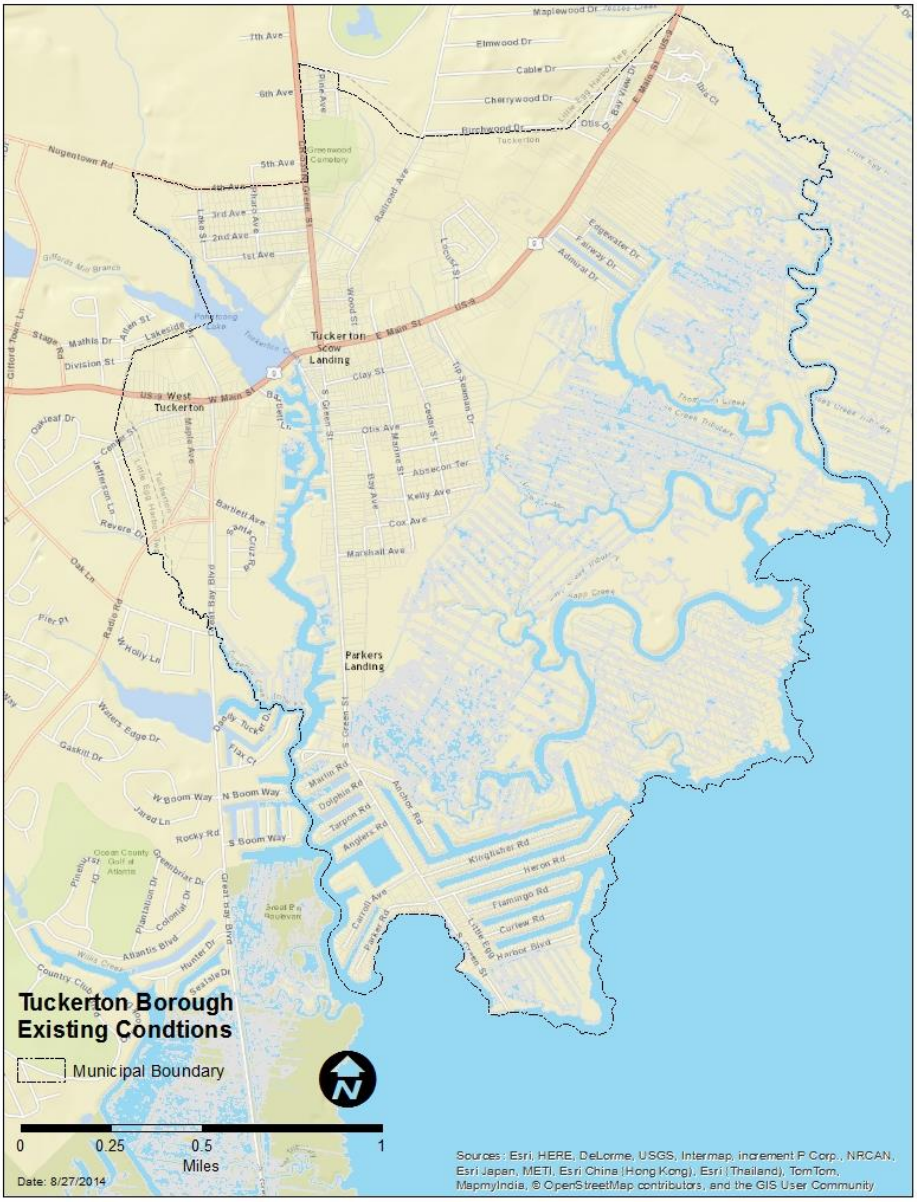
BOROUGH OF TUCKERTON

STRATEGIC RECOVERY PLANNING REPORT


Tuckerton Borough
Existing Condtions
Municipal Boundary
0
0.25
0.5
1
Miles
Date: 8/27/2014
Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Tuckerton Scow Landing
Parkers Landing
West Tuckerton
Nugentown Rd
Maplewood Dr
Elmwood Dr
Cable Dr
Cherrywood Dr
Bayview Dr
Obis Dr
Edgewater Dr
Fairway Dr
Admiral Dr
Railroad Ave
Lecount St
Wood St
Clay St
Otis Ave
Kelly Ave
Cox Ave
Marshall Ave
Absecon Ter
Bay Ave
Cedar St
Maple Ave
Barnegat Bay Blvd
Gaskill Dr
Rocky Rd
Jared Ln
Greenbrier Dr
Colonial Dr
Atlantis Blvd
Hunter Dr
Seaside Dr
Country Club
Kingfisher Rd
Heron Rd
Flamingo Rd
Curlew Rd
Harbor Blvd
Tarpon Rd
Angler Rd
Dolphin Rd
Marlin Rd
Anchor Rd
Carroll Ave
Tower Rd
Little Egg Harbor Blvd
Little Egg Harbor Tnp
Greenwood Cemetery
Gifford Mill Branch
Lake St
Lakeside
Stage
Mathis Dr
Division St
Allen St
Oakleaf Dr
Jefferson Ln
Revere Dr
Oak Ln
Pier Pt
Radio Rd
W Holly Ln
Waters Edge Dr
Barlett Ave
Santa Cruz
Flax Ct
Dally Tucker Dr
N Boom Way
W Boom Way
S Boom Way
Ocean County Gulf of Atlantic
Plantation Dr
Willis Creek
Little Egg Harbor
Tuckerton Creek
Thorofare Creek
Little Egg Harbor Tributary
Little Egg Harbor Tributary
Little Egg Harbor Tributary

BOROUGH OF TUCKERTON
STRATEGIC RECOVERY PLANNING REPORT

ADOPTED MARCH 2, 2015
PER TUCKERTON BOROUGH RESOLUTION #67-15

David M. Kutner, PP, AICP
NJ Professional Planner No.: 33LI00617900

The original of this document was signed and sealed in accordance with New Jersey Law.

RESOLUTION # 67-15

RESOLUTION OF THE BOROUGH OF TUCKERTON, OCEAN COUNTY, NEW JERSEY, APPROVING A STRATEGIC RECOVERY PLANNING REPORT FOR SUBMISSION TO THE NEW JERSEY DEPARTMENT OF COMMUNITY AFFAIRS POST SANDY RECOVERY PLANNING ASSISTANCE PROGRAM AND APPLICATION FOR SUBSEQUENT STUDIES

WHEREAS, the Borough of Tuckerton made application to the New Jersey Department of Community Affairs Post Sandy Recovery Planning Assistance Program for a grant for purposes of preparing a Strategic Recovery Planning Report (SRPR); and

WHEREAS, the Borough was awarded a grant for an amount not to exceed $20,000 for purposes of developing the SRPR; and

WHEREAS, after receiving proposals in response to a duly advertised Request for Proposals, the Borough retained the firm of Princeton Hydro to work in cooperation with the NJ Future Recovery Managers to prepare the SRPR; and

WHEREAS, the proposed SRPR was sealed by David M. Kutner, AICP/PP; and

WHEREAS, the Council is satisfied that all of the post sandy planning concerns have been identified and addressed in the SRPR dated January, 2015;

NOW, THEREFORE, BE IT RESOLVED by the Borough of Tuckerton, County of Ocean, State of New Jersey hereby:

A. Approves the January 2015 Strategic Recovery Planning Report prepared by NJ Future and Princeton Hydro.

B. The Borough is approved to submit the Strategic Recovery Planning Report to the New Jersey Department of Community Affairs.

C. The Borough is permitted to submit applications to the New Jersey Department of Community Affairs for additional planning assistance grants for the studies identified in the Strategic Recovery Planning Report.

D. The Mayor is authorized to execute and the Township Clerk to attest to agreements with New Jersey Department of Community Affairs for additional planning assistance grants identified in Strategic Recovery Planning Report.

RECORDED VOTE:

EDWARDS y SCHWARTZ y COLANGELO y

MATHISEN y SANTO y SHORT y

CERTIFICATION

I, JENNY GLEGHORN, RMC, Clerk of the Borough of Tuckerton, do hereby certify that the foregoing resolution is a true copy of a resolution adopted by the Tuckerton Borough Council at a meeting held on the 2nd day of March, 2015.

JENNY GLEGHORN, RMC
BOROUGH CLERK

Table of Contents

Introduction 1

Chapter 1 Background/Existing Conditions Analysis/Context 2
- **1. Demographics And Housing** 2
- **2. Land Use And Zoning** 3
- **3. Infrastructure And Critical Facilities** 6
- **4. Communications** 6
- **5. Emergency Facilities** 6

Chapter 2 Assessment of Sandy Impacts 8
- **1. Extent of Flooding** 8
- **2. Debris** 10
- **3. Emergency Response and Protective Measures** 10
- **4. Property Damage Overview** 11
- **5. Private Property Damages and Losses** 12
- **6. Public Property Damages and Losses** 13
- **7. Impact on Services and Infrastructure** 16
- **8. Post-Storm Government Operations** 20
- **9. New Jersey Future Local Recovery Manager Program** 20

Chapter 3 Risk Assessment 21
- **Introduction** 21
- **1. Vulnerability** 21
  - A. Flood Zones 22
  - B. Current storm water plans and infrastructure 24
  - C. Federal Recovery Assistance 24
  - D. Critical Services and Infrastructure 27
  - E. Zoning and Land Use 28
  - F. Wetlands Impacts 30
- **2. Inundation Impacts** 30
  - A. Exposure Analysis: 2050 Sea Level Rise Scenario 32
  - C. Exposure Analysis: 2050 Sea Level Rise with 1% Annual Flood 34
- **Conclusion** 37

Chapter 4 Getting To Resilience Process and Recommendations 39

Chapter 5 Assessment of Existing Planning Documents 40
- **1. Master Plan** 40
- **2. Tuckerton Revitalization Plan** 41
- **3. Recovery Management Plan** 41
- **4. Ocean County All Hazard Mitigation Plan** 41
- **5. Tuckerton Municipal Facility Consolidation Plan** 41
- **6. Tuckerton Getting to Resiliency Recommendations Report** 42
- **7. Natural Resources Inventory** 42

8. Stormwater Pollution Prevention Plan 42
9. Borough Emergency Management Plan 42
10. Assessment of Zoning Ordinance for Borough's Recovery Strategies 42
11. Comparison with Regional/State (CAFRA, Coastal Monmouth Plan) 43

Chapter 6 Recommendations for Action 44
Elevate Pump Houses and Equipment 47
Water Supply Infrastructure Study and Replacement of Interconnection with Little Egg Harbor Municipal Utilities Authority....50
Infiltration and Inflow Study of Sewers and necessary Improvements....52
Waterproof Manhole Covers 53
Little Egg Harbor Blvd. Flood Protection Project 54
Crowning of Parker Road 56
Crown Little Egg Harbor Boulevard 56
Extend Barrier into Marsh 57
Dredge Thompson Creek 58
Restore Green Street Park Amenities 60
Buy washed-out Properties 61
Demolition of Police Department....62
Dredging of Paradise Cove 62
South Green Street Plan Beach Nourishment 64

Chapter 7 Implementation Matrix 66

Tables

Table 1: Zoning Districts....5
Table 2: Land Use Type by Flood Zone....23
Table 3: Zoning Districts in AE and VE Flood Zones 29
Table 4: Vulnerable Parcels 2050 Sea Level Rise Scenario 34
Table 5: Exposure Value - Vulnerable Parcels 2050 Sea Level Rise Scenario....34
Table 6: Vulnerable Parcels 2050 Sea-Level Rise with 1% Annual Flood....36
Table 7: Exposure Value - Vulnerable Parcels 2050 Sea-Level Rise with 1% Annual Flood (100% Extinguished Land Value)....36
Table 8: Exposure Value - Vulnerable Parcels 2050 Sea-Level Rise with 1% Annual Flood (50% Extinguished Land Value)....37
Table 9: Exposure Value - Vulnerable Parcels 2050 Sea-Level Rise with 1% Annual Flood (0% Extinguished Land Value) 37

Figures

Figure 1: Regional Location....2
Figure 2: Generalized Land Use 4
Figure 3:Current Zoning 5
Figure 4: Borough Infrastructure 7
Figure 5: Flood Zones....22
Figure 6: Residential Areas/FEMA Flood Zones 24
Figure 7: NFIP Payouts 25

Figure 8: Public Assistance Payouts 26
Figure 9: Individual Assistance Payouts 27
Figure 10: Services and Infrastructure Impacts 28
Figure 11: Zoning and Flood Zones 29
Figure 12: Tuckerton 2050 Sea-level Rise 33
Figure 13: 2050 Sea-level Rise Scenario under a 1% Storm Event 35
Figure 14: CAFRA Planning Areas 43

Appendices

Appendix 1: Getting To Resilience Report Recommendations I
Appendix 2: FEMA Flood Zones Definitions XXVIII
Appendix 3: inundated Roadways - 2050 Sea Level Rise with 1% Annual Flood Scenario XXX
Appendix 5: Pre-Sandy Federal Recovery Assistance Payout Maps XXXI

NOTE*: The figures and tables presented in this report have been developed and should be used exclusively for Planning Purposes only*

A Note of Appreciation
Members of the Little Egg Harbor Township/Tuckerton Borough
Joint Steering Committee

This report would not have been possible without the guidance, insights and active participation of the ***Little Egg Harbor Township/Tuckerton Borough Joint Steering Committee***. Following are the names of the members of the Committee:

Lisa Auermuller ..... Jacques Cousteau National Estuarine Research Reserve
Sam Colangelo ..... Tuckerton Borough Council
Jim Edwards ..... Tuckerton Borough Council
Mark Ellis ..... Little Egg Harbor Codes Officer
Michael Fromosky ..... Little Egg Harbor Township
David Fuller ..... Osborne Island Homeowners Association
Jenna Gatto ..... Jacques Cousteau National Estuarine Research Reserve
Jenny Gleghorn ..... Tuckerton Borough Administrator/Municipal Clerk
Paul Hart ..... Tuckerton Seaport
Chris Huch ..... Jacques Cousteau National Estuarine Research Reserve
John Kehm ..... Little Egg Harbor Township Council
Gene Kobryn ..... Deputy Mayor, Little Egg Harbor Township
Garrett Loesch ..... Business Administrator, Little Egg Harbor Township
John Schwartz ..... Tuckerton Borough Council
Phil Reed ..... Tuckerton Borough Construction Officer
James Edwards ..... Tuckerton Borough Council
Marilyn Kent ..... Tuckerton Beach Association
Susan R. Marshall ..... Mayor, Tuckerton Borough
David McKeon ..... Director, Ocean County Department of Planning
Earl Sutton, Jr. ..... Little Egg Harbor Municipal Utilities Authority
Mark Villinger ..... Principal Planner, Ocean County Department of Planning

Acknowledgments

In developing this report New Jersey Future received invaluable assistance from many individuals who contributed to its preparation. **Leah B. Yasenchak** of Brownfields Redevelopment Solutions, Inc., who also served as the Local Recovery Planning Manager to Little Egg Harbor Township and Tuckerton Borough, was the principal author of several of the report chapters. **Stacy Perrine Krause**, Senior Research Associate; **Jennifer Rovito-Whytalw**, GIS Manager; and **Veda Truesdale**, Senior Research Associate, all of the Environmental Analysis and Communications Group of the Edward J. Bloustein School of Planning and Public Policy at Rutgers University, provided mapping and data analysis supporting the risk assessment. **John A. Miller**, Water Resources Engineer; **Kelly Klein**, Regulatory Compliance Specialist; and **Jessica Jahre**, Planner of Princeton Hydro prepared Chapter 6, Recommendations for Action. **Christiana L. Pollack**, GIS Specialist of Princeton Hydro developed the GIS analysis procedures used to conduct the detailed vulnerability assessment described in Chapter 3.

INTRODUCTION

This Strategic Recovery Planning Report (SRPR) serves as a blueprint to address conditions created or exacerbated by Hurricane Sandy, identify approaches to rebuilding that will be more resistant to damage from future storm events, and encourage sustainable economic growth. Accordingly, the report:

1. Evaluates Hurricane Sandy's impacts on community features;

2. Addresses conditions that Hurricane Sandy created or exacerbated;

3. Describes the existing and potential vulnerabilities that the Borough faces from significant storm events, and sea-level rise;

4. Articulates planning goals, strategies, and actions to improve public safety, develop resistance to future storms, and stimulate economic recovery; and,

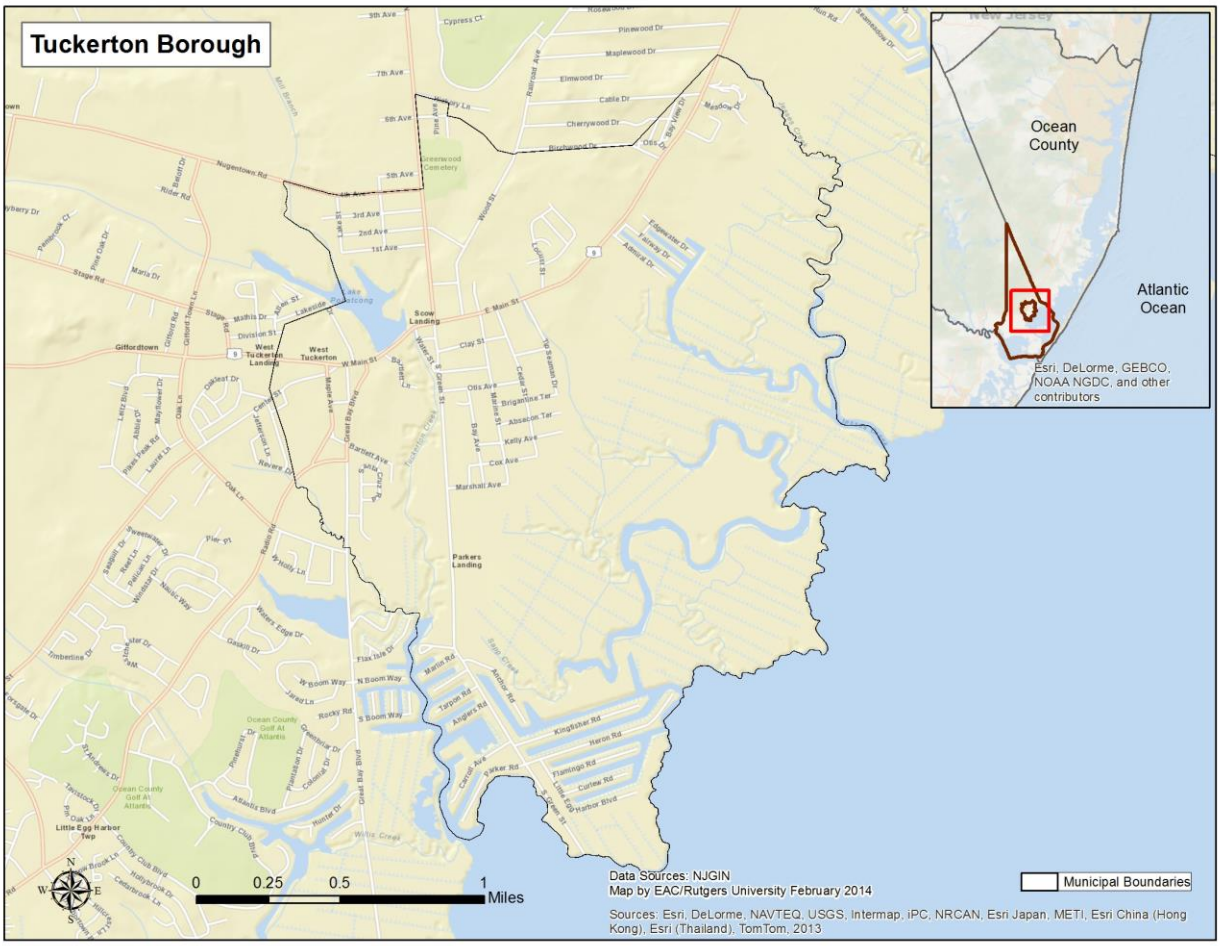
5. Describes each proposed project at a level of detail that:
   - Demonstrates how it relates to the storm's impacts;
   - Explains why it is important to the Borough's economic and environmental health;
   - Lists the major tasks with which it may be associated;
   - Includes an estimation of the cost of implementation;
   - Identifies potential or actual funding sources; and
   - Provides a timeline for implementation.

In the course of preparing this SRPR, the Borough participated in the Getting to Resilience (GTR) process, developed by the NJ Department of Environmental Protection and adapted and enhanced by the Jacques Cousteau National Estuarine Research Reserve (JCNERR). Through this process, the Borough was able to identify specific actions that will enhance long term resiliency in the town. These recommendations are integrated into this Report.

CHAPTER 1 BACKGROUND/EXISTING CONDITIONS ANALYSIS/CONTEXT

The Borough of Tuckerton is located in southern Ocean County. It is bordered on the south, west and north by Little Egg Harbor Township and on the east by the Barnegat Bay. The municipality's coast faces the Tuckerton and Barnegat Bays, several sedge islands, and Long Beach Island at Holgate. It is a community that is nearly completely developed, with the exception of large tracts of preserved open space and meadow/marsh areas. ***Figure 1*** shows the Borough and its regional position.

Figure 1: Regional Location



1. DEMOGRAPHICS AND HOUSING

It is important to note that all the demographic and housing data presented herein is based on pre-Sandy counts. Current, reliable demographic and/or housing unit estimates have yet to be released.

Tuckerton has a higher unemployment rate, a higher poverty rate, and a lower median income than New Jersey state averages. The Borough's pre-Sandy year-round population was 3,378 persons (ACS 2008-2012). Tuckerton's population is comparable in both age and income characteristics to that of Ocean County as a whole. The median age of the residents in the Borough was 42.5 years of age, about on par with the county's median age of 42.7. The median household income in Tuckerton was $60,301 (ACS 2008-2012), while the median household income for the entire county was $61,038 (ACS 2008-2012). Over 97% of the Borough's population was reported as white (ACS 2008-2012).

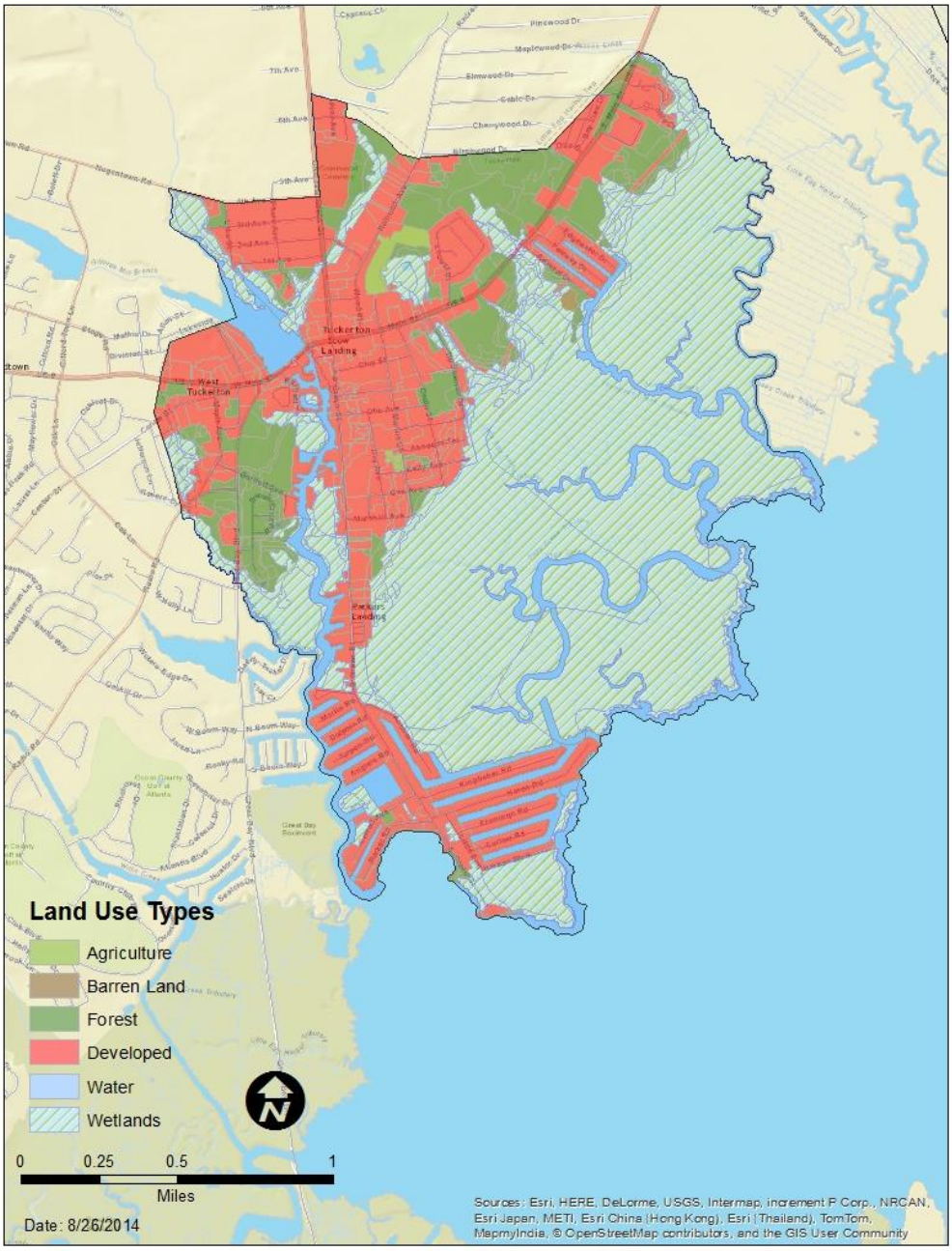
The Borough has a total of 1,902 housing units, 1,396 of which were occupied year-round. Of all housing units (year round and seasonal) pre-Sandy, 73.4% are owner occupied while 26.6% are renter occupied. Of the occupied units, 60.4% were single family detached, 8.1% were single family attached, 1.8% were 2 unit, 3.8% were 3 or 4 units, 9.2% are 5 or more units, 8.9% were 10 or more units, and 7.7% are mobile homes or other housing types (Census 2010). The median value of all owner occupied units was $259,100 (ACS 2008-2012).

2. LAND USE AND ZONING

Prior to the storm, Tuckerton was nearly all built out. Several areas of marshland had been slated for development as lagoon communities, a practice ended with passage of the New Jersey Wetlands Act of 1970. As a result, marsh that had been considered for development is now preserved wetlands, and has become part of the Edwin B. Forsythe National Wildlife Refuge. The Borough is bisected by Route 9 running roughly east/west, and County Road 539 (also known as North and South Green Street) running roughly north/south. The developed portion of the Borough comprises approximately 30% of the area, with 50% wetlands, 10% water, and 10% forest. Commercial areas are concentrated along Route 9, with the remaining development primarily residential.

39% of the Borough is located in flood hazard zone AE, according to the most recent FEMA Preliminary FIRMs, and approximately 32% of the Borough is located in the VE zone. These zones have the highest vulnerability to flood inundation. Flood zones are examined in greater detail in ***Chapter 3, Risk Assessment*** of this Report.

Figure 2: Generalized Land Use

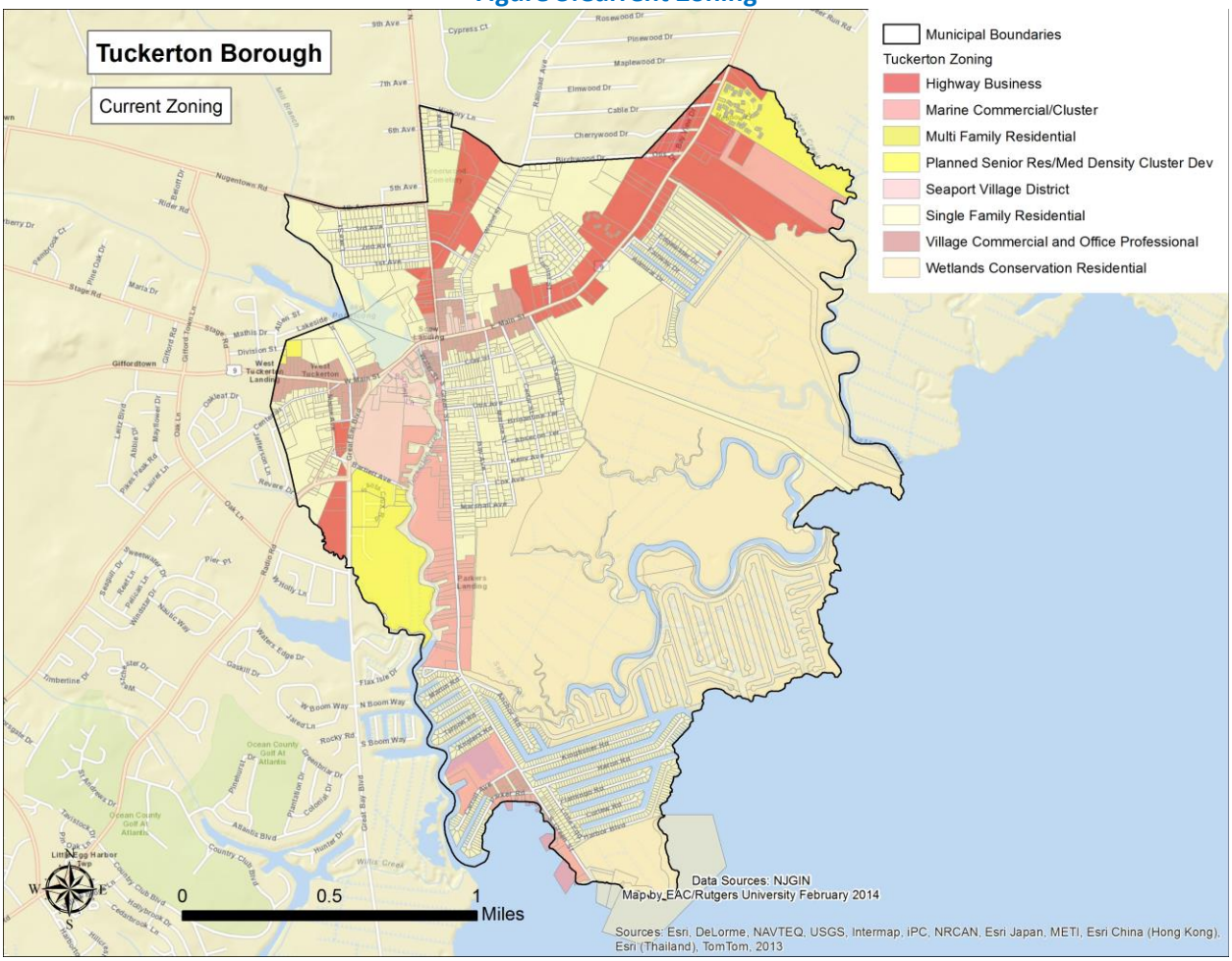


Tuckerton has 12 zoning districts comprising 87% of the area of the Borough, the remainder of which is open water or wetlands (***see Table 1, Zoning, and Figure 3, Current Zoning below***).

Table 1: Zoning Districts

District Name	Description	Total Acres	% of Total
B2	Highway Business	181.8	8.8%
B3	Marine Commercial	108.3	5.3%
B4	Marine Comm/Waterfront Cluster Development	19.1	0.9%
MF	Multifamily Residential	0.2	0.0%
PSC	Planned Senior Res/ Med Density Cluster	105.8	5.1%
SV	Seaport Village District	48.3	2.3%
R200	Single Family Residential	123.4	6.0%
R100	Single Family Residential	199.1	9.7%
R75	Single Family Residential	166.8	8.1%
R50	Single Family Residential	109.1	5.3%
B1	Village Commercial and Office Professional	52.5	2.6%
R400	Wetlands Conservation Residential	946.1	45.9%
Total		**2,060.4**	**100.0%**

Figure 3:Current Zoning



3. INFRASTRUCTURE AND CRITICAL FACILITIES

Tuckerton is served by storm sewers and 11 pump stations, and the entire municipality has a central sewer service system, which is connected to the Ocean County Sewage Authority. Sandy knocked out power to the Borough for up to 14 days, rendering the sewage system inoperable. Electricity is distributed by Atlantic City Electric. Natural gas service is provided by New Jersey Natural Gas Company.

Critical Facilities located within the Borough consist of the following:

- State of New Jersey, National Guard Armory
- Ocean County Sewage Pumping Station
- Borough of Tuckerton Water Tower
- Borough of Tuckerton Water Filtration Plant
- Brasil Telecon of America Inc / Globnet

The Borough has a network of stormwater catchment basins, piping and outfalls, consisting of approximately 299 catchment basins and 43 outfalls (30 of which are within the Tuckerton Beach area) all discharging to surface water. In addition, the Borough contains several detention and retention basins scattered throughout the Borough.

4. COMMUNICATIONS

The Borough's main communications center is located at the Police Station with backup communications the responsibility of the Ocean County Sheriff's Office. Police and Fire Departments are responsible for Route Alerting. Emergency Broadcast System, radio, television, and other media warnings are handled by the Ocean County Office of Emergency Management. Electronic paging units are used by the Fire Department and First Aid squad; there is no computerized telephone alert system. The single hazard specific warning/notification system is the Tuckerton Volunteer Fire Department Siren. Radio communications provide a link between the Police, Fire and EMS agencies and adjoining Little Egg Harbor Township, Ocean County Sherriff's Office and Ocean County OEM. The RACES network (backup radio system) is available through Ocean County. The Mayor serves as the Public Information Officer. Media available include:

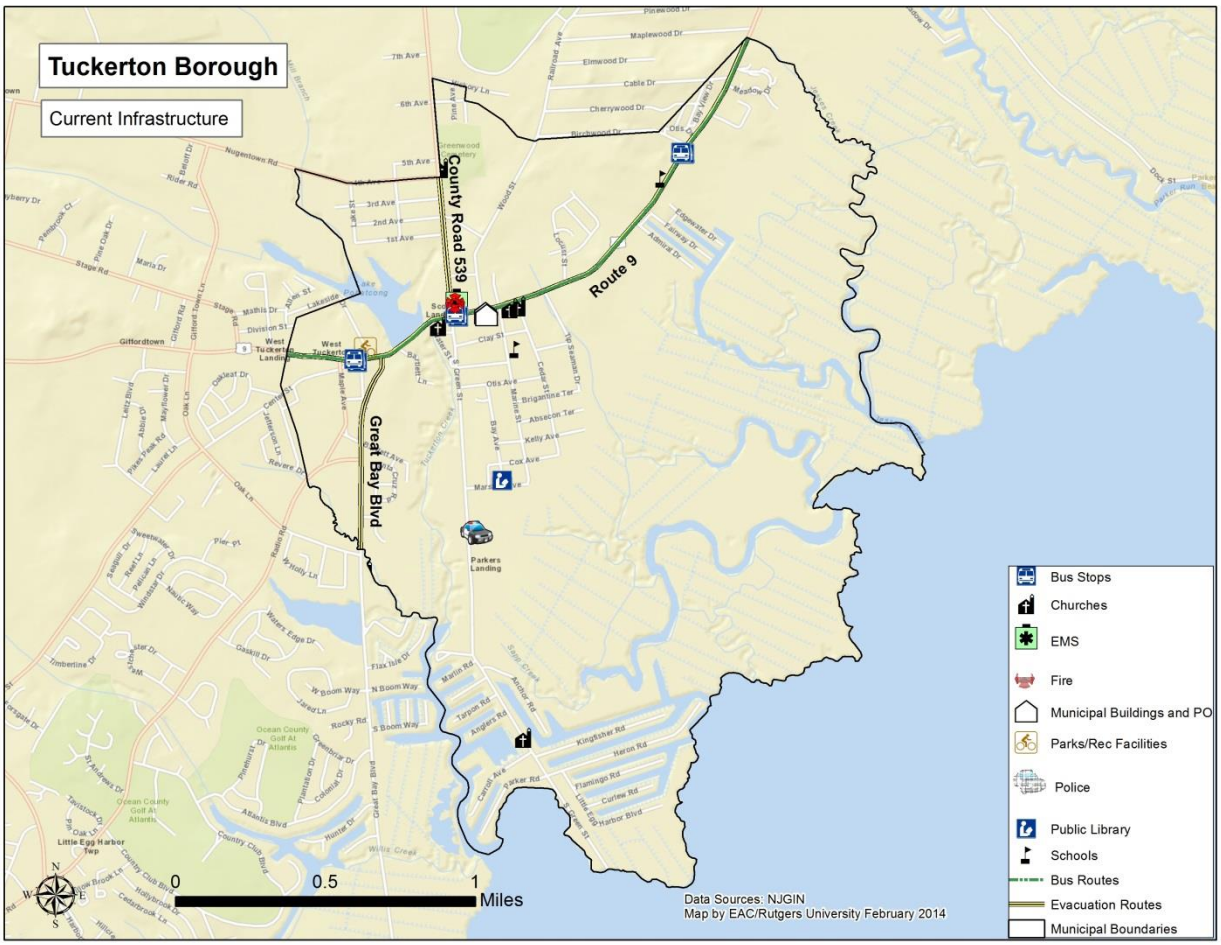
- Tuckerton Beacon Newspaper, Manahawkin, NJ
- Atlantic City Press Newspaper, Manahawkin, NJ
- Asbury Park Press Newspaper, Manahawkin, NJ
- Comcast Cable TV, Manahawkin, NJ
- WOBM Radio, Bayville, NJ
- WJRZ Radio, Manahawkin, NJ

5. **EMERGENCY FACILITIES**

The Tuckerton Elementary School and the Tuckerton Volunteer Fire Department serve as the Disaster Recovery Centers and/or emergency treatment centers for the Borough, with the three major churches serving as secondary recovery centers. The Great Bay EMS, Squad #85 is an independent command organization based in Little Egg Harbor Township, located on Center and Oak Street. Ocean County's Communications Center, located in Toms River, NJ handles all dispatching of personnel and equipment; however a recent shared services agreement with Little Egg Harbor Township has shifted this responsibility to this neighboring municipality. There are no hospitals or nursing homes located in the Borough. Primary evacuation routes are Green Street in a northern direction and Route 9 in a east or west direction. The provision of shelter in emergency situations is the responsibility of the Borough of Tuckerton, supported by the Tuckerton Fire Company #1 and the American Red Cross. A MOU between

Red Cross and Ocean County outlines overall responsibility during major emergencies. The American Red Cross and/or Salvation Army have committed to provide personnel bedding, and clothing to assist those sheltered persons. Fifty persons can be sheltered in Tuckerton Fire Hall, and approximately 250 in the Tuckerton Elementary School.

Figure 4: Borough Infrastructure



Critical infrastructure within the Borough includes six bus-stops, six churches, three community centers, one emergency medical response facility/ fire station, one municipal building and one post office, one park/recreational facility, one police station, one public library, two schools, four miles of bus routes and three miles of evacuation routes.

CHAPTER 2 ASSESSMENT OF SANDY IMPACTS

Assessment of damages was gathered via interviews with Borough officials, site visits, claims data from the National Flood Insurance Program (NFIP) for all properties in the Borough since it joined the NFIP, individual assistance records for Sandy, the project worksheets submitted by the Borough after Sandy for FEMA's Public Assistance program, information provided by Atlantic City Electric Company, and reports and data from USGS, NOAA, and FEMA on Sandy and the recovery process.

Immediately following Hurricane Sandy's landfall in Tuckerton, the Borough faced the following devastating impacts that had to be addressed without delay:

- Large numbers of boats blocked major roadways;
- Mounds of debris had to be removed to make the roads passable;
- Waterway debris poses a safety hazard for residents and boaters;

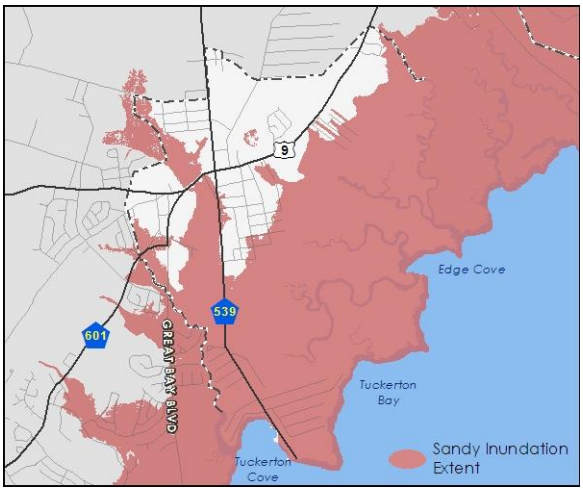
As the Borough addressed the initial impacts from the storm, additional extensive damage to utility services, public buildings and public facilities were identified including: beaches, roads, bulkheads, seawall, and damage to park facilities. In addition to the flooding, damage was caused by sewer overflows, broken sewer lines, failure of pumps, loss of power, and strong winds. Numerous rateables, including restaurants, an oyster farming plant, and marinas were also destroyed. The southern part of the borough, including a principal artery to the most impacted area, South Green Street, was inaccessible for weeks due to flooding and boat pile up. This road was flooded with eight feet of water, dumping many of the boats from the surrounding marinas onto the road, making access to and from the police station impossible.

1. EXTENT OF FLOODING

When the skies finally cleared above the Borough of Tuckerton after post-tropical cyclone Sandy, the waters had covered an estimated 2.43 square miles; 69 percent of the Borough. 1,277 parcels likely experienced some level of flooding, though the impact of this flooding varied widely across the Borough due to structure elevations.

There were 3 water marks in Tuckerton recorded by the United States Geological Survey (USGS) after the floodwaters receded. From these marks and other data, USGS estimated the extent of inundation from Sandy. According to these data, every waterway in the Borough of Tuckerton flooded to some degree. All of the lagoons and streams spilled water onto the adjacent properties.

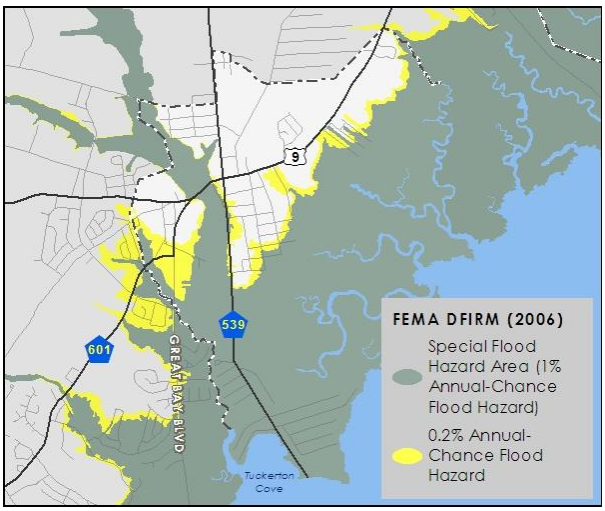
The extent of flooding reached as far north as the wetland area behind the Methodist Church on North Green Street, north of Main Street. The flooding north of Main Street was mostly limited to wetland areas and did not result in any individual assistance claims or National Flood Insurance Program policy claims for property damage. There may have been wind damage north of Main Street, but the data for wind damage on private property is not available at this scale since wind damage is covered through homeowner's insurance.



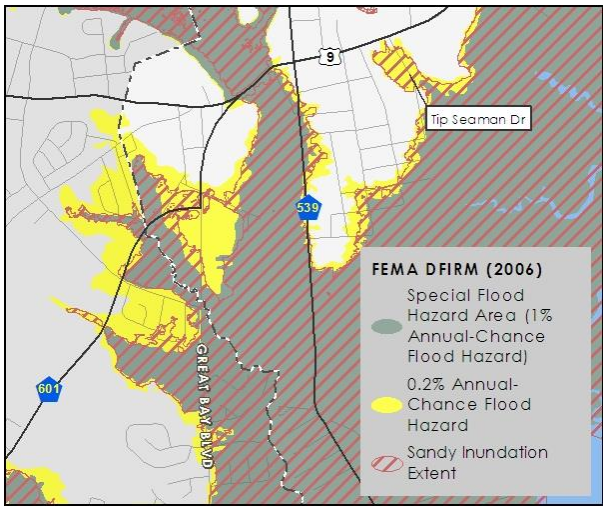
The effective FEMA Flood Insurance Rate Map (FIRM, 2006) at the time of Sandy estimates that 64 percent of the Borough, including marshlands, is in the floodplain. According to the data generated by USGS, Sandy's inundation extended beyond the mapped fringe of the floodplain, as seen in the figure to the bottom right. The flooding between Great Bay Boulevard and

Tuckerton's border extended beyond the Special Flood Hazard Area (100 year floodplain, 1% annual chance flood hazard), as it did near Tip Seaman Drive and in Paradise Cove area.

Sandy also exceeded the effective FIRM in flood elevations. In at least two locations, recorded by USGS, within the Borough the floodwaters from Sandy exceeded the base flood elevation assessed by FEMA. The best available data at the time of this report for the Borough is the Preliminary FIRM with new elevations and a change in zones, to reflect the current vulnerability of Tuckerton's coast.



The U.S Geological Survey (USGS) quickly records high water marks since the indications are transitory. The image to the below shows a clear line of debris left on a wall as the flood waters receded. This image is from a property on South Green Street between Flamingo Road and Curlew Road. The water line is 4.8 feet above the ground, and .8 feet above the FEMA base flood elevation for the effective FIRM at the time of Sandy. Since Sandy, FEMA has released a new flood study with new elevations. The elevation for this area on the Preliminary FIRM, dated March 28, 2014, is 2 feet higher than the existing FIRM.



USGS: HWM-NJ-OCE-390

The second high water mark on a building in the Borough was further north on South Green Street, near Otis Avenue. This water mark is on a door, 4.9 feet off the ground, which is 1 foot above the base flood elevation established by FEMA on the effective FIRM at the time of Sandy. The new Flood Insurance Study, released March 28, 2014 that accompanies the Preliminary FIRM shows an increase of 1 foot to the existing base flood elevation.

The third mark was a debris line in a gravel lot just south of Main Street in the Tuckerton Seaport and Baymans Museum. The water flooded from the Tuckerton Creek Tributary behind the museum. The debris line indicates that water did not flood Main

Street and the road remained passable. The USGS maps also indicate that the dam remained intact and was not overtopped during this storm event.

Since Hurricane Sandy, FEMA has updated the flood mapping for the Borough of Tuckerton. Currently the best available data are the Preliminary Flood Insurance Rate Maps. The new study and mapping does not incorporate sea level rise, and will not until the national Technical Mapping Advisory Council (TMAC), created by the Bigger-Waters Flood Insurance Reform Act of 2012, issues recommendations to FEMA. Given the extent of damage experienced in Tuckerton because of the strong storm surge, Tuckerton Borough amended its Flood Damage Prevention Ordinance to include three feet of freeboard to account for sea level rise and uncertainty in future conditions.

2. DEBRIS

Following Hurricane Sandy, efforts were made by the New Jersey Department of Environmental Protection (NJDEP) and their designated contractors to perform emergency waterway debris removal and dredging within Tuckerton Borough. Due to the vast amount of storm related flooding and destruction, debris continues to be found in channels, lagoons and marinas throughout the borough. Swimmers using the shallow lagoons are exposed to glass, metal and sharp objects, and boaters continue to find debris in areas previously scanned by NJDEP contractors. Shoaling, previously a problem in the Borough has become a much more serious concern for those navigating Tuckerton's waterways; many channels and lagoons that were barely navigable before the storm are now impassible. In addition, new areas of storm-related shoaling and silting need to be addressed. Marinas will suffer economic consequences if shoaling prevents boaters from using the waterways. The borough was given a deadline of August 15, 2013 to notify the state of any remaining debris. In many instances residents placed stakes in the lagoons to identify areas were debris was still present. However, because the DEP used side-sounding radar to identify the location of debris, it missed much of the debris that fell to the bottom and was silted over. Two years later, debris still remains in the waterways.

Debris was also a major concern along roadways and private property. The Borough needed to have over 16,500 cubic yards of disaster generated debris removed after Sandy. This included over 500 cubic yards of sand, 500 cubic yards of vegetative debris, and over 16,000 cubic yards of debris from houses and structures. These volumes include only the debris from the storm and does not account for all the houses and structures that have since been demolished.

Tuckerton Borough expended $955,616.90 in debris removal in the 30 day period of 10/29/12 through 11/27/12. This consisted of labor costs of $42,357.40 for regular time and $30,241.01 for overtime for a total of $72,598.41, and equipment costs to remove and haul construction and demolition (C&D) debris to Ocean County Landfill totaling $93,880.75. Tuckerton hired two contractors: Corless & Sons and Mathis Construction, to haul and accept 12,565.3 tons of C&D to Ocean County and Hainsport landfills. Costs for tipping fees, disposal, and engineering costs totaled $681,878.00. Corliss & Son was also hired to repair the parking lot from damages caused by temporary C&D storage at a cost of $1,400.00 Additional costs included materials for the parking lot repair and the removal of sand from the sanitary sewers.

Storm generated debris was deposited by wind and water action inside a commercial mobile home park located within the Borough's boundary. The Borough of Tuckerton and commercial mobile park owner identified an estimated: 107 cubic yards of vegetative debris, 64 cubic yards of construction and demolition debris, 1 unit classified as white goods, 2 trees classified as leaners, 7 branches classified as hangers, 12 gallons of Hazardous Material, 3 tires, and 1 boat. Municipal officials report that a year and a half post Sandy the mobile home park remains at only half capacity.

3. EMERGENCY RESPONSE AND PROTECTIVE MEASURES

The Borough took a proactive approach and issued a voluntary evacuation warning on October 28th for all residents. By 3:30pm that day, the Borough issued a mandatory evacuation order for all Tuckerton

Beach residents. Most individuals heeded the warnings and retreated to higher ground. However, some individuals chose to stay in the Tuckerton Beach area to weather the storm. Through an agreement with Little Egg Harbor, a shelter was set up for residents of both municipalities at the local junior high school. Throughout the storm and in the recovery response that followed, Borough personnel directed traffic, cleared roadways of debris, maintained emergency communication operations, performed protective patrols, search and rescue operations, emergency medical care, and wellness checks on residents. Staff put in a total of 717.5 overtime hours in order to provide these services to residents during and after the storm.

Only South Green Street connects the northern areas of the Borough to the properties in the Tuckerton Beach area. During Sandy the Borough reported 4 feet of water on South Green Street, making it dangerous for any vehicle to pass. Due to the extent of flooding and the limited access of the Tuckerton Beach during Sandy, the Borough was limited in its ability to rescue individuals who did not heed the warnings. Fortunately, the situation did not result in any fatalities. A storm the significance of Sandy is not the only concern for the Borough.

Accessibility in Tuckerton during a tidal event or storm event is a concern due to the limited access to the Tuckerton Beach area. During conditions just above high tide, there is often six inches of water on these roads, which occurs about six times a year.[i] This growing problem is the result of the roadway beginning to subside into the marsh mat under the road subgrade. The Borough reports that this subsidence problem has been more significant since Sandy.

Although floodwaters did not cross Main Street, they covered critical routes through the Borough. The Borough reports having driven public vehicles through 4-feet of water to execute emergency management and protective measures. The following two vehicles owned and maintained by the Borough of Tuckerton were damaged and were total losses: one 1993 Ford 4x4 F-250 truck belonging to the Public Works Department and one 2003 Ford Crown Victoria belonging to the Police Department. In addition, the following three vehicles parked inside the Public Works parking area were inundated by contaminated salt water and were total losses: one 1992 Ford 4x2 F-250 truck, one 2000 Ford Contour SVT, and one 1995 Ford 4x2 F-150 truck. These were not registered at the time of the storm and thus eligible for public assistance funds.

4. Property Damage Overview

The aerial extent and depths of the storm tide give an idea of how Sandy impacted the Borough, to a degree. But these numbers do not capture the energy of the storm surge during Sandy. The magnitude of the wave action during Sandy is represented by the damage realized to the infrastructure throughout the town. Sandy tore houses from foundations, deposited debris and structures on neighboring properties across the Borough, and damaged critical infrastructure.

Including National Flood Insurance Claims, Individual Assistance Claims, and Public Assistance Claims, the damages from Sandy throughout the Borough exceeded $39 million. These are just reported claims for FEMA assistance programs; they do not include the Small Business Administration programs that helped businesses and homeowners in the Borough with loans to assist in recovery from the storm. They also do not include claims from homeowners that

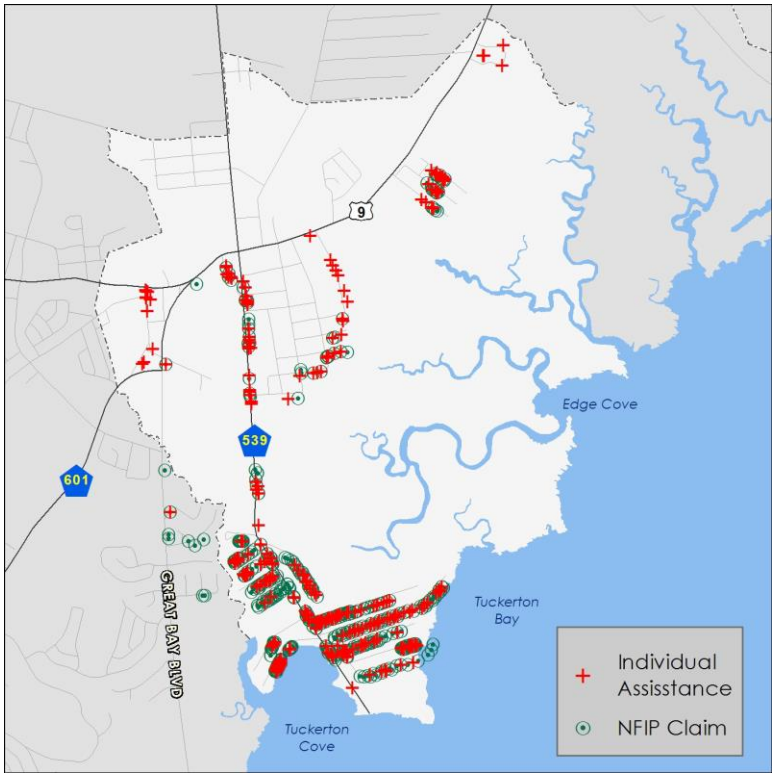
are related to wind damages or damages that were paid out of pocket by residents and businesses in the Borough. The storm was the most devastating and costly ever experienced by the Borough. Total damage magnitude can only be estimated in the scope of this SRPR.

5. Private Property Damages and Losses

The greatest impact from Sandy in the Borough of Tuckerton was the extensive property damage that occurred from the storm surge. Homes that had never been flooded took on water. After Sandy, individuals filed 470 flood insurance claims with the National Flood Insurance Program. Prior to Sandy, only 416 claims had been filed since 1977. No single event came close to generating the number of claims seen in Sandy. In December 1992, a Nor'easter caused extensive flooding and resulted in 139 claims within the Borough of Tuckerton. This was the largest storm to hit the Borough since it joined the NFIP in 1977 and it generated less than 30 percent as many claims as Sandy.

The extensive damage experienced in Sandy is evident in both the number of homes affected, as well as the value of the claims filed. The total flood insurance claim value for Sandy was over 34 million dollars, which is 87 percent of total paid losses to residents since joining the NFIP. Additionally, residents filed for over $3,716,400 in individual assistance. Individual assistance is offered to individuals who do not have a flood insurance policy and who suffered damage from the storm. Limited Individual Assistance payments are intended to perform minor repair to houses, provide temporary housing needs or other needs directly related to the damages caused by the storm. For individuals with insurance coverage, they are required to pay back the assistance upon receiving their insurance claim. For individuals without insurance coverage, the maximum FEMA provided for home repair in 2012 was $31,900. Fourteen individuals in the Borough received this maximum. As of August 31st, 2014, 574 buildings in Tuckerton have flood insurance with an average annual premium of $867. This premium average is low in comparison to other coastal communities and signifies the high percentage of primary residences in the Borough. The Homeowner Flood Insurance Affordability Act passed in 2014 changes some of the provisions of the Bigger-Waters 2012 flood insurance reform and will slow the increases of premiums in the Borough especially with respect to change in ownership.

As shown on the following map both the claims for the NFIP and individual assistance were heavily concentrated in the Tuckerton Beach area. The area south of 409 South Green Street accounted for just over half the individual assistance claims filed within the Borough and over 400 NFIP claims filed in the Borough during Sandy. This is over 85 percent of the total NFIP claims filed for the storm.



After the Borough was able to assess properties that had been damaged in the storm, the construction office estimated that 33 homes in need of repair had been substantially damaged. Residents in many neighborhoods were forced to vacate for four to six weeks before they were allowed to return to assess the damage. One year after

Sandy, the Borough reported 65 houses had been demolished and 31 houses still needed demolition. Repairs had been initiated on hundreds of houses across the Borough. One year after the storm the construction office reported that 490 building permits had been distributed across the Borough. As of June 17, 2014, 108 demolition permits had been issued by the town, 8 demolition permits were open and 13 demolition permits were pending. The borough has identified eight homes where no activity appears to have taken place since the storm, and demolition is needed. These homes, presumed abandoned, are located on Heron Road (three homes), Tarpon Road (two homes), and Water Street, Clay Street, and South Green Street (one home each). Of these eight abandoned homes, five are listed on the tax rolls with owners residing outside of the area, one of which has a bank listed as the owner. However, the vast majority of impacted buildings have construction activity taking place.

Several private bulkheads in the lagoon communities, particularly in the Tuckerton Beach area, were damaged, along with associated docks and the homes the bulkheads protected. Private owners are working to have repairs made to these bulkheads. Prior to Sandy, the Borough had increased inspections and enforcement of private bulkheads, and streamlined the municipal permitting process. As a result, most privately owned bulkheads were in good repair prior to Sandy. As reported by the Construction Official for the Borough, the average cost to repair a private bulkhead in Tuckerton is $13,000. Twenty-three private bulkheads were repaired in the period between the storm and June, 2014. These bulkheads were located on South Green Street (6 bulkheads), Curlew and Flamingo (three bulkheads on each street), Edgewater (2 bulkheads), and one each on the following streets: Carrol, Tarpin, Angler, Little Egg Harbor Boulevard, Anchor, Marlin, Parker, Heron, and Fairway. Public bulkheads associated with municipal boat slips were damaged at Scow Landing and Willow Landing Docks.

The Borough of Tuckerton experienced significant tax base loss as a result of the damages from Sandy. In 2013 there were 88 parcels that did not have a building assessment, but had an assessed building value prior to Sandy in 2011. All but 4 of these properties are in the Tuckerton Beach area. Almost all of these parcels, 85 properties, had a single family unit on their property prior to Sandy. The total loss of assessment value from these properties since 2011 is $80,318. Other properties in Tuckerton have also seen a reduction in assessed value, thereby reducing the tax base for the Borough. There were 365 properties in the Borough that had a lower total assessment value in 2013 than in 2011. The difference between the total assessed value of these properties between 2011 and 2013 is $24,874,800.

There has been some growth and recovery visible in the assessment data as well. There are 50 parcels that have increased in property or improvement value since 2011. The total increase in assessed value for these properties is $3,426,276. Though this growth does not balance the loss experienced during Sandy, 22 of these properties are in the affected area of Tuckerton Beach, which indicates that some residents have continued to invest in their properties in that area. The remaining properties that have seen improvements in assessment value are spread throughout the Borough, both inside and outside of the Sandy inundated areas.

6. Public Property Damages and Losses

The Borough of Tuckerton has a fire station, municipal building, police station, department of public works facilities, water and sanitary sewer utility, an elementary school, and a coastal learning center.

During Sandy, the Department of Public Works, Police Station, pump stations, and the water and sanitary sewer utility building all experienced damage. All of these facilities were located at in the floodplain at the time of Sandy.

The Borough has since relocated the police department and Borough Hall to a new building at 420 East Main Street. At this time, there are no emergency operation facilities, hospitals, rehabilitation centers, or schools in the floodplain in Tuckerton. Any new critical facilities should be constructed to an elevation above the 0.2% annual (500-year) floodplain with consideration given not only to the structure but to access and services to the building.

The Department of Public Works and the Borough's water and sewer infrastructure remain vulnerable to widespread flooding. The water and sewer utility is assessed in more detail below. The Public Works garage took on 1.5 feet of water during Sandy. Furthermore, because of the garage's proximity to the wastewater treatment plant that was inundated, the floodwaters in the garage were contaminated. This remains a concern as long as the garage is not flood-proofed and the wastewater system is vulnerable to failure during storm events. The Borough could consider moving storage to a higher level and relocating equipment before the onset of an event.

The Borough filed for $1,362,493.42 in Public Assistance after Sandy. These claims represent damage to public buildings, public property, equipment usage, personnel overtime hours, expenses to maintain critical operations, and to remove the debris left behind by the storm. This total excludes damages to unregistered vehicles that were owned by the Borough, as well as damages sustained to public property that did not qualify for public assistance. During Sandy the Police Station, Department of Public Works garage, 6 sanitary sewers lift stations, the Office of Emergency Management and Construction Office, South Green Street Park Facilities, and the water treatment plant all took on water and sustained damage.

The Borough of Tuckerton Police Station flooded during the storm and operations had to be immediately relocated to Borough Hall. After the storm the building remained uninhabitable; the Borough used a trailer until they were able to secure a permanent location on East Main Street. The Borough has also since acquired funding and approval to demolish the old police station. According to the project worksheet, the reimbursement of the damage sustained during Sandy was reduced due to insufficient NFIP coverage for the building. The project worksheet was reduced by almost $50,000 as a mandatory NFIP reduction for public assistance.

Police Station: The Tuckerton Police Department building and storage sheds located at 445 S Green Street were inundated with approximately 22 inches of water outside of the building and 6 inches of water within the buildings. The police station was significantly flooded, and sewage from a septic holding tank from underneath the building backed up and flooded the building, rendering it unusable. The water reached a height of approximately 3 feet around and into the storage sheds on the North and South sides of the building. The two wooden sheds and a plastic shed were total losses, including all contents. The vinyl siding shed on the south side of the building also faced 3 feet of flood waters, and suffered mold damage and destruction of contents. The police were forced out of the building immediately, and during the period directly after the storm, operated out of borough hall. Later, trailers were set up behind the police building, until they could be moved to a new, permanent home in May, 2014.

Department of Public Works: Located on the same property as the Police Station (445 South Green Street) the Borough DPW Garage received up to 1.5 ft. of contaminated water to the point that a fixed gas Heater (80,000 BTU, York-Model# P2UDD12N07601C) and one fixed AC unit(3 Ton, York, AC coil-Model #M3UF0325A) were damaged. The AC compressor unit was outside and the heating unit was inside located in the second floor. None of the units are working. In addition several motors were damaged, and multiple refuse containers were lost and/or damaged. The total damages reported by the

Borough for this building was $25,137.82. However, the Borough had to deduct $3,238.97 from their claim for what would have been covered under flood insurance, had they carried a policy on this building and its contents.

Grist Mill: The construction office and Office of Emergency Management Offices were located at 100 Water Street in the Grist Mill, a historic mill structure. This building suffered flooding during Sandy, but as it was designed to allow flood waters to pass through it, the building was not permanently damaged, though an above ground storage tank was moved off its footings. However, in May, 2014, Tuckerton relocated these offices to a new consolidated municipal facility outside the flood zone. The "Grist Mill," is a historic structure that dates back to 1704 and contains asbestos and potentially mold.

South Green Street Park: The other significant damage to public property occurred at South Green Street Park. Heavy rain and record storm surge associated with this storm system caused severe saltwater flood damage to the Tuckerton South Green Beach Park, with flooding of approximately eight feet. The force of the storm surge destroyed a permanent bathroom facility at this site, washed away the playground fixtures, and changed the shoreline along the beach at the park. The restroom facility was elevated four feet and sustained approximately three feet of interior flooding above the finished floor elevation. In addition, the private clam farm located adjacent to the park was destroyed, and the road and parking lot sustained damage. Tuckerton Beach suffered significant erosion. The image to the right shows the shingles that had been ripped off by the high winds at the park site. The Borough filed for public assistance to help pay for the repairs to the park site. The total damages reported for the park site are $114,801.68. The amount filed for public assistance was $32,176.50 due to NFIP deductions and anticipated insurance proceeds. The bathrooms have been replaced by temporary portable toilets, and the remains of the playground equipment have been removed, leaving the pad.

Since Sandy, with the new Preliminary Flood Insurance Rate Maps, South Green Street Park has been designated a VE zone with a BFE of 11 feet. Any new building constructed on this site would need to comply with FEMA's V-zone construction regulations. The Borough has decided to invest in a trailer instead of a permanent restroom structure. This removable trailer could be relocated prior to a storm event to minimize potential losses.

Roads: Roads were damaged by the storm, by the heavy equipment they were subjected to for debris removal and construction, and by infiltration of sand beneath the roads, which resulted in subsidence of the asphalt. The wind, tidal surges and overland flooding destroyed private structures, uprooted, trees, and deposited vegetative, construction and demolition debris, sand and other debris within the Borough. The Borough estimated that removal of 1 cubic yard of vegetative debris, 68 cubic yards of construction and demolition, 11 items of white goods, and 5 boats was required along roadways and on private property.

According to Bobby Hewit, Supervisor in the Department of Public Works during an interview on June 17, 2014, Parker Road sustained heavy damage, and Little Egg Harbor Boulevard was covered with mud and sand. Roads throughout the lagoon areas are subjected to regular flooding based on moon tides and northeast winds. Within the last 10-15 years, Tarpin, Angler, and Anchor roads were raised approximately two feet to address tidal flooding concerns. Additional roads that would benefit from

raising include Bass Road and Marlin Road, as well as some parts of Kingfisher Road, Little Egg Harbor Boulevard and Heron Road, where settlement is apparent. Curlew Road floods from the storm drain and would also benefit from raising. Carrol Road is in the process of being refinished by Ocean County, and when complete will have been raised a few inches.

Road	Status
Tarpin Road	Raised approximately two feet within last 10-15 years
Angler Road	Raised approximately two feet within last 10-15 years
Parker Road	Sustained severe damage
Little Egg Harbor Blvd	Covered in mud and sand and impassable directly following Sandy; Portions of roadway have settled, raising road is recommended
Anchor Road	Raised approximately two feet within last 10-15 years
Bass Road	Suffers from tidal flooding, raising road is recommended
Marlin Road	Suffers from tidal flooding, raising road is recommended
Kingfisher Road	Portions of roadway have settled, raising road is recommended
Heron Road	Portions of roadway have settled, raising road is recommended
Curlew Road	Flooding during storm events; raising road is recommended
Carrol Road	In the process of being repaved by County, resulting road will be approximately two inches higher than prior to Sandy

Seawall: Tuckerton has a seawall around South Green Street Park that dates to the 1950s. During Sandy, water overtopped the wall and buried the park in an estimated 10 feet of water. The seawall withstood the storm, but sections of it are failing due to rot and infestation and the entire bulkhead is due for refurbishment.

7. Impact on Services and Infrastructure

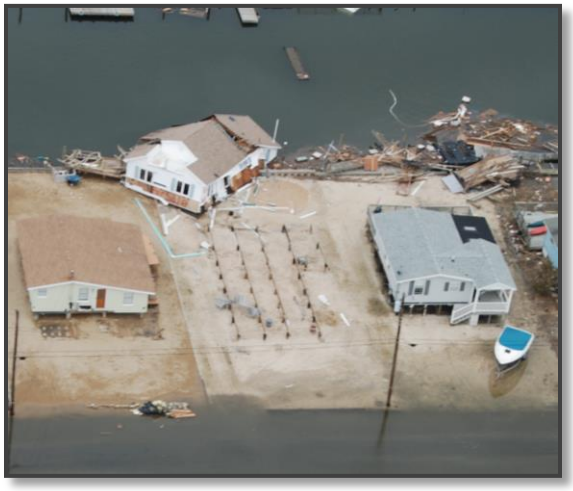
Based on the damages experienced by Hurricane Sandy, the Borough is significantly vulnerable to the impacts of strong storm surges that bring widespread flooding with significant depths. Disruptions in water, sewer, electricity, and gas during Sandy were largely caused by the extensive flooding, displacement of houses, and volume of debris that littered the town. Restoration of services was dependent on the ability of the Borough to access affected properties and inspect the damage, remove debris, and inspect the integrity of the structures within the Borough.

As a result of Sandy, the Borough of Tuckerton experienced disruption in electrical service, water and sewer services, and natural gas. The disruption in services was a consequence of severe flooding, houses being forcibly disconnected from service lines, and precautionary shut-off measures taken by local utility services and the Borough. The water and sewer systems within the Borough experienced damages to their facilities and infrastructure as a result of saltwater intrusion, wave action, and pressure from the storm.

The municipal utility suffered impacts as well, writing off $38,000 in lost utility rents from the mobile home park alone immediately following the storm. The Total Operating Revenue for the utility dropped by $64,366 the year following the storm, and future loss projections are expected to increase.

Electricity: The entire Borough is serviced by Atlantic City Electric. During the storm Atlantic City Electric experienced widespread outages across its service area. The Borough of Tuckerton experienced widespread power outages during and after Sandy. Atlantic City Electric reported the damage to their infrastructure within the Borough of Tuckerton was minimal. Electric service to the borough was interrupted by Sandy, and the entire town was without power for three days. Utility crews from Alabama came to the Borough to restore power. Power was restored to the entire town (including the most heavily damaged areas) within a month after the storm. As in many other communities, there were

likely downed wires and poles, but the greater concern in Tuckerton was the extent of flooding and the number of homes that had been knocked off their foundations in the Tuckerton Beach area. The Atlantic City Electric Company noted that the primary cause for service disruption was "customers unable to receive service".



At the height of the storm, the electric company estimated that 220,000 of its customers were without power, which is about 40 percent of its customer base. The utility company worked in the days leading up to the storm to prepare their company for the impacts of the storm. They lined up internal and external personnel, additional facilities, tree removal teams, and other necessary preparations to respond to outages as quickly as possible. This preparation directly correlated with the company's ability to restore power to southern New Jersey as quickly as it did. The other critical factor to Atlantic City Electric's ability to prepare was the fact that Sandy followed the predictions in both timing and track relatively closely. If the storm had drastically changed course or intensity these preparations may not have been as effective. However, for the Borough of Tuckerton it reduces the Borough's vulnerability to be serviced by a utility company that has a demonstrated history of effective storm response and recovery. One opportunity to minimize the disruption in service would be to divide the service zones within the Borough even more, allowing the utility company to isolate smaller areas during restoration.

The Borough asked Atlantic City Electric not to restore service to homes in the Tuckerton Beach area until the Borough could inspect the homes individually. Atlantic City Electric estimated that after Sandy approximately 550 customers were unable to receive electric service. Within 10 days the utility company was able to restore power to about 120 customers, with the timeline largely dictated by the Borough's capacity to access and inspect homes. By February there were still 197 homes unable to receive electric and in August 2013, Atlantic City Electric reported that over 100 homes were still without power.

Water: Water supply and sanitary sewer services were also substantially disrupted during Sandy due to inundation, leaks and breaks in the system, and power loss in the Borough. The Tuckerton Beach lagoon section of the Borough is by far the most problematic area for both water supply and wastewater collection. High tides, without the influence of storms, create Infiltration and Inflow increases, whereby lift station capacity is exceeded causing surcharge of untreated wastewater.

Two deep wells for public water supply draw on the Atlantic City "800 Foot" Sand Kirkwood-Cohansey Aquifer. The tops of the wells were just high enough in elevation to not be influenced by the flooding from Sandy, however the electrical system sustained saltwater saturation damage and disabled the system until repair was complete. With the dislocation of homes from foundations due to Sandy's energy, certain water supply mains remained shut until broken lines could be repaired. Interception of floodwater by the wells would require disinfection and it is suggested that the wellheads be secured to the 0.2% annual (500-year) flood water surface elevation to avoid contamination. The 1.2 million gallon water storage tank was not impacted by the flooding; unrelated to Sandy, a NJEIT loan is being obtained to rehabilitate the storage tank, necessitating the replacement of an inoperable water supply interconnection with the Little Egg Harbor Municipal Utilities Authority.

During the storm, the Borough Water Utility was losing water faster than they were producing it, as homes were ripped off their foundations. Water Treatment Facility #2 experienced flooding and power

outages. Tuckerton Beach was totally evacuated, and water and sewer were turned off (following DEP approval). Once the water receded, the water was turned back on, and the Borough sent a crew out to locate all the leaks and turn water off to those areas. There were multiple water service breaks where homes and businesses sustained severe damage. Water service to damaged homes was cut off, and has been reinstated as the homes have been rebuilt. At one year post Sandy, water production was about the same as pre-storm, but without the peak demands typically encountered during holiday weekends. One and a half years post storm, water consumption has peaked to holiday weekend levels on a daily basis, leading to speculation that there is a major leak in the system. The borough is moving forward with a contract to identify the locations of any leaks. The interconnection of the water main running under Tuckerton Creek failed the pressure test; it was disconnected and the borough is seeking funding for replacement. The water supply system is not mapped; mapping of the water supply system is important for identifying problems to be experienced in the future and to properly maintain the system.

Sanitary Sewer and Pump Stations: Tuckerton Borough owns and operates a sanitary sewer collection system that conveys untreated sewage to the Ocean County Utilities Authority. This local collection system exhibited damage from Sandy. Five of 11 pump stations were severely damaged by floodwater inundation and sustained electrical, generator and heating system failure, resulting in sewage being discharged into the streets. FEMA Public Assistance funding compensated the Borough for repairing the pump stations but that work did not reduce the risk of future damage. Isolated sections of the sanitary sewer system failed requiring emergency repairs; locations included Carol Avenue and South Green Street where collapsed pipes were replaced. While sanitary manholes were retrofitted with water resistant inserts years prior to Sandy, some manholes may need to be inspected triggering joint repair and replacement inserts.

Sewer flows by gravity to the Tuckerton Beach Pump Station located on S. Green Street (aka. County Rt 539) and then is pumped to the Ocean County Utility Authority (OCUA) southern Treatment Plant. The sewer service area is limited to the upland portion of the municipality. Tuckerton has a total of 11 pumping stations. Five Sewage Pump Stations experienced flooding and power outages. Five were damaged during the storm; four required refurbishing of the generators, and required mechanical and electrical work, three of these were so badly damaged as to be inoperable. The storm surges damaged equipment inside the buildings and caused failure of the emergency generators. In addition, the buildings also housed pump motor control devices in NEMA-4 enclosures, gas heaters, electric water heaters and electric actuators for the wall louvers; all of which sustained damages. The sewage pumps are outdoors in wet wells located next to sanitary manholes that receive sewage for the pumping stations. Surface water drained into the pump wet wells, filling the wells and requiring dewatering of the wells, and the gravity sewer line on Carroll Avenue was also damaged. As a result of Sandy and the loss of homes in the Tuckerton Beach area of the Borough, flood water and heavy debris entered the sanitary sewer conveyance system. There are suspected breaks in the sewer laterals at Tuckerton Beach, allowing infiltration into the system during storm events. When there is new construction the lateral lines are cut and capped. However, if a home has been damaged and is not yet under construction, there might be broken or missing pipes, which allow infiltration. About a year post-storm, there was a sewer main collapse at S Green Street, necessitating the replacement of 60 feet of pipe under emergency conditions. In addition to Tuckerton residents, the Tuckerton water and sewer also services 200 customers in Little Egg Harbor, and operates the sewage pump station at Holly Lake. A force main runs under Tuckerton Creek; both the sewer and water lines need to be replaced in that location.

Immediately following the storm, Tuckerton hired Video Pipe Services to clean sand from sanitary sewer system and perform a video inspection in the amount of $68,950.00, with associated engineering costs to monitor cleaning at $24,960 (40 days @8 hours per day at $78.00/day)

For utility systems and attendant equipment for critical facilities, FEMA requires an elevation 2 feet above the BFE for all structures that are not orientated perpendicular to waves in a Coastal A or V zone.

In those scenarios, structures should be elevated to at least 3 feet above the BFE. New or substantially damaged critical facilities should be elevated to the 0.2% annual chance flood. Given the reliance on these stations for the Borough of Tuckerton, it may be advisable for the Borough to assess if it can meet the higher standard.

The sites shown below, where damages occurred, are listed from north to south and are summarized as follows:

Fairway Drive Sewage Pump Station	89 Fairway Drive	Approximately 1FT of floodwater in the generator building resulted in the partial submergence of the 35KW generator set.
Borough Hall Sewage Pump Station	228 South Green Street	Approximately 1FT-5IN of floodwater in the generator building resulted in the partial submergence of the 45KW generator set.
Kelly Avenue Sewage Pump Station	400 Kelly Avenue	Approximately 1FT 10IN of floodwater in the generator building, which is approximately 1FT above grade, resulted in the partial submergence of the 60KW generator set.
Holly Lake Sewage Pump Station	36 North Boom Way	Approximately 3FT-4IN of floodwater above the concrete pad that supports the control panel and approximately 6FT above grade. (There is no building at this site.)
Tuckerton Beach Sewage Pump Station	1024 South Green Street	The 60KW generator set was partially submerged.
Carroll Avenue Sewer	Carroll Avenue	The 8” sewer main became misaligned vertically [sag] due to liquefaction of the surrounding soils, debris in the lines from broken laterals, and excess loads during the debris removal operations. A 380LF – 8” concrete sewer main including lateral connections was damaged, and incidental damages to lateral connections and water service connections.

Storm Sewer: Storm water runoff is a continuing problem in the Borough, with regular ponding and flooding as a result of high tides and small storms. Outflows in the bulkheads are intended to allow stormwater to drain into the Bay, but increased siltation from Sandy has clogged many of these outflows, causing water to back up into the streets. This is a particular problem in the Tuckerton Beach area. Storm drains throughout Tuckerton Beach required replacement as a result of damage sustained during Sandy. Throughout the flood prone area, with the exception of Tarpin, Angler, and Anchor Roads, which were recently replaced, water and sewer pipes are failing due to regular exposure to salt water, and the utility boxes are in disrepair. The result is that sinkholes are appearing along the private properties that line the streets, where the underground utility lines run between the street and the bulkhead.

Natural Gas: Gas service was shut off once leaks were discovered, with the Tuckerton Beach area particularly hard hit. However New Jersey Natural Gas completed assessments to all 660 customers in Tuckerton within a week after the storm and restored service.

Fuel: No widespread fuel shortages were experienced. The gas tank at the public works yard didn't function during the period of time that the power was out. The power to operate the tank came through the Police Station. Because the Police Station was destroyed during the flooding, all power was cut off to the building. The tank could not operate until a separate electrical line could be run to the tank's pump. Fuel continued to be available at commercial gas stations.

Telephone Service: Verizon service was intact through the storm. Telephone landlines that were serviced by Verizon remained intact. Comcast and AT&T customers did lose service. The police dispatching at the time of the storm was handled through the County, and this service was not disrupted. Likewise, the radios used by the police, OEM, and fire continued to be operational. The Borough has since signed an agreement for dispatch activities to be run through neighboring Little Egg Harbor Township. Little Egg did experience disruptions in radio service immediately following the storm.

8. Post-Storm Government Operations

In the immediate wake of Sandy, the Borough faced a long road to recovery and rebuilding, and these efforts were hampered not only by the amount of devastation wrought by the storm, but also by the interruption of the Borough's government operations due to damaged and destroyed facilities and understaffing. Furthermore, in the weeks and months after the storm, the Borough struggled to coordinate recovery efforts, prepare FEMA reimbursement documents, and process demolition and building permits with limited staff.

9. New Jersey Future Local Recovery Manager Program

A New Jersey Future Local Recovery Planning Manager is currently working with the Borough of Tuckerton to assist in its long-term recovery initiatives. New Jersey Future received funding through the Merck Foundation and the New Jersey Recovery Fund to create a Local Recovery Planning Manager Program. This program provides assistance to municipalities that were severely damaged by Hurricane Sandy, providing Local Recovery Planning Managers (LRPMs) to work with a community for a minimum of 18 months. The LRPMs act as adjunct staff, working directly with the municipal staff to provide additional capacity to plan, manage and implement plans and projects to address immediate and long-range recovery and rebuilding needs.

CHAPTER 3 RISK ASSESSMENT

INTRODUCTION

Over the past nine years New Jersey has experienced eleven flood-related events that were declared Federal Disasters by the President of the United States. Currently there is consensus among numerous scientifically-based studies that the state can expect to experience an increasing rate and intensity of storms in the foreseeable future[1]. Given New Jersey's settlement patterns, with extremely high-density residential and commercial development along its coastal fringe, and in light of the economic return the state depends upon from tourism at the shore – approximately $35.9 billion of state GDP in 2013, or 6.9% of the state's economy[2] - it's particularly important to evaluate the ***potential*** risk and vulnerabilities inherent in exposure to such storms. The extent of vulnerability has considerable consequences for the health of the state's residents, ecosystems, natural and built environments, and understanding risk is particularly important in guiding rebuilding and recovery strategies and financial investment.

The purpose of a risk assessment is to evaluate vulnerability to hazards a community is likely experience. The vulnerability assessment can then serve as a framework for identifying and prioritizing those actions that most effectively reduce or avoid future losses. The technical definition of the term "***risk***" is expected future losses; ***vulnerability*** is the tendency of something to be damaged when exposed to a hazard and ***exposure*** is the value of structures and number of people exposed to hazards. This assessment is intended to provide a basis for Tuckerton Borough's recovery and mitigation strategies by evaluating vulnerability and quantifying exposure.

One of the more prominent hazards that Tuckerton Borough faces is flooding caused by extreme rainfall events, storm surge and sea level rise. Flooding events are likely to be accompanied by coastal erosion - particularly along unprotected, bay-side coastal areas - which will exacerbate flood hazards. Consequently, this Risk Assessment focuses on Tuckerton's vulnerability to flood hazards and evaluates the types, number and value of structures within the Borough that are currently exposed to flood and storm surge events as well as those likely to be exposed given projections of sea level rise into the future.

1. VULNERABILITY

In this section, various factors of vulnerability with respect to flooding from future storm events are examined, including:

- The extent of the Borough's flood zones;
- The amount of Federal disaster recovery assistance that has been made available to the municipality and individual property owners to address damage from prior storm events the Borough has experienced;
- Impacts of current and projected sea level rise and inundation on the Borough's marshes and wetlands;
- The relationship of the location of community facilities and infrastructure to flood zones; and
- The relationship of the Borough's zoning districts to its flood zones.

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[1] See "What We Know, The Realities, Risks And Response To Climate Change", American Association for the Advancement of Science, 2014. "Climate Change 2013, The Physical Science Basis" Intergovernmental Panel on Climate Change. Climate Change 2014, Impacts, Adaptation and Vulnerabilities", Intergovernmental Panel on Climate Change. "State of the Climate, New Jersey", 2013, Rutgers Climate Institute.

[2] The figure represents direct, indirect and induced impacts. Source: "*The Economic Impact of Tourism in New Jersey, Tourism Satellite Account, Calendar Year 2013*", Tourism Economics

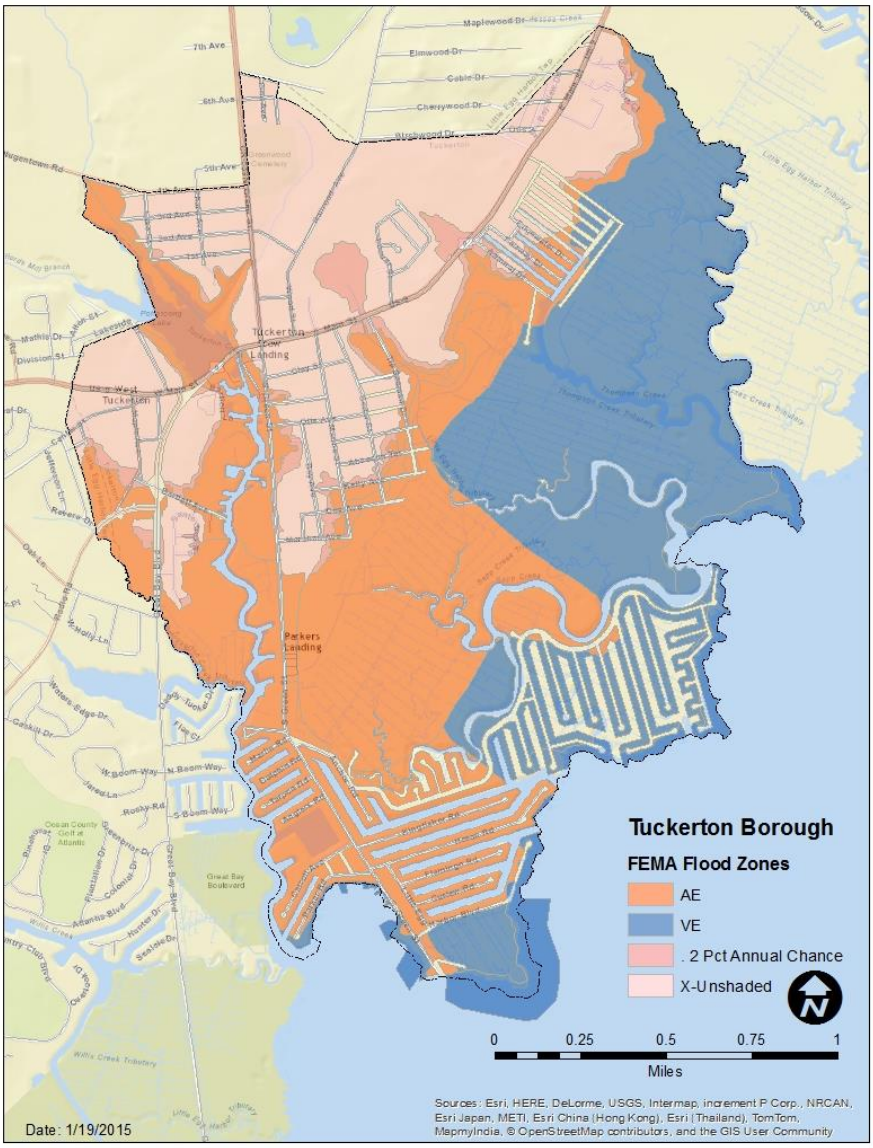
A. Flood Zones

The Federal Emergency Management Agency (FEMA) defines flood zones as geographic areas subject to varying levels of flood risk and types of flooding. These zones are delineated on Flood Insurance Rate Maps (FIRMs) and Flood Hazard Boundary Maps (FHBMs). FEMA delineates four different flood hazard areas:

- Special Flood Hazard Areas – High Risk;
- Coastal High Hazard Areas – High Risk;
- Moderate and Minimal Risk Areas; and
- Undetermined Risk Areas.

Each of these areas has an associated series of flood zones defined by FEMA and included in the ***Flood Zones Table*** provided in ***Appendix 1*** of this report. March, 2014 Preliminary Flood Plain maps currently available for Tuckerton Borough, illustrated in ***Figure 5*** below, show the entire area of the municipality is encompassed within one of four FEMA Flood Zones.

Figure 5: Flood Zones



AE Zone
Special Flood Hazard Areas (SFHAs), which include the AE Zone, have a 1% annual probability of being inundated by flooding and structures located in these zones have a 26% chance of flooding within the life of a standard 30-year mortgage. These are areas of highest vulnerability to flooding inundation. The AE zone encompasses 39% (914 acres) of the total area of the municipality and 35% of the Borough's developed area.

VE Zone
The VE Flood Zone encompasses 32% (762 acres) of the area of the Borough. The VE Zone is a Coastal High Hazard Area (CHHA), which has a 1% annual probability of being inundated by flooding and is subject to high velocity wave action. As with properties within the SFHA, structures within CHHA zones have a 26% chance of flooding within the life of a standard 30-year mortgage.

.2 Pct. Annual Chance
The .2% Zone, also referred to as the 500-year flood plain and X-Shaded zone, defined as a Moderate Risk Zone, encompasses 4.6% (2,786 acres) of the area of the Borough. According to FEMA, buildings in Moderate and Minimal Risk zones can be flooded by severe, concentrated rainfall coupled with inadequate local drainage systems.

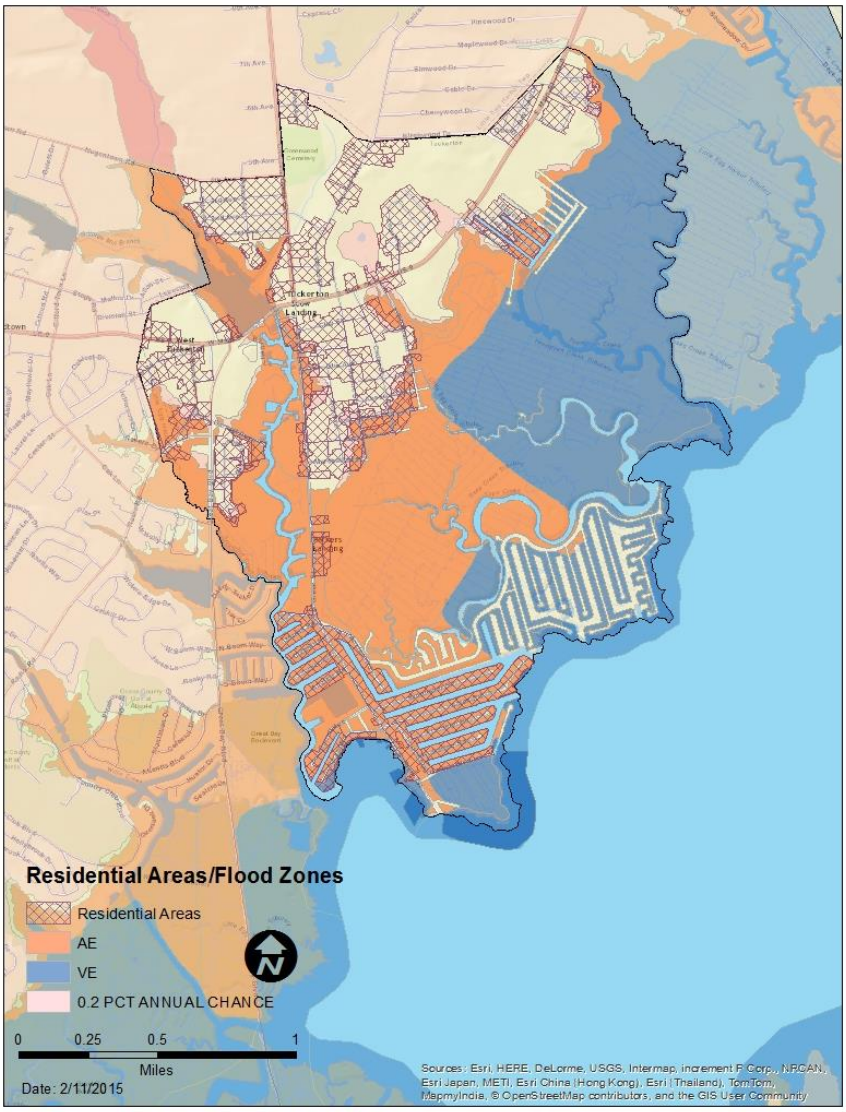
X-Unshaded Zone
The entire area of the Borough is included within a FEMA flood zone. The areas of the Borough ***outside*** the SFHAs, CHHAs and the areas with a .2 Percent Annual chance of flooding, are areas of minimal risk, also referred to as the X-Unshaded Zone.

Table 2: Land Use Type by Flood Zone

Land Use Type	Area (acres)	Area in AE Zone	Area in VE Zone	.2 Pct. Annual Chance	X-Unshaded Zone
Agriculture	11	0	0	1	10
Barren	4	2	0		2
Forest	230	41	1	15	173
Developed	685	241	6	34	404
Water	230	130	100	0	0
Wetlands	1,198	500	655	21	22
Total	**2,358**	**914**	**762**	**71**	**611**
% of Total	**100%**	**39%**	**32%**	**3%**	**26%**
Residential	**491**	**181**	**4**	**27**	**279**

Table 4 shows that 36% (247 acres) of the Developed Area of Tuckerton (685 acres) is located in the AE or VE FEMA flood zones. As noted above, these zones have the highest vulnerability to regular flooding inundation. Large portions of the residential areas of Tuckerton are within the AE zone. These areas have a 1% chance of flooding in any given year. For homeowners in this area, this means that they will be required to have flood insurance if they have a mortgage and they have a 26% probability of experiencing a flood over the course of a thirty year mortgage. Almost 72% (490 acres) of the developed area of the Borough is occupied by residential uses. ***Figure 6*** illustrates that almost 38% (180 acres) of the residential area in Tuckerton is within the AE or VE flood zones. 5% (27 acres) of residential areas in Borough is located within areas with a .2 percent annual flood probability and 279 acres (57%) are located within the X-unshaded area. Both of these areas have minimal risk of flooding.

Figure 6: Residential Areas/FEMA Flood Zones



B. Current storm water plans and infrastructure

The Borough of Tuckerton does have a stormwater management plan. The stormwater system as well as the water and sanitary sewer systems are managed by the Borough.

C. Federal Recovery Assistance

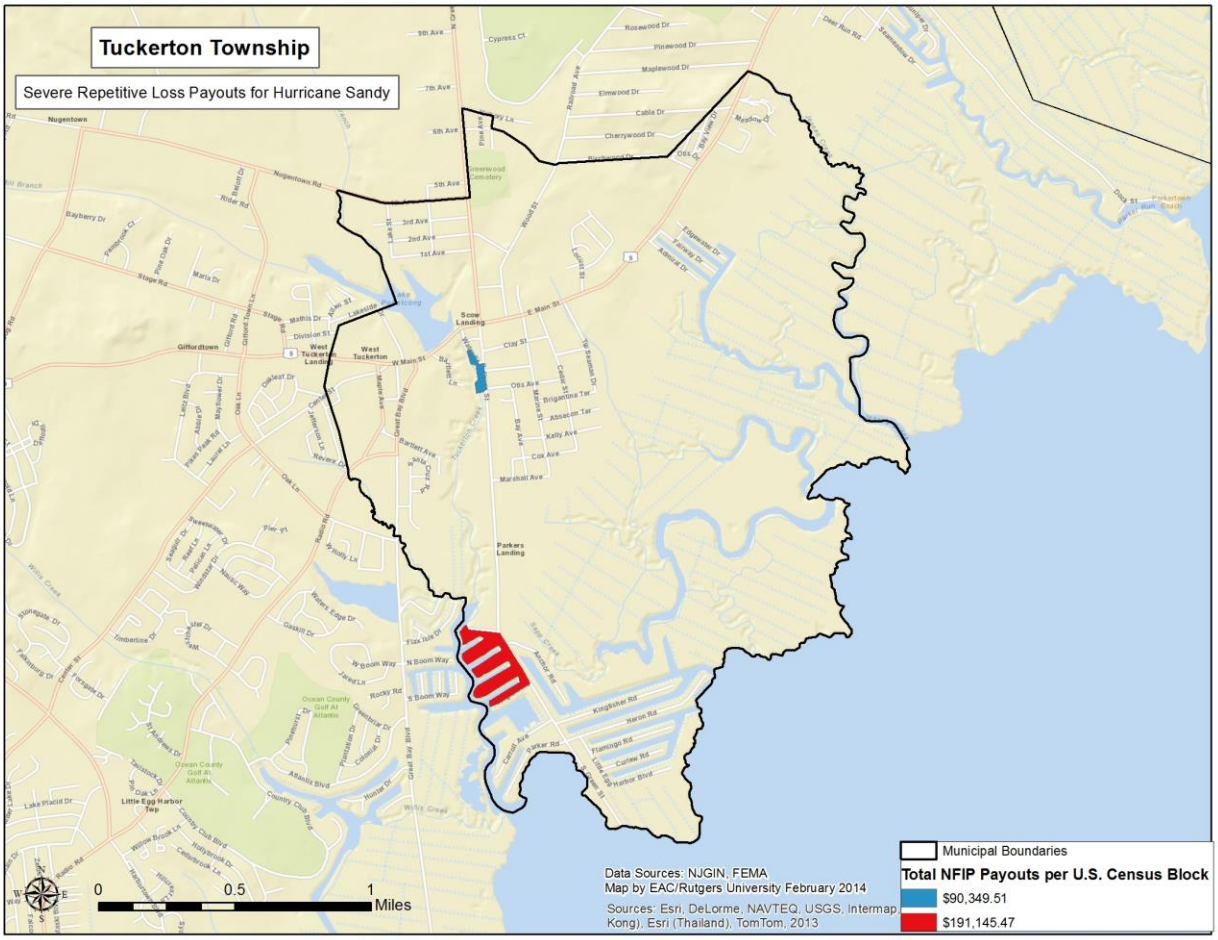
There are three principal sources of Federal assistance available to municipalities and individual property owners for disaster recovery: National Flood Insurance Program (NFIP), Public Assistance (PA), and Individual Assistance (IA). It's important to note that all payout figures quoted below are provided at the census block group or tract level to ensure data anonymity.

1. National Flood Insurance Program (NFIP)

The NFIP offers flood insurance to homeowners, renters, and business owners if their community participates in the program. Participating communities agree to adopt and enforce ordinances that meet or exceed FEMA requirements to reduce the risk of flooding. FEMA defines a Repetitive Loss (RL) property as "any insurable building for which two or more claims of more than $1,000 were paid

through the NFIP within any rolling ten-year period, since 1978." A Severe Repetitive Loss (SRL) is defined as "a single family property (consisting of 1 to 4 residences) that is covered under flood insurance by the NFIP and has incurred flood-related damage for which four or more separate claim payments have been paid under flood insurance coverage, with the amount of each claim payment exceeding $5,000 and with cumulative amount of such claims payments exceeding $20,000; or for which at least 2 separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property. The two claims must have occurred within any 10-year period and must be greater than 10 days apart.

Figure 7: NFIP Payouts



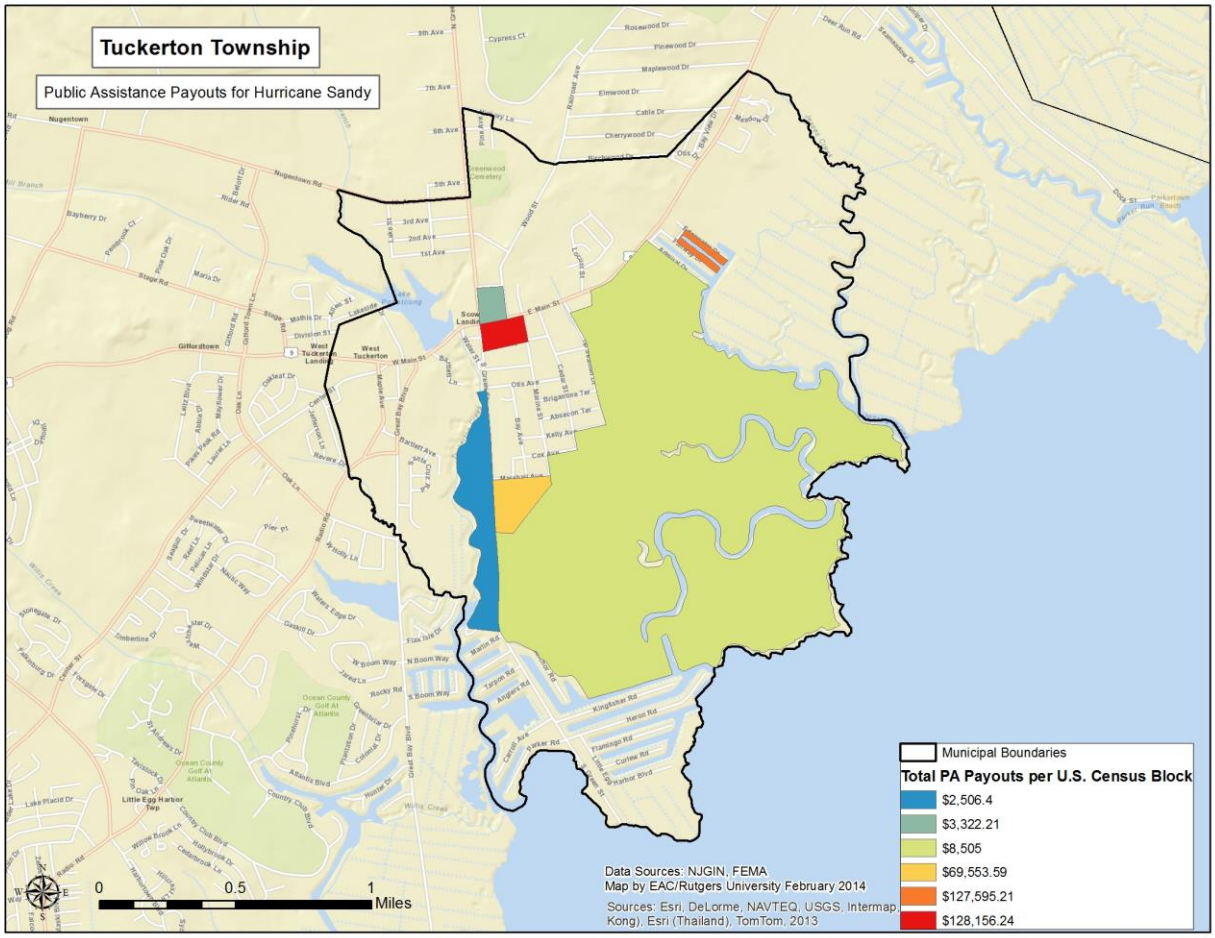
According to the information on NFIP payouts in the Repetitive Loss database held by the New Jersey Department of Environmental Protection for Hurricane Sandy, as of 11/30/13, there were a total of 3 claims payments in Tuckerton for a total of $281,500 made to properties located with the Borough's two census block groups. Total payouts ranged from $90,350 to $191,200 per census block group. An examination of the payout data maps reveals that the areas with Tuckerton's census block group areas where payouts were made following Sandy were roughly the same areas where payouts were made following unnamed Storm Event # 1897 (*See* **Appendix 5 *Pre-Sandy Payout Maps***).[3]

[3] Storm Event # 1897 refers to the incident period of March 12, 2010 to April 15, 2010, a Nor'easter for which Governor Christie requested a declaration of Public Assistance for 12 counties on March 26, 2010 and for which President Obama declared a major disaster on April 2, 2010.

2. Public Assistance (PA)

FEMA's Public Assistance (PA) Grant Program provides assistance to State, Tribal and local governments, and certain types of Private Nonprofit organizations so that communities can quickly respond to and recover from major disasters or emergencies declared by the President. This program provides supplemental Federal disaster grant assistance for debris removal, emergency protective measures, and the repair, replacement, or restoration of disaster-damaged, publicly owned facilities and the facilities of certain Private Non-Profit (PNP) organizations. The PA Program also encourages protection of these damaged facilities from future events by providing assistance for hazard mitigation measures during the recovery process. Following Hurricane Sandy, there were a total of 16 public assistance grants within the Borough for a total amount of $339,600, as of 11/30/13. Payout amounts ranged from $2,500 to $128,100.

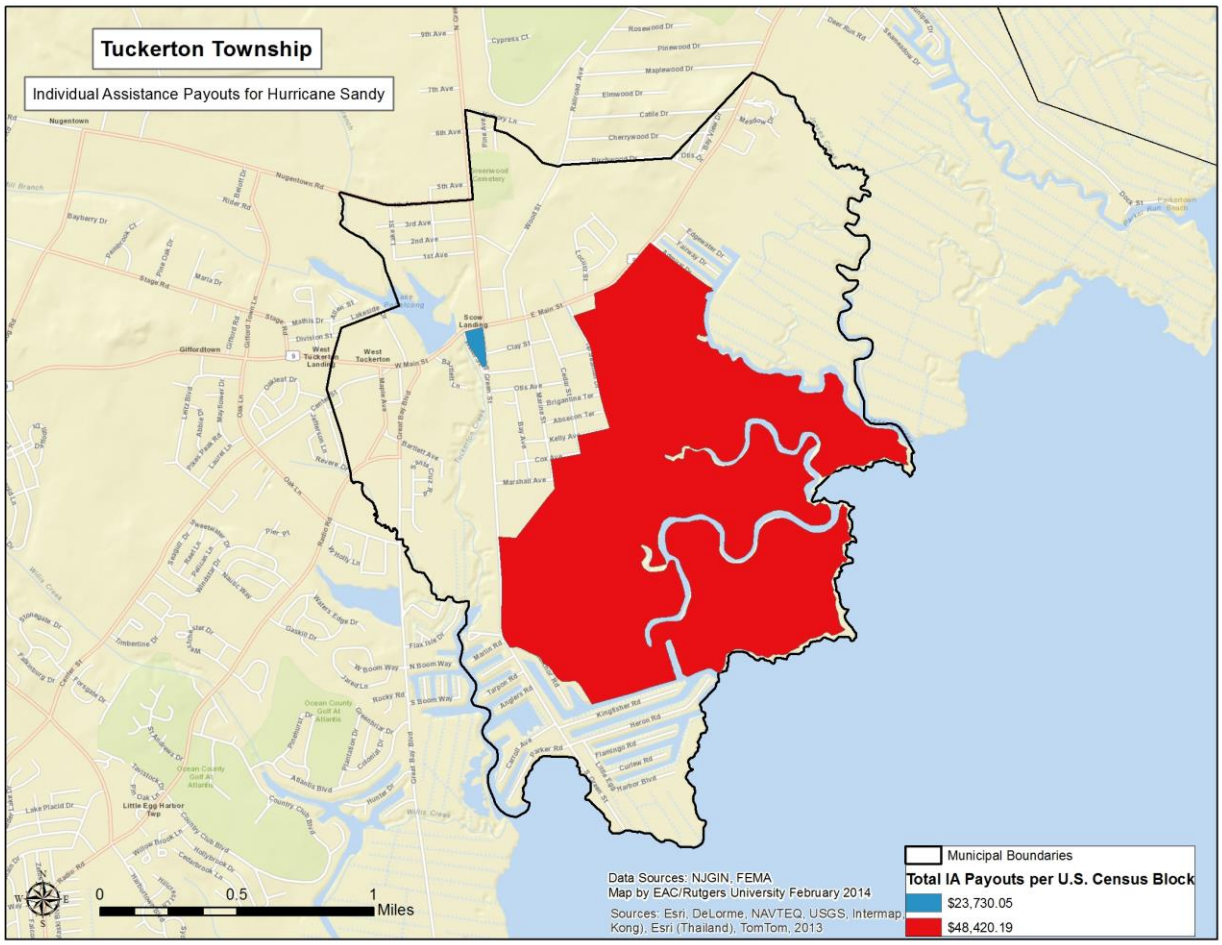
Figure 8: Public Assistance Payouts



3. Individual Assistance (IA)

FEMA Individual Assistance (IA) program provides financial or direct assistance to individuals and families whose property has been damaged or destroyed as a result of a federally-declared disaster, and whose losses ***are not*** covered by insurance. It is meant to help meet critical expenses that cannot be covered in other ways. This assistance provides for temporary housing, repair or replacement of a primary residence that is not covered by insurance. Following Sandy, a total of 10 individual assistance payouts were made to qualifying individuals and families living in Tuckerton, for a total payout of $72,150, as of 11/30/13. Payment amounts ranged from $23,700 to 48,400 per census block group.

Figure 9: Individual Assistance Payouts



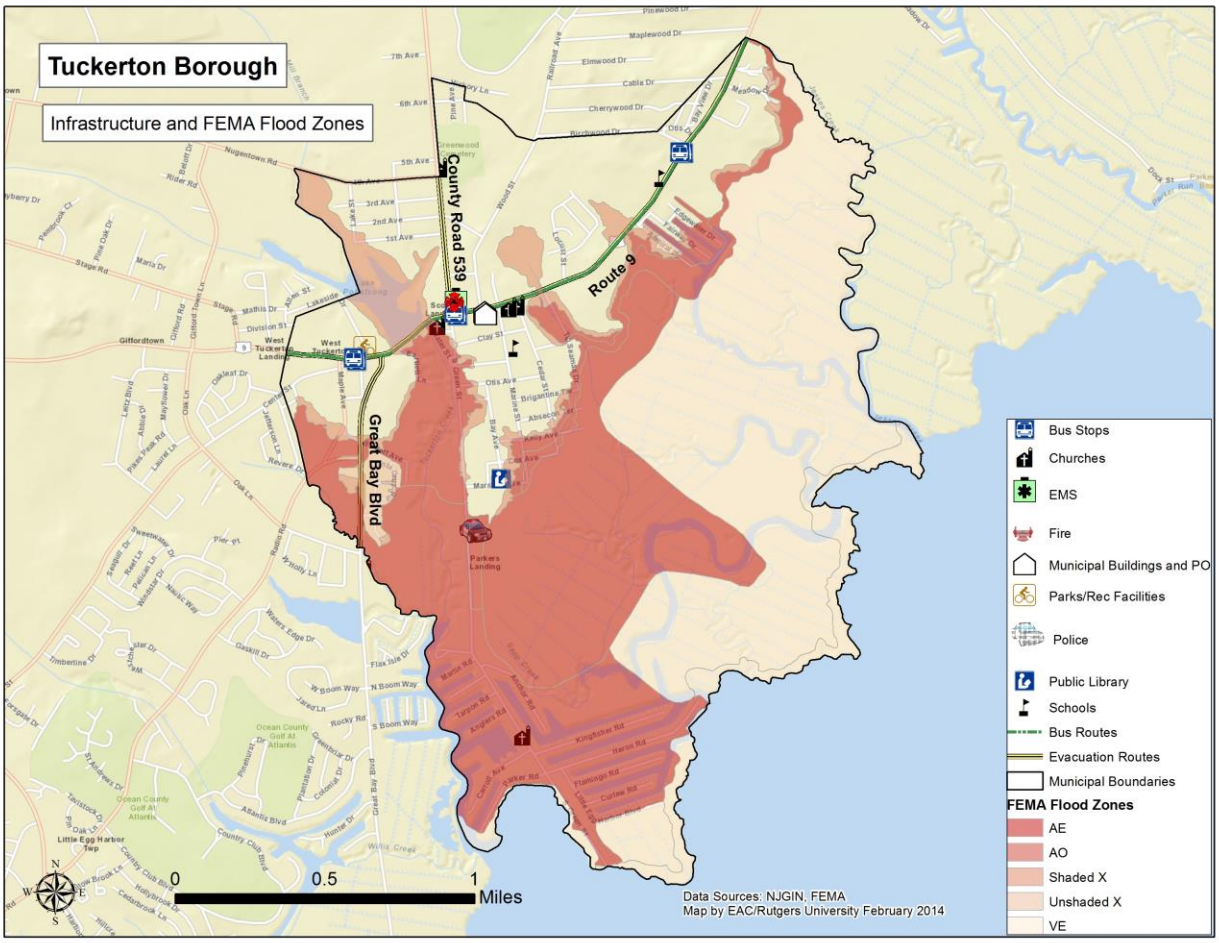
D. Critical Services and Infrastructure

Tuckerton's capacity to respond to severe storms and flooding events is, to a large extent, predicated on the extent to which these events are likely to impact critical infrastructure - such as evacuation routes – and emergency services – such as police and fire services. Figure 12 shows the location of critical facilities throughout Tuckerton and their proximity to areas of probable inundation in the event of future inundation.

Figure 10 shows that the VE and AE Special Hazard Flood (1% annual flood risk) Zones extend inland through the Borough crossing US Highway 9 in at least 4 locations, potentially impeding accessibility during flooding events. In addition, portions of Great Bay Boulevard are within these flood zones. This is significant because these major roadways serve as Tuckerton's principal east/west and north/south evacuation routes. (*The complete list of roadways that are within the boundary of areas of inundation under the 2050 sea level rise with a 1% annual flood scenario, either in the AE or VE Zones, is listed in* ***Appendix 3***). The Tuckerton Police Department, which had been located at 445 South Green Street within the AE Zone, was destroyed by flooding during Sandy and has since been abandoned and, along with the Borough municipal offices, relocated to 420 East Main Street (US Highway Route 9) outside designated flood zone boundaries. However, 2 churches in the municipality - Little Egg Harbor Friends Meeting House at 21 E Main Street, and the Tuckerton Congregation of Jehovah's Witnesses at 840 North Green Street - are located within the AE zone. During flooding events, churches and schools

frequently are used to shelter families that are forced to evacuate residential areas in peril. Due to their location, these church buildings would not be suitable shelter sites.

Figure 10: Services and Infrastructure Impacts



As is evident from ***Figure 10***, several of the Borough's roadways, either segments or entire lengths, are within flood hazard areas. A list of the names of these roadways is provided in ***Appendix 3*** to this report.

E. Zoning and Land Use

A municipality's zoning regulations determine where certain land uses will occur, and how buildings will be configured on lots within a range of use zones. For generations New Jersey's coastal communities have permitted relatively dense residential and commercial development patterns within close proximity to coastlines to take advantage of the attractive and unparalleled natural resource of the state's shore areas. This development has largely occurred without regard to exposure to storms and flooding. However, as sea levels rise and the probability of more intense and frequent storm events increases, it will be necessary to evaluate the extent to which these historic development patterns put people and property in increasing jeopardy and consider alternatives to minimize or avoid such risk.

Figure 11 and ***Table 5*** reveal that substantial portions of Tuckerton Borough's zoning districts are located within FEMA flood zones. Over 562 acres (34%) of areas zoned for residential uses are located the AE zone, which has a 1% annual chance of flooding annually or a 26% chance of flooding within the term of a thirty-year mortgage. Portions of several other districts are also located in the AE zone

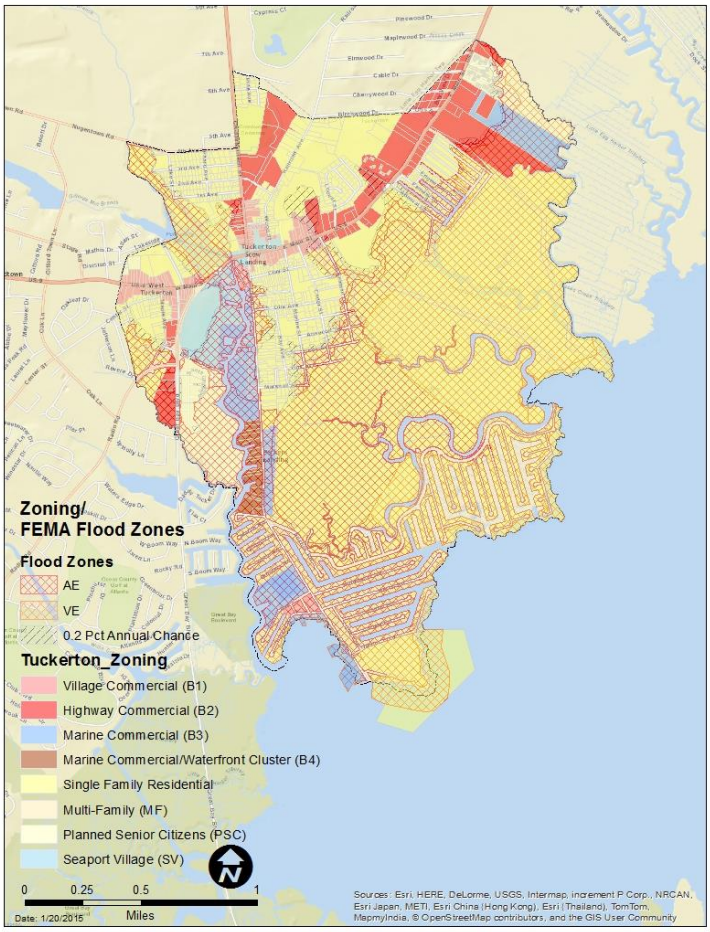
including more than one-third of the area zoned Seaport Village District, slightly more than half of the area zoned for Planned Senior Res/Med Density Cluster and almost 8% of the areas zoned Highway Business.

Table 3: Zoning Districts in AE and VE Flood Zones

Land Use Type	Area of Zone (acres)	Area in AE Flood Zone	% in AE Flood Zone	Area in Flood Zone VE	% in VE Flood Zone	Acres in.2% Annual Chance Flood Zone	% in .2% Annual Chance Flood Zone
Highway Business (B2)	182	14	8%	21	12%	14	8%
Marine Commercial/Waterfront Cluster Dev (B3)	19	19	100%	0	0%	0	0%
Marine Commercial (B4)	108	70	65%	32	29%	1	1%
Multi-Family Residential (MF)	0	0	0%	0	0%	0	0%
Planned Senior Res/Med Density Cluster (PSC)	106	55	52%	18	17%	4	4%
Seaport Village District (SV)	48	19	40%	0	0%	4	8%
Single Family Residential (R50, 75, 100, 200)	598	175	29%	25	4%	84	14%
Village Commercial and Office Professional (B1)	53	8	14%	0	0%	4	7%
Wetlands Conservation Residential (R400)	946	332	35%	585	62%	1	0%
Total	**2,060**	**692**	**34%**	**680**	**33%**	**112**	**5%**

As noted previously, in addition to flood risk, areas within the VE Zone are subject to storm-induced velocity wave action. In the Borough, those areas include 38% (610 acres) of the areas zoned for residential uses, 17% of the areas zoned for Planned Senior Residential/Medium Density Cluster (18 acres), and almost 12% (21 acres) of areas zoned Highway Business.

Figure 11: Zoning and Flood Zones



F. Wetlands Impacts

A comparison of ***Figures 1*** *(page 4)*, ***12*** *(page 33)*, and ***13*** *(page 35)* illustrate that by 2050 a considerable portion of the protective marsh areas that currently buffer vast extents of Tuckerton Borough's coastal areas will be inundated and will not provide protection for more inland developed areas. ***Table 4*** on Page 17 indicates that over 96% (1,155 acres) of the Borough's wetlands areas are in the AE or VE flood zones. The extent to which these areas are vulnerable to future storm events or flooding as a result of sea-level rise is an important factor for the community to consider as it evaluates its adaptation strategy options. These tidal wetlands serve several critical functions; they furnish essential spawning, foraging, and nesting habitat for fish, birds, and other wildlife. They function as the ecosystem's "kidneys," filtering contaminants, nutrients, and suspended sediments, allowing for higher water quality than would otherwise occur. Important finfisheries and shellfisheries are supported by tidal wetlands. They sequester more carbon than any other habitat in the watershed. And notably, they represent our first line of defense against storm surge and flooding. Acre for acre, tidal wetlands likely provide more ecosystem services than any other habitat type in the watershed.[4]

Salt marsh vegetation is adapted to tidal flooding. However, permanently inundated marshlands risk die-off and conversion to open water. Consequently, tidal wetlands are particularly susceptible to sea level rise. As a report from the Partners for the Delaware Estuary indicates, "*Tidal marshes maintain an elevation relative to sea level by the gradual accumulation of dead plant matter and sediment. Whether marshes keep pace with sea level rise or not depends on many factors, such as their productivity, sediment supply from other areas, nutrient loadings, wave and current energies, and the rate of sea level rise.*"[5] Marsh survival, therefore, depends on a balance between erosion and drowning and marshland accretion. Although it appears that accretion has slowed inundation within the Borough's coastal areas somewhat, it's unclear whether the rate of future accumulation will keep pace with rising sea levels. And some reports suggest that it's not likely that the balance can be maintained.[6]

2. INUNDATION IMPACTS

A report published by Kenneth Miller and Robert Kopp, of Rutgers University indicates that over the past century sea levels along the New Jersey coast have risen at a rate of approximately 3.8 mm (.15 inches)/year, roughly half of which is attributable to coastal subsidence. This rate has gradually accelerated into the current century.[7] According to Kopp, 70,000 more people were affected by Hurricane Sandy in the NY/NJ area due to sea level rise (SLR) than would have been the case had there been no such increase[8]. Rising sea levels will likely result in permanent inundations of areas that currently are frequently flooded and frequent inundation of areas that only episodically flood currently.

Permanent inundation from sea level rise is only one of the hazards that climate change presents to New Jersey's coastal property and infrastructure. Higher average sea levels lead to higher storm surges and increased flooding risks[9], even if the intensity or frequency of storms remains unchanged[10]. Kemp

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[4] "Climate Change in the Delaware Estuary", Partners for the Delaware Estuary, June 2010, p.29, http://delawareestuary.org/sciencereports
[5] ibid
[6] Atlantic Sea Level Rise, Lagoonal Marsh Loss and Wildlife Habitat Implications, Erwin, Michael R., University of Virginia, USGS, http://www.pwrc.usgs.gov/resshow/erwin1rs/erwin1rs.htm
[7] "*A Geological Perspective On Sea-Level Rise and Its Impacts Along the U.S. Mid-Atlantic Coast*", K. G. Miller, R.E. Kopp, B.P. Horton, J.V. Browning, A. C. Kemp, AGU Publications, Department of Earth and Planetary Sciences, Rutgers University, 5 Dec. 2013
[8] Robert Kopp interview, WHYY "Radio Times" interview, July 1, 2014
[9] Frumhoff et al. 2007

and Horton (2013) found that, while the record 13.9-foot storm tide in New York Harbor during Hurricane Sandy was primarily due to the coincidence of the strongest winds with high tide, SLR driven by historical climate change added more than one foot to that 13.9 foot total[11]. The impact of climate change on flooding during coastal storms is greater and more immediate than the impacts of inundation from gradually rising sea levels[12]. Potential damage of flooding from hurricanes and Nor'easters is projected to increase by 14%-36% in New Jersey by 2030, due to sea level rise.

Changing climate conditions are also predicted to drive increasing storm intensity. Recent research indicates that New Jersey is receiving more of its annual precipitation from intense storms than it has in the past[13]. This increases the risk of flash floods, urban flooding, and coastal flooding, which are all closely tied to heavy precipitation events[14].

In order to assess the extent to which the Borough of Tuckerton is exposed to flood inundation and storm surge it's necessary to evaluate the probable impacts of near-term sea-level rise for the community. An evaluation for the year 2050 is particularly informative because of the extent of possible impacts of predicted sea-level elevations by that time period. ***Figure 12*** (page 33) illustrates that these impacts will occur primarily in the lagoon areas and along Tuckerton Creek.

Exposure Analysis Procedure

This section of the analysis estimates the value of properties potentially exposed to flooding and sea level rise for 2050 sea-level rise projections. ***It's important to stress that the data presented herein are intended for planning purposes only.*** In estimating the extent of the Borough's future exposure as a result of flood inundation it was necessary to perform a detailed geographic analysis of the community. This analysis began with a determination of the current mean higher high water (MHHW) tide levels at the Borough's coast. MHHW is a measure of the higher of the two high tides that occur each day, averaged over a 19-year period. [15] Once the MHHW was established, it was necessary to determine the extent to which areas within the Borough would be subject to flooding under various future scenarios – for the purpose of this assessment, predicted sea-level rise for the periods 2030, 2050 and 2100 were considered, consistent with the Miller et al. report. [16] However, as noted above, ***this analysis focused on projections to 2050***.

The next step of the risk assessment was to evaluate specifically which parcels within the Borough were likely to be affected under the two scenarios: Mean Higher High Water Level and FEMA 1% Storm given an increase in sea-level rise for 2050 as projected by Miller et al. This was accomplished by analyzing and mapping the predicted inundation extent for each scenario. The predicted extent was then overlaid with the 2012 MOD-IV data set assembled and maintained by the New Jersey Division of Taxation and posted

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[10] Frazier et al. 2010
[11] American Climate Prospectus, Economic Risks in the US, 2014
[12] Ibid
[13] "State of the Climate: New Jersey, 2013"; Broccoli, Kaplan, Loikith, Robinson; Rutgers Climate Institute
[14] American Climate Prospectus, Economic Risks in the US, 2014
[15] The MHHW is the average of all high water heights observed over the National Tidal Datum Epoch - the specific 19-year period adopted by the National Ocean Service as the official time segment over which tide observations are taken and reduced to obtain mean values (e.g., mean lower low water, etc.) for tidal datum. For Tuckerton Borough, the mean higher high tide was derived from the National Oceanic and Atmospheric Administration vertical datum transformation tool. The higher high tide extent is interpolated from regional tidal stations and is dynamic along the shoreline.
[16] See Footnote 6

on the New Jersey Geographic Information Network web site[17]. Parcels with 10% or more inundation were included in this parcel-level calculation, under the assumption that if a parcel was less than 10% inundated it is not likely to experience significant structural damage. Parcels were also eliminated from the calculation if the structure did not overlap with the inundation extent. In addition, all parcels with units that have been elevated since Hurricane Sandy were identified, mapped and excluded from the calculation. According to data provided by Borough officials, as of July 2014, 129 dwellings have been elevated above the Base Flood Elevation in accordance with zoning regulations put into effect in Tuckerton Borough following the Hurricane. However, although units may be elevated above flood stage, at-grade streets and infrastructure will continue to be exposed to inundation, which is likely to adversely affect property value over time.

Evaluating property tax information and the inundated parcels in tandem enabled an assessment of probable damage at the parcel level, under the 2050 sea-level rise scenario[18], by comparing the predicted depths of inundation throughout the Borough. The scenarios were modeled using 1-meter Digital Elevation data derived from LiDAR (Light Detection and Ranging - remote sensing technology) collected in 2006. The output from this comparison was further refined through the application of depth damage curves, which are used to estimate the percentage of structural damage based on relative flood depths. [19]

A. Exposure Analysis: 2050 Sea Level Rise Scenario

Tables 6 and ***7*** were developed in accordance with the procedure outlined above. ***Table 6*** breaks down the number of vulnerable parcels by property classification and ***Table 7*** provides a breakdown of the value of these vulnerable parcels - "***exposure value***" - under the 2050 sea-level rise scenario.[20] The value of vulnerable parcels is the sum of two factors, the parcel *land value* and *improvement value* (value of structures occupying the parcel). These two factors are presented separately in ***Table 7***. ***Figure 12*** illustrates the 2050 Sea Level Rise inundation extent, demonstrating the projected impact within the boundaries of the Borough. It's important to note that since it is not possible to predict what the Borough's actual property values will be in 2050; exposure values presented in this analysis reflect the municipality's ***current*** assessment values.

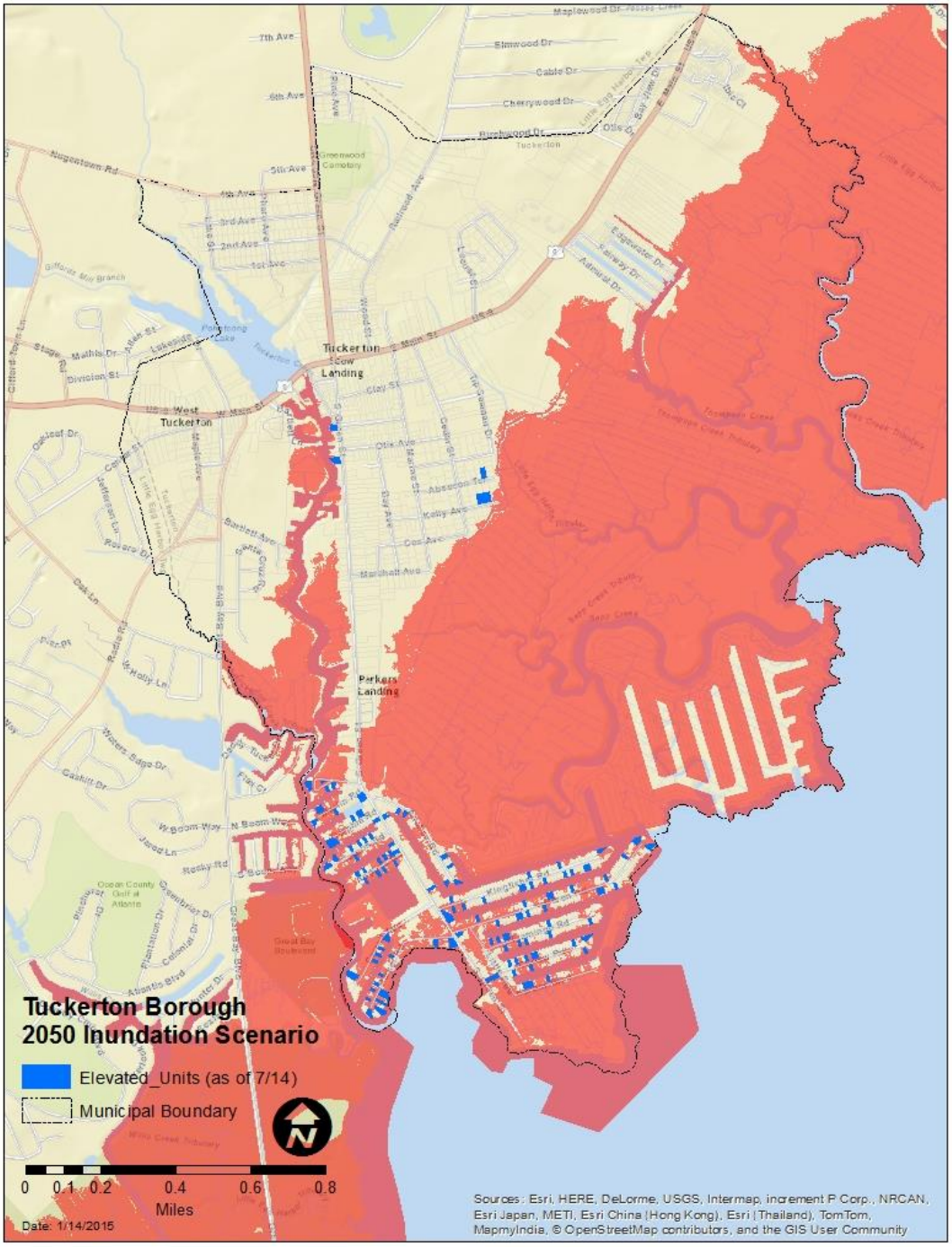
[17] https://njgin.state.nj.us/NJ_NJGINExplorer/DataDownloads.jsp

[18] The 2050 scenario was determined to be a reasonable planning horizon for the purpose of the detailed assessment of exposure value. The Miller et. al. report projects low, central and high sea level rise values for 2030, 2050 and 2100. For 2050, the values range from a low of 1.08' to a high of 1.94'. ***For the purpose of this analysis the central value, 1.48', was added to the current day MHHW***.

[19] Developed by the U.S Army Corps of Engineers, http://planning.usace.army.mil/toolbox/library/EGMs/egm04-01.pdf

[20] For the purpose of the analysis the depth damage function for residential, 2-story structures, with at-grade elevations was applied.

Figure 12: Tuckerton 2050 Sea-level Rise



As ***Table 6*** reveals, under the 2050 sea-level rise scenario, 620 (28%) of the Borough's 2,197 parcels and 55% (1,131 acres) of the total area of the community will be regularly inundated during high tide conditions. ***Table 7*** indicates that the value of these affected parcels represents over 30% of the assessed value of the entire municipality. [21]

[21]For the purpose of this analysis, all parcels less than 10% flooded were not considered inundated and not included in the exposure value

Table 4: Vulnerable Parcels
2050 Sea Level Rise Scenario

Property Class (Class Code)	Total Borough Lots	Vulnerable Lots	% Vulnerable Lots	Total Borough Acres	Vulnerable Acres	% Vulnerable Acres
Vacant (1)	342	140	41%	524	203.1	39%
Residential (2)	1,612	398	25%	374	30.0	8%
Commercial (4A)	94	17	18%	92	20.4	22%
Apartment (4C)	3	1	33%	59	30.1	51%
Public School Property (15A)	2		0%	5		0%
Public Property (15C)	123	61	50%	979	845.7	86%
Church/Charitable (15D)	11	2	18%	12	2.0	17%
Cemeteries/Graveyards (15E)	2		0%	13		0%
Other Exempt (15F)	8	1	13%	3	0.1	4%
Total	**2,197**	**620**	**28%**	**2,059**	**1,131.4**	**55%**

Table 5: Exposure Value - Vulnerable Parcels
2050 Sea Level Rise Scenario

Property Class (Class Code)	Total Borough Value	Value of Vulnerable Land	Value of Vulnerable Improvements	Total Value of Vulnerable Parcels	% of Total Borough Value
Vacant (1)	$40,024,316	$15,217,470	$0	$15,217,470	38%
Residential (2)	$348,435,140	$66,638,638	$33,142,000	$99,780,638	29%
Commercial (4A)	$41,084,753	$5,923,700	$3,991,500	$9,915,200	24%
Apartment (4C)	$18,614,000	$3,840,000	$6,660,000	$10,500,000	56%
Public School Property (15A)	$5,919,100			$0	0%
Public Property (15C)	$22,977,300	$8,377,800	$245,300	$8,623,100	38%
Church/Charitable (15D)	$10,461,000	$1,639,500	$4,520,000	$6,159,500	59%
Cemeteries/Graveyards (15E)	$1,237,700			$0	0%
Other Exempt (15F)	$1,975,800	$160,000	$33,000	$193,000	10%
Total	**$490,729,109**	**$101,797,108**	**$48,591,800**	**$150,388,908**	**31%**
Net Taxable Value	**$448,158,209**	**$91,619,808**	**$43,793,500**	**$135,413,308**	**30%**

As noted previously, parcel level property values presented in the exposure value tables in this report are obtained from the New Jersey Division of Taxation's MOD-IV data set. The data presently available is an extract from the Division of Taxation's 2012 MOD IV data base.

The 2012 General Tax Rate tables for New Jersey Counties and Municipalities is posted on New Jersey's Department of Treasury, Division of Taxation's web site.[22] The applicable table for Ocean County indicates that the 2012 General Tax Rate for Tuckerton Borough was $2.14 per $100 of assessed value. Based on this rate, ***if no actions are taken to mitigate sea level rise impacts***, under the 2050 Sea Level Rise scenario the loss to the Borough of $135.4 million of assessed value from the community's taxable properties would result in a potential real estate tax revenue loss of more than 31% of the Borough's total tax revenues, which in 2012 was $9.3 million.[23]

C. Exposure Analysis: 2050 Sea Level Rise with 1% Annual Flood

The foregoing 2050 Sea Level Rise scenario assumes that areas of the municipality will be regularly inundated and, therefore, exposure values included total land and structural values for all parcels that are projected to be more than 10% inundated. However, for those additional parcels impacted under the 2050 Sea Level Rise plus 1% Storm scenario, land value may or may not be affected. Structures on

[22] http://www.state.nj.us/treasury/taxation/lpt/taxrate.shtml
[23] Includes county, school and municipal taxes levied

properties that may be inundated by episodic flooding (e.g., a 1% storm) can and often are rebuilt. Since it's not possible to predict which parcels may or may not be suitable for redevelopment under this future scenario, three alternative exposure values have been calculated assuming: **1)** 100% of the land value is permanently extinguished; **2)** 50% of exposed land value is permanently lost, and **3)** no land value is permanently lost.

Figure 13: 2050 Sea-level Rise Scenario under a 1% Storm Event, identifies areas that will be affected in locations throughout the Borough under this future scenario.

Figure 13: 2050 Sea-level Rise Scenario under a 1% Storm Event

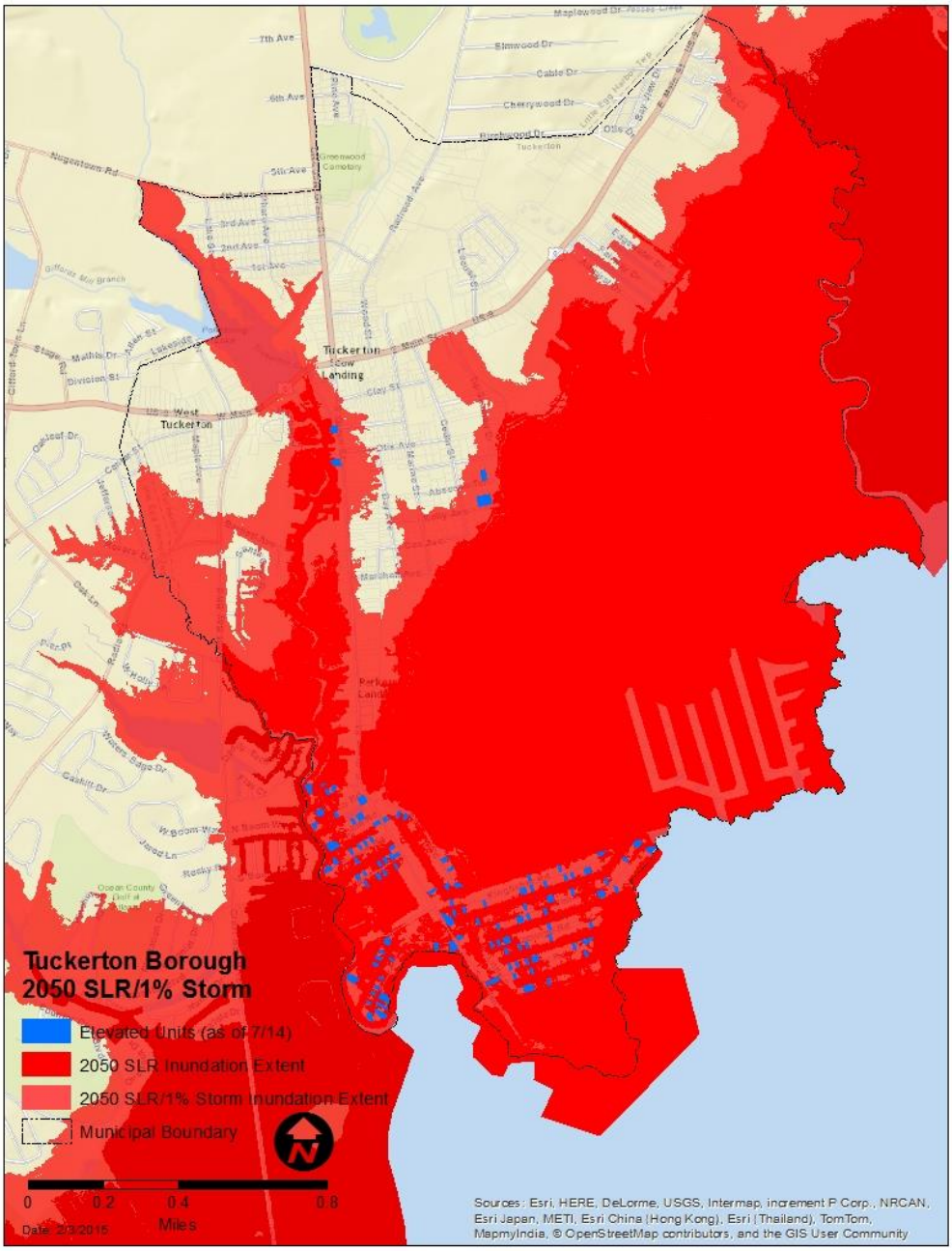


Exhibit 13 illustrates that by 2050, a 1% storm would inundate all areas of the Borough subject to flooding under the 2050 Sea Level Rise scenario as well as a considerably larger portion of the

municipality. ***Table 8*** indicates that under this scenario a total of 1,219 (620 under 2050 Sea Level Rise plus 599 parcels under the 1% storm scenario) of the Borough's 2,197 parcels (55%) would be inundated - parcels on which building have been elevated are excluded. [24] The total area of these parcels would exceed 1,357 acres, comprising almost 66% of the total area of the community.

Table 6: Vulnerable Parcels
2050 Sea-Level Rise with 1% Annual Flood

Property Class (Class Code)	Total Borough Lots	# of Vulnerable Lots	% Vulnerable Lots	Total Borough Acres	Vulnerable Acres	% Vulnerable Acres
Vacant (1)	342	204	60%	524	276	53%
Residential (2)	1,612	881	55%	374	125	33%
Commercial (4A)	94	34	36%	92	27	30%
Apartment (4C)	3	1	33%	59	30	51%
Public School Property (15A)	2	0	0%	5	0	0%
Public Property (15C)	123	92	75%	979	895	91%
Church/Charitable (15D)	11	4	36%	12	3	24%
Cemeteries/Graveyards (15E)	2	0	0%	13	0	0%
Other Exempt (15F)	8	3	38%	3	1	33%
Total	**2,197**	**1,219**	**55%**	**2,059**	**1,357**	**66%**

Table 7: Exposure Value - Vulnerable Parcels
2050 Sea-Level Rise with 1% Annual Flood (100% Extinguished Land Value)

Property Class (Class Code)	Total Borough Value	Value of Vulnerable Land	Value of Vulnerable Improvements	Total Value of Vulnerable Parcels	% of Total Borough Value
Vacant (1)	$40,024,316	$29,202,761	$0	$29,202,761	73%
Residential (2)	$348,435,140	$124,734,709	$47,413,303	$172,148,012	49%
Commercial (4A)	$41,084,753	$8,149,865	$4,427,061	$12,576,926	31%
Apartment (4C)	$18,614,000	$3,840,000	$6,660,000	$10,500,000	56%
Public School Property (15A)	$5,919,100	$0	$0	$0	0%
Public Property (15C)	$22,977,300	$13,136,200	$643,375	$13,779,575	60%
Church/Charitable (15D)	$10,461,000	$1,999,700	$4,607,374	$6,607,074	63%
Cemeteries/Graveyards (15E)	$1,237,700	$0	$0	$0	0%
Other Exempt (15F)	$1,975,800	$484,700	$79,309	$564,009	29%
Total	**$490,729,109**	**$181,547,935**	**$63,830,421**	**$245,378,356**	**50%**
Taxable Value	**$448,158,209**	**$165,927,335**	**$58,500,364**	**$224,427,699**	**50%**

Table 9 reveals that a **100% loss of land value** associated with 1,219 vulnerable lots would result in an overall loss (land value plus structure value) of $224.4 million, or 50% of the total assessed value of the Borough, based on Tuckerton's present day property values.

[24] 10% or greater inundation

Table 8: Exposure Value - Vulnerable Parcels
2050 Sea-Level Rise with 1% Annual Flood (50% Extinguished Land Value)

Property Class (Class Code)	Total Borough Value	Value of Vulnerable Land	Value of Vulnerable Improvements	Total Value of Vulnerable Parcels	% of Total Borough Value
Vacant (1)	$40,024,316	$22,289,166	$0	$22,289,166	55%
Residential (2)	$348,435,140	$106,402,124	$44,386,260	$150,788,383	43%
Commercial (4A)	$41,084,753	$7,211,783	$4,376,309	$11,588,091	28%
Apartment (4C)	$18,614,000	$3,840,000	$6,660,000	$10,500,000	56%
Public School Property (15A)	$5,919,100	$0	$0	$0	0%
Public Property (15C)	$22,977,300	$10,757,000	$643,375	$11,400,375	50%
Church/Charitable (15D)	$10,461,000	$1,819,600	$4,607,374	$6,426,974	61%
Cemeteries/Graveyards (15E)	$1,237,700	$0	$0	$0	0%
Other Exempt (15F)	$1,975,800	$322,350	$79,309	$401,659	20%
Total	**$490,729,109**	**$152,642,022**	**$60,752,626**	**$213,394,647**	**44%**
Taxable Value	**$448,158,209**	**$139,743,072**	**$55,422,569**	**$195,165,640**	**44%**

Table 10 assumes a **50% loss in land value** for parcels inundated in the event of a 1% flood, in addition to the parcels subject to 2050 Sea Level Rise inundation. This alternative assumes that the decline in land value would apply to all inundated parcels, including those with elevated structures. Under this alternative, the total loss (value of exposed land and structures) would amount to $195 million or approximately 44% of the Borough's net taxable assessed value.

Table 9: Exposure Value - Vulnerable Parcels
2050 Sea-Level Rise with 1% Annual Flood (0% Extinguished Land Value)

Property Class (Class Code)	Total Borough Value	Value of Vulnerable Land	Value of Vulnerable Improvements	Total Value of Vulnerable Parcels	% of Total Borough Value
Vacant (1)	$40,024,316	$15,217,470	$0	$15,217,470	38%
Residential (2)	$348,435,140	$66,638,638	$44,386,260	$111,024,898	32%
Commercial (4A)	$41,084,753	$5,923,700	$4,376,309	$10,300,009	25%
Apartment (4C)	$18,614,000	$3,840,000	$6,660,000	$10,500,000	56%
Public School Property (15A)	$5,919,100	$0	$0	$0	0%
Public Property (15C)	$22,977,300	$8,377,800	$643,375	$9,021,175	39%
Church/Charitable (15D)	$10,461,000	$1,639,500	$4,607,374	$6,246,874	60%
Cemeteries/Graveyards (15E)	$1,237,700	$0	$0	$0	0%
Other Exempt (15F)	$1,975,800	$160,000	$79,309	$239,309	12%
Total	**$490,729,109**	**$101,797,108**	**$60,752,626**	**$162,549,734**	**33%**
Taxable Value	**$448,158,209**	**$91,619,808**	**$55,422,569**	**$147,042,377**	**33%**

Table 11 assumes **no loss in land value** for parcels inundated in the event of a 1% flood, in addition to the parcels subject to 2050 Sea Level Rise inundation. This alternative assumes that the impacts of inundation would be applicable to all parcels within the inundation extent, including those with elevated structures. Under this alternative, the total loss (value of exposed land and structures) would amount to $147 million or approximately 33% of the Borough's net taxable assessed value.

CONCLUSION

The preceding analysis indicates that, **if no actions are taken to minimize future risk**, under the 2050 Sea Level Rise projection of 1.48 feet, 55% of the area of Borough, or over 1,100 acres – encompassing 620 parcels - would be exposed to flood inundation. The land value and the value of the structures currently constructed on the parcels subject to inundation would amount to over $135 million dollars, or 30% of the net taxable assessed value of the community, based on the Borough's present day valuation.

By 2050, a 1% storm, coupled with projected sea level rise would double the number of parcels that would be at risk of inundation to over 1,200, exposing 66% of the area of the Borough to flooding. The loss in the Borough's assessed value from the impact of such inundation is estimated to range from $150 million to $224 million, or from 34% to 50% of the total assessed value of the community. In addition, the above analysis indicates that more than 66% of the area of the Borough (1,372 acres) currently located within high-risk FEMA flood zones are zoned for residential and commercial development. Furthermore, over 96% (1,154 acres) of the Borough's wetlands areas are located in high-flood risk AE or VE flood zones. These areas currently provide spawning, foraging, and nesting habitat and are the Borough's first line of defense against flooding and storm surge providing critical protection to the adjacent residential and commercial areas.

This vulnerability and exposure analysis is intended to serve as the basis for an informed discussion among the elected and municipal officials of Tuckerton Borough and between the municipal officials and the residents of the community about how best to prepare for and adapt to potential risks associated with projections of sea level rise and increasing flooding. A thorough assessment is the first step in a long process in which the Borough will need to to decrease risk and vulnerability. The information presented in this report should better equip the Borough to make sound near- and long-term land use planning and development decisions and formulate efficient and effective public investment strategies to guide recovery management, reconstruction, resiliency and adaptation measures. To that end, the data raises several questions, including but certainly not limited to:

- What types of infrastructure should the Borough invest in that are most resistant to flooding, and can improve stormwater management capacity, particularly in those areas that are projected to be at risk?
- What strategies should the Borough pursue to protect residential and commercial development in vulnerable areas along the coastline as well as the infrastructure that serves these areas?
- What measures can be taken to preserve, protect and extend the Borough's coastal marshes and wetlands that currently serve as protective buffers? What is the likely impact to the economy and quality of life if these important natural resources revert to open water as a consequence of inundation?
- What emergency response measures can the Borough put in place in the event that flooding makes critical evacuation routes impassable?
- What land use strategies can be employed to help gradually shift development to areas that would avoid or minimize risks of exposure to future flooding and inundation? How can those strategies be designed to best protect the safety of the residents at risk areas, retain community character and preserve the Borough's economic stability?
- How can the Borough most effectively engage residents in discussion about vulnerability as well short- and long-term strategies that would be most suited to respond to potential risk?
- In view of the fact that effect strategies to address vulnerability may entail regional responses, what are the appropriate county, state and federal-level partnerships the Borough needs to foster to help manage future challenges?
- What interim measures are needed, such as modifications/updates to floodplain management regulations, building codes and elevation standards to ensure public safety? Are current standards effective and what monitoring measures should be enacted to gauge the need for regulatory changes over time?

CHAPTER 4 GETTING TO RESILIENCE PROCESS AND RECOMMENDATIONS

As noted previously, the Borough participated in a "Getting To Resilience" process that was facilitated by Jacques Cousteau National Estuarine Research Reserve (JCNERR) staff. The Getting to Resilience process started as a facilitated discussion regarding the Borough's strengths, weaknesses, and hurdles concerning resiliency.

The GTR questionnaire is broken into five sections: Risk and Vulnerability Assessments, Public Engagement, Planning Integration, Disaster Preparedness and Recovery, and Hazard Mitigation Implementation. In order to efficiently answer all of the questions within the questionnaire, participation from a wide array of municipal officials and staff is encouraged. These can include administrators, floodplain managers, emergency managers, stormwater managers, public works officials, town engineers, and appointed and elected officials. For Tuckerton this team included Marilyn Kent (Deputy OEM Coordinator), Phil Reed (Construction Official), Jenny Gleghorn (Administrator / Borough Clerk), James Edwards (Council President), Leah Yasenchak (NJ Future Local Recovery Manager). The questions in the GTR questionnaire were answered collectively by this group with JC NERR staff recording answers and taking notes on the discussions connected to each question.

The Getting to Resilience questionnaire was started with the town on March 20th. JC NERR staff met with representatives of both Tuckerton and Little Egg Harbor and one representative of NJ Future. A discussion of the towns' resilience strengths and weaknesses began the meeting. On March 27th, the questionnaire was completed.

Upon completion of the GTR questionnaire, JC NERR staff analyzed the answers provided by the Borough of Tuckerton; linkages provided by the GTR website; notes taken during the discussion of questions; various municipal plans and ordinances; and mapping of risks, hazards, and vulnerabilities provided by Rutgers University and the NJ Floodmapper website. After reviewing all of this information, this recommendations report was drafted to help assist Tuckerton's decision makers as the Borough works to recover from Superstorm Sandy and become more resilient.

The majority of the recommendations are related to communications and outreach activities, including ensuring that residents and businesses are aware of their vulnerability to storm events and flooding. However, there are also recommendations related to planning, and Borough ordinances.

These recommendations have been integrated into this report's recommendations chapter and implementation matrix.

The complete report is attached as ***Appendix 2 Getting To Resilience Recommendations Report***

CHAPTER 5 ASSESSMENT OF EXISTING PLANNING DOCUMENTS

As a necessary precursor to identifying priority actions that are most urgently needed to improve public safety, increase resistance from damage from future storms and stimulate economic recovery, ten recent plans and studies were reviewed. These included the Borough's master plan and subsequent amendment, a revitalization plan, the county All Hazards Mitigation plan, the Municipal Facility Consolidation plan, and the FEMA recovery management plan. ***Table 7*** provides a list of the plans and studies reviewed for this SRPR.

Table 7 - Planning Documents Examined

Name	Author	Date
Master Plan		2002
Master Plan Amendment		2007
Tuckerton Revitalization Plan	Tuckerton Revitalization Committee	2012(?)
Tuckerton Recovery Management Plan	FEMA	2013
Ocean County All Hazards Mitigation Plan	Ocean County	2014
Tuckerton Municipal Facility Consolidation Plan	Borough of Tuckerton	2013
Tuckerton Getting to Resiliency Recommendations Report	JC NERR, Rutgers	2014
Natural Resource Inventory	Tuckerton Environmental Commission	undated
Stormwater Pollution Prevention Plan	PMK Group	2005
Borough Emergency Management Plan	Tuckerton Office of Emergency Response	2009

A review of these ten plans and studies, along with discussions at meetings with FEMA representatives in the year following the storm, reveals 65 separate recommendations listed in ***Chapter 7: Implementation Matrix***.

This assessment of the Borough's existing planning documents, land-use regulations and other related regional or state plans are primarily intended accomplish three objectives:

1. Determine whether such documents contribute to or create obstacles for implementing the municipality's recovery strategies, and;
2. Determine the extent to which such documents account for the likelihood of future storms and impacts of climate change, most particularly sea-level rise in the case of coastal communities, and;
3. Recommend opportunities to modify, update and/or strengthen current plans and regulations to better equip the Borough to effectively accomplish recovery strategies and address climate changes.

1. MASTER PLAN

The 2002 Master Plan describes the community, provides descriptions of the zoning categories, and seeks to provide a framework for the development of Tuckerton Borough and the Greater Tuckerton Town Center into a community of place and achieve a balance between the needs of current residents, future economic development and environmental conservation. The primary thrust of the recommendations is to preserve the maritime nature and history of the Borough, revitalize commercial districts, and accommodate more transportation alternatives to include biking and walking. There is no explicit discussion of flooding or building to enhance resiliency from a disaster-resistant standpoint. In 2007 a Reexamination of the Master Plan was conducted. This plan confirmed the objectives laid out in the 2002 plan, with an increased emphasis on natural resource and wetlands protection, open space preservation, and development of walking trails. The reexam discussed the impervious coverage requirements stipulated by the Coastal Permit Program, the stormwater management plan, and

included a recommendation to explore Best Management Practices to improve the water quality of Lake Pohatcong and to consider the establishment of an open space tax. The Plan's goals and recommended actions do not account for the likelihood of future storms, climate change or sea-level rise. The next reexamination of the plan is already overdue, and the next iteration should add such considerations. This should be supplemented by additional data gathering and analysis using mapping to link recommendations to the level of risk from future storms.

2. TUCKERTON REVITALIZATION PLAN

This plan was developed by the Tuckerton Economic Development Committee (TEDC) formed after Sandy, to provide actionable ideas for the borough's recovery. They examined the re-use of former borough facilities, South Green Street corridor development, Main Street commercial district development, tourism, community trails, beautification, and branding and marketing. Seven specific economic development and revitalization projects were proposed, geared toward economic resiliency. These include the reuses of flood damaged municipal buildings, repairs and improvements to the South Green Street Park and Beach area; and the development of an RV park on the current site of the mobile home park. These measures were designed to take recovery and resiliency into account, promoting such portable development as mobile public restrooms and RVs that could be relocated in the event of another storm.

3. **RECOVERY MANAGEMENT PLAN**

The Tuckerton Recovery Management Plan provides a strategy for FEMA assistance in the Borough's recovery via project-oriented approaches to build resiliency and capacity to help Tuckerton recover from future disasters. Specific projects mentioned are the repairs to South Green Street Park and the South Green Street sewer line / water line repair project.

4. **OCEAN COUNTY ALL HAZARD MITIGATION PLAN**

The Borough of Tuckerton is part of a County-wide planning effort to develop the 2013 Multi-Jurisdictional All Hazard Mitigation Plan for Ocean County, recently approved by FEMA. The HMP was developed to provide a blueprint for saving lives and reducing property damage from the effects of future natural and man-made disasters in Ocean County; qualifying the County for pre-disaster and post-disaster grant funding; complying with state and federal legislative requirements related to local hazard mitigation planning; demonstrating a firm local commitment to hazard mitigation principles; and improving community resiliency following a disaster event. Tuckerton was an active participant in the development of the plan, participating in meetings and providing recommendation worksheets. The plan examined hazards to include flooding, but also coastal erosion, drought, earthquakes, extreme temperatures, storms, fires, environmental hazards, nuclear hazards, transportation accidents, power outages, and climate change. The plan notes that bayside communities are particularly vulnerable to sea level rise brought about through climate change. Nineteen individual recommendations specific to the Borough are included in the plan.

5. **TUCKERTON MUNICIPAL FACILITY CONSOLIDATION PLAN**

This plan was developed post-Sandy in response to the damage sustained to the Police Station building as a result of the storm. The Borough proposed relocating the police station outside of the flood zone to ensure the essential services remain available to Tuckerton residents. Several options were considered, with the preferred option the vacant Coastal Learning Center which could accommodate the police station, the municipal administrative offices, the Office of Emergency Management, and the Tuckerton Borough Court. The plan also considers the reuse of the buildings that currently provide these services.

6. **TUCKERTON GETTING TO RESILIENCY RECOMMENDATIONS REPORT**
Tuckerton participated in a joint Tuckerton / Little Egg Harbor series of meetings to work through a detailed questionnaire designed to assist the communities in reducing vulnerability and increase preparedness by linking planning, mitigation, and adaption. The resulting Tuckerton-specific report provides recommendations on improvements that the Borough can make to become more resilient, while gaining additional points through the Community Rating System.

7. **NATURAL RESOURCES INVENTORY**
This report provides a baseline on the physical resources, biotic resources, and current land uses of the Borough. Resources described include soils, vegetation, water bodies, wildlife, municipal infrastructure, historic resources, and a land use inventory. Water bodies within Tuckerton are Lake Pohatcong, Mill Creek, Thompson's Creek, Jesse's Creek, Jeremy's Creek, Sapp's Creek, Tuckerton Creek, Little Egg Harbor and a series of manmade lagoons. Floodplains are also discussed, with the floodplain of Tuckerton Creek noted as the most susceptible to flooding impacts, as well as areas with tidal influence such as Tuckerton Beach. A description is also provided of Lake Pohatcong Dam, which, at the time of the writing of the report, was classified as a high hazard dam (Class II) by the NJDEP Division of Dam Safety. Heavy rainstorms cause water to overtop the dam and flood adjacent properties.

8. STORMWATER POLLUTION PREVENTION PLAN
The Stormwater Pollution Prevention Plan (SPPP) is a prescriptive plan that describes in detail the permittee's implementation of the Statewide Basic Requirements (SBRs) in accordance with the specific permit requirements. This includes:

- Post-construction Stormwater Management in New Development and Redevelopment
- Local Public Education
- Improper Waste Disposal
- Solids and Floatable Control
- Maintenance Yard Operations
- Employee Training

The report notes that Tuckerton was examining the applicability of storm drain upgrades for the Tuckerton Beach area to mitigate flooding problems from Little Egg Harbor Bay. The flooding is influenced by high tides and excessive precipitation, which causes reverse flow from the outfalls to the storm drains carrying debris. The infiltration may include floatable objects which can cause blockage and complicate normal drainage once the water recedes.

9. BOROUGH EMERGENCY MANAGEMENT PLAN
The most recent approved Emergency Operation Plan for the Borough of Tuckerton is dated March 1, 2009. At the time of this writing, approval was pending on a revised plan which had been developed and submitted to the State. The plan is divided into multiple sections, each focused on a different area of concern. The plan lays out the current configuration of emergency responses and communications, and describes the processes to be carried out in the event of a disaster along with information on who the authority transitions to in the event that the designated individual is unable to fulfill the duties.

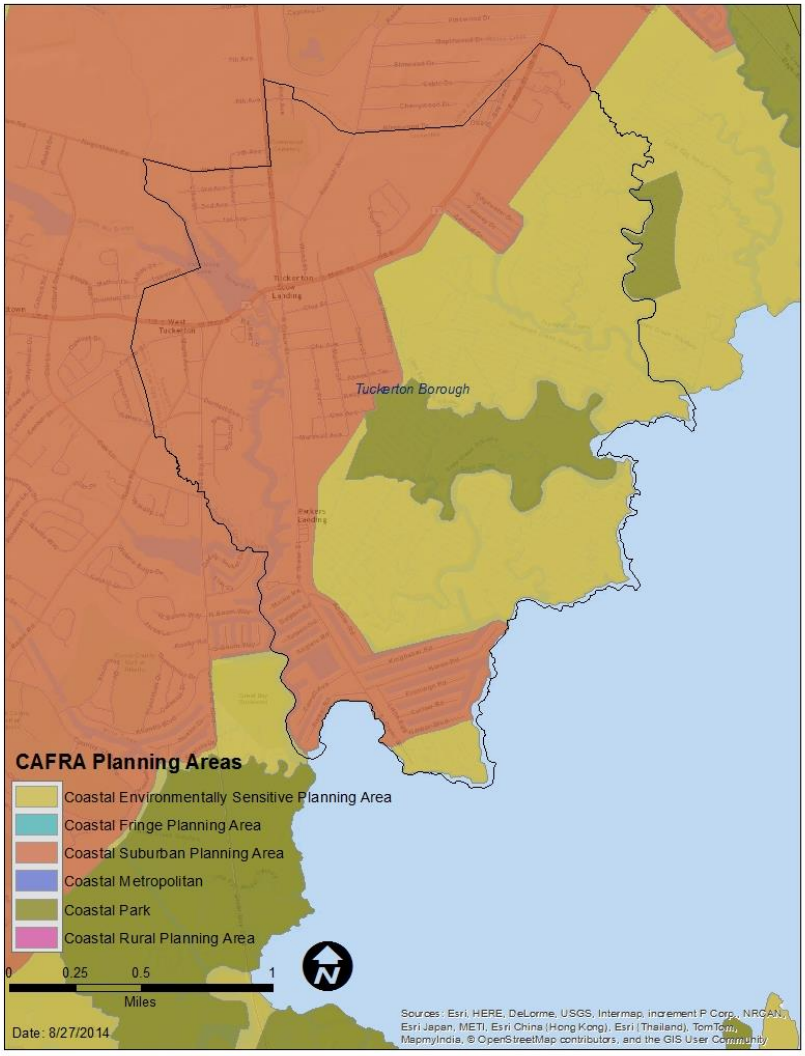
10. ASSESSMENT OF ZONING ORDINANCE FOR BOROUGH'S RECOVERY STRATEGIES
A summary assessment of Tuckerton's land use patterns and zoning regulations was provided in Chapter 1 of this Report. The Borough has taken the proactive step of adopting a floodplain management ordinance which requires that the lowest floor be elevated to or above base flood elevation and required Freeboard in A1-30 or AE zones, and in AO zones elevated above the highest adjacent grade at least as high as the depth number specified in feet (at least two feet if no depth number is specified) or

applicable freeboard, whichever is greater. A comprehensive review of all applicable ordinances in light of vulnerability projections is recommended.

11. COMPARISON WITH REGIONAL/STATE (CAFRA, COASTAL MONMOUTH PLAN)

The Coastal Area Facility Review Act (CAFRA) was enacted by the state of New Jersey in 1973. The Act is designed to protect the vital shore areas of New Jersey from being overdeveloped. In accordance with CAFRA, residential development, commercial development, industrial development, and public development in these areas are regulated through permitting from the New Jersey Department of Environmental Protection (NJDEP). Development activities include construction, relocation and enlargement of buildings or structures; and all related work, such as excavation, grading, shore protection structures and site preparation structures, and site preparation. This includes any excavation, clearing or grading of dunes, placement of sand, construction of revetment and retaining walls and bulkheads, and filling or grading of beaches. CAFRA zones extend through eight counties of New Jersey, from the coastline of Middlesex County south to Cape May County, west following the Delaware River to Salem County. The entire area of the Borough of Tuckerton is located within a CAFRA Planning Area, comprised of Coastal Park, Coastal Environmentally Sensitive Planning Area, Coastal Suburban Planning Area. Development restrictions commensurate with each of these designations are in place.

Figure 14: CAFRA Planning Areas



CHAPTER 6 RECOMMENDATIONS FOR ACTION

Chapter 5 offers an overview of the plans and studies undertaken by the Borough that relate to future development, resiliency planning, disaster response, and recovery. Many of these plans contained recommendations for future action. A compilation of these recommendations resulted in 65 individual recommendations (listed in ***Chapter 7, Implementation Matrix***). A subset of these actions, as well as some additional projects proposed by Princeton Hydro, an environmental resources management/restoration firm hired to evaluate the Borough's resiliency projects, was developed in concert with representatives of the Borough of Tuckerton and evaluated further by Princeton Hydro.

For each project, Princeton Hydro considered and evaluated the mitigation ranking, the process and feasibility of implementation, regulations and permitting requirements, potential funding options, and anticipated costs.

Each identified project was categorized into one of three categories: (1) infrastructure projects, (2) accessibility projects, and (3) economic sustainability projects. Infrastructure projects will evaluate and reinforce critical infrastructure throughout the Borough to minimize service disruptions, damage, and costs during a storm event. Accessibility projects are proactive measures to ensure emergency response is not hindered during a storm event. Economic Sustainability projects may have components that directly support mitigation, but largely will not reduce damage or loss during a storm event. Instead these projects minimize the long-term economic damage experienced by the Borough of Tuckerton by maintaining its residential, recreational and tourist value, and stabilizing its tax base.

Each project was further ranked as high, medium, and low resiliency, as defined by the following criteria:

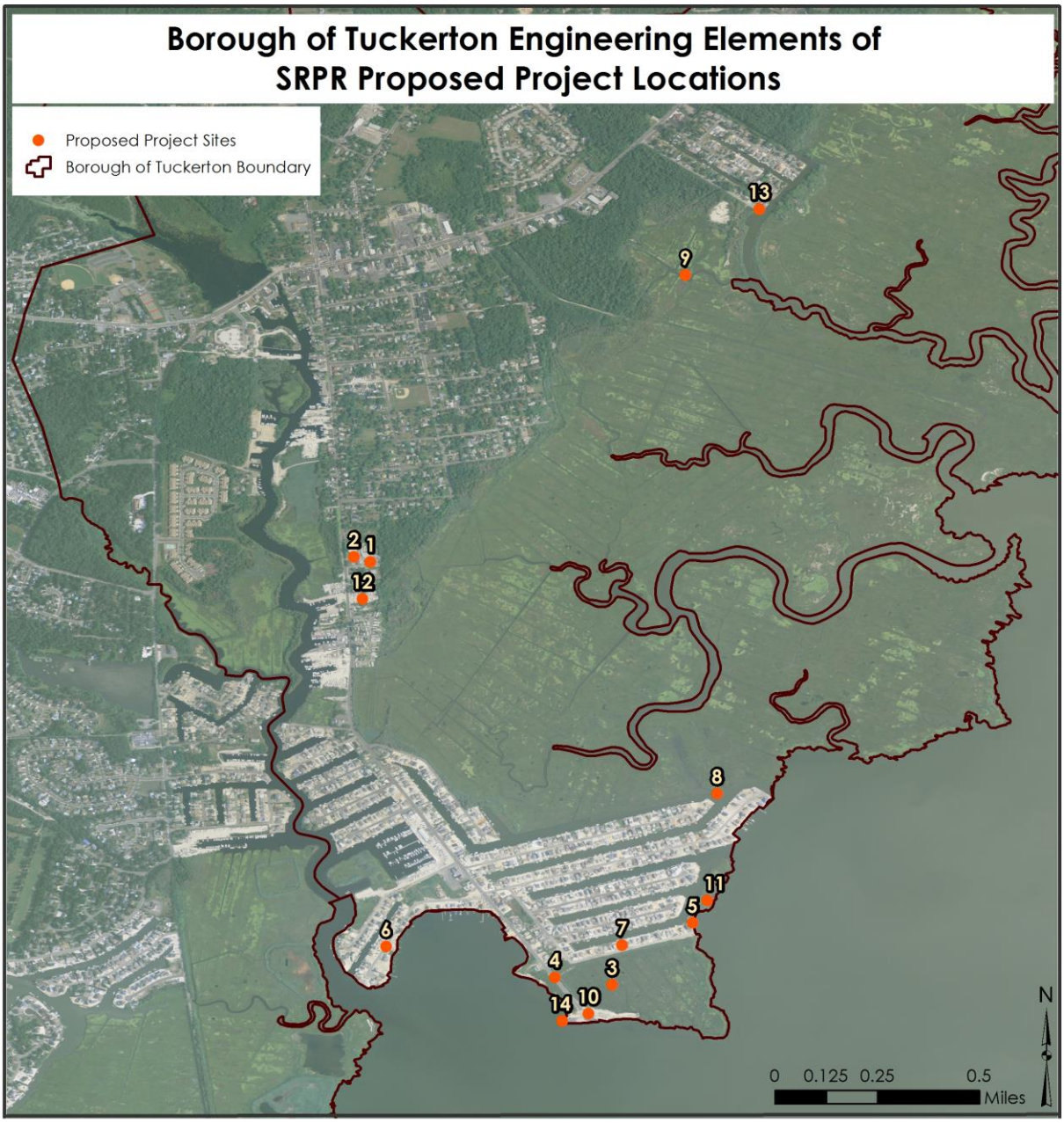
HIGH: Provides public health, safety and flood loss protection for existing and future storm conditions, including sea level rise. Has been designed or assessed to manage risk from a 1% annual chance event as depicted on the best available data (currently the Preliminary Flood Insurance Rate Map) plus sea level rise projection to 2050 (critical facilities to existing 500-year flood elevation). Facility is safe to occupy during a disaster and expected to require no measurable repairs post disaster. If infrastructure, there is an expectation that service will be uninterrupted, and will be accessible to emergency services during and after the disaster.

MEDIUM: Provides public health, safety and flood loss protection for existing storm conditions but does not specifically account for future conditions including sea level rise. Has been designed or assessed to manage risk from a 1% annual chance event as depicted on the vest available data (currently the Preliminary Flood Insurance Rate Map.) Facility is not to be designated for occupation during a disaster. Minor repairs are expected post disaster. If infrastructure, there is an expectation that service may be interrupted, and may not be accessible to emergency services during and after the disaster.

LOW: Provides limited to no public health, safety and flood loss protection for existing storm conditions and lunar high tides. Has been assessed to be at risk from a 1% annual chance event or lesser event as depicted on the best available data (currently the Preliminary Flood Insurance Rate Map.) Facility should be evacuated of people and contents during a disaster. Major repairs are expected post disaster. If infrastructure, there is an expectation that service will be interrupted, and will not be accessible to emergency services during and after the disaster. May provide value in other ways to the community such as quality of life, accessibility, reduced maintenance and/or economic benefits to municipality or businesses.

List of Projects:

1) Elevate Pump Houses and Equipment
2) Water Supply Infrastructure Study and Replacement of Interconnection with Little Egg Harbor Municipal Utilities Authority
3) Infiltration and Inflow Study of Sewers and Necessary Improvements
4) Waterproof Manholes in Flood prone Areas
5) Little Egg Harbor Boulevard Flood Protection Project
6) Crowning of Parker Road
7) Crowning of Little Egg Harbor Boulevard
8) Extension of Barrier into Marsh off Kingfisher Road
9) Dredging of Thompson Creek
10) Restoration of Green Street Park Amenities
11) Buy Washed out Properties
12) Demolition of Police Department
13) Dredging of Paradise Cove
14) Beach Nourishment at Green Street Park



Project List

1) Elevate Pump Houses and Equipment
2) Water Supply Infrastructure Study and Replacement of Interconnection with Little Egg Harbor Municipal Utilities Authority
3) Infiltration and Inflow Study of Sewers and Necessary Improvements
4) Waterproof Manholes in Floodprone Areas
5) Little Egg Harbor Boulevard Flood Protection Project
6) Crowning of Parker Road
7) Crowning of Little Egg Harbor Boulevard
8) Extension of Barrier Marsh off Kingfisher Road
9) Dredging of Thompson Creek
10) Restoration of Green Street Park Amenities
11) Buy Washed-Out Properties
12) Demolition of Police Department
13) Dredge Paradise Cove
14) Beach Nourishment at Green Street Park

Princeton Hydro

ELEVATE PUMP HOUSES AND EQUIPMENT

Location: All pump stations located within the FEMA identified special flood hazard area: Tuckerton Beach, Holly Lake, Water Treatment Facility, Kelly Avenue, Fairway Drive, and Borough Hall

Project Description

Six (6) of the seven (7) pump stations within the Borough's wastewater and sewage system experienced damage during Sandy. After the storm, the Borough sought to repair the damage to these lift stations and secure generators to minimize service disruption due to power outages. However, given the extent of damage to the controls in these stations, they will remain vulnerable to flooding, saltwater intrusion, and damage unless they are elevated.

In determining the level of protection required to enhance resiliency, it is important to know the elevation of the floodwater experienced, the elevation of the existing pump stations and the flood zone designation and elevation from the FEMA Preliminary FIRM maps that are the best available data. This information will aid in assessing the impacts of the pump stations resulting from backflow, Infiltration and Inflow (I/I) and surface flooding.

Mitigation and Resiliency Benefits

When the sanitary sewer system fails in a storm event, raw sewage backs up into the streets, buildings, and residential homes that do not have backflow preventers installed. If the system cannot find an outlet for extra volume it takes on, pipes will fail, leaks may occur, and the systemic damage requires greater repairs and investigation after the storm. Ensuring that the lift stations can continue to operate during the storm, despite flooding and power loss, will minimize the damage caused by sewage overflows and the disruption in sanitary services after the storm passes.

The elevation of the pump house and associated equipment would be a "High Resiliency" ranked Infrastructure project. The public health and safety needs from future storm events will be maintained. And environmental pollution will be prevented. The pump stations will be safe to occupy during and after the event and the service interruptions should be kept to a minimum.

Priority:	High
Stakeholders:	Tuckerton Borough M.U.A. Ocean County Utilities Authority (OCUA) NJDEP Municipal Finance and Construction Element. NJDEP – Land Use Regulation
Permits needed:	NJDEP Treatment Works Approval (TWA) NJDEP CAFRA / Waterfront Development may be required depending on the location of the individual Pump Stations. Soil Erosion and Sediment Control Plan Certification
Estimated Cost:	Base Cost per Pump Station: $15,000 Cost per addl. foot of elevation: $2,500

Implementation

Six (6) of the seven (7) pump stations have been identified and fall within the AE zone as identified on the FEMA Flood Mapping with a static base flood elevation of 7.0 feet. Given the extent of the damage experienced from the surge during Sandy, Tuckerton Borough amended its Flood Damage Prevention Ordinance to include three (3) feet of freeboard to account for sea level rise and uncertainty in future conditions.

Based on the review of the existing pump station locations, approximate ground elevations (from readily available on Google Earth), which ranged from 3 feet to 9 feet, and NJDEP Mapped Coastal Wetlands, the pump stations will require significant elevation in some cases.

The following permits are anticipated to be required:

1. NJDEP Treatment Works Approval (TWA)
2. NJDEP CAFRA or Waterfront Development (depending on Pump Station)
3. Soil Erosion and Sediment Control Plan Certification

The NJDEP – Municipal Finance and Construction Element regulates the construction and operation of industrial and domestic wastewater collection, conveyance and treatment facilities, including treatment plants, pumping stations, interceptors, sewer mains and other collection, holding and conveyance systems. The program is aimed at protecting the waters of the state by preventing the entry of increased pollutants from inadequate facilities. The administrative and technical requirements of the Treatment Works Approval (TWA) program are stipulated in N.J.A.C. 7:14A-22 and 23, respectively.

In accordance with NJAC 7:14A-22.5(d) the Department shall approve, condition, or deny an application for a treatment works approval within 90 days of receipt of a complete application by the Department. This time period may be extended for one thirty (30) day period upon the mutual consent of the applicant and the Department. The Coastal Area Facility Review Act of 1973 (CAFRA) established the CAFRA zone, as the bounds of CAFRA regulation. Certain activities undertaken within the CAFRA zone are regulated in accordance with N.JAC 7:7 2.1(b)(2)(i). For most coastal applications, the statutory deadline is 90 days.

The waterfront area includes all man-made waterways and lagoons subject to tidal influence found within the Hackensack Meadowland Development District, the CAFRA Zone and all lands lying thereunder up to and including the mean high water line. For the remainder of the state, additional waterfront areas are also regulated and include all tidal waterways and lands lying thereunder up to and including the mean high water line and adjacent upland areas within 100 feet of the mean high water line. Furthermore, for properties within 100 feet of the mean high water line that extend beyond 100 feet of the mean high water line, the regulated waterfront area extends inland to the lesser of 500 feet from the mean high water line or to the first paved public road, railroad, or surveyable property line generally parallel to the waterway that existed on September 26, 1980. Based on the NJDEP GIS mapping it is possible that several of the pump stations would require waterfront development approval instead of CAFRA approval. For most waterfront development applications, the statutory deadline is 90 days.

A Soil Erosion and Sediment Control Plan Certification is required for soil disturbance in excess of 5,000 square feet. Once the design of each of the pump stations is completed and the limit of disturbances is determined the appropriate soil erosion certifications will be obtained from the Ocean County Soil Conservation District.

Timeframe

Design: including survey – six (6) months per pump station.
Permitting: including preparation, submittal and review – five (5) months.
Construction: including bidding and construction – four (4) months.
The total timeframe for the elevation of each pump station is approximately fifteen (15) months.

Limitations

Due to the fact that Princeton Hydro was not provided with Construction As-Built Plans of each of the pump stations, sizes of pumps or elevations of pump stations the budgets above are generalized and should be considered order of magnitude costs only. The timelines are provided for general planning purposes; however, they are subject to change pending additional details on the pump stations.

Borough of Tuckerton
Pump Station Locations
PS Pump Station
Borough of Tuckerton Boundary
PS
PS
PS
PS
PS
PS
PS
N
0 0.125 0.25 0.5
Miles

WATER SUPPLY INFRASTRUCTURE STUDY AND REPLACEMENT OF INTERCONNECTION WITH LITTLE EGG HARBOR MUNICIPAL UTILITIES AUTHORITY

Location:
Borough-wide

Project Description
Two (2) deep wells for public water supply draw on the Atlantic City's 800 foot Sand Kirkwood-Cohansey Aquifer. According to an account by the Municipal Utilities Authority, the top of the well encasements were just high enough in elevation to not be influenced by the flooding from Sandy. The electrical system sustained saltwater saturation damage and disabled the system until a repair was complete. With the dislocation of homes from foundations due to Sandy's energy, certain water supply mains remained shut off until broken lines could be stabilized. The 1.2 million gallon water storage tank was not impacted by the flooding. The replacement of an inoperable water supply interconnection with the Little Egg Harbor Municipal Utilities Authority is needed. Losses are still being experienced in the system and it is unclear if Sandy influenced this leakage. A leak detection evaluation is planned to identify the causation as well as the long needed mapping of the existing water supply system.

(Photo courtesy of the Food & Water Worth, New Jersey)

Mitigation and Resiliency Benefits
When the water system is compromised during a storm event, contamination of the water supply is the result and impacts to the public health and safety of the community are realized. The interception of floodwater by the wells would require disinfection and it was suggested that the wellheads be secured to the 0.2% annual (500-year) flood water surface elevation to avoid contamination. The replacement of the inoperable water supply interconnection with the Little Egg Harbor Municipal Utilities Authority would further provide a safe and temporary water supply solution to ensure the distribution of potable water to the residents of Tuckerton Borough during a threat to the water system, such as a storm event. Redundancy is a basic tenet of resiliency.

In addition, the water supply infrastructure leak detection evaluation and mapping of the water supply system would provide additional benefits such as:

1. The identification of potential issues or critical areas in the system. Corrections/Modifications can be made in a timely and cost effective manner.
2. The identification of the exact locations of all components of the system, in the event that a repair/replacement is necessary.
3. Properly maintained system.

Funding may be available through the New Jersey Environmental Infrastructure Trust. The SAIL Bridge Loan Program is now available to assist with the financing for projects to repair Sandy damaged infrastructure and improve the resiliency of the Clean Water and Drinking Water Systems. The goal of SAIL is to provide timely and cost effective funds in order to expedite and support the State's recovery and rebuilding of environmental infrastructure. The Sandy NJEIFP Loan program is also available for environmental infrastructure projects to improve the resiliency of Hurricane Sandy damaged systems in future natural disasters.

The Water Supply Infrastructure Study and associated Improvements would be a "High Resiliency" Infrastructure ranked project. The public health and safety needs for future storm events will be

maintained. The water system will be safe and secure during and after the event and the service interruptions should be kept to a minimum. If the system does become compromised, the repair/replacement of the water interconnection with the Little Egg Harbor Municipal Utilities Authority will provide a safe and temporary water supply solution to ensure the safe distribution of water supply.

Implementation
A leak detection evaluation is planned to identify the causation as well as the mapping of the water supply system and the replacement of the inoperable water supply interconnection with the Little Egg Harbor Municipal Utilities Authority.

The leak detection evaluation does not require any Permits.

The interconnection with the Little Egg Harbor Municipal Utilities Authority will require a NJDEP Safe Drinking Water Permit, NJDEP CAFRA Permit and Soil Erosion and Sediment Control Plan Certification.

The Safe Drinking Water Act Rules implement New Jersey's Safe Drinking Water Program for the purpose of ensuring the provision of safe drinking water to consumers, and enabling the Department to assume primary enforcement responsibility under the Federal Safe Drinking Water Act, P.L. 93-523, 42 U.S.C. §§ 300f et seq. The Safe Drinking Water Program also ensures the provision of safe water of adequate pressure and volume by implementing portions of the Water Supply Management Act addressing storage, emergency plans and reducing unaccounted for water and by issuing physical connection permits under the N.J.S.A. 58:11-9.1 et seq.; and by establishing standards for construction and procedures for certifications. For most Bureau of Safe Drinking Water applications, a decision is made within 90 days.

The NJDEP Coastal Area Facility Review Act of 1973 (CAFRA) established the CAFRA zone, as the bounds of CAFRA regulation. Certain activities undertaken within the CAFRA zone are regulated in accordance with N.JAC 7:7 2.1(b)(2)(i). For most coastal applications, the statutory deadline is 90 days.

A Soil Erosion and Sediment Control Plan Certification is required for soil disturbance in excess of 5,000 square feet. Once the design of interconnection is completed and the limit of disturbance is determined the appropriate soil erosion certifications will be obtained from the Ocean County Soil Conservation District.

Timeframe
Water Supply Evaluation: eighteen (18) to twenty-four (24) months for completion.
Interconnection Replacement:
Design: including survey – six (6) months.
Permitting: including preparation, submittal and review – five (5) months.
Construction: including bidding and construction – four (4) months.

Limitations

Priority:	High
Stakeholders:	Tuckerton Borough Municipal Utilities Authority. Little Egg Harbor Municipal Utilities Authority NJDEP Bureau of Safe Drinking Water NJDEP – Land Use Regulation Ocean County Soil Conservation District
Permits needed:	NJDEP – Bureau of Safe Drinking Water NJDEP CAFRA / Waterfront Development Permit Soil Erosion and Sediment Control Plan Certification
Estimated Cost:	Unknown at this time

Due to the fact that Princeton Hydro was not provided with any As-Built Plans of the existing water supply system and the specifics of the interconnection are not known, the budgets above are generalized and should be considered order of magnitude costs only. The timelines are provided for general planning purposes; however, they are subject to change pending additional details on the water supply system.

INFILTRATION AND INFLOW STUDY OF SEWERS AND NECESSARY IMPROVEMENTS

Location:
Borough-wide

Project Description
The Borough of Tuckerton owns and operates the sanitary sewer collection system that conveys untreated sewage to the Ocean County Utilities Authority. Water supply and sanitary sewer service was substantially disrupted during Sandy due to inundation, leaks and breaks in the system and power loss in the Borough. High tides, without the influence of storms, create infiltration and inflow increases, whereby lift station capacity if exceeded causes a surcharge of untreated wastewater by the receiving treatment facility, in this case, Ocean County Utilities Authority.

Although FEMA Public Assistance funding compensated the Borough for repairing damaged pump stations, no work was authorized or funded for reducing the future risk to the Borough and its residents. It is assumed that the system has leaks and breaks at unknown locations causing excess flows. It would be advantageous to perform an Inflow and Infiltration Study of the collection system to identify areas of special concerns.

Mitigation and Resiliency Benefits
As a result of the sea level rise, ground settling and aging infrastructure, inflow and infiltration problems with the sewer system exist in the Borough of Tuckerton. The additional flow that is being conveyed through the collection system to the Ocean County Utilities Authority treatment facility and additional charges to the Borough from the Ocean County Utilities Authority are realized due to an additional load to their system.

Furthermore, when the Tuckerton Borough sanitary sewer system reaches capacity or becomes overloaded, wastewater flows at much high water levels than normal, and if sanitary fixtures or drains are below this overload level, water will flow backward through the sanitary sewer pipe causing manholes and lift stations to surcharge releasing wastewater into the street and onto the ground and in waterways.

(Photo courtesy of Magic Sewers at magic-mm.com/magicsewers.com)

Overflow occurrences put public health at risk and violate state and federal environmental regulations. Sanitary sewer overflows release wastewater and potential pathogens onto streets, into waterways and basements increasing potential health risks. As wastewater overflows into creeks, rivers, lakes and streams, it contaminates all bodies of water fed by the waterways and all animals/plants coming in contact with the polluted water. Sewer overflows can also contribute to beach advisories and closures due to contamination.

Inflow and infiltration reduces the ability of the sanitary sewer systems and treatment facilities to transport and treat domestic and industrial wastewater.

The Infiltration and Inflow Study and associated Improvements would be a “High Resiliency” Infrastructure ranked project. There is tremendous value to the Borough associated with the detection

of areas contributing to the inflow and infiltration into the existing collection system. Once the areas of concern are identified and the necessary improvements are made the system will not only function more effectively but the health and safety of the residents of Tuckerton will be provided. By correcting the I/I issues in the system, more capacity will be available to allow for the connection of new homes and businesses into the system thus contributing to the future growth of Tuckerton Borough.

Implementation
The Infiltration and Inflow Study does not require any NJDEP permits, however coordination with the Tuckerton Borough Municipal Utilities Authority, Ocean County Utilities Authority and the NJDEP - Municipal Finance and Construction Element is suggested.

Any improvements or upgrades to the system will require a NJDEP Treatment Works Approval and if more than 5,000 square feet of soil disturbance is proposed, a Soil Erosion and Sediment Control Plan Certification from the Ocean County Soil Conservation District may be required.

Timeframe
I/I Study: eighteen (18) to twenty-four (24) months for completion.
Improvements to the system based on I/I Study:
Design: including survey – six (6) months.
Permitting: including preparation, submittal and review – five (5) months.
Construction: including bidding and construction – four (4) months.

Limitations
Due to the fact that Princeton Hydro was not provided with any specific sewer service information, we assumed 19.9 miles of sewers since that is the amount of roadways within the Borough. The budgets above are generalized and should be considered order of magnitude costs only. The timelines are provided for general planning purposes. However, they are subject to change pending additional details on the sanitary sewer system.

Priority:	High
Stakeholders:	Bureau of Tuckerton Municipal Utilities Authority Ocean County Utilities Authority NJDEP – Municipal Finance and Construction Element.
Permits needed:	I/I Study: No permits needed. I/I Improvements: NJDEP – Treatment Works Approval Ocean County Soil Erosion and Sediment Control Plan Certification
Estimated Cost:	Unknown at this time

WATERPROOF MANHOLE COVERS

Location:
For Manholes located in FEMA identified Special Flood Hazard Areas.

Project Description
Manholes provide critical access points to sewer pipes and infrastructure, but during a storm event these access points can let water into the system. Infiltration from flooded streets adds volume to the sanitary sewer system, which can overwhelm the system and lead to back-ups and sewage spills into basements, streets, and waterways.

The Borough of Tuckerton has taken measures in the past to waterproof manhole covers, retrofitted manholes with water resistant inserts and inspected manholes with resulting joint and replacement of watertight inserts. The proposed project would assess the integrity of the waterproofing for manhole covers across flood prone streets in the Borough and address any covers that may be experiencing infiltration.

Mitigation and Resiliency Benefits

Priority:	Medium
Stakeholders:	Tuckerton Borough Municipal Utilities Authority. Tuckerton Borough Department of Public Works.
Permits needed:	No Permits Required
Estimated Cost:	$85,500 ($500 per manhole

Unprotected lids are a source of inflow and infiltration into the system during ponding rain and high tide events. By waterproofing the sewer manholes that are located in flood prone areas, the inflow and infiltration of stormwater into the sewer system will be reduced.

This project is a Medium Resiliency ranked Infrastructure Project. The reduction of stormwater into the sanitary sewer system will lead to a reduction of Inflow and Infiltration (I/I) which will public health and safety benefits.

Implementation
No permitting requirements exist for the proposal to install waterproof covers to the existing manholes within the FEMA designed Special Flood Hazard Area.

Timeframe:
Installation of Waterproof Covers: one (1) month

Limitations :
Due to the fact that Princeton Hydro was not provided with any specific sewer infrastructure maps, we assumed 8.1 miles of sewers within the FEMA designed Special Flood Hazard Area and a manhole every 250 feet, for a total of 171 manhole covers that will be installed.

LITTLE EGG HARBOR BLVD. FLOOD PROTECTION PROJECT

Location:
Little Egg Harbor Boulevard

Project Description
The magnitude of the storm surge experienced during Sandy was represented by the damage realized to the infrastructure throughout the Borough but also the effect it had on the shoreline from Tuckerton Bay, in the area of Little Egg Harbor Boulevard.

The proposed project consists of creating a bulkhead with pedestrian walkway access to enhance the protection for Tuckerton Beach along with the construction of additional recreational amenities.

Mitigation and Resiliency Benefits

As indicated above, the storm surge caused by Sandy was of a magnitude that eroded shorelines and increased sand deposits in navigable waters. The project proposed by the Borough is to install a bulkhead in the area of Little Egg Harbor Boulevard as a means to enhance protection for Tuckerton Beach. The project is intended to assist with the shoreline erosion and to provide protection to the adjacent residential properties along Little Egg Harbor Boulevard.

It is our opinion that this is a Medium Resiliency - accessibility project in that it will provide limited value to the public health, safety and flood loss protection for the existing storm conditions and lunar high tides. The installation of a breakwater will provide energy dissipation and land stabilization in the area where the breakwater is installed, but will not lessen flood inundation. The project will provide attenuation of waves thus providing energy protecting a limited area of the Tuckerton Beach lagoon properties.

Priority:	Medium
Stakeholders:	NJDEP – Land Use Regulation Program US Army Corps of Engineers US Coast Guard Ocean County Soil Conservation District
Permits needed:	NJDEP Waterfront Development US Army Corps of Engineers (ACOE) US Coast Guard Soil Erosion and Sediment Control Plan Certification
Estimated Cost:	$125,000 – $300,000

Implementation:

The following permits are required for the construction of the breakwater and shoreline stabilization project:

- NJDEP Waterfront Development
- Army Corp of Engineers (ACOE)
- US Coast Guard
- Soil Erosion and Sediment Control Plan Certification

Timeframe

It is estimated that it will take nine (9) to twelve (12) months for design and approvals for NJDEP Waterfront Development, ACOE, US Coast Guard and Soil Erosion and Sediment Control Plan Certification to be obtained. Construction efforts, including bidding is estimated to take three (3) months.

Limitations

It is our understanding that the breakwater design and shoreline stabilization measures has been developed by others and potentially have already received permits. The status of funding for this project is unknown and information provided herein is for general planning purposes.

CROWNING OF PARKER ROAD

Location:
Parker Road

Project Description
Parker Road has been known to experience inundation at the Moon Tide. The Borough of Tuckerton proposes to crown the road in order to improve access for emergency vehicles during periods of tidal rise.

Mitigation and Resiliency Benefits
By crowning the road surface of Parker Road, the elevation of the road will be raised, thus allowing first responders and emergency personnel to pass through Parker Road during times when it is inundated at Moon Tides or during storm events.

This project would be identified as a Medium Resiliency – Accessibility project. The crowing of Parker Road will provide public health, safety and flood loss protection to vehicles for existing storm conditions but does not specifically account for future conditions including sea level rise and subsidence of the road. This crowing process must be continually maintained in order to achieve the desired results during tidal rise or storm events.

Implementation
A Soil Erosion and Sediment Control Plan Certification is required for the disturbance of more than 5,000 square feet of land. Depending on the total area of disturbance proposed with the crowning activities, a Soil Erosion and Sediment Control Plan Certification may be required from the Ocean County Soil Conservation District.

Timeframe
Crowning of Parker Road – one (1) week

Limitations
The length of crowning of Parker Road is estimated to be approximately 1,800 feet, based on GIS mapping of the roads.

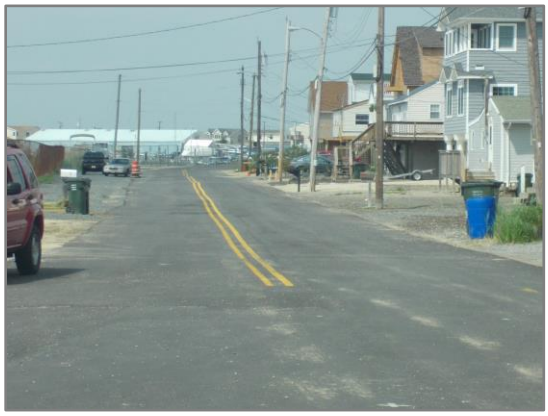
Priority:	Medium
Stakeholders:	Tuckerton Borough Department of Public Works. Ocean County
Permits needed:	Soil Erosion and Sediment Control Plan Certification
Estimated Cost:	$36,000 - $72,000 (based on $2,000 to $4,000 per 100 linear feet of roadway)

CROWN LITTLE EGG HARBOR BOULEVARD

Location:
Little Egg Harbor Boulevard

Project Description
Little Egg Harbor Boulevard has been known to experience inundation at the Moon Tide. The Borough of Tuckerton proposes to crown the road in order to improve access for emergency vehicles during periods of tidal rise.

Mitigation and Resiliency Benefits
By crowning the road surface of Little Egg Harbor Boulevard, the elevation of the road will be raised, thus allowing first responders and emergency personnel to pass through Little Egg Harbor Boulevard during times when it is inundated at Moon Tides or during storm events.



This project would be identified as a Medium Resiliency – accessibility project. The crowing of Little Egg Harbor Boulevard will provide public health, safety and vehicle flood loss reduction for existing storm conditions but does not specifically account for future conditions including sea level rise and wear down of the crowing. This crowing process must be continually maintained in order to achieve the desired results during tidal rise or storm events.

Implementation
A Soil Erosion and Sediment Control Plan Certification is required for the disturbance of more than 5,000 square feet of land. Depending on the total area of disturbance proposed with the crowning activities, a Soil Erosion and Sediment Control Plan Certification may be required from the Ocean County Soil Conservation District.

Timeframe
Crowning of Little Egg Harbor Boulevard – one (1) week.

Limitations
This cost assumes that the length of crowning of Little Egg Harbor Boulevard is 2,400 feet, based on GIS mapping of the roads.

Priority:	Medium
Stakeholders:	Tuckerton Borough Department of Public Works. Ocean County
Permits needed:	Soil Erosion and Sediment Control Plan Certification
Estimated Cost:	$48,000 - $96,000 ($2,000 to $4,000 per 100 linear feet of roadway)

EXTEND BARRIER INTO MARSH

Location:
In the marshland north of the eastern end of Kingfisher Boulevard.

Project Description
The existing bulkhead is circumvented by tides flanking the structure. The proposed project consists of the extension of the bulkhead into the marsh to reduce sedimentation deposit and circumvention necessitating future dredging activities.

Based on a review of the NJDEP GIS mapping of the area, it appears that this will involve extending the bulkhead by approximately fifteen (15) feet.

Mitigation and Resiliency Benefits

The storm surge caused by Sandy was of a magnitude that eroded shorelines and increased sand deposits in navigable waters. The reconstruction and/or repair of the barrier will provide a blockage of marsh sediments in the area of Kingfisher Boulevard.
The construction of the barrier does not eliminate the need for dredging activities in the channel, now and in the future.

This is a Low Resiliency project as it neither provides public health, safety and flood loss protection for the existing storm conditions nor account for future conditions including sea Level Rise. The installation of a barrier will block sediment migration for a time but the extension is likely to be flanked in the future and Sea Level Rise will compromise the marsh structure. The project will however provide an enhancement to the quality of life of the residents in the vicinity of Kingfisher Boulevard.

Implementation

The construction and extension into the marsh on the north and eastern end of Kingfisher Boulevard would require the following permits:

- NJDEP Waterfront Development
- US Army Corps of Engineers
- US Coast Guard
- Soil Erosion and Sediment Control Plan Certification

It is important to note that based on the information provided to this office on this project, it appears that 16 acres of coastal wetlands will be removed/disturbed. The disturbance of coastal wetland areas will require an Individual Waterfront Development Permit. It is our experience that this type of permitting would be difficult to impossible to obtain from the NJDEP. As such, this Medium Resiliency project becomes downgraded to a Low Resiliency project as the likelihood of obtaining a permit from the NJDEP.

Timeframe

Permitting: It is estimated that it will take nine (9) to twelve (12) months for design and permitting for approvals from ACOE, US Coast Guard and Soil Erosion and Sediment Control Plan Certification to be obtained. It is questionable as to whether an Individual Waterfront Development Permit would ever be issued for the proposed project.
Construction: Construction associated with the installation of the bulkhead is estimated to take three (3) months including the bidding process.

Limitations

The exact height of barrier needed and material type to be specified are important factors in determining costs for this project. As such, general costs are provided for planning purposes only.

DREDGE THOMPSON CREEK

Location:

Thompson Creek

Project Description

As a result of the storm surge and devastation experienced by Sandy, an accumulation of silt and sediment is present in Thompson Creek. The accumulated sedimentation in the Creek has caused concern over the flow from the Creek into the Marsh.

Mitigation and Resiliency Benefits

Thompson Creek is proposed to be dredged to remove the accumulated sediment that was brought in from Sandy. Dredging is the removal of wetlands or State open water soils or sediments through the use of mechanical, hydraulic, or pneumatic tools or other means necessary to restore or maintain a lake, pond, reservoir to its original bottom contours.

In addition, to the regulations and standards administered by the Office of Dredging and Sediment Technology dredging projects are also regulated by the Division of Land Use Regulation and dredging projects would require approvals from both.

This project would be ranked as a Low Resiliency Project. This project provides limited to no public health, safety and flood protection for the existing storm conditions and lunar high tides.

Priority:	Low
Stakeholders:	US Army Corps of Engineers NJDEP – Land Use NJDEP – Office of Dredging and Sediments US Coast Guard US Department of Interior Ocean County Soil Conservation District
Permits needed:	NJDEP Waterfront Development US Army Corps of Engineers US Coast Guard Soil Erosion and Sediment Control Plan Certification
Estimated Cost:	$600,000 - $1.74 million

Implementation

The following permits would be required for the proposed dredging operations:

- NJDEP Waterfront Development
- US Army Corps of Engineers
- US Coast Guard
- Soil Erosion and Sediment Control Plan Certification

In addition, sediment sampling and analyses are required as part of the permitting process. The permitting would be extremely difficult to obtain for this project given that there are is a large existing wetland complex in this area. Significant justification for the project would be required to satisfy regulatory requirements surrounding removal and disturbance of these coastal wetlands. It is unlikely that permits would be issued for this work.

Timeframe
It is anticipated that the design could be completed within two (2) months. The standard permitting timelines for the preparation, submission and review of the NJDEP Waterfront Development Permit is six (6) months.

The anticipated dredging operation is estimated to take between four (4) and eight (8) weeks depending on the size of the project.

Limitations
The volume of material to be dredged as well as the analytical data of the sediment sampling is unknown at this time. For planning purposes, it was assumed that approximately 2,500 linear feet of Thompson Creek would be dredged with a width of 25 feet and a depth of 5 feet (11,600 cubic yards of material). The contamination level of the material to be dredged is one of the largest determining factors in the cost for the project. As such, a large range of costs are provided for this project since the level of contamination for this project is unknown.

RESTORE GREEN STREET PARK AMENITIES

Location:
Green Street Park

Project Description
The playground amenities were washed away as a result of Super Storm Sandy. At this time, park improvements are sought to restore the park to pre-Sandy amenities with greater resiliency. In addition a boat ramp is being proposed.

Mitigation and Resiliency Benefits
This project would be considered a low resiliency – economic sustainability project. The rebuilding of the Green Street Park will provide limited to no public health, safety and flood loss protection for the existing storm conditions and lunar high tides. The proposed project area will still need to be evacuated of people and contents during storm events. Since the previous bathroom facilities were destroyed, it was proposed that the Borough invest in a trailer instead of permanent restroom structure. This removable trailer could be relocated prior to a storm event to minimize potential loss from storm events. Although the park may not be rated as a high resiliency project, it will provide aesthetic and economic sustainability benefits to the Borough and its residents.

Implementation
A NJDEP Waterfront Development Permit will be required will be required for all work required to restore the Green Street Playground and Amenities. All new structures will be required to be elevated above the base flood elevation as determined by FEMA.

The park reconstruction and boat ramp construction will be covered under the Waterfront Development Permitting. Approvals from the US Army Corps of Engineers, US Coast Guard and Ocean County Soil Conservation District will also be required.

It is our understanding that temporary restroom trailer facilities will be utilized in this area. These facilities can be moved in anticipation of storm events.

Priority:	Low
Stakeholders:	Residents of Tuckerton Beach US Army Corps of Engineers NJDEP – Land Use US Coast Guard US Department of Interior Ocean County Soil Conservation District
Permits needed:	NJDEP Waterfront Development US Army Corps of Engineers US Coast Guard Soil Erosion and Sediment Control Plan Certification
Estimated Cost:	$50,000 - $350,000

Timeline
The design and permitting (including preparation, submission and approvals) associated with this project is anticipated to take approximately nine (9) to twelve (12) months.
Construction should be completed within sixty (60) days.

Limitations
Since specific details on actual park reconstruction and boat ramp construction are unknown, the costs provided are for planning purposes only.

BUY WASHED-OUT PROPERTIES

Location:
Borough-wide.

Project Description
Lands not filled prior to the Wetlands Act and with Sea Level Rise, properties are now underwater and unbuildable. The proposed project consists of the purchase of these properties for preservation and possibly enhancement to provide storm buffering.

Mitigation and Resiliency Benefits
The actual purchase of the washed-out properties would be considered a Medium Resiliency project. It provides public health and safety improvements if the land is enhanced but diminishes with future conditions of accelerating sea level rise. Once the properties have been purchased by the Borough, the Borough should propose natural restoration projects for these areas to further promote protection to the Borough in storm events of any size.

Implementation
No Permits are required for the actual purchase of the properties by the Borough of Tuckerton. However, permitting will be required for restoration in these areas.

Timeframe
Depending on the obtaining the appropriate funding, it is our understanding that the buy-out process should be completed within twelve (12) months.

Limitations

The washed-out properties were not specifically identified by the Borough and would likely require a title search to know the location and ownership.

Priority:	Medium
Stakeholders:	FEMA NJDEP – Green Acres US Department of Interior & Forsythe National Wildlife Refuge
Permits needed:	None
Estimated Cost:	Unknown at this time

DEMOLITION OF POLICE DEPARTMENT

Project Description
The Borough of Tuckerton Police Station flooded during the storm and operations had to be immediately relocated to Borough Hall. After the storm, the former police station building still remains uninhabitable. The Borough used a temporary trailer until they were able to secure a permanent location on East Main Street, a location outside of the flood zone.

Mitigation and Resiliency Benefits
The actual demolition of the former police station would be considered a medium resiliency project. The demolition provides public health and safety conditions and a slight flood loss protection for the existing conditions. Once the properties have been demolished, the Borough can propose a project in this area to further promote protection to public works complex.

Implementation
No permits are required for the demolition of the Police Department.

Timeframe
The demolition of the former police station should be completed within six (6) weeks.

Limitations
It is our understanding that funding may have already been secured for the proposed demolition activities.

Priority:	Medium
Stakeholders:	FEMA NJ Office of Emergency Management
Permits needed:	None
Estimated Cost:	$100,000 - $250,000

DREDGING OF PARADISE COVE

Location:
Paradise Cove.

Project Description
As a result of the storm surge and devastation experienced by Sandy, an accumulation of silt and sediment is present in the Paradise Cove channel. The accumulated sedimentation in the Cove has caused concern with regard to boat access.

Mitigation and Resiliency Benefits

Paradise Cove is proposed to be dredged to remove the accumulated sediment that was brought in from Sandy. Dredging is the removal of wetlands or State open water soils or sediments through the use of mechanical, hydraulic, or pneumatic tools or other means necessary to restore or maintain a lake, pond, reservoir to its original bottom contours.

In addition, to the regulations and standards administered by the Office of Dredging and Sediment Technology dredging projects are also regulated by the Division of Land Use Regulation and dredging projects would require approvals from both.
This project would be ranked as a Low Resiliency Project. This project provides limited to no public health, safety and flood protection for the existing storm conditions and lunar high tides.

Implementation
The following permits would be required for the proposed dredging operations:

- NJDEP Waterfront Development
- US Army Corps of Engineers
- US Coast Guard
- Soil Erosion and Sediment Control Plan Certification

Priority:	Low
Stakeholders:	Residents of Tuckerton Beach US Army Corps of Engineers NJDEP – Land Use NJDEP – Office of Dredging and Sediments US Coast Guard US Department of Interior & Forsythe National Wildlife Refuge Ocean County Soil Conservation District
Permits needed:	NJDEP Waterfront Development US Army Corps of Engineers US Coast Guard Soil Erosion and Sediment Control Plan Certification
Estimated Cost:	$825,000 - $2.48 million

In addition, sediment sampling and analyses are required as part of the permitting process.

Timeframe
The design and permitting timelines for the preparation, submission and review of the NJDEP Waterfront Development Permit is six (6) months.

The anticipated dredging operation is anticipated to extend between four (4) and eight (8) weeks.

Limitations
The volume of material to be dredged as well as the analytical data of the sediment sampling is unknown at this time. For planning purposes, it was assumed that approximately 3,300 linear feet of waterway would be dredged with a width of 45 feet and a depth of 3 feet (16,500 cubic yards of

material). The contamination level of the material to be dredged is one of the largest determining factors in the cost for the project. As such, a large range of costs are provided for this project since the level of contamination for this project is unknown.

SOUTH GREEN STREET PLAN BEACH NOURISHMENT

Location:
South Green Street

Project Description
As a result of the storm surge and devastation experienced by Sandy, a portion of the beach has eroded. Full beach replenishment is proposed in this area.

Mitigation and Resiliency Benefits
New Jersey's beaches not only provide recreation for beachgoers and fishermen and support a multi-billion dollar tourism industry, but play a much more critical role when faced with a coastal storm. New Jersey's unique geography places the State in the potential path of hurricanes, tropical storms and nor'easters. Healthy beaches provide mitigation from these natural disasters by acting as a buffer between the pounding surf and the homes, businesses and infrastructure along the coast.

Beach nourishment projects consist of the initial placement of sand along a beach that has experienced erosion. Sources of sand for such projects can include a local source such as from a neighboring beach or sandbar, a dredged source such as a nearby inlet or waterway, an inland source such as a mining quarry, or, as used most commonly in large-scale projects, an offshore source such as a borrow site along the ocean bottom. This sand can be brought in with trucks or barges, hydraulically pumped or any combination of the above, and is then spread evenly along the beach using a common bulldozer. This completes the initial beach nourishment phase.

As nourished beaches undergo erosion, they must be maintained through beach re-nourishment. The re-nourishment process consists of restoring the beach to initial conditions and usually has less time and cost associated with the project when compared to the initial nourishment. The time between re-nourishment projects, called the re-nourishment cycle, is dependent upon the severity of annual erosion of the beach and is usually several years.

Funding is provided through the Shore Protection Fund (N.J.S.A. 13:19-16 et seq.), which ensures the critical funding needed annually to continue the beach nourishment program and protect New Jersey's coastal communities. Non-federal beachfill projects are funded through a state/local cost-share, with the state contributing 75% and the local governments contributing 25%. The Borough would be responsible for the preparation and submittal of applicable state and federal permit applications, conducting and overseeing the bidding process and contract administration, and for monitoring quality control and operations throughout the construction process.

This beach nourishment project would be classified a Low Resiliency project. The project will not provide public health, safety and flood loss protection for existing storm conditions and will not account for future conditions including Sea Level Rise. This project will however, provide an aesthetic appeal and economic sustainability to the residents of Tuckerton Borough.

Implementation

Priority:	Medium
Stakeholders:	Residents of Tuckerton Beach US Army Corps of Engineers NJDEP – Land Use US Department of Interior Ocean County Soil Conservation District
Permits needed:	NJDEP Waterfront Development US Army Corps of Engineers Soil Erosion and Sediment Control Plan Certification
Estimated Cost:	$30,000

The following permits would be required for the proposed beach nourishment operations:

- NJDEP Waterfront Development
- US Army Corps of Engineers
- Soil Erosion and Sediment Control Plan Certification

Timeframe

The standard permitting timelines for the preparation, submission and review / approval is six (6) months.

The anticipated beach nourishment is estimated to be four (4) months, including construction bid process.

Limitations

Details of the extent and volume of beach replenishment is unknown. Once additional details are provided, additional suggestions or guidance can be provided.

CHAPTER 7 IMPLEMENTATION MATRIX

The table below lists individual projects recommended across various planning documents that were reviewed for this report. Many of these were proposed for the purpose of increasing resiliency; many were proposed to meet other objectives. Projects are categorized as: acquisition, outreach, planning, regulatory, and construction, construction / infrastructure. An attempt was made to prove a resiliency impact ranking for each project, based on the definitions provided in Chapter 6.

	Project Categories	Project	Project Description	Source of Recommended Action	Resiliency Impact	Status
1	Acquisition	Acquire 131 homes to protect from flooding related hazards	A few properties are now underwater and unbuildable. Proposed project: Purchase properties for future projects/protection	Ocean County 2013 Multi-Jurisdictional All Hazard Mitigation Plan; Tuckerton SRPR discussions	High	No current action
2	Acquisition	Generators	Purchase and maintain generators to continue critical community services during utility interruptions and storm events	Ocean County 2013 Multi-Jurisdictional All Hazard Mitigation Plan	High	FEMA application submitted
3	Outreach	Implement tourism promotion strategy		Discussions with local officials re: FEMA project requests	Low	No current action
4	Outreach	Implement an economic development & business plan		Discussions with local officials re: FEMA project requests	Low	No current action
5	Outreach	Implement business retention & revitalization strategy		Discussions with local officials re: FEMA project requests	Low	No current action
6	Outreach	Revitalize downtown, commercial district or neighborhood		Discussions with local officials re: FEMA project requests	Low	No current action
7	Outreach	Continue to participate in the NFIP to support pro-active floodplain management	protect property from flood related hazards, clearly inform property owners about the risks of being in and near the SFHA, and promote flood insurance	Ocean County 2013 Multi-Jurisdictional All Hazard Mitigation Plan	high	ongoing
8	Outreach	Maintain, improve, and expand education and awareness programs to provide effective and relevant information to community members	Including increased campaigns to educated public on flooding risks	Ocean County 2013 Multi-Jurisdictional All Hazard Mitigation Plan	high	Pending via joint Little Egg Harbor Steering Committee
9	Outreach	Drill and ensure evacuation compliance for Tuckerton Elementary School, Pinelands Middle School, and Pinelands High School	Ensure 98% or greater evacuation compliance	Ocean County 2013 Multi-Jurisdictional All Hazard Mitigation Plan	high	
10	Outreach	Maintain local emergency AM radio station	Distribute effective, relevant information before, during and after disasters	Ocean County 2013 Multi-Jurisdictional All Hazard Mitigation Plan	high	
11	Outreach	Maintain and improve information on website	Provide relevant and up to date information to reach community members effectively before, during, and after disasters	Ocean County 2013 Multi-Jurisdictional All Hazard Mitigation Plan	high	
12	Outreach	Streamline outreach	Borough Hall should work with the Tuckerton Beach Association to disseminate information more centrally	GTR recommendations	low	
13	Outreach	Designate an existing committee or establish a committee to develop a Program for Public Information (PPI)	A PPI will provide a plan for public education and outreach and will provide CRS points	GTR recommendations	medium	

	Project Categories	Project	Project Description	Source of Recommended Action	Resiliency Impact	Status
14	Outreach	Make sure all outreach programs are quantified and catalogued according to CRS standards	Submit documentation for get CRS points	GTR recommendations	Low	
15	Outreach	Make meetings that took place post-Sandy about flood zones, flooding risk, building recommendations, etc into annual meetings	Submit documentation for get CRS points	GTR recommendations	Medium	
16	Outreach	Make sure all flood maps are available on the town website, Borough Hall, and in the public library	Submit documentation for get CRS points	GTR recommendations	Medium	
17	Outreach	Knowledge transfer	Transfer personal knowledge of coastal storm and flooding event damages to digital format to allow for access by multiple municipal departments	GTR recommendations	medium	
18	Outreach	Communicate Floodmap changes	Ensure the public is aware of any changes to FEMA's flood maps as they are updated and if those updates result in changes to the Borough's building requirements.	GTR recommendations	medium	
19	Outreach	Elevation code and Freeboard requirements	Rewrite elevation building code and freeboard requirements as based upon the Best Available Flood Hazard Data rather than individual titles of versions of FEMA's flood maps.	GTR recommendations	medium	
20	Outreach	Expand and publicize the Community Emergency Response Team (CERT)	The CERT Program educates people about disaster preparedness for hazards that may impact their area and trains them in basic disaster response skills.	GTR recommendations	High	
21	Outreach	FEMA training	Have town officials participate in FEMA training courses	GTR recommendations	High	
22	Outreach	Festivals and events expansion	Generate more foot traffic and robust tourism / commercial sector	Tuckerton Revitalization Plan	Low	
23	Planning / Outreach	Address sea level rise as a hazard	Identify sea level rise as a hazard in town plans and consider disclosing hazard risks to potential buyers and real estate agents.	GTR recommendations	high	
24	planning/ Outreach	Develop and implement brand campaign & marketing plan	To improve economic resiliency by attraction more tourists and residents	Discussions with local officials re: FEMA project requests; Tuckerton Revitalization Plan	Low	Partnership with Stockton
25	Planning	Initiate erosion program	Identify, map, and keep data on areas of coastal erosion and consider creating erosion protection programs or instituting higher regulations for building in areas subject to coastal erosion.	GTR recommendations	high	
26	Planning	Mitigation plan	Create a detailed mitigation plan for areas that experience repetitive loss.	GTR recommendations	High	
27	Planning	Identify Hazards	Utilize the Community Vulnerability Assessment Tool, Risk and Vulnerability Assessment Tool, Hazard Assessment Tool and HAZUS-MH to identify potential hazards, risks, and vulnerabilities and keep mapping information on file.	GTR recommendations	High	

	Project Categories	Project	Project Description	Source of Recommended Action	Resiliency Impact	Status
28	Planning	Develop an economic development, business plan, business retention & revitalization strategy	To improve the economic resiliency of the Borough's commercial sector in light of flooding hazards	Discussions with local officials re: FEMA project requests	Low	
29	Planning	Conduct waste water system feasibility study	Evaluate entire system to determine where there is inflow and infiltration.	Discussions with local officials re: FEMA project requests; Tuckerton SRPR discussions	high	Contract for work underway
30	Planning	Bayfront / Shoreline restoration; marshland stabilization alternatives analysis	Evaluate options for strengthening the marsh system	Discussions with local officials re: FEMA project requests	high	Component of the NFWF grant
31	Planning	Water Supply Infrastructure Study	Evaluate the integrity of the water supply infrastructure to pinpoint problems and identify the potential leak in the system.	Tuckerton SRPR discussions	High	
32	Planning/ Regulatory	Improve municipal land use regulations/zoning/ordinances	Examine the municipal plans, strategies, and ordinances and consider rewriting sections to include the previous recommendations or reflect the risks, hazards, and vulnerabilities explored in the Getting to Resilience process.	Discussions with local officials re: FEMA project requests; GTR recommendations	high	
33	Regulatory	Continue to enforce building codes to require building, renovations, and re-building meets or exceeds the Uniform Construction Code	To protect homes from risk related to hazards including flooding, fire, wind, earthquake, and winter storms.	Ocean County 2013 Multi-Jurisdictional All Hazard Mitigation Plan	high	ongoing
34	Regulatory	Adopt the FEMA Advisory BFE floodplain ordinance	Support proactive floodplain management that will assist property owners in rebuilding at or avoide regulatory standards when the new floodplain maps become effective in approximately 2015	Ocean County 2013 Multi-Jurisdictional All Hazard Mitigation Plan	High	
35	Regulatory	Join CRS program	Complete pro-active floodplain management and assist residents with flood insurance costs	Ocean County 2013 Multi-Jurisdictional All Hazard Mitigation Plan	High	In process
36	Regulatory	Adopt the latest version of FEMA's flood maps	Ensure that elevation and freeboard requirements in a Flood Damage Prevention Ordinance are based upon the Best Available Flood Hazard Data or the most stringent version of FEMA's flood maps.	GTR recommendations	high	
37	Regulatory	Waterway Debris	Form a commission to deal with the submerged debris lining their bayfront and in the tidal creeks.	DEP issues identified for Tuckerton; FEMA meeting 7/1/13	low	
38	Construction	South Green St. Park and Beach	Improvements to the South Green Street park to replace infrastructure damaged by Sandy (restrooms and playground) and add amenities to include a boat launch and beach access.	DEP issues identified for Tuckerton; FEMA meeting 7/1/13;Tuckerton Revitalization Plan; Tuckerton SRPR discussions, Tuckerton Recovery Management Plan	medium	CDBG-DR funding sought
39	Construction	Downtown beautification / South Green Street /Main Street commercial district development	Make the downtown area a more appealing place with signage, lighting, trees, benches to increase economic resiliency.	Discussions with local officials re: FEMA project requests; Tuckerton Revitalization Plan	Medium	
40	Construction	Elevation project for 653 homes	Build to higher standards and elevation that will mitigate impact of flood related hazards while maintaining residents in the community	Ocean County 2013 Multi-Jurisdictional All Hazard Mitigation Plan	High	Private sector initiatives ongoing

	Project Categories	Project	Project Description	Source of Recommended Action	Resiliency Impact	Status
41	Construction	Borough facilities re-purposing	Mitigate OEM, Police, Municipal buildings for reuse upon relocation of critical functions to disaster-resistant location	Ocean County 2013 Multi-Jurisdictional All Hazard Mitigation Plan; Tuckerton Revitalization Plan	Medium	
42	Construction	Develop FEMA 361 Shelter for New Police Station	Construct a community safe room to protect community members during all disasters requiring evacuation	Ocean County 2013 Multi-Jurisdictional All Hazard Mitigation Plan	High	
43	Construction	RV Park Development	Redevelop existing mobile home park as RV park to allow for evacuation in the case of storm events.	Tuckerton Revitalization Plan	High	
44	Construction	Acquisition and redevelopment of abandoned gas station on main street	Reuse as commercial venue to increase the attractiveness of the downtown	Tuckerton Revitalization Plan	medium	Privately owned gas station; EPA willing to assist with assessment
45	Construction	Community nature trail and bikeway development		Tuckerton Revitalization Plan; Discussions with local officials re: FEMA project requests	low	No current action
46	Construction	All Wars Memorial Field beautification		Tuckerton Revitalization Plan	low	No current action
47	Construction	South Green Street Sewer line/water line repair		Tuckerton Recovery Management Plan	high	Part of current EIT application (?)
48	Construction	Tuckerton Approved Riprap Project Area	NJDEP-approved project at the end of Little Egg Harbor Blvd. to install riprap for shoreline protection and create a bulkhead with walkway access to enhance protection for Tuckerton Beach and add recreation.	Tuckerton meeting notes on waterway debris management and dredging with DEP, 8/14/13; Ocean County 2013 Multi-Jurisdictional All Hazard Mitigation Plan	high	Fully approved and funded; requires easement.
49	Construction	Asbestos in the Gristmill	reuse OEM Office as a Welcome Center. Asbestos and possibly mold are need to be addressed prior to this conversion.	DEP issues identified for Tuckerton; FEMA meeting 7/1/13	low	Asbestos and mold survey completed
50	Construction	Police Station Demolition	This building was flooded during Sandy and major environmental issues were left behind. A ruptured sewage tank has left raw sewage in the basement that has not been removed since the building was abandoned following the storm.	DEP issues identified for Tuckerton; FEMA meeting 7/1/13;Tuckerton SRPR discussions	high	CDBG-DR provided funding
51	Construction	Potentially Leaking Oil Tank	A large commercial sized oil tank floated from its original location and landed in a wetland. Need proper removal of the tank.	DEP issues identified for Tuckerton; FEMA meeting 7/1/13	high	
52	Construction	Elevate Pump Houses	Pumps were damaged in Sandy. Proposed project: Elevate vulnerable pump stations.	Tuckerton SRPR discussions	high	
53	Construction	Crown roads: Parker Road, Little Egg Harbor Blvd, county & state roads	Roadways experience inundation at moon tide. Crowning roads would improve access for emergency vehicles and evacuations.	Tuckerton SRPR discussions; Discussions with local officials re: FEMA project requests	high	
54	Construction	Dredging Thompson Creek and Paradise Cove	Dredge Creek to improve circulation of marsh and protect health of marshes and provide boat access; dredge lagoons to provide access for boats.	Discussions with local officials re: FEMA project requests; Ocean County 2013 Multi-Jurisdictional All Hazard Mitigation	medium	NFWF grant to provide funding

	Project Categories	Project	Project Description	Source of Recommended Action	Resiliency Impact	Status
				Plan; LEH SRPR; Tuckerton SRPR discussions		
55	Construction	Waterproof manholes in floodprone areas	Unprotected lids are a source of Inflow/Infiltration into system during ponding rain and high tide events. Proposed project: Retrofit all manhole covers that are not waterproofed.	Tuckerton SRPR discussions	high	
56	Construction	Install way-finding & signage	Improve signage throughout the Borough to make the area more attractive to tourism	Discussions with local officials re: FEMA project requests	low	No current action
57	Construction / Infrastructure	Replace damaged bulkheads & rock jetties; construct new ones as required	Ensure that bulkheads are in good repair to withstand future storm events.	Discussions with local officials re: FEMA project requests	high	Private sector efforts ongoing; Bulkhead at South Green Street Park subject of CDBG-DR application
58	Construction / Infrastructure	Replenish beaches	Beach nourishment project at Tuckerton Beach to increase recreational opportunities and protect infrastructure	Discussions with local officials re: FEMA project requests	high	Subject of NFWF and CDBG-DR application
59	Construction / Infrastructure	Regional storm water drainage & flood mitigation		Discussions with local officials re: FEMA project requests	High	
60	Construction / Infrastructure	Repair/upgrade municipal waste water system		Discussions with local officials re: FEMA project requests	high	
61	Construction / Infrastructure	Bayfront / Shoreline restoration; marshland stabilization		Discussions with local officials re: FEMA project requests	high	
62	Construction / Infrastructure	Implement wastewater management plan		Discussions with local officials re: FEMA project requests	high	
63	Construction / Infrastructure	Improve municipal boat ramps	Repair bulkheads and add running water	Discussions with local officials re: FEMA project requests	low	No current action
64	Construction / Infrastructure	Relocate Borough Hall which includes Police, municipal services, and the EOC to maintain critical facilities during flood and storm related hazards	Consolidate the Borough offices, OEM and construction offices, and police station into a disaster resistant building.	Ocean County 2013 Multi-Jurisdictional All Hazard Mitigation Plan; Discussions with local officials re: FEMA project requests	high	complete
65	Construction	Reinforce bulkhead off Kingfisher Rd	Existing bulkhead is circumvented by tides flanking the structure. Extend bulkhead into Marsh to reduce sedimentation deposit and circumvention necessitating future dredging.	Tuckerton SRPR discussions	Medium	This is potentially part of the NFWF project in conjunction with disposal of dredge spoils.

Appendix 1: Getting To Resilience Report Recommendations

Tuckerton Borough
"Getting to Resilience"
Recommendations Report

Prepared by the Jacques Cousteau National Estuarine Research Reserve in partnership with New Jersey Future

April 2014

Recommendations based on the "Getting to Resilience" community evaluation process.

Table of Contents

Introduction 3

Methodology 4

Recommendations 5

Coastal Hazard Incorporation in Planning 9
- **Municipal Master Plan Example** 10

Mapping 12
- **Maps requested at GTR meetings** 12
- **Maps recommended during GTR meetings** 13

Sea Level Rise & Surge Vulnerability 14

CRS Sections That Likely Have Current Points Available 15

Appendix 20

Cover photograph by David Robert Gurtcheff, Modern Pictorials

Introduction

The Getting to Resilience questionnaire was originally developed and piloted by the New Jersey Department of Environmental Protection's Office of Coastal Management in an effort to foster municipal resiliency in the face of flooding, coastal storms, and sea level rise. The questionnaire was designed to be used by municipalities to assist communities in reducing vulnerability and increase preparedness by linking planning, mitigation, and adaptation. Originally developed by the State of New Jersey's Coastal Management Program, the Getting to Resilience process was later adapted by the Coastal Training Program of the Jacques Cousteau National Estuarine Research Reserve (JC NERR), converted into a digital format, and placed on an interactive website. Further improving the questionnaire, the JC NERR added linkages to evaluation questions including the National Flood Insurance Program's (NFIP) Community Rating System (CRS), Hazard Mitigation Planning, and Sustainable Jersey. While this website is publicly available, through the facilitated Getting to Resilience process, JC NERR Coastal Community Resilience Specialists can enhance the outcomes of the evaluation by providing community-specific recommendations, guided discussions with municipal representatives, a vulnerability analysis, and municipal plan reviews.

Tuckerton Borough was heavily impacted by Superstorm Sandy in 2012 and continues to recover and rebuild. As part of a combined letter of agreement between Tuckerton Borough, Little Egg Harbor Township, and New Jersey Future, New Jersey Future outlined a scope of services that would be provided to the towns through their Local Recovery Planning Manager Program. These services included providing guidance, technical assistance, project management, and staff support to develop and implement effective long term recovery and resilience strategies; assist Little Egg Harbor Township and Tuckerton Borough to rebuild in a manner that anticipates and responds to future severe storms and sea level rise; and to promote planning principles that were endorsed in town resolutions requesting that NJ Future provide a Local Recovery Planning Manager.

The JC NERR's participation is highlighted under *Task 6.1 Existing Conditions Analysis and Vulnerability Assessment* of the "Letter of Agreement Among Little Egg Harbor Township, Tuckerton Borough, and New Jersey Future". The recommendations given by JC NERR at the end of the Getting to Resilience process are part of this task that add to the deeper evaluation that NJ Future will be doing as the Vulnerability Assessment of both Tuckerton Borough and Little Egg Harbor Township. The assessment will be based on detailed mapping of the characteristics described in part 1 of the "Elements of a Vulnerability Assessment" summary attached to the Letter of Agreement. The assessment shall evaluate potential impacts of a range of hazards (coastal storm events/flood patterns, category 1-4 hurricanes, erosion, flooding, sea level rise, storm surge) for past events, existing conditions, and year 2030, 2050, 2100 planning horizons.

The Getting to Resilience process started as a facilitated discussion regarding the Borough's strengths, weaknesses, and hurdles concerning resiliency. Tuckerton noted major issues with rebuilding and house raising post-Sandy after initially adapting the Advisory Base Flood Elevation maps from FEMA and tieing their elevation and freeboard requirements into those initial maps. Subsequent map updates have created confusion and numerous cases of houses not meeting specified Borough standards. A large percentage of buildings in Tuckerton Borough were constructed prior to the establishment of the current building codes, resulting in many buildings not conforming to current standards. These homes are the ones that the Borough feels receive the most damage in storm and flooding events.

A large portion of Tuckerton Borough's population and ratables are contained in the Tuckerton Beach section of town. The land in this section of town was constructed using the lagoon dredging and filling method employed in various other locations which effectively converted intertidal saltmarsh into usable

land. This method of construction was banned by federal legislation by the 1970's but not before expansive areas of wetlands were built upon. Over time, these built up areas have experienced a slow and steady settling of their sediments due to compaction. This has led to subsidence of streets and lots in the Tuckerton Beach area. This has required the Borough to elevate roadways that have become frequented by tidal flooding. However, elevating roadways has created problematic runoff issues as precipitation pours off the elevated roadway and onto private lots, causing flooding on private property.

Tuckerton Borough identified their greatest challenge to resiliency as the financing of projects. As Tuckerton Borough is small and has a limited tax base, funding of projects is very difficult. The municipal budget and staff have already been stressed by the recovery effort after Sandy and there are very few resources left to either enact resiliency projects or find funding for resiliency projects. Due to the small tax base, there is also a concern that strategic retreat from certain locations could be extremely detrimental to tax ratables. All of these challenges were taken into consideration when planning this recommendations report.

Methodology

The Getting to Resilience (GTR) questionnaire is broken into five sections: Risk and Vulnerability Assessments, Public Engagement, Planning Integration, Disaster Preparedness and Recovery, and Hazard Mitigation Implementation. In order to efficiently answer all of the questions within the questionnaire, participation from a wide array of municipal officials and staff is encouraged. These can include administrators, floodplain managers, emergency managers, stormwater managers, public works officials, town engineers, and appointed and elected officials. For Tuckerton this team included Jenny Gleghorn (Borough Administrator), Garrett Loesch (Chief Financial Officer), Phil Reed (Construction Official, Zoning Officer, Building Subcode, Building Inspector, and Fire Protection Official), Jim Edwards (Council President), Marilyn Kent (OEM Deputy Coordinator), and Leah Yasenchak (NJ Future Local Recovery Manager). While the GTR process normally take place with individual municipalities, the spatial and cooperative relations between Tuckerton and Little Egg Harbor allowed JC NERR staff to hold combined meetings. However, the questions in the GTR questionnaire were answered individually by each municipality with JC NERR staff recording answers and taking notes on the discussions connected to each question.

Combined meetings with Tuckerton Borough and Little Egg Harbor Township began on March 12th. JC NERR met with four representatives of Little Egg Harbor Township, two representatives of Tuckerton, two representatives of New Jersey Future, two representatives of FEMA, and mapping specialist from Rutgers Bloustein Planning School. This meeting was a steering committee meeting and addressed what the towns can expect through the cooperation of JC NERR and NJ Future. The Getting to Resilience questionnaire was started with the towns on March 20th. JC NERR staff met with seven representatives of Little Egg Harbor, three representatives of Tuckerton, and one representative of NJ Future. A discussion of the towns' resilience strengths and weaknesses began the meeting and the first two sections of the questionnaire were completed. On March 27th, the questionnaire was completed with seven representatives of Little Egg Harbor, three representatives of Tuckerton, and one representative of NJ Future meeting with JC NERR staff.

Upon completion of the GTR questionnaire, JC NERR staff analyzed the answers provided by Tuckerton Borough, linkages provided by the GTR website, notes taken during the discussion of questions, the Borough Master Plan, and mapping of risks, hazards, and vulnerabilities provided by Rutgers University and the NJFloodmapper website. After reviewing all of this information, this recommendations report

was drafted to help assist Tuckerton Borough decision makers as the Borough works to recover from Superstorm Sandy and become more resilient.

Recommendations

1. Streamline outreach so that it originates from Borough Hall rather than appearing to originate from Tuckerton Beach Association.

While it is excellent to have other organizations such as the Tuckerton Beach Association be a part of distribution of outreach,in order to gain CRS credit, all outreach must originate from the town. Once it can be documented that outreach originates from the Borough, the Tuckerton Beach Association should continue to be involved in outreach activities. However, outreach for flooding should also target other properties within the floodplain that are not located in Tuckerton Beach. It would be beneficial to develop a Program for Public Information (PPI) which would help to organize outreach, continue to include the Tuckerton Beach Association, and gain additional CRS credits. A PPI is a researched, organized, and implemented program for public outreach that is seen as having a seven step process. These steps are Establish a PPI Committee, Assess the Community's Public Information Needs, Formulate Messages, Identify Outreach Projects to Convey the Messages, Examine Other Public Information Initiatives, Prepare a PPI Document, and Implement, Monitor and Evaluate the Program. If done correctly, a PPI will make outreach initiatives more effective and can gain CRS credits in numerous categories besides outreach. For guidance on establishing a PPI, visit http://crs2012.org/uploads/docs/300/developing_a_ppi_2-24-12.pdf. It is also recommended that the Tuckerton Seaport be included as a partner for a PPI.

2. Make sure all outreach programs are quantified and catalogued according to CRS standards.

Tuckerton should examine the current number of outreach programs it runs and what it would take to gain additional points by adding more or expanding on those that currently take place. Outreach should include information about the natural and beneficial functions of floodplains. Particularly after Sandy, residents throughout the impacted area have been looking for as much information as possible. A well organized and efficient outreach program can provide validated information from a trusted source and better prepare residents for natural risks. Outreach is one of the easiest sections to gain points in the CRS and one Tuckerton should focus on heavily. Establishment of a PPI would again help this process to maintain efficiency.

3. Make the community recovery meetings that took place post-Sandy about flood zones, flooding risk, building recommendations, etc into annual meetings.

Even if they are not as highly attended as the initial post-Sandy meetings, these community based recovery meetings are worth significant CRS credits if they become annual outreach meetings and they meet CRS guidelines. By continuing to discuss the importance of planning for flooding, the Borough can set an example to its residents that readiness for disaster events should be maintained, even in relatively "quiet" times.

4. Make sure all flood maps are available on the town website, at Borough Hall, and in the Tuckerton public library.

Having the most up to date FEMA issued floodplain maps available at numerous locations in different forms of dispersal is critical to ensuring your citizens are informed and has the added benefit of allowing for CRS credits (specifically for the town website and public library).

5. Transfer personal knowledge of coastal storm and flooding event damages to digital format to allow for access by multiple municipal departments.

Memories of historical storm events, specifically ones that were not documented by state and federal

agencies, are useful tools that can be used to plan for impending storms. However, it is vital that the information from these memories be available for all municipal staff. This information can be gathered and documented from current municipal staff, past municipal staff, and public input and may be very useful to identify past surge extents, conditions that caused amplification of storm damages, and vulnerable areas not shown by mapping. Meetings to allow for public input on historic storm damage extents may also earn CRS credits.

6. Adopt the latest version of FEMA's flood maps and rewrite elevation and freeboard requirements in a Flood Damage Prevention Ordinance as based upon the Best Available Flood Hazard Data or the most stringent version of FEMA's flood maps.

While basing elevation requirements off of FEMA's ABFE was the correct step, the changes in the flood maps since have caused problems for the Borough. By writing new requirements as related to the Best Available Flood Hazard Data, it should allow for change over time as FEMA's maps are redrawn regularly. While it had been decades since FEMA had remapped the FIRMs in our area, the remapping process was long overdue and can be anticipated to take place with a much higher frequency in the future. Best Available Flood Hazard Data is defined by NJ DEP as the most recent available flood risk guidance FEMA has provided. The Best Available Flood Hazard Data may be depicted on but not limited to Advisory Flood Hazard Area Maps, Work Maps or Preliminary FIS and FIRM. For more information on NJ DEP recommended Flood Damage Prevention Ordinances, visit http://www.nj.gov/dep/floodcontrol/modelords/modelde-bestavail.doc.

By adding "or the most stringent version of FEMA's flood maps" to this ordinance, higher standards may be instituted that may result in the town becoming more resilient. For example, the Advisory Base Flood Elevation maps may have a more expansive V-zone then the Flood Insurance Rate Maps. By requiring building to adhere to the stricter requirements of the Advisory Base Flood Elevation maps, more homes will be built to higher standards. This also can result in a large amount of CRS points in the Higher Regulatory Standards section.

7. Ensure the public is aware of any changes to FEMA's flood maps as they are updated and if those updates result in changes to the Borough's building requirements.

As per our discussions during the GTR process, Tuckerton Borough noted that there was much public confusion and additional expense incurred on behalf of the Borough associated with multiple releases of FEMA's flood maps. Ensuring that the information on the maps is understood by all municipal leaders and staff prior to discussions with the public is critical to ensure the correct information is disseminated by the Borough. For every release of a map update, the Borough could make a public announcement to its citizens and detail if any changes were made to the prior map, including if additional information such as the Limit of Moderate Wave Action has been added. For example, Preliminary FIRMs for Ocean County were just released on March 28th, 2014. Notifying the public of this new map product is an example of outreach that can be done by the Borough's PPI raising the potential for CRS points.

The new RISK map products include a GIS layer depicting the "changes since last FIRM" which will help the Borough in describing the changes in flood zones on individual properties and for the Borough as a whole. A description of this data set can be found at: http://www.region2coastal.com/flood-risk-tools/tool-descriptions and the new data layer is being developed as part of the preliminary FIRM process. This data is in draft form now but will be released at the www.region2coastal.com website soon. The more familiar the citizens are with the maps, the more likely they will take appropriate actions. Public announcements could also help to reduce the number of inquiries about the maps that Borough staff have to deal with in the future.

8. Tuckerton should identify, map, and keep data on areas of coastal erosion and consider creating erosion protection programs or instituting higher regulations for building in areas subject to coastal erosion.

Erosion can quickly become a problem in coastal areas. These areas could include any waterfront that is not bulkheaded and has experienced erosion. Factors that could amplify erosion (sea level rise, surge) should be defined. Throughout the Mid-Atlantic, the erosion of wetlands has been heavily documented. As much of the Tuckerton Beach region is bordered by or protected by wetlands, the Borough should make an effort to locate areas of erosion in their wetlands to identify possible problem areas. The Tuckerton Creek is also prone to erosion and should have the shoreline mapped. Identifying erosional hotspots and their potential impacts on homes and infrastructure can allow for mitigation actions that may prevent erosion from becoming a future problem. In the same mindset, unwanted deposition from shoaling and runoff can also be problematic for stormwater management and navigation in waterways.

9. Tuckerton should identify sea level rise as a hazard in town plans and consider disclosing hazard risks to potential buyers and real estate agents.

Even with the lowest level of predicted sea level rise, Tuckerton will experience significant impacts in the near future. Historical rates of sea level rise should be defined as part of this action and future predicted sea levels should be taken into account when making land use decisions, construction standards, etc. The historical rate of sea level rise along the New Jersey coast over the past half century was 3-4 mm/yr (or 0.12 -0.16 in/yr), while projected future rates are expected to increase. In the recent paper entitled "A geological perspective on sea-level rise and its impacts along the U.S. mid-Atlantic coast" Miller and Kopp state that by 2050 sea level rise is expected to rise 1.3 feet along the Jersey Shore. By 2100 sea level rise is projected to rise between 3.1 feet along the Jersey coast. While sea level rise is a monumental challenge to coastal areas, the challenge can not be tackled until it is properly identified. Disclosing these risks to the public also may result in CRS credits.

10. Create a detailed mitigation plan for areas that experience repetitive loss.

Repetitive loss properties can be a large burden on towns over time. By creating a mitigation plan for these areas, the Borough may identify new strategies to tackle this issue, pinpoint at what point in time in the future that buyouts of these properties may be prudent, and achieve CRS credits. Many of Tuckerton's homes were built prior to the release of the current building code and therefore, are more prone to damage in flooding and storm events. Creating a plan for these buildings as well can help to transition these properties towards better resiliency.

11. Utilize the Community Vulnerability Assessment Tool, Risk and Vulnerability Assessment Tool, Hazard Assessment Tool, and HAZUS-MH to identify potential hazards, risks, and vulnerabilities and keep mapping information on file.

There are numerous hazard, risk, and vulnerability assessment tools available to municipalities. Although NJ Future is going to be conducting a Vulnerability Assessment for you, it is good that the members of municipal staff are familiar with the use of these tools. The importance of identifying hazard, risk, and vulnerability cannot be overstressed. Use of these tools can be beneficial in the CRS, hazard mitigation planning, creating municipal plans, zoning, and writing construction codes.

- The Community Vulnerability Assessment Tool is used to conduct a community vulnerability assessment to a wide range of hazards. It is often used in conjunction with the Risk and Vulnerability Assessment. http://csc.noaa.gov/digitalcoast/training/roadmap
- The Risk and Vulnerability Assessment Tool is used to identify people, property, and resources that area at risk of injury, damage, or loss from hazardous incidents or natural hazards. http://csc.noaa.gov/digitalcoast/training/roadmap

- The Hazard Assessment Tool is a risk assessment process which will help identify hazards, profile hazard events, inventory assets, and estimate losses. http://www.fema.gov/hazard-mitigation-planning-risk-assessment
- HAZUS-MH is a software package that uses models and Geographic Information Systems (GIS) technology for estimating physical, economic, and social impacts from various hazards such as floods and hurricanes. http://www.fema.gov/hazus

12. Explore the possibility of expanding and publicizing the Community Emergency Response Team (CERT).

CERT programs can provide volunteer support to first responders, provide assistance to victims, help to organize volunteers at disaster sites, and collect disaster information to support first responder efforts. While Tuckerton Borough already has a CERT program, its expansion according to CRS standards can result in achieving CRS points as well as a stronger program.

13. Examine municipal plans, strategies, and ordinances and consider rewriting sections to include the previous recommendations or reflect the risks, hazards, and vulnerabilities explored in the Getting to Resilience process.

In order to fully embrace resiliency, municipal plans, strategies, or ordinances should incorporate resiliency recommendations and findings. These should include the Municipal Master Plan, All Hazards Mitigation Plan, Floodplain Management Plan, Evacuation Plan, Emergency Response Plan, Continuity of Operations Plan, Disaster Recovery Plan, Post Disaster Redevelopment Plan, Capital Improvements Plan, Economic Development Plan/Strategy, Coastal Plan, Shoreline Restoration Plan, Open Space Plan, Stormwater Management Plan, Historic Preservation Plan, Zoning Ordinance, Flood Damage Prevention Ordinance, and Building Code. If these plans, strategies, or ordinances do not currently exist, it is highly recommended the Borough move to create them. Further content regarding this recommendation can be found below in the section titled, "Coastal Hazard Incorporation in Planning".

Coastal Hazard Incorporation in Planning

Incorporation of coastal hazards into municipal planning is highly recommended to accurately reflect the risks of coastal living. Life in coastal towns largely revolves around weather and water conditions and planning should include consideration for current and future coastal hazards. While including information on coastal hazards in Emergency Response Plans and Evacuation plans is an easy connection to make, the path to incorporation of coastal hazards into documents such as a Master Plan may be more challenging to realize. However, to foster a community of resiliency, it is important to keep hazards in mind throughout all planning documents. The Master Plan should be used to catalogue and document the goals of all other planning documents. The following is an example of how identification of coastal hazards can be introduced to a Municipal Master Plan through the Floodplain Management section. This sort of language and related content can be utilized in various other planning documents and then rediscussed in the Master Plan under the corresponding sections.

Municipal Master Plan Example

The following excerpts are adapted from a comprehensive plan for Worcester County in Maryland, the equivalent to a municipal master plan. This comprehensive plan incorporates coastal hazards throughout the entire document to form an integrated approach to resiliency. Coastal hazards are often identified in the document as "current and anticipated challenges". Individual sections (such as the Floodplain Management section given in this example) identify objectives and recommendations that should be mirrored in individual plans (a Floodplain Management Plan in this example). In doing so, all municipal plans are organized under the master plan and share the same language and goals. Many of the recommendations in this municipal master plan example are closely tied to goals already addressed in the current Borough Master Plan. Refer to the link below for the Worcester County Comprehensive

Plan for more ideas and examples of a planning document drafted with resiliency in mind.
http://www.co.worcester.md.us/cp/finalcomp31406.pdf

Sample Introduction
Realizing that air, water, and land could be overused and despoiled, the plans organized within this document increasingly moved toward resource protection. If such damage occurred, local residents' quality of life and tourism, the economic linchpin, would suffer. Preserving the Borough's natural resources and character will therefore, continue to be this plan's main purpose.

The plan's purpose is to provide the following:
1. *An official statement of goals, objectives, policies and aspirations for future growth, development and the quality of life;*
2. *A set of guidelines for the government and private sectors to maximize the county's quality of life;*
3. *A strategy addressing current and anticipated challenges ; and*
4. *Sufficient policy guidance to effectively manage natural, human and financial resources.*

Sample Floodplain Management Section
Floodplains, lands along waterways subject to flooding, locally have low relief and sedimentary soils. Floodplains are defined by how often they flood. A 100-year floodplain has a 1% probability of flooding in a given year and is not tidally influenced. Local flooding can occur in major storm events. Areas of the Tuckerton Borough's 100-year floodplain are highly developed. Both residential and commercial uses exist within this floodplain.Most of the time a floodplain is available for use. However, during floods they can be dangerous. Superstorm Sandy reinforced this fact. Floods injure people physically and emotionally and cause economic damage. Beyond this, emergency personnel are put at risk when called upon to rescue flood victims. In Tuckerton, flooding must be taken very seriously.To protect public safety and property, limiting future building in floodplains and stringent construction standards will help reduce injuries and property damage. Federal, state and local policies should be consistent to implement this approach.

Objectives
The Borough's objectives for floodplain protection are:
- *Limit development in floodplains*
- *Reduce imperviousness of existing and future floodplain development where possible*
- *Preserve and protect the biological values and environmental quality of tidal and non-tidal floodplains, where reasonable and possible to do so.*

Developed floodplains have a reduced capacity to absorb stormwater, resulting in increased flooding. For example, development results in new impervious surfaces (roads, sidewalks, roofs, etc.), which limit the effectiveness of the floodplain by reducing the land's absorption capacity. This increases the potential for flooding. It is therefore important that the natural floodplain character be maintained, wherever reasonable, to promote public safety, to reduce economic losses, and to protect water quality and wildlife habitat.

Tuckerton Borough, with its low relief, faces additional flooding issues. Several areas of the Borough commonly flood during storms. Sea level rise will increase flooding hazards. New Jersey is particularly vulnerable to sea level rise. During this century, as sea level rises, shorelines could retreat significantly in parts of Tuckerton Borough. Narrow bay beaches and wetlands at low elevations, both important habitats, would be lost to even a modest rise in sea level. Currently, the state recognizes a right to

protect shores with hard structures (e.g. riprap). As sea level rises, these hard structures will prevent "migration" of beaches and wetlands, and these natural features will be lost.

Programs and Policies

Flooding from coastal storms is a serious threat to life and property with the potential for extensive damage and disruptions. To reduce potential damage, the county is developing a hazard mitigation plan. This first step will provide guidance for pre-disaster activities. The second phase of addressing disasters is to develop a post disaster plan. Confusion and rapid decision-making follow a disaster. Advance planning can position the Borough to reduce its exposure to future disasters and reduce the need for ad hoc decision-making. Superstorm Sandy has taught us that effective post-disaster planning is necessary for an effective recovery process.

Recommendations

1. *Work with federal and state federal agencies to regularly update the Borough floodplain maps, with first priority being areas that are mapped as 100-year floodplain without base flood elevation established.*
2. *Limit new development and construction in the floodplain.*
3. *For new development, encourage the dedication of 100-year floodplains (not including wetlands) to open space.*
4. *Promote uses, such as golf courses, open space easements, natural areas, and recreational open space to reduce impervious surfaces in floodplains.*
5. *Work to acquire properties in the 100-year floodplain, and return them to a natural state.*
6. *Reevaluate the effectiveness of the current floodplain protection regulations.*
7. *Discourage the location of new homes and roadways in the "V" or wave velocity zone and the 100-year floodplain.*
8. *Work with the county to complete a hazard mitigation plan for flooding, wildfire, and other natural hazards.*
9. *Develop and implement a post-disaster recovery and reconstruction plan to facilitate recovery and to reduce exposure to future disasters.*
10. *Participate in the Community Rating System to receive flood insurance premium credits.*
11. *Consider code changes that will limit impervious surfaces.*
12. *Develop a sea level rise response strategy (include a two foot freeboard requirement for properties exposed to flooding and discourage shoreline hardening).*

Mapping

The following maps can be found in the appendices of this document and were either requested by Borough staff or recommended by JC NERR staff during GTR meetings. As part of an expansion of the New Jersey Floodmapper website, the site will host community profiles that include municipal mapping packets that will be available for future download. These maps can and should be used to help write and update the Municipal Master Plan, All Hazards Mitigation Plan, Floodplain Management Plan, Evacuation Plan, Emergency Response Plan, Continuity of Operations Plan, Disaster Recovery Plan, Post Disaster Redevelopment Plan, Capital Improvements Plan, Economic Development Plan/Strategy, Coastal Plan, Shoreline Restoration Plan, Open Space Plan, Stormwater Management Plan, Historic Preservation Plan, Zoning Ordinance, Flood Damage Prevention Ordinance, and Building Code.

Maps Requested at GTR Meetings:

Repetitive Loss & Severe Repetitive Loss (working to secure)
Sandy Substantially Damaged Properties (provided in the appendix)

Repetitive Loss and Substantial Damage maps can be used to identify "problem" areas. Depending on the location and size of these areas, the Borough can make decisions about how to prevent repetitive loss from occurring. These options can range from utilizing Blue Acres funding to return the properties to a natural state to creating protective infrastructure projects in order to help protect from risk. Future conditions such as sea level rise should be included in these decisions.

Storm Surge (SLOSH Category 1, SLOSH Category 2, & SLOSH Category 3) (provided in Appendix)
SLOSH or Sea, Lake, and Overland Surge from Hurricanes is a computerized model from the National Hurricane Program. SLOSH takes into account various factors to compute surge inundation above ground level or simple inundation. These factors include storm size, storm pressure, storm speed, storm path, wind speed, bathymetry, and topography. With this set of factors, SLOSH determines the worst surge impacts that can be expected from hurricanes according to category. SLOSH maps are vital tools for Emergency Operations Center managers for making decisions about evacuation orders, timing of evacuation, and staging of emergency equipment prior to tropical weather systems.

Maps Recommended During GTR Meetings:
Sea Level Rise 1-3 feet with Critical Facilities (provided in Appendix)
Over the past hundred years, sea level has risen slightly higher than one foot in New Jersey. Due to a variety of factors including melting land ice and thermal expansion, it is anticipated that the rate of sea level rise will increase substantially in the future. While sea level rise poses it's own threat to coastal communities, it also will increase the severity of storm surge and erosion. By examining sea level rise maps, the Borough can better understand future flooding risk and plan accordingly. As much of Tuckerton Borough is near current sea level, Sea Level Rise maps should be utilized heavily for municipal planning documents.

Shoreline Change (coming at future time in municipal profile)
Shorelines are constantly in a state of change, be it from tidal fluctuations or erosional and depositional forces. Shoreline change can create large scale shifts in risk. Erosion may move shoreline closer to buildings and infrastructure, reducing natural buffers and heightening impacts. Deposition that moves shorelines or near shore features such as sandbars may in turn reduce rates of flow of streams and stormwater management systems and cause greater risk of precipitation driven flooding. Deposition can also cause navigation hazards to waterways such as Tuckerton Creek. Shoreline Change maps can identify trends and should be incorporated into appropriate municipal plans.

Overlays of Hazards and Populations, Infrastructure, and Building Footprints (coming at future time in municipal profile)
Though it is the goal of this report to guide Tuckerton Borough towards resiliency, risk will always exist. By overlaying hazards such as sea level rise and surge with population information, infrastructure, and building footprints, the Borough will be able to identify areas of highest risk and plan accordingly.

Natural Resources, Historical Resources, Cultural Resources, & Economic Resources (coming at future time in municipal profile)
Mapping of a community's resources is an extremely useful tool, not only for creating a catalogue of a community's strengths, but also for identifying areas that should be protected. Overlaying hazards such as sea level rise and surge may lead Tuckerton Borough to make decisions on protecting certain resources through retrofitting historical buildings or protecting natural resources by allowing for natural floodplain functions.

Sea Level Rise and Surge Vulnerability

As much of Tuckerton Borough is at or near current sea level, fluctuations in sea level through surge events and trends towards higher sea level are of great significance. Analysis of SLOSH maps show that as hurricane strength increases, potential surge impacts will increase in scope and severity as one would expect. SLOSH models indicate we should expect flooding on a similar scale of Sandy for powerful Category 1 hurricanes. SLOSH models for Category 2 and 3 storms show a much more dire situation with flooding covering roughly 75% of the town for a Category 2 storm and 90% of the town in a Category 3 storm. Both scenarios flood the critical evacuation routes of Green Street and Route 9. Although storms of this magnitude are very rare for our area, they remain a possibility that requires attention and planning.

Even the relatively low end scenario of one foot of sea level rise will require adaptation as a portion of almost every street of Tuckerton Beach will see fairly regular tidal inundation. Our best estimates for the arrival of one foot of sea level rise is before 2050. As sea level rise is expected to accelerate this century, three feet of sea level rise is very likely before 2100 (see table below).

Total sea level rise projections for New Jersey.

	Total cm	Total inches	Total feet
2050 best	**40**	**16**	**1.3**
2050 low	23	9	0.7
2050 high	60	24	2.0
2100 best	**96**	**38**	**3.1**
2100 low	50	20	1.6
2100 high	147	58	4.8

All values with respect to a year 2000 baseline.

NJ sea level rise projection ranges and best estimates. Miller AK, Kopp RE, Horton BP, Browning JV and Kemp AC. 2013. A geological perspective on sea-level rise and its impacts along the U.S. mid-Atlantic coast. Earth's Future 1(1):3-18.

Three feet of sea level rise will result in regular tidal inundation of all of Tuckerton Beach and areas bordering Tuckerton Creek. Any level of inundation due to regular tidal flooding will have large scale impacts on emergency response. Sea level rise will also result in greater impact of storm events as a surge atop a higher sea level will be more dramatic than the same surge atop a lower sea level. Necessary adaptation to sea level rise and the heightening of other hazards such as surge must be taken into account when planning for the future. The information provided in this recommendations document is the JC NERR part of the in depth Vulnerability Assessment that NJ Future is doing for Tuckerton Borough. While going through the tasks in the “Letter of Agreement...” New Jersey Future will be digging deeper into these vulnerabilities, sea level rise and storm surge, as well as the other hazards described in the introduction of this recommendation document..

CRS Sections That Likely Have Available Current Points

The following sections of the Community Rating System will likely contain credit points that are available for Tuckerton based off of the answers given in our Getting to Resilience questionnaire, discussions with JCNERR staff, and reviews of the Borough Master Plan and other documents. These sections represent the current state of the Borough but also include planned projects or uncompleted projects we are aware of. However, these projects may need to be complete in order to be granted credit. These sections do not represent guaranteed points for the CRS but are likely achievable to a certain degree

and should be investigated when submitting to the CRS. When working with your CRS coordinator, we recommend inquiring about the following sections.

Section 320: Map Information Service: To provide inquirers with information about the local flood hazard and about flood-prone areas that need special protection because of their natural functions.

- **Basic Firm Information (MI1):** 30 points for providing basic information found on a FIRM that is needed to accurately rate a flood insurance policy. (GTR 2.5)
- **Additional Firm Information (MI2):** 20 points for providing information that is shown on most FIRMS, such as protected coastal barriers, floodways, or lines demarcating wave action. (GTR 2.5)

Section 330: Outreach Projects: To provide the public with information needed to increase flood hazard awareness and to motivate actions to reduce flood damage, encourage flood insurance coverage, and protect the natural functions of floodplains.

- **Outreach projects (OP):** Up to 200 points for designing and carrying out public outreach projects. Credits for individual projects may be increased if the community has a Program for Public Information (PPI). (GTR 2.5.1, 2.11, 4.9)
- **Flood response preparations (FRP):** Up to 50 points for having a pre-flood plan for public information activities ready for the next flood. Credits for individual projects may be increased by the PPI multiplier. (GTR 2.11, 4.9)

Section 350: Flood Protection Information: To provide more detailed flood information than that provided by outreach products.

- **Flood protection library (LIB):** 10 points for having 10 Federal Emergency Management Agency publications on flood protection topics housed in the public library. (GTR 2.5.1, 2.15)
- **Locally pertinent documents (LPD):** Up to 10 points for having additional references on the community's flood problem or local or state floodplain management programs housed in the public library. (GTR 2.5.1)
- **Flood protection website (WEB):** Up to 76 points for providing flood protection information via the community's website. An additional 29 points are provided if the website is part of a Program for Public Information (credited under Activity 330 (Outreach Projects)). (GTR 2.5.1, 2.11, 4.7, 4.9)

Section 410: Floodplain Mapping: To improve the quality of the mapping that is used to identify and regulate floodplain management.

- **Floodplain mapping of special flood-related hazards (MAPSH):** Up to 50 points if the community maps and regulates areas of special flood related hazards. (GTR 2.5)

Section 420: Open Space Preservation: To prevent flood damage by keeping flood-prone lands free of development, and protect and enhance the natural functions of floodplains.

- **Natural shoreline protection (NSP):** Up to 120 points for programs that protect natural channels and shorelines. (GTR 3.3, South Green Street)
- **Natural functions open space (NFOS):** Up to 350 points extra credit for OPS-credited parcels that are preserved in or restored to their natural state. (GTR 3.3; South Green Street)
- **Special flood-related hazards open space (SHOS):** Up to 50 points if the OSP credited parcels are subject to one of the special flood-related hazards or if areas of special flood related hazard are covered by low density zoning regulations. (GTR 3.3, South Green Street)

Section 430- Higher Regulatory Standards: To credit regulations to protect existing and future development and natural floodplain functions that exceed the minimum criteria of the National Flood Insurance Program (NFIP).

- **Other higher standard (OHS):** Up to 100 points for other regulations Section 610: Flood Warning and Response: to encourage communities to ensure timely identification of impending flood threats, disseminate warnings to appropriate floodplain occupants, and coordinate flood response activities to reduce the threat to life and property. (GTR 2.11, 4.9)
- **Emergency warning dissemination (EWD):** Up to 75 points for disseminating flood warnings to the public. (GTR 2.11, 4.9)
- **Flood response operations (FRO):** Up to 115 points with 10 points awarded for maintaining a database of people with special needs who require evacuation assistance when a flood warning is issued and for having a plan to provide transportation to secure locations. (GTR 2.11, 4.9)
- **Critical facilities planning (CFP):** Up to 75 points for coordinating flood warning and response activities with operators of critical facilities. (GTR 2.11, 4.9)
- **Protection of critical facilities (PCF):** Up to 80 points for protecting facilities that are critical to the community. (GTR 4.7)
- **Regulations administration (RA):** Up to 67 points for having trained staff and administrative procedures that meet specified standards. (GTR 3.4.5, 3.5.4, 5.6, 5.8)
- **Freeboard (FRB):** Up to 500 points for a freeboard requirement. (GTR 5.4)
- **State Mandated Standards (SMS):** Up to 20 points for a state-required measure that
- is implemented in both CRS and non-CRS communities in that state. (freeboard)

Section 440: Flood Data Maintenance: The community must maintain all copies of Flood Insurance Rate Maps issued for that community.

- **Additional Map Data (AMD):** Up to 160 points for implementing digital or paper systems that improve access, quality, and/or ease of updating flood data within the community. (GTR 2.5)
- **FIRM Maintenance (FM):** Up to 15 points for maintaining copies of all FIRMs that have been issued for the community. (GTR 2.5)

Section 510: Floodplain Management Planning: To credit the production of an overall strategy of programs, projects, and measures that will reduce the adverse impact of the hazard on the community and help meet other community needs.

- **Repetitive Loss Area Analysis (RLAA):** Up to 140 points for a detailed mitigation plan for a repetitive loss area. (GTR 1.11, 1.12, 3.7)
- **Floodplain management planning (FMP):** 382 points for a community-wide floodplain management plan that follows a 10-step planning process: Step 7d - 5 points, if the plan reviews activities to protect the natural and beneficial functions of the floodplain, such as wetlands protection. (GTR 3.3, 3.3.2, 3.4, 3.4.1, 3.5; South Green Street)

Section 520: Acquisition and Relocation: To encourage communities to acquire, relocate, or otherwise clear existing buildings out of the flood hazard area.

- **Critical facilities (bCF):** Points awarded for facilities that have been acquired or relocated. (GTR 5.2; Police station relocated)

Section 530: Flood Protection: To protect buildings from flood damage by retrofitting the buildings so that they suffer no or minimal damage when flooded, and/or constructing small flood control projects that reduce the risk of flood waters' reaching the buildings.

- **Flood protection project technique used (TU_):** Credit is provided for retrofitting techniques or flood control techniques. Retrofitting technique used: Points are provided for the use of elevation

(TUE), dry floodproofing (TUD), wet floodproofing (TUW), protection from sewer backup (TUS), and barriers (TUB) Structural flood control technique used: Points are provided for the use of channel modifications (TUC), and storage facilities (TUF). (GTR 5.3, 5.7; work on LEH Blvd)

Section 540: Drainage System Maintenance: To ensure that the community keeps its channels and storage basins clear of debris so that their flood carrying and storage capacity and maintained.

- **Capital improvement program (CIP):** up to 70 points for having a capital improvement program that corrects drainage problems. (GTR 3.7)

Section 600: Warning and Response: The activities in this series focus on emergency warnings and response, because adequate notification combined with a plan for how to respond can save lives and prevent and/or minimize property damage. The activities emphasize coordinating emergency management functions with a community's other floodplain management efforts, such as providing public information and implementing a regulatory program. Separate, parallel activities are included for levees (Activity 620) and dams (Activity 630). Credit points are based on threat recognition, planning for a subsequent emergency response, and ongoing testing and maintenance. Up to 790 points. (GTR 4.2, 4.4)

Section 610: Flood Warning and Response: To encourage communities to ensure timely identification of impending flood threats, disseminate warnings to appropriate floodplain occupants, and coordinate flood response activities to reduce the threat to life and property. (GTR 4.4, 4.5.1, 4.5.2, 4.5.3, 4.5.4, 4.5.5, 4.6)

- **Flood response operations (FRO):** Up to 115 points with 10 points awarded for maintaining a data base of people with special needs who require evacuation assistance when a flood warning is issued and for having a plan to provide transportation to secure locations. (GTR 2.12, 4.8, 4.9.6)
- **Emergency warning dissemination (EWD):** Up to 75 points for disseminating flood warnings to the public. (GTR 4.7, 4.11)
- **Critical facilities planning (CFP):** Up to 75 points for coordinating flood warning and response activities with operators of critical facilities. (GTR 4.7)
- **EWD9:** 10 points, if all schools, hospitals, nursing homes, prisons, and similar facilities that need flood warning have NOAA Weather Radio receivers and at least one other automated backup system for receiving flood warnings.
- **DFW7:** Up to 10 points, if schools, hospitals, nursing homes, prisons, and similar facilities that need flood warning have NOAA Weather Radio receivers and at least one other automated backup system for receiving flood warnings, provided that the community has coordinated with NOAA and there are arrangements for issuing warnings about dam failures. (GTR 4.11)

Section 630: Dams: To encourage states to provide dam safety information to communities and to encourage communities, in turn, to provide timely identification of an impending dam failure, disseminate warnings to those who may be affected, and coordinate emergency response activities to reduce the threat to life and property.

- **Dam failure warning (DFW):** Up to 35 points for disseminating the warning to the public. (GTR 2.11, 4.7, 4.9)
- **Dam failure response operations (DFO):** Up to 30 points with 5 points awarded for maintaining a database of people with special needs who require evacuation assistance when a dam failure warning is issued, and for having a plan to provide transportation to secure locations. (GTR 2.11, 2.12, 4.8, 4.9, 4.9.6)

Appendix

JC NERR recommends Tuckerton consider learning from the resiliency planning process undertaken by Gilford, CT and described in "Town of Guilford Community Coastal Resilience Plan Report of Options to Increase Coastal Resilience": (http://www.ci.guilford.ct.us/pdf/Coastal%20Resilience%20Plan,%20Report%20&%20Options.pdf).

The goal of their Coastal Resilience Plan was to address the current and future social, economic and ecological resilience of the Town of Guilford to the impacts to sea level rise and anticipated increases in the frequency and severity of storm surge, coastal flooding, and erosion. The Town has drafted the report of options for increased coastal resilience as a step toward developing a Community Coastal Resilience Plan.

The four basic steps of the Coastal Resilience Plan are:

1. Generate awareness of coastal risk;
2. Assess coastal risks and opportunities;
3. Identify options or choices for addressing priority risks and vulnerabilities (short term); and
4. Develop and implement an action plan to put selected options or choices into place (long term).

Similar to Tuckerton, Guilford's coastal neighborhoods are diverse and it is likely that each will be faced with a combination of vulnerabilities to sea level rise and the increased incidence and severity of coastal storms. A combination of adaptation measures will therefore be necessary in each neighborhood in order to reduce risks and increase resilience. Likewise, neighborhood-scale resilience planning will likely be important. Steps should be taken to evaluate individual adaptation measures and determine how comprehensive solutions can be developed and implemented for building coastal resilience.

A comprehensive risk and vulnerability assessment for Tuckerton should include the following municipal sectors:

- Social – Residents, business community, and visitors.
- Economic – Residential Properties, commercial/industrial businesses, municipal resources, tourism, and future development.
- Infrastructure – Roads, bridges, railroads, stormwater, seawalls, tide gates, the marina, and municipal facilities.
- Utilities – Public and private water supplies, septic systems, telecommunications, and electricity.
- Emergency Services – Fire, police, medical, sheltering, evacuation/egress.
- Natural Systems – Tidal wetlands and other coastal landforms.

When considering options for coastal resilience, the following three types of adaptation responses are typically considered:

- **Retreat** involves no effort to protect the land from the sea. The coastal zone is abandonedand ecosystems shift landward. This choice can be motivated by excessive economic or environmental impacts of protection. In the extreme case, an entire area may beabandoned.
- **Accommodation** implies that people continue to use the land at risk but do not attempt toprevent the land from being flooded. This option includes erecting emergency floodshelters, elevating buildings on piles and elevating roadways.
- **Protection** involves hard structures such as sea walls and dikes, as well as soft solutions suchas dunes and vegetation, to protect the land from the sea so that existing land uses cancontinue.

Included in a 2010 NOAA's Office of Ocean and Coastal Resource Management manual titled, "Adapting to Climate Change: A Planning Guide for State Coastal Managers" is a thorough discussion of adaptation strategies and methods. (http://coastalmanagement.noaa.gov/climate/docs/adaptationguide.pdf). Tuckerton could consider some of the options presented in this document for long and short-term resiliency planning. Many of these suggestions complement the suggestions provided earlier in this GTR Recommendations report:

Impact Identification and Assessment

- Research and Data Collection – Predict possible social and economic effects of climatechange on communities. Calculate cost-to-benefit ratios of possible adaptation measures. Encourage adaptation plans that are tailored to specific industries.
- Monitoring – A comprehensive monitoring program that incorporates multiple tools and considers a variety of systems and processes can provide input to the vulnerability assessment and adaptation strategy.
- Modeling and Mapping – Map which areas are more or less susceptible to sea level rise in order to prioritize management efforts.

Awareness and Assistance

- Outreach and Education – Create scientific fact sheets about climate change addressing community members, visitors, elected officials, businesses and industries. Use multiple forms of communication such as news media, radio, brochures, community meetings, social networks, blogs and websites.
- Real Estate Disclosure – The disclosure of a property's vulnerability to coastal hazards enables potential buyers to make informed decisions reflecting the level of impacts they are willing and able to accept.
- Financial and Technical Assistance – Provide flood insurance discounts for properties that exceed floodproofing standards by one or two feet. Encourage hazard mitigation by providing grants to areas that implement adaptation measures.

Growth and Development Management

- Zoning – Zoning can be used to regulate parcel use, density of development, building dimensions, setbacks, type of construction, shore protection structures, landscaping, etc. It can also be used to regulate where development can and cannot take place, making it an invaluable tool in efforts to protect natural resources and environmentally sensitive areas and guide development away from hazard-prone areas.
- Redevelopment Restrictions – Combining restrictions with acquisition/demolition/relocation programs provides safer options to property owners in the wake of the loss of or damage to their homes or businesses.
- Conservation Easements – A conservation easement is a legal agreement between a landowner and a land trust or government agency that can be used to restrict development in sensitive and hazard-prone areas.
- Compact Community Design – The high density development suggested by compact community design can allow for more opportunities to guide development away from sensitive and hazard-prone areas.

Loss Reduction

- Acquisition, Demolition, and Relocation – The most effective way to reduce losses is to acquire hazard-prone properties, both land and structures, demolish or relocate structures, and restrict all future development on the land.

- Setbacks – Setbacks can protect structures from hazards by keeping the structures away from a property's most vulnerable areas.
- Building Codes – Building codes that regulate design, construction, and landscaping of new structures can improve the ability of structures in hazard-prone areas to withstand hazard events.
- Retrofitting – Existing structures can be protected from hazards through retrofitting.
- Infrastructure Protection – Infrastructure protection entails fortification against the impacts of climate change.
- Shore Protection Structures – Shore protection structures protect existing development allowing it to stay in place. They often damage or destroy other valuable coastal resources and create a false sense of security; nevertheless in some cases, for the purposes of protecting existing development, there may be no other acceptable or practical options.

Shoreline Management

- Regulation and Removal of Shore Protection Structures – To protect the natural shoreline and the benefits it provides, regulations can be used to limit shoreline hardening as well as promote alternative forms of protection.
- Rolling Easements – Rolling easements are shoreline easements designed to promote the natural migration of shorelines. Typically, rolling easements prohibit shore protection structures which interfere with natural shoreline processes and movement, but allow other types of development and activities. As the sea rises, the easement moves or "rolls" landward, wetland migration occurs, and public access to the shore is preserved.
- Living Shorelines – Living shorelines can be effective alternatives to shore protection structures in efforts to restore, protect, and enhance the natural shoreline and its environment. Living shorelines use stabilization techniques that rely on vegetative plantings, organic materials, and sand fill or a hybrid approach combining vegetative plantings with low rock sills or living breakwaters to keep sediment in place or reduce wave energy.
- Beach Nourishment – Beach nourishment is the process of placing sand on an eroding beach, typically making it higher and wider, to provide a buffer against wave action and flooding.
- Dune Management – Dunes may be restored or created in conjunction with a beach nourishment project or may be managed as part of a separate effort.
- Sediment Management – Dredging and placing sediment, building shore protection structures and other structures that trap or divert sediment.

Coastal Ecosystem Management

- Ecological Buffer Zones – Ecological buffers are similar to setbacks (and may be included within setbacks) but are typically designed to protect the natural environment by providing a transition zone between a resource and human activities.
- Open Space Preservation and Conservation – Open space preservation and conservation can be accomplished through the management of lands dedicated as open space through a number of the measures previously discussed, such as zoning, redevelopment restrictions, acquisition, easements, setbacks, and buffers.
- Ecosystem Protection and Maintenance – In the context of coastal adaptation, ecosystem protection largely involves the protection of tidal wetlands and other ecosystems. The facilitation of wetland migration is an important aspect of this.
- Ecosystem Restoration, Creation, and Enhancement – Similar to the above, ecosystem

restoration and creation can replace tidal wetlands that are lost to sea level rise.

Water Resource Management and Protection

- Stormwater Management – Drainage systems may be ill-equipped to handle the amount of stormwater runoff that will accompany the more intense rainfall events expected in the future, and those in low-lying areas will be further challenged by losses in elevation attributed to rising sea levels.
- Water Supply Management – Climate change will negatively affect both water quantity and quality, and coastal populations will continue to grow, so water supply managers must be prepared to respond to associated challenges to water supply.

Examples of adaptation measures considered in Guilford's plan include management of coastal real estate and structures, shoreline protection and management of coastal and nearshore lands, roadway alterations, and protection or replacement of water supply wells and septic systems. All these adaptation measures are presented with a variety of options for consideration.

Tuckerton may also gain some planning insight from the public participation process associated with Guilford's resiliency planning. Guilford found their public believes that physical changes are needed to address sea level rise and increase coastal resilience, but that there are societal and institutional obstacles. Common themes noted from the public comments included:

- Coastal resilience planning – and many of the solutions that are implemented – may be best accomplished at the neighborhood scale; and neighborhood planning groups may need to be organized to begin looking at appropriate solutions;
- The tax base associated with coastal properties would need to be preserved in the short term and then some of the tax base may need to be shifted in the long term;
- Education and technical assistance are needed and desired by homeowners, and education could also be accomplished in the schools;
- Comprehensive solutions will be needed such as: addressing water and wastewater at the same time in neighborhoods where these systems will struggle or fail; ensuring that roadway improvements in one location are effective because improvements are also made elsewhere in the transportation network; and working on coordinated roadway and railroad improvements.

In thinking of their own public participation in resilience planning, Tuckerton could likely expect similar themes to emerge and could be prepared to offer the long-term planning options that may be under consideration by the municipality.

Tuckerton Borough
1 Feet of Sea Level Rise

Legend

- Municipality
- Schools
- Fire Stations
- Law Enforcement
- Assisted Living
- Hospitals
- Evacuation Routes
- 1ft SLR

Year 2010 Population: 3347

According to Kenneth G. Miller et al. in the 2013 study "A Geological Perspective on Sea-Level Rise and its Impacts Along the U.S. Mid-Atlantic Coast" a probable threat is the 1ft sea level rise condition that could be expected by 2050. This map depicts that sea level rise and is centered on target municipalities.

0 0.175 0.35 0.7 Miles

Map Author: Bryan Serino
Rutgers, New Brunswick
Center for Remote Sensing
and Spatial Analysis

N

CRSSA

Tuckerton Borough
2 Feet of Sea Level Rise

Legend

- Municipality
- Schools
- Fire Stations
- Law Enforcement
- Assisted Living
- Hospitals
- Evacuation Routes
- 2ft SLR

Year 2010 Population: 3347

According to Kenneth G. Miller et al. in the 2013 study "A Geological Perspective on Sea-Level Rise and its Impacts Along the U.S. Mid-Atlantic Coast" a probable threat is the 1ft sea level rise condition that could be expected by 2050. This map depicts that sea level rise and is centered on target municipalities.

0 0.175 0.35 0.7 Miles

Map Author: Bryan Serino
Rutgers, New Brunswick
Center for Remote Sensing
and Spatial Analysis

N

CRSSA

Tuckerton Borough
3 Feet of Sea Level Rise

Legend

- Municipality
- Schools
- Fire Stations
- Law Enforcement
- Assisted Living
- Hospitals
- Evacuation Routes
- 3ft SLR

Year 2010 Population: 3347

According to Kenneth G. Miller et al. in the 2013 study "A Geological Perspective on Sea-Level Rise and its Impacts Along the U.S. Mid-Atlantic Coast" a probable threat is the 1ft sea level rise condition that could be expected by 2050. This map depicts that sea level rise and is centered on target municipalities.

0 0.175 0.35 0.7 Miles

Map Author: Bryan Serino
Rutgers, New Brunswick
Center for Remote Sensing
and Spatial Analysis

N

CRSSA

Tuckerton Borough
1, 2, and 3 Feet of Sea Level Rise

Legend

- Municipality
- Schools
- Fire Stations
- Law Enforcement
- Assisted Living
- Hospitals
- Evacuation Routes
- 1ft SLR
- 2ft SLR
- 3ft SLR

Year 2010 Population: 3347

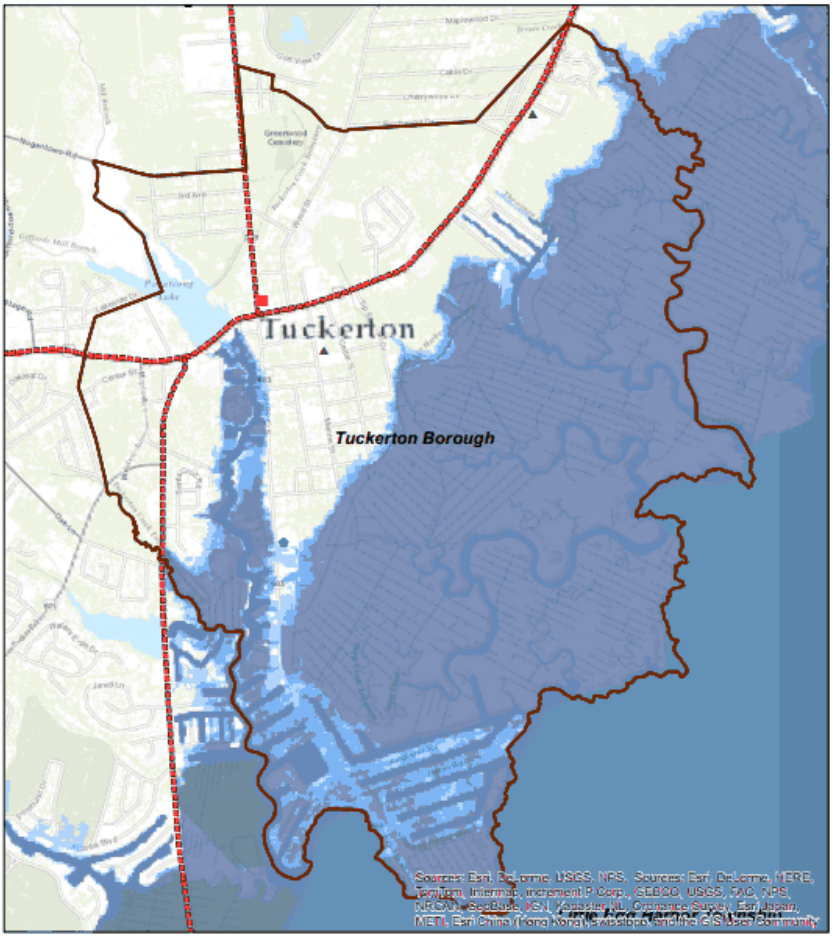
According to Kenneth G. Miller et al. in the 2013 study "A Geological Perspective on Sea-Level Rise and its Impacts Along the U.S. Mid-Atlantic Coast" a probable threat is the 1ft sea level rise condition that could be expected by 2050. This map depicts that sea level rise and is centered on target municipalities.

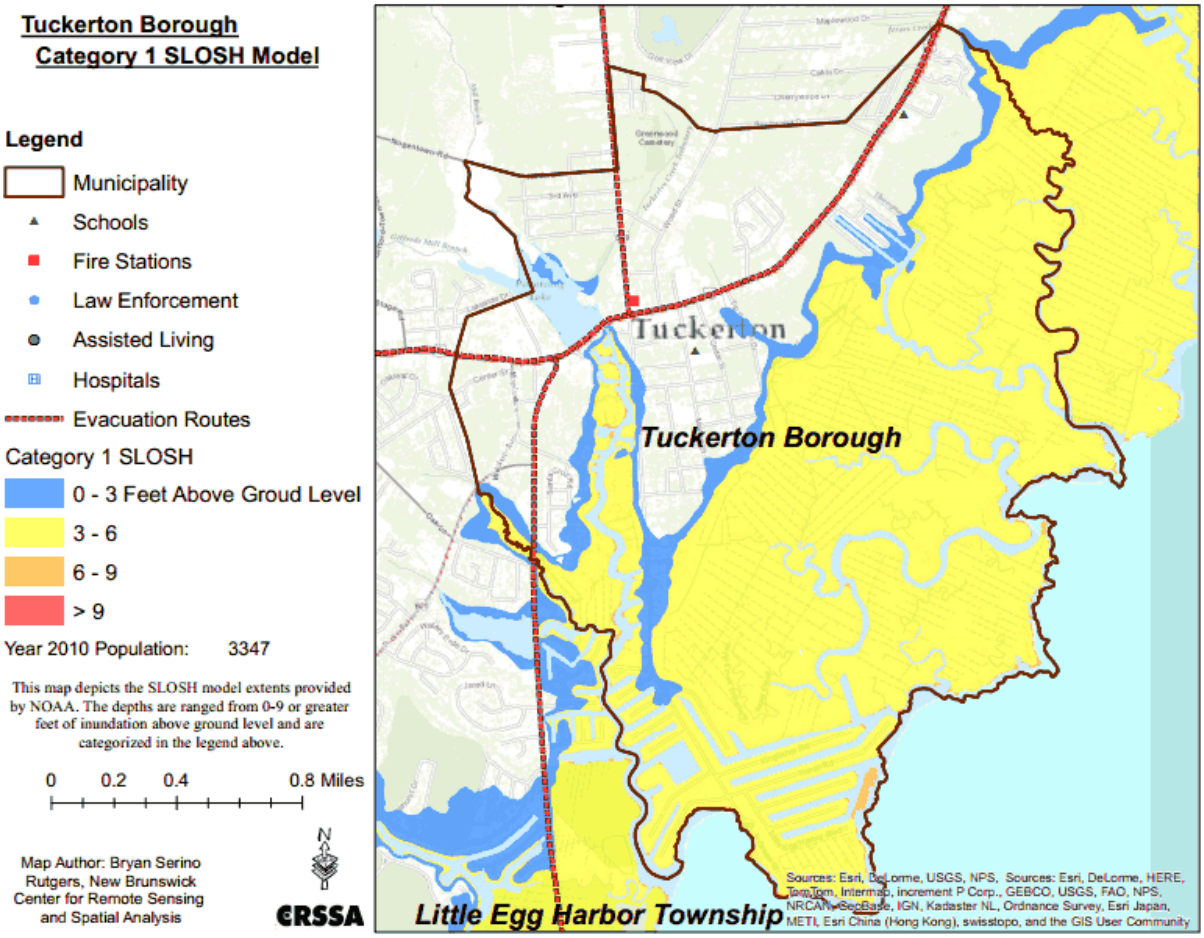
0 0.175 0.35 0.7 Miles

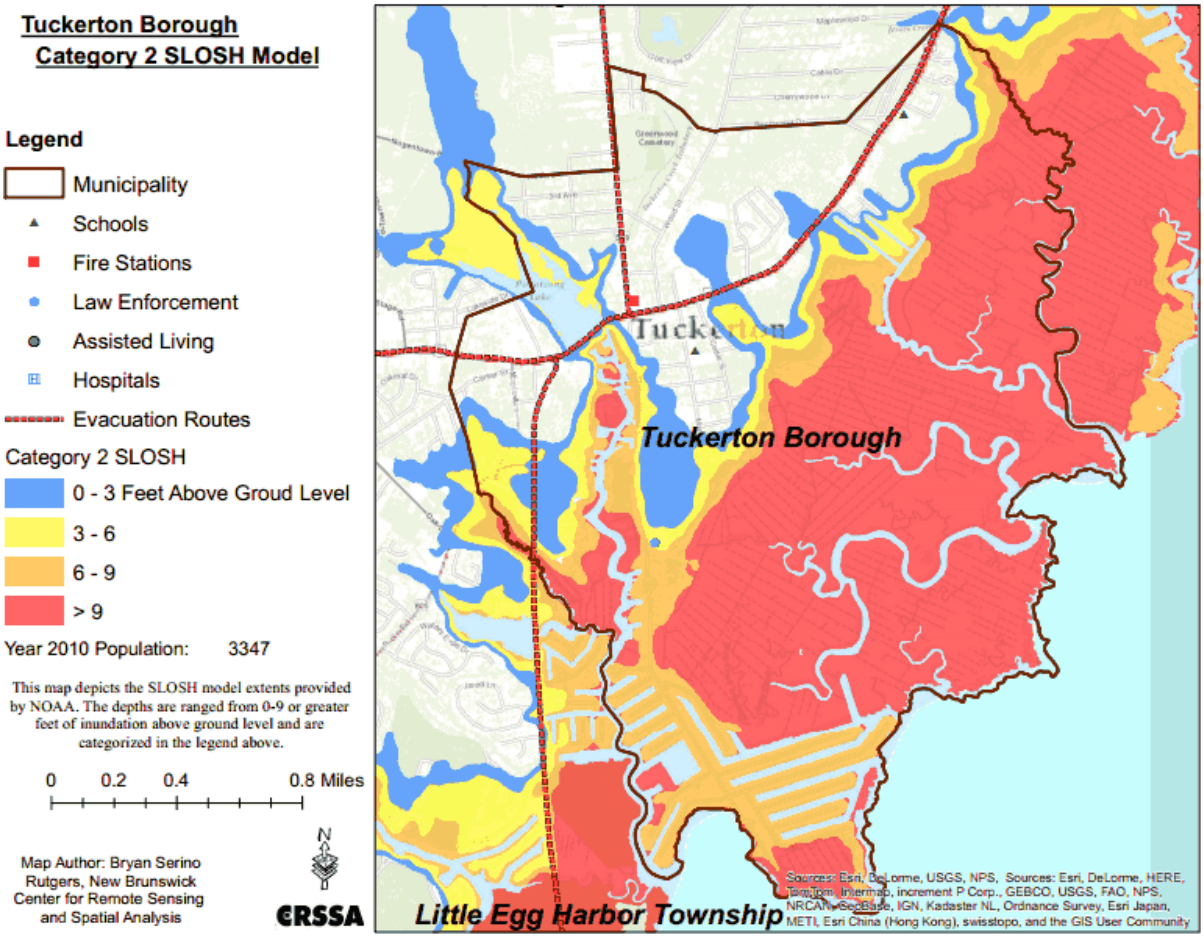
Map Author: Bryan Serino
Rutgers, New Brunswick
Center for Remote Sensing
and Spatial Analysis

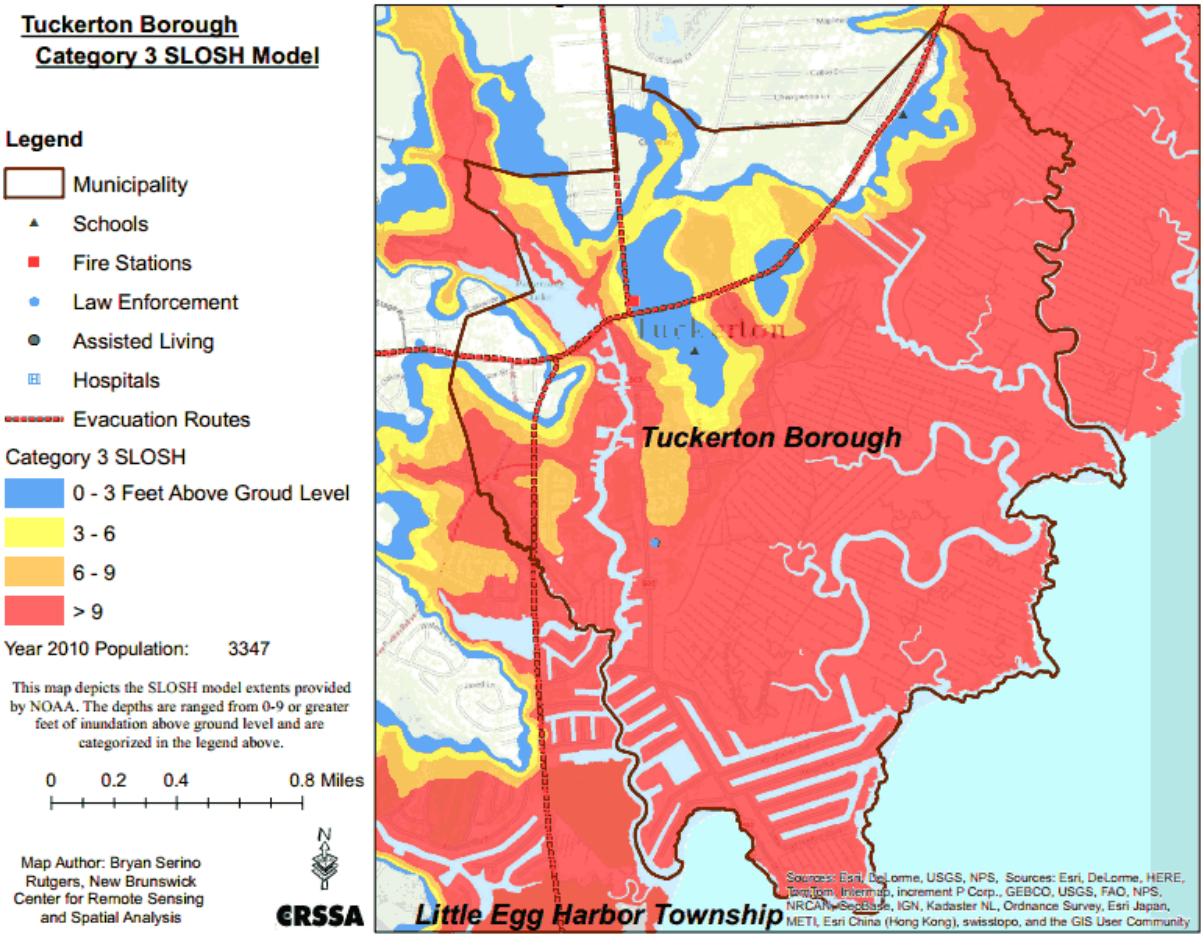
N

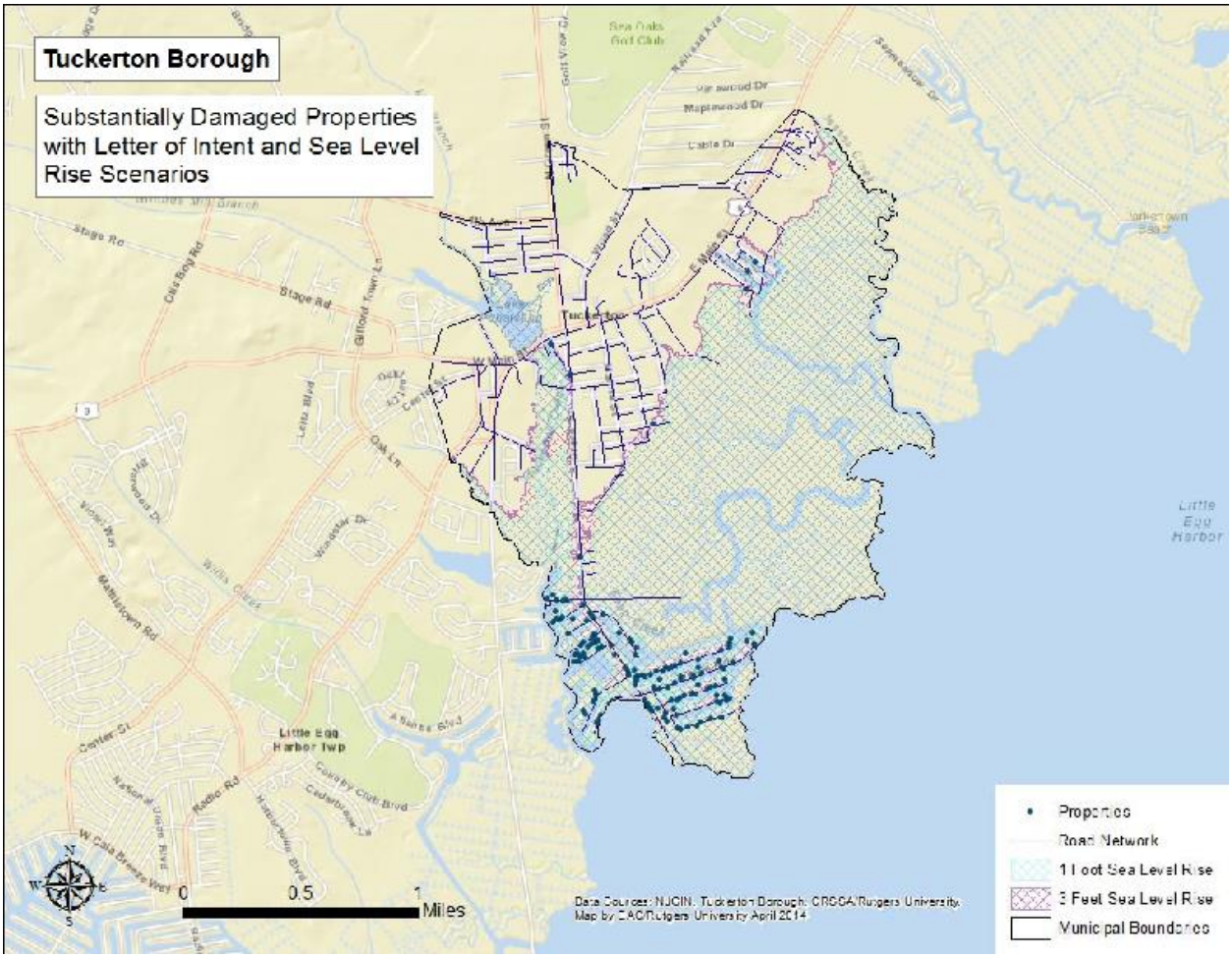
CRSSA




Tuckerton Borough
Category 1 SLOSH Model
Legend
Municipality
Schools
Fire Stations
Law Enforcement
Assisted Living
Hospitals
Evacuation Routes
Category 1 SLOSH
0 - 3 Feet Above Groud Level
3 - 6
6 - 9
> 9
Year 2010 Population: 3347
This map depicts the SLOSH model extents provided by NOAA. The depths are ranged from 0-9 or greater feet of inundation above ground level and are categorized in the legend above.
0 0.2 0.4 0.8 Miles
N
Map Author: Bryan Serino
Rutgers, New Brunswick
Center for Remote Sensing
and Spatial Analysis
CRSSA
Tuckerton
Tuckerton Borough
Little Egg Harbor Township
Sources: Esri, DeLorme, USGS, NPS, Sources: Esri, DeLorme, HERE, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community


Tuckerton Borough
Category 2 SLOSH Model
Legend
Municipality
Schools
Fire Stations
Law Enforcement
Assisted Living
Hospitals
Evacuation Routes
Category 2 SLOSH
0 - 3 Feet Above Groud Level
3 - 6
6 - 9
> 9
Year 2010 Population: 3347
This map depicts the SLOSH model extents provided by NOAA. The depths are ranged from 0-9 or greater feet of inundation above ground level and are categorized in the legend above.
0 0.2 0.4 0.8 Miles
Map Author: Bryan Serino
Rutgers, New Brunswick
Center for Remote Sensing
and Spatial Analysis
N
CRSSA
Tuckerton
Tuckerton Borough
Little Egg Harbor Township
Sources: Esri, DeLorme, USGS, NPS, Sources: Esri, DeLorme, HERE, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community


Tuckerton Borough
Category 3 SLOSH Model
Legend
Municipality
Schools
Fire Stations
Law Enforcement
Assisted Living
Hospitals
Evacuation Routes
Category 3 SLOSH
0 - 3 Feet Above Groud Level
3 - 6
6 - 9
> 9
Year 2010 Population: 3347
This map depicts the SLOSH model extents provided by NOAA. The depths are ranged from 0-9 or greater feet of inundation above ground level and are categorized in the legend above.
0 0.2 0.4 0.8 Miles
N
Map Author: Bryan Serino
Rutgers, New Brunswick
Center for Remote Sensing
and Spatial Analysis
CRSSA
Tuckerton Borough
Little Egg Harbor Township
Sources: Esri, DeLorme, USGS, NPS, Sources: Esri, DeLorme, HERE, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community


Tuckerton Borough
Substantially Damaged Properties with Letter of Intent and Sea Level Rise Scenarios
Properties
Road Network
1 Foot Sea Level Rise
3 Feet Sea Level Rise
Municipal Boundaries
0
0.5
1
Miles
Little Egg Harbor Twp
Little Egg Harbor
Data Sources: NJGIN, Tuckerton Borough, CRSSA/Rutgers University
Map by CAC/Rutgers University April 2014

Appendix 2: FEMA Flood Zones Definitions

Flood zones are geographic areas that FEMA has defined according to varying levels of flood risk and type of flooding. These zones are depicted on the published Flood Insurance Rate Map (FIRM) or Flood Hazard Boundary Map (FHBM).

Special Flood Hazard Areas – High Risk

Special Flood Hazard Areas represent the area subject to inundation by 1-percent-annual chance flood. Structures located within the SFHA have a 26-percent chance of flooding during the life of a standard 30-year mortgage. Federal floodplain management regulations and mandatory flood insurance purchase requirements apply in these zones.

Zone	Description
A	Areas subject to inundation by the 1-percent-annual-chance flood event. Because detailed hydraulic analyses have not been performed, no Base Flood Elevations (BFEs) or flood depths are shown.
AE, A1-A30	Areas subject to inundation by the 1-percent-annual-chance flood event determined by detailed methods. BFEs are shown within these zones. (Zone AE is used on new and revised maps in place of Zones A1–A30.)
AH	Areas subject to inundation by 1-percent-annual-chance shallow flooding (usually areas of ponding) where average depths are 1–3 feet. BFEs derived from detailed hydraulic analyses are shown in this zone.
AO	Areas subject to inundation by 1-percent-annual-chance shallow flooding (usually sheet flow on sloping terrain) where average depths are 1–3 feet. Average flood depths derived from detailed hydraulic analyses are shown within this zone.
AR	Areas that result from the decertification of a previously accredited flood protection system that is determined to be in the process of being restored to provide base flood protection.
A99	Areas subject to inundation by the 1-percent-annual-chance flood event, but which will ultimately be protected upon completion of an under-construction Federal flood protection system. These are areas of special flood hazard where enough progress has been made on the construction of a protection system, such as dikes, dams, and levees, to consider it complete for insurance rating purposes. Zone A99 may be used only when the flood protection system has reached specified statutory progress toward completion. No BFEs or flood depths are shown.

Coastal High Hazard Areas – High Risk

Coastal High Hazard Areas (CHHA) represent the area subject to inundation by 1-percent-annual chance flood, extending from offshore to the inland limit of a primary front al dune along an open coast and any other area subject to high velocity wave action from storms or seismic sources. Structures located within the CHHA have a 26-percent chance of flooding during the life of a standard 30-year mortgage. Federal floodplain management regulations and mandatory purchase requirements apply in these zones.

Zone	Description
V	Areas along coasts subject to inundation by the 1-percent-annual-chance flood event with additional hazards associated with storm-induced waves. Because detailed coastal analyses have not been performed, no BFEs or flood depths are shown.
VE, V1-V30	Areas along coasts subject to inundation by the 1-percent-annual-chance flood event with additional hazards due to storm-induced velocity wave action. BFEs derived from detailed hydraulic coastal analyses are shown within these zones. (Zone VE is used on new and revised maps in place of Zones V1–V30.)

Moderate and Minimal Risk Areas

Areas of moderate or minimal hazard are studied based upon the principal source of flood in the area. However, buildings in these zones could be flooded by severe, concentrated rainfall coupled with inadequate local drainage systems. Local stormwater drainage systems are not normally considered in a community's flood insurance study. The failure of a local drainage system can create areas of high flood risk within these zones. Flood insurance is available in participating communities, but is not required by regulation in these zones. Nearly 25-percent of all flood claims filed are for structures located within these zones.

Zone	Description
B, X (shaded)	Moderate risk areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-annual-chance flood by a levee. No BFEs or base flood depths are shown within these zones. (Zone X (shaded) is used on new and revised maps in place of Zone B.)
C, X (unshaded)	Minimal risk areas outside the 1-percent and .2-percent-annual-chance floodplains. No BFEs or base flood depths are shown within these zones. (Zone X (unshaded) is used on new and revised maps in place of Zone C.)

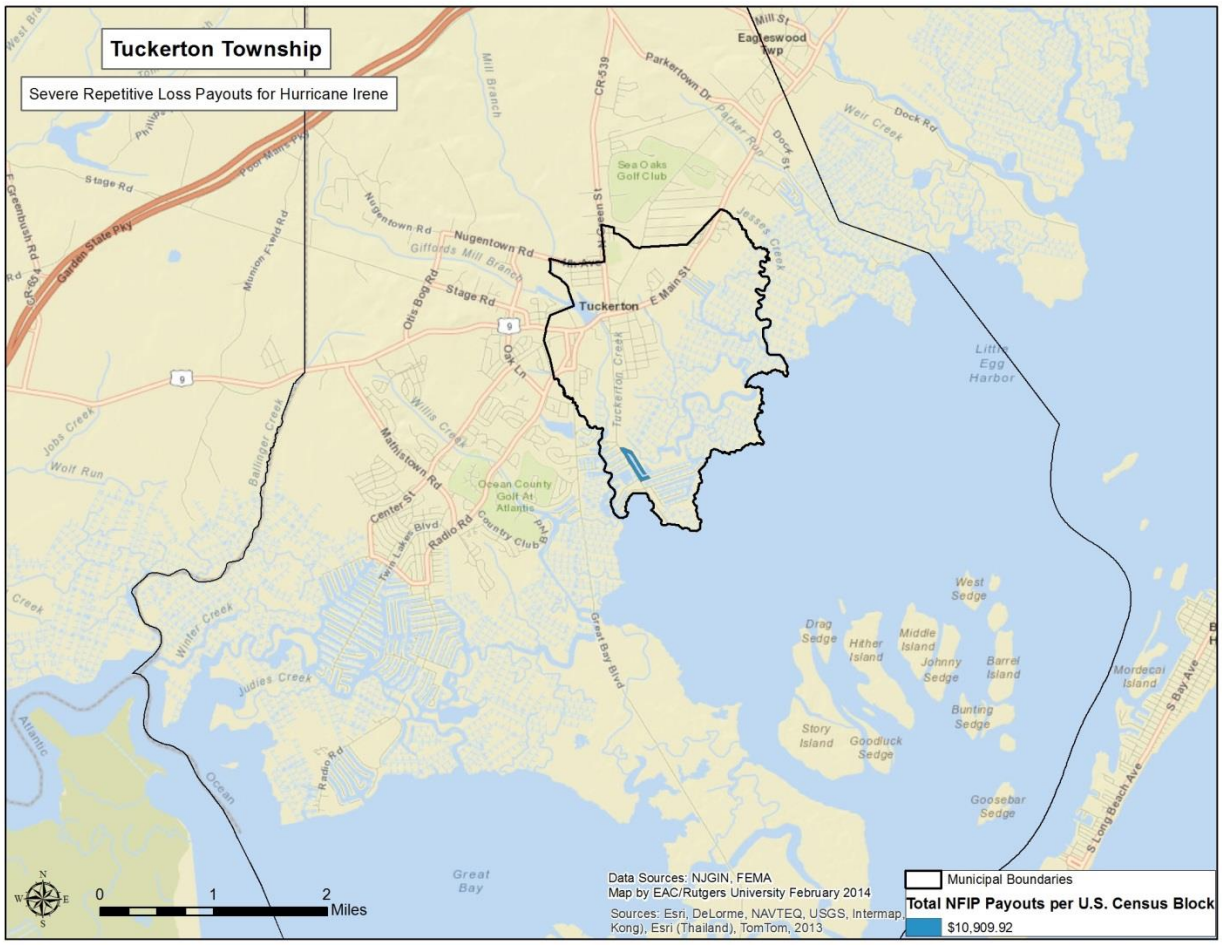
Undetermined Risk Areas

Zone	Description
D	Unstudied areas where flood hazards are undetermined, but flooding is possible. No mandatory flood insurance purchase requirements apply, but coverage is available in participating communities.

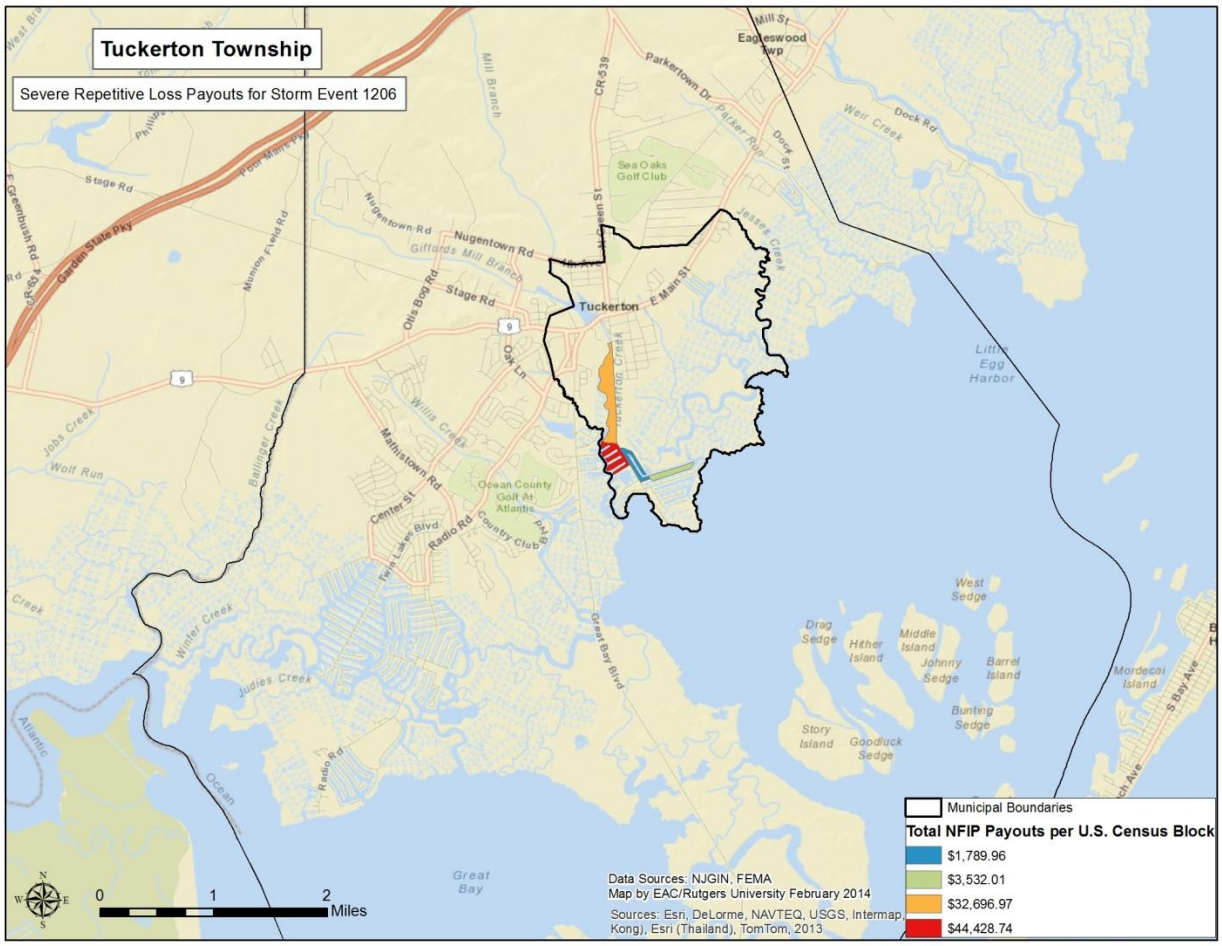
Appendix 3: inundated Roadways - 2050 Sea Level Rise with 1% Annual Flood Scenario

1. 1st Avenue
2. Absecon Terrace
3. Admiral Drive
4. Anchor Avenue
5. Angler Road
6. Barlett Lane
7. Bartlett Avenue
8. Bass Road
9. Bay Avenue
10. Beaumont Avenue
11. Brigantine Terrace
12. Cedar Street
13. Clay Street
14. County Route 12
15. County Route 4
16. County Route 6
17. County Route 601
18. County Route 603
19. County Route 8
20. Cox Avenue
21. Curlew Road
22. Dolphin Road
23. Edgewater Drive
24. Fairway Drive
25. Flamingo Road
26. Floyd Lane
27. Heron Road
28. Hialeah Drive
29. Ibis Court
30. Kelley Avenue
31. Kingfisher Road
32. Lady Slipper Court
33. Lake Street
34. Little Egg Harbor Blvd
35. Maple Avenue
36. Marlin Road
37. May Pink Court
38. Meadow Drive
39. Otis Avenue
40. Radio Road
41. Revere Drive
42. Shourds Lane
43. Skimmer Court
44. Sloop Landing Road
45. Tarpon Road
46. Tip Seaman Drive
47. US Hwy 9
48. Water Street
49. Willow Landing Terrace

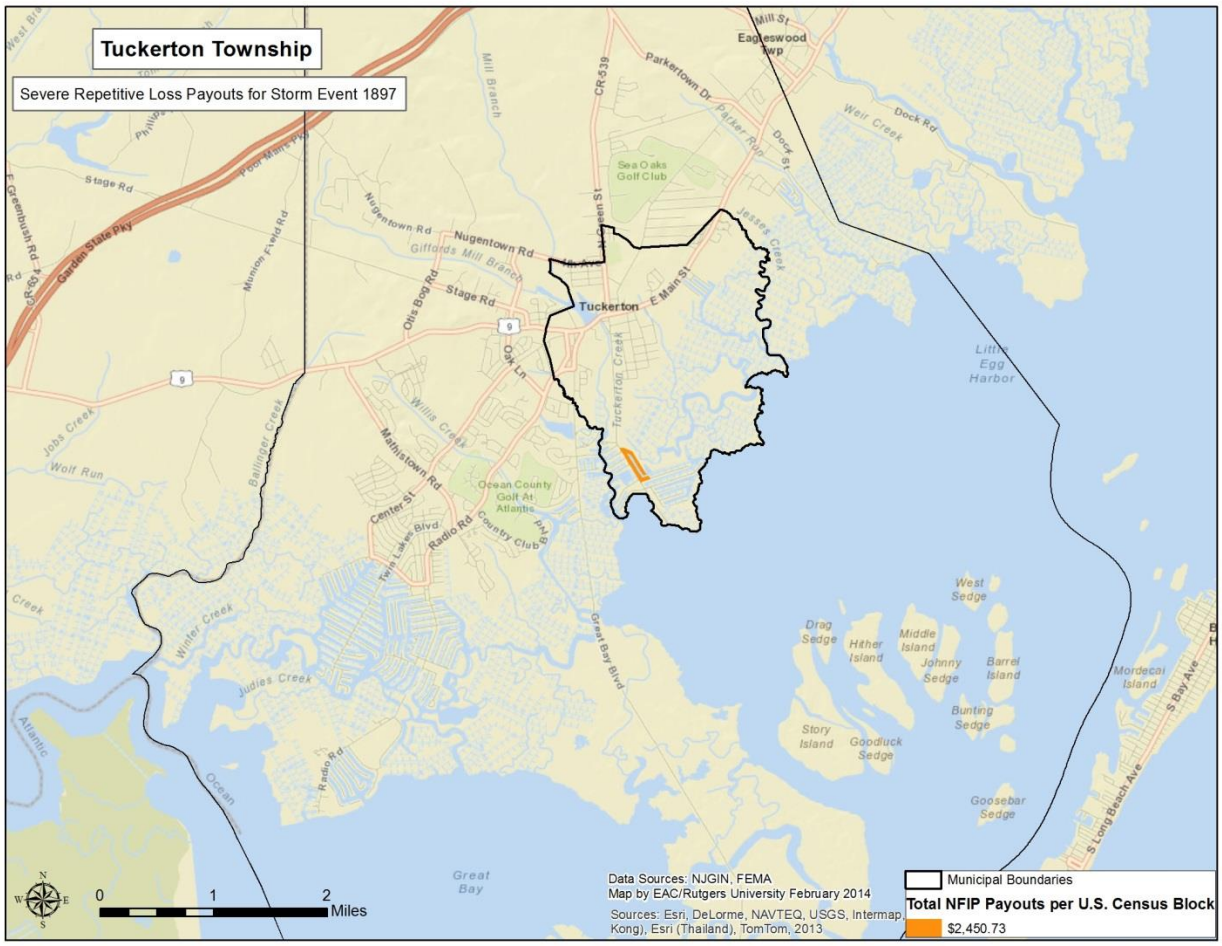
Appendix 4: Pre-Sandy Federal Recovery Assistance Payout Maps



This map shows total NFIP payouts in the Severe Repetitive Loss database held by the New Jersey Department of Environmental Protection for Hurricane Irene. The census block shown in blue received severe and repetitive loss payouts totaling $10,909.92.



This map shows total NFIP payouts in the Severe Repetitive Loss database held by the New Jersey Department of Environmental Protection for Storm Event 1206, which refers to the incident period of February 4, 1998 to February 8, 1998. Total payments per census block ranged from $1,789.96 (shown in blue) to $44,428.74 (shown in red).



This map shows total NFIP payouts in the Severe Repetitive Loss database held by the New Jersey Department of Environmental Protection for Storm Event 1206, which refers to the incident period of March 12, 2010 to April 15, 2010. The census block shown in orange received payments totaling $2,450.73.

[i] https://www.llis.dhs.gov/content/one-communitys-efforts-battle-future-flood-loss