



The Coastal Research Center

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NEW JERSEY'S DISTINCTIVE PUBLIC UNIVERSITY



Stone Harbor, on 81<sup>st</sup> Street Friday October 11, 2019 (view towards 3<sup>rd</sup> Avenue).

**FLOOD DATA COLLECTION to DOCUMENT NUISANCE FLOODING IMPACTS**  
**On**  
**STONE HARBOR, CAPE MAY COUNTY, NEW JERSEY (April 2018 – Nov 2019)**

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**FUNDED BY: STONE HARBOR BOROUGH**

August 27, 2020



### Site Elevations

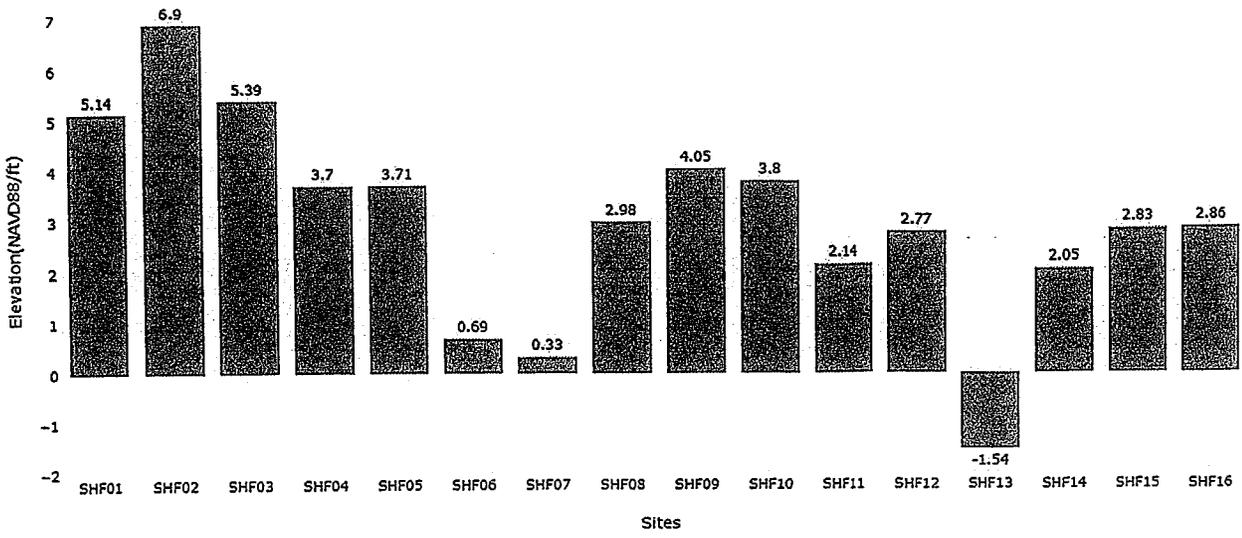
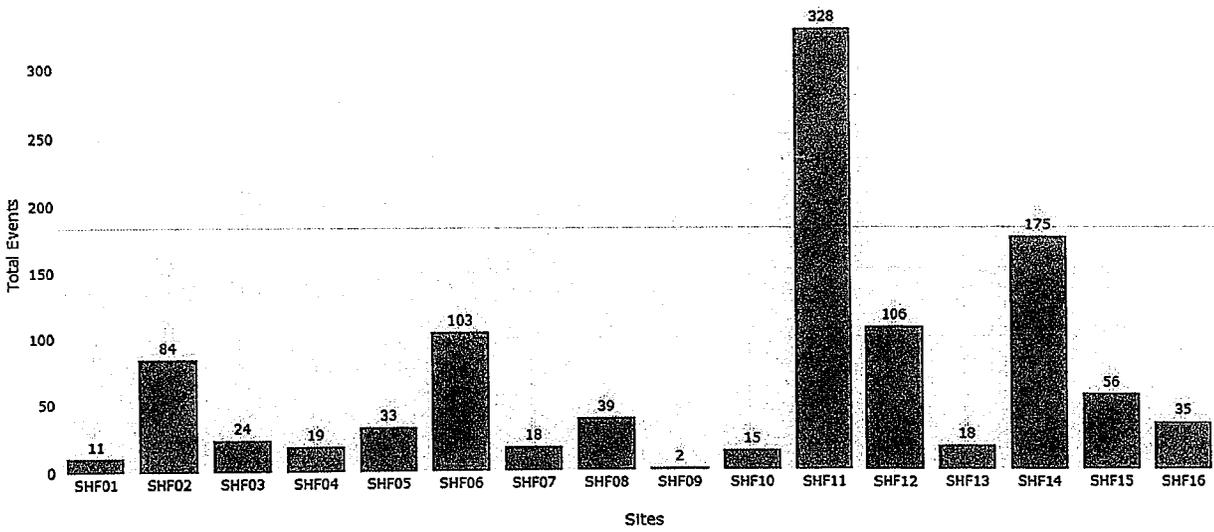
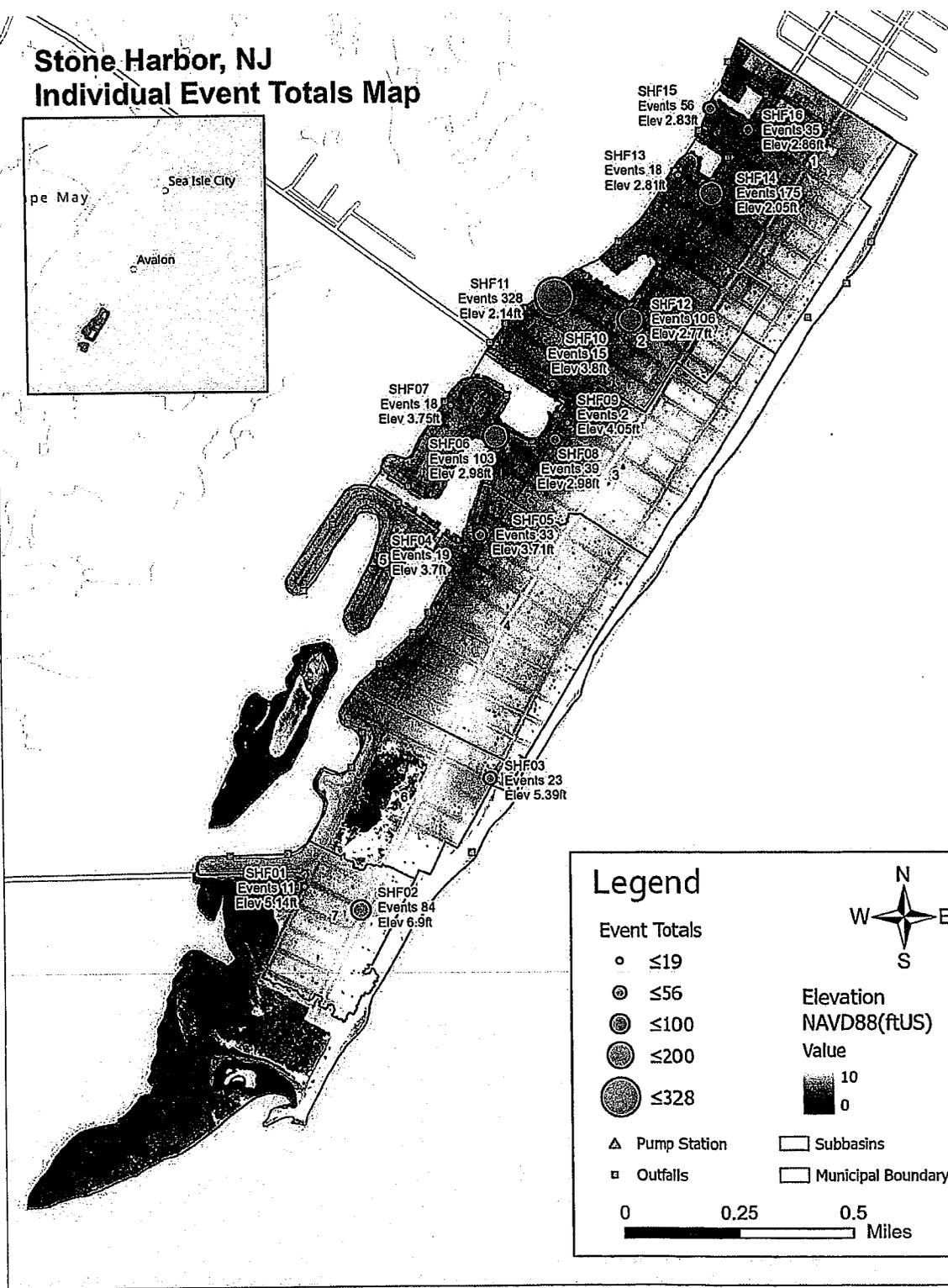
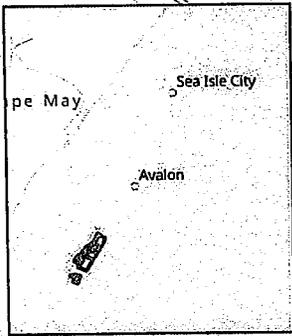


Figure 2. Site Elevations (NAVD 1988) of the Stone Harbor HOB0 sensors.  
 SHF06 grate surface = 2.98 ft.; SHF07 grate surface = 3.75 ft. and SHF13 grate surface = 2.81 ft. NAVD 1988

Figure 4. Bar Graph of Total Individual Events per site during the study  
 Total Individual Events Per Site



# Stone Harbor, NJ Individual Event Totals Map



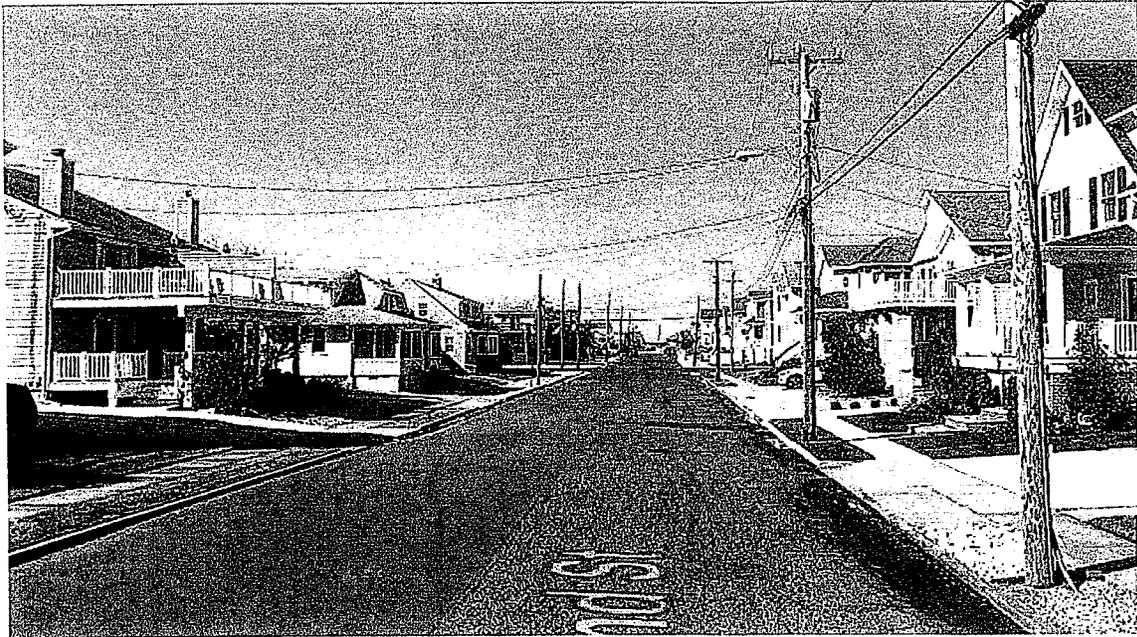
### Legend

<p><b>Event Totals</b></p> <ul style="list-style-type: none"> <li>○ ≤19</li> <li>⊙ ≤56</li> <li>⊚ ≤100</li> <li>⊛ ≤200</li> <li>⊜ ≤328</li> </ul>	<p><b>Elevation</b> NAVD88(ftUS) Value</p> <p>10 0</p>
<p>▲ Pump Station</p> <p>▣ Outfalls</p>	<p>▭ Subbasins</p> <p>▭ Municipal Boundary</p>
<p>0      0.25      0.5 Miles</p>	

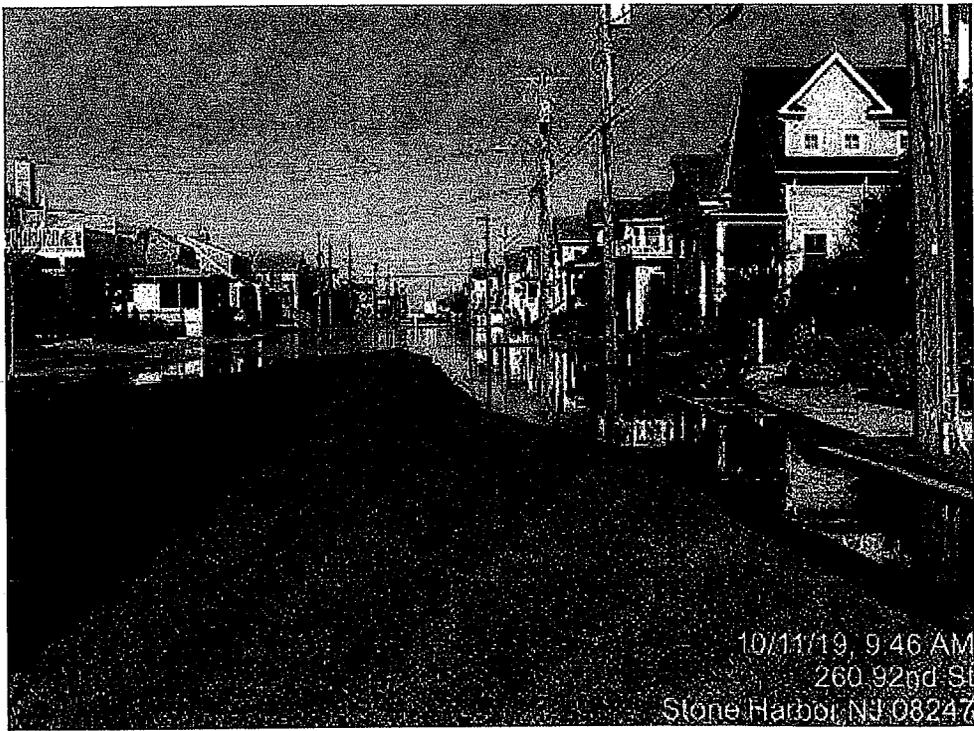


Table 3. Summary table for site Individual Event totals, frequency of Main Events starts, and frequency of Main Event ends.

Site	Total #. of Events	Percent Site Flooded/d	Event Started First	Percent Site Started/d First	Event Ended Last	Percent Site Ended/d Last
SHF01	11	1.03	0	0.00	1	0.27
SHF02	84	7.89	54	14.67	50	13.59
SHF03	23	2.16	2	0.54	0	0.00
SHF04	19	1.78	0	0.00	0	0.00
SHF05	33	3.10	0	0.00	0	0.00
SHF06	103	9.67	0	0.00	0	0.00
SHF07	18	1.69	0	0.00	0	0.00
SHF08	39	3.66	0	0.00	0	0.00
SHF09	2	0.19	0	0.00	0	0.00
SHF10	15	1.41	0	0.00	0	0.00
SHF11	328	30.80	265	72.01	263	71.47
SHF12	106	9.95	7	1.90	15	4.08
SHF13	18	1.69	0	0.00	0	0.00
SHF14	175	16.43	40	10.87	39	10.60
SHF15	56	5.26	0	0.00	0	0.00
SHF16	35	3.29	0	0.00	0	0.00



*Figure 8. Photo showing dry conditions along 92<sup>nd</sup> Street (view towards site SHF12).*



*Figure 9. Photo showing flood water associated with Stone Harbor Nuisance Flooding Event 332 towards site SHF12*

Nuisance Flooding Event 332: Flood Height Per Site

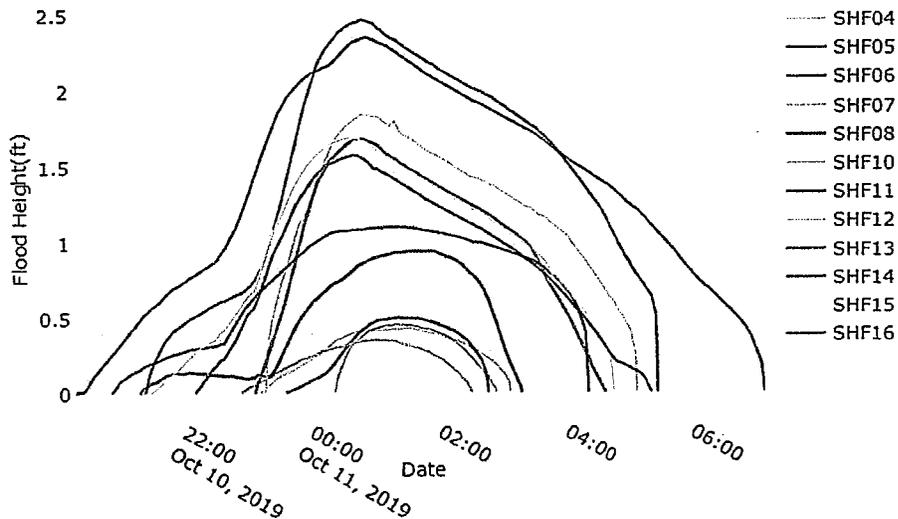


Figure 10. Nuisance Flooding Event 332 flood height above the surface of the stormwater grate per site

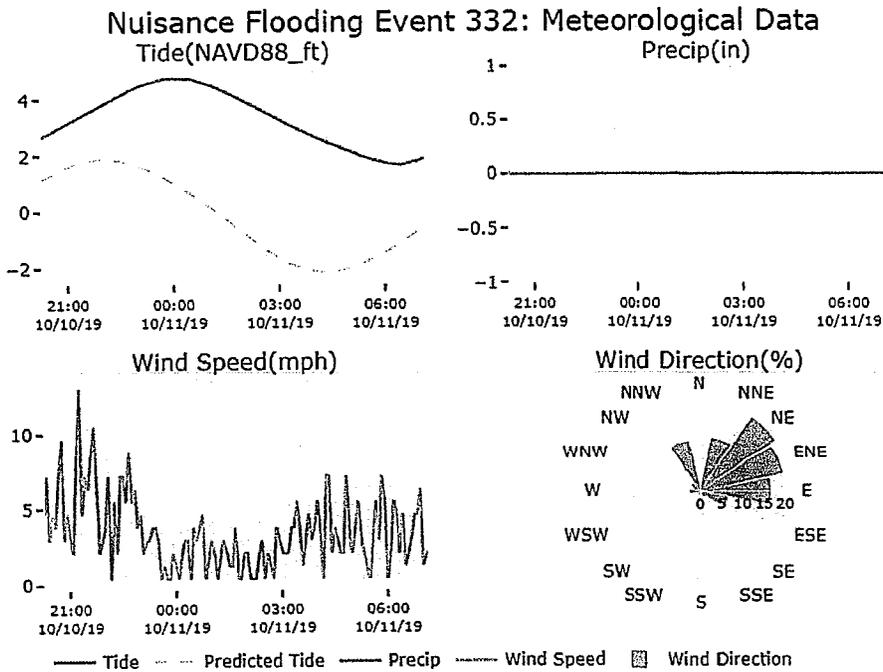


Figure 11. Nuisance Flooding Event 332 meteorological data

### Nuisance Flooding Event 335: Flood Height Per Site

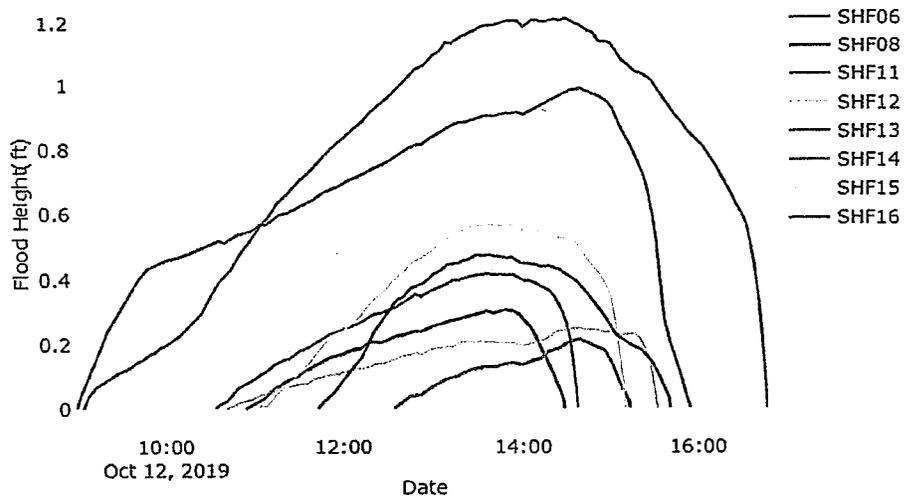
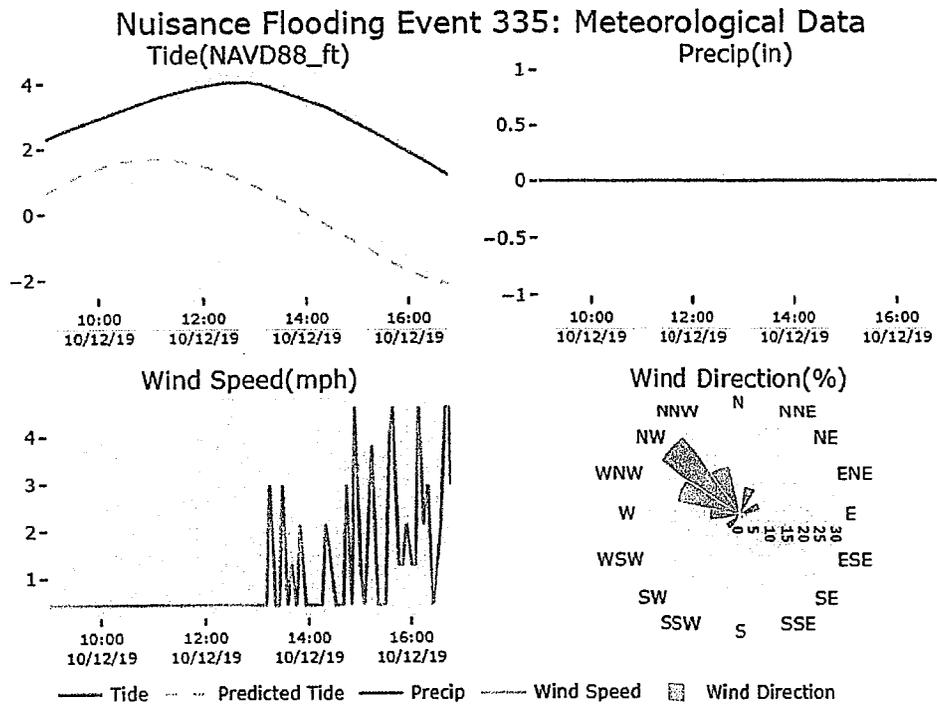


Figure 18. Nuisance Flooding Event 335 flood height above the surface of the stormwater grate per site



### Storm Flooding Event 10: Flood Height Per Site

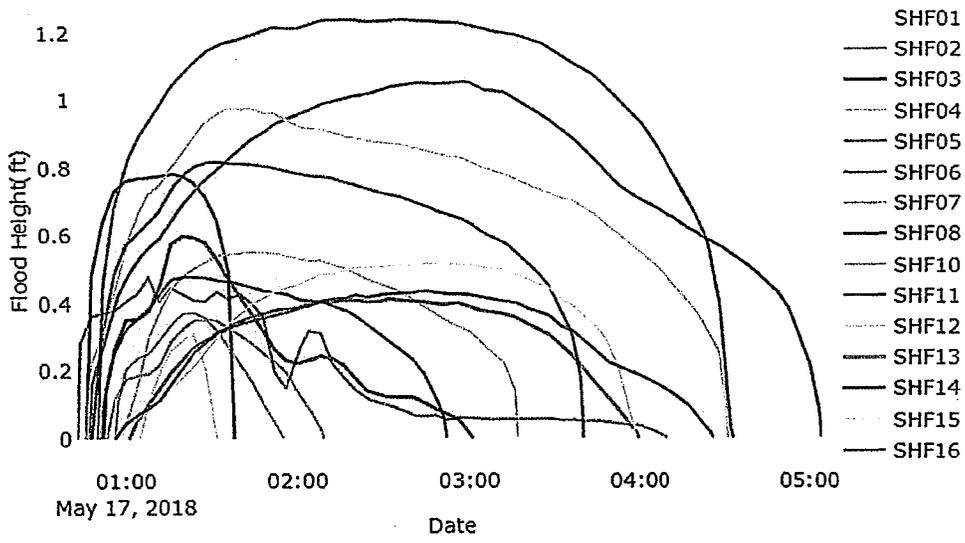


Figure 22. Storm Flooding Event 10 flood height above the surface of the stormwater grate per site.

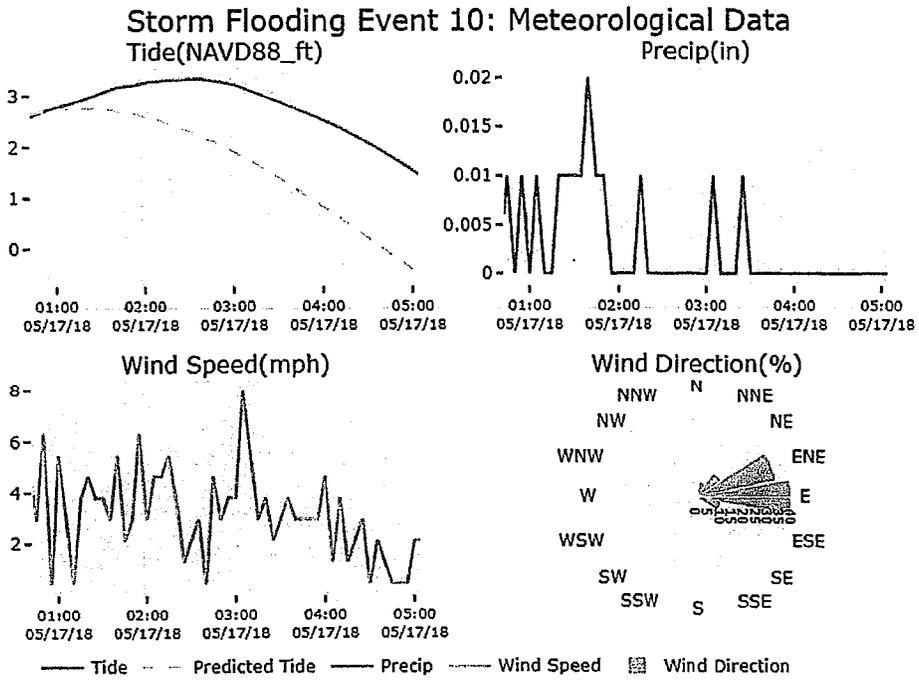


Figure 23. Storm Flooding Event 10 meteorological data

### Storm Flooding Event 77: Flood Height Per Site

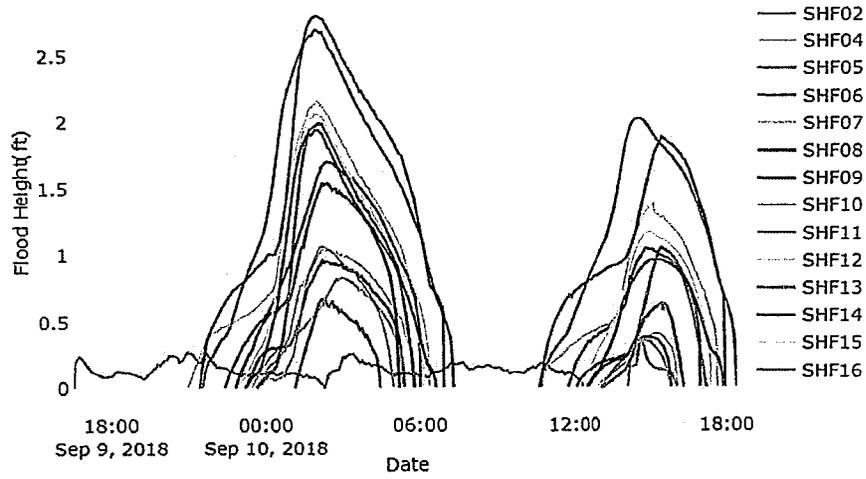


Figure 24. Storm Flooding Event 77 flood height above the surface of the stormwater grate per site

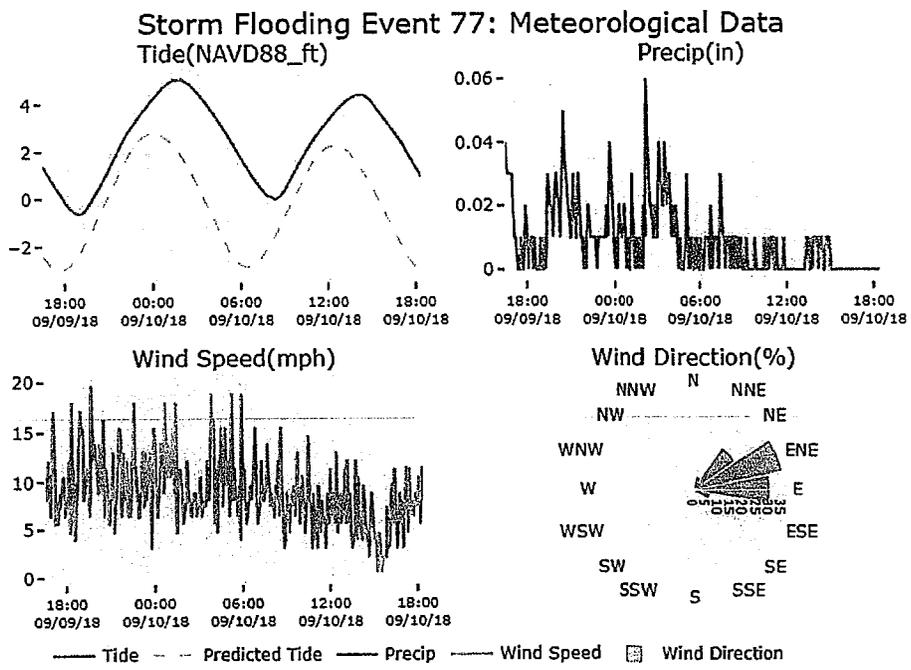


Figure 25. Storm Flooding Event 77 meteorological data

## Conclusions:

The Stockton University Coastal Research Center observed the following characteristics of flooding within Stone Harbor Borough from the 18-month monitoring study:

1. The range of water depths during 368 Main Events of any type produced between 0.17 and 3.10 ft. of water. Average depths ranged between 0.28 and 0.89 ft. Average durations ranged between 1.18 and 3.59 hours.
2. The Sensors at sites SHF06, SHF07, SHF13 were all located at the bottom of their stormwater vault at public works request. The distance from the sensor to the surface of the stormwater grate was corrected to show Individual Events above the grates surface to be comparable to the other sites. Water depths for episodes occurring below the three stormwater grates can be generated with further analysis.
3. Sites SHF01, SHF02, and SHF03 were all above 5 ft. NAVD88, however, they recorded a higher than expected number of events. Site SHF02 was redesigned ~2 weeks prior to the completion of deployment 3 (February 13, 2019). Prior to the redesign, there was a total of 62 Individual Events. After the redesign, there was a total of 22 Individual Events. Of the total 84 Individual Events, 79 were classified as Storm Flooding (presence of precipitation). This suggests there is a drainage issue caused primarily by precipitation. The number of events declined after redesign, confirming that probability.
4. The remaining sites (SHF04, SHF05, SHF08, SHF09, SHF10, SHF11, SHF12, SHF14, SHF15, and SHF16) showed an anticipated relationship between a lower number of Individual Events as elevation increased. Of those sites, the two with the lowest elevations accounted for the two highest total number of Individual Events (SHF11 at 2.14 ft. NAVD88 had 328 events while SHF14 at 2.05 ft. NAVD88 had 175 events). This is further confirmed by site SHF09 at 4.05 ft. NAVD88 having only 2 events.
5. SHF02 was the 2<sup>nd</sup> highest to start flooding with 54 (14.67%) and ended flooding with 50 (13.59%). The first and third highest to start and end were SHF11 and SHF14, respectively. This further suggests a draining issue at site SHF02, compared to an elevation problem at SHF11 and SHF14.
6. 4 out of the top 5 Nuisance Flooding Events were affected most by northwest winds and had a higher recorded tide than predicted. This suggests that wind direction and tidal conditions could be predictive indicators for future Nuisance Flooding Events.

Some limitations exist in this preliminary study that require further analysis:

1. Main Events were defined by a single site or multiple sites in Stone Harbor recording water depths above the surface of the stormwater grate during the same time period. Since all sites were above elevation 2 ft. NAVD88\*, many sites did not remain flooded for extended periods of time. If these sites are compared to other towns, such as Long Beach Island during the same time frame, elevations should be considered as well as the meteorological conditions when determining the classification between Nuisance Flooding Events and Storm Flooding Events.

*\*The three storm vaults (SHF06, SHF07 and SHF13) with sensors placed at the bottom of the vault were corrected to yield grate surface flooding events. The surface of the stormwater grate at SHF06 was 2.98 ft. NAVD88, SHF07 was 3.75 ft. NAVD88, and SHF13 was 2.81 ft. NAVD88.*

On many of New Jersey's barrier islands, low elevation roadways appear to be flooding more than in past decades. If predicted sea levels of 3.0 to 4.5 feet higher than today do become reality by 2100, the worst nuisance flood of today becomes normal high tide flooding twice every day. While this study was designed to quantify all flooding events in the Stone Harbor Borough between April 2018 and November 2019,

further analysis of actionable data is required to specifically correlate Individual Events with unique causes (meteorological & astronomical) and flooding impacts to the surrounding area. This continued analysis can help communities assess future flood risk and may be useful in developing an early warning system.

Stone Harbor was unique in requesting the installation of a recording rain gauge at public works to more precisely characterize the accumulated rainfall volume in the Borough rather than rely on external, yet regional recording stations. The Rutgers University Cape May Courthouse station records precipitation on a 5-minute cumulation basis whereas the Stone Harbor rain gauge recorded rainfall on an hourly cumulative basis. Correlating the sensor records with the Cape May Court House data was far easier due to the similar time stamps, but each record for both the Cape May Court House and Stone Harbor on site rainfall information is collated in the appendix to provide direct comparison as to time, frequency and amount of rainfall recorded. It did not seem a prudent expenditure of time to attempt to correlate the Stone Harbor rain data with the event times after observing the relative similarity of the two sources. Both rainfall records are complete and could be subjected to a subsequent investigation at some point, perhaps by a local student.