City of New Brunswick
"Getting to Resilience"
Recommendations Report

Prepared by the Jacques Cousteau National Estuarine Research Reserve

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(Photo credit: http://newbrunswicktoday.com/sites/newbrunswicktoday.com/files/IaZI3vr.jpg)

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

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Introduction

The Getting to Resilience (GTR) 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 reduce vulnerability and increase preparedness by linking planning, mitigation, and adaptation. The GTR 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 GTR process, JC NERR Community Resilience Specialists enhance the outcomes of the evaluation by providing community-specific recommendations, guided discussions with municipal representatives, a vulnerability analysis, and municipal plan reviews. This Recommendations Report was prepared by JC NERR in order to assist the City of New Brunswick's decision makers as the City works to become more resilient. The Reserve defines resilience as the ability of a community to both withstand a hazard event as well as recover in a manner that allows the community to be better equipped to handle future events. The City of New Brunswick should decide if and how to implement these recommendations as part of achieving their resilience goals. The Recommendations Report focuses on coastal hazards and coastal resilience and could be considered one step in efforts to improve overall resilience.

Many recommendations in this report are connected to the Community Rating System (CRS) program which helps residents save money on flood insurance rates and helps guide communities to becoming better prepared. The CRS is a Federal Emergency Management Association (FEMA) program, designed to reward communities for taking steps to reduce flooding risk. These activities and elements include public information, mapping, regulation, flood damage reduction, and warning and response initiatives. Actions under these categories are eligible for points that are added up to designate where the community is "rated" according to class rankings of 10 through 1. For each class the community moves up, they receive a reduction in flood insurance premiums of 5%. This can result in serious deductions for flood insurance costs for the community and its residents. Although New Brunswick is not currently participating in the CRS program, it would be beneficial to consider planning outreach and other actions according to CRS guidelines as the program is based upon increasing flood preparedness and reduction of risk. If the City chooses to enter the CRS program in future, the transition between outreach and other actions will be easier.

The GTR process in New Brunswick began after the City received a Municipal Public Access Grant from the New Jersey Department of Environmental Protection (DEP). The goal of the grant program is to help municipalities develop plans that improve the public's enjoyment of New Jersey's beaches, bays, and tidal waterways and to make public access points and related facilities more storm-resilient. As part of the grant contract New Brunswick worked with the JC NERR to go through the GTR Questionnaire. JC

NERR staff met with municipal leaders for a discussion of their resilience strengths and challenges, to review maps of the City's vulnerabilities to coastal hazards, and to complete the questionnaire.

New Brunswick is located on the western side of Middlesex County, New Jersey. The northern boundary of the City is the Raritan River, with Lawrence Brook and Westons Mill Pond creating the northeastern boundary. To the south of the City is North Brunswick and to the west is Franklin Township in Somerset County. New Jersey Route 18 runs through the northern section of the City, linking the City to East Brunswick in the east and across the Raritan River to Piscataway Township in the north. New Jersey Route 27 runs along the southwestern border of the City before crossing the City through the downtown and then crossing the Raritan River, linking the City to Highland Park in the north. New Jersey Route 1 links the City to North Brunswick in the south and Edison in the north. Crossing an eastern portion of the City is Interstate 95, which links New Brunswick immediately south to East Brunswick and crossing the Raritan River, immediately north to Edison. Interstate 95 traverses the East Coast from Maine to Florida, and thus connects the City of New Brunswick to many additional communities throughout the East Coast.

The City of New Brunswick has experienced flooding throughout it's history. The Raritan River is a tidal waterway that is vulnerable to storm surge as well as precipitation based flooding from areas higher in the watershed. Both vulnerabilities can lead to high river crest heights, causing the river to spill over its banks into adjacent lands. During both Hurricane Floyd in 1999 and Hurricane Irene in 2011, the City of New Brunswick experienced precipitation based flooding. The total rainfall in the City during Hurricane Floyd was 7.04 inches (http://www.erh.noaa.gov/er/phi/floyd/rainfall.txt) and during Hurricane Irene was 8.12 inches (http://www.cocorahs.org/Maps/ViewMap.aspx?state=usa). August of 2011 was also the wettest summer on record for the state of New Jersey. New Brunswick received a total of 17.43 inches of rain over the course of the month (http://climate.rutgers.edu/stateclim/?section=menu&%20target=aug11). As Irene reached New Jersey on August 27th and 28th, the City's soils were already saturated, contributing to extensive flooding within the City.

The flooding experienced during Superstorm Sandy was caused primarily by storm surge up the Raritan River, combined with some precipitory flooding. Winds caused trees to come down in the City, causing property and infrastructure damage. Areas of the City had power outages of 10-13 days as there was major damage to the power station's infrastructure. The City was shutdown on Monday October 29, 2012. Residents living near the Raritan River who were flooded during Irene were required to evacuate. Power outages also caused Rutgers University to evacuate all dorms and move students into shelters.

The City incorporated floodplain preservation as an important ecological function in the City's 2004 Master Plan. In the introduction of the Parks, Recreation and Open Space Plan Element of the Master Plan it breaks down open space as having four main elements. The importance of floodplains as open space is defined in the Ecological Function section,

> *"Ecological Function – Lands in open space protection can help maintain the important balance in air and water quality. Open space can also help preserve vital storm water recharge lands and protect important environmental features. Floodplains, wetlands, and steep slopes can become*

hazards if developed, but if they are preserved in their natural state, they provide important ecological functions by maintaining their ability to absorb flood waters and retain pollutants, preserving air and water quality."

The City is familiar with its risks and vulnerabilities caused by flooding. The GTR process is intended to be a tool to help the City identify additional risks and vulnerabilities and provide recommendations aimed at addressing resiliency planning for the future.

Methodology

The City of New Brunswick received a Municipal Public Access Plan (MPAP) grant from the New Jersey Department of Environmental Protection (NJDEP). As New Brunswick works on their Municipal Public Access Plan the NJDEP will work one-on-one with the City to aid in the mapping and MPAP planning process. The GTR process is included in these efforts and will add increased knowledge of vulnerability and resilience planning to the process of creating a MPAP.

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 New Brunswick this team included Mark Siegle (Principal Planner New Brunswick), Tom Dobkowski (Fire/OEM New Brunswick), Pamela Stefanek (E.D. New Brunswick City Market), Bob O'Neil (Watershed Protection Specialist), Mirah Becker (Middlesex County Office of Planning), Andres Roda (Center for Advanced Infrastructure and Transportation), Frank Wong, (University Facilities and Capital Planning), Jenn Stuart (RU Transportation Planner), John Ferguson (Middlesex County OEM), Gregory Prott (MIddlesex County Hazmat Chief), Stacy Krause (Bloustein Research Associate), Veda Truesdale (Senior Research Associate), Jeanne Herb (Bloustein School), Thea Berkhout (Associate Dean, Bloustein School), David Eisenhower (Rutgers PhD student), Heather Fenyk (New Brunswick Environmental Commission), Vince Rifici (New Brunswick Environmental Commission), Becky Foster (NJ DEP), Thomas Valenti (Assistant City Engineer New Brunswick), Ismael A. Montanez (Superintendent of Parks and Shade Tree New Brunswick), and Megan Gosselink (NJ DEP). 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 GTR questionnaire was started with the City on April 29, 2015. JC NERR staff met with six representatives of New Brunswick, three representatives from Middlesex County, seven representatives of Rutgers University, and one representative of the NJ DEP. A graduate student from Rutgers University observed the process and assisted in note taking. A discussion of the City's resilience strengths and challenges began the meeting and current and future coastal hazard risk and vulnerability mapping was reviewed. The Risk and Vulnerability Assessments and Public Engagement sections of the questionnaire were completed. On June 24th, the Planning Integration, Disaster Preparedness and Recovery, and

Hazard Mitigation Implementation sections of the questionnaire were completed with six representatives of New Brunswick, two representatives of Rutgers University, and one representative of NJ DEP, facilitated by JC NERR staff. A graduate student from Rutgers University observed the process and assisted in note taking.

Upon completion of the GTR questionnaire, JC NERR staff analyzed the answers provided by the City staff, 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 by JC NERR staff to help assist the City of New Brunswick's decision makers as the City works to become more resilient.

Recommendations

OUTREACH

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

New Brunswick should examine the current number of outreach programs it runs and determine what it would take to earn CRS points. Outreach should include information about the natural and beneficial functions of floodplains. A well organized and efficient outreach program can provide validated information from a trusted source within the City's structure and better prepare residents for natural risks. Past outreach efforts should be examined and revisited if they were successful. The City should coordinate outreach efforts with Rutgers University to ensure that outreach messages are in alignment. Educational materials regarding floodplains may also be supplemented by input from faculty at the University who specialize in riverine and coastal sciences.

It would be beneficial to develop a Program for Public Information (PPI) which would help to organize outreach and continue to include the current methods and avenues for outreach. 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. The PPI can establish what New Brunswick identifies as outreach, who should be targeted by outreach, and the goals of the outreach program. If done correctly, a PPI will make outreach initiatives more effective and can gain CRS credits in numerous categories besides outreach. Although a PPI is not eligible for credit on its own, it acts as a multiplier in many CRS sections if the PPI is used to oversee outreach development. For guidance on establishing a PPI, visit http://crsresources.org/files/300/developing_a_ppi_for_credit_under_the_crs_2014.pdf. For more information on Outreach Projects, visit http://crsresources.org/files/300/outreach_projects_for_credit_under_the_crs_2014.pdf. For more

information on Outreach Projects credit requirements, visit page 330-2 of the CRS Coordinator's Manual. http://crsresources.org/files/2013-manual/crs_manual_508_ok_5_10_13_bookmarked.pdf

2. Develop a pre-flood plan for public information projects that will be implemented during and after a flood.

New Brunswick should consider developing a collection of outreach projects in anticipation of future flooding events. The outreach should cover all necessary information such as evacuation routes, safety procedures, and recovery operations. This action could be undertaken through the PPI and would help the City save time and energy leading up to, during, and after a flooding event as outreach will already have been prepared. Pre-flood planning should take place with careful coordination with the community's emergency manager. Examples of messages include evacuation routes, shelter locations, "Turn Around Don't Drown," when it is safe to go back, don't enter a flooded building until it has been cleared by an inspector, get a permit for repairs, substantial damage rules, mitigation opportunities during repairs, and information on mitigation grants. It is recommended that the City take advantage of social scientists and risk communication experts at the Bloustein School at Rutgers University. Pre-flood planning is eligible for CRS credits under Flood Response Preparations. For more information on Flood Response Preparations credit requirements, visit page 330-9 of the CRS Coordinator's Manual . (http://crsresources.org/files/2013-manual/crs_manual_508_ok_5_10_13_bookmarked.pdf)

3. Create annual public talks about flood zones, flooding risk, building recommendations, etc.

After flood and storm events, many municipalities have held talks and discussions on various flood related topics. By discussing the importance of planning for flooding, the City can set an example to its residents and businesses that readiness for disaster events should be maintained, even in relatively "quiet" times. A PPI can ensure these talks are well placed and effective. Suggested topics could include science behind storm surge, Base Flood Elevations, and elevating buildings to increase resiliency and reduce flood insurance rates. Additionally, these meetings can become an action in the Hazard Mitigation Plan.

A PPI can ensure these talks are well placed and effective. Well publicized and attended talks can reduce the workload on staff that would otherwise need to give numerous one-on-one meetings. However, continuing to have staff available for one on one meetings is highly recommended as it is beneficial and earns CRS credits in the Regulations Administration section. For more information on Outreach Projects credit requirements, visit page 330-2 of the CRS Coordinator's Manual. For more information on the Regulations Administration credit requirements, visit page 430-40 of the CRS Coordinator's Manual. http://crsresources.org/files/2013-manual/crs_manual_508_ok_5_10_13_bookmarked.pdf

4. Create and maintain a Flood Information section of the City website with input and guidance from the PPI.

The New Brunswick website should have a flood related information posted under a dedicated Flood Information section. It would be beneficial to maintain information to highlight flooding and coastal

hazard risks according to CRS outreach criteria. For CRS credit for a Flood Information section, the section only needs to be easily searchable through the City website. However, the more prominent the section is, the more likely the information will reach residents. The PPI should be responsible for this section of the website and should update it with care to ensure eligibility for CRS credits in the Outreach section. This tab should also highlight a link to the FEMA Region II website, http://www.region2coastal.com/. This website hosts Flood Insurance Rate Maps (FIRMs) and a wide variety of other information that can further educate residents. By directing residents to this site, it can help reduce the workload on City staff that may be asked to assist the public with simple items like finding a resident's Base Flood Elevation. The Flood Information section could also include pdf versions of CRS approved outreach brochures as well. The Monmouth County Planning Department has collected and received CRS approval for many outreach materials and they can be found on their website: http://co.monmouth.nj.us/page.aspx?Id=4382. For more information on Outreach Projects credit requirements, visit page 330-2 of the CRS Coordinator's Manual. http://crsresources.org/files/2013-manual/crs_manual_508_ok_5_10_13_bookmarked.pdf

5. Encourage community participation in citizen science initiatives such as the Community Collaborative Rain Hail Snow (CoCoRAHS) precipitation monitoring program.

Programs that encourage citizens to take part in monitoring of storms and climate change impacts benefit communities in multiple ways. Citizens that participate will become better educated about various climate and flood related topics, leading to better decision making. Collection of such data also can result in a local repository for historical storm information and microclimate datasets. The CoCoRAHS program administered by the Office of the New Jersey State Climatologist and the Rutgers New Jersey Agricultural Experiment Station is an excellent example of such a program (http://www.cocorahs.org/state.aspx?state=nj).

6. Create a coastal hazard disclosure policy.

Disclosure of known flood, erosion, or other coastal hazard risks at the time of property transfer is an important educational effort consistent with No Adverse Impact (NAI) (http://www.floods.org/index.asp?menuID=460) attitude. Some States (such as Florida and California) have disclosure requirements. If a disclosure is required for property in a flood or coastal hazard area, the seller is required to notify potential buyers of the risks and these risks can be factored into the purchase decision. If there is a shoreline protection structure on riverine property for sale, a disclosure policy could also require that prospective buyers be made aware of the issues surrounding such structures—their drawbacks, negative impacts, and the need for monitoring and maintenance. This type of policy can help sellers avoid transferring known adverse impacts that become unpleasant surprises to buyers.

During GTR meetings, City staff noted that some lenders and real estate agents disclose information about hazards associated with properties being considered for purchase. To ensure that this process continues and to establish congruence of methodology regarding these disclosures, a hazard disclosure policy could be established. The City would then be able to dictate what information must be shared

with potential buyers and set guidelines for the education of new residents concerning their flooding risk. Disclosing these risks to the public using various techniques also may result in CRS credits in the Outreach Projects and Hazard Disclosure sections. For more information on Outreach Projects credit requirements, visit page 330-2 of the CRS Coordinator's Manual. For more information on Hazard Disclosure credit requirements, visit page 340-2 of the CRS Coordinator's Manual. http://crsresources.org/files/2013-manual/crs_manual_508_ok_5_10_13_bookmarked.pdf

7. Share flood information and resilience strategies with Rutgers University and industrial and commercial entities within New Brunswick.

Flooding can result in major damages and indirect impacts to the commercial and industrial businesses in New Brunswick. Recovery and repairs can be costly and result in interruption of classes, research, and business, potentially harming the local economy and environment. New Brunswick should work with Rutgers University, as well as industrial and commercial entities to discuss coastal hazards that impact the City and work to partner on strategies to increase resiliency.

MITIGATION

8. Utilize sea level rise and storm surge mapping to identify possible roadways at risk to sea level rise.

Although New Brunswick is more than 5 miles inland from Raritan Bay and more than 20 miles from the open ocean, the City still experiences tides and is susceptible to coastal hazards such as sea level rise and storm surge. Sea level rise and storm surge mapping indicates several roadways that may become impassable during flooding events. Some of these roadways may be adequately raised to avoid flooding but others may not. The City could identify roadways where flooding is indicated and survey for elevation of the road. This information could be used merely for identification of flooding hazards, evacuation planning or flood response planning, or as a catalyst for road raising infrastructure upgrades. A writeup on the likely areas threatened by flooding events is included in this report. Raising at risk roadways could be included as possible actions in the Middlesex County Multi-Jurisdictional Hazard Mitigation Plan which is currently being updated.

9. Consider returning any City owned lands, parks or, properties acquired through Blue Acres or other buyout or acquisition programs to natural floodplain functions.

As New Brunswick is built out with the exception of possible brownfield redevelopment, limited areas of land are left that still have natural floodplain functions, mainly restricted to wetlands and other open space. Floodplains can absorb runoff and mitigate flooding issues. Returning lands to natural floodplain function can be done utilizing a variety of techniques including wetlands restoration, planting natural vegetation, reducing sediment compaction, eliminating impervious surfaces, and creating a natural profile. These efforts could be coordinated with Rutgers University and the New York-New Jersey Harbor & Estuary Program. As New Brunswick has already demonstrated a willingness to purchase high risk properties along the riverfront, future buyout strategies could include efforts to return properties to

natural floodplain function. Returning acquired land to natural floodplain functions can achieve significant CRS credits in the Natural Functions Open Space (NFOS) section. Funding for mitigation projects like this could be available by applying for a portion of the funding available through the Federal Emergency Management Agency (FEMA) in two recently announced Hazard Mitigation Assistance (HMA) grant programs: Flood Mitigation Assistance (FMA) and Pre-Disaster Mitigation (PDM). Acquisition of properties could be included as actions in the Middlesex County Multi-Jurisdictional Hazard Mitigation Plan. For more information on Natural Functions Open Space credit requirements, visit page 420-13 of the CRS Coordinator's Manual.
http://crsresources.org/files/2013-manual/crs_manual_508_ok_5_10_13_bookmarked.pdf

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

Erosion can become a problem in riverine areas. Areas that should be closely monitored could include any waterfront that is not bulkheaded and has experienced erosion. Factors that could amplify erosion such as stormwater flows, impervious surfaces, sea level rise, and surge should be defined. Sea level rise and surge also have the capacity to change the erosional identity of an area, making monitoring important. The City should make an effort to identify, document, and quantify areas of erosion. Identifying erosional hot spots and their potential impacts on homes and infrastructure can allow for mitigation actions that may prevent erosion from becoming a future problem. Additionally, unwanted deposition from shoaling and runoff can also be problematic for stormwater management near outfall pipes and navigation in waterways. Erosional hot spots could then be monitored for change, allowing for more informed and documented requests to fund shoreline restoration projects. This information should be used to supplement a Shoreline Management Plan, the Stormwater Management Plan, impervious surface remediation, and other infrastructure projects.

Ongoing monitoring may also present a stronger case for funders when the City seeks support for shoreline restoration projects. Keeping information on coastal erosion can result in CRS credit in the Erosion Data Maintenance (EDM) section. In addition, this information will be valuable to monitor the success of any mitigation projects instituted to reduce erosion such as breakwaters, rip rap, or living shoreline projects. Additionally, erosion monitoring can be included in the capabilities section of the Middlesex County Multi-Jurisdictional Hazard Mitigation Plan. For more information on the hazards of coastal erosion and possible CRS credit requirements, visit http://crsresources.org/files/2013-manual/coastal_hazards_supplement_2015.pdf.

PREPAREDNESS

11. Work with Middlesex County, Rutgers University, and neighboring municipalities to expand sheltering options.

It is vital to have backup plans in the event that the primary county shelters are full, the county is unable to provide the necessary services at those shelters, or routes to those shelters are cut off. Storm shelters

would need to be outside of the floodplain and be built to withstand high winds and other storm hazards. Shelters would need to be placed in areas outside of the reach of potential floodwaters and beyond the limits of the 500 year floodplain, where possible. New Brunswick should be involved in communications with the County, Rutgers University, and neighboring municipalities to ensure plenty of shelter availability and options during future disaster events. Shelters should have backup power and fuel supplies. Sheltering should include options for special needs, pets, other variables. Sheltering should also take non-natural disaster events into account such as industrial accidents. Where possible, the City should anticipate sheltering students of Rutgers University and residents of neighboring communities as well if local shelters are at capacity. Memorandums of agreement may be an effective tool to manage these increased sheltering expectations.

12. Back up all municipal planning documents and other critical materials.

In the event of a disaster, important information and documentation that could be used to guide the City to recovery needs to be accessible. In order to ensure sustained availability, all City planning documents, outreach associated with disaster events, and other critical materials should be backed up at offsite locations or in "cloud" networks.

13. Establish a flood warning system

With the use of mapping information and personal knowledge of flooding events, New Brunswick has the capability to identify flood prone areas, conditions that result in flooding of those areas, and the severity and reach of flooding during past storm events. By combining this information with the City's warning system, Nixle, New Brunswick can target and alert residents in flood zones that flooding is expected in their neighborhood when warnings are released from the National Weather Service or National Hurricane Center. New Brunswick could also take advantage of the various tide gauges in the area to create an automated system. When the gauge reads predetermined heights, a warning could be triggered in corresponding neighborhoods known to flood during those conditions. A full listing of the United States Geological Survey (USGS) stream and tide guages for the area can be found at http://waterdata.usgs.gov/NJ/nwis/current?type=flow.

County officials noted they would like to see additional tide gauges set up along the river, possibly with partnership from Rutgers. The City could work with the University if looking to expand the tide gauge network. Additionally, the Silver Jackets program has assisted with such efforts in other states and may be a good resource. NJ Silver Jackets is USACE led with State (NJDEP/NJOEM) priorities. Jason Miller from the Philadelphia District is the USACE contact. More information regarding the Silver Jackets can be found at http://www.nfrmp.us/state/factNewJersey.cfm. Such a system could be eligible for credit for Flood Threat Recognition. For more information on Flood Threat Recognition credit requirements, visit page 610-5 of the CRS Coordinator's Manual.
http://crsresources.org/files/2013-manual/crs_manual_508_ok_5_10_13_bookmarked.pdf

14. Create an access and functional needs (AFN) population database.

In the event of a disaster, New Brunswick must have mechanisms in place to care for the most high risk residents. This should include residents with health conditions that prevent them from evacuating without assistance. New Brunswick should gather AFN addresses and refer AFN residents to the state's Register Ready program, administered through the New Jersey Office of Emergency Management. Once a resident registers they will get email reminders to update their information once a year. As many AFN residents may not have email access, the City may choose to create a mechanism other than email reminders (letters, phone calls, door to door, etc). Each municipality can receive a login and password to access those who registered in their town. This is usually done by the law enforcement in the town. If City staff have any questions or issues with the program they can visit http://www.state.nj.us/njoem/plan/special_needs7.html

15. Work to become designated as a StormReady Community by the National Weather Service.

The National Weather Service has created a community preparedness program to assist towns as they develop plans for a wide variety of severe weather events. This program provides guidance on hazardous weather identification, warning systems, and creating public readiness. This guidance can in turn be used to help inform possible mitigation actions for Hazard Mitigation planning. For more information, visit http://www.stormready.noaa.gov/howto.htm. Becoming a StormReady Community results in CRS credits. For more information on the StormReady Community credit requirements, visit page 610-17 of the CRS Coordinator's Manual.
http://crsresources.org/files/2013-manual/crs_manual_508_ok_5_10_13_bookmarked.pdf

16. Develop a program for post-hazard event assessment of municipal preparedness.

When a natural disaster event requires emergency response, it is important to evaluate the quality of the response in order to determine if there are opportunities for improvement. Reflection of the performance of the municipality during emergencies could include municipal staff, members of the public, Middlesex County OEM, and local stakeholder groups.

MUNICIPAL ORGANIZATION

17. Transfer personal knowledge, documents, and other records of coastal storm and flooding event damages to digital format and place on a shared City computer drive to allow for access and sharing between multiple municipal departments.

Memories of historical storm and flooding 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 City 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 and river flooding 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 in the Outreach section. Hard copies of documents and other records should also be digitized for preservation and access. Having all storm and flooding related information on a shared drive will help educate the staff and allow for access without having to coordinate an exchange of information. For more information on Outreach Projects credit requirements, visit page 330-2 of the CRS Coordinator's Manual.
http://crsresources.org/files/2013-manual/crs_manual_508_ok_5_10_13_bookmarked.pdf

18. Have City municipal officials , Planning Board members, and Environmental Commissioners participate in FEMA training courses and other educational opportunities.

While going through the GTR questionnaire, it was expressed that some City officials had not taken advantage of FEMA trainings for certification. FEMA offers in person training and independent study programs. To find more information about in person training topics and dates please visit http://training.fema.gov/ and for independant study programs please visit http://training.fema.gov/is/. Through the Coastal Training Program, the JC NERR offers free courses for municipal staff and elected/appointed officials. JC NERR is willing to work with the City to understand training needs and provide relevant courses when possible. Having municipal officials trained on various topics and techniques can result in CRS credits in the Regulations Administration (RA) section though it may require SID codes. For more information on Regulations Administration credit requirements, visit page 430-40 of the CRS Coordinator's Manual.
http://crsresources.org/files/2013-manual/crs_manual_508_ok_5_10_13_bookmarked.pdf

19. 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. It is recommended that the members of the 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, creating municipal plans, zoning, and writing construction codes. As several of these tools are commonly used in hazard mitigation plan writing, Middlesex County may be able to provide access to assessments done using these tools as the Middlesex County Multi-Jurisdictional Hazard Mitigation Plan is updated.

- 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 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

- Additional non-regulatory tools are being developed by FEMA and can be accessed on www.region2coastal.com. Included in these tools is a Coastal Flood Risk Assessment which provides estimates of potential flood damage based on the new coastal flood study results using FEMA's Hazus loss estimation software . Draft versions of these tools are currently available by county at http://www.region2coastal.com/community-officials/flood-risk-tools/. For more information about the datasets and product descriptions visit http://www.region2coastal.com/community-officials/flood-risk-tools/tool-descriptions/

20. Receive guidance on environmental justice cases through the Rutgers Climate Adaptation Alliance.

When examining social vulnerabilities, low income populations are often at high risk and most exposed to hazards. New Brunswick's connection to Rutgers University yields the benefit of access to Rutgers Climate Adaptation Alliance (http://njadapt.rutgers.edu/). The Alliance can be looked at as an excellent resource in cases dealing with environmental justice.

FEMA MAPPING

21. Adopt the latest version of FEMA's flood maps as they are released, consider strengthening elevation requirements in the Flood Hazard Areas Ordinance as based upon the most stringent version of FEMA's flood maps, and meet or exceed state standards for freeboard requirements.

New Brunswick last updated the Flood Damage Prevention Ordinance in May 2010. The City needs to update the ordinance to include the state mandated freeboard requirement of one foot. Freeboard is additional feet of clearance above the Base Flood Elevation (BFE) that is required for new or substantially improved structures. As this update is done, New Brunswick should consider writing new requirements as related to the Best Available Flood Hazard Data, as it should allow for change over time as FEMA's maps are redrawn. 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 maintaining the language "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 100 year floodplain or higher base flood elevations than future 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 action can result in a large amount of CRS points in the Higher Regulatory Standards section. It is also recommended that New Brunswick consider exceeding the state's 1 foot freeboard requirement to provide better protection during storm events and to provide a buffer for expected sea level rise. Each additional foot of freeboard requirement will gain additional points in the Community Rating System, to as high as 500 points. The Freeboard credits are located in the section of Higher Regulatory Standards. For more information on the Higher Regulatory credit requirements, visit 430-2 of the CRS Coordinator's

Manual. http://crsresources.org/files/2013-manual/crs_manual_508_ok_5_10_13_bookmarked.pdf

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

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 City. For every release of a map update, the City 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. Notifying the public of a new map product is an example of outreach that can be done by the City's PPI, raising the potential for CRS points. Including information on what changes occur when new maps are released on the City's Flood Information webpage may help to alleviate questions the public may have as each map is updated, thereby reducing the workload on City staff.

The new RISK map products from FEMA include a GIS layer depicting the "changes since last FIRM" which will help the City in describing the changes in flood zones on individual properties and for the City as a whole. A description of this data set can be found at: http://www.region2coastal.com/community-officials/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 and businesses are with the maps, the more likely they will take appropriate actions.

23. Make sure all flood maps are available on the City website, at the municipal building, and at the local libraries.

New Brunswick has made Flood Insurance Rate Maps (FIRMs) available in the past but must ensure that these maps are accessible and easy to find. 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 in the Outreach section. Creating a link to FEMA's Region II website on the City website is highly recommended. Some municipalities have trained librarians to direct and lead residents through the FEMA Region II website. For more information on Outreach Projects credit requirements, visit page 330-2 of the CRS Coordinator's Manual. http://crsresources.org/files/2013-manual/crs_manual_508_ok_5_10_13_bookmarked.pdf

SUSTAINABLE JERSEY

Sustainable Jersey is a certification program for municipalities in New Jersey that want to go green, save money, and take steps to sustain their quality of life over the long term. The City of New Brunswick registered for Sustainable Jersey in December of 2009. The following Sustainable Jersey actions are recommended to the City based on the answers to the GTR questionnaire.

24. Climate Adaptation: Flooding Risk

This Sustainable Jersey action, under the category of "Climate Adaptation," is designed to help communities identify: 1) community vulnerability to flooding impacts (both coastal and inland) and 2) options for improving overall community resilience. This action focuses on the various causes of flooding that could impact a community, either now or in the future, including increased precipitation, increased frequency of heavy precipitation events, sea level rise and storm surge. Completion of this action item counts for a total of 20 Certification Points and as a Priority Action and will serve as a prerequisite for future companion Sustainable Jersey actions related to flooding and resiliency.

The City of New Brunswick has gone through the GTR process with staff at JC NERR. This recommendation report is an in-depth look at the City's linkages to other programs (provided on www.prepareyourcommunitynj.org) and the City's plans and ordinances.
Documentation for this action needs to include a signed list of members of a Flooding Risk Team formed to focus on the town's flooding risk issues, the maps viewed, and the town's assessment. The team that worked on GTR is listed in the methodology section of this report. As the maps in the appendix of this document were viewed at the first meeting while going through the GTR questionnaire, and are comprised from the same data as the maps on NJFloodmapper, they may be submitted for documentation. The section of this report that is labeled Sea Level Rise and Surge Vulnerability may be used as the description of the town's analysis of the use of the NJFloodMapper tool, as this section highlights many of the points talked about while going through Sea Level Rise maps of 1-3 feet and Storm Surge maps for Categories 1-3. The City is however responsible for writing the 300 word summary of the discussion on the flood risk maps and risk to the community. For more information on this action please visit http://www.sustainablejersey.com/actions-certification/actions/#/open/action/513.

25. Tree Protection Ordinance

Adopting municipal tree protection ordinances provides for legal protection of critical natural resources. Trees help to prevent flooding, sequester carbon, improve water quality, and provide timber. They also contribute to climate control and reduce soil erosion and sedimentation. The long-term health of the municipality's and the state's ecosystems will be more sustainable in the future as a result. These natural resource protection ordinances preserve not only the quality of drinking water, soils, and habitat, but also the overall quality of life for New Jersey's municipalities and citizens.

The Tree Protection Ordinance action is one of four actions that can receive points as a Natural Resource Protection Ordinance for the Sustainable Jersey program. In general, Natural Resource Protection Ordinances are designed to provide municipalities with the ability to protect various resources within the community from possible harmful effects caused by development. Municipalities with Natural Resource Inventories (NRI) or Environmental Resource Inventories (ERI) should implement those ordinances that protect the vulnerable resources identified in the inventory. Ordinances are the body of public law that implement the goals of the local Master Plan and protect public assets like special environmental features identified in the Environmental or Natural Resource inventory. Completion of this action item

will count for a total of 10 points and submissions for this action will not expire. (http://www.sustainablejersey.com/actions-certification/actions/#open/action/64)

The City of New Brunswick adopted a Tree Replacement Requirements ordinance in 2009. This is under Chapter 8 - Health and Safety, 8.48 - Tree Replacement Requirements in "New Brunswick, New Jersey - Code of Ordinances" (https://www.municode.com/library/nj/new_brunswick/codes/code_of_ordinances?nodeId=TIT8HESA_CH8.48TRRERE). In section 8.48.110 - Intent it states,

> *"The city of New Brunswick having found that indiscriminate, uncontrolled and excessive destruction, removal and clear cutting of trees upon lots and tracts of land results in increased drainage control costs, increased soil erosion and sedimentation, decreased fertility of the soil, degradation of water resources, decreased groundwater recharge, increased buildup of atmospheric carbon and increased dust and decreased property values, all of which negatively affect the character of the city of New Brunswick.*
>
> *The city of New Brunswick realizing that the removal of trees adversely affects the health, safety and general welfare of our residents, desires to regulate and control indiscriminate and excessive cutting of trees by preserving the maximum possible number of trees in the course of development of a site, ensuring that the health of trees preserved on a site is maintained throughout the development process, protecting larger, older specimens of trees and encouraging innovative design and grading to promote the preservation of existing trees. It is recognized that there is a strong relationship between the integrity of the city of New Brunswick and the region's water resources, the development on steep slopes, tree removal, soil disturbance, stormwater management and the general use of land resources. Therefore, the appropriate management of these resources is an important health, safety and general welfare concern."*

The content and intent of this ordinance reflects the requirements of the Sustainable Jersey Tree Protection Ordinance Action and should be investigated and pursued for possible credit. For more information on this action please visit, http://www.sustainablejersey.com/actions-certification/actions/#open/action/64.

26. Natural Resource Inventory

The Natural Resource Inventory (NRI), also known as an Environmental Resource Inventory (ERI), serves as an index of natural resources and is a compilation of text and visual information about the natural resource characteristics and environmental features of an area. It provides baseline documentation for measuring and evaluating resource protection issues. The NRI is an important tool for environmental commissions, planning boards, and zoning boards of adjustment. A municipality will earn 20 points toward Sustainable Jersey certification for a Natural Resource Inventory completed from within 10 years of the June submission deadline or for an older Inventory that has been reviewed and updated from within 10 years of the June submission deadline.

New Brunswick could pursue a Natural Resource Inventory or Environmental Resource Inventory for the City. When the City goes through its Master Plan update this inventory could be included and potentially earn the City Sustainable Jersey points. The Association of New Jersey Environmental Commissions (ANJEC) offers technical, financial, and resource support to municipal Environmental Commissions and other local officials that seek to develop an NRI. For more information on how ANJEC supports Environmental Commissions visit http://www.anjec.org/WhatECsDo.htm. For more information about ANJEC's NRI resources visit http://www.anjec.org/ERIs.htm.

27. The Municipal Blue Star Program

In September 2014 Sustainable Jersey and Clean Ocean Action launched The Municipal Blue Star Program. The Municipal Blue Star Program focuses on water quality protection. The goal of the program is to inspire coastal towns to reap the benefits of achieving Sustainable Jersey Certification while also focusing on watershed-wide water quality improvements. For more information about Clean Ocean Action and Sustainable Jersey's Blue Star Program visit, http://www.cleanoceanaction.org/index.php?id=811.

PLANNING

28. Update the Evacuation Plan to include more information.

Evacuation Plans are critical planning documents designed to ensure efficient movement of citizens to safe locations prior to and during disaster events. The current Evacuation Plan can be updated to include more information in order to create a more thorough document. Information that could be added includes what evacuation routes are prone to flooding, the necessary time frame to evacuate areas of residents and tourists, and conditions that would spur lane reversal. Emergency managers are already aware of much of this information, requiring only adding this personal knowledge to the plan update. Additionally, the plan can include outreach activities about personal and family evacuation routes and what to put in evacuation kits. This plan should be updated with input from the Middlesex County Office of Emergency Management and Preparedness and neighboring municipalities which may rely upon the evacuation routes through the City.

29. Consider creating a City-specific Continuity of Operations Plan.

A Continuity of Operations Plan (COOP) is separate from an Emergency Operations Plan and ensures that primary essential functions continue to be performed before, during, and after a wide range of emergencies. It is developed and maintained to enable each department, agency, and other governmental entity to continue to function effectively in the event of a threat or occurrence of any disaster or emergency that could potentially disrupt governmental operations and services. A COOP can protect essential facilities, equipment, vital records, and other assets. It can reduce or mitigate disruptions to operations. It can facilitate decision-making during an emergency. A COOP can also contain information about how to record work done during and after a disaster that may be eligible for FEMA compensation. JC NERR is able to provide example COOP plans from the Borough of Avalon

(http://www.prepareyourcommunitynj.org/media/27952/Avalon_COOP_COG.pdf) and Brick Township. FEMA also provides a Continuity Plan Template (http://www.fema.gov//media-library/assets/documents/90025) that can be used as a starting point for local governments.

30. Focus on including numerous possible mitigation projects in the upcoming Middlesex County Multi-Jurisdictional Hazard Mitigation Plan, explore creating a municipal specific Mitigation Plan, and incorporate those projects into the Capital Improvements Plan.

Middlesex County's Multi-Jurisdictional Hazard Mitigation Plan was completed in October 2010 and the update process is underway. Sandy has shown the need for numerous potential projects but funding is always an issue. By including these "wish list" projects in the Hazard Mitigation Plan, it leaves the door open for grant programs to fund the projects. In the 2010 Multi-Jurisdictional Hazard Mitigation Plan, New Brunswick listed two municipal specific actions, one of which was outreach oriented. One of the general actions for New Brunswick identified in the plan was to undertake engineering studies to improve drainage problems. Any mitigation plan should heavily examine stormwater issues and identify projects to mitigate problems. The Middlesex County Multi-Jurisdictional Hazard Mitigation Plan could be used to target regional stormwater goals and the municipal specific hazard mitigation actions could be used for City specific stormwater projects.

An interdisciplinary approach should be used during hazard mitigation planning to ensure projects suit the needs of the City and are in line with Master Plan objectives The City, county and University group that participated in the GTR process would be well suited to continue with Hazards Mitigation planning as an extension of resilience planning. Other input and expertise for individual topics such as stormwater could be derived from groups and resources such as the New Jersey Association of Floodplain Managers, the Rutgers Cooperative Extension's Impervious Cover Assessment for New Brunswick, the Department of Transportation, New Jersey Future, Sustainable Jersey, and the Rutgers Climate Adaptation Alliance.

Adding additional resilience projects to the Multi-Jurisdictional Hazard Mitigation Plan update would make it easier to be funded through future Hazard Mitigation funding opportunities. Projects that are not listed in the Hazard Mitigation Plan will struggle to find funding sources through hazard mitigation grant funding. The 2010 Multi-Jurisdictional Hazard Mitigation Plan lists New Brunswick as having a low flood risk, a ranking based upon acres in the 100 year floodplain in the FIRM and number of NFIP claims. These two numbers are expected to have increased since FEMA's coastal remapping effort, possibly increasing New Brunswick's flood risk ranking and increasing the likelihood of funding assistance for hazard mitigation projects. A crosswalk of possible mitigation projects should be included in the Capital Improvements Plan which should be updated during the Master Plan rewrite. New Brunswick could reference FEMA's "Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards" for mitigation project ideas. https://www.fema.gov/media-library/assets/documents/30627. It is also recommended that New Brunswick correspond with other Middlesex County towns to learn what hazard mitigation projects they have planned.

31. Create a shoreline management plan.

As shorelines are dynamic systems, it is important to have a well researched and documented plan that takes into account the forces at play and the desired uses for the shoreline and wetland areas as recreational, economic, and environmental resources. The shoreline management plan should work in conjunction with future Public Access planning to ensure that the shoreline is able to be utilized for many years without being too costly to maintain. Planning efforts should include input from Rutgers University, the New York-New Jersey Harbor & Estuary Program, master plan considerations, and possible impacts to open space and parks such as Boyd Park. Anticipated shoreline changes from sea level rise should be taken into consideration. Responsibilities for maintenance of streams, tributaries, and other waterways including stream cleaning and desnagging should be outlined.

32. Create an action plan for precipitation flooding events.

New Brunswick occasionally receives localized flooding during heavy rain events. The Raritan River is also prone to flooding when the region receives heavy rains. Both types of flooding can prompt street closures and emergency response. By drawing upon the knowledge of past events and topographical information, an action plan could be created to identify how much rain it takes to create flooding at vulnerable locations. When heavy rain events are forecast, the City would be able to preemptively prepare staff and resources to address the anticipated issues. In addition, the development of this action plan could result in the understanding of the cause for flooding, possibly allowing mitigation of causes such as clogged or undersized stormwater pipes. These findings could supplement the Rutgers Cooperative Extension's Impervious Cover Assessment for New Brunswick (http://water.rutgers.edu/Projects/NFWF/ICA/ICA_NewBrunswick_Compiled.pdf) and other possible analysis of the transportation system and the conveyance of water on roadway systems. Mitigation actions could then be included in the Multi-Jurisdictional Hazards Mitigation Plan or a City specific Mitigation Plan. The 2010 Multi-Jurisdictional Hazards Mitigation Plan already noted the need for engineering studies to examine stormwater issues.

New Brunswick has two dams located along Lawrence Brook. Westons Arch Dam and Westons Mill Pond Dam are both considered significant hazard dams. The designation of significant hazard is not the highest hazard. Only the presence of high hazard dams qualify municipalities for certain additional CRS credit opportunities but the dams still require attention. By definition, significant hazard dam failures are not likely to have a loss of life but the potential for significant property damage exists. These dams should be factored into action plans for heavy precipitation events as monitoring may be necessary.

33. New Brunswick should identify long-term inundation caused by sea level rise as a hazard in municipal plans and consider disclosing hazard risks.

New Brunswick will experience impacts due to sea level rise and like all potential hazard impacts, this risk should be identified in town plans to ensure proper response. Flooding, storm severity, storm frequency, and sea level rise are combined hazards. 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 for 2050, the "best" estimate for sea level rise is 1.3 feet for areas with bedrock and 1.5 feet along the Jersey Shore. By 2100, the "best" estimate for sea level rise is 3.1 feet in areas with bedrock and 3.5 feet along the Jersey coast. "Best" refers to a 50% likelihood of that level of sea level rise occurring, meaning that actual sea levels may be lower or higher than the "best" estimates.

While sea level rise is a monumental challenge to coastal areas, the challenge cannot be tackled until it is properly identified. Middlesex County is undergoing a Hazard Mitigation Plan update. It is likely that sea level will be included as a hazard in this plan. Once this takes place, New Brunswick should revise other municipal plans to reflect sea level rise as a hazard as well. This should include the recommended hazard disclosure policy (GTR recommendation #5). Disclosing these risks to the public using various techniques also may result in CRS credits in the Outreach Projects and Hazard Disclosure sections. For more information on Outreach Projects credit requirements, visit page 330-2 of the CRS Coordinator's Manual. For more information on Hazard Disclosure credit requirements, visit page 340-2 of the CRS Coordinator's Manual.
http://crsresources.org/files/2013-manual/crs_manual_508_ok_5_10_13_bookmarked.pdf

34. 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, 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 City move to create them. Further content regarding this recommendation can be found below in the section titled, "Coastal Hazard Incorporation in Planning". Rewriting certain planning documents such as Floodplain Management Plans, Evacuation Plans, Stormwater Management Plans could involve the creation of actions that in turn should be included in hazard mitigation plans.

Beginning the Long-term Planning Process for Sea Level Rise

New Brunswick, like most other coastal cities, will experience impacts from sea level rise in the form of regular tidal flooding, heightened storm impacts, and saltwater intrusion of aquifers and freshwater systems, requiring mitigation actions. The range of options include buyouts, elevating properties, and

green/blue/gray infrastructure to name a few, but the use of these options must be weighed, discussed, and decided upon.

The Blue Acres program is currently being administered by the NJDEP throughout the state and other buyout programs are also available. It would be prudent to look into repetitive loss properties that will also be threatened by sea level rise and future flooding events to determine if buyouts of these properties would be an effective way to plan for sea level rise and flooding. If the City feels that buyouts are not a good option, mitigation strategies should be investigated. However, not only will the individual mitigation options need to be examined, but the time frame of their effectiveness should be a factor. Cost-benefit analysis should accompany all mitigation projects to ensure that the lifespan of the mitigation and effectiveness when compared to rate of sea level rise is weighed against anticipated protection. In some instances, it may be determined that the cost of protecting already flood prone areas against sea level rise will be less effective than property acquisition. This may lead the City to reconsider mitigation measures such as buyout programs. Again, these decisions will not be easy ones to make but it is critical that the decisions do take place.

Guilford, CT Example

JC NERR recommends New Brunswick consider learning from the resiliency planning process undertaken by Guilford, 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 of 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 New Brunswick, 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 the City of New Brunswick 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, tide gates, marinas, 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:

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

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.

The City of New Brunswick 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, New Brunswick 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.

Salem, Massachusetts Example

Additionally, Salem, Massachusetts recognized the importance of being prepared for climate change and produced a Climate Change Vulnerability Assessment and Adaptation Plan (referred to as the "Plan" from hereon in). The Plan investigates some of the most serious climate change impacts, the resulting stresses to different sectors in the City, and outlines project ideas to address some of the most critical issues. The goal for this plan was to identify immediate, actionable adaptation priorities, and incorporate these into existing and future projects and policies.

This Plan was intentionally designed to focus on four of the most critical climate change impacts on six sectors in the City, and to prioritize the vulnerabilities to help inform which actions will give the greatest benefit for Salem. The four key climate change impacts are extreme heat events, extreme precipitation events, sea level rise, and storm surge. The six sectors assessed in this Plan are critical building infrastructure, water, energy, stormwater, transportation, and vulnerable populations.

Highlights of Salem's approach included having a diverse stakeholder group involved and engaged in the planning process and engaging the public and business in the implementing of new projects and policies as a result of the plan. Additionally, section 4 of the Plan lays out adaptation strategies to address Salem's priority vulnerabilities. The Plan can be found at: http://www.cakex.org/sites/default/files/documents/SalemClimateChangePlan.pdf.

NOAA's "Adapting to Climate Change: A Planning Guide for State Coastal Managers" Example

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). New Brunswick 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 climate change 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 and flooding in order to prioritize management efforts.

Awareness and Assistance

- Outreach and Education – Disseminate and make scientific fact sheets about climate change available to 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

- Sediment Management – Dredging and placing sediment, building shore protection structures and other structures that trap or divert sediment.
- 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.

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.

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 communities 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 discussed in the Master Plan under the corresponding sections. Staff noted that the City Master Plan will soon be due for an update. This represents a timely opportunity to incorporate coastal hazards.

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 City Master Plan. When choosing to update the Floodplain Management Plan, it is highly recommended to do so by following the guidelines set in Section 510 of the CRS which can result in large CRS credits. Refer to the following link 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 City'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 City'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 City of New Brunswick's 100-year floodplain are highly developed. Residential, industrial, and commercial uses exist within this floodplain. Most of the time a floodplain is available for use. However, during floods they can be dangerous. Hurricane Floyd, Hurricane Irene, and 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 New Brunswick, 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 City'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.

New Brunswick faces additional flooding issues. Several areas of the City commonly flood during storms with heavy precipitation. Sea level rise will increase flooding hazards as stormwater systems will become less effective. New Jersey is particularly vulnerable to sea level rise. During this century, as sea level rises, shorelines could retreat significantly in parts of the City. Narrow river beaches and wetlands at low elevations, all important habitats, would be lost to even a modest rise in sea level and erosion would increase. 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 City 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 agencies to regularly update the City floodplain maps, with first priority being areas that are mapped as 100-year floodplain without base flood elevation established.
2. Limit new development and subdivisions in the floodplain.
3. Promote uses, such as open space easements, natural areas, and recreational open space to reduce impervious surfaces in floodplains.
4. Work to acquire properties in the lowest lying portions of the 100-year floodplain, and return them to a natural state.
5. Reevaluate the effectiveness of the current floodplain protection regulations.
6. Discourage the location of new homes and roadways in the 100-year floodplain.
7. Work with the county to complete a hazard mitigation plan for flooding, wildfire, and other natural hazards.
8. Develop and implement a post-disaster recovery and reconstruction plan to facilitate recovery and to reduce exposure to future disasters.
9. Consider code changes that will limit impervious surfaces.
10. Develop a sea level rise response strategy (including a two foot freeboard requirement for properties exposed to flooding and discourage further shoreline hardening).

Mapping

The following maps can be found in the appendices of this document. Maps were either requested by City staff or recommended by JC NERR staff during GTR meetings. As part of updates to the Getting to Resilience website, the site will host community profiles that include municipal mapping profile packets that are available for future download. These maps can 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.

Sea Level Rise 1-3 feet with Critical Facilities

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 City can better understand future flooding risk and plan accordingly. As a portion of the City is near current sea level, including some municipal property, sea level rise maps should be utilized heavily for municipal planning documents.

Storm Surge (SLOSH Category 1, SLOSH Category 2, & SLOSH Category 3)

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.

Marsh Migration 1-3 feet

Marsh reaction to sea level rise has been mapped according to the Sea Level Affecting Marshes Model (SLAMM). Marshes provide various environmental and storm protection functions to communities and should be preserved. As sea level rises, many marshes will convert to open water or tidal mud flats. However, if suitable land is connected to current marshes, conversion of ecosystems may occur which could allow marshes to "migrate" further inland in balance with sea level. Upland areas that are deemed to be suitable marsh migration areas should be identified and preserved if possible and barriers to marsh migration should be eliminated. In doing so, the environmental and storm protection functions of marshes may persist despite sea level rise.

Preliminary Flood Insurance Rate Map

FEMA's Preliminary Flood Insurance Rate Map (PFIRM) represents the current best available data for New Brunswick concerning 1% and 0.2% flooding scenarios. Base Flood Elevations and wave modeling are established for the 1% flood. Flood Insurance Rate Maps should be used to assist in zoning and building code decisions. Additional mapping information about floodplain maps can be accessed off of FEMA's www.Region2Coastal.com.

Preliminary Flood Insurance Rate Map Table

FEMA's Preliminary Flood Insurance Rate Map (PFIRM) represents the current best available data for New Brunswick concerning 1% and 0.2% flooding scenarios. This table displays the coverage for the 0.2% zone, A zone, AE zone, and AO zone in terms of square miles and percent coverage. This table can be used to better understand the City's floodplain and be used as reference for various decisions concerning zoning, building, etc.

Sandy Surge Extent

FEMA has mapped the limits of the storm surge caused by Superstorm Sandy. This map can be used as a reference for this historical flooding event. Officials noted that the mapping available for this event appears to be too extreme.

Other Suggested Maps

Repetitive Loss & Severe Repetitive Loss

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

Shoreline Change

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 shorelines closer to buildings and infrastructure, reducing natural buffers and heightening impacts. Deposition that moves shorelines or near shore features such as sandbanks 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 and navigation channels. Shoreline change maps can identify trends and should be incorporated into appropriate municipal plans.

Overlays of Hazards and Populations, Infrastructure, and Building Footprints

Though it is the goal of this report to guide the City of New Brunswick towards resiliency, risk will always exist. By overlaying hazards such as sea level rise and surge with population information, infrastructure, and building footprints, the City will be able to identify areas of highest risk and plan accordingly.

Natural Resources, Historical Resources, Cultural Resources, & Economic Resources

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 New Brunswick to make decisions on protecting certain resources through retrofitting historic buildings or protecting natural resources by allowing for natural floodplain functions.

Additional Mapping Resources

NJADAPT (www.NJAdapt.org) is a New Jersey-based website being built to host and apply climate science and impacts data. The objective of the NJADAPT platform is to provide communities with the ability to develop municipal profiles of various risks that may potentially impact their areas

by making climate projection data for NJ more accessible. The initial development of the platform has been supported by the New Jersey Recovery Fund and NOAA.

The Coastal Hazard Profiler is the first tool developed as part of the larger All Climate Hazards tools being developed through the NJADAPT initiative. The Profiler is broken into three major themes:

- Society (demographic data that shows information about populations, businesses, and employees)
- Infrastructure (provides information on facility and infrastructure locations that should be considered when planning for disaster events),
- Environment (data on coastal land use areas - marsh, open space, land use land cover).

Each of the profiles allow you to see the themed data and then overlay a hazard layer of your choice to see what the potential impacts may be. The hazard layers include SLOSH for Categories 1-4, NJ Coastal Flooding Exposure (CFE), Sea Level Rise for 1-6 feet, Coastal Vulnerability Index, Shallow Coastal Flooding, FEMA Flood Zones, and Sandy Surge Extent. This tool allows you to create maps that you can then package and share links to or create pdfs from for further use.

Sea Level Rise and Surge Vulnerability

New Brunswick includes a variety of natural ecosystems, industrial areas, and residential communities. Fluctuations in tidal levels through surge events and rising sea levels are very significant for low lying areas and areas bordering wetlands and creeks. Scientists anticipate the arrival of one foot of sea level rise before 2050. As sea level rise is expected to accelerate this century, three feet of sea level rise is very likely before 2100. In the table below, the “central”, “low”, “high”, and “higher” estimates for sea level rise projections for New Jersey for the years 2050 and 2100 are displayed. “Central” refers to a 50% likelihood of that level of sea level rise occurring.

	Sea-level rise (feet)		
	Global	Bedrock	Shore
2030 central	**0.5**	**0.7**	**0.8**
2030 low	0.3	0.5	0.6
2030 high	0.7	1.0	1.1
2030 higher	0.9	1.2	1.4
2050 central	**0.8**	**1.3**	**1.5**
2050 low	0.5	0.9	1.1
2050 high	1.3	1.8	1.9
2050 higher	1.6	2.1	2.3
2100 central	**2.5**	**3.1**	**3.5**
2100 low	1.4	2.2	2.5
2100 high	4.0	4.6	4.9
2100 higher	4.6	5.5	5.9
2100 collapse	8.7	9.7	10.1

NJ sea level rise projection ranges and best estimates. K.G. Miller, R.E. Kopp, B.P.Horton, J.V. Browning, and A.C. Kemp, 2013, A geological perspective on sea - level rise and its impacts along the U.S. mid - Atlantic coast. Earth’s Future 1: 3 - 18, doi:10.1002/2013EF000135

In New Brunswick, areas bordering the Raritan riverfront and the areas adjacent to Lawrence Brook are the most likely to experience direct impacts from sea level rise. In other areas of the City, sea level rise impacts will be felt in the form of greater impacts of storm events as surges and river flooding will rise atop a higher sea level. Sea level rise maps for 1, 2, and 3 feet show that wetlands, areas draining into Mile Run, and other low lying areas will see the greatest impacts. Modeling for 1 foot of sea level rise indicates that the waterfront edges of many natural wetlands along the Raritan River and Lawrence Brook up to the Westons Mill Pond Dam will experience regular inundation. However, wetlands are able to withstand such flooding to a certain degree. Models for 2 feet and 3 feet of sea level rise indicates that these waterfront sections of New Brunswick will experience greater areas of inundation as sea level rises with the greatest impact in the eastern portion of the City at the junction of the Raritan River and the Lawrence Brook.

Marsh migration modeling indicates that although regular flooding of these wetlands will occur, only limited portions of the wetlands at the water's edge will convert to open water in this area. Loss of wetlands appears to be counterbalanced by the presence of marsh retreat zones. These are uplands areas that can potentially convert to wetland areas over time. Recent studies on sea level rise have indicated that higher rates of sea level rise might take place due to the collapse of ice sheets in the Antarctic. Higher rates of sea level rise could threaten additional areas of the City. As sea level projections are dynamic, New Brunswick should continue to be informed by the latest science-based data.

Analysis of SLOSH maps show that as hurricane strength increases, potential surge impacts will increase in scope and severity. It is important to note that this mapping aims to represent only surge impacts and does not take into account downstream effects of precipitation flooding leading to increased stage heights. As New Brunswick sits on the banks of the Raritan River and Lawrence Brook, heavy precipitation will increase the flooding impacts. It should be noted that Superstorm Sandy had a relatively low amount of precipitation when compared with other tropical systems that have impacted the areas. Storms that have had weaker surge but heavy precipitation events such as Hurricane Floyd had a much greater high water mark during their flood events than Sandy. This should be taken into account when reviewing SLOSH mapping.

SLOSH models indicate flooding should be expected to be near Sandy's flood levels for powerful Category 1 hurricanes. This flooding could be expected in wetland areas and the immediate riverfront for most of the City. The exception is the area from the railroad bridge for the Northeast Corridor line at Johnson Drive downriver to the junction of County Road 527 and Memorial Parkway. Flooding in this area would extend a greater distance from the riverfront and reach just to the west of Memorial Parkway, impacting developed properties. SLOSH models for Category 2 and 3 storms show increased vulnerability and intensity. Areas that have inundation depths of 0-3 feet during a Category 1 storm are capable of depths of greater than 9 feet in a Category 2 storm. The area of high impact along the Memorial Parkway is exposed to greater flooding depths and a larger flooding extent, reaching Neilson Street. In the eastern corner of the City, the flooding extent also impacts several homes along Wilcox Road. SLOSH maps for Category 3 show an extreme scenario. Areas that were flooded during Sandy and even some that did not see any flooding have the potential to be submerged with over 9 feet of

floodwaters. The area of high impact along the Memorial Parkway would continue to be exposed to greater flooding depths and a larger flooding extent, just reaching George Street. Portions of Regency Manor Drive, Manor Court, Wilcox Road, Goodale Circle, the south end of South Pennington Road, and the area around the intersection of Edgebrook Road and Burnet Street would all be exposed to flooding. Properties that are adjacent to Mile Run at the western border of the City may also be at risk for flooding. It is important to note that sections of Rutgers University's property and portions of the New Jersey Turnpike are capable of being flooded in a severe surge event during powerful tropical and subtropical weather systems. Memorial Parkway is threatened by floodwaters in all SLOSH surge scenarios.

As New Brunswick is prone to flooding impacts from coastal flooding (sea level rise and storm surge) and precipitation based flooding (heavy rains leading to higher stage heights in the Raritan River), it must be understood that a combination of flooding types will lead to greater cumulative flooding events. Currently, modeling of combined flooding impacts is unavailable for this report. However, efforts are underway from several groups to create methods to accurately reflect flooding risk during combined hazard events. The NJ Adapt website (www.njadapt.org) is in the process of developing a Precipitation Exposure Profiler tool to further inform flooding risk.

CRS Sections That Likely Have Available Current Points

The following sections of the Community Rating System will likely contain points for New Brunswick based off of the answers given in our Getting to Resilience questionnaire, discussions with JC NERR staff, and reviews of the City Master Plan and other documents. These sections represent the current state of the City but also include planned projects, uncompleted projects, and recommended actions deemed to be within the New Brunswick's reach. However, these projects may need to be completed in order to be granted credit. It is likely that the Outreach Projects in Section 330 will be highly achievable and less costly than other sections within the CRS. The following sections do not represent guaranteed points for the CRS but are likely achievable to a certain degree and should be investigated to determine the costs and benefits of the required actions if submitting to the CRS. New Brunswick is not currently a member of the Community Rating System. If the City chooses to join the CRS, we recommend inquiring about the following sections when working with the Coordinator. If New Brunswick chooses not to join the CRS, it still would be useful to use the program as a guideline for resiliency efforts.

Section 310: Elevation Certificates: To maintain correct federal emergency management agency (FEMA) Elevation Certificates and other needed certifications for new and substantially improved buildings in the Special Flood Hazard Area (SFHA).

- **Maintaining Elevation Certificates (EC):** Up to 38 points for maintaining FEMA elevation certificates on all buildings built in the special SFHA after the date of application to the CRS. All communities applying to the CRS must apply for this element. (Could be done)
- **Maintaining Elevation Certificates for Post-FIRM Buildings (ECPO):** Up to 48 points for maintaining EC on buildings built before the date of application to the CRS but after the initial date of the FIRM. (Could be done)

- **Maintaining Elevation Certificates for Pre-FIRM Buildings (ECPR):** Up to 30 points for maintaining elevation certificates on buildings built before the initial date of the FIRM. (Could be done)

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 1.7, 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 1.7, 2.5)

- **Problems Not Shown on the FIRM (MI3):** Up to 20 points for providing information about flood problems other than those shown on the FIRM. (GTR 1.7, 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. (GTR)

- **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 2.9, 2.11, 2.14, 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 2.9, 2.11, 4.9)
- **Program for Public Information (PPI):** Up to 50 points added to OP credits and up to 20 points added to FRP credits, for projects that are designed and implemented as part of an overall public information program. (could be done)
- **Stakeholder delivery (STK):** Up to 80 points added to OP credits for having information disseminated by people or groups from outside the local government. (could be done)

Section 340: Hazard Disclosure: To disclose a property's potential flood hazard to potential buyers before the lender notifies them of the need for flood insurance.

- **Disclosure of the flood hazard (DFH):** Up to 25 points if real estate agents notify those interested in purchasing properties located in the Special Flood Hazard Area (SFHA) about the flood hazard and the flood insurance purchase requirement. An additional 10 points are provided if the disclosure program is part of a Program for Public Information credited under Activity 330 (Outreach Projects). (Could be instituted as a requirement)
- **Other disclosure requirements (ODR):** Up to 5 points for each other method of flood hazard disclosure required by law, up to a maximum of 25 points. (could be done)
- **Real estate agents' brochure (REB):** Up to 8 points if real estate agents are providing brochures or handouts that advise potential buyers to investigate the flood hazard for a property. An additional 4 points are provided if the disclosure program is part of a Program for Public Information credited in Activity 330 (Outreach Projects). (Could be required)
- **Disclosure of other hazards (DOH):** Up to 8 points if the notification to prospective buyers includes disclosure of other flood-related hazards, such as erosion, subsidence, or wetlands. (Could be instituted as a requirement)

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. (could be done)
- **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. (could be done)
- **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 2.9, 2.11, 4.7, 4.9)

Section 360: Flood Protection Assistance: To provide one-on-one help to people who are interested in protecting their property from flooding.

- **Property protection advice (PPA):** Up to 25 points for providing one-on-one advice about property protection (such as retrofitting techniques and drainage improvements). An additional 15 points are provided if the assistance program is part of a Program for Public Information (credited under Activity 330 (Outreach Projects)). (could be done)
- **Advisor training (TNG):** 10 points if the person providing the advice has graduated from the EMI courses on retrofitting or grants programs. (could get training if not trained yet)

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

- **New Study (NS):** Up to 290 points for new flood studies that produce base flood elevations or floodways. (GTR 1.1, 1.7(Could be eligible if other elevation studies have been or are going to be done))
- **Higher Study Standards (HSS):** Up to 160 points if the new study was done to one or more standards higher than the FEMA mapping criteria. (GTR 1.7)
- **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 1.1, 1.7, 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.

- **Open space preservation (OSP):** Up to 1,450 points for keeping land vacant through ownership or regulations. (GTR 5.9, 5.12)
- **Natural shoreline preservation (NSP):** Up to 120 points for programs that protect natural channels and shorelines. (GTR 5.9)
- **Deed restrictions (DR):** Up to 50 points extra credit for legal restrictions that ensure parcels credited for OPS will never be developed. (GTR 5.9)
- **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 5.9, 5.12)
- **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 5.9)
- **Open space incentives (OSI):** Up to 250 points for local requirements and incentives that keep flood-prone portions of new development open (GTR 5.9)

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. (GTR 2.9, 2.11, 4.9)
- **Special Flood-related Hazard Regulations (SHR):** Up to 370 points for higher regulatory standards in areas subject to coastal erosion. (could be done)
- **Emergency warning dissemination (EWD):** Up to 75 points for disseminating flood warnings to the public. (GTR discussions)
- **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. (could be done)
- **Critical facilities planning (CFP):** Up to 75 points for coordinating flood warning and response activities with operators of critical facilities. (could be done)
- **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, 3.6.1, 3.7.1, 5.4)
- **Freeboard (FRB):** Up to 500 points for a freeboard requirement. (GTR 5.4)
- **Foundation Protection (FDN):** Up to 80 points for engineered foundations. (could be done)
- **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. (GTR discussions)

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 1.7, 2.5)
- **FIRM Maintenance (FM):** Up to 15 points for maintaining copies of all FIRMs that have been issued for the community. (GTR 1.7, 2.5)

Section 450: Stormwater Management: To prevent future development from increasing flood hazards to existing development and to maintain and improve water quality.

- **Watershed Master Plan (WMP):** Up to 315 points for regulating development according to a watershed management master plan (WMP). (could be done)

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.

- **Floodplain management planning (FMP):** 382 points for a community-wide floodplain management plan that follows a 10-step planning process. (GTR 3.4, 3.4.1, 3.7)
- **Repetitive Loss Area Analysis (RLAA):** Up to 140 points for a detailed mitigation plan for a repetitive loss area. (GTR 1.11)
- **Natural Floodplains Function Plan (NFP):** 100 points for adopting plans that protect one or more natural functions within the community's floodplain. (could be done)

Section 520: Acquisition & Relocation of buildings : To encourage communities to acquire, relocate, or otherwise clear existing buildings out of the flood hazard area. Up to 2,250 points based on the number of buildings that fit the criteria and have been acquired or relocated. (GTR 1.11)

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). (could be done)

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.

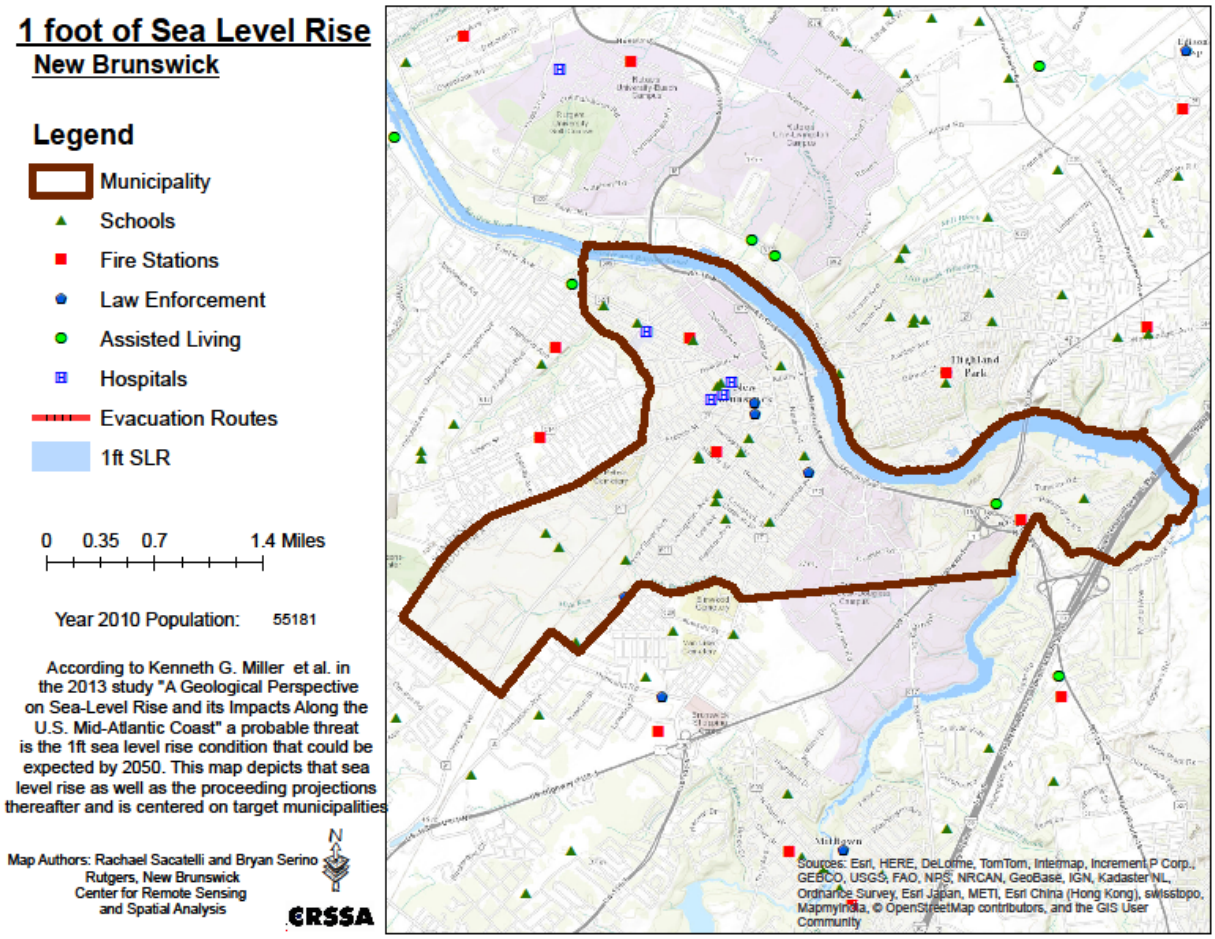
- **Capital improvement program (CIP):** up to 70 points for having a capital improvement program that corrects drainage problems. (GTR 3.7)
- **Coastal Erosion Protection Maintenance (EPM):** Up to 100 points for maintaining erosion protection programs in communities with coastal erosion prone areas. (GTR 5.9)

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)

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 4.5, 4.5.1, 4.5.2, 4.5.3, 4.5.4)

- **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 2.9, 2.11, 4.9, 4.9.6)
- **Flood threat recognition system (FTR):** Up to 75 points for a system that predicts flood elevations and arrival times at specific locations within the community (GTR 1.7 (could be done))
- **Emergency warning dissemination (EWD):** Up to 75 points for disseminating flood warnings to the public. (GTR 2.9, 2.11, 4.7, 4.9)
- **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 automated backup system for receiving flood warnings. (GTR 4.11)
- **Critical facilities planning (CFP):** Up to 75 points for coordinating flood warning and response activities with operators of critical facilities. (GTR 2.11, 4.7, 4.9)
- **StormReady community (SRC):** 25 points for designation by the National Weather Service as a StormReady community (GTR 4.6 (Could become designated))

Appendix


1 foot of Sea Level Rise
New Brunswick
Legend
Municipality
Schools
Fire Stations
Law Enforcement
Assisted Living
Hospitals
Evacuation Routes
1ft SLR
0 0.35 0.7 1.4 Miles
Year 2010 Population: 55181
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 as well as the proceeding projections thereafter and is centered on target municipalities
Map Authors: Rachael Sacatelli and Bryan Serino
Rutgers, New Brunswick
Center for Remote Sensing
and Spatial Analysis
N
CRSSA
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

2 feet of Sea Level Rise
New Brunswick

Legend

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

0 0.35 0.7 1.4 Miles

Year 2010 Population: 55181

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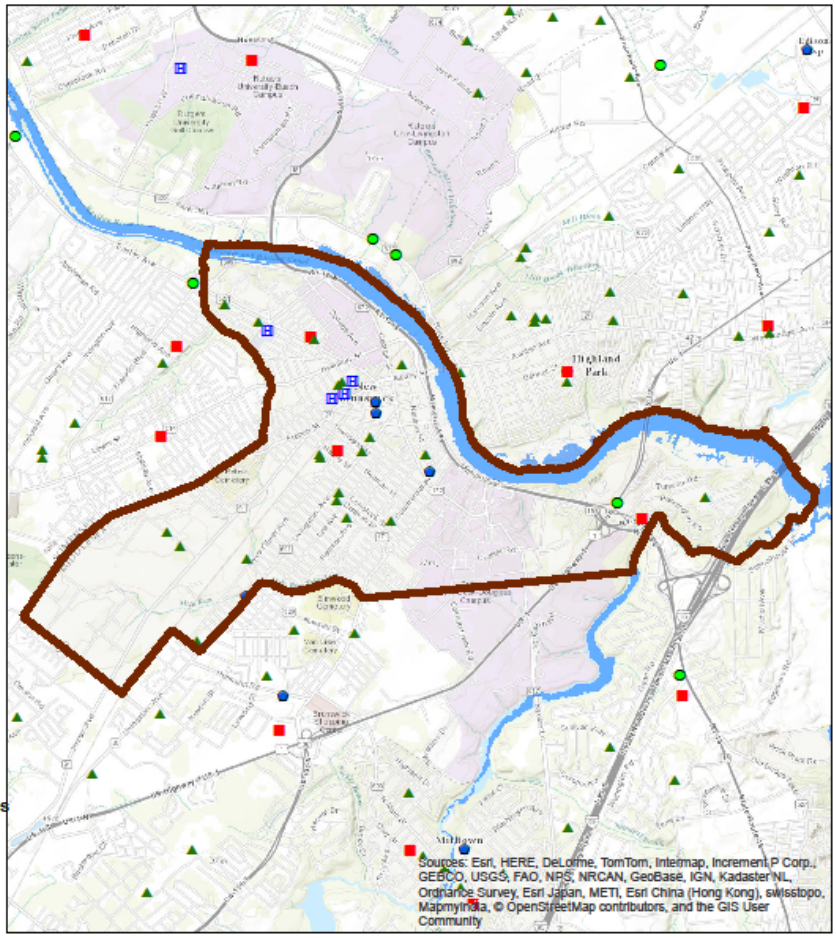

3 feet of Sea Level Rise

New Brunswick

Legend

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

0 0.35 0.7 1.4 Miles

Year 2010 Population: 55181

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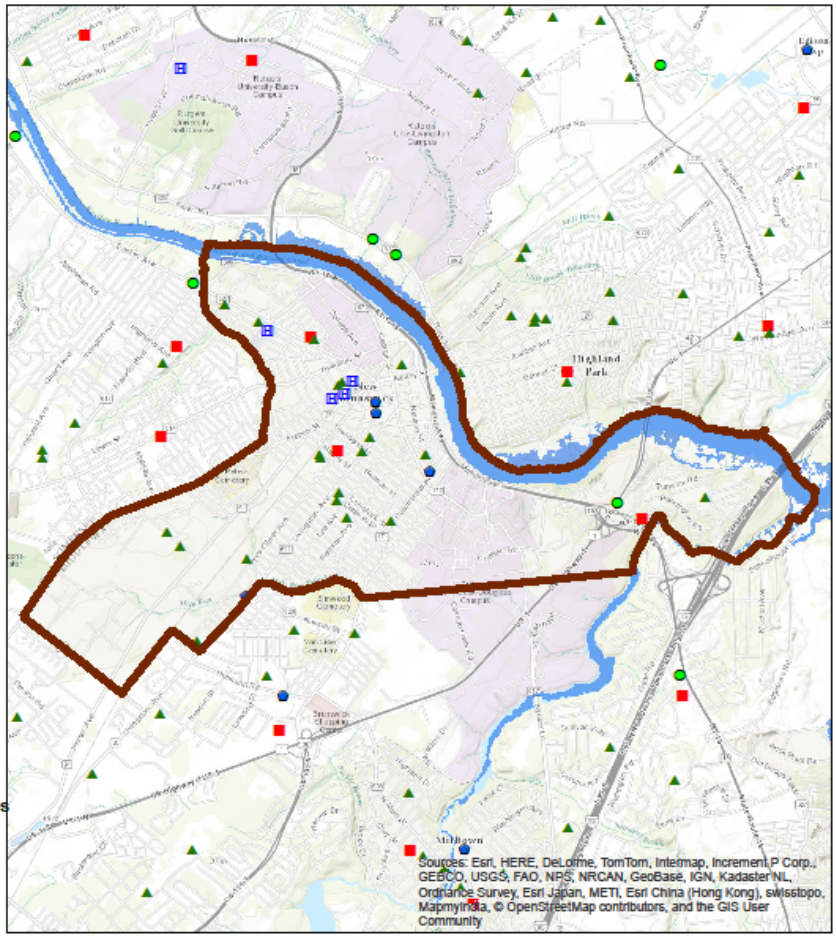

Category 1 SLOSH Model
New Brunswick

Legend

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

Category 1 SLOSH

- 0 - 3 Feet Above Ground Level
- 3 - 6
- 6 - 9
- > 9

0 1 2 Miles

Year 2010 Population: 55181

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.

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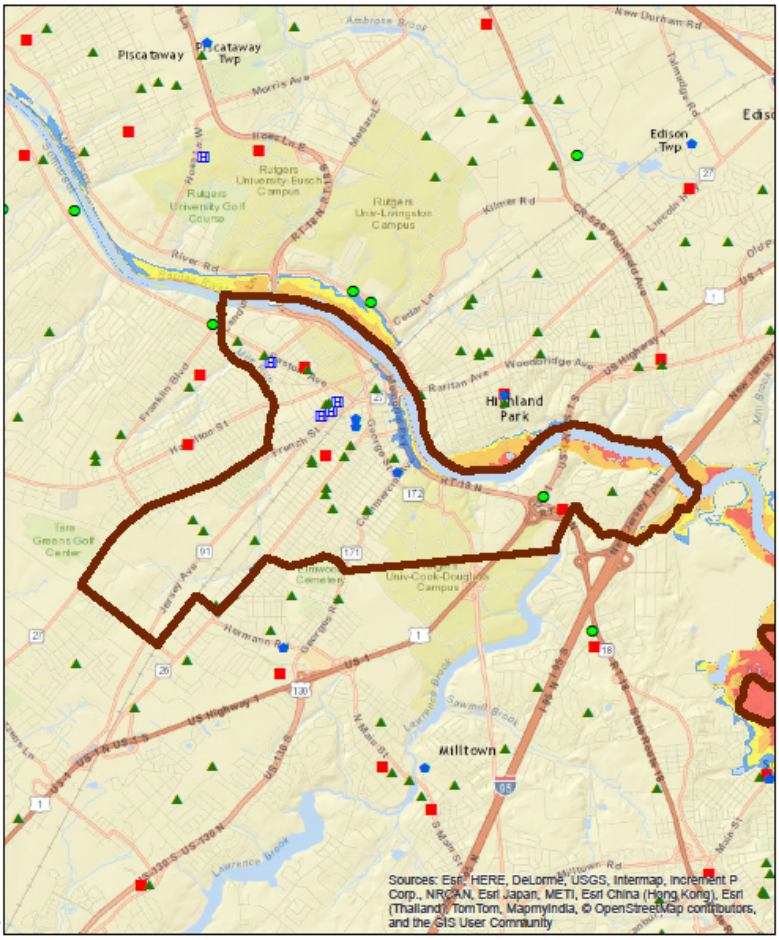

Category 2 SLOSH Model
New Brunswick

Legend

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

Category 2 SLOSH

- 0 - 3 Feet Above Ground Level
- 3 - 6
- 6 - 9
- > 9

0 1 2 Miles

Year 2010 Population: 55181

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.

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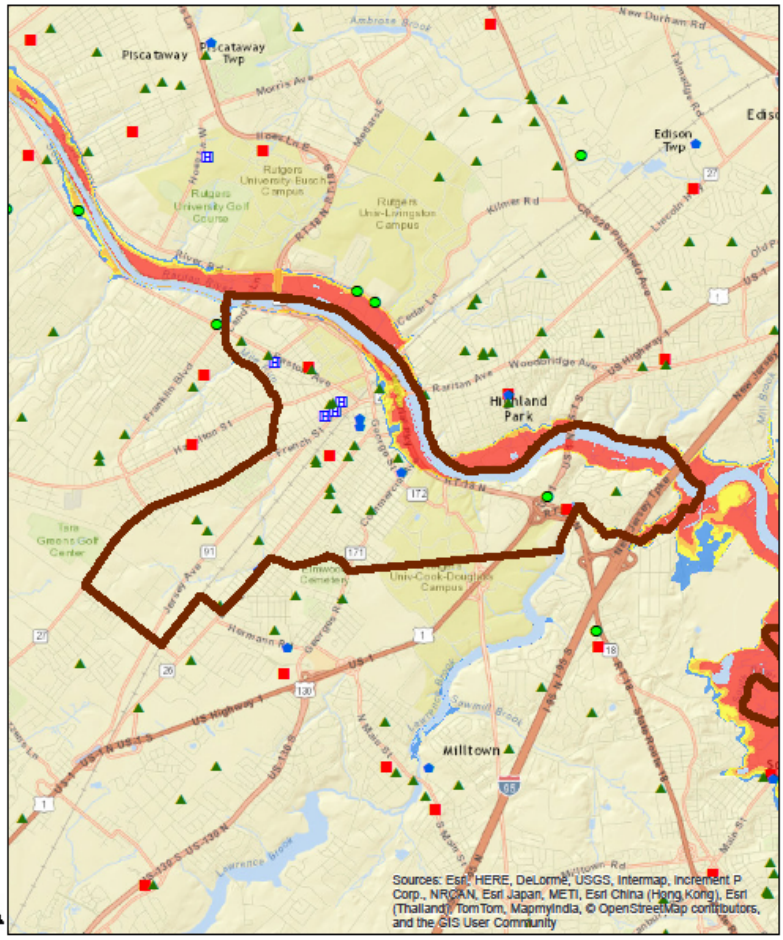

Category 3 SLOSH Model
New Brunswick

Legend

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

Category 3 SLOSH

- 0 - 3 Feet Above Ground Level
- 3 - 6
- 6 - 9
- > 9

0 1 2 Miles

Year 2010 Population: 55181

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.

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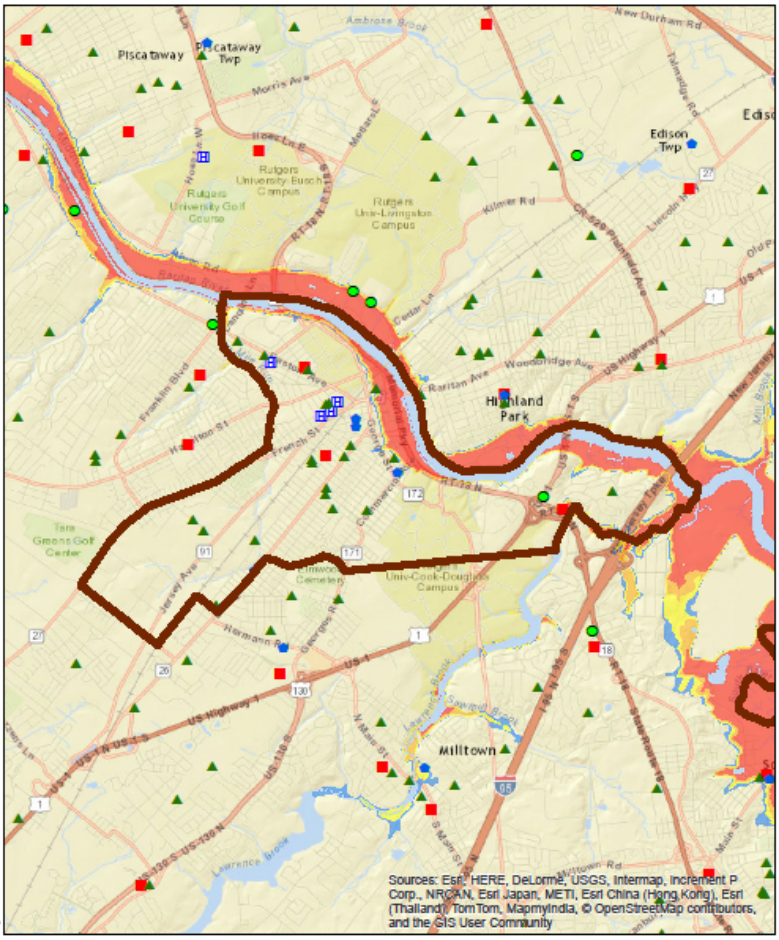

Marsh Retreat at 1 feet of Sea Level Rise New Brunswick

Legend

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

Marsh Retreat at 1ft SLR

- Unimpeaded Marsh Retreat Zone
- Impeded Marsh Retreat Zone
- Marsh Conversion: Unconsolidated Shore
- Marsh Conversion: Open Water
- Unchanged Tidal Marsh

0 0.4 0.8 1.6 Miles

Year 2010 Population: 55181

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 the marsh retreat caused by sea level rise centered on target municipalities.

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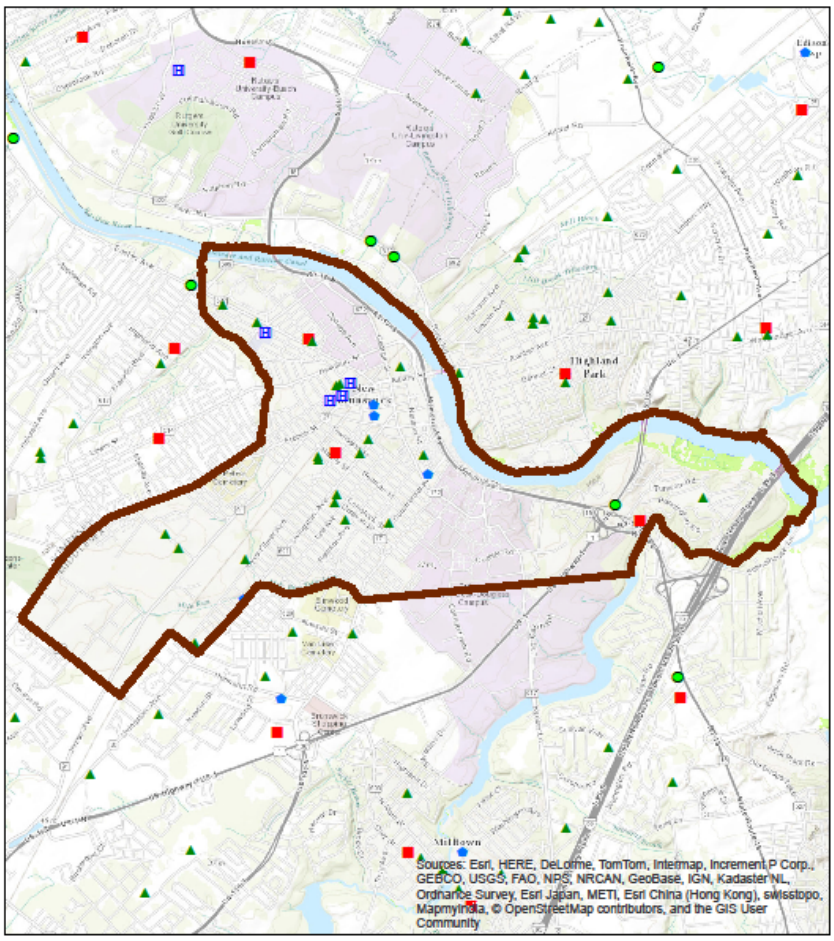

Marsh Retreat at 2 feet of Sea Level Rise New Brunswick

Legend

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

Marsh Retreat at 2ft SLR

- Unimpeaded Marsh Retreat Zone
- Impeded Marsh Retreat Zone
- Marsh Conversion: Unconsolidated Shore
- Marsh Conversion: Open Water
- Unchanged Tidal Marsh

0 0.4 0.8 1.6 Miles

Year 2010 Population: 55181

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 the marsh retreat caused by sea level rise centered on target municipalities.

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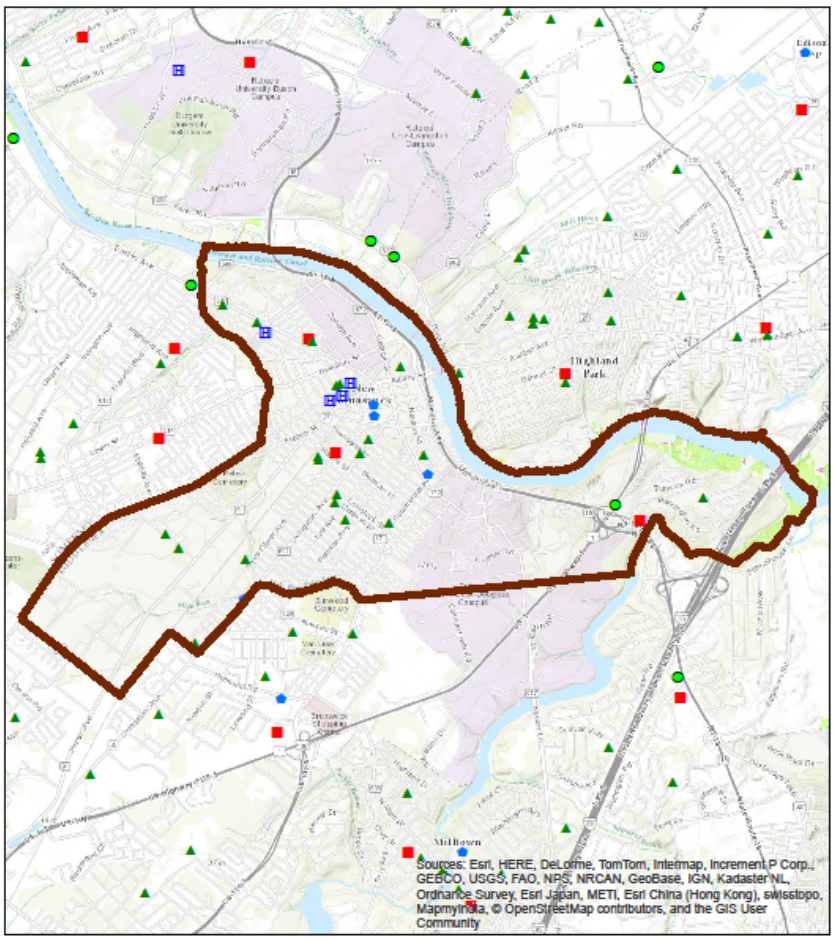

Marsh Retreat at 3 feet of Sea Level Rise New Brunswick

Legend

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

Marsh Retreat at 3ft SLR

- Unimpeded Marsh Retreat Zone
- Impeded Marsh Retreat Zone
- Marsh Conversion: Unconsolidated Shore
- Marsh Conversion: Open Water
- Unchanged Tidal Marsh

0 0.4 0.8 1.6 Miles

Year 2010 Population: 55181

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 the marsh retreat caused by sea level rise centered on target municipalities.

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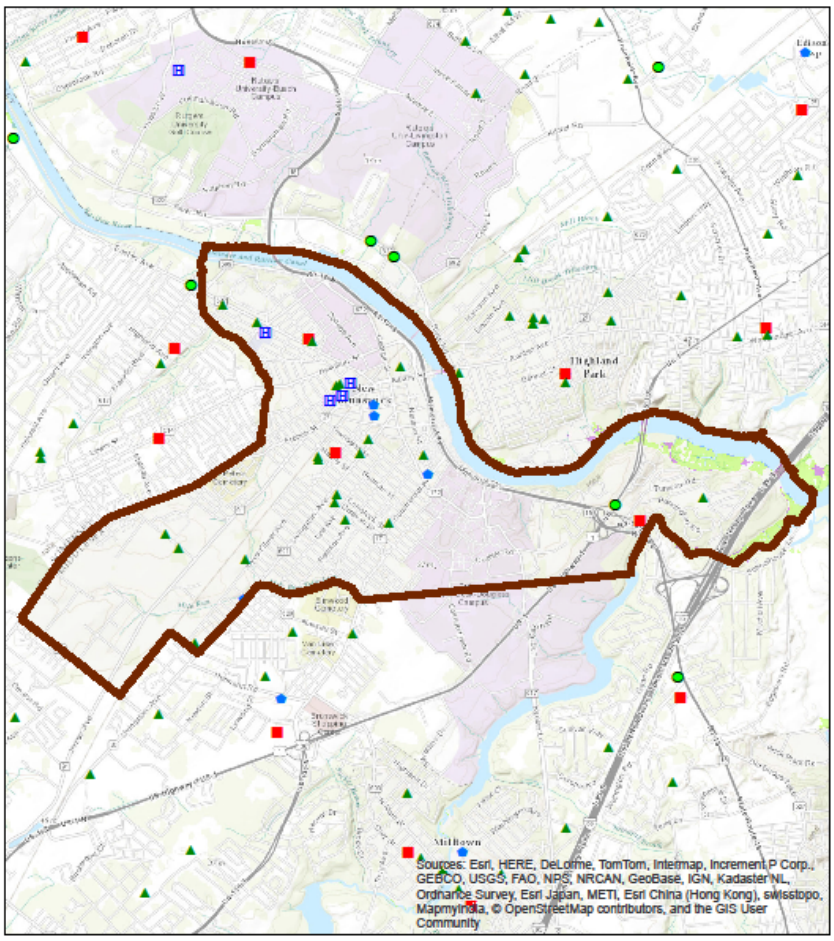
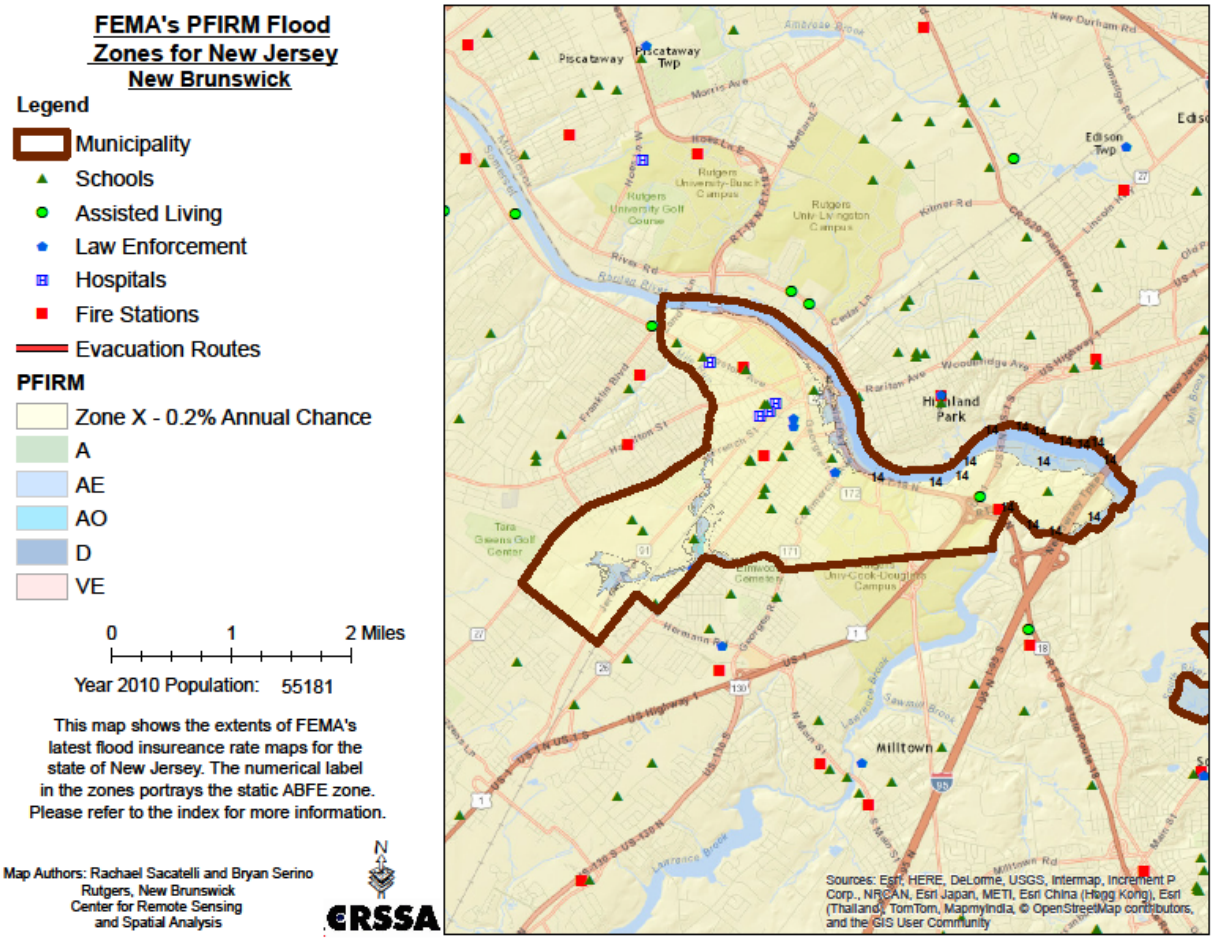


FEMA's PFIRM Flood Zones for New Jersey
New Brunswick



PFIRM Zones				
Municipality	Flood Zone	Coverage (Sq. Mi.)	Percent Coverage	Municipality Size (Sq. Mi)
New Brunswick City	0.2 PCT ANNUAL CHANCE FLOOD HAZARD	0.16	2.75	5.76
New Brunswick City	A	0.00	0.01	5.76
New Brunswick City	AE	0.98	17.00	5.76
New Brunswick City	AO	0.01	0.24	5.76

Sandy Storm Surge
New Brunswick

Legend

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

Sandy Storm Surge

High: More Water

Low: Less Water

0 0.5 1 2 Miles

Year 2010 Population: 55181

This map depicts the Sandy Storm Surge extents provided by FEMA. The depths are ranged in meters of inundation above ground level and are categorized in the legend above.

Map Authors: Rachael Sacatelli and Bryan Serino
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N

CRSSA