

**FLOOD MITIGATION STUDY**

**CITY OF SEA ISLE CITY**

**CAPE MAY COUNTY, NEW JERSEY**



**MC PROJECT NO. SIC163**

*Prepared By*

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## **I. INTRODUCTION**

Sea Isle City is a barrier island community located in Cape May County, New Jersey. The City is located on Ludlam's Island, which is also known as Ludlam's Beach and shares this island with the Strathmere Section of Upper Township.

Sea Isle City encompasses over 1,400 acres of land and water on the eastern coast of Cape May County. The City is bordered on the west by Ludlam's Thorofare and Ludlam Bay, on the south by Townsends Inlet and on the north by Strathmere.

The entire City is located east of the Intracoastal Waterway on land which is a typical barrier island characterized by sandy soils, beaches, dunes, tidal flats and wetlands. The entire island, and therefore, the City itself, is subject to storm related flooding. The City is densely developed, and those areas not developed are beach, wetlands or are under water.

Flooding issues, particularly bay flooding issues, have become more problematic in recent years. The City's Planning Board in its 2017 Master Plan Re-examination Report recommends that the City work with Federal and State governments to address bay flooding solutions. The Planning Board also recommends that the City implement a comprehensive Flood Control Plan in partnership with Cape May County to address flooding issues. This partnership is necessary since John F. Kennedy Boulevard and the entire length of Landis Avenue are under County Jurisdiction. The report also recommends that the City should prepare a flood area study as a first step in the process.

The City Administration has authorized Maser Consulting to prepare this Flood Mitigation Study following the recommendations of the City's Planning Board.

## II. **PROJECT SCOPE**

The study will include the following three (3) Phases:

- Mapping
- Evaluation
- Preparation of Report

Each Phase will include the following:

### **Mapping**

- Prepare a Map of the City which identifies all storm water structures including outfalls.
- Prepare Topographic Map Overlay to the Storm Structures Map based on information received from Cape May County.
- Prepare a Drainage Area Map Overlay to the Storm Water Structure Map which identifies drainage basins in the City.

### **Evaluation**

- Evaluate topographic information and identify drainage basins within the City.
- Identify agency responsible for maintaining specific storm water systems including outfall. Include this information on Storm Water Structures Map.
- Identify drainage areas which exhibit recurring flooding issues.
- Evaluate causes of area flooding.
- Evaluate possible solutions to flooding problems.

### *Preparation of Report*

- Report to include all items noted in Mapping and Evaluation Phases.
- Report will integrate local problem areas and possible solutions into regional plans.
- Report will include recommendations on possible plans of action.

This study is the first step in identifying specific problem areas and should be considered a planning tool. The City will use this study to develop a partnership with the County. The City will also use this study in order to integrate itself with the New Jersey Back Bays (NJBB) Flood Risk Management Study being undertaken by the U.S. Army Corps of Engineers and the New Jersey Department of Environmental Protection.

### **III. BACKGROUND**

#### **A. Sewerage Infrastructure Improvement Act (SIIA)**

The City's first City-wide stormwater infrastructure mapping was completed in 1990 utilizing funding provided under the Sewerage Infrastructure Improvement Act. This mapping identified stormwater collection systems and located and numbered each storm system outfall structure.

Since the time of the 1990 mapping Sea Isle City and Cape May County have both undertaken extensive projects to upgrade their stormwater systems including pipe replacement with larger pipes and the installation of check valves to prevent bay water from entering the pipe systems at high and storm tides. Therefore, there is a need for updated mapping.

#### **B. Data from Cape May County**

The Cape May County Planning Department, Geographic Information System Department has provided topographic information which has been utilized in preparing this study. This information has been provided by Leslie Gimeno, Planning Director and Brian O'Connor, GIS Specialist.

#### **C. Historical Development of Sea Isle City and the Stormwater System**

Sea Isle City was founded in 1882 by Charles K. Landis. Development first occurred along the beachfront and the main road, Landis Avenue. As development continued over the years the areas west of Landis Avenue also developed.

The beachfront area is higher in elevation than Landis Avenue. Central Avenue, which lies to the west of Landis Avenue, extends from 29<sup>th</sup> Street to 84<sup>th</sup> Street and was generally developed at a higher elevation than Landis Avenue. Due to these conditions the beachfront area and the Central Avenue areas slope toward Landis Avenue, which is under Cape May County Jurisdiction. Therefore, rainfall is generally carried from the beachfront and Central Avenue areas to Landis Avenue and is collected in the stormwater system which Cape May County has developed over the years.

The entire Cape May County stormwater system discharges stormwater to the back bay areas. This is accomplished thru a series of pipe systems which extend down various side streets, such as 63<sup>rd</sup> Street, cross Central Avenue and then discharges to the marsh area lying to the west of Central Avenue. This is the general pattern from 48<sup>th</sup> Street south to 84<sup>th</sup> Street. North of 48<sup>th</sup> Street the County's system extend to the west of Park Road, Cini Street and Kneass Street and then discharges to either the City's lagoon system or the back bays.

Over the years the City has at certain locations connected its stormwater collection systems to the County's systems. Therefore, the systems have become interconnected within certain areas, but the main line system and outfall structures remain under the jurisdiction of the County. Therefore, a partnership with the County in addressing flood related issue is necessary.

#### **IV. STORMWATER STRUCTURES MAP**

This report includes a map of the City which identifies all stormwater structures including outfalls. The SIIA map of 1990 has been updated to reflect all stormwater system improvements which have been made by the City and County since that time. This has been accomplished by reviewing the historical record of construction plans as prepared by the Municipal Engineer and County Engineer. The updated map reflects improvements and changes made thru June of 2018.

The upgraded map reflects pipe systems and outfalls which have been abandoned and which have been replaced by new systems and outfalls. We have retained the abandoned systems on the map for reference but have indicated that they have been abandoned.

The maps include pipe size in inches, pipe material, direction of flow, outfall locations, and check valves were present. The pipe material information from the 1990 SIIA mapping was based on field observations which at times was made under difficult conditions, such as water in the systems, recessed pipes under manhole openings, and depth of manhole. Therefore, similar type pipe materials, such as reinforced concrete pipe (RCP) and asbestos cement pipe (ACP), were sometimes misidentified.

The map also includes the agency responsible for the maintenance of the pipe system and outfall. The County's systems are identified. The County is responsible for the mainline system and the outfall, with the understanding that the City's interconnecting pipelines are the City's responsibility. The systems which are completely City systems are so identified.

## V. TOPOGRAPHIC MAP

Topographic information has been provided by the Cape May County Planning Department, Geographic Information Systems division, and has been overlaid onto the Stormwater Structures Map. The resulting Topographic Map covers the entire City. The following note appears on the Topographic Map and explains how the information was generated:

**Topographic information as shown has been provided by Cape May County Geographic Information System Department. The contours were created utilizing ArcGis advanced with 3D Spatial Analysis utilizing a Lidar created digital elevation model with a NAVD 88 datum and is accurate vertically to 0.13m (5") with a 95% confidence level.**

Maser Consulting has checked the generated topographic elevations against our survey data from construction projects and have found the generated data to be consistent with our survey data.

The Topographic Map contains various contour lines. A contour line is defined as a line connecting the points on a land surface that have the same elevation. These lines are then numbered with that same elevation. For example, the Topographic Map indicates an elevation 9 at the intersection of 83<sup>rd</sup> Street and Pleasure Avenue. This indicates that the land surface at that location is 9 feet above the reference elevation of 0.00 which is commonly referred to as Sea Level based on the 1988 NAVD datum. The Topographic Map indicates an elevation 3.8 at the intersection of 38<sup>th</sup> Street and Sounds Avenue. The difference in the elevations at these separate points in the City illustrates the differing topographic character within the City. While elevation 9 is not high when compared to elevations found in the mainland communities of Cape May County, it is high relative to the elevation 3.8. The lower elevation is more susceptible to flooding than the higher elevation.

A review of the Topographic Maps indicates areas which are at low elevations and, therefore, which are more prone to flooding conditions.

Some of these areas are as follows:

- 32<sup>nd</sup> Street and Landis Avenue
- 34<sup>th</sup> Street and Landis Avenue
- 38<sup>th</sup> Street at both Sounds Avenue and Kneass Street
- 55<sup>th</sup> Street and Landis Avenue
- 46<sup>th</sup> Street and Central Avenue
- 47<sup>th</sup> Street and Landis Avenue
- 72<sup>nd</sup> Street and Landis Avenue

The topographic data indicates how the land surface is sloped. This data has been utilized to identify the various drainage areas within the City. Drainage areas will be addressed in the next section of this report.

## **VI. DRAINAGE AREA MAP**

The area tributary to any point under consideration in a storm sewer system must be determined. The topographic information found on the Topographic Maps has been used to determine these tributary areas. Drainage Area Maps have been generated using this data.

The Drainage Area Maps have been developed and overlaid onto the Stormwater Structures Maps. We have designated each tributary area as a Drainage Area and have used the symbol **DA** to signify the various drainage areas. We have identified each specific Drainage Area by using the Outfall Pipe Number associated with that particular drainage area. For example, Drainage Area – DA 46 is the drainage area associated with outfall structure OF-46. Storm sewer runoff from the land surface within DA 46 ultimately discharges into the back bay thru OF-46. This particular system is the responsibility of Cape May County.

We have not designated Drainage Areas in the Lagoon Section of the City which consists of 47<sup>th</sup> Place, 46<sup>th</sup> Place, 45<sup>th</sup> Place, 44<sup>th</sup> Street west of Park Road, Venician Road and 43<sup>rd</sup> Place. These areas have multiple small stormwater collection systems which are not interconnected and which service small drainage areas. The stormwater collection and outfall structures in these areas are noted on the Stormwater Structures Map. While not given specific drainage area designations due to their small size, these areas will be included in the possible solutions and recommendation section of this report.

The area along Landis Avenue north of 20<sup>th</sup> Street has also not been broken down into separate drainage areas. The collection systems and outfalls within this area are the responsibility of Cape May County and Sea Isle City has no storm sewers which interconnect with County systems in the area. Therefore, the City has no direct involvement with these systems. While not given specific drainage area designations, these areas will be included in the possible solutions and recommendations section of this report relating to Cape May County.

The area along Central Avenue from 31<sup>st</sup> Street to 29<sup>th</sup> Street has also not been broken down into separate drainage areas. The three (3) pipelines under Central Avenue were constructed in the 1970's to return tidal flow to the area east of Central Avenue between 31<sup>st</sup> and 777729th Streets, under an agreement with the Army Corps of Engineers. Tidal flow into this area cannot be disturbed under this agreement. We are recommending no changes to this existing condition.

## **VII. IDENTIFICATION OF RESPONSIBLE AGENCY**

The stormwater collection system in the City is extensive as indicated on the Stormwater Structures Map and is not an interconnected system. Some collection systems service small drainage areas, while others service large areas.

We have indicated agency responsibility on the Stormwater Structure Map and the Drainage Area Map. Many of the systems are clearly the sole responsibility of the City. However, even in some of these cases runoff from a County road enters the City's system. An example of this is the collection system on 87<sup>th</sup> Street which is a City system, but which receives runoff from Landis Avenue.

We have indicated on the Maps the systems which are the responsibility of Cape May County. We indicated previously that the main line system and outfall is the responsibility of the County. The City has connected the City's collection system into the County system at certain locations over the years. An example of this is the system which services Drainage Area 15 (DA-15) which is the largest drainage area in the City and which services the land area from 44<sup>th</sup> Street to 37<sup>th</sup> Street and from the Promenade west to Park Road and Cini Street. While the outfall 15 and the main line system is the responsibility of the County, the City has connected its stormwater systems on Pleasure Avenue, Central Avenue, 44<sup>th</sup> Street and 43<sup>rd</sup> Street to the County system. This is only one example of many interconnections throughout the City.

These system interconnections highlight the need for the City to develop a partnership with Cape May County to address bay flooding conditions.

The stormwater systems for which Cape May County is responsible include the following systems which are described by street locations, outfall number, presence of check valve (CV) and drainage area number:

<b><u>Street</u></b>	<b><u>Outfall Number</u></b>	<b><u>Drainage Area Number</u></b>
• 1 <sup>st</sup> Street	OF-110	Not Designated
• 4 <sup>th</sup> Street	OF-109	Not Designated
• 8 <sup>th</sup> Street	OF-108	Not Designated
• 12 <sup>th</sup> Street	OF-107	Not Designated
• 16 <sup>th</sup> Street	OF-106	Not Designated
• 20 <sup>th</sup> Street	OF-105	Not Designated
• 24 <sup>th</sup> & 25 <sup>th</sup> Sts.	OF-103	DA-103

<u>Street</u>	<u>Outfall Number</u>	<u>Drainage Area Number</u>
• 27 <sup>th</sup> Street	OF-102	DA-102
• 28 <sup>th</sup> Street	OF-101(CV)	DA-101
• 32 <sup>nd</sup> Street	OF-2(CV)	DA-2
• 34 <sup>th</sup> Street	OF-4	DA-4
• JFK Blvd. West of Cini Street	OF-111	DA-111
• JFK Blvd. Bridge	OF-11	DA-11
• Landis Ave./ JFK Blvd.	OF-15(CV)	DA-15
• Landis Ave./ 48 <sup>th</sup> Street	OF-155(CV)	DA-155
• Landis Ave./ 51 <sup>st</sup> Street	OF-156(CV)	DA-156
• Landis Ave./ 55 <sup>th</sup> Street	OF-35	DA-35
• Landis Ave./ 59 <sup>th</sup> Street	OF-114(CV)	DA-114
• Landis Ave./ 63 <sup>rd</sup> Street	OF-39(CV)	DA-39
• Landis Ave./ 69 <sup>th</sup> Street	OF-41	DA-41
• Landis Ave./ 72 <sup>nd</sup> Street	OF-43(CV)	DA-43
• Landis Ave./ 75 <sup>th</sup> Street	OF-158(CV)	DA-158
• Landis Ave./ 79 <sup>th</sup> Street	OF-46	DA-46
• Landis Ave./ 90 <sup>th</sup> Street	OF-53	DA-53
• Landis Ave./ 93 <sup>rd</sup> Street	OF-115	DA-115

City stormwater systems interconnect to the County systems at many locations and this is illustrated on Drainage Area Maps A thru E.

All other outfalls and drainage areas are the responsibility of the City.

## **VIII. CAUSES OF AREA FLOODING**

The issue of flooding is an issue shared by all barrier island communities in New Jersey. The general causes of flooding within these communities can be attributed to the following:

- Location in a part of the country susceptible to storm surge caused by Hurricanes and Coastal Storms. These events move large volumes of water onto the land surface.
- Location on a barrier island exposes the City to the first and most forceful impact of the storm event. The barrier island absorbs the storms energy and protects the mainland. However, it does so at the cost of damage to structures and infrastructure.
- Elevation plays a significant role in flooding. Barrier islands are generally flat and low in elevation. Sea Isle City is no exception to this rule. The City does contain areas which are higher in elevation. These areas are less effected by flooding. The areas of the City which are low in elevation experience chronic flooding conditions.

Flooding in low lying areas occurs due to the following:

- Stormwater collection system outfall structures in areas of low elevation should be equipped with check valves which are sometimes called Flood or Tide Gates. These valves are designed to keep tidal water out of the storm collection system and from over-flowing onto City streets.

The valves operate by water pressure. When tidal waters rise they exert pressure on the valves to close the valves. This effectively keeps tidal water out of the system. However, if a high tidal event occurs at the same time as a significant rain event, such as a hurricane, coastal storm or nor'easter, the check valve will prevent the rainfall runoff from being discharged at the outfall and the rainwater will fill the pipe system and then will overflow and flood the street area. The stronger the rain event and the longer the high tide event the more severe the flooding.

- High tidal events are at times so severe that tidal water will flow over tops of curbs onto the street surface. These events flood and cover the salt marsh creating the appearance of one large body of water extending from the back bay area to the Garden State Parkway. These events could also overtop bulkheads which are at low elevations.
- Lack of land buffers between the salt marsh areas and development. Development occurs directly adjacent to the salt marsh or water areas.
- Lack of berms or levees.

**IX. DRAINAGE AREAS WHICH EXHIBIT RECURRING FLOODING ISSUES**

We have identified ten (10) Drainage Areas which experience recurring flooding issues. These areas and the agency responsible for the stormwater system are as follows:

<u>Street</u>	<u>Outfall Number</u>	<u>Drainage Area Number</u>	<u>Agency</u>
• Landis Ave./ 72 <sup>nd</sup> Street	OF-43	DA-43	Cape May County
• Landis Ave./ 63 <sup>rd</sup> Street	OF-39	DA-39	Cape May County
• Landis Ave./ 59 <sup>th</sup> Street	OF-114	DA-114	Cape May County
• Landis Ave./ 55 <sup>th</sup> Street	OF-35	DA-35	Cape May County
• Landis Ave./ 48 <sup>th</sup> Street	OF-155	DA-155	Cape May County
• 46 <sup>th</sup> Street	OF-23	DA-23	Sea Isle City
• Landis Ave./ JFK Blvd.	OF-15	DA-15	Cape May County
• 38 <sup>th</sup> Street	OF-B	DA-B	Sea Isle City
• Landis Ave./ 34 <sup>th</sup> Street	OF-4	DA-4	Cape May County
• Lands Ave./ 32 <sup>nd</sup> Street	OF-2	DA-2	Cape May County

Eight (8) of the ten (10) Drainage Areas include Landis Avenue as part of the Drainage Area, and therefore, are under the jurisdiction of Cape May County. Landis Avenue has been developed over the years at lower elevations than Pleasure Avenue, which extends along the beachfront area, and Central Avenue, which lies to the west of Landis Avenue. The relatively low elevations along Landis Avenue within these Drainage Areas contributes significantly to the incidents of flooding.

Two (2) Drainage Areas which experience recurring flooding are the responsibility of Sea Isle City. These are Drainage Areas DA-23, which includes the 46<sup>th</sup> Street area, and DA-B which is identified as the 38<sup>th</sup> Street area. Both areas are low in elevation.

The 38<sup>th</sup> Street area has experienced chronic flooding. The low elevation of the area and its location adjacent to the marsh areas makes this area especially susceptible to flooding. Flood waters overtop the curbs and low bulkheads in this area and storm sewers overflow during those times when high tidal events occur simultaneously with rain events. The lack of land buffers between the salt marsh and development and the lack of levees contribute to the flooding problem.

The City has taken steps to address flood conditions within the 38<sup>th</sup> Street Drainage Area DA-B. These measures will be reviewed in the next section of this report.

## **X. POSSIBLE SOLUTIONS TO FLOODING PROBLEMS**

Flood risk management is addressed most effectively on a regional basis. We indicated in Section II, Project Scope, that this study was the first step in identifying specific problem areas and that the study would be used to develop a partnership with Cape May County. The City also intends to use this study as part of its involvement with the New Jersey Back Bays (NJBB) Flood Risk Management Study being performed by the U.S. Army Corps of Engineers and the New Jersey Department of Environmental Protection.

The NJBB FRM Study is considering a full array of coastal storm risk management measures for possible implementation. These measures include structural, non-structural, and natural and nature-based features. Appendix A is a list of individual management measures.

Sea Isle City has already implemented many of the management measures. These include:

### **A. Structural**

- Low-Profile Groins on Ocean Front
- Bulkheads along Ocean Front & at Back Bay Street Ends
- Check Valves on Selected Outfall Structures
- Beach and Dune Restoration along Atlantic Ocean Shorefront.  
This work has been ongoing for over 50 years with the help of the NJDEP, and has been recently taken over by the Army Corps of Engineers when the City became part of the Federal Program.
- Stormwater System Improvements
- Berms and Levees – Berm Construction along 38<sup>th</sup> Street, Sounds Avenue and Kneass Street

### **B. Non-Structural**

- Acquisitions
- Early Warning Systems
- Elevating Structures
- Floodproofing
- Public Engagement and Education
- Emergency Response Systems
- Building Codes and Zoning
- Hazard Mitigation Plans

## C. Natural and Nature-Based Features

- Vegetated Dunes and Beaches

The title of this study, Flood Mitigation Study, accurately depicts the flooding situation on barrier island communities. We cannot stop flooding. What can be done is to mitigate or reduce the risk of flooding and reduce the adverse impacts caused by flooding. Sea Isle City has implemented many management measures already as described above. We are now recommending that the following additional measures be considered to further advance the City's management program:

- **Stormwater Pump Stations to be located within the drainage areas which experience recurring flooding.**
- **Placement of Check Valves on all outfall structures.**
- **Placement of berms along street areas which are adjacent to salt marshes and are in low lying areas.**

### 1. Stormwater Pump Stations

These facilities will not prevent flooding. They will enable the removal of flood waters at a higher rate. They will also reduce street flooding at times of simultaneous high tidal events and significant rainfall events by enabling the removal of rainwater when check valves are closed.

The City is in the process of constructing a Stormwater Pump Station to service the DA-B Drainage Area, and which will be located at the street end of 38<sup>th</sup> Street. The system consists of an underground Diversion Chamber which will divert stormwater from the stormwater collection system and channel it to the Pump Station. Due to spatial limitations the pump station will also be underground and will utilize submersible pumps to remove flood waters and discharge these waters to the back bay adjacent to 38<sup>th</sup> Street. The pump station will be equipped with three (3) twenty-five (25) horsepower pumps. The electric controls to operate the pump station must be elevated above elevation 11.0, the City's Base Flood Elevation, and will be placed on an elevated platform.

The other nine (9) drainage areas identified in Section IX. should be considered for Stormwater Pump Station construction. These drainage areas contain low lying areas which experience chronic flooding conditions at times of tidal and rainfall events. Locating Pump Stations within certain drainage areas will be challenging due to similar spatial limitations as were encountered with the 38<sup>th</sup> Street Pump Station. However, the use of underground stations with submersible pumps will help to meet this challenge.

Eight (8) of these nine (9) other drainage areas are under the jurisdiction of Cape May County. The City's stormwater collection system in these drainage areas connects to the County system. Therefore, there will be a need for the city and County to work together to design and construct these pump stations.

DA-23 is the responsibility of Sea Isle City. The outfall of this system discharges to Rio Delle Ponte and Rio Dell Luna, the lagoon systems lying to the west of Park Road between 45<sup>th</sup> Place and 46<sup>th</sup> Place. A new check valve and the replacement of deteriorated piping have recently been completed within the past year. This construction has reduced street flooding within this drainage area, the low point of which is located at the intersection of 46<sup>th</sup> Street and Central Avenue. However, during simultaneous high tidal and significant rainfall events this low point in the system will flood due to the check valve being closed by tidal pressure. A pump station within this drainage area would mitigate this situation.

## **2. Placement of Check Valves on all Outfall Structures**

The City's past practice has been to place check valves on City outfall structures where the lowest stormwater inlet in the system was at Elevation 3.25 (NAVD 1988) or lower. Outfalls with check valves for which the City is responsible are located on the maps included with this study.

Due to the rise in sea level and the increase in the frequency of storm events in recent years, we are now recommending that check valves be placed on all outfall structures which do not already have a check valve.

We also recommend that Cape May County install check valves on all of their outfall systems that do not already have check valves. We specifically recommend that the outfall structure which services DA-111 be equipped with a check valve. The main pipeline in this system connects to a stormwater junction chamber located at the intersection of John F. Kennedy Boulevard and Central Avenue at the northwest corner. This pipeline was installed as part of the County's reconstruction of the Boulevard in 2013 and represents a relief storm sewer to the system which services DA-15, the largest drainage area in the city. The mainline storm sewer of DA-111 extends from the junction chamber at John F. Kennedy Boulevard and Central Avenue and runs

along the north side of John F. Kennedy Boulevard crossing Cini Street and Kneass Street and outfalling at OF-111 located beneath the John F. Kennedy Boulevard Bridge. The lack of a check valve on this system permits tidal flood water to enter DA-15 and compromises the functionality of the check valves on OF-15.

### **3. Placement of Berms along Street Areas adjacent to Salt Marshes and are in Low Lying Areas**

Few areas are left in the City where streets are directly adjacent to salt marshes. One such area is 38<sup>th</sup> Street and also Kneass Street. The City has recently installed a berm system along 38<sup>th</sup> Street from a point midway between Kneass Street and Cini Street west to Sounds Avenue, and along Kneass Street from 38<sup>th</sup> Street to 40<sup>th</sup> Street. These areas experienced tidal waters flowing over the curbs onto the street from the adjacent salt marshes when they flood. The construction of the berms have eliminated this condition. The berms consist of an earth core wrapped in a geo-textile to contain the earth and then covered in a layer of 6"-8" broken quarry stone.

Several other areas are adjacent to salt marshes, and although higher in elevation we recommend that similar berms be constructed in the areas which follows:

- 38<sup>th</sup> Street from mid-point where existing berm ends to Cini Street
- Cini Street from 38<sup>th</sup> street to 36<sup>th</sup> street and along street end
- Central Avenue from 35<sup>th</sup> Street to 29<sup>th</sup> Street
- 29<sup>th</sup> Street from Central Avenue to Landis Avenue
- Kneass Street from the existing berm to the Department of Public Works yard area
- Sounds Avenue from the existing berm at 38<sup>th</sup> Street to the northern end of Sounds Avenue

The Sea Isle City Marina Area should also be considered, although berm construction would be difficult. A portion of the marina area is bulkheaded. However, a portion of the Marina Boardwalk is constructed above salt marsh. Flood waters flow over the marsh, under the Boardwalk and flood the surrounding area. The boat ramp area also permits flood waters to flow into the drainage area which is part of DA-112. A berm system for this area would require regulatory permitting due to the proximity of wetlands and construction work would be difficult due to the existence of the Boardwalk and the boat ramp. However, we recommend that berming for these areas be considered.

## **XI. RECOMMENDATIONS AND PLANS OF ACTION**

We have the following recommendations based on the findings of this study:

- **Sea Isle City should continue to implement and monitor the flood risk management measures which are in place.**
- **Sea Isle City should be actively involved in the New Jersey Back Bays Flood Risk Management Study.**
- **Sea Isle City should develop a partnership with Cape May County which would address chronic flooding issues within these Drainage Areas which are the responsibility of Cape May County. Stormwater Pump Stations should be constructed in each of those problem Drainage Areas. Funding for these pump stations should be included in Capital Fund Programs.**
- **Sea Isle City should include funding in its Five (5) Year Capital Funding Plan for the construction of a stormwater pump station to service Drainage Area, DA-23.**
- **Sea Isle City should include funding in its Five (5) Year Capital Funding Plan for the installation of check valves on all City outfall structures which do not currently have a check valve.**
- **Sea Isle City should include funding in its Five (5) Year Capital Plan for the construction of berms along areas which are adjacent to salt marshes and are in low lying areas.**
- **Cape May County should include funding in its Capital Improvement Program for the installation of check valves on all County outfall structures which do not currently have a check valve.**

## **APPENDIX A**

A list of Individual Management Measures being considered in the New Jersey Back Bays Flood Risk Management Study

### **Structural**

- 1) Seawall/Revetment
- 2) Groins
- 3) Detached Breakaways
- 4) Berms/Levees
- 5) Multipurpose Berms/Levees
- 6) Floodwalls and Bulkheads
- 7) Flood/Tide Gates
- 8) Portable Floodwalls
- 9) Portable Berms/Cofferdams
- 10) Storm Surge Barrier
- 11) Road, Rail, or Light Rail Raises
- 12) Beach and Dune Restoration
- 13) Stormwater System Improvements
- 14) Bridge Trash Racks

### **Non-Structural**

- 1) Acquisition/Buyouts/Retreat
- 2) Early Warning Systems
- 3) Elevating Structures
- 4) Floodproofing
- 5) Increase Storage
- 6) Public Engagement and Education
- 7) Relocating Utilities and Critical Infrastructure
- 8) Preservation
- 9) Resilience Performance Standards
- 10) Emergency Response Systems
- 11) Modify/Remove Structures for Better Channel Function
- 12) Design or Redesign and Location of Services and Utilities
- 13) Surface Water/Stormwater Management
- 14) Building Codes and Zoning
- 15) Strategic Acquisition
- 16) Emergency Plans/Hazard Mitigation Plans
- 17) Wetland Mitigation
- 18) Regional Sediment Management (RSM)
- 19) Coastal Zone Management

### **Natural and Nature-Based Features**

- 1) Green Stormwater Management
- 2) Constructed or Rehabilitated Reefs
- 3) Salt Marshes
- 4) Freshwater Wetlands
- 5) Vegetated Dunes and Beaches
- 6) Vegetated Submerged Aquatic Vegetation (SAV), Salt Marshes and Wetlands
- 7) Oyster and Coral Reefs
- 8) Barrier Island Restoration
- 9) Maritime Forests/Shrub Communities
- 10) Living Shorelines