

# STOCKTON UNIVERSITY COASTAL RESEARCH CENTER



*Hereford Inlet, Cape May County, March 10, 1991, seven years prior to the initial NJ State and municipally funded beach restoration. Bird habitat consisted of four large intertidal shoals situated between the 123rd Street groin in Stone Harbor and the rock revetment protecting North Wildwood. 25 years and 4.8 million cubic yards of beach restoration later, nesting habitat had expanded into a 7,500 foot long spit extending to a point south of the third shoal in the photo.*

## An Analysis of Thirty Years' Study of Sand Redistribution and Shoreline Changes in New Jersey's Four Coastal Counties Raritan Bay, the Atlantic Ocean Coast, and Delaware Bay Fall 1986 Through Fall 2016

### ***VOLUME 2 of 4 OCEAN COUNTY***

Prepared for:  
New Jersey Department of Environmental Protection  
Division of Coastal Engineering  
1510 Hooper Avenue, Toms River, New Jersey 08753

Prepared by:  
Stockton University Coastal Research Center  
30 Wilson Avenue, Port Republic, NJ 08241

July 31, 2017

Stockton University  
Coastal Research Center



An Analysis of Thirty Years' Study of  
Sand Redistribution and Shoreline  
Changes in New Jersey's Four Coastal  
Counties  
Raritan Bay, the Atlantic Ocean Coast,  
and Delaware Bay

***VOLUME 2 of 4    OCEAN COUNTY***

Prepared by:  
Dr. Stewart C. Farrell  
Kim McKenna, Steven Hafner,  
Brad Smith, Crist Robine, Holly Pimpinelli  
Nick DiCosmo, Christie Tracey, Irina Beal  
Alex Ferencz, Marcus Gruver, and Mat Suran

July 31, 2017

# TABLE OF CONTENTS

## VOLUME 2: OCEAN COUNTY

Figure 218. Map of Ocean County Beach Profile Site Locations	238
Ocean County Summary	239
Individual Profile Site Descriptions	239
Graphical Presentations and Photographs of Each Site (Figures 219 – 387)	242
Summary & Conclusions	409
Figure 388. Summary of Cumulative Shoreline and Sand Volume Changes	410
<b>Tables 5 – 6. Tabulated Volume and Shoreline Change Data for Ocean County (Volume 4)</b>	<b>679</b>



# New Jersey Beach Profile Network

## Ocean County

Manasquan Inlet  
to Little Egg Inlet

NJBPN Profile #'s  
156 - 234

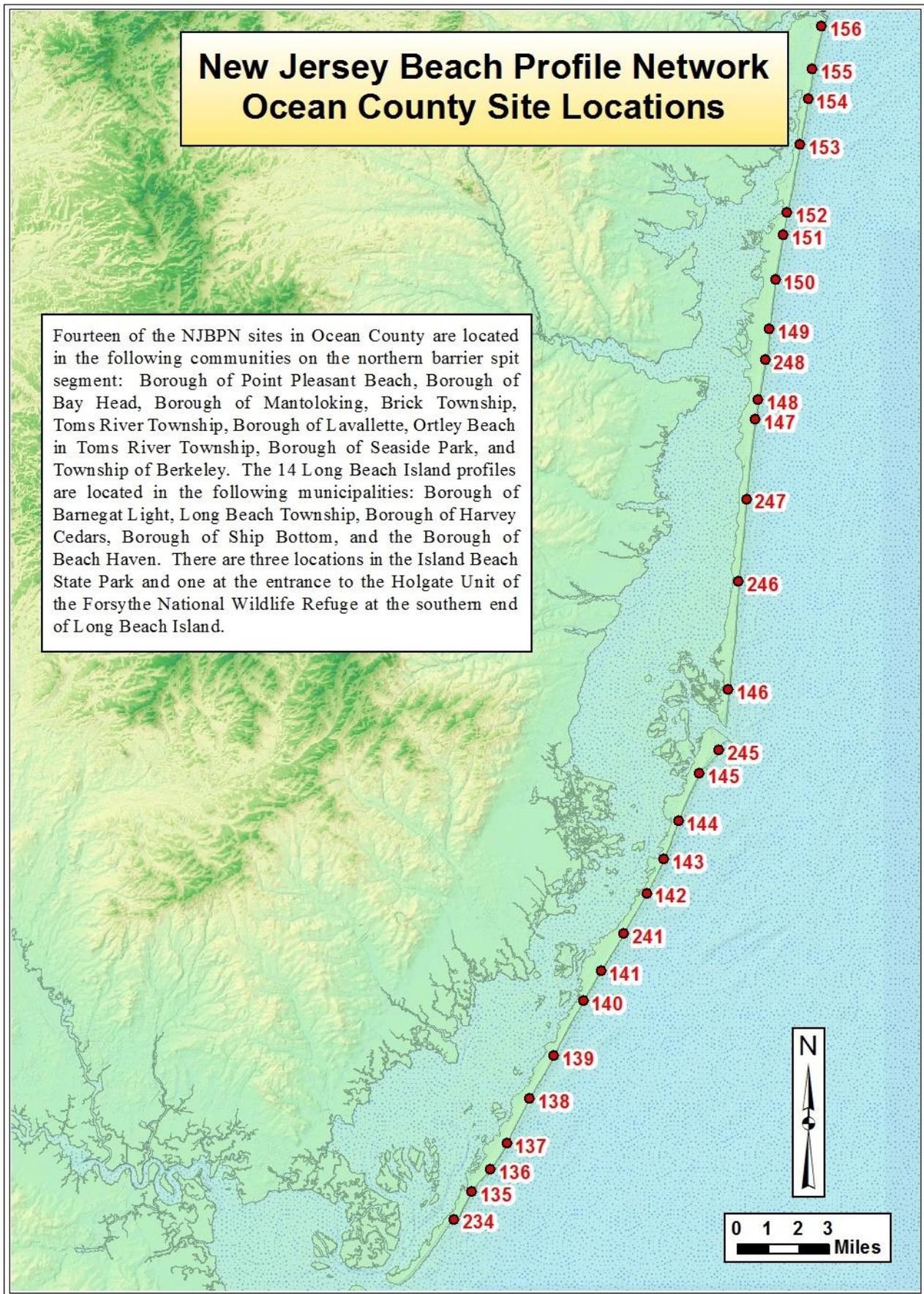


Figure 218. Locations of the 28 NJBPN profile sites in Ocean County, NJ. Two extensive shoreline reaches represent Ocean County with the northern spit extending to Barnegat Inlet, across which lies Long Beach Island, the northernmost barrier island on the NJ coastline.

## Ocean County Summary

The Ocean County Atlantic Ocean shoreline is the longest of the four coastal counties (45.2 mi) and is bounded by Manasquan Inlet to the north and Little Egg Inlet to the south. The northern section comprises 23.6 mi and Long Beach Island makes up 21.6 mi. There is a total of 13.4 mi of undeveloped shoreline in two large parcels (Island Beach State Park – 10.0 mi and Holgate – 3.4 mi). Barnegat Inlet divides the Northern Ocean County section from Long Beach Island.

The northern Ocean County shoreline is unique to the New Jersey coast in that it lies within a zone where sand transport parallel to the shoreline is essentially zero over long periods of time. The absence of inlets along this segment of shoreline also means fewer zones where tidal currents interact with waves that can alter shoreline orientation and stability. Northeast storms move sand south along the northern Ocean County shoreline, but these impacts are nearly balanced by southeast waves that move the sand back to the north in near equal quantities. Therefore, for most of this section of the coast, over long periods of time the net transport in either direction is zero.

### Individual Profile Site Descriptions

#### **Point Pleasant Beach, Water Street and Maryland Avenue, #156 and #155**

The recreational beach at Water Street has no dune due to local custom and high volume beach use in season. The Maryland Avenue location has had a long-established dune of about 16 feet. Dry beach widths remained stable over the past 18-months at these sites, maintained through the natural migration of sand from areas to the south.

#### **Bay Head, Johnson Avenue, #154**

The rock revetment that was installed after the 1962 NE storm was extended south into Mantoloking to Lyman Avenue at individual property owner expense. Sand recovered from Hurricane Sandy overwash deposits was placed on the revetment and beach after the storm. The site has had an erratic history of shoreline stability. Some residents are opposing the federal shore protection project dune because they feel that the presence of the rock revetment is sufficient storm protection.

#### **Mantoloking, 1117 Ocean Avenue, #153**

The steel vertical sheet-pile wall was installed here in 2014 and has been exposed to wave action by even modest storms. Completed at top elevation of 16.0 feet NAVD 88, this wall was initially buried in recovery sand making up a “dune” containing the wall as a core. This was promoted as a final line of defense for protecting NJ State highway 35. The new structure survived its first winter, but even minor storms exposed the wall for hundreds of feet. The January 23, 2016 northeaster exposed 85% of the wall’s length leaving between 6 and 22 ft of vertical surface exposed above either a wet beach at low tide or a sand surface below the elevation of low tide. The second winter was less intense in terms of storms, so wall exposure was more limited to heights between 4 and 8 ft across 45% of its length.

#### **Brick Township, Public Beach #3, #152**

The steel wall extends south past this site. It was exposed after the January 2016 northeast storm, Jonas, but not at the amount measured in Mantoloking. The wall was covered with sand again in spring 2016. The site has shown slight recovery but has not reached pre-Sandy conditions.

#### **Toms River Township (Normandy Beach, Ortley Beach), 1<sup>st</sup> Avenue and 8<sup>th</sup> Avenue; #151 and #149**

Overwash, dune loss and extensive structural damage occurred along this segment of northern Ocean County during Hurricane Sandy. Ortley Beach was particularly hard hit. No tidal inlet breach occurred, but overwash damaged many homes as well as the dune and beach. Overwashed sand was brought back to recreate the former dune and sand migrated back to the shoreline from Sandy-generated deposits offshore. Both sites are in

desperate need of sand to provide protection to landward properties, because the 2016 January northeaster came close to inflicting additional property damage.

**Lavallette, White Avenue #150**

The post-Sandy dune reaches nearly 23 ft, but is less than 100 ft at its base. The profile has had swings in shoreline position and volume change over time.

**Seaside Heights, Franklin Avenue #248**

There is no dune at this heavily used beach that fronts a popular boardwalk. Local infrastructure that was damaged by Hurricane Sandy has been repaired. The 2016 shoreline position is at a greater distance seaward than what was measured at the initial profile first established in 2009.

**Seaside Park, 4<sup>th</sup> Avenue; #148**

This location has had dune growth over time. Hurricane Sandy eroded the seaward slope, but the volumes have increased since 1986.

**Midway Beach (Berkeley Township), 6<sup>th</sup> Avenue #147**

The dune here was wide and high (due to local efforts) enough during Hurricane Sandy and protected the landward structures from storm surge. While there have been volumetric gains, the shoreline is still 20 ft landward of its 1986 position.

**Island Beach State Park, Sites #247, #246, and #146**

Since the passage of Hurricane Sandy, there have been general volume losses at the two northern park locations. The southernmost location had continuous gains since 1994, but lost volume between 2015 and 2016.

**Barnegat Light Borough, 10<sup>th</sup> Street and 26<sup>th</sup> Street #245 and #145**

The 10th Street location had major advancements for 10 years following the completion of the jetty work at Barnegat Inlet but has fluctuated since. The 26<sup>th</sup> Street location has had steady gains since 1993.

**Long Beach Township (Loveladies), La Baia Street #144**

The Loveladies site was added to the federal shore protection program during the summer of 2016. Prior to that time, the location had suffered episodic volume losses but benefitted from the beach fill that took place to the south.

**Harvey Cedars, 73<sup>rd</sup> Street and Tranquility Drive #143 and #142**

Both of the Harvey Cedars locations are included in the federal shore protection project and were restored to the design template following Hurricane Sandy. Recent storms have initiated a follow-up fill at site 142 in 2016.

**Surf City, 20<sup>th</sup> Street, #241**

The Surf City location was the site of the first part of the LBI federal project in 2007. The project was restored to design specifications in 2013. Since then, the berm has responded to seasonal and storm wave conditions.

**Ship Bottom, 8<sup>th</sup> Street, #141**

This site is included in the federal shore protection project and was restored in 2015. This site has shown gradual gains since 2012.

**Long Beach Township (Brant Beach, 32<sup>nd</sup> St. #140; Beach Haven Crest, 81<sup>st</sup> St #139; Spray Beach, Old Whaling Rd #138)**

All of these Long Beach Township sites are included in the federal shore protection project and were sites of post-storm restoration (Brant Beach) or were the recipients of new sand in 2015 or 2016.

### **Beach Haven (Taylor Ave #137 and Dolphin Ave #136); Long Beach Township (Webster Ave #135)**

All of the Beach Haven and Long Beach Township-Holgate locations are included in the federal shore protection project. The project commenced here in 2015 and an engineered dune and berm had been completed by 2016.

### **Long Beach Township (Holgate natural site at boundary with Forsythe NWR #234)**

This natural site has had wide swings in shoreline position and beach volume with changes brought about by storms. Overwash occurred here during Hurricanes Irene (2011) and Sandy (2012). Since beach fill commencement in Beach Haven and in Holgate, the site has shown tremendous gains in volume and seaward shoreline position.

## **INSTRUCTIONS FOR USING THE GRAPHICAL ILLUSTRATIONS PROVIDING INFORMATION ON EACH OF THE 107 NEW JERSEY COASTAL SITES DEVELOPED SINCE 1986 (OR A MORE RECENT ESTABLISHMENT DATE)**

1. The initial page for each survey location is a full-page photograph showing the beach condition as it existed during the fall survey season of 2016.
2. The second page is a pair of beach photographs showing the comparison from the fall survey season of 2015 with the corresponding view taken during the survey season completed in the fall of 2016 with descriptive comments below the two photographs.
3. The third page is the cross section plot for the site showing the most recent four surveys dating from spring 2015, fall 2015, spring 2016 and fall 2016 accompanied with a text description of pertinent changes to the dune, beach or offshore segment.
4. The fourth page is a shoreline position and sand volume trend analysis showing each fall survey since the profile was established in 1986 or a later date for some sites. The bars represent annual shoreline position changes and sand volume gain or loss combined with a pair of lines showing the cumulative effect of the annual change data. Major projects always appear the year they are constructed and subsequent years of change that follow.
5. The fifth page is a presentation of all profile surveys at the specific site color-coded by date of survey. Initial surveys are plotted in blue, shifting green, then yellow, finally to orange and red colors for the most recent years. The plots show the evolution of the profiles over the complete 30-years of measured data, with the ability to see the dramatic impact of major beach restoration efforts as a significant alteration to the pattern. Colors progressing from blue to red in the seaward direction indicate an accretional pattern and colors progressing from blue to red in the landward direction indicate an erosional pattern. The thick black line displays the mean profile shape, which is calculated by taking the average of all measured profiles from each site.
6. The sixth and final page shows a pair of aerial photographs paired with a cross-section plot of the site. The aerial photographs are composed of a historical aerial from around the year 1995 and a more recent aerial from around the year 2015 (exact years are indicated on the plot). The cross-section plot displays the profile view of the site from the same years as displayed in the aerial photographs and both the plots and aerials are set to the same distance scale. This figure shows the change over time at each profile site as presented by an aerial image comparison and a cross-sectional comparison. Combining these two different means of data presentation allows for changes in topographic features, vertical elevations, and shoreline positions to be displayed simultaneously in the same figure.

**NJBPN 156 - Water Street, Point Pleasant Beach (December 21, 2016)**



**Figure 219. View to the north from the backshore at Water Street in Point Pleasant Beach. The en eschelon rows of sand fence could be the locus of a dune along this section of beach. Any dune over 4 ft high would have prevented the overwash that was experienced during Hurricane Sandy.**

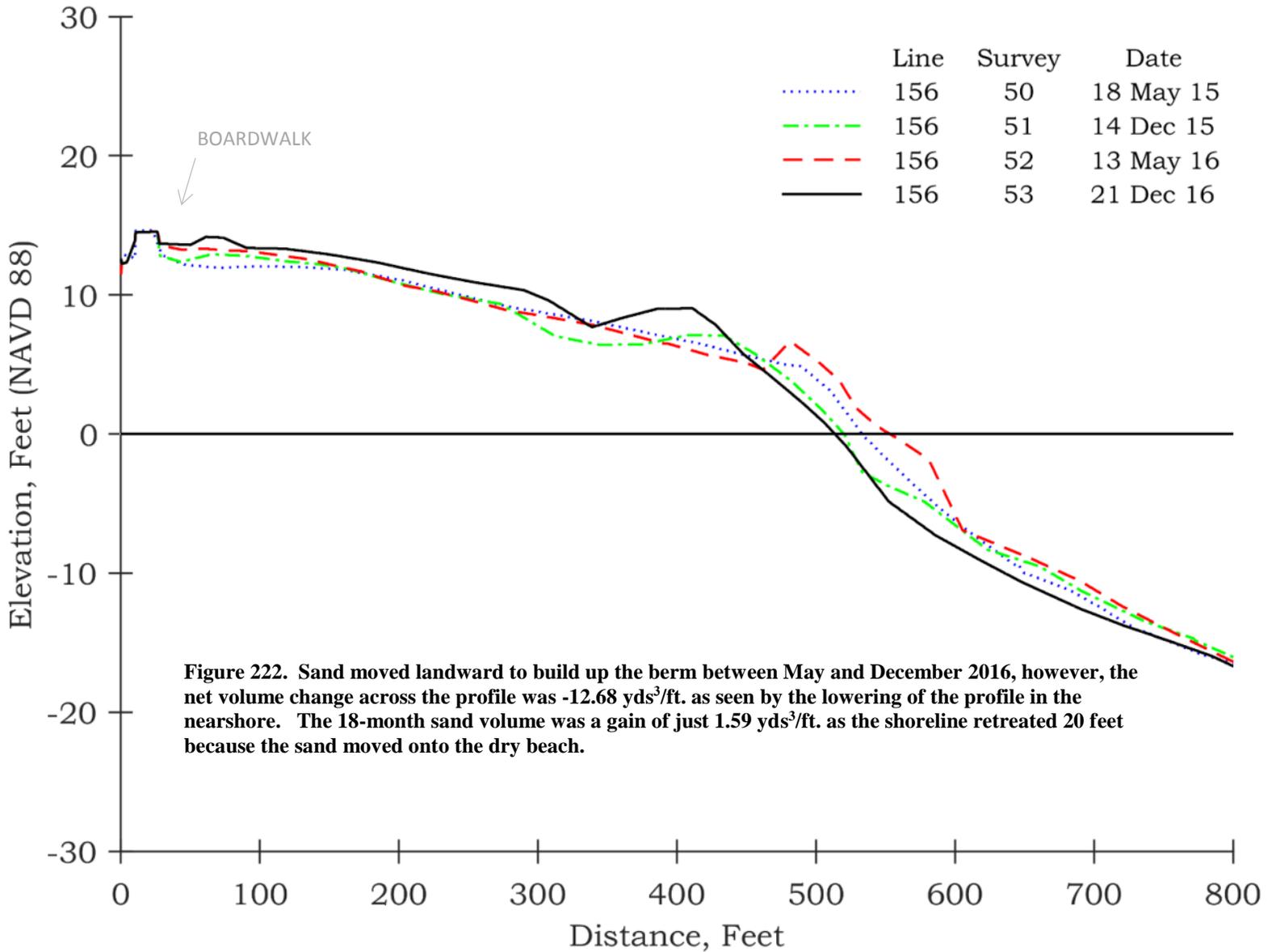
**NJBPN 156 – Water Street, Point Pleasant Beach**



**Figure 220a & 221b. The Water Street site is located toward the south end of the Point Pleasant Beach boardwalk. The photo on the left (taken December 14, 2015) shows the backshore as a result of local efforts in maintaining the dry beach. The photo on the right (taken December 21, 2016) shows a similar backshore to 2015. This beach is included in the proposed federal shore protection project (Manasquan Inlet to Barnegat Inlet).**

# New Jersey Beach Profile Network

## #156 - Water Street, Point Pleasant, Ocean County



**Figure 222.** Sand moved landward to build up the berm between May and December 2016, however, the net volume change across the profile was -12.68 yds<sup>3</sup>/ft. as seen by the lowering of the profile in the nearshore. The 18-month sand volume was a gain of just 1.59 yds<sup>3</sup>/ft. as the shoreline retreated 20 feet because the sand moved onto the dry beach.

### 30-Year Coastal Changes at Site 156, Water Street, Point Pleasant, Ocean Co.

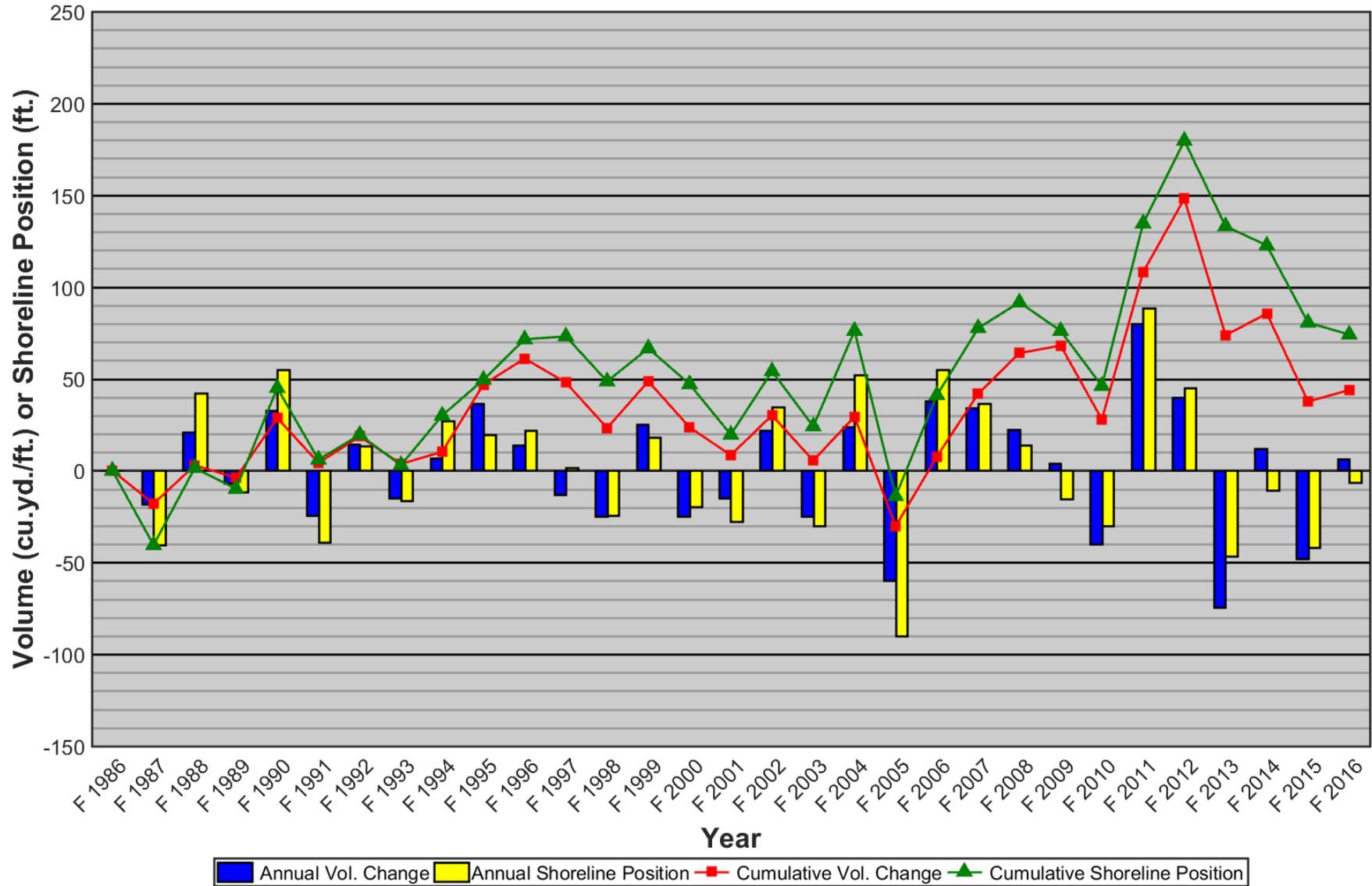


Figure 223. The trends at this beach are a compilation of littoral transport where northeast events tend to remove sand while southeast periods of wave activity tend to build sand supplies as they are trapped by the Manasquan Inlet jetties. There were sand volume and shoreline gains in the mid-to late 1990s and again from Hurricanes Irene and Sandy. More common are northeasters that tend to drive sand south into Bay Head.

### 30-Year Ensemble Mean Profile at Site 156, Water Street, Point Pleasant, Ocean Co.

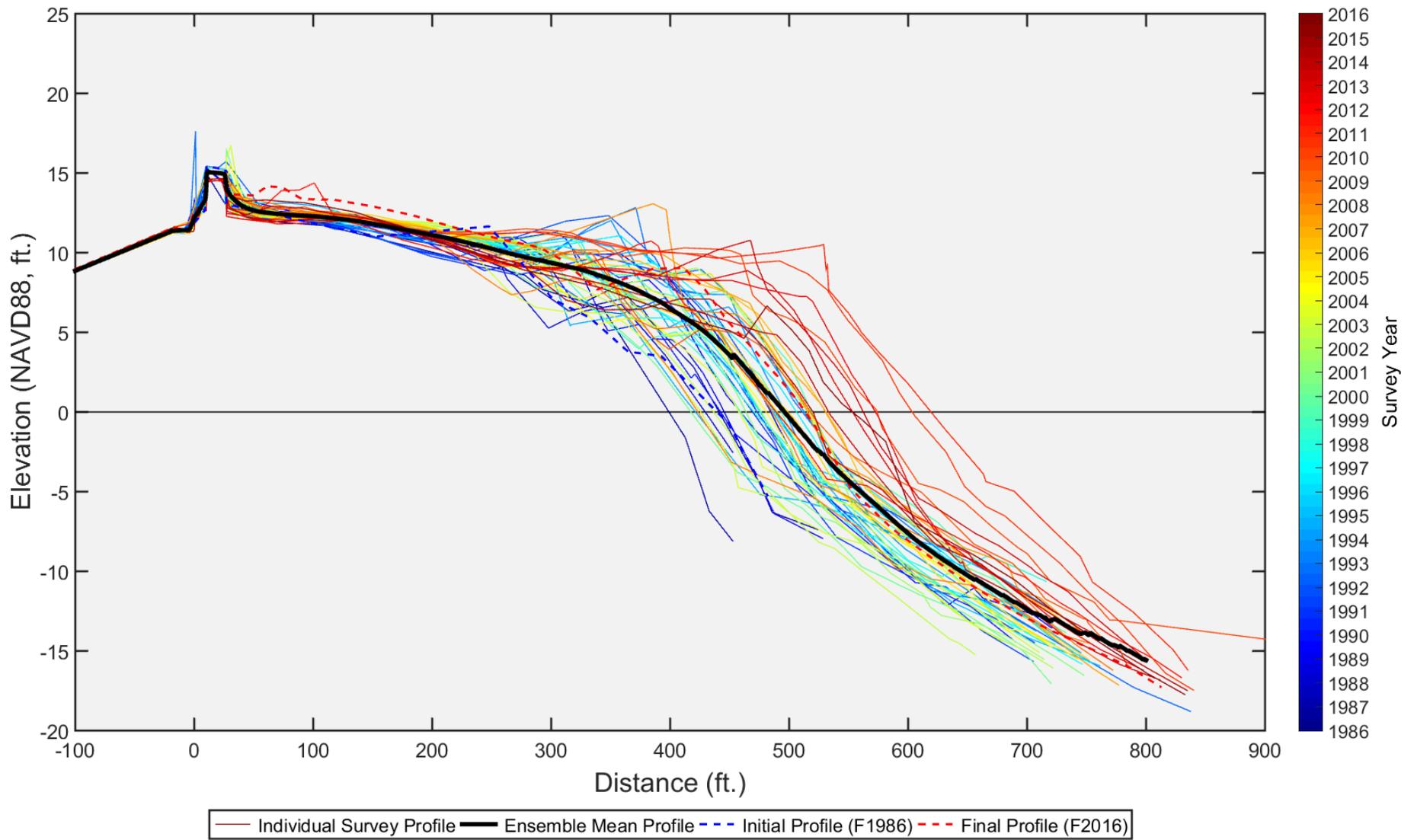


Figure 224. The profile measurements over the 30-year span show recent (mid-2000s) sand volume increases at the seaward extent of the beach.

#156 - Water Street, Point Pleasant Beach Borough, Ocean County  
**Comparison of 1995 to 2015**

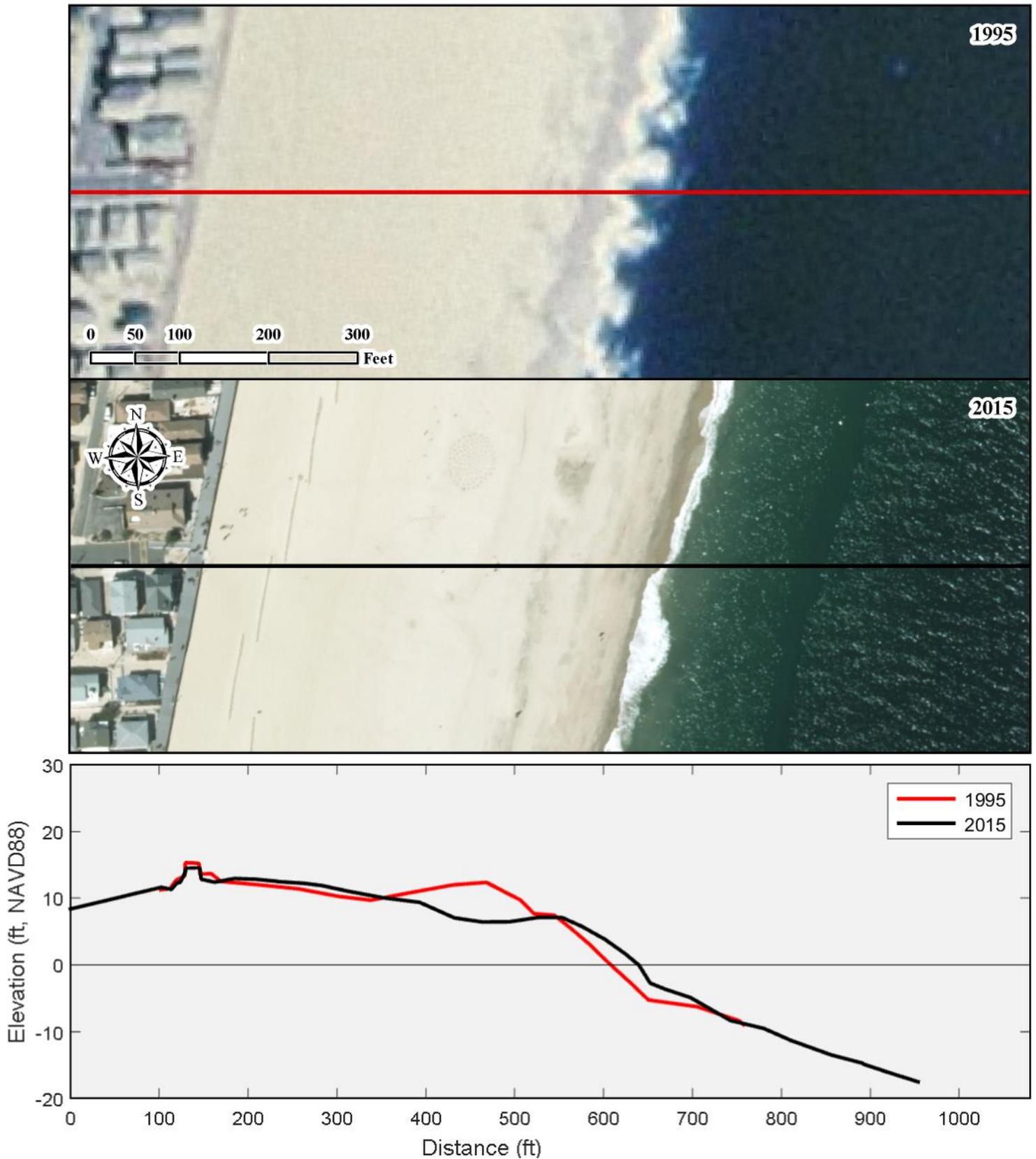
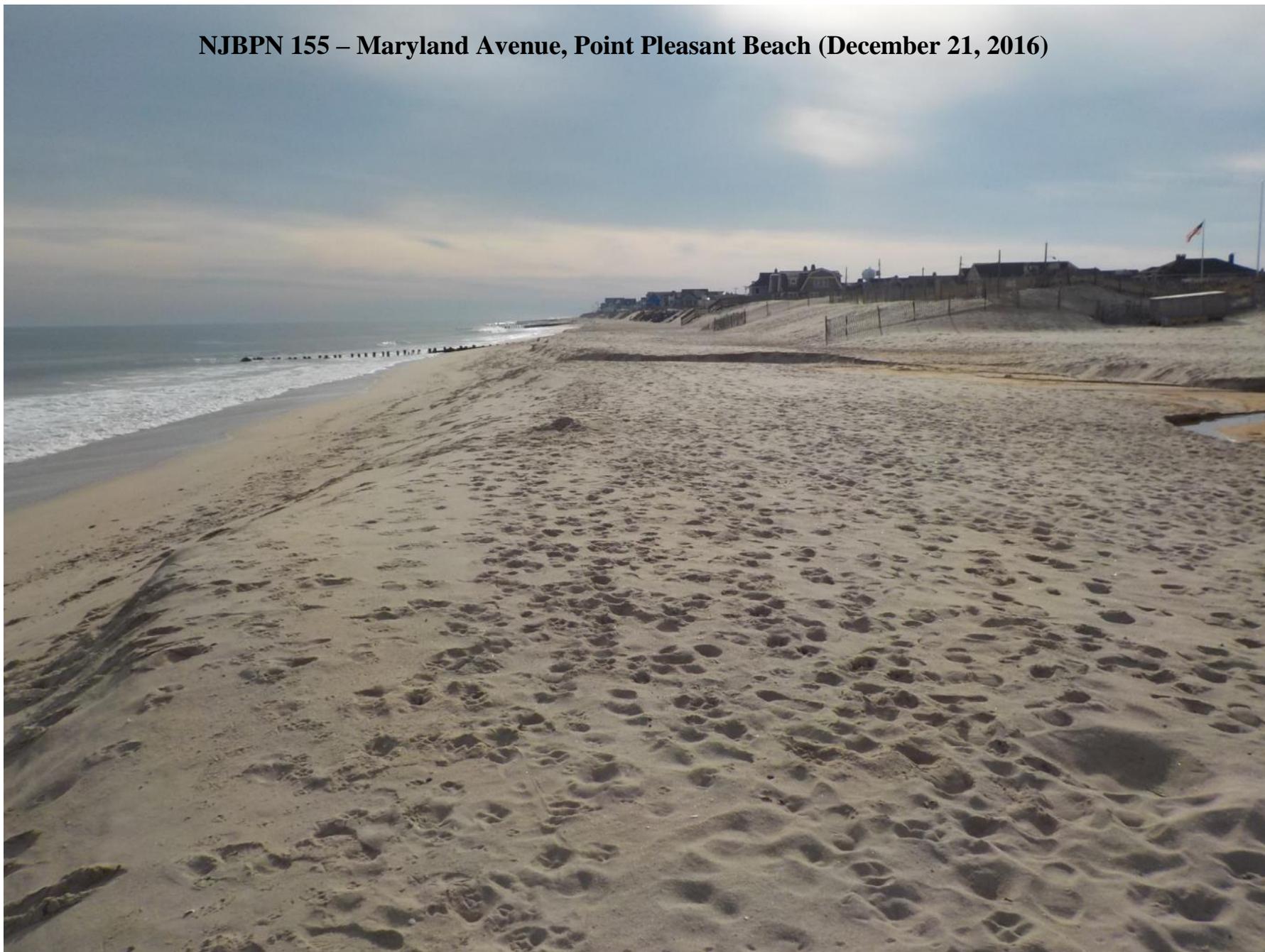


Figure 225. No sand was placed at this location during the study period, though the shoreline moved 31 feet seaward. This is due to the location of the profile with respect to the Manasquan Inlet jetties

**NJBPN 155 – Maryland Avenue, Point Pleasant Beach (December 21, 2016)**



**Figure 226. View to the south from the top of the berm at Maryland Avenue in Point Pleasant Beach showing the restored dune and timber groin structure on the beach**

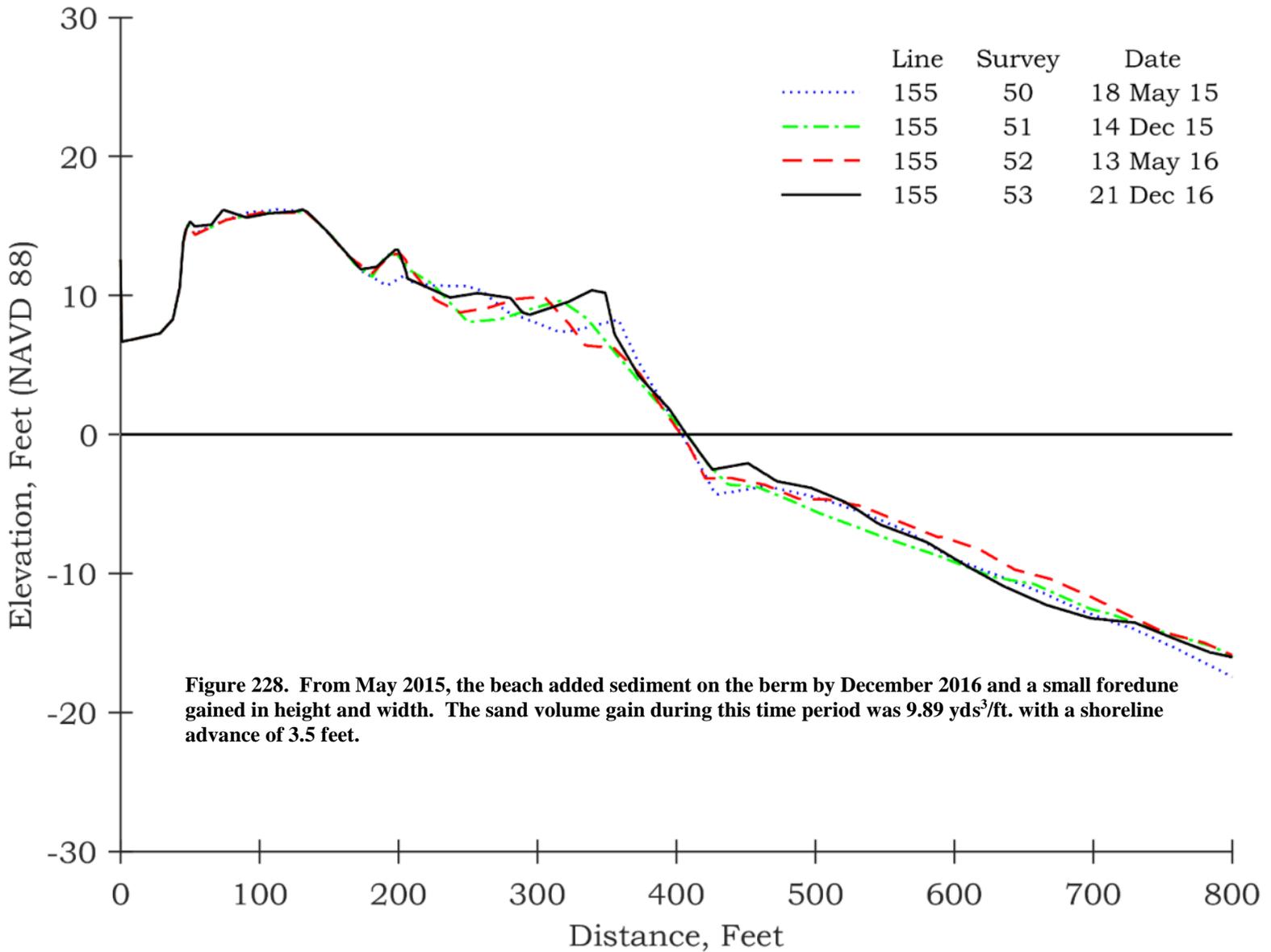
**NJBPN 155 – Maryland Avenue, Point Pleasant Beach**



**Figure 227a & 227b. The Maryland Avenue profile is located over a mile south of Manasquan Inlet. The photos (left taken December 14, 2015 and right taken December 21, 2016) show a maintained beach. Installation of sand fencing seaward of existing fence is a local effort to capture wind-blown sand. The stormwater discharge station from Sea Avenue is evident on the right photograph, but not so visible on the left.**

# New Jersey Beach Profile Network

#155 - Maryland Avenue, Point Pleasant, Ocean County



### 30-Year Coastal Changes at Site 155, Maryland Avenue, Point Pleasant, Ocean Co.

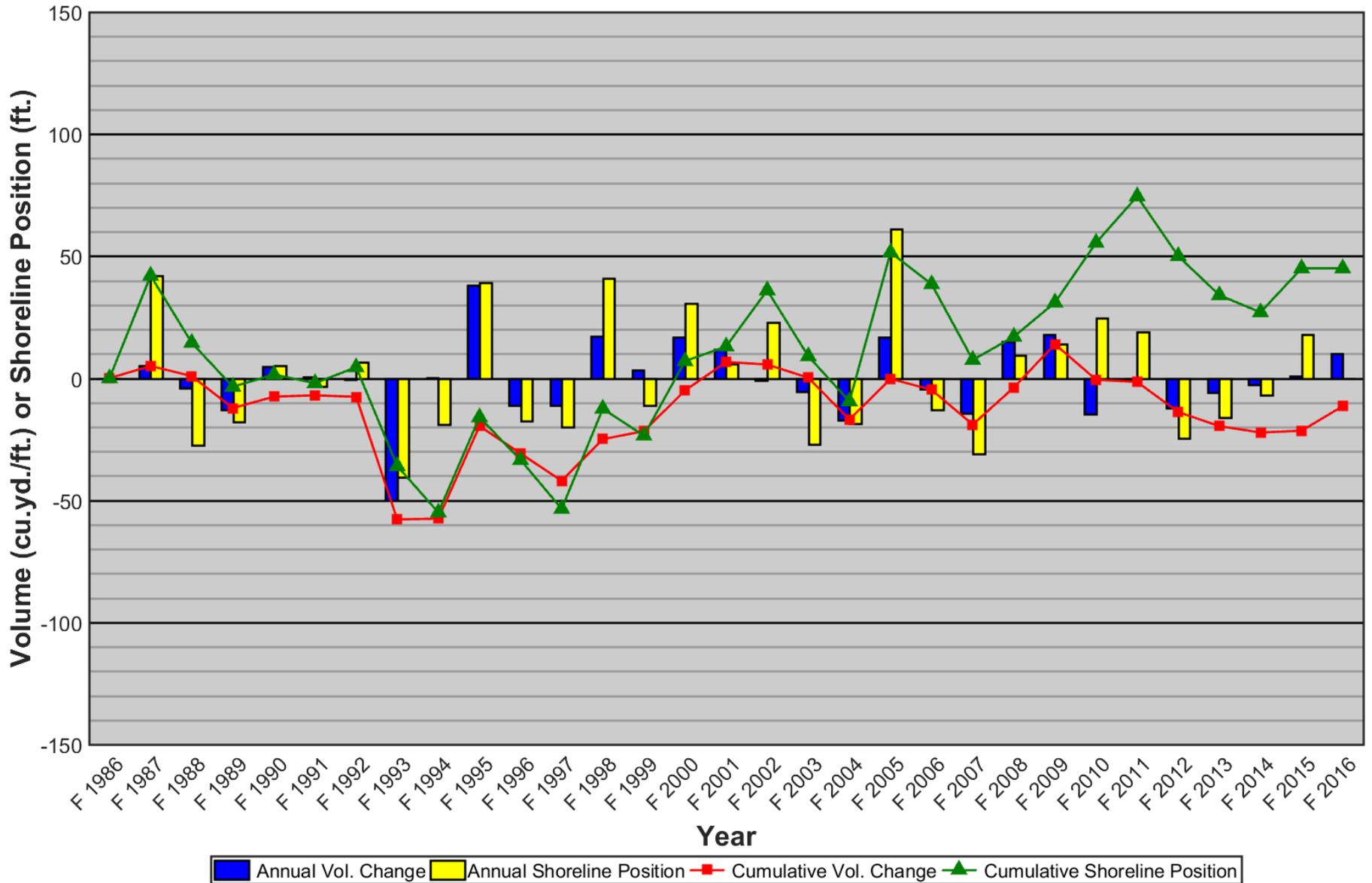
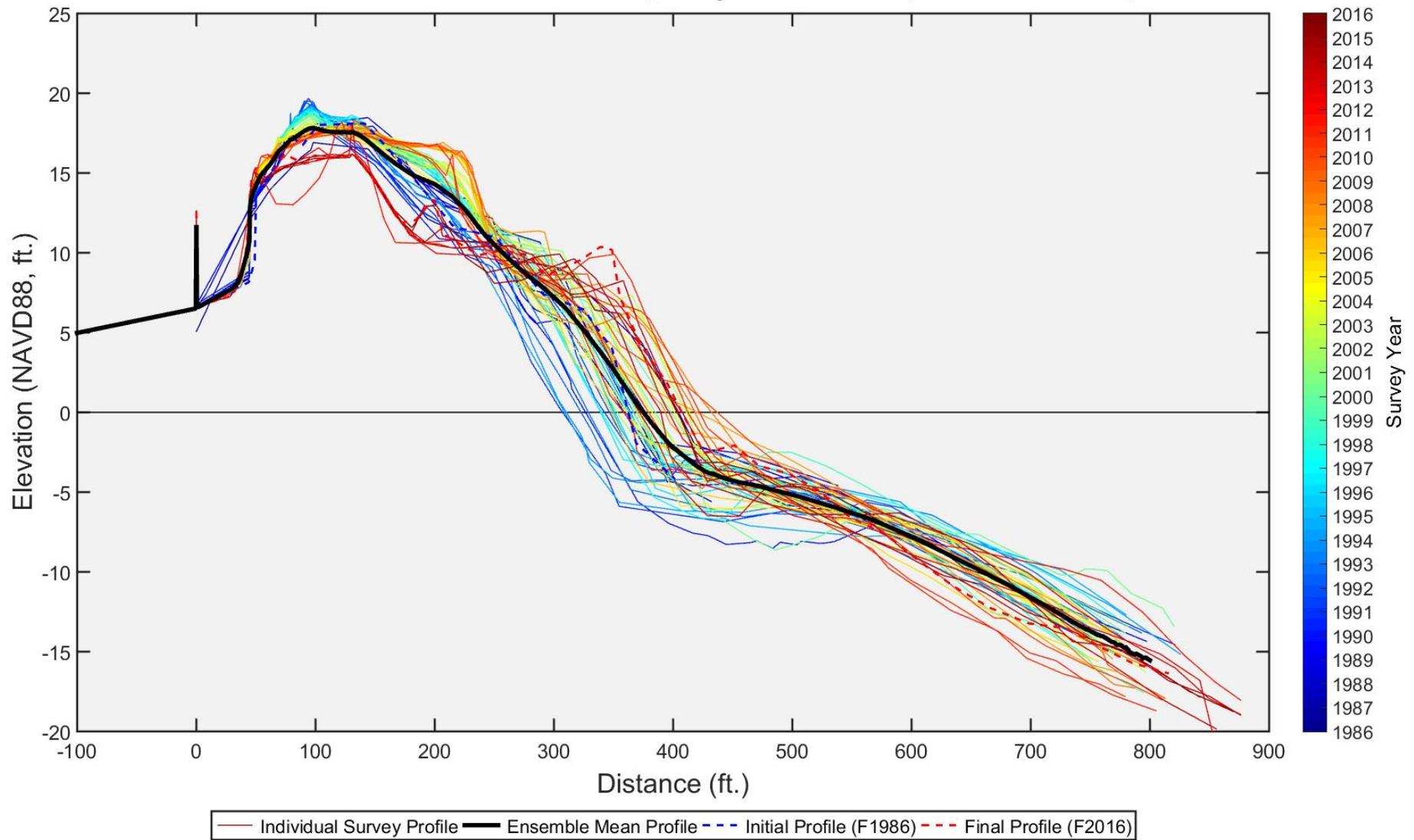


Figure 229. This site rebounded from a prolonged mid-1990's decline in both sand volume and shoreline position. Hurricane Sandy took a toll that continued into 2013 and 2014 before rebounding in 2015. No sand was added other than that returned to the beach from having been washed inland by Sandy. Note that the sand volume declined while the shoreline advanced.

### 30-Year Ensemble Mean Profile at Site 155, Maryland Avenue, Point Pleasant, Ocean Co.



**Figure 230.** The Maryland Avenue profile has a decent dune that is lower in elevation from its 1986 position. The site is adjacent to a low elevation pedestrian accessway from Maryland Avenue that was exploited by Hurricane Sandy and generated a sizable breach in the dunes. Since then, the dune has recovered, though not to pre-Sandy conditions. The beach has grown slightly wider since the Hurricane.

#155 - Maryland Avenue, Point Pleasant Beach Borough, Ocean County  
**Comparison of 1995 to 2015**

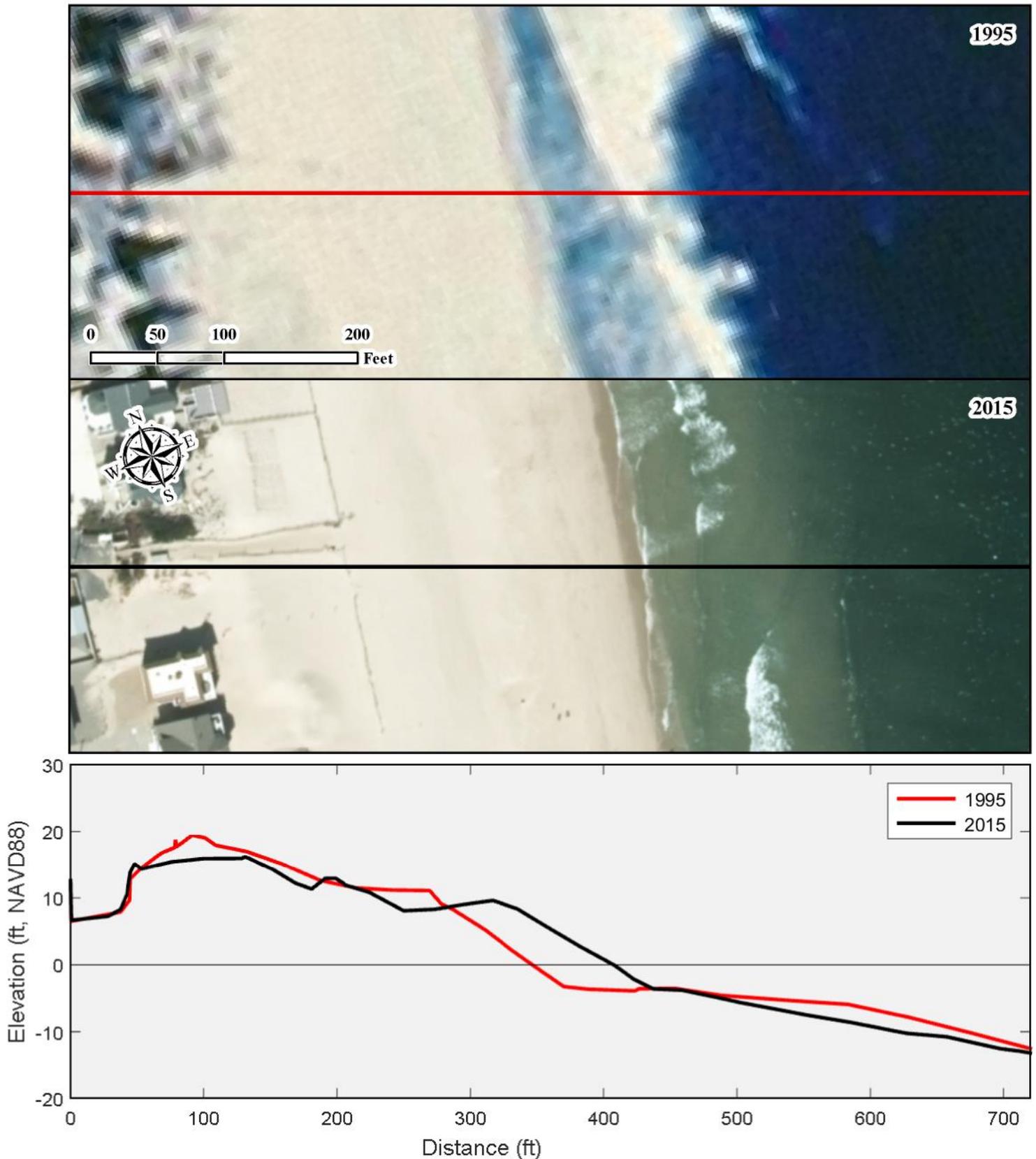


Figure 231. The dune and berm were lowered after the passage of Hurricane Sandy. Even though the beach topography was flattened, the shoreline moved seaward by 61 feet from its 1995 position.

**NJBPN 154 – Johnson Avenue, Bay Head (December 22, 2016)**



**Figure 232. View to the north from the berm break at Johnson Avenue in Bay Head. The rock revetment was exposed following the January 23, 2016 northeaster (Jonas). Here, the berm was eroded into a steep slope with waves reaching its base.**

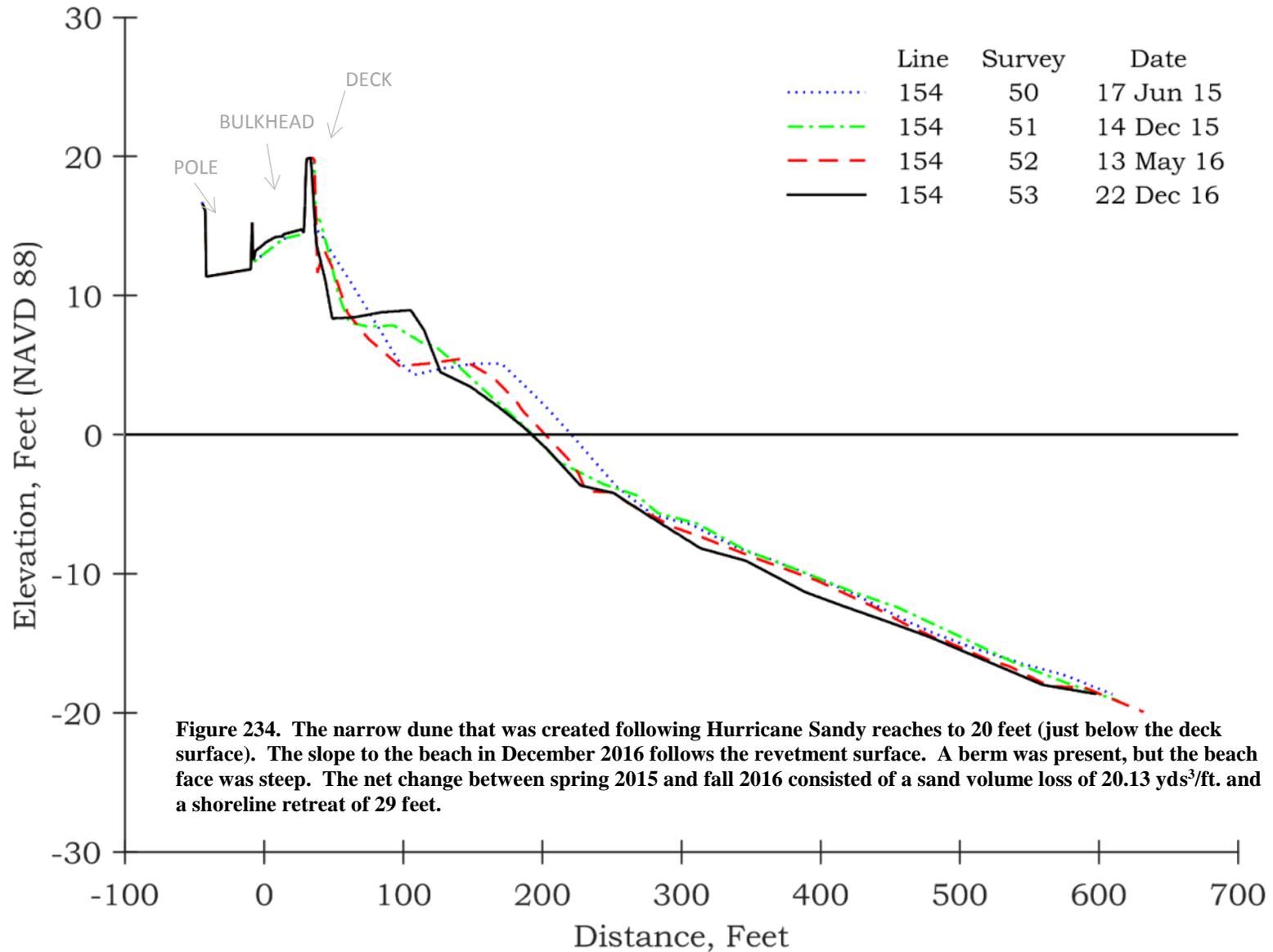
**NJBPN 154 – Johnson Avenue, Bay Head**



**Figure 233a & 233b. Both photos (left taken December 14, 2015 and right taken December 22, 2016) show the condition of the berm at the Bay Head location. The revetment rocks were covered just prior to Jonas on the left, but were exposed on the right 11 months later.**

# New Jersey Beach Profile Network

## #154 - Johnson Avenue, Bay Head, Ocean County



### 30-Year Coastal Changes at Site 154, Johnson Avenue, Bay Head, Ocean Co.

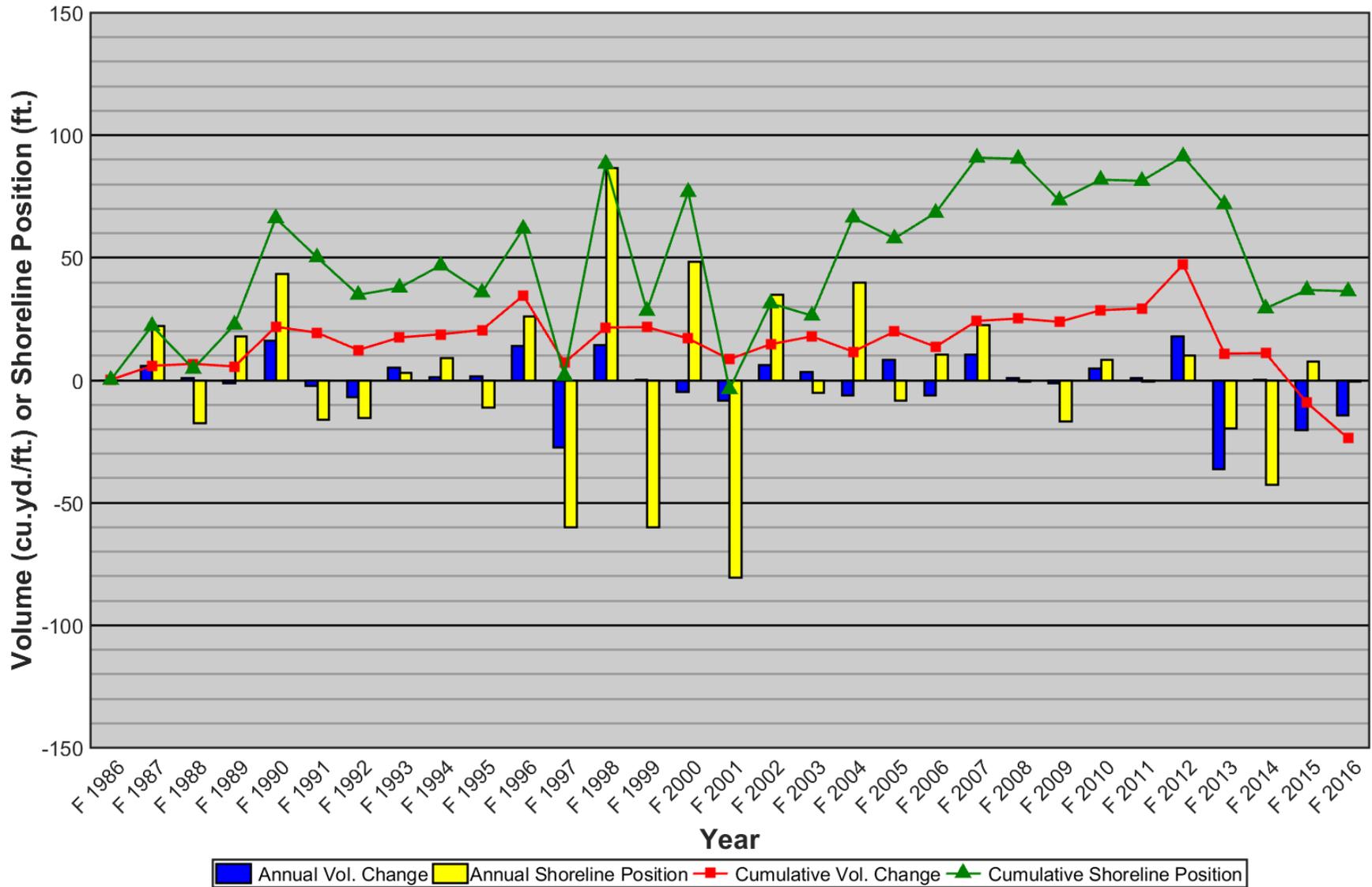


Figure 235. Between 1997 and 2004 the Bay Head site showed an erratic shoreline variation annually that then slowly went positive until just after Sandy when both sand volume declined and the shoreline retreated. The net change over 30 years leaves the site down 25 yds<sup>3</sup>/ft. while the shoreline is 37 feet farther seaward than it was in 1986.

### 30-Year Ensemble Mean Profile at Site 154, Johnson Avenue, Bay Head, Ocean Co.

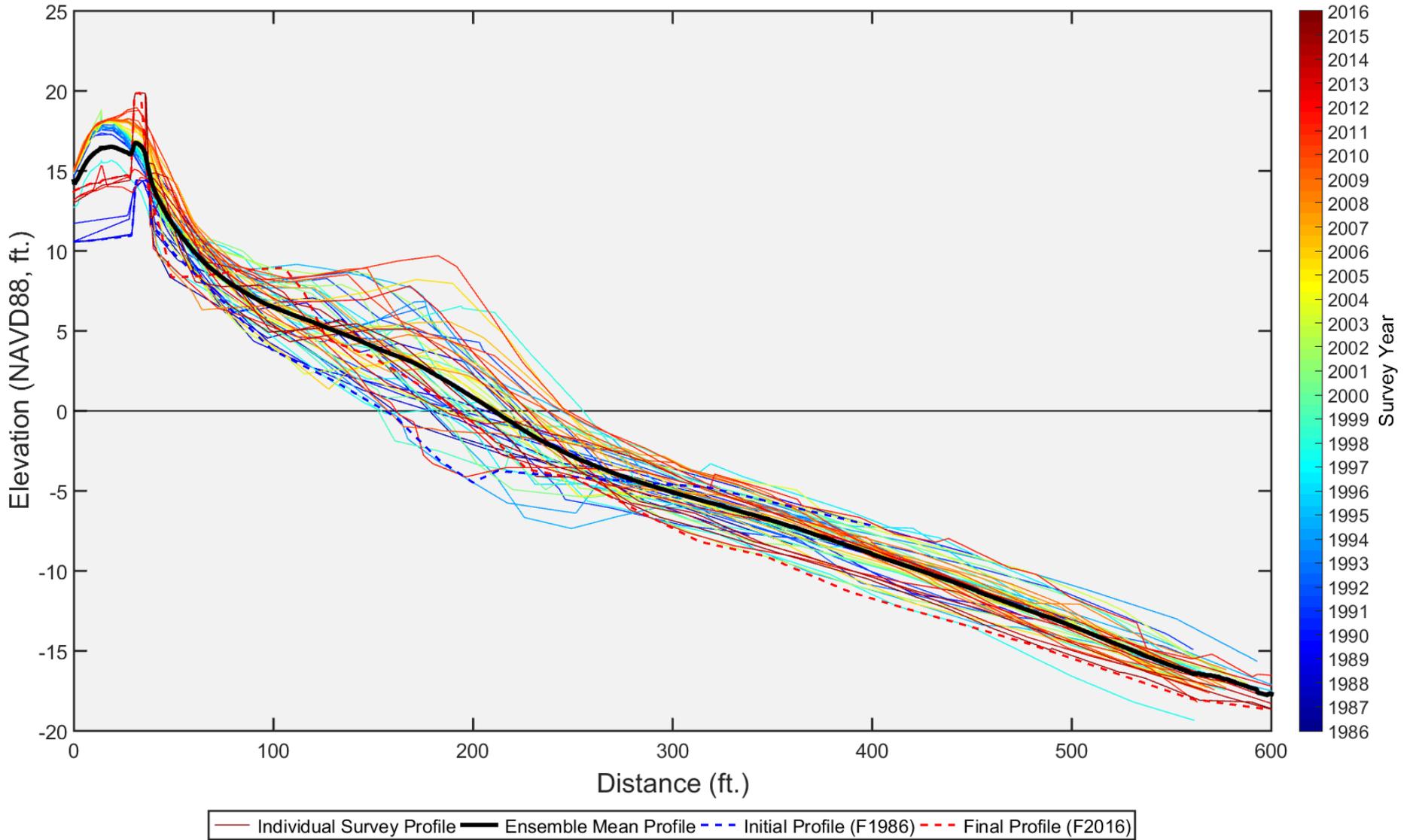


Figure 236. The dune is located over the rock revetment that was installed prior to the first NJBPN survey. The wall/dune was exposed following three major storms since 1986 (1992, 2012 and 2016). Local efforts added sand to the dune and the trend is shown in the dune height and seaward position of the dune face through time. The site is marginally stable over time with a great deal of variability among all the surveys.

#154 - Johnson Street, Bay Head Borough, Ocean County  
**Comparison of 1995 to 2015**

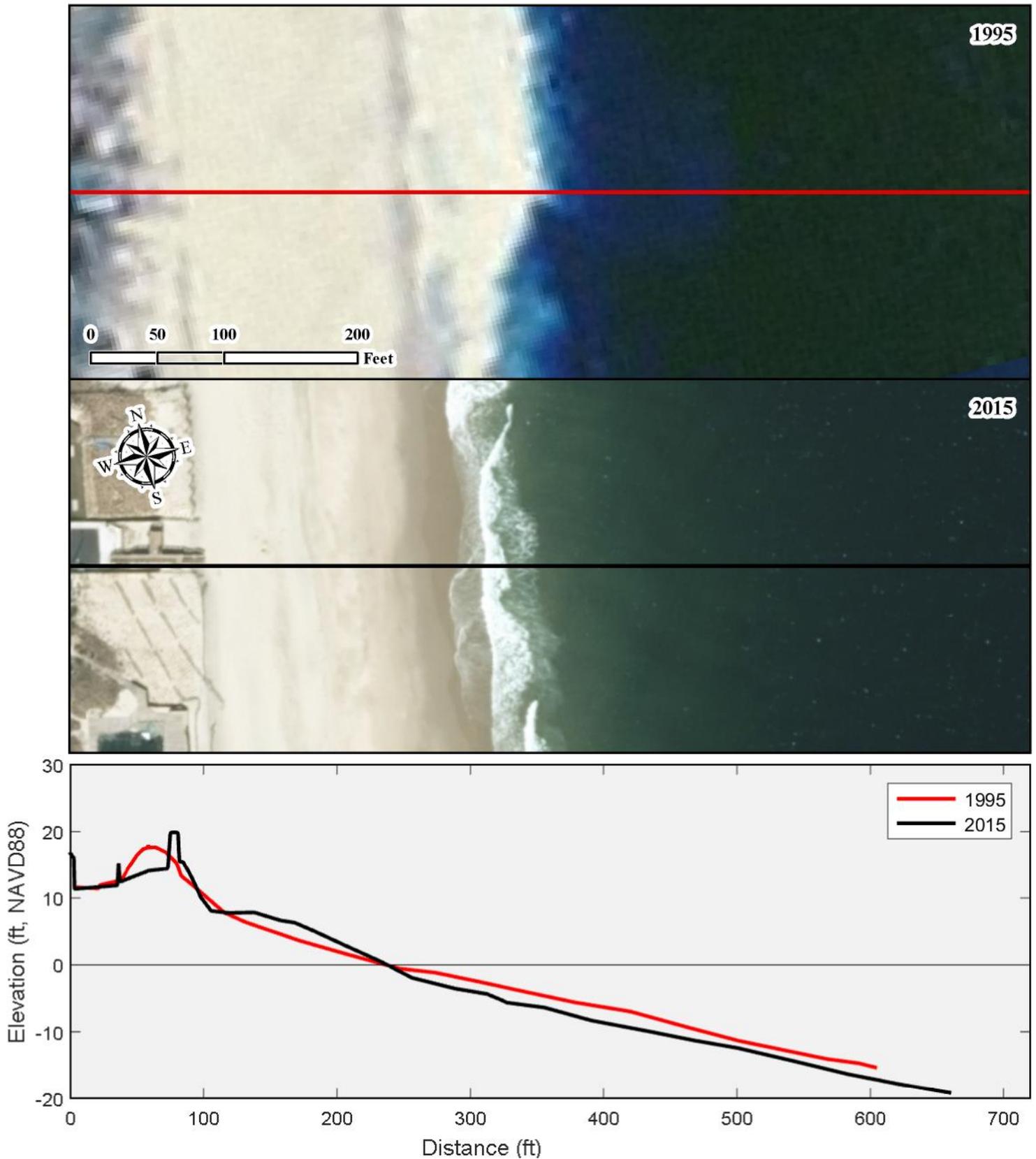


Figure 237. There was a change in the shape of the dune, but little change in shoreline position between 1995 and 2015 (seaward movement +1 ft).

**NJBPN 153 – 1117 Ocean Avenue, Mantoloking (October 17, 2016)**



**Figure 238. View to the north from the top of the sheet-pile wall at 1117 Ocean Avenue in Mantoloking. The Borough conducted an extensive operation in bulldozing sand from the berm back to the steel wall following the northeast storm (Jonas) in late January 2016. This view shows the steep slope to the beach existing as of December 2016.**

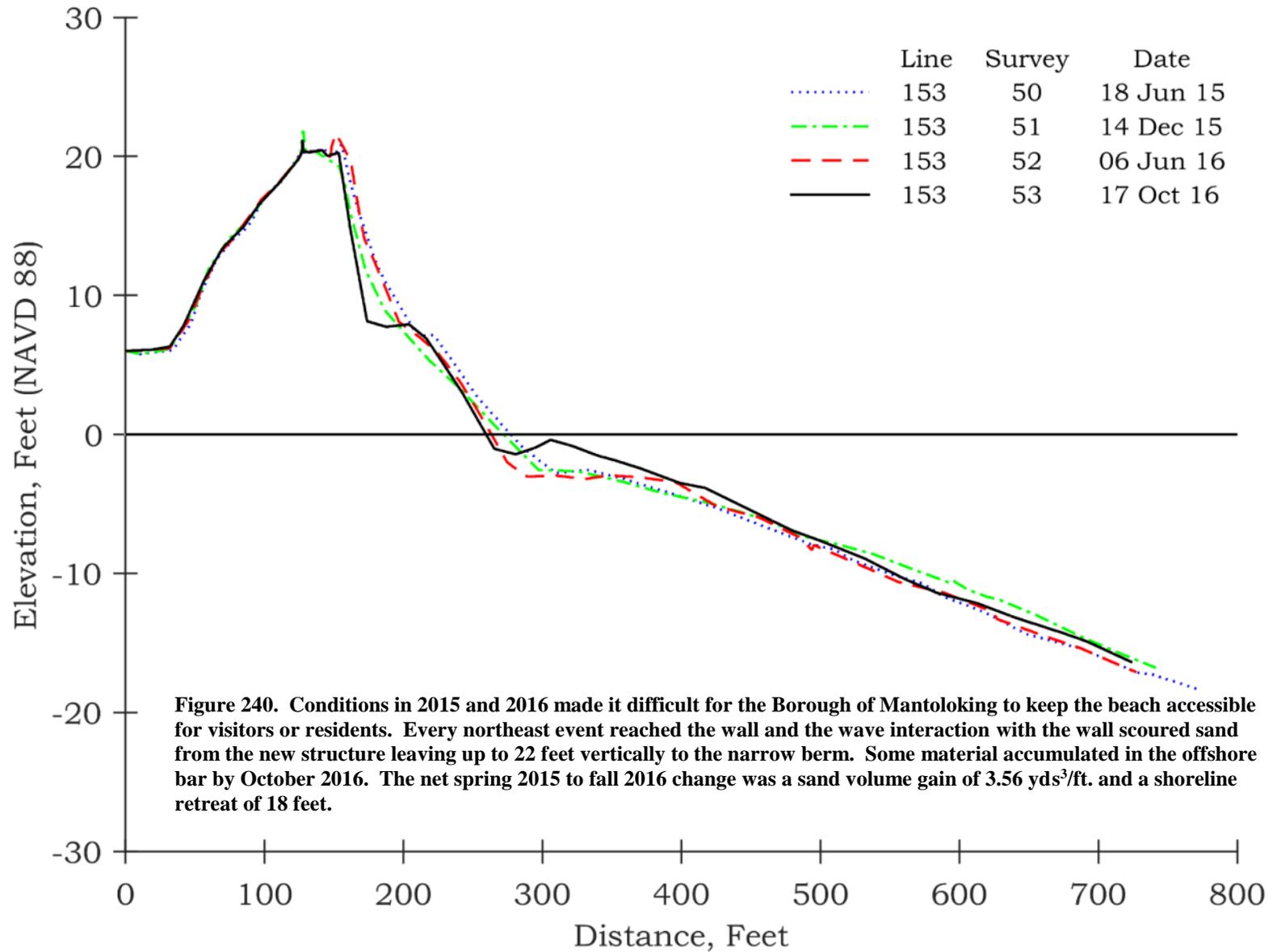
**NJBPN 153 – 1117 Ocean Avenue, Mantoloking**



**Figure 239a & 239b. The photos (left taken December 14, 2015 and right taken October 17, 2016) show the narrow dry beach that is less than 100 ft in width and sand scraped from the berm to cover the steel bulkhead which was exposed following the January 23, 2016 northeast storm. It took the borough from January to June 2016 to re-cover the exposed steel wall following that winter storm (Jonas).**

# New Jersey Beach Profile Network

#153 - 1117 Ocean Avenue, Mantoloking, Ocean County



### 30-Year Coastal Changes at Site 153, 1117 Ocean Avenue, Mantoloking, Ocean Co.

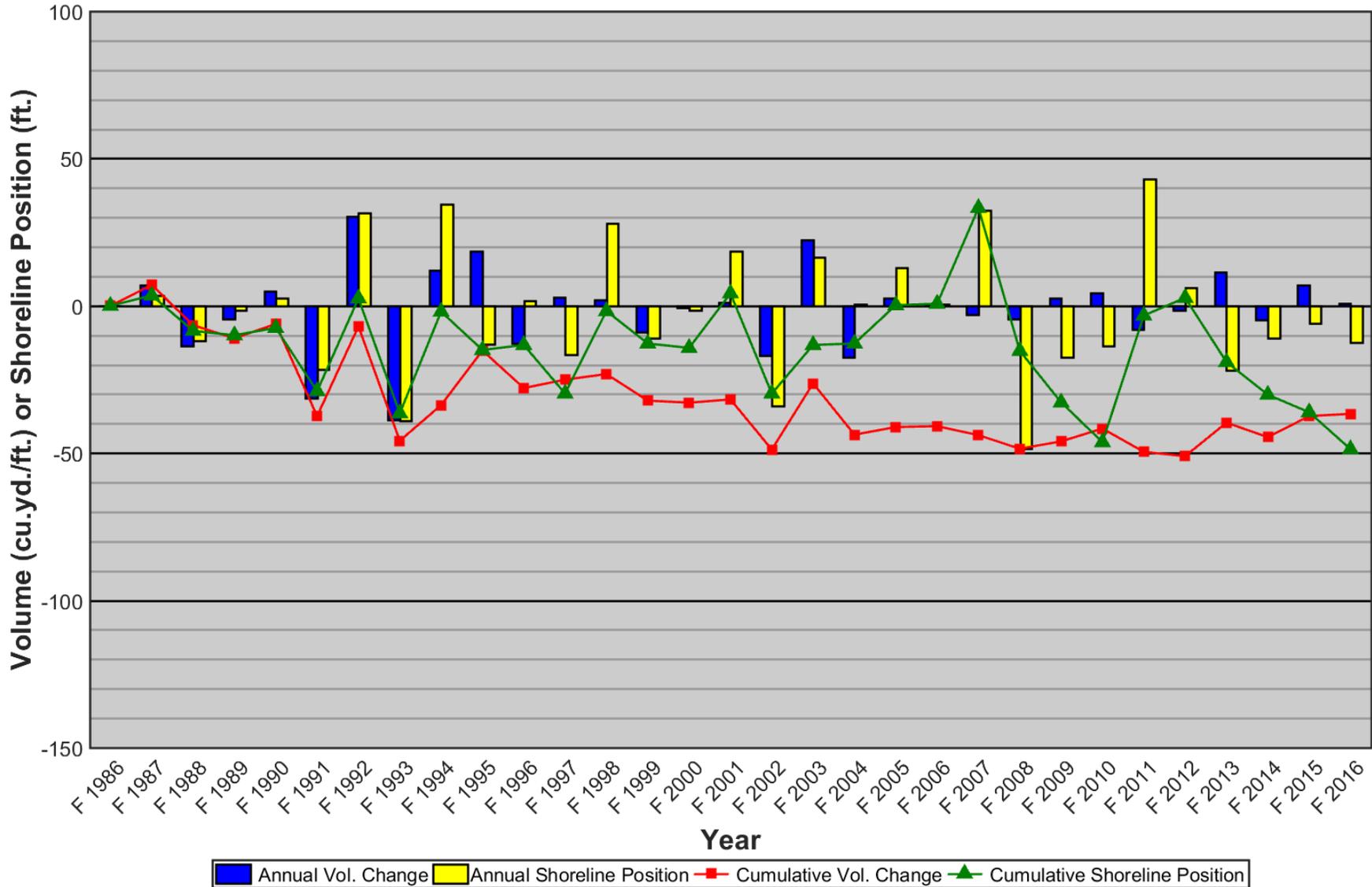


Figure 241. The Mantoloking site has suffered a prolonged 28-year period of less sand present on the beach (-38 yds<sup>3</sup>/ft.) and a shoreline 49 feet landward of the 1986 position. This situation has gotten rapidly worse since Sandy in terms of shoreline position. Sand volume has improved slightly likely due to both new quarry sand added plus recovered material put back following Sandy.

### 30-Year Ensemble Mean Profile at Site 153, 1117 Ocean Avenue, Mantoloking, Ocean Co.

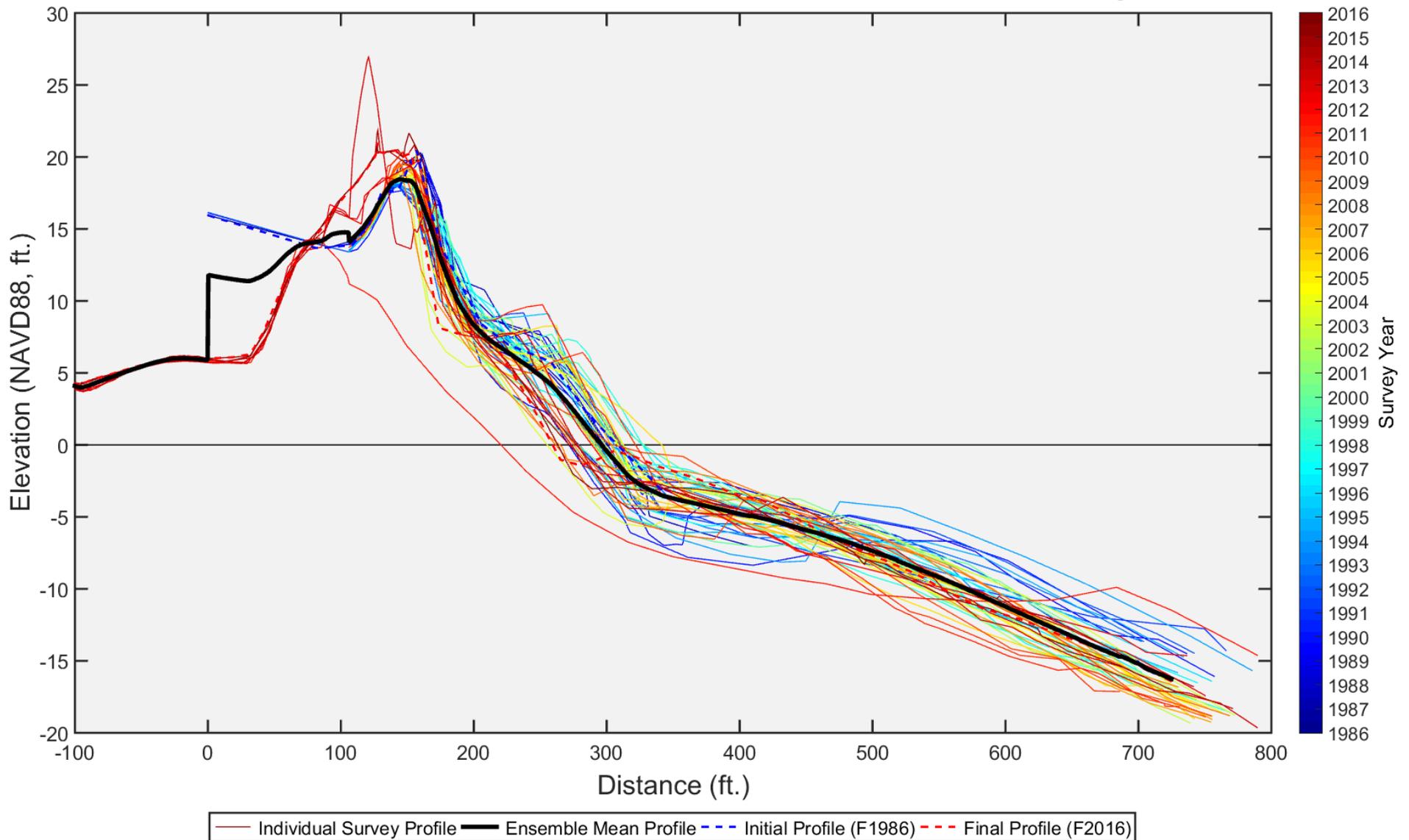


Figure 242. The earliest profiles started from a dune that was altered for a new residence. The envelope of change is relatively small at this site, as the individual profiles do not vary far from the mean and the mean profile shows that the site is typically composed of a berm and offshore bar. The damage from Hurricane Sandy resulted in a complex of reconstructed dunes from sand recovered from nearby streets, lots, and from Barnegat Bay. The only profile to vary farther from the mean is the Spring 2013 survey (orange line below all others) and this was a result of Hurricane Sandy breaching the dune, which is displayed nicely in this cross-section view.

#153 - 1117 ocean ave, Mantoloking Borough, Ocean County  
**Comparison of 1995 to 2015**

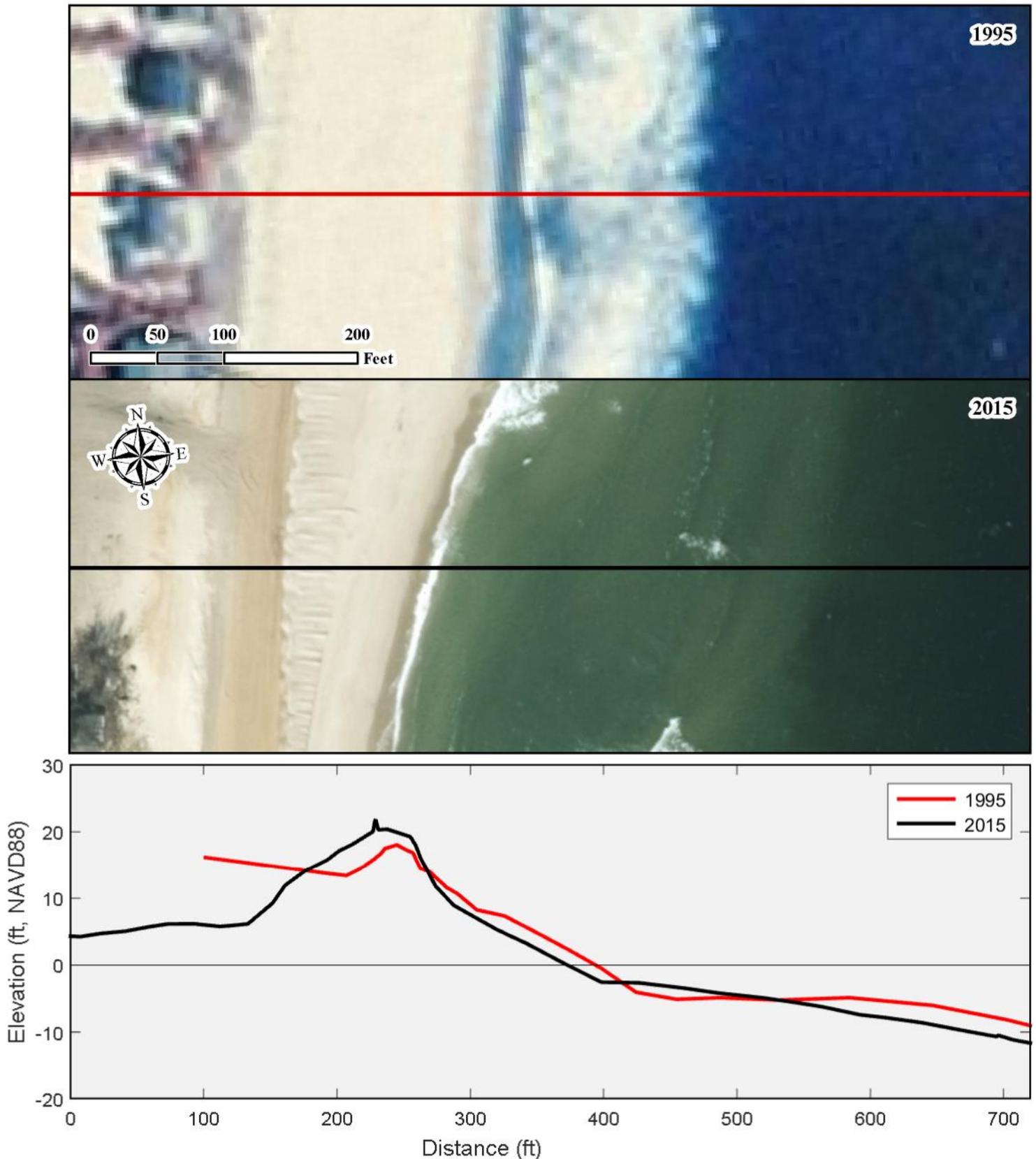
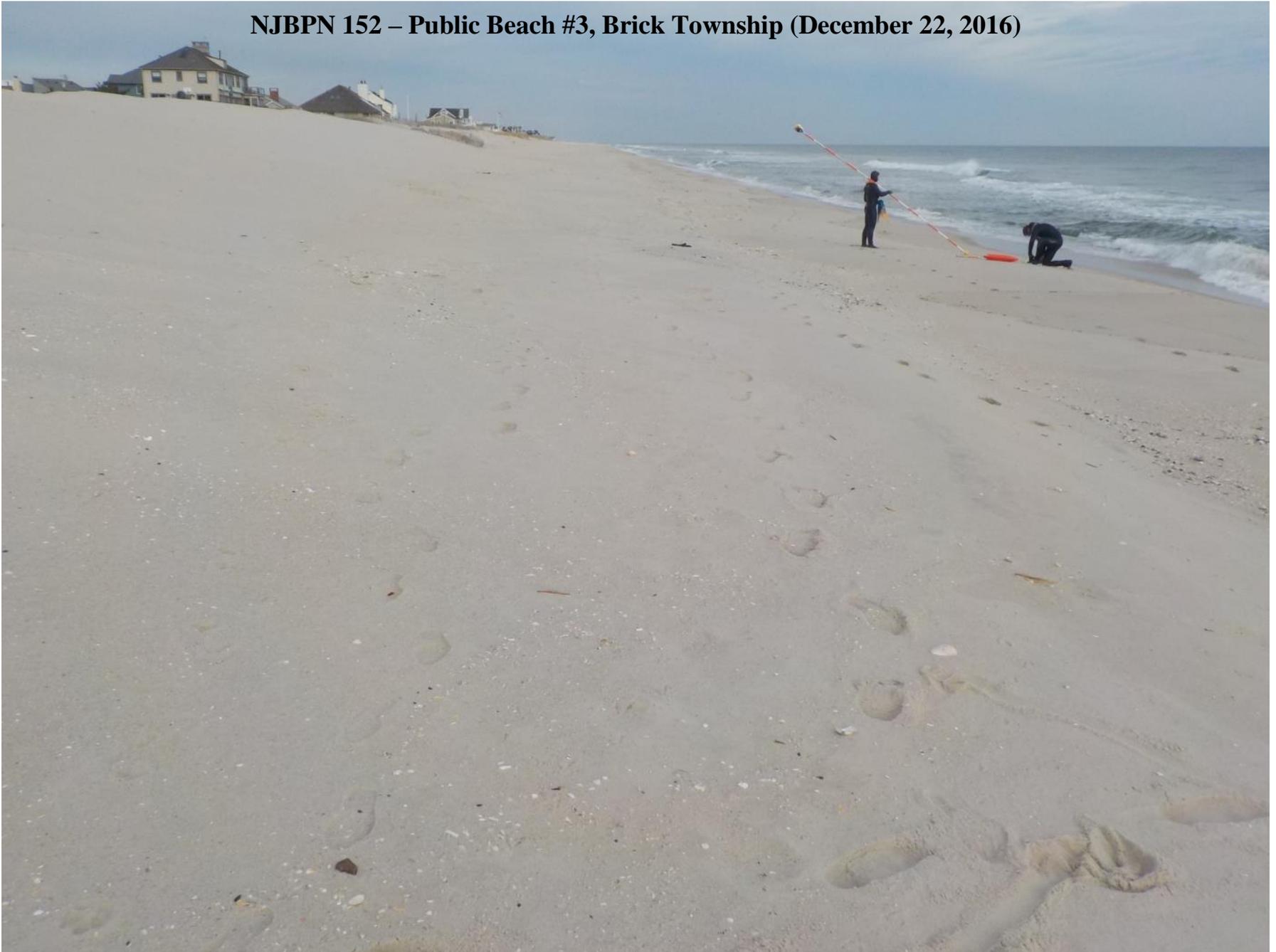


Figure 243. The sand on top of the 2015 vertical wall rises well above the dune that was measured in 1995. Shoreline position moved landward about 21 feet between 1995 and 2015.

**NJBPN 152 – Public Beach #3, Brick Township (December 22, 2016)**



**Figure 244. View to the north from the berm at Public Beach #3 in Brick Township. This public beach is just south of Mantoloking and was overwashed during Sandy.**

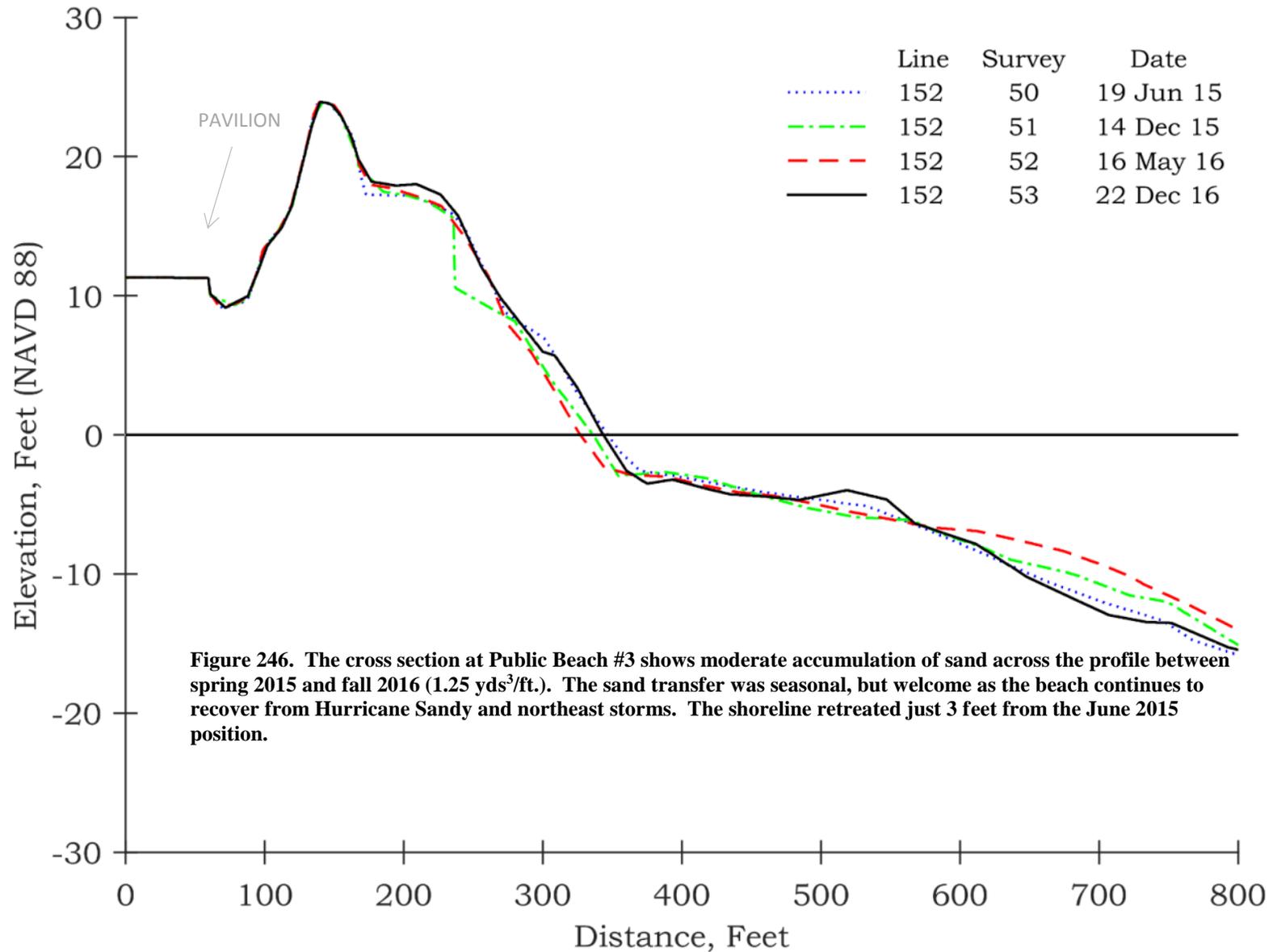
**NJBPN 152 – Public Beach #3, Brick Township**



**Figure 245a & 245b. The view on the left was taken (December 14, 2015) with the new sand fence line erected along the sand ridge covering the steel bulkhead. Covered during the spring of 2016 following a northeast storm, the site returned to recreational uses by June 2016. The right photo was taken December 22, 2016 with a reasonable amount of beach width.**

# New Jersey Beach Profile Network

## #152 - Public Beach #3, Brick Township, Ocean County



### 30-Year Coastal Changes at Site 152, Public Beach #3, Brick Township, Ocean Co.

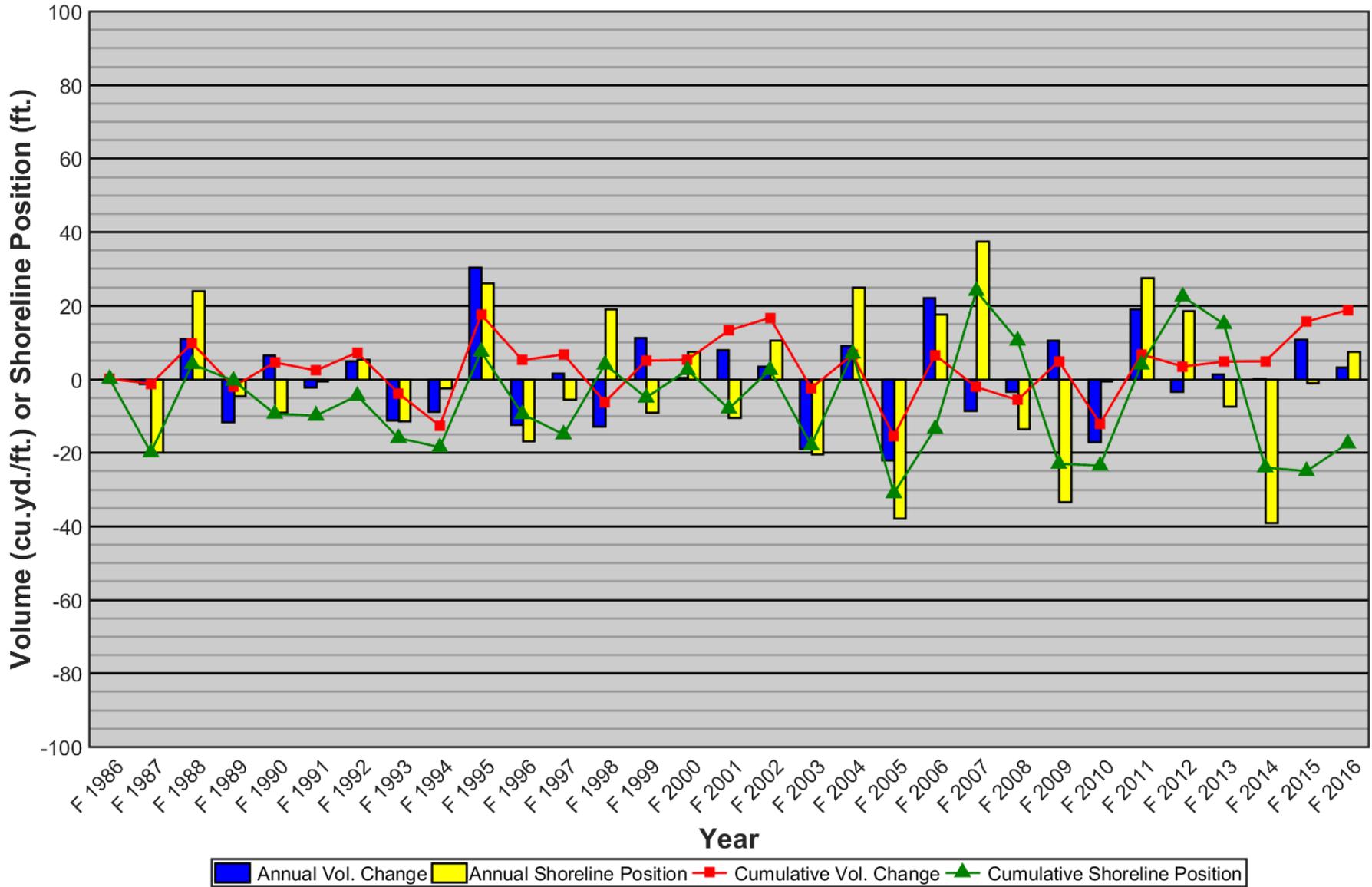


Figure 247. The Public Beach #3 location has had swings in sand volume and shoreline position that hovered around zero net change. Slight advances are noted in 2015 and 2016. Shoreline retreat that most recently began in 2014 is now 18 feet landward of the 1986 position.

### 30-Year Ensemble Mean Profile at Site 152, Public Beach #3, Brick Township, Ocean Co.

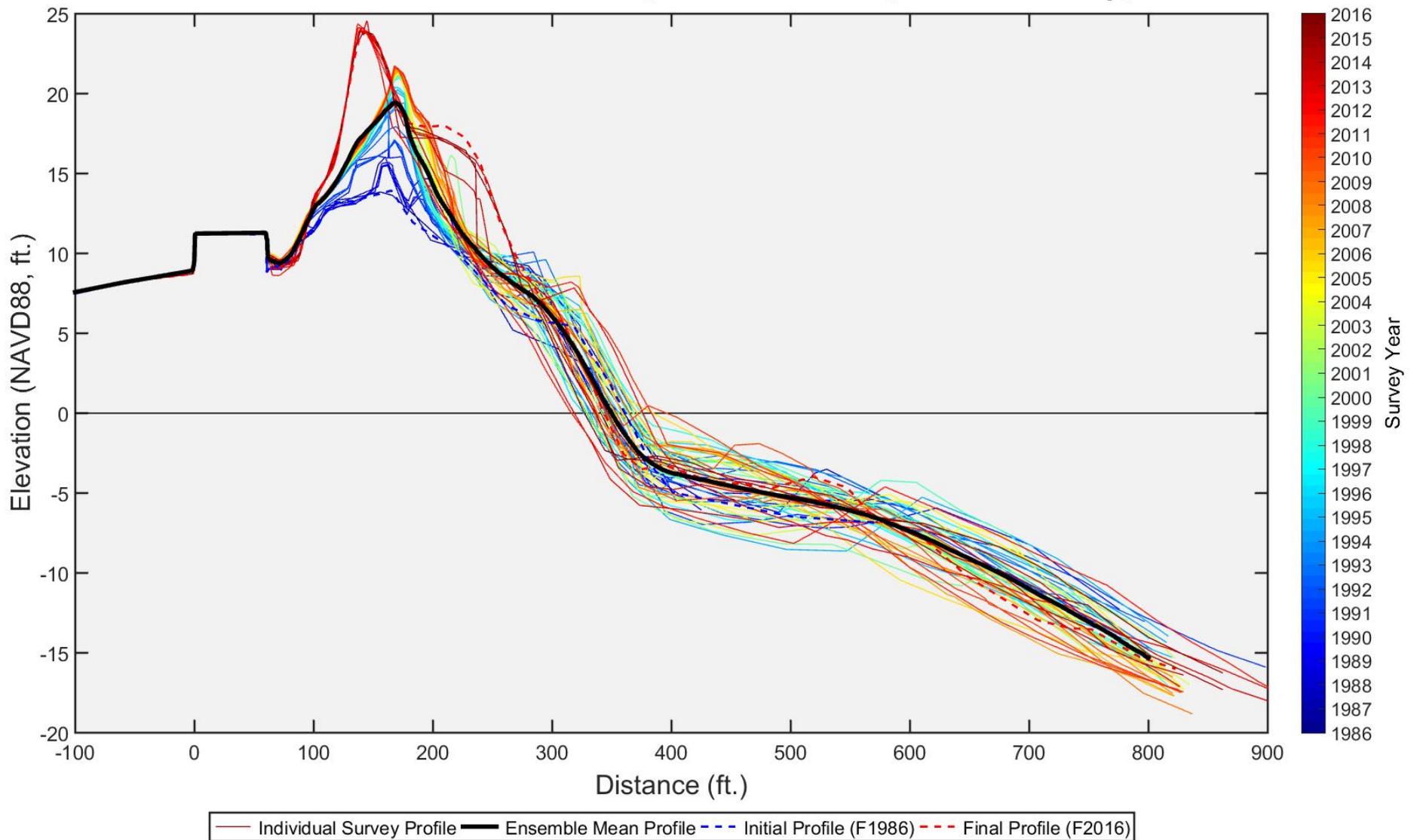


Figure 248. The post-Sandy dune was restored to a higher elevation than the 1986 dune and contains a steel sheet pile bulkhead in its core. The envelope of change on the beach and offshore remained relatively small in vertical distribution but highly variable over time since there is no obvious increasing or decreasing trend (as evident by the colors bouncing back and forth about the mean over time).

#152 - Public Beach #3, Brick Township, Ocean County  
Comparison of 1995 to 2015

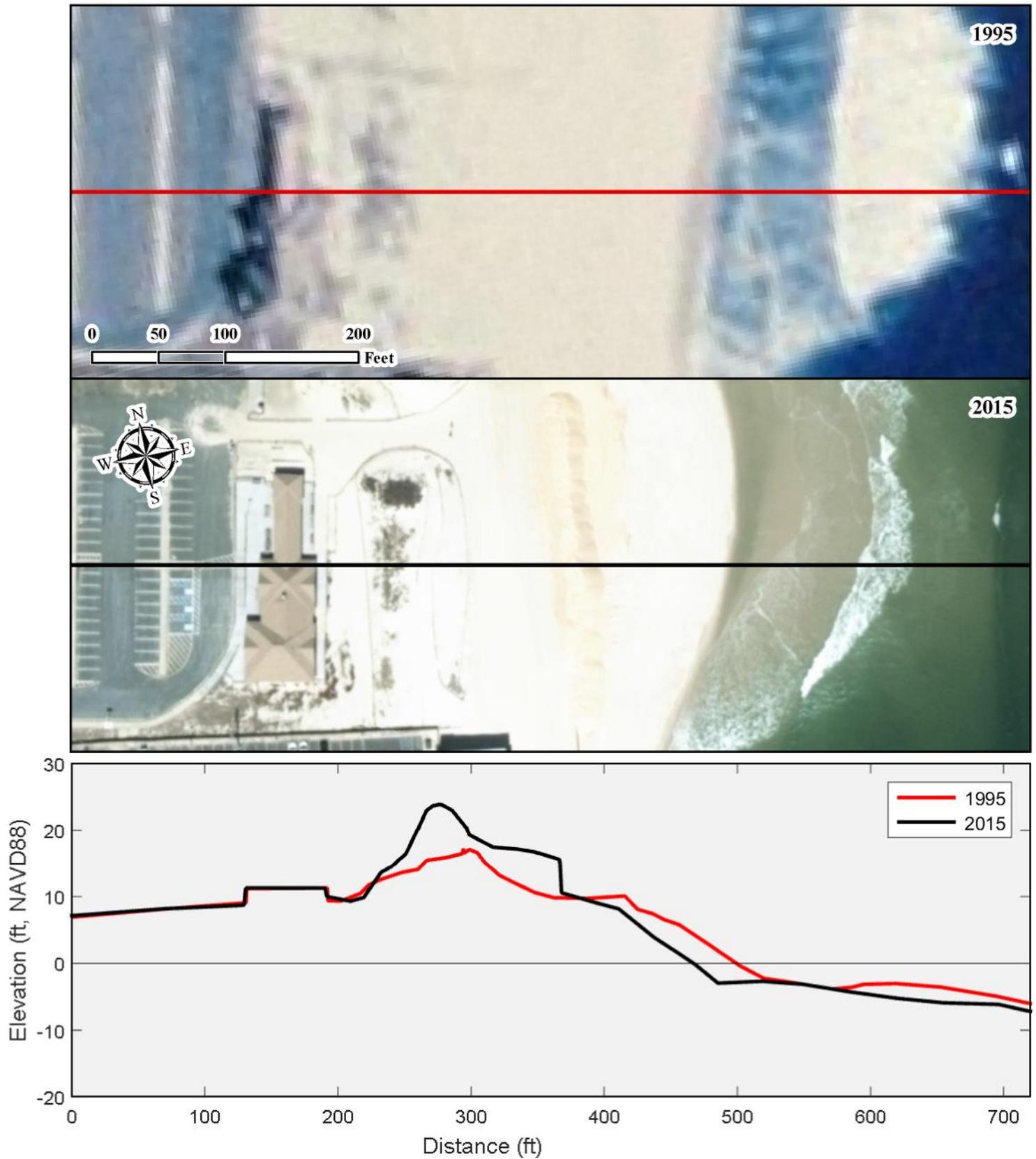


Figure 249. The 2015 cross section shows the dune and sand piles that were created after Hurricane Sandy. The shoreline moved landward about 32 ft between 1995 and 2015.

**NJBPN 151 – 1<sup>st</sup> Avenue, Normandy Beach (December 22, 2016)**



**Figure 250. View to the south from the berm at 1<sup>st</sup> Avenue in Normandy Beach. A prominent offshore bar was present at the time of the photograph (Dec 2016).**

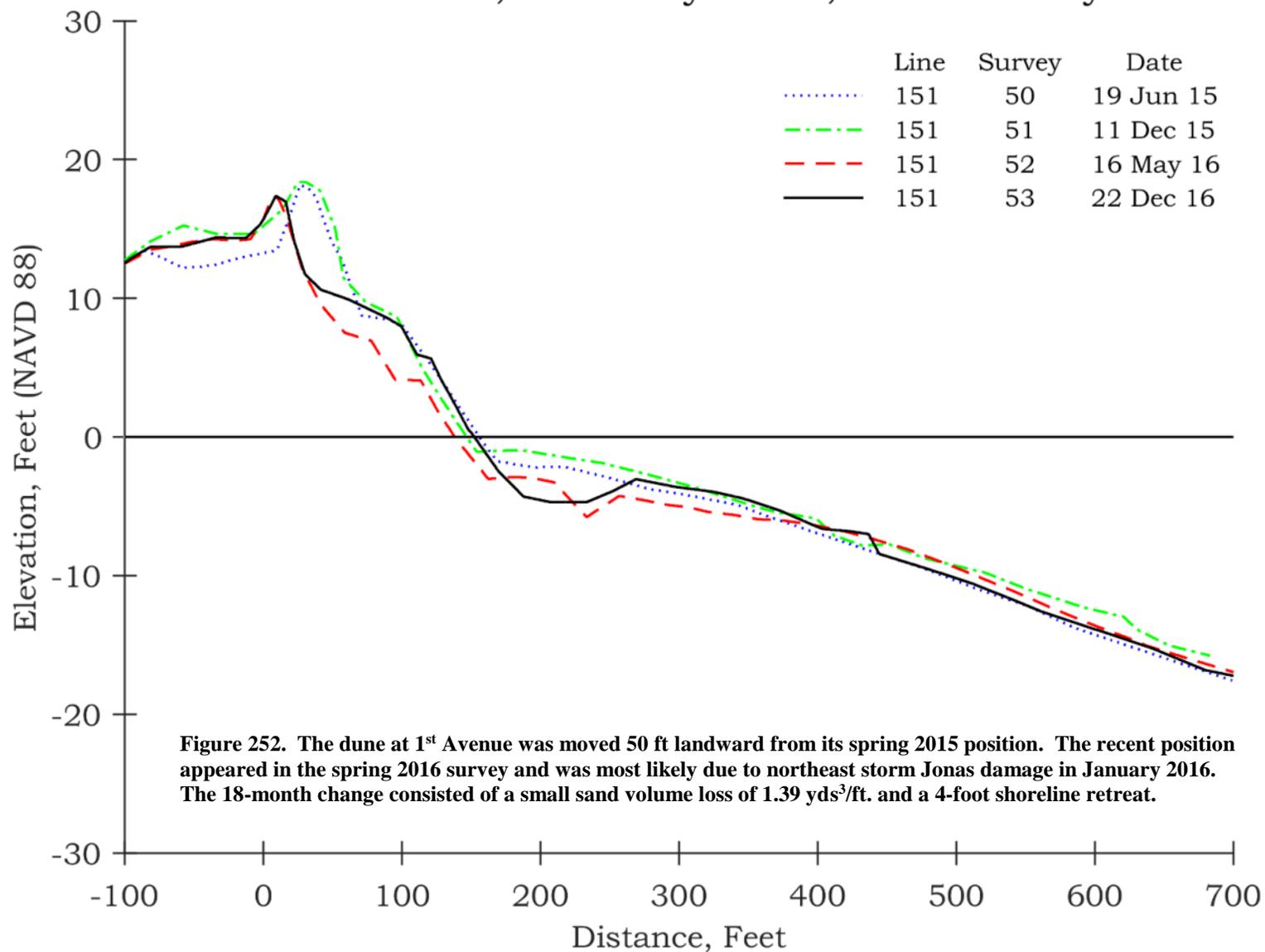
**NJBPN 151 – 1<sup>st</sup> Avenue, Normandy Beach**



**Figure 251a & 251b. The view on the left (December 11, 2015), shows the scarped dune, protected by a narrow 50-foot berm. On the right, (taken December 22, 2016) shows a wider beach following a summer of sand accumulation.**

# New Jersey Beach Profile Network

#151 - 1<sup>st</sup> Avenue, Normandy Beach, Ocean County



### 30-Year Coastal Changes at Site 151, 1<sup>st</sup> Avenue, Normandy Beach, Ocean Co.

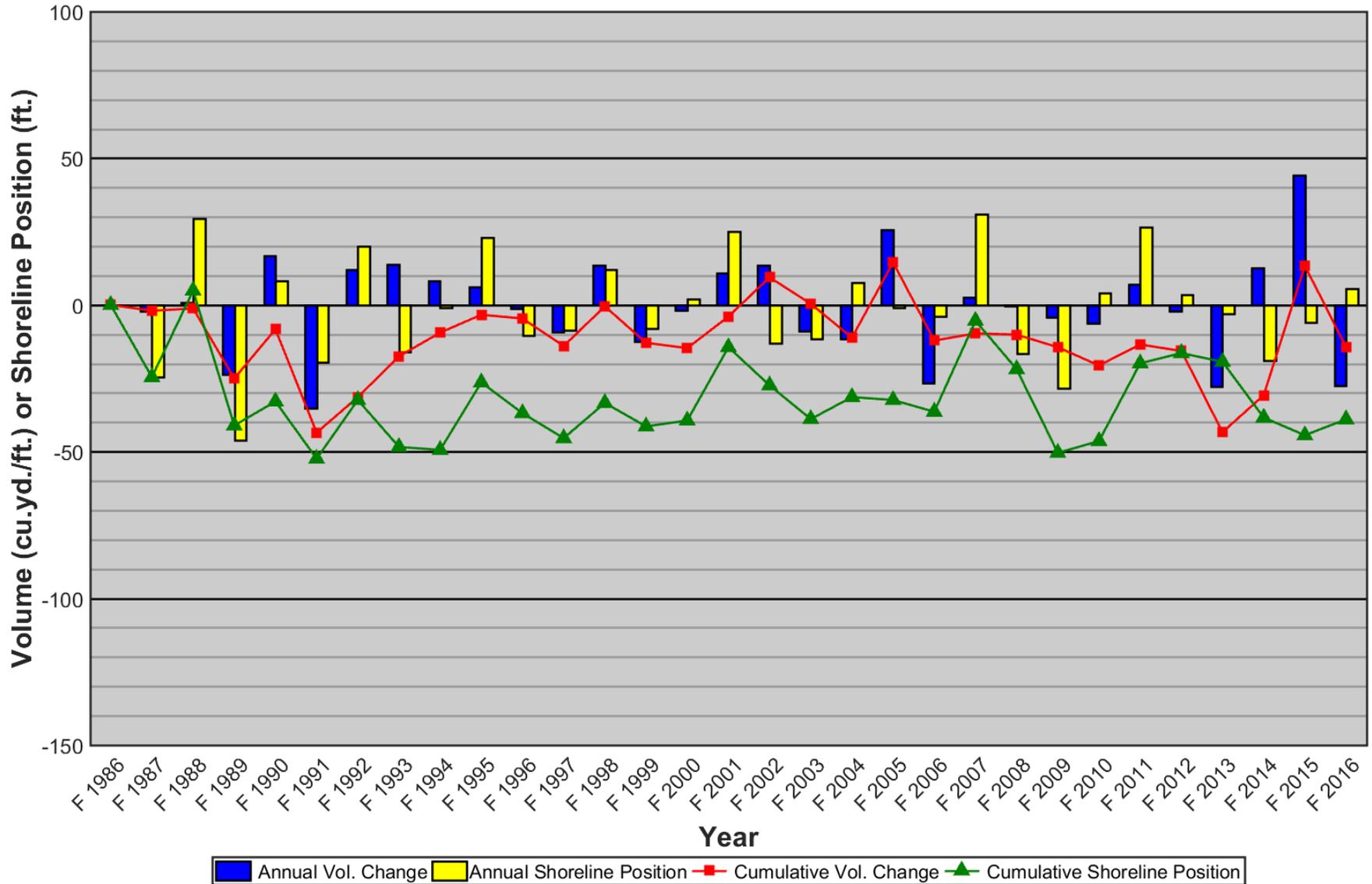


Figure 253. While sand volumes have varied around the zero net change line, the shoreline position retreated 40 feet since 1986. A moderate seaward advance occurred in 2011 but retreat resumed in 2014. Sand volumes experienced a substantial net gain in 2015, but had an overall decline by about 14 yds<sup>3</sup>/ft. from 1986 to the present year of 2016.

### 30-Year Ensemble Mean Profile at Site 151, 1<sup>st</sup> Avenue, Normandy Beach, Ocean Co.

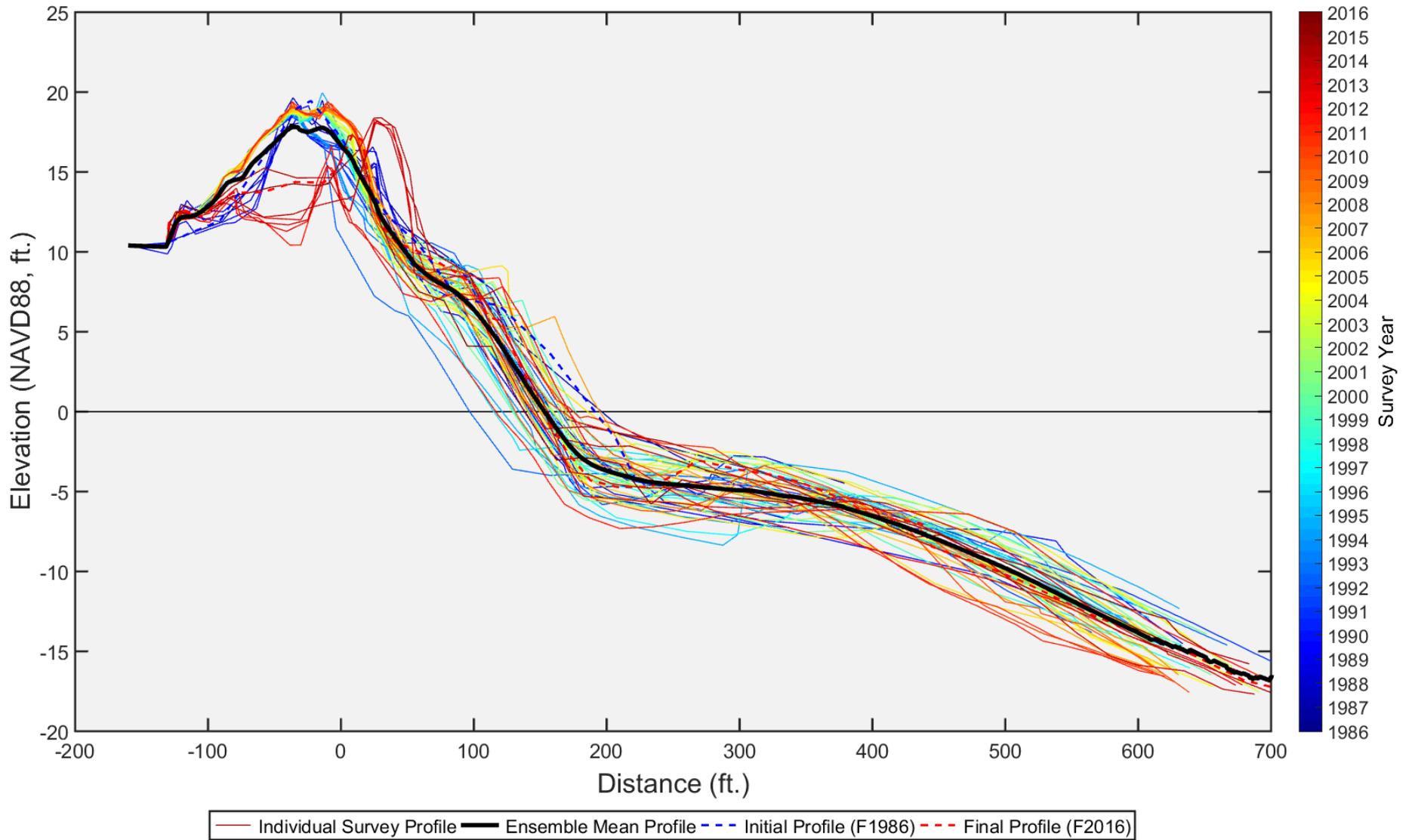


Figure 254. The 1<sup>st</sup> Avenue site has not varied by large amounts other than losing the dune during Hurricane Sandy. Even though variation has been minimal, the variation in shoreline position has trended landward, as evident by the first profile (dashed blue line) being seaward of the most recent profile (dashed red line).

#151 - 1st Street, Normandy Beach, Ocean County  
Comparison of 1995 to 2015

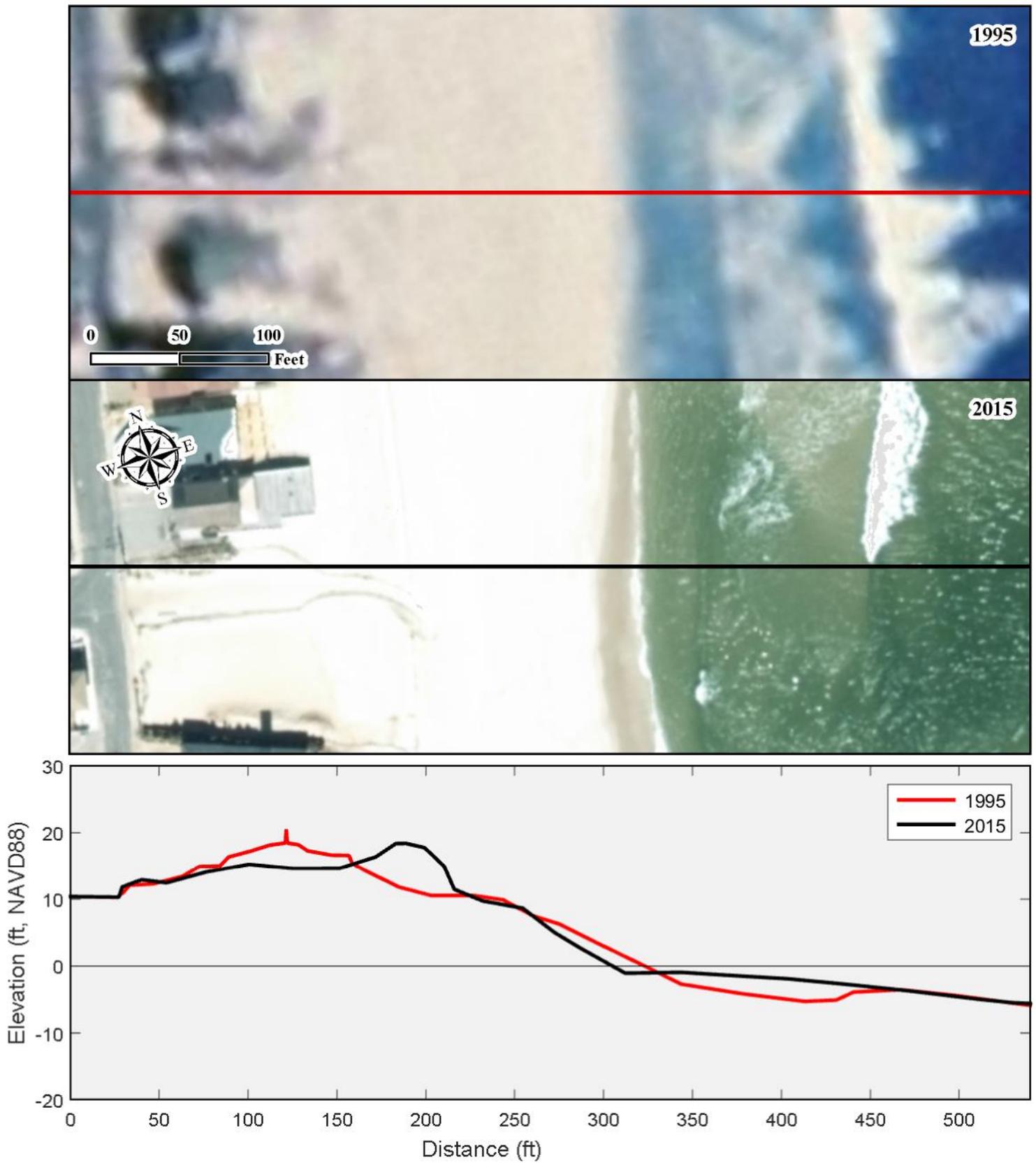


Figure 255. The dune that was measured in 1995 was removed during Hurricane Sandy. The 2015 profile shows a shift in the post-storm dune to a more seaward location. The shoreline retreated by about 18 ft over the 20 year period from 1995 to 2015.

**NJBPN 150 – White Avenue, Lavallette (December 9, 2016)**



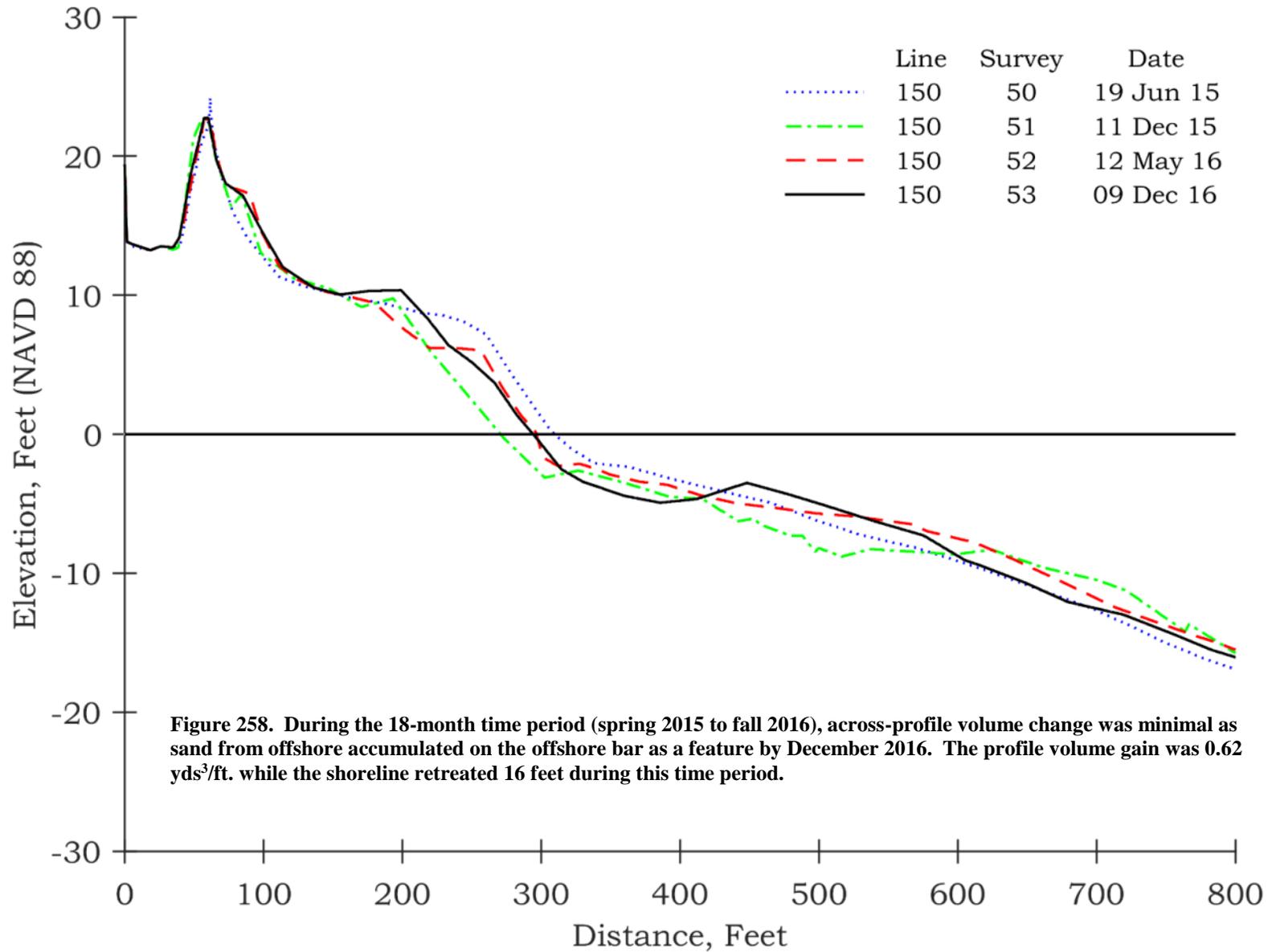
**Figure 256. View to the north from the berm at White Avenue in Lavallette. The late fall beach appeared in good condition.**

**NJBPN 150 – White Avenue, Lavallette**



**Figure 257a & 257b.** The photos show the condition of the dunes at the Lavallette site (left photo taken December 11, 2015 and right photo taken December 9, 2016). Hurricane Sandy eroded the dunes at this site and these modest dunes were created from sand that was recovered after the storm. Some sand accumulated at the seaward base of the dune after the June 2015 survey.

## New Jersey Beach Profile Network #150 - White Avenue, Lavallette, Ocean County



### 30-Year Coastal Changes at Site 150, White Avenue, Lavellette, Ocean Co.

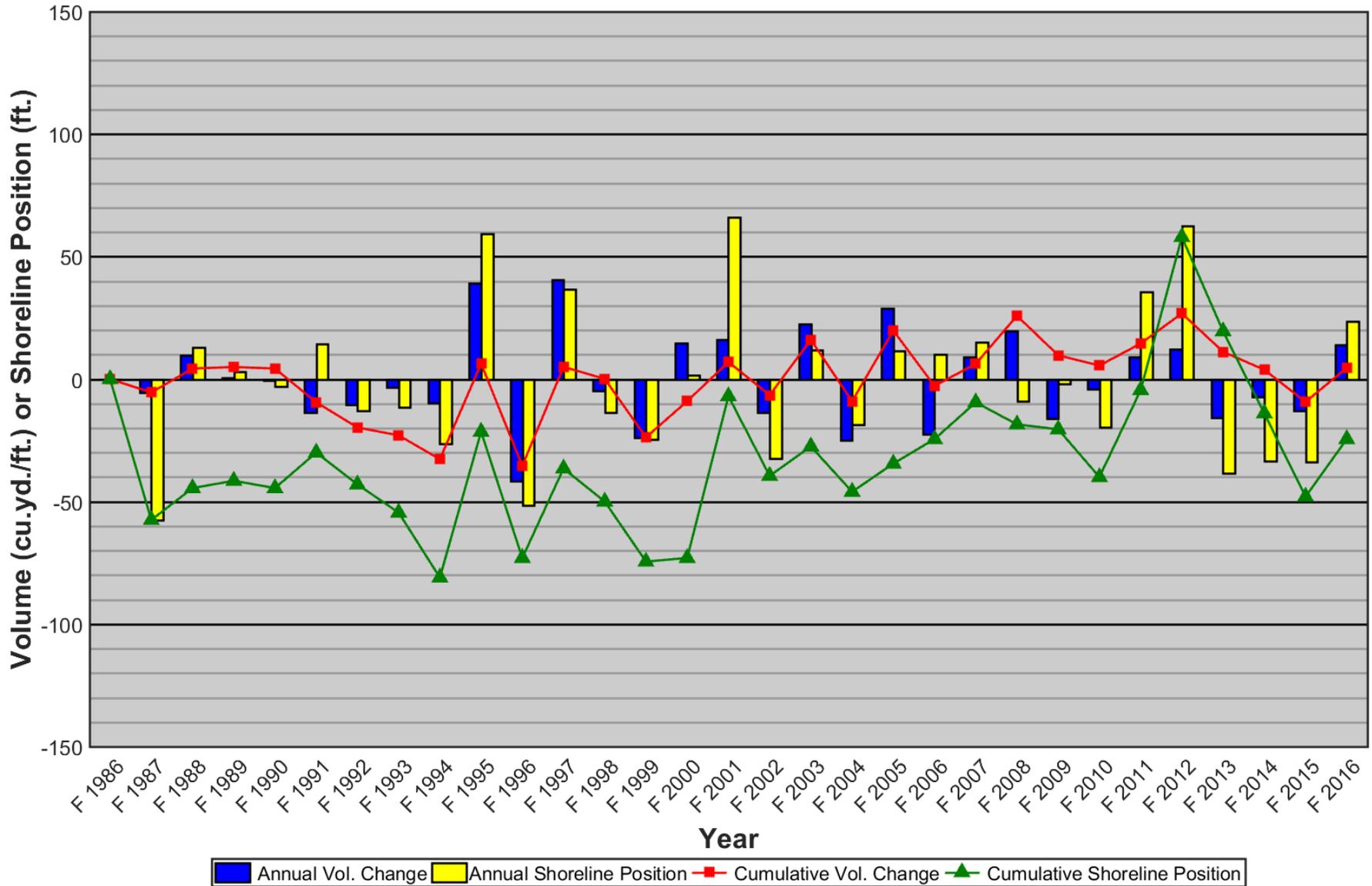


Figure 259. The White Avenue site experienced variable sand volume changes of 25 yds<sup>3</sup>/ft. above or below zero for 30 years while the shoreline retreated relative to 1986, between 50 and 100 ft multiple times. There was a relatively large shoreline advance between the fall 2011 and fall 2012 surveys, but note that the fall 2012 survey occurred over a month prior to Hurricane Sandy. The site shows an erosional trend from 2013 until gains in fall 2016, with the shoreline in 2016 retreating about 22 ft landward of the original 1986 position. The 30-year sand volume change ended up increasing by about 5.0 yds<sup>3</sup>/ft. above the original 1986 value.

### 30-Year Ensemble Mean Profile at Site 150, White Avenue, Lavallette, Ocean Co.

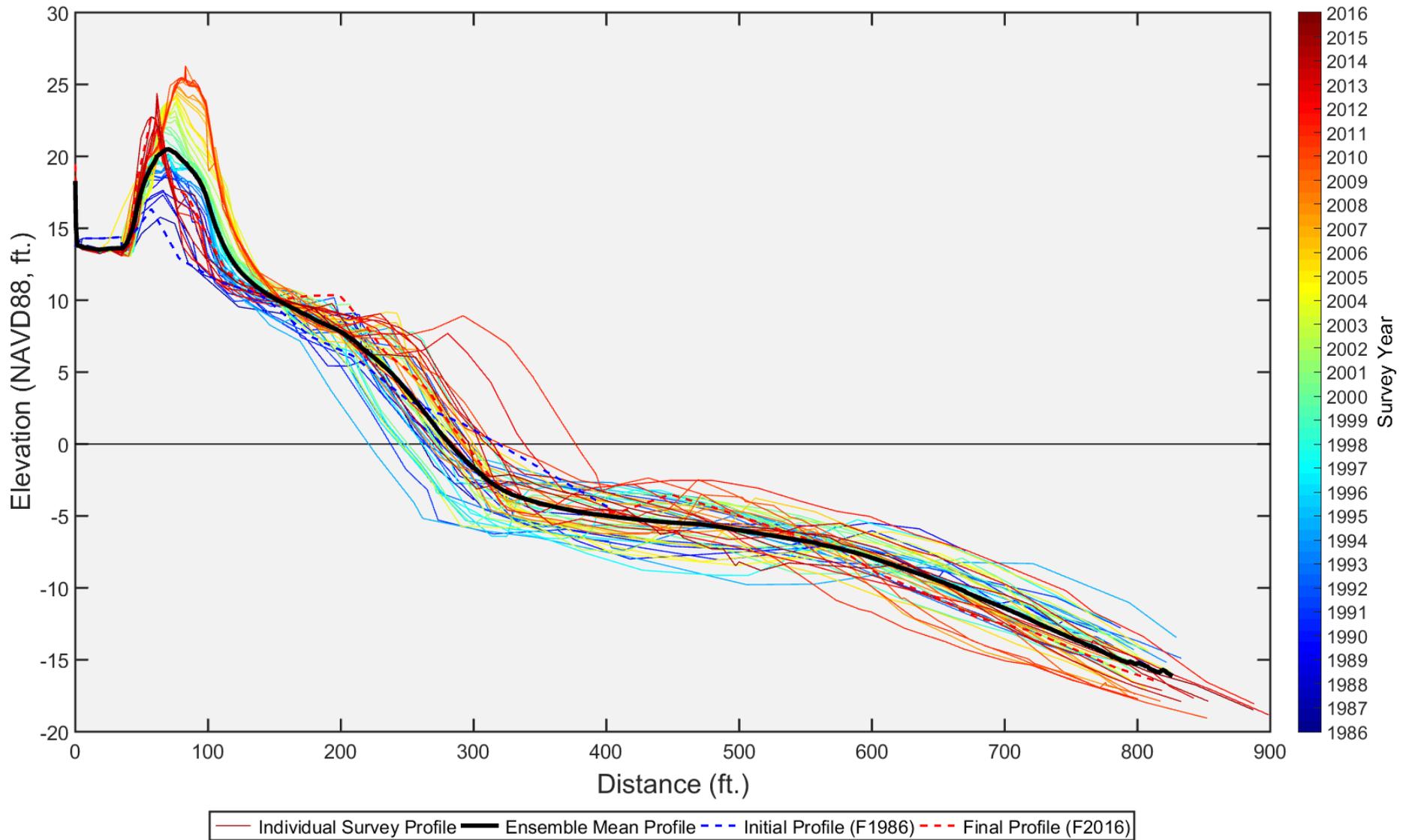


Figure 260. The 30-year progression of profiles over time at White Avenue shows the upward growth of the sand dune until the passage of Hurricane Sandy which breached the nearly 25-foot dune. The post-storm dune location was moved landward by 30 ft. Only two surveys showed a shoreline position seaward of the initial 1986 survey and the most seaward shoreline position was the September 2012 survey just before the landfall of Hurricane Sandy. The nearshore elevations can be describes as variable throughout time.

#150 - White Avenue, Lavallette Borough, Ocean County  
**Comparison of 1995 to 2015**

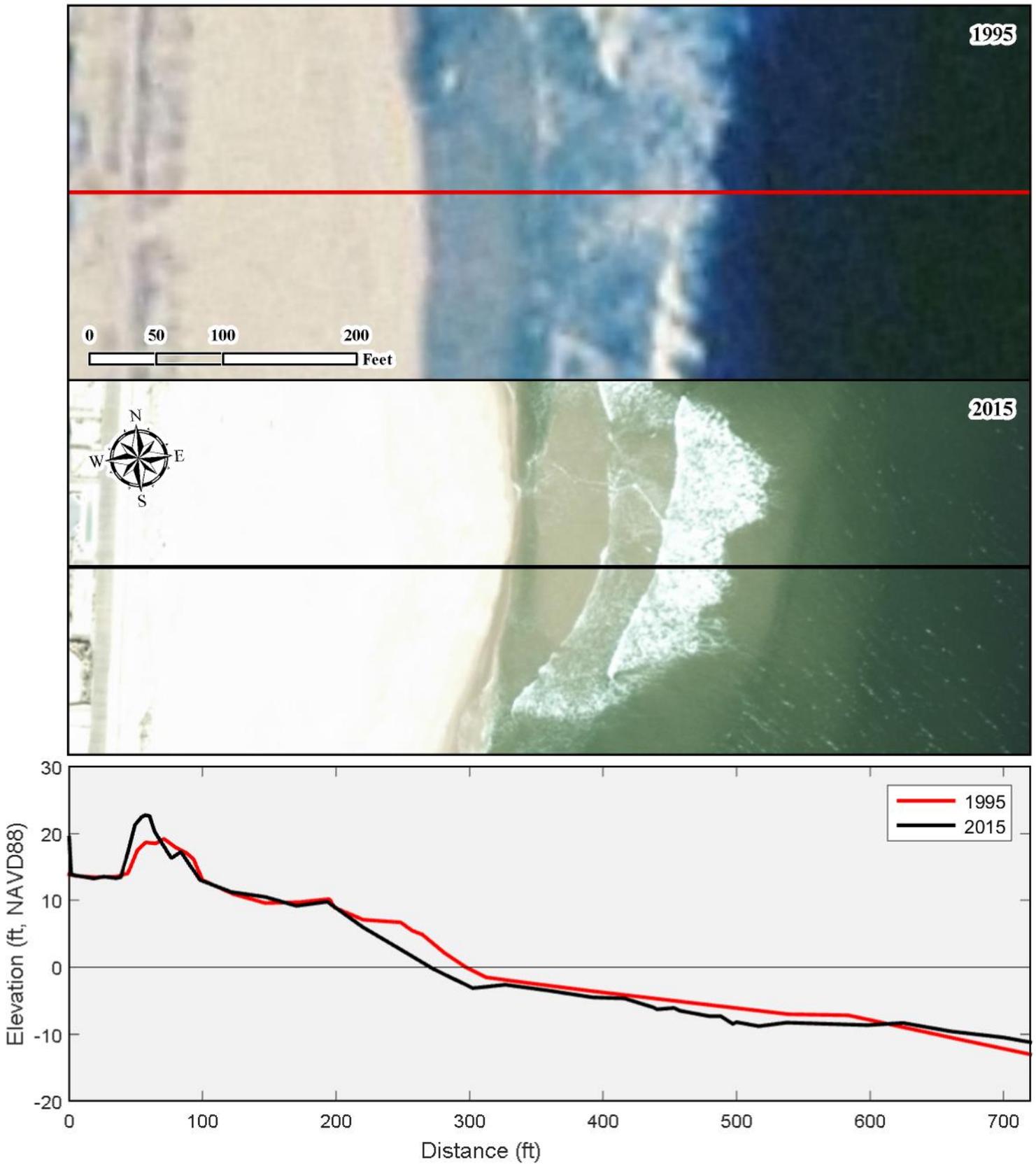
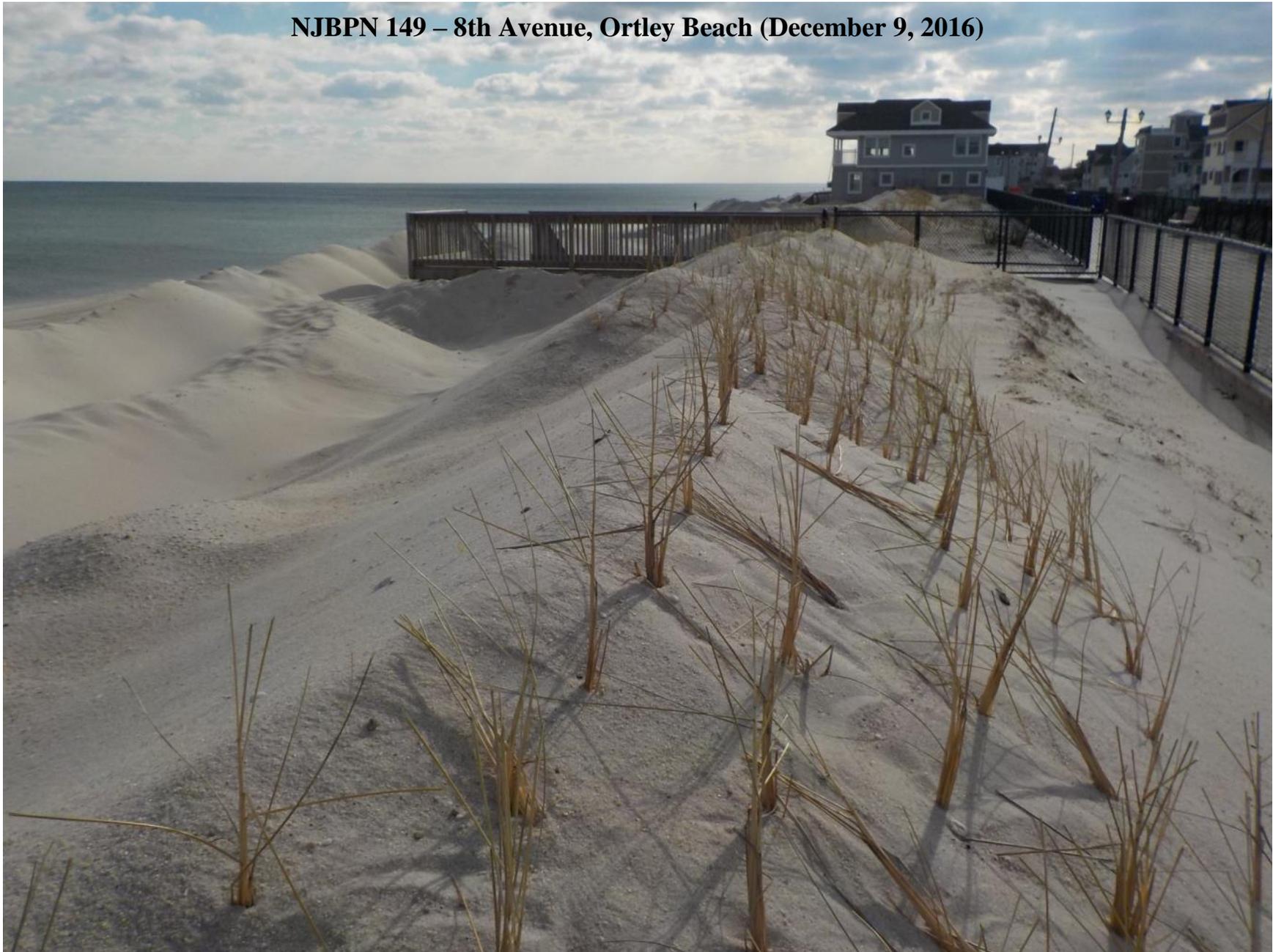


Figure 261. The dune gained in elevation but the shoreline retreated landward by about 35 feet from 1995 to 2015.

**NJBPN 149 – 8th Avenue, Ortley Beach (December 9, 2016)**



**Figure 262. View to the south from the dune crest at 8th Avenue in Ortley Beach. The January 2016 northeast storm (Jonas) eroded the seaward portion of the dune. While the dune was not breached entirely, the proximity of failure was clear enough to municipal officials that they chose to add sand to the seaward dune slope for protection for the upcoming winter.**

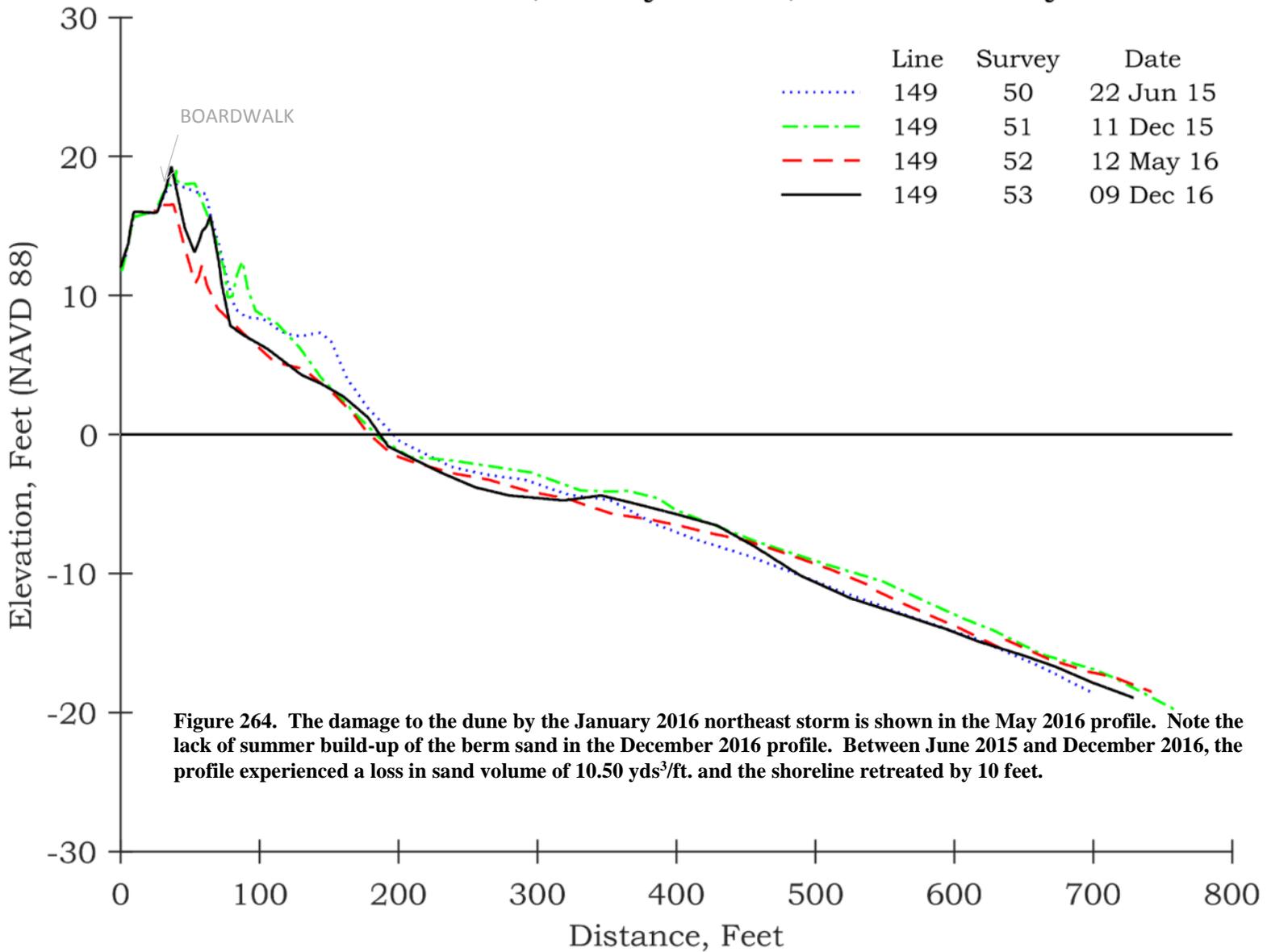
**NJBPN 149 – 8<sup>th</sup> Avenue, Ortley Beach**



**Figure 263a & 263b. The photos show the condition and width of the berm at 8<sup>th</sup> Avenue in Ortley Beach (left photo taken December 11, 2015 and right photo taken December 9, 2016). Sand was added to reinforce the dune that was damaged during the January 2016 northeast storm.**

# New Jersey Beach Profile Network

## #149 - 8<sup>th</sup> Avenue, Ortley Beach, Ocean County



### 30-Year Coastal Changes at Site 149, 8<sup>th</sup> Avenue, Ortley Beach, Ocean Co.

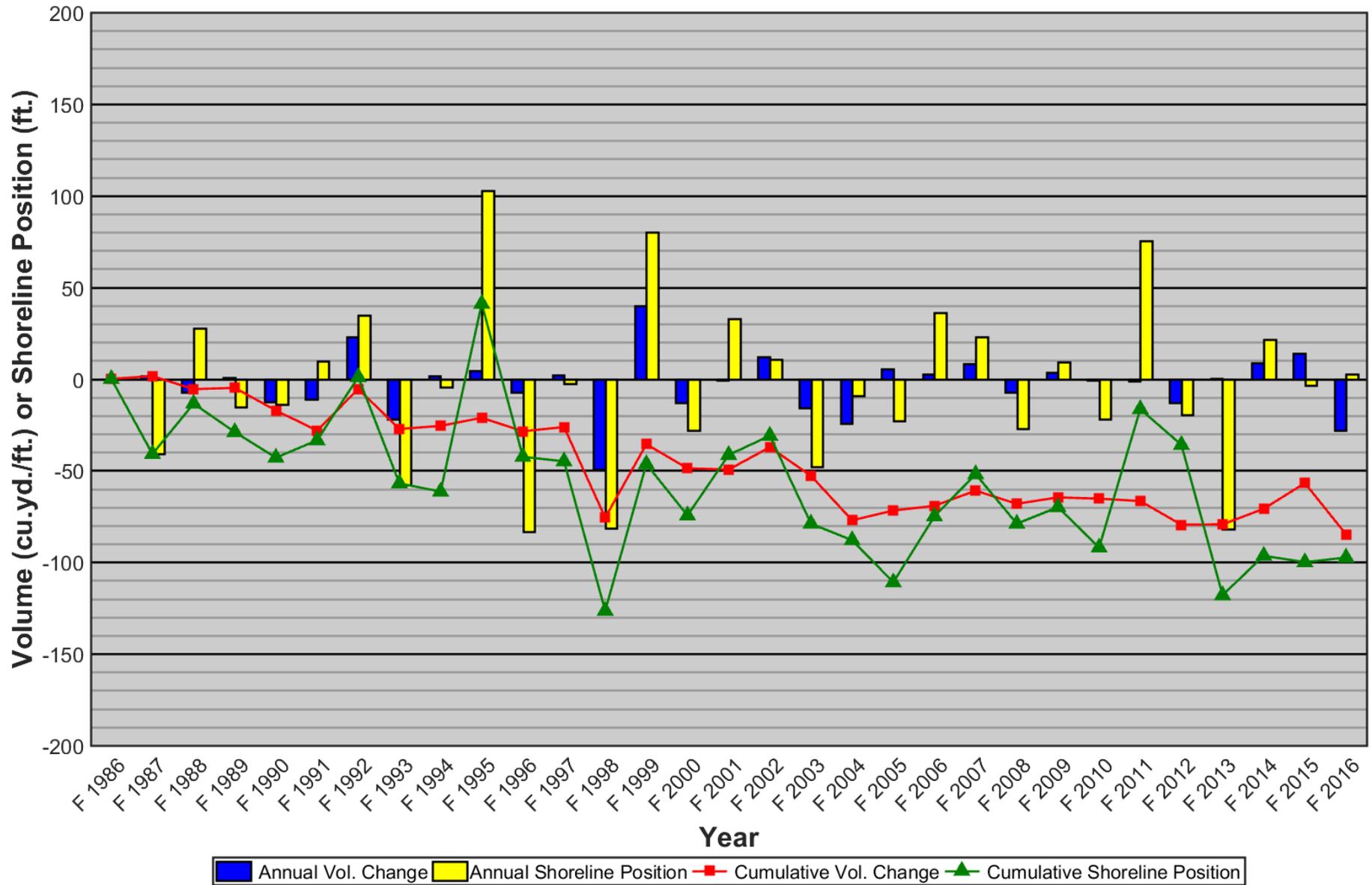


Figure 265. Both the sand volume and shoreline position trend for Ortley Beach have been negative since 1986. Hurricane Sandy had a great impact on the shoreline position, resulting in a shoreline retreat of 83 ft. Volume change after Hurricane Sandy, however, was near zero because sand was eroded from the foreshore and deposited in the offshore region of the profile line. The large shoreline retreat posed a problem (even though volume change was negligible) and was the primary reason the USACE beach restoration project initially started at Ortley in the summer of 2017.

### 30-Year Ensemble Mean Profile at Site 149, 8<sup>th</sup> Avenue, Ortley Beach, Ocean Co.

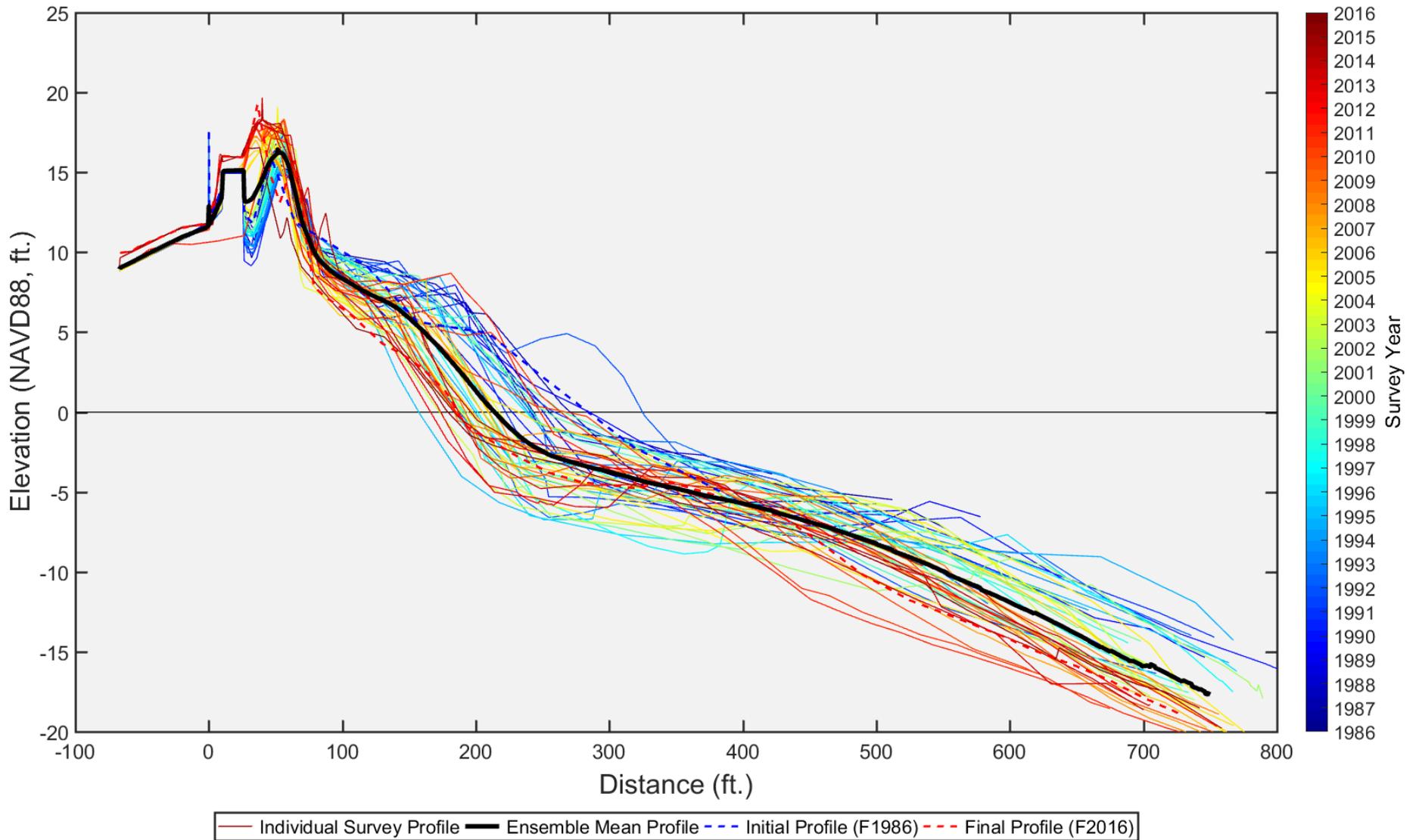


Figure 266. The 30-year profiles show that the original dune elevation grew through time but was no match for Hurricane Sandy which moved the sand inland and into the bay. The general trend of the site shows the lowering of the berm and landward movement of the shoreline through time. The USACE northern Ocean County shore protection project could not occur soon enough.

#149 - 8th Avenue, Ortley Beach, Ocean County  
**Comparison of 1995 to 2015**

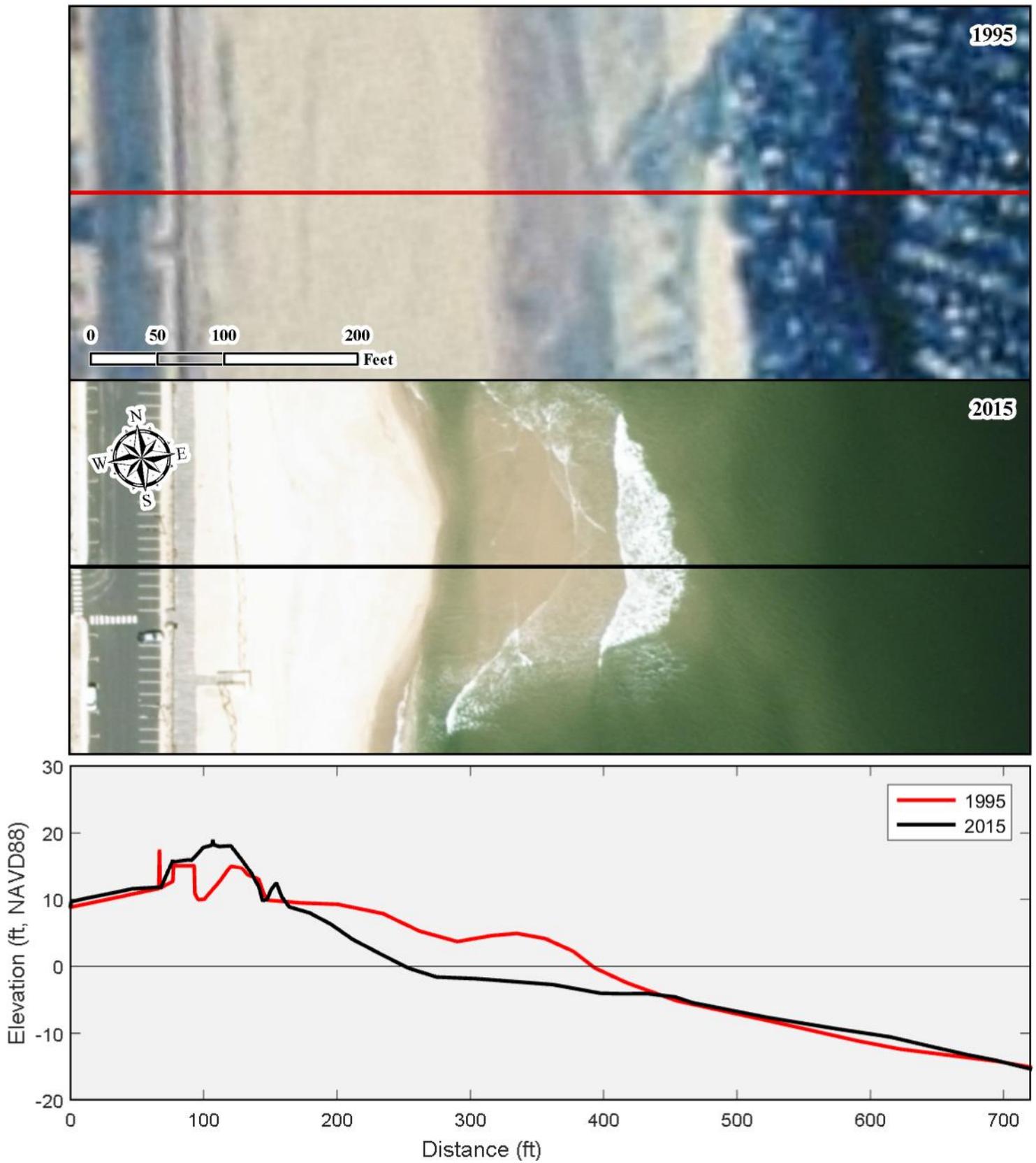


Figure 267. The 2015 profile shows the restored dune at an elevation nearly 20 ft. The berm is much lower in elevation from its 1995 position and the shoreline has retreated by about 140 ft between 1995 and 2015.

**NJBPN 248 – Franklin Avenue, Seaside Heights (December 7, 2016)**



**Figure 268. View to the north from the beach at Franklin Avenue in Seaside Heights looking at the amusement pier complex.**

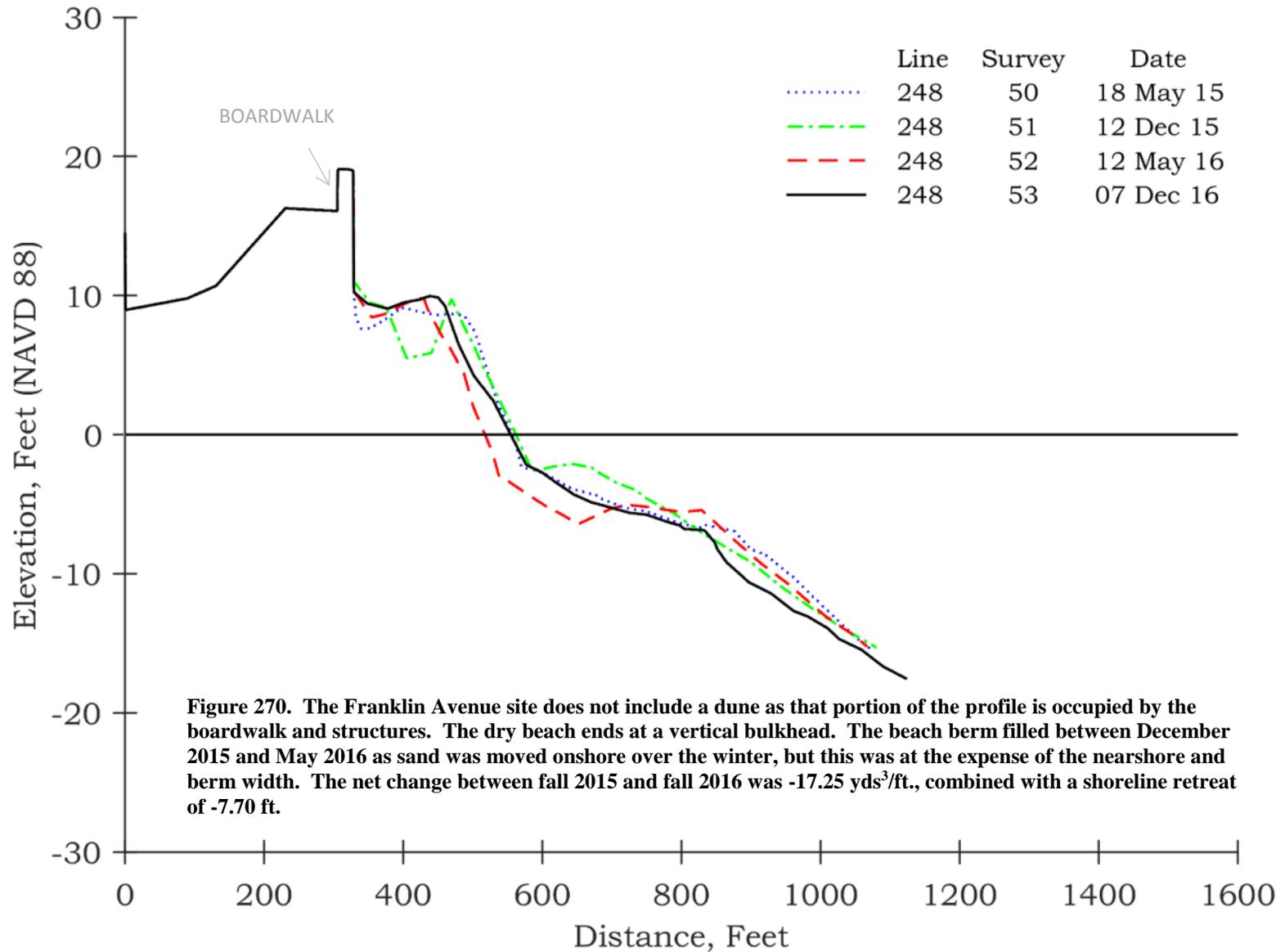
**NJBPN 248 – Franklin Avenue, Seaside Heights**



**Figure 269a & 269b. The two annual photos at the Franklin Avenue site show a nearly identical backshore elevation (left taken December 12, 2015 and right photo taken December 7, 2016). However, the 2015 photo does not clearly depict the deep runnel feature on the berm that is apparent in the profile cross section below.**

# New Jersey Beach Profile Network

#248 - Franklin Avenue, Seaside Heights, Ocean County



### 7-Year Coastal Changes at Site 248, Franklin Avenue, Seaside Heights, Ocean Co.

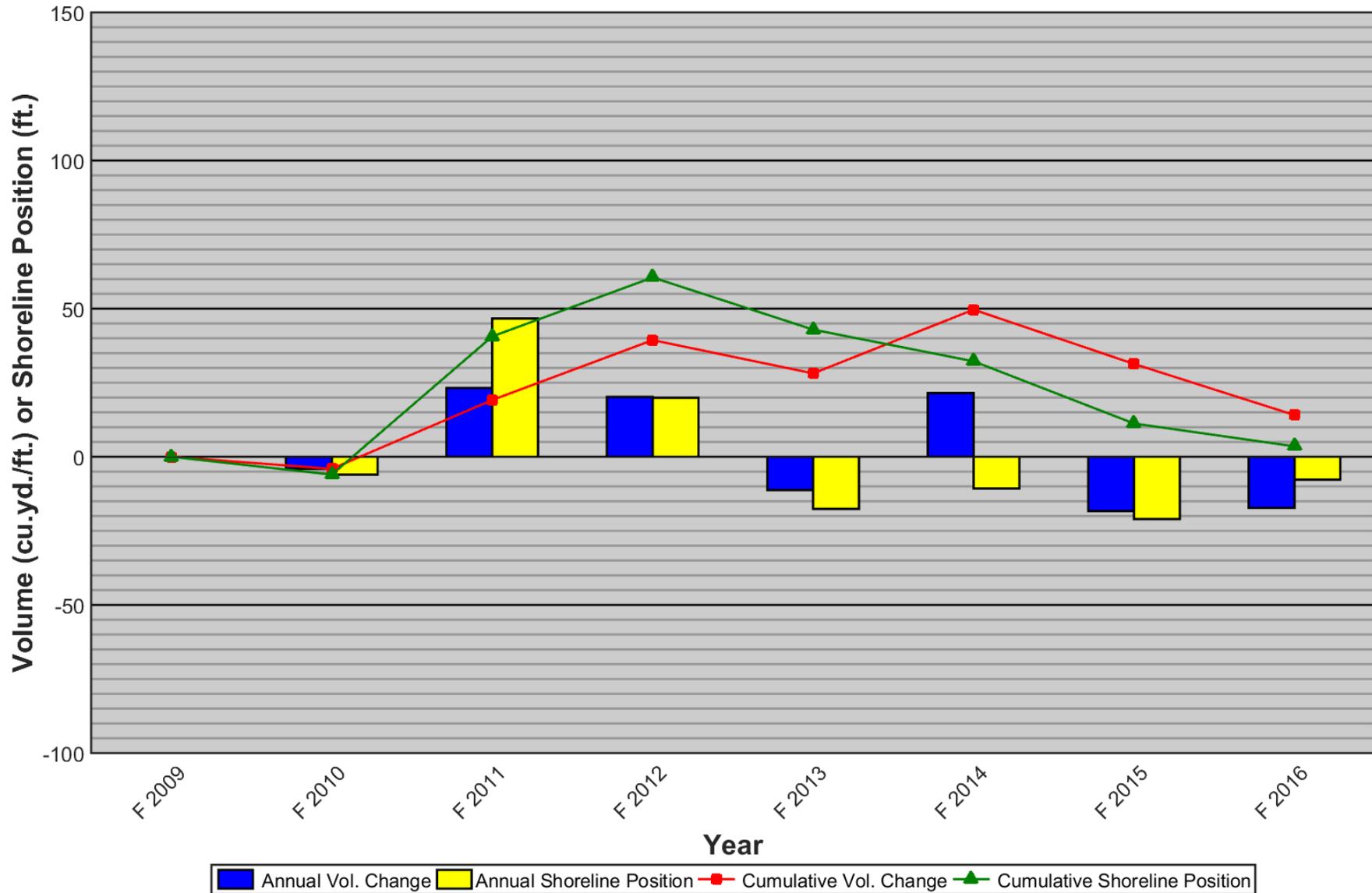


Figure 271. The Franklin Avenue site was added in 2009 to include the municipality in the annual surveys. Minor additions to the sand volume have decreased since 2014 with a shoreline position advancing 60 feet and then returning to within 4 feet of the starting location in 2009. Beach nourishment will arrive sometime in 2017.

### 7-Year Ensemble Mean Profile at Site 248, Franklin Avenue, Seaside Heights, Ocean Co.

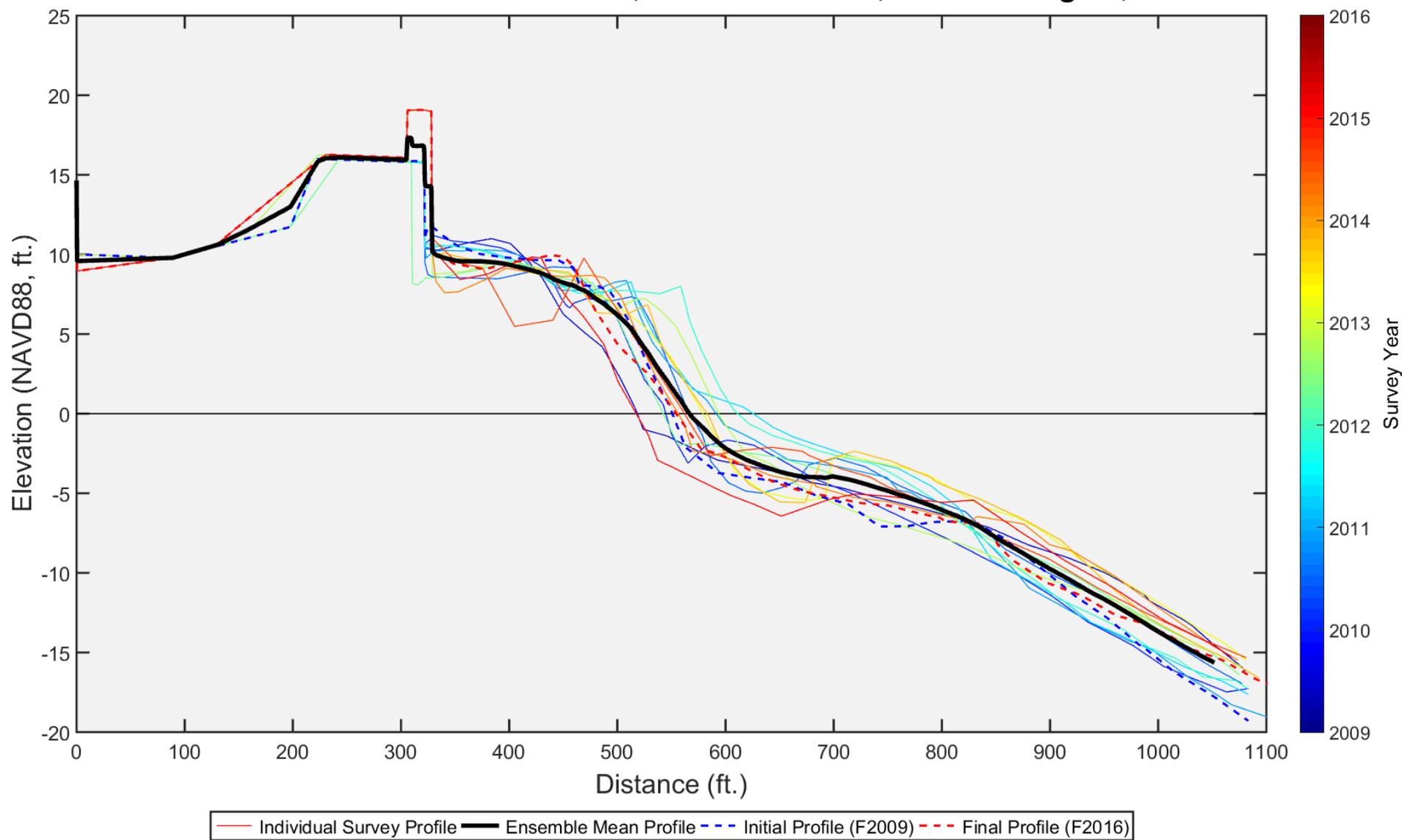


Figure 272. The individual survey profile lines show a tendency of retreat over the past 8 years. Post Sandy work on the bulkhead has added height.

#248 - Franklin Avenue, Seaside Heights Borough, Ocean County  
Comparison of 2010 to 2015

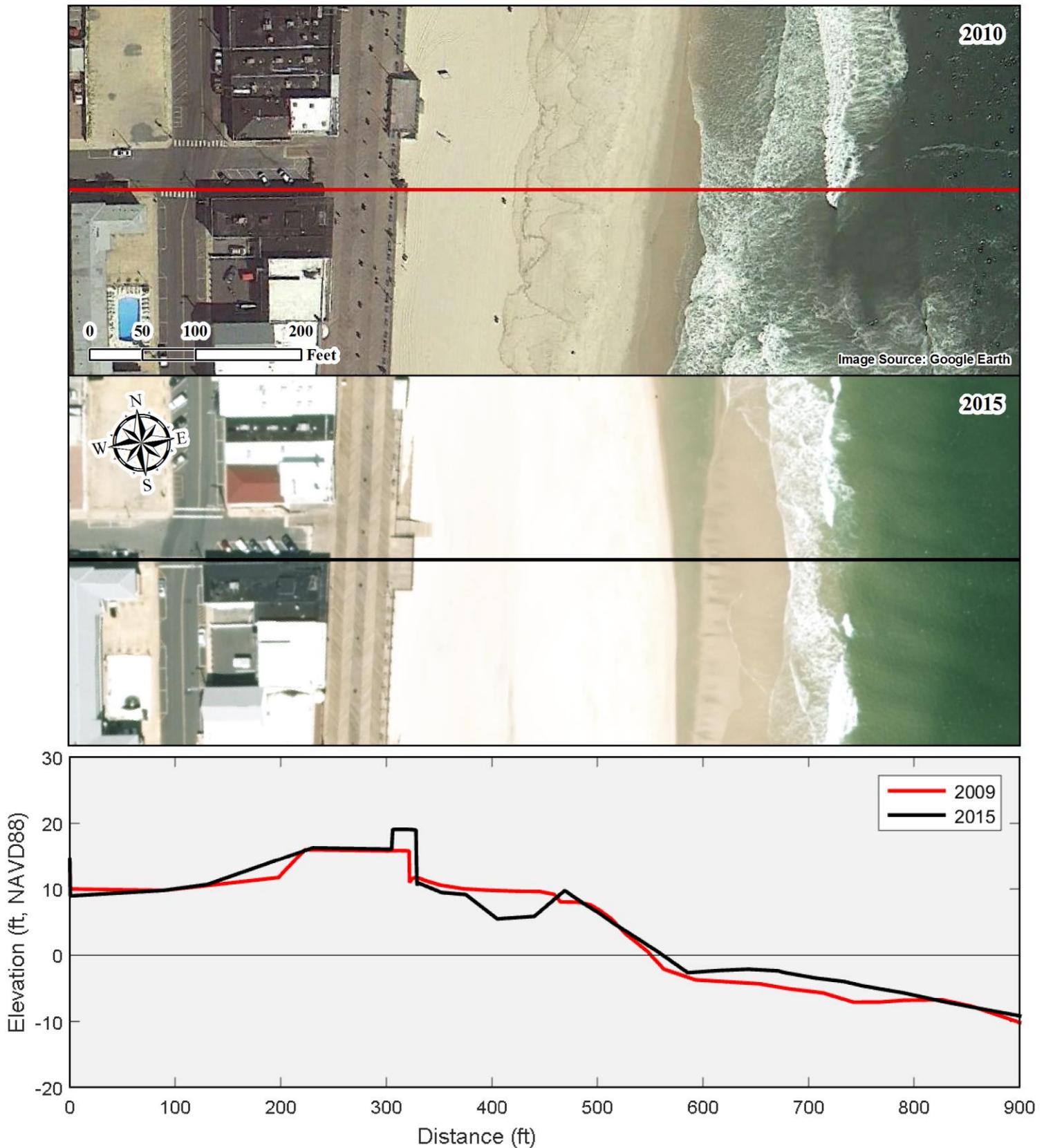


Figure 273. A revised boardwalk structure was added to this site after Hurricane Sandy. The berm lowered from its 2009 position. The shoreline moved 15 ft seaward between 2009 and 2015.

**NJBPN 148 – 4th Avenue, Seaside Park (December 9, 2016)**



**Figure 274. View to the south from the dune crest at 4<sup>th</sup> Avenue in Seaside Park that show parking, dune condition, and new fencing partially buried by wind deposited sand.**

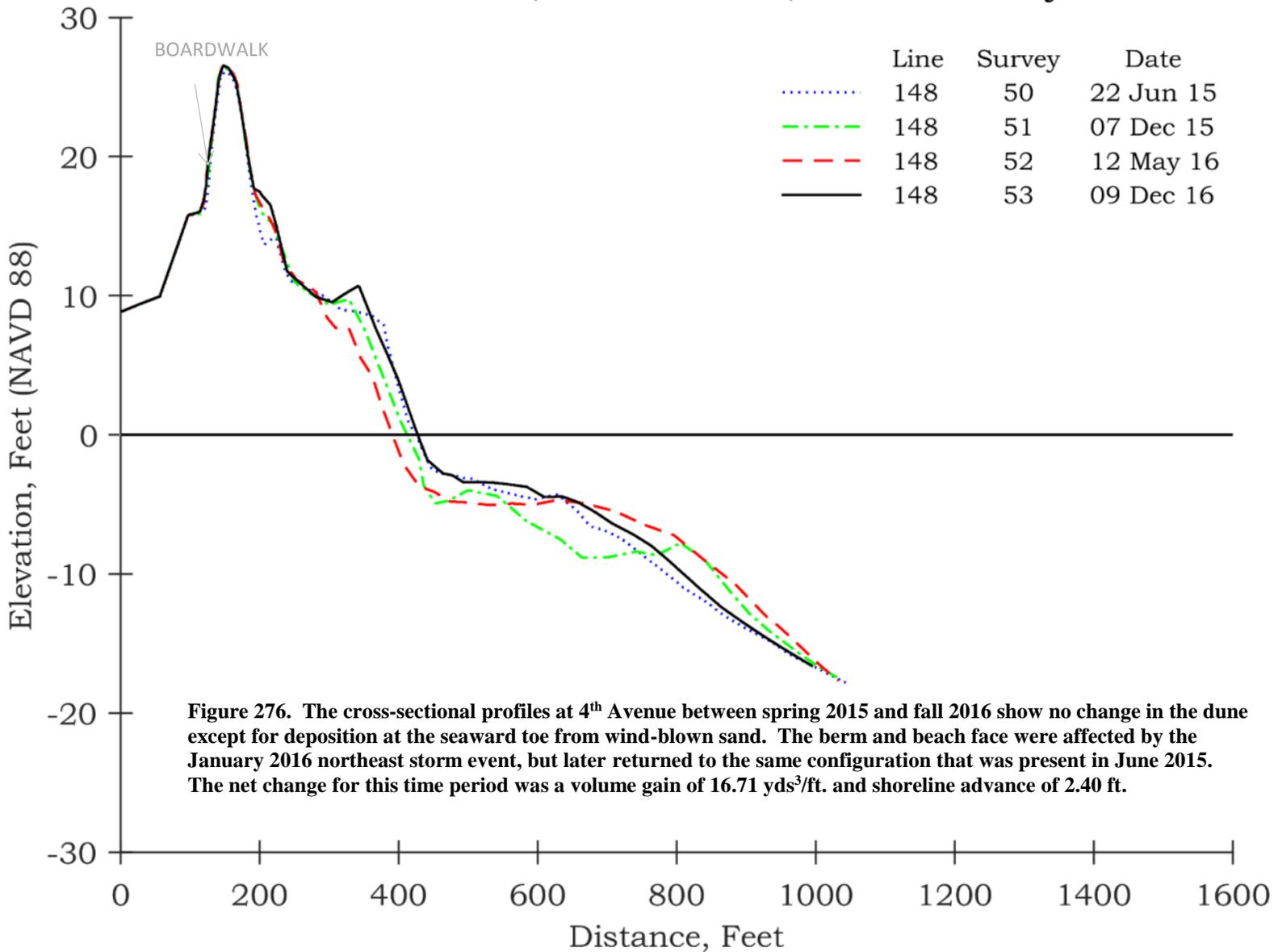
**NJBPN 148 – 4<sup>th</sup> Avenue, Seaside Park**



**Figure 275a & 275b. The photo on the left (taken December 7, 2015) shows the dune has gained sand landward of the old fence line. The right photo (December 9, 2016) shows the toe of the foredune developed at the original fencing. A more recently installed row of fence is set landward of the original fence line.**

# New Jersey Beach Profile Network

## #148 - 4<sup>th</sup> Avenue, Seaside Park, Ocean County



### 30-Year Coastal Changes at Site 148, 4<sup>th</sup> Avenue, Seaside Park, Ocean Co.

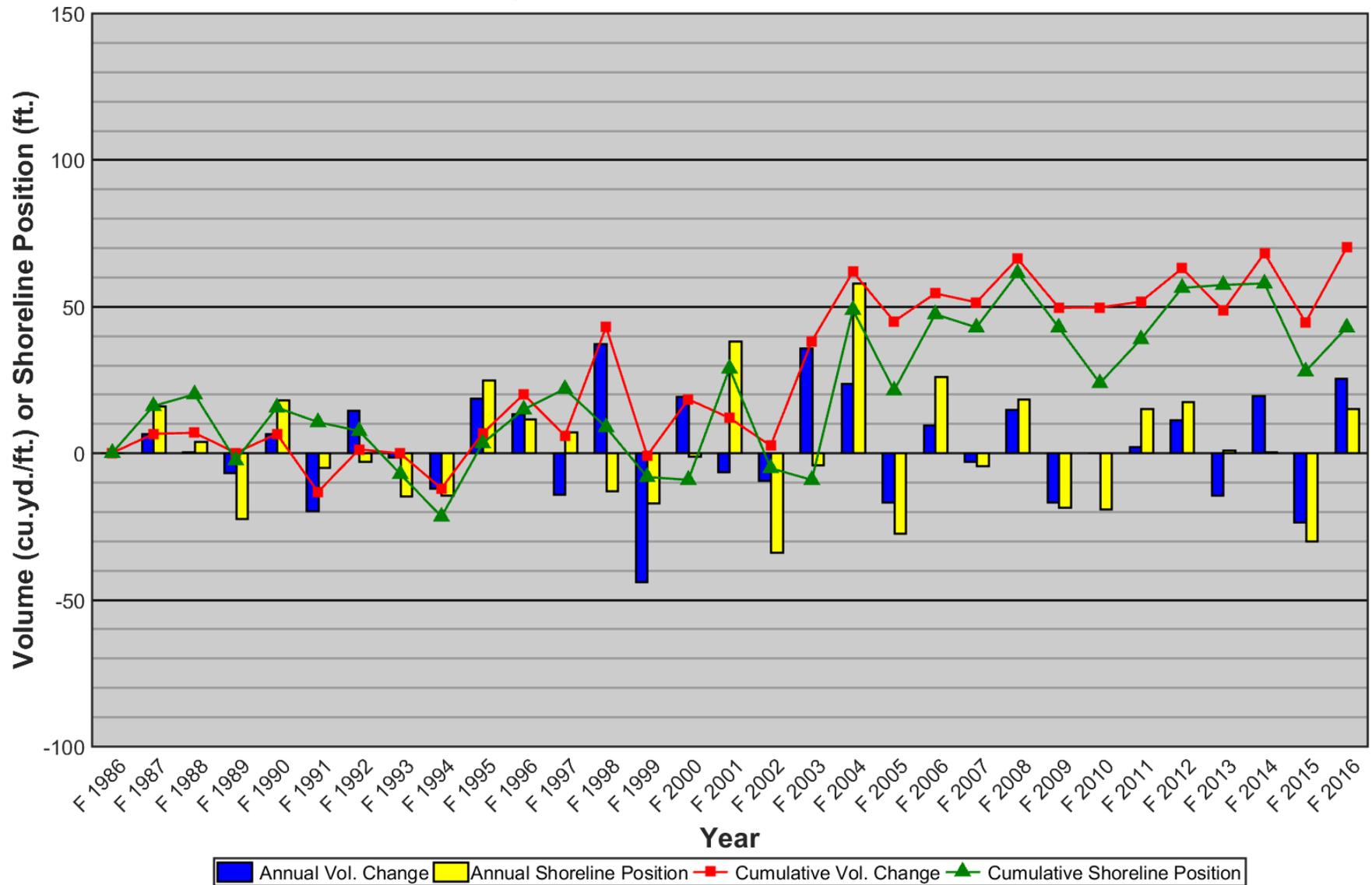


Figure 277. After 2002, the sand volume increased by almost 60 yds<sup>3</sup>/ft in just two years at the 4<sup>th</sup> Avenue site. Hurricane Sandy eroded some of the dune but was of little significance here. The shoreline advanced seaward by over 40 ft and the profile volume increased by about 70 yds<sup>3</sup>/ft from 1986 to 2016.

### 30-Year Ensemble Mean Profile at Site 148, 4<sup>th</sup> Avenue, Seaside Park, Ocean Co.

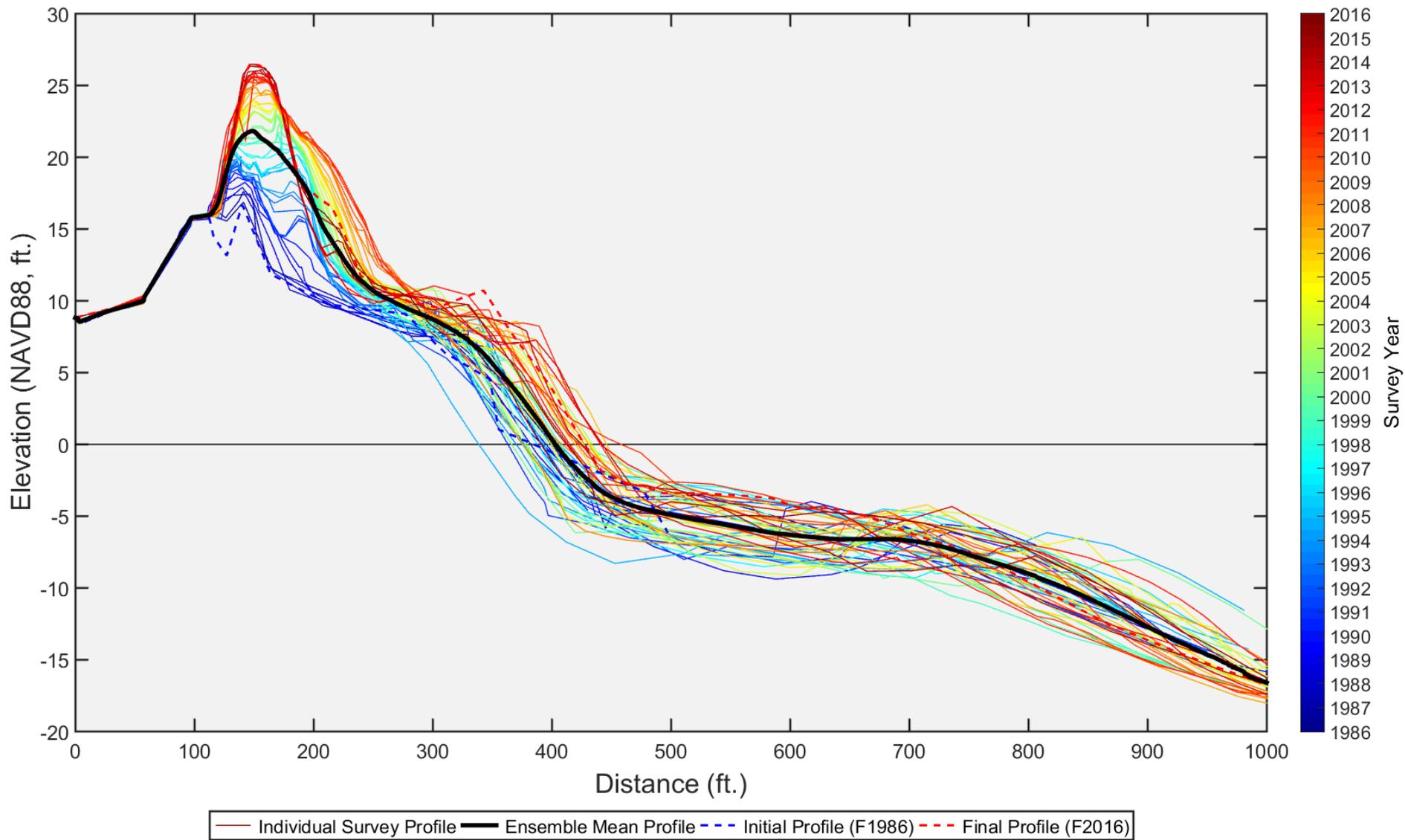


Figure 278. The 30-year profile time series shows the original dune grew much larger over time and without any outside help. Local efforts added fencing frequently and occasionally placed Christmas trees at the base of the dune. The beach is wider today and the dune is a better shore protection for the effort.

#148 - 4th Avenue, Seaside Park Borough, Ocean County  
**Comparison of 1995 to 2015**

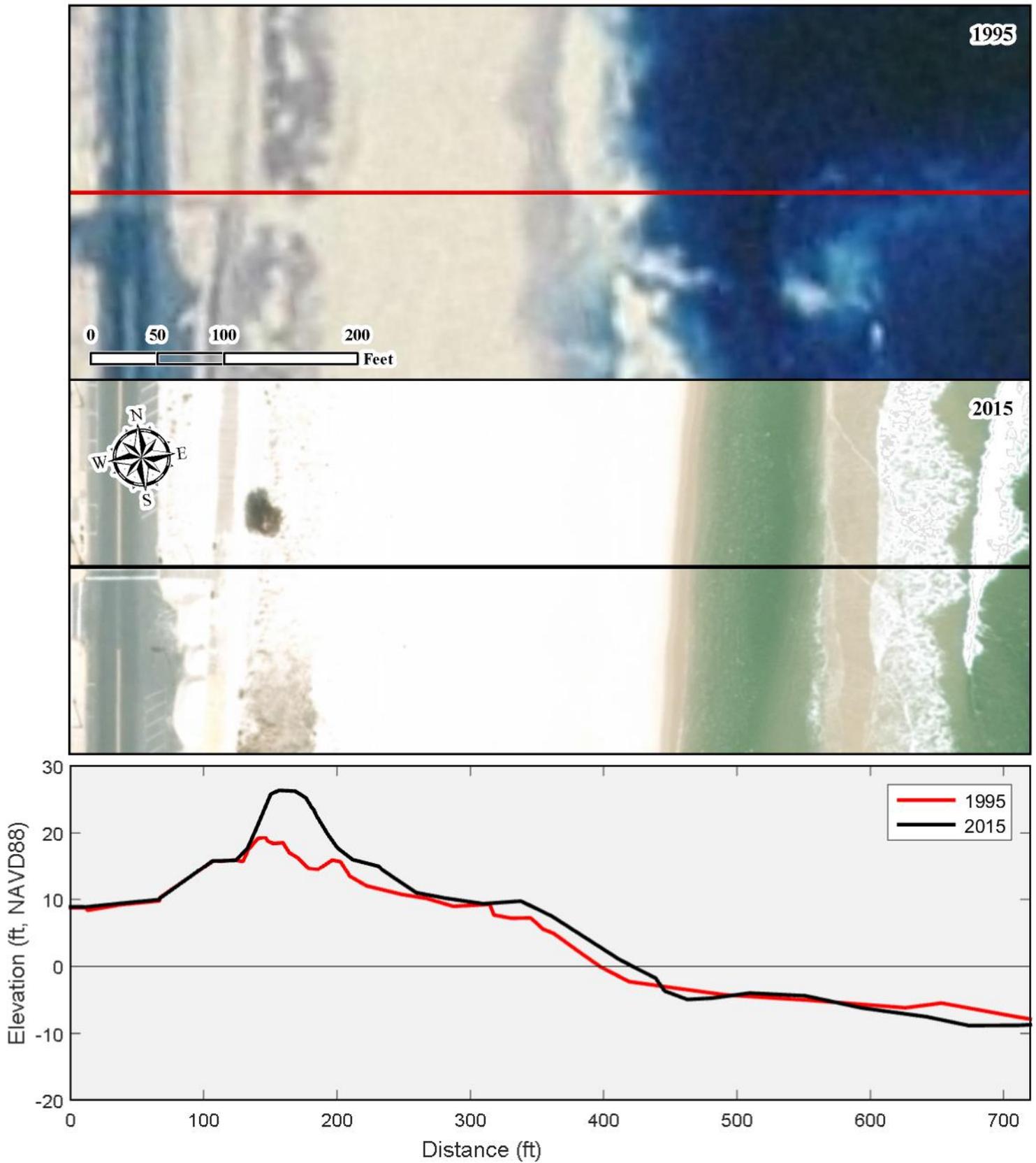


Figure 279. The dune and berm grew through natural accretion between 1995 and 2015. The shoreline advanced 25 ft seaward.

**NJBPN 147 – 6<sup>th</sup> Lane, Midway Beach (December 9, 2016)**



**Figure 280. View to the north from the dune crest at 6<sup>th</sup> Lane in Midway Beach, NJ.**

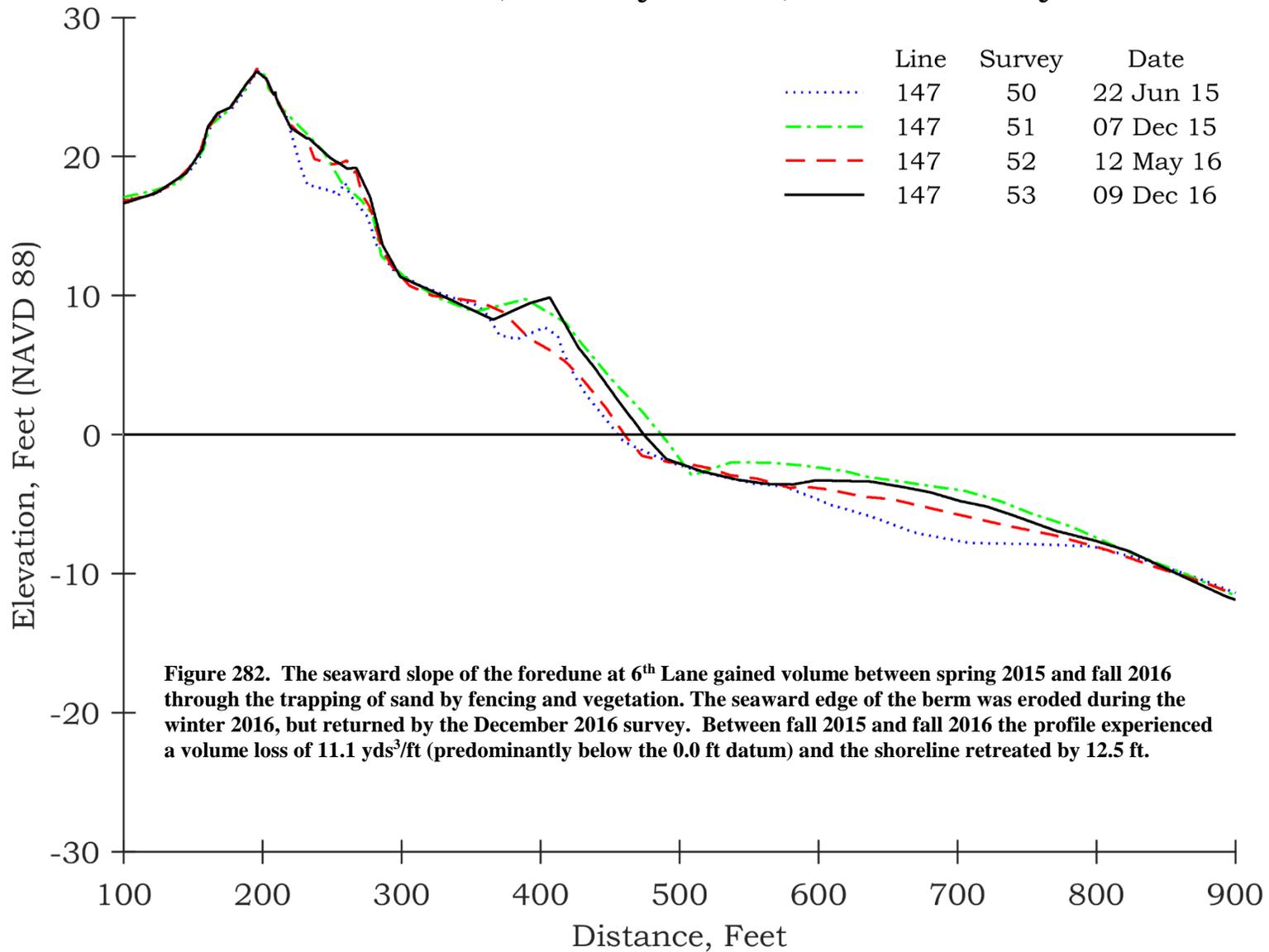
**NJBPN 147 – 6<sup>th</sup> Lane, Midway Beach**



**Figure 281a & 281b. The photos show the condition of the backshore and seaward dune toe at 6<sup>th</sup> Lane (left taken December 7, 2015 and right taken December 9, 2016). This section of the profile showed little change over the past year and appeared to have fared well through the January 2016 northeast storm.**

# New Jersey Beach Profile Network

## #147 - 6<sup>th</sup> Lane, Midway Beach, Ocean County



### 30-Year Coastal Changes at Site 147, 6<sup>th</sup> Lane, Midway Beach, Ocean Co.

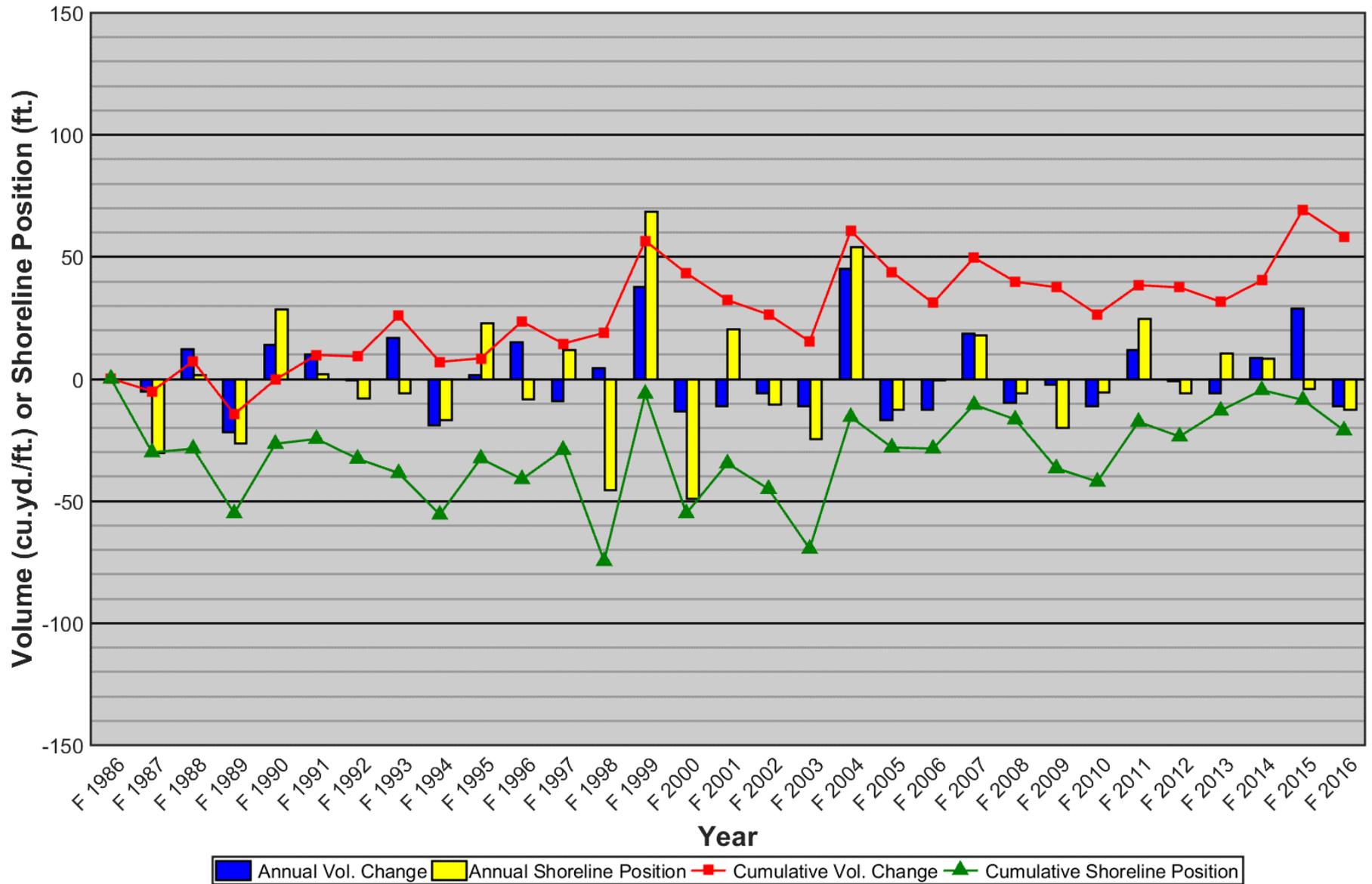


Figure 283. The long-term trend of the profile at 6<sup>th</sup> Lane has shown a sand volume increase of about 60 yds<sup>3</sup>/ft, but the shoreline position has retreated 20 ft landward of its original position in 1986. In fall 2005, this profile was moved several feet south (from within the center of the access path) to capture the changes in the adjacent dune area.

### 30-Year Ensemble Mean Profile at Site 147, 6<sup>th</sup> Lane, Midway Beach, Ocean Co.

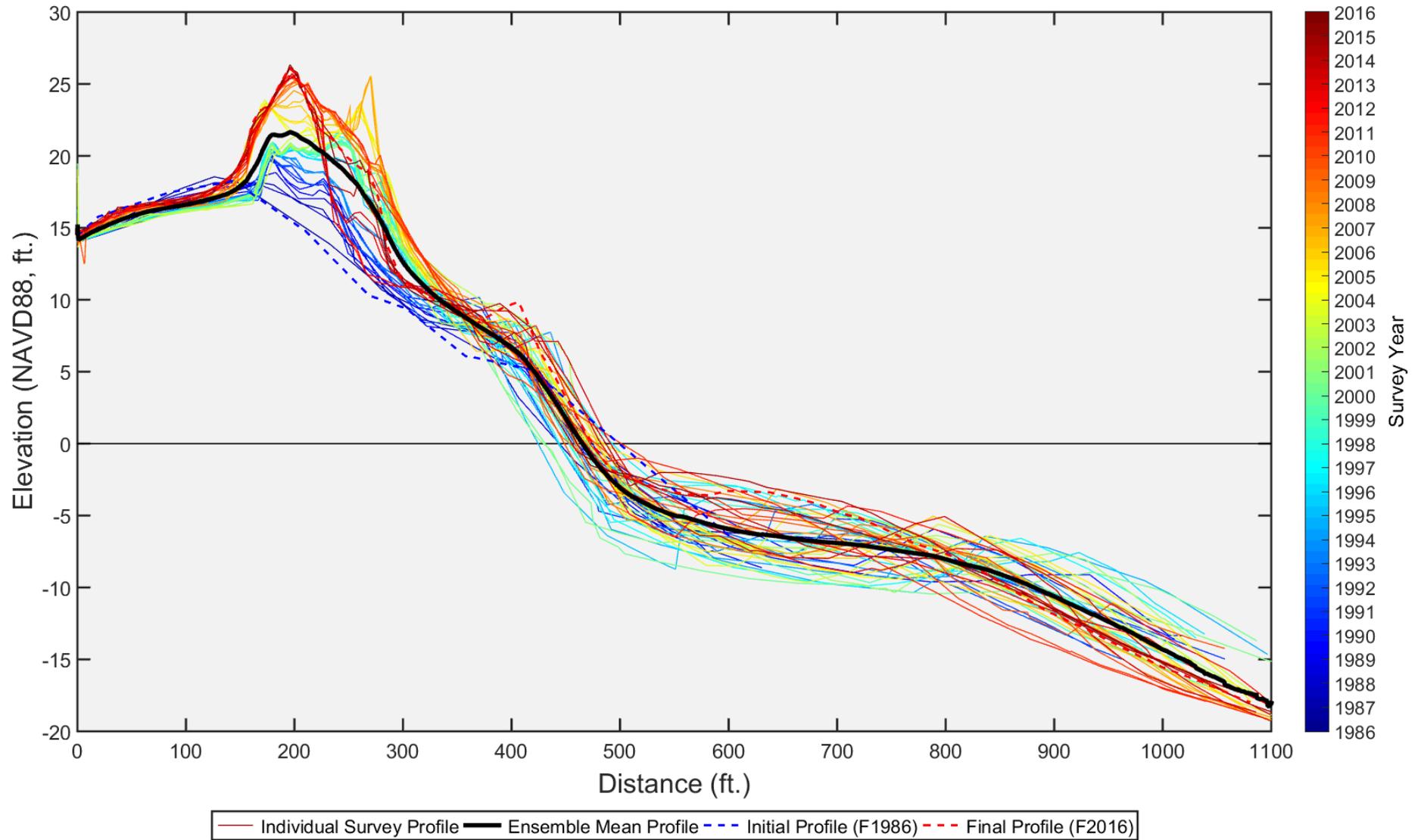


Figure 284. The overall envelope of change at the 6<sup>th</sup> Lane site is minimal, but does display variation about the mean in the nearshore region of the profile. The berm elevations have remained at a similar position (as evident by the lack of variation in the foreshore area), but the variation in the nearshore is evident in the presence of multiple different sandbars being measured over the years. Hurricane Sandy created a dramatic dune scarp that has since been building seaward on its own.

#147 - 6th Lane, Midway Beach, Ocean County  
Comparison of 1995 to 2015

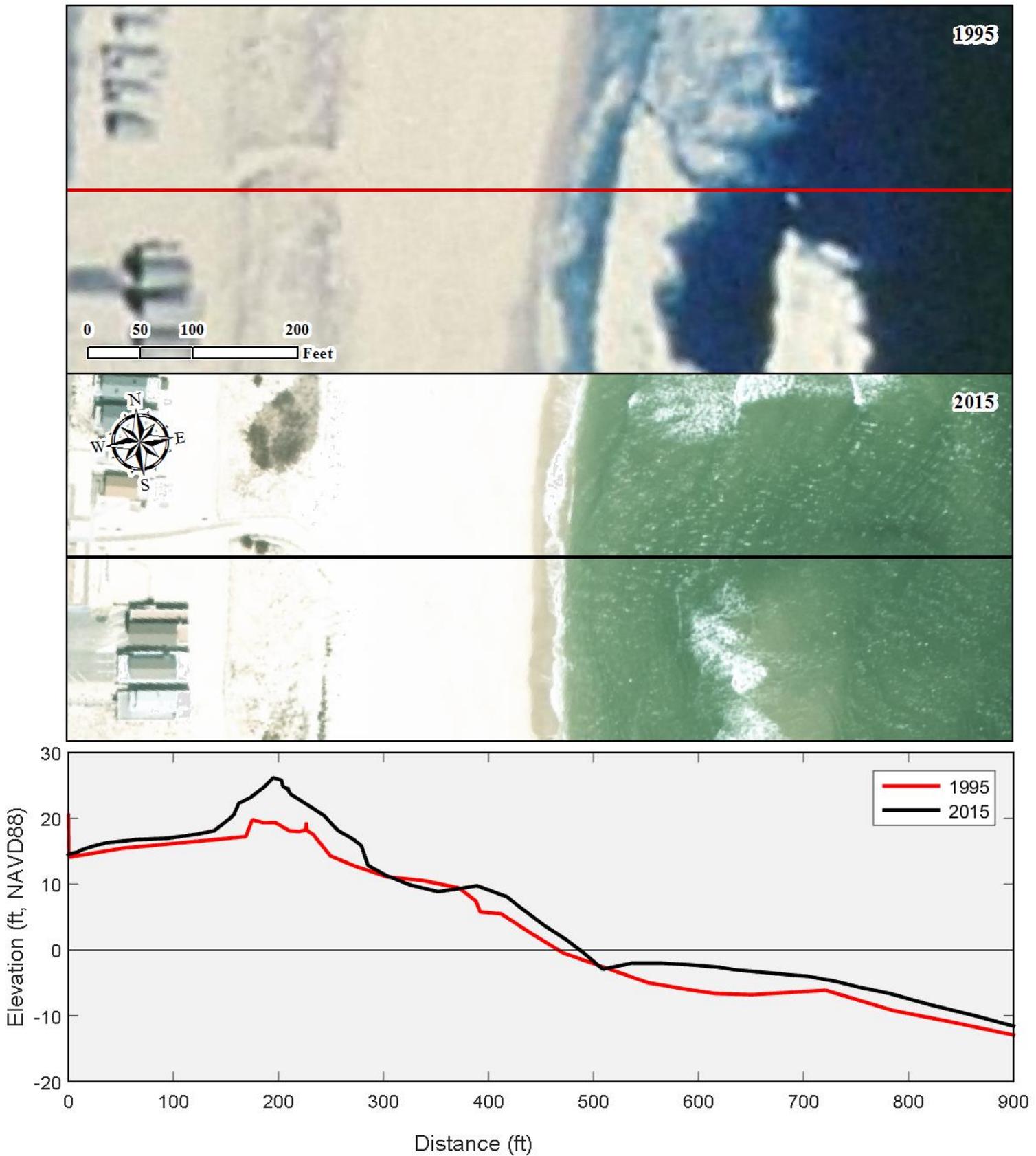


Figure 285. Comparison of site 147 after it was moved in 2005 out of the beach access way and onto the adjacent dune. The berm and nearshore sections fall along the original transect and the shoreline moved about 20 ft seaward.

**NJBPN 247 – North End, Island Beach State Park (December 8, 2016)**



**Figure 286. View to the south from the dune crest at the North End location in Island Beach State Park.**

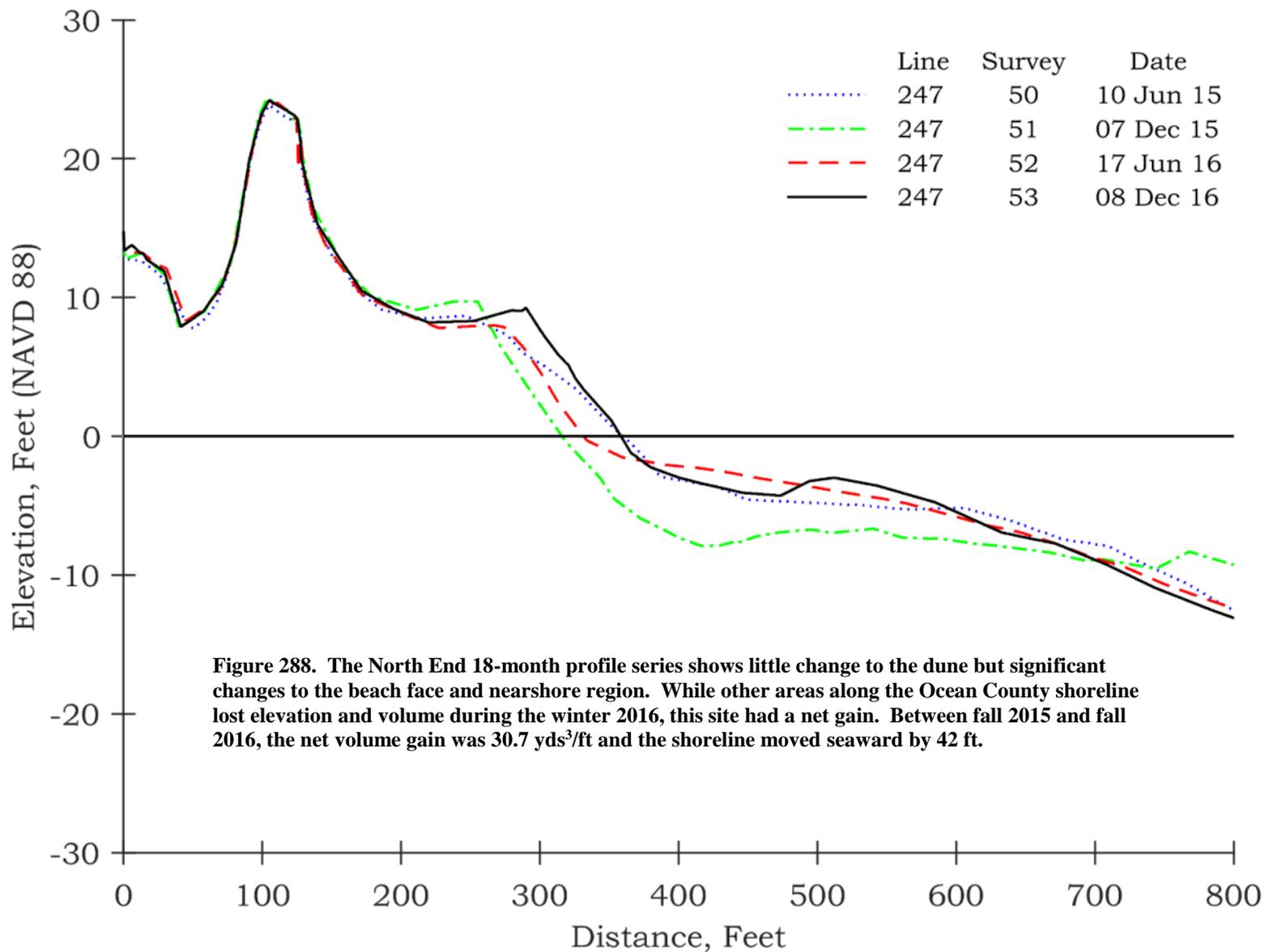
**NJBPN 247 – North End, Island Beach State Park**



**Figure 287a & 287b. The left photo (taken December 7, 2015) shows the scarp in the dune system that was generated during Hurricane Sandy and still not recovered three years later. The December 8, 2016 photo (right) shows nearly exact conditions four years later. Sporadic sections along the dune scarp have begun to vegetate and trap sand.**

# New Jersey Beach Profile Network

#247 - North End, Island Beach State Park, Ocean County



### 30-Year Coastal Changes at Site 247, North End, Island Beach State Park, Ocean Co.

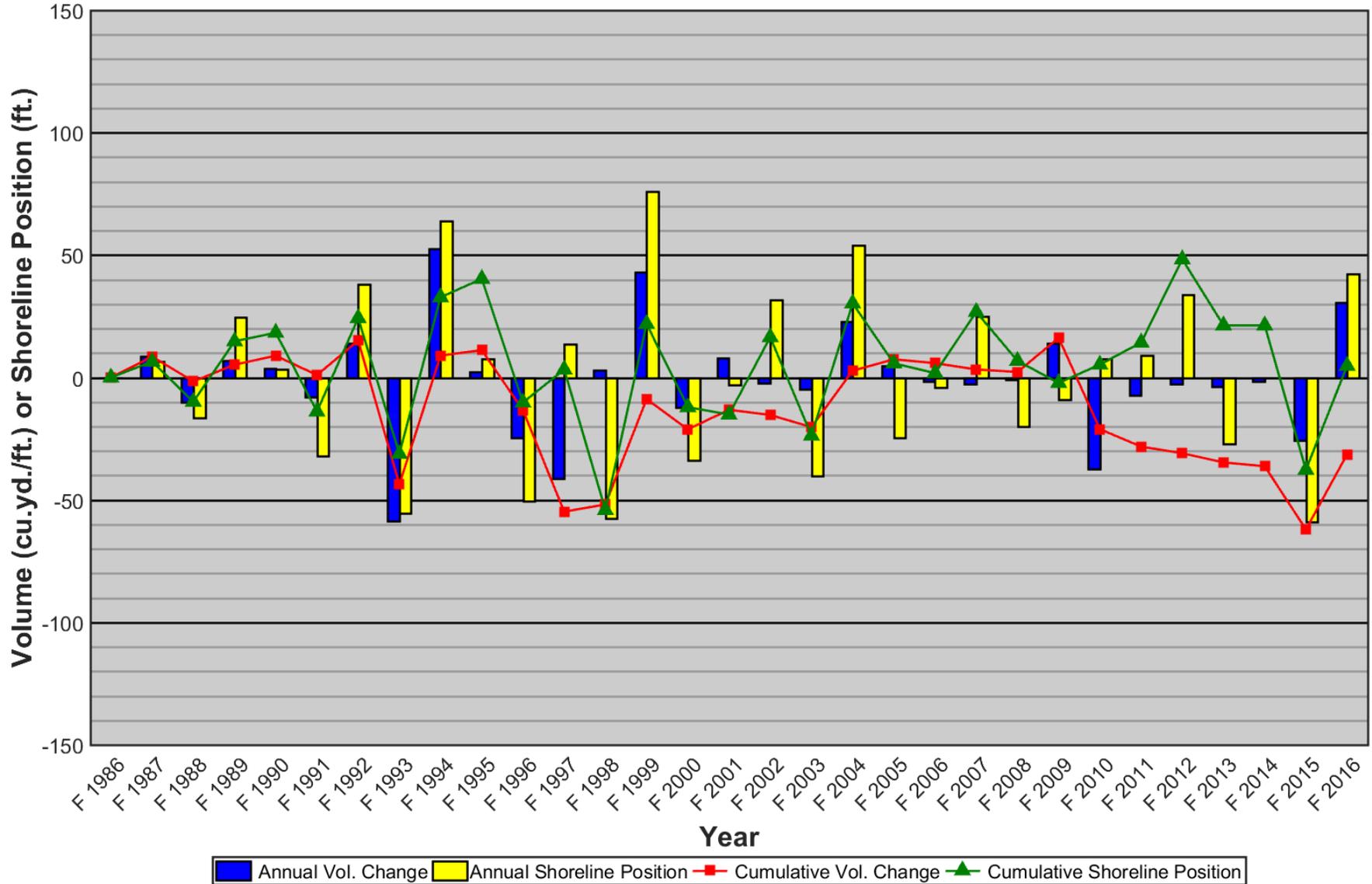
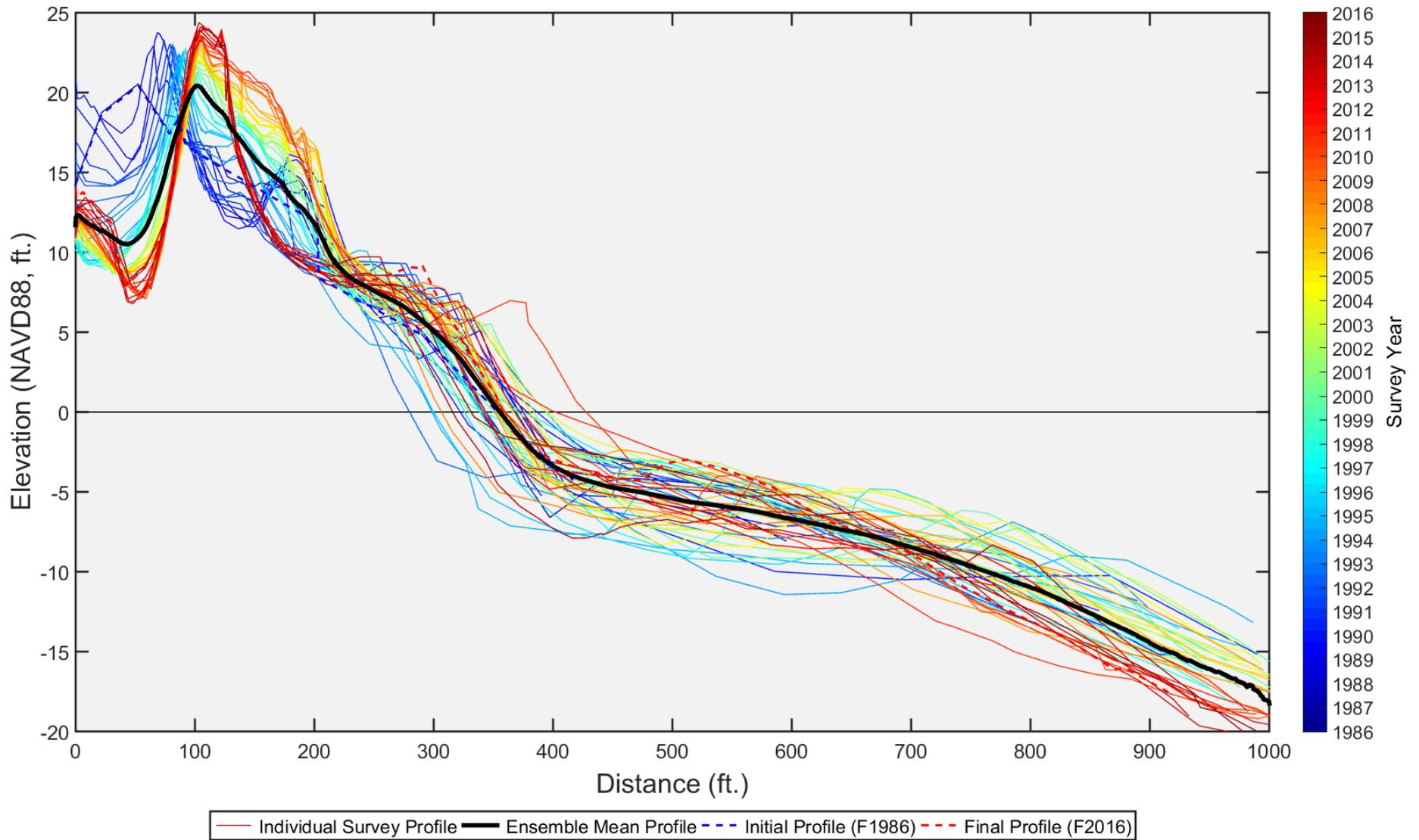


Figure 289. The North End Island Beach State Park profile has undergone wide swings in sand volume and shoreline position. Since 2010, the site experienced volume loss, but this reversed in 2016 leaving the site about 30 yds<sup>3</sup>/ft below the 1986 sand volume. In contrast, the shoreline ended the 30-year interval about 5 ft seaward of the initial 1986 shoreline position.

### 30-Year Ensemble Mean Profile at Site 247, North End, Island Beach State Park, Ocean Co.



**Figure 290. The 30-year profile time-series at the North End natural area shows no particular pattern for long-term trends. The dune that was measured in 1986 has migrated seaward nearly 50 ft. Berm width remained consistent with only a few outlier positions. Numerous sand bars have been measured through time indicating the influence of cross-shore sediment transport at this location.**

#247 - North End, Island Beach State Park, Ocean County  
**Comparison of 1995 to 2015**

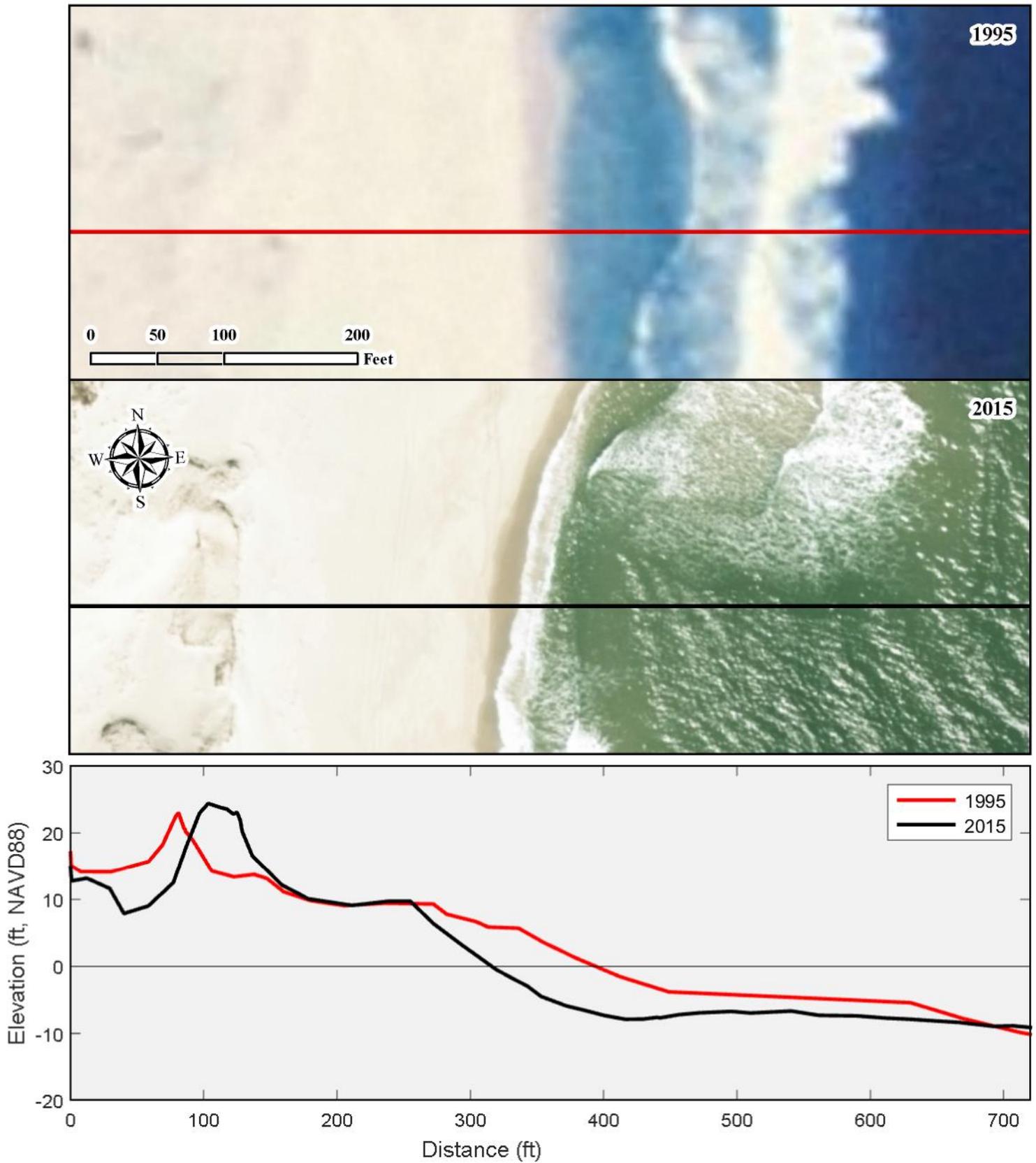


Figure 291. The dune moved seaward from its 1995 position while the berm remained in the same elevation. The shoreline retreated landward by almost 80 ft from 1995 to 2015.

**NJBPN 246 – Parking Lot A7, Island Beach State Park (December 8, 2016)**



**Figure 292. View to the south from the berm at the Parking Lot A7 location in Island Beach State Park. The profile line is located 400 ft north of the vehicle access point.**

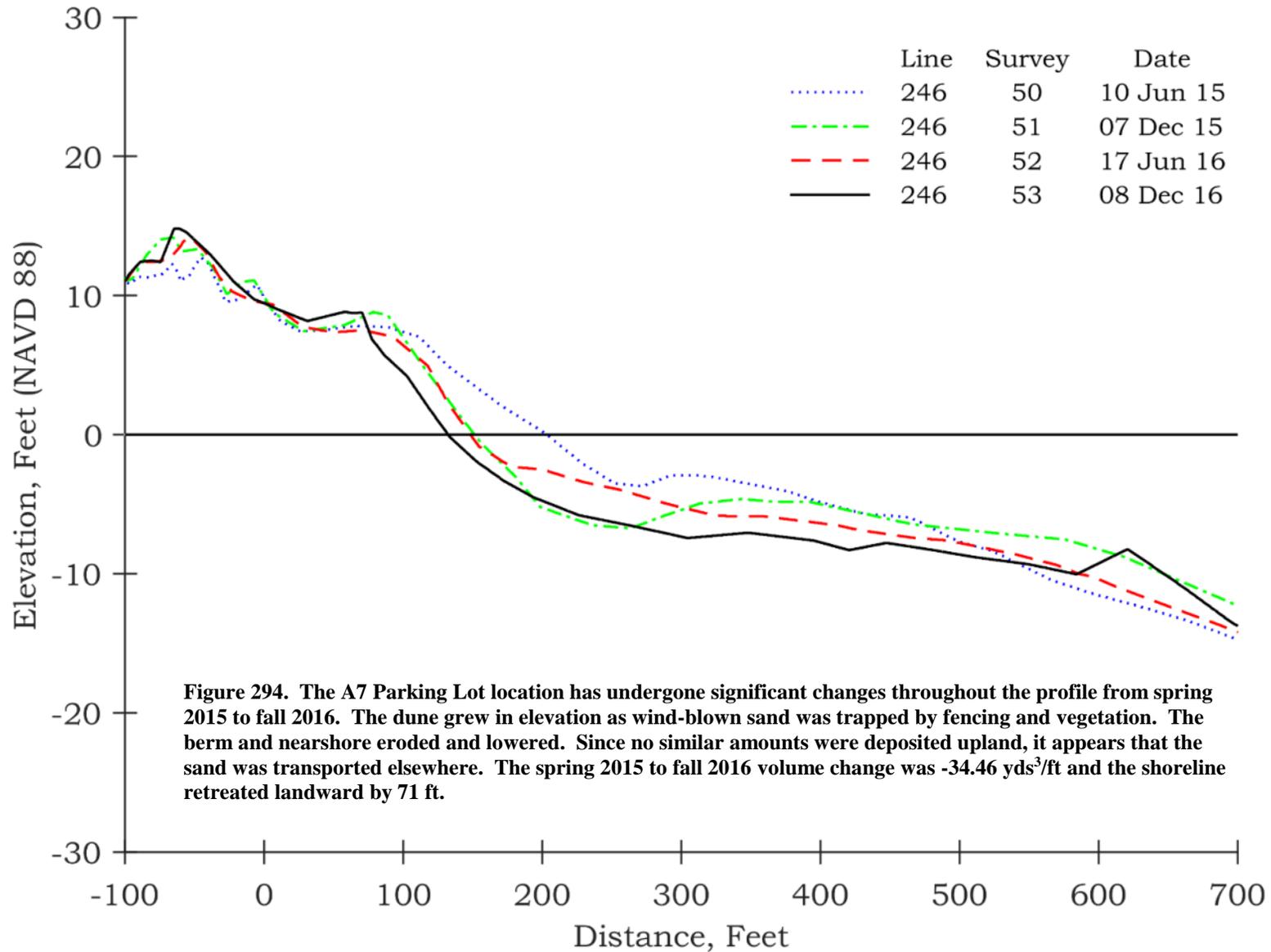
**NJBPN 246 – Parking Lot A7, Island Beach State Park**



**Figure 293a & 293b. The photos along the fence line show the sparsely vegetated dunes at the Parking Lot A7 location (left taken December 7, 2015 and right taken December 8, 2016). Dune elevations along this profile are low compared to other measured locations within the park, though the dune field is nearly 200 ft in width.**

# New Jersey Beach Profile Network

## #246 - Island Beach State Park, Ocean County



### 30-Year Coastal Changes at Site 246, Island Beach State Park, Ocean Co.

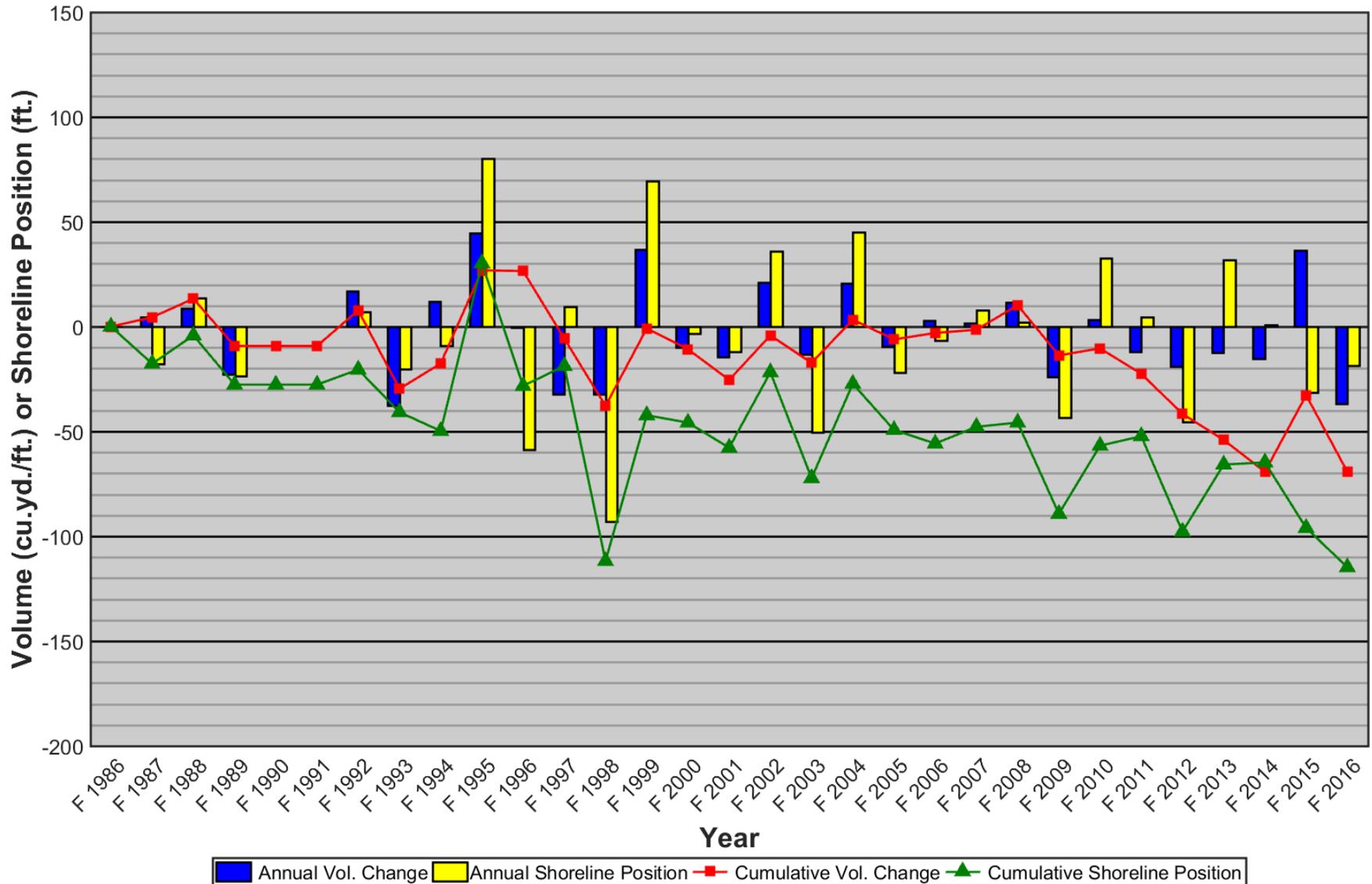


Figure 295. The A7 Parking Lot location has undergone long-term sand volume loss of 69 yds<sup>3</sup>/ft and a shoreline retreat of 115 ft since the initial survey in 1986. Temporary gains occurred in 1995 and 1998, but were not enough to keep the profile stable. No data was collected in fall 1990, as evident by the lack of annual change data and “flat” cumulative change lines.

### 30-Year Ensemble Mean Profile at Site 246, Island Beach State Park, Ocean Co.

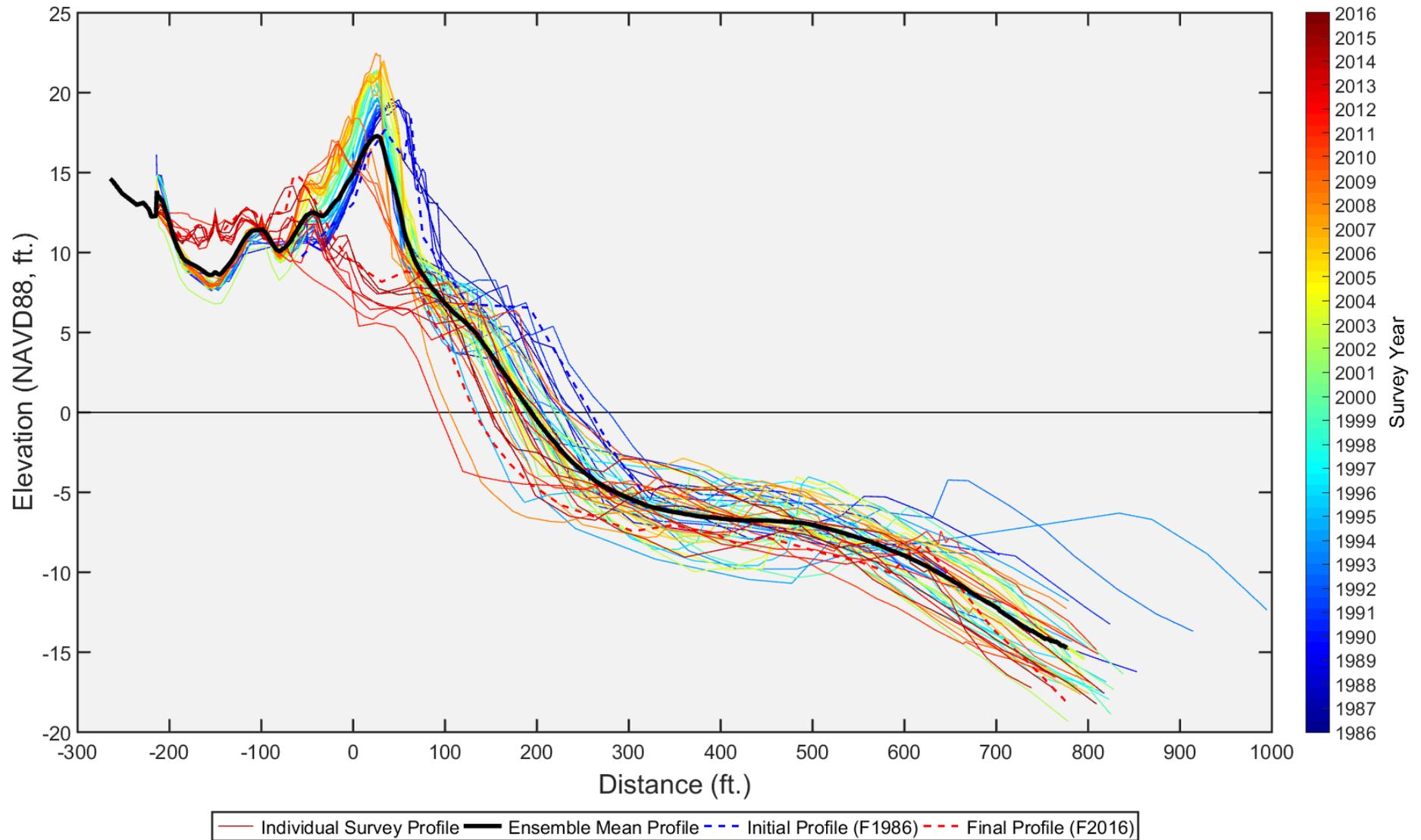


Figure 296. The 30-year profile time series at the A7 Parking Lot location shows a varied, but overall erosional trend and displays the dynamic nature in this section of the park. The dune grew from its 1986 elevation to 22+ ft by early 2000s but was eroded by fall 2010 and never recovered to that elevation. The series displays large differences in dune elevation and position as well as changes to berm width and elevation. Several nearshore bars were documented through time, indicating cross-shore sand transport.

#246 - Parking Lot A7, Island Beach State Park, Ocean County  
**Comparison of 1995 to 2015**

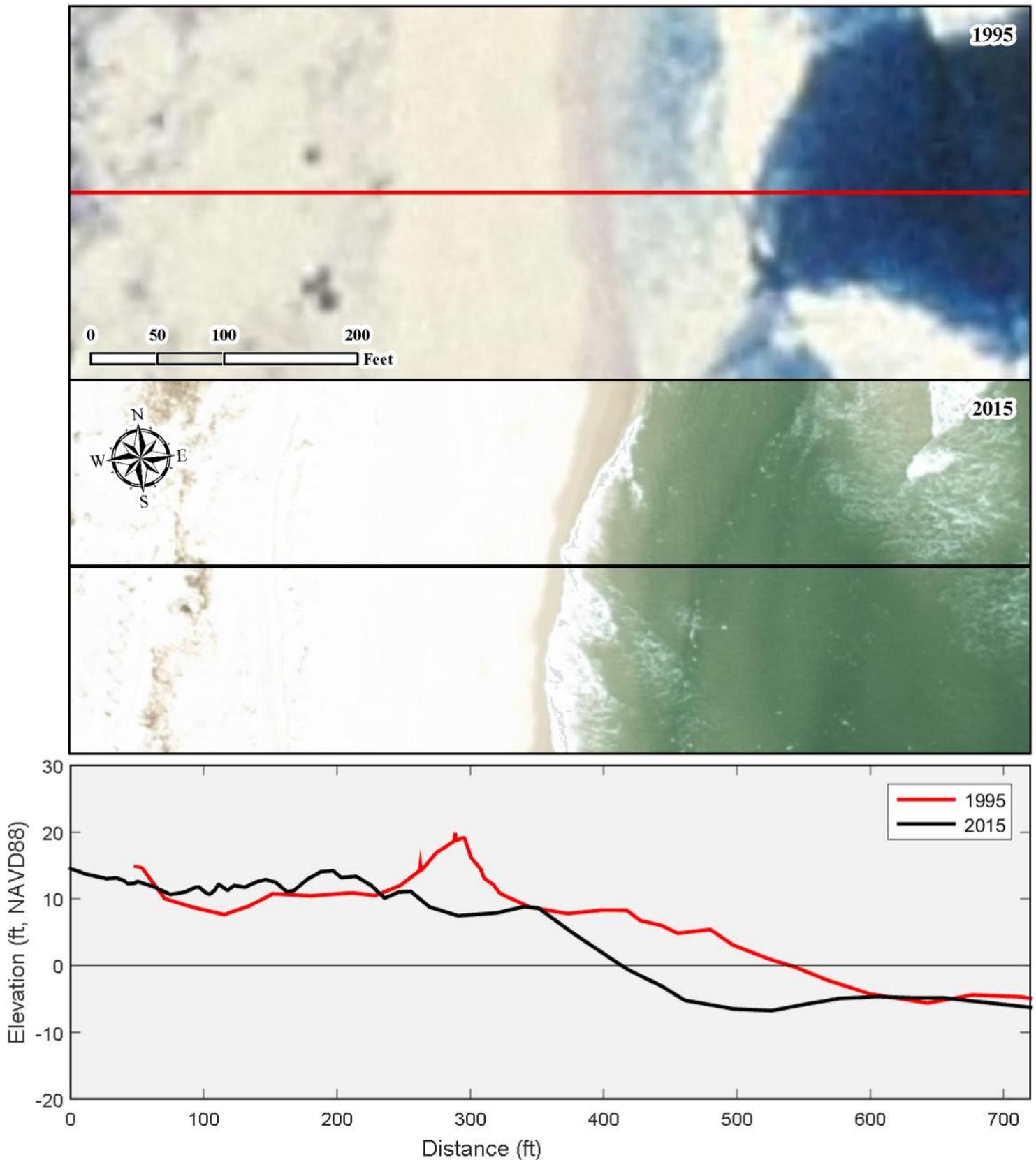


Figure 297. The comparison between 1995 and 2015 shows a significant change between dune elevation and position, due in part to northeast storms (2009, 2015, 2016), Hurricanes Irene and Sandy, and the profile's position near a "blow out" in the dune. The shoreline moved landward by almost 130 ft over this time period.

**NJBPN 146 – South End, Island Beach State Park (December 8, 2016)**



**Figure 298. View to the south from the berm at the South End location in Island Beach State Park. This profile location is located about 6,500 ft north of the Barnegat Inlet north jetty.**

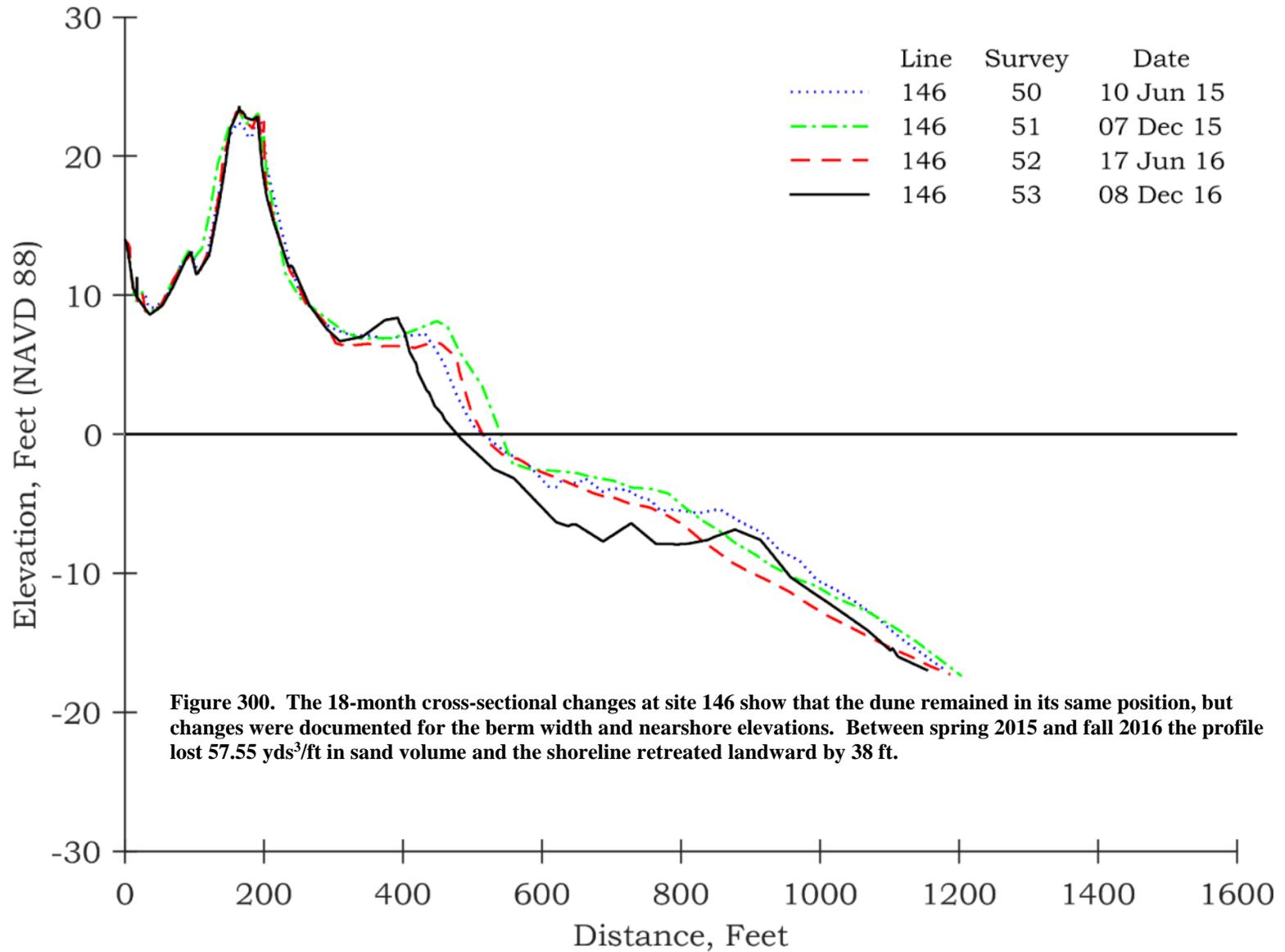
**NJBPN 146 – South End, Island Beach State Park**



**Figure 299a & 299b. The views of the seaward dune slope and backshore at the South End Island Beach State Park site shows little change in vegetation cover or sand accumulation (left photo taken December 7, 2015 and right photo taken December 8, 2016). The dunes here were scarped during Hurricane Sandy but less affected than the dune areas at the other two park locations.**

# New Jersey Beach Profile Network

#146 - South End, Island Beach State Park, Ocean County



### 30-Year Coastal Changes at Site 146, South End, Island Beach State Park, Ocean Co.

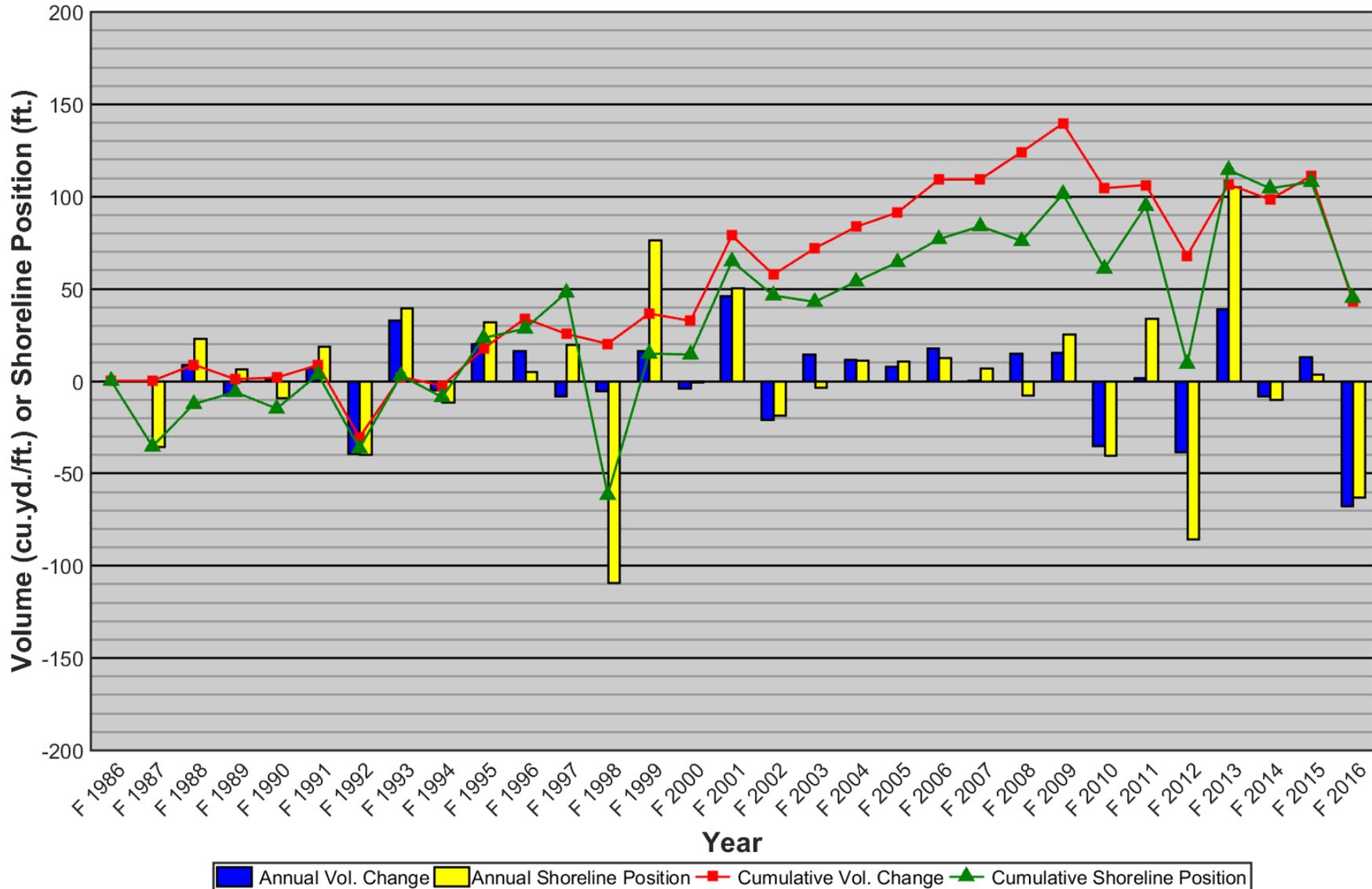
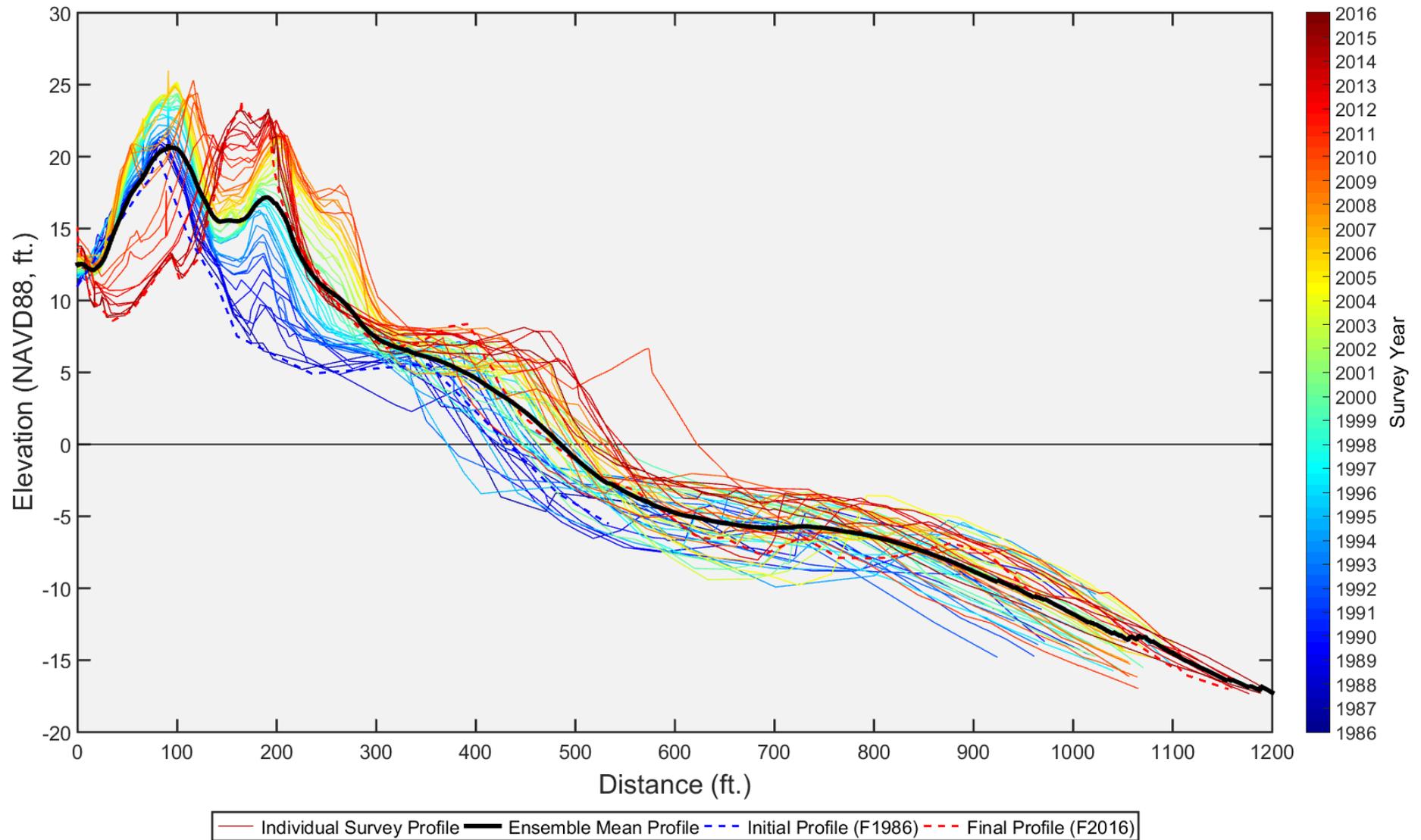


Figure 301. The 30-year trend at the South End location shows a gradual increase in volume and advance in shoreline position from the original survey. The 2012 loss created by Hurricane Sandy was recovered by the following fall survey as nearshore sand bars moved onto the berm. The majority of the losses shown in the 2016 survey occurred during summer 2016 and took about half of the 30-year accumulated gains.

### 30-Year Ensemble Mean Profile at Site 146, South End, Island Beach State Park, Ocean Co.



**Figure 302.** The 30-year profile time series shows the gradual upward and seaward movement of the dune and berm until the passage of Hurricane Sandy. The seaward-most berm outlier was measured in spring 2012 (orange line). Sand bars were common throughout the 30-year time period and show the variability of the nearshore region at this site.

#146 - South End, Island Beach State Park, Ocean County  
**Comparison of 1995 to 2015**

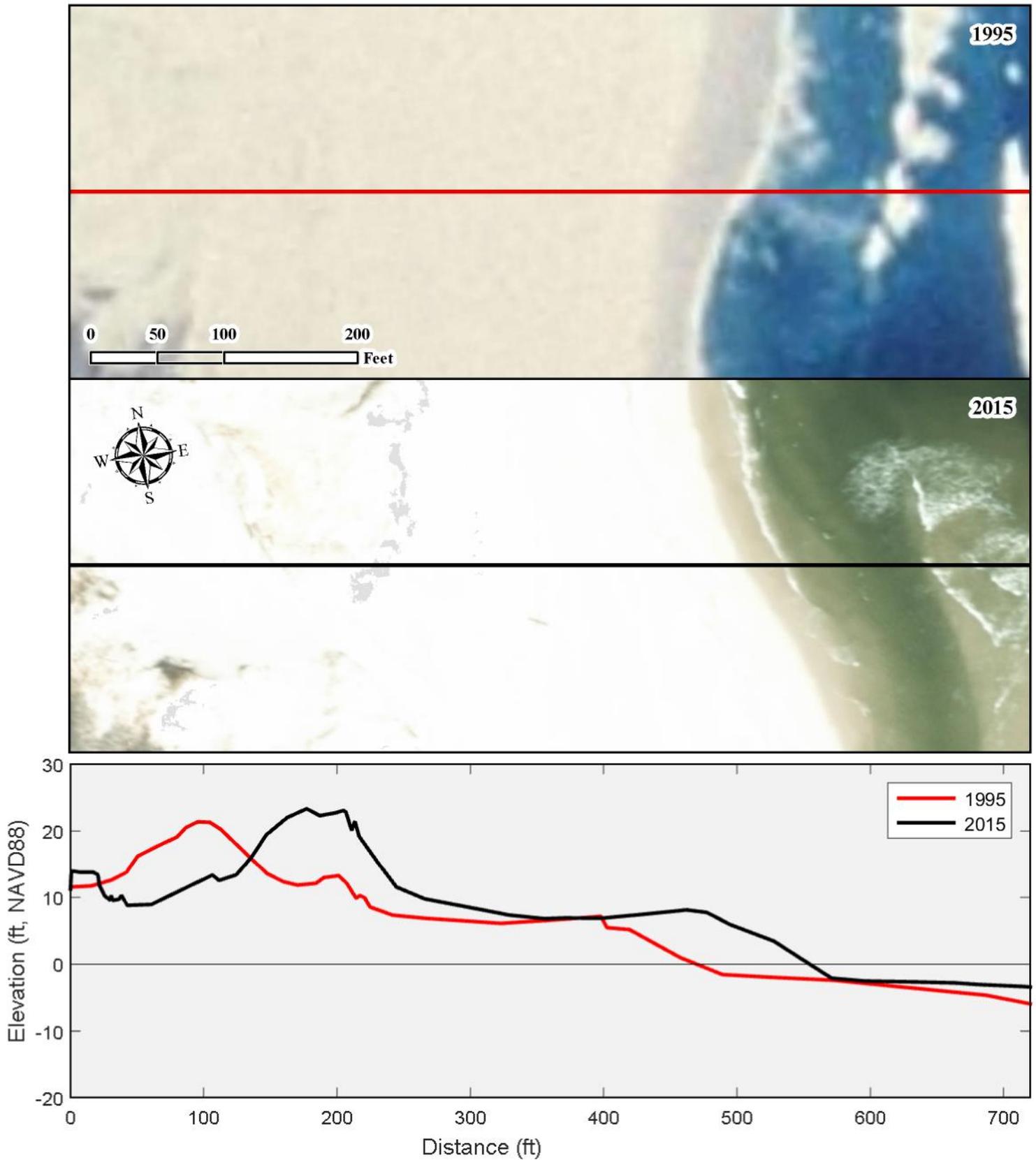
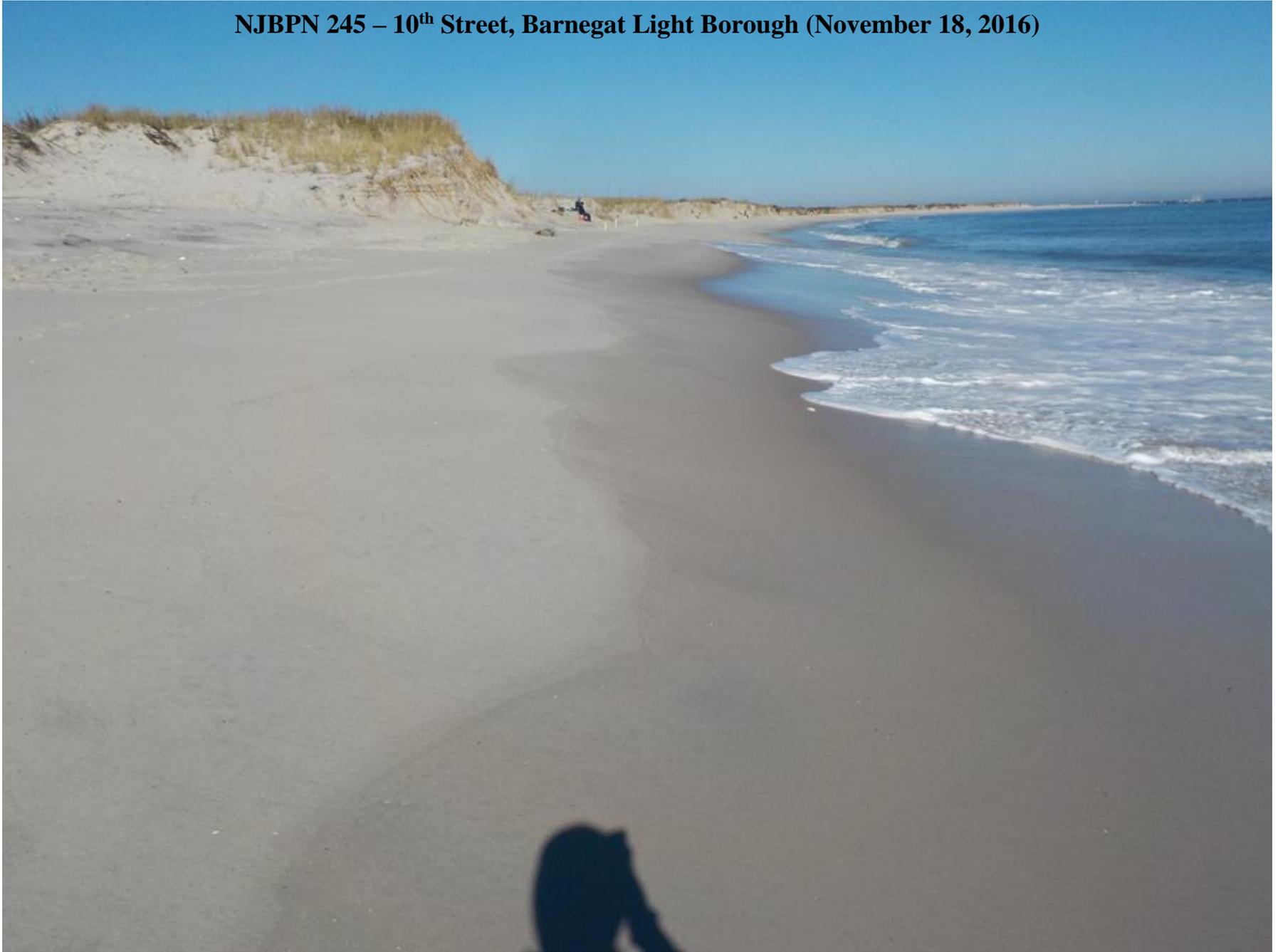


Figure 303. The 1995 and 2015 cross sections show the seaward movement of the dune and berm. The shoreline moved 85 ft seaward during the period from 1995 to 2015.

**NJBPN 245 – 10<sup>th</sup> Street, Barnegat Light Borough (November 18, 2016)**



**Figure 304. View to the north of the scarped foredune from the swash at 10<sup>th</sup> Street in Barnegat Light Borough. The dune field at this site is nearly 1000 ft wide and developed naturally through windblown processes. All thanks to the trapping of sand by the new Barnegat Inlet south jetty that was reconfigured in 1991.**

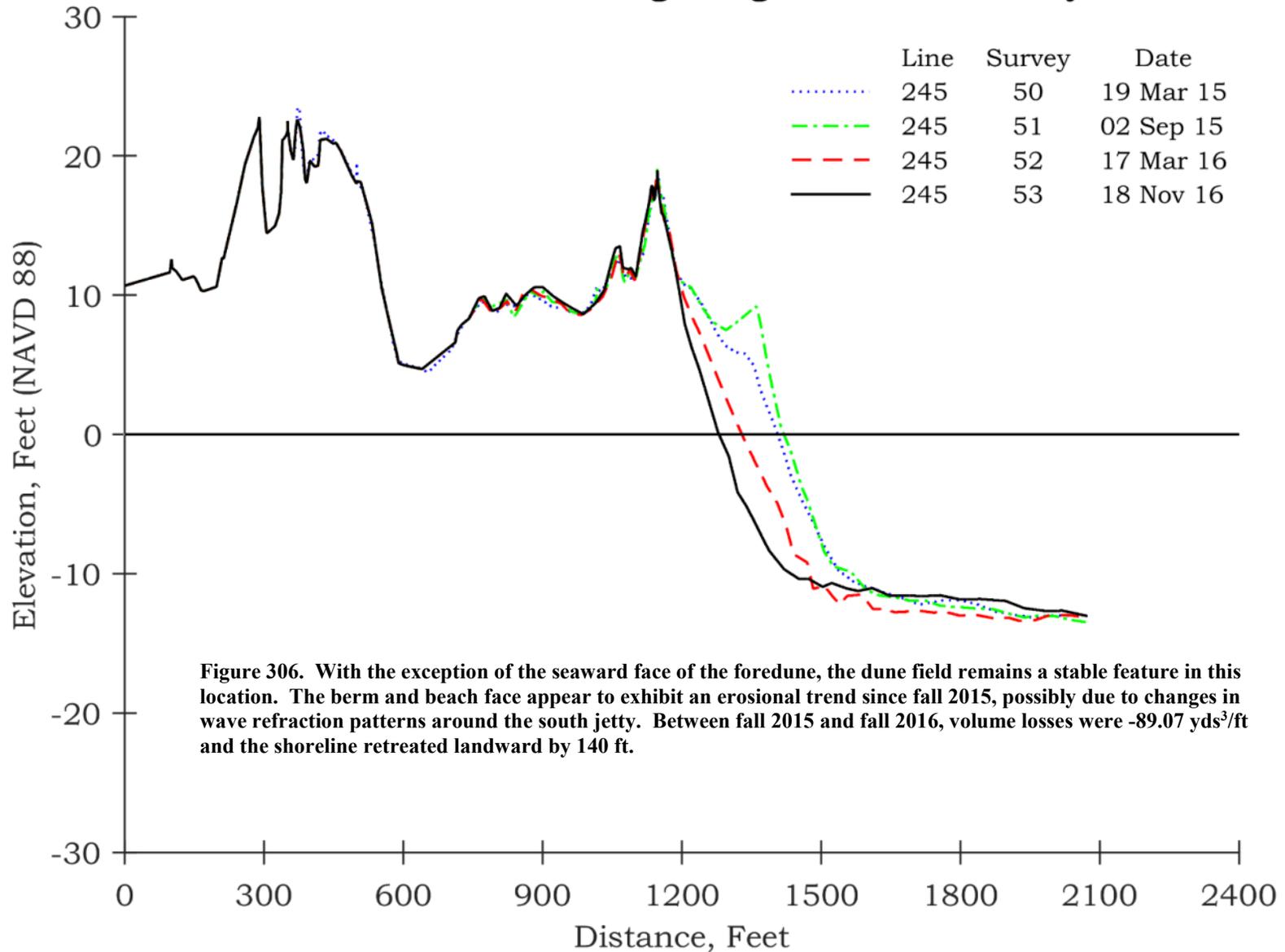
**NJBPN 245 – 10<sup>th</sup> Street, Barnegat Light**



**Figure 305a & 305b.** This site is located approximately 1500 ft south of the Barnegat Inlet south jetty and was established to monitor the changes at the inlet. The foredune shown in both photos (left taken September 2, 2015 and right November 18, 2016) shows evidence of recent scarping, but has little effect on the stability of the entire dune field at this location.

# New Jersey Beach Profile Network

## #245 - 10<sup>th</sup> Street, Barnegat Light, Ocean County



## 22-Year Coastal Changes at Site 245, 10<sup>th</sup> Street, Barnegat Light, Ocean Co.

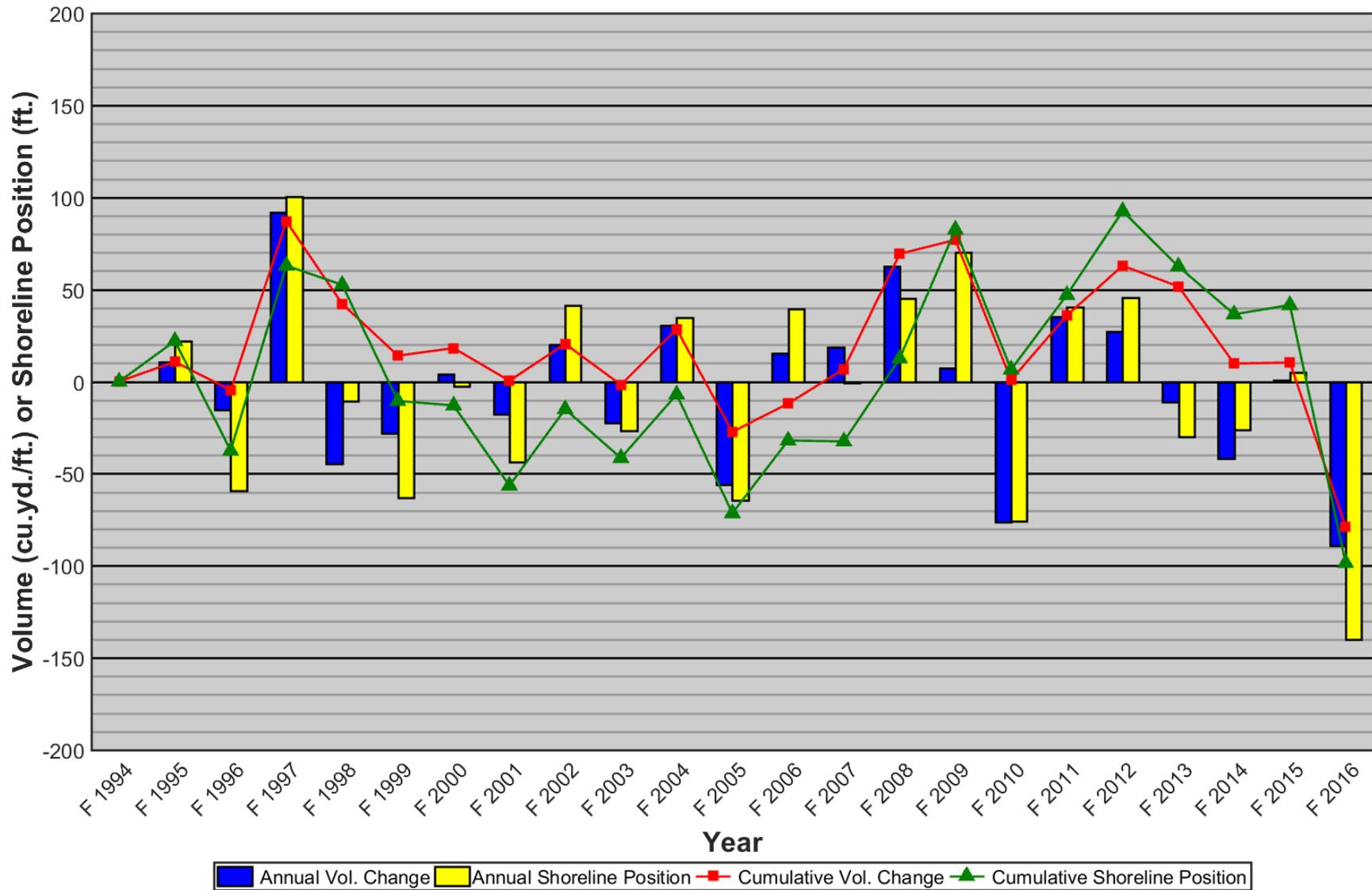


Figure 307. This profile is located approximately 1500 ft south of the Barnegat Inlet south jetty. Major advances in shoreline position and volume gains occurred in the mid-1990s and in 2008-2009, however, sand volume loss and shoreline retreat have continued since the passage of Hurricane Sandy. While this site has advanced almost 1,000 ft seaward since 1986, establishment of the survey location did not occur until the majority of the adjacent inlet shoreline change due to the new southern Barnegat Inlet jetty had occurred. Stability ruled for 20 years and since 2012 the trend has been negative, leaving the site's shoreline 100 ft landward of the 1994 position and down by 79 yds<sup>3</sup>/ft in volume.

### 22-Year Ensemble Mean Profile at Site 245, 10<sup>th</sup> Street, Barnegat Light, Ocean Co.

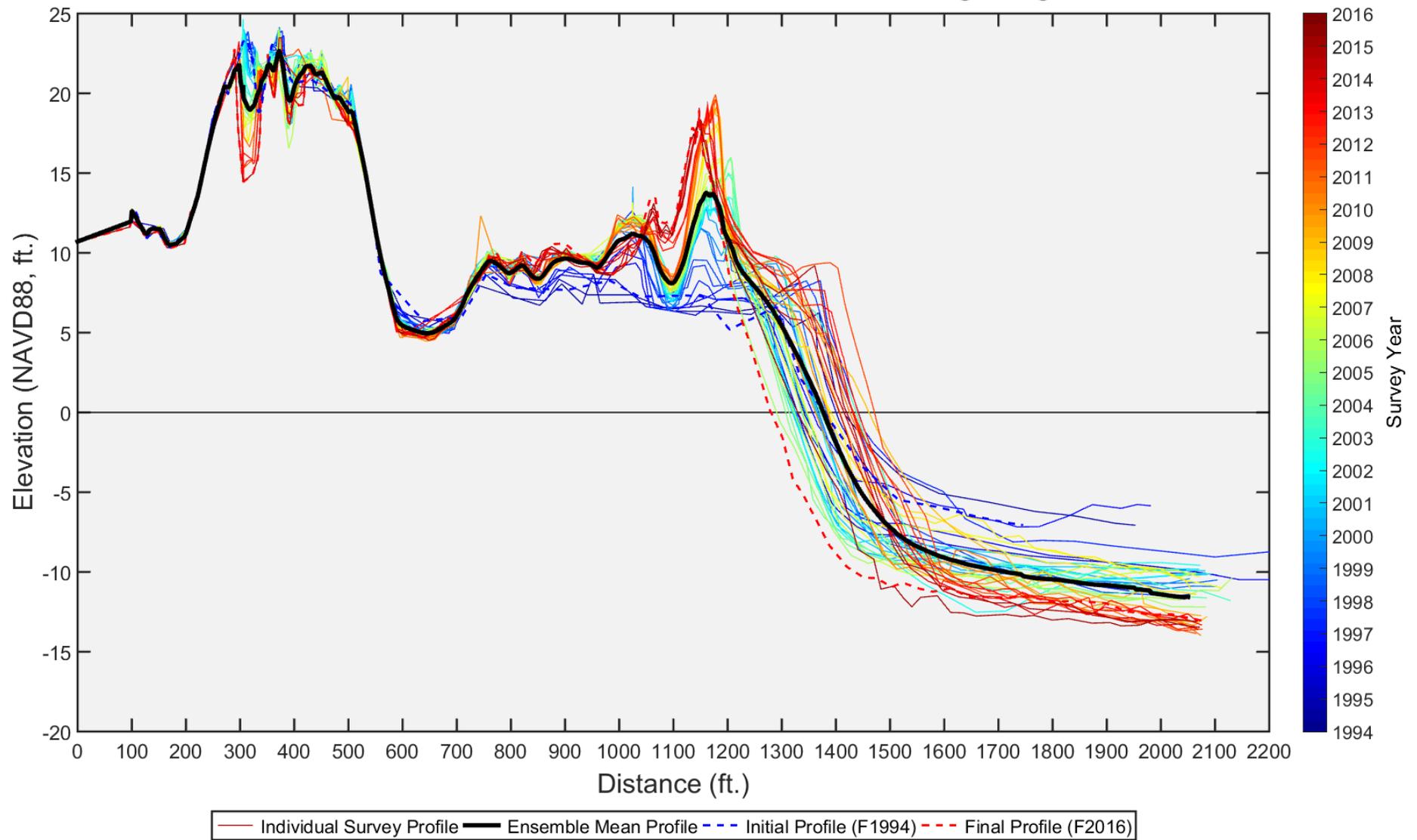


Figure 308. The 22-year changes in the profile show a 10 ft vertical growth of the foredunes from the initial profile in 1994. Changes in berm width varied over time and the nearshore seabed appears to demonstrate a consistent decrease in elevation over time.

#245 - 10th Street, Barnegat Light Borough, Ocean County  
**Comparison of 1995 to 2015**

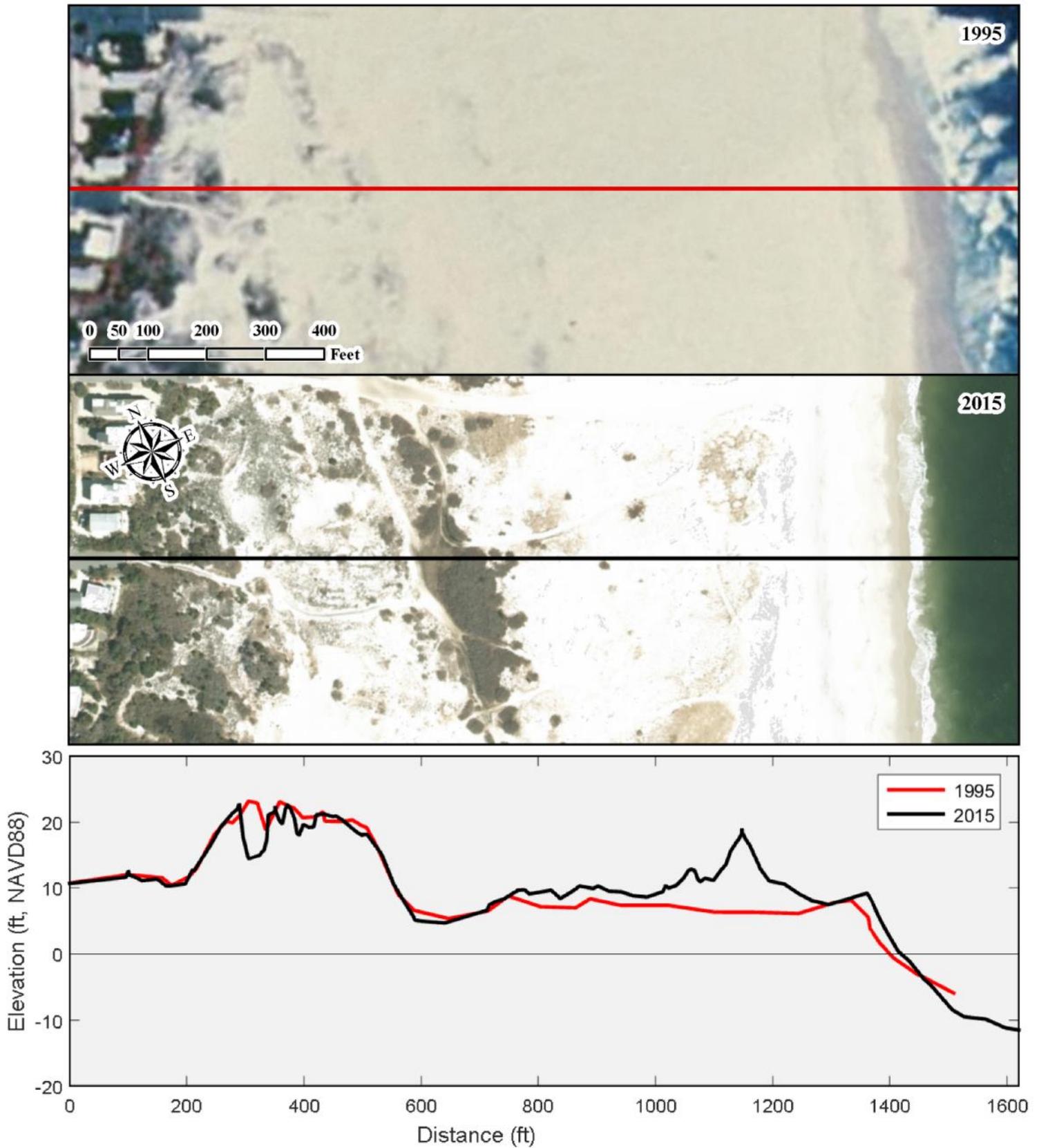


Figure 309. The 1995 and 2015 cross section comparison shows the growth of the foredune following the reconfiguration of the Barnegat Inlet jetties. The shoreline moved 19 ft seaward during this time and dune growth at the seaward margin was substantial.

**NJBPN 145 – 26<sup>th</sup> Street, Barnegat Light (November 18, 2016)**



**Figure 310. View to the south from the berm at 26<sup>th</sup> Street in Barnegat Light Borough.**

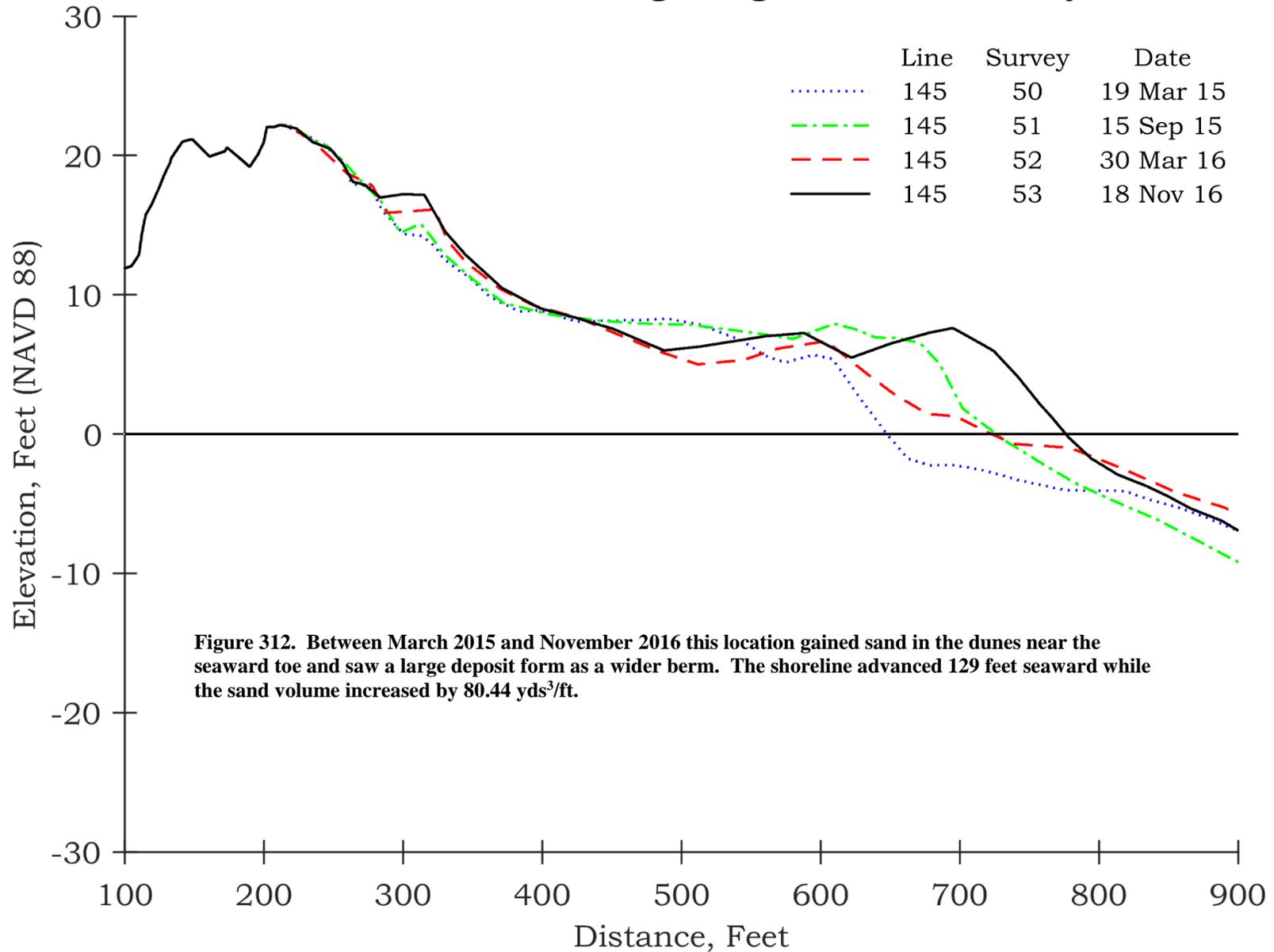
**NJBPN 145 – 26<sup>th</sup> Street, Barnegat Light**



**Figure 311a & 311b. Though never included in the federal shore protection project boundaries, the dune field at the 26<sup>th</sup> Street location is nearly 200 feet wide, sparsely vegetated and stable (left photo taken September 2, 2015 and right photo taken November 18, 2016). The growth is related to the new Barnegat Inlet south jetty's sand capture capacity**

# New Jersey Beach Profile Network

## #145 - 26<sup>th</sup> Street, Barnegat Light, Ocean County



### 30-Year Coastal Changes at Site 145, 26<sup>th</sup> Street, Barnegat Light, Ocean Co.

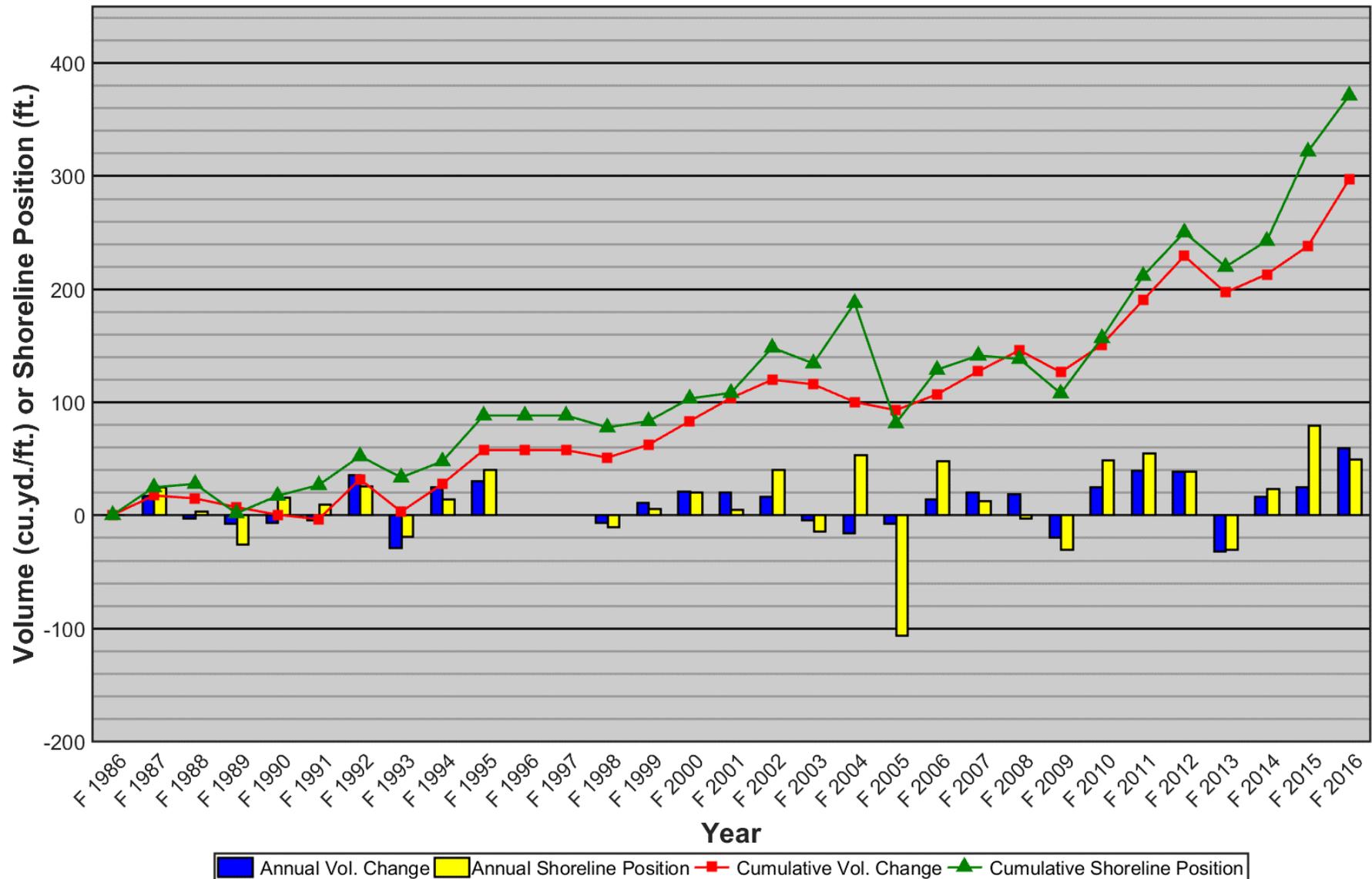


Figure 313. Since 1994, the 26<sup>th</sup> Street profile has continued to gain sand volume. This profile is located over 7,500 ft south of the Barnegat Inlet jetties and outside of the ebb tidal delta shield that may act to protect the site during northeast storms. The Long Beach Island Feasibility Report (USACE, 1999) notes that net sediment transport is to the south, though this site may fall within a nodal area, in which sand is captured from both the north and south). The reconfigured Barnegat Inlet jetties modified the ebb tidal delta and may now provide sand to southerly beaches driven by littoral drift. Note the sand volume increase rate changes following the federal beach fills in Harvey Cedars (2010 and 2013) and in Loveladies (2016). The 30-year sand volume change was 298 yds<sup>3</sup>/ft and the shoreline advanced 386 ft seaward.

### 30-Year Ensemble Mean Profile at Site 145, 26<sup>th</sup> Street, Barnegat Light, Ocean Co.

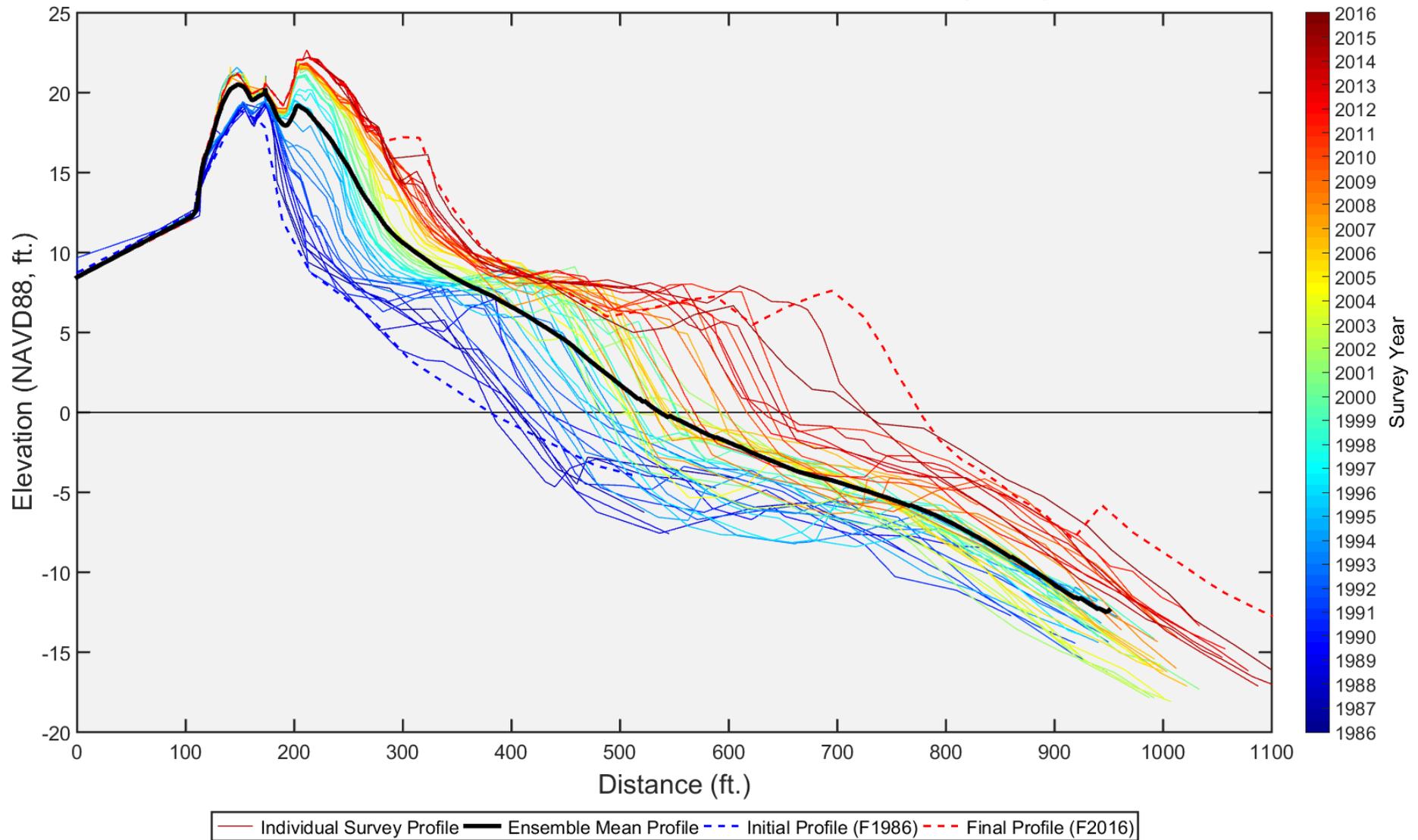


Figure 314. The profile time series at 26<sup>th</sup> Street shows a pro-grading shoreline and berm with foredune development seaward and upward from the initial profile in 1986. This site displays the greatest long-term sand volume increases of all of the NJBPN locations in Ocean County, despite never being included in a shore protection project. It is clear from this analysis that there is an excess amount of sand in the littoral system and the location in which it tends to be deposited appears to be strongly influenced by the new inlet jetty.

#145 - 26th Street, Barnegat Light Borough, Ocean County  
**Comparison of 1995 to 2015**

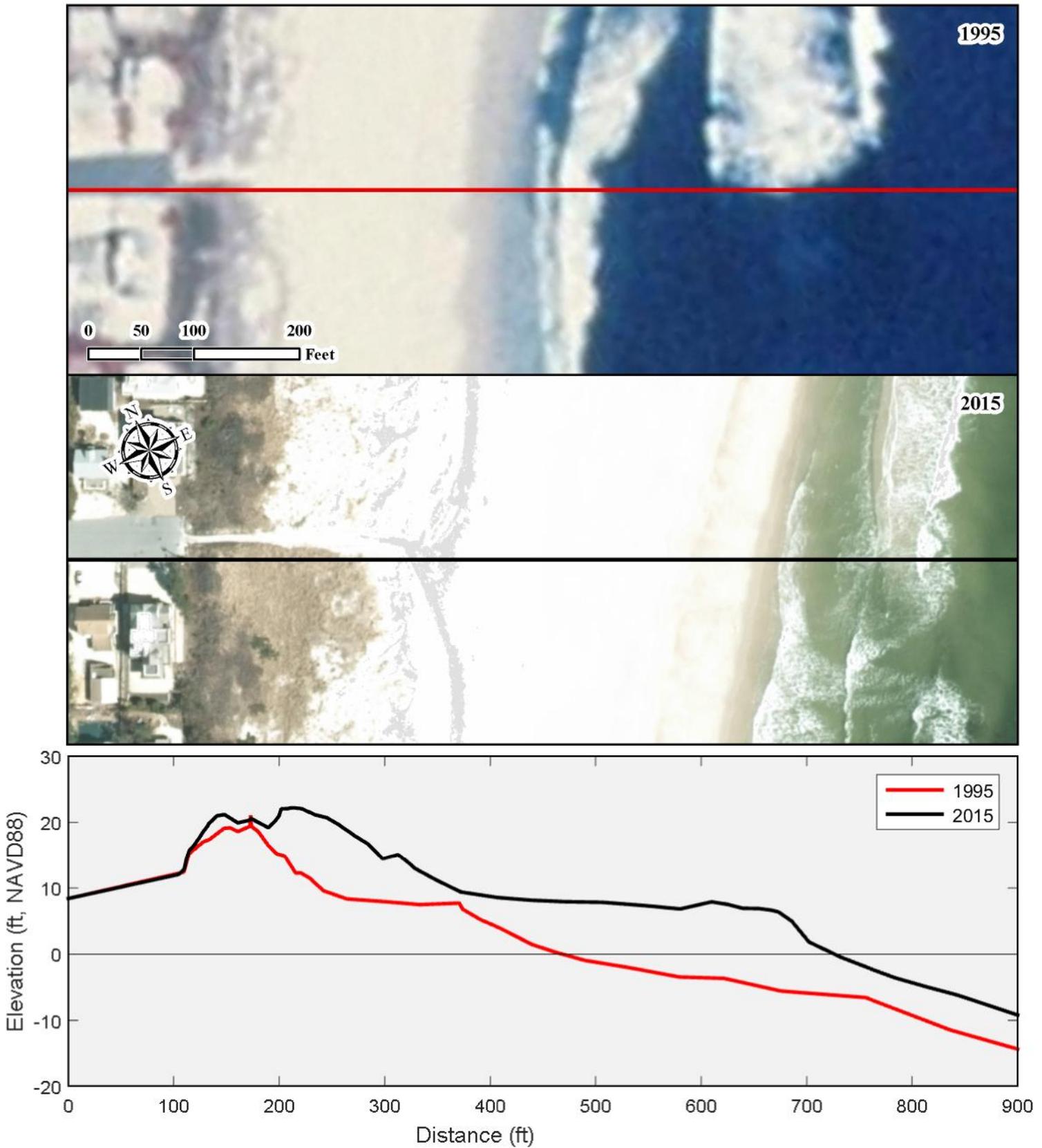


Figure 315. Though this site is not included in the federal shore protection project, it has shown long-term growth of the dune and berm throughout time. Between 1995 and 2015, the shoreline advanced seaward by 258 ft, which is a greater amount than USACE project beaches to the south.

**NJBPN 144 – La Baia Street, Loveladies (November 18, 2016)**



**Figure 316. View to the south from the recently completed engineered dune at La Baia Street in Loveladies.**

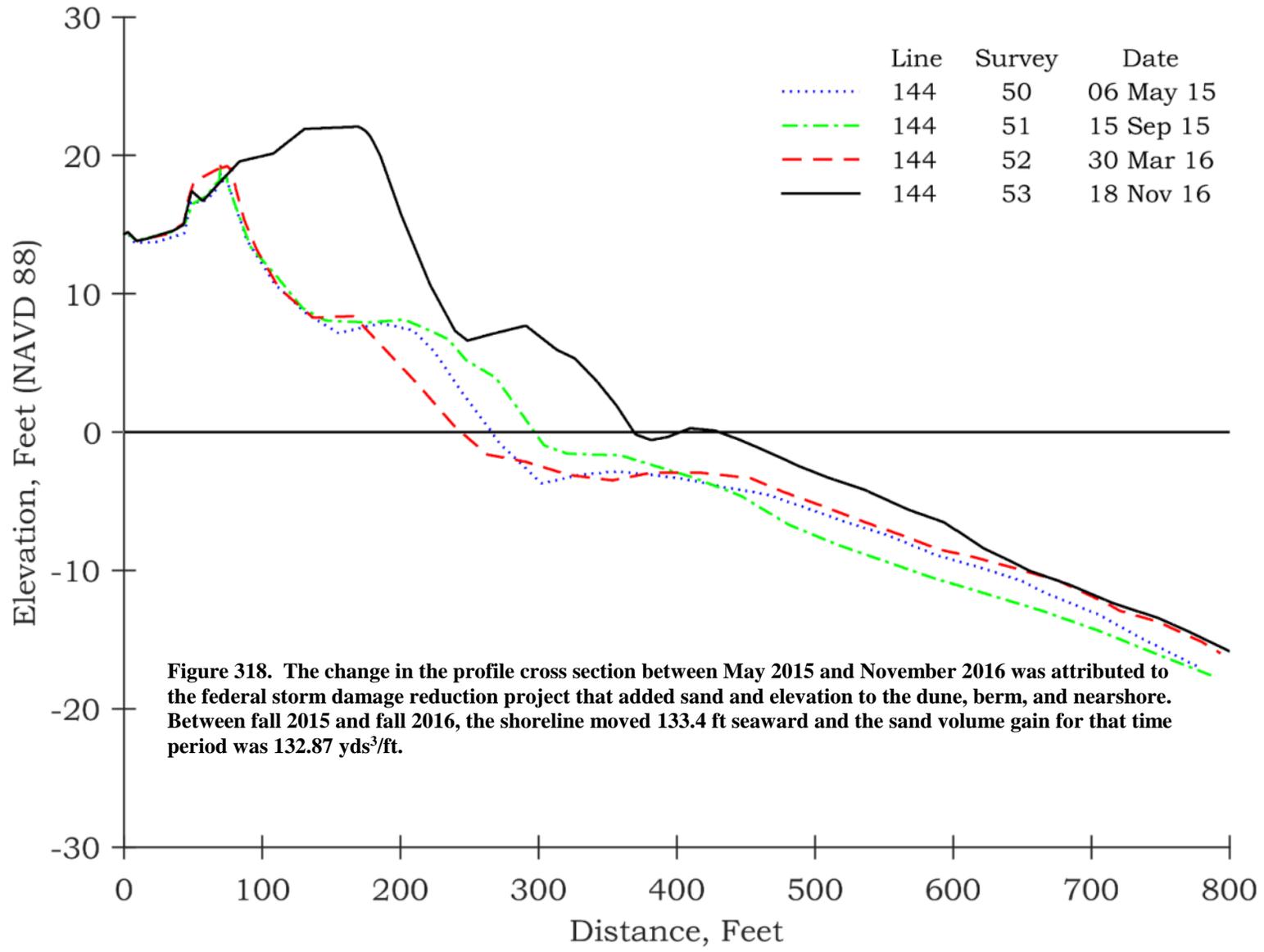
**NJBPN 144 – La Baia Street, Loveladies**



**Figure 317a & 317b. The La Baia Street site is located in Loveladies, an unincorporated community in the Township of Long Beach. This site was included in the federal shore protection project in 2016, which constructed an engineered dune that added significant elevation to the pre-project dune (left taken right taken September 15, 2015 versus the view to the right taken November 18, 2016).**

# New Jersey Beach Profile Network

## #144 - La Baia Street, Loveladies, Ocean County



### 30-Year Coastal Changes at Site 144, La Baia Street, Loveladies, Ocean Co.

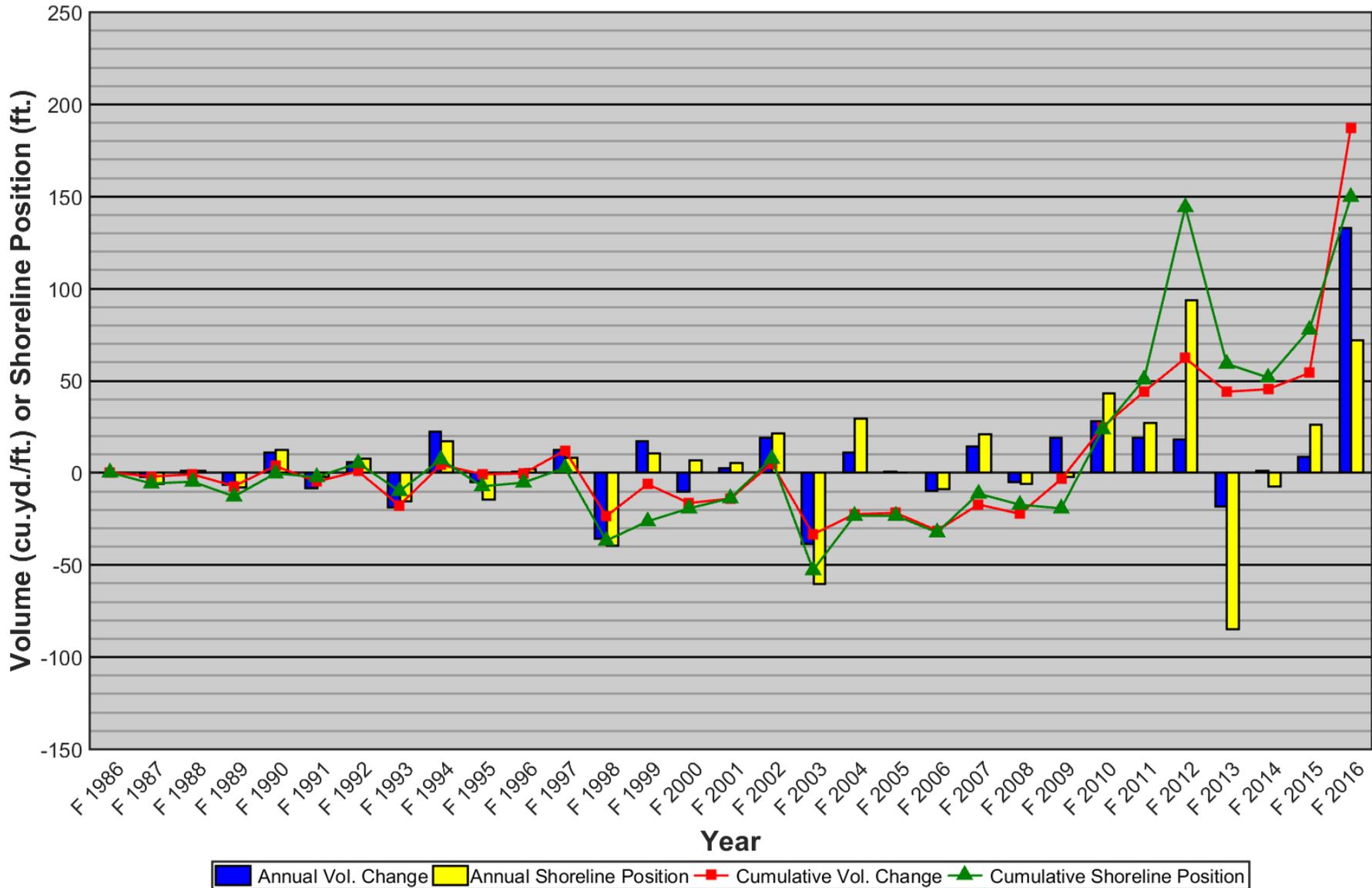


Figure 319. Shoreline and sand volume changes were minimal at Site 144 but were influenced by episodic events (1992 and 1998 northeast storms, 2003 Hurricane Isabel, and 2012 Hurricane Sandy). The USACE (1999) notes that this section of the Township can be sand starved due to the presence of a movable divergence of the longshore current (a nodal zone). Volume gains were recorded following the 2010 Harvey Cedars beach fill indicating localized northward sediment transport. Note that the fall 2012 survey shows a gain in both shoreline and volume because it was completed in September 2012 (1.5 months before Hurricane Sandy’s landfall). This site was included in the federal fill in spring 2016. The 30-year shoreline has now advanced 150 ft seaward as the sand volume increased by 188 yds<sup>3</sup>/ft.

### 30-Year Ensemble Mean Profile at Site 144, La Baia Street, Loveladies, Ocean Co.

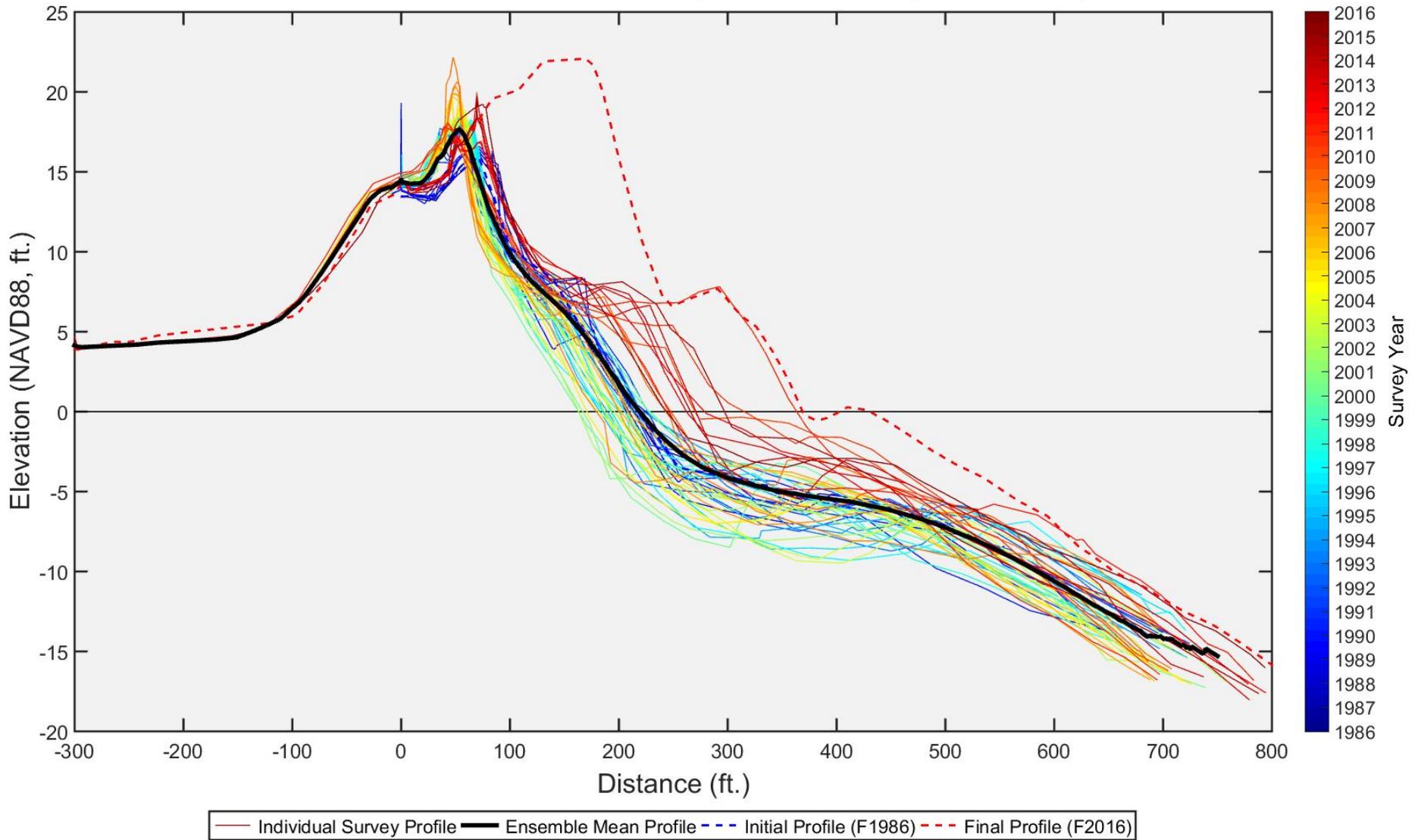


Figure 320. The plots of the individual profiles show near stable conditions from the 1980s to early 1990s and a generally erosional pattern up to about 2010. The fall 2016 profile (red dashed line) shows the significance of the size of the engineered dune that was constructed in the summer of 2016 when compared to the early profiles.

#144 - LaBaia Lane, Long Beach Township, Ocean County  
**Comparison of 1995 to 2015**

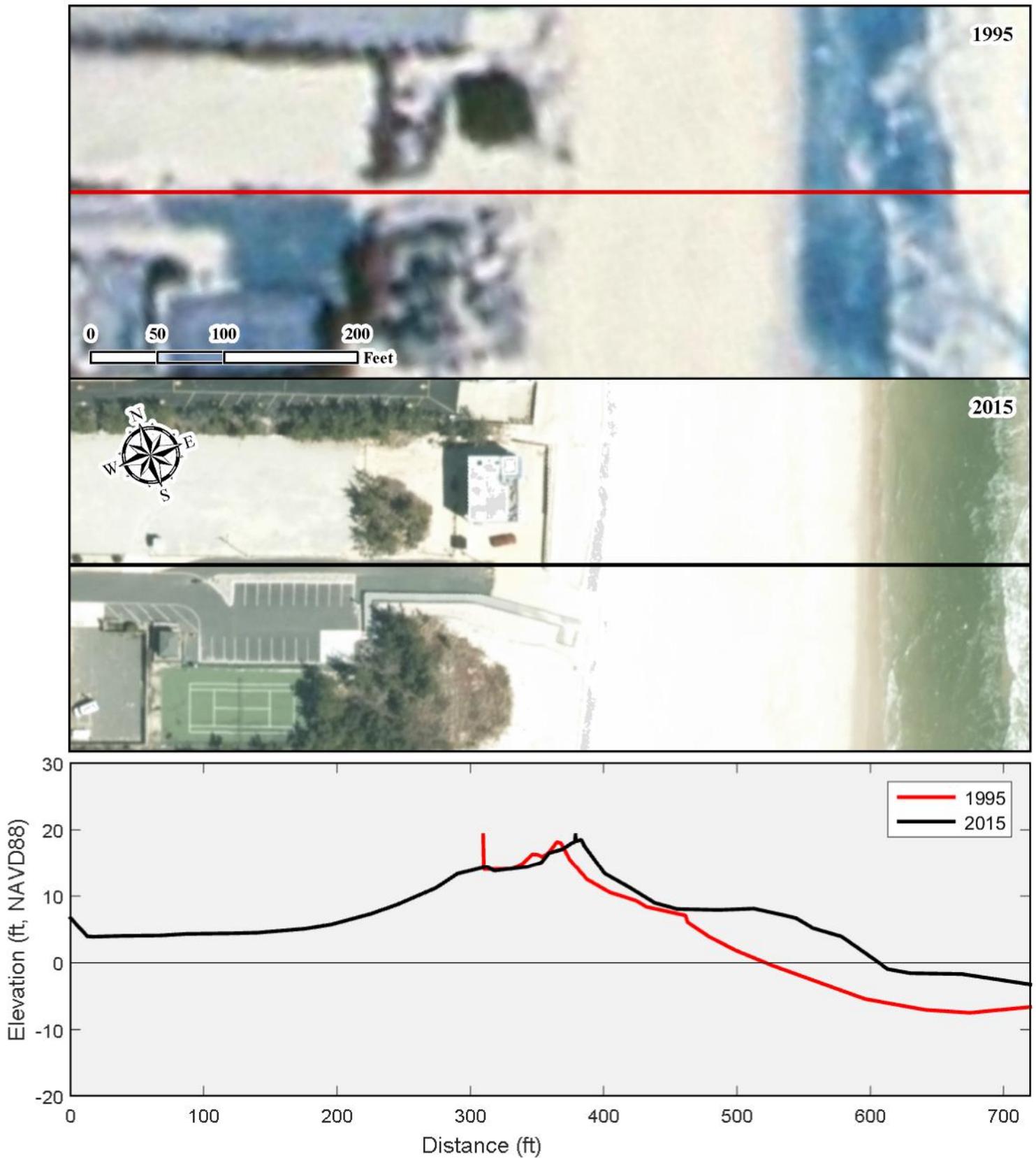


Figure 321. The 1995 and 2015 comparison shows the conditions before the federal beach fill was completed. The shoreline advanced seaward by 85 ft during this period without benefit of direct sand fill placement until 2016.

**NJBPN 143 – 73<sup>rd</sup> Street, Harvey Cedars (November 18, 2016)**



**Figure 322. View to the south from the dune at 73<sup>rd</sup> Street in Harvey Cedars. The accumulation of sand trapped by fencing adds to the dune's volume.**

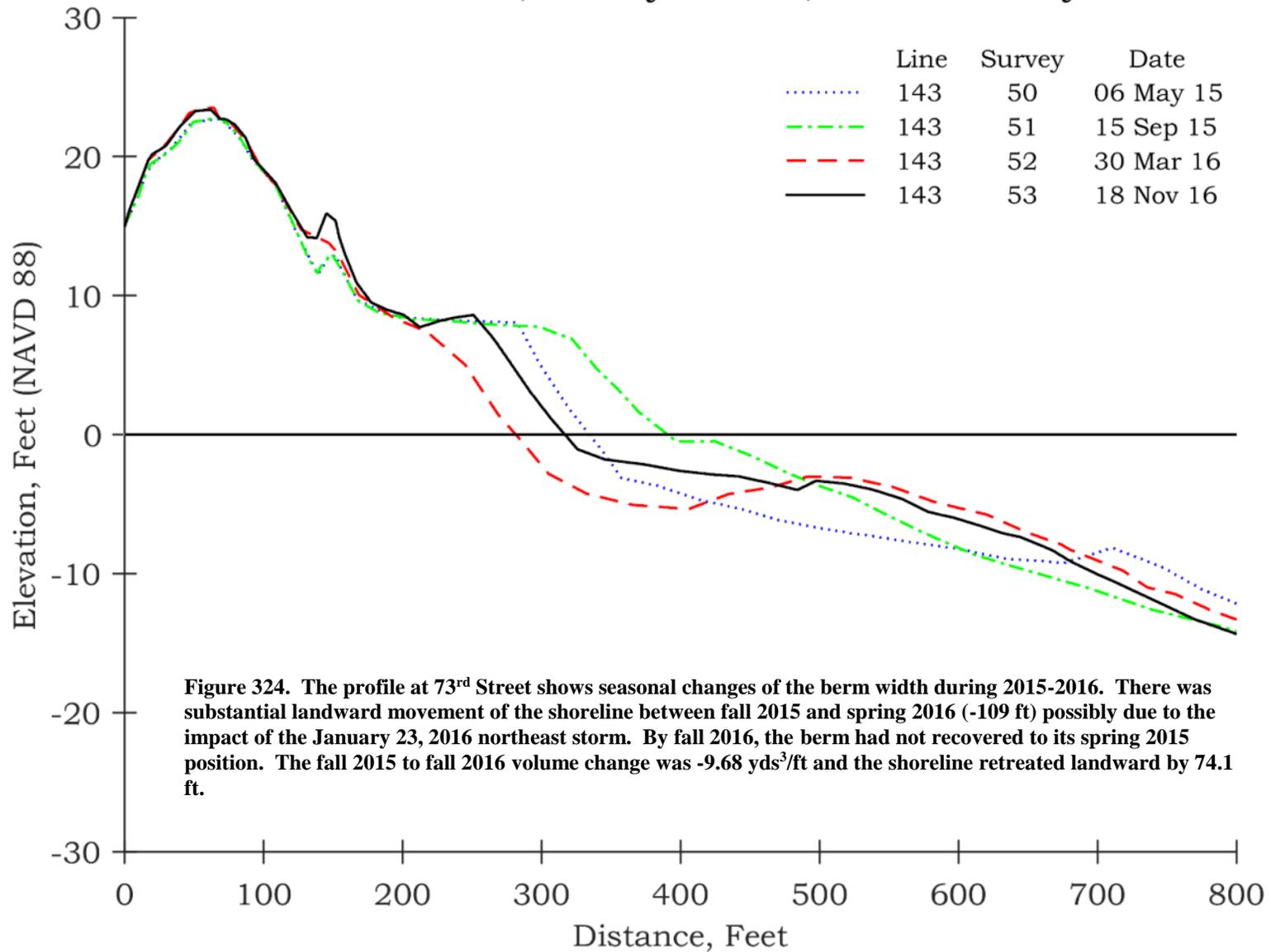
**NJBPN 143 – 73<sup>rd</sup> Street, Harvey Cedars**



**Figure 323a & 323b. The photos show the condition of the vegetation on the engineered dune that was created in the 2009 federal shore protection project. Though scarped by Hurricane Sandy's waves, the dune (and wide beach) provided the necessary protection to landward properties during the storm. The 2013 emergency fill restored the dune and berm to the original design template. Left photo was taken September 15, 2015 and right photo taken November 18, 2016.**

# New Jersey Beach Profile Network

## #143 - 73<sup>rd</sup> Street, Harvey Cedars, Ocean County



### 30-Year Coastal Changes at Site 143, 73<sup>rd</sup> Street, Harvey Cedars, Ocean Co.

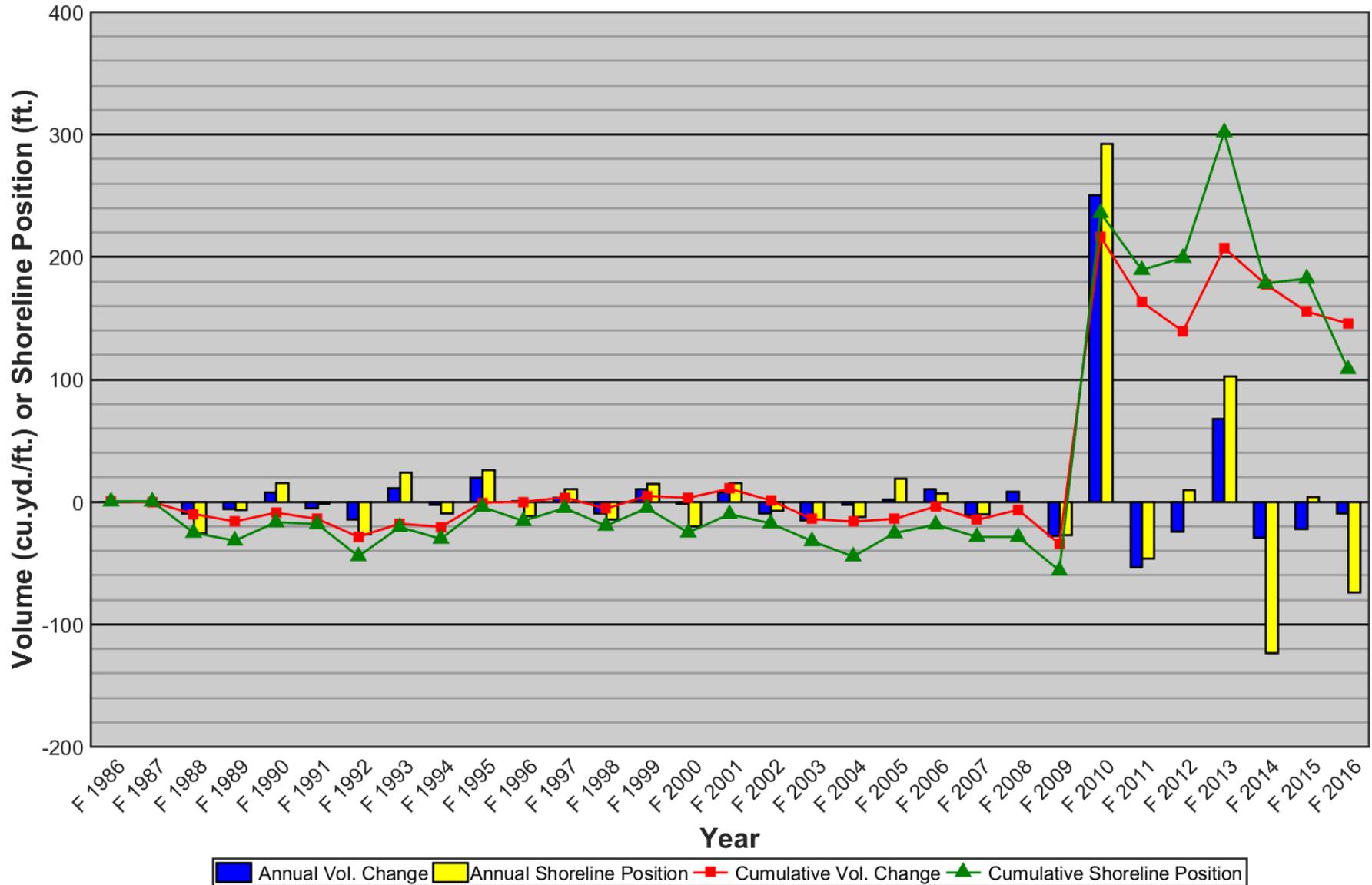
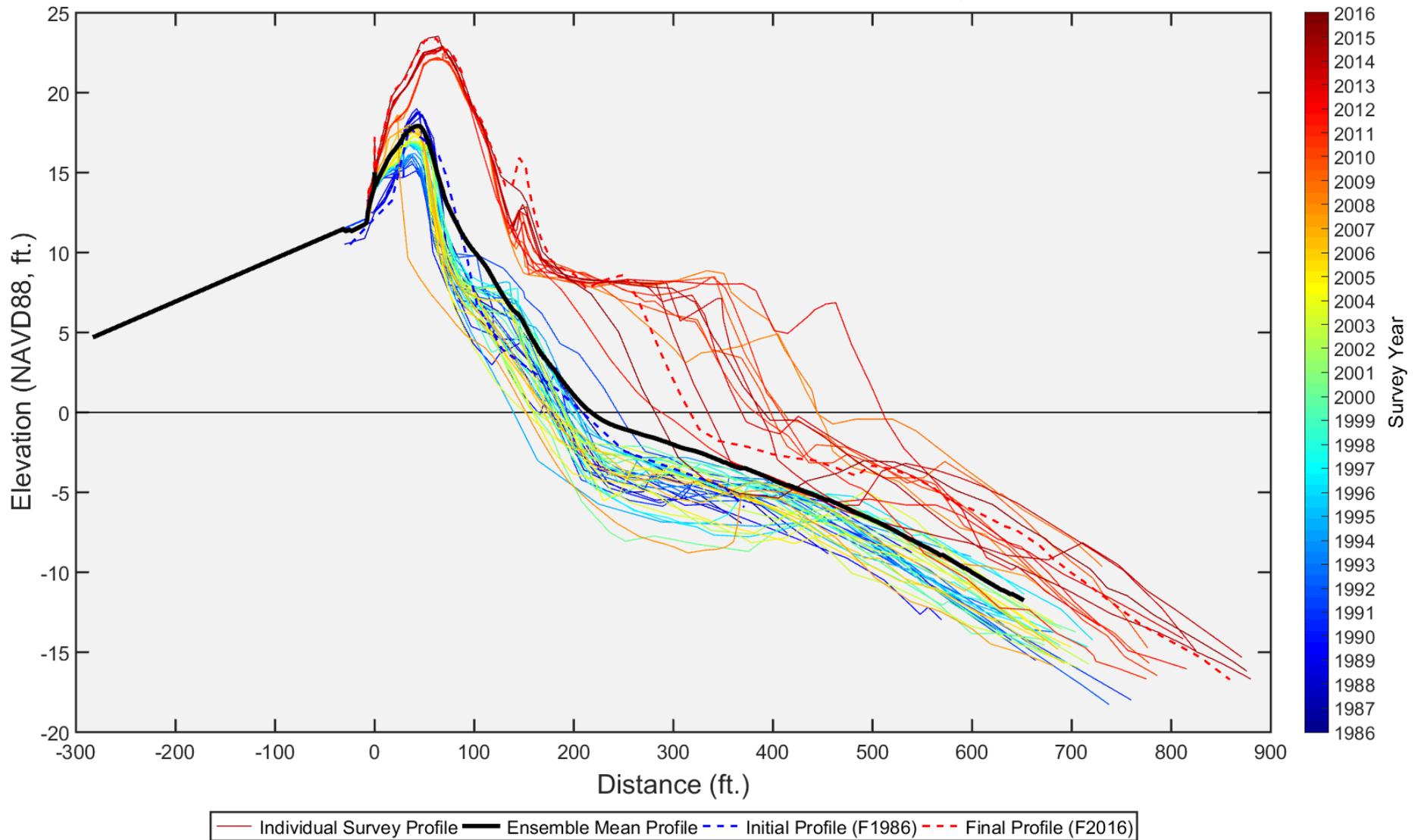


Figure 325. The shoreline and volume trends at the 73<sup>rd</sup> St. site in Harvey Cedars displayed modest changes until the fall 2010 survey (and again in 2013) which showed the influence of the federal shore protection projects. Since the 2013 beach fill, the site has shown erosional episodes with the 2013 positive changes due to post-Sandy USACE restoration work.

### 30-Year Ensemble Mean Profile at Site 143, 73<sup>rd</sup> Street, Harvey Cedars, Ocean Co.



**Figure 326. The 30-year time series of profiles at 73<sup>rd</sup> Street show the drastic change in shape and elevation of the dune, berm and nearshore region that are attributed to the initiation of federal involvement (2010 survey). Prior to federal involvement, the majority of profiles fall within a small envelope of change and reside landward of the mean (thick black line). After federal involvement (post-2010), profiles extend farther seaward, are higher in elevation, and are seaward of the mean. Profiles after federal involvement are so much farther seaward, in fact, that they were responsible for shifting the mean profile completely seaward of the 24-year envelope of profiles prior to federal involvement.**

#143 - 73rd Street, Harvey Cedars Borough, Ocean County  
**Comparison of 1995 to 2015**

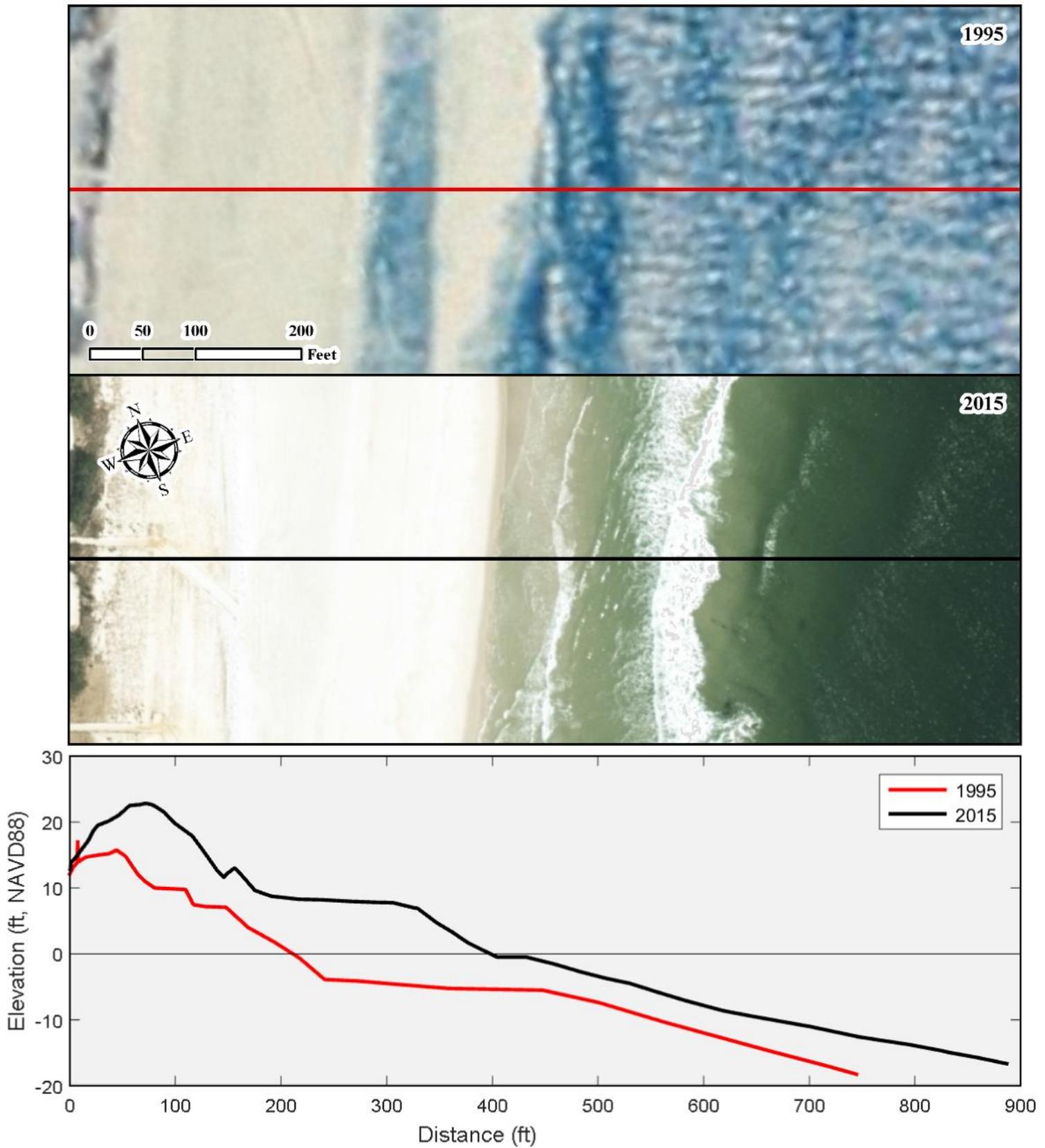


Figure 327. The cross section comparison shows the effects of the federal shore protection project that includes an engineered dune and a 9 ft berm elevation. The shoreline moved 187 ft seaward during this time.

**NJBPN 142 – Tranquility Drive, Harvey Cedars (October 28, 2016)**



**Figure 328. View to the north from the crest of the engineered dune at Tranquility Drive in Harvey Cedars.**

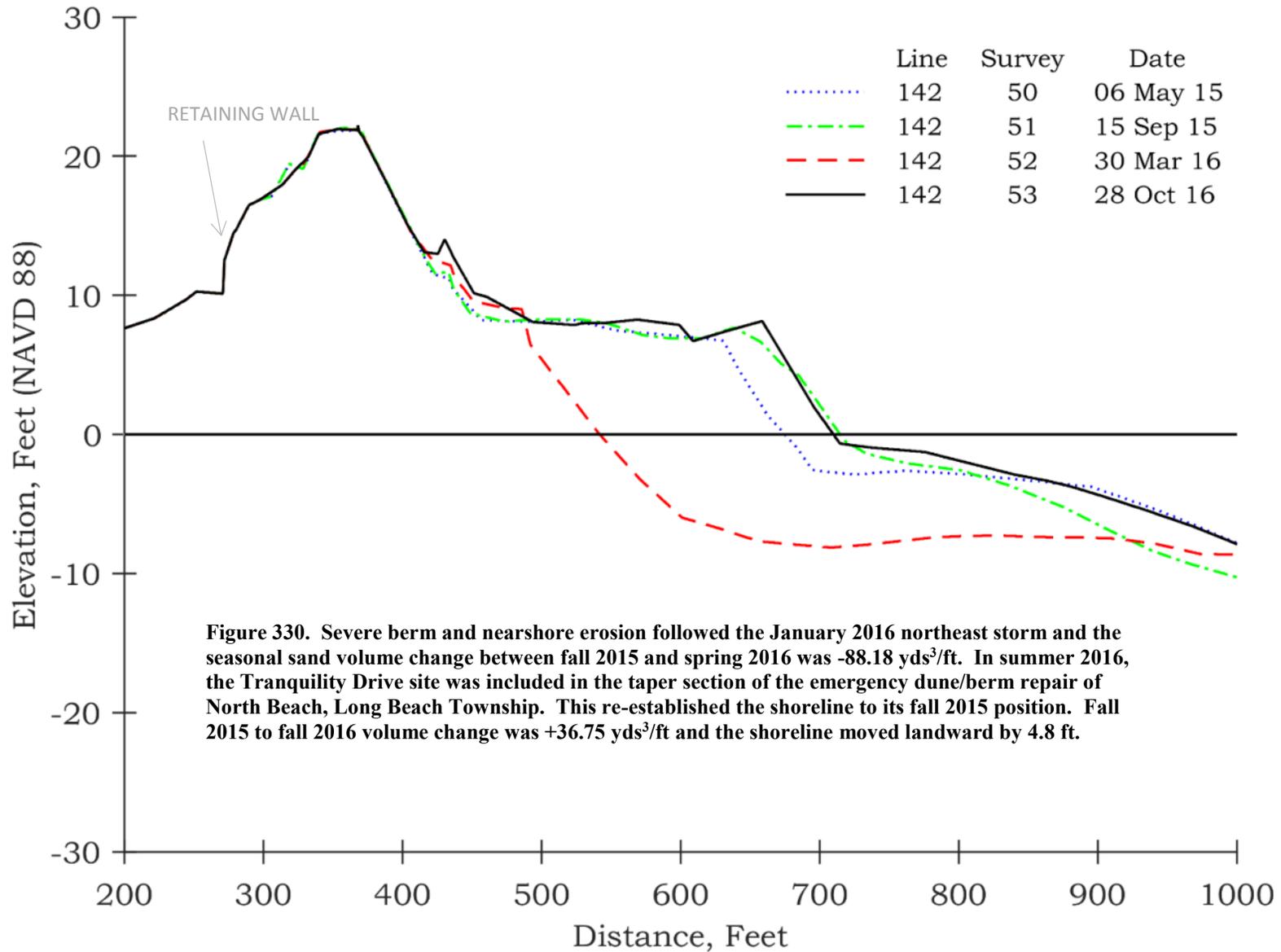
**NJBPN 142 – Tranquility Drive, Harvey Cedars**



**Figure 329a & 329b. Conditions of the engineered dune have remained unchanged since the completion of the post-Sandy emergency beach fill. Sand accumulated at the seaward toe during fall 2016 (left taken September 16, 2015 and right taken October 28, 2016).**

# New Jersey Beach Profile Network

## #142 - Tranquility Drive, Harvey Cedars, Ocean County



**Figure 330. Severe berm and nearshore erosion followed the January 2016 northeast storm and the seasonal sand volume change between fall 2015 and spring 2016 was  $-88.18 \text{ yds}^3/\text{ft}$ . In summer 2016, the Tranquility Drive site was included in the taper section of the emergency dune/berm repair of North Beach, Long Beach Township. This re-established the shoreline to its fall 2015 position. Fall 2015 to fall 2016 volume change was  $+36.75 \text{ yds}^3/\text{ft}$  and the shoreline moved landward by 4.8 ft.**

### 30-Year Coastal Changes at Site 142, Tranquility Drive, Harvey Cedars, Ocean Co.

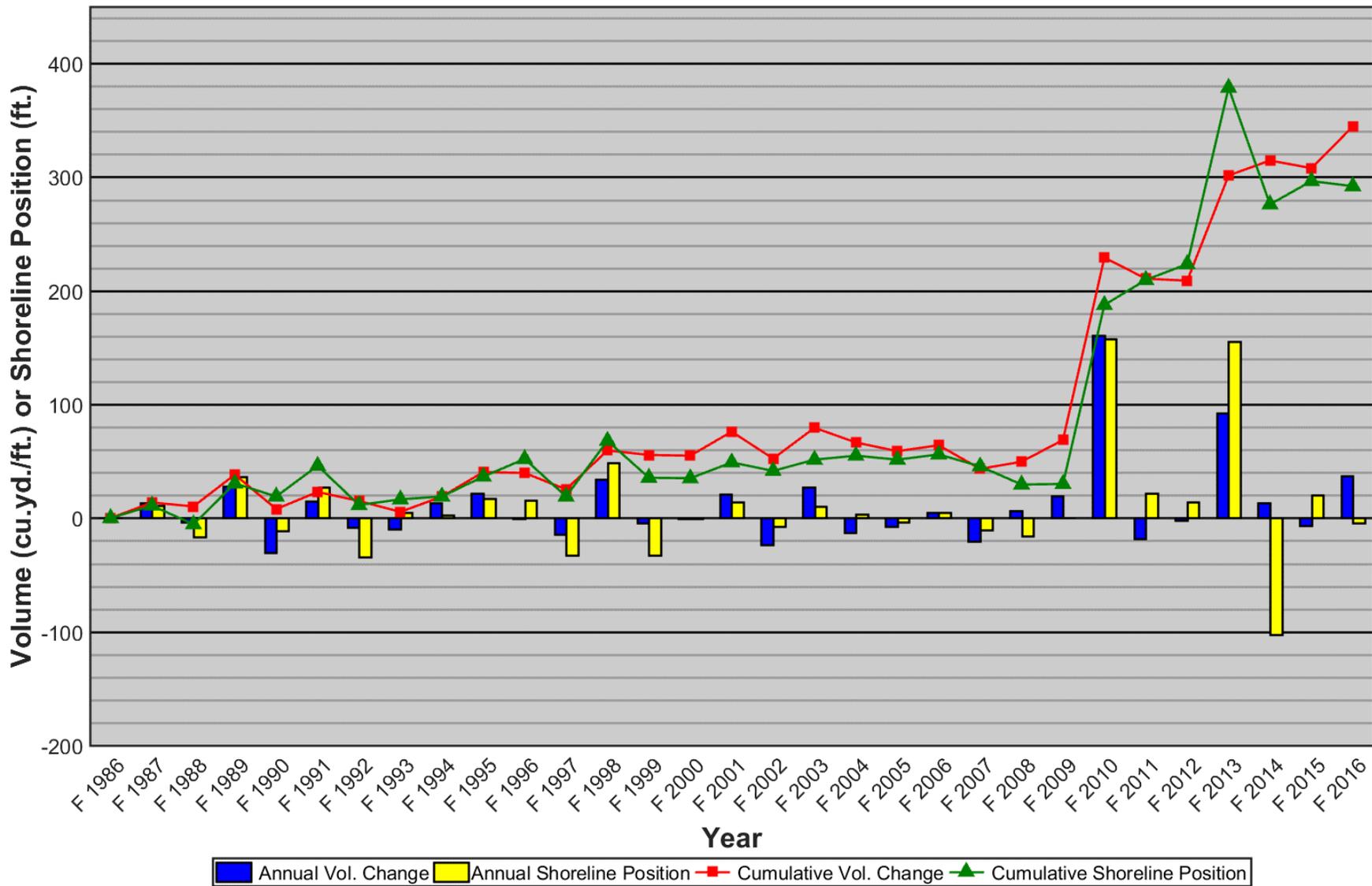
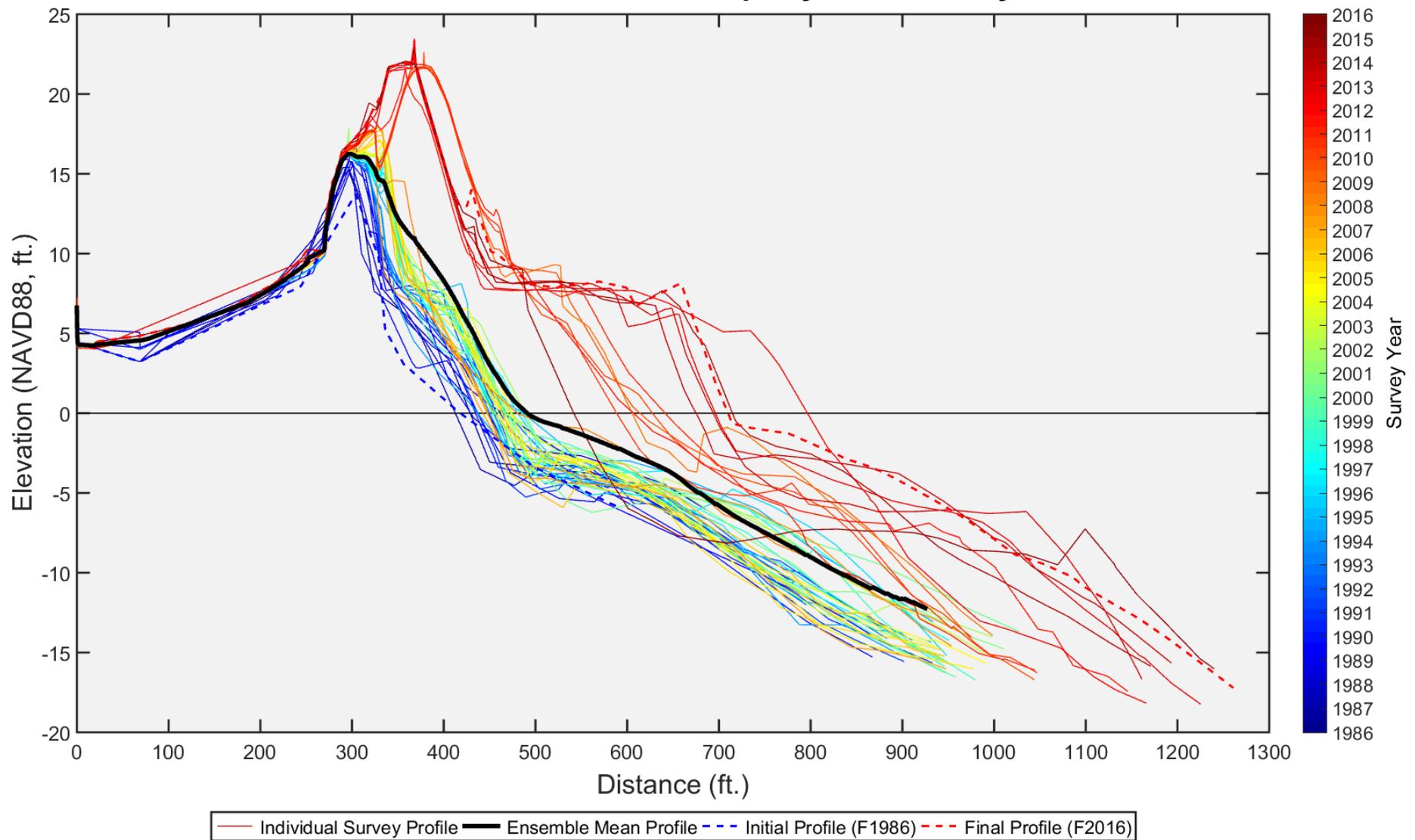


Figure 331. Over the past 30 years, sand volumes at Tranquility Drive were relatively stable. Note the dramatic increase in volume and shoreline position in 2010 and again in 2013 from the federal shore protection and emergency post-Sandy restoration projects. The southern Harvey Cedars site appears to be more stable and accretional, as compared to the 73<sup>rd</sup> Street site. Both sand volume and shoreline change show large, positive increases of 342 yds<sup>3</sup>/ft and 292 ft, respectively.

### 30-Year Ensemble Mean Profile at Site 142, Tranquility Drive, Harvey Cedars, Ocean Co.



**Figure 332.** The Tranquility Drive 30-year profile dataset shows a relatively stable dune with a modest berm throughout the first two decades of data collection. By the mid-2000s, the dune increased in elevation, but at the expense of the berm width. The 2010 federal shore protection project increased the dune height to 22 ft NAVD88 and berm width by approximately 300 ft. After Hurricane Sandy, the dune was not reconstructed to its 2010 design position, but moved landward by approximately 30 ft.

#142 - Tranquility Drive, Harvey Cedars Borough, Ocean County  
**Comparison of 1995 to 2015**

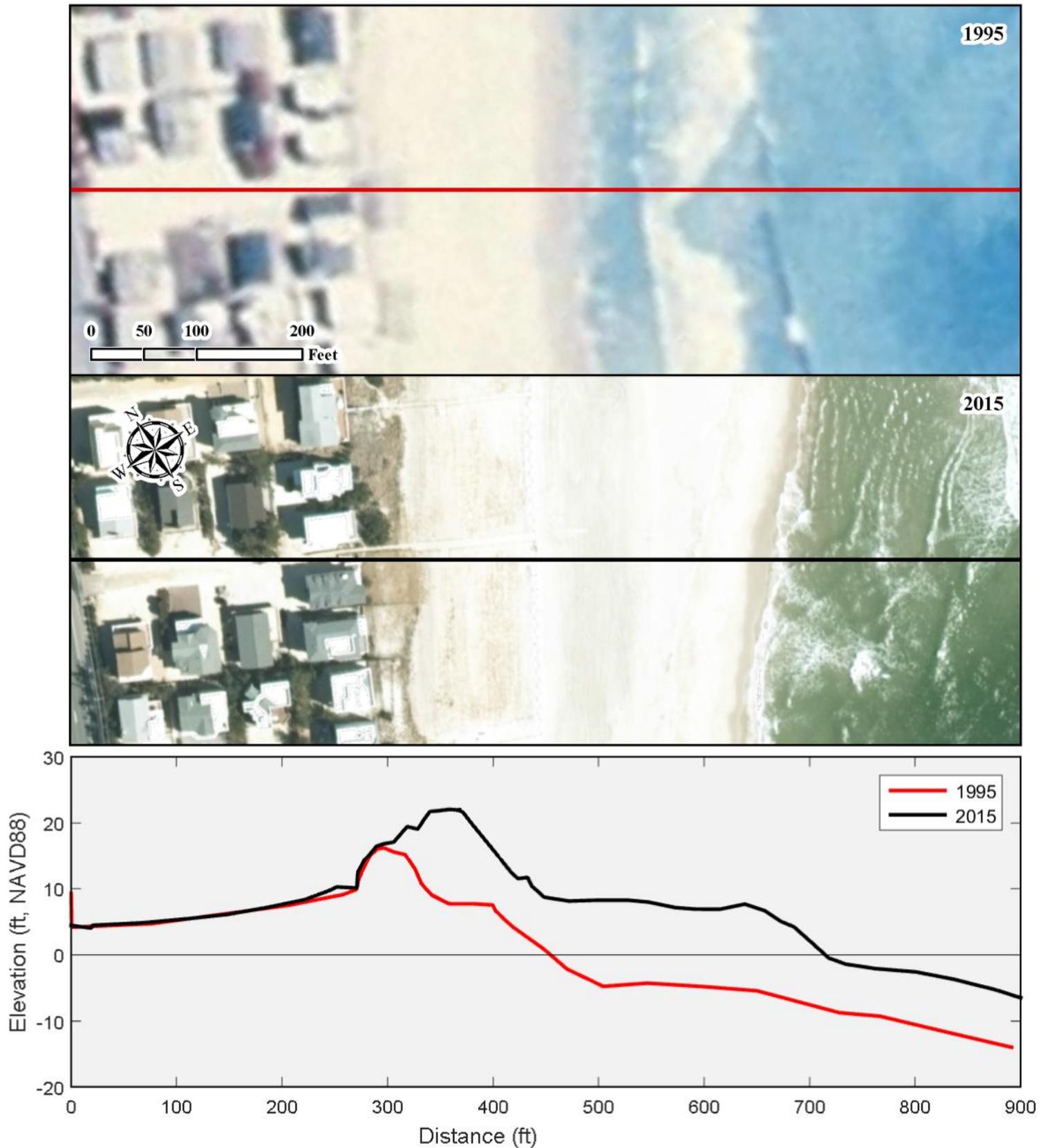


Figure 333. The federal project incorporated the 1995 dune into the engineered dune design. The shoreline moved 260 ft seaward from its 1995 position.

**NJBPN 241 – 20<sup>th</sup> Street, Surf City (October 28, 2016)**



**Figure 334. View to the north from the crest of the engineered dune at 20<sup>th</sup> Street in Surf City.**

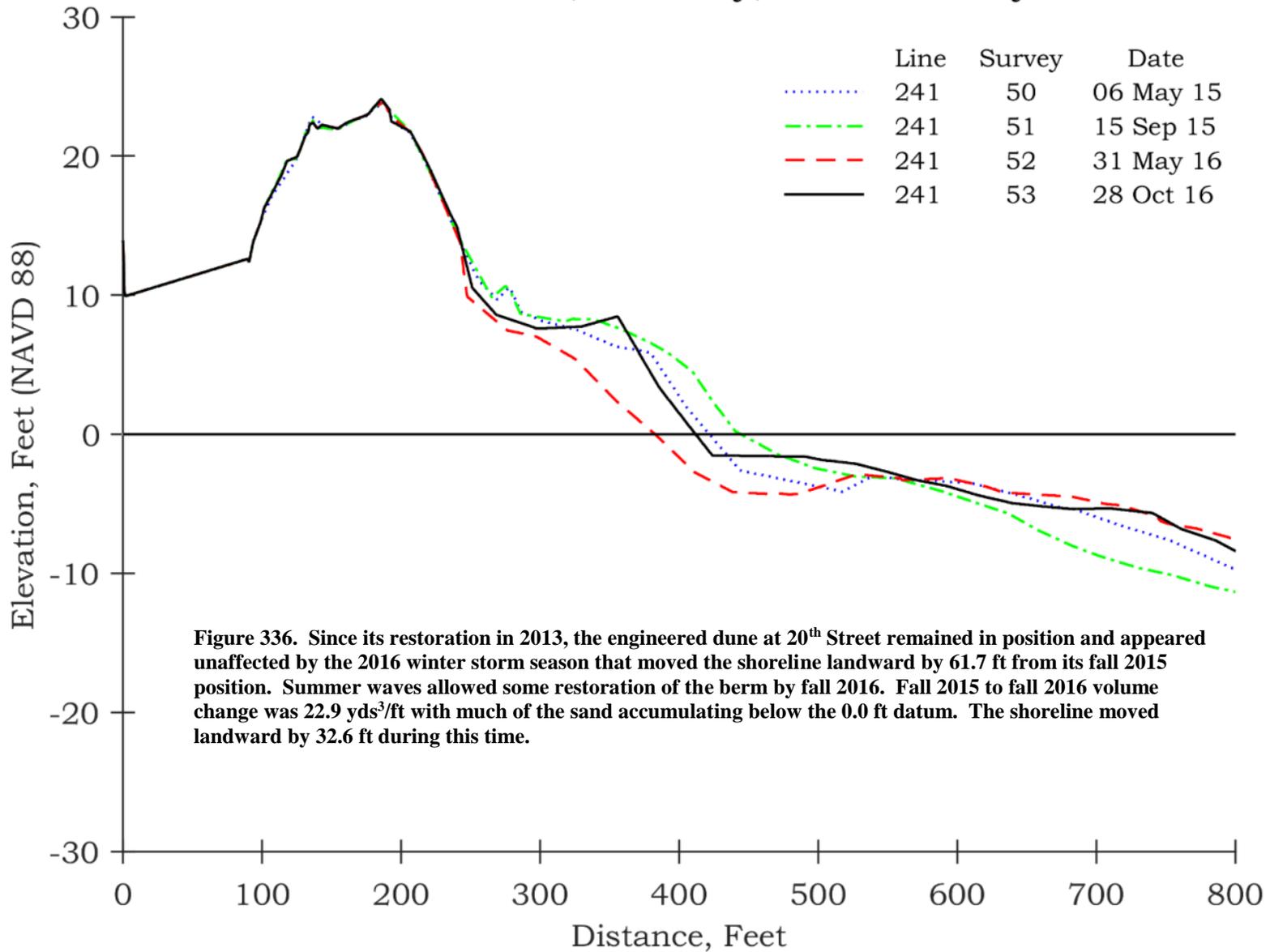
NJBPN 241 – 20<sup>th</sup> Street – Surf City



Figure 335a & 335b. The photos show the conditions of the backshore/seaward dune toe at 20<sup>th</sup> Street. Berm widths were comparable and are typical for late summer/early fall accretional beach conditions. The left photo was taken on September 15, 2015 and right photo taken October 28, 2016.

# New Jersey Beach Profile Network

## #241 - 20<sup>th</sup> Street, Surf City, Ocean County



## 22-Year Coastal Changes at Site 241, 20<sup>th</sup> Street, Surf City, Ocean Co.

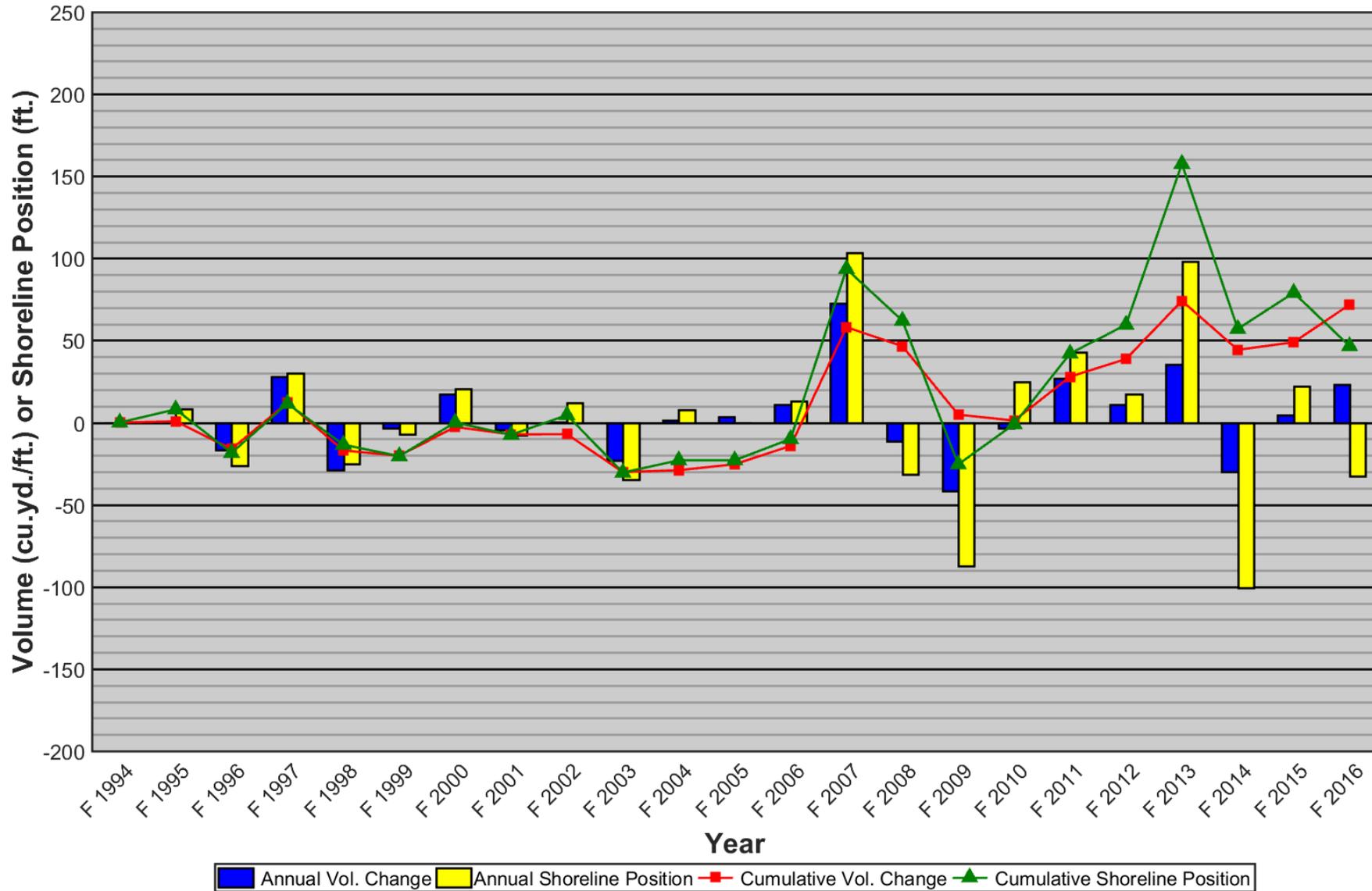
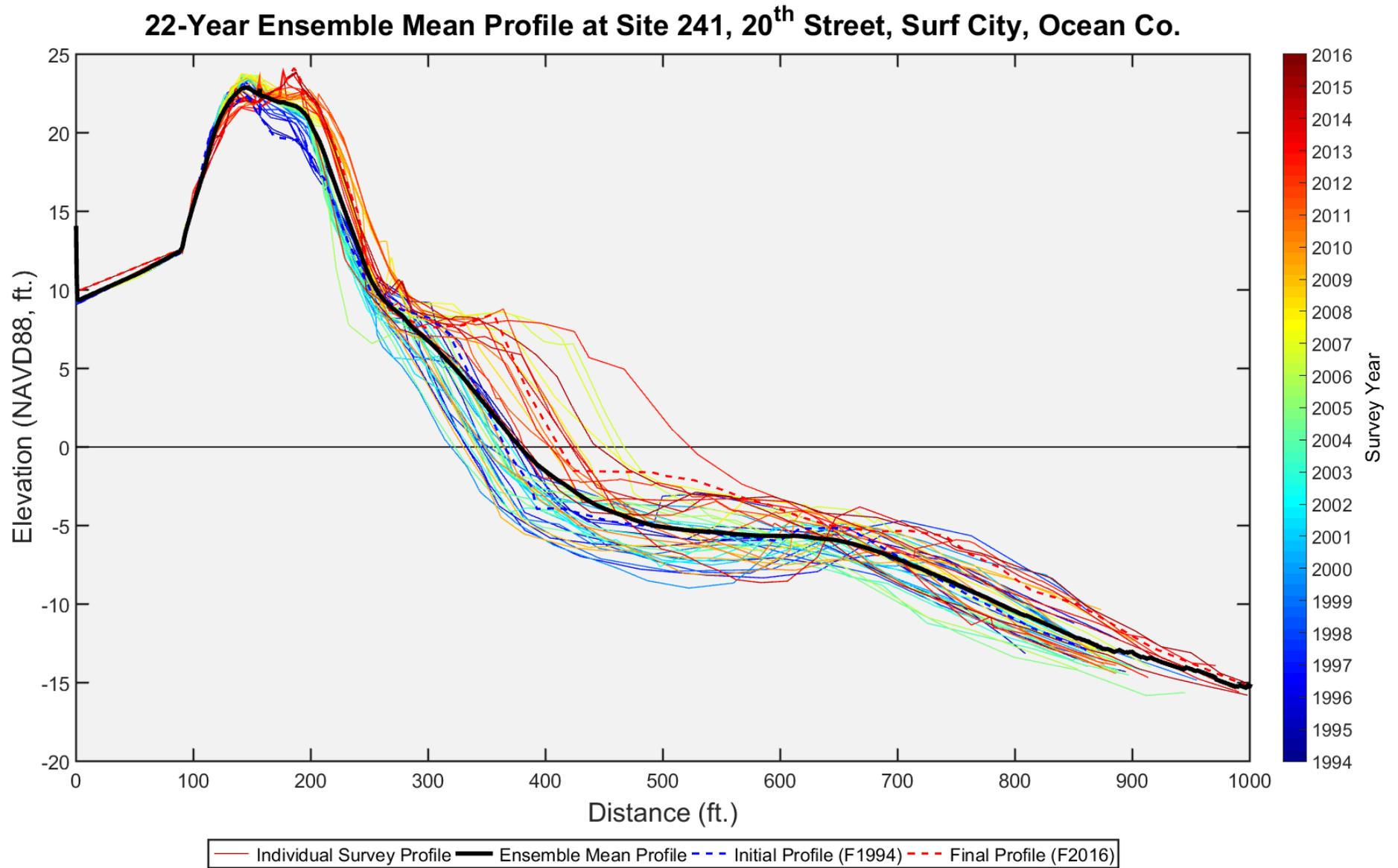
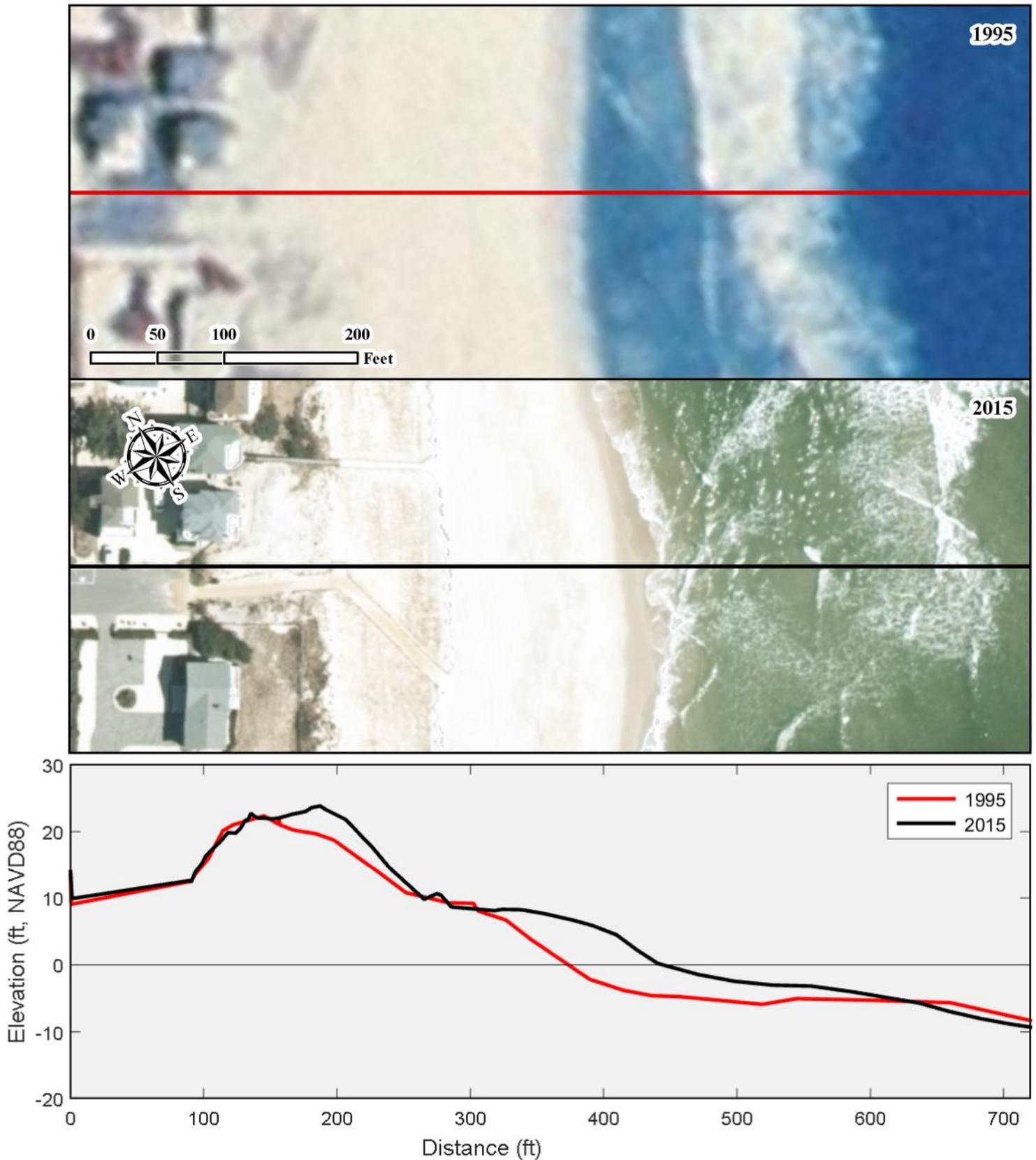


Figure 337. Shoreline position and volume changes were variable, but moderate at the 20<sup>th</sup> Street location prior to the 2007 federal shore protection project. Significant gains were measured in 2013 following the federal emergency fill. Losses since then have been linked to profile adjustment and winter weather events.



**Figure 338.** The 22-year profile data comparison shows the dune in relatively the same position from the monument and its gradual vertical growth to the time of the first beach fill in 2007. However, during that same time, the berm widths, elevation, and nearshore region varied and were generally lower in elevation prior to the federal project.

#241 - 20th Street, Surf City Borough, Ocean County  
Comparison of 1995 to 2015



**Figure 339.** The federal shore protection project incorporated the 1995 dune into the engineered dune design. This site was restored in 2013 and the shoreline moved seaward by 71 ft between 1995 and 2015.

**NJBPN 141 – 8<sup>th</sup> Street, Ship Bottom (October 28, 2016)**



**Figure 340. View to the south from the berm at 8<sup>th</sup> Street in Ship Bottom.**

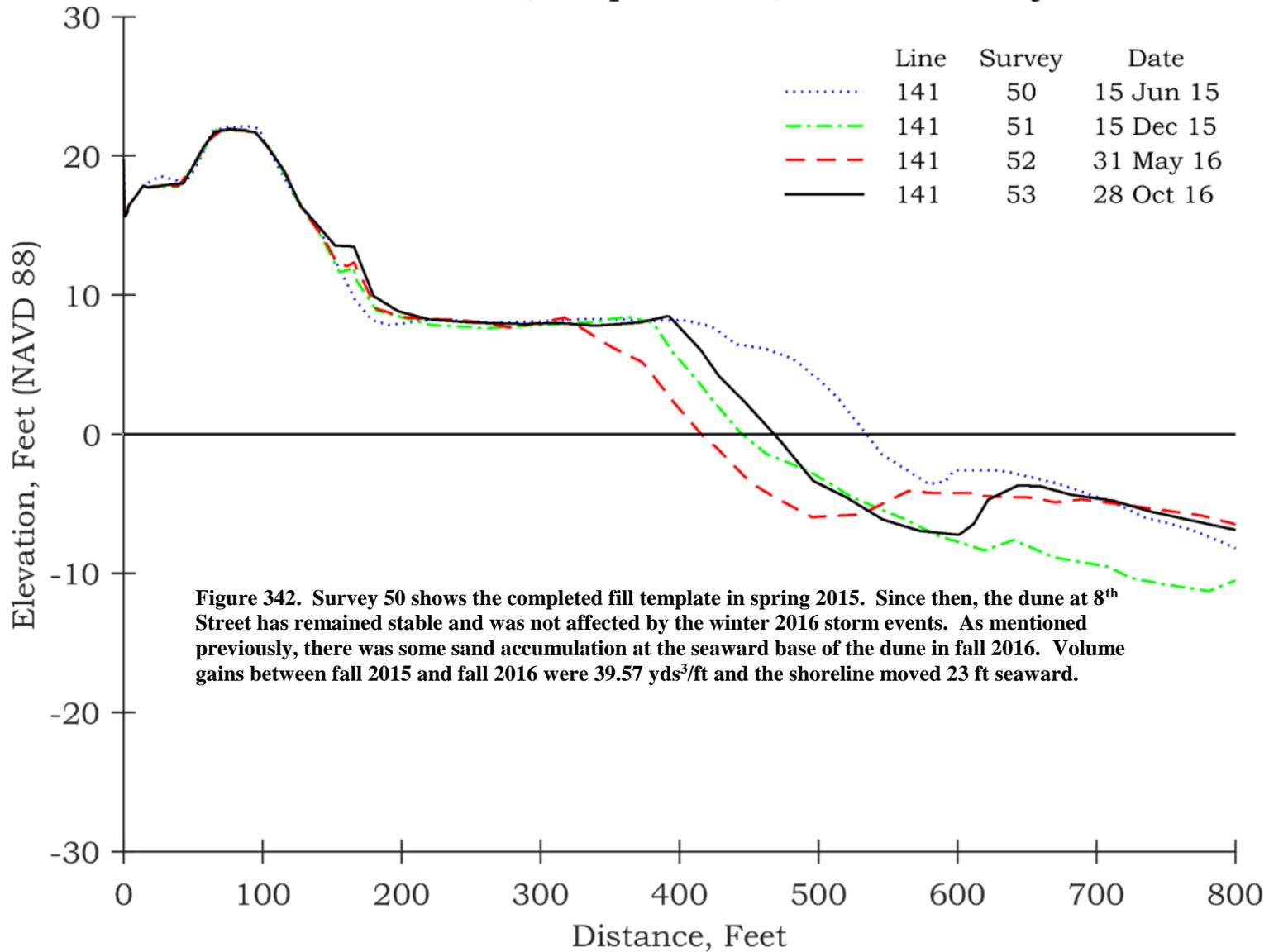
**NJBPN 141 – 8<sup>th</sup> Street, Ship Bottom**



**Figure 341a & 341b.** The photos of the 8<sup>th</sup> Street location (left taken December 15, 2015 and right taken October 28, 2016) show the conditions of the dune toe and backshore. This site was included in the federal beach fill which was completed in spring 2015. The right photo shows sand that accumulated from early fall high winds, burying the dune vegetation and sand fencing.

# New Jersey Beach Profile Network

## #141 - 8<sup>th</sup> Street, Ship Bottom, Ocean County



### 30-Year Coastal Changes at Site 141, 8<sup>th</sup> Street, Ship Bottom, Ocean Co.

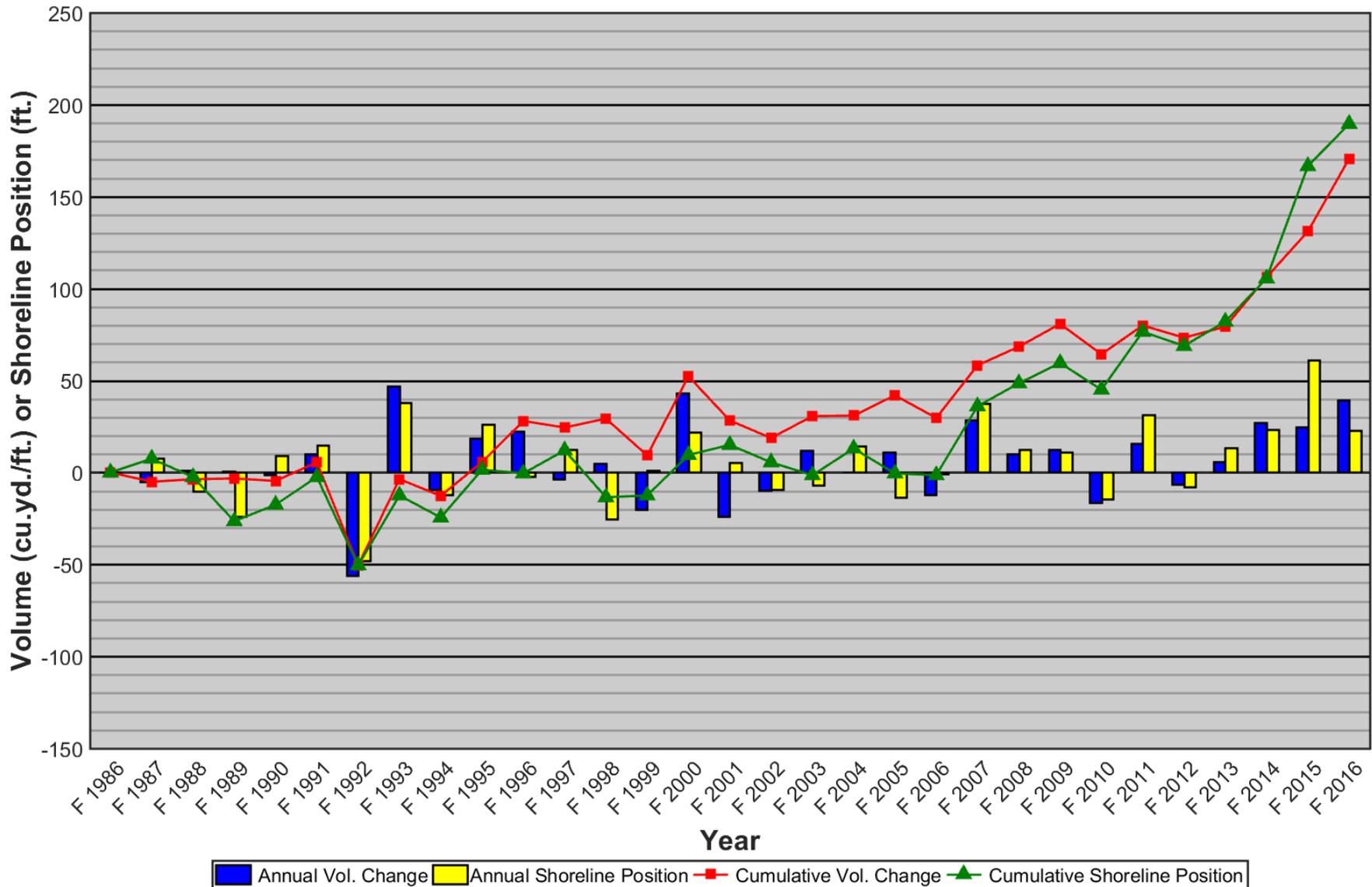


Figure 343. The 8<sup>th</sup> Street site has gradually accreted and recovered from storms since the 1992 northeaster. Hurricane Sandy removed much of the berm and seaward dune fence, but by fall 2013, the site had regained much of the berm losses as sediment moved from offshore to the beach. The volume gained from the 2015 emergency beach fill was added to the following year. The 30-year sand volume gain was 170 yds<sup>3</sup>/ft and the shoreline advanced by 180 ft.

### 30-Year Ensemble Mean Profile at Site 141, 8<sup>th</sup> Street, Ship Bottom, Ocean Co.

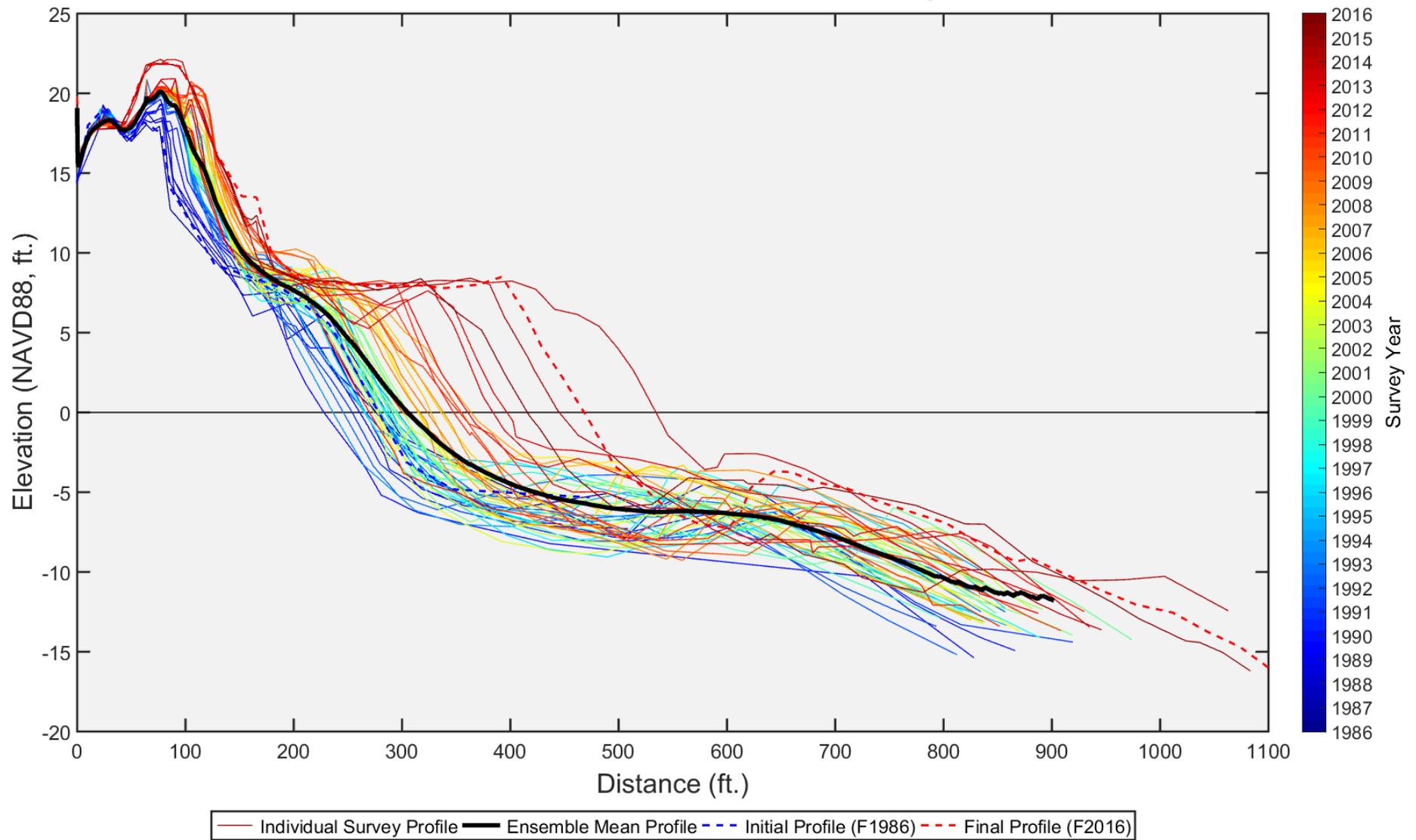


Figure 344. At 8<sup>th</sup> Street, the profile plots clearly show the upward and seaward progression of the dune and shoreline through time. This site was included in the 2012 federal shore protection project and was nourished in 2015.

#141 - 8th Street, Ship Bottom Borough, Ocean County  
**Comparison of 1995 to 2015**

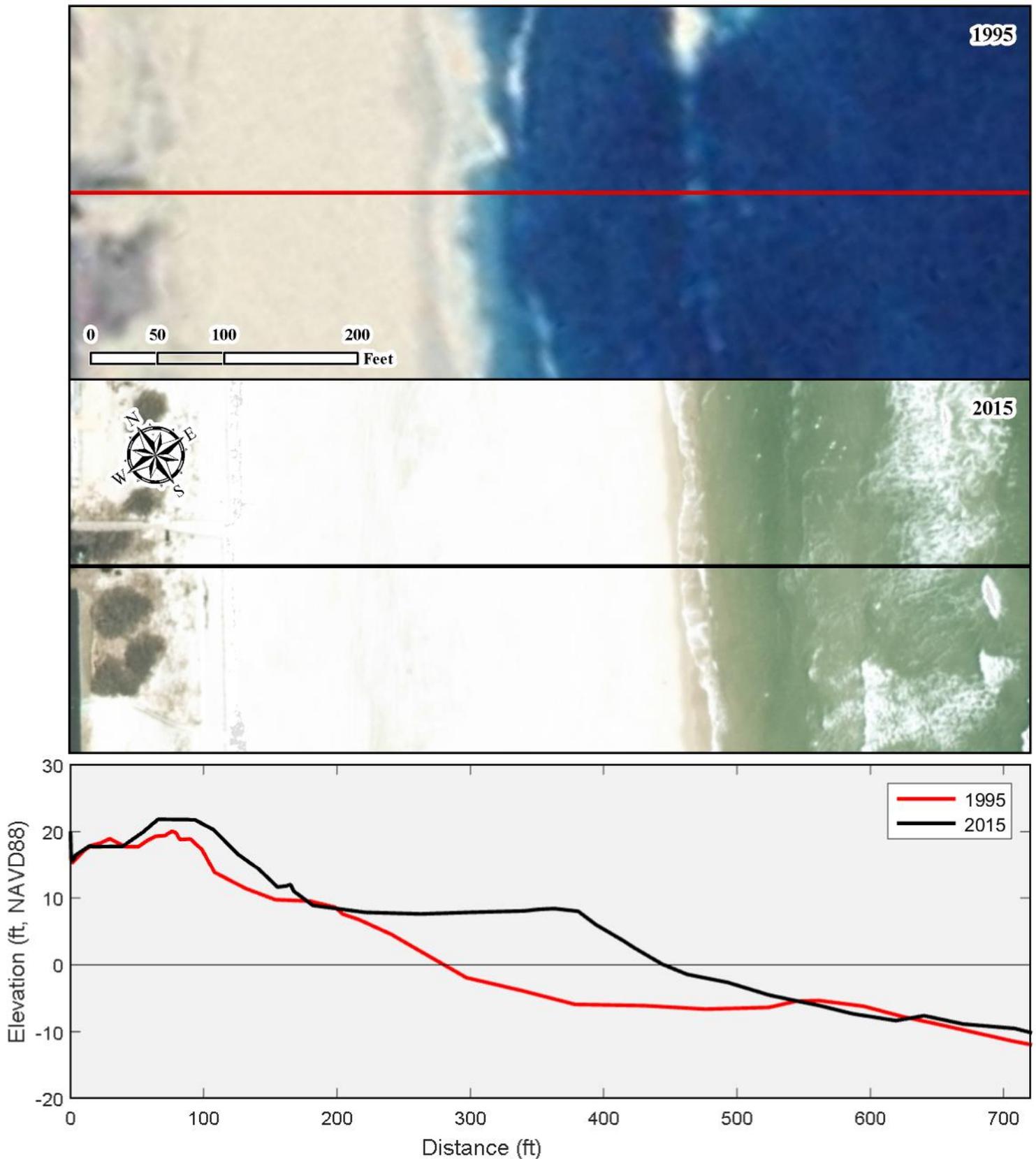


Figure 345. The 2015 profile shows a newly restored engineered dune and elevated berm. Between the 1995 and 2015 surveys, the shoreline moved seaward by 165 ft.

**NJBPN 140 – 32<sup>nd</sup> Street, Long Beach Township (September 23, 2016)**



**Figure 346. View to the north from the berm at 32<sup>nd</sup> Street in Long Beach Township.**

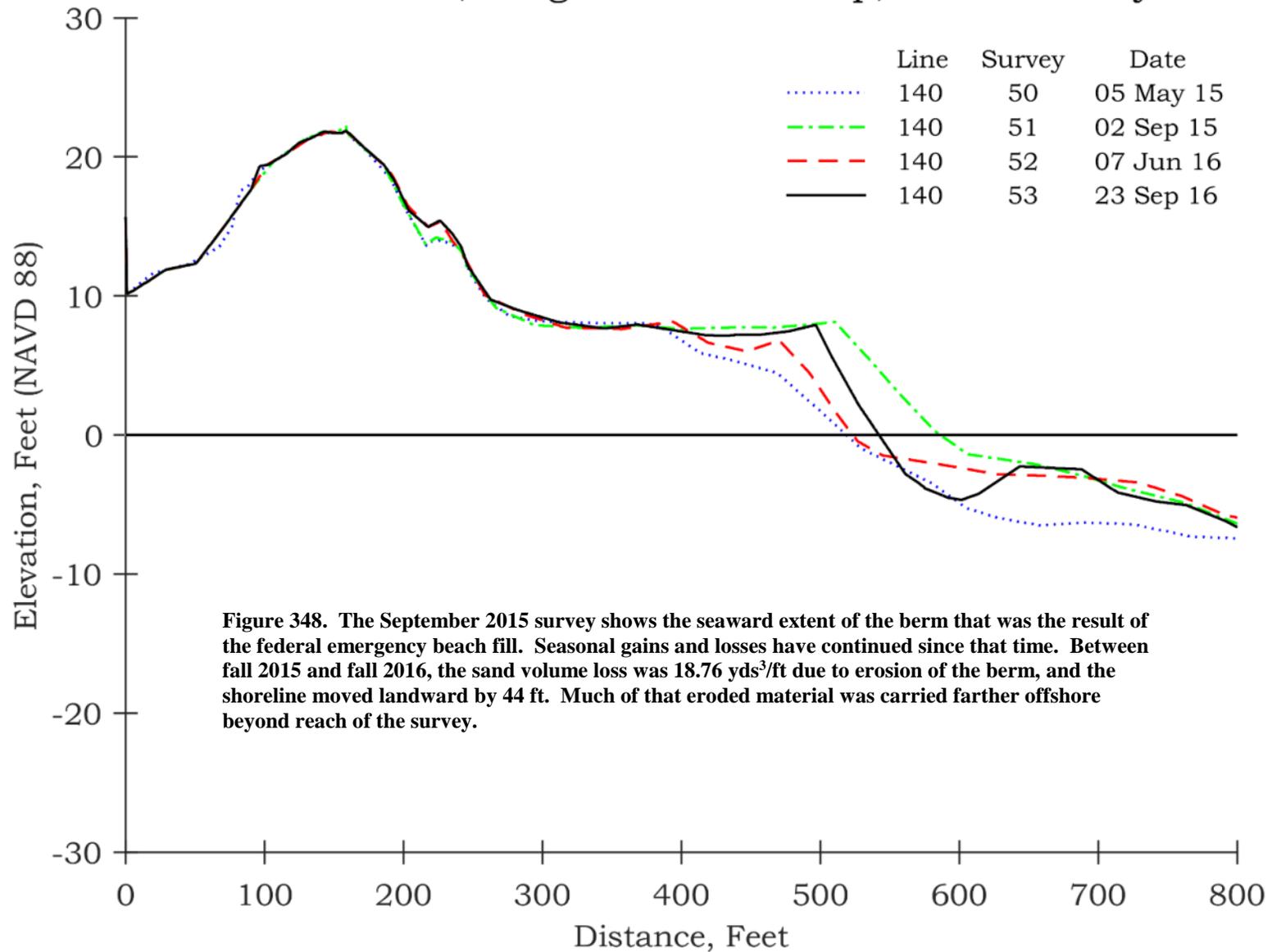
**NJBPN 140 – 32<sup>nd</sup> Street, Long Beach Township**



**Figure 347a & 347b. The photos at 32<sup>nd</sup> Street show a stable engineered dune that has remained in place since it was constructed in spring 2012 (left taken September 2, 2015 and right taken September 23, 2016). The 2015 emergency beach fill restored the berm to the template design.**

# New Jersey Beach Profile Network

#140 - 32<sup>nd</sup> Street, Long Beach Township, Ocean County



### 30-Year Coastal Changes at Site 140, 32<sup>nd</sup> Street, Long Beach Township, Ocean Co.

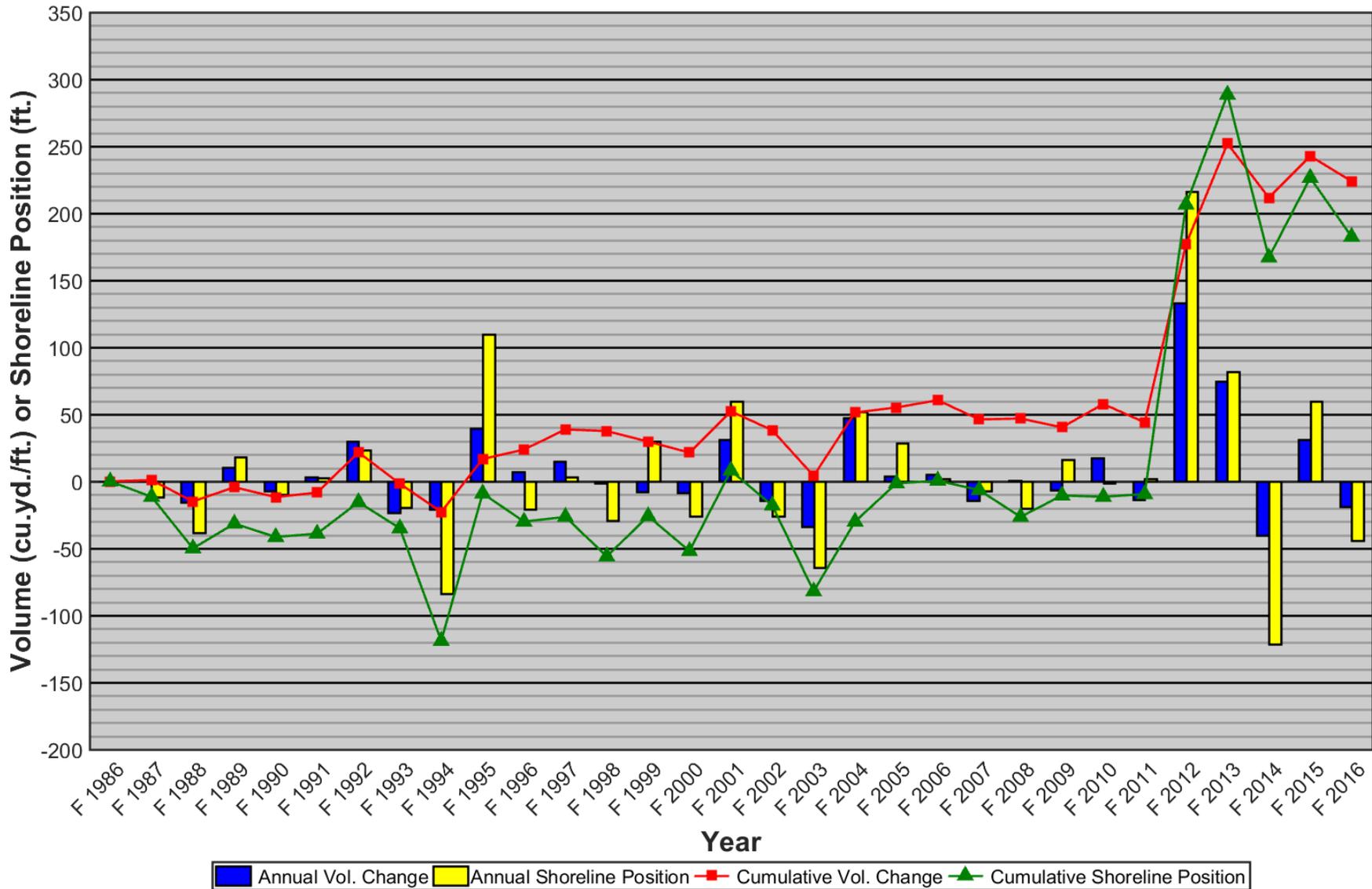


Figure 349. The 32<sup>nd</sup> Street location shows some moderate swings in erosion and accretion prior to nourishment in 2012. This site was included in the post-Sandy federal restoration in summer 2013 and the losses found in 2014 are probably due to profile adjustment. Note that the fall 2012 survey was completed one month prior to Hurricane Sandy and only a few months following the 2012 beach fill. This site has benefited from the federal project because the shoreline has advanced 184 ft seaward while the sand volume increased by 225 yds<sup>3</sup>/ft since 2012.

### 30-Year Ensemble Mean Profile at Site 140, 32<sup>nd</sup> Street, Long Beach Township, Ocean Co.

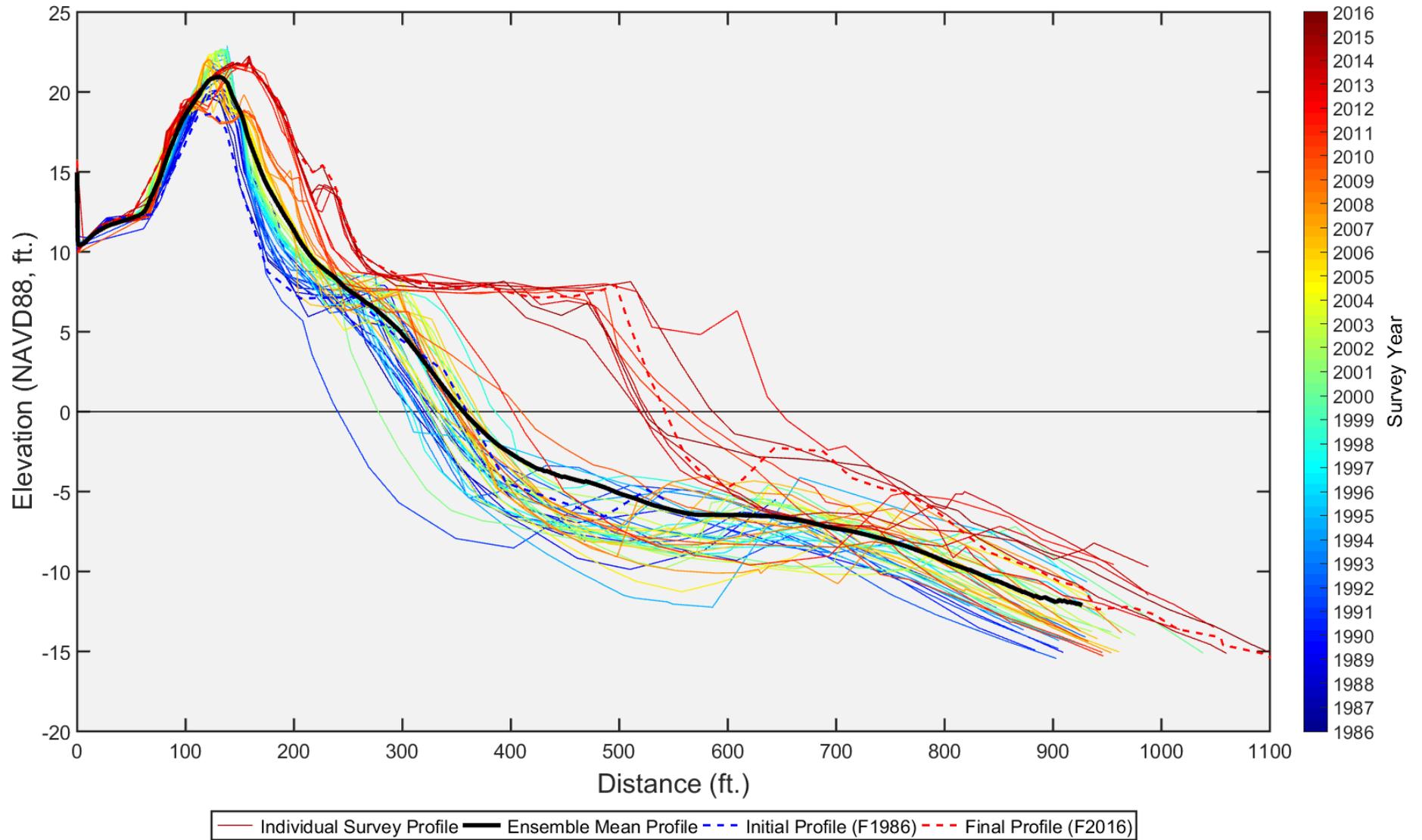


Figure 350. The profile time series at 32<sup>nd</sup> Street shows variability of the berm location and elevation until the construction of the federal shore protection in 2012. The original dune has remained in relatively the same position and was increased to the design template standard (approximately 22 ft NAVD88).

#140 - 32nd Street, Long Beach Township, Ocean County  
Comparison of 1995 to 2015

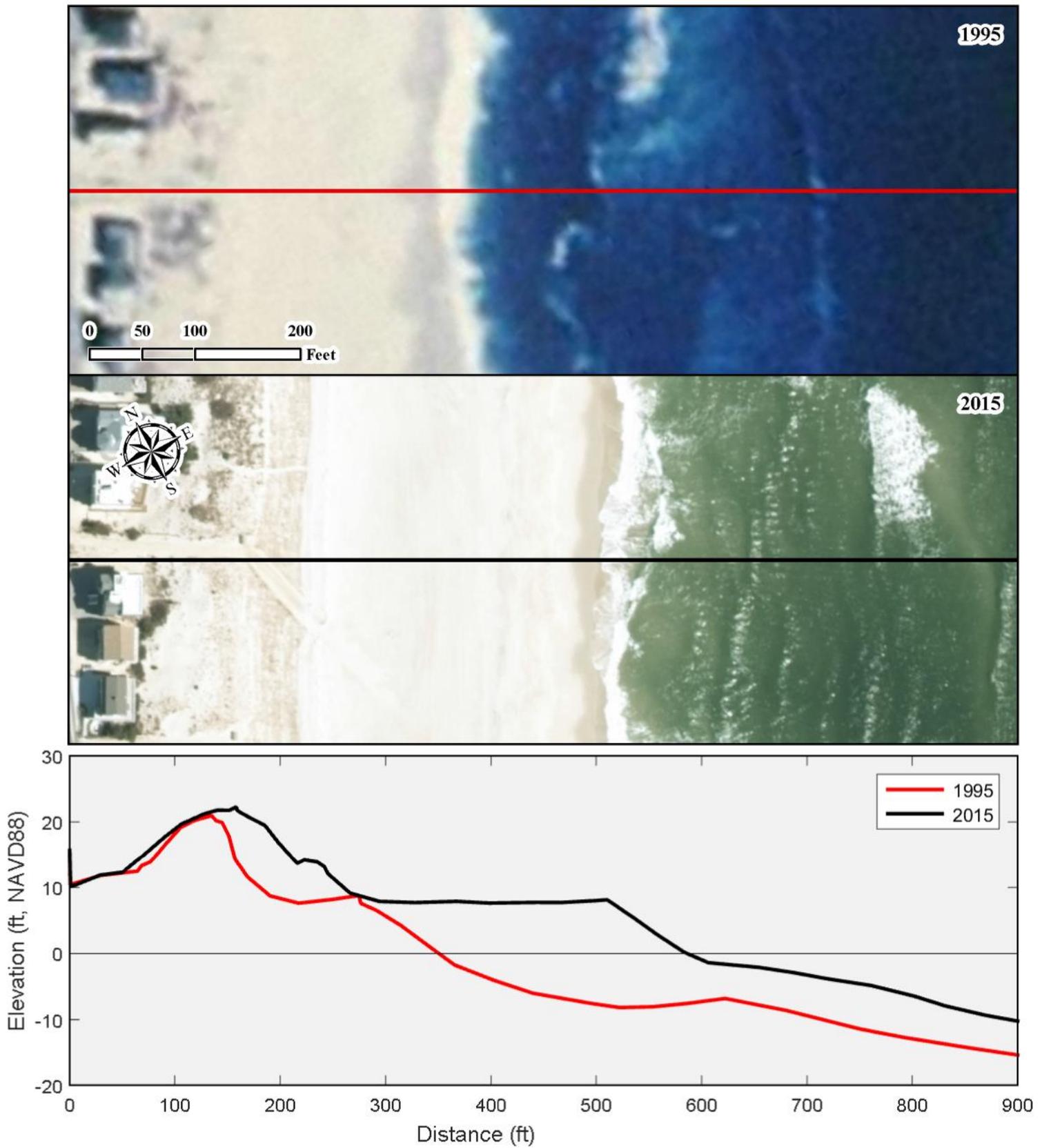


Figure 351. The profile comparison shows the inclusion of the 1995 dune into the engineered dune design. Between 1995 and 2015, the shoreline moved seaward by 236 ft.

**NJBPN 139 – 81<sup>st</sup> Street, Long Beach Township (October 28, 2016)**



**Figure 352. View to the north from the dune toe and vehicular access at 81<sup>st</sup> Street in Long Beach Township.**

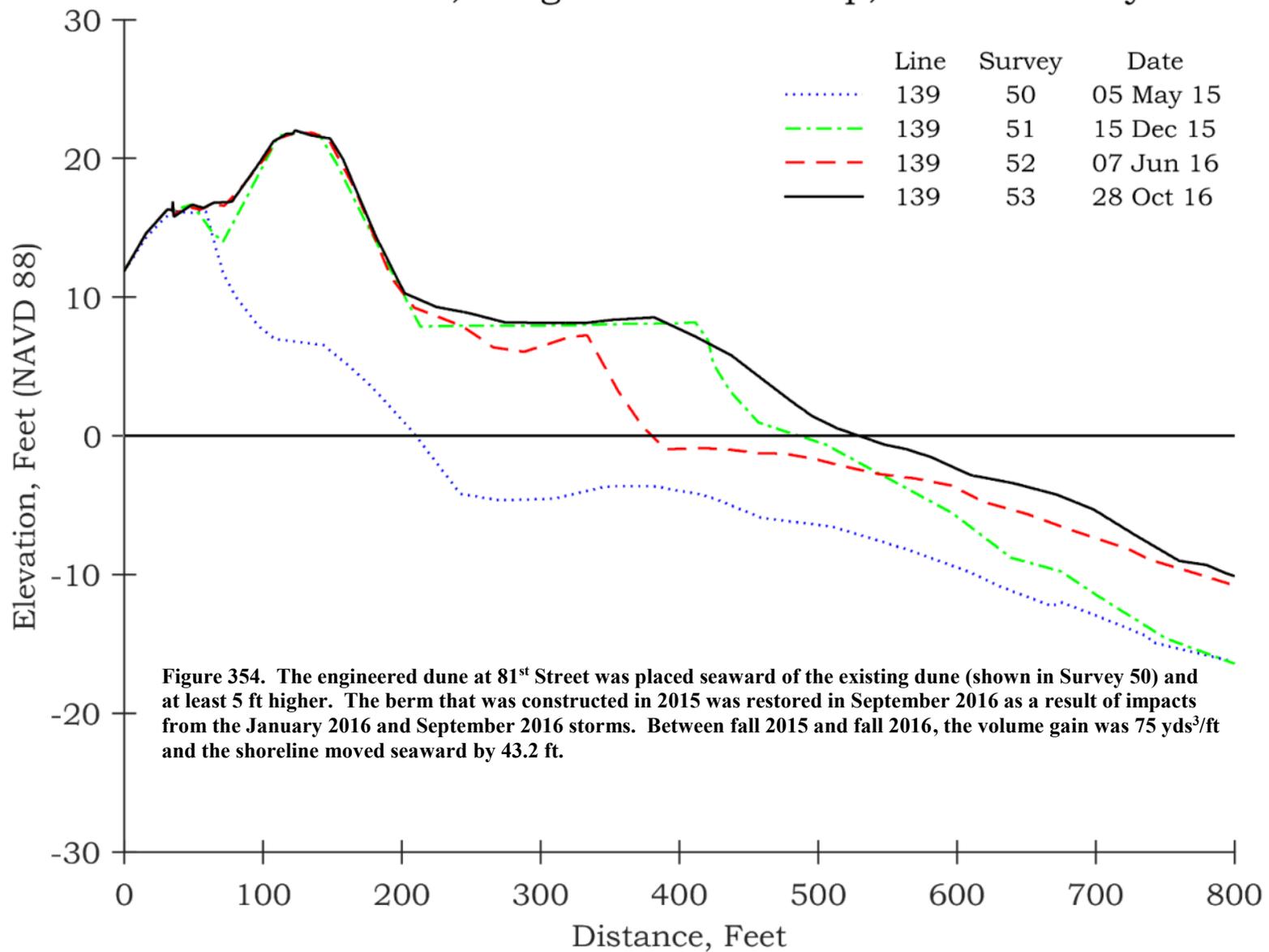
**NJBPN 139 – 81<sup>st</sup> Street, Long Beach Township**



**Figure 353a & 353b. The view from the dune crest at the 81<sup>st</sup> Street location shows the newly constructed dune in 2015 (left photo taken December 15, 2015) and the dune with partially planted vegetation (right photo taken October 28, 2016). Sand fencing and more planting was set to be completed shortly after the picture was taken.**

# New Jersey Beach Profile Network

#139 - 81<sup>st</sup> Street, Long Beach Township, Ocean County



### 30-Year Coastal Changes at Site 139, 81<sup>st</sup> Street, Long Beach Township, Ocean Co.

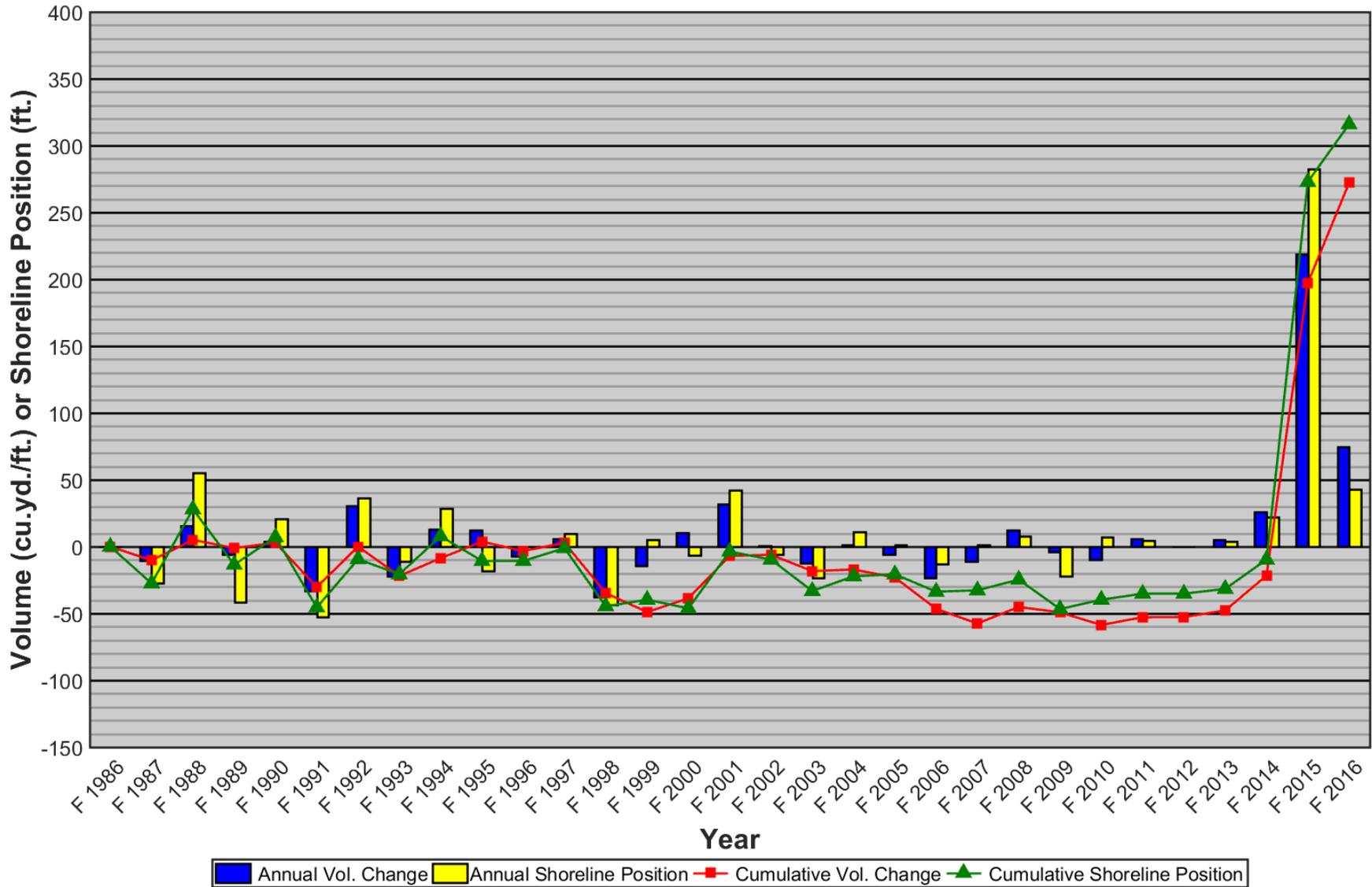


Figure 355. Moderate swings in shoreline position and volume change were recorded from the early history of this profile up until 2001. Since that time, volume losses have been greater than the gains. Note the significant sand volume gain and corresponding shoreline advance seaward due to the 2015 federal beach fill.

### 30-Year Ensemble Mean Profile at Site 139, 81<sup>st</sup> Street, Long Beach Township, Ocean Co.

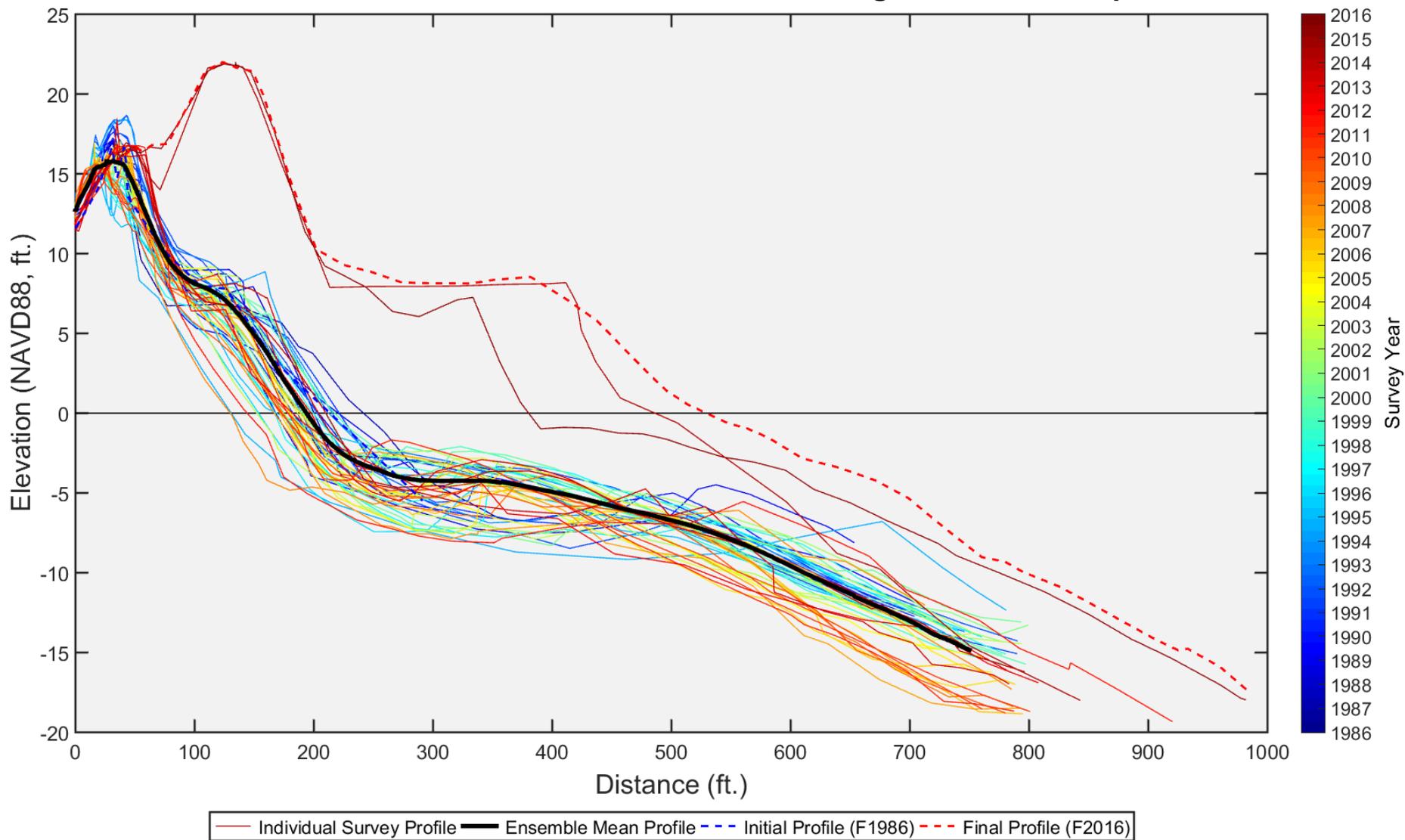


Figure 356. The profiles at 81<sup>st</sup> Street reinforce what is shown by the volume and shoreline changes in Figure 355. Prior to the 2015 beach fill the dune was less than 20 ft high and sparsely vegetated. Berm widths were also less than 100 ft, leaving limited protection during storms. After Hurricane Sandy, sand was recovered from the streets and returned to the beach and dune. Note that the position of the 2015 engineered dune toe lies seaward of the 1986 shoreline and that the new shoreline position is 320 ft farther seaward than the original.

#139 - 81st Street, Long Beach Township, Ocean County  
**Comparison of 1995 to 2016**

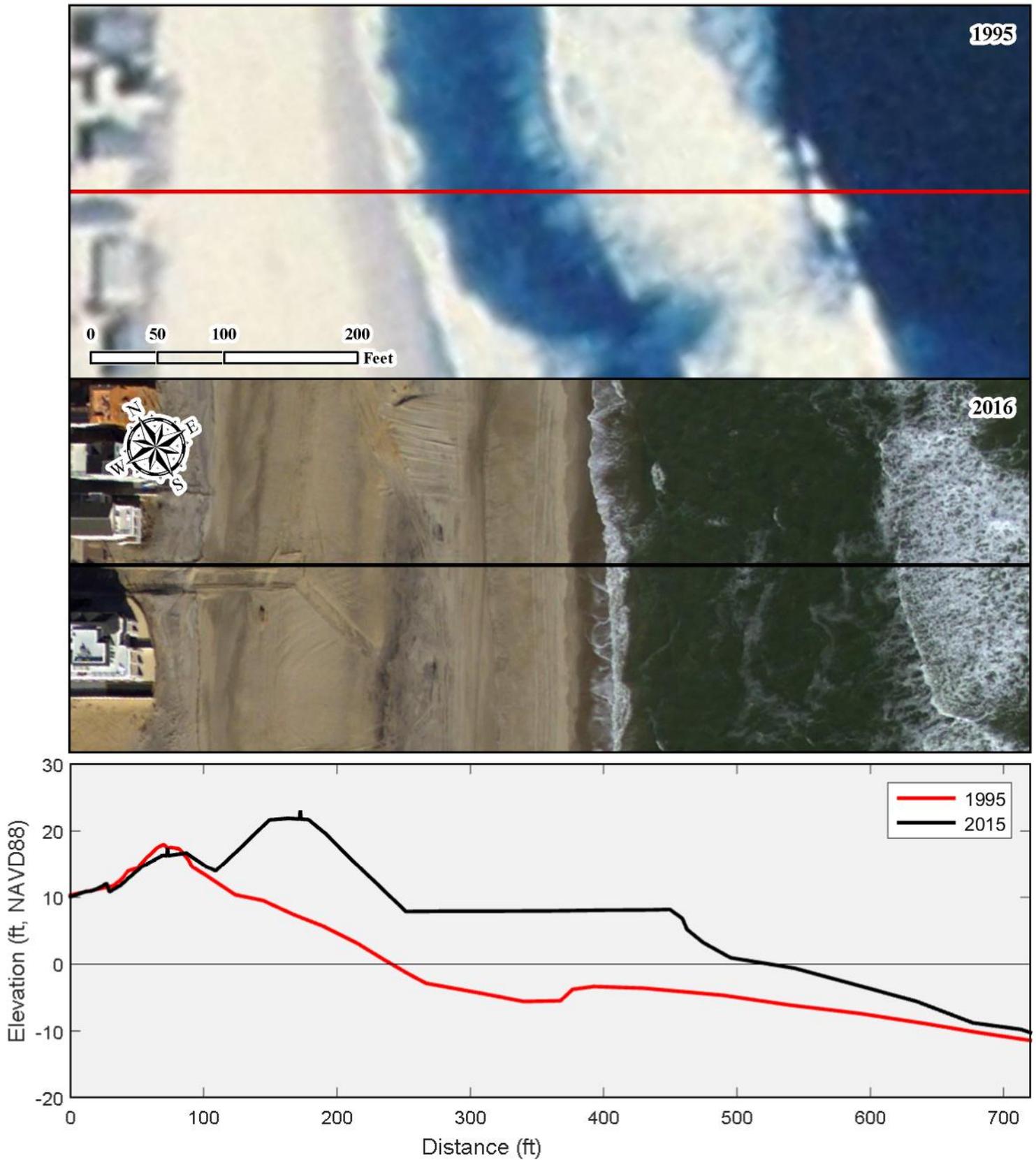


Figure 357. The 2015 federal shore protection project raised the dune elevation and moved it seaward by 283 ft from its 1995 position due to the beach fill.

**NJBPN 138 – Old Whaling Road, Long Beach Township (September 23, 2016)**



**Figure 358. View to the north from the berm at Old Whaling Road (124<sup>th</sup> Street) in Long Beach Township.**

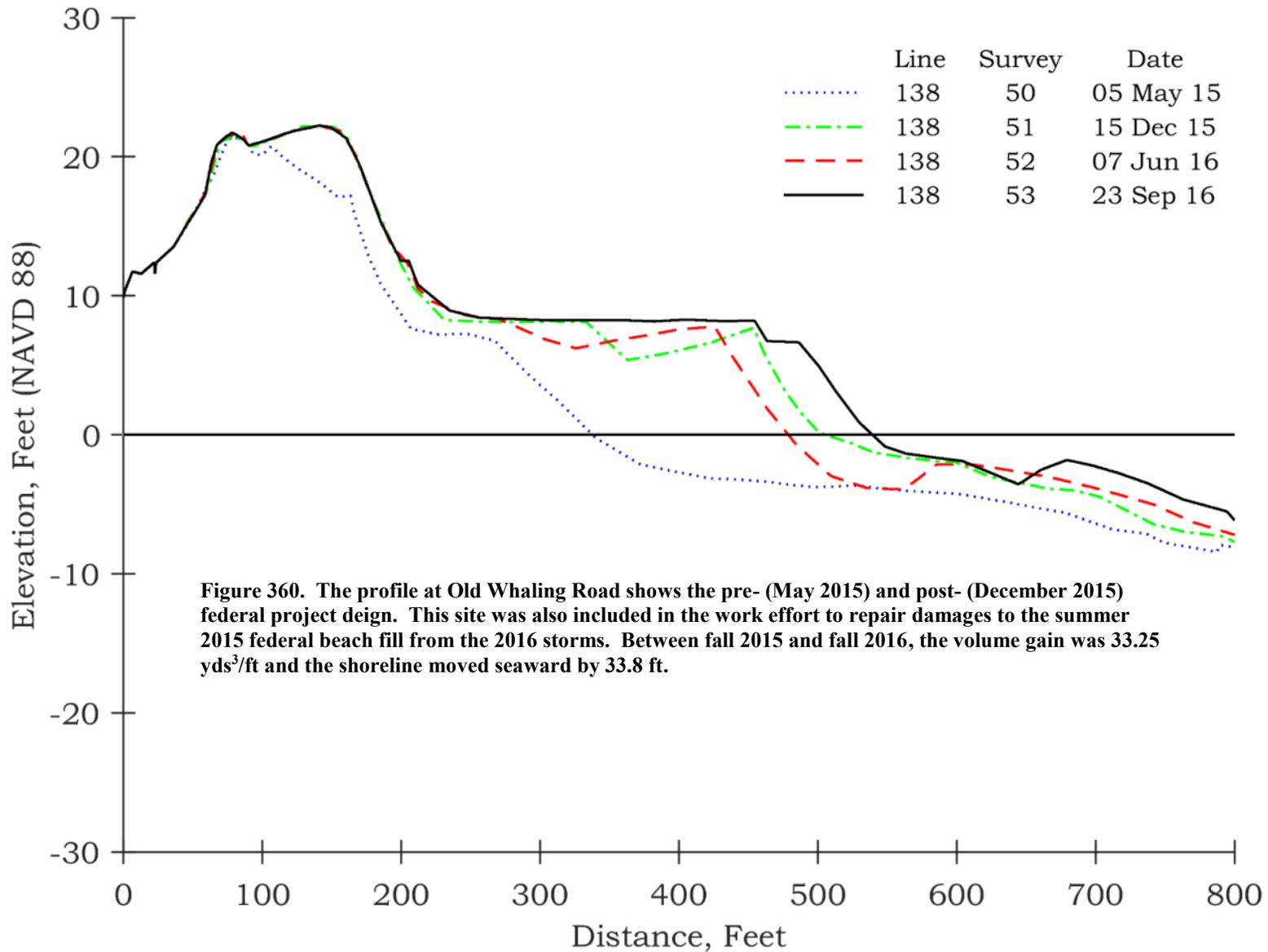
**NJBPN 138 – Old Whaling Road (124<sup>th</sup> Street), Long Beach Township**



**Figure 359a & 359b.** The photos from the top of the dune at 124<sup>th</sup> Street show the changes in the dune vegetation from December 15, 2015 (left) to September 23, 2016 (right). The federal project incorporated the original dune into the engineered design.

# New Jersey Beach Profile Network

#138 - Old Whaling Rd., Long Beach Township, Ocean County



### 30-Year Coastal Changes at Site 138, Old Whaling Rd., Long Beach Township, Ocean Co.

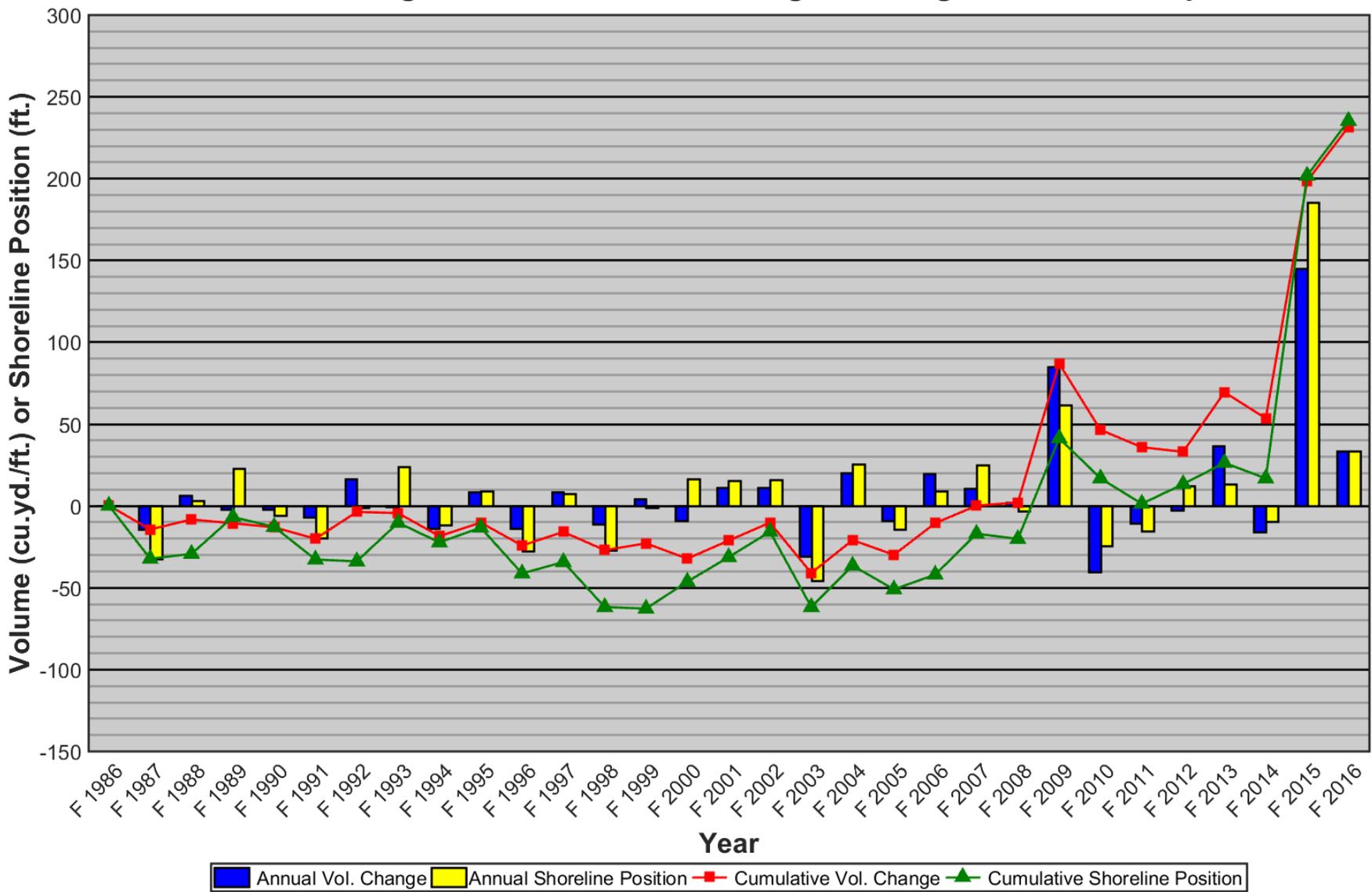


Figure 361. The Old Whaling Road site has experienced long-term shoreline recession and sand volume losses. The notable gain in 2009 was a result of the November 2009 northeast storm that moved sand onto the berm and accumulated material in the nearshore. Gains in 2013 were from the placement of sand that was over-washed into the streets during Hurricane Sandy. The 2015 gains resulted from the federal shore protection project.

### 30-Year Ensemble Mean Profile at Site 138, Old Whaling Rd., Long Beach Township, Ocean Co.

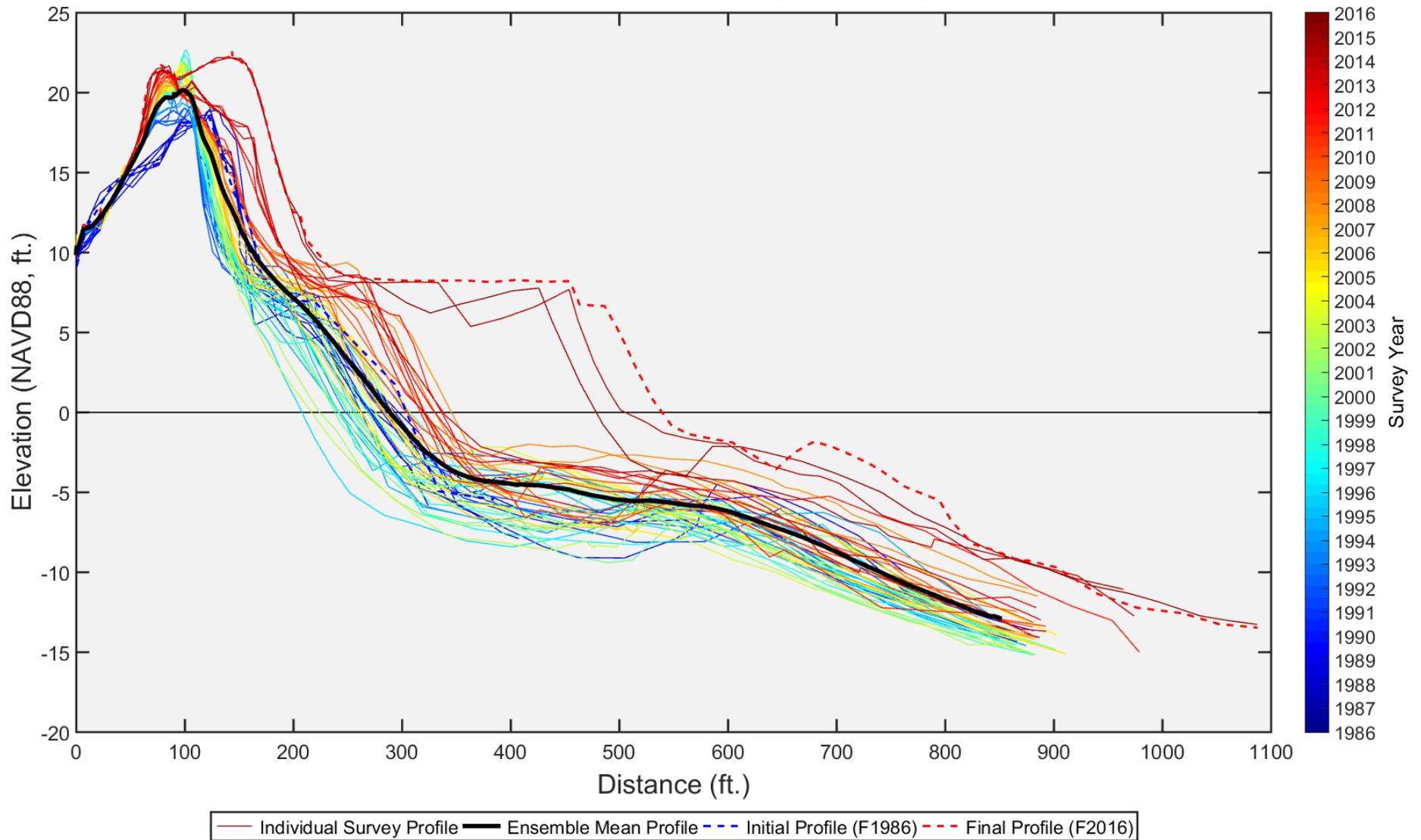


Figure 362. The profile time series at Old Whaling Road shows the slow erosion of the berm and nearshore from the initial profile while the dune increased in height. Note the location and incorporation of the dune into the 2015 engineered template. The seaward slope of the engineered dune is approximately 50 ft from the 1986 position.

#138 - Old Whaling Road, Long Beach Township, Ocean County  
**Comparison of 1995 to 2016**

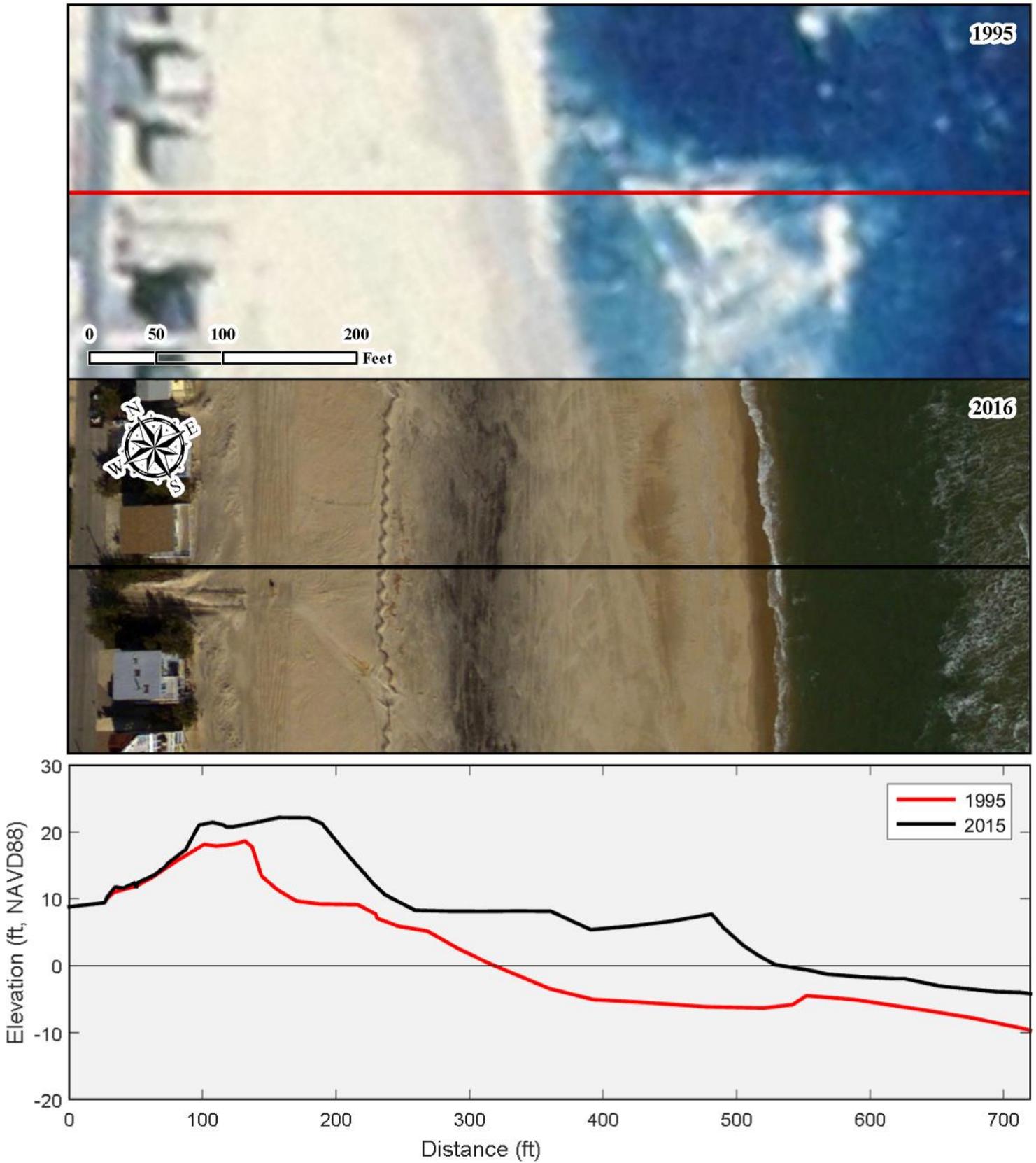


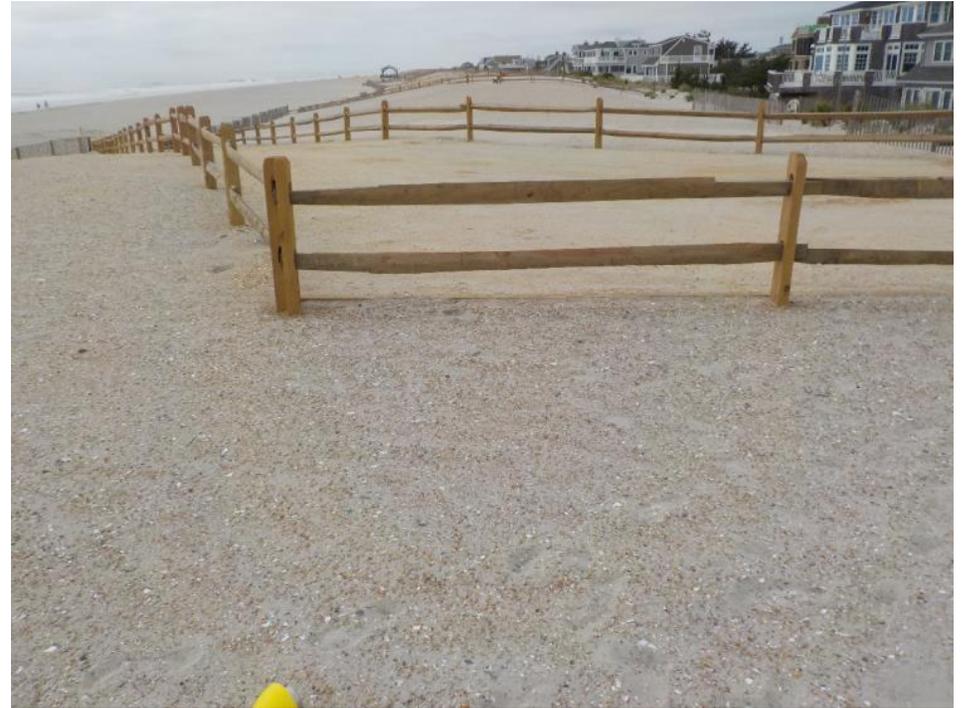
Figure 363. The 2015 profile shows the newly completed engineered dune and berm. The 1995 to 2015 comparison shows a seaward movement of the shoreline by 215 ft.

**NJBPN 137 – Taylor Avenue, Beach Haven (September 23, 2016)**



**Figure 364. View to the south from the foreshore at Taylor Avenue in Beach Haven.**

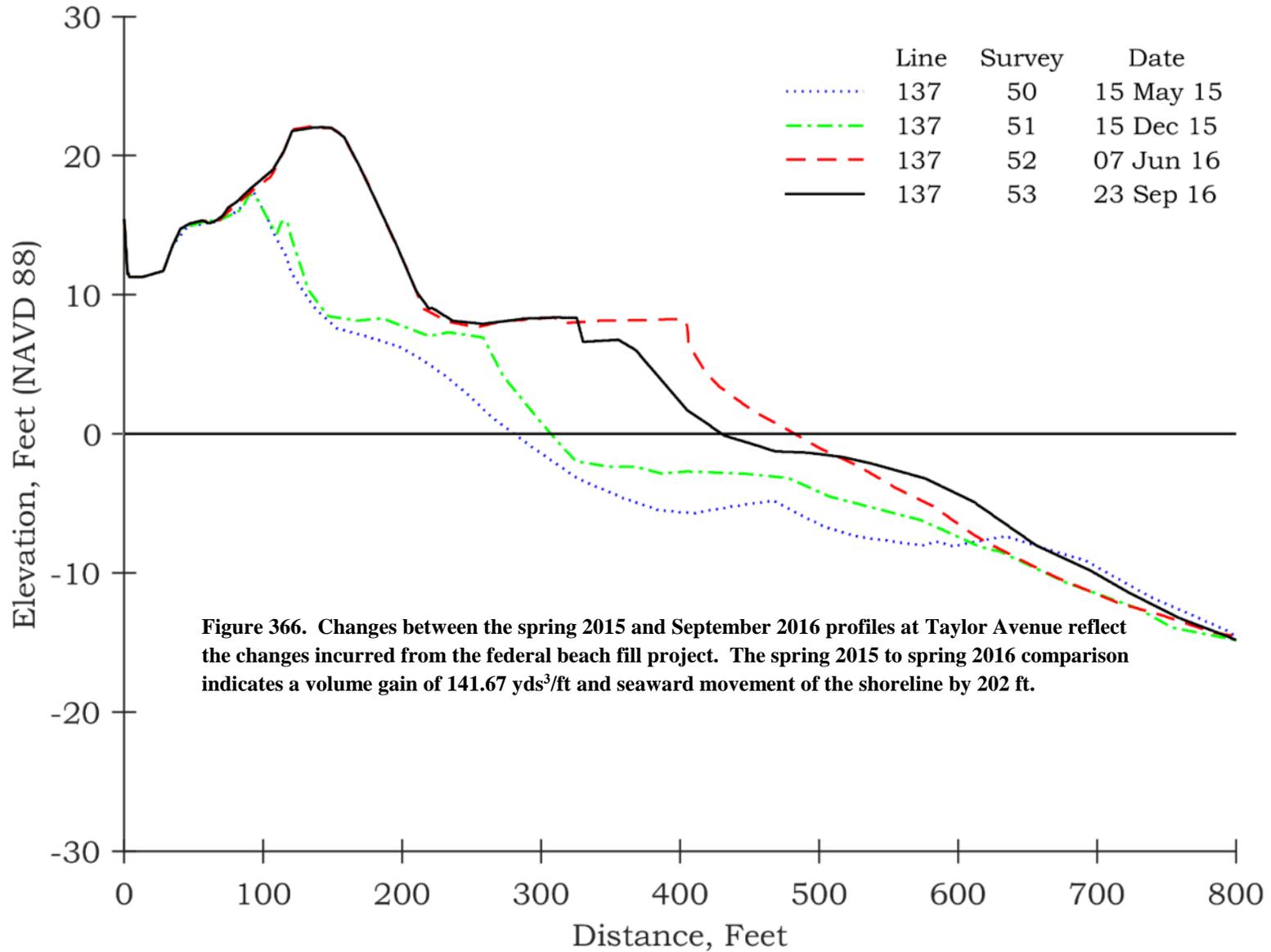
**NJBPN 137 – Taylor Avenue, Beach Haven**



**Figure 365a & 365b. The photos from the Taylor Avenue location were taken from the dune crest (left taken December 15, 2015 and right taken September 23, 2016). The engineered dune was completed at this location in spring 2016 but not yet planted by the time of the fall survey.**

# New Jersey Beach Profile Network

## #137 - Taylor Avenue, Beach Haven, Ocean County



### 30-Year Coastal Changes at Site 137, Taylor Avenue, Beach Haven, Ocean Co.

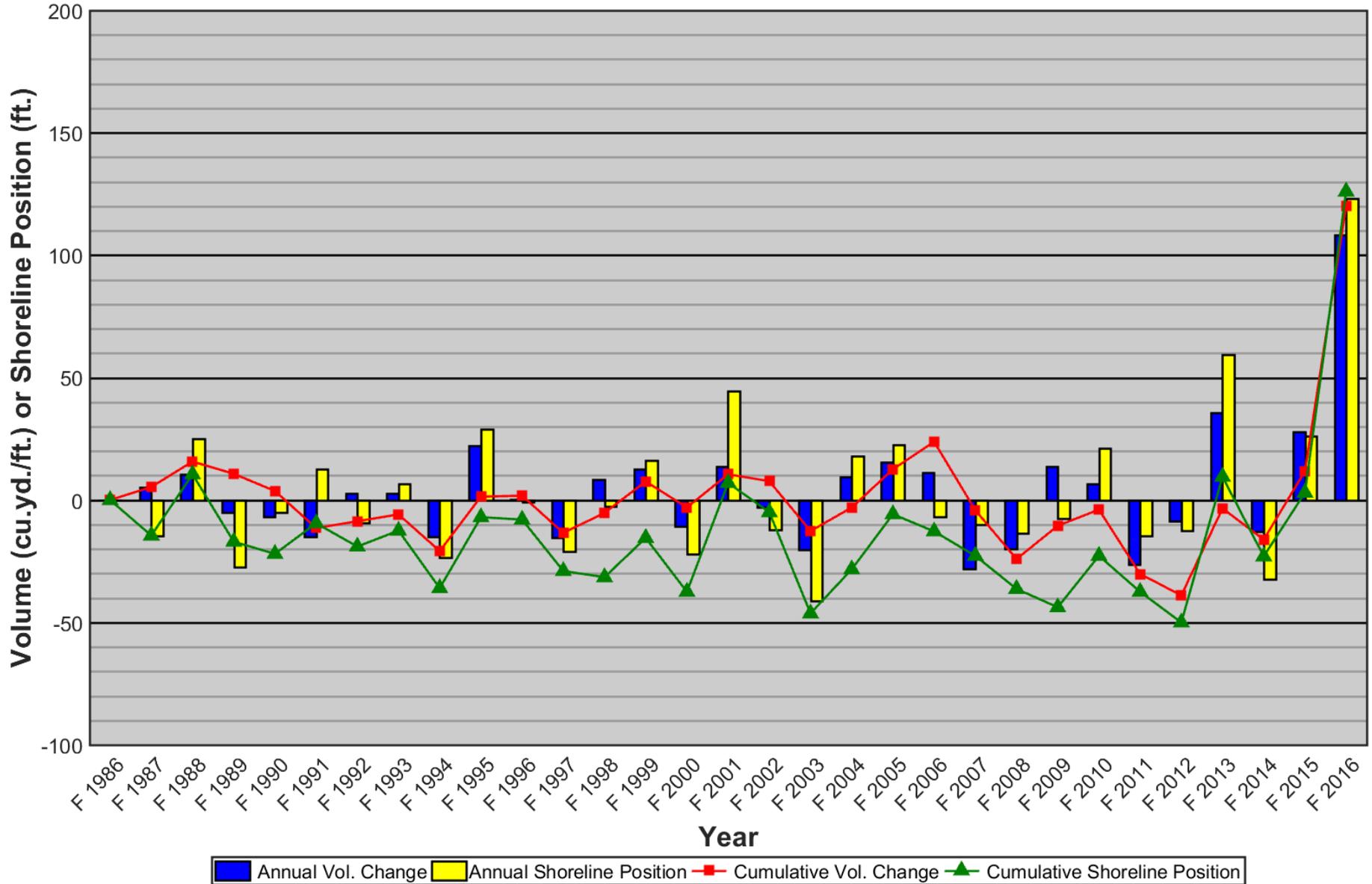


Figure 367. The profile at Taylor Avenue has been variable throughout the past 30-years with only minimal sand volume gains or shoreline advances. The gains shown in fall 2013 were from local sand recovery efforts following Hurricane Sandy. The gains shown in fall 2015 and 2016 are attributed to the federal shore protection project. Sites numbered 139 to 136 all saw up to 200 ft in shoreline advance and over 125 cubic yards of sand added by the project.

### 30-Year Ensemble Mean Profile at Site 137, Taylor Avenue, Beach Haven, Ocean Co.

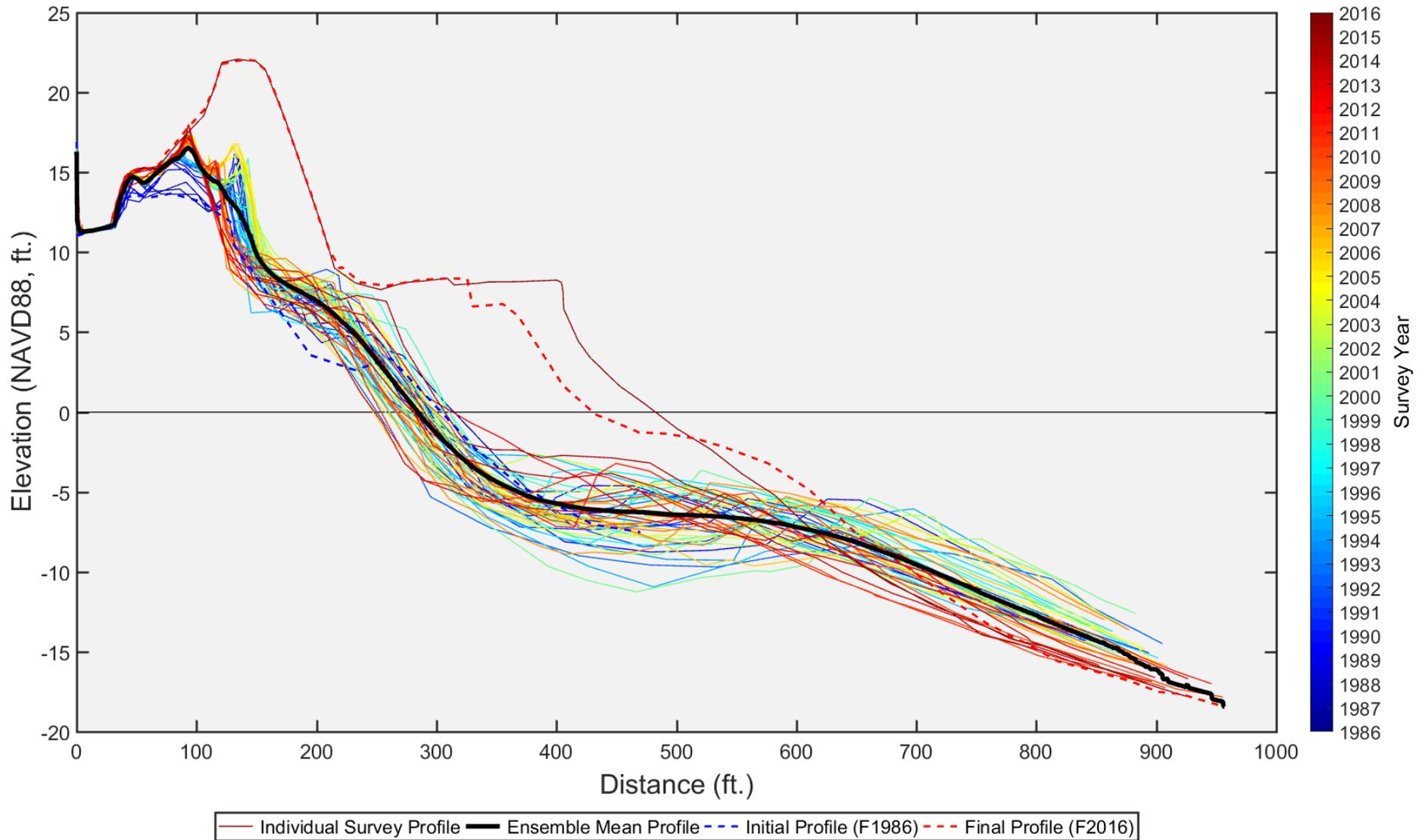


Figure 368. The profile time series at Taylor Avenue matches the variability shown in Figure 367. The dune appears to grow vertically from its 1986 position. This was incorporated into the federal shore protection project with a new dune elevation at 22 ft and seaward slope about 75 ft from its original position. The federal project also raised the berm elevation by 5 ft and extended the shoreline position by nearly 200 ft.

#137 - Taylor Avenue, Beach Haven Borough, Ocean County  
**Comparison of 1995 to 2015**

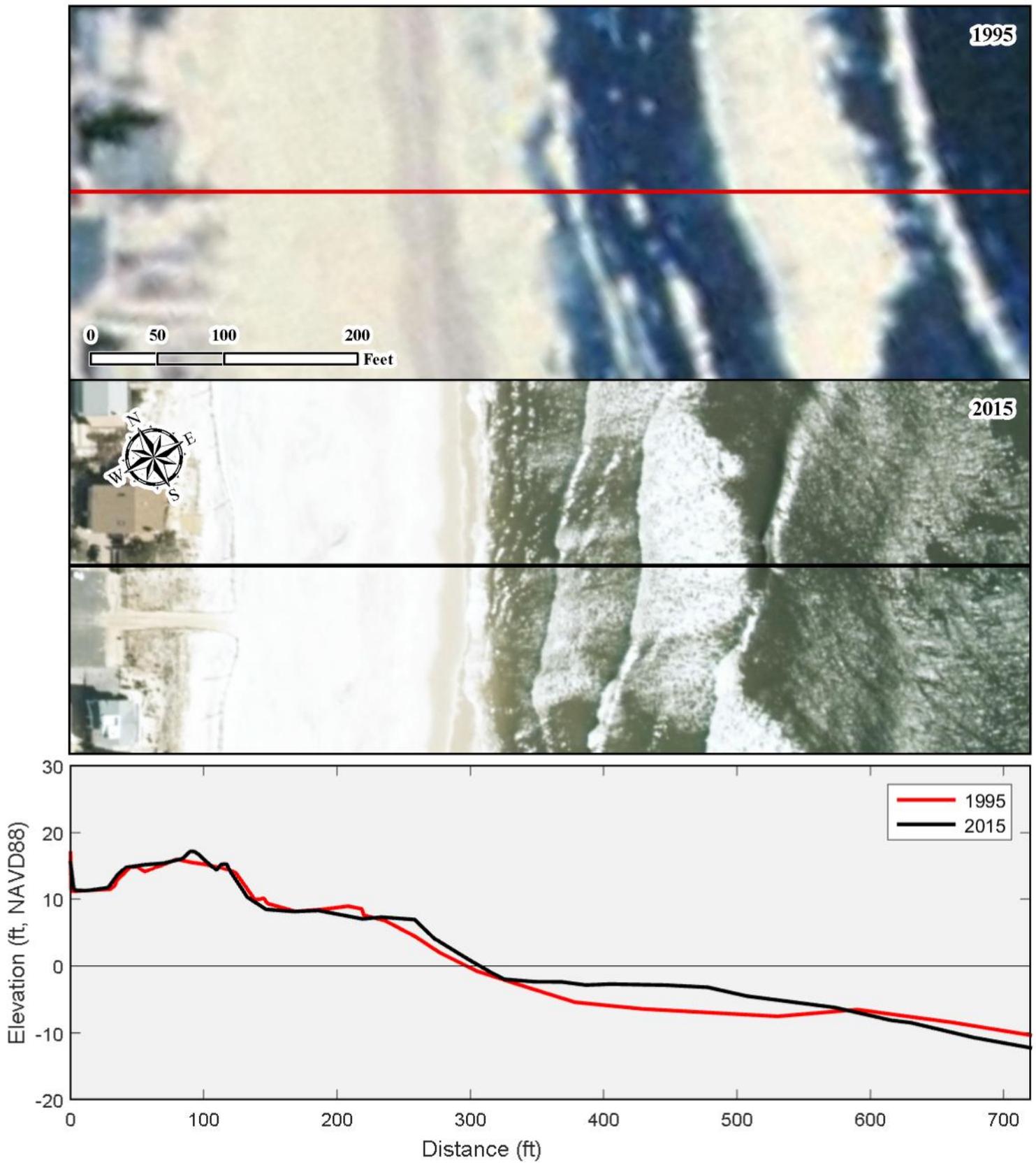


Figure 369. The 2015 profile was measured prior to the federal shore protection project. Between 1995 and 2015, the shoreline moved seaward by 10 ft.

**NJBPN 136 – Dolphin Avenue, Beach Haven (September 21, 2016)**



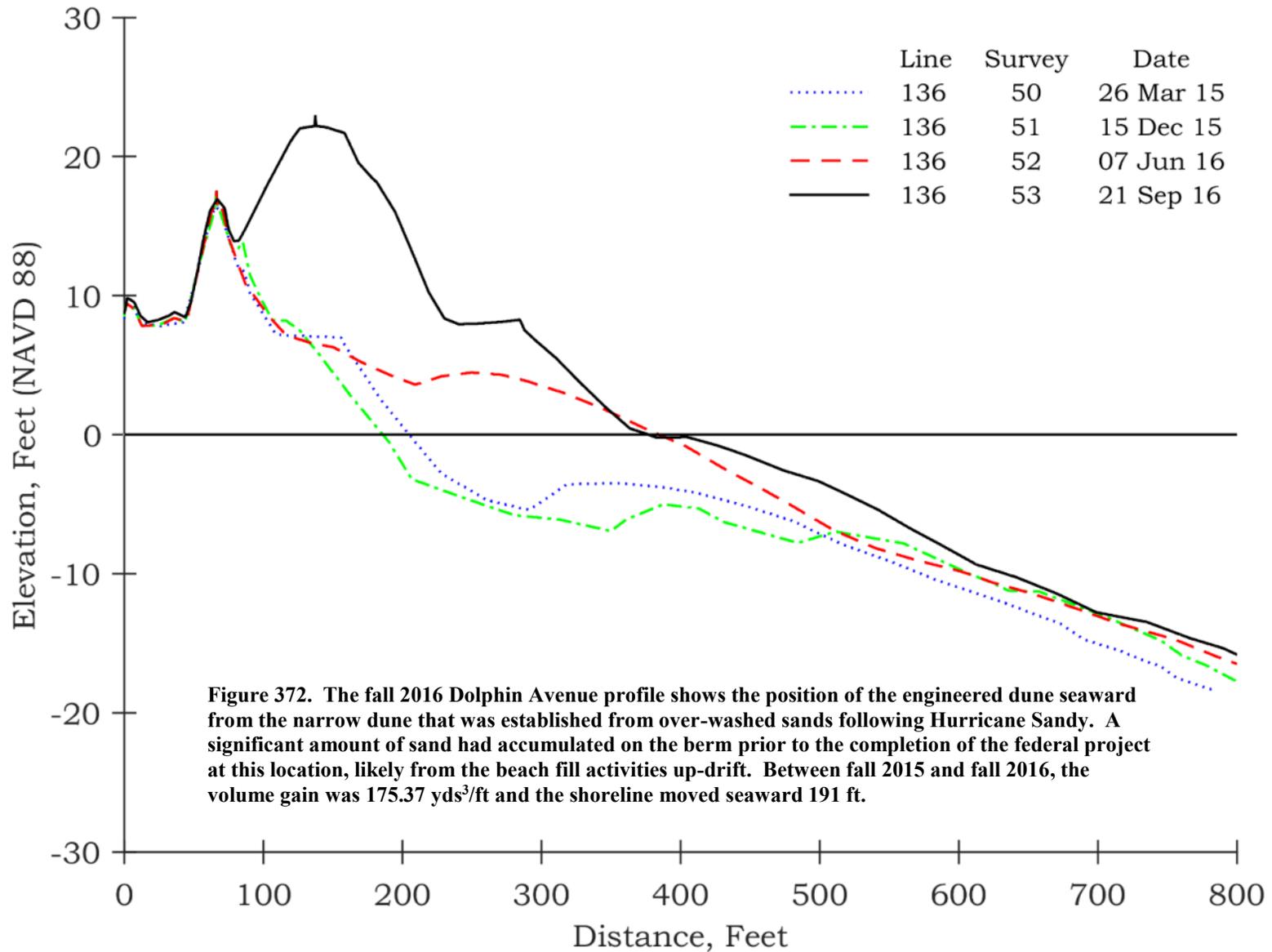
**Figure 370. View to the south from the berm at Dolphin Avenue in Beach Haven.**

**NJBPN 136 – Dolphin Avenue, Beach Haven**



**Figure 371a & 371b. The photos above (left taken December 15, 2015 and right photo taken September 21, 2016) show the drastic change in the dune at Dolphin Avenue. The narrow dune shown in the 2015 photo was created from recovered sand that was over-washed during Hurricane Sandy. The engineered dune and berm was completed during the summer of 2016.**

## New Jersey Beach Profile Network #136 - Dolphin Avenue, Beach Haven, Ocean County



### 30-Year Coastal Changes at Site 136, Dolphin Avenue, Beach Haven, Ocean Co.

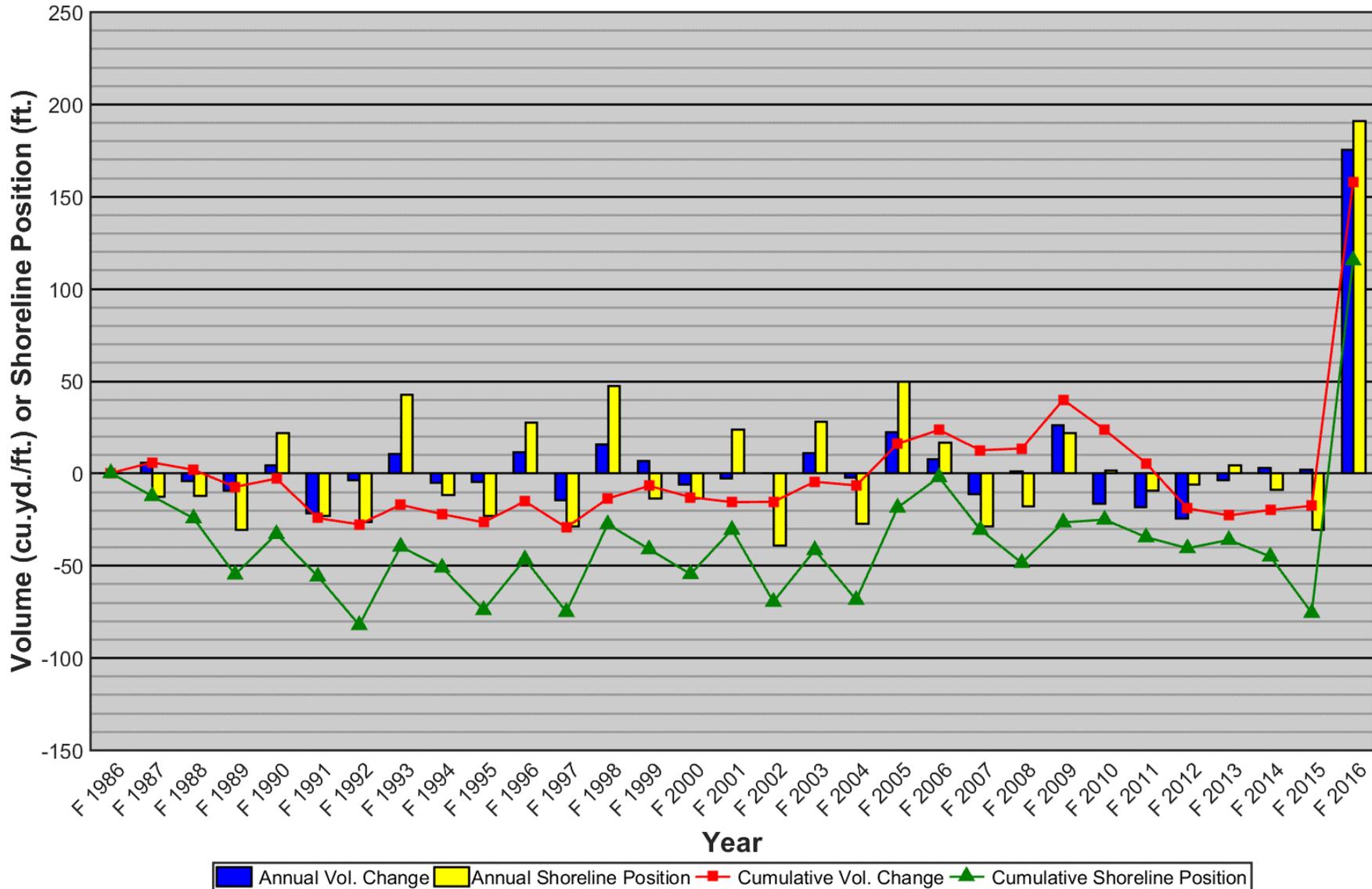


Figure 373. The Dolphin Avenue site has experienced wider swings in shoreline position than changes in sand volume. The periodic gains in volume prior to the 2016 federal project were from sand that accumulated naturally on the berm and in the nearshore.

### 30-Year Ensemble Mean Profile at Site 136, Dolphin Avenue, Beach Haven, Ocean Co.

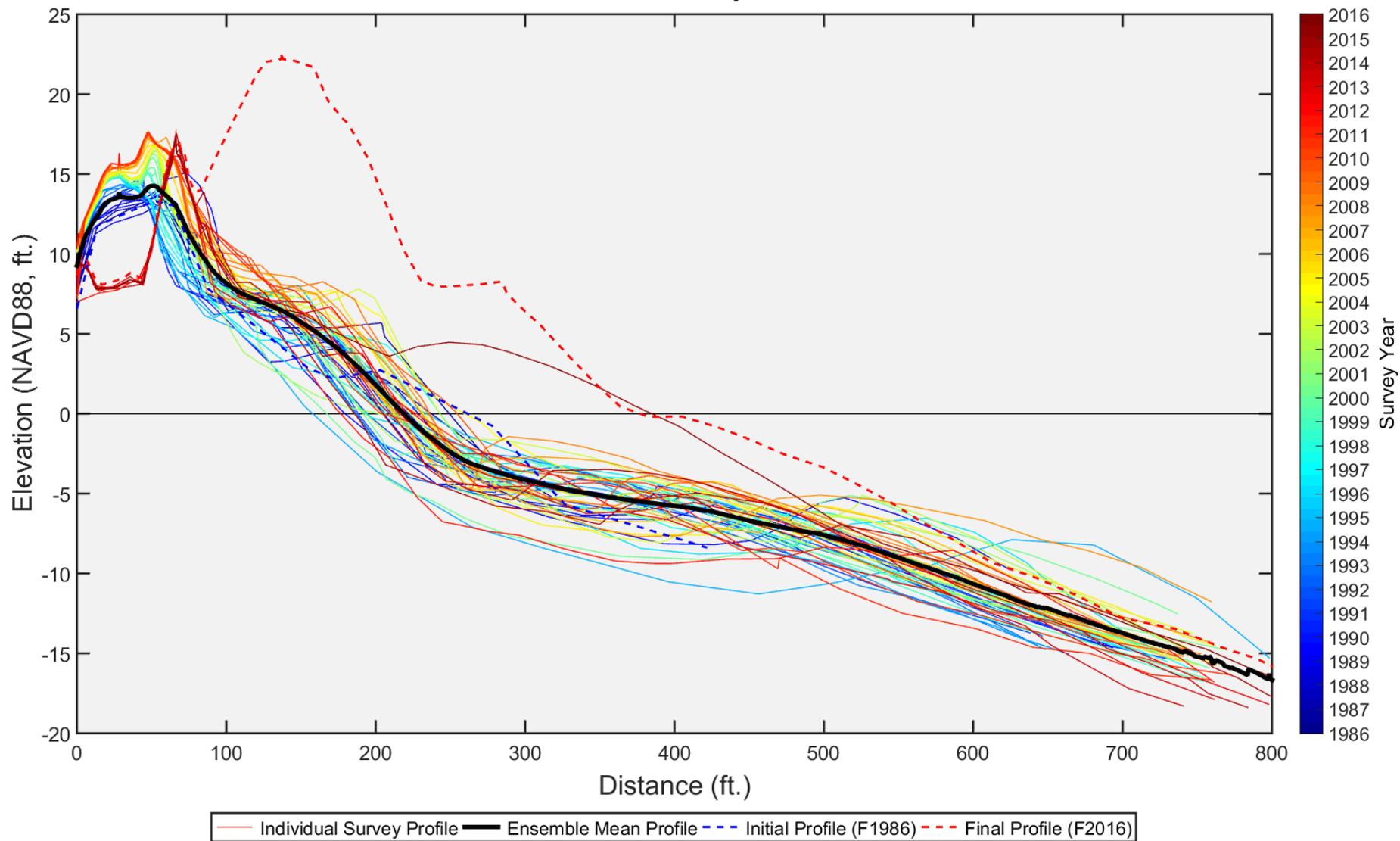


Figure 374. The 30-year profile trend at Dolphin Avenue shows the upward progression of the dune to 2012 when Hurricane Sandy removed the feature. The berm shows a similar upward progression but widths have varied. Note the spring 2016 berm width (dark red line) prior to the fall 2016 profile (dashed red line). The nearshore shows swings in elevation due to the periodic presence of sand bars.

#136 - Dolphin Avenue, Beach Haven Borough, Ocean County  
**Comparison of 1995 to 2015**

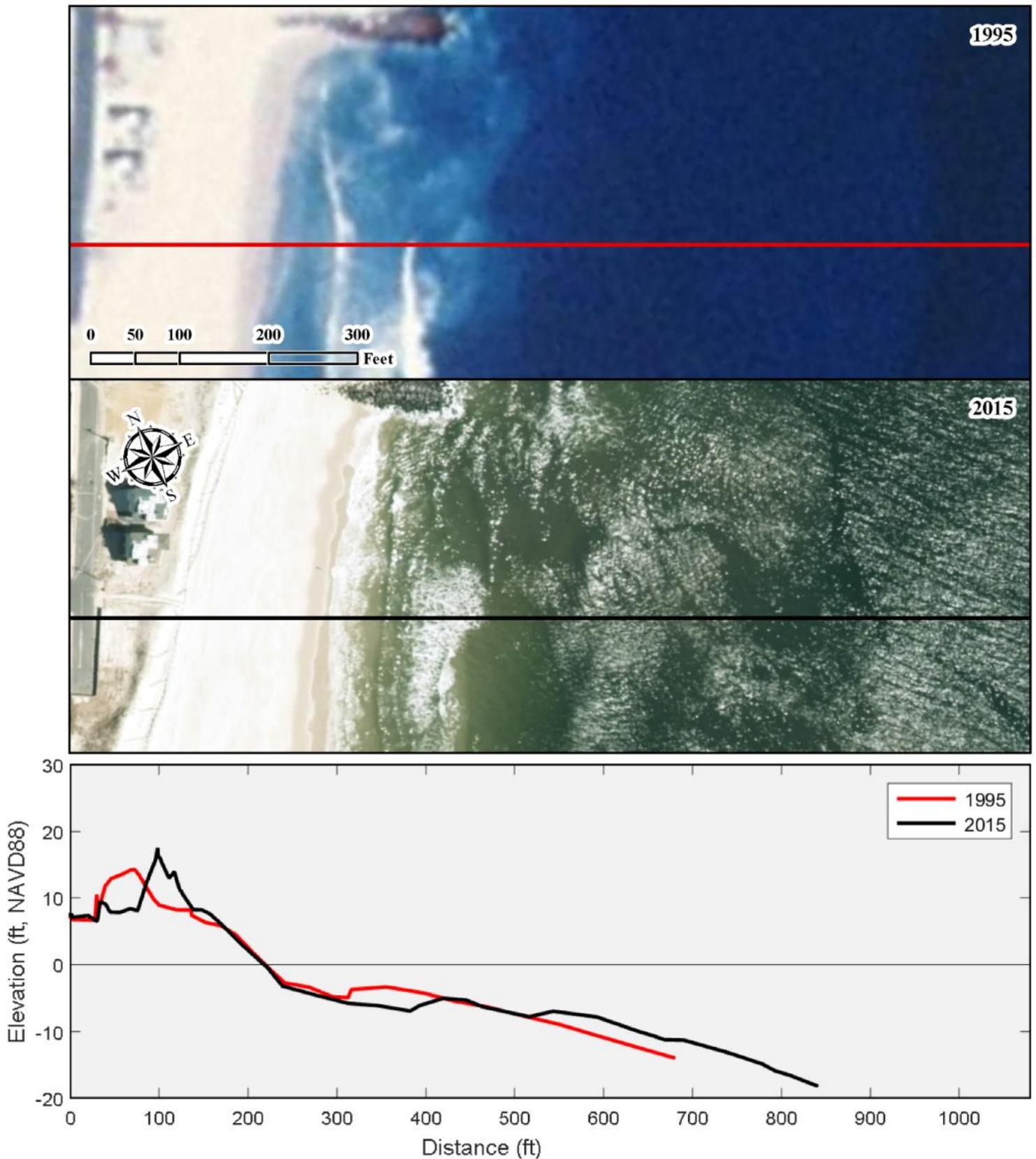
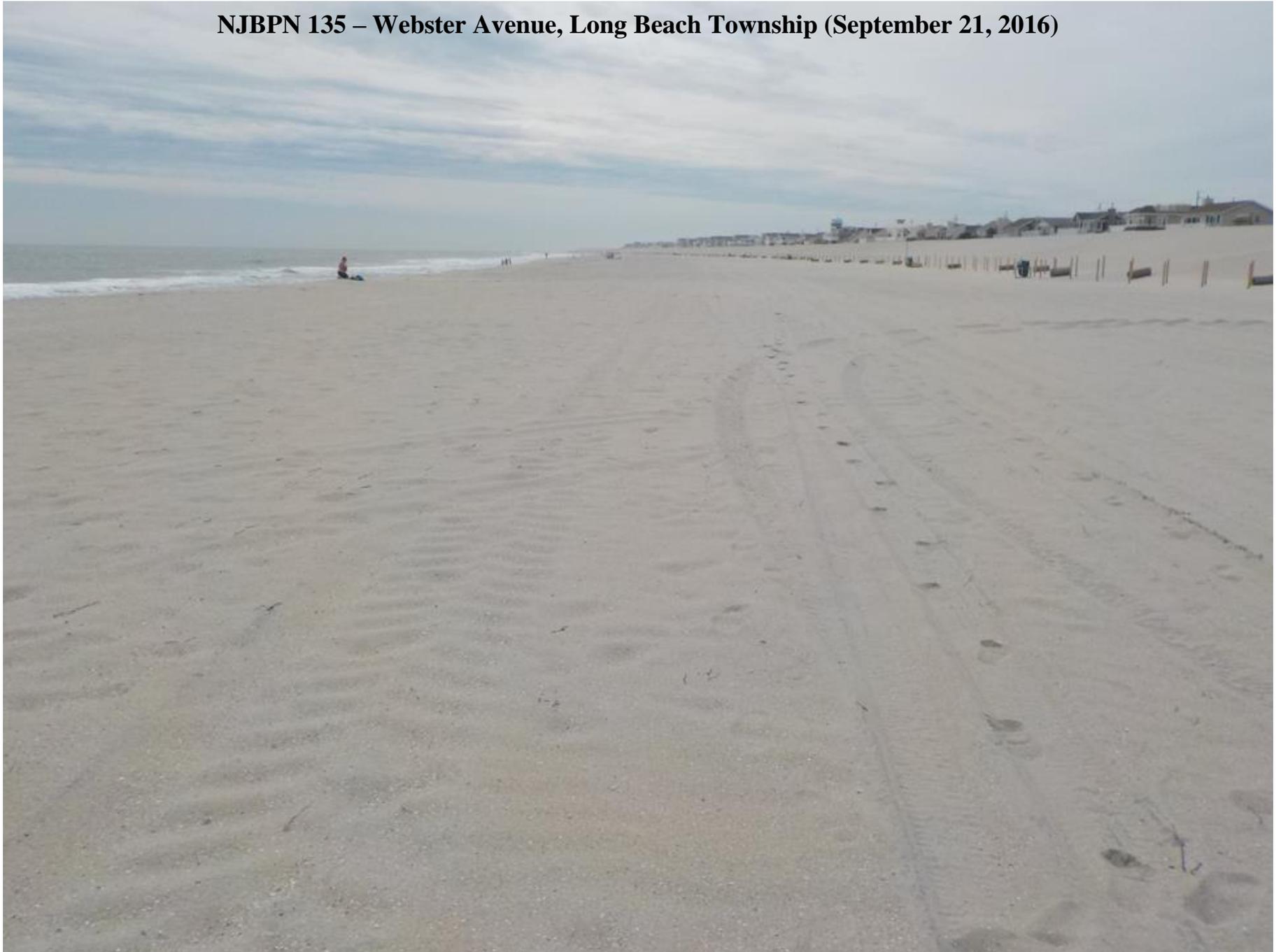


Figure 375. The 2015 survey was completed prior to the construction of the federal shore protection project. The 1995 to 2015 comparison shows a post-Sandy dune that is seaward of the 1995 position. The beach face and shoreline are nearly in the same location for both profiles, with a shoreline retreat of just 1.0 ft.

**NJBPN 135 – Webster Avenue, Long Beach Township (September 21, 2016)**



**Figure 376. View to the south from the berm at Webster Avenue in Long Beach Township.**

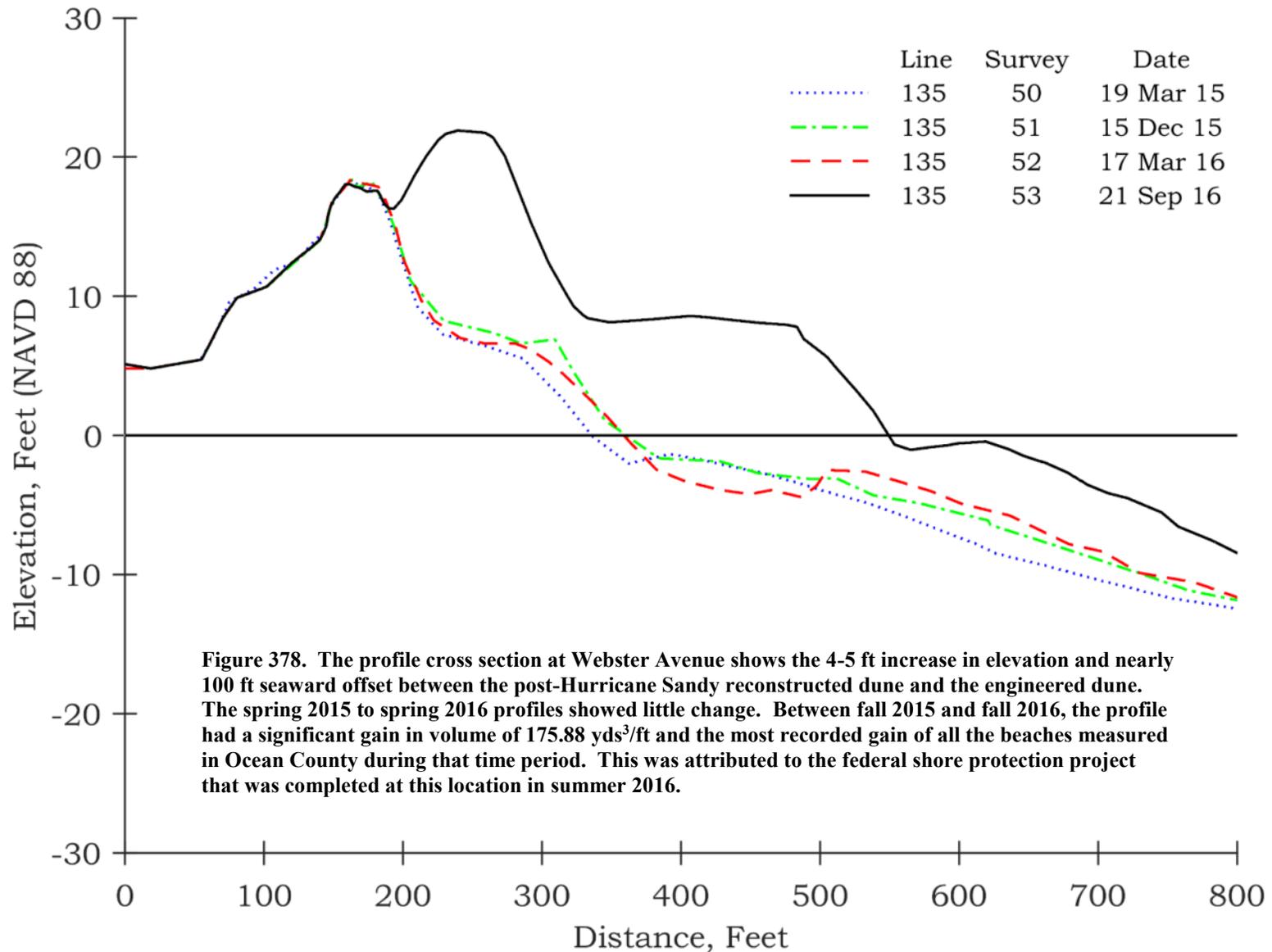
**NJBPN 135 – Webster Avenue, Long Beach Township**



**Figure 377a & 377b. The photos show the view to the south from the dune crest at Webster Avenue. The left photo (taken December 15, 2015) shows the dune that was constructed in 2013 from sand that had been recovered following Hurricane Sandy. The right photo (taken September 21, 2016) shows the condition of the engineered dune prior to fencing and planting of vegetation. The engineered dune was constructed seaward of the 2013-2015 feature.**

# New Jersey Beach Profile Network

#135 - Webster Ave., Long Beach Township, Ocean County



### 30-Year Coastal Changes at Site 135, Webster Ave., Long Beach Township, Ocean Co.

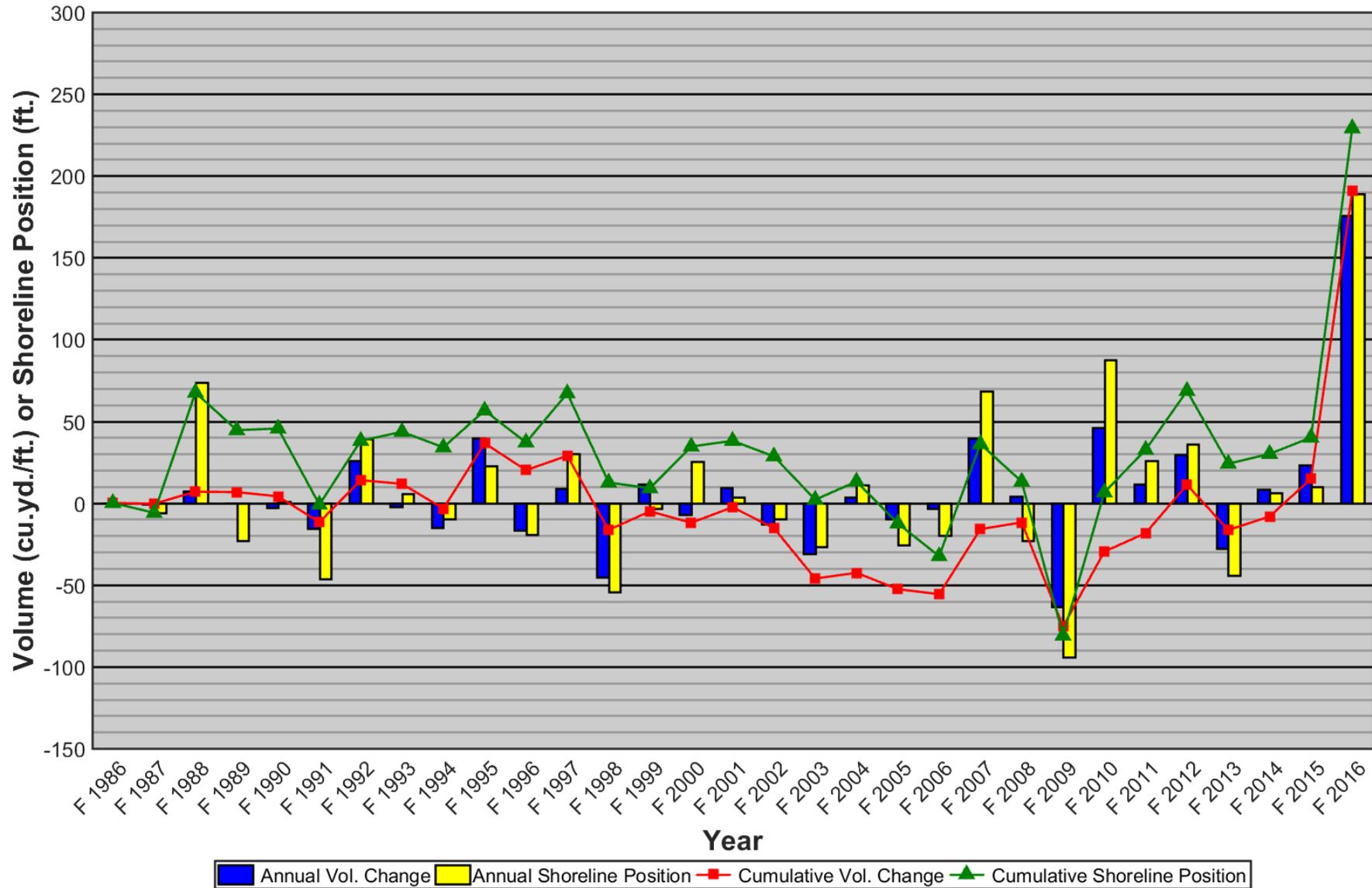


Figure 379. The Webster Avenue site has had variable gains and losses since the start of monitoring. Gains generally occurred through to the late 1990s, and then an erosional trend began. The 2009 profile was measured within a month of the Veteran’s Day storm and the site was in the state of recovery until Hurricane Sandy. The fall 2016 gains are attributed to the federal shore protection project.

### 30-Year Ensemble Mean Profile at Site 135, Webster Ave., Long Beach Township, Ocean Co.

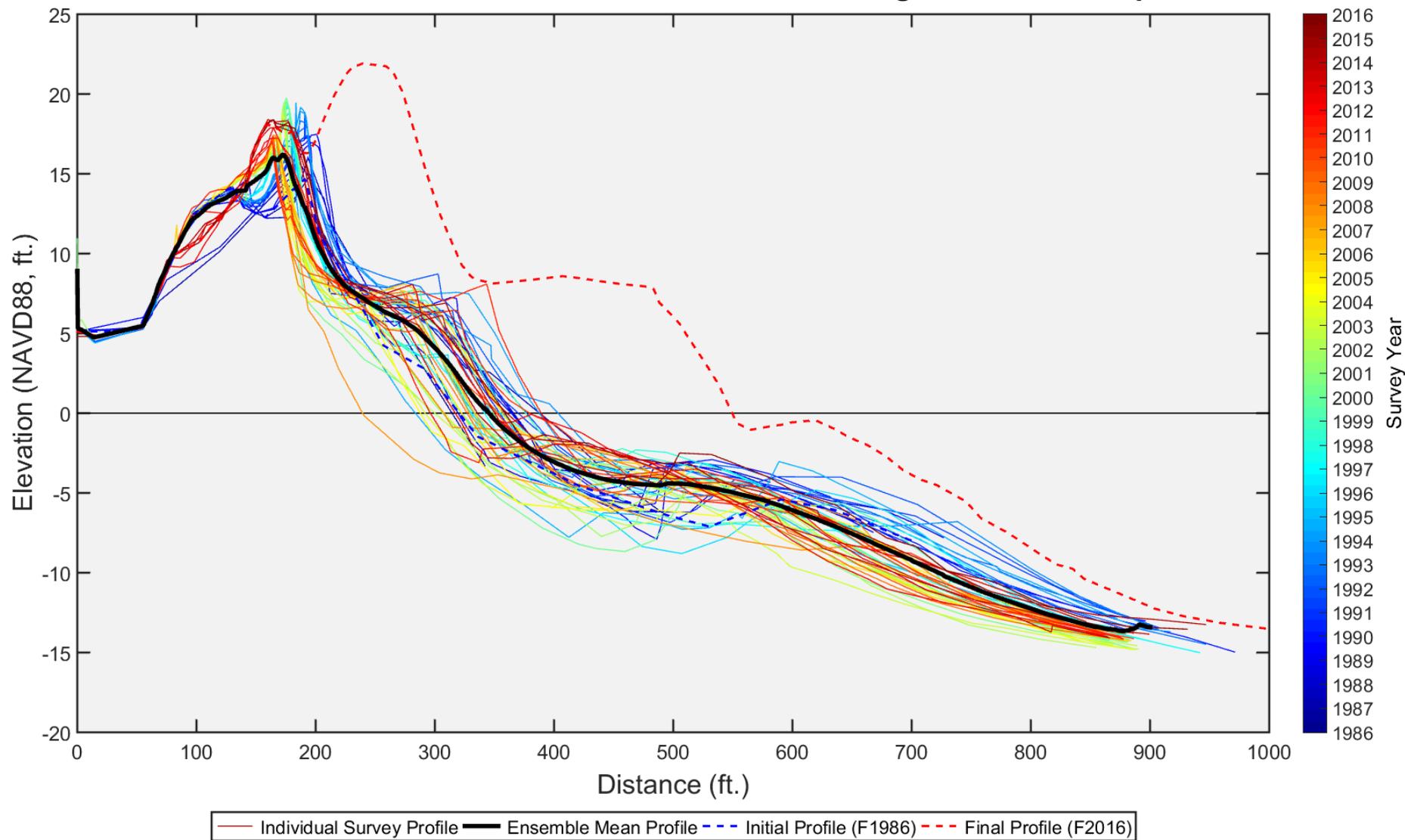


Figure 380. The profile time series at Webster Avenue shows the landward progression of the dune and great variability in berm width over time. Nearshore elevations appear to have lowered from its 1986 position. Note the seaward shift of the entire beach/dune system by the federal shore protection project (red dashed line).

#135 - Webster Avenue, Long Beach Township, Ocean County  
**Comparison of 1995 to 2015**

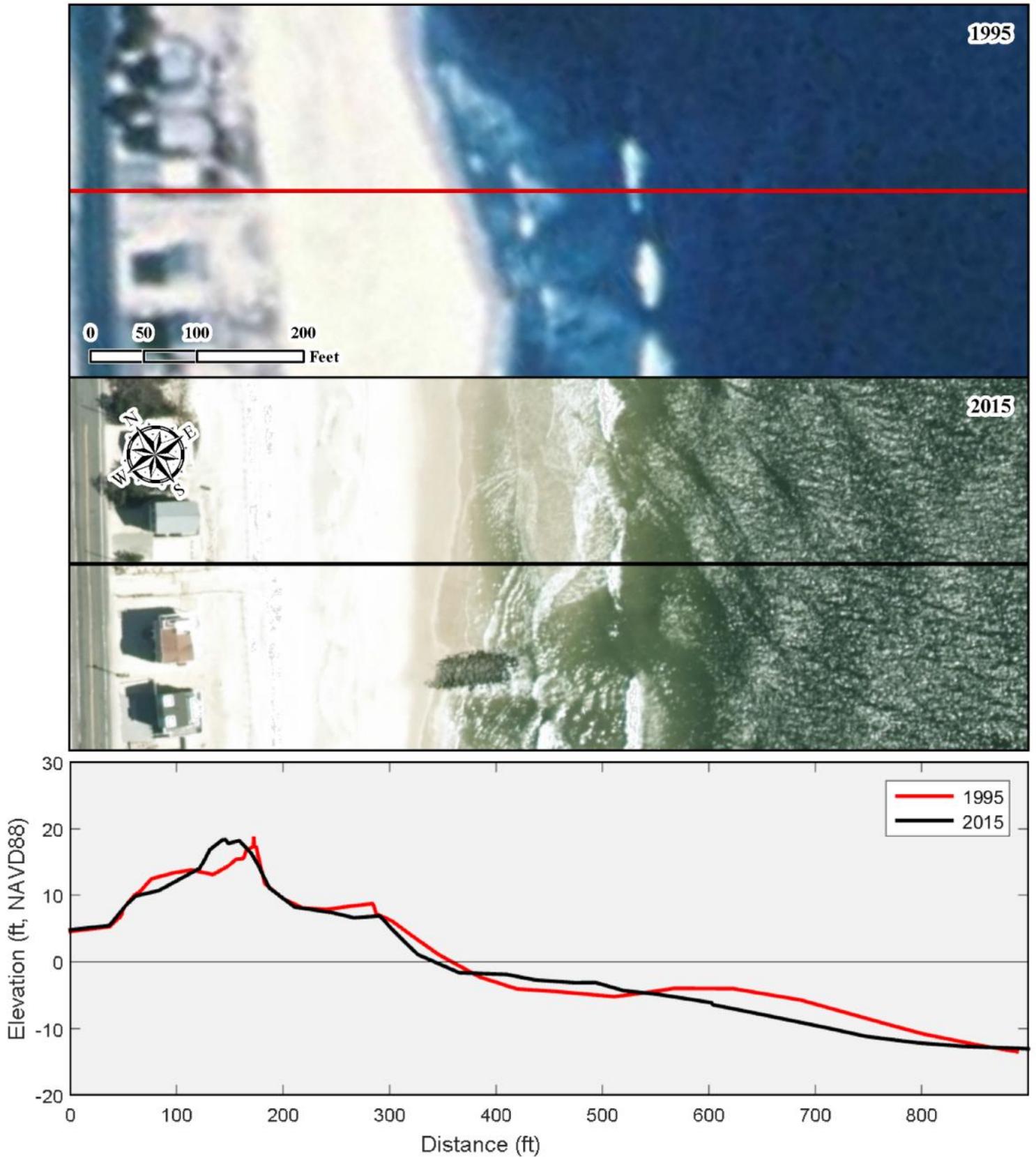


Figure 381. The 2015 post-Sandy dune was reconstructed landward of its 1995 position. The shoreline moved landward by 16 ft between 1995 and 2015.

**NJBPN 234 – Forsythe NWR-Holgate Unit Entrance, Long Beach Township (September 21, 2016)**



**Figure 382. View to the southwest from the berm at the border between the Forsythe National Wildlife Refuge-Holgate Unit and Long Beach Township.**

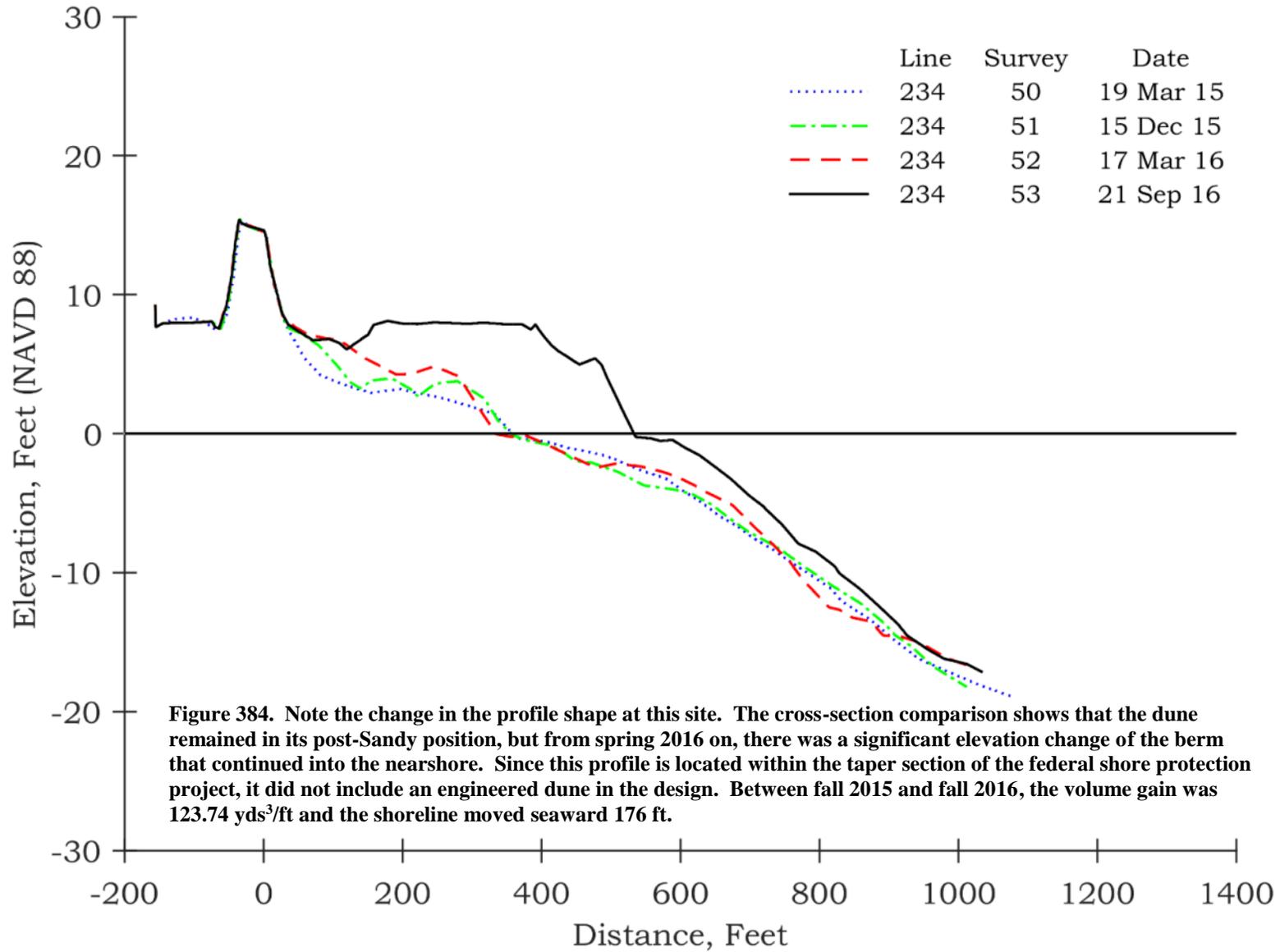
**NJBPN 234 – Forsythe NWR-Holgate Unit Entrance, Long Beach Township**



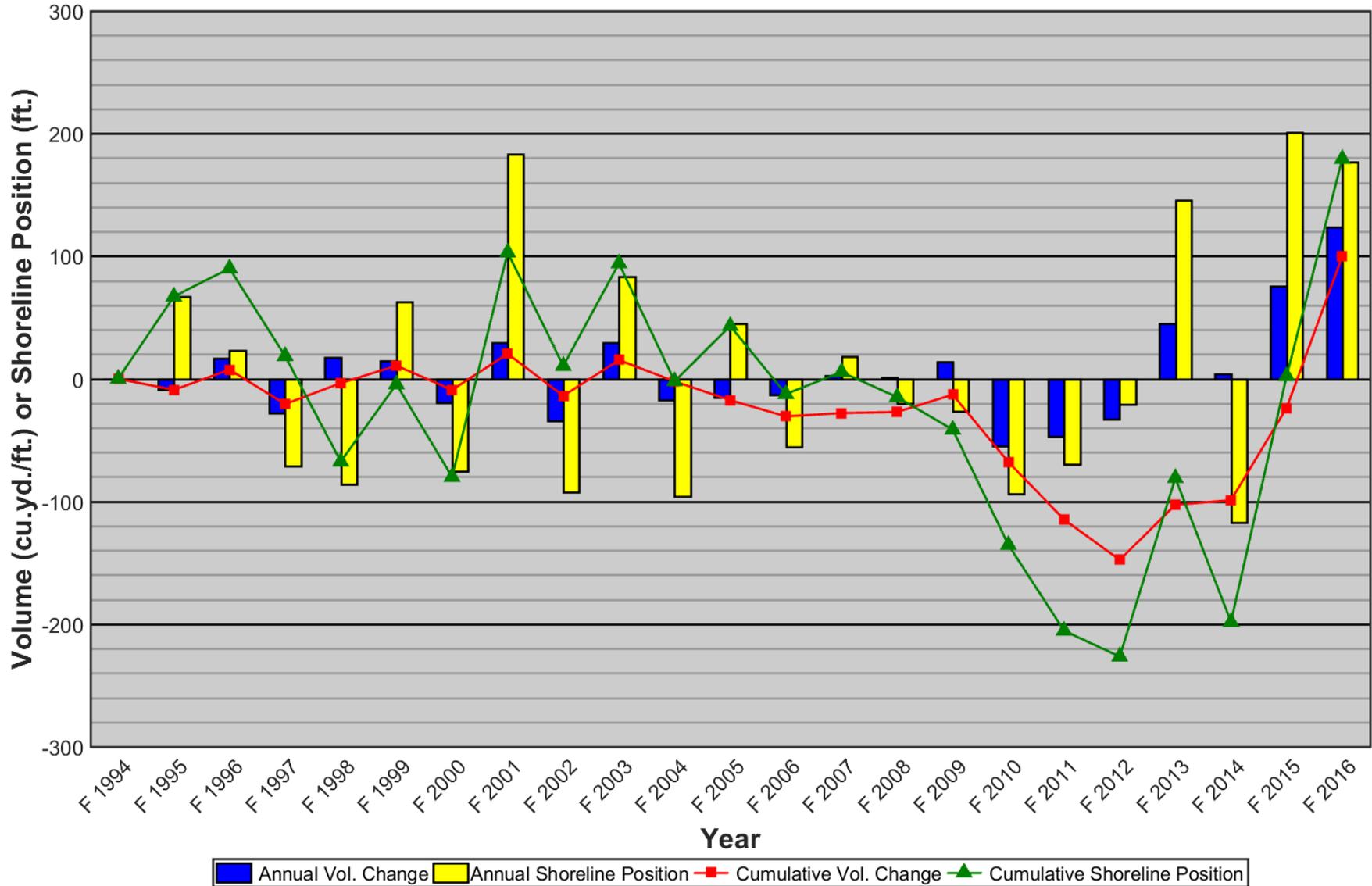
**Figure 383a & 383b. The comparison views from a similar vantage point at the Forsythe-Holgate site shows the extreme change in beach conditions within the year (left photo taken December 15, 2015 and right photo taken September 21, 2016). The profile is located in the “taper” section of the federal beach fill.**

# New Jersey Beach Profile Network

#234 - Natural Area, Long Beach Township, Ocean County

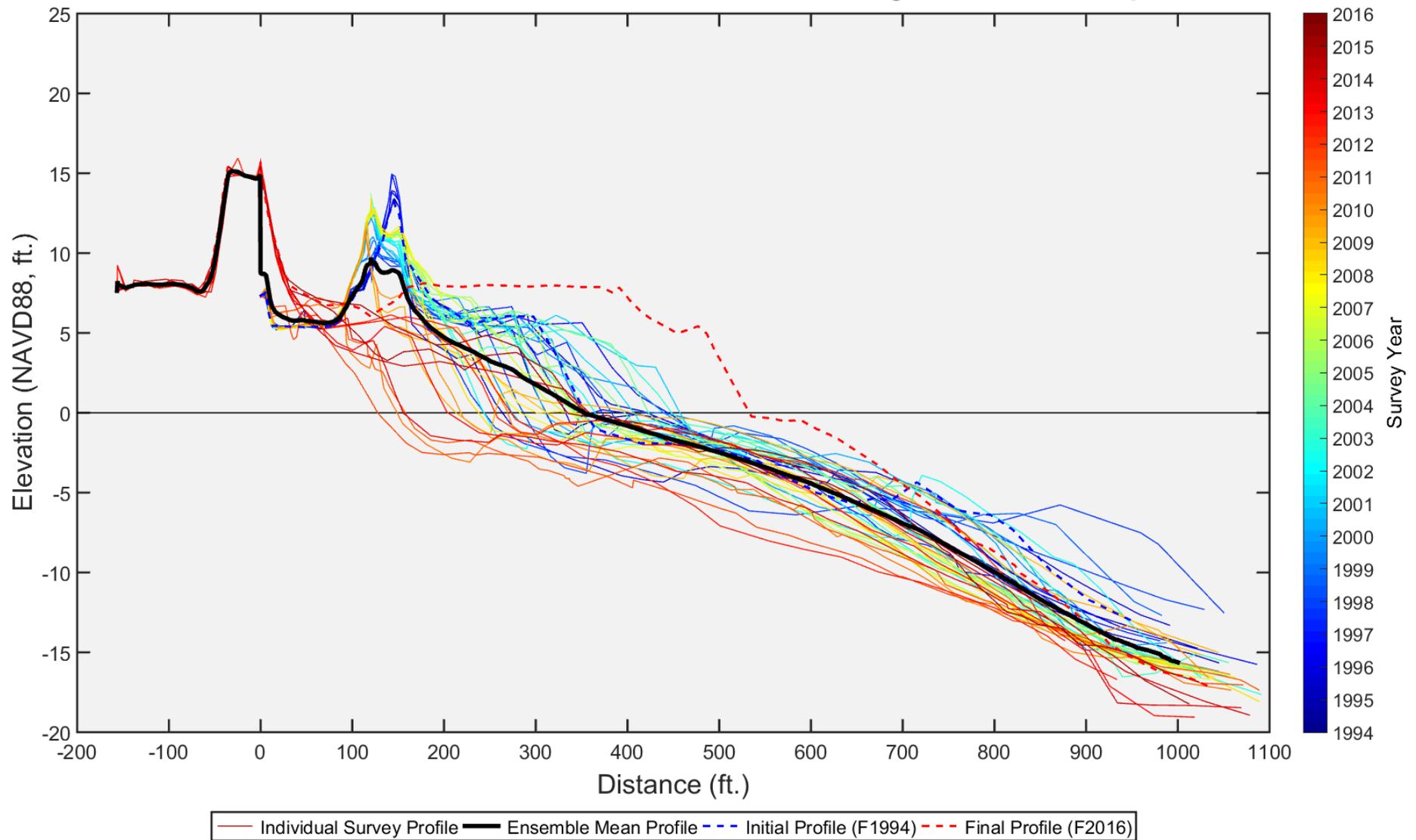


## 22-Year Coastal Changes at Site 234, Natural Area, Long Beach Township, Ocean Co.



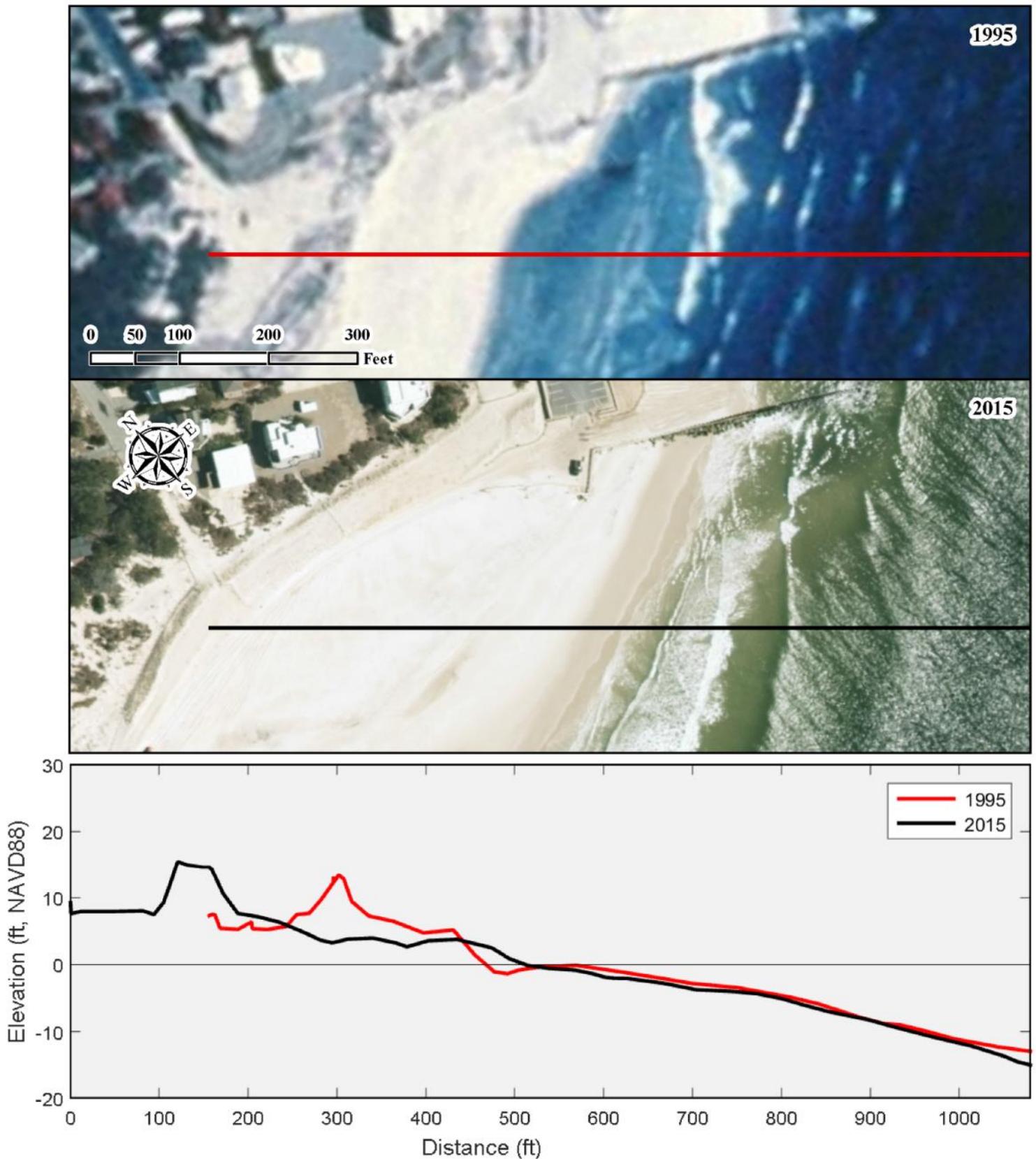
**Figure 385.** Early on, the Forsythe-Holgate Unit Entrance site experienced periods of beach volume stability punctuated by wide swings in shoreline position. An erosional trend began around 2004 that made the site susceptible to storms (2009 northeaster, 2011 Hurricane Irene, and 2012 Hurricane Sandy). The fall 2013 gains were from recovered sand that was used to reconstruct the dune as well as from sand that accumulated during berm and nearshore recovery. The site gained volume in 2015 as a result of sand that was placed up-drift as the federal beach nourishment project commenced construction. The 2016 gains were from sand placement in the taper area.

## 22-Year Ensemble Mean Profile at Site 234, Natural Area, Long Beach Township, Ocean Co.



**Figure 386. The 30-year profile dataset shows the former location of the dune in 1994 seaward of its present location. The former dune was removed between spring and fall of 2011, and the site was overwashed during Hurricane Sandy. The present dune sits at the CRC's original back-shot reference position. The profile appears to demonstrate a lowering trend until the the federal shore protection project had begun.**

#234 - Natural Area, Long Beach Township, Ocean County  
**Comparison of 1995 to 2015**



**Figure 387. Site 234 was overwashed during Hurricanes Irene and Sandy. The 2015 dune was created during post-storm reconstruction. The 1995 to 2005 changes at this natural area location show a shoreline change of 11 ft seaward.**

## Summary & Conclusions

Observations of the NJBPN 30-year dataset for Ocean County show that in the northernmost section of the shoreline near Manasquan Inlet, the littoral current favors a northern direction, evidenced by a far larger beach width present (without beach nourishment) in Point Pleasant Beach south of the inlet than in the Borough of Manasquan which lies north of the inlet. The reverse pattern appears to be evident at Barnegat Inlet where sand preferentially accumulates at the north side of the north jetty in Island Beach State Park.

Littoral transport along Long Beach Island differs from the barrier to the north and is influenced by proximity to the tidal inlets (structured Barnegat Inlet and non-structured Little Egg Inlet), NE-SW orientation of the shoreline, and changes in wave climate. In general, the littoral current moves to the south but there is a local reversal of the current to the north toward Barnegat Inlet near the Loveladies section of Long Beach Township. NJBPN sites north of Loveladies show increases in sand volume over the 30-year time period despite not being included in the federal shore protection project. The transect locations in the Borough of Barnegat Light show large quantities of sand accumulation since the reconstruction of the south inlet jetty by the US Army Corps of Engineers in the 1990's. The "arrowhead" pattern for the 1930's placement of two stone jetties included 12 blocks of Barnegat Light Borough inside the jetties, which when the new south jetty was constructed parallel with the north jetty allowed the capture of almost a square mile of new sand habitat in this part of the Borough shoreline. Adjacent to the new south jetty, the shoreline advanced 2,400 ft seaward with the relative advance declining in amount to the south into Loveladies.

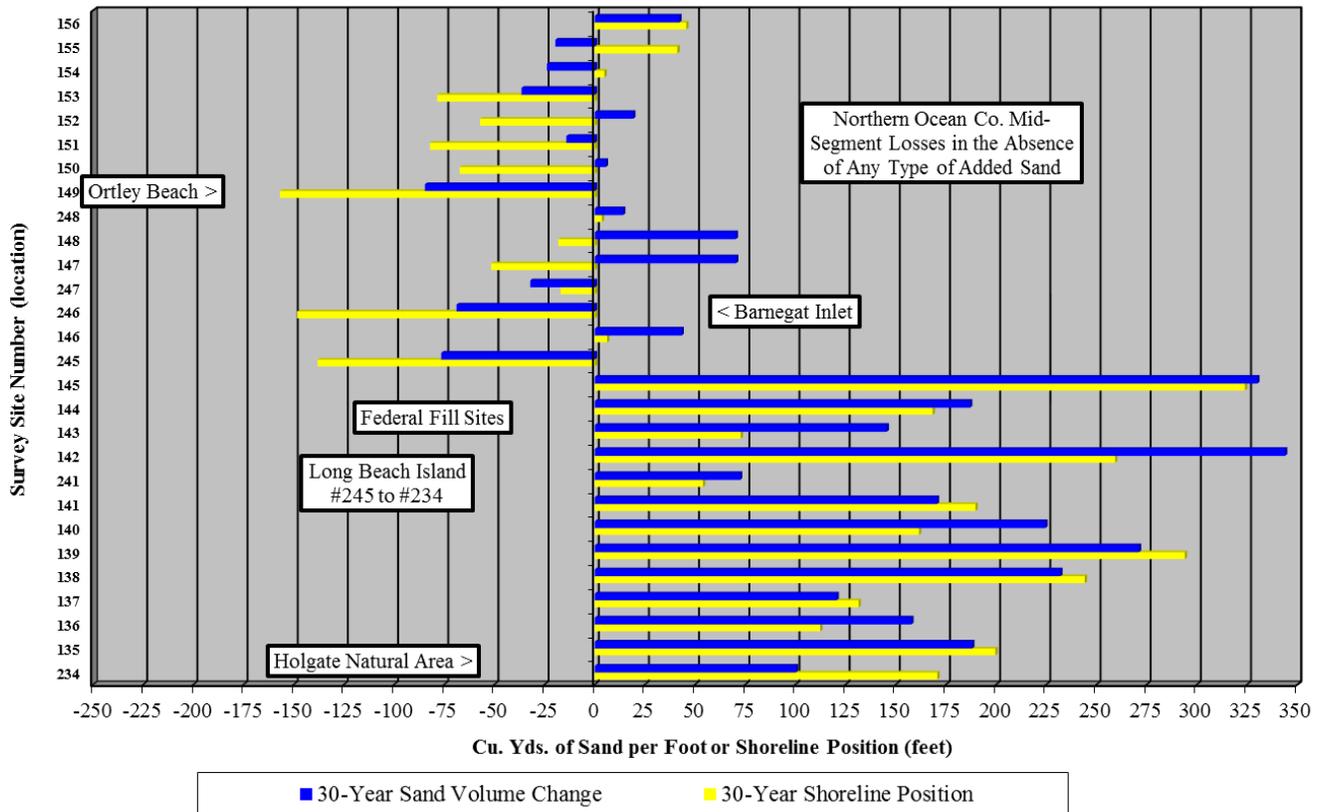
Over the past 30 years, the shoreline in the northern Ocean County segment has not been the recipient of significant amounts of beach nourishment sand. If any beach or dune restoration projects occurred, they were completed by local efforts. Nearly all of the communities within the developed sections of the northern Ocean County barrier are included in the *New Jersey Shore Protection, Manasquan Inlet to Barnegat Inlet* federal/state/local project that will commence in 2017. This project received Congressional authorization in 2007, but funds were not appropriated until after the passage of Hurricane Sandy when Congress enacted PL 113-2, Disaster Relief Appropriations Act in 2013. A total of 11 million cubic yards of sand are expected to be placed on the beaches from Point Pleasant Beach to Berkeley Township (approximately 14 miles). Real estate/easement issues in some communities (including litigation) within the federal project area should be resolved before the full project can be completed.

In contrast, sections of the Long Beach Island shoreline have received large quantities of beach nourishment sand. Authorization of the federal/state/local *Barnegat Inlet to Little Egg Inlet* shore protection project occurred in 2000 and implementation began in 2006. Since that time, sand has been placed on the beaches of Surf City, Harvey Cedars, Loveladies, Long Beach Township, Ship Bottom, Brant Beach, and Beach Haven. The project design template included a 22 ft (NAVD88) elevation dune and approximately 300 ft wide berm depending on the location on the island. Some sections of the replenishment project were completed before Hurricane Sandy and proved that the wide, high dunes and a wide berm design was effective in protecting landward property and infrastructure during the catastrophic storm. Should a future damaging storm occur, all beaches within the federal project limits are eligible for emergency federal involvement and funding to bring the projects back to the design template but must rely on Congressional appropriations to complete the work.

After Hurricane Sandy, a state/federal partnership initiated another form of coastal hazard mitigation to protect coastal highway Route 35 in northern Ocean County. In 2014, the Federal Highway Administration and New Jersey Department of Transportation provided funding for the installation of a steel sheet-pile vertical bulkhead (Dune Restoration Project) that stretches continuously along the shoreline between the end of the rock revetment at Lyman Street in Mantoloking into Brick Township (approximately 18,000 ft). The design incorporates the wall as the base of the dune and includes sand placement at the top and seaward slope. Since completion in early 2015, several sections of the wall have been exposed by wave action by moderate northeast storms. The northeast storm of January 23, 2016 exposed up to 22 ft of vertical steel in Mantoloking with averages of 12 to 15 ft common. The beach fronting the wall recovered by June 2016 for summer use.

There have been significant storms that may not have had direct landfall but have impacted the entire Ocean County shoreline after the establishment of the New Jersey Beach Profile Network. Such storms include Halloween 1991, Northeaster December 1992, Northeasters in 1998, Mother's Day Northeaster 2008, Veteran's Day Northeaster 2009, Hurricane Irene 2011, Hurricane Sandy 2012, October Northeaster 2015, Northeaster January 2016 (Jonas), and Tropical Storm Hermine 2016. By far, Hurricane Sandy was the most devastating to the county's shoreline sections that did not have adequate dunes or beaches.

**Ocean County, Cumulative Profile Volume & Shoreline Position Changes (1986 to 2016)**



**Figure 388. Cumulative volume and shoreline changes over 30 years at each NJBPN location in Ocean County.**

Figure 388 shows the cumulative volume and shoreline position changes at each of the Ocean County profile locations from the earliest dataset to fall 2016. This chart shows the impact of federal involvement in shore protection. Sites 156 to 146 are located in northern Ocean County (north of Barnegat Inlet). Sites 245 to 234 are located on Long Beach Island. Several of the profile locations are included in the federal/state/local *Barnegat Inlet to Little Egg Inlet* flood and coastal storm damage reduction project which was initiated in 2006 in Surf City (NJBPN 241). The graphic clearly depicts the influence of beach nourishment with sand volume gains in some areas of the island exceeding 325 yds<sup>3</sup>/ft along the profile. The beach fill design was tested during Hurricane Sandy. NJBPN profiles with wide berms and high dunes protected landward properties from the storm surge (Coastal Research Center, 2013; Barone, McKenna, and Farrell, 2014). The initial commencement of the Long Beach Island Coastal Storm Damage Reduction Project began in Surf City in 2006, Harvey Cedars 2010, and Brant Beach between 31<sup>st</sup> & 57<sup>th</sup> Streets in 2012 (Surf City and Harvey Cedars were repaired in 2012 after Hurricane Irene). All three locations were restored to the design template by August 2013 following Hurricane Sandy. Ship Bottom, Beach Haven, and the remainder of Long Beach Township were restored by November 2016 (funded by PL 113-2 – 2013 Disaster Relief Appropriations Act).