

**SPECIAL SPRING 2018 STORM REPORT ON
THE CONDITION OF THE MUNICIPAL BEACHES FOR
THE BOROUGH OF STONE HARBOR, CAPE MAY COUNTY, NEW JERSEY**



Aerial photograph taken April 21, 2018 showing the view up the beach from Stone Harbor Point beach. Note the new deposit of sand extending south from the terminal groin. This is sand derived from the 2nd Periodic Nourishment Cycle in the Borough's southern section moved beyond the groin by the series of northeast storms in March/April (courtesy Ted Kingston).

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May 20, 2018

Contents

Introduction	1
2018 Weather Events.....	1
Beach Monitoring Program Methodology	1
Stone Harbor Engineered Beach Performance.....	1
Table 1 - Stone Harbor October 2017 to April 2018 Semi-Annual Changes	2
Table 2 - Stone Harbor June 2017 to April 2018 Annual Changes	3
Individual Site Descriptions.....	3
Photoplates (1a-8b) Beach Conditions at each Profile Location.....	4
Figures (1-8) Comparison Plots.....	5
Summary	27

Introduction:

The Borough's beaches between 105th and 123rd Streets received maintenance sands in the 2nd Periodic Nourishment Cycle that commenced in February 2017 using Hereford Inlet as the borrow source. By March 7, 2017 the total amount placed in the southerly section was 394,000 cubic yards (CY). In May, repairs commenced in Stone Harbor's north end beaches (80th Street to 105th Street) using Flood Control Coastal Emergency Act (FCCE) funding. A borrow site within Townsends Inlet was the sand source for approximately 320,000 CY that was placed on the Borough's north end beaches (80th to 105th Streets). The north end project was completed a few days prior to the Stockton University Coastal Research Center (CRC) June survey. Adding these two sand volume totals, the Borough oceanfront received 714,000 cubic yards of additional sand.

2018 Weather Events;

The fall of 2017 was relatively mild with a few northeast events and Hurricane Jose passed well off the NJ coastline September 18 and 19, 2017. December, January ("Grayson" Jan. 4&5, 2018) and February were cold, but without numerous storms. March commenced with a moderate northeaster on the 2nd and 3rd, followed by a less intense one March 7th, then a similar event March 12th and 13th, followed by a final storm in March on the 20th and 21st with 50 knot winds. April continue the storms with a mild event on the 7th and 8th with a final storm on the 15th with 35 knot winds. There were 6 northeast events in 7 weeks of time. While no one storm was particularly intense or damaging, the cumulative impact was one of substantial beach erosion and abundant sand transport from north to south along each barrier island.

The effects can be readily seen in the April 21st picture on the cover showing Stone Harbor beaches from South Point looking north where a deposit several hundred feet wide and about 800 feet long extends at the lower portion of the beach from the 123rd Street groin south into the natural area of South Point. The new sand is a bit more tan in color than the older sediment landward. Its ending point shape at the low tide line is the best evidence of recent deposition.

Beach Monitoring Program Methodology

The CRC established eight survey location and each was surveyed last year in June and October. These two surveys became the base line for an emergency survey completed April 9th and 10th to determine the sand volume lost over the winter. Each profile starts at a fixed reference position behind the dunes, crosses the dunes, beach and extends over 600 feet into the water, ending at a depth of 12-16 feet. Each of the groin compartments or cells along the Borough beachfront contains one profile line.

The following is a list of the profile locations:

♦ SH-82	82 nd Street	Border with Avalon – 84 th St. groin
♦ SH-90	90 th Street	84 th St. groin – 92 nd St. groin
♦ SH-95	95 th Street	92 nd St. groin – 98 th St. groin
♦ SH-103	103 rd Street	98 th St. groin – 106 th St. groin
♦ SH-108	108 th Street	106 th St. groin – 111 th St. groin
♦ SH-112	112 th Street (paper street)	111 th St. groin – 114 th St. groin
♦ SH-116	116 th Street	114 th St. groin – 122 nd St. groin
♦ SH-123	123 rd Street (paper street)	122 nd St. groin – terminal groin

Stone Harbor Engineered Beach Performance:

Tables 1 and 2 provide shoreline and volume change information for each of the ocean beach profile locations within the Borough of Stone Harbor. Shoreline changes were calculated by comparing the zero datum positions for the October 2017 to April 2018 monitoring period to focus on the winter series of storms. The second table

contains the same computations for the period from June 2017 to April 2018. These values are expressed in cubic yards of sand per linear foot of beachfront (yds³/ft.). The total beach volume change is calculated using this value. The distance (cell width) between groins along the beachfront of Stone Harbor was measured between the centerlines of adjacent groins. Each cell's net sand volume change is determined by multiplying each cross section volume change by its corresponding groin cell width.

Table 1
Stone Harbor
October 2017 (#50) to April 2018 (#51)
Semi-Annual Shoreline and Profile Sand Volume Changes

Profile Number	Shoreline Change (feet)	Volume Change (yds³/ft)	Cell Distance (feet)	Cell Volume Change (yds³)
SH-82	-3	-24.95	1,381	-34,455
SH-90	20	-2.88	2,240	-6,451
SH-95	22	13.35	1,680	22,426
SH-103	-24	14.12	2,208	31,170
SH-108	-77	-27.15	1,433	-38,902
SH-112	-71	-4.15	804	-3,335
SH-116	-26	11.68	2,273	26,542
SH-123	-52	-3.07	1,058	-3,252
Total Volume Change =				-6,256

The compilation of losses in Table 1 between October 2017 and April 2018 was not enormous at -6,256 cubic yards between 82nd Street site and the terminal groin at 123rd Street, but as the shoreline retreat values show, the losses were concentrated south of 103rd Street. However, 82nd and 108th Streets lost the greatest quantity of sand with either gains or fairly minor sand volume loss elsewhere.

Table 2 provides the changes that occurred between June 2017 and April 2018. The data seems to indicate that the summer through the winter was reasonably accretional in sand volume with a net gain of 54,697 cubic yards of material. There were two major changes, one negative (108th Street) and one positive (116th Street). The 82nd Street site lost about the same sand volume that the 90th Street cell gained as well.

Table 2
Stone Harbor Survey
June 2017 (#49) to April 2018 (#51)
Shoreline and Total Sand Volume Changes

Profile Number	Shoreline Change (feet)	Volume Change (yds³/ft)	Cell Distance (feet)	Cell Volume Change (yds³)
SH-82	-62	-20.97	1,381	-28,957
SH-90	-1	27.55	2,240	61,721
SH-95	-30	28.38	1,680	47,678
SH-103	-88	-15.38	2,208	-33,952
SH-108	-143	-76.64	1,433	-109,824
SH-112	-42	-0.24	804	-190
SH-116	49	53.77	2,273	122,219
SH-123	-35	-3.78	1,058	-3,999
Total Volume Change =				54,697

Loss rates were highly variable in both sand volume and shoreline variations. The 143-foot retreat at 108th Street was the largest value, but was between two adjacent cell shoreline retreats of considerable magnitude. It appears that sand lost from 82nd Street benefitted the 90th Street beach cell. The cumulative losses between 103rd and 112th Streets was a benefit to the 116th Street site. Minimal sand was lost from the 123rd Street cell in spite of the 35-foot shoreline retreat.

It would appear that the lion's share of the municipal shoreline sediment loss was actually completed prior to the 5 serial northeast events between early March and mid-April 2018. Also, that the losses were cell-specific and the entire municipal beachfront actually gained sand volume between June 2017 and April 2018.

Individual Site Descriptions:

SH-82 is located at 82nd Street along 1st Avenue and seaward of the 82nd Street recreation area. The profile line is set approximately midway between the Avalon border and the groin at 84th Street. This site is included in the Borough's monitoring program to represent typical beach conditions on the Borough's only stretch of beach without a groin (in the northern section of the community). The profile is located about 800 feet south of the Avalon border and about 1,350 feet south of the USACE federal project taper. This site consists of 200 feet of primary dune width seaward of the asphalt promenade that is set on top of the revetment from its landward offset at 83rd Street to 80th Street.

Site SH-82 – 82nd Street (Photoplates 1a & 1b)



Photoplates 1a & b - Photo taken April 9, 2018 after the series of spring northeast storms. Views to the north and south show no dune damage, with plant debris almost at the dune fence on a flat beach surface.

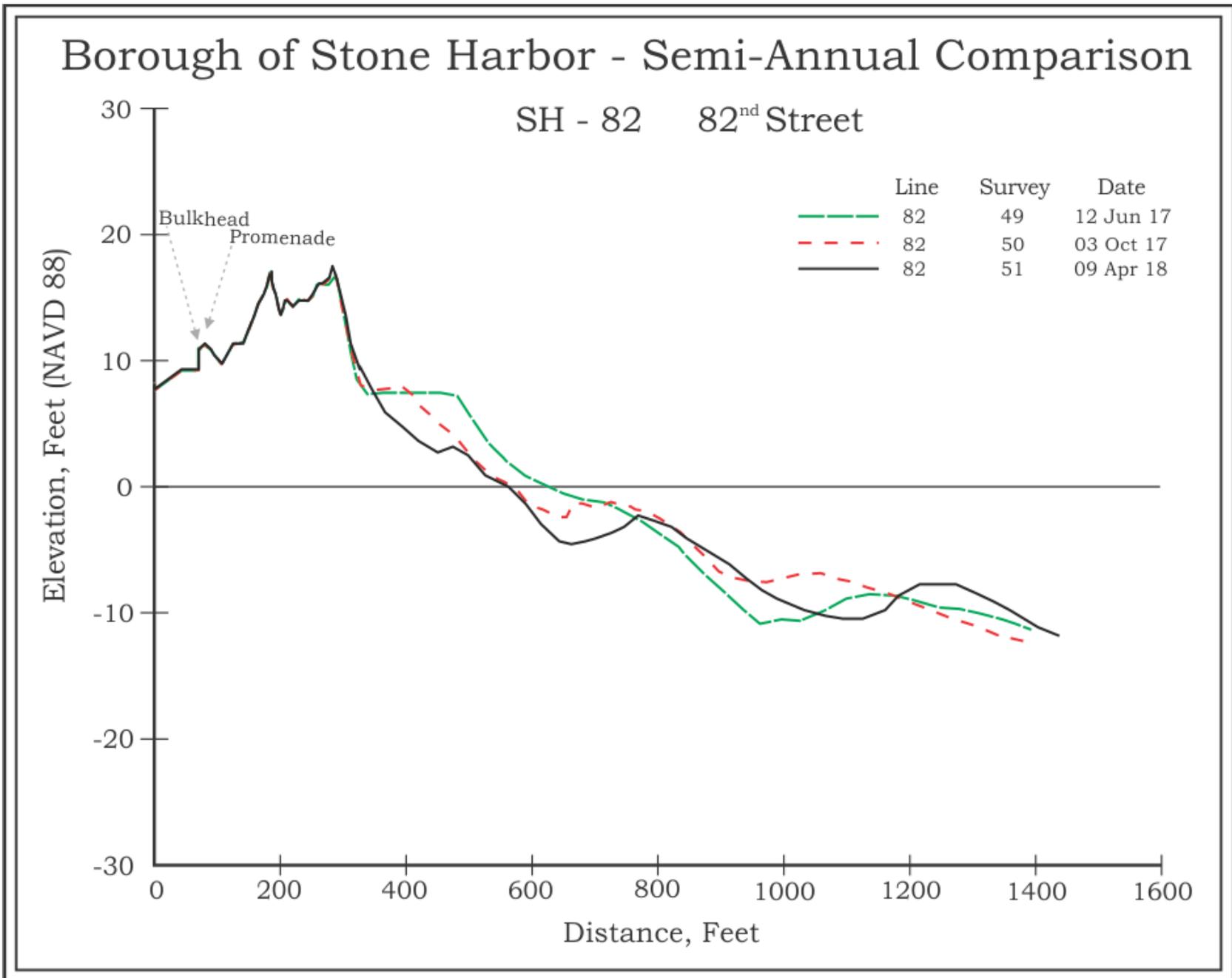


Figure 1. The post beachfill berm was partially eroded by October 2017, and by April 2018 was reduced to a sloping beach into the water. Offshore two bars emerged that did not vertically compensate for the sand lost on the beach. (-24.18 yds³/ft. lost above zero and 3.21 yds³/ft. added below the zero datum).

SH-90, is located at 90th Street and was originally established in 1986 as a survey site for the New Jersey Beach Profile Network (NJBPN). The profile line is set north of the public beach access path to provide a typical cross-sectional representation of the dune and beach that is bounded by groins at 84th Street and 92rd Street. The dune system consists of two ridges approximately 150 feet wide extending from the street end revetment to the seaward dune toe.

Site SH-90 – 90th Street (Photoplates 2a-2b)



Photoplate 2a & b - Photos taken April 9, 2018 just prior to the final northeast storm April 15th. The plant debris indicates that the waves reached the toe of the dunes, but did no damage. The beach was flattened and sand was added offshore.

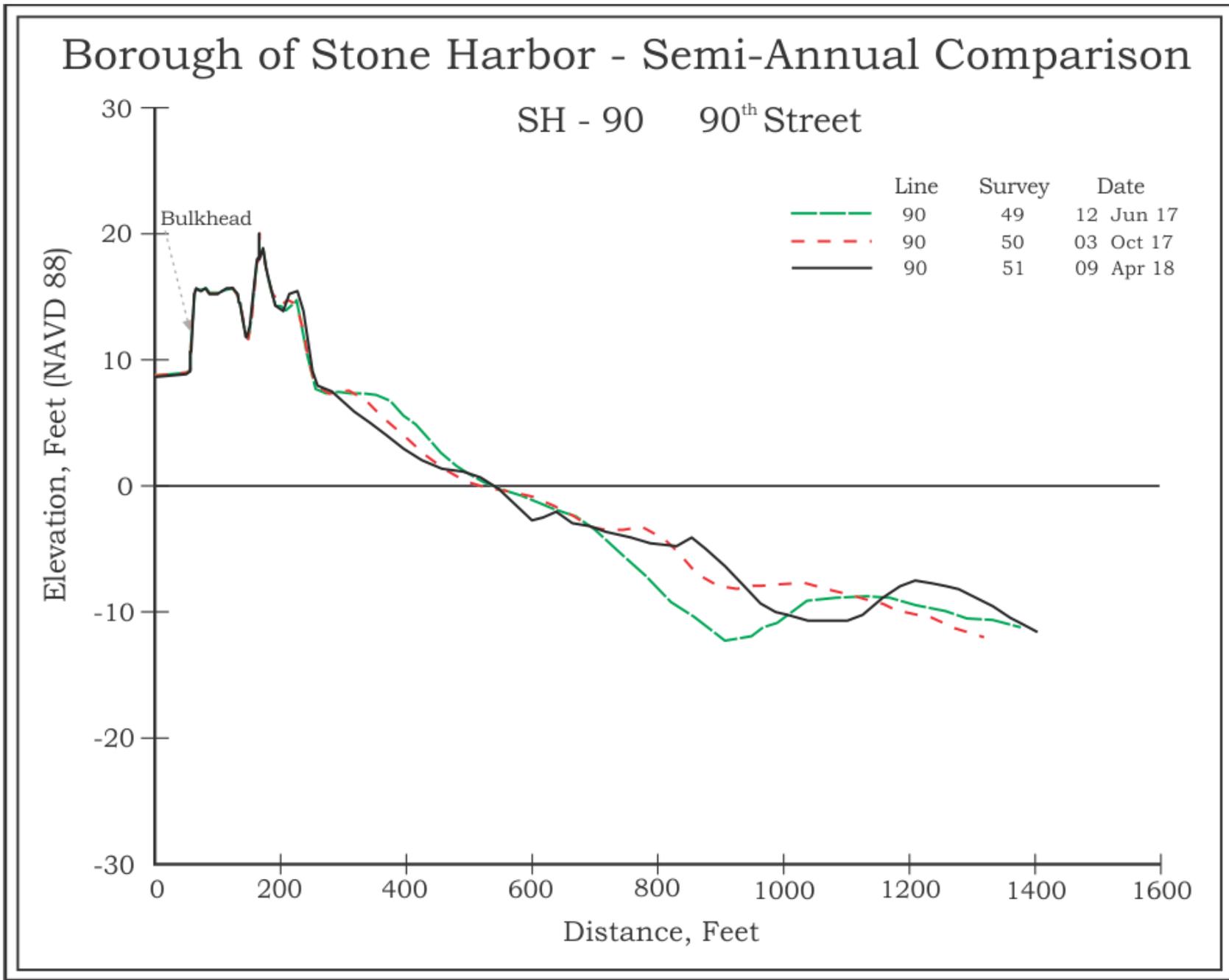


Figure 2. The change on the beach between June and October 2017 was likely the pattern set by the passage of Hurricane Jose Sept. 2017. By April 2018 the beach was flattened into a uniform slope into the water, but offshore a large volume was added close to the beach. Storms took $-10.86 \text{ yds}^3/\text{ft.}$ from the beach while $38.41 \text{ yds}^3/\text{ft.}$ was added below the zero datum elevation. The potential is that sand from the 82nd Street cell moved into this cell.

SH-95, the 95th Street site was established along the north side of 95th Street and the beach access path. The profile line crosses the municipal parking lot, a wooden bulkhead, access ramp and dune located just north of the municipal beach observation platform. The dune system is essentially a single ridge that extends seaward 140 feet from the street end revetment to the seaward dune toe with a crest elevation of 15 feet NAVD88.

Site SH-95 – 95th Street (Photoplates 3a-3b)



Photoplates 3a & b – The April 9, 2018 photo shows a flat beach with debris within 50 feet of the dune toe, but no dune erosion. The offshore region shows the deposition of sand stripped off the upper beach.

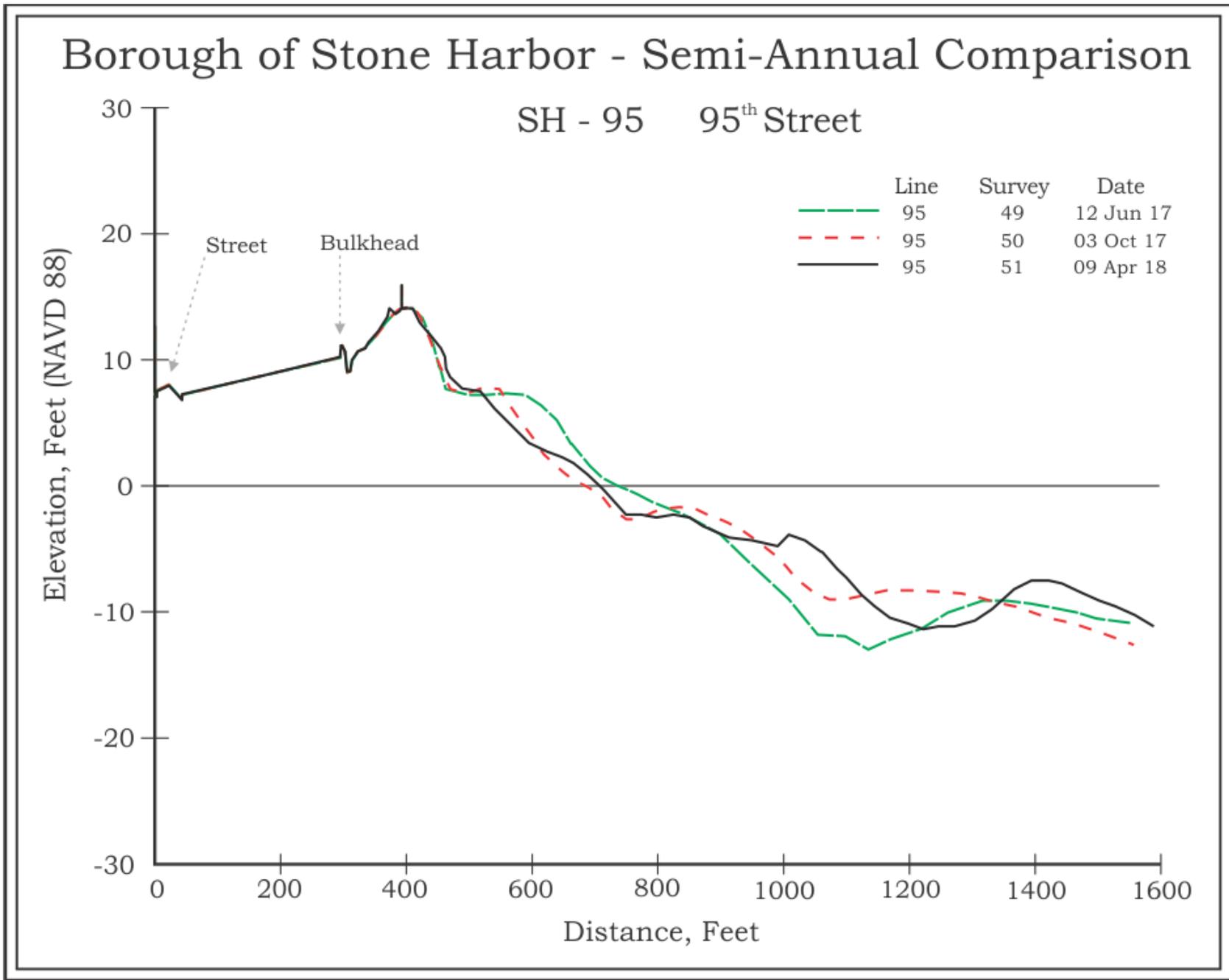


Figure 3. The post-beachfill berm was reduced by half by the time of the October 2017 survey. Further erosion took half of what remained. Offshore sand was deposited close to the beach as well as in a bar well offshore (-12.56 yds³/ft. sand lost above the datum, and 40.94 yds³/ft. gained offshore below zero elevation).

SH-103, located at 103rd Street was established for the Borough's beach monitoring program at the seaward end of 103rd Street along the north sidewalk. When the site was originally established in 1996, the profile crossed the bulkhead and dropped to the rock revetment at the toe of the bulkhead. An extremely narrow beach just seaward of the rocks provided limited recreational area for beach patrons. Storm waves and surge overtopped the revetment and caused local flooding. This beach continued to erode until by 1998 no dry beach existed seaward of the rock revetment. Sand was placed here during the 1998 municipal beach fill re-establishing a dry beach berm and dune ridge. In 2003 the initial Federal project enhanced the width of both the dune and beach. Several subsequent projects have been required to provide periodic beach maintenance that included the 2009 state/municipal project, the spring/summer 2011 federal project, and the summer 2013 Hurricane Sandy emergency beach fill.



Photoplate 4a & b - Photo taken April 9, 2018 shows that the beach at 103rd Street was unaffected within 100 feet of the dune toe. No dune erosion, but the beach was badly flattened at the berm without significant sand deposited offshore.

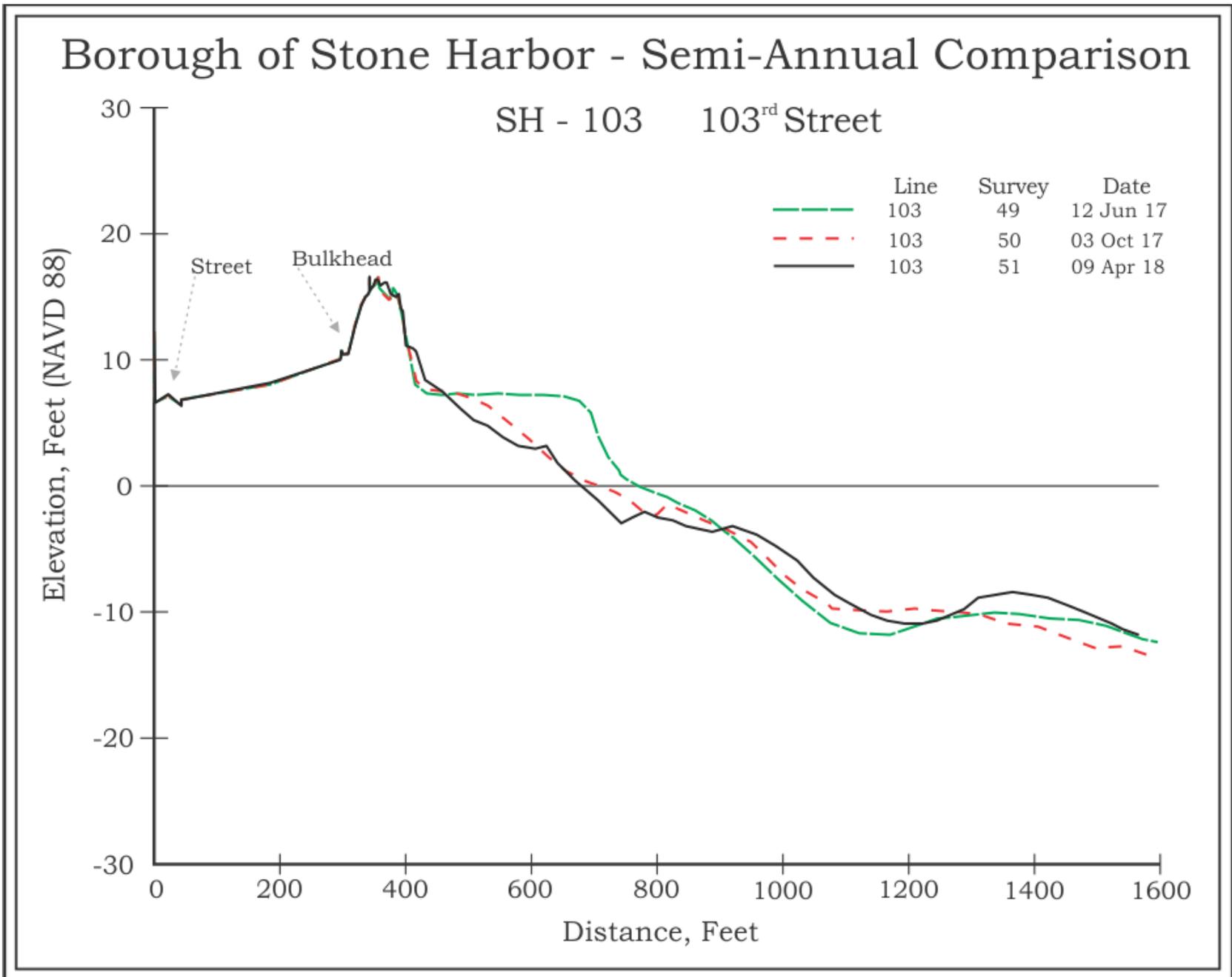


Figure 4. The post-beachfill berm was severely eroded by October 2017 and further pushed landward by April 2018. Offshore sand accumulated as a pair of bars, one close to the beach and one well offshore. The beach sand volume loss was 34.24 yds³/ft. while 18.86 yds³/ft. was added offshore.

SH-108, is located at the end of 108th Street and was placed near the middle of the groin cell. This site shares a history similar to site SH-103. The original 1996 profile crossed the bulkhead and dropped to the rock revetment at the bulkhead toe and a narrow beach just seaward of the rocks provided limited recreational area for beach patrons. Exposure of the rocks accelerated the beach erosion as waves refracted off the hard structure and scoured the sandy beach. Larger storm waves and surge overtopped the revetment and caused local flooding. Sand was placed here during the 1998 municipal beach fill that re-established a dry beach and dune ridge. In 2003, the initial Federal project enhanced the width of both the dune and beach. Post Hurricane Sandy beach fill commenced in 2013 to cover erosion from the previous storms, but the site showed repeated volume losses since the 2013 fill.

Site SH-108 – 108th Street (Photoplates 5a-5b)



Photoplates 5a & b – The photo taken April 10, 2018 is in sharp contrast with those four sites to the north. Here the dune toe was eroded to the fence installation compromising some fence sections. The beach is very flat and much narrower than in June or October 2017.

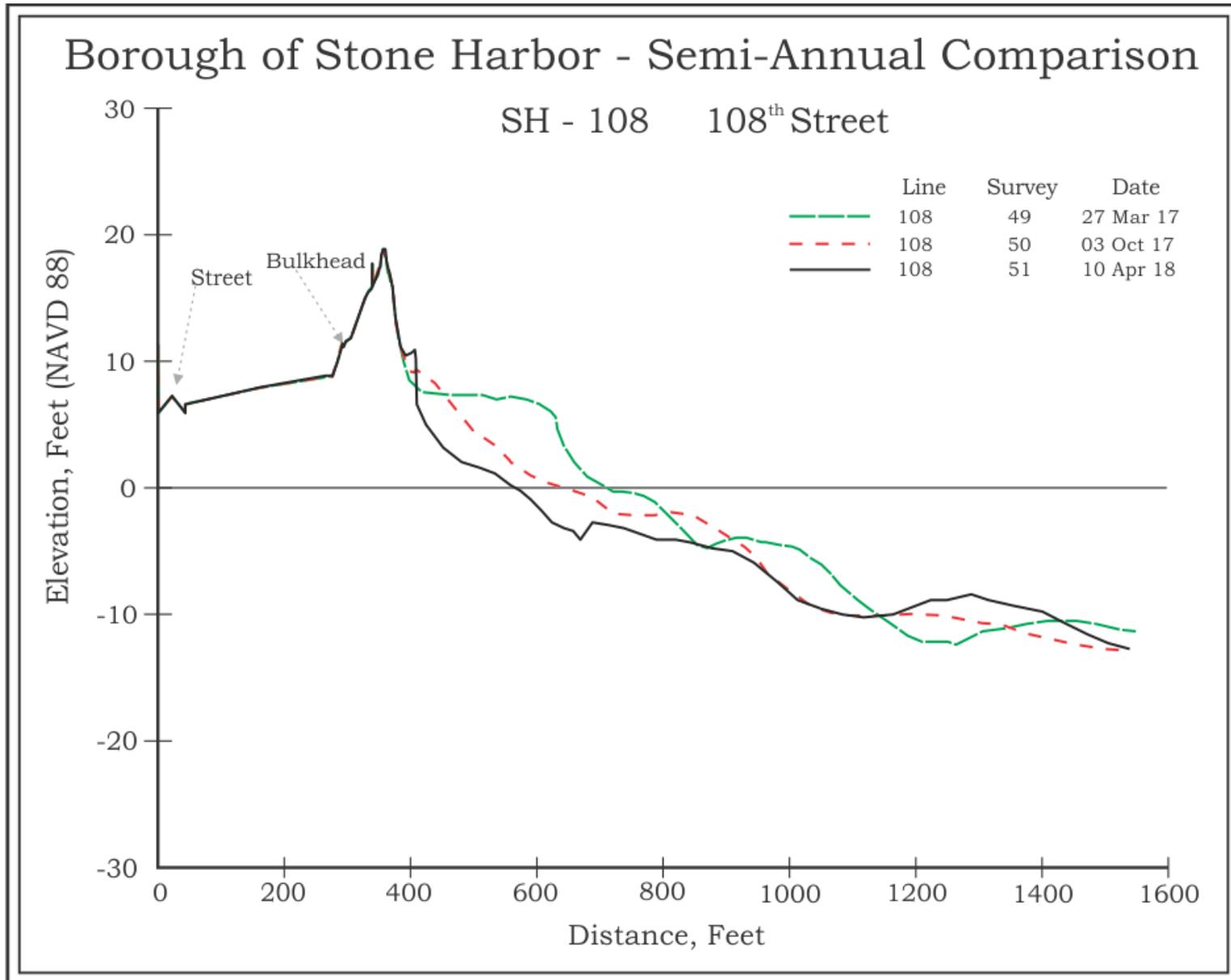


Figure 5. The storm damage was extensive at 108th Street in comparison to those sites to the north. This and 123rd Street cell were the two most heavily impacted by the storms since the beach was repaired. Between March and October 2017, the as-built berm was eroded substantially and sand piled offshore. The total change including the past winter was a beach sand volume loss of 47.89 yds³/ft. while the offshore region lost 28.75 yds³/ft. yielding the 76.74 yds³/ft. in combined losses.

SH-112 is located on the open lot adjacent to the Villa Maria Catholic retreat that occupies the paper location of 112th Street. The profile line extends landward to a reference location along 2nd Avenue. An open grass lot occupies the city block between 2nd Avenue and the wooden bulkhead revetment. The wooden revetment runs parallel to the beach the entire length of the Borough along the oceanfront property lines and seaward street ends. The bulkhead is significantly offset landward at 111th Street, providing additional area for dune development to occur naturally. As a result, the width of the primary dune was nearly 200 feet from the bulkhead to the seaward dune toe. This location has a very significant primary dune largely due to the limited oceanfront development on this parcel. Occupied by the Catholic Church as a retreat for over a century, the site has no structures directly at the landward dune toe. The dunes spill over the bulkhead and occupy most of the original dry beach that existed prior to the USACE project in 2004.

Site SH-112 – 112th Street (Photoplates 6a-6b)



Photoplates 6 a & b - Photos taken April 10, 2018 show that the storms did not reach or damage the dunes at 112th Street. Plant debris did accumulate on the dune toe slope and the beach became narrower.

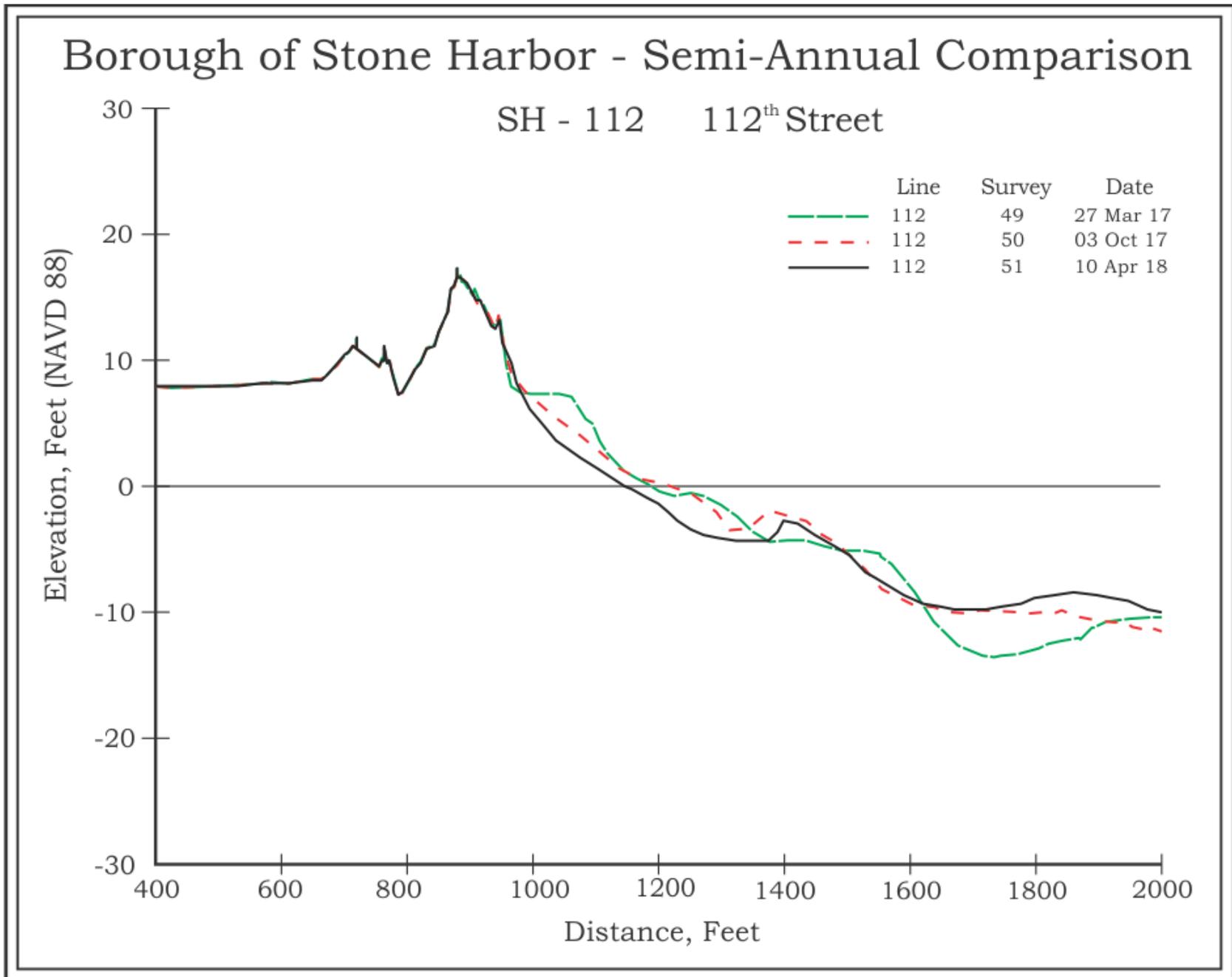


Figure 6. The profiles at 112th Street show the loss of the as-built berm by October 2017 with sand transferred offshore. The winter storms flattened the beach slope into a uniform concave-up curve into the water where offshore bars dominated. The sand loss above the zero datum was 16.06 yds³/ft. while below the datum, the offshore gained 15.82 yds³/ft.

SH-116 is located along the west side of 2nd Avenue and 116th Street. Seaward of the bulkhead at 116th Street is the best-established natural dune system in the Borough. A landward offset in the bulkhead just north of this site produced the area on which this dune developed, sheltered from storm overwash by the 114th Street groin and the bulkhead offset to the west. The dune system consists of two distinct ridges with a combined width of nearly 300 feet from the street end bulkhead to the seaward dune toe with a crest elevation of 16.5 feet NAVD88. This spring, the site was unique along the Stone Harbor oceanfront with a substantial shoreline advance and a positive sand volume change as material was added both to the beach and offshore.

Site SH-116 – 116th Street (Photoplates 7a-7b)



Photoplates 7a & b – Photos taken April 10, 2018 show a wide beach with storm debris up to the dune fencing, but no dune damage. The series of storms moved sand to this location adding to a generally wider beach.

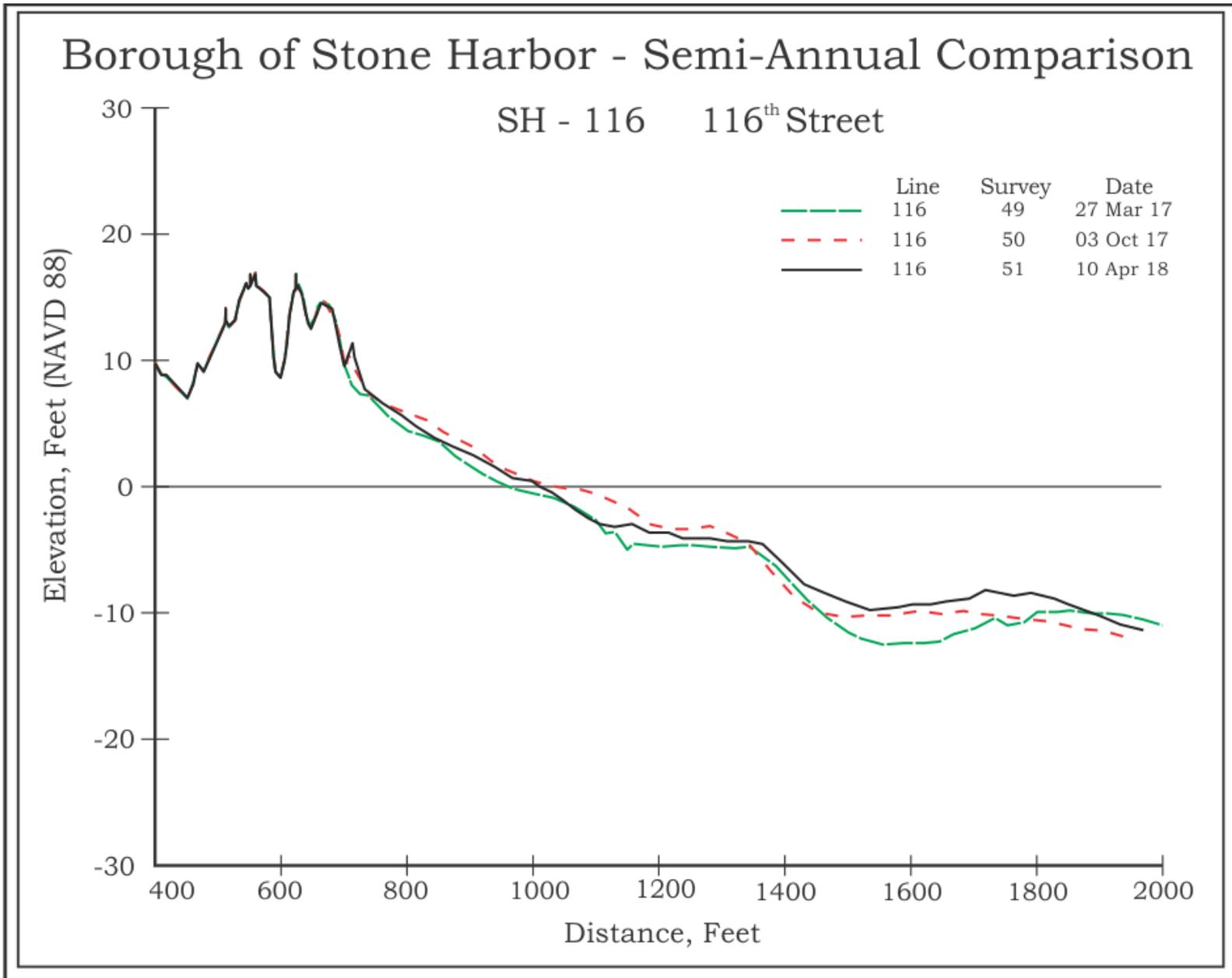


Figure 7. The 116th Street location was the anomaly of the eight sites where the sand gains far exceeded any other location both above and below the datum. Above the datum the beach gained 8.37 yds³/ft. and 45.40 yds³/ft. below zero elevation. The shoreline advanced 49 feet as well indicating specific sand deposition at this site.

SH-123 is located at 123rd Street south of the developed part of town and just north of the terminal groin originally constructed by the Philadelphia District of the U.S. Army Corps of Engineers. In 1994, the site was added to the NJBPN in the expansion of the State's monitoring project and as a replacement cross section for former site #112 that was erased from South Pointe by weather events in 1990 where the entire natural zone south of the terminal groin was eroded to a shoal at and below low tide. Because of this prior history of data collection and its proximity to Hereford Inlet, this site was included in the Borough's beach monitoring project. The profile reference marker is located in a dense stand of bayberry west of a vehicle access path to the Hereford Inlet terminal groin. This site has benefited tremendously since the completion of the initial USACE project both from direct sand placement and from longshore currents that have carried a substantial volume of sand shed from the northern project beaches south toward South Point. The result has been a larger dune system that completely buries the revetment that was once exposed along this beach and the formation of an expansive point that stretches over a mile from the terminal groin into Hereford Inlet. This was the second site of eight to suffer impacts to the dunes during the series of northeast storms between early March and April 2018. The dune toe was cut into a scarp of 3 feet in height removing the wind transported sand that had been added over the summer of 2017.

Site SH-123 – 123rd Street (Photoplate 8a-8b)



Photoplates 8a & b – Photos taken April 10, 2018 showing storm damage to the dune toe where sand was removed and the beach was flattened to the point where high tide reaches the dunes.

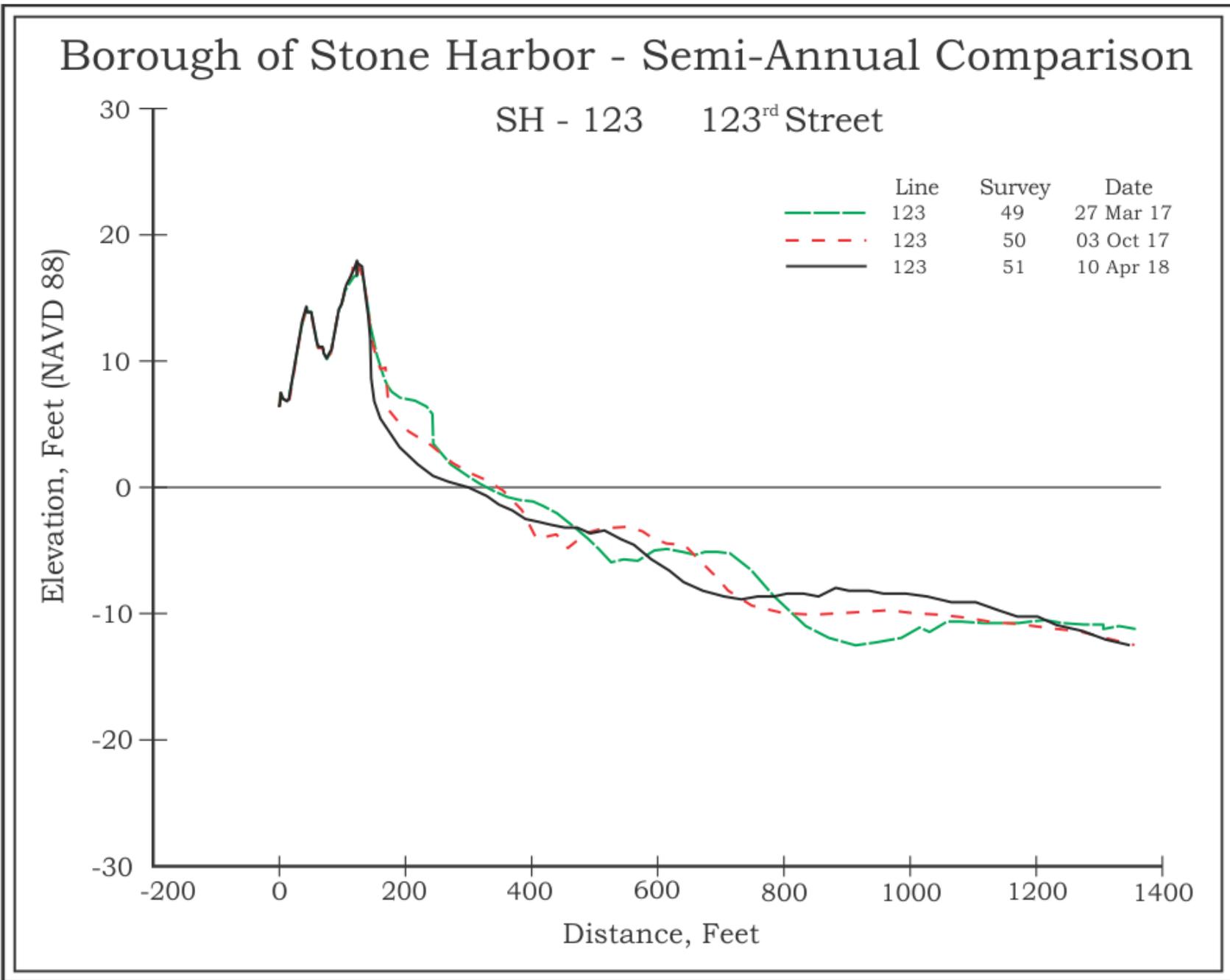


Figure 8. 123rd Street was the second of two where the dune was eroded generating a scarp in the dune toe. The beach was reduced in steps by half in October 2017 and to a concave-up storm beach by April 10, 2018. Sand redistribution removed 19.40 yds³/ft. in sand volume on the beach and took 3.78 yds³/ft. offshore. Bar redistribution was extreme among the three surveys.

Summary

Following the 2016 beach restoration using both Hereford Inlet sand for the southern section and being forced to use Townsend's Inlet sand for the northern segment, the fall season saw one significant hurricane pass the NJ coastline well offshore. Hurricane Jose likely moved the 8.5-foot elevation berm deposited by the USACE work into the nearby offshore region and generated a flatter beach profile. The northeast events concentrated in March into April acted to flatten the profile on the beach from the dune toe in 6 of 8 sites as a uniform sloped surface leading to a pair of offshore bars. The proximal bar is likely to transition back to the beach under low energy wave conditions this summer. The distant bar has never been documented to migrate landward and add to the beach sand volume in Stone Harbor. The tidal currents/littoral current combine to keep the trough over 10 feet deep and prevent sand in the bar from moving landward with sufficient speed to reach the beach before the first fall storm rebuilds the sandbar position 400 to 500 feet from the water's edge. In addition, the further the bar is from the beach and the deeper the trough between the bar and the beach, the larger and more frequent waves need to be from distant storms (hurricanes) that produce those great surfing swells so eagerly anticipated by the surfers. The longer the wave period (mean in NJ is 6-8 seconds), the greater the sand transporting power is contained in each breaking wave, so the bar moves landward much faster during big swell events.

The actual winter storm sand loss was surprisingly small at 6,200 cubic yards across the entire Stone Harbor oceanfront. This was due to massive accumulation at the 116th Street beach cell and a pair of smaller similar accumulations at the 90th and 95th Street beach cells. Big losses occurred at the 108th Street cell and a pair of lesser losses occurred at the 82nd Street and 103rd Street cells. Loss was balanced with gain within the extent of the Stone Harbor oceanfront, but sand definitely shifted from the beach to the offshore regions due to both Hurricane Jose and the multiple northeasters this March and April. Recalculating each cross section for the sand volume summary above the zero elevation datum versus the volume change offshore is found below.

BEACH LOSS VOLUME ACROSS STONE HARBOR = -237,451 CUBIC YARDS

OFFSHORE VOLUME GAIN ACROSS STONE HARBOR = 292,147 CUBIC YARDS

The two distinct zones of sand residence on Stone Harbor's shoreline could not be more indicative of storm transfer across the shoreline between the beach and the offshore region. This examination of the data confirms why the net volume change was positive for the March or June 2017 survey data close to when the beach restoration was completed and after the multiple storm events. The difference between the offshore deposition and the beach erosion was 54,696 cubic yards of added sediment likely derived from the southern beaches of Avalon.

There will be interest in how much of the offshore material finds its way back onto the subaerial beach this coming summer.