Borough of Monmouth Beach Infrastructure Capacity Analysis

March 28, 2018

Introduction

- Borough Commissioners authorized T&M Associates to conduct an assessment of the existing Borough drainage system

- Study goals
  - Assess capacity of existing drainage
  - Identify existing drainage systems which are under capacity
  - Analyze current capacity with Post-Super Storm Sandy (with rebuild)
  - Provide recommendations to reduce flooding from future weather events

Introduction (Cont.)

- Data gathering and analysis tools and methodology
- Site investigation and field reconnaissance by T&M and Borough Public Works personnel
- Compile and review of available topographical mapping
- Determined drainage areas (areas tributary to each system)
- Identified runoff coefficients for engineering calculations (losses associated with land uses vegetative cover and soil types used to estimate the fraction of rainfall that appears as surface runoff from the drainage area)

Field Investigation

- Conducted field reconnaissance on the entire drainage system (4/5/17 – 4/14/17).
  - Determined overall condition of the existing drainage system.
  - Size and type of existing drainage pipes.
  - Locate existing drainage structures within the Borough (GPS Ground Survey).
- Verified drainage areas on topographical maps .
- Develop and summarize findings in drainage structure inventory (excerpt below).

Structure Name Drainage Maps	Pipe Material	Eco Curb Piece	Bicycle Safe Grate	Road	Out Pipe Size (in)	Inlet Type	Comments
12-9I	RCP	Yes	Yes	Navesink Drive	12	B	-
13-1I	RCP	Yes	Yes	Meadow Avenue	-	B	Sand Point North parking lot.
13-2I	RCP	No	No	Meadow Avenue	-	B	Walls collapsing and hole behind curb piece. Sand Point parking lot.

Existing Conditions

- Borough of Monmouth Beach is approximately one (1) square mile
- Predominantly residential neighborhoods with some commercial development
- Topography throughout the Borough is relatively flat with slight variations in grade
- Properties within 100 Year Flood Limits per Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps
  - Structures - 74%
  - Properties – 65%
- Normal and moon tides cause regular flooding on existing roads

Floodplain and Property Data

Item	Borough Total	100-Year Floodplain	500-Year[1] Floodplain	100-Year + 500-Year Floodplain*	Percent Located within the 100-Year Floodplain
Structures	1,246	919	98	970	73.76%
Properties	2,239	1,488	182	1,541	66.46%
Land Area (acres)[2]	571.31	71.08	4.63	75.71	12.44%

*100 + 500 year total may not equal total due to some structures and/or properties being located in both areas.
1. This does not include the area within the 100-year floodplain.
2. Land area only includes land parcel areas. Waterways and roads are not included in this area.

Existing Drainage Systems

- Existing drainage system consists of approximately 446 structures (370 stormwater inlets / 76 manholes)
- Drainage pipes range from 4” to 36” in diameter
- Approximately 44 existing drainage system outfalls to the Shrewsbury River (44 separate drainage systems)
- Each drainage outfall was identified and the hydrologic parameters used in the engineering analysis were summarized (sample below)

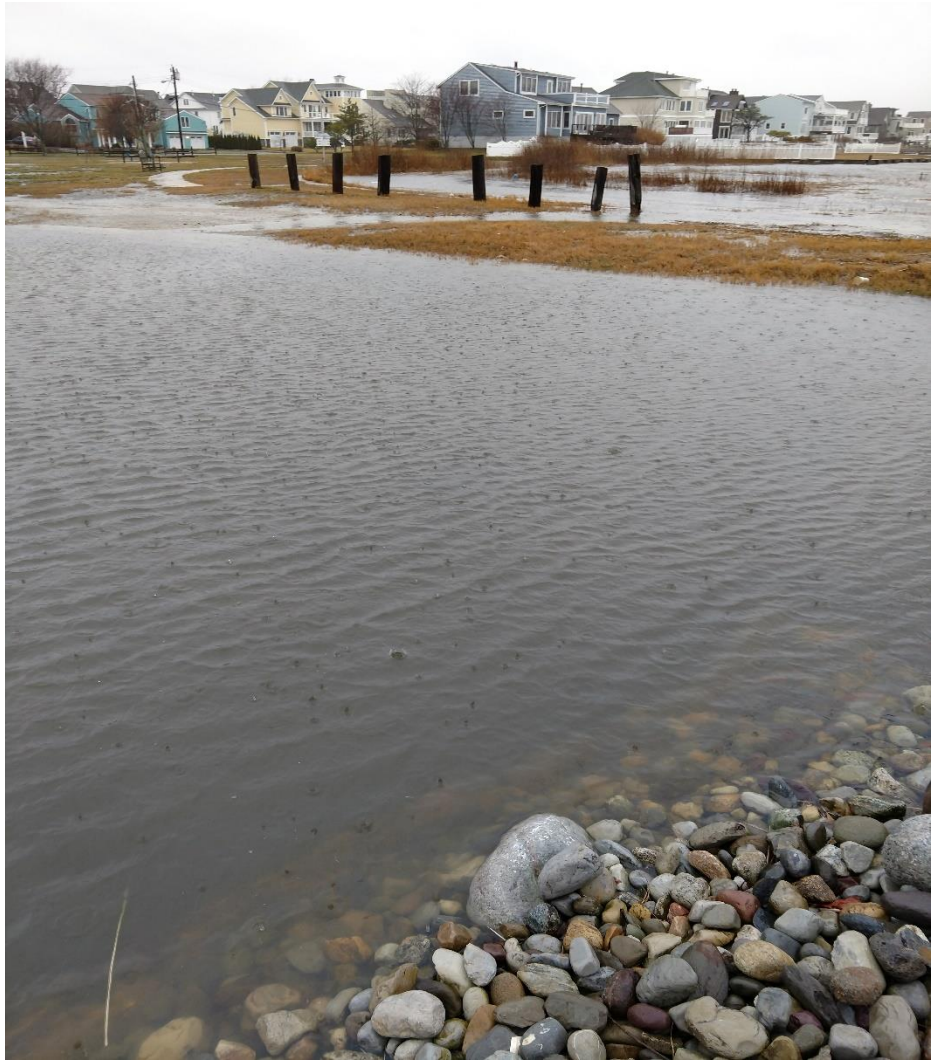
Outfall No. 13 – The drainage area consists of 0.83 acres and an overall runoff coefficient of 81 Pre-Super Storm Sandy and 81 Post-Super Storm Sandy. This outfall collects runoff from Sands Point North and is not owned by the Borough.

Analysis Scenarios

- Existing drainage system analyzed using two (2) scenarios
  - Pre-Sandy Development
  - Post Sandy Development
  - With (submerged) and without (free flow) tidal influences
- Analyzed each scenario for the two (2) and ten (10) year Design Storm (Statistical term used when referring to the frequency of occurrence)
- Utilized rainfall intensities from the Sandy Hook Rainfall Intensity Curve (published source of rainfall data in this region)
- Established degree of development Pre-and Post-Super Storm Sandy using development data provided by Matrix New World Engineering
- Calculated runoff coefficient for the drainage area tributary to each drainage outfall
- Calculated stormwater runoff

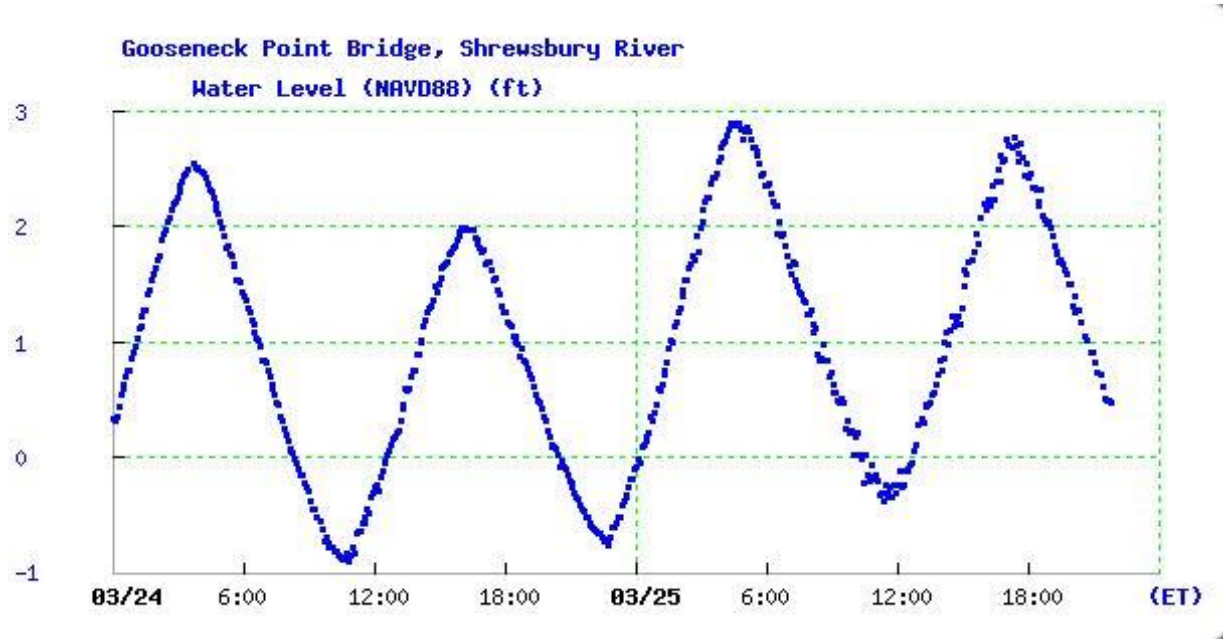
Findings

- Certain roadways within the Borough are below the high tide and moon tide elevations which contributes to periodic nuisance flooding
- Many of the existing drainage systems are under capacity having drainage pipes at flat slopes and/or back pitched which limits the drainage system flow carry capacity
- The analysis shows approximately twenty-four (24) of the forty-four (44) existing outfalls are under capacity for the 2 and 10 year design storm



Findings (cont.)

- All the existing forty-four (44) drainage outfalls become submerged during high tide and moon tide which further limits the flow carry capacity of the system
- During the field reconnaissance we found a number of drainage structures filled with debris and water. This is a direct result of tidal influence



- Flooding conditions are further aggravated by tidal action of the Shrewsbury River

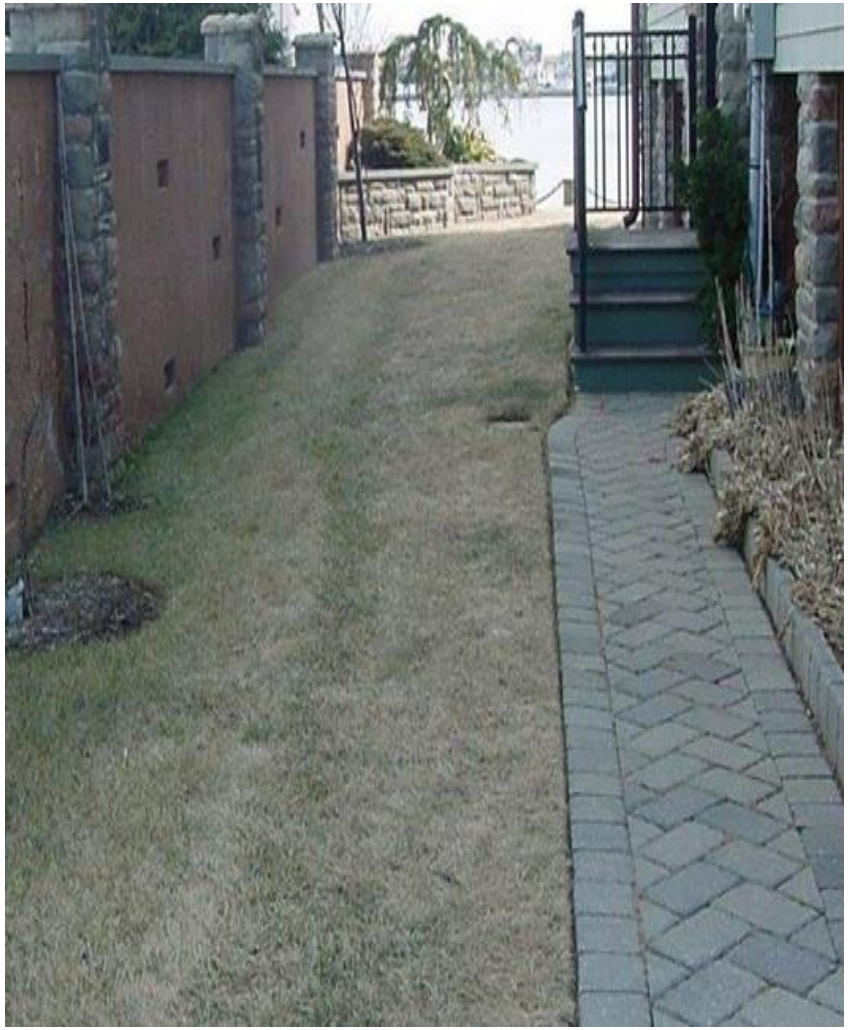
  Mean tide level in the Shrewsbury River is 5.60 feet, with all annual high tides estimated to be approximately 6.90 feet above mean sea level

This study identifies short term and long term recommendations to reduce the frequency and duration of flooding as a result of certain storms or tidal events.

- Short Term Recommendations are lower cost recommendations that can be easily implemented in next few months
- Develop program to clean and TV inspect a portion of the drainage system on an annual basis. The program can be a reoccurring program phased over several years
- Adopt an ordinance requiring new site plans and subdivisions to provide a fair share contribution towards offsite drainage improvements

Short Term Recommendations (cont.)

- Develop program to inspect and maintain existing drainage outfall pipe with Flap Valves before and after each major storm
- Educate residents of the impact of tidal flooding and protective measures that can be implemented to minimize impacts to their properties
- Work with realtors to educate through handouts and information sessions all new residents on the flooding impacts
- Encourage residents to assist with regular inspections of inlets and outfalls on private property and strive to minimize disruptions



Long Term Recommendations

- Long term recommendations can be implemented over a period of years depending on the availability of funding
- Replacement of existing drainage outfalls identified as being under capacity
- Based on 2018 construction costs, we estimated the replacement of 24 outfalls to be approximately $1.63M total. The implementation of these improvements may be phased over a number of years
  - Outfall pipe with flap valve and chamber
  - Each replacement requires NJDEP and ACOE permits
    - Permits good for five (5) years
    - Depending on funding, this process could take several years (multiple permits) to replace
  - Requisition of easements if one does not exist

Long Term Recommendations (cont.)

- Summary of recommendations provided to Borough Commissioners for implementation as part of the annual capital project
- Replace overcapacity outfalls with larger pipes
- Due to site constraints a larger pipe having sufficient capacity might not fit
- In those instances the pipe will be replaced with the largest pipe possible while maintaining positive pitch
- Some instances larger pipe and altered inverts still failed to provide sufficient capacity
- Back pitched outfall pipes were evaluated for slope modification
- Detailed summary of each deficient outfall recommendation was provided and prioritized

Recommendation Example

Over Capacity Outfall	Street	Recommendation	Const. Cost	Eng. Cost	Cost of Rec.
Outfall 5	Monmouth Parkway	Increase pipe size from 16-inch DIP to 20-inch DIP to increase the capacity for the 2-year storm. However, the outfall pipe size is not adequate and is over capacity for the 2-year storm. Additionally, the upstream invert of the pipe cannot be increased to bring the pipe to capacity or decreased to install a larger pipe.	$33,000.00	$7,000.00	$40,000.00
Outfall 7	Central Road	Increase pipe size from 16-inch DIP to 18-inch DIP pipe to increase the capacity for the 2-year storm. However, the outfall pipe size is not adequate and is over capacity for the 2-year storm. Additionally, the upstream invert of the pipe cannot be increased to bring the pipe to capacity or decreased to install a larger pipe. Approximately 250 linear fear of bulk head at this location needs to be repaired since as of now the tide leaks in through the bulk head	$495,000.00	$100,000.00	$595,000.00

Questions?

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