

Borough of Atlantic Highlands

“Getting to Resilience”

Recommendations Report

Prepared by the Jacques Cousteau National Estuarine Research Reserve

January 2015



Recommendations based on the “Getting to Resilience” community evaluation process.



Table of Contents

Introduction.....	3
Methodology.....	4
Recommendations.....	5
Coastal Hazard Incorporation in Planning.....	18
Municipal Master Plan Example.....	18
Mapping.....	21
Sea Level Rise & Surge Vulnerability.....	22
CRS Sections That Likely Have Current Points Available	23
Appendix.....	30

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 assist reduce vulnerability and increase preparedness by linking planning, mitigation, and adaptation. Originally developed by the State of New Jersey's Coastal Management Program, the Getting to Resilience process was later adapted by the Coastal Training Program of the Jacques Cousteau National Estuarine Research Reserve (JC NERR), converted into a digital format, and placed on an interactive website. Further improving the questionnaire, the JC NERR added linkages to evaluation questions including the National Flood Insurance Program's (NFIP) Community Rating System (CRS), Hazard Mitigation Planning, and Sustainable Jersey. While this website is publicly available, through the facilitated Getting to Resilience process, JC NERR Coastal Community Resilience Specialists can enhance the outcomes of the evaluation by providing community-specific recommendations, guided discussions with municipal representatives, a vulnerability analysis, and municipal plan reviews.

The Getting to Resilience process started as a facilitated discussion regarding the Borough's strengths, challenges, and hurdles concerning resiliency. Atlantic Highlands is bordered by Sandy Hook Bay to the north, Highlands to the east, and Middletown to the south and west with Wagner Creek forming the western border. The eastern half of town is perched upon a significant coastal bluff system, rising over 200 feet above sea level in some locations, including Mount Mitchell, the highest coastal headland south of Maine on the eastern seaboard. This coastal bluff is prone to slumping and has experienced several well documented slump blocks, a unique hazard in New Jersey's coastal region. Slump blocks are one of the major vulnerabilities of the Borough. Mitigation to this hazard has included the Borough adopting steep slope ordinances and continuing studies by United States Geological Survey (USGS). The western portion of town has a lower relief though most property still exists outside of the 100 year floodplain. The lowest areas of Atlantic Highlands border the bayfront, Wagner Creek, and Many Mind Creek which runs through the middle of the lower half of the town.

While the low lying areas of Atlantic Highlands can experience tidal flooding, flooding along the creeks is also common during heavy precipitation events. Development further upstream in neighboring Middletown seems to have increased the flooding risk. Atlantic Highlands actively works to monitor the streams for potential blockages that could lead to flooding, working with Monmouth County at times. The mouths of both Wagner and Many Mind Creek seem to have issues with shoaling which also can result in flooding. Efforts to form a cooperation between Atlantic Highlands and Middletown for stream monitoring and health have not been successful as of yet, though Middletown has been interested in wetlands restoration projects.

Atlantic Highlands has experienced obstacles when it comes to recovering from the impacts of Hurricane Irene and Superstorm Sandy and becoming more resilient. Many of the frustrations have come from dealing with FEMA and concerns that new floodplain mapping is incorrect. Atlantic

Highlands has also expressed issues with obtaining grants to complete resiliency work. This is an added challenge to resiliency efforts as the community has a small size and limited budget. In an effort to become more competitive in the grant market, Atlantic Highlands has hired outside contractors to work on grant applications. This has been costly and has only resulted in marginal improvements. The Borough noted that they felt they had been doing a good job with resiliency efforts leading up to Irene and Sandy. As a result of those efforts and the benefit of a more elevated geography, the town incurred far less damage to residential properties than neighboring communities. This allowed Atlantic Highlands to assist their neighbors who were less fortunate after Sandy. However, the Borough feels that its lower level of damage and solid base of resiliency projects prior to the storm has resulted in a lower ranking of need for grants, essentially punishing the community for doing good work.

With financial assistance from FEMA, the Borough has moved forward with rebuilding the damaged waterfront. A large portion of the waterfront is comprised of a public harbor, hosting private vessels and a high speed ferry to New York City. The harbor docks were destroyed and the public buildings on the shoreline were heavily damaged by Sandy but have since been rebuilt to standards that should be able to withstand a Category 3 hurricane. The Borough's Harbor Commission convinced FEMA's mitigation officials to make an exception to the usual 'replace as before rule' and allowed the destroyed fixed docks to be replaced by a more resilient floating dock system with tall pilings. Numerous proactive citizens groups have continued to work to help the Borough recover and improve, taking a large part of the burden off of the limited municipal staff and budget. Atlantic Highlands is proud of their outreach programs, disseminating information through their website.

With changes still taking place with flood insurance reform, the Borough is doing their due diligence in order to identify what impacts these changes, in addition to FEMA mapping updates, will have on the citizens of Atlantic Highlands. At this point, it seems that no more than 100 residents would be impacted by flood insurance and mapping changes. With that situation, the Borough is still waiting to decide whether to invest time and money into joining the Community Rating System program seeing as only a small portion of the population would reap any benefits. The Borough plans to make a decision sometime in the near future, hopefully using some of the information provided by the Getting to Resilience process to inform their decision making.

Methodology

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 Atlantic Highlands this team included Adam Hubeny (Administrator, OEM), James Krauss (Environmental Commission), Michelle Clark (Planning Board Secretary), James Phillips (Public Works), Jane Austin (Environmental

Commission), and Edward Cetron (Environmental Commission, Planning Board). 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. In addition to these individuals, several observers took in the meetings to better understand the Getting to Resilience process. These included Alison McKenna (Rutgers), Veda Truesdale (Rutgers), Marney Kimmel (Resiliency Network), Brittany Ashman (Monmouth County Division of Planning), and Meghan Leavey (Monmouth County Division of Planning).

The Getting to Resilience questionnaire was started with the town on June 20th. JC NERR staff met with six representatives of Atlantic Highlands and two observers from Rutgers University. A discussion of the towns' resilience strengths and weaknesses began the meeting and section one of the questionnaire were completed. On June 30th, the questionnaire was completed with four representatives of Atlantic Highlands and three observers from Sustainable Jersey and Monmouth County Planning meeting with JC NERR staff.

Upon completion of the GTR questionnaire, JC NERR staff analyzed the answers provided by the Borough of Atlantic Highlands, 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 Community Resiliency Specialist Christopher Huch to help assist the Borough of Atlantic Highlands' decision makers as the Borough works to recover from Superstorm Sandy and become more resilient.

Recommendations

OUTREACH

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

Atlantic Highlands should examine the current number of outreach programs it runs and determine what it would take to gain additional points by adding more or expanding current efforts. Outreach should include information about the natural and beneficial functions of floodplains. Particularly after Sandy, residents throughout the impacted area have been looking for as much information as possible. A well organized and efficient outreach program can provide validated information from a trusted source and better prepare residents for natural risks. Outreach is one of the easiest sections to gain points in the CRS and one Highlands should focus on heavily. Past outreach efforts should be examined and revisited if they were successful. It is particularly important to revive past programs to educate the public on the importance of disaster plans and emergency kits.

It would be beneficial to develop a Program for Public Information (PPI) which would help to organize outreach, continue to include the current methods and avenues for outreach, and gain additional CRS credits. A PPI is a researched, organized, and implemented program for public outreach that is seen as

having a seven step process. These steps are Establish a PPI Committee, Assess the Community's Public Information Needs, Formulate Messages, Identify Outreach Projects to Convey the Messages, Examine Other Public Information Initiatives, Prepare a PPI Document, and Implement, Monitor and Evaluate the Program. If done correctly, a PPI will make outreach initiatives more effective and can gain CRS credits in numerous categories besides outreach. It would be beneficial to work with the already established Monmouth County CRS User Group. For guidance on establishing a PPI, visit http://crsresources.org/files/300/developing_a_ppi_march_13.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.

Atlantic Highlands 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 a PPI and would help Atlantic Highlands save time and energy leading up to, during, and after a flooding event as outreach will already have been prepackaged and prepared for dispersal. 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. 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. Make the public talks that took place post-Sandy about flood zones, flooding risk, building recommendations, etc into annual meetings.

After Sandy, Atlantic Highlands staff have held talks and discussions on various flood related topics which can be worth significant CRS credits if they become annual outreach meetings and they meet CRS guidelines in the Outreach section. Section 320 of the CRS discusses a wide variety of outreach projects and initiatives that can be covered. By continuing to discuss the importance of planning for flooding, the Borough can set an example to its residents that readiness for disaster events should be maintained, even in relatively "quiet" times. A PPI can ensure these talks are well placed and effective. Well publicized and attended talks can reduce the workload on Borough 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 highly 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. Communicate the different information available within different pages of the Borough website to be easily accessible to the public.

The Atlantic Highlands website currently has some Sandy related information posted under the Emergency Management tab. However, it would be beneficial to add information to highlight flooding and coastal hazard risks according to CRS outreach criteria. A new section entitled “Flood Information” could replace the “Hurricane Sandy Information” section that would contain this information while still displaying relevant Sandy information. Once again, by establishing a PPI, the process for establishing this section of the website and subsequently updating it will be defined, documented, and eligible for CRS credits in the Outreach section. To make this information easier to find, it might be beneficial to have the new website section under its own tab. 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

MITIGATION

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

Repetitive loss properties can be a large burden on towns over time. By creating a mitigation plan for these areas, the Borough may identify new strategies to tackle this issue, pinpoint at what point in time in the future that buyouts of these properties may be prudent, and achieve CRS credits in the Repetitive Loss Area Analysis section. Furthermore, enacting mitigation for repetitive loss areas opens up a wide variety of CRS credits. For more information on Repetitive Loss Area Analysis credit requirements, visit page 510-29 of the CRS Coordinator’s Manual. http://crsresources.org/files/2013-manual/crs_manual_508_ok_5_10_13_bookmarked.pdf

6. Consider returning any properties acquired through Blue Acres or other buyout or acquisition programs to natural floodplain functions.

Due to buildout, Atlantic Highlands has very limited areas of land left that still have natural floodplain functions. Floodplains can absorb runoff and mitigate flooding issues. This can be done utilizing a variety of techniques including wetlands restoration, planting natural vegetation, reducing sediment compaction, and creating a natural profile. Returning 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 \$112 million in 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). 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

7. Look into becoming 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. For more information, visit <http://www.stormready.noaa.gov/howto.htm>. Atlantic Highlands likely already meets much of the required criteria. 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

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

Erosion can quickly become a problem in coastal areas. These areas could include any waterfront that is not bulkheaded and has experienced erosion. Factors that could amplify erosion (sea level rise, surge) should be defined. The Borough should make an effort to identify and document the 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. In the same mindset, unwanted deposition from shoaling and runoff can also be problematic for storm water management in streams and navigation in waterways. Large-scale replenishment projects often change the erosional patterns of beaches nearby as well so a change could be expected if a USACE project is completed in neighboring Highlands or Middletown. Keeping information on coastal erosion can result in CRS credit in the Erosion Data Maintenance (EDM) section. For more information on the Erosion Data Maintenance credit requirements, visit page 27 of Management of Coastal Erosion Hazards.

http://www.fema.gov/media-library-data/20130726-1755-25045-9869/crs_credit_coastal_erosion.pdf

MUNICIPAL ORGANIZATION

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

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

storm damage extents may also earn CRS credits in the Outreach section. Hard copies of documents and other records should also be digitized for preservation and access. Given the small size and sometimes limited hours of Borough staff, 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

10. Have Borough municipal officials participate in FEMA training courses.

While going through the GTR questionnaire, it was expressed that many Borough 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 <http://www.fema.gov/training-1> and for independent 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 township 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

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

There are numerous hazard, risk, and vulnerability assessment tools available to municipalities. 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, hazard mitigation planning, creating municipal plans, zoning, and writing construction codes.

- The Community Vulnerability Assessment Tool is used to conduct a community vulnerability assessment to a wide range of hazards. It is often used in conjunction with the Risk and Vulnerability Assessment. <http://csc.noaa.gov/digitalcoast/training/roadmap>
- The Risk and Vulnerability Assessment Tool is used to identify people, property, and resources that area at risk of injury, damage, or loss from hazardous incidents or natural hazards. <http://csc.noaa.gov/digitalcoast/training/roadmap>
- The Hazard Assessment Tool is a risk assessment process which will help identify hazards, profile hazard events, inventory assets, and estimate losses. <http://www.fema.gov/hazard-mitigation-planning-risk-assessment>

- HAZUS-MH is a software package that uses models and Geographic Information Systems (GIS) technology for estimating physical, economic, and social impacts from various hazards such as floods and hurricanes. <http://www.fema.gov/hazus>

12. Establish a Community Emergency Response Team (CERT).

CERT programs can provide volunteer support to first responders, provide assistance to victims, help to organize volunteers at disaster sites, and collect disaster information to support first responder efforts. For small municipalities with limited staff, CERT teams are particularly useful and can help cut costs.

FEMA MAPPING

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

The Borough should amend the current Flood Damage Prevention Ordinance by using language available in the current NJ DEP recommended Ordinance to include the state mandated 1 foot freeboard requirements. Also, by writing new requirements as related to the Best Available Flood Hazard Data, it should allow for change over time as FEMA’s maps are redrawn regularly. While it had been decades since FEMA had remapped the FIRMs in our area, the remapping process was long overdue and can be anticipated to take place with a much higher frequency in the future. Best Available Flood Hazard Data is defined by NJ DEP as the most recent available flood risk guidance FEMA has provided. The Best Available Flood Hazard Data may be depicted on but not limited to Advisory Flood Hazard Area Maps, Work Maps or Preliminary FIS and FIRM. For more information on NJ DEP recommended Flood Damage Prevention Ordinances, visit <http://www.nj.gov/dep/floodcontrol/modelords/modelde-bestavail.doc>.

By adding “or the most stringent version of FEMA’s flood maps” to this ordinance, higher standards may be instituted that may result in the town becoming more resilient. For example, the Advisory Base Flood Elevation maps may have a more expansive V-zone than the Flood Insurance Rate Maps. By requiring building to adhere to the stricter requirements of the Advisory Base Flood Elevation maps, more homes will be built to higher standards. Likewise, a higher freeboard requirement may result in a safer community and better CRS credits. An amended ordinance may also include some of the newer information coming out on FEMA’s maps including the Limit of Moderate Wave Action (LiMWA). That information can also be used to enhance the building standards. Both actions can result in a large amount of CRS points in the Higher Regulatory Standards section. 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

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

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 disseminated by the Borough. For every release of a map update, the Borough could make a public announcement to its citizens and detail if any changes were made to the prior map, including if additional information such as the Limit of Moderate Wave Action has been added. Notifying the public of a new map product is an example of outreach that can be done by the township's PPI, raising the potential for CRS points. Including information on what changes occur when new maps are released on the Borough's Flood Information webpage may help to alleviate questions the public may have as each map is updated, thereby reducing the workload on Borough staff.

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

15. Make sure all flood maps are available on the town website, at Borough Hall, and at the Atlantic Highlands Library.

Atlantic Highlands 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. Maintaining a link to FEMA's website on the Borough website is highly recommended and should highlight a section that deals specifically with flooding and other coastal hazards rather than Sandy recovery. 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

PLANNING

16. Create a detailed evacuation plan, noting conditions that would require evacuation, how much of the Borough would need to evacuate, and the time an evacuation would take for numerous potential hazards.

When it comes to evacuations that are caused by storm systems, Atlantic Highlands is lucky to have elevation to safely move residents to. The low number of residents in the floodplain affords the Borough the ability to plan according to the individual storm event, reacting to forecasts. However,

not all evacuations are caused by storm events. Larger disasters may require the entire Borough to be evacuated rapidly and it is important to have plans in place prior to events so the evacuation is quick and efficient. Having the public aware of evacuation plans will also result in a better prepared community. This evacuation plan should be created to compliment the county plan and be compared to the hazard mitigation plan.

17. Consider bolstering the 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 COP 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. While the current Atlantic Highlands Continuity of Government Plan is a fantastic starting point, the Plan can be supplemented with more information on triggers for the Plan to be enacted, back up plans in the case of breakdown of chain of command, alternatives, etc. JC NERR is able to provide example COP plans from the Borough of Avalon 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.

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

Atlantic Highlands will experience significant impacts due to sea level rise in the near future. Historical rates of sea level rise should be defined as part of this action and future predicted sea levels should be taken into account when making land use decisions, construction standards, etc. The historical rate of sea level rise along the New Jersey coast over the past half century was 3-4 mm/yr (or 0.12 -0.16 in/yr), while projected future rates are expected to increase. In the recent paper entitled "A geological perspective on sea-level rise and its impacts along the U.S. mid-Atlantic coast" Miller and Kopp state that for 2050, the "best" estimate for sea level rise is 1.3 feet along the Jersey Shore. By 2100 sea level rise the "best" estimate is 3.1 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. 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

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

In order to fully embrace resiliency, municipal plans, strategies, or ordinances should incorporate resiliency recommendations and findings. These should include the Municipal Master Plan, All Hazards Mitigation Plan, Floodplain Management Plan, Evacuation Plan, Emergency Response Plan, Continuity of Operations Plan, Disaster Recovery Plan, Post Disaster Redevelopment Plan, Capital Improvements Plan, Economic Development Plan/Strategy, Coastal Plan, Shoreline Restoration Plan, Open Space Plan, Stormwater Management Plan, Historic Preservation Plan, Zoning Ordinance, Flood Damage Prevention Ordinance, and Building Code. If these plans, strategies, or ordinances do not currently exist, it is highly recommended the Borough move to create them. Further content regarding this recommendation can be found below in the section titled, "Coastal Hazard Incorporation in Planning". Atlantic Highlands should contact the New Jersey Resiliency Network for additional assistance as they are able to provide technical assistance and resources on risk and vulnerability assessments, model plans and ordinances for mitigation and recovery, and adaptation strategies for community resilience.

20. Begin the long term planning process to prepare for sea level rise.

Atlantic Highlands, like most other coastal municipalities, will experience future impacts from sea level rise in the form of regular tidal flooding and heightened storm impacts. However, Atlantic Highlands' higher elevations in most of town results in a far more limited number of properties, facilities, and infrastructure that will eventually need to have a plan in place to mitigate or respond to these heightened flooding threats when compared to neighboring communities. A lower scope of vulnerability to sea level rise does not mean that Atlantic Highlands should not prepare. The need for careful planning and informed decisions cannot be understated. The range of options are bountiful, ranging from buyouts to elevating properties to hardening techniques but the use of these options must be weighed, discussed, and decided upon. While this may seem like a monumental task, it is a critical one.

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 in the future to determine if buyouts of these properties would be an effective way to plan for sea level rise. It is important to note that as sea level rises, the competition for buyout programs will be higher and funding may become more limited. If the Borough still feels that buyouts are not a good option, mitigation strategies will need to be looked into. However, not only will the individual mitigation options need to be examined, but the time frame of their effectiveness will need to be determined as well. 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 Borough to reconsider more drastic 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.

JC NERR recommends Atlantic Highlands 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 to sea level rise and anticipated increases in the frequency and severity of storm surge, coastal flooding, and erosion. The Town has drafted the report of options for increased coastal resilience as a step toward developing a Community Coastal Resilience Plan.

The four basic steps of the Coastal Resilience Plan are:

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

Similar to Atlantic Highlands, 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 Atlantic Highlands should include the following municipal sectors:

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

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

- **Retreat** involves no effort to protect the land from the sea. The coastal zone is 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.
- **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 sea walls 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.

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>). Atlantic Highlands 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 in order to prioritize management efforts.

Awareness and Assistance

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

Growth and Development Management

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

Loss Reduction

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

Shoreline Management

- Regulation and Removal of Shore Protection Structures – To protect the natural shoreline and the benefits it provides, regulations can be used to limit shoreline hardening as well as promote alternative forms of protection.
- Rolling Easements – Rolling easements are shoreline easements designed to promote the natural migration of shorelines. Typically, rolling easements prohibit shore protection structures which interfere with natural shoreline processes and movement, but allow other types of development and activities. As the sea rises, the easement moves or “rolls” landward, wetland migration occurs, and public access to the shore is preserved.

- Living Shorelines – Living shorelines can be effective alternatives to shore protection structures in efforts to restore, protect, and enhance the natural shoreline and its environment. Living shorelines use stabilization techniques that rely on vegetative plantings, organic materials, and sand fill or a hybrid approach combining vegetative plantings with low rock sills or living breakwaters to keep sediment in place or reduce wave energy.
- Beach Nourishment – Beach nourishment is the process of placing sand on an eroding beach, typically making it higher and wider, to provide a buffer against wave action and flooding.
- Dune Management – Dunes may be restored or created in conjunction with a beach nourishment project or may be managed as part of a separate effort.
- Sediment Management – Dredging and placing sediment, building shore protection structures and other structures that trap or divert sediment.

Coastal Ecosystem Management

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

Water Resource Management and Protection

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

Examples of adaptation measures considered in Gilford’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.

Atlantic Highlands may also gain some planning insight from the public participation process associated with Gilford's resiliency planning. Gilford 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, Atlantic Highlands 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.

Coastal Hazard Incorporation in Planning

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

Municipal Master Plan Example

The following excerpts are adapted from a comprehensive plan for Worcester County in Maryland, the equivalent to a municipal master plan. This comprehensive plan incorporates coastal hazards throughout the entire document to form an integrated approach to resiliency. Coastal hazards are often identified in the document as "current and anticipated challenges". Individual sections (such as the Floodplain Management section given in this example) identify objectives and recommendations that should be mirrored in individual plans (a Floodplain Management Plan in this example). In doing

so, all municipal plans are organized under the master plan and share the same language and goals. Many of the recommendations in this municipal master plan example are closely tied to goals already addressed in the current Borough Master Plan. If 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 Borough's natural resources and character will therefore, continue to be this plan's main purpose.

The plan's purpose is to provide the following:

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

Sample Floodplain Management Section

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

Objectives

The Borough's objectives for floodplain protection are:

- Limit development in floodplains*
- Reduce imperviousness of existing and future floodplain development where possible*
- Preserve and protect the biological values and environmental quality of tidal and non-tidal floodplains, where reasonable and possible to do so.*

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

Atlantic Highlands faces additional flooding issues. Several areas of the Borough commonly flood during storms. Sea level rise will increase flooding hazards. New Jersey is particularly vulnerable to sea level rise. During this century, as sea level rises, shorelines could retreat significantly in parts of the Borough. Narrow bay beaches and wetlands at low elevations, both important habitats, would be lost to even a modest rise in sea level and erosion of the oceanfront 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 Borough to reduce its exposure to future disasters and reduce the need for ad hoc decision-making. Superstorm Sandy has taught us that effective post-disaster planning is necessary for an effective recovery process.

Recommendations

- 1. Work with federal and state federal agencies to regularly update the Borough floodplain maps, with first priority being areas that are mapped as 100-year floodplain without base flood elevation established.*
- 2. Limit new development and 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 "V" or wave velocity zone and 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. Participate in the Community Rating System to receive flood insurance premium credits.
10. Consider code changes that will limit impervious surfaces.
11. 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 Borough 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 will be available for future download. These maps can and should be used to help write and update the Municipal Master Plan, All Hazards Mitigation Plan, Floodplain Management Plan, Evacuation Plan, Emergency Response Plan, Continuity of Operations Plan, Disaster Recovery Plan, Post Disaster Redevelopment Plan, Capital Improvements Plan, Economic Development Plan/Strategy, Coastal Plan, Shoreline Restoration Plan, Open Space Plan, Stormwater Management Plan, Historic Preservation Plan, Zoning Ordinance, Flood Damage Prevention Ordinance, and Building Code.

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 Borough can better understand future flooding risk and plan accordingly. As a portion of the Borough 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 seal 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 Atlantic Highlands 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 Atlantic Highlands concerning 1% and 0.2% flooding scenarios. This table displays the coverage for the 0.2% zone, AE zone, and VE zone in terms of square miles and percent coverage. This table can be used to better understand the Borough’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.

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 Borough 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 shoreline closer to buildings and infrastructure, reducing natural buffers and heightening impacts. Deposition that moves shorelines or near shore features such as sandbars may in turn reduce rates of flow of streams and stormwater management systems and cause greater risk of precipitation driven flooding. Deposition can also cause navigation hazards to

waterways 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 Atlantic Highlands towards resiliency, risk will always exist. By overlaying hazards such as sea level rise and surge with population information, infrastructure, and building footprints, the Borough will be able to identify areas of highest risk and plan accordingly.

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

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 Atlantic Highlands to make decisions on protecting certain resources through retrofitting historical 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 Flood Exposure 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 four major themes:

- Flooding (which shows the flooding hazards individually)
- 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. 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

While most of the Borough of Atlantic Highlands is significantly elevated above sea level, fluctuations in sea level through surge events and trends towards higher sea level are still of great significance for waterfront areas and those bordering Many Mind Creek and Wagner Creek. Analysis of SLOSH maps show that as hurricane strength increases, potential surge impacts will increase in scope and severity as one would expect. SLOSH models indicate we should expect flooding on a similar scale of Sandy for powerful Category 1 hurricanes. SLOSH models for Category 2 and 3 storms show a much more dire situation with flooding spreading further outward from Many Mind and Wagner Creek. This results in potential flooding of the Municipal Complex and Elementary School in more powerful storm. In addition, the evacuation route of Route 36 is threatened by flooding from surge. Although storms of this magnitude are very rare for our area, they remain a possibility that requires attention and planning.

While the relatively low end scenario of one foot of sea level rise will not result in flooding of Atlantic Highlands, there will be an increased threat of flooding from storm events, in the form of coastal flooding in low lying areas and precipitation based flooding in areas along the 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 “low”, “high”, and “best” estimates for sea level rise projections for New Jersey for the years 2050 and 2100 are displayed. “Best” refers to a 50% likelihood of that level of sea level rise occurring.

Total sea level rise projections for New Jersey.			
	Total	Total	Total
	cm	inches	feet
2050 best	40	16	1.3
2050 low	23	9	0.7
2050 high	60	24	2.0
2100 best	96	38	3.1
2100 low	50	20	1.6
2100 high	147	58	4.8
All values with respect to a year 2000 baseline.			

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

While one foot of sea level rise does not significantly impact Atlantic Highlands, two feet of sea level rise sees regular tidal flooding of numerous areas that border Many Mind Creek and Wagner Creek. Three feet of sea level rise will impact the same areas with slightly more intensity. Any level of inundation due to regular tidal flooding will have large scale impacts on emergency response. Sea level rise will also result in greater impact of storm events as a surge atop a higher sea level will be more dramatic than the same surge atop a lower sea level. Necessary adaptation to sea level rise and the heightening of other hazards such as surge must be taken into account when planning for the future.

CRS Sections That Likely Have Available Current Points

The following sections of the Community Rating System will likely contain credit points that are available for Atlantic Highlands based off of the answers given in our Getting to Resilience questionnaire, discussions with JCNERR staff, and reviews of the Borough Master Plan and other documents. These sections represent the current state of the Borough but also include planned projects, uncompleted projects, and recommended actions deemed to be within the Borough's reach. However, these projects may need to be complete 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. Municipal officials noted that the Borough is uncertain of what CRS Class Atlantic Highlands would be able to reach due to limited staff time but it should be noted that NJ DEP has informed JCNERR that towns that are in compliance with state regulations should be able to enter the program at a Class 9, providing a solid starting point. 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 when submitting to the CRS. When working with your CRS coordinator, we recommend inquiring about the following sections.

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.

- **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 2.5)
- **Additional Firm Information (MI2):** 20 points for providing information that is shown on most FIRMS, such as protected coastal barriers, floodways, or lines demarcating wave action. (GTR 2.5)

- **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 2.5 [could be done])

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 4.4)

- **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 2.4, 2.5.1, 2.5.2, 2.8, 2.14)
- **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 2.4, 2.8 [could be done])
- **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 (GTR 2.4, 2.8 [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 (GTR 2.4, 2.8 [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). (GTR 2.5.2, 2.6)
- **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. (GTR 2.5.2, 2.6)
- **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). (GTR 2.5.2, 2.6 [could be done])
- **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. (GTR 1.4, 2.5.2, 2.6 [could be done])

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

- **Flood protection library (LIB):** 10 points for having 10 Federal Emergency Management Agency publications on flood protection topics housed in the public library. (GTR 2.5.1, 2.5.2, 2.15)
- **Locally pertinent documents (LPD):** Up to 10 points for having additional references on the community's flood problem or local or state floodplain management programs housed in the public library. (GTR 2.5.1, 2.5.2)
- **Flood protection website (WEB):** Up to 76 points for providing flood protection information via the community's website. An additional 29 points are provided if the website is part of a Program for Public Information (credited under Activity 330 (Outreach Projects)). (GTR 2.5.1, 2.5.2, 2.8)

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)). (GTR 5.7)

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

- **Floodplain mapping of special flood-related hazards (MAPSH):** Up to 50 points if the community maps and regulates areas of special flood related hazards. (GTR 1.1, 1.3, 2.5)
- **New Study (NS):** Up to 290 points for new flood studies that produce base flood elevations or floodways. (GTR 1.1)

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 3.3, 5.9, 5.12)
- **Natural functions open space (NFOS):** Up to 350 points extra credit for OPS-credited parcels that are preserved in or restored to their natural state. (GTR 3.3, 5.9, 5.12)

- **Deed restrictions (DR):** Up to 50 points extra credit for legal restrictions that ensure that parcels credited for OPS will never be developed. (GTR 3.3, 5.9)
- **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 1.3, 3.3, 5.9)
- **Natural Shoreline Protection (NSP):** Up to 120 points for programs that protect natural channels and shorelines. (GTR 3.3, 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 3.3, 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).

- **Special Flood-related Hazard Regulations (SHR):** Up to 370 points for higher regulatory standards in areas subject to coastal erosion. (GTR 1.3 (could be done))
- **Emergency warning dissemination (EWD):** Up to 75 points for disseminating flood warnings to the public. (notes from GTR meetings)
- **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. (notes from GTR meetings)
- **Critical facilities planning (CFP):** Up to 75 points for coordinating flood warning and response activities with operators of critical facilities. (notes from GTR meetings)
- **Protection of critical facilities (PCF):** Up to 80 points for protecting facilities that are critical to the community. (notes from GTR meetings)
- **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[if further training of staff takes place])
- **Freeboard (FRB):** Up to 500 points for a freeboard requirement. (GTR 5.4)
- **Foundation Protection (FDN):** Up to 80 points for engineered foundations. (notes from GTR meetings)
- **Coastal A Zone Requirements (CAZ):** Up to 500 points if if all new buildings in the coastal A Zone must meet the requirements for buildings in V Zones and for openings in A Zones (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. (freeboard)

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

- **Additional Map Data (AMD):** Up to 160 points for implementing digital or paper systems that improve access, quality, and/or ease of updating flood data within the community. (GTR 2.5)
- **FIRM Maintenance (FM):** Up to 15 points for maintaining copies of all FIRMs that have been issued for the community. (GTR 2.5)
- **Erosion Data Maintenance (EDM):** up to 20 points for maintaining coastal erosion data. (GTR 1.3, 2.1 [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.

- **Repetitive Loss Area Analysis (RLAA):** Up to 140 points for a detailed mitigation plan for a repetitive loss area. (GTR 1.12, 2.1 (could be done))
- **Floodplain management planning (FMP):** 382 points for a community-wide floodplain management plan that follows a 10-step planning process. (GTR 2.4, 3.3, 3.4, 3.4.1, 3.7 [if new plan written])
- **Natural Floodplains Function Plan (NFP):** 100 points for adopting plans that protect one or more natural functions within the community's floodplain (notes from GTR meetings)

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

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

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

- **Flood protection project technique used (TU_):** Credit is provided for retrofitting techniques or flood control techniques. Retrofitting technique used: Points are provided for the use of elevation (TUE), dry floodproofing (TUD), wet floodproofing (TUW), protection from sewer backup

(TUS), and barriers (TUB) Structural flood control technique used: Points are provided for the use of channel modifications (TUC), and storage facilities (TUF). (GTR 5.3, 5.7)

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 1.3, 5.12 [could be done])

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

Section 610: Flood Warning and Response: To encourage communities to ensure timely identification of impending flood threats, disseminate warnings to appropriate floodplain occupants, and coordinate flood response activities to reduce the threat to life and property. (GTR 4.5, 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 data base of people with special needs who require evacuation assistance when a flood warning is issued and for having a plan to provide transportation to secure locations. (GTR 4.8)
- **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 4.3)
- **Emergency warning dissemination (EWD):** Up to 75 points for disseminating flood warnings to the public. (notes from GTR meetings)
- **Critical facilities planning (CFP):** Up to 75 points for coordinating flood warning and response activities with operators of critical facilities. (GTR 4.3)

StormReady Community (SRC): 25 points for designation by the National Weather Service as a StormReady Community. (GTR 4.6 [could be done])

Appendix

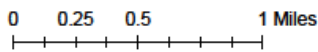
1 Foot of Sea Level Rise Atlantic Highlands Borough

Legend

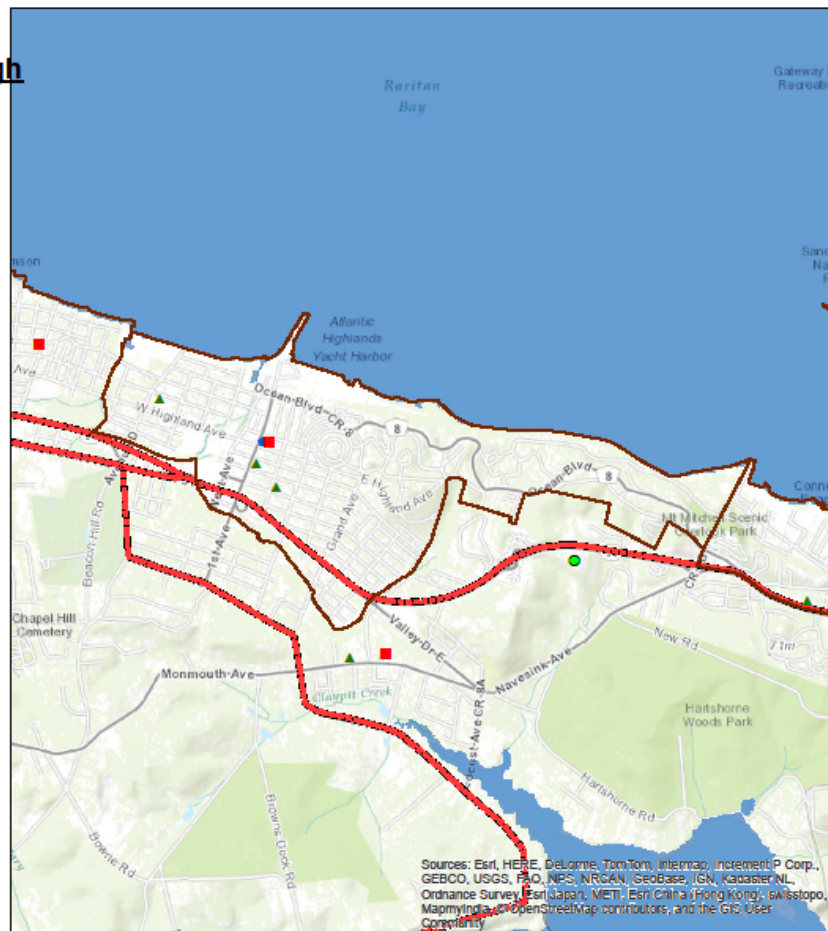
- Municipality
- ▲ Schools
- Fire Stations
- Law Enforcement
- Assisted Living
- Hospitals
- Evacuation Routes
- 1ft SLR

Year 2010 Population: 4385

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



Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Geoaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), Swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

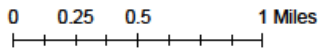
2 Feet of Sea Level Rise Atlantic Highlands Borough

Legend

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

Year 2010 Population: 4385

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.



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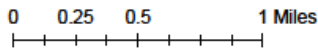
3 Feet of Sea Level Rise Atlantic Highlands Borough

Legend

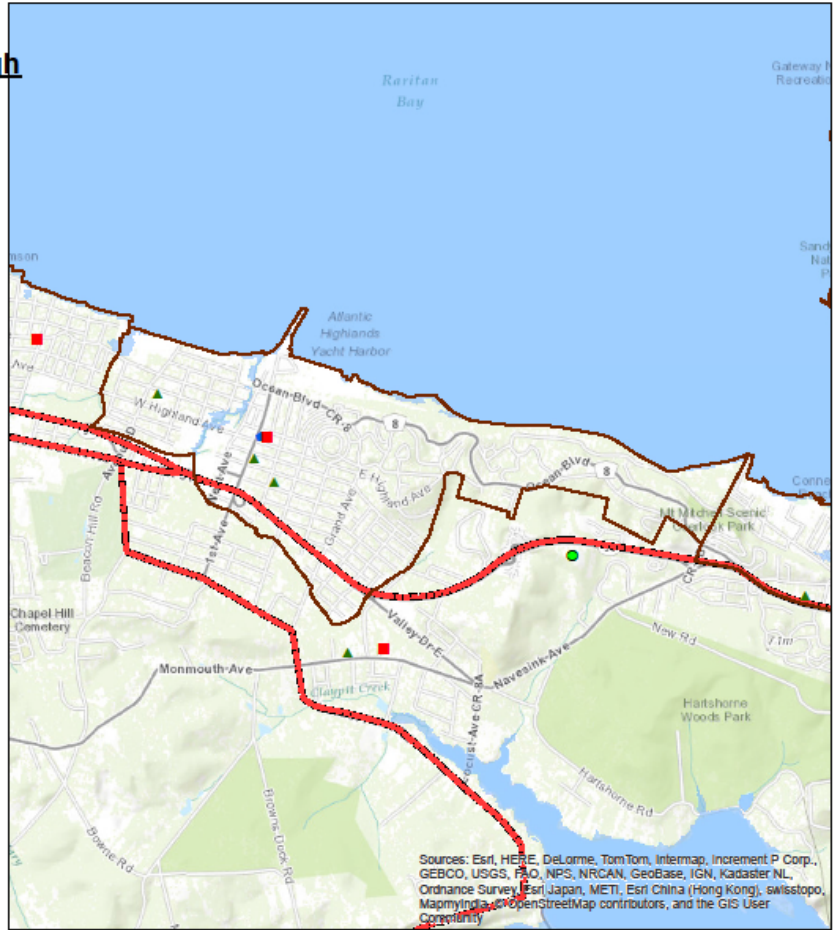
- Municipality
- ▲ Schools
- Fire Stations
- Law Enforcement
- Assisted Living
- Hospitals
- Evacuation Routes
- 3ft SLR

Year 2010 Population: 4385

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.



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**Category 1 SLOSH Model
Atlantic Highlands Borough**

Legend

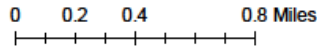
- Municipality
- ▲ Schools
- Fire Stations
- ◆ Law Enforcement
- Assisted Living
- Hospitals
- Evacuation Routes

Category 1 SLOSH

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

Year 2010 Population: 4385

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.



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



Sources: Esri, GEBCO, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Category 2 SLOSH Model
Atlantic Highlands Borough

Legend

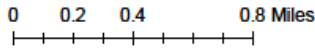
- Municipality
- ▲ Schools
- Fire Stations
- ◆ Law Enforcement
- Assisted Living
- Hospitals
- Evacuation Routes

Category 2 SLOSH

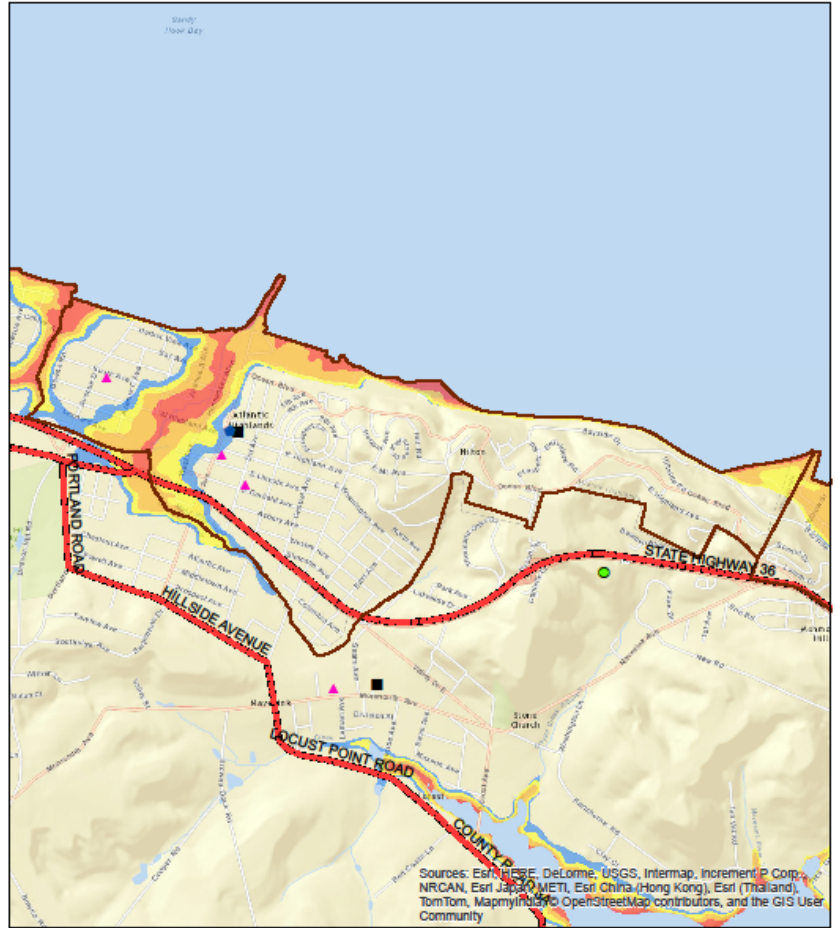
- 0 - 3 Feet Above Ground Level
- 3 - 6
- 6 - 9
- > 9

Year 2010 Population: 4385

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
Atlantic Highlands Borough**

Legend

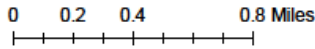
- Municipality
- ▲ Schools
- Fire Stations
- ◆ Law Enforcement
- Assisted Living
- Hospitals
- Evacuation Routes

Category 3 SLOSH

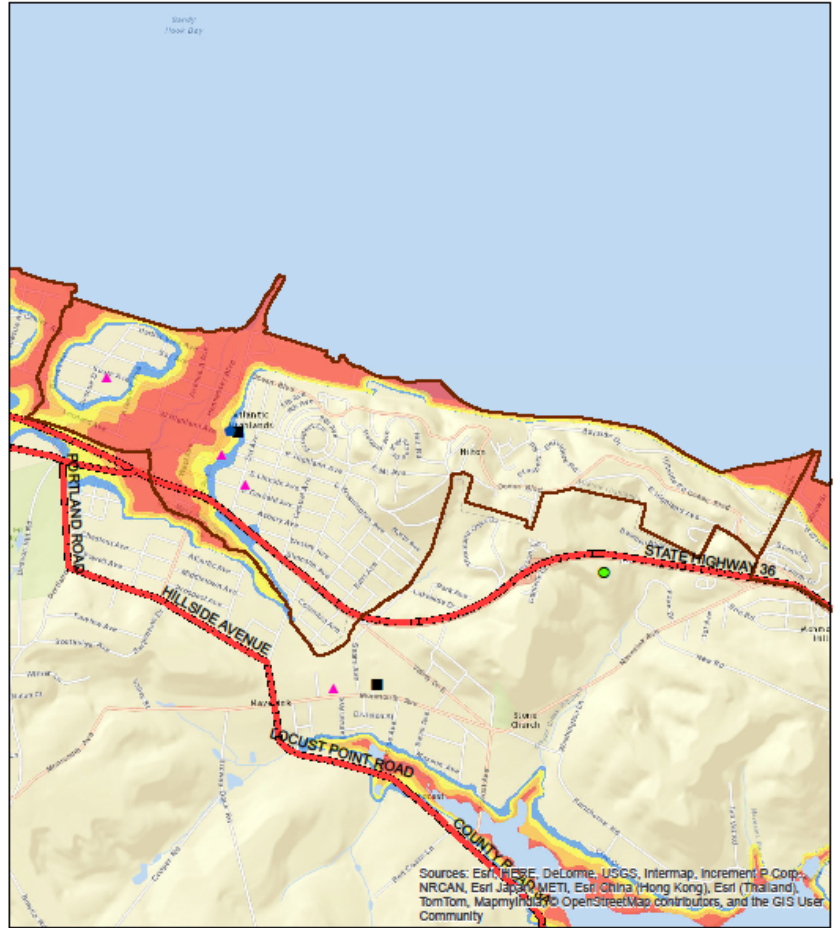
- 0 - 3 Feet Above Ground Level
- 3 - 6
- 6 - 9
- > 9

Year 2010 Population: 4385

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.










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









Sources: Esri, GEBCO, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, OpenStreetMap contributors, and the GIS User Community

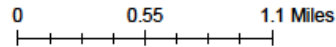
**FEMA's PFIRM Flood
Zones for New Jersey
Atlantic Highlands Borough**

Legend

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

PFIRM

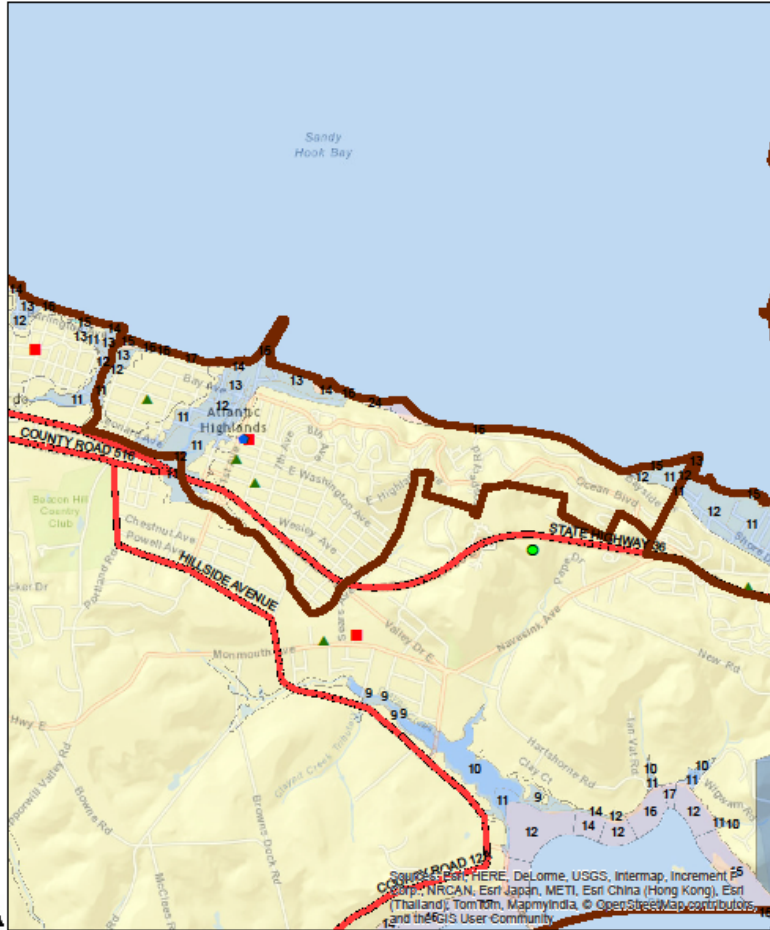
-  Zone X - 0.2% Annual Chance
-  A
-  AE
-  AO
-  D
-  VE



Year 2010 Population: 4385

This map shows the extents of FEMA's latest flood insurance rate maps for the state of New Jersey. The numerical label in the zones portrays the static ABFE zone. Please refer to the index for more information.

Map Authors: Rachael Sacatelli and Bryan Serino
Rutgers, New Brunswick
Center for Remote Sensing
and Spatial Analysis



PFIRM Zones				
Municipality	Flood Zone	Coverage (Sq. Mi.)	Percent Coverage	Municipality Size (Sq. Mi)
	0.2 PCT ANNUAL CHANCE FLOOD HAZARD			
Atlantic Highlands Borough		0.06	4.90	1.23
Atlantic Highlands Borough	AE	0.17	13.84	1.23
Atlantic Highlands Borough	VE	0.05	4.28	1.23

Marsh Retreat at 1 feet of Sea Level Rise Atlantic Highlands Borough

Legend

Municipality

Schools

Fire Stations

Law Enforcement

Assisted Living

Hospitals

Evacuation Routes

Marsh Retreat at 1ft SLR

Unimpeded Marsh Retreat Zone

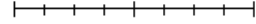
Impeded Marsh Retreat Zone

Marsh Conversion: Unconsolidated Shore

Marsh Conversion: Open Water

Unchanged Tidal Marsh

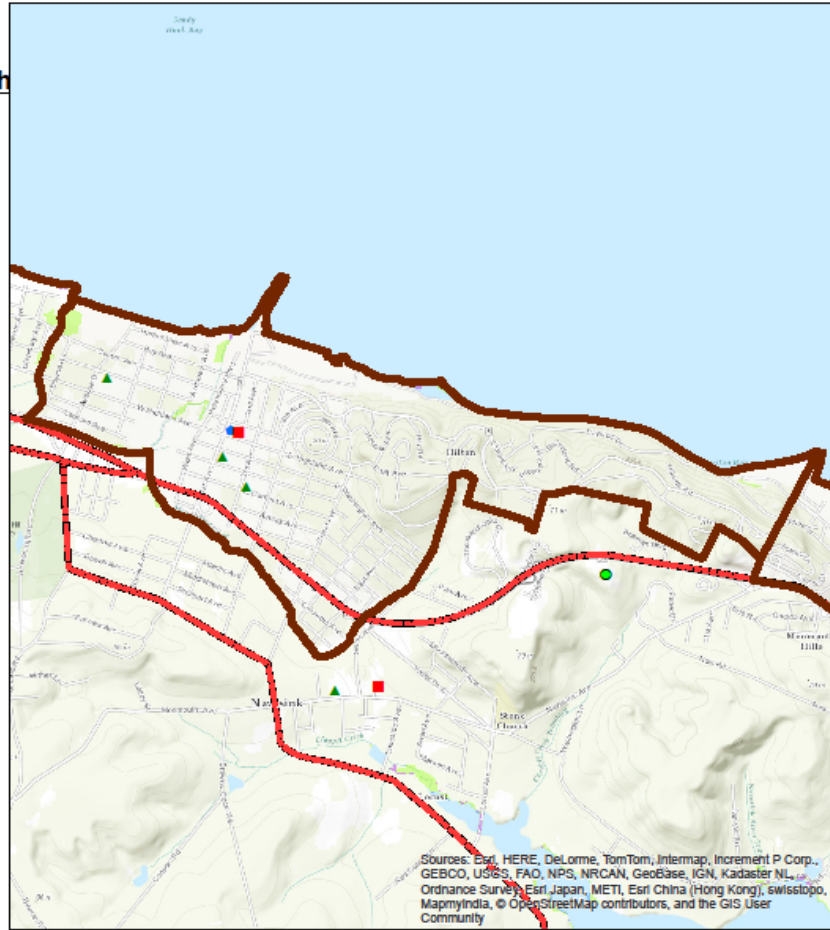
0 0.2 0.4 0.8 Miles



Year 2010 Population: 4385

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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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

Marsh Retreat at 2 feet of Sea Level Rise Atlantic Highlands Borough

Legend

Municipality

Schools

Fire Stations

Law Enforcement

Assisted Living

Hospitals

Evacuation Routes

Marsh Retreat at 2ft SLR

Unimpeded Marsh Retreat Zone

Impeded Marsh Retreat Zone

Marsh Conversion: Unconsolidated Shore

Marsh Conversion: Open Water

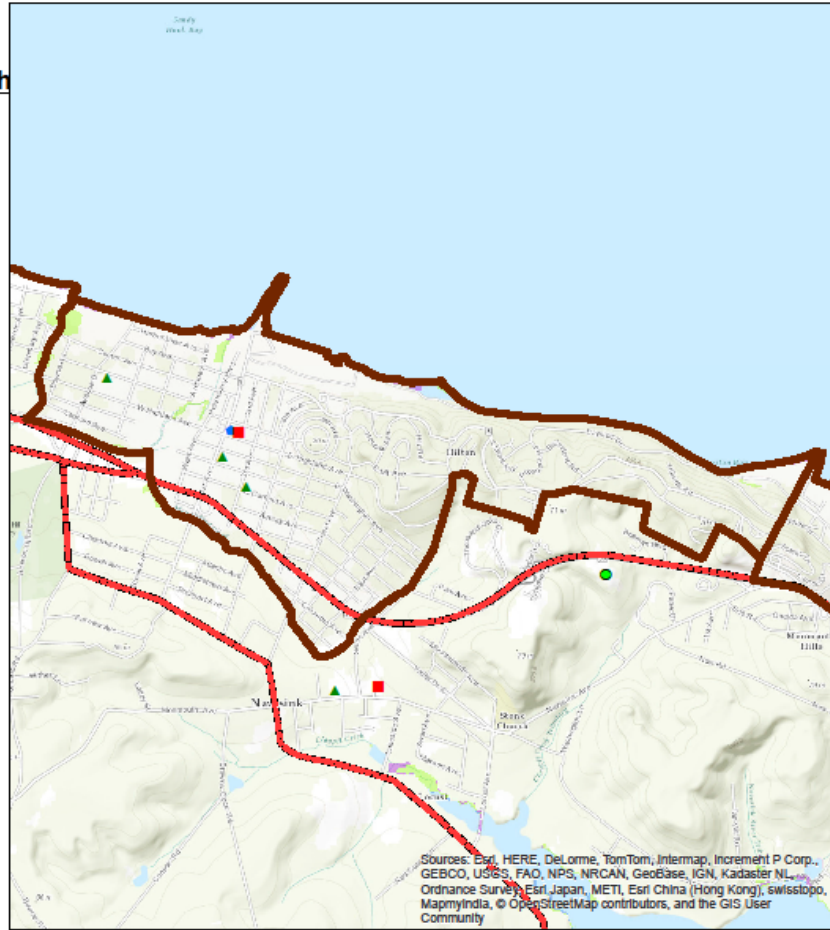
Unchanged Tidal Marsh

0 0.2 0.4 0.8 Miles

Year 2010 Population: 4385

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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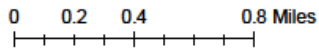
Marsh Retreat at 3 feet of Sea Level Rise Atlantic Highlands Borough

Legend

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

Marsh Retreat at 3ft SLR

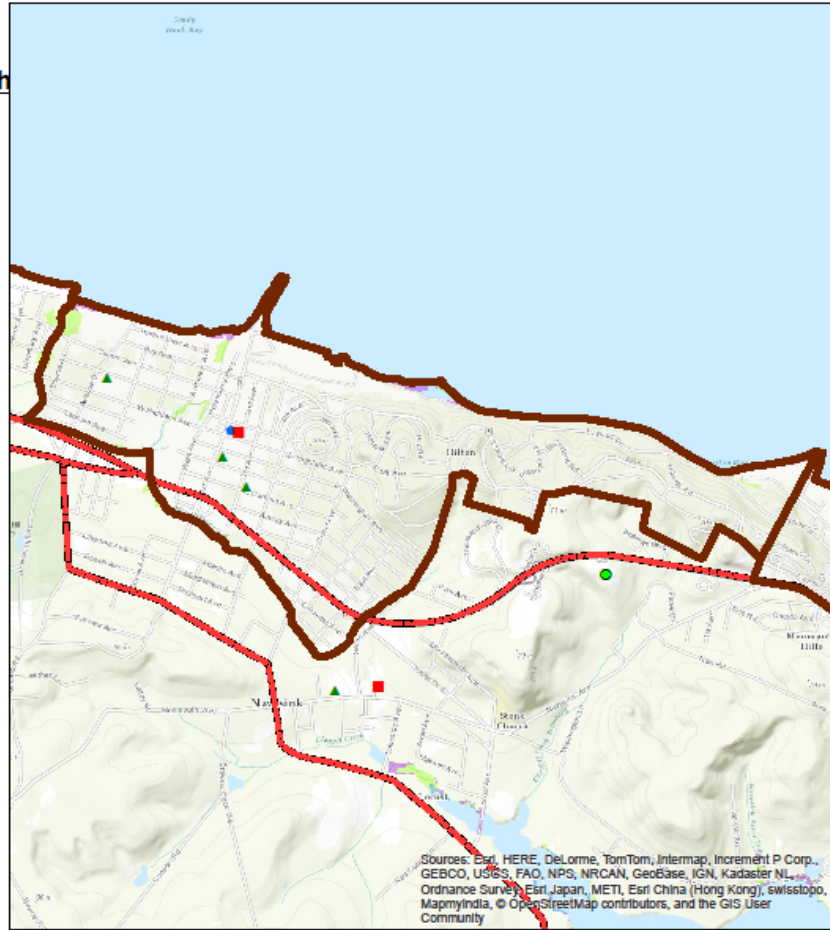
-  Unimpeded Marsh Retreat Zone
-  Impeded Marsh Retreat Zone
-  Marsh Conversion: Unconsolidated Shore
-  Marsh Conversion: Open Water
-  Unchanged Tidal Marsh



Year 2010 Population: 4385

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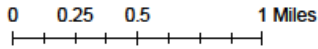
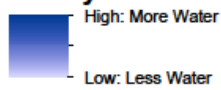
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Sandy Storm Surge Atlantic Highlands Borough

Legend

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

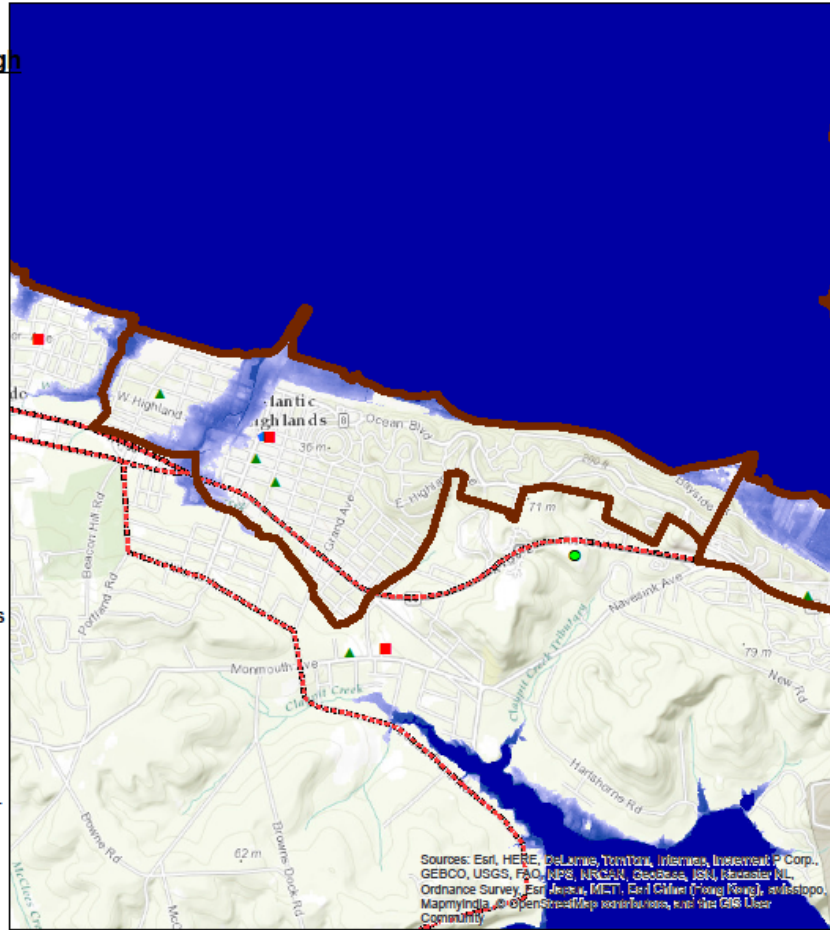
Sandy Storm Surge



Year 2010 Population: 4385

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
Rutgers, New Brunswick
Center for Remote Sensing
and Spatial Analysis



Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GEBCO, IGN, swisstopo, Ordnance Survey, Esri, DeLorme, Mits, CofA, Garmin, Swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community