Periodic Survey Evaluation: Ocean View Beach

Presented to:

City of Norfolk

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1. Executive Summary

In March 2014 Geodynamics, LLC conducted the eighteenth survey of the Ocean View shoreline. The study area extends from the western end of Willoughby Spit to the western edge of the Little Creek Inlet in East Ocean View. The periodic surveys are collected bi-annually in March/April and September/October to assess the condition of the shoreline and the state of existing shore protection projects. A baseline and transects 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 seasonal surveys (i.e. April 2013 to March 2014) eliminates seasonal variation of profiles in volumetric change analyses. Consecutive survey comparisons are useful to assess the direct impact of extreme events which may occur during the six month period between surveys. This report documents the data sources, methods, and results of a periodic surveying evaluation performed to compare the March 2014 survey data with previous surveys taken in April 2013 (spring to spring comparison) and October 2013 (most recent periodic survey comparison) in the Ocean View Beach area between Willoughby Spit and Little Creek Inlet.

Comparison	Parameter	Quantity
April 2013 vs. March 2014	Average Shoreline Change Rate at MHW (+0.98 ft NAVD88)	-7.40 ft/yr
	Cumulative Volume Change Rate Above 0 ft NAVD88	2,978 cy/yr
	Cumulative Volume Change Rate Above -15 ft NAVD88	-47,460 cy/yr
October 2013 vs. March 2014	Average Shoreline Change at MHW (+0.98 ft NAVD88)	-4.07 ft
	Cumulative Volume Change Above 0 ft NAVD88	44,516 cy
	Cumulative Volume Change Above -15 ft NAVD88	48,817 cy

The average annual shoreline change rate for the entire shoreline at MHW between the April 2013 and March 2014 surveys was -7.40 ft/yr, and the cumulative volume change above 0 feet NAVD88 was approximately 2,978 cy/yr. This indicates that while there was an overall loss to the MHW shoreline, there was an overall volumetric gain in the dune and subaerial beach over the past year. The overall loss above -15 feet NAVD88 of -47,460 cy/yr indicates that while there were gains to the dune and subaerial beach, there was sediment loss across the nearshore system. The most recent period of comparison, from the October 2013 survey to the March 2014 survey depicts an overall loss at the MHW line of -4.07 feet. The cumulative volume change above 0 feet NAVD88 shows a sediment gain to the subaerial beach of 44,516 cy. There was also a gain to the nearshore system above -15 feet NAVD88 of 48,817 cy, which indicates that a majority of these gains occurred within the most recent monitoring period.

While the shoreline showed overall volume losses for the year, there was variability within the various regions. The Willoughby Spit region is still feeling the effects from the equilibration of the Willoughby Spit Shoreline Improvement Project, which finished construction in December 2013. The nourishment placed at the eastern end of this reach has begun moving westward and is staying in the nearshore system due to the seven newly constructed breakwaters. Overall, this reach

experienced accretion in the MHW shoreline, and volumetric gains above both 0 feet NAVD88 and -15 feet NAVD88 over the past year.

In the 800 Block region, there has been a net loss of sediment above 0 feet NAVD88 and -15 feet NAVD88 and erosion of the MHW shoreline over the past year; however, the most recent survey period showed minimal change. The tombolo located at the realigned breakwater has remained detached allowing sand to transport freely through this reach.

The West Ocean View region was characterized by the shoreline improvement project that took place during the most recent survey period. At the time of survey, all timber groins had been removed, the reconstruction of the rock groin at station 129+17 was complete, and a majority of the 73,600 cy nourishment had been placed. Station 129+17 was removed from analysis for this report because it could not be surveyed due to the presence of construction equipment. This prevented the majority of the nourishment placed to be accounted for in the analysis. The volumetric change that could be calculated for the year showed an overall loss to this reach. The current period showed a minor gain to the subaerial beach.

The Central Ocean View Breakwaters region showed gains in the MHW shoreline position and volumetric gains above 0 feet NAVD88 and -15 feet NAVD88 over the past year. A majority of these gains occurred during the most recent survey period.

Typically a very stable region, Central Ocean View has experienced erosion of the MHW shoreline, with a volumetric loss above 0 feet NAVD88 and -15 feet NAVD88 over the past year; however, during the current monitoring period, there were overall volumetric gains.

Due to the normal direction of sediment movement, there are minor volumetric losses to the beach in the East Ocean View region over the entire year. During the most recent survey period there were more significant volumetric gains above 0 feet NAVD88 and -15 feet NAVD88. The Bay Oaks breakwaters are continuing to perform well, trapping sediment and eliminating the hotspot at this location. The east end of the region, adjacent to the jetty, is more erosive than most areas west in this region due to the lack of a sediment source.

In addition to regional assessments, comparison of the October 2013 survey was made against post-fill surveys from the East Ocean View beach nourishment and Willoughby Spit to Central Ocean View dune restoration which took place in March 2009 and January-March 2005 respectively.

Comparison	Average Shoreline Change	Average Volume Change Above	Cumulative Volume Change Above	Average Volume Change Above -15 ft NAVD88	Cumulative Volume Change Above -15 ft NAVD88
East Ocean View Nourishment vs. March 2014 Comparison	-90.83 ft	-17.91 cy/ft	-93,074 cy	-29.24 cy/ft	-151,029 cy
Central Ocean View Nourishment vs. March 2014 Comparison	-26.08 ft	-10.17 cy/ft	-191,972 cy	-6.99 cy/ft	-128,225 cy

Since the East Ocean View Nourishment project in 2009, roughly 82% of the placed material above 0 feet NAVD88 has been lost. Since the Central Ocean View Nourishment project in 2005, roughly 60% of the placed material above 0 feet NAVD88 has been lost. The Willoughby Spit shoreline improvement project has alleviated a majority of the areas of concern in this reach. The West Ocean View shoreline improvement project is near completion and should replenish this area and alleviate hotspots, while East Ocean View may need renourishment in the next 1-2 years.

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 March 2014 survey data with previous surveys taken in April 2013 (spring to spring comparison) and October 2013 (most recent periodic survey comparison) in the Ocean View Beach area between Willoughby Spit and Little Creek Inlet. In addition, comparison of the most recent survey (March 2014) was made to pre-fill and post-fill surveys from the Central Ocean View beach nourishment project that took place in January-March 2005 and the most recent East Ocean View beach nourishment project which took place in March 2009.

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

3. Data Sources

Geodynamics, LLC, conducted the most recent survey of Ocean View Beach in March 2014. 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 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 and long profiles near Willoughby Spit. Therefore, volumetric changes discussed herein are analyzed with regard to potential volumetric margins of error.

Also in April 2014, the Virginia Institute of Marine Science (VIMS) flew aerial photography of the Ocean View shoreline, georectified the images, and digitized a shoreline position from the images. The April 2014 aerial photos with the digitized shoreline positions from March 2014, October 2013, and April 2013 are presented 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.

Pre- and post-fill survey data from the East Ocean View beach nourishment, collected in June 2003 and March 2009, respectively, were used as baseline data for assessing the current state of that nourishment project. Similarly, pre- and post-fill survey data from the Willoughby Spit to Central Ocean View dune restoration were utilized; these surveys were collected in December 2004 – February 2005 and March 2005, respectively. Pre-fill and post-fill data were available in xyz format from previous studies of these projects by Moffatt & Nichol.

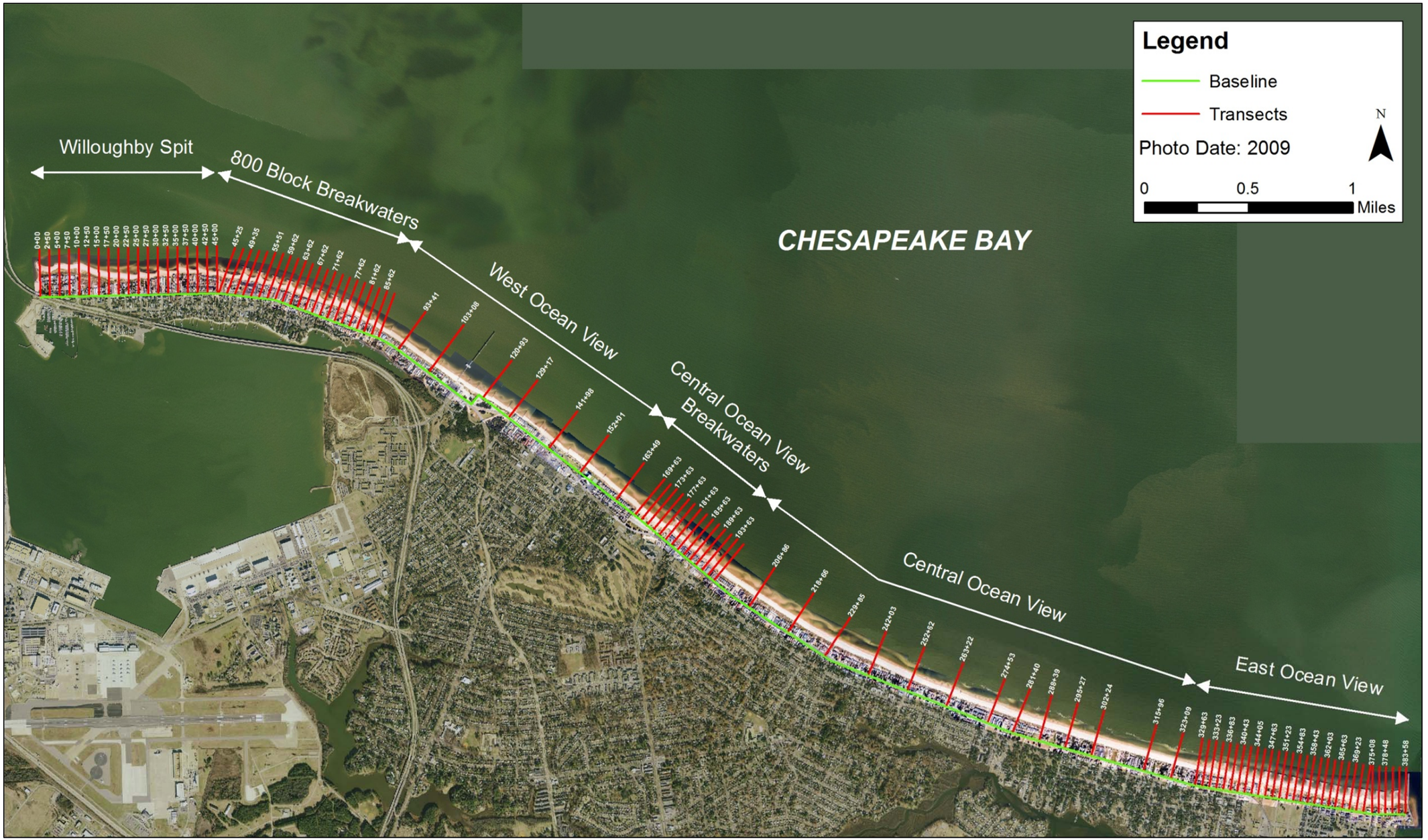

Figure 3-1: Survey Baseline and Transects

4. Methods

Survey comparisons and respective analysis were performed using a combination of Autodesk Civil 3D 2012 (Civil 3D), Microsoft Excel (Excel), Surfer and the USACE's Beach Morphology Analysis Package (BMAP). Civil 3D is an AutoCAD based program which allows the user to create and analyze Digital Terrain Models (DTMs). 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.

All pertinent survey data were imported into Civil 3D in xyz format. The horizontal coordinate system used was Virginia South State Plane NAD 1983 (HARN), US Survey feet with a vertical datum of NAVD88. DTMs were created for each set of survey data, and a beach profile was extracted at each survey transect in station-elevation format. Individual profile plates showing the extracted profile at each transect for each date are presented in Appendix B. From the profiles, shoreline change and volumetric change were then calculated at each transect for the following time periods:

1. April 2013 to March 2014 (Entire Shoreline)
2. October 2013 to March 2014 (Entire Shoreline)
3. March 2009 (East Ocean View post-fill) to March 2014 (Sta 329+63 through Sta 383+58)
4. March 2005 (Central Ocean View post-fill) to March 2014 (Sta 15+00 through Sta 195+63)
5. December 2004-February 2005 (Central Ocean View pre-fill) to March 2014 (Sta 15+00 through Sta 195+63)
6. June 2003 (East Ocean View pre-fill) to March 2014 (Sta 329+63 through Sta 383+58)

First, the change in shoreline based on the profiles extracted from Civil 3D 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 change above -15 feet NAVD88 and volume change 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 offshore while reducing the amount of uncertainty 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 the East Ocean View and Central Ocean View nourishment projects. 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 Comparisons

Profile variations in the surveys taken as part of the ongoing program of periodic surveying of the Ocean View shoreline (April 2013, October 2013, and March 2014) 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. The only discrepancy which impacted calculations was the vertical margin of error in the hydrographic portion of the survey as mentioned in Section 3.

The pre-fill and post-fill surveys taken for the East Ocean View and Central Ocean View nourishment projects did not use the same baseline and transects or cover the same extents as the periodic surveys. Therefore, the profiles extracted from the DTMs in Civil 3D at the periodic surveying transects are interpolations between the actual pre- and post-fill data points. In addition, the surveys did not extend as far offshore as the periodic surveys, limiting computations and the ability to track the offshore movement of sand.

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 reporting period which likely had an impact on the changes in shoreline position as well as profile volume gains and losses.

5.2.1. Storm 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. The dates that the wave data were collected during this survey period were between September 10, 2013 and January 31, 2014.

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

- The average significant wave height and peak period over this measurement period was approximately 1.4 feet and 4.9 seconds.
- The typical direction of the waves was from the northeast to southeast.

- The largest significant wave height observed during this deployment was approximately 6.6 feet with a corresponding peak period of approximately 6.3 seconds and mean direction of 10 degrees (January 22, 2014).

The overall wave climate was typical for this time of year with four storm events where significant wave heights reached or exceeded 4.9 feet (1.5 m). These events occurred on October 10, 2013, November 14, 2013, January 22, 2014, and March 7, 2014 and are shown in Figure 5-1, Figure 5-2, Figure 5-3, and Figure 5-4.

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 storm winds within the bay and tend to have shorter wave periods. There were four storm events during this 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 during this deployment is given in Table 5-1.

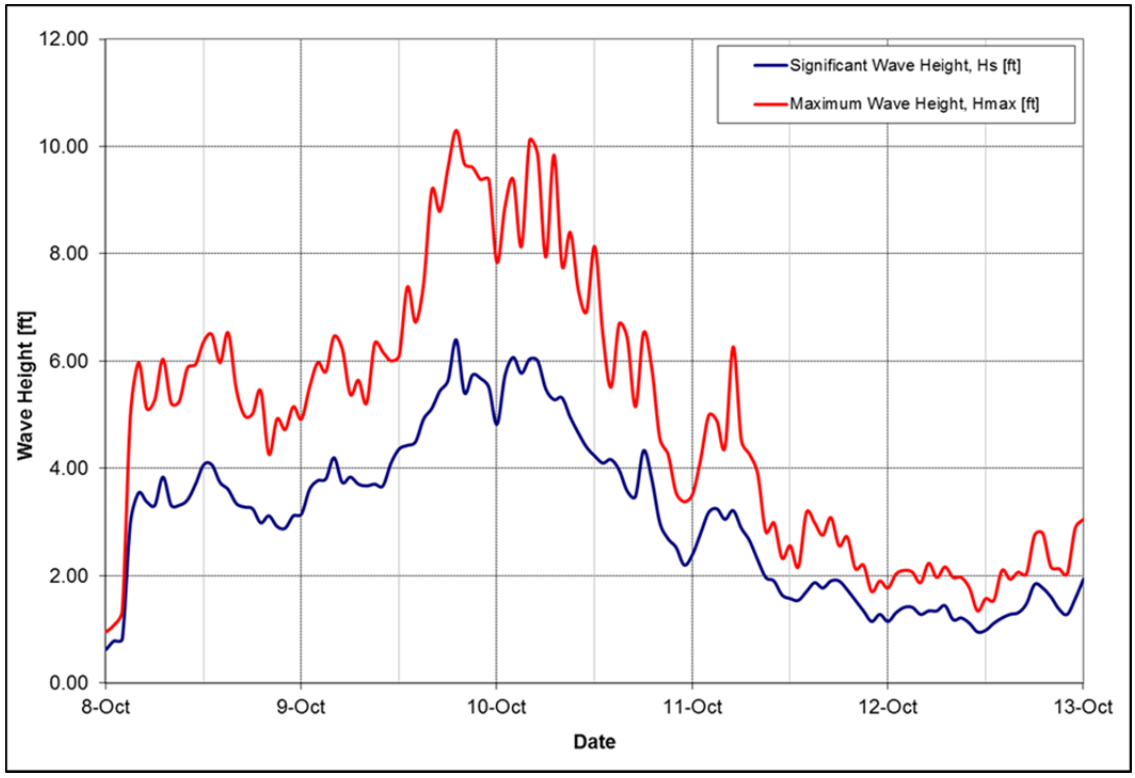

Figure 5-1: October 10, 2013 Storm

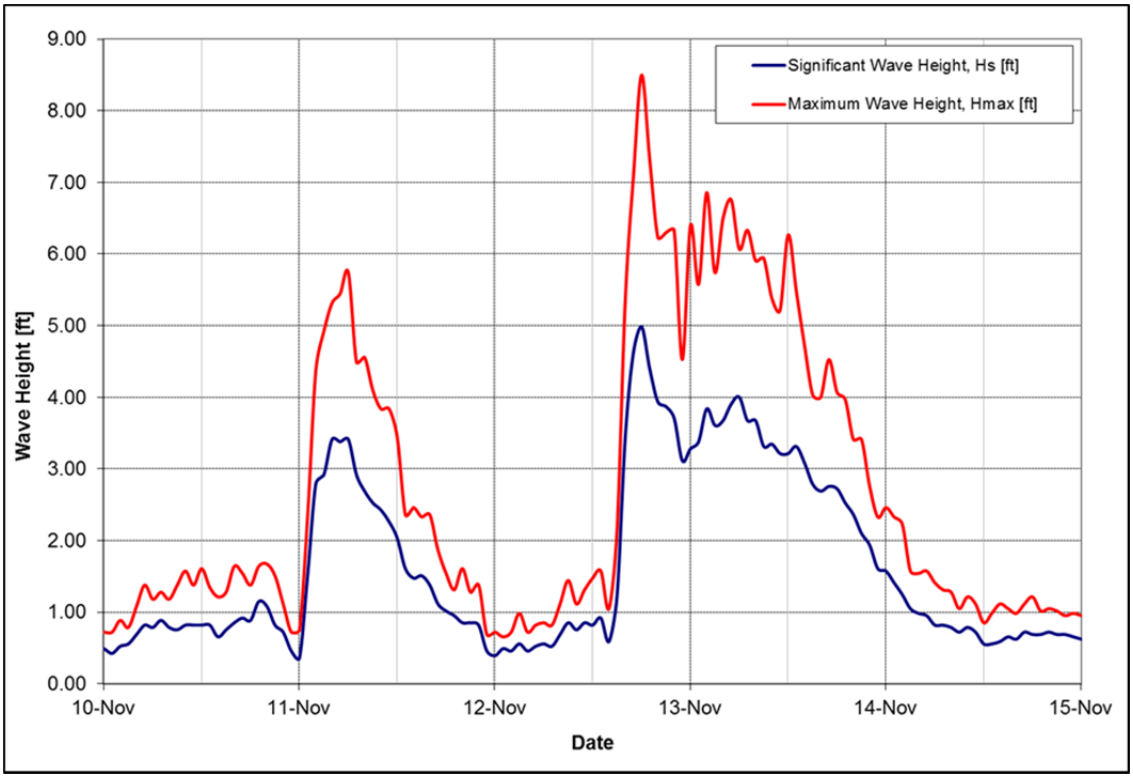

Figure 5-2: November 14, 2013 Storm

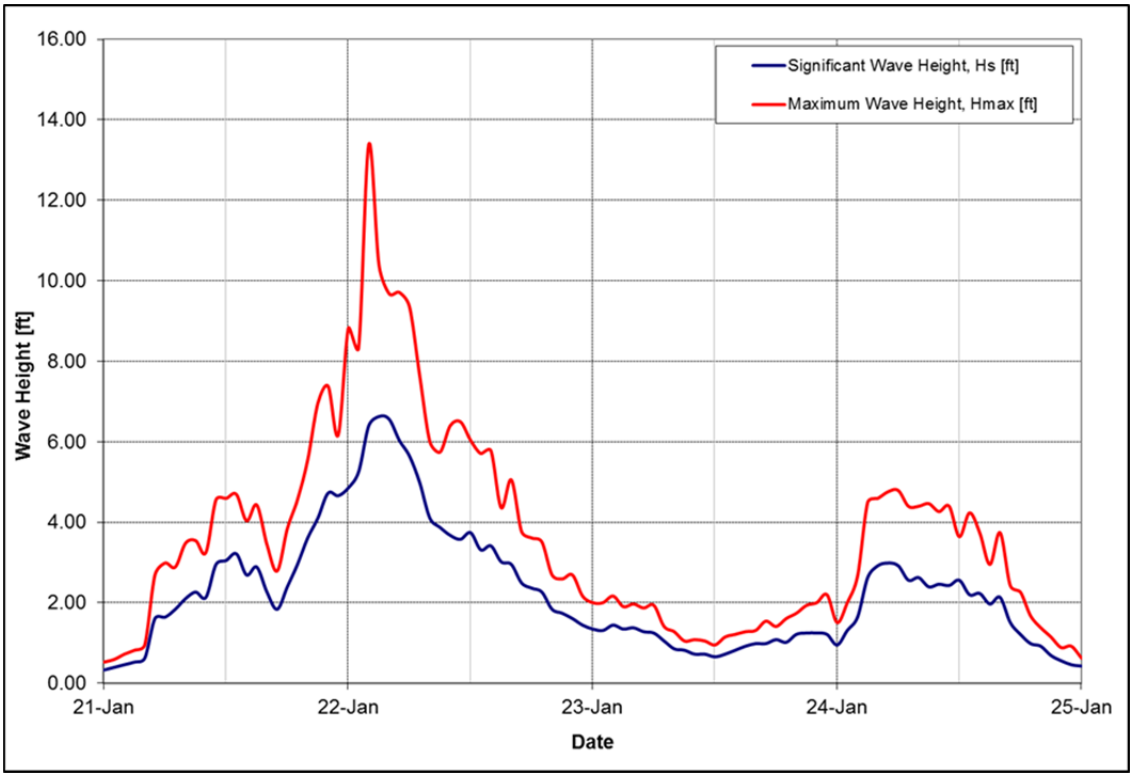

Figure 5-3: January 22, 2014 Storm

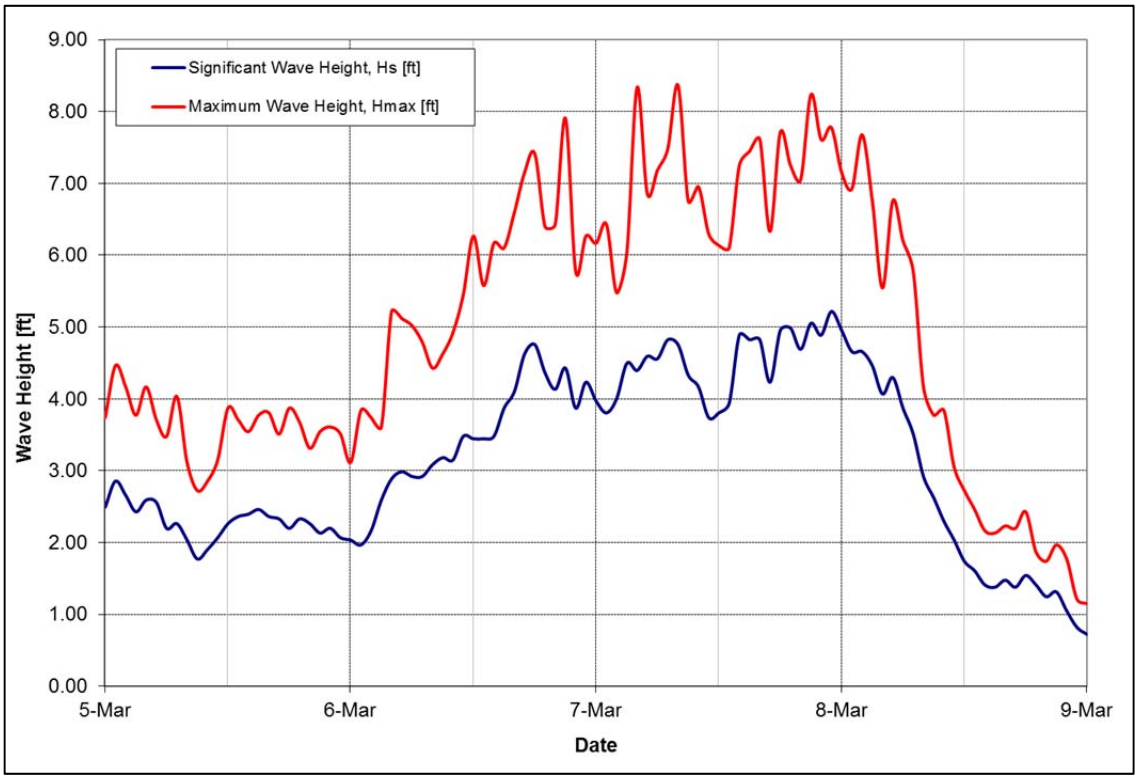

Figure 5-4: March 7, 2014 Storm

Table 5-1: Monthly Wave Statistics Summary

Wave Statistic	Sep-13	Oct-13	Nov-13	Dec-13	Jan-14	Feb-14	Mar-14
Average Significant Wave Height, H_s (ft)	1.3	1.4	1.6	1.1	1.3	1.3	1.8
Average Wave Period, T_m (s)	2.6	2.7	2.7	2.5	2.6	2.7	2.8
Average Peak Wave Period, T_p (s)	5.4	5.3	4.5	5.3	4.9	4.5	5.0
Maximum Observed Significant Wave Height, H_s (ft)	3.6	6.4	5.0	3.5	6.6	4.5	5.2
Maximum Observed Wave Height, H_{max} (ft)	5.7	10.3	8.5	6.4	13.4	7.4	8.4

5.2.2. Engineering Activities

Construction of the West Ocean View Shoreline Improvement Project was completed during the most recent survey period. This project included the removal of the existing groin field east of the pier, reconstruction of a groin in between the 200 Block and Sarah Constant Shrine Park, and a 73,600 cy nourishment project**.** The new groin was designed to be shorter and tighter than the previous groins, helping to maintain the beach width in front of the 200 Block adequately for vehicle access. The 73,600 cy nourishment project would add 30 feet of berm width in front of Sarah Constant Shrine Park, on the dowdrift side of the groin. More nourishment is needed in front of the park to mitigate the downdrift erosional effects of the new groin. The completed project is shown below in Figure 5-5.

Figure 5-5: Completed West Ocean View Shoreline Improvement Project

5.3. General Shoreline Trends

Key statistics were calculated to describe the average shoreline and volume changes 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 April 2013 to March 2014 comparison are presented in Table 5-2. A summary of the resulting statistics for the October 2013 to March 2014 comparison are presented in Table 5-3. Evaluation of the computed statistics took into account volume changes computed for portions of the profile above 0 feet NAVD88 and above -15 feet NAVD88 in order to better understand onshore and offshore processes.

According to Table 5-2, the Ocean View shoreline has experienced overall losses at MHW over the past year with a change rate of -7.40 feet per year. While the beach gained a minor amount of material above 0 feet NAVD88, there was an overall loss of material in the system with a change rate of -47,460 cy/yr.

While the overall trends over the past year show shoreline erosion and volumetric loss of the system, patterns vary within each region of the shoreline as defined in Figure 3-1. The calculated statistics with respect to each region will be discussed in more detail in the following section.

Table 5-2: Regional Shoreline and Volume Change Statistics (April 2013 to March 2014)

Region	Average Shoreline Change Rate	Average Volume Change Rate Above 0 ft NAVD88	Cumulative Volume Change Above 0 ft NAVD88	Average Volume Change Rate Above -15 ft NAVD88	Cumulative Volume Change Above -15 ft NAVD88
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
Willoughby Spit (0+00 to 45+00)	10.18	2.73	10,697	1.72	7,046
800 Block Breakwaters (45+25 to 87+62)	-9.44	-0.92	-4,143	-5.00	-21,080
West Ocean View (93+41 to 163+49)	2.13	-0.20	-3,041	-3.24	-24,304
Central Ocean View Breakwaters (169+63 to 195+63)	3.31	1.48	4,285	2.52	4,201
Central Ocean View (206+86 to 323+09)	-18.65	-0.31	-2,032	-1.23	-13,128
East Ocean View (329+63 to 383+58)	-14.25	-0.50	-2,789	-0.21	-196
OVERALL	Weighted Average (ft/yr)	Weighted Average (cy/ft/yr)	Total (cy/yr)	Weighted Average (cy/ft/yr)	Total (cy/yr)
	-7.40	0.13	2,978	-1.24	-47,460

Table 5-3: Regional Shoreline and Volume Change Statistics (October 2013 to March 2014)

Region	Average Shoreline Change	Average Volume Change Rate Above 0 ft NAVD88	Cumulative Volume Change Above 0 ft NAVD88	Average Volume Change Rate 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)	4.85	2.46	11,607	6.06	26,739
800 Block Breakwaters (45+25 to 87+62)	-1.33	0.15	986	-0.81	-984
West Ocean View (93+41 to 163+49)	1.32	0.06	2,107	-1.66	-6,145
Central Ocean View Breakwaters (169+63 to 195+63)	6.47	1.44	3,527	3.76	5,432
Central Ocean View (206+86 to 323+09)	-13.10	1.70	21,454	0.22	1,565
East Ocean View (329+63 to 383+58)	-7.09	0.77	4,836	3.51	22,210
OVERALL	Weighted Average (ft)	Weighted Average (cy/ft)	Total (cy)	Weighted Average (cy/ft)	Total (cy)
	-4.07	1.12	44,516	1.22	48,817

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 5-6 through Figure 5-9, 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 Willoughby Spit region (Sta 0+00 to Sta 45+00) previously included two offshore breakwaters, timber groins and has historically been a stable and accreting region. This region is still continuing to adjust due to the completion of the Willoughby Spit Shoreline Improvement Project in December 2013, which included the removal of the existing groin field and connected the 800 Block breakwater field with the existing Willoughby Spit breakwaters by adding seven new breakwaters. A summary of average shoreline and volume change rates for the Willoughby Spit region between April 2013 and March 2014 and between October 2013 and March 2014 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
April 2013 vs. March 2014 Comparison					
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
Willoughby Spit (0+00 to 45+00)	10.18	2.73	10,697	1.72	7,046
October 2013 vs. March 2014 Comparison					
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
Willoughby Spit (0+00 to 45+00)	4.85	2.46	11,607	6.06	26,739

The information shown in Table 5-4 is still influenced by the recent Willoughby Spit Shoreline Improvement Project on this region over the last year. The shoreline at MHW as well as the volume change above 0 feet NAVD88 and -15 feet NAVD88 was highly variable throughout this reach. For the year between the spring surveys (April 2013 and March 2014), this region experienced overall accretion of the MHW shoreline as well as an overall gain of sediment above 0 feet NAVD88 and above -15 feet NAVD88. This reach now has a total of 9 nearshore breakwaters, which connects the two existing breakwaters near the terminal groin to the 800 block breakwater field. Effects from this new breakwater field can be seen in the MHW shoreline change in Figure 5-6 and Figure 5-8 by the gain in shoreline behind the breakwaters and loss between the breakwaters. The nourishment that was placed along the eastern end of the reach has begun to equilibrate and move to the west as shown in Figure 5-9. As the sand moves west, the new breakwater field is holding the sand in the system.

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 the pre-existing groin spur and toe extension. This new breakwater was built further offshore since the previous structural configuration caused the beach to fill out and impair natural sediment transport to the west. In conjunction with the Willoughby Spit Project, the second easternmost breakwater, has been 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 April 2013 and March 2014 and between October 2013 and March 2014 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
April 2013 vs. March 2014 Comparison					
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
800 Block Breakwaters (45+25 to 87+62)	-9.44	-0.92	-4,143	-5.00	-21,080
October 2013 vs. March 2014 Comparison					
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
800 Block Breakwaters (45+25 to 87+62)	-1.33	0.15	986	-0.81	-984

Table 5-6 shows the annual shoreline change as well as the volume change above 0 feet NAVD88 and -15 feet NAVD88 as an overall loss. These losses occurred primarily within the previous survey

period (April 2013 – October 2013) due to the realignment of the breakwater in this reach. This is the case because the shoreline change and the volume change above 0 feet NAVD88 and -15 feet NAVD88 during the most recent survey period (October 2013 – March 2014) was minimal. The newly realigned breakwater has continued to be successful in eliminating the tombolo and has allowed sand to move freely through this reach. The change in MHW as well as the volume change at the western end of the reach is highly negative, as seen in Figure 5-8 and Figure 5-9. This was expected as a result of the equilibration of the nourishment from the Willoughby Spit Shoreline Improvement project.

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, is characterized by a series of timber groins. A summary of average shoreline and volume change rates for the West Ocean View region April 2013 and March 2014 and between October 2013 and March 2014 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
April 2013 vs. March 2014 Comparison					
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
West Ocean View (93+41 to 163+49)	2.13	-0.20	-3,041	-3.24	-24,304
October 2013 vs. March 2014 Comparison					
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
West Ocean View (93+41 to 163+49)	1.32	0.06	2,107	-1.66	-6,145

The changes within this region were controlled by the West Ocean View Shoreline Improvement Project that took place during the most recent survey period. At the time of survey, all timber groins had been removed, the reconstruction of the rock groin at station 129+17 was complete, and a majority of the 73,600 cy nourishment had been placed. At the time of survey there was construction equipment located at station 129+17; therefore, no data were recorded at this station. This station was removed from analysis for this monitoring report and the nourishment placed between stations 120+93 and 141+98 was not accounted for. The April 2013 to March 2014 survey comparison showed a minor gain of the MHW shoreline position, with overall volume loss above elevation 0 feet NAVD88 and -15 feet NAVD88. The majority of this loss occurred at the eastern end of the reach as shown in Figure 5-7. The shoreline change as well as the volume change along the rest of the reach was fairly stable. The shoreline and volume change over the most recent period, October 2013 to March 2014, showed this reach as being stable with minimal changes. This reach experienced slight accretion of the MHW shoreline and overall sediment volume gains above elevation 0 feet NAVD88. The volume change above -15 feet NAVD88 showed minor losses, which occurred predominantly in the eastern section of this reach as shown in Figure 5-9.

5.4.4. Central Ocean View Breakwaters

The Central Ocean View breakwater 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 April 2013 and March 2014 and between October 2013 and March 2014 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
April 2013 vs. March 2014 Comparison					
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
Central Ocean View Breakwaters (169+63 to 195+63)	3.31	1.48	4,285	2.52	4,201
October 2013 vs. March 2014 Comparison					
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
Central Ocean View Breakwaters (169+63 to 195+63)	6.47	1.44	3,527	3.76	5,432

The Central Ocean View Breakwaters region showed an overall gain in the MHW shoreline position and an overall volume gain above 0 feet NAVD88 and -15 feet NAVD88 over the past year. The majority of these gains occurred in the most recent monitoring period. The end effects of the eastern end of the breakwater field at station 195+63 are apparent within the most recent monitoring period as shown in the loss in MHW shoreline shown in Figure 5-8, as well as the volume loss in Figure 5-9. Overall, this reach has fared well over the past few monitoring periods.

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 April 2013 and March 2014 and between October 2013 and March 2014 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
April 2013 vs. March 2014 Comparison					
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
Central Ocean View (206+86 to 323+09)	-18.65	-0.31	-2,032	-1.23	-13,128
October 2013 vs. March 2014 Comparison					
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
Central Ocean View (206+86 to 323+09)	-13.10	1.70	21,454	0.22	1,565

As shown in Table 5-8, Central Ocean View has experienced erosion at the MHW shoreline, a volumetric loss in sediment above 0 feet NAVD88 and a volumetric gain in sediment above -15 feet NAVD88 over the past year. The majority of the volumetric loss above -15 feet NAVD88 occurred during the period from April 2013 to October 2013. Assessment of Figure 5-7 through Figure 5-10 shows that even though there were higher losses of the MHW shoreline over the past year, the volume losses were minimal. This loss in berm width correlates to an overall erosion of the MHW shoreline as shown in Figure 5-6 and Figure 5-8.

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 of 2009. Prior to the breakwater construction, a beach renourishment project took place in March 2009, adding approximately 196,000 cy of material to the beach. A summary of average shoreline and volume change rates for the East Ocean View region between April 2013 and March 2014 and between October 2013 and March 2014 are presented in Table 5-9.

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
April 2013 vs. March 2014 Comparison					
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
East Ocean View (329+63 to 383+58)	-14.25	-0.50	-2,789	-0.21	-196
October 2013 vs. March 2014 Comparison					
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
East Ocean View (329+63 to 383+58)	-7.09	0.77	4,836	3.51	22,210

This region is normally characterized by a consistent erosional pattern due to sediment movement along the shoreline from east to west with no sand source due to the terminal groin at Little Creek Inlet. Over the past year, there was an overall loss of the MHW shoreline, as well as minor volume losses above 0 feet NAVD88 and -15 feet NAVD88. The loss of the MHW shoreline was higher towards the terminal groin, as shown in Figure 5-6. During the past monitoring period, there were volume gains above 0 feet NAVD88 and -15 feet NAVD88, as shown in Table 5-9 and Figure 5-9. The volumetric gain observed within this reach will be monitored over the next survey period to obtain a better understanding for this occurrence. The Bay Oaks breakwaters have continued to be very successful at retaining sand that may be eroding from the beach and eliminating the previous hotspot Figure 5-7. Typically, the east end of the region, adjacent to the jetty, is more erosive than most areas west in this region due to the lack of a sediment source and the littoral sediment movement in this region going from east to west. Also, this region has a fairly steady pattern of accretion on the profiles behind the breakwaters and erosion on the profiles between the breakwaters. This indicates the influence of the breakwaters on decreasing the wave heights and retaining sediment along the shore.

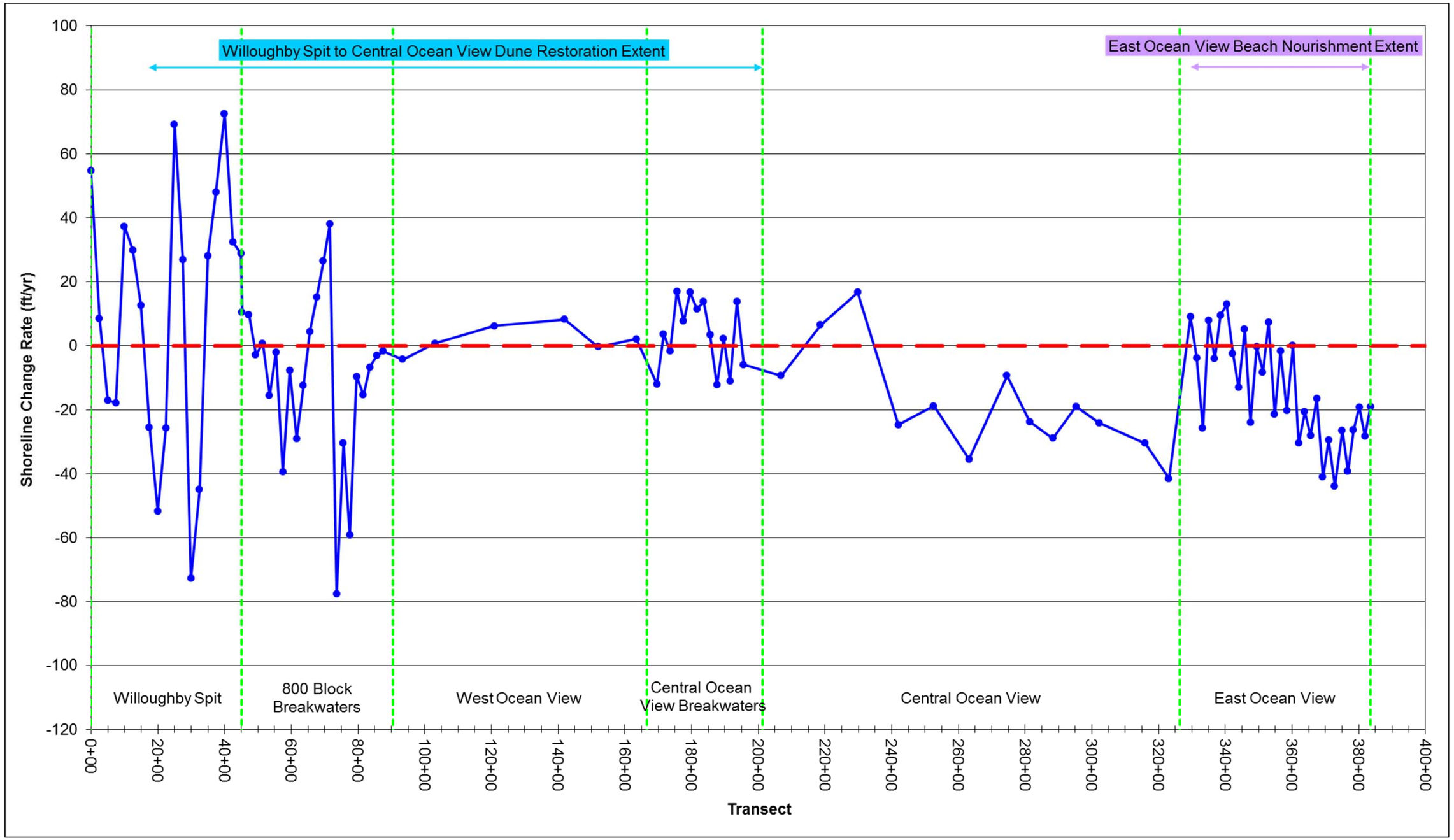

Figure 5-6: Shoreline Change Rate (ft/yr) at Mean High Water (+0.98 ft NAVD88) for April 2013 to March 2014 (Note: Positive = Accretion, Negative = Erosion)

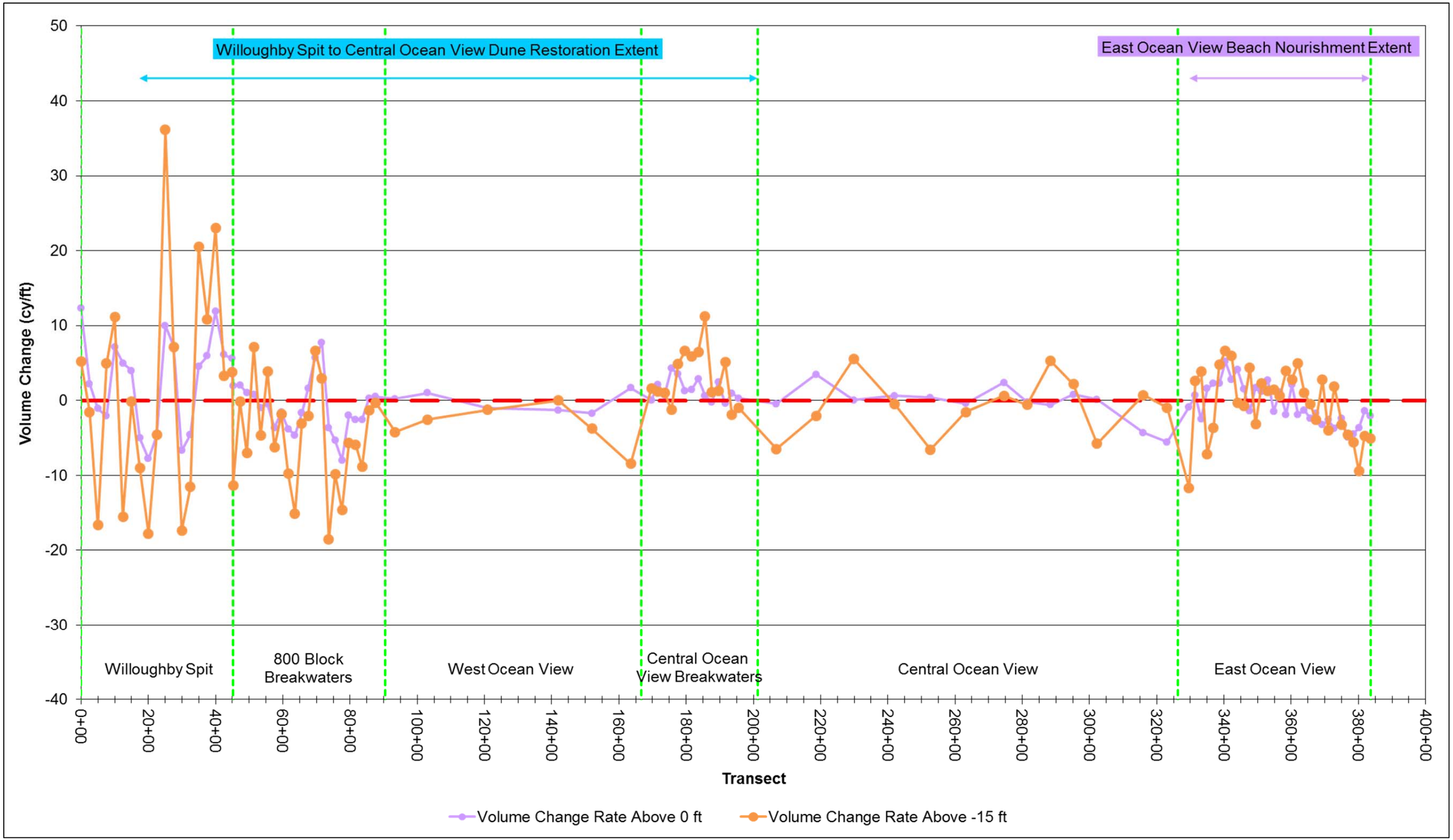

Figure 5-7: Volume Change Above 0 ft NAVD88 and -15 ft NAVD88 (cy/ft) for April 2013 to March 2014 (Note: Positive = Accretion, Negative = Erosion)

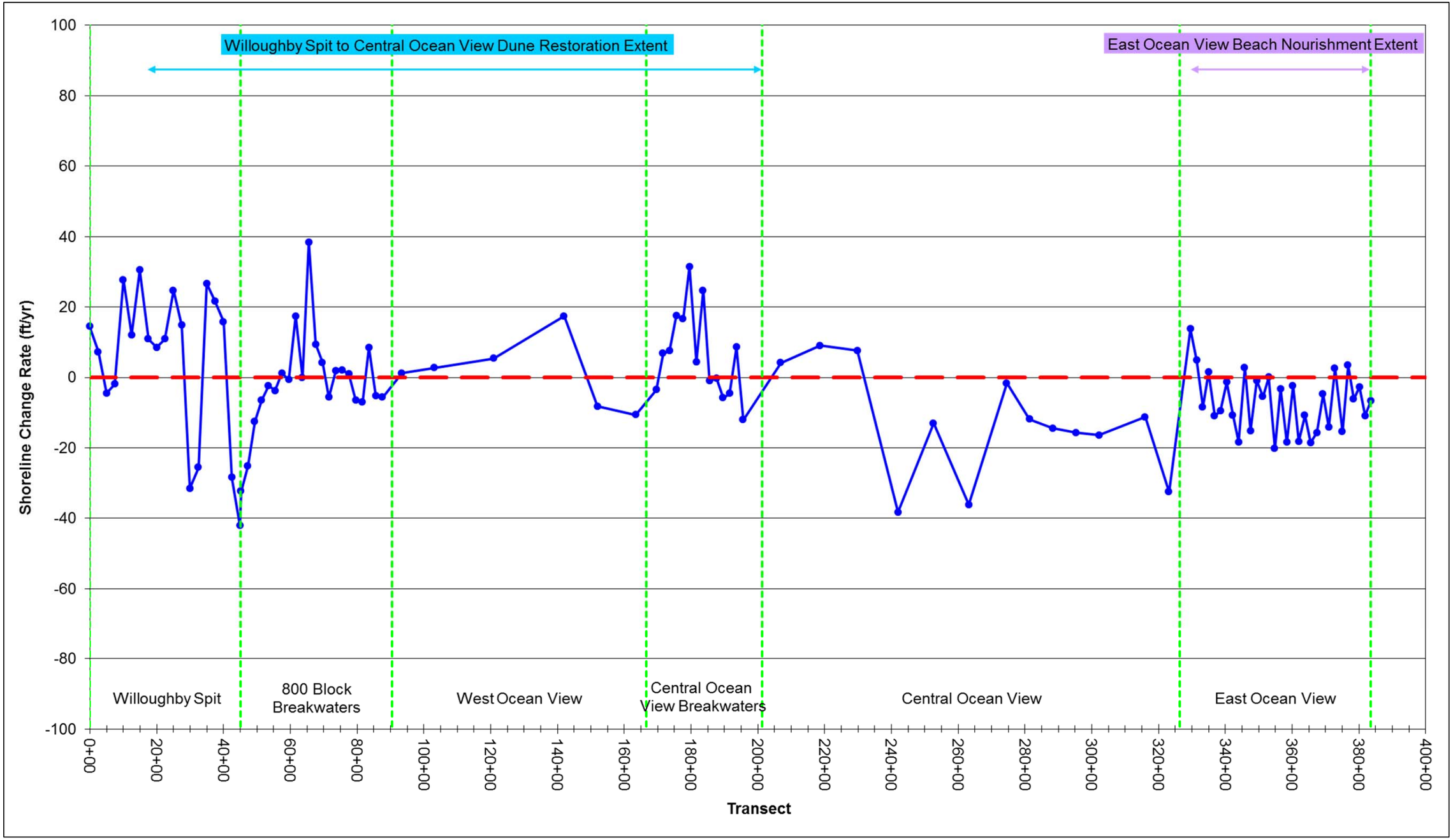

Figure 5-8: Shoreline Change (ft) at Mean High Water (+0.98 ft NAVD88) for October 2013 to March 2014 (Note: Positive = Accretion, Negative = Erosion)

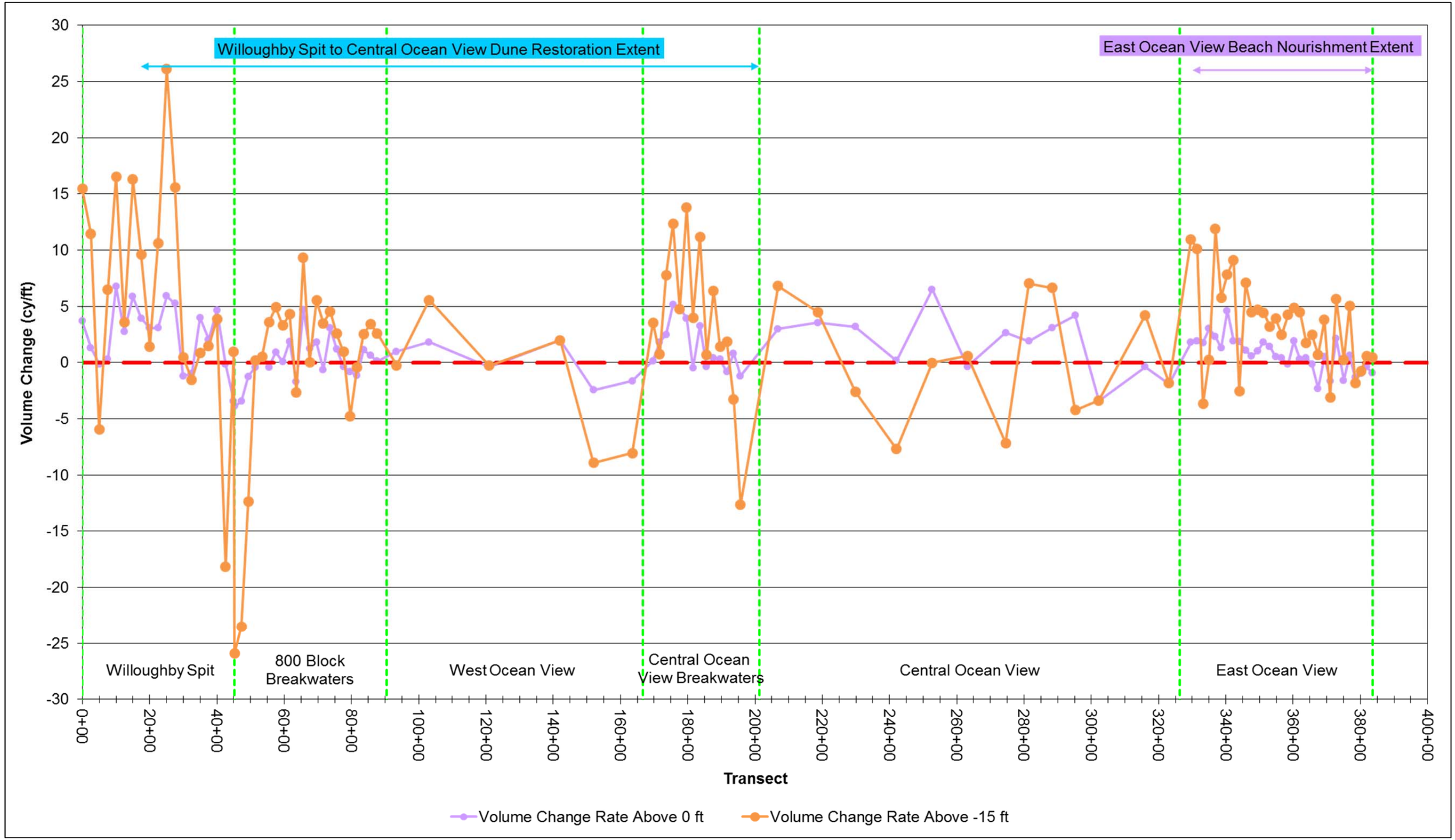

Figure 5-9: Volume Change Above 0 ft NAVD88 and -15 ft NAVD88 (cy/ft) for October 2013 to March 2014 (Note: Positive = Accretion, Negative = Erosion)

5.5. East Ocean View Beach Nourishment Project (2009)

An initial beach nourishment project took place along the East Ocean View shoreline in November 2003. Approximately 359,000 cy of material was placed on the beach between Sta 329+63 and Sta 383+58. More recently, the East Ocean View shoreline was renourished with approximately 196,000 cy of material in March 2009. The most recent periodic survey, taken in April 2013, was compared to the post-fill survey taken in March 2009. Table 5-10 presents the shoreline and volume change statistics comparing the two surveys.

Table 5-10: Overall Shoreline and Volume Change Statistics – East Ocean View Nourishment Project (March 2009 Post-Fill – March 2014 Comparison)

Region		Average Shoreline Change (ft)	Average Volume Change Above 0 ft NAVD88 (cy/ft)	Cumulative Volume Change Above 0 ft NAVD88 (cy)	Average Volume Change Above -15 ft NAVD88 (cy/ft)	Cumulative Volume Change Above -15 ft NAVD88 (cy)
East Ocean View (329+63 to 383+58)	Rate per Year	-18.16	-3.58	-18,605	-5.84	-30,189
	Total	-90.83	-17.91	-93,074	-29.24	-151,029

Results indicate that the East Ocean View shoreline has remained fairly constant at MHW. Roughly 93,000 cy of material has been lost above 0 feet NAVD88, or approximately 82% of the 113,000 cy originally placed above 0 feet NAVD88. This was the same as the previous survey period, which indicates there was no loss of additional sediment over the most recent survey period. This loss of sediment is the result of the expected erosion due to design life of the nourishment project combined with storm activity. Previous experience from the 2003 nourishment project indicates that the design life of projects in this area is limited to 4-5 years due to storm impact and lack of sediment source to the east. Therefore, it is anticipated that renourishment will likely be needed within the next 1 to 2 years.

Figure 5-10 shows areas of elevation change between the post-fill survey and the March 2014 survey. As depicted in the figure, there has been erosion of the beach face and nearshore in-between the breakwaters with some of that sediment being trapped behind each of the breakwaters. The magnitude of the loss is much larger to the east, which is to be expected since this shoreline is cut off from a sediment source by the jetty. Some of the sediment eroded from the beach face and nearshore appears to be caught offshore in the vicinity of the Bay Oaks breakwaters. At station 329+63, there seems to be some slight end effects from the Bay Oaks breakwaters. These breakwaters have continued to be very successful eliminating the previous hotspot and providing a transition into the Central Ocean View region. There has also been an increase in the dune area, which may partially be attributed to the annual dune planting project providing a mechanism for sand accumulation.

In addition, the March 2014 MHW shoreline was compared to the MHW shoreline from June 2003, before the first nourishment project in November 2003, as another way to measure the amount of protection being supplied by the March 2009 nourishment project. Areas where the current shoreline is within 20 feet of the June 2003 shoreline need to be targeted for nourishment. Figure 5-11 shows the MHW shoreline position difference between the June 2003 pre-fill and March 2014 shorelines. As can be seen, the MHW shoreline at a majority of transects along the East Ocean View Breakwaters have retreated within 20 feet of the pre-fill shoreline. However, no new stations have

retreated within 20 feet of the pre-fill shoreline over the most recent monitoring cycle. A portion of the shoreline has eroded past the original pre-fill position at four locations, which are the same stations from the previous monitoring period. These four locations, Station 331+43, 347+63, 351+23, 362+03, and 363+83, have not retreated any addition distance beyond the pre-fill shoreline over the most recent monitoring period. It will be important to monitor this portion of shoreline for planning purposes of future nourishment projects.

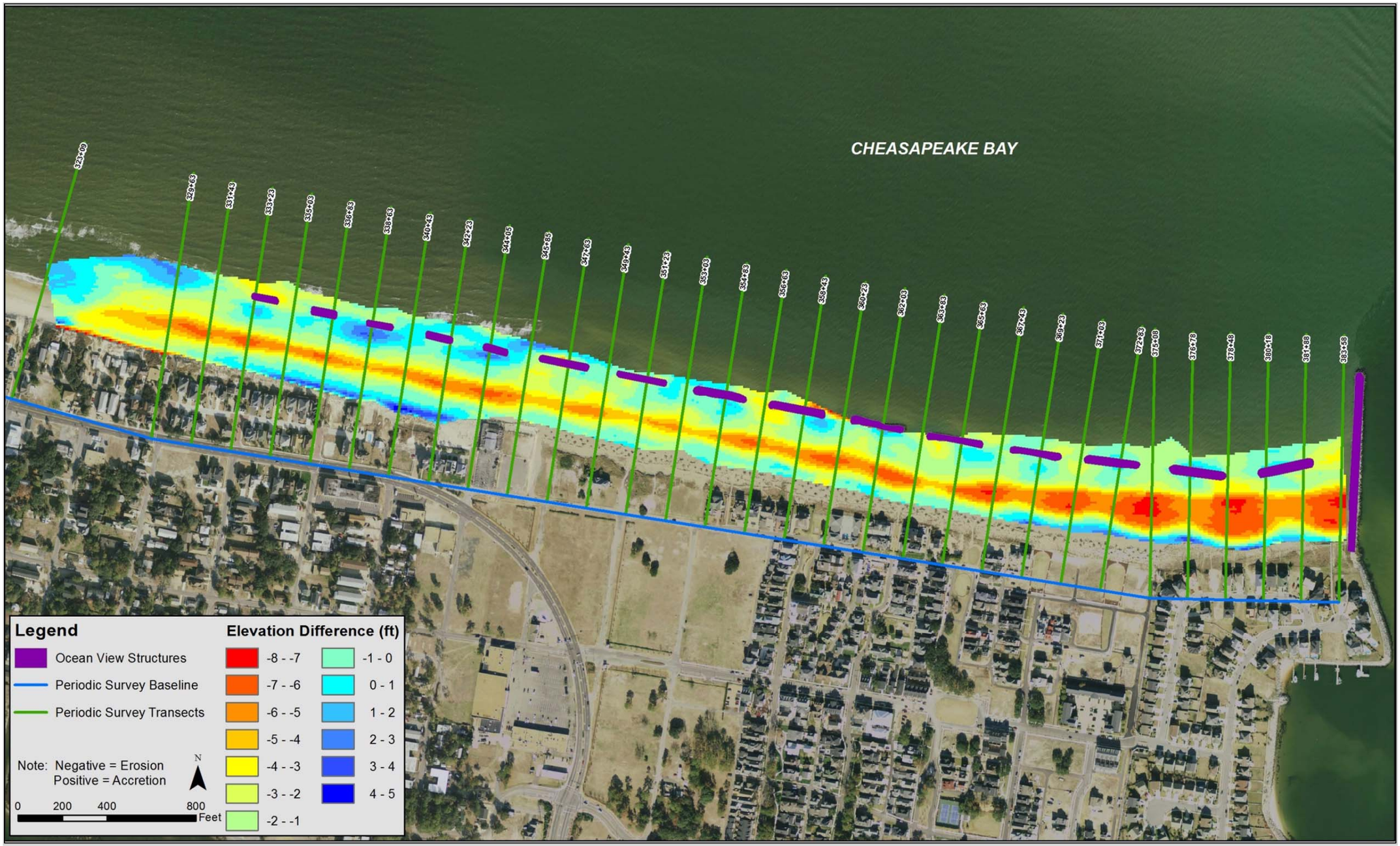

Figure 5-10: Net Volume Change Since the East Ocean View Nourishment Project (March 2009)

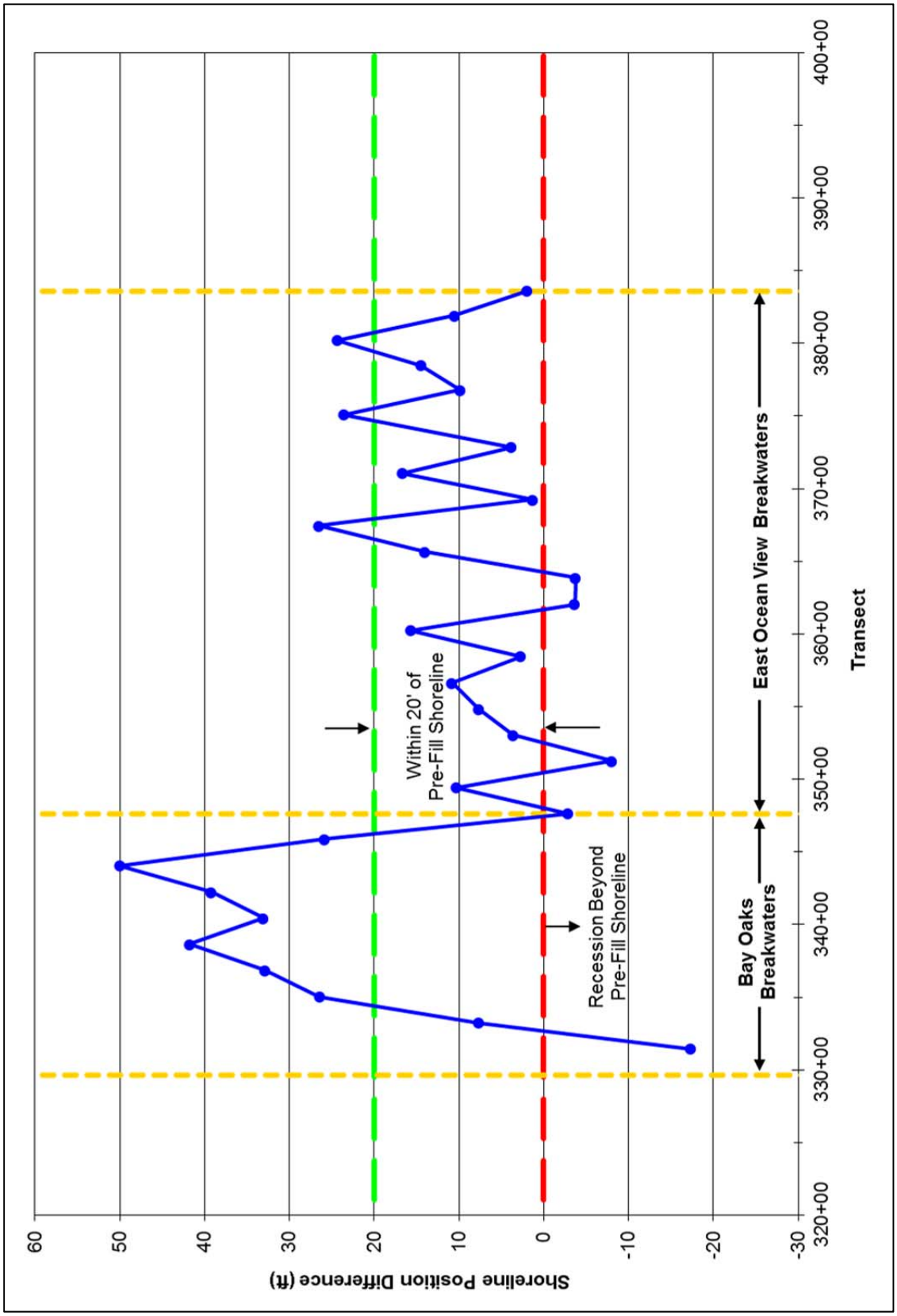

Figure 5-11: Shoreline Position Difference (ft) at MHW Between 2003 Pre-Fill and March 2014 Shorelines for East Ocean View

5.6. Central Ocean View Dune Restoration Project (2005)

The most recent periodic survey, taken in March 2014, was also compared to the post-fill survey taken in March 2005 after completion of the Willoughby Spit to Central Ocean View Dune Restoration project. A total of 504,300 cy of sand was placed from Sta 15+00 to Sta 195+63. Table 5-11 presents the shoreline and volume change statistics comparing the two surveys.

Table 5-11: Regional and Overall Shoreline and Volume Change Statistics for Central Ocean View Nourishment Project (March 2005 Post-Fill – March 2014 Comparison)

Region		Average Shoreline Change (ft)	Average Volume Change Above 0 ft NAVD88 (cy/ft)	Cumulative Volume Change Above 0 ft NAVD88 (cy)	Average Volume Change Above -15 ft NAVD88 (cy/ft)	Cumulative Volume Change Above -15 ft NAVD88 (cy)
Willoughby Spit (0+00 to 45+00)	Rate per Year	0.08	-0.89	-2,621	-0.45	-1,180
	Total	0.70	-8.00	-23,635	-4.07	-10,641
800 Block Breakwaters (45+25 to 87+62)	Rate per Year	-5.54	-1.20	-5,249	-1.66	-7,181
	Total	-49.95	-10.84	-47,337	-14.94	-64,765
West Ocean View (93+41 to 163+49)	Rate per Year	-3.48	-1.62	-12,865	-1.22	-8,942
	Total	-31.36	-14.60	-116,031	-11.01	-80,651
Central Ocean View Breakwaters (169+63 to 195+63)	Rate per Year	-0.83	-0.17	-551	1.06	3,086
	Total	-7.50	-1.53	-4,969	9.57	27,832
OVERALL		Weighted Average	Total	Weighted Average	Total	Weighted Average
Rate per Year		-2.89	-1.13	-21,285	-0.78	-14,217
Total		-26.08	-10.17	-191,972	-6.99	-128,225

It is important to consider changes above the 0 feet contour since the project was primarily a dune restoration, placing the majority of sand above the intertidal zone. Table 5-11 shows that there has been significant loss of material in the dune system and subaerial beach above 0 feet NAVD88 since the project was completed. Roughly 192,000 cy of material has been lost above 0 feet NAVD88, or approximately 60% of the 320,700 cy originally placed above 0 feet NAVD88. Over the past monitoring period, this percentage dropped from 69% due to the influence of the Willoughby Spit and West Ocean View Shoreline Improvement Projects. This also does not include the majority of the nourishment that was placed within West Ocean View because station 129+17 was removed from the analysis.

Figure 5-12 shows areas of elevation change between the post-fill survey and the March 2014 survey. As depicted in the figure, there has been erosion of the beach face and nearshore in-between the Willoughby Spit breakwaters, the 800 Block breakwaters, and the Central Ocean View breakwaters. These losses are less in the Central Ocean View breakwaters than in the 800 Block breakwaters and Willoughby Spit breakwaters. The losses due to the end effects from the 800 Block breakwaters can also be seen between stations 42+50 and 47+30. Since station 129+17 was removed from the analysis, there is a gap in the surface at this location.

In addition, the March 2014 MHW shoreline was compared to the pre-fill MHW shoreline as another way to measure the amount of protection still being supplied by the January-March 2005 nourishment (dune restoration) project. The design life of the nourishment project was outlined in the M&N Willoughby Spit to Central Ocean View Dune Restoration Project Performance Analysis from October 2004. The study anticipated a project design life of 5 to 6 years with no major storm activity and 2 to 3 years at hot spot areas if there were impacts to this reach of shoreline from storms. The nourishment project is in its eighth year and has been impacted by several storms since its construction, e.g. October 2006 and November 2009 nor'easters, and Hurricane Irene in August 2011. Areas where the current shoreline is within 20 feet of the pre-fill shoreline need to be targeted for nourishment. Figure 5-13 shows the MHW shoreline position difference between the pre-fill and March 2014 shorelines. As can be seen, the March 2014 Willoughby Spit to Central Ocean View MHW shoreline comes within 20 feet of the pre-fill shoreline in many locations and has even receded past the pre-fill shoreline at several locations. Areas of concern include the shoreline to the west of the 800 Block breakwater field as well as portions of the breakwater field itself which exist at stations 45+00 through 57+57. The breakwaters are most likely inhibiting the transport of sand to the western portion of the field and shoreline beyond. Due to the most recent nourishment along the eastern section of Willoughby Spit, the MHW shoreline between stations 35+00 and 45+00, which was of concern have remained greater than 20 feet from the pre-fill shoreline with one exception at station 32+50. This station has receded within 20 feet of the pre-fill shoreline. The West Ocean View shoreline remains an area of concern with a majority of transects showing recession either beyond the pre-fill shoreline or within 20 feet of the pre-fill shoreline. The conditions in this reach have improved since the completion of the West Ocean View shoreline improvement project even without seeing the nourishment placed at station 129+17. The location of most concern was between stations 120+93 to 141+98, which had the largest recession beyond the pre-fill shoreline, has improved due to the equilibration of the nourishment. The timber groin was reconstructed as a rock groin and 73,600 cy of sand was placed on both sides of the groin, which has helped the situation at this location. The shoreline suffered significant impacts from the November 2009 nor'easter which were further exacerbated by Hurricane Irene in August 2011. Targeted nourishment projects should continue to be planned for these areas in the future.

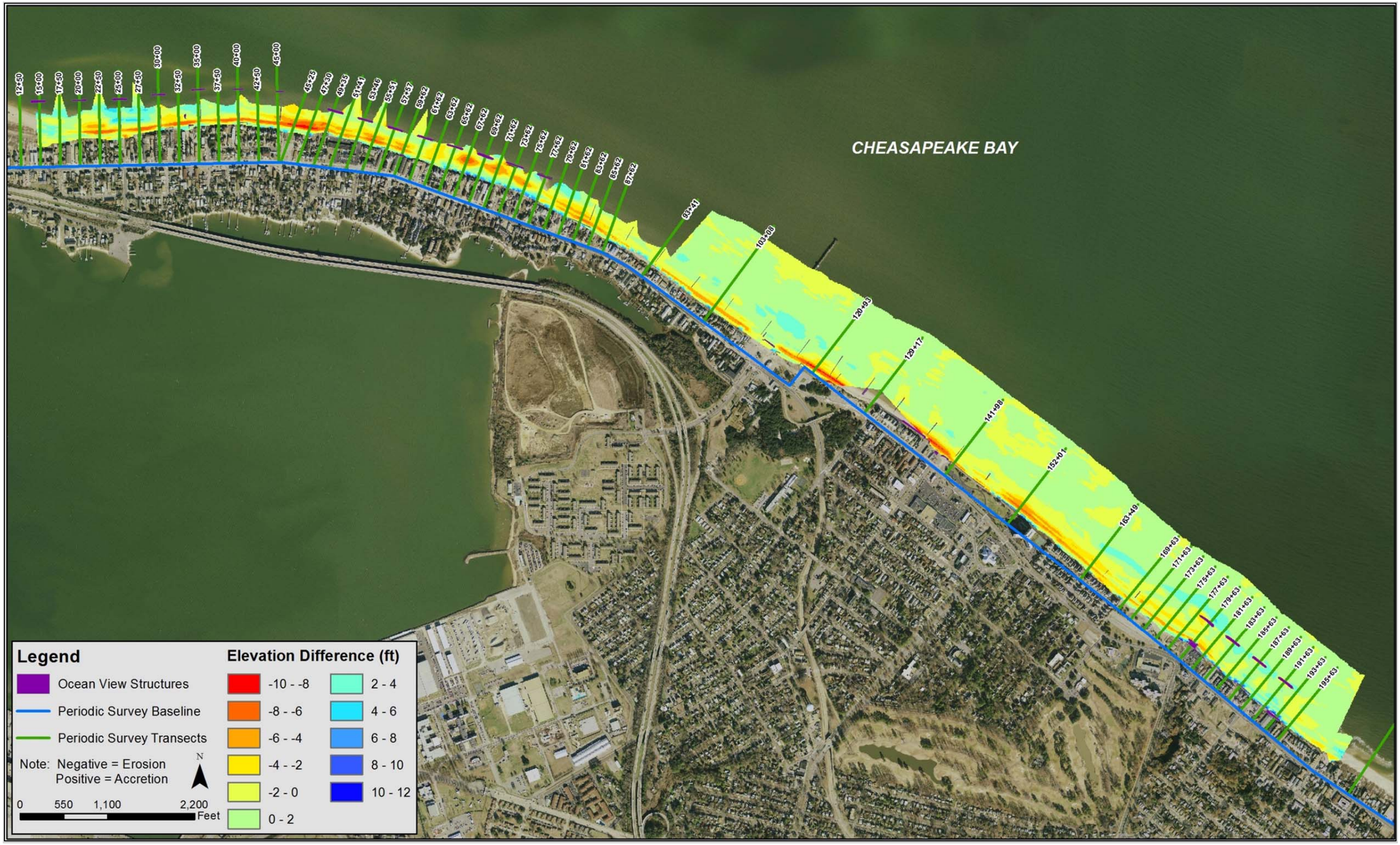

Figure 5-12: Net Volume Change Since the Willoughby Spit to Central Ocean View Dune Restoration Project (March 2005)

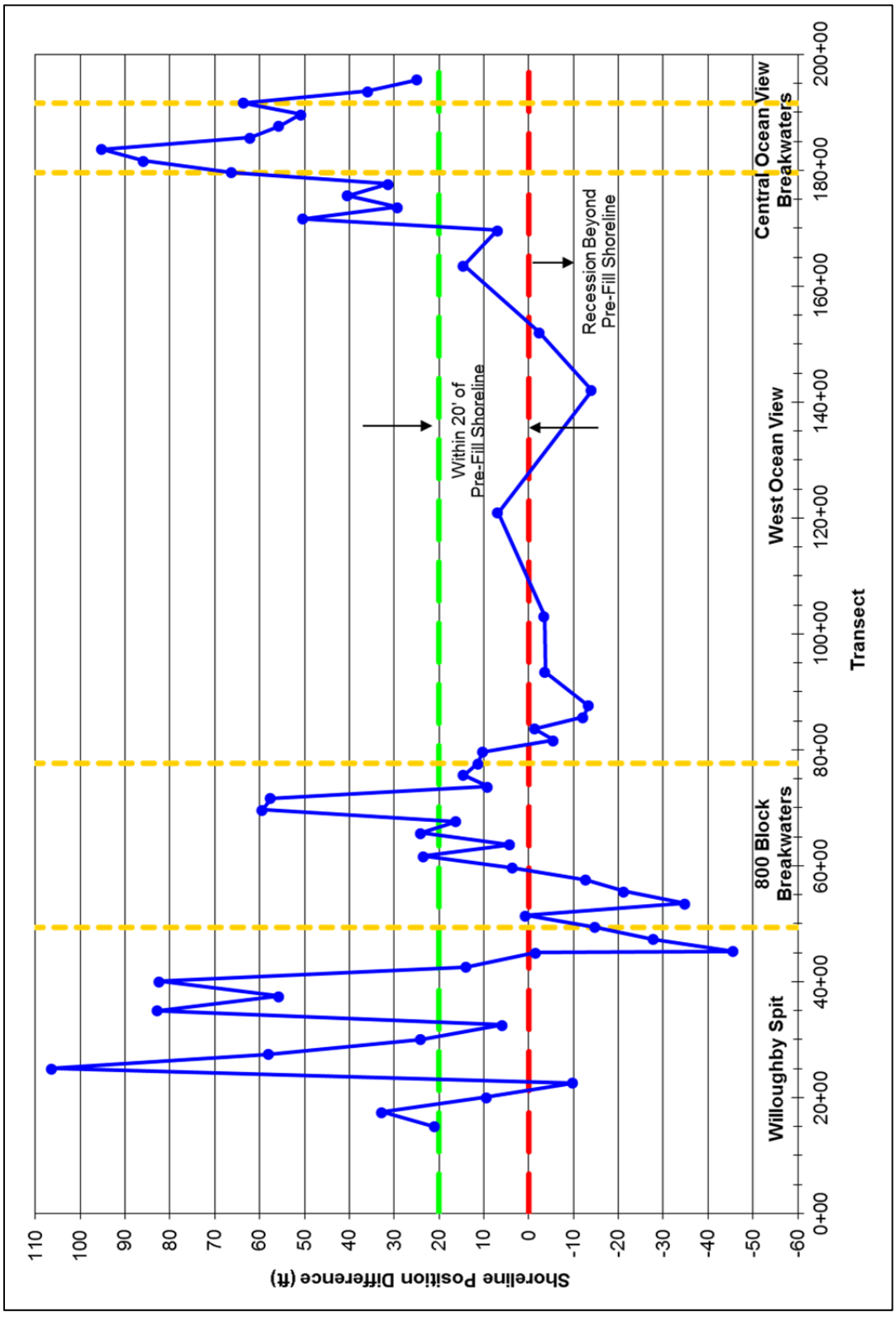

Figure 5-13: Shoreline Position Difference (ft) at MHW Between 2003 Pre-Fill and March 2014 Shorelines for Central Ocean View

6. 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 March 2014. Subsequent surveys are planned to be conducted and evaluated every six months, in March/April and September/October. 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 March 2014 survey was compared with both the October 2013 and April 2013 surveys. The surveys were used to compute shoreline change at MHW and volume change above 0 feet NAVD88 and above -15 feet NAVD88.

In addition, the most recent survey in March 2014 was compared to pre- and post-fill surveys taken after the East Ocean View beach nourishment and Willoughby Spit to Central Ocean View dune restoration projects in March 2009 and January-March 2005 respectively. This was done to quantify the amount of material loss since the projects were completed and condition of the shoreline with respect to pre-fill conditions.

Key statistics were computed for defined regions along Ocean View and the entire shoreline for the time period between both the April 2013 and March 2014 surveys and the October 2013 and March 2014 surveys.

Comparison	Parameter	Quantity
April 2013 vs. March 2014	Average Shoreline Change Rate at MHW (+0.98 ft NAVD88)	-7.40 ft/yr
	Cumulative Volume Change Rate Above 0 ft NAVD88	2,978 cy/yr
	Cumulative Volume Change Rate Above -15 ft NAVD88	-47,460 cy/yr
October 2013 vs. March 2014	Average Shoreline Change at MHW (+0.98 ft NAVD88)	-4.07 ft
	Cumulative Volume Change Above 0 ft NAVD88	44,516 cy
	Cumulative Volume Change Above -15 ft NAVD88	48,817 cy

The average shoreline change rate for the entire shoreline at MHW between the April 2013 and March 2014 surveys was -7.40 ft/yr, and the cumulative volume change above 0 feet NAVD88 was approximately 2,978 cy/yr. This indicates an overall volumetric gain in the dune and subaerial beach over the past year. The overall loss above -15 feet NAVD88 of -47,460 cy/yr indicates that while there were gains to the dune and subaerial beach, there was sediment loss across the nearshore system. The most recent period of comparison, from the October 2013 survey to the March 2014 survey depicts an overall loss at the MHW line of -4.07 feet. The cumulative volume change above 0 feet NAVD88 indicates a sediment gain to the subaerial beach of 44,516 cy, which accounts for the majority of the gain throughout the entire year. There was also a gain of sediment in the nearshore system above -15 feet NAVD88 of 48,817 cy. This can be attributed primarily to the equilibration of the Willoughby Spit Shoreline Improvement Project as well as the construction of the West Ocean View Shoreline Improvement Project, which took place during this monitoring period.

Willoughby Spit

The Willoughby Spit region is still undergoing equilibration from the Willoughby Spit Shoreline Improvement Project, which finished construction in December 2013. The nourishment placed at the eastern end of this reach has begun moving westward and is being retained by the seven newly constructed breakwaters. Overall, this reach experienced accretion in the MHW shoreline, and volumetric gains above both 0 feet NAVD88 and -15 feet NAVD88 over the past year

800 Block Breakwaters

In the 800 Block region, there has been a net loss of sediment above 0 feet NAVD88 and -15 feet NAVD88 and erosion of the MHW shoreline over the past year; however, the most recent survey period showed minimal change. The tombolo located at the realigned breakwater has remained detached allowing sand to transport freely through this reach.

West Ocean View

The West Ocean View region was characterized by the shoreline improvement project that took place during the most recent survey period. At the time of survey, all timber groins had been removed, the reconstruction of the rock groin at station 129+17 was complete, and a majority of the 73,600 cy nourishment had been placed. Station 129+17 was removed from analysis for this report due do the presence of construction equipment. This prevented the majority of the nourishment placed to be accounted for in the analysis. The volumetric change for the year showed an overall loss to this reach. The current period showed a minor gain to the subaerial beach.

Central Ocean View Breakwaters

The Central Ocean View Breakwaters region showed gains in the MHW shoreline position and volumetric gains above 0 feet NAVD88 and -15 feet NAVD88 over the past year. A majority of these gains occurred during the most recent survey period.

Central Ocean View

Typically a very stable region, Central Ocean View has experienced erosion of the MHW shoreline, with a volumetric loss above 0 feet NAVD88 and -15 feet NAVD88 over the past year. However, during the current monitoring period, there were overall volumetric gains.

East Ocean View

Due to the normal direction of sediment movement, there are minor volumetric losses to the beach in the East Ocean View region over the entire year. During the most recent survey period there were more significant volumetric gains above 0 feet NAVD88 and -15 feet NAVD88. The Bay Oaks breakwaters are continuing to perform well, trapping sediment and eliminating the hotspot at this location. The east end of the region, adjacent to the jetty, is more erosive than most areas west in this region due to the lack of a sediment source.

In addition to regional assessments, comparison of the March 2014 survey was made against post-fill surveys from the East Ocean View beach nourishment and Willoughby Spit to Central Ocean View dune restoration which took place in March 2009 and January-March 2005 respectively.

Comparison	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
East Ocean View Nourishment vs. October 2013	-90.83 ft	-17.87 cy/ft	-93,016 cy	-29.37 cy/ft	-152,100 cy
Central Ocean View Nourishment vs. October 2013	-30.02 ft	-11.83 cy/ft	-221,166 cy	-8.59 cy/ft	-156,523 cy

The approximately 93,000 cy volumetric loss above 0 feet NAVD88 from the East Ocean View project is roughly 82% of the original amount placed in this dune and subaerial beach area while the approximately 221,200 cy loss above 0 feet NAVD88 in the Central Ocean View project area is roughly 60% of the original amount placed above 0 feet NAVD88. Due to storm impacts and background erosion that has occurred, as anticipated, over the projects' design life, there are areas in both of these shoreline regions that should be targeted for nourishment. The completed Willoughby Spit project as well as the West Ocean View project under way will help alleviate the concerns with these hot spots and provide additional protection in vulnerable areas; however, there are still other areas that may require nourishment to provide adequate storm protection. The East Ocean View project may also require a renourishment in the next 1 to 2 years.

As another measure of the protection being supplied by the East Ocean View and Central Ocean View nourishment projects, the projects' pre-fill and March 2014 MHW shoreline positions were compared. Areas where the current shoreline has receded beyond or eroded within 20 feet of the pre-fill shoreline may need to be targeted for immediate nourishment. Results of this analysis indicate that the East Ocean View nourishment project has provided ample shoreline protection for the majority of the shoreline with only slight end effects immediately west of the most recently constructed breakwaters; however, the November 2009 Nor'easter and Hurricane Irene have impacted the design life and renourishment of this area may be required in the next 1 to 2 years. The Willoughby Spit to Central Ocean View shoreline continues to have various problem spots. The western portion of the shoreline in the Willoughby Spit groin field, the majority of the shoreline behind the 800 Block breakwaters and West Ocean View shoreline has eroded to within 20 feet of the pre-fill shoreline and even receded beyond the pre-fill shoreline in some locations. This project had an anticipated design life of 5 to 6 years, with no storm activity, with hot spot areas anticipated to require nourishment after 2 to 3 years if storm activity impacted this region. The project is at the end of the anticipated design life and has been impacted by storm activity. While the emergency dune restoration project in 2010 restored a portion of the dunes in certain areas, there are still concerns about the hot spots in the area. As the Willoughby Spit shoreline equilibrates, the areas of concern in this reach should be alleviated. The West Ocean View Shoreline Improvement Project will also help alleviate the concerns with the hot spots within this reach and provide additional protection in vulnerable areas.

This is the eighteenth periodic survey report completed to date, and seventeenth 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 seasonal surveys (i.e. April 2013 to March 2014) eliminates seasonal variation of profiles in volumetric change analyses. Consecutive survey comparisons are useful to assess the direct impact of extreme events which may occur during the six month period between surveys. Future periodic survey evaluations will continue to improve on analysis techniques so that the rich survey data sets are best utilized.

Appendix A: Aerial Photography and Digitized Shorelines

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 6, 2014)
- Digitized Shoreline (October 28, 2013)
- Digitized Shoreline (April 25, 2013)
- Survey Transects
- Survey Baseline

Shoreline Aerial Photo Date: April 2014

Background Aerial Photo Date: 2009

0 250 500 1,000 Feet

N


CHESAPEAKE BAY
45+25
47+30
49+35
51+41
53+46
55+51
57+57
59+62
61+62
63+62
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69+62
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83+62
85+62
87+62
Willoughby Spit
800 Block
West Ocean View
Central Ocean View
East Ocean View
Legend
Digitized Shoreline (April 6, 2014)
Digitized Shoreline (October 28, 2013)
Digitized Shoreline (April 25, 2013)
Survey Transects
Survey Baseline
Shoreline Aerial Photo Date: April 2014
Background Aerial Photo Date: 2009
0
250
500
1,000
Feet
N

CHESAPEAKE BAY

93+41

103+08

120+93

129+17

141+98

152+01

163+49

Legend

- Digitized Shoreline (April 6, 2014)
- Digitized Shoreline (October 28, 2013)
- Digitized Shoreline (April 25, 2013)
- Survey Transects
- Survey Baseline

Shoreline Aerial Photo Date: April 2014

Background Aerial Photo Date: 2009

N

0 375 750 1,500 Feet


CHESAPEAKE BAY
Legend
Digitized Shoreline (April 6, 2014)
Digitized Shoreline (October 28, 2013)
Digitized Shoreline (April 25, 2013)
Survey Transects
Survey Baseline
Shoreline Aerial Photo Date: April 2014
Background Aerial Photo Date: 2009
0
250
500
1,000
Feet
N
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 6, 2014)
Digitized Shoreline (October 28, 2013)
Digitized Shoreline (April 25, 2013)
Survey Transects
Survey Baseline
Shoreline Aerial Photo Date: April 2014
Background Aerial Photo Date: 2009
0
625
1,250
2,500
Feet
N
Willoughby Spit
800 Block
West Ocean View
Central Ocean View
East Ocean View

CHESAPEAKE BAY

Legend

- Digitized Shoreline (April 6, 2014)
- Digitized Shoreline (October 28, 2013)
- Digitized Shoreline (April 25, 2013)
- Survey Transects
- Survey Baseline

Shoreline Aerial Photo Date: April 2014

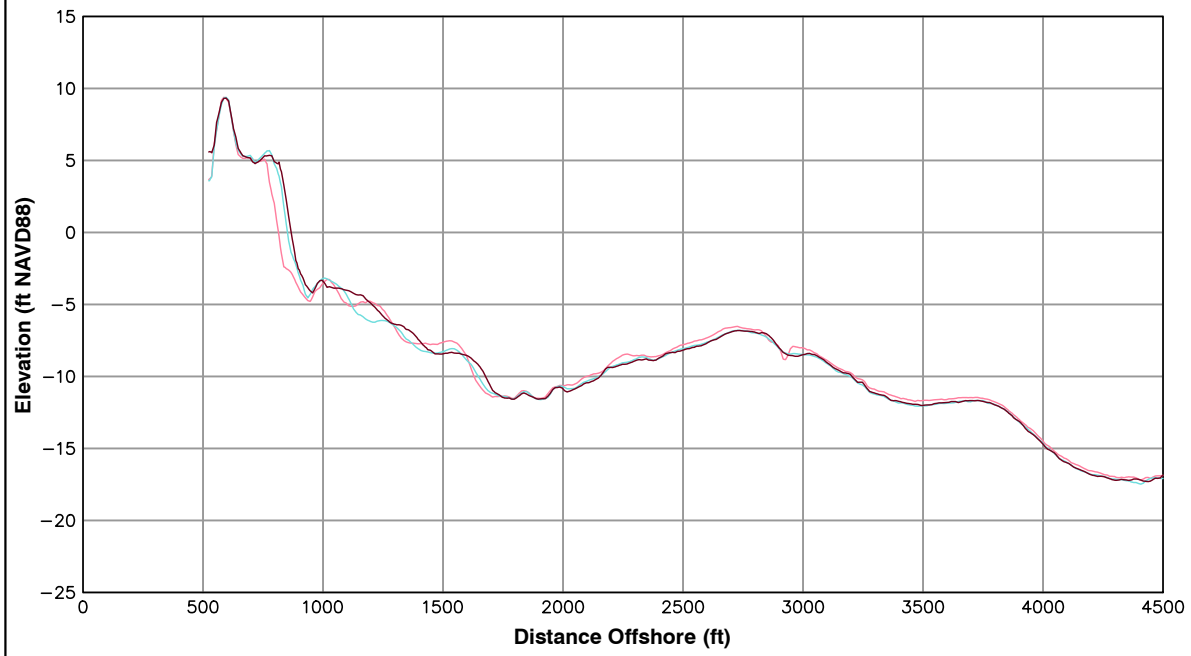
Background Aerial Photo Date: 2009

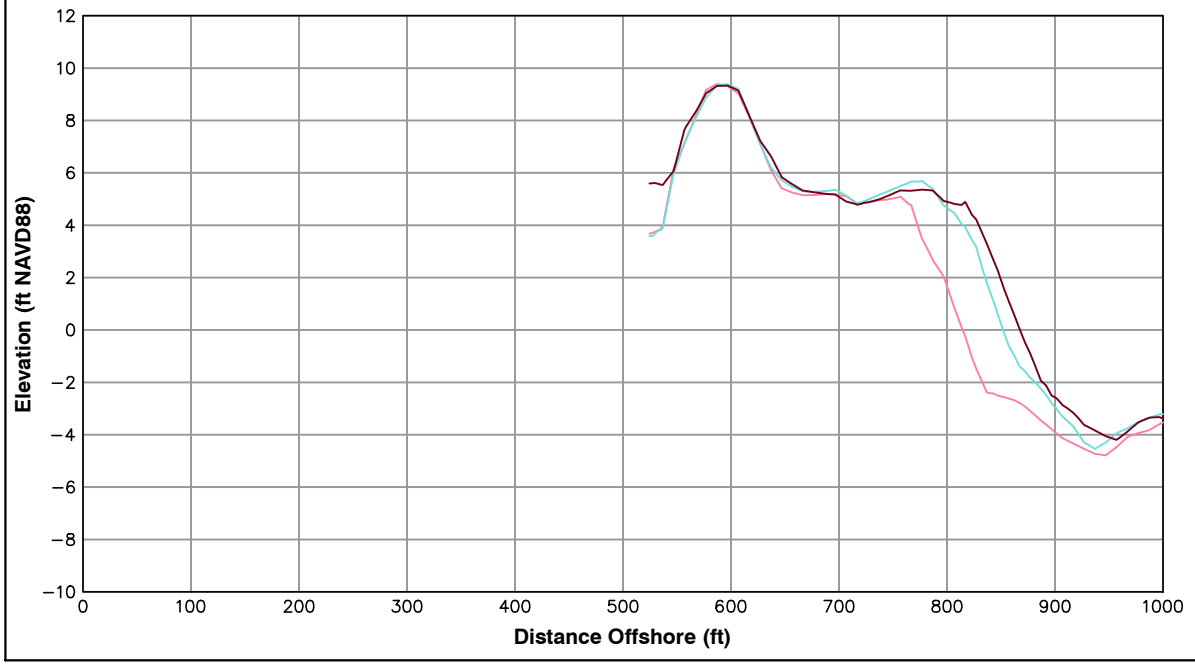
0 300 600 1,200 Feet

N

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

Appendix B: Survey Comparison Plots





Survey Transect 0+00	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	54.62 ft/yr	14.51 ft
Volume Change Above -15 ft NAVD88	5.40 cy/ft/yr	15.44 cy/ft
Volume Change Above 0 ft NAVD88	12.80 cy/ft/yr	3.68 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR

Notes:
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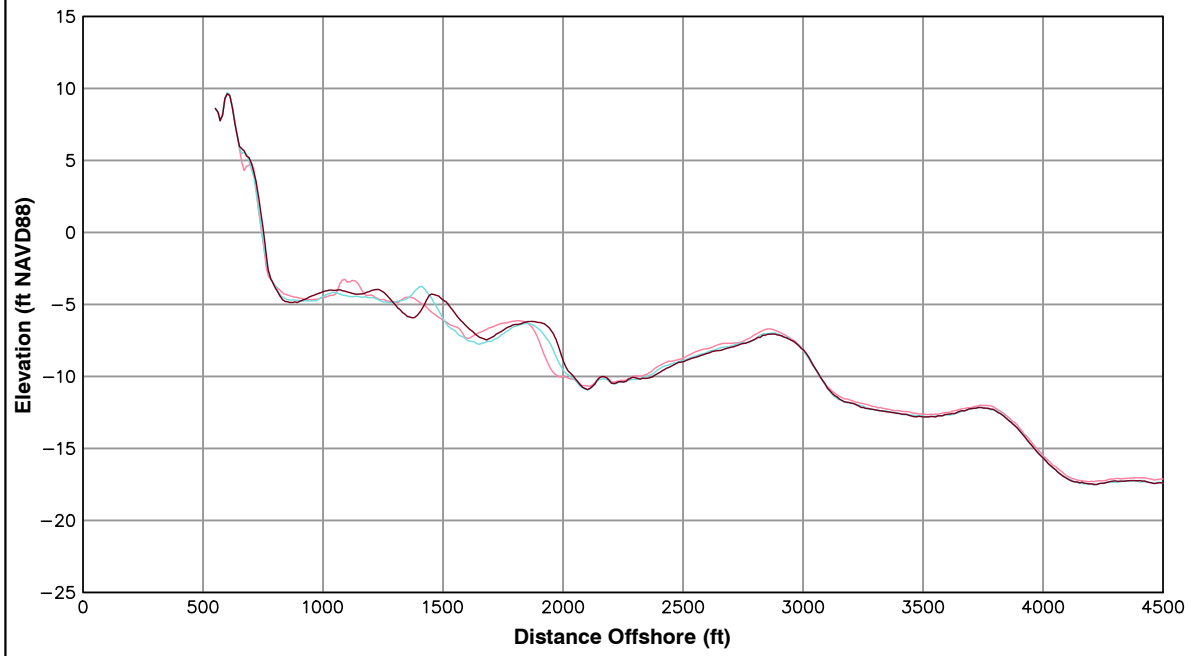
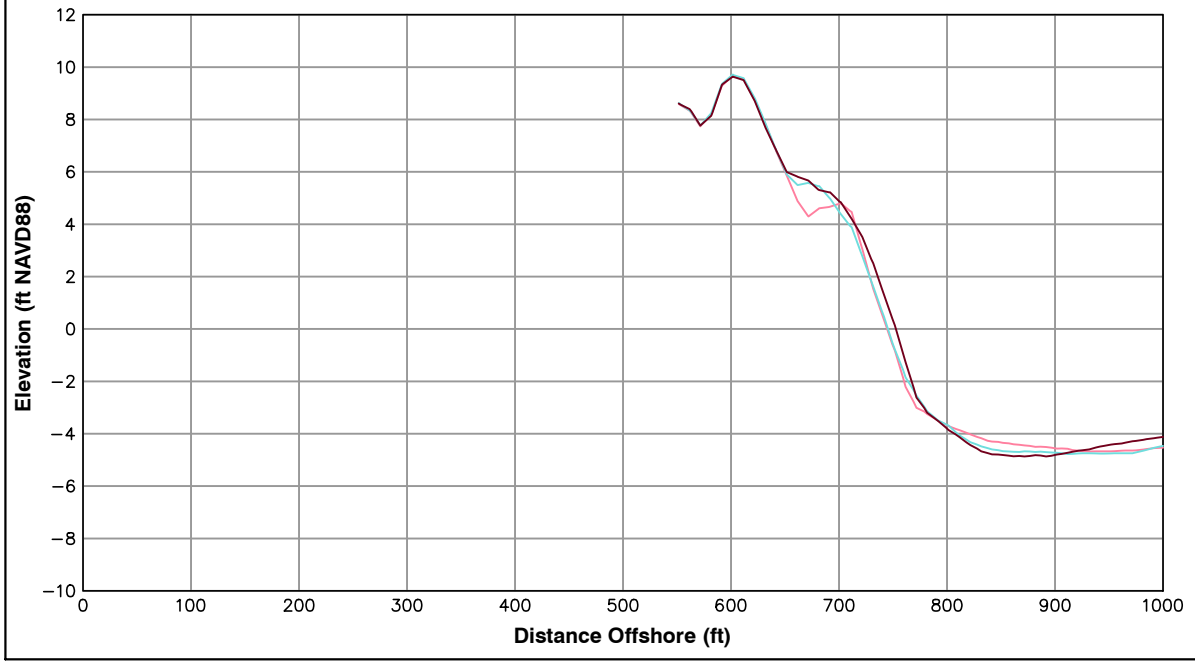
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS

ST 0+00	Pg 1 of 106	Spring 2014





Survey Transect 2+50	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	8.46 ft/yr	7.28 ft
Volume Change Above -15 ft NAVD88	-1.62 cy/ft/yr	11.44 cy/ft
Volume Change Above 0 ft NAVD88	2.28 cy/ft/yr	1.31 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR

Notes:
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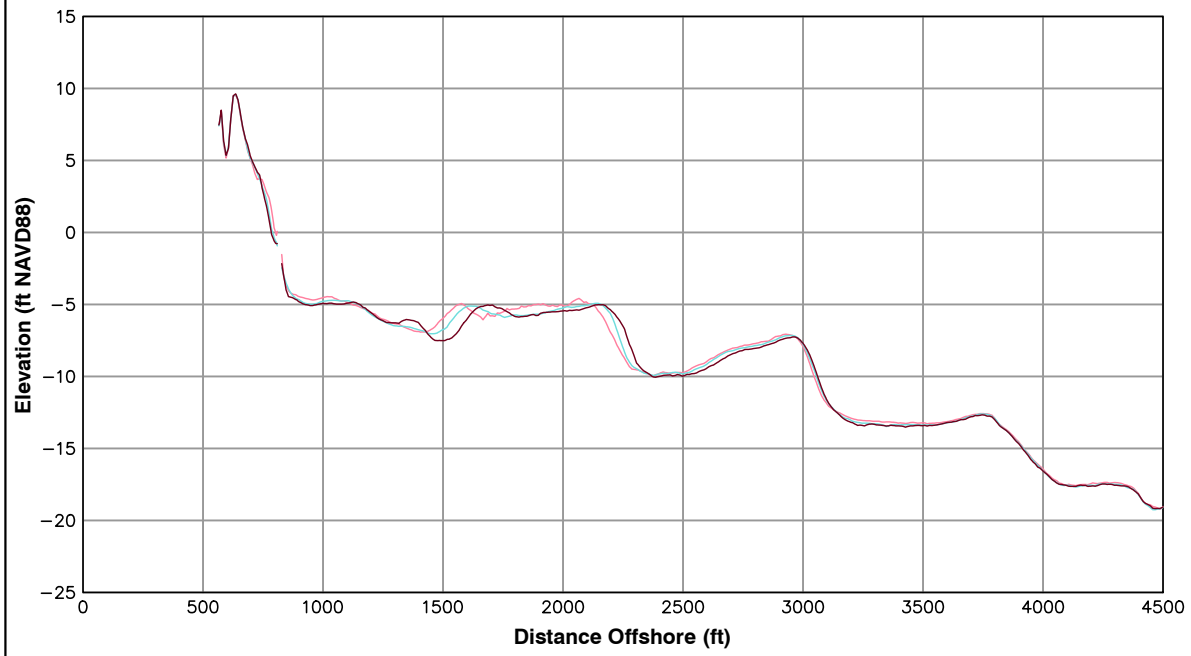
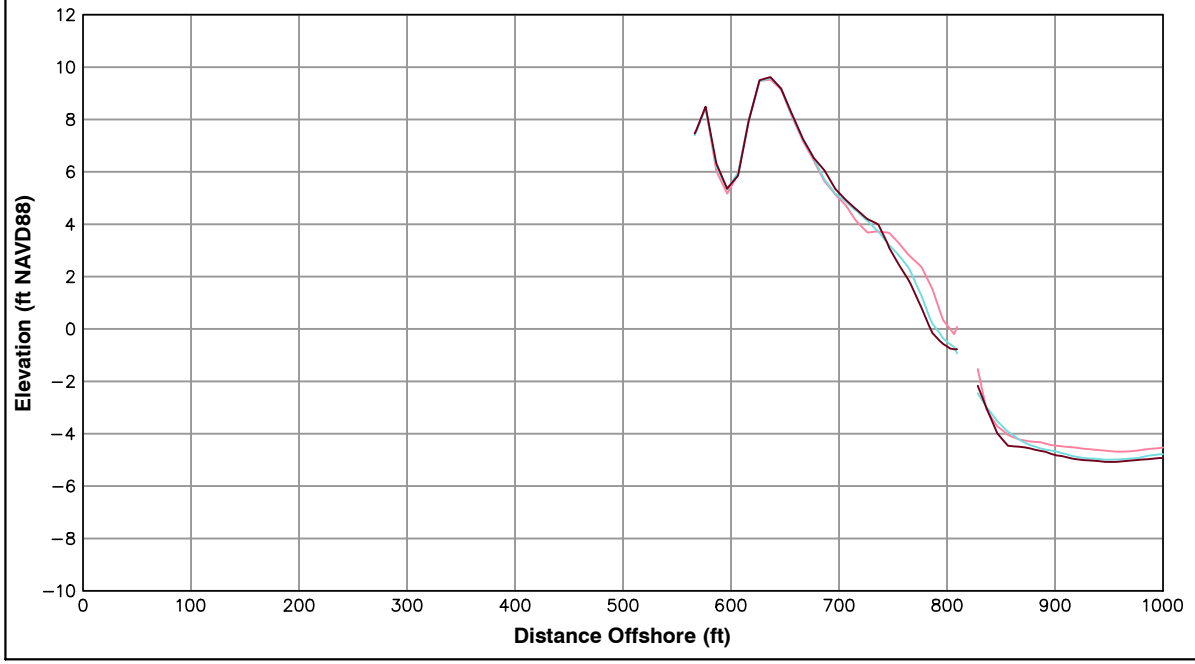
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS

ST 2+50	Pg 2 of 106	Spring 2014





Survey Transect 5+00	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-17.12 ft/yr	-4.51 ft
Volume Change Above -15 ft NAVD88	-17.27 cy/ft/yr	-5.97 cy/ft
Volume Change Above 0 ft NAVD88	-1.12 cy/ft/yr	-0.12 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR

Notes:
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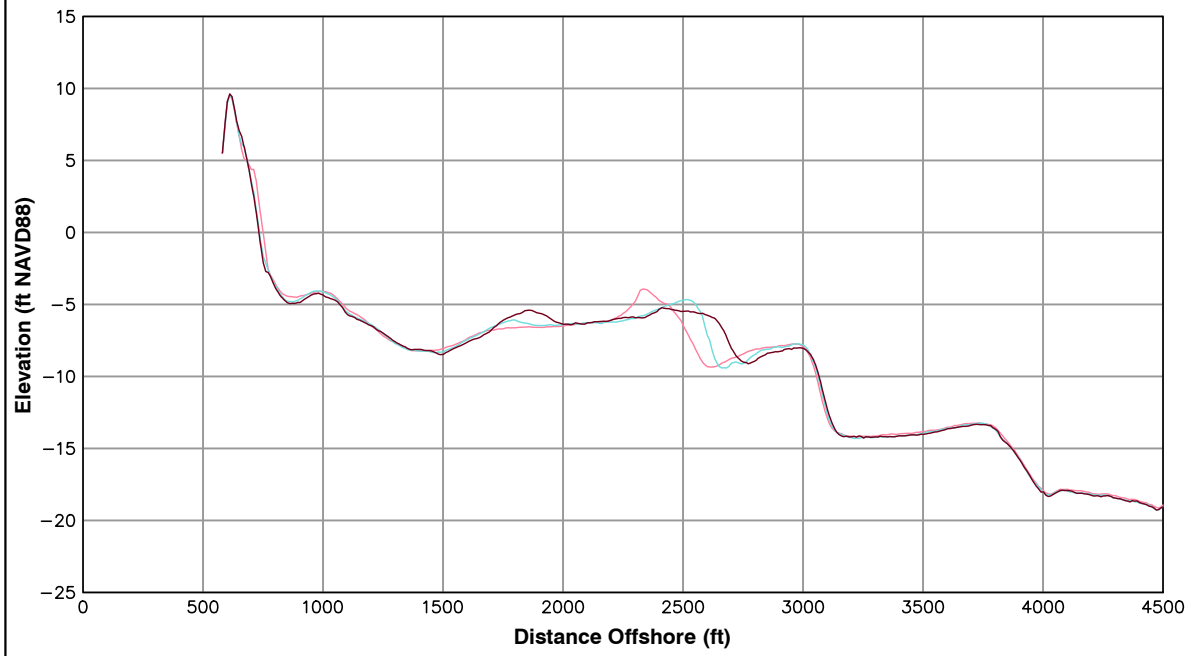
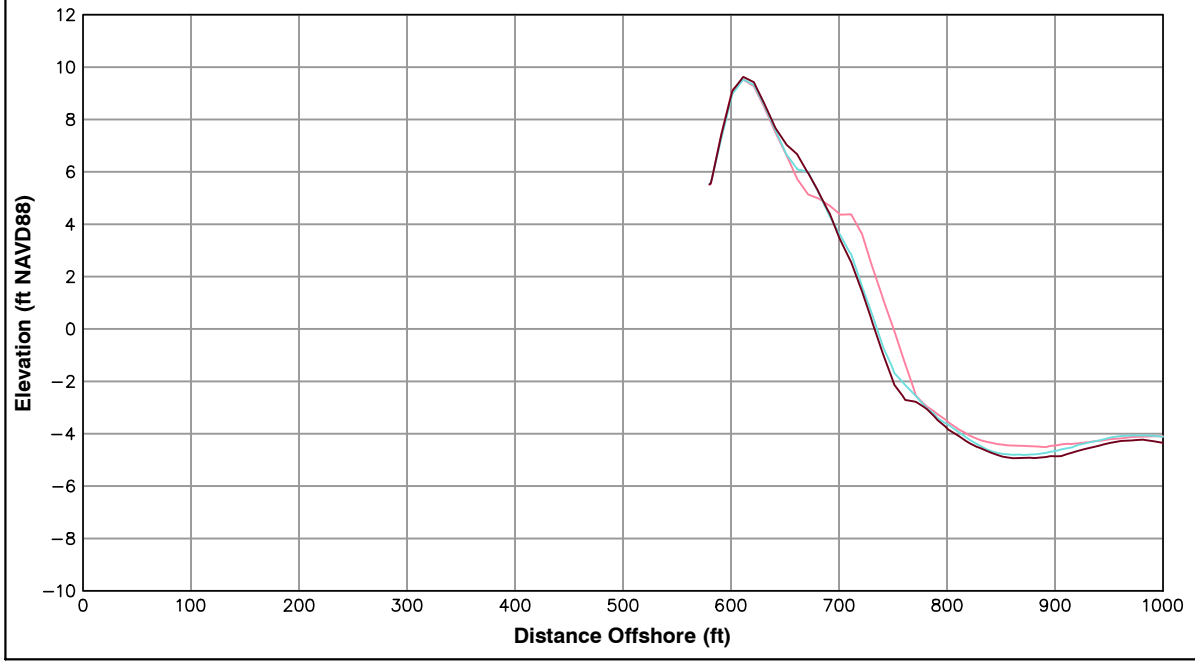
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 7+50	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-17.84 ft/yr	-1.90 ft
Volume Change Above -15 ft NAVD88	5.11 cy/ft/yr	6.49 cy/ft
Volume Change Above 0 ft NAVD88	-2.17 cy/ft/yr	0.28 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR

Notes:
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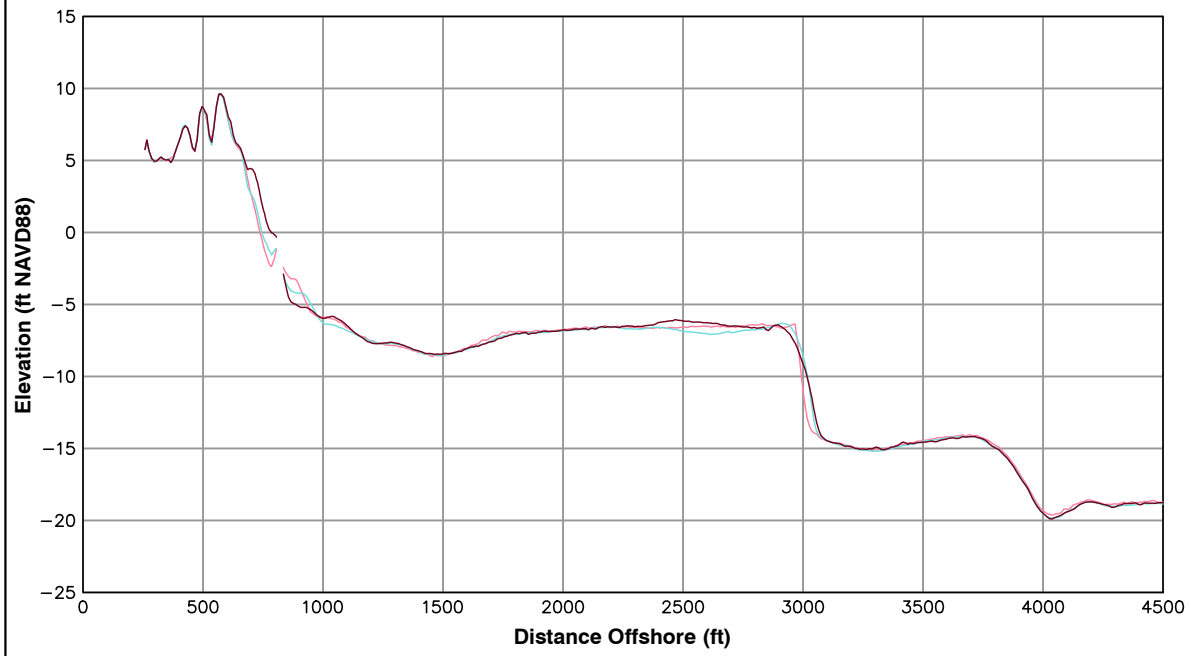
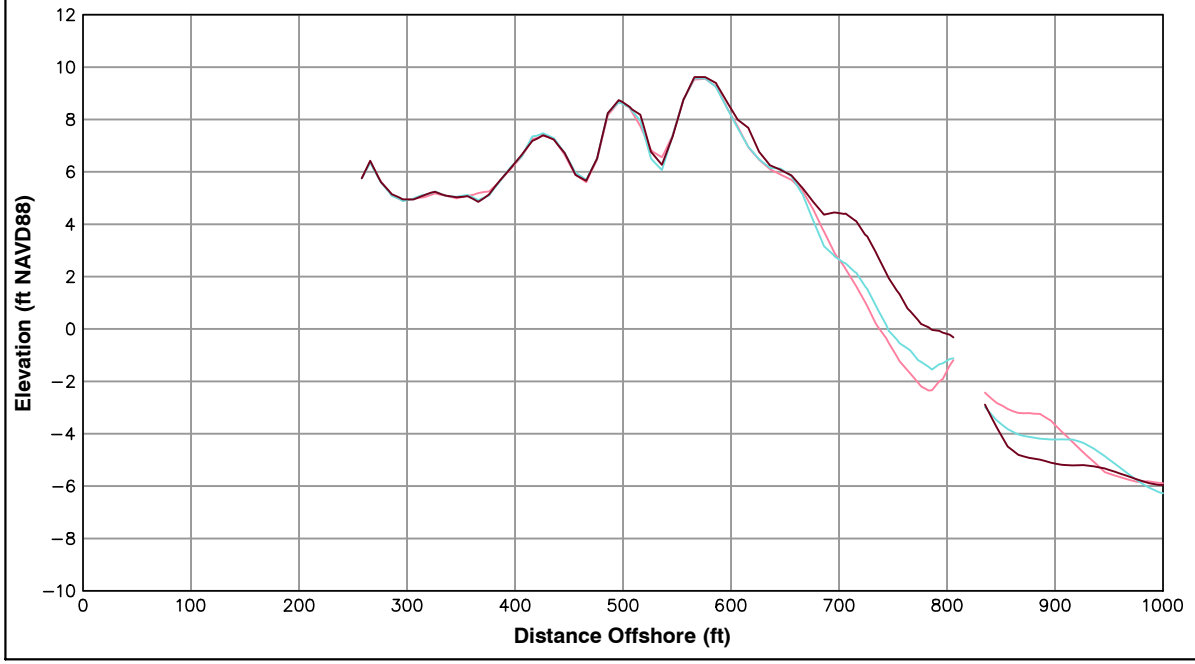
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 10+00	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	37.30 ft/yr	27.73 ft
Volume Change Above -15 ft NAVD88	11.53 cy/ft/yr	16.55 cy/ft
Volume Change Above 0 ft NAVD88	7.39 cy/ft/yr	6.74 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR

Notes:
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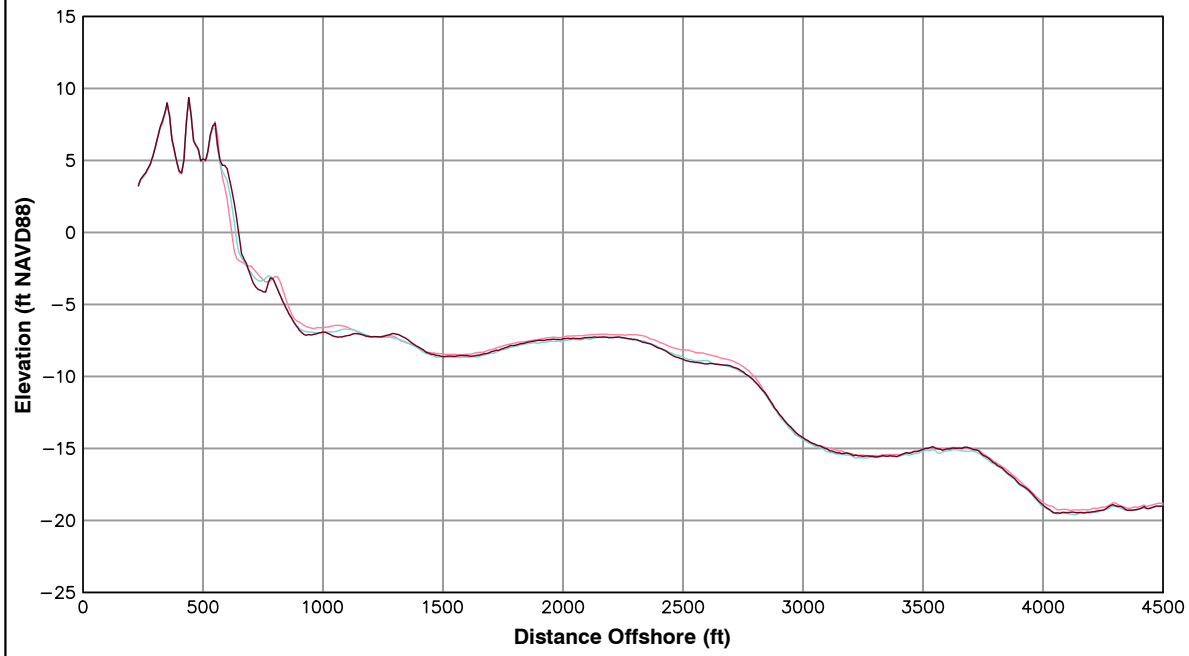
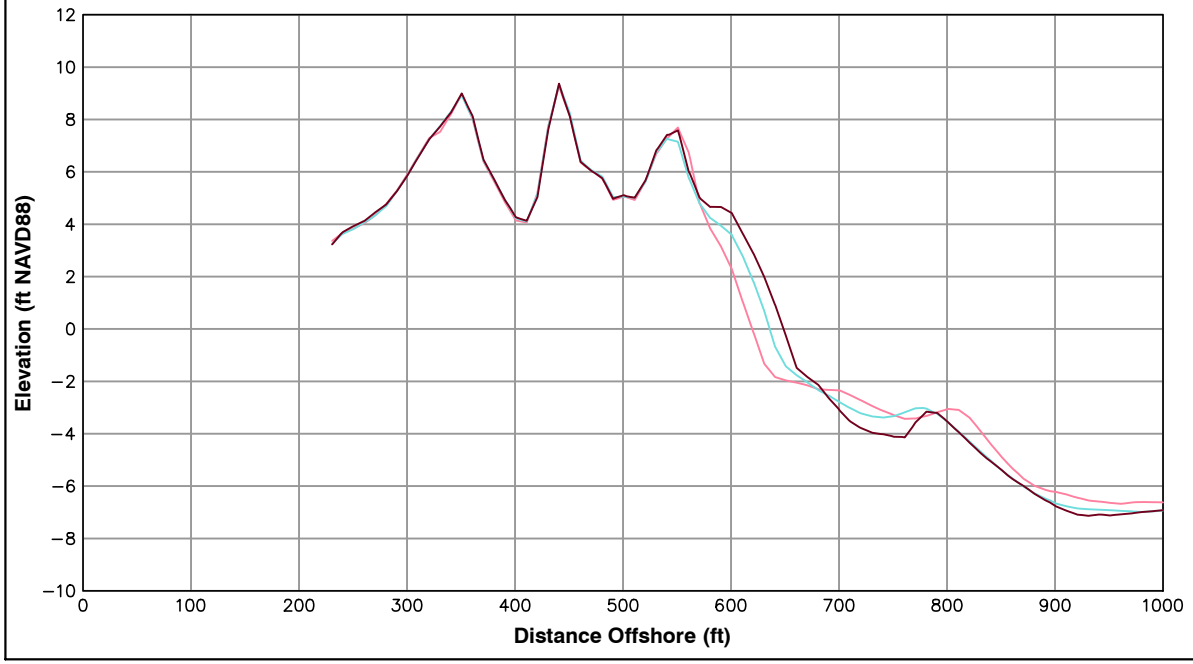
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 12+50	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	29.92 ft/yr	12.04 ft
Volume Change Above -15 ft NAVD88	-16.16 cy/ft/yr	3.61 cy/ft
Volume Change Above 0 ft NAVD88	5.14 cy/ft/yr	2.78 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR

Notes:
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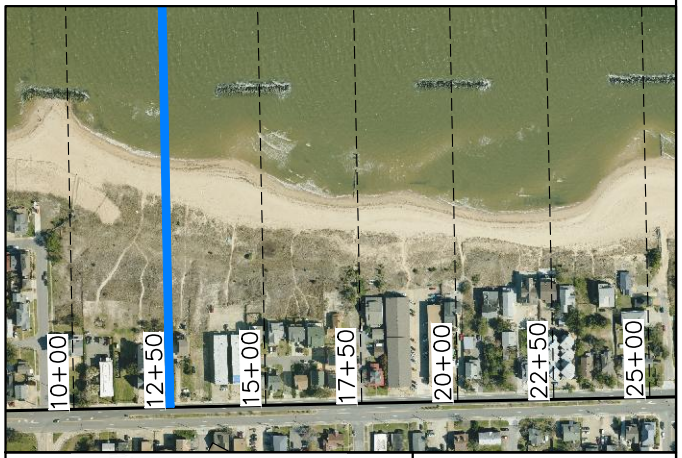
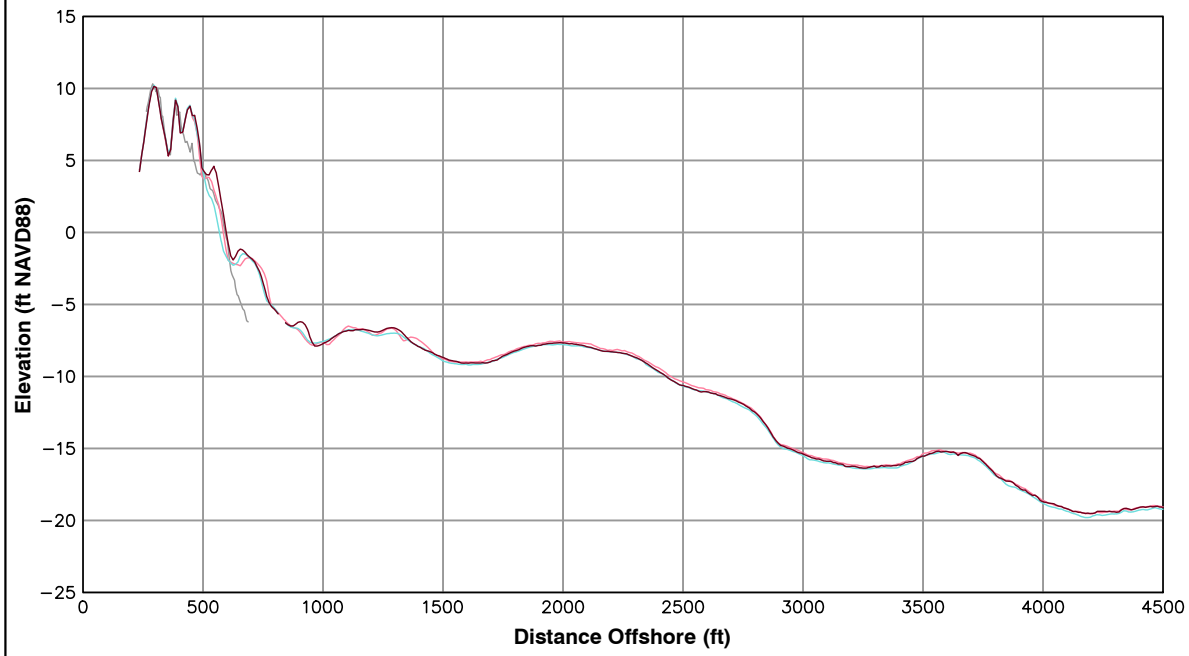
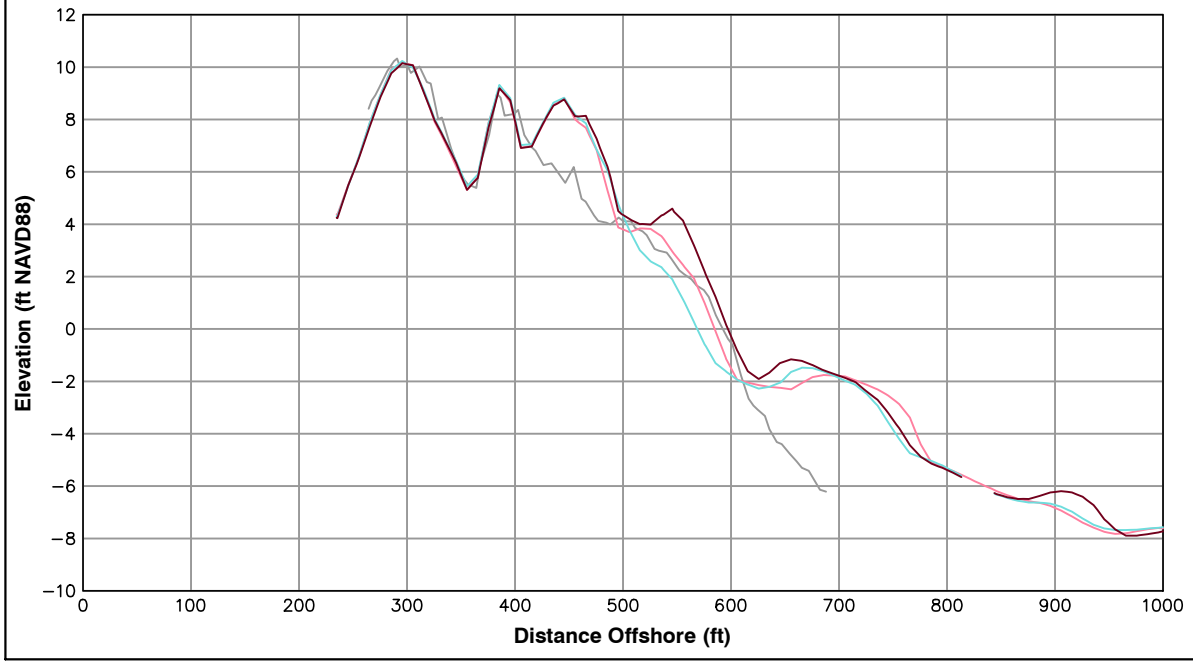


City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 15+00	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	12.64 ft/yr	30.48 ft
Volume Change Above -15 ft NAVD88	-0.17 cy/ft/yr	16.30 cy/ft
Volume Change Above 0 ft NAVD88	4.13 cy/ft/yr	5.86 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
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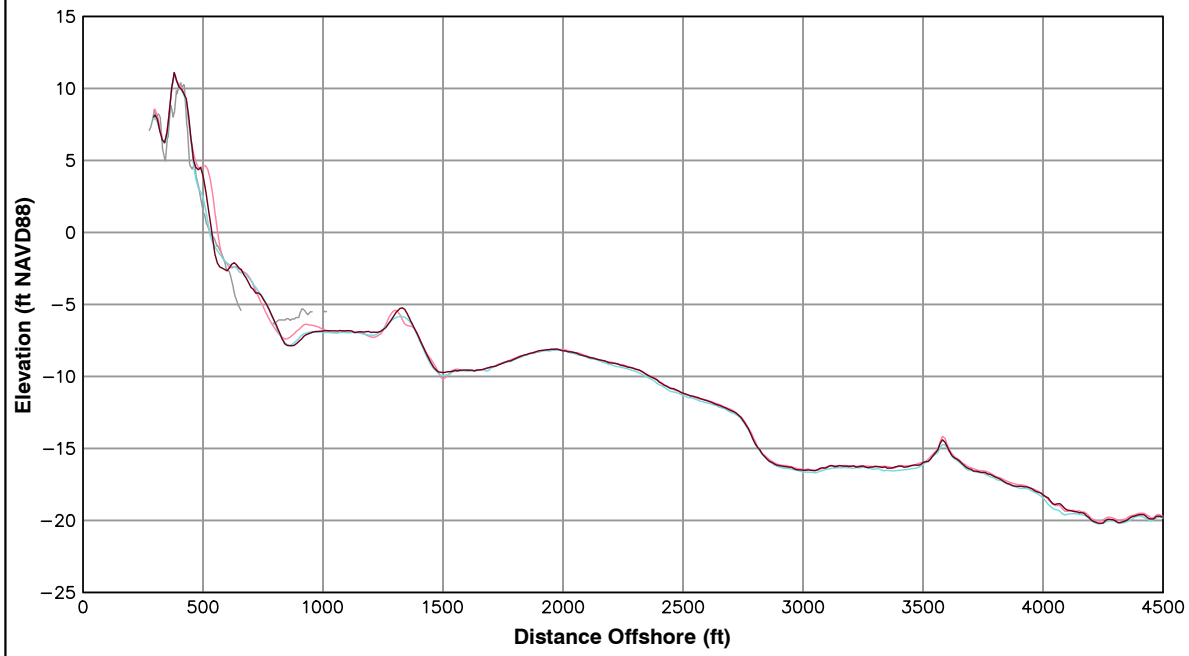
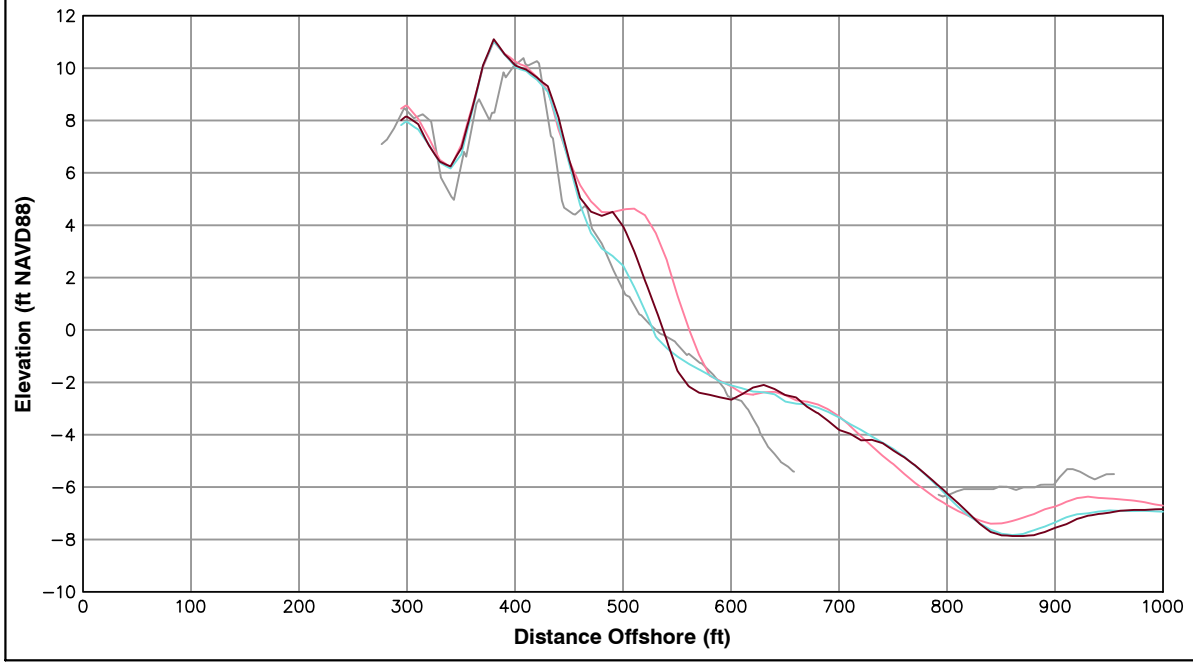
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS

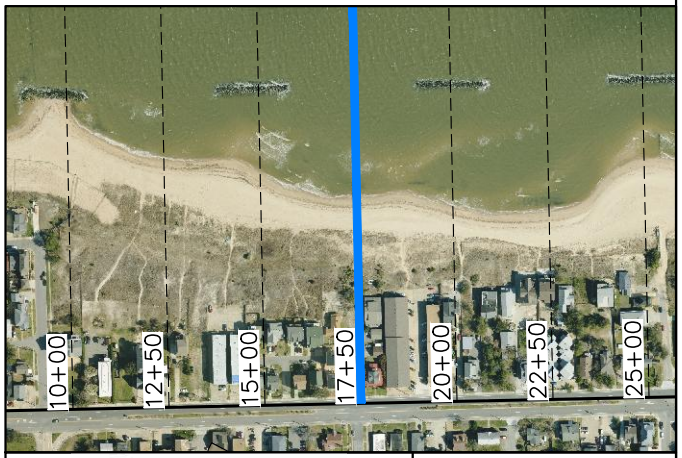




Survey Transect 17+50	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-25.51 ft/yr	10.91 ft
Volume Change Above -15 ft NAVD88	-9.34 cy/ft/yr	9.61 cy/ft
Volume Change Above 0 ft NAVD88	-5.21 cy/ft/yr	3.93 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
1. Stationing 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 April 2013 and October 2013.
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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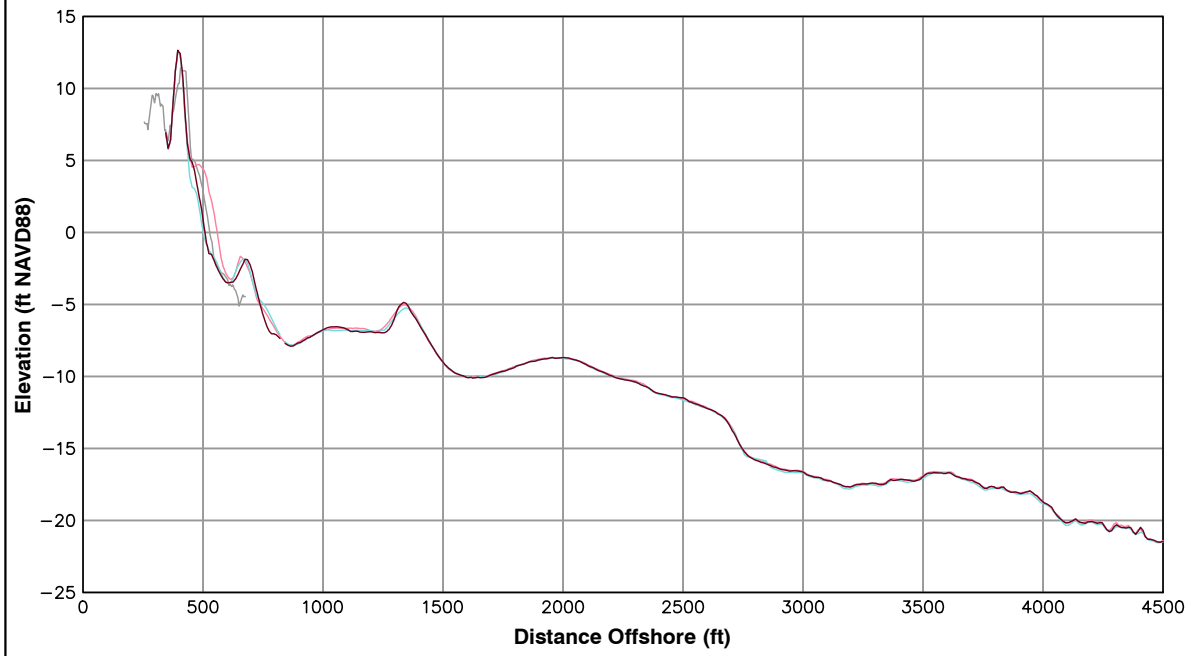
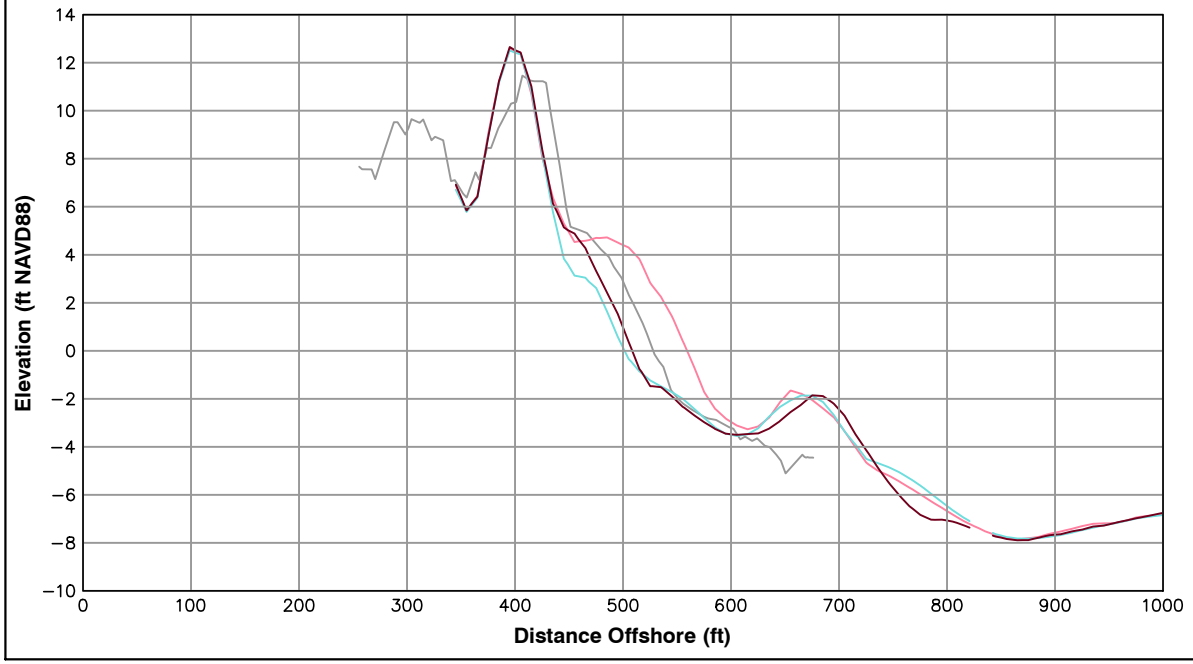
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 20+00	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-51.69 ft/yr	8.51 ft
Volume Change Above -15 ft NAVD88	-18.44 cy/ft/yr	1.42 cy/ft
Volume Change Above 0 ft NAVD88	-8.09 cy/ft/yr	3.08 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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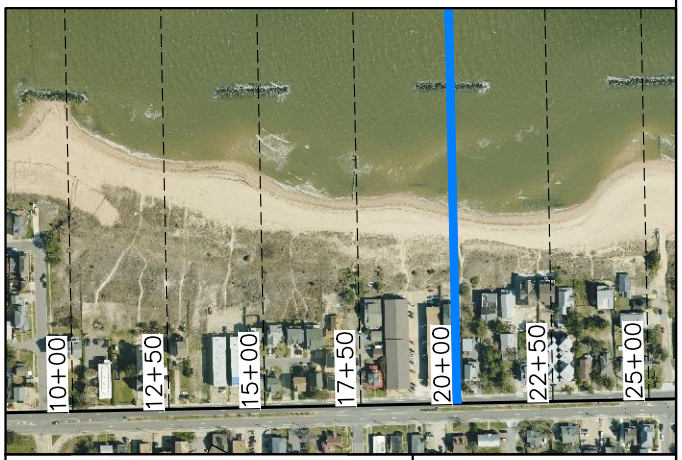
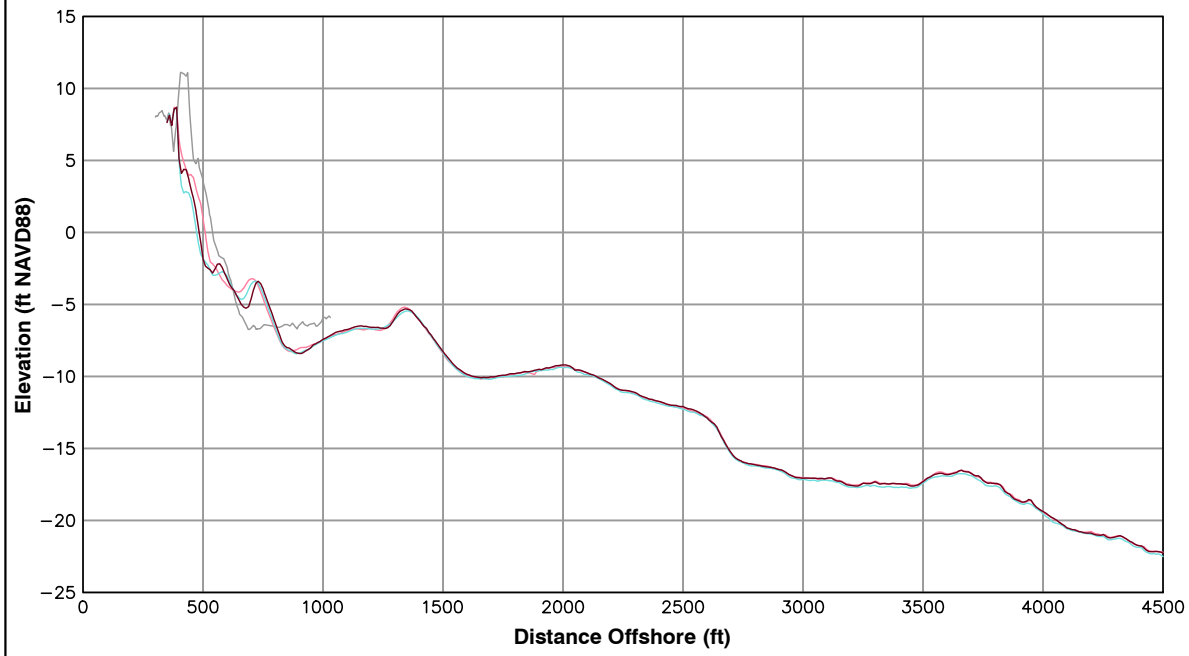
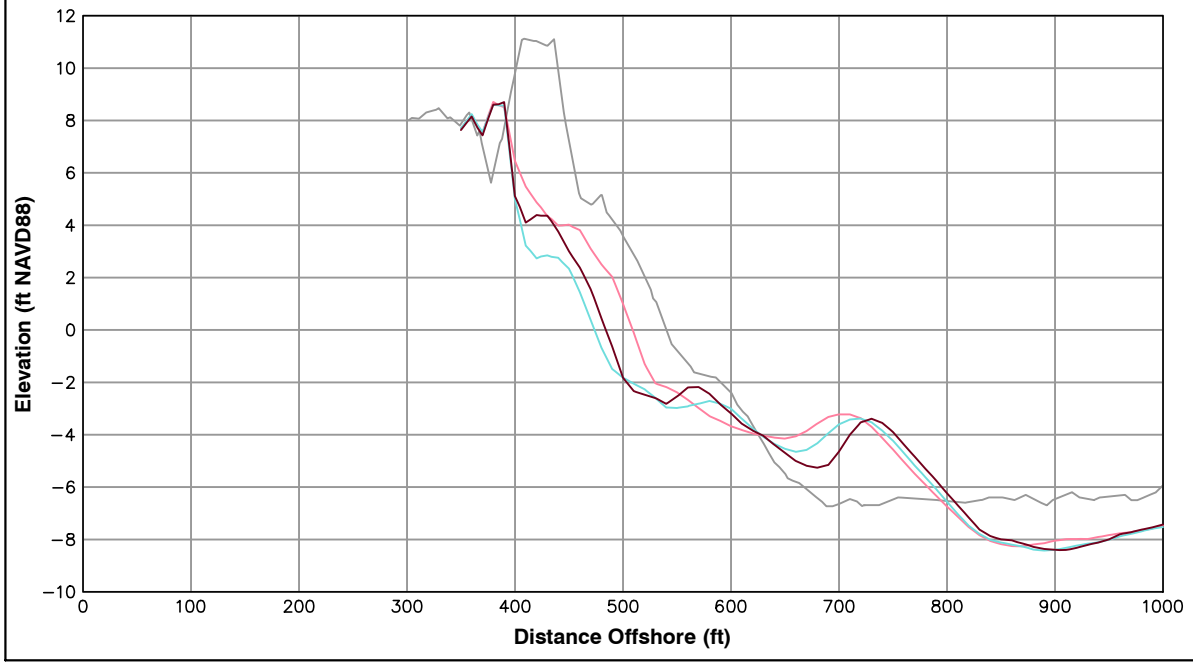


City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 22+50	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-25.72 ft/yr	10.94 ft
Volume Change Above -15 ft NAVD88	-4.74 cy/ft/yr	10.61 cy/ft
Volume Change Above 0 ft NAVD88	-4.85 cy/ft/yr	3.08 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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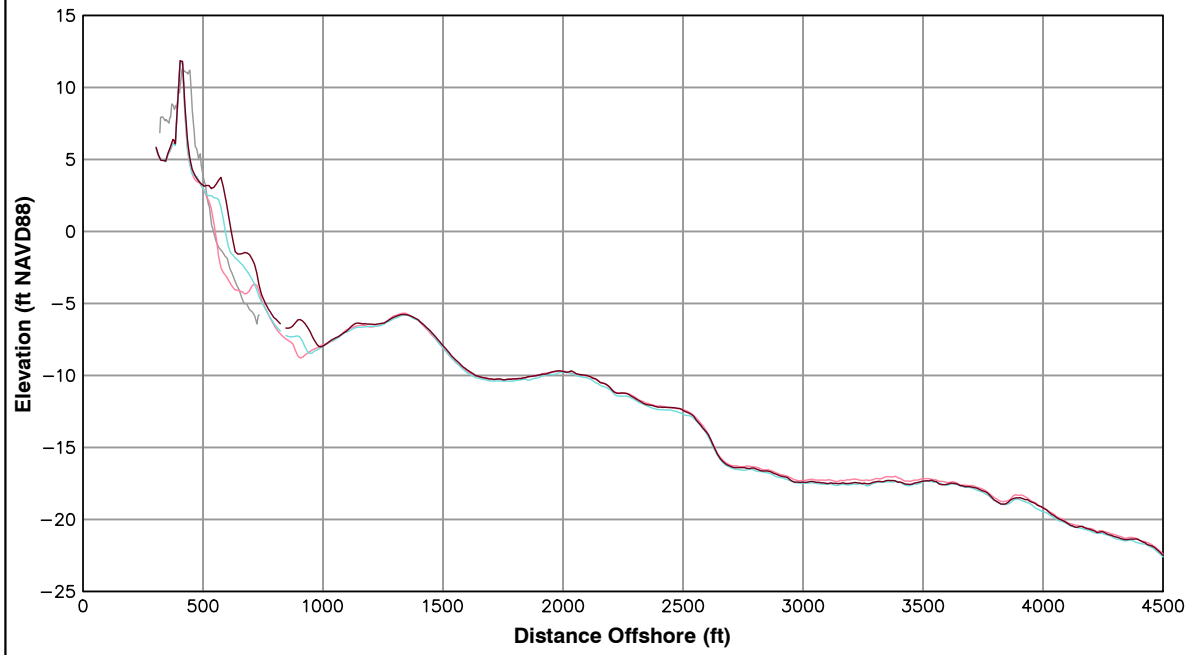
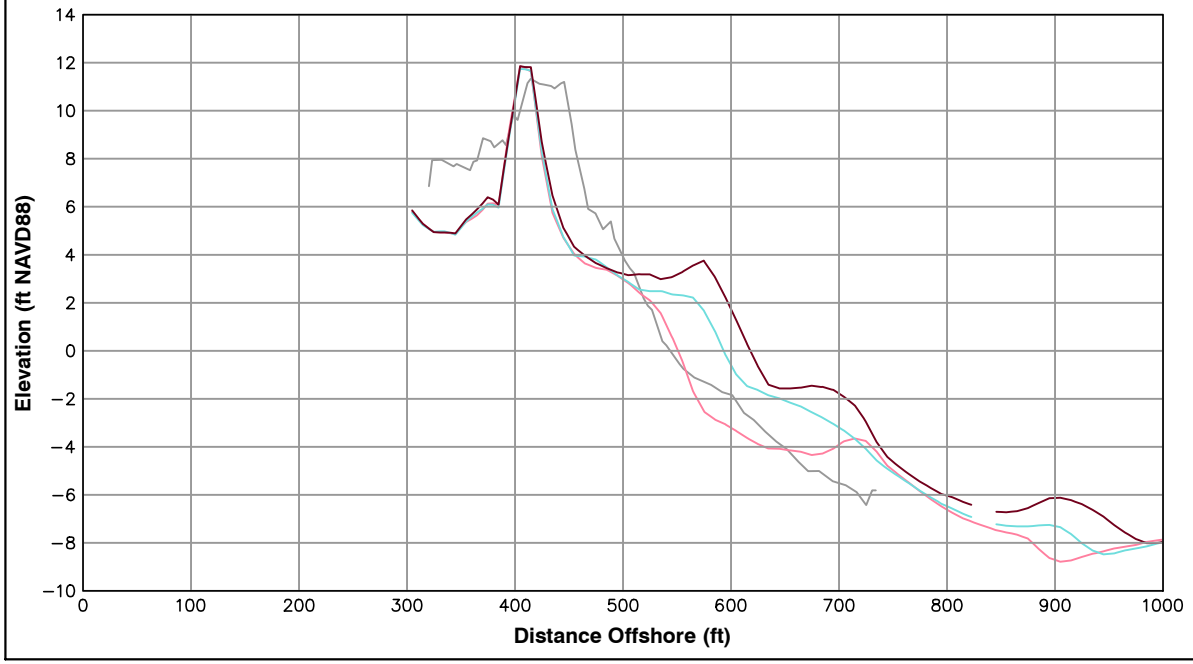
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 25+00	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	69.23 ft/yr	24.66 ft
Volume Change Above -15 ft NAVD88	37.45 cy/ft/yr	26.09 cy/ft
Volume Change Above 0 ft NAVD88	10.34 cy/ft/yr	5.93 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

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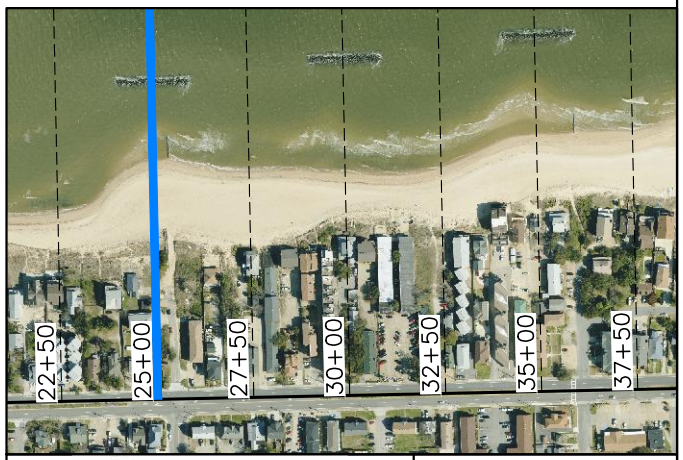
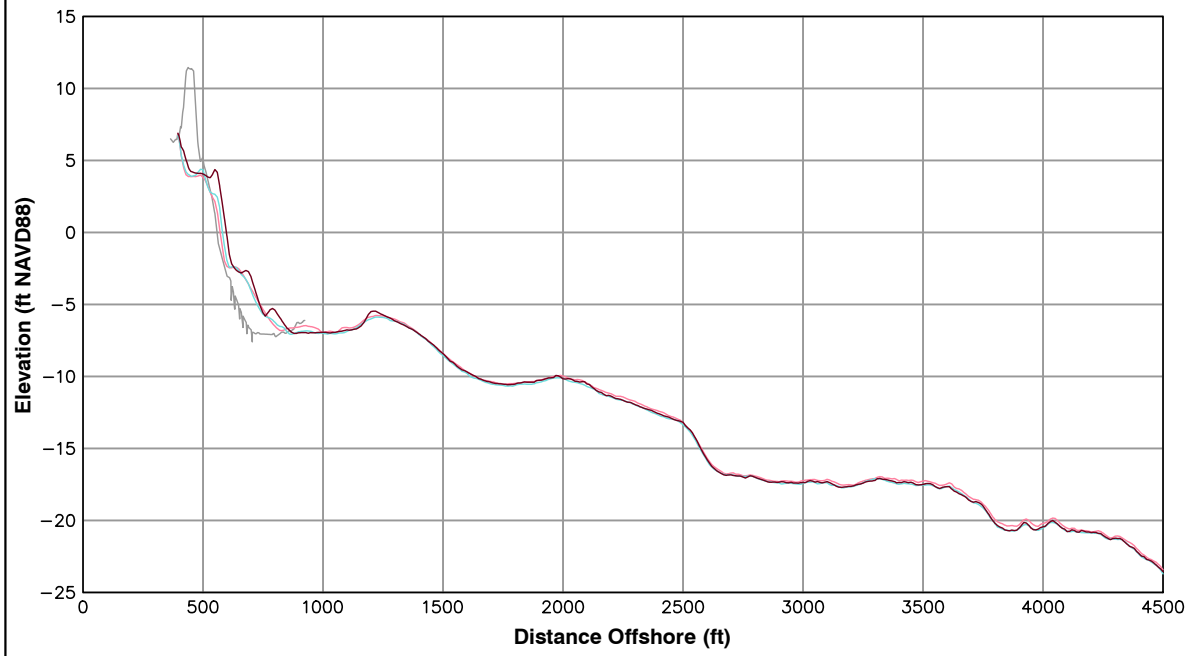
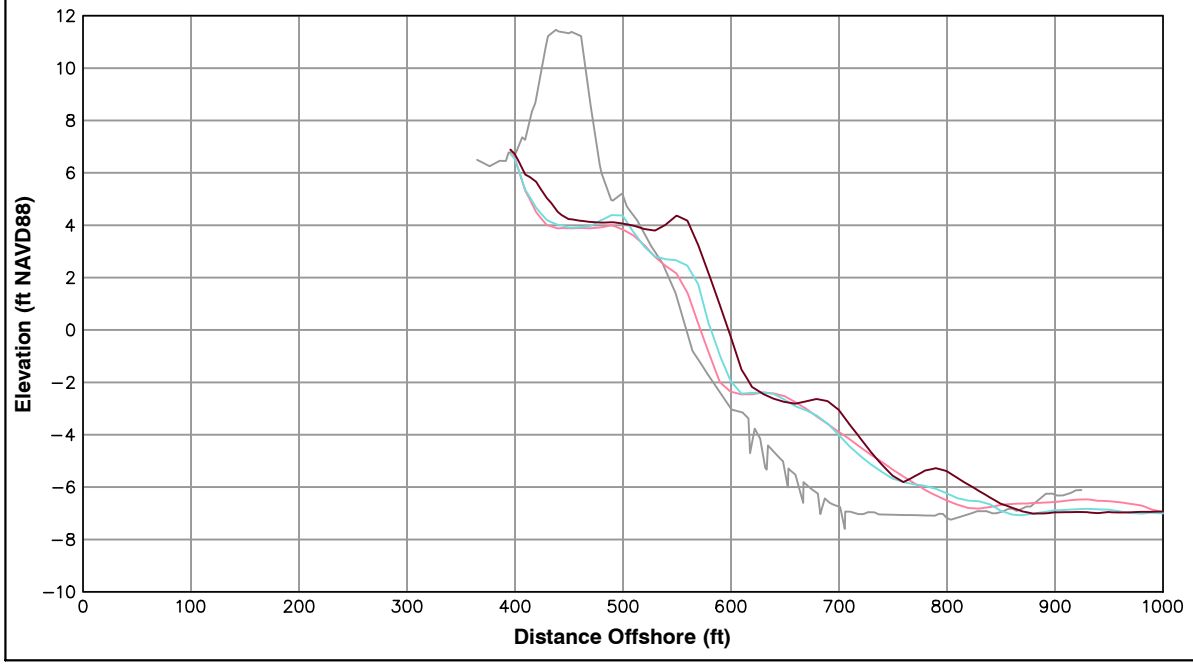


City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 27+50	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	26.96 ft/yr	14.84 ft
Volume Change Above -15 ft NAVD88	7.34 cy/ft/yr	15.58 cy/ft
Volume Change Above 0 ft NAVD88	7.51 cy/ft/yr	5.25 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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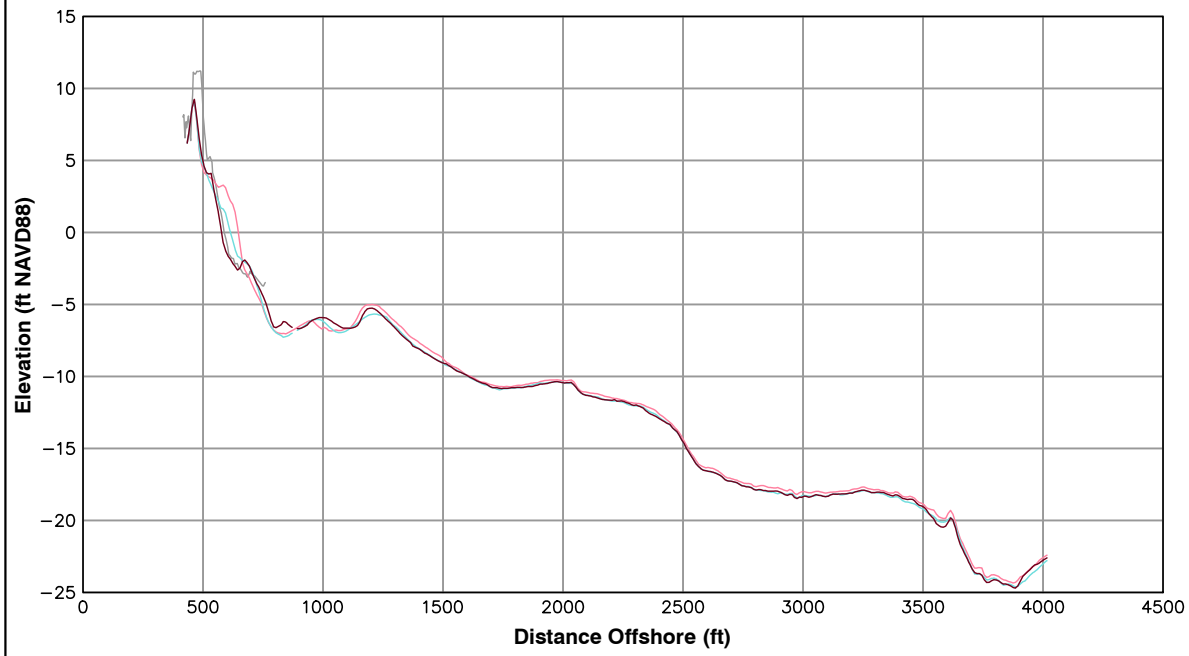
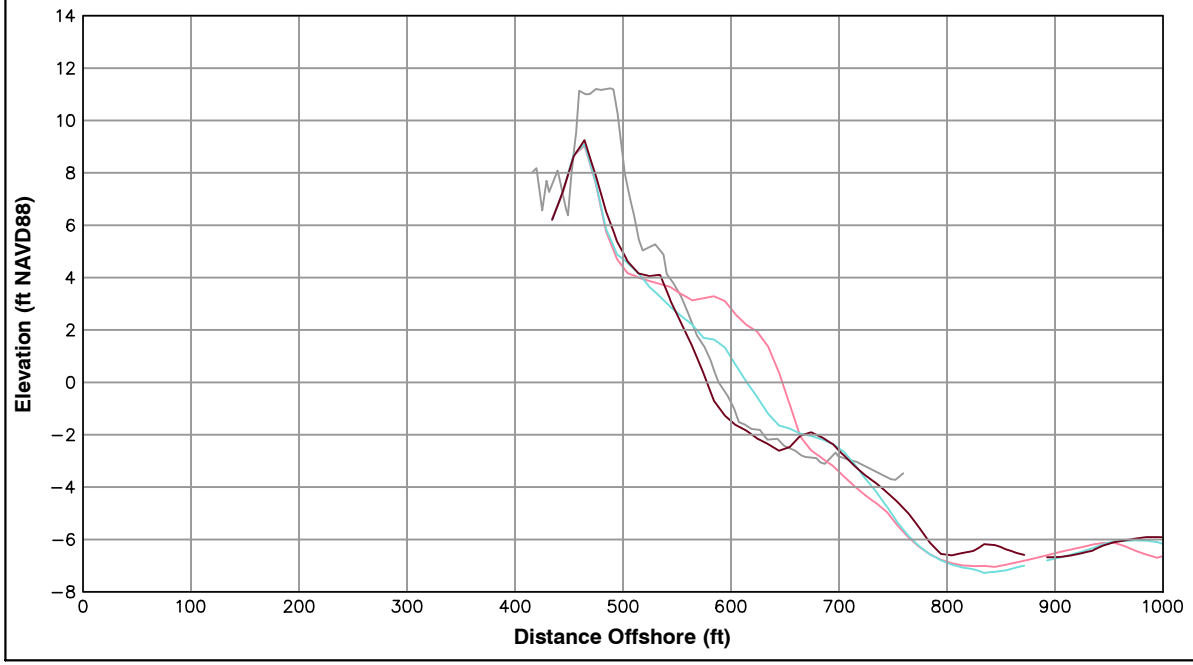
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 30+00	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-72.76 ft/yr	-31.51 ft
Volume Change Above -15 ft NAVD88	-18.02 cy/ft/yr	0.48 cy/ft
Volume Change Above 0 ft NAVD88	-6.94 cy/ft/yr	-1.19 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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4. Survey Comparison Made To April 2013 and October 2013.
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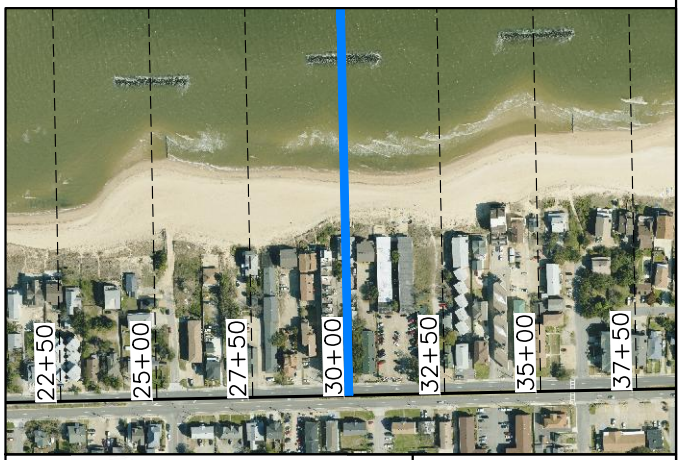
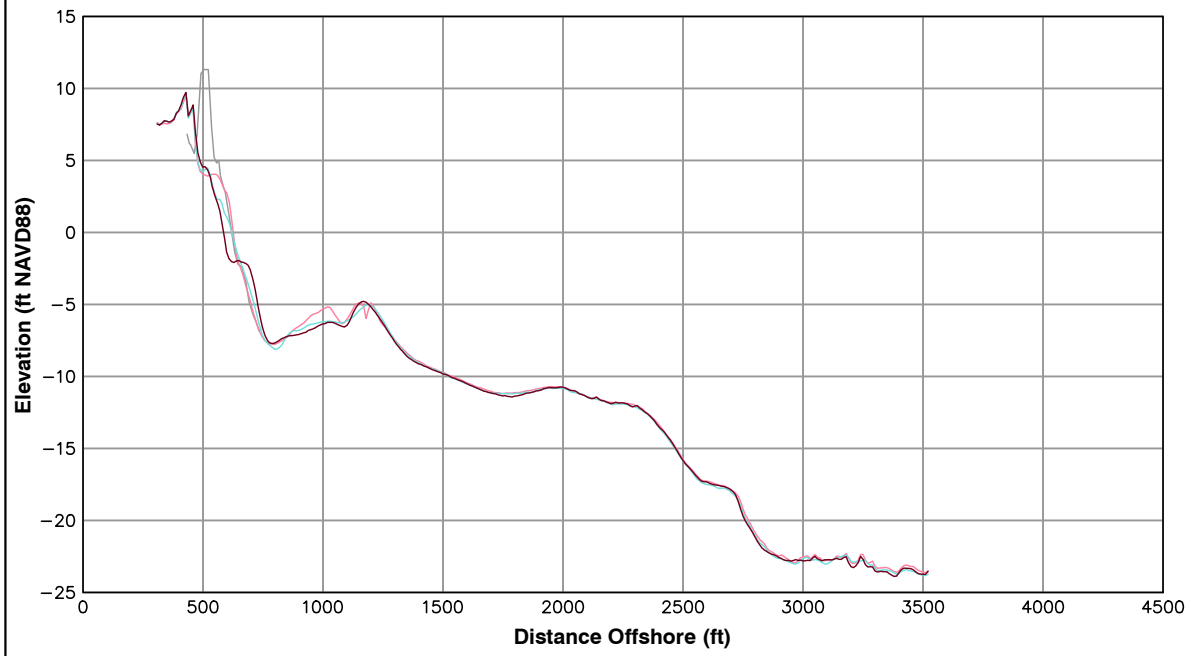
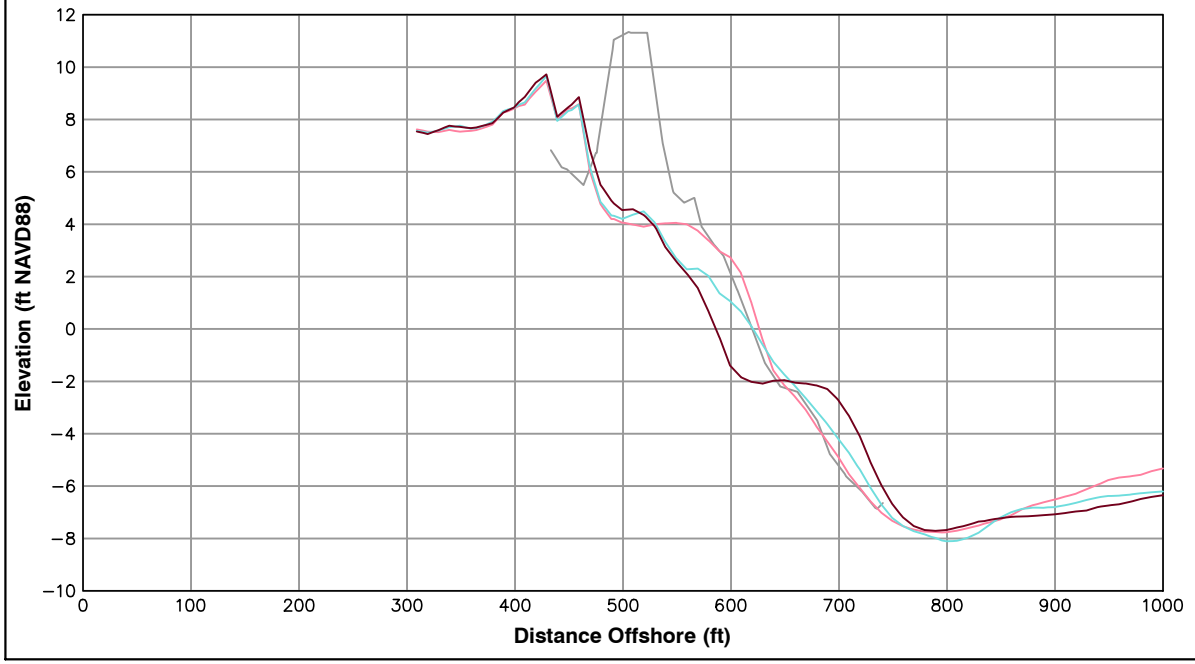


City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 32+50	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-44.94 ft/yr	-25.55 ft
Volume Change Above -15 ft NAVD88	-11.99 cy/ft/yr	-1.52 cy/ft
Volume Change Above 0 ft NAVD88	-4.74 cy/ft/yr	-0.99 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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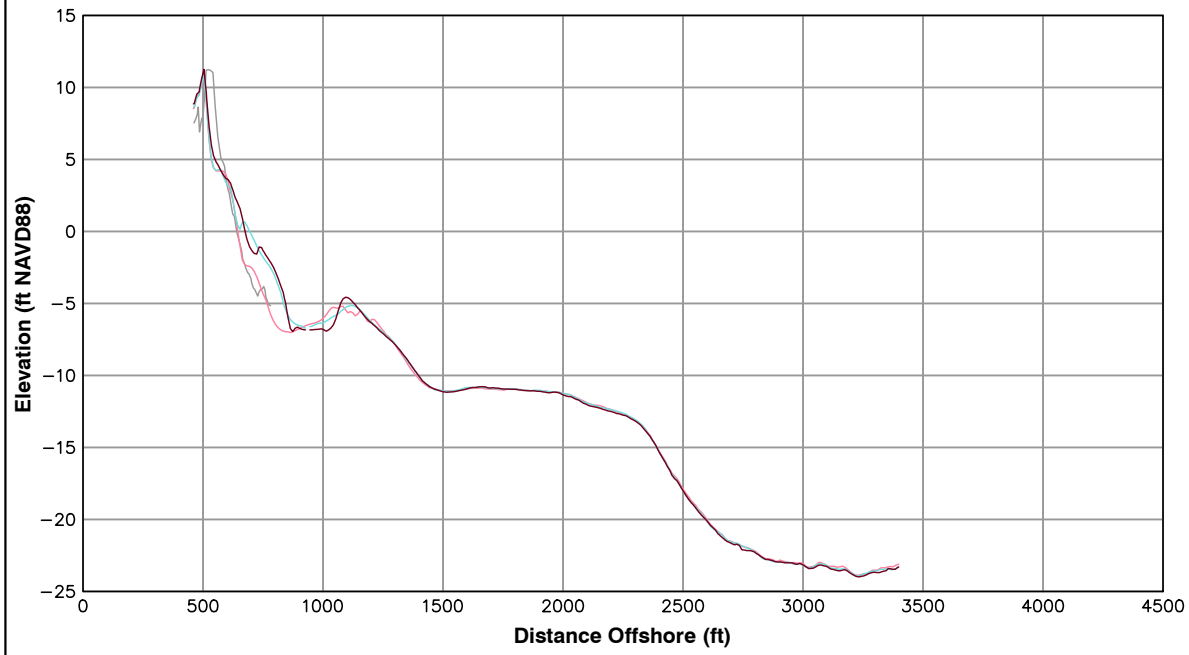
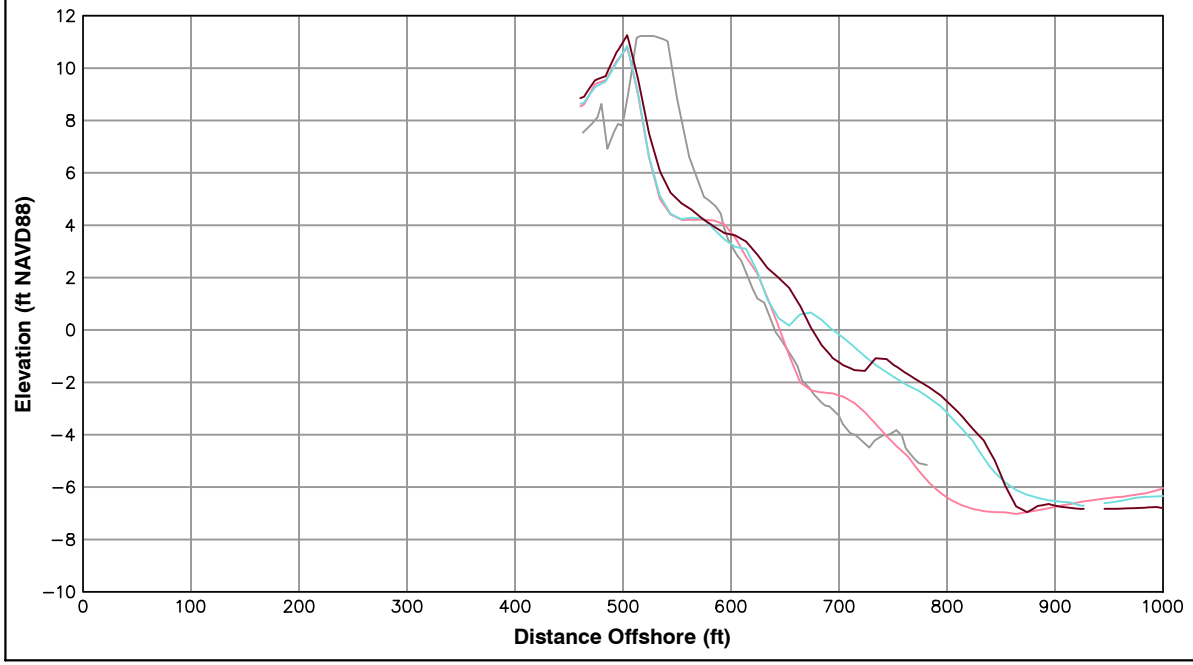
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 35+00	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	28.01 ft/yr	26.69 ft
Volume Change Above -15 ft NAVD88	21.28 cy/ft/yr	0.84 cy/ft
Volume Change Above 0 ft NAVD88	4.73 cy/ft/yr	3.98 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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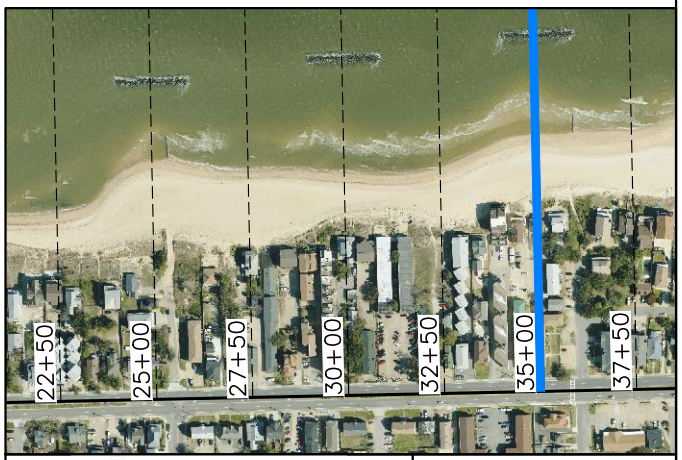

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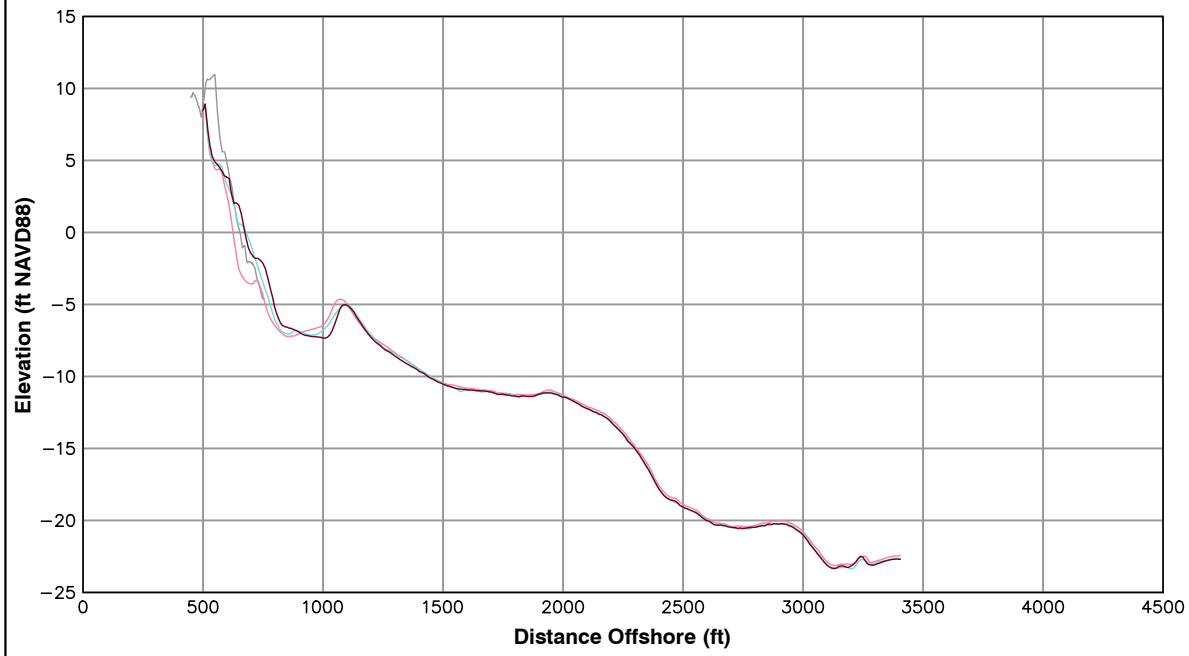
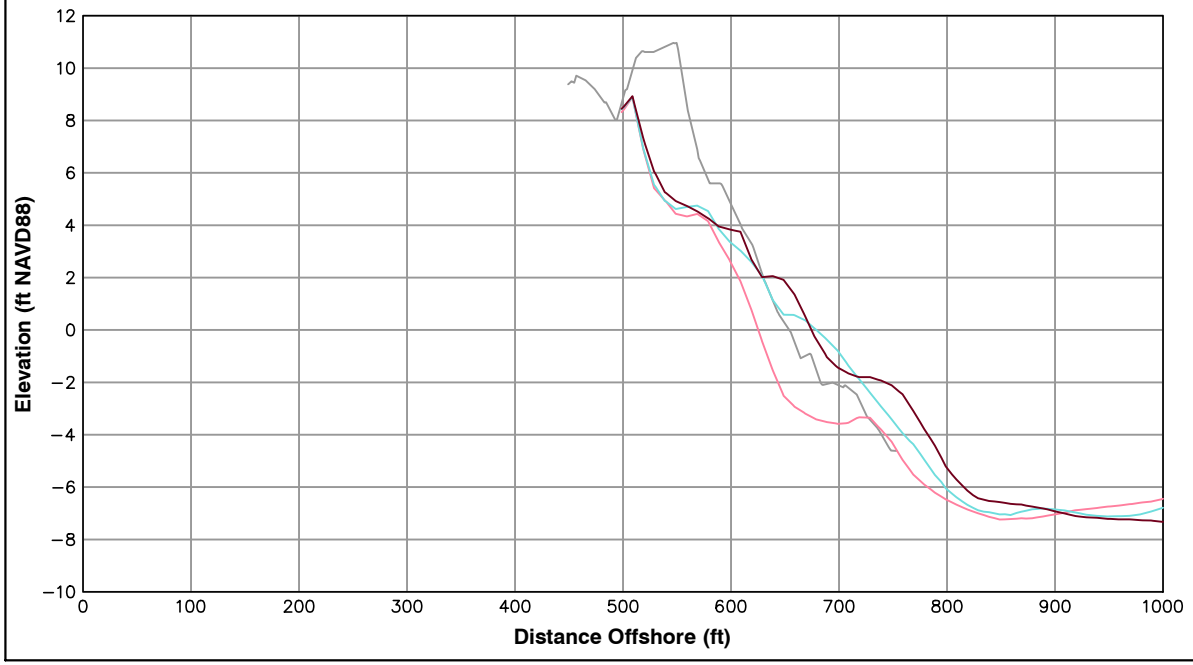
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 37+50	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	48.10 ft/yr	21.71 ft
Volume Change Above -15 ft NAVD88	11.16 cy/ft/yr	1.45 cy/ft
Volume Change Above 0 ft NAVD88	6.16 cy/ft/yr	2.06 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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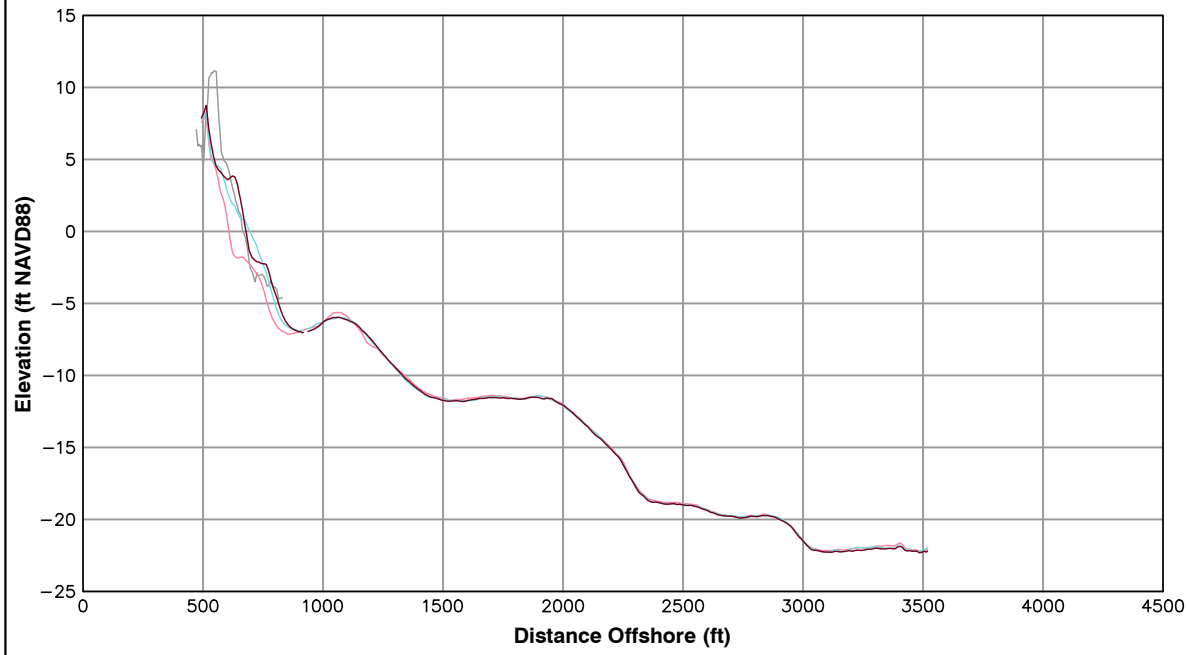
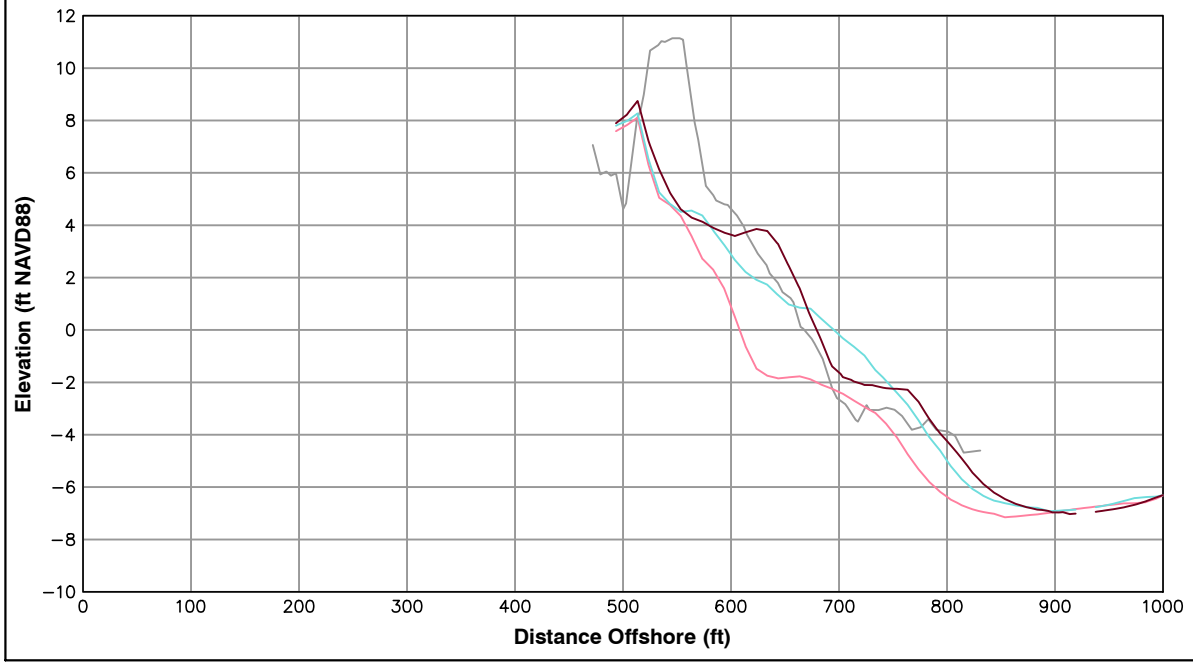
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 40+00	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	72.58 ft/yr	15.82 ft
Volume Change Above -15 ft NAVD88	23.84 cy/ft/yr	3.89 cy/ft
Volume Change Above 0 ft NAVD88	12.32 cy/ft/yr	4.67 cy/ft

LEGEND:
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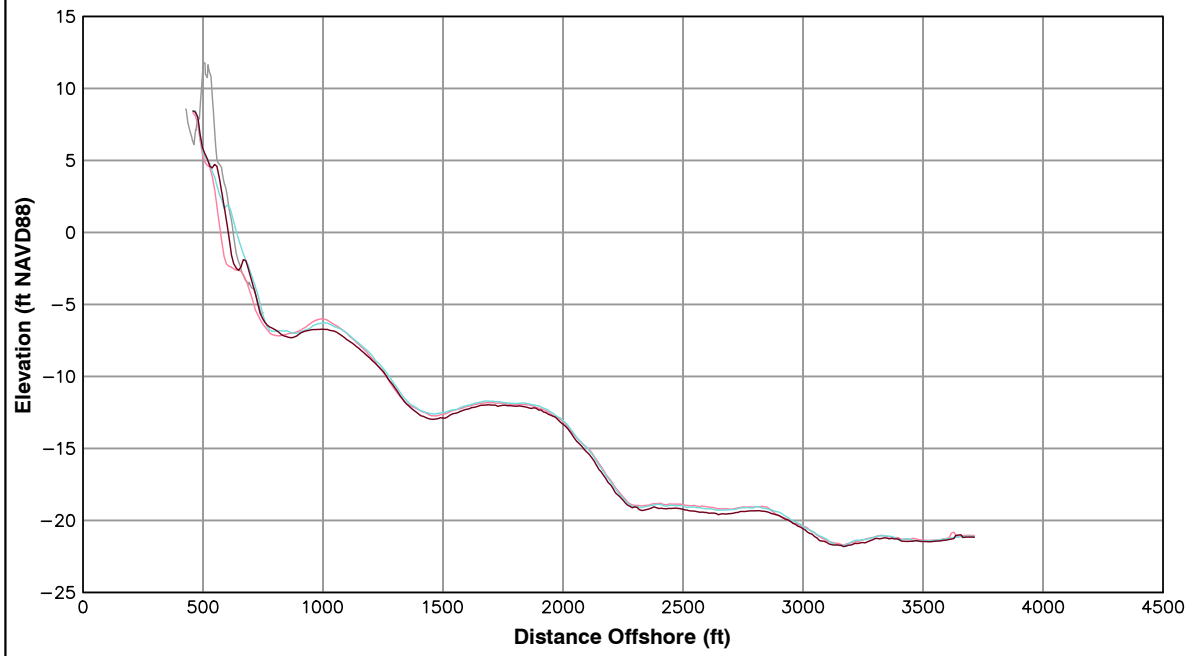
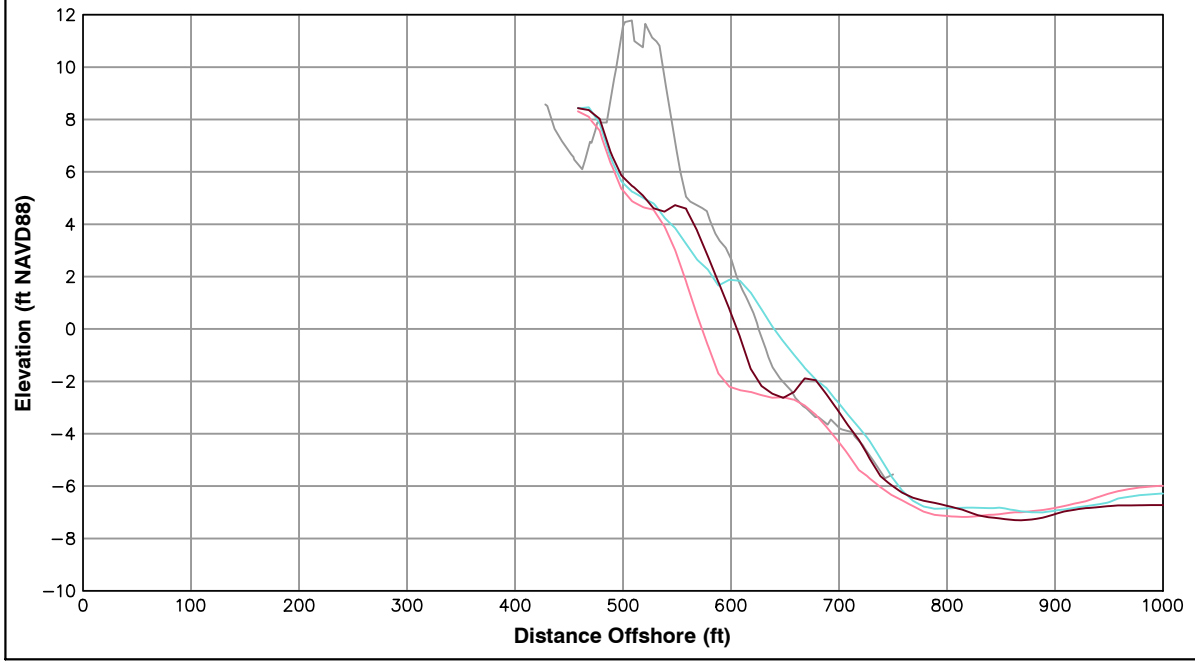
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 42+50	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	32.44 ft/yr	-28.38 ft
Volume Change Above -15 ft NAVD88	3.37 cy/ft/yr	-18.17 cy/ft
Volume Change Above 0 ft NAVD88	6.32 cy/ft/yr	-0.15 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

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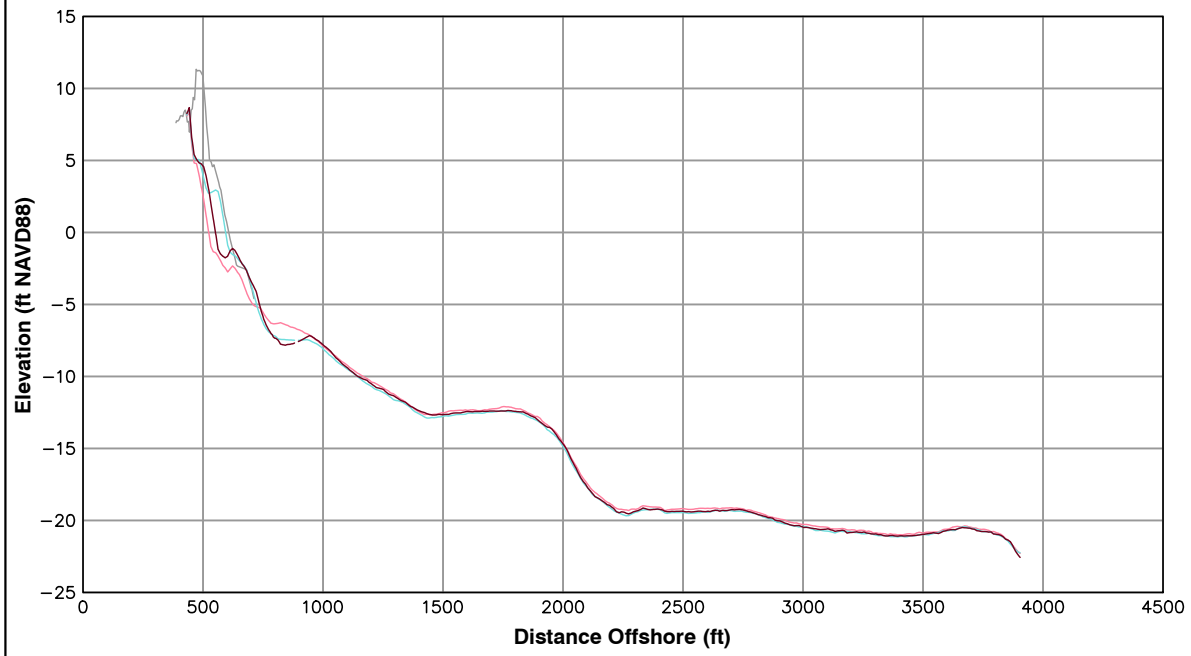
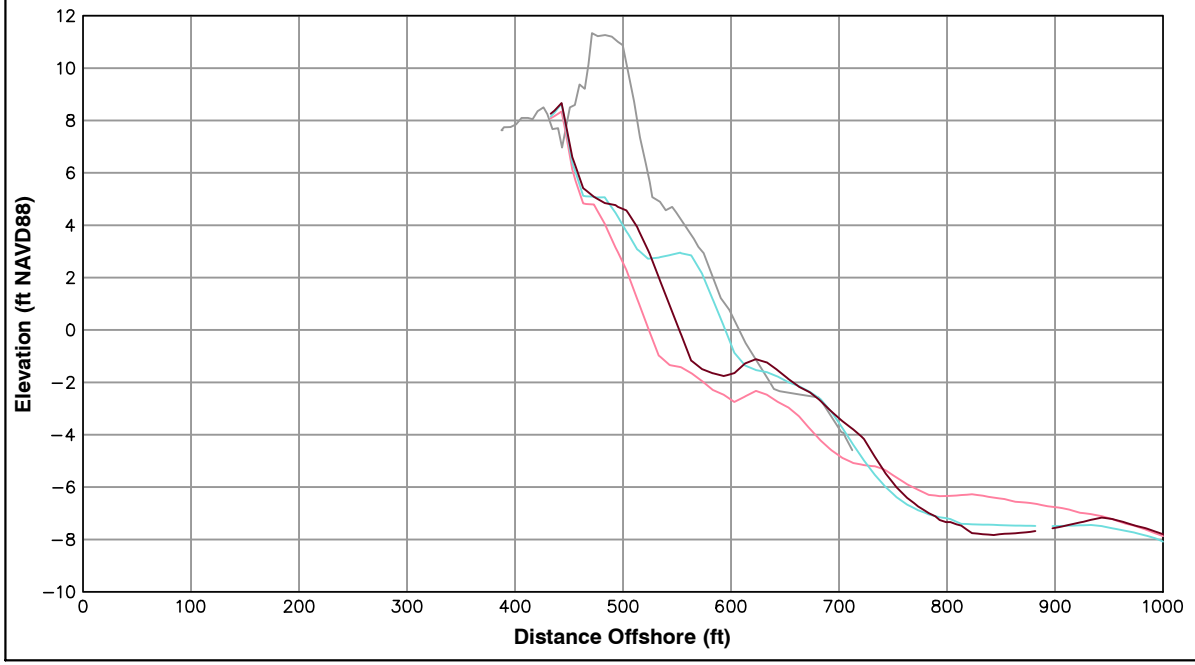
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 45+00	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	28.84 ft/yr	-42.10 ft
Volume Change Above -15 ft NAVD88	3.91 cy/ft/yr	0.97 cy/ft
Volume Change Above 0 ft NAVD88	5.80 cy/ft/yr	-3.43 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
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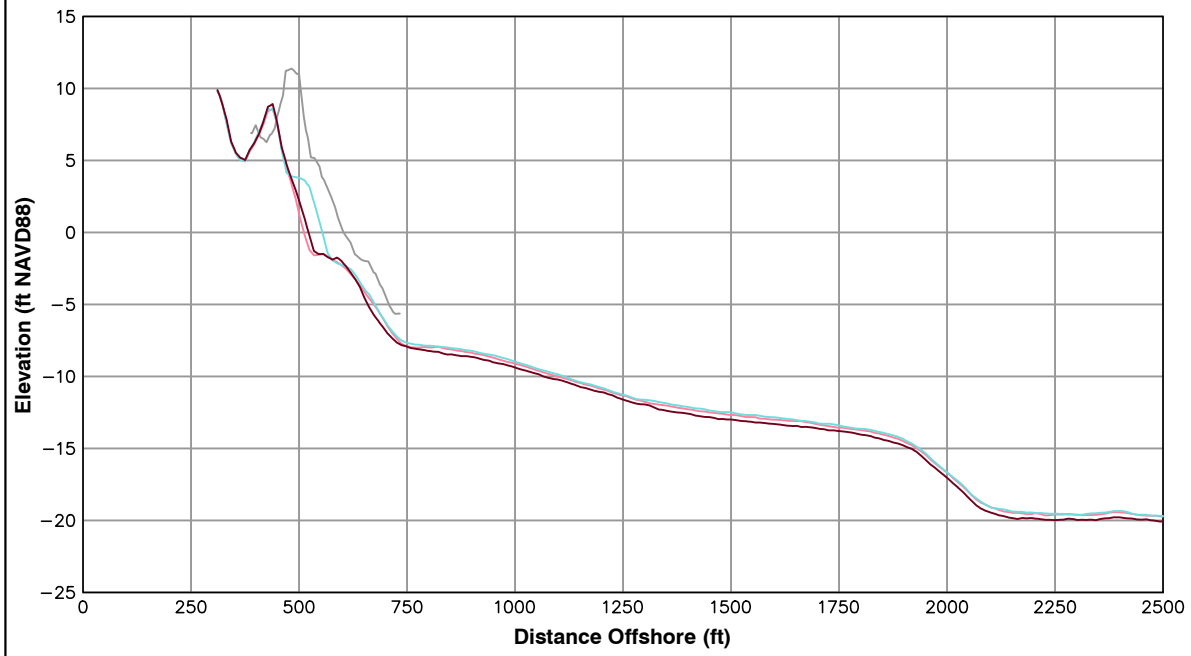
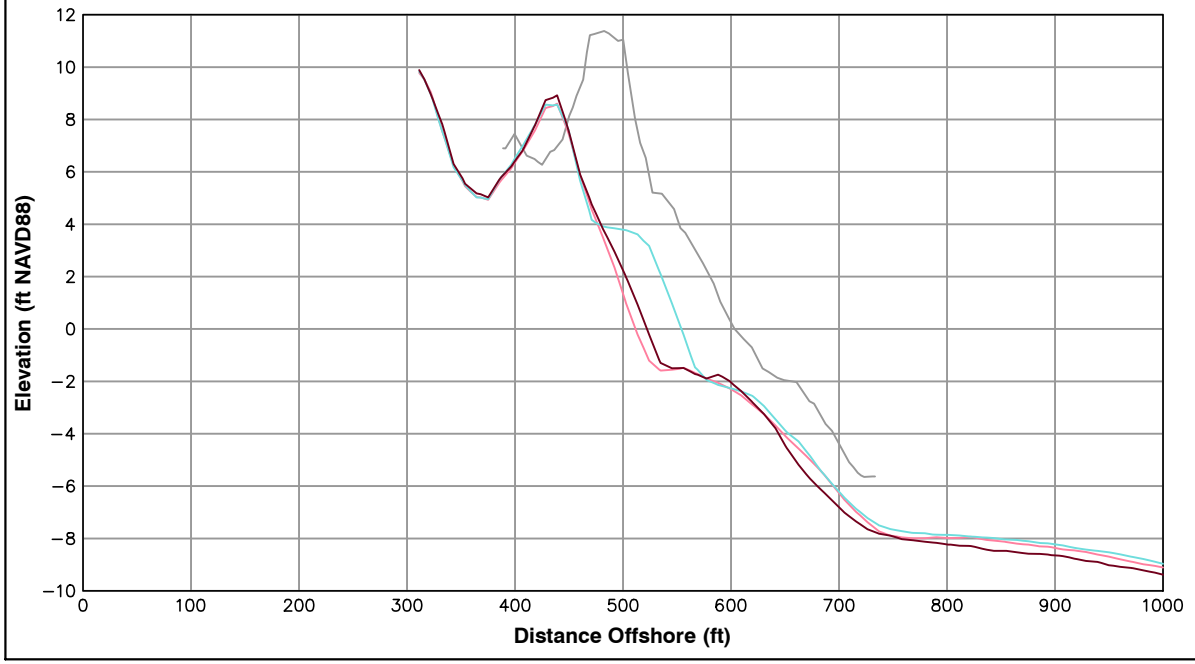
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 45+25	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	10.50 ft/yr	-32.34 ft
Volume Change Above -15 ft NAVD88	-11.81 cy/ft/yr	-25.94 cy/ft
Volume Change Above 0 ft NAVD88	1.99 cy/ft/yr	-3.90 cy/ft

LEGEND:
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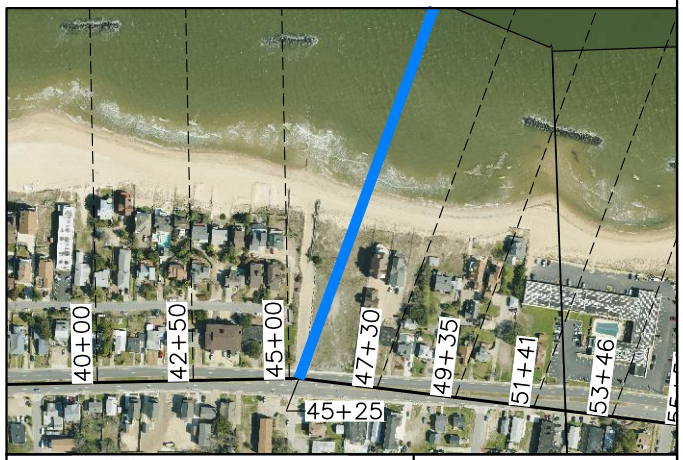

City of Norfolk

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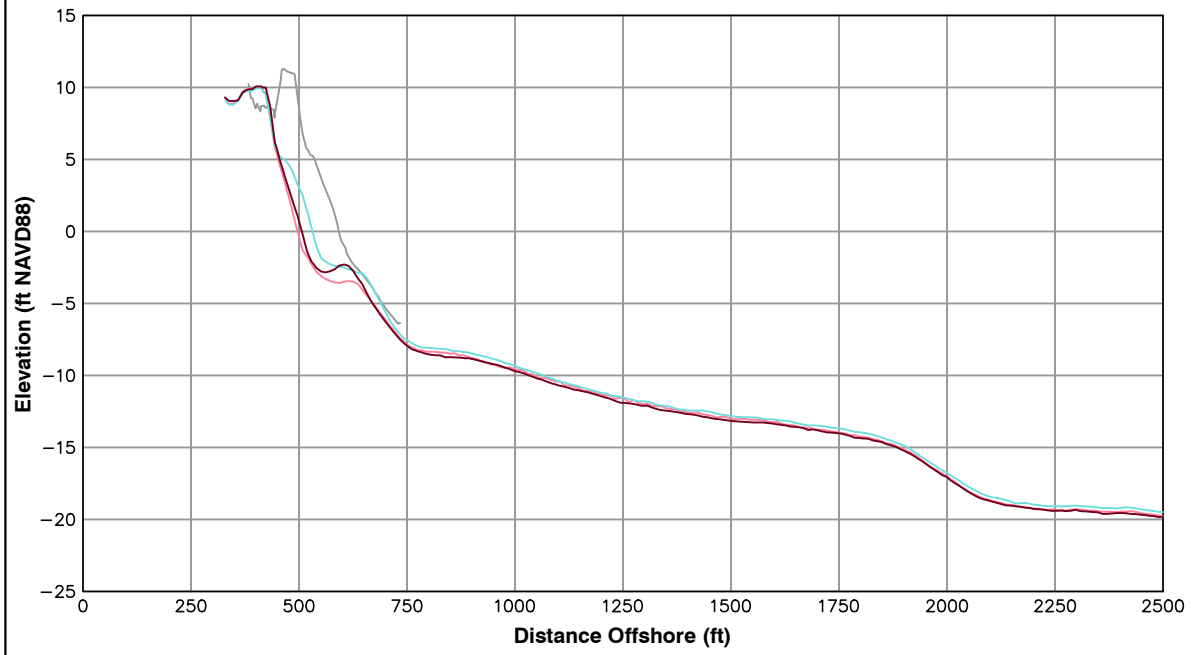

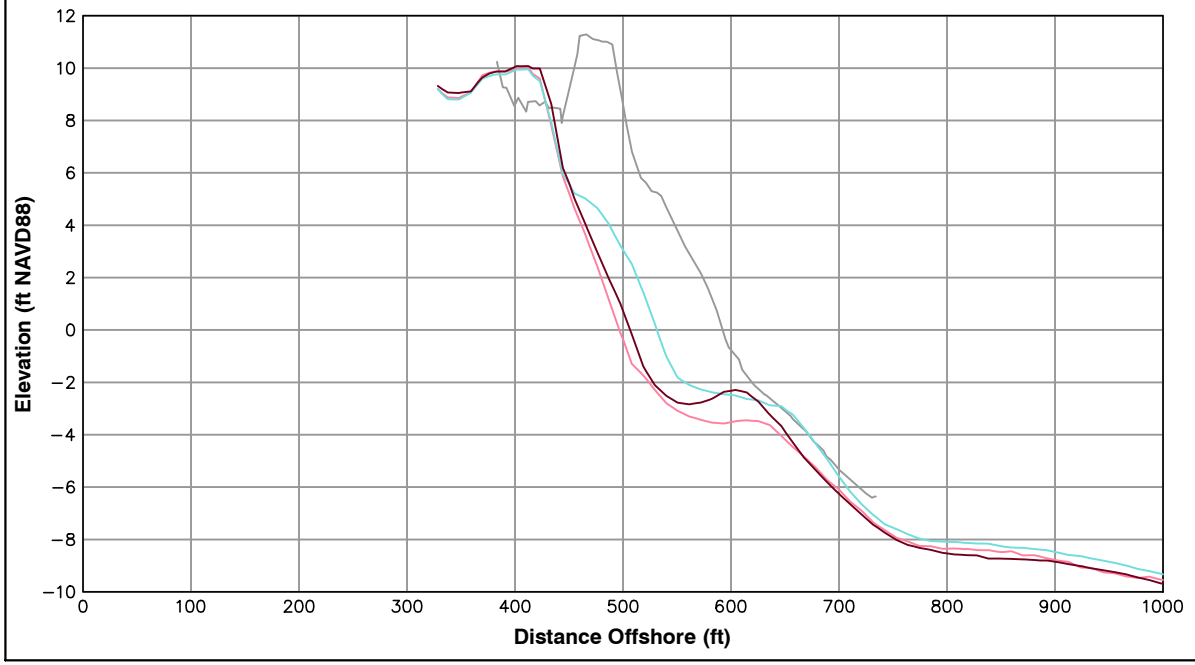

Survey Transect 47+30	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	9.72 ft/yr	-25.07 ft
Volume Change Above -15 ft NAVD88	-0.13 cy/ft/yr	-23.50 cy/ft
Volume Change Above 0 ft NAVD88	2.13 cy/ft/yr	-3.46 cy/ft

LEGEND:
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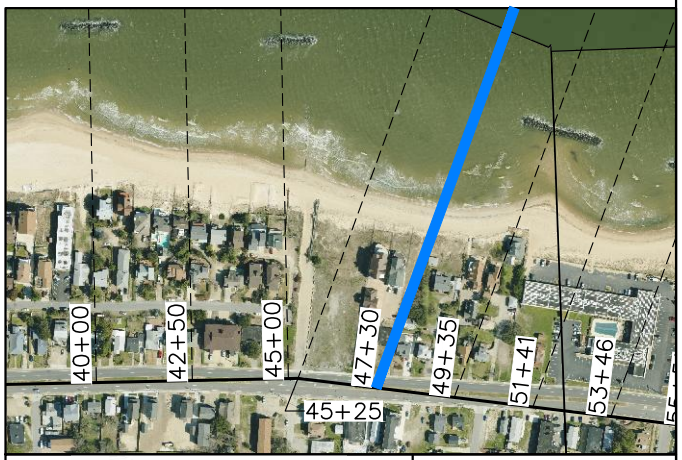
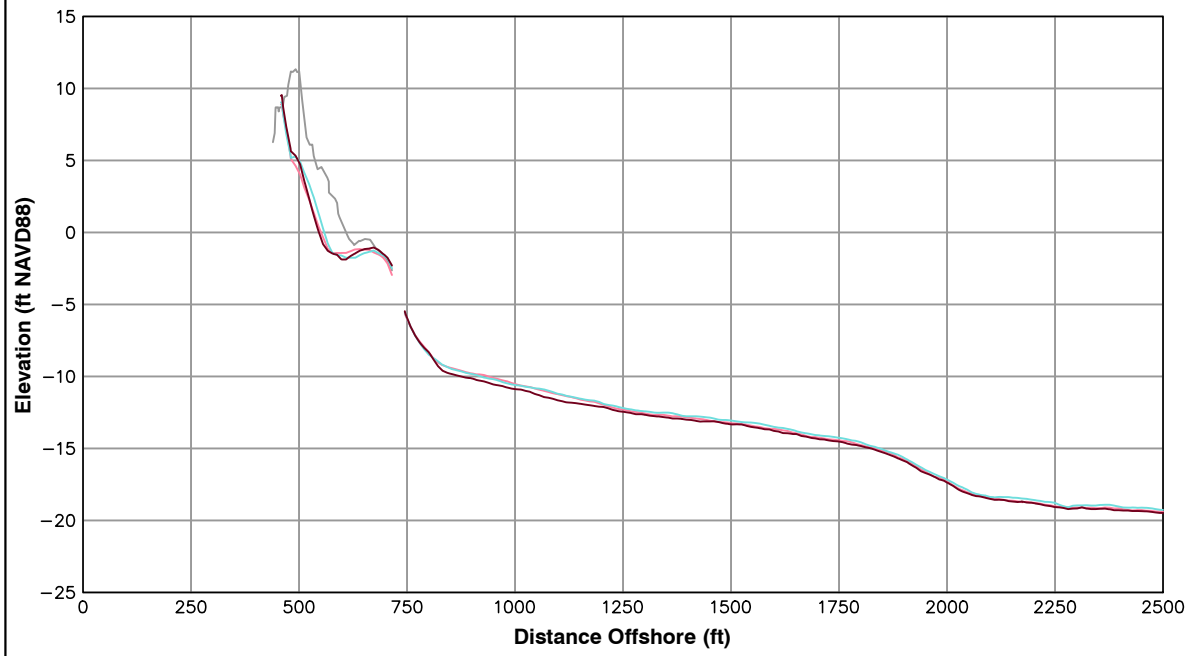
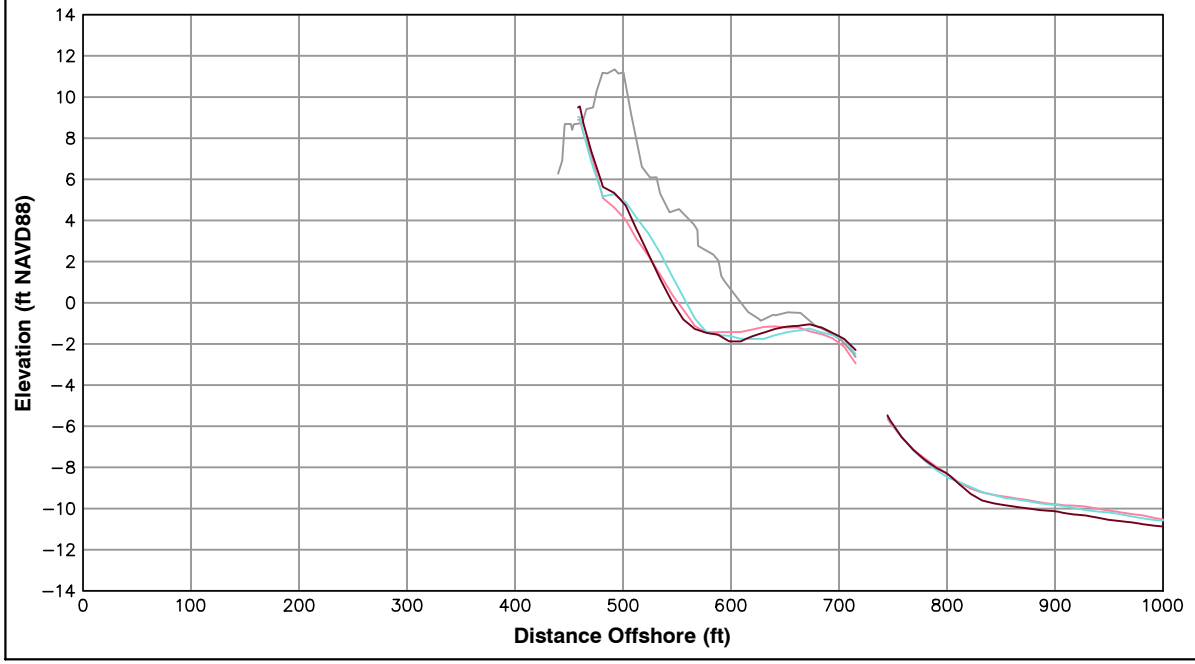


City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 49+35	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-2.78 ft/yr	-12.50 ft
Volume Change Above -15 ft NAVD88	-7.31 cy/ft/yr	-12.38 cy/ft
Volume Change Above 0 ft NAVD88	1.05 cy/ft/yr	-1.24 cy/ft

LEGEND:
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- 2013 OCT
- 2013 APR
- POST-FILL

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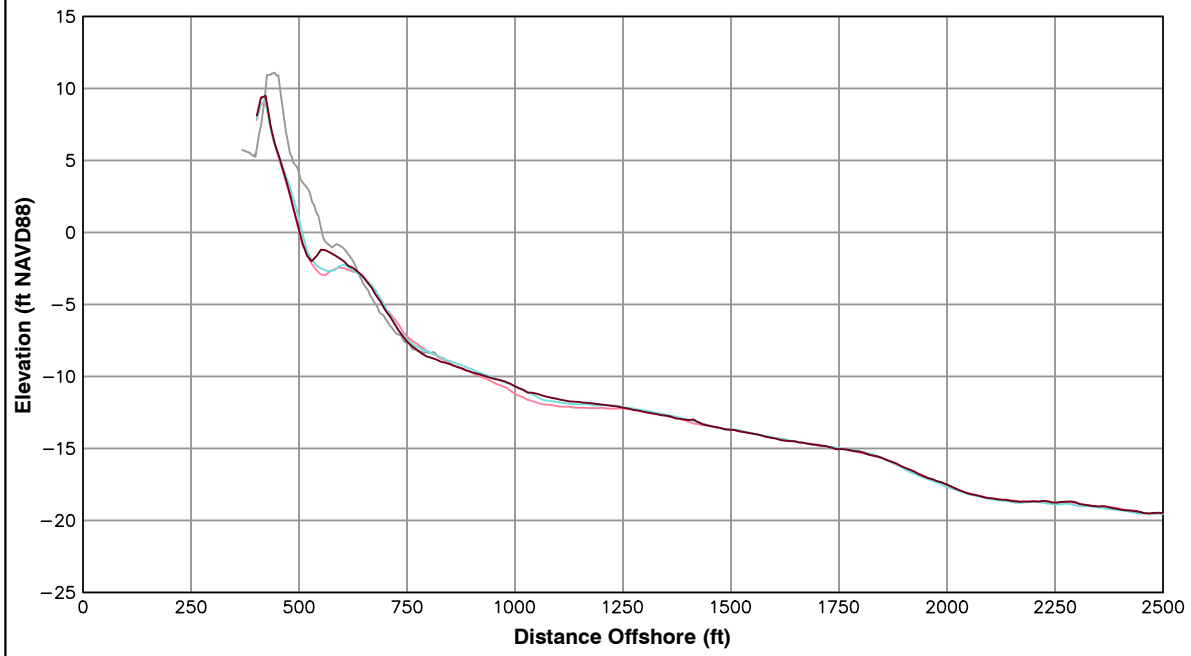
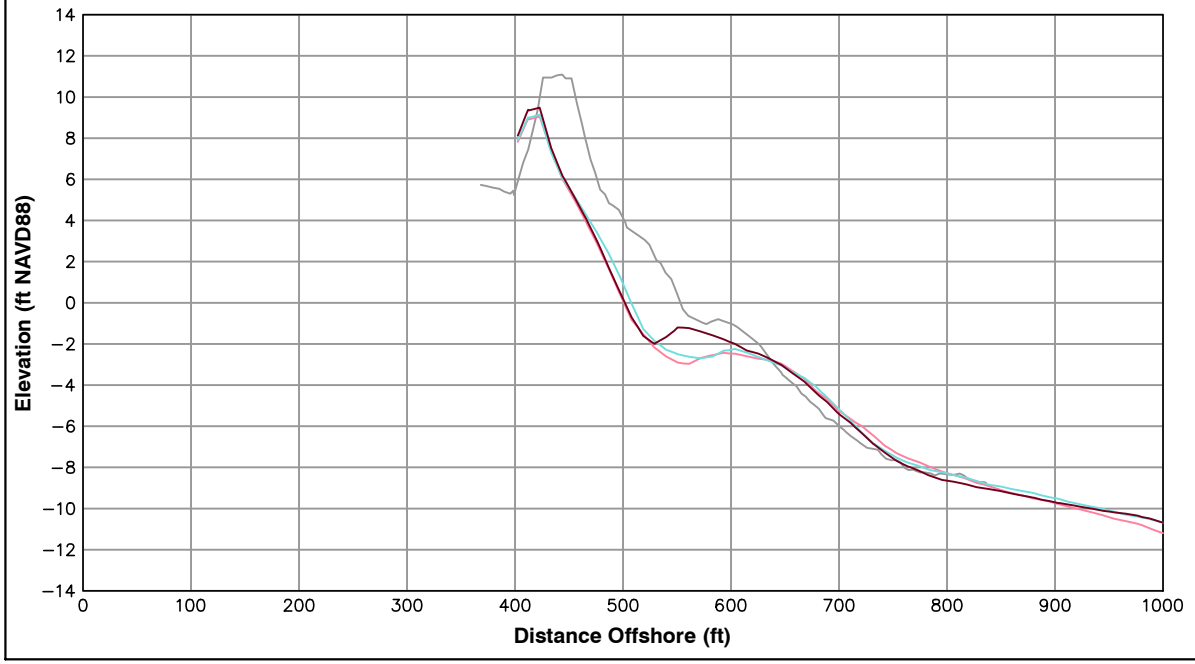
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 51+41	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	0.71 ft/yr	-6.39 ft
Volume Change Above -15 ft NAVD88	7.35 cy/ft/yr	0.18 cy/ft
Volume Change Above 0 ft NAVD88	0.76 cy/ft/yr	-0.40 cy/ft

LEGEND:
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City of Norfolk

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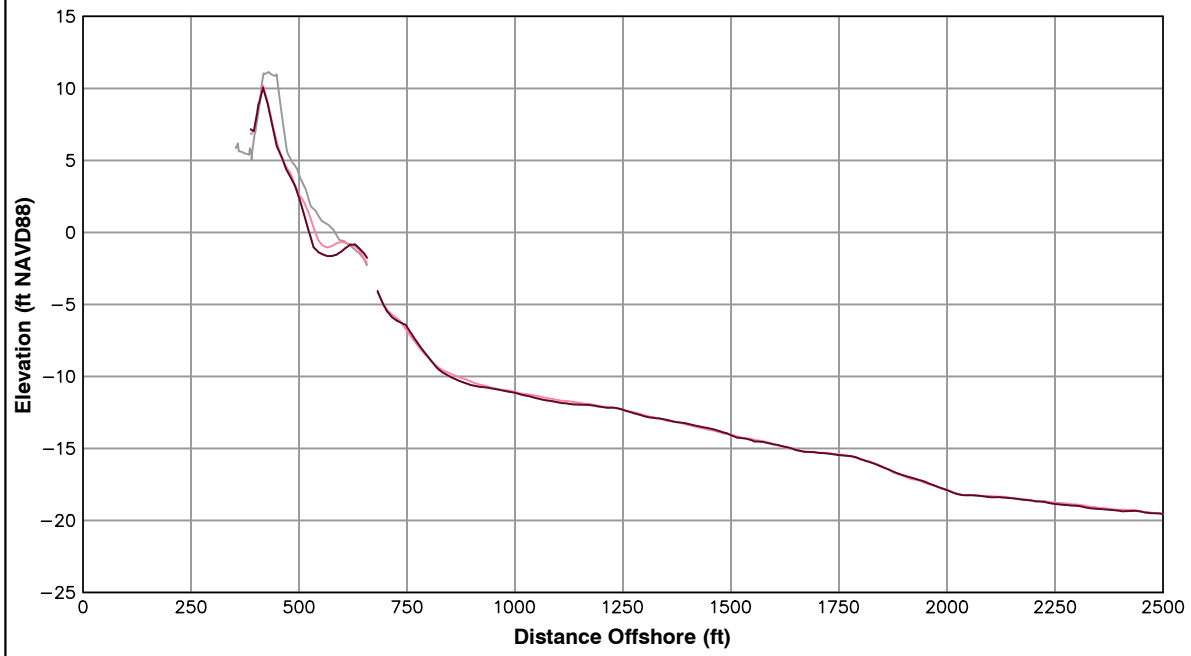

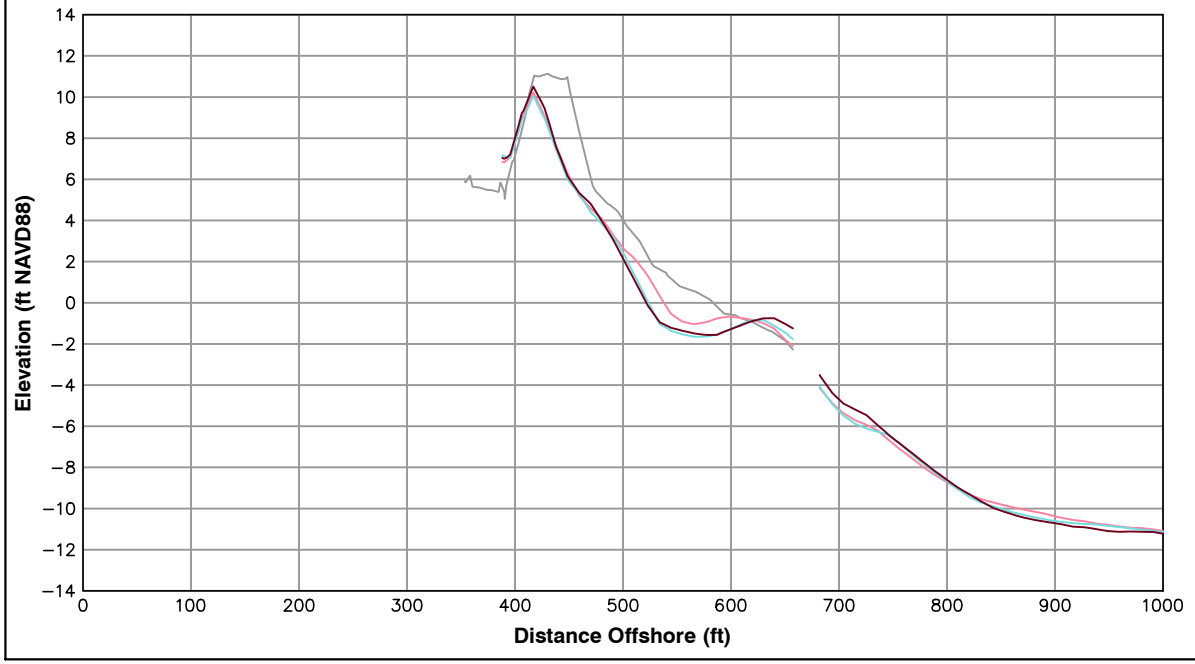

Survey Transect 53+46	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-15.49 ft/yr	-2.37 ft
Volume Change Above -15 ft NAVD88	-4.86 cy/ft/yr	0.52 cy/ft
Volume Change Above 0 ft NAVD88	-0.99 cy/ft/yr	0.59 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

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City of Norfolk

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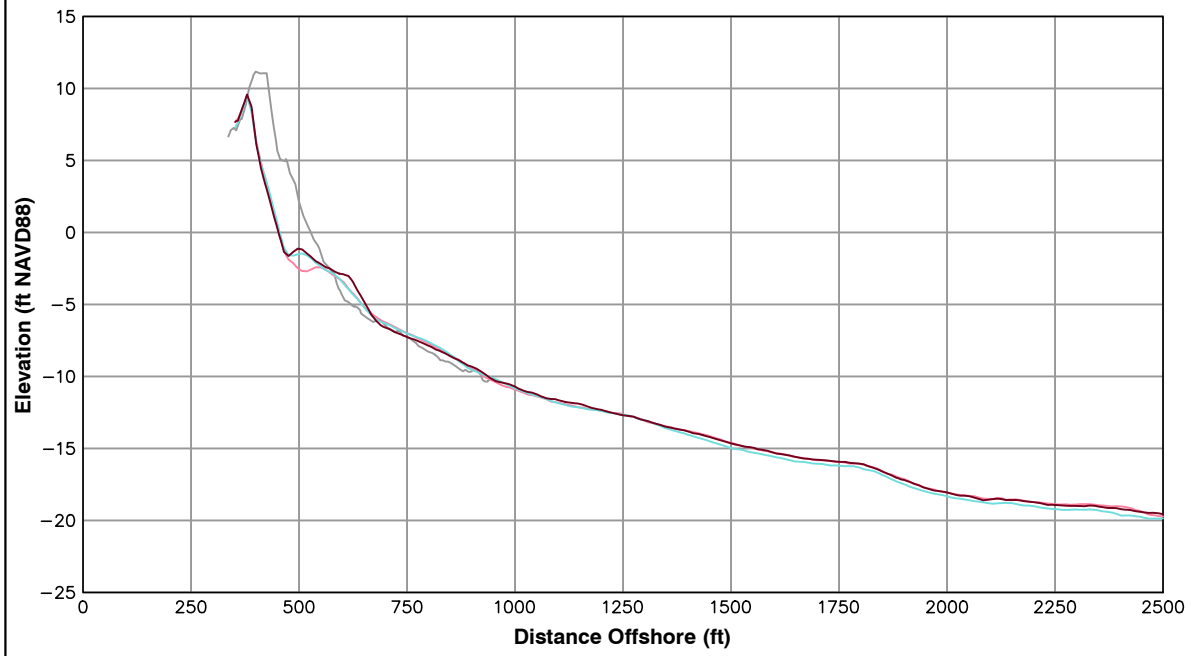

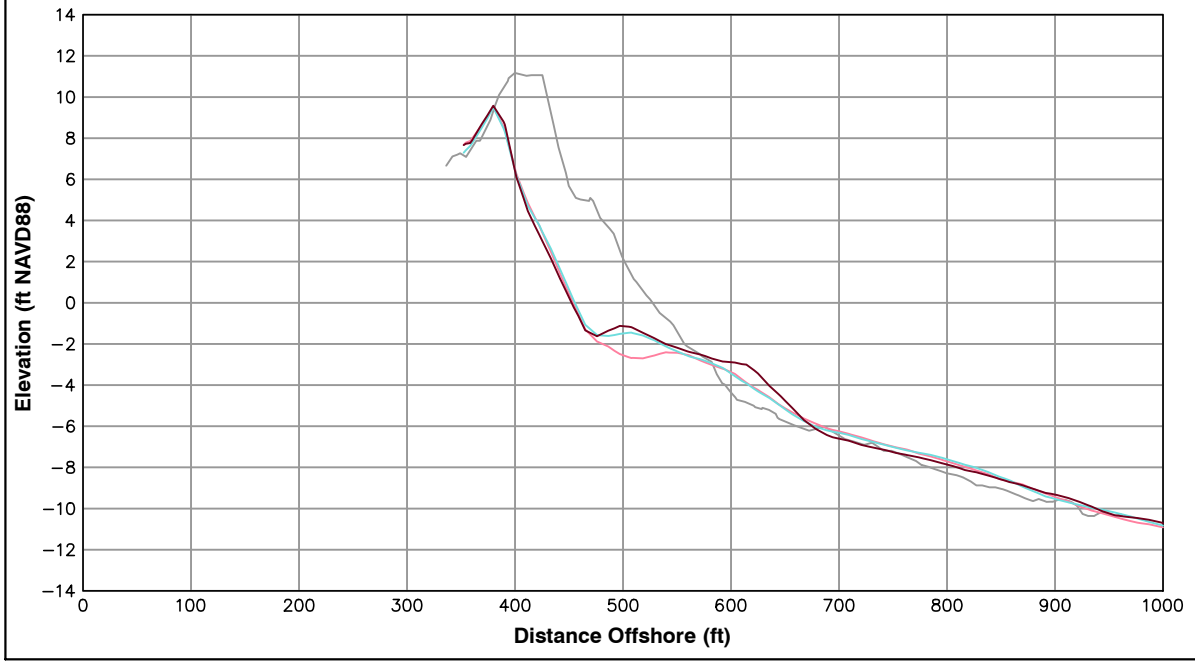

Survey Transect 55+51	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-2.00 ft/yr	-3.75 ft
Volume Change Above -15 ft NAVD88	4.01 cy/ft/yr	3.61 cy/ft
Volume Change Above 0 ft NAVD88	-0.53 cy/ft/yr	-0.40 cy/ft

LEGEND:
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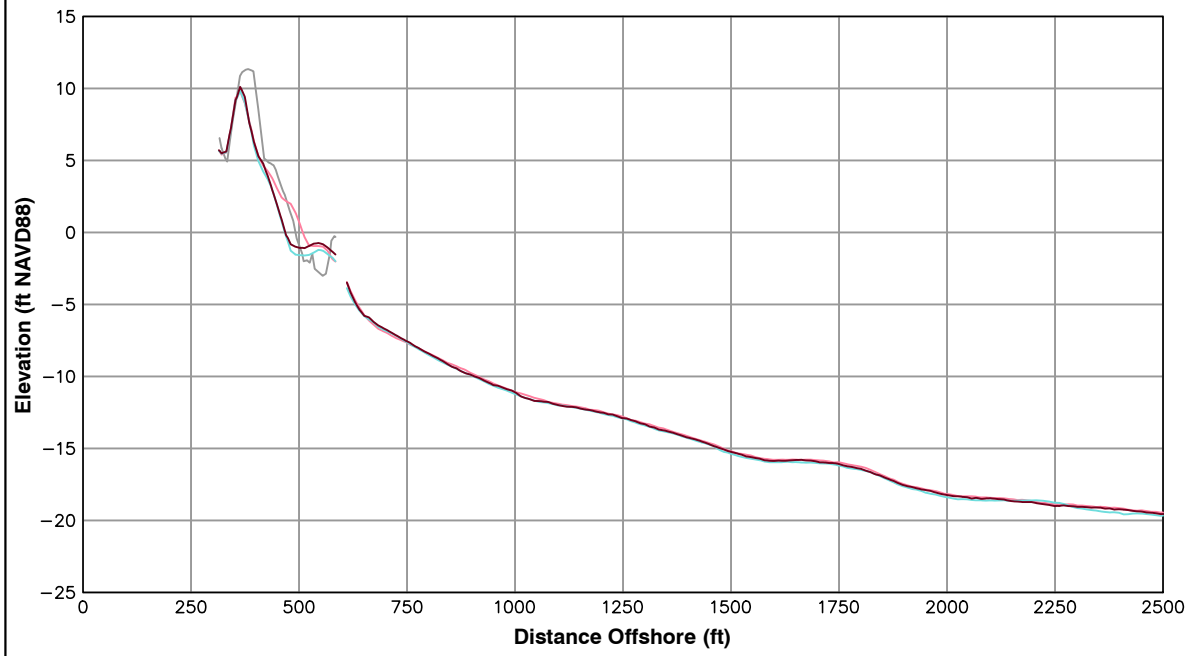

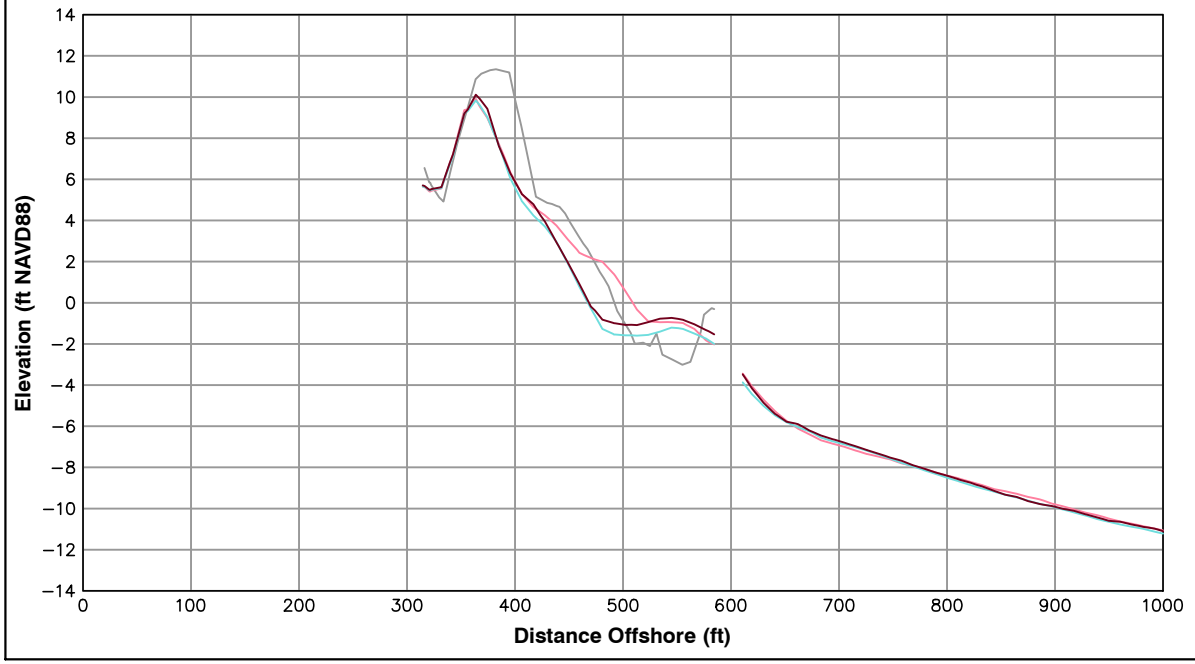

Survey Transect 57+57	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-39.43 ft/yr	1.19 ft
Volume Change Above -15 ft NAVD88	-6.52 cy/ft/yr	4.92 cy/ft
Volume Change Above 0 ft NAVD88	-3.78 cy/ft/yr	0.93 cy/ft

LEGEND:
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City of Norfolk

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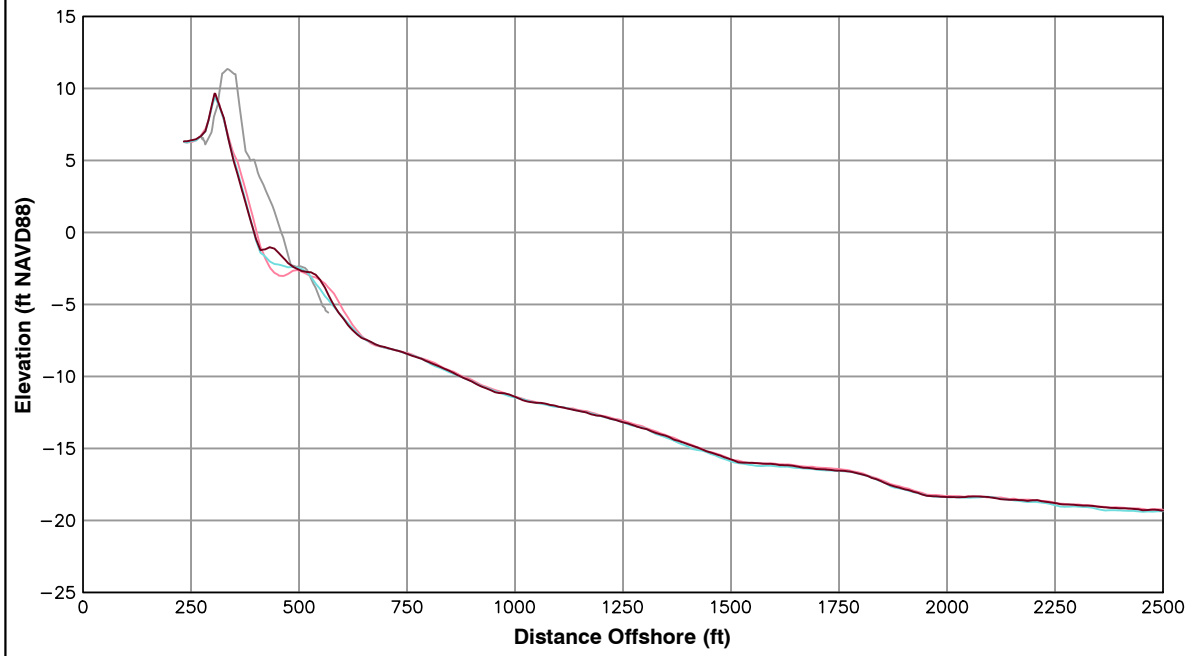

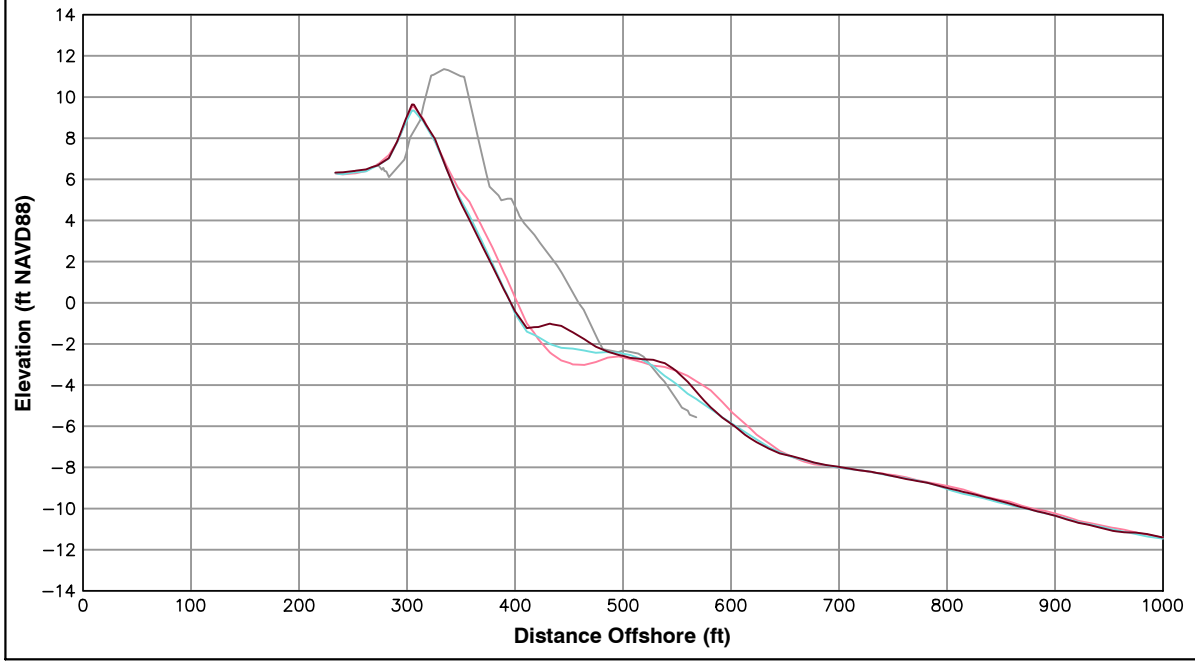

Survey Transect 59+62	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-7.66 ft/yr	-0.65 ft
Volume Change Above -15 ft NAVD88	-1.90 cy/ft/yr	3.31 cy/ft
Volume Change Above 0 ft NAVD88	-1.64 cy/ft/yr	0.06 cy/ft

LEGEND:
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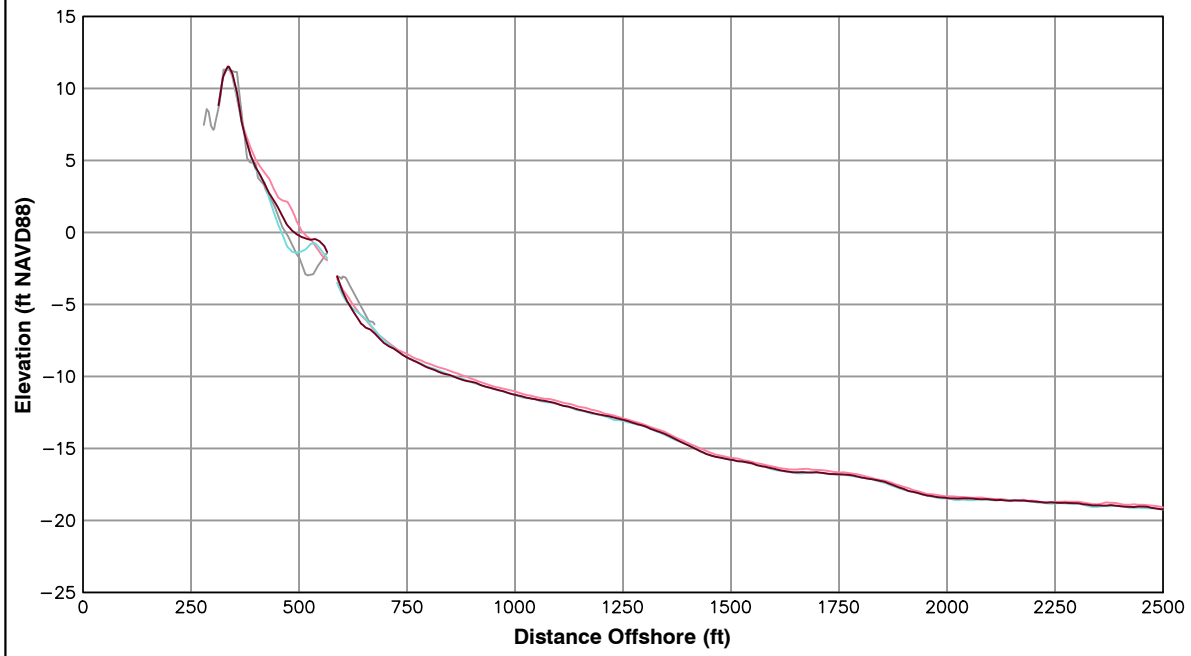
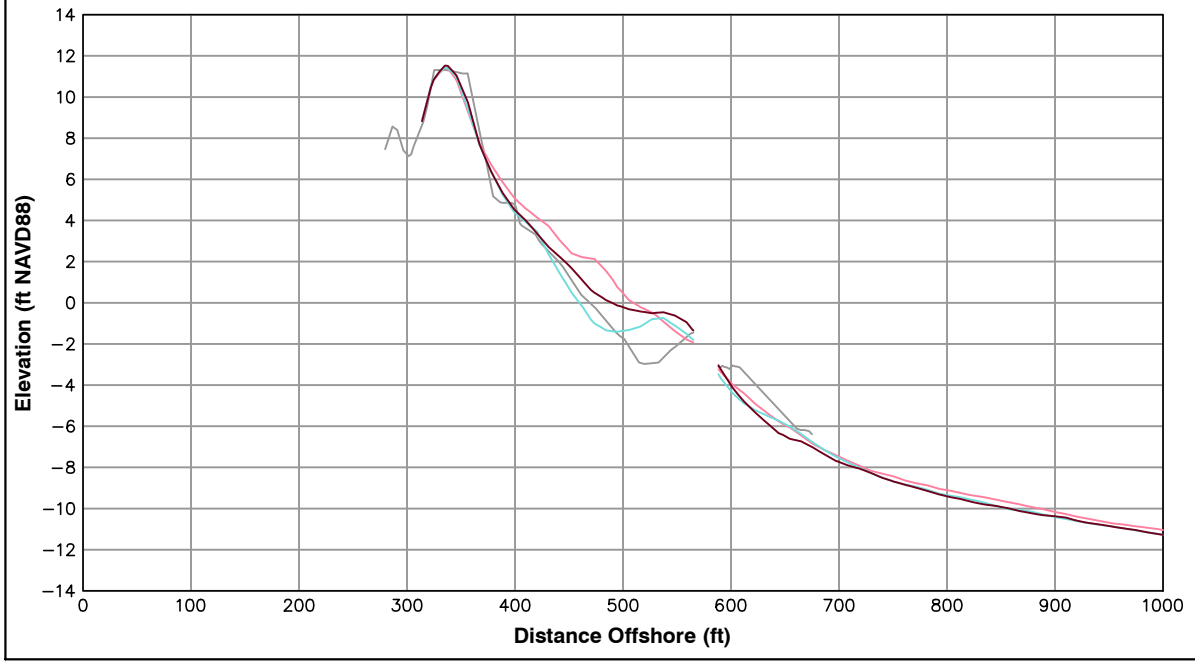
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 61+62	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-28.97 ft/yr	17.40 ft
Volume Change Above -15 ft NAVD88	-10.15 cy/ft/yr	4.30 cy/ft
Volume Change Above 0 ft NAVD88	-3.97 cy/ft/yr	1.86 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

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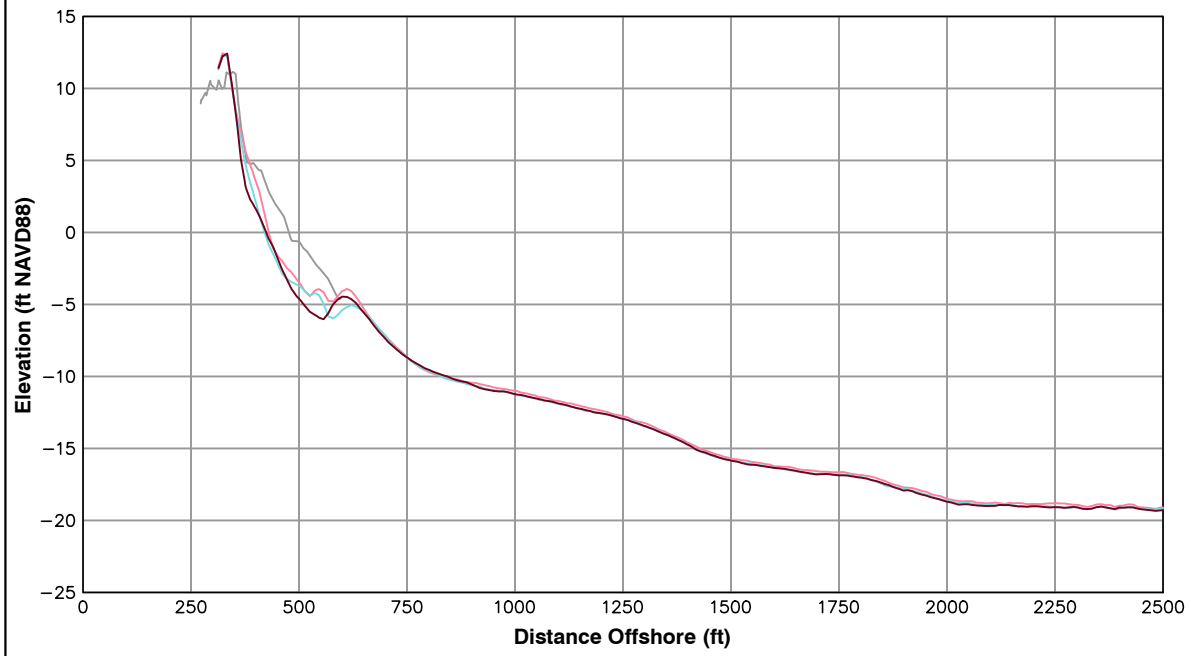
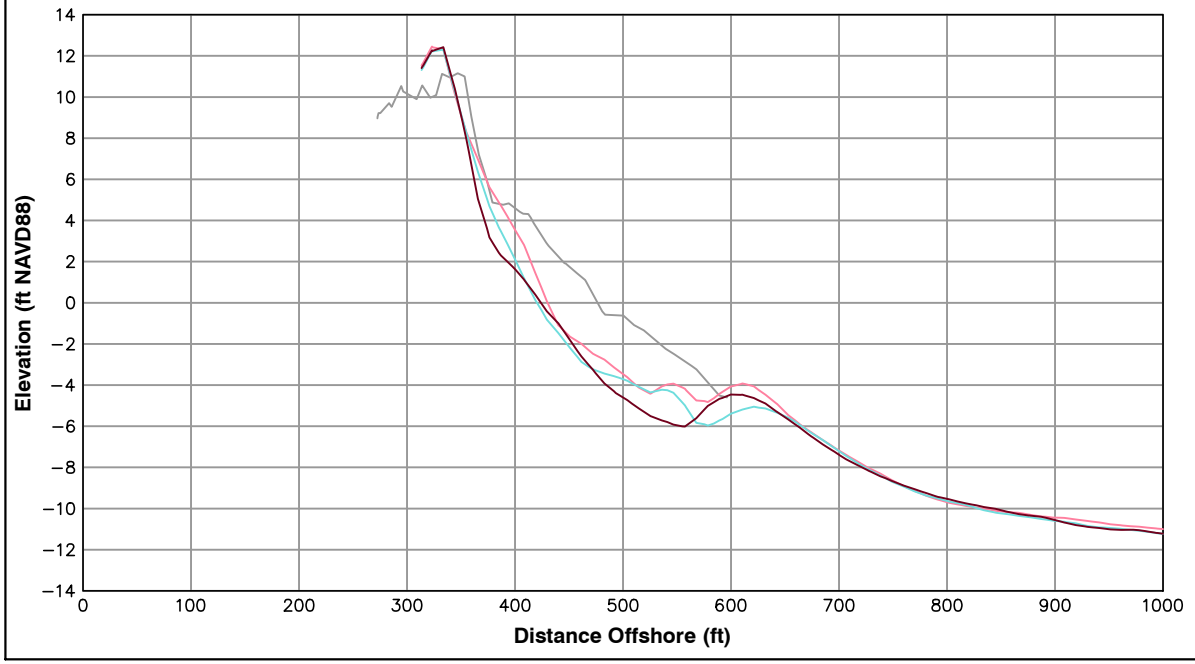
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 63+62	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-12.47 ft/yr	-0.04 ft
Volume Change Above -15 ft NAVD88	-15.64 cy/ft/yr	-2.63 cy/ft
Volume Change Above 0 ft NAVD88	-4.84 cy/ft/yr	-1.73 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

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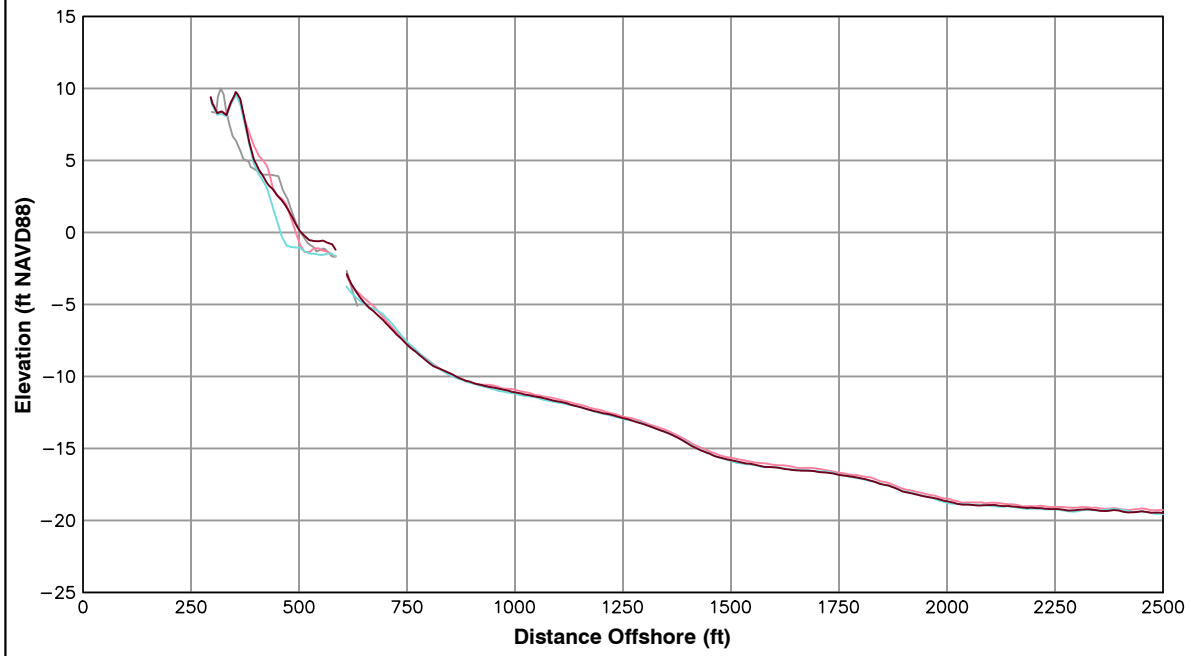
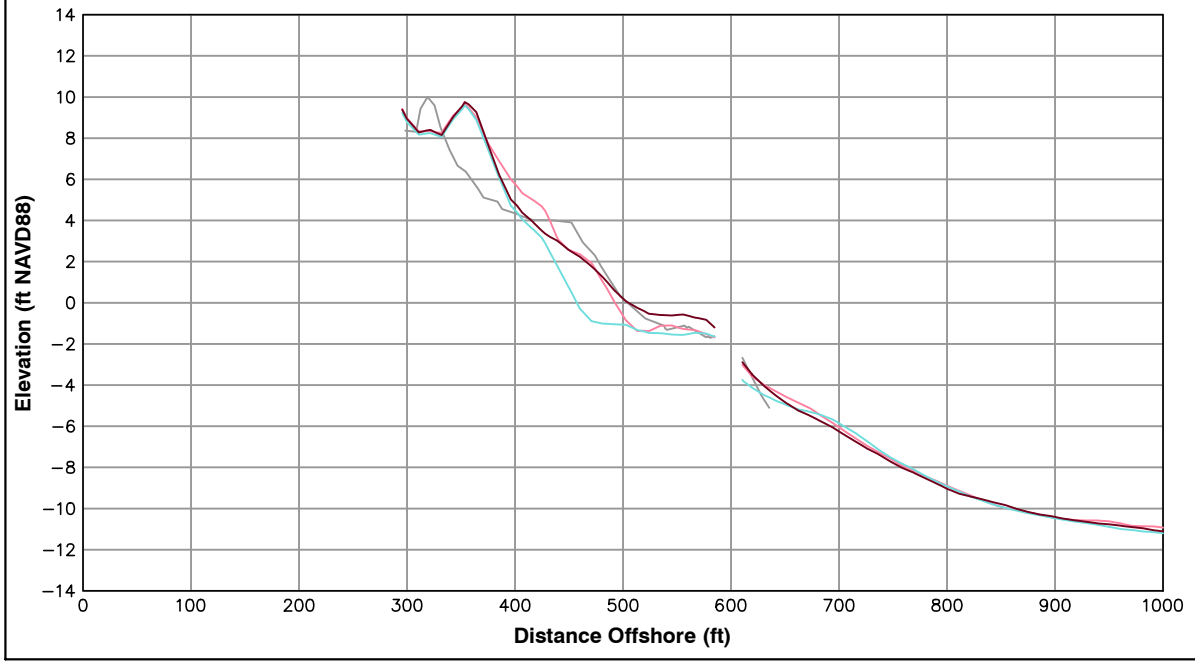
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 65+62	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	4.35 ft/yr	38.38 ft
Volume Change Above -15 ft NAVD88	-3.19 cy/ft/yr	9.33 cy/ft
Volume Change Above 0 ft NAVD88	-1.75 cy/ft/yr	4.72 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

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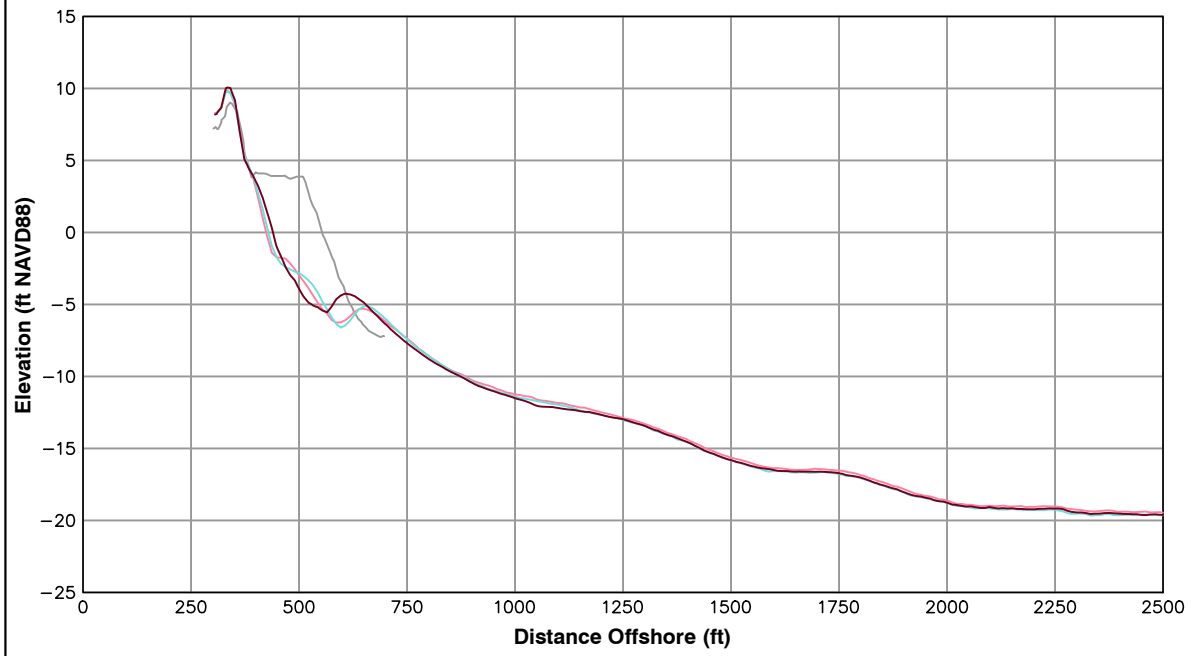
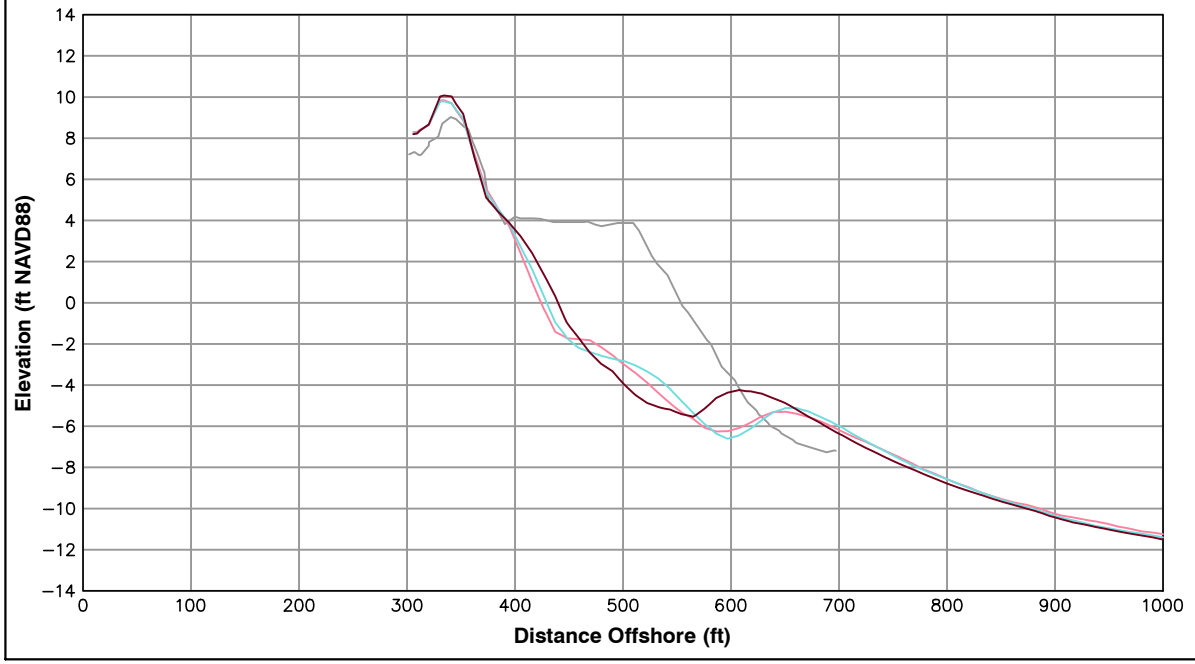
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 67+62	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	15.09 ft/yr	9.39 ft
Volume Change Above -15 ft NAVD88	-2.13 cy/ft/yr	0.02 cy/ft
Volume Change Above 0 ft NAVD88	1.70 cy/ft/yr	1.23 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

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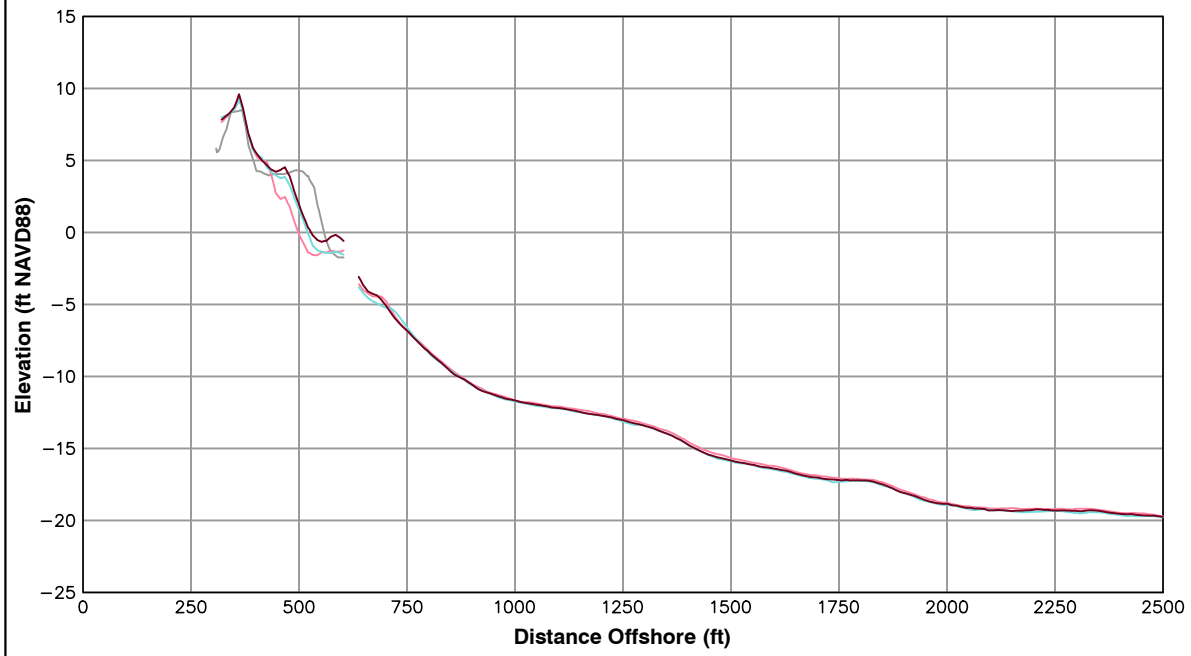
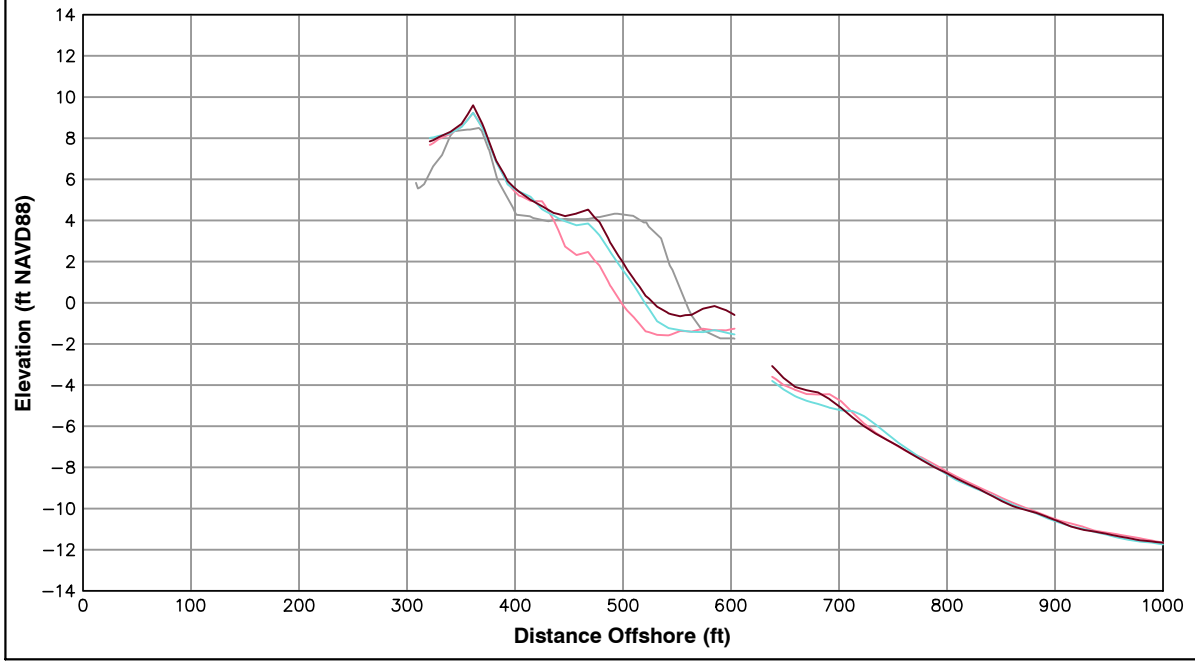
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 69+62	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	26.51 ft/yr	4.21 ft
Volume Change Above -15 ft NAVD88	6.89 cy/ft/yr	5.52 cy/ft
Volume Change Above 0 ft NAVD88	5.93 cy/ft/yr	1.79 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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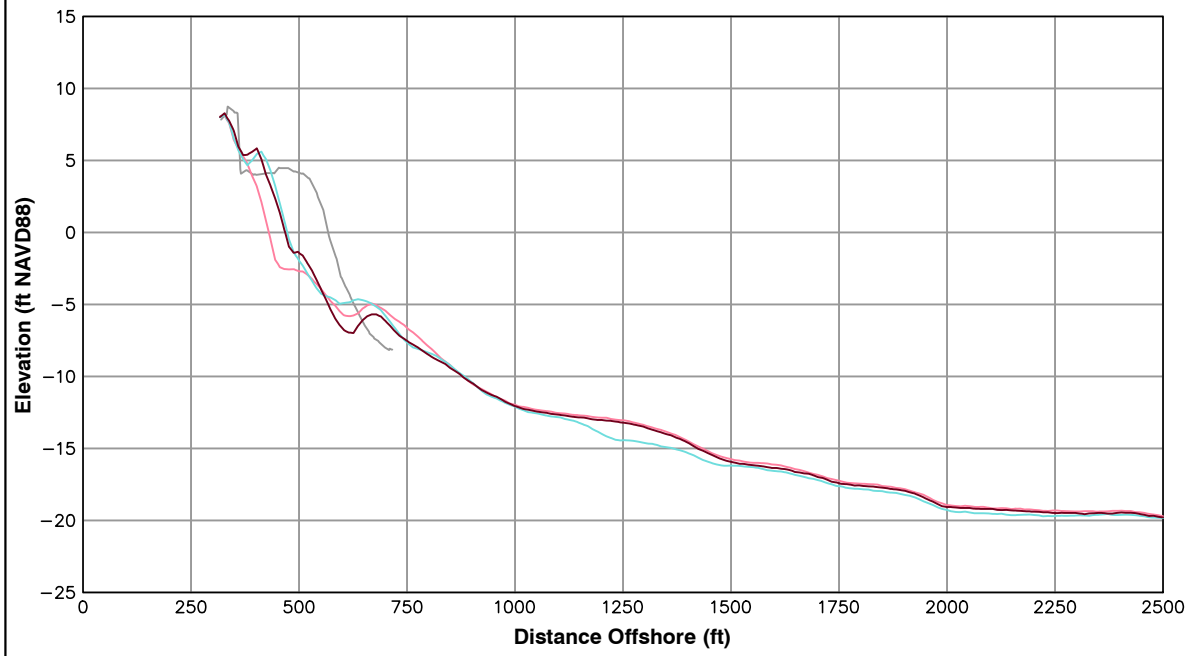
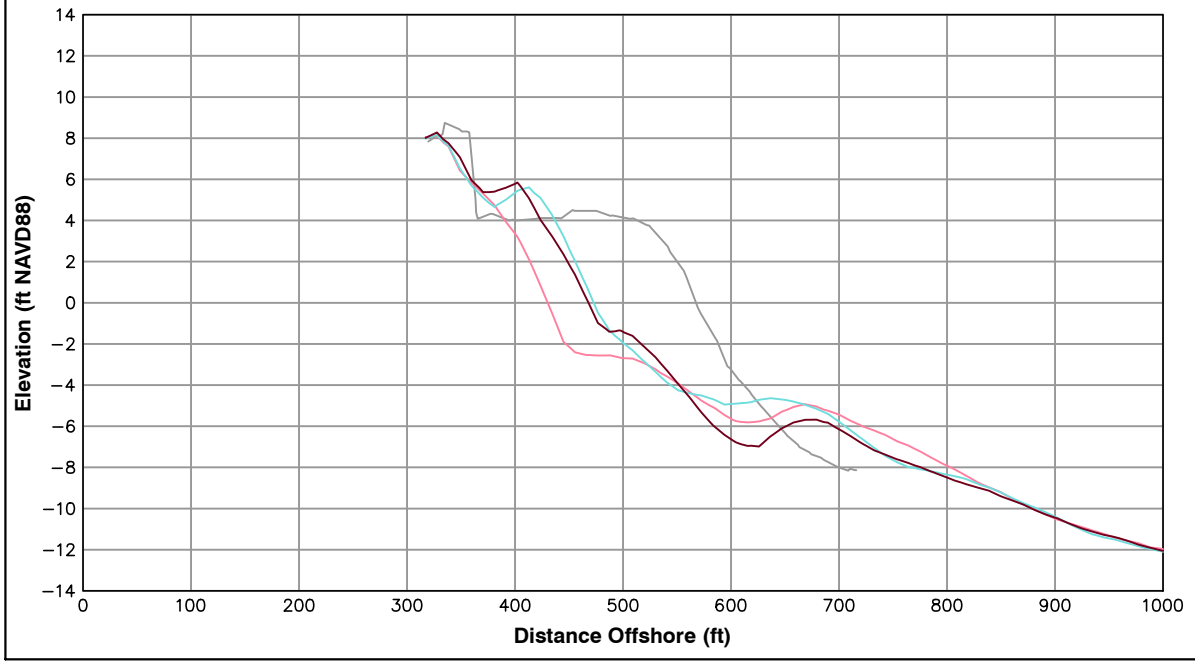
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 71+62	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	37.98 ft/yr	-5.67 ft
Volume Change Above -15 ft NAVD88	3.09 cy/ft/yr	3.49 cy/ft
Volume Change Above 0 ft NAVD88	7.97 cy/ft/yr	-0.64 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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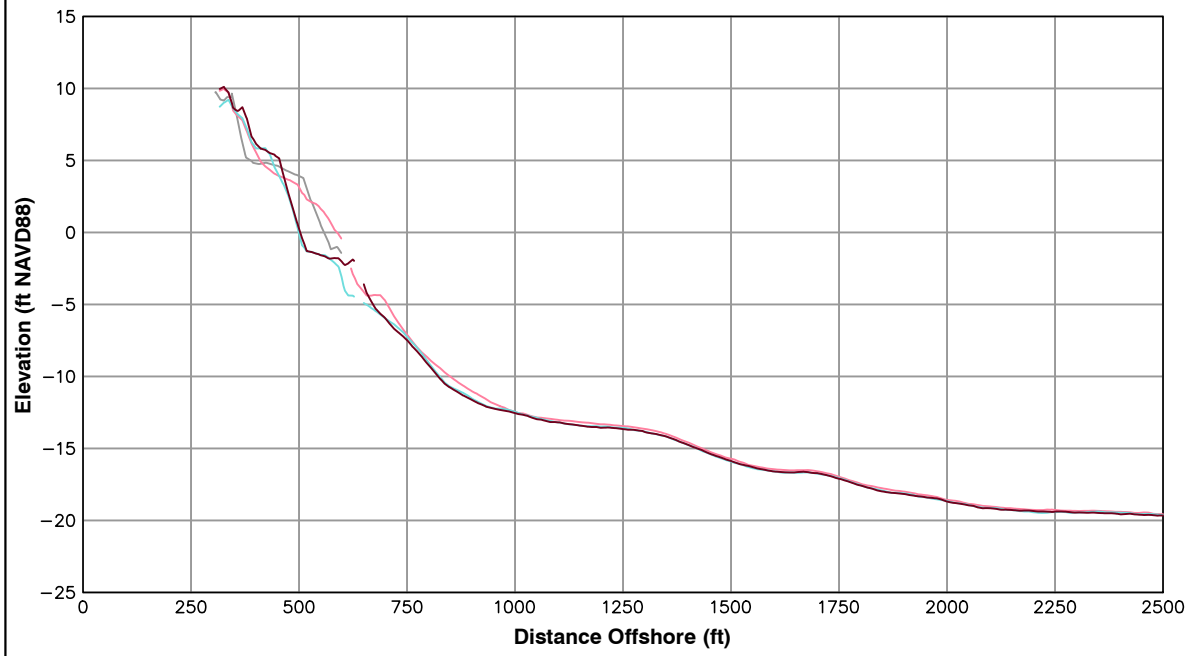
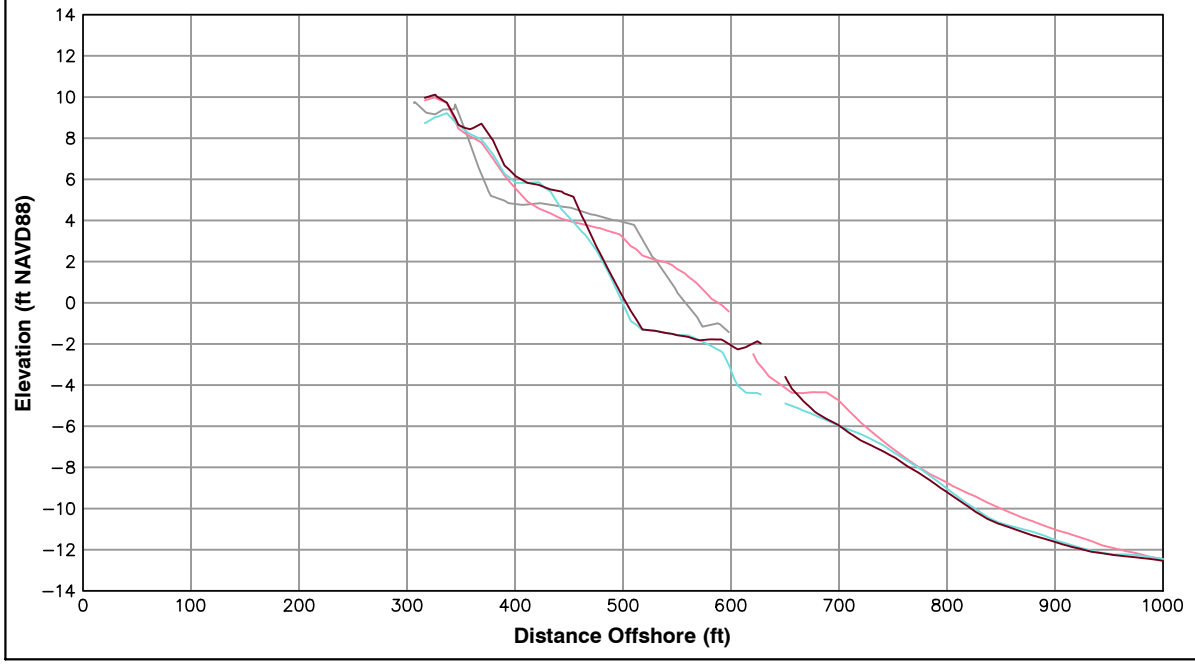
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 73+62	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-77.49 ft/yr	1.87 ft
Volume Change Above -15 ft NAVD88	-19.29 cy/ft/yr	4.57 cy/ft
Volume Change Above 0 ft NAVD88	-3.78 cy/ft/yr	3.06 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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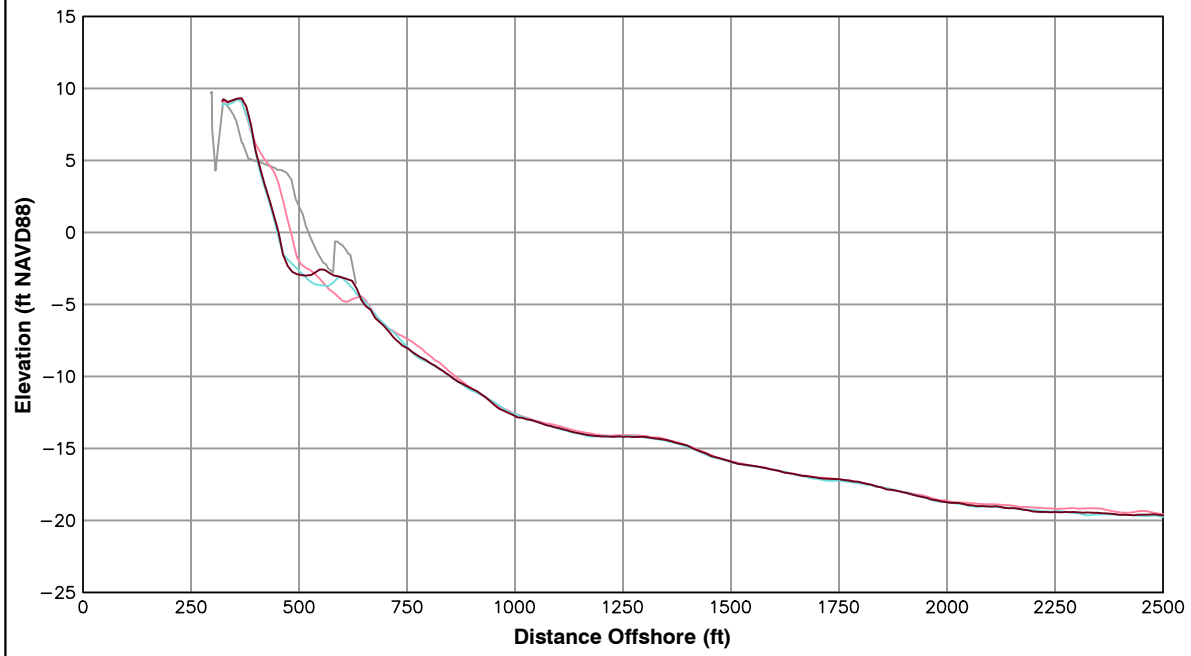
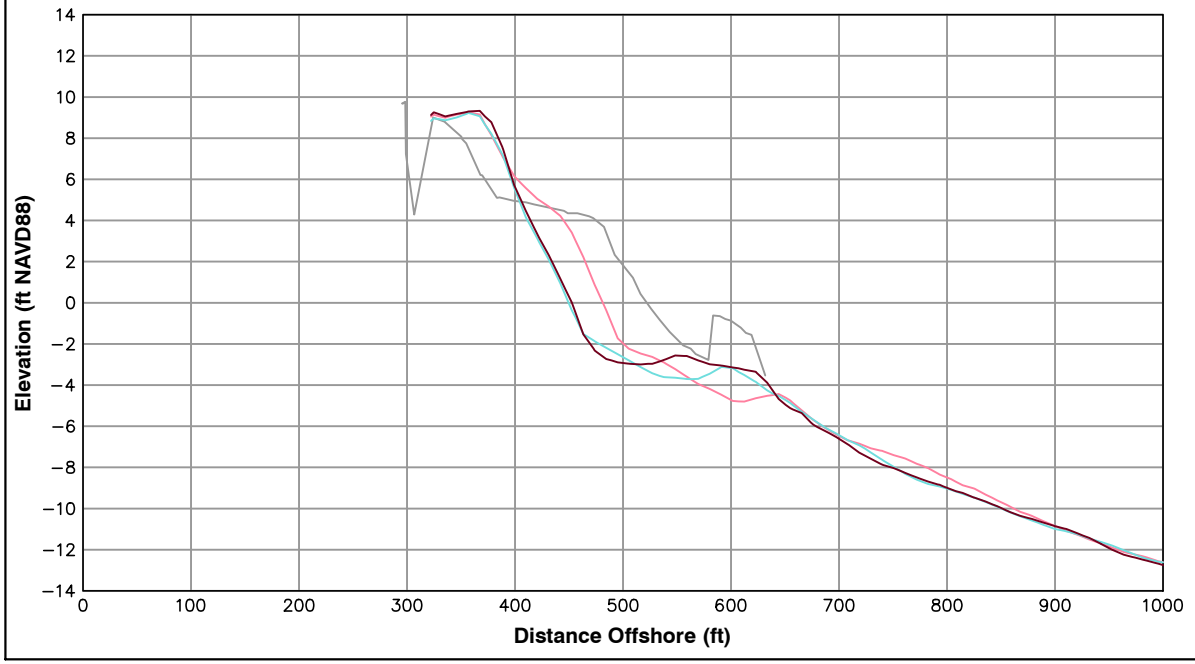
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 75+62	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-30.35 ft/yr	2.07 ft
Volume Change Above -15 ft NAVD88	-10.22 cy/ft/yr	1.20 cy/ft
Volume Change Above 0 ft NAVD88	-5.56 cy/ft/yr	1.20 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

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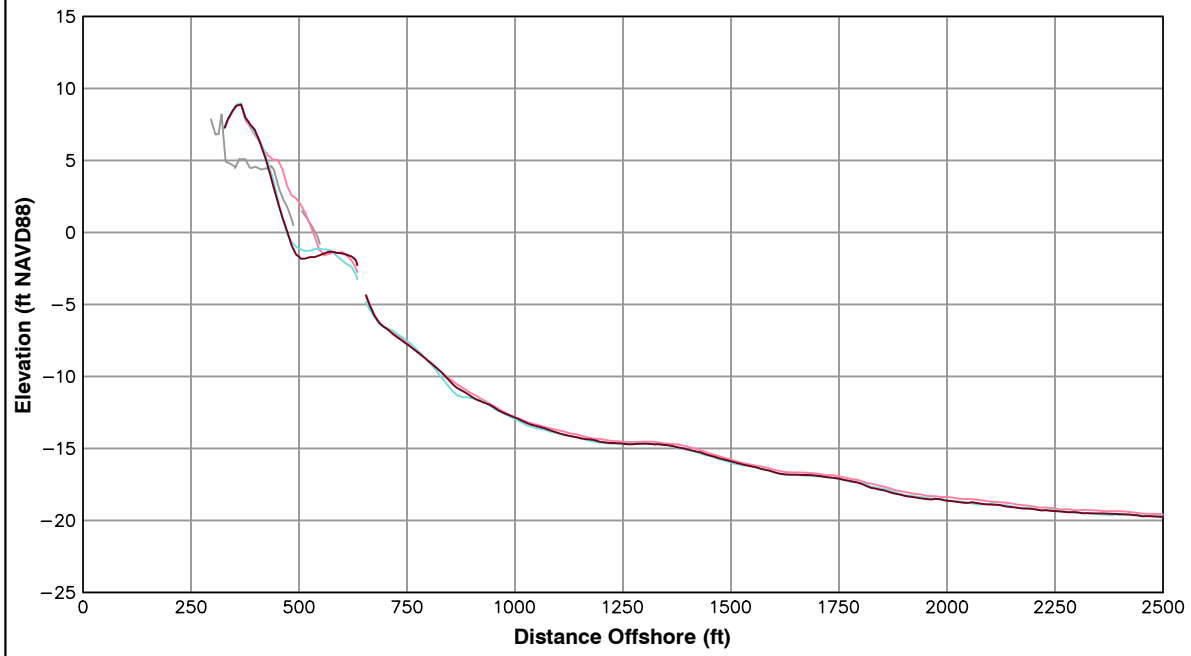
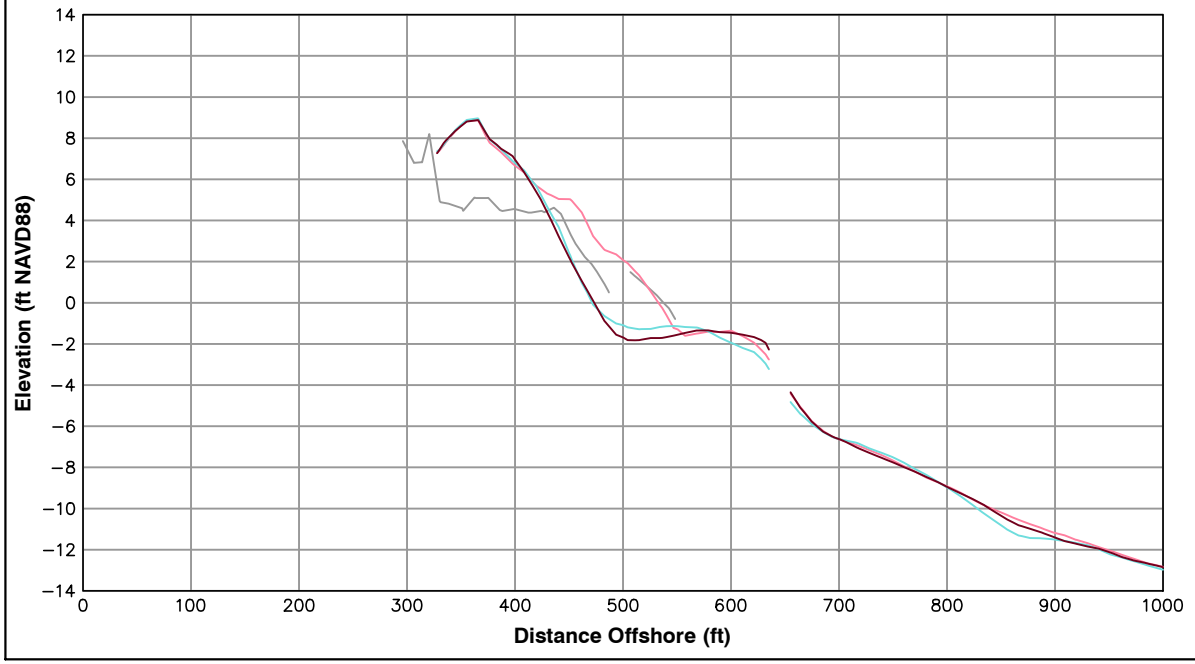
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 77+62	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-59.23 ft/yr	0.97 ft
Volume Change Above -15 ft NAVD88	-15.17 cy/ft/yr	0.96 cy/ft
Volume Change Above 0 ft NAVD88	-8.27 cy/ft/yr	-0.36 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

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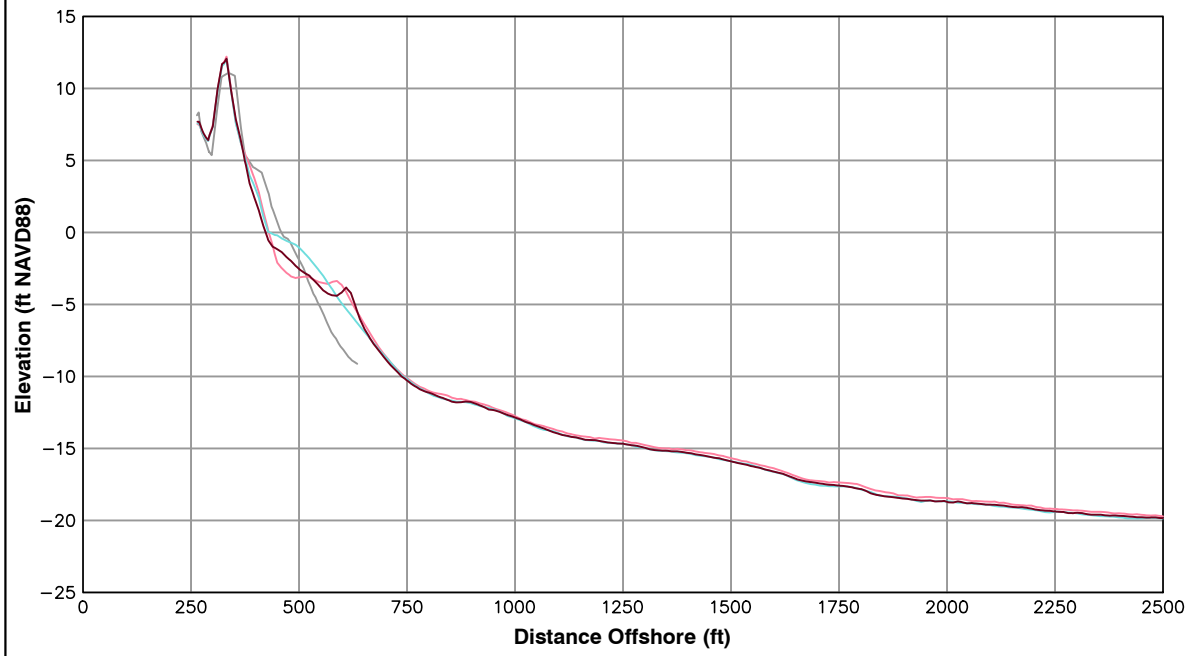
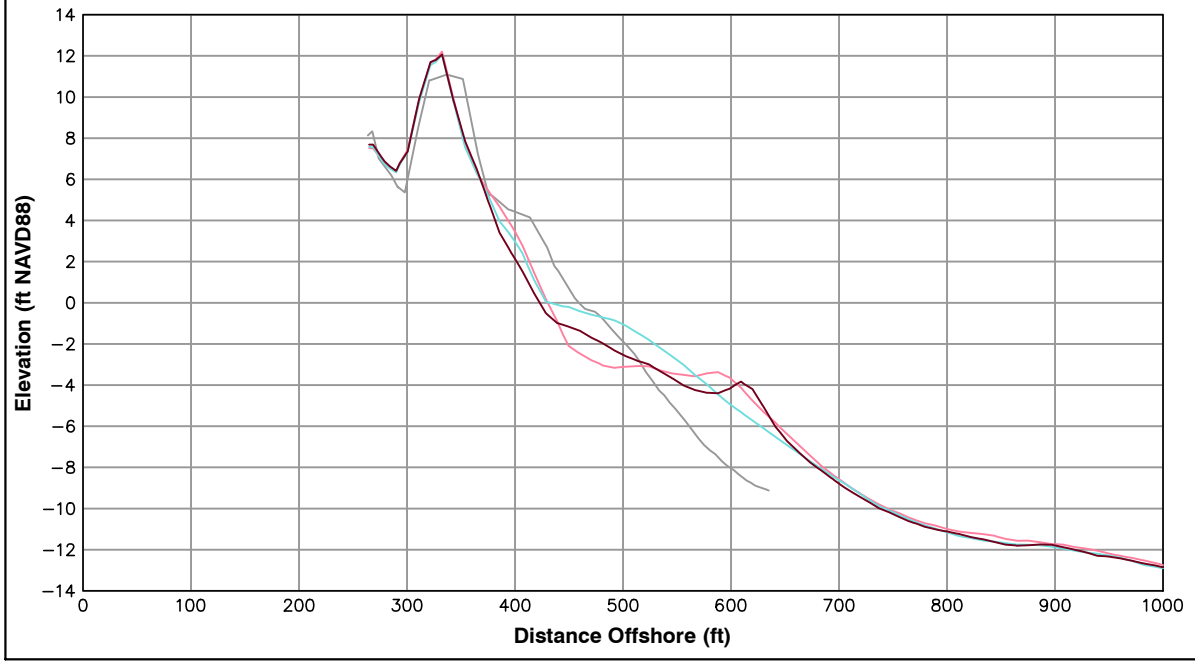
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 79+62	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-9.60 ft/yr	-6.53 ft
Volume Change Above -15 ft NAVD88	-5.92 cy/ft/yr	-4.76 cy/ft
Volume Change Above 0 ft NAVD88	-2.10 cy/ft/yr	-0.83 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
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City of Norfolk

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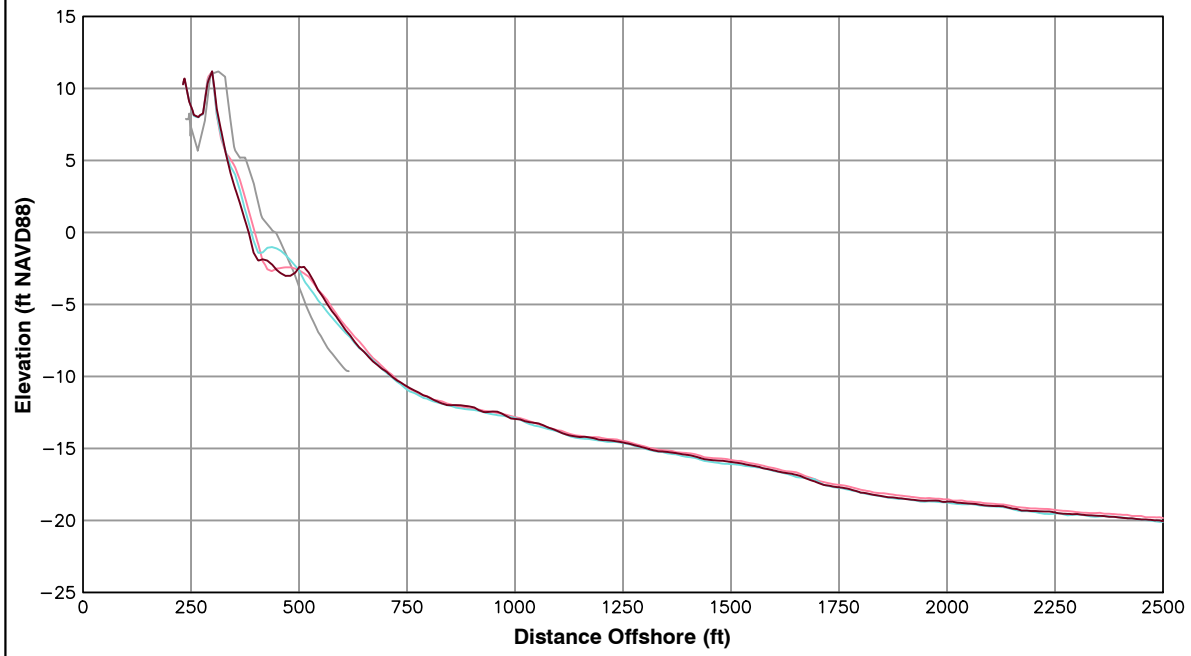

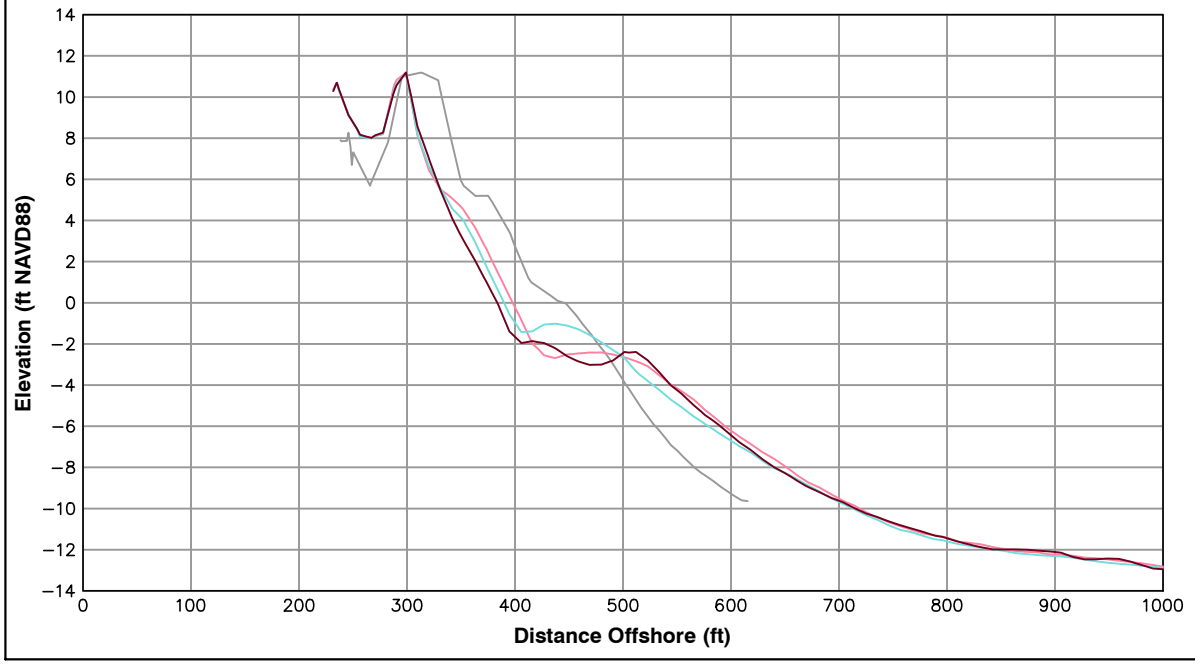

Survey Transect 81+62	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-15.46 ft/yr	-6.98 ft
Volume Change Above -15 ft NAVD88	-6.12 cy/ft/yr	-0.42 cy/ft
Volume Change Above 0 ft NAVD88	-2.70 cy/ft/yr	-1.13 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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City of Norfolk

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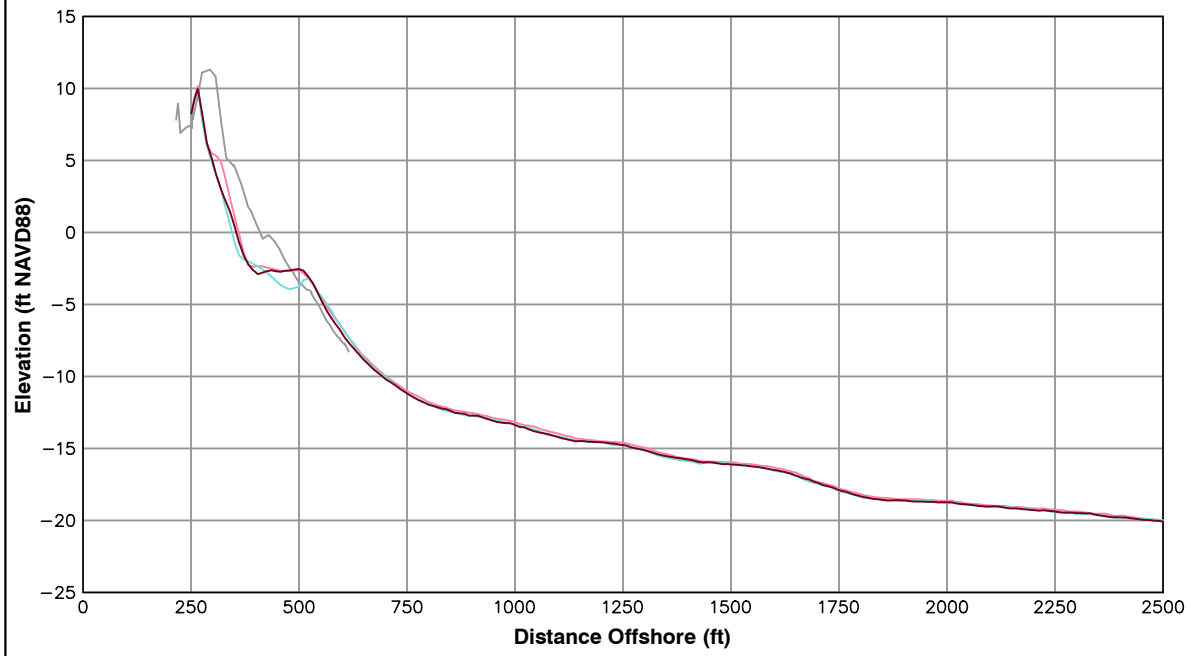

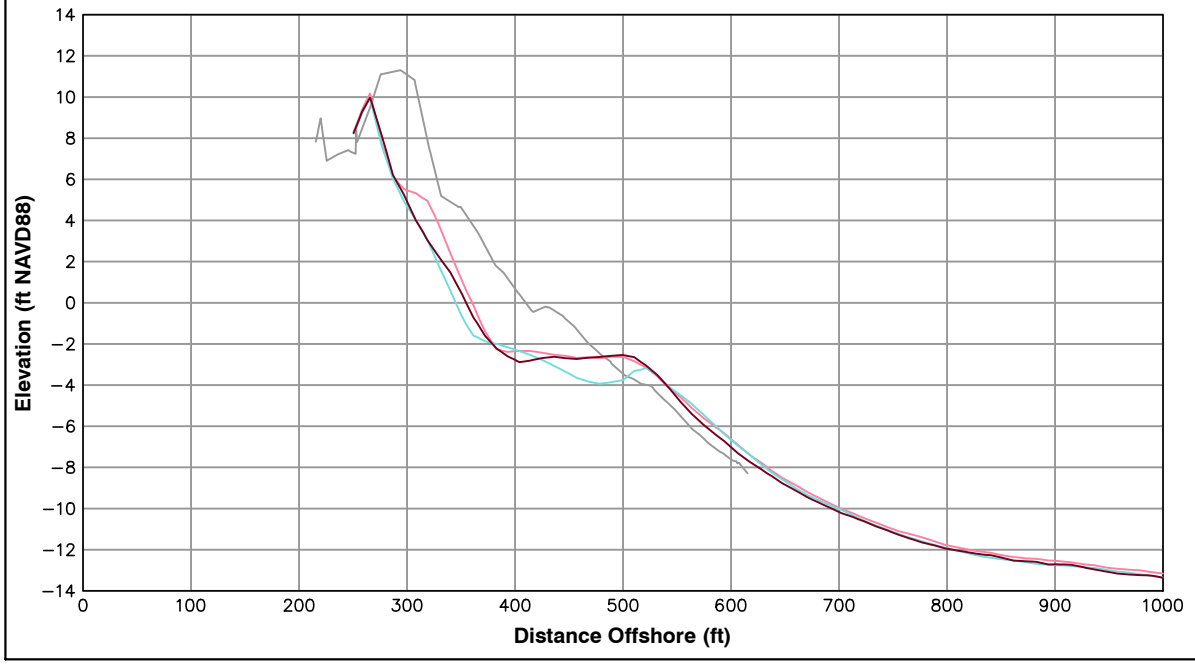

Survey Transect 83+62	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-6.75 ft/yr	8.47 ft
Volume Change Above -15 ft NAVD88	-9.21 cy/ft/yr	2.51 cy/ft
Volume Change Above 0 ft NAVD88	-2.65 cy/ft/yr	1.13 cy/ft

LEGEND:
- 2014 MAR
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- 2013 APR
- POST-FILL

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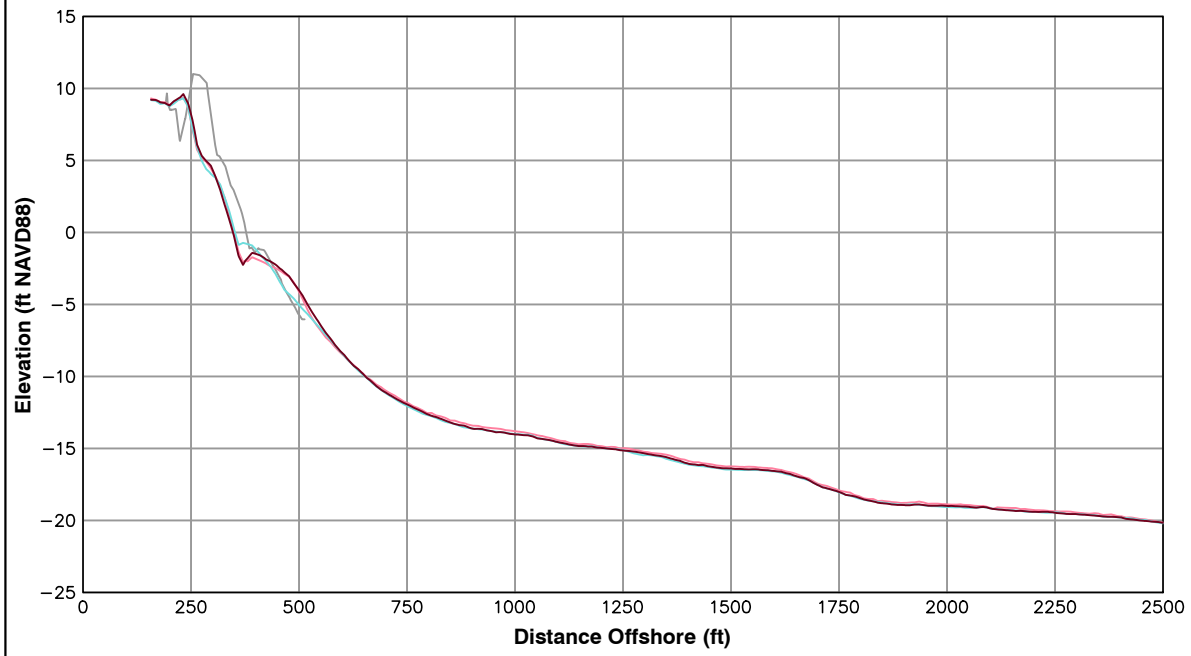

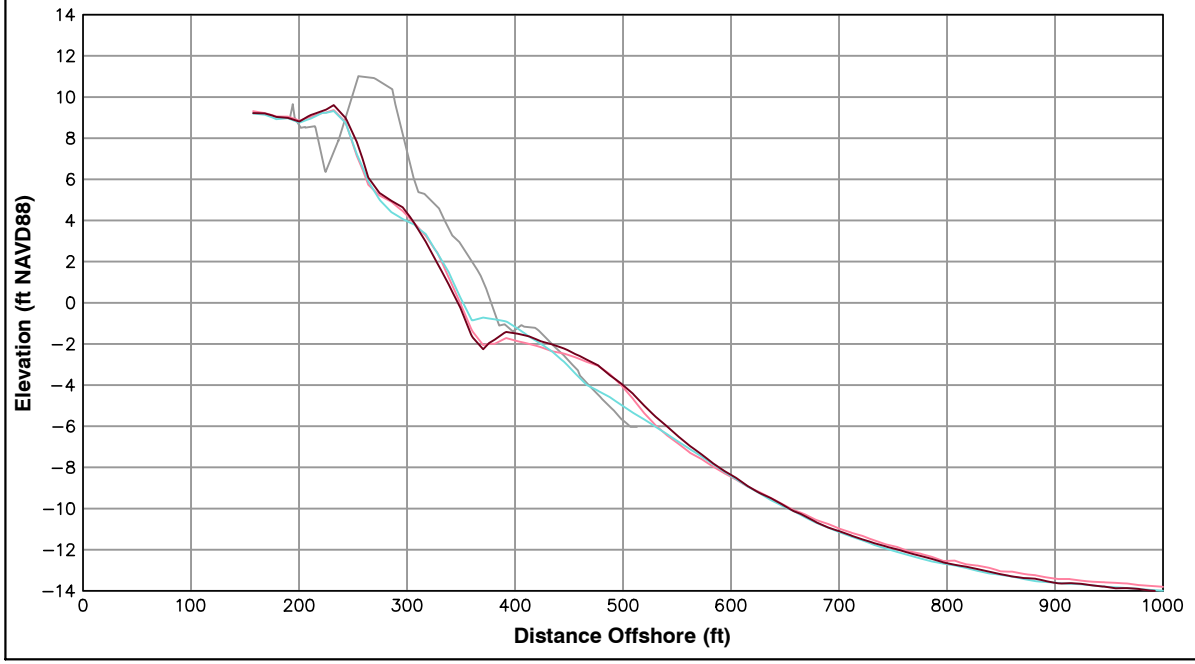

Survey Transect 85+62	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-3.12 ft/yr	-5.27 ft
Volume Change Above -15 ft NAVD88	-1.38 cy/ft/yr	3.44 cy/ft
Volume Change Above 0 ft NAVD88	0.26 cy/ft/yr	0.66 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

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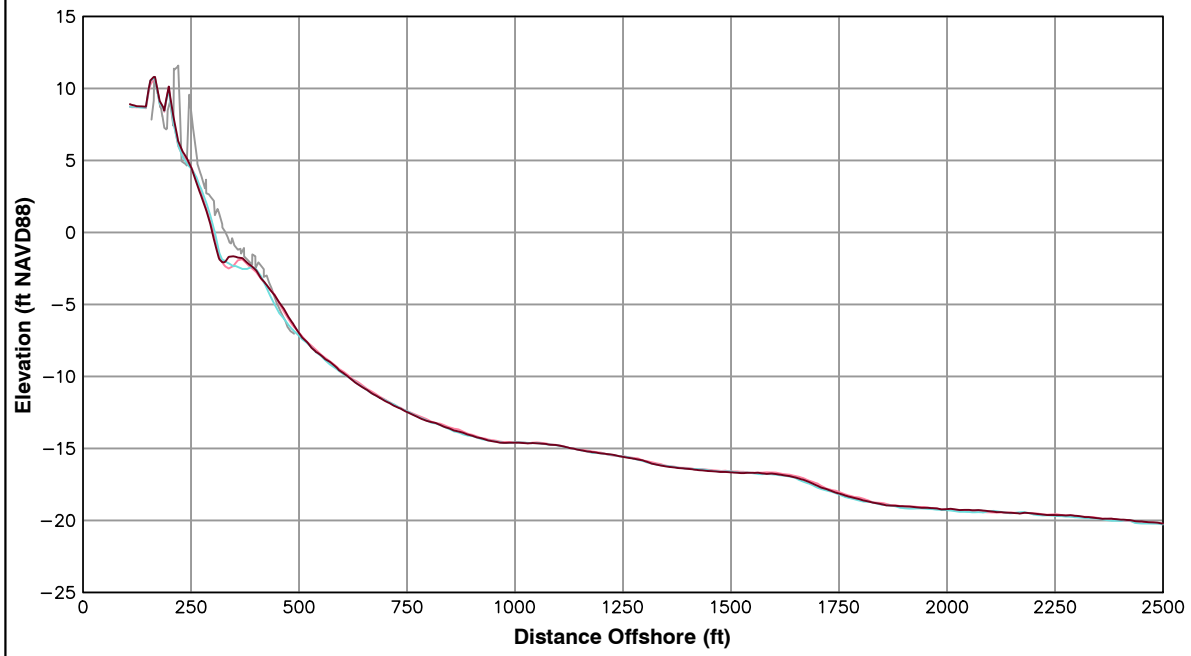

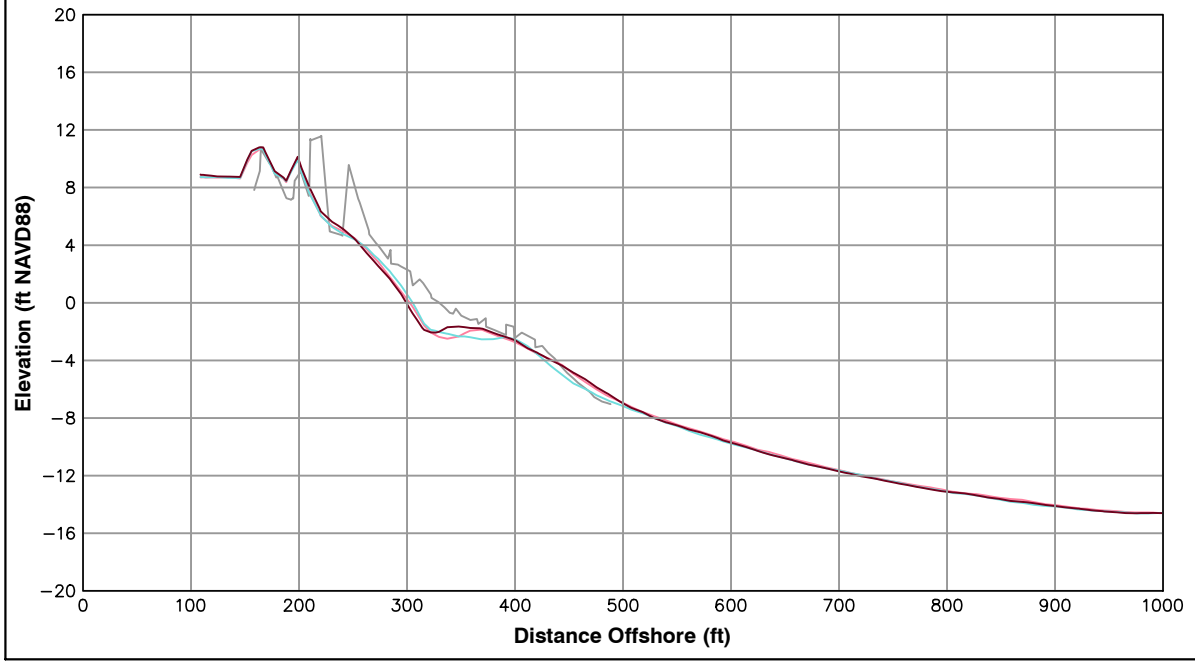

Survey Transect 87+62	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-1.69 ft/yr	-5.62 ft
Volume Change Above -15 ft NAVD88	-0.30 cy/ft/yr	2.59 cy/ft
Volume Change Above 0 ft NAVD88	0.49 cy/ft/yr	0.11 cy/ft

LEGEND:
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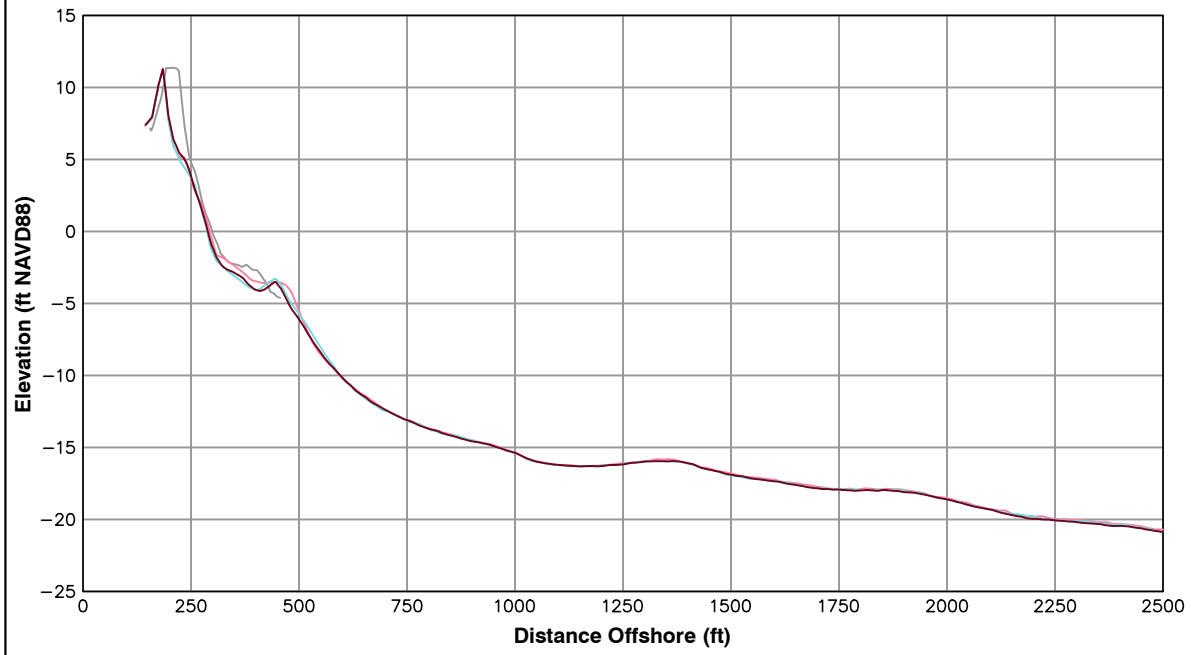

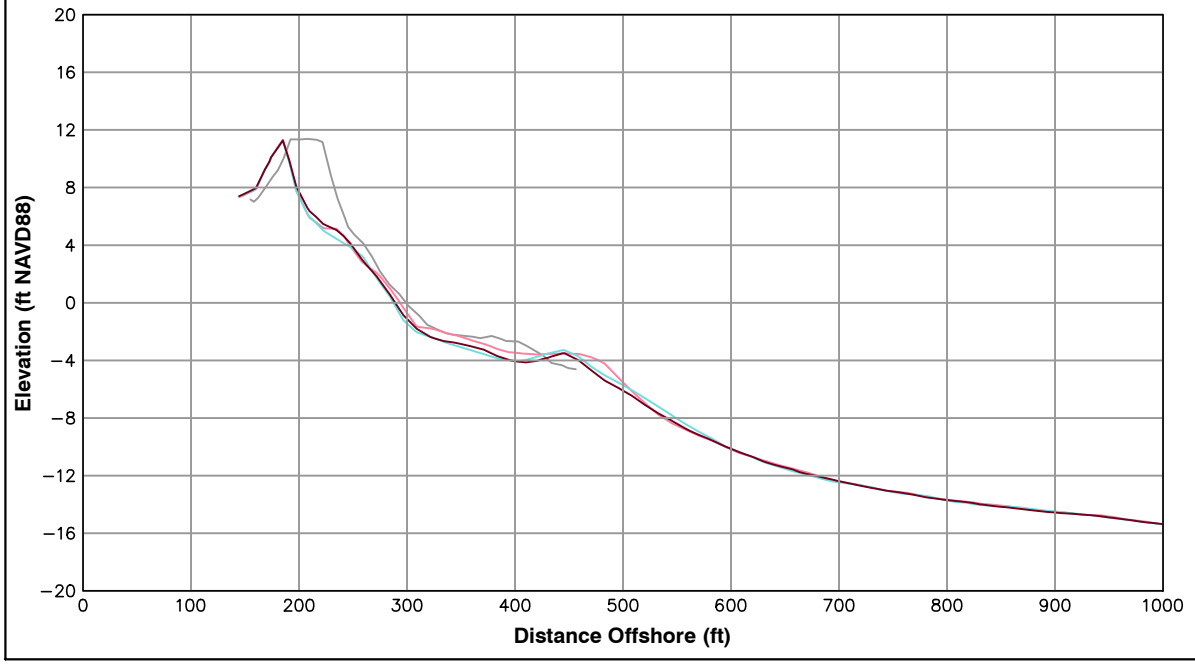

Survey Transect 93+41	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-4.22 ft/yr	1.22 ft
Volume Change Above -15 ft NAVD88	-4.41 cy/ft/yr	-0.24 cy/ft
Volume Change Above 0 ft NAVD88	0.22 cy/ft/yr	0.99 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
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- POST-FILL

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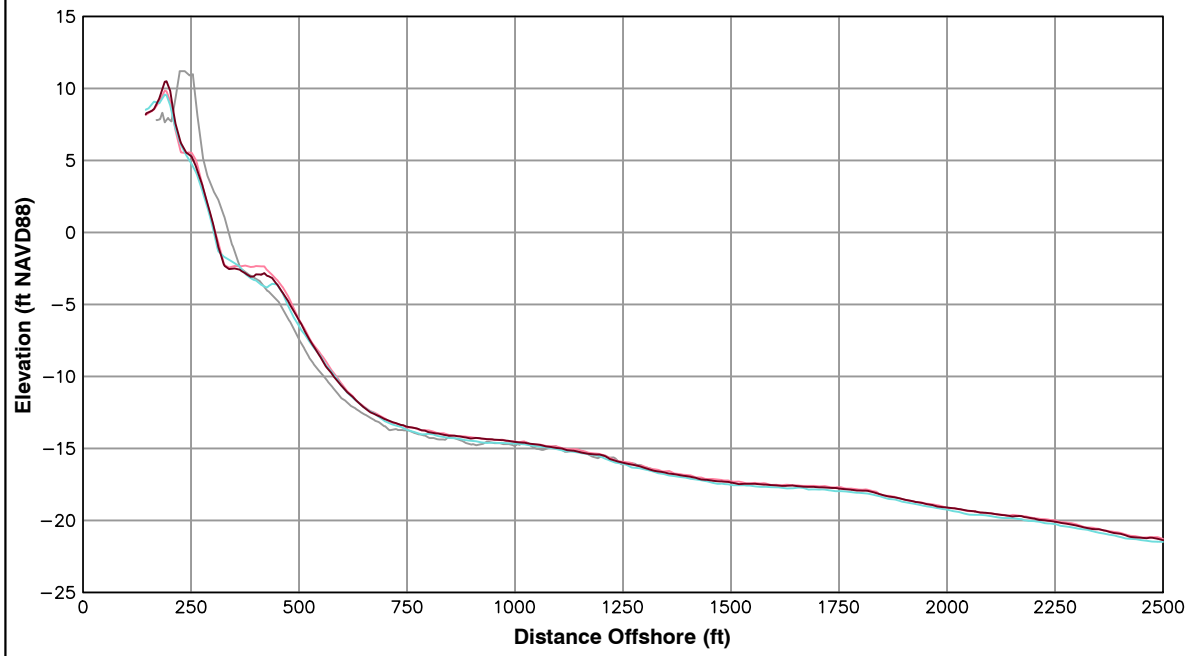
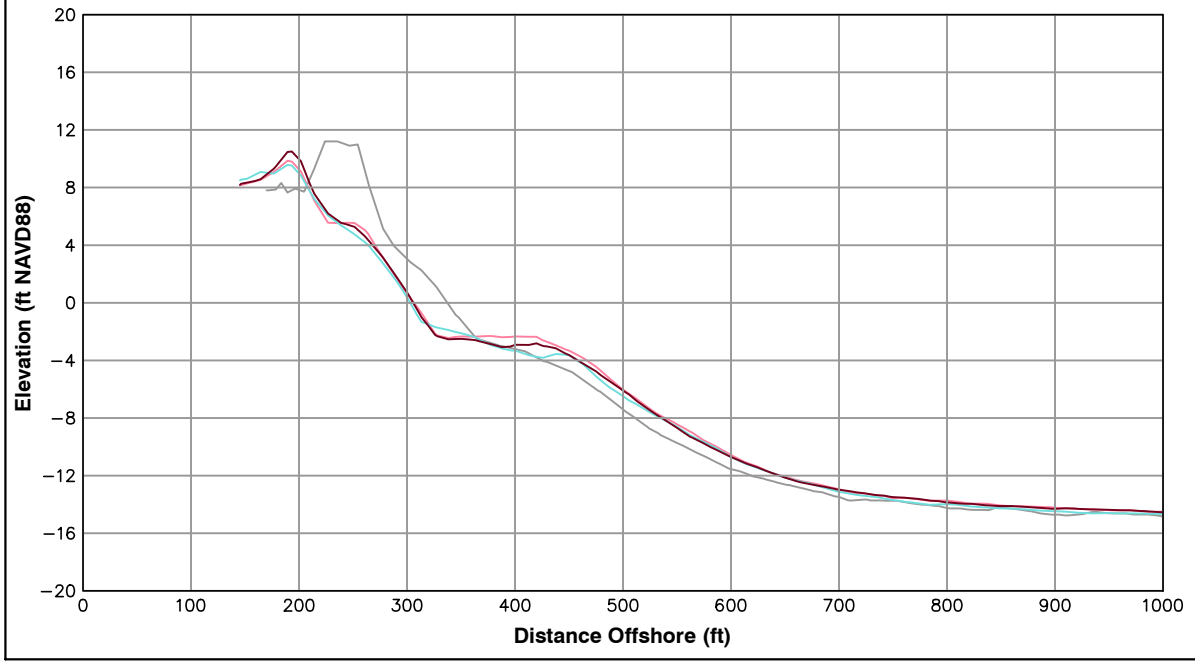
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS

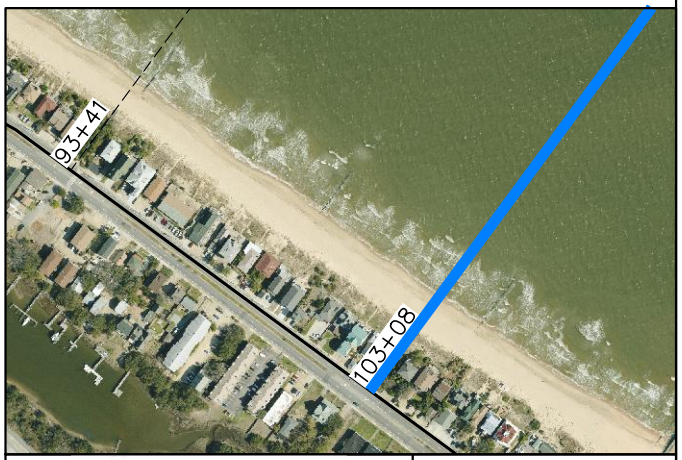




Survey Transect 103+08	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	0.72 ft/yr	2.75 ft
Volume Change Above -15 ft NAVD88	-2.67 cy/ft/yr	5.56 cy/ft
Volume Change Above 0 ft NAVD88	1.03 cy/ft/yr	1.81 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
1. Stationing 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 April 2013 and October 2013.
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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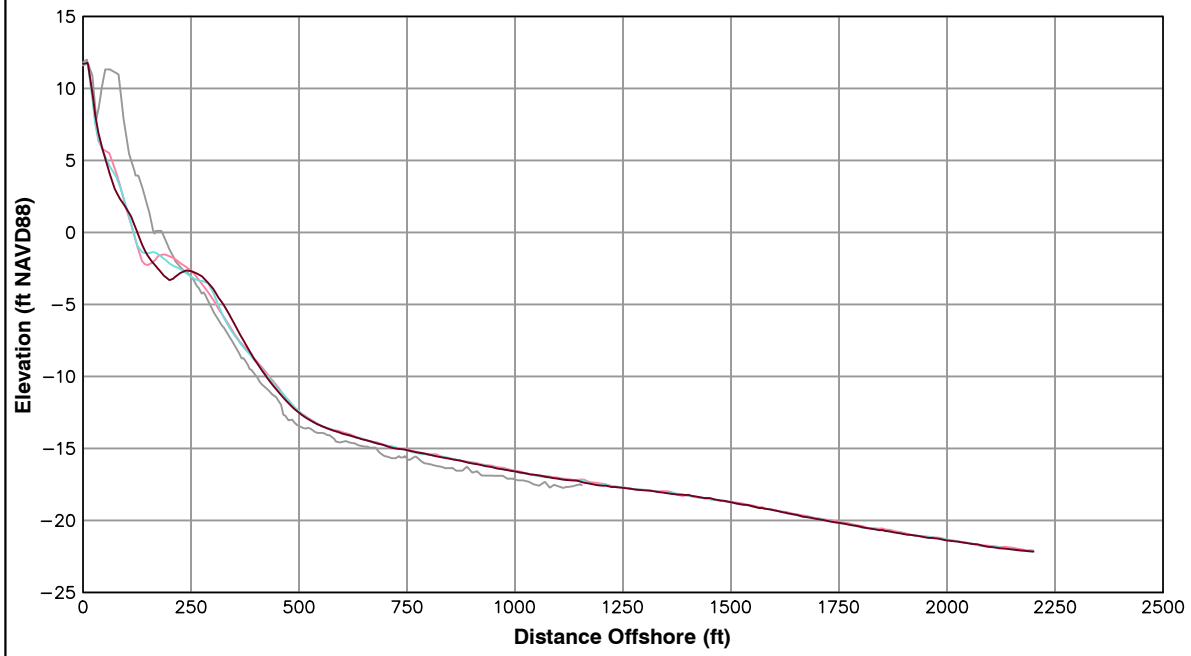
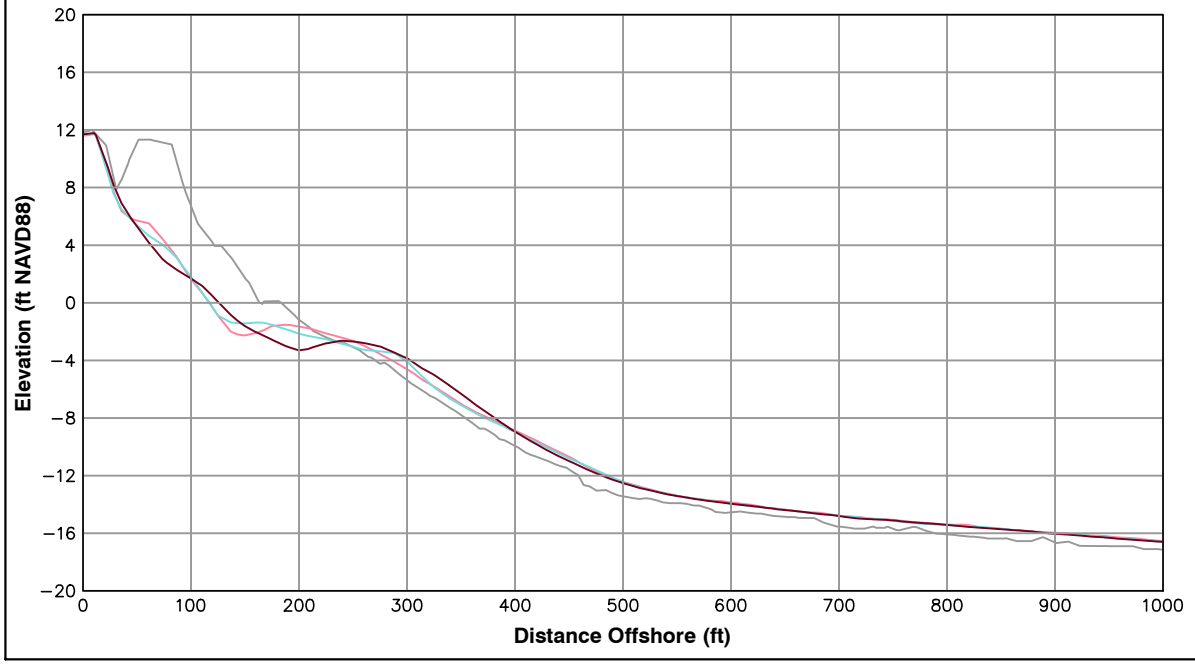
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 120+93	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	6.19 ft/yr	5.38 ft
Volume Change Above -15 ft NAVD88	-1.30 cy/ft/yr	-0.27 cy/ft
Volume Change Above 0 ft NAVD88	-1.11 cy/ft/yr	-0.38 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
1. Stationing From West To East At Varying Intervals.
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4. Survey Comparison Made To April 2013 and October 2013.
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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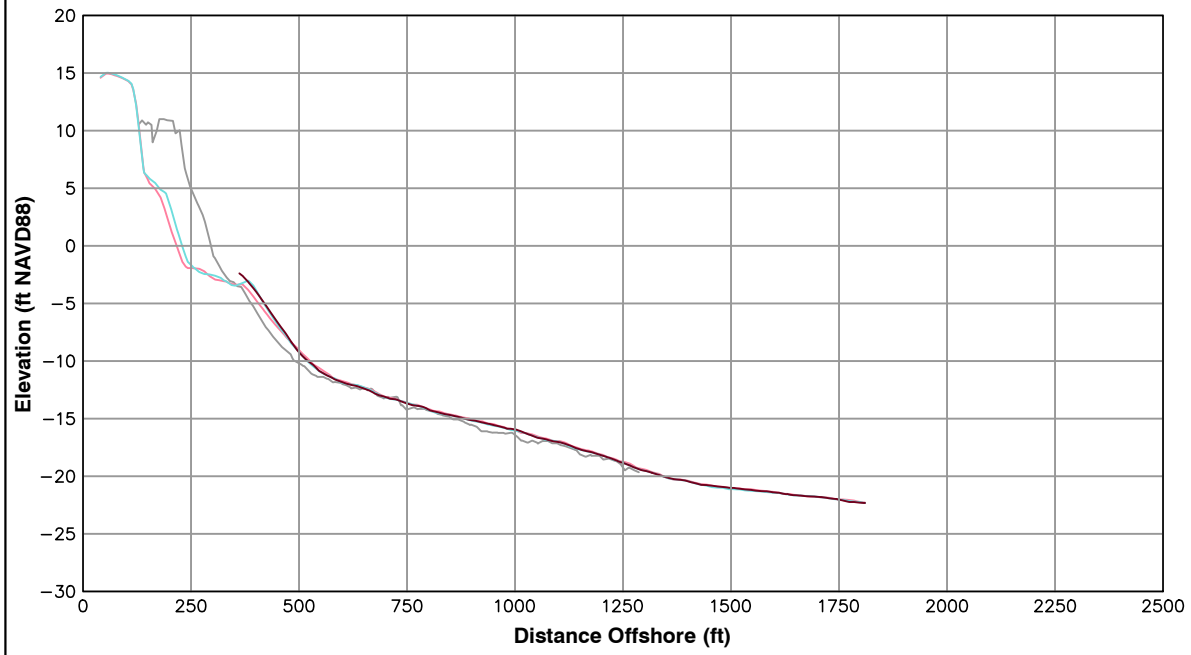
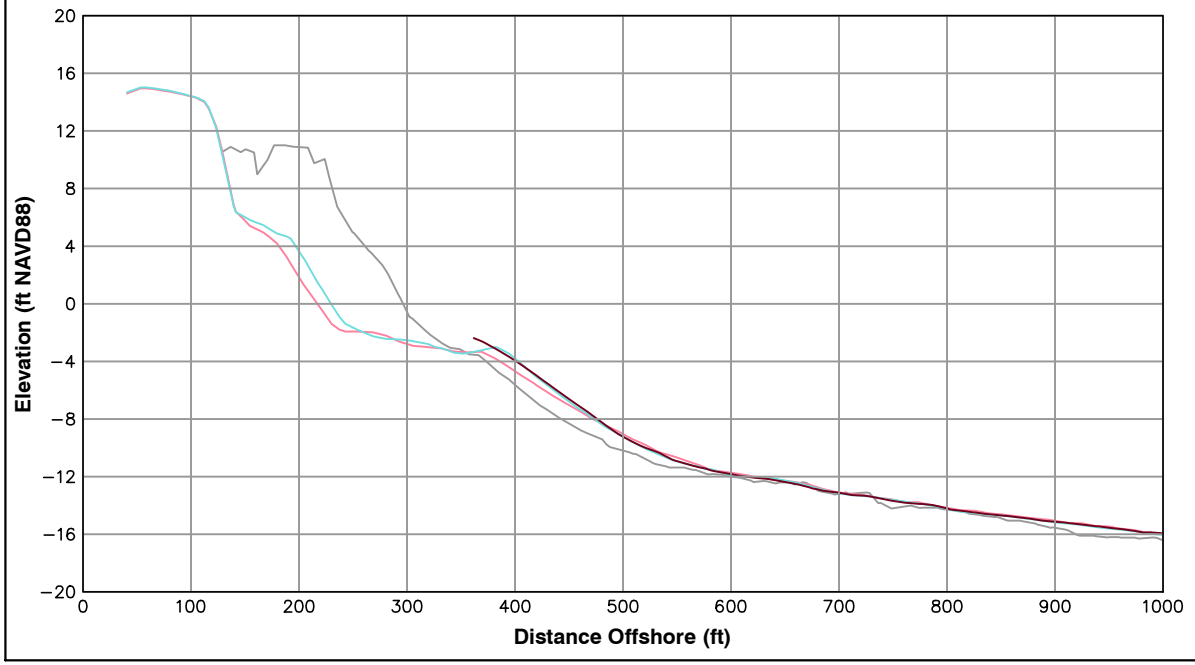
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 129+17	March 2014 - April 2013	March 2014 - October 2013
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:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
1. Stationing 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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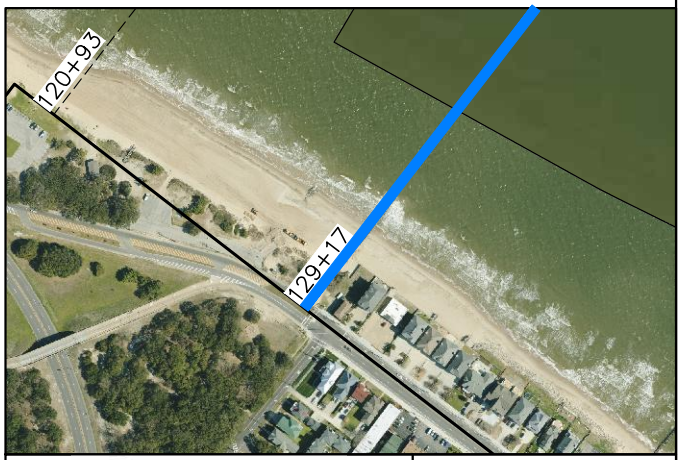
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



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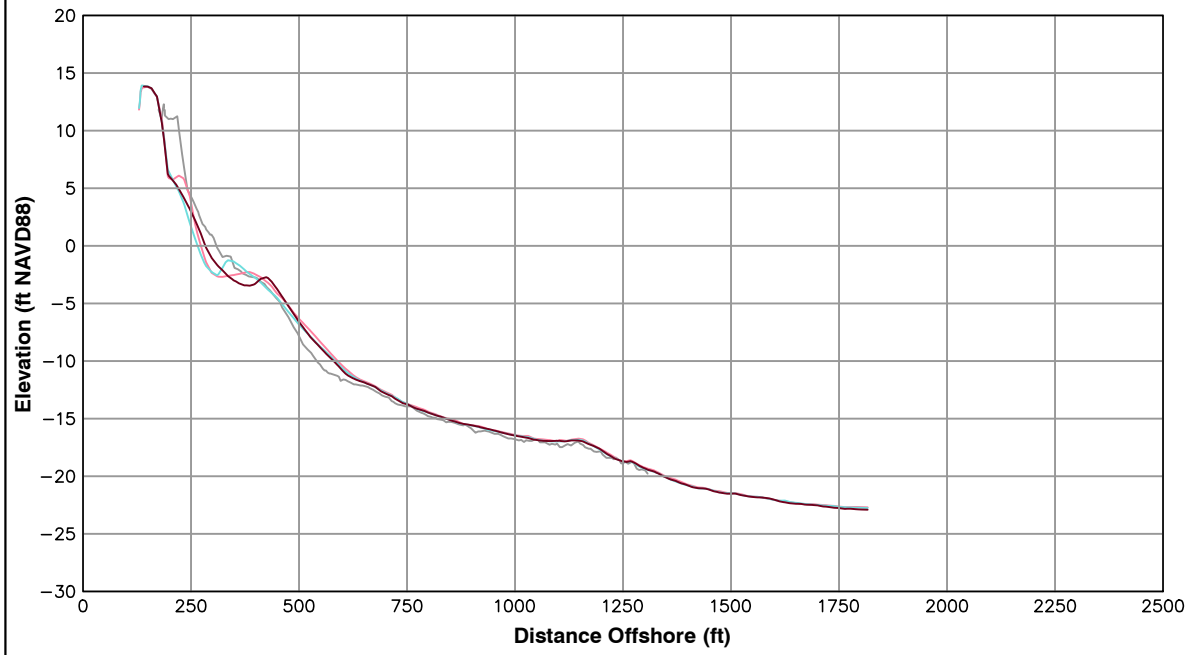
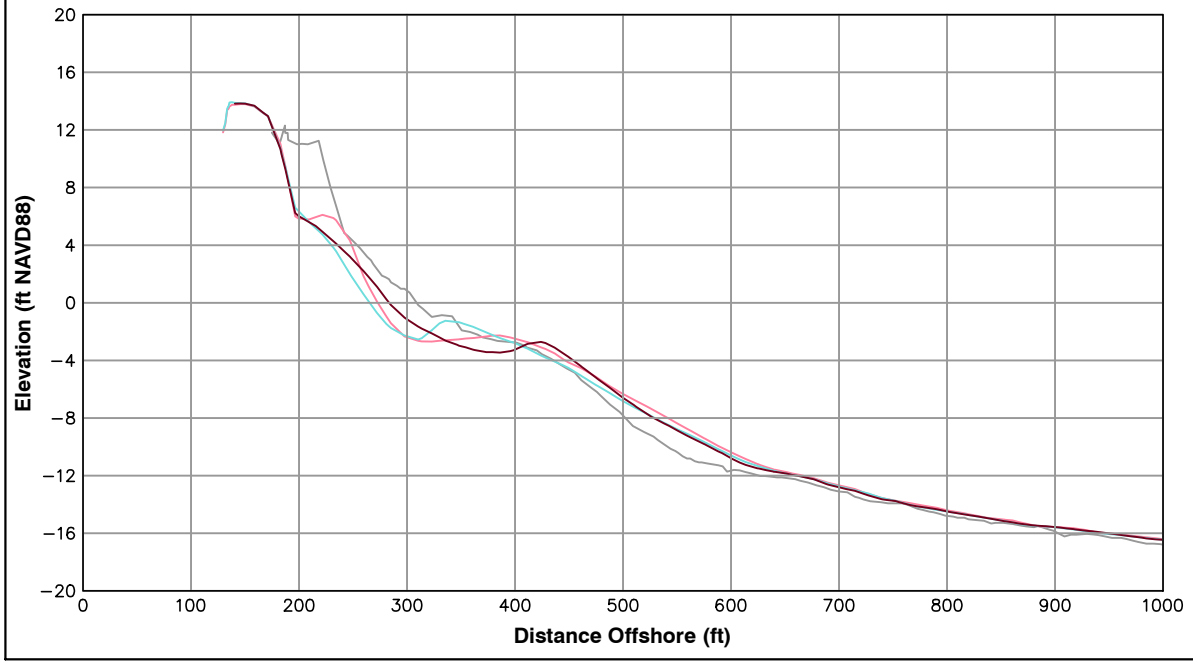
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 141+98	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	8.31 ft/yr	17.36 ft
Volume Change Above -15 ft NAVD88	-3.92 cy/ft/yr	1.99 cy/ft
Volume Change Above 0 ft NAVD88	-1.33 cy/ft/yr	2.00 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
1. Stationing 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 April 2013 and October 2013.
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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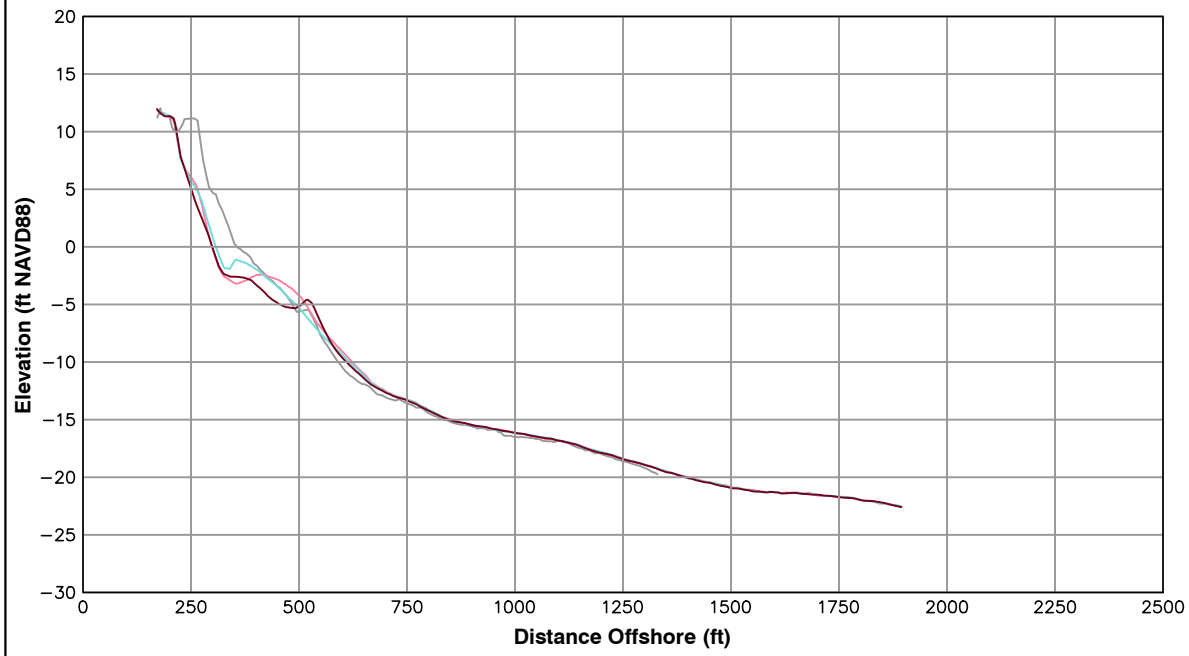
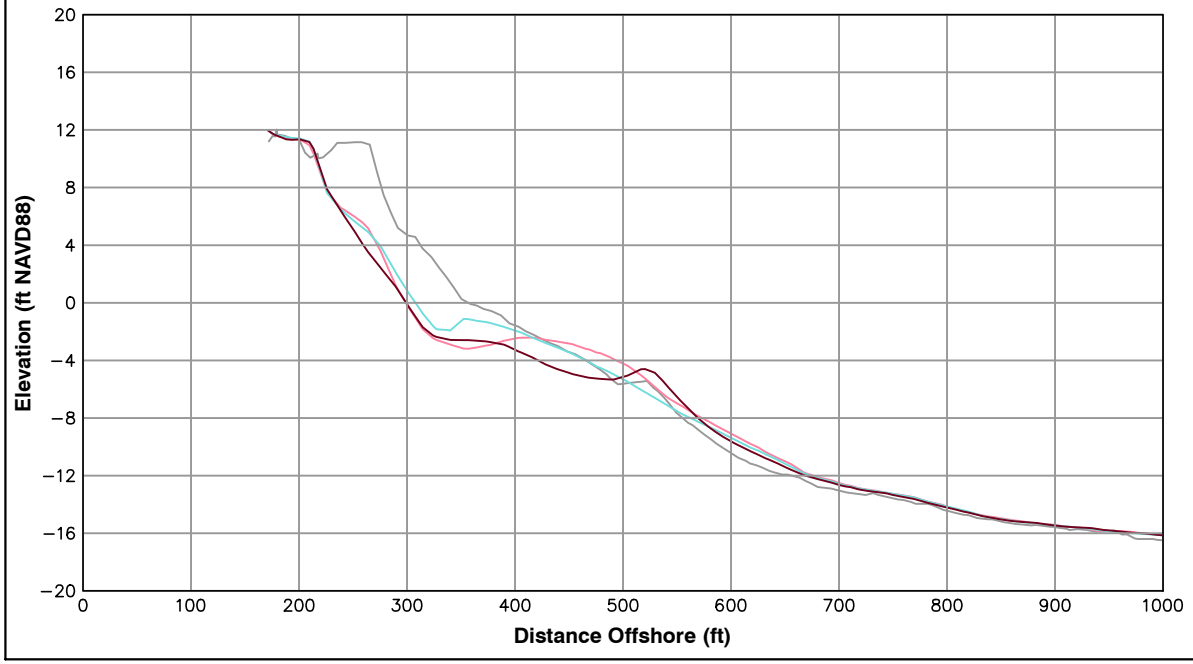
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 152+01	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-0.31 ft/yr	-8.18 ft
Volume Change Above -15 ft NAVD88	-8.77 cy/ft/yr	-8.92 cy/ft
Volume Change Above 0 ft NAVD88	-1.77 cy/ft/yr	-2.45 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

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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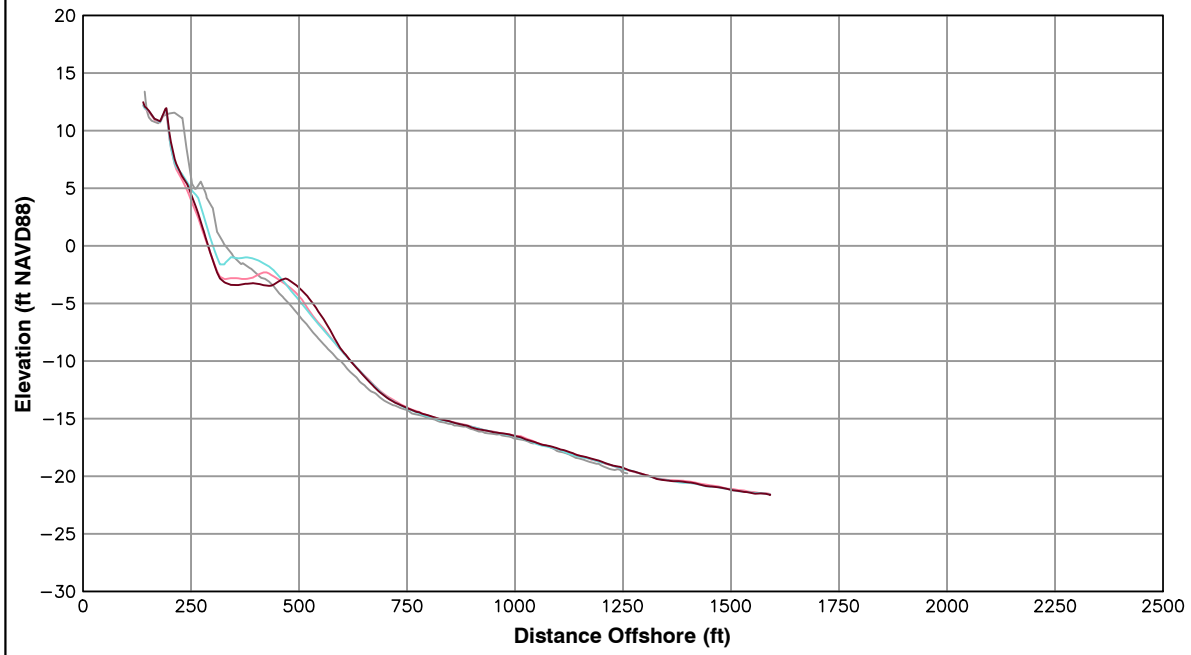
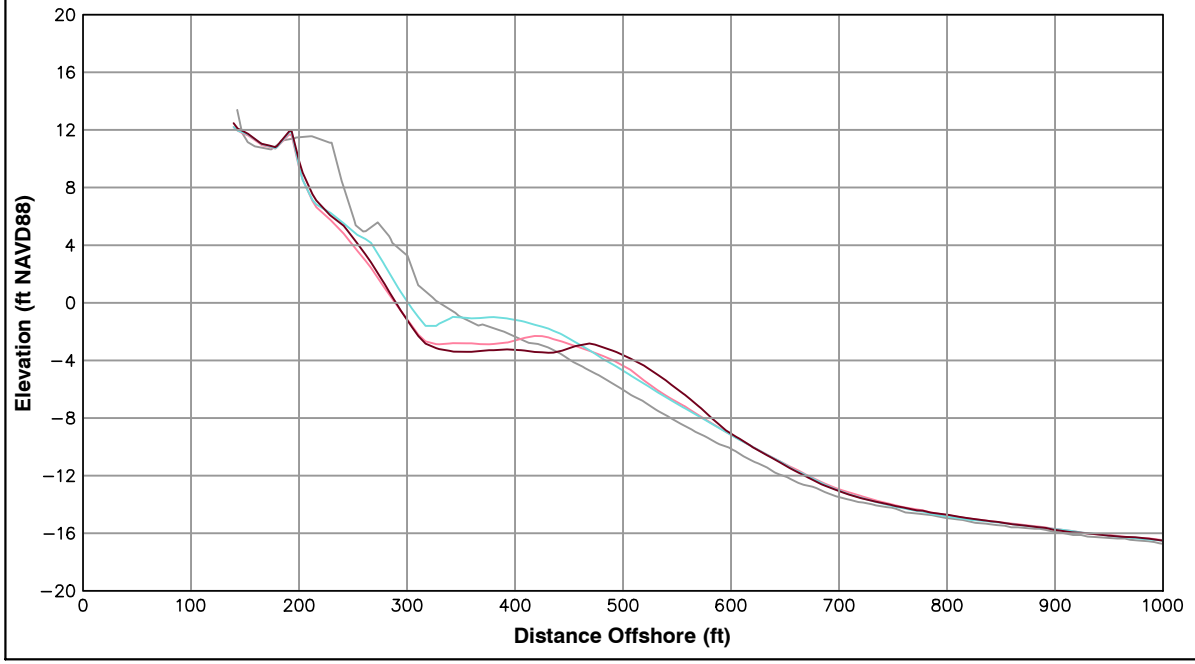
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 163+49	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	2.11 ft/yr	-10.59 ft
Volume Change Above -15 ft NAVD88	1.62 cy/ft/yr	-8.06 cy/ft
Volume Change Above 0 ft NAVD88	1.75 cy/ft/yr	-1.63 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

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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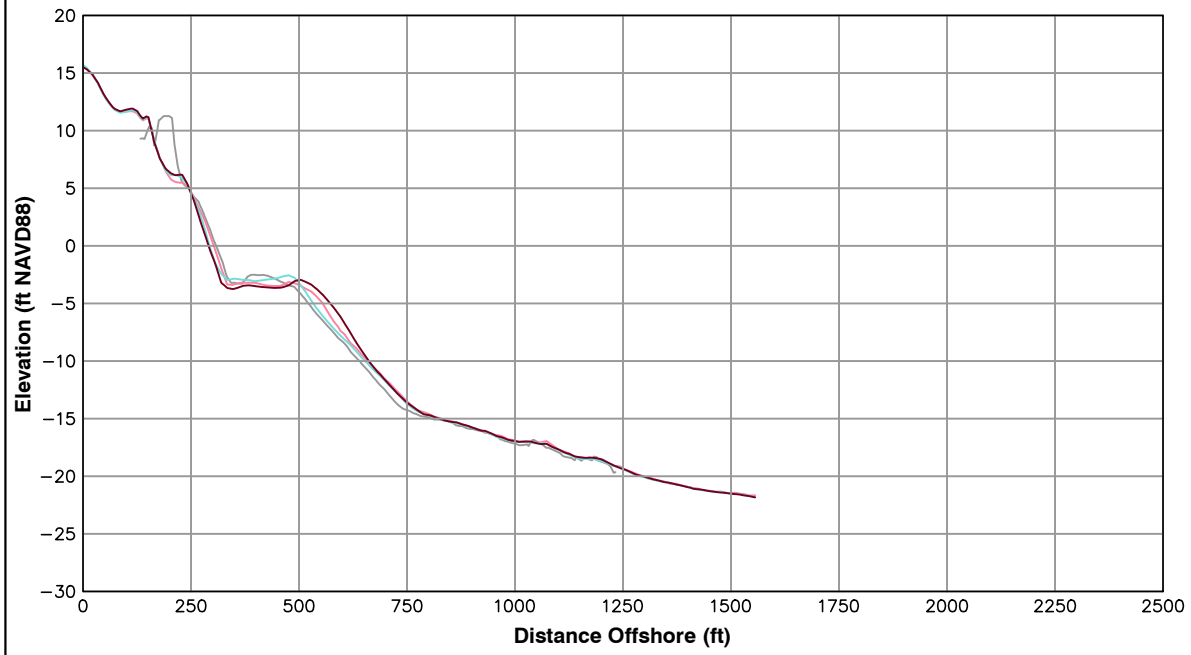
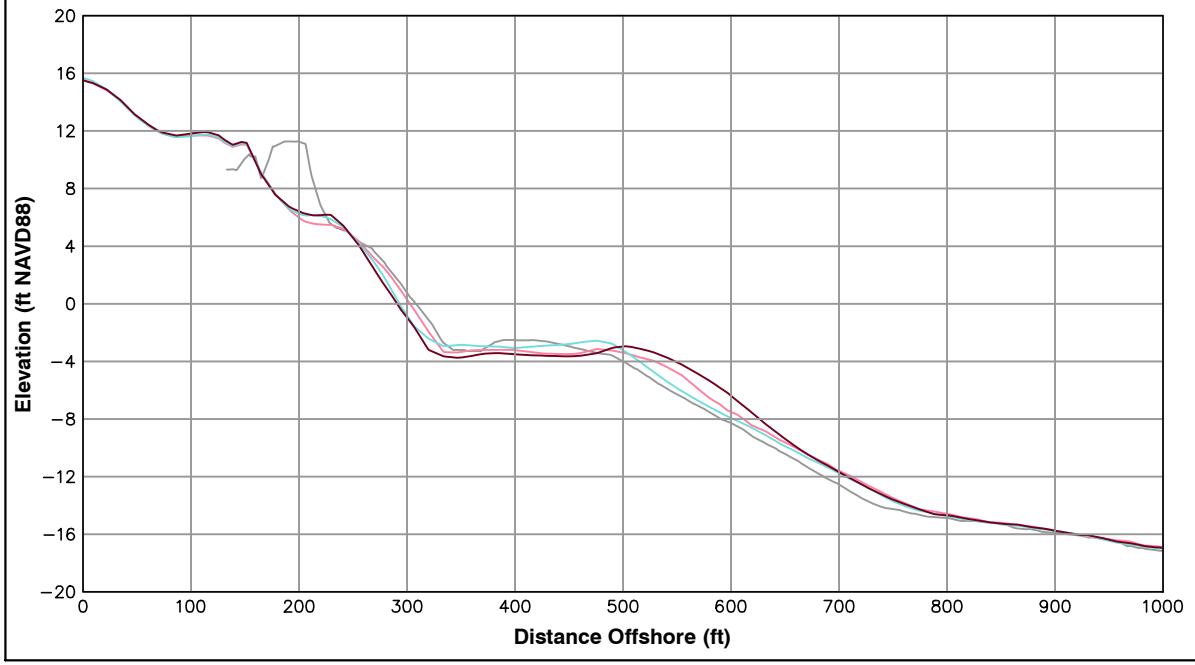
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 169+63	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-12.02 ft/yr	-3.48 ft
Volume Change Above -15 ft NAVD88	1.23 cy/ft/yr	3.55 cy/ft
Volume Change Above 0 ft NAVD88	0.04 cy/ft/yr	0.15 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

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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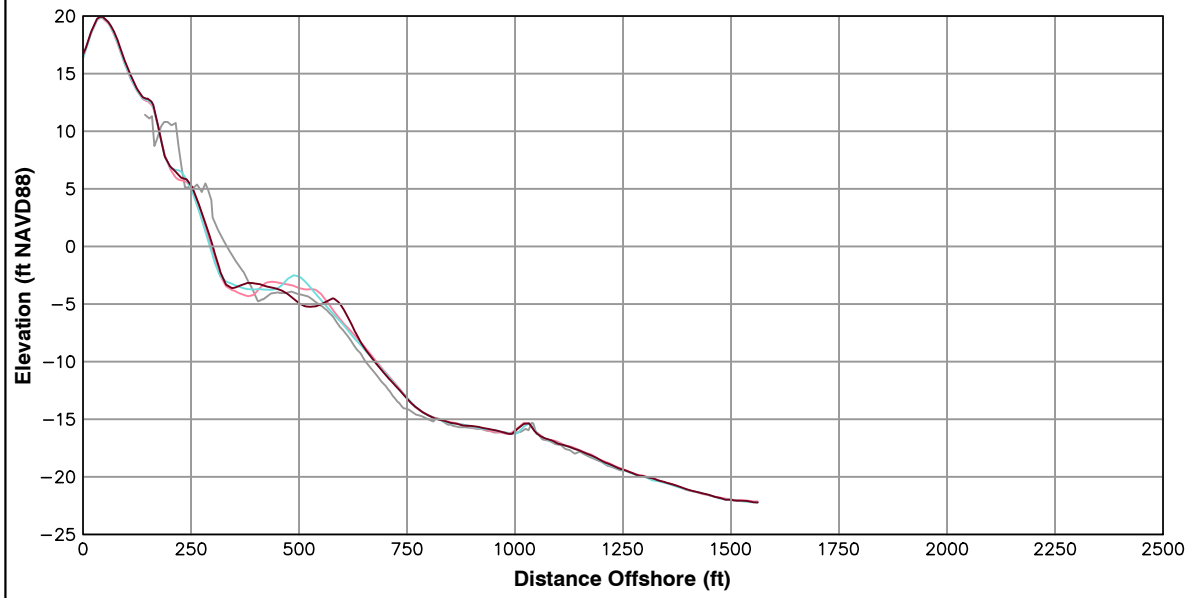
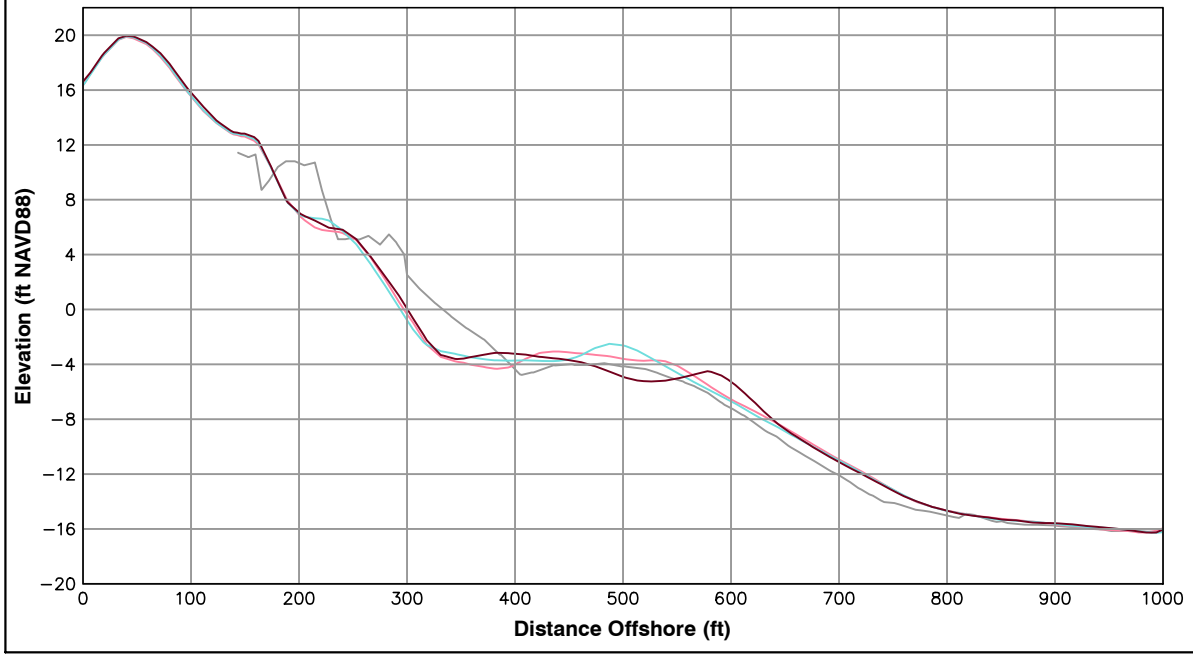
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 171+63	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	3.66 ft/yr	6.84 ft
Volume Change Above -15 ft NAVD88	1.07 cy/ft/yr	0.72 cy/ft
Volume Change Above 0 ft NAVD88	2.21 cy/ft/yr	1.81 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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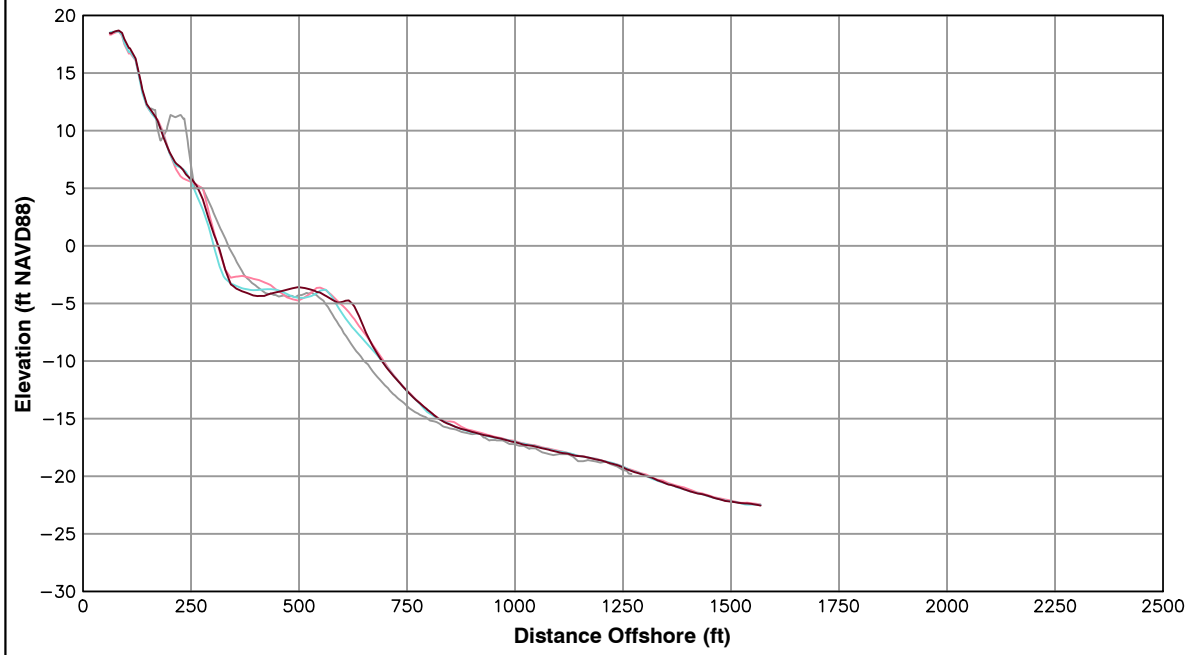
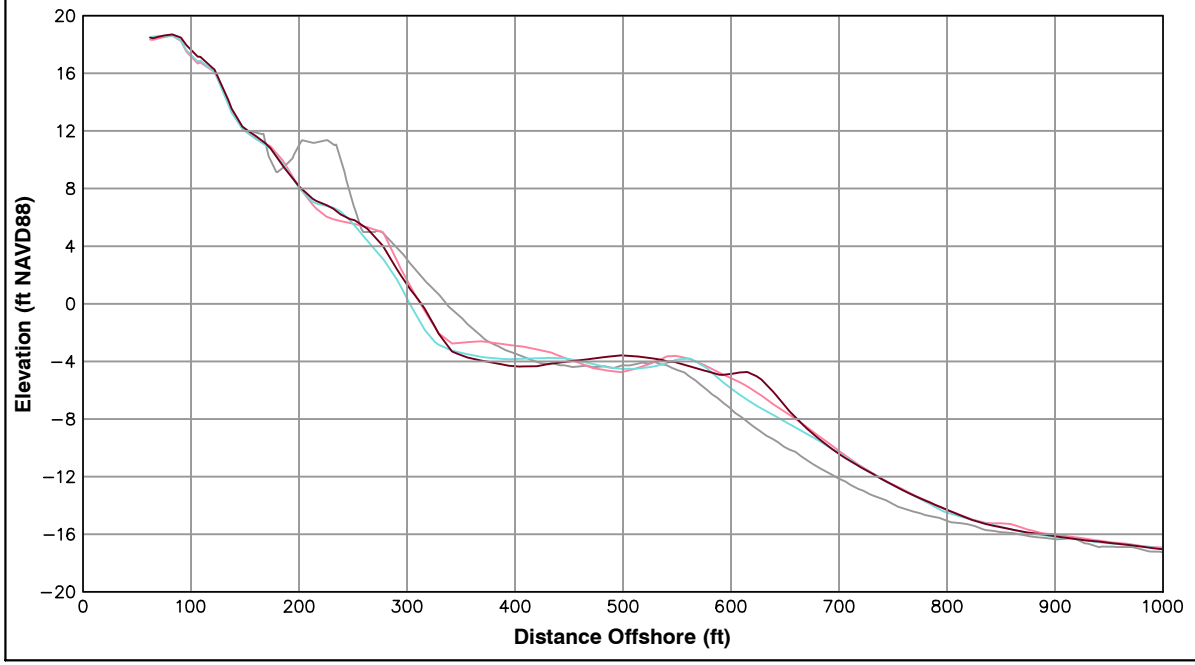
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 173+63	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-1.72 ft/yr	7.50 ft
Volume Change Above -15 ft NAVD88	-1.31 cy/ft/yr	7.78 cy/ft
Volume Change Above 0 ft NAVD88	0.70 cy/ft/yr	2.48 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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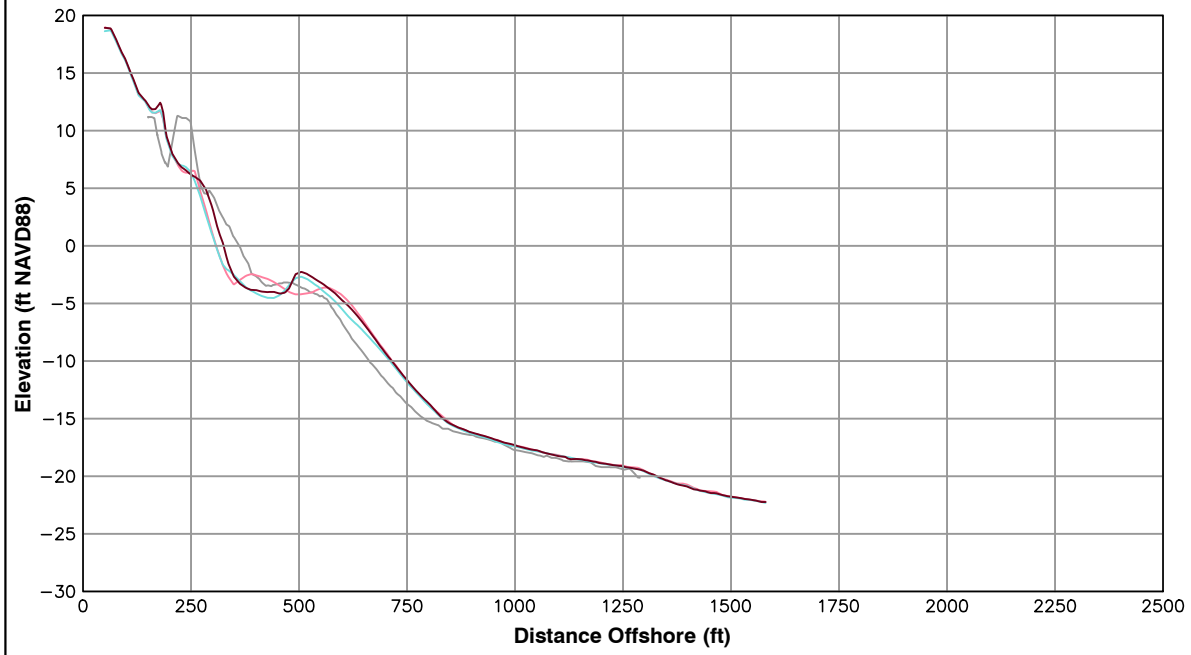
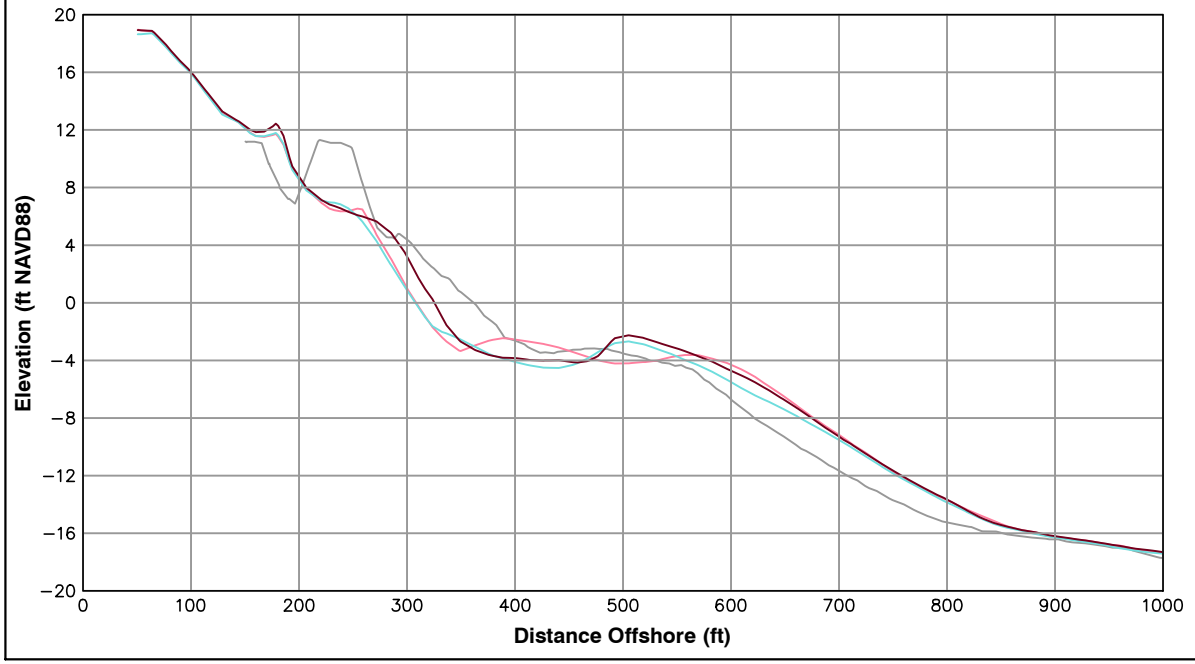
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 175+63	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	16.92 ft/yr	17.56 ft
Volume Change Above -15 ft NAVD88	5.05 cy/ft/yr	12.34 cy/ft
Volume Change Above 0 ft NAVD88	4.44 cy/ft/yr	5.15 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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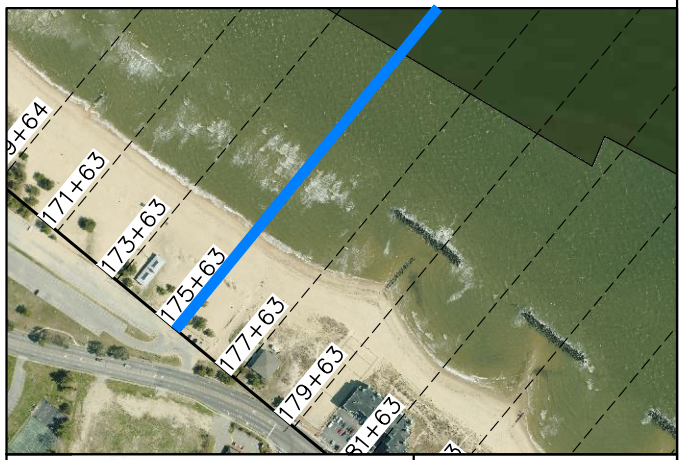

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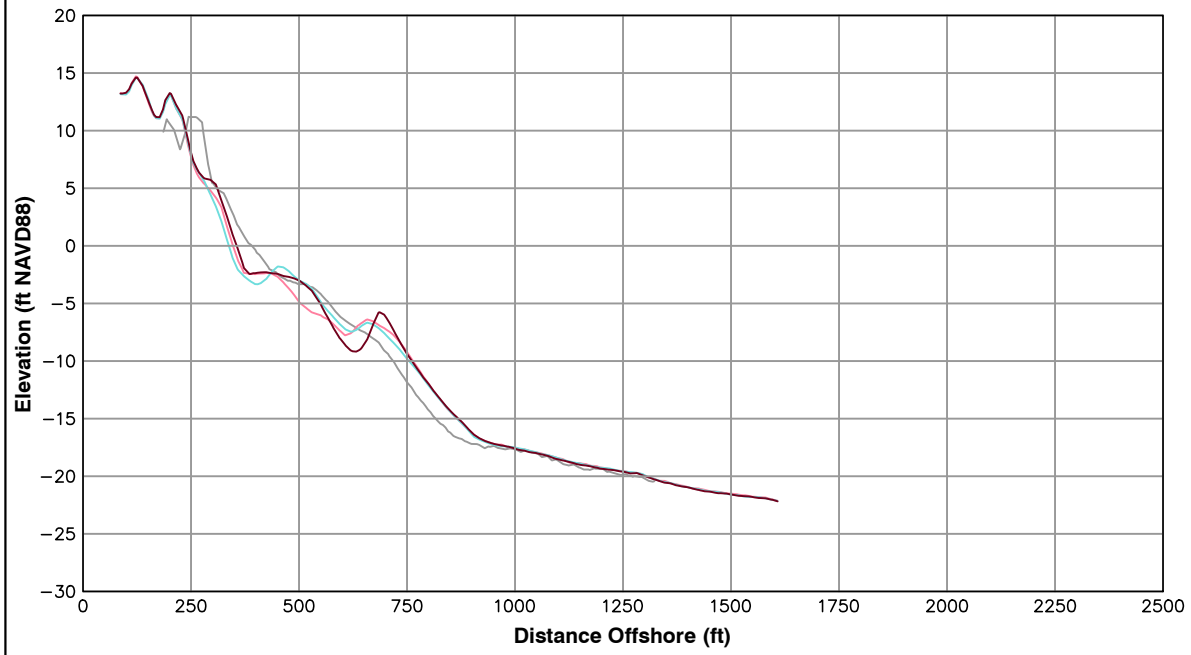
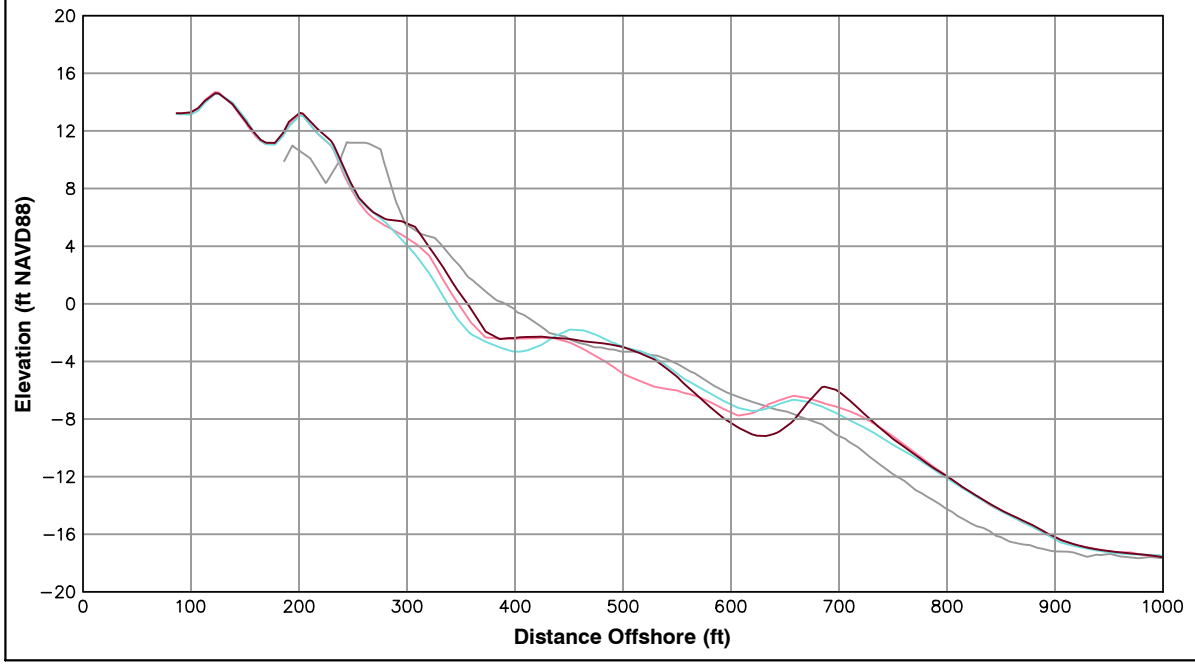
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 177+63	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	7.65 ft/yr	16.60 ft
Volume Change Above -15 ft NAVD88	6.85 cy/ft/yr	4.77 cy/ft
Volume Change Above 0 ft NAVD88	3.67 cy/ft/yr	4.84 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

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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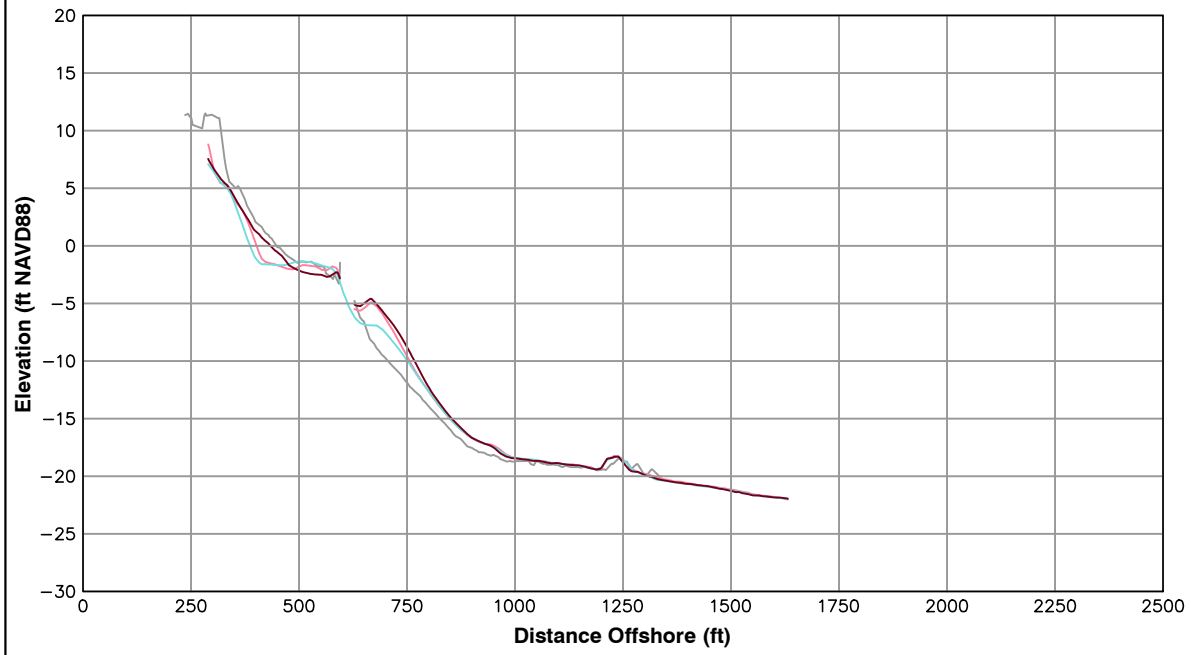
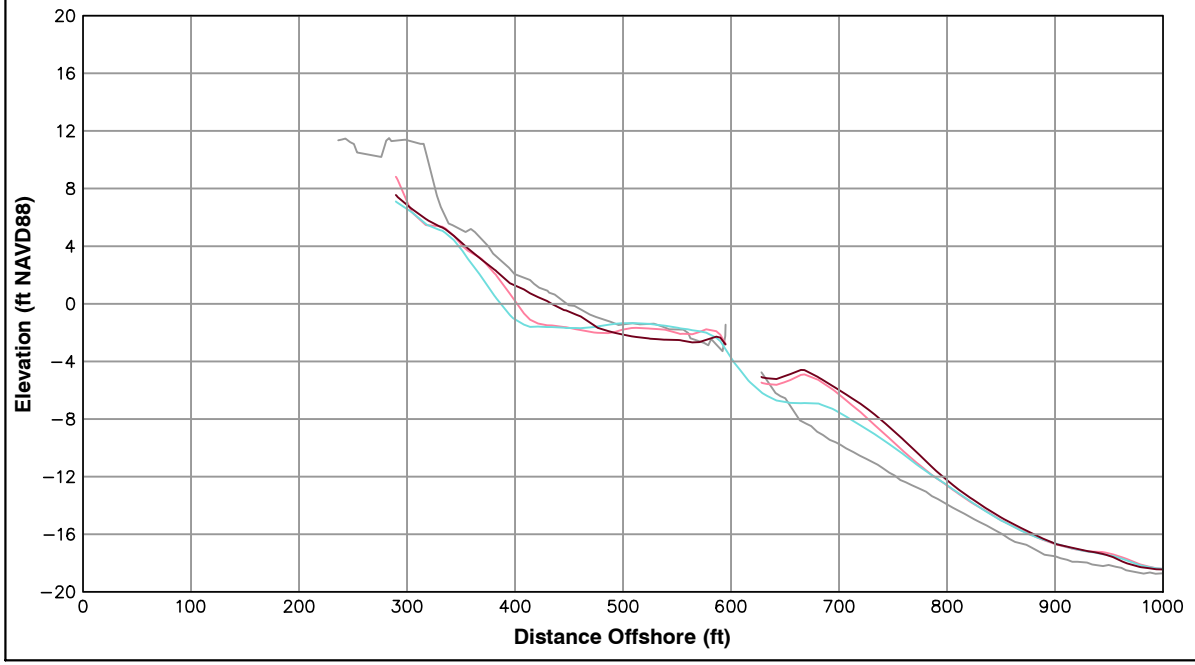
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 179+63	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	16.66 ft/yr	31.48 ft
Volume Change Above -15 ft NAVD88	6.06 cy/ft/yr	13.78 cy/ft
Volume Change Above 0 ft NAVD88	1.31 cy/ft/yr	3.94 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
1. Stationing From West To East At Varying Intervals.
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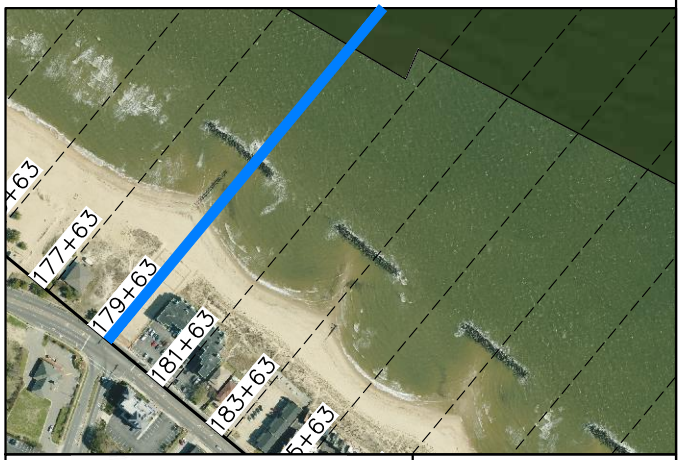

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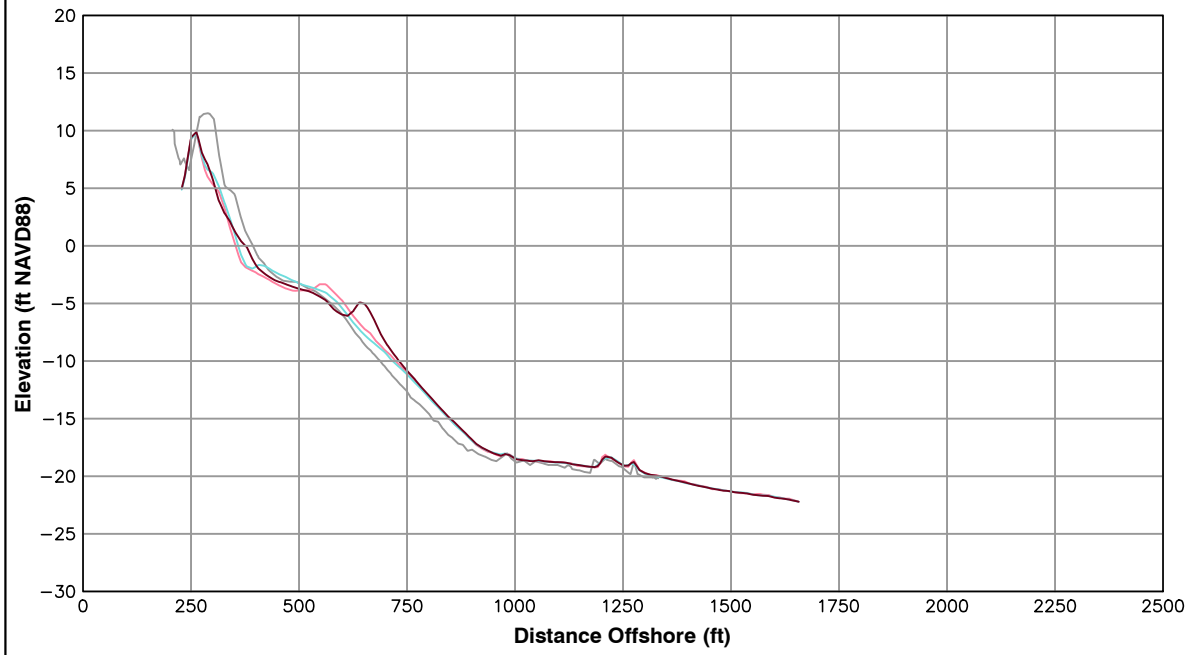
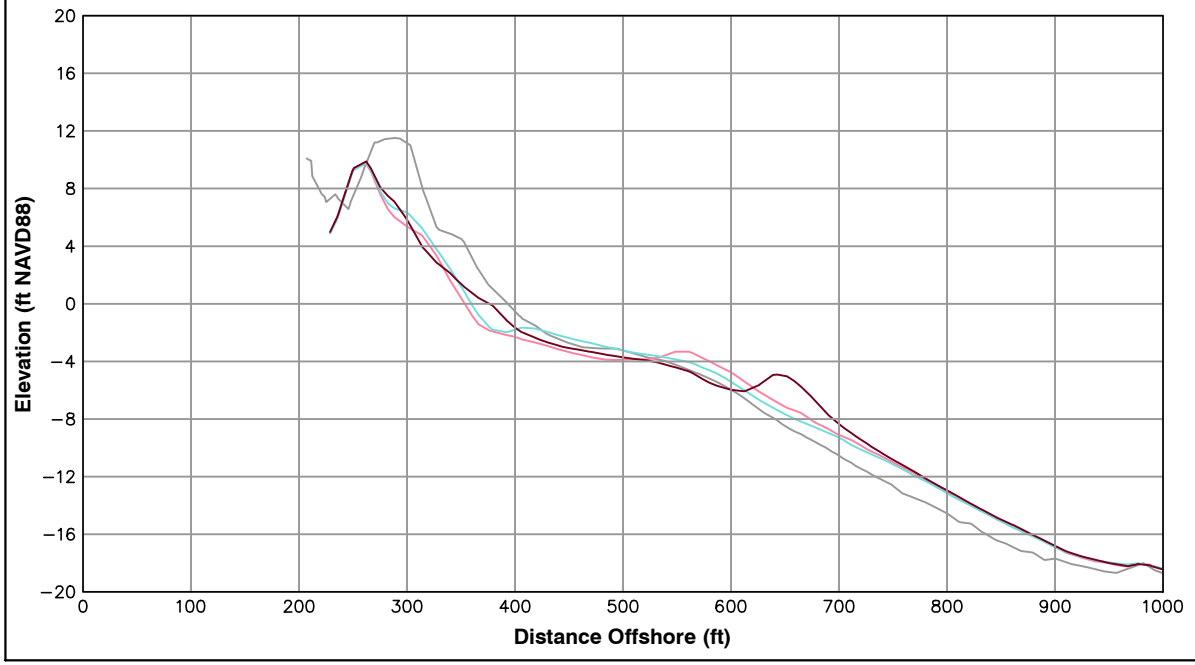
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 181+63	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	11.45 ft/yr	4.39 ft
Volume Change Above -15 ft NAVD88	6.73 cy/ft/yr	3.99 cy/ft
Volume Change Above 0 ft NAVD88	1.46 cy/ft/yr	-0.48 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

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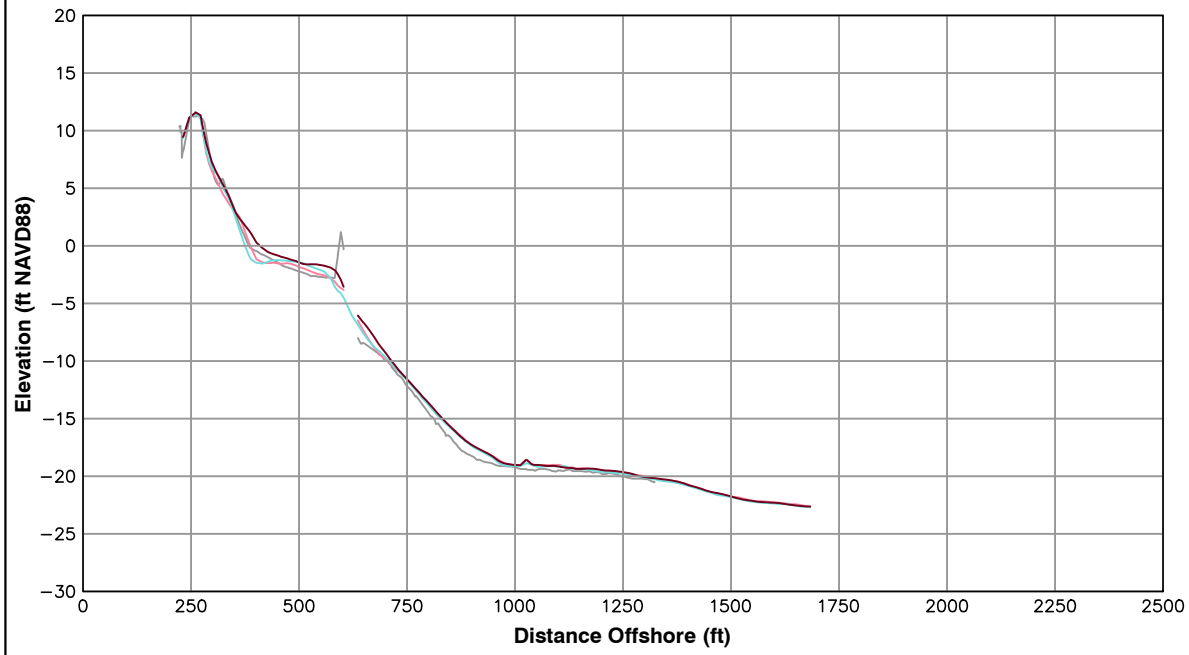
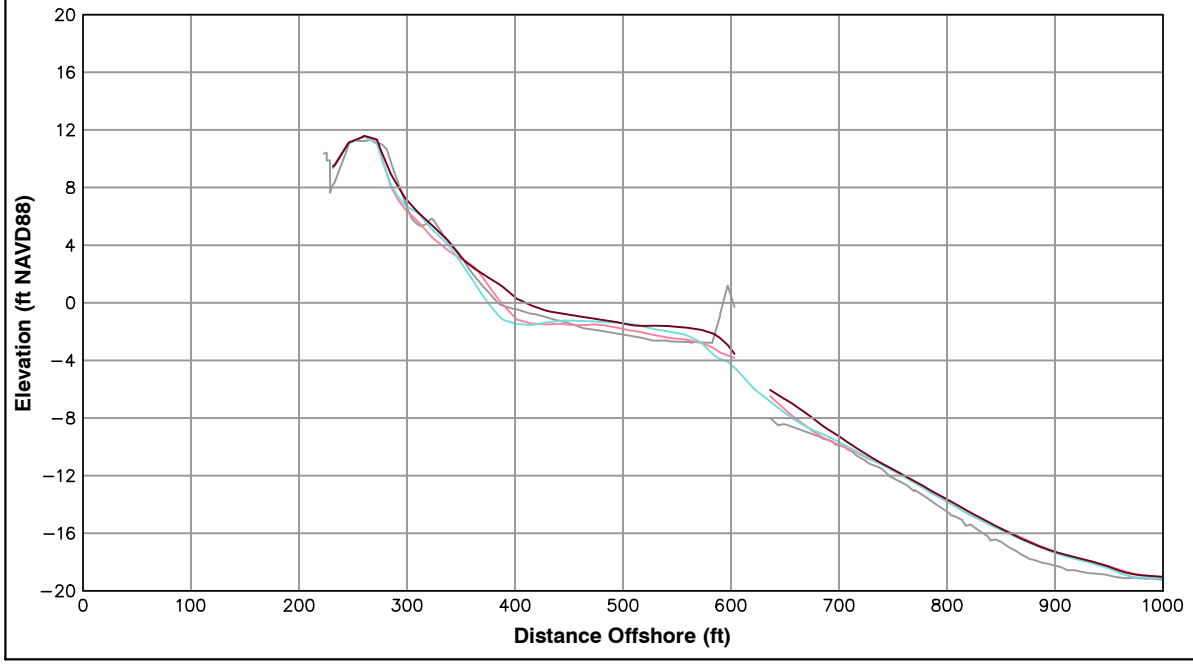
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 183+63	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	13.71 ft/yr	24.71 ft
Volume Change Above -15 ft NAVD88	11.60 cy/ft/yr	11.19 cy/ft
Volume Change Above 0 ft NAVD88	2.99 cy/ft/yr	3.27 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
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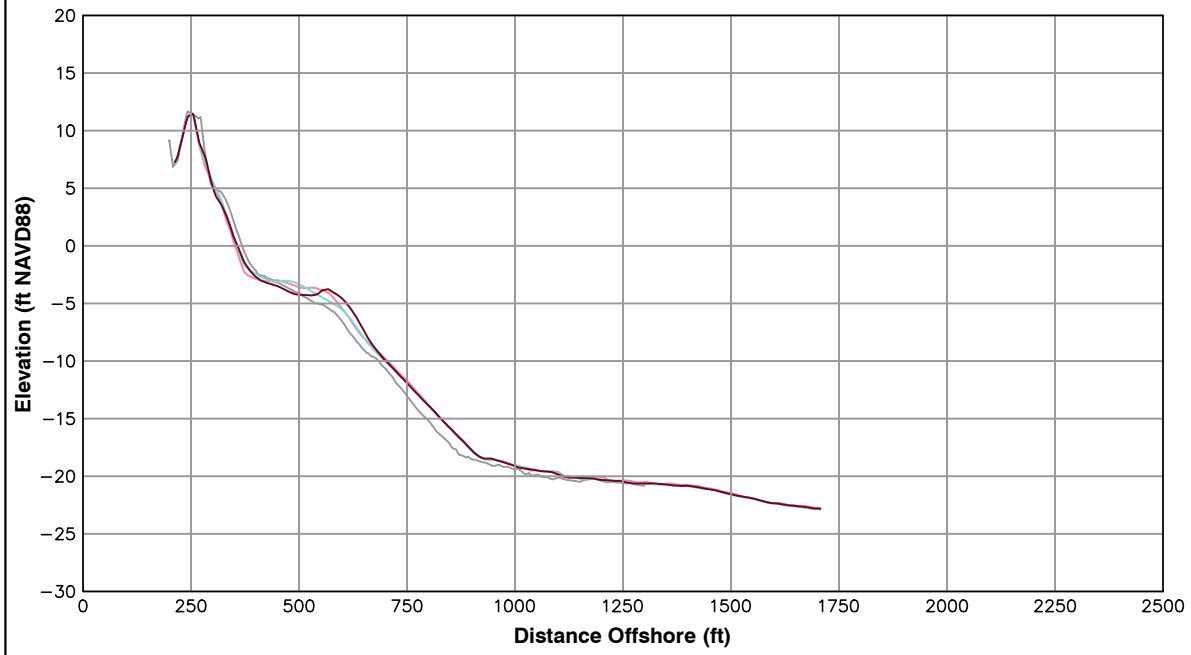
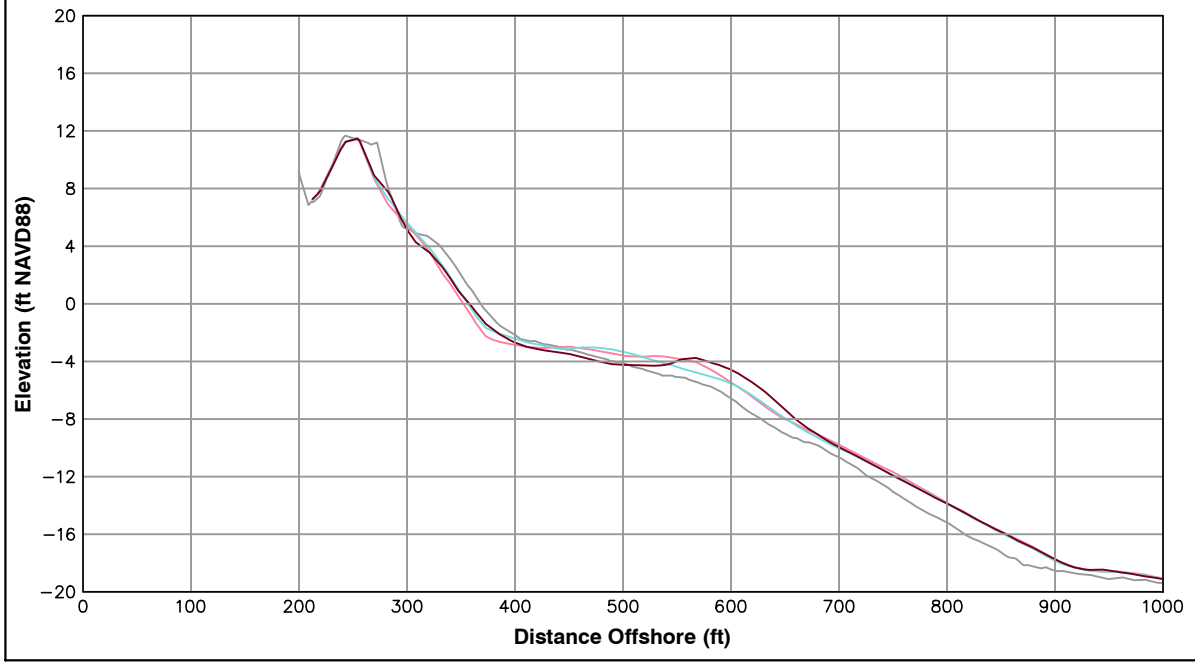
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 185+63	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	3.36 ft/yr	-0.99 ft
Volume Change Above -15 ft NAVD88	1.15 cy/ft/yr	0.71 cy/ft
Volume Change Above 0 ft NAVD88	0.66 cy/ft/yr	-0.38 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
1. Stationing 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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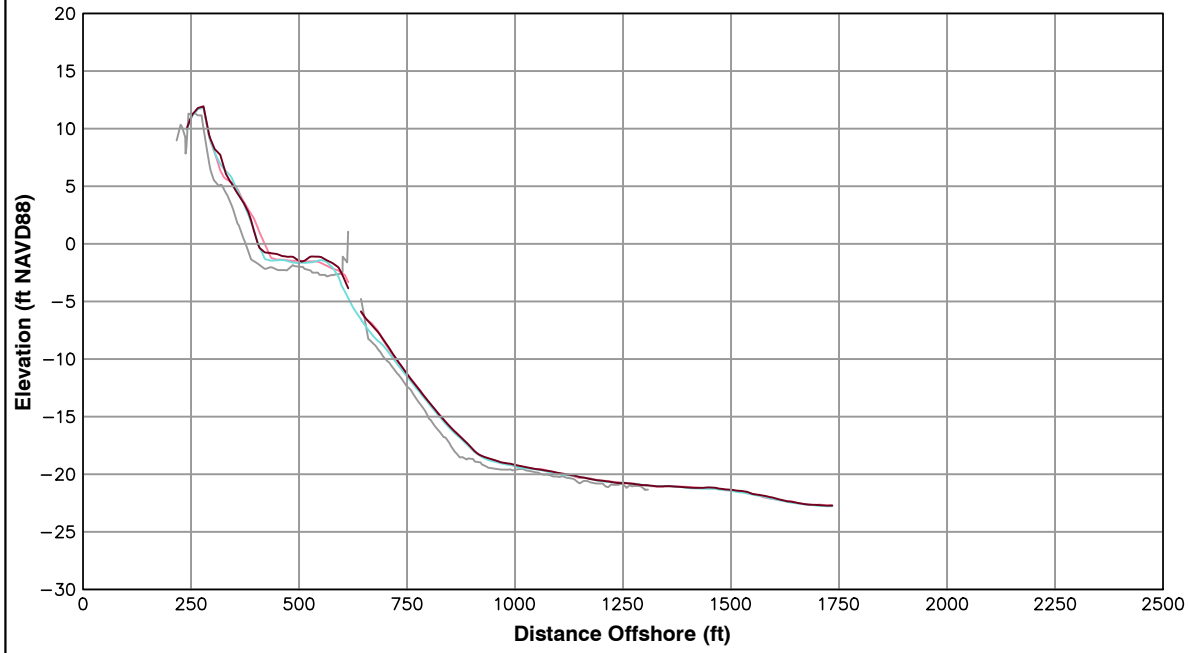
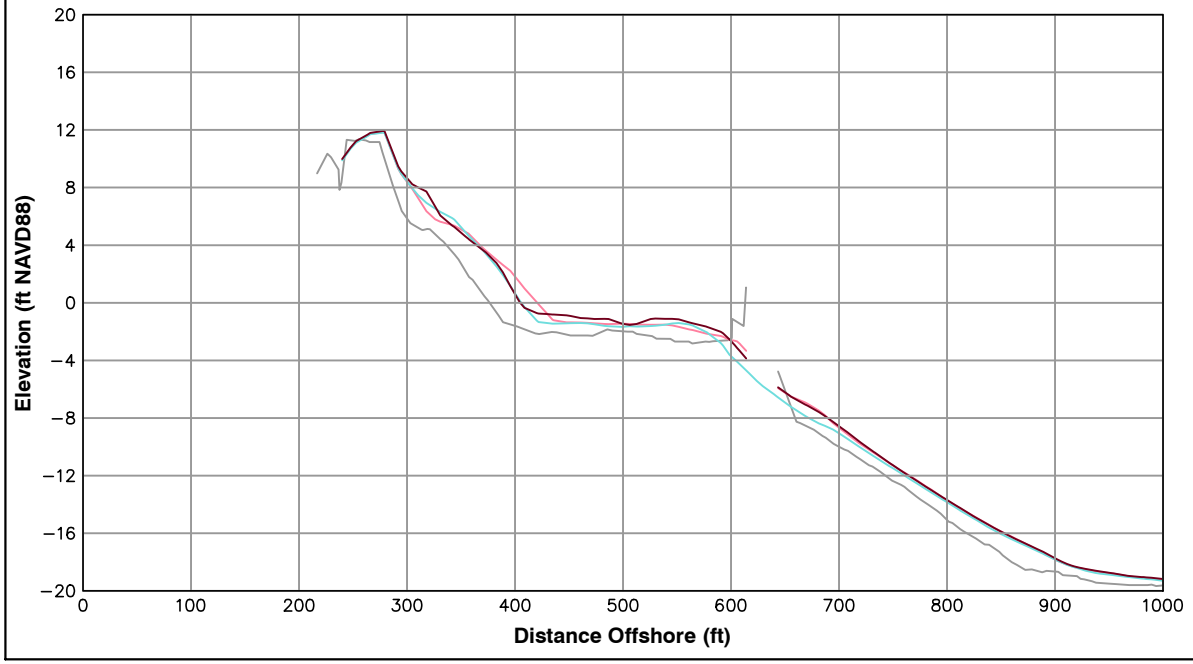
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 187+63	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-12.32 ft/yr	-0.24 ft
Volume Change Above -15 ft NAVD88	1.35 cy/ft/yr	6.40 cy/ft
Volume Change Above 0 ft NAVD88	-0.22 cy/ft/yr	0.39 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
1. Stationing From West To East At Varying Intervals.
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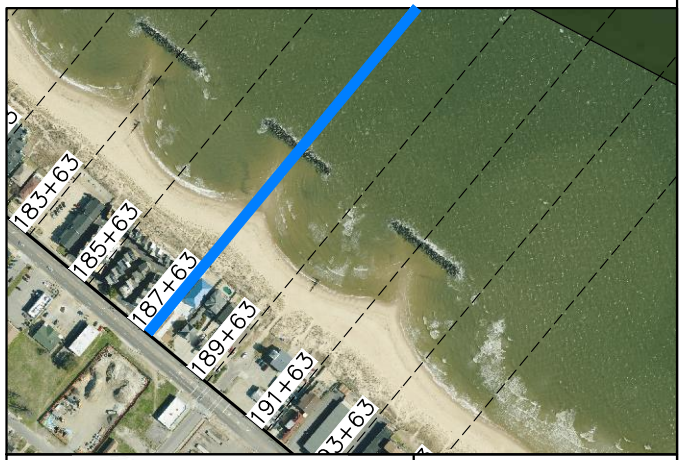
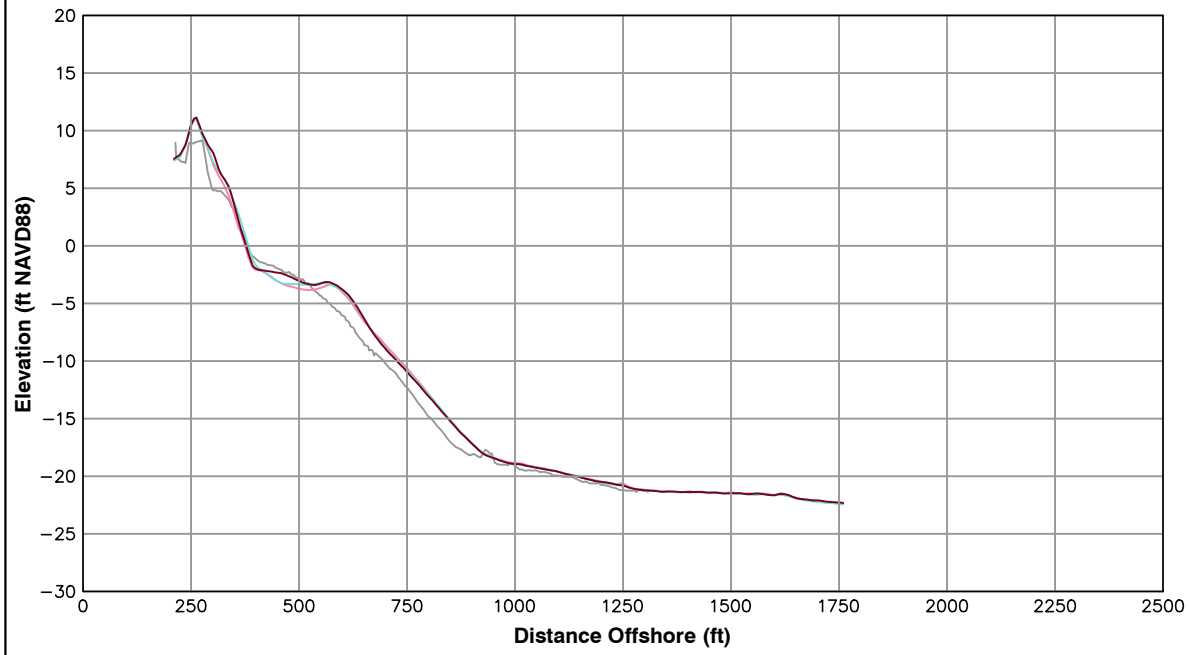
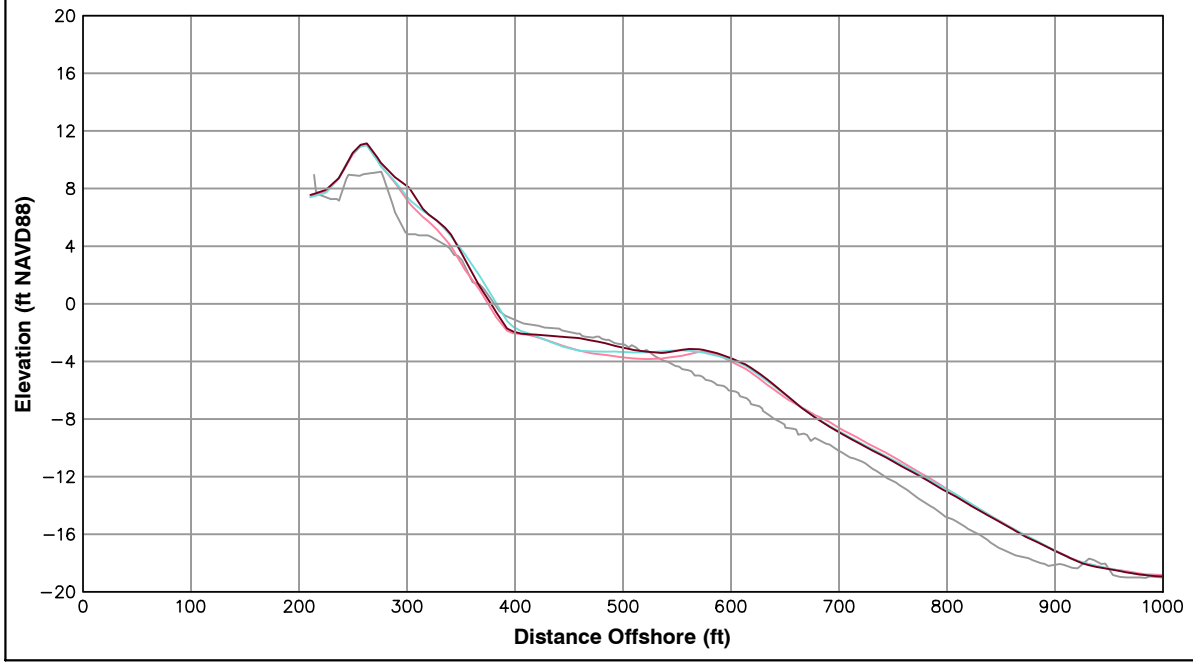


City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 189+63	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	2.26 ft/yr	-5.77 ft
Volume Change Above -15 ft NAVD88	5.29 cy/ft/yr	1.40 cy/ft
Volume Change Above 0 ft NAVD88	2.54 cy/ft/yr	0.28 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
1. Stationing From West To East At Varying Intervals.
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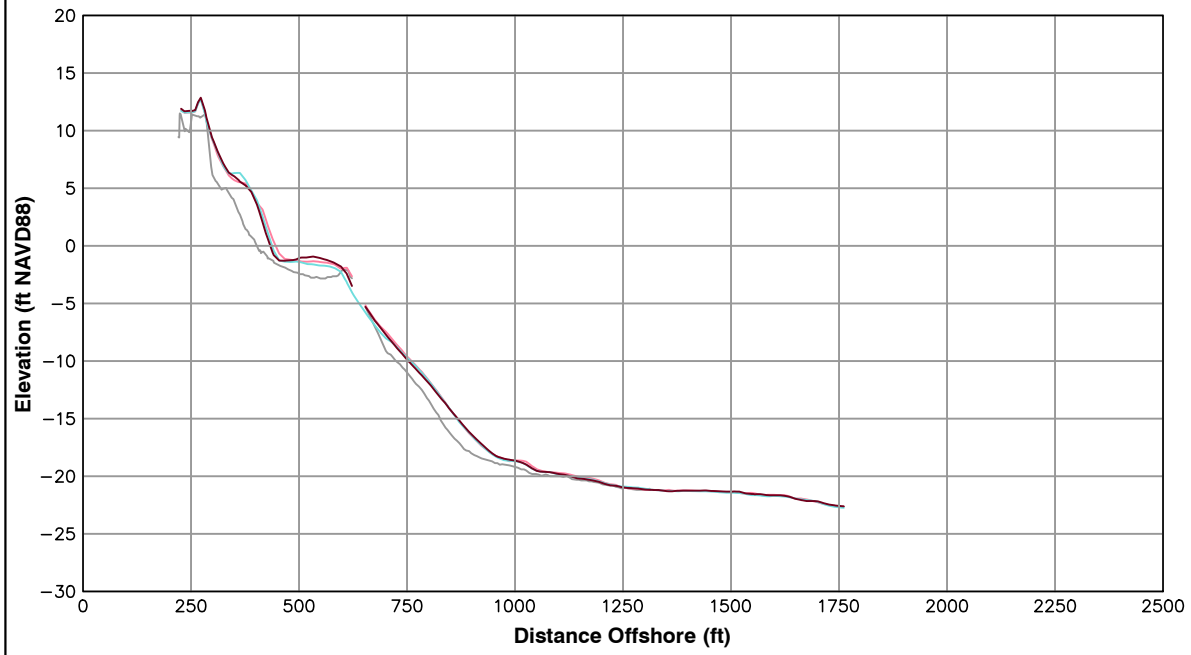
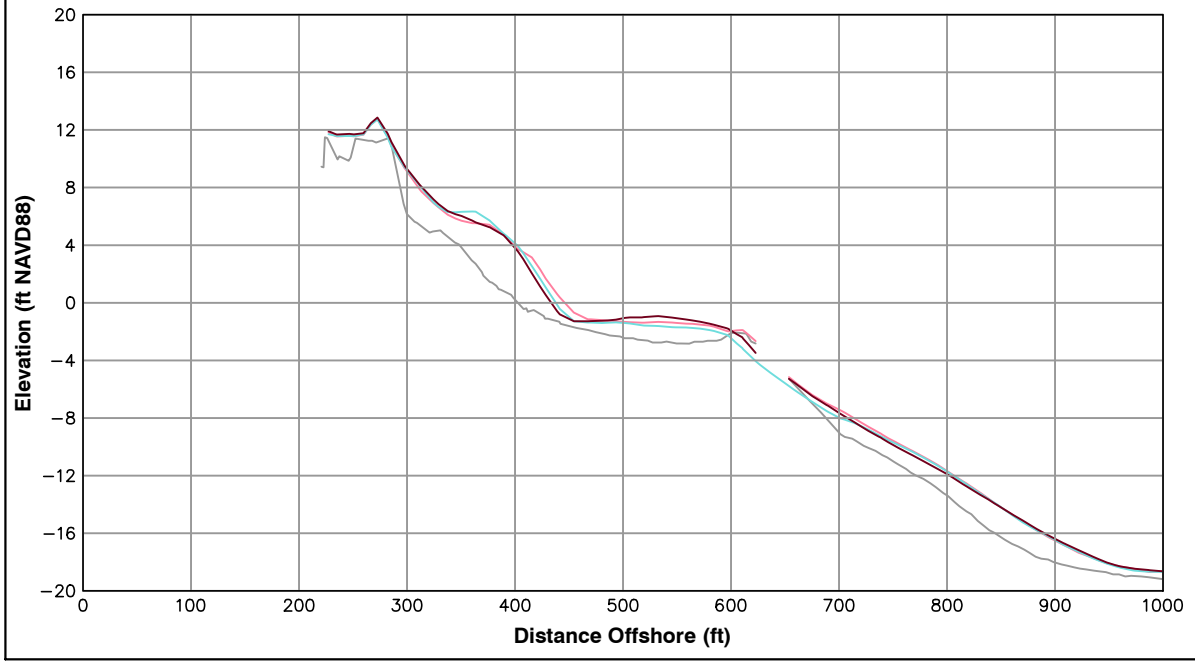
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 191+63	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-11.06 ft/yr	-4.58 ft
Volume Change Above -15 ft NAVD88	-2.02 cy/ft/yr	1.86 cy/ft
Volume Change Above 0 ft NAVD88	-0.43 cy/ft/yr	-0.84 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
1. Stationing From West To East At Varying Intervals.
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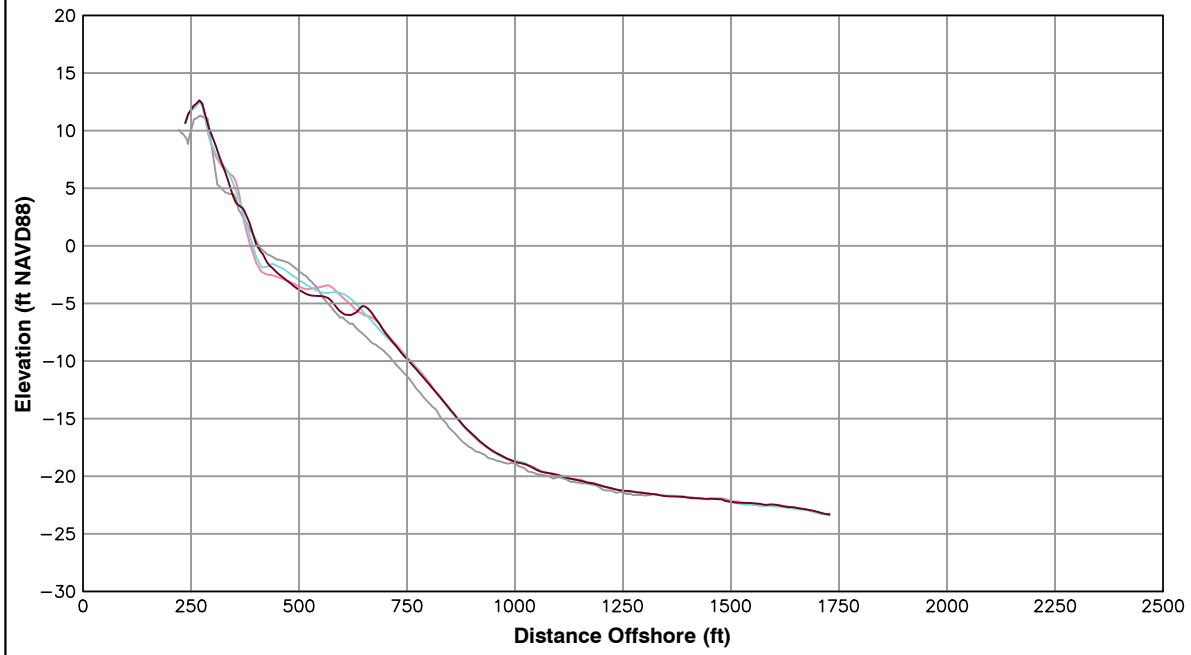
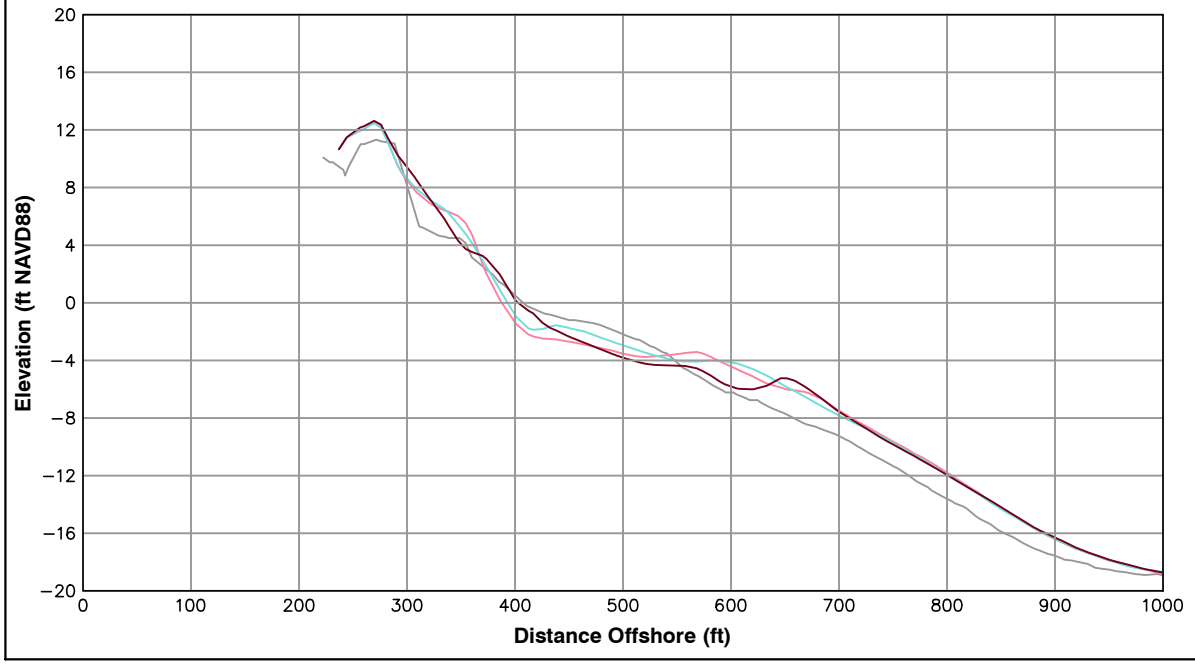
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 193+63	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	13.77 ft/yr	8.57 ft
Volume Change Above -15 ft NAVD88	-1.05 cy/ft/yr	-3.27 cy/ft
Volume Change Above 0 ft NAVD88	0.98 cy/ft/yr	0.82 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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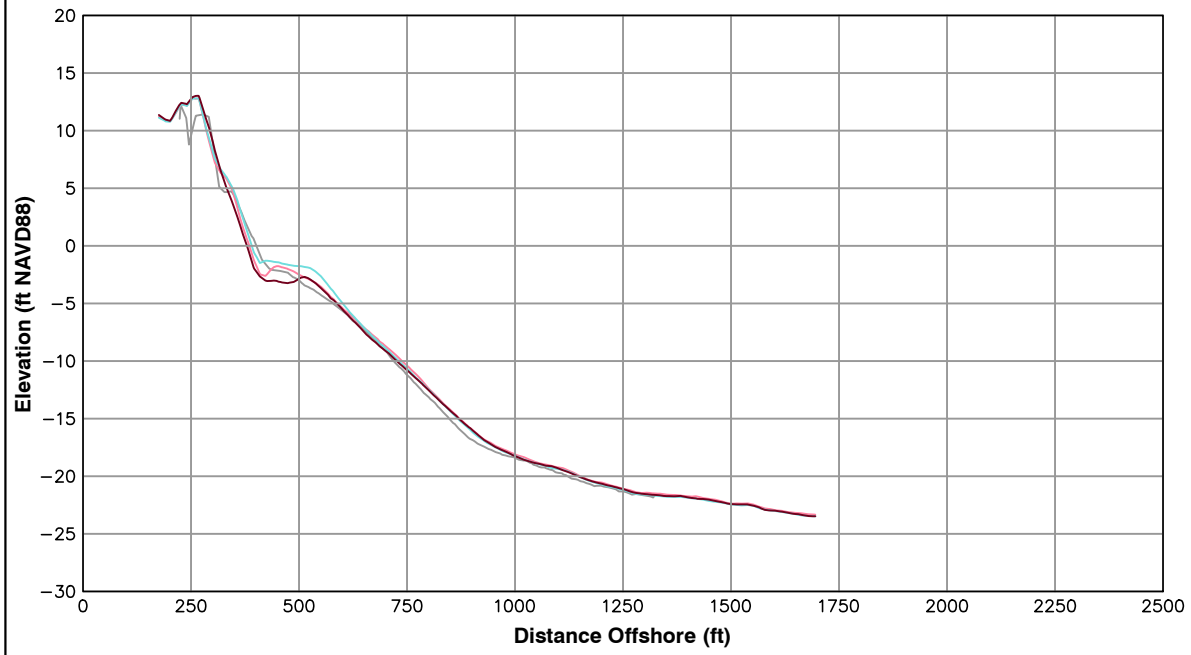
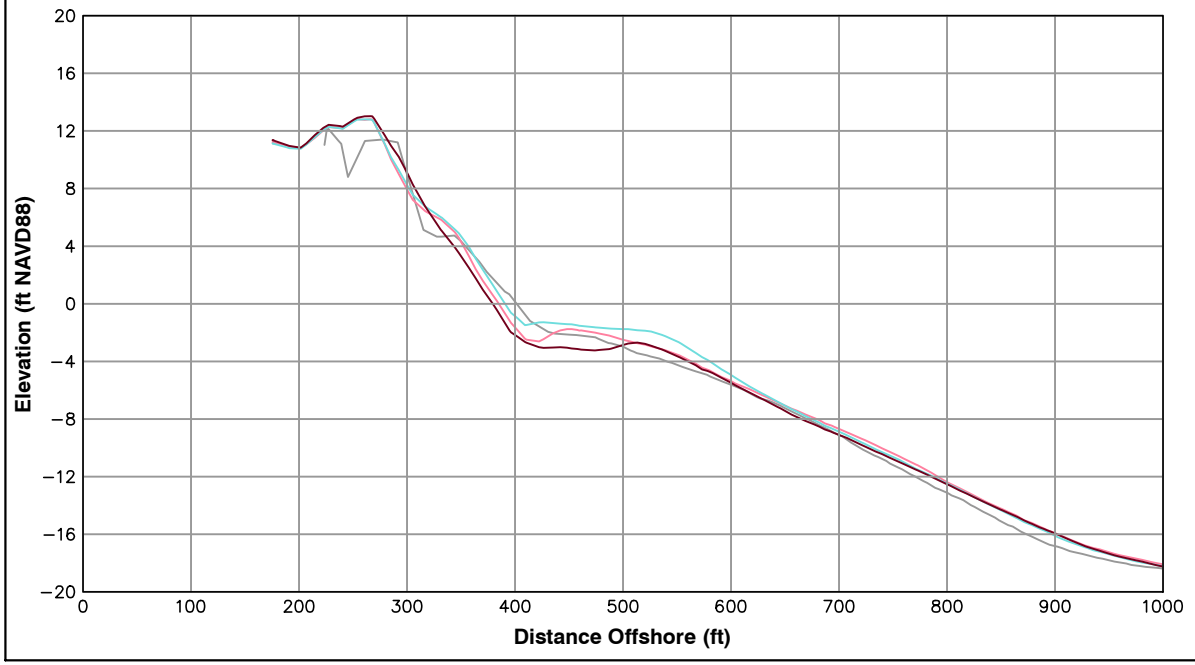
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 195+63	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-5.91 ft/yr	-12.02 ft
Volume Change Above -15 ft NAVD88	-6.73 cy/ft/yr	-12.63 cy/ft
Volume Change Above 0 ft NAVD88	0.32 cy/ft/yr	-1.19 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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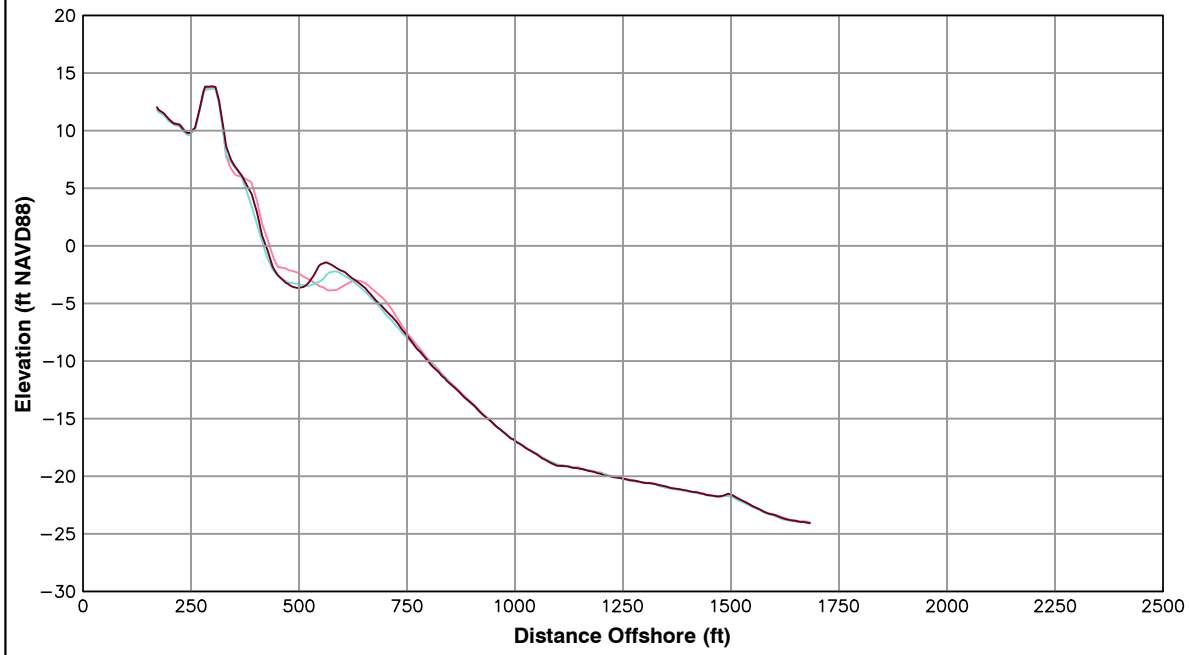
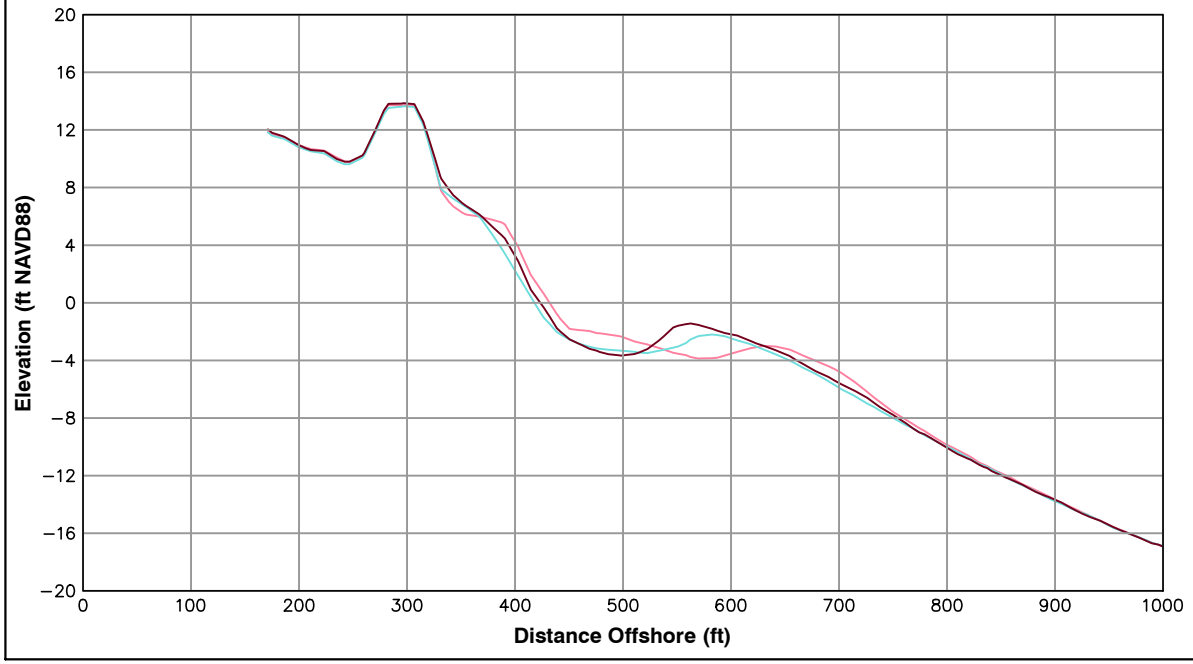
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 206+86	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-9.38 ft/yr	4.18 ft
Volume Change Above -15 ft NAVD88	-2.14 cy/ft/yr	6.82 cy/ft
Volume Change Above 0 ft NAVD88	-0.50 cy/ft/yr	2.98 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR

Notes:
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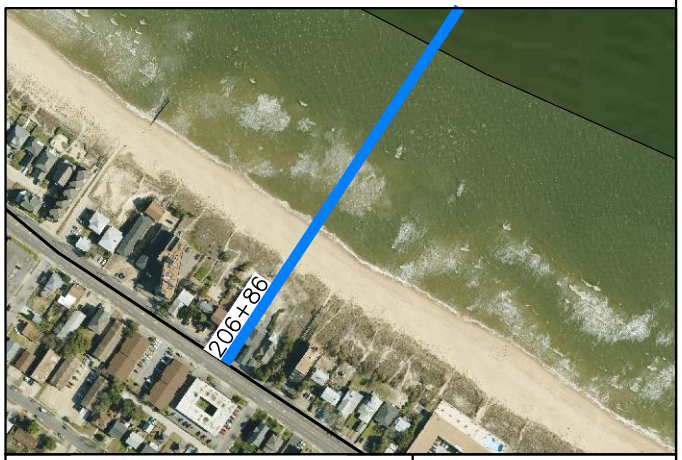

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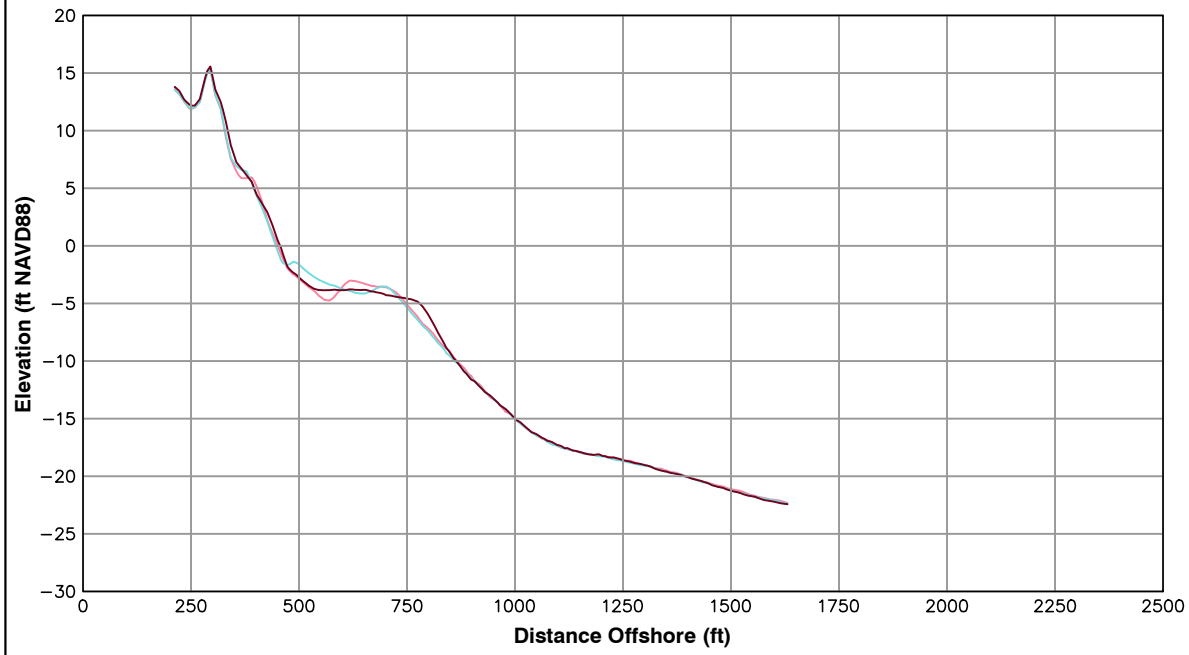
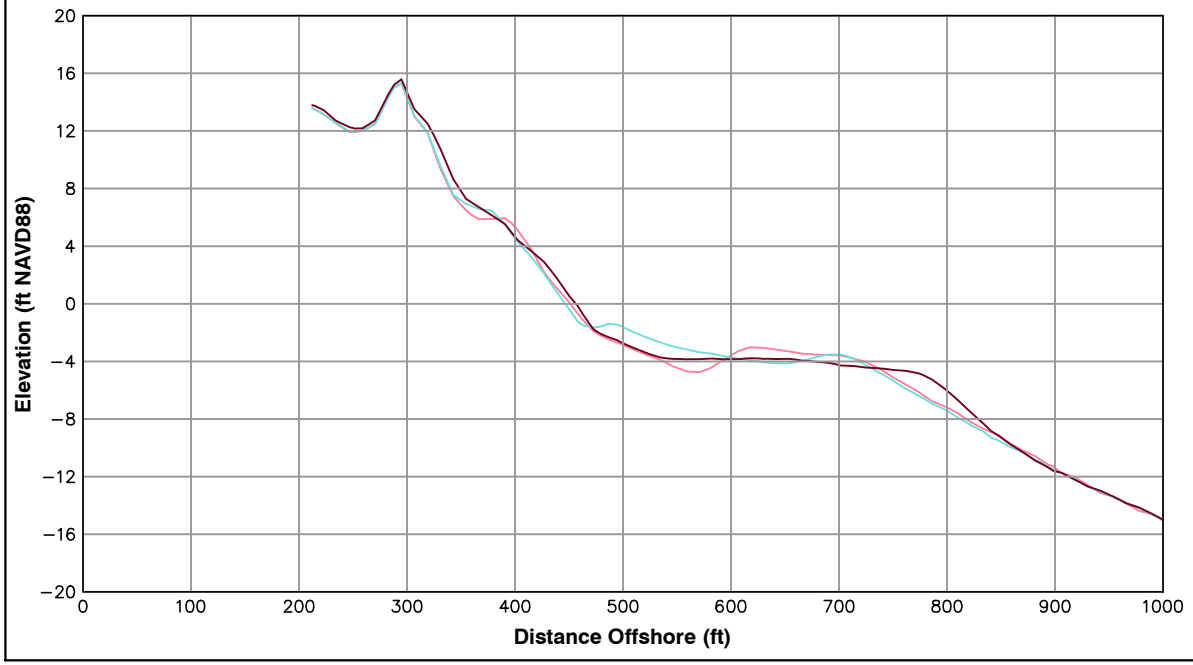
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 218+66	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	6.46 ft/yr	9.05 ft
Volume Change Above -15 ft NAVD88	5.77 cy/ft/yr	4.50 cy/ft
Volume Change Above 0 ft NAVD88	3.59 cy/ft/yr	3.55 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR

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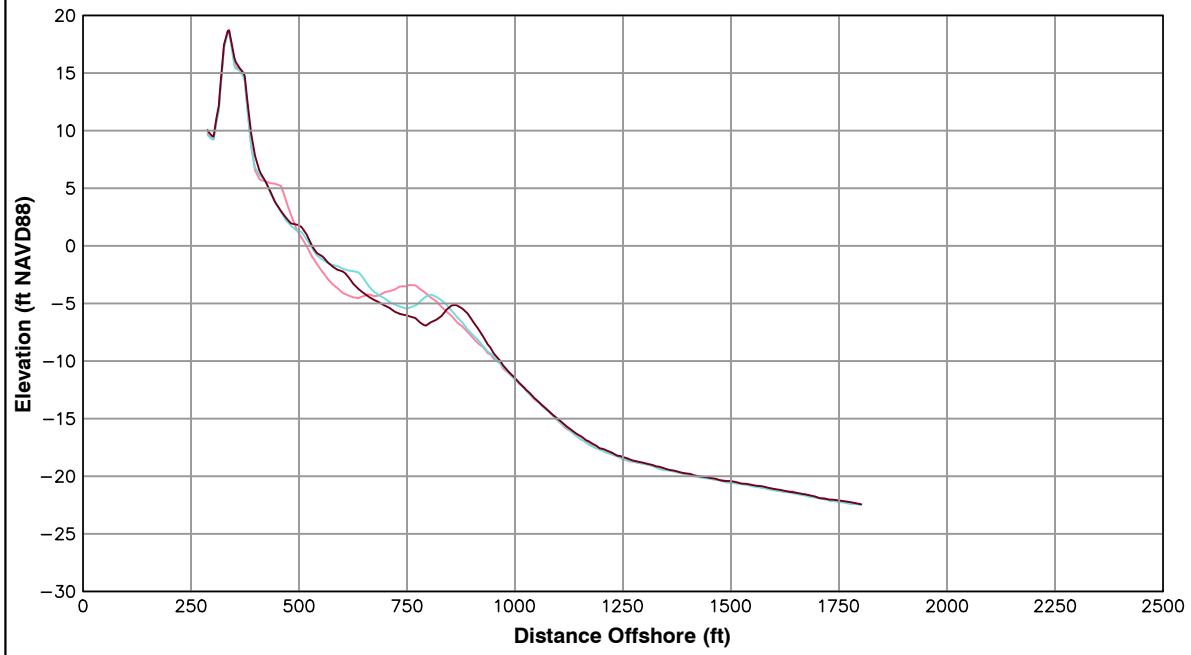
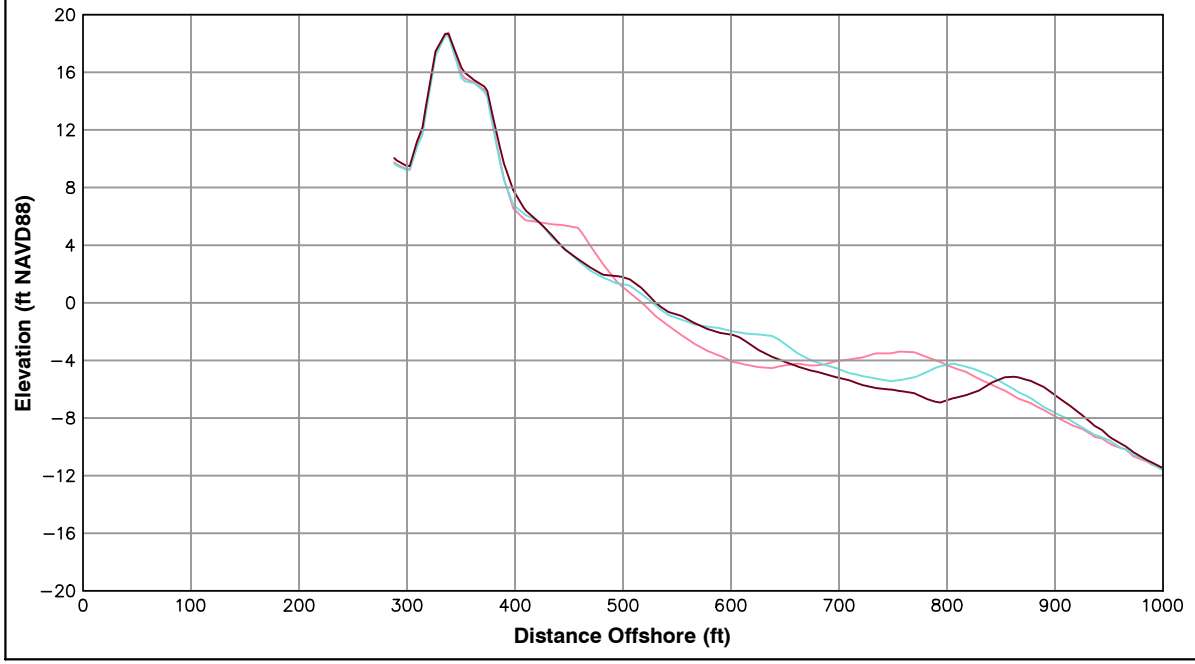
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 229+85	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	16.70 ft/yr	7.58 ft
Volume Change Above -15 ft NAVD88	-0.51 cy/ft/yr	-2.59 cy/ft
Volume Change Above 0 ft NAVD88	0.02 cy/ft/yr	3.19 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR

Notes:
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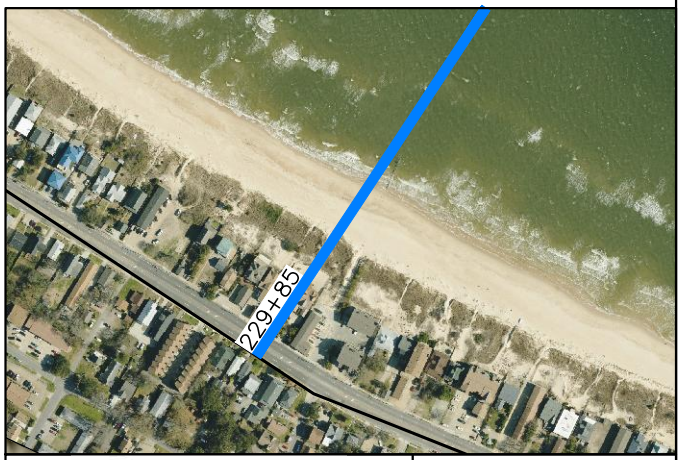

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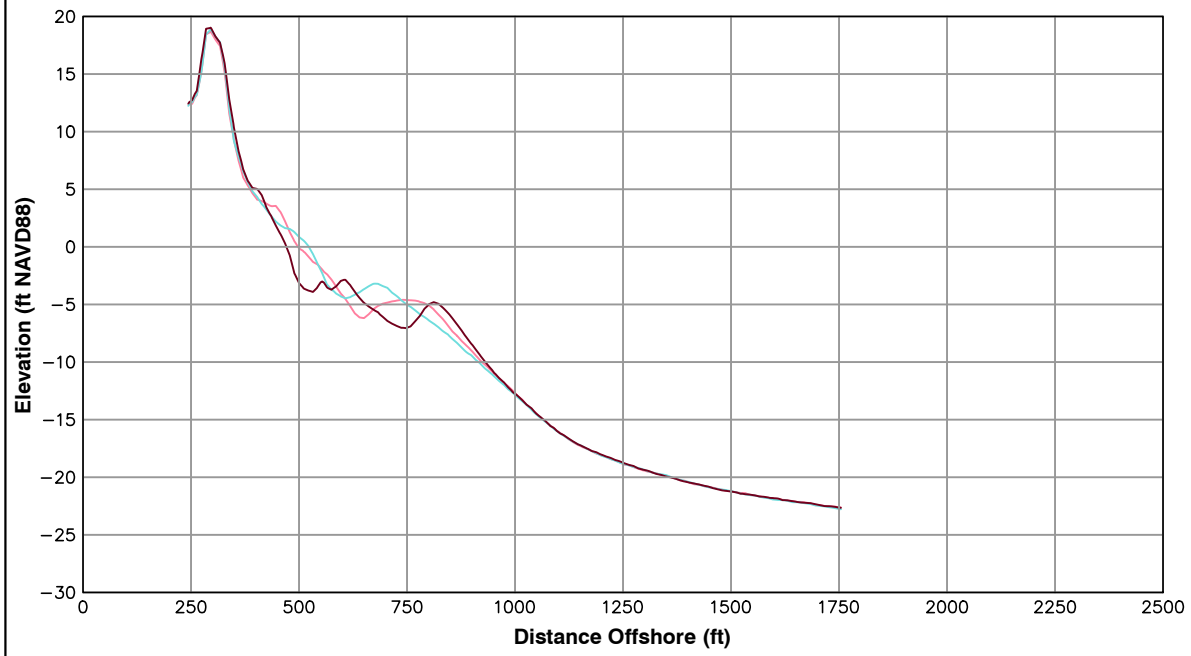
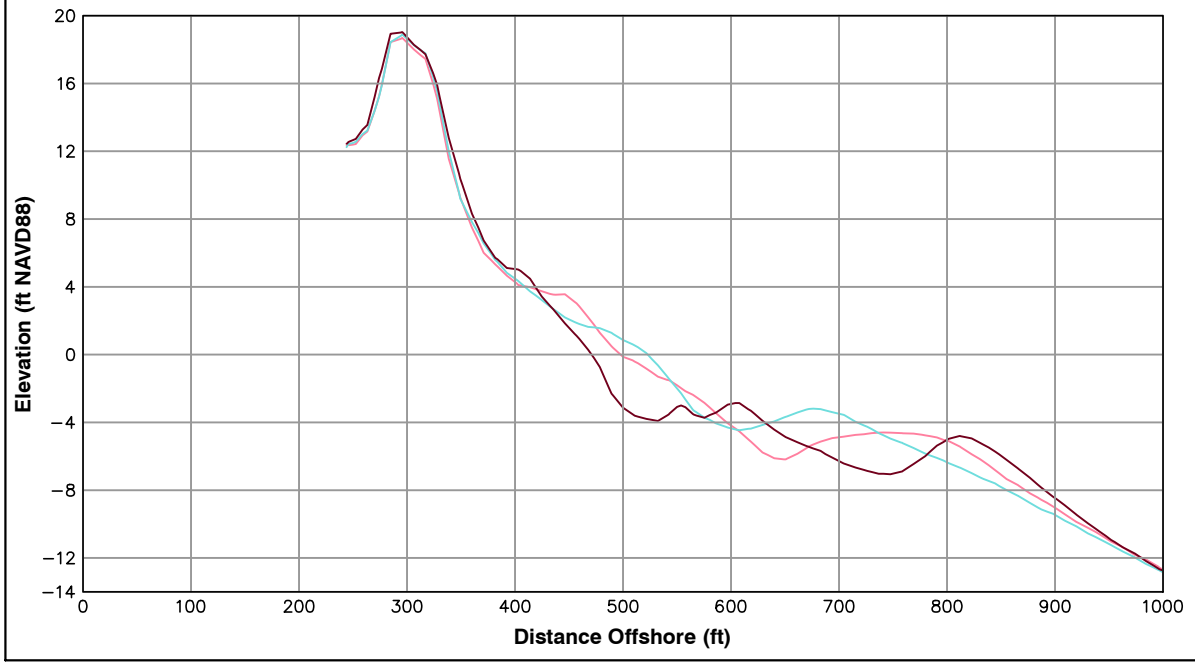
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 242+03	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-24.72 ft/yr	-38.25 ft
Volume Change Above -15 ft NAVD88	-6.81 cy/ft/yr	-7.70 cy/ft
Volume Change Above 0 ft NAVD88	0.66 cy/ft/yr	0.17 cy/ft

LEGEND:
2014 MAR
2013 OCT
2013 APR

Notes:
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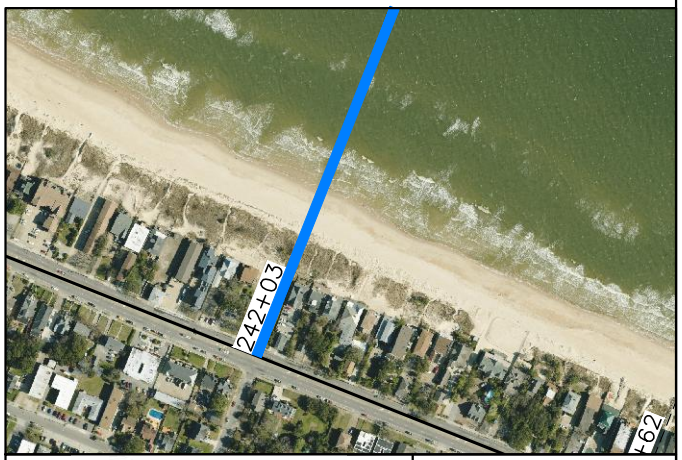
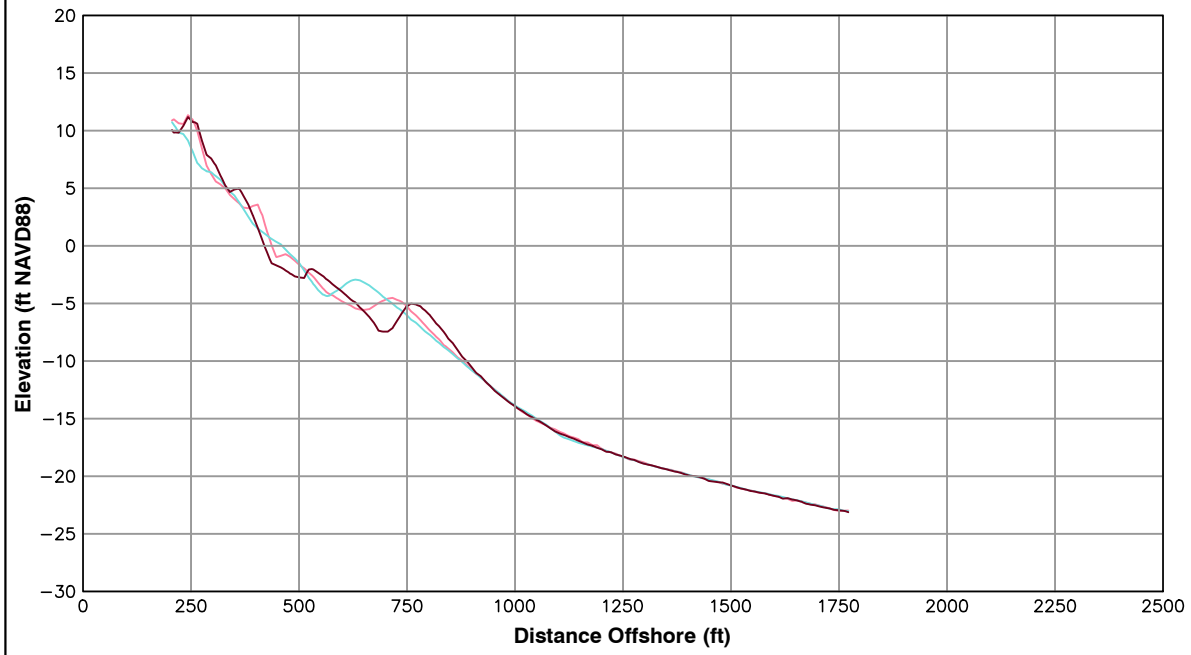
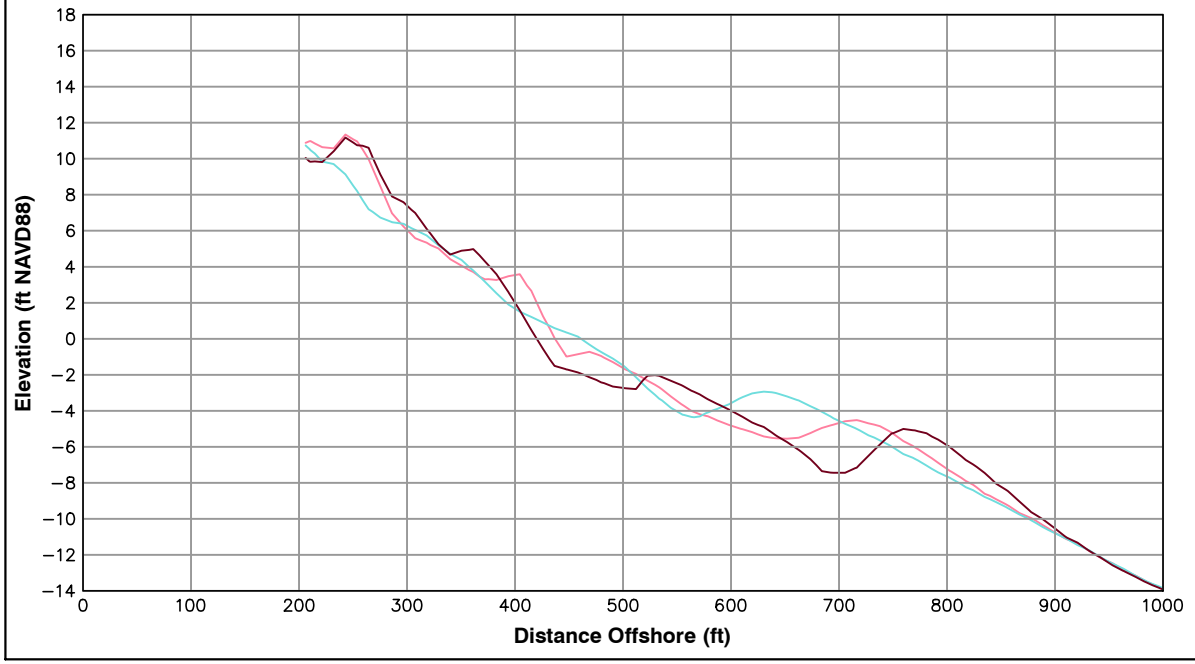


City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 252+62	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-18.79 ft/yr	-13.01 ft
Volume Change Above -15 ft NAVD88	-1.61 cy/ft/yr	-0.03 cy/ft
Volume Change Above 0 ft NAVD88	0.38 cy/ft/yr	6.52 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR

Notes:
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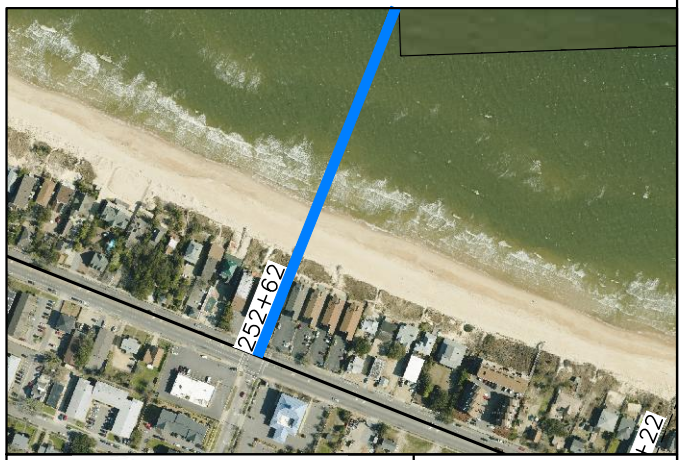

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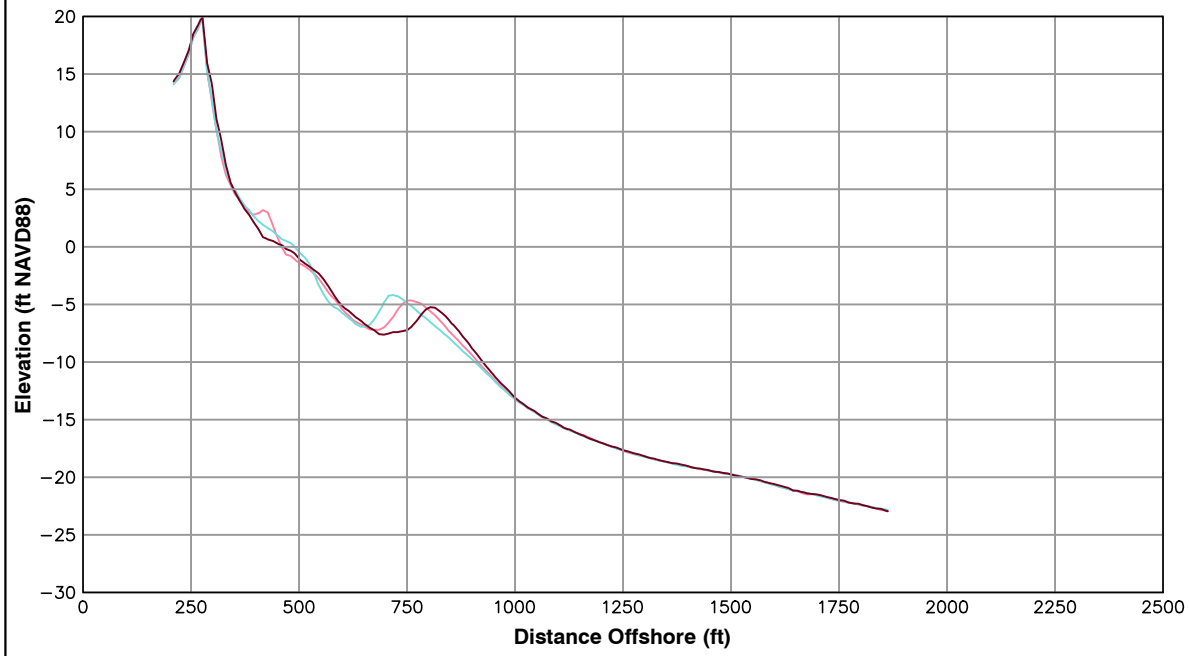
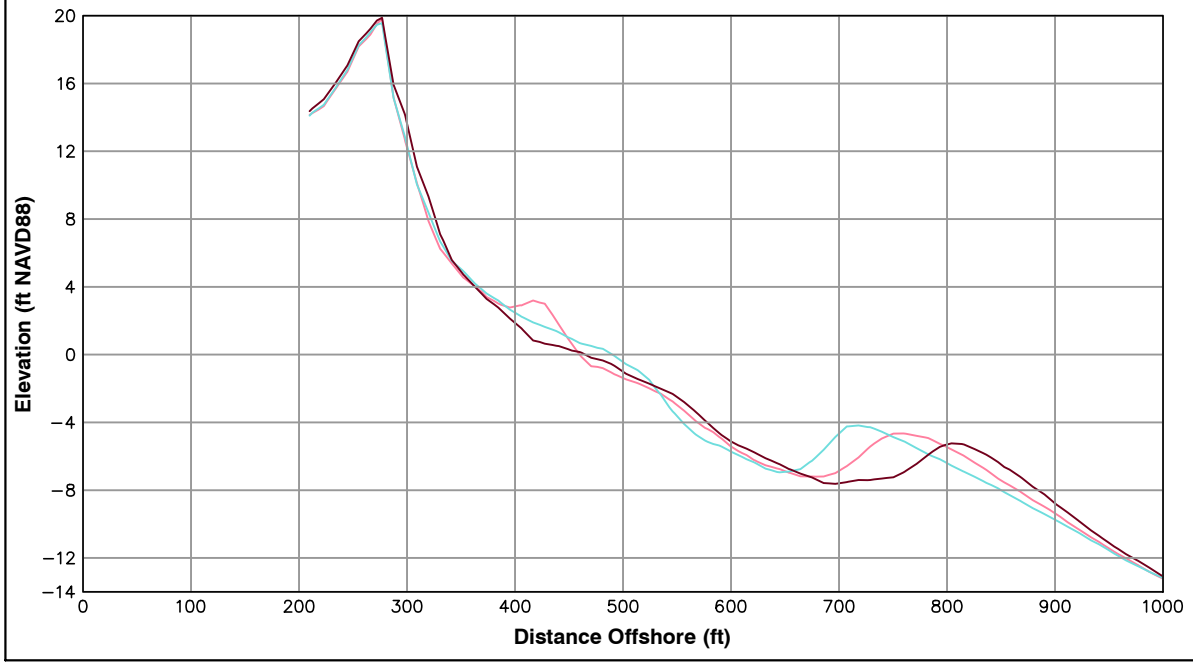
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 263+22	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-35.51 ft/yr	-36.13 ft
Volume Change Above -15 ft NAVD88	0.64 cy/ft/yr	0.58 cy/ft
Volume Change Above 0 ft NAVD88	-0.44 cy/ft/yr	-0.36 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR

Notes:
1. Stationing From West To East At Varying Intervals.
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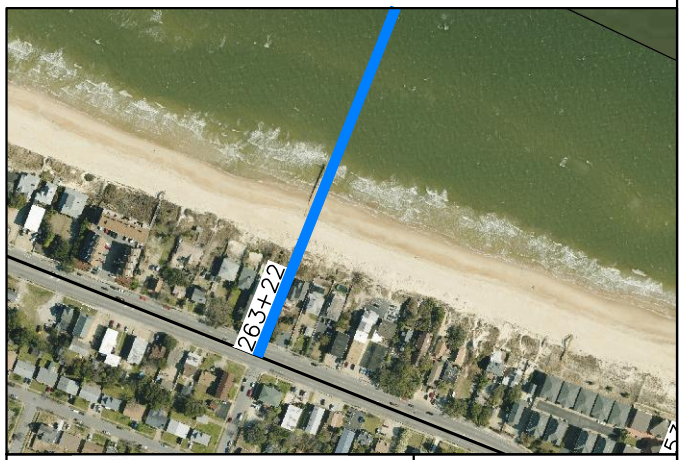

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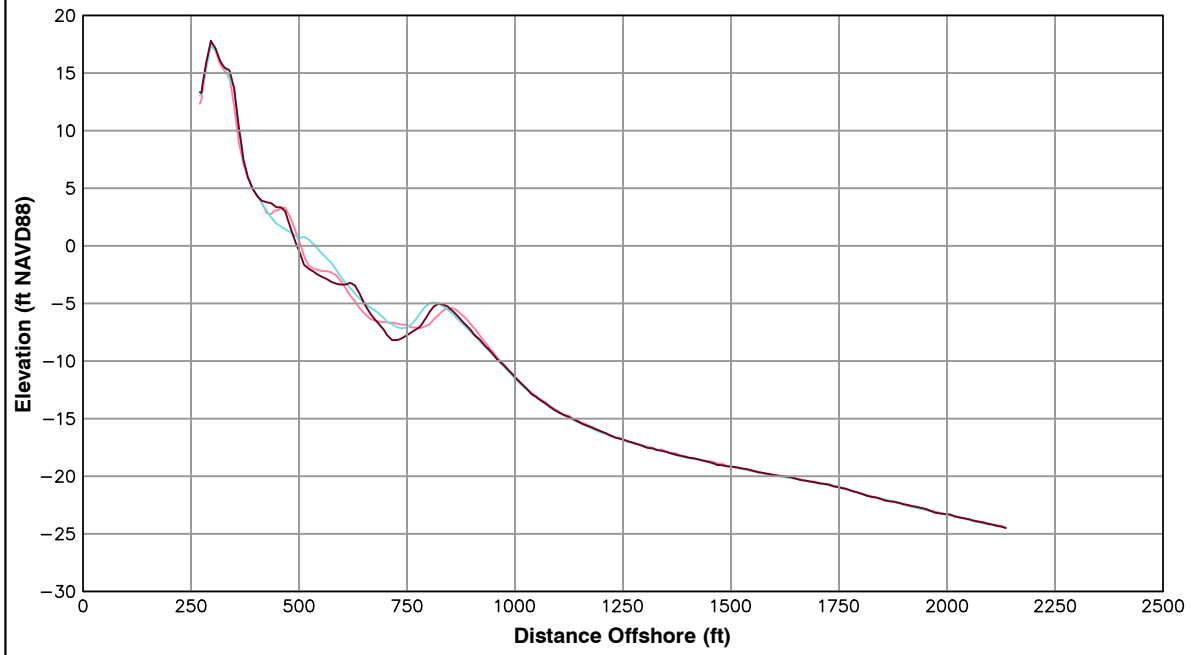
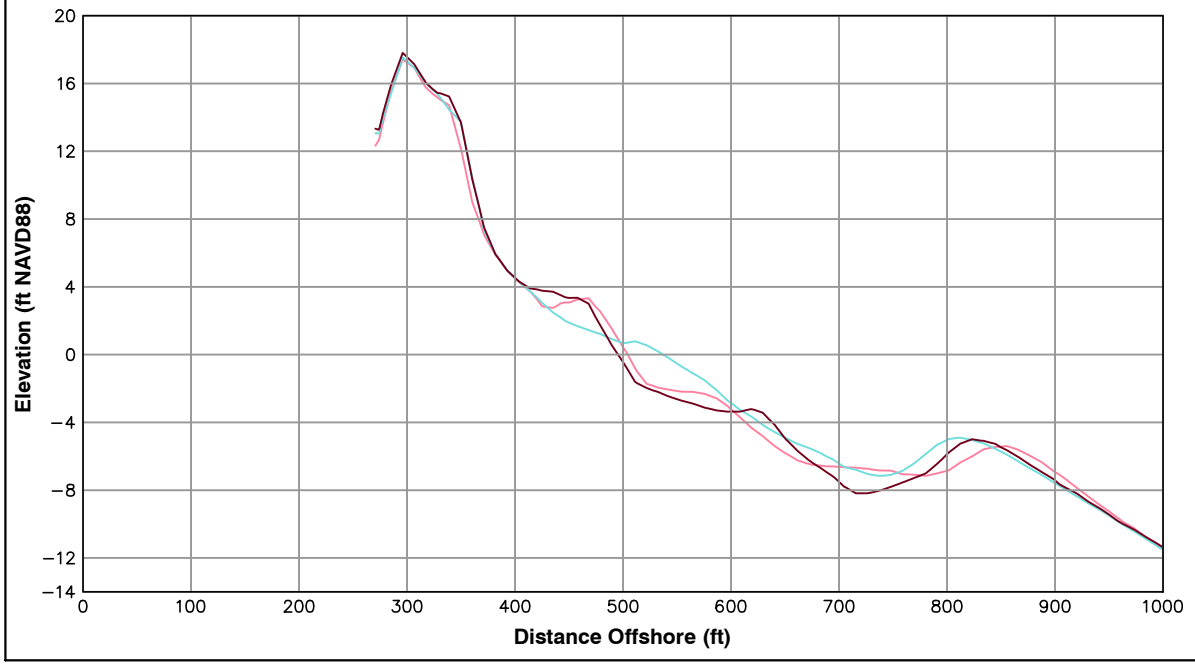
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 274+53	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-9.39 ft/yr	-1.66 ft
Volume Change Above -15 ft NAVD88	-0.60 cy/ft/yr	-7.15 cy/ft
Volume Change Above 0 ft NAVD88	2.47 cy/ft/yr	2.65 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR

Notes:
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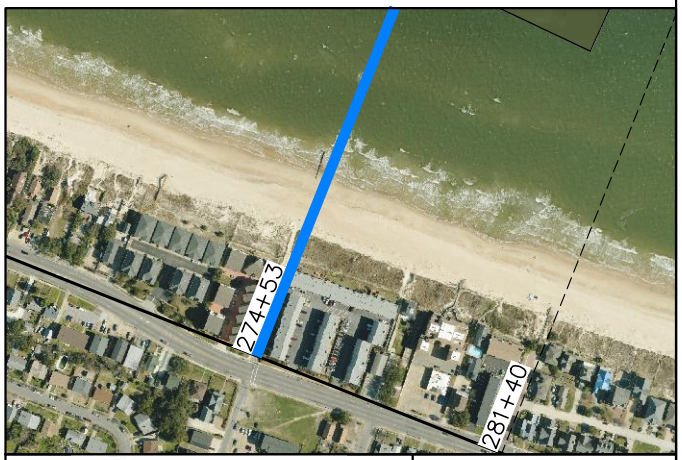

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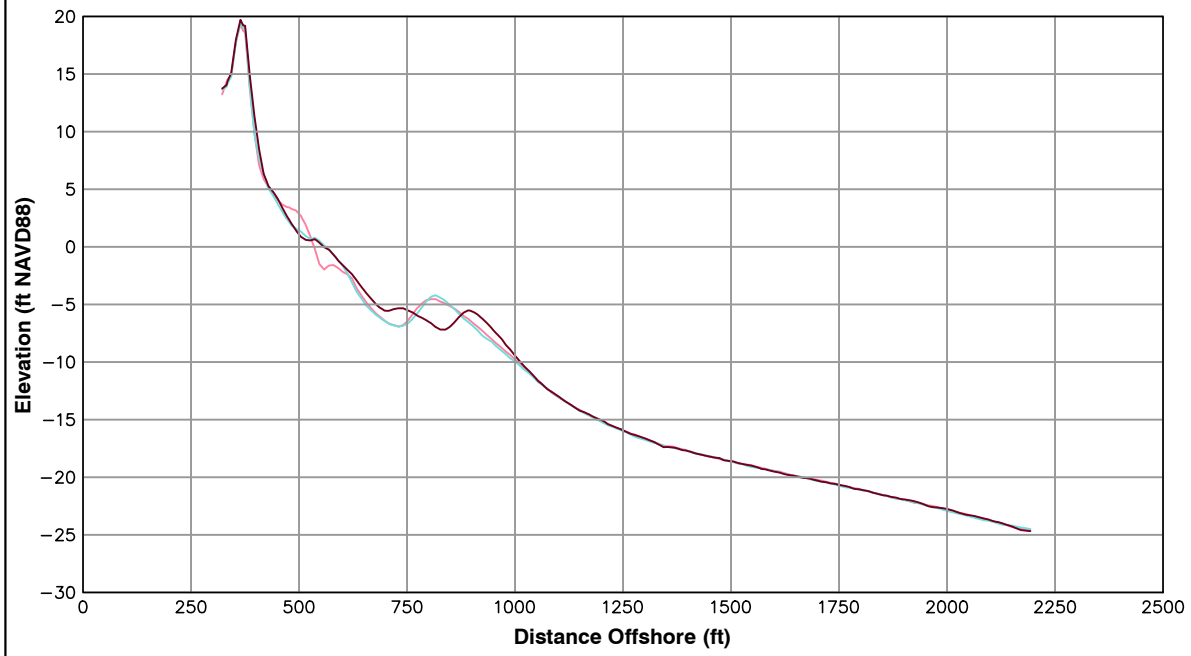
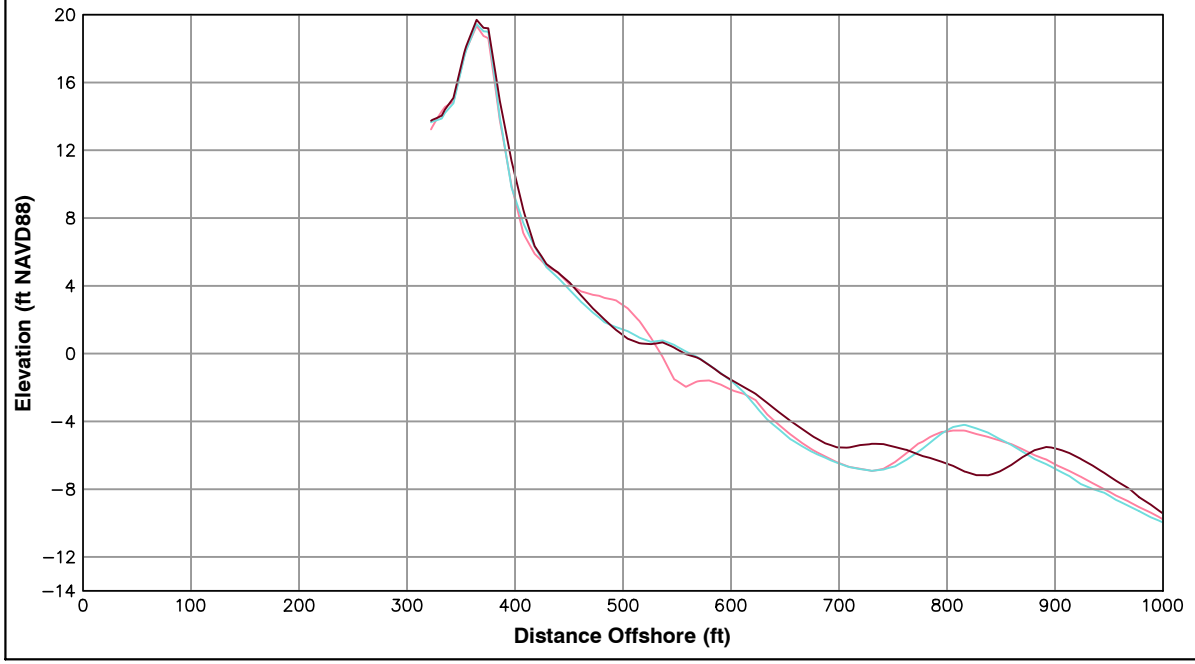
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 281+40	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-23.71 ft/yr	-11.88 ft
Volume Change Above -15 ft NAVD88	5.46 cy/ft/yr	7.03 cy/ft
Volume Change Above 0 ft NAVD88	-0.21 cy/ft/yr	1.91 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR

Notes:
1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
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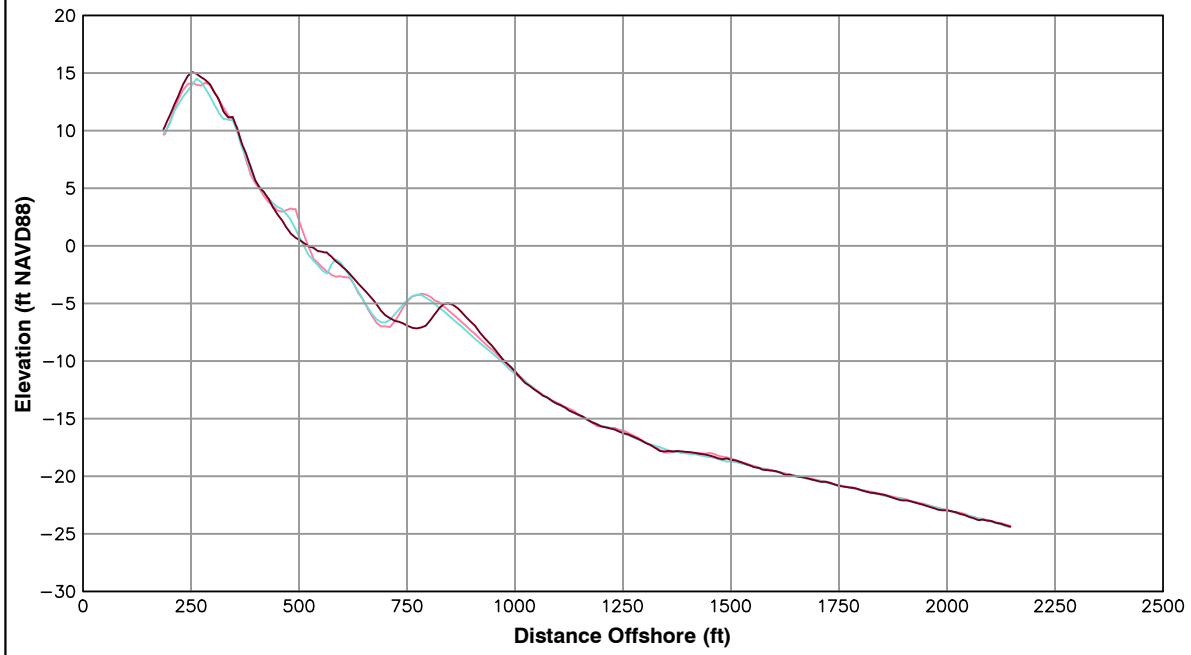
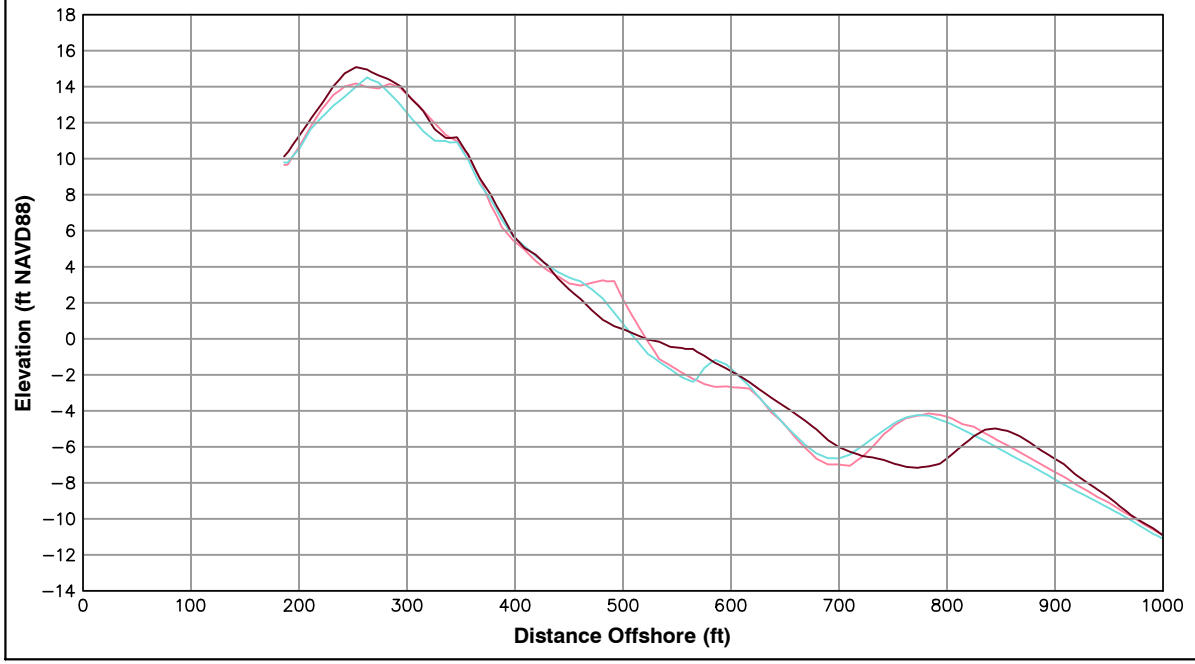
4. Survey Comparison Made To April 2013 and October 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 288+39	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-28.92 ft/yr	-14.40 ft
Volume Change Above -15 ft NAVD88	2.24 cy/ft/yr	6.65 cy/ft
Volume Change Above 0 ft NAVD88	-0.62 cy/ft/yr	3.10 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR

Notes:
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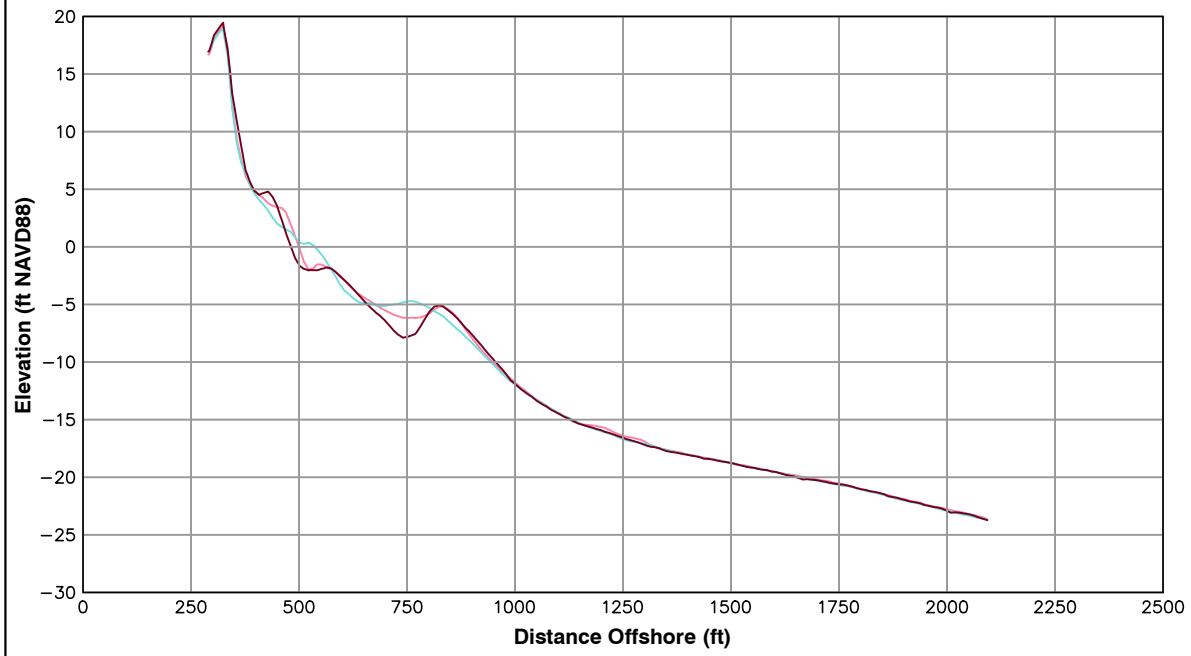
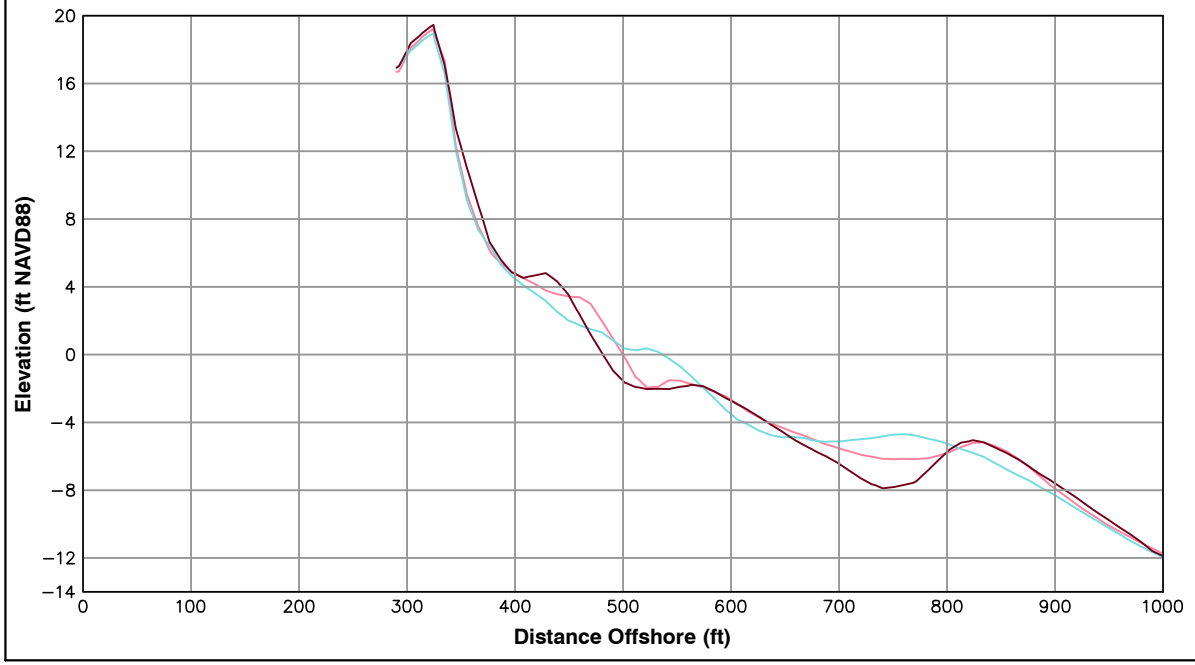
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 295+27	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-19.02 ft/yr	-15.70 ft
Volume Change Above -15 ft NAVD88	-5.99 cy/ft/yr	-4.22 cy/ft
Volume Change Above 0 ft NAVD88	0.80 cy/ft/yr	4.18 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR

Notes:
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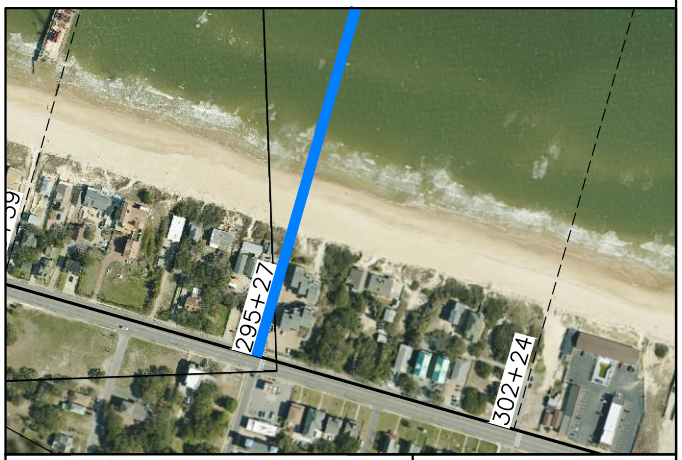

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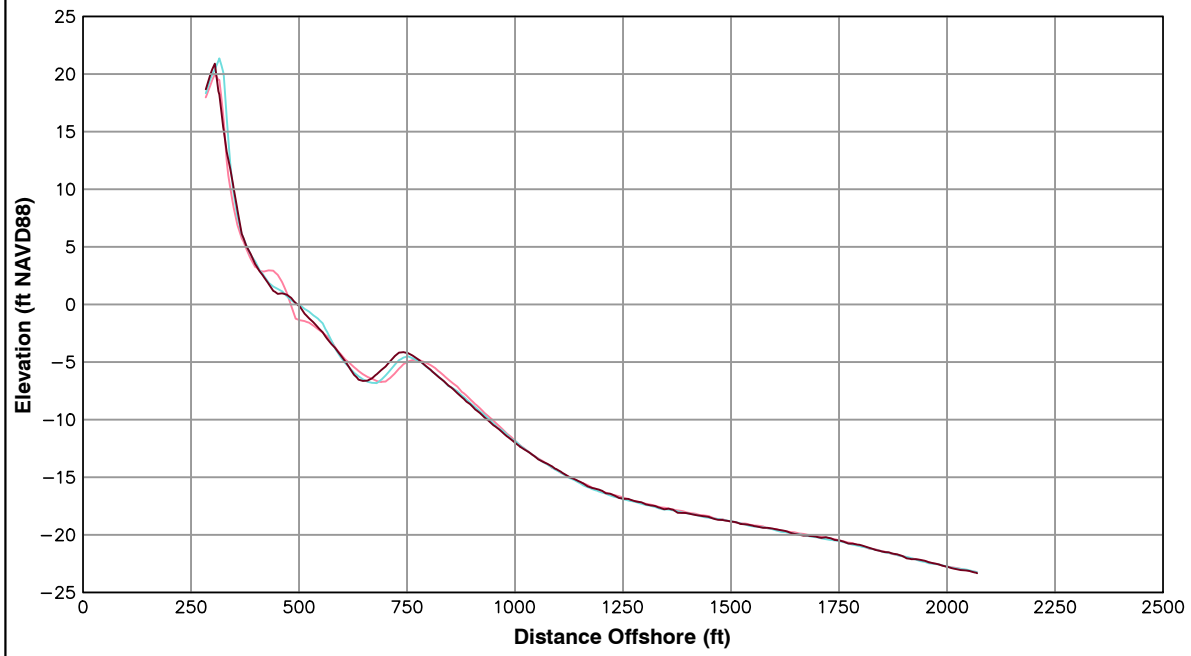
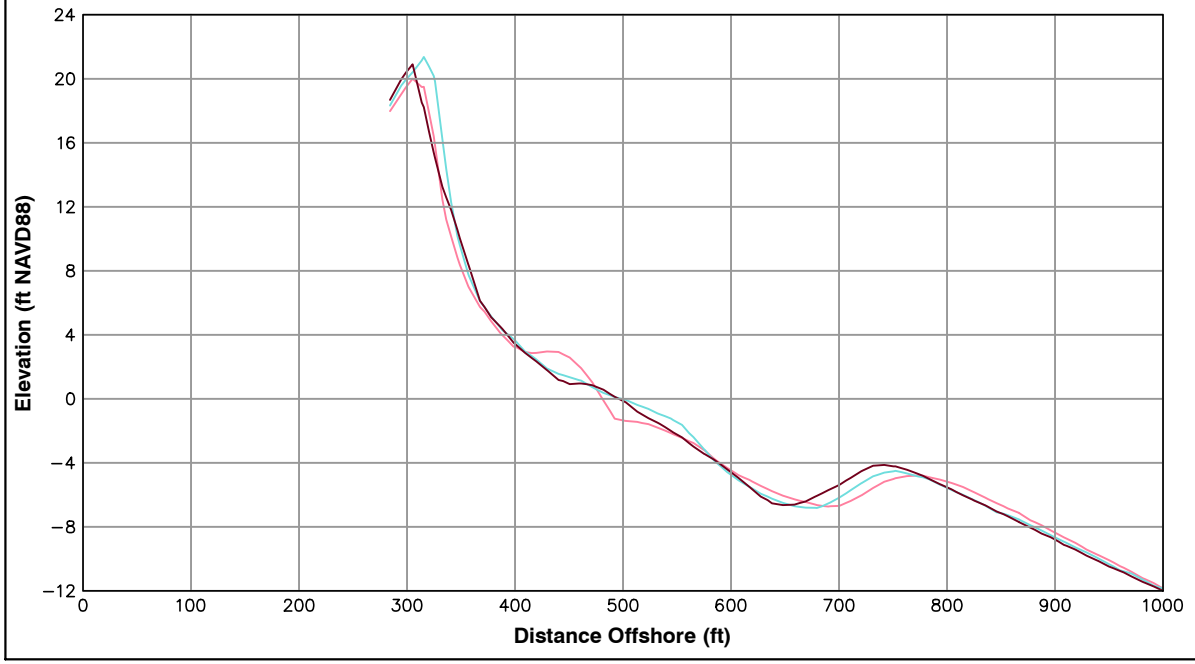
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 302+24	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-24.07 ft/yr	-16.39 ft
Volume Change Above -15 ft NAVD88	0.71 cy/ft/yr	-3.36 cy/ft
Volume Change Above 0 ft NAVD88	0.11 cy/ft/yr	-3.42 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR

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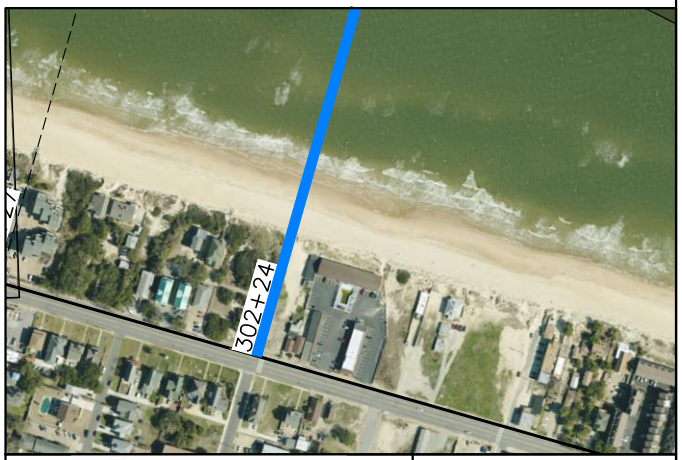

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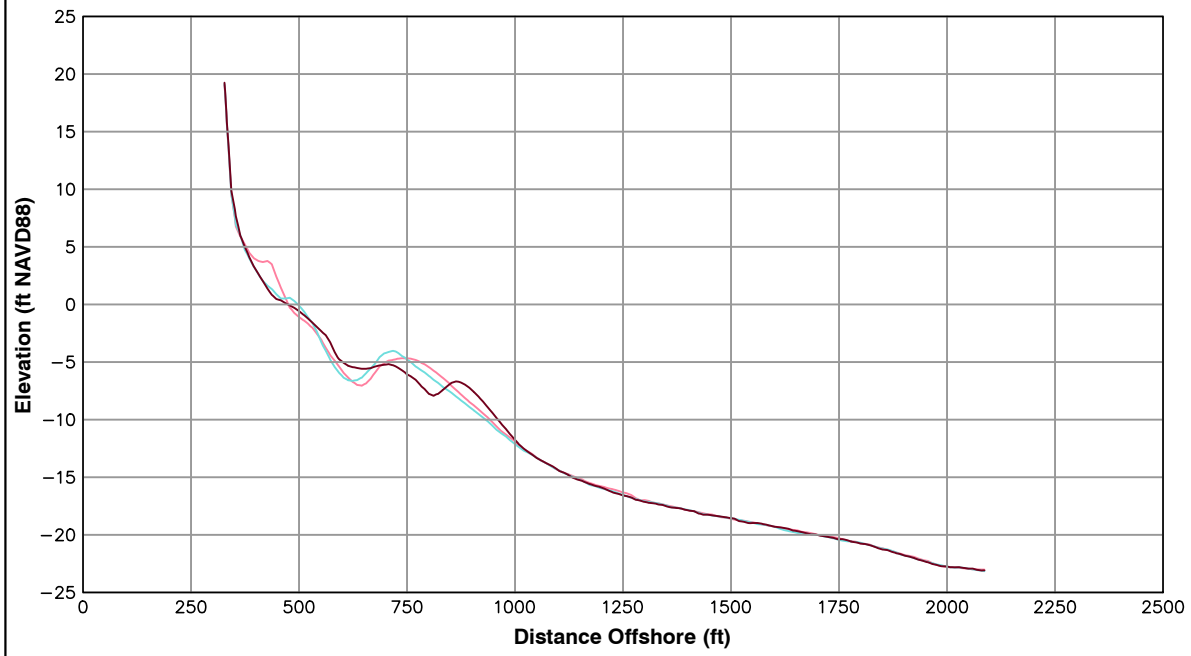
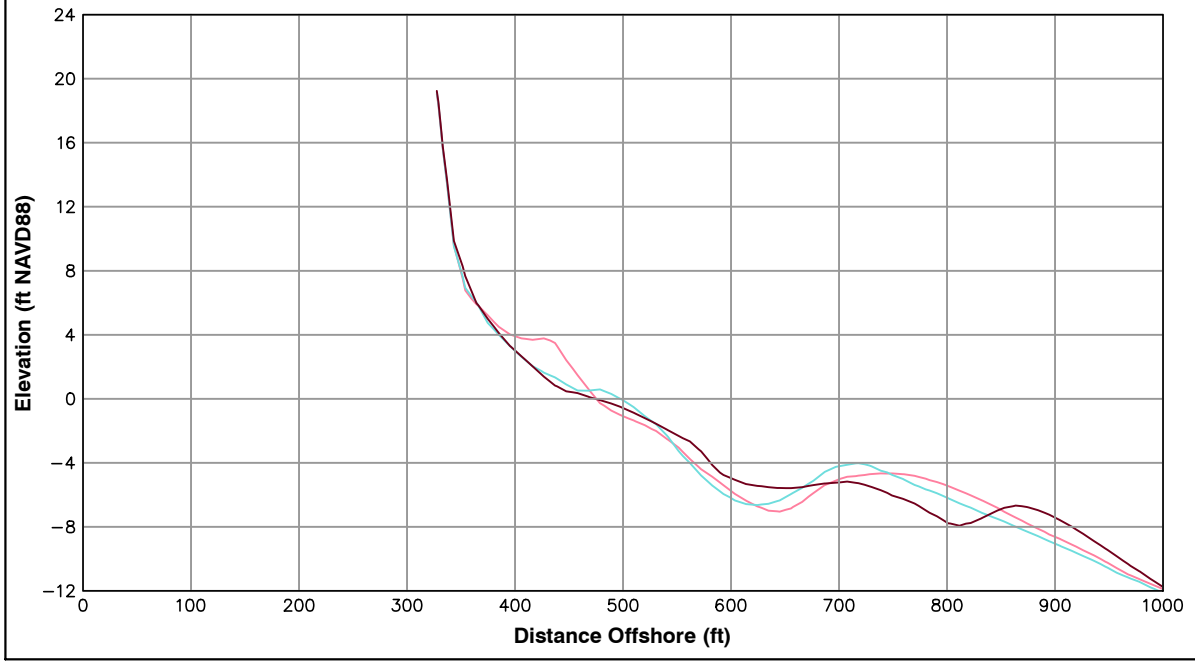
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 315+96	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-30.48 ft/yr	-11.25 ft
Volume Change Above -15 ft NAVD88	-0.98 cy/ft/yr	4.22 cy/ft
Volume Change Above 0 ft NAVD88	-4.47 cy/ft/yr	-0.39 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR

Notes:
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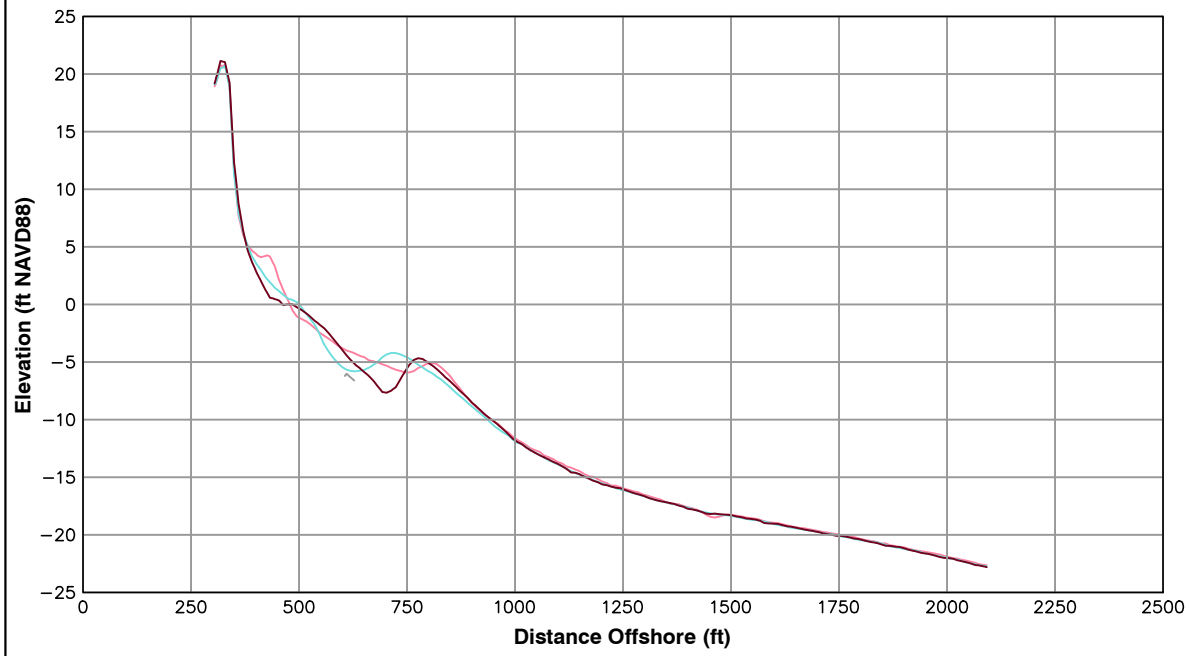
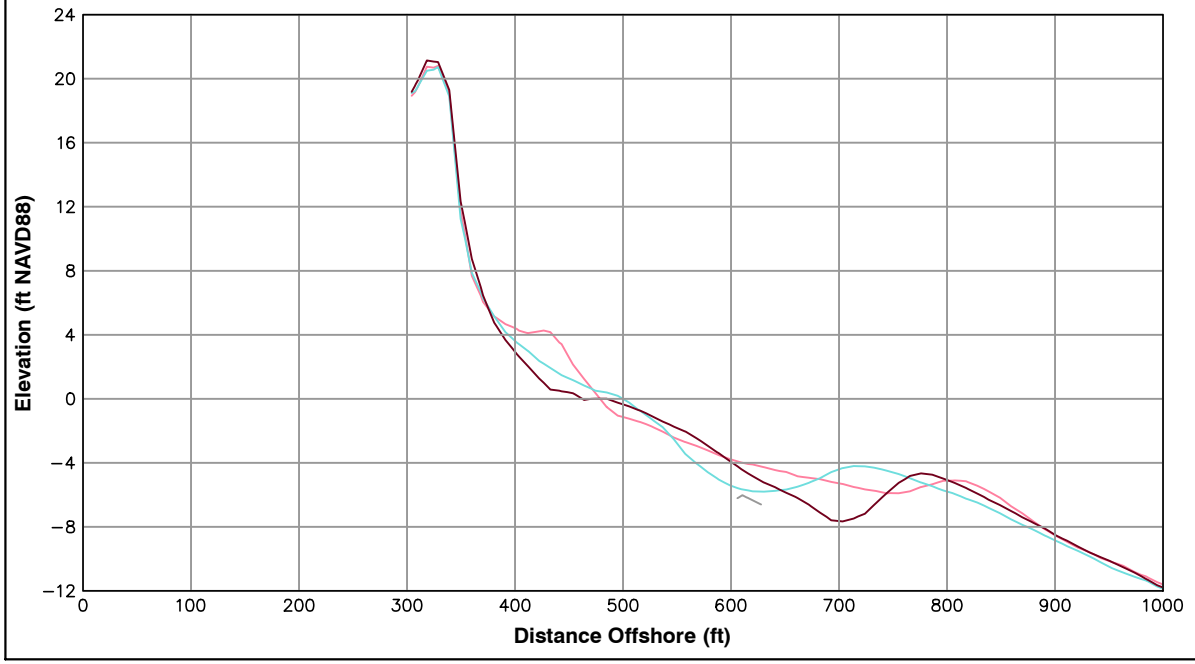
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 323+09	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-41.56 ft/yr	-32.46 ft
Volume Change Above -15 ft NAVD88	-12.13 cy/ft/yr	-1.83 cy/ft
Volume Change Above 0 ft NAVD88	-5.78 cy/ft/yr	-1.92 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR

Notes:
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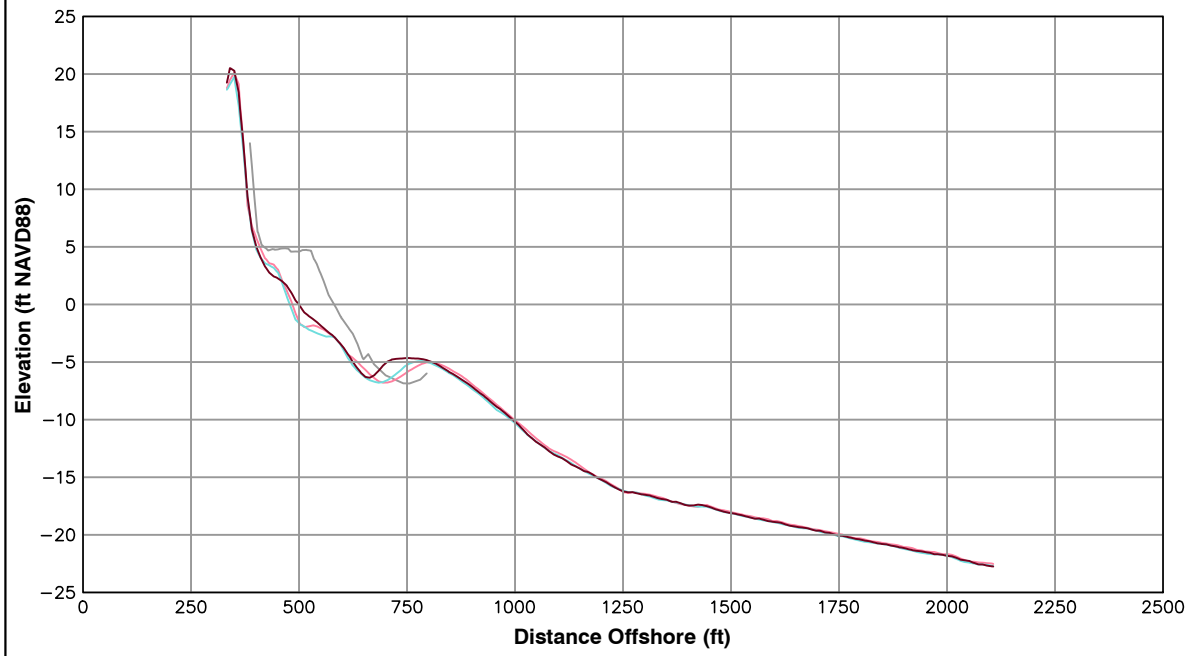
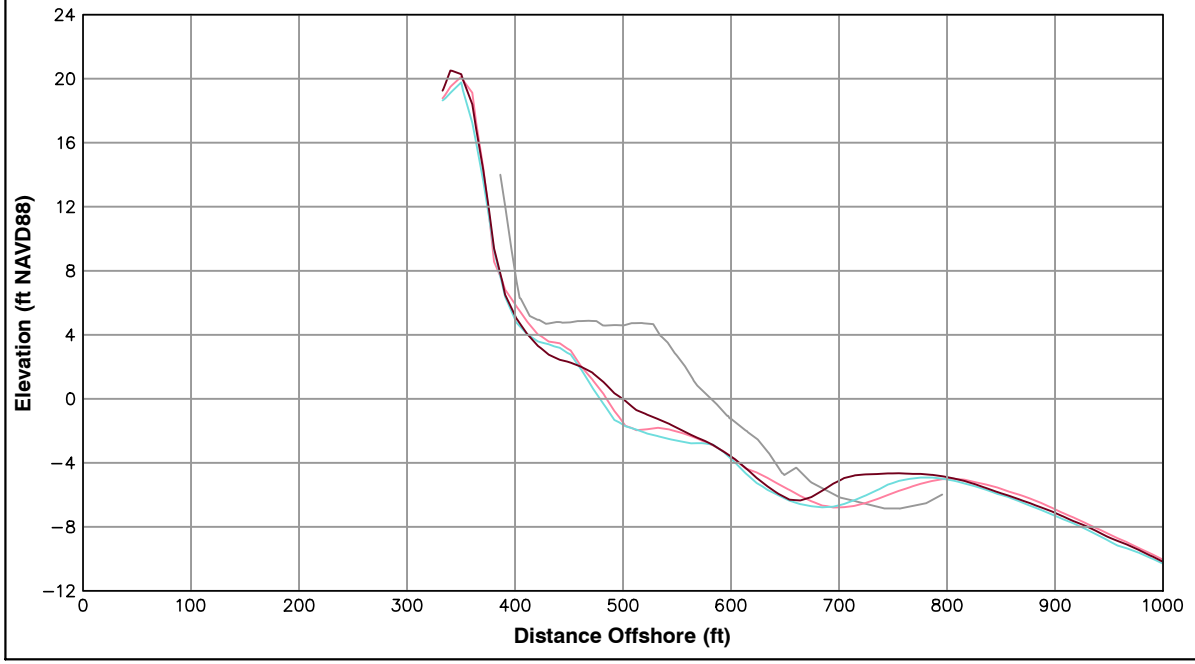
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 329+63	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	9.03 ft/yr	13.76 ft
Volume Change Above -15 ft NAVD88	2.67 cy/ft/yr	10.94 cy/ft
Volume Change Above 0 ft NAVD88	-0.93 cy/ft/yr	1.80 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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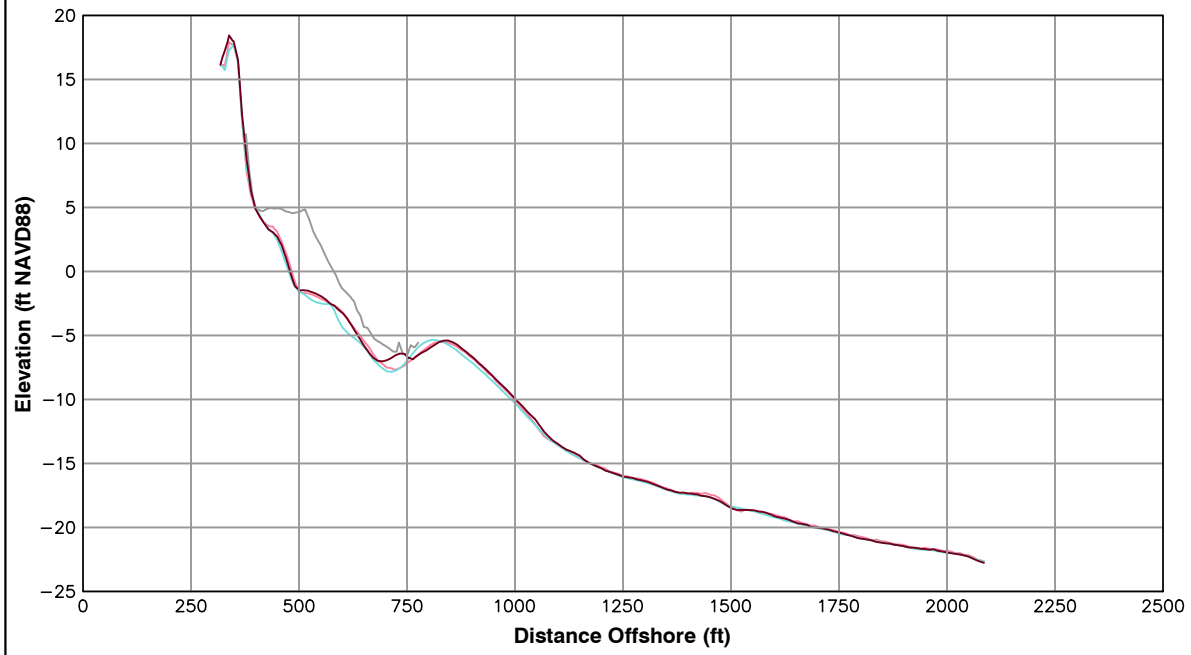
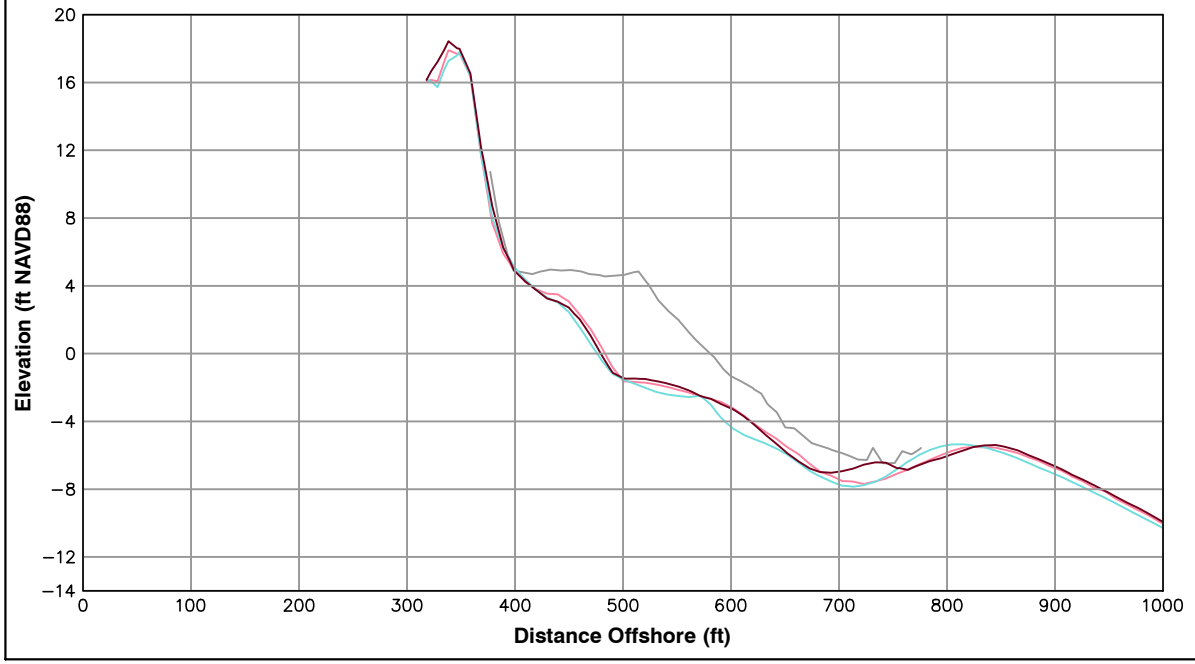
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 331+43	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-3.79 ft/yr	4.90 ft
Volume Change Above -15 ft NAVD88	4.01 cy/ft/yr	10.13 cy/ft
Volume Change Above 0 ft NAVD88	0.73 cy/ft/yr	1.90 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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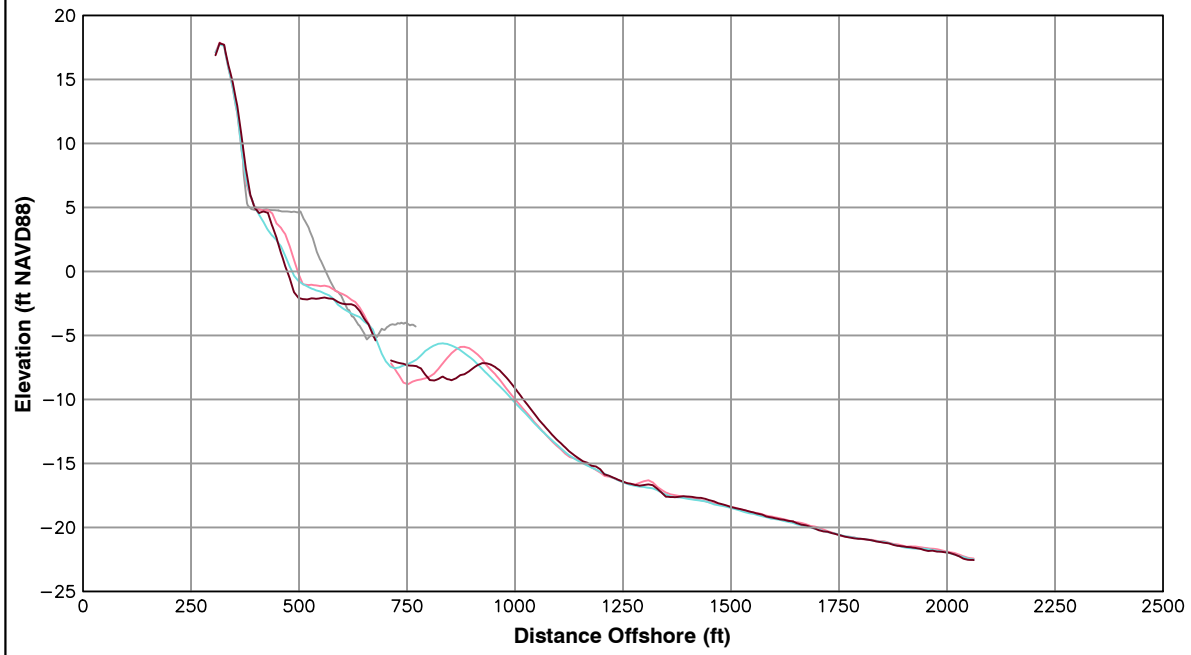
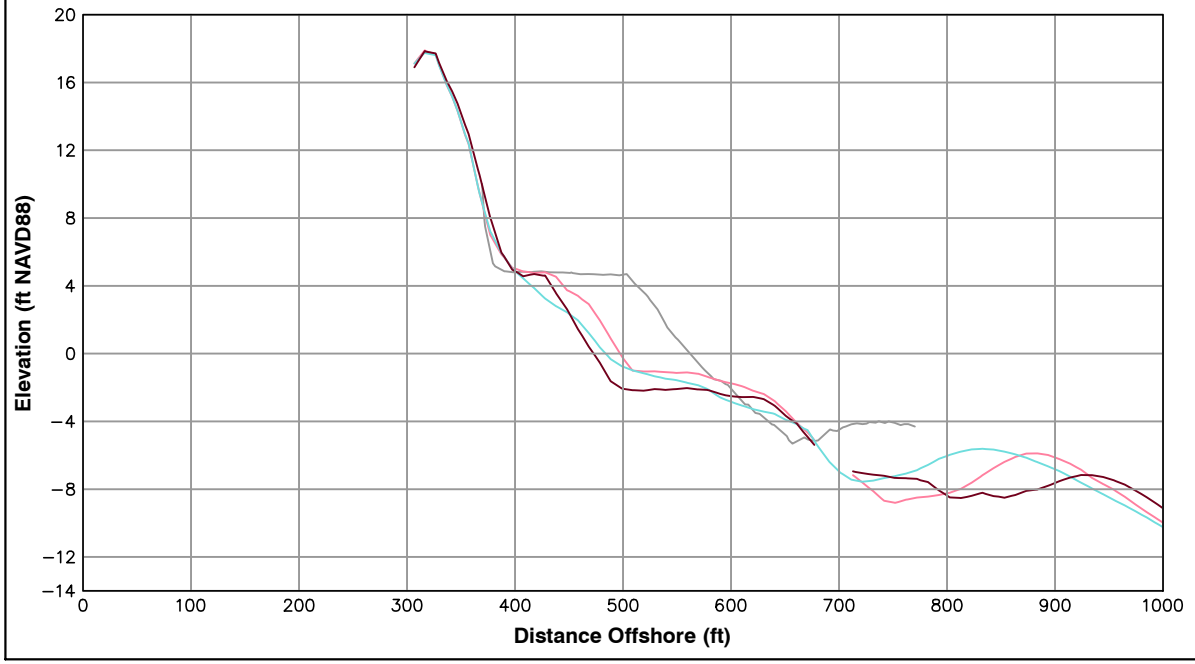
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 333+23	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-25.79 ft/yr	-8.36 ft
Volume Change Above -15 ft NAVD88	-7.41 cy/ft/yr	-3.66 cy/ft
Volume Change Above 0 ft NAVD88	-2.61 cy/ft/yr	1.78 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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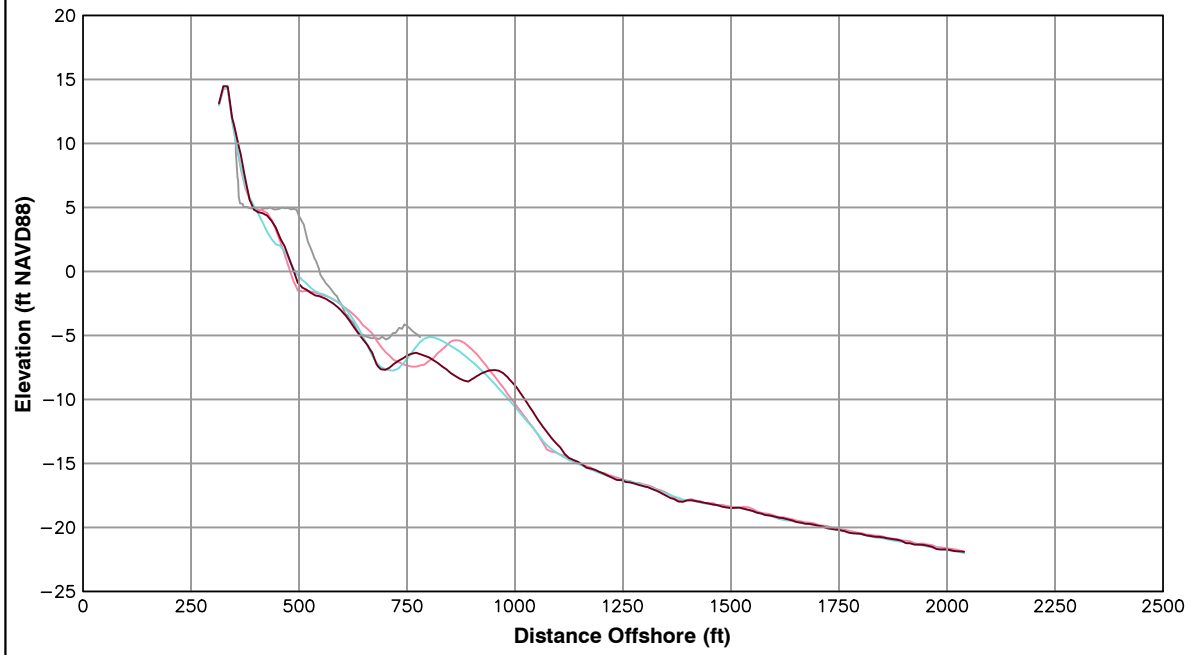
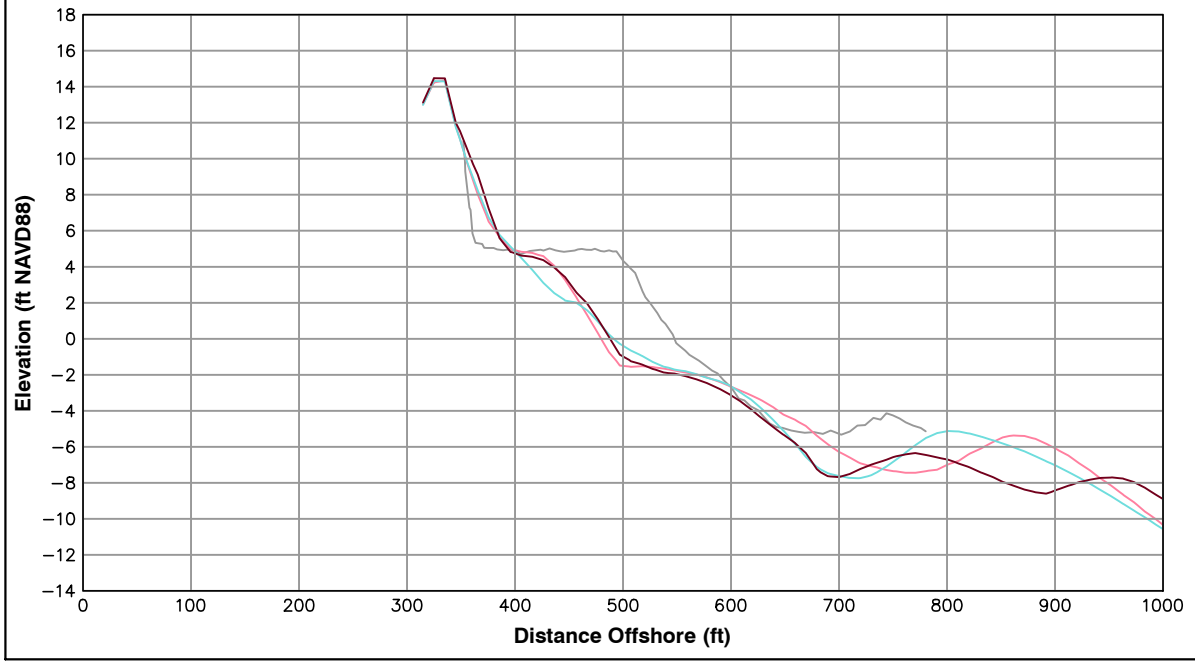
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 335+03	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	7.96 ft/yr	1.49 ft
Volume Change Above -15 ft NAVD88	-3.80 cy/ft/yr	0.23 cy/ft
Volume Change Above 0 ft NAVD88	1.64 cy/ft/yr	3.02 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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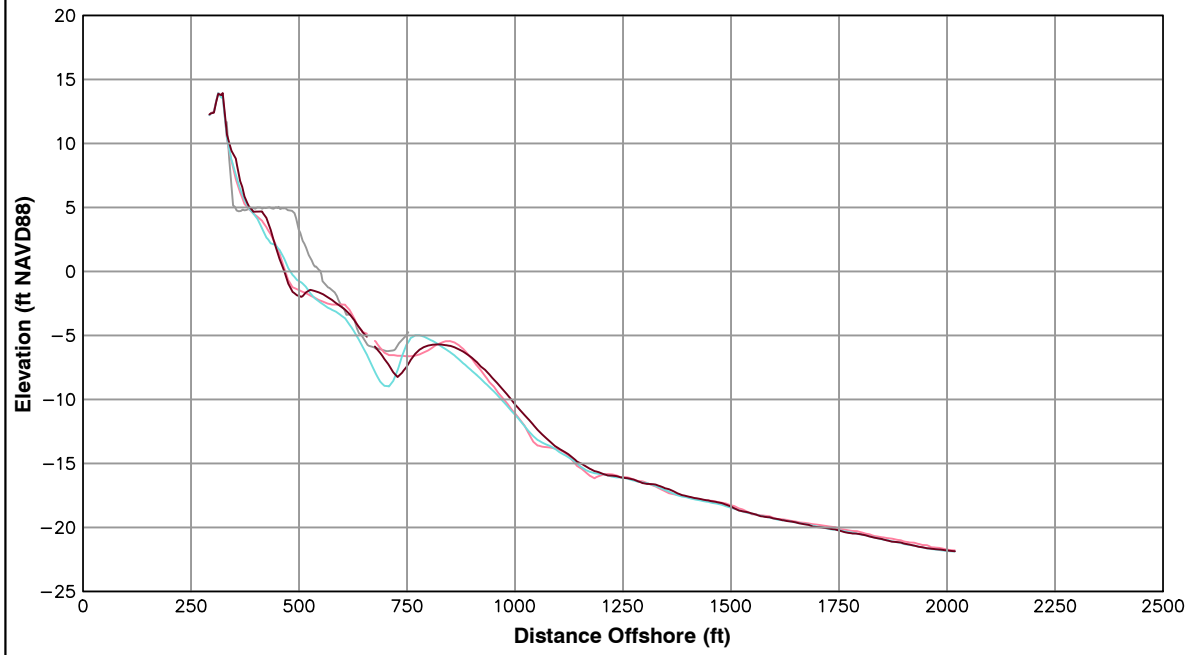
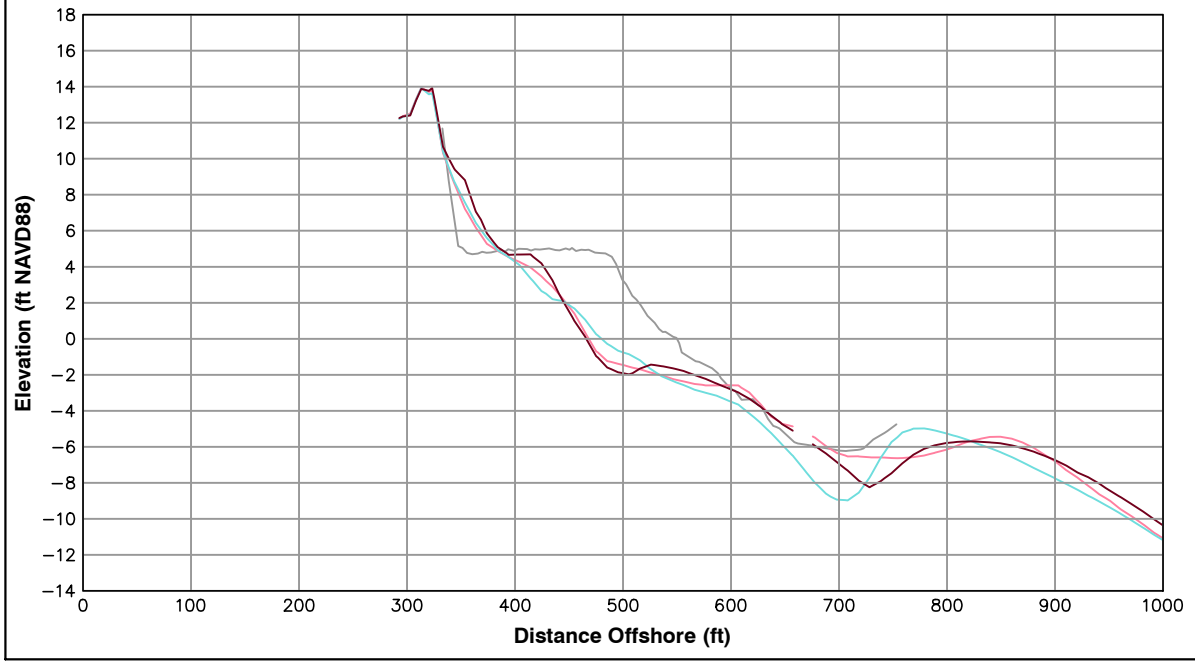
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 336+83	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-4.03 ft/yr	-10.96 ft
Volume Change Above -15 ft NAVD88	4.92 cy/ft/yr	11.89 cy/ft
Volume Change Above 0 ft NAVD88	2.35 cy/ft/yr	2.33 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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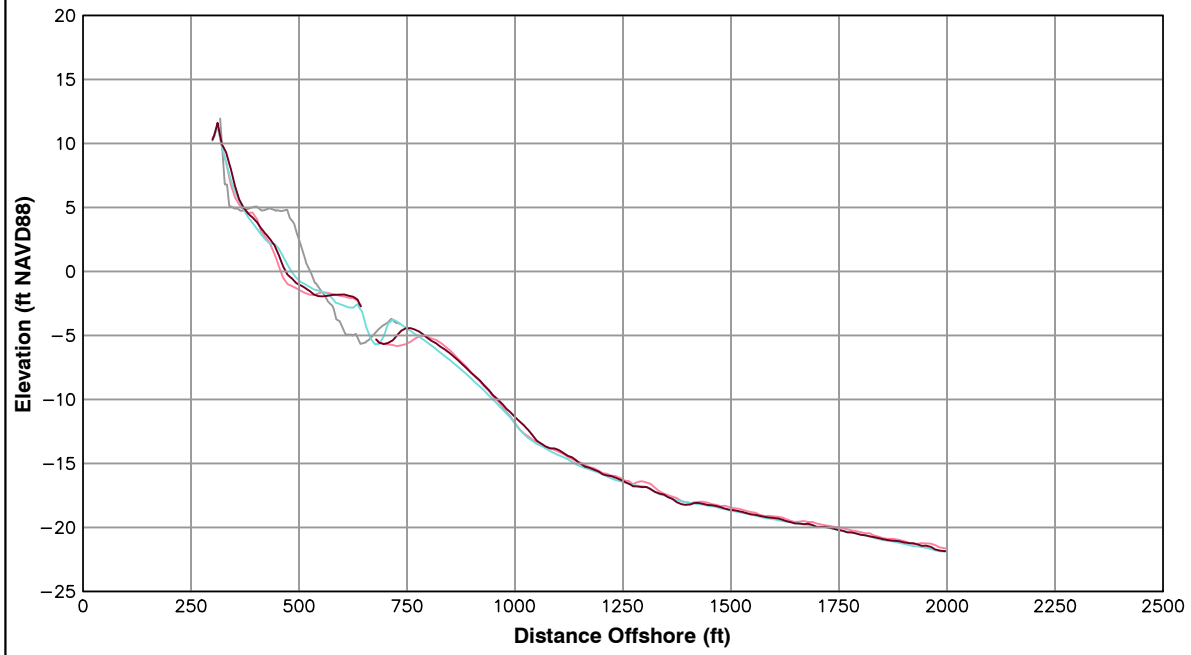
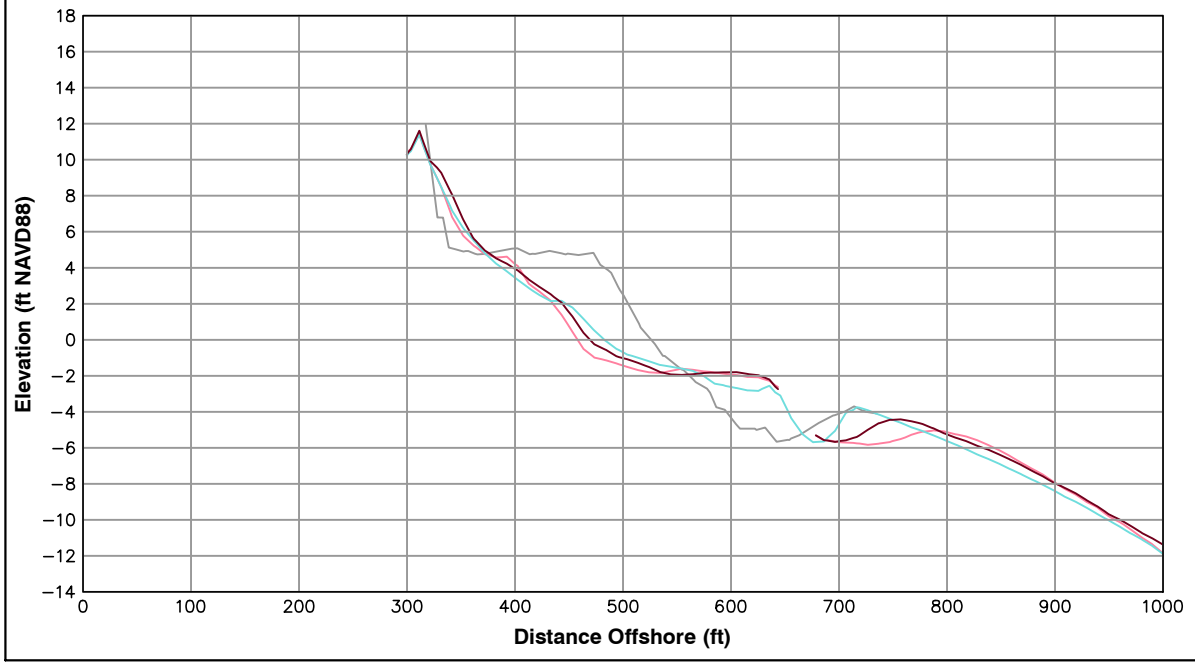
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 338+63	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	9.58 ft/yr	-9.43 ft
Volume Change Above -15 ft NAVD88	6.86 cy/ft/yr	5.78 cy/ft
Volume Change Above 0 ft NAVD88	2.32 cy/ft/yr	1.29 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

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City of Norfolk

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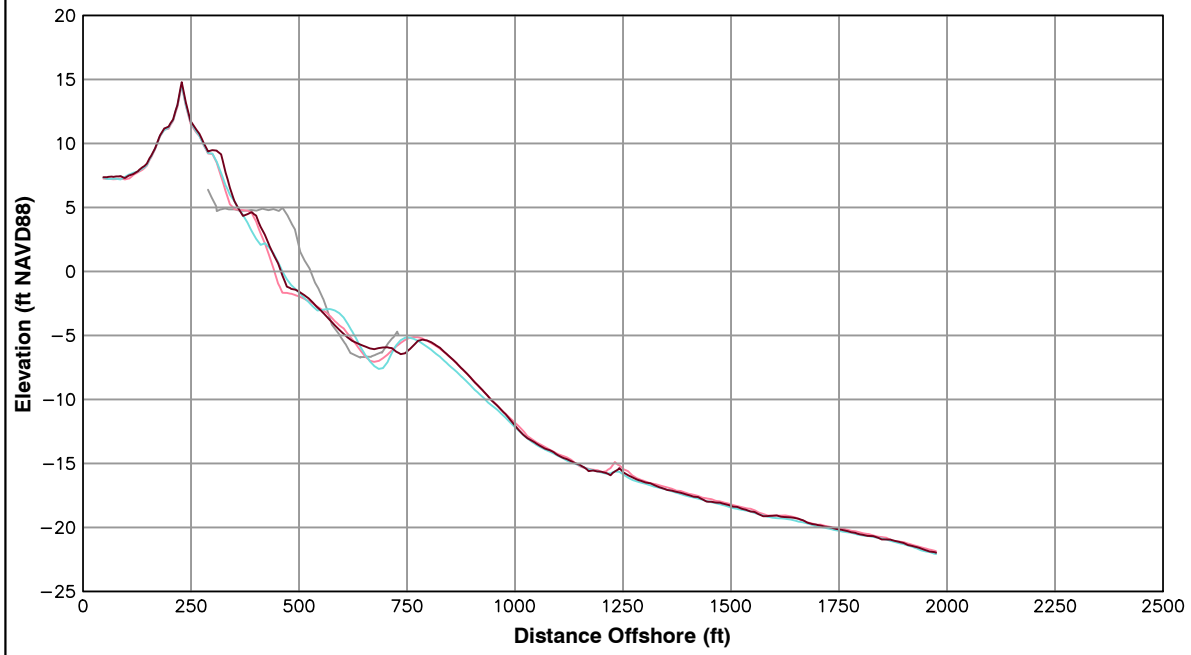

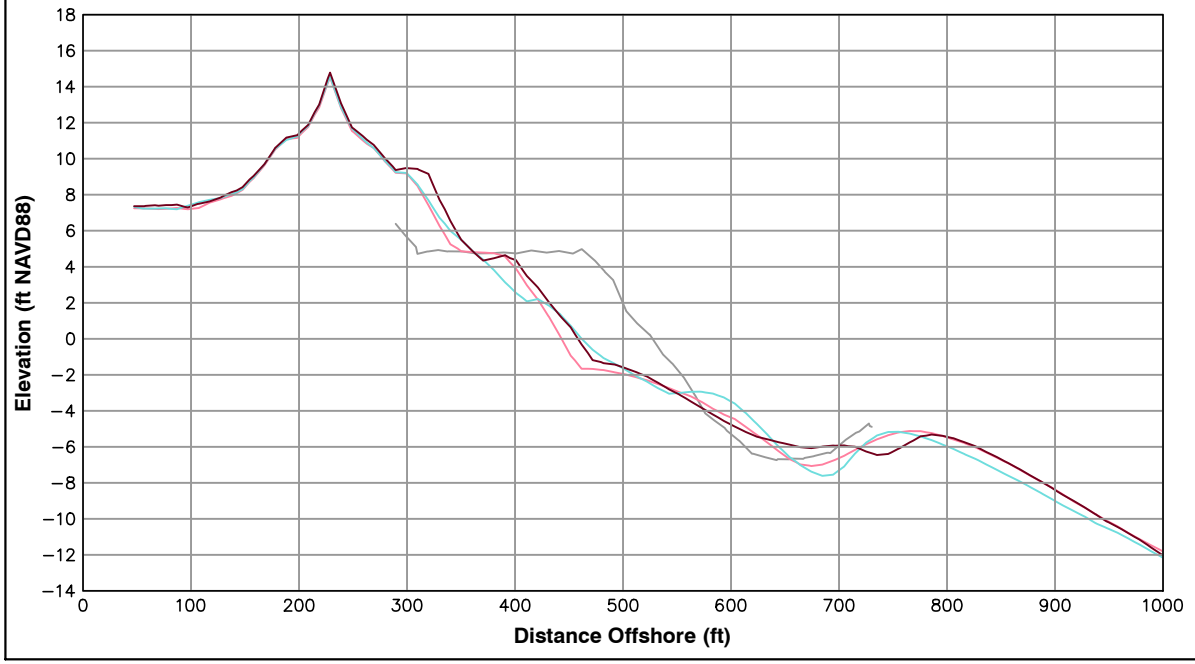

Survey Transect 340+43	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	13.00 ft/yr	-1.39 ft
Volume Change Above -15 ft NAVD88	6.17 cy/ft/yr	7.86 cy/ft
Volume Change Above 0 ft NAVD88	5.37 cy/ft/yr	4.61 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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City of Norfolk

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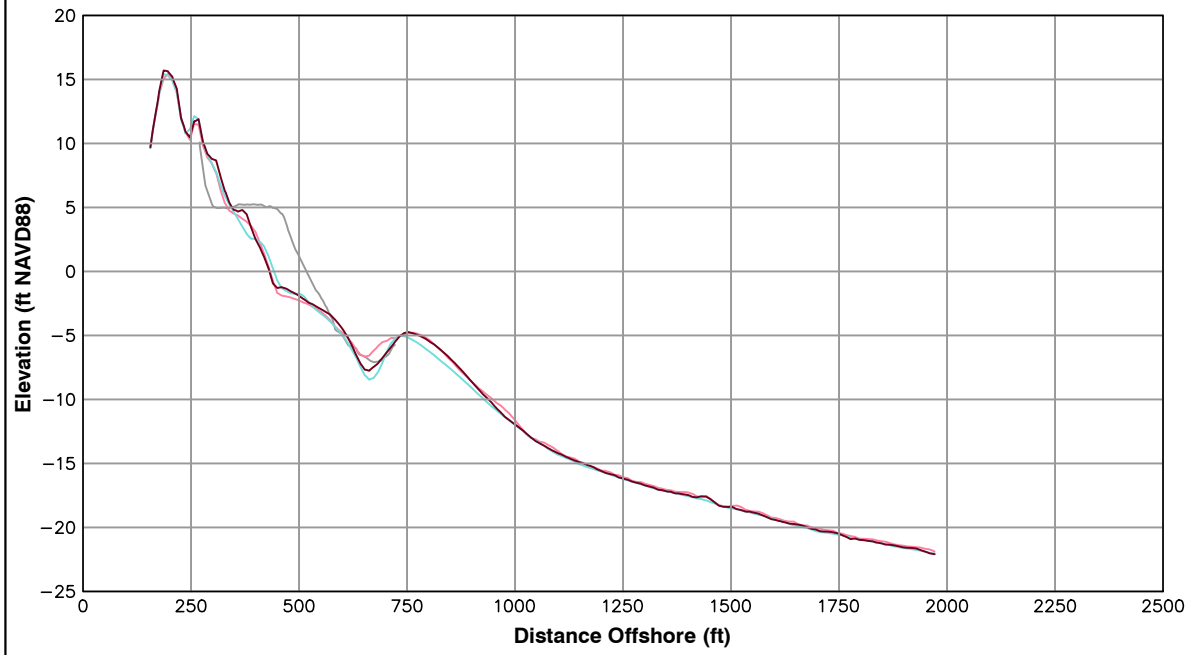

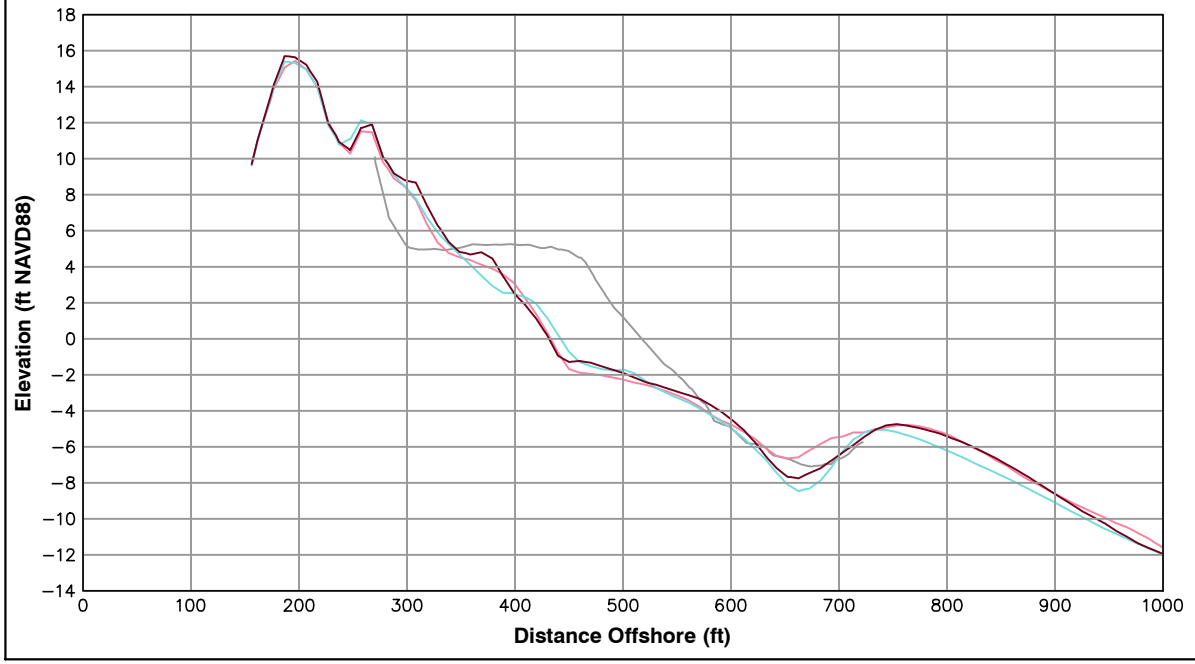

Survey Transect 342+23	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-2.38 ft/yr	-10.70 ft
Volume Change Above -15 ft NAVD88	-0.30 cy/ft/yr	9.13 cy/ft
Volume Change Above 0 ft NAVD88	2.90 cy/ft/yr	1.93 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

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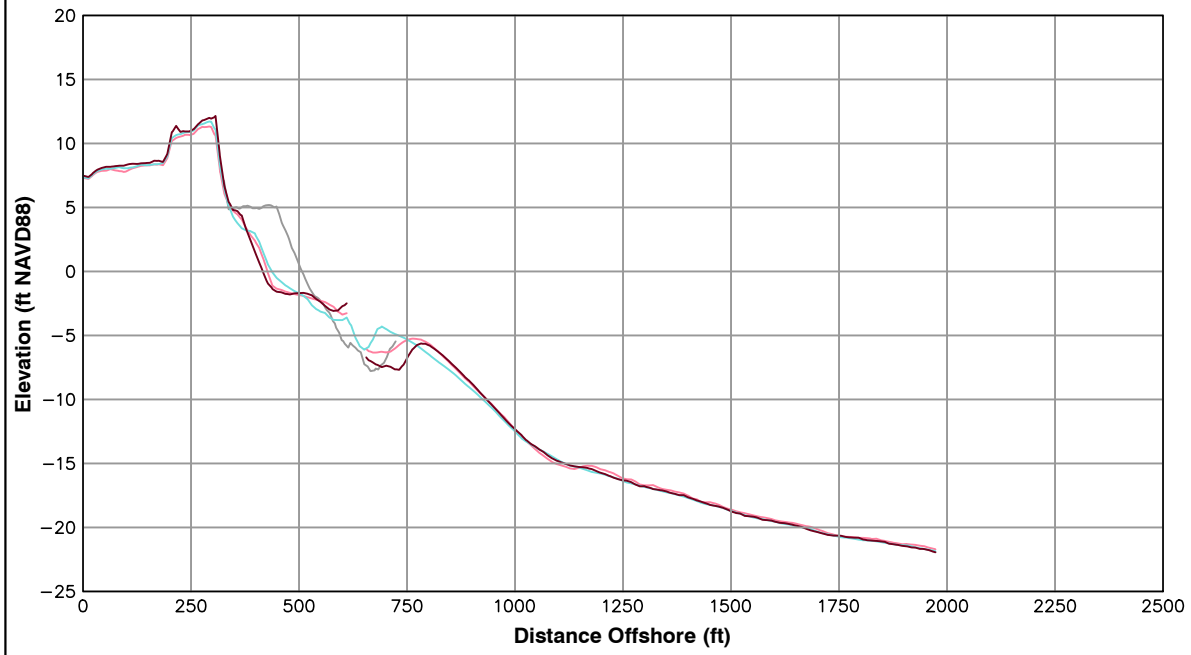

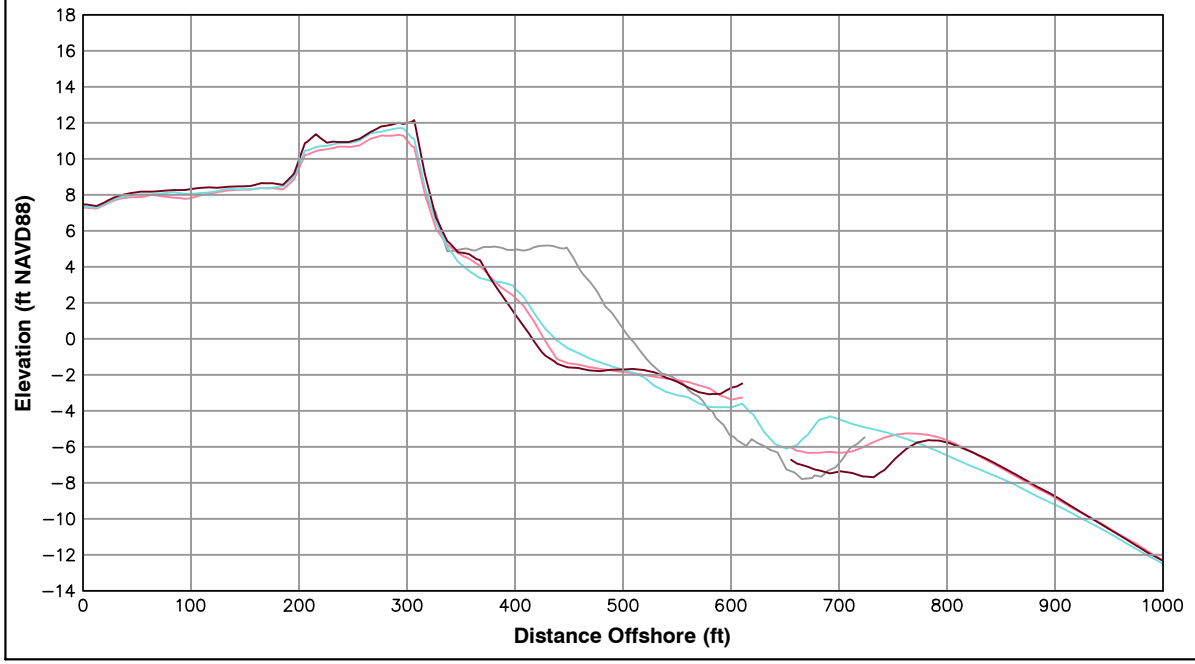

Survey Transect 344+05	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-13.09 ft/yr	-18.31 ft
Volume Change Above -15 ft NAVD88	-0.80 cy/ft/yr	-2.54 cy/ft
Volume Change Above 0 ft NAVD88	4.31 cy/ft/yr	1.85 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

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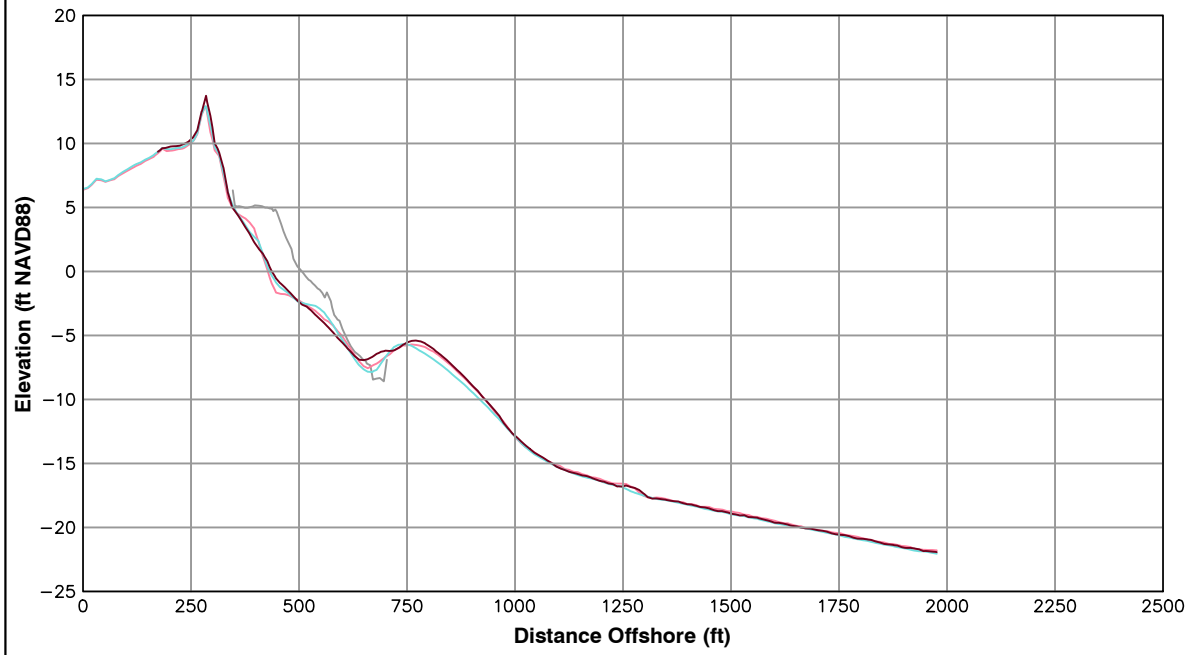
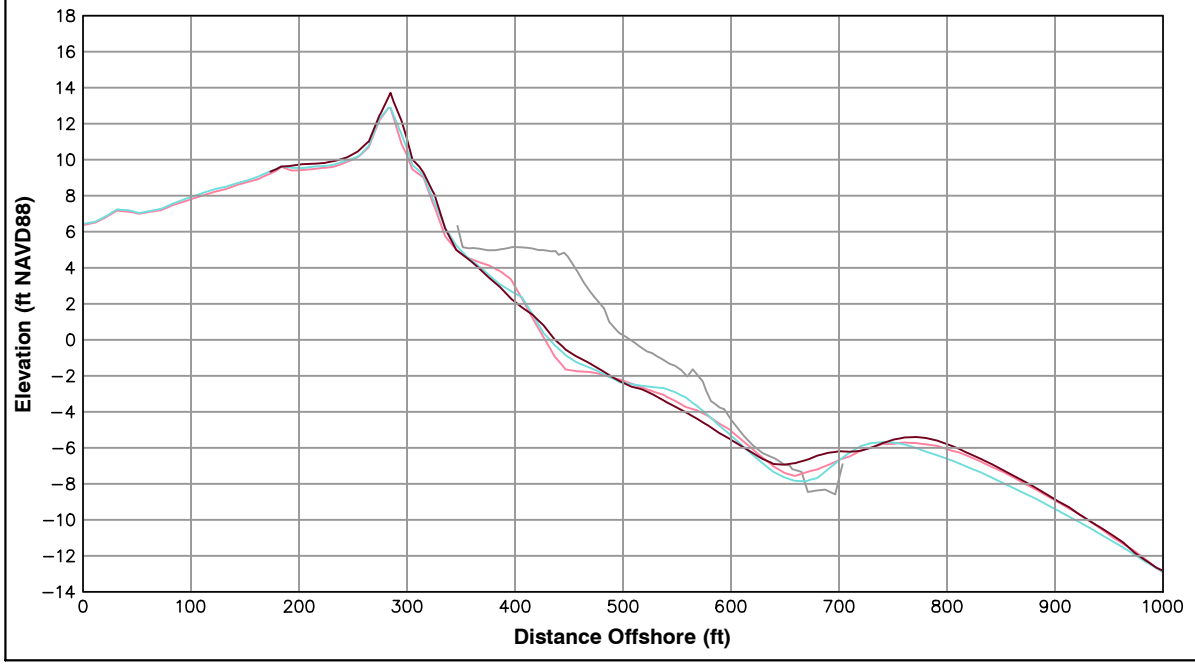
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





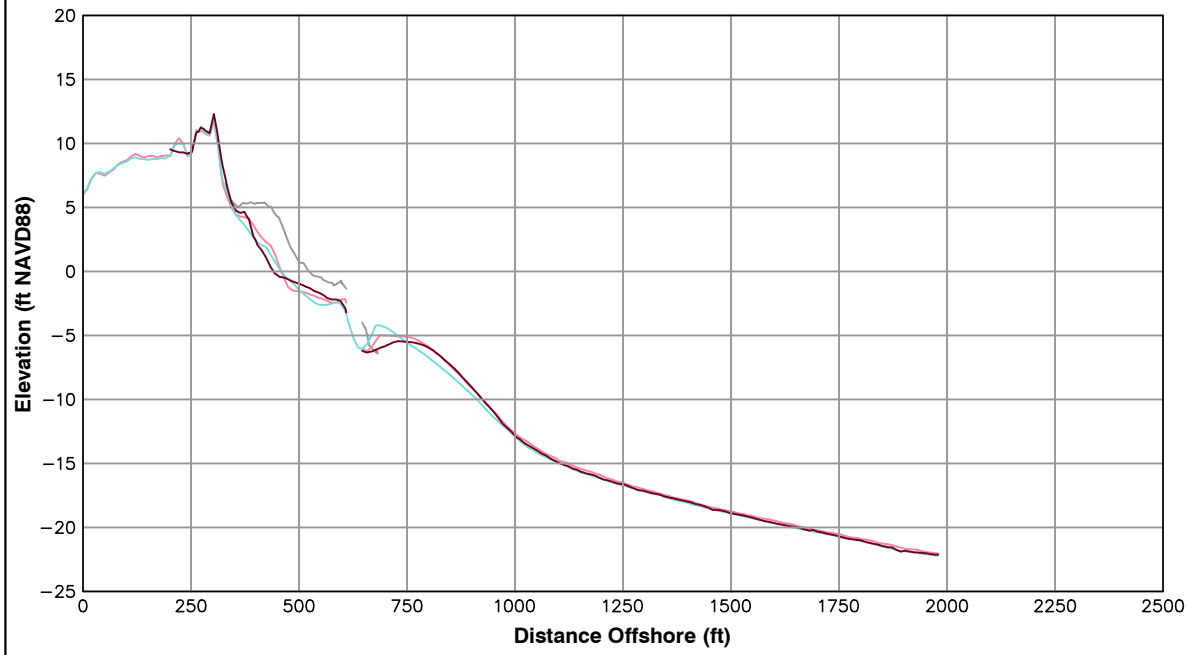
Survey Transect 345+85	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	5.17 ft/yr	2.84 ft
Volume Change Above -15 ft NAVD88	4.50 cy/ft/yr	7.09 cy/ft
Volume Change Above 0 ft NAVD88	1.61 cy/ft/yr	1.10 cy/ft

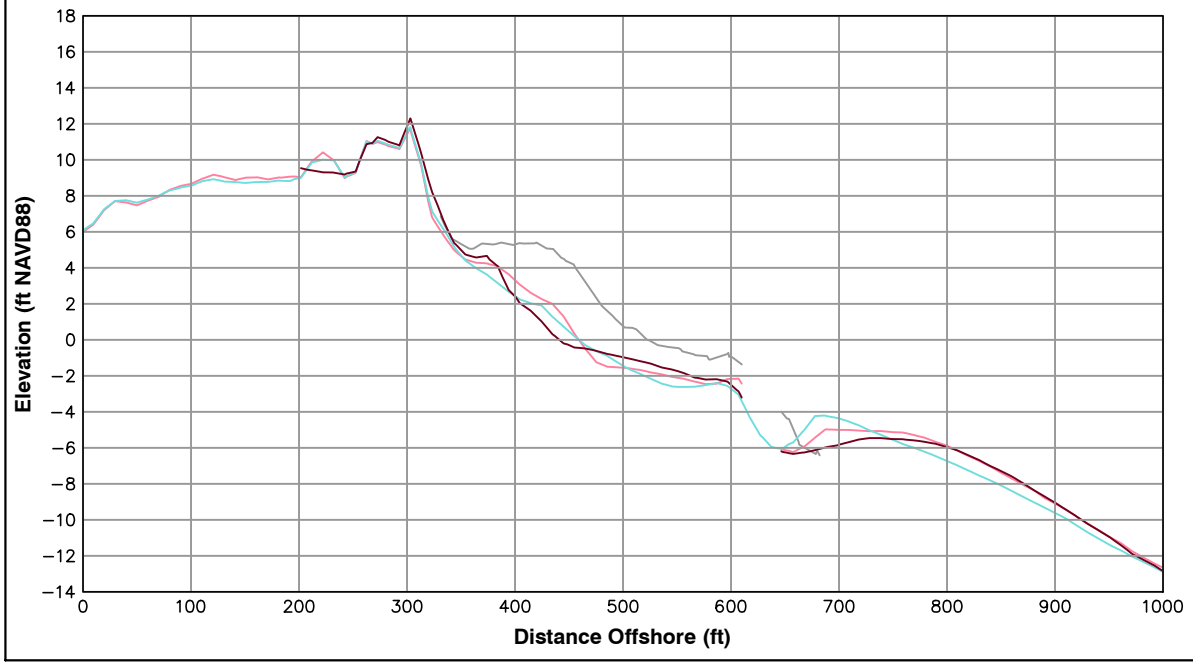
LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
1. Stationing 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 April 2013 and October 2013.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 347+63	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-24.05 ft/yr	-15.16 ft
Volume Change Above -15 ft NAVD88	-3.31 cy/ft/yr	4.51 cy/ft
Volume Change Above 0 ft NAVD88	-1.44 cy/ft/yr	0.57 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

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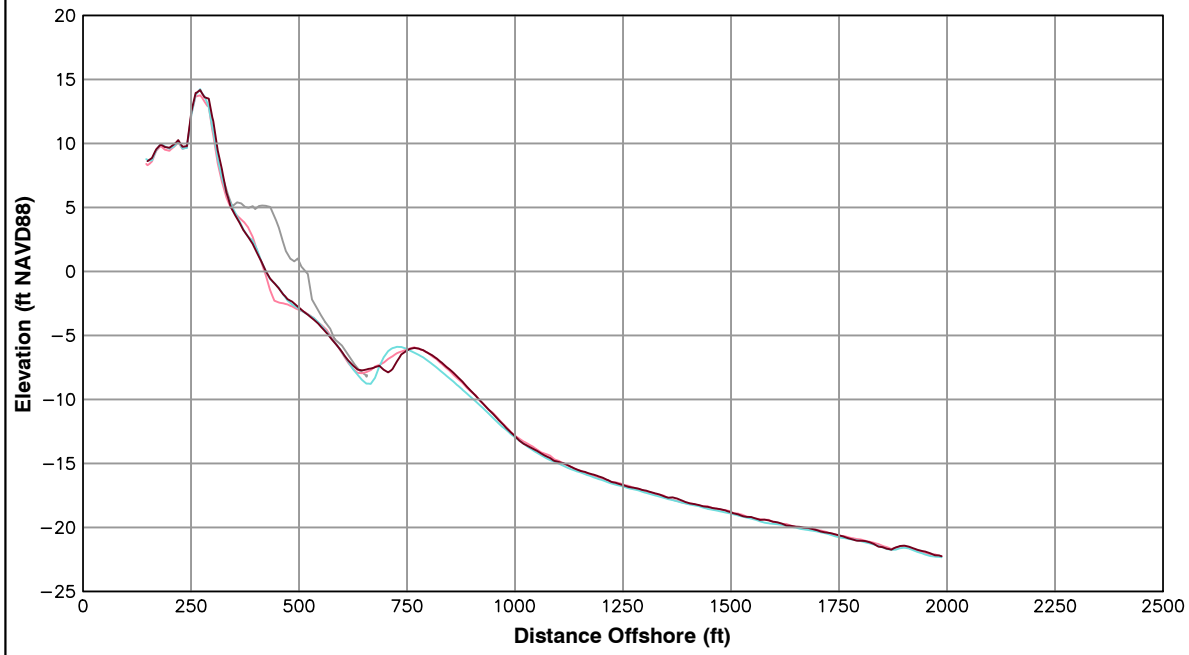
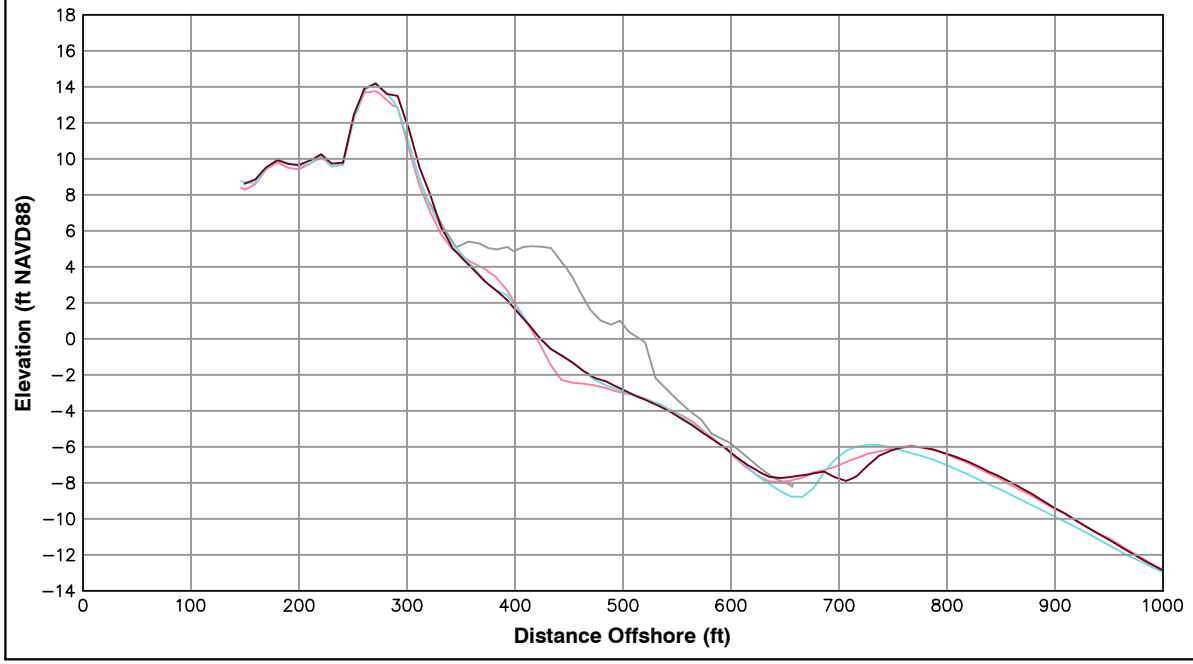
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 349+43	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-0.23 ft/yr	-0.89 ft
Volume Change Above -15 ft NAVD88	2.35 cy/ft/yr	4.73 cy/ft
Volume Change Above 0 ft NAVD88	1.79 cy/ft/yr	1.02 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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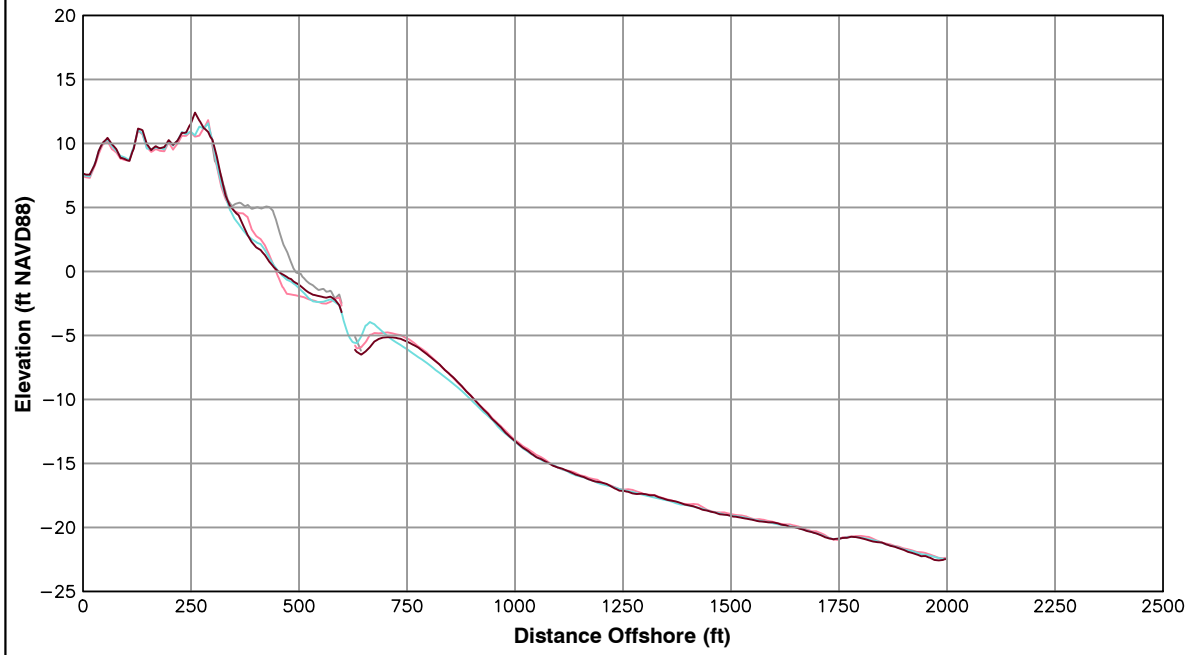
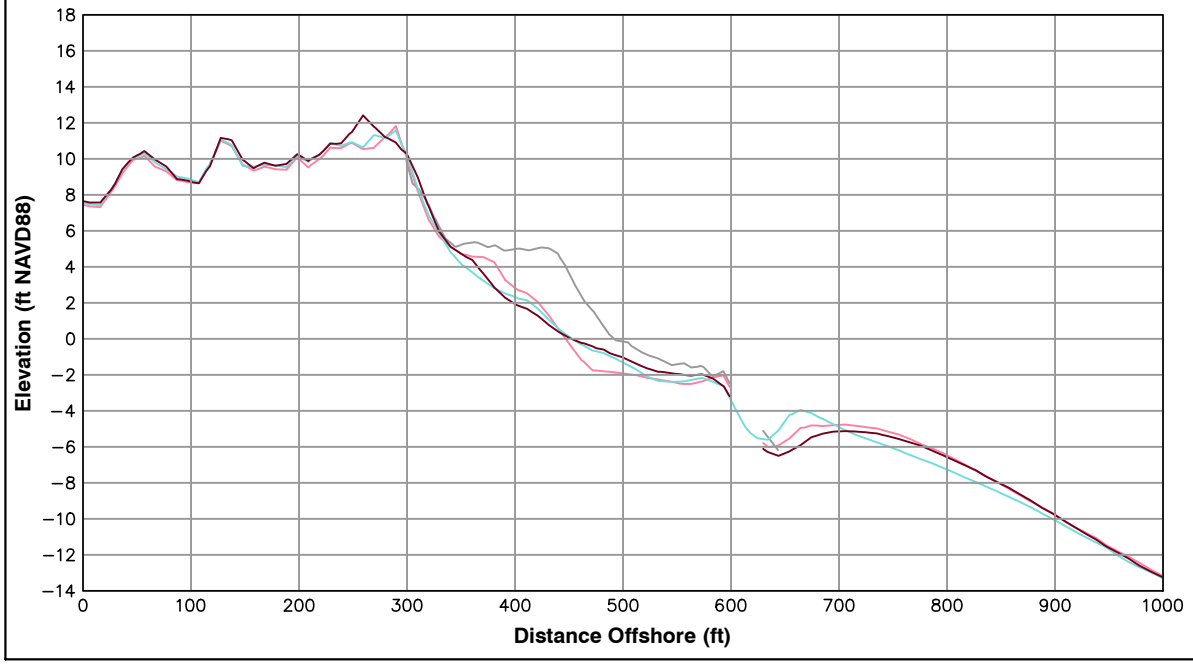
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 351+23	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-8.26 ft/yr	-5.49 ft
Volume Change Above -15 ft NAVD88	1.33 cy/ft/yr	4.43 cy/ft
Volume Change Above 0 ft NAVD88	1.20 cy/ft/yr	1.83 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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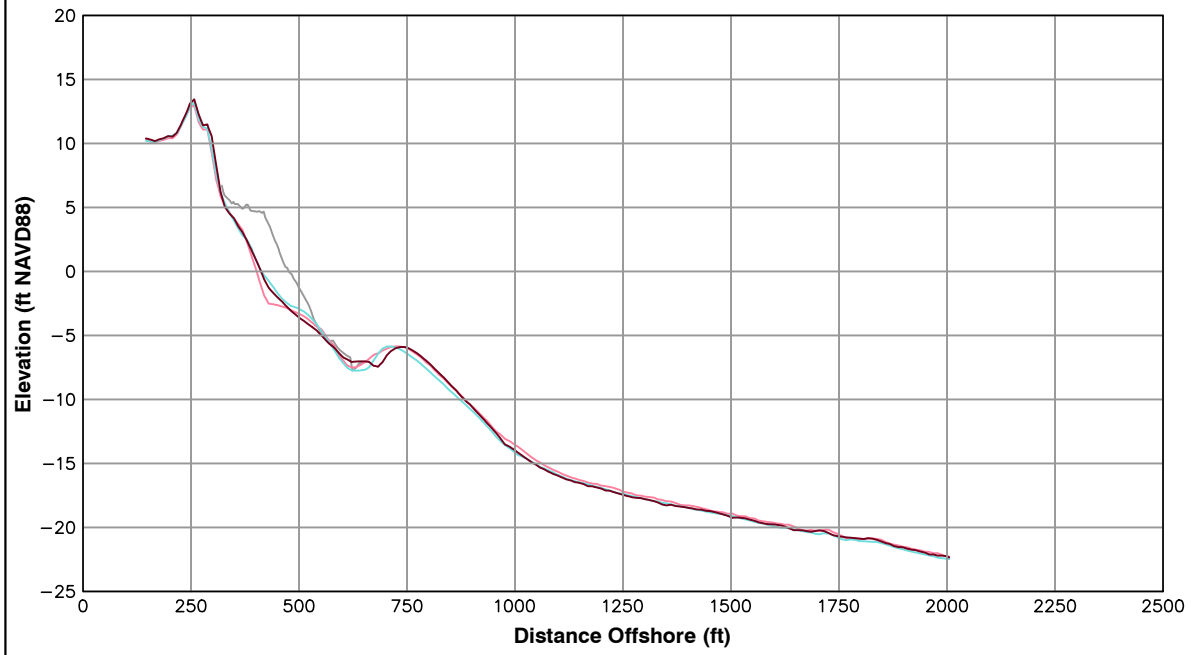
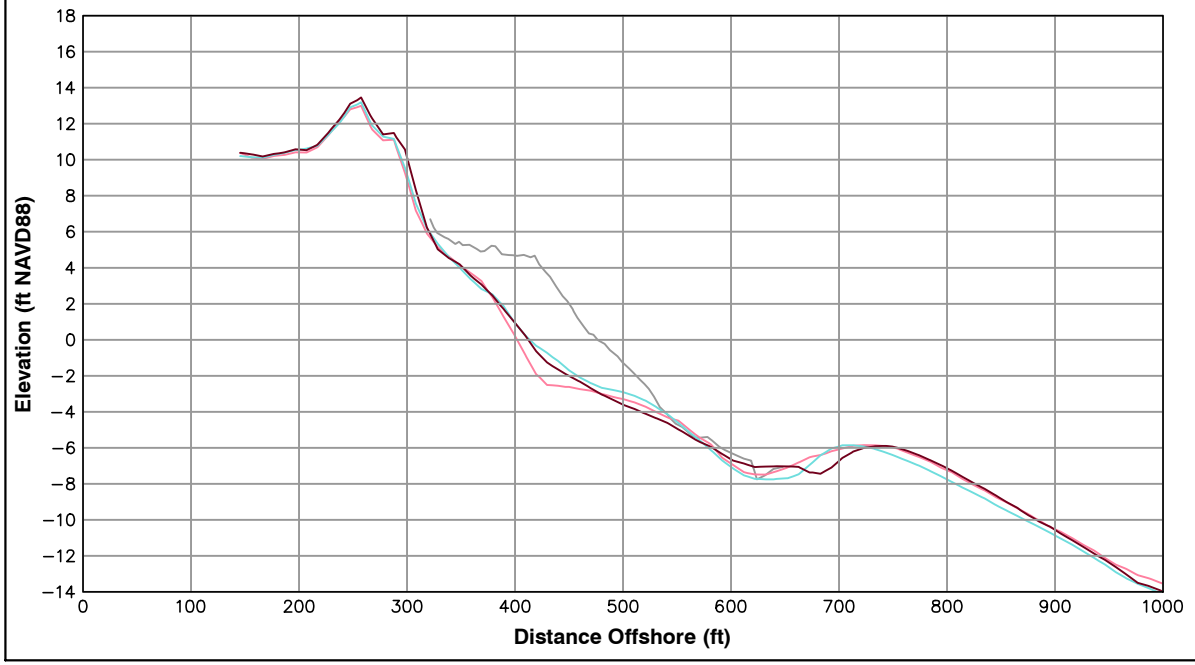
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 353+03	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	7.31 ft/yr	0.07 ft
Volume Change Above -15 ft NAVD88	1.53 cy/ft/yr	3.21 cy/ft
Volume Change Above 0 ft NAVD88	2.75 cy/ft/yr	1.44 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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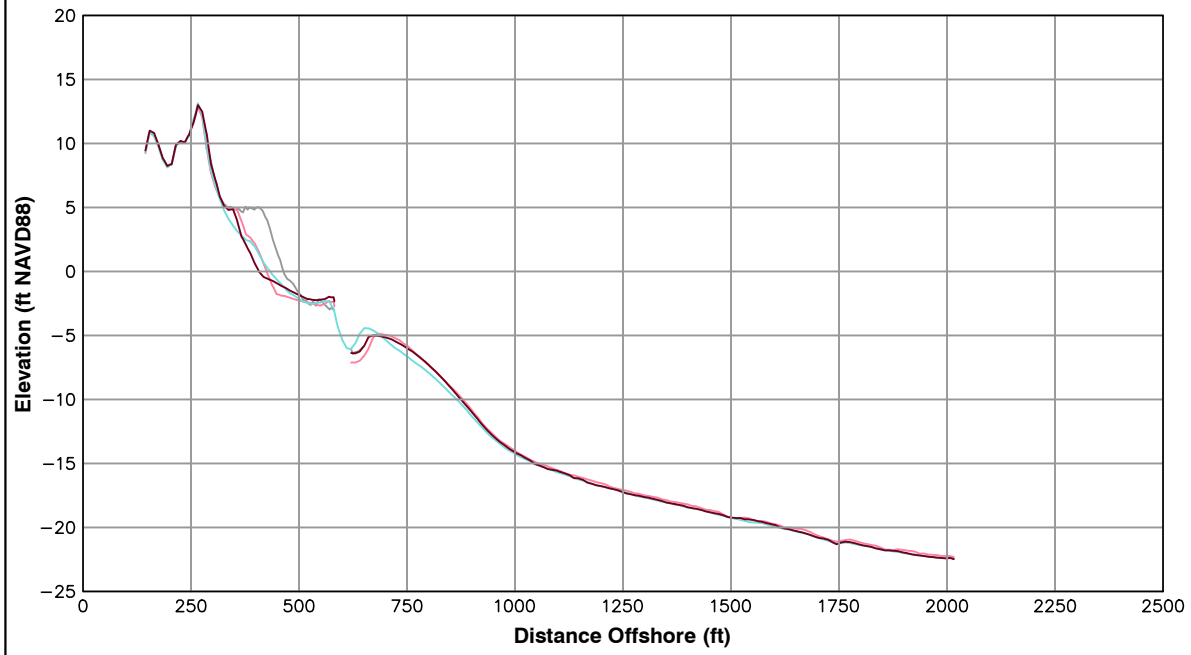
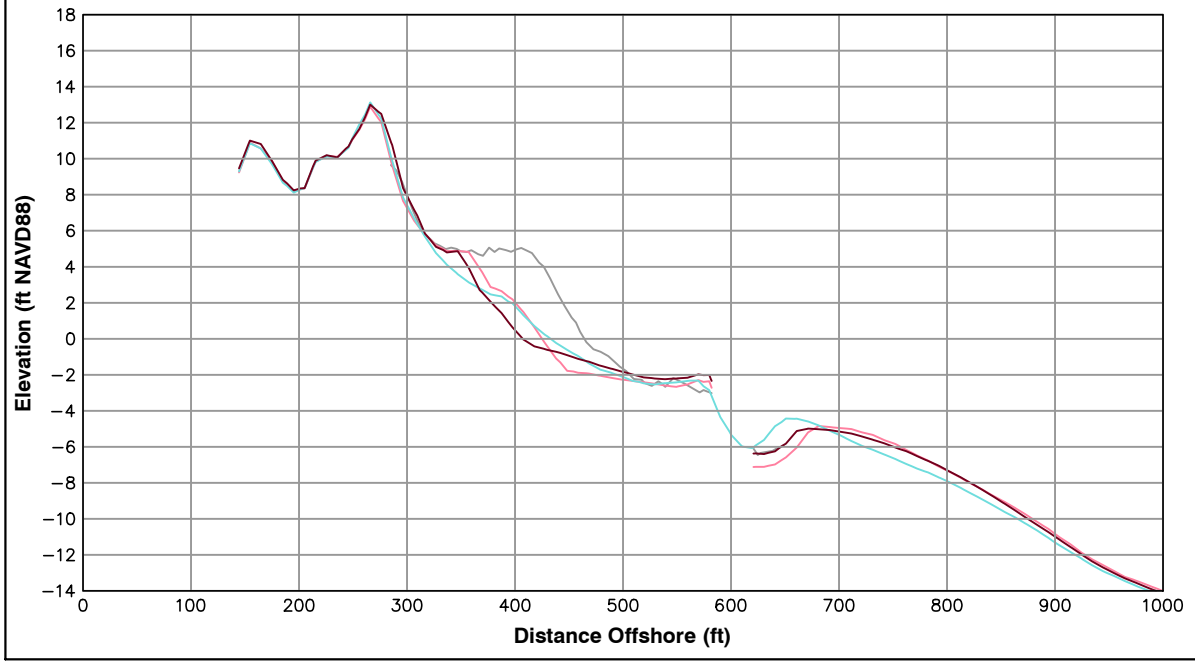
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 354+83	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-21.44 ft/yr	-20.22 ft
Volume Change Above -15 ft NAVD88	0.62 cy/ft/yr	3.92 cy/ft
Volume Change Above 0 ft NAVD88	-1.54 cy/ft/yr	0.50 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

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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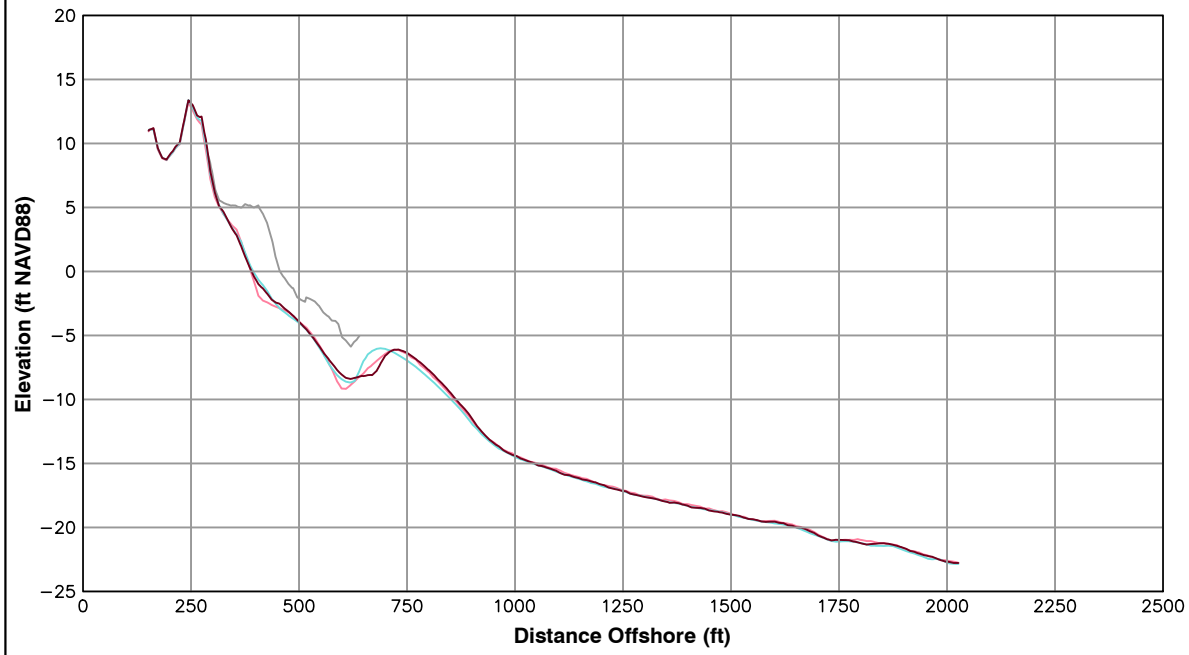

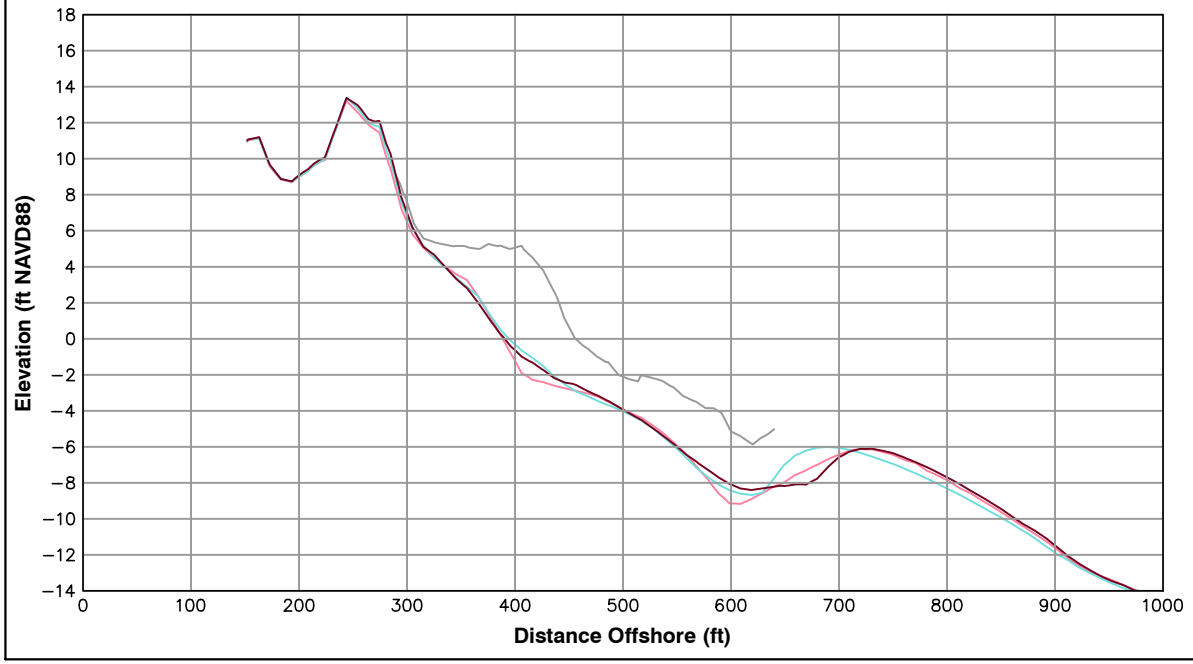

Survey Transect 356+63	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-1.74 ft/yr	-3.24 ft
Volume Change Above -15 ft NAVD88	4.07 cy/ft/yr	2.50 cy/ft
Volume Change Above 0 ft NAVD88	1.17 cy/ft/yr	0.39 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

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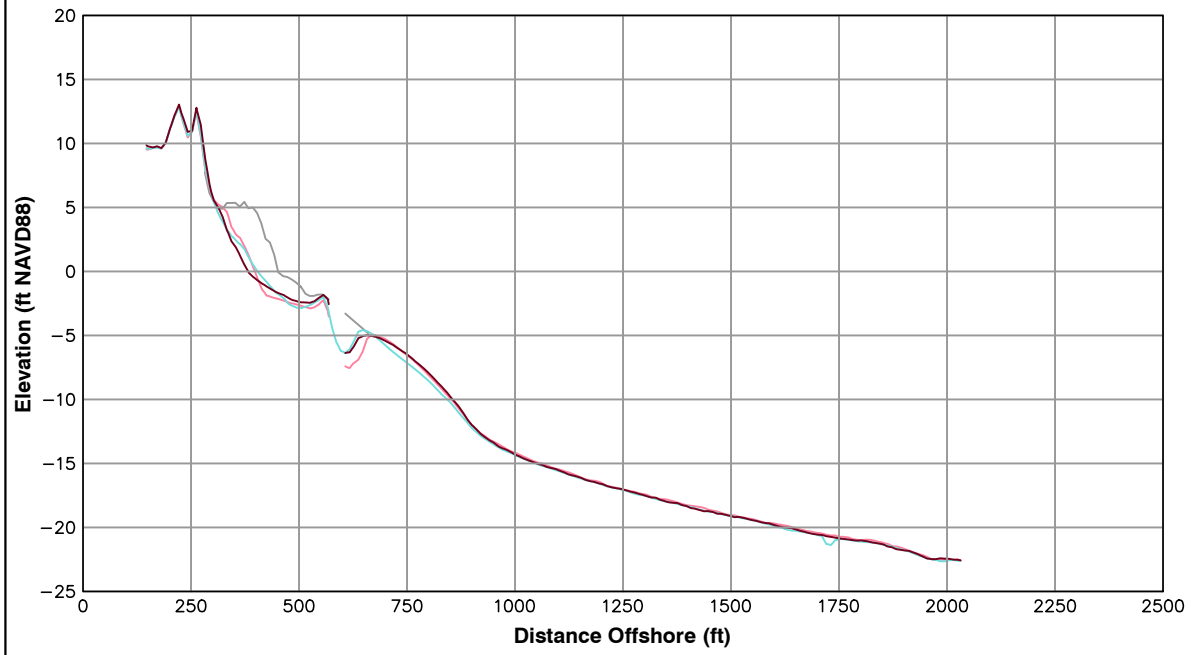
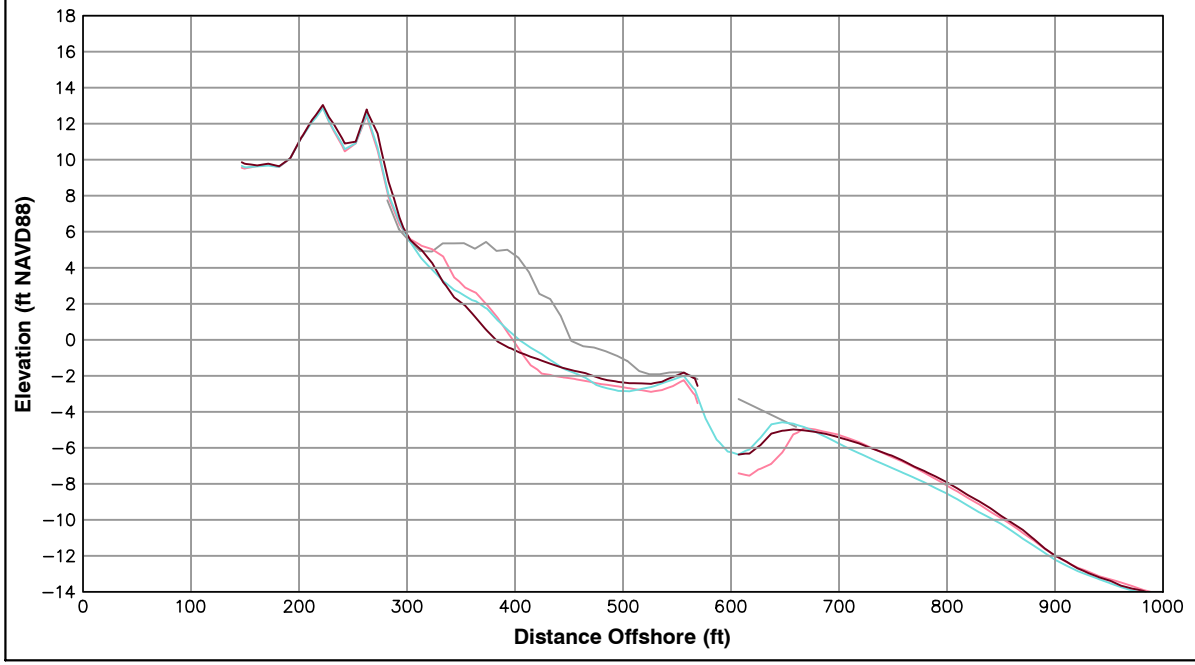
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 358+43	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-20.18 ft/yr	-18.47 ft
Volume Change Above -15 ft NAVD88	2.88 cy/ft/yr	4.24 cy/ft
Volume Change Above 0 ft NAVD88	-1.96 cy/ft/yr	-0.17 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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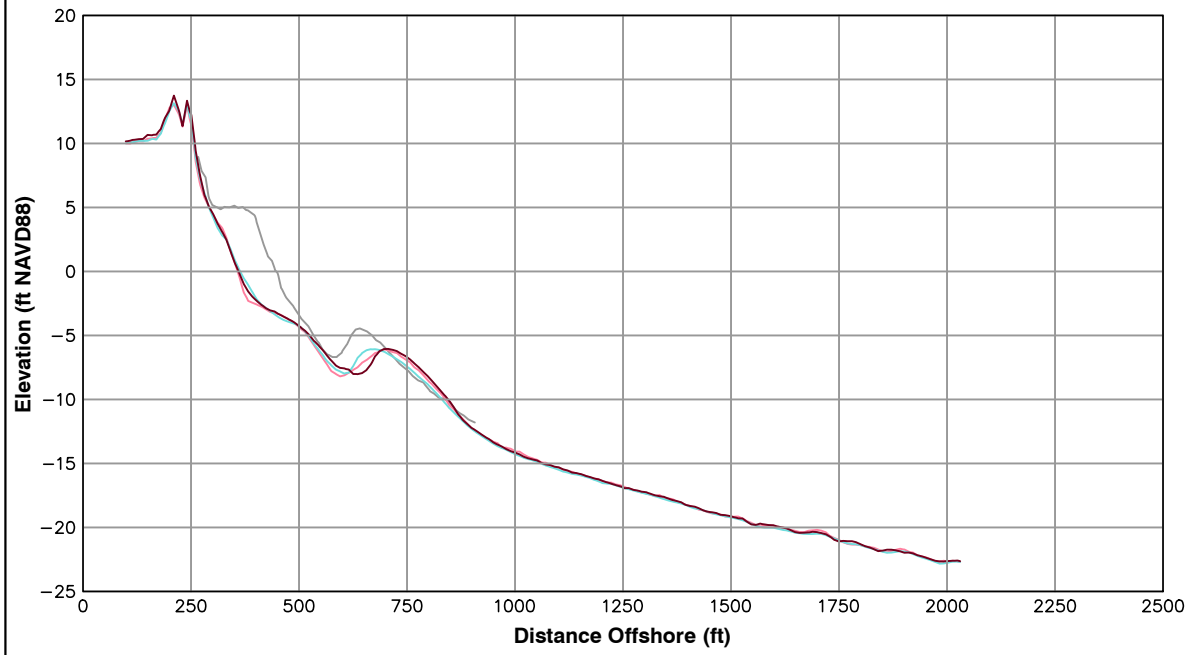
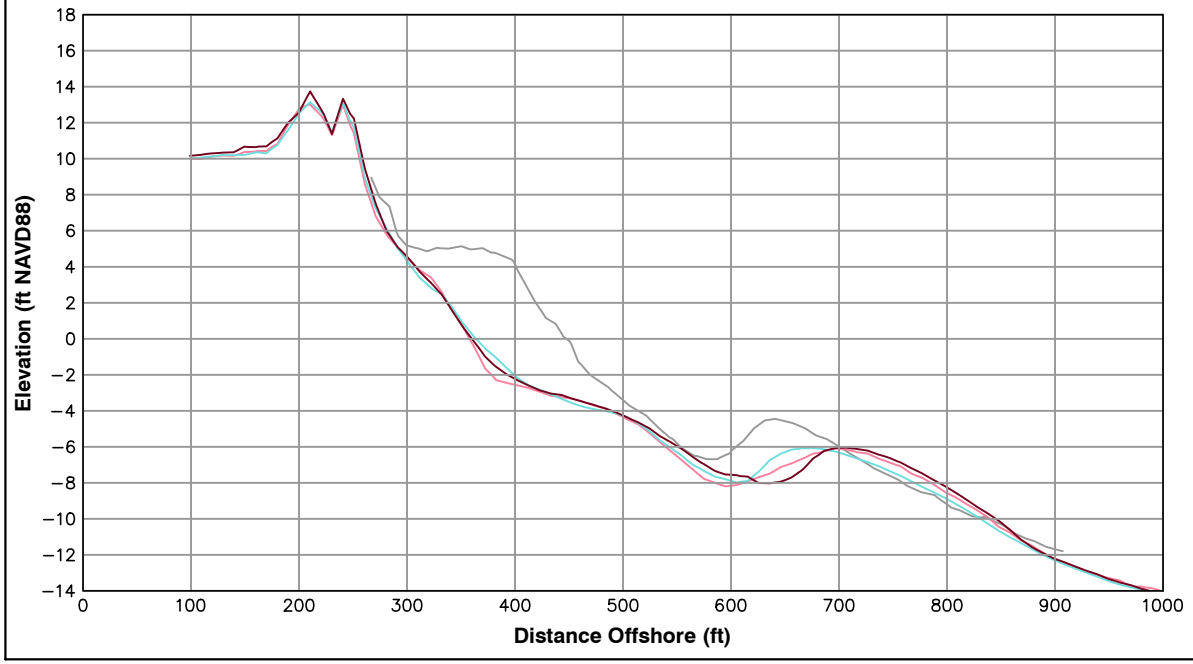
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 360+23	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	0.09 ft/yr	-2.33 ft
Volume Change Above -15 ft NAVD88	5.16 cy/ft/yr	4.87 cy/ft
Volume Change Above 0 ft NAVD88	2.15 cy/ft/yr	1.91 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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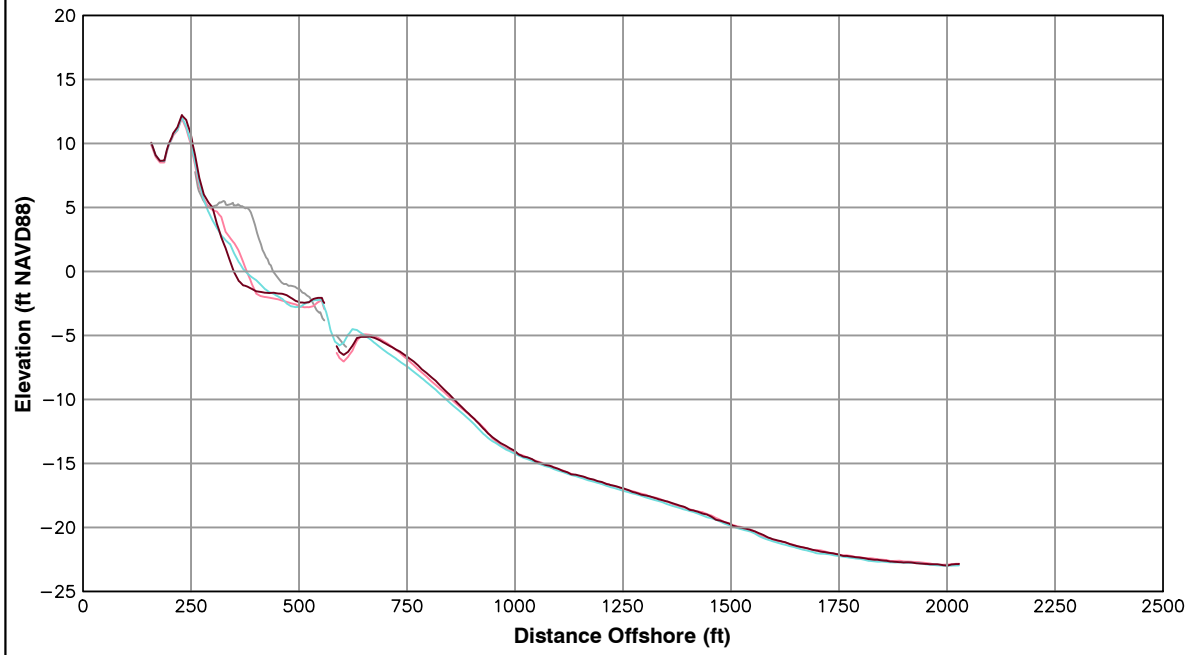
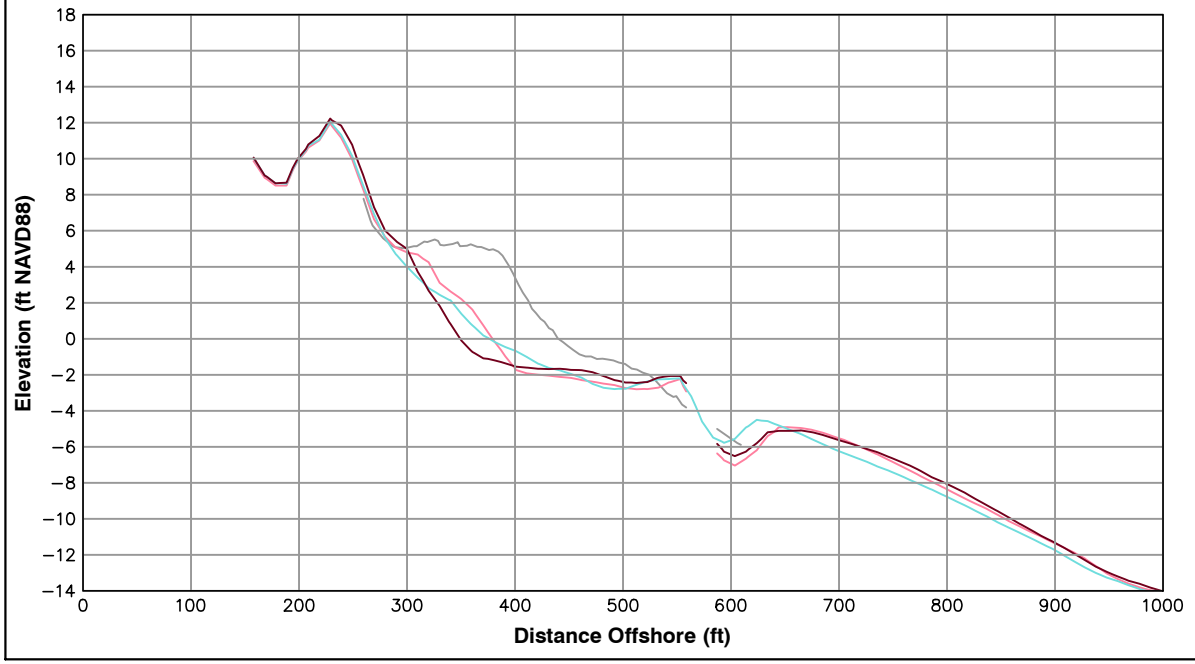
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 362+03	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-30.50 ft/yr	-18.19 ft
Volume Change Above -15 ft NAVD88	1.07 cy/ft/yr	4.46 cy/ft
Volume Change Above 0 ft NAVD88	-1.95 cy/ft/yr	0.28 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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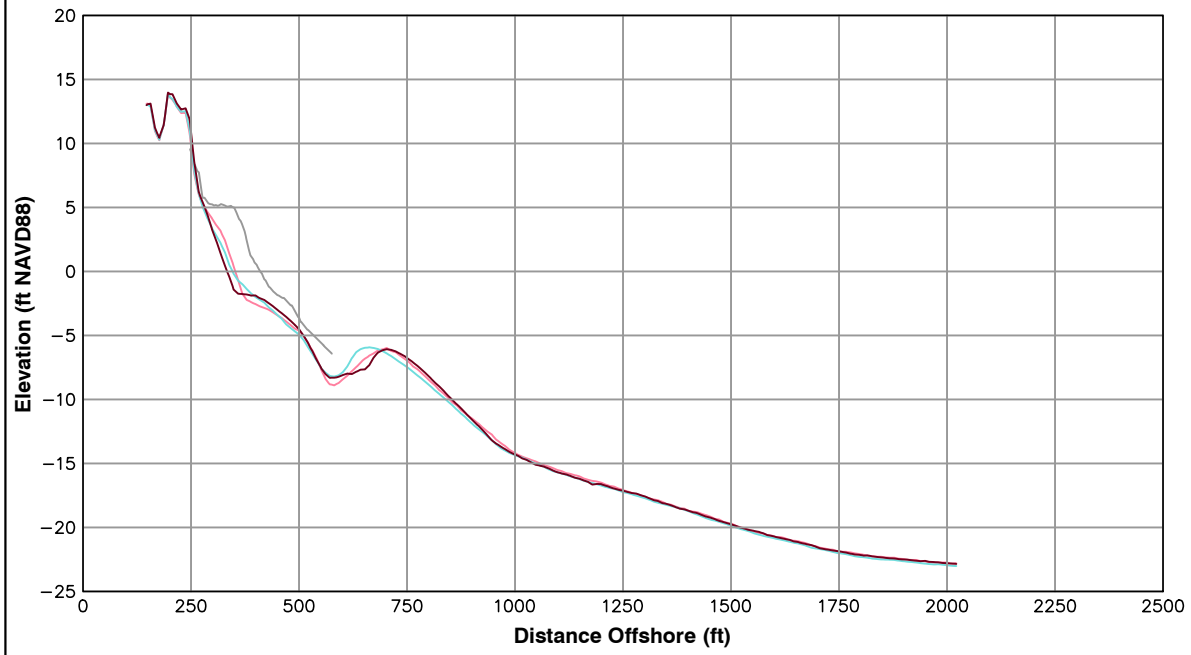
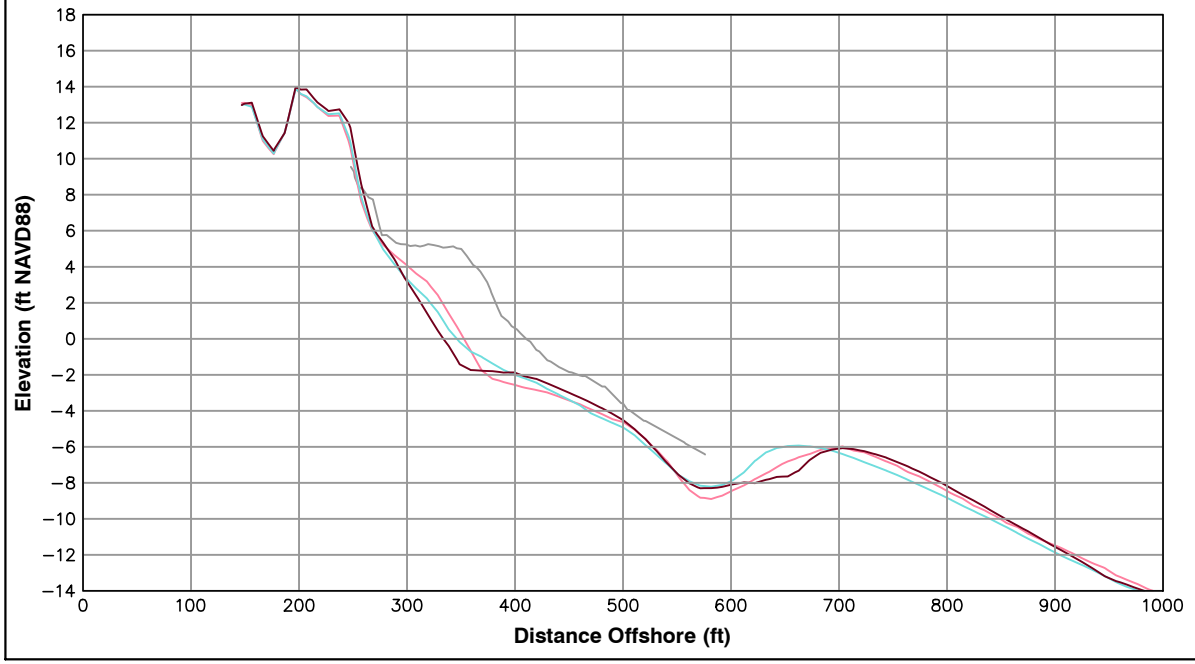
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 363+83	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-20.67 ft/yr	-10.79 ft
Volume Change Above -15 ft NAVD88	-0.53 cy/ft/yr	1.76 cy/ft
Volume Change Above 0 ft NAVD88	-1.34 cy/ft/yr	0.43 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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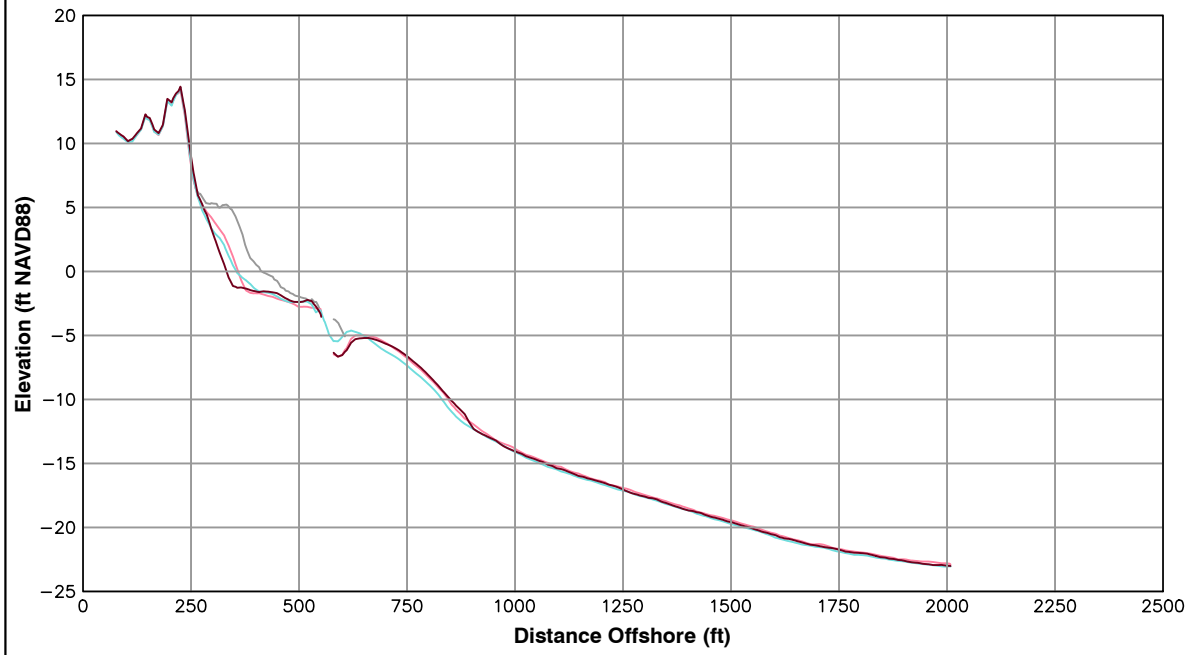
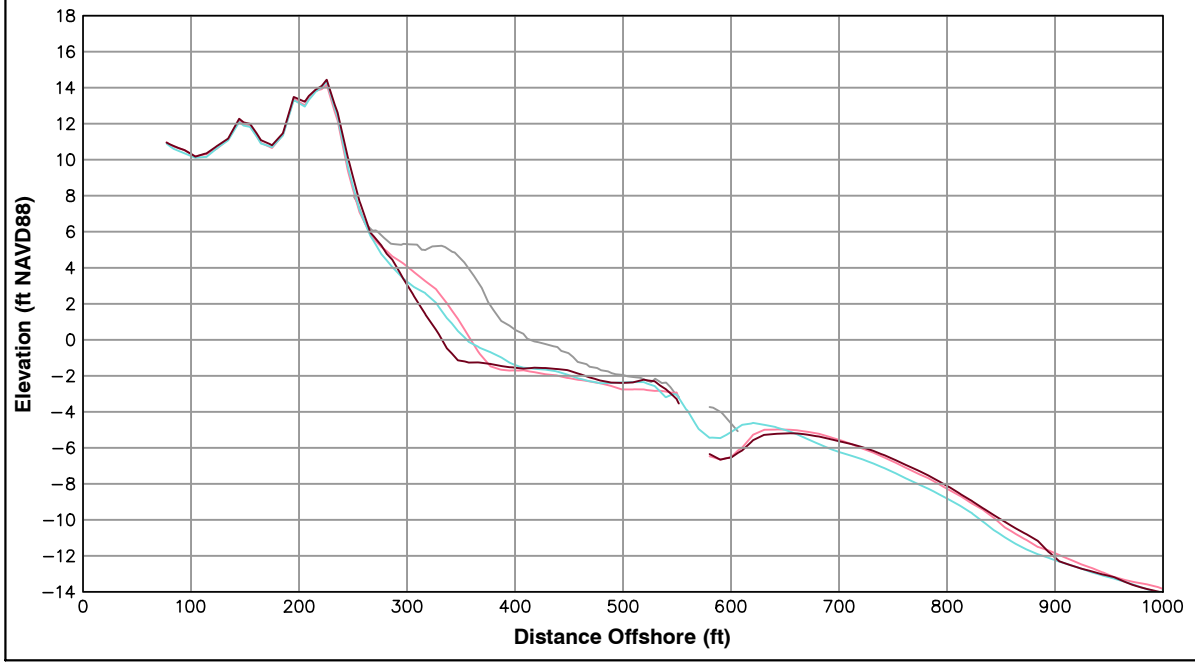
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 365+63	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-28.00 ft/yr	-18.55 ft
Volume Change Above -15 ft NAVD88	-2.65 cy/ft/yr	2.46 cy/ft
Volume Change Above 0 ft NAVD88	-2.48 cy/ft/yr	-0.17 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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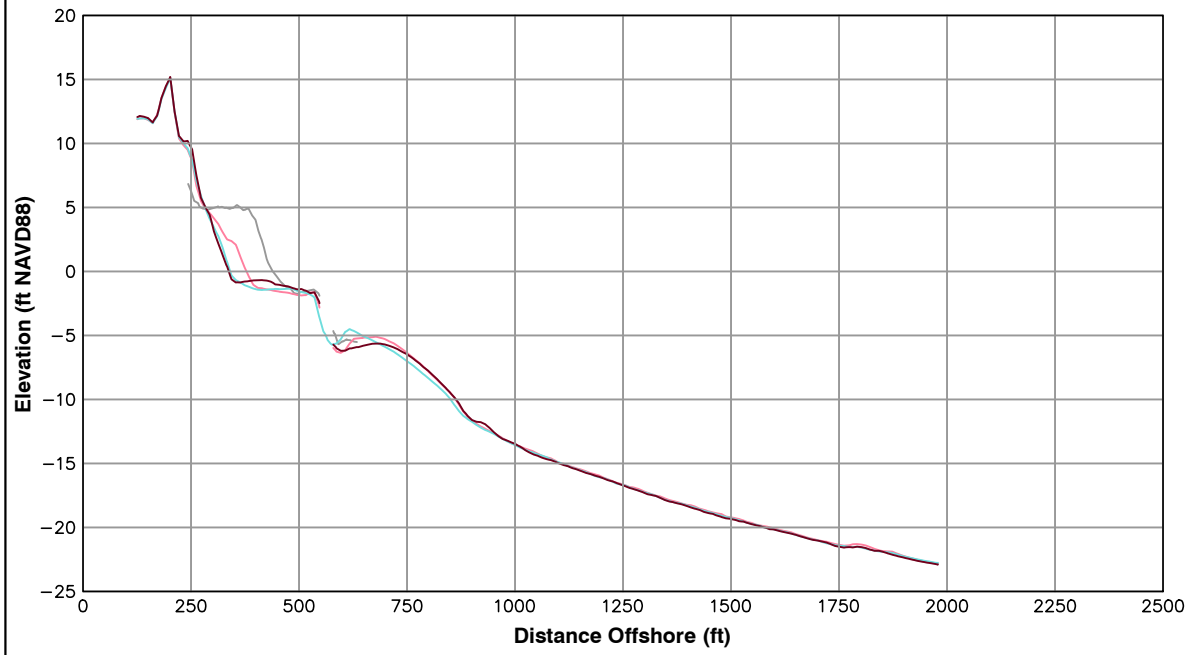
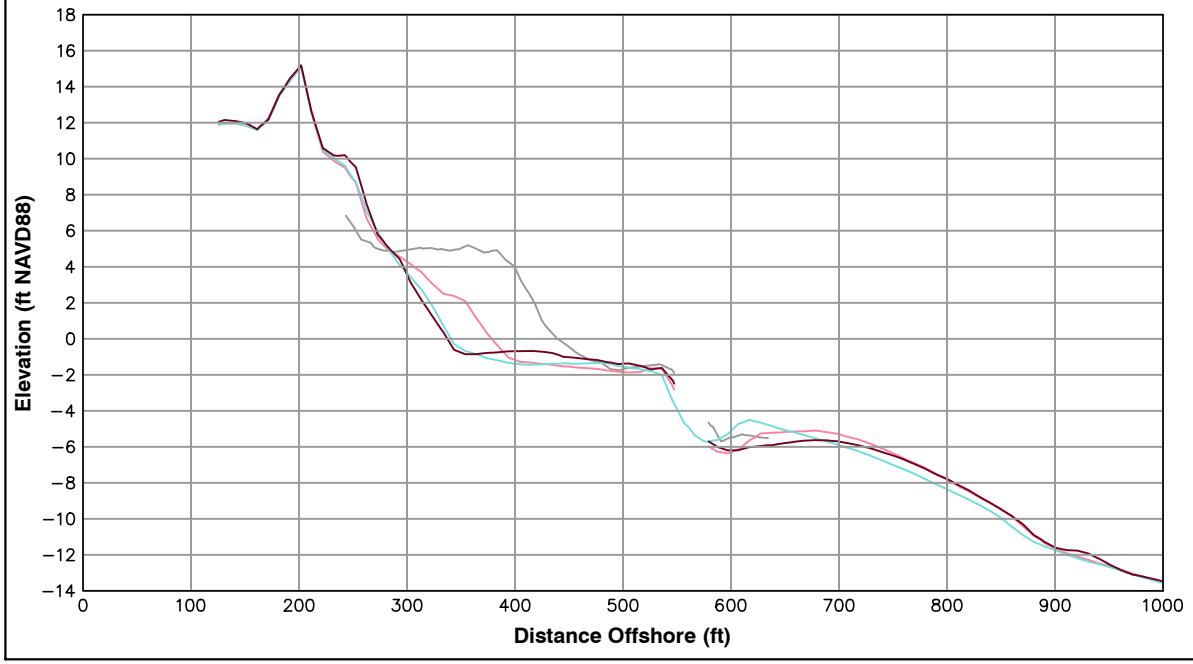
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 369+23	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-41.06 ft/yr	-4.74 ft
Volume Change Above -15 ft NAVD88	-4.19 cy/ft/yr	3.79 cy/ft
Volume Change Above 0 ft NAVD88	-3.41 cy/ft/yr	0.50 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
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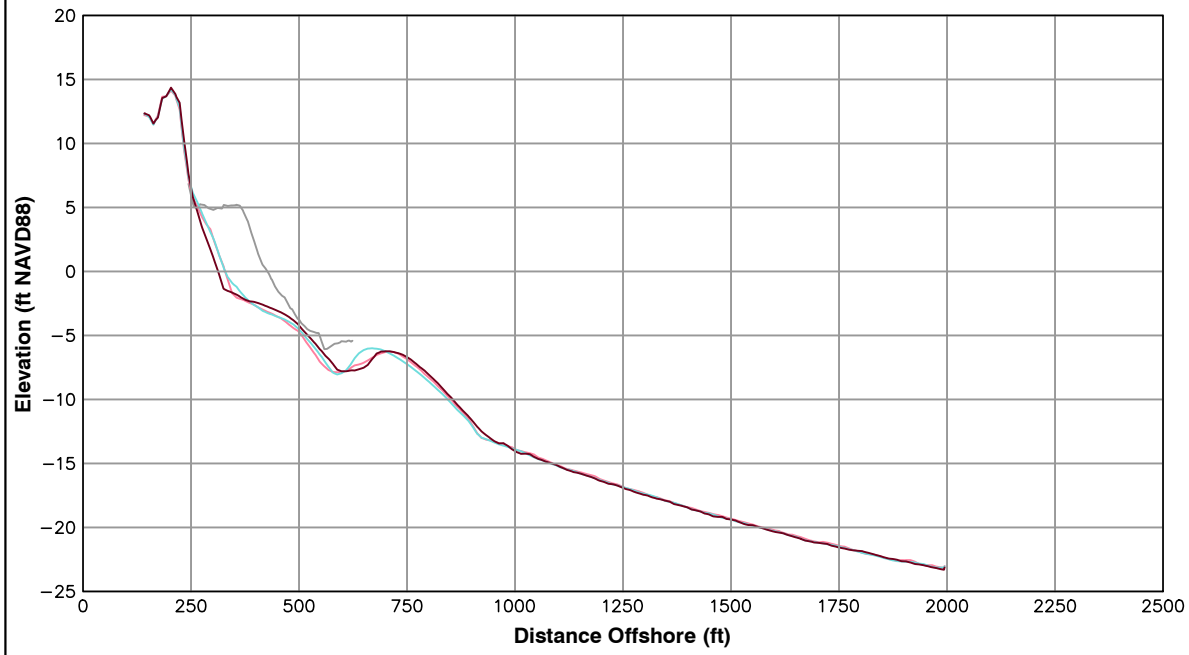
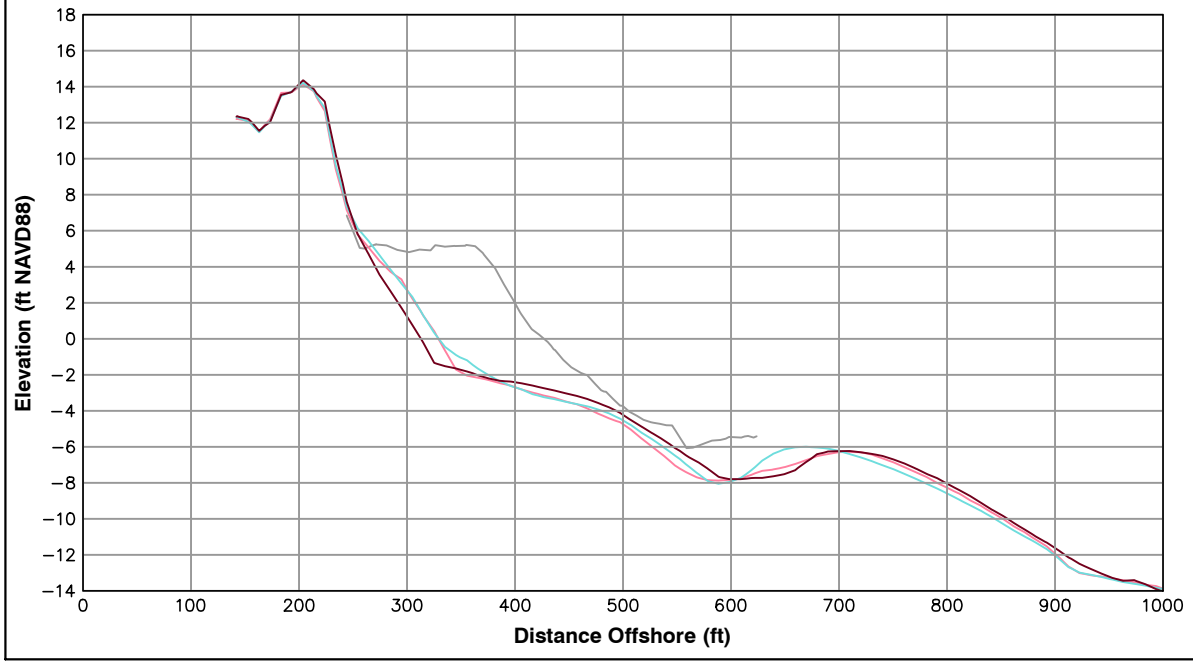
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 367+43	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-16.53 ft/yr	-15.69 ft
Volume Change Above -15 ft NAVD88	2.84 cy/ft/yr	0.70 cy/ft
Volume Change Above 0 ft NAVD88	-1.84 cy/ft/yr	-2.32 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
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Notes:
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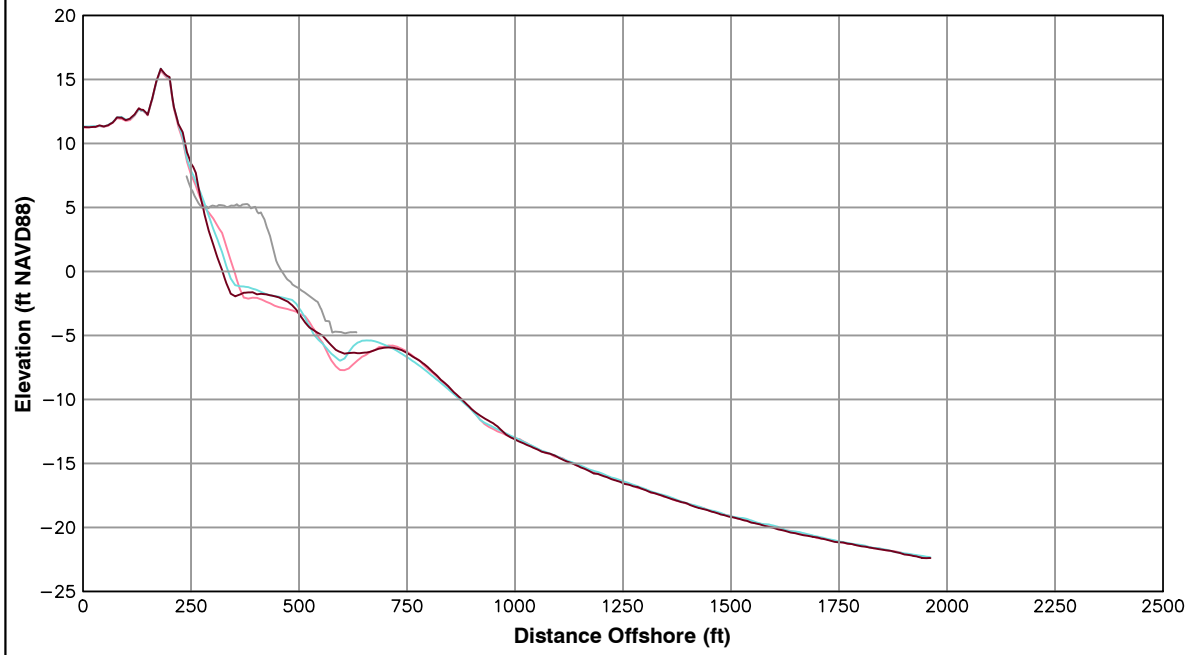
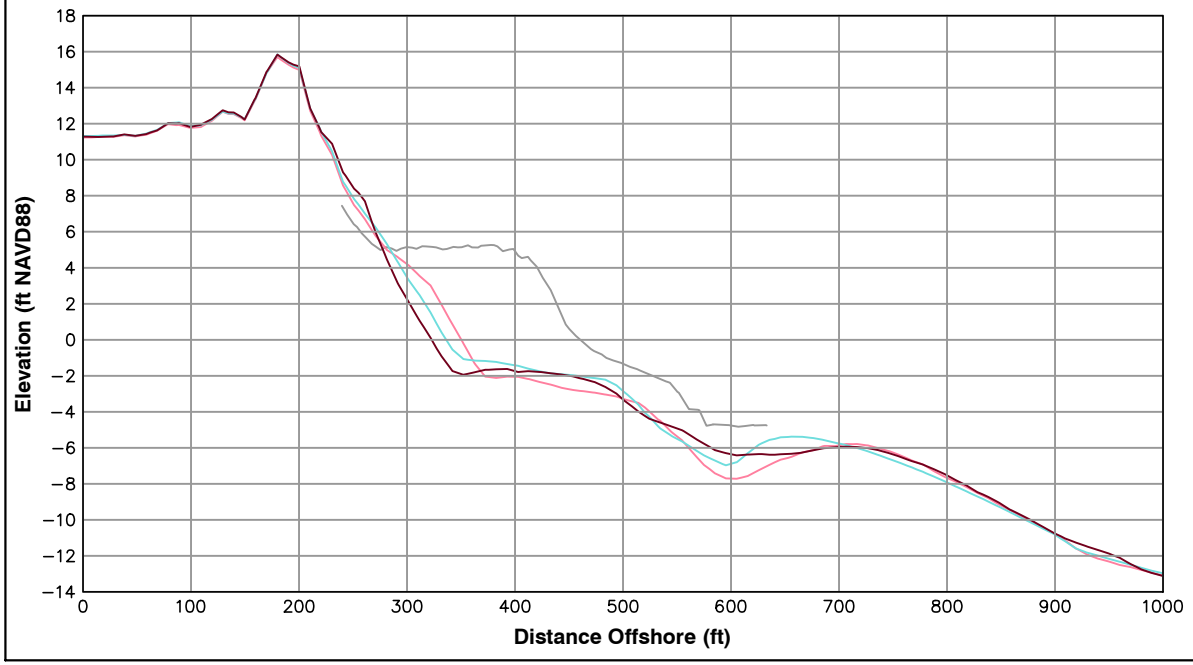
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 371+03	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-29.50 ft/yr	-14.18 ft
Volume Change Above -15 ft NAVD88	1.95 cy/ft/yr	-3.08 cy/ft
Volume Change Above 0 ft NAVD88	-2.70 cy/ft/yr	-1.64 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
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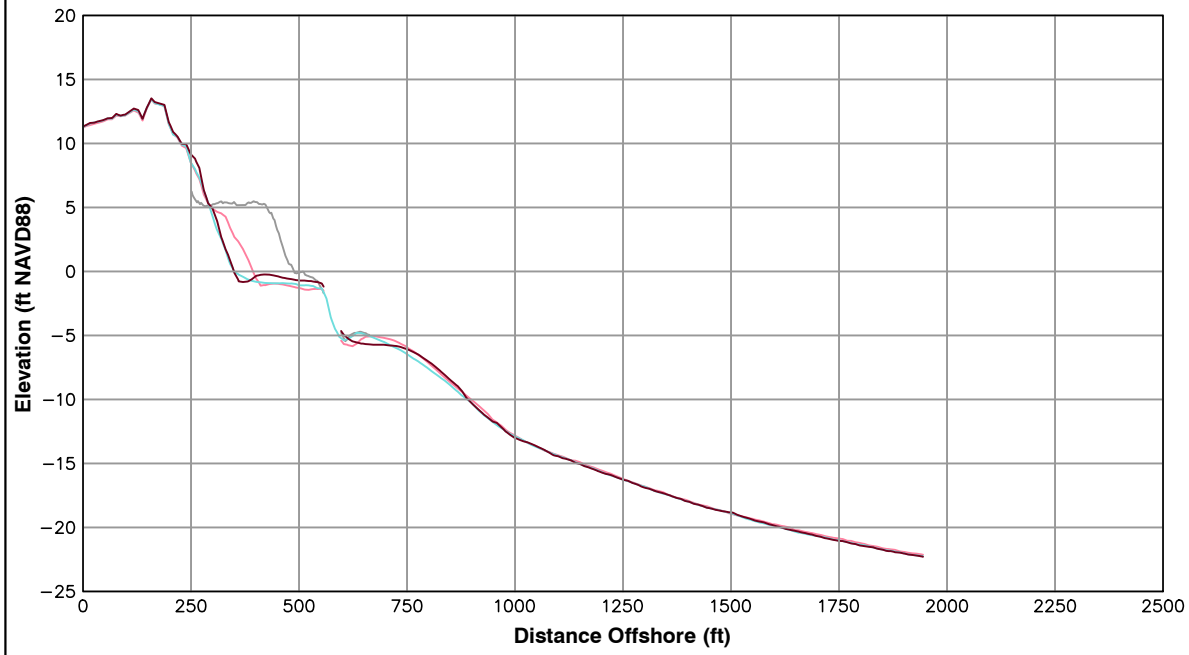
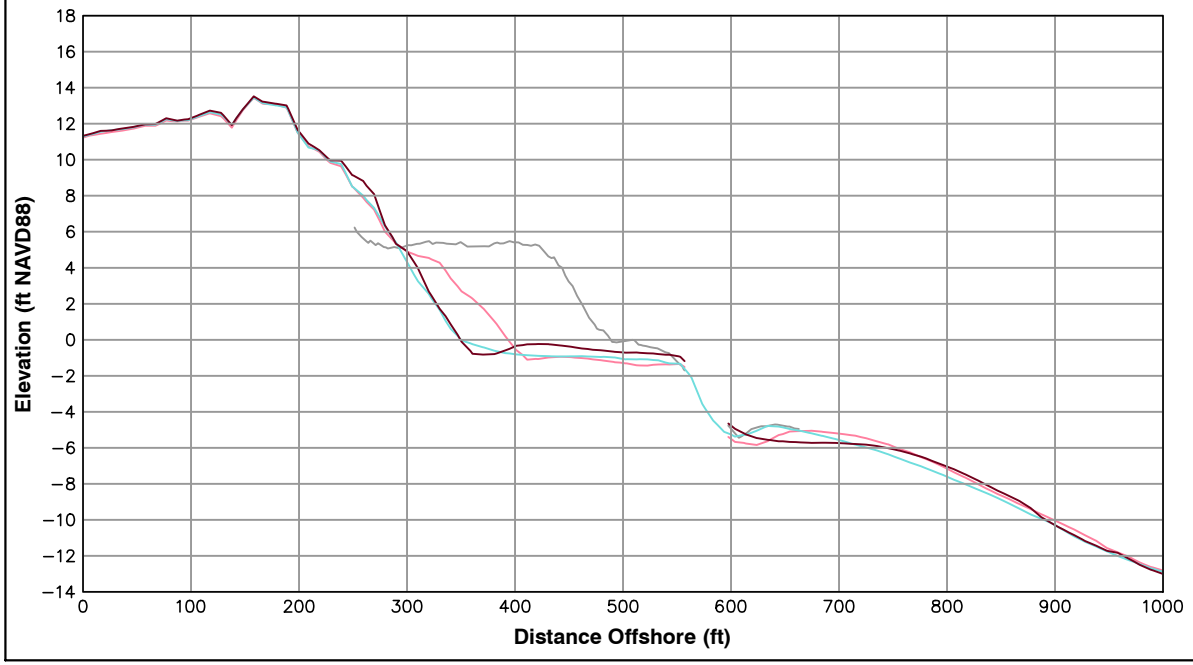
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 372+83	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-43.90 ft/yr	2.63 ft
Volume Change Above -15 ft NAVD88	-3.36 cy/ft/yr	5.65 cy/ft
Volume Change Above 0 ft NAVD88	-3.85 cy/ft/yr	2.12 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
1. Stationing 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 April 2013 and October 2013.
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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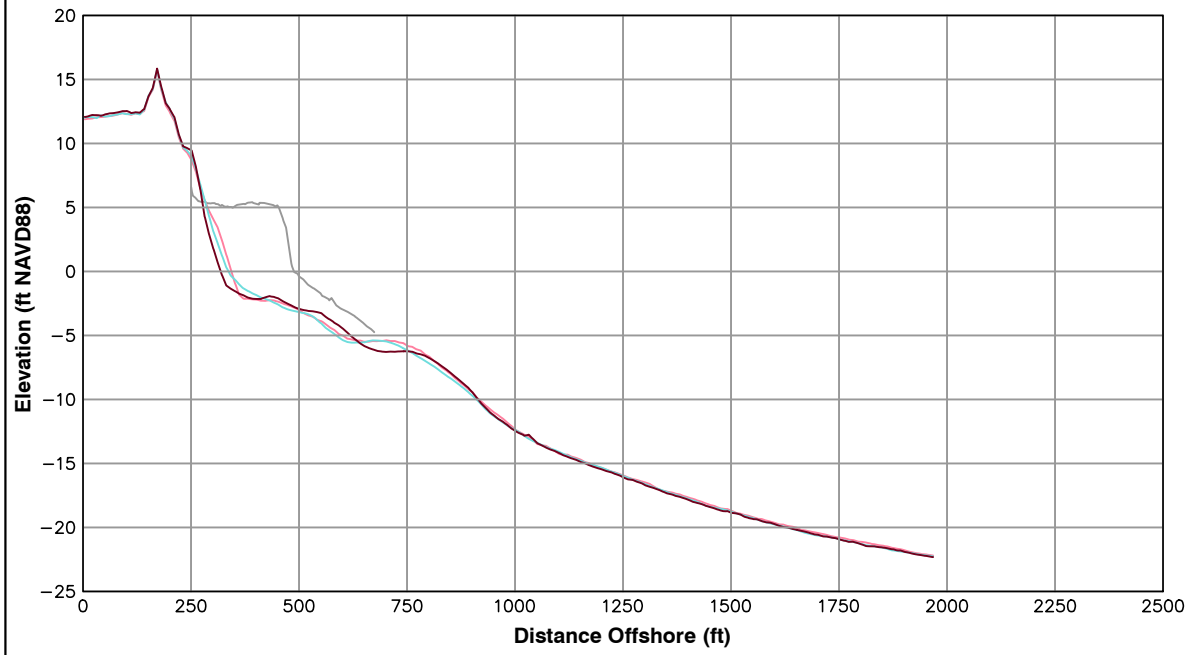
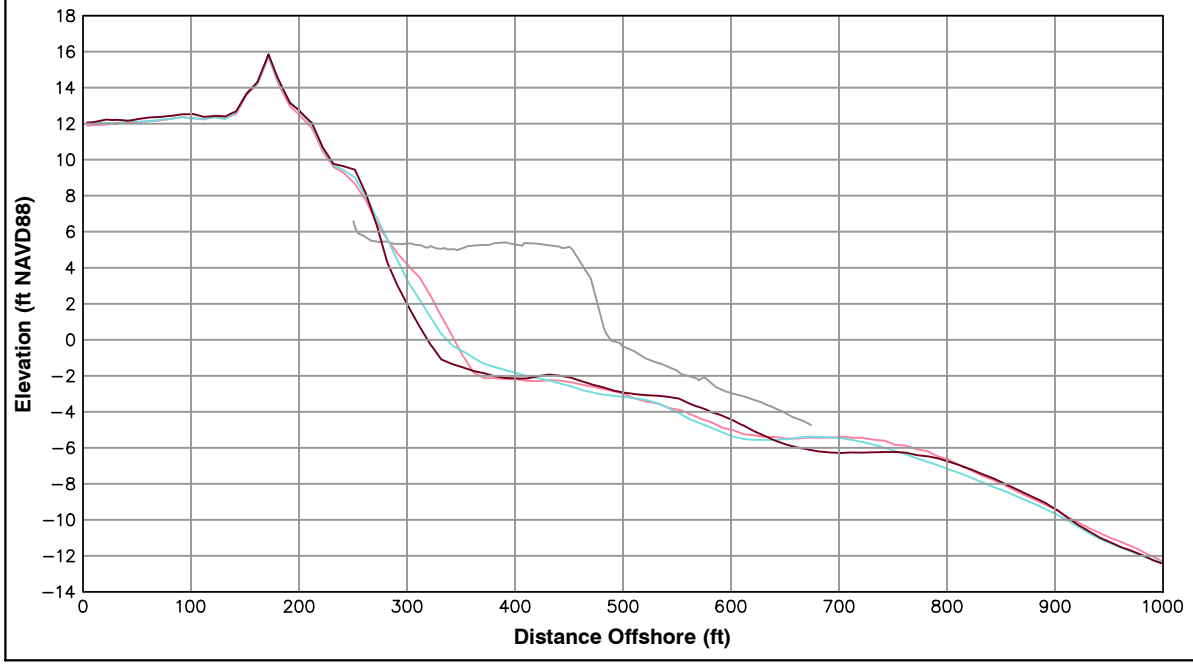
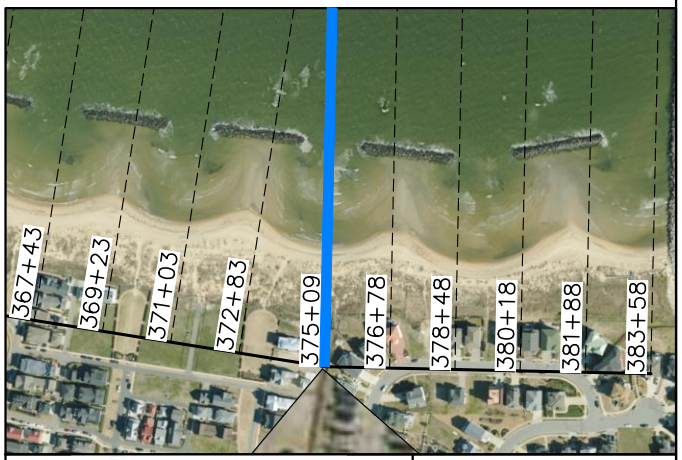




Survey Transect 375+08	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-26.43 ft/yr	-15.39 ft
Volume Change Above -15 ft NAVD88	-4.76 cy/ft/yr	0.23 cy/ft
Volume Change Above 0 ft NAVD88	-2.53 cy/ft/yr	-1.58 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
1. Stationing 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 April 2013 and October 2013.
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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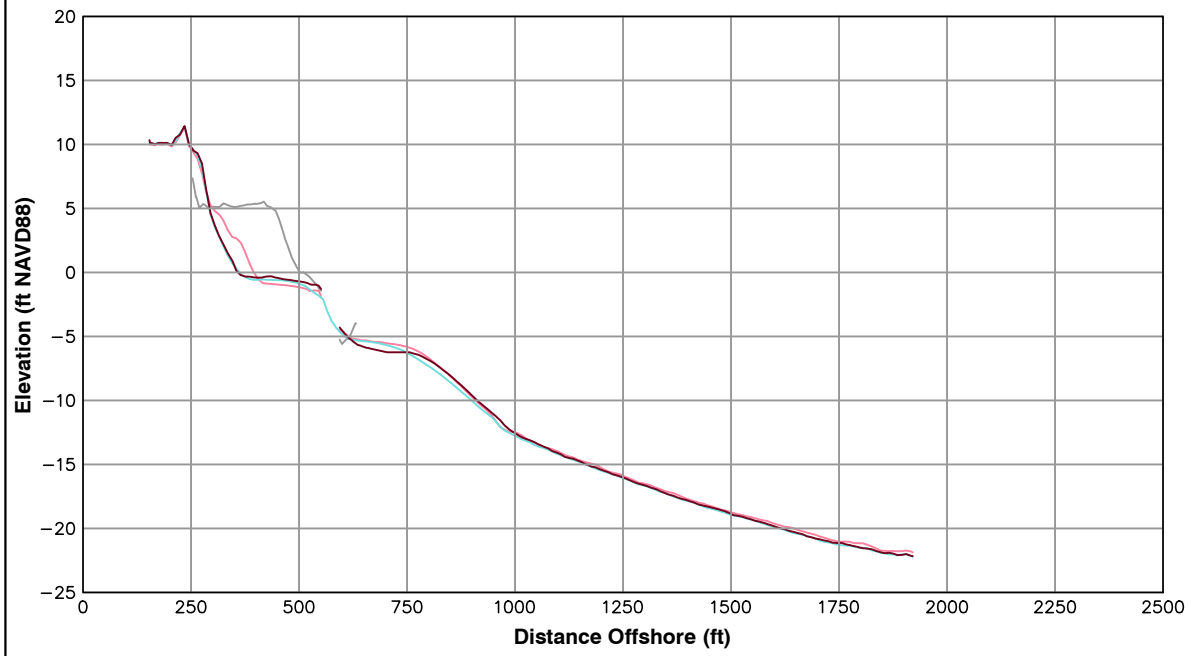
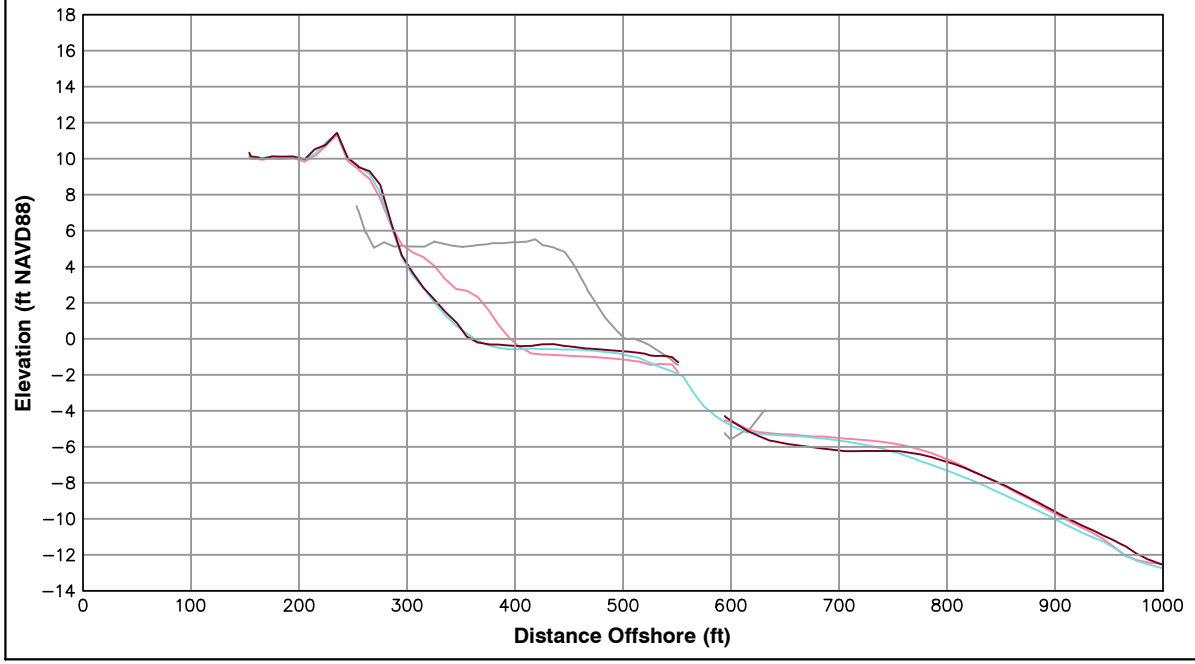
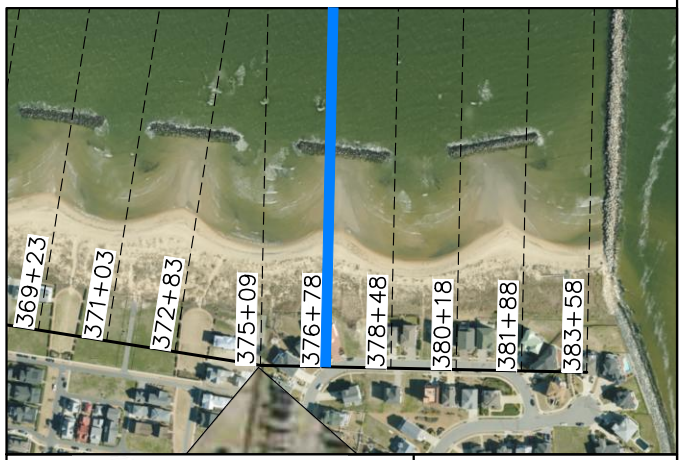




Survey Transect 376+78	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-39.33 ft/yr	3.44 ft
Volume Change Above -15 ft NAVD88	-5.78 cy/ft/yr	5.04 cy/ft
Volume Change Above 0 ft NAVD88	-5.12 cy/ft/yr	0.65 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
1. Stationing 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 April 2013 and October 2013.
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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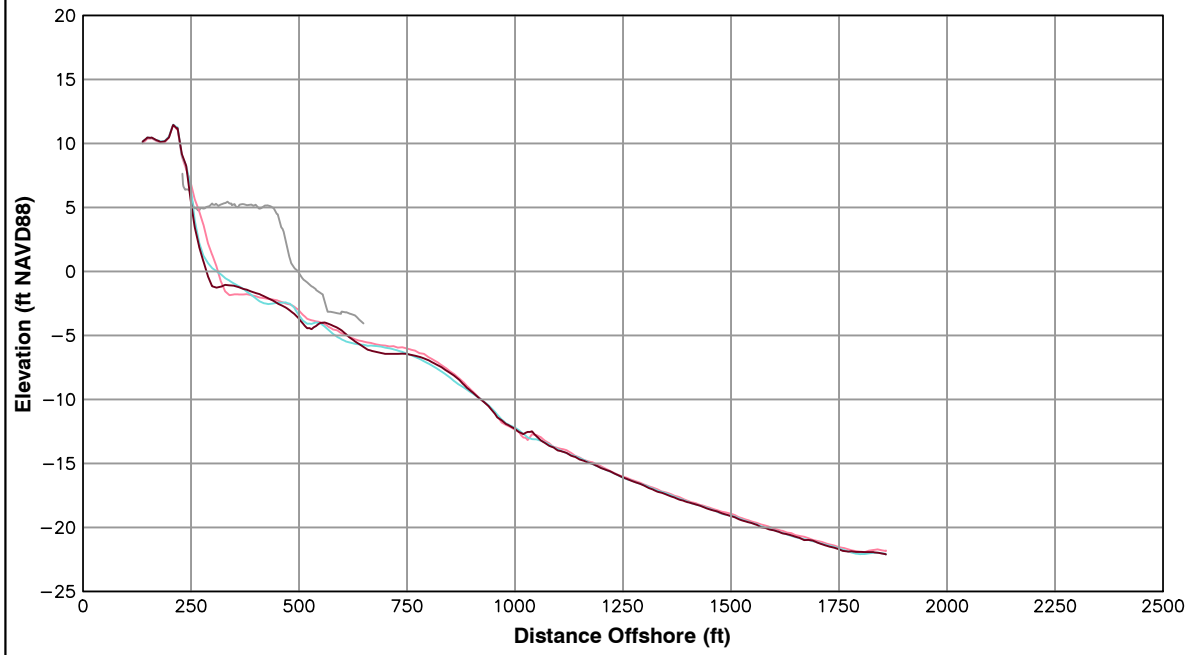
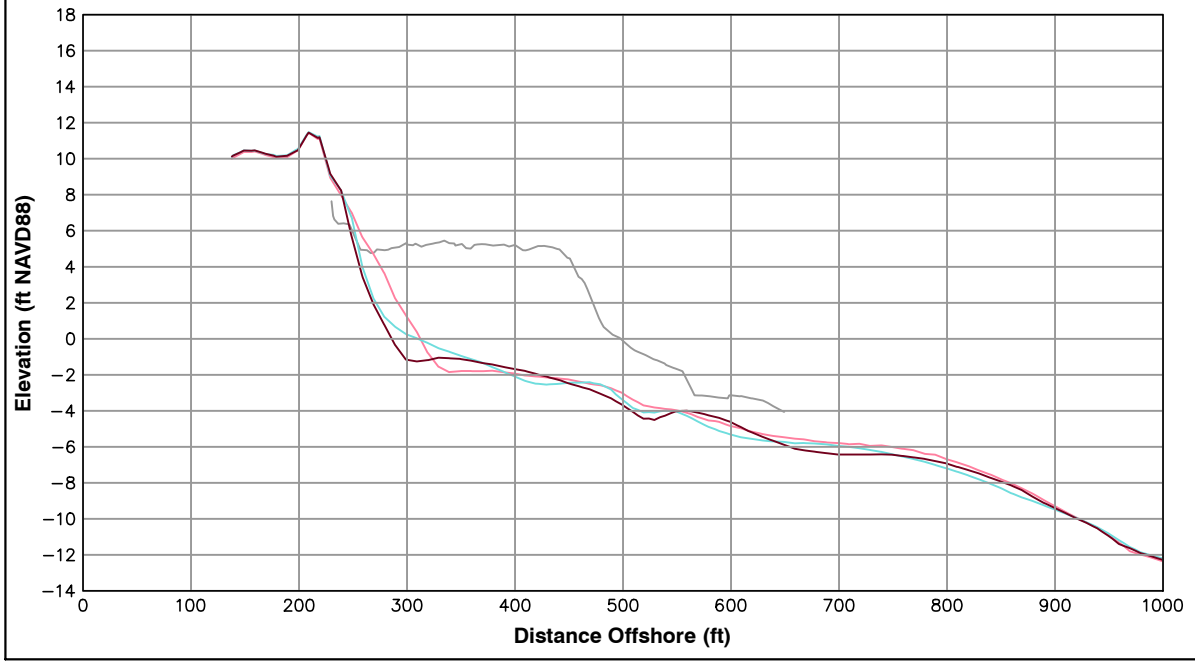
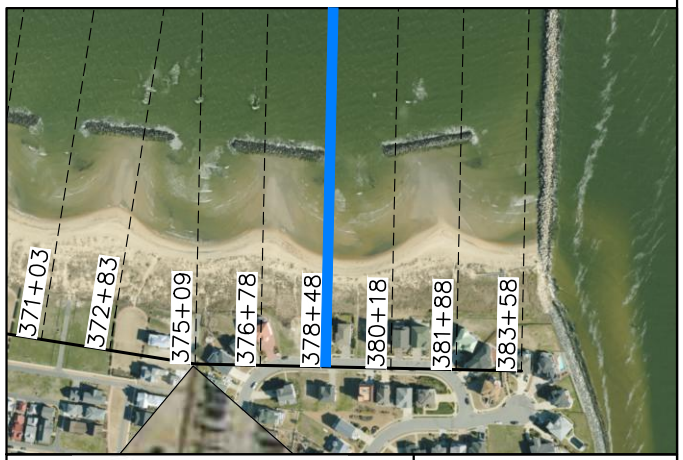




Survey Transect 378+48	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-26.30 ft/yr	-6.16 ft
Volume Change Above -15 ft NAVD88	-9.81 cy/ft/yr	-1.81 cy/ft
Volume Change Above 0 ft NAVD88	-4.66 cy/ft/yr	-1.33 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
1. Stationing 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 April 2013 and October 2013.
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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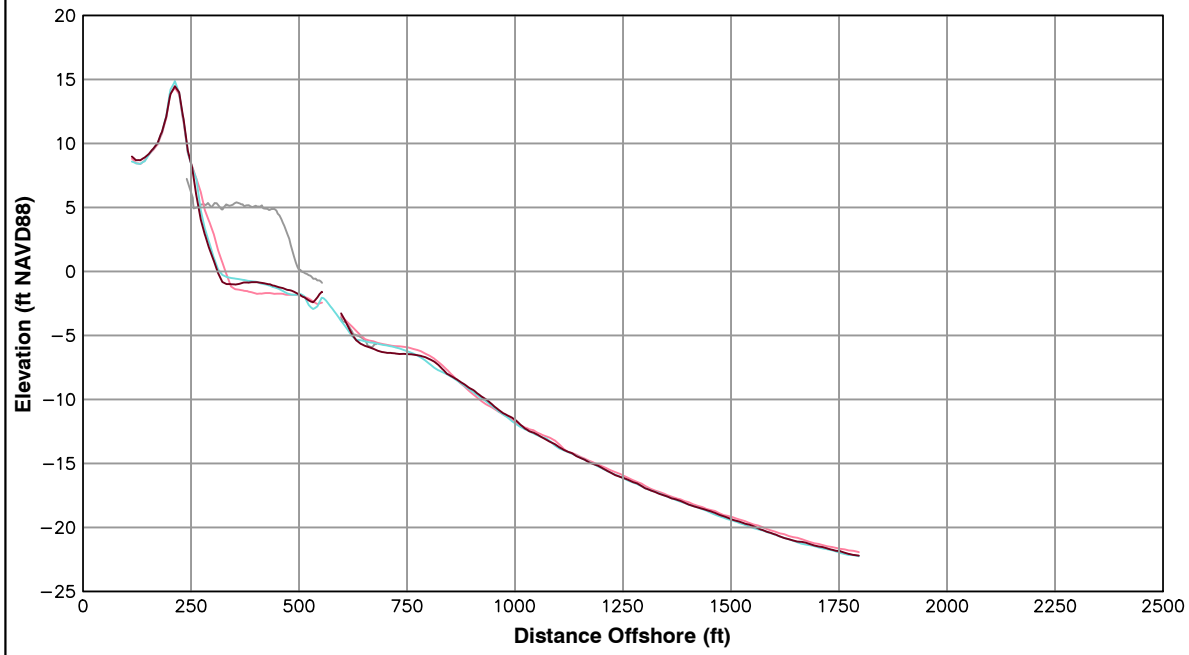
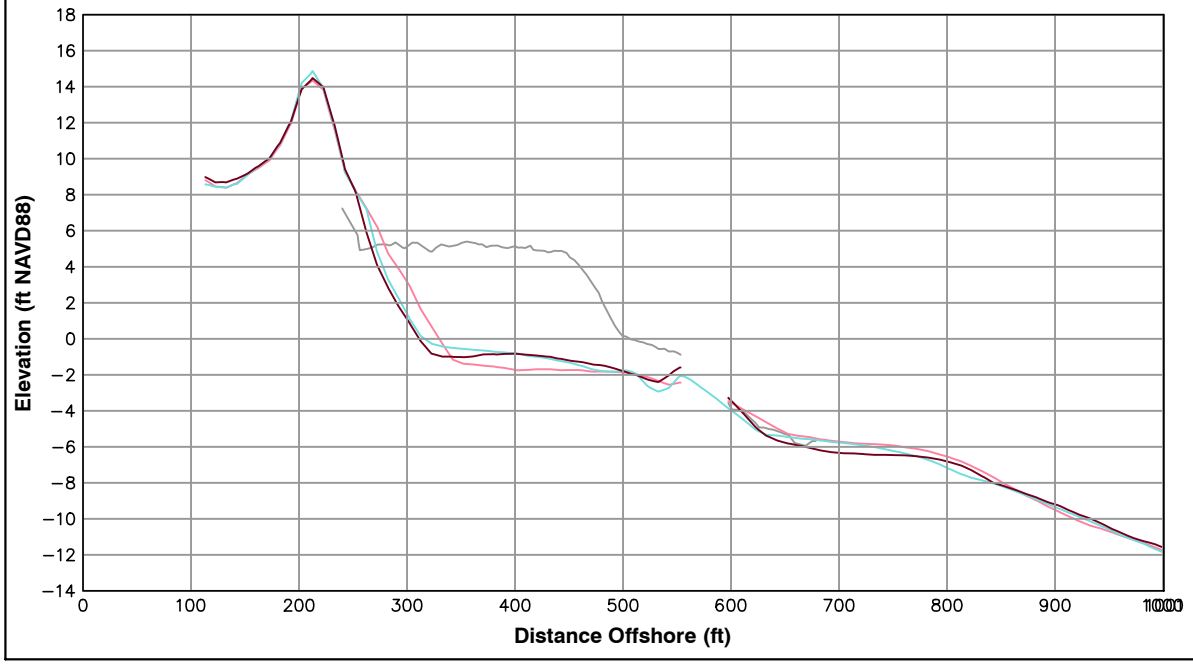
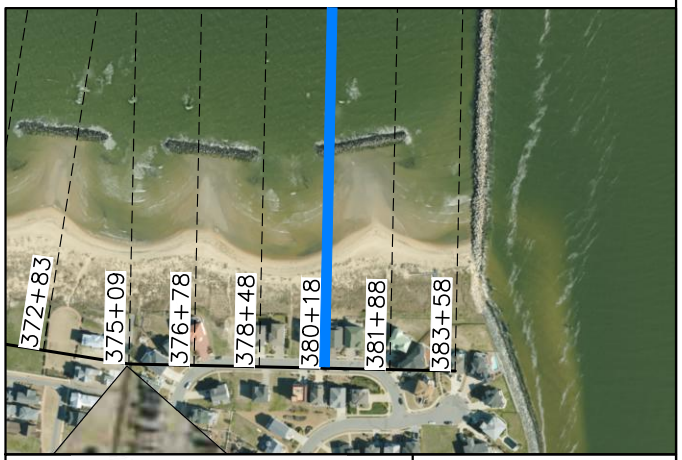




Survey Transect 380+18	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-19.20 ft/yr	-2.71 ft
Volume Change Above -15 ft NAVD88	-4.93 cy/ft/yr	-0.78 cy/ft
Volume Change Above 0 ft NAVD88	-3.83 cy/ft/yr	-0.96 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
1. Stationing 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 April 2013 and October 2013.
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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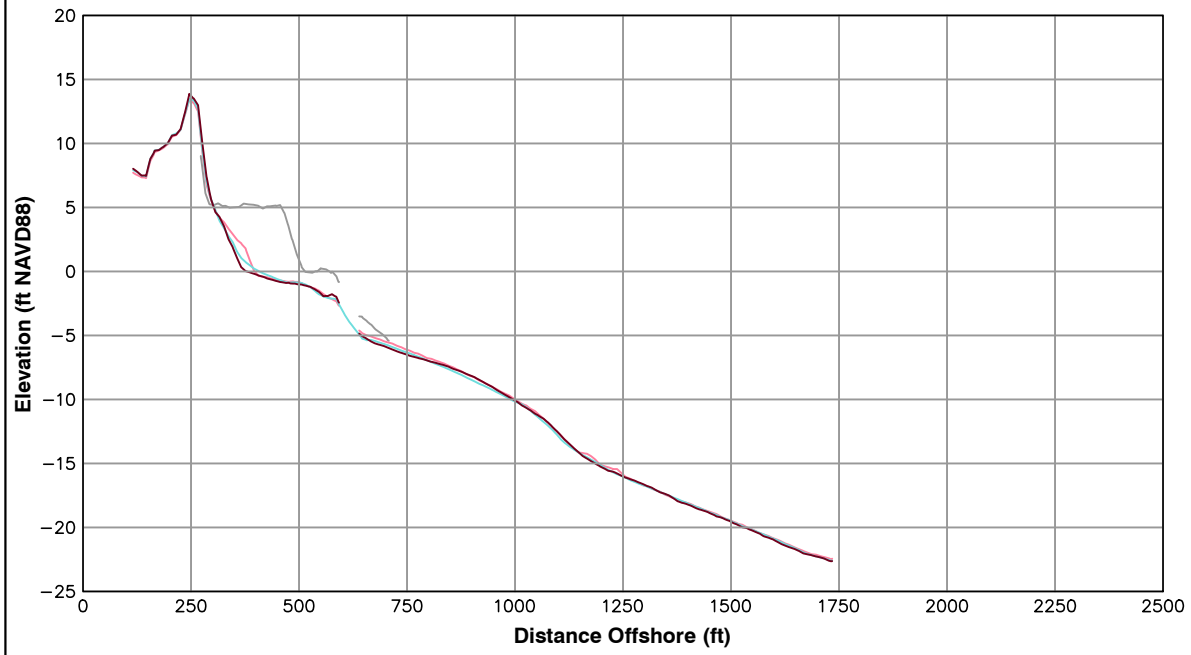
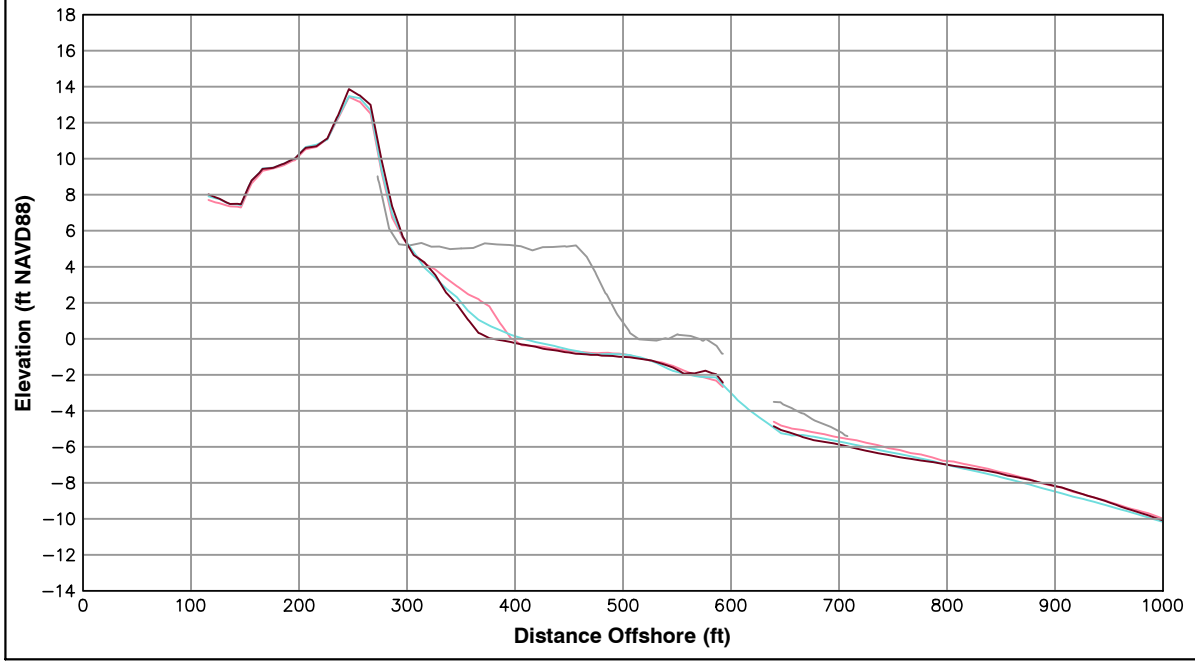
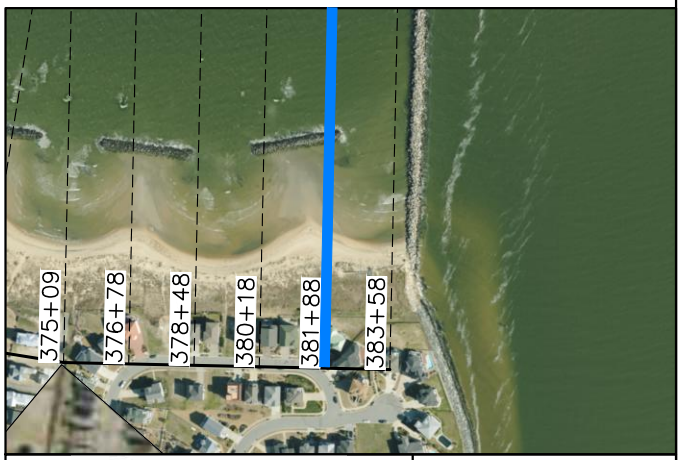




Survey Transect 381+88	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-28.25 ft/yr	-10.86 ft
Volume Change Above -15 ft NAVD88	-5.26 cy/ft/yr	0.56 cy/ft
Volume Change Above 0 ft NAVD88	-1.50 cy/ft/yr	-0.38 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
1. Stationing 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 April 2013 and October 2013.
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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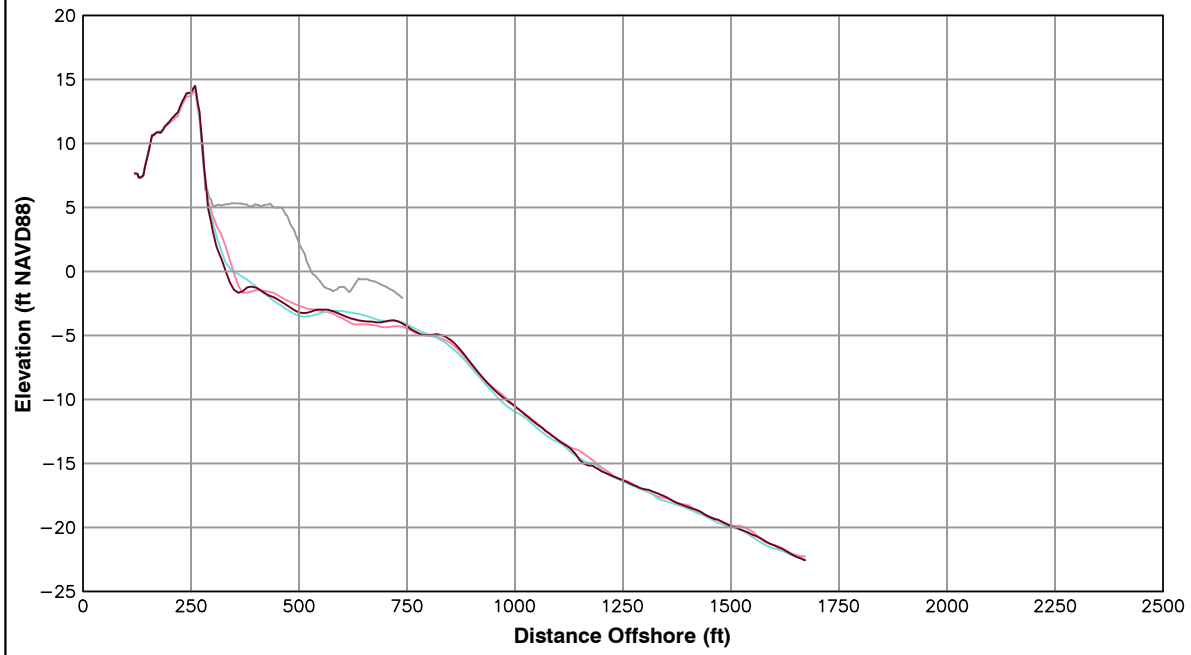
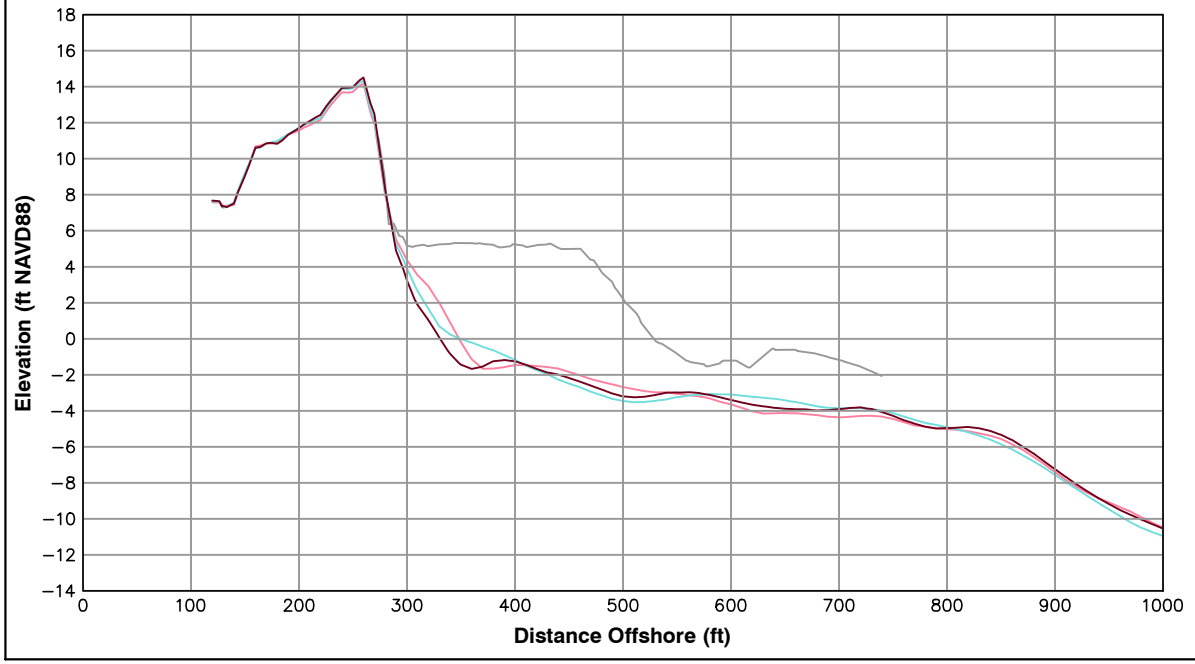
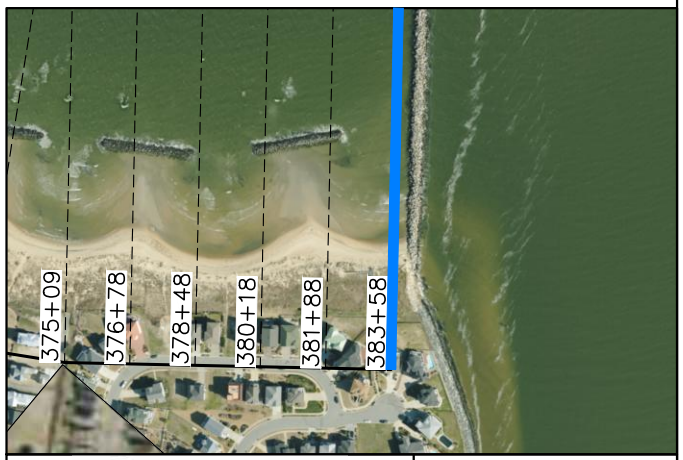




Survey Transect 383+58	March 2014 - April 2013	March 2014 - October 2013
Shoreline Change at MHW (0.98 ft NAVD88)	-19.07 ft/yr	-6.66 ft
Volume Change Above -15 ft NAVD88	-2.50 cy/ft/yr	0.45 cy/ft
Volume Change Above 0 ft NAVD88	-2.13 cy/ft/yr	-0.94 cy/ft

LEGEND:
- 2014 MAR
- 2013 OCT
- 2013 APR
- POST-FILL

Notes:
1. Stationing 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 April 2013 and October 2013.
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

Appendix C: Summary of Shoreline Change and Volume Change Tables

Table C-1. Summary of Shoreline Change and Volume Change (April 2013 to March 2014)

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 April 2, 2013 to March 20, 2014.

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	4/2/2013	3/20/2014	54.62	12.80	5.40
2+50	4/2/2013	3/20/2014	8.46	2.28	-1.62
5+00	4/2/2013	3/20/2014	-17.12	-1.12	-17.27
7+50	4/2/2013	3/20/2014	-17.85	-2.17	5.11
10+00	4/2/2013	3/20/2014	37.30	7.39	11.53
12+50	4/2/2013	3/20/2014	29.92	5.14	-16.16
15+00	4/2/2013	3/20/2014	12.64	4.13	-0.17
17+50	4/2/2013	3/20/2014	-25.51	-5.21	-9.34
20+00	4/2/2013	3/20/2014	-51.69	-8.09	-18.44
22+50	4/2/2013	3/20/2014	-25.72	-4.85	-4.74
25+00	4/2/2013	3/20/2014	69.23	10.34	37.45
27+50	4/2/2013	3/20/2014	26.96	7.51	7.34
30+00	4/2/2013	3/20/2014	-72.76	-6.94	-18.02
32+50	4/2/2013	3/20/2014	-44.94	-4.74	-11.99
35+00	4/2/2013	3/20/2014	28.01	4.73	21.28
37+50	4/2/2013	3/20/2014	48.10	6.16	11.16
40+00	4/2/2013	3/20/2014	72.59	12.32	23.84
42+50	4/2/2013	3/20/2014	32.44	6.32	3.37
45+00	4/2/2013	3/20/2014	28.85	5.80	3.91
45+25	4/2/2013	3/20/2014	10.50	1.99	-11.81
47+30	4/2/2013	3/20/2014	9.73	2.13	-0.13
49+35	4/2/2013	3/20/2014	-2.78	1.05	-7.31
51+41	4/2/2013	3/20/2014	0.72	0.76	7.35
53+46	4/2/2013	3/20/2014	-15.49	-0.99	-4.86
55+51	4/2/2013	3/20/2014	-2.00	-0.53	4.01
57+57	4/2/2013	3/20/2014	-39.43	-3.78	-6.52
59+62	4/2/2013	3/20/2014	-7.66	-1.64	-1.90
61+62	4/2/2013	3/20/2014	-28.97	-3.97	-10.15
63+62	4/2/2013	3/20/2014	-12.47	-4.84	-15.64
65+62	4/2/2013	3/20/2014	4.34	-1.75	-3.19
67+62	4/2/2013	3/20/2014	15.09	1.70	-2.13
69+62	4/2/2013	3/20/2014	26.50	5.93	6.89
71+62	4/2/2013	3/20/2014	37.97	7.97	3.09
73+62	4/2/2013	3/20/2014	-77.49	-3.78	-19.29
75+62	4/2/2013	3/20/2014	-30.35	-5.56	-10.22
77+62	4/2/2013	3/20/2014	-59.23	-8.27	-15.17
79+62	4/2/2013	3/20/2014	-9.60	-2.10	-5.92
81+62	4/2/2013	3/20/2014	-15.46	-2.70	-6.12
83+62	4/2/2013	3/20/2014	-6.75	-2.65	-9.21
85+62	4/2/2013	3/20/2014	-3.12	0.26	-1.38
87+62	4/2/2013	3/20/2014	-1.69	0.49	-0.30

Table C-1. Summary of Shoreline Change and Volume Change (April 2013 to March 2014) 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.

2. MHW assumed at +0.98 ft-NAVD88.

3. Shoreline Change and Volume Change is calculated for the period between surveys from April 2, 2013 to March 20, 2014.

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	4/2/2013	3/20/2014	-4.22	0.22	-4.41
103+08	4/2/2013	3/20/2014	0.72	1.03	-2.67
120+93	4/2/2013	3/20/2014	6.19	-1.11	-1.30
129+17	4/2/2013	3/20/2014	-	-	-
141+98	4/2/2013	3/20/2014	8.31	-1.33	-3.92
152+01	4/2/2013	3/20/2014	-0.31	-1.77	-8.77
163+49	4/2/2013	3/20/2014	2.10	1.75	1.62
169+63	4/2/2013	3/20/2014	-12.03	0.04	1.23
171+63	4/2/2013	3/20/2014	3.66	2.21	1.07
173+63	4/2/2013	3/20/2014	-1.72	0.70	-1.31
175+63	4/2/2013	3/20/2014	16.92	4.44	5.05
177+63	4/2/2013	3/20/2014	7.65	3.67	6.85
179+63	4/2/2013	3/20/2014	16.66	1.31	6.06
181+63	4/2/2013	3/20/2014	11.45	1.46	6.73
183+63	4/2/2013	3/20/2014	13.71	2.99	11.60
185+63	4/2/2013	3/20/2014	3.36	0.66	1.15
187+63	4/2/2013	3/20/2014	-12.32	-0.22	1.35
189+63	4/2/2013	3/20/2014	2.26	2.54	5.29
191+63	4/2/2013	3/20/2014	-11.06	-0.43	-2.02
193+63	4/2/2013	3/20/2014	13.77	0.98	-1.05
195+63	4/2/2013	3/20/2014	-5.91	0.32	-6.73
206+86	4/2/2013	3/20/2014	-9.37	-0.50	-2.14
218+66	4/2/2013	3/20/2014	6.46	3.59	5.77
229+85	4/2/2013	3/20/2014	16.70	0.02	-0.51
242+03	4/2/2013	3/20/2014	-24.72	0.66	-6.81
252+62	4/2/2013	3/20/2014	-18.79	0.38	-1.61
263+22	4/2/2013	3/20/2014	-35.50	-0.44	0.64
274+53	4/2/2013	3/20/2014	-9.38	2.47	-0.60
281+40	4/2/2013	3/20/2014	-23.71	-0.21	5.46
288+39	4/2/2013	3/20/2014	-28.92	-0.62	2.24
295+27	4/2/2013	3/20/2014	-19.03	0.80	-5.99
302+24	4/2/2013	3/20/2014	-24.08	0.11	0.71
315+96	4/2/2013	3/20/2014	-30.49	-4.47	-0.98
323+09	4/2/2013	3/20/2014	-41.56	-5.78	-12.13
329+63	4/2/2013	3/20/2014	9.03	-0.93	2.67
331+43	4/2/2013	3/20/2014	-3.80	0.73	4.01
333+23	4/2/2013	3/20/2014	-25.80	-2.61	-7.41
335+03	4/2/2013	3/20/2014	7.96	1.64	-3.80
336+83	4/2/2013	3/20/2014	-4.03	2.35	4.92
338+63	4/2/2013	3/20/2014	9.58	2.32	6.86
340+43	4/2/2013	3/20/2014	13.00	5.37	6.17
342+23	4/2/2013	3/20/2014	-2.38	2.90	-0.30

Table C-1. Summary of Shoreline Change and Volume Change (April 2013 to March 2014) 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.

2. MHW assumed at +0.98 ft-NAVD88.

3. Shoreline Change and Volume Change is calculated for the period between surveys from April 2, 2013 to March 20, 2014.

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	4/2/2013	3/20/2014	-13.10	4.31	-0.80
345+85	4/2/2013	3/20/2014	5.17	1.61	4.50
347+63	4/2/2013	3/20/2014	-24.05	-1.44	-3.31
349+43	4/2/2013	3/20/2014	-0.23	1.79	2.35
351+23	4/2/2013	3/20/2014	-8.26	1.20	1.33
353+03	4/2/2013	3/20/2014	7.31	2.75	1.53
354+83	4/2/2013	3/20/2014	-21.44	-1.54	0.62
356+63	4/2/2013	3/20/2014	-1.74	1.17	4.07
358+43	4/2/2013	3/20/2014	-20.19	-1.96	2.88
360+23	4/2/2013	3/20/2014	0.09	2.15	5.16
362+03	4/2/2013	3/20/2014	-30.51	-1.95	1.07
363+83	4/2/2013	3/20/2014	-20.67	-1.34	-0.53
365+63	4/2/2013	3/20/2014	-28.00	-2.48	-2.65
367+43	4/2/2013	3/20/2014	-16.53	-1.84	2.84
369+23	4/2/2013	3/20/2014	-41.06	-3.41	-4.19
371+03	4/2/2013	3/20/2014	-29.50	-2.70	1.95
372+83	4/2/2013	3/20/2014	-43.90	-3.85	-3.36
375+08	4/2/2013	3/20/2014	-26.43	-2.53	-4.76
376+78	4/2/2013	3/20/2014	-39.33	-5.12	-5.78
378+48	4/2/2013	3/20/2014	-26.30	-4.66	-9.81
380+18	4/2/2013	3/20/2014	-19.19	-3.83	-4.93
381+88	4/2/2013	3/20/2014	-28.25	-1.50	-5.26
383+58	4/2/2013	3/20/2014	-19.07	-2.13	-2.50

Table C-2. Summary of Shoreline Change and Volume Change (October 2013 to March 2014)

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 17, 2013 to March 20, 2014.

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	10/17/2013	3/20/2014	14.51	3.68	15.44
2+50	10/17/2013	3/20/2014	7.28	1.31	11.44
5+00	10/17/2013	3/20/2014	-4.51	-0.12	-5.97
7+50	10/17/2013	3/20/2014	-1.90	0.28	6.49
10+00	10/17/2013	3/20/2014	27.73	6.74	16.55
12+50	10/17/2013	3/20/2014	12.04	2.78	3.61
15+00	10/17/2013	3/20/2014	30.48	5.86	16.30
17+50	10/17/2013	3/20/2014	10.91	3.93	9.61
20+00	10/17/2013	3/20/2014	8.51	3.08	1.42
22+50	10/17/2013	3/20/2014	10.94	3.08	10.61
25+00	10/17/2013	3/20/2014	24.66	5.93	26.09
27+50	10/17/2013	3/20/2014	14.84	5.25	15.58
30+00	10/17/2013	3/20/2014	-31.51	-1.19	0.48
32+50	10/17/2013	3/20/2014	-25.55	-0.99	-1.52
35+00	10/17/2013	3/20/2014	26.69	3.98	0.84
37+50	10/17/2013	3/20/2014	21.71	2.06	1.45
40+00	10/17/2013	3/20/2014	15.82	4.67	3.89
42+50	10/17/2013	3/20/2014	-28.38	-0.15	-18.17
45+00	10/17/2013	3/20/2014	-42.10	-3.43	0.97
45+25	10/17/2013	3/20/2014	-32.34	-3.90	-25.94
47+30	10/17/2013	3/20/2014	-25.07	-3.46	-23.50
49+35	10/17/2013	3/20/2014	-12.50	-1.24	-12.38
51+41	10/17/2013	3/20/2014	-6.39	-0.40	0.18
53+46	10/17/2013	3/20/2014	-2.37	0.59	0.52
55+51	10/17/2013	3/20/2014	-3.75	-0.40	3.61
57+57	10/17/2013	3/20/2014	1.19	0.93	4.92
59+62	10/17/2013	3/20/2014	-0.65	0.06	3.31
61+62	10/17/2013	3/20/2014	17.40	1.86	4.30
63+62	10/17/2013	3/20/2014	-0.04	-1.73	-2.63
65+62	10/17/2013	3/20/2014	38.38	4.72	9.33
67+62	10/17/2013	3/20/2014	9.39	1.23	0.02
69+62	10/17/2013	3/20/2014	4.21	1.79	5.52
71+62	10/17/2013	3/20/2014	-5.67	-0.64	3.49
73+62	10/17/2013	3/20/2014	1.87	3.06	4.57
75+62	10/17/2013	3/20/2014	2.07	1.20	2.58
77+62	10/17/2013	3/20/2014	0.97	-0.36	0.96
79+62	10/17/2013	3/20/2014	-6.53	-0.83	-4.76
81+62	10/17/2013	3/20/2014	-6.98	-1.13	-0.42
83+62	10/17/2013	3/20/2014	8.47	1.13	2.51
85+62	10/17/2013	3/20/2014	-5.27	0.66	3.44
87+62	10/17/2013	3/20/2014	-5.62	0.11	2.59

Table C-2. Summary of Shoreline Change and Volume Change (October 2013 to March 2014) 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.

2. MHW assumed at +0.98 ft-NAVD88.

3. Shoreline Change and Volume Change is calculated for the period between surveys from October 17, 2013 to March 20, 2014.

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)
93+41	10/17/2013	3/20/2014	1.22	0.99	-0.24
103+08	10/17/2013	3/20/2014	2.75	1.81	5.56
120+93	10/17/2013	3/20/2014	5.38	-0.38	-0.27
129+17	10/17/2013	3/20/2014	-	-	-
141+98	10/17/2013	3/20/2014	17.36	2.00	1.99
152+01	10/17/2013	3/20/2014	-8.18	-2.45	-8.92
163+49	10/17/2013	3/20/2014	-10.59	-1.63	-8.06
169+63	10/17/2013	3/20/2014	-3.48	0.15	3.55
171+63	10/17/2013	3/20/2014	6.84	1.81	0.72
173+63	10/17/2013	3/20/2014	7.50	2.48	7.78
175+63	10/17/2013	3/20/2014	17.56	5.15	12.34
177+63	10/17/2013	3/20/2014	16.60	4.84	4.77
179+63	10/17/2013	3/20/2014	31.48	3.94	13.78
181+63	10/17/2013	3/20/2014	4.39	-0.48	3.99
183+63	10/17/2013	3/20/2014	24.71	3.27	11.19
185+63	10/17/2013	3/20/2014	-0.99	-0.38	0.71
187+63	10/17/2013	3/20/2014	-0.24	0.39	6.40
189+63	10/17/2013	3/20/2014	-5.77	0.28	1.40
191+63	10/17/2013	3/20/2014	-4.58	-0.84	1.86
193+63	10/17/2013	3/20/2014	8.57	0.82	-3.27
195+63	10/17/2013	3/20/2014	-12.02	-1.19	-12.63
206+86	10/17/2013	3/20/2014	4.18	2.98	6.82
218+66	10/17/2013	3/20/2014	9.05	3.55	4.50
229+85	10/17/2013	3/20/2014	7.58	3.19	-2.59
242+03	10/17/2013	3/20/2014	-38.25	0.17	-7.70
252+62	10/17/2013	3/20/2014	-13.01	6.52	-0.03
263+22	10/17/2013	3/20/2014	-36.13	-0.36	0.58
274+53	10/17/2013	3/20/2014	-1.66	2.65	-7.15
281+40	10/17/2013	3/20/2014	-11.88	1.91	7.03
288+39	10/17/2013	3/20/2014	-14.40	3.10	6.65
295+27	10/17/2013	3/20/2014	-15.70	4.18	-4.22
302+24	10/17/2013	3/20/2014	-16.39	-3.42	-3.36
315+96	10/17/2013	3/20/2014	-11.25	-0.39	4.22
323+09	10/17/2013	3/20/2014	-32.46	-1.92	-1.83
329+63	10/17/2013	3/20/2014	13.76	1.80	10.94
331+43	10/17/2013	3/20/2014	4.90	1.90	10.13
333+23	10/17/2013	3/20/2014	-8.36	1.78	-3.66
335+03	10/17/2013	3/20/2014	1.49	3.02	0.23
336+83	10/17/2013	3/20/2014	-10.96	2.33	11.89
338+63	10/17/2013	3/20/2014	-9.43	1.29	5.78
340+43	10/17/2013	3/20/2014	-1.39	4.61	7.86

(October 2013 to March 2014) 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.

2. MHW assumed at +0.98 ft-NAVD88.

3. Shoreline Change and Volume Change is calculated for the period between surveys from October 17, 2013 to March 20, 2014.

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	10/17/2013	3/20/2014	-10.70	1.93	9.13
344+05	10/17/2013	3/20/2014	-18.31	1.85	-2.54
345+85	10/17/2013	3/20/2014	2.84	1.10	7.09
347+63	10/17/2013	3/20/2014	-15.16	0.57	4.51
349+43	10/17/2013	3/20/2014	-0.89	1.02	4.73
351+23	10/17/2013	3/20/2014	-5.49	1.83	4.43
353+03	10/17/2013	3/20/2014	0.07	1.44	3.21
354+83	10/17/2013	3/20/2014	-20.22	0.50	3.92
356+63	10/17/2013	3/20/2014	-3.24	0.39	2.50
358+43	10/17/2013	3/20/2014	-18.47	-0.17	4.24
360+23	10/17/2013	3/20/2014	-2.33	1.91	4.87
362+03	10/17/2013	3/20/2014	-18.19	0.28	4.46
363+83	10/17/2013	3/20/2014	-10.79	0.43	1.76
365+63	10/17/2013	3/20/2014	-18.55	-0.17	2.46
367+43	10/17/2013	3/20/2014	-15.69	-2.32	0.70
369+23	10/17/2013	3/20/2014	-4.74	0.50	3.79
371+03	10/17/2013	3/20/2014	-14.18	-1.64	-3.08
372+83	10/17/2013	3/20/2014	2.63	2.12	5.65
375+08	10/17/2013	3/20/2014	-15.39	-1.58	0.23
376+78	10/17/2013	3/20/2014	3.44	0.65	5.04
378+48	10/17/2013	3/20/2014	-6.16	-1.33	-1.81
380+18	10/17/2013	3/20/2014	-2.71	-0.96	-0.78
381+88	10/17/2013	3/20/2014	-10.86	-0.38	0.56
383+58	10/17/2013	3/20/2014	-6.66	-0.94	0.45

Table C-3. Summary of Shoreline Change and Volume Change from East Ocean View Nourishment (March 2009 to March 2014)

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 March 20, 2009 to March 20, 2014.

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)
329+63	3/20/2009	3/20/2014	-19.44	-4.29	-
331+43	3/20/2009	3/20/2014	-19.81	-3.57	-
333+23	3/20/2009	3/20/2014	-15.41	-2.67	-
335+03	3/20/2009	3/20/2014	-12.07	-1.74	-
336+83	3/20/2009	3/20/2014	-12.35	-1.82	-
338+63	3/20/2009	3/20/2014	-9.57	-1.89	-
340+43	3/20/2009	3/20/2014	-12.70	-1.11	-
342+23	3/20/2009	3/20/2014	-14.29	-1.96	-
344+05	3/20/2009	3/20/2014	-14.42	-3.31	-
345+85	3/20/2009	3/20/2014	-13.36	-2.96	-
347+63	3/20/2009	3/20/2014	-11.16	-2.94	-
349+43	3/20/2009	3/20/2014	-13.94	-3.08	-
351+23	3/20/2009	3/20/2014	-9.23	-2.55	-
353+03	3/20/2009	3/20/2014	-12.26	-2.62	-
354+83	3/20/2009	3/20/2014	-8.39	-2.36	-
356+63	3/20/2009	3/20/2014	-13.24	-3.09	-
358+43	3/20/2009	3/20/2014	-11.81	-2.98	-
360+23	3/20/2009	3/20/2014	-16.57	-3.43	-
362+03	3/20/2009	3/20/2014	-13.98	-3.13	-
363+83	3/20/2009	3/20/2014	-11.87	-2.78	-
365+63	3/20/2009	3/20/2014	-9.71	-2.61	-
367+43	3/20/2009	3/20/2014	-18.34	-4.01	-
369+23	3/20/2009	3/20/2014	-18.78	-3.12	-
371+03	3/20/2009	3/20/2014	-23.87	-4.65	-
372+83	3/20/2009	3/20/2014	-27.06	-4.63	-
375+08	3/20/2009	3/20/2014	-31.21	-6.45	-
376+78	3/20/2009	3/20/2014	-29.02	-5.00	-
378+48	3/20/2009	3/20/2014	-39.13	-7.48	-
380+18	3/20/2009	3/20/2014	-37.24	-6.77	-
381+88	3/20/2009	3/20/2014	-26.10	-5.35	-
383+58	3/20/2009	3/20/2014	-37.73	-7.30	-

Table C-4. Summary of Shoreline Change and Volume Change from Central Ocean View Nourishment (March 2005 to March 2014)

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 March 15, 2005 to March 20, 2014.

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)
15+00	3/15/2005	3/20/2014	0.69	0.99	-
17+50	3/15/2005	3/20/2014	2.08	0.89	-
20+00	3/15/2005	3/20/2014	-2.19	-0.50	-
22+50	3/15/2005	3/20/2014	-6.25	-2.31	-
25+00	3/15/2005	3/20/2014	8.39	-0.66	-
27+50	3/15/2005	3/20/2014	4.17	-1.01	-
30+00	3/15/2005	3/20/2014	-1.28	-1.07	-
32+50	3/15/2005	3/20/2014	-3.87	-1.89	-
35+00	3/15/2005	3/20/2014	3.52	-0.12	-
37+50	3/15/2005	3/20/2014	2.56	-1.14	-
40+00	3/15/2005	3/20/2014	1.21	-0.74	-
42+50	3/15/2005	3/20/2014	-2.27	-1.64	-
45+00	3/15/2005	3/20/2014	-5.76	-2.33	-
45+25	3/15/2005	3/20/2014	-8.63	-2.76	-
47+30	3/15/2005	3/20/2014	-9.62	-2.96	-
49+35	3/15/2005	3/20/2014	-6.52	-2.13	-
51+41	3/15/2005	3/20/2014	-5.86	-1.58	-
53+46	3/15/2005	3/20/2014	-4.09	-1.12	-
55+51	3/15/2005	3/20/2014	-7.69	-2.46	-
57+57	3/15/2005	3/20/2014	-2.86	-1.10	-
59+62	3/15/2005	3/20/2014	-6.85	-1.97	-
61+62	3/15/2005	3/20/2014	1.14	0.10	-
63+62	3/15/2005	3/20/2014	-6.20	-1.07	-
65+62	3/15/2005	3/20/2014	-0.38	0.29	-
67+62	3/15/2005	3/20/2014	-12.63	-1.65	-
69+62	3/15/2005	3/20/2014	-4.24	-0.34	-
71+62	3/15/2005	3/20/2014	-11.26	-1.57	-
73+62	3/15/2005	3/20/2014	-5.75	-0.22	-
75+62	3/15/2005	3/20/2014	-7.50	-0.65	-
77+62	3/15/2005	3/20/2014	-2.15	0.75	-
79+62	3/15/2005	3/20/2014	-3.79	-0.65	-
81+62	3/15/2005	3/20/2014	-4.61	-1.26	-
83+62	3/15/2005	3/20/2014	-5.63	-1.96	-
85+62	3/15/2005	3/20/2014	-3.69	-1.43	-
87+62	3/15/2005	3/20/2014	-3.05	-0.69	-
93+41	3/15/2005	3/20/2014	-0.85	-0.85	-
103+08	3/15/2005	3/20/2014	-3.40	-1.34	-
120+93	3/15/2005	3/20/2014	-4.82	-2.55	-
129+17	3/15/2005	3/20/2014	-	-	-
141+98	3/15/2005	3/20/2014	-2.28	-1.31	-
152+01	3/15/2005	3/20/2014	-5.91	-2.22	-

Table C-4. Summary of Shoreline Change and Volume Change from Central Ocean View Nourishment (March 2005 to March 2014) 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.

2. MHW assumed at +0.98 ft-NAVD88.

3. Shoreline Change and Volume Change is calculated for the period between surveys from March 15, 2005 to March 20, 2014.

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)
163+49	3/15/2005	3/20/2014	-3.60	-1.44	-
169+63	3/15/2005	3/20/2014	-1.77	-0.82	-
171+63	3/15/2005	3/20/2014	-2.91	-0.94	-
173+63	3/15/2005	3/20/2014	-2.41	-1.15	-
175+63	3/15/2005	3/20/2014	-3.27	-0.78	-
177+63	3/15/2005	3/20/2014	-2.70	-0.57	-
179+63	3/15/2005	3/20/2014	-2.11	-1.12	-
181+63	3/15/2005	3/20/2014	-2.62	-1.50	-
183+63	3/15/2005	3/20/2014	2.03	0.19	-
185+63	3/15/2005	3/20/2014	-1.41	-0.42	-
187+63	3/15/2005	3/20/2014	3.37	1.21	-
189+63	3/15/2005	3/20/2014	-0.27	0.86	-
191+63	3/15/2005	3/20/2014	4.44	1.79	-
193+63	3/15/2005	3/20/2014	0.06	0.66	-
195+63	3/15/2005	3/20/2014	-2.07	0.21	-

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
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

No	Date	Project Type	Location	Description	Vol (cy)	Extent (ft)	Unit Vol (cy/ft)	Sand Source
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
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	March-June 2014	Beach Nourishment	West Ocean View	Beach Nourishment	35,000			

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.