NJ Sea Grant Consortium
2014 NEW JERSEY

STATE of the SHORE REPORT

Welcome to the 12th Annual State of the Shore Media Event

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Characterized by endless snowfall, howling winds, and chattering teeth, the winter of 2013-14 was one for the record-books. Thank goodness, it's over. Spring has sprung, summer is right around the corner and it's time to retire the phrase "polar vortex" from our vocabulary, at least for a few months. It's also time for the *State of the Shore* report, New Jersey Sea Grant Consortium's pre-summer assessment of our coast and its beaches. With the help of top coastal scientists, and especially Dr. Jon Miller and Dr. Stewart Farrell, the Consortium has coordinated and hosted this event each May since 2003, and although the agenda has evolved over time, the aim remains the same; to communicate the best coastal science and research on New Jersey's beaches to a winter-weary public.

Communicating science to the public is a challenging task. However, year after year, this event brings together scientists, environmental managers, tourism representatives, members of the media and others who embrace the opportunity to share this important information with others just in time for the start of what I hope will be a most wonderful summer season.

From Sandy Hook to Cape May, New Jersey's beaches are open for business and, as Dr. Miller's report will tell you, in fine shape to welcome residents and tourists alike. Today, as it has for several years now, our event will conclude with the announcement of the winners of New Jersey Top Ten Beaches poll. I thank all the many respondents who took the time to share their love for New Jersey's beaches by casting votes for their favorites. Their enthusiasm should be a reminder to all of us that summer is short and winter is long, and to make time to visit New Jersey beaches. Have a terrific summer!

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Winter Storm Review

The winter of 2013-2014 was one of the most extreme winters in recent memory in terms of cold temperatures and snowfall. Just how extreme? So extreme that the meteorological term "polar vortex" has become a part of the American lexicon. Fortunately, however, for many of New Jersey's beaches still recovering from Sandy, few of these intense winter storms generated much in the way of beach erosion or coastal flooding. Most of the more memorable storms from the winter of 2013-2014 followed storm tracks that crossed over land rather than water. As a result of these landward tracks, the storm winds which typically blow over water during Nor'easters to generate waves and storm surge, were incapable of generating extended periods of erosional conditions.

Records from the NOAA tide gauge at Atlantic City, and the NDBC wave buoy off the coast of Cape May were analyzed to provide further detail on some of the more significant storms of the season, and to help put the season as a whole in context. Water levels measured in feet above mean lower low water (MLLW) at the Atlantic City tide gauge are shown in Figure 1. Hourly observations are shown in gray, daily maxima in blue, and the storm surge (difference between the measured and predicted water levels) in red. Three flood levels defined by the National Weather Service are shown in addition to the water level recorded during Sandy to provide some context to the numbers. The wave heights measured offshore of New Jersey during 2013-2014 are shown in Figures 2 and 3. In Figure 2, the average wave height, along with the wave heights exceeded on average only 5% (or roughly 438 hours per year) and 1% (or roughly 87 hours per year) of the time, are shown to provide context to these observations. Figure 3 provides a summary of these observations, where each bin represents the number of hours waves in a given range were measured.

Figure 1. Winter 2013-2014 Observed Water Levels at Atlantic City

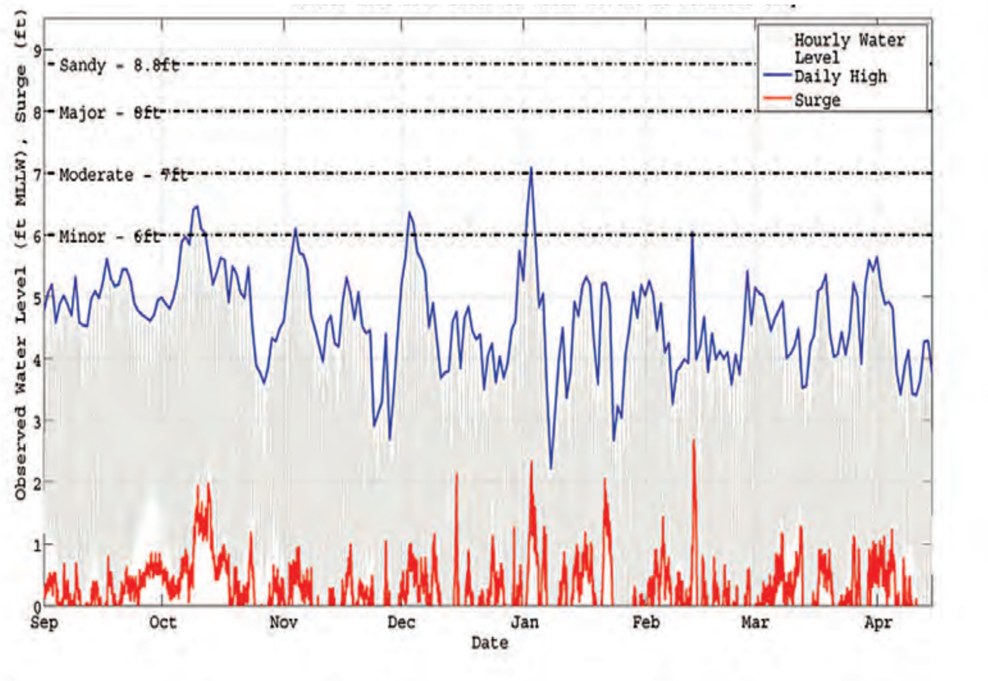
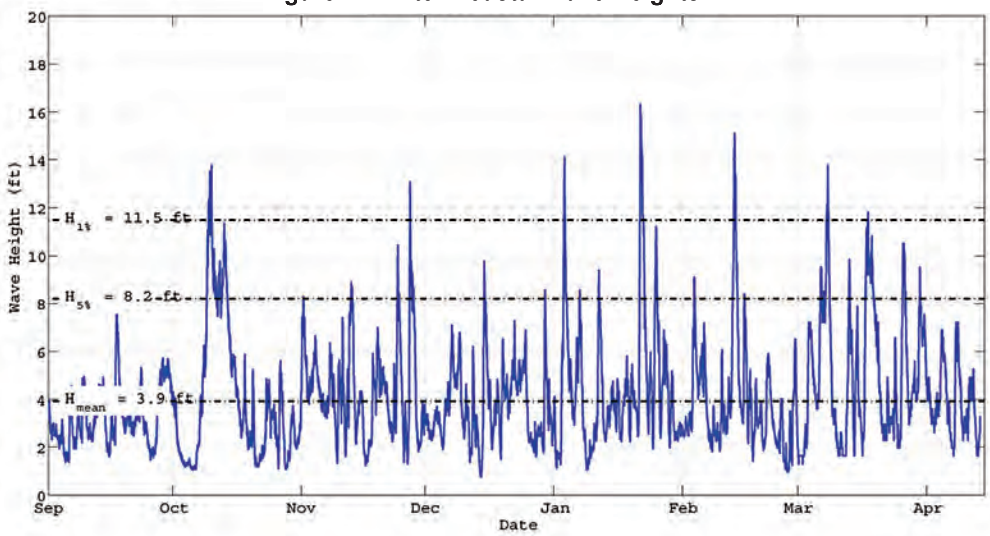


Figure 2. Winter Coastal Wave Heights



The first notable storm of the 2013-2014 winter occurred in mid-October. Observed water levels during the storm exceeded the minor flood level on four consecutive high tides. The tide gauge in Atlantic City measured a storm surge in excess of 1 ft. over a 4-day period from October 9th to October 13th. During that time, the waves offshore peaked at 13.78 ft. and were consistently measured in excess of 8 ft. The combination of storm tide elevation, large waves, and storm duration helped make this storm a weak-moderate early season erosional event. Typically this type of storm doesn't pose much of a threat to New Jersey's coastal communities; however with large sections of the coastline still struggling to rebuild their beaches and dunes in the wake of Sandy, the storm posed more of a threat than usual.

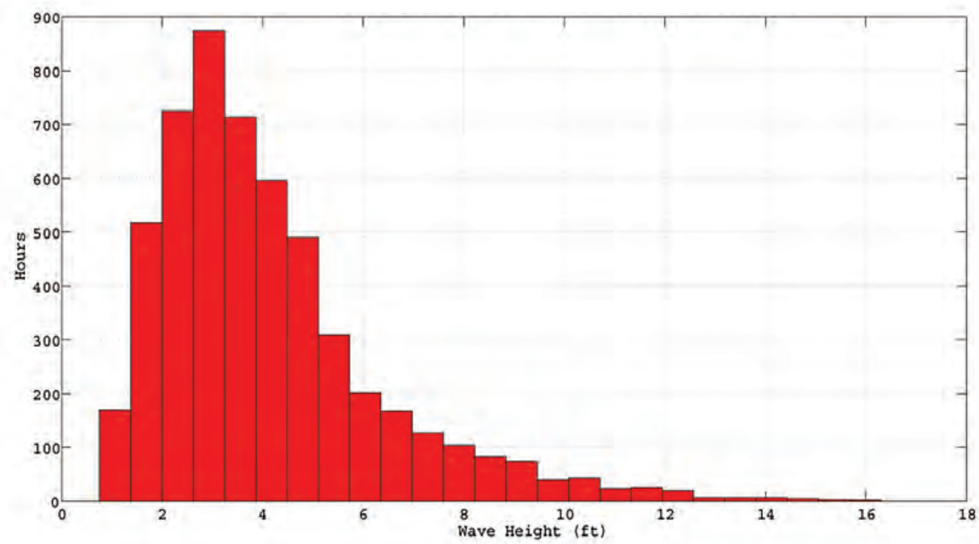
November and December were relatively calm; however two storms generated water levels that briefly exceeded the minor flooding threshold. During both storms the flooding was more related to timing than the strength of the storm. Both events occurred during a spring tide, and only generated small storm surges (<1 ft.) and minimal surf (wave heights < 8 ft.). Minimal beach erosion was associated with these storms due to their short duration and their relatively small wave heights.

The most significant flooding event of the winter took place in early January. Water levels peaked at 7.08 ft. above MLLW at the Atlantic City tide gauge on January 3rd, barely exceeding the moderate flooding threshold of 7.0 ft. above MLLW. Storm water levels were magnified during the storm due to its timing which was coincident with an extra high spring tide known as a King tide. Wave heights during the storm reached a maximum of 14.1 ft., but peaked and dropped off sharply, reducing the erosion potential of the storm.

The largest wave observations of the winter were recorded during a tumultuous January and February. On January 21st, a 16.3 ft. wave was measured off the New Jersey coast. Although the storm generated one of the larger storm surges of the season (2.05 ft.), it occurred during a neap tide and peaked near low tide, and therefore the observed water level fell well short of even the minor flooding threshold. On February 13th, a passing storm generated the second highest waves of the season, peaking at 15.09 ft., and the largest storm surge of 2.68 ft. Unlike the January storm, this storm coincided with a spring tide, resulting in observed water levels that peaked just above the minor flood threshold at 6.04 ft. MLLW. While the storm had most of the ingredients typically associated with significant erosional events, the storm was so quick moving that it simply did not last long enough to generate significant erosion.

March and April generated some of the best and most consistent surf of the season; however there was not a single significant coastal flooding event. The storm surge associated with these spring storms, while consistent, was generally less than one foot. While these storms generated some beach erosion, any sand eroded from the berm most likely remains in the nearshore as a part of the winter bar system. More recently there has been some evidence that the conditions are beginning to turn, and

Figure 3. Winter 2013-2014 Coastal Wave Height Distribution



that the onset of the late spring/early summer pattern may be approaching.

Tropical Outlook

Hurricane season runs from June 1st until November 30th, and the National Hurricane Center will be releasing its first seasonal forecast during the third week of May. The Tropical Meteorological Project at Colorado State University released its extended range forecast on April 10th. Among the highlights of that report is the prediction of a below average Atlantic basin hurricane season with only 9 named storms, 3 hurricanes, and 1 major hurricane. This compares to historical averages of 12 named storms, 7 hurricanes, and 2 major hurricanes. The probability of a major hurricane making landfall along the U.S. east coast is 35% lower than normal. The main factors identified as contributing to these predictions are the likely development of El Niño conditions in the Pacific (typically associated with a decrease in hurricane activity) and cooler water temperatures in the tropical Atlantic.

Closer to home, the forecasted probability of a hurricane making landfall in New Jersey remains low (approximately 1%). Of New Jersey's four Atlantic coastal counties, Ocean County actually has the highest forecasted probability of a named storm making landfall at 0.7%. There is, however, approximately a four times greater chance that the county will experience tropical storm force wind gusts (> 40 mph). While these yearly probabilities seem low, residents should keep in mind that over a 50 year period, there's nearly a 100% chance (99.1%) that a named storm will make landfall somewhere in the region between southern Virginia and northern New Jersey. It is important to keep in mind that even though the probabilities of a direct strike in any given year are low, it doesn't take a direct strike to cause significant damage, and the consequences of not being prepared can have devastating results.

Summer Outlook

With the unofficial onset of summer just a few days away, New Jersey's beaches will benefit from the type of summer wave conditions that help to build up the beaches. During the summer gentle long period swell from the southeast begins to push the offshore bars generated by the winter wave conditions back on shore. Eventually these bars make their way to the shoreline, where they reattach, building out the berm and creating a wide beach. As always, New Jersey residents should take caution as some of these swell conditions will create conditions favorable for the development of rip currents. The National Weather Service issues daily Surfzone forecasts which include rip current outlooks and beach goers should always check with their local lifeguards for the most up to date information on surf conditions.

NEW JERSEY BEACH PROFILE NETWORK UPDATE

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DR. STEWART FARRELL

The New Jersey Department of Environmental Protection (NJDEP) authorized the New Jersey Beach Profile Network (NJBPN) project in 1986. The project report is divided into four coastal county segments and provides a summary of beach changes for that county. This year is unique in that Hurricane Sandy had such a profound impact on the beach/dune systems of the State, especially in Monmouth and Ocean Counties. Therefore, most of the traditional remarks have been set aside in favor of a focus on what worked and how well things did or did not work to protect or defend public and private development in each county.

All major beach restoration or hard structure projects were reviewed for performance and effectiveness. Each segment of the coastline was individually published on the Coastal Research Center (CRC) website as soon as it was complete. This report attempts to combine all six Sandy reports plus a review of the seasonal changes prior to Sandy in a summary of this extraordinary event.

The photographs, cross sections, trend charts, and text focus on the impacts of Sandy but will review seasonal and year to year changes observed since the previous report. The report is also found on the website at www.stockton.edu/crc. Past reports are linked to the site so comparisons can be made to the 2011-2012 observations along the New Jersey coastline.

The survey data was analyzed and evaluated to show changes in the four county shorelines and sand volume changes for the 18-month study interval. The three-month seasonal average sand volume changes for each county plus the 18-month summary are shown below. Beach nourishment projects in Atlantic County produced the extensive sand volume increases over this study period. Keep in mind that these average sand volume changes and the corresponding shoreline position shifts reflect conditions prior to Hurricane Sandy since the fall 2012 surveys were essentially complete by October 29, 2012.

	S 11 – F 11 Cu. yds/ft.	F 11 – S 12 Cu. yds/ft.	S 12 – F 12 Cu. yds/ft.	S 11 – F 12 Cu. yds/ft.
Monmouth County	-0.68	7.91	-5.14	1.44
Ocean County	2.70	3.99	1.72	8.12
Atlantic County	17.29	10.19	13.83	35.31
Cape May County	-9.99	4.83	-1.77	-8.25

The shoreline change values represent the derived difference in horizontal distance to the zero elevation position (NAVD88) from the reference monument on the two profiles being compared. Advances seaward are positive and retreats landward are negative. Each number shown below is the average change for all the sites in each county.

ACKNOWLEDGEMENTS

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NEW JERSEY BEACH PROFILE NETWORK UPDATE

	S 11 – F 11	F 11 – S 12	S 12 – F 12	S 11 – F 12
	Feet	Feet	Feet	Feet
Monmouth County	10.61	20.29	0.32	31.22
Ocean County	17.16	20.56	-4.24	34.00
Atlantic County	17.29	10.19	13.83	35.31
Cape May County	-10.58	7.97	-13.66	-8.68

Beach nourishment in Atlantic County produced the large average seaward advances in the zero elevation position (shoreline). Work on LBI at Brant Beach also increased the average shoreline position due to several 250-foot advances factored into the averages while the sand volume was more diluted across the entire county.

Introduction

The New Jersey Beach Profile Network (NJBPN) project provides local and regional information on coastal zone changes and is designed to document seasonal and storm-related damage assessments of the New Jersey shoreline. Each site has been visited annually in the fall since 1986. Semiannual visits, each spring and fall, began in 1994 following the passage of Public Law 93. The program was expanded to take surveys every spring following the winter northeasters and in the fall following summer beach accretion. In addition, new sites were established in the gaps of coverage and adjacent tidal inlet shorelines. The information collected consists of photographs of the beach/dune system at each site, a topographic profile of the dune, beach and seafloor to a minimum depth of 14-16 feet, and field notes on significant geologic changes. Also, construction activity is noted and necessary information regarding quantity and duration of such activity is gathered. The field data are used to generate graphical cross section plots, which can be used for comparison across the width of the active coastal zone. The cross section is also used to calculate sand volume and shoreline position changes. The 2012 report follows an in-depth analysis in 2011 looking across the 25-year history of the project and is the latest in a series of annual reports prepared for the New Jersey Department of Environmental Protection (NJDEP) that began in 1987. The information is arranged by county and sequential profile site location, and includes the survey cross sections, site photographs, and the description of significant changes.

The tables of beach volume and shoreline change data are found after the county site descriptions for Cape May County. A summary of each county's coastal zone activities follows the county profile site location diagram.

The New Jersey Coastal Zone

The northern coast in Monmouth County is considered a headland beach (carved into older geologic sedimentary units that created a sandy beach backed by a bluff of the older sediments) which erode during serious storm events. As a matter of fact, the erosion loss to the armored bluff between 1962 and 2012 was very minimal due to the abundance of timber, rock, steel and concrete used to prevent it. The impact of Hurricane Sandy changed much of this by producing over 30-foot breaking waves that damaged or destroyed multiple levels of revetment or bulkhead construction frequently exposing the old sediments of the uplands to erosion. Several locations saw retreat in the order of 30 to 50 feet with the sediment distributed along the shoreline just as it has for thousands of years. Centuries of this sort of erosion had created two major sand spits, one to the north from Long Branch (Sandy Hook), and the other to the south from Bay Head (Mantoloking to Barnegat Inlet). To the south of Barnegat Inlet, barrier islands compose the remainder of the New Jersey coastline where individual islands are separated from the mainland by a series of bays and tidal lagoons. These islands provide no local sand supply to the beach and as a result the shoreline moves landward with rising sea level.

Sandy's impact strongly reinforced the time-honored thesis known to coastal geologists that time, storms and sea level rise all result in landward migration of the sand shoreline due to storm impacts. Sand is transported across the barrier beach into the bay or lagoon adding to the landward edge of the barrier and moving the entire coastal landform up the existing coastal plain slope that comprises the four coastal New Jersey counties. New inlets formed, overwash buried the salt marshes on Long Beach Island, and Barnegat Bay received tens of thousands of cubic yards of sand and debris that removed sediments from the beaches and dunes and transported them westward into the bays. Early recovery efforts as the CRC survey crews conducted the post-storm work were focused on removing this sand from the roads and properties on the islands and returning as much as possible to the beaches.

Storm Events in 2009-2012

Between December 1992 and November 2009, the New Jersey shoreline received just one Federal Presidential Disaster Declaration due to a northeast storm February 6, 1998 (applied only to Cape May and Atlantic Counties). Since the “Nor-Ida” combination storm of November 11, 2009 there have been three northeast disaster declarations and two hurricanes (Irene 2011 and Sandy 2012). The three northeast storms preceded Hurricane Irene, which made landfall in New Jersey as a strong tropical storm in late August. There was an additional Nor’easter October 29, 2011, but no declaration for that event.

Hurricane Sandy crossed the New Jersey coastline exactly a year later, also as the combination of a late season hurricane that was fading into a tropical storm and a strong cold front that wrapped around the hurricane circulation generating an enhanced wind field that extended across a 1,200 mile diameter in the western Atlantic. A blocking high pressure cell over Greenland forced an unusual left-hand turn to the west and allowed Sandy to make an abnormal shoreline-perpendicular crossing just north of Atlantic City during the evening of Monday, October 29, 2012. This crossing point created two differing impacts between limited shoreline damage due to waves in Cape May and Atlantic Counties (flooding in the back bays excepted) and catastrophic shoreline losses in Ocean and Monmouth Counties extending into New York Harbor and Long Island. This extreme damage was compounded by storm surge flood tide elevations of up to 14 feet NAVD88 in NY Harbor and wave run up on dunes in Long Branch, NJ of 24 foot elevation. The type of approach meant that the southern counties did not have a second high tide accompanied by 80 MPH on-shore winds because the wind reversed direction as the storm center came on land. The northern counties saw the second high tide Monday night slash through battered dunes and pour waves and water across the barrier beaches and over most all protective structures. The tidal surge flooded areas surrounding Barnegat Bay and pushed into Shark River, Manasquan River, Navesink and Shrewsbury Rivers plus opened several coastal fresh water lakes to marine flooding for the first time in decades (Wreck Pond, Lake Como, Wesley Lake, Deal Lake, and Takanassee Lake, all in Monmouth County).

Barnegat Bay was especially impacted by the disaster. Tide elevation gauges in the bay showed that the strong northeast winds were pushing bay water south, away from Bay Head, the Toms River, Mantoloking, etc. with successive high tides in the bay actually slightly lower each cycle as the storm approached land. Water flow at a USGS stream gauge in the Manasquan Canal showed nearly constant in-flow with almost no ebb-tidal flow during the two days just prior to the landfall. The tide elevation shot up 5+ feet in two hours as the breach and overwash occurred on October 29-30th and the stream flow dramatically reversed in the Manasquan Canal to all ebb-directed flow that continued for two days after the storm. It also took the same two days for the tide elevation to return to a normal high tide range at the Herbert Street gauge site.

The Richard Stockton College of NJ Coastal Research Center (CRC) initiated a post-storm survey and assessment of the New Jersey shoreline in response to severe beach erosion resulting from the impact and landfall of Hurricane Sandy. The field work started October 31, 2012 in Cape May County and continued northward into northern Monmouth County by November 26, 2012 as clean-up work continued to remove debris. Any sand excavated from roadways was being returned to the beach and is included in the survey cross section since it is now part of the post-Sandy beach.

Each of the other surveys was completed within the seasonal windows used for this study. The cross sections all show the spring of 2011, fall of 2011, spring of 2012, the SANDY survey, and fall of 2012. As fate would have it all the sites in Cape May, Atlantic and Ocean Counties had been surveyed prior to October 29, 2012. Work had been completed in southern Monmouth County as well, leaving only the sites in Raritan Bay, on Sandy Hook and north of Long Branch to be surveyed to normal depths following Sandy.

Hurricane Sandy

The coastal segment between Long Branch to Sandy Hook was the shoreline where the New York District Army Corps of Engineers conducted its Phase I Shore Protection Project between 1994-1996 (initial contract for Monmouth Beach to Sea Bright) and 1997-1999 (for Monmouth Beach to Long Branch). There have been several maintenance contracts conducted in this reach to address erosional “hotspots” (1997, 1999, 2002, 2010 and currently in Monmouth Beach December 2012). The 2011 Coastal Center 25-year report evaluated the sand quantity remaining within this reach at the 12 sites within the project extent at between 14% and 116% of the initial placement volume. The phase I reach between Sandy Hook National Seashore and the Elberon/Long Branch border did have several maintenance fills (1997, 1999, 2002, 2009, a minor addition in 2010 and the current project underway in late 2012). However, there are two significant points of erosion that have hampered the overall project success. There is a large rock groin at the Cottage Road site (#179) that blocks sand movement along the beach. Since sand moves north, this site is perpetually starved for sand moving into the area from the south. The second location is #173 at West End in Long Branch where the project ends moving south. Elberon and Deal did not participate in the initial project, so sand leaves West End moving north leaving erosion the only option. No sand arrives from the north except during a northeaster. The best evidence for this was the limited success for the 2009 maintenance project focused on the West End site that declined by over 50% between 2009 and 2011. The Morris Avenue location 5,000 feet north benefited substantially within 6 months however.

Another issue with the Long Branch to Sea Bright segment of the Army project was the failure to include a significant dune system in the original plan. The presence of the 28-foot high Sea Bright seawall and a 20+foot high natural bluff in Long Branch armored with rock and steel meant that the dune was more or less an after thought to the project’s effectiveness. Initially, two lines of sand fence were erected in Sea Bright with grass planted between them. No initial ridge of sand was designed or built, so the dune system evolved naturally as grass spread and the wind transported material toward the fencing. As a result after 12 years, the dune was irregular, varied greatly in width and elevation and was positioned a considerable distance from the rock wall. There was no dune system in Long Branch due to a very high tourism usage. Grass plants did colonize at the toe of the rock revetment, but no consequential dunes developed.

The major observation was that Sandy's waves were dramatically higher upon breaking than they were further south, especially south of the center of rotation for the storm. Damage seen in Deal and Elberon demanded that waves exceeded 30 feet in NAVD 88 elevation levels on breaking on the bluff. The Pullman Avenue site saw two homes with foundation elevations at +28 feet destroyed and a third of the lot transformed into empty space where the land once stood. The Lake Takanassee site was obliterated and the entire Long Branch boardwalk on the top of the bluff was destroyed. These huge breakers essentially bulldozed the berm, beach and irregular dune system to the base of the massive Sea Bright seawall, and then ramped up that slope, over the wall and slammed down onto the space between the highway and the wall. The gaps in the seawall were exploited in a devastating manner in the Borough of Sea Bright especially in the town center where the municipal public beach is located in a gap in the rock seawall. Sandy just blasted through this gap with awful consequences. Lake Takanassee remained closed to tidal flow until a northeast storm March 6, 2013 opened this small estuary lake back to tidal circulation. Sandy toppled over a row of concrete barrier wall segments that remain in an irregular pattern along the beachface, but the ebb-flow drainage from the lake is restricted by an ancient corroded steel bulkhead that was long buried in sand landward of the concrete sections by about 150 feet. High tide submerges the entire entry with flow limited by the elevation difference between high and low tide. At low tide a drainage stream flows down a gradient from the remnants of the steel bulkhead to the low tide elevation at the ocean. This inlet will close naturally as sand is transported into the opening and generates a bay-mouth barrier above the average high tide elevation.

Beach/Dune Damage Assessment by Municipal Island Segment

To measure the erosion, pre-existing New Jersey Beach Profile Network (NJBPN) monitoring sites were used to provide an accurate comparison and assessment of storm related shoreline and beach volume changes. Using the data from those sites surveyed for fall 2012 NJBPN survey, completed in Monmouth County by October 12, 2012, provides a good baseline for damages that occurred during the hurricane. For those sites not yet surveyed, data from spring 2012 was used for comparison. Data collected at the 15 oceanfront beach profile locations was done November 12-26, 2012 using RTK GPS and extending from the reference location, across the dunes, beach and into the surf to wader depth and by traditional survey methods (swimmers going to -16 feet of water) at those sites not yet surveyed during NJBPN fall 2012 survey. By the 12th, it was clear that sand recovery was well under way as a berm had been deposited on the erosional surface generated by Sandy with a substantial offshore bar present in water less than 5 feet deep offshore. However, in some locations massive amounts of sand had been transported inland and were being returned to the beach. Very little sand was transported over the bluff or steel wall in Long Branch, but wave damage was evident from moving water. Substantial sand volumes were moved over the Sea Bright seawall and through the gaps in the rock wall. This was being hauled back to the beach.

Profile Locations

Site locations in Deal, Elberon, Monmouth Beach and Sea Bright were not surveyed during fall 2012 prior to the arrival of Sandy, the Long Branch sites were surveyed on October 5 & 8, 2012 and all sites again post-Sandy through November 26, 2012 (Figure 1). This report covers the New York District Corps of Engineers Monmouth County Shore Protection project's initial Phase I where sand was placed from the border with the National Sea Shore, south through Sea Bright, Monmouth Beach, and Long Branch, NJ late in the 20th Century into the first two years of the 21st Century. Maintenance work was done on Phase I beaches in places, but none has been preformed on the southern segment (Phase II) between Asbury Park and Manasquan Inlet. Based on the performance of the fill project, clearly the dune system's design needs to be evaluated and a new approach implemented along this pair of Monmouth County reaches as the post-storm data is processed and analyzed.

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