

Strategy for Reducing Risks From Natural Hazards in North Kingstown, Rhode Island

A Multi-Hazard Mitigation Strategy 2019

5-Year Update





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Executive Summary

Purpose: This plan will update the adopted 2005 Hazard Mitigation Plan and recommends updated objectives and actions for the Town of North Kingstown to minimize the social and economic loss and disruption associated with natural hazard events. This plan will address the capability of North Kingstown to reduce the vulnerability of our community to these natural hazards and will provide comprehensive guidance for hazard mitigation in the town of North Kingstown. Hazard mitigation is an ongoing process that requires continued implementation, evaluation, and revision. This plan identifies goals, objectives and recommended actions for both short-term and long-term hazard mitigation with an intention to preserve and enhance the safety, quality of life, and natural resources of North Kingstown.

This Plan serves the people of North Kingstown by providing the impetus for making homes, businesses and communities more resilient to the impacts of hurricanes, floods, tornadoes, earthquakes, winter storms, wildfires and other natural hazards. A major update to this Plan from the 2005 plan is that it addresses adaptation to climate change and projected sea-level rise scenarios in North Kingstown. Much of this information was made available from recent partnership work as part of a pilot project with the University of Rhode Island Coastal Resources Center and the RI Sea Grant to study climate change and sea level rise. (*RISG*)

This document should be referenced as:

Strategy for Reducing Risks from Natural Hazards in North Kingstown, Rhode Island: A Multi-Hazard Mitigation Strategy 2019.

This document is available electronically at www.northkingstown.org.



Plan Format

The North Kingstown Plan is divided into the following six (6) sections followed by Appendices.

Section 1: Introduces the reader to the plan.
Section 2: Provides the reader with a profile of North Kingstown.
Section 3: Provides an overview of the planning process, including stakeholders who participated in the process and key planning steps.
Section 4: Presents the reader with the hazard identification and risk assessment that includes hazard descriptions & vulnerabilities with a capability assessment of North Kingstown, including resources and assistance that can be used for mitigation activities.
Section 5: Highlights the hazard mitigation goals, objectives and recommended actions for the Town of North Kingstown that will reduce injury and damage from natural hazards for the reader.
Section 6: Outlines the implementation of the Plan and processes for updating the Plan for the reader.

Scope of the Plan

The Plan addresses all-natural hazards which pose significant risks to North Kingstown. Each hazard has been assessed using the same methodology, and information including the historical significance, vulnerability, exposure and potential losses, as available, for all hazards identified in the Plan. The following types of hazards are analyzed and discussed in the Plan:

Wind Related Hazards	Winter Related Hazards	Flood Related Hazards	Geological Related Hazards	Additional Hazards
Storm Surge	Snow	Riverine Flooding	Earthquakes	Wildfire
Hurricanes	Ice	Flash Flooding		Drought
Tornadoes	Extreme Cold	Urban Flooding		Extreme Heat
High Winds		Coastal Flooding		
		Climate Change and Seal Level Rise		
		Coastal Erosion		
		Dam Breach		



More information about these hazards and the potential impacts to North Kingstown and critical facilities can be found in Section 4 of this plan.

Goal Statement

The Goal Statement of this plan is to identify areas at risk from natural hazards and to develop policies and actions that could be implemented to reduce the impacts of natural hazards on the residents, properties and natural resources of North Kingstown. A high priority is placed on protecting the safety of residents and visitors alike. The town's many historic buildings and coastal resources are of special concern. This hazard mitigation plan update has also taken steps to incorporate climate change into planning analyses as a first step in considering its impact on North Kingstown, including how it may exacerbate natural hazards such as floods, hurricanes, and drought.

Goal 1 Reduce risks and increase resilience from natural hazards in North Kingstown.
Goal 2 Ensure public safety from natural hazards.
Goal 3 Maintain emergency services during an event.
Goal 4 Retrofit hazard prone facilities .
Goal 5 Reduce the vulnerability of the town's infrastructure and utilities, cultural resources and recreational resources to natural hazards.
Goal 6 Maintain essential services at Quonset Point.
Goal 7: Improve CRS classification.
Goal 8 Increase resilience towards coastal hazards and climate change.



Section 1.0 – Introduction

The North Kingstown Hazard Mitigation Plan update provides a comprehensive guidance for hazard mitigation throughout the Town of North Kingstown. Hazard mitigation focuses on reducing repetitive loss and the vulnerability of communities in an attempt to break the disaster cycle. This plan has compiled an overview of hazard profiles, ranging from high to low, to identify natural hazards that have either posed or could pose potential risks and losses to residents and structures in the Town. The Plan outlines a coordinated mitigation strategy, which includes long-term goals, short-term objectives and the assignment of specific, measurable tasks or actions that will reduce injury and damage from natural hazards.

Having mitigation actions in place plays a vital role in helping safeguard personal and public safety. Actions can range from retrofitting structures to increasing coastal setbacks to simply raising public awareness. The most immediate benefit of natural hazard mitigation planning is the reduction and elimination of the negative impacts of natural disasters in terms of lost life and property. With adequate preparation the town can significantly reduce the economic and social disruptions caused by natural disasters and reduce the costs of recovery for the town, local businesses, and residents.

The Federal Emergency Management Agency (FEMA) offers three distinct incentives for the adoption of local hazard mitigation plans. These are:

- FEMA's Pre-Disaster Mitigation (PDM) grant program and Flood Mitigation Assistance (FMA) program provide grants for activities designed to mitigate the effects of floods and other disasters in a community. Funds from these grants can go to acquisition, relocation, and retrofitting of structures but are only available if an approved hazard mitigation plan is in place.
- Secondly, a hazard mitigation plan can expedite the approval process for receiving money after a federally declared disaster through the FEMA Post-Disaster Hazard Mitigation Grant Program (HMGP).
- Finally, a mitigation plan can be counted towards credit points in FEMA's Community Rating System (CRS). Points are awarded for having the plan, as well as for going through the various steps involved in creating the plan, including having community involvement and coordinating with other agencies. The better a community's CRS score, the greater the discounts provided on individual property owner's National Flood Insurance Program (NFIP) premiums.

Advances in the town's ability to prepare, mitigate and respond to natural disasters. In preparing this plan, the Town of North Kingstown utilized both internal and external staff to obtain resources, to include GIS data, mapping, changing sea conditions,



development patterns and climate shifts to identify and understand the risks facing the town. The town was also able to incorporate the recent pilot projects for sea level rise into this plan as it has formed a source of invaluable research in identifying areas of the town which are most at risk to increased flooding, erosion, infrastructure and property damage and displacement of coastal residents.

1.1 NATIONAL FLOOD INSURANCE PROGRAM (NFIP)

North Kingstown participates in the National Flood Insurance Program (NFIP), a voluntary program through which participating municipalities agree to regulate development in floodplains according to defined criteria and standards. North Kingstown has been a participant in the NFIP since July 14, 1972- Towns that have elected to participate in the NFIP make federally subsidized flood insurance available to their residents. The program offers flood hazard maps, flood insurance and regulations.

The FEMA Digital Flood Insurance Rate Maps (DFIRMS) issued by the Federal Emergency Management Agency (FEMA) for the administration of the National Flood Insurance Program are available on the Town's website and on the FEMA website (<https://msc.fema.gov>) and provides a panel number for each map that covers North Kingstown's flood prone areas. There are 24 panels that cover North Kingstown.

The following maps were revised October 19, 2010:

44009C0013H, 44009C0085H, 44009C0092H, 44009C0094H, 44009C0101H, 44009C0103H, 44009C0111H, 44009C0113H, 44009C0185H, and 44009C0201H.

The following panels were updated October 16, 2013:

440090014J, 44009C0018J, 44009C0019J, 44009C0102J, 44009C0104J, 44009C0106J, 44009C0107J, 44009C0108J, 44009C0109J, 44009C0112J, 44009C0114J, 44009C0116J, 44009C0118J and 44009C0202J.

The coastal panels are outlined below:

- *44009C0018J- Pojac Point/Mount View*
- *44009C0019J – Calf Pasture Point/Mount View*
- *44009C0106J-Quonset/Davisville*
- *44005C0107J- Quonset/Davisville*
- *44009C0108J- Blue Beach/Shore Acres*
- *44009C0109J – Quonset/RI Air National Guard*
- *44009C0104J- Mill Cove/Wickford*
- *44009C0112J- Duck Cove/ Earle Drive*
- *44009C0116J- Hamilton/Bissell Cove*
- *44009C0118J- Plum Point/Plum Beach/Saunderstown*
- *44009C0114J- Gilbert Stuart/ Walmsley Lane*



The Town's zoning ordinance was also amended in 2019 to include Special Flood Hazard Overlay (SFHA) District language. This ordinance seeks to “ensure public safety, minimize hazards to persons and property from flooding, protect watercourses from encroachment, and to maintain the capability of floodplains to retain and carry off floodwaters”.

In addition to these maps, RIEMA launched a mapping tool in 2013 that provides a user-friendly way to view properties with approximate flood zone boundaries based on flood hazard areas as presented in the FEMA FIRMs. This tool also allows the user to view those properties that have received Letters of Map Amendments (LOMAs). In addition, the town has an interactive mapping tool available on the town's web site which allows users to access flood zone information in combination with parcel boundaries as well.

1.2 COMMUNITY RATING SYSTEM (CRS)

The Community Rating System (CRS) is a voluntary program that recognizes and encourages a community's efforts that exceed the NFIP minimum requirements for floodplain management. North Kingstown's entry date to the CRS was on October 1, 1993. The CRS program emphasizes three (3) goals: the reduction of flood losses, facilitating accurate insurance rating and promoting the awareness of flood insurance. By participating in the CRS program, communities can earn a 5% -45% discount for flood insurance premiums based on the activities that reduce the risk of flooding within the community. North Kingstown is one (1) of eleven (11) communities in Rhode Island that currently participates in the CRS and receive flood insurance premium discounts. North Kingstown has a CRS rating of 9, which entitles property owners to a 5% discount on their flood insurance premium. The total annual savings to all those policy holders in North Kingstown is \$54,430.00, averaging \$76 per policy holder. It is a priority and stated goal for North Kingstown to improve their CRS rating over the life of this plan. The town intends to achieve a class 7 rating by the next Plan update.

2.0 North Kingstown Profile

This section of the plan provides demographic and geographic information for the Town with major infrastructural and development trend changes included from the 2005 plan. This information acts as a base for the development of hazard mitigation strategies.

2.1 LOCATION & GEOGRAPHY

North Kingstown is a coastal community in the northeastern portion of the United States situated on the Narragansett Bay in the State of Rhode Island. It measures at 58.3



square miles and is one of nine (9) towns located in Washington County. The town is landlocked on three sides with the Bay forming its eastern boundary. The Hunt River forms the northern border of the town while the Annaquatucket and Pettaquamscutt (Narrow) Rivers both run through the southern portions of the town. Significant coastal features along the Town's 30 mile coast include Allen Harbor, Quonset Point, Wickford Harbor, and Bissel Cove. There are approximately 6,343 acres of wetlands (22.6%) and 14,085 acres of forest (49.8%) in the town. North Kingstown's coastal location and low lying areas, makes the town susceptible to coastal flooding, river flooding and flash flooding and more recently storm surges as witnessed in Hurricane Sandy in 2012.

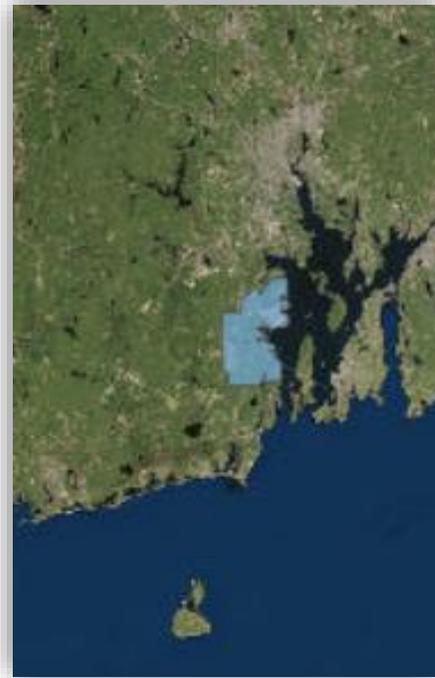


Figure 1: North Kingstown Location Maps from www.provplan.org

2.2 DEMOGRAPHICS & HOUSING

Development in the Town varies from the large industrial/business park of Quonset Point to the turf farms and low-density residential areas of Slocum to historic coastal village of Wickford. Based on the 2013 American Community Survey from the US Census, the population of North Kingstown was estimated at 26,554 and the town has approximately 11,226 housing units. This represents an increase of 228 people since the 2000 census. It is estimated that this slow but steady increase exhibits "flat" growth



and is projected to continue through to 2018 (*Forward Planning North Kingstown Market Study*).

The housing stock in North Kingstown is relatively newer in comparison to other towns with only 20 percent built before the 1940s. Of the housing stock 72 percent are single family detached units and seven (7) percent represent multi-family with five (5) or more units. There are over 1,200 new housing units either under construction or in some stage of permitting in the Town. The largest of these is Reynolds Farms on Post Road, a development of 574 units comprising of senior housing, apartments, work to live units, cottages, multi-family and single-family units. In addition to this project, the development pipeline consists of more than 3,000,000 square feet of nonresidential space.

The findings of the recent Market Study indicate that North Kingstown has a residential demand for an additional 500-1,600 units over the next fifteen years. The largest need for housing is among the 25-34 and over 55-year old demographics for one (1) to two (2) bed units for starter homes, down grading and “empty nesters”. Two areas in town identified to absorb this future residential growth are Wickford Junction (WJ) and Post Road (PR).

2.3 GENERAL LAND USE/DEVELOPMENT PATTERNS

North Kingstown’s scenic coastline has attracted residential, waterfront commercial, and other development for many years. Coastal buildings are primarily residential with more than 3,000 homes and businesses in coastal flood or storm surge areas. Most of these areas are close to being fully built out, and it is expected that existing land uses will generally continue. More recently, development has moved towards the western portion of the town and along Post Road, as the available land on the coast has become mostly developed. During the time between 1990 and 2010 the number of residential units in town increased approximately 19%.

The bar chart below indicates the total number of permits that have issued every year between 2011 and 2018.

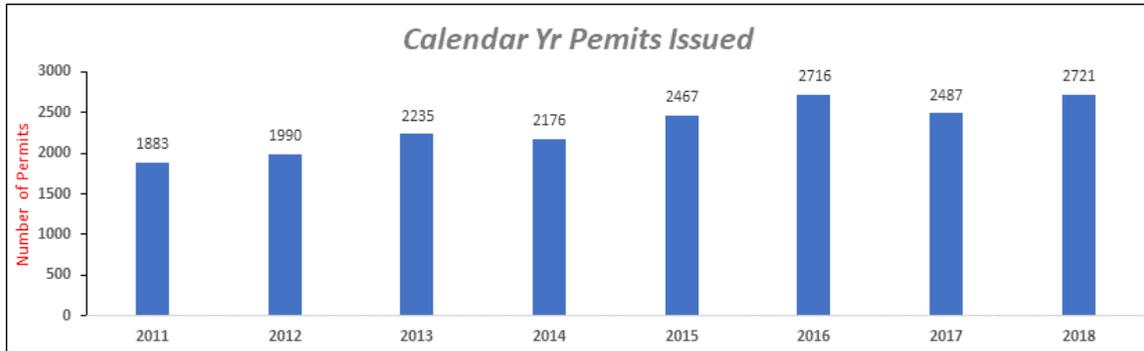


Figure 2: Total Permits issued from Building Inspectors office since 2011

The only remaining large tract of developable land in the coastal area is the Quonset Business Park (QBP) under the control of the Quonset Development Corporation (QDC). This 3,207-acre area includes an airport, a seaport, retail area, several recreational facilities, and is the primary location for industrial land uses in town. Of this acreage, 1,143 acres have been developed (leased and sold) and 84 acres are under agreement or short-term lease. There are approximately 178 acres still available in the park for future industrial/commercial development. The park has over 10 million square feet of existing buildings with an additional 655,000 square feet of buildings under construction. The park currently employs 11,439 people with an additional 1,500 new employees expected by 2020. It is projected that total employment at build out (2025-2030) will be about 15-17,000.

Parts of the industrial park are highly vulnerable to storm surge based on the SLOSH model and storm history in that area. Included in this plan are action items intended to promote disaster resistant design for future development at the QBP and to reduce the vulnerabilities of existing structures.

2.4 INFRASTRUCTURE

Although coastal, the geographic position of North Kingstown, in addition to its well-developed roadway system provides local and regional access to employment centers for residents. This roadway system has helped define the sense of place for North Kingstown's villages, neighborhoods, and commercial districts. Roads and highways are assigned by a functional classification system that is based upon the road's intended level of service. The five major classifications of roads present in North Kingstown are Freeway/Expressway, Principal Arterial, Minor Arterial, Collector, and Local.

Since the 2005 plan, the State constructed a new 4-lane limited access highway that extends approximately 4.5 miles from Route 4 to QBP. These infrastructure improvements have significantly enhanced traffic circulation to and from QBP and have alleviated congestion from many residential areas in the north end of town adjacent to



the former Route 403. The business park also has a new bus transit line, the QX route, that services the park.

The town has recently installed the first phases of sewers as outlined in the North Kingstown Wastewater Facilities Plan. These phases include Post Road South Phases I and II and the Wickford village area. Future phases included in the plan may include sewer installation in the northern segment of Post Road. The installation of sewers corresponds to the areas where commercial growth is expected to occur over the lifetime of this plan.

Another significant advancement since the last plan is the Wickford Junction commuter rail station with a 1,100-car parking garage completed in April of 2012. At present there is commercial development of nearly 300,000 square feet at Wickford Junction, with the Town continuing to plan for new development opportunities at this commuter station to capitalize on this asset. As part of this effort, the town is utilizing \$100,000 in funding from the RIDOT to re-write the zoning ordinance as it relates to Wickford Junction. This will include the necessary coordination between land use and transportation as well as the zoning implementation to allow more mixed-use development around the station. Through this initiative the town adopted a new Transit Oriented Development (TOD) district.

2.5 OPEN SPACE

Today, there are approximately 8,300 acres of land preserved as open space through such mechanisms as residential compound development, cluster development, planned village development and public spaces including the Town Beach, Ryan Park, Rome Point, Wilson Park, Cocumscussoc State Park, Calf Pasture Point and the municipal golf course. In total, these represent approximately 30 percent of the Town's land area.

The Town of North Kingstown has an active and long-standing open space preservation program for the entire community. The Town works collaboratively with several local and state agencies to protect farmland, wetlands, shorelines, woodlands, wildlife, trails, and open spaces of North Kingstown. As part of this open space preservation program a sizeable amount of land in the special flood hazard area has been protected as well. The town has 5,463 acres total land area in the SFHA (A, AE or V zones) and 1,729 acres protected land in the SFHA. The parcels with portions of land in the X zone or entirely outside of the floodplain are not included. Only those areas of preserved open space that intersect with the A, AE or V zones were included. One thousand seven hundred and twenty-nine (1,729) acres of the SFHA is designated as protected open space.



Most recently, the town received grant funding to protect two parcels of land, one located at 300 Fletcher Road and one off of Gilbert Stuart Road. These parcels both have a portion of land in the special flood hazard area. Protecting these properties will prohibit development from taking place and protect these flood zone areas. It will also protect the upland areas that buffer the flood zone.

The town continues to work towards protecting additional lands in town working collaboratively with the Land Conservancy of North Kingstown (LCNK), Narrow River Land Trust, Rhode Island Department of Environmental Management (RIDEM) Agricultural Land Preservation Commission, US Department of Agriculture (USDA)/ Natural Resources Conservation Service (NRCS), the Washington County Land Trust Coalition, the Rhode Island Land Trust Coalition, the Nature Conservancy, the Rhode Island Forest Conservators Organization and others to protect farmland, wetlands, shorelines, woodlands, wildlife, trails, and open spaces of North Kingstown.

3.0 Planning Process

The North Kingstown Hazard Mitigation Committee (NKHMC) initially re-convened on December 8th, 2010 for the purpose of updating the plan. The committee includes the Town Manager, town safety officials, Department of Public Works, the Building Official, town planners, a Quonset Development Corporation (QDC) representative, community members and the Executive Director of the North Kingstown Chamber of Commerce. The committee is supervised by the Director of Planning.

Federal regulations require that an effective planning process is essential in developing and maintaining a good plan. There were several meetings of the Hazard Mitigation Committee (HMC) that featured discussions of the goals of hazard mitigation, the risks North Kingstown faces from natural hazards, the town's vulnerabilities, and steps the town could take to reduce its vulnerabilities to those hazards. Technical aid, research, and meeting facilitation were provided by the North Kingstown Department of Planning and Development. Planning Staff developed maps using Geographic Information System data detailing hazard risks, critical facilities, known flood hazards and vulnerabilities. These maps were reviewed by the committee and used as a guide to further develop discussions and have included within (*Maps 4, 5 & 9*). This allowed for re-assessment of required updates and action plans needed in this HMP.

Additional opportunities for public input took place during the Planning Commission and Town Council review of the plan. This action requires a public meeting before the Planning Commission for a recommendation on the plan and a public hearing before the



Town Council for the plan's adoption. The plan was presented to both the Planning Commission and the Town Council in January 2014. The town Council adopted the initial plan on January 27, 2014. This plan includes subsequent revisions based on RIEMA feedback to incorporate additional information to meet FEMA requirements.

The goals, policies and actions from the hazard mitigation plan were presented in the Manager's report at the Town Council meeting of January 22, 2018. The Town Council members received a copy of the goals, policies and actions from the hazard mitigation plan in advance of the meeting to provide an opportunity to review. This information was also available to members of the public as it formed part of the agenda backup material on the Town's website.

In the data gathering stages and throughout the planning process, public input was achieved through additional committee members including representatives from the QDC, South County Nursing and Rehabilitation Center, RI Air National Guard, Army Guard. To ensure neighbor involvement the neighboring communities of South Kingstown, East Greenwich, Exeter, Warwick, Narragansett and Jamestown will be notified of the updates for their review and consideration. The plan is also available on the town's website (www.northkingstown.org) for public review and to receive further public input.

3.1 PUBLIC ENGAGEMENT & OUTREACH

The town has provided several opportunities for public engagement and outreach as it relates to hazard mitigation planning. The North Kingstown Planning Department maintains a small repository of pamphlets related to flooding and flood zones for the public to review and keep for reference. In addition, the library maintains a comprehensive collection of flooding and flood hazard related material for the public to reference. The Building Official's office also has building and flood-related information available to the residents and contractors who have projects in the flood zone areas.

As part of our participation in the Community Rating System (CRS) program, the town has to provide a public outreach component. As part of this requirement, the town maintains Elevation Certificates (EC) for all new construction and substantially improved buildings in the Special Flood Hazard Area. We also provide basic flood information, additional FIRM information, flood depth data, historical flood information, and natural floodplain functions to inquirers on a regular basis. We also provide information on the flood insurance requirements to the public who come to the office or ask by phone. As in previous years, this information can be accessed by visiting these offices in person, telephoning the offices or emailing staff from these two departments. The town also provides access to the FIRM and flooding information on the municipal web site at <http://northkingstown.org/212/Flooding-Flood-Insurance-Information> . We also send



yearly outreach to lenders, insurance agents and real estate offices about the FIRM, flood insurance and elevation certificate information that is available. The town also publishes a public notice advertisement in the local newspaper announcing where residents can access information related to flood zones and flood protection information. The North Kingstown Free Library continues to be a repository of information for flood protection data as well. A flyer informing property owners of the availability of flood hazard information is available at the local library as well as the Planning Department as part of our repository. A similar publication is included in the local newspaper the Standard Times.

PUBLIC NOTICE

Do you live in a FLOOD ZONE?



Wickford, 9/10/10

T. Crean

Are you looking for information regarding FLOOD HAZARD AREAS in North Kingstown?

- ▶ If so, the North Kingstown Free Library can help. The Library Reference Department has an entire section dedicated to **flood hazard areas**. In this section you will find the important information you are looking for on flood protection and repair measures.
- ▶ You can also find additional information to determine whether your property is located in a **flood zone** by visiting the Department of Planning and Development located at 100 Fairway Dr., North Kingstown or accessing the town's web site at <http://www.northkingstown.org/flooding-and-flood-insurance-information>.
- ▶ Please feel free to call 294-3331, Extension 311 if you have any questions regarding this notice.

As part of the town's yearly submission for the CRS program, an update is also provided on the goals and actions found in the Hazard Mitigation plan.

North Kingstown's GIS site (internet mapping server (IMS)) allows the public to search for parcel information, request GIS maps, and provide the ability of users to print maps in PDF format. One of the available layers on the IMS is flood zone information. The GIS data and maps can also be purchased from the town. In 2017, the town upgraded our online GIS system. We have recently contracted with App Geo to provide an online mapping service called Map Geo. This new online tool makes the flood hazard information readily available to the public in a user-friendly format. It is a much more user-friendly format than our previous online mapping tool.

Each year, the Town of North Kingstown Planning Department inserts a public information paragraph into the quarterly publication put forth by the North Kingstown



Water Department, The Puddle, which informs readers of the availability of flooding and flood-related information. This publication goes to all water service customers in North Kingstown, approximately 90% of the households.

Additionally, the University of Rhode Island’s Coastal Resources Center / Rhode Island Sea Grant College Program worked with North Kingstown as pilot community in its Green and Resilient Infrastructure Program (GRIP) to consider how green infrastructure can help the municipality rethink the design of vulnerable coastal assets in the face of rising seas and coastal hazards. Community design charrettes and targeted discussions were held to determine what could be possible for implementing design improvements in Wickford’s Brown Street parking lot. The goal was to ensure that this municipal lot would be able to provide parking for Wickford Village businesses and access to the waterfront over the long term. Participants proposed utilizing green infrastructure to mitigate hazard risks and facilitate post-recovery planning in Wickford.

The town is in the process of re-writing the comprehensive plan as well. There were several opportunities for public input throughout the planning process. One of the outreach tools utilized were public workshops and planning exercises to solicit input on the state of the town today and where residents see the town tomorrow. Some of the comments received were related to natural hazards, sea level rise and flooding. Some of the comments about the future of the town included the following:

“Resilient to climate change. May require moving structure.”

“Flood resistant”

“We have coastal flooding, exacerbated by sea level rise, which will increase in the years ahead. Part of this plan must consider Sea Level Rise, coastal flooding, insurance rates. We also have flooding due to increasingly intense rain, but it is secondary to coastal flooding”.

“Planning Dept. building change to arts & culture center. Not need offices in basement at sea level.”

There was also an online survey available for public input. Several goals were outlined and respondents were asked whether they supported those goals. One goal included the following:

Q1. Do you support each the following goals?

Q1. CONTINUED	Yes (Total)	Yes (%)	Maybe (Total)	Maybe (%)	No (Total)	No (%)
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Strategy for Reducing Risks from Natural Hazards in North Kingstown, RI

NATURAL HAZARD AND CLIMATE ADAPTATION Goal 1: Promote resilience and adaptation to natural hazards and a changing climate to protect lives, infrastructure, resources, and property	51	77%	10	15%	5	8%
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The following comments were given on this question:

“Should be incorporated into building codes and permitting. Can't be left to voluntary compliance.”

“Building codes are providing more resilience to hazardous weather conditions/building in flood zones. Need to be enforced though, not overlooked. Building the Senior Center in a flood zone was the most stupid move the Town could make for some of the most vulnerable citizens, it is not available for any evacuations support and is one of the first places to be shut down in an emergency.”

“This is too difficult for Wickford”

“I do think the town needs to think through measures to respond to floods, blizzards, and other natural disasters, particularly as weather becomes increasingly unstable.”

“Don't burden those that are already responsive. Tax payers should not foot the bill for those reaping the benefits now of water front property.”

Another survey question addressed the following related topics:

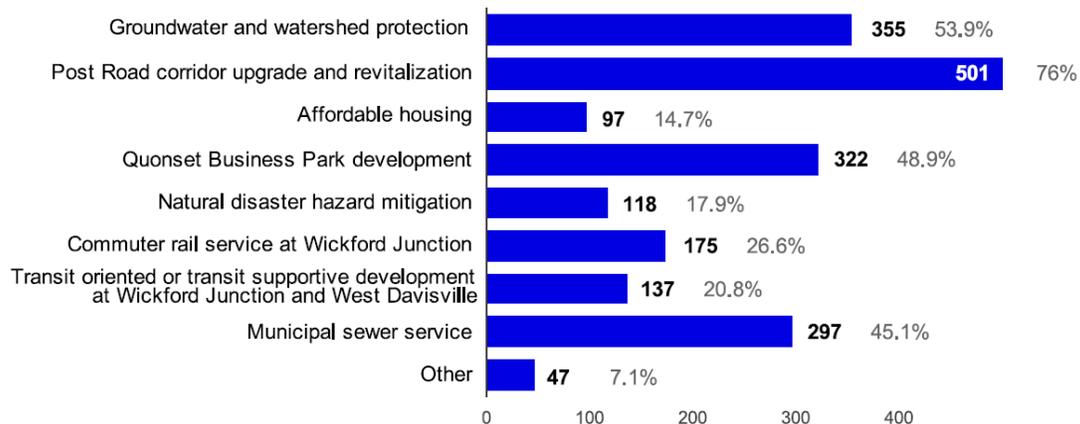
Q2. How should we commit our limited resources?

	Votes	Volunteers
06) HOUSING: Encourage voluntary implementation of flood resilience measures and provide guidance and incentives to property owners and builders.	6	1
22) CIRCULATION: Identify strategies to protect evacuation routes and prioritize roads currently and potentially impacted by flooding for inclusion on the state Transportation Improvement Program and town Capital Improvement Program.	1	0
25) OPEN SPACE/ENVIRONMENT: Preserve open space for natural resource protection and climate adaptation using purchase of land and development rights, land dedication, easements, and potential Purchase of Development Rights program.	20	2
38) LAND USE/ZONING: Direct future growth and higher density development out of current flood zones and areas projected to be affected by sea level rise, and consider a sea level rise overlay zone to evaluate future land use proposals.	8	1



The survey also included a question about priorities. The following bar chart depicts the results including where respondents prioritized natural disaster hazard mitigation:

The 2008 Comprehensive Plan identified the following as key areas. Which of these do you think are still priorities?



There was also a high volume of public participation through the pilot sea level rise project with URI Coastal Resources Center & Rhode Island Sea Grant. This pilot project is divided into three phases, which will be set out in greater detail in Section 4 of this Plan.

Constant liaising throughout phase I and now phase II has been maintained with the URI department head for SLR Grant, Teresa Crean and has allowed North Kingstown to utilize their expertise and to help inform board members and review committees within the town of the current and future hazards that face the town as a result of sea level rise. A list of sea level rise meetings that have been undertaken with the Town of North Kingstown members and public has been attached in Appendix F.

Phase II of this project is near completion and has engaged the public from the initial stages. This phase uses the sea level rise scenario maps to identify individual parcels and properties, as well as specific segments of roads and bridges that are projected to be at risk from future sea level rise in North Kingstown. Project meetings commenced for this second stage on November 14, 2012, which was the first Technical Review Committee (TRC) meeting. A public presentation was held on September 19, 2013 in the Community Center in North Kingstown. The meetings and public presentations to date for phase II have included roundtable discussions, public presentations and a sea level rise informational booth during the September 2013 Harbor Festival. Questionnaire boards were present at the Harbor Festival to obtain public views and knowledge on sea level rise and future implications. This provided a good discussion forum and informational session with members of the public.



Other opportunities to raise public awareness and for discussion included the following events:

- April 16, 2013 – North Kingstown Planning Commission presentation 7:30 p.m.
- April 18, 2013 –Public Lecture at North Kingstown Free Library, 6-8 p.m.
- April 20, 2013 - “Open House” at North Kingstown Free Library, 10-12 a.m.
- November 19, 2013- Sea level rise presentation at Planning Commission meeting at 7:30 p.m.
- November 19, 2013- Initial discussions of the draft HMP also took place at this Planning Commission meeting in November.
- January 27, 2014 – Local Adoption of Hazard Mitigation Plan by Town Council
- October 02, 2014- a resiliency walk was held as part of coastal weeks led by URI Coastal Resources Center and RISG. This 2-mile tour of Wickford began and ended at the Brown Street Bridge. It guided participants, 35 in total to learn about the flooding problem areas within this historic village, and what the Town of North Kingstown, aided by funding from R.I. Statewide Planning and assistance from URI, is doing to improve resilience to coastal flooding and sea level rise. (*Appendix F*)
- July 16, 2015 - Public Forum – North Kingstown Comprehensive Plan Re-Write
- October 15, 2015 - Public Forum – North Kingstown Comprehensive Plan Re-Write
- February 11, 2016 - Public Forum – North Kingstown Comprehensive Plan Re-Write
- May 9, 2016 - Town Council Meeting to Approve the Adaptation to Natural Hazards and Climate Change Plan
- March 2017 – Town Manager update to Town Council on the Hazard Mitigation Plan Actions
- January 2018 - Town Manager update to Town Council on the Hazard Mitigation Plan Actions

3.2 DEVELOPING & UPDATING MITIGATION STRATEGIES

This update provides a foundation for improved mitigation opportunities as the town completed its re-write of the comprehensive plan, consistent with General Laws in Chapter 45-22.2 entitled “Rhode Island Comprehensive Planning and Land Use Regulation Act” to incorporate a Natural Hazards element.” The plan must include an identification of areas that could be vulnerable to the effects of sea-level rise, flooding, storm damage, drought, or other natural hazards...”



The re-write of the comprehensive plan includes a separated element dedicated to natural hazards and climate adaptation. The first goal of this element is to “Promote resilience and adaptation to natural hazards and a changing climate to protect lives, infrastructure, resources, and property”. The first policy is to “Ensure existing property and business owners are aware of their exposure and risk to coastal hazards and support efforts to improve resiliency”. The actions related to this policy include:

PRIORITY	ACTION #	ACTIONS	RESPONSIBLE PARTY	TIMEFRAME	POTENTIAL SOURCE OF FUNDS
★	7.1.a	Notify property owners within the Special Flood Hazard Area (SFHA) of their exposure to projected sea level rise scenarios.	Building Official, Planning Dept	5 to 10 years	Staff time
★	7.1.b	Encourage more resilient housing stock through “code-plus ” techniques that go above and beyond local building codes to reduce damage and debris from structures during a storm or flooding event.	Building Official	5 to 10 years/10-20 years	Staff time

Another policy in the comprehensive plan is to “Avoid or minimize the exposure of future development to natural hazards and climate change”. The following actions are intended to meet this policy:

PRIORITY	ACTION #	ACTIONS	RESPONSIBLE PARTY	TIMEFRAME	POTENTIAL SOURCE OF FUNDS
★	7.2.a	Evaluate vacant properties within the SFHA and identify opportunities to acquire, purchase, or establish perpetual conservation easements on these parcels.	Town Council, URI Coastal Resources Center (CRC), CRMC, Building Official	10 to 20 years	Staff time, RIEMA, RIDEM
	7.2.b	Explore feasibility of structuring Purchase Development Rights (PDR) program specific to the SFHA to reduce density in the potential impacted areas of town.	URI CRC, NK Tax Assessor, Planning Commission, Town Council	10 to 20 years	RIDEM, RIEMA, Town Budget, Staff time
	7.2.c	Define areas impacted by sea level rise and other flood events for protection, accommodation, preservation, and managed retreat.	URI CRC, Building Official, Conservation Commission	10 to 20 years	RIDEM, CRMC, RIEMA, Staff time

CRMC=Coastal Resources Management Council, RIEMA=Rhode Island Emergency Management Agency, RIDEM=Rhode Island Dept of Environmental Management, URI CRC=University of Rhode Island Coastal Resources Center

Additionally, the comprehensive plan seeks to “Consider natural hazards and potential climate change impacts in all long-range planning and critical public facilities and infrastructure projects”. This will be accomplished by implementing the following activities:



Strategy for Reducing Risks from Natural Hazards in North Kingstown, RI

PRIORITY	ACTION #	ACTIONS	RESPONSIBLE PARTY	TIMEFRAME	POTENTIAL SOURCE OF FUNDS
★	7.3.a	Maintain a database of municipal properties and structures within the SFHA or projected sea level rise areas and record of flood impacts.	Building Official	5 to 10 years	Staff time
★	7.3.b	Request RIDOT conduct a feasibility study to identify strategies to protect evacuation routes and state roadways from storm damage and projected sea level rise inundation. Evaluate the necessity and feasibility of elevating low points along evacuation routes.	RIDOT, DPW	5 to 10 years	RIDOT, Staff time
★	7.3.c	Prioritize public facility improvements that are necessary for increased resiliency on the town Capital Improvement Program and roads currently and potentially impacted by a sea level rise or coastal flooding for inclusion on the state Transportation Improvement Program (TIP) and town Capital Improvement Program.	RIDOT, DPW	5 to 10 years	Staff time
	7.3.d	Restrict development of new roads in areas exposed to coastal flooding and sea level rise scenarios.	DPW, RIDOT, Planning Commission	1 to 5 years/5 to 10 years	Staff time
	7.3.e	Update and continue to implement the town's Hazard Mitigation Plan with regard to town-owned transportation infrastructure.	Planning Dept, DPW	5 to 10 years	Staff time, RIEMA

As it relates to our natural resources, the comprehensive plan has included a policy to “Protect and preserve natural resources to promote resilience and adaptation to natural hazards and climate change”. These actions will help to accomplish this.

PRIORITY	ACTION #	ACTIONS	RESPONSIBLE PARTY	TIMEFRAME	POTENTIAL SOURCE OF FUNDS
★	7.4.a	Preserve open space in existing salt marsh complexes, floodplain, and in areas exposed to coastal hazards, sea level rise projections and salt marsh migration.	Planning Commission, Town Council, Conservation Commission, NK Land Conservancy	5 to 10 years	RIDEM, CRMC, Staff time
	7.4.b	Establish a process and financial incentives for property owners to define conservation easements on their properties to protect areas projected to be inundated by sea level rise or salt marsh migration.	Conservation Commission, NK Land Conservancy	10 to 20 years	RIDEM, CRMC, NK Land Conservancy, Narrow River Land Trust

Historic and cultural resources are also addressed in the plan as demonstrated in the policy to “Protect and preserve important historic and cultural resources from natural hazards and climate change”. The following actions are related to this policy:



PRIORITY	ACTION #	ACTIONS	RESPONSIBLE PARTY	TIMEFRAME	POTENTIAL SOURCE OF FUNDS
★	7.5.a	Maintain a database of parcels within the historic districts, the Special Flood Hazard Areas (SFHA), and within the projected sea level rise areas to monitor impacts to these areas and coordinate with property owners on potential strategies to protect historic assets.	Historic District Commission (HDC), RI Historic Preservation and Heritage Commission (RIHPHC), Building Official, property owners	5 to 10 years	RIEMA, Staff time, RIHPHC, property owners
★	7.5.b	Coordinate with the State Historic Preservation Officer and the local Historic District Commission to provide resources and design guidelines for historic home owners within historic districts who may desire to flood-proof their property or structure.	Historic District Commission (HDC), RI Historic Preservation and Heritage Commission (RIHPHC), Building Official	1 to 5 years	Staff time, RIHPHC
	7.5.c	Establish financial incentives for owners of historic properties who voluntarily invest in adaptation strategies to flood-proof or otherwise protect vulnerable assets, such as low-interest loans or historic preservation grants.	Historic District Commission (HDC), RI Historic Preservation and Heritage Commission (RIHPHC), Building Official	10 to 20 years	Staff time, Town budget, RIHPHC, CRMC

CRMC=Coastal Resources Management Council, RIEMA=RI Emergency Management Agency, RIDEM=RI Dept of Environmental Management

Once approved by RIEMA and FEMA, the Hazard Mitigation Plan will be incorporated by reference to the town’s comprehensive plan. Phase II of the sea level rise program also includes a requirement for adaptation strategies to be incorporated in the re-write and this will be reflected in the updated goals and actions of this plan.

The goals, policies and actions outlined in the comprehensive plan will help to implement the mitigation strategies found in this plan.

4.0 Hazard Identification and Risk Assessment

The purpose of this section is to provide an overview of how various natural hazards can and have impacted North Kingstown. A natural hazard is defined as *“an event or physical condition that has the potential to cause fatalities, injuries, property and infrastructure damage, agricultural loss, damage to the environment, interruption of business, or other types of harm or loss.”* A natural hazard can also be exacerbated by societal behavior and practice, such as building in a floodplain, along a sea cliff or an earthquake fault. Natural disasters are inevitable, but the impacts of natural hazards can, at a minimum, be mitigated or, in some instances, prevented entirely.

The hazard identification process for North Kingstown consisted of reviewing the town’s previous plan (2005), the RI State Hazard Mitigation Plan (2019) and plans from other coastal communities in Rhode Island and utilizing recent studies and partnership



projects. Past newspaper articles of natural hazard events that have occurred in the town were researched and websites to include the National Centers for Environmental Information (NCEI) and National Weather Service were also viewed. The Town of North Kingstown’s Plan update has included all-natural hazards as identified in the State Hazard Mitigation Plan. The next step was to analyze them individually to determine the degree of threat that is posed by each natural hazard. Addressing risk and vulnerability through hazard mitigation measures will reduce societal, economic and environmental exposure to the natural hazards impacts. This Plan addresses only natural hazards, and does not consider man-made hazards (*i.e., structural fires, hazardous materials, chemical spills, and weapons of mass destruction*).

4.1 HAZARD PROFILES

North Kingstown’s 30-miles of coastline along the western edge of Narragansett Bay, coupled with its location 10-15 miles north of the Atlantic Ocean, make it especially exposed and susceptible to coastal hazards, including projected future conditions attributed to a changing climate.

For the purposes of this plan’s risk assessment, natural hazards have been grouped into the following categories and are listed in order of frequency and impact, starting at the top of the list with the most frequently occurring natural hazards. Based on the RIHMP 2019, NCEI data, and previous versions of this plan the following hazards will be discussed and analyzed in this report:

Table 1: Hazard Profiles from SHMP

Wind Related Hazards	Winter Related Hazards	Flood Related Hazards	Geological Related Hazards	Additional Hazards
Storm Surge	Snow	Riverine Flooding	Earthquakes	Wildfire
Hurricanes	Ice	Flash Flooding		Drought
Tornadoes	Extreme Cold	Urban Flooding		Extreme Heat
High Winds		Coastal Flooding		
		Climate Change and Seal Level Rise		
		Coastal Erosion		
		Dam Breach		



This list represents those hazards that impact North Kingstown most frequently and have the “potential to cause fatalities, injuries, property and infrastructure damage, agricultural loss, damage to the environment, interruption of business, or other types of harm or loss”, as described in the RIHMP. The following hazards will not be addressed in this plan:

- Avalanche
- Expansive soils
- Hail
- Land Subsidence
- Landslides
- Volcanoes
- Tsunamis

The town determined these hazards would not be considered for the following reasons:

- Lack of frequency in which they occur;
- The minimal probability of their occurrence; and / or
- The lack of resources to devote any amount of time to further research the likelihood or potential occurrence or impact (RIHMP 2019).

4.2 Wind Related Hazards

Wind is the movement of air caused by a difference in pressure from one place to another. Local wind systems are created by the immediate geographic features in a given area, such as mountains, valleys, or large bodies of water. Wind effects can include blowing debris, interruptions in elevated power and communications utilities, and intensification of the effects of other hazards related to winter weather and severe storms.

North Kingstown is included in Wind Zone II (160 MPH) as indicated in FEMA’s map which depicts the maximum speed for the design of safe rooms. Rhode Island is also within the Hurricane-Susceptible Region as shown in *Figure 2* below. Rhode Island wind events can produce damage often associated with thunderstorms or tornadoes. In some instances, these events have been associated with weakening tropical weather systems, including downgraded tropical and sub-tropical storm systems. This section examines the risks associated with damaging wind events with emphasis on storm surges, hurricanes, tornadoes, and thunderstorms.

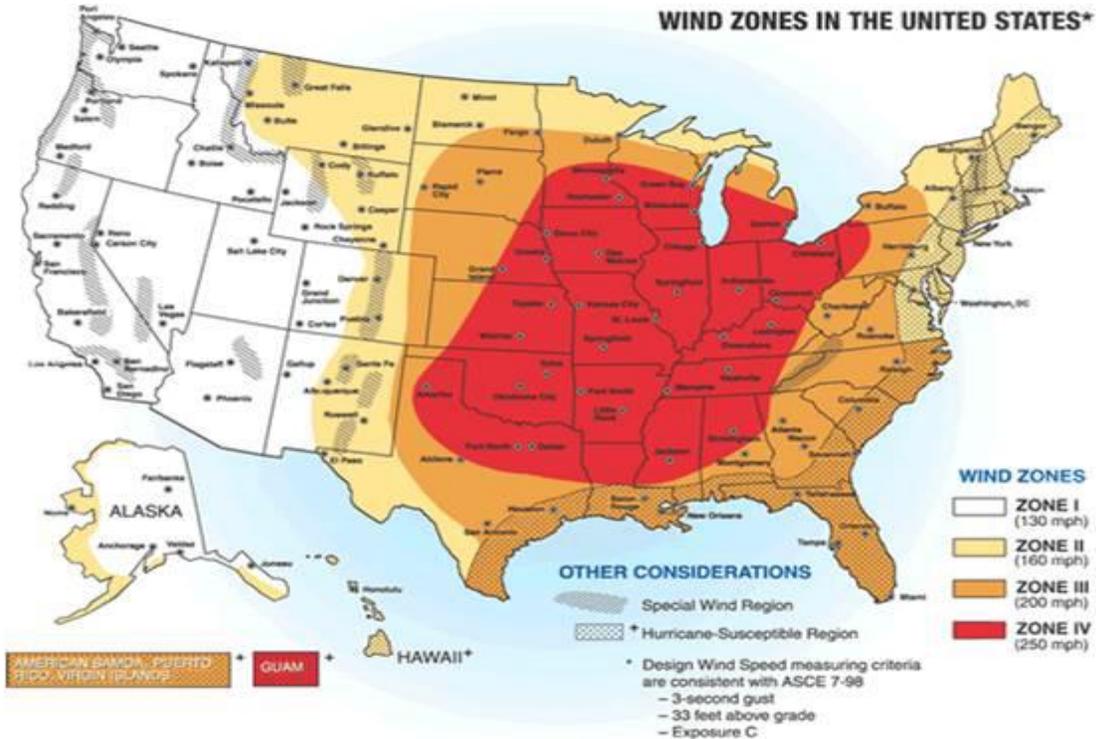


Figure 3: FEMA Safe Room Design Wind Speed Zones for the United States

4.2.1 STORM SURGE

DESCRIPTION

Storm surge is the abnormal rise in water level caused by the wind and pressure forces of a hurricane or nor'easter. The storm surge can result in flooding when storm winds push the elevated ocean water toward the shore. The storm surge combined with the normal tidal elevation is the storm tide. This is the observed level of the ocean during a storm event. The storm surge can cause extensive damage and is a serious hazard during coastal storms and hurricanes (RI Shoreline Change Special Area Management Plan 2018).

Nationally, storm surge flooding has caused billions of dollars in damage and hundreds of deaths. Given today's ever-increasing population densities in coastal communities, the need for information about the potential for flooding from storm surge has become even more important. Storm surge heights in Rhode Island range from a few feet higher than normal tides during nor'easters to more than 10 feet during hurricanes. The breaking wave height is related to water depth so that as water depth over a given surface increases with storm surge, larger waves can be generated.



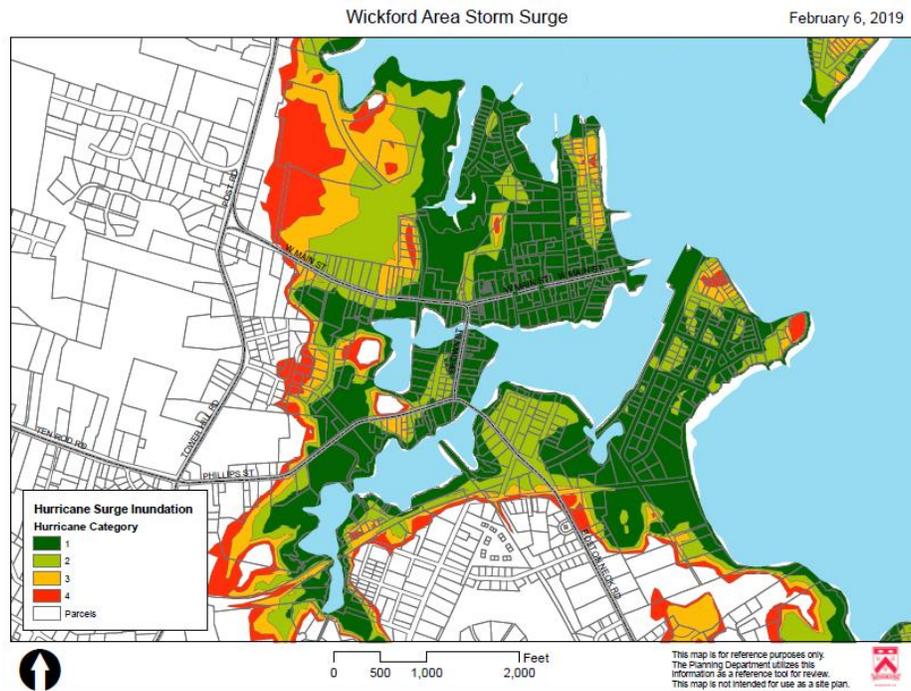
There are a number of factors which contribute to the generation of storm surge, but the fundamental forcing mechanism is wind and the resultant frictional stress it imposes on the water surface. Winds blowing over a water surface generate horizontal surface currents flowing in the general direction of the wind. These surface currents in turn create subsurface currents which, depending on the intensity and forward speed of the hurricane or nor'easter, may extend from one to several hundred feet below the surface. If these currents are in the onshore direction, water begins to pile up as it is impeded by the shoaling continental shelf causing the water surface to rise. This "dome of water" will increase shoreward until it reaches a maximum height at the shoreline or at some distance inland.

LOCATION

The entire State is vulnerable to storm surges. Storm surges also affect tidal rivers and creeks, potentially increasing the areas of town in need of evacuation. As noted in the RIHMP, because the Rhode Island shoreline faces south, storms passing to the west raise the highest storm surges for the area. In addition, Narragansett Bay funnels the surge northward where decreasing surface area amplifies the surge height (Boothroyd 2008). The 1938 Hurricane made landfall west of Rhode Island as a Category 3 hurricane with a forward speed in excess of 50 miles per hour. Because the center of the storm made landfall in Connecticut, the Rhode Island shoreline experienced the highest storm surge levels (RIHMP 2019).

EXTENT

The Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model is used to evaluate the potential impact of storm surge. Emergency managers use data from SLOSH to identify at-risk populations and determine evacuation areas. Storm surges also affect tidal rivers and creeks, potentially increasing evacuation areas (RIHMP 2019). The areas closest to the shoreline are most susceptible.



PREVIOUS OCCURRENCES

The highest storm surges recorded at the Newport tide gauge were 9.45' and 6.76' above MHHW during the Great September Hurricane of 1938 and Hurricane Carol, August 1954, respectively (RIHMP 2019). A storm surge occurrence of 3' happened in North Kingstown during Super Storm Sandy in 2012. Superstorm Sandy brought a 4-foot storm surge to Narragansett Bay and flooded downtown Wickford Village across the Brown Street bridge. The very large waves on top of the storm surge caused destructive coastal flooding along stretches of the Rhode Island exposed south coast.

PROBABILITY OF FUTURE

According to findings of the URI Graduate School of Oceanography, there are a number of factors that affect storm surge. These factors include the intensity of a storm, its size, translational speed, angle of approach to the coast, landfall location, and the bottom slope at that location. It is well accepted that the most influential factor in storm surge generation is the central pressure deficit, which controls the intensity of a hurricane, i.e., wind velocity and stress over the ocean surface and inverse barometric effects. The influence of the other factors, such as the storm size, speed, and the angle of approach are also important to consider as evidenced by Hurricane Katrina's catastrophic storm surge in 2005. Lower atmospheric pressure (faster wind speeds) and larger storms create a greater storm surge potential. Slower and larger but weaker hurricanes cause much higher storm surge and flooding when compared to faster and small but more



intense hurricanes. Storms with a perpendicular approach toward the coastline will also cause a greater storm surge, whereas those that travel parallel to the coastline will have a reduced storm surge (<http://www.hurricanescience.org/society/impacts/stormsurge>).

Storm surge associated with Nor'easters are a primary concern for Rhode Island residents because of the damage potential as well as the high rate of recurrence. Nor'easters have an average frequency of one (1) or two (2) per year, with a storm surge equal to or greater than two (2) feet (RIHMP 2019).

4.2.2 HURRICANE

DESCRIPTION

Hurricanes are tropical based storms that travel north up the Atlantic coast and feature heavy rain and high velocity winds. The state has seen an increase in storm intensity (not frequency) for nor'easters and hurricanes. The present 1% annual chance storm (100-year storm) could be seen more frequently and cause an increase in flooding, wind damage, and erosion. Hurricanes occur in the late summer to early fall, as opposed to nor'easters, which are similar to hurricanes in effect but occur in the winter months. Nor'easters have a typical storm surge of 3', which can increase flooding especially at high tide or spring tides. Both types of storms can cause large amounts of damage across a wide area. Because hurricanes and coastal storms are the major natural hazards that the town faces on a regular basis, they are the primary focus of this hazard mitigation plan.

Hurricanes are classified by wind speed into five types. Table 2 outlines these five hurricane categories. North Kingstown is considered to be susceptible to a direct landing of storms from categories I through IV. It has been estimated that North Kingstown's peak wind gust in a typical 100-year period is likely to be between 110 and 125 mph (HAZUS-MH). Hurricanes reaching the New England region experience an increase in forward motion that compensates for decreased wind speed so that lower class hurricanes can potentially cause considerably more damage than would normally be expected.

LOCATION

The entire State is vulnerable to hurricanes. Being located on Narragansett Bay and in close proximity to the Atlantic Ocean, North Kingstown is more susceptible to hurricanes and the impact these storms have on human life and property.



EXTENT

As shown in the table below, hurricanes are classified by their damage potential according to a scale developed in the 1970s by Robert Simpson and Herbert Saffir. This scale classifies hurricanes based on wind speed and storm surge. It estimates the magnitude of a storm. The storm surge levels provide an indication of the potential flooding and the wind speed approximates the wind damages associated with each hurricane category.

Table 2: Hurricane Category

Category	Wind Speed (MPH)	Storm Surge (FT)
1	74 - 95	4 - 5
2	96 - 110	6 - 8
3	111 - 130	9 - 12
4	131 - 155	13 - 18
5	> 155	> 18

Based on the Saffir /Simpson Hurricane-Scale Ranges

PREVIOUS OCCURRENCES

The most significant storm to hit North Kingstown was the hurricane of 1938, a category 3 storm. Wind speeds as high as 121 miles per hour were reported and there was severe coastal flooding. In the hurricane of 1938, a summer colony at Quonset lost 100 cottages and nine people were killed. Many homes were destroyed throughout the town and Wickford village in particular was hard hit. Students were trapped overnight in Wickford Elementary School and many of the elm trees lining Main Street were downed. A bronze plaque at the corner of Main and Brown Streets shows the historic high water mark from this storm.

The two most recent significant hurricane storms to strike Rhode Island since the 2005 plan were Tropical Storm Irene in August 2011 and Superstorm Sandy in October 2012. Each of these storms had similar impacts in that they caused serious damage to homes and infrastructure due to high winds and falling trees. In both storms there were many instances of power lines that were damaged and many streets were not passable due to fallen debris and trees. In each storm, thousands of residents throughout the state were left without power as a result of high winds and some flooding from the storm.

For Tropical Storm Irene, FEMA announced that federal aid had been made available to the State of Rhode Island to supplement state and local recovery efforts in the area affected by the storm beginning August 27, 2011. For Super Storm Sandy, FEMA made a similar announcement regarding the State of Rhode Island beginning October 26, 2012.



Nor'easters have a typical storm surge of 3', which can increase flooding especially at high tide or spring tides. Superstorm Sandy brought a 4-foot storm surge to Narragansett Bay and flooded downtown Wickford Village across the Brown Street bridge. These water levels, along with historic markers illustrating that Wickford Village and other neighborhoods along North Kingstown's coastline, are exposed and vulnerable to coastal storm surge forces. Adding projected sea level rise data to storm surge models shows that many properties within Wickford Village, including the historic district, will be inundated by 2100 with 2 daily tides.



Superstorm Sandy (left) had a devastating impact on communities along the eastern seaboard of the United States, including parts of North Kingstown.

PROBABILITY OF FUTURE EVENTS

North Kingstown has an increased susceptibility to hurricanes due to its position, along with Connecticut and Massachusetts, on a landform that juts eastward into the Atlantic Ocean. Also, the configuration of the Narragansett Bay can have a funneling effect on the tidal surges accompanying hurricanes causing high levels of coastal flooding in the upper portions of the bay.

Many hurricanes have directly or indirectly struck North Kingstown in the past century, so one can easily expect further hurricane activity in the future. Map 2 below shows the storm tracks of the 24 major coastal storms that have made land fall within 100 miles of North Kingstown in the past 50 years. Rhode Island has had three presidential disaster declarations due to hurricanes; Hurricane Gloria (1985), Hurricane Bob (1991), Tropical Storm Irene (2011) and Hurricane Sandy (2012). There were also flooding declarations in 2007 and 2010 (FEMA). The Town's history includes several severe storms, including hurricanes and nor'easters, which have caused significant levels of damage to North Kingstown. Damage in these storm events came primarily from two elements, flooding and wind.



The devastating hurricanes and storms that struck Rhode Island during the early and mid-1900s were part of a period of increased hurricane formation in the tropical Atlantic. Between 1970 and 1994 the Atlantic had a period of below normal hurricane formation. In the mid-1990s a new period of increased hurricane activity began due to warmer surface water temperatures in the tropical Atlantic. Therefore, the likelihood of a major hurricane striking North Kingstown is currently greater than it was in the past several decades.

If the predicted effects of global warming are correct, then hurricanes and other severe storms will occur with more frequency and intensity in the future, increasing the chances of a hurricane reaching North Kingstown's shores. The probability of a named storm directly hitting Rhode Island in any given hurricane season, based on past events is currently estimated at approximately 22.8 per cent.

Because the town's most damaging hurricanes occurred over fifty years ago, many new residents are unaware of the seriousness of the risk. As coastal population has increased, locations where development was previously destroyed by hurricanes have been redeveloped, some with particularly vulnerable structures. Figure 4 shows the increasing population of Washington County along with major hurricane strikes to the county.

The National Hurricane Center's Sea, Lake, and Overland Surges from Hurricanes model (SLOSH) shows areas subject to inundation from the sea in the event of a hurricane. The SLOSH model depicts the "worst case scenario" taking into account wind speed and direction, tides, and the topography of the land. Future sea level rise and coastal erosion will increase the area and extent of damage caused by coastal flooding.

The RI State Hazard Mitigation Plan presents an evaluation of Category 1-4 storms and their potential impact in Rhode Island. Rhode Island has not experienced a hurricane greater than a Category 3 to date (1938 and 1954 Hurricane Carol), and while a Category 5 storm is considered unlikely at this time, it is important to continue monitoring long-term climate patterns and trends to understand the probability, uncertainty and potential impacts of storms of varying sizes. The University of Rhode Island, in cooperation with the U.S. Department of Homeland Security and under the direction of URI's Dr. Isaac Ginis, is currently modeling a storm scenario, also called a synthetic storm, named "Hurricane Rhody" to illustrate the impacts of a more severe coastal storm than Rhode Island has seen in its history (North Kingstown Comprehensive Re-Write 2019).



Legend

Hurricane Track

-  Category 3-5
-  Category 1-2
-  Tropical Storm
-  Tropical Depression
-  Subtropical Storm
-  Subtropical Depression
-  Extratropical Storm
-  Tropical Low
-  Tropical Wave
-  Tropical Disturbance

Road



Water



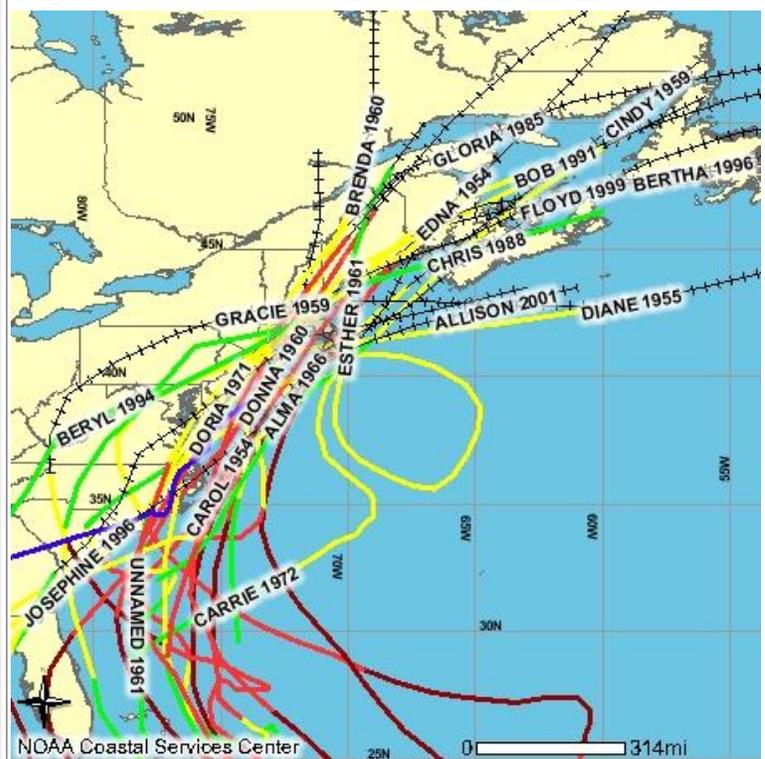
Country



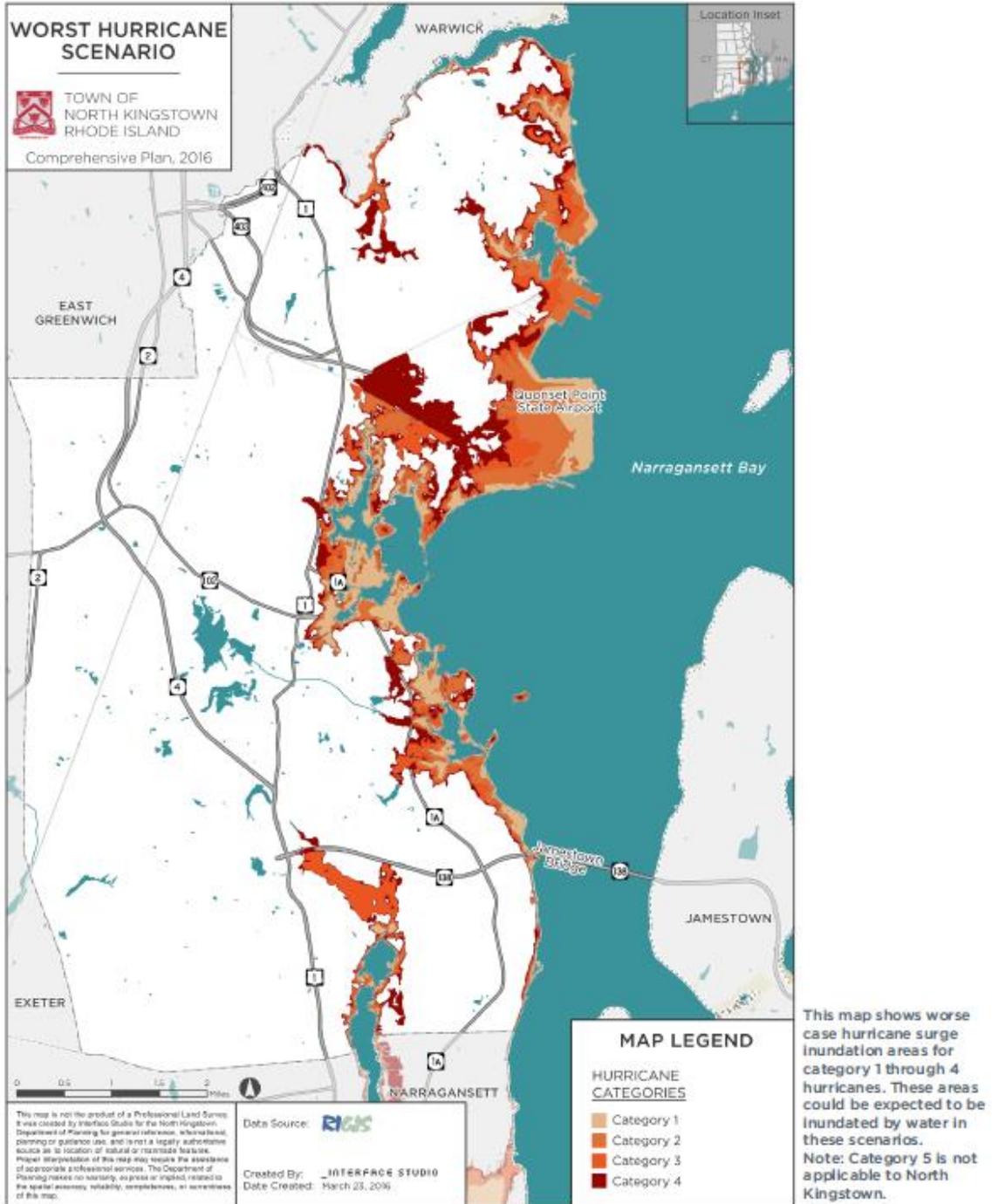
County/Municipality



Latitude/Longitude



Map 2: Historical storm tracks making landfall within 100 miles of North Kingstown in the past 50 years.

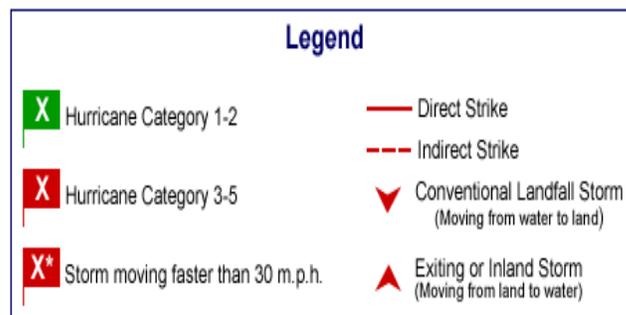
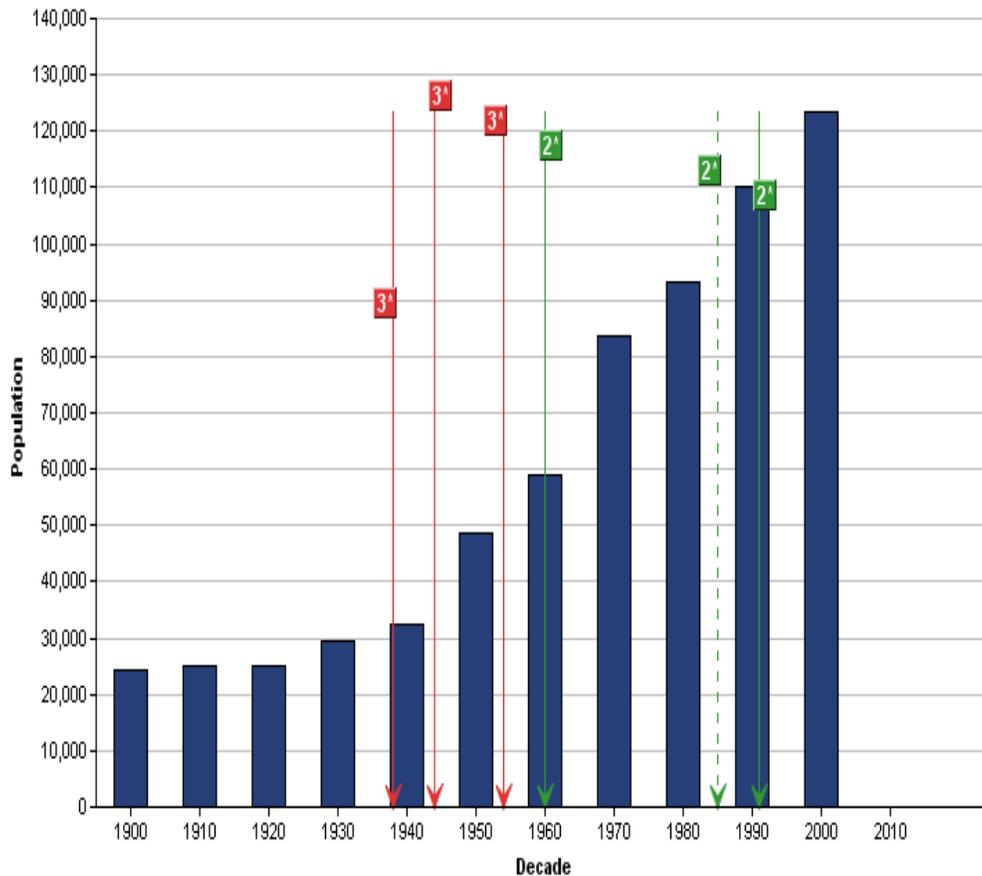


Map 3: Worst hurricane scenario

Source: North Kingstown Comprehensive Plan Re-Write



Hurricane Strikes vs Population for Washington, Rhode Island



Hurricane Strike Data: National Hurricane Center

Population Data: U.S. Census Bureau

NOTE: Population values may be missing in some counties, particularly for earlier periods. This is most often attributable to the fact that the county had not yet been established.

NOTE: There may be discrepancies between the strike data shown in this chart and the HURDAT strike data used in the Historical Hurricanes Tracks Tool.

The National Hurricane Center is currently updating the strike data used for these charts.

For more information visit http://www.aoml.noaa.gov/hrd/data_sub/re_anal.html

NOTE: Population data is current as of 2000 U.S. Census. X-axis on graphs depict years through 2010 to illustrate storms that have occurred from 2000-2006.

Figure 4: The Population of Washington County and Major Hurricane Strikes to the County



4.2.3 TORNADOES

DESCRIPTION

Tornadoes are considered to be low frequency, high-impact events. A tornado is a violently rotating column of air in contact with and extending between a cloud and the surface of the earth. Winds in most tornadoes are 100 MPH or less, but in the most violent, and least frequent tornadoes, wind speeds can exceed 250 MPH. Tornadoes, typically track along the ground for a few miles or less and are less than 100 yards wide, though some can remain in contact with the earth for well over fifty miles and exceed one (1) mile in width.

Several conditions are required for the development of tornadoes and the thunderstorm clouds with which most tornadoes are associated. Abundant low-level moisture is necessary to contribute to the development of a thunderstorm, and a "trigger" is needed to lift the moist air aloft. Once the air begins to rise and becomes saturated, it will continue rising to great heights and produce a thunderstorm cloud, if the atmosphere is unstable.

Tornadoes usually form in areas where winds at all levels of the atmosphere are not only strong, but also turning with height in a clockwise direction. Tornadoes can appear as a traditional funnel shape, or in a slender rope-like form. Others may be nearly invisible, with only swirling dust or debris at ground level as the only indication of the tornado's presence. The tornado season lasts from March to August, with peak tornado activity normally occurring in April, May, and June. The highest concentrations of tornadoes have been in the Central U.S. and portions of the Gulf Coast states.

LOCATION

Rhode Island does not see frequent occurrences of tornadoes, however it is possible that they may occur at any given time, anywhere across Rhode Island. The uncertainty of a tornado occurrence makes it difficult to prepare for such an event. As such, municipalities and their residents are not prepared to respond to a tornado. While tornadoes are considered to be low frequency events, they can have devastating impacts.

EXTENT

The Fujita scale, introduced in 1971 by Dr. Ted Fujita, provided a way to characterize tornadoes based on the damage they produced and relating that damage to the fastest quarter-mile wind at the height of a damaged structure. An Enhanced Fujita scale became operational in 2007 and improves upon the original scale by including more damage indicators, taking into account construction quality and variability, and providing a more definitive correlation between damage and wind speed.



Damage f scale	Little Damage	Minor Damage	Roof Gone	Walls Collapse	Blown Down	Blown Away	
	f0	f1	f2	f3	f4	f5	
Windspeed F scale	17 m/s F0	32 F1	50 F2	70 F3	92 F4	116 F5	142
	40 mph	73	113	158	207	261	319
↓ To convert f scale into F scale, add the appropriate number							
Weak Outbuilding	-3	f3	f4	f5	f5	f5	f5
Strong Outbuilding	-2	f2	f3	f4	f5	f5	f5
Weak Framehouse	-1	f1	f2	f3	f4	f5	f5
Strong Framehouse	0	F0	F1	F2	F3	F4	F5
Brick Structure	+1	-	f0	f1	f2	f3	f4
Concrete Building	+2	-	-	f0	f1	f2	f3

Fig. 2.4-1 The Fujita tornado scale (F scale) pegged to damage-causing windspeeds. The extent of damage expressed by the damage scale (f scale) varies with both windspeed and the strength of structures.

Figure 5: Fujita Scale

PREVIOUS OCCURRENCES

North Kingstown is located in wind zone II, which has a design wind speed of 160 mph. Based on historical tornado data North Kingstown is located in a very low risk area. Tornado risk is calculated from the destruction path that has occurred within 30 miles of the location. According to records, the largest Tornado in the North Kingstown area was an F2 in 1970 that caused 0 injuries and 0 deaths. (www.homefacts.com) Rhode Island does not fall into Tornado Alley; however, tornadoes do occur. While tornadoes do not occur frequently, they may occur anytime and anywhere in Rhode Island. In the highly unlikely event of a strong tornado in North Kingstown, the structures that would be most susceptible to damage would be those built before 1990, when the State building code was amended to include requirements for wind load resistance.

PROBABILITY OF FUTURE EVENTS

While North Kingstown has a low risk of tornadoes; wind shelters are still advisable due to the region’s susceptibility to hurricanes. The National Centers for Environmental Information reports an average of 0 tornadoes per year in Rhode Island, and the Tornado Project reports that there have been 0 tornadoes in Washington County between 1950 and 1995.

This situation may be more dangerous than states in Tornado Alley because Rhode Island residents do not expect severe tornadoes and are ill-prepared to respond to a tornado strike. The four mobile home parks in the northern part of town would also be of special concern. Based on this history, it can be concluded that a tornado in North Kingstown would be a very rare event; however it cannot be ruled out because the conditions that generate tornadoes can happen anywhere.



4.2.4 HIGH WIND AND THUNDERSTORMS

DESCRIPTION

Thunderstorms are formed when the right atmospheric conditions combine to provide moisture, lift, and warm unstable air that can rise rapidly. They can occur any time of the day and in all months of the year, but are most common during summer afternoons and evenings and in conjunction with frontal boundaries. The NWS classifies a thunderstorm as severe if it produces hail at least one inch in diameter, winds of 58 MPH or greater, or a tornado. (NOAA) Thunderstorms affect a smaller area compared with winter storms or hurricanes, but they can be dangerous and destructive for a number of reasons. Storms can form in less than 30 minutes, giving very little warning; they have the potential to produce lightning, hail, tornadoes, powerful straight-line winds, and heavy rains that produce flash flooding.

LOCATION

As noted in the Rhode Island Hazard Mitigation Plan, all areas of Rhode Island are vulnerable to severe thunderstorms and winds, especially those along the Atlantic coast in Washington and Newport counties (RIHMP 2019). Given that North Kingstown is located along the Atlantic Coast, it is more susceptible to severe thunderstorms and high winds.

EXTENT

The extent of high wind and thunderstorm impacts is variable based upon the specific characteristics of each property. Such characteristics include building construction, location, and nearby trees or other tall structures. These factors will have a large impact on how vulnerable an individual facility is to a lightning strike. A rough estimate of a structure's likelihood of being struck by lightning can be calculated using the structure's ground surface area, height, and striking distance between the downward-moving tip of the stepped leader and the object (RIHMP 2019). Logically, buildings are more likely to be struck by lightning if they are located on high ground or if they have tall projections such as steeples or poles. Similarly, electrical and communications utilities are also more vulnerable to direct lightning strikes. A consequence to strikes on these utilities is the potential to cause power and communications outages for businesses, residencies, and critical facilities (RIHMP 2019).

In a similar manner, a structure's vulnerability to hail is based upon construction as well as exposure. For example, siding and roofing made of metal can withstand the damages of a hailstorm better than other materials, however metal may also be more readily



damaged by denting from the hail. If a component of a structure is exposed, such as windows, they are also more susceptible to damage.

High winds are also a significant aspect of coastal storms and can have its most direct effect on coastal buildings. Wind speed can drop dramatically as one moves inland, falling 70 to 80 percent one-half mile to one mile inland (Planning for Post-Disaster Recovery and Reconstruction, 1998). Windblown debris broken free from buildings and trees can also be dangerous during a storm and are likely to accompany high winds. The Rhode Island State Building Code places North Kingstown in wind zone 2, which requires new constructions to be able to withstand winds up to 110 MPH. The previous design wind speed was 90 MPH. Flood proofing construction has been required in flood zones since the 1970's. Buildings constructed before these codes went into effect are potentially vulnerable to impacts from severe storm events.

PREVIOUS OCCURRENCES

Storms have brought thunder, wind and hail to North Kingstown on several occasions over several years.



Table 3: Rhode Island Historic Wind and Hail Incidents (1950-2017)

Date	Storm Event	Impacts
July 14, 1992	Thunderstorm and wind	Winds brought down trees in northern portions of town.
November 1, 1997	Strong wind	Many boats were reported blown off their moorings and minor coastal flooding occurred.
June 19, 1998	Severe Thunderstorm	Dime to nickel sized hail and damaging winds.
June 30, 1998	Severe Thunderstorm	Dime sized hail.
May 24, 2000	Severe Thunderstorm	Hail the size of nickels.
May 23, 2004	Severe Thunderstorm	Penny sized hail.
July 2, 2004	Severe Thunderstorm	Quarter sized hail.
March 5, 2008	Thunderstorm and wind	A warm front, a strong low pressure system and a potent low level jet combined to produce an assortment of weather. Thunderstorms produced severe damaging winds. Downed wires caused power outages.
July 18, 2006	Severe Thunderstorm	Thunderstorm winds brought down trees and large limbs. Power outages.
March 8, 2008	Strong Wind	Multiple trees were downed.
June 24, 2008	Severe Thunderstorm	Thunderstorms produced very heavy rain that resulted in flash flooding, hail, and damaging winds. Quarter to half dollar size hail was reported at the Quonset State Airport.
July 1, 2009	Severe Thunderstorm	Thunderstorms across southern New England. Plenty of moisture was in place across these areas, increasing the chance for heavy rain and flooding.
July 15, 2016	Thunderstorm and wind	Thunderstorms to develop during the afternoon. A few of these storms produced damaging winds. Trees and wires in Kiefer Park and Quonset Airport were downed.
July 22, 2016		A tree on Old Baptist Road was downed onto wires by thunderstorm winds.
September 6, 2017	Thunderstorm	Lightning Strike to a single family dwelling causing electrical fire.

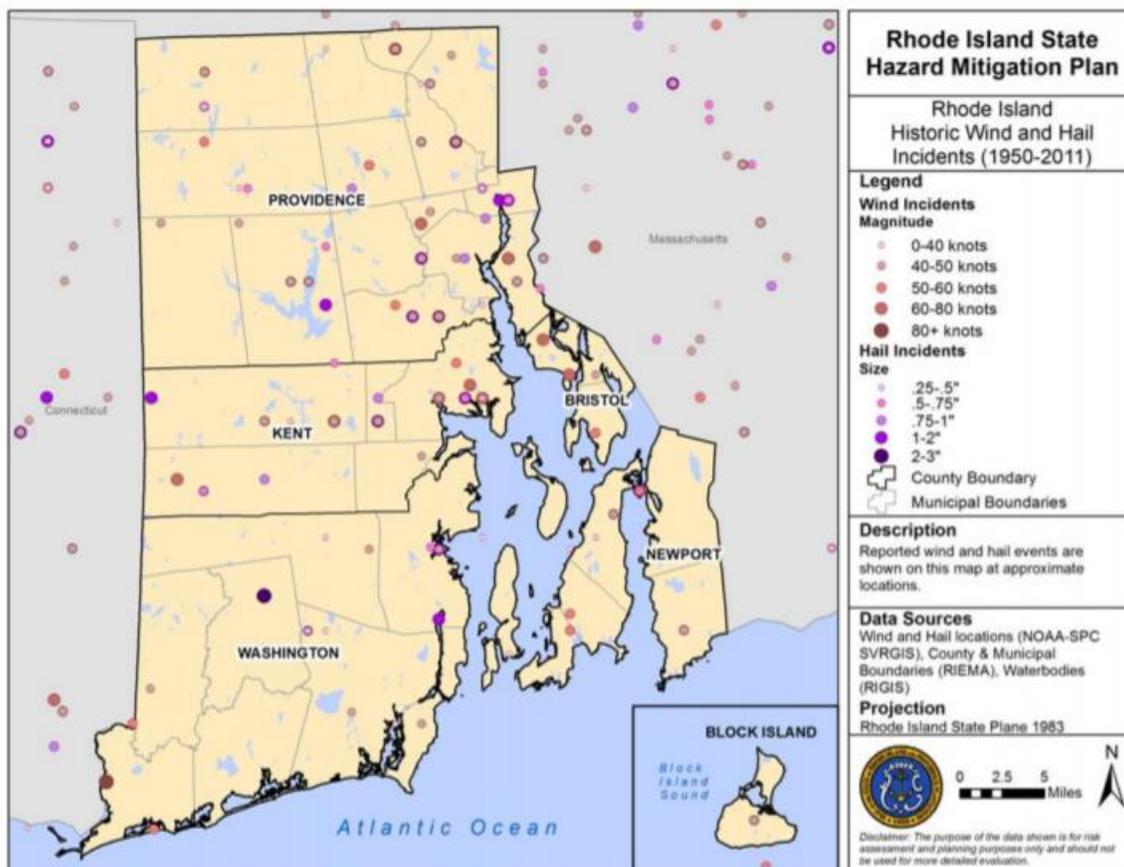


Figure 6: RI Historic Wind and Hail Incidents (Rhode Island Hazard Mitigation Plan 2019)

Table 4: Significant NCEI Hail, Lightning, and Wind Events (Rhode Island Hazard Mitigation Plan 2019)

Date	HIRA Type	County	Property Damage (Inflated to 2012 dollars)
12/23/1994	Wind	Statewide	\$7,746,053
8/5/1994	Lightning	Providence	\$774,605
8/24/1996	Wind	Washington	\$1,097,481
6/22/1997	Lightning	Kent	\$357,621
6/17/2001	Lightning	Providence	\$194,460
8/21/2004	Wind	Providence	\$607,710
10/28/2006	Wind	Kent	\$170,828
6/9/2011	Wind	Providence	\$255,173
6/25/2012	Lightning	Providence	\$150,000



PROBABILITY OF FUTURE EVENTS

The Rhode Island Hazard Mitigation Plan has utilized information on historical frequency of occurrence using NCEI data to determine a reasonable probability of future severe wind events. This data suggests that on an annual basis, approximately one (1) to four (4) wind events occur anywhere across Rhode Island. As a whole, Rhode Island may experience upwards of 12 events per year which can be related to a High probability of occurrence (RIHMP 2019).

Washington County has been determined to have a high thunderstorm ranking, with only Providence and Newport counties ranking higher. All facilities within North Kingstown are considered vulnerable to thunderstorms. As noted above, the location and construction of a facility plays a role in how it will be affected by lightning and hail incidents. If a structure is located on a hilltop, is tall or has other tall structures around it, or has large exposed windows, it may be damaged during a storm. Communications and power supplies may be compromised during thunderstorms, and some critical facilities might not be equipped with a backup power source. As the facilities datasets are expanded to include construction and value information, analysis to thunderstorms should be reconsidered.

4.3 Winter Related Hazards

Winter weather includes heavy snows, ice, and extreme cold and can affect the entire State. A heavy snow is generally defined as having more than eight (8) inches of accumulation in less than 24 hours. Heavy snow can bring a community to a standstill by inhibiting transportation, knocking down trees and utility lines, and by causing structural collapse in buildings not designed to withstand the weight of the snow. Repair and snow removal costs can be significant and surpass annual municipal salt and snow removal budgets, often before the end of the season. A winter storm warning is issued when snowfall is expected to accumulate more than four (4) inches in 12 hours and/or a quarter inch or more of freezing rain accumulation.

4.3.1 SNOW

DESCRIPTION

A heavy snow is generally defined as having more than eight (8) inches of accumulation in less than 24 hours (RIHMP 2019). A winter storm warning is issued when snowfall is expected to accumulate more than four (4) inches in 12 hours and/or a quarter inch or more of freezing rain accumulation.



Heavy snow can immobilize a community by bringing transportation to a halt. Until the snow can be removed, airports and roadways are impacted, even closed completely, stopping the flow of supplies and disrupting emergency and medical services. Accumulations of snow can cause roofs to collapse and knock down trees and power lines. A quick thaw after a heavy snow can cause substantial flooding, especially along small streams and in urban areas. The cost of snow removal, repairing damages, and the loss of business caused by power outages can have severe economic impacts on cities and towns. Injuries and deaths related to heavy snow usually occur as a result of vehicle accidents. Casualties also occur due to overexertion while shoveling snow and hypothermia caused by overexposure to the cold weather.

LOCATION

Heavy snow can have an impact on the entire State of Rhode Island but the greatest amounts of snow are found in the northern and northwestern areas of the state. As such, heavy snow can affect the entire town.

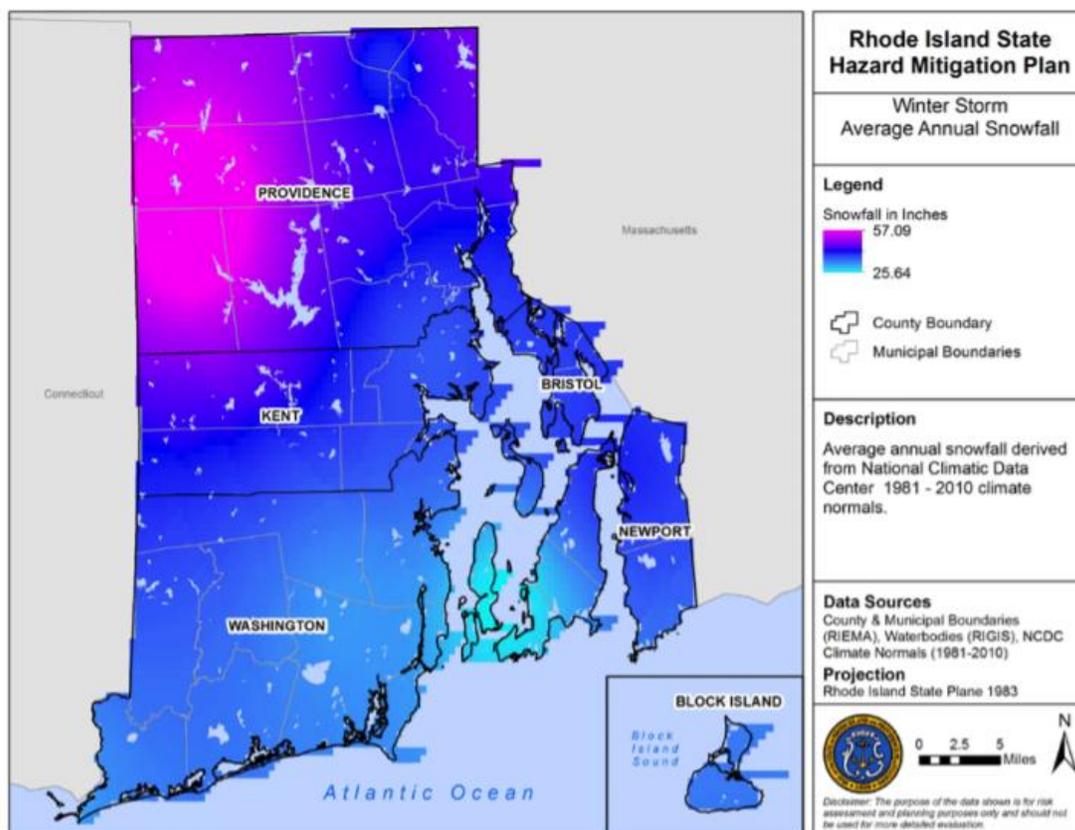


Figure 7: RI Winter Storm Average Annual Snowfall (Rhode Island Hazard Mitigation Plan 2019)



EXTENT

Costs associated with preparing for, responding to, and recovering from the winter storm event will determine the impact of a winter storm on the town. All parts of the town could be affected by severe winter weather including significant snow and ice accumulation. Buildings with flat roofs are especially vulnerable to collapse due to snow accumulation; and ice accumulation can bring down utility lines and damage forests. Business functions and activities can be disrupted by temporary loss of electricity and impassable roads. The largest loss of property value caused by a winter storm within the past decade was \$700,000 for all of Washington County (NCEI).

PREVIOUS OCCURRENCES

Average annual snowfall in North Kingstown is approximately 35.16 inches, which is 3.69 inches below the state average of 38.85 inches and 11.89 inches more than the national average. Although somewhat more variable in terms of distribution, northwest portions of Providence and Kent counties see these heavy snowfall events with greater frequency, roughly five (5) –six (6) events per year, compared to Washington County, which tends to have less than two (2) significant events per year. The heaviest snowfall generally occurs in the northern and northwest areas of the state.

Although generally outside of the extreme winter weather areas of the Northeast, Rhode Island is still subject to possible heavy winter weather events including significant snow and ice accumulation. Snow accumulation can cause serious damage to structures, especially those with flat roofs, and possibly cause roof collapse. The combination of ice and wind can bring down utility poles, leading to a variety of problems with communication and electricity loss. Snowmelt can lead to flooding well after the actual snowstorm has past.

Blizzards in 1906 and 1978, along with an ice storm in 1966 are remembered as some of the town's worst winter storms. In the 1978 blizzard some residents were without electricity for up to a week and many roads remained impassable for up to five days. The Blizzard of 2013 caused major power outages and dropped upwards of 3 feet of snow throughout areas of Rhode Island. The National Centers for Environmental Information storm events database contains records for severe winter storms that have struck Washington County, Rhode Island between 1996 and 2018. No deaths or injuries are reported. The table below details these storm events.



Snow

Average Annual Snowfall, #52



Figure 8: Average Annual North Kingstown Snowfall

A major disaster declaration (DR-4107) was declared on March 22, 2013 due to a severe winter storm and snowstorm in Washington county. Reports indicated that this storm stretched from New Jersey to Maine and into Canada. More than two (2) feet of snow fell in Rhode Island from Friday night to Saturday morning with extensive power outage throughout all of Washington Country.

An historic winter storm brought heavy snow to southern New England with blizzard conditions to much of Rhode Island Monday, January 26 until the early morning hours of Tuesday, January 27, 2015. The Blizzard of January 2015 produced very strong winds late Monday into Tuesday near the Massachusetts and Rhode Island coasts where gusts of 50 to 65 mph were common. The Governor of Rhode Island declared a statewide travel ban beginning at midnight on January 27th and continuing through 8 pm. President Obama issued a federal disaster declaration for the State of Rhode Island for this storm, allowing federal assistance for emergency work and repairs to facilities damaged by the storm (www.NCEI.noaa.gov/stormevents).

According to the NCEI there have been 71 winter weather related events in Washington County and Block Island between 1993 and 2018. The NCEI estimates are believed to be an underrepresentation of the actual losses experienced due to hazards as losses from events that go unreported or that are difficult to quantify are not likely to appear in the NCEI database. Based on past history and climatic conditions, there is a great probability that winter hazards will continue to occur and impact North Kingstown. Winter storms have had significant impacts on North Kingstown in the past and are likely to impact the Town in the future.



Table 5: Winter Storm Events

Date	Event	Impacts
January 7, 1996	Heavy Snow	Very heavy snowfall of one to two feet fell across the entire state. Roof collapses which damaged homes and businesses during the week following the storm.
February 2, 1996	Heavy Snow	8 inches of snow. Difficult travel conditions.
March 2, 1996	Heavy Snow	Most of the state received 6 to 11 inches of snow.
February 2, 1999	Heavy Snow	Heavy snow fall and school closings.
March 15, 1999	Heavy Snow	Heavy snow fall. The storm produced poor traveling conditions and shut down many schools and businesses.
February 7, 2003	Winter Storm	8 inches of snow fell in town.
February 17, 2003	Winter storm	Heavy snow and strong winds. 15 inches of snow fell in town.
December 5, 2003	Winter storm	A major winter storm brought heavy snow and strong winds. 16 inches of snow fell in town.
December 26, 2004	Winter storm	Powerful winter storm brought heavy snow and strong winds. 8 inches of snow fell in town.
December 19, 2008	Heavy Snow	Nine to ten inches of snow fell across Washington County.
December 19, 2009	Heavy Snow	Fifteen to twenty inches of snow fell in Washington County.
January 12, 2011	Heavy Snow	Ten to eleven inches of snow fell across Washington County.
January 26, 2011	Heavy Snow	Nine to eleven inches of snow fell across Washington County.
February 8, 2013	Blizzard	Historic winter storm. Very strong winds. Extensive power outages from downed trees and wires. Nineteen to twenty inches of snow fell across Washington County.
January 21, 2014	Heavy Snow	Heavy snow and strong winds Three to ten inches of snow fell across Washington County.
February 15, 2014	Heavy Snow	Strong winds and heavy snow. Six to nine inches of snow fell across Washington County.



January 26, 2015	Blizzard	Heavy snow to southern New England with blizzard conditions to much of Rhode Island.
February 14, 2015	Heavy Snow	Heavy snow. Five to nine inches of snow fell across Washington County.
March 5, 2015	Heavy Snow	Eight to twelve inches of snow fell across Washington County.
January 7, 2017	Winter Storm	Snow and wind. Eleven to sixteen inches of snow fell on Washington County.
February 9, 2017	Winter Storm	Strong winds and heavy snow. Six to thirteen inches fell on Washington County.
January 4, 2018	Winter Storm	Heavy snow and damaging winds. Eleven to fourteen inches of snow fell on Washington County.
March 12, 2018	Winter Storm	Seven to fifteen inches of snow fell on Washington County.

www.NCEI.noaa.gov/stormevents

PROBABILITY OF FUTURE EVENTS

Winter weather events in Rhode Island are unpredictable. A string of days with frigid air can be followed mild temperatures in the 40s or 50s. There can be both snow as well as rain events. Typically, a winter in Rhode Island will bring several nor'easters to the area. These events can cause coastal erosion, blizzard conditions or heavy rainstorms. Based on past history and climatic conditions, there is a great probability that winter hazards will continue to occur and impact RI. Using NCEI data, a reasonable determination of probability of future winter storm events can be made. Winter storms have had significant impacts on Rhode Island in the past and are likely to impact the state in the future (RIHMP 2019).

NCEI data suggests that on an annual basis, approximately two (2) to six (6) winter weather events of some significance occur in any particular county which can be related to a Medium-High to High probability of occurrence (RIHMP 2019).

4.3.2 ICE STORMS

DESCRIPTION

The term "ice storm" is used to describe occasions when damaging accumulations of ice are expected during freezing rain situations. Ice storms result from the accumulation of freezing rain, which is rain that becomes super-cooled and freezes upon impact with cold surfaces. Freezing rain most commonly occurs in a narrow band within a winter



storm that is also producing heavy amounts of snow and sleet in other locations. If extreme cold conditions are combined with low/no snow cover, the cold can better penetrate downward through the ground and potentially create problems for underground infrastructure as well. When utilities are affected and heaters do not work, water and sewer pipes can freeze and even rupture.

LOCATION

Ice storms can have an impact on the entire town.

EXTENT

Ice storms can be the most devastating of winter weather phenomena and are often the cause of automobile accidents, power and communication system outages, personal injury and death. Moreover, they can hinder the delivery of emergency services needed in response to these catastrophes and endanger the responders. Ice storms accompanied by wind gusts cause the most damage.

The greatest threat from ice storms is to essential utility and transportation systems, also known as lifelines. It coats power and communications lines, trees, highways, bridges and other paved surfaces. Ice-weighted wires, antennae, and structures holding them can break and collapse. Downed trees and limbs can also damage lines and block transportation routes. Both pedestrians and automobiles are at risk.

PREVIOUS OCCURRENCES

Ice storms are typically part of larger winter storm events noted above. These winter storms often bring with them ice along with the snow and wind.

PROBABILITY OF FUTURE EVENTS

As noted above, based on past history and climatic conditions, there is a great probability that winter hazards will continue to occur and impact RI. Using NCEI data, a reasonable determination of probability of future winter storm events can be made. Winter storms have had significant impacts on Rhode Island in the past and are likely to impact the state in the future (RIHMP 2019). This includes the likelihood of winter ice storms.

4.3.3 EXTREME COLD

DESCRIPTION

The greatest danger from extreme cold is to people. Prolonged exposure to the cold can



cause frostbite or hypothermia and become life threatening. The risk of hypothermia due to exposure greatly increases during episodes of extreme cold. Infants and elderly people are most susceptible. Certain medications, medical conditions or the consumption of alcohol can also make people more susceptible to the cold. House fires and carbon monoxide poisoning are also possible as people use supplemental heating devices

Excessive cold may accompany winter storms, be left in their wake, or can occur without storm activity. Extreme cold can lead to hypothermia and frostbite, which are both serious medical conditions. What is considered an excessively cold temperature varies according to the normal climate of a region. In areas unaccustomed to winter weather, near freezing temperatures are considered “extreme cold.” In Rhode Island, extreme cold usually involves temperatures below zero degrees Fahrenheit.

The wind chill index attempts to quantify the cooling effect of wind with the actual outside air temperature to determine a wind chill temperature that represents how cold people and animals feel, based on the rate of heat loss from exposed skin. A wind chill index of -5 indicates that the effects of wind and temperature on exposed flesh are the same as if the air temperature alone were five (5) degrees below zero (0), even though the actual temperature could be much higher. The NWS issues a wind chill advisory when wind chill temperatures are potentially hazardous and a wind chill warning when the situation can be life-threatening.

LOCATION

Extreme cold can have an impact on the entire town.

EXTENT

As noted above, the impact of a winter storm and extreme cold is primarily measured in terms of the financial costs associated with preparing for, responding to, and recovering from the event.

PREVIOUS OCCURRENCES

As noted above, ice storms are typically part of larger winter storm events.

PROBABILITY OF FUTURE EVENTS

As noted above, based on past history and climatic conditions, there is a great probability that winter hazards will continue to occur and impact RI. Using NCEI data, a reasonable determination of probability of future winter storm events can be made. Winter storms have had significant impacts on Rhode Island in the past and are likely to



impact the state in the future (RIHMP 2019). This includes the likelihood of winter ice storms.

4.4 FLOOD RELATED HAZARDS

“Floods are among the worst frequent and costly natural disasters in terms of human hardship and economic loss. Seventy –five percent of federal disaster declarations are related to flooding. “(www.riema.ri.gov) It is oftentimes the direct result of other weather events such as snow melt combined with heavy rains, nor’easters, tropical rainstorms or hurricanes. The State Hazard Mitigation Plan, 2019 categorizes flood events into six categories. The following have impacts on North Kingstown: riverine, coastal, flash, storm surge, urban flooding, climate change and sea level rise, coastal erosion and dam breaches and each is defined below as per the SHMP.

A flood, which can be slow or fast rising but generally develops over a period of days, is defined by the NFIP as:

- A general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties from: overflow of inland or tidal waters; unusual and rapid accumulation or runoff of surface waters from any source; or a mudflow; or
- The collapse or subsidence of land along the shore of a lake or similar body of water as a result of erosion or undermining caused by waves or currents of water exceeding anticipated cyclical levels that result in a flood as defined above. By their very nature, floodplains are the low, flat, periodically flooded lands adjacent to rivers, lakes and oceans and subject to geo-morphic (land-shaping) and hydrologic (water flow) processes. It is only during and after major flood events that the connections between a river and its floodplain become more apparent. These areas form a complex physical and biological system that not only supports a variety of natural resources but also provides natural flood and erosion control. In addition, the floodplain represents a natural filtering system, with water percolating back into the ground and replenishing groundwater. When a river is divorced from its floodplain with levees and other flood control structures then natural benefits are either lost, altered, or significantly reduced.

PROBABILITY OF FUTURE EVENTS

NOAA has determined that there are three (3) times of the year where the potential of flood activity is the greatest:



- Late winter/spring melt;
- Late summer/early fall; and
- Early winter.

Flooding in general is often a result of the occurrence of other natural hazards such as hurricanes and tropical storm systems, winter and coastal storms, ice jams, dam failures, and severe precipitation events (RIHMP 2019). For riverine flooding, severe precipitation events, ice jams and dam failures will certainly cause or certainly exacerbate the flooding event. Rhode Island has historically experienced all these other natural hazards at one time or another and can expect to experience them in the future.

4.4.1 RIVERINE FLOODING

DESCRIPTION

Riverine flooding is a function of precipitation levels (both rain and snow) and water runoff volumes within the stream or river. Riverine flooding is defined as the periodic occurrence of over bank flows of rivers or streams resulting in partial or complete inundation of the adjacent floodplain. The recurrence interval of a flood is defined as the average time interval, in years, expected to take place between the occurrence of a flood of a particular magnitude to an equal or larger flood. Flood magnitude increases with increasing recurrence interval. When land next to or within the floodplain is developed, these cyclical floods can become costly and dangerous events.

LOCATION

The Pawcatuck River and tributaries run west to east through the southern reaches of the State including portions North Kingstown. While there is limited development in these areas, during significant flood events flooding damages do occur (RIHMP 2019).

EXTENT

People and property are extremely vulnerable to all types of flooding, causing damage to their homes and businesses. In addition, floodwaters can carry chemicals, sewage, and toxins from roads, factories, and farms and as such contaminate properties with these hazardous materials. The floodwaters can also carry debris from vegetation and man-made structures and create a hazard both during and after a flood. Floods may also threaten water supplies and water quality and lead to power outages. Regarding riverine flooding, the areas largely affected are those bordering rivers and are impacted by large discharges caused by heavy rainfall over upstream areas.



PREVIOUS OCCURRENCES

In March of 2010, five to ten inches of rain fell across Washington County resulting in rises in rivers and streams in North Kingstown. Numerous roads were flooded disrupting transportation for residents, employees, and emergency response personnel in town. A mudslide washed onto two rail tracks near Routes 403 and 4, disrupting rail service throughout Rhode Island. Some town roads, such as Featherbed Lane were washed out from the flooding and were closed for a considerable duration for repairs. Additionally, the flooding rendered a town well pump station out of service for several months following the event.

4.4.2 FLASH FLOODING

DESCRIPTION

A flash flood is the fastest-moving type of flood. It happens when heavy rain collects in a stream or gully, turning the normally calm area into an instant rushing current. Any flood involves water rising and overflowing its normal path. A flash flood is a specific type of flood that appears and moves quickly across the land, with little warning making it very dangerous.

Flash floods are the result of heavy rainfall concentrated over one area. Most flash flooding is caused by slow-moving thunderstorms, thunderstorms that repeatedly move over the same area, or heavy rains from hurricanes and tropical storms. Dam failures can create the most damaging flash flood events. When a dam or levee breaks, a large quantity of water is suddenly let loose downstream, destroying anything in its path. Flash flood waters move at very fast speeds. They have the power to move boulders, tear out trees, destroy buildings, and obliterate bridges. Walls of water can reach heights of 10' to 20', and generally carry a huge amount of debris with them. The best response to any signs of flash flooding is to move immediately and quickly to higher ground.

LOCATION

Inland areas of town are most at risk from flash flooding caused by intense rainfall over short periods of time.

EXTENT

Similar to location, the extent of the impact of flash flooding is on inland areas of town. They are most at risk from flash flooding when intense rain falls over short periods of time.



PREVIOUS OCCURRENCES

On February 18, 1998, there was a storm event that brought heavy rainfall, isolated flash floods, and thunderstorms to Rhode Island. North Kingstown received 2.7 inches of rainfall during this event. There were few other noted flash flood events.

4.4.3 URBAN/ STORMWATER FLOODING

DESCRIPTION

Urban flooding occurs where there has been development within stream floodplains. This is partly a result of the use of waterways for transportation purposes in earlier times. Sites adjacent to rivers and coastal inlets provided convenient places to ship and receive commodities. Floodways and wetlands which are the natural storage basins for flood waters were filled to accommodate development. The price of this accessibility to the rivers was increased flooding of the ensuing urban areas. Urbanization increases the magnitude and frequency of floods by increasing impermeable surfaces, increasing the speed of drainage collection, reducing the carrying capacity of the land and, occasionally, overwhelming sewer systems. The large amounts of impervious surfaces in urban areas can increase runoff amounts and decrease the time between when the rain event occurs and when the streams start to flood.

Rhode Island's stormwater infrastructure is undersized for today's storms by 25% to 30% (UNH Stormwater Center). The most common cause of urban flooding is due to poor or insufficient storm water drainage, high groundwater levels, and high percentage of impervious surfaces which prevent groundwater recharge. More often than not, when heavy rains occur, Rhode Island's aging sewer systems (or combined sewer overflows –CSOs) are overrun and this results in raw sewage flowing into Narragansett Bay, often creating Bay closures to shell fishing and swimming.

LOCATION

Areas with higher amounts of impervious surface and poor drainage are more vulnerable to urban/stormwater flooding. Such areas in North Kingstown include Post Road/Route 1 and Quaker Lane/Route 2. In addition, as part of the CRS program, the town has identified problematic drainage areas that may also be more susceptible to urban/stormwater flooding.



TOWN OF NORTH KINGSTOWN
PROBLEMATIC DRAINAGE AREAS

NORTH

DATE	STREET NAME	DESCRIPTION	CHECKED		NOTES
			BY		
	Fletcher@Signal Rock	catch basin at intersection			
	Pine River Drive	outfall behind #135			
	Edmond Drive				
	Austin Road	by the bridge			
	Austin Road	@ Austin Meadows			
	Forge Road	by the bridge			
	Forge@North Quidnessett	intersection			
	640 North Quidnessett	RT hand side of driveway			
	Old Baptist Road	Basin by Blais Farm			
	Old Baptist Road	Basin @ Midway			
	Evergreen Road	4 Basins			
	Chaucer Drive				
	Dana Drive	#137			
	School Street	opposite Hancock "West"			
	Potowamut	by the bridge			
	Potowamut	on the bridge			
	Highbank	opposite Allen			
	Lake Drive	at end by school			
	Old Mill Lane	DBL basins on RT hand side set off the road			
	Sachem Road	2 @ dead end			
	Yorktown Park	basin across the street			

In addition, the following roads in the southern section of town have also experienced poor drainage: Stillman Road, Plum Point Road, Walmsley Lane, River Road, Tomahawk Circle, Oak Hill Road, and Village Hill, Terre Mar Drive, Duck Cove Road, and Laurel Ridge.

EXTENT

Areas with higher amounts of impervious surface and poor drainage are more vulnerable to urban/stormwater flooding. Large amounts of impervious surfaces in urban areas can increase runoff amounts and decrease the time between when the rain event occurs and when the streams start to flood. Manmade channels may also constrict stream flow and increase flow velocities.



PREVIOUS OCCURRENCES

On October 28, 2006, significant urban flooding was reported in North Kingstown. The storm brought damaging winds to much of central and southern Rhode Island and included downed trees and power lines.

On March 2, 2007, low pressure over the mid-Atlantic states strengthened as it tracked over southeast New England. Snow quickly changed to heavy rain as the storm reached Rhode Island, when milder air was drawn into the region. Rainfall totals of 2 to 3 inches caused widespread urban and small stream flooding. Route 2 in North Kingstown was closed due to flooding, as well as West Allenton Road.

4.4.4 COASTAL FLOODING

DESCRIPTION

Coastal flooding is typically a result of storm surge and wind-driven waves, which erode the coastline. These conditions are produced by hurricanes (tropical storms) during the summer and fall, and nor'easters and other large coastal storms (extra-tropical storms) during the fall, winter, and spring. Storm surges may overrun barrier islands and push seawater up coastal rivers and inlets, blocking the downstream flow of inland runoff. Thousands of acres of crops and forest lands may be inundated by both saltwater and freshwater. Escape routes, particularly from barrier islands, may be cut off quickly, stranding residents in flooded areas and hampering rescue efforts.

Coastal floods are the most common type of natural disaster for North Kingstown. Flooding during a hurricane can be caused by heavy rains and storm surge tides that rise from the sea up to 25 ft. higher than the normal high-water level. North Kingstown has land area in the A, AE, VE, and X Flood Hazard zones as designated by FEMA. The "A" and "AE" zones are classified as zones where properties have a 1 % chance of flooding in any year and a 26 % chance of flooding over the life of a 30-year mortgage. "VE" zones indicate that properties have a 1 % chance of flooding in any year and also face hazards associated with coastal storm waves. "X" zones are subject to a 500-year flood. These properties are outside the high-risk zones; therefore, the risk is reduced, but not removed. These properties are in an area of overall lower risk.

LOCATION

The entire coastline of North Kingstown is vulnerable to coastal flooding. These areas coincide with the FEMA designated flood zones as designated on the Nation Flood Insurance Rate (NFIP) maps. The flood zones are determined based on the elevation of the land and indicate areas that would be flooded in the event of heavy rains.



Development, including simply paving, can increase the height and extent of flooding due to the loss of ground permeability.

Locations in North Kingstown that are vulnerable to inundation from the sea are indicated on Map 3 as hurricane surge inundation areas. Locations that are vulnerable to flooding due to heavy rain events are indicated as flood zones on Maps 3, 4 and 5.

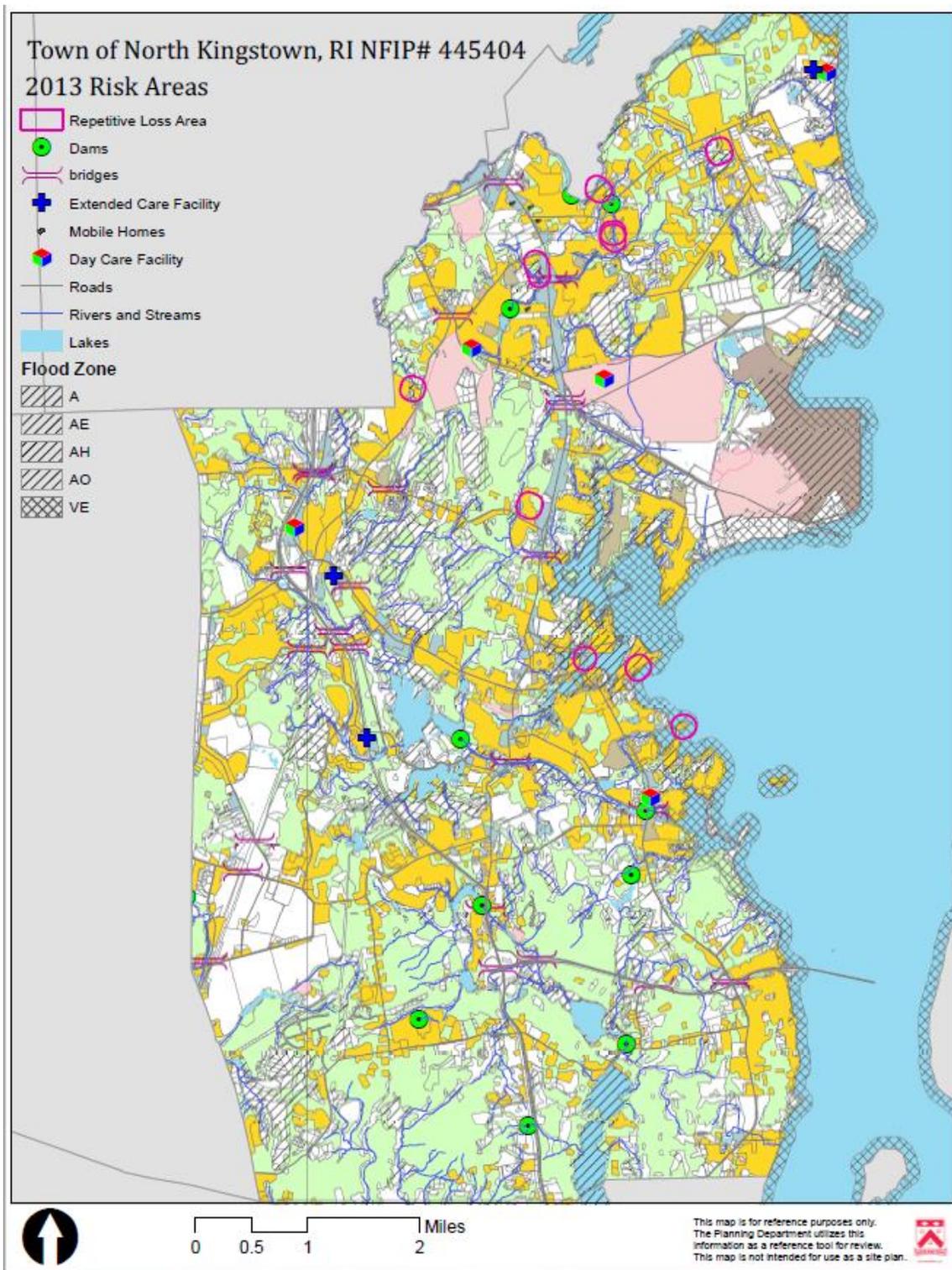
EXTENT

The major extent of a hurricane or coastal storm hitting North Kingstown would come from inundation of the flood zones and storm surge areas.

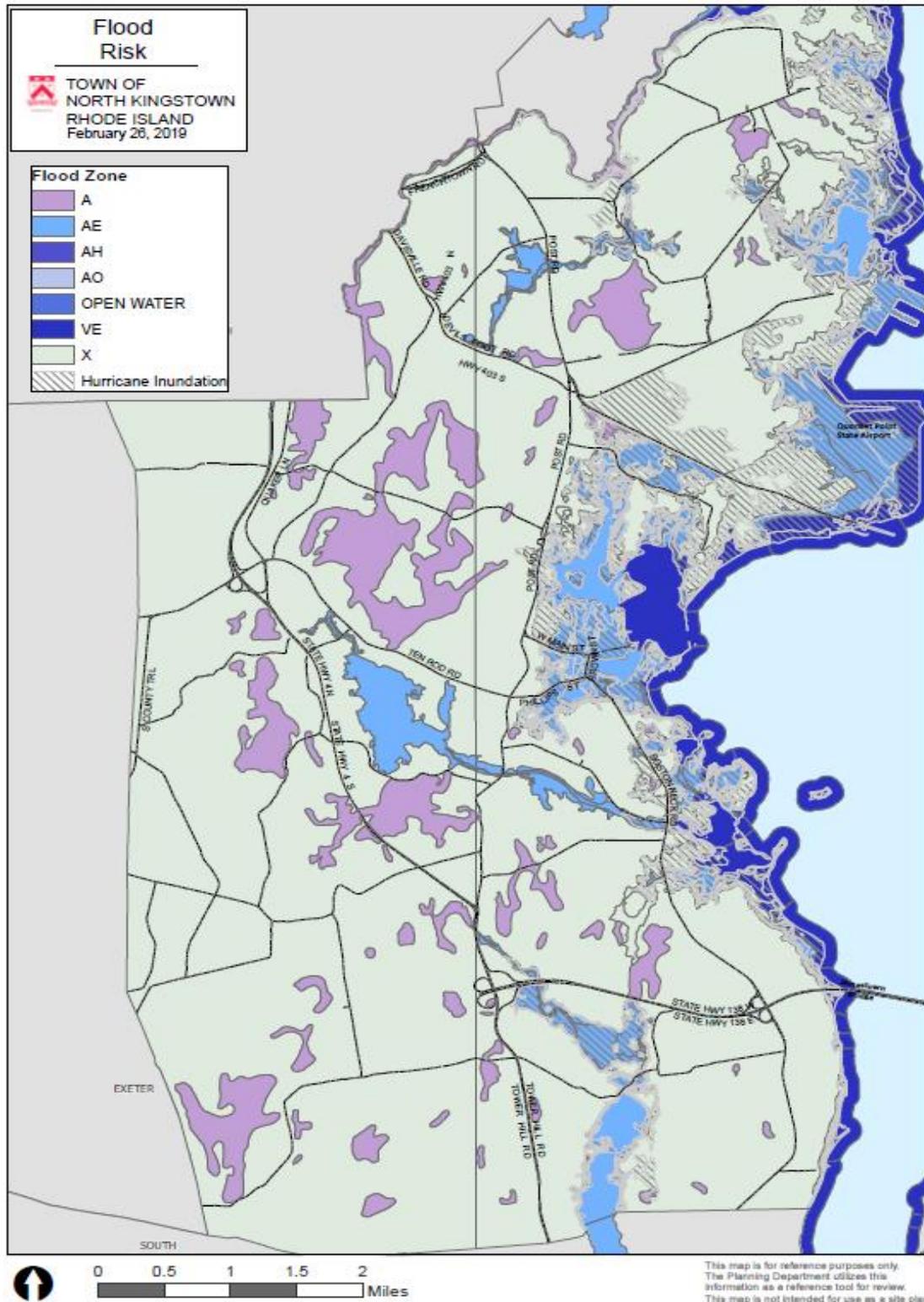
PREVIOUS OCCURRENCES

On October 29, 2012, Superstorm Sandy, a hybrid storm with both tropical and extra-tropical characteristics, brought high winds and coastal flooding to southern New England. The very large waves on top of the storm surge caused destructive coastal flooding along stretches of the Rhode Island exposed south coast. It also brought a 4-foot storm surge to Narragansett Bay and flooded downtown Wickford Village across the Brown Street bridge. Major coastal flooding struck those areas of Rhode Island located on the exposed south coast during the evening high tide. These water levels, along with historic markers illustrating that Wickford Village and other neighborhoods along North Kingstown's coastline, are exposed and vulnerable to coastal storm surge forces. Adding projected sea level rise data to storm surge models shows that many properties within Wickford Village, including the historic district, will be inundated by 2100 with 2 daily tides.

On February 9, 2016, a very powerful low-pressure system tracked up the east coast, passing southeast of Southern New England. This storm brought heavy snow and gusty winds. Earle Drive was flooded, nearly cutting off access to the peninsula.



Map 4: Risk Areas in North Kingstown (North Kingstown Planning Department)



Map 5: Known Flood Hazards in North Kingstown (North Kingstown Planning Department)



4.4.5 SEA LEVEL RISE & CLIMATE CHANGE

DESCRIPTION

Sea level is related to the level of the continental crust. Relative sea level changes can thus be caused by absolute changes of the sea level and/or by absolute movements of the continental crust. Sea level presents a hazard that should be considered in long-term land use, development, and critical infrastructure planning. North Kingstown has large exposure to the potential impacts of sea level rise with approximately 30 miles of shoreline and its many inlets, coves, marshlands of Narragansett Bay, coastal residential neighborhoods, public beaches, parklands and public access points. Climate change, including the continued increase in global temperature, is projected to result in an acceleration of observed rates of sea level rise.

The Rhode Island Coastal Resources Management Council has adopted the NOAA high curve for use in future planning and coastal permitting. Current projections for sea level rise according to NOAA's 2017 report, "Global and Regional Sea Level Rise Scenarios for the United States" are approximately:

- 1 foot by 2020
- 3 feet by 2050
- 5 feet by 2070
- 7 feet by 2085

Since 1930 (NOAA, *Tides & Currents website*), sea levels recorded on the Newport tide gauge in Narragansett Bay have increased approximately 10 inches and the rate of sea level rise is accelerating. Projections in increases in sea level by 2100 in North Kingstown due to climate change range from three to five feet. Although

SLR is a gradual process, impacts may be experienced in the short term. Some examples include increased frequency of low-level inundation, exacerbated flood elevations during storm events, increased rates of coastal erosion, and increased saltwater intrusion into groundwater.

Changes in storm intensity and frequency, precipitation levels, and rising sea levels have been attributed to a changing climate. Because climate research and data are evolving rapidly, the state is following several federal sources to keep up with new information and ensure Rhode Island state agencies and municipal governments are using the best available science in decision making. For example, NOAA's National Climate Assessment was last updated in 2014 and is scheduled for a new update in 2018; in early 2017, NOAA released a new report, "Global and Regional Sea Level Rise Scenarios for the United States," that increased the sea level rise projections at the Newport tide gauge for 2100 from 7-feet to 9-feet. Parcels along North Kingstown's coastline, especially within Wickford Village, are currently inundated with sea water several times each year with extreme high tides following the lunar cycle. Tidal "sunny day" flooding on the Brown Street parking lot in Wickford illustrates

Sea levels have increased approximately 10 inches since 1930.

CRMC predicts over the 20-year period of this Comprehensive Plan, sea levels are projected to rise 1-2 feet, relative to 2010 levels.

Evacuation routes in Wickford will be exposed to inundation at 3-feet of sea level rise, relative to 2010 levels.



the changes the state of Rhode Island is experiencing across its 400-miles of coastline (North Kingstown Comprehensive Plan Re-Write 2019).

When considering the potential exposure of municipal infrastructure in North Kingstown to projected sea level rise, only the Town Hall Annex in Wickford Village falls within the 5-foot sea level rise scenario. For a coastal storm scenario, municipal structures including the Town Hall Annex, Town Hall, Senior Center, Community Center, Quonset Fire Station, and the Quonset Wastewater Treatment Facility are vulnerable to inundation.

In the case of the municipal water supply, it is important to note that all 11 municipal wells that supply potable water lie outside of defined and projected coastal hazard areas. While there is no documented threat of salt water intrusion to the municipal potable water supply system, residential properties with private well systems along the North Kingstown coastline and salt marshes may be vulnerable to salt water intrusion of their individual water supply. More study and research on this is needed, and is being identified by the RI Coastal Resources Management Council as an area of future research as part of its Shoreline Change Special Area Management Plan (SAMP) (North Kingstown Comprehensive Plan Re-Write 2019).

LOCATION

The coastal areas of North Kingstown are most vulnerable to impacts from sea level rise.

EXTENT

Sea level rise can have an impact on many sectors of North Kingstown. The *Adaptation to Natural Hazards & Climate Change North Kingstown* completed by the URI Coastal Resources Center established the following list of sectors vulnerable to sea level rise across town:

Land Use	Open Space, Recreation, and Public Access
Transportation and Circulation	Vulnerable Populations
Building Stock	Greenhouse Gas Reduction
Municipal Properties and Facilities	Utilities and Other Infrastructure
Emergency Management Facilities	Communications
Wastewater	Municipal Operations
Stormwater	
Drinking Water	
Groundwater	
Wetlands	
Historic and Cultural Resources	
Contaminated Sites	



Sea level rise primarily impacts many of the coastal area of town in which there are a mix of residences, business uses, and public facilities. Wickford Village and the Quonset Business Park, both within the “VE” and “AE” zones are particularly vulnerable to sea level rise. It cannot be understated the impact sea level rise will inevitably have on wetlands, which are critically important for flood control and habitat viability.

PREVIOUS OCCURRENCES

In recent years it has been noted that in periods of extreme annual high tides and “moon tide” periods that properties have been susceptible to flooding. This is very visible in North Kingstown’s municipal parking lot located off Brown Street in Wickford Village behind the Town Hall Annex office building. During these extreme high tide events this parking lot floods with sea water as a result of water flowing into the lot up through the storm drain in the middle of the lot. This severely limits the public use of this area during periods of high tides causing parking and access issues for all. This is not only true at this location, but also throughout a large portion of the coastal areas of the town, especially the coastal neighborhoods.

The Rhode Island Coastal Resources Management Council (CRMC) adopted its Climate Change and Sea Level Rise policy as part of Section 145 of the R.I. Coastal Resources Management Plan (RICRMP) in January 2008. The policy specifies that the CRMC is proactively planning for sea level rise and climate change impacts, as well as integrating this information into decision-making.

Tide gauge observations in Newport indicate a rate of 10.8 inches (27.4 cm) of relative sea level rise over the last century or 2.74 mm per year (NOAA Tide Gauge Data for Newport, RI:

http://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?stnid=8452660). As taken from the *Adaptation to Natural Hazards and Climate Change North Kingstown*, the findings within Section 145 indicate that, based on historic observations, sea level has already risen nearly 10 inches at the Newport, R.I. tide station since 1930 and that the rate of sea-level rise is accelerating. CRMC has stated that the rate of rise during the past 20 years is 25% faster than the rate of rise in any other 20-year period recorded in Newport (Adaptation to Natural Hazards and Climate Change 2015).

Historic sea level rise and annual SLR rates, Rhode Island and global average

	Historic sea level rise	Annual rate of SLR	Annual rate – recent acceleration
Rhode Island	10 in (0.25 m) <i>(1930 to 2017)</i>	0.11 in (2.75 mm)/yr <i>(1930 to 2017)</i>	0.16 inches (3.98 mm)/yr <i>(1986-2017)</i>
Global average	7.48 inches (0.19 m) <i>(1901 to 2010)</i>	0.07 inches (1.7 mm)/yr <i>(1901 to 2010)</i>	0.12 inches (3.1mm)/yr <i>(1993-2017)</i>

Source: RI Shoreline Change SAMP 2018



As a result of increasing sea level, CRMC findings state:

- There will be wide-scale changes in both terrestrial and marine environments that will result in ecosystem shifts and present major challenges to natural resource managers;
- Coastal populations will be displaced and infrastructure threatened;
- Residential and commercial structures, roads and bridges will become more susceptible to flooding;
- Existing sea walls and revetments will be less effective; and
- Salt water intrusion may impact drinking water supplies, and higher water tables may compromise wastewater treatment systems and impact storm water dynamics.

From a coastal zone management perspective, perhaps no other factor associated with climate change is more problematic than sea-level rise and its impacts along the coastline. Through the policies enacted by the CRMC in Section 145 of the RICRMP and the comprehensive planning effort underway through their Shoreline Change Special Area Management Plan (see Section 2.5), the state's coastal administrator is making climate change and sea-level rise planning priorities.

NORTH KINGSTOWN CAPABILITY

In 2011 the Town of North Kingstown collaborated with Rhode Island Sea Grant College Program (RISG) at the University of Rhode Island on a pilot project to map assets of the town vulnerable to sea level rise. Sea level rise is an increasingly important consideration for hazard mitigation as it relates to flooding and the impacts of severe storms in coastal areas. RISG has a long-term commitment to understanding climate change impacts on sea level rise, flooding and erosion, and the resulting economic, social and environmental implications. The Town of North Kingstown is fortunate to have these innovative mapping resources available as a result of this pilot project. This is a 3 phase project with a brief synopsis of what is included within each phase below.

Phase I had a goal of creating maps and on-line data display tools to identify sea level rise vulnerabilities of local assets including public property and infrastructure, as well as community threats in North Kingstown. Phase I produced a set of maps for the town illustrating sea level rise scenarios over the digital elevation model and an aerial photograph using a "bathtub model" approach to show the projected boundaries of two high tides per day on the municipal landscape. The map atlas, "Mapping Assets Vulnerable to Sea Level Rise in North Kingstown" includes two sets of maps: (1) Real Property and (2) Facilities/ Infrastructure. Each map depicts related assets vulnerable to various inundation scenarios.



Inundation Zones

-  Mean Higher High Water (MHHW)
-  MHHW plus 1' Sea Level Rise (SLR)
-  MHHW plus 3' SLR
-  MHHW plus 1' SLR and 3' Storm Surge
-  MHHW plus 5' SLR
-  Hurricane of 1938 Surge Height

Property Type

-  Structure Location
-  Flooded Structure
-  Flooded Parcel

Map Date: 2011-06-13

These include Mean Higher High Water, (MHHW) plus 1-foot sea level rise, MHHW plus 1 foot sea level rise and 3 foot storm surge assets of the town vulnerable to sea level rise. The mapping also included evacuation routes, emergency shelters, public safety buildings, bridges, sewer lines, culverts and dams throughout town. These maps can be viewed in Appendix F.

In 2012, the RI Statewide Planning Program funded a pilot project to explore the vulnerability of municipal assets, adaptation strategies, and possible implementation techniques that could be applied in Rhode Island's coastal municipalities in the face of changing coastal conditions. Since sea level rise projection data was newly available from NOAA, and a proof-of-concept sea level rise mapping effort was completed for North Kingstown under Phase I, the pilot project focused explicitly on sea level rise scenarios of 1-, 3-, and 5- feet of sea level rise across North Kingstown's coastline.

The resulting report, *Adaptation to Natural Hazards and Climate Change in North Kingstown*, presented over 100 adaptation strategies across 18 municipal sectors, including land use, transportation, building stock, municipal properties, and community facilities, among others. The Phase II objectives are as follows:

- Develop collaboratively with North Kingstown and the state a comprehensive community plan element to address climate change adaptation as it relates to transportation and land use issues;
- Prepare with the town and the state a detailed listing of priority transportation and land use projects that support the climate change adaptation effort and are appropriate for inclusion in the state Transportation Improvement Program (TIP) and municipal Capital Improvement Program (CIP).

The Phase II report evaluates 12 distinct neighborhood study areas in North Kingstown for their exposure to the three sea level rise scenarios, and presents maps for each neighborhood illustrating the sea level rise extent of inundation across the landscape, as well as the individual parcels that will be exposed by each scenario. Property values for parcels in each neighborhood as well as linear feet of roadways that will be inundated were calculated for the three sea level rise scenarios.



Preliminary vulnerability assessment results show that, for sea level rise scenarios of 1-foot, 3-feet, and 5-feet, the number of parcels exposed to sea water along all 26 miles of the North Kingstown coastline range from almost 500 parcels under the 1-foot scenario to over 1,000 parcels in the 5-foot scenario.¹⁰ The numbers at the top right corner of Figures 61-64 convey the number of parcels exposed to each scenario for the entire coastline of North Kingstown, the total property value of those parcels, linear feet (miles) of roadways exposed, and the number of structures projected to be exposed to each of the three sea level scenarios.

Wickford Village is illustrated as an example in the following figures because, of the 12 neighborhood study areas identified in the 2015 report by the URI Coastal Resources Center, Wickford's commercial business district and its historic district were determined to have the most exposed assets when compared to all neighborhoods along North Kingstown's coastline. In the following figures, note that the [!] and [!!] indicate that West Main Road and Phillips Street are projected to be inundated with sea water under these scenarios, thus presenting barriers to ingress and egress in Wickford Village and the neighboring historic district. (North Kingstown Comprehensive Plan Re-Write, 2019).

Phase 3 of this project will begin as part of a grant funded project with URI and the US Department of Interior. This will include designing implementation strategies and measures in town for the mitigation and adaption of climate change, flooding impacts and sea level rise (<http://www.seagrant.gso.uri.edu>).

As part of this project, a Climate Change Adaptation Fact Sheet has been developed. This fact sheet provides an overview of the project, highlights the three phases of the project and lists various ways to get involved.

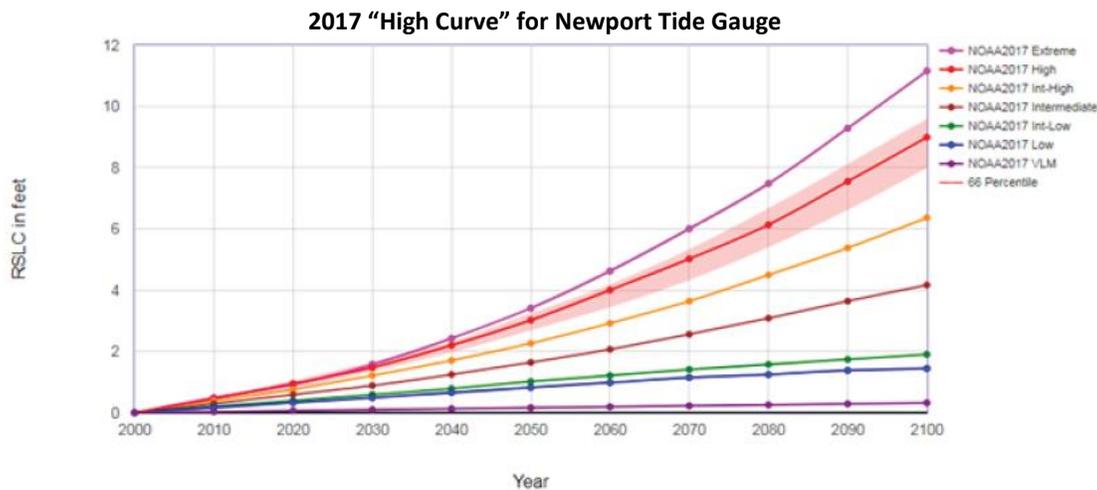


Figure 9: Historic and Projected Sea Level Rise (North Kingstown Comprehensive Plan Re-Write)

PROBABILITY OF FUTURE EVENTS

The future probability of impacts for SLR for North Kingstown is very high as recent research has indicated with Newport and Washington counties representing the largest portion of inundation areas within the state. It is anticipated that with a foundation of data from these pilot projects that North Kingstown decision makers can begin to assess vulnerability and prioritize risks to sea level rise and increased storminess into future plans, including the Hazard Mitigation Plan updates.

NOAA’s 2017 “high curve” projections for Newport, Rhode Island suggest that by 2100 sea levels may rise as much as 10 feet above 1990 levels (U.S. Army Corps of Engineers and NOAA Sea Level Rise Curves <http://www.corpsclimate.us/ccaceslcurves.cfm>). Ultimately, the rate and extent of sea-level rise in Rhode Island will be determined by global changes in temperature and the extent of glacial melting. While the future projections for sea-level rise for Rhode Island are continually refined based on new scientific evidence, it is our understanding that the CRMC will be adapting its policies to reflect the best available information (Adaptation to Natural Hazards and Climate Change 2015).

Sea level rise projections for Rhode Island

	2030	2050	2080	2100
NOAA 2017 projections based on “high curve”	1.67 feet (83% CI)	3.25 feet (83% CI)	6.69 feet (83% CI)	9.6 feet (83% CI)

Source: RI Shoreline Change SAMP 2018

As sea level rises, both hurricanes and Nor'easters will have a more severe impact and the effects of flooding will be felt even further inland. In addition, storm surge and wave



heights will increase, damaging more properties during a storm and impacting inland properties that have never before experienced flood damage before. Frequent tidal inundation of coastal properties, roadways and parking lots is already an issue especially experienced in Wickford. As sea level rises, even more areas will be affected by high tides on a daily basis (RI Shoreline Change SAMP 2018).

4.4.6 COASTAL EROSION

DESCRIPTION

Coastal zones are dynamic areas that are constantly undergoing change in response to a multitude of factors, including SLR, wave and current patterns, hurricanes, coastal flooding and human influences. High winds and associated marine flooding from storm events such as hurricanes, nor'easters, flooding and SLR, all increase the risk exposure along developed coastal lands. Storm impacts and long-term erosion threatens developed areas with potential loss of life and billions of dollars in property damage. In addition to the natural processes that cause erosion, human alterations are affecting erosion rates. As shorelines retreat inland, waterfront homes, public infrastructure such as roads, bridges, wastewater treatment facilities, and stormwater drainage systems, eventually become severely damaged (RIHMP 2019). In addition, as the rate of sea level increases, Rhode Island shorelines are eroding and coastal properties and public infrastructure are becoming more and more vulnerable (Coastal Erosion and Adaptation on the Rhode Island Coastline 2013).

LOCATION

The entire coastline of North Kingstown is vulnerable to coastal erosion.

EXTENT

The vulnerability of North Kingstown's shoreline areas to coastal erosion increases as manmade structures are built along the shoreline, impeding the natural, dynamic system of the beach (RIHMP 2019).

PREVIOUS OCCURRENCES

In addition to wind and flooding, erosion is a hazard that can threaten life and property during a coastal storm. The Coastal Resources Management Program has documented shoreline change and average erosion rates. The location with the most severe erosion in North Kingstown is the Narragansett Bay shoreline from Pojac Point to just north of the Mount View neighborhood. This area is considered to be a "Category A" critical erosion area (CRMC), and is eroding at an average rate of 2.2 ft. annually. Development in this area must be set back at least 75ft. from a coastal feature, or 150 ft. in the case of



Figure 11: Shoreline Change 1939-2014 – North Kingstown Town Beach

http://www.crmc.ri.gov/maps/shorechange/North_Kingstown_Wickford_Harbor.pdf

The Rhode Island shoreline is naturally eroding and migrating over time. A recent USGS study showed that 84% of measured coastal transects between South Dartmouth Massachusetts and Napatree Point, Rhode Island are erosional (USGS, 2010). Erosion typically occurs during short term storm events such as hurricanes and Nor'easters. Long term erosion rates have been measured and are available to the public through Shoreline Change maps (http://www.crmc.state.ri.us/maps/maps_shorechange.html). The Rhode Island shoreline is migrating landward as a result of sea level rise and local factors such as fetch, wave energy, and other shoreline dynamics. This has impacted coastal natural resources such as salt marshes that have nowhere to migrate and are being lost (Coastal Erosion and Adaptation on the Rhode Island Coastline 2013).

PROBABILITY OF FUTURE EVENTS

To address challenges from a changing shoreline, the R.I. Shoreline Change Special Area Management Plan (Beach SAMP <https://www.beachsamp.org/>) is focused on improving our understanding of how fast erosion is occurring and what areas and infrastructure are at risk of flooding during storms or from future sea level rise. This plan will improve state policies to better address the impacts of shoreline change. North Kingstown's current Shoreline Change Maps

(http://www.crmc.ri.gov/maps/maps_shorechange.html) were last updated in 2003.

Due to the recent storm frequency, coastal communities in Rhode Island, including North Kingstown have been experiencing greater erosion rates than present day



shoreline change maps suggest. CRMC plans to update these maps as part of the Beach Shoreline Change Special Area Management Plan (SAMP) process to allow for more accurate future predictions.

4.4.7 DAM BREACH

DESCRIPTION

Dam failures can result from natural events, human-induced events, or a combination of the two (2). Failures due to natural events such as prolonged periods of rainfall and flooding can result in overtopping, which is the most common cause of dam failure. Overtopping occurs when a dam's spillway capacity is exceeded and portions of the dam which are not designed to convey flow begin to pass water, erode away, and ultimately fail. Other causes of dam failure include design flaws, foundation failure, internal soil erosion, inadequate maintenance, or mis-operation. Complete failure occurs if internal erosion or overtopping results in a complete structural breach, releasing a high-velocity wall of debris-laden water that rushes downstream, damaging or destroying everything in its path. An additional hazard concern is the cascading effect of one dam failure causing multiple dam failures downstream due to the sudden release of flow.

While dam failures that occur during flood events compound an already tenuous situation and are certainly problematic, the dam failures that occur on dry days are the most dangerous. These "dry day" dam failures typically occur without warning, and downstream property owners and others in the vicinity are more vulnerable to being unexpectedly caught in life threatening situations than failures during predicted flood events.

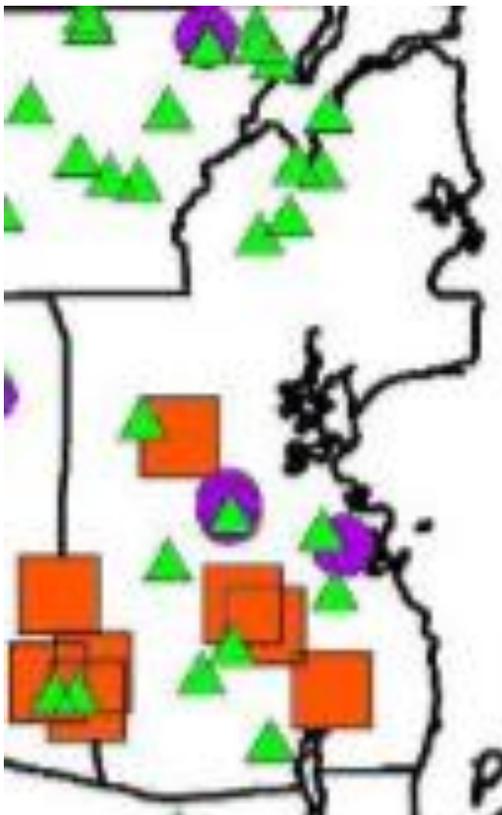
As noted in the RIHMP, two factors influence the severity of a dam failure: the amount of water impounded, and the density, type, and value of development and infrastructure located downstream. The potential severity of a dam failure may be classified for each dam according to its hazard potential. This hazard potential addresses the likely impact that would occur if the structure failed in terms of loss of human life and economic loss or environmental damage (RIHMP 2019).

Dams are classified by size and hazard ratings. The size classification provides a relative description of small, medium, or large, based on the storage capacity and height of the impounded water. The hazard classification relates to the probable consequences of failure or improper operation of the dam; however, it does not relate to the current condition or the likelihood of failure of the dam. The hazard classifications are defined in the Rhode Island Dam Safety Regulations as follows:



Strategy for Reducing Risks from Natural Hazards in North Kingstown, RI

- **High Hazard** – means a dam where failure or mis-operation will result in a probable loss of human life.
- **Significant Hazard** – means a dam where failure or mis-operation results in no probable loss of human life but can cause major economic loss, disruption of lifeline facilities, or impact other concerns detrimental to the public's health, safety, or welfare.
- **Low Hazard** – means a dam where failure or mis-operation results in no probable loss of human life and low economic losses. Intense storms may produce a flood in a few hours or even minutes for upstream locations. Flash floods occur within six (6) hours of the beginning of heavy rainfall, and dam failure may occur within hours of the first signs of breaching. Other failures and breaches can take much longer to occur, from days to weeks, as a result of debris jams or the accumulation of melting snow.



North Kingstown has a total of 22 dams as per the 2018 DEM inventory. Of these, 6 are high hazard: 3 are significant hazard: and 13 are low hazard:

HAZARD

- High
- Significant
- ▲ Low

Figure 12: Dams in North Kingstown

<http://www.dem.ri.gov/programs/benviron/compinsp/pdf/damrpt18.pdf>



Table 6: RIDEM 2018 Dam Safety Annual Report - North Kingstown

STATE ID	RIVER/STREAM	DAM NAME	HAZARD
439	PETTAQUAMSCUTT RIVER-TRIB	MAYO FARM POND	LOW
444	MATTATUXET RIVER	SILVER SPRING LAKE	HIGH
471	WANNACHECOME CUT BROOK	WERTZ + VIAL POND	LOW
497	MATTATUXET RIVER - TRIB	BALD HILL NURSERY POND	LOW
513	MATTATUXET RIVER	CARR POND	HIGH
536	DUCK COVE BROOK-TRIB	MILL POND	LOW
550	ANNAQUATUCKET RIVER	HAMILTON RESERVOIR	SIGNIFICANT
551	POTOWOMUT RIVER	POTOWOMUT POND	LOW
552	SAND HILL BROOK	TAYLOR POND	LOW
553	ANNAQUATUCKET RIVER	BELLEVILLE POND	SIGNIFICANT
569	SAND HILL BROOK	DAVISVILLE MILL POND	LOW
615	ANNAQUATUCKET RIVER	RODMAN MILL	HIGH
693	CHIPUXET RIVER-TRIB	SLOCUM WOODS	HIGH
703	SAND HILL BROOK	SANDHILL	LOW
704	ANNAQUATUCKET RIVER-TRIB	SECRET LAKE	SIGNIFICANT
705	ANNAQUATUCKET RIVER-TRIB	SECRET LAKE LOWER	LOW
706	ANNAQUATUCKET RIVER	SIERSTORPFF	LOW
708	MATTATUXET RIVER	SHADY LEA MILL	HIGH
709	ANNAQUATUCKET RIVER-TRIB	KETTLE HOLE	LOW
710	CHIPUXET RIVER-TRIB	SLOCUM ROAD UPPER	HIGH
712	SILVER SPRING LAKE-TRIB	PENDAR ROAD	LOW
767	SODCO		LOW

PREVIOUS OCCURRENCES

During 2018, the DEM addressed 60 dams with unsafe or potentially unsafe conditions. By the end of 2018, the safety issues at three of these dams were properly addressed and the dam was considered to be in compliance. One of these dams assessed is in North Kingstown, Dam No. 444, the Silver Spring Dam. There is high vegetation around the dam prohibiting inspection and vegetation affecting the spillway flow. Discussions



are ongoing to address the unsafe conditions. (RIDEM Annual Report to the Governor on the Activities of the DAM SAFETY PROGRAM, 2018).

Featherbed Lane Dam was closed following the historic March 2010 floods, with more than 9 inches of rain that caused unprecedented flooding which damaged the dam and road, prompting town officials to close it to traffic. Design plans to repair the dam and roadway were approved by Town Council in March 2012. GZA Engineering reported on the current state of the dam and indicated that the culvert, which channels the water, was in a “state of collapse” and there are sinkholes under the roadway.

The proposal to repair included opening the road to traffic, widen the spillway by 15 feet and remove sediment from the spillway channel. It also required the installation of stop logs so that the town could lower them in the event of a major storm. This allowed for a “controlled topping” of the dam, which allows water to flow over the roadway after it is temporarily closed for traffic. The price tag ranged from \$434,000 with just pedestrian access to \$551,000 with vehicular access. The Featherbed Lane dam was repaired in 2014 and the road re-opened.

PROBABILITY OF FUTURE EVENTS

The probability of future dam failure events is related to the probability of future major flood events along with what preventative measures each community is utilizing to maintain the structure. Such preventative measures include routine inspection, maintenance, repair, and proper operation of dams as regulated by the Rhode Island dam safety program (RIHMP 2019).

As shown below, while there is a medium low hazard ranking and risk parameter associated with dams in Washington County, there is still risk for future dam breaches in North Kingstown. Past flooding events in the Town have spotlighted a need for removing aging and obsolete dams in the North Kingstown to eliminate flood risk. Removing these dams would also address human safety and liability concerns. Priority should be given to those Dams in high hazard areas, with regular inspections to all dams to keep an up to date data base.

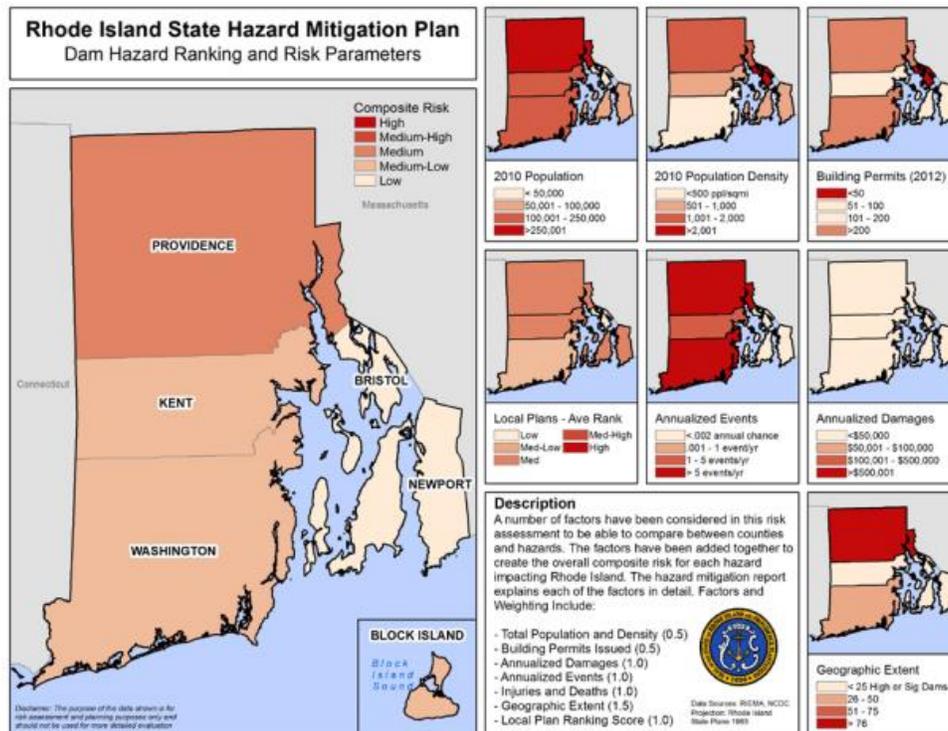


Figure 13: NCEI Dam Breach Hazard Ranking (Rhode Island Hazard Mitigation Plan 2019)

The RIDEM has designated the Rodman Mill and Slocum Upper dams as unsafe. In addition, the RIDEM has also designated two additional dams in North Kingstown as unsafe or potentially unsafe, but has not been able to issue enforcement actions because the owners have not been determined. Those two dams are numbers 550 in the Hamilton area and 704 in the Secret Lake area.

As stipulated Rhode Island General Laws Section 46-19-9, the RIEMA has approved Emergency Action Plans for the following dams in North Kingstown:

- #444 Silver Spring Pond (High Hazard)
- #513 Carr Pond (High Hazard)
- #550 Hamilton (Significant Hazard)
- #553 Belleville Pond (Significant Hazard)
- #615 Rodman Mill (High Hazard)
- #693 Slocum Woods (High Hazard)
- #704 Secret Lake (Significant Hazard)
- #708 Shady Lea Mill (High Hazard)
- #710 Slocum Road Upper (High Hazard)



4.5 GEOLOGICAL RELATED HAZARDS

4.5.1 EARTHQUAKE

DESCRIPTION

An earthquake is an abrupt release of accumulated strain on the Earth’s tectonic plates occurring along a fault line. Damage in an earthquake stems from ground motion, surface faulting, and ground failure in which weak or unstable soils, such as those composed primarily of saturated sand or silts, liquefy. The effects of an earthquake are mitigated by distance and ground materials between the epicenter and a given location (Planning for Post-Disaster Recovery and Reconstruction, 1998). An earthquake in New England affects a much wider area than a similar earthquake in California due to New England’s solid bedrock geology (NESEC).

Earthquakes are measured using the Richter Scale. The Richter Scale measures the magnitude of an earthquake, assigning a number from 0 to 10, as measured on a seismograph. The scale is a logarithmic scale which means that an earthquake that measures 2 on the Richter scale is 10 times as powerful as an earthquake that measures 1.

10	EXTRAORDINARY
9	OUTSTANDING
8	FAR-REACHING
7	HIGH
6	NOTEWORTHY
5	INTERMEDIATE
4	MODERATE
3	MINOR
2	LOW
1	INSIGNIFICANT

Figure 14: Richter Scale

LOCATION

According to the RI Hazard Mitigation Plan, Rhode Island is located in the North Atlantic tectonic plate and is in a region of historically low seismicity. Only three or four earthquakes of significance have been centered in Rhode Island, including the 1951 South Kingstown earthquake of magnitude 4.6 on the Richter scale. There have been earthquakes in the past centered in Narragansett Bay. (RIHMP 2019).



EXTENT

According to the US Geological Survey website the seismic hazard for Rhode Island is 2-4% (peak acceleration). While there is a low probability of an earthquake occurring in Rhode Island, it is not an impossible event. There have, in fact, been 15 earthquakes since 1928 with one in June 1951 registering a 4.6 on the Richter scale centered in Kingston. Narragansett Bay is considered a regional hot spot for earthquake activity, with many of the past quakes occurring in the bay or its immediate vicinity.

The buildings most vulnerable to earthquake damage are those built before 1976, when State Building Codes began requiring greater earthquake resistance. Masonry buildings are especially vulnerable, as well as structures located on deep or unconsolidated soils. Because North Kingstown's peak ground acceleration is approximately 3.6%, with a 10% chance of exceedance in 50 years (U.S. Geological Survey), an earthquake with enough intensity to cause damage would be unlikely.

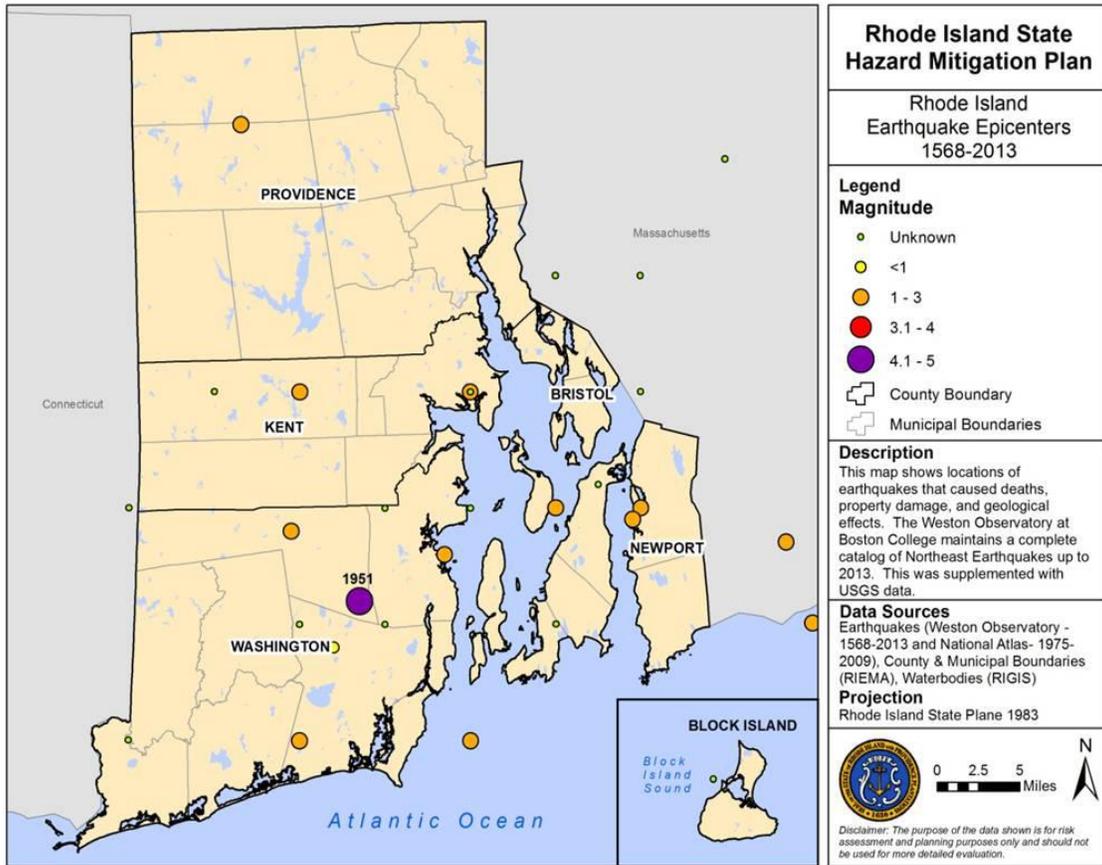
Since 1976, State Building Code has required that new buildings and major reconstructions be designed to withstand earthquakes measuring up to 3.0 on the Richter scale. Therefore, buildings built before 1976 may be particularly vulnerable to earthquakes of that scale. Old masonry buildings and large structures are most vulnerable to earthquake damage. Bridges, dams, and roadways are also susceptible to damage in the event of an earthquake.

PREVIOUS OCCURRENCES

Throughout 2016, a total of 34 felt earthquakes have been centered in Rhode Island since the first known shock on August 25, 1776. Of these felt earthquakes, only one caused some slight damage (<http://nsec.org/rhode-island-earthquakes>). As noted above, in 1951, an earthquake that measured 4.6 on the Richter Scale was measured in Kingston, RI. Earthquakes, mostly with a magnitude of < 3.0, do occur in a large frequency within the Northeast United States. The Northeast States Emergency Consortium notes that from 1538 to 1989 1,215 earthquakes occurred in New England (<http://nsec.org/hazards/earthquakes.cfm>).

Table 7: Earthquakes in RI 1766-2016 (<http://nsec.org/rhode-island-earthquakes/>)

State	Year of Earthquake Records	Number of Felt Earthquakes
Rhode Island	1766-2016	34



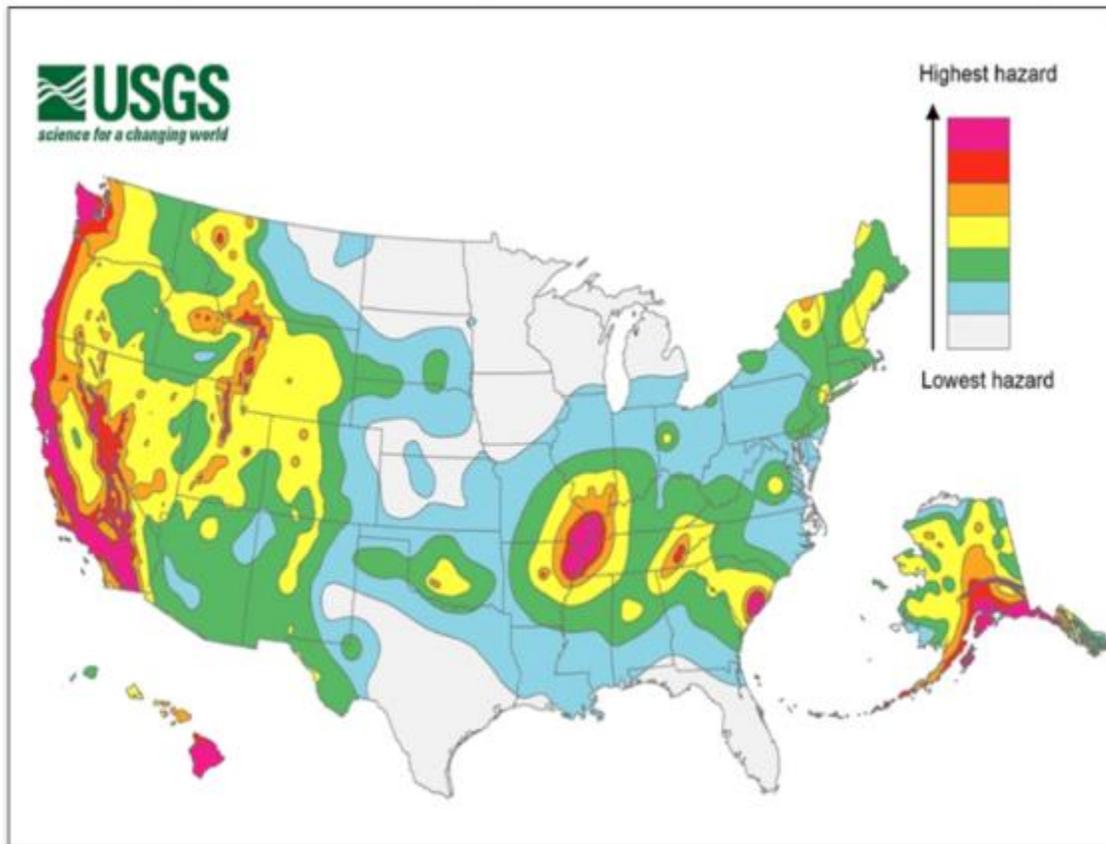
Map 6: Earthquake Epicenters near Rhode Island (1568 – 2013) Source: Weston earthquake center

FUTURE PROBABILITY

Because of Rhode Island’s low seismic level, there is a general opinion that the state has very little risk of sustaining any earthquake induced damage.



USGS Seismic Hazard Map



Map 7: USGS Seismic Hazards Map (<http://nesec.org/earthquakes-hazards/>)

Despite the low probability of a high impact earthquake, physical characteristics in Rhode Island may increase earthquake vulnerability:

1. Hard Rock: Given New England's geological composition of base rock, seismic energy is conducted on a greater scale (four to ten times) that of an equivalent Richter magnitude earthquake in California.
2. Soft Soil: Coastal regions of New England are mainly made up of soft soils. These soils can magnify an earthquake as much as two times.
3. Structures: The New England region has an abundance of older, unreinforced masonry structures that are inherently brittle and very vulnerable to seismic forces.
4. Low Public Awareness of Vulnerability: There is a minimal perceived threat of an earthquake occurring in Rhode Island. In addition, there is a lack of an established system for educating or informing the public regarding earthquakes or a process as to how to prepare for or respond during an earthquake. As such, higher losses will occur here than in other regions of the country (RIHMP 2019).



4.6 ADDITIONAL HAZARDS

4.6.1 WILDFIRE

DESCRIPTION

A wildfire is an unplanned fire sparked by natural causes, by human ignition or by an escaped prescribed fire (<https://www.livescience.com/63458-wildfires.html>). Wildfires are fueled by natural cover, including trees, brush, grasses, and crops. Wildfires can also be intensified by certain weather conditions and the topography of the area. Unfortunately, in most cases, wildfires are caused by a person's purposeful or accidental misuse of fire.

LOCATION

Forests cover more than half of Rhode Island's land area and these woodlands are increasingly being developed. As human development gets closer to the undeveloped forested areas, fire can move readily between developed areas and the vegetated areas that provide the fuel for these wildfires.

As shown below, there are a few forested blocks in North Kingstown that represent the highest risk for these wildfires.



Map 8: Natural Habitats in North Kingstown (North Kingstown Comprehensive Plan Re-Write 2019)

EXTENT

The extent of wildfire is influenced by a variety of factors, such as land cover conditions, weather, and the effectiveness of land management techniques (RIHMP 2019).

While fire is now known to have an important regenerative role in many ecosystems, many factors, natural and manmade, can combine to create devastating natural disasters far beyond the effects of natural wildfire processes. Drought conditions, coupled with a build-up of dead underbrush and other kindling can lead to a fire, with the presence of a spark. Such a situation is especially dangerous when there are a number of homes present in forested areas, as is the case in parts of North Kingstown. The forested areas in North Kingstown are in close proximity to residential areas at their perimeter.



Firefighters use different and often incompatible methods when fighting wildfires as opposed to home fires. In addition, the presence of homes precludes the ability to conduct controlled burns in order to keep the amount of kindling low and mitigate large-scale wildfires. Access to both the site and to a water source is another important issue that can affect how intense and potentially damaging a wildfire can be. (*Planning for Post-Disaster Recovery and Reconstruction, 1998*).

PAST OCCURRENCES

As of 2005, almost 50 percent of North Kingstown's total acreage was forested. While this percentage has fluctuated over time, there have been very few wildfire occurrences in the town and none of these have caused great amounts of damage or burned on a large, uncontrolled scale. The two largest fires in North Kingstown's recent history occurred in 1968 and 1974 in the Slocum area. Sparks from the adjacent railroad tracks lit both of these fires, which burned in an area exceeding 500 and 300 acres respectively. Currently, North Kingstown is considered to be in a low fire danger class (*U.S. Forest Service, 2004*), and a recent state wide analysis prepared by the Rhode Island Department of Environmental Management Division of the Forest Environment concluded that, based on land cover, North Kingstown has a low risk of wildfire.

FUTURE PROBABILITY

Using historical NCEI records, it can be estimated that Rhode Island will experience one wildland type or natural vegetation fire event every 10 years or a 10 percent occurrence annually (RIHMP 2019). Because North Kingstown's land cover places it in a low fire danger class, it is unlikely that a fire would burn out of control and cause significant damage; Since the previous plan was adopted, a new fire station was constructed in Slocum in accordance with the comprehensive plan's objective to relocate one of the town's fire stations to better serve this portion of town.

4.6.2 DROUGHT & EXTREME HEAT

DROUGHT

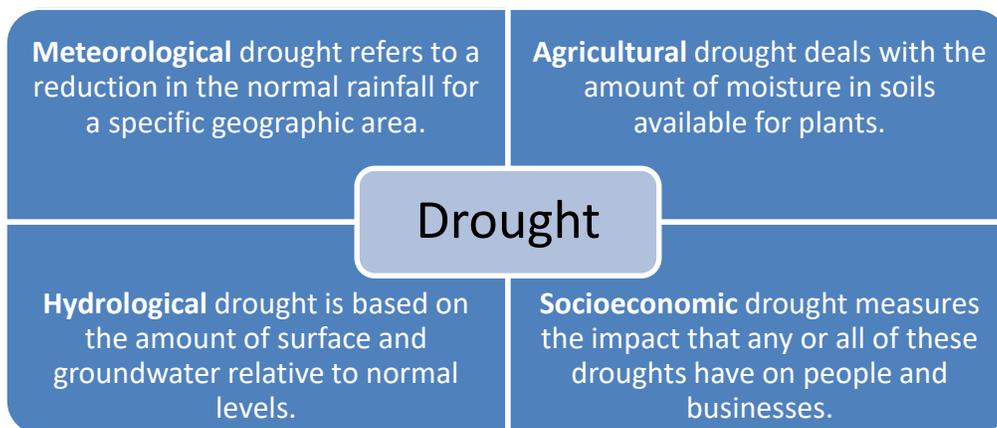
DESCRIPTION

Drought can be generally defined as a period of drier than normal conditions over a large area, which, in some manner, reduces water levels. Droughts are different from other natural hazards in that they do not consist of a short, easily defined event such as a hurricane or an earthquake, but instead they gradually appear, last for a time period, and then gradually return to normal. Drought conditions can last for weeks, months, even years. Droughts can have serious economic, social and environmental effects on an area. Crops and livestock can be lost, industries can lose productivity, and wildlife



habitat can be destroyed. Cumulatively these effects can easily equal the cost of a severe hurricane or other natural disaster. As aquifer levels are drawn down, seawater can be drawn into wells located near the coast (*RI Drought Management Plan, 2002*).

Four methods are used to define the severity of drought: meteorological, hydrological, agricultural, and socioeconomic. (RIHMP 2019).



Drought is difficult to quantify given that the characteristics and impacts of each type of drought vary in many ways. An existing index called the Palmer Drought Severity Index (PDSI) uses temperature and precipitation levels to determine dryness. The PDSI measures a departure from the normal rainfall in a given area. The advantage of the PDSI is that it is standardized to local climate, so it can be applied to any part of the country to demonstrate relative drought or rainfall conditions. A monthly PDSI value below -2.0 indicates moderate drought, and a value below -3.0 indicates severe drought (RIHMP 2019). The RI Drought Steering Committee assigns drought levels, for the seven (7) designated drought regions in the state, based on hydrological indices such as precipitation, groundwater, stream flow, and the PDI as well as local supply indices such as static groundwater levels and reservoir levels. North Kingstown is in the Southern Region. The Normal, Advisory, and Watch levels are issued statewide. The Warning and Emergency levels are issued on a regional basis and consider local conditions, source of water supply, and water storage capacity issues (RIHMP 2019).

Palmer Drought Severity Index	
Severity	Index
Extreme Drought	-4 or less
Severe Drought	-4 to -3
Moderate Drought	-2 to -1
Mild Drought	-2 to -1
Incipient Dry Spell	-1 to -0.5



Hydrologic Drought Indices

Generally, when three of the four major hydrologic indices reach a designated threshold, a corresponding drought phase is assigned. Please refer to the table, Hydrologic Drought Indices and Phases below. The four major indices are: the Palmer Drought Index, precipitation, ground water and stream flow. Precipitation, groundwater and surface water are evaluated in terms of departure from normal. Normal is defined as the statistical average of the data for the period of record.

Palmer Drought Index (PDI): PDI is an index that reflects soil moisture and weather conditions, including temperature. It is compiled by the National Weather Service and the National Climatic Data Center.

Crop Moisture Index (CMI): CMI is an index that reflects short-term soil moisture conditions, particularly as it pertains to agriculture. The agricultural sector is usually the first to be affected because of its heavy dependence on stored soil water, which can be rapidly depleted in extended dry periods.

Precipitation: Precipitation data is collected by the National Weather Service at eight data points and reported by county. A drought phase determination is based on conditions relative to normal in three, six, and twelve-month intervals.

Ground Water Levels: Ground water levels are monitored by the US Geological Survey from 38 observation wells. A drought phase determination is based on the number of months ground water levels are below normal (lowest 25% of period of record). Local water suppliers also monitor public wells in order to make seasonal water availability comparisons.

Stream Flow: Stream flow conditions are monitored by the US Geological Survey from 21 near-real-time stations with 30 or more years of record. A drought phase determination is based on the number of months that stream flow levels are below normal compared to historical trend data.

Surface Water Reservoir Levels: Reservoir data is typically reported by water suppliers, relative to normal conditions or percent "full". A drought phase determination considers historic monthly averages of small, medium, and large index reservoirs.

Source: RI Water Resources Board

LOCATION

Previous drought events in RI have affected the entire state. As is the case in North Kingstown, most of Southern Rhode Island relies on extensive groundwater aquifers for water supply. Precipitation levels vary widely from region to region and from year to year. In Rhode Island, the average yearly precipitation is 41 to 47 inches. A drought becomes apparent after a period of time over which there are lower than normal precipitation levels. Stream and river flow is reduced, lake and reservoir levels fall, and groundwater is found at increasingly lower depths. As water availability becomes increasingly scarce, water use prioritization becomes necessary. Rhode Island is considered at risk to short-term droughts, which often occur in the summer months and long-term droughts, which on average appear once every eleven years. Droughts in Rhode Island most often begin with an abnormally dry winter (*RI Drought Management Plan, 2002*).



EXTENT

A drought in North Kingstown would primarily be felt in the form of lost income to agricultural and tourist industries, damage to wildlife habitat, increased risk of wild fires, and well salinization and residents would also be affected by water use restrictions. Demand Management, System management, Integration of water and wastewater planner and policy, legislative and regulatory considerations are important to the future prevention of droughts.

PREVIOUS OCCURRENCES

There have been at least seven (7) major droughts in Rhode Island since 1929 including a long-term drought in the mid-sixties and seasonal droughts in the summers of 1999 and 2002 (*RI Drought Management Plan, 2002*). During the 1999 drought many shallow wells in the state dried up. During summer of 2002 Rhode Island experienced increasing levels of drought as water levels dropped and water use restrictions were enacted all over the state. www.drought.gov/drought/states/rhode-island

Table 8: Historical Droughts (RI Hazard Mitigation Plan 2019 and NOAA)

Date	Area Affected	Conditions
1930-31	Statewide	Estimated stream flow about 70% normal
1941-45	Statewide	Estimated stream flow about 70% normal
1949-50	Statewide	Estimated stream flow about 70% normal
1963-67	Statewide	Water restrictions and well replacements common
1980-81	Statewide	Considerable crop damage in 1980
1987-88	Southern RI	Crop damage, \$25 million
2012	Statewide	January 1 - April 15: precipitation levels were six to eight inches below normal across Rhode Island.

The U.S. Drought Monitor declared severe drought over Washington County from April 12 through April 24. This was deemed a meteorological drought due to precipitation levels approximately one half of normal.

PROBABILITY OF FUTURE OCCURRENCES

Currently, North Kingstown has mid-range hydrological conditions, meaning that it is not significantly drier or more moist than normal. The current town water plan predicts a rise in water use as the town's population increases. This increase in water use may lead to greater problems during drought conditions in the future. Additionally, climate change studies suggest that higher summer temperatures will likely increase drought, especially since precipitation is not expected to increase in summer. The Town has



adopted numerous strategies to reduce the use of water for non-essential uses such as watering restrictions in the months of July and August to include a twice a week lawn watering program, an inkling block rate price structure, and most recently a major reduction in size to the Town's water service area. This will substantially reduce the maximum build out requirements of the water system. The Water Department alerts, notifies and provides awareness through constant updates in "The Puddle" to its residents regarding water issues.

The Town recently adopted changes to the Town's water service area to direct future development to where infrastructure is available, particularly to those areas in town that are planned for future growth. The town worked with our consultants to determine the impacts, positive or negative to the proposed changes in the Water Service Area. This was a key step to work towards making water available for economic development and growth in identified villages and growth areas.

EXTREME HEAT

DESCRIPTION

The National Weather Service will issue advisories or warnings when the heat index is expected to have a significant impact on public safety. The common guidelines for the issuance of excessive heat warnings is when the maximum daytime index is expected to reach 105, and the nighttime low temperature does not fall below 75 or 80 degrees (www.weather.gov).

LOCATION

Extreme heat can affect all of North Kingstown as well as other portions of southern New England.

EXTENT

Unusually hot days are becoming much more common. Prolonged periods of these unusually hot days - known as heat waves - are serious weather phenomena that can be deadly. Heat wave length, intensity, and frequency are all expected to continue increasing, posing a pressing public health concern both in the US and around the globe. From 1979-2003, excessive heat exposure caused 8,015 deaths in the U.S. according to the CDC. During that period, more people died from extreme heat than from hurricanes, lightning, tornadoes, floods, and earthquakes combined (www.cpo.noaa.gov). By the end of this century, what have previously been once-in-20-year extreme heat days (1-day events) are projected to occur every two or three years over most of the nation (National Climate Assessment, 2014).



PREVIOUS OCCURRENCES

On July 6, 2010, Washington County experienced extreme heat conditions. A strong ridge built into Southern New England resulting in temperatures nearing 100 with high humidity. Heat index values ranged from 100 to 106 for most of Southern New England on the 6th (www.NCEI.noaa.gov/stormevents).

PROBABILITY OF FUTURE OCCURRENCES

Extreme heat events have been increasingly frequent in the past decade and that trend is expected to continue. In 2011, the United States had its hottest heat wave in 75 years. The National Integrated Heat Health Information System (NIHHIS) along with researchers at NOAA and ESRI have developed a new tool in an effort to plan and prepare for increasing extreme heat. This is a new set of visualizations and analytical tools to understand, prepare for, and respond to extreme heat and its human health impacts (including economic impacts). This tool uses temperature projections and social indexes to identify vulnerable populations that might be exposed to dangerous heat in the future. It includes layers that help decision makers understand and compare their options for reducing risk, such as locations of cooling centers and health care facilities, or where to improve the urban tree canopy. It also provides access to view and share heat action plans around the world. Utilizing this tool, Washington County was determined to have an overall vulnerability score of 0.046. This would be considered a low vulnerability to future heat events. In contrast, the most vulnerable area of the country is Brooks County, Texas with an overall vulnerability score of 1.00.

Future Heat Events and Social Vulnerability Washington County

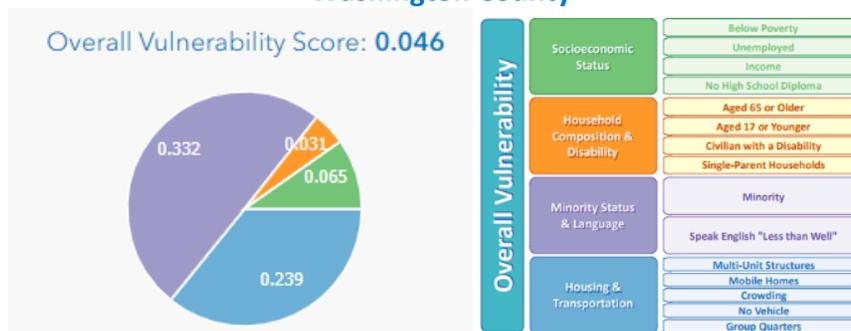


Figure 15: Future Heat Events and Social Vulnerability in Washington County (NOAA and the National Integrated Heat Health Information System (NIHHIS))

In order to better address heat risk and allow communities to prepare for upcoming heat events, the National Weather Service (NWS) has developed the experimental HeatRisk forecast. The NWS HeatRisk forecast provides a quick view of heat risk



potential over the upcoming seven days. The heat risk is portrayed in a numeric (0-4) and color scale which is similar in approach to the Air Quality Index (AQI) or the UV Index. In a similar way, it provides one value each day that indicates the approximate level of heat risk concern for any location, along with identifying the groups who are most at risk. The NWS web site (www.wrh.noaa.gov/wrh/heatrisk) allows access to an online map where you can zoom in on your area of interest and determine the heat risk for the next seven day period. This would help better prepare an area for extreme heat.

4.7 Summary of the Hazards

Historically, hurricanes and winter weather related events have caused the most damage to North Kingstown and its citizens. Recent disasters have focused the attention of North Kingstown's citizens and Town Officials on the resultant human, economic and environmental impacts. A list of the events from 1938 to present and the areas damaged have been outlined below. The table indicates that there have been a total of seven flood related hazards, six wind related hazards, three winter related hazards, one geological related hazard and five additional hazards.



Table 9: Past Natural Hazard Events in North Kingstown

Name/Date of Storm	Damaged Areas
Hurricane of 1938	Historical marker in the Gregory Building in Wickford village shows the high water mark from this storm. One hundred small cottage homes on Quonset Point were destroyed and nine people were killed there. Homes in Wickford were flooded, some destroyed. Many boats from the harbor were destroyed including the fishing fleet.
Earthquake - 1951	Epicenter in Kingston, measured 4.6 on the Richter Scale
Hurricane Carol - 1954	Historic Marker on the West Main Street Highway Garage in Wickford village shows the high water mark from this storm. Homes stripped from their foundations and upended at Poplar Point. Military facilities at Quonset Point flooded.
Wildfire - 1968	500 acres in the Slocum area
Wildfire - 1974	300 acres in the Slocum area
Blizzard - 1978	Town Services shut down for a week.
Hurricane Gloria - 1985	Boathouse at Town Beach was blown down and much of the sand was washed away. Salt spray led to extensive defoliation of trees.
Hurricane Bob - 1991	Boats washed ashore and piled on lawns fronting Wickford Harbor. Docks damaged.
Flooding - 2010	Five to ten inches of rain fell across Washington County resulting in rises in rivers and streams in North Kingstown. Numerous roads were flooded. A mudslide washed onto two rail tracks near Routes 403 and 4, disrupting rail service throughout Rhode Island on the Amtrack Northeast Corridor Line.
Tropical Storm Irene - 2011	Many power lines were damaged and many streets were not passable due to fallen debris and trees. Thousands of residents throughout Rhode Island were left without power as a result of high winds from the storm. Minimal coastal flooding except for Wickford.
Hurricane/ Super-storm Sandy - 2012	Many power lines were damaged and many streets were not passable due to fallen debris and trees. Thousands of residents throughout Rhode Island were left without power as a result of high winds from the storm. There was minimal coastal flooding except for Wickford Village.
Blizzard -2013	Many power lines were damaged and many streets were not passable due to fallen debris and trees. This storm affected 28 per cent of the States population. Thousands of residents throughout Rhode Island were left without power as a result of high winds and snow from the storm. Cold temperatures and lack of power made heating homes difficult during the period of below freezing weather.
Blizzard/Severe Snow Event – January 2015	An historic winter storm brought heavy snow to southern New England with blizzard conditions to much of Rhode Island Monday, January 26 until the early morning hours of Tuesday, January 27, 2015. The Blizzard of January 2015 produced very strong winds late Monday into Tuesday near the Massachusetts and Rhode Island coasts where gusts of 50 to 65 mph were common. The Governor of Rhode Island declared a state wide travel ban beginning at midnight on January 27th and continuing through 8 pm. President Obama issued a federal disaster declaration for the state of Rhode Island for this storm, allowing federal assistance for emergency work and repairs to facilities damaged by the storm.



4.8 Vulnerability

The following section provides a general description of the community's assets, which would be at risk in the event of a natural disaster. In order to better quantify North Kingstown's potential losses, the action plan also includes strategies to conduct a detailed inventory of structures, infrastructure, and critical facilities vulnerable to damage. The outcome of the analysis will be dollar estimates of potential losses due to damage to structures and their contents, and loss of function of structures. This analysis will also reveal in greater detail the structures or neighborhoods of town that are most susceptible to damage in the event of a natural disaster, so that actions can be taken to reduce these vulnerabilities. It cannot be understated the effect that climate change and sea level rise will have on potential losses, with increasing frequency of storms, surges, and spring tide elevations.

4.8.1 COMMUNITY ASSETS (EXPOSURE TO LOSS)

Populations that would be of particular concern during a coastal storm include two daycare facilities in the evacuation 'A' areas, located in Wickford and near Bissel Cove, and one daycare center in the 'B' evacuation area in Quidnessett. There are also two (2) day-care centers that are in close proximity to 'A' flood zones. There are no elderly housing or nursing homes located in either a flood zone or an evacuation area. While there are no mobile home parks in the evacuation areas, these locations can still be vulnerable to damage from high winds.

The areas of town that are vulnerable to rain-caused-flooding are combined with the areas that are vulnerable to storm surge inundation, they together cover approximately 5,500 acres, or 19% of the town (RIEMA). These flood hazard zones include all coastal areas and a large amount of the stream, river, and wetland areas of the interior of the town. Approximately 7,280 people, or 30% of the town's total population, live in these flood vulnerable areas during hurricane season.

The coastal area of town can be broken down into twelve (12) neighborhoods and these constitute the most vulnerable area of the Town. These areas are currently being assessed in Phase III of the Sea Level Rise project and include the following areas: 1) Pojac Point/ Mount View, 2) Quonset, Davisville, 3) Mill Cove/ Shore Acres, 4) Intrepid Drive, 5) Wickford Historic, 6) Wickford Commercial, 7) Phillips/ Loop Drive, 8) Poplar Point, 9) Duck Cove Earl Drive, 10) Hamilton/ Bissell Cove, 11) Plum Point/Plum Beach and 12) Gilbert Stuart/Walmsley Lane.

Wickford Village, includes a large portion of the Historic District which is particularly vulnerable to flooding as most of these lands are located within an 'AE' flood zone. In addition to residences and businesses, many public facilities and utility lines are located



in flood and storm surge areas. These include the Town Hall, Town Hall Annex, and Town Emergency Operations Center, as well as water lines that are carried across potentially vulnerable bridges.

4.8.2 CRITICAL FACILITIES

Critical facilities for the purposes of this plan are facilities that are vital to the health and welfare of the population and that are especially important following disasters. Critical facilities include, but are not limited to, shelters, police and fire and hospitals. They can also include those structures that have social or historical significance.

There are several different historical and socially significant structures that are located in evacuation and flood zones. The historic district in Wickford and its harbor are particularly vulnerable to hurricane damage. The existing Harbor Management Plan includes a Storm Preparedness Plan that is consistent with this Hazard Mitigation Plan. The residential, commercial, and industrial areas subject to inundation during a flood or hurricane all pose the threat of introducing hazardous chemicals and wastewater into the environment and therefore represent a possible health risk after the event that can inhibit rescue operations. Large inundation areas can be found along the Hunt and Narrow Rivers, at Pojac Point, Quonset Point, Wickford, and around Bissel Cove.

The town owns and operates a large number of facilities in coastal areas subject to flooding, storm surge as well as impacts from high winds. Most significant of these are the two Town Hall buildings; both are located in the hurricane surge area while the main Town Hall is in an X zone and the Town Hall Annex is in an AE zone (*Map 3*). In the event of a serious storm, sensitive equipment and important documents can both be destroyed leading to a variety of problems in town management including the loss of historic records. In addition, the town emergency operations center and the National Guard Stations at Quonset are within the hurricane evacuation areas designated for the most severe hurricane events.

Two elementary schools, Fishing Cove, and Hamilton, face damage as well in the event of a severe storm (*Critical Facilities Map 9*). The North Kingstown Free Library is another vulnerable town structure subject to storm surge and high winds.

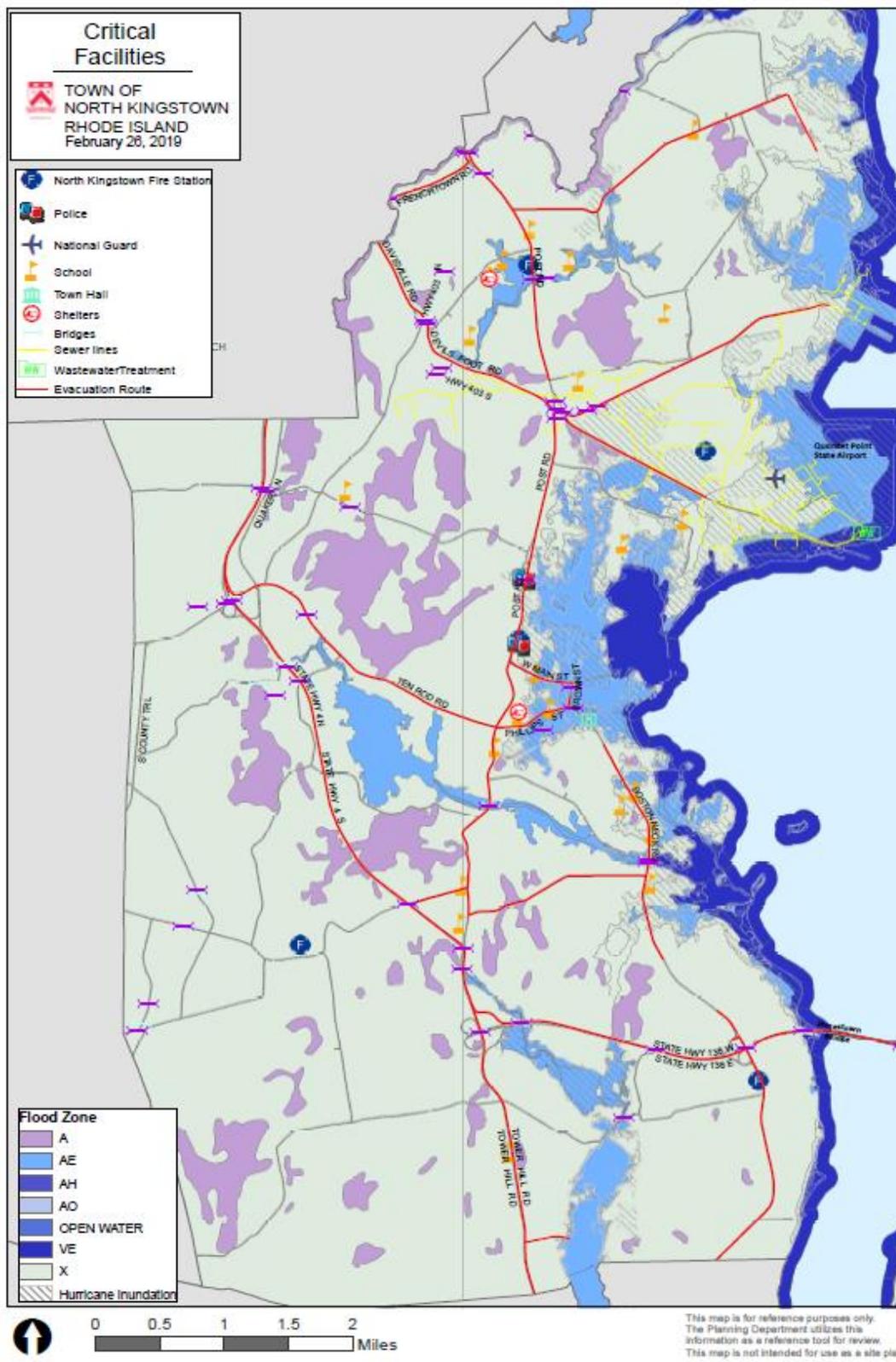
Flooding can expose or otherwise compromise septic systems leading to contamination and public health concerns. The Town maintains two (2) wastewater pumping facilities, one at Wickford Point and the other on Mark Drive, while the QDC has a wastewater facility in Quonset Point. All of these wastewater facilities are subject to flooding and storm surge presenting severe water contamination issues. Flooding can also wash out bridges leading to disruption in water provision at the point where it is carried over bridges. The Hussey and Brown Street Bridges in Wickford both carry water lines, as do bridges over Cocumscussoc Brook on Post Road and the Annaquatucket River on Boston Neck Road. The Town has several different recreational facilities in coastal areas subject



Strategy for Reducing Risks from Natural Hazards in North Kingstown, RI

to flooding and storm surge including Allen Harbor Marina, the Town Dock in Wickford, the various buildings at the end of Beach Street, and Wilson Park. Finally, the highway garage on West Main Street is subject to both flooding and storm surge.

Utility lines represent another key vulnerability in the town. High winds and ice/snow storms can bring down phone and electric lines disrupting power and communication to parts of the community and affecting the operations of businesses. The Town also has 19 dams, that may be vulnerable to flooding or earthquake damage. An earthquake, although not a high risk, could also pose a threat to older town buildings such as the Town Hall and Wickford Elementary School in the event that one strikes.



Map 9: Critical Facilities in North Kingstown (North Kingstown Planning Department)



4.8.3 NATURAL RESOURCES

The most important natural resource upon which North Kingstown is dependent is its water supply. The Town's water comes from three (3) different aquifers, the Hunt, Annaquatucket, and Pettaquamscutt. The average daily use is well below the safe yield levels and water is supplied to parts of both Narragansett and Jamestown. Volume II of the North Kingstown Water Supply System Management Plan deals extensively with emergency responses and mitigation actions for droughts, water contamination, supply disruption, and many other situations. Impermeable surfaces above the aquifer can severely restrict the amount of water infiltrating the ground and recharging the aquifer, exacerbating the effects of a drought.

With almost 50 percent of the Town being forested, wildfire can be a concern, especially during drought conditions. Large areas of forested lands include the town owned parks, Cocumscussoc State Park, and private lands, mostly in the western and southern parts of the town. Protection of wetlands should continue to be a central effort as these resources are critically important for flood control and habitat viability.

The town's aquatic environments are significant not only for their high level of quality but also in their susceptibility to disruption from natural and manmade events. Flooding may also pose a significant risk to the RI Department of Environmental Management fish hatchery on Hatchery Road. In the event of septic failure due to flooding or storm surge, the resulting discharge could severely impact, and even destroy, important aquatic habitats such as eelgrass beds and shellfisheries. Large-scale coastal storms can also cause serious erosion to Town beaches, thereby eliminating important coastal buffers and town recreational areas.

4.8.4 SHELTERS AND EVACUATION ROUTES

The number of people seeking emergency shelter in the event of a natural disaster is difficult to determine; it can be affected by the type and severity of the disaster, amount of forewarning, awareness of shelter locations, and the number of alternative destinations for individual residents. Severe storms with little forewarning can cause the most stress on shelter capacity, as people are more likely to seek shelter when they have less time to make alternative arrangements. Residents of nursing homes and mobile home parks are often the most likely groups to seek public shelter in the event of a natural disaster. Tourists visiting the town may also require shelter access, especially during the summer months that coincide with the hurricane season.

The Red Cross estimates that an average of 10 percent of the town's population will need to utilize public shelters in the event of an emergency situation. With a current



population of 26,486 in North Kingstown, that would be approximately 2,648 town residents seeking public shelter. Currently the town has two (2) Red Cross surveyed shelters, North Kingstown High School and Wickford Middle School. The Red Cross has identified some regional shelters to bolster town capacities, such as utilizing space at the University of Rhode Island during the summer months. In recent months the Senior Center and Wickford Public Library have also been used for shelters during periods of excessive cold.

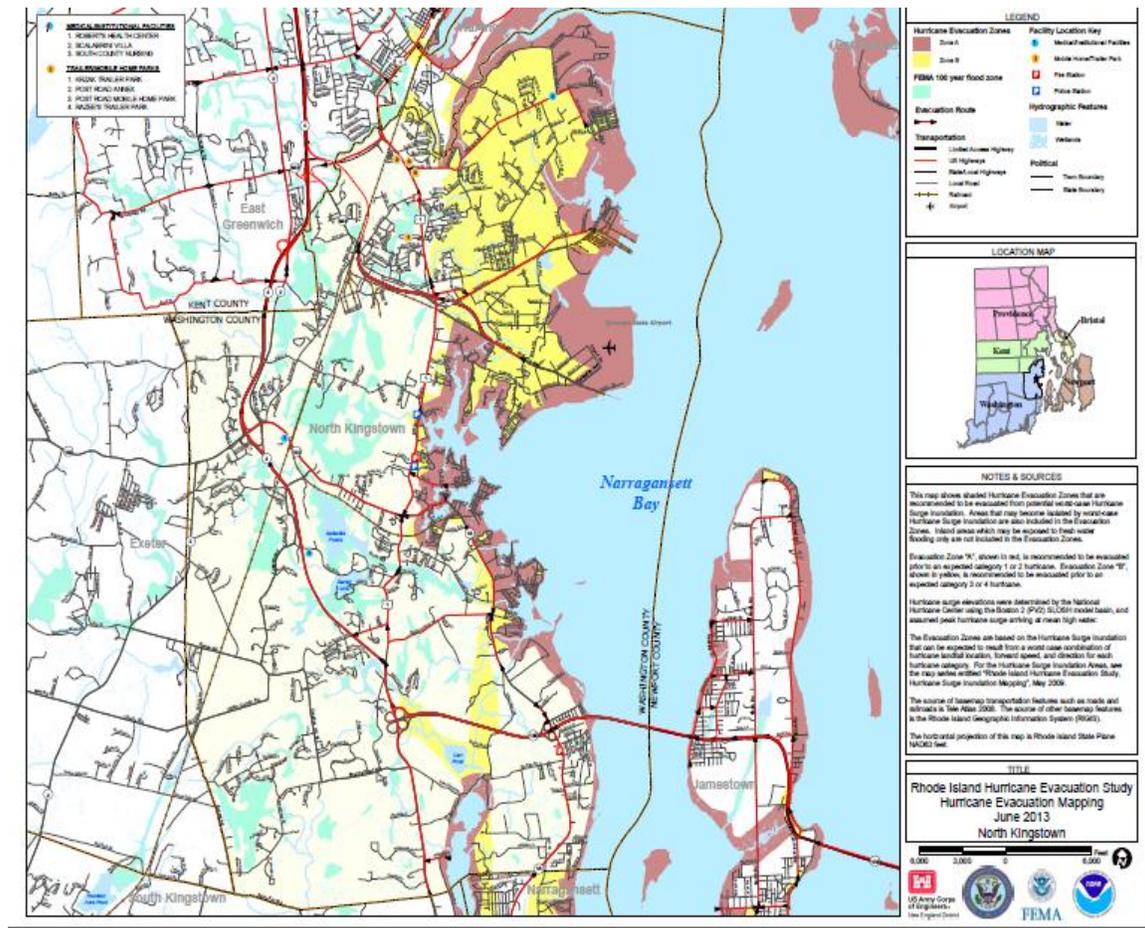
As with emergency shelter use, it is also difficult to determine how many residents will evacuate coastal areas in the event of a severe storm, except in cases in which evacuation is mandatory. Many people often decide to remain in their homes for the duration of a storm. Evacuation routes for residents leaving the coastal evacuation areas, designated using the SLOSH models, have been created by the North Kingstown Police Department. To facilitate evacuation, traffic control points to be manned by police officers during an evacuation have been created at significant road crossings and bridges. Evacuating some areas will be of special concern due to limited access, specifically those places with only a single access road that can potentially be blocked by flooding or downed trees. These include roads such as Loop Drive in Wickford, which can only be exited over the Loop Drive Culvert, a prime example of flooding that could keep residents from evacuating.

Evacuation routes connecting Wickford Village with arterial roadways are along West Main Street and Phillips Street are extremely vulnerable to flooding and future inundation at points where alternate routes are limited or nonexistent and would provide a barrier to a ingress/egress to a number of coastal neighborhoods.

The United States Army Corps of Engineers (USACE) Hurricane Evacuation Study has been updated and a map was prepared in June 2013 to reflect this, which is available to view on the town's website. This indicates hurricane evacuation zones that are recommended from potential worst-case hurricane surge inundation.



Strategy for Reducing Risks from Natural Hazards in North Kingstown, RI



Map 10: Hurricane Evacuation Zones

http://www.riema.ri.gov/resources/citizens/prepare/Updated_Evac_Maps/NorthKingstown_Evacuation_081213.pdf

The USACE maps show shaded Hurricane Evacuation Zones that are recommended to be evacuated from potential worst-case Hurricane Surge Inundation. Areas that may become isolated by worst-case Hurricane Surge Inundation are also included in the Evacuation Zones. Inland areas, which may be exposed to fresh water flooding only, are not included in the Evacuation Zones.

Evacuation Zone "A", shown in red, is recommended to be evacuated prior to an expected Category 1 or 2 hurricane. Evacuation Zone "B", shown in yellow, is recommended to be evacuated prior to an expected Category 3 or 4 hurricane. The Evacuation Zones are based on the Hurricane Surge Inundation that can be expected to result from a worst-case combination of hurricane landfall location, forward speed, and direction for each hurricane category.



4.8.5 COORDINATION WITH NEIGHBORING MUNICIPALITIES

North Kingstown borders on five other towns: East Greenwich, Exeter, Narragansett, South Kingstown and Warwick and is connected via Jamestown Bridge to the Town of Jamestown. Issues concerning hazard mitigation transcend these boundaries requiring that planning for natural hazards coordinate with and make considerations to these neighboring municipalities. Water is one of the most important issues concerning North Kingstown and many of its neighbors regarding both its source and supply. The aquifers from which the town draws its drinking water extend into East Greenwich and Exeter, requiring that mitigation issues concerning drought and water supply contamination be coordinated with these towns. In addition, the town supplies water to Narragansett and also to Jamestown on an emergency basis such that water use restrictions during a drought must be coordinated with these towns. The North Kingstown Water Supply Management Plan deals with many of these inter municipal issues.

Emergency evacuation is another important issue that sometimes requires cooperation with neighboring towns. Residents of both Jamestown and Narragansett will be utilizing North Kingstown evacuation routes in the event of a natural disaster. Jamestown, in particular, could have many residents evacuating through North Kingstown on Route 138. Jamestown students also attend North Kingstown schools. Some North Kingstown residents may evacuate through Warwick and East Greenwich across the Forge Road Bridge or Warwick residents may come through North Kingstown over the same bridge. Evacuation routes and emergency shelters are issues that should be coordinated amongst all six (6) of these communities for the safety of all area residents.

Other areas for cooperation between towns have been identified in the actions portion of the plan. Before the plan can be amended into the comprehensive plan, copies will be provided to the neighboring communities for their review and comment.



4.9 RISK ANALYSIS

Table 10: Risk Analysis & Assessment Matrix							
Vulnerable Areas <i>(in order of priority)</i>	Location	Ownership	Natural Hazard	Risk H=Historical P= Potential	Primary Effects or Problem	Mitigation Action	
Life and Property							
1	Coastal Neighborhoods	Coastal/Riverside Quidnessett; Shore Acres; Camp Avenue; Wickford; Hamilton; Coastal Saunderstown; Narrow River Area; Mount View	Private & Municipal	Flooding (A,AE); Storm surge; Wind	H - '38 and '54 Hurricanes P	Public safety; Septic system exposure leading to pollution and health risks; Private property loss; Utility interruptions	Ensure the safety of current and future residents. Protect property from damage. Reduce the cost of disaster clean-up.
2	Wickford Commercial Districts	Wickford Village	Municipal & Private	Flooding (AE); Storm surge; Wind; Earthquake	H - '38 and '54 Hurricanes P	Loss of services and revenue; Private & public property loss	Ensure post-disaster business continuation.
3	Elderly Housing	Town-wide	Private	Storm surge; Wind	 P	Public safety; Structural damage; Housing unit loss	Ensure the safety of elderly residents. Reduce the cost of disaster clean-up.



4	Wickford Village Housing	Wickford	Private	Flooding (X); Storm surge; Wind	P	Public safety; Public health (potential inundation of housing's sewage treatment facility); Environmental health; Housing unit loss	Ensure the safety of current and future residents. Protect property from damage. Reduce the cost of disaster clean-up.
5	Masonry Apartment and Mill Buildings	Town-wide	Private	Earthquake	P	Public safety; Structural damage	Ensure the safety of current and future residents. Protect property from damage. Reduce the cost of disaster clean-up.
6	Mobile Home Parks	Off of Post Road	Private	Wind	P	Public Safety; Private property loss; Utility damage	Ensure the safety of current and future residents. Protect property from damage. Reduce the cost of disaster clean-up.
7	All Vulnerable Structures	Town-wide	Municipal & Private	Flooding; Storm Surge; Wind	H & P	Public safety; Property loss and damage	Inventory all vulnerable structures and estimate expected losses from a major hazard event.



Child Safety							
1	Town Schools	Town-wide	Municipal	Flooding (A); Storm surge; Wind; Earthquake	H - '38 and '54 Hurricanes	Public safety; Structural & property damage; Loss of services	Ensure the safety of children. Reduce the cost of disaster clean-up and repair.
2	Day Care Centers	N.K. Daycare-Boston Neck Rd; St. Paul's Nursery-Main St; Sunshine Early Child Care Center-lafrate Rd	Private	Flooding (A); Storm surge; Wind	P	Public safety; Structural & property damage; Utility damage	Ensure the safety of children. Reduce the cost of disaster clean-up.



Emergency Services and Recovery Plans							
1	Evacuation Routes	Town-wide	Town and State	Flooding; Storm surge; Wind	P	Public safety; Loss of evacuation ability	Ensure the viability of evacuation routes.
2	Emergency Shelters	Davisville Elementary School; Wickford Middle School	Municipal		P	Lack of sufficient emergency shelter	Ensure available capacity for town residents in local emergency shelters.
3	Town Emergency Operations Center and Public Safety Complex	Post Road	Municipal	Wind; Earthquake	P	Loss of emergency response capability; Loss of communications	Ensure the accessibility and operational status of the center during an emergency.
4	Town Fire Stations 2, 3 & 5	Boston Neck Road, Post Road, Indian Corner Road	Municipal		P	Loss of emergency response capability	Ensure the accessibility and operational status of the stations during an emergency
5	Rhode Island Air and Army National Guard	Quonset Point	State and Federal	Flooding; Storm surge; Wind	H - '38 and '54 Hurricanes	Structural & property damage; Loss of services; Utility damage	Ensure the accessibility and operational status of the base during an emergency.
6	Post-Disaster Plans	Town-wide	Municipal & Private	Flooding; Stormsurge; Wind; Ice and Snow; Earthquake; Drought	H & P	Public safety; Property damage; Loss of services and utilities	Expedite debris removal and recovery /reconstruction after a disaster.



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Infrastructure and Utilities							
1	Dams	Town-wide	Municipal and Private	Flooding; Storm surge; Earthquake	P H- Mainly 2010 Flood	Public safety; Debris; Structural damage; Major property damage	Ensure structural integrity and ability to withstand coastal and riverine flooding.
2	Town Bridges (with utilities)	Hussey; Brown Street; Babbit Farm; and Hamilton Mill	Municipal and State	Flooding (AE, A); Storm Surge	H - '38 and '54 Hurricanes P	Loss of access; Structural damage; Water service disruption; Gas service disruption	Ensure structural integrity and ability to withstand coastal and riverine flooding.
3	Town Bridges (without utilities)	Loop Drive; Gilbert Stuart; Jamestown; Library Pedestrian; and Bridges over the Potowomut	Municipal and State	Flooding (A, AE); Storm Surge	H - '38 and '54 Hurricanes P	Loss of access; Structural damage	Ensure structural integrity and ability to withstand coastal and riverine flooding.
4	Town Roads and Streets	Town-wide	Municipal and State	Flooding; Storm surge; Snow and Ice	H - '38 and '54 Hurricanes P	Loss of access; Structural damage	Maintain pass ability and repair roads quickly after a disaster.
5	All town and QDC Wells	Town-wide and in East Greenwich and Warwick	Municipal	Flooding (A); Storm Surge; Drought	P	Public safety; Public health; Loss of services	Ensure protection of the water supply from contamination in the event of flooding. Ensure continued operation.



6	Water Distribution System	Standpipe Lane	Municipal	Wind, Flood	P	Public safety; Public health; Loss of services	Ensure protection of the water supply from contamination in the event of flooding. Ensure continued operation.
7	Electric Utility Lines and Facilities	Town-wide	National Grid	Wind; Earthquake	P H	Public safety; Loss of services	Ensure public safety and continued service.
8	QDC Wastewater Facility	Quonset Point/Davisville	State	Flooding (VE); Storm surge; Wind	H - '54 Hurricane P	Loss of operations and services; Pollution; Loss of shellfish beds	Prevent contamination of surrounding environment.
9	Town Sewage Pumping Facilities	Wickford Point and Mark Drive	Municipal	Flooding (A); Storm surge	P	Public safety; Public health; Loss of services	Prevent contamination of surrounding environment.
10	Town Sewer Lines	Post Road Corridor	Municipal	Flooding; Storm surge	P	Public safety; Public health; Loss of services	Prevent contamination of surrounding environment.
10	Wind Energy Systems and Meteorological Tower	Town Wide	Private and Municipal	Wind; Earthquake	P	Public safety; Public health; Loss of services	Prevent contamination of surrounding environment.
11	Phone Lines and Cell Towers	Town-wide	Various Private Utilities	Wind; Earthquake	P	Loss of services	Ensure continued service.



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12	Wickford Service Station	Boston Neck Rd.	Private	Flooding (A); Storm surge; Wind	H - '54 Hurricane P	Loss of services; Pollution; Hazardous materials; Property loss	Prevent contamination of surrounding environment.
Municipal Facilities							
1	Town Hall	80 Boston Neck Road	Municipal	Flooding (X); Storm surge; Wind; Earthquake	H - '38 and '54 Hurricanes P	Loss of operations, records, and historic information; Structural damage; Loss of public services	Protect town records. Reduce the cost of disaster clean-up and repair.
2	Town Hall Annex	55 Brown Street	Municipal	Flooding (AE); Storm surge; Wind; Earthquake	H - '38 and '54 Hurricanes & 2012 Hurricane Sandy P	Loss of operations, records, and historic information; Structural damage; Loss of public services	Protect town records. Reduce the cost of disaster clean-up and repair.
3	Senior Center; Cold Spring Community Center; and Art Association Building	Beach Street	Municipal	Flooding (A,VE); Storm surge; Wind	H - '38 and '54 Hurricanes P	Public safety; Loss of social services; Structural damage	Reduce the cost of disaster clean-up and repair. Reduce service disruption.
4	North Kingstown Free Library	Boone Street	Municipal	Storm surge; Wind	P	Loss of Services; Structural damage	Reduce the cost of disaster clean-up and repair. Protect library resources.



5	Highway Department Facilities Building	West Main Street	Municipal	Flooding (A); Storm surge; Wind	H - '38 and '54 Hurricanes P	Debris; Hazardous materials; Loss of services; Property loss	Reduce the cost of disaster clean-up and repair. Prevent contamination of surrounding environment. Reduce service disruption.
Cultural Resources							
1	Wickford Historic District	Wickford Village	Municipal & Private	Flooding (AE); Storm surge; Wind; Earthquake	P H - '38 and '54 Hurricanes	Historic loss; Private and public property loss	Protect historic resources.
2	Gilbert Stuart Birthplace and Smith's Castle	Gilbert Stuart Road	Private	Flooding (A); Storm surge; Wind	H - '54 Hurricane	Structural damage; Historic loss	Protect historic resources.
Quonset Point							
1	Existing and Proposed Development at Quonset Point/Davisville	Quonset Point/Davisville	State, QDC and Private	Flooding (A,VE,X); Storm surge; Wind	H - '38 and '54 Hurricanes	Hazardous materials; Loss of revenue	Prevent contamination of surrounding environment. Ensure post-disaster business continuation.
2	Quonset State Airport	Quonset Point/Davisville	State	Flooding (A,VE); Storm surge; Wind	H - '38 and '54 Hurricanes	Loss of emergency response capability; Loss of transportation	Ensure continued operation. Reduce the cost of disaster clean-up.



Recreational Resources							
1	Town Harbors and Moorings	Wickford Harbor Allen Harbor	Municipal and Private	Flooding (A); Storm surge; Wind	H - '38 and '54 Hurricanes	Public safety; Structural damage; Loss of boats; Damage to fishing industry; Utility damage	Protect property on land and water from damage. Reduce the cost of disaster clean-up and repair.
2	Town Beach, concession and restrooms	Beach Street	Municipal	Flooding (A,VE); Storm surge; Wind	H - '38 and '54 Hurricanes	Public safety; Loss of recreational services; Erosion	Maintain beach integrity; Reduce seawall damage; Reduce structural damage.
3	Ryan Park, Rome Point, Wilson Park, Cocumscussoc State Park, and Calf Pasture Point	Belleville Pond, Boston Neck Rd., and W. Main St.	Municipal and State	Flooding (A,VE); Storm surge; Wind; Fire	H	Structural damage; Pollution; Loss of services; Loss of trees; Loss of access	Reduce the cost of disaster clean-up and repair.
4	Municipal Golf Course	Quonset Point/Davisville	Municipal	Storm surge; Wind	H - '54 Hurricane	Debris; Loss of trees; Pollution; Hazardous materials; Loss of access; Structural damage; Economic loss	Reduce the cost of disaster clean-up and repair.



5.0 – MITIGATION ACTIONS

After reviewing the Town’s existing hazard mitigation activities and capabilities for expansion, the North Kingstown Hazard Mitigation Committee has created a set of actions in order to address the previously identified risks and vulnerabilities and achieve the town’s hazard mitigation goals. In general, the changes that have been made to the plan as part of the Hazard Mitigation Plan Update are designed to reflect changes in development, update information on natural hazards, show progress made toward mitigation efforts and changes in the Town’s priorities. The actions identified with this update will serve as an implementation plan as the Town attempts to reduce its vulnerability to natural disasters. These actions are intended to reduce risks to public safety and to existing structures as well as to future development in town.

5.1 EXISTING HAZARD MITIGATION ACTIVITIES AND TOWN CAPABILITIES

There are many existing plans, policies, and reports that in some way contribute to or inform the hazard mitigation process in North Kingstown. In order to formalize and greatly expand the town’s hazard mitigation program, the town will use the **Capital Improvement Program (CIP)** to schedule funding for implementation of the actions in this **Hazard Mitigation Plan**. Other potential funding opportunities have been set out in Appendix C.

The **comprehensive plan** has objectives and actions that can contribute to hazard mitigation and will help implement the policies and action of this plan.

The re-write of the comprehensive plan includes a separated element dedicated to natural hazards and climate adaptation. The first goal of this element is to “Promote resilience and adaptation to natural hazards and a changing climate to protect lives, infrastructure, resources, and property”. The first policy is to “Ensure existing property and business owners are aware of their exposure and risk to coastal hazards and support efforts to improve resiliency”. The actions related to this policy include:

PRIORITY	ACTION #	ACTIONS	RESPONSIBLE PARTY	TIMEFRAME	POTENTIAL SOURCE OF FUNDS
★	7.1.a	Notify property owners within the Special Flood Hazard Area (SFHA) of their exposure to projected sea level rise scenarios.	Building Official, Planning Dept	5 to 10 years	Staff time
★	7.1.b	Encourage more resilient housing stock through “code-plus ” techniques that go above and beyond local building codes to reduce damage and debris from structures during a storm or flooding event.	Building Official	5 to 10 years/10-20 years	Staff time



Another policy in the comprehensive plan is to “Avoid or minimize the exposure of future development to natural hazards and climate change”. The following actions are intended to meet this policy:

PRIORITY	ACTION #	ACTIONS	RESPONSIBLE PARTY	TIMEFRAME	POTENTIAL SOURCE OF FUNDS
★	7.2.a	Evaluate vacant properties within the SFHA and identify opportunities to acquire, purchase, or establish perpetual conservation easements on these parcels.	Town Council, URI Coastal Resources Center (CRC), CRMC, Building Official	10 to 20 years	Staff time, RIEMA, RIDEM
	7.2.b	Explore feasibility of structuring Purchase Development Rights (PDR) program specific to the SFHA to reduce density in the potential impacted areas of town.	URI CRC, NK Tax Assessor, Planning Commission, Town Council	10 to 20 years	RIDEM, RIEMA, Town Budget, Staff time
	7.2.c	Define areas impacted by sea level rise and other flood events for protection, accommodation, preservation, and managed retreat.	URI CRC, Building Official, Conservation Commission	10 to 20 years	RIDEM, CRMC, RIEMA, Staff time

CRMC=Coastal Resources Management Council, RIEMA=Rhode Island Emergency Management Agency, RIDEM=Rhode Island Dept of Environmental Management, URI CRC=University of Rhode Island Coastal Resources Center

Additionally, the comprehensive plan seeks to “Consider natural hazards and potential climate change impacts in all long-range planning and critical public facilities and infrastructure projects”. This will be accomplished by implementing the following activities:



PRIORITY	ACTION #	ACTIONS	RESPONSIBLE PARTY	TIMEFRAME	POTENTIAL SOURCE OF FUNDS
★	7.3.a	Maintain a database of municipal properties and structures within the SFHA or projected sea level rise areas and record of flood impacts.	Building Official	5 to 10 years	Staff time
★	7.3.b	Request RIDOT conduct a feasibility study to identify strategies to protect evacuation routes and state roadways from storm damage and projected sea level rise inundation. Evaluate the necessity and feasibility of elevating low points along evacuation routes.	RIDOT, DPW	5 to 10 years	RIDOT, Staff time
★	7.3.c	Prioritize public facility improvements that are necessary for increased resiliency on the town Capital Improvement Program and roads currently and potentially impacted by a sea level rise or coastal flooding for inclusion on the state Transportation Improvement Program (TIP) and town Capital Improvement Program.	RIDOT, DPW	5 to 10 years	Staff time
	7.3.d	Restrict development of new roads in areas exposed to coastal flooding and sea level rise scenarios.	DPW, RIDOT, Planning Commission	1 to 5 years/5 to 10 years	Staff time
	7.3.e	Update and continue to implement the town's Hazard Mitigation Plan with regard to town-owned transportation infrastructure.	Planning Dept, DPW	5 to 10 years	Staff time, RIEMA

As it relates to our natural resources, the comprehensive plan has included a policy to “Protect and preserve natural resources to promote resilience and adaptation to natural hazards and climate change”. These actions will help to accomplish this.

PRIORITY	ACTION #	ACTIONS	RESPONSIBLE PARTY	TIMEFRAME	POTENTIAL SOURCE OF FUNDS
★	7.4.a	Preserve open space in existing salt marsh complexes, floodplain, and in areas exposed to coastal hazards, sea level rise projections and salt marsh migration.	Planning Commission, Town Council, Conservation Commission, NK Land Conservancy	5 to 10 years	RIDEM, CRMC, Staff time
	7.4.b	Establish a process and financial incentives for property owners to define conservation easements on their properties to protect areas projected to be inundated by sea level rise or salt marsh migration.	Conservation Commission, NK Land Conservancy	10 to 20 years	RIDEM, CRMC, NK Land Conservancy, Narrow River Land Trust

Historic and cultural resources are also addressed in the plan as demonstrated in the policy to “Protect and preserve important historic and cultural resources from natural hazards and climate change”. The following actions are related to this policy:



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PRIORITY	ACTION #	ACTIONS	RESPONSIBLE PARTY	TIMEFRAME	POTENTIAL SOURCE OF FUNDS
★	7.5.a	Maintain a database of parcels within the historic districts, the Special Flood Hazard Areas (SFHA), and within the projected sea level rise areas to monitor impacts to these areas and coordinate with property owners on potential strategies to protect historic assets.	Historic District Commission (HDC), RI Historic Preservation and Heritage Commission (RIHPHC), Building Official, property owners	5 to 10 years	RIEMA, Staff time, RIHPHC, property owners
★	7.5.b	Coordinate with the State Historic Preservation Officer and the local Historic District Commission to provide resources and design guidelines for historic home owners within historic districts who may desire to flood-proof their property or structure.	Historic District Commission (HDC), RI Historic Preservation and Heritage Commission (RIHPHC), Building Official	1 to 5 years	Staff time, RIHPHC
	7.5.c	Establish financial incentives for owners of historic properties who voluntarily invest in adaptation strategies to flood-proof or otherwise protect vulnerable assets, such as low-interest loans or historic preservation grants.	Historic District Commission (HDC), RI Historic Preservation and Heritage Commission (RIHPHC), Building Official	10 to 20 years	Staff time, Town budget, RIHPHC, CRMC

CRMC=Coastal Resources Management Council, RIEMA=RI Emergency Management Agency, RIDEM=RI Dept of Environmental Management

Once approved by RIEMA and FEMA, the Hazard Mitigation Plan will be incorporated by reference to the town’s comprehensive plan.

An adaptation to natural hazards and climate change for the Town of North Kingstown was prepared by RISG and URICRC and adopted by the North Kingstown Town Council. The aim was to develop adaptation strategies to natural hazards in local planning, which could then be incorporated into the comprehensive plan as required by 2016 (RIGL 45-22.2). This will ensure that the comprehensive plan addresses climate change adaptation as it relates to transportation, land use and other relevant issues. This document will also provide a detailed listing of priority transportation and land use projects that support climate change adaptation strategies and are appropriate for inclusion in the **State Transportation Improvement Program (TIP)** and municipal CIP proposals.

Actions to protect the water supply appear frequently in the comprehensive plan and other town plans and documents. The town’s **Groundwater Protection Plan** forms the basis of the groundwater protection overlay zone. This overlay zone regulates the uses and densities that can locate in the aquifer area in an effort to protect the town’s drinking water from contamination. The **Water Supply System Management Plan** has extensive actions that should take place in the event of natural or man-made disasters to protect the water supply from contamination. As an additional protection measure,



the town is committed to acquiring land and conservation easements in the groundwater protection areas. All of these actions limit the potential for groundwater contamination and ensure sufficient recharge of the aquifer, ultimately mitigating the effects of drought.

A watershed plan was developed for improving groundwater and surface water quality in the Saw Mill Pond watershed was completed as part of the **Davisville Neighborhood Revitalization Plan**. The town was awarded a grant from RIDEM and USEPA under their 319 nonpoint source pollution grant program for over \$248, 000.

Another pertinent document is the **North Kingstown Tree Inventory Management Plan**. This plan recommends regular tree trimming to reduce the potential for damage to utility lines from fallen limbs. The Emergency Operations Plan also includes a framework to assist town officials in planning and performing their emergency functions during a disaster. In addition to hazard mitigation, other related issues addressed in the Emergency Operations Plan include 1) preparedness, which is aimed at saving lives and minimizing damage, 2) response, which is aimed at preventing the loss of lives, reducing property damage, and 3) providing emergency assistance, and recovery, which is aimed at returning all systems to normal post-disaster. The town also has a **Hazardous Materials Plan**, which lists locations in the town where hazardous materials are stored, and covers response and recovery in the event of a hazardous materials spill. In addition, the **Harbor Management Plan** includes a **Storm Preparedness Plan**, which is consistent with the actions developed in this Hazard Mitigation Plan. The goals of the Storm Preparedness Plan are as follows:

To prevent the loss of life and property by:

- Properly preparing harbor and shoreline areas for storm events;
- Having a completed and enforceable response and recovery plan;
- Working in cooperation with harbor and shoreline users to ensure that a coordinated approach is applied to hazard mitigation;
- Integrating harbor hazard mitigation activities with other, ongoing, local hazard mitigation programs; and
- Identifying and completing long-term actions to redirect, interact with, or avoid the hazard.

The Town is also commencing a project funded by USEPA on “**Green Infrastructure**” to perform a sea level rise-related economic analysis. The project will determine and assess impacts of climate change and sea level rise in North Kingstown business and economic development possibilities. This will provide a great opportunity for the town’s involvement in piloting an EPA tool that helps water utilities understand the economic impacts of scenarios such as losing assets (pump stations) to a flood or sea level rise.



The Planning Department has also received a grant from the RICRMC **Coastal and Estuary Habitat Restoration Fund** program (\$4, 700) to pursue a marsh adaptation project coordination with Save the Bay and the RIDEM’s Mosquito Abatement Coordinator on the remnant salt march on the east side of Calf Pasture Point. This adaptation project will facilitate drainage on the recently impounded water on the upper marsh. The goal of this project is to restore health and function of this marsh complex and enable the upper marsh to remain a productive habitat as sea level rises.

The town also participated in the **RI Community Resilience Planning with Green Infrastructure** pilot project. This project utilized an integrated design process to evaluate sites in North Kingstown and develop conceptual plans to employ green infrastructure (GI) to enhance water quality, habitat, and access to these coastal areas, while reducing flooding impacts. Evaluation of existing plans, practices, and procedures led to guidance and recommendations instituted in comprehensive plans, maintenance programs, structural retrofits among others (NFWF Final Programmatic Report).

ECONOMIC CAPABILITY

According to tax assessor’s data as of 2005, the total value of coastal and riverfront residential and commercial buildings in town is approximately \$138,079,100. Therefore, if a hypothetical storm event were to result in an average of 25% damage to these structures, the structural damage would total \$34,519,775. Damage to building contents and functional down time of businesses would cause additional losses. A building can be damaged to 25% of its replacement cost in a flood of less than two (2) feet depth.

FEMA’s data from October 2018 indicates a total of 719 properties insured by NFIP and vulnerable to flooding (*Table 11*). There are a total of 14 repetitive loss properties in North Kingstown as of October 2018. Twelve of the repetitive loss properties are residential and two are commercial. Ten of the repetitive loss properties are non-mitigated. Since 1978 there have been a total of 284 claims with \$1,630,971.16 paid for losses. Specific vulnerabilities can be found on the risk matrix (*Table 10*) and on Maps 4, 5 & 9.

Total Flood Insurance Policies	Polices in 'V' Zones	Polices in 'A' Zones	Total Coverage	Number of Claims Since 1978	Number of Severe Repetitive Loss Properties
719	22	366	\$206,220,300	284	0



Table 12: Exposed Assets (ADAPTATION TO NATURAL HAZARDS & CLIMATE CHANGE NORTH KINGSTOWN, RI, 2015)

Land Use and Parcel Data: exposed assets considering storm and sea level rise simulations created using a GIS-based bathtub model.

Land Use	Coastal Storm Scenario (single event)	Future Sea Level Rise Scenarios (Daily tides)		
Scenario	1938 Hurricane Flood Levels: Mean Higher High Water (MHHW) + 9.5ft	Sea level rise (SLR) at 1 foot above MHHW	SLR at 3 feet above MHHW	SLR at 5 feet above MHHW
Exposed Assets (Properties)*	1564 properties are within or adjacent to the boundary of the storm surge	500 properties are within or adjacent to the boundary of MHHW +1 foot	772 properties are within or adjacent to the boundary of MHHW +3 feet	1041 properties are within or adjacent to the boundary of MHHW +5 feet
Property Categories By Parcel Tax Code*	72% Residential 6% Business 9% Civic 12% Undeveloped 2% Other	63% Residential 7% Business 14% Civic 14% Undeveloped 2% Other	69% Residential 6% Business 10% Civic 13% Undeveloped 2% Other	70% Residential 6% Business 10% Civic 12% Undeveloped 2% Other
Owned by	Publicly Owned Properties*			
Federal	9	6	8	9
State	65	25	28	37
Municipality	27	17	19	21
Total	101	48	55	67
	Historic District Properties Among Exposed Assets*			
Historic District Properties	87	38	64	86

5.2 Action Plan- Update on 2005 Actions

There were over 70 actions in the 2005 Plan, with many of the stated actions in the previous plan not detailed enough, which made the plan difficult to implement and monitor. This plan will reduce the number of actions, by consolidating some and aims to make them more detailed to allow for the actions to be monitored regularly with regard to their performance.

Town Staff in North Kingstown assessed the risks to the town and developed mitigation actions that address a mix of structural initiatives (building code enforcement, repair and retrofit of existing structures and removal of vulnerable structures) and nonstructural initiatives which include: educational programs, preventing construction in high-hazard areas, enforcing regulations). The updated actions has also taken into account adaptation strategies for sea level rise and climate change that has been the result of recent works as part of the pilot project with URICRC and RISG. A complete list of the actions from the 2005 Plan is set out in the appendices, with a status update to



indicate if the action was completed, rolled over into this plan, consolidated with other actions or no longer a stated action.

The Committee will meet twice a year to review the actions with additional meetings after any major storm event to help with the implementation and monitoring of the Plan.

The action plan was created to achieve the mitigation objectives identified in the Risk Assessment Matrix. The matrix is organized into major categories of concerns drawn from the town's mitigation goals. Within each major category vulnerable areas are identified. The mitigation actions in this plan are grouped with the relevant goal they support.

IDENTIFICATION OF MITIGATION ACTIONS

Mitigation actions are actions that are designed to reduce a town's vulnerability to the effects of natural hazards. Mitigation actions are different from emergency preparedness actions in that emergency actions address a town's response to a hazard event, while mitigation attempts to reduce the amount of damage a natural hazard can possibly cause in the first place. An emergency action in response to flooding would involve decisions about how to build an emergency sandbag levee while a mitigation plan would involve implementing actions to reduce a structure's vulnerabilities to flooding in a designated floodplain. Mitigation is about reducing the threats, costs, and need for emergency action that is usually associated with natural disaster events.

Actions were drawn from the FEMA approved hazard mitigation plans of other Rhode Island towns, the deliberations of the Hazard Mitigation Committee, suggestions from the public, and the research of the planning staff. Actions were chosen for implementation based on their being within the authority and ability of the town to enact, feasibility, and having mitigation benefits sufficient to justify their costs of implementation. The following actions are considered appropriate for implementation.

Each action includes a brief description of what the action will accomplish, who the responsible parties are, how much it will cost, how the action will be financed, and in what time frame the action will be completed. The actions identified include modifications to the built environment, changes in town policies, distribution of public information on hazard risks, and the creation of community-based organizations. In addition, consideration has been made for actions to be taken both before and after a disaster occurs.



PRIORITIZATION OF ACTIONS

The vulnerable areas identified on the Risk Assessment Matrix were prioritized according to the town's hazard mitigation goals. The highest priority was assigned to the following:

- Areas where life and property or child safety
- Emergency services
- Infrastructure
- Utilities
- Municipal facilities
- Cultural resources
- Quonset Point, and
- Recreational resources.

Further prioritization was based on a variety of considerations including historical damage, number of residents potentially impacted, and the value of property, in economic as well as cultural/environmental terms. The priority assignment given to the vulnerable areas on the matrix plays a role in determining money allocation and the timeframe priority given to specific actions addressing those areas.

The Hazard Mitigation Committee's prioritization of each action was based on the prioritization of the vulnerable area each action is intended to protect and on the overall benefit each action is likely to achieve as compared to its costs and overall feasibility.

The Hazard Mitigation Committee created a set of time frames for the completion of each hazard mitigation action: Where feasible, short term actions will be completed within six months, medium term actions within six to 18 months and long-term actions will be completed within 18 months to five years. In general, the time frame assigned to each action also corresponds to its priority. High priority actions were assigned a short-term time frame and low priority actions were assigned a long-term time frame.



Table 13: Hazard Mitigation Updated Goals & Actions	
Goal 1 Reduce risks and increase resilience from natural hazards in North Kingstown.	
<p>Action 1.1: Open Space Acquisition of lands within SFHA areas with a priority on the protection of open space landward of sensitive features to help create a buffer to storm surge drainage and erosion.</p> <p>Priority: High</p> <p>Lead Departments: Department of Planning and Development</p> <p>Partnerships: North Kingstown Land Conservancy, Narrow River Land Trust, Town Council, Conservation Commission, and RIDEM, CRMC Coastal and Estuary Habitat Restoration Program/Trust</p> <p>Time Frame: Long Term</p> <p>Benefit: Future Planning Mitigation, Public safety</p> <p>Cost:</p> <p>Status: Continued and enhanced action from 2005 Plan</p>	
<p>Action 1.2: Continue to enforce Building Code Compliance for land uses and structures in SFHA and those prone to other potential hazards to residents in accordance with updated legislation, ordinances and State Building Code requirements as part of the building permitting process to reduce risk to structures and facilities.</p> <p>Priority: High</p> <p>Lead Departments: Building Department</p> <p>Time Frame: Long Term</p> <p>Benefit: Future Mitigation Planning, Public Safety & Property Protection</p> <p>Cost: Part of Permit Review Process, Cost will vary depending on the action needs (elevation of structures outside of BFE)</p> <p>Status: Continued and enhanced action from 2005 Plan</p>	
<p>Action 1.3: Educate and promote awareness to homeowners of the benefit of elevating or otherwise storm-proofing coastal structures to reduce losses and protect public health, safety and welfare through mailings and through the Town’s website.</p> <p>Priority: High</p> <p>Lead Departments: Planning Department & Building Department</p> <p>Time Frame: short term</p> <p>Benefit: Future Mitigation Planning, Public Safety & Property Protection</p> <p>Cost: \$1,000 per year in flyers in addition to staff time to update website data</p> <p>Status: Continued and enhanced goal from previous plan.</p>	
<p>Action 1.4: Identify the “design life” of critical facilities at the time of construction and maintain data to allow for clear planning horizons to be defined for the development of phasing plans for implementation and prioritizing funding from federal and state grants and through the municipal CIP by utilizing the STORMTOOLS mapping program to reduce future risk.</p> <p>Priority: High</p> <p>Lead Departments: Building Department & DPW</p> <p>Time Frame: Long Term</p> <p>Benefit: Future Mitigation Planning, Public Safety and Property Protection</p> <p>Cost: staff time and expenses</p> <p>Status: New Action</p>	



Action 1.5: Create policy to direct development away from areas subject to erosion and flooding from gale-force winds, storm surge and sea level rise.

Priority: High

Lead Departments: Planning Department, Building Department & DPW

Time Frame: Long Term

Benefit: Future Mitigation Planning

Cost: Staff time, Consultant fees

Status: New action

Action 1.6: The town should utilize the municipal web site and direct mailings as outreach to North Kingstown's Historic District (HD) property owners and residents in Wickford located within the SFHA to educate and assist these homeowners with the long term management of their property to balance the preservation of the structure's historic integrity with protection of the property from future flood damage.

Priority: High

Lead Departments: Planning Department, Building Department & DPW

Time Frame: short term

Benefit: Future Mitigation Planning

Cost: \$1,000 in staff time and mailings

Status: New action

Action 1.7: Complete database updates of: 1) building permits and elevation certificates issues within the SFHA 2) parcels within the HDC, the SFHA and projected sea level rise areas 3) open space parcels and public parks to help identify trends and patterns and to protect assets in the town.

Priority: Medium

Lead Departments: Planning Department, Building Department & DPW

Time Frame: Long Term

Benefit: Future Mitigation Planning

Cost: Staff time, Consultant fees , requires adequate GIS updates

Status: Continued and expanded action

Action 1.8: Plan and Raise awareness via the municipal web site and CodeRED for the Safe Evacuation of Tourist, Residents & Business Owners during Hazard Events.

Priority: Medium

Lead Departments: Department of Public Works & Planning Dept.

Time Frame: Long Term

Benefit: Future Mitigation Planning

Cost: Staff time, Consultant fees

Status: Continued and consolidated action

Goal 2 Ensure public safety from natural hazards.

Action 2.1: Complete an assessment of municipal structures located in SFHA that are utilized by vulnerable populations.

Priority: Medium

Lead Departments: Building Dept. & Planning Dept.

Time Frame: Long Term

Benefit: Future Mitigation Planning, Public Safety

Cost: Staff time, Consultant fees

Status: Continued and consolidated action



Action 2.2: Provide information via direct mailings to schools and day-care facilities located in the flood zone in order to educate children and day care providers on natural hazard preparedness to raise awareness and improve response.

Priority: High

Lead Departments: Planning Department, Police Department, Schools and Day-Care Centers

Time Frame: Long Term

Benefit: Future Mitigation Planning, Public Safety

Cost: Staff time

Status: Continued and merged action from previous plan

Goal 3: Maintain emergency services during an event.

Action 3.1: Identify all evacuation routes serving coastal hazard areas that will be inundated with future sea level rise scenarios. Identify strategies for upgrades to the segments identified for evacuation routes. Publish and make these available to educate and raise awareness to those citizens impacted.

Priority: High

Lead Departments: Planning Department, Police Department, Schools and Day-Care Centers

Time Frame: Long Term

Benefit: Future Mitigation Planning, Public safety

Cost: Staff time

Status: Continued and merged action from previous plan

Action 3.2: Continue to maintain viable evacuation routes through the implementation of the Town's Tree Maintenance Plan which prioritizes maintaining those trees running along evacuation routes and roads offering single access to coastal and flood prone neighborhoods and encourage routine inspections for trees that are a potential storm threat.

Priority: High

Lead Departments: Department of Public Works

Time Frame: Long Term

Benefit: Future Mitigation Planning & Public Safety

Cost: Staff time

Status: Continued and merged action from previous plan

Action 3.3: Coordinate Evacuation Plans with Neighboring Towns to ensure each Town's evacuation routes are compatible.

Priority: Medium

Lead Departments: Department of Public Works & Police Department

Time Frame: Long Term

Benefit: Future Public safety

Cost: Staff time, Consultant fees

Status: Continued action

Action 3.4: Evaluate shelter sites (existing and potential) on an annual basis.

Priority: Medium

Lead Departments: Department of Public Works

Time Frame: Long Term

Benefit: Future Mitigation Planning, Public Safety

Cost: Staff time, Consultant fees

Status: Continued and merged action from previous plan



<p>Action 3.6: The Town will research feasibility of a recovery and reconstruction ordinance that will expedite re-building after a natural hazard event.</p> <p>Priority: High</p> <p>Lead Departments: Building Dept. & Planning/Zoning Dept.</p> <p>Time Frame: Long Term</p> <p>Benefit: Future Property Protection</p> <p>Cost: Staff time, Consultant fees</p> <p>Status: Continued and enhanced action</p>
<p>Goal 4 Retrofit hazard prone facilities.</p>
<p>Action 4.1: Maintain a database with record of flood impacts on municipal properties and structures to better plan for improvements and protect the town’s assets.</p> <p>Priority: Medium</p> <p>Lead Departments: Building Dept. & Planning Dept.</p> <p>Time Frame: Long Term</p> <p>Benefit: Future property protection</p> <p>Cost: Staff time, Consultant fees</p> <p>Status: Continued and Updated Action.</p>
<p>Action 4.2: Retrofit municipal structures in SFHA .</p> <p>Priority: Medium</p> <p>Lead Departments: Department of Public Works, Building Dept. & Planning Dept.</p> <p>Time Frame: Long Term</p> <p>Benefit: Future Mitigation Planning, Property Protection & Public Safety</p> <p>Cost: Staff time, Consultant fees</p> <p>Status: Continued and Updated Action.</p>
<p>Action 4.3: Develop a cooperative strategy for municipal officials/facilities.</p> <p>Priority: Medium</p> <p>Lead Departments: Building Dept. & Department of Public Works</p> <p>Time Frame: Long Term</p> <p>Benefit: Future Mitigation Planning</p> <p>Cost: Staff time, Consultant fees</p> <p>Status: Continued and Updated Action.</p>
<p>Goal 5 Reduce the vulnerability of the town’s infrastructure and utilities, cultural resources and recreational resources to natural hazards.</p>
<p>Action 5.1: Evaluate new technologies promoting “green infrastructure” solutions that are available and could be applied to increase stormwater infiltration upstream and reduce runoff.</p> <p>Priority: Medium</p> <p>Lead Departments: Department of Public Works, Planning Dept. & Building Dept.</p> <p>Time Frame: Long Term</p> <p>Benefit: Future Mitigation Planning</p> <p>Cost: Staff time, Consultant fees</p> <p>Status: Continued and Updated Action.</p>



Action 5.2: Promote OWTS upgrades in accordance with the Cesspool Phase-out Act, 2007 through potential grants and determine feasibility of sewerage neighborhoods and commercial centers in SFHA with storm surge and sea level rise impacts.

Priority: High

Lead Departments: DEM, Department of Public Works, Planning Dpt. & Building Dpt.

Time Frame: Long Term

Benefit: Future Mitigation Planning

Cost: Staff time, Consultant fees

Status: Continued and Updated Action.

Action 5.3: Continue to monitor, update and evaluate town owned and private dams in accordance with Emergency Action Plan (EAP) with a view to implementing preventative actions in the event of a dam failure. This should be reviewed with an update occurring annually.

Priority: High

Lead Departments: Department of Public Works, RIDEM, Water Department

Time Frame: Long Term

Benefit: Future Public Safety, Mitigation Planning

Cost: Staff time, Consultant fees

Status: Continued and Updated Action.

Action 5.4: Inspect municipally owned bridges and work with the RIDOT via the State Transportation Improvement Program to inspect state-owned bridges for structural integrity to determine their individual vulnerability to damage in a hazard event. Records will be maintained to allow for the prioritization of funds for bridges which may have been to be retrofitted to prevent failure.

Priority: Medium

Lead Departments: Department of Public Works, RIDOT

Time Frame: Long Term

Benefit: Future Public Safety

Cost: Staff time, Consultant fees

Status: Continued Action

Action 5.5: Create an emergency response plan in the event of bridge collapse. Hussey Bridge, Brown Street Bridge, Babbit Farm Bridge over Cocumscussoc Brook and the Hamilton Mill Bridge on Boston Neck.

Priority: Medium

Lead Departments: Department of Public Works, RIDOT

Time Frame: Long Term

Benefit: Future Public Safety

Cost: Staff time, Consultant fees

Status: Continued Action



Action 5.6: Continue to Protect the Town Water Supply from contamination and drought through the increased monitoring and review of activities allowed in Groundwater Overlay Areas and through the Purchase of Development Rights (PDR) and Transfer of Development Rights (TDR) to direct development outside of the GW Overlay zones.

Priority: High

Lead Departments: Water Department, Department of Public Works, RIDOT

Time Frame: Long Term

Benefit: Future Public Safety

Cost: Staff time, Consultant fees

Status: Continued Action

Action 5.7: Move utility lines underground for public safety by prioritizing lines in coastal areas and requiring that all utilities for new residential development to be installed underground.

Priority: Medium

Lead Departments: Department of Public Works, RIDOT

Time Frame: Long Term

Benefit: Future Public Safety

Cost: Staff time, Consultant fees

Status: Continued Action

Action 5.8 Retrofitting flood prone homes located within the Historic District . and other historical buildings and structures in town As ownership changes over time, properties will be upgraded to meet flood standards. Historic homeowners should be directed to resources that will assist them in a self-inspection of their properties to determine how vulnerable their structures are to storm damage.

Priority: Medium

Lead Departments: Planning Department & Building Department

Time Frame: Long Term

Benefit: Mitigation Planning & Property protection

Cost: Staff time

Status: Continued Action

Action 5.9 Continue to implement the Storm Preparedness Plan to mitigate the effect of storms on boats, marina, infrastructure and docks and by preparing harbor and shoreline areas for storm events.

Priority: Medium

Lead Departments: Harbor Commission

Time Frame: Long Term

Benefit: Future Public Safety

Cost: Staff time, Consultant fees

Status: Continued Action



Action 5.10 Maintain town beaches and work with CRMC to re-nourish local beaches to help prevent erosion and protect coastal properties. The Town should also research the possibility of establishment of new beaches.

Priority: Medium

Lead Departments: Department of Public Works, CRMS & Planning Department

Time Frame: Long Term

Benefit: Future Public Safety

Cost: Staff time, Consultant fees

Status: Continued Action

Action 5.11 Perform actions to provide adequate access to forested parcels and a local source of water.

Priority: Medium

Lead Departments: Department of Public Works, Planning Department, Fire Dept., Water Dept.

Time Frame: Long Term

Benefit: Future Public Safety and forest protection

Cost: Staff time, Consultant fees

Status: Continued Action

Goal 6: Maintain essential services at Quonset Point.

Action 6.1 Work with the Quonset Development Corporation to ensure new and existing development at Quonset Point meets State Building Code requirements.

Priority: Medium

Lead Departments: State Building Official

Time Frame: Long Term

Benefit: Future Public Safety

Cost: Staff time, Consultant fees

Status: Continued & Merged Action

Action 6.2: Coordinate closely with RI Airport Corporation and the Army National Guard through the master planning process to assess the need for improvements at Quonset airport to prevent or mitigate flood damage from coastal storms.

Priority: Medium

Lead Departments: Department of Public Works, RIDOT

Time Frame: Long Term

Benefit: Future Public Safety

Cost: Staff time, Consultant fees

Status: Continued Action

Action 6.3: Actively involve flood prone businesses in Quonset Point involved in the outreach process to inform of natural hazards, primarily hurricanes and protection of their property and employees.

Priority: Medium

Lead Departments: Department of Public Works, RIDOT

Time Frame: Long Term

Benefit: Future Public Safety, Mitigation Planning, Protection of Property

Cost: Staff time, Consultant fees

Status: Continued Action



<p>Goal 7: Improve CRS classification.</p>
<p>Action 7.1: Update CRS application and earn s class 7 rating.</p> <p>Priority: Medium Lead Departments: Planning Dept, Building Official, Department of Public Works Time Frame: Long Term Benefit: Future Public Safety Cost: Staff time, Consultant fees Status: New Action</p>
<p>Goal 8: Increase resilience towards coastal hazards and climate change.</p>
<p>Action 8.1 Inform citizens and business owners of impacts from storm surges and rising sea levels through the municipal web site, local information sessions and dissemination of information at the town hall, libraries and chamber of commerce.</p> <p>Priority: Medium Lead Departments: Planning Dept., URICRC & RISG, RIDOT, Building Dept. & DPW Time Frame: Long Term Benefit: Future Public Safety, Mitigation Planning and Property Protection Cost: Staff time, Consultant fees Status: New Action</p>
<p>Action 8.2: Implement recommendations based on the findings of the climate adaptation strategies at local level to help North Kingstown make informed decisions and build an increased resilience to coastal hazards and climate change.</p> <p>Priority: Medium Lead Departments: Planning Department Time Frame: Long Term Benefit: Mitigation Planning Cost: Staff time, Consultant fees Status: New Action</p>
<p>Action 8.3: Implement projects using the TIP and CIP funds.</p> <p>Priority: Medium Lead Departments: Planning Department Time Frame: Long Term Benefit: Future Public Safety & Mitigation Planning Cost: Staff time, Consultant fees Status: New Action</p>
<p>Action 8.4: Continue to coordinate with state agencies and educational institutions to identify new or innovative strategies that have been successfully implemented in other location to address emerging problems.</p> <p>Priority: Medium Lead Departments: Planning Department, Building Department Time Frame: Long Term Benefit: Future Public Safety Cost: Staff time, Consultant fees Status: New Action</p>



6.0 – Implementation

In any plan, the implementation section is one of the most important. Without a clear sense of who is responsible for a given action and in what timeframe it should be completed, many important goals can be lost. Each mitigation action in the previous section includes a brief statement of responsible parties and expected timeframe for completion. These will help to provide parameters for the implementation process.

In compiling these actions there was an emphasis on incorporating the emerging lessons and trends that have been learned since the 2005 plan. From this basis, actions will be incorporated into departmental work plans. Individuals, organizations, and other groups outside of town departments with responsibility for plan actions will work with the appropriate town department to form a schedule for implementation and coordination with town activities. The Capital Improvement Program (CIP) will be used to schedule the funding of actions from the town budget.

The process did highlight potential barriers, most notably, access issues. There are also issues with stormwater that could provide a barrier to ingress/egress in many of the Town's coastal neighborhoods and further concerns with evacuation routes with no alternate routes such as along West Main Street and Phillips Street which are vulnerable to flooding and future inundation. This process has helped to get the discussion and mitigation process started before it's too late. The actions prioritized within will seek to reduce risks from natural hazards and serve as a guide for decision makers as they commit resources to reducing the effects of natural hazards.

PLAN ADOPTION AND INCORPORATION INTO EXISTING PLANS

The plan was approved for submission by the Town Council at the public meeting on January 27, 2014. The plan was reviewed by RIEMA in 2014 and amendments have been included in this draft.

Incorporating the North Kingstown Hazard Mitigation Plan by reference into the North Kingstown Comprehensive Plan will ultimately have an effect on all nine elements of the Comprehensive plan. In the land use section, further development will be directed away from hazard areas, such as the flood zones, as well as away from groundwater recharge areas. The evacuation routes and bridge maintenance make up the additions to the circulation element. Economic development is affected in many ways, from placing development away from hazard areas to forming cooperative agreements with businesses to ensure that adequate supplies are available to the town in the event of an emergency.



The hazard mitigation plan will have some of its greatest influence in the community services and facilities element as outreach programs are developed to inform and prepare residents for natural hazards; as important building and site plan review processes incorporate hazard mitigation into their reviews; and as town facilities are retrofitted to protect them and the important records they contain from damage or destruction during a natural hazard. Natural and cultural resources will also be protected as plans are developed for park clean-up after a storm and methods of protecting historic buildings are researched and distributed. The open space, conservation, and recreation element will benefit from both the preserved open space in hazard vulnerable areas and the storm hazard plans that will be developed for the town's harbors. The Post Road corridor element will be influenced in the storm water management techniques and underground utility lines that will be encouraged for the purpose of hazard mitigation. Finally, the hazard mitigation plan will strongly affect the Quonset Point element in that, much of Quonset Point is located in flood zones and storm surge areas therefore requiring that new construction respect that fact and build to avoid and resist storm damage.

6.1 MONITORING, EVALUATION, AND UPDATES

The North Kingstown Hazard Mitigation Committee will meet bi-annually (July and December) to assess progress on action completion and the effectiveness of actions already completed. The priority actions of this plan will also be reviewed by the committee for funding purposes. Changes in timeframe or other aspects of implementation will be made as necessary. The Director of Planning will serve as the Hazard Mitigation Plan lead, coordinator and point person for the public. The updates will be incorporated into the plan and will be submitted to and reviewed by RIEMA. In addition, the committee will meet within a month following a natural hazard event to discuss the effectiveness of plan elements and to review community input based on their experiences during and after the event.

Evaluation of the plan will consider whether there have been any changes to the nature, magnitude, or type of risks and whether the goals and objectives of the plan are still current and appropriate. New actions will be considered at this time. Outcomes of implementation will also be discussed, including participation and coordination of all involved agencies, resources available for plan implementation, and any problems that have arisen in implementation.

Lessons learned from partnerships projects, such as the sea level rise project will continue to have a profound impact on the way the Town looks at the prevention and adaptation policies. The Town will be ensuring that through the monitoring stages that the incorporation of any new recommendations or findings from policy, studies, research, etc. that could help increase resilience will be a priority.



A full update to the plan will be completed every five years. The update process will include a mechanism for reviewing the existing actions and identifying new priorities as needed. The cost/benefit of these actions will also be considered. The Hazard Mitigation Committee will be integral to this process. The Planning Commission will also have the opportunity to review the plan and provide their input. The North Kingstown Town Council will hold a public hearing as part of the plan revision process which includes an advertised public meeting during which the recommended revisions will be discussed. The public will be encouraged to provide their input into this process. Revised plans will also be sent to the neighboring communities for their review and comment. As required, these updates will be submitted to the RIEMA for review and approval.

CONTINUED PUBLIC INVOLVEMENT

The public will continue to be involved in the hazard mitigation planning process through outreach, public meetings and notifications via emails and in some instances mailing, at all possible stages. The public can also stay involved through the use of the town's web site www.northkingstown.org, where updates to the plan, upcoming meetings and other hazard mitigation topics, will be posted regularly. The town's website has been improved significantly since 2005, with the level of information available regarding flooding information, details of NFIP and the requirements, CRS information, mapping and Town projects, all have been made readily available. This will continue and be enhanced as the Town's GIS capabilities improve.

Recent engagement with the public as outlined in Section 2.0 via walking tours, public presentations, booths, etc. will continue, especially through the sea level rise work and climate adaptation works. This offers a more interactive form of engagement, has resulted in good attendance and has allowed for good discussion opportunities for all. This is a forum that works and should be continued. The Planning Commission and Town Council will also involve the public in the plan maintenance process by holding annual advertised meetings to provide updates and findings on the progress and implementation of the plan. Communication with the public will be provided at all stages, to include the adoption, implementation, evaluation and monitoring of the plan and will play a key role for the Town of North Kingstown in the Hazard Mitigation process.

6.2 CONCLUSION

The purpose of this plan is to help make North Kingstown capable of working towards becoming a safe, more resilient and sustainable town with adequate measures in place to manage a natural hazard event and to have implemented mitigation actions to help reduce the impacts of a natural hazard event. Utilizing mitigation funds helps to ensure that money spent on long term risk reduction measures will reduce the impact of



disasters in the future, including the cost of emergency response and post-disaster cleanup.

The update has sought to embrace all aspects of the process which encompasses the actions of prevention, protection, mitigation, response and recovery to ensure the public health, safety and welfare of residents of the town. In working towards achieving a more resilient North Kingstown, the town will continue to actively coordinate with its many partners, agencies, residents, business owners and educational institutions with the implementation of this plan and future.



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Appendix A: 2005 Plan Actions and Status

Actions from 2005 Plan	Status
Life & Property	
<u>Vulnerable Area #1: Coastal Neighborhoods</u>	
Action #1: Open Space Acquisition	Continuing & Enhanced Action- Open space remains a priority for the Town. Benson property located in the Narrow River watershed was protected in 2014.
Action #2: Volunteer Disaster Assistance Program	Completed
Action #3: Building Code Compliance Enforcement	Continued & Enhanced Action
Action #4: Hazard Mitigation Review in TRC	Consolidated Action- forms part of Hazard Mitigation Committee meeting who are all TRC members
Action #5 Hazard Mitigation Brochure	Ongoing and Improving- Brochures have been prepared and are available on the Town Websites. The town has been continually improving the website and will continue to do
Action #6 Evacuation of Tourist	Consolidate Action
Action #7: Reduce and Manage Storm Water	Continuing & Enhanced Action
Action #8: Post-Disaster Hazard Mitigation Opportunities	Continuing & Enhanced Action
Action #9: Encourage OWTS Upgrades-	Required by Law; update sewer facts here- planned routes for next sewer installments.
<u>Vulnerable Area #2: Wickford Village</u>	
Action #10: Business Continuation-	Completed Action- will be updated and maintained
Action #11: Protection of Repetitive Flood Loss Properties	Continuing Action- The number increased from 13 properties from 3 in the 2005 plan. This remains an important action.
<u>Vulnerable Area #3: Elderly Housing</u>	
Action #12: Protecting Coastal Facilities	Consolidated action
Action #13: Ensuring the Safety of Elderly Housing and Nursing Homes	Only one nursing home in flood zone- no works were done since the last plan
Action #14: Elderly and Handicapped Residents	Consolidated with other vulnerable residents
<u>Vulnerable Area #4: Wickford Village Housing</u>	
Action #15: Protecting Wickford Village Housing from Flooding and Storm Surge	Continued Action
<u>Vulnerable Area #5: Masonry Apartments and Mill Buildings</u>	
Action #16: Earthquake Mitigation	Low priority- nothing was done as never received any request/complaints.
<u>Vulnerable Area #6: Mobile Home Parks</u>	
Action #17: Protecting Mobile Home Parks from High Winds	Low priority- nothing was done.
<u>Vulnerable Area #7: All Hazard Vulnerable Structures</u>	
Action #18: Inventory Assets and Estimate Potential Losses	Continued Action- needs to be better maintained and updated. Difficult action with limited resources.
Action #19: Maintain GIS Capabilities	Ongoing & Improving- the town is in the process of investing in new GIS software to enhance and maintain GIS capabilities
Child Safety	
<u>Vulnerable #1: Town Schools</u>	
Action #20: Protecting Schools in the Flood Zone	Continued Action
Action #21: Safety Procedures for School Children	Continued Action
Action #22: Earthquake Preparation	Consolidated Action
Action #23: Post-Disaster Relocation	Consolidated Action
<u>Vulnerable Area #2: Day-Care Centers</u>	
Action #24: Protecting Day-Care Centers in the Flood Zone	Consolidated Action



Emergency Services and Recovery Plans	
<u>Vulnerable Area #1: Evacuation Routes</u>	
Action #25: Evacuation Route Markers	Needs reviewing
Action #26: Maintain Viable Evacuation Routes	Continued Action
Action #27: Publish Evacuation Routes	Done
Action #28: Coordinate Evacuation Plans with Neighboring Towns	Done
<u>Vulnerable Area #2: Emergency Shelters</u>	
Action #29: Additional Emergency Shelters	Done
<u>Vulnerable Area #3: Town Emergency Operations Center</u>	
Action #30: Ensure Operation Ability of the Town Emergency Operations Center	Continued Action
<u>Vulnerable Area #4: Rhode Island Air and Army National Guard</u>	
Action #31: Ensure Operation Ability of the National Guard Base	Continued Action
<u>Vulnerable Area #5: Town-wide Post-Disaster Plans</u>	
Action #32: Debris Management Plan	Done
Action #33: Recovery and Reconstruction Ordinance	Not Done, Continued concept through new action
Utilities and Infrastructure	
<u>Vulnerable Area #1: Dams</u>	
Action #34: Dam Inspection and Classification	Completed
<u>Vulnerable Areas #2 and 3: Town Bridges</u>	
Action #35: Bridge Inspection	Completed
Action #36: Emergency Procedure for Gas Lines Running on Bridges	Continued Action
Action #37: Emergency Procedure for Water Lines Running on Bridges	Continued Action
<u>Vulnerable Area #4: Town Roads and Streets</u>	
Action #38: Keep Roads Passable During a Hazard Event and Extreme Tides	Continued Action
<u>Vulnerable Area #5: Wells</u>	
Action #39: Protect Town Wells from Flood Waters	Continued Action
Action #40: Protect the Town Water Supply from Contamination and Drought	Continued Action
<u>Vulnerable #6: Electric Utility Lines and Facilities</u>	
Action #41: Tree Trimming	Continued Action
Action #42: Underground Utility Lines	Continued Action
<u>Vulnerable Area #7: QDC Wastewater Treatment Facility</u>	
Action #43: Investigate Vulnerability and Retrofit as Necessary	Continued in Actions
<u>Vulnerable Area #8: Town Wastewater Pumping Facilities</u>	
Action #44: Shutting Off Service	Continued in Actions
Action #45: Flood-proofing	Continued in Actions
Action #46: Emergency Pumping	Continued in Actions
<u>Vulnerable Area #9: Phone Lines</u>	
Action #47: Protecting Land Line Phone Service	Not included Action in update
<u>Vulnerable Area #10: Boston Neck Road Service Station</u>	
Action #48: Contain Hazardous Materials	DEM completed
Action #49: Investigate Vulnerability and Retrofit	Follow up needed- State Law implications- Reviewed Action
Municipal Facilities	
<u>Vulnerable Area #1: Town Hall</u>	
Action #50: Investigate Vulnerability and Retrofit	Continued Action
Action #51: Post-Disaster Relocation	Continued Action



Strategy for Reducing Risks from Natural Hazards in North Kingstown, RI

<u>Vulnerable Area #2: Town Hall Annex</u>	
Action #52: Investigate Vulnerability and Retrofit	<i>Partially completed</i>
Action #53: Post-Disaster Relocation	<i>Continued Action</i>
<u>Vulnerable Area #3: Senior Center, Cold Spring Community Center, and the Art Association Building</u>	
Action #54: Investigate Vulnerability and Retrofit	<i>Partially completed</i>
<u>Vulnerable Area #4: North Kingstown Free Library</u>	
Action #55: Investigate Vulnerability and Retrofit	<i>Continued Action</i>
Action #56: Protect Library Resources	<i>Continued Action</i>
<u>Vulnerable Area #5: Highway Department Facilities Building</u>	
Action #57: Contain Hazardous Materials	<i>Continued & Consolidated Action</i>
Cultural Resources	<i>Continued & Consolidated Action</i>
<u>Vulnerable Area #1: Wickford Historic District</u>	
Action #58: Retrofitting Historic Homes	
<u>Vulnerable Area #2: Gilbert Stuart Birthplace and Smith's Castle</u>	
Action # 59: Retrofitting the Buildings	<i>Continued & Consolidated Action</i>
Quonset Point	
<u>Vulnerable Area #1: Existing and Proposed Development at Quonset Point</u>	
Action #60: New Development	<i>Consolidated Action</i>
Action #61: Current and New Development	<i>Consolidated Action</i>
Action #62: Outreach	<i>Continued Action</i>
Action #63: Hazardous Material Containment	<i>Continued Action</i>
Action #64: Business Continuation	<i>Continued Action</i>
<u>Vulnerable Area #2: Quonset State Airport</u>	
Action #65: Investigate Vulnerability and Retrofit	<i>Continued Action</i>
Recreational Resources	
<u>Vulnerable #1: Town Harbors, Docks, and Moorings</u>	
Action #66: Storm Preparedness Plan	<i>Completed</i>
Action #67: Wickford Harbor Breakwater	<i>Continued Action</i>
<u>Vulnerable Area #2: Town Beaches</u>	
Action #68: Beach Maintenance	<i>Continued & consolidated Action</i>
<u>Vulnerable Area #3: Ryan Park, Chafee Nature Preserve (Rome Point), Wilson Park, Cocumscussoc State Park, Calf Pasture Point</u>	
Action #69: Fire Protection	<i>Continued Action</i>
<u>Vulnerable Area #4: Municipal Golf Course</u>	
Action #70: Investigate Vulnerability and Retrofit	<i>Not completed</i>



Appendix B: Glossary of Key Terms

100-Year Flood (also called the Base Flood). The flood having a one percent chance of being equaled or exceeded in magnitude in any given year. Contrary to popular belief, it is not a flood occurring once every 100 years.

AAL. Average Annualized Loss.

ACAMS. Automated Critical Asset Management System.

AEL. Annualized Earthquake Losses.

AE LR. Annualized Earthquake Loss Ratio.

AFG. Assistance to Firefighters Grants.

All-hazards Approach. Integrated hazard mitigation strategy that incorporates planning for and consideration of all potential natural and manmade hazard threats.

APA. Approved Pending Adoption.

ASFPM. Association of State Floodplain Managers.

Flood. The flood having a one percent chance of being equaled or exceeded in magnitude in any given year. (Also known as the 100-year flood). This is the flooding event that is used to calculate flood risk for the National Flood Insurance Program (NFIP) and the Federal Emergency Management Agency (FEMA).

Base Flood Elevation. The height (above mean sea level) that flood waters will reach at a given location in the event of the base (100-year) flooding event.

BOCA. Building Official & Code Administration.

CAP. Community Assistance Program.

CAP-SSE. Community Assistance Program Support Services Element.

CAP-SSSE. Community Assistance Program – State Support Services Element

CAZ. Coastal A Zone (CAZ) is a term that is used to draw a distinction between coastal and inland A Zones, and to highlight similarities between V Zones and A Zones in coastal areas. In a Coastal A Zone, the principal source of flooding will be astronomical tides, storm surges, seiches or tsunamis, not riverine flooding. During base flood conditions the potential for breaking wave heights between 1.5 feet and 3.0 ft will exist.

CBO. Community Based Organizations.

CCP. Community Comprehensive Planning Program.

CDBG. Community Development Block Grant.

CDBG-DR. Community Development Block Grant – Disaster Recovery

CDC. Centers for Disease Control.

CEPR. Center for Emergency Preparedness and Response.

CFAA. Cooperative Forestry Assistance Act.

CFP. Cooperative Fire Protection.

CFR. Code of Federal Regulations.

CIKR. Critical Infrastructure and Key Resources.

CMI. Crop Moisture Index.

Contour. A line of equal ground elevation on a topographic map.

COOP. Continuity of Operations Plan.



CPD. The Office of Community Planning and Development

CPG. Comprehensive Preparedness Guide.

CRC. Coastal Resources Center.

Critical Facility. Facilities that are vital to the health and welfare of the population and that are especially important following disasters. Critical facilities include, but are not limited to, shelters, police and fire and hospitals.

CRMC. Rhode Island Coastal Resources Management Council

CRS. Community Rating System a National Flood Insurance Program that provides incentives for NFIP-member communities to complete activities that reduce flood hazard risk. When the community completes specified activities, the insurance premiums of NFIP policyholders in these communities are reduced.

CSC. Coastal Services Center, part of NOAA, located in Charleston, SC.

CT. Connecticut.

CTM. Coastal Terrain Model

CTP. Cooperating Technical Partners.

DBR. Department of Business Regulation.

DEM. Department of Environmental Management.

DFIRM. Digital Flood Insurance Rate Map.

DHTF. Disaster Housing Task Force.

DHS. Department of Homeland Security.

DMA 2000. Disaster Mitigation Act of 2000.

DMAT. Disaster Medical Assistance Team.

DPUC. Division of Public Utilities and Carriers.

DOA. Department of Administration.

DOF. Department of Forestry.

DOH. Department of Health.

DOT. Department of Transportation

DWQ. Drinking Water Quality.

EAP. Emergency Action Plan.

EAS. Emergency Alert System.

Earthquake. A sudden motion or trembling that is caused by a release of strain accumulated within or along the edge of the earth's tectonic plates.

EDC. University of Rhode Island Environmental Data Center.

EMA. Emergency Management Agency.

EMD. Emergency Management Director.

Enhanced Fujita Tornado Scale. An update to the original F-scale by a team of meteorologists and wind engineers that was implemented in the US on February, 1, 2007.

EOC. Emergency Operations Center.

EOP. Emergency Operations Plan.

EPA. Environmental Protection Agency.



ESF. Emergency Support Function.

EWP. Emergency Watershed Protection Program.

FEMA. Federal Emergency Management Agency.

FHA. Federal Highway Act.

FHWA. Federal Highway Administration.

FIRM. Flood Insurance Rate Map. The insurance and floodplain management map issued by FEMA that identifies areas of 100-year flood hazard in a community. In some areas, the map also shows base flood elevations and 500-year floodplain boundaries and occasionally, regulatory floodway boundaries.

FIS. Flood Insurance Study. Engineering study performed by FEMA to identify flood hazard areas, flood insurance risk zones, and other flood data in a community.

Flash Flood. A flash flood is a specific type of flood that appears and moves quickly across the land with little warning, making it very dangerous. A flash flood is the fastest moving type of flood. It happens when heavy rain collect in a stream or gully, turning the normally calm area into an instant rushing current.

Flood. A general and temporary condition of partial or complete inundation of normally dry land areas from: (1) the overflow of inland or tidal waters; (2) the unusual and rapid accumulation of runoff of surface water from any source.

Flood Depth. Height of the floodwater surface above the ground surface.

Flood Elevation. Elevation of the water surface above an established datum, e.g. National Geodetic Vertical Datum of 1929, North American Vertical Datum of 1988, or Mean Sea Level.

Flood Fringe. That portion of the 100-year floodplain outside the floodway in which total encroachment is permissible.

Floodplain. Any land area susceptible to inundation by floodwaters from any source.

Floodproofing. Any combination of structural and non-structural additions, changes or adjustments to structures which reduce or eliminate flood damage to real estate or improved real property, water and sanitary facilities, structures and their contents.

Floodway. The channel of a river or watercourse and the adjacent land areas that must be reserved in order to discharge the 100-year flood without cumulatively increasing the water surface elevation more than one foot.

FMA. Flood Mitigation Assistance.

FMAP. Flood Mitigation Assistance Program.

FMO. Fire Marshall's Office.

FP&S. Fire Prevention and Safety Grants

FPMS. Floodplain Management Services.

FTE. Full-time employee.

Fujita Scale of Tornado Intensity. An intensity scale which rates tornadoes with numeric values from F0 to F5 based on tornado wind speed and damage sustained. An F0 rating indicates light damage such as broken tree limbs or signs, while an F5 rating indicates incredible damage was sustained.

Geographic Information System (GIS). A computer software application that relates



physical features on the earth to a database to be used for mapping and analysis.

Hazard. A source of potential danger or adverse conditions. Hazards included in this plan are natural in origin and include: floods, droughts, high winds, winter storms; hurricanes; tornadoes; dam failures and coastal erosion. These events are hazards when they have the potential to harm people or property.

Hazard Identification. The process of identifying hazards that threaten an area.

Hazard Mitigation. Sustained actions taken to reduce or eliminate long-term risk from hazards and their effects.

Hazard Profile. A description of the physical characteristics of hazards and a determination of various descriptors including magnitude, duration, frequency, probability and extent.

Hazards U.S. (HAZUS). A GIS-based software program that is a nationally standardized earthquake, flood, and hurricane wind loss estimation tool developed by FEMA.

Hazus-MH. Hazards US Multi-Hazard.

HEALTH. Rhode Island Department of Health.

HHS. Department of Health and Human Services.

HIRA. Hazard Identification and Risk Assessment.

HMA. Hazard Mitigation Assistance.

HMGP. Hazard Mitigation Grant Program.

HSIN. Homeland Security Information Network.

HUC. Hydrologic Unit Code.

HUD. Department of Housing and Urban Development.

Hurricane. An intense tropical cyclone, formed in the atmosphere over warm ocean areas, in which wind speeds reach 74 miles-per-hour or more and blow in a large spiral around a relatively calm center or “eye.” Hurricanes develop over the North Atlantic Ocean, northeast Pacific Ocean, or the South Pacific Ocean east of 160 degrees longitude. Hurricane circulation is counter-clockwise in the northern hemisphere and clockwise in the southern hemisphere.

HWM. High Water Marks.

Hydrology. The science of dealing with the waters of the earth. A flood discharge is developed by a hydrologic study.

IA. Individual Assistance.

IBC. International Building Code.

ICC. International Code Council, Inc.

ICS. Incident Command System.

IHP. Individual and Households Program.

IPCC. Intergovernmental Panel on Climate Change.

Intensity. A measure of the effects of a hazard event at a particular place.

ISR. Infrastructure, Safety and Reliability.

LHMC. Local Hazard Mitigation Committee.

LiDAR. Light Detection and Radar.

Liquefaction. The phenomenon that occurs when ground shaking causes loose soils



(such as till and outwash) to lose strength and act like a viscous fluid. Liquefaction causes two types of ground failure: lateral spread and loss of bearing strength.

Lowest Floor. Under the NFIP, the lowest floor of the lowest enclosed area (including basement) of a structure.

Magnitude. A measure of the strength of a hazard event. The magnitude (also referred to as severity) of a given hazard is usually determined using technical measures specific to a hazard.

MHHW. Mean Higher High Water.

Mitigation. The process of reducing the severity of the impact of natural hazards through planning. Each hazard requires a specific type of mitigation. In some cases, we can use engineering solutions (such as an earthquake -resistant building) to at least temporarily reduce the impact of a natural hazard. In other cases, the only form of mitigation that is guaranteed to be successful is to limit or not allow human activities where the hazard occurs (such as in floodplains).

Mitigation Plan. A systematic evaluation of the nature and extent of vulnerability to the effects of natural hazards typically present in the state and includes a description of actions to minimize future vulnerability to natural hazards.

MMI. Modified Mercalli Intensity.

MOU. Memorandum of Understanding.

MRC. Medical Reserve Corps.

National Grid. The State's dominant electric utility and sole natural gas service provider.

Natural Disaster. A natural hazard event, such as a flood or tornado, which results in widespread destruction of property or caused injury and/or death.

Natural Hazard. An unexpected or uncontrollable natural event of unusual magnitude that threatens the activities of people or people themselves.

NCEI. National Centers for Environmental Information.

NECIA. Northeast Climate Impact Assessment Group.

NEHRP. National Earthquake Hazards Reduction Program.

NERACOOS. Northeast Regional Association of Coastal and Ocean Observing Systems.

NESEC. New England States Emergency Consortium.

NFIF. National Flood Insurance Fund.

NFIP. National Flood Insurance Program.

NFR. National Response Framework.

NHC. National Hurricane Center.

NHRP. National Register of Historic Places.

NIPP. National Infrastructure Protection Plan.

NIMS. National Incident Management System.

NOAA. National Oceanic and Atmospheric Administration.

Nor'easter. An extra-tropical cyclone producing gale-force winds and precipitation in the form of heavy snow.

NPCC. New York Panel on Climate Change.

NPDP. National Performance of Dams Program.



NRCS. Natural Resources Conservation Service.

NROC. Northeast Regional Ocean Council.

NWI. National Wetland Inventory.

NWS. National Weather Service.

OER. Office of Emergency Response.

OHCD. Office of Housing and Community Development

OSHA. Occupational Safety and Health Administration

OWR. Office of Water Resources

PA. Public Assistance.

PAC. Public Assistance Coordinator.

PAS. Planning Assistance to States.

PCII. Protected Critical Infrastructure Information.

PDA. Preliminary Damage Assessment.

PDI. Palmer Drought Index,

PDM. Pre-Disaster Mitigation Program. Authorized by Section 203 of the Robert T. Stafford Disaster Assistance and Emergency Relief Act (Stafford Act), 42 USC, as amended by 102 of the Disaster Mitigation Act Mitigation Fund to assist States and local governments (to include Indian Tribal governments) in implementing cost-effective hazard mitigation activities that complement a comprehensive mitigation program.

PDSI. Palmer Drought Severity Index.

PGA. Peak Ground Acceleration.

PHEP. Public Health Emergency Preparedness.

ProvPlan. The Providence Plan.

PUC. Public Utilities Commission.

PWS. Public Water System. A system that provides water for human consumption through pipes or other constructed conveyances to at least 15 service connections or serves an average of at least 25 people for at least 60 days a year

RFC. Repetitive Flood Claims . The Repetitive Flood Claims (RFC) grant program was authorized by the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004 (P.L. 108–264), which amended the National Flood Insurance Act (NFIA) of 1968 (42 U.S.C. 4001, et al).

RL. Repetitive Loss. A property that is currently insured for which two or more National Flood Insurance Program losses (occurring more than ten days apart) of at least \$1,000.00 each have been paid within any 10-year period of time since 1978.

RI. Rhode Island.

RIBC. Rhode Island Building Commission.

RIEMA. Rhode Island Emergency Management Agency.

RIGIS. Rhode Island Geographic Information System.

RISCON. Rhode Island Statewide Communications Network.

RISG. Rhode Island Sea Grant.

Risk. The estimated impact that a hazard would have on people, services, facilities, and structures in a community; the likelihood of a hazard event resulting in an adverse



condition that causes injury or damage. Risk is often expressed in relative terms such as high, moderate, or low likelihood of sustaining damage above a particular threshold due to a specific type of hazard event. It can also be expressed in terms of potential monetary losses associated with the intensity of the hazard.

RISNER. Rhode Island Special Needs Emergency Registry.

Riverine. Of or produced by a river.

SAMP. Special Area Management Plan.

SAR. Suspicious Activity Report.

SBA. Small Business Administration.

Scour. Removal of soil or fill material by the flow of floodwaters. The term is frequently used to describe storm-induced, localized conical erosion around pilings and other foundation supports where the obstruction of flow increases turbulence.

SEOC. State Emergency Operations Center.

SHARP. Safety and Health Achievement Recognition Program.

SHMO. State Hazard Mitigation Officer. The representative of state government who is the primary point of contact with FEMA, other state and federal agencies, and local units of government in the planning and implementation of pre- and post-disaster mitigation activities.

SHMP. State Hazard Mitigation Plan Update

SHPO. State Historic Preservation Office.

SIHMC. State Interagency Hazard Mitigation Council. Representatives of state agencies, non-profits, and who the primary point of contact for the Rhode Island Hazard Mitigation Plan

SLAMM. Sea Level Rise affecting Marsh Model.

SLOSH. Sea, Lake, Overland Surges from Hurricane is a computerized model run by the National Hurricane Center to estimate storm surge heights and winds resulting from historical, hypothetical or predicted hurricanes by taking into account pressure, size, forward speed, track and winds.

SLR. Sea Level Rise.

SMART. Specific, Measureable, Achievable, Realistic, and Time-Oriented.

Special Flood Hazard Area (SFHA). The shaded area on the Flood Hazard Boundary Map (FHBM) or Flood Insurance Rate Map (FIRM) which identifies an area that has a one percent chance of being flooded in any given year (100-year floodplain). The FIRM identifies these shaded areas as FIRM Zones A, AO, AH, A1 -A30, AE, A99, V, V1 -30, and VE.

SRF. State Revolving Fund.

SRL. Severe Repetitive Loss. The Severe Repetitive Loss (SRL) grant program was authorized by the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004, which amended the National Flood Insurance Act of 1968 to provide funding to reduce or eliminate the long-term risk of flood damage to severe repetitive loss (SRL) structures insured under the National Flood Insurance Program (NFIP).

SSEER. Scientific Support for Environmental Emergency Response.



Stafford Act. The Robert T. Stafford Disaster Relief and Emergency Act, P.L. 100-107 was signed into law November 23, 1988 and amended the Disaster Relief Act of 1974, P.L. 23-288. The Stafford Act is the statutory authority for most federal disaster response activities, especially as they pertain to FEMA and its programs.

STAPLEE. Social, Technical, Administrative, Political, Legal, Economic and Environmental Criteria.

Storm Surge. A rise in the water surface above normal water level on the open coast due to the action of wind stress and atmospheric pressure on the water surface

Substantial Damage. Damage of any origin sustained by an obstruction whereby the cost of restoring the obstruction to its before-damage condition would equal or exceed 50 percent of the market value of the obstruction before the damage occurred.

Substantial Improvement. Any reconstruction, rehabilitation, addition, or other improvement of an obstruction, the cost of which equal or exceed 50 percent of the market value of the obstruction before "start of construction" of the improvement. This includes obstructions which have incurred "substantial damage," regardless of the actual

repair work performed. The term does not, however, include either (1) any project for improvement of a structure or other obstruction to correct existing violations of state or local health, sanitary, or safety code specifications which have been identified by the local code enforcement official and which are the minimum necessary to assure safe living conditions, or (2) any alteration of a "historic structure," provided that the alteration will not preclude the structure's continued designation as a "historic structure."

Technological Disaster. A disaster that results from a technological or man-made hazard event

Technological Hazard. A hazard that originates in accidental or intentional human activity (oil spill, chemical spill, building fires, terrorism, etc.)

THIRA. Threat and Hazard Identification and Risk Assessment.

Topographic Map. A map which shows natural features and indicates the physical shape of the land using contour lines. These maps may also include manmade features.

Tornado. A violently rotating column of air extending ground-ward

Tropical Cyclone. A generic term for a cyclonic, low pressure system over tropical or sub-tropical waters

Tropical Storm. A tropical cyclone with maximum sustained winds greater than 39 miles per hour and less than 74 miles per hour.

URI. University of Rhode Island.

USACE. United States Army Corps of Engineers

USDA. United States Department of Agriculture.

USGS. United States Geological Survey.

VFA. Volunteer Fire Assistance Grants

Vulnerability. Describes how exposed or susceptible to damage an asset is. Vulnerability depends upon an asset's construction, contents, and the economic value of its



functions. Like indirect damages, the vulnerability of one element of the community is often related to the vulnerability of another.

WFO. Weather Forecast Office.

Wildfire. An uncontrollable fire spreading through vegetative fuels, exposing and possibly consuming structures

WRB. Water Resources Board.

WSSMP. Water Supply System Management Plan program.

WUI. Wildland Urban Interface.

ZONE A (UNNUMBERED). Special Flood Hazard Areas subject to inundation from the 100-year flood. Because detailed hydraulic analyses have not been performed, no base flood elevations or depths are shown. Mandatory flood insurance purchase requirements apply.

ZONE AE and A1 -30. Special Flood Hazard Areas subject to inundation by the 100-Year flood determined in a Flood Insurance Study by detailed methods. Base flood elevations are shown within these zones. Mandatory flood insurance purchase requirements apply. (Zone AE is used on new and revised maps in place of Zones A1 -30.)

ZONE AH. Special Flood Hazard Areas subject to inundation by 100-year shallow flooding (usually areas of ponding) where average depths are between one and three feet. Base flood elevations derived from detailed hydraulic analyses are shown in this zone. Mandatory flood insurance purchase requirements apply.

ZONE AO. Special Flood Hazard Areas subject to inundation by 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between one and three feet. Average flood depths derived from detailed hydraulic analyses are shown within this zone. Mandatory flood insurance purchase requirements apply.

ZONE X. Areas that have been identified in the community flood insurance study as areas of moderate or minimal flooding from a principal source in the area. However, buildings in these zones could be flooded by severe, concentrated rainfall coupled with inadequate local drainage systems. Flood insurance is available in participating communities but is not required by regulation in these zones.



Appendix C: Rhode Island State Interagency Hazard Mitigation Committee (SIHMC)

Chris Albert Senator Reed's Office

Nicole Alexander-Scott Rhode Island Department of Health (RIDOH)

Ernie Allen Rhode Island State Police (RISP)

Peter Alviti Rhode Island Department of Transportation (RIDOT)

Dave Aucoin Narragansett Bay Commission

Scott Avedisian Rhode Island Public Transit Authority (RIPTA)

Jim Ball Rhode Island Department of Environmental Management (DEM)

Brian Balukonis United States Army Corp o Appendices

Edward Capone National Weather Service (NWS) /

Northeast River Forecast Center (NERFC)

Steven Cascione Rhode Island Department of Transportation (RIDOT)

Michael Casey Rhode Island State Police (RISP)

Janet Coit Rhode Island Department of Environmental Management (DEM)

Bob Cooper Governor's Commission on Disabilities

Kathy Crawley Rhode Island Water Resources Board

Teresa Crean University Of Rhode Island Coastal Resources Center

Ryan Curtis Congressman Langevin's Office

Brian Daniels Rhode Island League of Cities and Towns

Michael DiBiase Rhode Island Department of Administration (DOA)

Warren Ducharme Rhode Island Building Code Commission

Sue Earley Rhode Island Department of Behavioral Healthcare, Developmental Disabilities and Hospitals (BHDDH)

Jeffrey Emidy Rhode Island Historic Preservation & Heritage Commission

Chris Fox Wood-Pawcatuck Watershed Association

Edward Fratto Northeast States Emergency Consortium (NESEC)

Janet Freedman Rhode Island Coastal Resources Management Council (CRMC)

Grover Fugate Rhode Island Coastal Resources Management Council (CRMC)

Randall Galpin Natural Resources Conservation Services (NRCS)

Peter Gaynor Rhode Island Emergency Management Agency (RIEMA)

Alan Gillespie Natural Resources Conservation Services (NRCS)

Peter Ginaitt Warwick Sewer

Authority Russ Godin Rhode Island Interlocal Risk Management Trust

Alicia Good Rhode Island Department of Environmental Management (DEM)

Carol Grant Rhode Island Office of Energy Resources (OER)

Terry Gray Rhode Island Department of Environmental Management (DEM)

Caitlin Greeley Rhode Island Department of Administration (DOA) - Division of Planning

Chris Hatfield United States Army Corp of Engineers (USACE)

Peter Healey Rhode Island Department of Transportation (RIDOT)

Melinda Hopkins Rhode Island Emergency Management Agency (RIEMA)

Christopher Kearns Rhode Island Office of Energy Resources (OER)



John Kennedy National Grid
John Kennelly United States Army Corp of Engineers (USACE)
Stephen King Quonset Development Corporation
Anne Kirori ANA
Kenya Seth Klaiman Congressman Langevin's Offi
Alysia Mihalakos Rhode Island Department of Health (RIDOH)
Kara Morris National Grid
Erin Norris Rhode Island Emergency Management Agency (RIEMA)
Shaun O'Rourke Rhode Island Infrastructure Bank
Paula Pallozzi Department of Business Regulations (DBR)
Bill Patenaude Rhode Island Department of Environmental Management (DEM)
Spencer Peck Rhode Island EMA
Jamie Pereira Rhode Island Public Transit Authority (RIPTA)
Daniel Porter Rhode Island Airport Corporation
Denise Poyer Wood-Pawcatuck Watershed Association
Christine Quigley Narragansett Chamber of Commerce Chamber
Samantha Richer Rhode Island Emergency Management Agency (RIEMA)
Susan Roberts Red Cross
Christopher Rolleston Federal Emergency Management Agency (FEMA)
Pam Rubinoff University of Rhode Island Coastal Resources Center
Shannon Ruff Rhode Island Interlocal Risk Management Trust
Peder Schaefer Rhode Island League of Cities and Towns
John Shea Aquidneck Island Planning Commission
Philip Sheridan Rhode Island Department of Health (RIDOH)
Anthony Silva Lt. Governor's Office Brett Smiley Governor's Office
Stephen Soito Providence Water
Dinalyn Spears Narragansett Indian Tribe
Monica Staaf Rhode Island Association of Realtors (RIAR)
Greg Stewart United States Geologic Survey (USGS)
Jonathan Stone Save the Bay
Laura Sullivan (DOA)- Office of Housing and Community Development
Melissa Surette Federal Emergency Management Agency (FEMA)
Brian Tardiff Rhode Island Division of Information Technology (DOIT)
Erica Tefft University of Rhode Island Environmental Data Center
Michael Tondra (DOA)- Office of Housing and Community Development
Erik Ulmen U.S. Department of Homeland Security
Dave Vallee National Weather Service (NWS)
Phou Vongkhamdy Natural Resources Conservation Services (NRCS)
Henry Walker Environmental Protection Agency (EPA) - Rhode Island
Michael Walker Rhode Island Department of Commerce
Matt Walsh United States Army Corp of Engineers (USACE)
Jen West Narragansett Bay Estuary Research Reserve



APPENDIX D: TECHNICAL AND FINANCIAL ASSISTANCE FOR MITIGATION

STATE RESOURCES

Rhode Island Emergency Management Agency

645 New London Avenue
Cranston, RI 02920
Phone: (401) 946-9996

Coastal Resources Center

University of Rhode Island
Narragansett Bay Campus
Narragansett, RI 02882
Phone: (401) 874-6224

Coastal Resources Management Council

Stedman Government Center
4808 Tower Hill Road
Wakefield, RI 02879
Phone: (401) 277-2476

Department of Administration/Division of Planning

One Capitol Hill
Providence, RI 02908
Phone: (401) 277-6478

State of Rhode Island Building Commissioner's Office

560 Jefferson Boulevard, 2nd Floor
Suite 204
Warwick, RI 02886
(401) 889-5550

Rhode Island Builders Association

The Terry Lane Corporation
Terry Lane
Gloucester, RI 02814
Phone: (401) 568-8006



Department of Transportation-Design Section/Bridges

2 Capitol Hill, Room 231D
Providence, RI 02903
Phone: (401) 277-2053

Rhode Island Department of Business Regulations

233 Richmond Street
Providence, RI 02903
Phone: (401) 277-2246

State Fire Marshal's Office

272 West Exchange Street
Providence, RI 02903
Phone: (401) 277-2335

Rhode Island Banking Commission/Associate Director

233 Richmond Street
Providence, RI 02903
Phone: (401) 277-2405

Public Utilities Commission

100 Orange Street
Providence, RI 02903
Phone: (401) 277-3500 Ext. 153

Department of Environmental Management

235 Promenade Street
Providence RI 02908
Phone: (401) 222-6800



FEDERAL RESOURCES

Federal Emergency Management Agency

Mitigation Division
Region I Office
99 High Street
Boston, MA
(617) 223-9561

U.S. Army Corps of Engineers

New England District
424 Trapelo Road
Waltham, MA 02254
(617) 647-8505

Department of Agriculture Natural Resources Conservation Service

(formerly Soil Conservation Service)
451 West Street
Amherst, MA 01002
(413) 253-4362

National Weather Service

Boston / Norton, MA
46 Commerce Way
Norton, MA 02766
(508) 622-3250

Economic Development Administration

Philadelphia Regional Office
The Curtis Center
601 Walnut Street, Suite 140 South
Philadelphia, PA 19106-3323
(215) 597-8822

Department of the Interior

1849 C St., NW
Washington, DC 20240
(202) 208-3100



National Park Service

Rivers and Trails Conservation Program
Regional Office
15 State Street
Boston, MA 02109
(617) 223-5203

U.S. Fish and Wildlife Service

Northeast Regional Office
U.S. Fish and Wildlife Service
300 Westgate Center Drive
Hadley, MA 01035-9587
(413) 253-8200

Department of Housing and Urban Development

Community Development Block Grants
Region I - O'Neill Federal Building
10 Causeway Street
Boston, MA 02222
(617) 565-5354

Small Business Administration

10 Causeway Street
Room 265
Boston, MA 02222
(617) 565-5590

Environmental Protection Agency

Region I Offices
5 Post Office Square - Suite 100
Boston, MA 02109-3912
(617) 565 3400

U.S. Department of Agriculture

Natural Resources Conservation Service

451 West Street
Amherst, MA 01002
(413) 253-4362



OTHER RESOURCES

The Association of State Floodplain Managers (ASFPM)

Professional association with a membership of almost 1,000 state employees that assist communities with the NFIP. ASFPM has developed a series of technical and topical research papers and a series of proceedings from their annual conferences. Many mitigation “success stories” have been documented through these resources and provide a good starting point for planning.

Floodplain Management Resources Center

Free library and referral service of the ASFPM for floodplain management publications. Co-located with the Natural Hazards Center at the University of Colorado in Boulder, staff can use keywords to identify useful publications from the more than 900 flood-related documents in the library.

Institute for Business and Home Safety (IBHS) (formally Insurance Institute for Property Loss Reduction)

An insurance industry-sponsored, nonprofit organization dedicated to reducing losses—deaths, injuries, and property damage—resulting from natural hazards. IBHS efforts are directed at five specific hazards: flood, windstorm, hail, earthquake, and wildfire. Through its public education efforts and information center, IBHS communicates the results of its research and statistical gathering, as well as mitigation information, to a broad audience.

Volunteer Organizations

Organizations, such as the American Red Cross, the Salvation Army, Habitat for Humanity, Interfaith, and the Mennonite Disaster Service, are often available to help after disasters. Service organizations, such as the Lions, Elks, and VFW are also available. These organizations have helped others with food, shelter, clothing, money, etc. Habitat for Humanity and the Mennonite Disaster Service provide skilled labor to help rebuild damaged buildings incorporating mitigation or flood-proofing concepts. The offices of individual organizations can be contacted directly, or the FEMA Regional Office may be able to assist.

Flood Relief Funds

After a disaster, local businesses, residents, and out-of-town groups often donate money to local relief funds. They may be managed by the local government, one or more local churches, or an ad hoc committee. No government disaster declaration is needed. Local officials should recommend that the funds be held until an applicant



exhausts all sources of public disaster assistance. Doing so allows the funds to be used for mitigation and other projects that cannot be funded elsewhere.

**New England States Emergency Consortium (NESEC)
Lakeside Office Park**

NESEC conducts public awareness and education programs on natural disaster and emergency management activities throughout New England. Brochures and videotapes are available on such topics as earthquake preparedness, mitigation, and hurricane safety tips. NESEC maintains a web page that is accessible at <http://www.serve.com/NESEC>.

**The New England Floodplain and Stormwater Managers Association
(NEFSMA)**

Professional organization for New England floodplain and stormwater managers. Provides workshops, conferences, and a newsletter to membership and interested individuals and companies. Contact: Nicholas Winter, chairman, at (617) 727-0488 or NEFSMA's homepage on the Web at <http://www.seacoast.com/~nefsma>.



APPENDIX E: EXISTING PROTECTION SYSTEMS - FEDERAL AND STATE

National Flood Insurance Program:

All of Rhode Island's 39 municipalities participate in the NFIP. This program is a direct agreement between the federal government and the local community that flood insurance will be made available to residents in exchange for community compliance with minimum floodplain management regulations. Communities participating in the NFIP must:

1. Adopt the Flood Insurance Rate Maps as an overlay regulatory district.
2. Require that all new construction or substantial improvement to existing structures in the flood hazard area be elevated or (if nonresidential) flood-proofed to the identified flood level on the maps.
3. Require design techniques to minimize flood damage for structures being built in high hazard areas, such as floodways or velocity zones

In return for community adoption of these standards, any structure in that community is eligible for protection by flood insurance, which covers property owners from losses due to inundation from surface water of any source. Coverage for land subsidence, sewer backup and water seepage is also available subject to the conditions outlined in the NFIP standard policy (see Appendix A, Federal Resources, for contacts regarding insurance coverage and purchase). Since homeowners' insurance does not cover flooding, a community's participation in the NFIP is vital to protecting property in the floodplain as well as being essential to ensure that federally backed mortgages and loans can be used to finance flood prone property.

Increased cost of compliance (ICC) coverage has recently been implemented for all new NFIP policies and renewals and is intended to be "mitigation insurance" to allow homeowners whose structures have been repeatedly or substantially damaged to cover the cost of elevation and design requirements for rebuilding with their flood insurance claim up to a maximum of \$15,000.

Community Rating System:

A voluntary initiative of the NFIP, the CRS was developed to encourage communities to perform activities that exceed the minimum NFIP floodplain management standards. If a community participating in the CRS performs activities that include maintaining records for floodplain development, publicizing the flood hazard, improving flood data, and floodplain management planning, then the flood insurance premiums paid by policy holders in the community will be reduced by 5 to 45 percent. Developing a flood mitigation plan will help communities gain additional credit under the CRS.



Coastal Barrier Resource Act:

Administered by the U.S. Fish and Wildlife Service, this program has mapped public and private land identified as undeveloped coastal barrier areas. These areas may be denoted as “Otherwise Protected Areas” if they are owned by public entities. In the coastal barrier areas shown on FEMA’s Flood Insurance Rate Maps, structures newly built or substantially improved after the date shown on the maps are ineligible for federal flood insurance. This serves to restrict new development in these areas because the purchase of flood insurance is required to obtain federal-backed mortgages and improvement loans for structures located in special flood hazard areas.

State Barrier Beaches:

Your community may have barrier beaches, as defined by the state’s R.I. Coastal Resources Management Program. The regulations applying to these areas are enforced by CRMC. These regulations restrict alteration of the beach and/or dunes and the construction of coastal engineering structures. New or substantially reconstructed buildings generally must be elevated to a minimum of one foot above base flood elevation. No new commercial development is allowed on barrier beaches. If a structure is damaged more than 50 percent, it cannot be rebuilt.

Warning Systems and Emergency Operations Plans:

Your community may have a flood warning system in place and should have a plan for response to flooding. In addition, RIEMA has offices throughout the state that maintain area-wide plans for flood events.

Evacuation Plans and Systems:

Your community’s emergency operations center should have evacuation plans in place. For communities near a nuclear power plant, evacuation plans are required, and may also be used for flood evacuation. RIEMA may have additional evacuation plan information.

Land Use Restrictions:

There are several federal and state regulations that serve to restrict land use in certain areas that may help reduce flood hazard vulnerability. If your community has open land owned by the state or federal government, examine what restrictions are placed on its development. In addition, the state Wetlands Protection Act regulates the development of all lands identified as significant to the protection of resources identified in the Act.



Septic Systems:

If there are areas in the community not served by a public sewer system, state septic system regulations influence development and may be a consideration for mitigation alternatives that include rebuilding and elevation of structures. Specific design requirements must be met for any construction in coastal velocity zones or river floodways. Generally, an inspection of a septic system is required if there is a change in use of the structure, an increase in flow, or failed system. Limited inspections are required if the footprint of the structure is being changed. Upgrades are required by the state if an inspection reveals a failed system. However, local regulations may be more restrictive than state requirements, requiring inspections or upgrades in other cases.

Economic/Community Development:

There may be programs existing to help flood proof homes using Community Development Block Grant funds. There may be housing assistance programs in the community that can be used following a major flood, achieving both the objectives of reducing flood damage and improving the community's housing stock (see Appendix A, federal resources, for more information).

Hazard Mitigation Grant Program:

Also known as the 404 Program or HMGP, this program is available only after a federally declared disaster occurs. It represents an additional 15 percent of all the infrastructure and individual assistance funds that are provided to states to repair damages and recover from losses, and is administered by the state in partnership with FEMA. Having a plan or completed mitigation action matrix prior to a disaster event is extremely helpful in meeting the state's deadlines for applications and ensuring the project is eligible and technically feasible. It provides 75/25 matching grants on a competitive basis to state, local, and tribal governments, as well as certain nonprofit organizations that can be matched by either cash or in-kind services. The grants are specifically directed toward reducing future hazard losses, and can be used for projects protecting property and resources against the damaging effects of floods, earthquakes, wind, and other hazards. Specific activities encouraged under the HMGP include acquiring damaged structures to turn the land over to the community for open space or recreational use, relocating damaged or damage-prone structures out of the hazard area, and retrofitting properties to resist the damaging effects of disasters. Retrofitting can include wet or dry flood-proofing, elevation of the structure above flood level, elevation of utilities, or proper anchoring of the structure.



Flood Mitigation Assistance:

The Flood Mitigation Assistance (FMA) program makes grants available on a pre-disaster basis for flood mitigation planning and activities, including acquisition, relocation, and retrofitting of structures. FMA grants for mitigation projects will be available only to those communities with approved hazard mitigation plans. A certain amount of funding is allotted to each state per year based on a risk formula for floods. Each state has the discretion to award funds to communities or to state government agencies. States may use whatever criteria or method they choose to award the funds as long as the applicant and the proposal are eligible. The program may fund up to 75 percent of the total cost of the proposed project, with a minimum of 25 percent of the cost coming from the community. A minimum of half the community share must be cash or “hard match.” Funds can also be granted to communities to help them prepare local flood mitigation plans. The same match requirements apply. Once a community receives a planning grant, however, it is not eligible to receive additional planning grants for another five years. For further information on the FMA program or ICC coverage contact RIEMA at (401) 946-9996.

Pre-Disaster Mitigation:

FEMA’s Pre-Disaster Mitigation (PDM) grant program is a nationally competitive program. Projects can be funded up to a maximum \$3 million federal share. Up to 75% of the total project cost can be federally funded. The state or local community provides a 25% cost share, which can be “in-kind”. Small, impoverished communities may be funded up to 90%. In order to be eligible to receive a PDM 2004 grant, the state or local community must have an approved hazard mitigation plan in place by Nov. 1 2004.

Earthquakes and Hurricanes:

A certain amount of funding is allotted to each state per year based on a risk formula for earthquakes. Coastal states are allocated funds based on a risk formula for hurricanes. Each state receiving such funds has the ability to grant project funds to a community. There is not a match requirement on the part of the community, but the funds are limited, and are generally only available once a year. The projects or products proposed for such funding must demonstrate that earthquake or hurricane risk will be reduced or eliminated, and the proposed project or product is a cost-effective measure (a stringent cost/benefit analysis need not be performed). Information about the amount of funding available per year and the state requirements for eligibility and performance may be obtained from RIEMA at (401) 946-9996.



APPENDIX F: Newspaper Clippings Related to Past Natural Disasters

Rhode Island Mother Says, 'Oh, We're Living' How Hurricane 'Carol' Hit One Family

By JOHN WARD
(Providence Journal-Bulletin)

Wickford

WICKFORD, R. I. (AP)—Mr. and Mrs. Malcolm Jenne and their four children go to bed at 9 p. m. by the light of a single kerosene lamp that their family physician gave them. That's all the light they have.

They didn't have any light Tuesday night and had to go to bed at dusk. The hurricane had carried away power lines in this little village on Narragansett Bay, 18 miles south of Providence.

That storm had left them with their home but with a cellar full of water, a yard covered with puddles of salt water, no lights, no heat, no facilities for storing food and none for cooking it.

The Jennes, whose children range from three years to 22, are typical of hundreds of families braving it out in many of

the flood areas of Rhode Island, leading a bare existence in their water-soaked homes, struggling along with makeshift meals, sleeping in makeshift beds, wearing what clothes the storm has left them.

Mr. and Mrs. Jenne were working at the Quonset Point Naval Air Station and their son Robert at a bank in Providence when the storm hit.

A nursemaid, Mrs. Ethel Rose of Allenton, got the three children, two boys and a girl, three to six years old, rushed them from the house and drove them in her auto through rising waters to refuge at her own home.

The Jenne family was reunited late Tuesday afternoon to find the flood waters had virtually destroyed all of their first-floor furnishings, including everything in two bedrooms.

Last night, Mrs. Jenne, who perhaps typifies all the housewives and mothers in the area, said, "Oh, we're living."

"We have just one kerosene lamp, Dr. Patrick O'Brien loaned it to us. The first night we went to bed at eight, but now we go at nine."

"We have been cleaning up and cleaning up. We get food as we need it for each meal from a store four miles away."

"We finally got our gas man to hook up our bottled gas stove yesterday afternoon. Before that we had to eat cold food like frankfurters although Wednesday we had steaks cooked on our outdoor grill."

"We invited our neighbors, Mr. and Mrs. Gardner Willis and their children over that night. They're worse off than we are. They live on the first floor and had 36 inches of water. We only had 24 inches."

"We just threw out all the

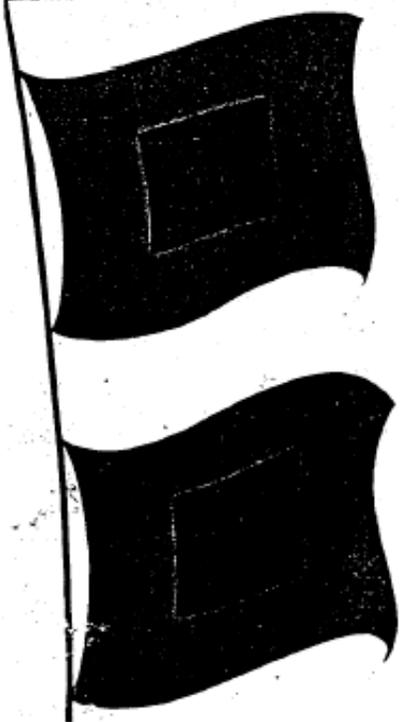
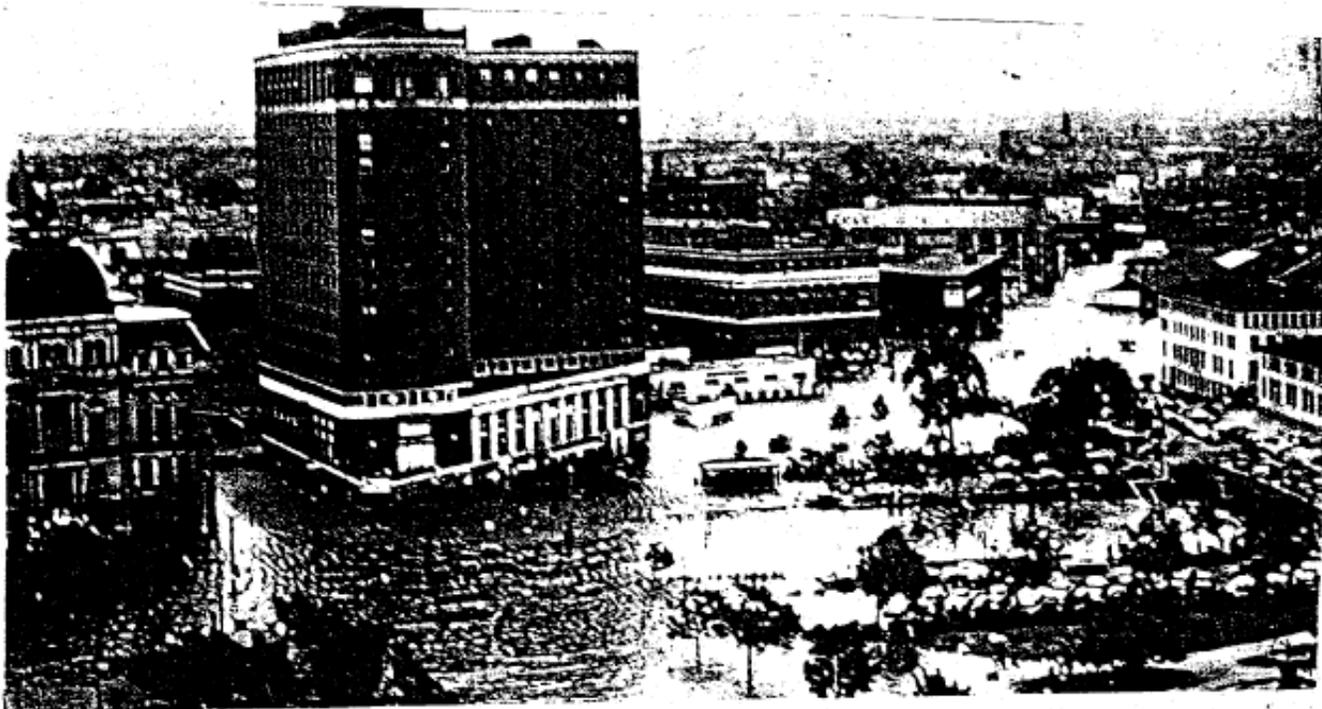
children's shoes—10 pairs—and bed slippers. When we get paid tomorrow, we've got to buy new shoes for everybody. We've got most of our spare clothes hanging on the line to dry."

"My husband has carried four trailer loads of stuff, including our studio couch and rugs, to the town dump and there's a lot more down the cellar to go."

The back and side yard at the Jenne place were typical—shortly before dark last night—of yards throughout the flood area, as families ate meager meals at makeshift picnic tables, mostly salvaged furniture, and cooked food nearby over charcoal fires.

A reporter inquired whether the Jennes had asked for assistance from the Red Cross. Mrs. Jenne answered, "We leave the Red Cross to the poor people. They need it a lot more than we do."

56 FOWLER STREET
WICKFORD



Hurricane *Carol* Lashes Rhode Island

August 31, 1954

Published by
PROVIDENCE JOURNAL COMPANY

Price: \$1. a Copy



IN 1954 Rhode Island realized it must learn how to live with hurricanes. The hard fact was driven home, leaving no chance to rationalize. Another huge cyclonic storm, spawned in the subtropics, had come and gone. Banshee winds and massive tides had done their savage work once more.

Sixteen years before, on September 21, 1938, the greatest hurricane in Rhode Island history raged across the state leaving 317 dead and \$100,000,000 in property damage in its wake. It was a freak, said many as they picked through the debris, and will never happen again.

But in 1944, in the predawn darkness of September 14, there was grim warning that this was not the case. Another hurricane zeroed in upon the state, smashed down thousands of trees, ripped at roofs and roared impotently along the shores, its power impaired by an unfavorable tide.

Then on August 31, 1954, the lesson was learned. Pouring out of the night, the winds of Hurricane *Carol* brought Rhode Island summer to a premature end. The storm arrived at express train speed and departed as fast, leaving the shores of the state a shambles, 19 dead, scores injured, and the business district of the state's largest city spitting out dirty flood water from its basements and street level shops for the second time in 16 years.

Carol, a pretty name for a monster, was the third hurricane of the year to form in the warm latitudes of the Atlantic. Some said the U.S. Weather Bureau chose women's names for the storms because they were unpredictable. *Carol* was unpredictable, lazing along the southern coast for days before taking deadly aim, but there its feminine characteristics stopped.

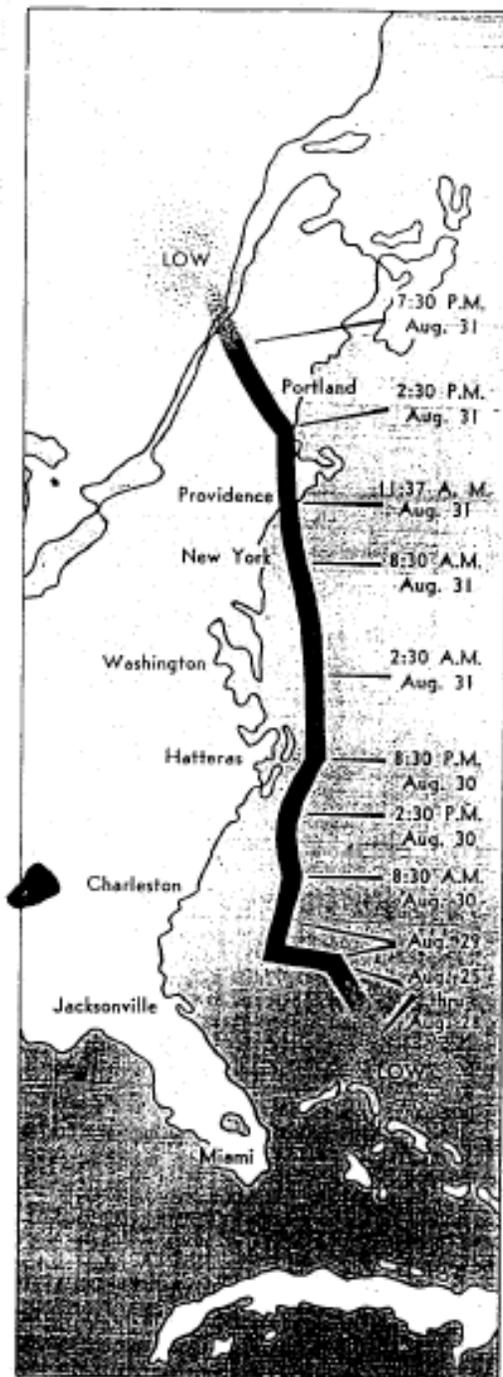
The forces of nature built a roadway for *Carol*, a low pressure area suitably moistened by rains, and the hurricane bored in. It caught Rhode Island and eastern Massachusetts in the outside arc of its counter-clockwise winds, with its center moving along the Rhode Island-Connecticut boundary line. The state lay in the zone where the speed of the vicious storm, estimated at more than 50 miles an hour, is added to the speed of the winds whirling within it.

The result: devastation. Property damage totaled at least \$200,000,000 in Rhode Island alone, possibly half a billion dollars in the entire Northeast. Nearly 3,800 Rhode Island homes simply disappeared or lay in shattered heaps along the beaches. More than 2,000 boats, skiffs, fishing craft and proud yachts were destroyed or seriously damaged.

But these are cold statistics.

The real story was in the hearts and eyes of the people who suffered, the waterfront home owners who clambered to rooftops in terror as great gray waves chewed out the insides of their neat dwellings, the boatowners who watched helplessly as their gallant craft fought at their moorings for hours and then disintegrated, the store owners in Providence who saw the flood tides thrust down the aisles, swell over countertops and destroy millions of dollars worth of choice merchandise.

After the storm the state gasped for breath for days, and those who lived and worked inland realized that they too had been hit. Almost all electric power, the life blood of a modern community, had ceased to flow over the wires. An estimated 200,000 workers were idle as repair crews sought to restore power to the business offices and manufacturing plants. Home-



CAROL'S course, from its origin near the Bahama Islands to its breakup in Canada, shows rate the hurricane picked up speed in the hours before it hit Rhode Island.

owners ate suppers cooked over charcoal or Sterno, by candlelight, and kept perishables and milk in tubs or picnic cold boxes filled with ice.

Some residents in the rural areas had no water. Their electric pumps were useless. And others found service through certain water systems reduced or interrupted for various reasons attributed to the storm.

The great storm had its heroes, hundreds of them, who waded, swam and floundered through swirling water to bring their marooned fellows to safety. And along the shore areas it brought forth the best in human nature as neighbors pooled their meagre resources to help one another.

It spawned a small but ugly crop of human vultures too, the looters who moved into stricken homes and shops even before the waters completely receded to fatten on the possessions of the victims.

Police acted fast in the days that followed to offer what protection they could. Aided by the full force of the National Guard, military reserve units and civil defense workers, they cordoned off the battered sections of the state to all except emergency workers.

Gradually order replaced chaos as bulldozers thrust back the deep sand dunes where once there had been roads and great cranes lifted the hulks of sunken boats. Carpenters beat a staccato symphony on thousands of damaged roofs while fleets of trucks, pressed into service from many sources, roamed the streets of city and hamlet alike gathering the mountainous piles of limbs and trunks which once spread a green canopy over the state. Gradually power returned. Lights winked on and the big factories summoned their workers back.

And in the talk of the veterans of the storm comparisons were made. Which was the greater, Hurricane Carol or the nameless fury of September 21, 1938? The facts were indisputable. The hurricane of 1938 was still without peer. Its flood tides mounted 13 feet nine inches above normal high water level in Providence. Hurricane Carol had pushed the tide up precisely 13 feet above normal.

The 1938 storm moved more slowly and poured its peak destruction on the state for about two hours, with sustained winds of 121 miles an hour and gusts of far greater force. Hurricane Carol lashed the state with its peak winds for about half as long, reaching full force at 11:37 a.m. when a gust estimated at 105 to 115 miles an hour thrust the anemometer needle off the dial at the U.S. Weather Bureau at Hills-grove. Moments earlier the top sustained velocity of 90 miles an hour was recorded.

The 1938 storm was a massive doughnut with its center over the Connecticut River Valley. Its deadly eastern semicircle spread a wide band of destruction through the heart of New England. Hurricane Carol achieved its greatest fury in a band stretching from New London, Conn., to the Cape Cod Canal.

Loss of life was not comparable. Yet in this fact there was a puzzle. The shore areas where damage was greatest in both storms appeared to have suffered almost equal devastation. The surge of tide thrust up by Hurricane Carol was almost as high. And on August 31, 1954, the summer season at Rhode Island's beach resorts was at the zenith. Yet the death toll was low.

The reasons were several. Hurricane Carol struck in the morning. Visibility, vital when you are



struggling for the safety of a stairway, rooftop or improvised raft, was relatively high. The hurricane of 1938 reached its peak about 5:15 p.m., nearly a month later in the year. Almost complete darkness came with the storm. This time thousands fled from unprotected sections before the storm reached its full fury. Before, many refused to believe what they saw, clung to their exposed dwellings to the last and actually rushed to the shore to watch the water rise.

The lesson had been partially learned, but not completely.

On the afternoon of August 31 and the days that followed complaints arose that the U.S. Weather Bureau had provided insufficient warning of the storm's approach. Its bulletins had spoken of northeasterly gales and abnormal tides until too late to take full precautions for the southeast hurricane winds and flood tides which actually arrived.

Power failed over much of the state at 9:10 a.m. on August 31, and when the full import of the storm was realized radio warnings were almost useless.

Two days after the storm the season's fourth hurricane rushed harmlessly past, well out to sea, touching off brief panic in certain exposed coastal communities. Then on Friday, September 10, eleven days after Hurricane Carol, the state settled down to the business of living with the storms.

Hurricane Edna, a huge storm with 135 mile an

hour winds near its center, rolled toward the battered shore. This time the state was ready.

Through the daylight hours of Friday newspapers, radio and television warned of the storm's progress. All radio and television stations went on night-long watch. Storm shutters and sandbags appeared. Water-front districts were evacuated as sweating clerks in downtown stores cleaned out cellars only recently cleared of flood water, removed all merchandise to upper floors. Firemen, police, civil defense units, the Red Cross and other welfare agencies mobilized all personnel. Never in the history of Rhode Island had such complete preparations against disaster been made.

At the last moment the storm veered northeastward, arriving on an ebb tide. Rhode Island caught the backlash of its winds, suffering relatively minor damage.

A glancing blow. The state now knew that two facts are vital once hurricane warnings have gone out: the condition of the tide when the storm arrives and the location of its center.

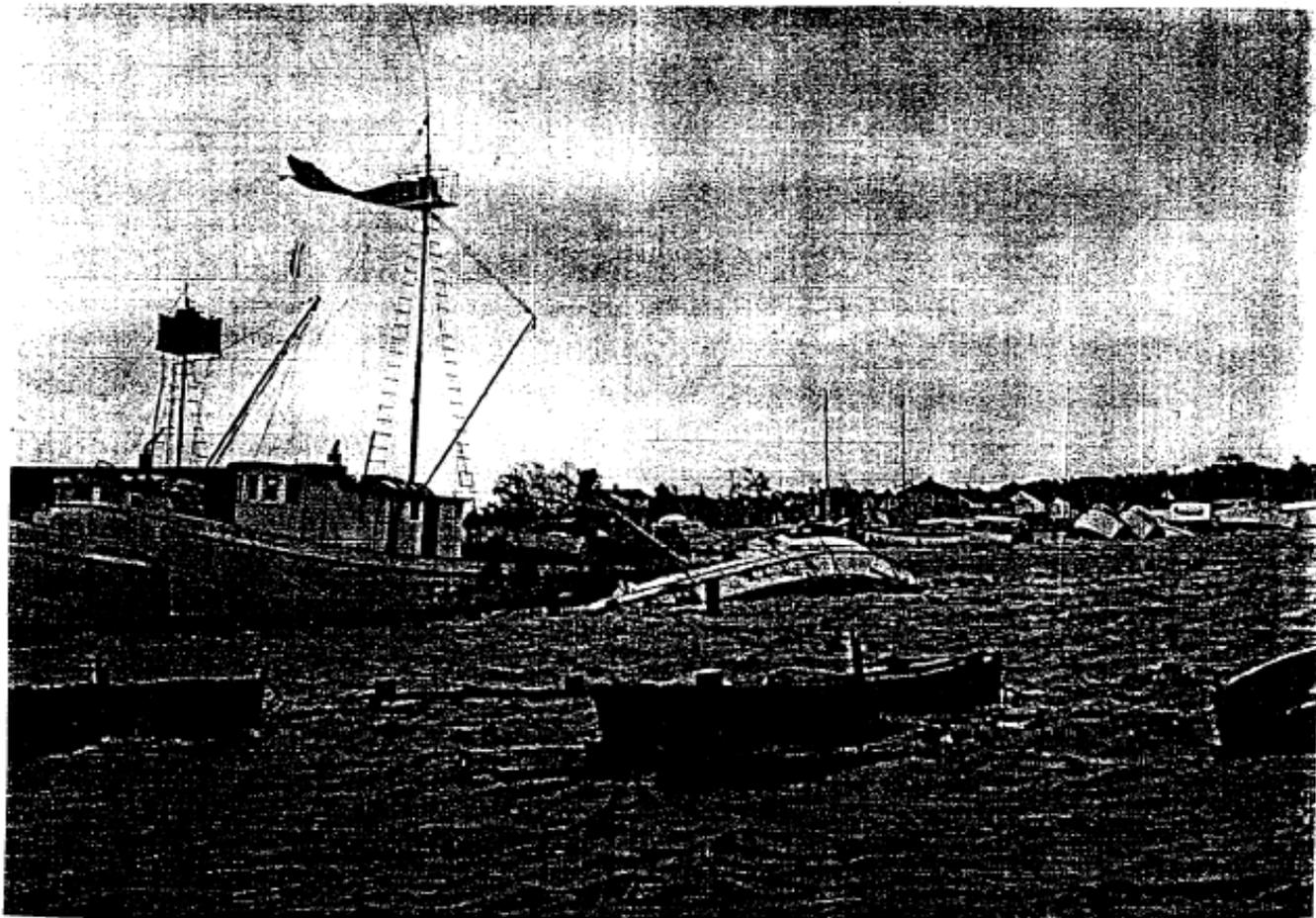
In 1815, 1938 and on August 31, 1954, the storm center had passed to the westward and the hurricane had arrived at high tide with destructive force. In 1869, 1944 and September 11, 1954, the tide was on the ebb.

The ledger was neatly balanced, three and three.



1954

EAST GREENWICH Cove water engulfed East Greenwich Yacht Club. The scene off Water Street looked like this at the storm's height.



POGIE BOATS tied up at Wickford took a fierce battering. Here's Wickford harbor when wind abated at noon.



HURRICANE EXTRA
THE PROVIDENCE JOURNAL
PROVIDENCE, RHODE ISLAND, WEDNESDAY, SEPTEMBER 1, 1954
PRICE FIVE CENTS

Hurricane Leaves 16 Dead, Scores Hurt, \$100,000,000 Damage Along R. I. Coast

Rhode Island Casualties DEAD

RELATIVES of 16 persons killed in Rhode Island by the hurricane are listed below. The names of the deceased are in bold type. The names of the survivors are in regular type.

ALLEN, John W., 60, of 100 West St., Providence, killed by a falling tree.

ALLEN, William H., 60, of 100 West St., Providence, killed by a falling tree.

ALLEN, William H., 60, of 100 West St., Providence, killed by a falling tree.

ALLEN, William H., 60, of 100 West St., Providence, killed by a falling tree.

ALLEN, William H., 60, of 100 West St., Providence, killed by a falling tree.

STILL MISSING

THE BODIES of the following persons are still missing:

ALLEN, John W., 60, of 100 West St., Providence, killed by a falling tree.

ALLEN, William H., 60, of 100 West St., Providence, killed by a falling tree.

ALLEN, William H., 60, of 100 West St., Providence, killed by a falling tree.

INJURED

SCORES of persons were injured in Rhode Island by the hurricane. The names of the injured are listed below.

ALLEN, John W., 60, of 100 West St., Providence, killed by a falling tree.

ALLEN, William H., 60, of 100 West St., Providence, killed by a falling tree.

ALLEN, William H., 60, of 100 West St., Providence, killed by a falling tree.



WINDSHIELD BEEP, WATER INUNDATES INTERSECTION, BUS TERMINAL AT FOUNTAIN AND EGGY STREETS

Warning Late On Hurricane

HUB BUREAU ADVISORY GIVEN ONLY HALF HOUR BEFORE ARRIVAL

FOR WEEKS it was said all over the world that the hurricane was not a warning was given only half an hour before its arrival.

Westerly is Badly Battered; Nine Are Reported Missing

NINE persons were reported missing in Westerly, R.I., after the hurricane. The names of the missing persons are listed below.

ALLEN, John W., 60, of 100 West St., Providence, killed by a falling tree.

ALLEN, William H., 60, of 100 West St., Providence, killed by a falling tree.

ALLEN, William H., 60, of 100 West St., Providence, killed by a falling tree.

Electric Power Out In State

PROSPECT OF RESTORED SERVICE TODAY DIM; WORK CREWS IMPLORED

STATE ISLAND was without electric power for eight and nine hours.

Minority Report Hits McCarthy

WASHINGTON, Aug. 31.—The minority report of the Senate subcommittee on the activities of the American Civil Liberties Union was published today.

Horror of Watching Parents Perish In Wild Sea Described

GRUESOME SCENE OF a parent watching his child perish in the wild sea was described by a survivor of the hurricane.

Flooded Our Journal Is Published At The Footsocket Club

THE JOURNAL OF THE Providence Journal was flooded today by the hurricane.

Minority Report Hits McCarthy

WASHINGTON, Aug. 31.—The minority report of the Senate subcommittee on the activities of the American Civil Liberties Union was published today.

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WASHINGTON, Aug. 31.—The minority report of the Senate subcommittee on the activities of the American Civil Liberties Union was published today.

Devastating Blow, High Tides Mash Houses, Piers, Boats

Rhode Island lies wounded this morning in the wake of a devastating hurricane which ripped its coastal communities into shreds, smashed houses, docks and boats to splinters and left a mounting toll of dead and injured.

Early today at least 16 persons were known dead and scores were injured. Initial estimates placed property damage at more than the \$100,000,000 hurricane of Sept. 21, 1938, until yesterday the greatest storm to strike the state in modern times.

Most of the state was without power throughout the night and yesterday the Narragansett Electric Company, the principal power source, reported little improvement today.

Hundreds of families, driven from their homes and scattered dwellings along both sides of Narragansett Bay and on the ocean shore, spent the night in fire stations, makeshift shelters and the beams of inland friends. In many cases their belongings consisted of the clothes on their backs.

Shortly before midnight Chief Murphy ordered the downtown sections of Providence closed to general public until further notice. His order was designed to prevent looting during the many hours of tedious salvage operations awaiting state operators.

Horror struck at the South Atlantic beach, where a course of devastation across Rhode Island visited without warning. Rhode Islanders awoke yesterday morning to find the ocean slowly rising around them. Although weather advisers urged mariners to remain alert, no solid warning as to the seriousness of the storm came from official weather bureau sources until 10:30 a.m. (EST). By then time 180-mile-an-hour gusts and towering waves generated all but cleanup preparations.



On the morning of August 31, 1954, about 10:30, a tropical hurricane struck Providence, roaring a symphony of death and destruction. The waters of the Providence River rose to a height of approximately 18 feet above the average low tide level in three hours' time. The entire central business section, an area nearly a mile in diameter, was flooded, as well as three miles of the industrial area along the waterfront.

By rare good fortune, a photographic account was made of the harrowing scenes and appalling damage in downtown Providence. These pictures are reproduced here without any re-touching to provide a graphic historical record for posterity, and to portray the paralyzing blow that Providence has suffered and survived.

At this time the business establishments affected are working at their Herculean tasks of reconstruction needed for normal operation.



This booklet was placed in production Thursday, September 2, 1954 at 4:30 P. M. Halftones were made, assembled, and plates completed for the presses to start printing at 2:00 A. M. Friday morning. Twenty thousand copies were placed on sale at 2:30 Friday afternoon.

This was all accomplished at Livermore and Knight Company and Bank Lithograph Company in the heart of the disaster area, although no commercial power was available and no other companies were manufacturing.

Both plants will be back to normal operation on Tuesday morning, September 7, 1954.

Providence, September 3, 1954

Copyright 1954
Livermore & Knight Co., Providence, R. I.
Plated, lithographed, and bound in their own plant
in the heart of the flood area.

Photographs by Adler's, Inc. and the
Reproduction Service

Great hurricane left residents without potable water



If there's one thing that most folks take for granted these days, it's that when you turn on the faucet in your kitchen or bath-room, good clean, drinkable water is going to come out. But it wasn't always that way. Back exactly 64 years ago this week, the good people of the villages of Wickford and Hamilton were learning this lesson the hard way.

You see, 64 years ago, these folks had just gotten over the horror of the worst hurricane to ever hit these parts. The waters of the Narragansett Bay had subsided and left an awful mess.



They were uprooted, homes were destroyed or moved off their foundations, boats were parked where no one ever imagined they could be, people were missing, families were separated, cars were swept away never to be seen again, and everything was covered in the most foul stinky mud that you could possibly imagine. But that wasn't the worst of it, as these harried and overwhelmed folks were just realizing. Everywhere from Pleasant Street to Poplar Point to Salisbury Avenue people were realizing that the truly unthinkable

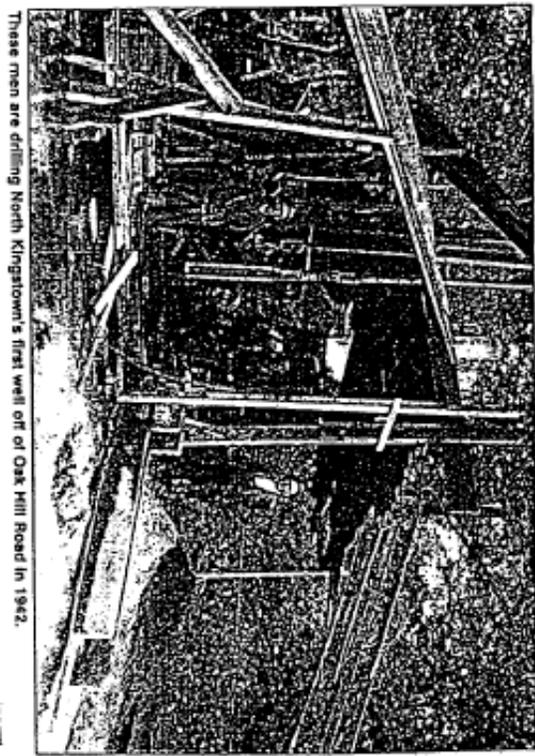
had happened. Everyone's well had turned brackish. Nowhere across that wide swath of homes was there anyone with drinkable water. The delicate balance between the fresh groundwater of the land and the salty sea of the Narragansett Bay had been forever changed by the giant hurricane. It was a public health crisis of major proportions.

The elected and appointed officials of the town met in crisis mode. For the time being it was decided that the overworked men of the town's Fire Department would bear another burden. Each day they would make the rounds and fill up the pails and buckets that were left out on the front steps and porches of all the residents of the affected areas without water. That was for the short term; the long-term solution required something that seemed an enormous task. Some way would be found to provide the town's people with good drinking water again.

With this daunting task in mind, a group of prominent citizens began to meet informally at the beginning of 1938. By spring of that year, they were officially sworn in as members of the state-sanctioned North Kingstown Water Commission.

Chairman Hiram Kendall, secretary Irving Hazard and committee members Wilfred Kingsley, Walter Cook and Edgar Churchill wasted no time. They immediately weighed all options and decided that designing and constructing a distribution system that would run from the North Kingstown-East Greenwich border at the Hunt River all the way down the Post Road to a standpipe at Juniper Hill and then into the affected areas would be the most expeditious. They negotiated a contract to purchase water from the neighboring town of East Greenwich at the rate of 75 cents per thousand gallons.

Eventually, in 1942, the town would sink its own well and end its dependence on its neighbor to the north. But that was not an issue then.

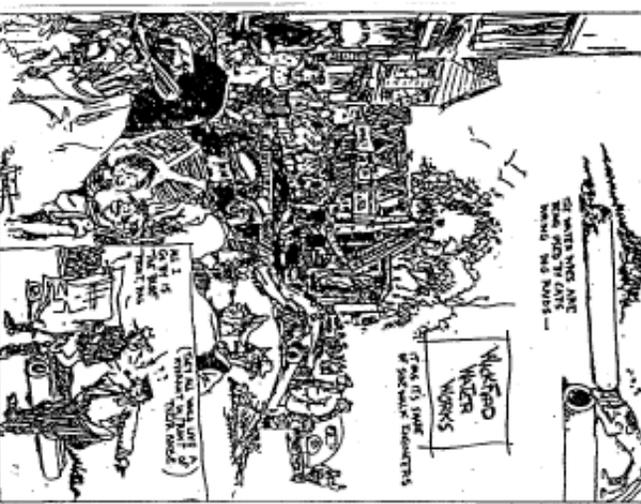


These men are drilling North Kingstown's first well off of Oak Hill Road in 1942.

Engineering firms and construction contractors were interviewed, plans were drawn up, contracts were signed, and work began post haste. All this was done in the evenings, night after night, as these men were volunteers and had full-time jobs to go to as well. All the while the Fire Department continued their daily ritual of water deliveries door to door, one home at a time. It was an exhibition of community spirit at its finest.

After a mere nine months, in January 1940, in which nine miles upon miles of 12-inch water main was laid, a 625,000-gallon riveted standpipe was constructed and countless homes were tied into the system. The valves were opened at the border and clean water again began to flow into the homes of Wickford, Poplar Point and Hamilton.

Eventually, in 1942, the town would sink its own well and end its dependence on its neighbor to the north. But that was not an issue then.



Although noted cartoonist and illustrator Paul Lorring poked fun at the water system installation in September 1939, all of Wickford knew how serious a business the project was. Lorring's artwork is used with permission of his family.

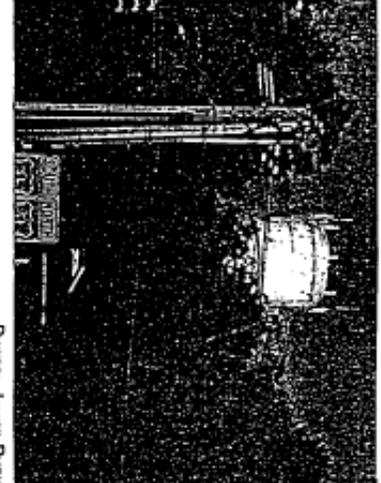


Photo: James Rusli
The water tower at Juniper Hill, shown as it appears today, brought drinking water back to the residents of Wickford and Hamilton about 18 months after the Hurricane of 1938.



Providence Journal 9/19/02

Emergency plan would aid town during disasters

A plan drafted by a town committee will help the town deal with natural disasters, put it in line for emergency aid and save residents money on flood insurance.

BY ERIN EMLOCK
JOURNAL STAFF WRITER

NORTH KINGSTOWN — As the town faces record-low water levels and a ban on outdoor watering, the threat of a hurricane is probably the farthest thing from most residents' minds.

NORTH KINGSTOWN

But the town's Local Hazard Mitigation Committee has been working for the past eight months on a plan to better prepare the town for floods, wildfires and even earthquakes.

The committee recently completed a draft Hazard Mitigation Plan, which will

SEE **DISASTER, B 5**

Disaster

Continued from Page B-1

which will be discussed at the Town Council's work session tonight.

Once the plan is in place, the town will be eligible to get money from the Rhode Island Emergency Management Agency and the Federal Emergency Management Agency to implement strategies identified in the plan, according to committee member James Freas.

"The plan is meant to make the town less vulnerable to a natural disasters before they happen," Freas said.

And if a natural disaster does strike and a state of emergency is declared, towns that have Hazard Mitigation Plans have priority in getting state and federal funds to help deal with the disaster.

In North Kingstown, the biggest threat is coastal flooding associated with hurricanes and northeasters, according to Freas.

The plan also lists tornadoes, wildfires, ice and snow, earthquakes and droughts as potential hazards to the town.

North Kingstown borders East Greenwich, Exeter, Jamestown, Narragansett, South Kingstown and Warwick; the plan identifies ways

the town can cooperate with those communities during emergency.

Freas said one of the plan's goals is to ensure that buildings on the coast are able to withstand coastal flooding. He said that by creating this plan, the town will help residents in these areas potentially save money on their flood insurance.

'The plan is meant to make the town less vulnerable to natural disasters before they happen.'

James Freas,
Local Hazard Mitigation Committee

The committee developed the plan in part by examining a map provided to the town by the Rhode Island EMA which shows flood and storm surge areas.

The committee then determined which areas of town could be vulnerable during a natural disaster.

The committee's members include representatives of the Police, Fire, Public Works and Planning Departments and the Rhode Island National Guard. The Town Council, town manager, harbormaster and a representative of the Chamber of Commerce are also on the committee.



North Kingstown, R.I., August 28, 2011 : A home and power lines are damaged after Tropical Storm Irene passes through Rhode Island. Photograph courtesy of FEMA.



APPENDIX G: PUBLIC OUTREACH

LIST OF MEETINGS FOR PHASE II: SEA LEVEL RISE

NORTH KINGSTOWN PHASE 2 - PROJECT MEETINGS

11/14/2012	NK TRC
3/14/2013	Peter Galvin
3/25/2013	NK Town Council
4/16/2013	NK Planning Board
4/18/2013	NK Public Lecture
4/19/2013	NK Public Roundtable discussions
4/20/2013	NK Open House
5/1/2013	NK Planning Dept. Meeting
5/9/2013	NK Public Works & Engineering
5/14/2013	Madis Suvani, Wickford Plan Committee
5/15/2013	Quonset Development Corp
5/15/2013	NK Public Works & Engineering
5/16/2013	Wickford Plan Committee
5/23/2013	NK Planning Dept. Meeting
6/6/2013	NK Chamber, Martha Pughe
6/7/2013	RIDOT - Peter Healey & Courtney
6/19/2013	Cedarhurst annual meeting
6/20/2013	Wickford Plan Committee presentation
6/25/2013	NK Planning Dept. Work session (June 25-27)
7/8/2013	NK Historic District Commission - provided notes for meeting
7/9/2013	NK Planning Dept. Meeting
7/10/2013	NK Chamber walk around Wickford



7/10/2013	NK Conservation Commission presentation
7/15/2013	NK Chamber & Wickford Merchants Association meeting
7/16/2013	NK Planning Dept. Meeting
8/1/2013	NK Planning Dept. Meeting
8/6/2013	NK Planning Dept. Meeting
8/15/2013	NK Planning Dept. Meeting
8/24/2013	State Agency Data/Mapping Coordination Meeting
9/15/2013	North Kingstown Harborfest - Booth
9/19/2013	North Kingstown Community Forum - Cold Spring Community Center
11/19/2013	Sea level rise presentation at Planning Commission meeting at 7:30 p.m.
10/2/2014	Resiliency walk was held as part of coastal weeks led by URI Coastal Resources Center and RISG
5/9/2016	Town Council Meeting to Approve the Adaptation to Natural Hazards and Climate Change Plan



Resiliency Walk at Wickford Harbor



Instructor: Teresa Crean, Coastal Resources Center/Sea Grant

Date: October 2, 4:30-6:30 p.m. (**Rain Date:** October 7)

Location: Wickford Village

This walk will take participants on a 2-mile tour of Wickford, beginning and ending at the Brown Street Bridge. Participants will learn about the flooding problem areas within this historic village and what the town of North Kingstown, aided by funding from R.I. Statewide Planning and with assistance from URI, is doing to improve resilience to coastal flooding and sea level rise. Parking is available at the Brown Street municipal parking lot. **Limited space available; RSVP to Tracy Kennedy at tkennedy@mail.uri.edu or call 401-874-6805.**





Rhode Island Sea Grant Program's COASTWEEKS
WICKFORD RESILIENCE WALK
October 2, 2014, 4:30 p.m. to 6:30 p.m.
Brown Street Municipal Parking Lot, Wickford, RI

INSTRUCTOR: Teresa Crean, AICP, Coastal Community Planner and Extension Specialist, University of Rhode Island Coastal Resources Center and Rhode Island Sea Grant

AGENDA & TALKING POINTS

4:30 p.m. Welcome and Introduction, Dennis Nixon, RI Sea Grant Director

4:33 p.m. Welcome to Senator Sheldon Whitehouse [*ask staffers in advance if the Senator would like to say a few words*]

4:36 p.m. Overview of the Walking Tour and Introduction to Town Staff (joining us to answer questions)

- The tour is scheduled to be 2 hours in length and we will be walking from Brown Street Municipal Parking Lot, to West Main Street, and down to the Town's dock at the end of West Main.
- 6 stops along the route have been planned to share information about each area, and 3 of the 6 stops will include the business owners talking to us about their sites. I will be keeping an eye on the time and will move us along to ensure we get everyone back to the parking lot by 6:30 as scheduled.
- Walking with us are several town staffers, including the planner, public works director, economic development director, and town engineer, as well as the Executive Director of the Chamber of Commerce. They will be on hand to help answer questions and discuss opportunities and challenges.
- The tour is meant to share some of the analysis work that has been completed to date, and discuss some of the opportunities and challenges that Rhode Island cities and towns are likely to face while addressing projected future impacts from storms and sea level rise in North Kingstown.

4:40 p.m. Begin Tour – STOP #1, Brown Street Bridge

- Introduce and share sea level rise scenario maps
- Discuss the “moon tides” and impacts on the municipal parking lot
- Describe what this area looked like during Superstorm Sandy and the impact on Wickford Village
- Discuss some of the implications for the businesses in this area, and the long-term planning considerations for the Wickford Village Center



5:00 p.m. STOP #2, West Main / Newtown intersection at the Wickford Package Store

- Jeff Ryan and/or Mike Sherman will be on hand to discuss Wickford Package Store’s experience during Sandy
- The tidal inlet/salt marsh across the street is a concern. This section of West Main Street is prone to flooding.
- Looking at the SLR scenario maps, the salt marsh complex to the north, “behind” Wickford Package also shows tide waters encroaching from the north. The 3-foot scenario shows that the 2 water inlets are close to connecting across West Main Street, the 5-foot scenario shows complete inundation, meaning 2 tides per day will flood this segment of roadway.
- This flooding and projected sea level change will present a challenge to the long-term use of this roadway, which is a state road and serves as a designated evacuation route. Should the state invest funding to improve or completely redesign this road into more of a “causeway”? What alternatives might be considered?
- On the Wickford Package Store site, there are several “Observation Monitoring Wells” capped in the parking lot. Who manages these? Are there concerns with the maintenance of these wells in the face of tidal inundation? *[Town will speak to this.]*

5:20 p.m. STOP #3, West Main, Behind the Wickford Gourmet Factory Outlet

- Donna and Joe Dubay, owners of this property and business, will join us to share their experiences with recent “moon tides” and storm events.
- The parking area for this site sits at the same elevation as the edge of the salt marsh, and frequently floods with tidewater.
- What is the long-term plan for this property?
- What steps have the owners taken to protect the inventory of their businesses?
- How long do they think they will be able to remain on this site operating their business?

5:35 p.m. STOP #4, Washington Street / Wickford Historic District

- URI Landscape Architecture dedicated a recent project to considering the design options homeowners might consider to adapt to tidal inundation.
- Options for homeowners to floodproof or accommodate water on their property can be costly and have existing restrictions because their property is in a designated historic district.
- Statewide discussions are happening to assist local Historic District Commissions with this challenge, including a mapping effort to identify all historic districts at risk in the state.



-
- This neighborhood is not scheduled to be sewered, and many homes have recently upgraded their septic systems, which typically have a 30-year lifespan. Septic system failures during storm events were seen in North Kingstown, namely in the Town Annex building where the planning and building official's offices are located.

5:50 p.m. STOP #5, Gardiner's Seafood

- Pete Chevalier will join us to share the recent improvements he made to the property – vegetation and bulkhead.
- Discuss long-term viability of this site, any improvements that might have to be made as sea levels are projected to rise in the next 20 years, and discuss water levels seen in recent storms, including the August 13th surge event (show photos and the NOAA tide graph).

6:05 p.m. STOP #6, North Kingstown Town Dock

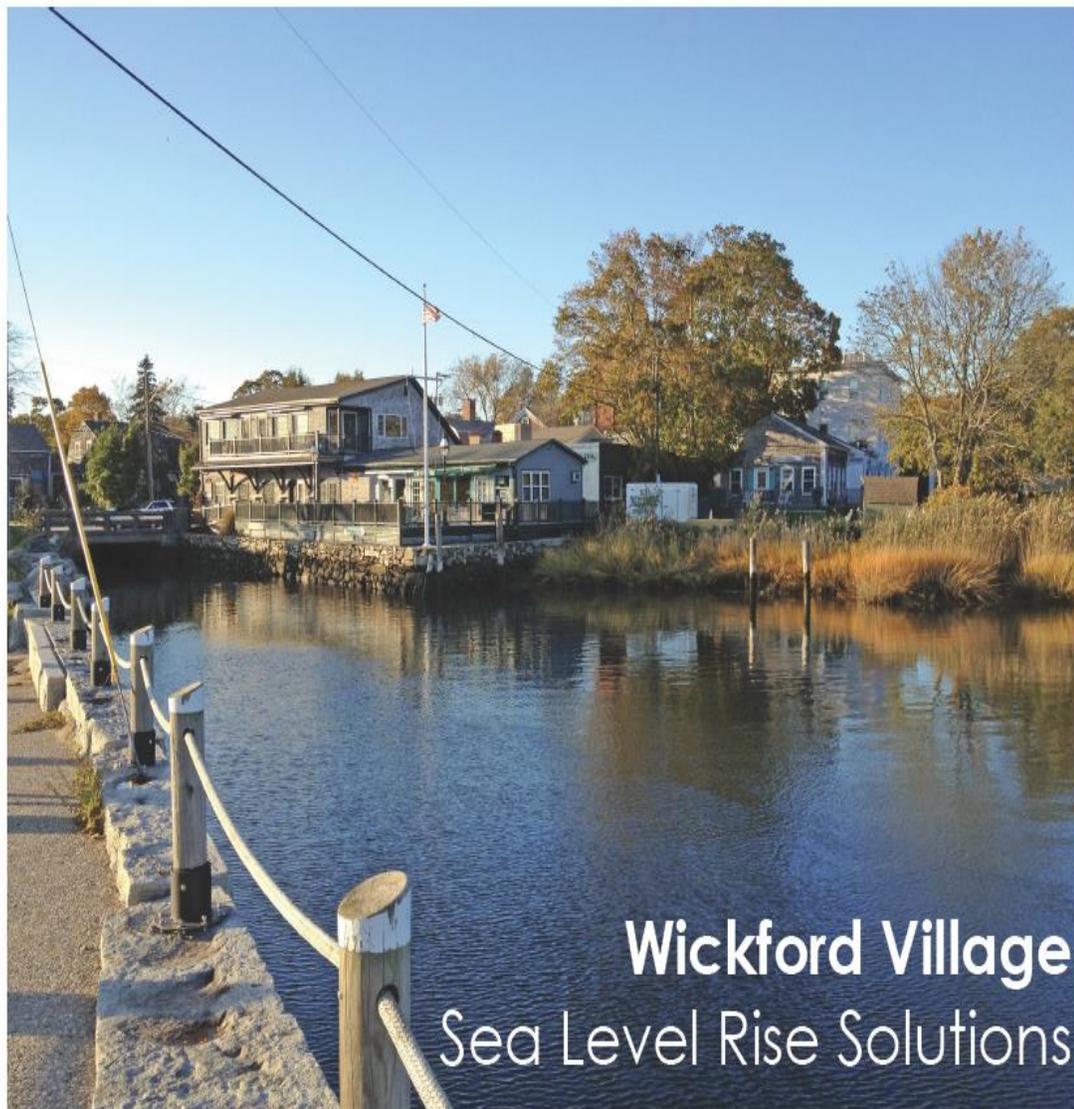
- Enjoy the view of the Wickford Harbor back toward the Village, and take the opportunity to ask questions to town officials related to next steps for adaptation planning in North Kingstown

6:15 p.m. Walk back to Brown Street Municipal Parking Lot along Main Street

6:25 p.m. Closing Comments

6:30 p.m. Conclude Walk





The Town of North Kingstown worked with a class from URI on addressing sea level rise in the historic district of Wickford last spring. As a result of the works a student prepared the booklet entitled “Wickford Village: Sea Level Rise Solutions” which gives a brief overview of the different strategies they used in their work. This can be found on the Town’s website at www.northkingstown.org



Appendix H: List of Grants & Awards Secured to Support Resilience Planning in NK

Map Atlas Phase (2009-2011)

- NOAA \$30K grant in 2009 that initiated the mapping project
- CRMC contributed staff time and funds
- The Nature Conservancy contributed staff time and funds for the SLAMM mapping (wetland migration)

Municipal Planning Phase (2012-2014):

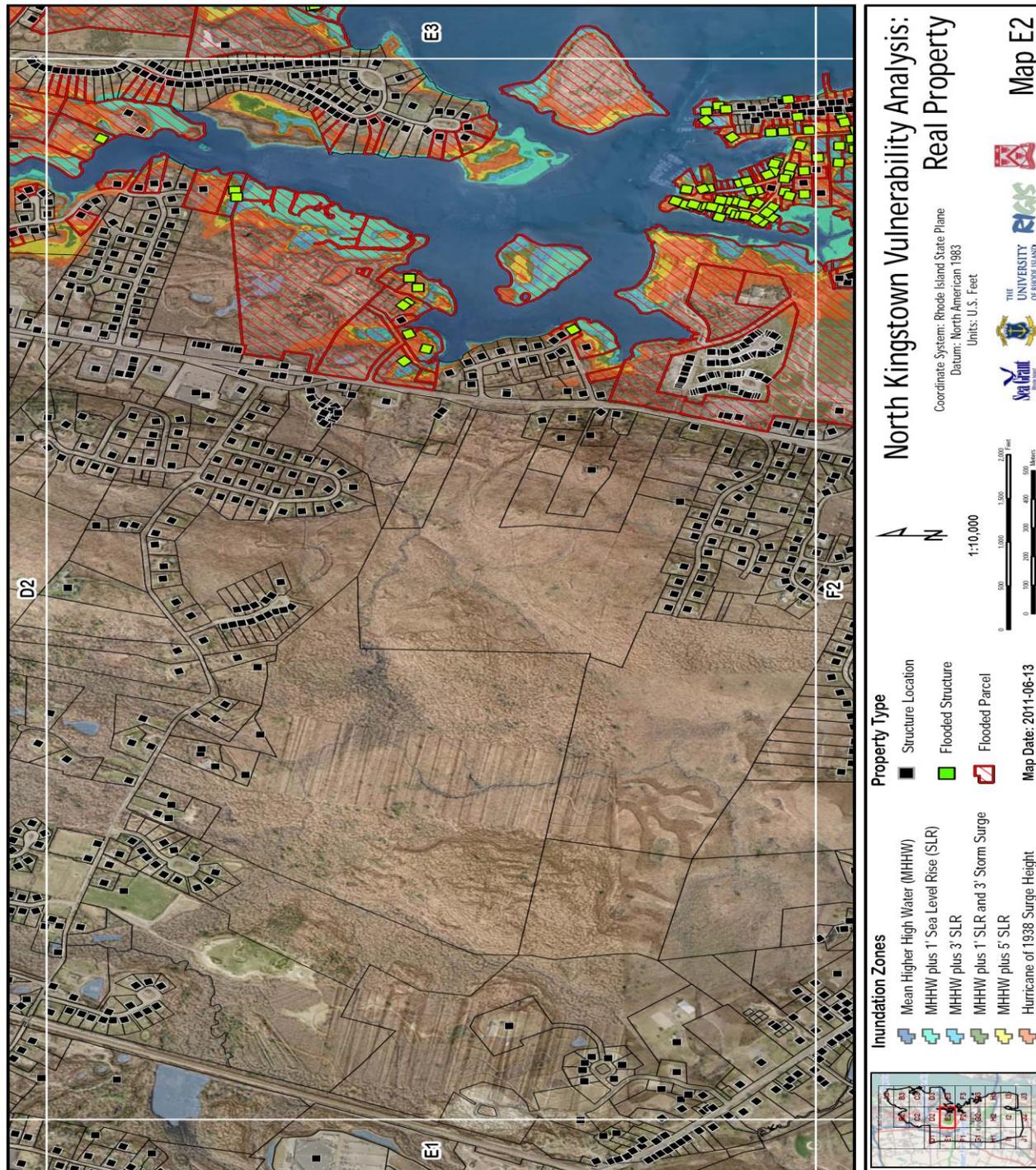
- RISPP Challenge Grant (FHWA) = \$100,000 w/25K match from URI
- Rhode Island Foundation - Anonymous Donor provided a small portion of a grant we received for statewide work to be focused on NK
- RI Sea Grant Extension Funds - Coastal Community Development (for Sea Grant Extension staff time)

Implementation Phase (2014-on)

- EPA Smart Growth Implementation Assistance grant to RISPP - focus on Economics of Climate Change in North Kingstown
- US Dept of Interior Grant to URI for Green Infrastructure - North Kingstown will be one of three communities addressed
- RI Sea Grant Extension Funds - to support ongoing efforts
- Climate Change award from RI APA in 2014
- Beach SAMP: The Beach SAMP is a statewide effort that is focused on Shoreline Change in coastal Rhode Island. All 21 coastal communities are included in the study area for the Beach SAMP. There are multiple funding sources that have been awarded for the Beach SAMP supporting updated shoreline change maps, projected shoreline change maps with sea level rise and storm surge scenarios included, and development of a "Storm Tools" model to assist RI municipalities model different storm and SLR scenarios. North Kingstown is considered an early-phase pilot community for this effort.

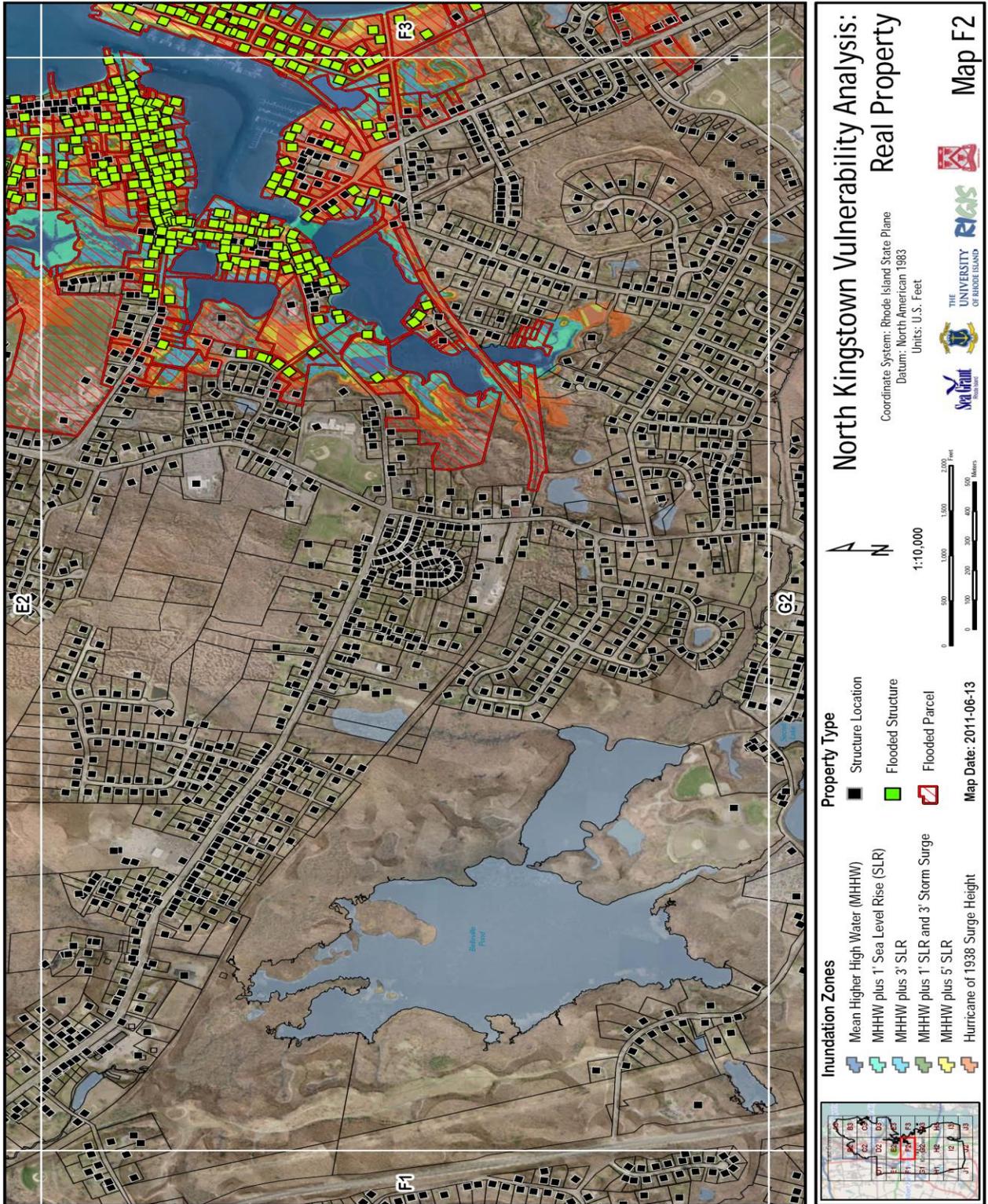


Appendix I: SLR- Phase I Maps: Map 6:Sample 1 from "Mapping Assets Vulnerable to Sea Level Rise, North Kingstown, RI" by RISG





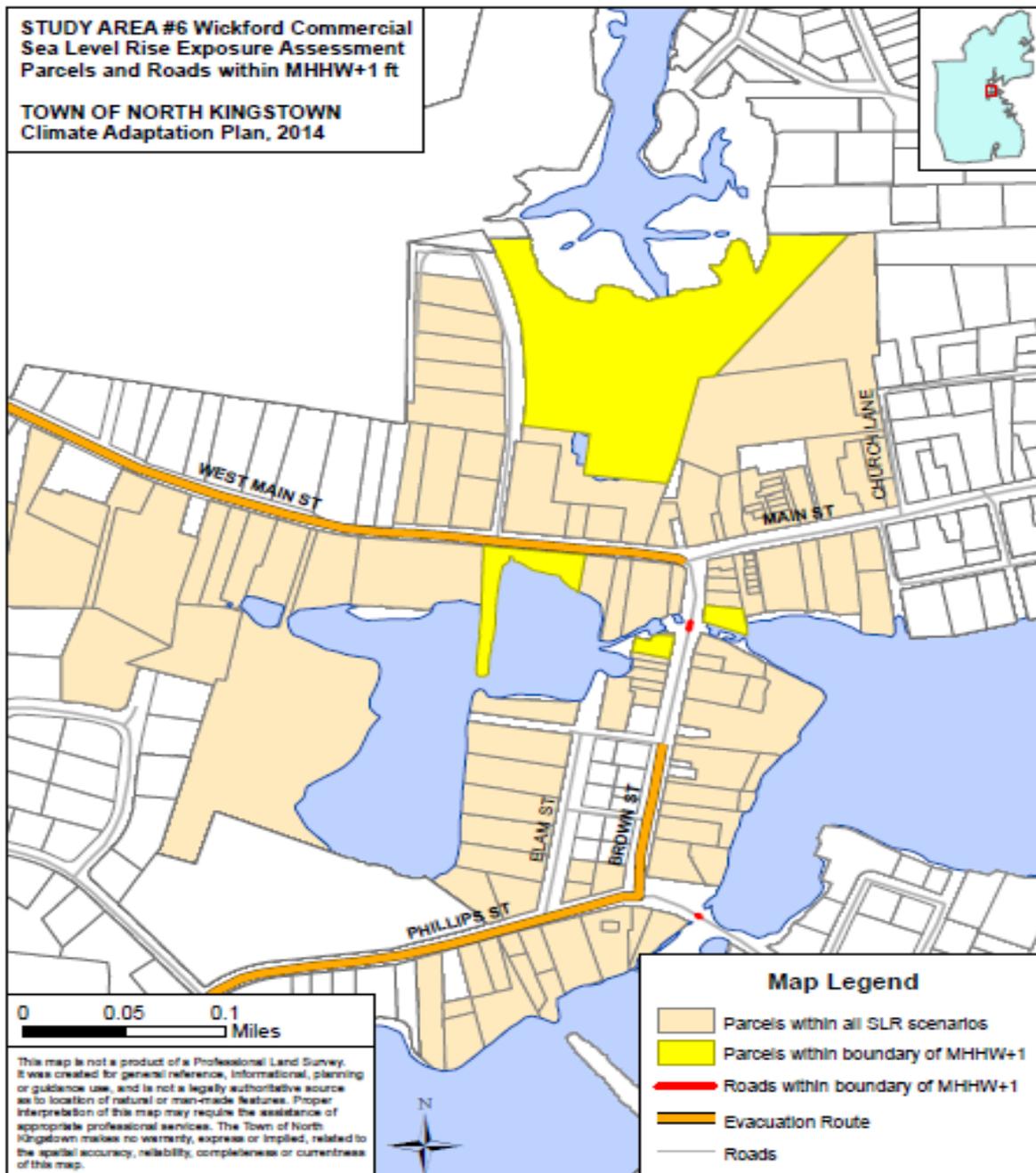
Strategy for Reducing Risks from Natural Hazards in North Kingstown, RI

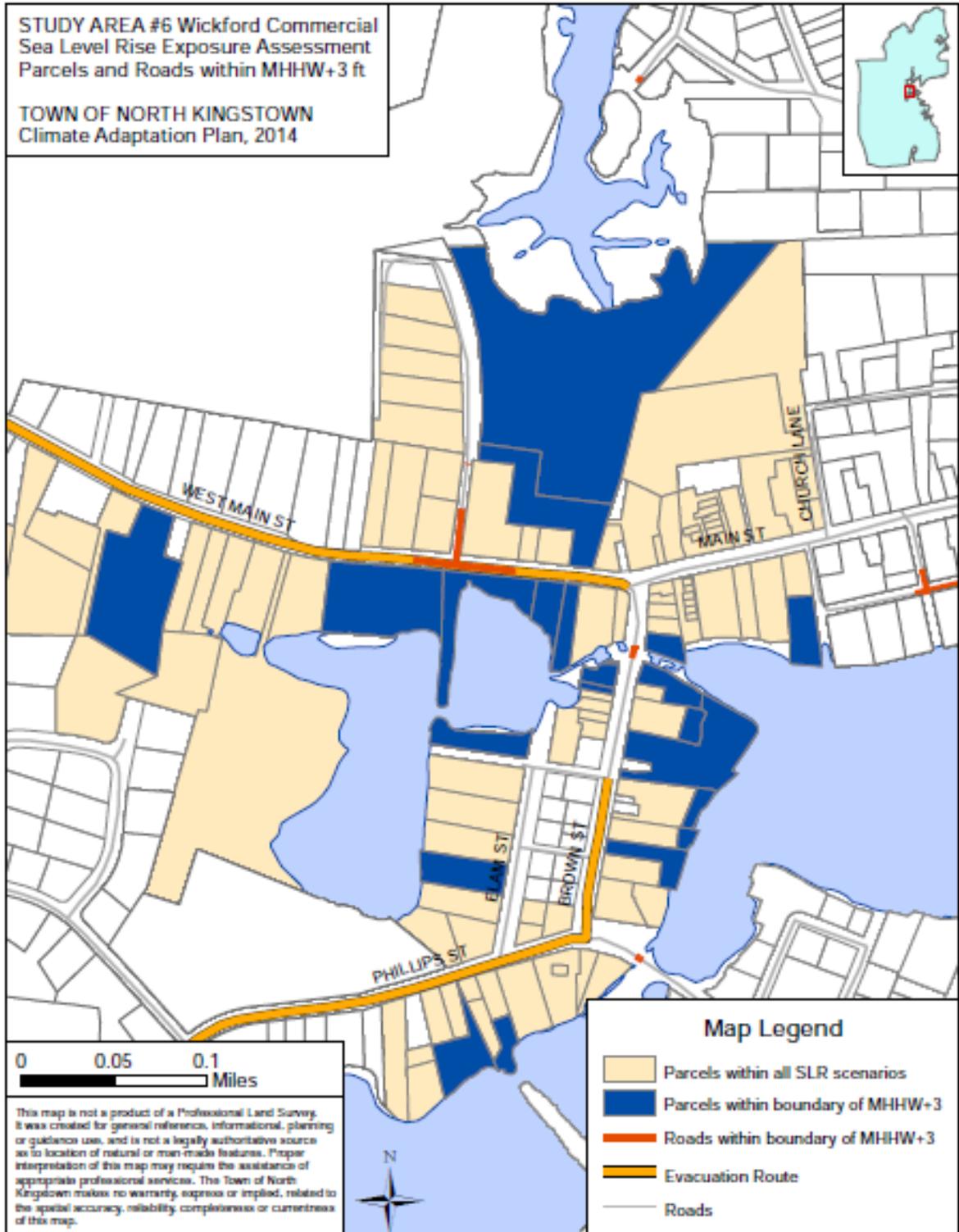




Appendix J: Climate Adaptation Plan, 2014: SLR maps for the Wickford Commercial Study area.

These include 7 maps - 3 scenario maps with the 1, 3, 5-foot levels plus the projected wetland migration areas; 3 parcel/road maps showing which parcels and roads intersect with the scenarios; and the FEMA floodplain map.

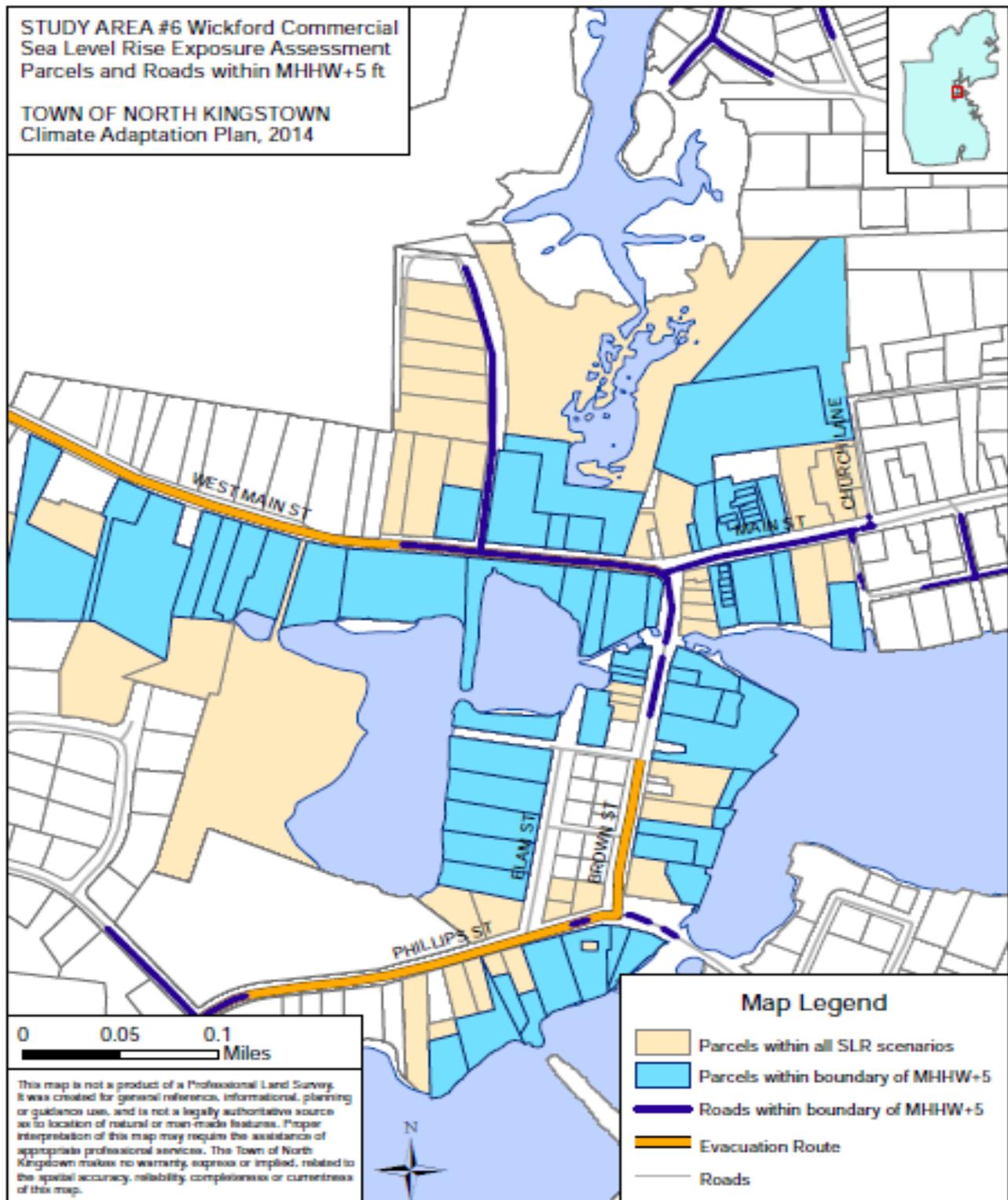


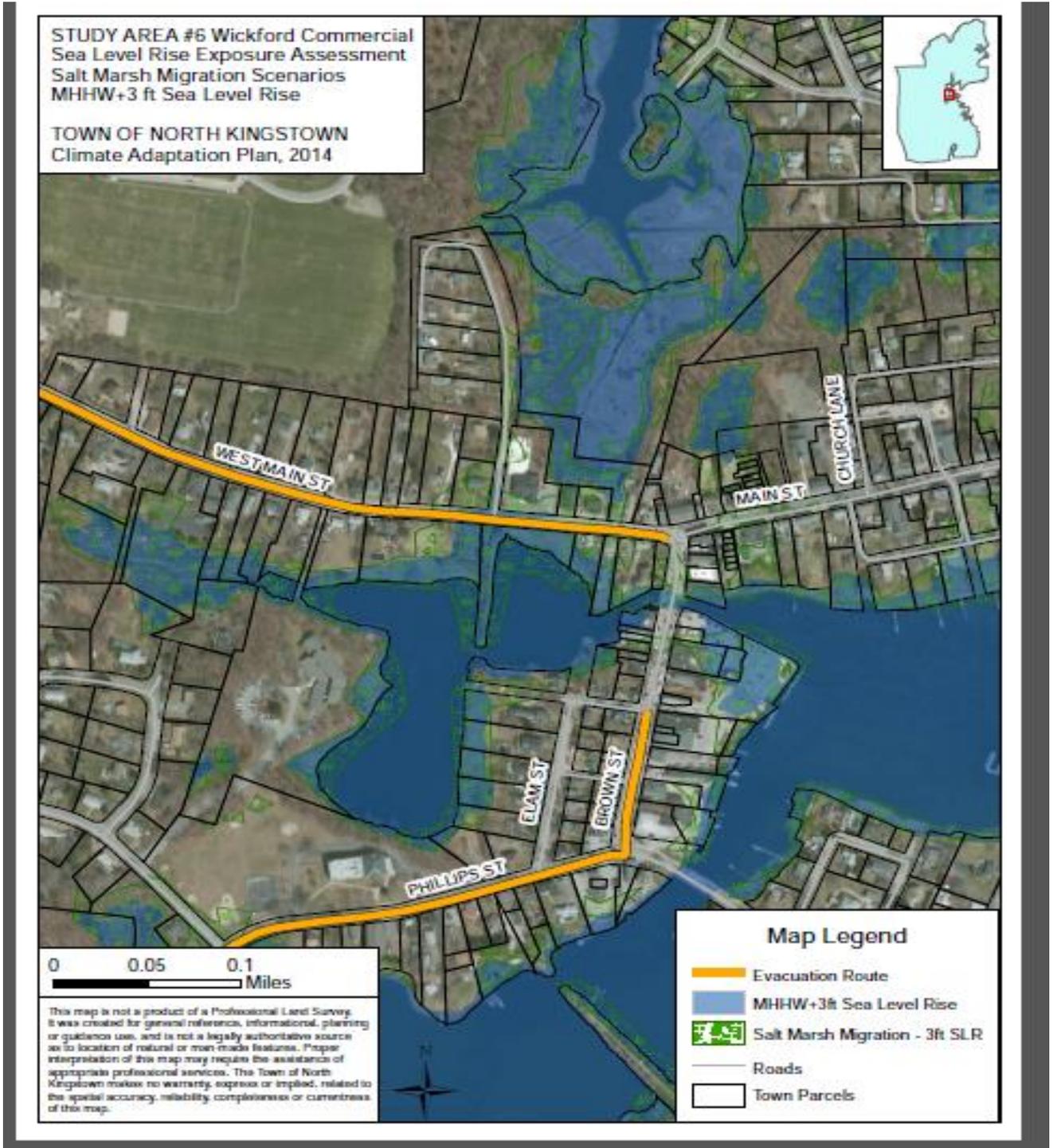




STUDY AREA #6 Wickford Commercial
Sea Level Rise Exposure Assessment
Parcels and Roads within MHHW+5 ft

TOWN OF NORTH KINGSTOWN
Climate Adaptation Plan, 2014

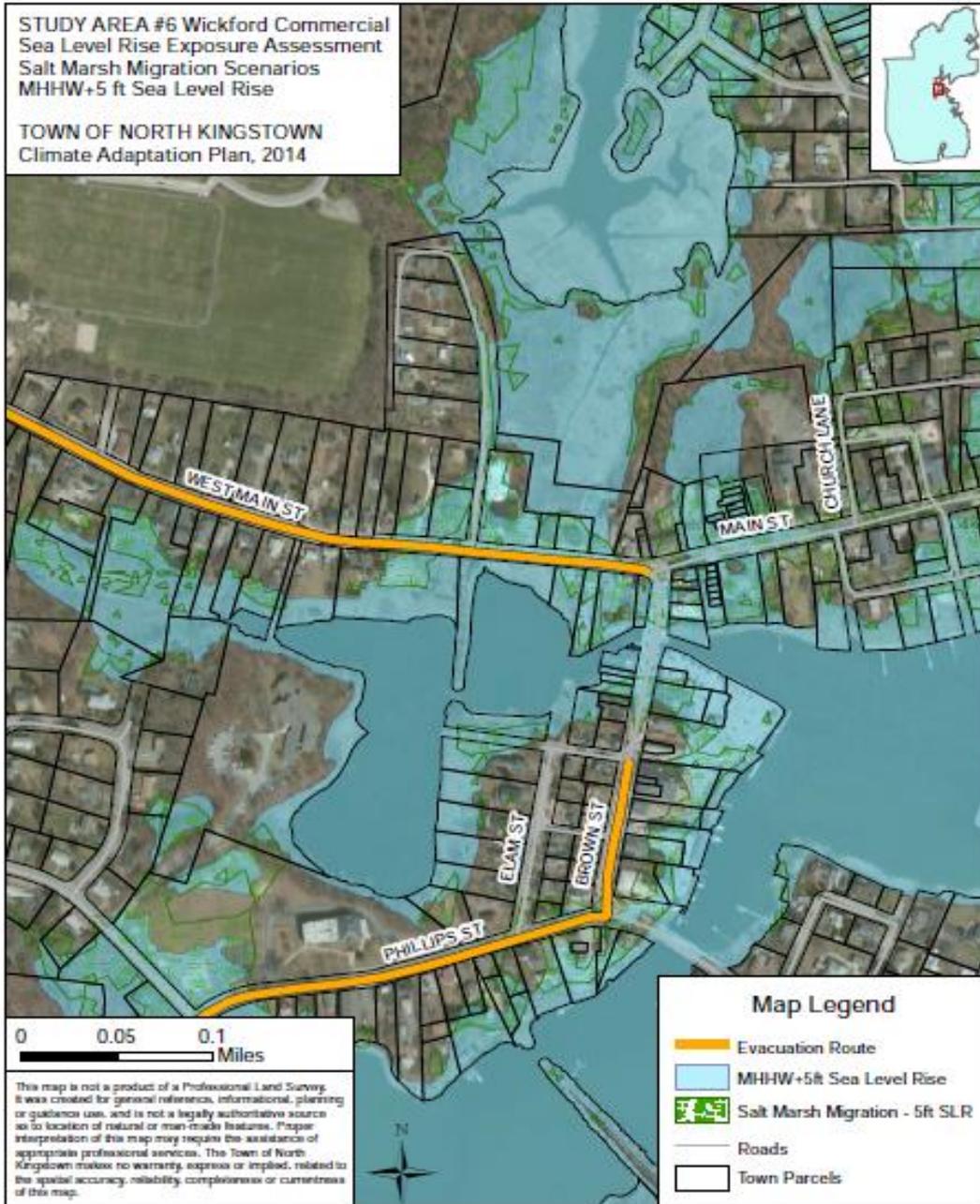


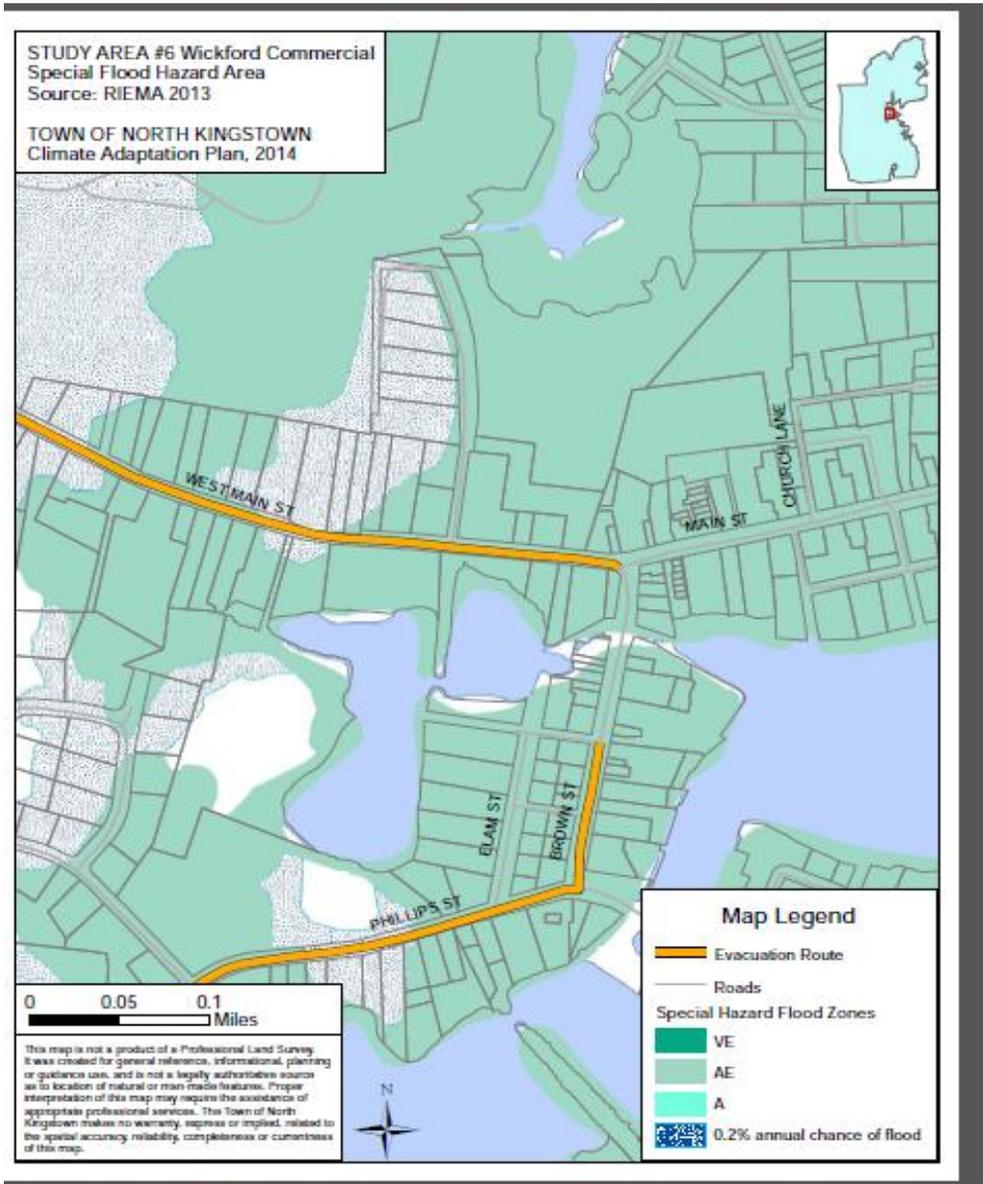




STUDY AREA #6 Wickford Commercial
Sea Level Rise Exposure Assessment
Salt Marsh Migration Scenarios
MHHW+5 ft Sea Level Rise

TOWN OF NORTH KINGSTOWN
Climate Adaptation Plan, 2014







APPENDIX K: PHOTOGRAPHS OF FLOODING IN NORTH KINGSTOWN





Strategy for Reducing Risks from Natural Hazards in North Kingstown, RI







Appendix L:

Agenda Item and Advertisement for Town Council Hearing to Adopt the Plan



	Town Council Agenda Item Report
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Submitted by: [Jeannette Alyward](#)

Submitting Department: Planning and Development

Meeting Date: July 15, 2019

Agenda Action:

Public Hearing - Adoption of Hazard Mitigation Plan - 5-Year update

Motion:

To adopt the Hazard Mitigation Plan, entitled, "Strategy for Reducing Risks from Natural Hazards in North Kingstown, Rhode Island: A Multi-Hazard Strategy", 5-Year Update; and a

FURTHER MOTION: To authorize the Town Manager to submit the "Plan" to the Rhode Island Emergency Management Agency and the Federal Emergency Management Agency.

ATTACHMENTS

- |



NOTICE OF PUBLIC HEARING
NORTH KINGSTOWN TOWN COUNCIL

JULY 15, 2019

TO CONSIDER ADOPTION OF AN UPDATE TO THE NORTH KINGSTOWN HAZARD
MITIGATION PLAN

NOTICE is hereby given that the Town Council of the Town of North Kingstown will conduct a Public Hearing at the North Kingstown Beechwood Senior Center, 44 Beach Street, North Kingstown, Rhode Island at 7:00 p.m. on Monday, July 15, 2019 for the purpose of considering amendments to the North Kingstown Hazard Mitigation Plan.

Proposed amendments may be altered or amended prior to the close of the Public Hearing without further advertising, as a result of further study or because of the views expressed at the Public Hearing. Any such alteration or amendment must be presented for comment in the course of said Public Hearing.

The amendment would incorporate updates to the hazard mitigation plan entitled *Strategy for Reducing Risks from Natural Hazards in North Kingstown, Rhode Island: A Multi-Hazard Mitigation Strategy*.

The plan has been written and updated in conjunction with a Local Hazard Mitigation Committee (LHMC) formed of town staff and community members and has been reviewed by the Rhode Island Emergency Management Agency. The purpose of the hazard mitigation plan is to reduce the town's vulnerability to the effects of natural disasters. The plan has an assessment of the town's risk of and vulnerability to a variety of different natural hazards as well as a detailed set of actions in response to those risks and vulnerabilities. The plan also looks at the specific vulnerabilities identified for the town and connects them to actions that will be completed to reduce, and even eliminate, those vulnerabilities.

Copies of the proposed amendment may be examined at the Department of Planning and Development and the Town Clerk's Office located at Municipal Office, 100 Fairway Drive, Monday through Friday 8:30 AM to 4:30 PM, and at the North Kingstown Free Library, 100 Boone Street, North Kingstown, during normal business hours.

The town will provide interpreters for the hearing impaired provided three (3) days notice is provided by calling 401-294-3331 ext. 122.

Jeannette Alyward
Town Clerk

DISPLAY AD: To be printed (2) two times July 4 and July 11, 2019 issue of the Standard Times.

ACCT # Town Clerk 16842 – PO 50202
Bill to: North Kingstown Town Clerk, 80 Boston Neck Road, North Kingstown RI 02852
(401) 294-3331, Ext. 122