FINAL REPORT FOR 2021
ON CHANGES TO THE MUNICIPAL BEACHES
THE BOROUGH OF MANTOLOKING, OCEAN COUNTY, NEW JERSEY

View to the north from the public access pathway at Princeton Avenue, Mantoloking, New Jersey on December 1, 2021. The dune grass planted in early 2020 has taken root and doing well. This beach is a little narrower than others in the Borough, but thus far has been undamaged by storms.

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Annual Report for 2021
On the
Mantoloking
Oceanfront Municipal Shoreline

Executive Summary:

Coastal Research Center (CRC) at Stockton University completed a 28th year monitoring effort along the municipal shoreline in Mantoloking with a fall 2021 survey of the five municipal profile sites within the Borough. Previous annual summaries included the direct comparison of the beach conditions prior to the federal Northern Ocean County Shore Protection Project. The December 2017 transect CRC survey data; the US Army Corps of Engineers (USACE) "as built" condition surveys, and the CRC-surveys from Nov. 4, 2019 demonstrated an "as-built" sand volume to be **1,377,081** cubic yards of new material placed along the Mantoloking oceanfront. The total of 1,377,081 cubic yards of new sand represents material never previously on any existing NJ beach. This material was derived from offshore borrow sources that could never naturally become modern beach sand resources.

2021 Storm Activity:

Tropical storm Ida moved across inland New Jersey generating far more interior flood damage than the impacts to the shoreline, but this event was the major tropical seasonal storm for 2021. A number of moderate to mild northeast events occurred between December 2020 and December 2021 (12-16-2020; 12-24-2020; 2-1&2-2021; 5-30&31-2021; 10-10-2021; and 10-28&29-2021). Storm events eroded into the dry beach width over the past year but did not damage the dunes in any material fashion. Sand removed from the dry beach berm appears as of the December 2021 survey to have been deposited offshore raising the slope elevation beyond the water's edge at low tide.

Beach Monitoring Program Methodology:

There are five sites in the Borough that were monitored by the CRC on a quarterly schedule over 28 years, ensuring a continuous and coherent data set, which provided the Borough with a valuable resource tool when determining coastal management issues. The monitoring shifted to semi-annual with the 2016 contract and continued with this schedule in 2017. CRC monitoring was suspended during the USACE construction phase in 2018, resuming as an annual survey in the fall of the past three years. The following is a list of the selected sites and locations:

- Mant-1: Beach access path at Carrigan Place
- Mant-2: Beach access path at 1041 Ocean Avenue
- Mant-3: 1117 Ocean Avenue (NJBPN site #153)*
- Mant-4: Princeton Avenue street end
- Mant-51: Beach access path at 1543 Ocean Avenue**

* 1117 Ocean Avenue established on private land in 1986 for the NJ Beach Profile Network
* * Replaced Mant-5 formerly located on private property at 1547 Ocean Ave. and was moved following that property's sale to a new owner who declined to allow access to the old site.

The past two years' survey dates:

Fall	Survey #102	November 23, 2020
Fall	Survey #103	December 1, 2021

Shoreline changes shown measured in feet while sand volume changes are in cubic yards per foot ($yds^3/ft.$). Individual profile changes averaged with adjacent sites and multiplied by the distance between sites determine a

net cell volume change. Total volume change for the Borough is determined by summing the net cell volume changes. Table 1 reproduces last year's survey data so direct comparison can be made with the current survey.

Table 1
Shoreline & Sand Volumes Changes
November 4, 2019 to November 23, 2020

Profile Number	Shoreline Change (feet)	Volume Change (yds^3/ft)	Avg.Volume Change (yds^3/ft)	Distance Between (feet)	Net Volume Change (yds^3)
Northern Municipal Boundary					
			9.551	294	2,808
Mant-1	-6	9.55			
			4.646	3,033	14,090
Mant-2	3	-0.26			
			-12.866	2,584	-33,244
Mant-3	-46	-25.47			
			-13.814	2,789	-38,526
Mant-4	-20	-2.16			
			-16.190	2,164	-35,035
Mant-51	-37	-30.22			
			-30.224	495	-14,961
Southern Municipal Boundary					
			Total Volume Change =		**-104,869**

Table 1 illustrates the annual changes since Nov. 4, 2019 where 104,869 cubic yards of sand were lost from the Borough oceanfront by November 23, 2020. The beach berm retreated generating most of the loss with sand transported offshore beyond the survey distance combined with transport from the Borough oceanfront into Toms River Township (-30.22 yds^3/ft. lost from Mant-51). Sand was still being added to the Carrigen Place site with minimal loss seen at Mant-2.

Table 2
Shoreline & Sand Volumes Changes
November 23, 2020 to December 1, 2021

Profile Number	Shoreline Change (feet)	Volume Change (yds^3/ft)	Avg.Volume Change (yds^3/ft)	Distance Between (feet)	Net Volume Change (yds^3)
Northern Municipal Boundary					
			-7.146	294	-2,101
Mant-1	-11	-7.15			
			-6.131	3,033	-18,595
Mant-2	-19	-5.12			
			0.182	2,584	470
Mant-3	0	5.48			
			-15.575	2,789	-43,439
Mant-4	-38	-36.63			
			-6.810	2,164	-14,737
Mant-51	23	23.01			
			23.010	495	11,390
Southern Municipal Boundary					
			Total Volume Change		**-67,012**

The survey results for 2021 show that 67,012 cubic yards of sand were lost from Mantoloking concentrated at Princeton Avenue site where 36.63 yds^3/ft. were removed, but most of the Princeton Avenue loss appeared as deposition at the southernmost site in the Borough (+23.01 yds^3/ft.). Both annual comparisons seem to show sand arriving into Mantoloking from Bay Head as storm-generated littoral currents transport it into the Borough.

The final summary table of data is specific for the beaches and dunes to show that sand was still moving from the dry beach into the offshore region seaward of the low tide line. This material can return to the beach during low wave activity periods as migrating sand bars (see Mant-2 profile plot, Figure 2d).

Table 3
Shoreline & Sand Volumes Changes for the Dunes & Municipal Beach Only
November 23, 2020 to December 1, 2021

Profile Number	Shoreline Change (feet)	Volume Change (yds^3/ft)	Avg.Volume Change (yds^3/ft)	Distance Between (feet)	Net Volume Change (yds^3)
Northern Municipal Boundary					
			-5.219	294	-1,534
Mant-1	-11	-5.22			
			-8.747	3,033	-26,530
Mant-2	-19	-12.28			
			-6.602	2,584	-17,060
Mant-3	0	-0.93			
			-11.122	2,789	-31,018
Mant-4	-38	-21.31			
			-8.665	2,164	-18,751
Mant-51	23	3.98			
			3.984	495	1,972
Southern Municipal Boundary					
			Total Volume Change		**-92,920**

The beach and dunes saw 92,920 cubic yards of sand removed which is 25,909 cubic yards of sand more than the entire surveyed transects showed in Table 2 above. This material was deposited offshore below the low tide line and continues a process (termed Cross-shore transport) outlined in last year's report. Ocean wave action will flatten the beachface slope during any storm event and move material offshore. Later during calm intervals, the waves slowly transfer that sand back toward the beach as a small bar that eventually attaches to the beachface adding to its sand supply. These events are largely seen during the summer and early fall when wave energy is generally lower.

Therefore, over the past two years (2019 to 2021) the Mantoloking Federal Project beachfront has shed a total of **171,881** cubic yards or at a rate of **15.13 yds^3/ft**. along the entire 11,359-foot Mantoloking oceanfront. The loss rate from the 1,377,081 cubic yards that the CRC measured as placed amounts to **12.48%** of that total.

Profile Site Descriptions:

For 2021, the four most recent beach profile transects are presented showing the two 2019 post project surveys, and two fall CRC surveys to provide a post-beach restoration progress report. The array of change is most dramatic offshore showing shallower depths offshore largely on the northern two sites as the beach berm eroded. Material is also being transferred into Mantoloking Borough from Bay Head as littoral currents transport it south during northeast storm events. Most of this material appears to accumulate on the nearshore terrace just below the mean low water line.

Mant-1 Carrigan Place;

Mant-1 is located at the seaward end of Carrigan Place, along the municipal beach access path between the private residential properties at #911 and #915 East Avenue. Carrigan Place is located about 500 feet south of the Bay Head – Mantoloking boundary. The profile reference location is a fire hydrant located along the west curb of East Avenue. The cross-section includes the road and beach access path on the landward dune toe between the oceanfront homes.

Following Sandy, work commenced to extend the rock revetment south from Bayhead to include this location. South of Lyman Street installation of a steel sheet pile wall was installed by the NJDOT. Today, the 22-foot elevation dune buries the rock revetment which remains as a last line of defense. Since July 2019, sand has been transferred to the dune toe by the wind generating a low foredune at the fence line. Sand was generously added offshore since July 2019 and remained in place since. Differing berm configurations also reflect general stability in spite of elevation changes. The little foredune contains about 4.52 yds^3/ft. added as the first buffer to major storms.

1a. December 21, 2017

1c. December 1, 2021

1b. November 23, 2020

Mant-1 Photographs 1a, 1b, and 1c show views to the north from the dune beach path.

Photograph 1a. The December 2017 survey show the seaward dune slope and width of the toe, partially restored through maintenance efforts covering the rock revetment. The beach width and elevation were similar to its fall 2016 appearance during the last era prior to beach nourishment.

Photograph 1b. shows the public dune cross over where the dune grass has developed and the owner to the north has a dune deck added.

Photograph 1c. shows the rate of dune grass growth along with the small foredune developing at the fence line at the beach.

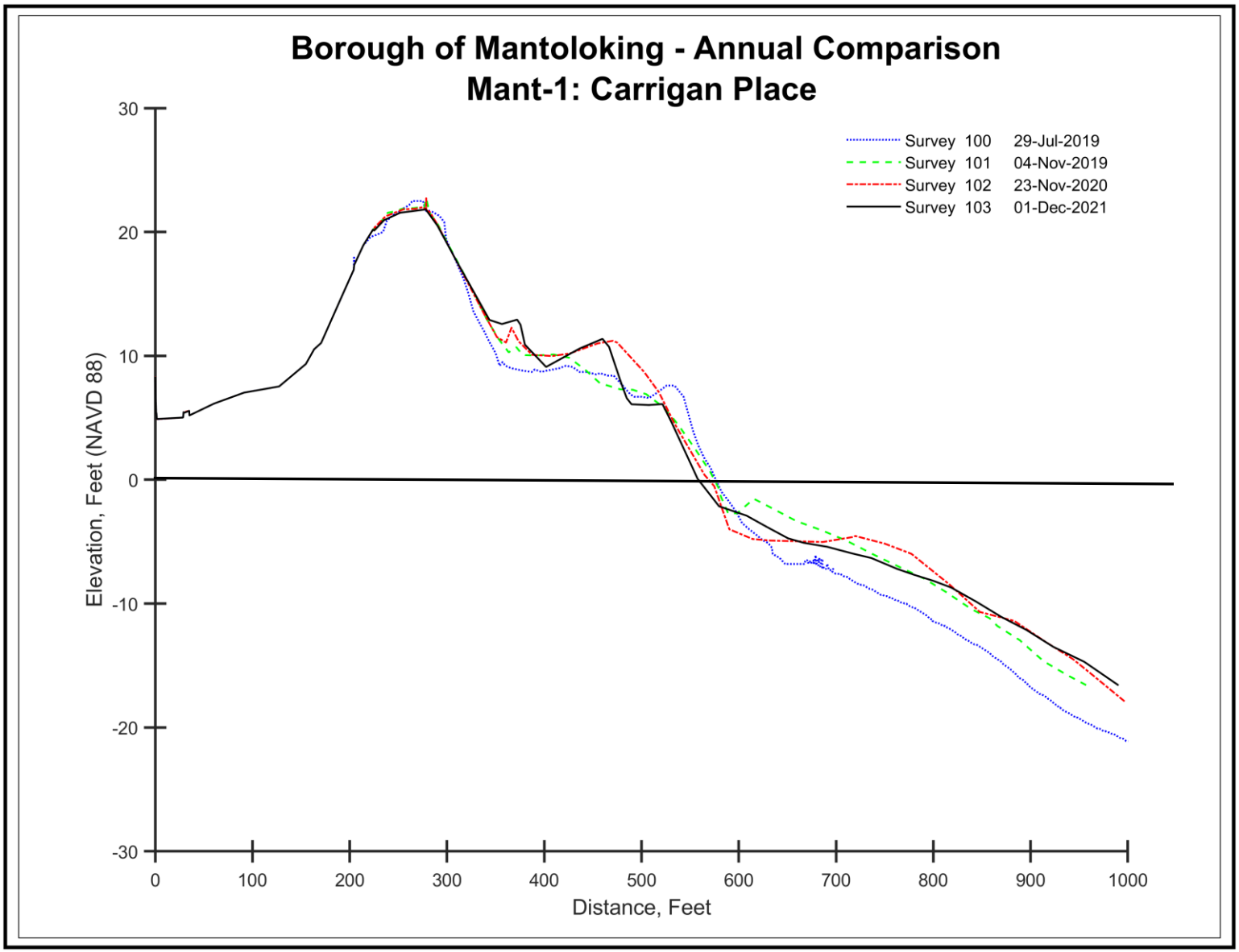

Figure 1d: The four cross sections display conditions since July 2019. As of December 2021, a large berm was present with additional sand added to the foredune developed since July 2019. Offshore a large volume of sand was added by November 2019 that has remained in place where bar formation can move some of the sand toward the beach during calm wave periods. There was a modest sand volume loss on the beach (-5.22 yds^3/ft.) between Nov. 2020 and Dec. 2021 and -1.93 yds^3/ft. lost offshore (-7.146 yds^3/ft. total).

- **Mant-2 #1041 Ocean Avenue;**

Mant-2 is located along Ocean Avenue on the municipal beach access path between the private residences at #1039 and #1041 Ocean Avenue. The site selection was because of its position is approximately midway between Carrigan Place and the pre-existing New Jersey Beach Profile Network site located at #1117 Ocean Avenue and it has public accessibility. The profile starts at a reference location monument, midway along the access path 150 feet landward of the landward dune toe.

The vertical steel wall installation started in September 2014 at approximately the location of the old dune crest. The profile cycled between erosional wall exposures and burial through maintenance efforts. The wall is now buried under the 22-foot elevation dune with several hundred feet of dry sand beach seaward of its position.

The four surveys indicate a substantial increase in the primary dune's seaward slope sand volume between July and November 2019. Sand was added offshore as well raising the seafloor elevation by over a foot across over 400 feet of offshore distance. This change has been maintained since November 2019. As of December 2021, a substantial offshore bar was about to merge with the beachface toe at the site.

2a. December 21, 2017

2c. December 1, 2021

2b. November 23, 2020

Mant-2 Photographs 2a, 2b and 2c. All views are to the north.

Photograph 2a. the 2017 beach was far narrower with a restored dune from maintenance efforts moving sand onto the seaward dune slope covering the steel wall, restoring the seaward slope and a modest recreational beach.

Photograph 2b. Dune decks have appeared on the crest of the federal dune and the small wind-generated foredune is in place at the seaward toe.

Photograph 2c. This photograph was taken at the seaward dune toe showing the beach width and the development of wind deposition on the new federal dune.

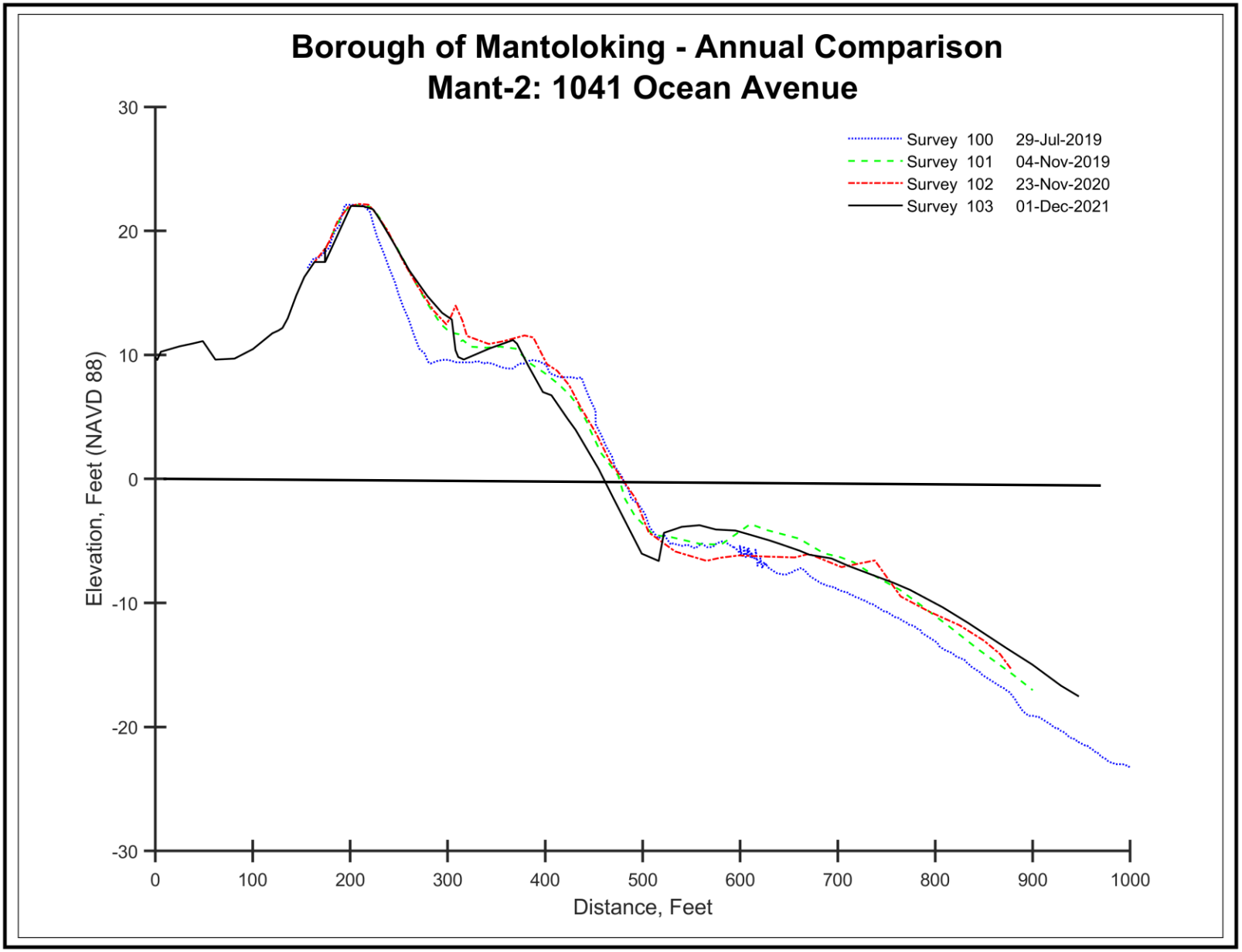

Figure 2d: The profile series begins with July 2019. Sand was added to the seaward dune slope by November 2019. This material may have been graded into place prior to the planting of the dune grass. Sand deposited offshore here, and the December 2021 survey shows a significant bar system about to migrate onto the beach.

- **Mant-3 #1117 Ocean Avenue**;

The #1117 Ocean Avenue monitoring site is located on private property. This site, originally established in 1986, is included in the State of New Jersey's coastal monitoring program (NJBPN). The site was later included in the beach-monitoring program in Mantoloking because of the pre-existing data collected for the State at this location. The profile line was set along the former home's dune walkover to minimize damage to the dune vegetation. Positioned nearly in the center of the municipal shoreline, this site has shown to be vulnerable to dune erosion over the years.

To prevent a reoccurrence of the Hurricane Sandy storm breach the state installed a steel wall, completed in late 2014. The dune crest following these restoration efforts remained near 22 ft. (NAVD88) with dry beach widths that ranged from 75 to 125 feet.

Since July 2019, sand has accumulated at the fence line at the toe of the seaward dune slope. Minimal sand has been added offshore at this location and the July/November 2019 berm retreated 35 feet by November 2020. Sand accumulated at the base of the beachface toe since November 2020 and the berm has been stable.

3a. December 21, 2017

3b. November 23, 2020

3c. December 1, 2021

Mant-3 Photographs 3a, 3b & 3c show the view to the north from the seaward dune crest.

Photograph 3a. By December 2017, a combination of natural sand recovery over the summer and an infusion of sand from the startup of the federal shore protection project in fall restored the seaward dune slope and added significant beach width.

Photograph 3b. By November 2020, the dune grass had gotten an excellent start and the beach situation remains good.

Photograph 3c. The 2021 view shows the seaward dune toe slope where sand has been depositing from wind effects. The beach width remains constant.

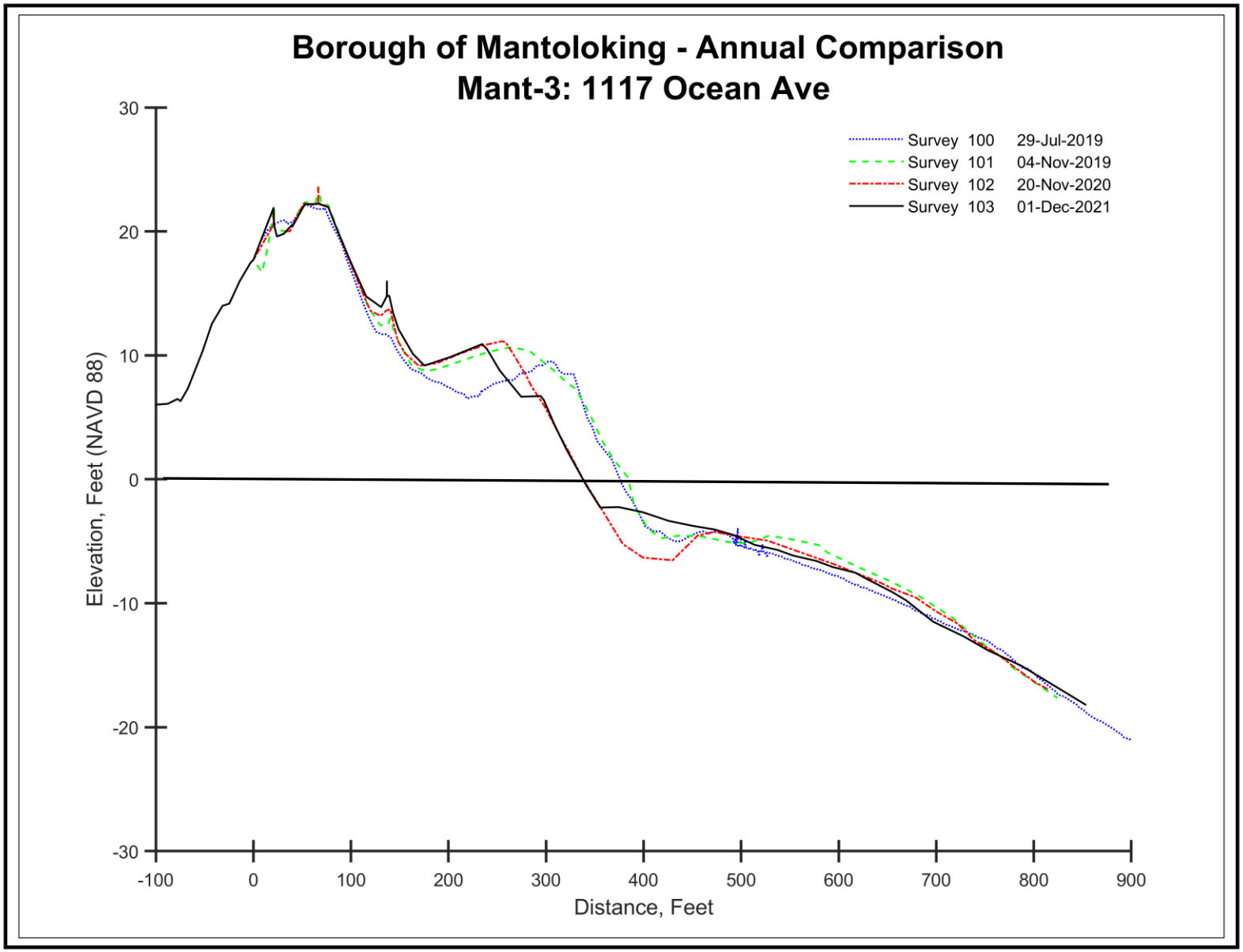

Figure 3d: Four surveys show change since July 2019 where the berm retreated 35 feet since Nov. 2019 then stabilized. Minimal sand was deposited offshore, but the Nov. 2020 beachface toe trough filled in (+9.73 yds^3/ft. added). The beach and dune lost 0.93 yds^3/ft. while the offshore region gained 6.41 yds^3/ft. since November 2020. The shoreline position changed very little (-0.21 feet in a year).

- **Mant-4 Princeton Avenue;**

The Mant-4 beach profile is located at the seaward end of Princeton Avenue along the municipal dune walkover. This site is located approximately midway between the #1117 and #1543 Ocean Avenue sites and is readily accessible.

The USACE project started in this region during late fall 2017, a massive quantity of sand placed by January 19, 2018 masked any natural changes that occurred since April. The dune volume nearly doubled while the crest elevation reached 22 feet and 30 feet wide with a dune toe width of 200 feet.

The July 2019 berm and offshore elevation profile was the most depositional with erosion commencing modestly by Nov. 2019 and continuing at a slow pace into Nov. 2020. Between Nov. 2020 and Nov. 2021, the erosion took a 38-foot thick bite out of the berm and beach width removing 21.31 yds^3/ft. from the berm. Sand was also lost offshore (-15.32 yds^3/ft.) making Princeton Avenue the largest loss profile of the five (-36.63 yds^3/ft.).

4a. January 19, 2018

4c. December 1, 2021

4b. November 23, 2020

Mant-4 Photographs 4a to 4c. All views are to the north from essentially the same location at the Princeton Avenue entrance.

Photograph 4a. The Federal shore protection project, partially completed here by January 19, 2018, added a massive quantity of sand to this site that extended seaward to the profile limits. The dune more than doubled in size and beach width expanded seaward several hundred feet.

Photograph 4b. The public access pathway was complete by November 23, 2020 with fencing and handicap access rebuilt

Photograph 4c. Here the narrower beach is clearly visible with a shallow terrace just offshore. The dune toe is stable with minimal sand deposition at the fence line

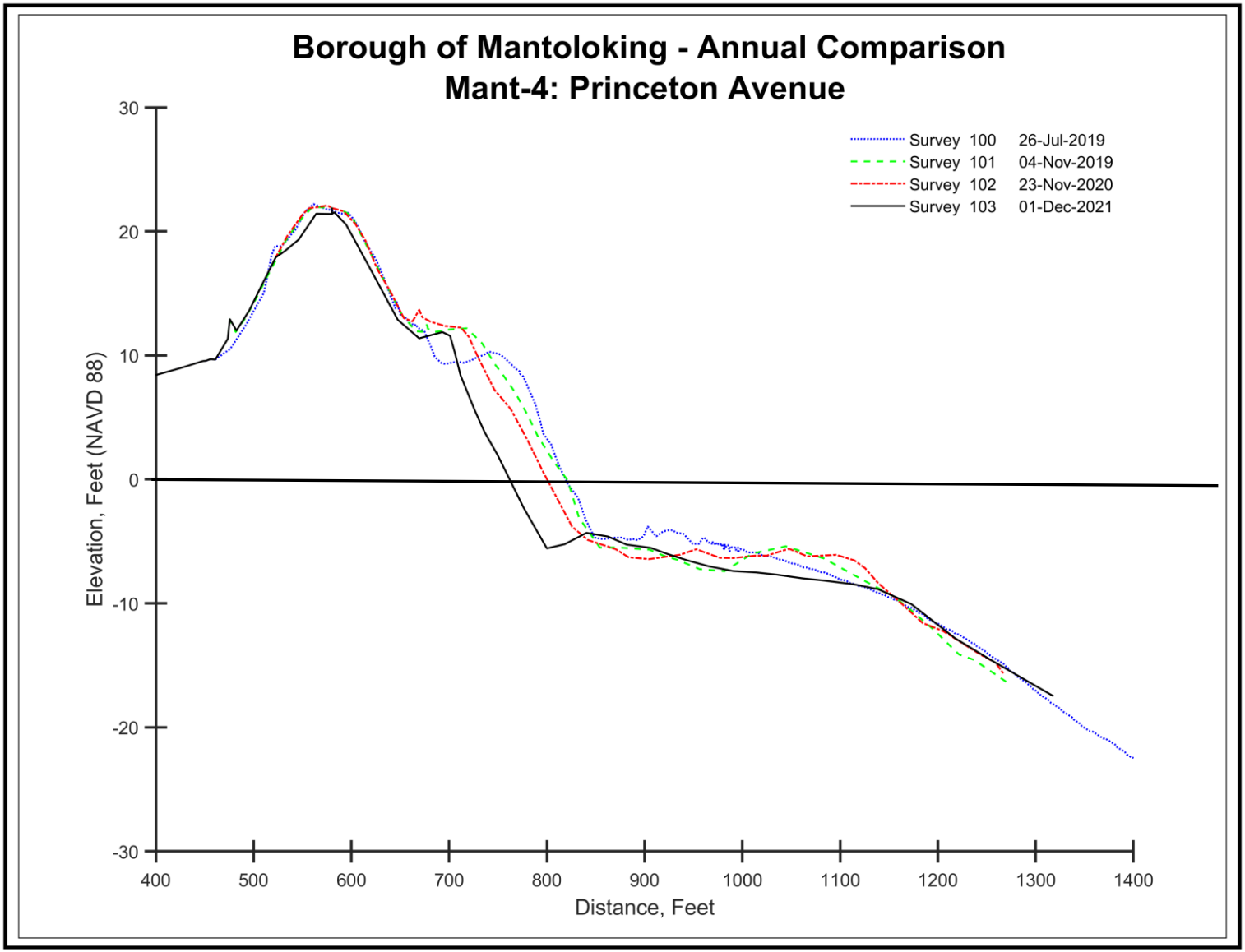

Figure 4d: This series of four surveys presents the most erosional picture along the Borough oceanfront. A total of 36.63 yds^3/ft. in sand volume was lost between Nov. 2020 and Dec. 2021. The shoreline retreated 38 feet as well. Sand present offshore in Nov. 2020 diminished as well, but the final toe well offshore remained constant among the four surveys.

- **Mant-51 #1543 Ocean Avenue;**

This monitoring site was initially located on private property between the homes at #1547 and #1549 Ocean Avenue. Because of its proximity to the border with Brick Township, this location became the southernmost site for the Borough monitoring program. During 2005, new property owners curtailed accessibility to the private property and the site resulting in the its relocation to the public access pathway between #1543 and #1539 Ocean Avenue. The shift in the line's location was 202 feet to the north.

The beach at this location was modified between July and November 2019 filling in a trough between the new front dune crest and the former primary dune's higher elevations over 22 feet NAVD88. Between Nov. 2020 and Dec. 2021, a large volume of sand was naturally deposited just offshore and up onto the lower beachface slope (+30.60 yds^3/ft.). This material was most likely derived from the erosion seen toward the Princeton Avenue location. The offshore slope became uniform in gradient into deep water. The beach only gained 3.98 yds^3/ft. while offshore saw 19.03 yds^3/ft. added for a total of 23.01 yds^3/ft. The shoreline advanced 23 feet seaward in 2021.

5a. December 21, 2017

5c. December 1, 2021

5b. November 23, 2020

Mant-51 Photographs 5a to 5c. All views are to the north from the beach access or the berm at 1543 Ocean Ave.

Photograph 5a. Natural recovery onshore over the summer and fall months restored the beach width by December 2017, with the seaward dune slope regraded through maintenance activity. The ongoing USACE project activity and resulting seaward beach offset is visible in the far distance.

View 5b. There has been considerable wind transport into the dune as of Nov. 23, 2020. New dune decks have appeared along the Borough oceanfront as well.

View 5c. As of December 2021, the foredune slope was graded higher into the grass since fencing was absent. The beach width remained relatively constant.

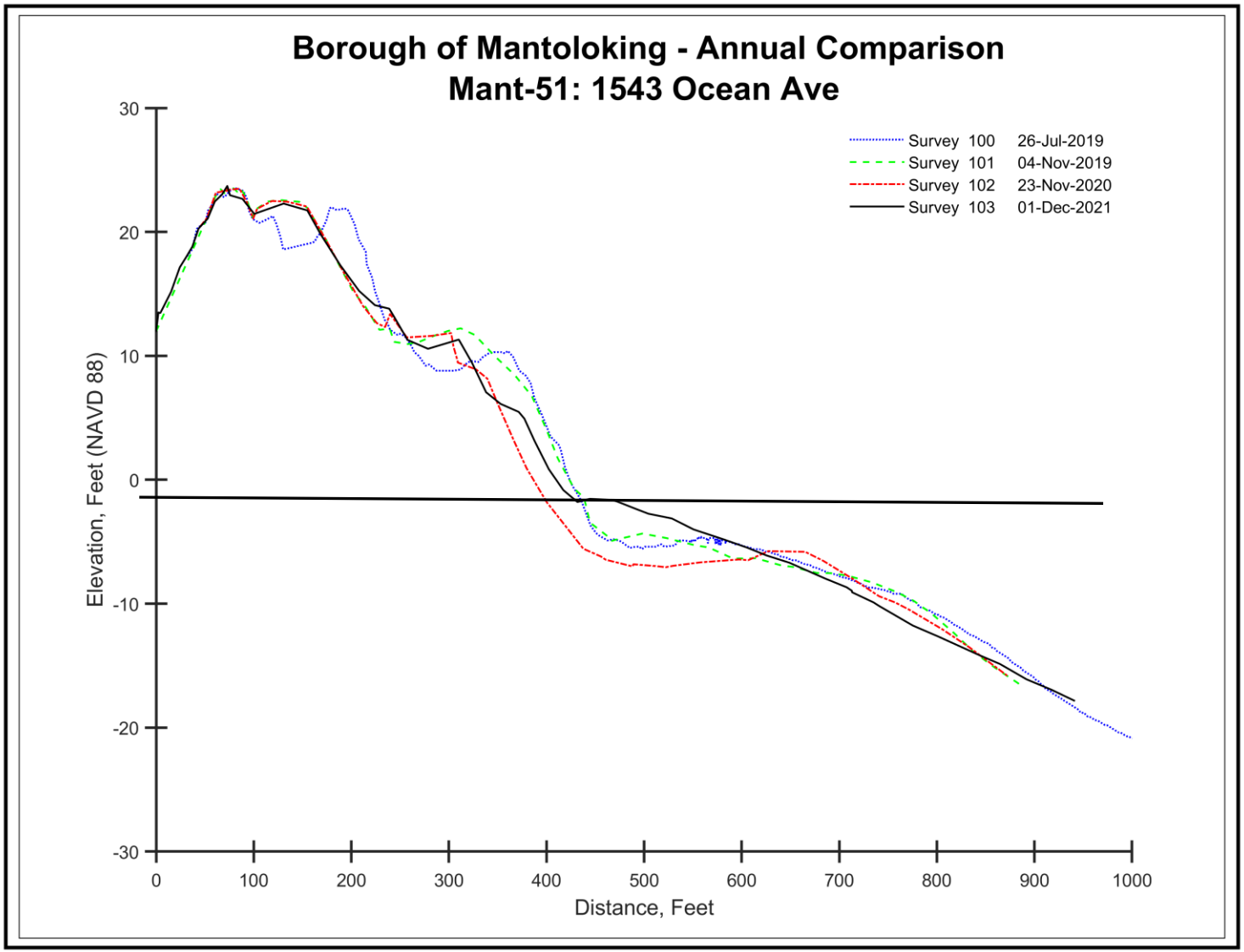

Figure 5d: The southern site did not see dune breaching during Sandy because of the greater width of the feature. The July 2019 survey shows the new primary dune with a deep trough between it and the old primary dune. This was filled in by Nov. 2019 and graded into the dune profile surveyed since. The beachface slope and adjacent nearshore region gained large volumes of sand compared to other sites between Nov. 2020 and Dec. 2021. Further seaward the 4 surveys become parallel to each other indicating little change.

Conclusions:

As of completing the December 2021 survey series, the CRC found that **12.48% of the 1,377,081 cubic yards** of new sand pumped onto the Mantoloking shoreline from source sites offshore had eroded to points either further seaward than the surveying or moved south into Brick Township. The entire northern Ocean County project has been sustained by sand supplies never previously available to the modern or historical oceanfront to provide added shore protection.

When the sand volume placed prior to the December 2017 CRC surveys is included in the total sand placement count, the **Borough received 2,153,249 cubic yards of sand between April 2017 and July 2019.** The US Army **"as-built" sand volume was given as 2,571,591 cubic yards** of material (Keith Watson, communication). Using these "as built" figures provided by the US Army Project Manager, the 2-year net loss in sand volume **becomes 6.68% of the Army Corps total sand volume placed.**

The CRC surveys stopped as of December 2017 and did not resume until Nov. 4, 2019 so the 418,342-cubic yard difference between the combined CRC sand volume and that provided by the US Army project manager is understandable as well as the fact that the USACE survey density was many times the CRC's five individual sites in the Borough. However, past comparisons did not demonstrate significant variations that were attributable to results from the five locations as compared to the US Army's survey contractor results. The five municipal survey locations represent the Mantoloking oceanfront beach changes quite accurately over the past three decades.

Over the past two years, sand appears to have migrated into the Borough oceanfront particularly in the offshore area derived from losses in Bay Head. Princeton Avenue had the highest erosion rate, losing 36.36 yds^3/ft. in sand volume between the dunes and beach plus offshore. The southernmost site about 500 feet from the Township border did naturally accumulate 23.01 yds^3/ft. in added sand between Nov. 2020 and Dec. 2021. This corresponds to the general sand migration to the south since the project completion.

The presumed US Army Corps initial maintenance interval is expected during 2023 and will address the gathering sand losses near Princeton Avenue. Congressional appropriations are necessary to the process but have been forthcoming since this federal shore protection program started in the late 1980's in New Jersey.