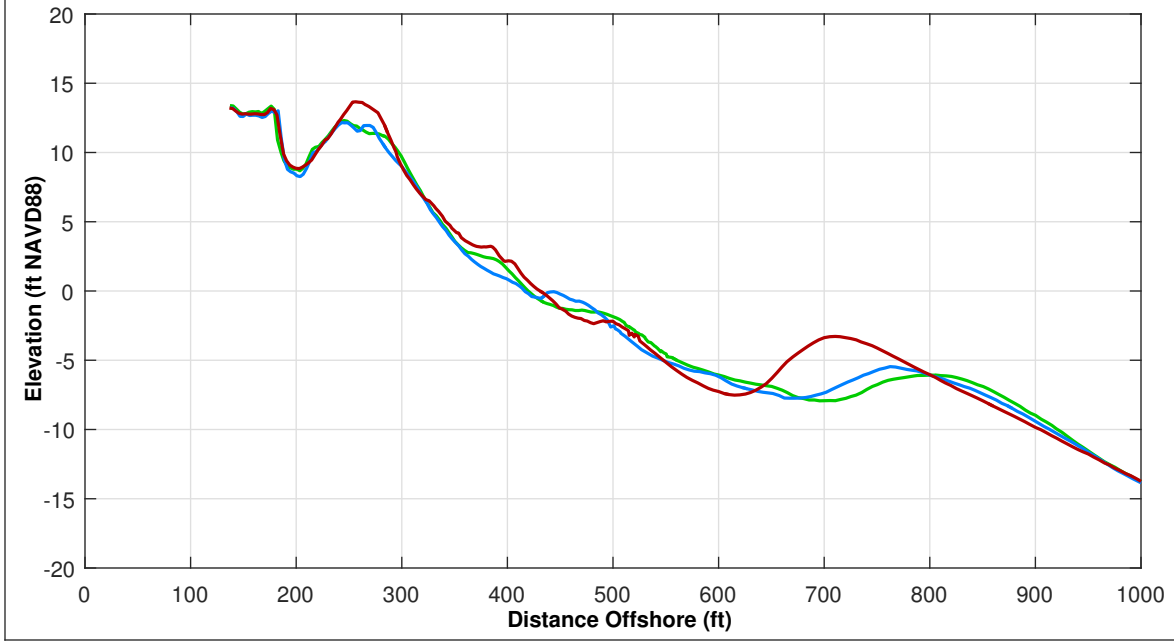

Survey Transect 252+62	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	9.88 ft/yr	20.45 ft
Volume Change Above -15 ft NAVD88	12.17 cy/ft/yr	14.68 cy/ft
Volume Change Above 0 ft NAVD88	4.94 cy/ft/yr	7.09 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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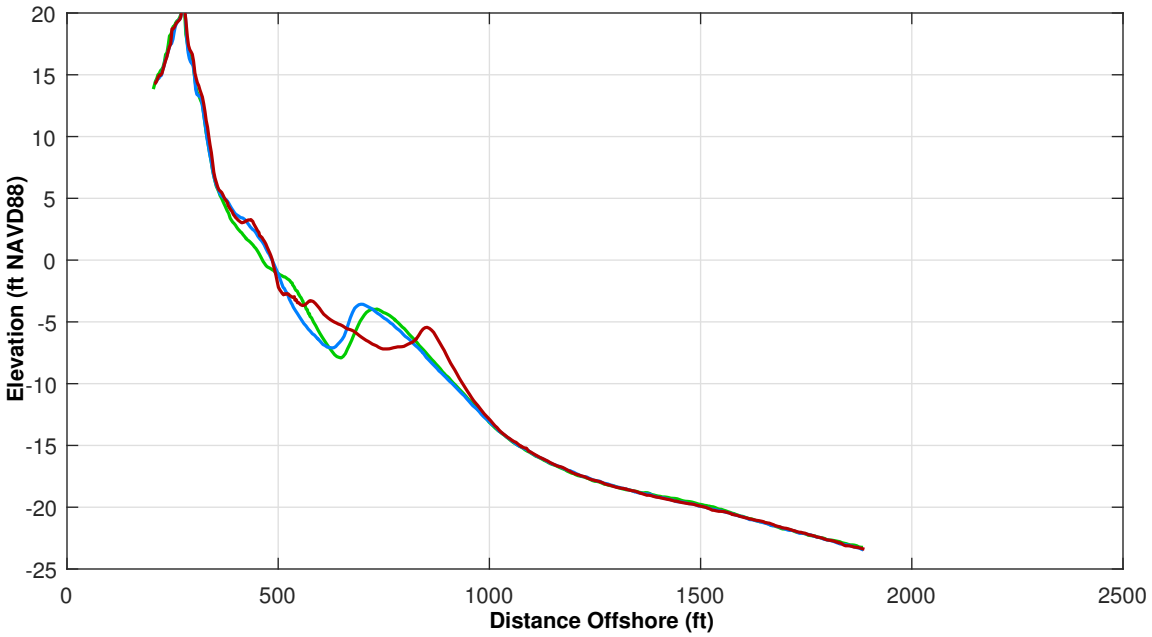

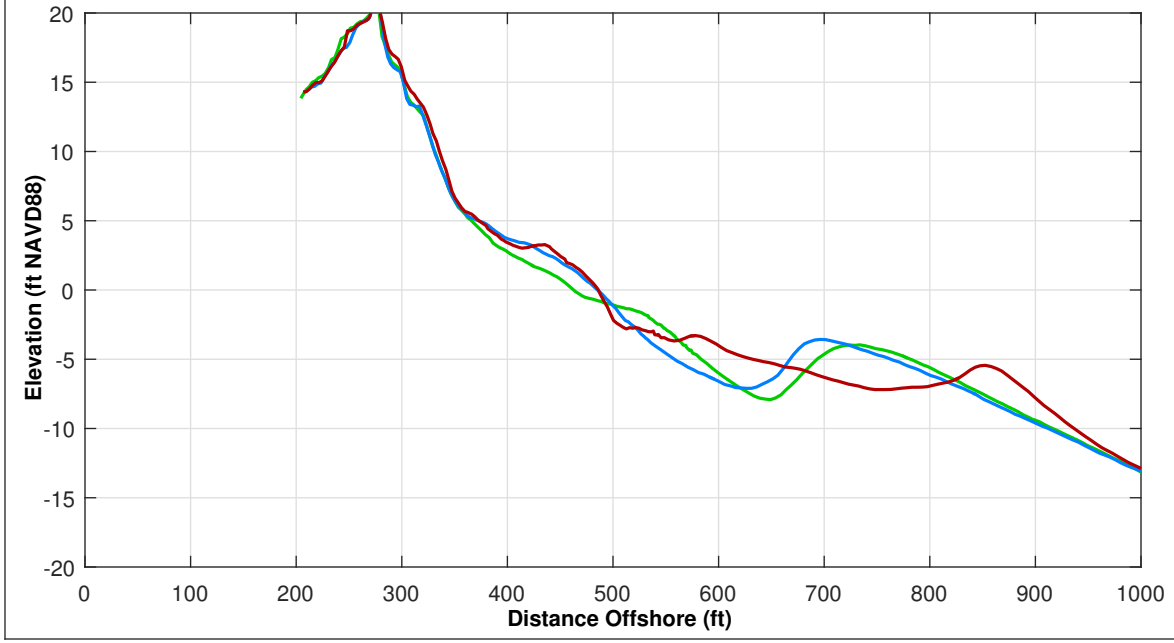

Survey Transect 263+22	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	32.51 ft/yr	4.40 ft
Volume Change Above -15 ft NAVD88	11.08 cy/ft/yr	8.76 cy/ft
Volume Change Above 0 ft NAVD88	7.11 cy/ft/yr	2.65 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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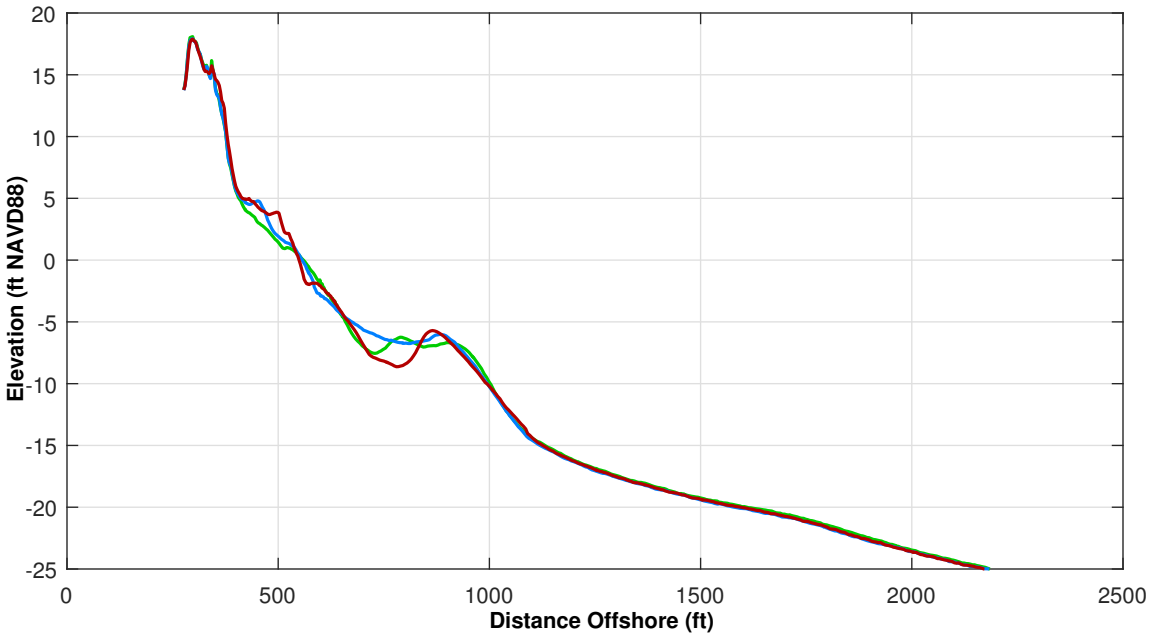

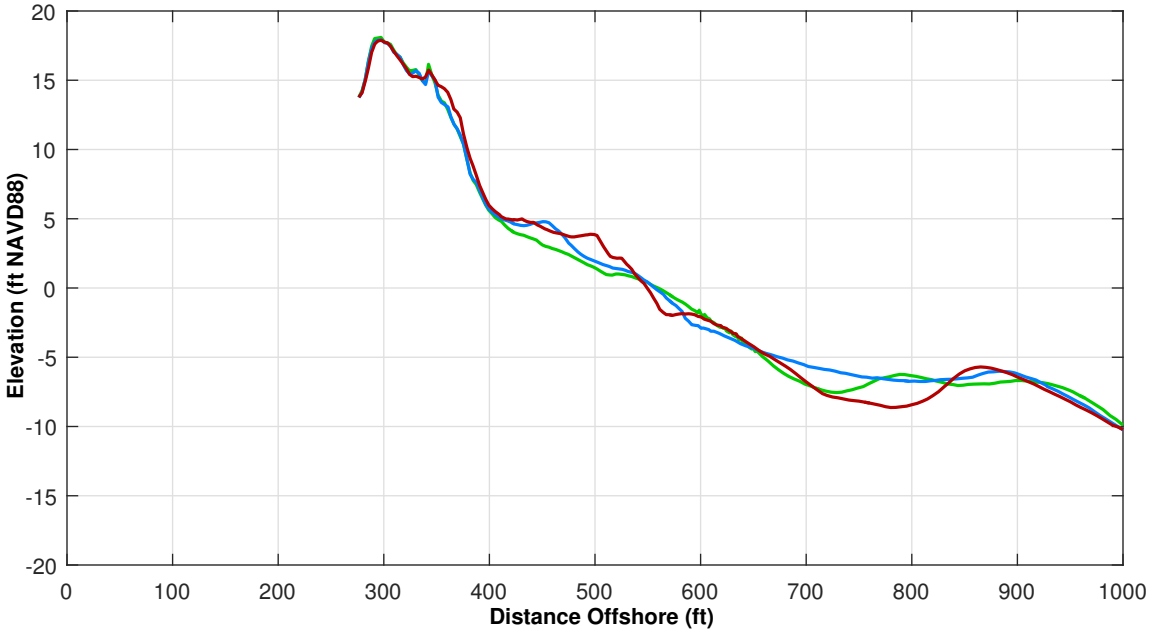

Survey Transect 274+53	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	14.24 ft/yr	-1.17 ft
Volume Change Above -15 ft NAVD88	1.88 cy/ft/yr	-3.87 cy/ft
Volume Change Above 0 ft NAVD88	8.48 cy/ft/yr	3.85 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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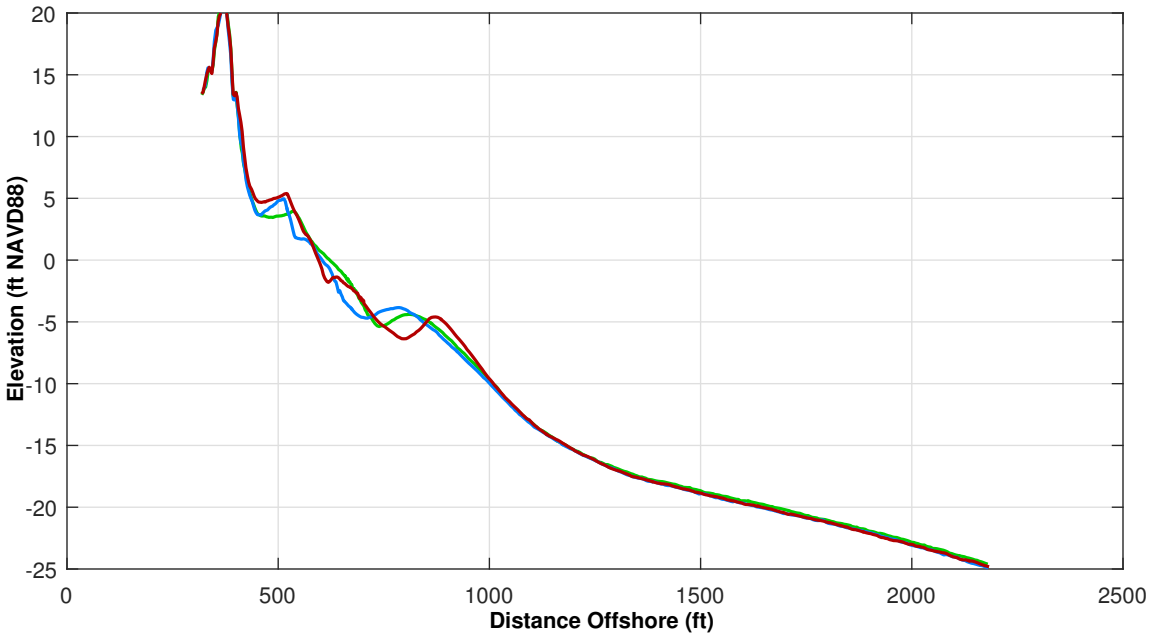
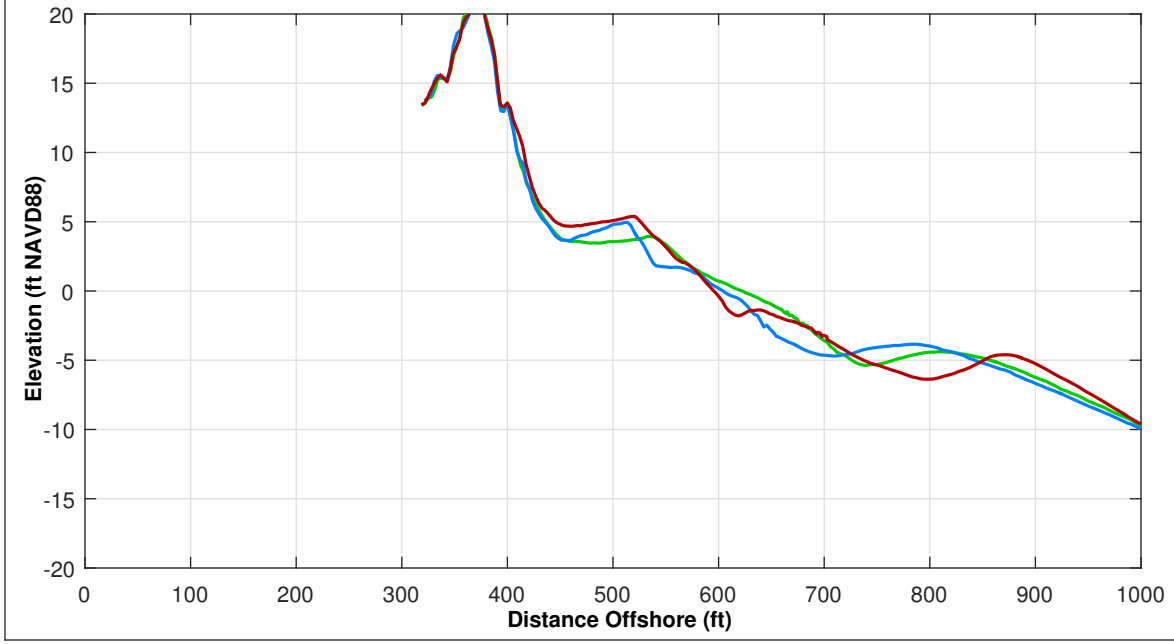
ST 274+53	Pg 69 of 106	Spring 2018





Survey Transect 281+40	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-9.76 ft/yr	-1.79 ft
Volume Change Above -15 ft NAVD88	2.29 cy/ft/yr	8.59 cy/ft
Volume Change Above 0 ft NAVD88	5.65 cy/ft/yr	5.89 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

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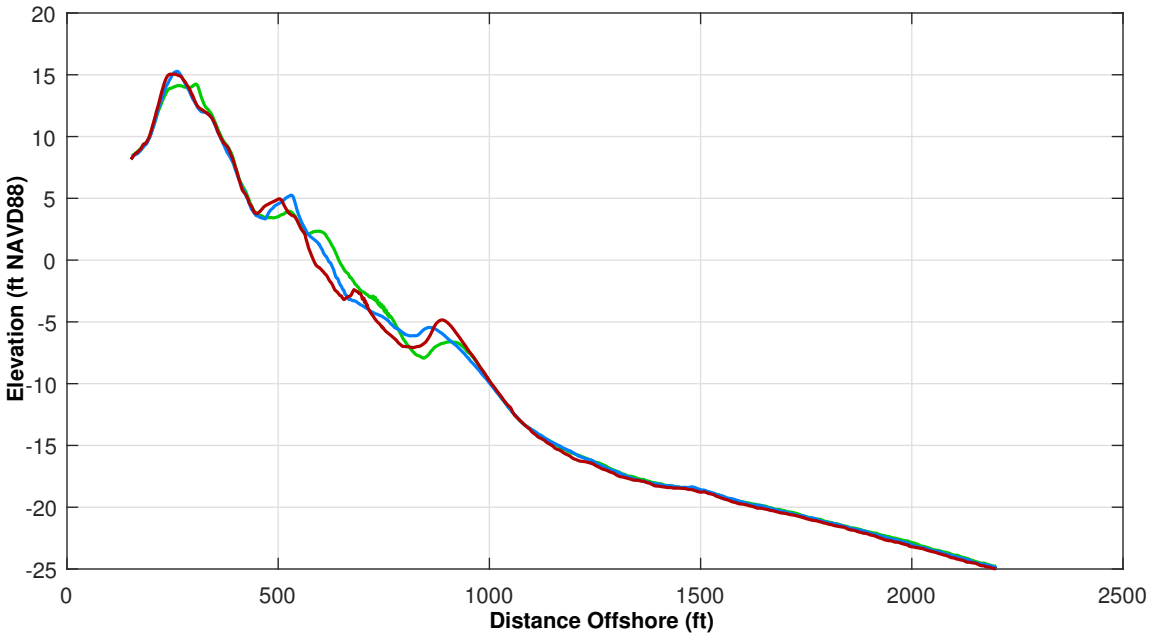

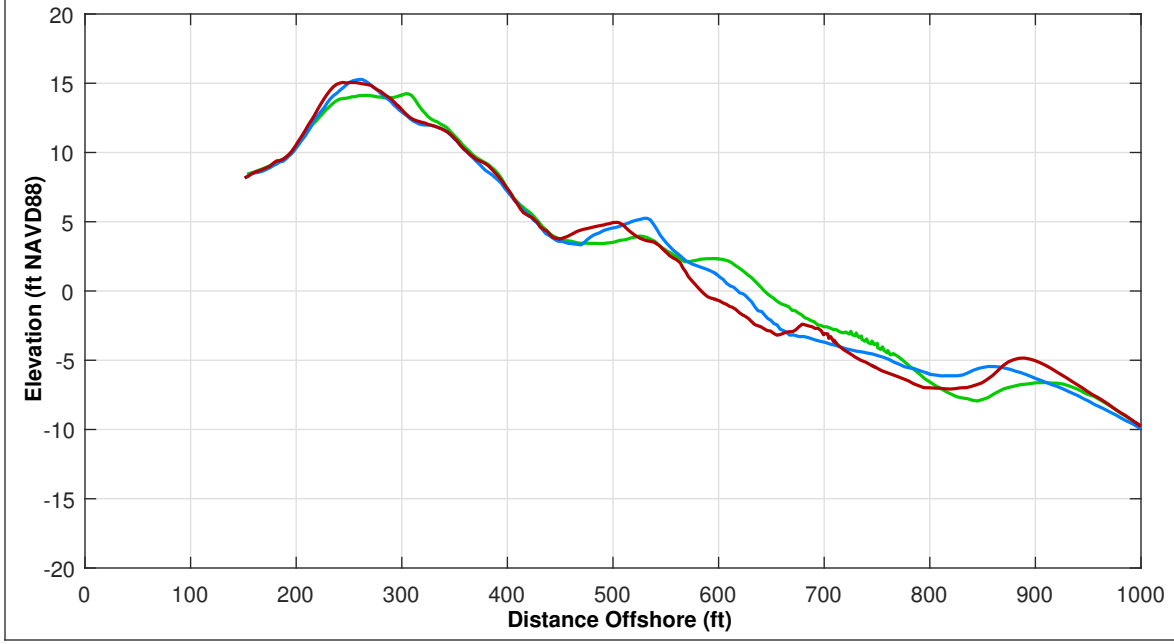

Survey Transect 288+39	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-67.04 ft/yr	-29.59 ft
Volume Change Above -15 ft NAVD88	-8.46 cy/ft/yr	-4.13 cy/ft
Volume Change Above 0 ft NAVD88	-2.46 cy/ft/yr	-1.13 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

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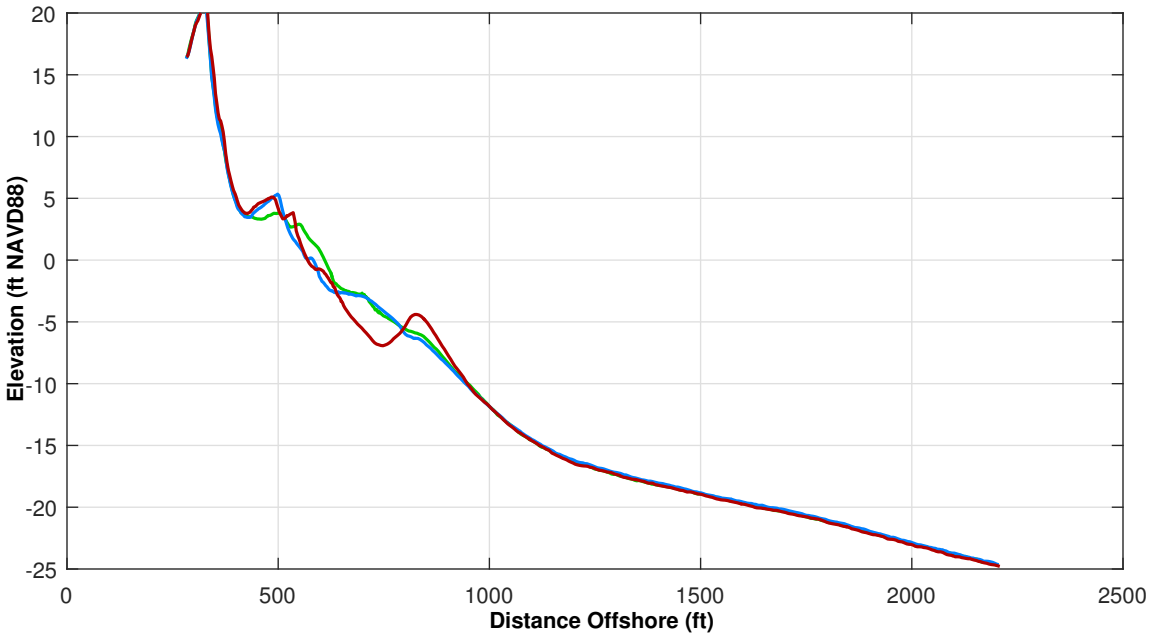

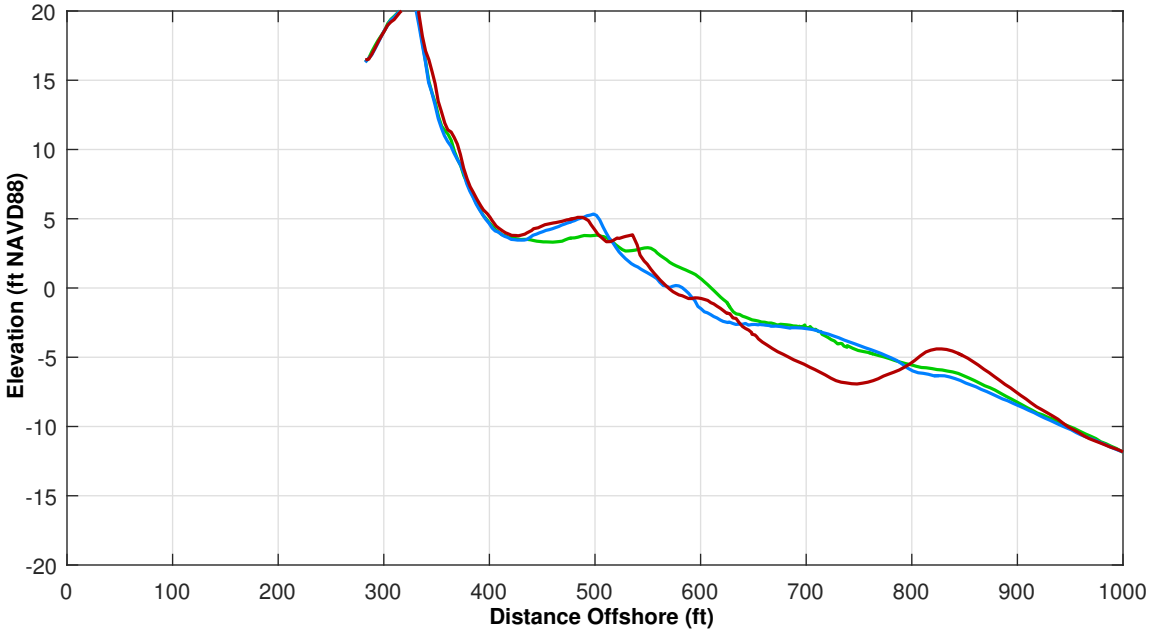

Survey Transect 295+27	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-43.06 ft/yr	4.74 ft
Volume Change Above -15 ft NAVD88	-7.22 cy/ft/yr	-0.25 cy/ft
Volume Change Above 0 ft NAVD88	2.57 cy/ft/yr	4.29 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

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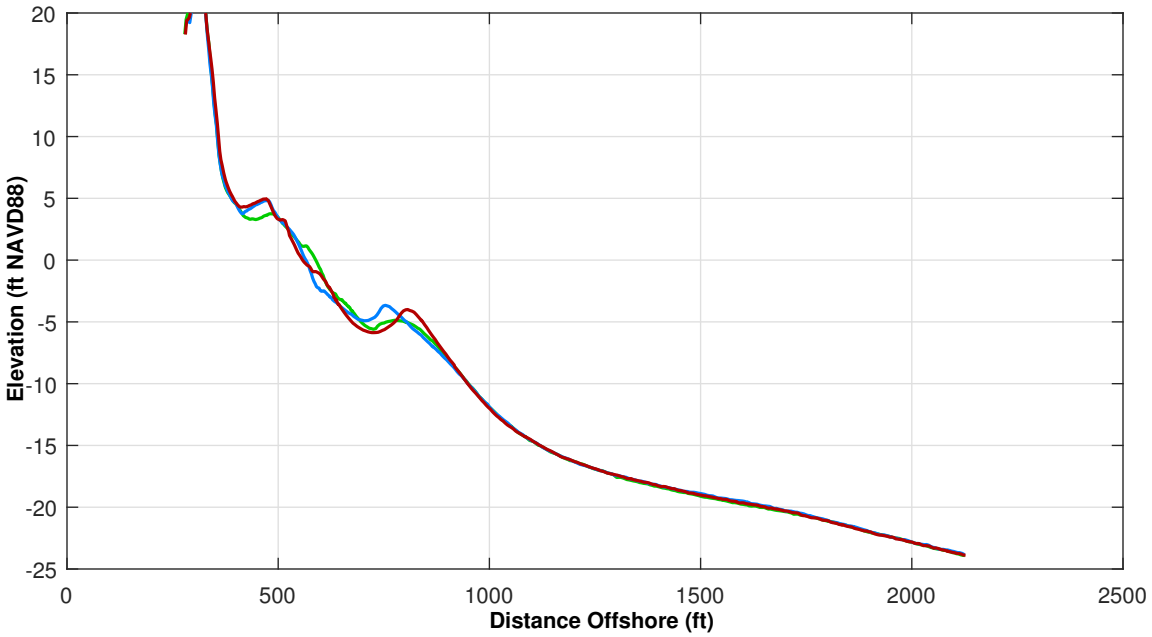

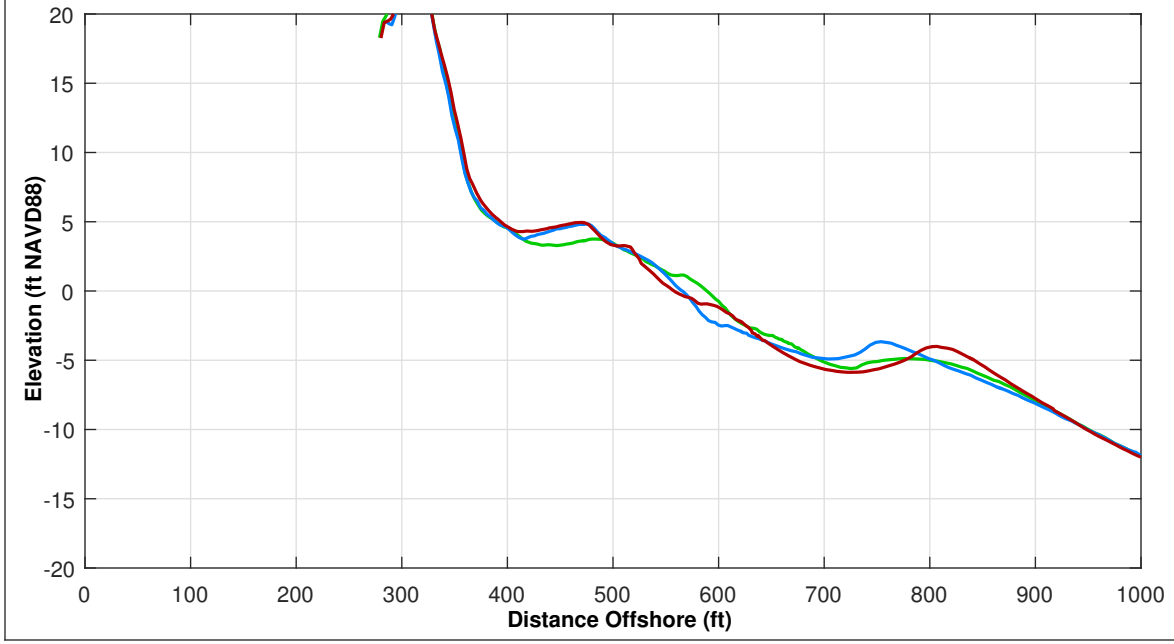

Survey Transect 302+24	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-33.63 ft/yr	-10.69 ft
Volume Change Above -15 ft NAVD88	1.53 cy/ft/yr	2.55 cy/ft
Volume Change Above 0 ft NAVD88	3.14 cy/ft/yr	2.21 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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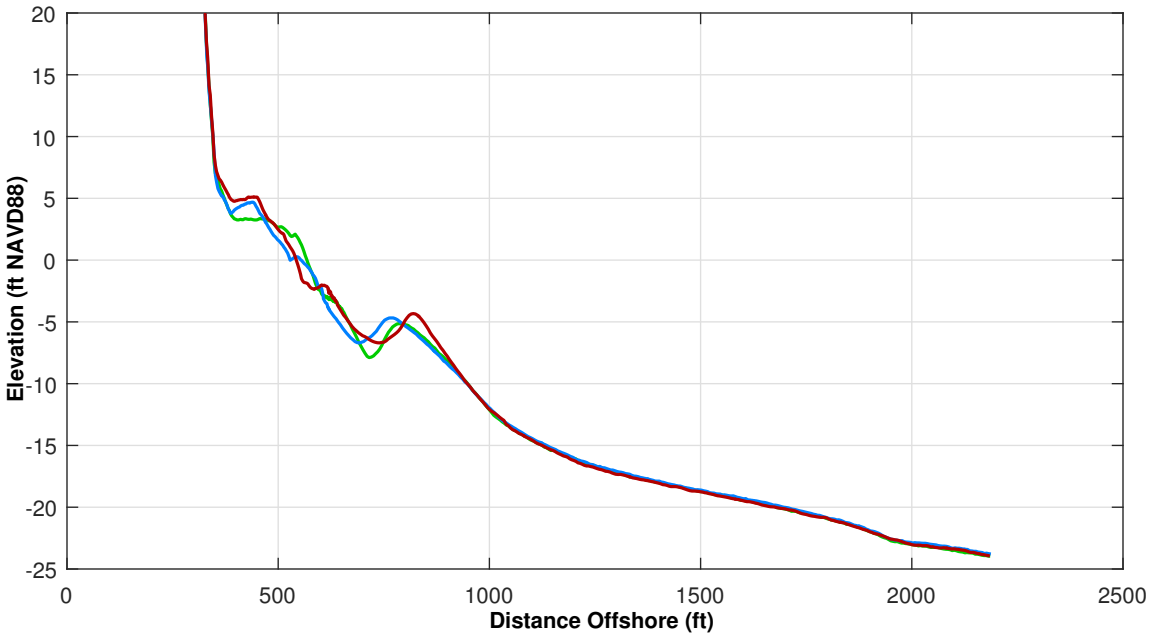

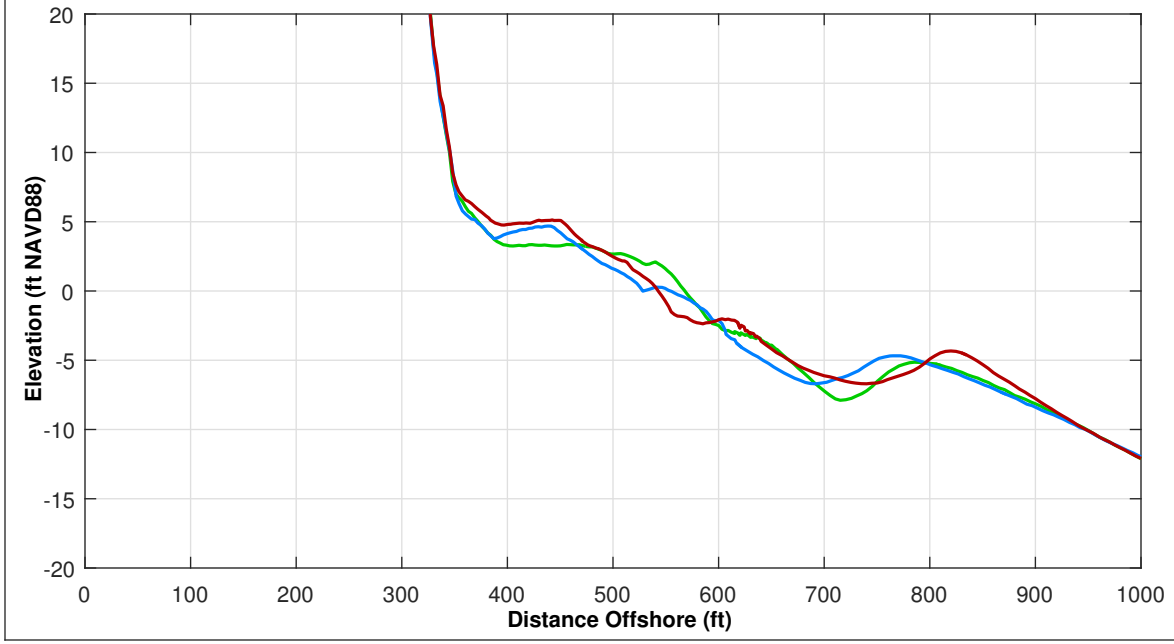

Survey Transect 315+96	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-32.03 ft/yr	14.95 ft
Volume Change Above -15 ft NAVD88	8.60 cy/ft/yr	8.80 cy/ft
Volume Change Above 0 ft NAVD88	4.05 cy/ft/yr	5.66 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

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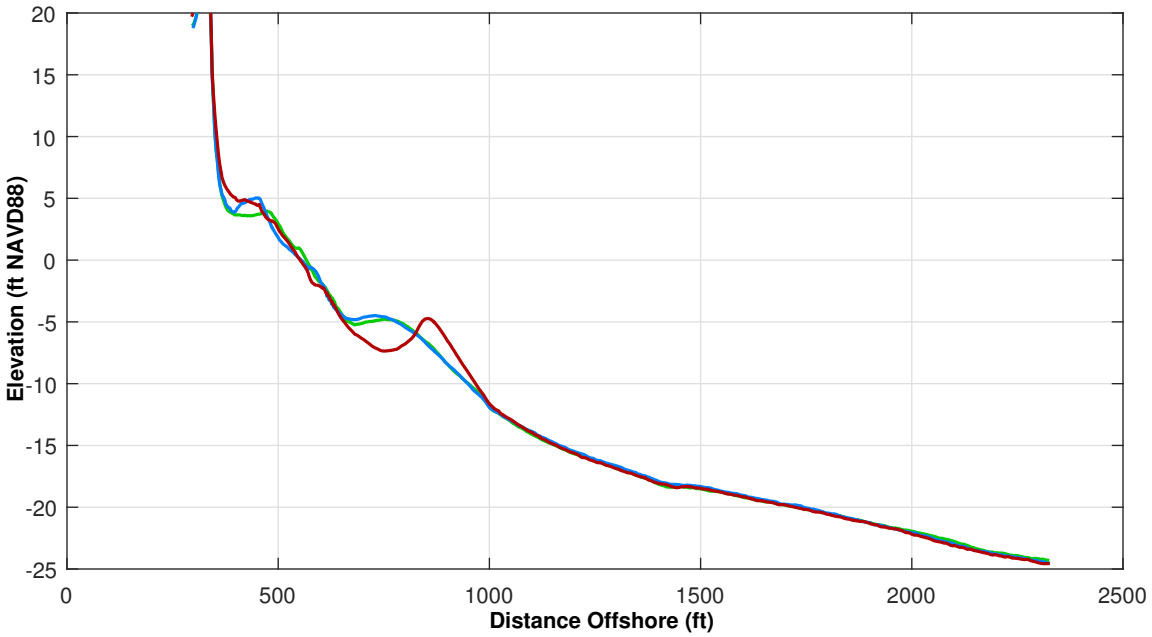

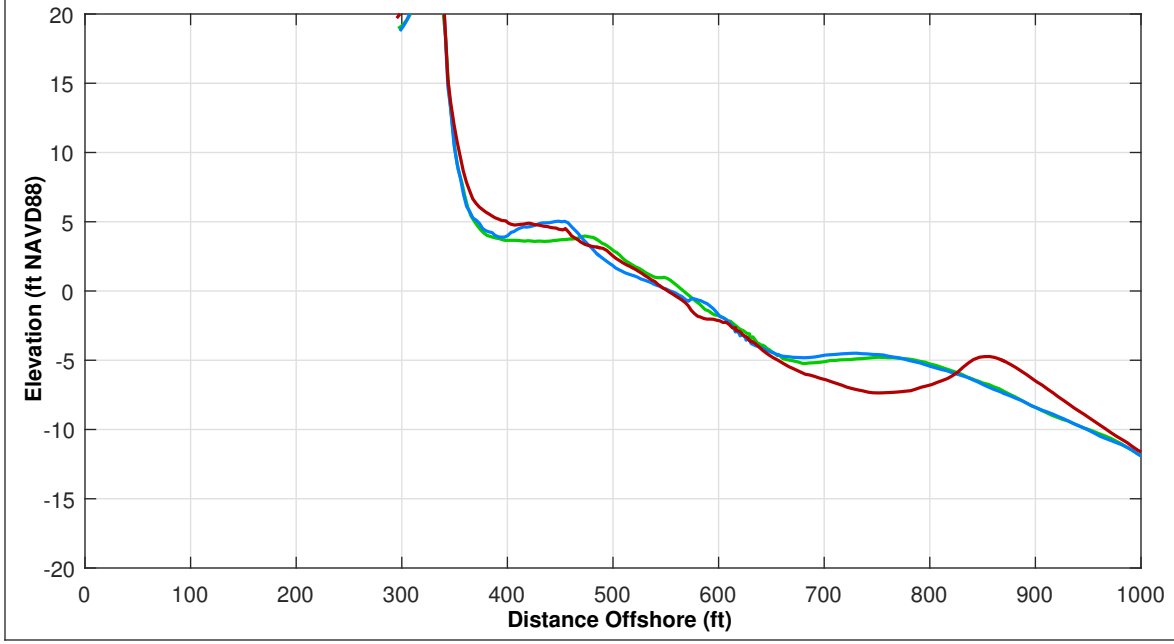

Survey Transect 323+09	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	ft/yr	ft
Volume Change Above -15 ft NAVD88	cy/ft/yr	cy/ft
Volume Change Above 0 ft NAVD88	cy/ft/yr	cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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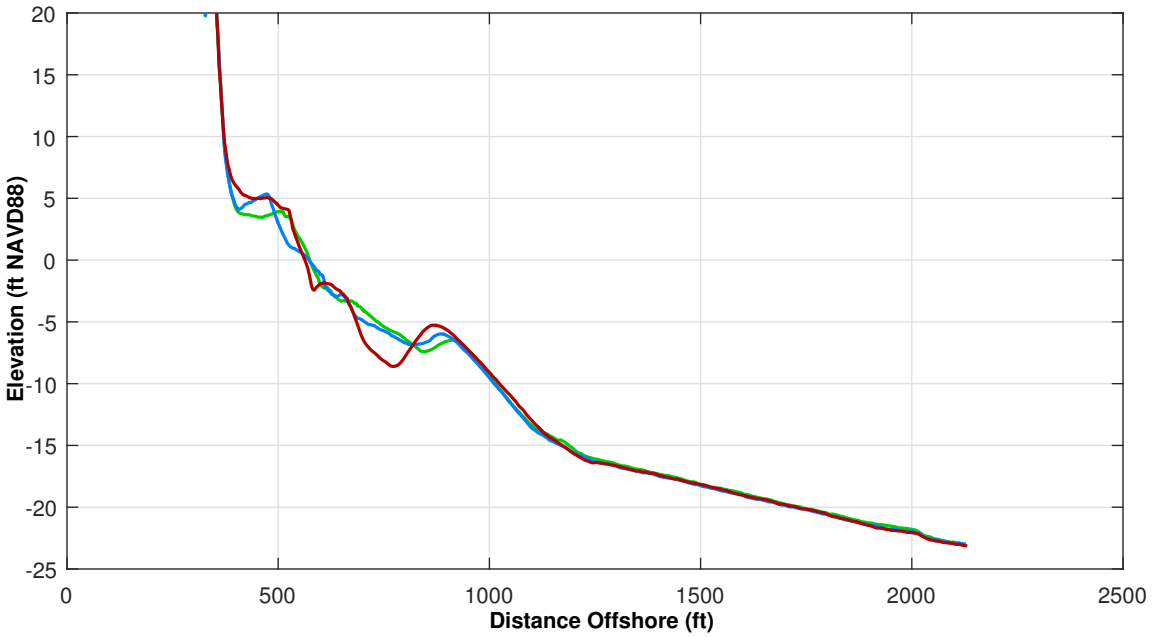

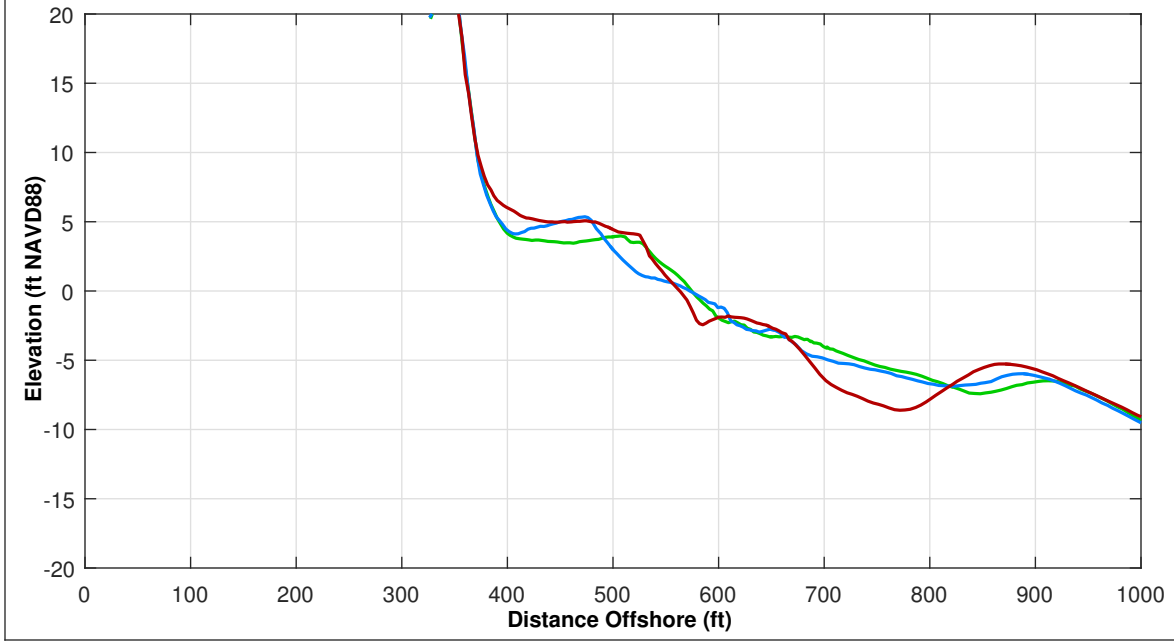

Survey Transect 329+63	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-13.61 ft/yr	16.75 ft
Volume Change Above -15 ft NAVD88	1.38 cy/ft/yr	3.12 cy/ft
Volume Change Above 0 ft NAVD88	7.61 cy/ft/yr	6.52 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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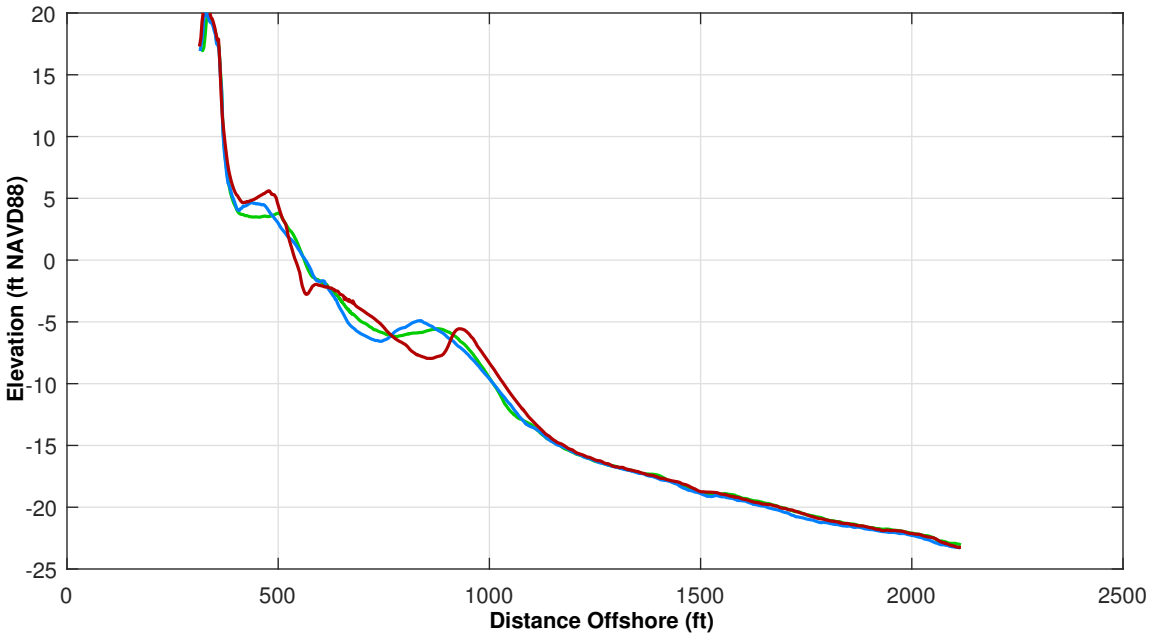

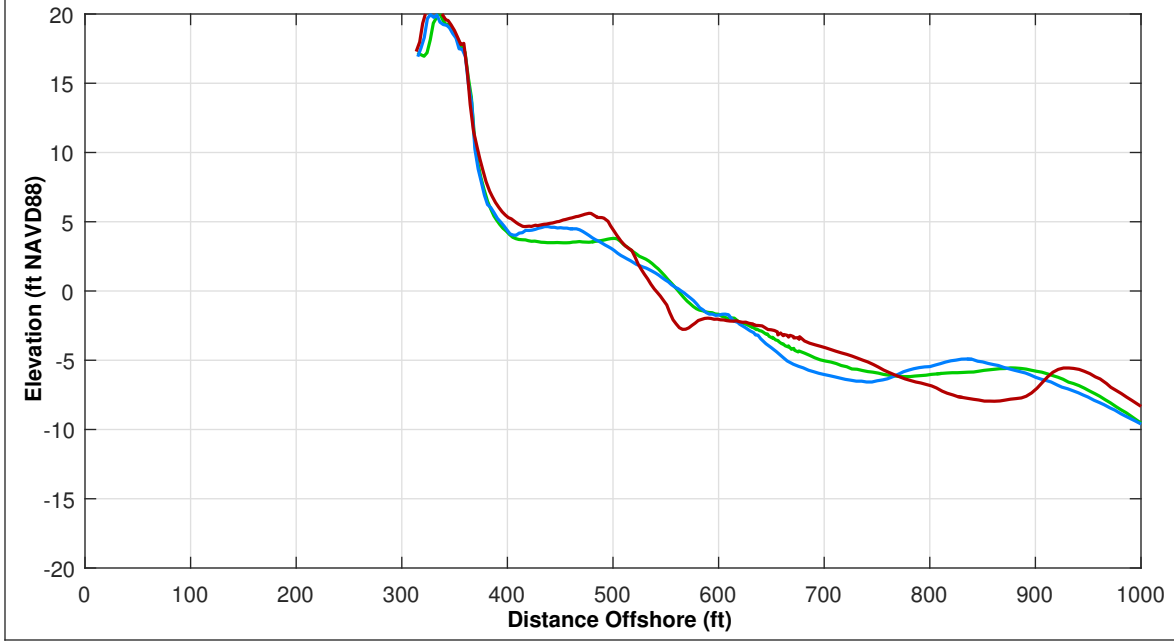

Survey Transect 331+43	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-20.98 ft/yr	-14.27 ft
Volume Change Above -15 ft NAVD88	9.22 cy/ft/yr	9.70 cy/ft
Volume Change Above 0 ft NAVD88	7.51 cy/ft/yr	5.38 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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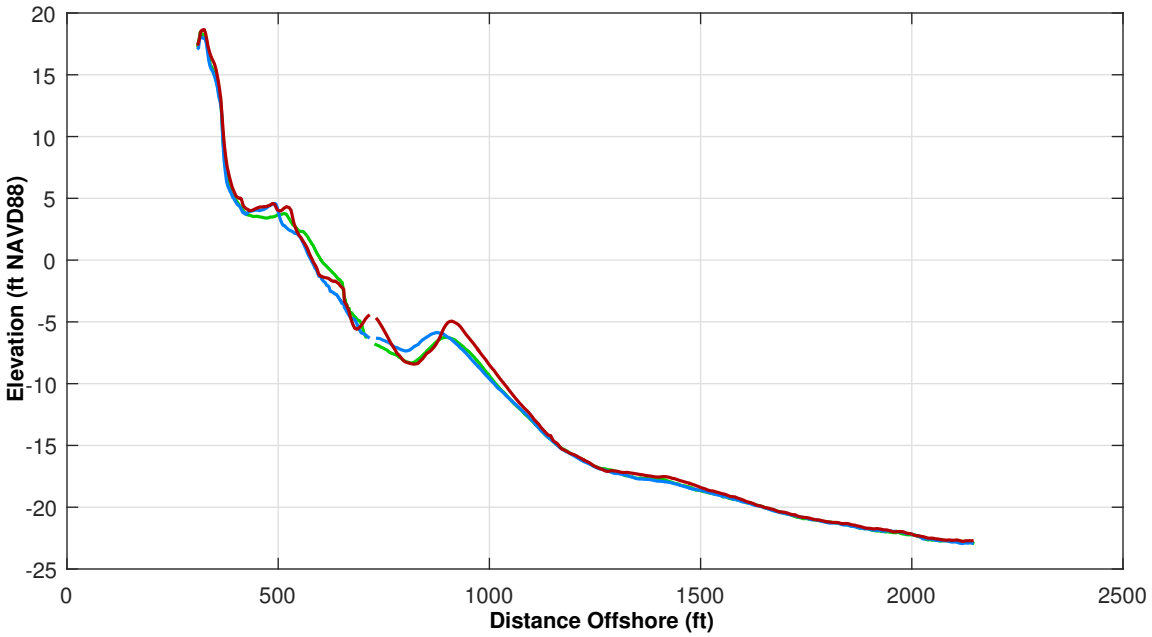

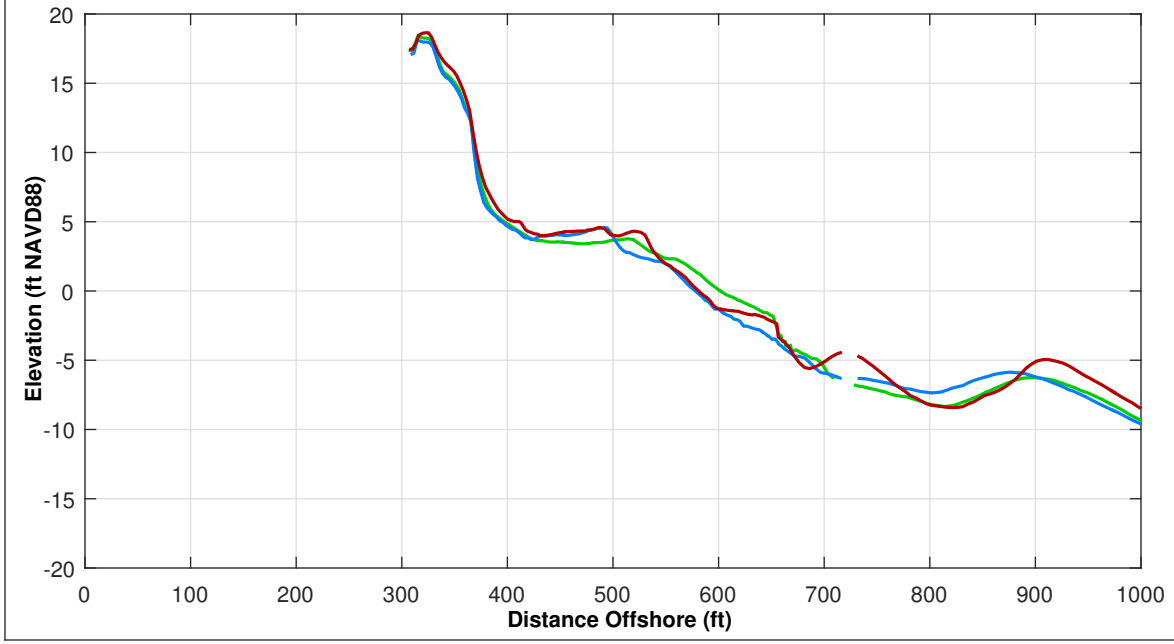

Survey Transect 333+23	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-19.25 ft/yr	4.22 ft
Volume Change Above -15 ft NAVD88	12.74 cy/ft/yr	13.92 cy/ft
Volume Change Above 0 ft NAVD88	4.06 cy/ft/yr	5.71 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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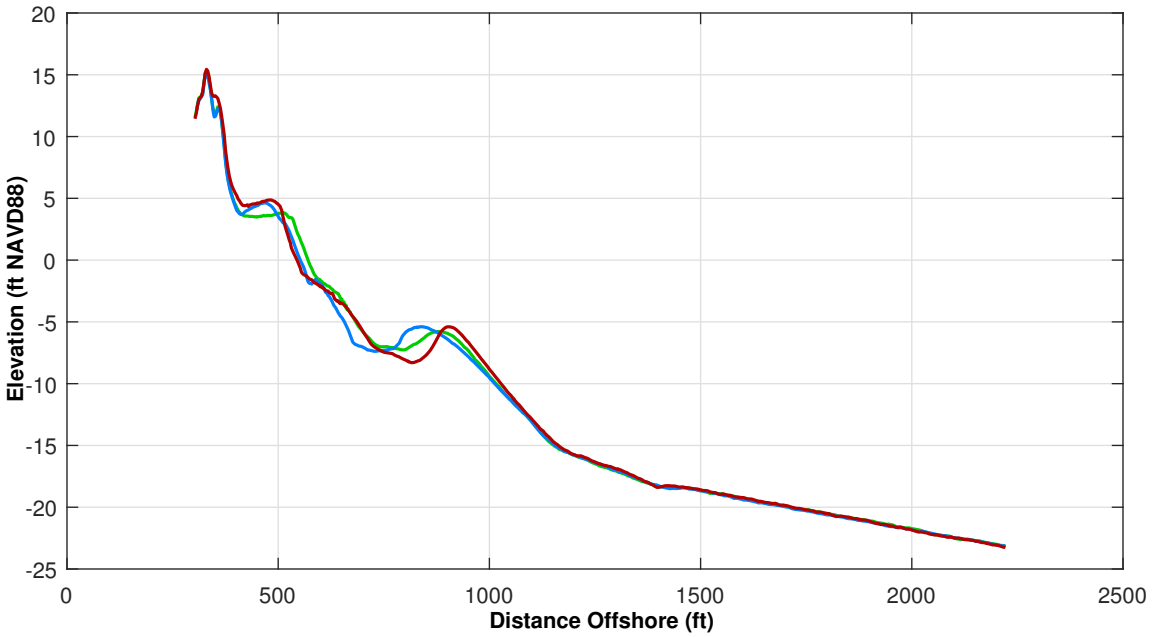

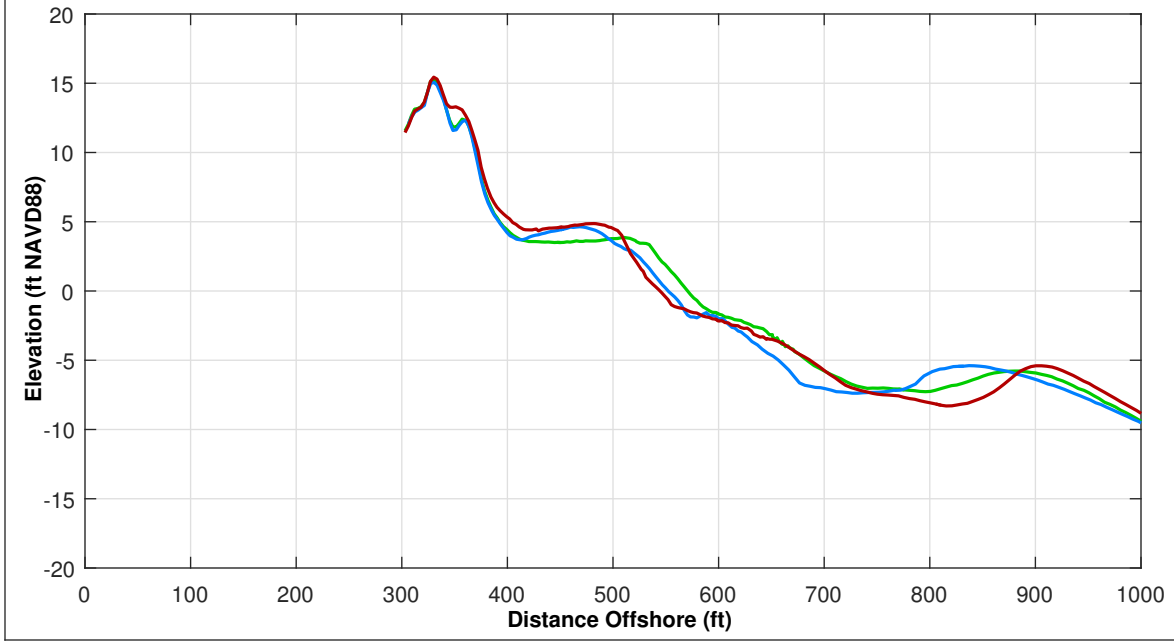

Survey Transect 335+03	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-33.00 ft/yr	-9.78 ft
Volume Change Above -15 ft NAVD88	-1.03 cy/ft/yr	6.81 cy/ft
Volume Change Above 0 ft NAVD88	2.63 cy/ft/yr	3.62 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

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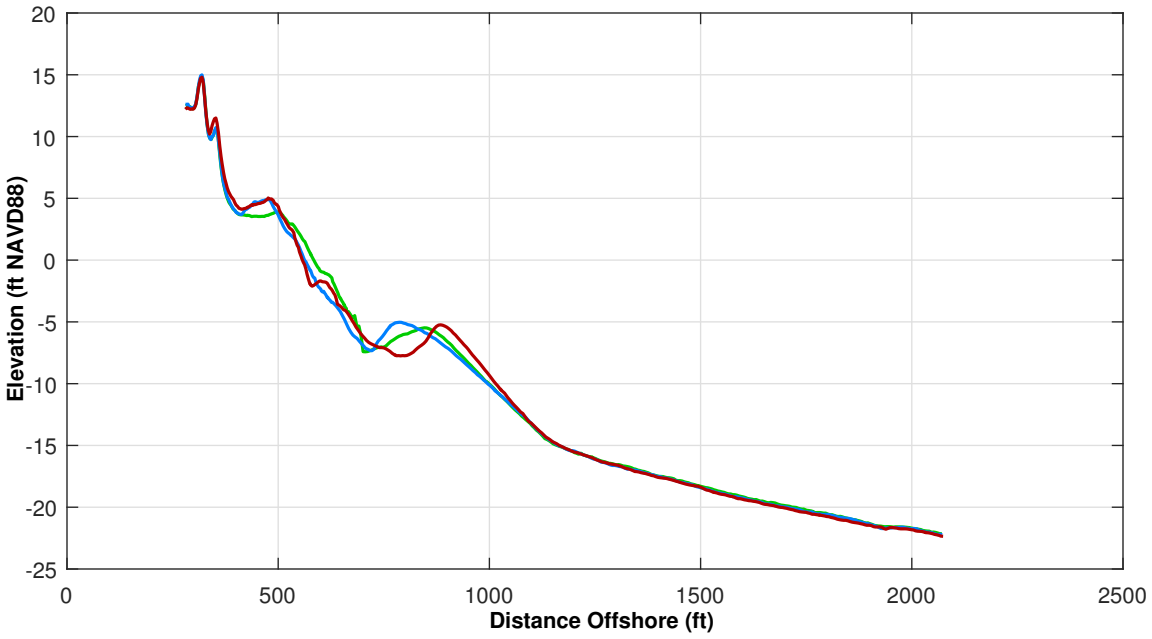
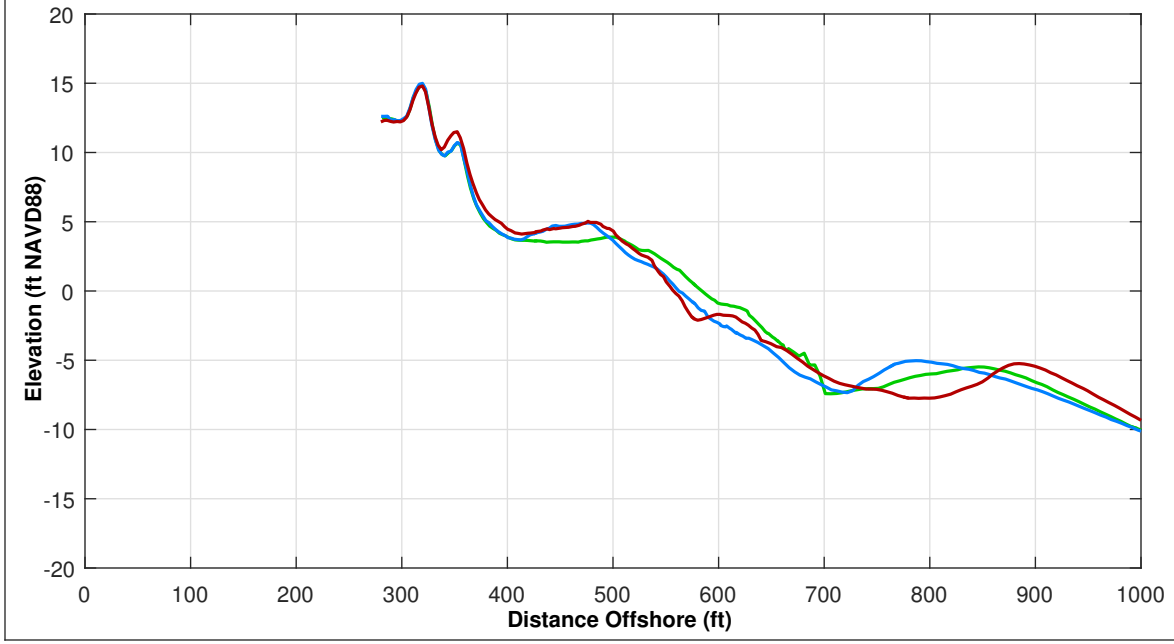
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 336+83	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-24.38 ft/yr	-2.61 ft
Volume Change Above -15 ft NAVD88	1.06 cy/ft/yr	5.65 cy/ft
Volume Change Above 0 ft NAVD88	3.28 cy/ft/yr	2.77 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2017 and OCT 2017
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.

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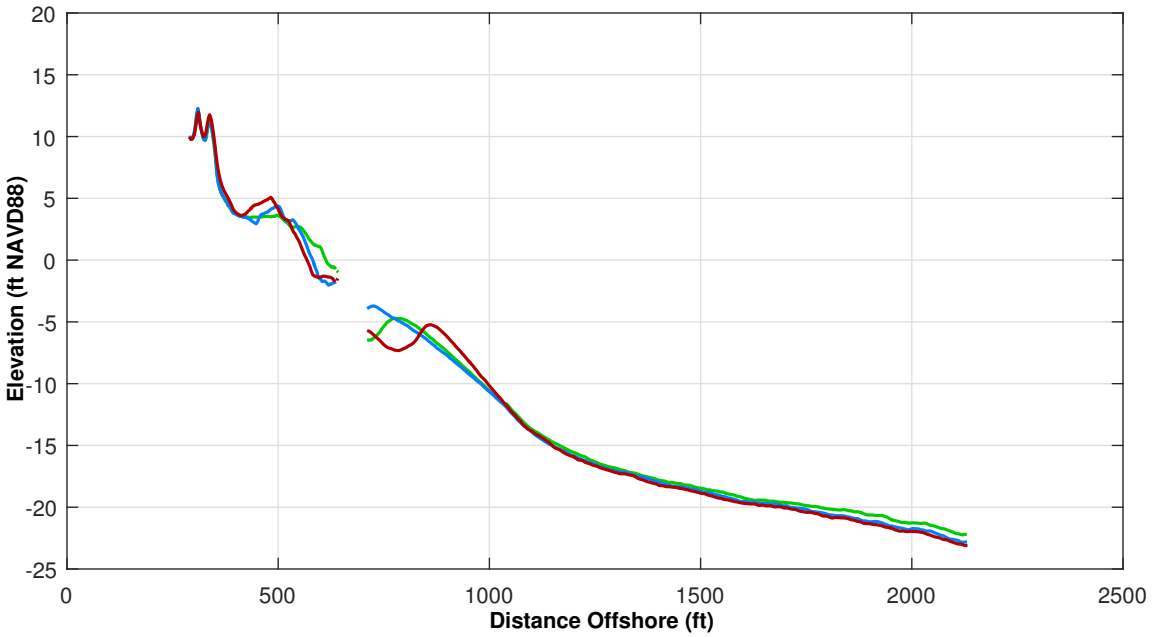
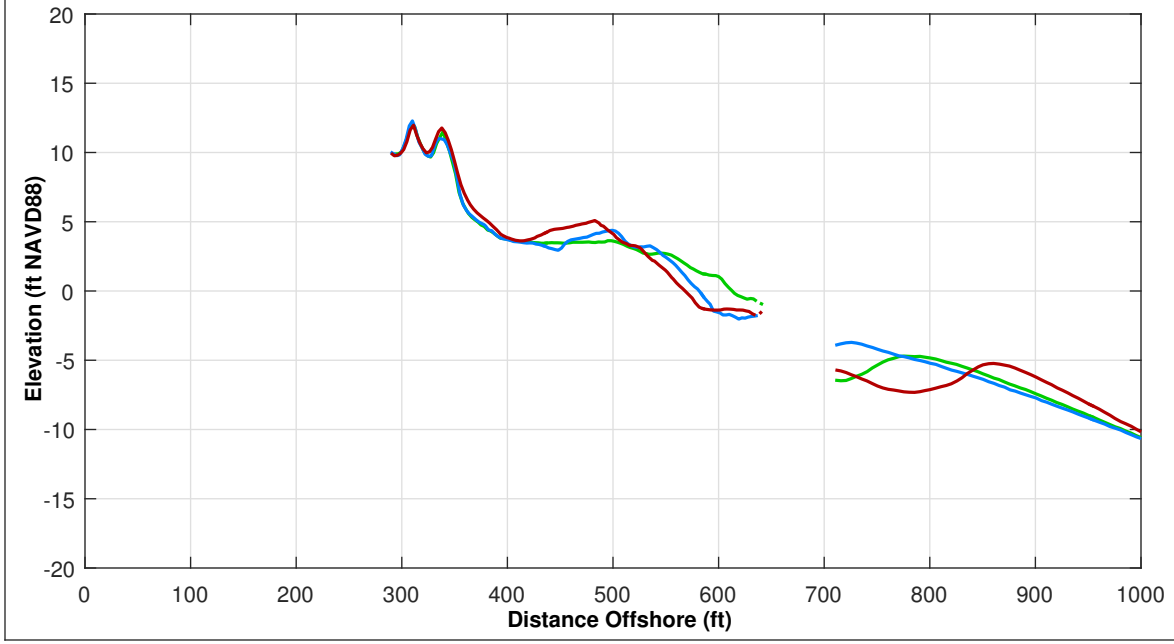
ST 336+83	Pg 80 of 106	Spring 2018





Survey Transect 338+63	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-51.75 ft/yr	-13.86 ft
Volume Change Above -15 ft NAVD88	-3.59 cy/ft/yr	0.48 cy/ft
Volume Change Above 0 ft NAVD88	1.47 cy/ft/yr	2.10 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

1. Station From West To East At Varying Intervals.
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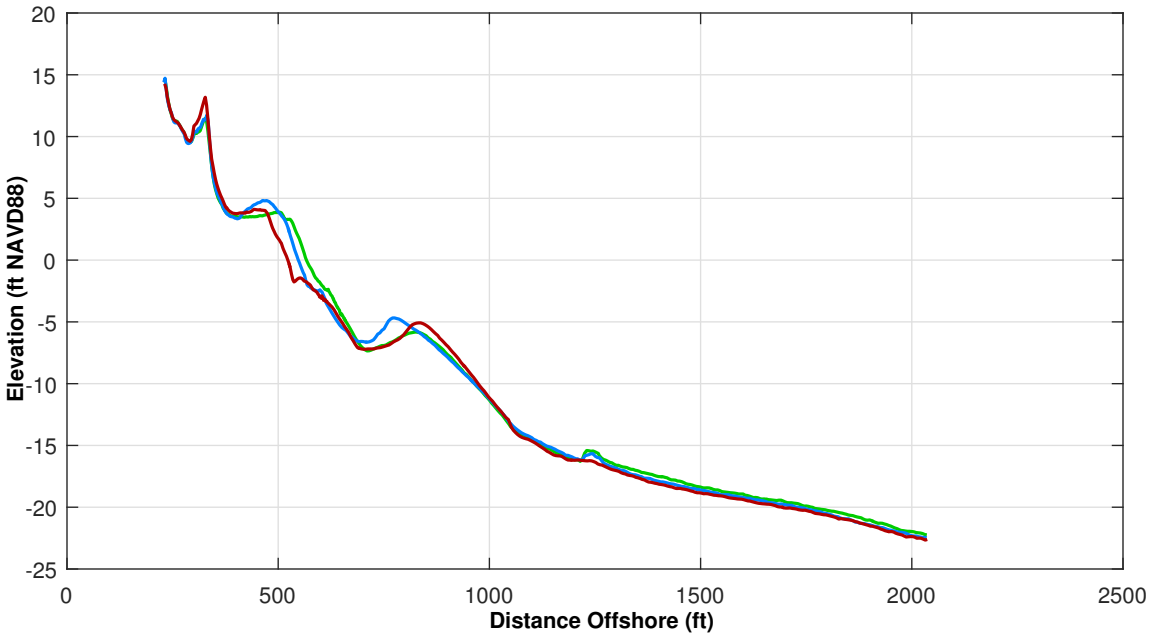
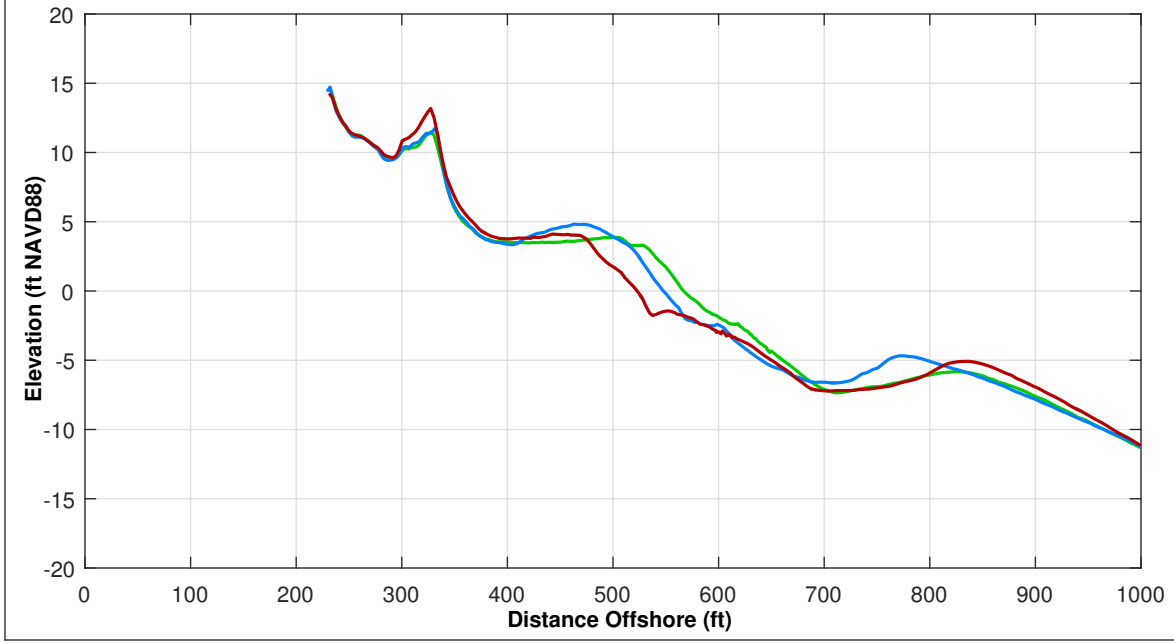
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 340+43	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-52.77 ft/yr	-26.54 ft
Volume Change Above -15 ft NAVD88	-5.40 cy/ft/yr	-5.59 cy/ft
Volume Change Above 0 ft NAVD88	-2.93 cy/ft/yr	-3.12 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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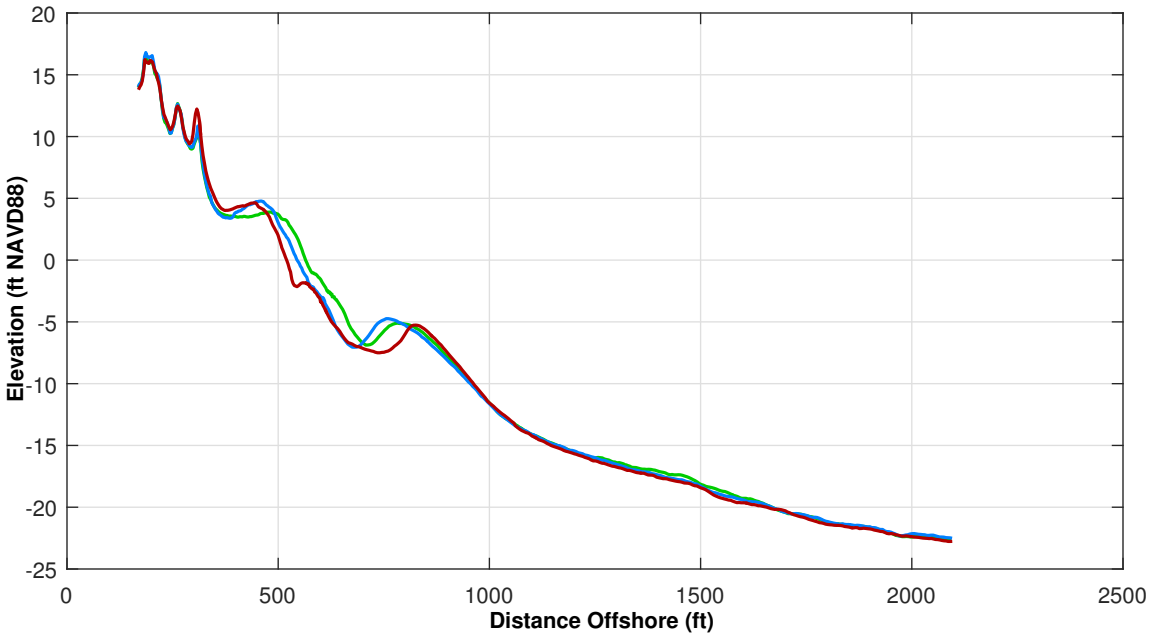

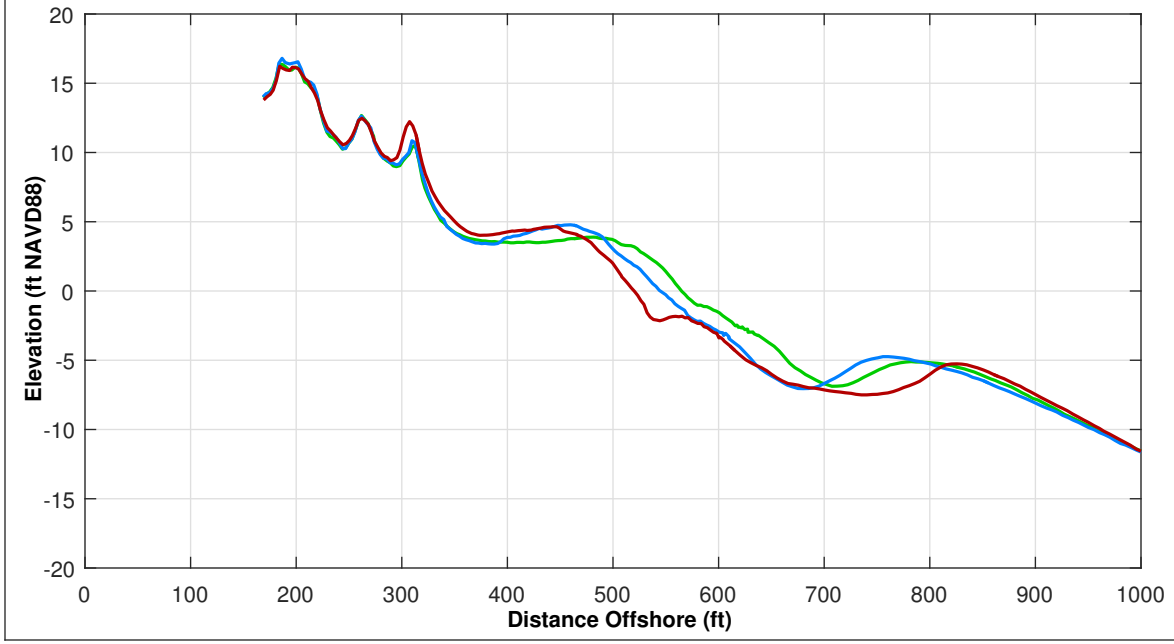

Survey Transect 342+23	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-52.17 ft/yr	-23.65 ft
Volume Change Above -15 ft NAVD88	-15.91 cy/ft/yr	-6.75 cy/ft
Volume Change Above 0 ft NAVD88	-0.02 cy/ft/yr	-0.20 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

1. Station From West To East At Varying Intervals.
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4. Survey Comparison Made to MAY 2017 and OCT 2017
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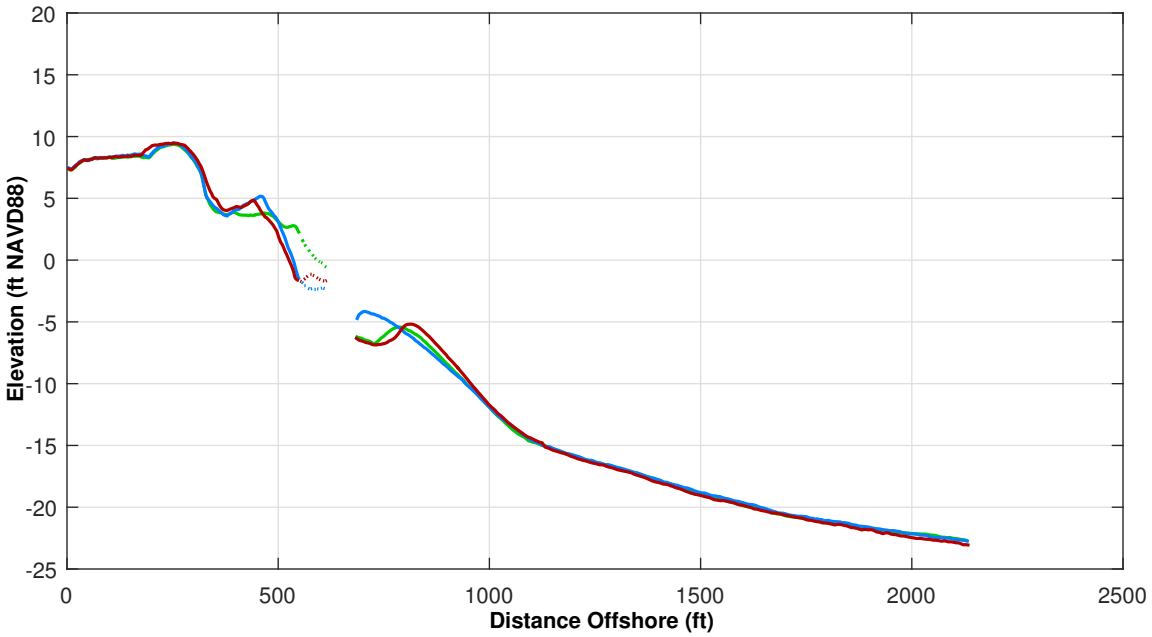
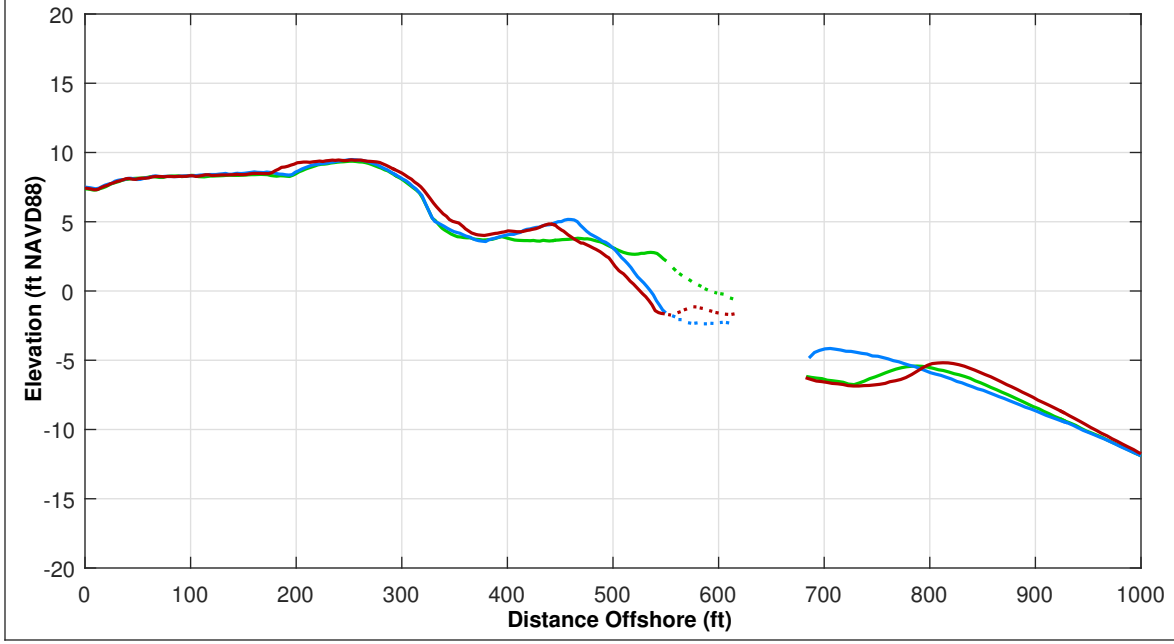
ST 342+23	Pg 83 of 106	Spring 2018





Survey Transect 344+05	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-63.18 ft/yr	-10.72 ft
Volume Change Above -15 ft NAVD88	4.09 cy/ft/yr	-1.54 cy/ft
Volume Change Above 0 ft NAVD88	-0.40 cy/ft/yr	-0.14 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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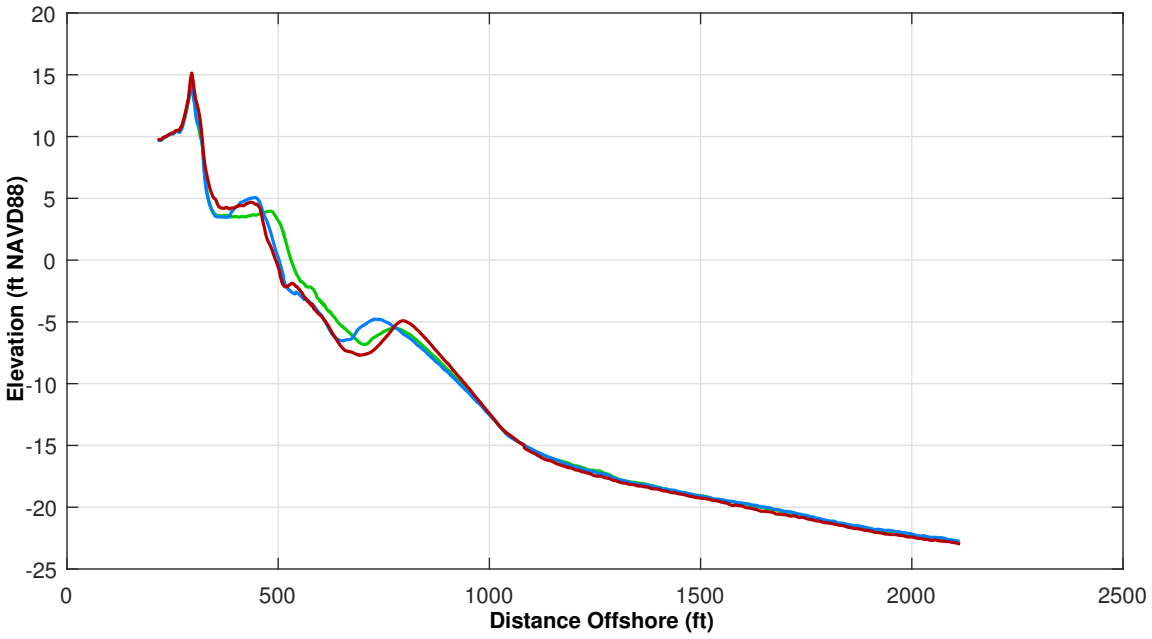

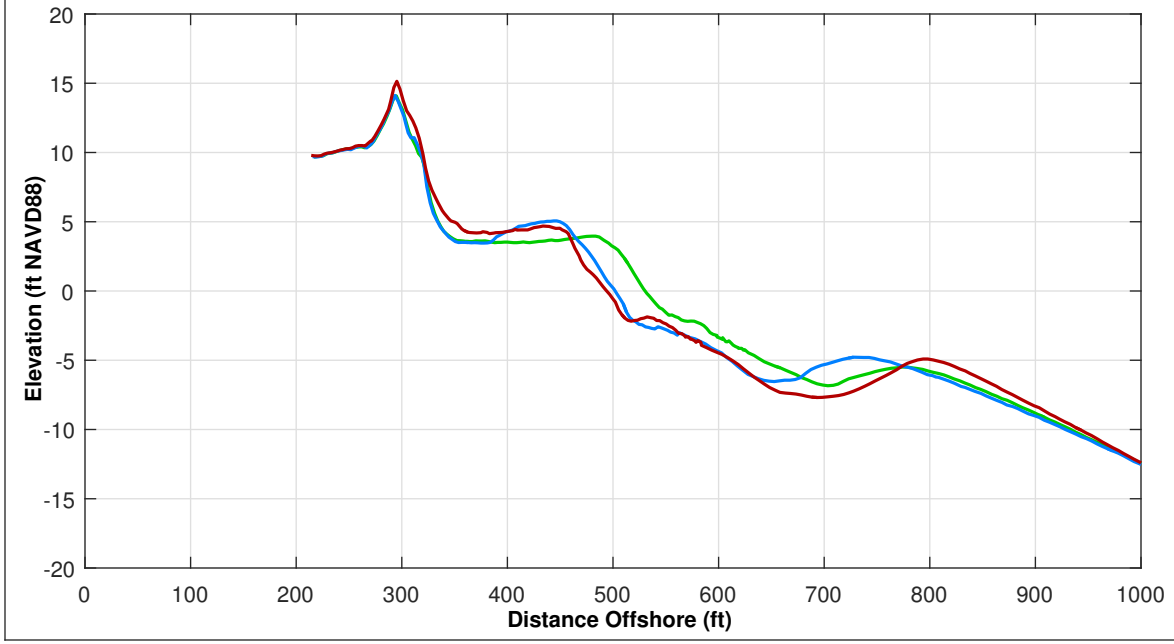

Survey Transect 345+85	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-43.67 ft/yr	-8.52 ft
Volume Change Above -15 ft NAVD88	-8.42 cy/ft/yr	0.43 cy/ft
Volume Change Above 0 ft NAVD88	0.47 cy/ft/yr	1.81 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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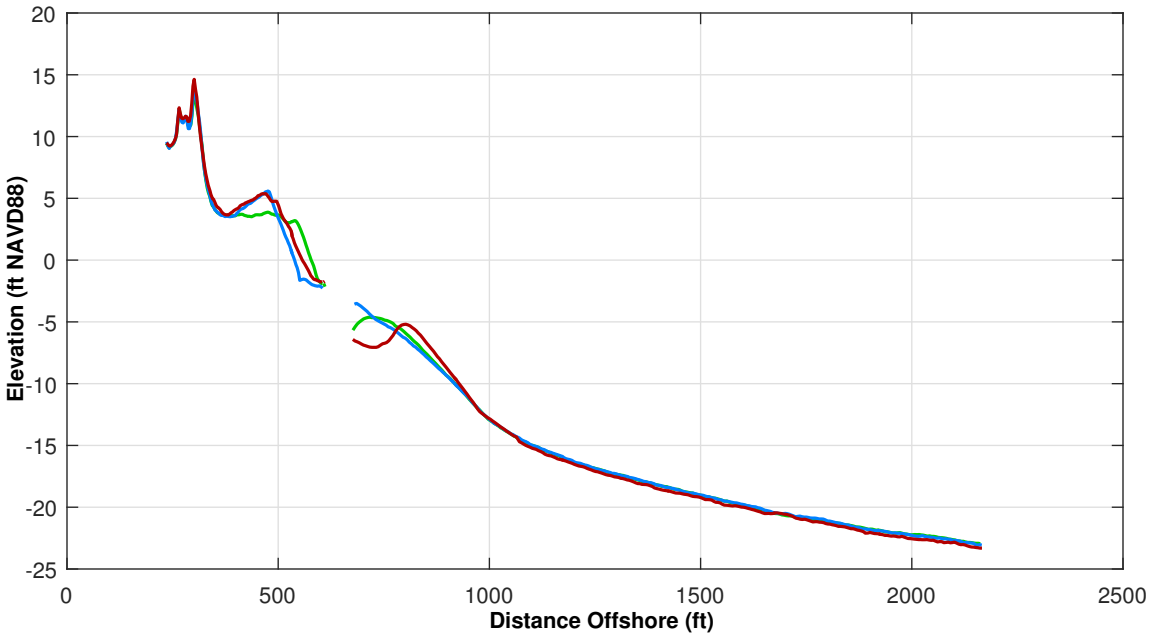

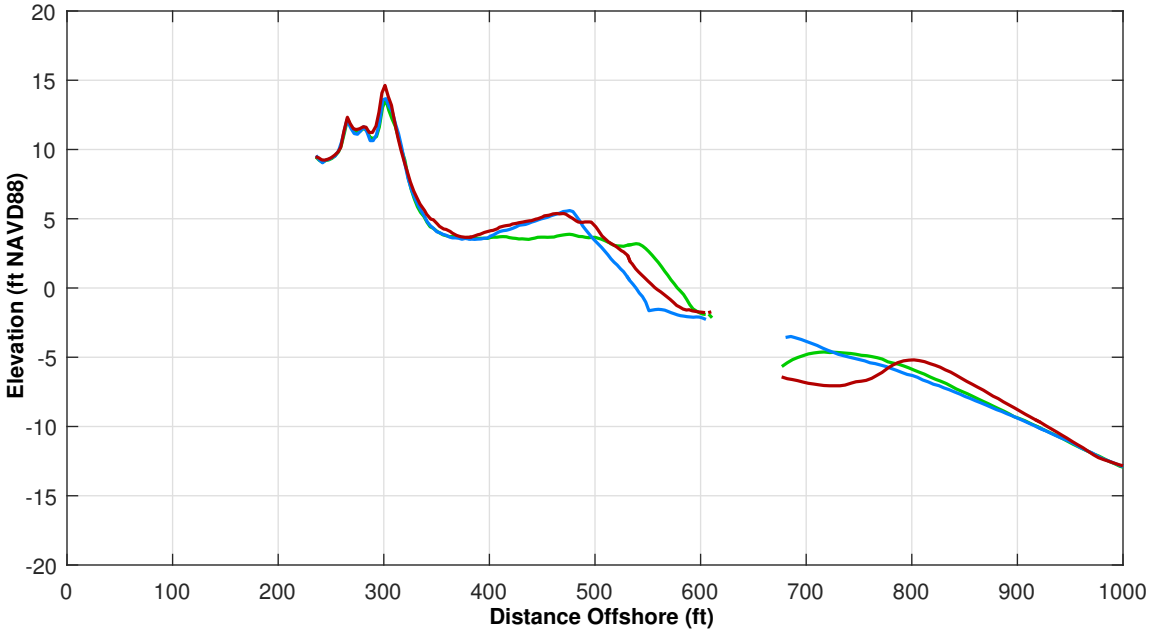

Survey Transect 347+63	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-28.04 ft/yr	14.76 ft
Volume Change Above -15 ft NAVD88	-0.15 cy/ft/yr	4.04 cy/ft
Volume Change Above 0 ft NAVD88	4.12 cy/ft/yr	4.52 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

1. Station From West To East At Varying Intervals.
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4. Survey Comparison Made to MAY 2017 and OCT 2017
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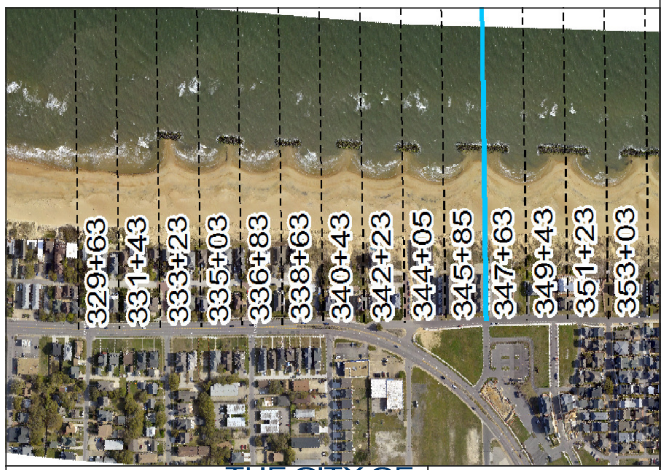

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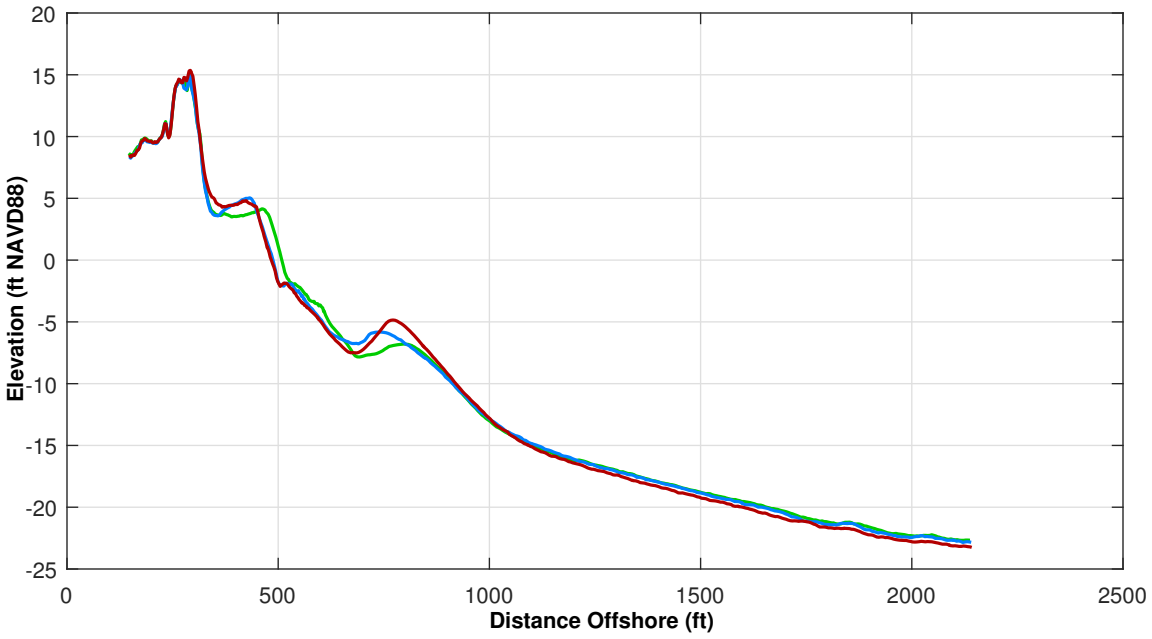
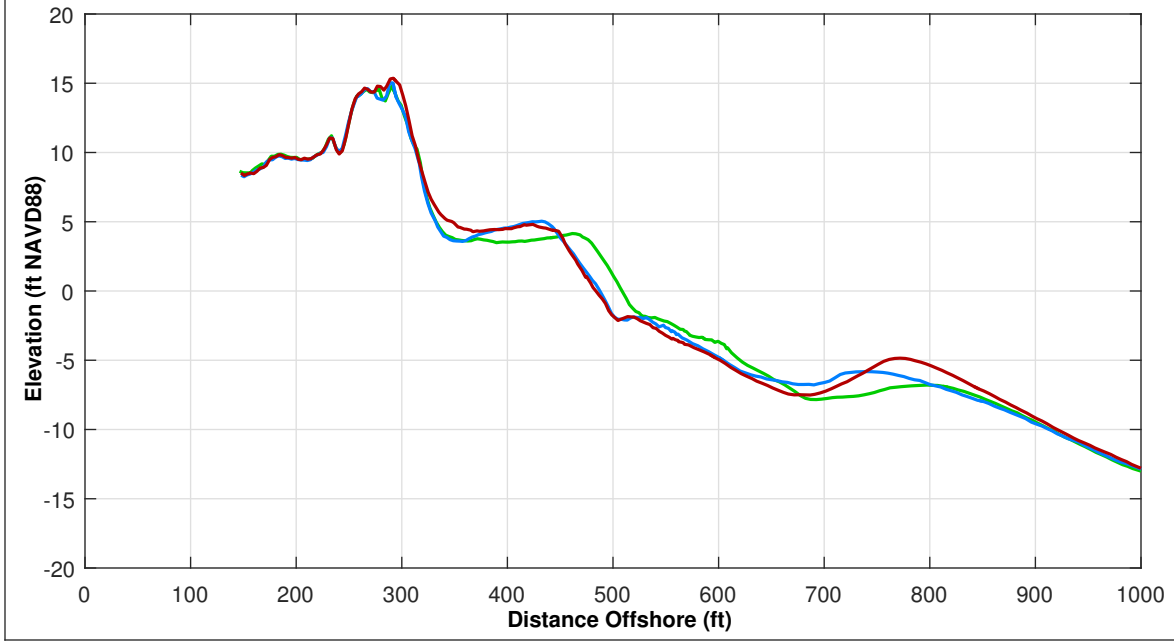
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 349+43	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-29.27 ft/yr	-3.12 ft
Volume Change Above -15 ft NAVD88	4.89 cy/ft/yr	4.53 cy/ft
Volume Change Above 0 ft NAVD88	1.28 cy/ft/yr	2.50 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

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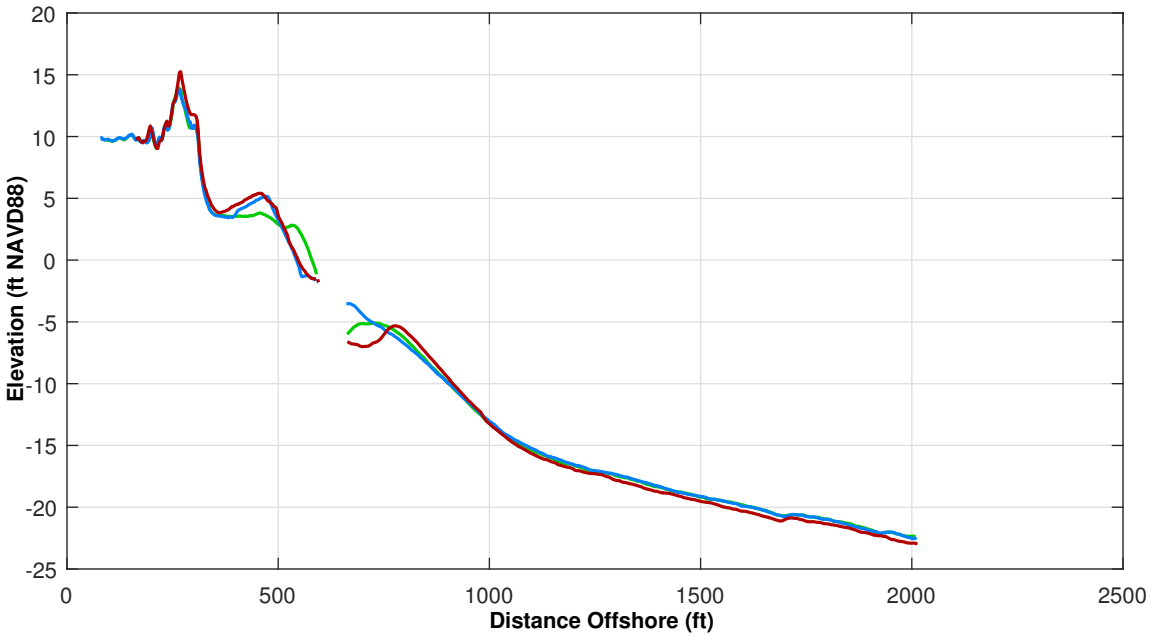

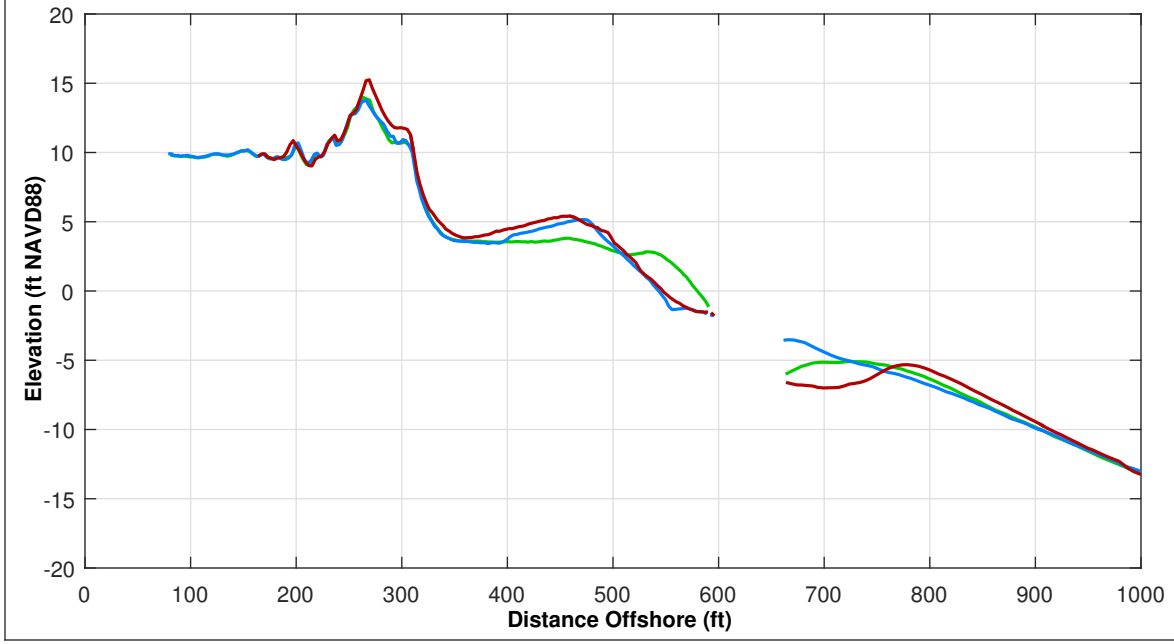

Survey Transect 351+23	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-41.23 ft/yr	1.90 ft
Volume Change Above -15 ft NAVD88	3.04 cy/ft/yr	3.09 cy/ft
Volume Change Above 0 ft NAVD88	6.39 cy/ft/yr	5.91 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

1. Station From West To East At Varying Intervals.
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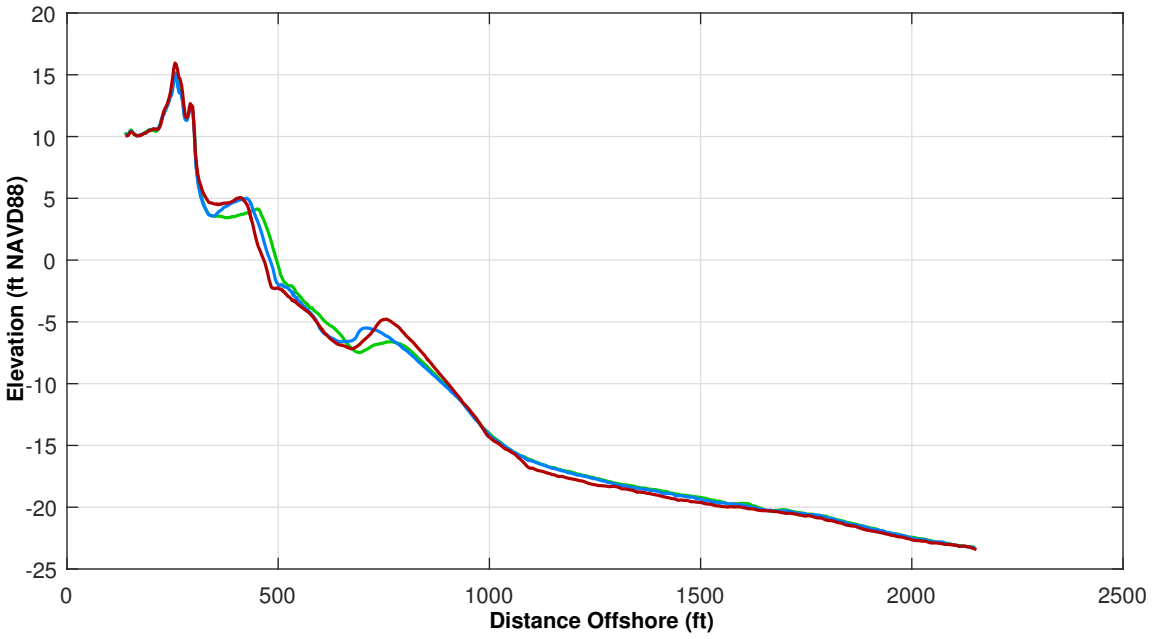
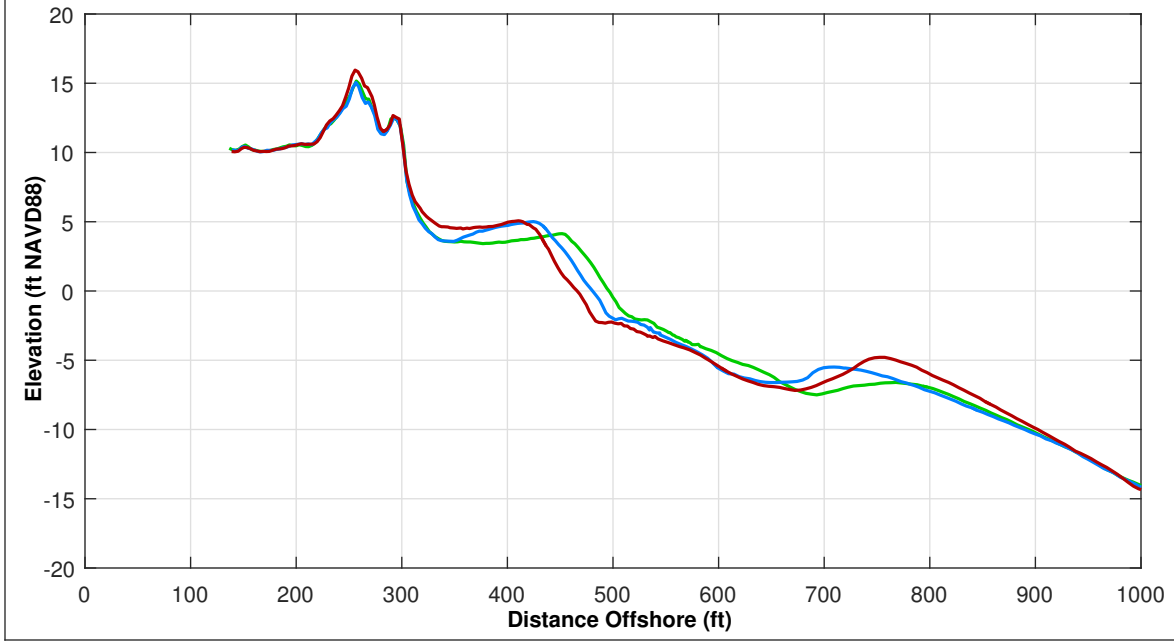
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS

ST 351+23	Pg 88 of 106	Spring 2018





Survey Transect 353+03	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-37.98 ft/yr	-16.48 ft
Volume Change Above -15 ft NAVD88	1.98 cy/ft/yr	3.16 cy/ft
Volume Change Above 0 ft NAVD88	1.12 cy/ft/yr	1.01 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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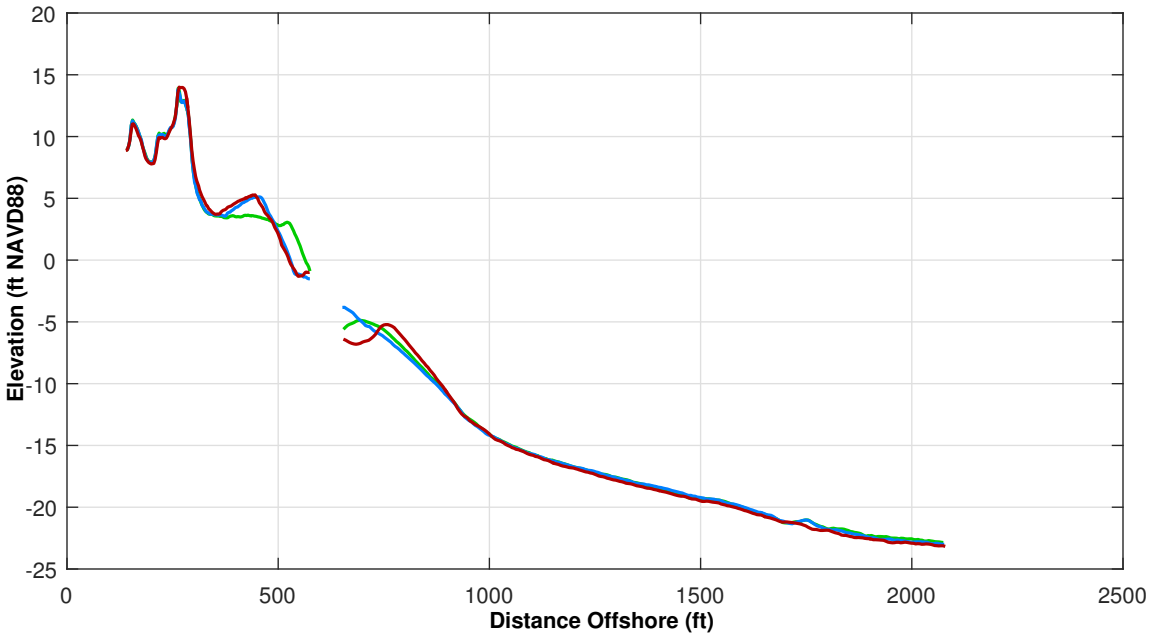
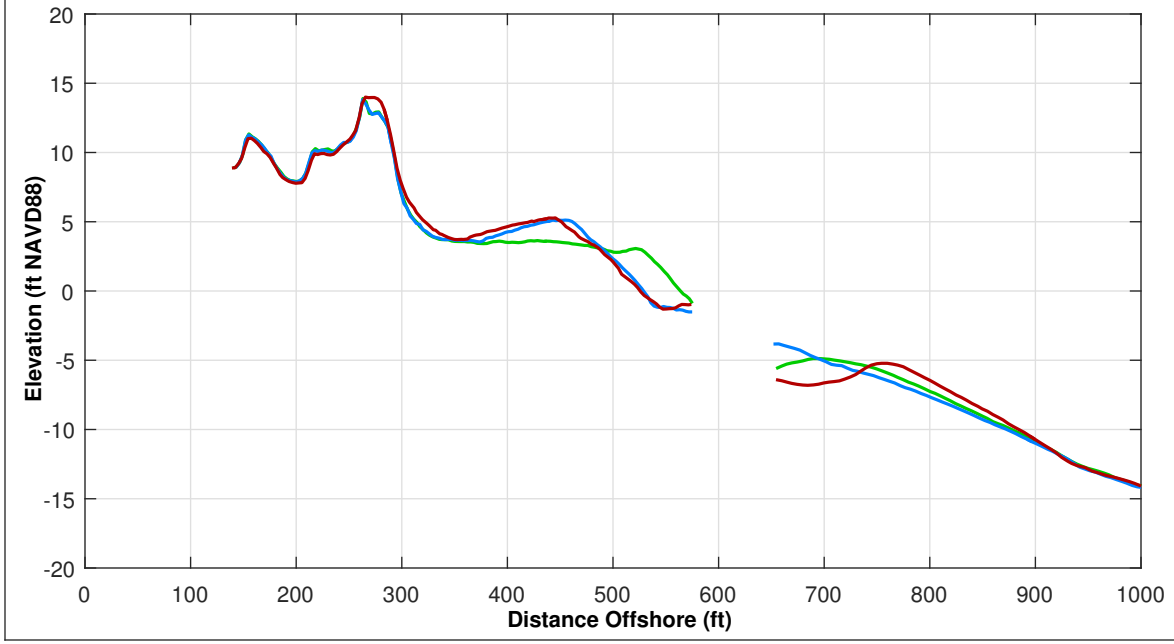
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 354+83	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-46.94 ft/yr	-6.04 ft
Volume Change Above -15 ft NAVD88	-1.55 cy/ft/yr	1.91 cy/ft
Volume Change Above 0 ft NAVD88	1.72 cy/ft/yr	1.35 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

1. Station From West To East At Varying Intervals.
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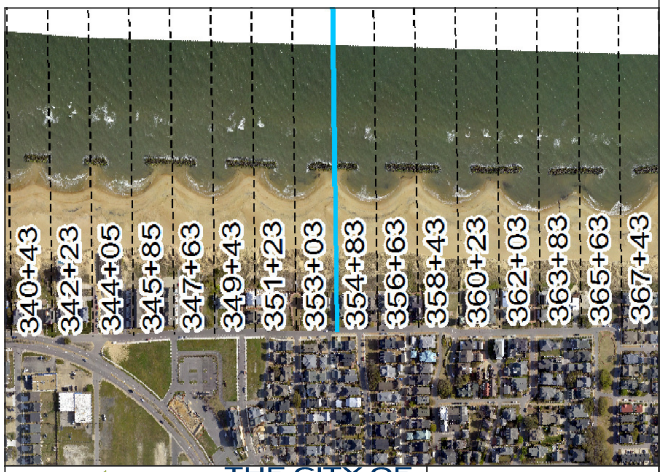

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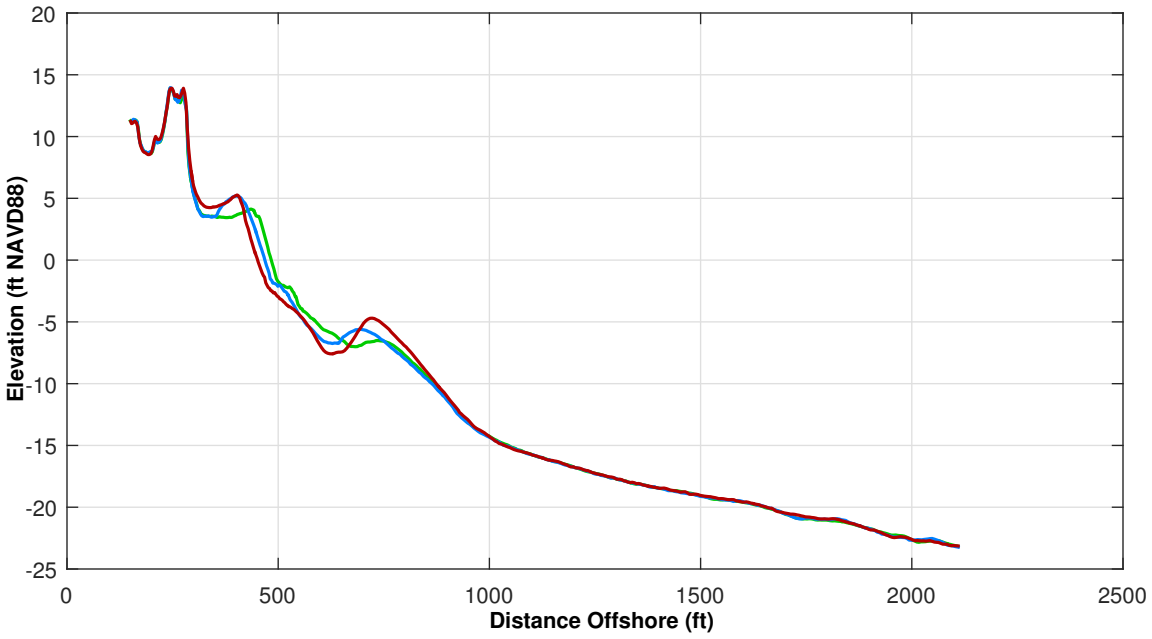
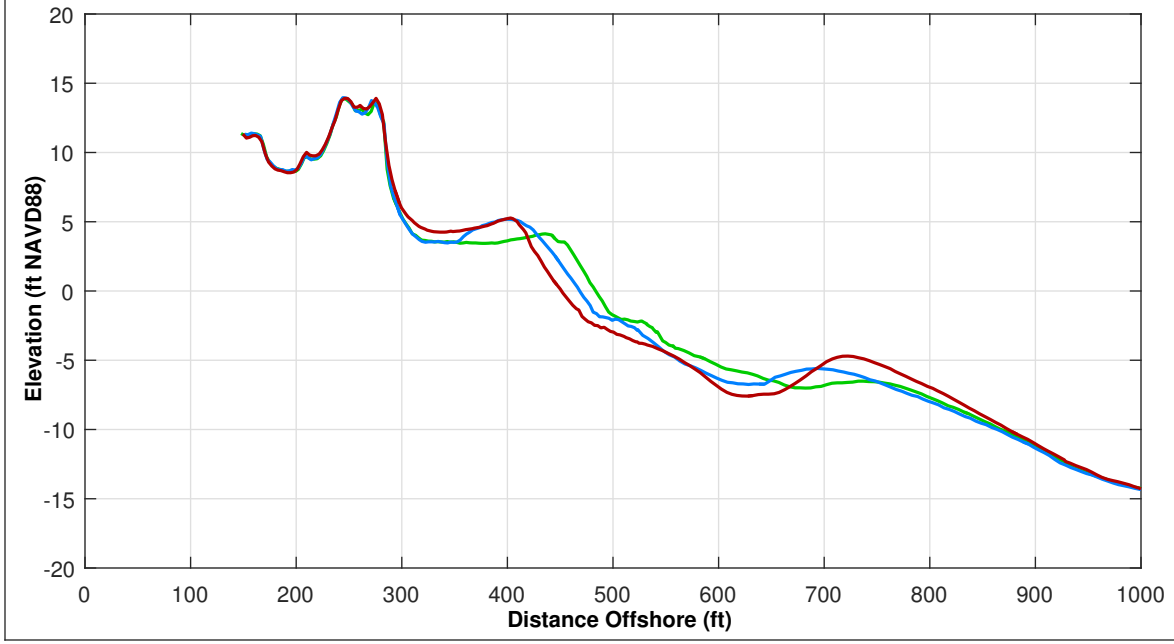
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 356+63	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-38.72 ft/yr	-17.95 ft
Volume Change Above -15 ft NAVD88	-2.30 cy/ft/yr	1.29 cy/ft
Volume Change Above 0 ft NAVD88	0.39 cy/ft/yr	-0.31 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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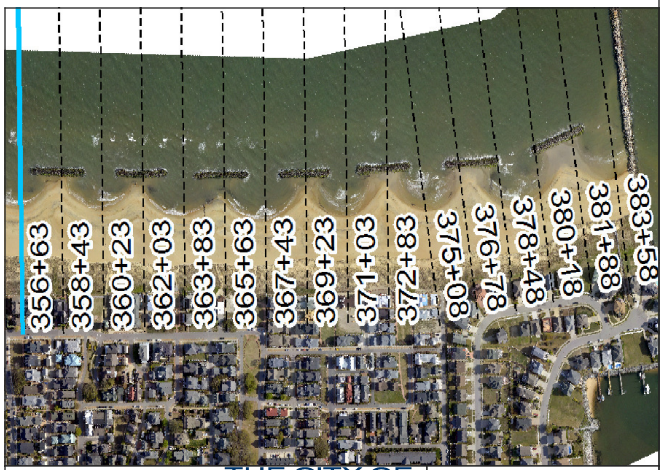

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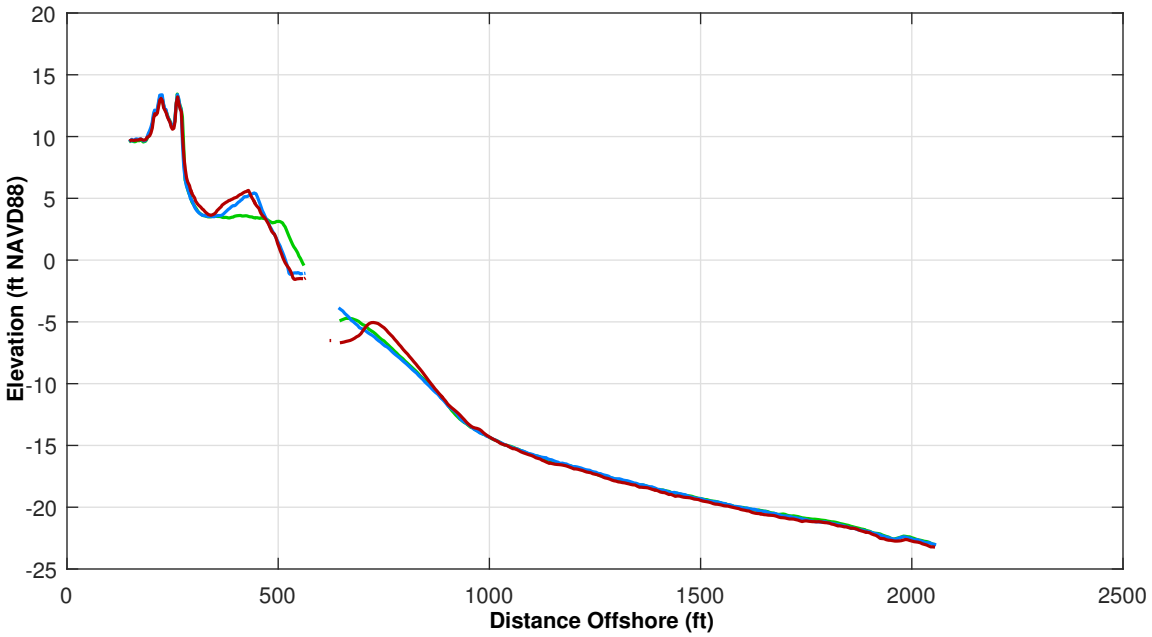

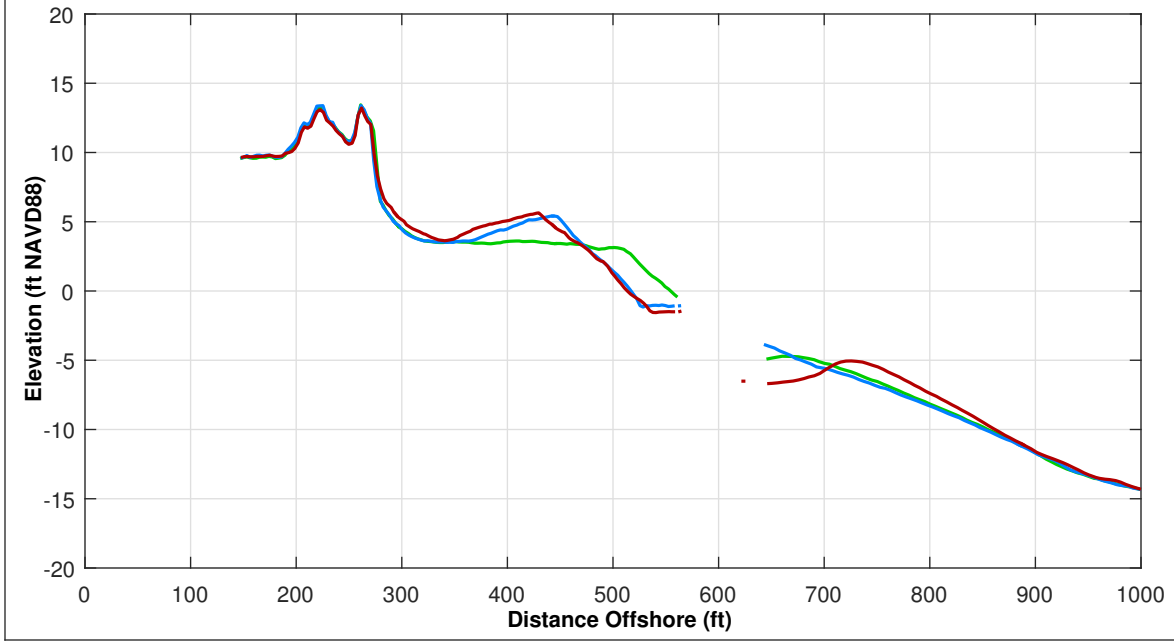

Survey Transect 358+43	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-41.45 ft/yr	-3.65 ft
Volume Change Above -15 ft NAVD88	1.76 cy/ft/yr	3.71 cy/ft
Volume Change Above 0 ft NAVD88	2.11 cy/ft/yr	1.45 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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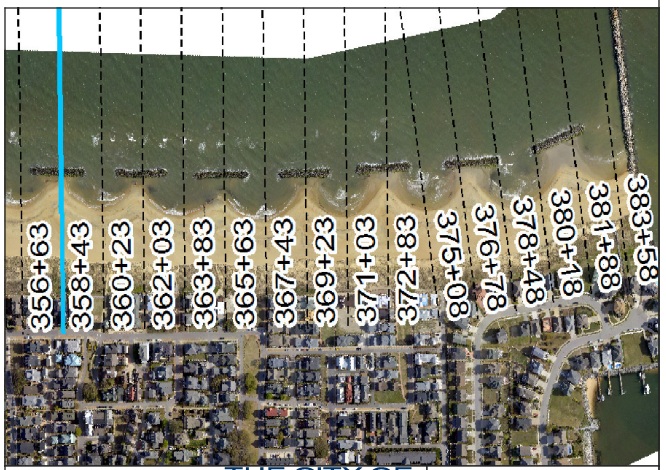

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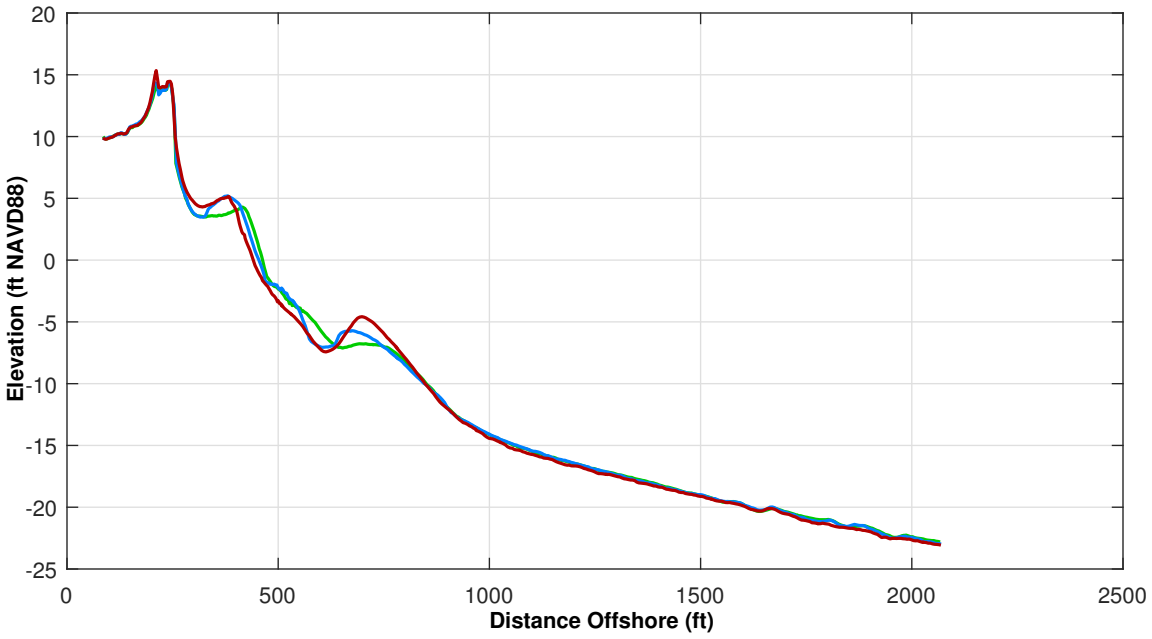

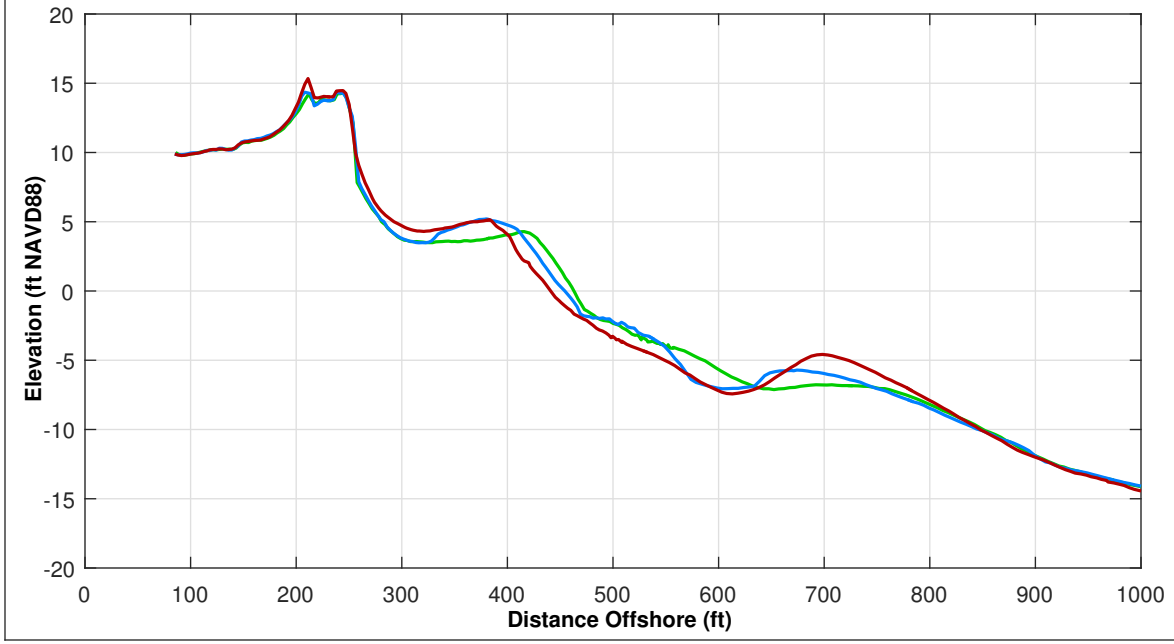

Survey Transect 360+23	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-27.01 ft/yr	-12.15 ft
Volume Change Above -15 ft NAVD88	0.53 cy/ft/yr	-0.59 cy/ft
Volume Change Above 0 ft NAVD88	2.42 cy/ft/yr	0.22 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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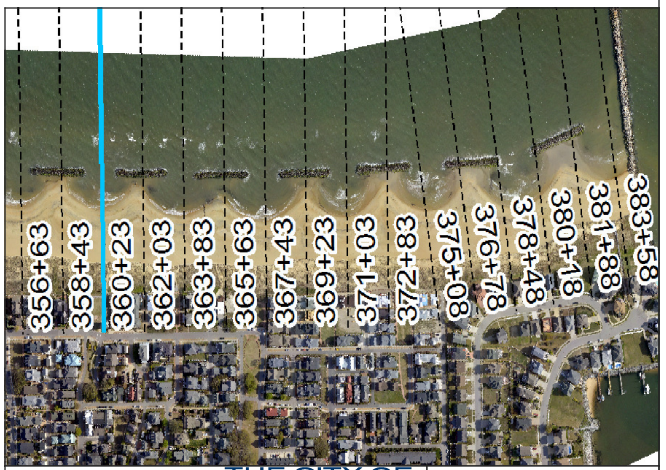

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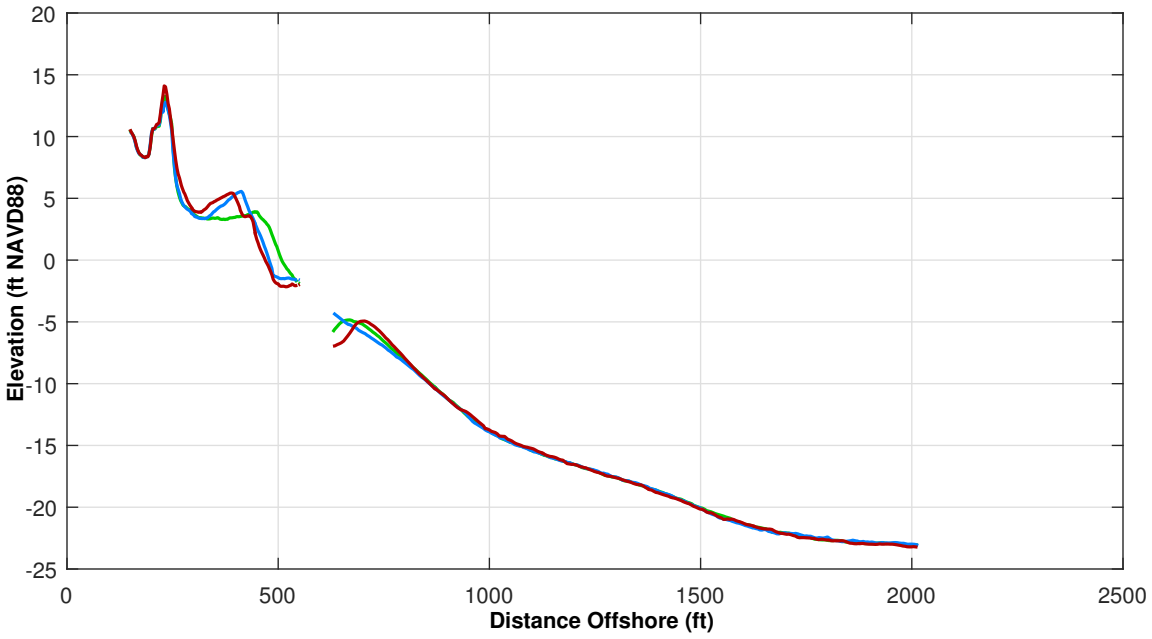
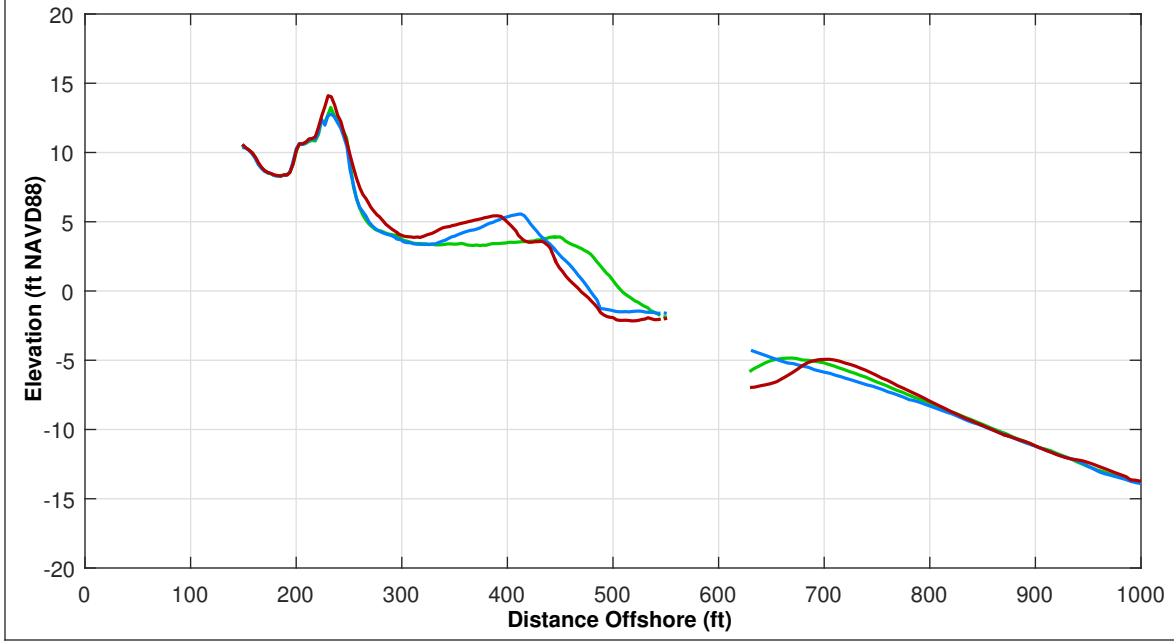
PUBLIC WORKS

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 362+03	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-47.04 ft/yr	-12.39 ft
Volume Change Above -15 ft NAVD88	-1.33 cy/ft/yr	2.97 cy/ft
Volume Change Above 0 ft NAVD88	2.95 cy/ft/yr	2.30 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
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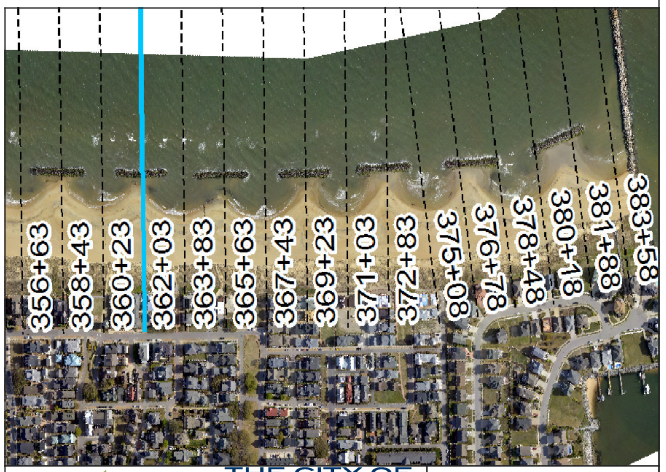

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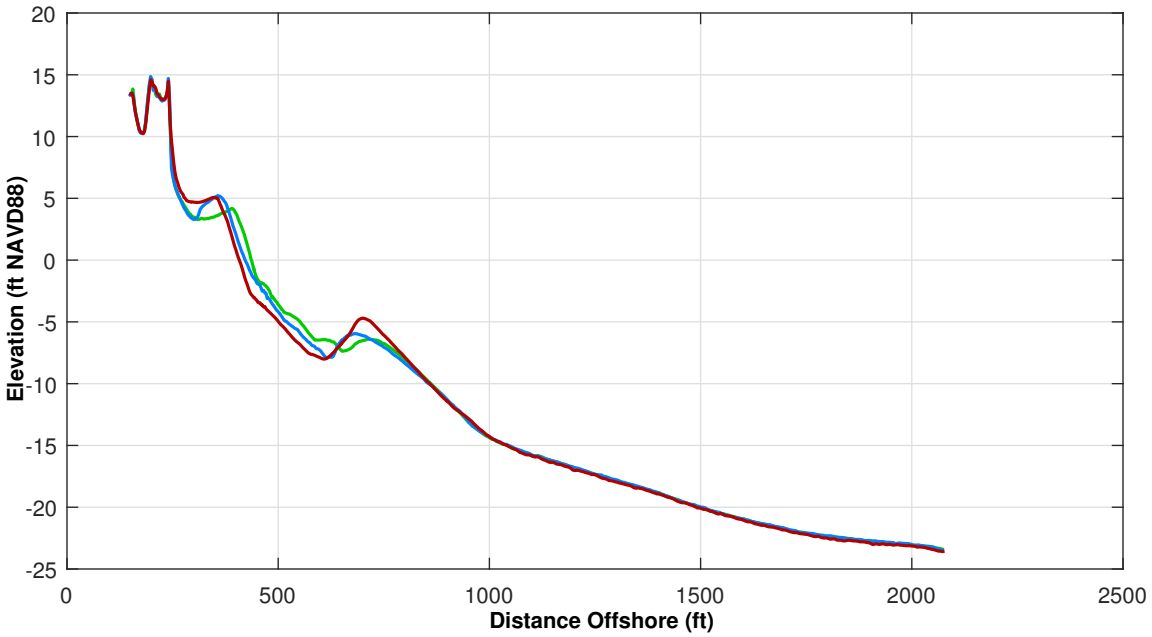

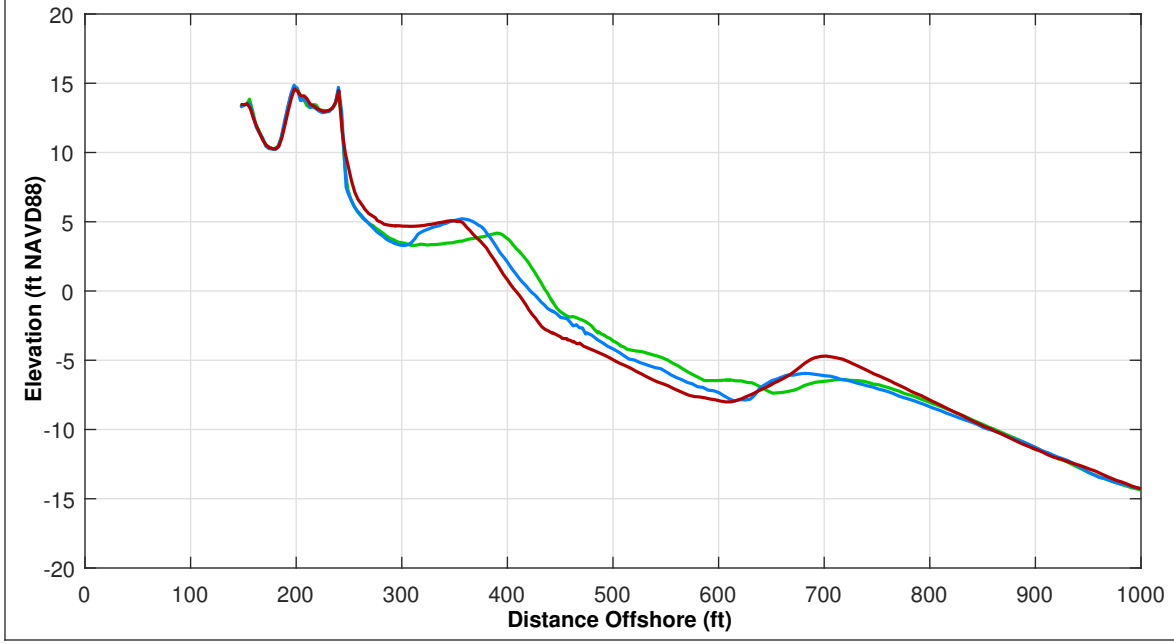

Survey Transect 363+83	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-34.66 ft/yr	-12.15 ft
Volume Change Above -15 ft NAVD88	-7.42 cy/ft/yr	-1.25 cy/ft
Volume Change Above 0 ft NAVD88	0.89 cy/ft/yr	0.73 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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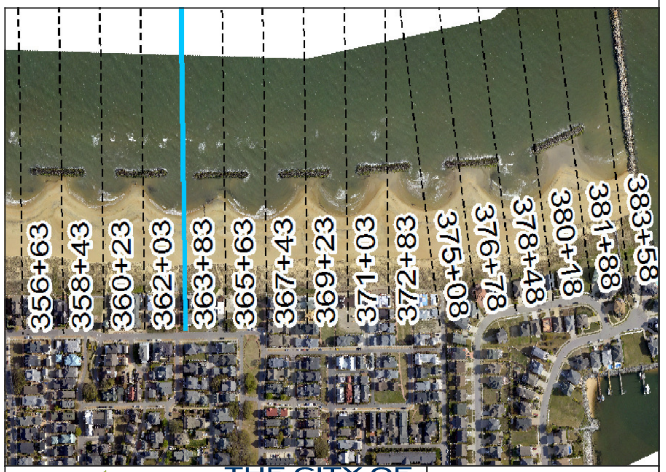

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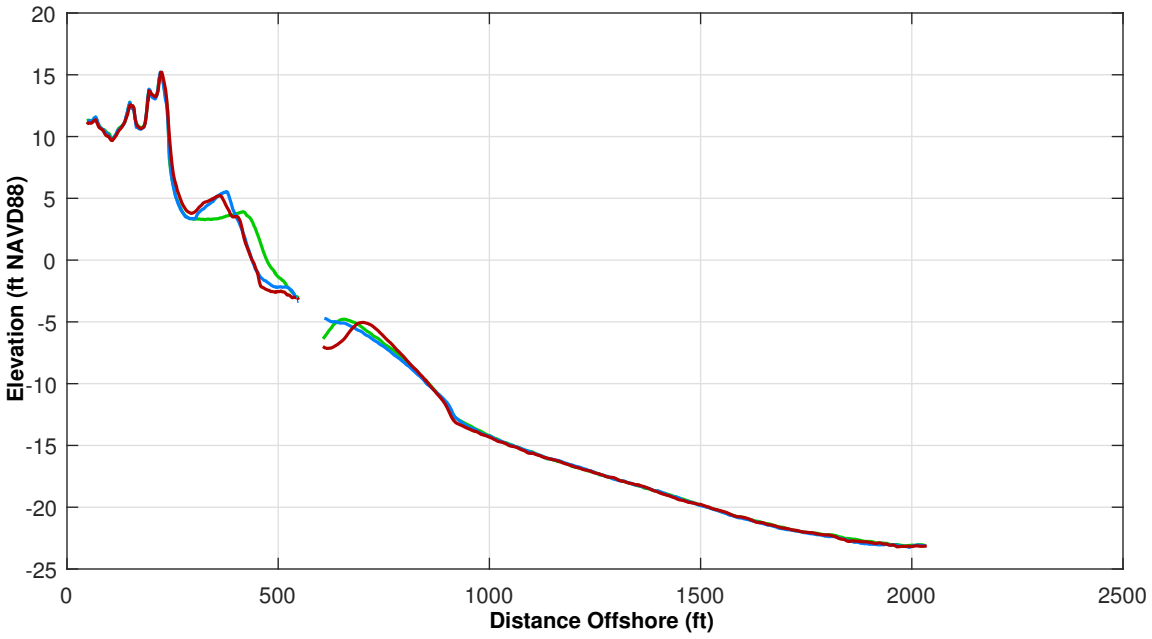

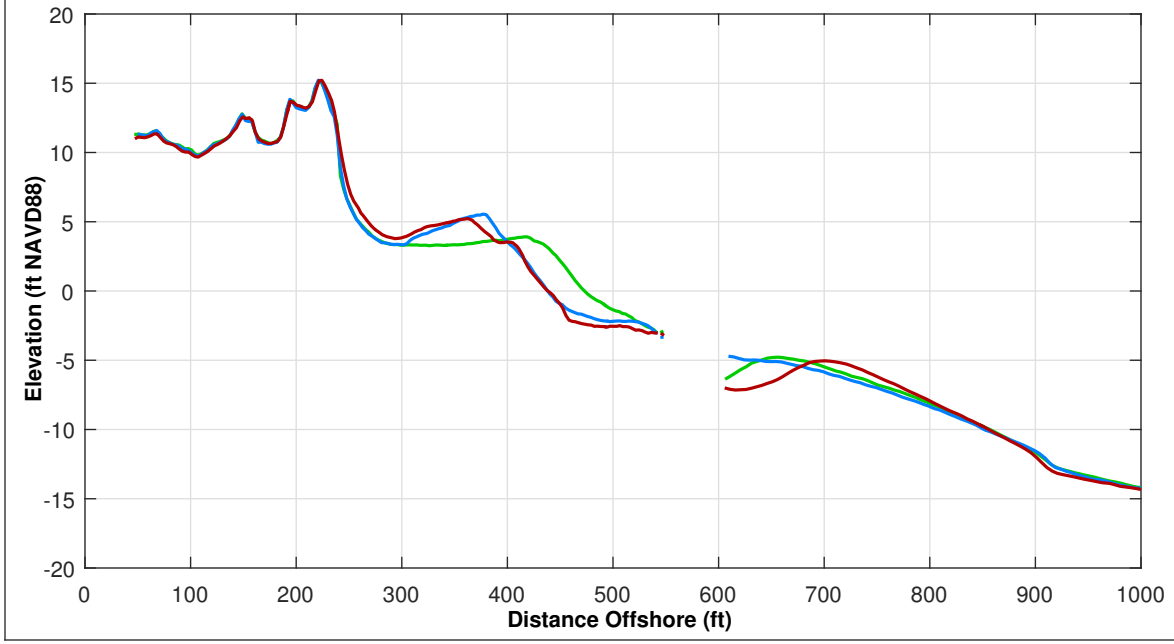

Survey Transect 365+63	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-39.88 ft/yr	-1.50 ft
Volume Change Above -15 ft NAVD88	-8.14 cy/ft/yr	-1.29 cy/ft
Volume Change Above 0 ft NAVD88	0.69 cy/ft/yr	1.39 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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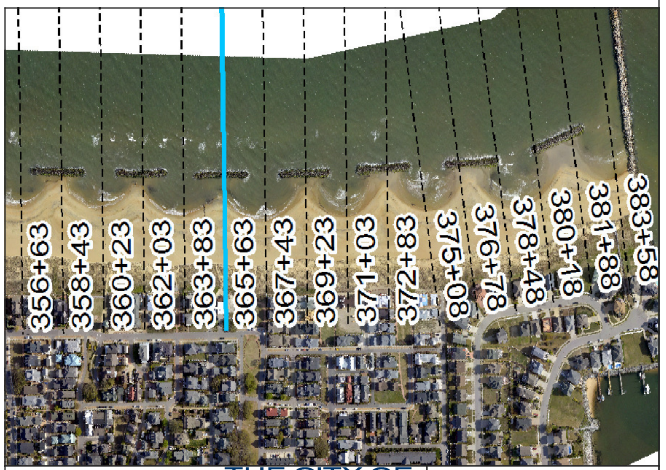

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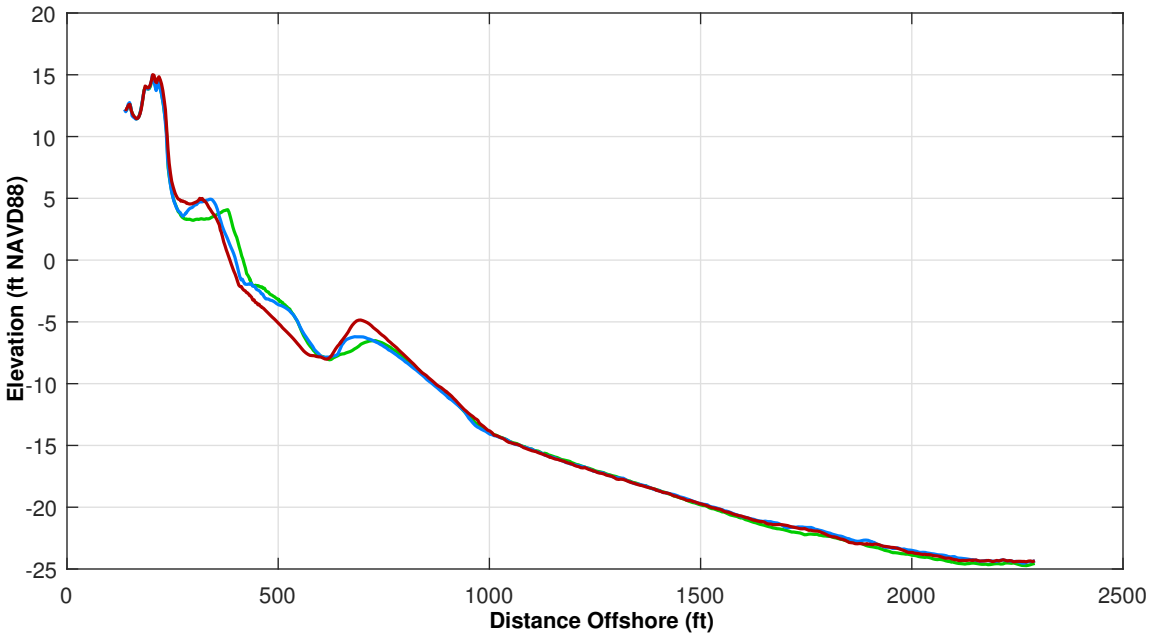

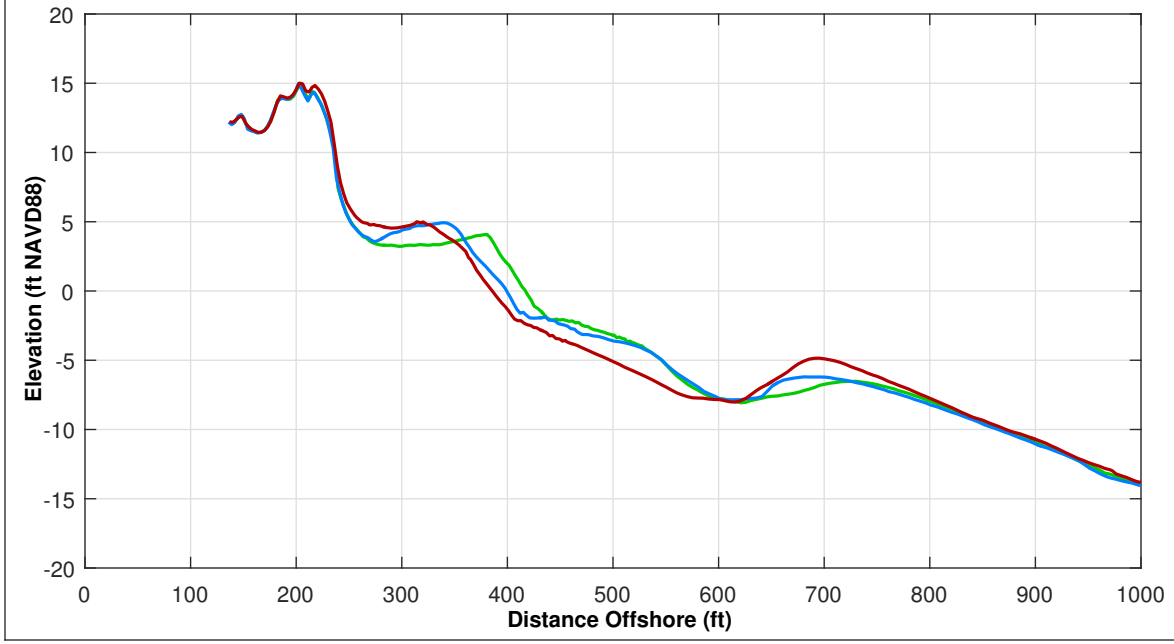

Survey Transect 367+43	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-37.32 ft/yr	-13.16 ft
Volume Change Above -15 ft NAVD88	-3.34 cy/ft/yr	-1.14 cy/ft
Volume Change Above 0 ft NAVD88	0.95 cy/ft/yr	0.85 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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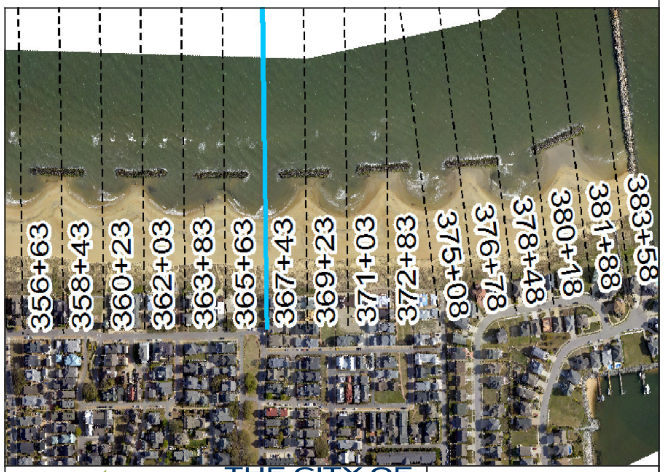

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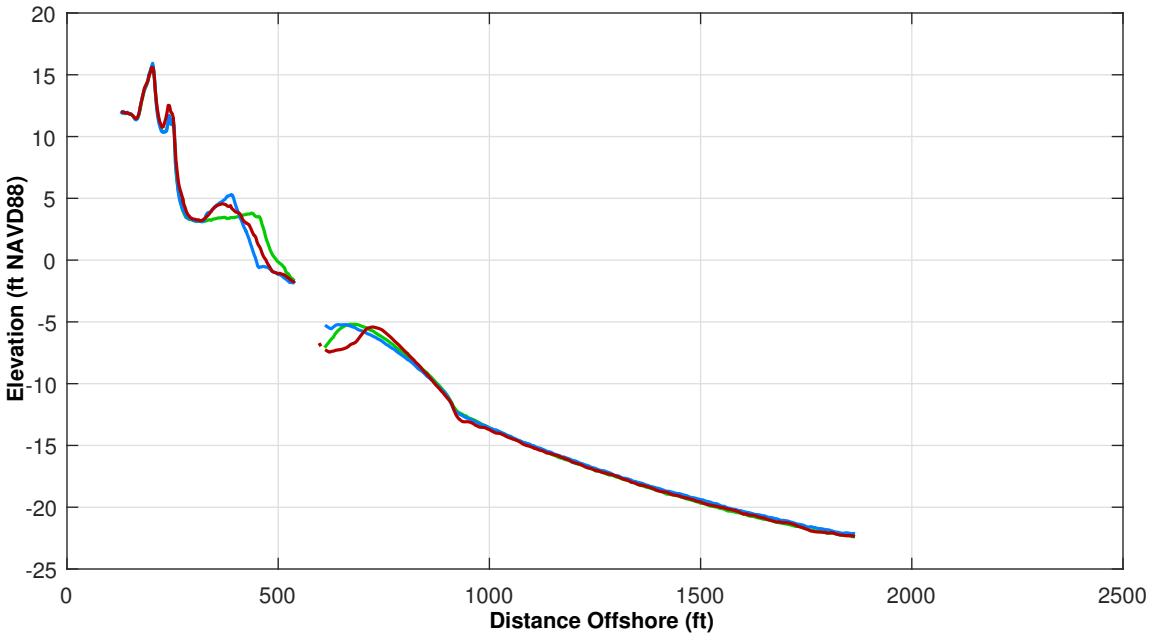
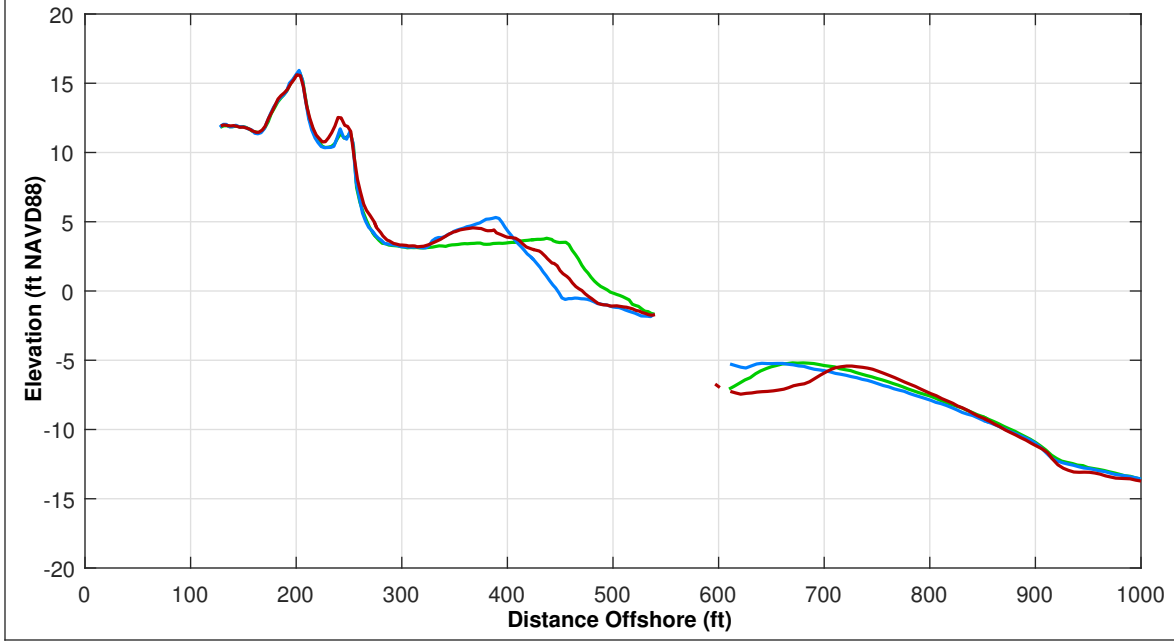
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 369+23	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-25.04 ft/yr	19.49 ft
Volume Change Above -15 ft NAVD88	-6.67 cy/ft/yr	-0.09 cy/ft
Volume Change Above 0 ft NAVD88	0.62 cy/ft/yr	3.01 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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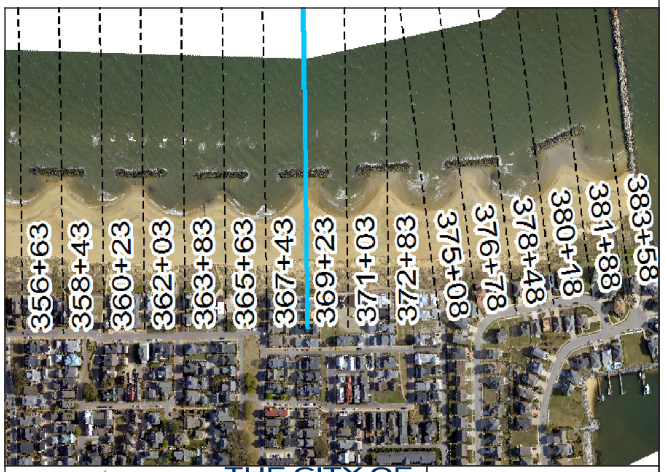

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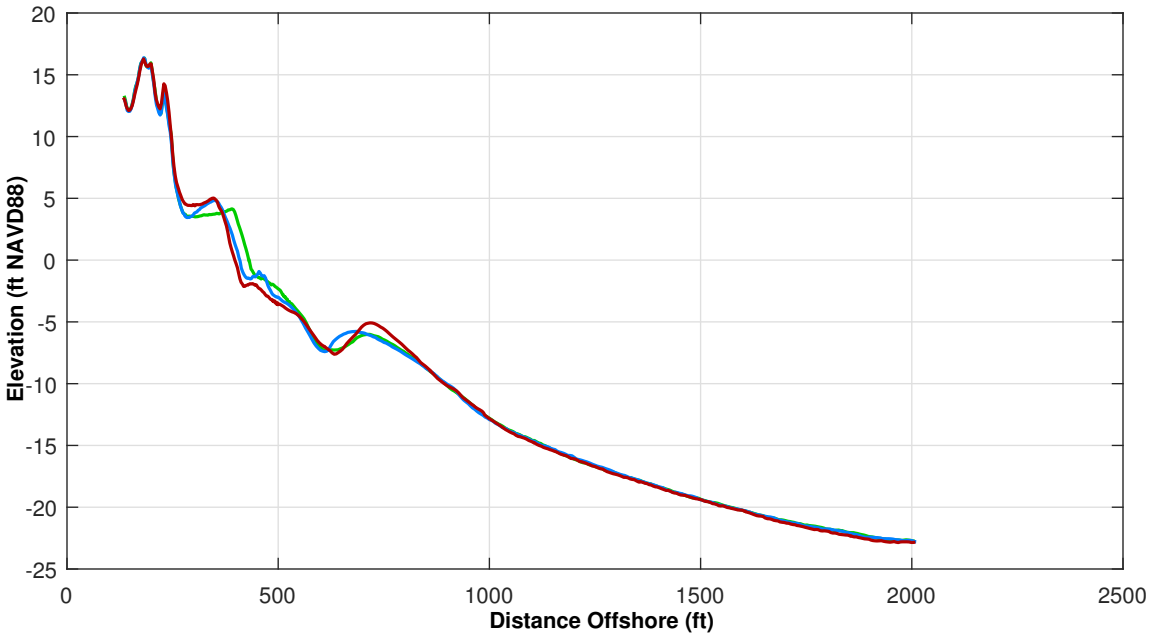

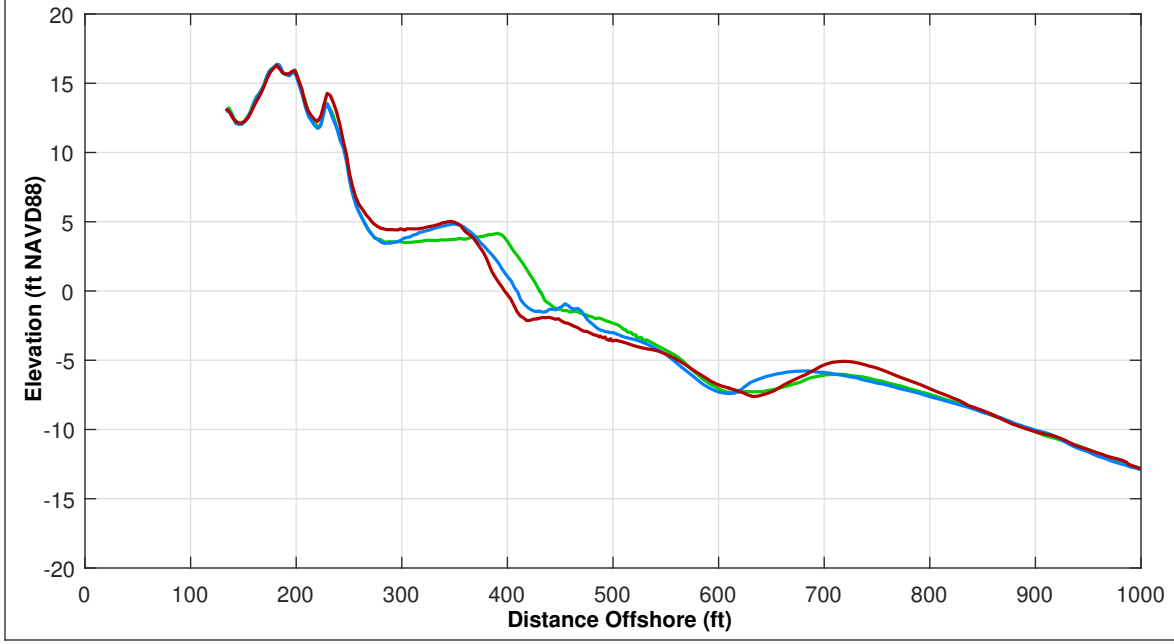

Survey Transect 371+03	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	ft/yr	ft
Volume Change Above -15 ft NAVD88	cy/ft/yr	cy/ft
Volume Change Above 0 ft NAVD88	cy/ft/yr	cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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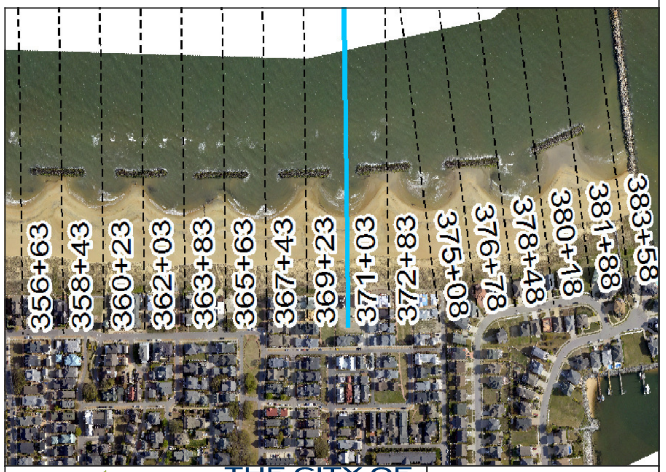

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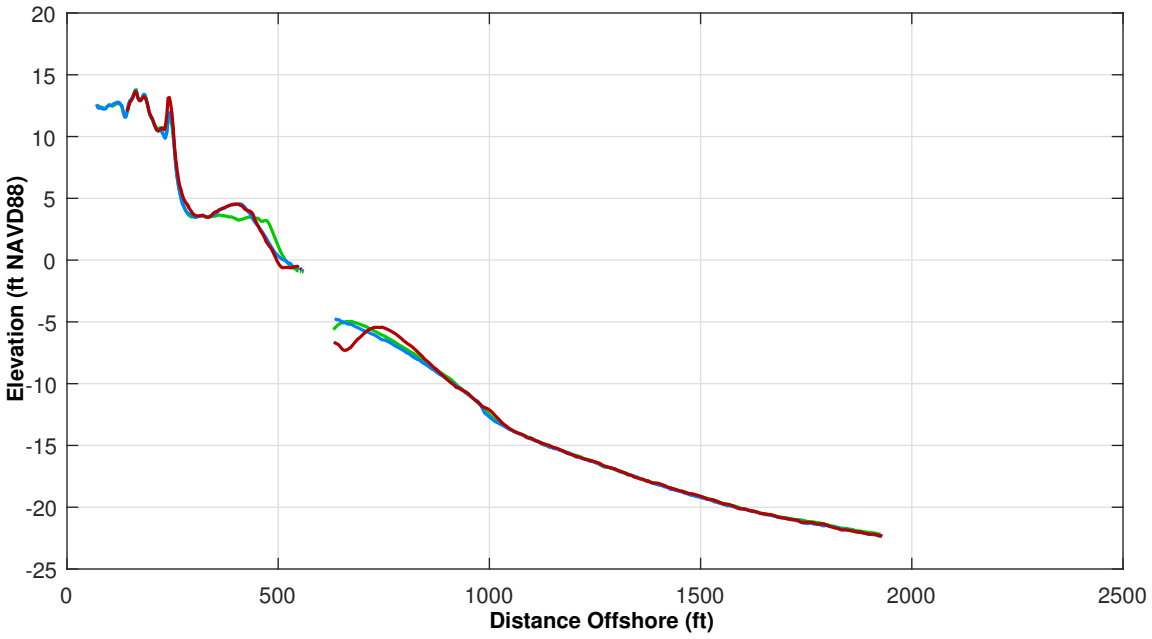

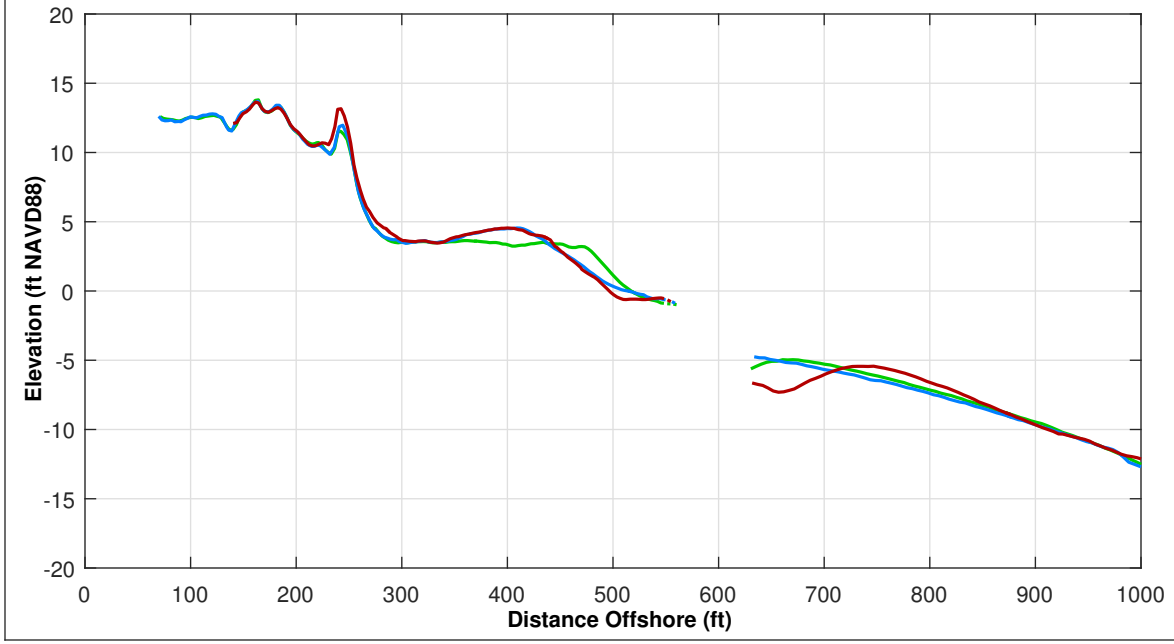

Survey Transect 372+83	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-22.14 ft/yr	-2.90 ft
Volume Change Above -15 ft NAVD88	-0.43 cy/ft/yr	1.83 cy/ft
Volume Change Above 0 ft NAVD88	2.08 cy/ft/yr	1.56 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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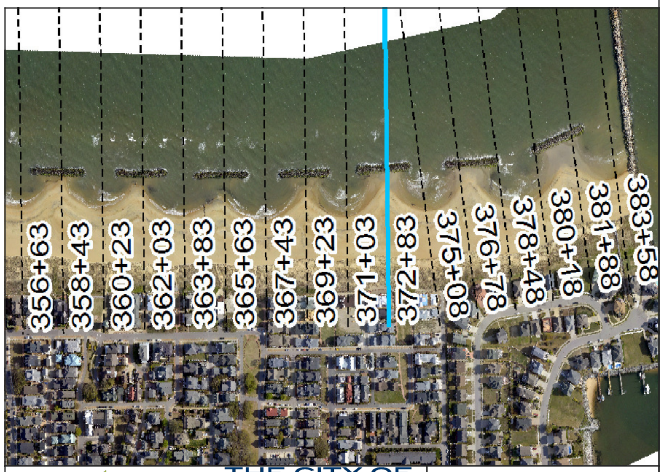

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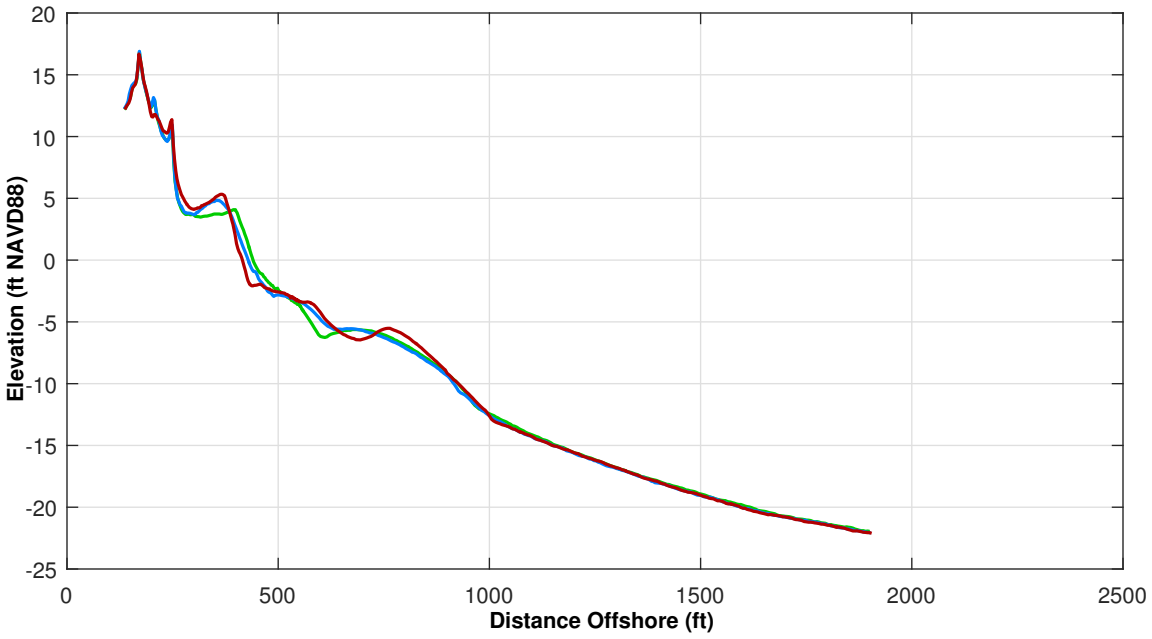
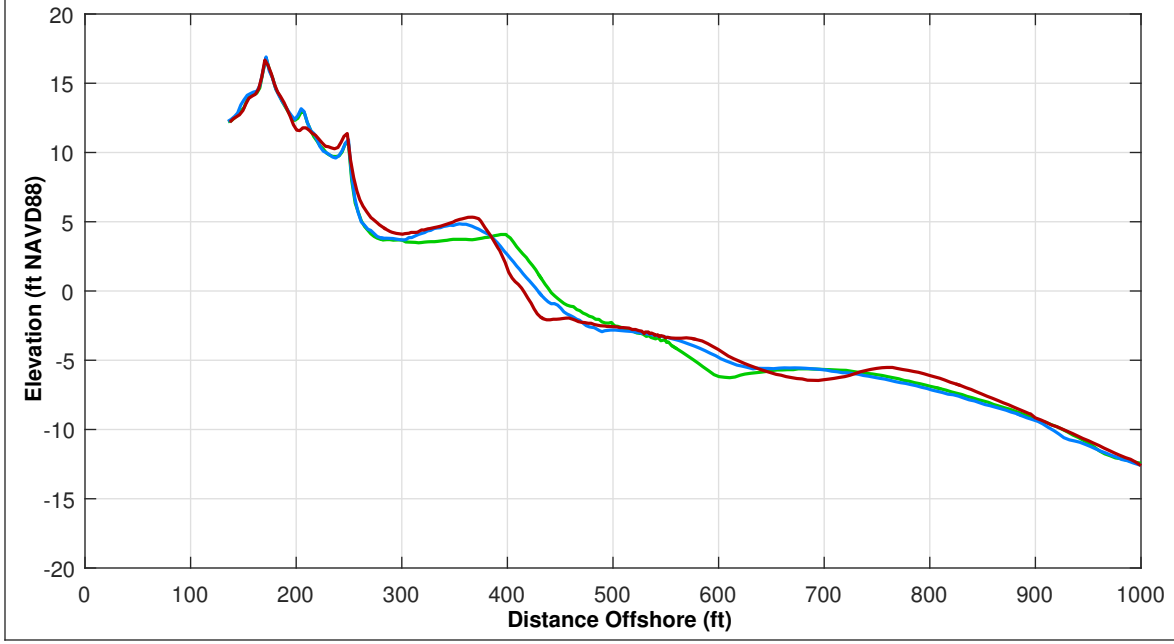
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 375+08	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-31.04 ft/yr	-13.69 ft
Volume Change Above -15 ft NAVD88	4.32 cy/ft/yr	4.80 cy/ft
Volume Change Above 0 ft NAVD88	2.03 cy/ft/yr	1.08 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

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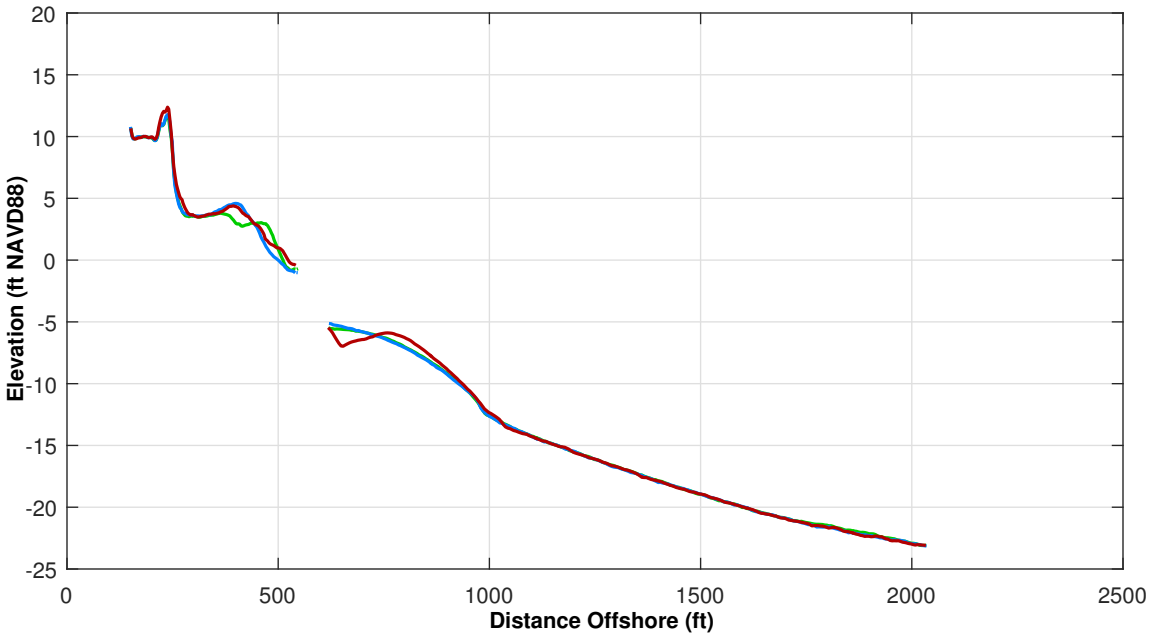

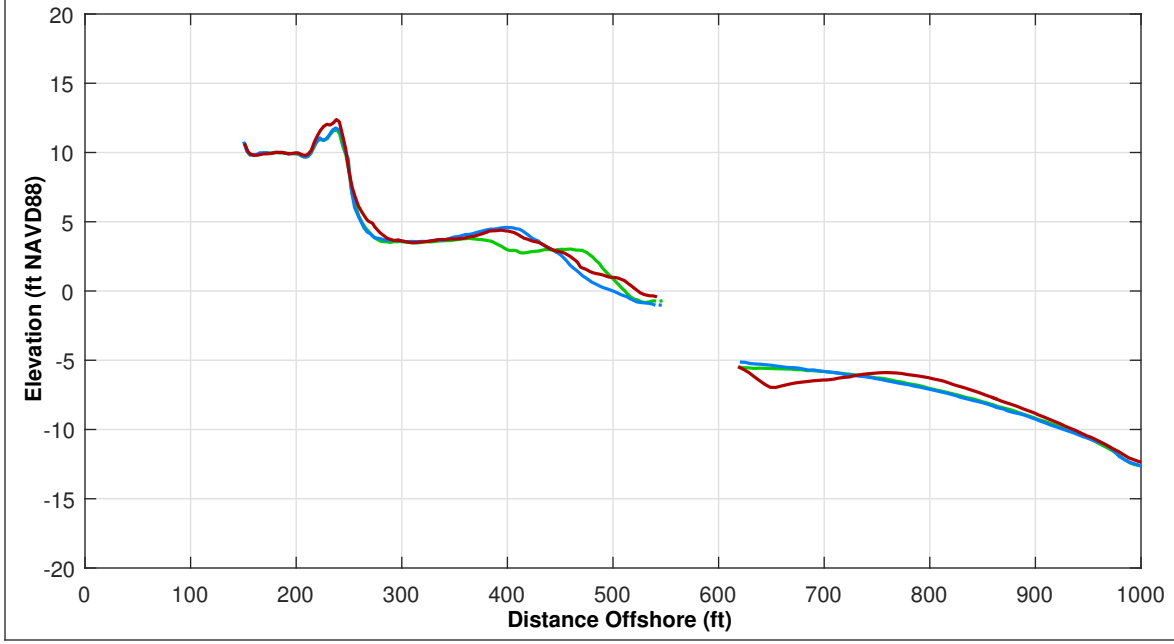

Survey Transect 376+78	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	2.29 ft/yr	27.18 ft
Volume Change Above -15 ft NAVD88	5.54 cy/ft/yr	4.67 cy/ft
Volume Change Above 0 ft NAVD88	3.58 cy/ft/yr	2.63 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

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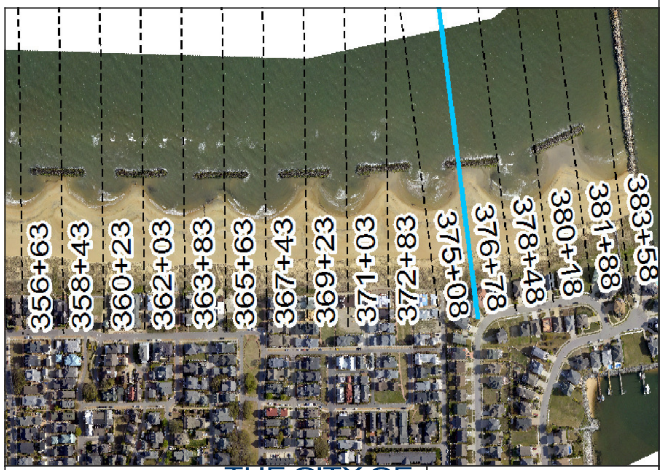

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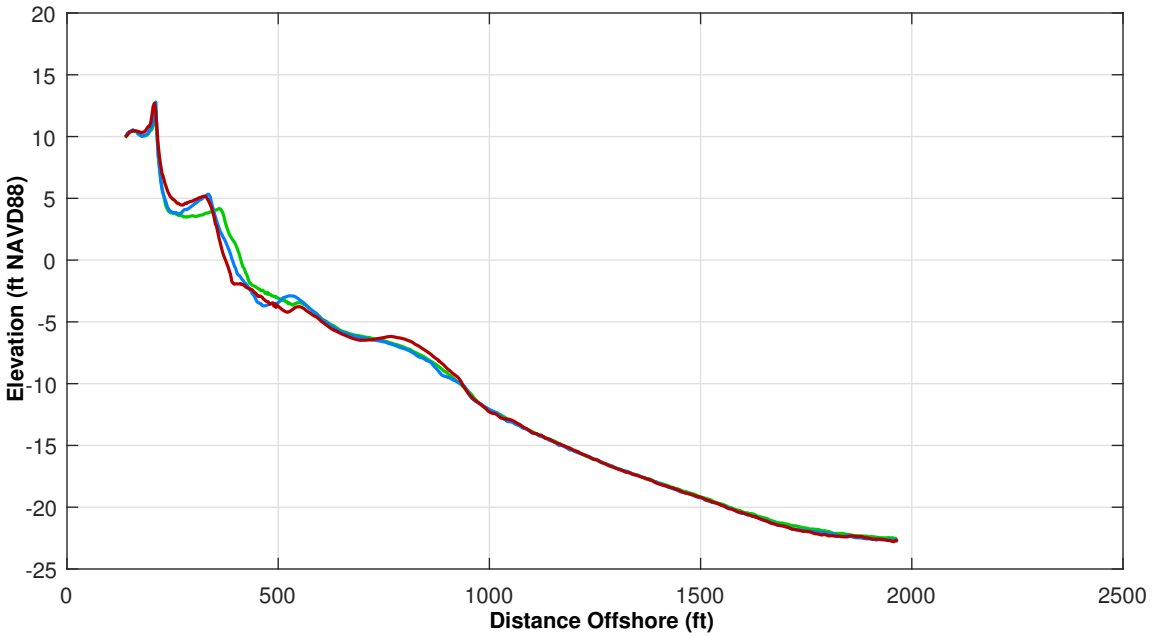

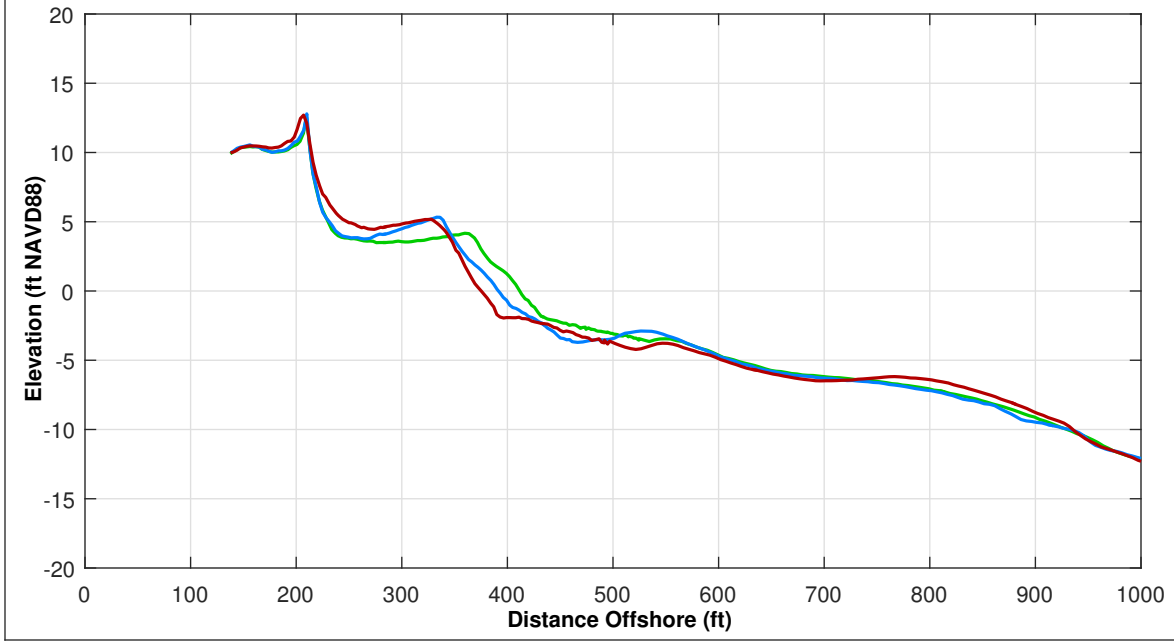

Survey Transect 378+48	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-41.86 ft/yr	-15.70 ft
Volume Change Above -15 ft NAVD88	-2.28 cy/ft/yr	2.81 cy/ft
Volume Change Above 0 ft NAVD88	2.38 cy/ft/yr	1.91 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

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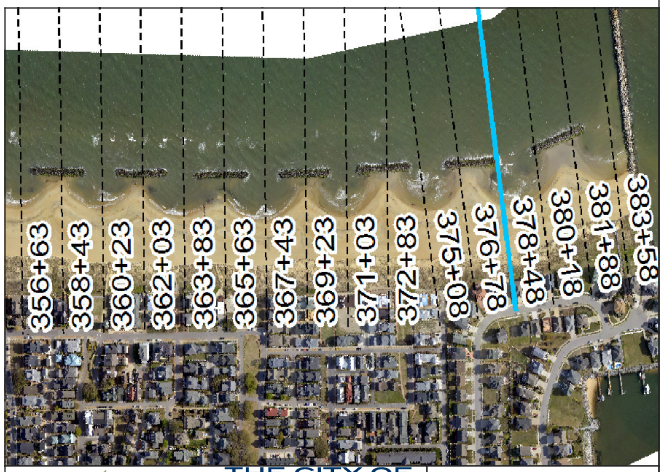

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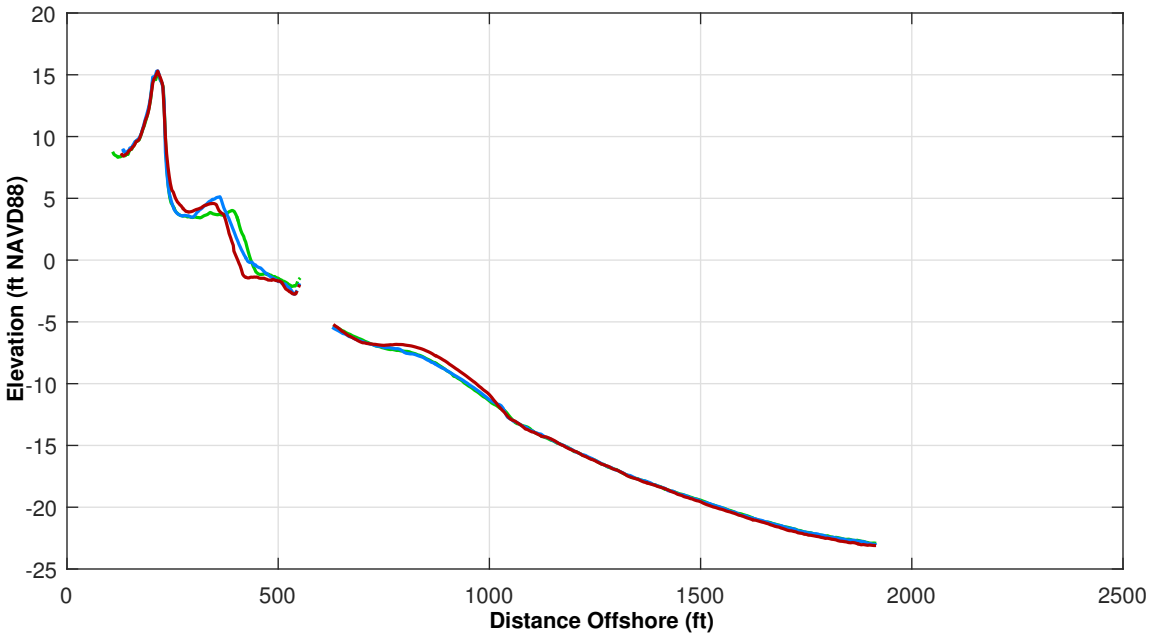

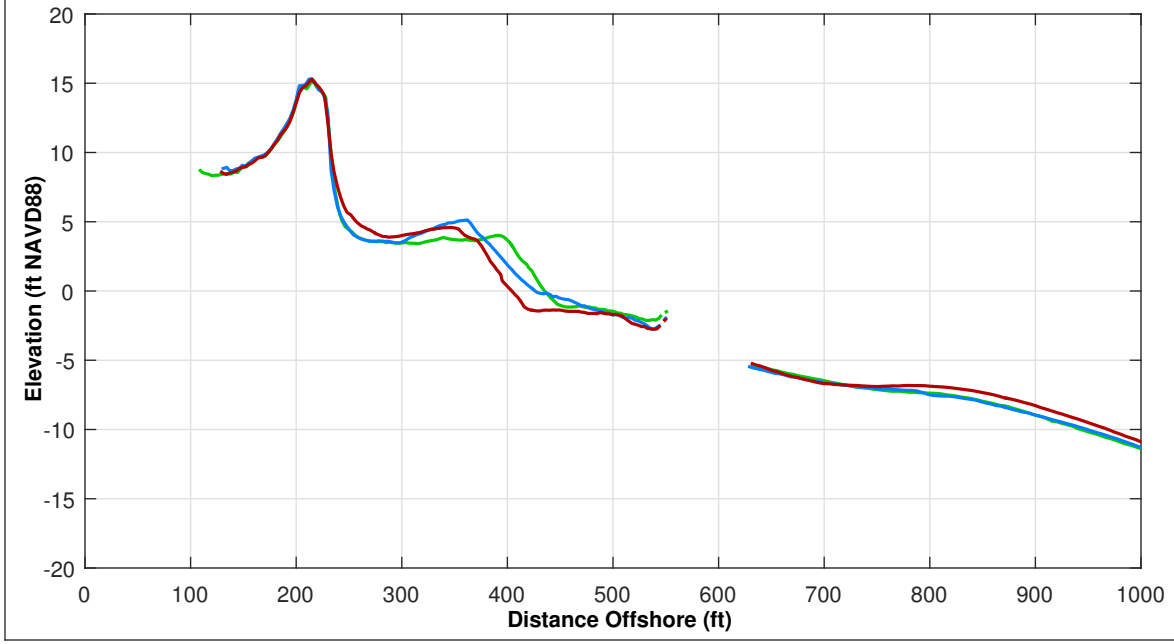

Survey Transect 380+18	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-36.75 ft/yr	-16.84 ft
Volume Change Above -15 ft NAVD88	1.63 cy/ft/yr	1.35 cy/ft
Volume Change Above 0 ft NAVD88	-0.75 cy/ft/yr	-1.13 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

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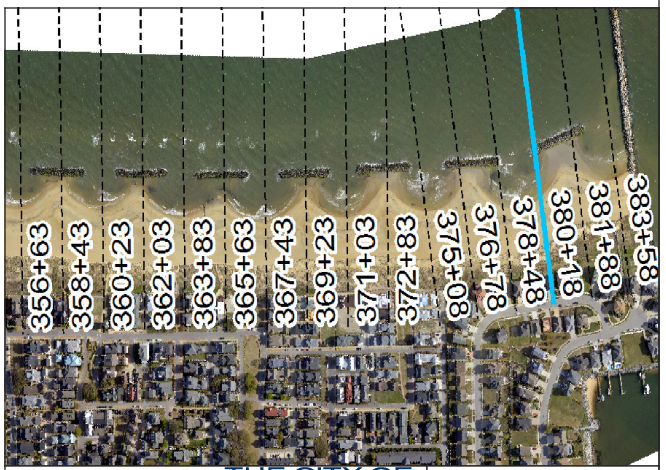

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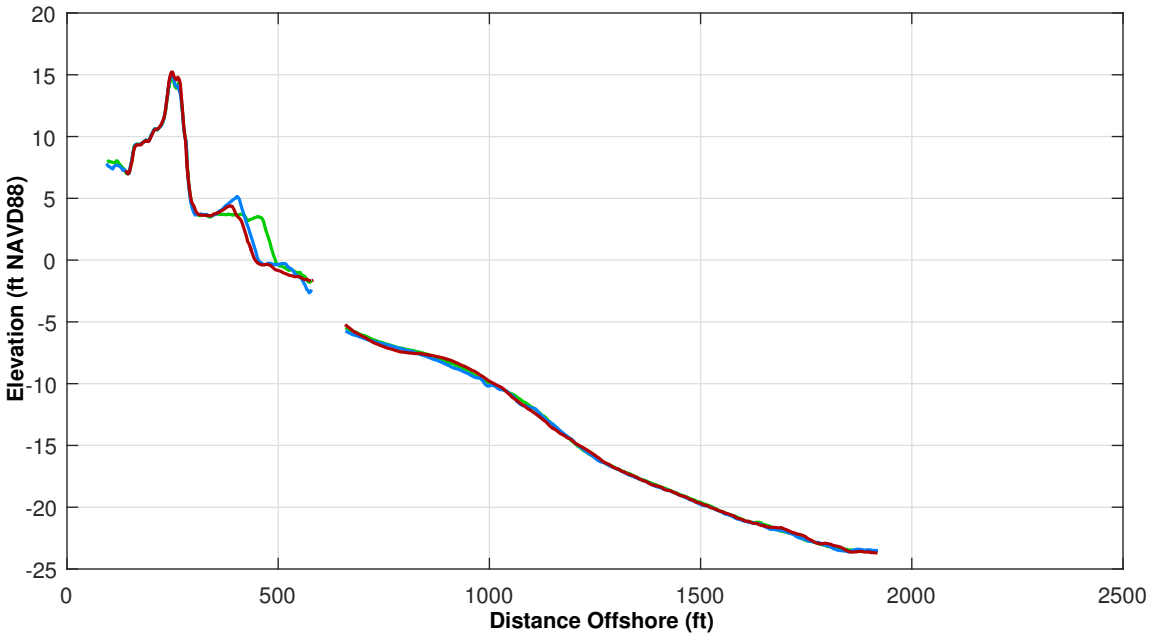

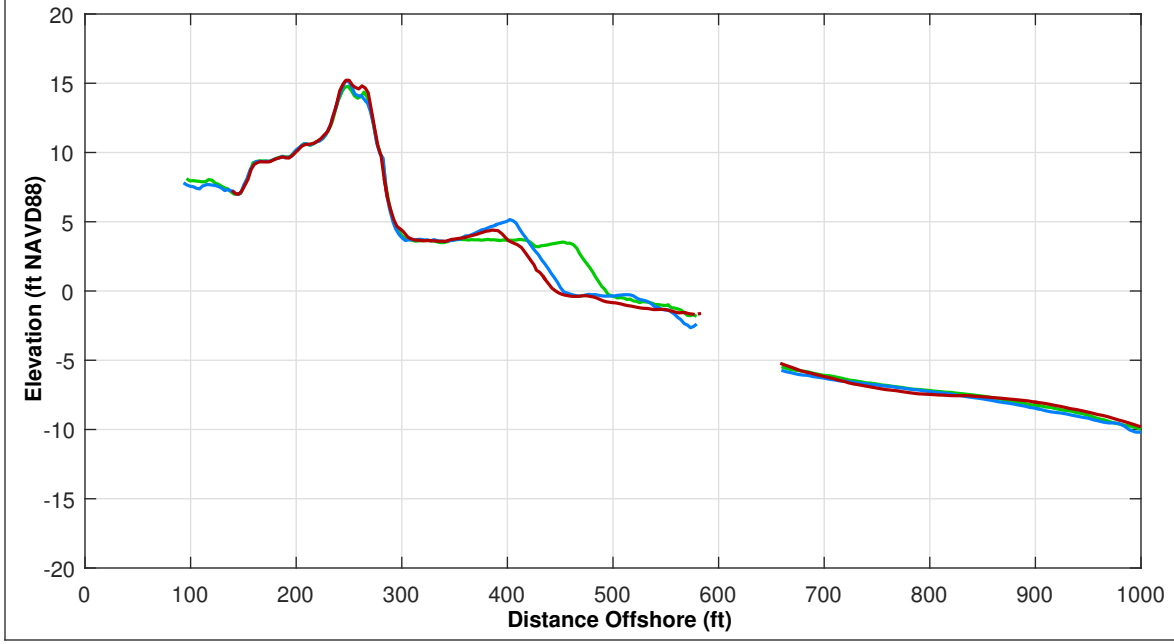

Survey Transect 381+88	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-56.05 ft/yr	-9.82 ft
Volume Change Above -15 ft NAVD88	-9.12 cy/ft/yr	-1.37 cy/ft
Volume Change Above 0 ft NAVD88	-5.79 cy/ft/yr	-2.02 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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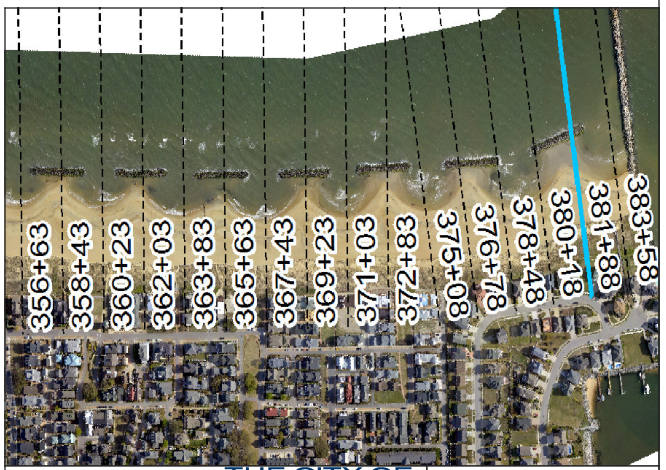

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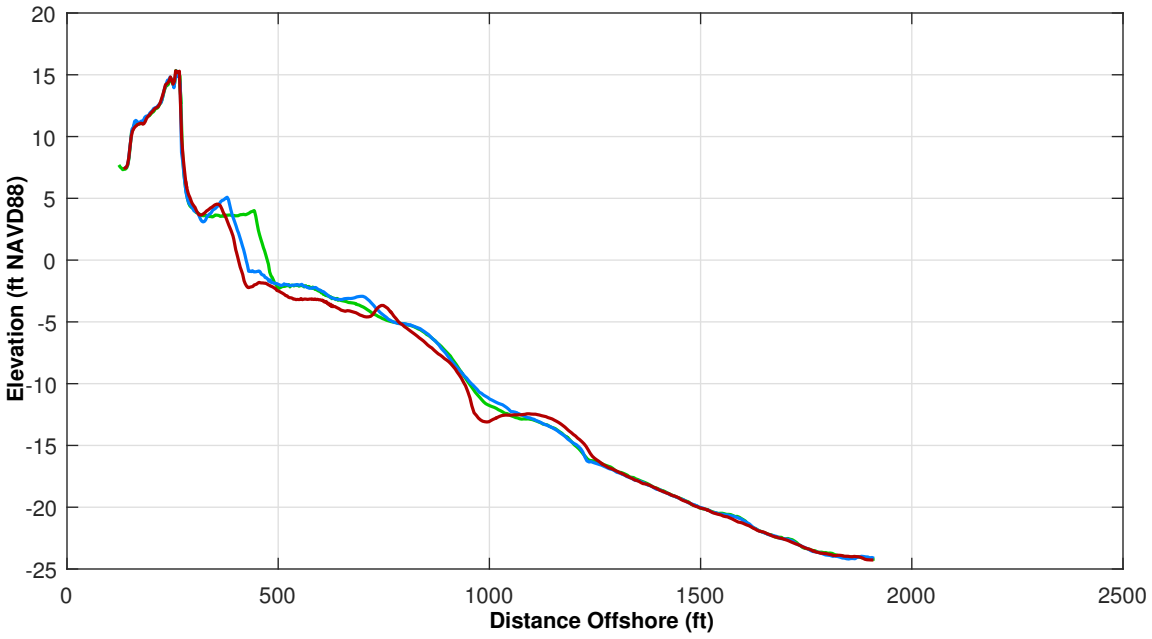

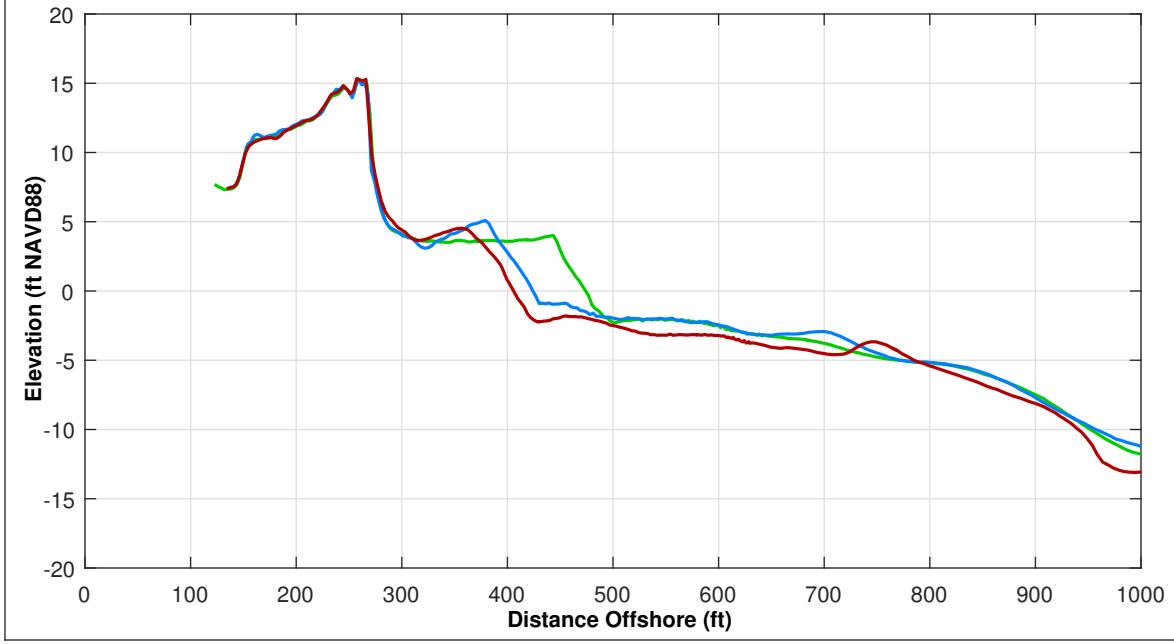

Survey Transect 383+58	APR 2018 - MAY 2017	APR 2018 - OCT 2017
Shoreline Change at MHW (0.98 ft NAVD88)	-75.72 ft/yr	-18.20 ft
Volume Change Above -15 ft NAVD88	-24.33 cy/ft/yr	-18.43 cy/ft
Volume Change Above 0 ft NAVD88	-8.40 cy/ft/yr	-2.15 cy/ft

LEGEND:

APR 2018
OCT 2017
MAY 2017

Notes:

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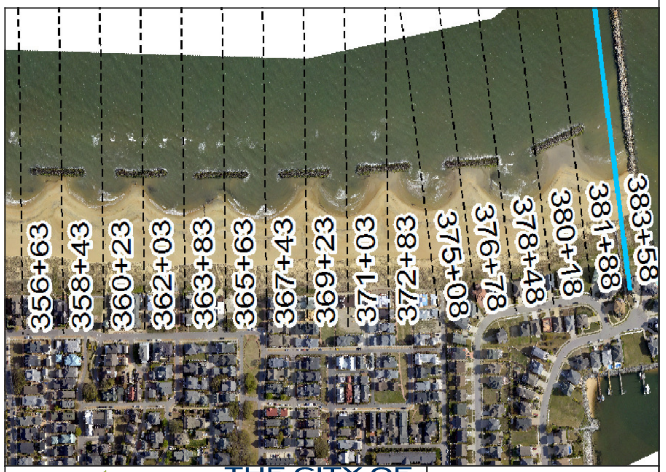
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2017 and OCT 2017
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.



THE CITY OF NORFOLK
PUBLIC WORKS

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS

Table C-1. Summary of Shoreline Change and Volume Change (May 2017 to April 2018)

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. MHW assumed at +0.98 ft-NAVD88.

3. Shoreline Change and Volume Change is calculated for the period between surveys from May 25, 2017 to April 11, 2018.

Transect Number (Station)	Old Survey Date	New Survey Date	Shoreline Change Rate at MHW (ft/yr)	Volume Change Rate Above 0 ft NAVD88 (cy/ft/yr)	Volume Change Rate Above -15 ft NAVD88 (cy/ft/yr)
0+00	5/25/2017	4/11/2018	12.60	5.06	21.63
2+50	5/25/2017	4/11/2018	9.24	3.24	3.28
5+00	5/25/2017	4/11/2018	-3.59	1.59	25.62
7+50	5/25/2017	4/11/2018	13.45	3.70	10.87
10+00	5/25/2017	4/11/2018	-17.41	-2.76	-16.91
12+50	5/25/2017	4/11/2018	8.33	2.98	3.41
15+00	5/25/2017	4/11/2018	-14.07	3.20	3.20
17+50	5/25/2017	4/11/2018	5.99	5.85	6.09
20+00	5/25/2017	4/11/2018	48.50	6.15	13.54
22+50	5/25/2017	4/11/2018	-42.23	-3.35	-1.90
25+00	5/25/2017	4/11/2018	52.70	8.10	18.42
27+50	5/25/2017	4/11/2018	-35.44	-0.24	-3.65
30+00	5/25/2017	4/11/2018	110.41	16.70	22.66
32+50	5/25/2017	4/11/2018	-16.33	5.86	0.32
35+00	5/25/2017	4/11/2018	31.01	7.14	11.66
37+50	5/25/2017	4/11/2018	-20.24	4.71	1.46
40+00	5/25/2017	4/11/2018	-31.94	-1.69	-13.43
42+50	5/25/2017	4/11/2018	-61.36	-1.36	-6.37
45+00	5/25/2017	4/11/2018	-21.87	-1.12	-6.96
45+25	5/25/2017	4/11/2018	-94.17	-4.16	-18.94
47+30	5/25/2017	4/11/2018	-100.65	-9.27	-22.86
49+35	5/25/2017	4/11/2018	-79.12	-8.88	-1.90
51+41	5/25/2017	4/11/2018	-64.14	-3.78	-5.18
53+46	5/25/2017	4/11/2018	-10.67	2.82	10.30
55+51	5/25/2017	4/11/2018	-20.96	2.04	4.22
57+57	5/25/2017	4/11/2018	0.47	2.73	6.42
59+62	5/25/2017	4/11/2018	-33.25	-0.63	-2.68
61+62	5/25/2017	4/11/2018	-0.70	-0.27	4.51
63+62	5/25/2017	4/11/2018	-31.03	0.12	-4.80
65+62	5/25/2017	4/11/2018	-8.46	-0.58	2.48
67+62	5/25/2017	4/11/2018	-46.90	-1.96	-13.20
69+62	5/25/2017	4/11/2018	-12.93	0.99	2.89
71+62	5/25/2017	4/11/2018	-43.23	-0.10	-14.10
73+62	5/25/2017	4/11/2018	-15.56	1.45	6.94
75+62	5/25/2017	4/11/2018	-44.03	-3.51	-6.62
77+62	5/25/2017	4/11/2018	34.64	7.51	14.26
79+62	5/25/2017	4/11/2018	-16.85	3.73	2.46
81+62	5/25/2017	4/11/2018	-3.50	5.22	6.47
83+62	5/25/2017	4/11/2018	-21.33	3.01	-1.70
85+62	5/25/2017	4/11/2018	-15.65	4.36	5.26
87+62	5/25/2017	4/11/2018	-34.45	1.34	-4.28

Table C-1. Summary of Shoreline Change and Volume Change (May 2017 to April 2018) Cont.

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. MHW assumed at +0.98 ft-NAVD88.

3. Shoreline Change and Volume Change is calculated for the period between surveys from May 25, 2017 to April 11, 2018.

Transect Number (Station)	Old Survey Date	New Survey Date	Shoreline Change Rate at MHW (ft/yr)	Volume Change Rate Above 0 ft NAVD88 (cy/ft/yr)	Volume Change Rate Above -15 ft NAVD88 (cy/ft/yr)
93+41	5/25/2017	4/11/2018	-11.11	3.89	-2.80
103+08	5/25/2017	4/11/2018	-40.33	1.96	-2.08
120+93	5/25/2017	4/11/2018	-30.94	2.26	-0.84
129+17	5/25/2017	4/11/2018	-33.30	-1.02	-4.21
141+98	5/25/2017	4/11/2018	-52.54	-1.63	-11.46
152+01	5/25/2017	4/11/2018	-44.41	0.25	1.69
163+49	5/25/2017	4/11/2018	-39.45	2.19	2.48
169+63	5/25/2017	4/11/2018	-48.04	1.62	0.99
171+63	5/25/2017	4/11/2018	-34.00	0.46	2.28
173+63	5/25/2017	4/11/2018	-31.37	2.26	0.38
175+63	5/25/2017	4/11/2018	-9.30	6.32	11.99
177+63	5/25/2017	4/11/2018	-15.32	5.58	5.61
179+63	5/25/2017	4/11/2018	-36.94	0.58	3.83
181+63	5/25/2017	4/11/2018	-28.64	0.22	-2.57
183+63	5/25/2017	4/11/2018	-23.58	0.26	6.84
185+63	5/25/2017	4/11/2018	-42.91	-0.90	1.43
187+63	5/25/2017	4/11/2018	-4.38	1.81	10.08
189+63	5/25/2017	4/11/2018	-23.80	1.41	5.05
191+63	5/25/2017	4/11/2018	-16.93	2.09	5.38
193+63	5/25/2017	4/11/2018	-108.37	-9.86	-24.35
195+63	5/25/2017	4/11/2018	-94.89	-10.22	-24.81
206+86	5/25/2017	4/11/2018	16.97	7.33	5.08
218+66	5/25/2017	4/11/2018	1.71	4.68	2.90
229+85	5/25/2017	4/11/2018	10.95	4.20	-4.22
242+03	5/25/2017	4/11/2018	-14.57	1.20	-2.02
252+62	5/25/2017	4/11/2018	9.88	4.94	12.17
263+22	5/25/2017	4/11/2018	32.51	7.11	11.08
274+53	5/25/2017	4/11/2018	14.24	8.48	1.88
281+40	5/25/2017	4/11/2018	-9.76	5.65	2.29
288+39	5/25/2017	4/11/2018	-67.04	-2.46	-8.46
295+27	5/25/2017	4/11/2018	-43.06	2.57	-7.22
302+24	5/25/2017	4/11/2018	-33.63	3.14	1.53
315+96	5/25/2017	4/11/2018	-32.03	4.05	8.60
323+09	5/25/2017	4/11/2018	-17.76	4.71	1.87
329+63	5/25/2017	4/11/2018	-13.61	7.61	1.38
331+43	5/25/2017	4/11/2018	-20.98	7.51	9.22
333+23	5/25/2017	4/11/2018	-19.25	4.06	12.74
335+03	5/25/2017	4/11/2018	-33.00	2.63	-1.03
336+83	5/25/2017	4/11/2018	-24.38	3.28	1.06
338+63	5/25/2017	4/11/2018	-51.75	1.47	-3.59
340+43	5/25/2017	4/11/2018	-52.77	-2.93	-5.40
342+23	5/25/2017	4/11/2018	-52.17	-0.02	-15.91

Table C-1. Summary of Shoreline Change and Volume Change (May 2017 to April 2018) Cont.

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.

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3. Shoreline Change and Volume Change is calculated for the period between surveys from May 25, 2017 to April 11, 2018.

Transect Number (Station)	Old Survey Date	New Survey Date	Shoreline Change Rate at MHW (ft/yr)	Volume Change Rate Above 0 ft NAVD88 (cy/ft/yr)	Volume Change Rate Above -15 ft NAVD88 (cy/ft/yr)
344+05	5/25/2017	4/11/2018	-63.18	-0.40	4.09
345+85	5/25/2017	4/11/2018	-43.67	0.47	-8.42
347+63	5/25/2017	4/11/2018	-28.04	4.12	-0.15
349+43	5/25/2017	4/11/2018	-29.27	1.28	4.89
351+23	5/25/2017	4/11/2018	-41.23	6.39	3.04
353+03	5/25/2017	4/11/2018	-37.98	1.12	1.98
354+83	5/25/2017	4/11/2018	-46.94	1.72	-1.55
356+63	5/25/2017	4/11/2018	-38.72	0.39	-2.30
358+43	5/25/2017	4/11/2018	-41.45	2.11	1.76
360+23	5/25/2017	4/11/2018	-27.01	2.42	0.53
362+03	5/25/2017	4/11/2018	-47.04	2.95	-1.33
363+83	5/25/2017	4/11/2018	-34.66	0.89	-7.42
365+63	5/25/2017	4/11/2018	-39.88	0.69	-8.14
367+43	5/25/2017	4/11/2018	-37.32	0.95	-3.34
369+23	5/25/2017	4/11/2018	-25.04	0.62	-6.67
371+03	5/25/2017	4/11/2018	-39.19	-0.47	-3.48
372+83	5/25/2017	4/11/2018	-22.14	2.08	-0.43
375+08	5/25/2017	4/11/2018	-31.04	2.03	4.32
376+78	5/25/2017	4/11/2018	2.29	3.58	5.54
378+48	5/25/2017	4/11/2018	-41.86	2.38	-2.28
380+18	5/25/2017	4/11/2018	-36.75	-0.75	1.63
381+88	5/25/2017	4/11/2018	-56.05	-5.79	-9.12
383+58	5/25/2017	4/11/2018	-75.72	-8.40	-24.33

Table C-2. Summary of Shoreline Change and Volume Change (October 2017 to April 2018)

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. MHW assumed at +0.98 ft-NAVD88.

3. Shoreline Change and Volume Change is calculated for the period between surveys from October 16, 2017 to April 11, 2018.

Transect Number (Station)	Old Survey Date	New Survey Date	Shoreline Change at MHW (ft)	Volume Change Above 0 ft NAVD88 (cy/ft)	Volume Change Above -15 ft NAVD88 (cy/ft)
0+00	10/16/2017	4/11/2018	4.33	1.16	-2.54
2+50	10/16/2017	4/11/2018	-0.89	0.50	-4.17
5+00	10/16/2017	4/11/2018	1.45	0.60	20.27
7+50	10/16/2017	4/11/2018	3.20	0.90	-2.30
10+00	10/16/2017	4/11/2018	-2.85	-2.66	-11.64
12+50	10/16/2017	4/11/2018	4.32	0.10	1.94
15+00	10/16/2017	4/11/2018	24.36	4.91	10.65
17+50	10/16/2017	4/11/2018	5.46	2.73	1.56
20+00	10/16/2017	4/11/2018	-5.01	0.21	6.44
22+50	10/16/2017	4/11/2018	-19.73	-2.72	-0.58
25+00	10/16/2017	4/11/2018	7.33	1.29	7.25
27+50	10/16/2017	4/11/2018	-7.03	0.55	-3.71
30+00	10/16/2017	4/11/2018	28.54	3.39	4.70
32+50	10/16/2017	4/11/2018	7.70	2.98	-2.93
35+00	10/16/2017	4/11/2018	20.52	3.99	0.29
37+50	10/16/2017	4/11/2018	-12.91	1.57	-4.49
40+00	10/16/2017	4/11/2018	-38.77	-3.47	-12.65
42+50	10/16/2017	4/11/2018	-28.67	-0.59	-10.15
45+00	10/16/2017	4/11/2018	-44.20	-4.27	-10.06
45+25	10/16/2017	4/11/2018	-33.77	-1.00	-7.86
47+30	10/16/2017	4/11/2018	-27.28	-1.63	-3.35
49+35	10/16/2017	4/11/2018	-30.76	-3.25	-3.79
51+41	10/16/2017	4/11/2018	-26.06	-2.46	-5.89
53+46	10/16/2017	4/11/2018	-2.49	1.11	0.51
55+51	10/16/2017	4/11/2018	-14.67	0.57	-4.04
57+57	10/16/2017	4/11/2018	2.01	2.81	0.10
59+62	10/16/2017	4/11/2018	-13.29	1.46	-2.72
61+62	10/16/2017	4/11/2018	6.92	0.84	-1.87
63+62	10/16/2017	4/11/2018	-16.51	2.22	-6.45
65+62	10/16/2017	4/11/2018	3.58	1.22	-0.56
67+62	10/16/2017	4/11/2018	-22.66	0.10	-6.94
69+62	10/16/2017	4/11/2018	-20.22	0.99	-1.65
71+62	10/16/2017	4/11/2018	-18.70	-0.01	-9.00
73+62	10/16/2017	4/11/2018	-5.87	1.46	-1.56
75+62	10/16/2017	4/11/2018	-22.59	-0.57	-5.80
77+62	10/16/2017	4/11/2018	13.74	3.06	3.76
79+62	10/16/2017	4/11/2018	-37.65	-0.38	-8.61
81+62	10/16/2017	4/11/2018	-14.33	0.71	-3.28
83+62	10/16/2017	4/11/2018	-5.59	2.54	-4.62
85+62	10/16/2017	4/11/2018	10.65	4.40	2.06
87+62	10/16/2017	4/11/2018	-8.80	0.25	-6.39

Table C-2. Summary of Shoreline Change and Volume Change (October 2017 to April 2018) Cont.

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. MHW assumed at +0.98 ft-NAVD88.

3. Shoreline Change and Volume Change is calculated for the period between surveys from October 16, 2017 to April 11, 2018.

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93+41	10/16/2017	4/11/2018	-5.35	1.18	-6.19
103+08	10/16/2017	4/11/2018	-6.42	2.35	-0.51
120+93	10/16/2017	4/11/2018	-5.67	0.83	-2.10
129+17	10/16/2017	4/11/2018	-6.47	0.92	-6.21
141+98	10/16/2017	4/11/2018	-12.77	-1.00	-6.51
152+01	10/16/2017	4/11/2018	-20.40	-2.21	-3.13
163+49	10/16/2017	4/11/2018	-2.62	0.16	-0.19
169+63	10/16/2017	4/11/2018	-0.90	1.82	1.85
171+63	10/16/2017	4/11/2018	8.24	2.13	5.67
173+63	10/16/2017	4/11/2018	6.10	2.51	1.62
175+63	10/16/2017	4/11/2018	26.01	5.24	16.23
177+63	10/16/2017	4/11/2018	15.19	4.94	2.58
179+63	10/16/2017	4/11/2018	16.80	2.97	7.39
181+63	10/16/2017	4/11/2018	3.07	1.03	1.35
183+63	10/16/2017	4/11/2018	23.09	2.43	8.48
185+63	10/16/2017	4/11/2018	-8.91	-0.60	2.43
187+63	10/16/2017	4/11/2018	28.55	2.78	9.34
189+63	10/16/2017	4/11/2018	-9.72	-1.28	1.65
191+63	10/16/2017	4/11/2018	13.55	-0.13	0.63
193+63	10/16/2017	4/11/2018	-32.74	-5.44	-10.61
195+63	10/16/2017	4/11/2018	-28.75	-4.80	-11.30
206+86	10/16/2017	4/11/2018	-9.03	-0.63	-8.64
218+66	10/16/2017	4/11/2018	11.40	3.42	4.31
229+85	10/16/2017	4/11/2018	7.27	3.81	2.05
242+03	10/16/2017	4/11/2018	-11.83	0.80	-4.85
252+62	10/16/2017	4/11/2018	20.45	7.09	14.68
263+22	10/16/2017	4/11/2018	4.40	2.65	8.76
274+53	10/16/2017	4/11/2018	-1.17	3.85	-3.87
281+40	10/16/2017	4/11/2018	-1.79	5.89	8.59
288+39	10/16/2017	4/11/2018	-29.59	-1.13	-4.13
295+27	10/16/2017	4/11/2018	4.74	4.29	-0.25
302+24	10/16/2017	4/11/2018	-10.69	2.21	2.55
315+96	10/16/2017	4/11/2018	14.95	5.66	8.80
323+09	10/16/2017	4/11/2018	9.45	4.18	0.54
329+63	10/16/2017	4/11/2018	16.75	6.52	3.12
331+43	10/16/2017	4/11/2018	-14.27	5.38	9.70
333+23	10/16/2017	4/11/2018	4.22	5.70	13.92
335+03	10/16/2017	4/11/2018	-9.78	3.61	6.81
336+83	10/16/2017	4/11/2018	-2.61	2.77	5.65
338+63	10/16/2017	4/11/2018	-13.86	2.10	0.48
340+43	10/16/2017	4/11/2018	-26.54	-3.12	-5.59

Table C-2. Summary of Shoreline Change and Volume Change (October 2017 to April 2018) Cont.

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.

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3. Shoreline Change and Volume Change is calculated for the period between surveys from October 16, 2017 to April 11, 2018.

Transect Number (Station)	Old Survey Date	New Survey Date	Shoreline Change at MHW (ft)	Volume Change Above 0 ft NAVD88 (cy/ft)	Volume Change Above -15 ft NAVD88 (cy/ft)
342+23	10/16/2017	4/11/2018	-23.65	-0.20	-6.75
344+05	10/16/2017	4/11/2018	-10.72	-0.14	-1.54
345+85	10/16/2017	4/11/2018	-8.52	1.81	0.43
347+63	10/16/2017	4/11/2018	14.76	4.52	4.04
349+43	10/16/2017	4/11/2018	-3.12	2.50	4.53
351+23	10/16/2017	4/11/2018	1.90	5.91	3.09
353+03	10/16/2017	4/11/2018	-16.48	1.01	3.16
354+83	10/16/2017	4/11/2018	-6.04	1.35	1.90
356+63	10/16/2017	4/11/2018	-17.95	-0.31	1.29
358+43	10/16/2017	4/11/2018	-3.65	1.45	3.71
360+23	10/16/2017	4/11/2018	-12.15	0.22	-0.59
362+03	10/16/2017	4/11/2018	-12.39	2.30	2.97
363+83	10/16/2017	4/11/2018	-12.15	0.73	-1.25
365+63	10/16/2017	4/11/2018	-1.50	1.39	-1.29
367+43	10/16/2017	4/11/2018	-13.16	0.85	-1.14
369+23	10/16/2017	4/11/2018	19.49	3.01	-0.09
371+03	10/16/2017	4/11/2018	-12.16	1.78	1.17
372+83	10/16/2017	4/11/2018	-2.90	1.55	1.83
375+08	10/16/2017	4/11/2018	-13.69	1.08	4.80
376+78	10/16/2017	4/11/2018	27.18	2.63	4.67
378+48	10/16/2017	4/11/2018	-15.70	1.91	2.81
380+18	10/16/2017	4/11/2018	-16.84	-1.13	1.35
381+88	10/16/2017	4/11/2018	-9.82	-2.02	-1.37
383+58	10/16/2017	4/11/2018	-18.20	-2.15	-18.43

ENGINEERING ACTIVITIES LOG AND LOG OF SURVEYS FOR ENTIRE OCEAN VIEW SHORELINE

No	Date	Project Type	Location	Description	Vol (cy)	Extent (ft)	Unit Vol (cy/ft)	Sand Source
1	1920-1937	Groin Construction	Willoughby Spit Shoreline	62 groins built by private property owners				
2	Dec 1926-Jan 1928	Jetty Construction	Little Creek Inlet	East Jetty Construction				
3	Dec 1926-Nov 1928	Jetty Construction	Little Creek Inlet	West Jetty Construction				
4	1938	Groin Construction	Between Willoughby Spit and Chesapeake Blvd.	37 timber groins built by City of Norfolk				
5	1953	Beach Nourishment	18th Bay St to 27th Bay St (East Ocean View)	Beach Nourishment	1,260,000	3,000	420	
6	1953	Beach Nourishment	27th Bay St to West Jetty (East Ocean View)	Beach Nourishment	500,000	1,800	278	
7	1960	Beach Nourishment	East End Parking Lot to West Jetty (East Ocean View)	Beach Nourishment	159,000	900	177	
8	1962	Beach Nourishment	Terminal Groin to 9th View St (Willoughby Spit)	Beach Nourishment	176,000	6,900	25	
9	1981	Groin reconstruction	Willoughby Spit area	5 timber groins were reconstructed				
10	1982	Beach Nourishment	East Ocean View	Beach Nourishment	400,000			Pretty Lake
11	1983	Groin Removal	Ocean View Park area	3 groins removed				
12	1983	Groin Construction	Western end of Willoughby Spit	5 groins built by the City of Norfolk				
13	Jan-Apr 1984	Beach Nourishment	Terminal Groin to 5th View St (Willoughby Spit)	Beach Nourishment	537,500	11,000	49	Navy Piers
14	Aug-Nov 1984	Beach Nourishment	21st Bay St to East End Parking Lot (East Ocean View)	Beach Nourishment	400,000	3,000	133	Pretty Lake
15	1985	Beach Nourishment	6th View St to Sarah Constant Shrine Park	Beach Nourishment	50,000			Navy's Willoughby project site
16	1987	Beach Nourishment	5th View St to Mason Creek	Beach Nourishment	50,000	2,000	25	Truck Haul
17	1988	Beach Access Construction	Willoughby and Ocean View	19 pedestrian beach access ways constructed				
18	Spring 1988	Dune Repair	Willoughby Beach	used 10,000 cy of accretion from terminal groin				
19	June, 1989	Dune Repair	Willoughby Beach	used 25,000 cy of accretion from terminal groin				
20	1989	Beach Nourishment	21st Bay St to East End Parking Lot (East Ocean View)	Beach Nourishment	133,000	3,000	44	Cape Henry Channel
21	1990	Breakwater Construction	Western end of Willoughby Spit-Lea View Ave.	2 near shore breakwaters				
22	1990	Terminal Groin Reconstruction	Western end of Willoughby Spit-Lea View Ave.	Original wooden groin raised and extended using rock				
23	1990	Beach Nourishment	Willoughby Spit-Near Terminal Groin	Beach Nourishment	100,000			West of Terminal Groin
24	1990-1991	Dune Stabilization/repair	Various Locations	dune vegetation planting,sand fence construction, elevated public access way, cross-over structures, and timber roads for vehicles				
25	1995	Beach Nourishment	Willoughby Spit	Beach Nourishment	240,000			15th View
26	December, 1995	Beach Nourishment	13th View St to 12 View St (in 4 groin pockets)	Beach Nourishment	4,000			15th View
27	December, 1995	Beach Nourishment	Critical Area 1: 8th View St to 7th View St	Beach Nourishment	30,000	1,000	30	15th View
28	March, 1997	Terminal Groin (trunk) Elevated	Willoughby Spit	terminal groin (trunk) elevated +4 ft				
29	Jan 1997- April 1997	Breakwater Construction	Critical Area 1: Worth St to 8th View	nearshore breakwaters 1-4 constructed				
30	December 1997 - March 1998	Breakwater Construction	Critical Area 1: Worth St to 8th View	nearshore breakwaters 5-7 constructed				
31	***October 1998 City Survey***		***Entire Ocean View Shoreline***					
32	December, 1998	Beach Nourishment	Critical Area 1: East of 8th View St-near site of future groin spur	Beach Nourishment	500	175	3	
33	***October 1999 City Survey***		***Entire Ocean View Shoreline***					
34	1999	Breakwater Construction	Critical Area 2: Just east of Community Beach	4 nearshore breakwaters constructed				
35	November-December 1999	Groin Spur Construction	Critical Area 1: Worth St to 8th View	groin spur construction				
36	December, 1999	Beach Nourishment	Center of COV breakwaters	Beach Nourishment	4,000			
37	December, 1999	Beach Nourishment	Critical Area 1: East of 8th View St-leeward of newly constructed groin spur	Beach Nourishment	1,000	200	5	15th View
38	***July 2000 City Survey***		***From Approx. 9th View St to Little Creek Inlet***					
39	August, 2000	Breakwater Construction	Critical Area 3: 21st Bay to Little Creek Inlet	nearshore breakwaters 2,3,4 constructed				
40	***October 2000 City Survey***		***From Approx. 12th View St to Little Creek Inlet***					
41	July, 2001	Beach Nourishment	Critical Area 1: Worth St to 8th View	Beach Nourishment	500			Truck Haul
42	September, 2001	Beach Nourishment	Critical Area 1: East of 8th View St-between breakwater 7 and groin spur	Beach Nourishment	2,000	300	7	15th View
43	***October 2001 City Survey***		***Entire Ocean View Shoreline***					
44	November, 2001	Breakwater Construction	Critical Area 3: 21st Bay to Little Creek Inlet	nearshore breakwaters 1,5,6,7 constructed				
45	March - April, 2002	Breakwater Work	Critical Area 1: breakwater 7	work on toe extensions				
46	May, 2002	Beach Nourishment	Critical Area 1: East of 8th View St-between breakwater 7 and groin spur	Beach Nourishment	3,438	300	11	15th View
47	June, 2002	Groin Removal	Critical Area 1: Worth St to 8th View	Removal of timber groin channalward of rock spur				
48	***July 2002 City Survey***		***Entire Ocean View Shoreline - excluding approx. Sherwood Pl. to Warwick Ave.***					
49	***October 2002 City Survey***		***Entire Ocean View Shoreline - minimal survey data (no beach or bathymetric survey points)***					
50	***March 2003 City Survey***		***East Ocean View Shoreline (19th Bay to Little Creek Inlet)***					
51	***April 2003 City Survey***		***East Ocean View Shoreline (17th Bay to Little Creek Inlet)***					
52	***June 2003 Waterway Survey***		***East Ocean View Shoreline (17th Bay to Little Creek Inlet)***					
53	September, 2003	Beach Nourishment	Critical Area 1: West of 8th View St beach access	Beach Nourishment	1,100	350	3	15th View

No	Date	Project Type	Location	Description	Vol (cy)	Extent (ft)	Unit Vol (cy/ft)	Sand Source
54	***October 2003 Waterway Survey***		***Post-Isabel Survey - East Ocean View Shoreline (17th Bay to Little Creek Inlet)***					
55	October, 2003	Beach Nourishment	Critical Area 3: 19th Bay St	Beach Nourishment	6,000	545	11	upland sand trucked in
56	October, 2003	Beach Nourishment	Critical Area 3: East of 30th Bay St	Beach Nourishment	1,000	150	7	upland sand trucked in
57	December, 2003	Beach Nourishment	Critical Area 3: 17th Bay St to Little Creek Inlet	Beach Nourishment	359,000	5,280	68	Thimble Shoal Channel
58	December, 2003	Beach Nourishment	Critical Area 1: 9th View St to 7th View St (+400 ft)	Beach Nourishment	39,800	1,260	32	
59	***Nov-Dec 2003 Post-Fill Survey***		***East OceanView Shoreline (17th Bay to Little Inlet Creek)***					
60	***Feb-April, 2004 Waterway Survey***		***From Approx. Willoughby Spit to 17th Bay St***					
61	August, 2004	Beach Nourishment	13th View to 11th View, Behind Western 4 Breakwaters at 800 Block, 1200' East of dogleg	Beach Nourishment	37,000	4,950	7	Truck Haul
62	January-March, 2005	Dune Restoration	Willoughby Spit to Central Ocean View (14th View St to Warwick Ave)	Willoughby Spit to Central Ocean View Dune Restoration Project	504,329	18,300	28	Thimble Shoal Channel
63	***January-March 2005 Post-Fill Survey***		***Willoughby Spit to Warwick Ave.***					
64	***September 2005 McKim & Creed Periodic Survey***		***Entire Ocean View Shoreline***					
65	January-February, 2006	Groin Spur & Toe Extension Removal	Critical Area 1: East of 8th View	groin spur removal				
66	January-February, 2006	Breakwater Construction	Critical Area 1: East of 8th View	nearshore breakwater 8 constructed				
67	January-February, 2006	Breakwater Construction	Critical Area 3: 29th Bay to Little Creek Inlet	nearshore breakwaters 8, 9, & 10 constructed				
68	***March 2006 McKim & Creed Periodic Survey***		***Entire Ocean View Shoreline***					
69	***October 2006 McKim & Creed Periodic Survey***		***Entire Ocean View Shoreline***					
70	***March 2007 McKim & Creed Periodic Survey***		***Entire Ocean View Shoreline***					
71	***October 2007 McKim & Creed Periodic Survey***		***Entire Ocean View Shoreline***					
72	***March 2008 McKim & Creed Periodic Survey***		***Entire Ocean View Shoreline***					
73	***October 2008 McKim & Creed Periodic Survey***		***Entire Ocean View Shoreline***					
74	March, 2009	Beach Nourishment	East Ocean View and Bay Oaks	Beach Nourishment	196,000			
75	***April 2009 McKim & Creed Periodic Survey***		***Entire Ocean View Shoreline***					
76	August-October, 2009	Breakwater Construction	Bay Oaks	5 Nearshore Breakwaters Constructed				
77	***October 2009 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
78	***November-December 2009 Post-Storm Survey***		***Entire Ocean View Shoreline***					
79	***March 2010 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
80	April, 2010	Dune Restoration	Willoughby Spit and 800 Block	Dune restoration using sediment from terminal groin and 800 block breakwaters				
81	***October 2010 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
82	***April 2011 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
83	***October 2011 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
84	***March 2012 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
85	***October 2012 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
86	January-May, 2013	Breakwater Construction	Willoughby Spit	7 Nearshore Breakwaters Constructed				
87	January-May, 2013	Dune Restoration/Beach Nourishment	Willoughby Spit	Dune Restoration at Lea View Ave and Beach Nourishment from 11th View to 13th View	35,000			Willoughby Spit / Truck Hual
87	January-May, 2013	Breakwater Relocation	800 Block	Breakwater 7 moved further offshore				
88	***April 2013 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
89	May-October, 2013	Timber Groin Removal	West Ocean View	7 Timber Groins removed east of the Pier				
90	October, 2013	Rock Groin Construction	West Ocean View	Rock Groin Constructed between Sarah Constant Shrine Park and the 200 Block				
91	***October 2013 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
92	November 2013	Beach Nourishment	West Ocean View	Beach Nourishment	73,600			Truck Haul
93	***March 2014 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
94	***October 2014 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
95	***April 2015 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
96	***October 2015 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
97	January-February 2016	Beach Nourishment	Toler Place (between 11th View and 12th View Streets)	Emergency nourishemnt placed above MHW	16,400			Willoughby Spit
98	February 2016	Beach Nourishment	Adjacent to Terminal Groin	Emergency nourishemnt placed above MHW	1,500			Truck Hual Upland Source
99	***May 2016 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
100	***October 2016 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
101	***February 2017 Federal Project Ore-Construction Survey (by GLDD)***		***Entire Ocean View Shoreline***					
102	March-May 2017	Beach Nourishment	14th View Street to Warwick Avenue, and 1st Bay Street to Little Creek Inlet	Initial Construction of the Federal Project by USACE	1,200,358		variable	Thimble Shoal Aux. Channel
103	***May 2017 Federal Project Post-Construction Survey (by GLDD)***		***Entire Ocean View Shoreline***					
104	***May 2017 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
105	***October 2017 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
106	***April 2018 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					

REFERENCE*

Critical area 1: Worth St to 8th View
Critical area 2: Chesapeake Blvd. to Atlans St.
Critical area 3: 21st Bay to Little Creek Inlet

*Critical areas of concern for erosional damage defined in

Andrews, Miller & Assoc., Inc. “Beach Management Plan, City of Norfolk Virginia”, January, 1993.

CHESAPEAKE BAY

0+00 2+50 5+00 7+50 10+00 12+50 15+00 17+50 20+00 22+50 25+00 27+50 30+00 32+50 35+00 37+50 40+00 42+50 45+00 46+25 47+30 49+35 51+41 53+46 55+51 57+57 59+62 61+62 63+62 65+62 67+62 69+62 71+62 73+62 75+62 77+62 79+62 81+62 83+62 85+62 87+62 88+41

Legend

Ocean View Structures

Periodic Survey Baseline

Periodic Survey Transects

Note: Negative = Erosion
Positive = Accretion

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Feet

N

Elevation Difference (ft), October 2017 to April 2018

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- -8 to- -6
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CHESAPEAKE BAY

93+41
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163+49
169+63
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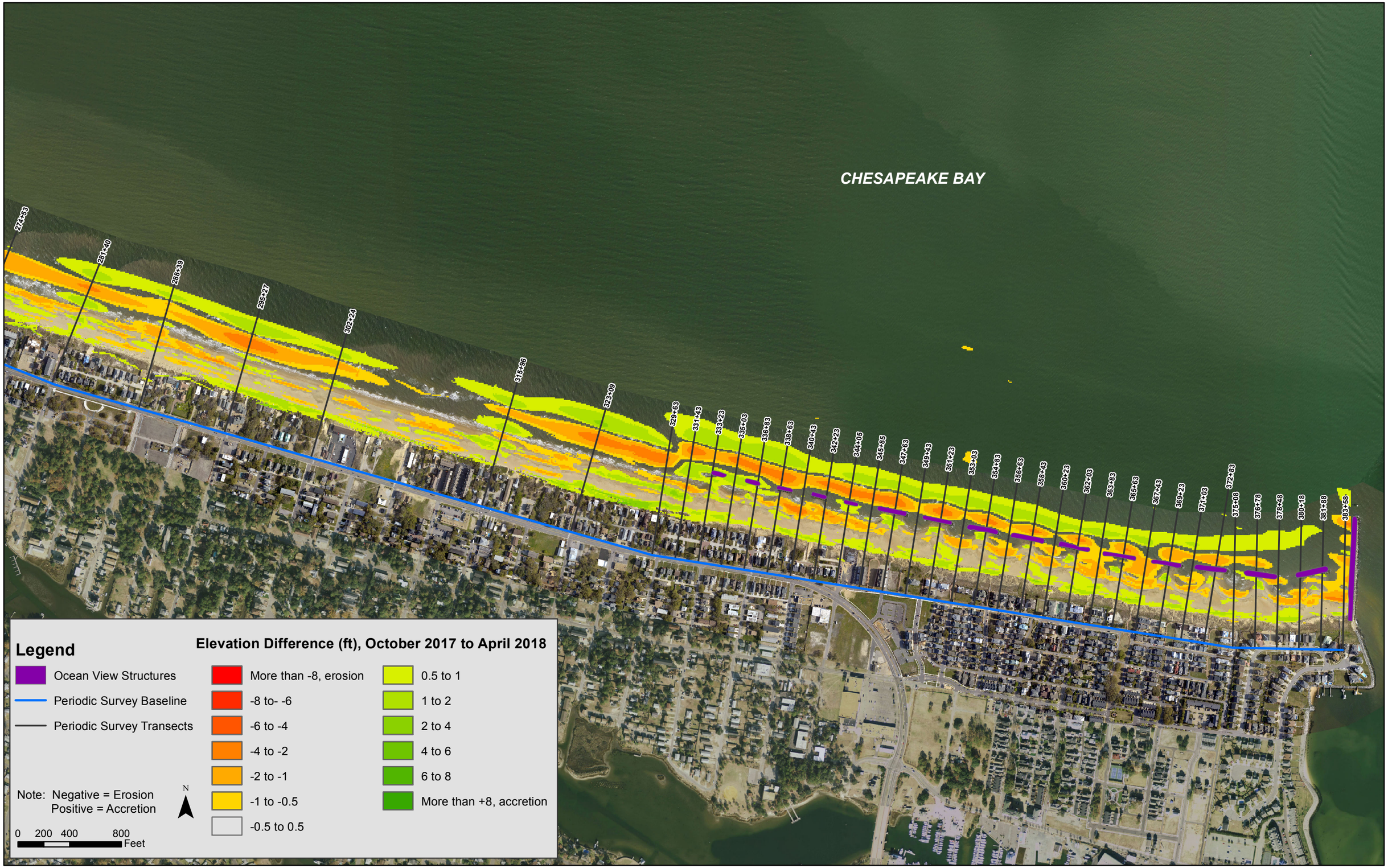
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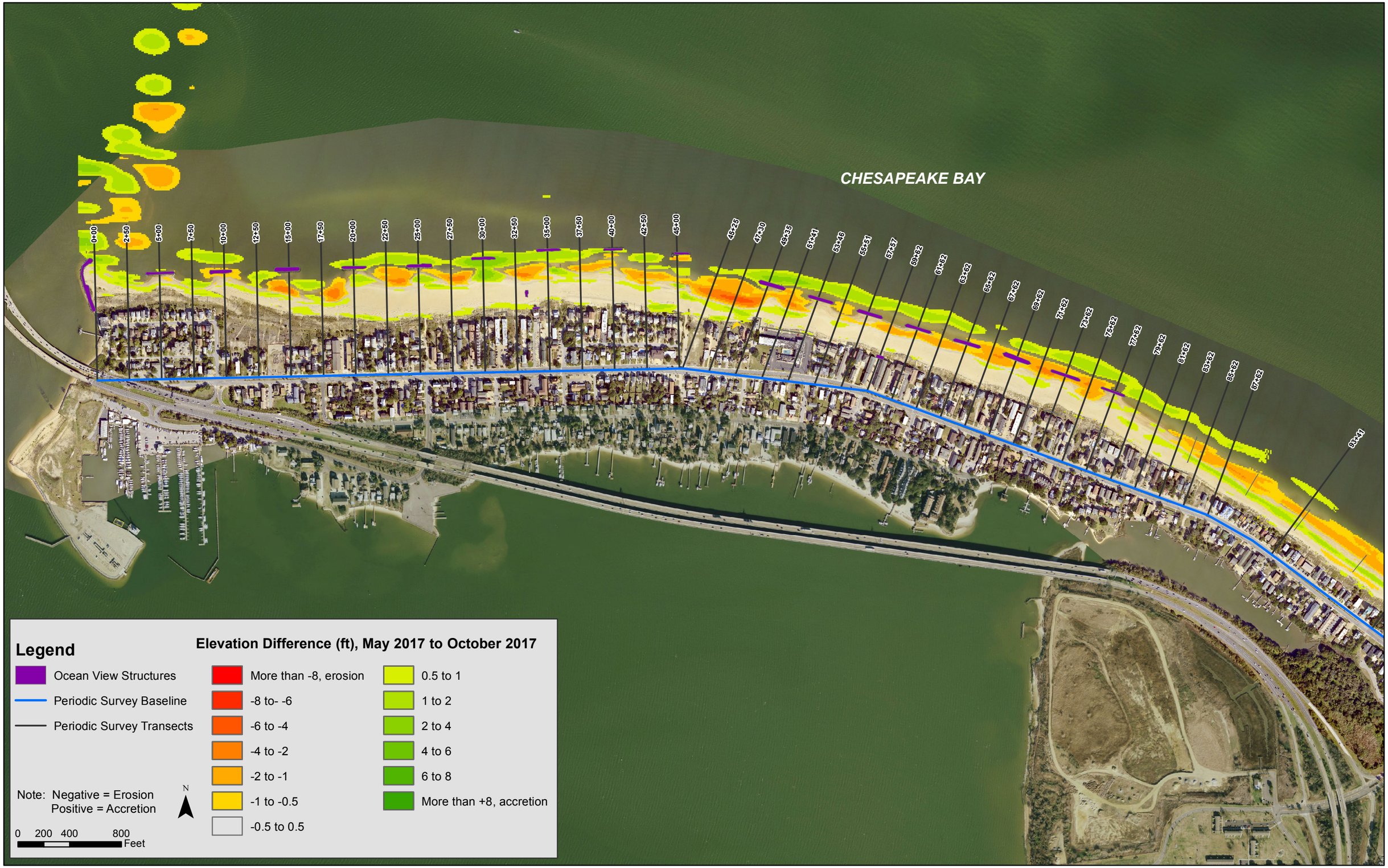
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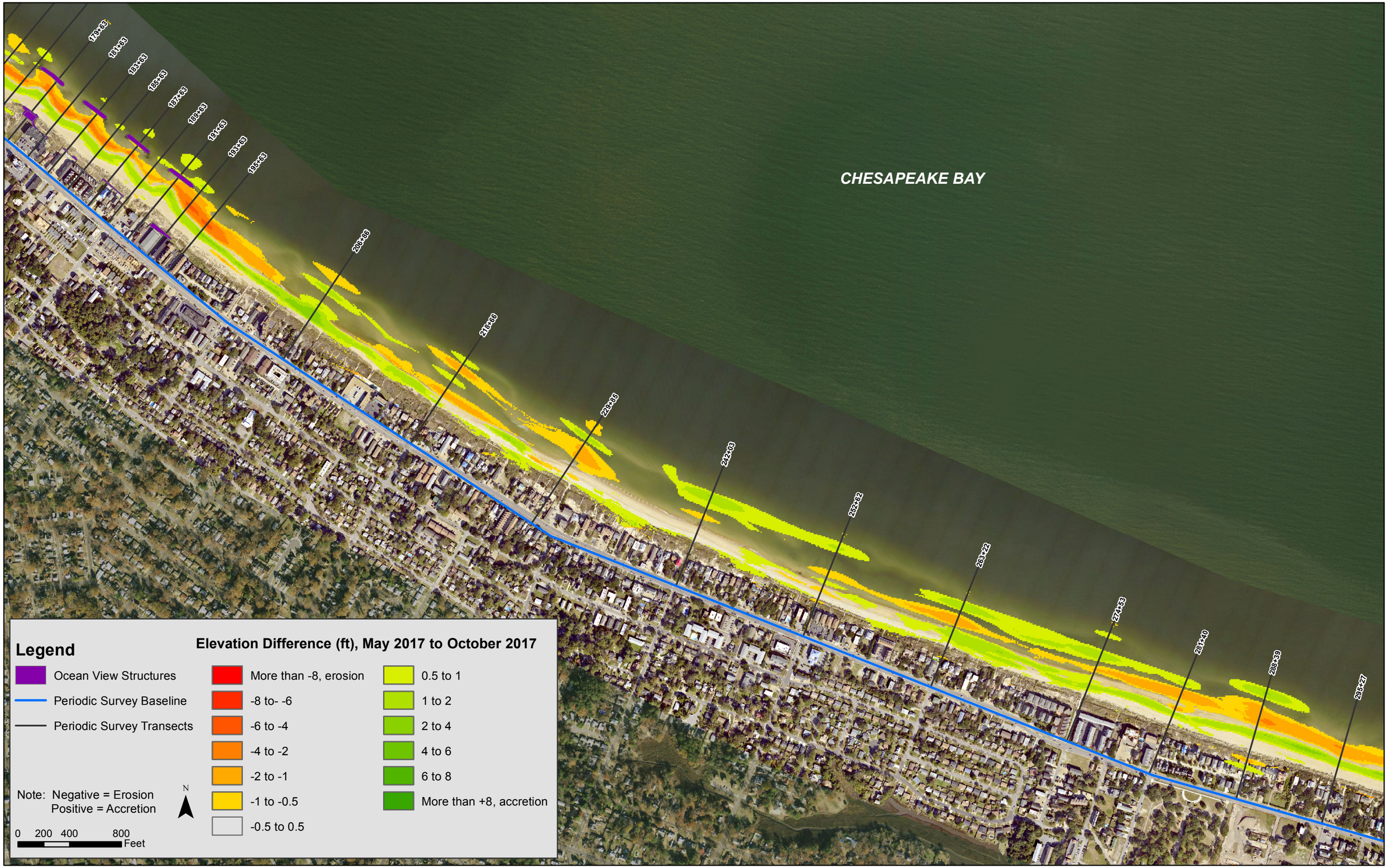
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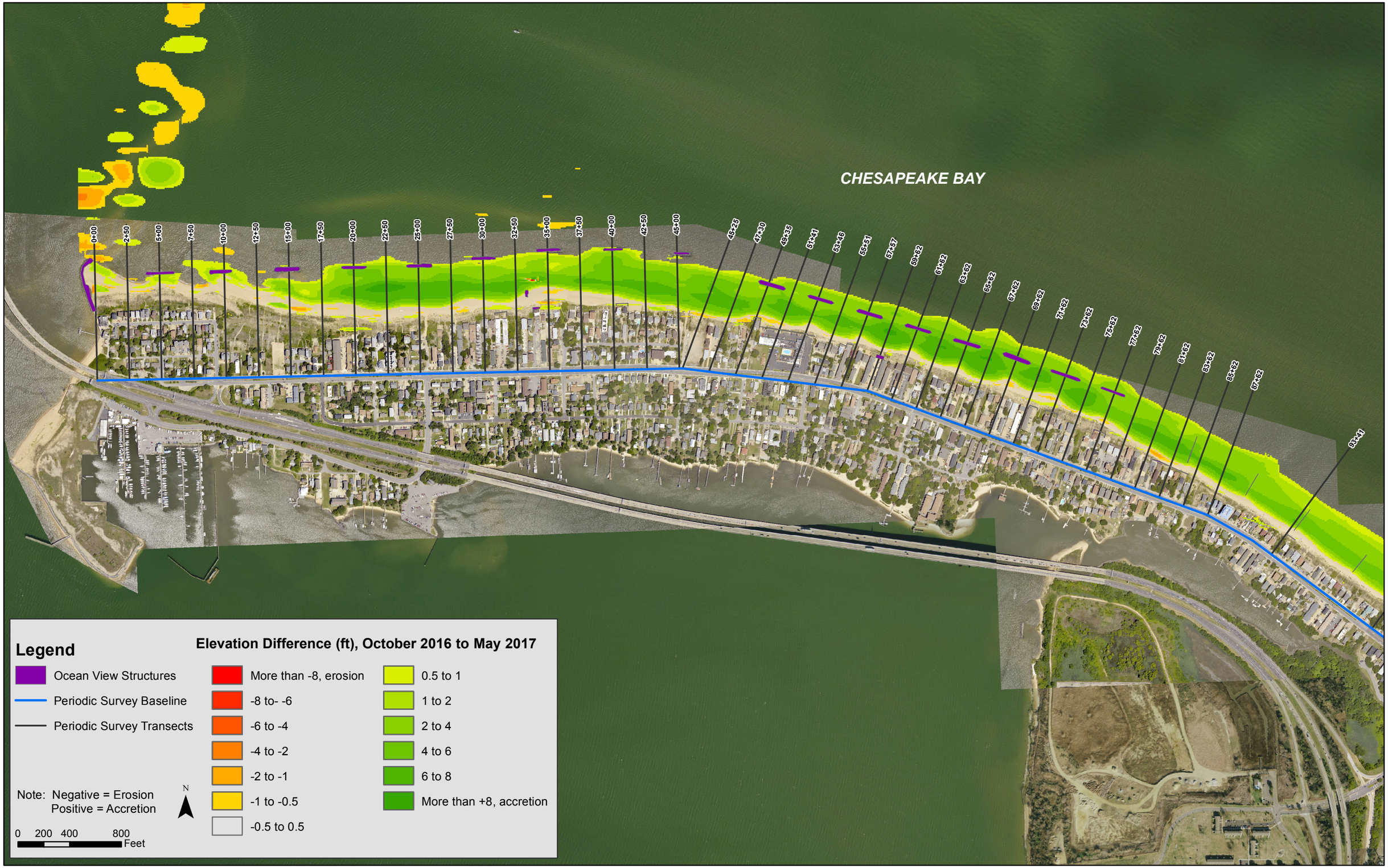
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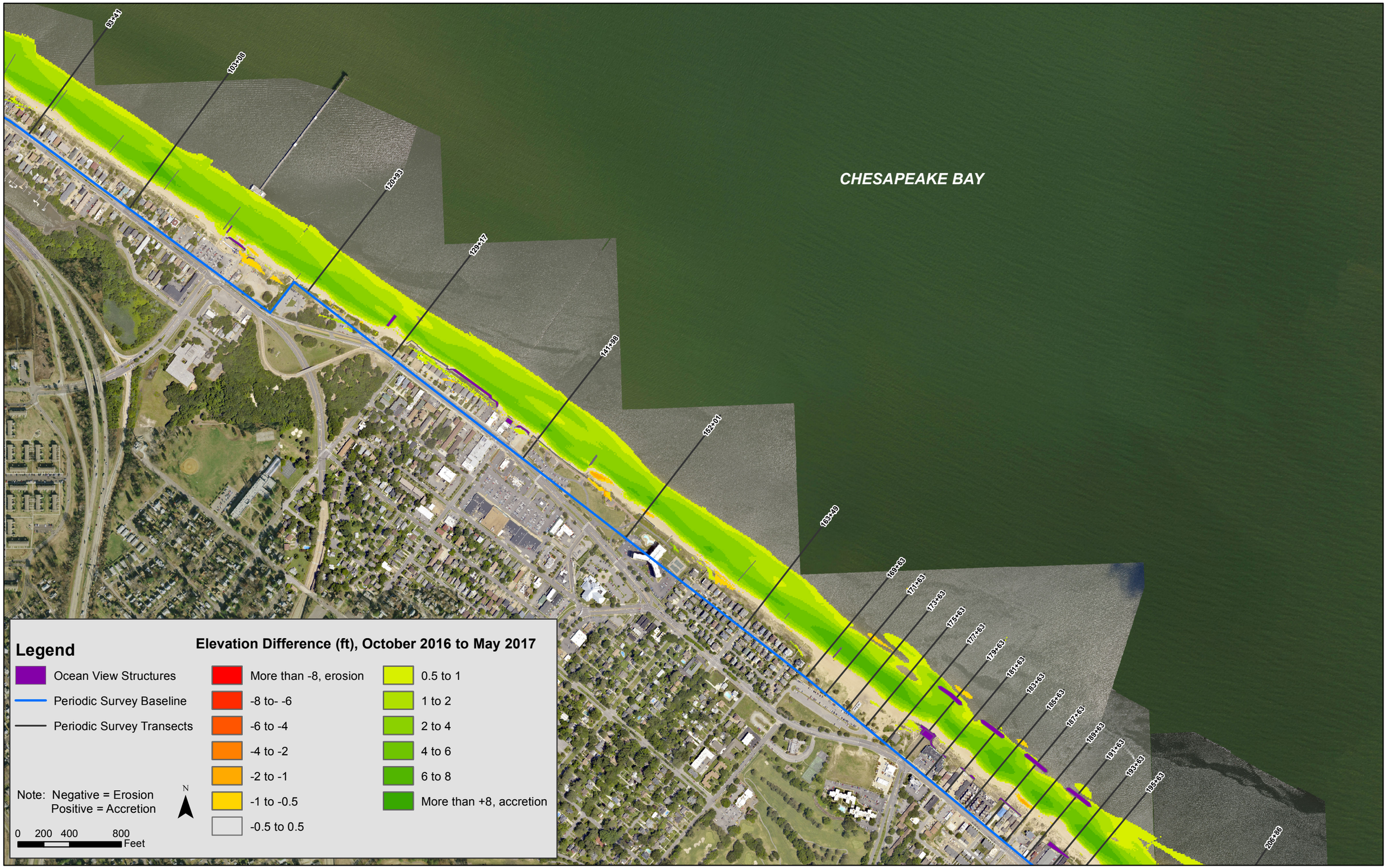
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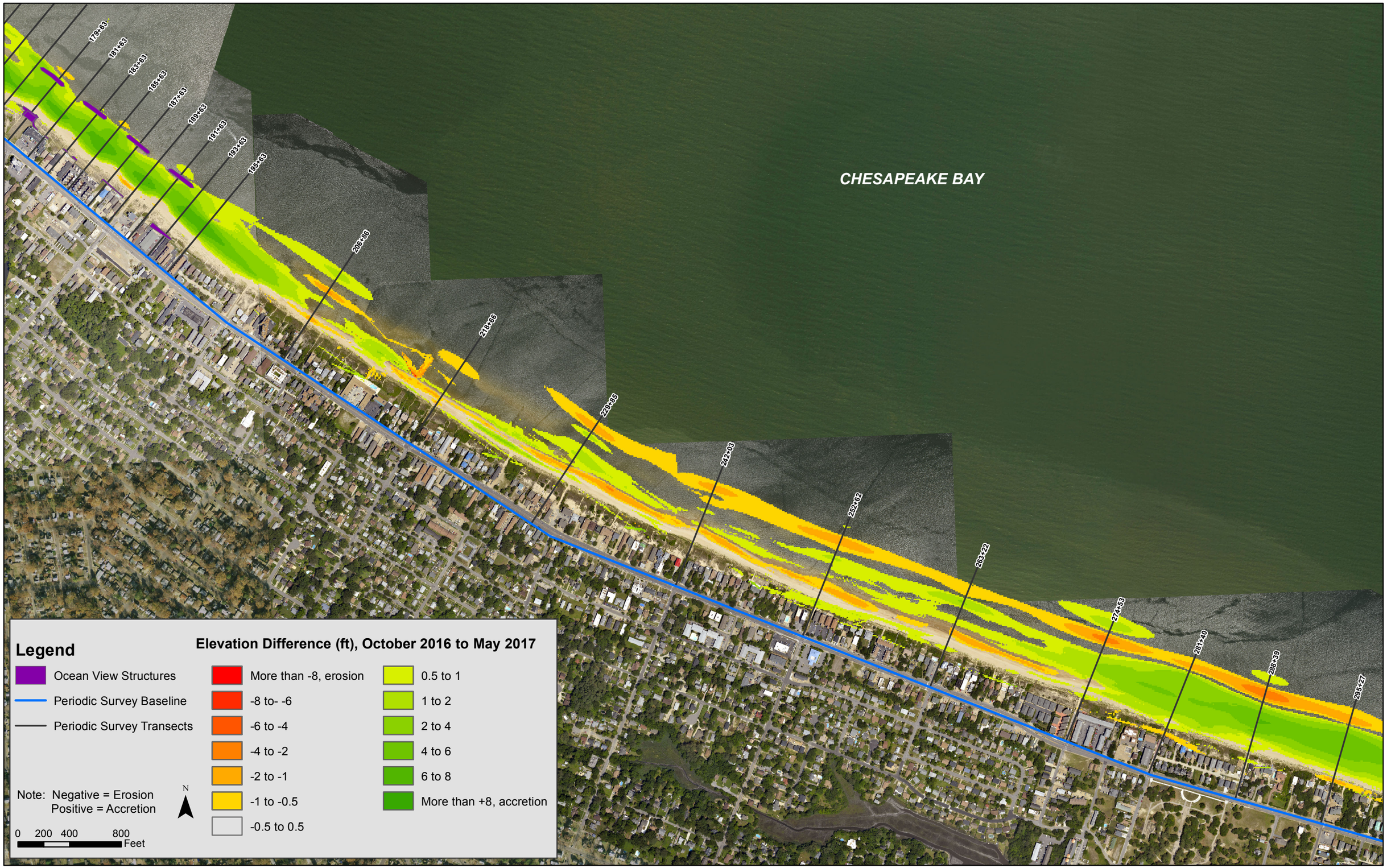
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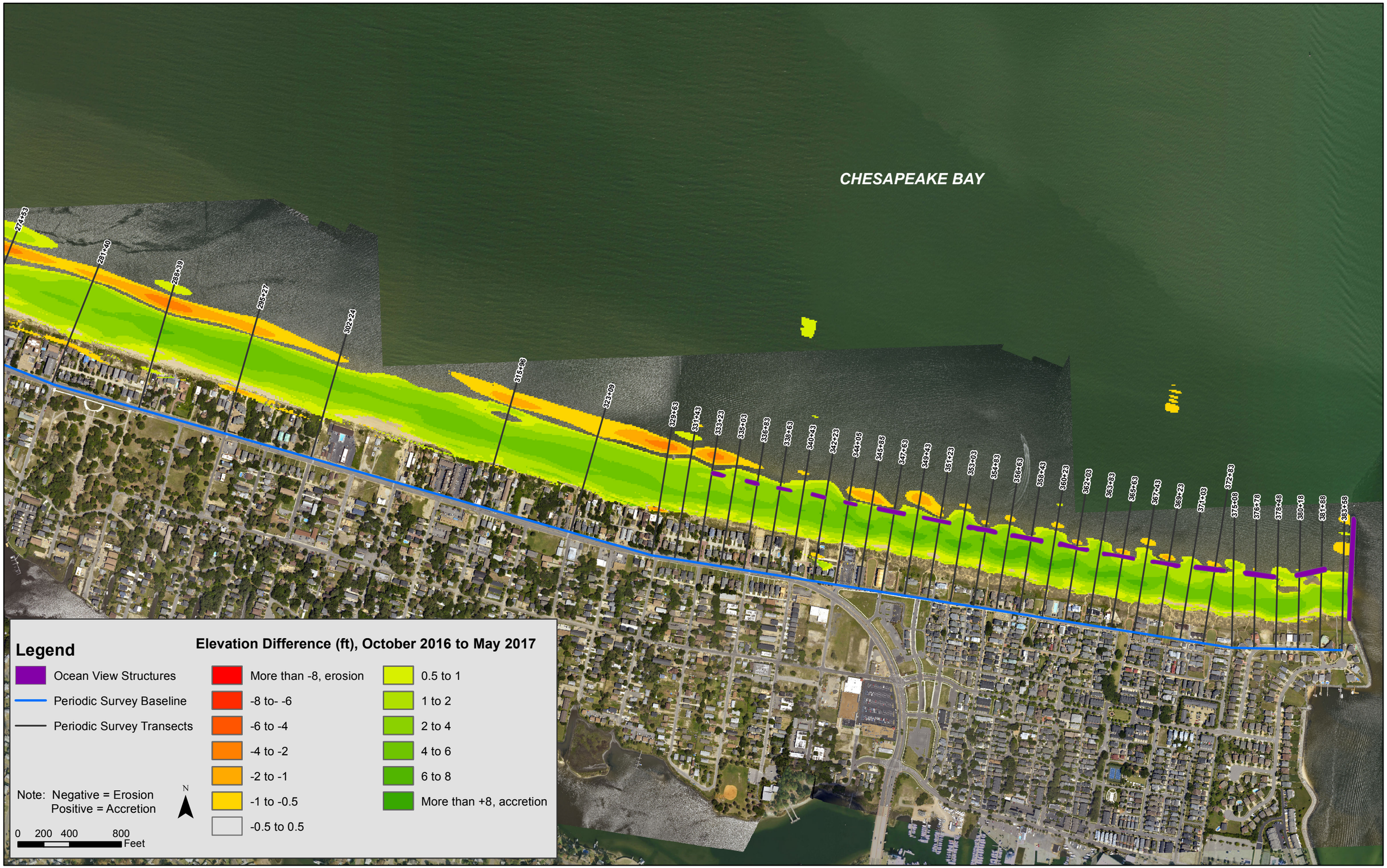

Legend

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moffatt & nichol

101 W. Main Street, Suite 800
Norfolk, Virginia 23510
Tel 757.628.8222

www.moffattnichol.com