

PERIODIC SURVEY EVALUATION: OCEAN VIEW BEACH

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Norfolk

Periodic Survey Evaluation: Ocean View Beach Fall 2015

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1. Executive Summary

The twenty-first consecutive twice-yearly survey of the Ocean View shoreline was conducted on October 7-11, 2015. The study area extends from the western end of Willoughby Spit to the western edge of Little Creek Inlet in East Ocean View. The periodic surveys are collected bi-annually in March/April and September/October to monitor the condition of the shoreline and the state of existing shore protection projects. A baseline and transect locations were established with the first survey in September 2005 and have been used for each subsequent survey. Shoreline changes at Mean High Water (MHW) and volumetric changes above 0 feet NAVD88 and -15 feet NAVD88 are calculated at each transect. Differences in the region above 0 feet NAVD88 are indicative of changes to the dune and subaerial beach berm, while the differences above -15 feet NAVD88 indicate changes in the nearshore zone. Comparison of seasonal surveys (i.e. October 2014 to October 2015) eliminates seasonal variation of profiles in volumetric change analyses. Consecutive survey comparisons are useful to assess the direct impact of extreme events which have occurred 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 October 2015 survey data with previous surveys taken in October 2014 (fall to fall comparison) and April 2015 (most recent periodic survey comparison) in the Ocean View Beach area between Willoughby Spit and Little Creek Inlet.

| Comparison | Parameter | Quantity |
|-------------------------------|--|---------------|
| October 2014 vs. October 2015 | Average Shoreline Change Rate at MHW (+0.98 ft NAVD88) | -3.21 ft/yr |
| | Cumulative Volume Change Rate Above 0 ft NAVD88 | -77,843 cy/yr |
| | Cumulative Volume Change Rate Above -15 ft NAVD88 | 36,746 cy/yr |
| April 2015 vs. October 2015 | Average Shoreline Change at MHW (+0.98 ft NAVD88) | -3.84 ft |
| | Cumulative Volume Change Above 0 ft NAVD88 | -95,586 cy |
| | Cumulative Volume Change Above -15 ft NAVD88 | -57,240 cy |

The Ocean View region experienced an overall loss in material above 0 feet NAVD88 and a gain in material above -15 feet NAVD88 over the past year (October 2014 to October 2015). The average MHW shoreline change over the past year shows erosion over the entire beach. Over the most recent survey period (April 2015 to October 2015), there was also overall erosion of the average MHW shoreline. The Ocean View shoreline experienced a loss in material above 0 feet NAVD88 and above -15 feet NAVD88 during this period. This can be attributed largely to the effects of significantly elevated waves and water levels during storms in late September and early October, including effects from Hurricane Joaquin. All of the surveyed shoreline reaches were affected by these storms and experienced dune and subaerial beach erosion. It is important to note that the October 2015 survey was obtained two days after the October 2-6 storm dissipated, so that the survey reflects the conditions of the subaerial beach with little or no post-storm recovery.

While the Ocean View system showed overall volume loss for the past year, there was variability within the defined shoreline regions. The Willoughby Spit region experienced accretion of the MHW shoreline, volumetric loss above 0 feet NAVD88, and volumetric gain above -15 feet NAVD88 over the past year. The eastern end of the reach has continued to experience erosion while the western end accreted.

In the 800 Block region, there has been significant erosion of the MHW shoreline, with moderate volumetric loss above 0 feet NAVD88 and above -15 feet NAVD88 over the year and the most recent survey period comparisons. The tombolo previously located at the second-easternmost breakwater appears to have been successfully corrected by the 2013 breakwater realignment, as this realigned breakwater has remained detached from the shoreline allowing sand to transport more freely through this reach.

The West Ocean View region was characterized by the shoreline improvement project that took place during the October 2013 to April 2014 survey period. The reconstructed groin has performed well over the past year, even considering the intense storm wave climate. The yearly analysis shows overall volumetric loss above both 0 feet NAVD88 and -15 feet NAVD88 as well as erosion of the MHW shoreline.

The Central Ocean View Breakwaters region experienced erosion of the MHW shoreline, with minor volumetric loss above 0 feet NAVD88 and volumetric gain above -15 feet NAVD88 over the past year. Over the current survey period, this reach experienced overall erosion due to storms.

Typically a very stable region, Central Ocean View has experienced accretion of the MHW shoreline, with a volumetric loss above 0 feet NAVD88 and gain above -15 feet NAVD88 over the past year. However, like the other reaches, Central Ocean View experienced net erosion over the current survey period primarily in the dune and subaerial beach due to storms.

There has been accretion of the MHW shoreline along with moderate volumetric losses above both 0 feet NAVD88 and -15 feet NAVD88 in the East Ocean View region over the past year and during the most recent survey period. 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 2015 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 2015 Comparison | -98.13 ft | -21.34 cy/ft | -111,539 cy | -36.03 cy/ft | -187,292 cy |
| Central Ocean View Nourishment vs. October 2015 Comparison | -33.50 ft | -11.83 cy/ft | -218,109 cy | -7.26 cy/ft | -130,373 cy |
| West Ocean View Pre-Nourishment vs October 2015 Comparison | 0.46 ft | 1.20 cy/ft | 7909.79 cy | 4.08 cy/ft | 24,941 cy |

Since the East Ocean View Nourishment project in 2009, 99% of the placed material above 0 feet NAVD88 has been lost. Since the Central Ocean View Nourishment project in 2005, 68% 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 that reach; however, the eastern end of the

reach has been experiencing higher rates of erosion. This will continue to be monitored and studied in the near future. The West Ocean View Shoreline Improvement Project completed in 2013 has mitigated erosion in the hotspot between the 200 Block and Sarah Constant Shrine Park. The remaining volume for the 2013 West Ocean View project is approximately 24,900 cy out of the 73,600 cy placed, so that 34% of the original fill volume remained at the time of the October 2015 survey.

It is expected that the upcoming federal coastal storm damage reduction project will provide all of the Ocean View reaches (directly, or indirectly in the case of the Cottage Line area of Central Ocean View) with significant additional beach profile volume over the next one to two years. It is also expected that this bi-annual monitoring program will continue post-construction of the federal project, allowing the City and the federal agencies involved to track the evolution of the federal project over time and to respond to future storm impacts.

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 October 2015 survey data with previous surveys taken in October 2014 (fall to fall comparison) and April 2015 (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 (October 2015) was made to 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 |
| October 2014 | Geodynamics, LLC |
| April 2015 | Geodynamics, LLC |
| October 2015 | Geodynamics, LLC |

3. Data Sources

Geodynamics, LLC, conducted the most recent survey of Ocean View Beach on October 7-11, 2015. The baseline and transects established for the September 2005 survey were used for the most recent survey. Figure 3-1 shows the location of the baseline, transects and the stationing applied by Geodynamics for the surveying. As shown in Figure 3-1, transects were stationed from west to east along the Ocean View shoreline. The survey data were provided in xyz and shapefile formats allowing for compatibility with multiple programs.

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

Also in October 2015, the Virginia Institute of Marine Science (VIMS) flew aerial photography of the Ocean View shoreline, georectified the images, and digitized the apparent MHW shoreline position from the images. The October 2015 aerial photos with the digitized shoreline positions from October 2015, April 2015, and October 2014 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.

Post-fill survey data from the East Ocean View beach nourishment, collected in March 2009, were used as baseline data for assessing the current state of that nourishment project. Similarly, post-fill survey data from the Willoughby Spit dune restoration (February 2005) and Central Ocean View dune restoration project (March 2005) were utilized to assess the present state of those project areas. 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 2014 (Civil 3D), Microsoft Excel, Golden Software 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. October 2014 to October 2015 (Entire Shoreline)
2. April 2015 to October 2015 (Entire Shoreline)
3. March 2009 (East Ocean View post-fill) to October 2015 (Sta 329+63 through Sta 383+58)
4. March 2005 (Central Ocean View post-fill) to October 2015 (Sta 15+00 through Sta 195+63)
5. December 2004-February 2005 (Central Ocean View pre-fill) to October 2015 (Sta 15+00 through Sta 195+63)
6. June 2003 (East Ocean View pre-fill) to October 2015 (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 in the submerged active profile; removing profile data deeper than the -15 feet NAVD88 contour from the analysis reduces uncertainty that would be associated with hydrographic data beyond this depth.

5. Discussion of Periodic Surveying Evaluation

This section discusses differences observed between the noted surveys, overall shoreline trends, regional shoreline trends and the 2009 East Ocean View and 2005 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 Coverage

Variation in profile positions between surveys taken as part of the ongoing program of periodic surveying of the Ocean View shoreline (October 2014, April 2015, and October 2015) 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 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 pre- and post-construction surveys for the historical nourishment projects did not extend as far offshore as the regular periodic surveys, and this limits the extent of the 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 present reporting period which likely had an impact on shoreline position changes and profile volume gains and losses.

5.2.1. Storm Wave Events

Understanding of the wave climate immediately offshore of the Norfolk shoreline is vital for the design, monitoring, and understanding of projects along the shoreline and the behavior of the beach. The data used were collected from the City's AWAC (Acoustic Wave and Current) gage, which was deployed in 2006 directly offshore of the Norfolk Shoreline in approximately 23 feet of water. Wave data were collected throughout this survey period up to October 10, 2015.

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 1.2 feet and 5.1 seconds.
- Waves approached 75% of the time from northeast to southeast, 20% of the time from north to northeast, and 2% of the time from northwest to north.
- The largest significant wave height observed during this deployment was approximately 6.5 feet with a corresponding peak period of approximately 5.2 seconds and mean direction of 49

degrees (October 4, 2015). In addition, this wave height occurred at an elevated bay water level of approximately +5 feet NAVD88, allowing the concurrent large storm waves to completely overwash the Ocean View beach berms and cause significant beach berm and dune erosion.

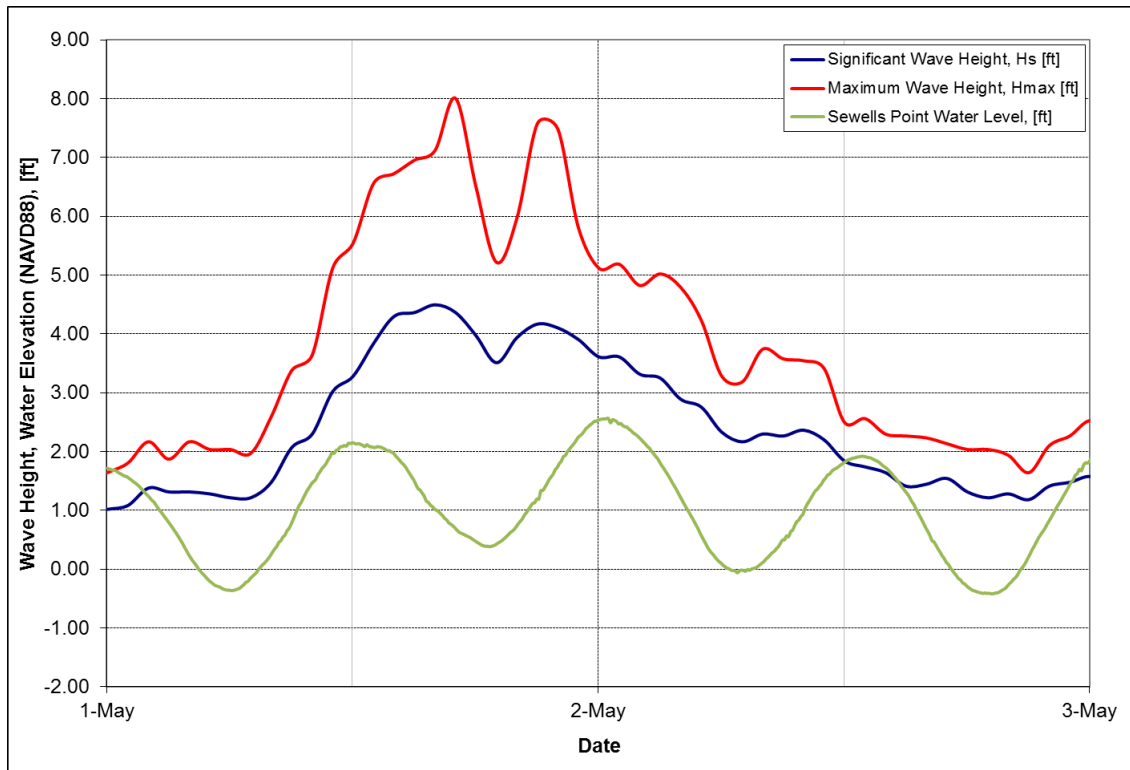
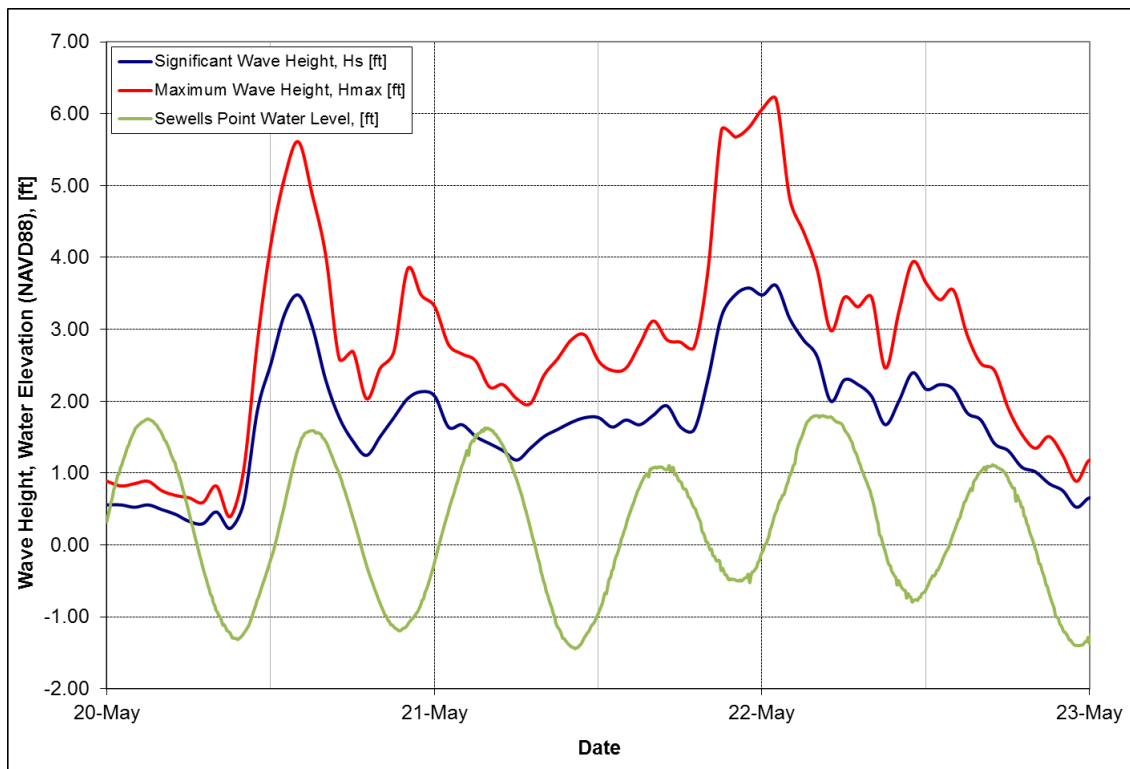
The overall wave climate was more active than usual during this period. There were seven day-long or multi-day events that occurred during the survey period for which the significant wave height at the wave gauge exceeded 3.3 feet (1.0 meter). Six of these events occurred on May 1, 2015, May 20, 2015, August 8, 2015, August 21, 2015, September 5, 2015, and September 26, 2015 and are shown in Figure 5-1 through Figure 5-6. The largest waves were associated with northeasterly winds in advance of and associated with Hurricane Joaquin (which passed in the Atlantic Ocean offshore of Virginia's coast) on October 2-6, 2015; significant wave heights in this event exceeded 5 feet (1.5 m) for nearly 96 total hours over the course of six days, as illustrated in Figure 5-7.

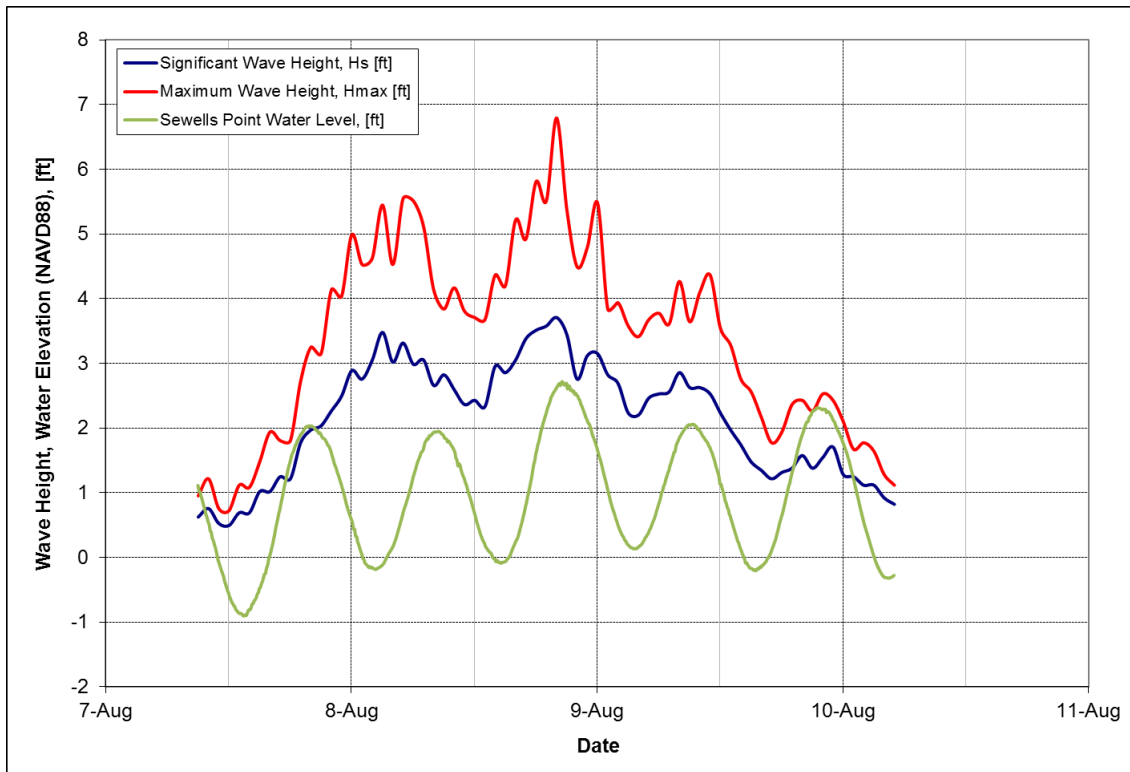
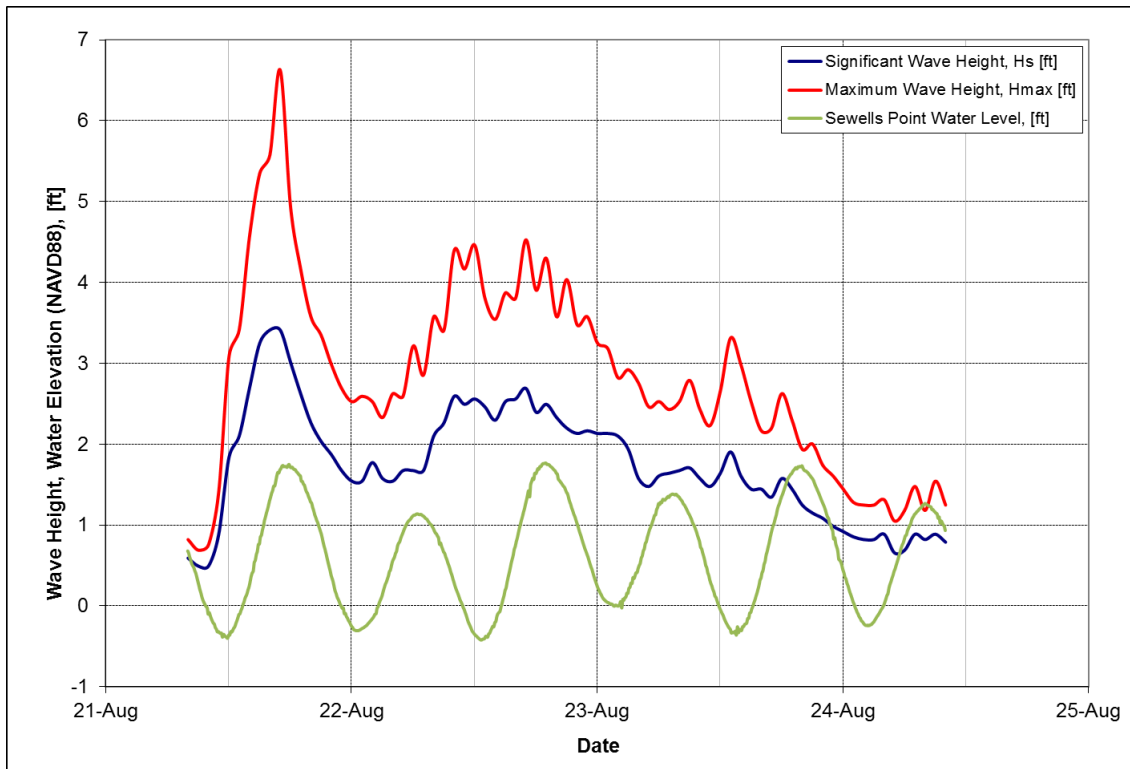
The overall trends remained consistent with prior measurement periods with waves during calm periods being predominantly swell traveling into the bay from the ocean and having longer wave periods and lower wave heights. Typically, the larger wave height events are driven by northerly and northeasterly storm winds within the bay and tend to have shorter wave periods. There were seven storm events identified 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.

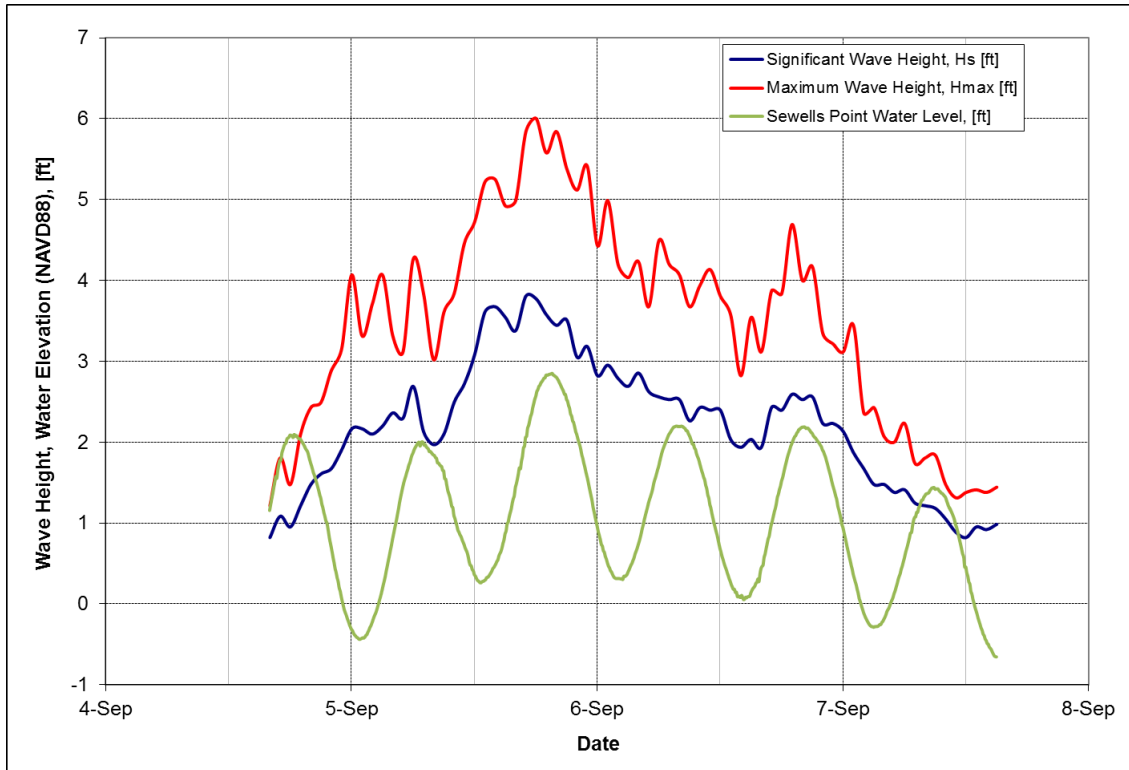
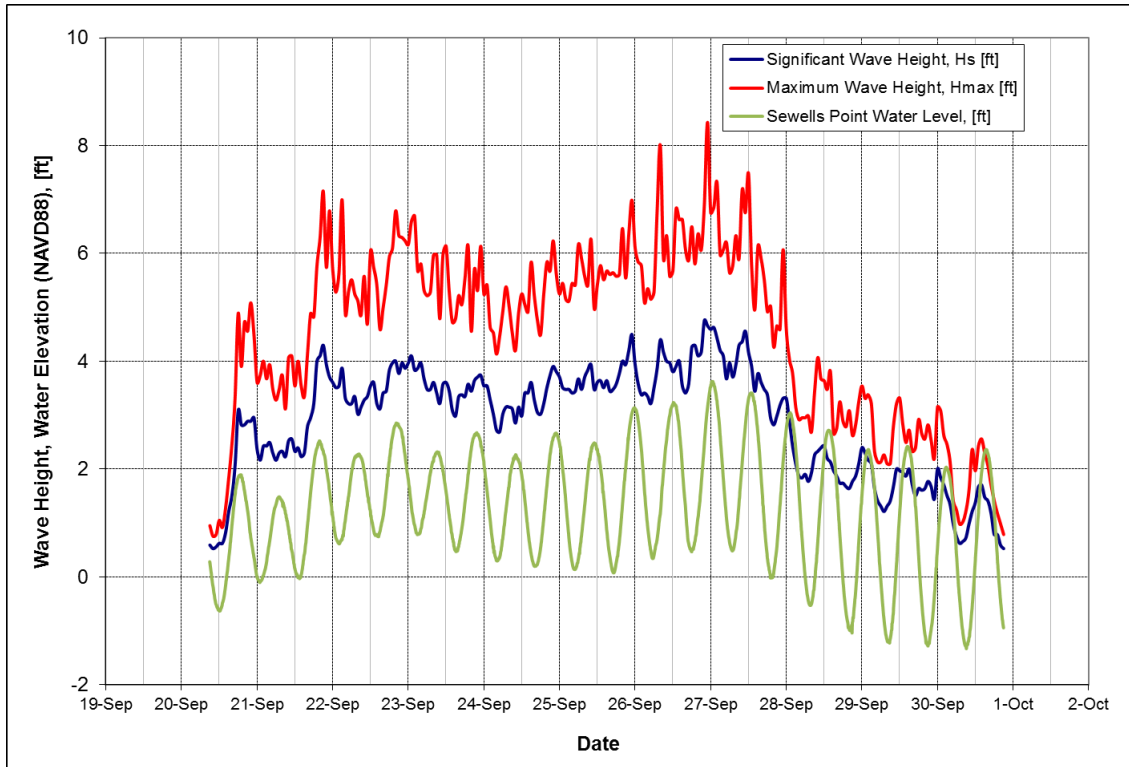
Table 5-1: Monthly Wave Statistics Summary

| Wave Statistic | May-15 | Jun-15 | Jul-15 | Aug-15 | Sep-15 | Oct-15* |
|--|--------|--------|--------|--------|--------|---------|
| Average Significant Wave Height, H_s (ft) | 1.09 | 0.88 | 0.91 | 1.10 | 1.64 | 3.05 |
| Average Wave Period, T_m (s) | 2.48 | 2.36 | 2.41 | 2.61 | 2.81 | 3.34 |
| Average Peak Wave Period, T_p (s) | 5.33 | 4.92 | 4.99 | 5.27 | 4.93 | 5.34 |
| Maximum Observed Significant Wave Height, H_s (ft) | 4.49 | 2.56 | 2.95 | 3.71 | 4.76 | 6.53 |
| Maximum Observed Wave Height, H_{max} (ft) | 8.01 | 4.33 | 4.89 | 6.79 | 8.43 | 11.78 |

*October 1, 2015 – October 10, 2015 (comprising storms leading up to and including Hurricane Joaquin)

**Figure 5-1: May 1, 2015 Storm****Figure 5-2: May 20, 2015 Storm**

**Figure 5-3: August 8, 2015 Storm****Figure 5-4: August 21, 2015 Storm**

**Figure 5-5: September 5, 2015 Storm****Figure 5-6: September 26, 2015 Storm**

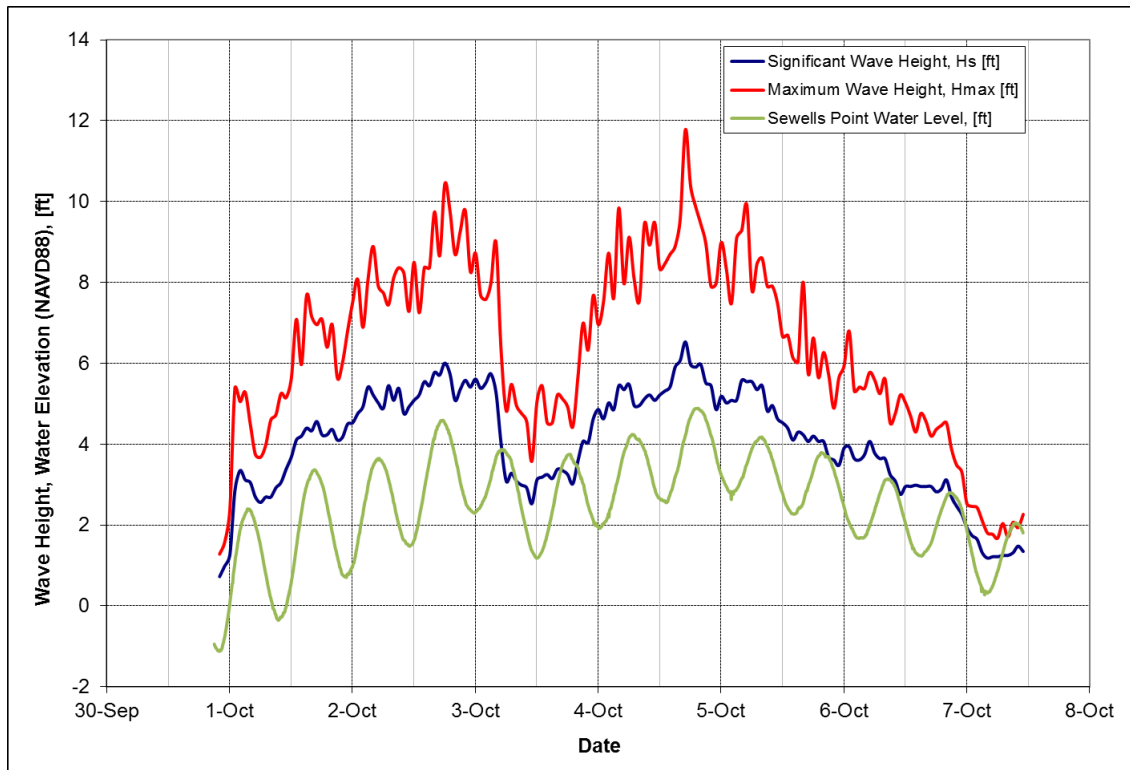


Figure 5-7: October 2 - 6, 2015 Storm (Including Effects of Offshore Hurricane Joaquin)

5.2.2. Engineering Activities

No new engineering activities took place along the Ocean View Shoreline over the most recent monitoring period (April 2015 – October 2015). The most recently completed coastal engineering project in the survey area was the construction of the West Ocean View Shoreline Improvement Project, which was substantially complete in December 2013. See Section 5.7 for a detailed analysis of changes noted within that project area.

5.3. General Shoreline Trends

Key statistics were calculated to describe the shoreline and volume change trends over the entire shoreline as well as for each region of the shoreline as defined in Figure 3-1. The computed statistics include average shoreline change, average volume change, and cumulative volume change (e.g. total volume of material lost or gained along a section of shoreline). A summary of the resulting statistics for the October 2014 to October 2015 comparison are presented in Table 5-2. A summary of the resulting statistics for the April 2015 to October 2015 comparison are presented in Table 5-3.

As illustrated in Table 5-2, the Ocean View shoreline has experienced overall erosion at MHW over the past year with a length-weighted average change rate of -3.21 ft/yr. While the beach and dune above 0 feet NAVD88 lost sediment at a rate of 77,843 cy/yr, the Ocean View area gained volume at a rate of 36,746 cy/yr above -15 ft NAVD88. From April 2015 to October 2015, the overall MHW shoreline showed erosion of -3.84 feet, as shown in Table 5-3. The volumetric change over the same

period showed loss above 0 feet NAVD88 and above -15 feet NAVD88 of 95,586 cy and 57,240 cy, respectively.

Over the prior year (October 2014 to October 2015), the Ocean View shoreline gained sand volume above -15 feet NAVD88. That this occurred while the shoreline generally retreated and the dune and beach above 0 feet NAVD88 generally lost volume indicates that a significant gain of sand occurred in the submerged profile between 0 and -15 feet NAVD88. While this overall trend is interesting, especially in light of significant shoreline erosion and volume loss from April to October 2015, the behavior of the system is better understood by looking at patterns of change on a reach-by-reach basis, as discussed in more detail in the following section.

Table 5-2: Regional Shoreline and Volume Change Statistics (October 2014 to October 2015)

| Region | Average Shoreline Change | Average Volume Change Rate Above 0 ft NAVD88 | Cumulative Volume Change Rate Above 0 ft NAVD88 | Average Volume Change Rate Above -15 ft NAVD88 | Cumulative Volume Change Rate Above -15 ft NAVD88 |
|---|--------------------------|--|---|--|---|
| | (ft/yr) | (cy/ft/yr) | (cy/yr) | (cy/ft/yr) | (cy/yr) |
| Willoughby Spit (0+00 to 45+00) | 0.70 | -0.18 | -833 | 6.05 | 27,316 |
| 800 Block Breakwaters (45+25 to 87+62) | -10.60 | -3.55 | -16,119 | -4.00 | -18,144 |
| West Ocean View (93+41 to 163+49) | -16.11 | -2.57 | -17,095 | -2.20 | -13,065 |
| Central Ocean View Breakwaters (169+63 to 195+63) | -3.95 | -0.03 | -109 | 3.19 | 11,070 |
| Central Ocean View (206+86 to 323+09) | 2.72 | -1.91 | -23,930 | 2.91 | 36,367 |
| East Ocean View (329+63 to 383+58) | 4.18 | -3.45 | -19,757 | -1.19 | -6,798 |
| OVERALL | Weighted Avg (ft/yr) | Weighted Avg (cy/ft/yr) | Total (cy/yr) | Weighted Avg (cy/ft/yr) | Total (cy/yr) |
| | -3.21 | -2.09 | -77,843 | 0.86 | 36,746 |

Table 5-3: Regional Shoreline and Volume Change Statistics (April 2015 to October 2015)

| Region | Average Shoreline Change | Average Volume Change Above 0 ft NAVD88 | Cumulative Volume Change Above 0 ft NAVD88 | Average Volume Change Above -15 ft NAVD88 | Cumulative Volume Change Above -15 ft NAVD88 |
|---|--------------------------|---|--|---|--|
| | (ft) | (cy/ft) | (cy) | (cy/ft) | (cy) |
| Willoughby Spit (0+00 to 45+00) | -1.23 | -1.00 | -4,501 | 1.30 | 5,866 |
| 800 Block Breakwaters (45+25 to 87+62) | -10.13 | -3.60 | -16,344 | -5.02 | -22,768 |
| West Ocean View (93+41 to 163+49) | -8.73 | -1.31 | -9,936 | -1.70 | -12,893 |
| Central Ocean View Breakwaters (169+63 to 195+63) | -7.45 | -0.66 | -2,274 | -0.48 | -1,653 |
| Central Ocean View (206+86 to 323+09) | -3.52 | -3.34 | -41,760 | -0.67 | -8,414 |
| East Ocean View (329+63 to 383+58) | 7.06 | -3.63 | -20,770 | -3.04 | -17,379 |
| OVERALL | Weighted Avg (ft) | Weighted Avg (cy/ft) | Total (cy) | Weighted Avg (cy/ft) | Total (cy) |
| | -3.84 | -2.49 | -95,586 | -1.49 | -57,240 |

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 5-8 through Figure 5-11, 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) has, since regular monitoring started in 2005, been a relatively stable and accreting region. Prior to December 2012, coastal structures in this region included two offshore breakwaters, a rock terminal groin, and several timber groins. Construction of the Willoughby Spit Shoreline Improvement Project was started in December 2013, and it included the removal of the existing timber groin field addition of seven new detached breakwaters connecting 800 Block breakwater field with the two prior existing Willoughby Spit breakwaters. A summary of average shoreline and volume change rates for the Willoughby Spit region between October 2014 and October 2015 and between April 2015 and October 2015 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 |
|---|--------------------------|---|--|---|--|
| October 2014 vs. October 2015 Comparison | | | | | |
| | (ft/yr) | (cy/ft/yr) | (cy/yr) | (cy/ft/yr) | (cy/yr) |
| Willoughby Spit (0+00 to 45+00) | 0.70 | -0.18 | -833 | 6.05 | 27,316 |
| April 2015 vs. October 2015 Comparison | | | | | |
| | (ft) | (cy/ft) | (cy) | (cy/ft) | (cy) |
| Willoughby Spit (0+00 to 45+00) | -1.23 | -1.00 | -4,501 | 1.30 | 5,866 |

This region was on average erosional in the dune and subaerial beach and accretional in the submerged profile over the seasonal comparison (April 2015 - October 2015) and the yearly comparison (October 2014 - October 2015). For the yearly comparison, the MHW shoreline accreted slightly at a rate of 0.70 ft/yr, lost sediment above 0 ft NAVD88 at a rate of 833 cy/yr, and gained sediment above -15 ft NAVD88 at a rate of 27,316 cy/yr. The seasonal comparison showed erosion of the MHW shoreline of -1.23 feet on average and a cumulative sediment loss above 0 feet NAVD88 of 4,501 cy with a gain above -15 feet NAV/D88 of 5,866 cy. The loss to the dune and subaerial beach occurred predominantly between April and October 2015 and was most intense between stations 35+00 and 45+00 (Appendix B). This erosion in the vicinity of Toler Place (between 11th View and 12th View Streets) was mainly due to storms occurring successively, with only a few days between them, in late September and early October (including effects of the offshore-passing Hurricane Joaquin). The sediment lost in this area appears to have moved west to be deposited between stations 12+00 and 22+50. There was also a large loss located at station 10+00 above -15 ft NAVD88 as shown in Figure 5-9; however, this loss occurred approximately 1500 ft offshore of the breakwater, which is driving the magnitude of the change at this location.

The breakwaters that were part of the 2014 shoreline improvement project that connected the existing breakwaters to the 800 Block breakwaters have continued to perform as designed, providing stability to the majority of the Willoughby Spit reach as shown in Figure 5-9 and Figure 5-11. This correlates well to the accretion of the MHW shoreline in the western section of the reach and the erosion of the MHW shoreline in the eastern section of the reach as shown in Figure 5-8 and Figure 5-10. However, the shoreline at the eastern end of the Willoughby Spit reach experienced significant erosion in the September / October 2015 storms, such that several homes along Toler Place and near 11th View Street were seen to be vulnerable to wave action if a similar set of storms were to occur before the beach and dune recovered. The City has initiated an emergency beach nourishment project to restore a measure of dune volume along this reach as a buffer against storms that may occur in the winter and spring of 2016.

5.4.2. 800 Block Breakwaters

The 800 Block Breakwaters region (Sta 45+25 to Sta 87+62) is characterized by a field of eight breakwaters. The easternmost breakwater was relocated in February 2006 along with removal of a pre-existing groin spur and toe extension. This relocated breakwater was placed further offshore to mitigate an excessive salient / tombolo formation, caused by the prior structural configuration that had impaired natural sediment transport to the west. In conjunction with the 2014 Willoughby Spit Project, the second easternmost breakwater in the 800 Block set was also relocated further offshore to enhance natural sediment transport in the region. A summary of average shoreline and volume change rates for the 800 Block Breakwaters region between October 2014 and October 2015 and between April 2015 and October 2015 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 |
|---|--------------------------|---|--|---|--|
| October 2014 vs. October 2015 Comparison | | | | | |
| | (ft/yr) | (cy/ft/yr) | (cy/yr) | (cy/ft/yr) | (cy/yr) |
| 800 Block Breakwaters (45+25 to 87+62) | -10.60 | -3.55 | -16,119 | -4.00 | -18,144 |
| April 2015 vs. October 2015 Comparison | | | | | |
| | (ft) | (cy/ft) | (cy) | (cy/ft) | (cy) |
| 800 Block Breakwaters (45+25 to 87+62) | -10.13 | -3.60 | -16,344 | -5.02 | -22,768 |

The 800 Block was predominantly erosional over the seasonal comparison (April 2015 - October 2015) and yearly comparison (October 2014 - October 2015). For the yearly comparison, there has been an erosion of the MHW shoreline of -10.60 ft/yr as well as an overall volume loss above 0 feet NAVD88 and -15 ft NAVD88 of -16,119 cy/yr and -18,144 cy/yr respectively. The seasonal comparison showed there was erosion of the MHW shoreline of -10.13 feet and a loss of sediment above 0 feet NAVD88 and -15 feet NAVD88 of -16,344 cy and -22,768 cy respectively. These losses were primarily to the dune and subaerial beach across the entire reach, as shown in Figure 5-9 and the profiles in Appendix B. This is indicative of storm induced erosion due to the storms of late September and early October. Give the proximity of the survey after the storm event, post-storm recovery of the beach would not have occurred prior to the survey.

5.4.3. West Ocean View

The West Ocean View area (Sta 93+41 to Sta 163+49), between the 800 Block and Central Ocean View breakwaters, was historically characterized by a series of timber groins. The 2013 West Ocean View Shoreline Improvement Project included the removal of all timber groins located between the Ocean View Fishing Pier and Station 141+98, the reconstruction of a rock groin at station 129+17, and 73,600 cy of sand nourishment placed in front of Sarah Constant Beach Park. A summary of average shoreline and volume change rates for the West Ocean View region October 2014 and October 2015 and between April 2015 and October 2015 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 |
|---|--------------------------|---|--|---|--|
| October 2014 vs. October 2015 Comparison | | | | | |
| | (ft/yr) | (cy/ft/yr) | (cy/yr) | (cy/ft/yr) | (cy/yr) |
| West Ocean View (93+41 to 163+49) | -16.11 | -2.57 | -17,095 | -2.20 | -13,065 |
| April 2015 vs. October 2015 Comparison | | | | | |
| | (ft) | (cy/ft) | (cy) | (cy/ft) | (cy) |
| West Ocean View (93+41 to 163+49) | -8.73 | -1.31 | -9,936 | -1.70 | -12,893 |

This region was predominantly erosional over the yearly comparison (October 2014 - October 2015) and seasonal comparison (April 2015 - October 2015). The yearly survey comparison showed erosion of the MHW shoreline at a rate of -16.11 ft/yr, and a volume loss above 0 feet NAVD88 and -15 feet NAVD88 at a rate of -17,095 cy/yr and -13,065 cy/yr respectively. The seasonal comparison showed an erosion of the MHW shoreline of -8.73 feet and a loss of material above 0 feet NAVD88 and -15 feet NAVD88 of -9,936 cy and -12,893 cy respectively. Figure 5-10 and Figure 5-11 show the effects of the West Ocean View Shoreline Improvement Project on the MHW shoreline and volume change above 0 ft NAVD88 and -15 ft NAVD88 respectively. As expected, the rock groin added in 2013 performed well. The area updrift of the groin has remained fairly constant even with Hurricane Joaquin affecting this region.

5.4.4. Central Ocean View Breakwaters

The Central Ocean View Breakwaters region covers the four offshore breakwaters at Central Ocean View and approximately 800 feet westward (Sta 169+63 to Sta 195+63). A summary of average shoreline and volume change rates for the Central Ocean View Breakwaters region between October 2014 and October 2015 and between April 2015 and October 2015 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 |
|---|--------------------------|---|--|---|--|
| October 2014 vs. October 2015 Comparison | | | | | |
| | (ft/yr) | (cy/ft/yr) | (cy/yr) | (cy/ft/yr) | (cy/yr) |
| Central Ocean View Breakwaters (169+63 to 195+63) | -3.95 | -0.03 | -109 | 3.19 | 11,070 |
| April 2015 vs. October 2015 Comparison | | | | | |
| | (ft) | (cy/ft) | (cy) | (cy/ft) | (cy) |
| Central Ocean View Breakwaters (169+63 to 195+63) | -7.45 | -0.66 | -2,274 | -0.48 | -1,653 |

This region was on average erosional over the yearly comparison (October 2014 - October 2015). The seasonal comparison (April 2015 – October 2015) had a minimal erosion of the dune and subaerial beach with overall gains to the system above depth of closure. The yearly comparison showed an overall erosion of the MHW shoreline at a rate of -3.95 ft/yr and an overall volume loss above 0 feet NAVD88 at a rate of -109 cy/yr and volume gain above -15 feet NAVD88 at a rate of 11,070 cy/yr. The seasonal comparison showed erosion of the MHW shoreline of -7.45 feet and a slight loss of material above 0 feet NAVD88 and -15 feet NAVD88 of -2,274 cy and -1,653 cy respectively. The end effects of the breakwaters in this region are evident in Figure 5-9, Figure 5-10 and Figure 5-11. Overall, this reach has continued to fare well over the past few monitoring periods, though it showed more erosion of the MHW shoreline compared in this period compared to the previous monitoring period.

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 October 2014 and October 2015 and between April 2015 and October 2015 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 |
|---|--------------------------|---|--|---|--|
| October 2014 vs. October 2015 Comparison | | | | | |
| | (ft/yr) | (cy/ft/yr) | (cy/yr) | (cy/ft/yr) | (cy/yr) |
| Central Ocean View (206+86 to 323+09) | 2.72 | -1.91 | -23,930 | 2.91 | 36,367 |
| April 2015 vs. October 2015 Comparison | | | | | |
| | (ft) | (cy/ft) | (cy) | (cy/ft) | (cy) |
| Central Ocean View (206+86 to 323+09) | -3.52 | -3.34 | -41,760 | -0.67 | -8,414 |

As shown in Table 5-8, Central Ocean View region was on average erosional in the dune and subaerial beach over the yearly comparison (October 2014 - October 2015) and seasonal comparison (October 2014 - April 2015). The yearly comparison showed accretion of the MHW shoreline at a rate of 2.72 ft/yr and an overall volume loss above 0 feet NAVD88 at a rate of -23,930 cy/yr and an overall volume gain above -15 feet NAVD88 at a rate of 36,367 cy/yr. The seasonal comparison showed erosion of the MHW shoreline of -3.52 feet and a loss of material above 0 feet NAVD88 and -15 feet NAVD88

of -41,760 cy and -8,414 cy respectively. Figure 5-10 and Figure 5-11 shows the losses to dune and subaerial beach are primarily located in the eastern section of the reach. The material from the subaerial beach was deposited directly offshore as shown in the profile plots in Appendix B.

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. Table 5-9 summarizes average shoreline and volume change rates for the East Ocean View region between October 2014 and October 2015 and between April 2015 and October 2015.

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 |
|---|--------------------------|---|--|---|--|
| October 2014 vs. October 2015 Comparison | | | | | |
| | (ft/yr) | (cy/ft/yr) | (cy/yr) | (cy/ft/yr) | (cy/yr) |
| East Ocean View (329+63 to 383+58) | 4.18 | -3.45 | -19,757 | -1.19 | -6,798 |
| April 2015 vs. October 2015 Comparison | | | | | |
| | (ft) | (cy/ft) | (cy) | (cy/ft) | (cy) |
| East Ocean View (329+63 to 383+58) | 7.06 | -3.63 | -20,770 | -3.04 | -17,379 |

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. East Ocean View was predominantly erosional over the yearly (October 2014 - October 2015) and over the seasonal (April 2015 - October 2015) comparisons. The yearly comparison showed an overall accretion of the MHW shoreline at a rate of 4.18 ft/yr and an overall volume loss above 0 feet NAVD88 and -15 feet NAVD88 at a rate of -19,757 cy/yr and -6,798 cy/yr respectively. The seasonal comparison showed an accretion of the MHW shoreline of 7.06 feet and a loss of material above 0 feet NAVD88 and -15 feet NAVD88 of -20,770 cy and -17,379 cy respectively. The majority of the loss experienced in this reach occurred to the dune and subaerial beach within the seasonal comparison due to Hurricane Joaquin. From Appendix B, some of the material lost from the subaerial beach was deposited directly offshore and was held in the system by the breakwaters. 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. 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. Usually, 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.

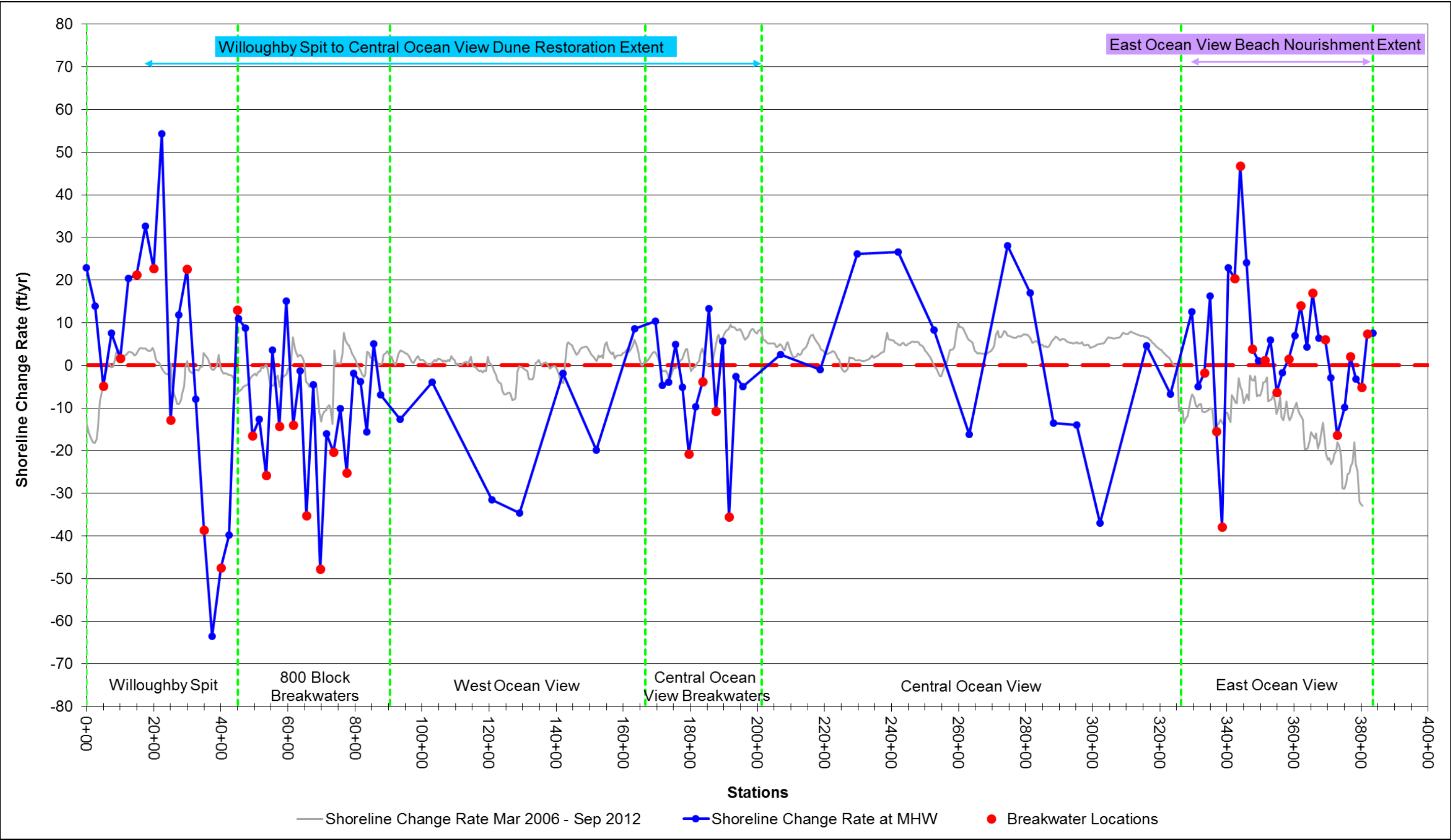


Figure 5-8: Shoreline Change Rate (ft/yr) at Mean High Water (+0.98 ft NAVD88) for October 2014 to October 2015 (Note: Positive = Accretion, Negative = Erosion)

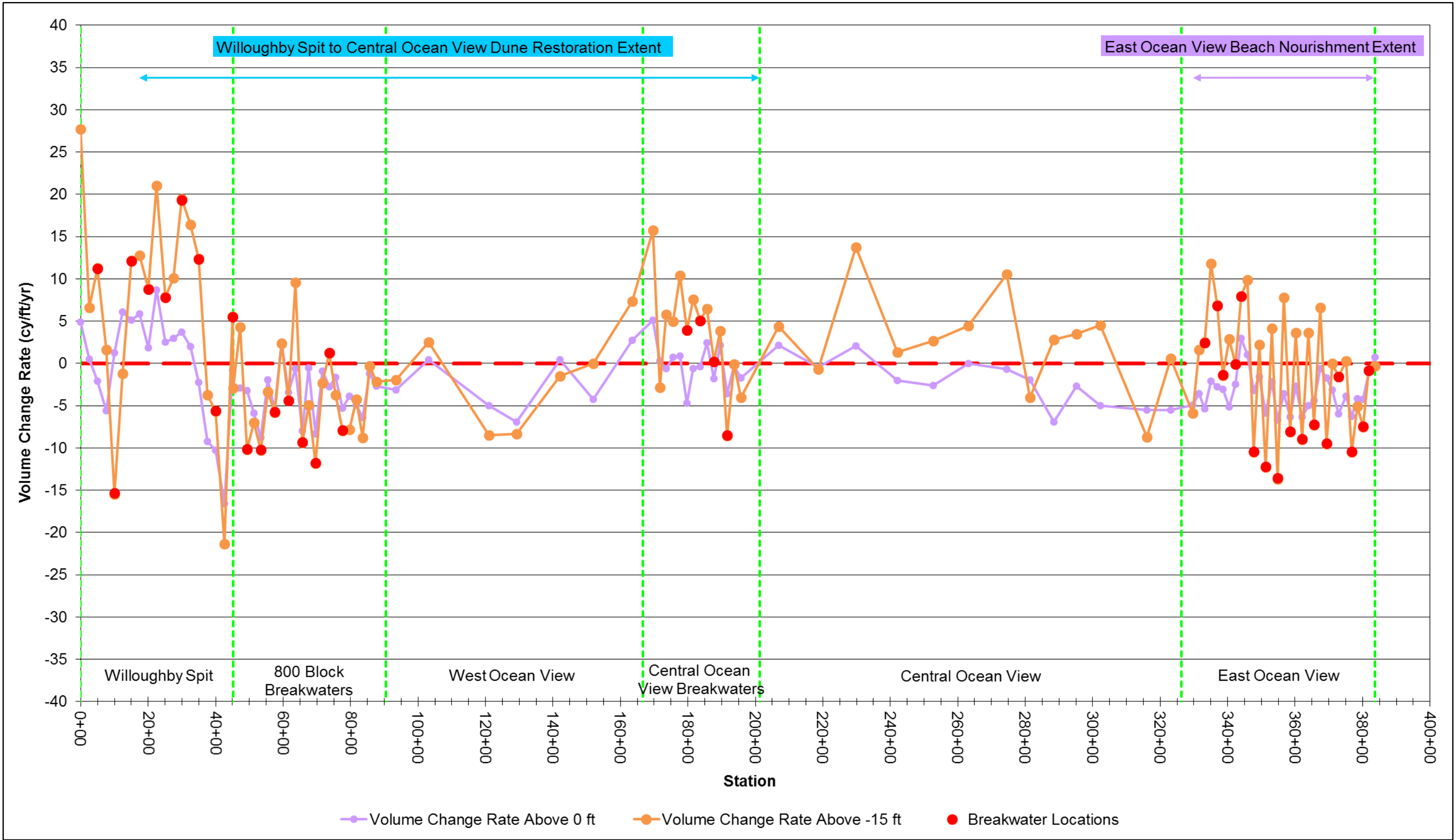


Figure 5-9: Volume Change Rate Above 0 ft NAVD88 and -15 ft NAVD88 (cy/ft/yr) for October 2014 to October 2015 (Note: Positive = Accretion, Negative = Erosion)

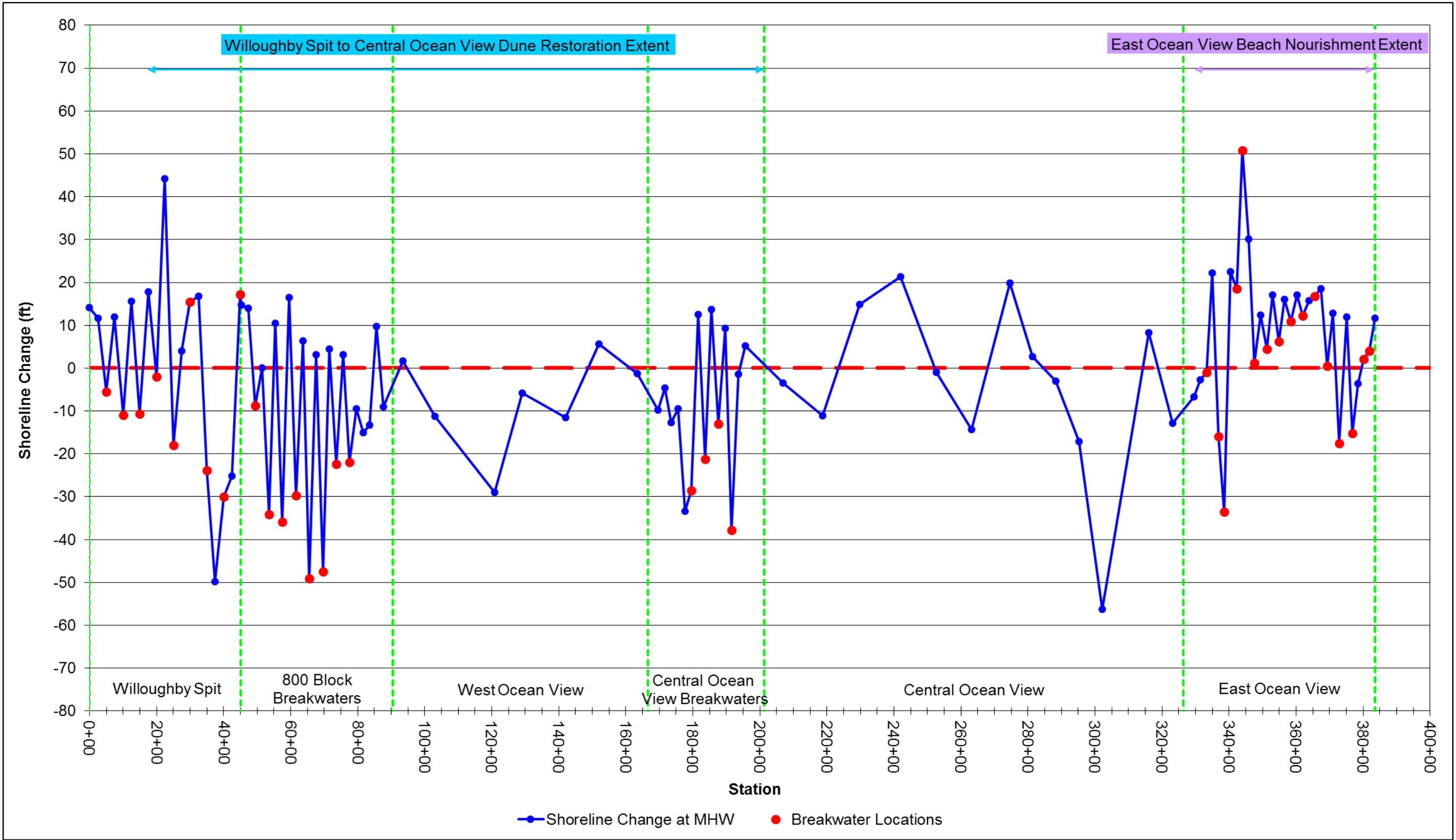


Figure 5-10: Shoreline Change (ft) at Mean High Water (+0.98 ft NAVD88) for April 2015 to October 2015 (Note: Positive = Accretion, Negative = Erosion)

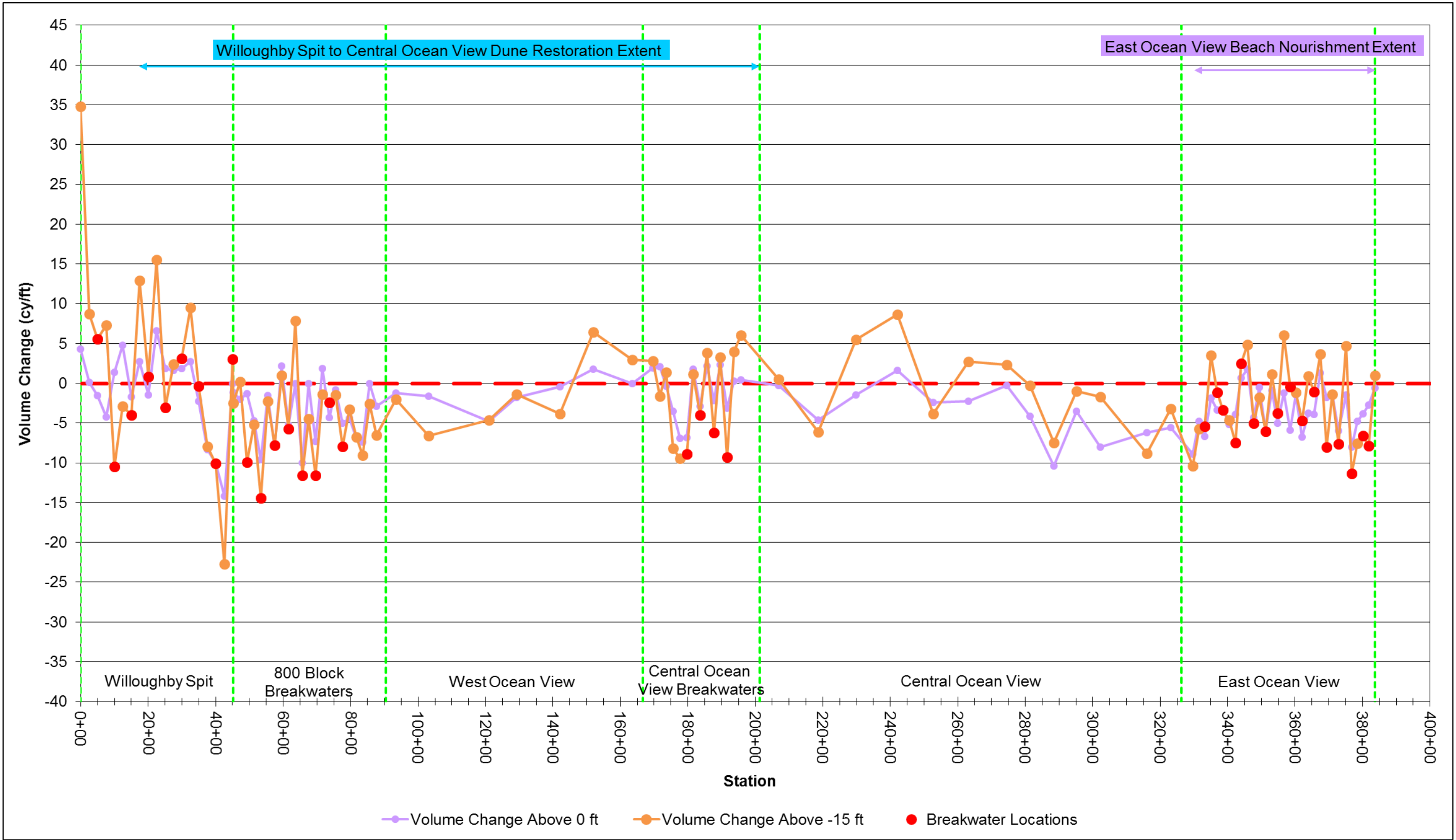


Figure 5-11: Volume Change Above 0 ft NAVD88 and -15 ft NAVD88 (cy/ft) for April 2015 to October 2015 (Note: Positive = Accretion, Negative = Erosion)

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 Station 329+63 and Station 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 October 2015, 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 – October 2015 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 | -14.96 | -3.25 | -16,999 | -5.49 | -28,543 |
| | Total | -98.13 | -21.34 | -111,539 | -36.03 | -187,292 |

Results indicate that the East Ocean View MHW shoreline has continued to erode and that approximately 111,500 cy of the 113,000 cy originally placed above 0 feet NAVD88 (for approximately 99% loss) has been lost from the East Ocean View reach. The previous monitoring period indicated that the percentage loss at that time was 87%, which indicates there was a significant loss of additional sediment over the most recent survey period. This finding is consistent with the significant erosion since April 2015 apparently due to the storms of September / October 2015. It also confirms that the East Ocean View nourishment project is at the end of its effective performance life. 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, and from this perspective the 2009 East Ocean View nourishment project has performed well. The need for renourishment is indicated, and this is expected to be provided by the upcoming federal coastal storm damage reduction project.

Figure 5-12 shows areas of elevation change between the post-fill survey and the October 2015 survey. As depicted in the figure, there has been erosion of the beach face and nearshore, with more erosion in-between the breakwaters than in the areas directly behind the breakwaters. The magnitude of the loss is much larger in the east than in the west of the breakwater field, which is to be expected since this eastern shoreline is cut off from a sediment source by the jetty. Some of the sediment eroded from the beach face and nearshore in the East Ocean View breakwater field appears to have accreted within 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 in addressing the previous hotspot and providing a transition into the Central Ocean View region.

The October 2015 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 5-13 shows the MHW shoreline position difference between the June 2003 pre-fill and October 2015 shorelines. As can be seen, the

MHW shoreline at all stations along the East Ocean View Breakwaters have retreated within 20 feet of the pre-fill shoreline with some receding beyond the pre-fill shoreline position. Half of the stations within the Bay Oaks Breakwaters have remained outside of the 20 foot buffer for the pre-fill shoreline; with an increase seen in the distance outside the buffer up to almost 80 feet at station (344+05). One new station (336+83) has receded within 20 feet of the pre-fill shoreline. Two stations (335+03 and 345+85) that were within the buffer previously have now moved outside and two stations that were within the buffer previously (333+23 and 338+63) have now receded beyond this mark. As for the East Ocean View Breakwaters, an additional seven stations (353+03, 356+63, 360+23, 365+63, 367+43, 375+08, and 381+88) have moved within 20 feet of the prefill shoreline to bring the total up to eleven stations. Only one station (372+83) that was previously within the buffer has now receded beyond this mark. The remaining eight stations are beyond the pre-fill shoreline; however, they have all shown a significant decrease in the distance outside this buffer from the previous monitoring period.

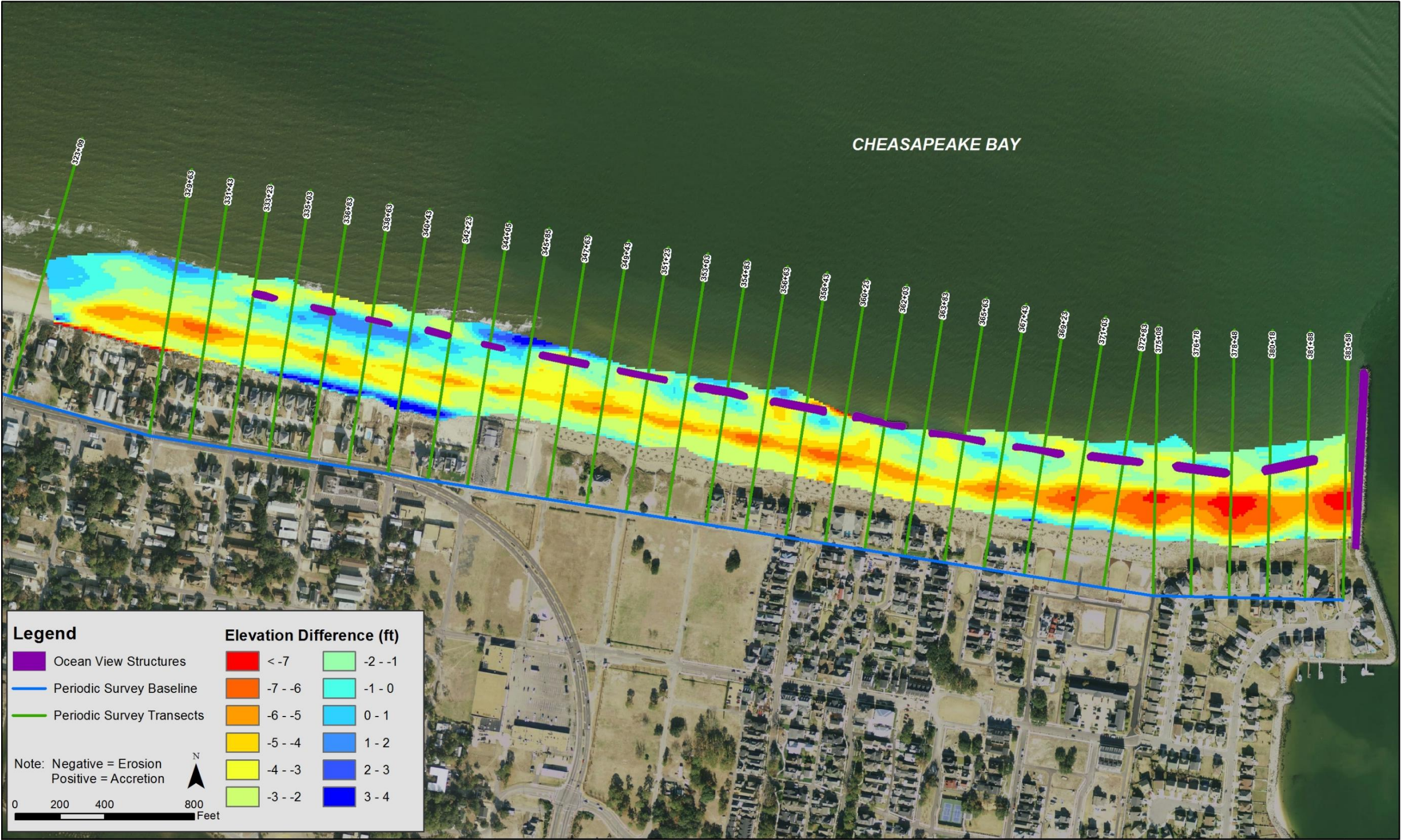


Figure 5-12: Net Volume Change Since the East Ocean View Nourishment Project (March 2009)

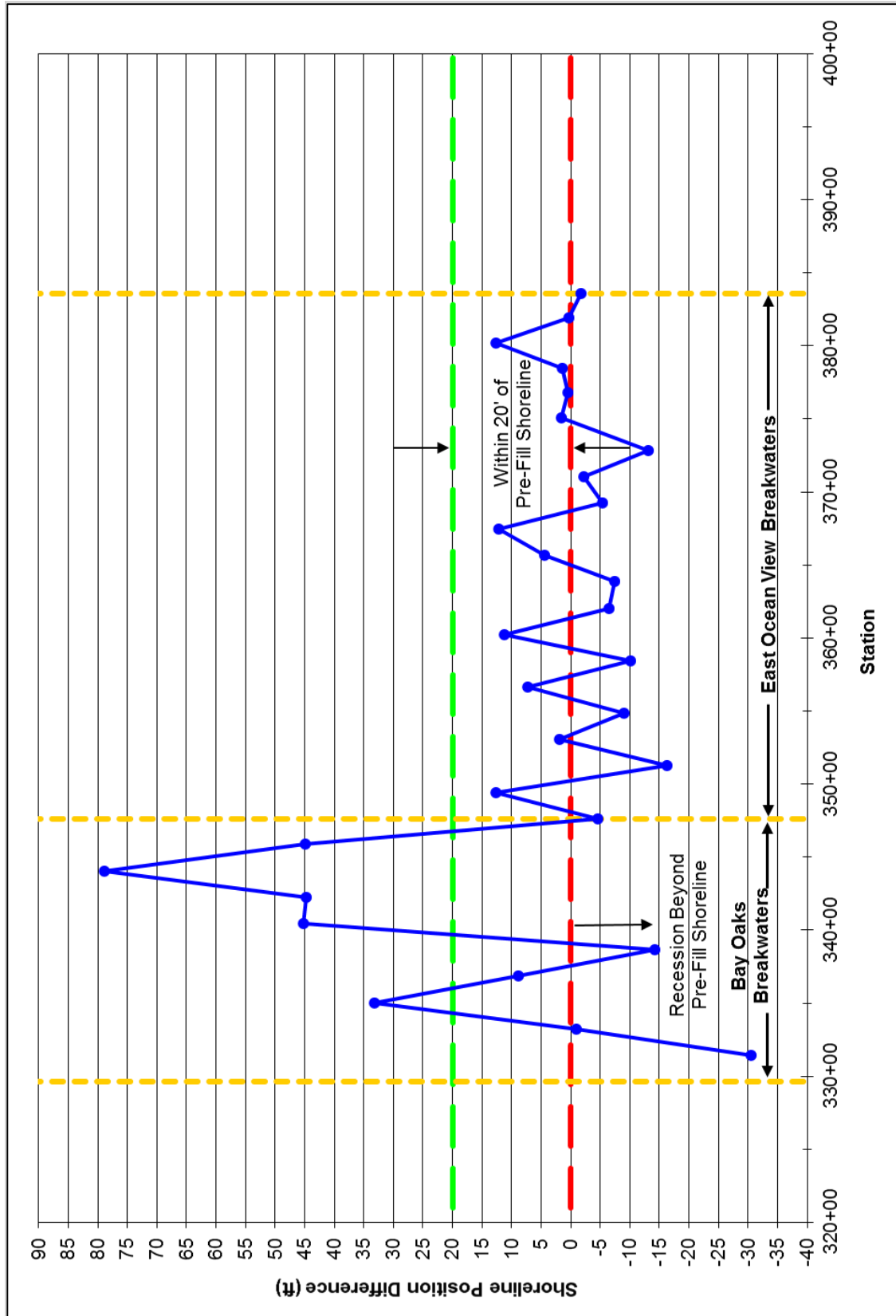


Figure 5-13: Shoreline Position Difference (ft) at MHW Between 2003 Pre-Fill and October 2015 Shorelines for East Ocean View

5.6. Central Ocean View Dune Restoration Project (2005)

The most recent periodic survey, taken in October 2015, 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 in 2005 from Station 15+00 to Station 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 – October 2015 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 | 0.12 | -0.72 | -2,048 | -0.31 | -652 |
| | Total | 1.31 | -7.61 | -21,663 | -3.32 | -6,897 |
| 800 Block Breakwaters (45+25 to 87+62) | Rate per Year | -5.97 | -1.39 | -6,108 | -1.91 | -8,293 |
| | Total | -63.12 | -14.76 | -64,612 | -20.17 | -87,728 |
| West Ocean View (93+41 to 163+49) | Rate per Year | -3.74 | -1.57 | -12,183 | -0.93 | -6,834 |
| | Total | -39.58 | -16.64 | -128,869 | -9.78 | -72,289 |
| Central Ocean View Breakwaters (169+63 to 195+63) | Rate per Year | -1.22 | -0.12 | -280 | 1.10 | 3,454 |
| | Total | -12.90 | -1.27 | -2,965 | 11.61 | 36,542 |
| OVERALL | | Weighted Average | Total | Weighted Average | Total | Weighted Average |
| Rate per Year | | -3.17 | -1.12 | -20,619 | -0.69 | -12,325 |
| Total | | -33.50 | -11.83 | -218,109 | -7.26 | -130,373 |

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. Approximately 218,100 cy of the 320,700 cy originally placed above 0 feet NAVD88 (for approximately 68% loss) has been lost from this reach. The previous monitoring period (April 2015) report indicated that the percentage loss at that time was 57%, which indicates there was a significant loss of additional sediment over the most recent survey period. The majority of the additional erosion from the subaerial beach and dune over the past year is attributed to the September / October 2015 storm effects.

Figure 5-14 shows areas of elevation change between the March 2005 post-fill survey and the October 2015 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 in dune volume seen immediately west of the 800 Block Breakwaters (between Stations 42+50 and 47+30) persist even after the construction of the seven Willoughby Spit breakwaters in 2013 served to slow erosion of the shoreline and subaerial beach in the vicinity of and west of 12th View Street.

In addition, the October 2015 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 ninth 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 5-15 shows the MHW shoreline position difference between the pre-fill and October 2015 shorelines. As can be seen, the October 2015 Willoughby Spit to Central Ocean View MHW shoreline comes within 20 feet of the pre-fill shoreline in several locations and has even receded past the pre-fill shoreline at several locations. Areas of concern remain as the shoreline to the west of the 800 Block breakwater field as well as portions of the breakwater field itself which exist at Stations 42+50 through 57+57. While the majority of stations in the 800 Block Breakwaters from 59+62 through 79+62 show either the shoreline within the 20 feet buffer or accretion beyond the buffer. 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 15+00 and 35+00, which was of concern has remained greater than 20 feet from the pre-fill shoreline. Stations 22+50 and 32+50, which were within 20 feet of the prefill shoreline during the previous monitoring period (March 2014 – April 2015), accreted beyond this line during the current monitoring period. The conditions in the western end and central section of the West Ocean View shoreline remains an area of concern with Stations 81+62 through 152+01 showing recession beyond the pre-fill shoreline. The entire Central Ocean View Breakwaters reach remain stable, all stations within or beyond the 20 feet of prefill shoreline. This shoreline historically has suffered significant impacts from the November 2009 nor'easter which were further exacerbated by Hurricane Irene in August 2011.

The upcoming federal coastal storm damage reduction project is expected to provide this reach with significant additional beach berm widths and associated beach profile volume between +3.5 feet and depth of closure in the submerged profile.

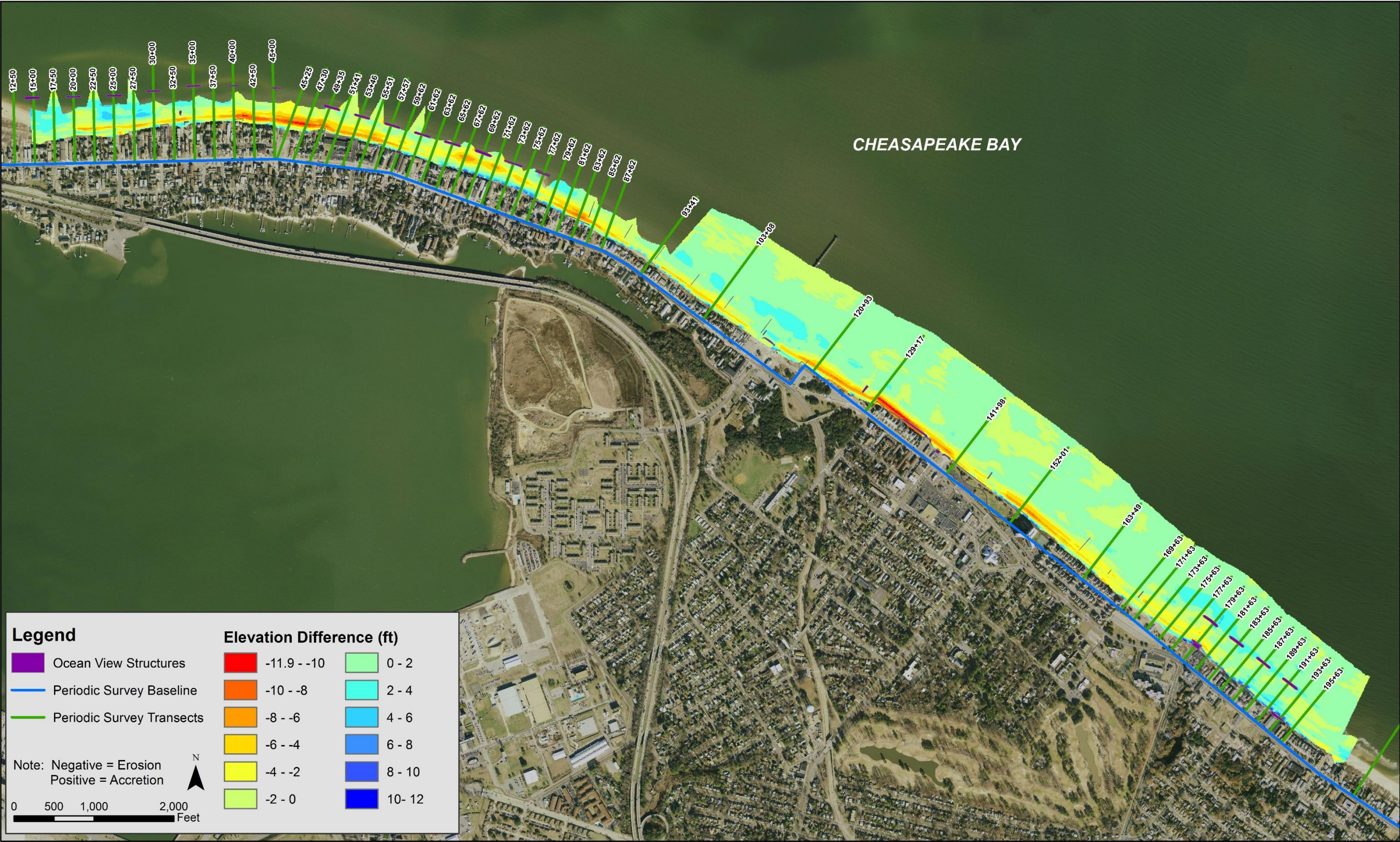


Figure 5-14: Net Volume Change Since the Willoughby Spit to Central Ocean View Dune Restoration Project (March 2005)

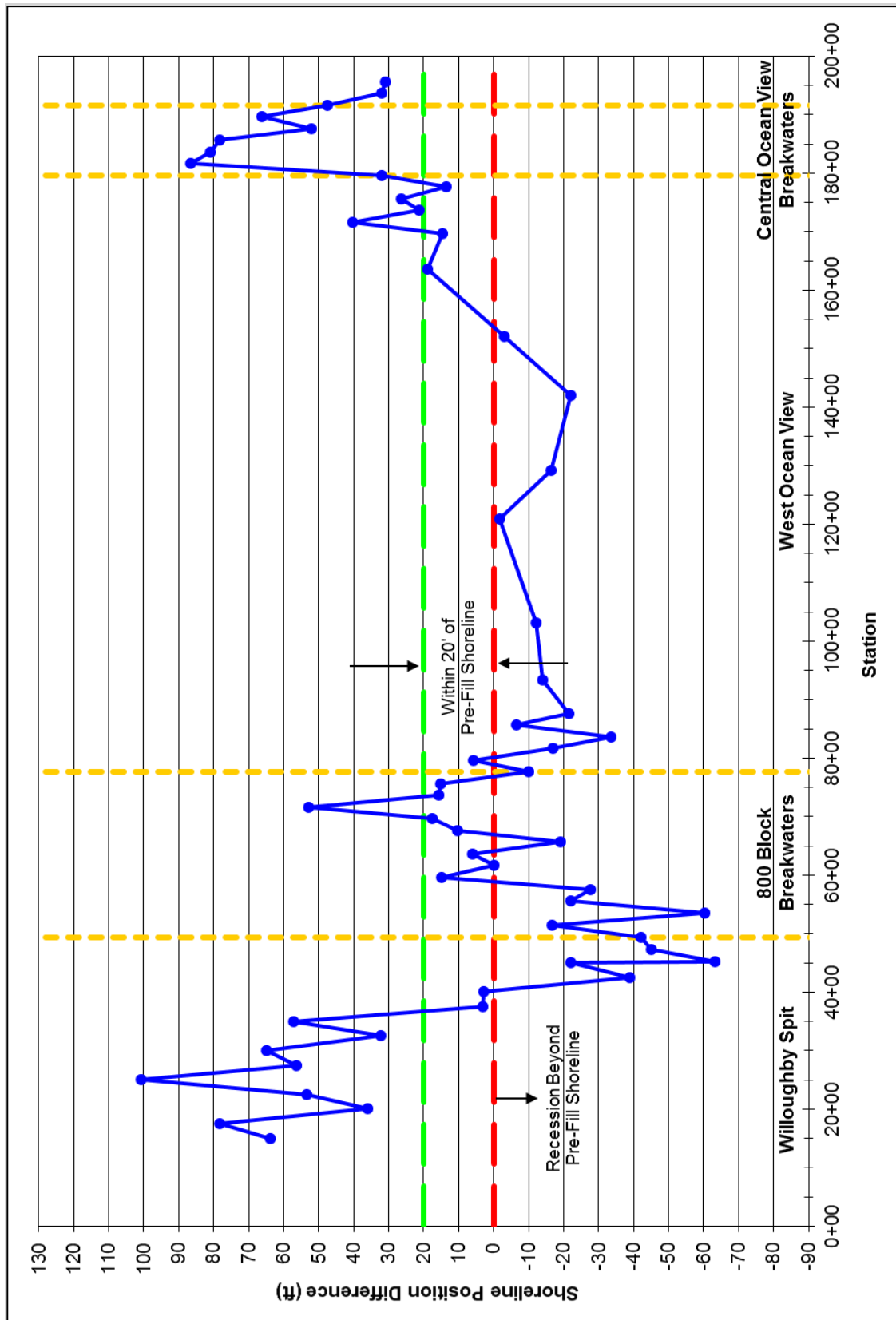


Figure 5-15: Shoreline Position Difference (ft) at MHW Between 2003 Pre-Fill and October 2015 Shorelines for Central Ocean View

5.7. West Ocean View Shoreline Improvement Project (2013)

The most recent periodic survey, taken in October 2015, was also compared to the October 2013 survey of the West Ocean View Shoreline Improvement Project area. A total of 73,600 cy of sand was placed from Station 103+08 to Station 152+01.

Table 5-12: Overall Shoreline and Volume Change Statistics for West Ocean View shoreline Improvement Project (October 2013 – October 2015 Comparison)

| 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 |
|------------------------------------|-------|--------------------------|---|--|---|--|
| West Ocean View (103+08 to 152+01) | Total | 0.46 ft | 1.20 cy/ft | 7,910 cy | 4.08 cy/ft | 24,941 cy |

Construction of the West Ocean View Shoreline Improvement Project was substantially complete prior to the March 2014 monitoring 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, as shown in Figure 5-16. The new groin was designed to be shorter and more sand-tightened 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 added 30 feet of berm width in front of Sarah Constant Beach Park, on the downdrift side of the groin.



Figure 5-16: West Ocean View Shoreline Improvement Project Area

A majority of the material placed within this subreach was placed above -3 ft NAVD88; therefore, the volume change above -15 ft NAVD88 was examined to capture as much of the remaining material as possible. Approximately 24,900 cy of material remains above -15 feet NAVD88 or 34% of the 73,600 cy originally placed.

In addition, the October 2015 MHW shoreline was compared to the MHW shoreline from October 2013, before the shoreline improvement project was completed in November 2013, as another way to measure the amount of protection being supplied by this nourishment project. Areas where the current shoreline is within 10 feet of the October 2013 shoreline need to be targeted for nourishment. Figure 5-17 shows the MHW shoreline position difference between the October 2013 and October 2015 shorelines. As can be seen, the MHW shoreline at all transects along the project area have receded beyond the 10 feet of the pre-fill shoreline. The average MHW shoreline erosion within this reach is -18 ft.

The upcoming federal coastal storm damage reduction project is expected to provide this reach with significant additional beach berm widths and associated beach profile volume between +3.5 feet and depth of closure in the submerged profile

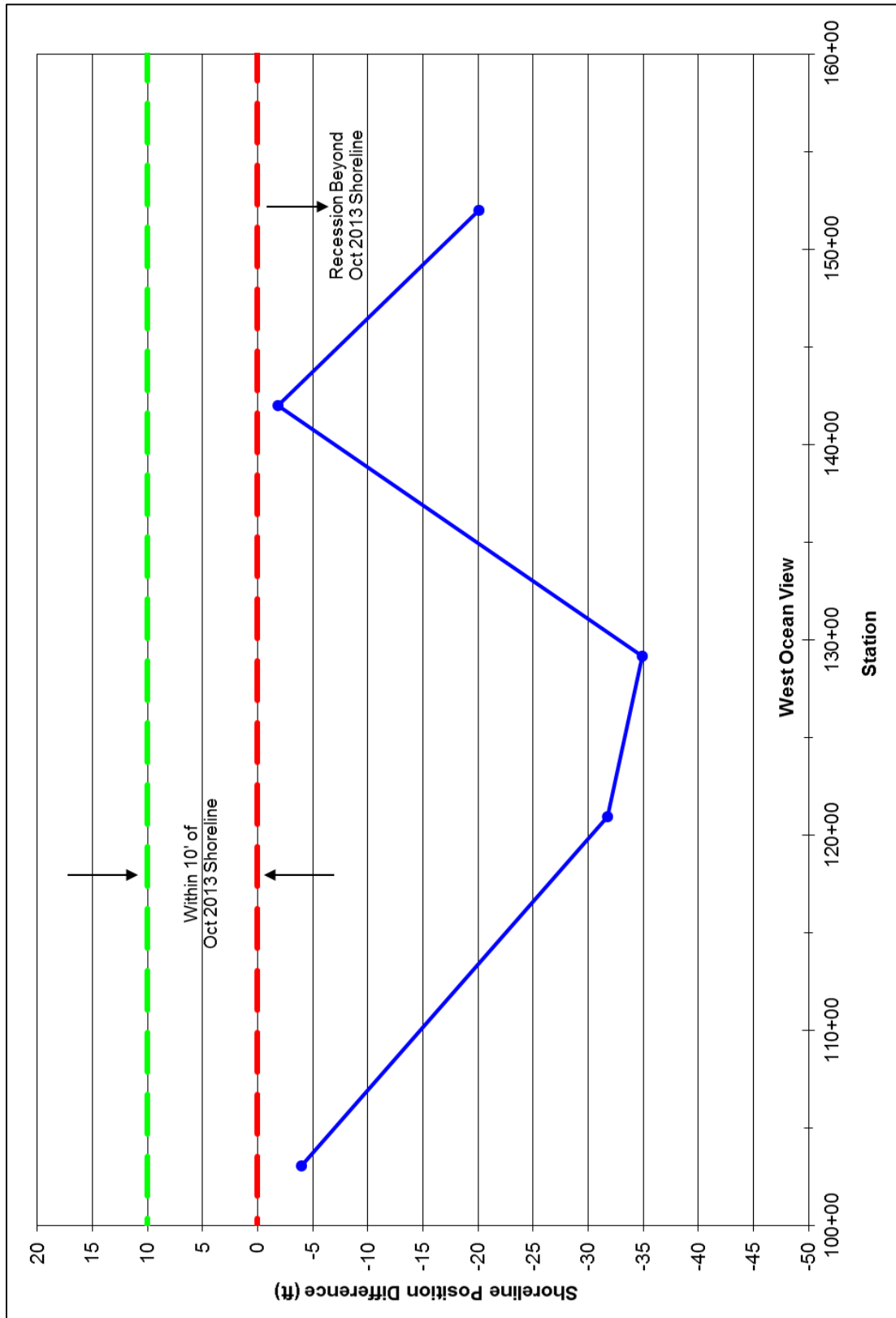


Figure 5-17: Shoreline Position Difference (ft) at MHW Between October 2013 and October 2015 Shorelines for West Ocean View

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 October 2015, within one week following the occurrence of two separate but closely spaced periods of elevated waves and water levels (September 22-27 and October 2-6). 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 October 2015 survey was compared with both the October 2014 and April 2015 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 October 2015 was compared to pre- and post-fill surveys taken after the East Ocean View beach nourishment (March 2009) and Willoughby Spit to Central Ocean View dune restoration (January-March 2005) projects. 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 October 2014 and October 2015 surveys and the April 2015 and October 2015 surveys.

| Comparison | Parameter | Quantity |
|-------------------------------|--|---------------|
| October 2014 vs. October 2015 | Average Shoreline Change Rate at MHW (+0.98 ft NAVD88) | -3.21 ft/yr |
| | Cumulative Volume Change Rate Above 0 ft NAVD88 | -77,843 cy/yr |
| | Cumulative Volume Change Rate Above -15 ft NAVD88 | 36,746 cy/yr |
| April 2015 vs. October 2015 | Average Shoreline Change at MHW (+0.98 ft NAVD88) | -3.84 ft |
| | Cumulative Volume Change Above 0 ft NAVD88 | -95,586 cy |
| | Cumulative Volume Change Above -15 ft NAVD88 | -57,240 cy |

The average shoreline change rate for the entire shoreline at MHW between the October 2014 and October 2015 surveys was -3.21 ft/yr, and the cumulative volume change above 0 feet NAVD88 was approximately -77,843 cy. This indicates an overall volumetric loss in the dune and subaerial beach over the past year, and this is largely due to the effects of the above-mentioned storms in late September and early October (including Hurricane Joaquin's passage in the Atlantic Ocean). However, even with this net erosion of the subaerial profile, the system as a whole gained approximately 36,746 cy above -15 feet NAVD88 over the previous year from October 2014 to October 2015.

The most recent six-month period of comparison (April 2015 - October 2015) depicts erosion of the MHW line of -3.84 feet. The cumulative volume change above 0 feet NAVD88 indicates a sediment loss to the subaerial beach of -95,586 cy, and there was also a loss of sediment in the nearshore system above -15 feet NAVD88 of -59,769 cy. Again, this can be attributed largely to the storm effects from late September and early October. All of the surveyed shoreline reaches were affected by these storms and experienced dune and subaerial beach erosion. It is important to note that the October 2015 survey was obtained two days after the October 2-6 storm dissipated, so that the survey reflects the conditions of the subaerial beach with little or no post-storm recovery.

Willoughby Spit

The Willoughby Spit region overall experienced accretion of the MHW shoreline, volumetric loss above 0 feet NAVD88, and volumetric gain above -15 feet NAVD88 over the past year. The eastern end of the reach has continued to experience erosion while the western end accreted.

800 Block Breakwaters

In the 800 Block region, there has been significant erosion of the MHW shoreline, with moderate volumetric loss above 0 feet NAVD88 and above -15 feet NAVD88 over the year and the most recent survey period comparisons. The tombolo previously located at the breakwater appears to have been successfully corrected by the 2013 breakwater realignment, as this realigned breakwater has remained detached from the shoreline allowing sand to transport more freely through this reach.

West Ocean View

The West Ocean View region was characterized by the shoreline improvement project that took place during the October 2013 to April 2014 survey period. The reconstructed groin has performed well over the past year, even considering the intense storm wave climate. The yearly analysis shows overall volumetric loss above both 0 feet NAVD88 and -15 feet NAVD88 as well as erosion of the MHW shoreline.

Central Ocean View Breakwaters

The Central Ocean View Breakwaters region experienced erosion of the MHW shoreline, with minor volumetric loss above 0 feet NAVD88 and volumetric gain above -15 feet NAVD88 over the past year. Over the current survey period, this reach experienced overall erosion due to storms.

Central Ocean View

Typically a very stable region, Central Ocean View has experienced accretion of the MHW shoreline, with a volumetric loss above 0 feet NAVD88 and gain above -15 feet NAVD88 over the past year. However, like the other reaches, Central Ocean View experienced net erosion over the current survey period primarily in the dune and subaerial beach due to storms.

East Ocean View

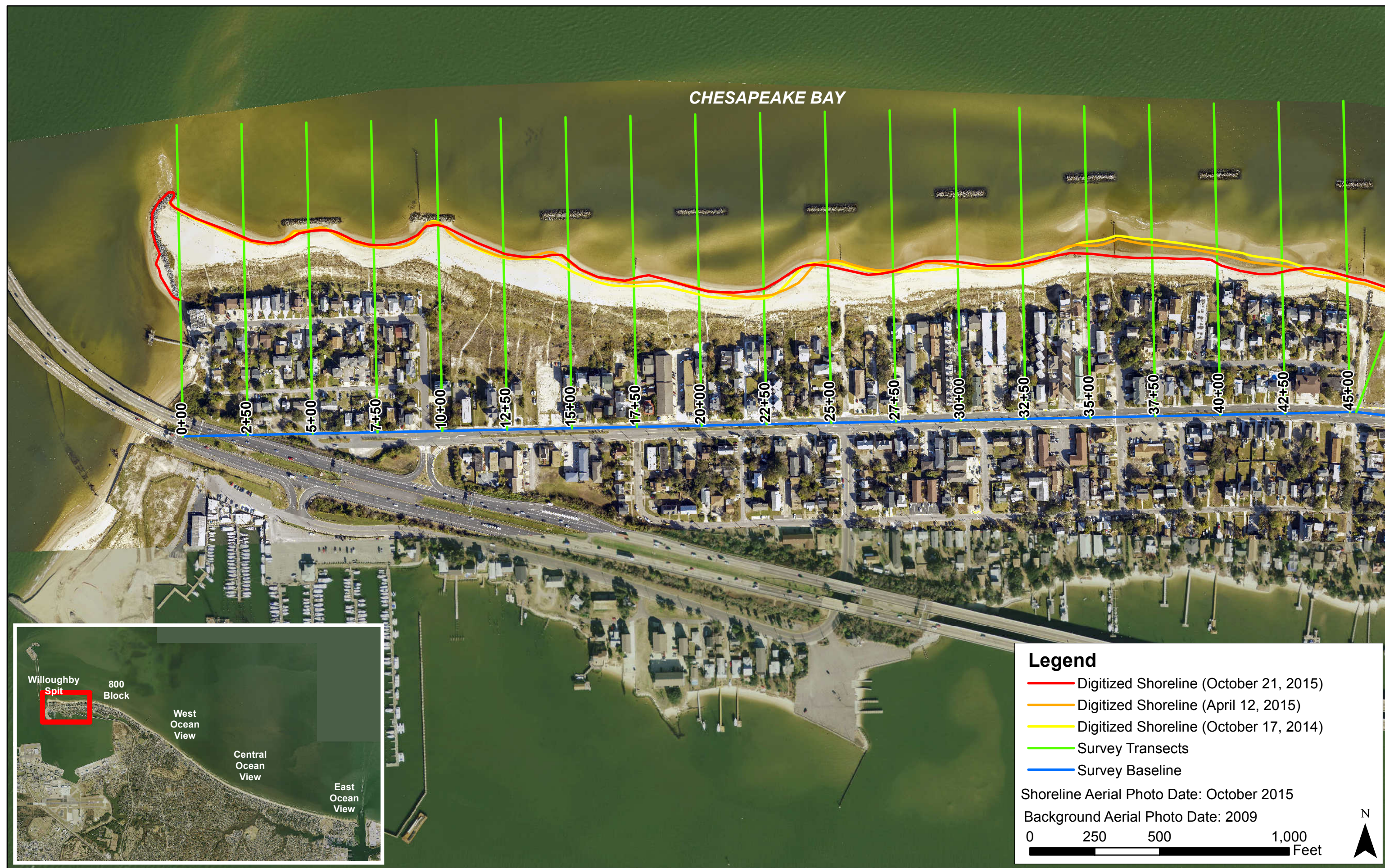
There has been accretion of the MHW shoreline along with moderate volumetric losses above both 0 feet NAVD88 and -15 feet NAVD88 in the East Ocean View region over the past year and during the most recent survey period. The Bay Oaks breakwaters are continuing to perform well, trapping sediment and eliminating 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 2015 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 2015 Comparison | -98.13 ft | -21.34 cy/ft | -111,539 cy | -36.03 cy/ft | -187,292 cy |
| Central Ocean View Nourishment vs. October 2015 Comparison | -33.50 ft | -11.83 cy/ft | -218,109 cy | -7.26 cy/ft | -130,373 cy |
| West Ocean View Pre-Nourishment vs October 2015 Comparison | 0.46 ft | 1.20 cy/ft | 7909.79 cy | 4.08 cy/ft | 24,941 cy |

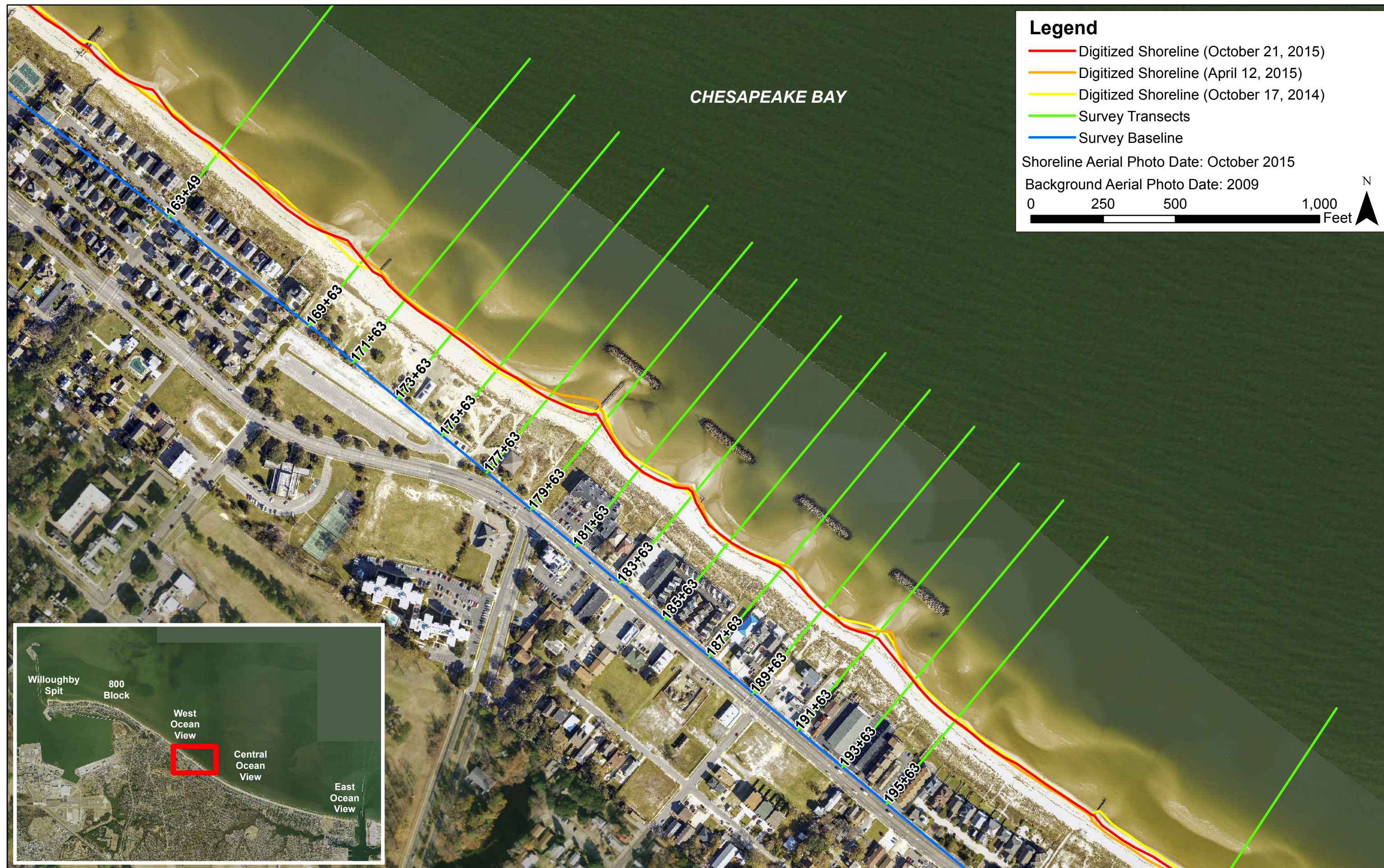
The 111,500 cy volumetric loss above 0 feet NAVD88 within the East Ocean View project (since construction in 2009) is roughly 99% of the original amount placed in this dune and subaerial beach area. The 218,100 cy loss above 0 feet NAVD88 in the Central Ocean View project area (since 2005) is roughly 68% of the original amount placed above 0 feet NAVD88. The remaining volume for the West Ocean View project is approximately 24,900 cy out of the 73,600 cy placed in 2013, which is 34% of the original fill volume remaining. Due to storm impacts and background erosion that has occurred, as anticipated, over the projects' design lives, there are areas in the East Ocean View and Central Ocean View regions that should be targeted for nourishment. The completed Willoughby Spit (2013) project and the West Ocean View (2013) projects have alleviated the concerns with these hot spots and have provided additional protection in vulnerable areas; however, this area as well as others may require additional nourishment to provide adequate storm protection. It is expected that the upcoming federal coastal storm damage reduction project will provide all of these reaches (directly, or indirectly in the case of the Cottage Line area of Central Ocean View) with significant additional beach profile volume over the next one to two years.

This is the twenty-first periodic survey report completed to date, and twentieth 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. October 2014 to October 2015) 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.







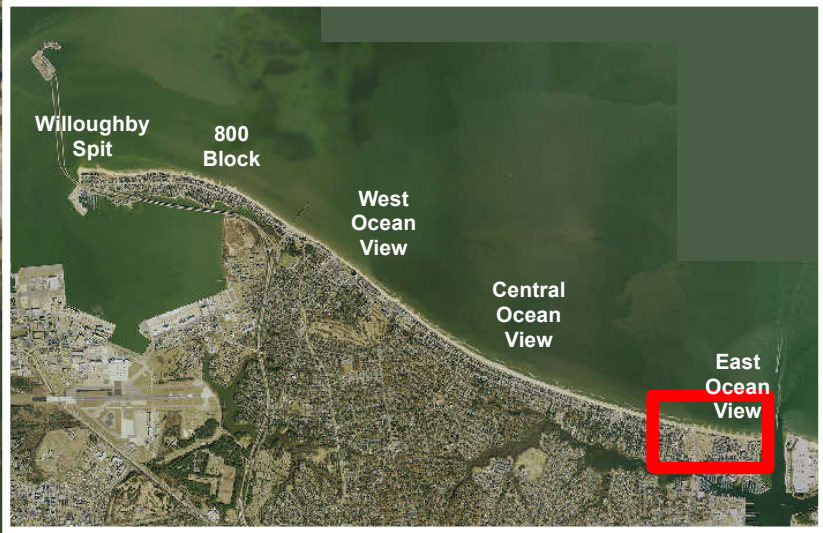
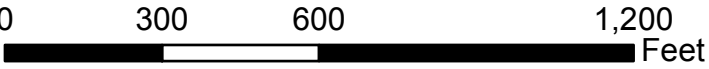


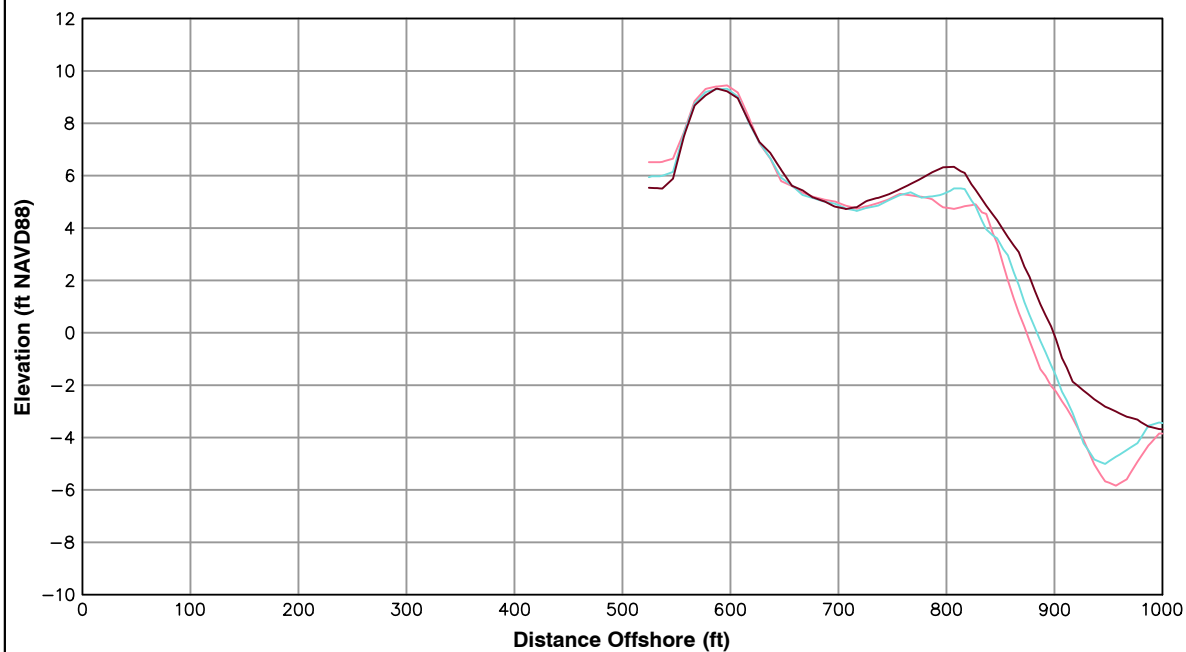
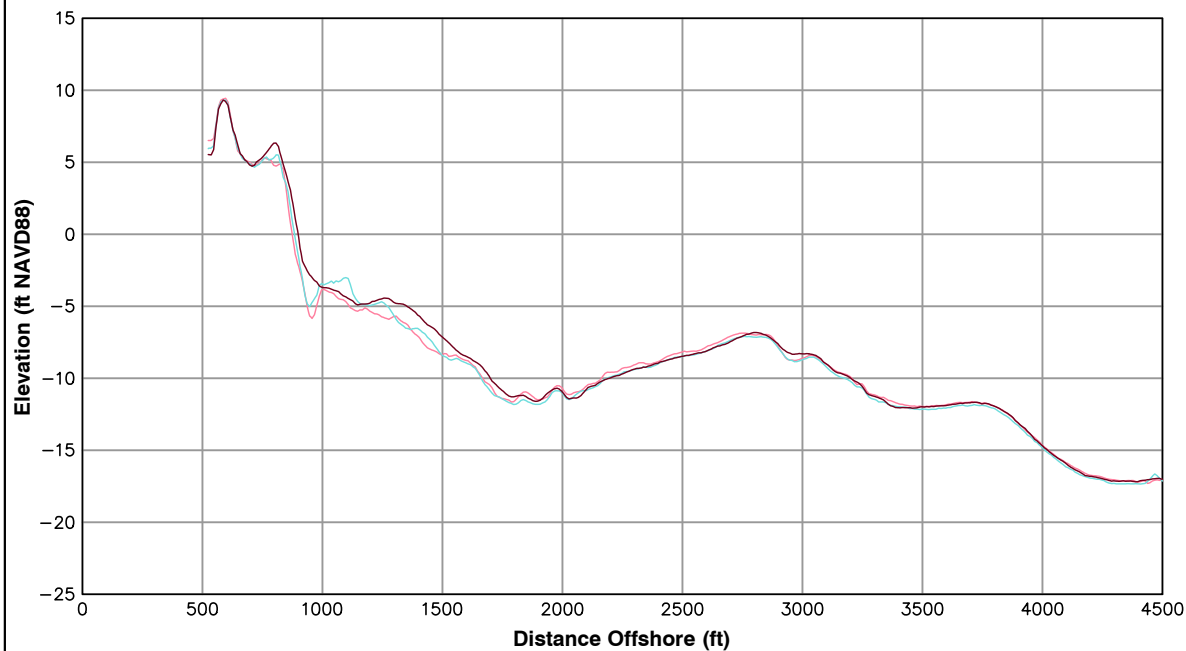


CHESAPEAKE BAY

- Legend**
- Digitized Shoreline (October 21, 2015)
 - Digitized Shoreline (April 12, 2015)
 - Digitized Shoreline (October 17, 2014)
 - Survey Transects
 - Survey Baseline

Shoreline Aerial Photo Date: October 2015
Background Aerial Photo Date: 2009





| Survey Transect 0+00 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 22.90 ft/yr | 14.16 ft |
| Volume Change Above -15 ft NAVD88 | 27.47 cy/ft/yr | 34.83 cy/ft |
| Volume Change Above 0 ft NAVD88 | 4.86 cy/ft/yr | 4.34 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —

Notes:

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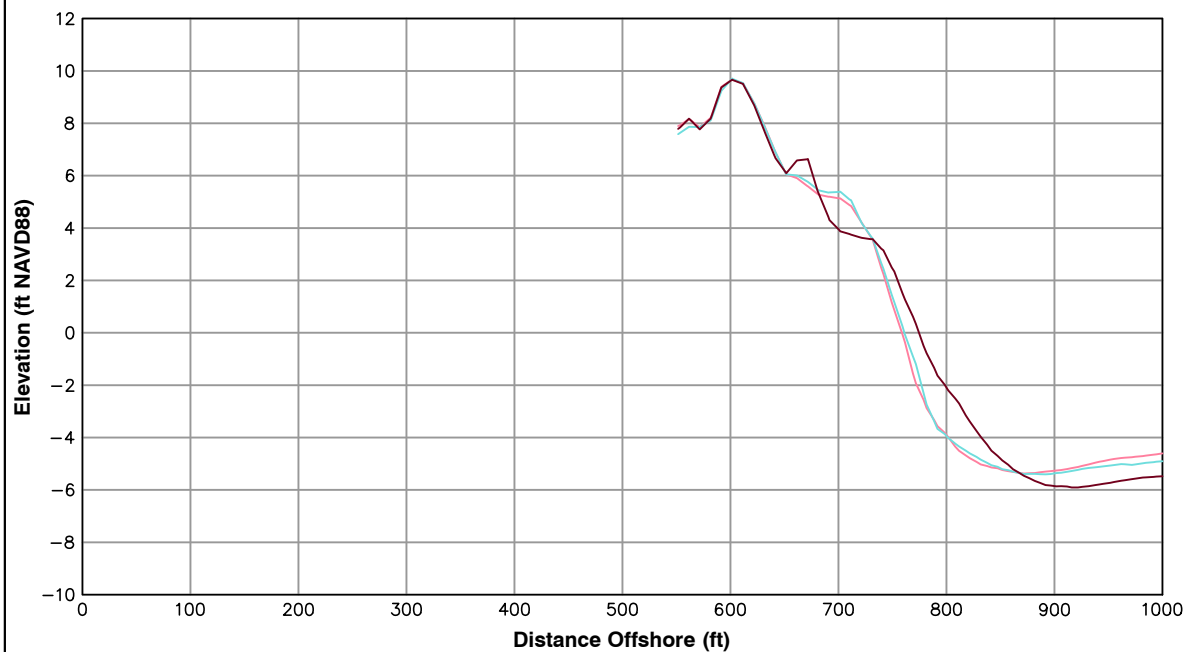
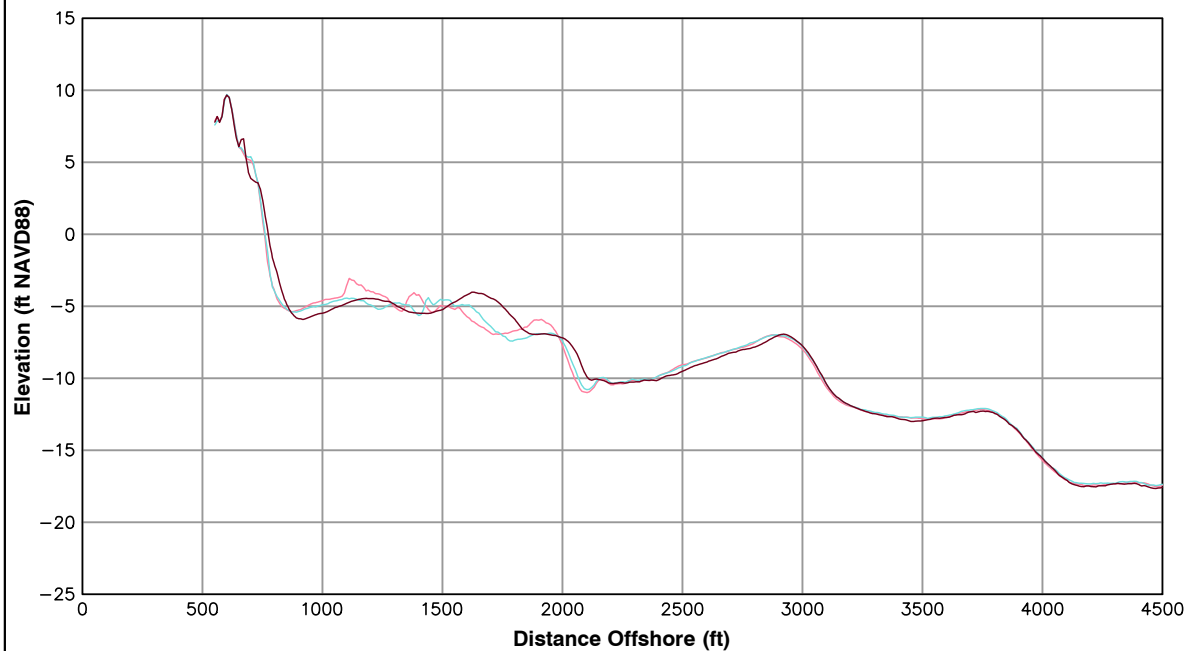
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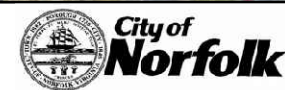
| Survey Transect 2+50 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 13.92 ft/yr | 11.62 ft |
| Volume Change Above -15 ft NAVD88 | 6.54 cy/ft/yr | 8.75 cy/ft |
| Volume Change Above 0 ft NAVD88 | 0.48 cy/ft/yr | 0.10 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —

Notes:

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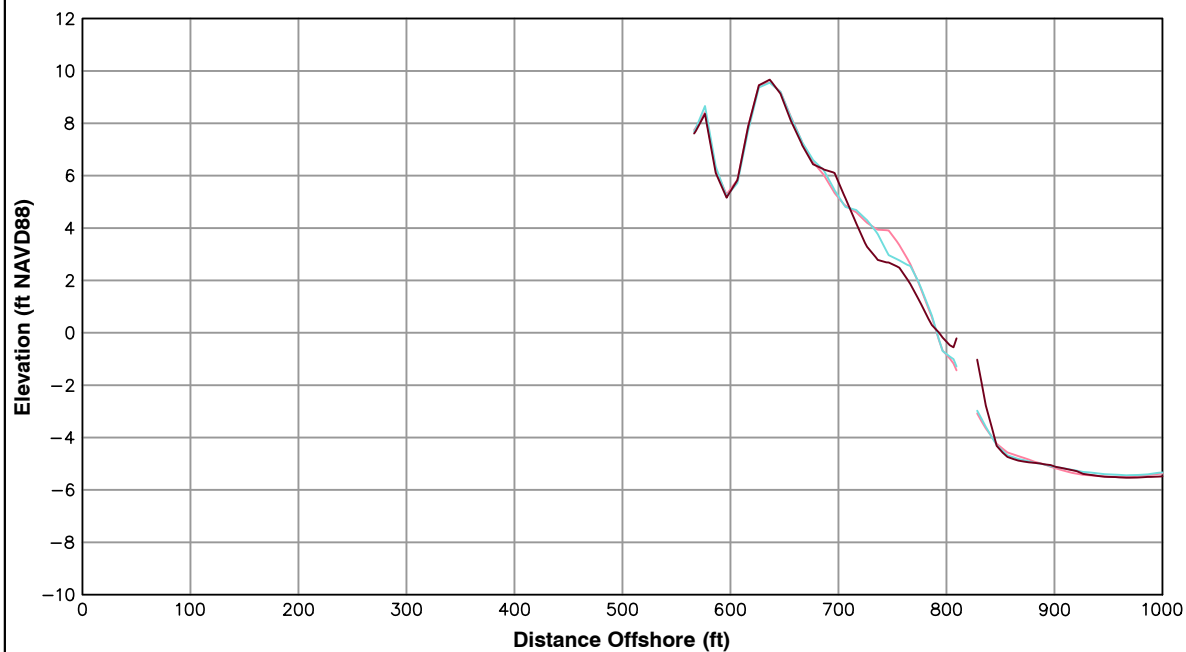
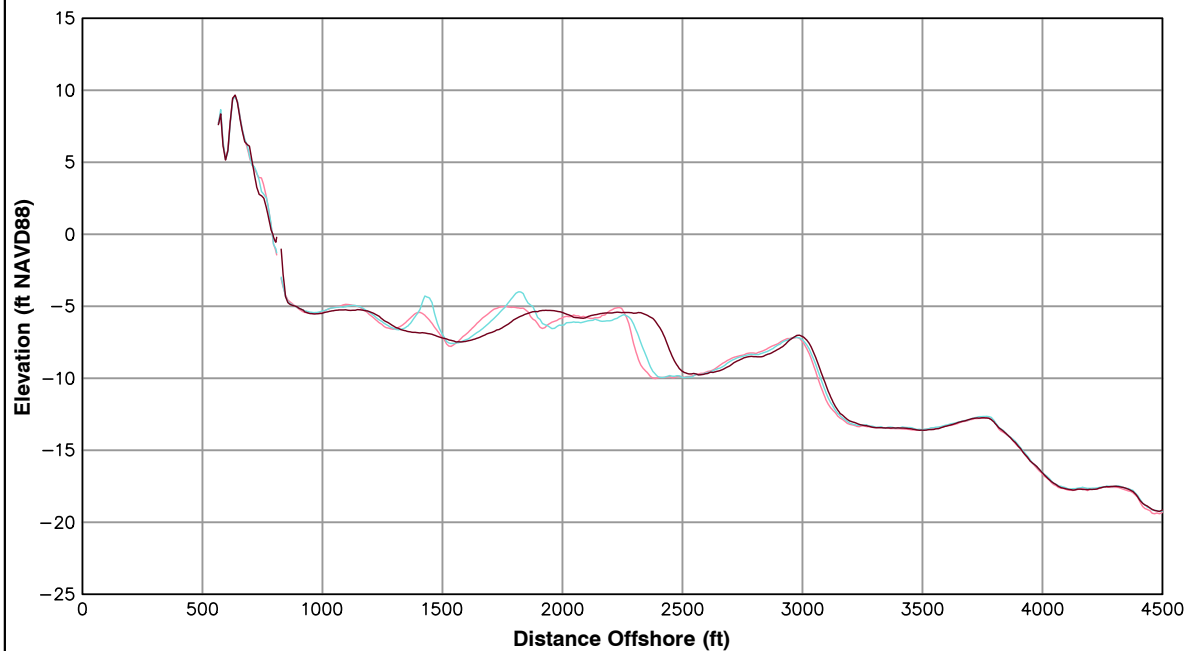


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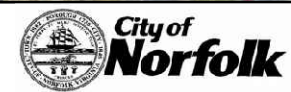
| Survey Transect 5+00 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -4.87 ft/yr | -5.51 ft |
| Volume Change Above -15 ft NAVD88 | 11.20 cy/ft/yr | 5.55 cy/ft |
| Volume Change Above 0 ft NAVD88 | -2.04 cy/ft/yr | -1.57 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —

Notes:

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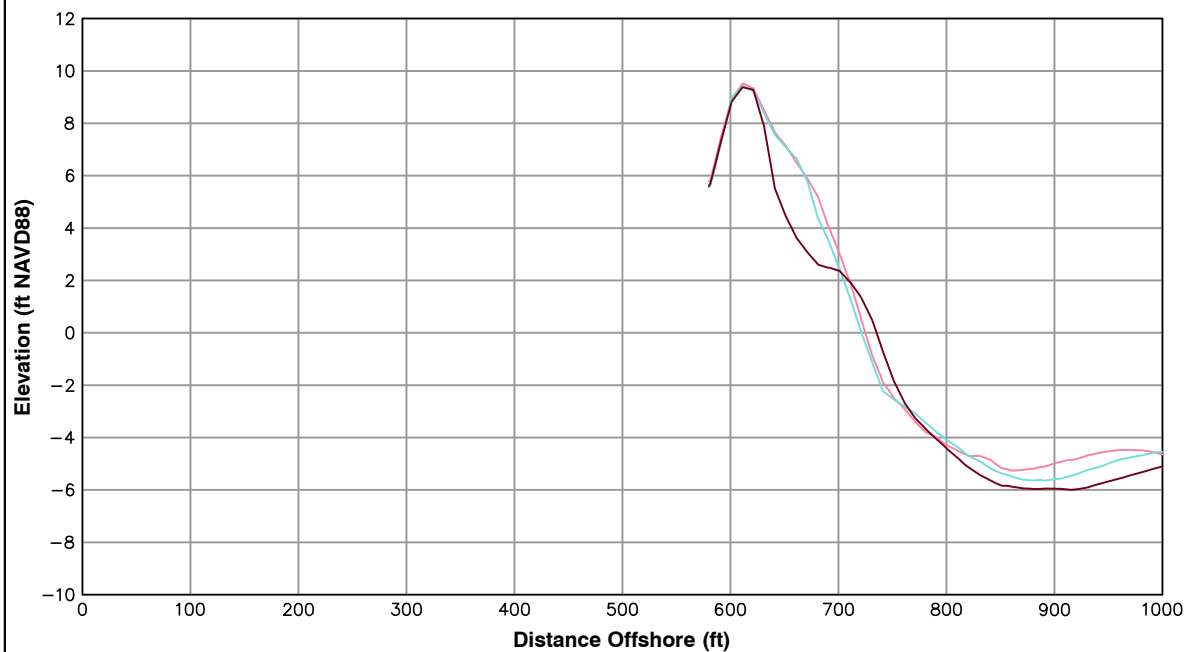
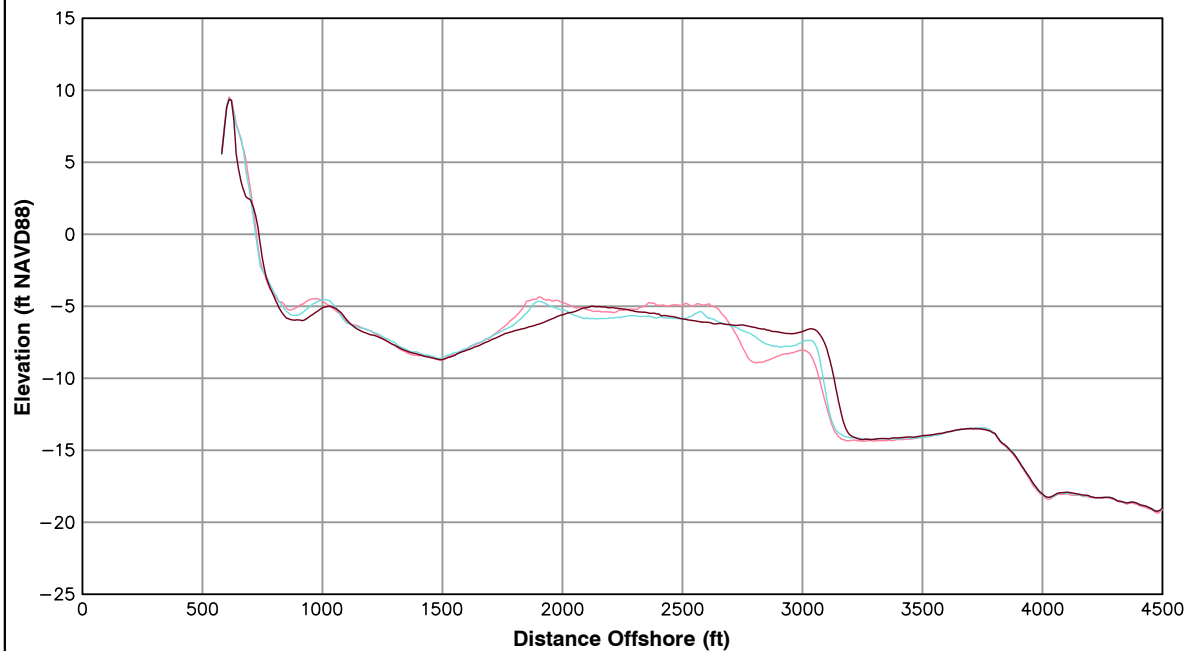


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| Survey Transect 7+50 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 7.58 ft/yr | 11.90 ft |
| Volume Change Above -15 ft NAVD88 | 1.63 cy/ft/yr | 7.30 cy/ft |
| Volume Change Above 0 ft NAVD88 | -5.52 cy/ft/yr | -4.26 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —

Notes:

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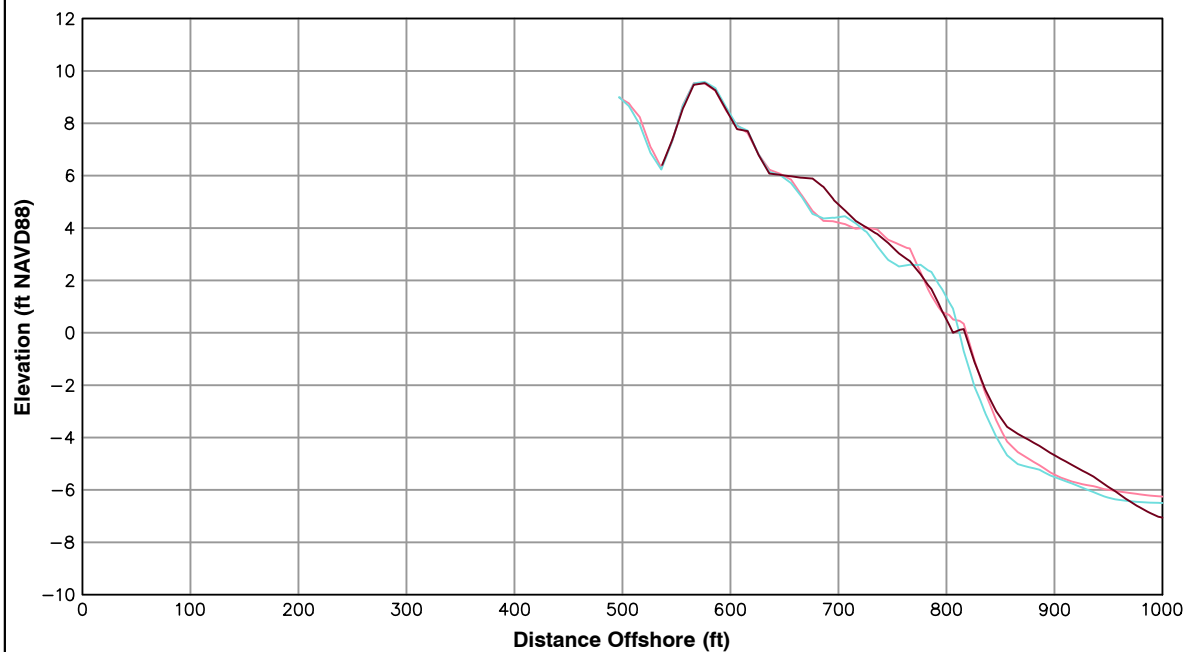
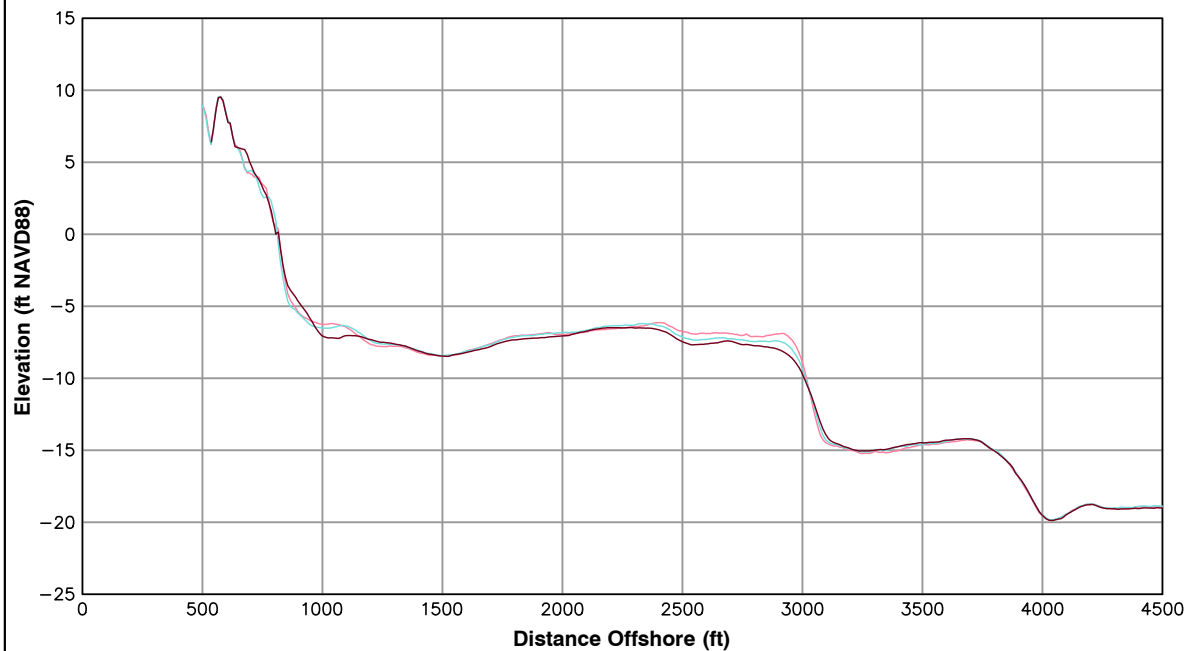
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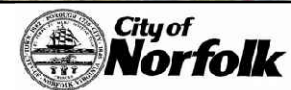
| Survey Transect 10+00 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 1.67 ft/yr | -10.88 ft |
| Volume Change Above -15 ft NAVD88 | -15.36 cy/ft/yr | -10.43 cy/ft |
| Volume Change Above 0 ft NAVD88 | 1.27 cy/ft/yr | 1.35 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —

Notes:

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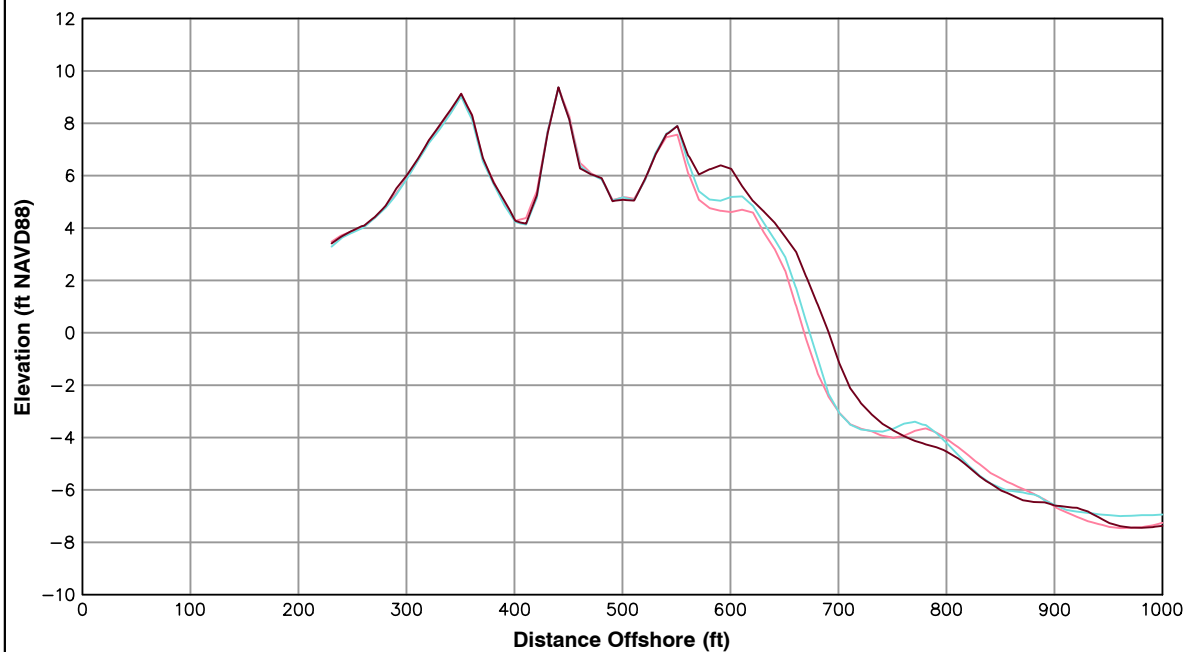
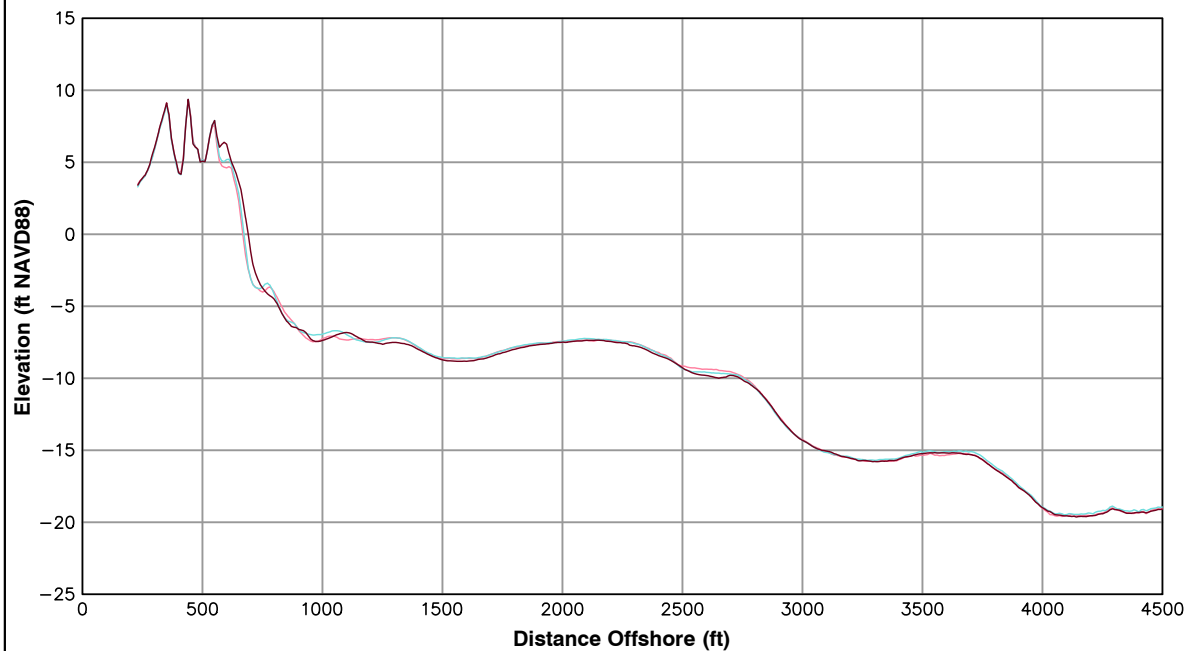


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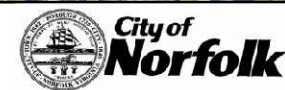
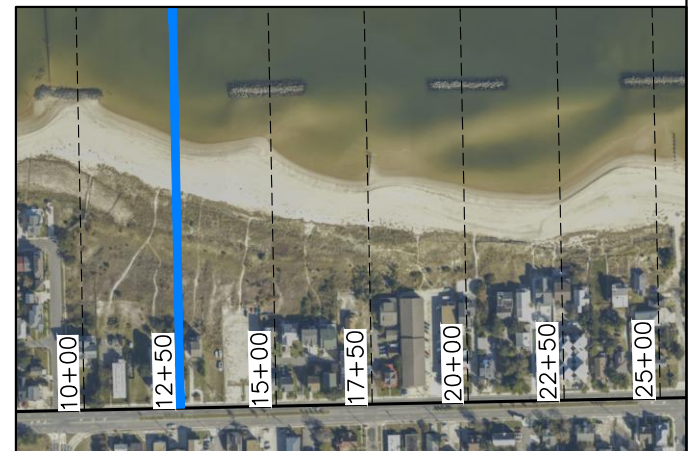
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|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 20.34 ft/yr | 15.58 ft |
| Volume Change Above -15 ft NAVD88 | -1.22 cy/ft/yr | -2.90 cy/ft |
| Volume Change Above 0 ft NAVD88 | 6.04 cy/ft/yr | 4.81 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —

Notes:

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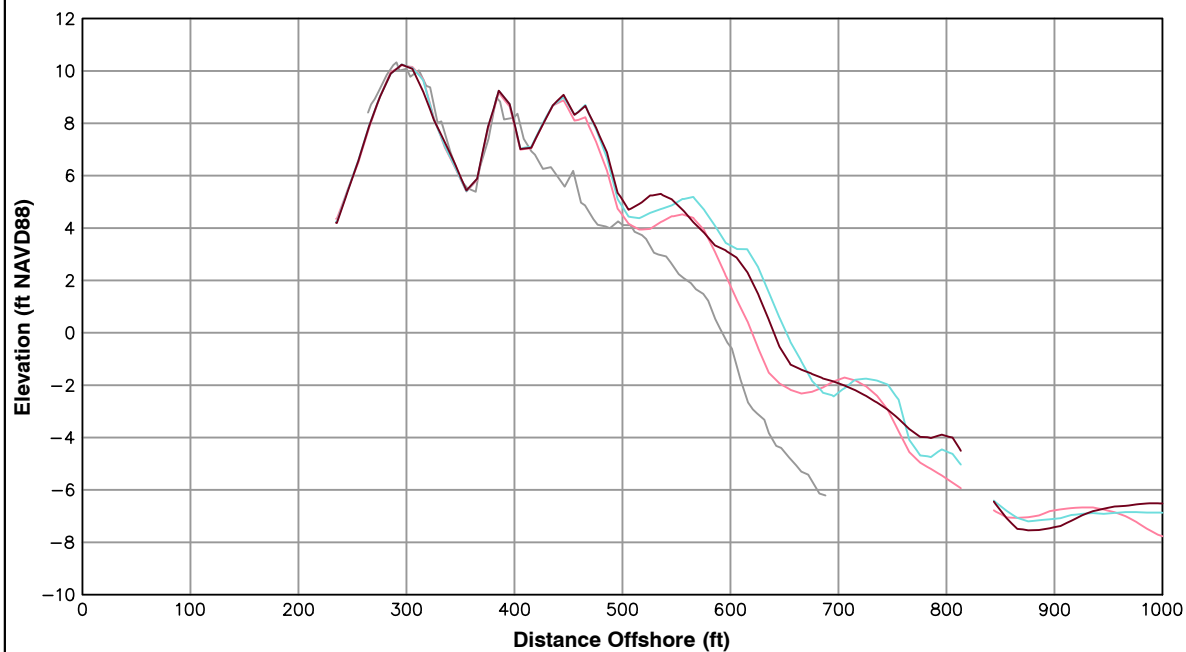
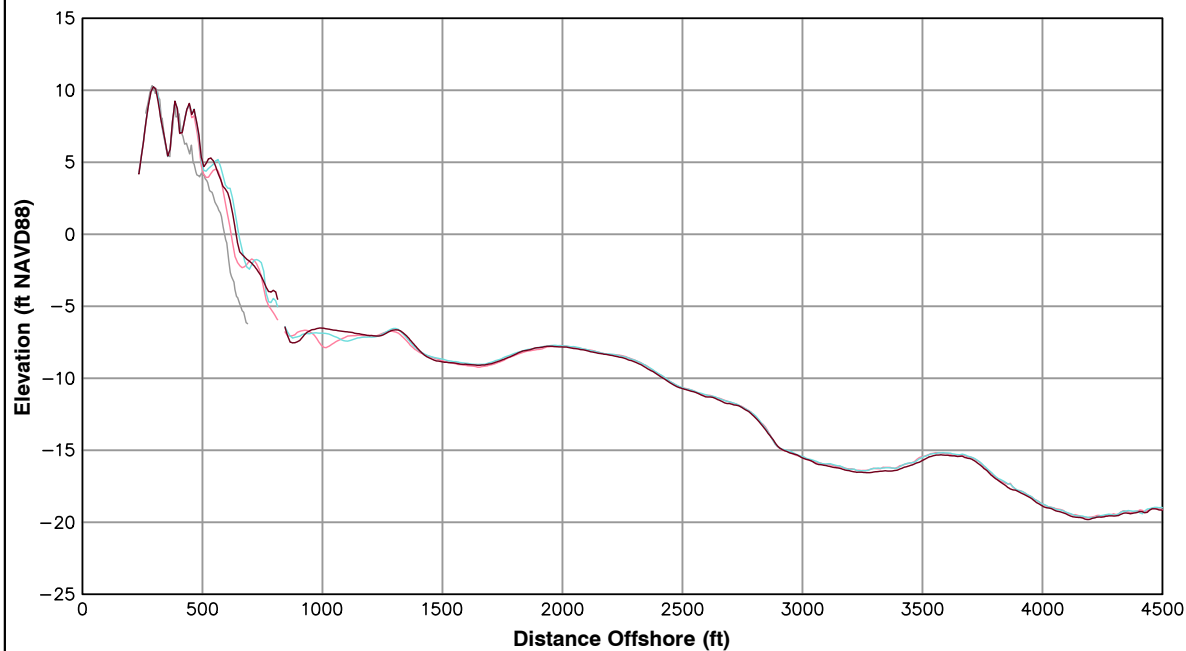


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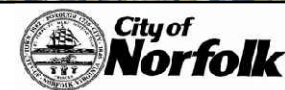
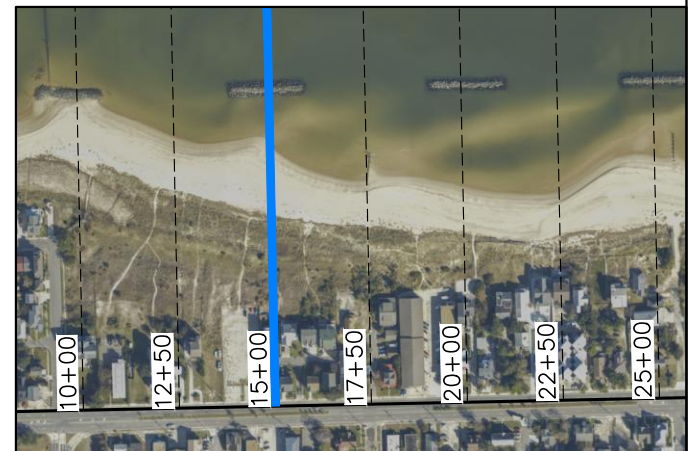
| Survey Transect 15+00 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 21.28 ft/yr | -10.66 ft |
| Volume Change Above -15 ft NAVD88 | 12.08 cy/ft/yr | -3.99 cy/ft |
| Volume Change Above 0 ft NAVD88 | 5.07 cy/ft/yr | -1.74 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
POST-FILL —

Notes:

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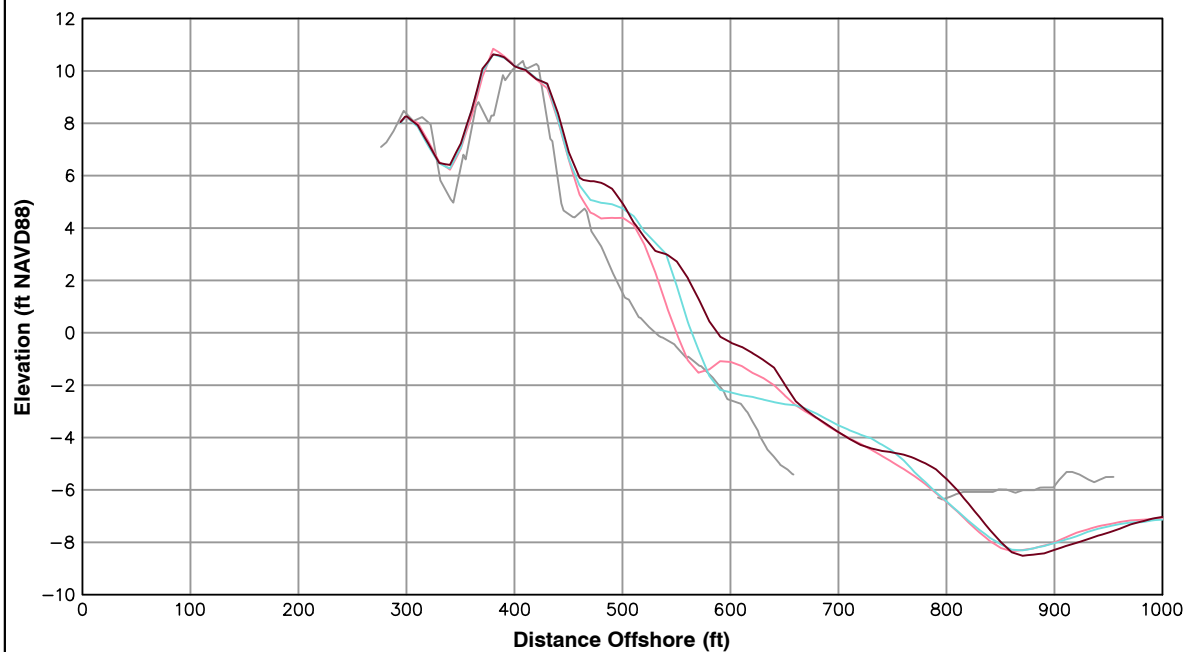
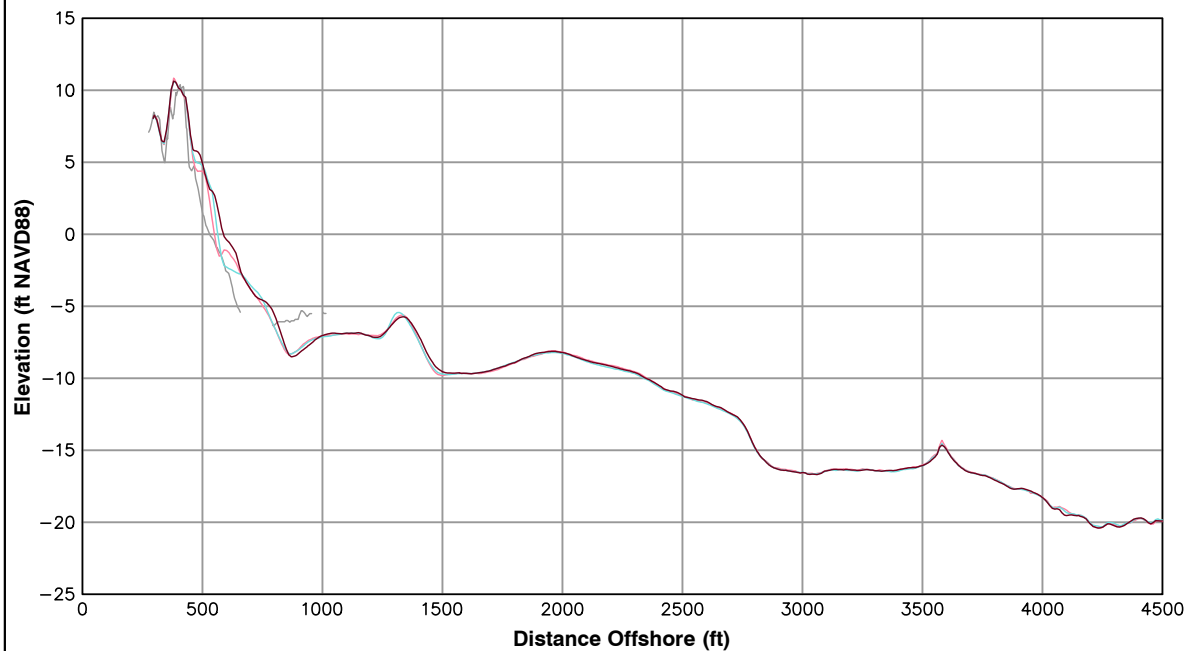


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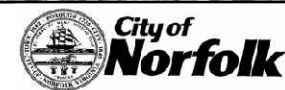
| Survey Transect 17+50 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 32.61 ft/yr | 17.79 ft |
| Volume Change Above -15 ft NAVD88 | 12.68 cy/ft/yr | 12.88 cy/ft |
| Volume Change Above 0 ft NAVD88 | 5.80 cy/ft/yr | 2.70 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
POST-FILL —

Notes:

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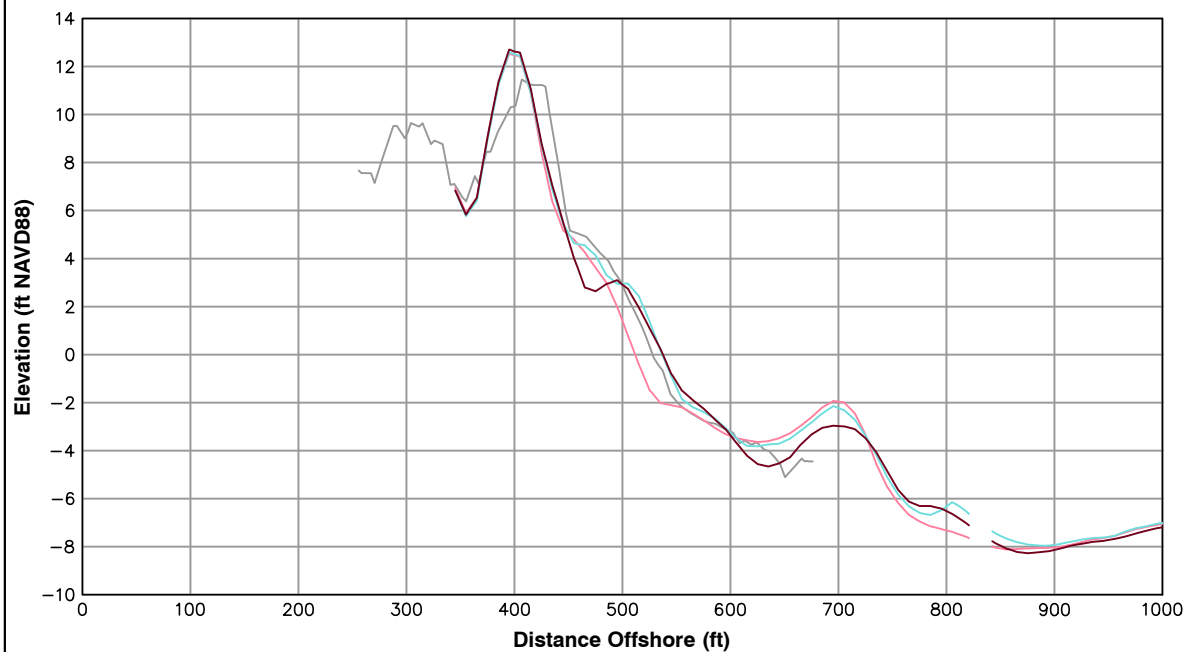
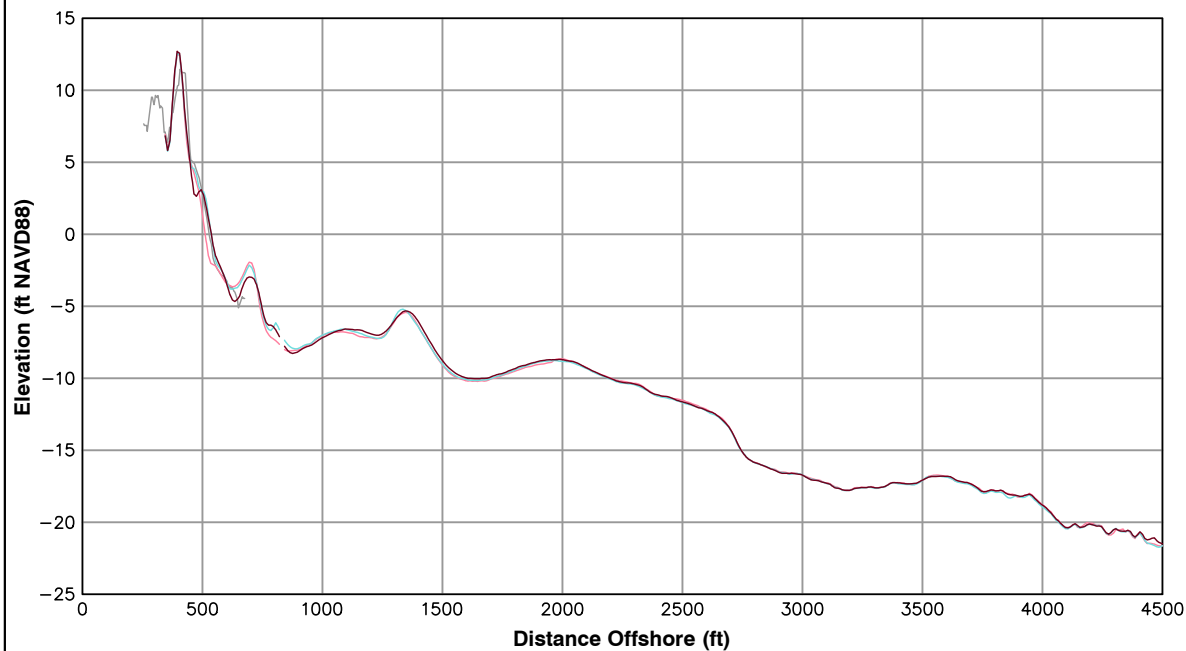


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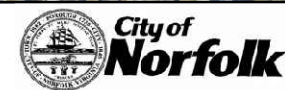
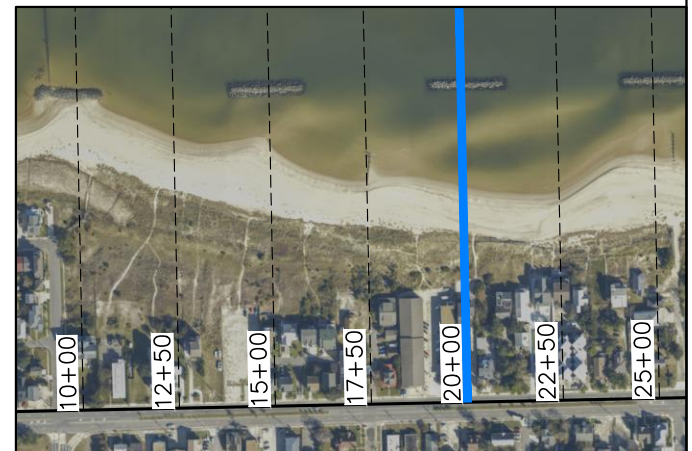
| Survey Transect 20+00 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 22.83 ft/yr | -2.00 ft |
| Volume Change Above -15 ft NAVD88 | 8.77 cy/ft/yr | 0.82 cy/ft |
| Volume Change Above 0 ft NAVD88 | 1.84 cy/ft/yr | -1.43 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
POST-FILL —

Notes:

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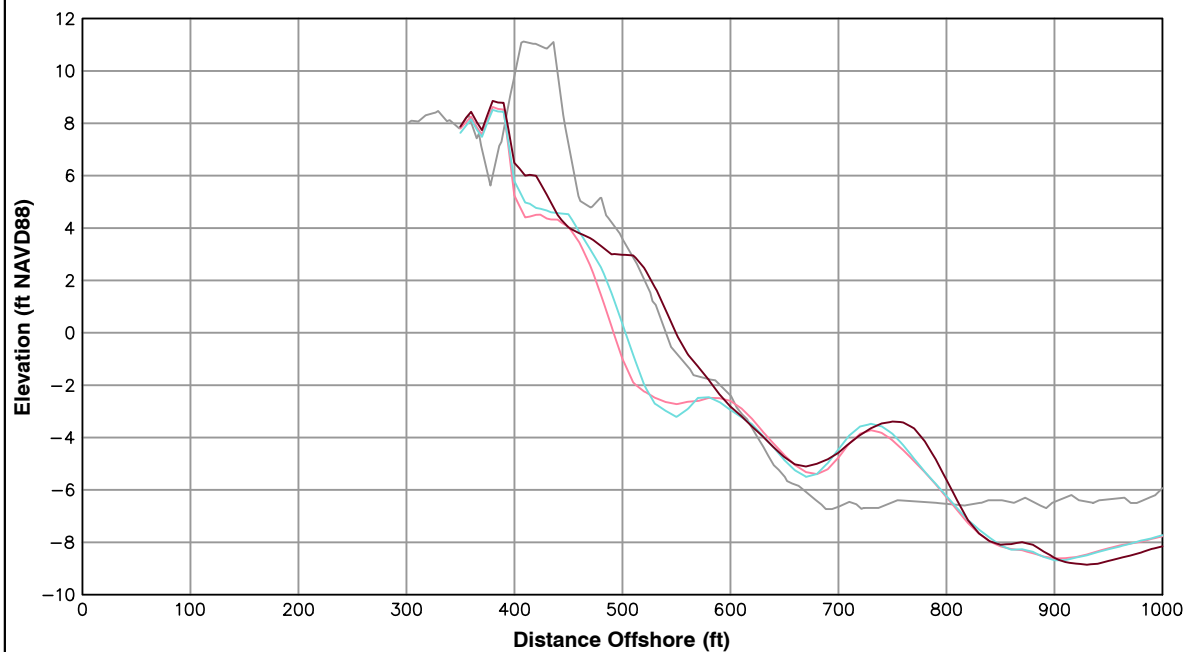
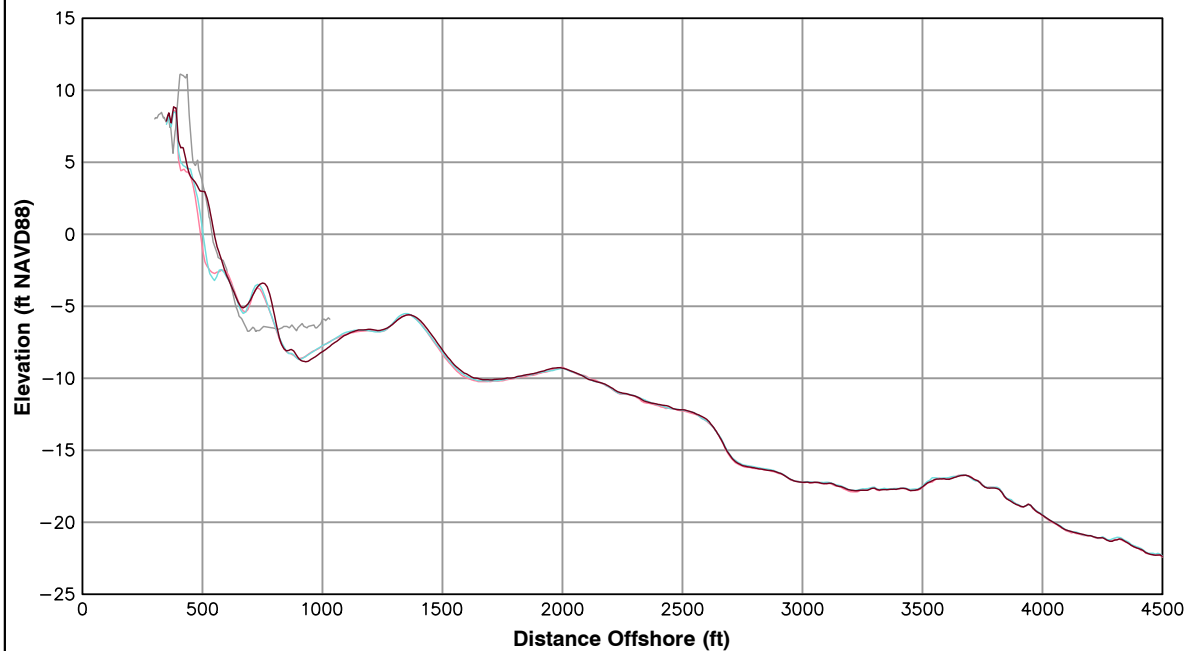


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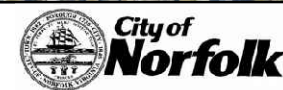
| Survey Transect 22+50 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 54.33 ft/yr | 44.21 ft |
| Volume Change Above -15 ft NAVD88 | 20.88 cy/ft/yr | 15.53 cy/ft |
| Volume Change Above 0 ft NAVD88 | 8.60 cy/ft/yr | 6.60 cy/ft |

LEGEND:

2015 OCT —
 2015 APR —
 2014 OCT —
 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 October 2014 and April 2015.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

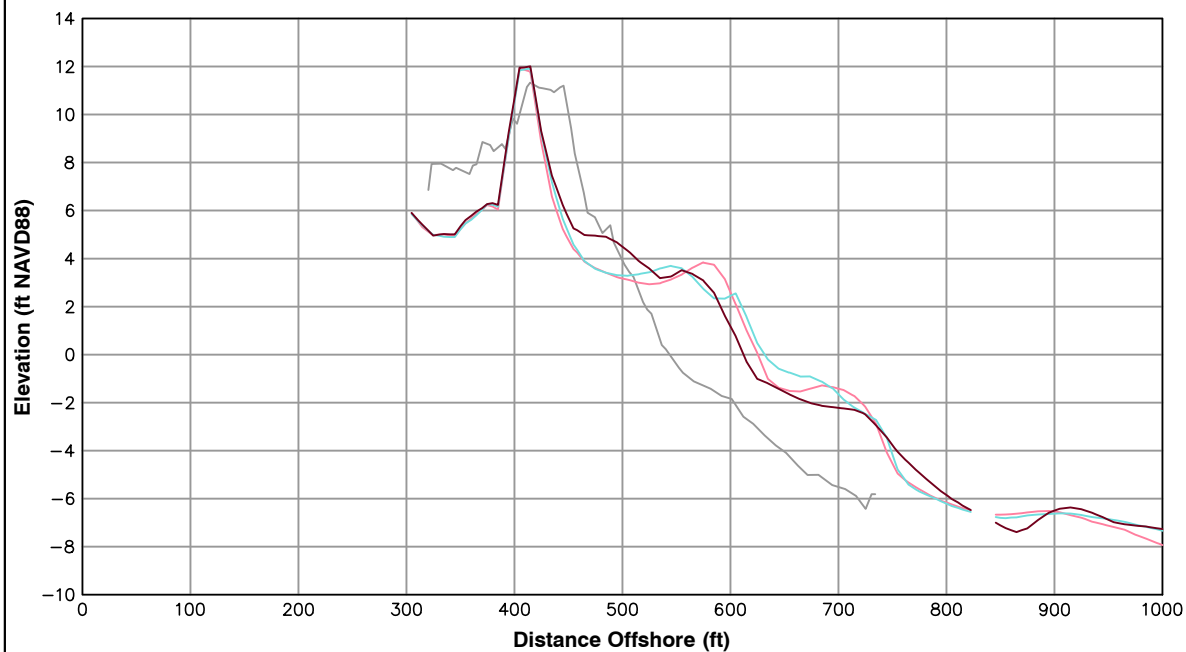
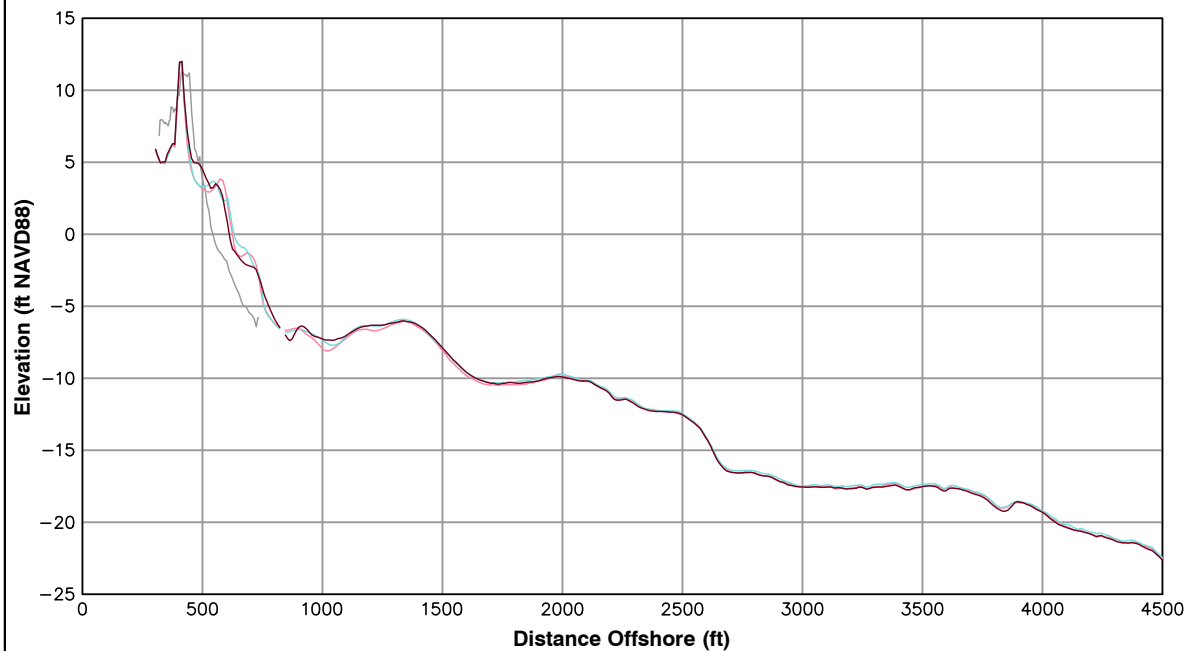


**OCEAN VIEW PERIODIC
SURVEYING DATA &
ANALYSIS**

ST 22+50

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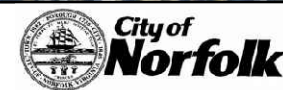
| Survey Transect 25+00 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -12.75 ft/yr | -17.92 ft |
| Volume Change Above -15 ft NAVD88 | 7.78 cy/ft/yr | -3.08 cy/ft |
| Volume Change Above 0 ft NAVD88 | 2.49 cy/ft/yr | 1.82 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
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.

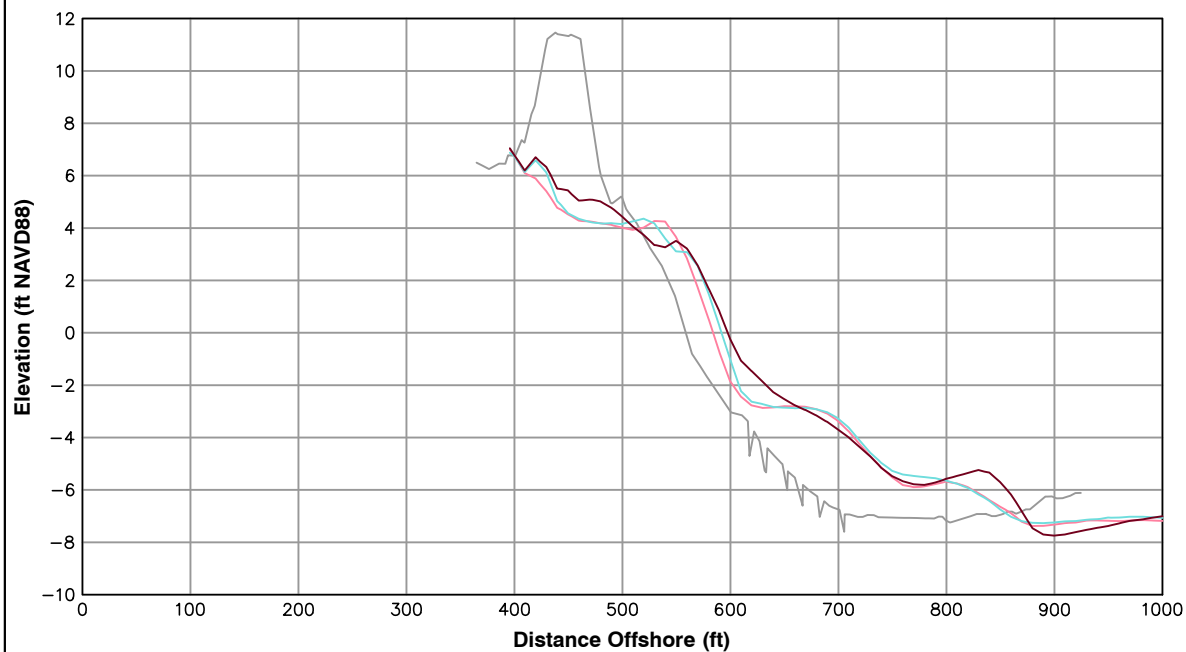
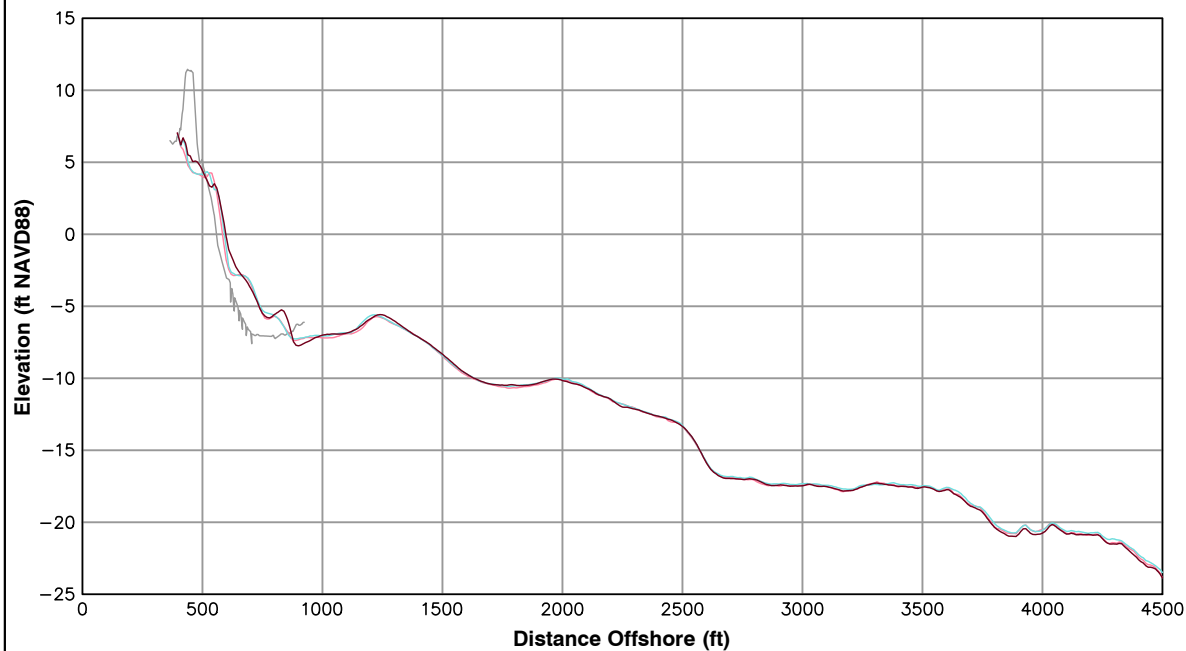


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SURVEYING DATA &
ANALYSIS**

ST 25+00

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Fall 2015



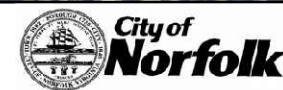
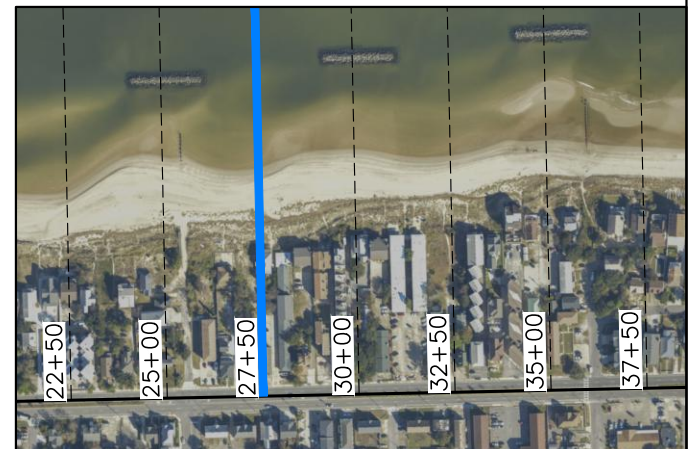
| Survey Transect 27+50 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 11.81 ft/yr | 3.97 ft |
| Volume Change Above -15 ft NAVD88 | 10.04 cy/ft/yr | 2.41 cy/ft |
| Volume Change Above 0 ft NAVD88 | 2.97 cy/ft/yr | 1.64 cy/ft |

LEGEND:

2015 OCT —
 2015 APR —
 2014 OCT —
 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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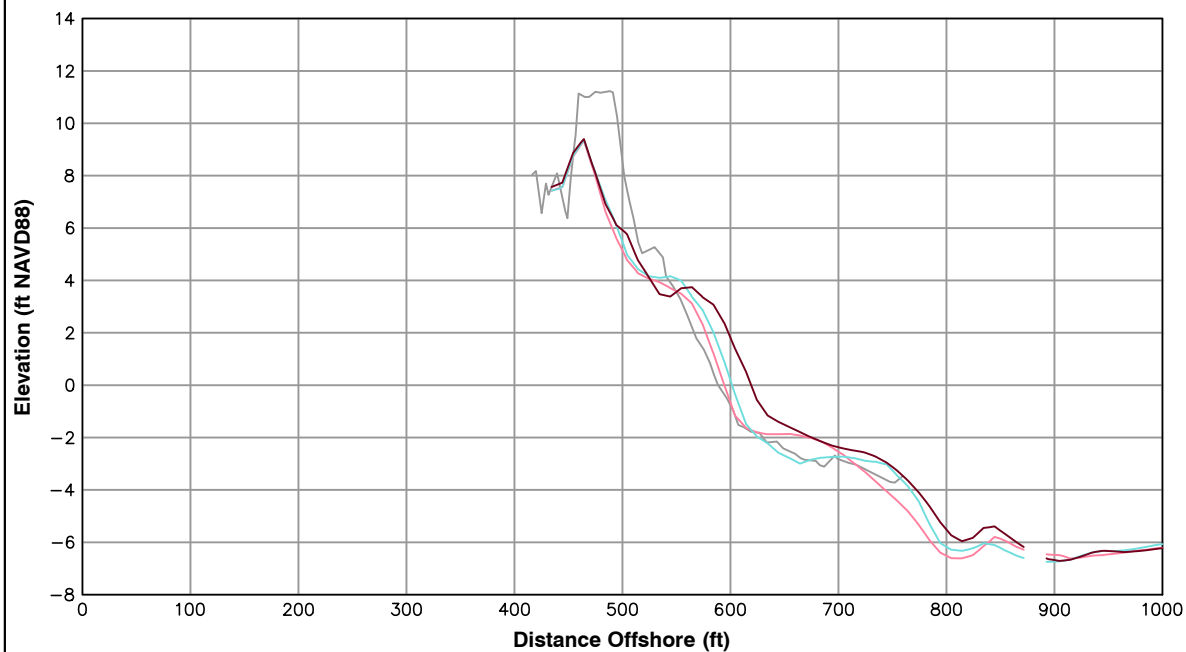
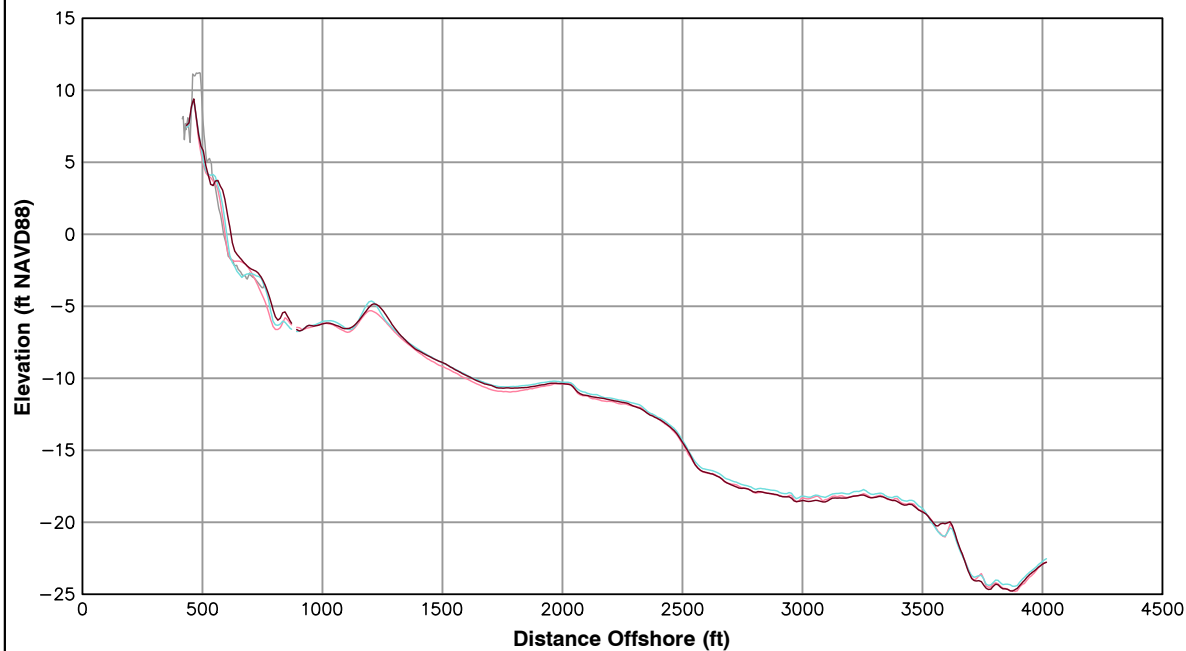


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ANALYSIS**

ST 27+50

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Fall 2015



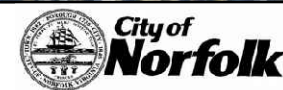
| Survey Transect 30+00 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 22.59 ft/yr | 15.44 ft |
| Volume Change Above -15 ft NAVD88 | 19.32 cy/ft/yr | 3.09 cy/ft |
| Volume Change Above 0 ft NAVD88 | 3.67 cy/ft/yr | 1.82 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
POST-FILL —

Notes:

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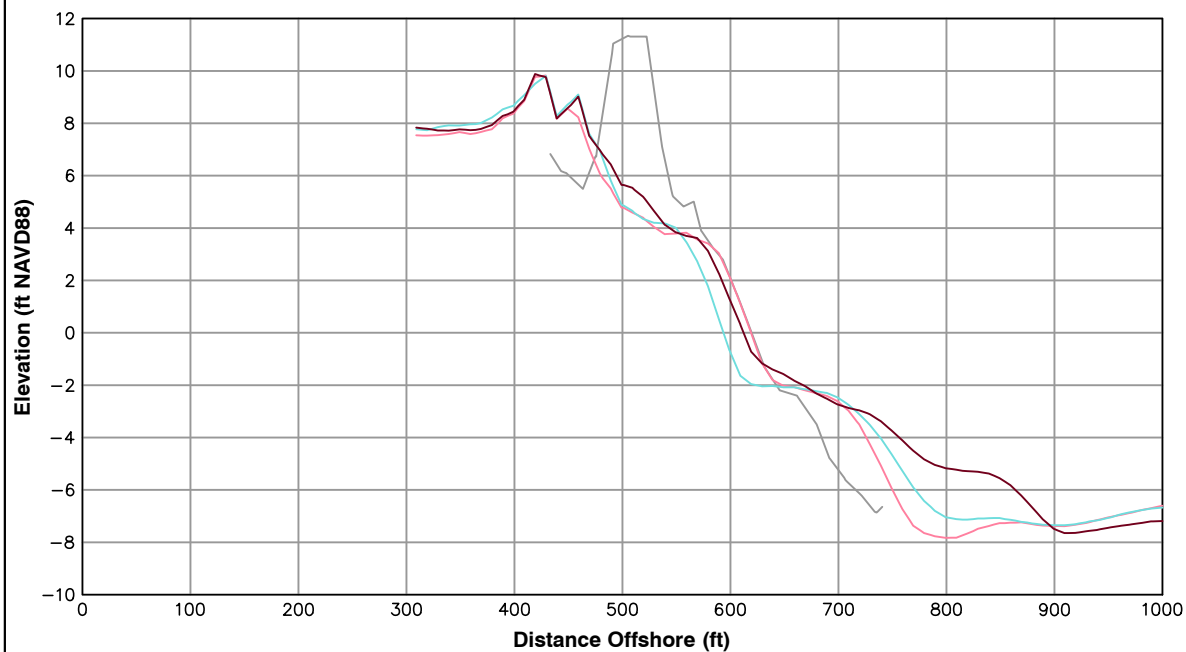
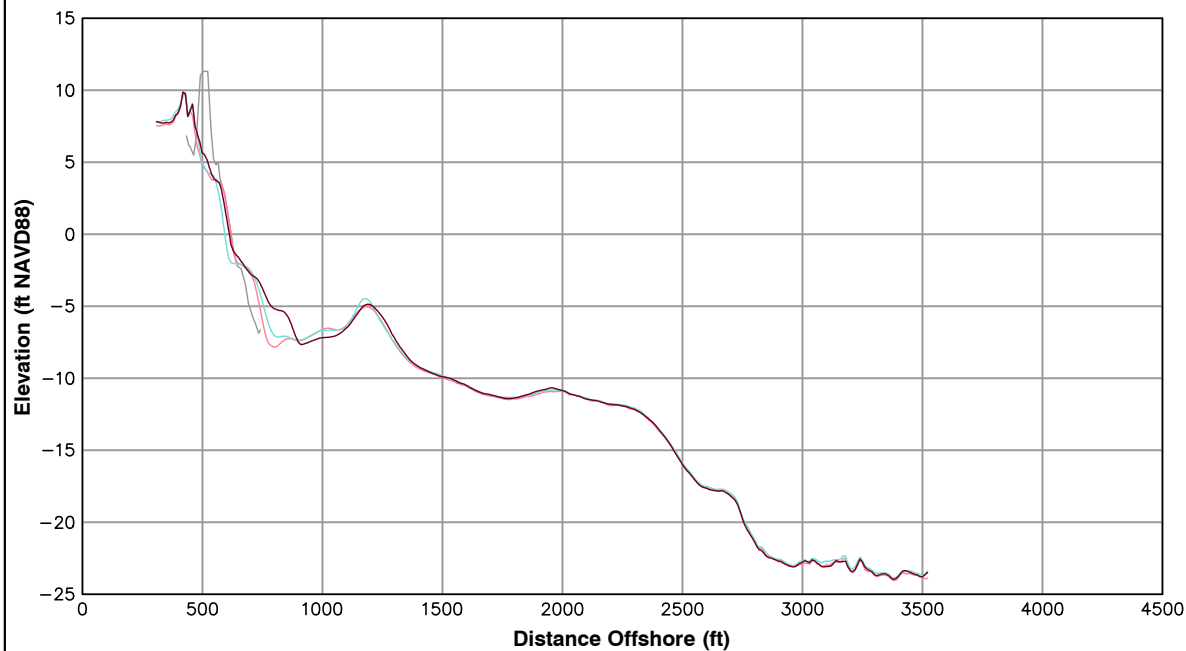


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SURVEYING DATA &
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ST 30+00

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Fall 2015



| Survey Transect 32+50 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -7.97 ft/yr | 16.76 ft |
| Volume Change Above -15 ft NAVD88 | 16.32 cy/ft/yr | 9.53 cy/ft |
| Volume Change Above 0 ft NAVD88 | 1.98 cy/ft/yr | 2.73 cy/ft |

LEGEND:

2015 OCT —
 2015 APR —
 2014 OCT —
 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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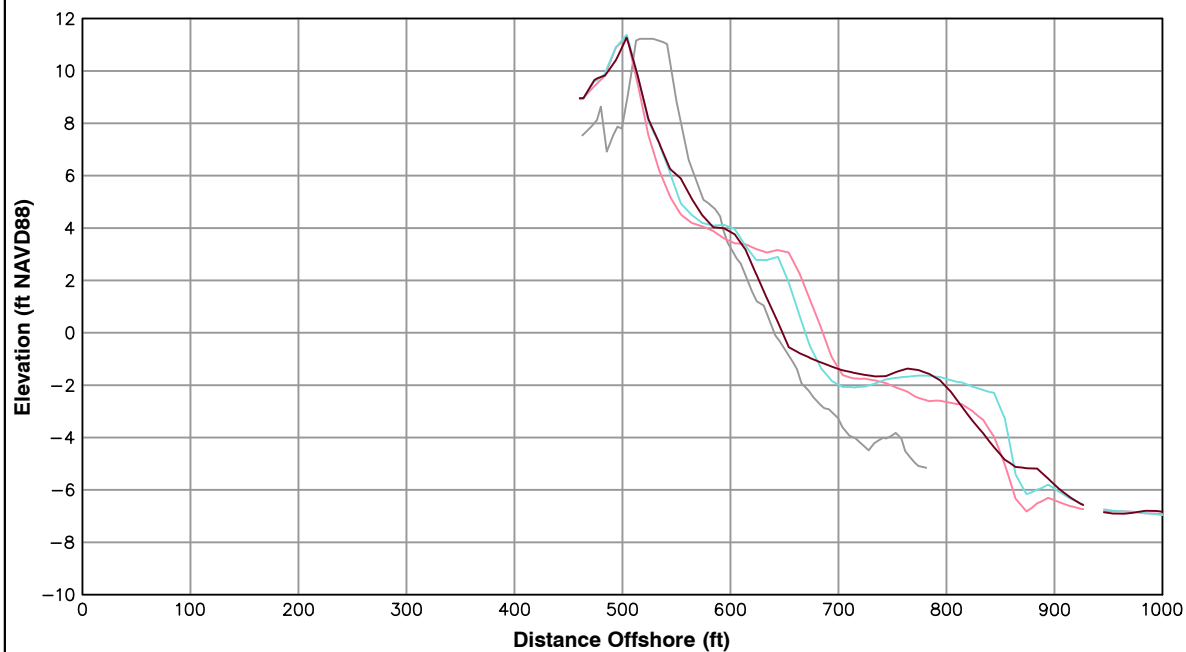
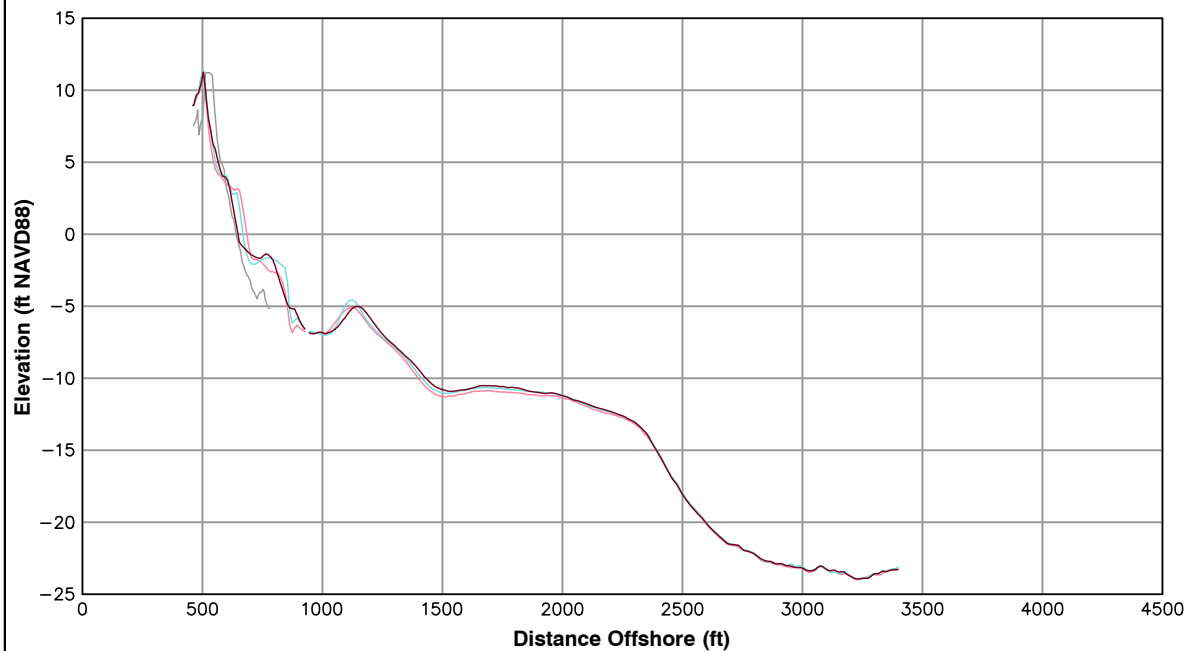
**City of
Norfolk**

**OCEAN VIEW PERIODIC
SURVEYING DATA &
ANALYSIS**

ST 32+50

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Fall 2015



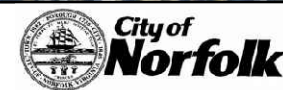
| Survey Transect 35+00 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -38.53 ft/yr | -23.91 ft |
| Volume Change Above -15 ft NAVD88 | 12.32 cy/ft/yr | -0.37 cy/ft |
| Volume Change Above 0 ft NAVD88 | -2.25 cy/ft/yr | -2.25 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
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 October 2014 and April 2015.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

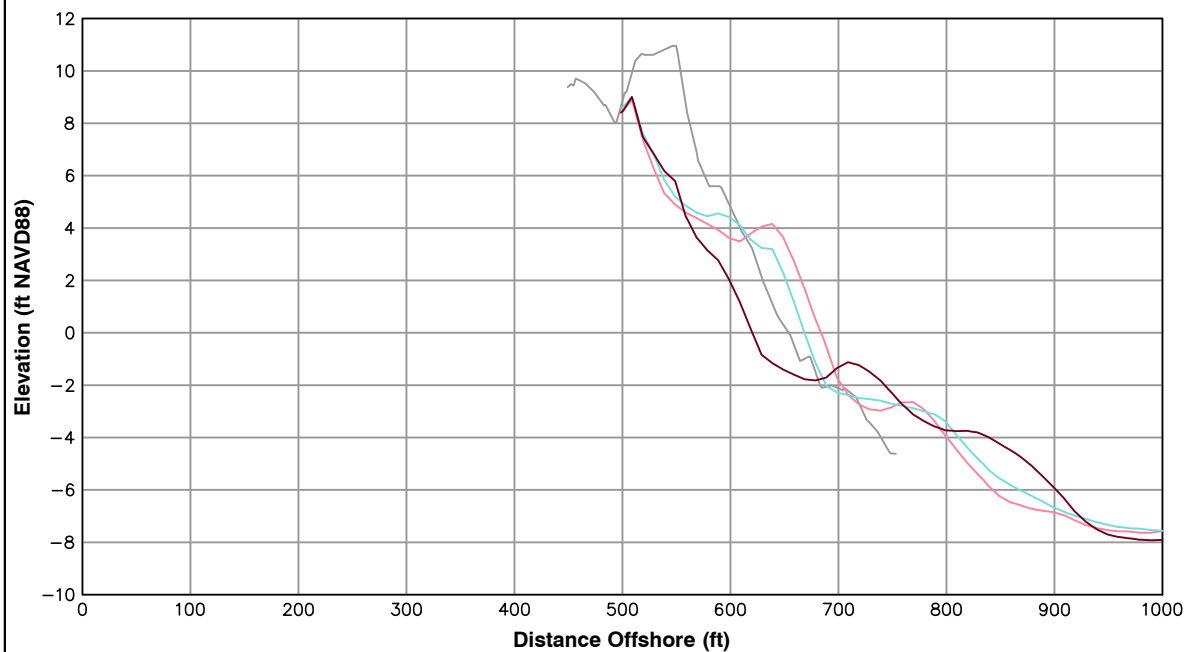
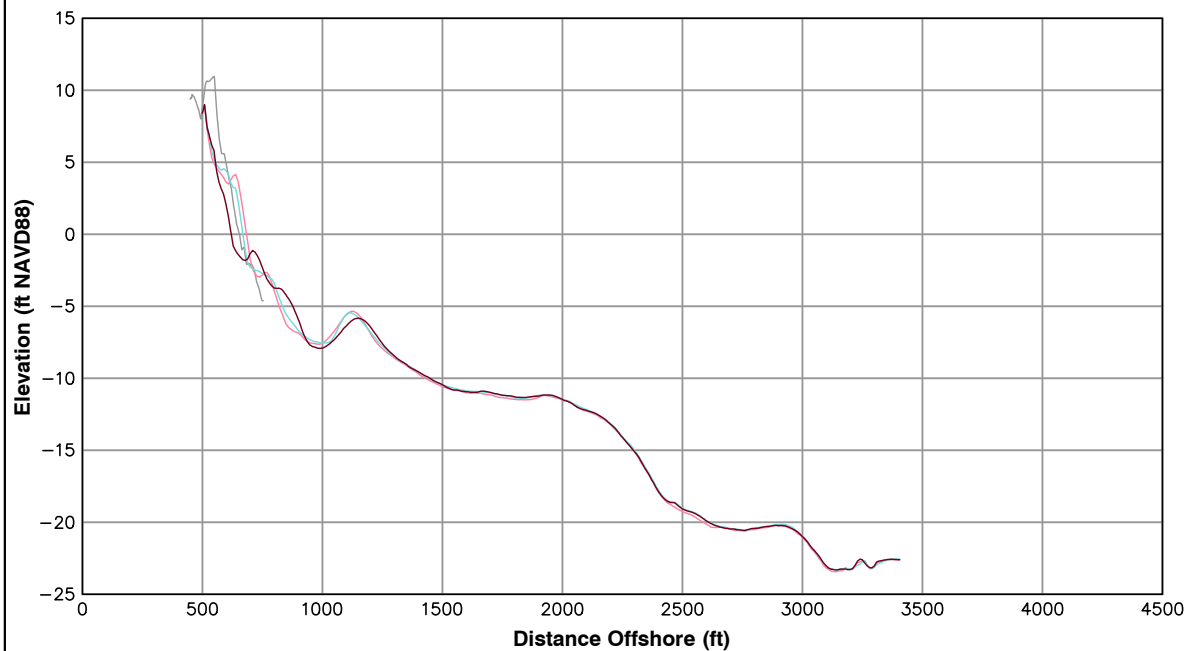


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ANALYSIS**

ST 35+00

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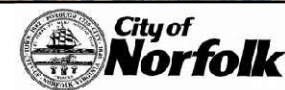
| Survey Transect 37+50 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -63.55 ft/yr | -49.81 ft |
| Volume Change Above -15 ft NAVD88 | -3.71 cy/ft/yr | -7.91 cy/ft |
| Volume Change Above 0 ft NAVD88 | -9.13 cy/ft/yr | -8.30 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
POST-FILL —

Notes:

1. Stationing From West To East At Varying Intervals.
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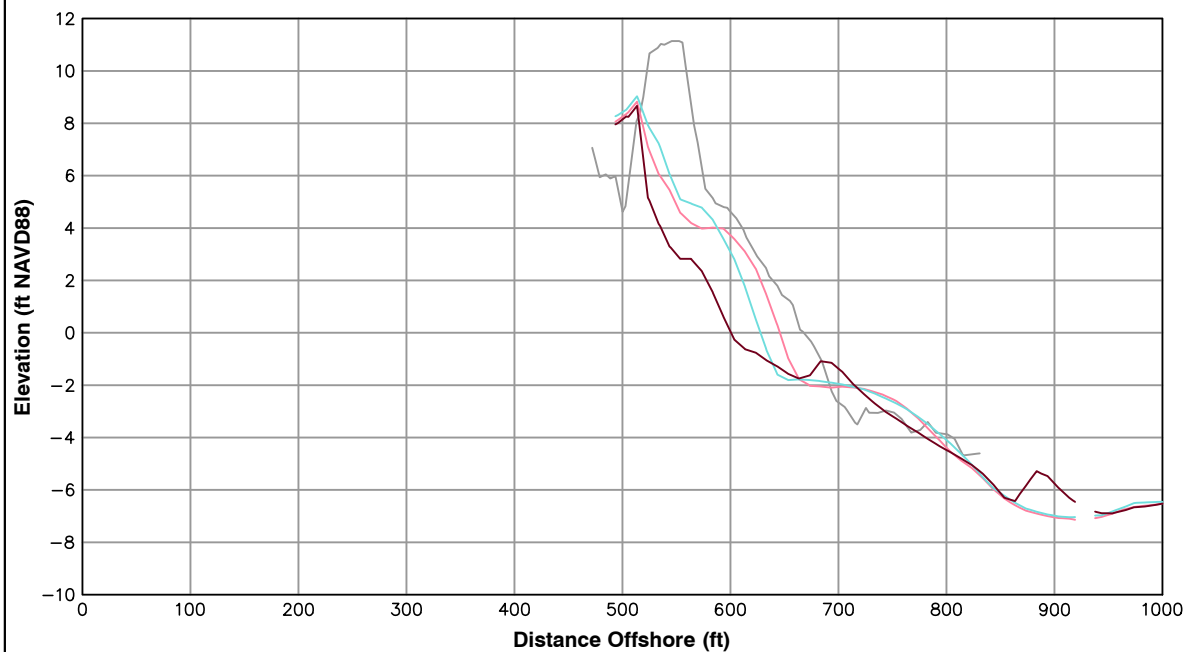
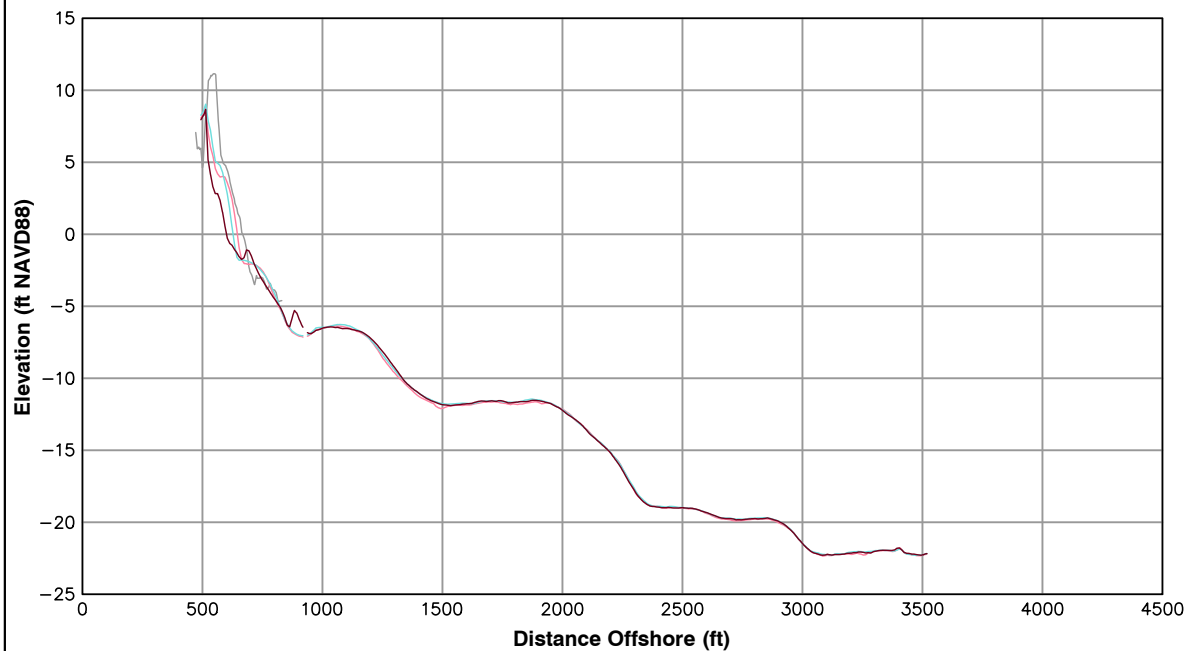


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SURVEYING DATA &
ANALYSIS**

ST 37+50

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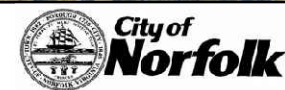
| Survey Transect 40+00 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -47.40 ft/yr | -30.07 ft |
| Volume Change Above -15 ft NAVD88 | -5.62 cy/ft/yr | -10.08 cy/ft |
| Volume Change Above 0 ft NAVD88 | -10.18 cy/ft/yr | -9.99 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
POST-FILL —

Notes:

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3. All Survey Elevations In Feet Referenced to NAVD88.
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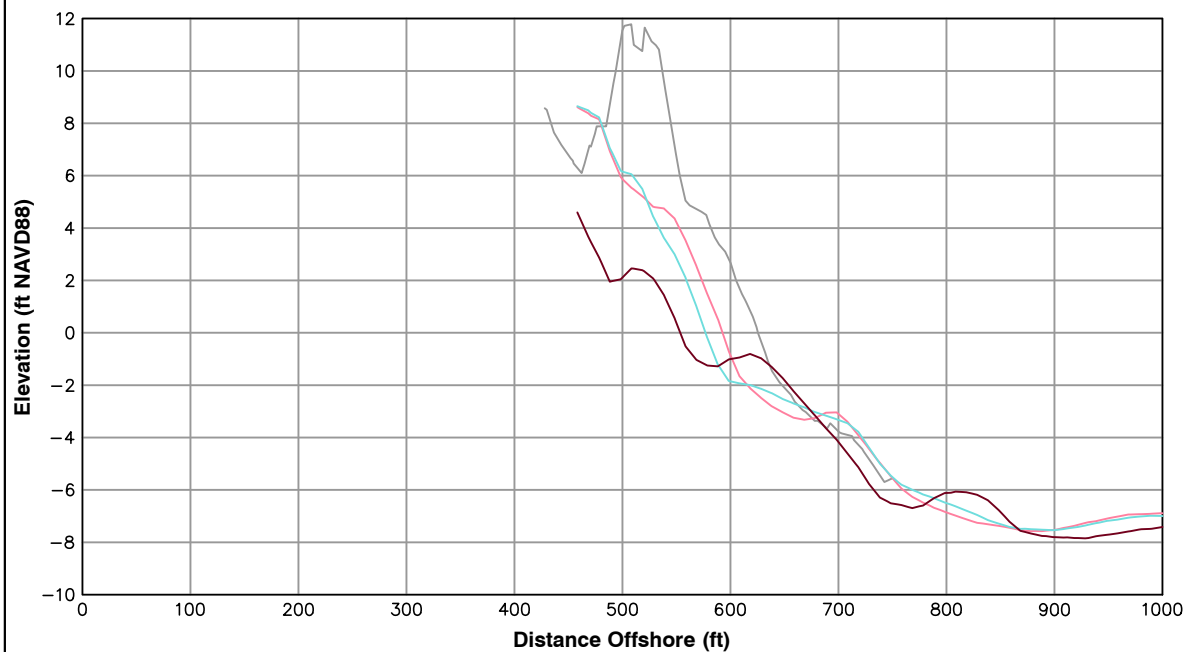
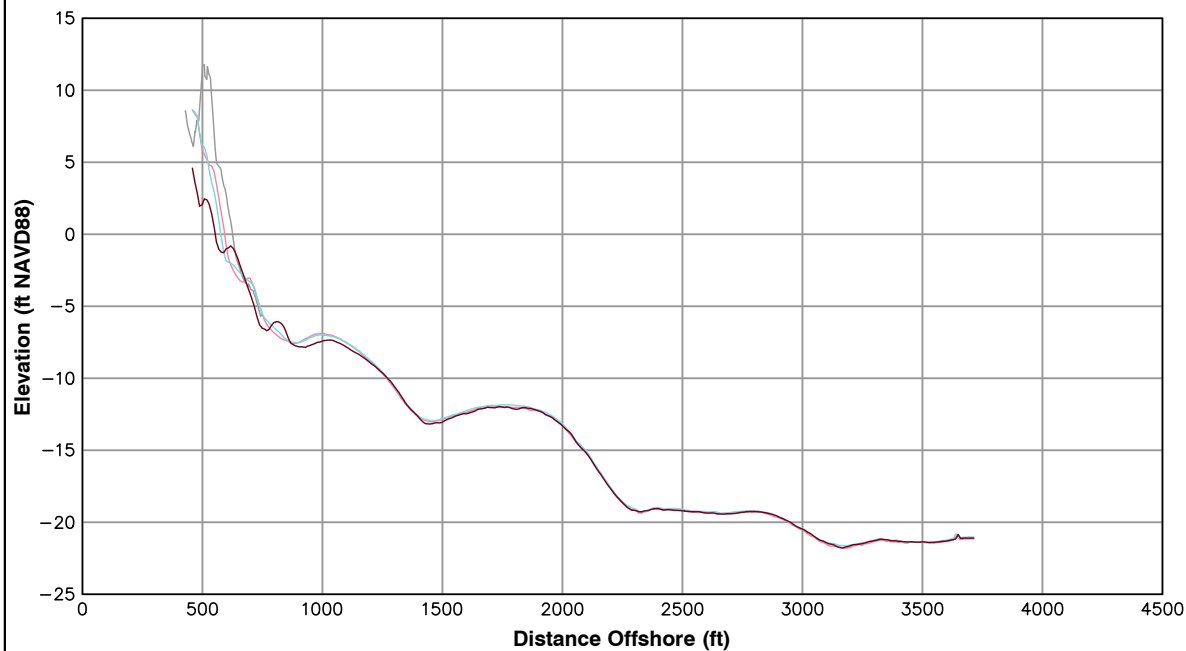


**OCEAN VIEW PERIODIC
SURVEYING DATA &
ANALYSIS**

ST 40+00

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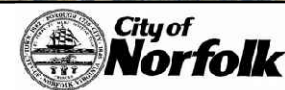
| Survey Transect 42+50 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -39.79 ft/yr | -25.18 ft |
| Volume Change Above -15 ft NAVD88 | -21.17 cy/ft/yr | -22.74 cy/ft |
| Volume Change Above 0 ft NAVD88 | 1.44 cy/ft/yr | -14.19 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
POST-FILL —

Notes:

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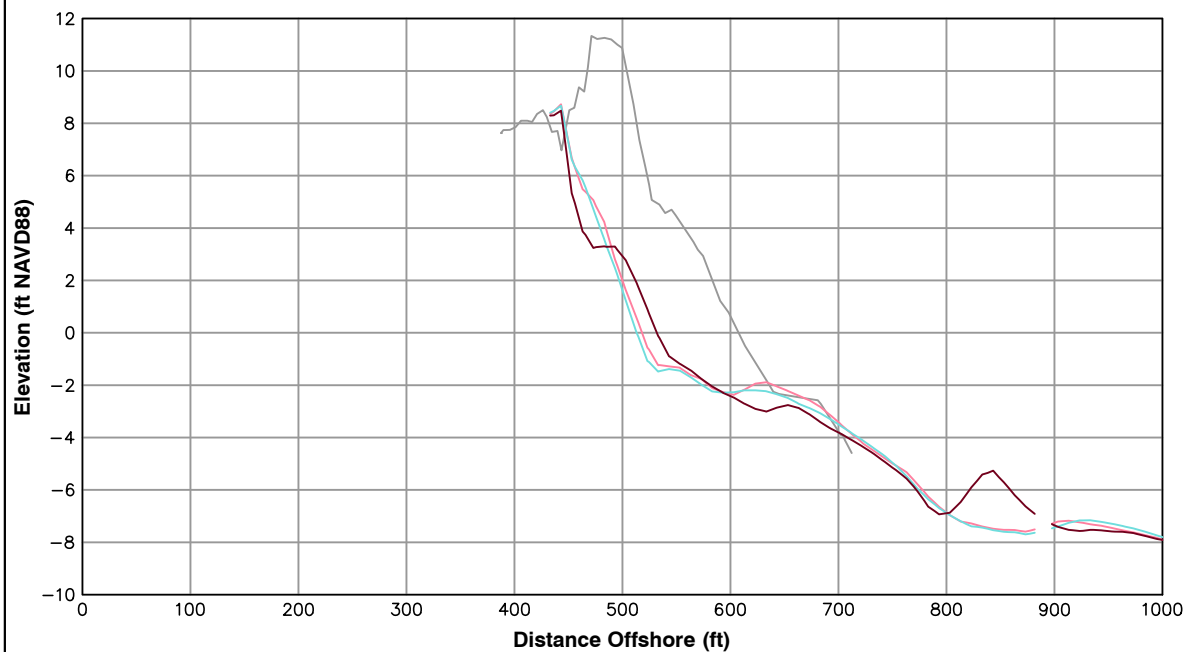
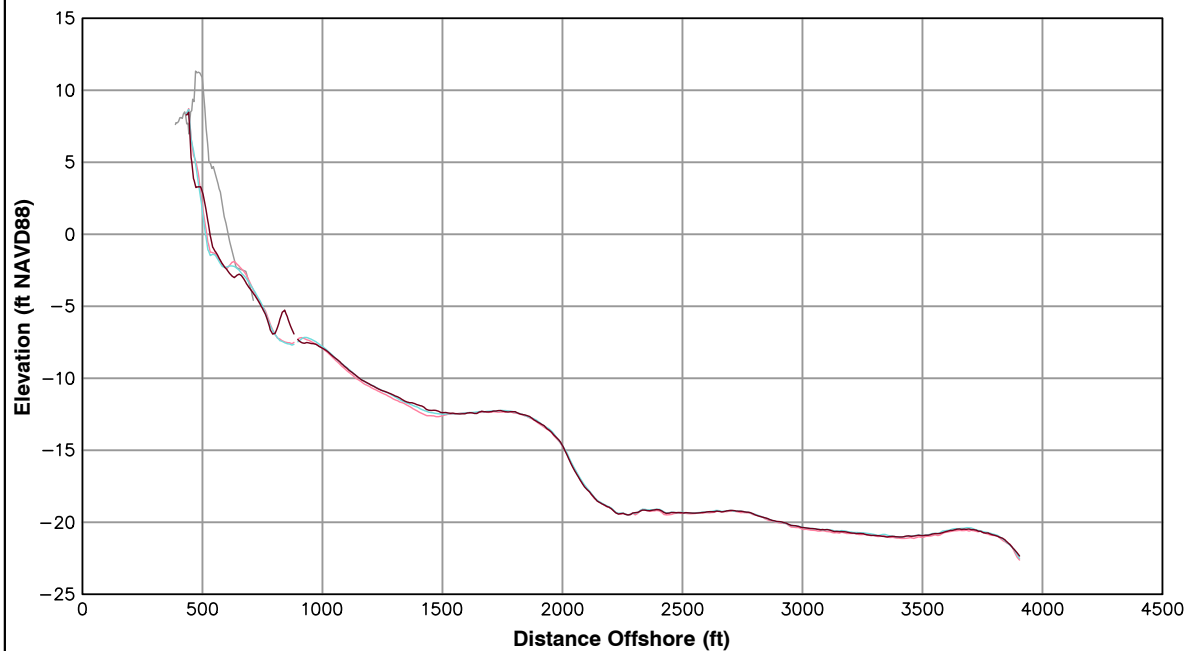


**OCEAN VIEW PERIODIC
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ANALYSIS**

ST 42+50

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| Survey Transect 45+00 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 12.97 ft/yr | 17.20 ft |
| Volume Change Above -15 ft NAVD88 | 5.50 cy/ft/yr | 3.07 cy/ft |
| Volume Change Above 0 ft NAVD88 | -0.73 cy/ft/yr | -0.04 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
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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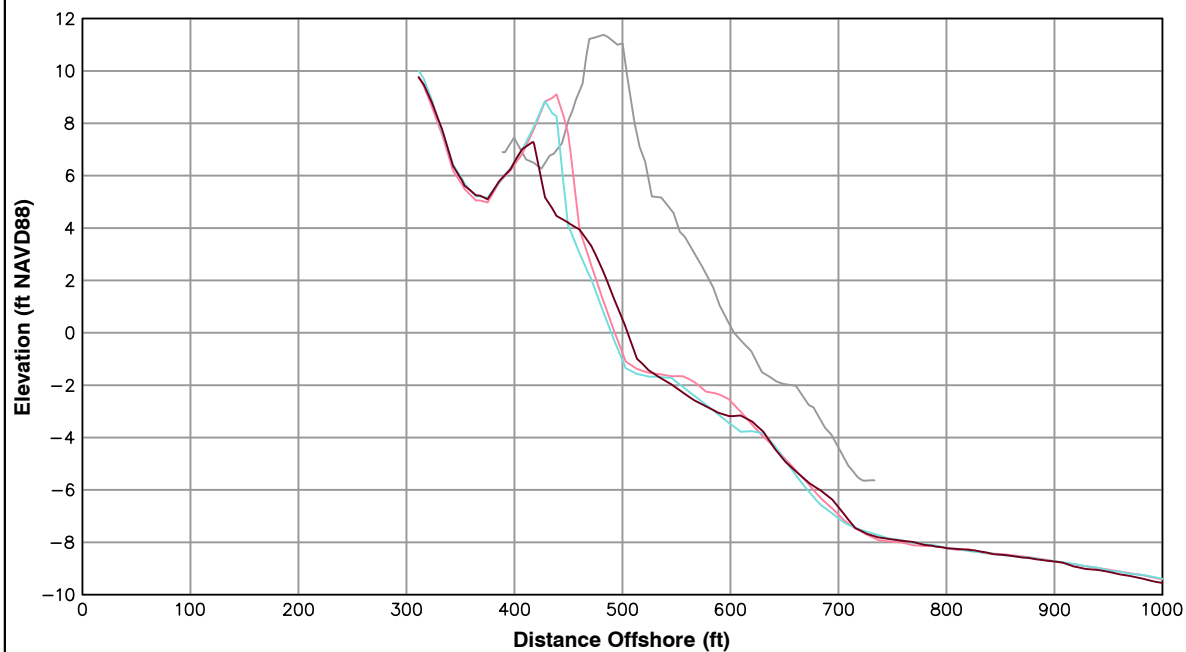
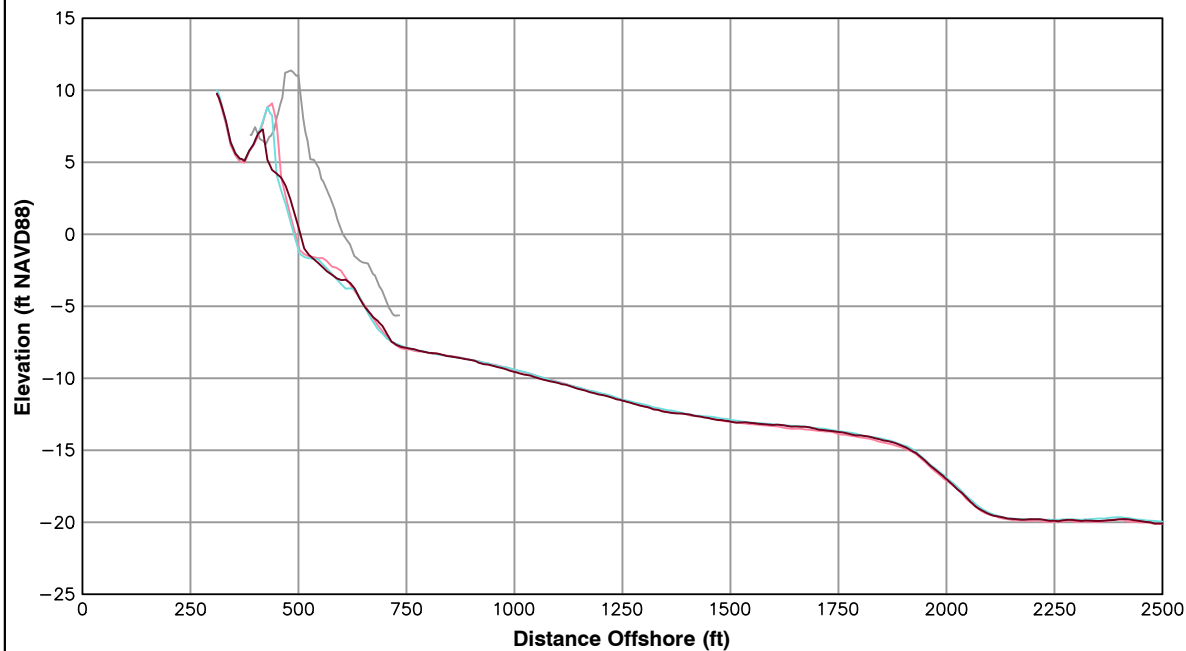
**City of
Norfolk**

**OCEAN VIEW PERIODIC
SURVEYING DATA &
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ST 45+00

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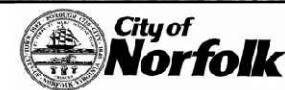
| Survey Transect 45+25 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 10.95 ft/yr | 14.71 ft |
| Volume Change Above -15 ft NAVD88 | -2.85 cy/ft/yr | -2.46 cy/ft |
| Volume Change Above 0 ft NAVD88 | -3.00 cy/ft/yr | -1.12 cy/ft |

LEGEND:

2015 OCT —
 2015 APR —
 2014 OCT —
 POST-FILL —

Notes:

1. Stationing From West To East At Varying Intervals.
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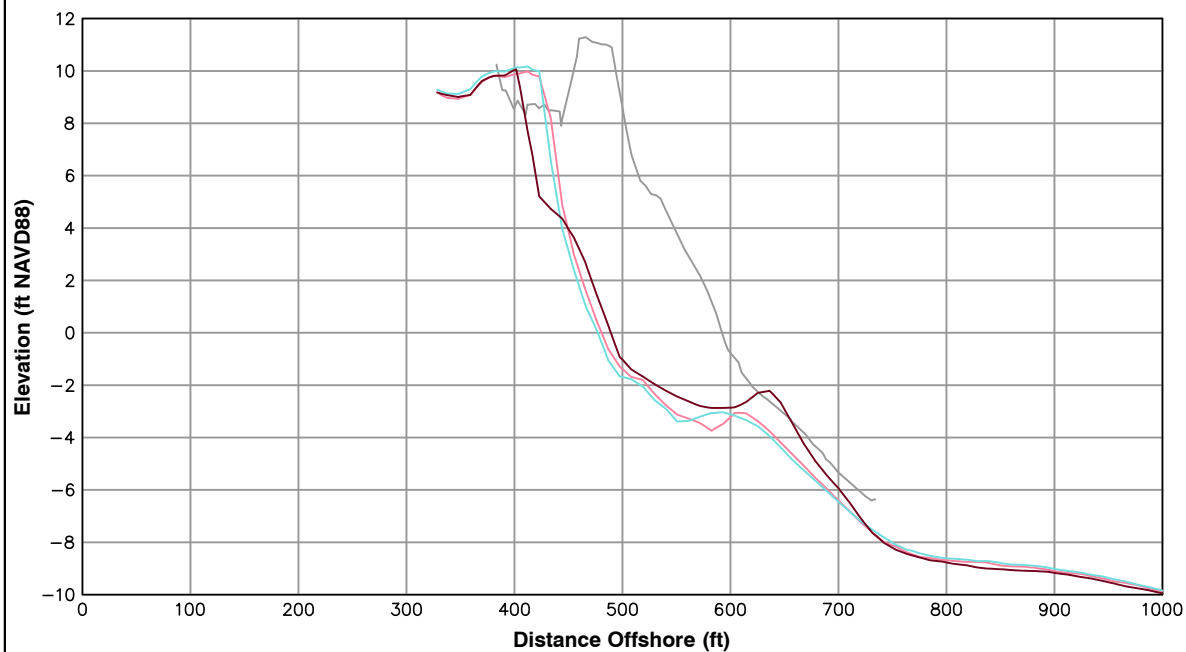
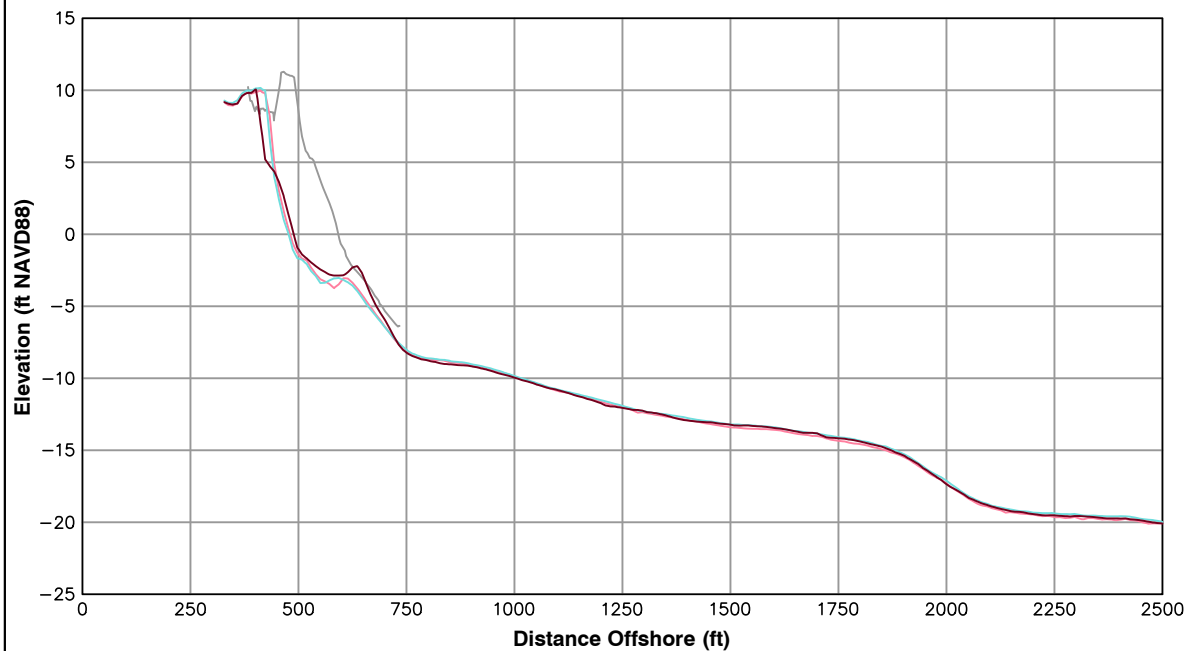


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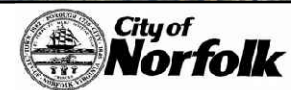
| Survey Transect 47+30 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 8.79 ft/yr | 14.01 ft |
| Volume Change Above -15 ft NAVD88 | 4.27 cy/ft/yr | 0.17 cy/ft |
| Volume Change Above 0 ft NAVD88 | -2.88 cy/ft/yr | -2.04 cy/ft |

LEGEND:

2015 OCT —
 2015 APR —
 2014 OCT —
 POST-FILL —

Notes:

1. Stationing From West To East At Varying Intervals.
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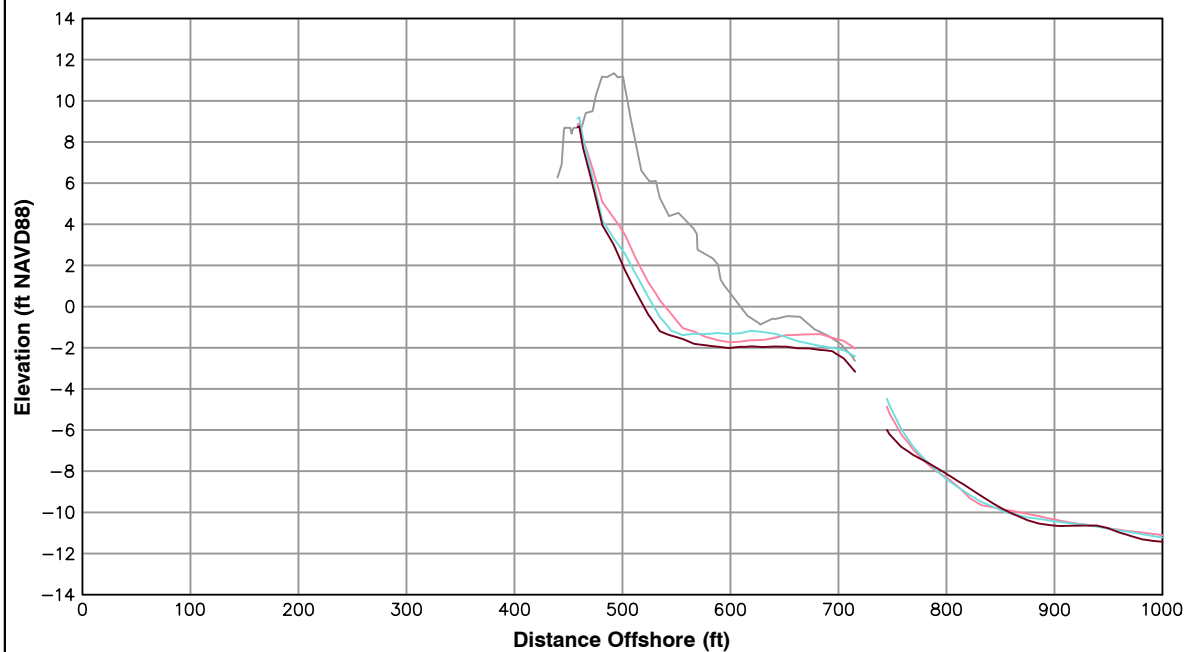
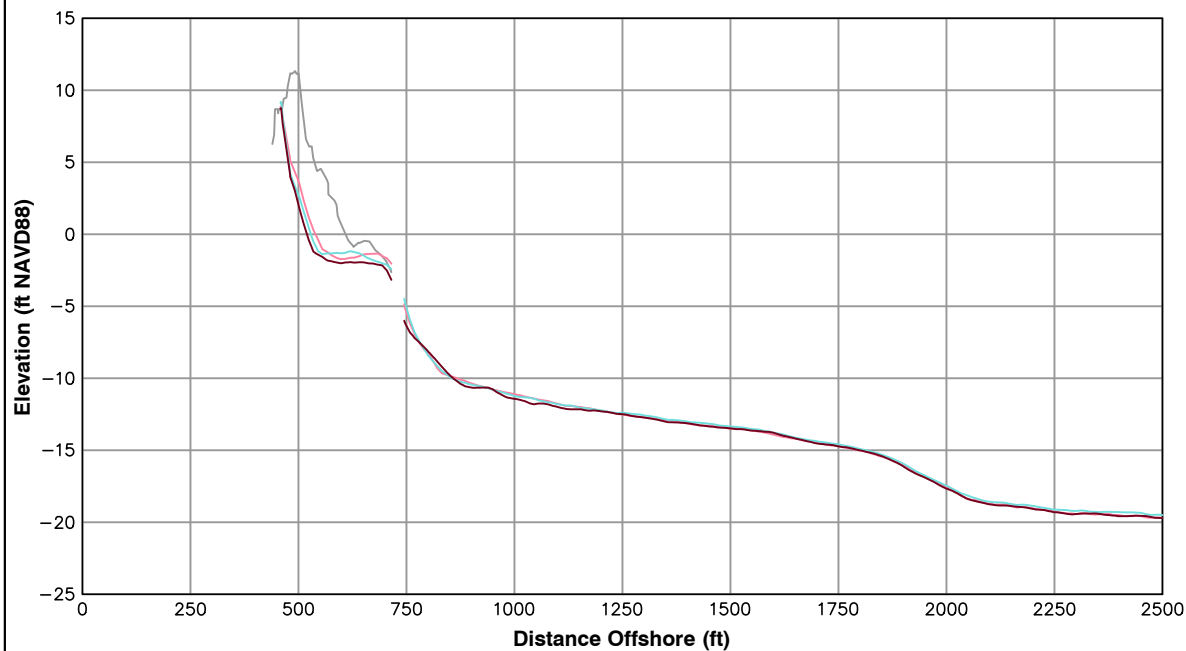


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ANALYSIS**

ST 47+30

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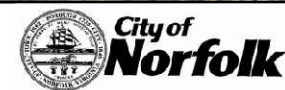
| Survey Transect 49+35 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -16.44 ft/yr | -8.73 ft |
| Volume Change Above -15 ft NAVD88 | -10.10 cy/ft/yr | -9.89 cy/ft |
| Volume Change Above 0 ft NAVD88 | -3.20 cy/ft/yr | -1.32 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
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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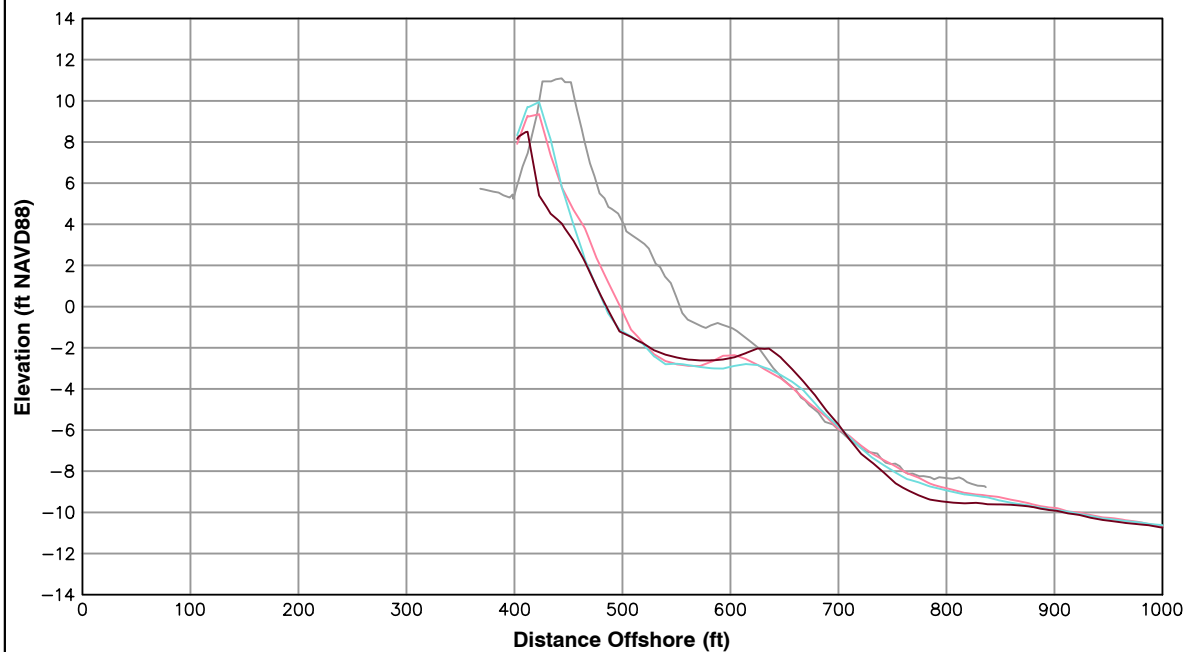
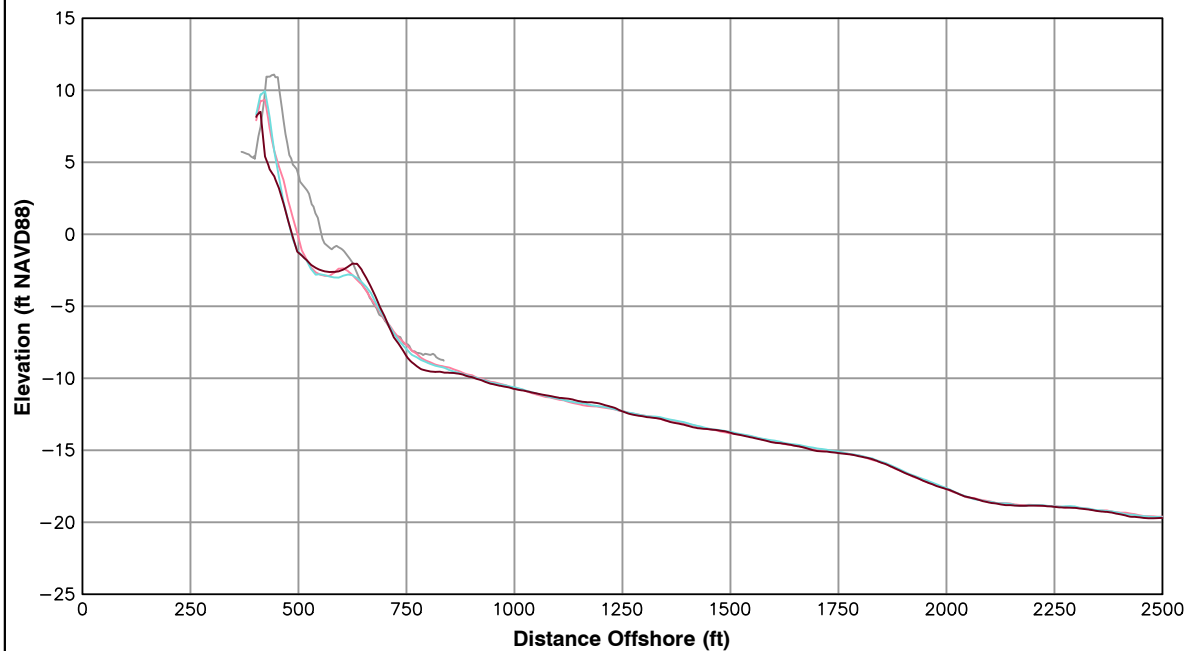


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ST 49+35

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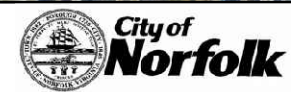
| Survey Transect 51+41 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -12.67 ft/yr | 0.02 ft |
| Volume Change Above -15 ft NAVD88 | -6.92 cy/ft/yr | -5.21 cy/ft |
| Volume Change Above 0 ft NAVD88 | -5.84 cy/ft/yr | -4.69 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
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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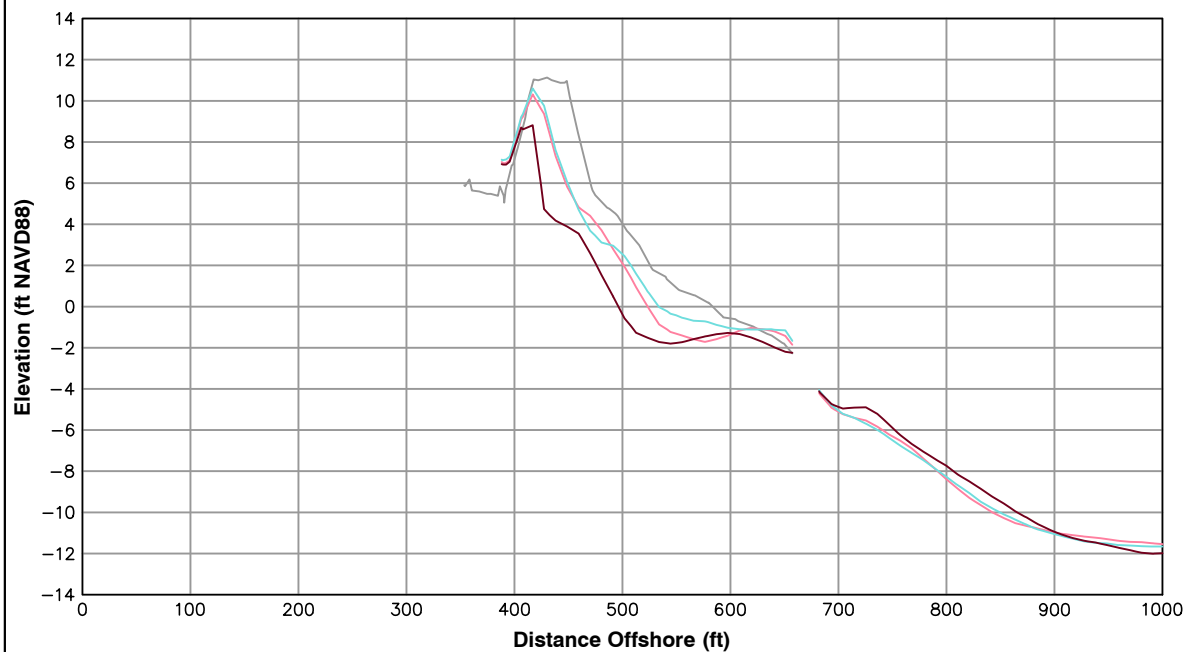
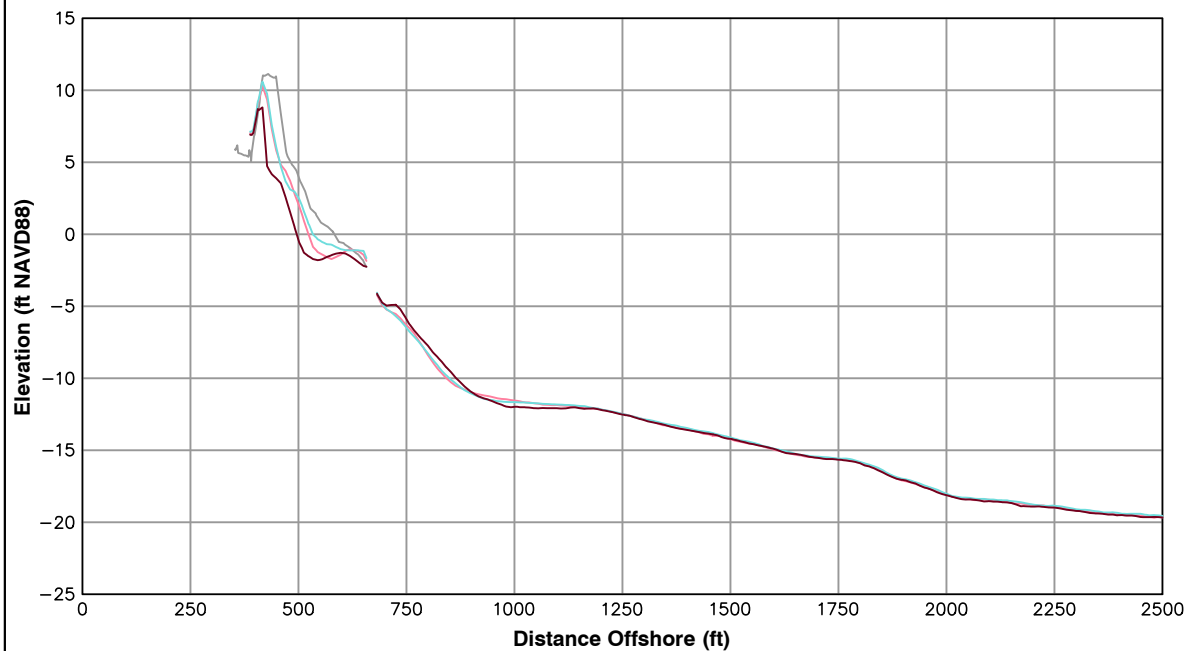


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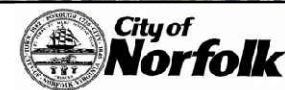
| Survey Transect 53+46 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -25.73 ft/yr | -34.16 ft |
| Volume Change Above -15 ft NAVD88 | -10.22 cy/ft/yr | -14.42 cy/ft |
| Volume Change Above 0 ft NAVD88 | -8.72 cy/ft/yr | -9.63 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
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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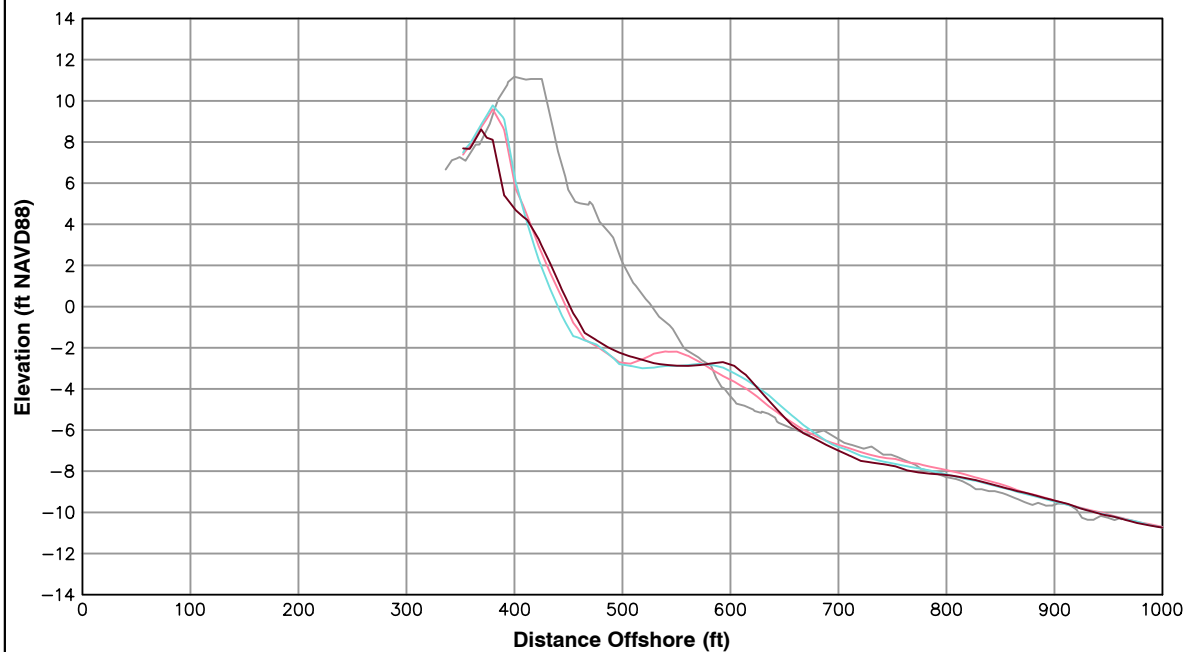
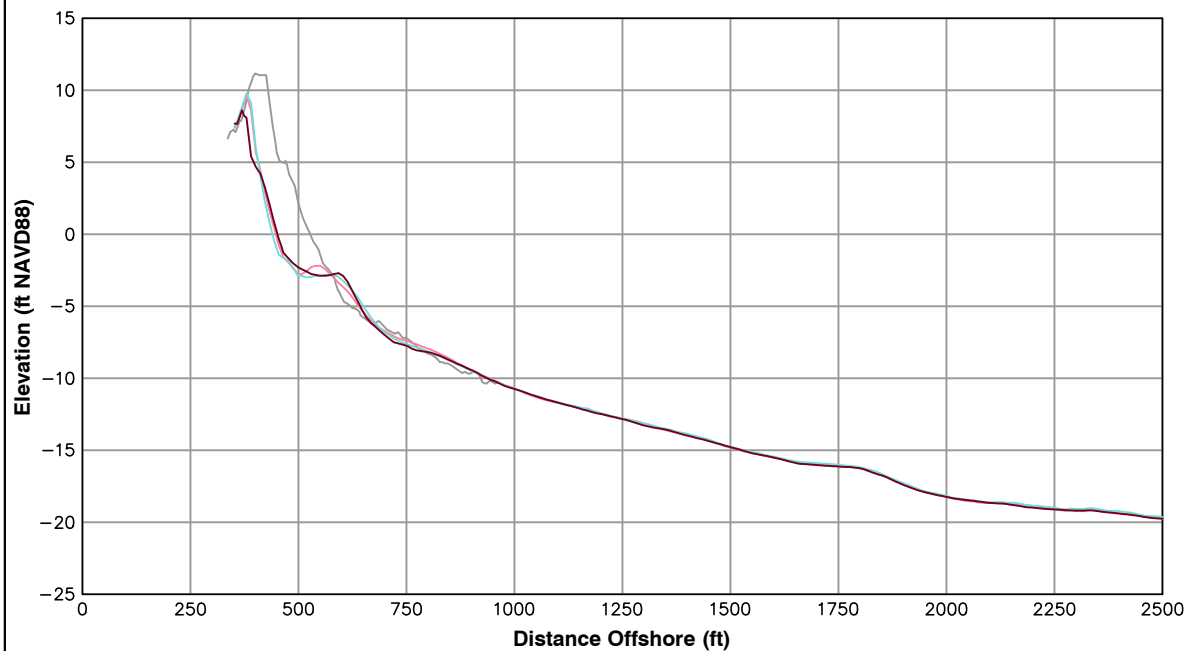


**OCEAN VIEW PERIODIC
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ANALYSIS**

ST 53+46

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| Survey Transect 55+51 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 3.58 ft/yr | 10.47 ft |
| Volume Change Above -15 ft NAVD88 | -3.33 cy/ft/yr | -2.22 cy/ft |
| Volume Change Above 0 ft NAVD88 | -1.92 cy/ft/yr | -1.54 cy/ft |

LEGEND:

2015 OCT —
 2015 APR —
 2014 OCT —
 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 October 2014 and April 2015.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

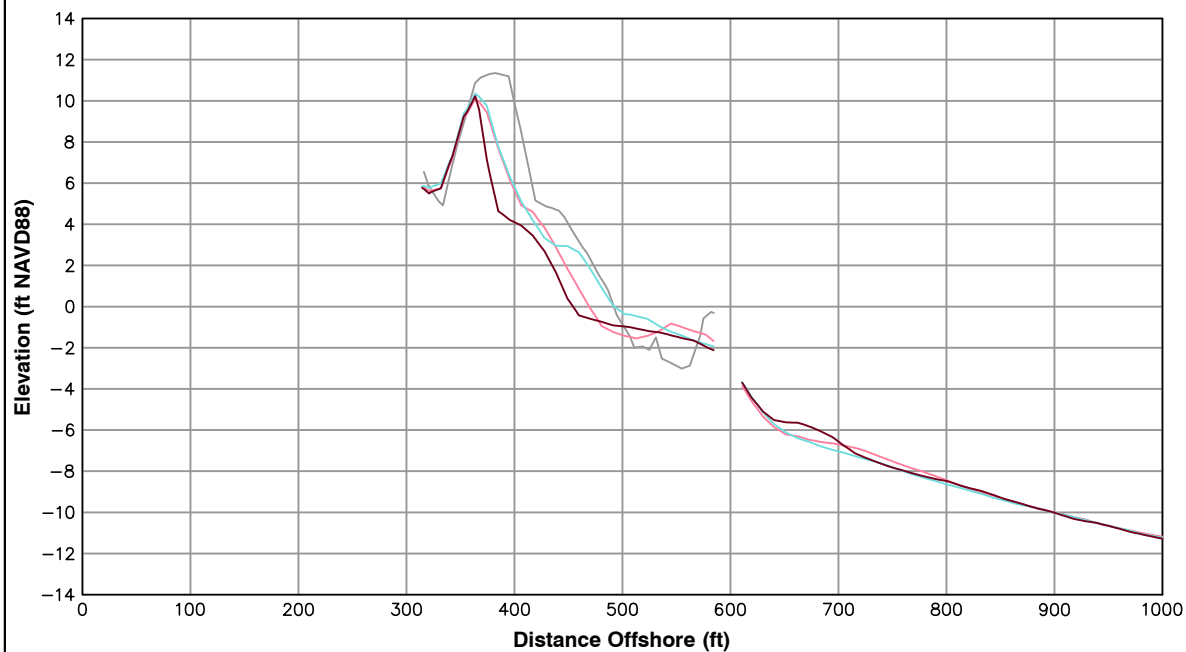
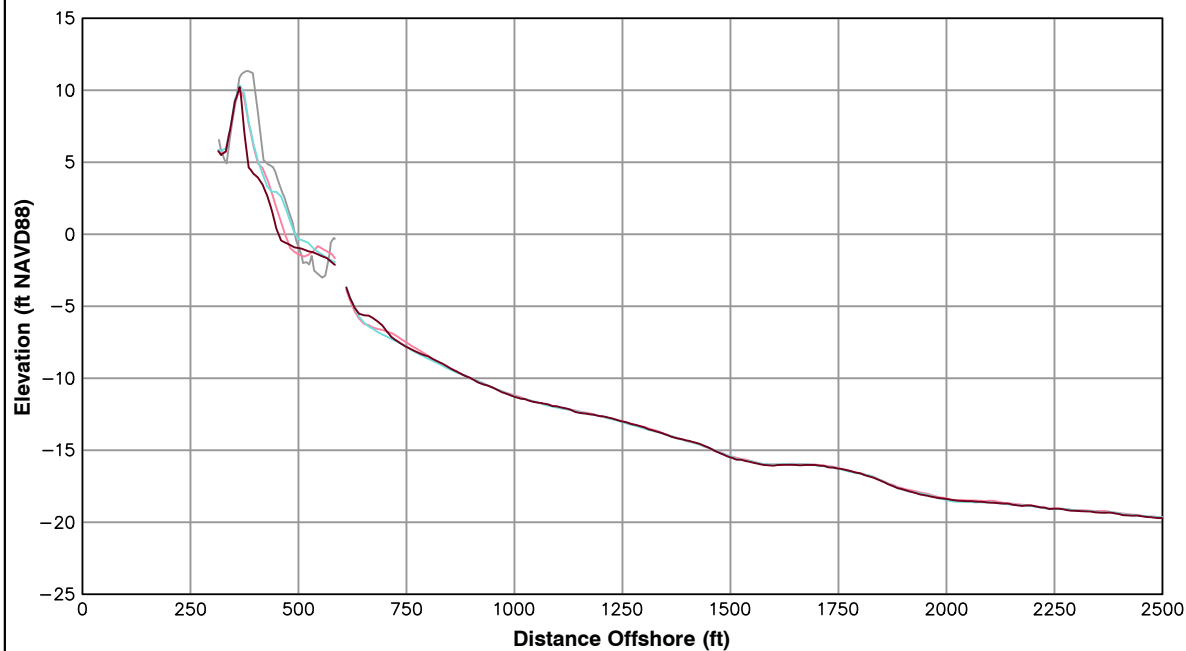


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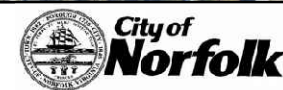
| Survey Transect 57+57 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -14.24 ft/yr | -35.90 ft |
| Volume Change Above -15 ft NAVD88 | -5.75 cy/ft/yr | -7.75 cy/ft |
| Volume Change Above 0 ft NAVD88 | -5.41 cy/ft/yr | -8.03 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
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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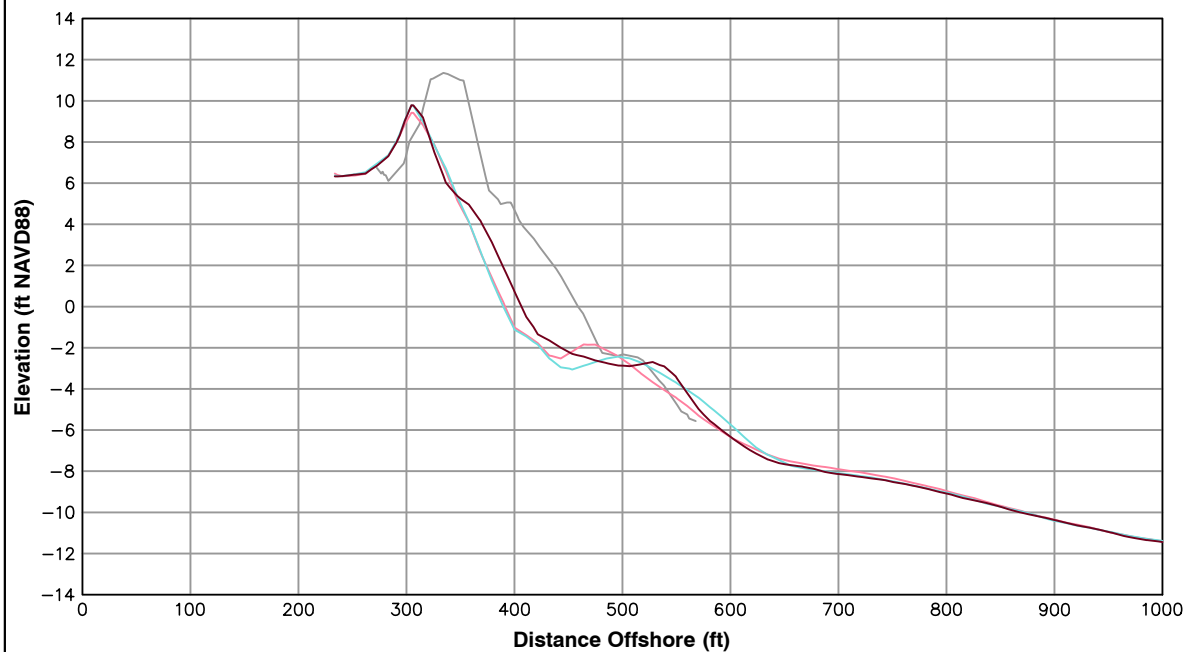
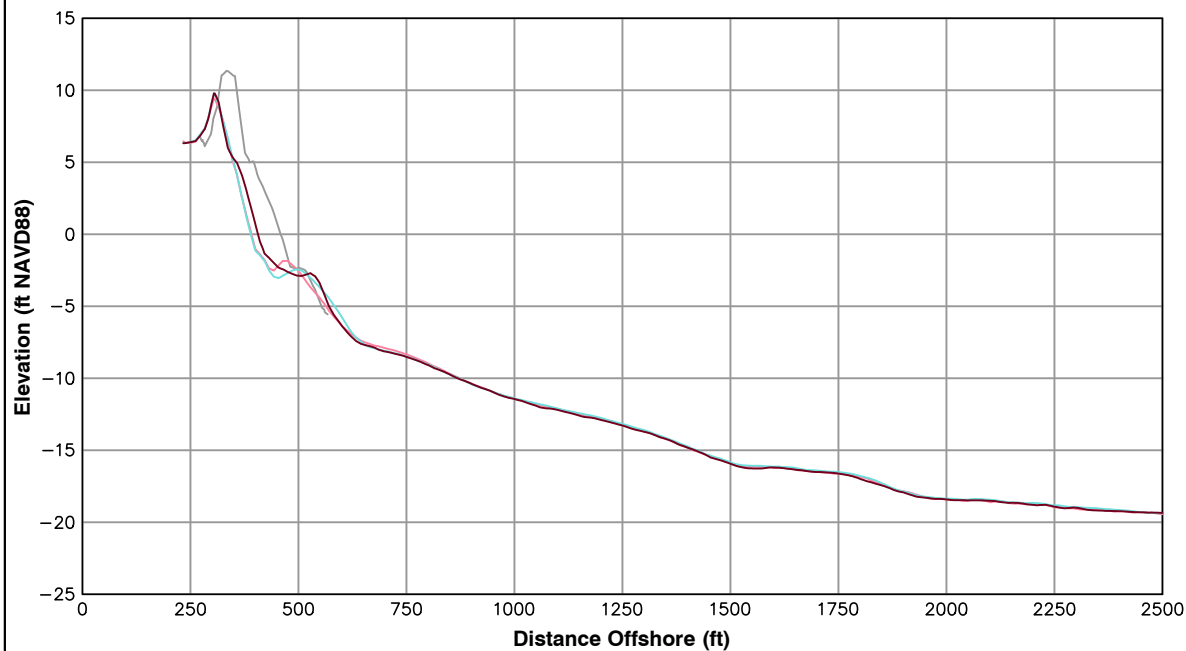


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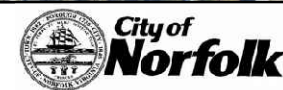
| Survey Transect 59+62 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 15.04 ft/yr | 16.47 ft |
| Volume Change Above -15 ft NAVD88 | 2.39 cy/ft/yr | 0.96 cy/ft |
| Volume Change Above 0 ft NAVD88 | 2.52 cy/ft/yr | 2.17 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
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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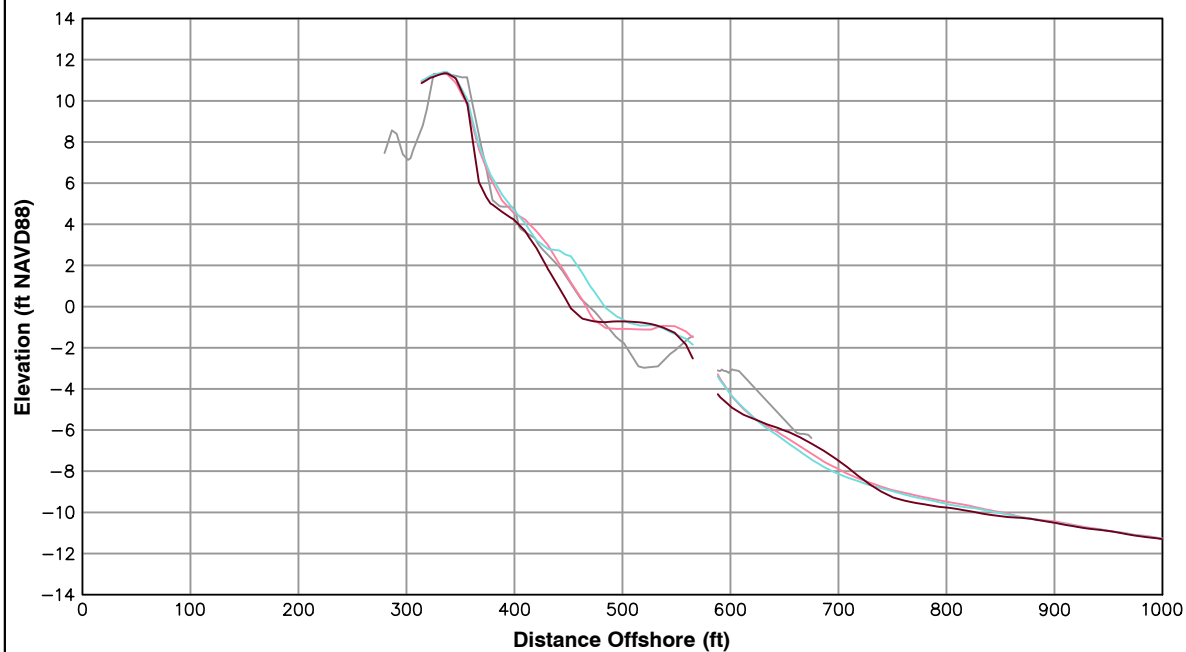
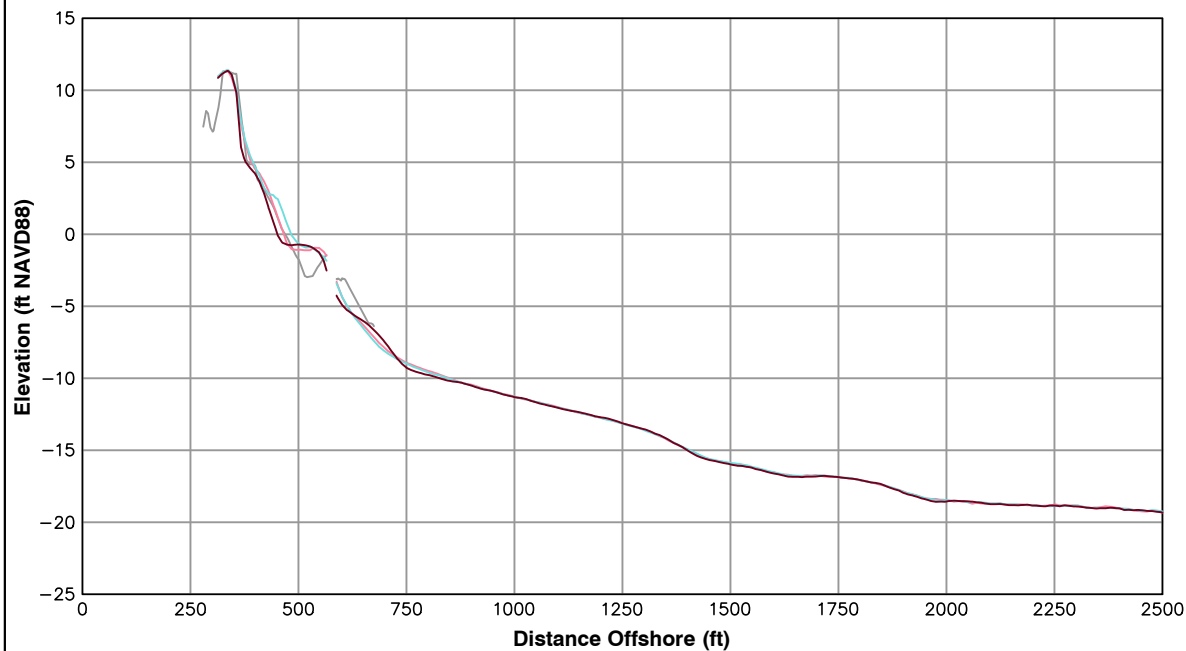


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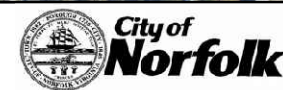
| Survey Transect 61+62 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -13.95 ft/yr | -29.68 ft |
| Volume Change Above -15 ft NAVD88 | -4.40 cy/ft/yr | -5.75 cy/ft |
| Volume Change Above 0 ft NAVD88 | -3.40 cy/ft/yr | -5.26 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
POST-FILL —

Notes:

1. Stationing From West To East At Varying Intervals.
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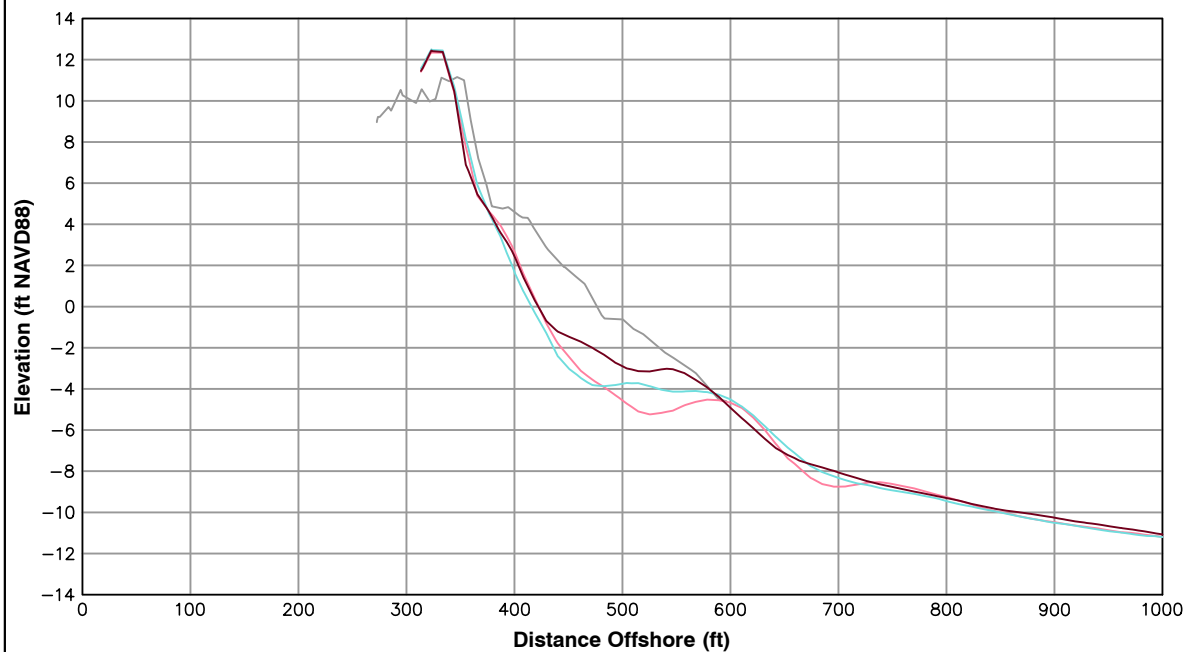
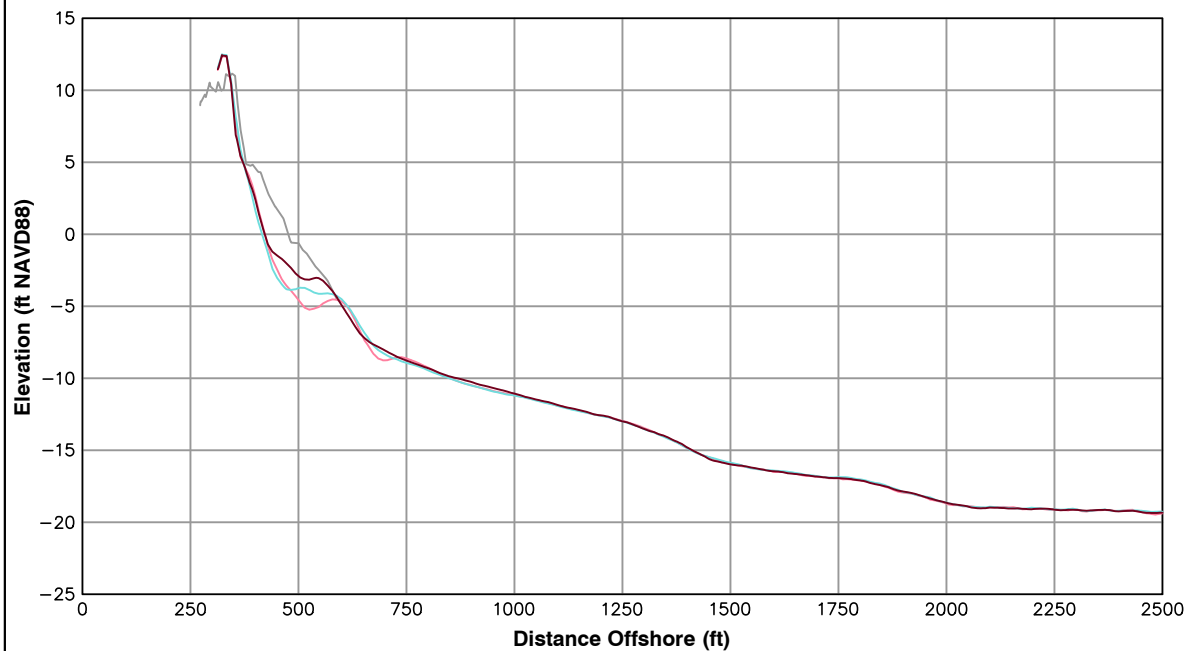


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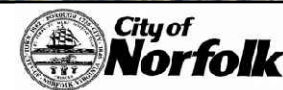
| Survey Transect 63+62 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -1.25 ft/yr | 6.33 ft |
| Volume Change Above -15 ft NAVD88 | 9.47 cy/ft/yr | 7.87 cy/ft |
| Volume Change Above 0 ft NAVD88 | -0.58 cy/ft/yr | -0.05 cy/ft |

LEGEND:

2015 OCT —
 2015 APR —
 2014 OCT —
 POST-FILL —

Notes:

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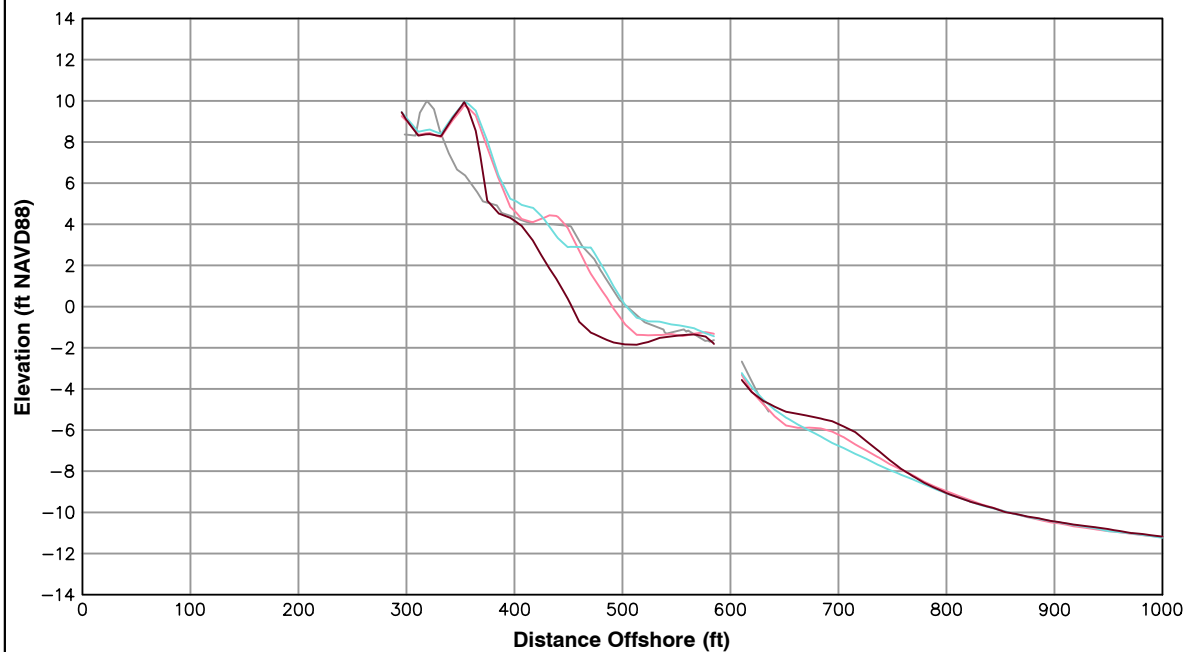
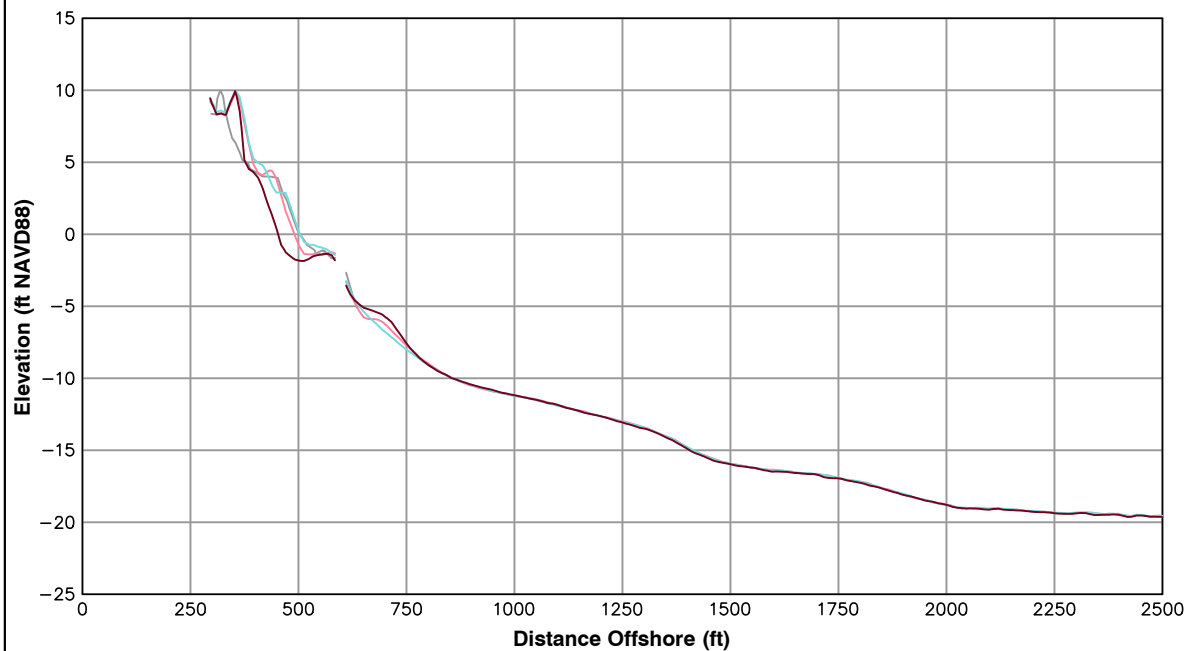


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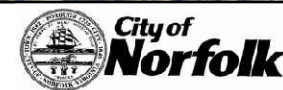
| Survey Transect 65+62 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -35.28 ft/yr | -49.01 ft |
| Volume Change Above -15 ft NAVD88 | -9.33 cy/ft/yr | -11.60 cy/ft |
| Volume Change Above 0 ft NAVD88 | -7.91 cy/ft/yr | -9.97 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
POST-FILL —

Notes:

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3. All Survey Elevations In Feet Referenced to NAVD88.
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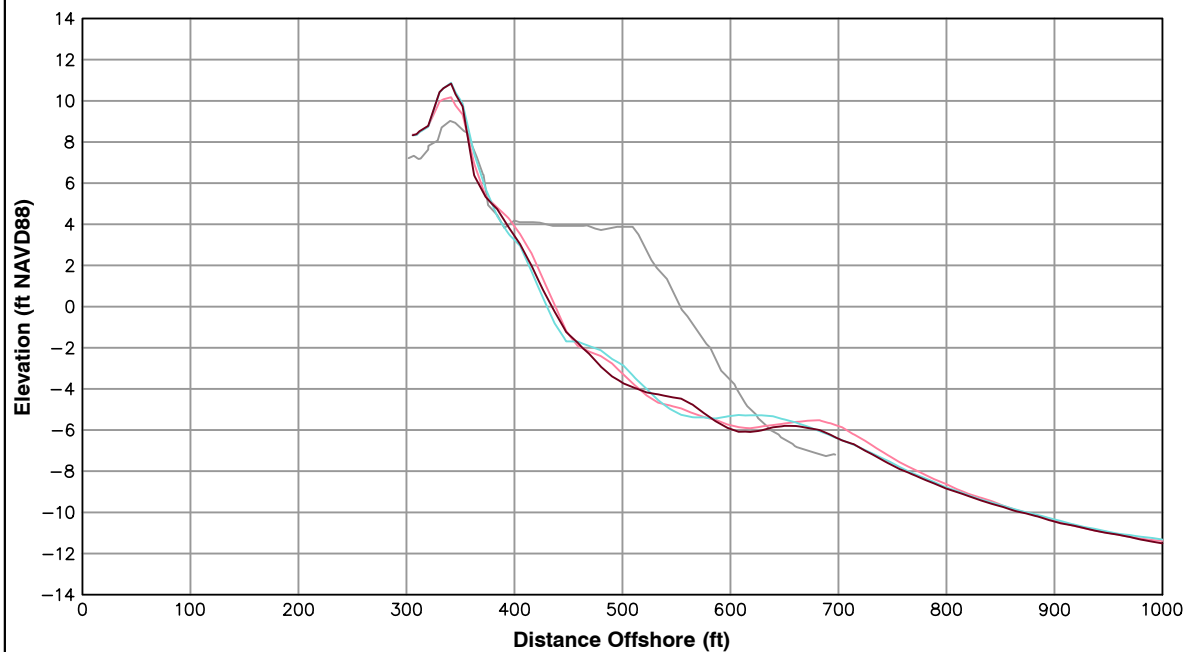
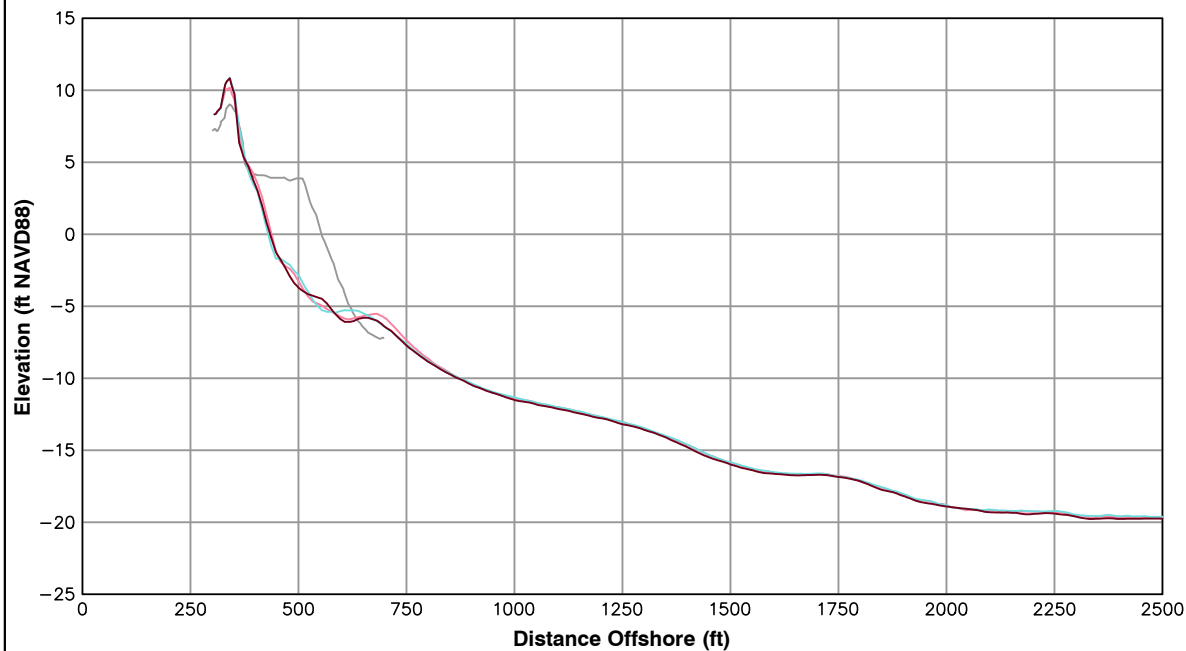


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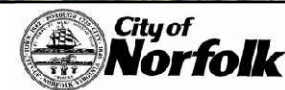
| Survey Transect 67+62 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -4.52 ft/yr | 3.07 ft |
| Volume Change Above -15 ft NAVD88 | -4.87 cy/ft/yr | -4.48 cy/ft |
| Volume Change Above 0 ft NAVD88 | -0.53 cy/ft/yr | -0.04 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
POST-FILL —

Notes:

1. Stationing From West To East At Varying Intervals.
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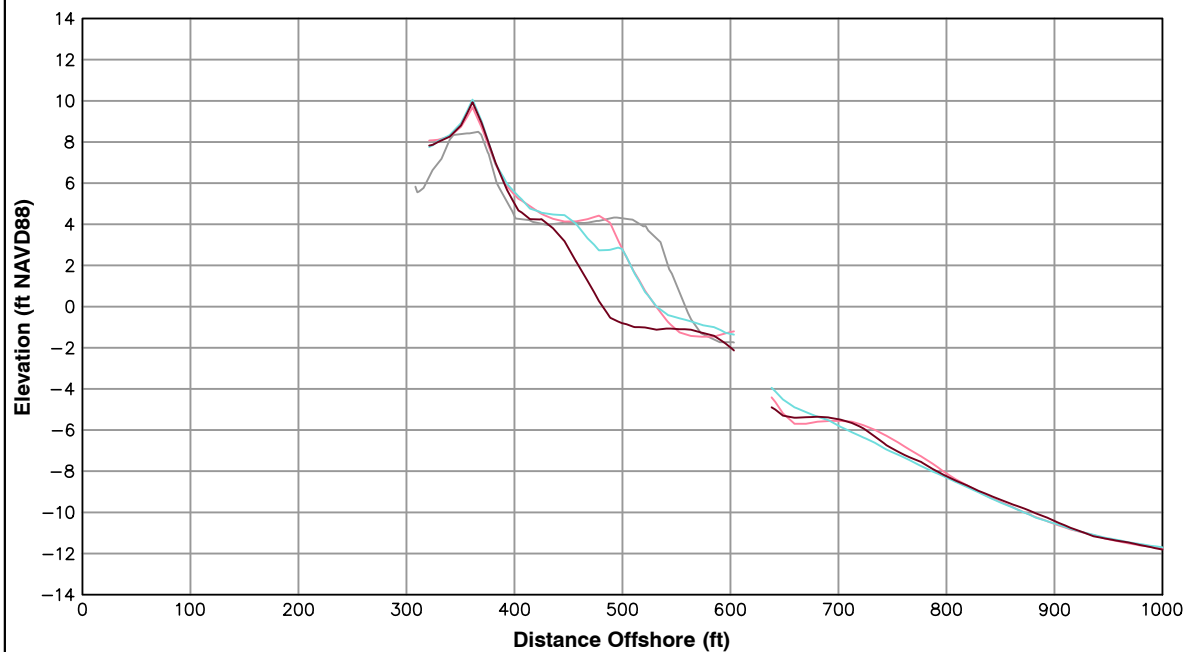
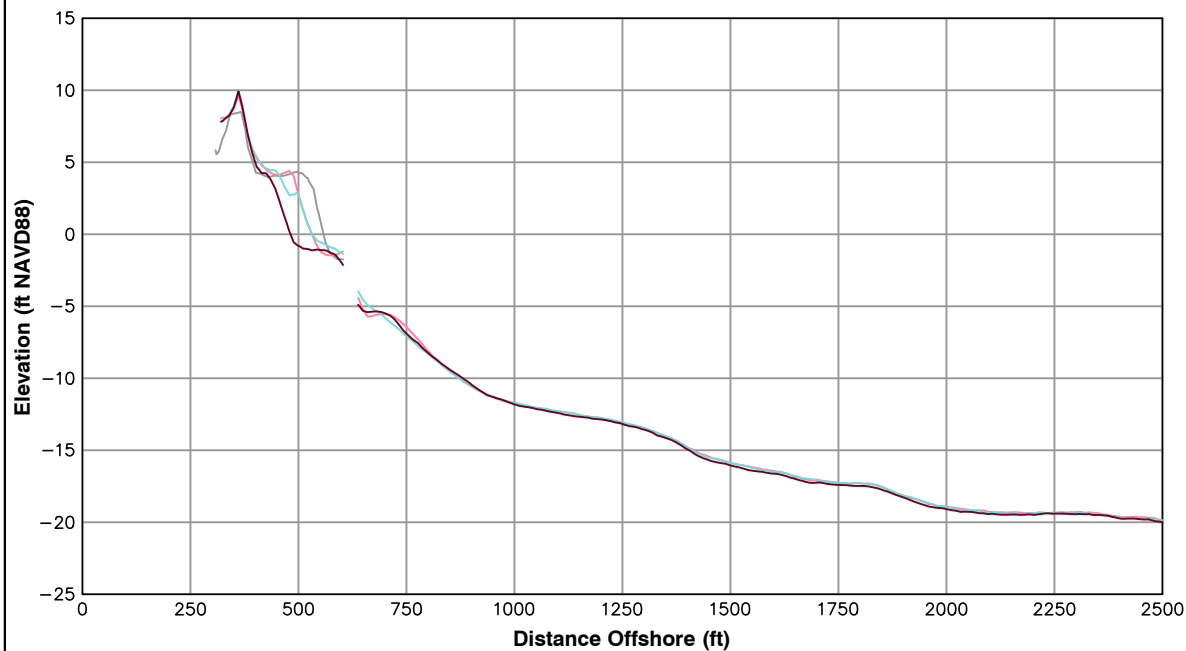


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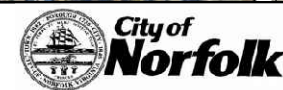
| Survey Transect 69+62 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -47.68 ft/yr | -47.48 ft |
| Volume Change Above -15 ft NAVD88 | -11.76 cy/ft/yr | -11.60 cy/ft |
| Volume Change Above 0 ft NAVD88 | -8.30 cy/ft/yr | -7.34 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
POST-FILL —

Notes:

1. Stationing From West To East At Varying Intervals.
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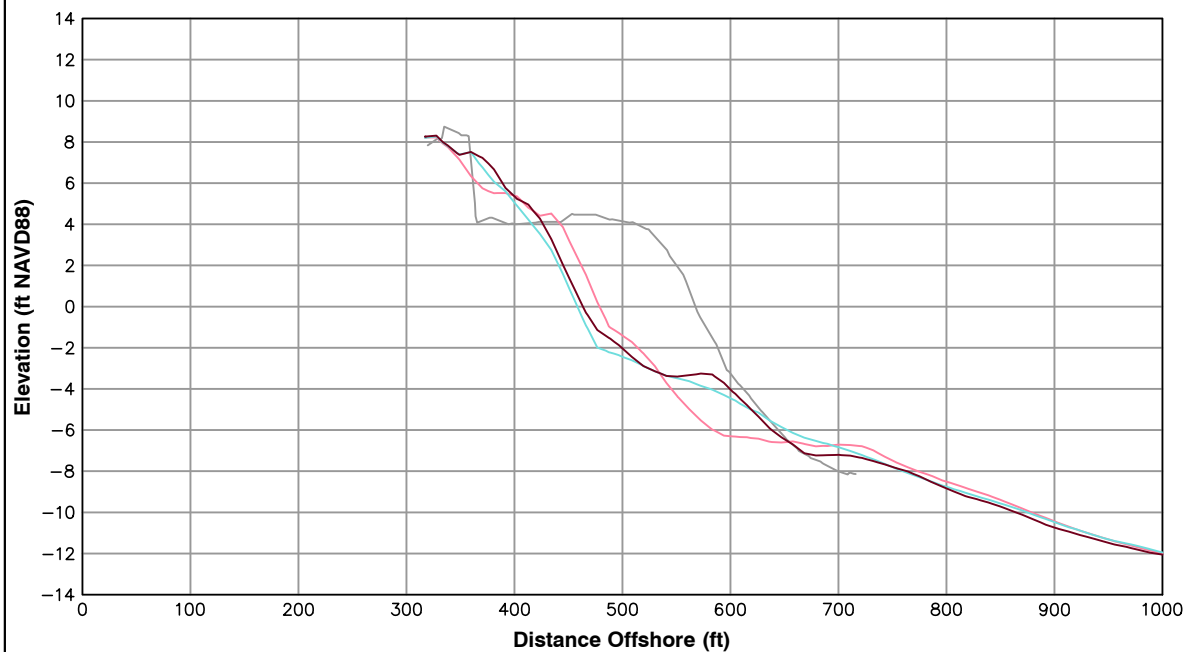
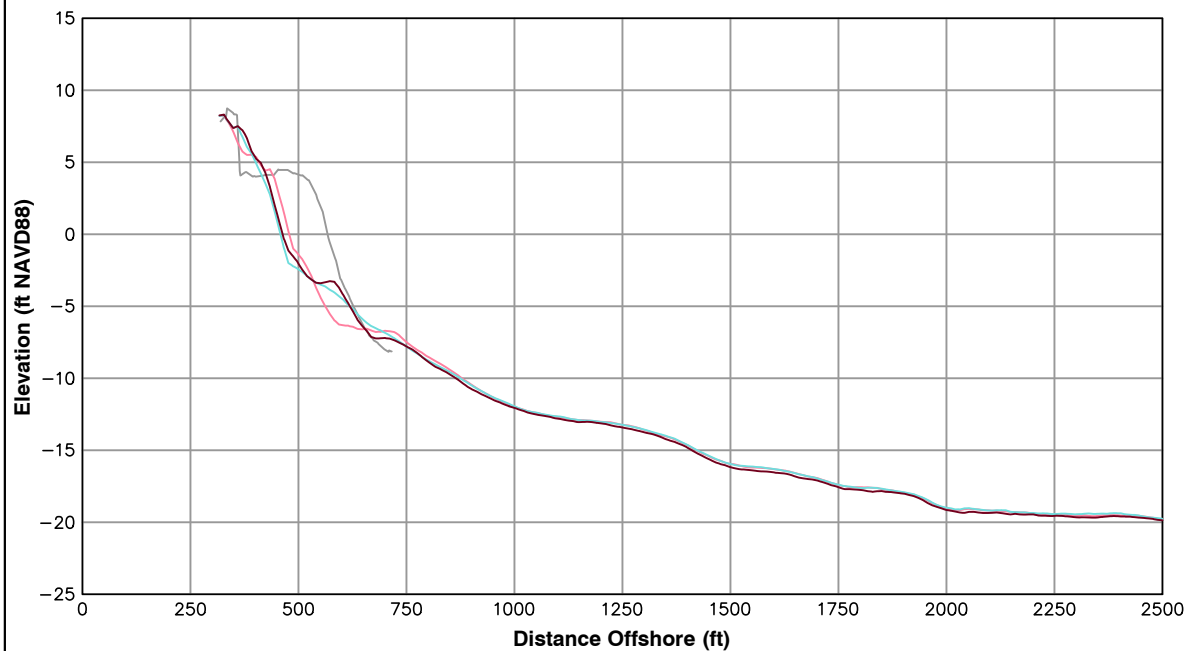


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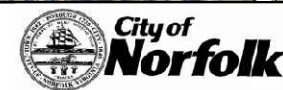
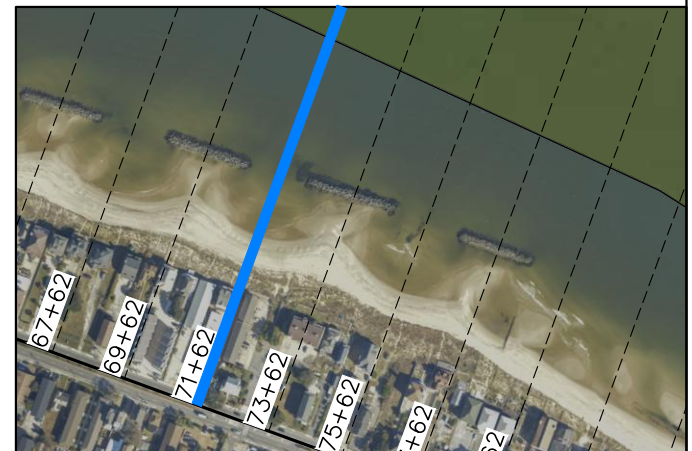
| Survey Transect 71+62 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -16.10 ft/yr | 4.45 ft |
| Volume Change Above -15 ft NAVD88 | -2.27 cy/ft/yr | -1.42 cy/ft |
| Volume Change Above 0 ft NAVD88 | -0.91 cy/ft/yr | 1.83 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
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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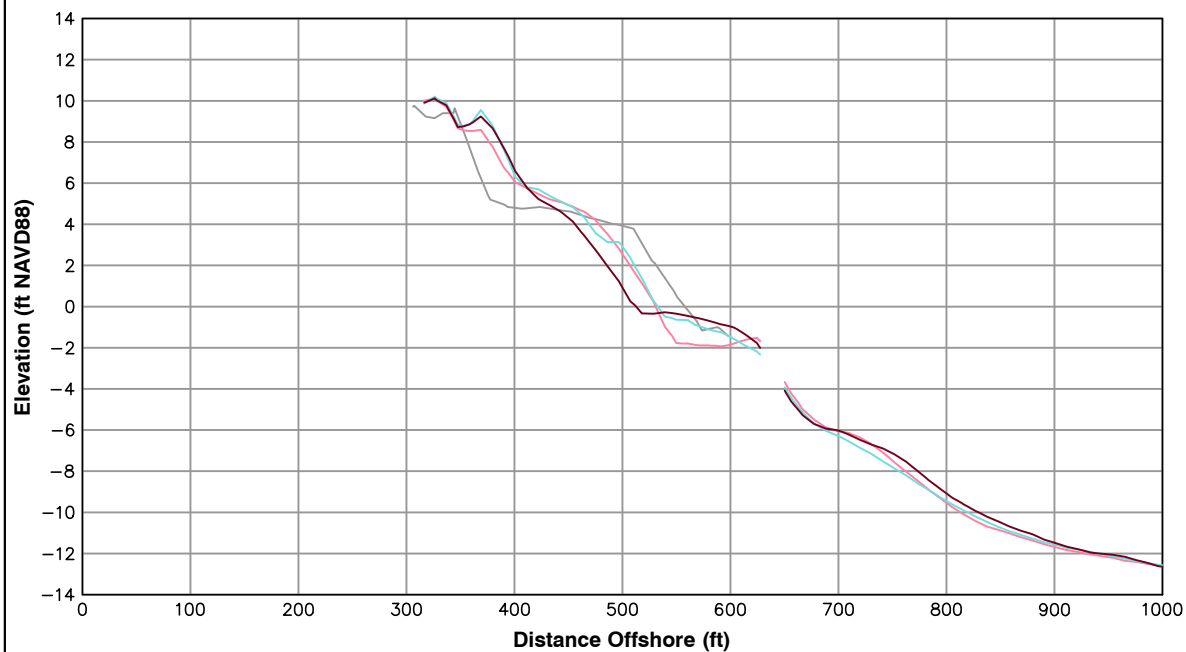
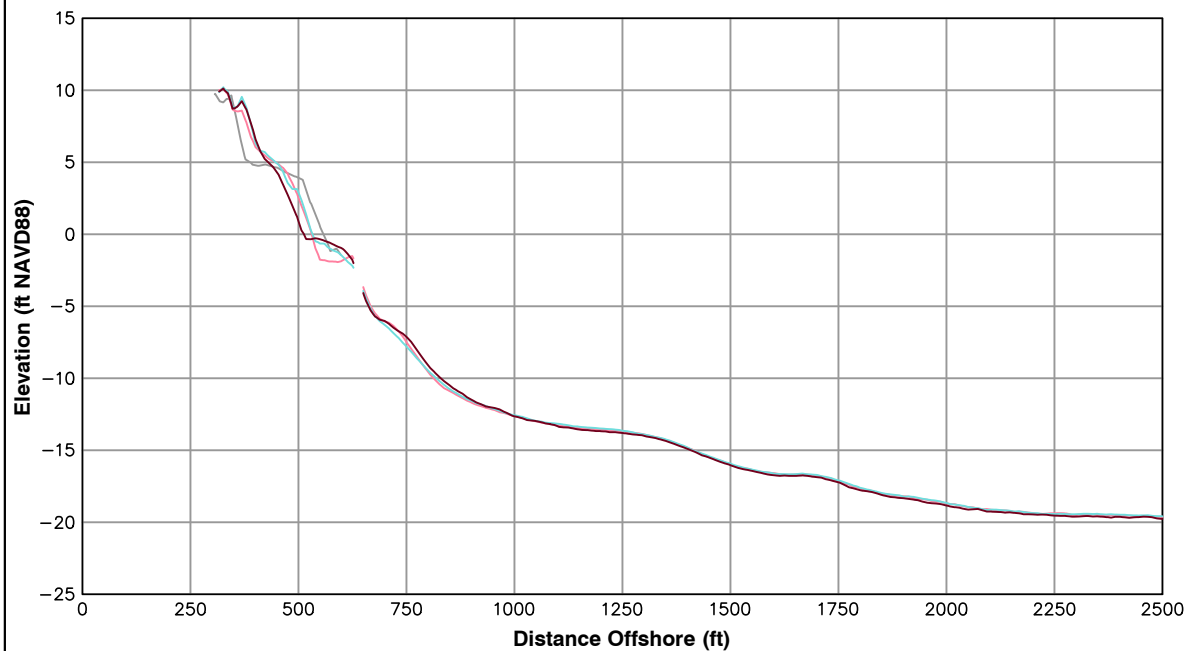


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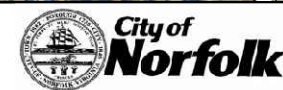
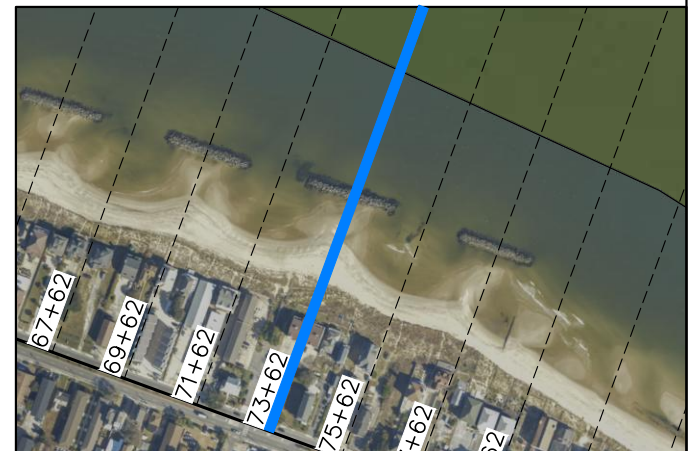
| Survey Transect 73+62 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -20.30 ft/yr | -22.45 ft |
| Volume Change Above -15 ft NAVD88 | 1.25 cy/ft/yr | -2.40 cy/ft |
| Volume Change Above 0 ft NAVD88 | -2.76 cy/ft/yr | -4.33 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
POST-FILL —

Notes:

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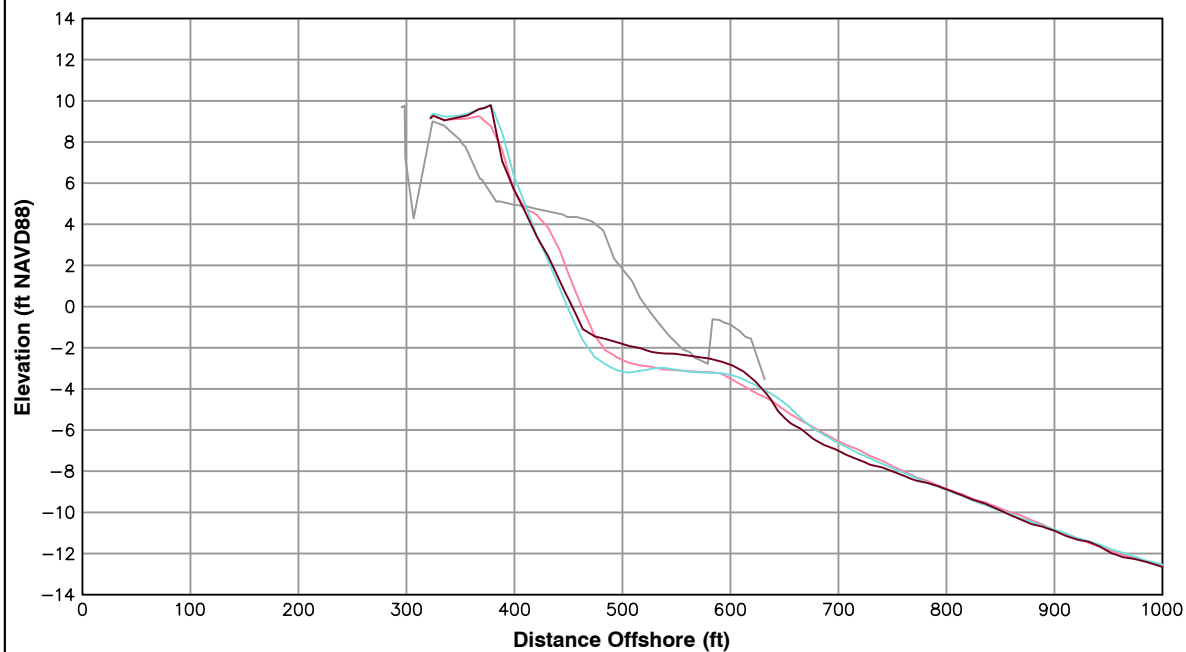
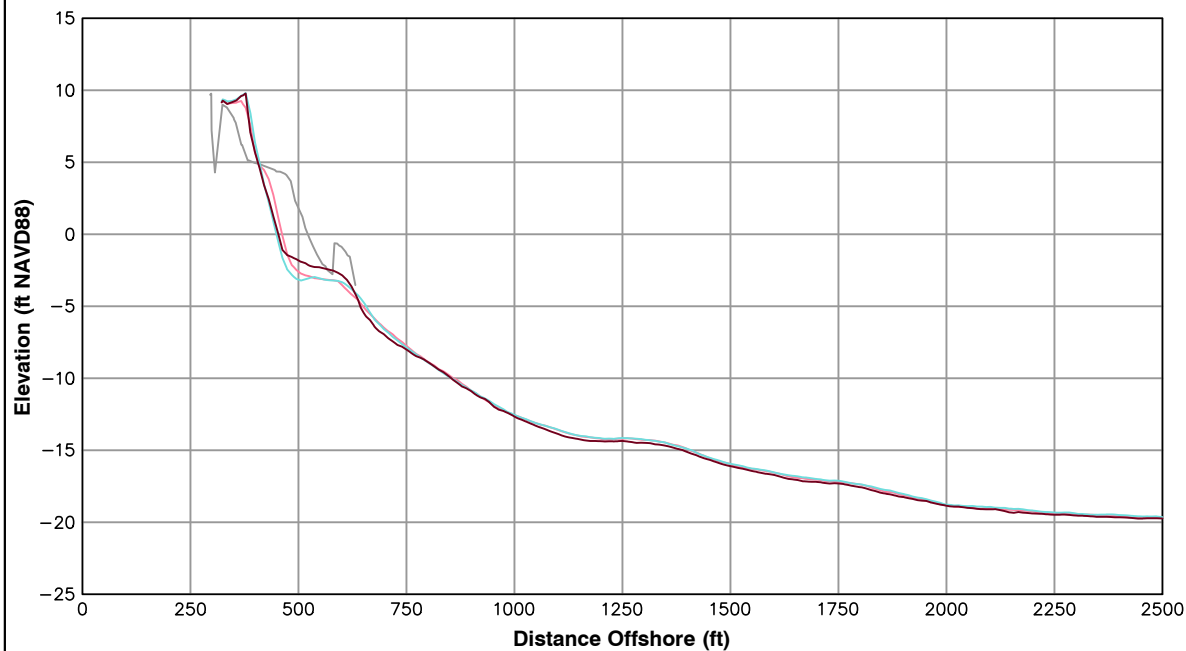


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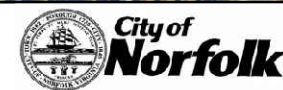
| Survey Transect 75+62 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -10.18 ft/yr | 3.18 ft |
| Volume Change Above -15 ft NAVD88 | -3.71 cy/ft/yr | -0.86 cy/ft |
| Volume Change Above 0 ft NAVD88 | -1.63 cy/ft/yr | -0.86 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
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.

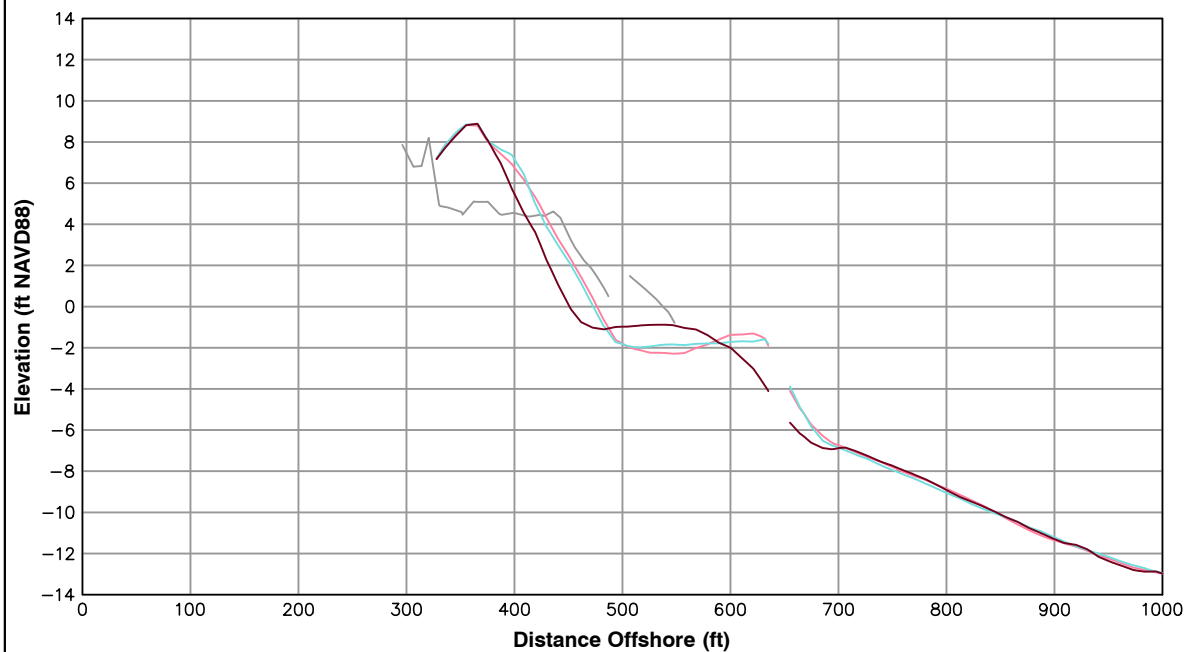
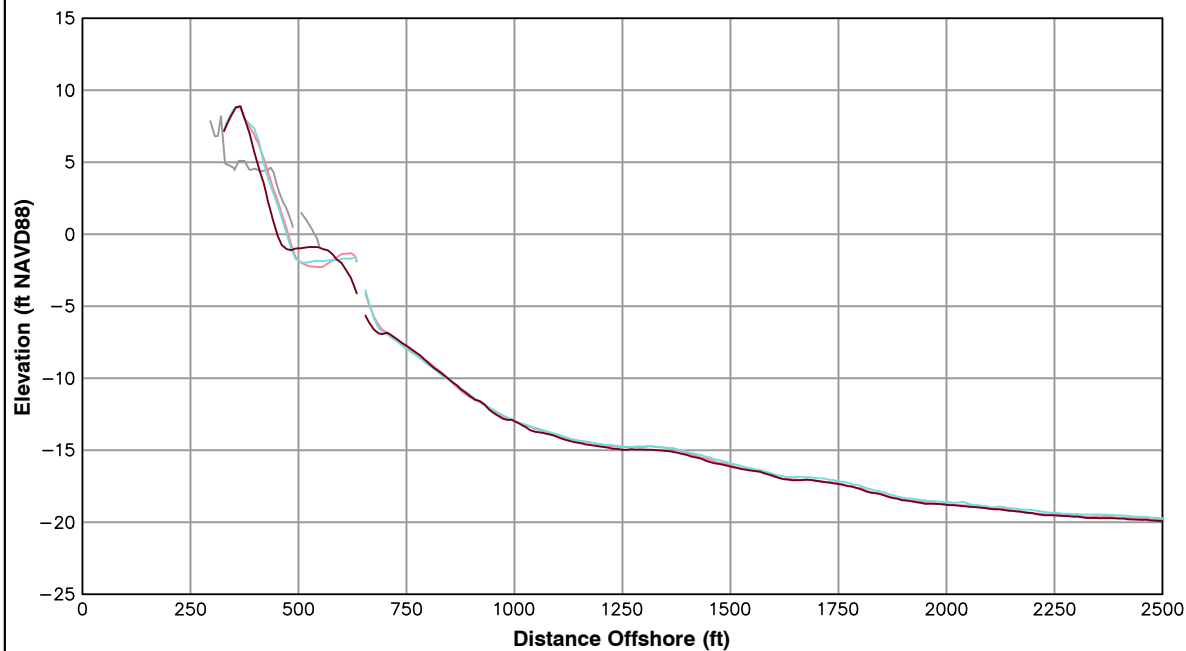


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| Survey Transect 77+62 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -25.14 ft/yr | -21.98 ft |
| Volume Change Above -15 ft NAVD88 | -7.89 cy/ft/yr | -7.96 cy/ft |
| Volume Change Above 0 ft NAVD88 | -5.27 cy/ft/yr | -5.02 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
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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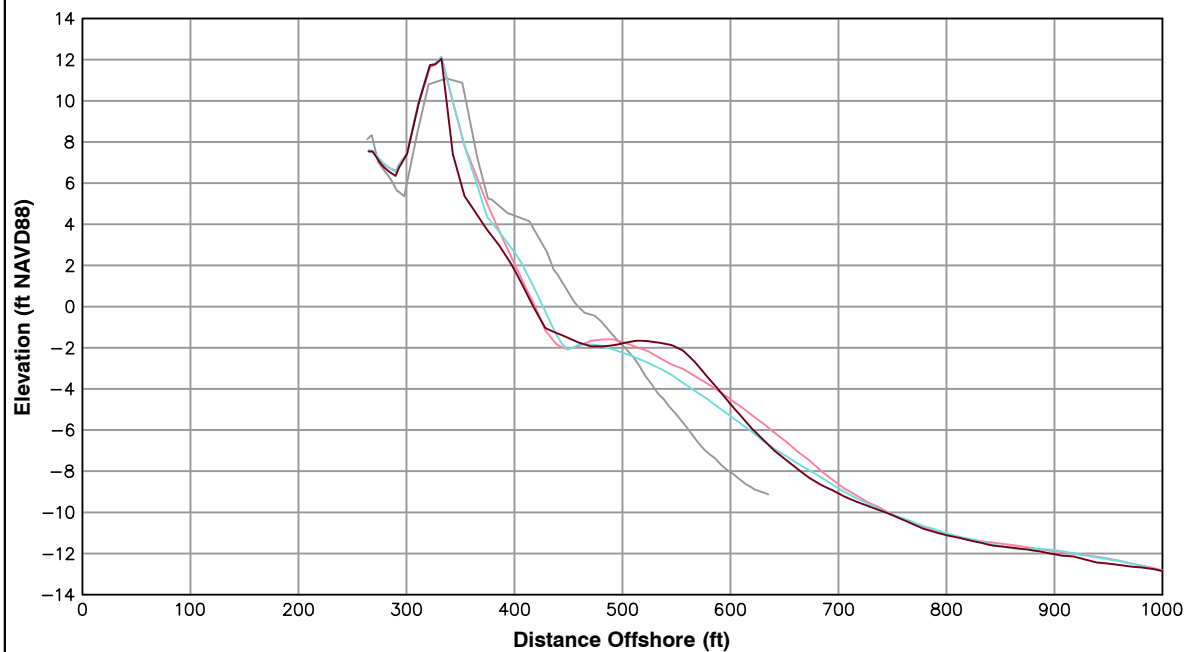
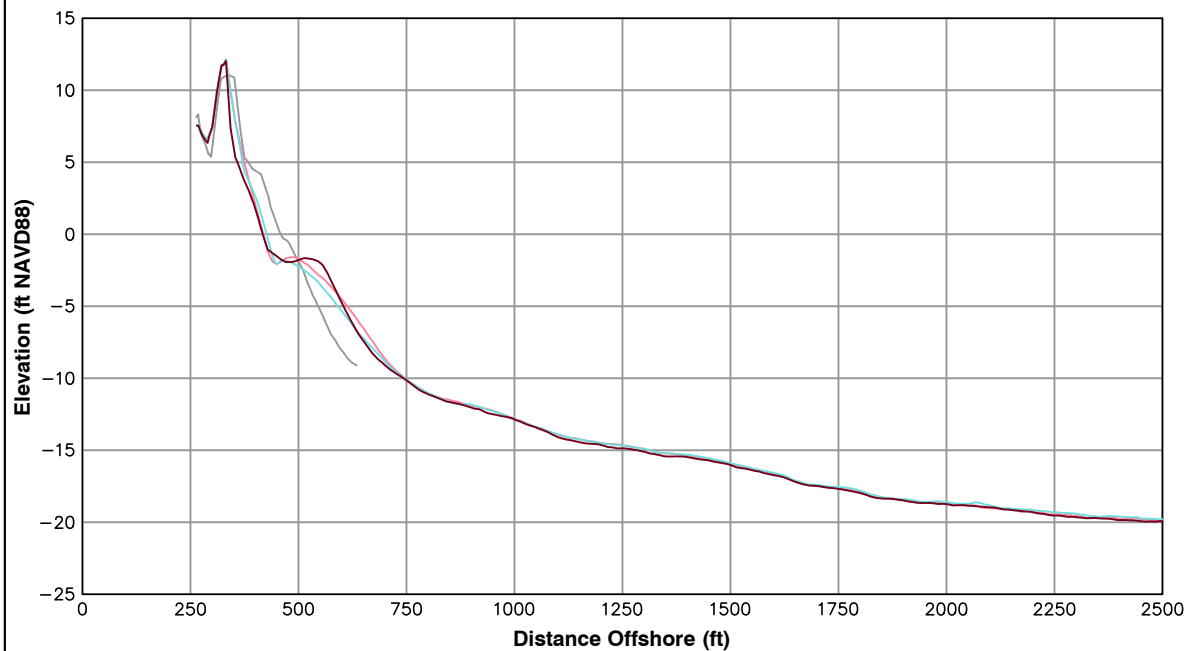


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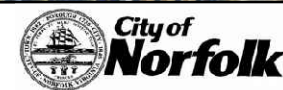
| Survey Transect 79+62 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -1.88 ft/yr | -9.49 ft |
| Volume Change Above -15 ft NAVD88 | -7.72 cy/ft/yr | -3.28 cy/ft |
| Volume Change Above 0 ft NAVD88 | -3.87 cy/ft/yr | -4.41 cy/ft |

LEGEND:

2015 OCT —
 2015 APR —
 2014 OCT —
 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 October 2014 and April 2015.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

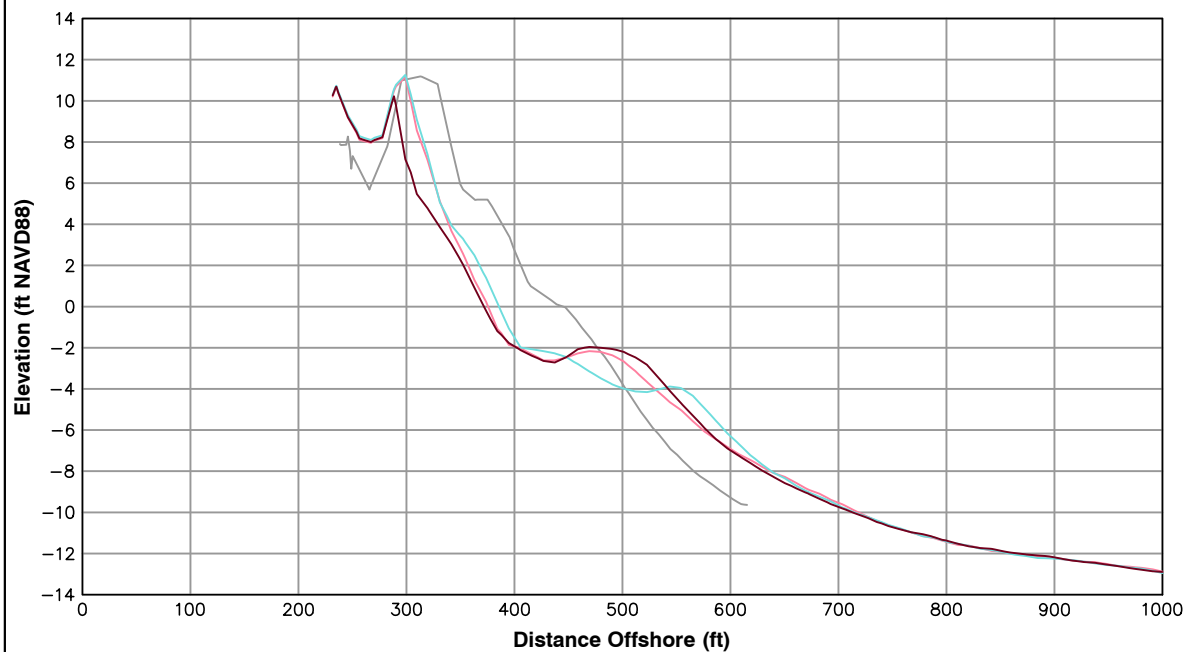
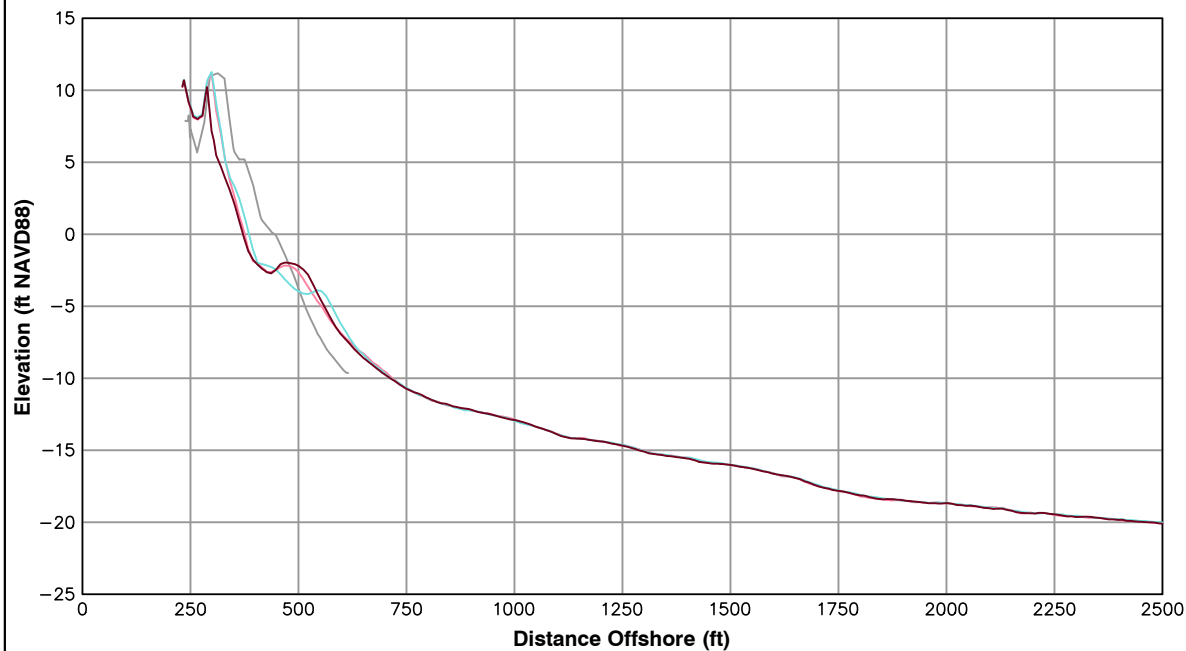


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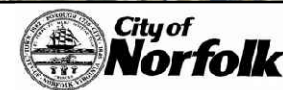
| Survey Transect 81+62 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -3.75 ft/yr | -15.01 ft |
| Volume Change Above -15 ft NAVD88 | -4.18 cy/ft/yr | -6.72 cy/ft |
| Volume Change Above 0 ft NAVD88 | -4.85 cy/ft/yr | -6.90 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
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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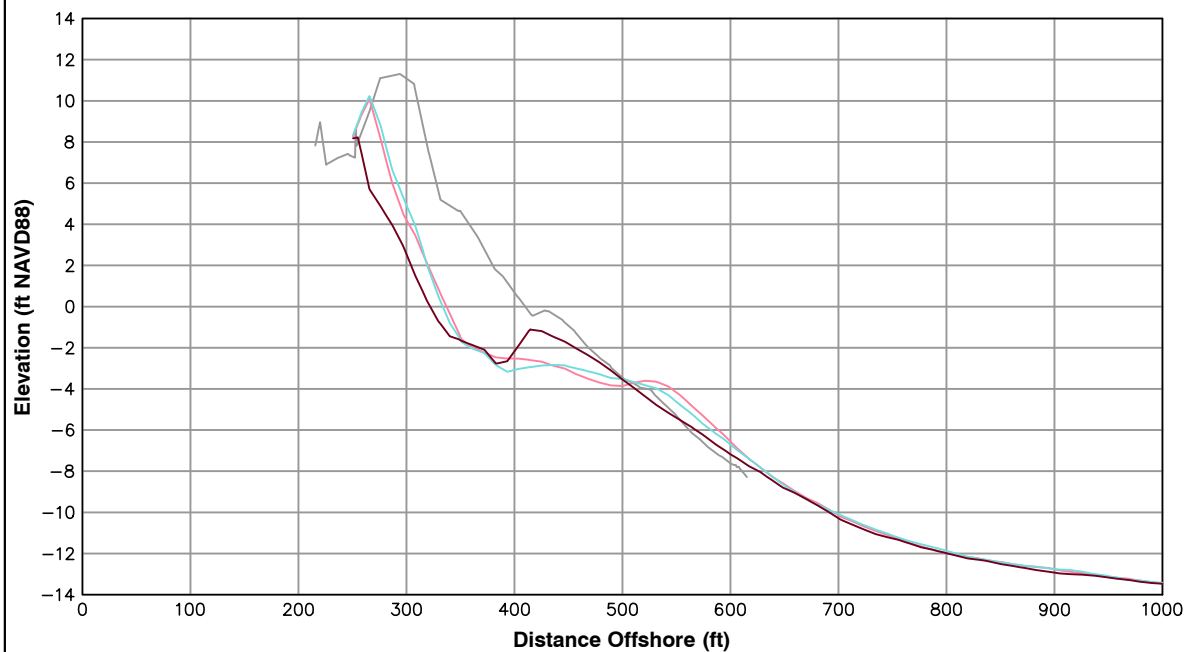
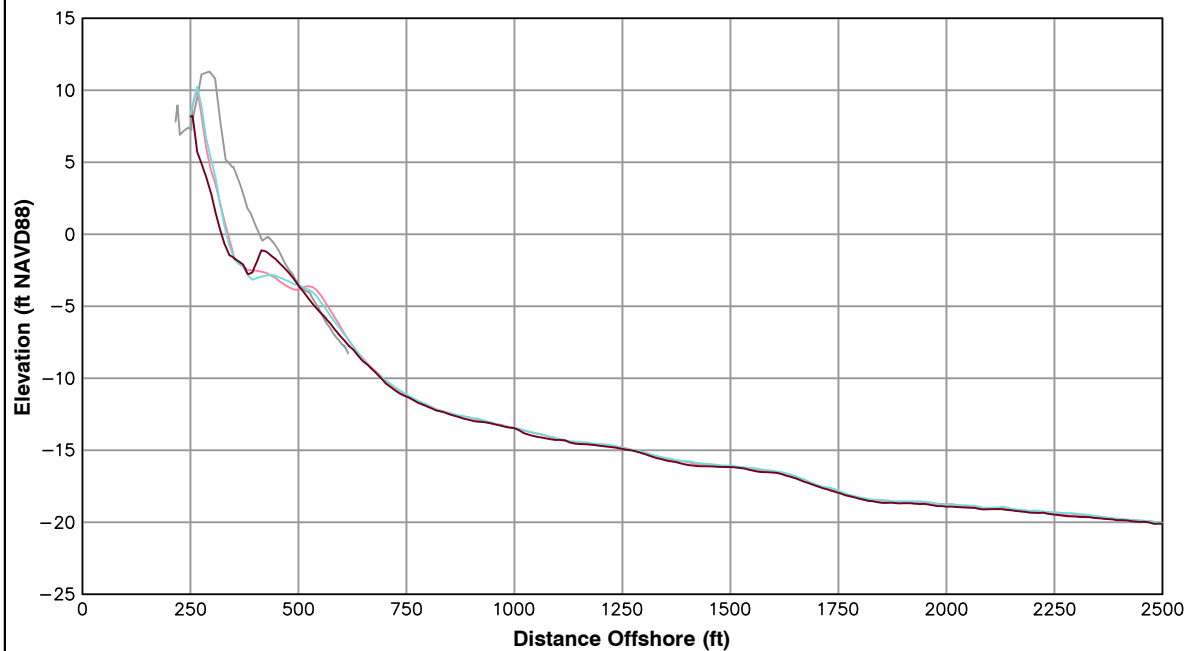


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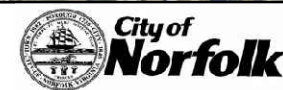
| Survey Transect 83+62 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -15.57 ft/yr | -13.35 ft |
| Volume Change Above -15 ft NAVD88 | -8.70 cy/ft/yr | -9.05 cy/ft |
| Volume Change Above 0 ft NAVD88 | -6.37 cy/ft/yr | -7.36 cy/ft |

LEGEND:

2015 OCT — dark red line
 2015 APR — cyan line
 2014 OCT — pink line
 POST-FILL — grey line

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.

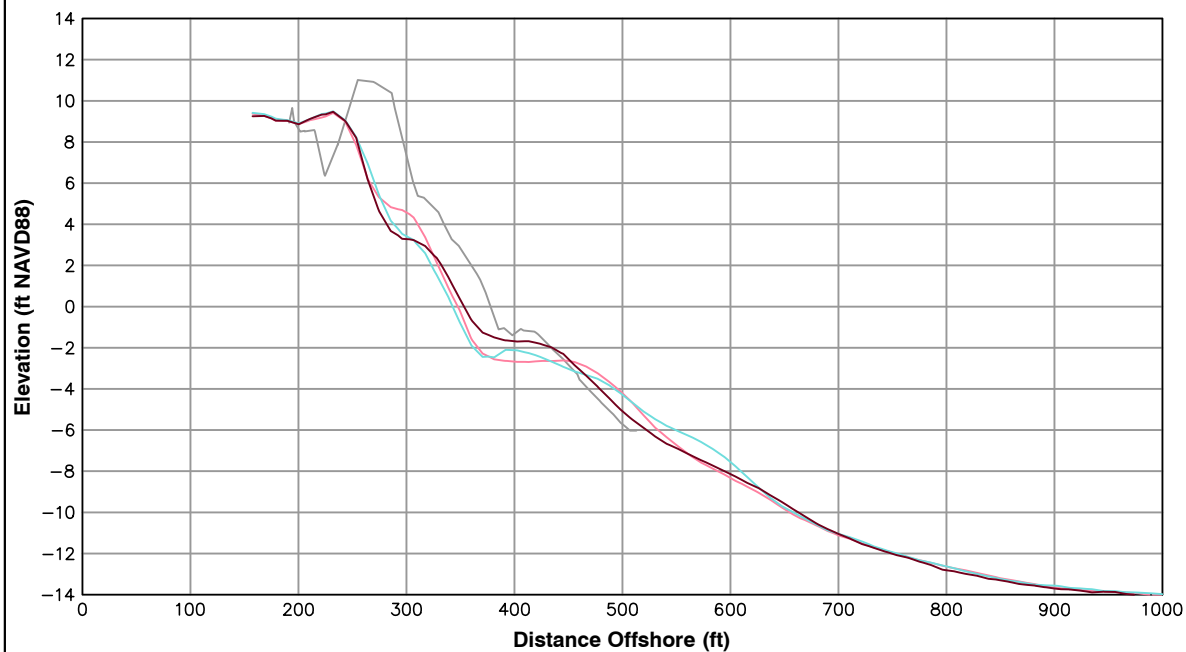
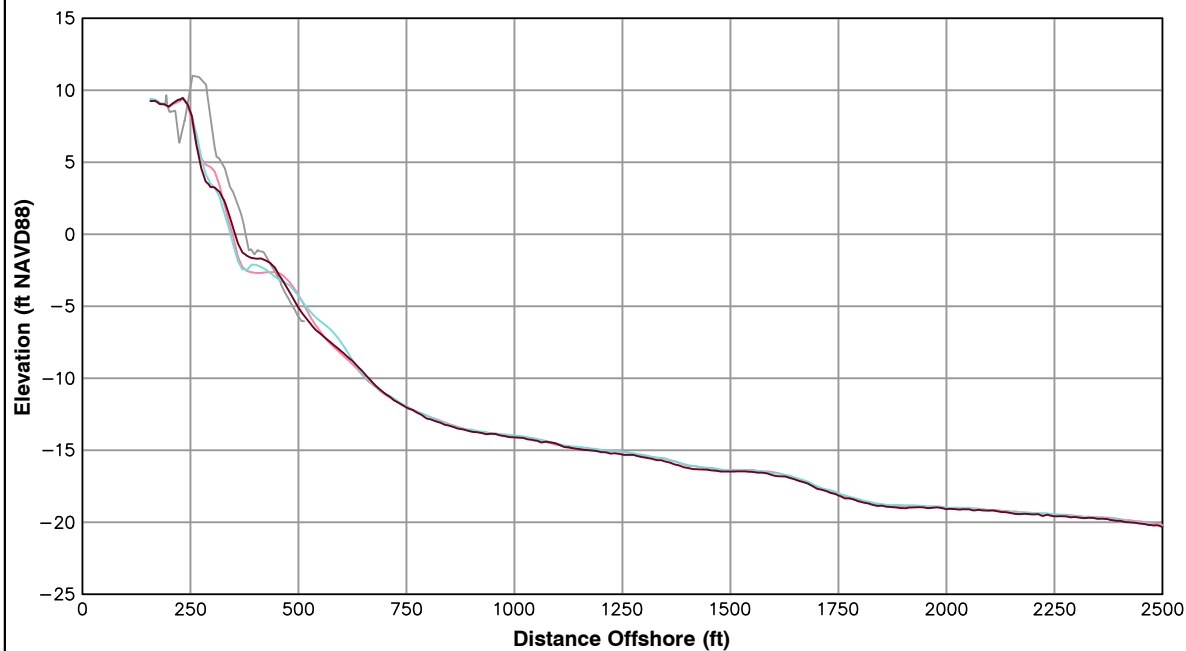


**OCEAN VIEW PERIODIC
SURVEYING DATA &
ANALYSIS**

ST 83+62

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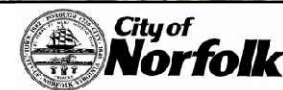
| Survey Transect 85+62 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 5.06 ft/yr | 9.72 ft |
| Volume Change Above -15 ft NAVD88 | -0.29 cy/ft/yr | -2.58 cy/ft |
| Volume Change Above 0 ft NAVD88 | -1.22 cy/ft/yr | -0.06 cy/ft |

LEGEND:

2015 OCT —
 2015 APR —
 2014 OCT —
 POST-FILL —

Notes:

1. Stationing From West To East At Varying Intervals.
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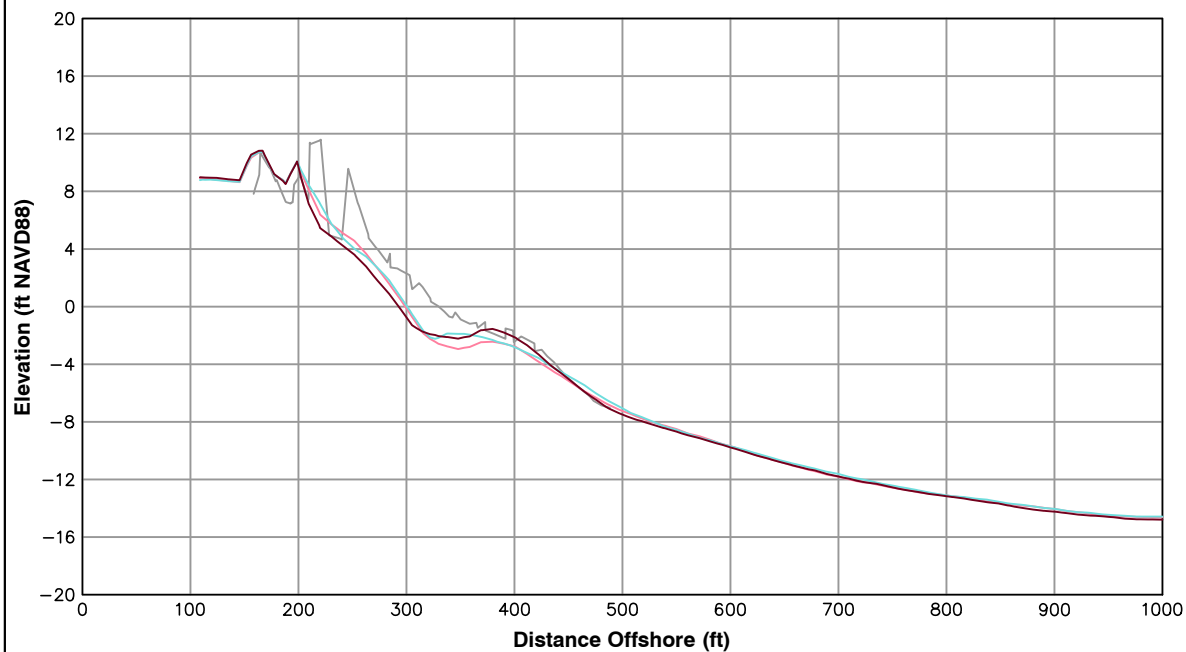
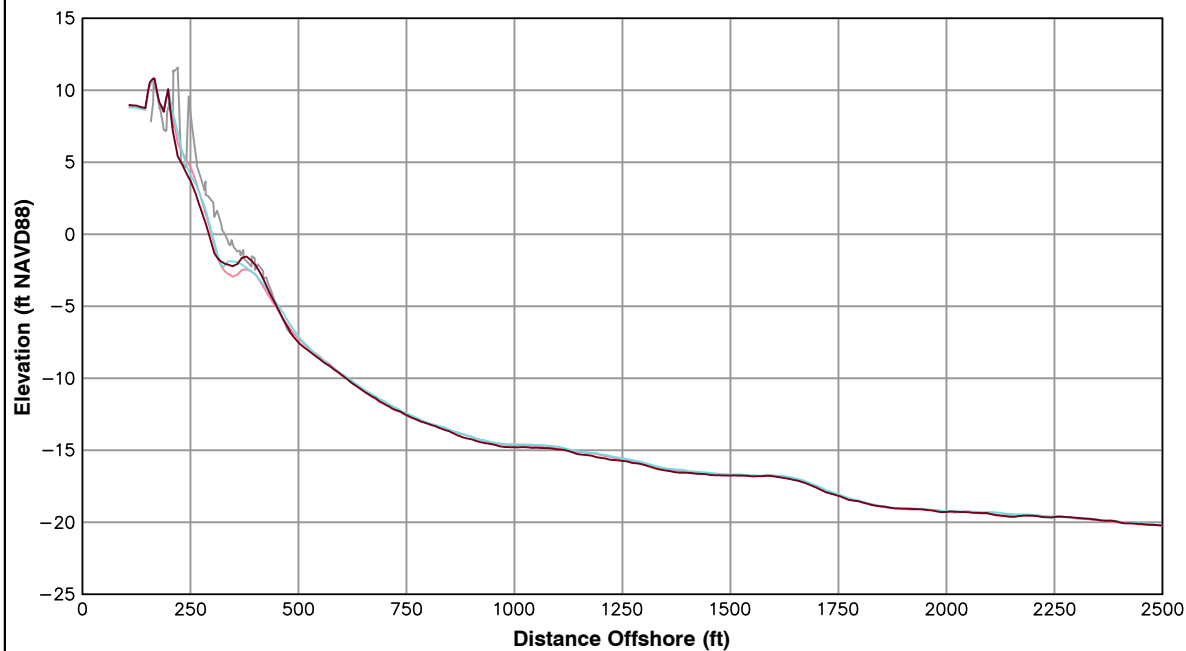


**OCEAN VIEW PERIODIC
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ANALYSIS**

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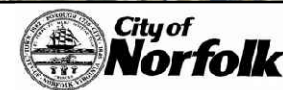
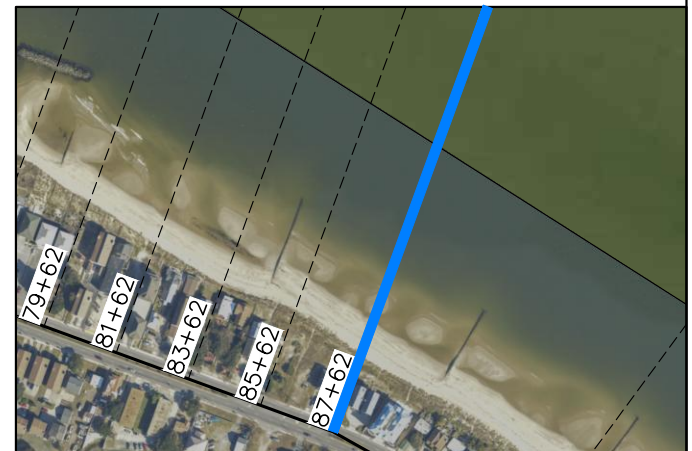
| Survey Transect 87+62 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -6.86 ft/yr | -8.99 ft |
| Volume Change Above -15 ft NAVD88 | -2.15 cy/ft/yr | -6.48 cy/ft |
| Volume Change Above 0 ft NAVD88 | -2.63 cy/ft/yr | -2.85 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
POST-FILL —

Notes:

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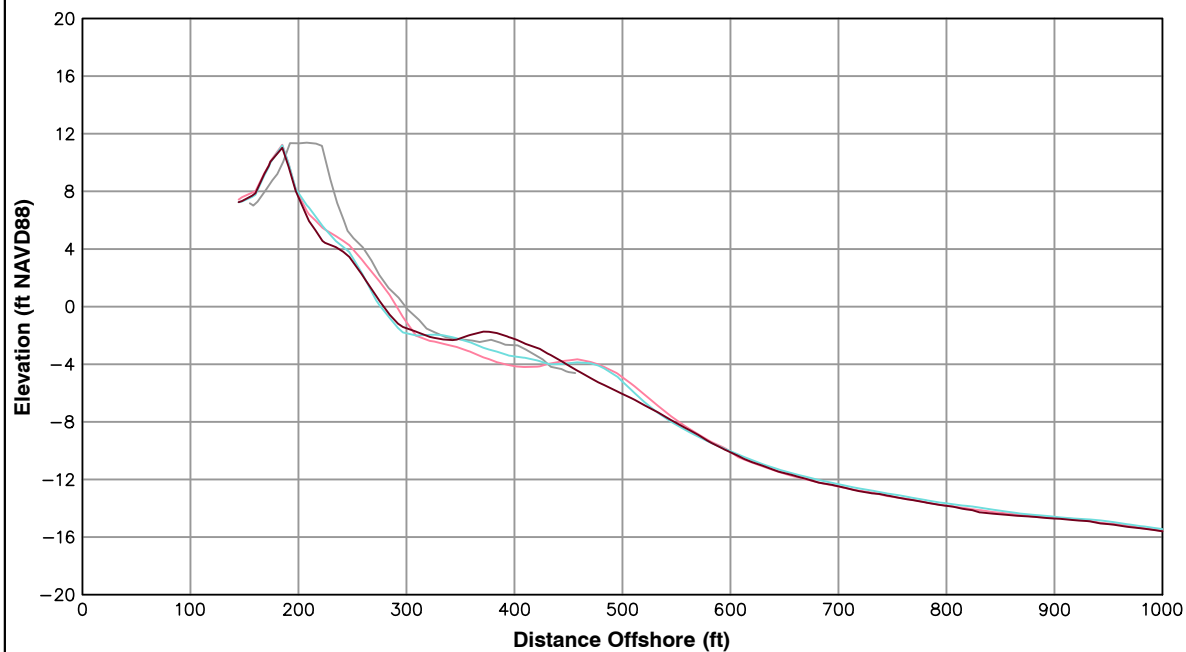
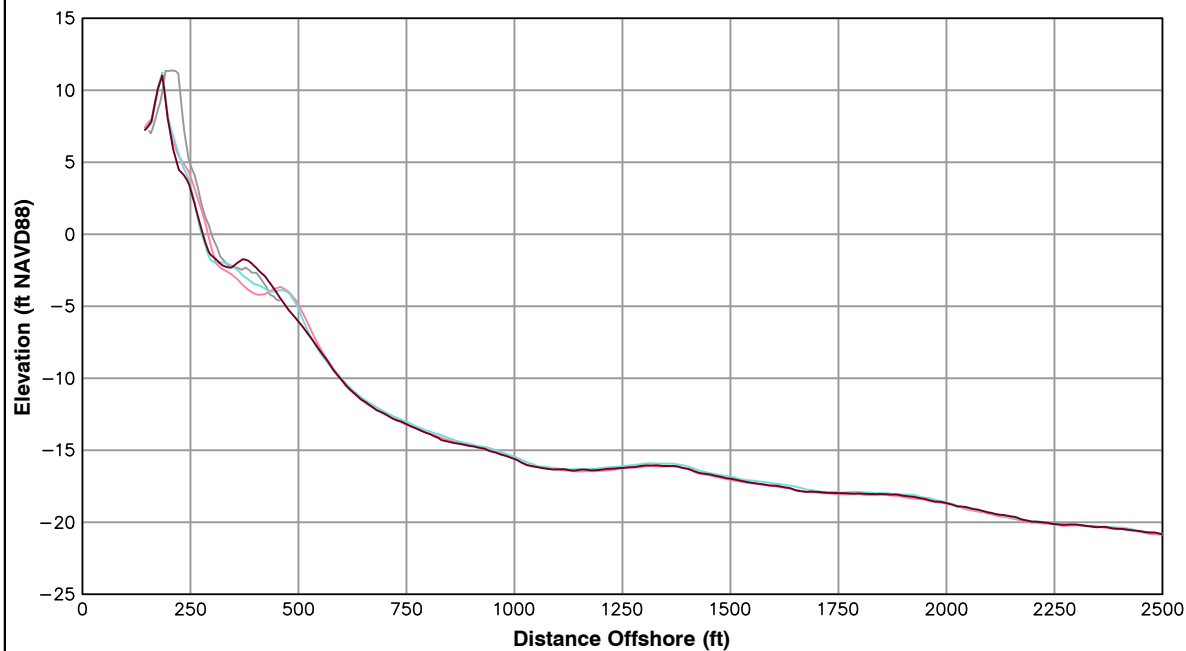


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ANALYSIS**

ST 87+62

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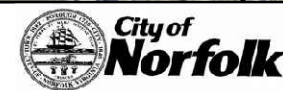
| Survey Transect 93+41 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -12.70 ft/yr | 1.69 ft |
| Volume Change Above -15 ft NAVD88 | -1.90 cy/ft/yr | -2.01 cy/ft |
| Volume Change Above 0 ft NAVD88 | -3.09 cy/ft/yr | -1.20 cy/ft |

LEGEND:

2015 OCT —
 2015 APR —
 2014 OCT —
 POST-FILL —

Notes:

1. Stationing From West To East At Varying Intervals.
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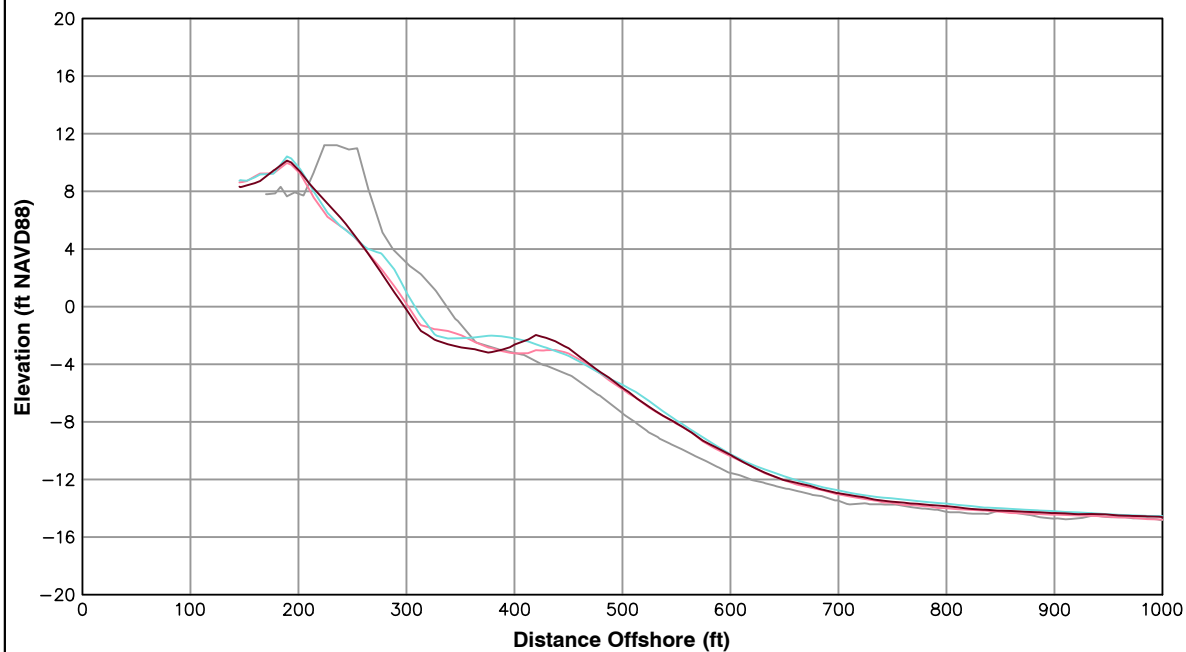
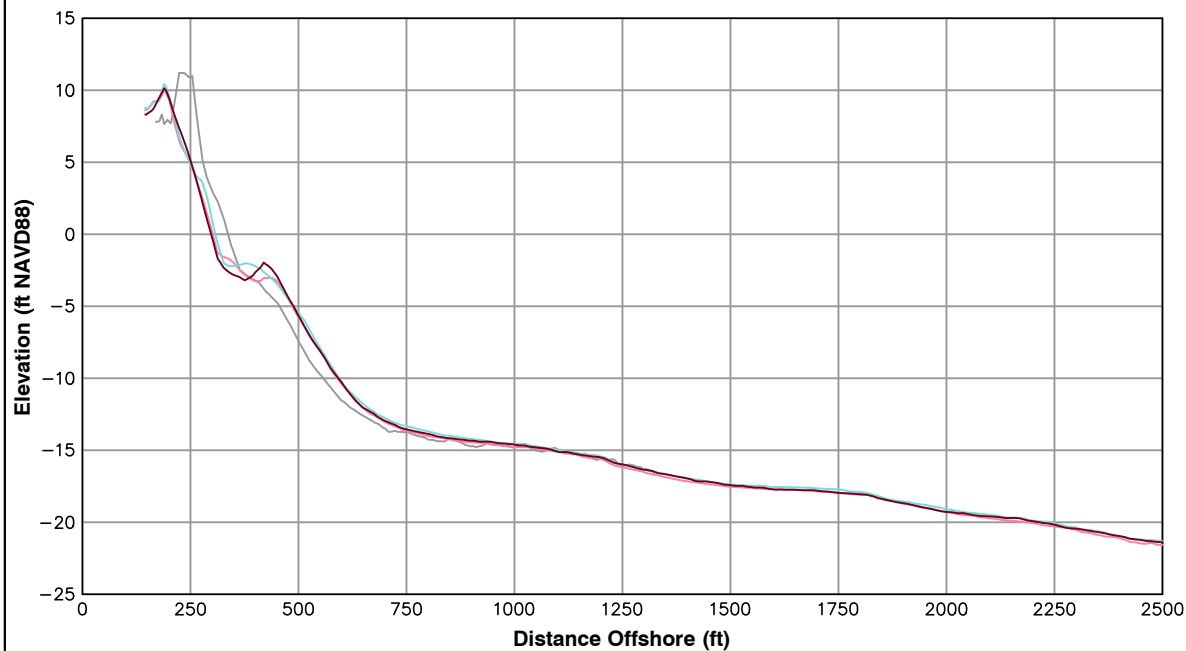


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SURVEYING DATA &
ANALYSIS**

ST 93+41

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| Survey Transect 103+08 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -3.90 ft/yr | -11.18 ft |
| Volume Change Above -15 ft NAVD88 | 2.48 cy/ft/yr | -6.63 cy/ft |
| Volume Change Above 0 ft NAVD88 | 0.46 cy/ft/yr | -1.60 cy/ft |

LEGEND:

2015 OCT —
 2015 APR —
 2014 OCT —
 POST-FILL —

Notes:

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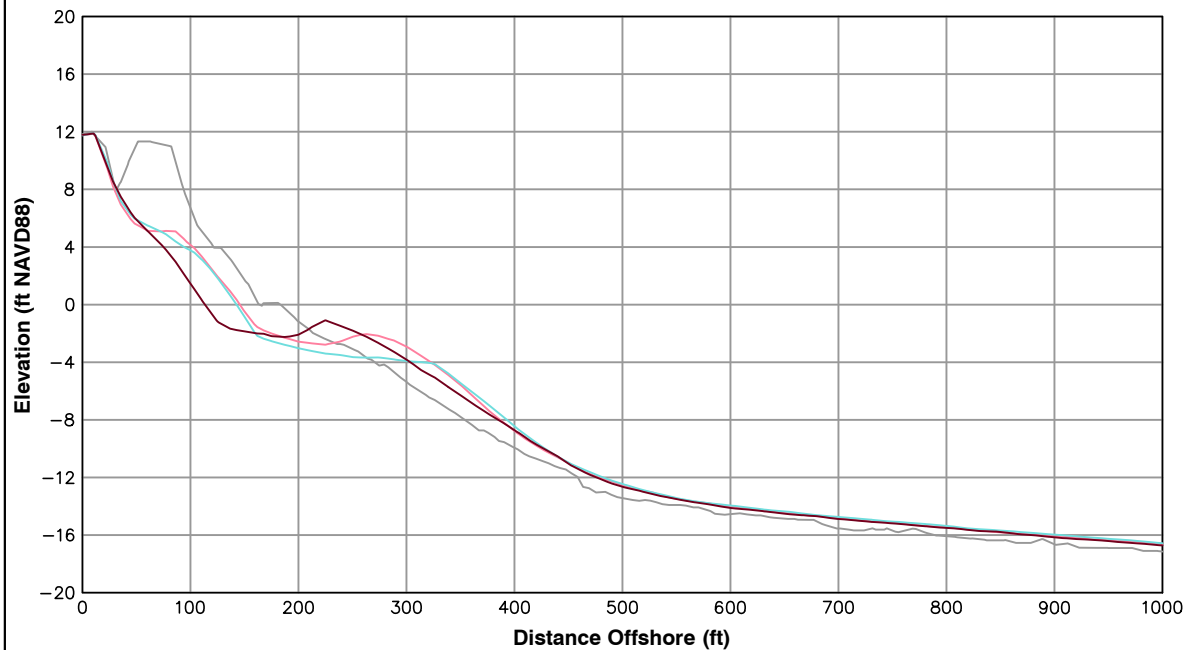
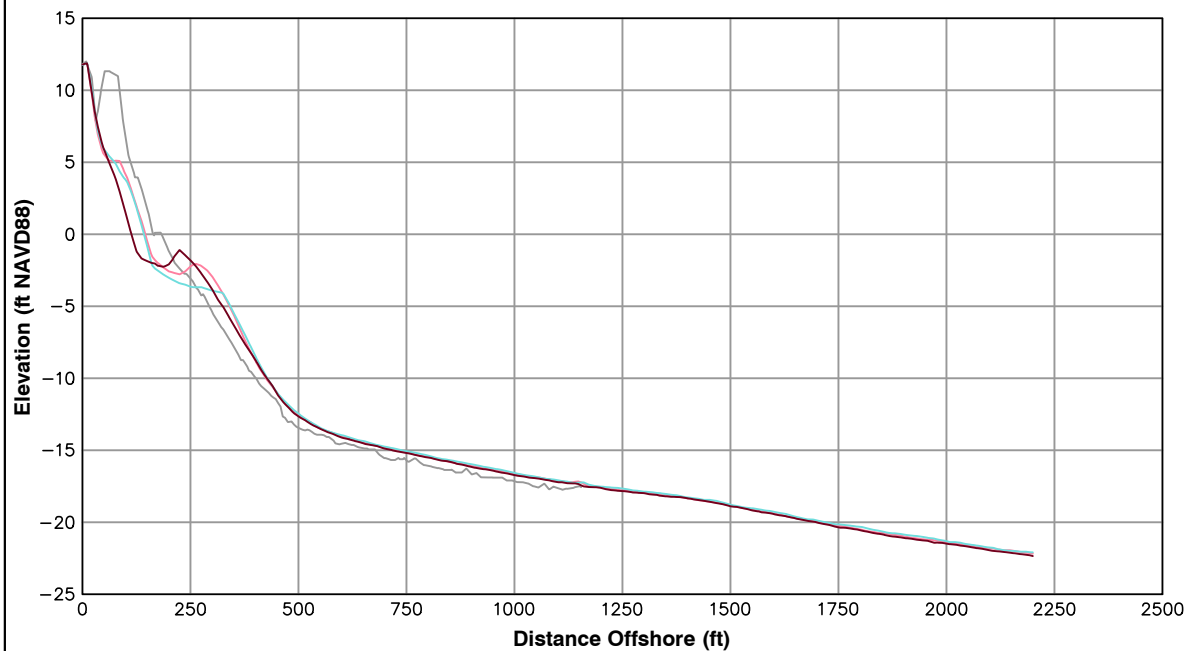
**City of
Norfolk**

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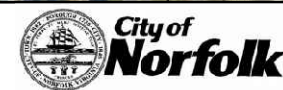
| Survey Transect 120+93 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -31.53 ft/yr | -29.05 ft |
| Volume Change Above -15 ft NAVD88 | -8.44 cy/ft/yr | -4.61 cy/ft |
| Volume Change Above 0 ft NAVD88 | -4.95 cy/ft/yr | -4.82 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
POST-FILL —

Notes:

1. Stationing From West To East At Varying Intervals.
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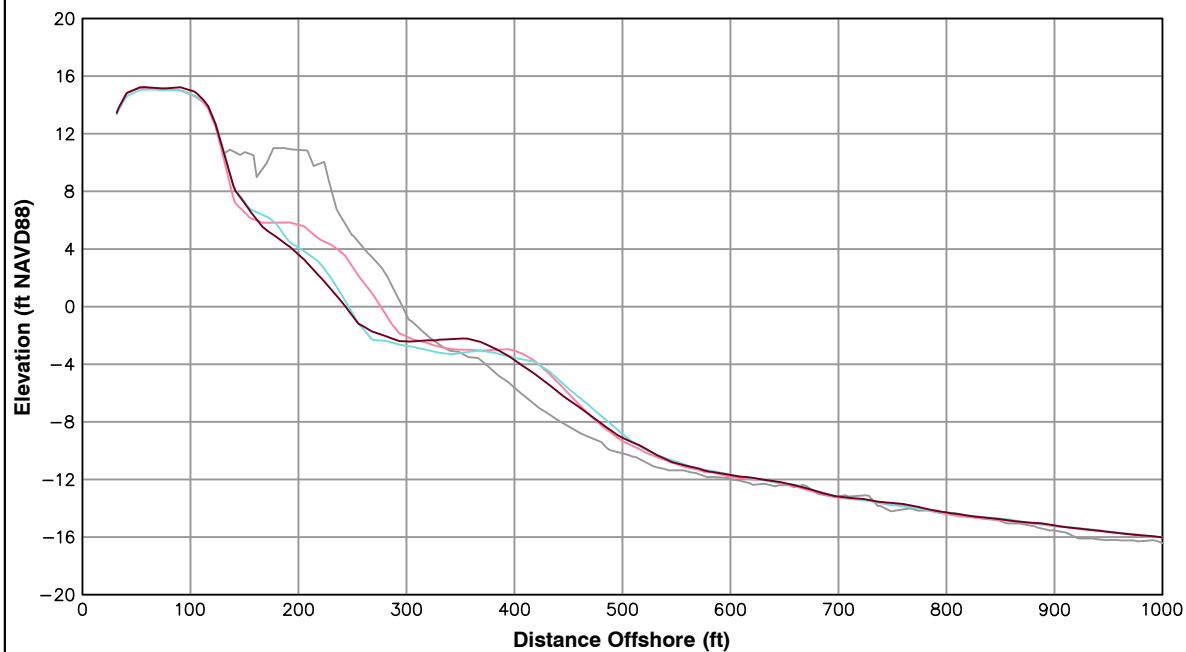
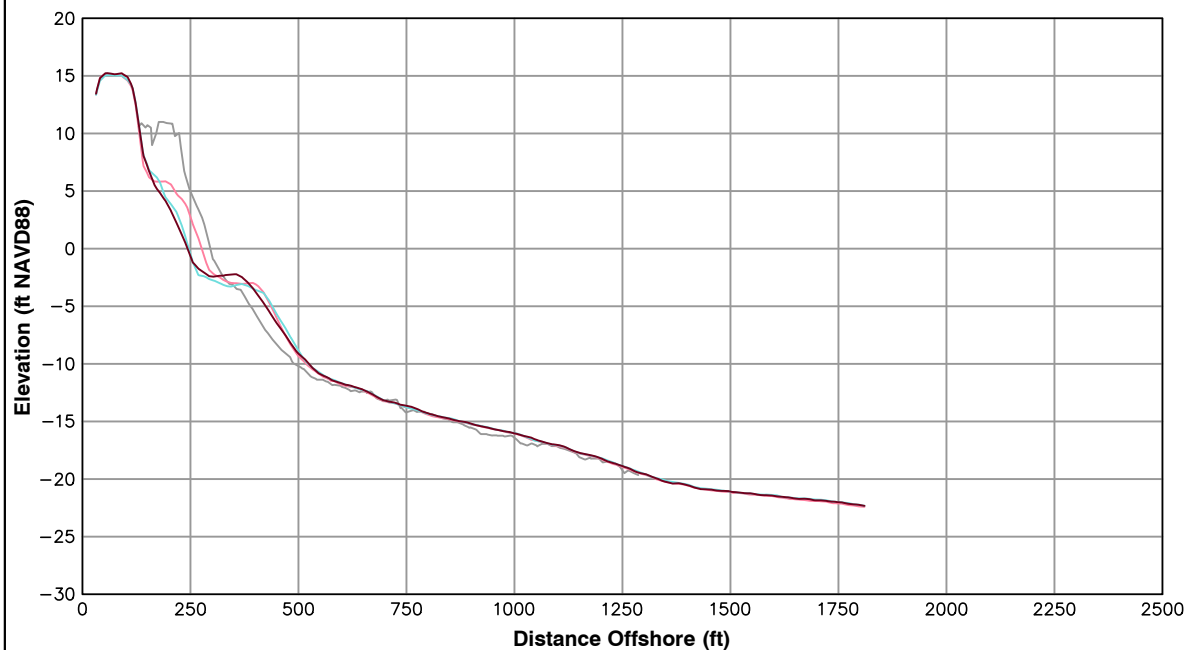


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ST 120+93

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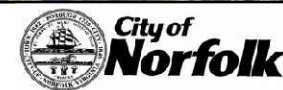
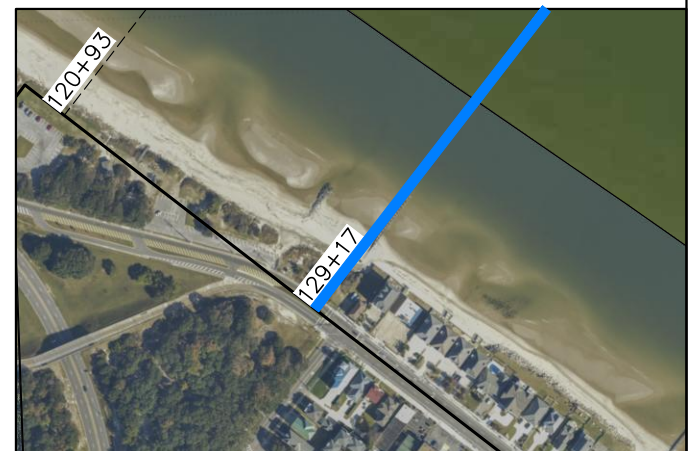
| Survey Transect 129+17 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -34.59 ft/yr | -5.84 ft |
| Volume Change Above -15 ft NAVD88 | -8.24 cy/ft/yr | -1.34 cy/ft |
| Volume Change Above 0 ft NAVD88 | -6.84 cy/ft/yr | -1.78 cy/ft |

LEGEND:

2015 OCT — dark red line
 2015 APR — cyan line
 2014 OCT — pink line
 POST-FILL — grey line

Notes:

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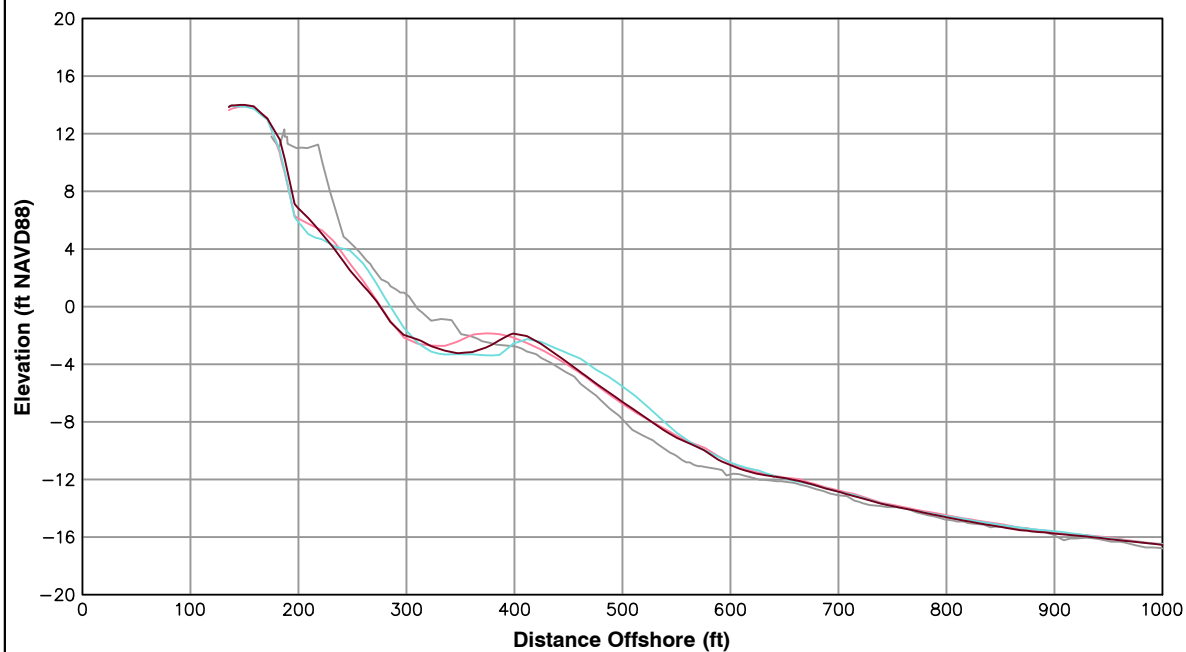
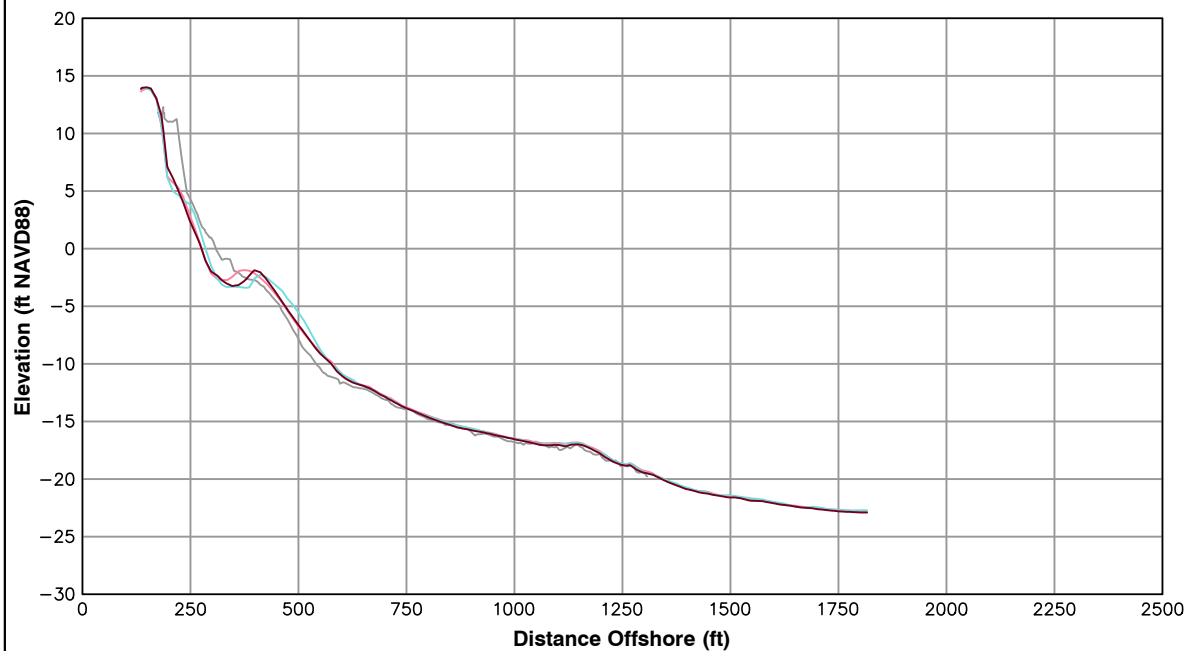


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ANALYSIS**

ST 129+17

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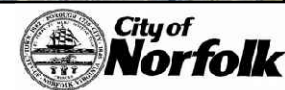
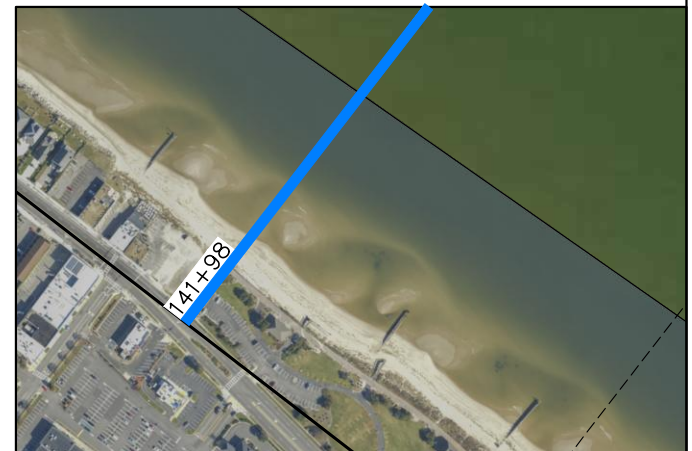
| Survey Transect 141+98 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -1.82 ft/yr | -11.59 ft |
| Volume Change Above -15 ft NAVD88 | -1.48 cy/ft/yr | -3.81 cy/ft |
| Volume Change Above 0 ft NAVD88 | 0.43 cy/ft/yr | -0.44 cy/ft |

LEGEND:

2015 OCT —
 2015 APR —
 2014 OCT —
 POST-FILL —

Notes:

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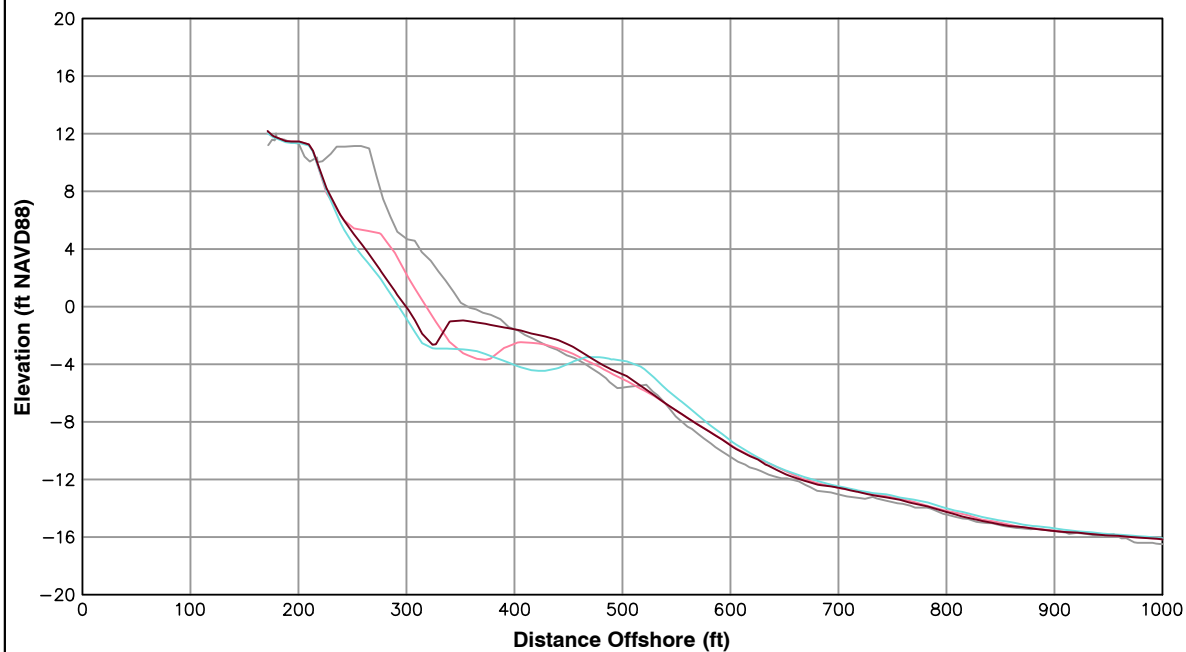
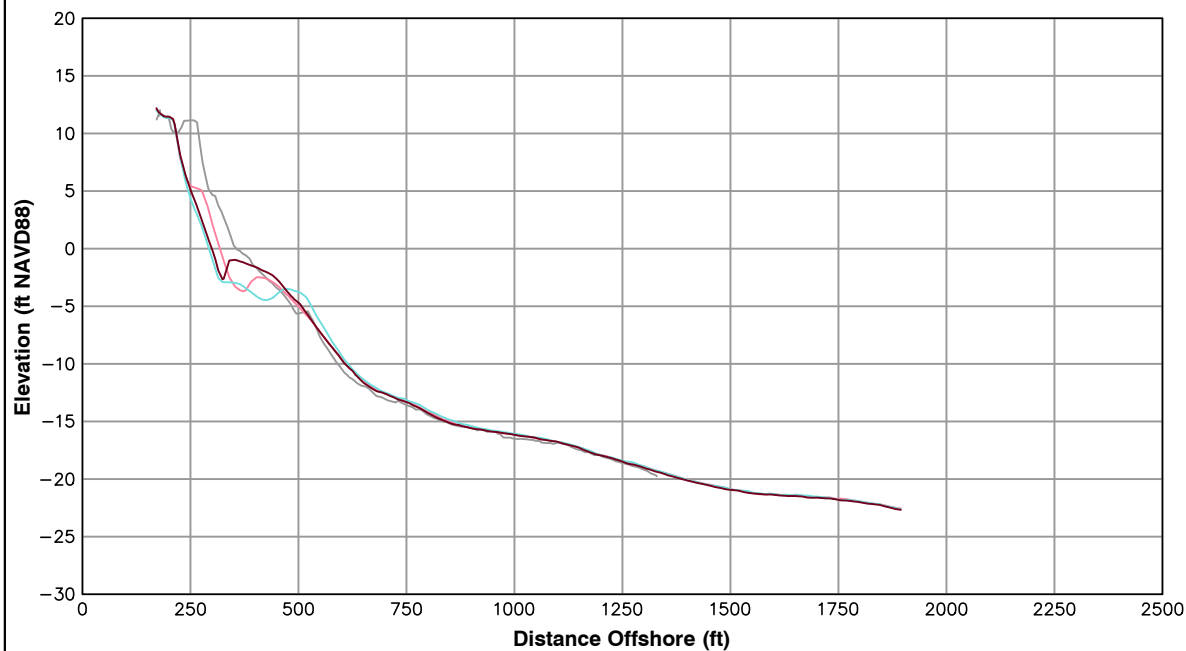


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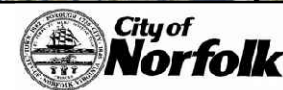
| Survey Transect 152+01 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -19.92 ft/yr | 5.61 ft |
| Volume Change Above -15 ft NAVD88 | -0.04 cy/ft/yr | 6.44 cy/ft |
| Volume Change Above 0 ft NAVD88 | -4.23 cy/ft/yr | 1.78 cy/ft |

LEGEND:

2015 OCT —
 2015 APR —
 2014 OCT —
 POST-FILL —

Notes:

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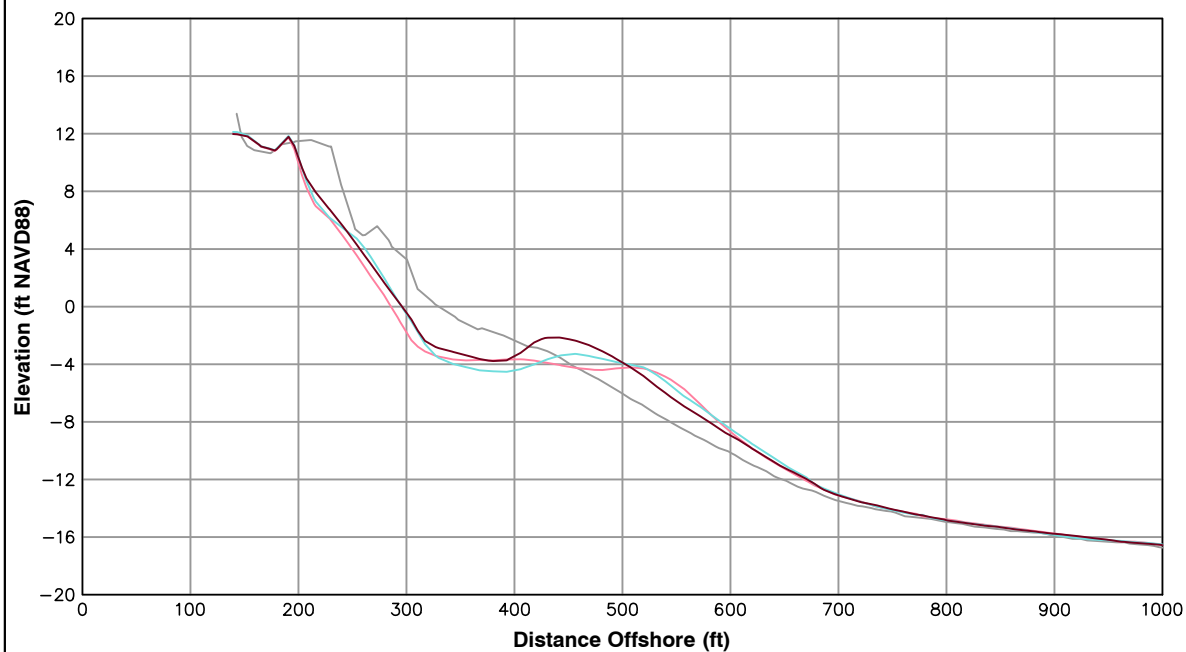
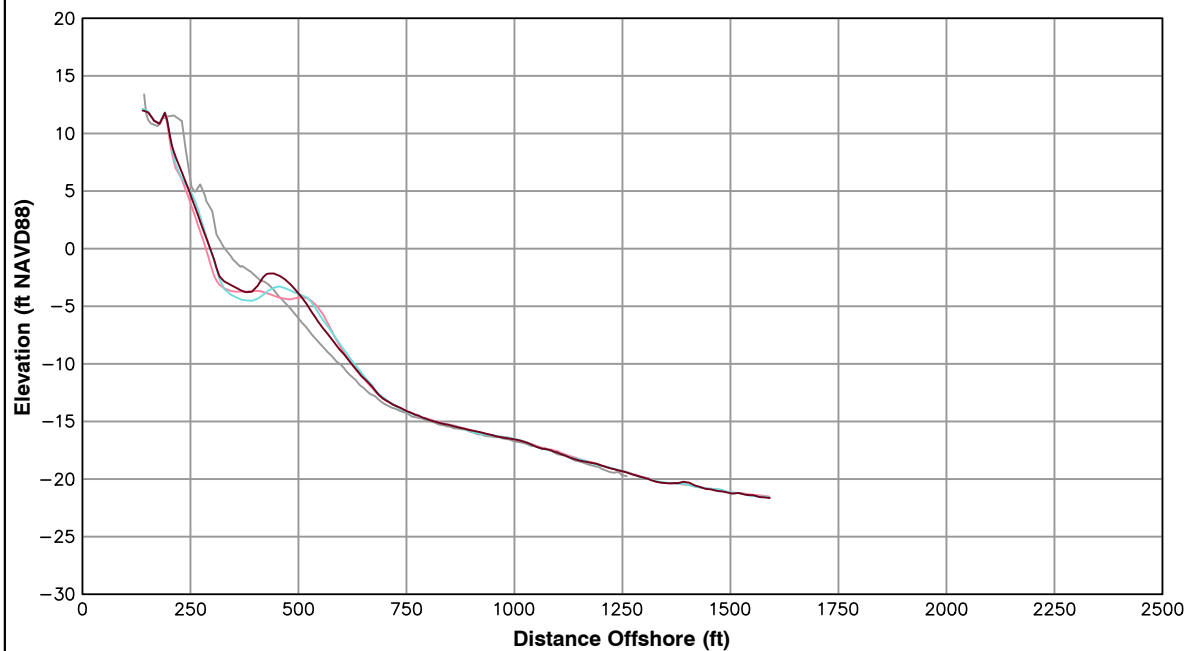


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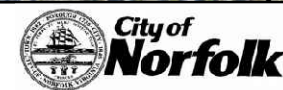
| Survey Transect 163+49 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 8.61 ft/yr | -1.25 ft |
| Volume Change Above -15 ft NAVD88 | 7.27 cy/ft/yr | 2.99 cy/ft |
| Volume Change Above 0 ft NAVD88 | 2.71 cy/ft/yr | -0.07 cy/ft |

LEGEND:

2015 OCT —
 2015 APR —
 2014 OCT —
 POST-FILL —

Notes:

1. Stationing From West To East At Varying Intervals.
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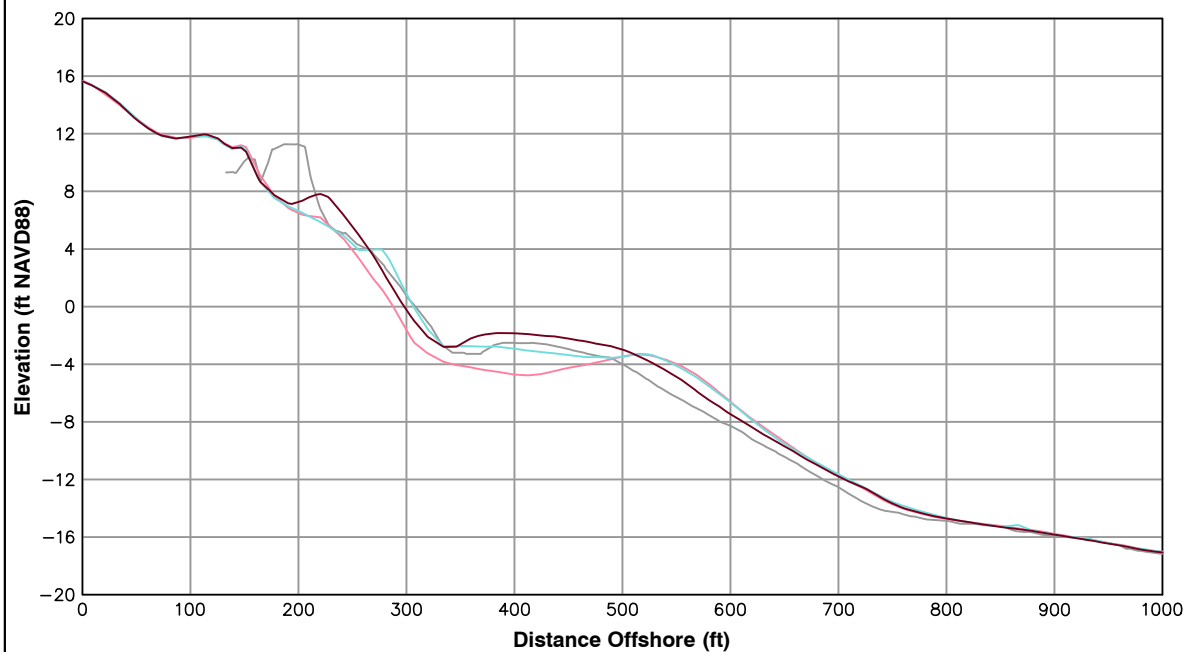
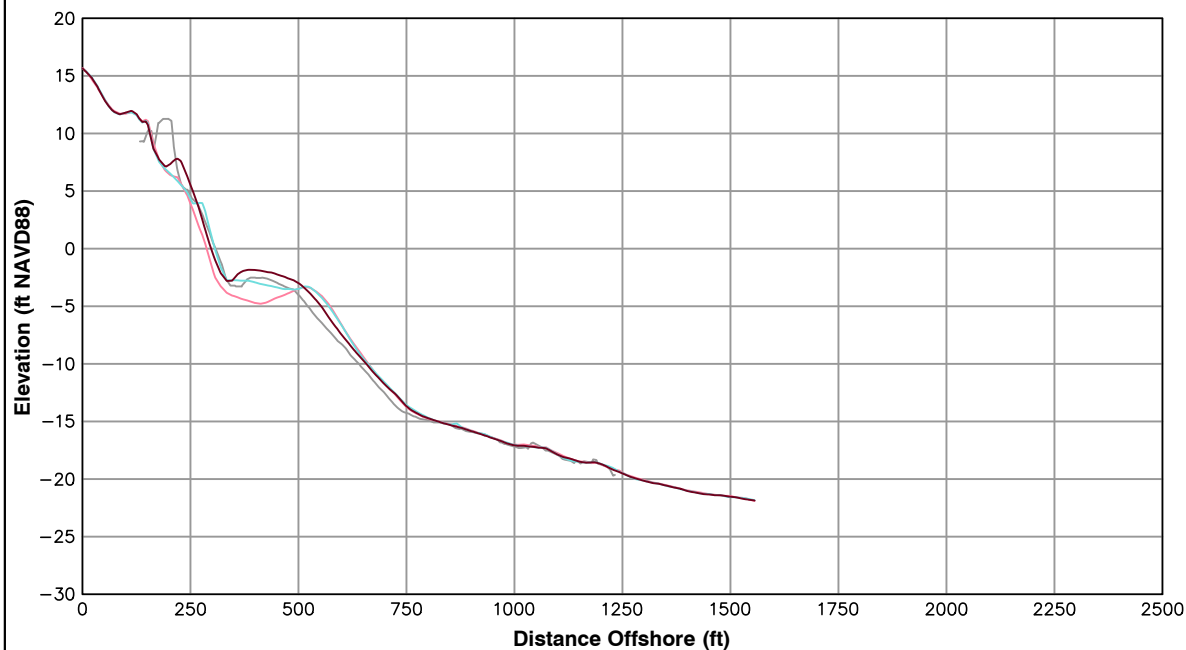


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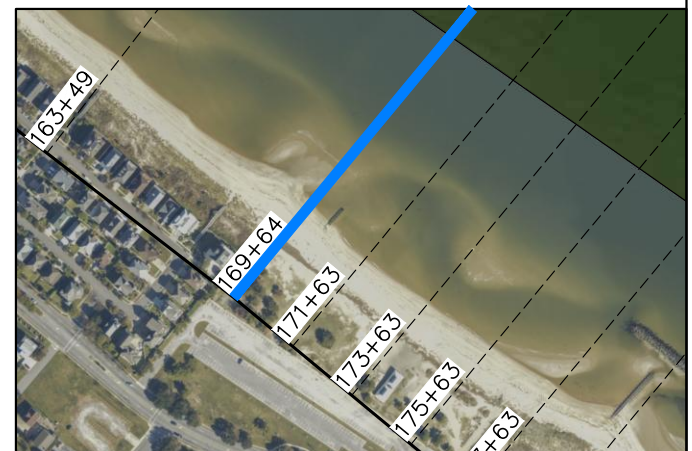
| Survey Transect 169+63 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 10.30 ft/yr | -9.79 ft |
| Volume Change Above -15 ft NAVD88 | 15.66 cy/ft/yr | 2.79 cy/ft |
| Volume Change Above 0 ft NAVD88 | 5.09 cy/ft/yr | 1.98 cy/ft |

LEGEND:

2015 OCT —
 2015 APR —
 2014 OCT —
 POST-FILL —

Notes:

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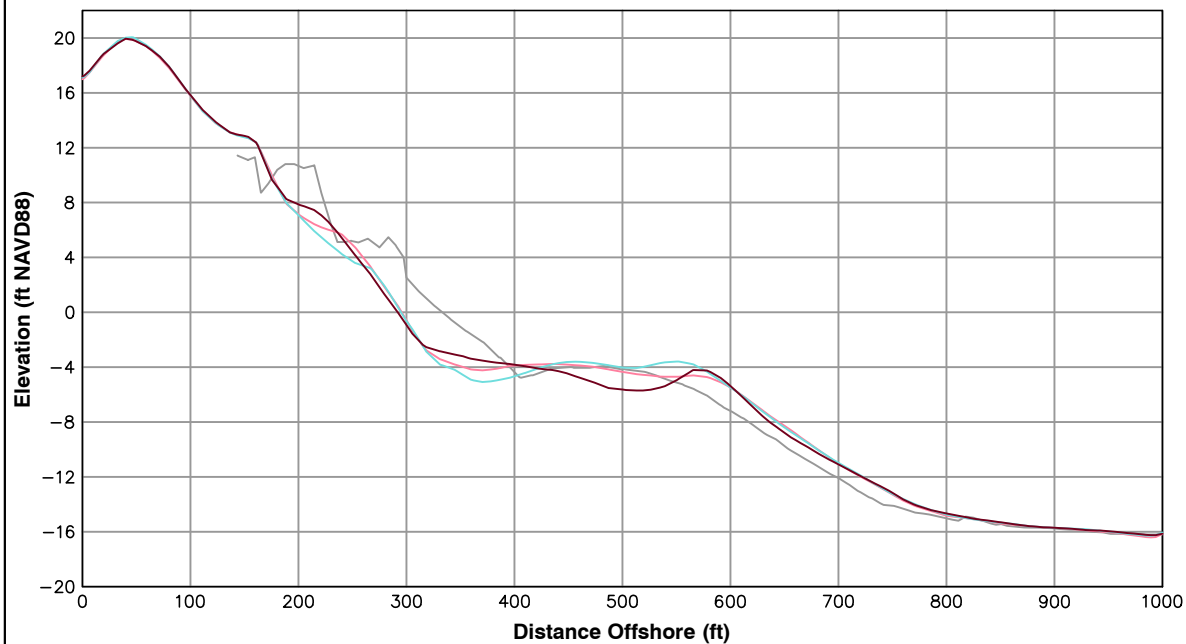
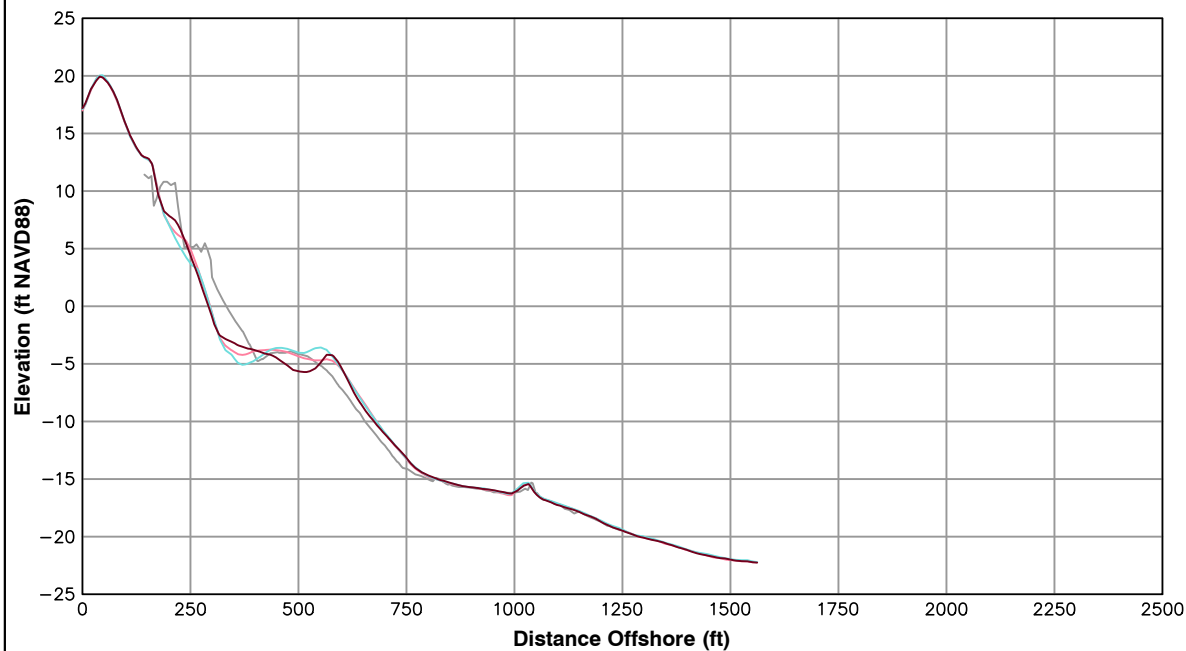
**City of
Norfolk**

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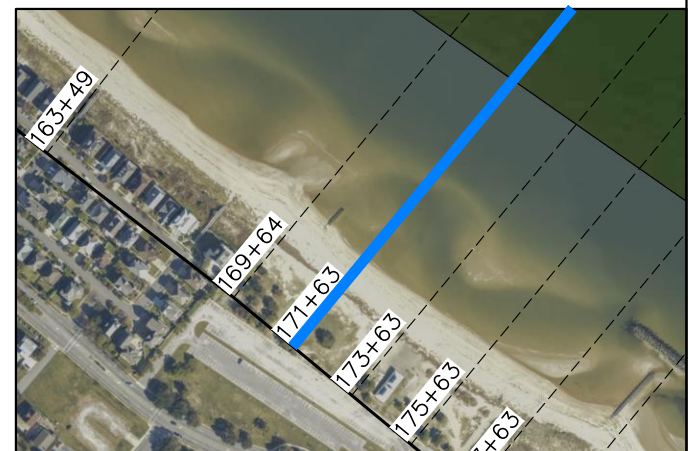
| Survey Transect 171+63 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -4.64 ft/yr | -4.58 ft |
| Volume Change Above -15 ft NAVD88 | -2.79 cy/ft/yr | -1.66 cy/ft |
| Volume Change Above 0 ft NAVD88 | 0.32 cy/ft/yr | 2.12 cy/ft |

LEGEND:

2015 OCT —
 2015 APR —
 2014 OCT —
 POST-FILL —

Notes:

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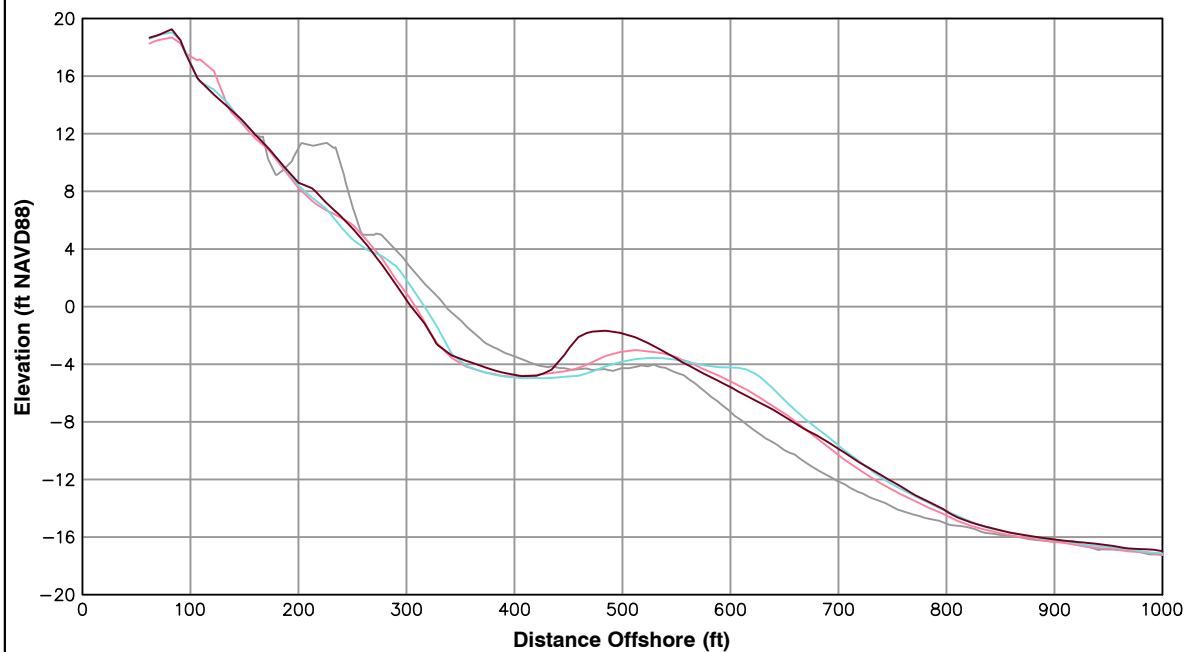
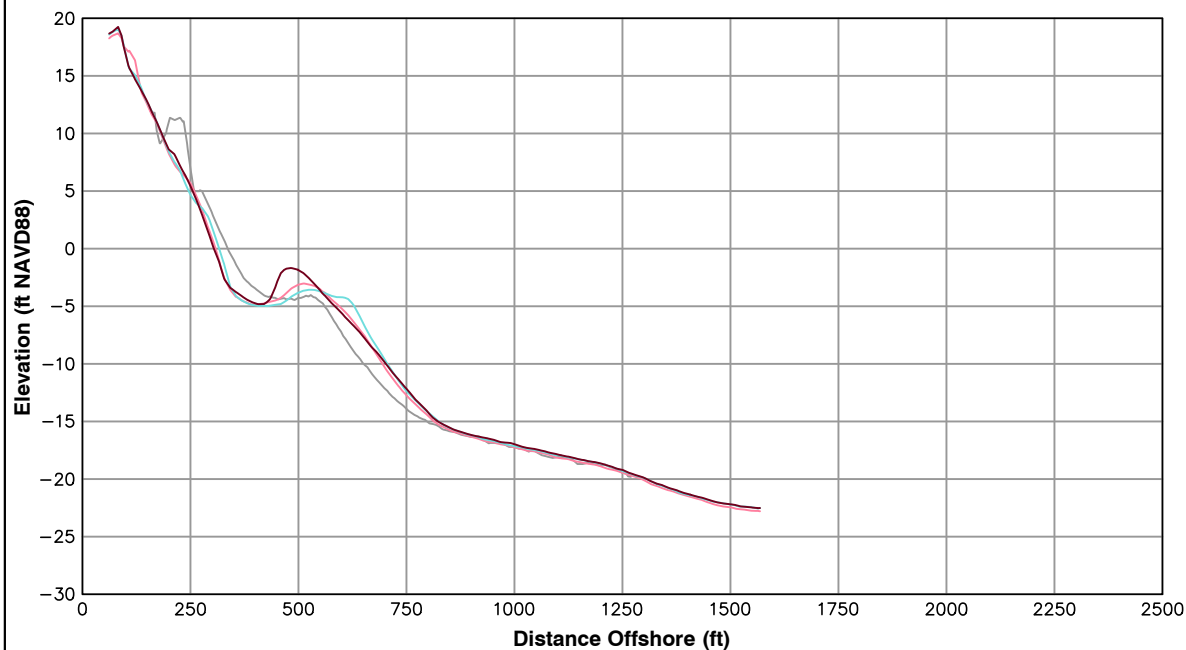
**City of
Norfolk**

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ANALYSIS**

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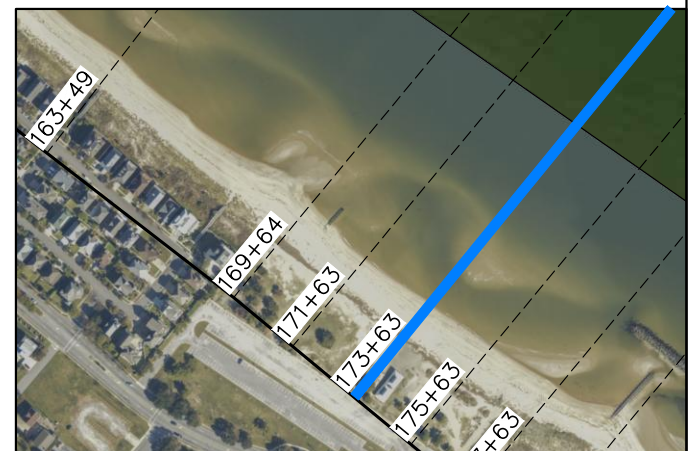
| Survey Transect 173+63 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -3.95 ft/yr | -12.64 ft |
| Volume Change Above -15 ft NAVD88 | 5.77 cy/ft/yr | 1.41 cy/ft |
| Volume Change Above 0 ft NAVD88 | -0.60 cy/ft/yr | -0.34 cy/ft |

LEGEND:

2015 OCT —
 2015 APR —
 2014 OCT —
 POST-FILL —

Notes:

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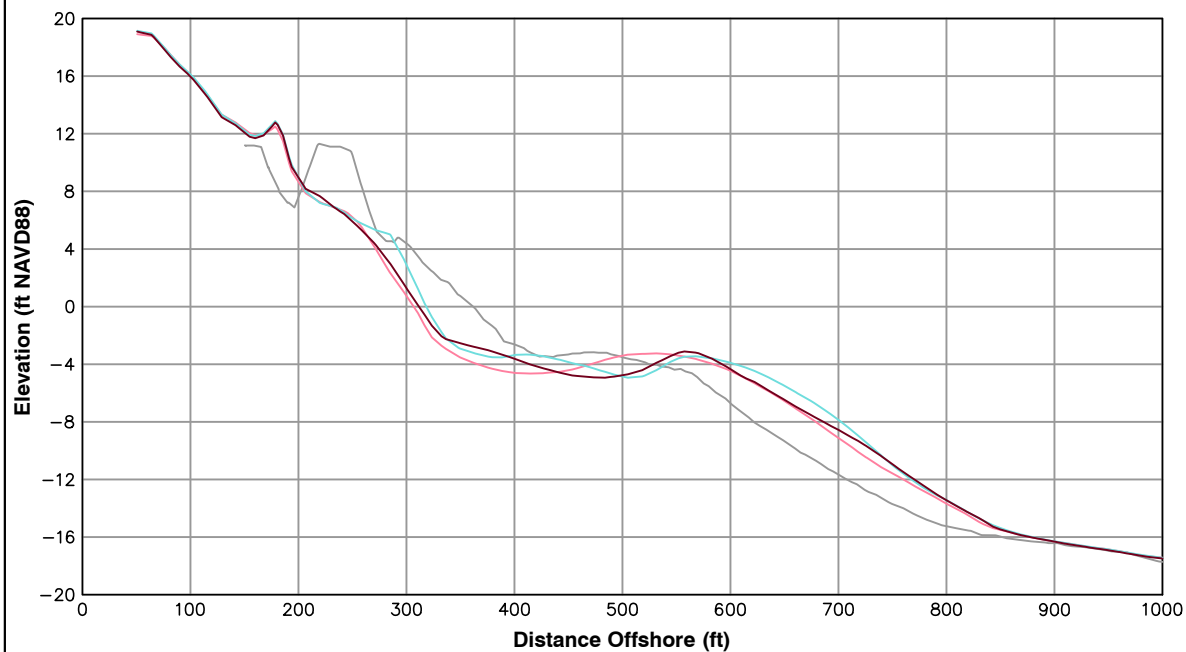
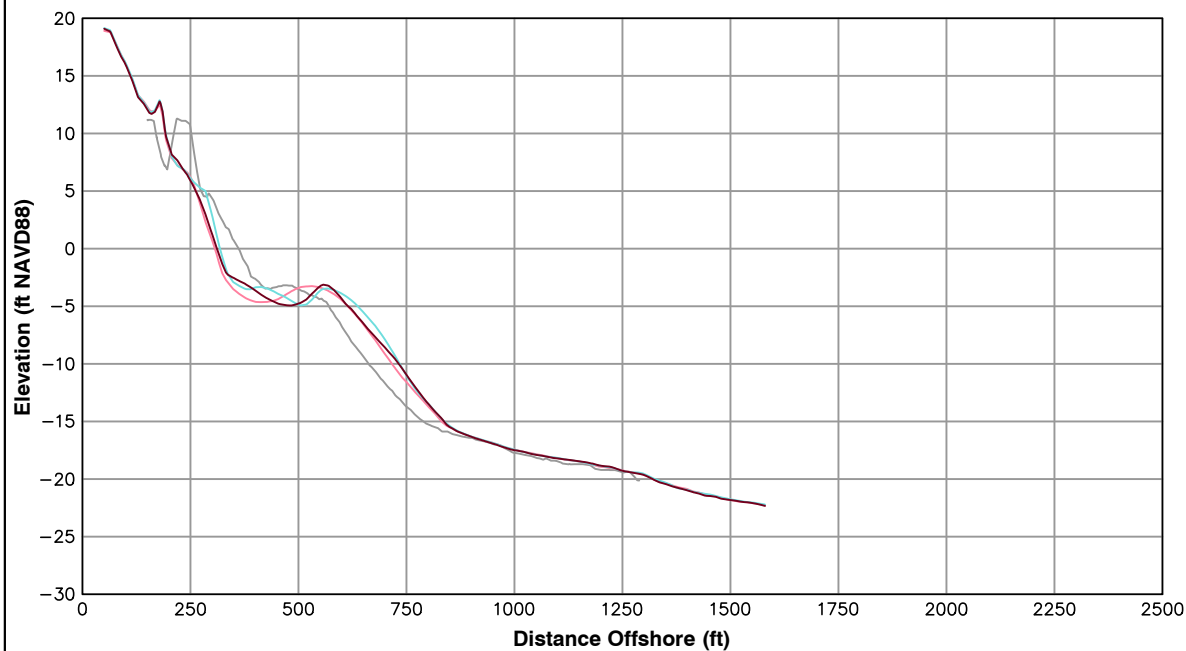
**City of
Norfolk**

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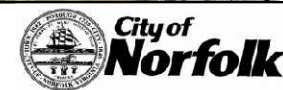
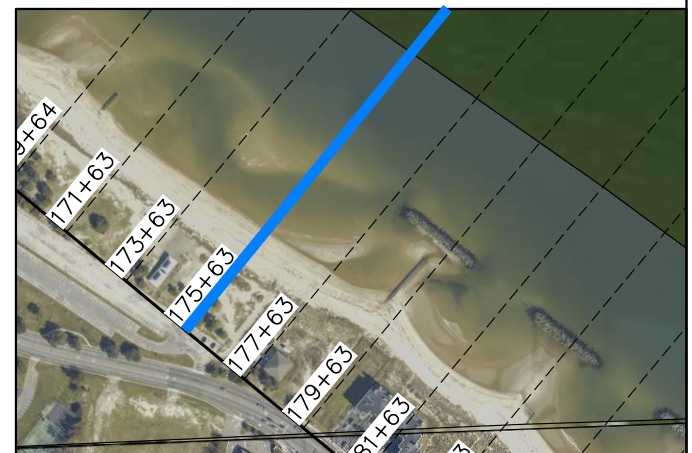
| Survey Transect 175+63 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 4.85 ft/yr | -9.41 ft |
| Volume Change Above -15 ft NAVD88 | 4.94 cy/ft/yr | -8.19 cy/ft |
| Volume Change Above 0 ft NAVD88 | 0.76 cy/ft/yr | -3.48 cy/ft |

LEGEND:

2015 OCT —
 2015 APR —
 2014 OCT —
 POST-FILL —

Notes:

1. Stationing From West To East At Varying Intervals.
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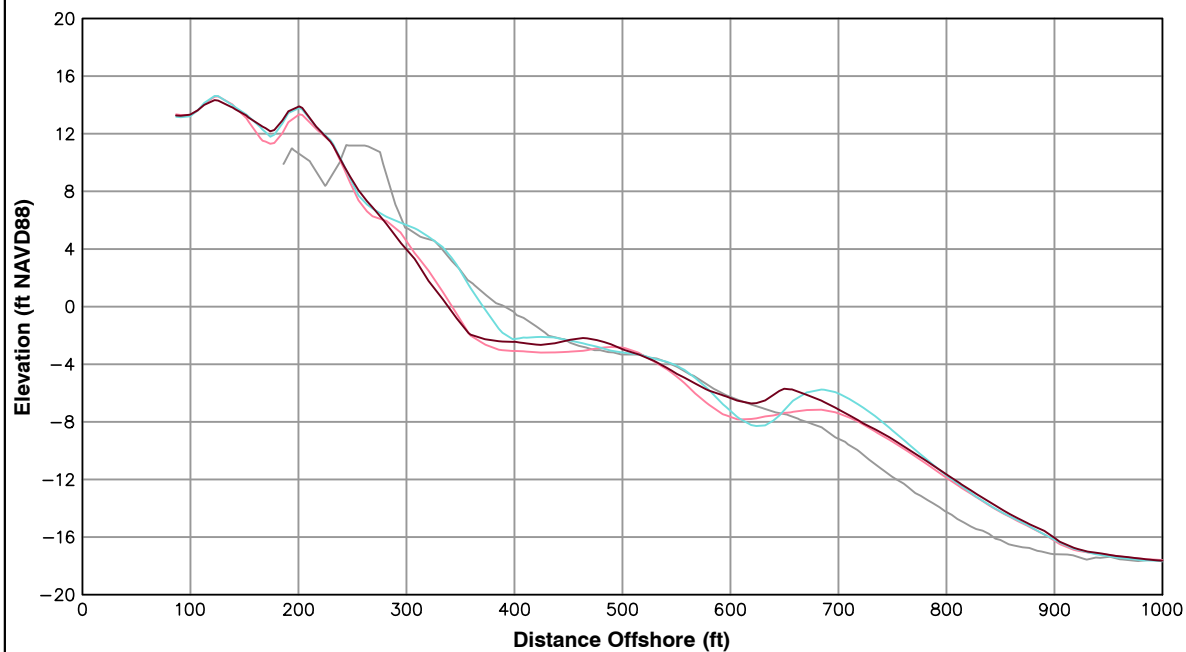
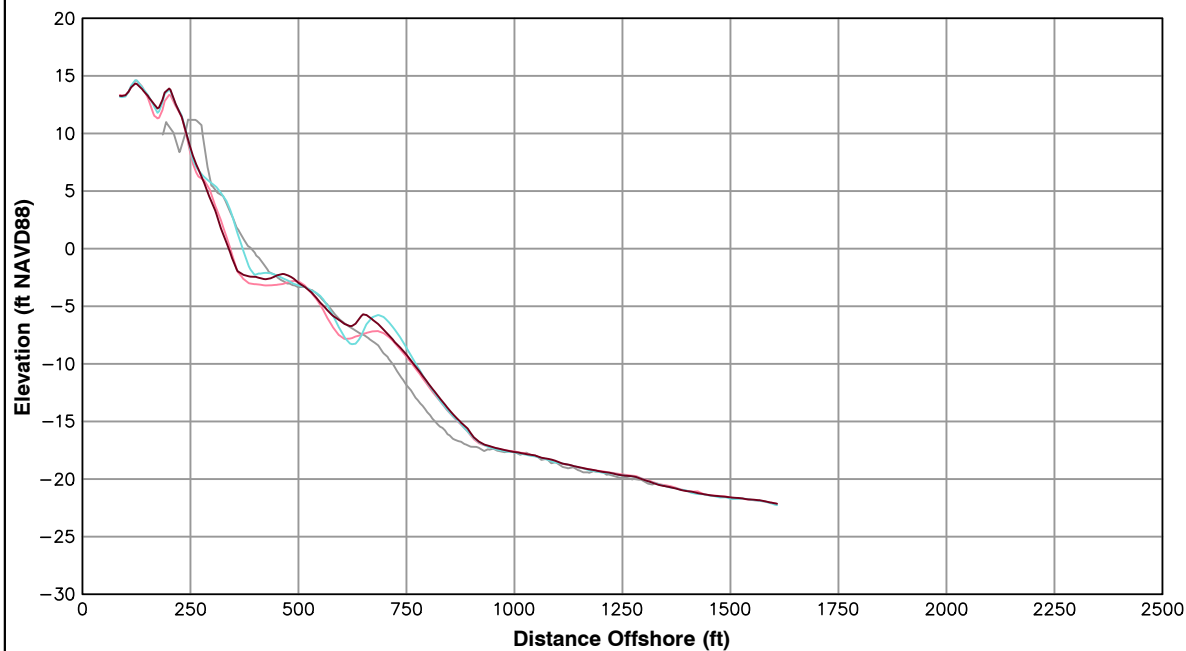


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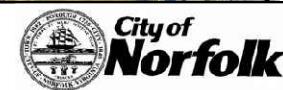
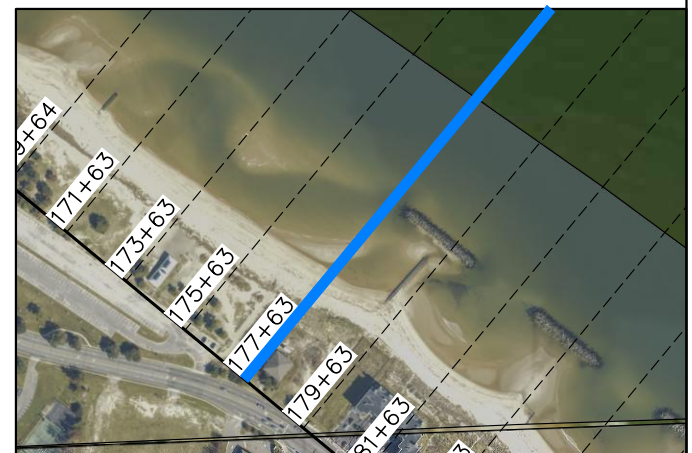
| Survey Transect 177+63 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -5.17 ft/yr | -33.41 ft |
| Volume Change Above -15 ft NAVD88 | 10.35 cy/ft/yr | -9.45 cy/ft |
| Volume Change Above 0 ft NAVD88 | 0.89 cy/ft/yr | -6.94 cy/ft |

LEGEND:

2015 OCT — dark red line
 2015 APR — cyan line
 2014 OCT — pink line
 POST-FILL — grey line

Notes:

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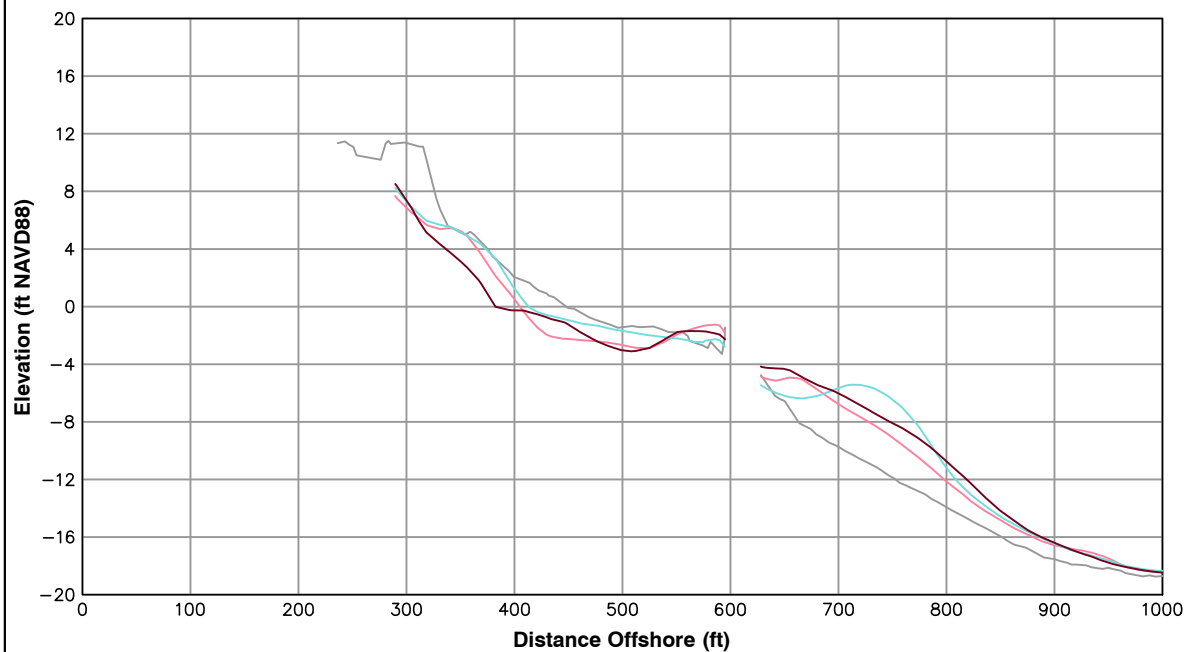
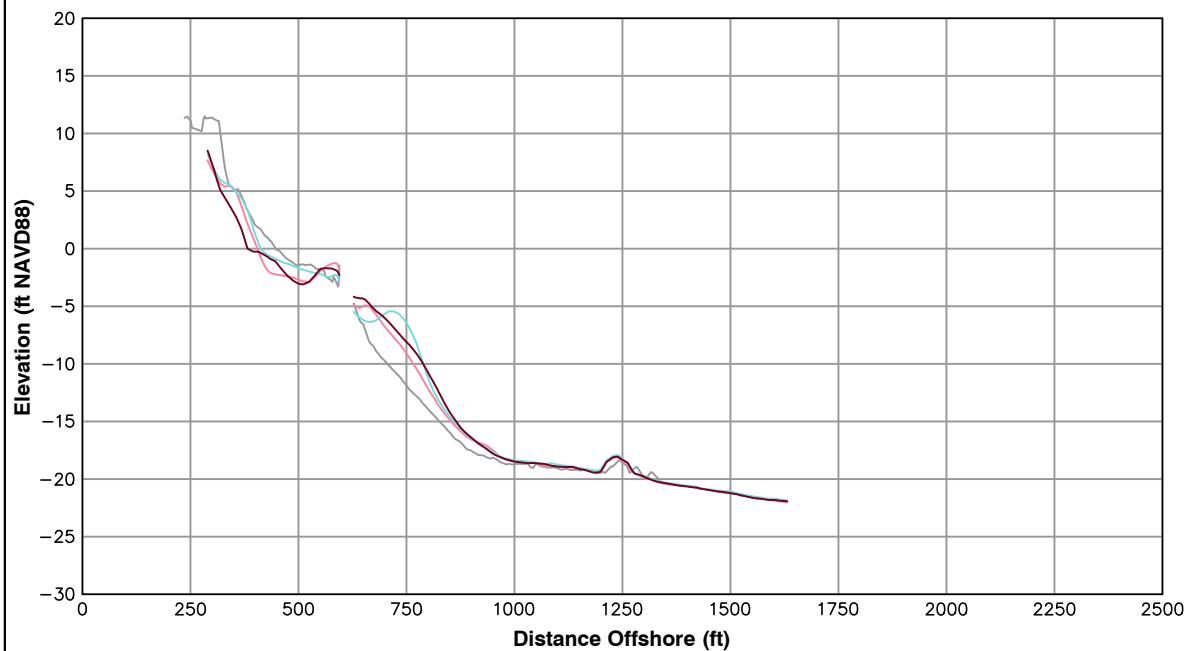


**OCEAN VIEW PERIODIC
SURVEYING DATA &
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Fall 2015



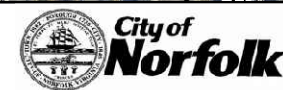
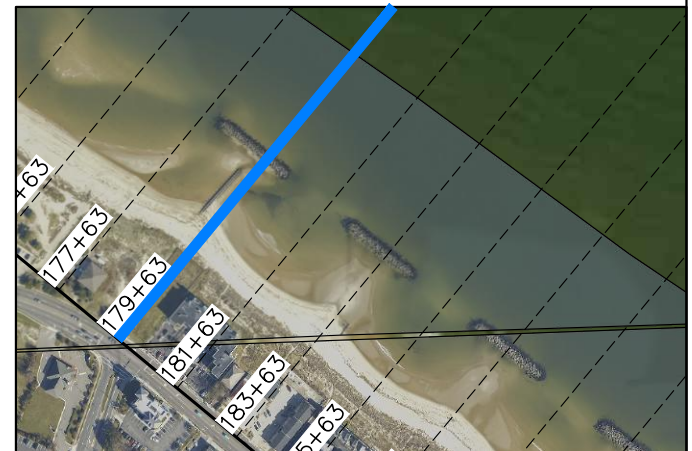
| Survey Transect 179+63 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -20.69 ft/yr | -28.49 ft |
| Volume Change Above -15 ft NAVD88 | 3.91 cy/ft/yr | -8.87 cy/ft |
| Volume Change Above 0 ft NAVD88 | -4.65 cy/ft/yr | -6.83 cy/ft |

LEGEND:

2015 OCT —
 2015 APR —
 2014 OCT —
 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 October 2014 and April 2015.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

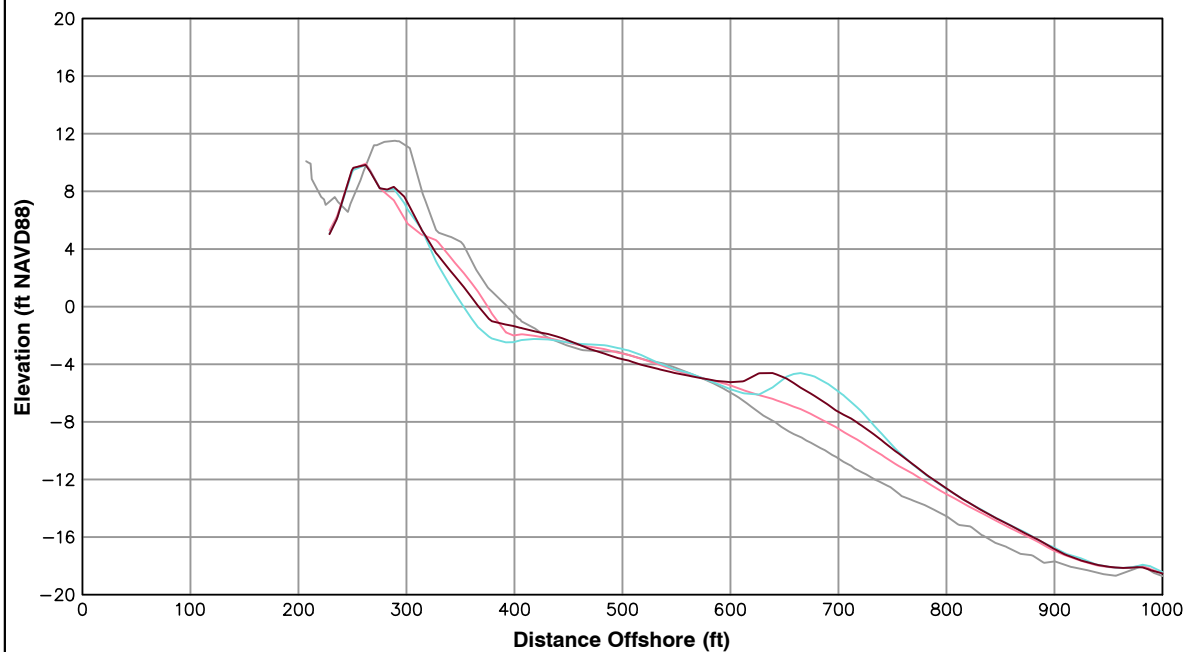
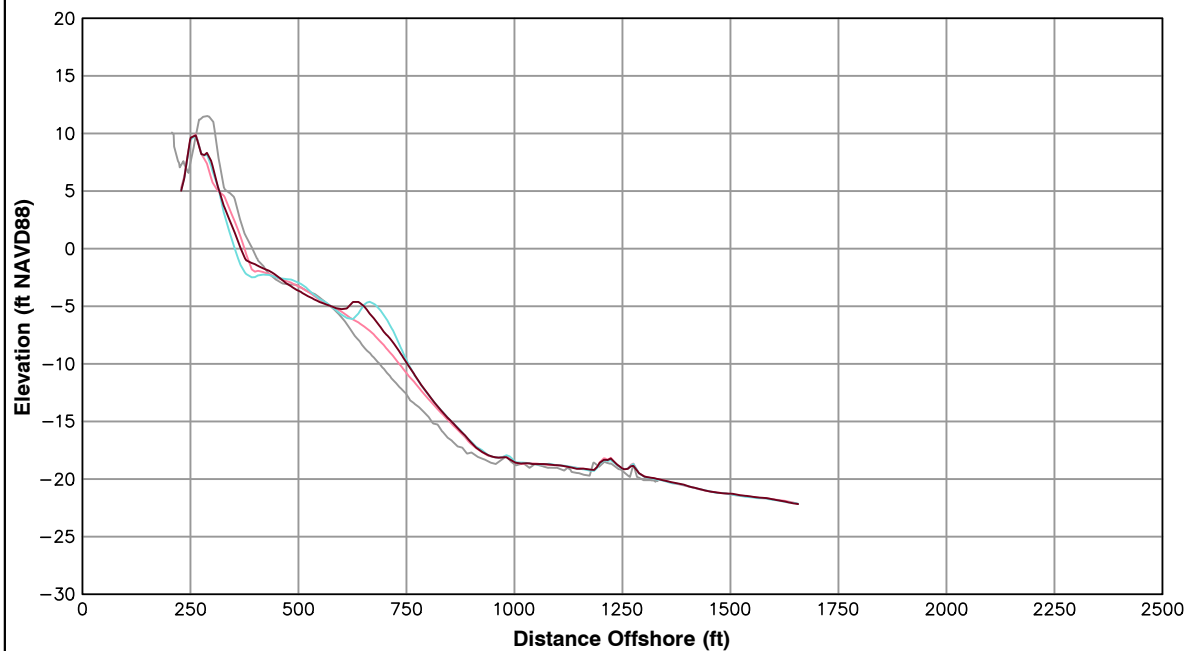


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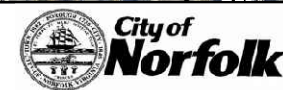
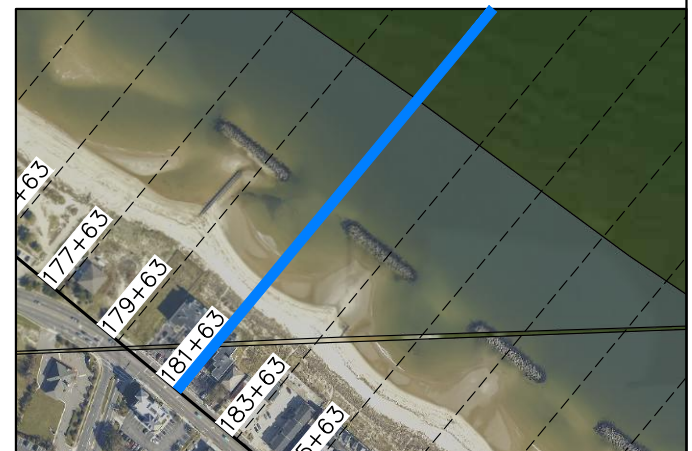
| Survey Transect 181+63 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -9.69 ft/yr | 12.51 ft |
| Volume Change Above -15 ft NAVD88 | 7.51 cy/ft/yr | 1.14 cy/ft |
| Volume Change Above 0 ft NAVD88 | -0.57 cy/ft/yr | 1.80 cy/ft |

LEGEND:

2015 OCT —
 2015 APR —
 2014 OCT —
 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 October 2014 and April 2015.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

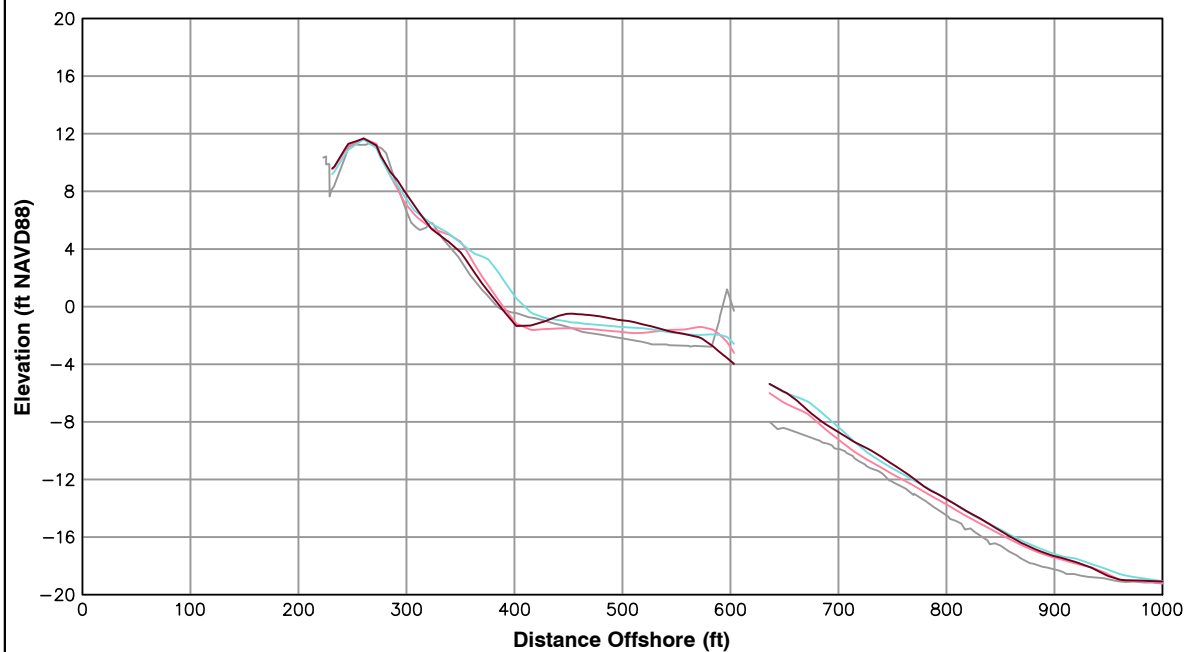
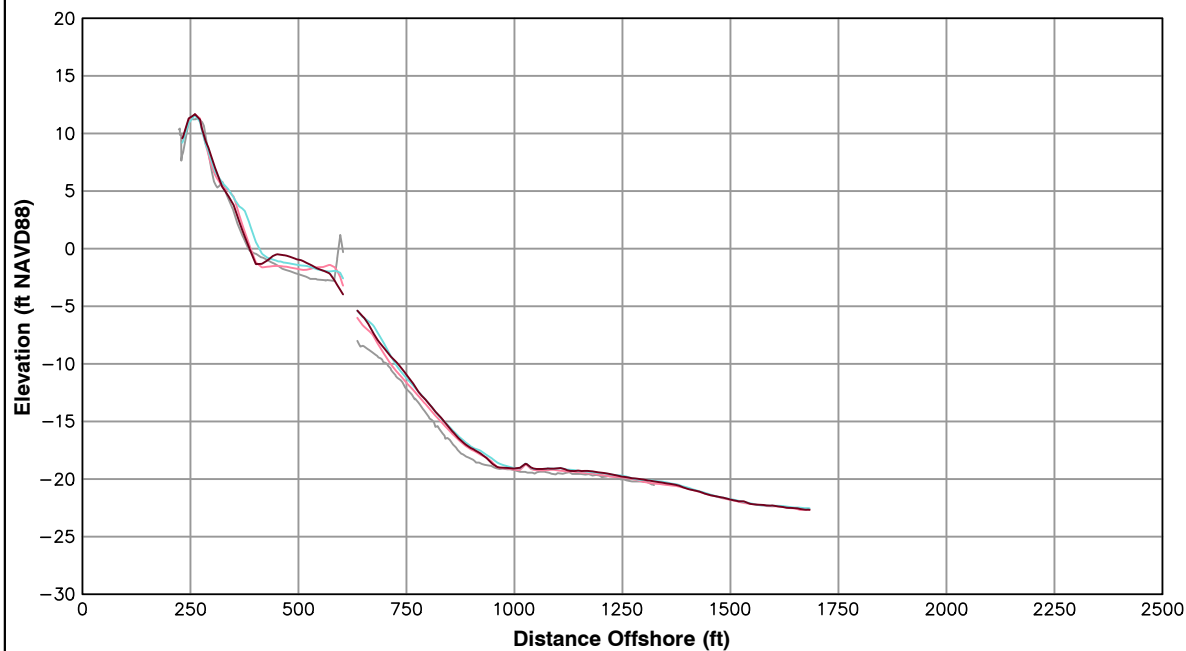


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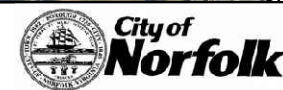
| Survey Transect 183+63 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -3.78 ft/yr | -21.26 ft |
| Volume Change Above -15 ft NAVD88 | 5.08 cy/ft/yr | -3.97 cy/ft |
| Volume Change Above 0 ft NAVD88 | -0.34 cy/ft/yr | -2.85 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
POST-FILL —

Notes:

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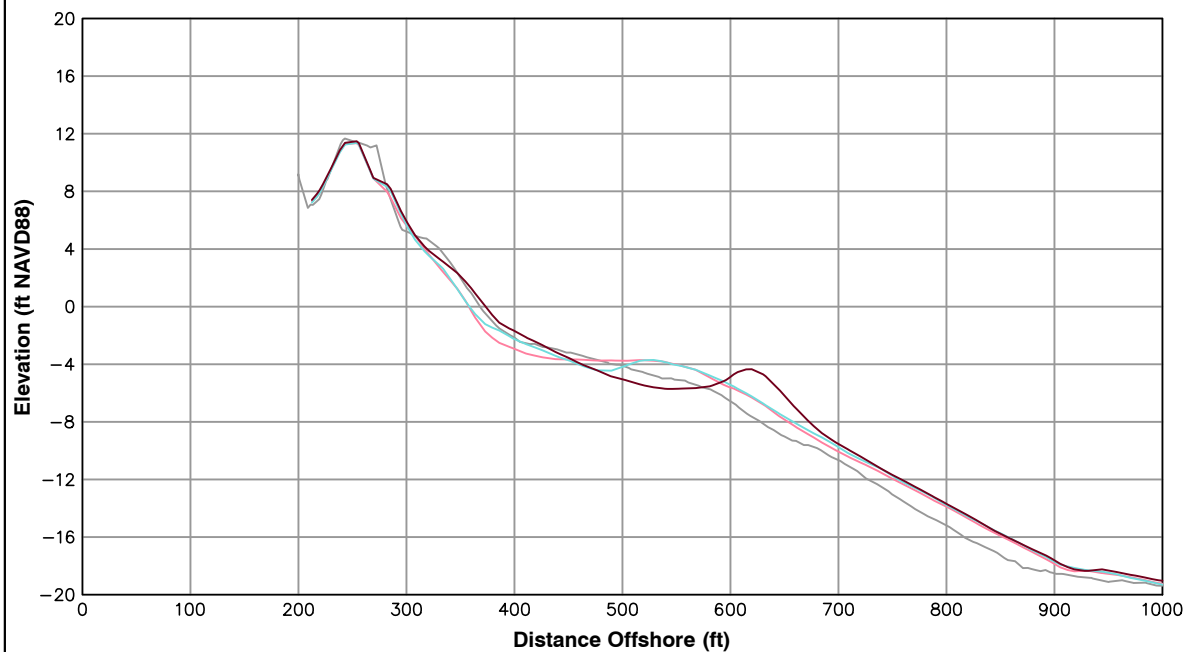
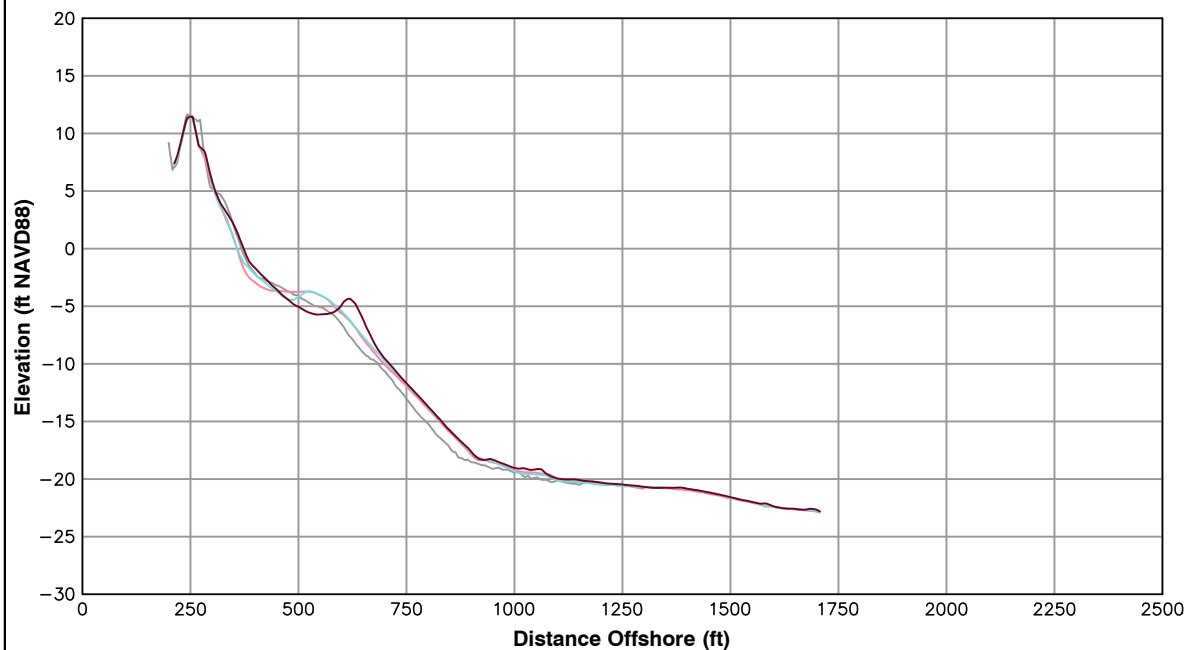


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| Survey Transect 185+63 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 13.38 ft/yr | 13.75 ft |
| Volume Change Above -15 ft NAVD88 | 6.40 cy/ft/yr | 3.83 cy/ft |
| Volume Change Above 0 ft NAVD88 | 2.40 cy/ft/yr | 2.21 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
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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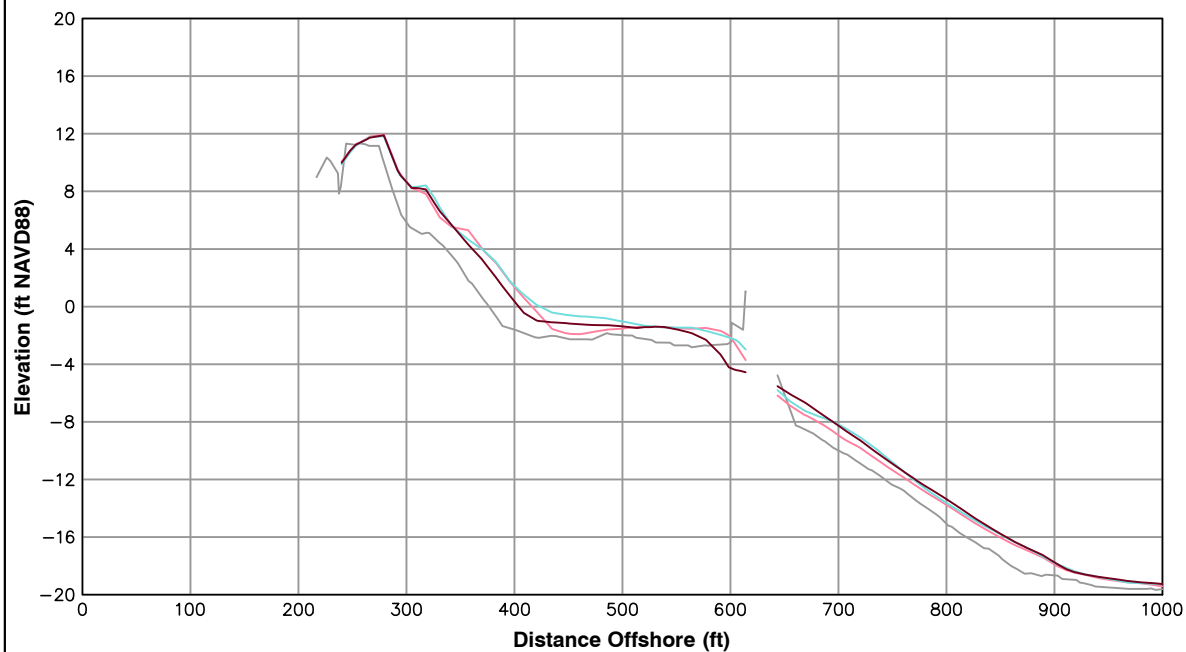
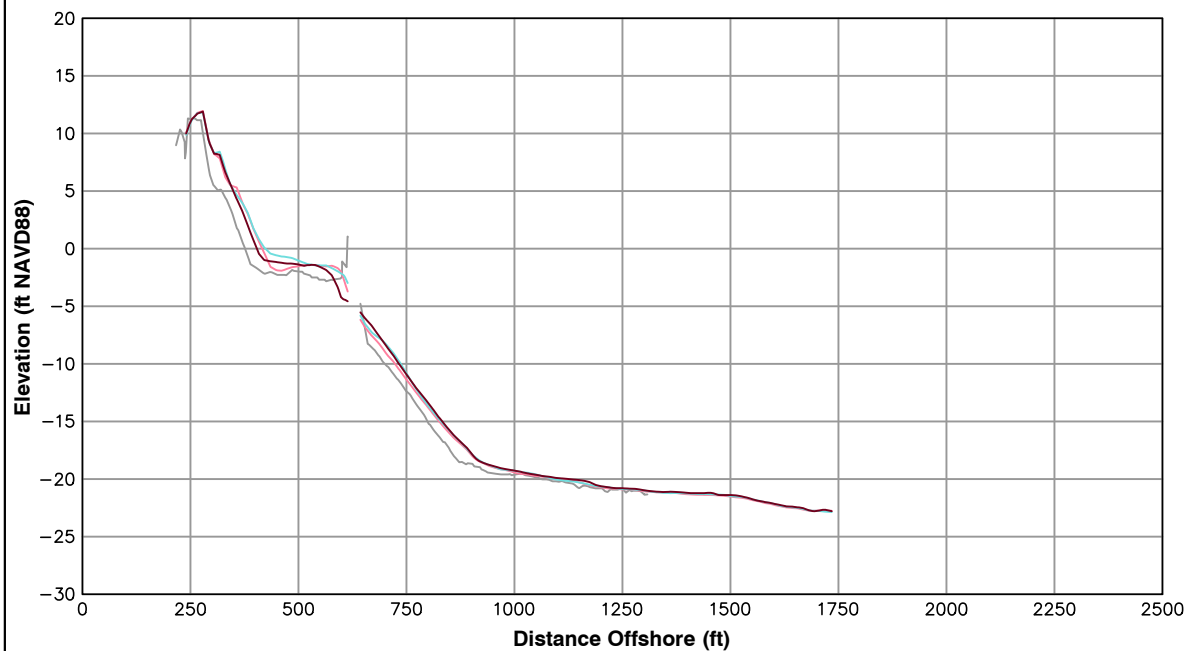


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| Survey Transect 187+63 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -10.79 ft/yr | -13.03 ft |
| Volume Change Above -15 ft NAVD88 | 0.23 cy/ft/yr | -6.18 cy/ft |
| Volume Change Above 0 ft NAVD88 | -1.81 cy/ft/yr | -2.17 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
POST-FILL —

Notes:

1. Stationing From West To East At Varying Intervals.
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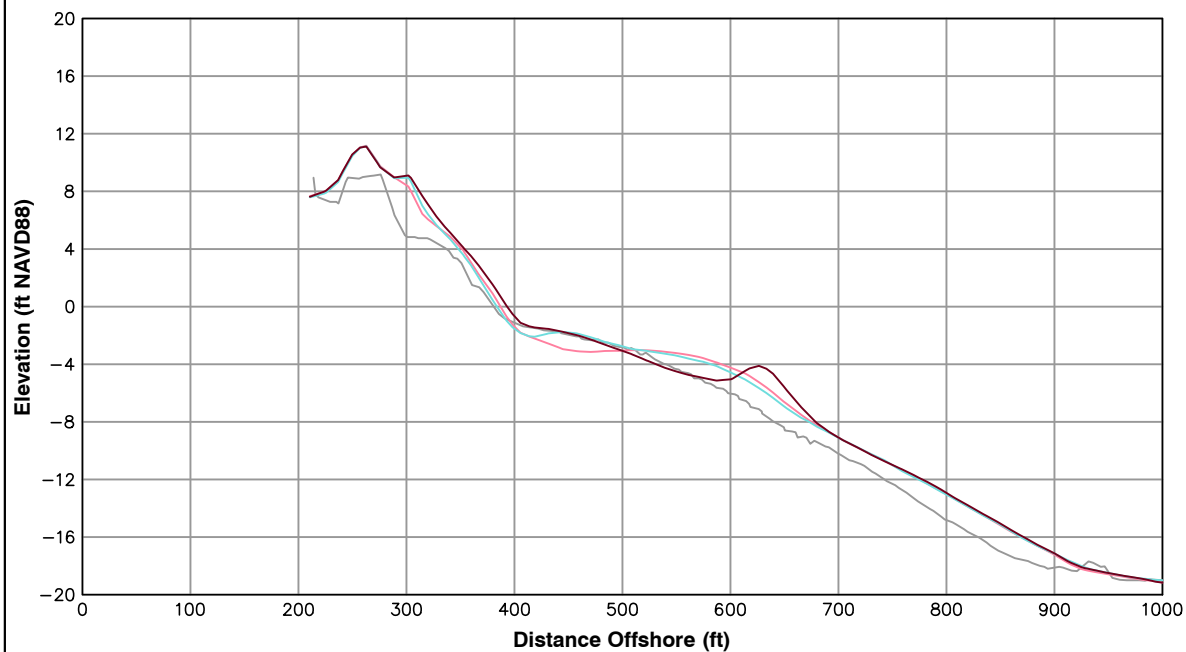
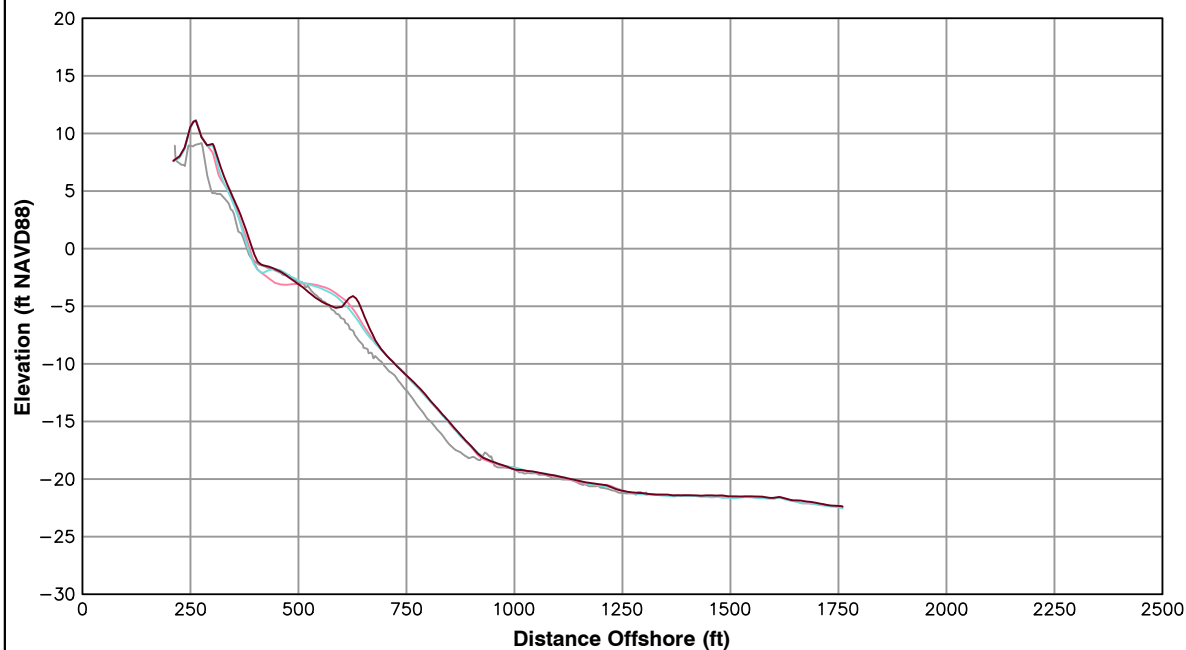


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ANALYSIS**

ST 187+63

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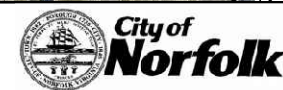
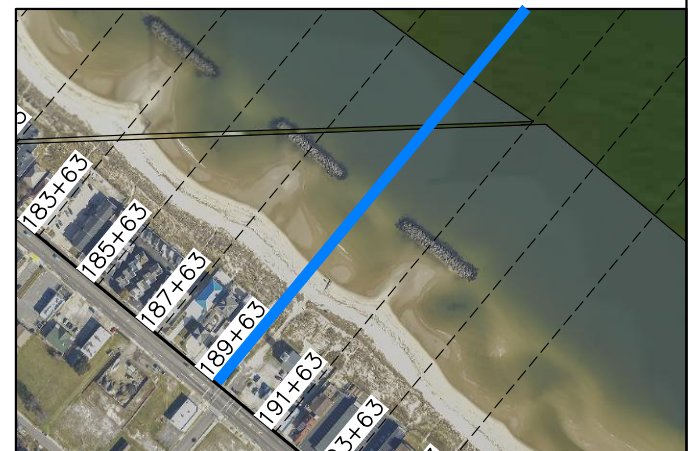
| Survey Transect 189+63 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 5.58 ft/yr | 9.26 ft |
| Volume Change Above -15 ft NAVD88 | 3.81 cy/ft/yr | 3.29 cy/ft |
| Volume Change Above 0 ft NAVD88 | 2.16 cy/ft/yr | 2.36 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
POST-FILL —

Notes:

1. Stationing From West To East At Varying Intervals.
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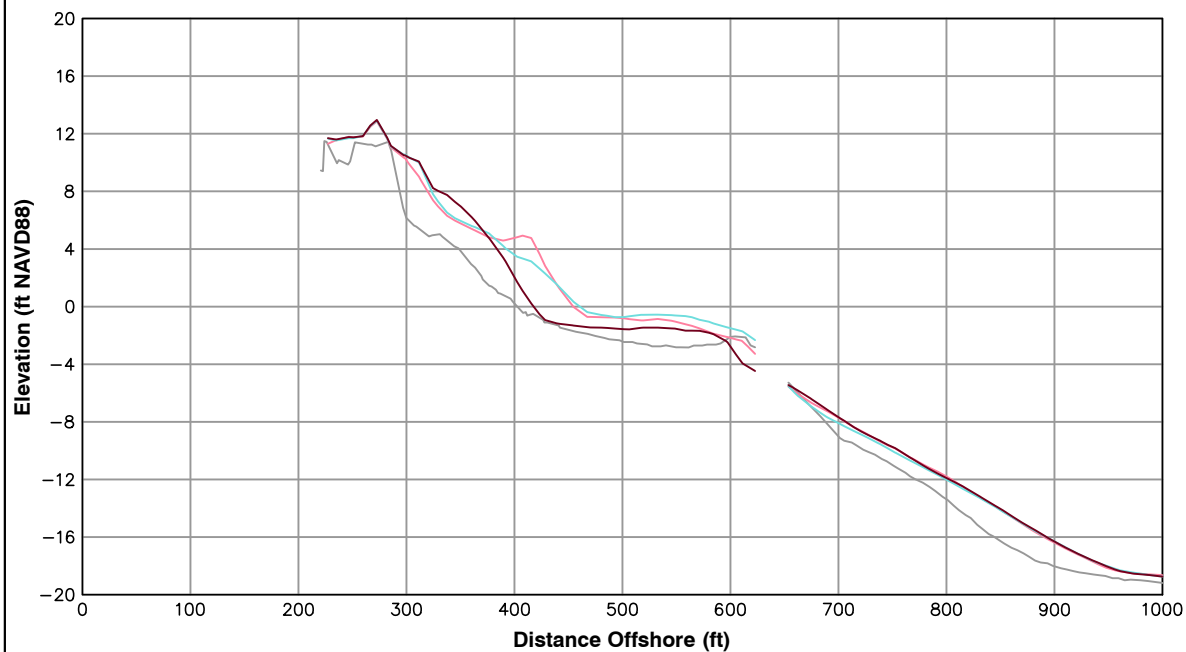
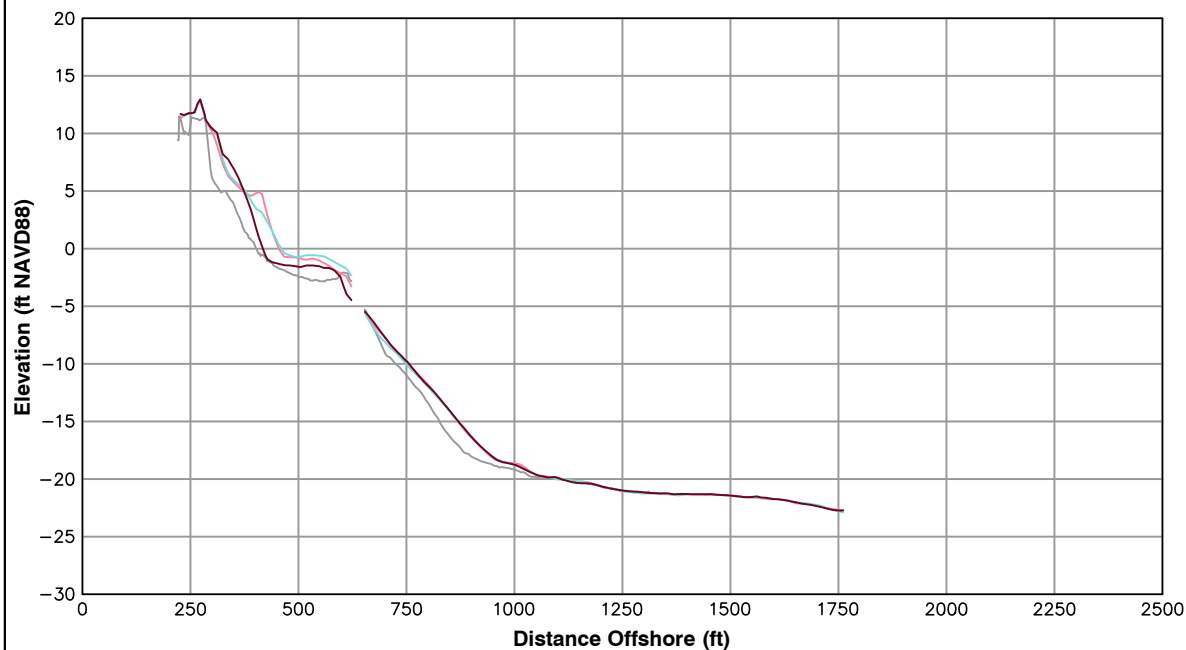


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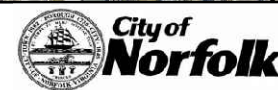


| Survey Transect 191+63 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -35.55 ft/yr | -37.76 ft |
| Volume Change Above -15 ft NAVD88 | -8.47 cy/ft/yr | -9.24 cy/ft |
| Volume Change Above 0 ft NAVD88 | -3.52 cy/ft/yr | -3.11 cy/ft |

| LEGEND: | |
|-----------|--|
| 2015 OCT | — |
| 2015 APR | — |
| 2014 OCT | — |
| POST-FILL | — |

Notes:

1. Stationing From West To East At Varying Intervals.
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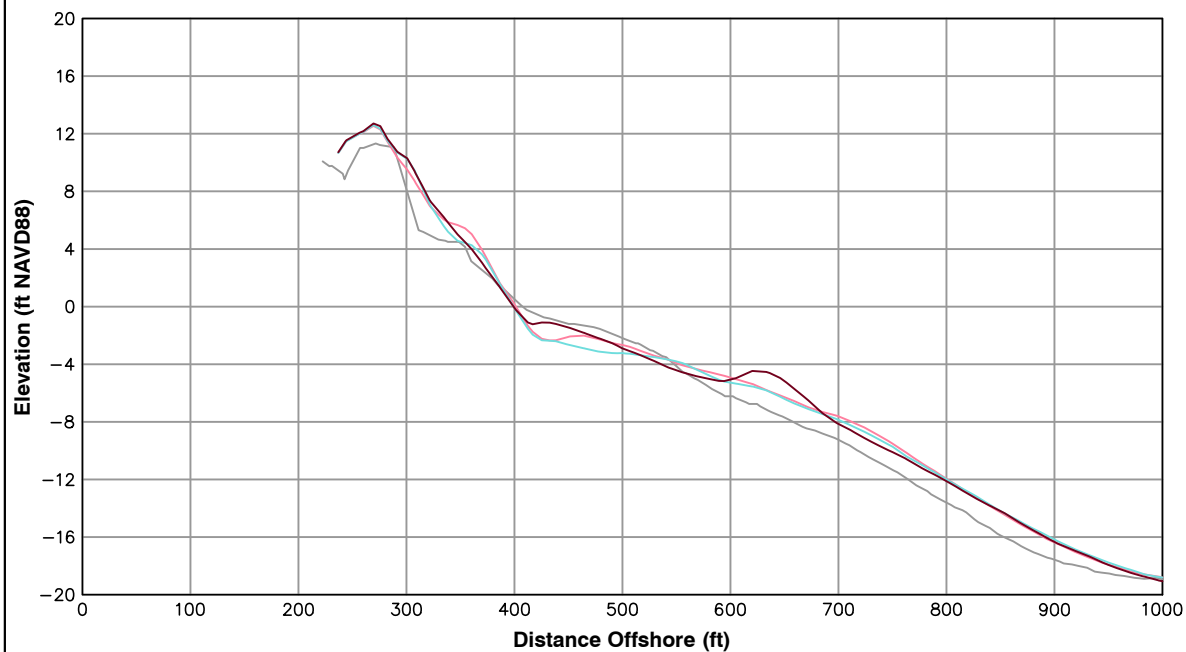
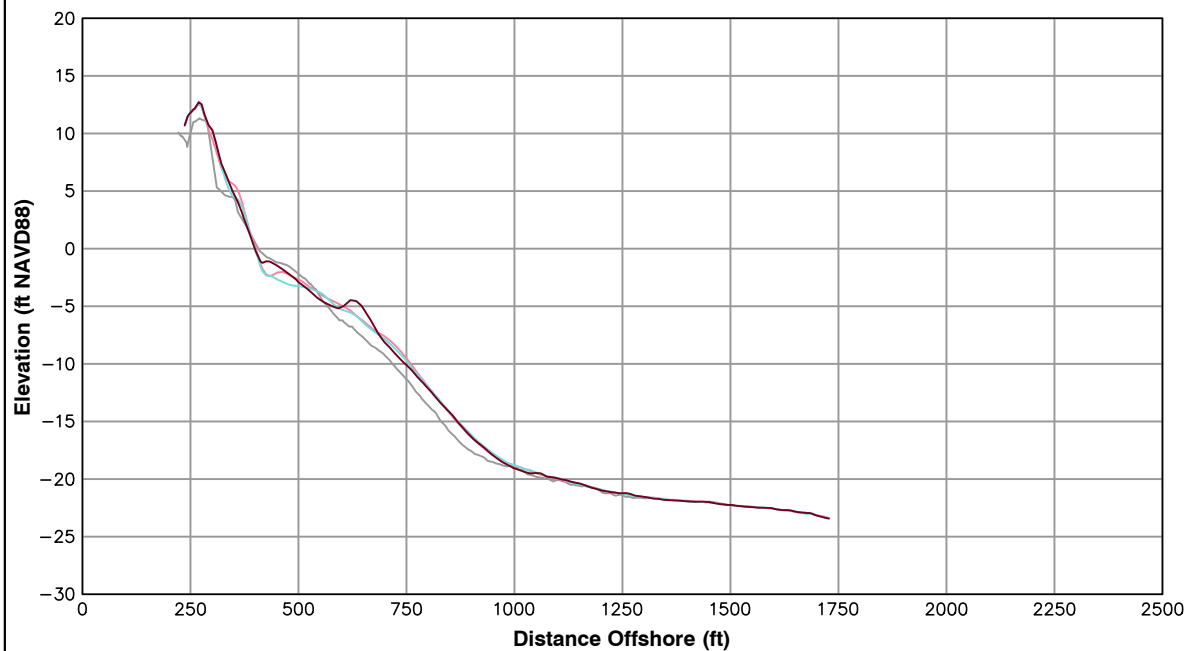


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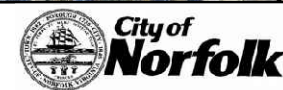
| Survey Transect 193+63 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -2.65 ft/yr | -1.47 ft |
| Volume Change Above -15 ft NAVD88 | -0.10 cy/ft/yr | 4.03 cy/ft |
| Volume Change Above 0 ft NAVD88 | -0.30 cy/ft/yr | 0.29 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
POST-FILL —

Notes:

1. Stationing From West To East At Varying Intervals.
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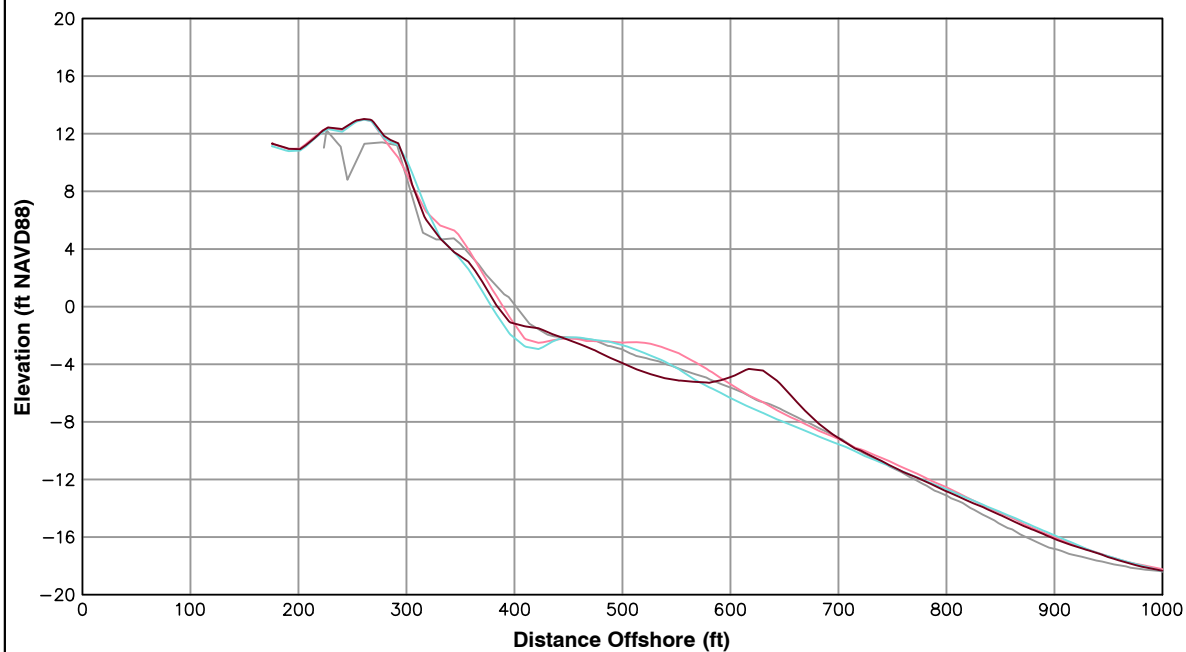
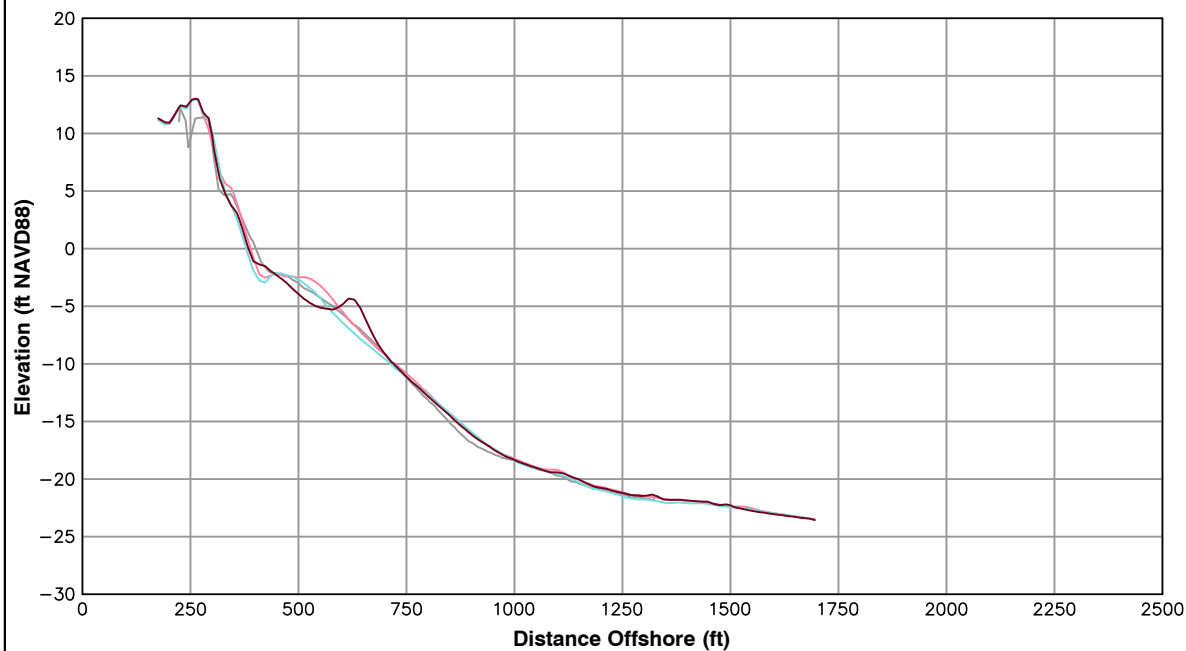


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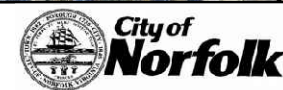
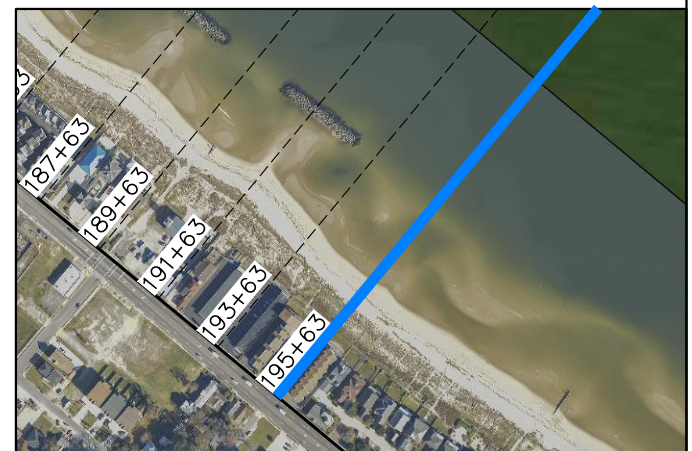
| Survey Transect 195+63 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -4.97 ft/yr | 5.22 ft |
| Volume Change Above -15 ft NAVD88 | -3.98 cy/ft/yr | 6.02 cy/ft |
| Volume Change Above 0 ft NAVD88 | -1.70 cy/ft/yr | 0.46 cy/ft |

LEGEND:

2015 OCT — dark red line
 2015 APR — cyan line
 2014 OCT — pink line
 POST-FILL — grey line

Notes:

1. Stationing From West To East At Varying Intervals.
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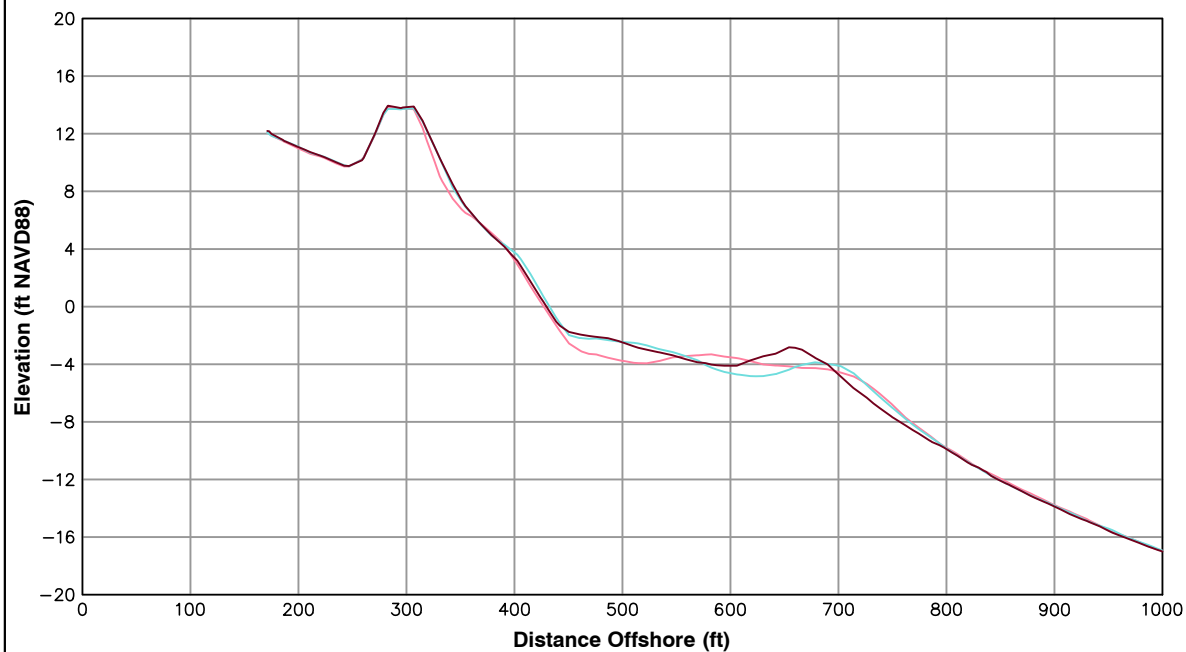
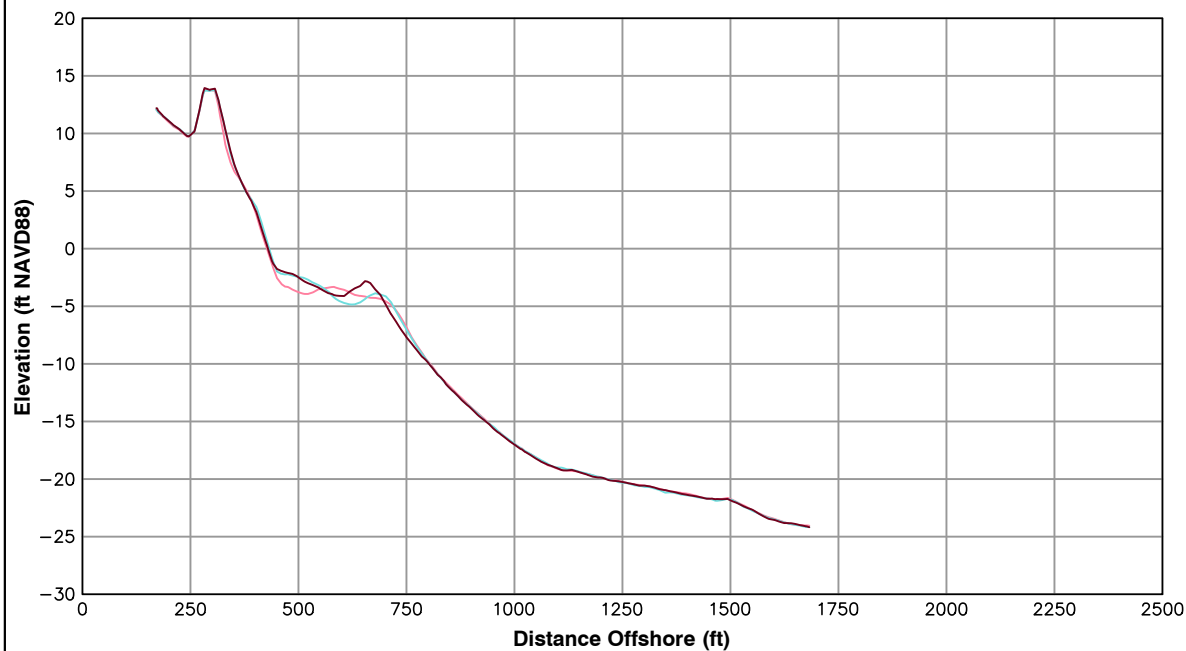


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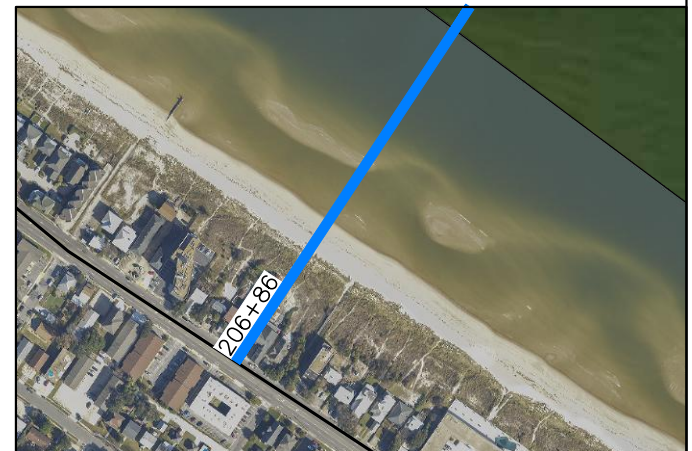
| Survey Transect 206+86 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 2.62 ft/yr | -3.48 ft |
| Volume Change Above -15 ft NAVD88 | 4.34 cy/ft/yr | 0.48 cy/ft |
| Volume Change Above 0 ft NAVD88 | 2.13 cy/ft/yr | -0.25 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —

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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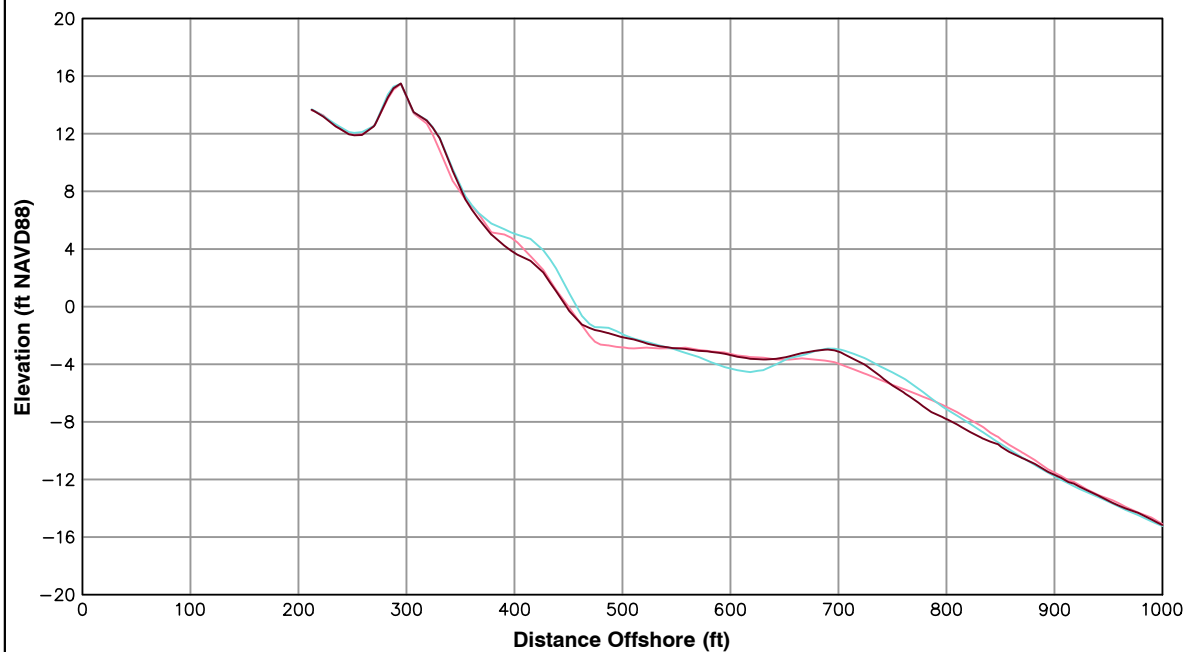
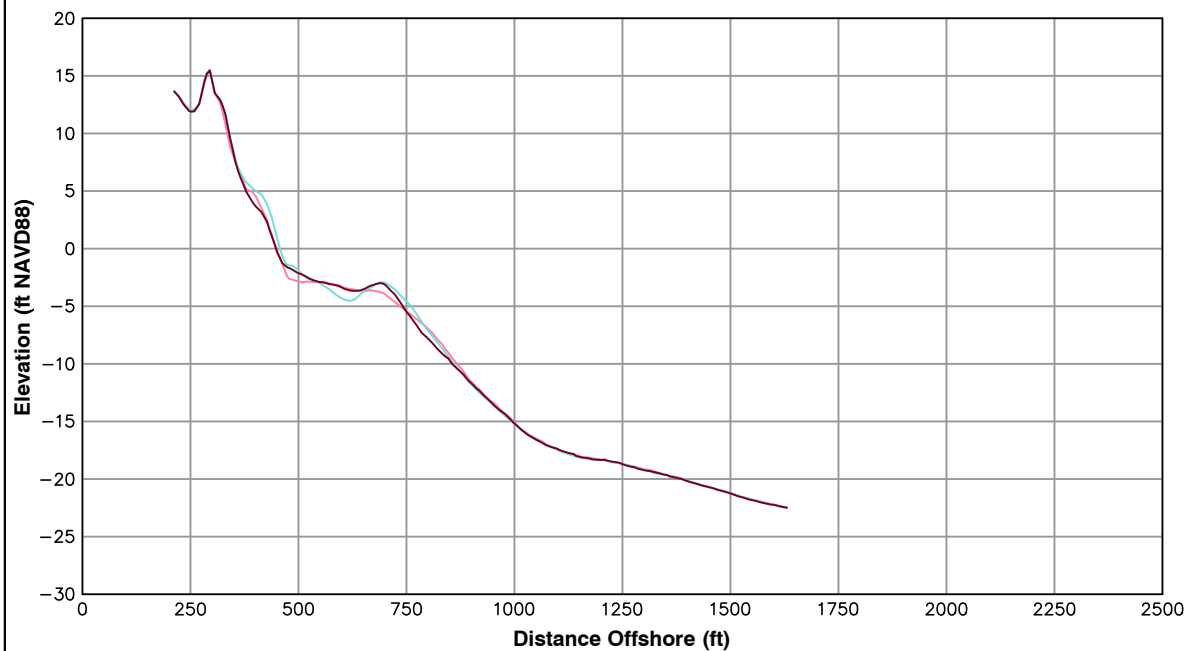
**City of
Norfolk**

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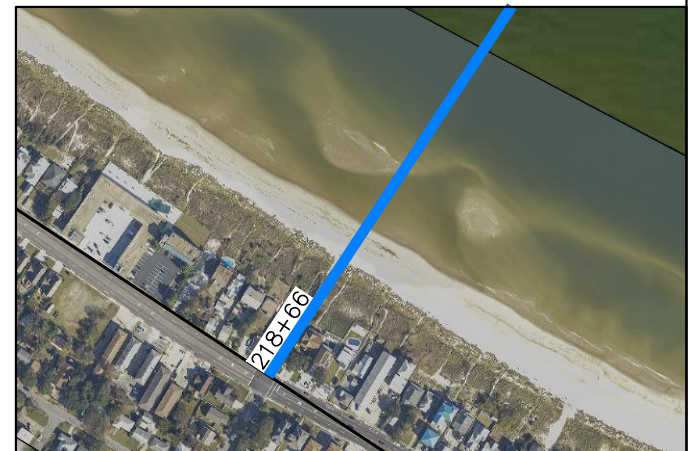
| Survey Transect 218+66 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -0.99 ft/yr | -11.03 ft |
| Volume Change Above -15 ft NAVD88 | -0.67 cy/ft/yr | -6.14 cy/ft |
| Volume Change Above 0 ft NAVD88 | -0.49 cy/ft/yr | -4.61 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —

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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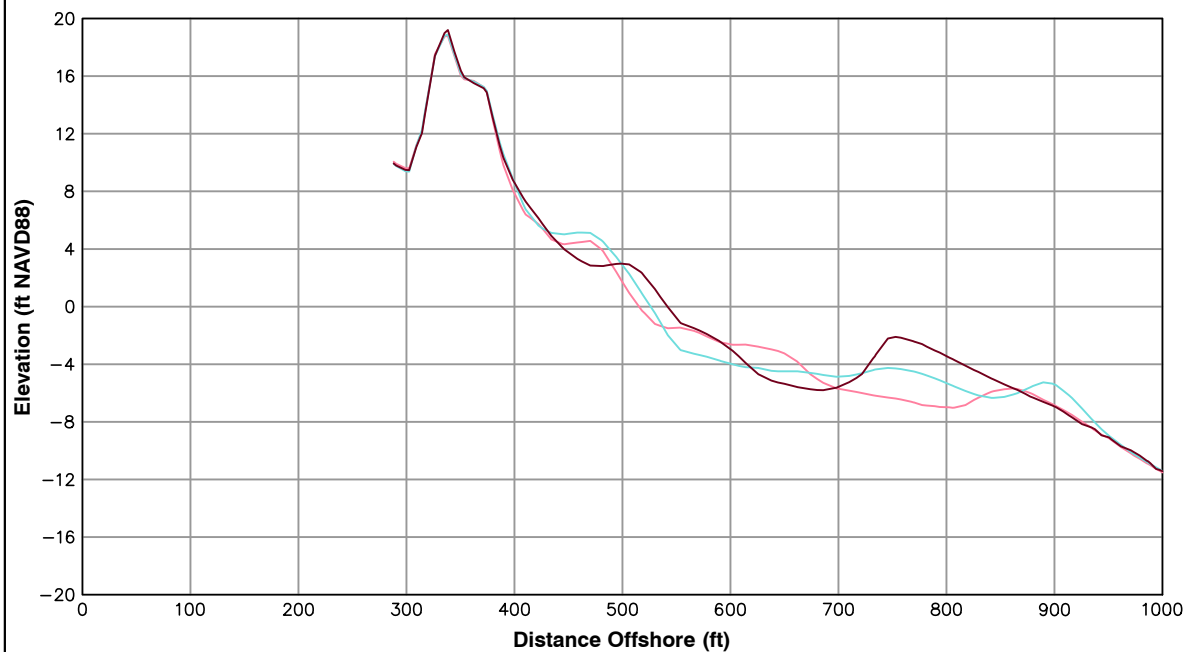
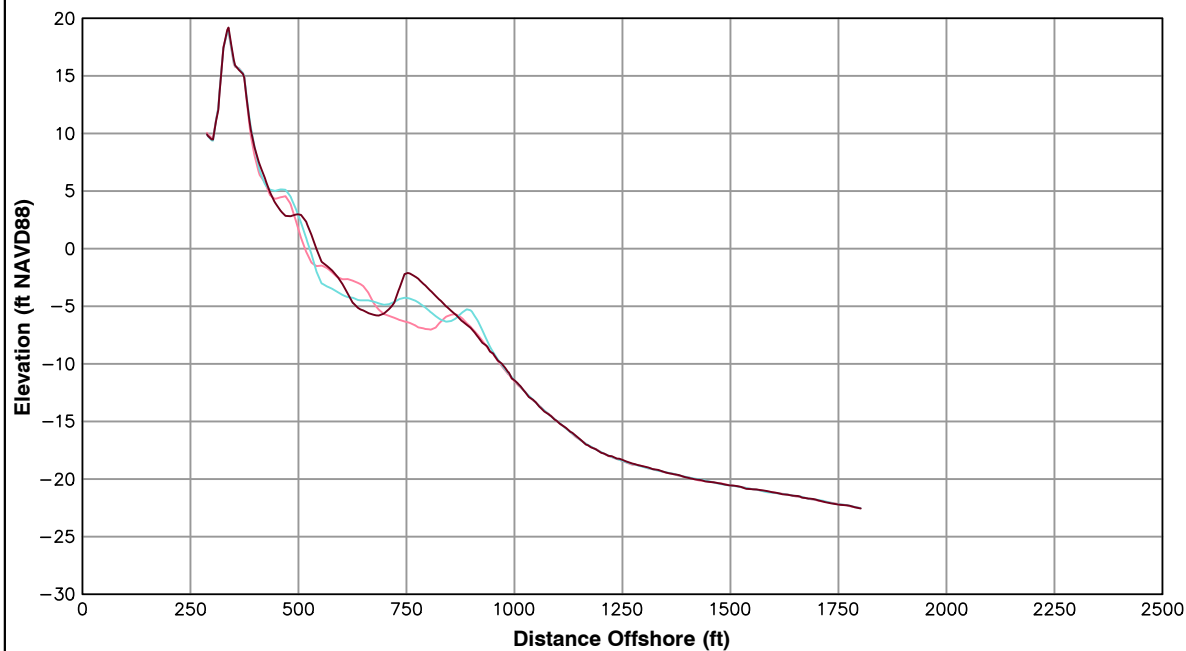
**City of
Norfolk**

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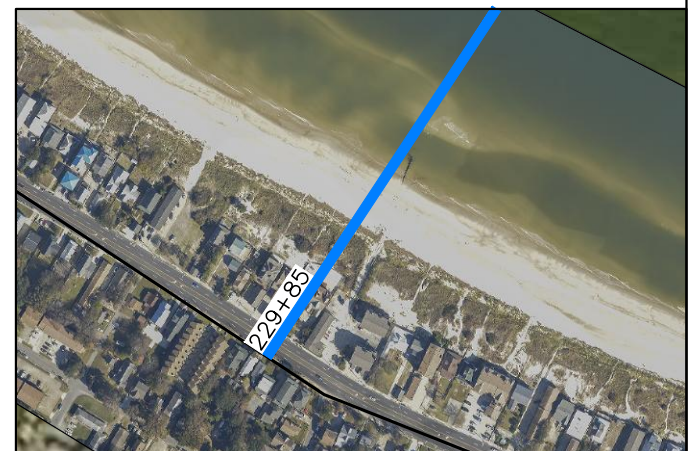
| Survey Transect 229+85 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 26.20 ft/yr | 14.80 ft |
| Volume Change Above -15 ft NAVD88 | 13.63 cy/ft/yr | 5.52 cy/ft |
| Volume Change Above 0 ft NAVD88 | 2.03 cy/ft/yr | -1.43 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —

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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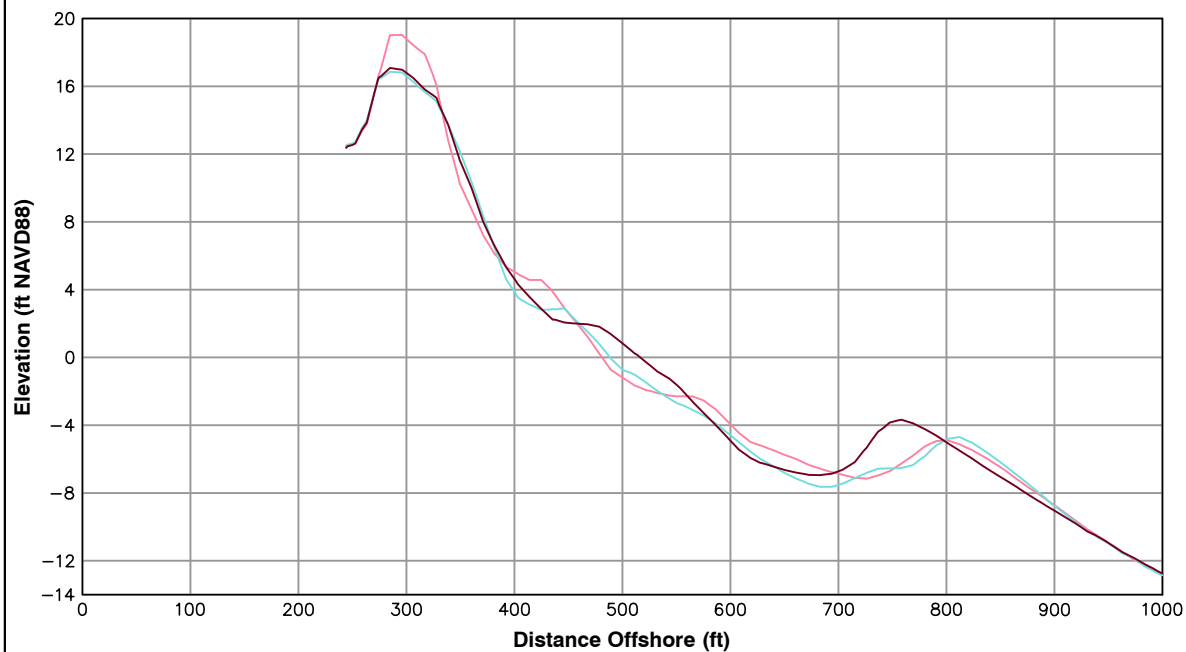
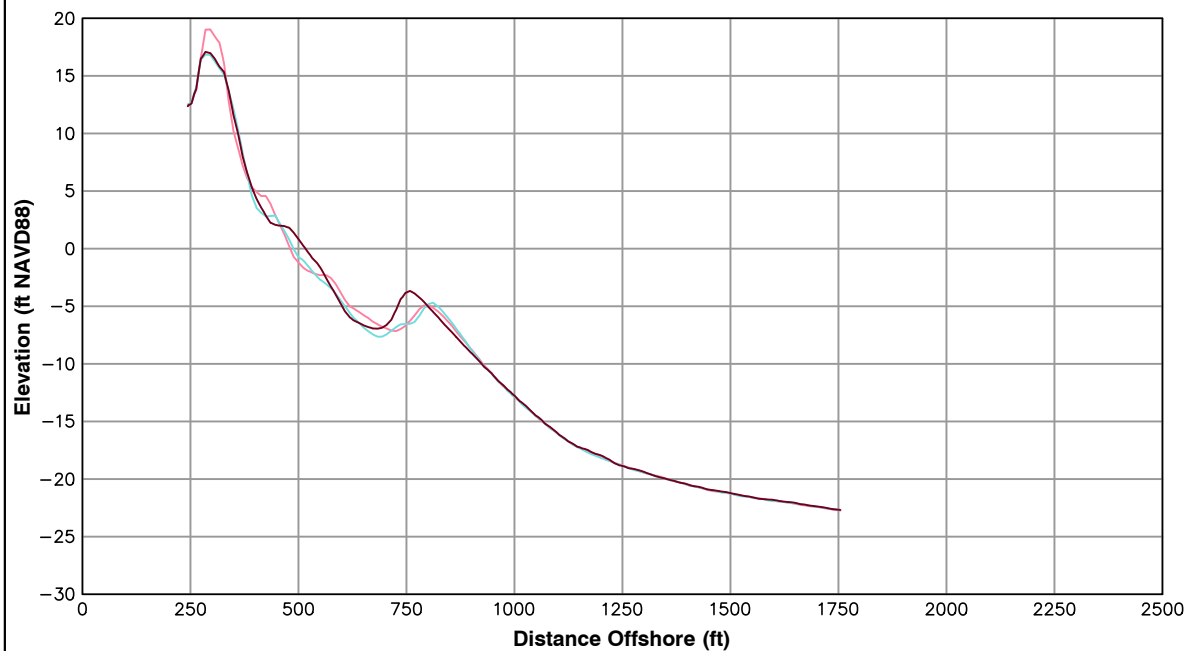
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Norfolk**

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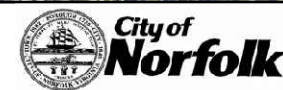
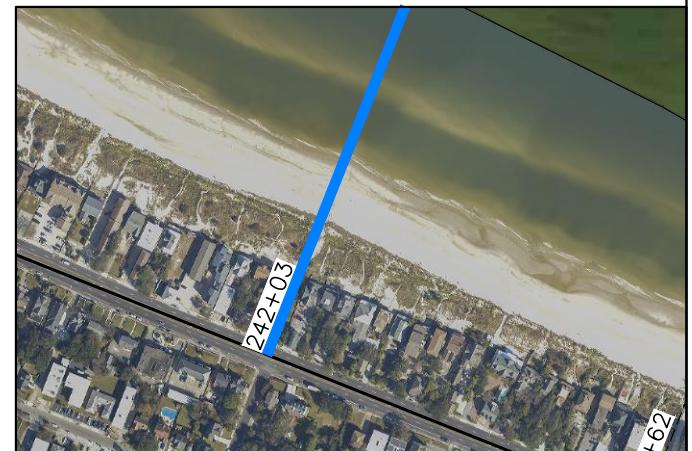
| Survey Transect 242+03 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 26.55 ft/yr | 21.33 ft |
| Volume Change Above -15 ft NAVD88 | 1.32 cy/ft/yr | 8.62 cy/ft |
| Volume Change Above 0 ft NAVD88 | -2.00 cy/ft/yr | 1.62 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —

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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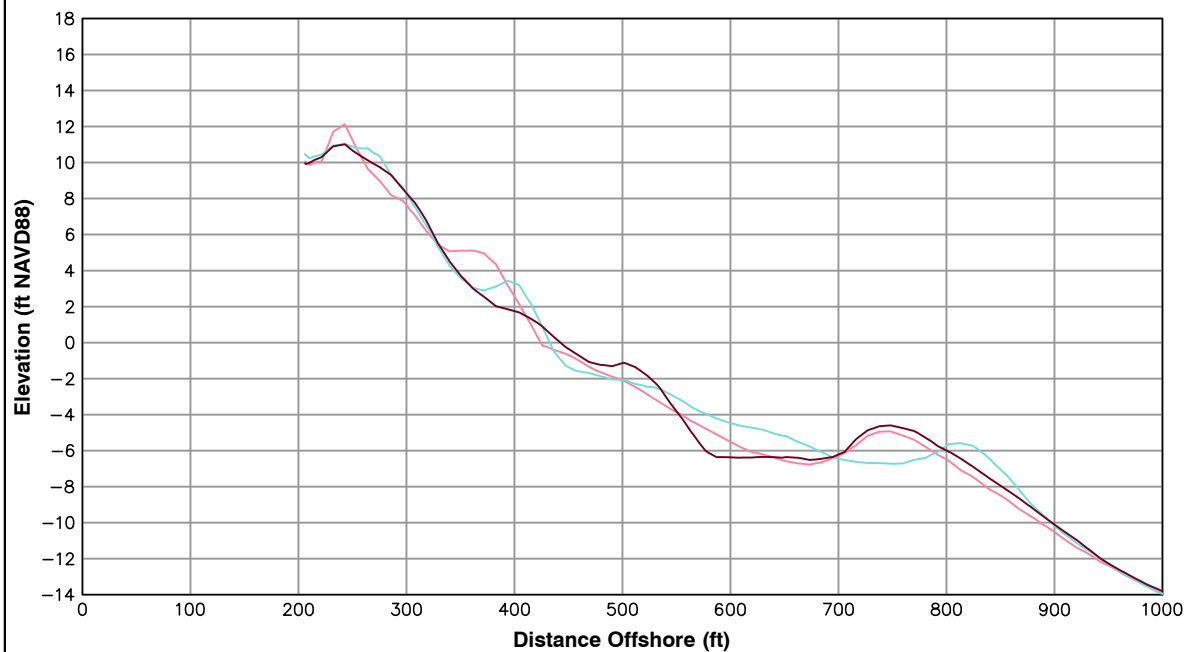
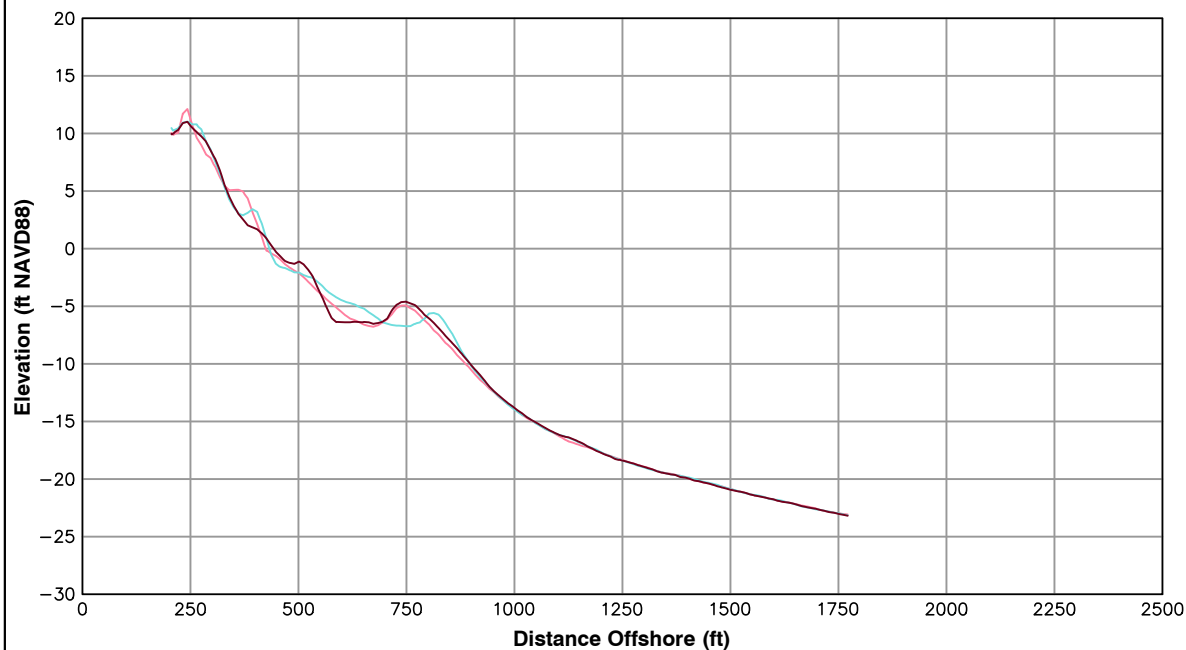


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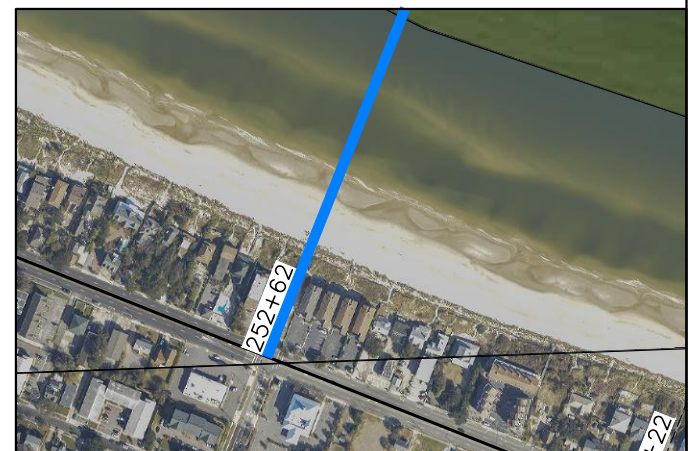
| Survey Transect 252+62 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 8.36 ft/yr | -0.98 ft |
| Volume Change Above -15 ft NAVD88 | 2.65 cy/ft/yr | -3.87 cy/ft |
| Volume Change Above 0 ft NAVD88 | -2.59 cy/ft/yr | -2.41 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —

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.



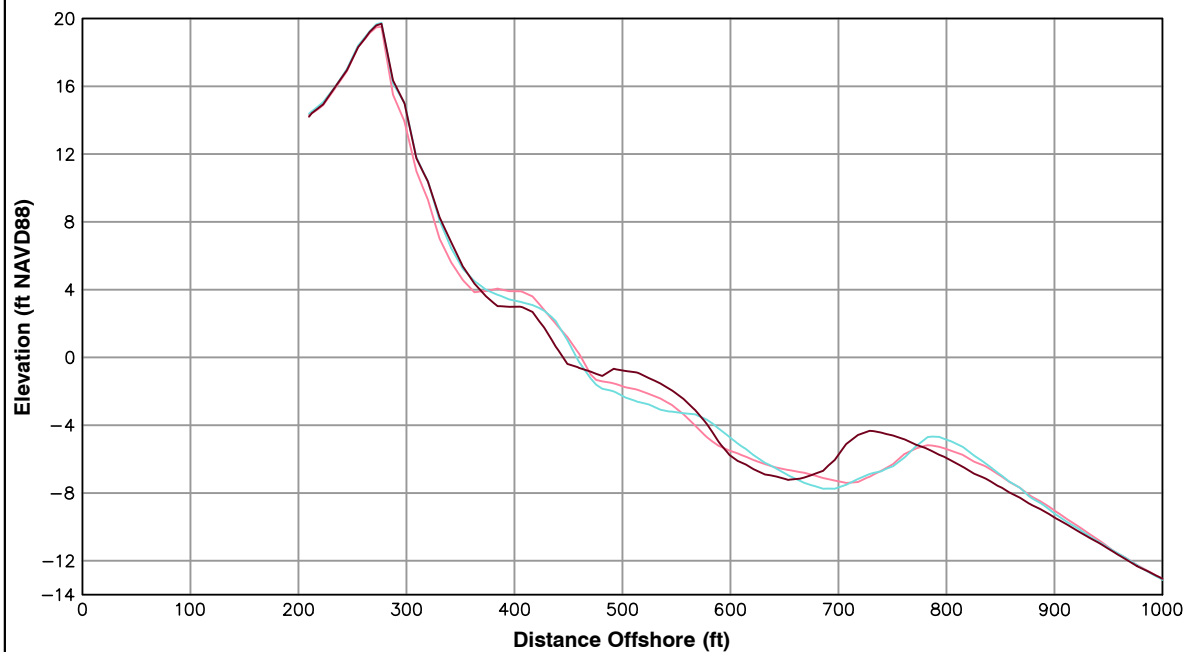
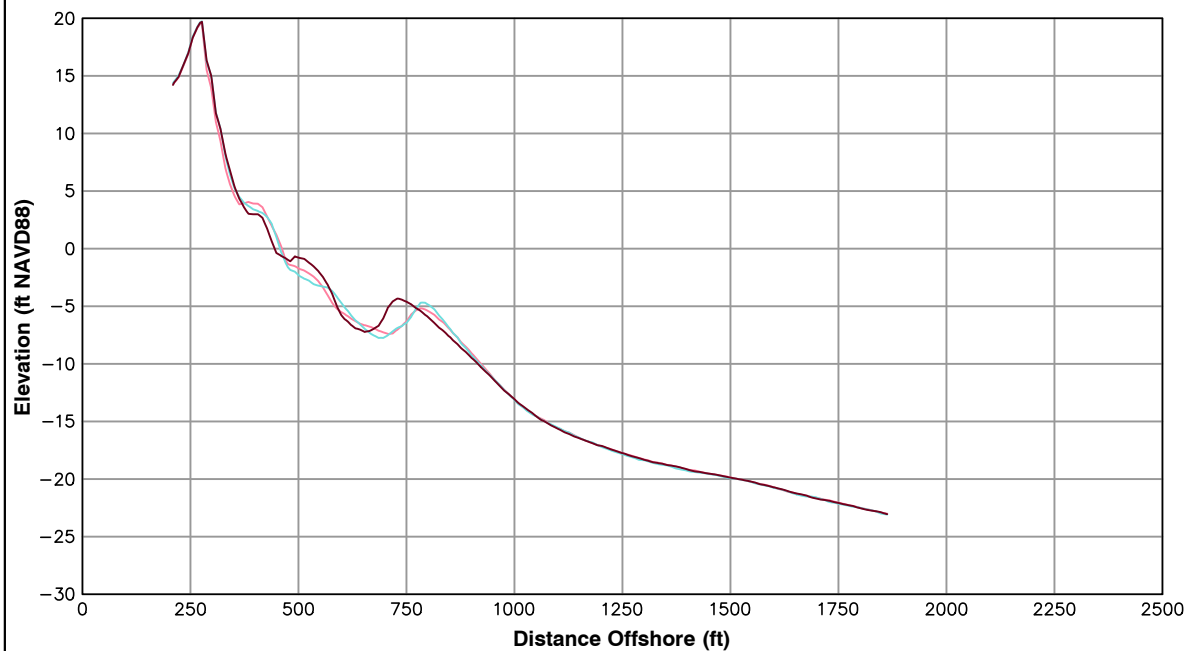
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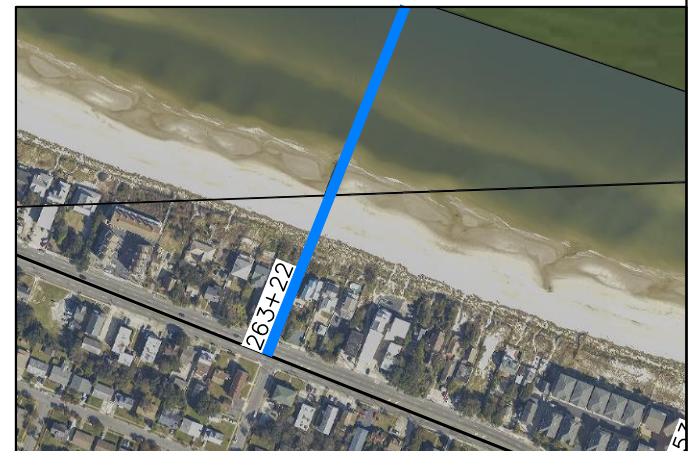
| Survey Transect 263+22 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -16.25 ft/yr | -14.31 ft |
| Volume Change Above -15 ft NAVD88 | 4.44 cy/ft/yr | 2.70 cy/ft |
| Volume Change Above 0 ft NAVD88 | 0.01 cy/ft/yr | -2.25 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —

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 October 2014 and April 2015.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

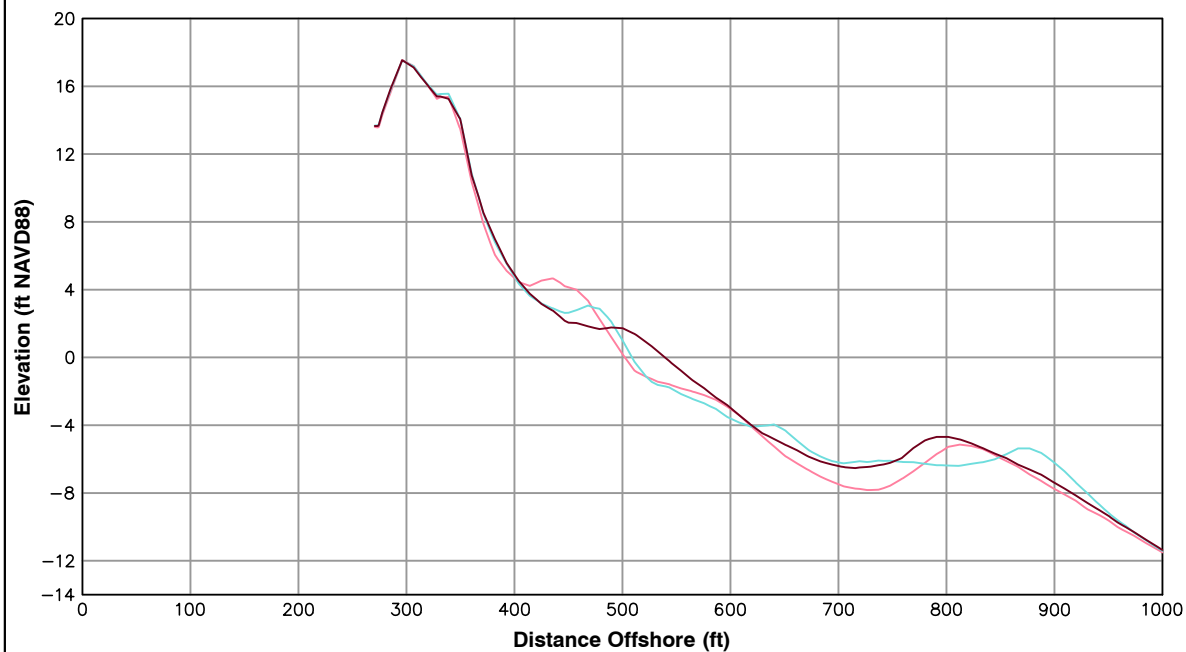
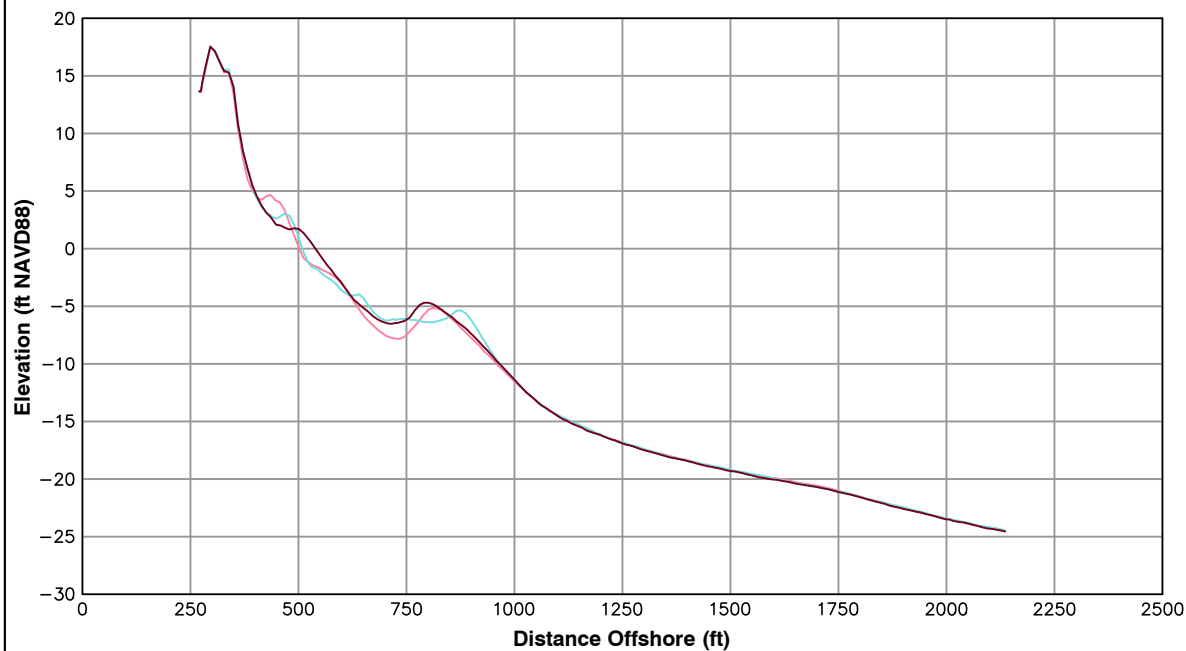


**OCEAN VIEW PERIODIC
SURVEYING DATA &
ANALYSIS**

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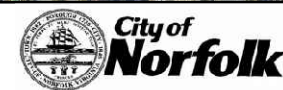
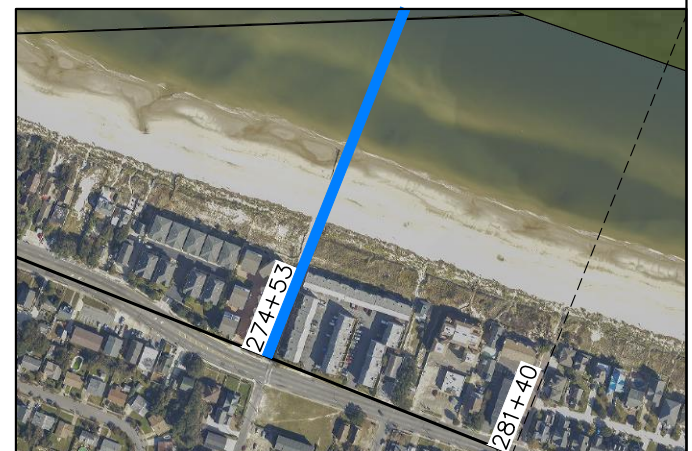
| Survey Transect 274+53 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 28.12 ft/yr | 19.86 ft |
| Volume Change Above -15 ft NAVD88 | 10.43 cy/ft/yr | 2.35 cy/ft |
| Volume Change Above 0 ft NAVD88 | -0.70 cy/ft/yr | -0.28 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —

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 October 2014 and April 2015.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

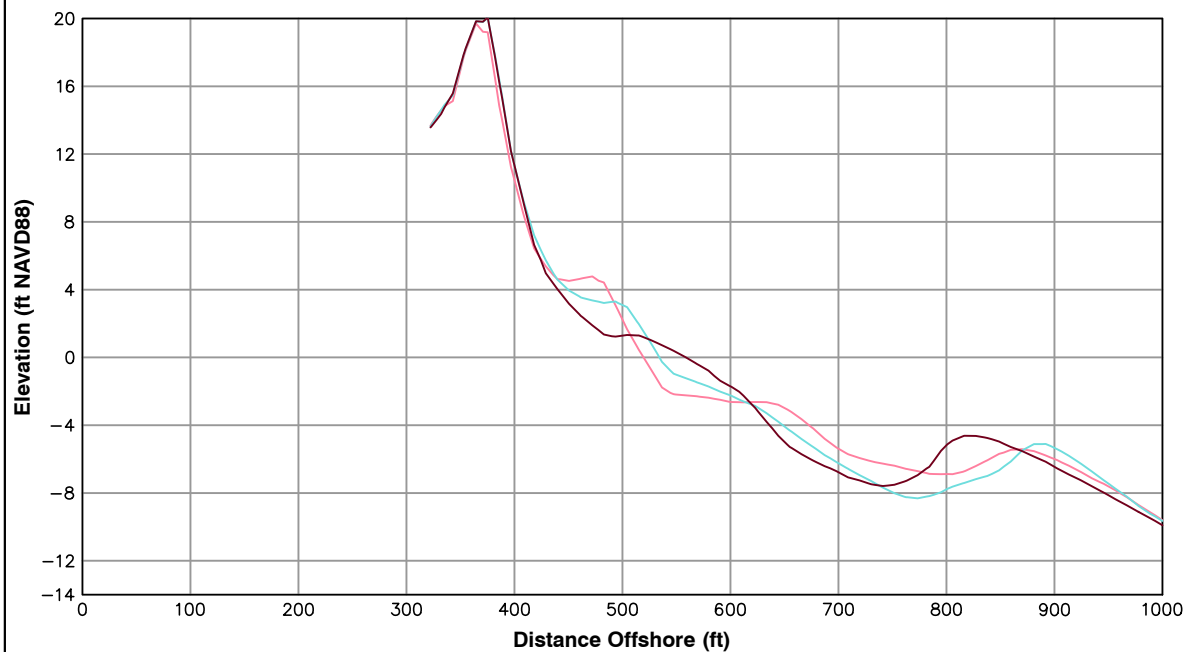
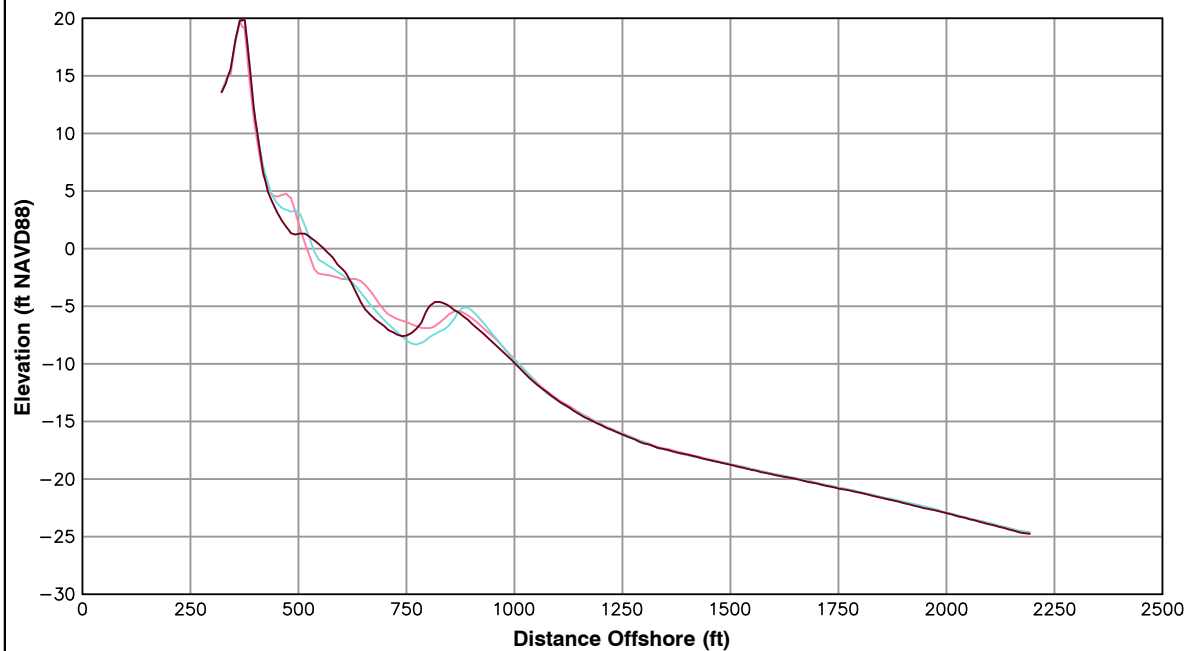


**OCEAN VIEW PERIODIC
SURVEYING DATA &
ANALYSIS**

ST 274+53

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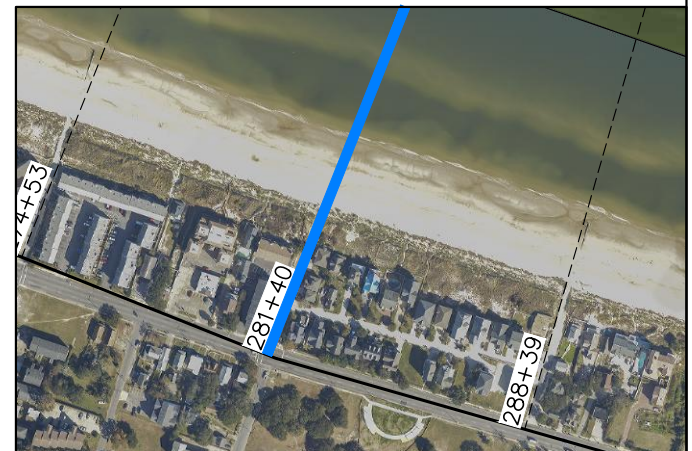
| Survey Transect 281+40 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 17.06 ft/yr | 2.76 ft |
| Volume Change Above -15 ft NAVD88 | -4.00 cy/ft/yr | -0.29 cy/ft |
| Volume Change Above 0 ft NAVD88 | -1.93 cy/ft/yr | -4.13 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —

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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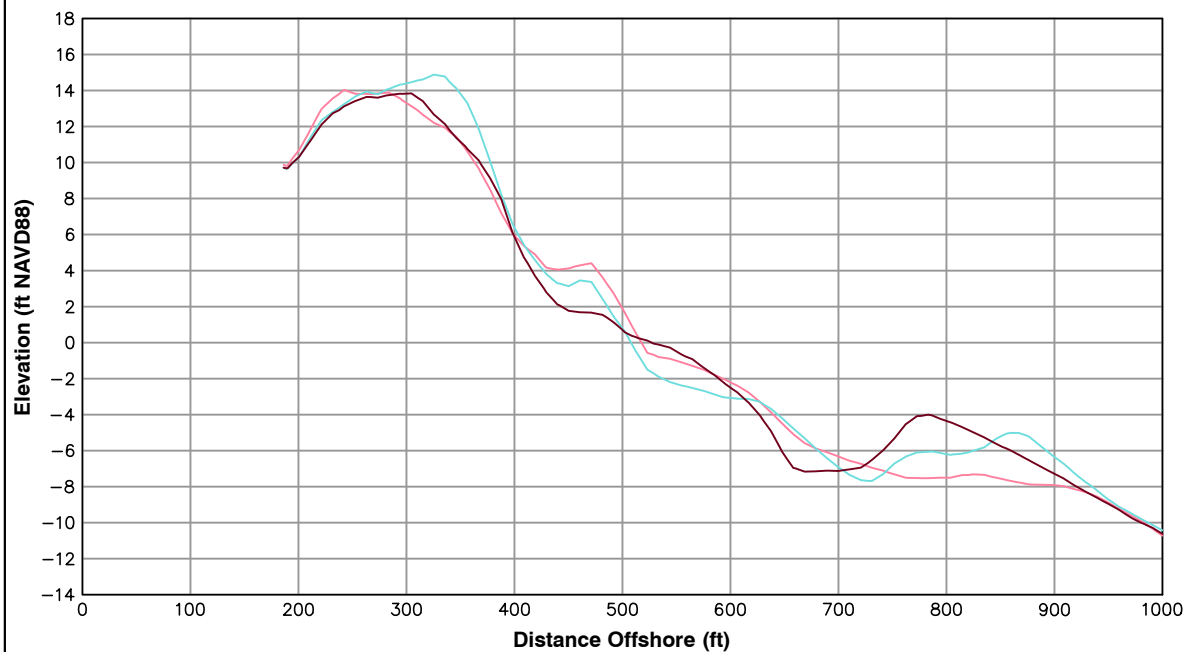
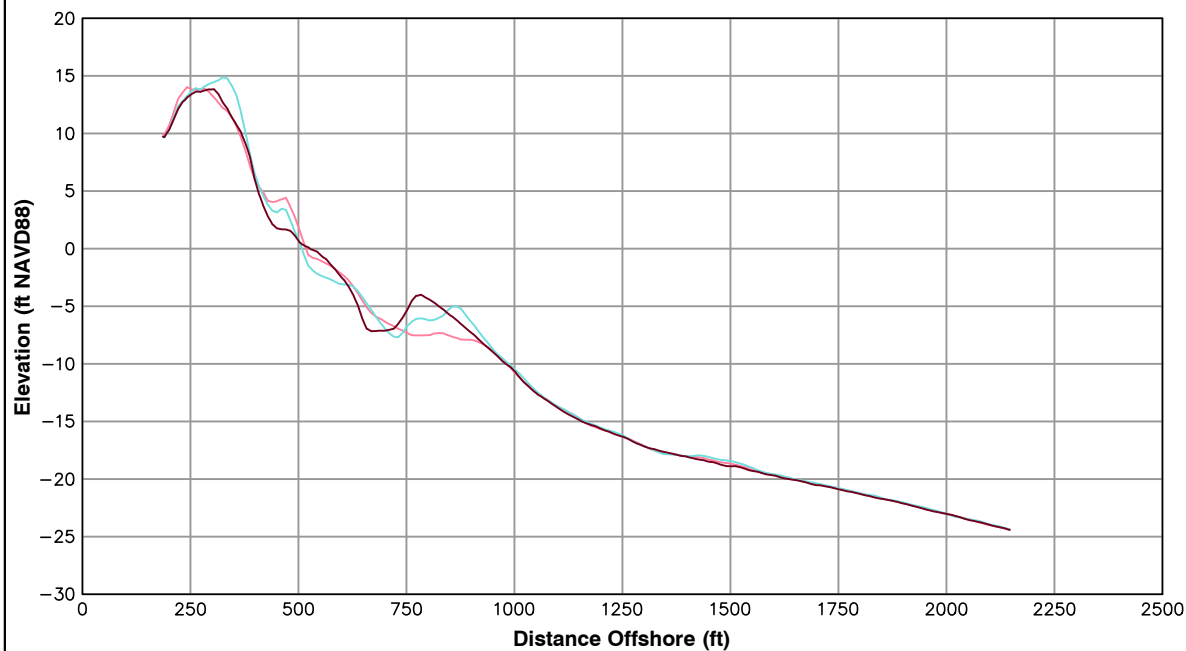


**OCEAN VIEW PERIODIC
SURVEYING DATA &
ANALYSIS**

ST 281+40

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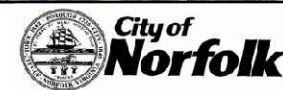
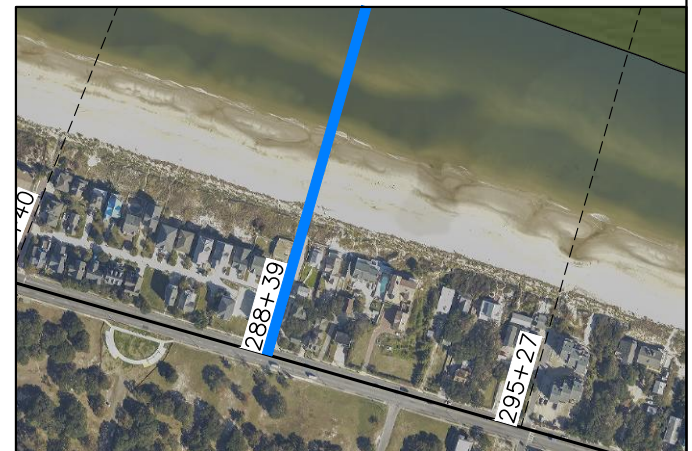
| Survey Transect 288+39 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -13.52 ft/yr | -2.96 ft |
| Volume Change Above -15 ft NAVD88 | 2.79 cy/ft/yr | -7.45 cy/ft |
| Volume Change Above 0 ft NAVD88 | -6.83 cy/ft/yr | -10.36 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —

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 October 2014 and April 2015.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

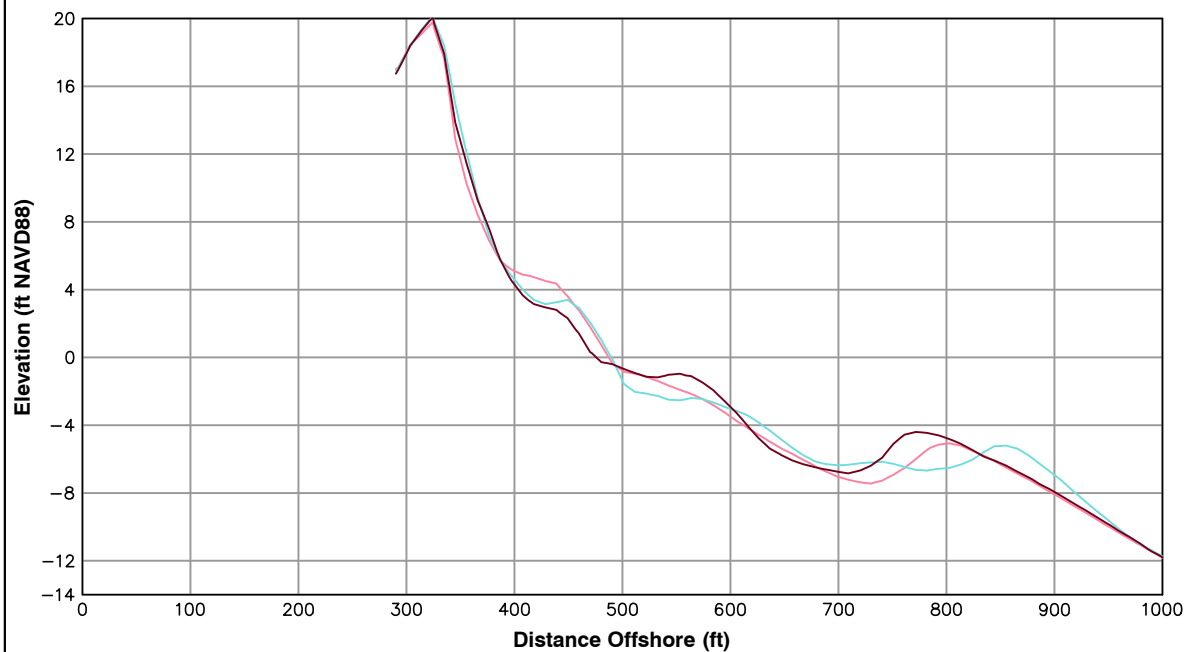
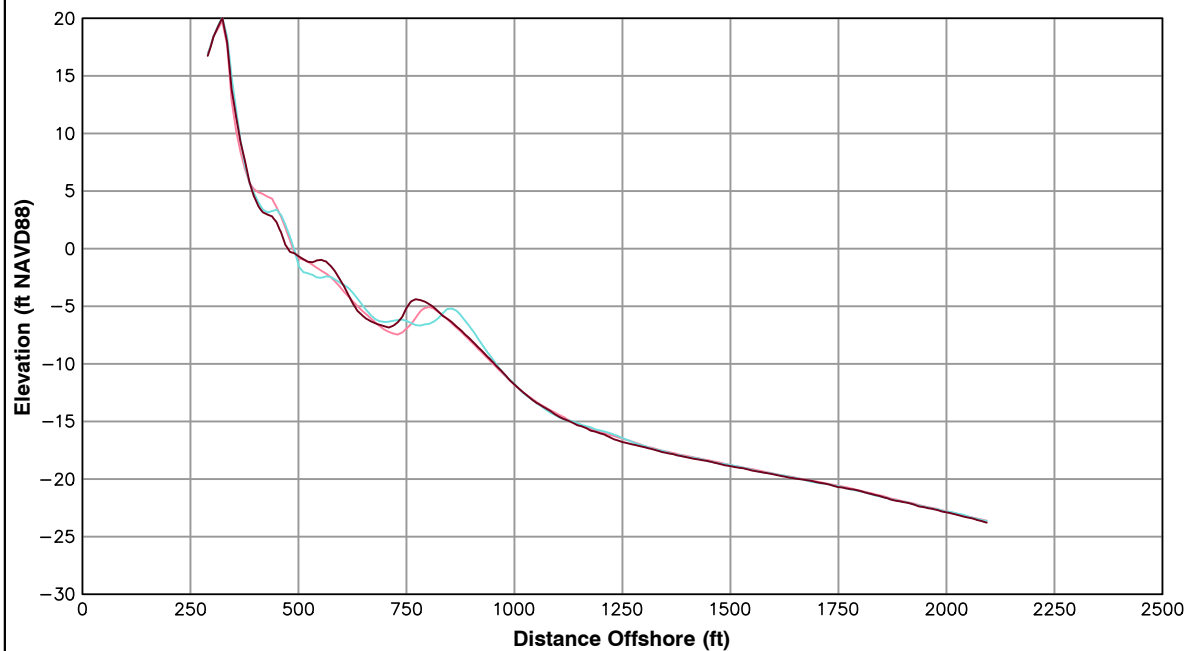


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ANALYSIS**

ST 288+39

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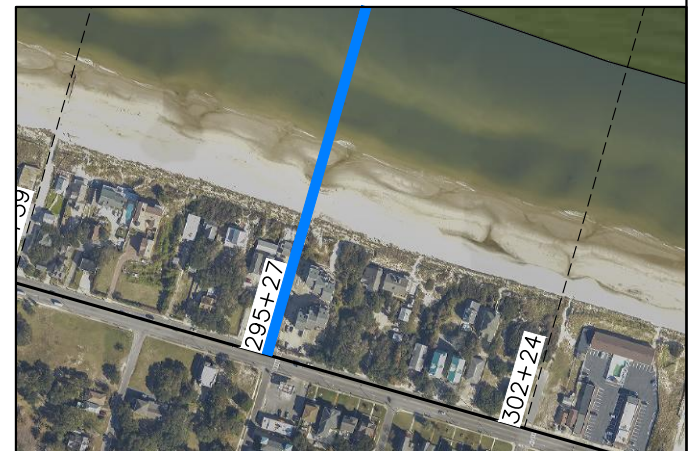
| Survey Transect 295+27 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -14.03 ft/yr | -17.11 ft |
| Volume Change Above -15 ft NAVD88 | 3.43 cy/ft/yr | -0.98 cy/ft |
| Volume Change Above 0 ft NAVD88 | -2.69 cy/ft/yr | -3.50 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —

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 October 2014 and April 2015.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



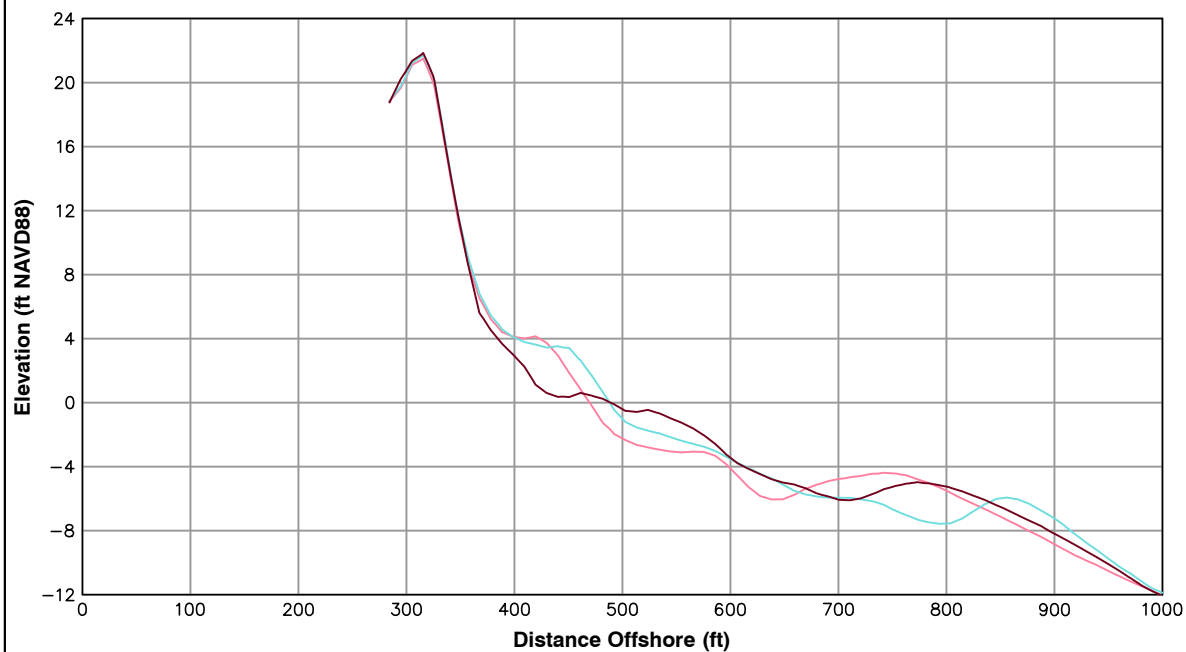
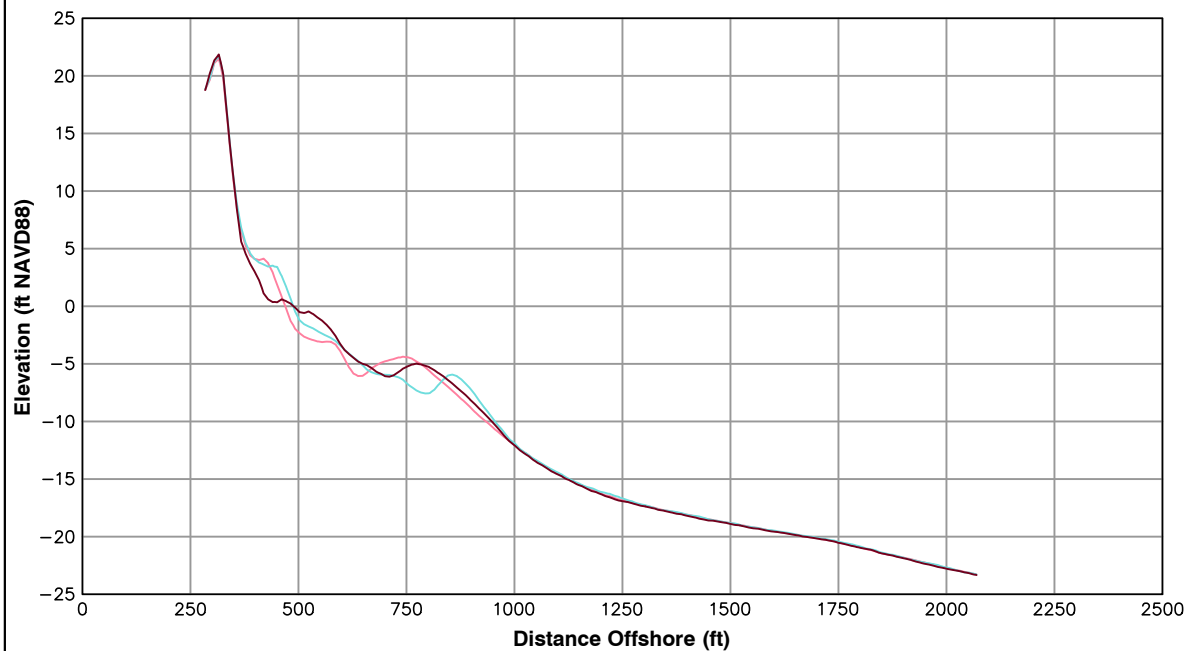
**City of
Norfolk**

**OCEAN VIEW PERIODIC
SURVEYING DATA &
ANALYSIS**

ST 295+27

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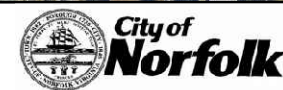
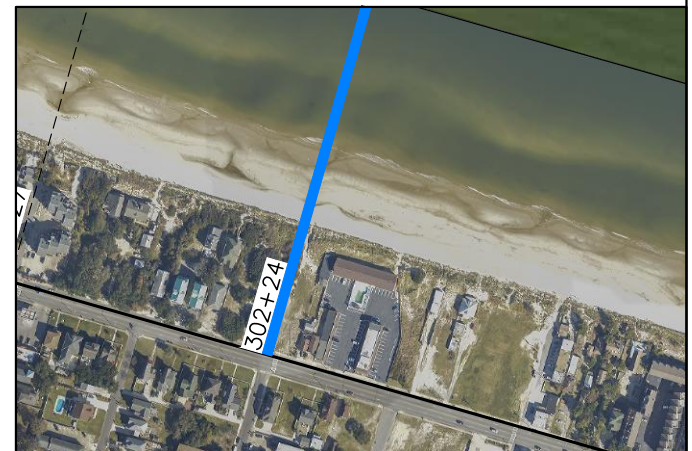
| Survey Transect 302+24 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -37.01 ft/yr | -56.30 ft |
| Volume Change Above -15 ft NAVD88 | 4.48 cy/ft/yr | -1.69 cy/ft |
| Volume Change Above 0 ft NAVD88 | -4.97 cy/ft/yr | -8.01 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —

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 October 2014 and April 2015.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

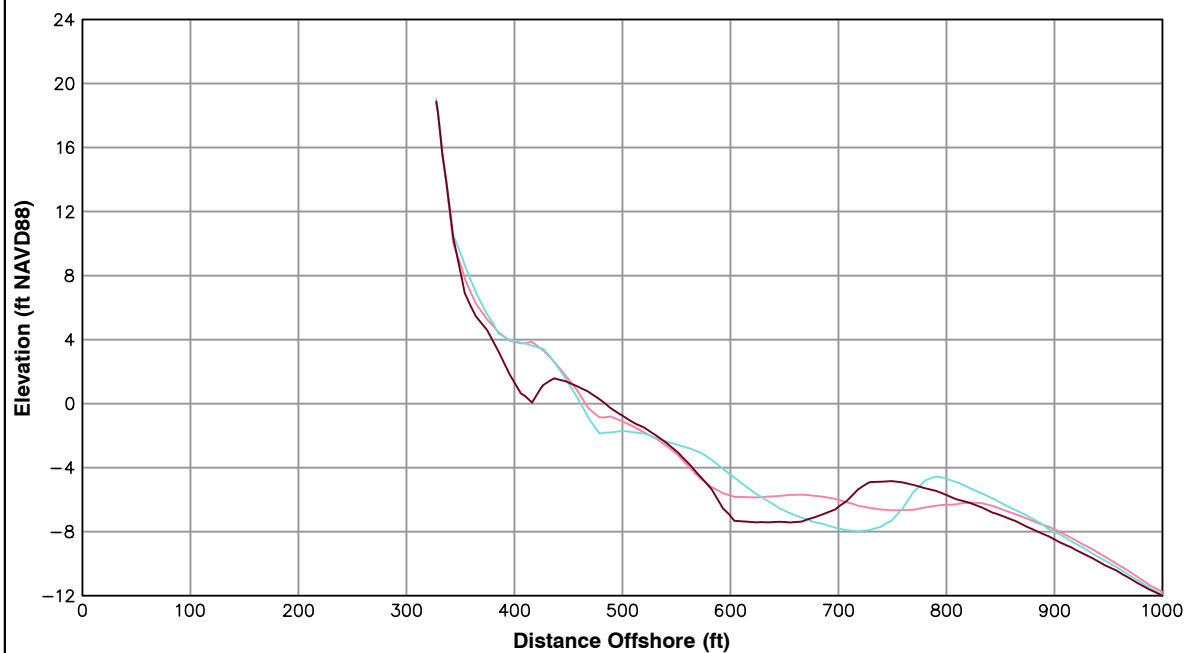
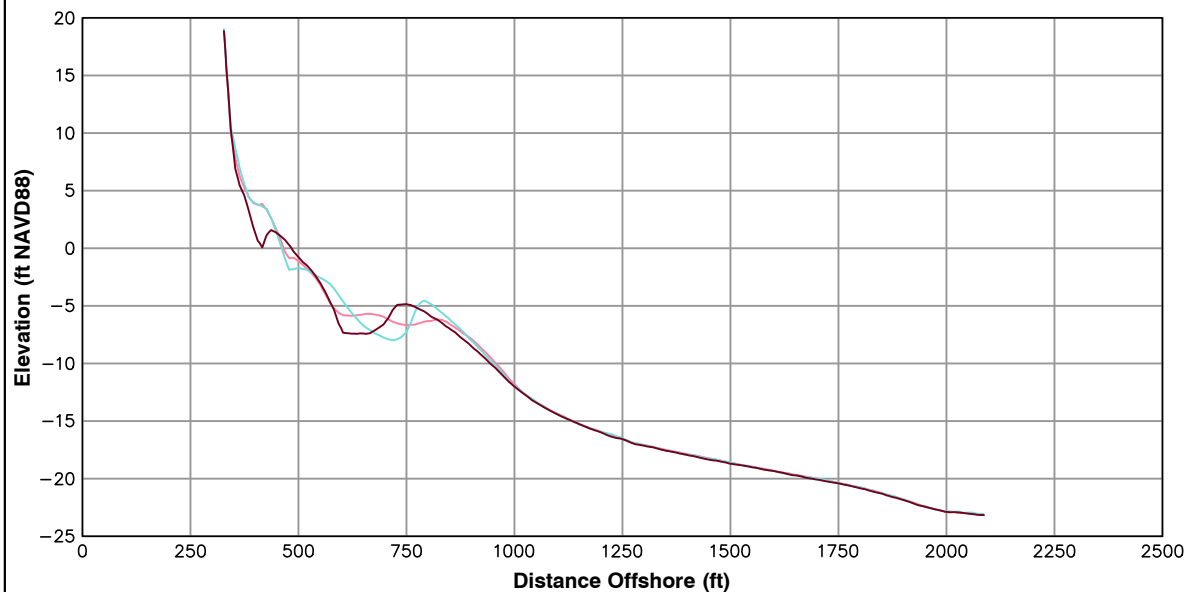


**OCEAN VIEW PERIODIC
SURVEYING DATA &
ANALYSIS**

ST 302+24

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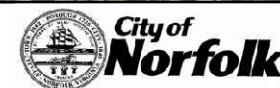
| Survey Transect 315+96 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 4.68 ft/yr | 8.34 ft |
| Volume Change Above -15 ft NAVD88 | -8.63 cy/ft/yr | -8.79 cy/ft |
| Volume Change Above 0 ft NAVD88 | -5.50 cy/ft/yr | -6.22 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —

Notes:

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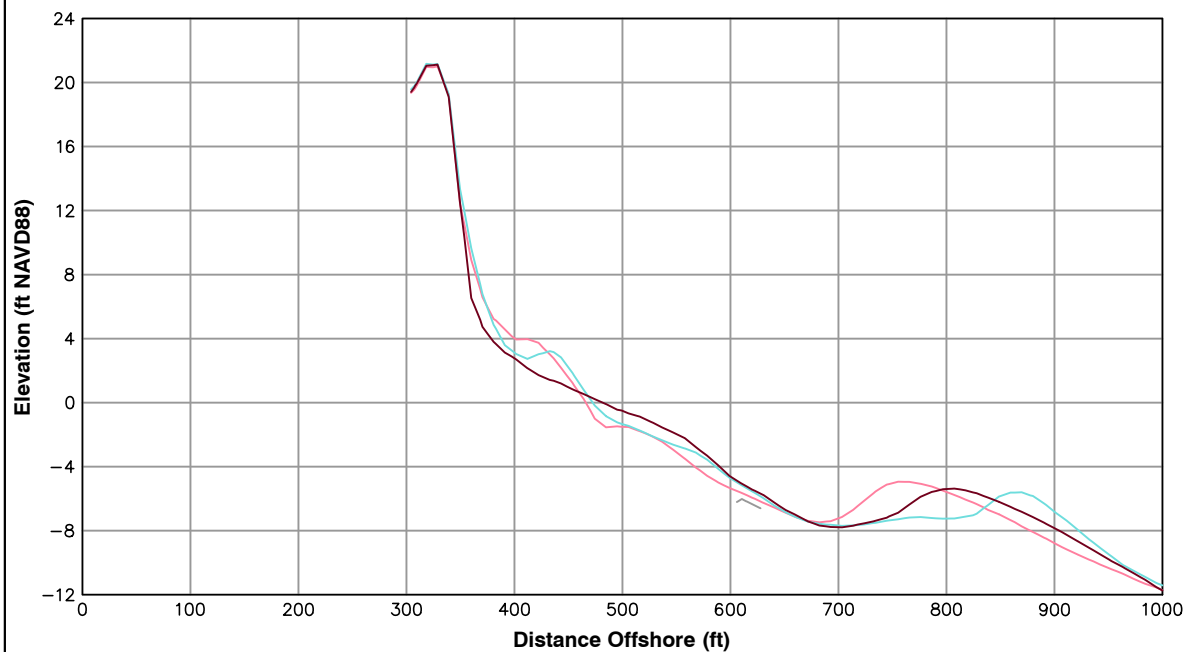
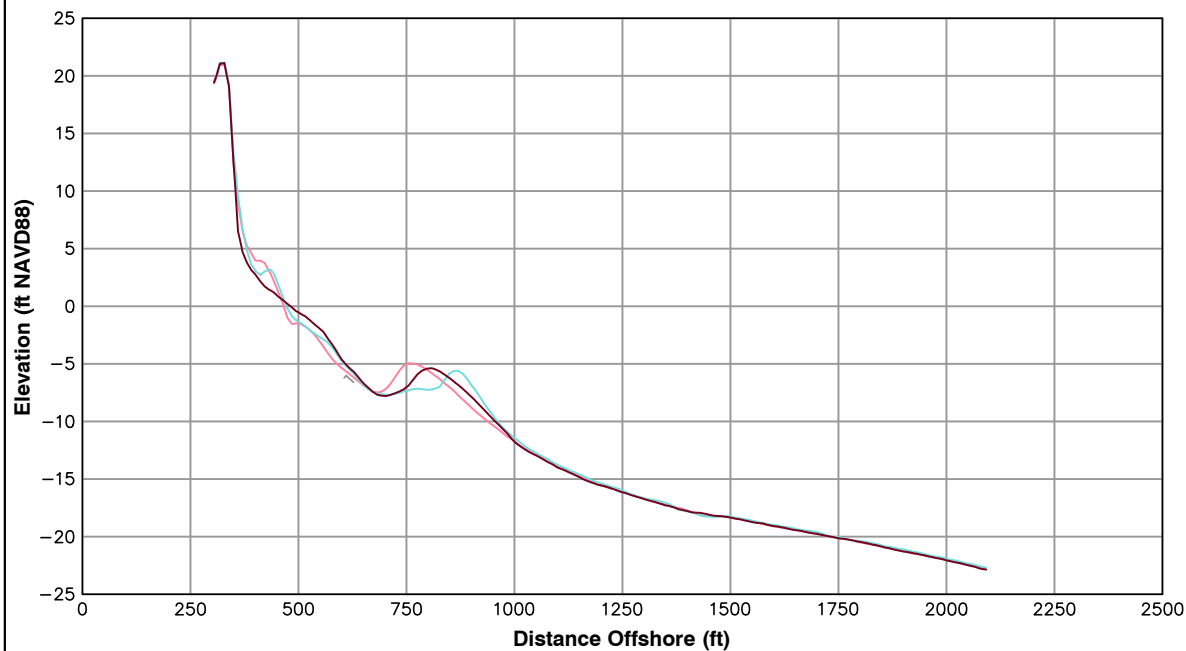


**OCEAN VIEW PERIODIC
SURVEYING DATA &
ANALYSIS**

ST 315+96

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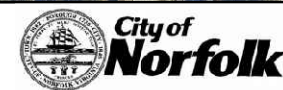
| Survey Transect 323+09 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -6.77 ft/yr | -12.83 ft |
| Volume Change Above -15 ft NAVD88 | 0.57 cy/ft/yr | -3.23 cy/ft |
| Volume Change Above 0 ft NAVD88 | -5.44 cy/ft/yr | -5.60 cy/ft |

LEGEND:

2015 OCT (dark red line)
 2015 APR (cyan line)
 2014 OCT (pink line)

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 October 2014 and April 2015.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

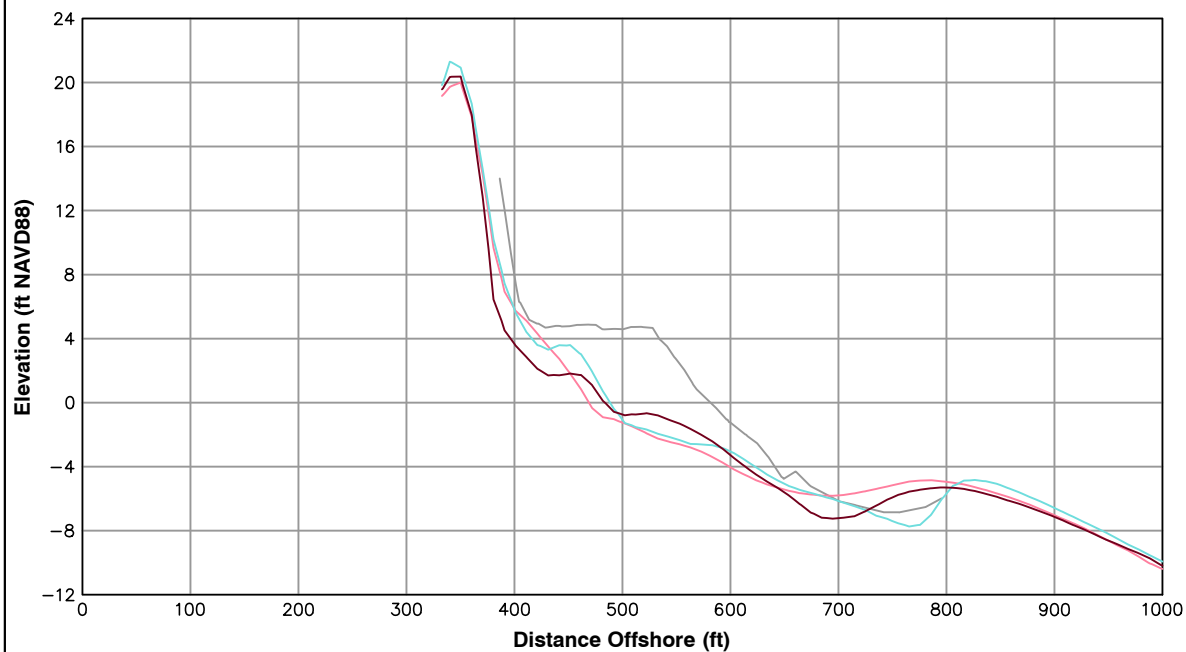
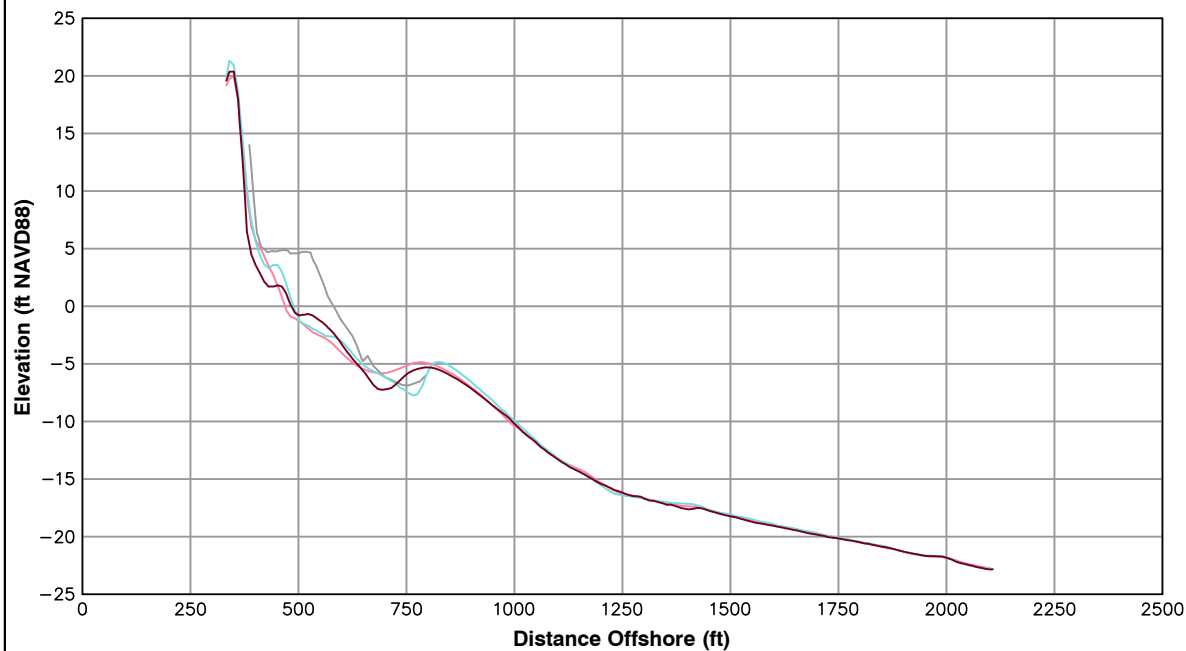


**OCEAN VIEW PERIODIC
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ST 323+09

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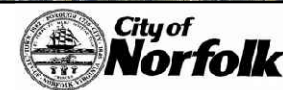
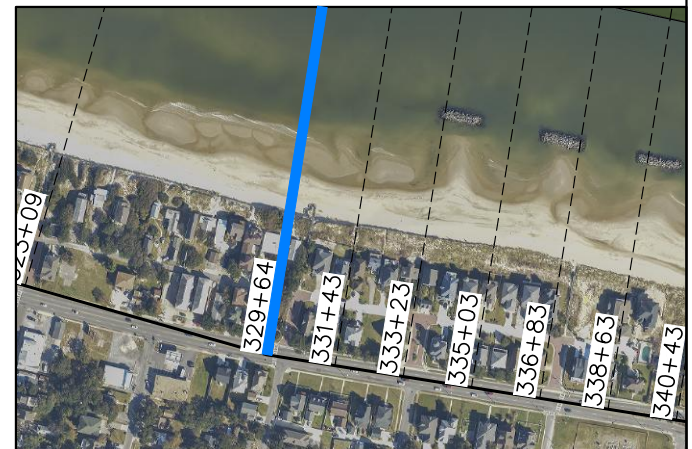
| Survey Transect 329+63 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 12.63 ft/yr | -6.68 ft |
| Volume Change Above -15 ft NAVD88 | -5.83 cy/ft/yr | -10.39 cy/ft |
| Volume Change Above 0 ft NAVD88 | -4.89 cy/ft/yr | -8.86 cy/ft |

LEGEND:

2015 OCT —
 2015 APR —
 2014 OCT —
 POST-FILL —

Notes:

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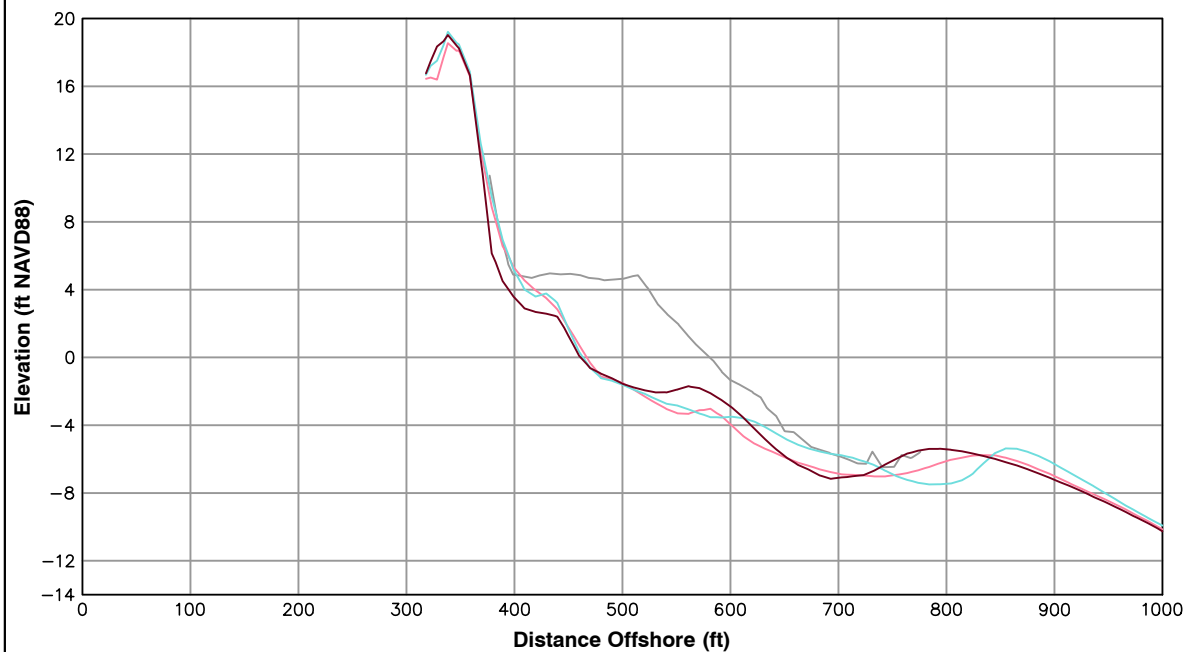
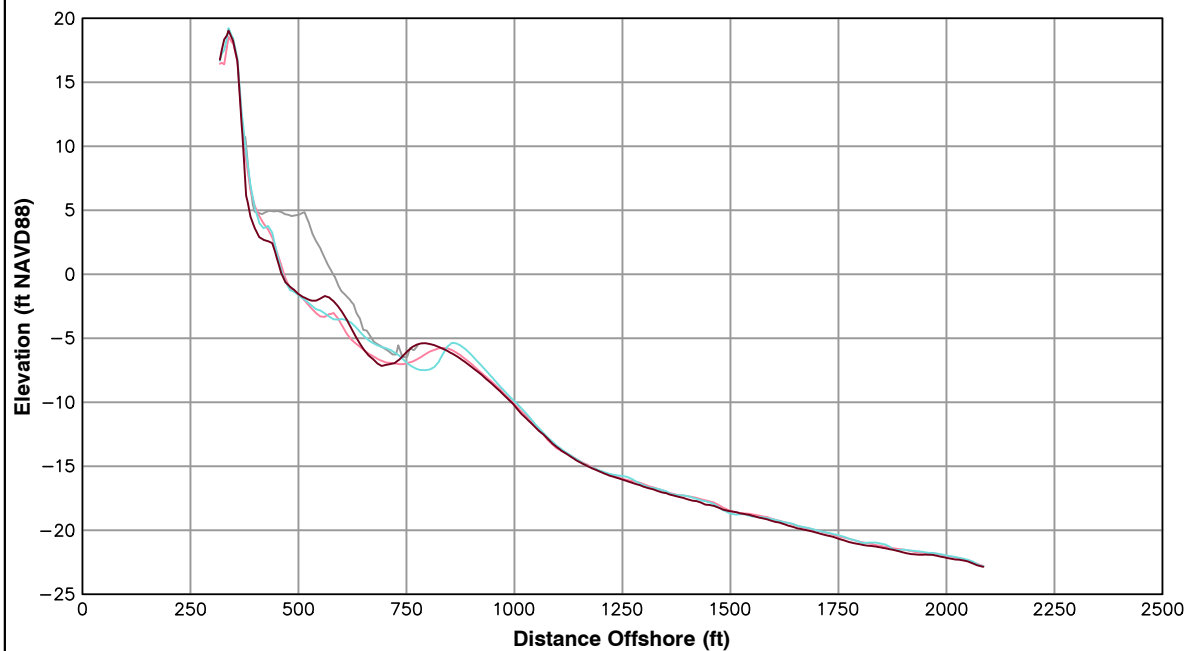


**OCEAN VIEW PERIODIC
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ST 329+63

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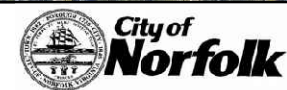
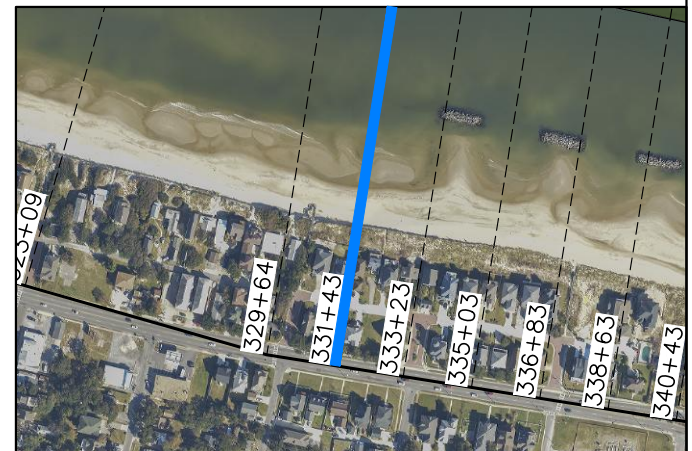
| Survey Transect 331+43 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -5.01 ft/yr | -2.68 ft |
| Volume Change Above -15 ft NAVD88 | 1.60 cy/ft/yr | -5.70 cy/ft |
| Volume Change Above 0 ft NAVD88 | -3.57 cy/ft/yr | -4.74 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
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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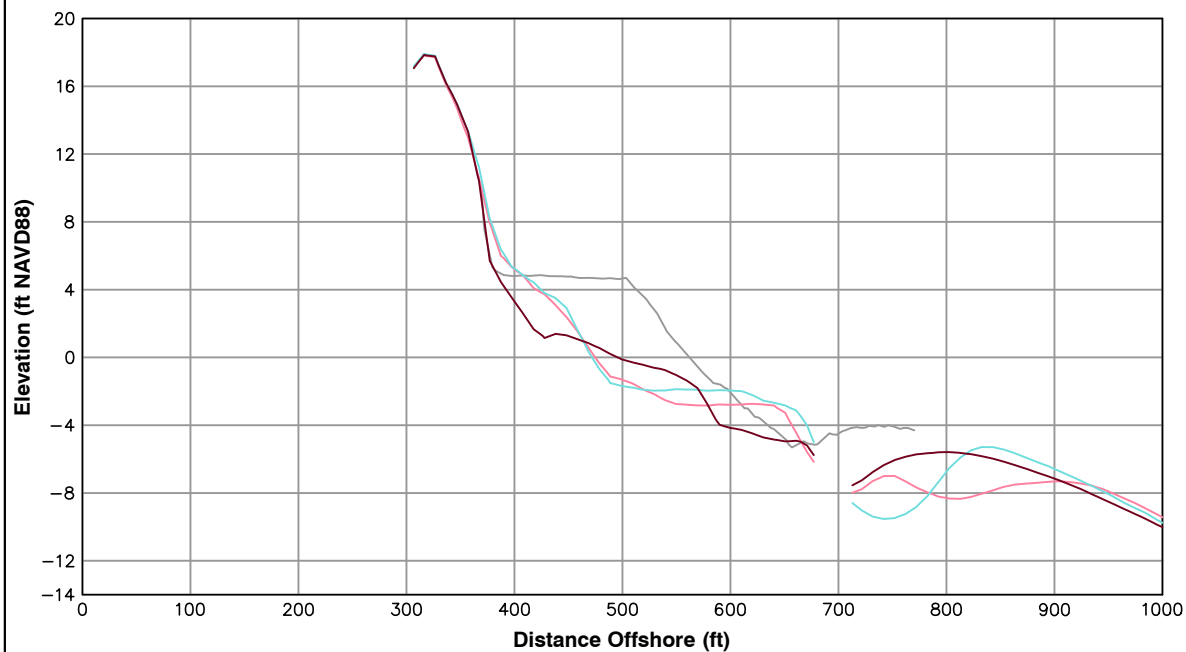
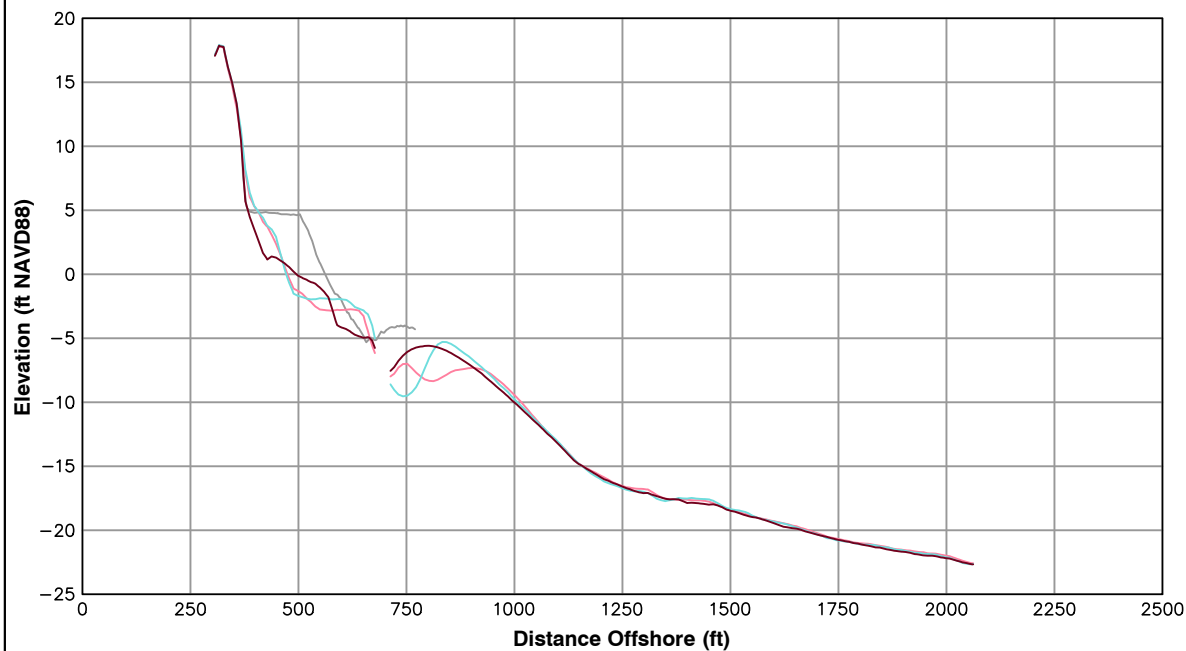


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ST 331+43

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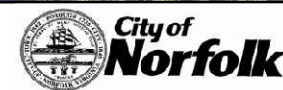
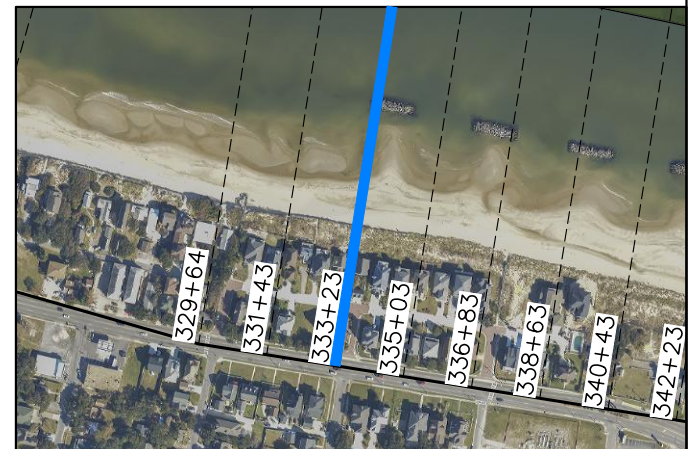
| Survey Transect 333+23 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -1.72 ft/yr | -0.96 ft |
| Volume Change Above -15 ft NAVD88 | 2.46 cy/ft/yr | -5.38 cy/ft |
| Volume Change Above 0 ft NAVD88 | -5.35 cy/ft/yr | -6.68 cy/ft |

LEGEND:

2015 OCT — dark red line
 2015 APR — cyan line
 2014 OCT — pink line
 POST-FILL — grey line

Notes:

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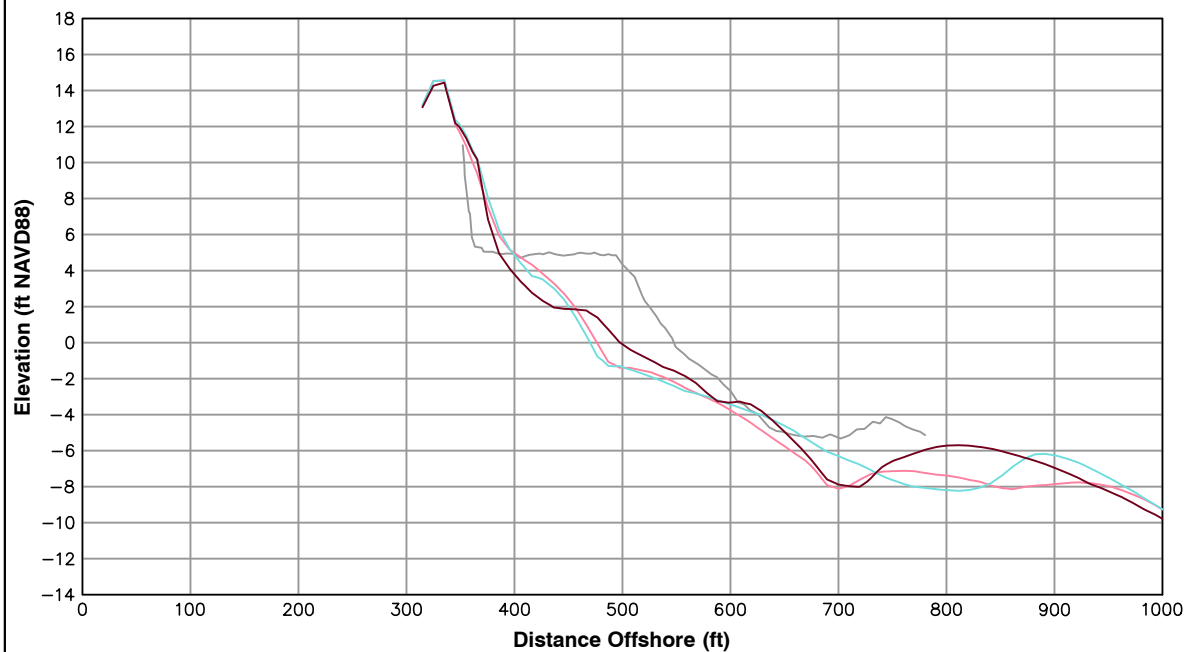
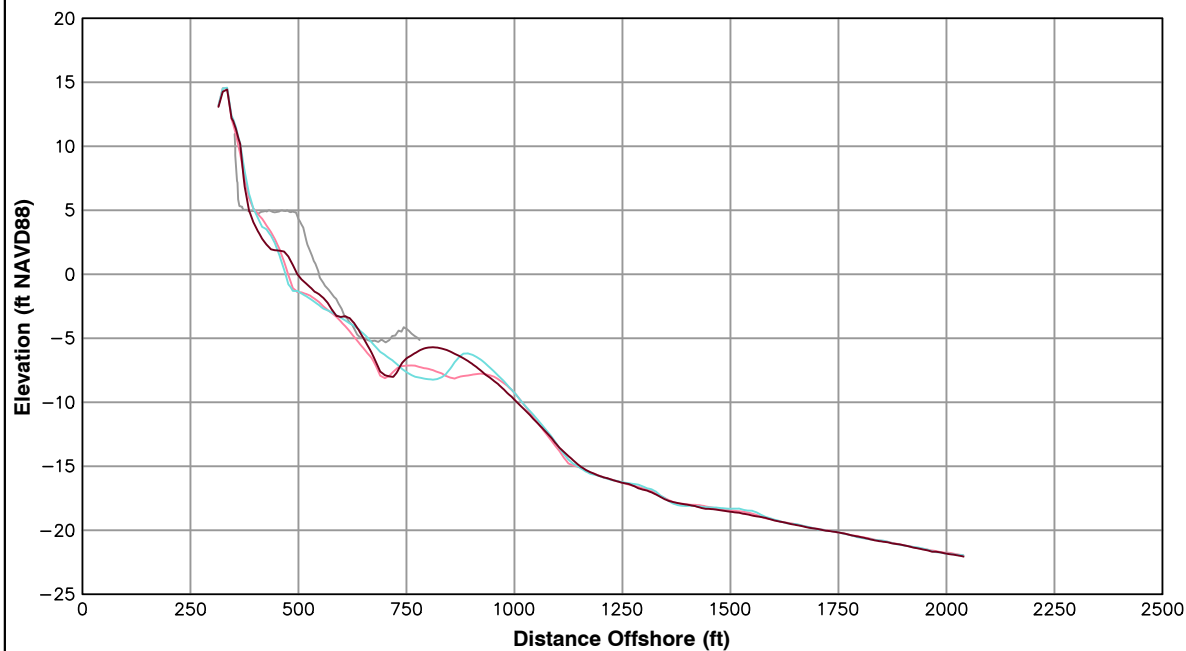


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ANALYSIS**

ST 333+23

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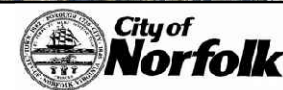
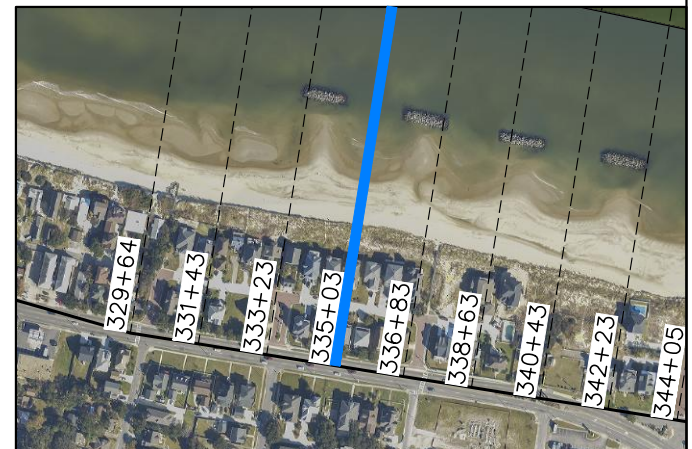
| Survey Transect 335+03 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 16.21 ft/yr | 22.21 ft |
| Volume Change Above -15 ft NAVD88 | 11.68 cy/ft/yr | 3.52 cy/ft |
| Volume Change Above 0 ft NAVD88 | -2.06 cy/ft/yr | -1.89 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
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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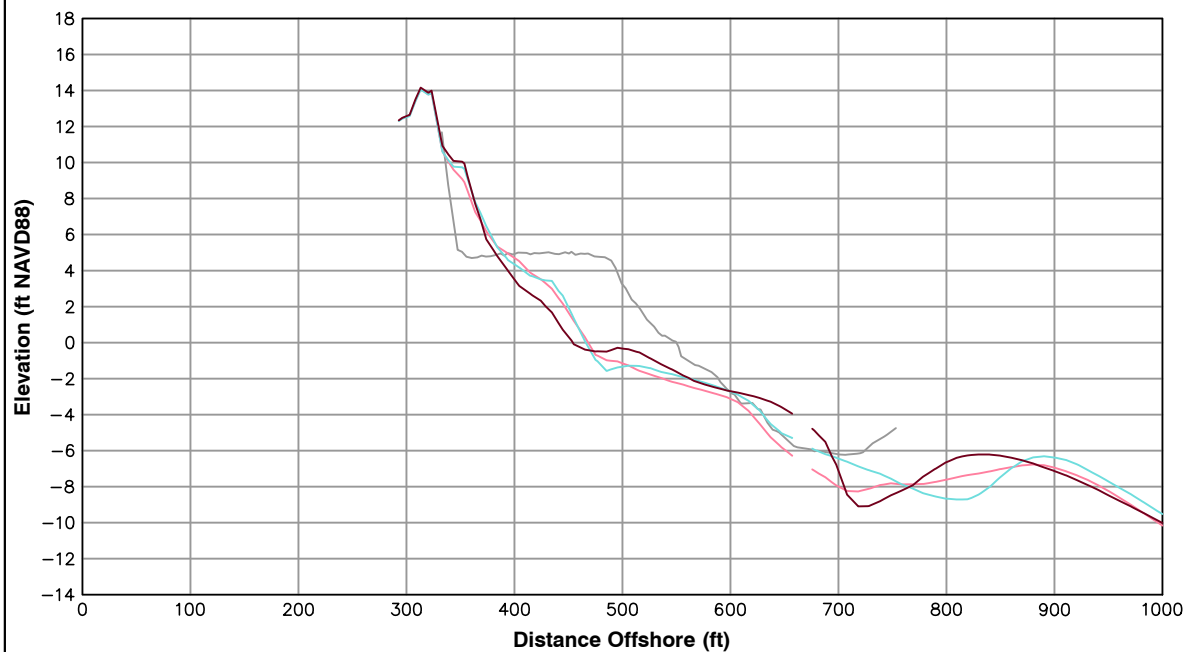
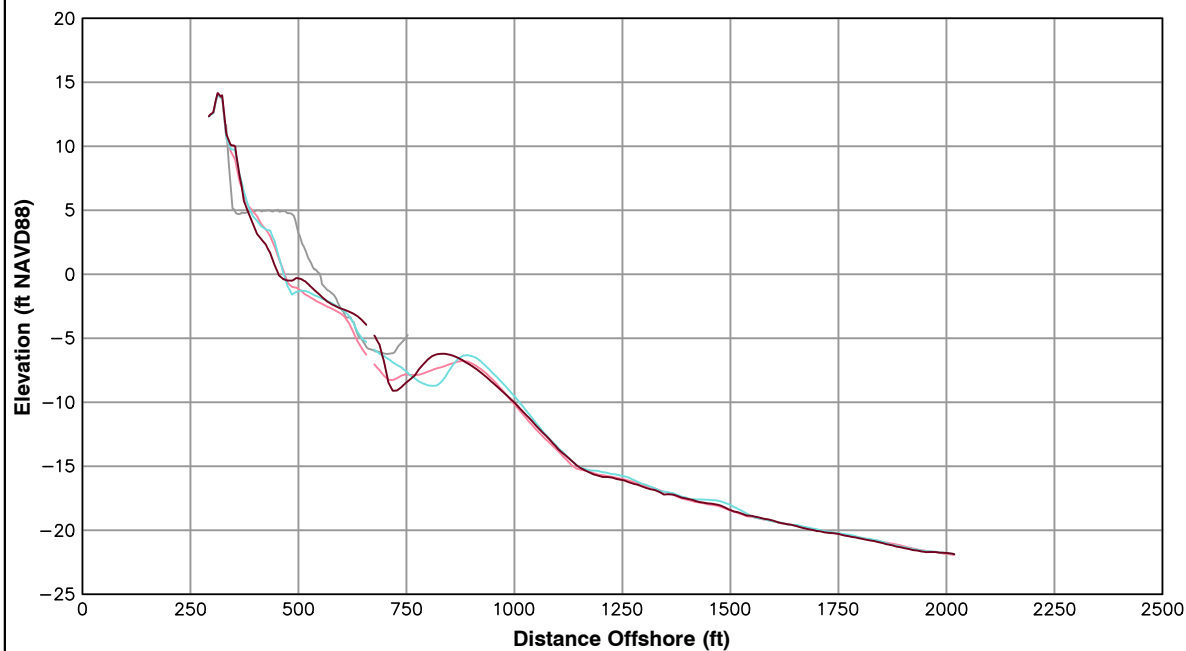


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ANALYSIS**

ST 335+03

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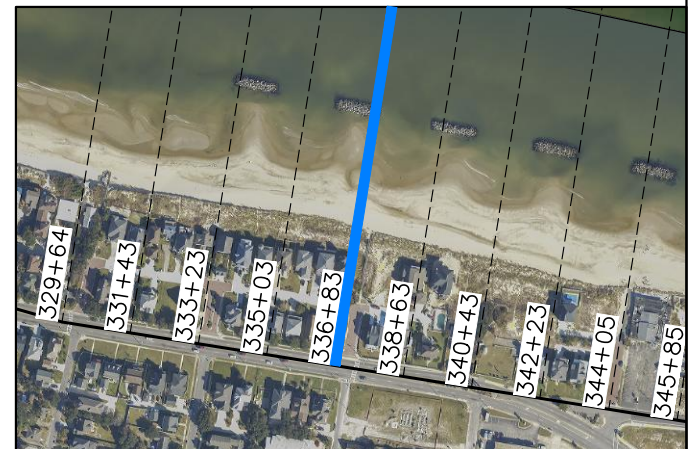
| Survey Transect 336+83 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -15.42 ft/yr | -15.93 ft |
| Volume Change Above -15 ft NAVD88 | 6.83 cy/ft/yr | -1.15 cy/ft |
| Volume Change Above 0 ft NAVD88 | -2.72 cy/ft/yr | -3.34 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
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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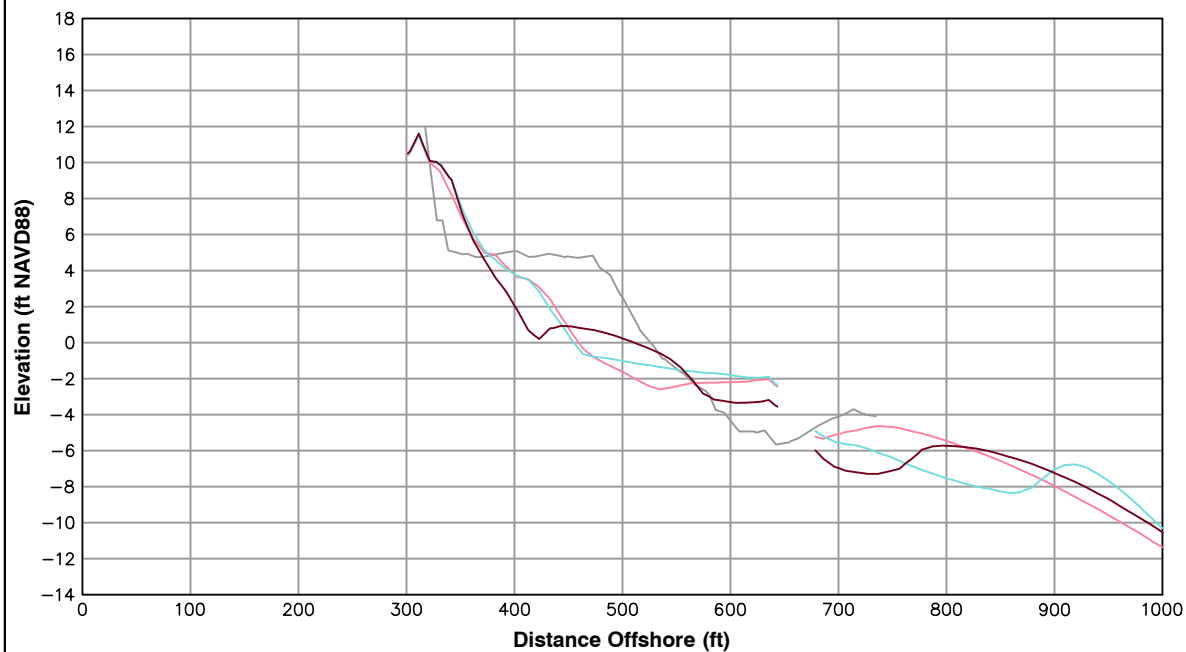
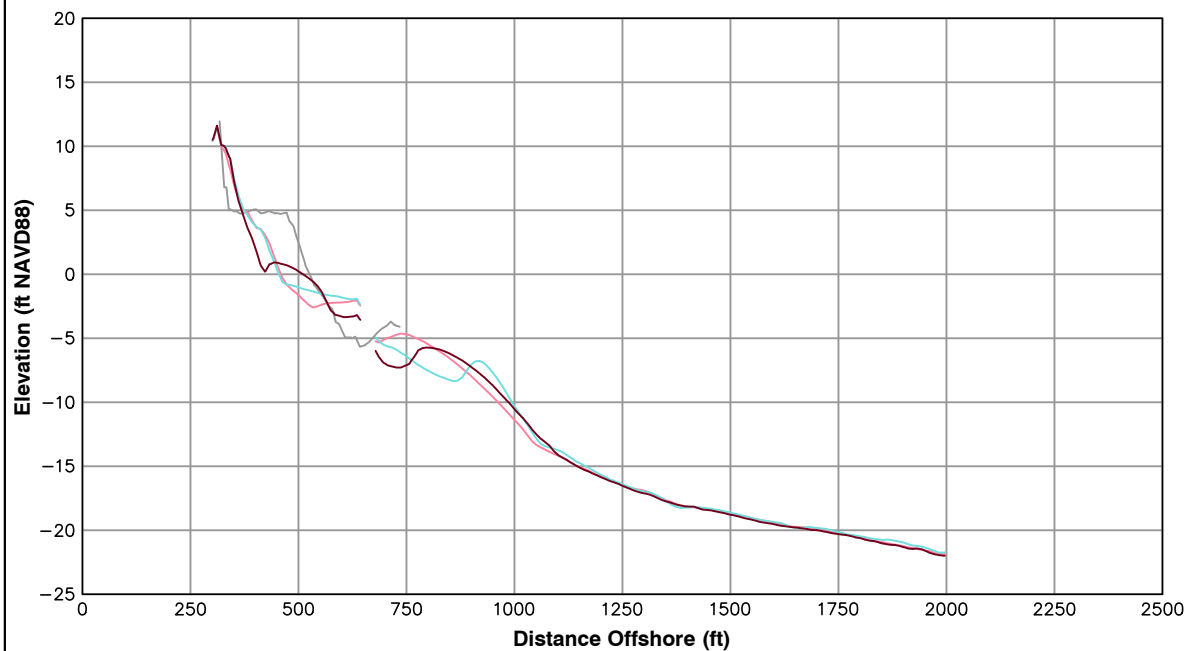
**City of
Norfolk**

**OCEAN VIEW PERIODIC
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ST 336+83

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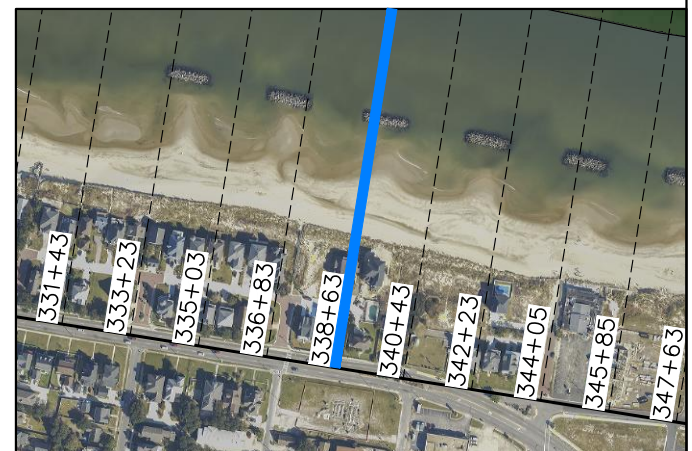
| Survey Transect 338+63 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -37.84 ft/yr | -33.59 ft |
| Volume Change Above -15 ft NAVD88 | -1.38 cy/ft/yr | -3.36 cy/ft |
| Volume Change Above 0 ft NAVD88 | -3.05 cy/ft/yr | -3.21 cy/ft |

LEGEND:

2015 OCT —
 2015 APR —
 2014 OCT —
 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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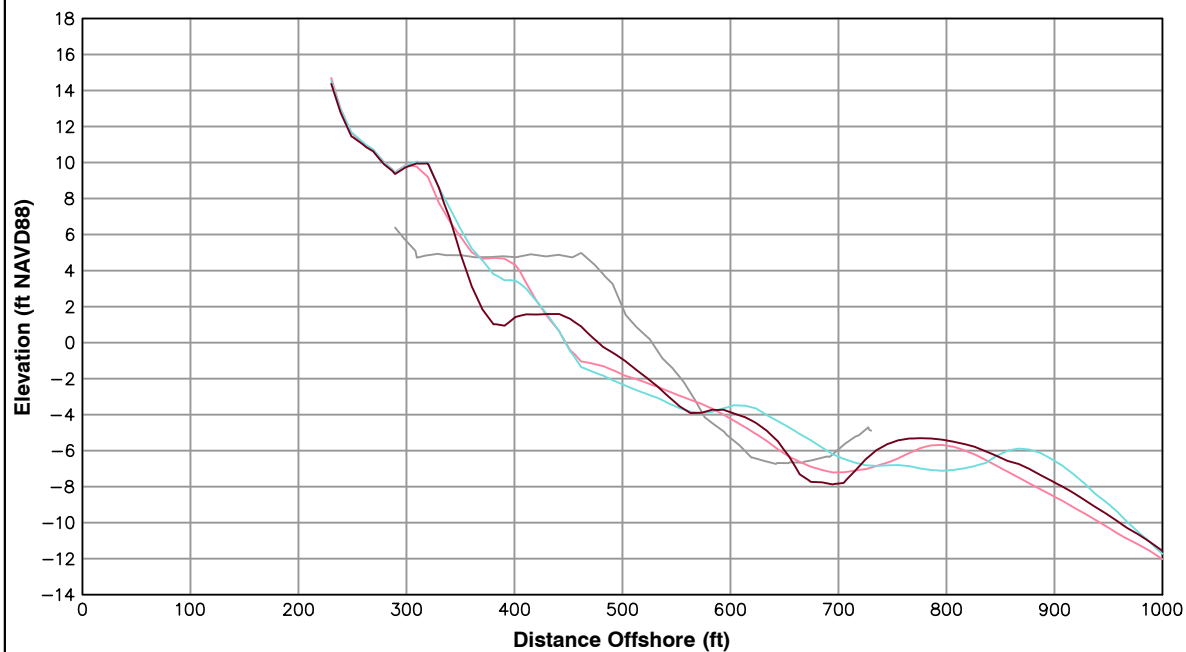
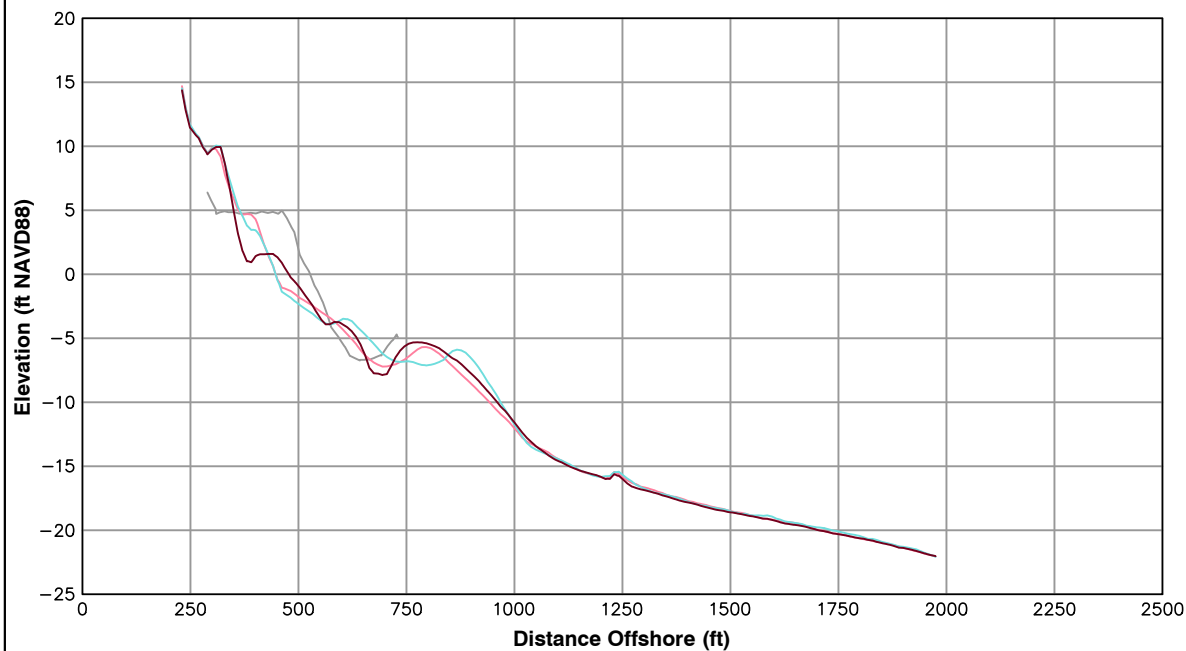
**City of
Norfolk**

**OCEAN VIEW PERIODIC
SURVEYING DATA &
ANALYSIS**

ST 338+63

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Fall 2015



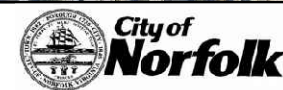
| Survey Transect 340+43 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 22.89 ft/yr | 22.54 ft |
| Volume Change Above -15 ft NAVD88 | 2.88 cy/ft/yr | -4.63 cy/ft |
| Volume Change Above 0 ft NAVD88 | -5.11 cy/ft/yr | -5.15 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
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 October 2014 and April 2015.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

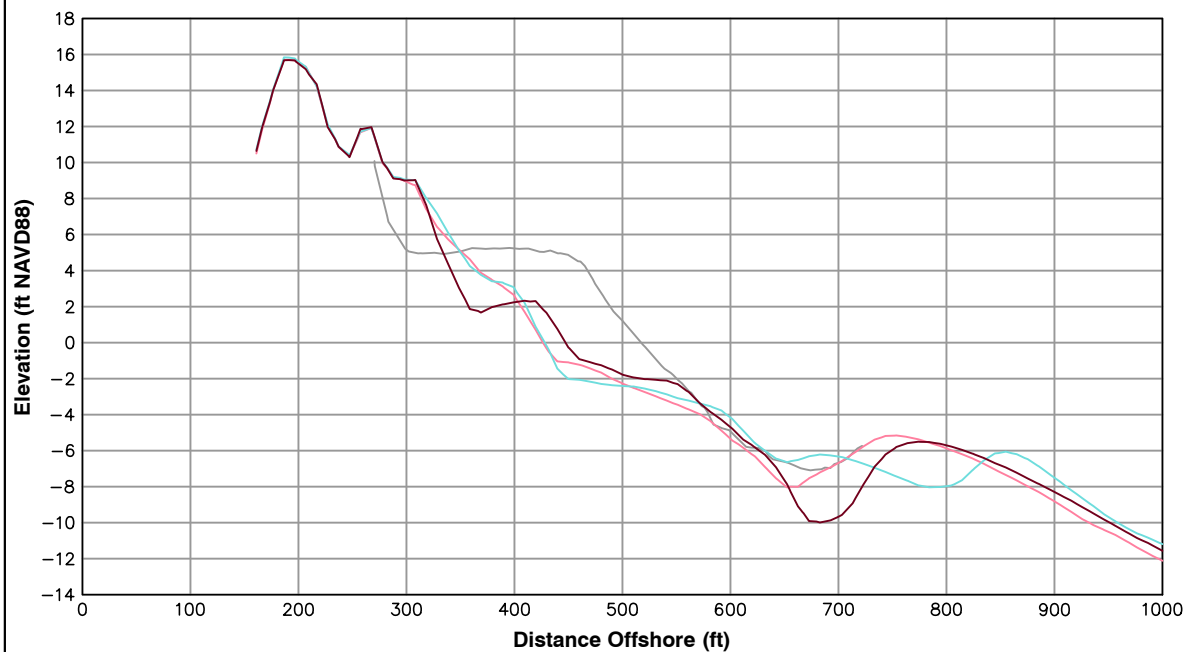
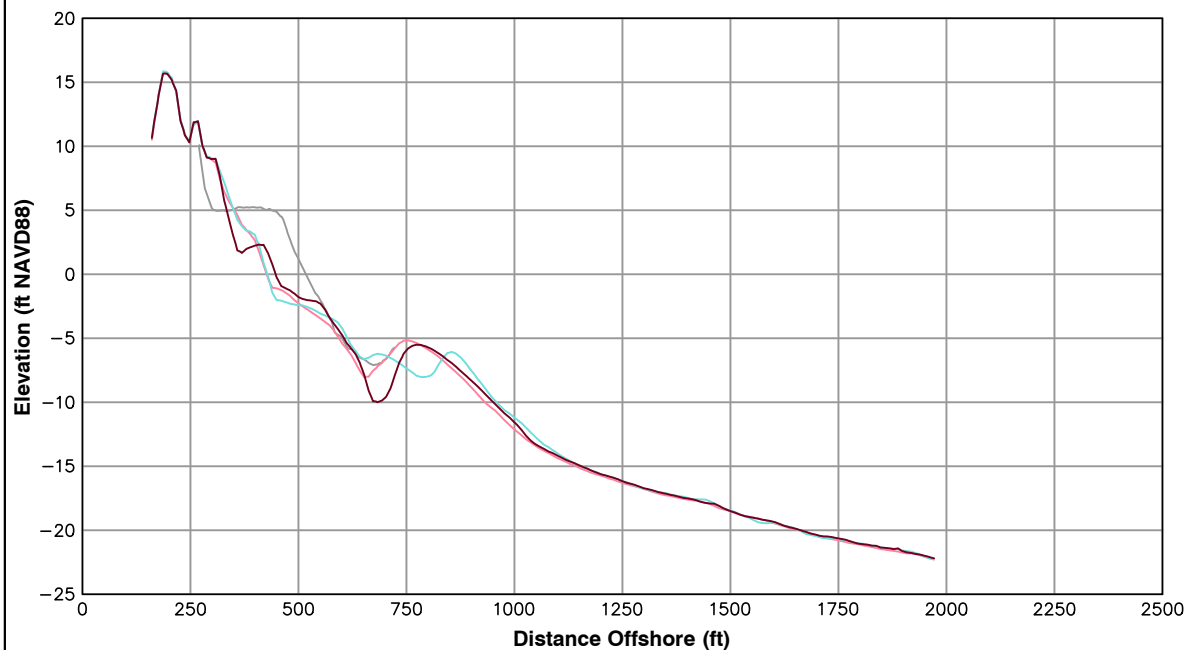


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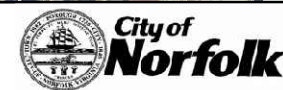
| Survey Transect 342+23 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 20.36 ft/yr | 18.54 ft |
| Volume Change Above -15 ft NAVD88 | -0.09 cy/ft/yr | -7.42 cy/ft |
| Volume Change Above 0 ft NAVD88 | -2.46 cy/ft/yr | -3.88 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
POST-FILL —

Notes:

1. Stationing From West To East At Varying Intervals.
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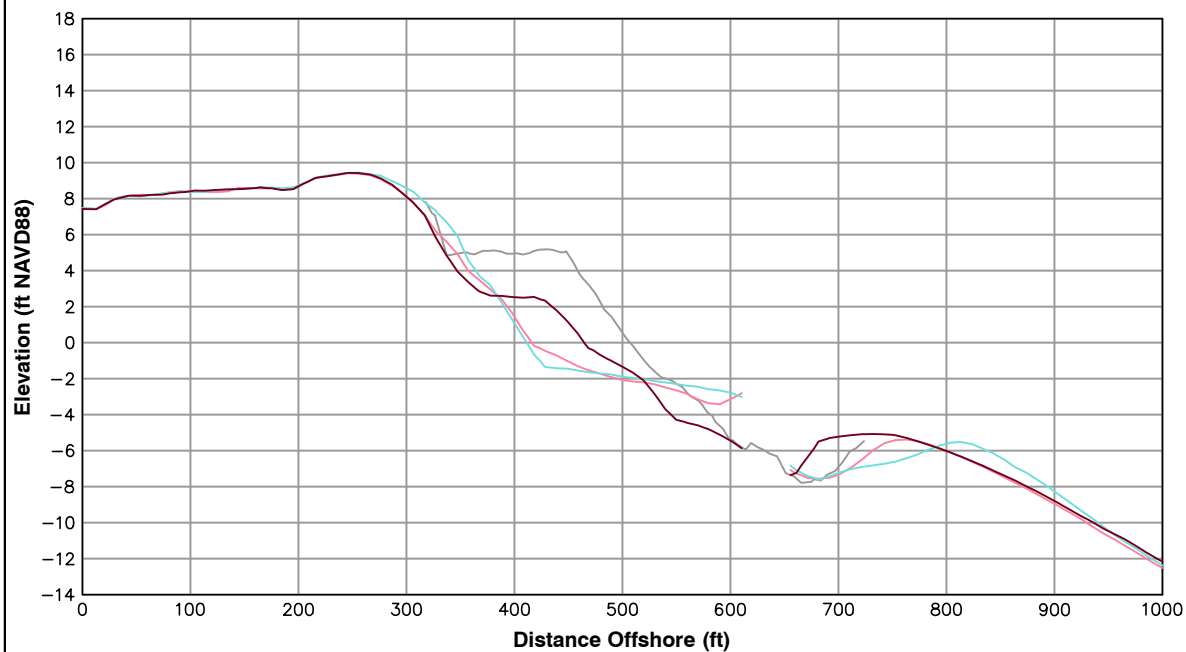
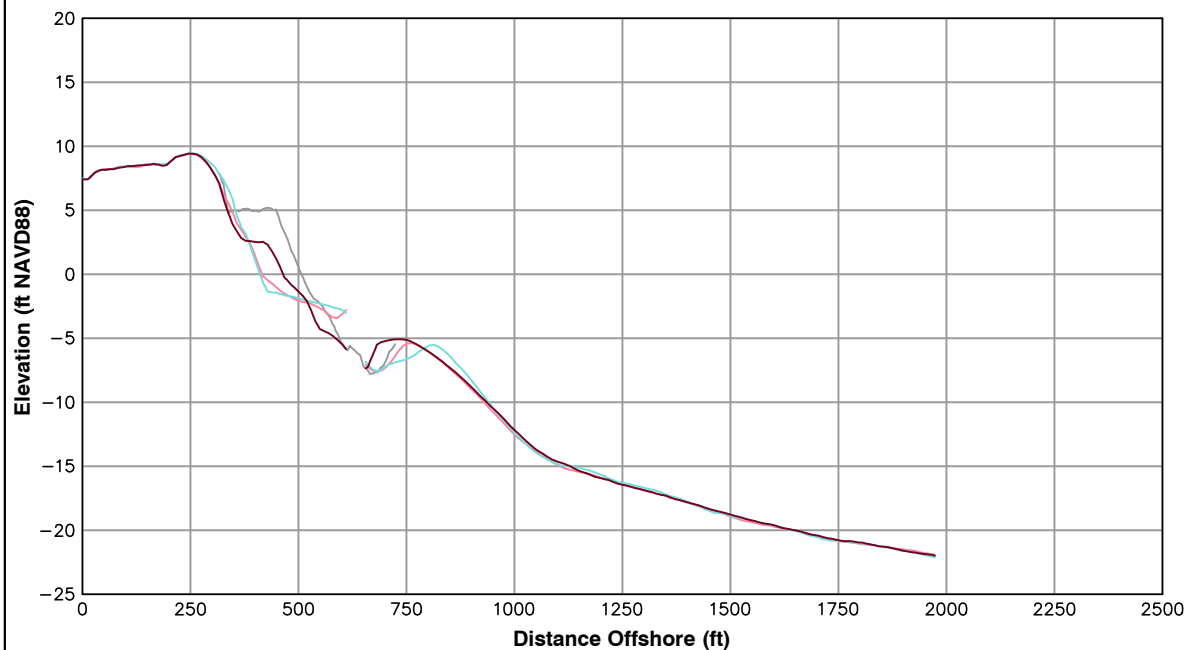


**OCEAN VIEW PERIODIC
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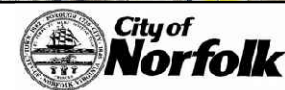
| Survey Transect 344+05 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 46.77 ft/yr | 50.86 ft |
| Volume Change Above -15 ft NAVD88 | 7.92 cy/ft/yr | 2.51 cy/ft |
| Volume Change Above 0 ft NAVD88 | 2.91 cy/ft/yr | 0.65 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
POST-FILL —

Notes:

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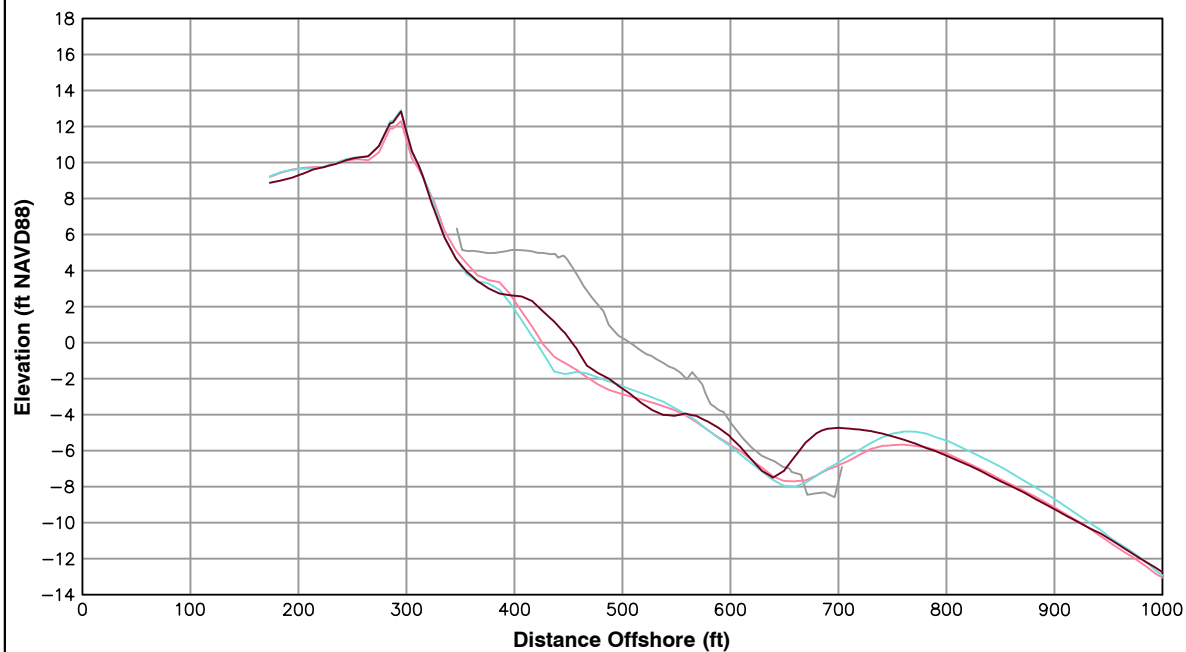
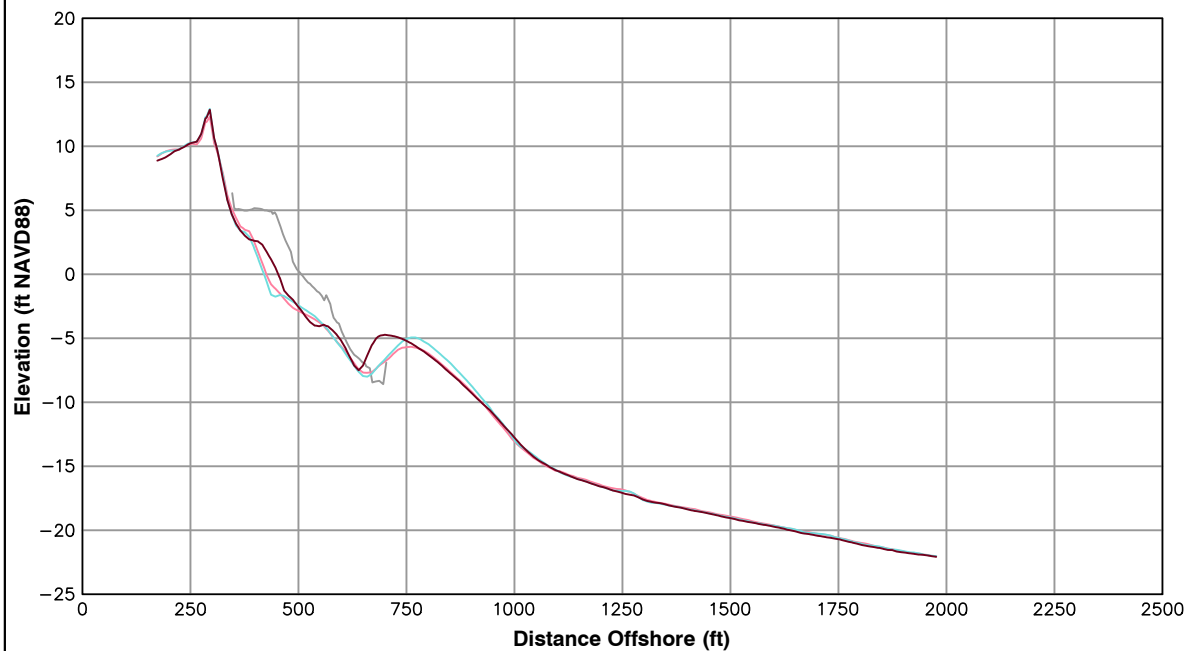


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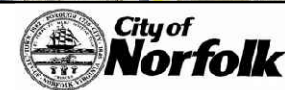
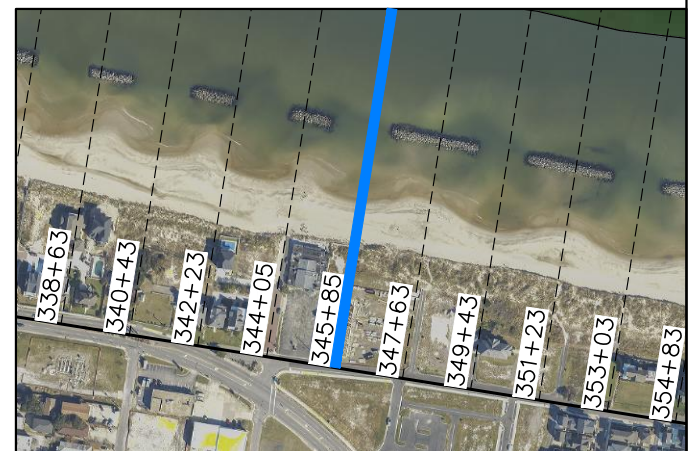
| Survey Transect 345+85 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 24.12 ft/yr | 30.12 ft |
| Volume Change Above -15 ft NAVD88 | 9.80 cy/ft/yr | 4.85 cy/ft |
| Volume Change Above 0 ft NAVD88 | 1.05 cy/ft/yr | 1.80 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
POST-FILL —

Notes:

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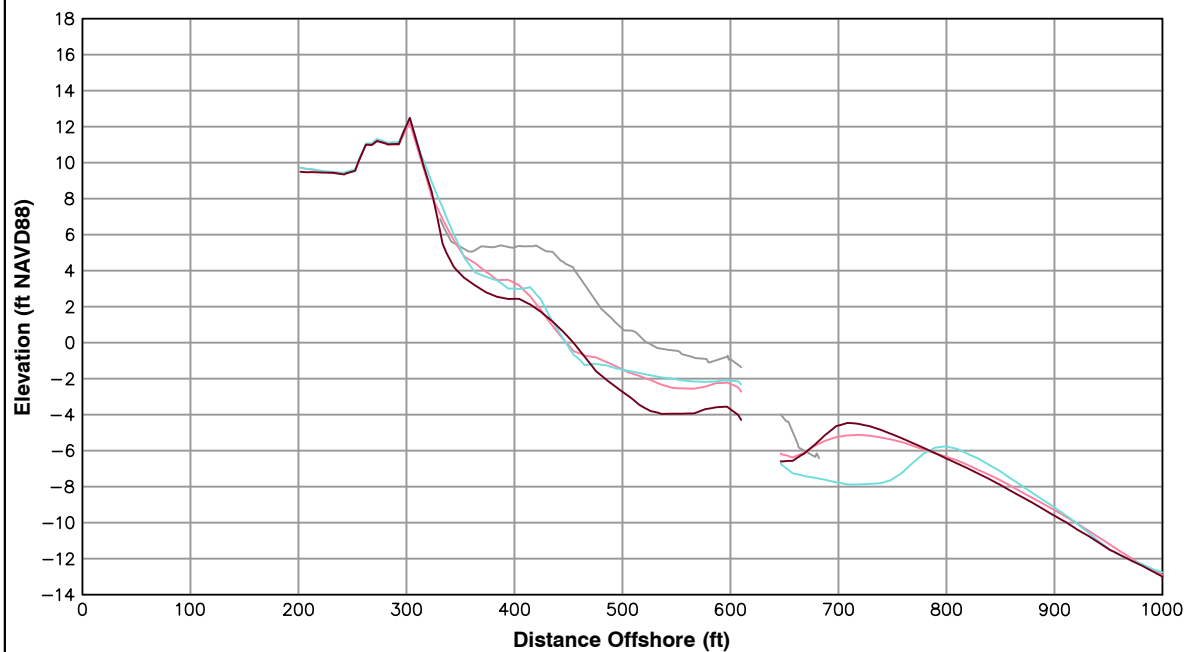
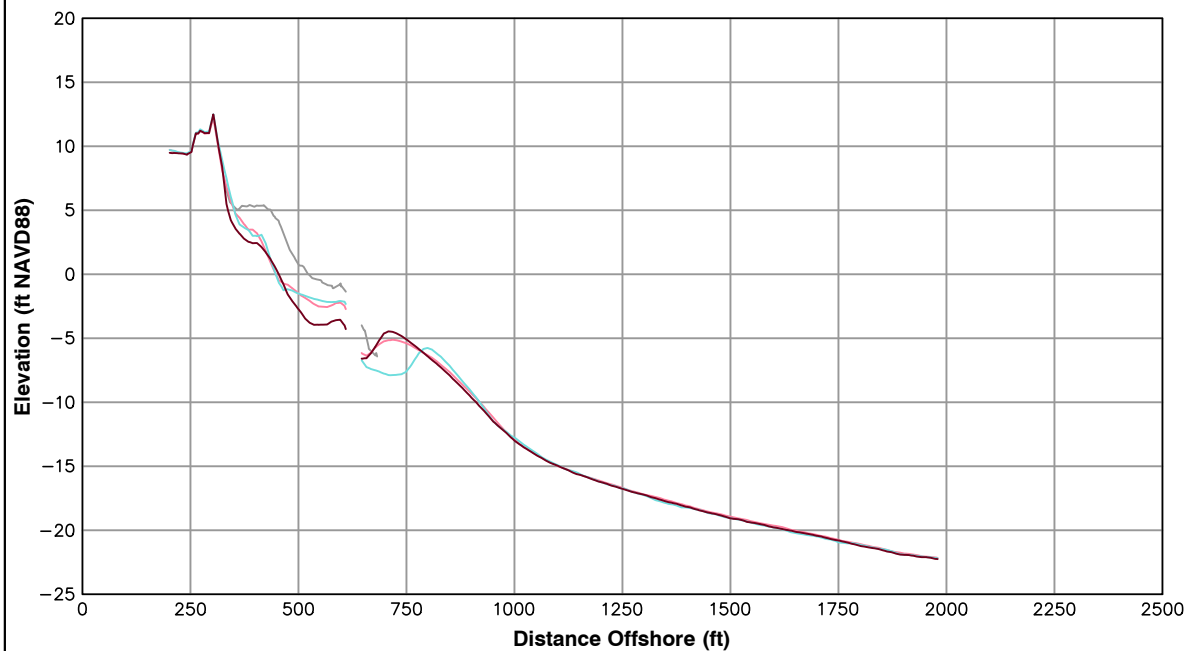


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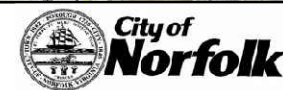
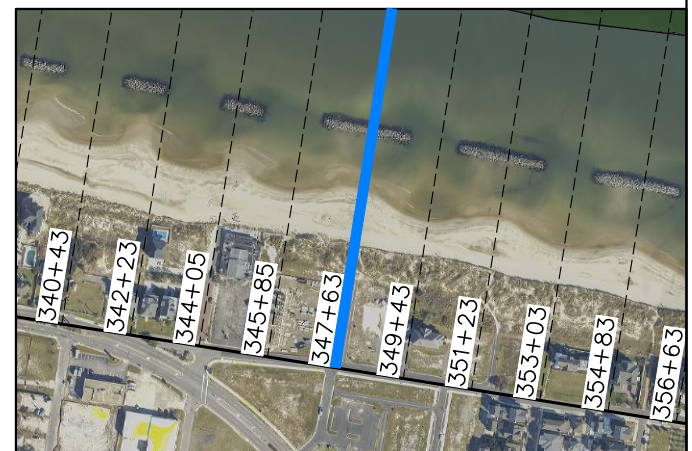
| Survey Transect 347+63 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 3.88 ft/yr | 1.31 ft |
| Volume Change Above -15 ft NAVD88 | -10.42 cy/ft/yr | -5.02 cy/ft |
| Volume Change Above 0 ft NAVD88 | -3.17 cy/ft/yr | -4.27 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
POST-FILL —

Notes:

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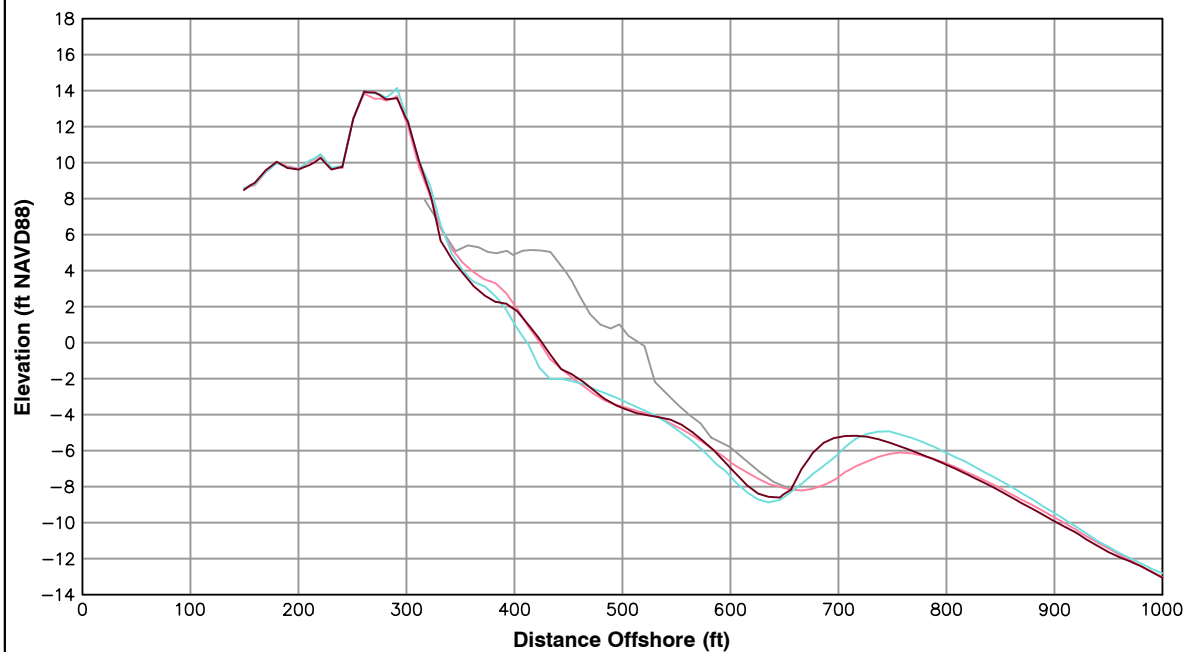
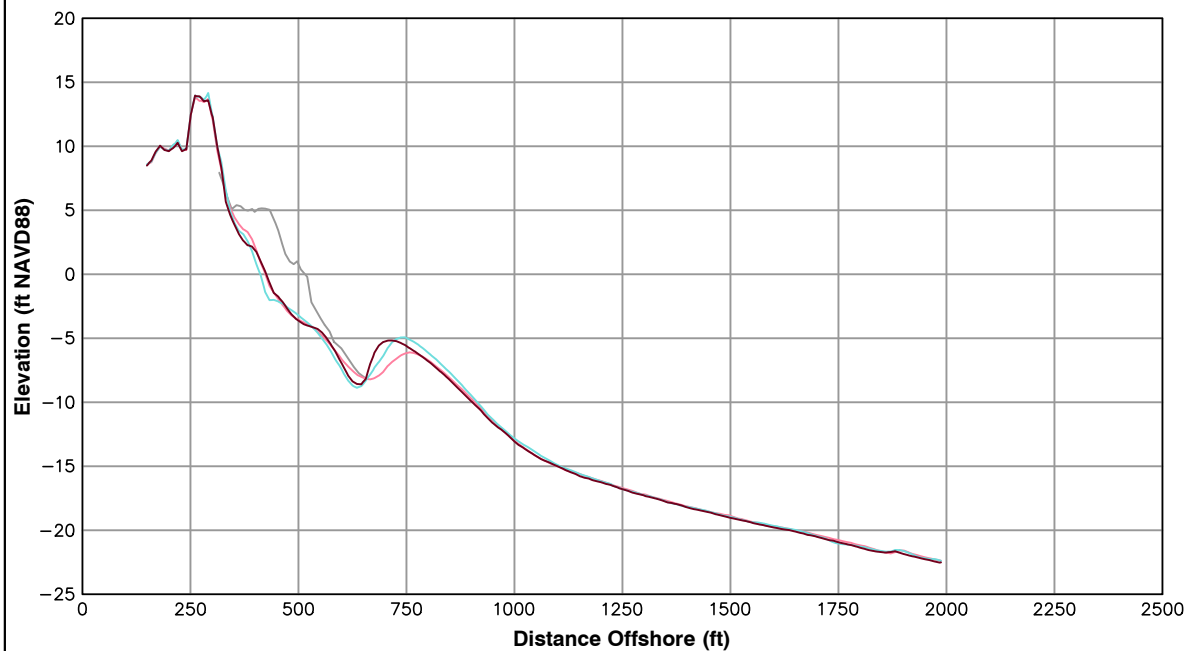


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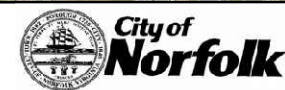
| Survey Transect 349+43 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 1.08 ft/yr | 12.36 ft |
| Volume Change Above -15 ft NAVD88 | 2.17 cy/ft/yr | -1.76 cy/ft |
| Volume Change Above 0 ft NAVD88 | -1.55 cy/ft/yr | -0.55 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
POST-FILL —

Notes:

1. Stationing From West To East At Varying Intervals.
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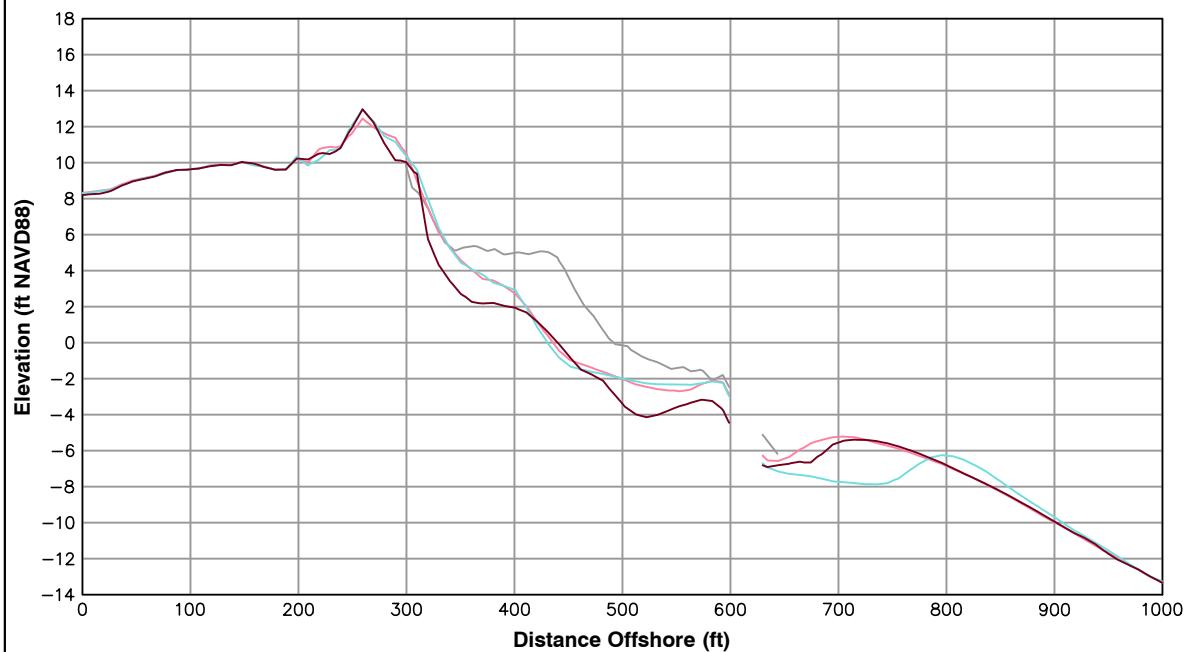
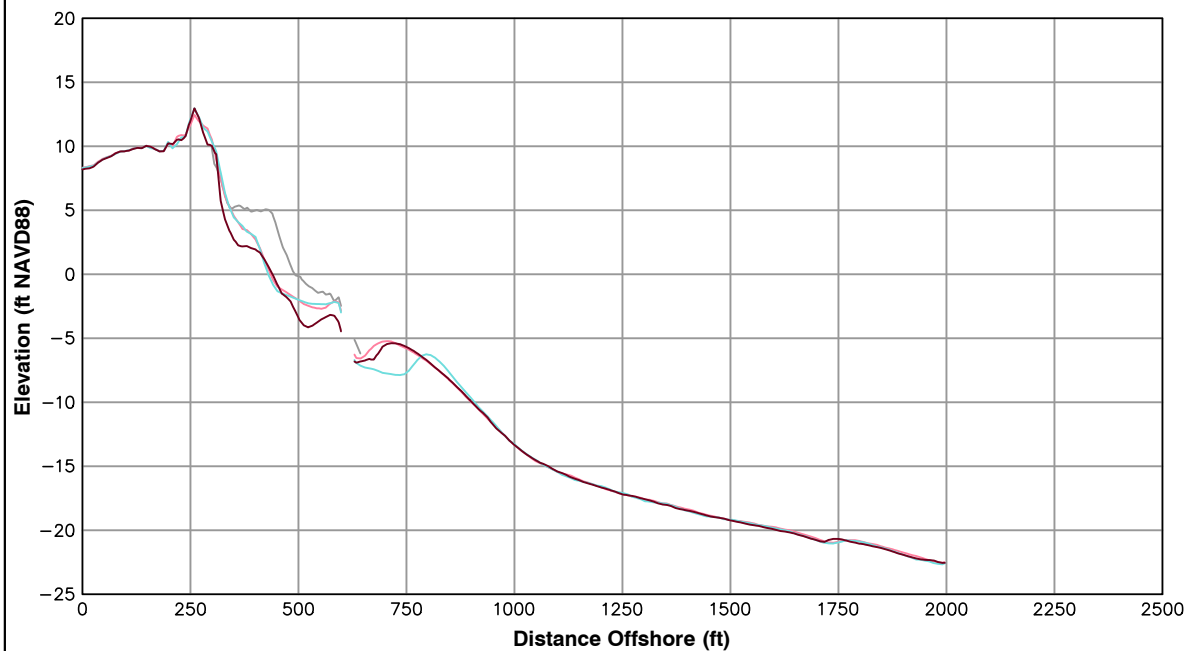


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ANALYSIS**

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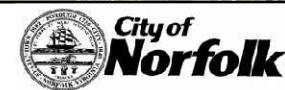
| Survey Transect 351+23 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 1.19 ft/yr | 4.39 ft |
| Volume Change Above -15 ft NAVD88 | -12.17 cy/ft/yr | -6.02 cy/ft |
| Volume Change Above 0 ft NAVD88 | -5.82 cy/ft/yr | -6.00 cy/ft |

LEGEND:

2015 OCT — dark red line
 2015 APR — cyan line
 2014 OCT — pink line
 POST-FILL — grey line

Notes:

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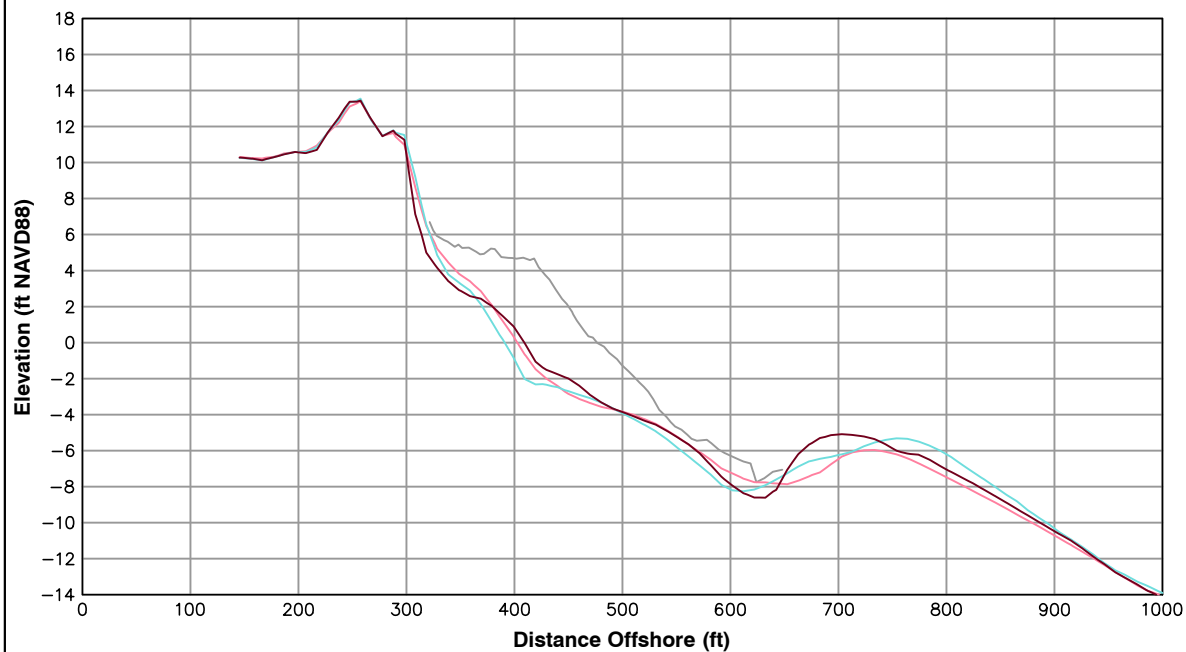
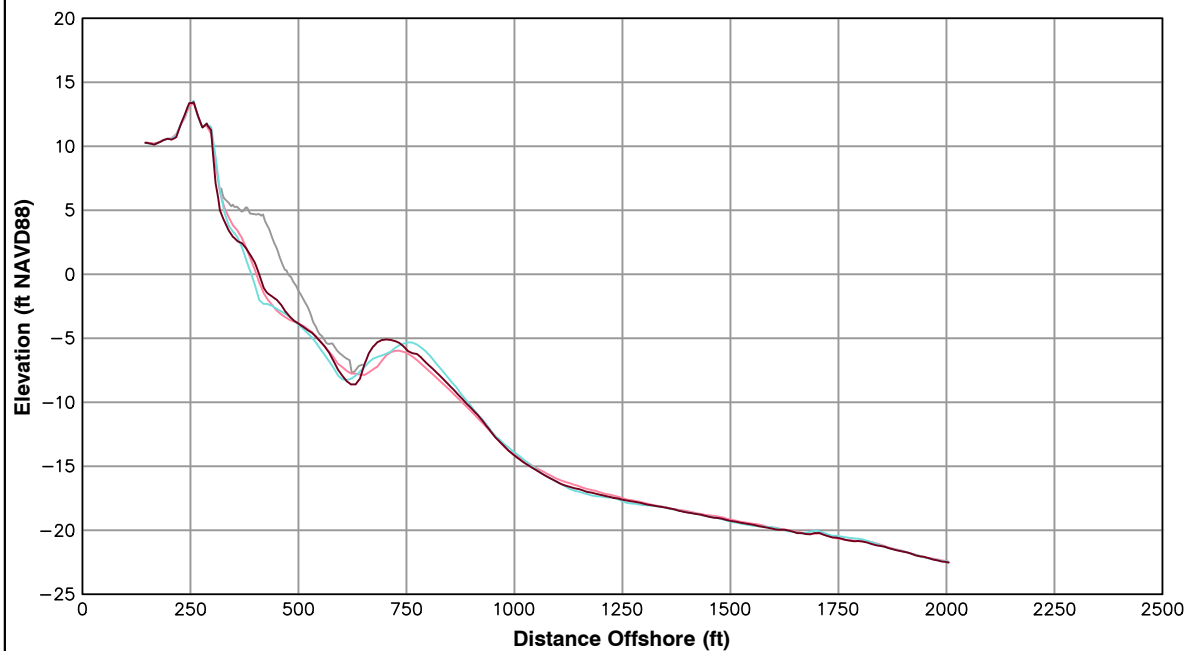


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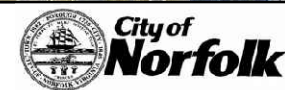
| Survey Transect 353+03 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 6.01 ft/yr | 17.05 ft |
| Volume Change Above -15 ft NAVD88 | 4.11 cy/ft/yr | 1.16 cy/ft |
| Volume Change Above 0 ft NAVD88 | -2.18 cy/ft/yr | -0.89 cy/ft |

LEGEND:

2015 OCT —
 2015 APR —
 2014 OCT —
 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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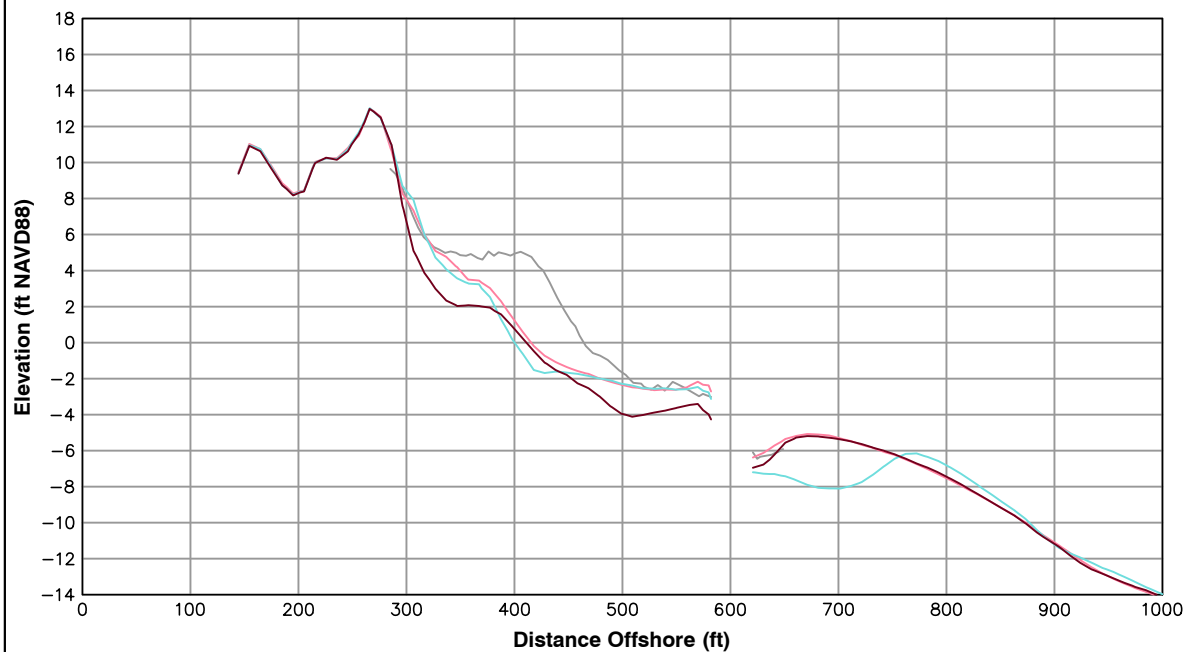
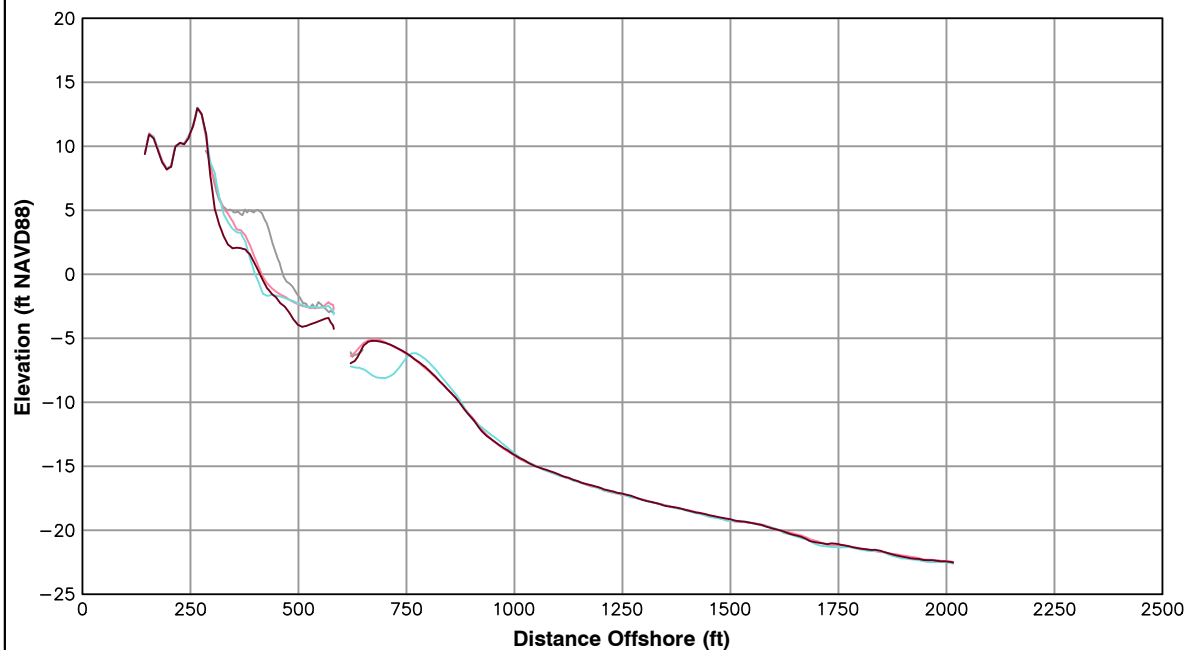


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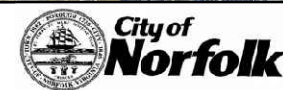
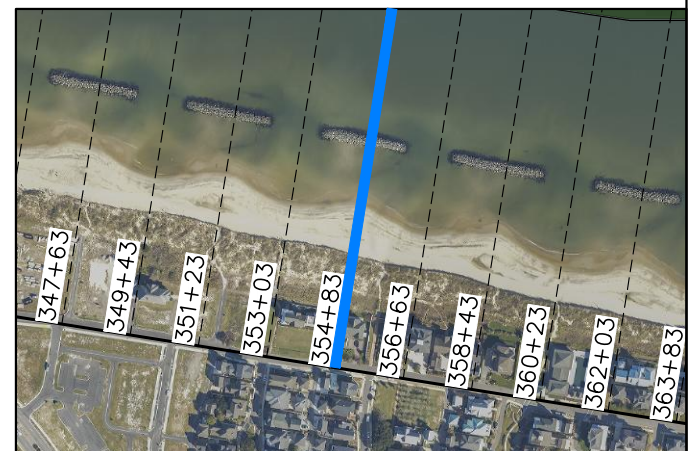
| Survey Transect 354+83 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -6.27 ft/yr | 6.16 ft |
| Volume Change Above -15 ft NAVD88 | -13.57 cy/ft/yr | -3.74 cy/ft |
| Volume Change Above 0 ft NAVD88 | -6.62 cy/ft/yr | -5.00 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
POST-FILL —

Notes:

1. Stationing From West To East At Varying Intervals.
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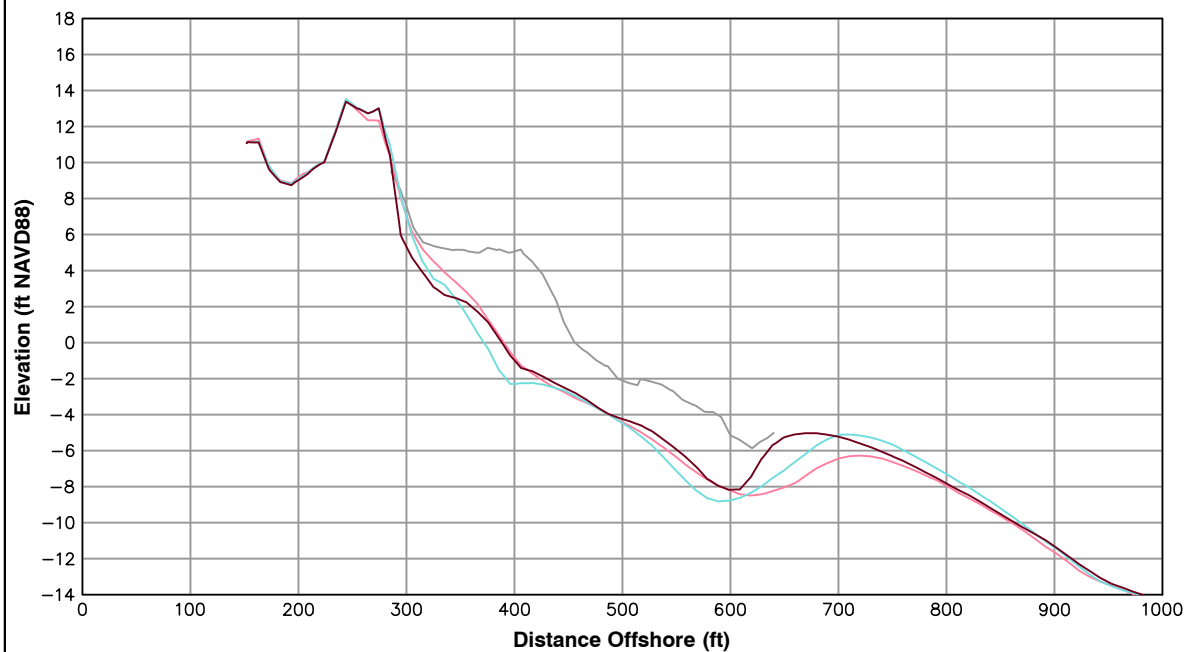
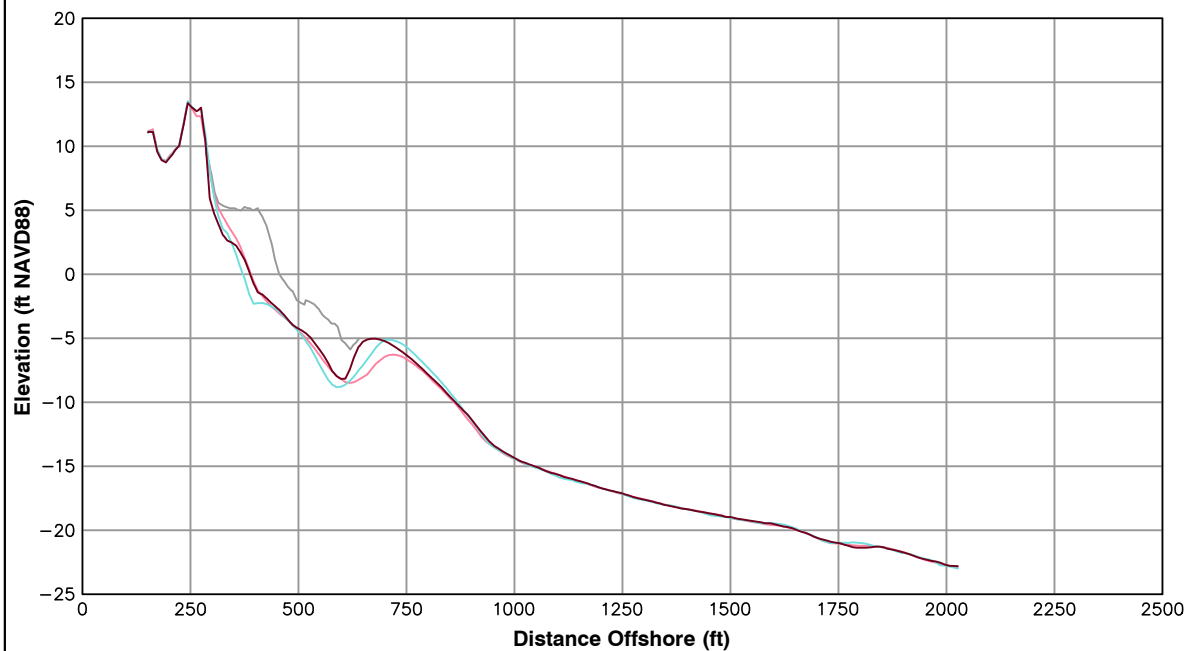


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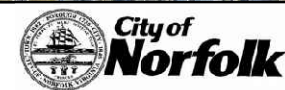
| Survey Transect 356+63 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -1.68 ft/yr | 16.01 ft |
| Volume Change Above -15 ft NAVD88 | 7.72 cy/ft/yr | 6.08 cy/ft |
| Volume Change Above 0 ft NAVD88 | -3.52 cy/ft/yr | -1.19 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
POST-FILL —

Notes:

1. Stationing From West To East At Varying Intervals.
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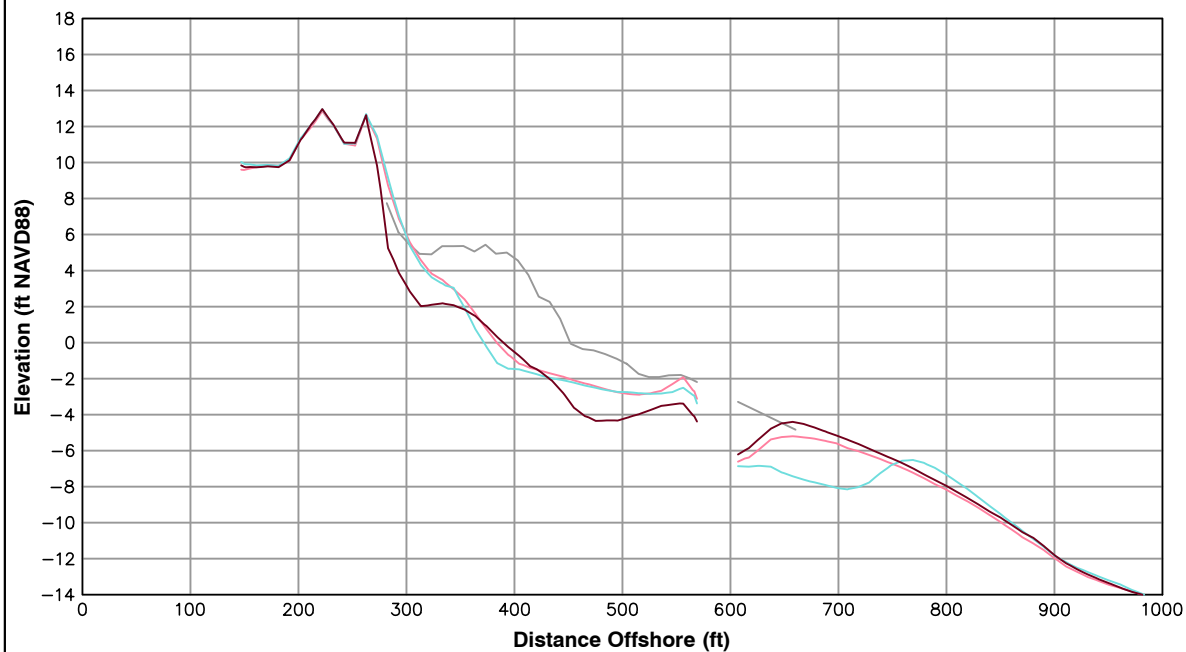
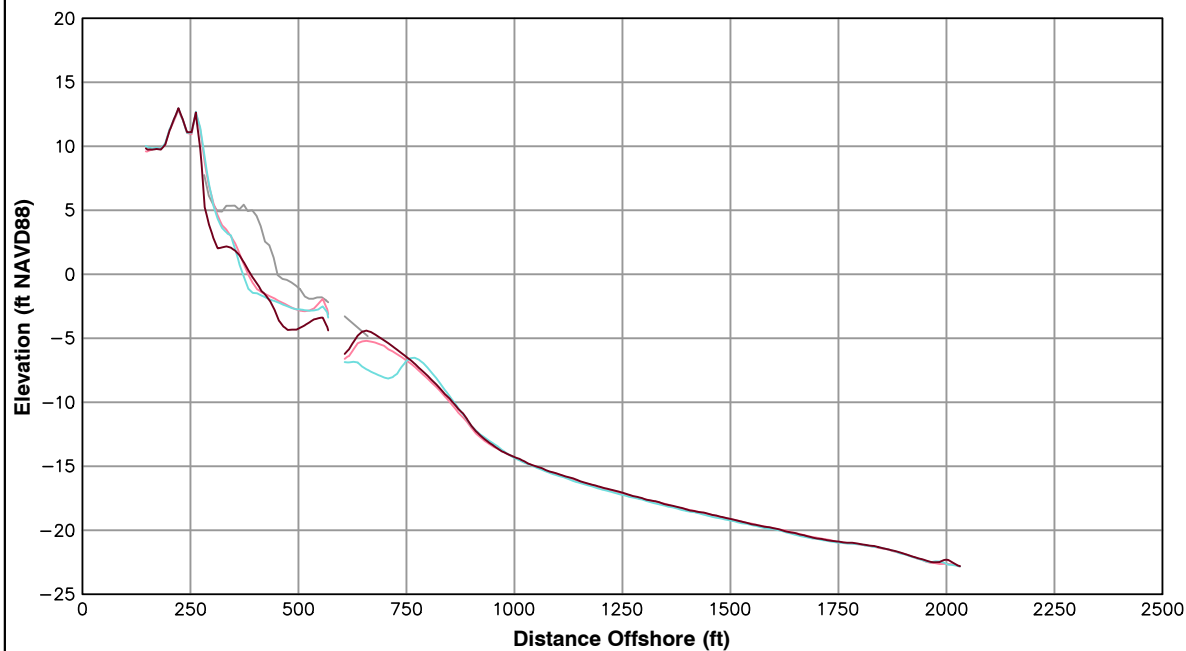


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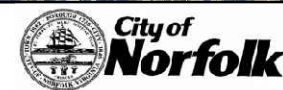
| Survey Transect 358+43 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 1.52 ft/yr | 10.87 ft |
| Volume Change Above -15 ft NAVD88 | -8.05 cy/ft/yr | -0.41 cy/ft |
| Volume Change Above 0 ft NAVD88 | -6.30 cy/ft/yr | -5.88 cy/ft |

LEGEND:

2015 OCT —
 2015 APR —
 2014 OCT —
 POST-FILL —

Notes:

1. Stationing From West To East At Varying Intervals.
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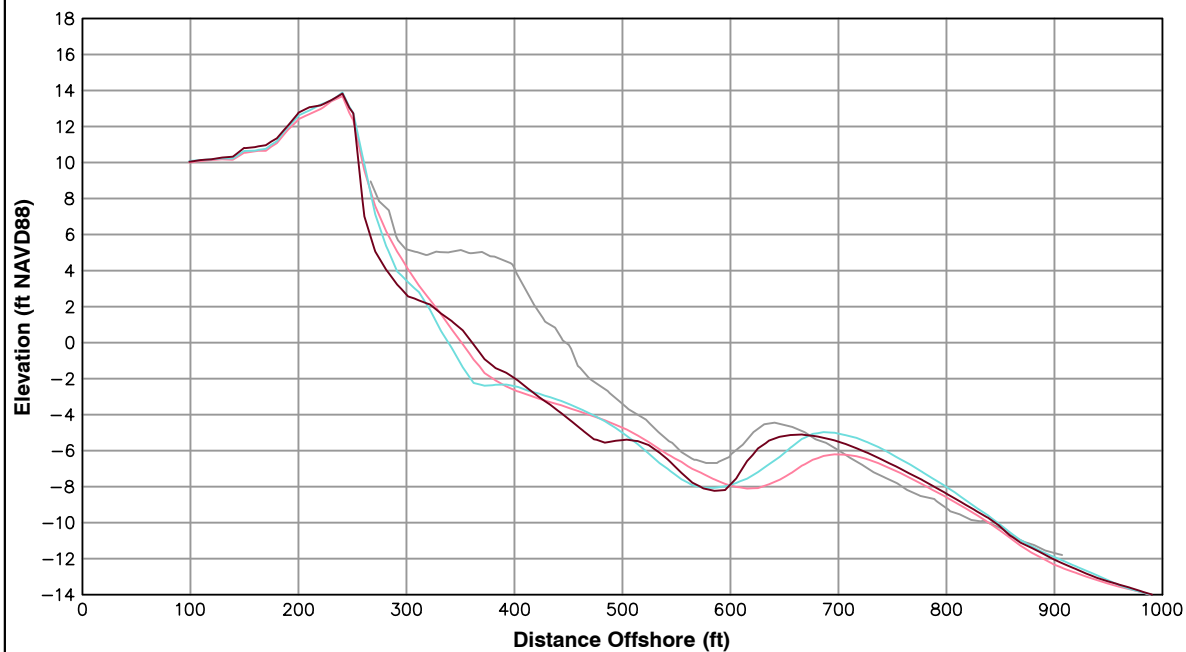
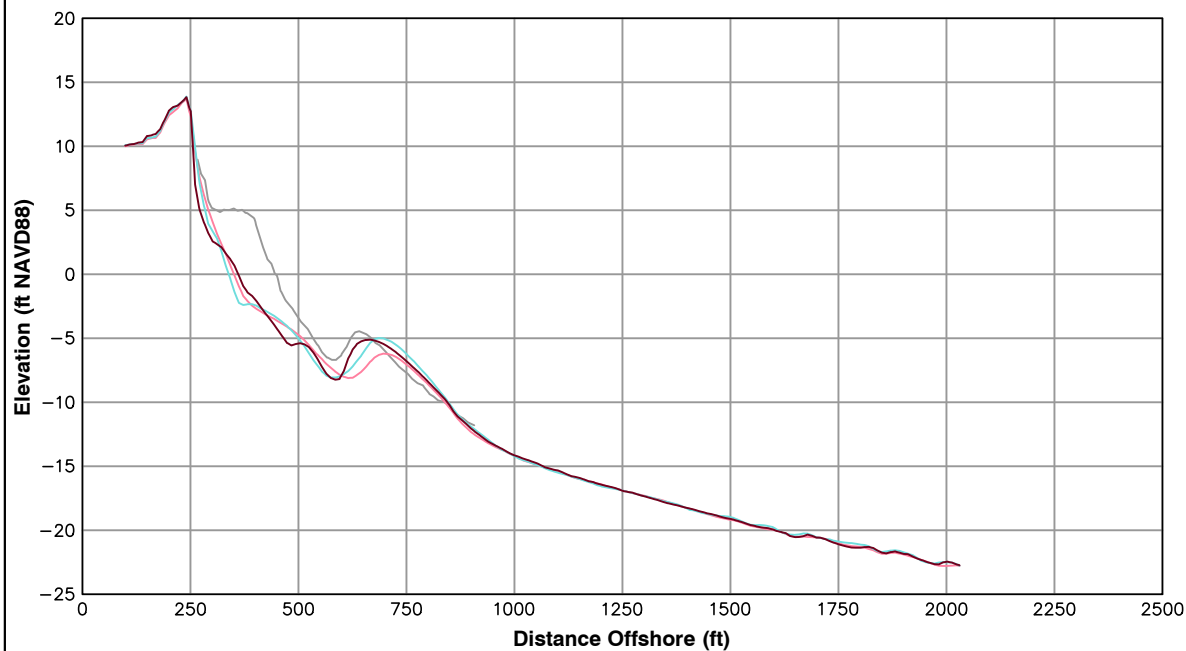


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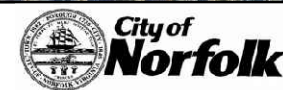
| Survey Transect 360+23 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 6.98 ft/yr | 17.04 ft |
| Volume Change Above -15 ft NAVD88 | 3.62 cy/ft/yr | -1.12 cy/ft |
| Volume Change Above 0 ft NAVD88 | -2.69 cy/ft/yr | -1.48 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
POST-FILL —

Notes:

1. Stationing From West To East At Varying Intervals.
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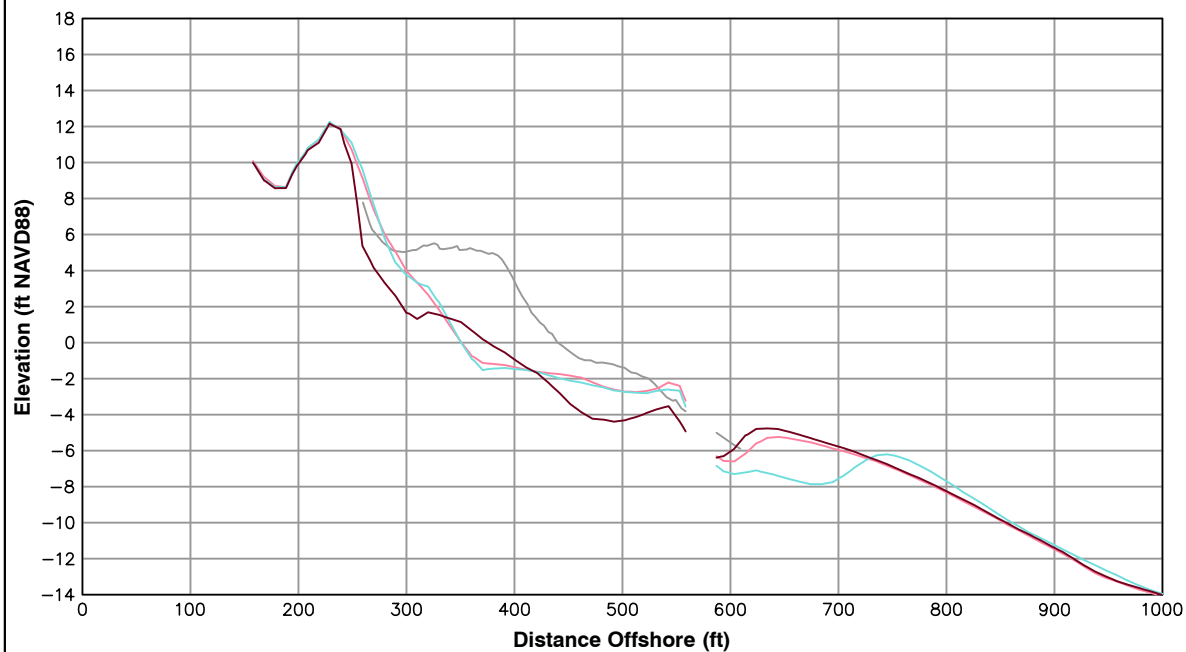
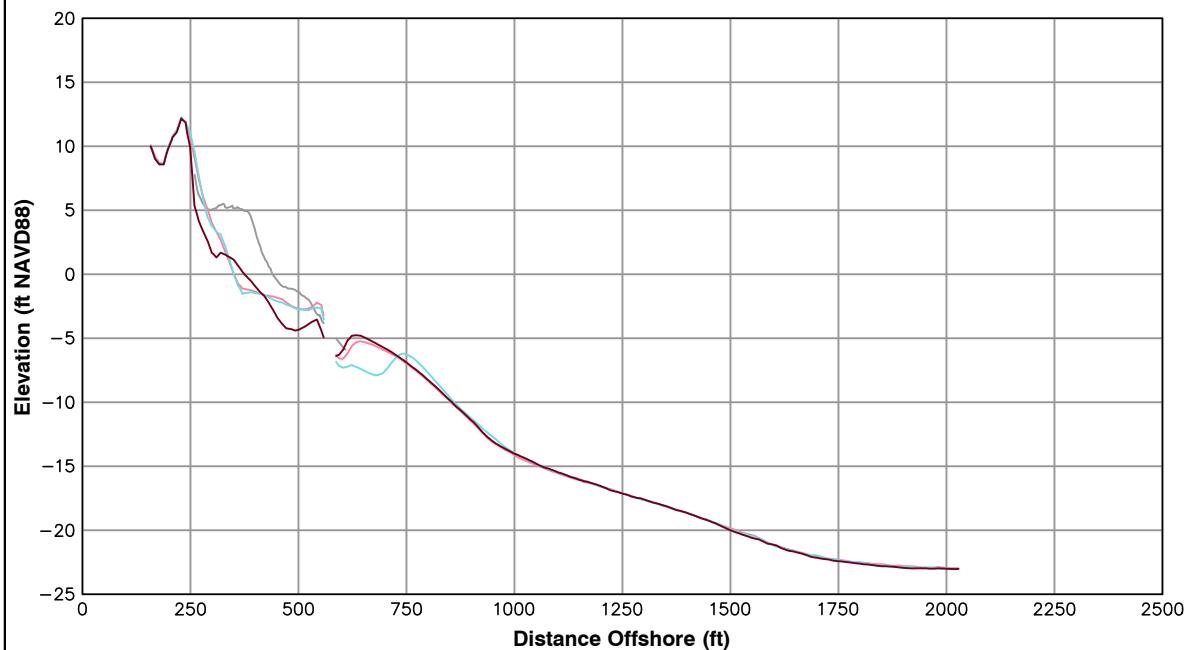


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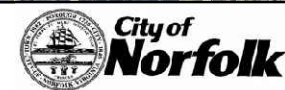
| Survey Transect 362+03 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 14.07 ft/yr | 12.24 ft |
| Volume Change Above -15 ft NAVD88 | -8.95 cy/ft/yr | -4.67 cy/ft |
| Volume Change Above 0 ft NAVD88 | -6.31 cy/ft/yr | -6.74 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
POST-FILL —

Notes:

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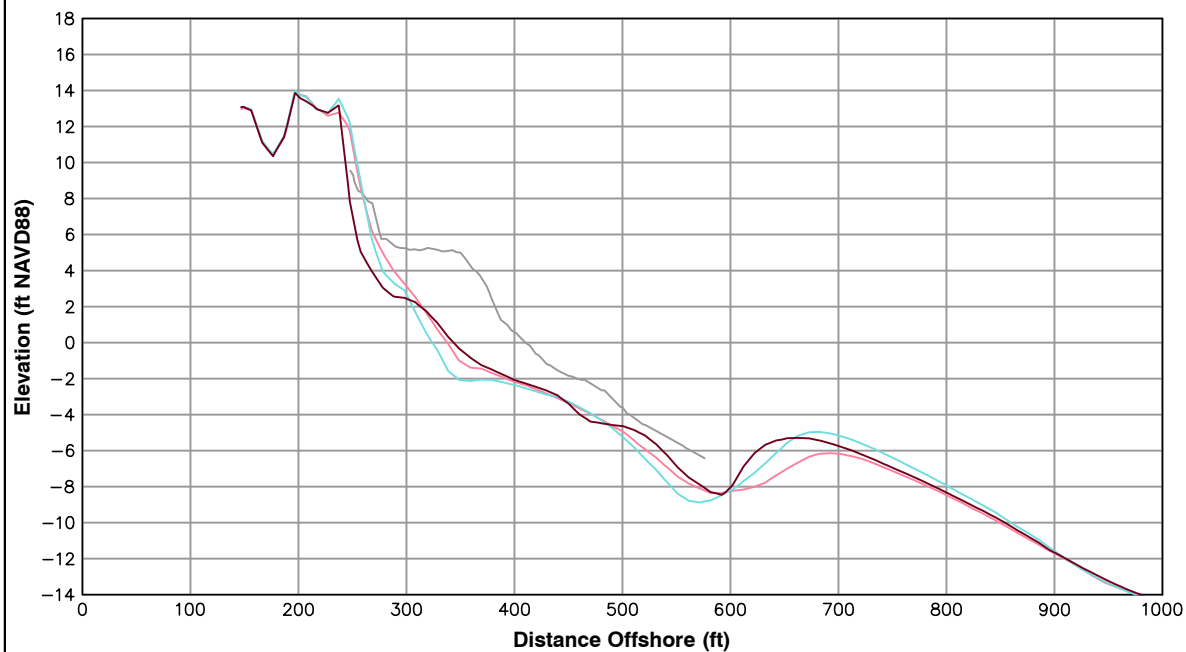
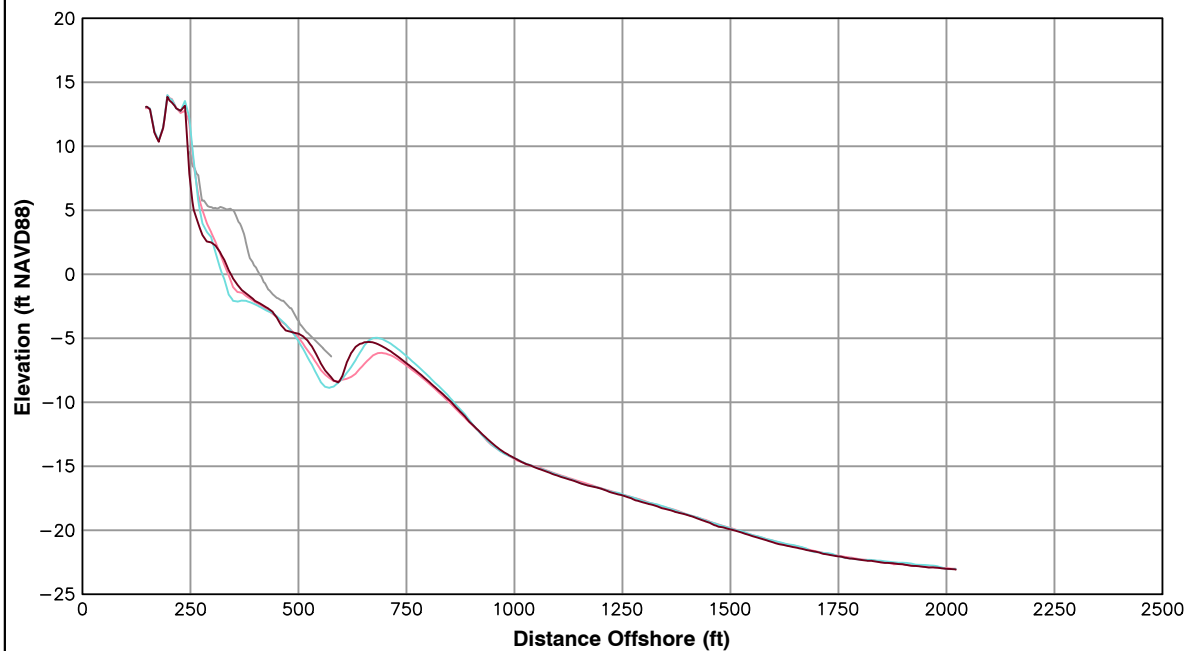


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SURVEYING DATA &
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ST 362+03

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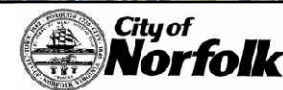
| Survey Transect 363+83 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 4.26 ft/yr | 15.75 ft |
| Volume Change Above -15 ft NAVD88 | 3.59 cy/ft/yr | 0.92 cy/ft |
| Volume Change Above 0 ft NAVD88 | -4.95 cy/ft/yr | -3.71 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
POST-FILL —

Notes:

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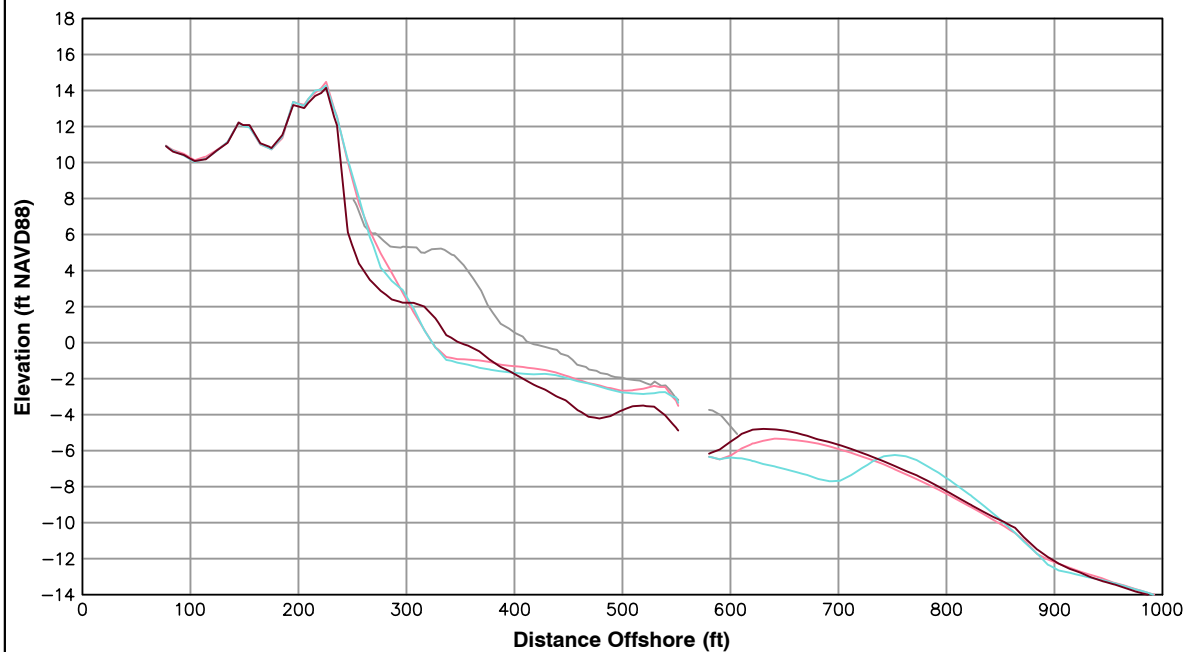
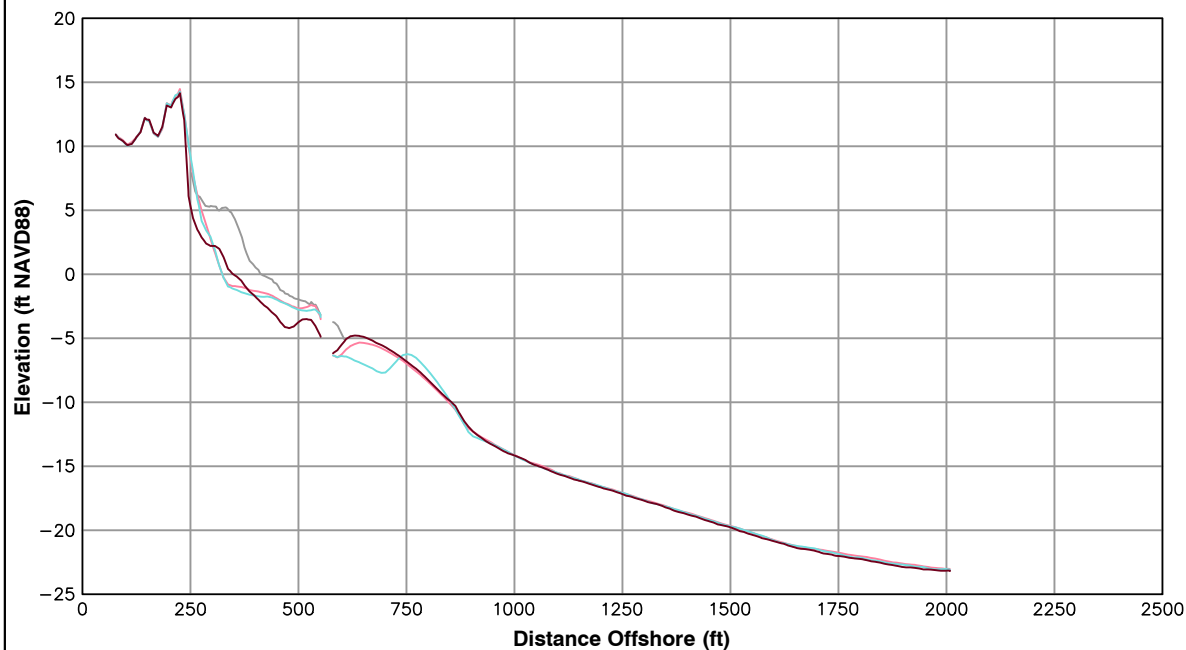


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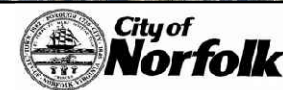
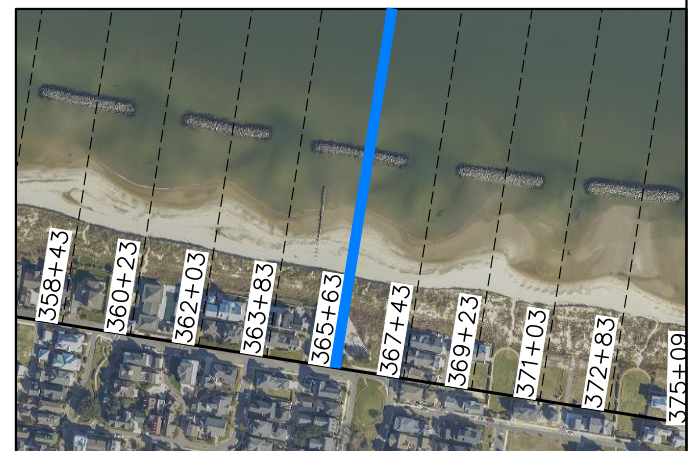
| Survey Transect 365+63 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 16.95 ft/yr | 16.73 ft |
| Volume Change Above -15 ft NAVD88 | -7.23 cy/ft/yr | -1.05 cy/ft |
| Volume Change Above 0 ft NAVD88 | -4.37 cy/ft/yr | -3.94 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
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 October 2014 and April 2015.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

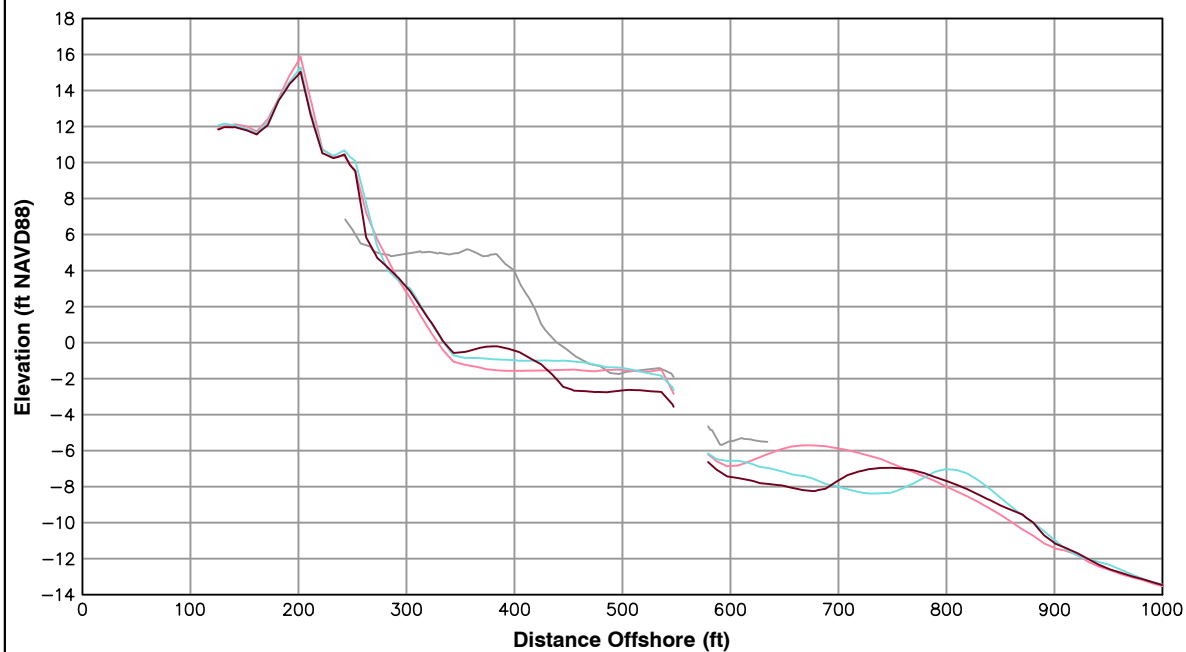
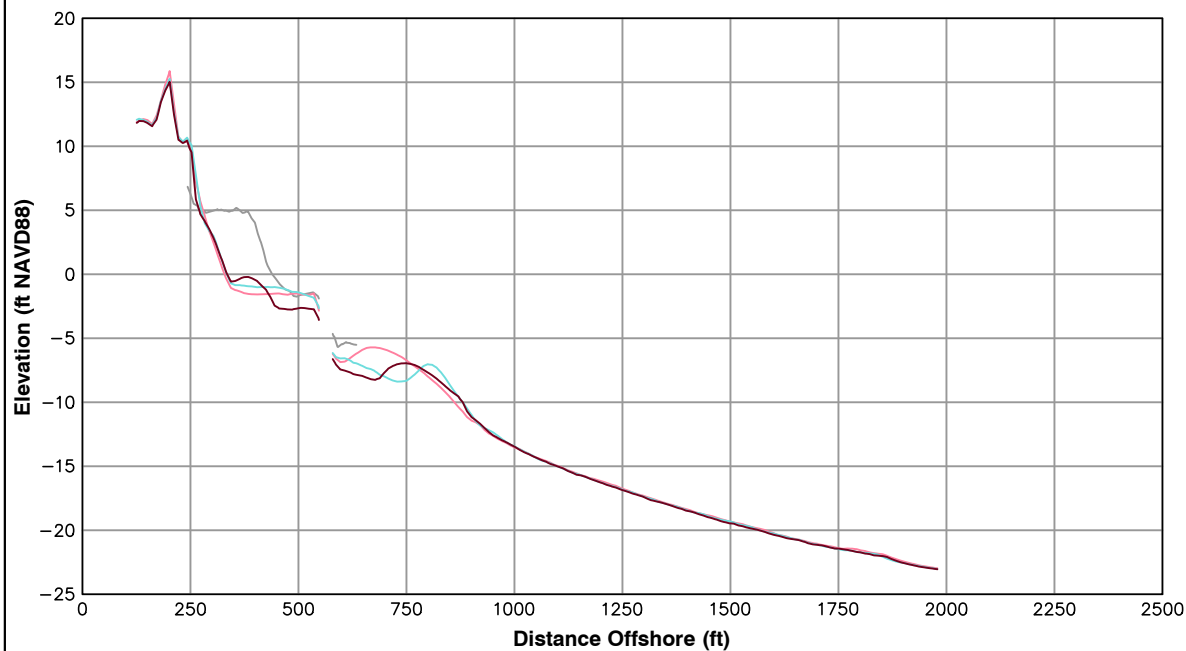


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| Survey Transect 369+23 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 6.08 ft/yr | 0.56 ft |
| Volume Change Above -15 ft NAVD88 | -9.43 cy/ft/yr | -8.01 cy/ft |
| Volume Change Above 0 ft NAVD88 | -1.68 cy/ft/yr | -1.80 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
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 October 2014 and April 2015.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

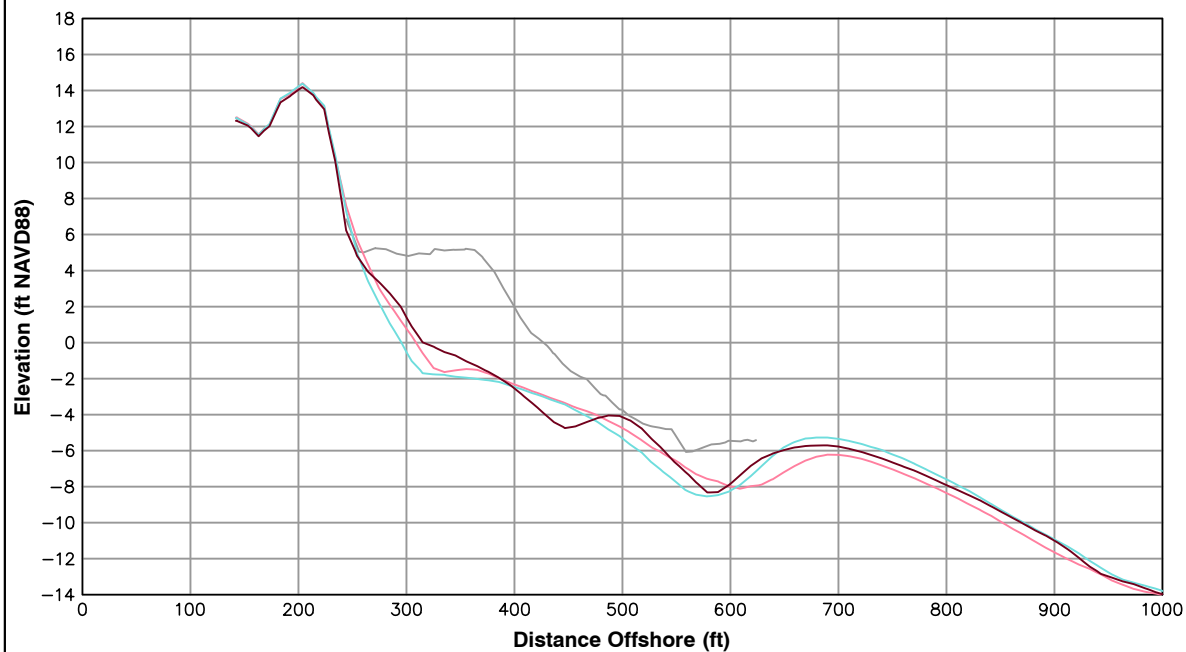
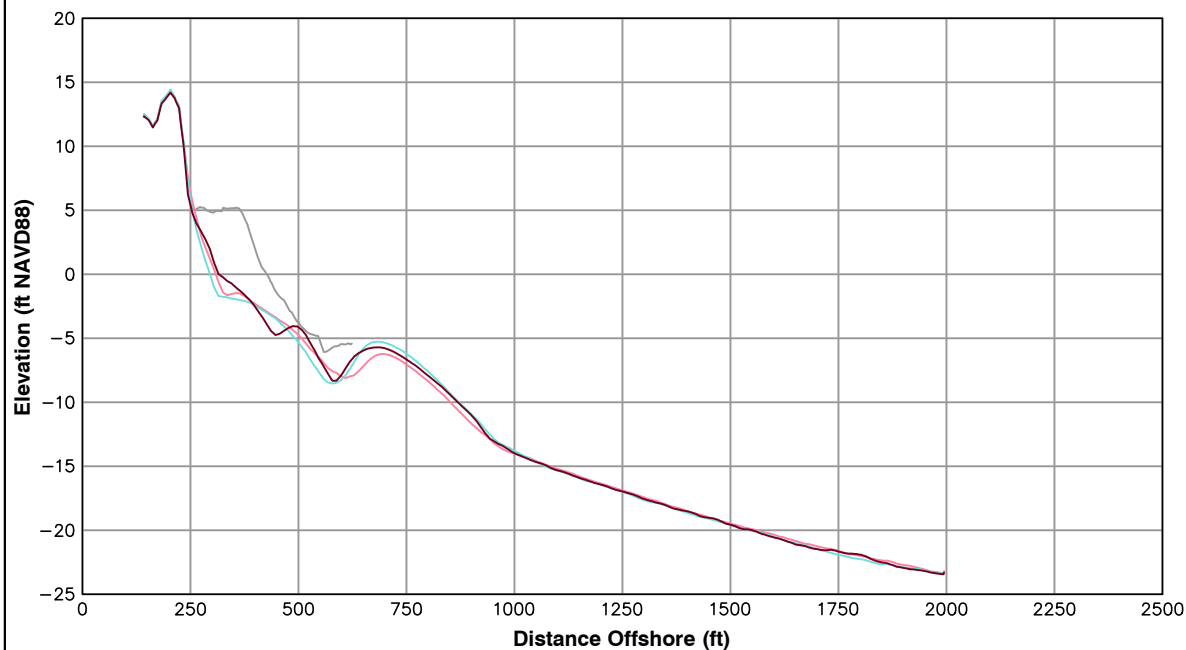


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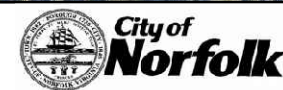
| Survey Transect 367+43 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 6.42 ft/yr | 18.56 ft |
| Volume Change Above -15 ft NAVD88 | 6.58 cy/ft/yr | 3.69 cy/ft |
| Volume Change Above 0 ft NAVD88 | -0.59 cy/ft/yr | 1.28 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
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 October 2014 and April 2015.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

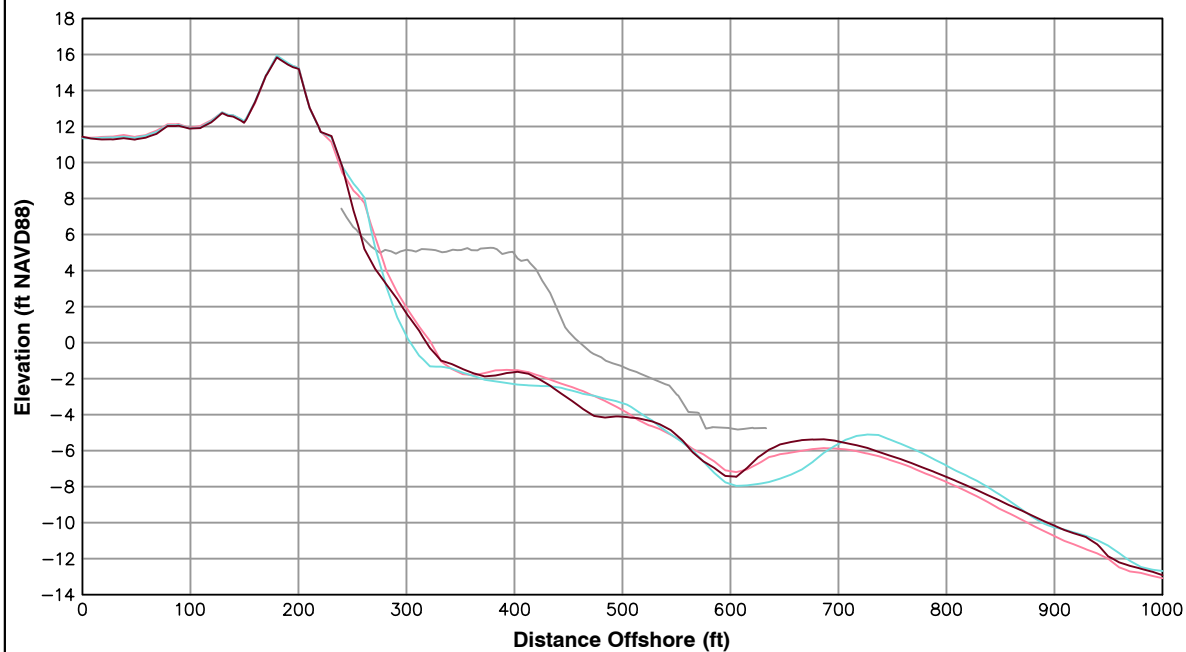
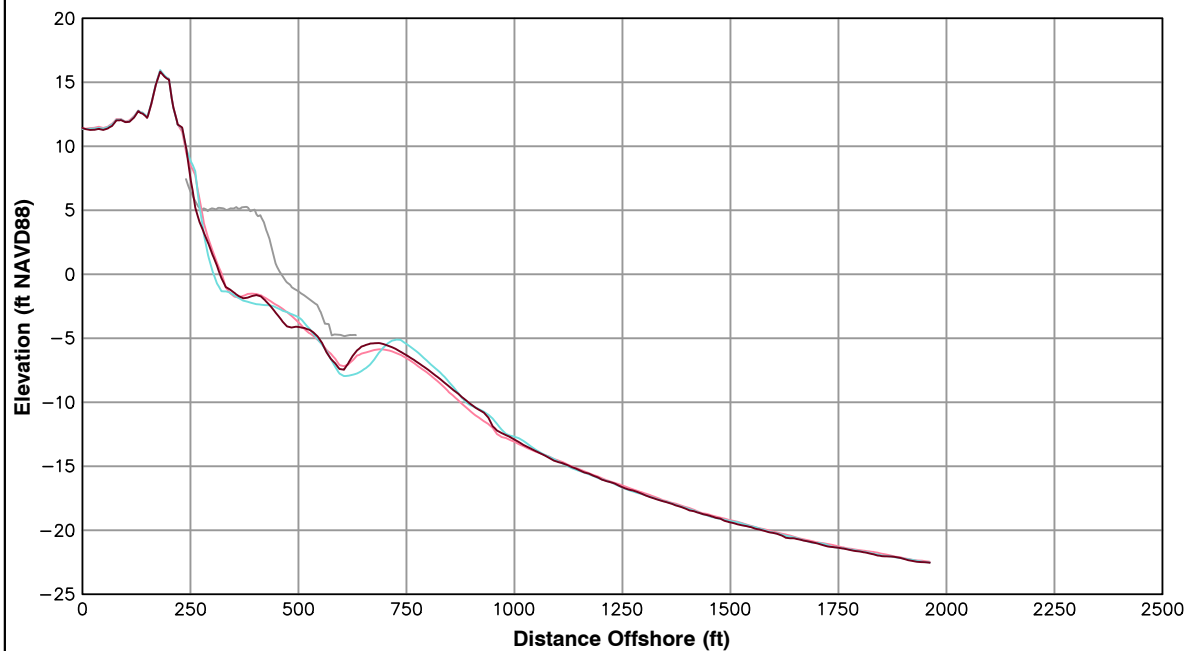


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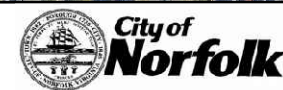
| Survey Transect 371+03 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -2.88 ft/yr | 12.84 ft |
| Volume Change Above -15 ft NAVD88 | -0.01 cy/ft/yr | -1.39 cy/ft |
| Volume Change Above 0 ft NAVD88 | -3.10 cy/ft/yr | -1.36 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
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 October 2014 and April 2015.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

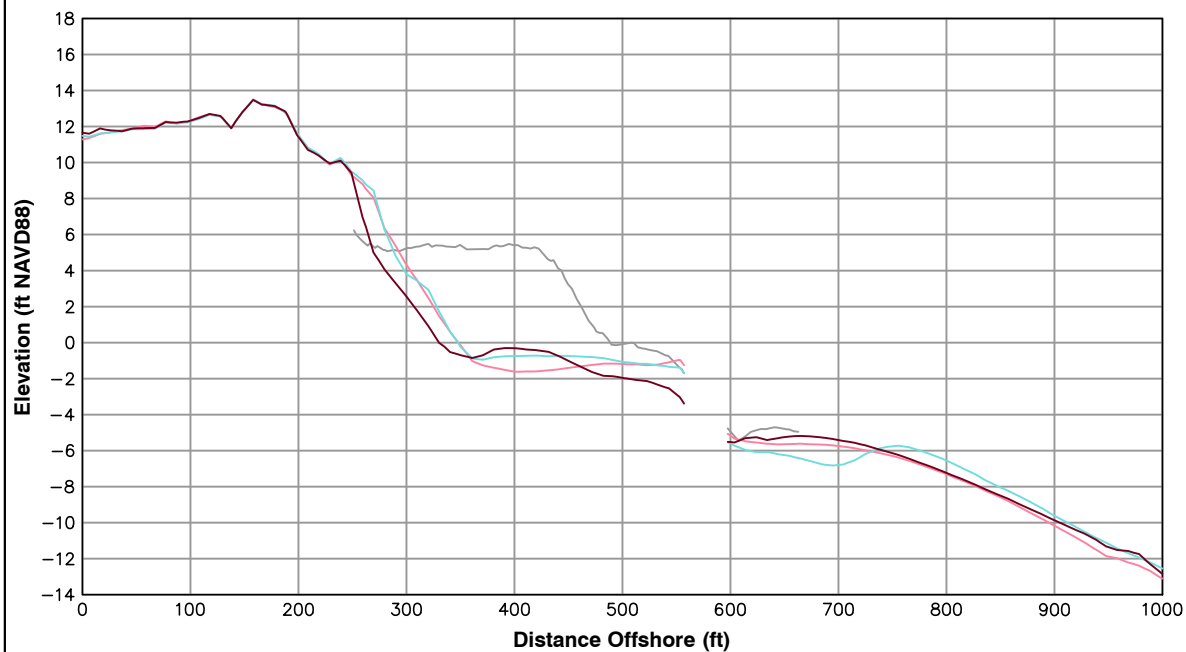
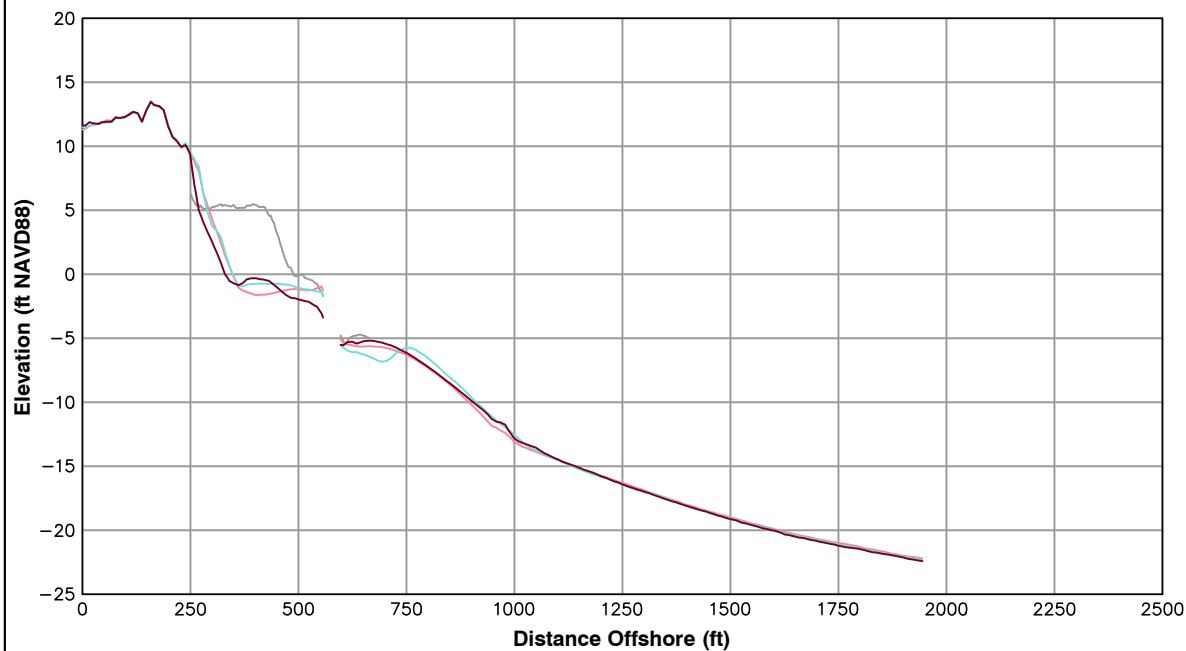


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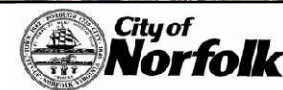
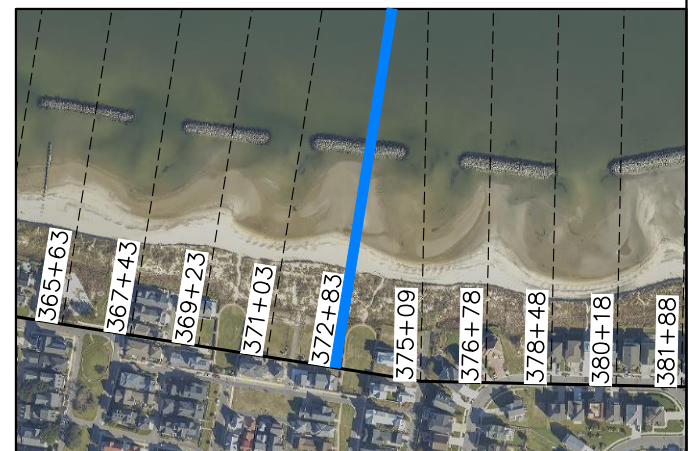
| Survey Transect 372+83 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -16.31 ft/yr | -17.48 ft |
| Volume Change Above -15 ft NAVD88 | -1.56 cy/ft/yr | -7.61 cy/ft |
| Volume Change Above 0 ft NAVD88 | -5.87 cy/ft/yr | -5.97 cy/ft |

LEGEND:

2015 OCT —
 2015 APR —
 2014 OCT —
 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 October 2014 and April 2015.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

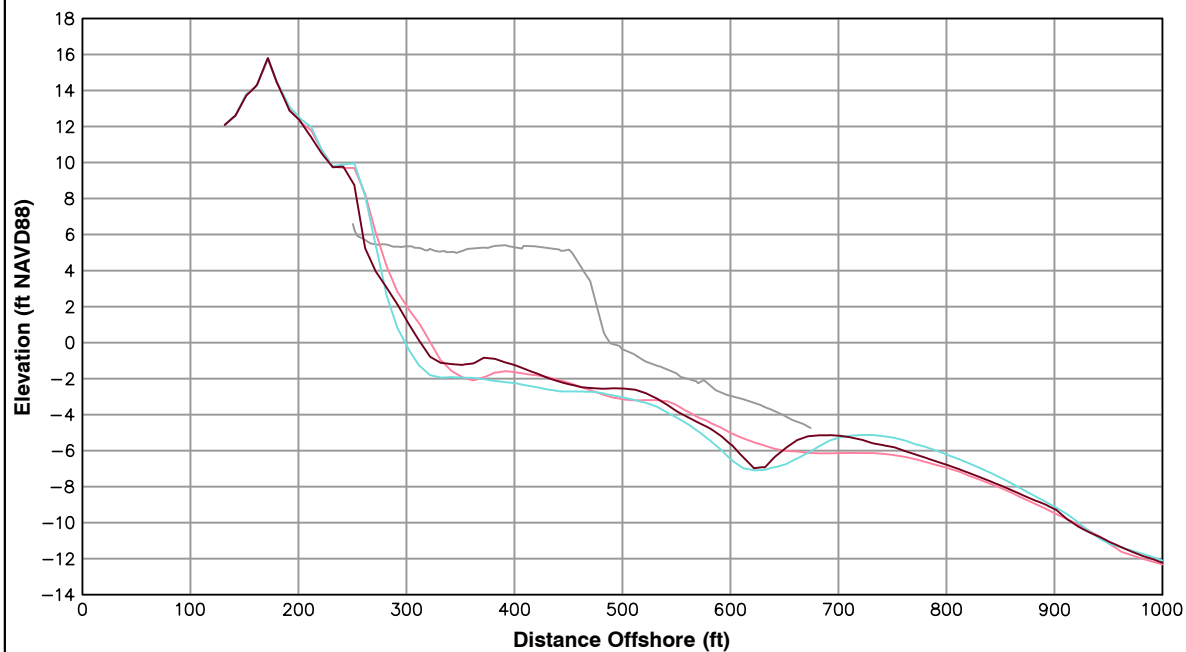
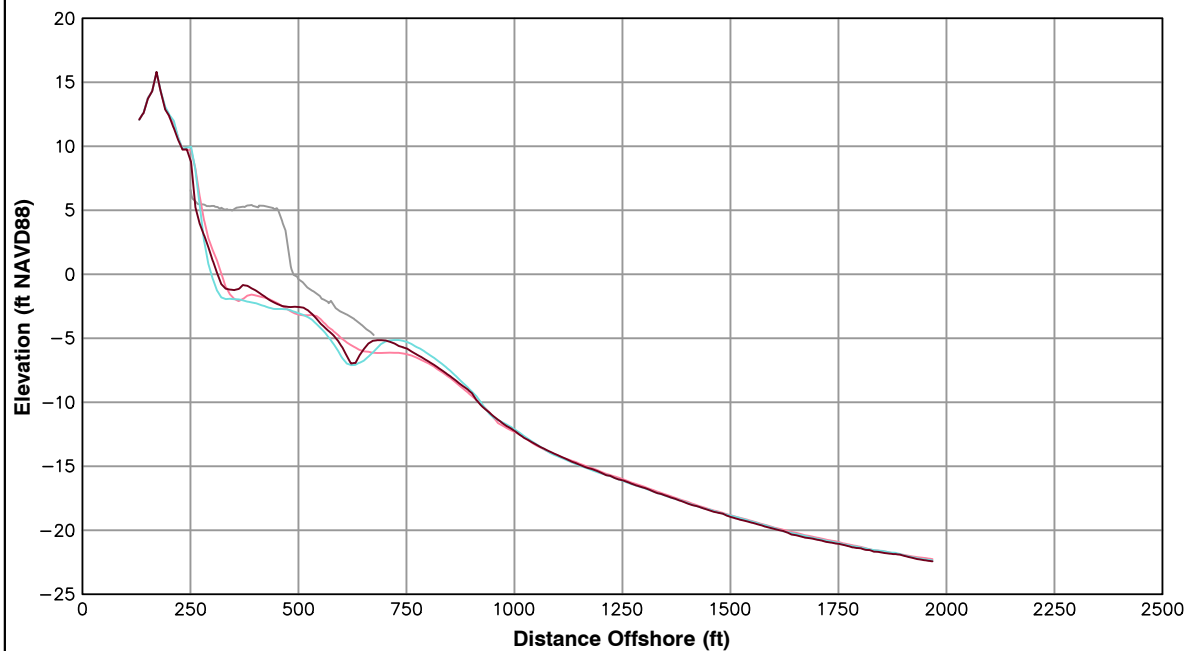


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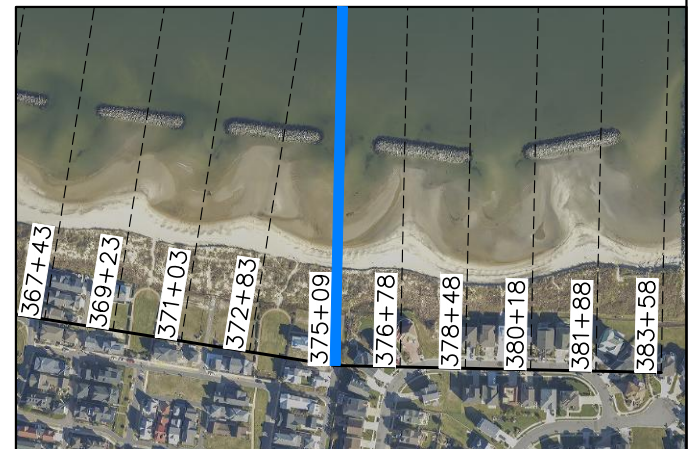
| Survey Transect 375+08 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -9.91 ft/yr | 11.95 ft |
| Volume Change Above -15 ft NAVD88 | 0.26 cy/ft/yr | 4.73 cy/ft |
| Volume Change Above 0 ft NAVD88 | -3.82 cy/ft/yr | -1.44 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
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 October 2014 and April 2015.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



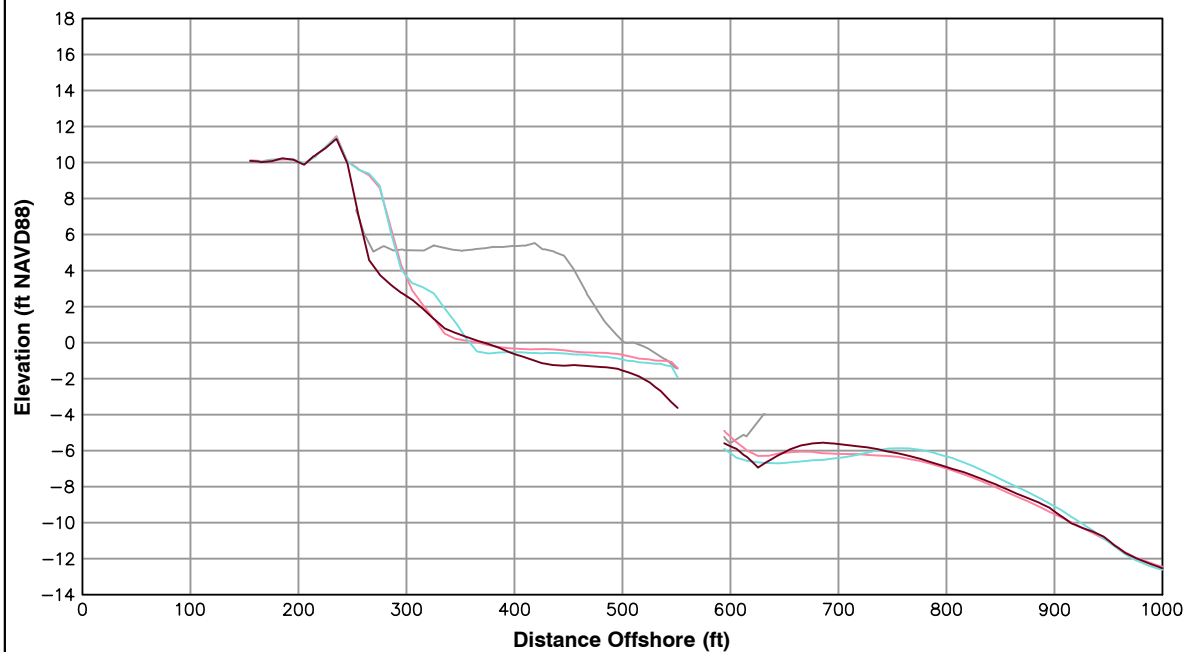
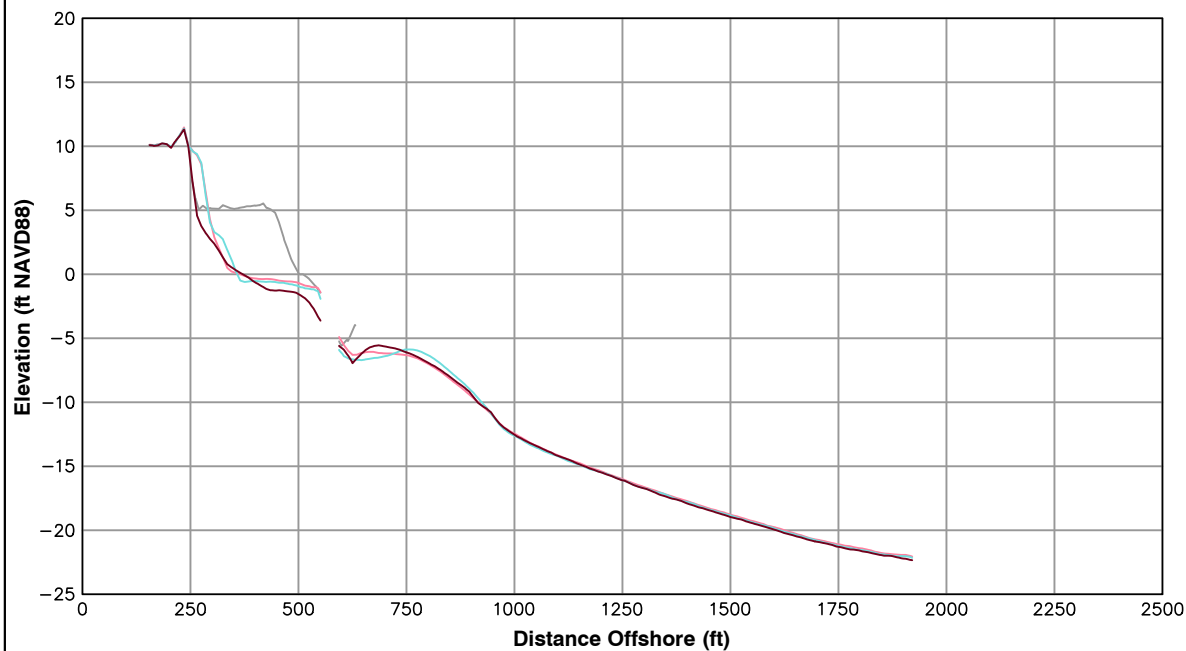
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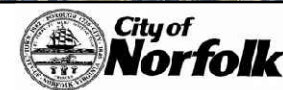
| Survey Transect 376+78 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 2.18 ft/yr | -15.25 ft |
| Volume Change Above -15 ft NAVD88 | -10.39 cy/ft/yr | -11.32 cy/ft |
| Volume Change Above 0 ft NAVD88 | -6.23 cy/ft/yr | -8.04 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
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 October 2014 and April 2015.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

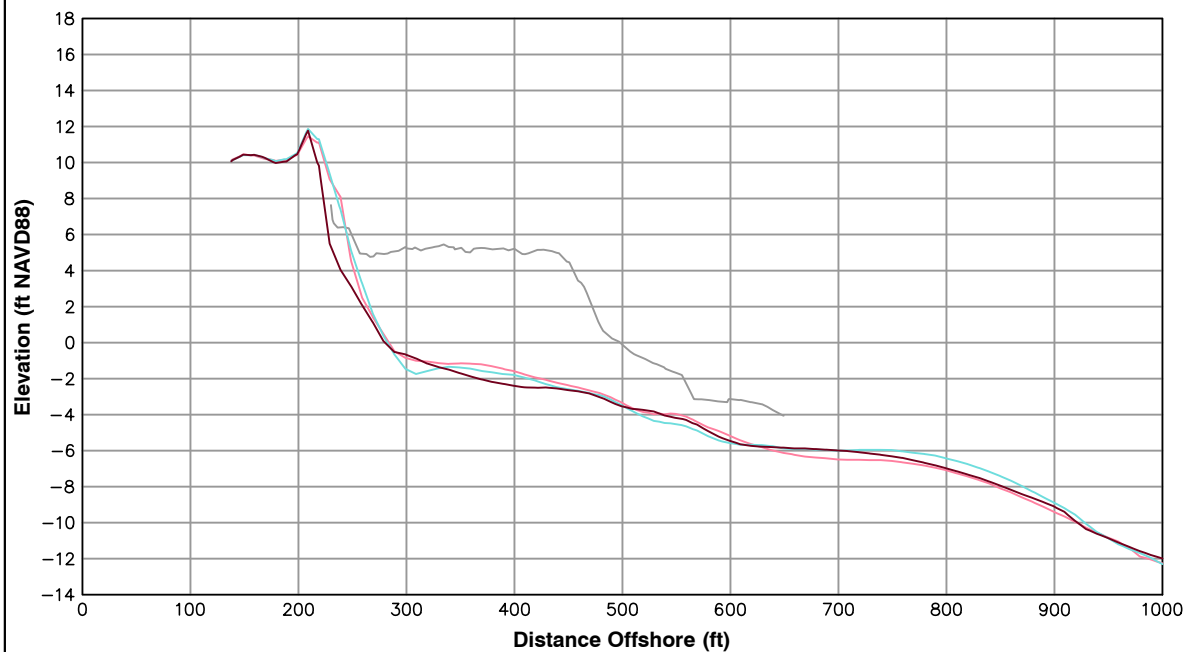
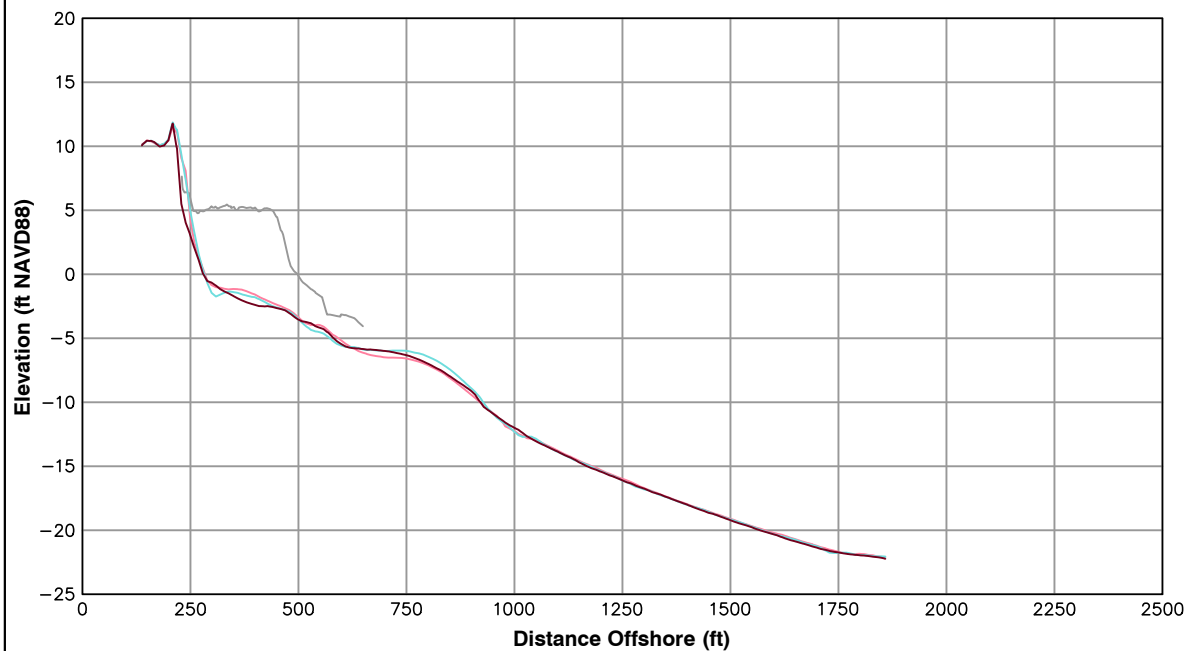


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ANALYSIS**

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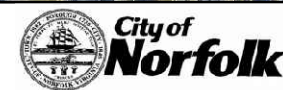
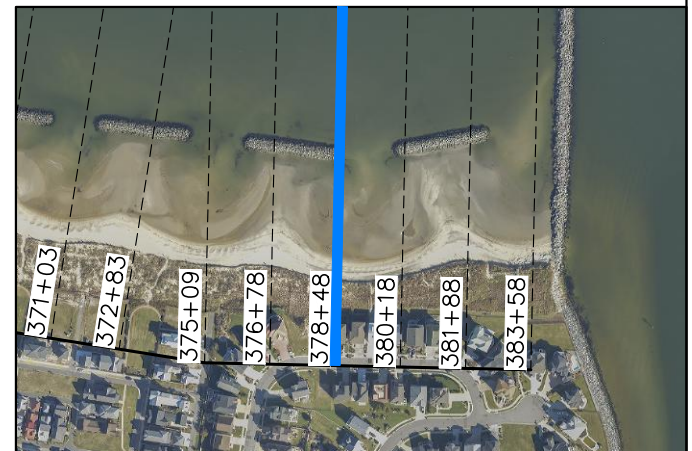
| Survey Transect 378+48 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -3.19 ft/yr | -3.67 ft |
| Volume Change Above -15 ft NAVD88 | -5.02 cy/ft/yr | -7.54 cy/ft |
| Volume Change Above 0 ft NAVD88 | -4.10 cy/ft/yr | -4.80 cy/ft |

LEGEND:

2015 OCT —
 2015 APR —
 2014 OCT —
 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 October 2014 and April 2015.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

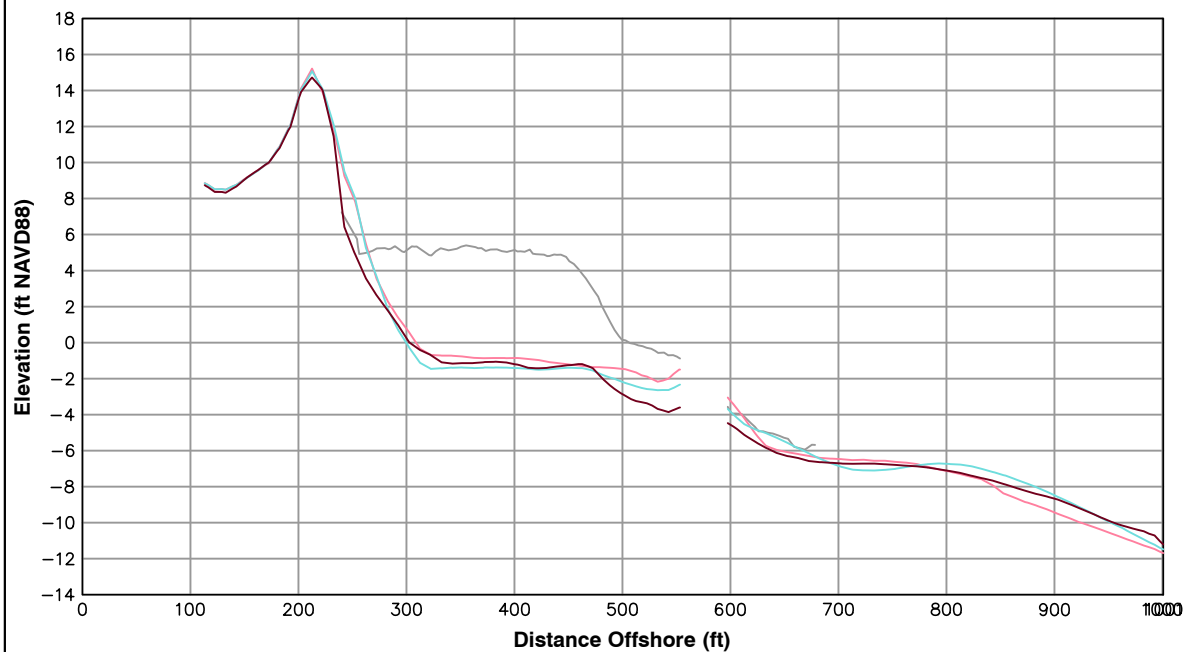
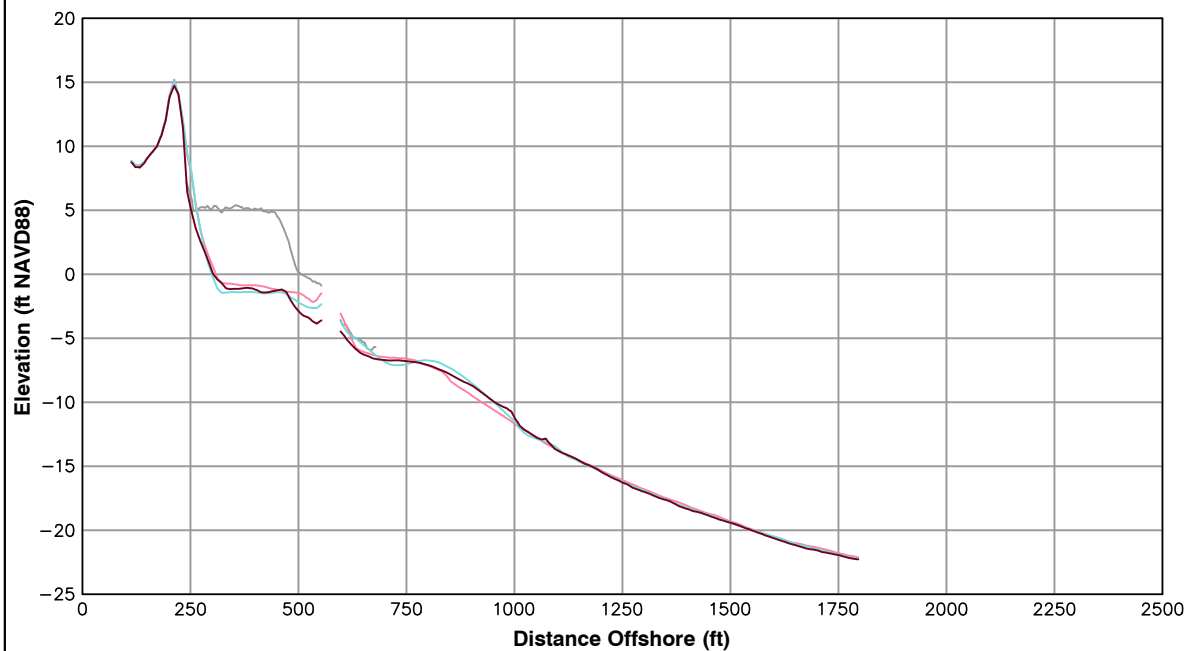


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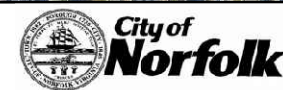
| Survey Transect 380+18 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | -5.18 ft/yr | 2.08 ft |
| Volume Change Above -15 ft NAVD88 | -7.45 cy/ft/yr | -6.60 cy/ft |
| Volume Change Above 0 ft NAVD88 | -4.22 cy/ft/yr | -3.85 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
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 October 2014 and April 2015.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

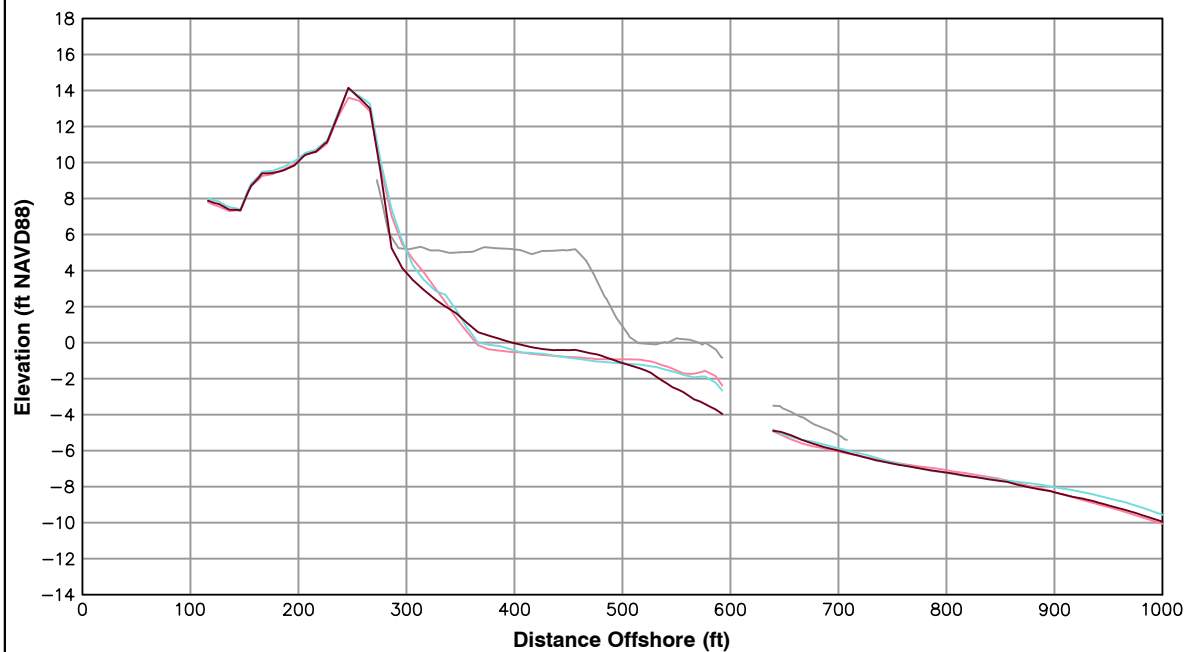
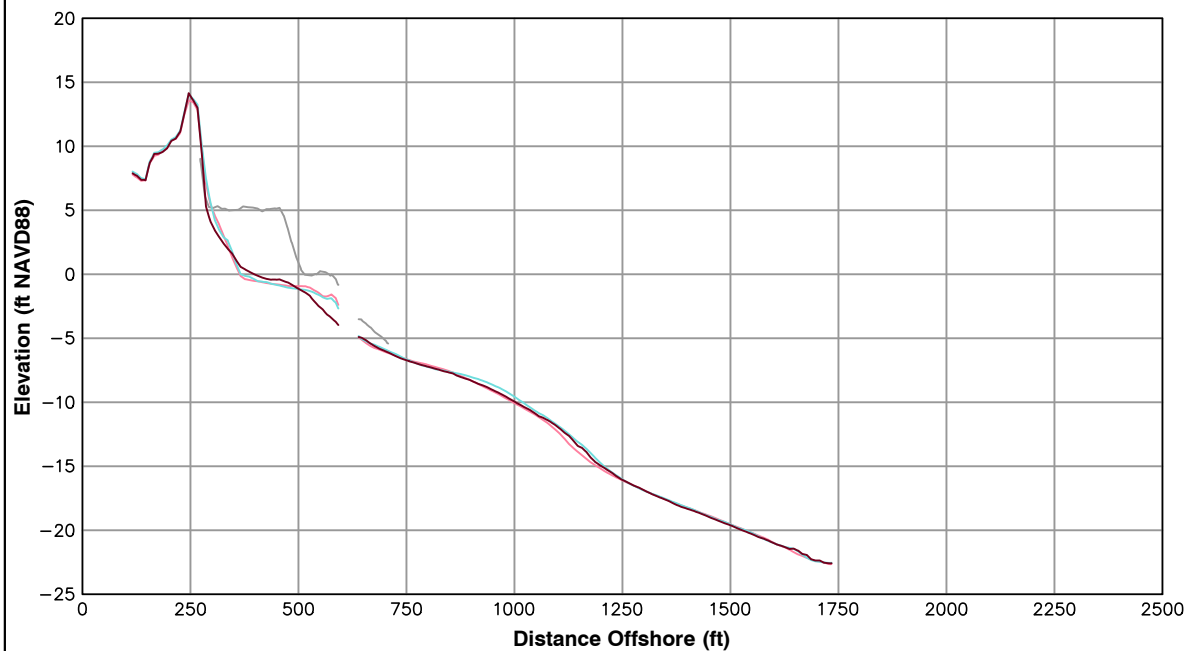


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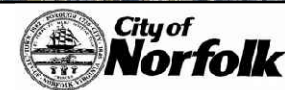
| Survey Transect 381+88 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 7.38 ft/yr | 3.97 ft |
| Volume Change Above -15 ft NAVD88 | -0.81 cy/ft/yr | -7.83 cy/ft |
| Volume Change Above 0 ft NAVD88 | -1.11 cy/ft/yr | -2.72 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
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 October 2014 and April 2015.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

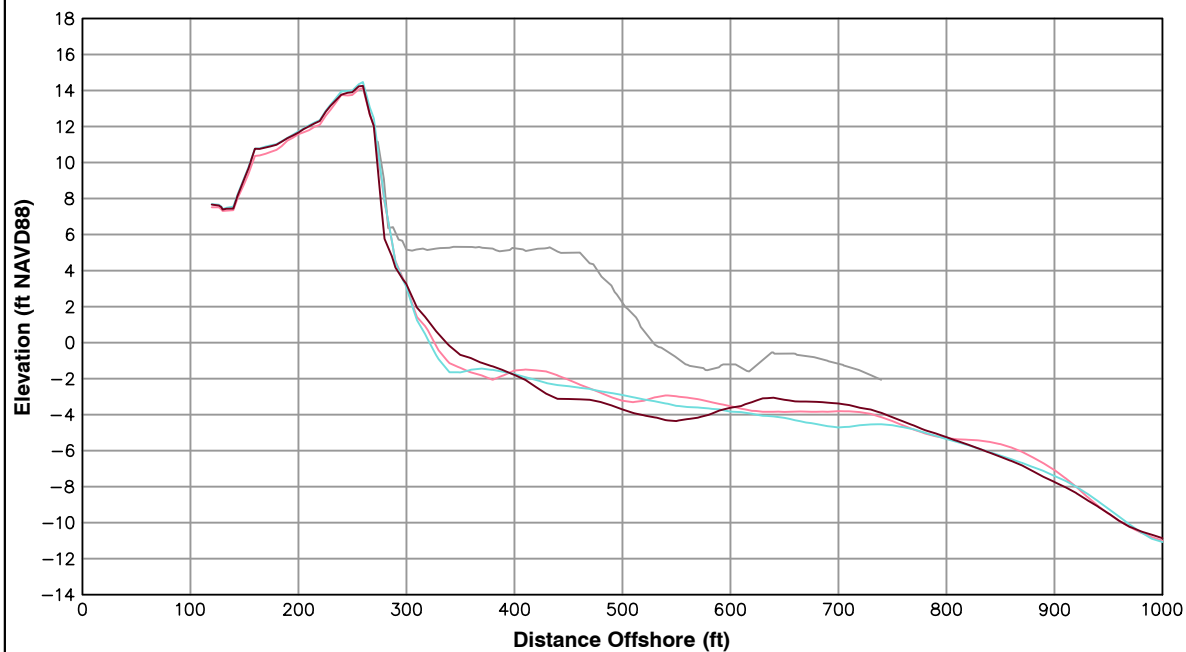
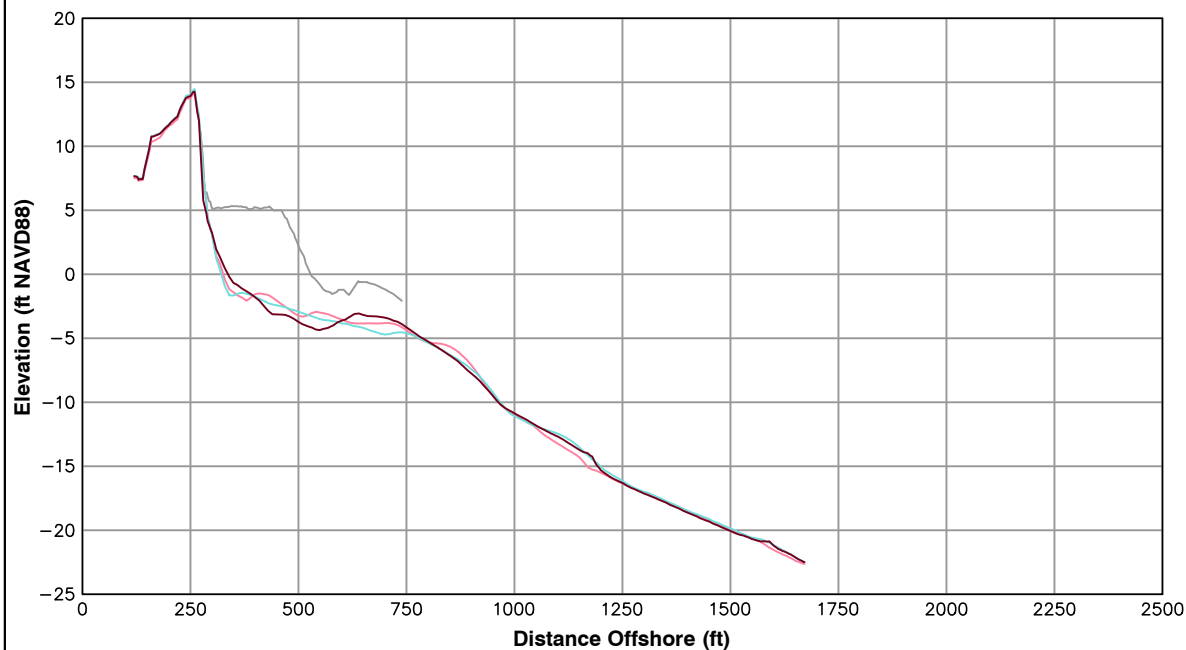


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| Survey Transect 383+58 | October 2015 - October 2014 | October 2015 - April 2015 |
|---|--------------------------------|------------------------------|
| Shoreline Change at MHW (0.98 ft NAVD88) | 7.55 ft/yr | 11.61 ft |
| Volume Change Above -15 ft NAVD88 | -0.33 cy/ft/yr | 0.99 cy/ft |
| Volume Change Above 0 ft NAVD88 | 0.73 cy/ft/yr | -0.56 cy/ft |

LEGEND:

2015 OCT —
2015 APR —
2014 OCT —
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 October 2014 and April 2015.
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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**Table C-1. Summary of Shoreline Change and Volume Change
(October 2014 to October 2015)**

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 7, 2014 to October 10, 2015.

| 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 | 10/7/2014 | 10/10/2015 | 22.90 | 4.86 | 27.47 |
| 2+50 | 10/7/2014 | 10/10/2015 | 13.92 | 0.48 | 6.54 |
| 5+00 | 10/7/2014 | 10/10/2015 | -4.87 | -2.04 | 11.20 |
| 7+50 | 10/7/2014 | 10/10/2015 | 7.58 | -5.52 | 1.63 |
| 10+00 | 10/7/2014 | 10/10/2015 | 1.67 | 1.27 | -15.36 |
| 12+50 | 10/7/2014 | 10/10/2015 | 20.34 | 6.04 | -1.22 |
| 15+00 | 10/7/2014 | 10/10/2015 | 21.28 | 5.07 | 12.08 |
| 17+50 | 10/7/2014 | 10/10/2015 | 32.61 | 5.80 | 12.68 |
| 20+00 | 10/7/2014 | 10/10/2015 | 22.83 | 1.84 | 8.77 |
| 22+50 | 10/7/2014 | 10/10/2015 | 54.33 | 8.60 | 20.88 |
| 25+00 | 10/7/2014 | 10/10/2015 | -12.75 | 2.49 | 7.78 |
| 27+50 | 10/7/2014 | 10/10/2015 | 11.81 | 2.97 | 10.04 |
| 30+00 | 10/7/2014 | 10/10/2015 | 22.59 | 3.67 | 19.32 |
| 32+50 | 10/7/2014 | 10/10/2015 | -7.97 | 1.98 | 16.32 |
| 35+00 | 10/7/2014 | 10/10/2015 | -38.53 | -2.25 | 12.32 |
| 37+50 | 10/7/2014 | 10/10/2015 | -63.55 | -9.13 | -3.71 |
| 40+00 | 10/7/2014 | 10/10/2015 | -47.40 | -10.18 | -5.62 |
| 42+50 | 10/7/2014 | 10/10/2015 | -39.79 | -16.43 | -21.17 |
| 45+00 | 10/7/2014 | 10/10/2015 | 12.97 | -0.73 | 5.50 |
| 45+25 | 10/7/2014 | 10/10/2015 | 10.95 | -3.00 | -2.85 |
| 47+30 | 10/7/2014 | 10/10/2015 | 8.79 | -2.88 | 4.27 |
| 49+35 | 10/7/2014 | 10/10/2015 | -16.44 | -3.20 | -10.10 |
| 51+41 | 10/7/2014 | 10/10/2015 | -12.67 | -5.84 | -6.92 |
| 53+46 | 10/7/2014 | 10/10/2015 | -25.73 | -8.72 | -10.22 |
| 55+51 | 10/7/2014 | 10/10/2015 | 3.58 | -1.92 | -3.33 |
| 57+57 | 10/7/2014 | 10/10/2015 | -14.24 | -5.41 | -5.75 |
| 59+62 | 10/7/2014 | 10/10/2015 | 15.04 | 2.52 | 2.39 |
| 61+62 | 10/7/2014 | 10/10/2015 | -13.95 | -3.40 | -4.40 |
| 63+62 | 10/7/2014 | 10/10/2015 | -1.25 | -0.58 | 9.47 |
| 65+62 | 10/7/2014 | 10/10/2015 | -35.28 | -7.91 | -9.33 |
| 67+62 | 10/7/2014 | 10/10/2015 | -4.52 | -0.53 | -4.87 |
| 69+62 | 10/7/2014 | 10/10/2015 | -47.68 | -8.30 | -11.76 |
| 71+62 | 10/7/2014 | 10/10/2015 | -16.10 | -0.91 | -2.27 |
| 73+62 | 10/7/2014 | 10/10/2015 | -20.30 | -2.76 | 1.25 |
| 75+62 | 10/7/2014 | 10/10/2015 | -10.18 | -1.63 | -3.71 |
| 77+62 | 10/7/2014 | 10/10/2015 | -25.14 | -5.27 | -7.89 |
| 79+62 | 10/7/2014 | 10/10/2015 | -1.88 | -3.87 | -7.72 |
| 81+62 | 10/7/2014 | 10/10/2015 | -3.75 | -4.85 | -4.18 |
| 83+62 | 10/7/2014 | 10/10/2015 | -15.57 | -6.37 | -8.70 |
| 85+62 | 10/7/2014 | 10/10/2015 | 5.06 | -1.22 | -0.29 |
| 87+62 | 10/7/2014 | 10/10/2015 | -6.86 | -2.63 | -2.15 |

**Table C-1. Summary of Shoreline Change and Volume Change
(October 2014 to October 2015) 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 7, 2014 to October 10, 2015.

| 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 | 10/7/2014 | 10/10/2015 | -12.70 | -3.09 | -1.90 |
| 103+08 | 10/7/2014 | 10/10/2015 | -3.90 | 0.46 | 2.48 |
| 120+93 | 10/7/2014 | 10/10/2015 | -31.53 | -4.95 | -8.44 |
| 129+17 | 10/7/2014 | 10/10/2015 | -34.59 | -6.84 | -8.24 |
| 141+98 | 10/7/2014 | 10/10/2015 | -1.82 | 0.43 | -1.48 |
| 152+01 | 10/7/2014 | 10/10/2015 | -19.92 | -4.23 | -0.04 |
| 163+49 | 10/7/2014 | 10/10/2015 | 8.61 | 2.71 | 7.27 |
| 169+63 | 10/7/2014 | 10/10/2015 | 10.30 | 5.09 | 15.66 |
| 171+63 | 10/7/2014 | 10/10/2015 | -4.64 | 0.32 | -2.79 |
| 173+63 | 10/7/2014 | 10/10/2015 | -3.95 | -0.60 | 5.77 |
| 175+63 | 10/7/2014 | 10/10/2015 | 4.85 | 0.76 | 4.94 |
| 177+63 | 10/7/2014 | 10/10/2015 | -5.17 | 0.89 | 10.35 |
| 179+63 | 10/7/2014 | 10/10/2015 | -20.69 | -4.65 | 3.91 |
| 181+63 | 10/7/2014 | 10/10/2015 | -9.69 | -0.57 | 7.51 |
| 183+63 | 10/7/2014 | 10/10/2015 | -3.78 | -0.34 | 5.08 |
| 185+63 | 10/7/2014 | 10/10/2015 | 13.38 | 2.40 | 6.40 |
| 187+63 | 10/7/2014 | 10/10/2015 | -10.79 | -1.81 | 0.23 |
| 189+63 | 10/7/2014 | 10/10/2015 | 5.58 | 2.16 | 3.81 |
| 191+63 | 10/7/2014 | 10/10/2015 | -35.55 | -3.52 | -8.47 |
| 193+63 | 10/7/2014 | 10/10/2015 | -2.65 | -0.30 | -0.10 |
| 195+63 | 10/7/2014 | 10/10/2015 | -4.97 | -1.70 | -3.98 |
| 206+86 | 10/7/2014 | 10/10/2015 | 2.62 | 2.13 | 4.34 |
| 218+66 | 10/7/2014 | 10/10/2015 | -0.99 | -0.49 | -0.67 |
| 229+85 | 10/7/2014 | 10/10/2015 | 26.20 | 2.03 | 13.63 |
| 242+03 | 10/7/2014 | 10/10/2015 | 26.55 | -2.00 | 1.32 |
| 252+62 | 10/7/2014 | 10/10/2015 | 8.36 | -2.59 | 2.65 |
| 263+22 | 10/7/2014 | 10/10/2015 | -16.25 | 0.01 | 4.44 |
| 274+53 | 10/7/2014 | 10/10/2015 | 28.12 | -0.70 | 10.43 |
| 281+40 | 10/7/2014 | 10/10/2015 | 17.06 | -1.93 | -4.00 |
| 288+39 | 10/7/2014 | 10/10/2015 | -13.52 | -6.83 | 2.79 |
| 295+27 | 10/7/2014 | 10/10/2015 | -14.03 | -2.69 | 3.43 |
| 302+24 | 10/7/2014 | 10/10/2015 | -37.01 | -4.97 | 4.48 |
| 315+96 | 10/7/2014 | 10/10/2015 | 4.68 | -5.50 | -8.63 |
| 323+09 | 10/7/2014 | 10/10/2015 | -6.77 | -5.44 | 0.57 |
| 329+63 | 10/7/2014 | 10/10/2015 | 12.63 | -4.89 | -5.83 |
| 331+43 | 10/7/2014 | 10/10/2015 | -5.01 | -3.57 | 1.60 |
| 333+23 | 10/7/2014 | 10/10/2015 | -1.72 | -5.35 | 2.46 |
| 335+03 | 10/7/2014 | 10/10/2015 | 16.21 | -2.06 | 11.68 |
| 336+83 | 10/7/2014 | 10/10/2015 | -15.42 | -2.72 | 6.83 |
| 338+63 | 10/7/2014 | 10/10/2015 | -37.84 | -3.05 | -1.38 |
| 340+43 | 10/7/2014 | 10/10/2015 | 22.89 | -5.11 | 2.88 |
| 342+23 | 10/7/2014 | 10/10/2015 | 20.36 | -2.46 | -0.09 |

**Table C-1. Summary of Shoreline Change and Volume Change
(October 2014 to October 2015) 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 7, 2014 to October 10, 2015.

| 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 | 10/7/2014 | 10/10/2015 | 46.77 | 2.91 | 7.92 |
| 345+85 | 10/7/2014 | 10/10/2015 | 24.12 | 1.05 | 9.80 |
| 347+63 | 10/7/2014 | 10/10/2015 | 3.88 | -3.17 | -10.42 |
| 349+43 | 10/7/2014 | 10/10/2015 | 1.08 | -1.55 | 2.17 |
| 351+23 | 10/7/2014 | 10/10/2015 | 1.19 | -5.82 | -12.17 |
| 353+03 | 10/7/2014 | 10/10/2015 | 6.01 | -2.18 | 4.11 |
| 354+83 | 10/7/2014 | 10/10/2015 | -6.27 | -6.62 | -13.57 |
| 356+63 | 10/7/2014 | 10/10/2015 | -1.68 | -3.52 | 7.72 |
| 358+43 | 10/7/2014 | 10/10/2015 | 1.52 | -6.30 | -8.05 |
| 360+23 | 10/7/2014 | 10/10/2015 | 6.98 | -2.69 | 3.62 |
| 362+03 | 10/7/2014 | 10/10/2015 | 14.07 | -6.31 | -8.95 |
| 363+83 | 10/7/2014 | 10/10/2015 | 4.26 | -4.95 | 3.59 |
| 365+63 | 10/7/2014 | 10/10/2015 | 16.95 | -4.37 | -7.23 |
| 367+43 | 10/7/2014 | 10/10/2015 | 6.42 | -0.59 | 6.58 |
| 369+23 | 10/7/2014 | 10/10/2015 | 6.08 | -1.68 | -9.43 |
| 371+03 | 10/7/2014 | 10/10/2015 | -2.88 | -3.10 | -0.01 |
| 372+83 | 10/7/2014 | 10/10/2015 | -16.31 | -5.87 | -1.56 |
| 375+08 | 10/7/2014 | 10/10/2015 | -9.91 | -3.82 | 0.26 |
| 376+78 | 10/7/2014 | 10/10/2015 | 2.18 | -6.23 | -10.39 |
| 378+48 | 10/7/2014 | 10/10/2015 | -3.19 | -4.10 | -5.02 |
| 380+18 | 10/7/2014 | 10/10/2015 | -5.18 | -4.22 | -7.45 |
| 381+88 | 10/7/2014 | 10/10/2015 | 7.38 | -1.11 | -0.81 |
| 383+58 | 10/7/2014 | 10/10/2015 | 7.55 | 0.73 | -0.33 |

**Table C-2. Summary of Shoreline Change and Volume Change
(April 2015 to October 2015)**

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 21, 2015 to October 10, 2015.

| 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 | 4/21/2015 | 10/10/2015 | 14.16 | 4.34 | 34.83 |
| 2+50 | 4/21/2015 | 10/10/2015 | 11.62 | 0.10 | 8.75 |
| 5+00 | 4/21/2015 | 10/10/2015 | -5.51 | -1.57 | 5.55 |
| 7+50 | 4/21/2015 | 10/10/2015 | 11.90 | -4.26 | 7.30 |
| 10+00 | 4/21/2015 | 10/10/2015 | -10.88 | 1.35 | -10.43 |
| 12+50 | 4/21/2015 | 10/10/2015 | 15.58 | 4.81 | -2.90 |
| 15+00 | 4/21/2015 | 10/10/2015 | -10.66 | -1.74 | -3.99 |
| 17+50 | 4/21/2015 | 10/10/2015 | 17.79 | 2.70 | 12.88 |
| 20+00 | 4/21/2015 | 10/10/2015 | -2.00 | -1.43 | 0.82 |
| 22+50 | 4/21/2015 | 10/10/2015 | 44.21 | 6.60 | 15.53 |
| 25+00 | 4/21/2015 | 10/10/2015 | -17.92 | 1.82 | -3.08 |
| 27+50 | 4/21/2015 | 10/10/2015 | 3.97 | 1.64 | 2.41 |
| 30+00 | 4/21/2015 | 10/10/2015 | 15.44 | 1.82 | 3.09 |
| 32+50 | 4/21/2015 | 10/10/2015 | 16.76 | 2.73 | 9.53 |
| 35+00 | 4/21/2015 | 10/10/2015 | -23.91 | -2.25 | -0.37 |
| 37+50 | 4/21/2015 | 10/10/2015 | -49.81 | -8.30 | -7.91 |
| 40+00 | 4/21/2015 | 10/10/2015 | -30.07 | -9.99 | -10.08 |
| 42+50 | 4/21/2015 | 10/10/2015 | -25.18 | -14.19 | -22.74 |
| 45+00 | 4/21/2015 | 10/10/2015 | 17.20 | -0.04 | 3.07 |
| 45+25 | 4/21/2015 | 10/10/2015 | 14.71 | -1.12 | -2.46 |
| 47+30 | 4/21/2015 | 10/10/2015 | 14.01 | -2.04 | 0.17 |
| 49+35 | 4/21/2015 | 10/10/2015 | -8.73 | -1.32 | -9.89 |
| 51+41 | 4/21/2015 | 10/10/2015 | 0.02 | -4.69 | -5.21 |
| 53+46 | 4/21/2015 | 10/10/2015 | -34.16 | -9.63 | -14.42 |
| 55+51 | 4/21/2015 | 10/10/2015 | 10.47 | -1.54 | -2.22 |
| 57+57 | 4/21/2015 | 10/10/2015 | -35.90 | -8.03 | -7.75 |
| 59+62 | 4/21/2015 | 10/10/2015 | 16.47 | 2.17 | 0.96 |
| 61+62 | 4/21/2015 | 10/10/2015 | -29.68 | -5.26 | -5.75 |
| 63+62 | 4/21/2015 | 10/10/2015 | 6.33 | -0.05 | 7.87 |
| 65+62 | 4/21/2015 | 10/10/2015 | -49.01 | -9.97 | -11.60 |
| 67+62 | 4/21/2015 | 10/10/2015 | 3.07 | -0.04 | -4.48 |
| 69+62 | 4/21/2015 | 10/10/2015 | -47.48 | -7.34 | -11.60 |
| 71+62 | 4/21/2015 | 10/10/2015 | 4.45 | 1.83 | -1.42 |
| 73+62 | 4/21/2015 | 10/10/2015 | -22.45 | -4.33 | -2.40 |
| 75+62 | 4/21/2015 | 10/10/2015 | 3.18 | -0.86 | -1.44 |
| 77+62 | 4/21/2015 | 10/10/2015 | -21.98 | -5.02 | -7.96 |
| 79+62 | 4/21/2015 | 10/10/2015 | -9.49 | -4.41 | -3.28 |
| 81+62 | 4/21/2015 | 10/10/2015 | -15.01 | -6.90 | -6.72 |
| 83+62 | 4/21/2015 | 10/10/2015 | -13.35 | -7.36 | -9.05 |
| 85+62 | 4/21/2015 | 10/10/2015 | 9.72 | -0.06 | -2.58 |
| 87+62 | 4/21/2015 | 10/10/2015 | -8.99 | -2.85 | -6.48 |

**Table C-2. Summary of Shoreline Change and Volume Change
(April 2015 to October 2015) 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 21, 2015 to October 10, 2015.

| 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 | 4/21/2015 | 10/10/2015 | 1.69 | -1.20 | -2.01 |
| 103+08 | 4/21/2015 | 10/10/2015 | -11.18 | -1.60 | -6.63 |
| 120+93 | 4/21/2015 | 10/10/2015 | -29.05 | -4.82 | -4.61 |
| 129+17 | 4/21/2015 | 10/10/2015 | -5.84 | -1.78 | -1.34 |
| 141+98 | 4/21/2015 | 10/10/2015 | -11.59 | -0.44 | -3.81 |
| 152+01 | 4/21/2015 | 10/10/2015 | 5.61 | 1.78 | 6.44 |
| 163+49 | 4/21/2015 | 10/10/2015 | -1.25 | -0.07 | 2.99 |
| 169+63 | 4/21/2015 | 10/10/2015 | -9.79 | 1.98 | 2.79 |
| 171+63 | 4/21/2015 | 10/10/2015 | -4.58 | 2.12 | -1.66 |
| 173+63 | 4/21/2015 | 10/10/2015 | -12.64 | -0.34 | 1.41 |
| 175+63 | 4/21/2015 | 10/10/2015 | -9.41 | -3.48 | -8.19 |
| 177+63 | 4/21/2015 | 10/10/2015 | -33.41 | -6.94 | -9.45 |
| 179+63 | 4/21/2015 | 10/10/2015 | -28.49 | -6.83 | -8.87 |
| 181+63 | 4/21/2015 | 10/10/2015 | 12.51 | 1.80 | 1.14 |
| 183+63 | 4/21/2015 | 10/10/2015 | -21.26 | -2.85 | -3.97 |
| 185+63 | 4/21/2015 | 10/10/2015 | 13.75 | 2.21 | 3.83 |
| 187+63 | 4/21/2015 | 10/10/2015 | -13.03 | -2.17 | -6.18 |
| 189+63 | 4/21/2015 | 10/10/2015 | 9.26 | 2.36 | 3.29 |
| 191+63 | 4/21/2015 | 10/10/2015 | -37.76 | -3.11 | -9.24 |
| 193+63 | 4/21/2015 | 10/10/2015 | -1.47 | 0.29 | 4.03 |
| 195+63 | 4/21/2015 | 10/10/2015 | 5.22 | 0.46 | 6.02 |
| 206+86 | 4/21/2015 | 10/10/2015 | -3.48 | -0.25 | 0.48 |
| 218+66 | 4/21/2015 | 10/10/2015 | -11.03 | -4.61 | -6.14 |
| 229+85 | 4/21/2015 | 10/10/2015 | 14.80 | -1.43 | 5.52 |
| 242+03 | 4/21/2015 | 10/10/2015 | 21.33 | 1.62 | 8.62 |
| 252+62 | 4/21/2015 | 10/10/2015 | -0.98 | -2.41 | -3.87 |
| 263+22 | 4/21/2015 | 10/10/2015 | -14.31 | -2.25 | 2.70 |
| 274+53 | 4/21/2015 | 10/10/2015 | 19.86 | -0.28 | 2.35 |
| 281+40 | 4/21/2015 | 10/10/2015 | 2.76 | -4.13 | -0.29 |
| 288+39 | 4/21/2015 | 10/10/2015 | -2.96 | -10.36 | -7.45 |
| 295+27 | 4/21/2015 | 10/10/2015 | -17.11 | -3.50 | -0.98 |
| 302+24 | 4/21/2015 | 10/10/2015 | -56.30 | -8.01 | -1.69 |
| 315+96 | 4/21/2015 | 10/10/2015 | 8.34 | -6.22 | -8.79 |
| 323+09 | 4/21/2015 | 10/10/2015 | -12.83 | -5.60 | -3.23 |
| 329+63 | 4/21/2015 | 10/10/2015 | -6.68 | -8.86 | -10.39 |
| 331+43 | 4/21/2015 | 10/10/2015 | -2.68 | -4.74 | -5.70 |
| 333+23 | 4/21/2015 | 10/10/2015 | -0.96 | -6.68 | -5.38 |
| 335+03 | 4/21/2015 | 10/10/2015 | 22.21 | -1.89 | 3.52 |
| 336+83 | 4/21/2015 | 10/10/2015 | -15.93 | -3.34 | -1.15 |
| 338+63 | 4/21/2015 | 10/10/2015 | -33.59 | -3.21 | -3.36 |
| 340+43 | 4/21/2015 | 10/10/2015 | 22.54 | -5.15 | -4.63 |

**Table C-2. Summary of Shoreline Change and Volume Change
(April 2015 to October 2015) 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 21, 2015 to October 10, 2015.

| 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 | 4/21/2015 | 10/10/2015 | 18.54 | -3.88 | -7.42 |
| 344+05 | 4/21/2015 | 10/10/2015 | 50.86 | 0.65 | 2.51 |
| 345+85 | 4/21/2015 | 10/10/2015 | 30.12 | 1.80 | 4.85 |
| 347+63 | 4/21/2015 | 10/10/2015 | 1.31 | -4.27 | -5.02 |
| 349+43 | 4/21/2015 | 10/10/2015 | 12.36 | -0.55 | -1.76 |
| 351+23 | 4/21/2015 | 10/10/2015 | 4.39 | -6.00 | -6.02 |
| 353+03 | 4/21/2015 | 10/10/2015 | 17.05 | -0.89 | 1.16 |
| 354+83 | 4/21/2015 | 10/10/2015 | 6.16 | -5.00 | -3.74 |
| 356+63 | 4/21/2015 | 10/10/2015 | 16.01 | -1.19 | 6.08 |
| 358+43 | 4/21/2015 | 10/10/2015 | 10.87 | -5.88 | -0.41 |
| 360+23 | 4/21/2015 | 10/10/2015 | 17.04 | -1.48 | -1.12 |
| 362+03 | 4/21/2015 | 10/10/2015 | 12.24 | -6.74 | -4.67 |
| 363+83 | 4/21/2015 | 10/10/2015 | 15.75 | -3.71 | 0.92 |
| 365+63 | 4/21/2015 | 10/10/2015 | 16.73 | -3.94 | -1.05 |
| 367+43 | 4/21/2015 | 10/10/2015 | 18.56 | 1.28 | 3.69 |
| 369+23 | 4/21/2015 | 10/10/2015 | 0.56 | -1.80 | -8.01 |
| 371+03 | 4/21/2015 | 10/10/2015 | 12.84 | -1.36 | -1.39 |
| 372+83 | 4/21/2015 | 10/10/2015 | -17.48 | -5.97 | -7.61 |
| 375+08 | 4/21/2015 | 10/10/2015 | 11.95 | -1.44 | 4.73 |
| 376+78 | 4/21/2015 | 10/10/2015 | -15.25 | -8.04 | -11.32 |
| 378+48 | 4/21/2015 | 10/10/2015 | -3.67 | -4.80 | -7.54 |
| 380+18 | 4/21/2015 | 10/10/2015 | 2.08 | -3.85 | -6.60 |
| 381+88 | 4/21/2015 | 10/10/2015 | 3.97 | -2.72 | -7.83 |
| 383+58 | 4/21/2015 | 10/10/2015 | 11.61 | -0.56 | 0.99 |

**Table C-3. Summary of Shoreline Change and Volume Change from
East Ocean View Nourishment (March 2009 to October 2015)**

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 October 10, 2015.

| 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 | 10/10/2015 | -14.23 | -3.85 | - |
| 331+43 | 3/20/2009 | 10/10/2015 | -17.12 | -3.46 | - |
| 333+23 | 3/20/2009 | 10/10/2015 | -13.07 | -2.96 | - |
| 335+03 | 3/20/2009 | 10/10/2015 | -8.17 | -1.82 | - |
| 336+83 | 3/20/2009 | 10/10/2015 | -13.07 | -1.84 | - |
| 338+63 | 3/20/2009 | 10/10/2015 | -15.83 | -1.95 | - |
| 340+43 | 3/20/2009 | 10/10/2015 | -7.83 | -1.63 | - |
| 342+23 | 3/20/2009 | 10/10/2015 | -10.05 | -2.00 | - |
| 344+05 | 3/20/2009 | 10/10/2015 | -6.60 | -2.26 | - |
| 345+85 | 3/20/2009 | 10/10/2015 | -7.28 | -2.11 | - |
| 347+63 | 3/20/2009 | 10/10/2015 | -8.77 | -2.54 | - |
| 349+43 | 3/20/2009 | 10/10/2015 | -10.29 | -2.47 | - |
| 351+23 | 3/20/2009 | 10/10/2015 | -8.30 | -2.62 | - |
| 353+03 | 3/20/2009 | 10/10/2015 | -9.60 | -2.35 | - |
| 354+83 | 3/20/2009 | 10/10/2015 | -8.93 | -2.61 | - |
| 356+63 | 3/20/2009 | 10/10/2015 | -10.64 | -2.89 | - |
| 358+43 | 3/20/2009 | 10/10/2015 | -10.97 | -3.03 | - |
| 360+23 | 3/20/2009 | 10/10/2015 | -13.31 | -3.27 | - |
| 362+03 | 3/20/2009 | 10/10/2015 | -11.09 | -3.23 | - |
| 363+83 | 3/20/2009 | 10/10/2015 | -9.61 | -2.78 | - |
| 365+63 | 3/20/2009 | 10/10/2015 | -8.87 | -2.54 | - |
| 367+43 | 3/20/2009 | 10/10/2015 | -16.17 | -3.17 | - |
| 369+23 | 3/20/2009 | 10/10/2015 | -15.33 | -2.68 | - |
| 371+03 | 3/20/2009 | 10/10/2015 | -21.07 | -4.01 | - |
| 372+83 | 3/20/2009 | 10/10/2015 | -23.22 | -4.56 | - |
| 375+08 | 3/20/2009 | 10/10/2015 | -27.16 | -5.44 | - |
| 376+78 | 3/20/2009 | 10/10/2015 | -23.55 | -4.95 | - |
| 378+48 | 3/20/2009 | 10/10/2015 | -31.82 | -6.31 | - |
| 380+18 | 3/20/2009 | 10/10/2015 | -30.18 | -5.83 | - |
| 381+88 | 3/20/2009 | 10/10/2015 | -21.45 | -4.51 | - |
| 383+58 | 3/20/2009 | 10/10/2015 | -29.32 | -5.71 | - |

**Table C-4. Summary of Shoreline Change and Volume Change from
Central Ocean View Nourishment (March 2005 to October 2015)**

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 October 10, 2015.

| 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 | 10/10/2015 | 4.63 | 1.71 | - |
| 17+50 | 3/15/2005 | 10/10/2015 | 6.08 | 1.53 | - |
| 20+00 | 3/15/2005 | 10/10/2015 | 0.64 | -0.18 | - |
| 22+50 | 3/15/2005 | 10/10/2015 | 0.67 | -0.95 | - |
| 25+00 | 3/15/2005 | 10/10/2015 | 6.64 | -0.21 | - |
| 27+50 | 3/15/2005 | 10/10/2015 | 3.41 | -0.71 | - |
| 30+00 | 3/15/2005 | 10/10/2015 | 2.78 | -0.26 | - |
| 32+50 | 3/15/2005 | 10/10/2015 | -0.78 | -0.92 | - |
| 35+00 | 3/15/2005 | 10/10/2015 | 0.59 | -0.13 | - |
| 37+50 | 3/15/2005 | 10/10/2015 | -2.79 | -1.52 | - |
| 40+00 | 3/15/2005 | 10/10/2015 | -6.49 | -2.01 | - |
| 42+50 | 3/15/2005 | 10/10/2015 | -6.92 | -3.13 | - |
| 45+00 | 3/15/2005 | 10/10/2015 | -6.85 | -2.57 | - |
| 45+25 | 3/15/2005 | 10/10/2015 | -9.02 | -3.12 | - |
| 47+30 | 3/15/2005 | 10/10/2015 | -9.84 | -3.26 | - |
| 49+35 | 3/15/2005 | 10/10/2015 | -8.04 | -2.38 | - |
| 51+41 | 3/15/2005 | 10/10/2015 | -6.63 | -2.02 | - |
| 53+46 | 3/15/2005 | 10/10/2015 | -5.89 | -1.87 | - |
| 55+51 | 3/15/2005 | 10/10/2015 | -6.63 | -2.35 | - |
| 57+57 | 3/15/2005 | 10/10/2015 | -3.84 | -1.48 | - |
| 59+62 | 3/15/2005 | 10/10/2015 | -4.77 | -1.47 | - |
| 61+62 | 3/15/2005 | 10/10/2015 | -1.26 | -0.26 | - |
| 63+62 | 3/15/2005 | 10/10/2015 | -5.09 | -0.78 | - |
| 65+62 | 3/15/2005 | 10/10/2015 | -4.38 | -0.40 | - |
| 67+62 | 3/15/2005 | 10/10/2015 | -11.31 | -1.39 | - |
| 69+62 | 3/15/2005 | 10/10/2015 | -7.56 | -0.98 | - |
| 71+62 | 3/15/2005 | 10/10/2015 | -10.03 | -1.20 | - |
| 73+62 | 3/15/2005 | 10/10/2015 | -4.28 | -0.14 | - |
| 75+62 | 3/15/2005 | 10/10/2015 | -6.33 | -0.51 | - |
| 77+62 | 3/15/2005 | 10/10/2015 | -3.86 | 0.14 | - |
| 79+62 | 3/15/2005 | 10/10/2015 | -3.65 | -0.93 | - |
| 81+62 | 3/15/2005 | 10/10/2015 | -5.02 | -1.64 | - |
| 83+62 | 3/15/2005 | 10/10/2015 | -7.85 | -2.49 | - |
| 85+62 | 3/15/2005 | 10/10/2015 | -2.62 | -1.30 | - |
| 87+62 | 3/15/2005 | 10/10/2015 | -3.37 | -0.85 | - |
| 93+41 | 3/15/2005 | 10/10/2015 | -1.70 | -0.98 | - |
| 103+08 | 3/15/2005 | 10/10/2015 | -3.72 | -1.22 | - |
| 120+93 | 3/15/2005 | 10/10/2015 | -4.93 | -2.05 | - |
| 129+17 | 3/15/2005 | 10/10/2015 | -5.38 | -2.74 | - |
| 141+98 | 3/15/2005 | 10/10/2015 | -2.70 | -1.11 | - |
| 152+01 | 3/15/2005 | 10/10/2015 | -5.10 | -1.84 | - |

**Table C-4. Summary of Shoreline Change and Volume Change from
Central Ocean View Nourishment (March 2005 to October 2015) 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 October 10, 2015.

| 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 | 10/10/2015 | -2.65 | -1.08 | - |
| 169+63 | 3/15/2005 | 10/10/2015 | -0.79 | -0.33 | - |
| 171+63 | 3/15/2005 | 10/10/2015 | -3.42 | -0.89 | - |
| 173+63 | 3/15/2005 | 10/10/2015 | -2.80 | -1.07 | - |
| 175+63 | 3/15/2005 | 10/10/2015 | -4.10 | -0.96 | - |
| 177+63 | 3/15/2005 | 10/10/2015 | -3.97 | -0.72 | - |
| 179+63 | 3/15/2005 | 10/10/2015 | -5.04 | -1.40 | - |
| 181+63 | 3/15/2005 | 10/10/2015 | -2.18 | -1.02 | - |
| 183+63 | 3/15/2005 | 10/10/2015 | 0.40 | 0.19 | - |
| 185+63 | 3/15/2005 | 10/10/2015 | 0.32 | -0.07 | - |
| 187+63 | 3/15/2005 | 10/10/2015 | 2.54 | 1.01 | - |
| 189+63 | 3/15/2005 | 10/10/2015 | 1.23 | 1.07 | - |
| 191+63 | 3/15/2005 | 10/10/2015 | 2.28 | 1.56 | - |
| 193+63 | 3/15/2005 | 10/10/2015 | -0.33 | 0.68 | - |
| 195+63 | 3/15/2005 | 10/10/2015 | -1.20 | 0.27 | - |

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 channelward 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 |
| 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) | | | | | |

| No | Date | Project Type | Location | Description | Vol (cy) | Extent (ft) | Unit Vol (cy/ft) | Sand Source |
|----|---|------------------------------------|---|--|----------|-------------|------------------|-----------------------|
| 60 | <i>Feb-April, 2004 Waterway Survey</i> | | <i>From Approx. Willoughby Spit to 17th Bay St</i> | | | | | |
| 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 | <i>January-March 2005 Post-Fill Survey</i> | | <i>Willoughby Spit to Warwick Ave.</i> | | | | | |
| 64 | <i>September 2005 McKim & Creed Periodic Survey</i> | | <i>Entire Ocean View Shoreline</i> | | | | | |
| 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 | <i>March 2006 McKim & Creed Periodic Survey</i> | | <i>Entire Ocean View Shoreline</i> | | | | | |
| 69 | <i>October 2006 McKim & Creed Periodic Survey</i> | | <i>Entire Ocean View Shoreline</i> | | | | | |
| 70 | <i>March 2007 McKim & Creed Periodic Survey</i> | | <i>Entire Ocean View Shoreline</i> | | | | | |
| 71 | <i>October 2007 McKim & Creed Periodic Survey</i> | | <i>Entire Ocean View Shoreline</i> | | | | | |
| 72 | <i>March 2008 McKim & Creed Periodic Survey</i> | | <i>Entire Ocean View Shoreline</i> | | | | | |
| 73 | <i>October 2008 McKim & Creed Periodic Survey</i> | | <i>Entire Ocean View Shoreline</i> | | | | | |
| 74 | March, 2009 | Beach Nourishment | East Ocean View and Bay Oaks | Beach Nourishment | 196,000 | | | |
| 75 | <i>April 2009 McKim & Creed Periodic Survey</i> | | <i>Entire Ocean View Shoreline</i> | | | | | |
| 76 | August-October, 2009 | Breakwater Construction | Bay Oaks | 5 Nearshore Breakwaters Constructed | | | | |
| 77 | <i>October 2009 Geodynamics Periodic Survey</i> | | <i>Entire Ocean View Shoreline</i> | | | | | |
| 78 | <i>November-December 2009 Post-Storm Survey</i> | | <i>Entire Ocean View Shoreline</i> | | | | | |
| 79 | <i>March 2010 Geodynamics Periodic Survey</i> | | <i>Entire Ocean View Shoreline</i> | | | | | |
| 80 | April, 2010 | Dune Restoration | Willoughby Spit and 800 Block | Dune restoration using sediment from terminal groin and 800 block breakwaters | | | | |
| 81 | <i>October 2010 Geodynamics Periodic Survey</i> | | <i>Entire Ocean View Shoreline</i> | | | | | |
| 82 | <i>April 2011 Geodynamics Periodic Survey</i> | | <i>Entire Ocean View Shoreline</i> | | | | | |
| 83 | <i>October 2011 Geodynamics Periodic Survey</i> | | <i>Entire Ocean View Shoreline</i> | | | | | |
| 84 | <i>March 2012 Geodynamics Periodic Survey</i> | | <i>Entire Ocean View Shoreline</i> | | | | | |
| 85 | <i>October 2012 Geodynamics Periodic Survey</i> | | <i>Entire Ocean View Shoreline</i> | | | | | |
| 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 | <i>April 2013 Geodynamics Periodic Survey</i> | | <i>Entire Ocean View Shoreline</i> | | | | | |
| 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 | <i>October 2013 Geodynamics Periodic Survey</i> | | <i>Entire Ocean View Shoreline</i> | | | | | |
| 92 | December 2013 | Beach Nourishment | West Ocean View | Beach Nourishment | 46,800 | | | Truck Haul |
| 93 | <i>March 2014 Geodynamics Periodic Survey</i> | | <i>Entire Ocean View Shoreline</i> | | | | | |
| 94 | <i>October 2014 Geodynamics Periodic Survey</i> | | <i>Entire Ocean View Shoreline</i> | | | | | |
| 95 | <i>April 2015 Geodynamics Periodic Survey</i> | | <i>Entire Ocean View Shoreline</i> | | | | | |
| 96 | <i>October 2015 Geodynamics Periodic Survey</i> | | <i>Entire Ocean View Shoreline</i> | | | | | |

| |
|---|
| 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.



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