



Strategy for Reducing Risks From Natural Hazards in Narragansett, Rhode Island: A Multi-Hazard Mitigation Strategy 2024

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transform your environment



Strategy for Reducing Risks From Natural Hazards in Narragansett, Rhode Island: A Multi-Hazard Mitigation Strategy



Acknowledgements

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With Consulting Assistance from Weston & Sampson

Approved by Narragansett Town Council

April 01, 2024

Adoption by Narragansett Town Council

September 16, 2024

Approved by the Federal Emergency Management Agency

September 03, 2024

Funding for development and update provided by the Town of Narragansett

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Town of Narragansett

Rhode Island

Resolution No. 2024-13



A RESOLUTION RELATIVE TO LOCAL HAZARD MITIGATION PLAN UPDATES

WHEREAS the Town of Narragansett passed Resolution 99-25, adopting a local hazard mitigation plan entitled, “Strategy for Reducing Risks from Natural Hazard Mitigation Strategy” on June 21, 1999 and

WHEREAS the Federal Emergency Management Agency (FEMA) published on February 26, 2002 CFR parts 202 and 205, which require review and approval by FEMA of local Hazard Mitigation Plans as a condition for pre and post-disaster grants, and

WHEREAS the Town of Narragansett passed Resolution 05-23, adopting the 2005 updates to the local hazard mitigation on July 18, 2005 and

WHEREAS the Town of Narragansett passed Resolution 2013-02, adopting the 2013 full re-write of the local hazard mitigation on January 22, 2013 and

WHEREAS the Town of Narragansett passed Resolution 2019-01, adopting the 2013 full re-write of the local hazard mitigation on January 7, 2019 and

WHEREAS FEMA has reviewed and approved the recent re-write of the local hazard mitigation plan approved on September 3, 2024 and submitted by the Town,

NOW THEREFORE BE IT RESOLVED that the Hazard Mitigation Plan, updated in 2024 is adopted by the Town of Narragansett.

Adopted this 16th day of September, 2024


Ewa Dzwierzynski
President

ATTEST:


Sarah Masson
Council Clerk Pro Tem



ADDITIONAL ACKNOWLEDGEMENTS

Mitigation planning has been successfully initiated in Narragansett with the continuing support and resources provided by the Rhode Island Emergency Management Agency, and with Special Thanks to Jess Henry former State Hazard Mitigation Officer. The guidance and assistance provided by the Rhode Island State Hazard Mitigation Committee is essential for implementing the strategy presented in this plan. Narragansett is also grateful for the efforts of the Town Planning Board, the Emergency Management Agency, and the Local Hazard Mitigation Committee in preparing this plan.

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1 INTRODUCTION

1.1 What is Hazard Mitigation Planning?

Hazard mitigation planning (HMP) is an iterative process that seeks to reduce the impact of natural hazards on people and property. Narragansett has assessed a variety of natural hazards that pose a risk to the health and welfare of residents, identified specific vulnerabilities associated with those hazards and climate change, and identified location capabilities and specific mitigation actions to protect homes, businesses, and the critical infrastructure that keeps the Town running. This process is tailored to address the issues affecting Narragansett residents now and into the future and is crucial to building community resilience.

What are Natural Hazards?

Natural hazards are a source of harm or difficulty created by a meteorological, environmental or geological event (such as extreme wind events, tornadoes, winter weather as well as earthquakes flooding, and fires).

Vulnerability is a description of which community "assets" (e.g., people, structures, systems, natural resources, cultural resources, historic resources, etc.) are at risk from the effects of a natural hazard.

Hazard Mitigation

is the effort to reduce impacts from natural hazards through community planning, policy changes, educational programs, infrastructure projects, and other activities.

Climate change refers to long-term fluctuations in Earth's average weather patterns. These fluctuations are driven by a combination of natural and human activities, primarily due to the increase in greenhouse gases in the atmosphere. Human activities that are the common cause of climate change include burning of fossil fuels, deforestation, and land use changes. Impacts of climate change including changing temperatures, precipitation, and wind patterns. Climate change has increased the frequency and intensity of these natural hazards and many others, creating a greater need for proactive planning. Chapter 3 includes additional information on natural hazard severity and risk.



Resilience is the ability to withstand and swiftly recover from an extreme event. Ideally, resilient systems "bounce forward" to create healthier, greener, and more equitable systems and spaces.



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1.2 Benefits of Natural Hazard Mitigation Planning

Completing natural hazard mitigation planning provides benefits to Narragansett:

1. Increasing public awareness of natural hazards that may affect the community reduces overall risk. By providing education and outreach, individuals are able to understand how natural hazards may affect their lives and what the region, the Town, and they as individuals can do and are doing to minimize impacts of those hazards.
2. Proactive planning creates efficiency beyond Town limits. Developing a HMP allows state and local governments to work together and combine hazard risk reduction with other community goals and plans.
3. The community's greatest vulnerabilities can be prioritized to receive resources. Developing a plan of hazard mitigation measures considers a prioritization process that reflects the cost and benefit of safety, property protection, technical, political, legal, environmental, economic, social, administrative, and other community objectives, quantitatively and/or qualitatively.
4. The implementation of an HMP saves taxpayer money. According to FEMA, one dollar spent on federal hazard mitigation grants saves an average of six dollars on disaster response (NIBS, 2019).
5. Maintaining a FEMA compliant HMP also makes the municipality eligible for federal grant funding (FEMA, 2020). Hazard mitigation funding is available through the Federal Emergency Management Agency (FEMA). To be eligible for FEMA Grants, local governments must prepare an HMP that meets the requirements established in the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended by the Disaster Mitigation Act of 2000. The HMP also ensures that federally funded projects reflect a community's priorities and offer solutions to specific threats. Please refer to Chapter 7 for more information on FEMA grants and other potential funding sources.

1.3 Organization of HMP

The report presents the results of the HMP planning process, which was informed by data review and analysis, input received from steering committee during and outside of meetings, input from the HMP workshops held with and Local Hazard Mitigation Committee (LHMC), and input from public engagement activities. Each committee is described below.



The Steering Committee (STC): A small group of Town staff working with the consultant whose work focuses on specific related groups and issues and who met regularly to consult on the HMP



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The **Local Hazard Mitigation Committee (LHMC)**: A team of Town Staff representatives and representatives of RIEMA with a wide of variety of knowledge and experiences



Public Engagement: Outreach, public surveys, and public meetings open to all community members and neighbors

This plan is organized as visualized in the diagram on the following page.

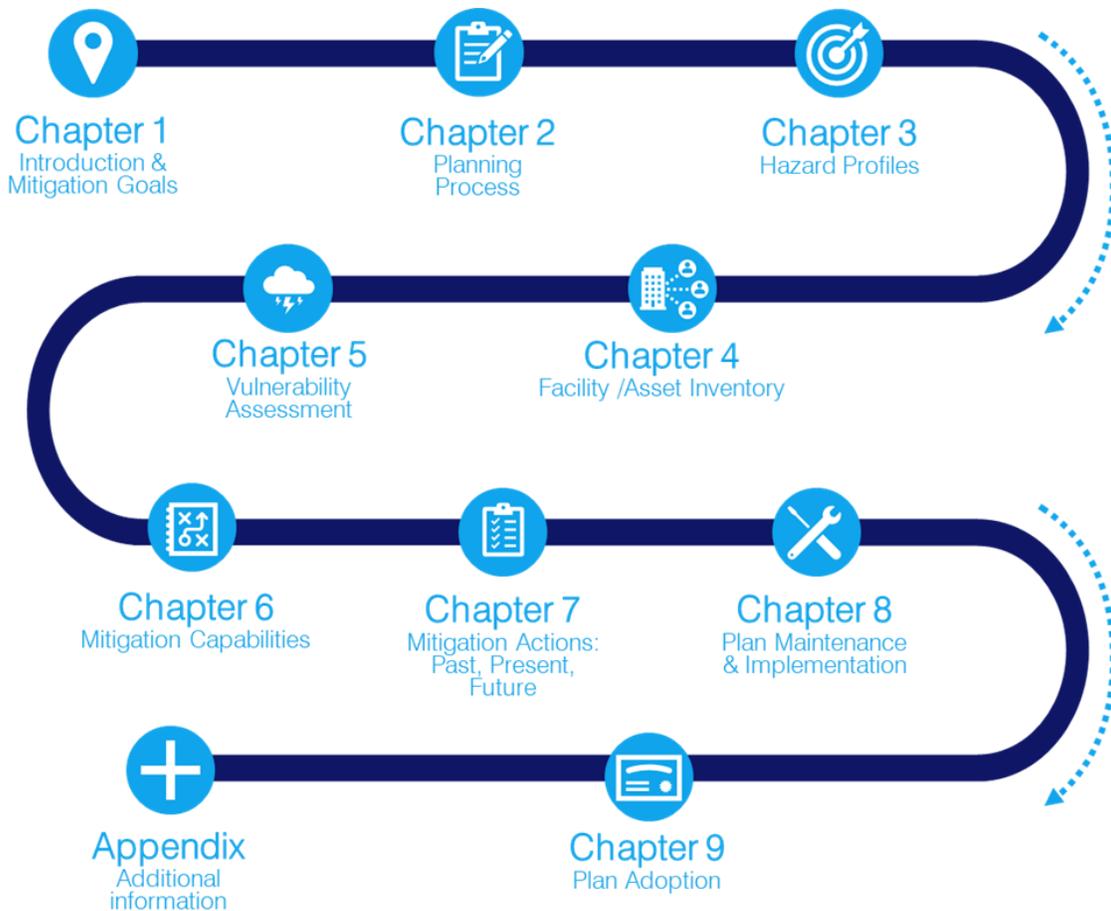


Figure 1.1. Organization of the Hazard Mitigation Plan

1.4 Narragansett's Natural Hazard Mitigation & Climate Adaptation Goals

The Narragansett Hazard Mitigation Steering Committee established the goals and objectives for natural hazard mitigation planning. The LHMC reviewed and endorsed the goals at their subsequent meeting



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on February 1st, 2024. The goals were restructured to better represent the current hazard mitigation efforts in Narragansett, create consistency with other climate resilience planning processes, and provide simplified messaging to the public.

1. Protecting the health, safety and general welfare of the Town's residents and visitors.
2. Implementing hazard mitigation actions in order to protect Narragansett's cultural, historical, structural, economic, and natural environment. Actions will include:
 - Protecting Narragansett's critical infrastructure.
 - Continuing to manage the development in hazard-prone areas to reduce economic loss.
 - Continuing to reduce flood losses through compliance with NFIP requirements.
3. Promoting educational opportunities to introduce residents and visitors to the risks of natural hazards and the various appropriate mitigation strategies that can be taken. Promotion of educational opportunities will include:
 - Continuing and expanding outreach efforts through various communication methods.
 - Continuing to work with residents on mitigation strategies.
4. Identify and seek funding for measures to mitigate or eliminate each known significant flood hazard area.
5. Integrate hazard mitigation planning as an integral factor in all relevant municipal departments, committees, and boards.
6. Encourage the business community, major institutions, and non-profits to work with the Town to develop, review and implement the HMP.
7. Work with surrounding communities, state, regional and federal agencies to ensure regional cooperation and solutions for hazards affecting multiple communities.
8. Ensure that future development meets federal, state and local standards for preventing and reducing the impacts of natural hazards.
9. Take maximum advantage of resources from FEMA and RIEMA to educate Town staff and the public about hazard mitigation.
10. Consider the impacts of climate change and incorporate climate sustainability, mitigation, and resiliency into hazard mitigation and other Town plans and policies.



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2 PLANNING PROCESS

The Narragansett HMP was informed by data review and analysis, input received from the Steering Committee (STC) during and outside of STC meetings, the Local Hazard Mitigation Committee (LHMC), and input from Hazard Mitigation Plan Workshops held with targeted stakeholders and as well as from public engagement activities. The HMP planning process proceeded according to the timeline below. The subsequent pages describe the involvement of STC, Local Hazard Mitigation Committee (LHMC), and the public in the HMP planning process in more detail.

Table 2.1. HMP Planning Timeline

TASK	2023				2024		
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Task 1 – Project Kickoff							
Task 2 – Comparison of the Existing Draft							
Task 3 – Review Meeting with the Guidance Committee							
Task 4 - Update the 2019 HMP							
Task 5 – Work Delegated by the Guidance Committee							
Task 6 - Mapping							
Task 7 – Monthly Progress Reports and Bimonthly Meetings							
Task 8 Public Meetings							
Task 9 Address Public Comments							

2.1 Community Engagement Approach

The goal of public engagement for this HMP process was to center the experiences of those who are most vulnerable to natural hazards in Narragansett. To truly mitigate hazards, the Town must develop strategies for protecting and supporting those who are most exposed. Priority populations include people or communities who may be disproportionately impacted by climate change due to life circumstances that systematically increase their exposure to climate hazards or make it harder to respond. In addition to factors such as income, race, and language, other factors like physical ability, access to transportation, health status, and age shape whether someone or their community will be disproportionately affected by climate change. This is because of underlying contributors such as racial inequality, financial insecurity, or accessibility barriers that create vulnerability.



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These engagement activities and the input gathered from the community were invaluable to the development of the HMP. The STC, LHMC, and community members helped shape the asset inventory, vulnerability assessment, mitigation actions, and other elements of the plan.

For the Asset Inventory, LHMC gave input on assets that are critical to them or their community. For the Hazard Profile and Vulnerability Assessment, community members gave feedback on specific experiences they or others have had in a variety of hazards. They also brought attention to potential vulnerabilities in the face of a changing climate. Additionally, community members helped develop specific mitigation actions to address these vulnerabilities and strengthen the resilience of the community. These assets, vulnerabilities, and actions have all been incorporated into the HMP.

Bringing as many people, particularly vulnerable people, as possible into the hazard mitigation process will help Narragansett be more equitable and resilient in the future. All the public engagement materials are included in Appendix C.

2.1.1 Steering Committee (STC)

The Town of Narragansett convened a STC for the development of the HMP. Jill Sabo, Environmental Planning Specialist and Michael Deluca, Director of Community Development were part of the STC. The STC met six times to guide the planning process and make final planning decisions. The STC played an important role in identifying critical infrastructure, involving key stakeholders, and documenting the Town's capacity to mitigate hazards alongside ongoing operations. To assist in drafting the plan, the STC also suggested and made available reports, maps, and other pertinent information related to natural hazards in Narragansett.

Table 2.2 Steering Committee Meeting Schedule

Meeting	Date	Meeting Topics
Kickoff Meeting	October 24, 2023	<ul style="list-style-type: none"> • Overview of Hazard Mitigation Planning • Scope and Schedule • Outreach Strategy • Questions/ Discussion/ Action Items
Steering Committee Meeting #1	December 1, 2023	<ul style="list-style-type: none"> • Overview of work in progress • Chapter 3 Hazard Profiles • Stakeholder Outreach and Engagement Plan • Capabilities Assessment



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Meeting	Date	Meeting Topics
		<ul style="list-style-type: none"> • Next Steps
Steering Committee Meeting #2	December 8, 2023	<ul style="list-style-type: none"> • Overview of work in progress • Mitigation Goals • Mitigation Actions: Past • Outreach and LHMC Meetings • Next Steps
Steering Committee Meeting #3	December 15, 2023	<ul style="list-style-type: none"> • Overview of Work in progress • Hazard Mitigation Goals • Capabilities Assessment • Asset Inventory • Outreach and LHMC Meetings • Next Steps
Steering Committee Meeting #4	January 5, 2024	<ul style="list-style-type: none"> • Overview of work in progress • Outreach and NLHMC Meetings • Mitigation Actions • Plan Evaluation and Maintenance • Next Steps
Steering Committee Meeting #5	January 11, 2024	<ul style="list-style-type: none"> • Overview of work in progress • Prioritization Criteria and Process for Prioritizing Mitigation Actions • Asset Inventory Discussion • Next Steps
Steering Committee Meeting #6	January 19, 2024	<ul style="list-style-type: none"> • Results of Asset Inventory • Results of Vulnerability Assessment • Draft HMP • Next Steps

2.1.2 Local Hazard Mitigation Committee (LHMC)

Town Staff with subject matter expertise and local knowledge and experience were invited to join the LHMC and attend a series of two workshops. The names of the LHMC members are:

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- James R. Tierney, Town Manager and Public Safety Commissioner
- Christine Wilson, Finance Director
- Jonathan Gerhard, Town Engineer
- Melinda Hopkins, RIEMA Planning Branch Chief
- Rae-Anne Culp, State Mitigation Planning Supervisor
- Scott Partington, Fire Chief
- Sean Corrigan, Police Chief
- Stephen Daignault, Director of Public Works
- Wayne Pimental, Building/Zoning Official
- Michelle Kershaw, Director of Parks and Recreation
- Dan Holland, IT Manager

During the LHMC workshops, Weston & Sampson provided information about local features and hazards impacting the Town of Narragansett and reviewed the Town’s vulnerability to these hazards. Participants identified and prioritized key actions that will improve the Town’s resilience to natural and climate-related hazards.

Municipal staff and representative from RIEMA participated in these workshops and helped aligning the HMP update with the operational policies and hazard mitigation strategies at different levels of government and implementation. A summary of key findings from each workshop is included on the following table.

To enhance accessibility, stakeholder workshops were conducted as online sessions. LHMC workshops were organized around topic areas that included:

1. Asset, vulnerability, and impact identification
2. Mitigation action development
3. Mitigation action prioritization

Table 2.3 Natural Hazard Mitigation Planning Team Workshop Schedule

Meeting	Date	Meeting Topics
LHMC Workshop #1	October 24, 2023	<ul style="list-style-type: none"> • Overview of plan • Discussion of natural hazards • Asset inventory • Identify vulnerabilities.
LHMC Workshop #2	February 1, 2024	<ul style="list-style-type: none"> • Review climate adaptation strategies and mitigation goals.



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Meeting	Date	Meeting Topics
		<ul style="list-style-type: none"> Solicit feedback on how well these goals protect all groups. Initial discussion to identify mitigation actions. Incorporate input from public surveys.

2.1.3 Stakeholders

A variety of stakeholders were invited to participate in plan development and review.

- Municipal staff beyond those involved in the LHMC:** Commentary on the plan development was sought from members of the Harbor Management Commission, Galilee Advisory Committee, Land Conservancy Trust, Zoning Board, and the Plan was presented to the Planning Board for review and comment as well as the Town Council twice, once for initial review comment and then for final adoption.
- Business, academia, and other private organizations:** Survey invitations were provided to residents, business owners, other people employed in the Town as well as people from other organizations doing business in town. Invitees included representatives from banks, restaurant owners, and local schools – private and public. The local media was also informed of the survey, public meetings and was invited to comment of the Plan.
- State and Regional entities:** State Senators and Representatives also had access to review and comment on the Plan as well as attend a public meeting (2 held) to discuss the Plan. The RI Department of Administration, RI Department of Transportation, Coastal Resources Management Council, RI Department of Environmental Management, University of Rhode Island, and RI Emergency Management Agency representatives were also forward access to comment on the Plan as well as attend public meetings.
- Adjacent communities:** Access to comment complete the survey and comment on the Plan were sent to both North Kingstown and South Kingstown, as well as South County Hospital.
- Representative of non-profit organizations:** Nonprofit organizations such as the Narrow River Preservation Association, Pettaquamscutt Lake Shores Improvement Association and the Narragansett Library were invited to complete the survey, comment of the Plan, and attend a public meeting.

2.1.4 Public Engagement

In order to gather information from the community and educate community members on hazard mitigation, the Town pursued the following approach:

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2.1.4.1 Getting the word out (Survey)

This first step involved posting an online survey and an online interactive mapping survey to capture initial input. The interactive mapping survey allowed residents to map hazard areas that they have experienced in addition to responding to survey questions. The online survey provided residents the opportunity to engage with the project on their own time, and as their schedules allowed. Materials were posted for four weeks in December and January on the Narragansett Town website and advertised through email blasts, a social media posts on the Town's Facebook page, Police and Fire Department's Facebook page, Parks and recreation Facebook Page, and the Public Works Facebook Page. The online survey received 147 responses and mapping survey received two responses. A full report of survey responses can be found in Appendix B.

Responses indicated that "Hurricanes/Tropical Storms" was the top hazard of concern for over 85% of respondents, followed by "Thunderstorms and Windstorms" at nearly 50% (Figure 2.1). The same climate hazards are also experienced by the residents in Narragansett.



Figure 2.1. Survey Responses: "Which Natural Hazards are you most concerned with?"

The natural hazard impacts that were of top concern to respondents were damage to their home (>88%), power outages (57%), or contaminated drinking water (~40%) (Figure 2.2). Residents have purchased homeowners' insurance (~88%), trimmed or removed trees close to house (70%), bought generators (50%) to reduce the impact of natural hazards for their property.



NARRAGANSETT HAZARD MITIGATION PLAN 2024

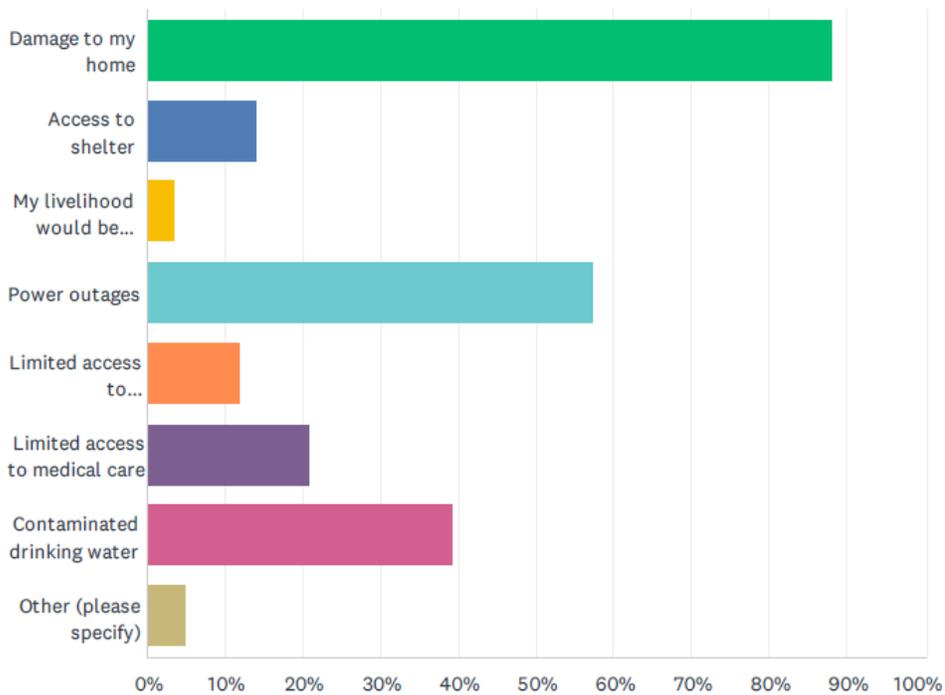


Figure 2.2. Survey Responses: “What impacts from Natural Hazards most concerns you?”

The most common answer to the question, “how would you like to receive information about Hazard Mitigation planning in Narragansett?” was through “Email advice from the Town” (86%).

2.1.4.2 Public meeting

Community input was also collected through public meetings with the help of the STC. Public Meetings were announced to community members through virtual, hard copy, and community outreach network methods. These included several notices in the Daily Update email, posting on Town’s social media and other department specific social media, virtual flier distribution, two advertisements in the local paper (Narragansett Times) and promotion in partnership with local networks and the community engagement teams from various Town departments.

The first public meeting was held in-person on December 20, 2023, from 6:00 to 7:00 PM, and was primarily focused on informing the public about the history and purpose of the HMP update, FEMA mitigation funding programs, project work plan, and the overall planning process. The meeting included a discussion of local vulnerabilities, strengths, historic hazard impacts on the community, and potential adaptation action items.



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The second public meeting was held on February 28, 2024, as the draft review period was open on February 16, 2024, to present the initial results and review the draft HMP Update. The draft review period was open for two weeks. Attendees were invited to submit comments on the draft plan and in the following two weeks through an online comment form.

2.2 Plans Related to Hazard Mitigation

The Town of Narragansett has undertaken significant long-range planning efforts related to hazard mitigation, climate resilience, and sustainability. Key focus areas of these efforts include developing plans to reduce the impact of extreme events, preparing the community for extreme events and chronic impacts, and mitigating risks to the built and natural environments from natural hazards. There are a variety of ordinances and regulations, as well as committees and task forces, that further the Town's efforts to proactively address natural hazards and climate change, which are discussed in Chapter 6 in the Capabilities Assessment.

2.3 FEMA Review Tool

All aspects of the planning process were created and implemented in accordance with the updated [FEMA Local Mitigation Planning Policy Guide](#) (FEMA, 2022).



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3 HAZARD PROFILES

Natural hazards have the potential to induce damage or loss to physical assets, such as buildings, infrastructure, and natural, historic, and cultural resources within the Town. Natural hazards also have the potential to affect people, including underserved communities and priority populations, municipal processes and operations, important Town resources, and activities that have value to the community. Analysis through the Environmental Protection Agency (EPA) reveals that socially, priority population are disproportionately affected by the impacts of natural hazards (EPA, 2021). For each natural hazard profile, the following components of the hazard are identified in this chapter:

The following hazard profiles were developed based on the natural hazards that can affect the jurisdiction:

 <p>Sea Level Rise and Precipitation Flooding</p> <ul style="list-style-type: none">• Inland Flooding (Stormwater and Riverine)• Coastal Flooding• Coastal Erosion• Dam Overtopping	 <p>Changes in Groundwater</p> <ul style="list-style-type: none">• Rise in groundwater levels• Groundwater depletion• Changes in water quality and characteristics	 <p>Wind-Related Hazards</p> <ul style="list-style-type: none">• Hurricanes / Tropical Storms• Tornadoes
 <p>Winter Storm Hazards</p> <ul style="list-style-type: none">• Winter Storms / Nor'easters	 <p>Geological Hazards</p> <ul style="list-style-type: none">• Earthquakes• Landslides• Tsunami• Coastal Erosion	 <p>Temperature-Related Hazards</p> <ul style="list-style-type: none">• Extreme heat• Extreme cold
 <p>Drought Hazards</p> <ul style="list-style-type: none">• Drought	 <p>Fire-Related Hazards</p> <ul style="list-style-type: none">• Brushfire	 <p>Severe Thunderstorms</p> <ul style="list-style-type: none">• Thunderstorm



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1. **Description:** A description for each natural hazard stemming from the 2024 RI State Hazard Mitigation and Climate Adaptation Plan.

2. **Previous Occurrence(s) of the Hazard Event:** A list of historical occurrences of the natural hazard event, in chronological order. Understanding the history of a hazard in the Town, including the extent, frequency, and location of the occurrence, aids in the planning process.
 - i. **Extent (Severity or Magnitude):** FEMA defines extent as “the range of anticipated intensities of the identified hazard(s)” (FEMA, 2022). This can be expressed in varying scientific charts and scales, as relevant to the hazard and Narragansett. Extent can be summarized as how serious the hazard event is.
 - ii. **Frequency:** Frequency refers to the likelihood of occurrences over a given period of time.
 - iii. **Location:** Location is the geographic boundary in which a hazard occurs. This may include areas larger or smaller than the Town of Narragansett's jurisdiction.

3. **Probability of Future Hazard Events due to Climate Change:** Climate projections indicate a change in long-term weather patterns. This section identifies how climate change may affect the probability of natural hazards occurring, and to what degree they may change. Probability, by definition is likelihood of a hazard occurring or reoccurring. This includes the effects of future conditions, including long term weather patterns, temperatures, and sea levels, on the type, location, and range of anticipated intensities of the hazard.

Table 3.1 provides definitions of hazard location, extent, frequency, and probability. The definitions support the basis of determination in Table 3.2. In accordance with guidance from FEMA, quantification and definitions are necessary.

Table 3.1: Summary of Natural Hazard Risks for the Town of Narragansett

Points	Description
Hazard Extent (Severity/Intensity)	
Minor	Limited damages to property, no damage to public infrastructure (roads, bridges, trains, airports, public parks); contained geographic area (e.g., one or two neighborhoods); essential services (utilities, hospitals, schools, etc.) not interrupted; no injuries or fatalities.
Serious	Scattered major property damage (more than 10% destroyed); some minor infrastructure damage; wider geographic area (several communities); essential services briefly interrupted up to 1 day; some minor injuries.



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Points	Description
Extensive	Consistent major property damage (more than 25%); major damage public infrastructure damage (up to several days for repairs); essential services are interrupted from several hours to several days; many injuries and possible fatalities.
Catastrophic	Property and public infrastructure destroyed (more than 50%); essential services stopped for 30 days or more, multiple injuries and fatalities.
Present Frequency of Hazard	
Very Low	Events that occur less frequently than once in 100 years (less than 1% chance per year).
Low	Events that occur from once in 50 years to once in 100 years (1% to 2% chance per year).
Medium	Events that occur from once in 5 years to once in 50 years (2% to 20% chance per year).
High	Events that occur more frequently than once in 5 years (greater than 20% chance per year).
Future Probability of Hazard	
Very Low	Events that are projected to occur less frequently than once in 100 years (less than 1% chance per year).
Low	Events that are projected to occur from once in 50 years to once in 100 years (1% to 2% chance per year).
Medium	Events that are projected to occur from once in 5 years to once in 50 years (2% to 20% chance per year).
High	Events that are projected occur more frequently than once in 5 years (greater than 20% chance per year).
Location of Hazard	
N/A	Hazard has not yet affected the Town over the last 10 years
Small	Less than 10% of the Town is or could be affected by the hazard



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Points	Description
Medium	Between 10-50% of the Town is or could be affected by the hazard
Large	More than 50% of the Town is or could be affected by the hazard

Table 3.2, below, provides a summary of the natural hazards that have been affecting Narragansett since 2019 HMP. This evaluation takes into account historical records, the extent, frequency, location, and anticipated future probability. Information regarding future projections for specific scenarios is not available for every natural hazard, each hazard section contains best available science, and discusses projections in the context of specific future scenarios when available and appropriate.

Table 3.2: Summary of Natural Hazard Risks for the Town of Narragansett (update since 2019)

Natural Hazard	Previous Occurrence of Hazard Event in Narragansett	PRESENT			FUTURE
		Extent	Frequency	Location	Probability of Occurrence
Precipitation Flooding	Yes	Serious	High	Coastal areas	High
Winter Storms / Nor'easters	Yes	Serious	High	Town wide	High
Hurricanes / Tropical Cyclones	Yes	Catastrophic	High	County wide	High
Tornadoes	No	Serious	Very Low	N/A	Medium
Earthquakes	None	Minor	Very Low	N/A	Cannot be predicted
Landslides / Mudflows	No	Minor	Very Low	N/A	Medium



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Natural Hazard	Previous Occurrence of Hazard Event in Narragansett	PRESENT			FUTURE
		Extent	Frequency	Location	Probability of Occurrence
Average / Extreme Temperatures	Yes	Minor	High	Town wide	High
Drought	Yes	Minor	Low	Town wide	Medium
Changes in Groundwater	No	Serious	Low	Local	High
Wildfires	Yes	Minor	High	Local	Medium
Coastal Erosion	Yes	Serious	High	Coastal areas	High
Sea Level Rise	Yes	Serious	High	Coastal areas	High

3.1 Precipitation Flooding

3.1.1 Description

Extreme precipitation can lead to flooding, posing risks to infrastructure and ecosystem services, and has the potential to cause injury, disease, or death. Flooding caused by extreme precipitation is often called inland flooding, to differentiate from coastal flooding. This type of flooding occurs when normally dry land is inundated by the rising or overflowing of water and poses a major threat to the Town. Precipitation flooding can be exacerbated by nor'easters, ice jams, hurricanes/tropical storms, or dam failure. Spring snowmelt, rain on snow or frozen ground, impervious surfaces, and steep slopes with minimal soil or ground cover can also worsen the impacts.

This section covers three types of precipitation flooding that could impact Narragansett: riverine flooding, stormwater flooding, and dam overtopping. Riverine flooding occurs when prolonged and



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substantial precipitation results in an accumulation of water within a watershed, causing the river to surpass its drainage capacity and the banks to overtop. Areas with steep terrain and limited soil coverage are notable susceptible to flash floods arising from rapid runoff during intense precipitation events, often worsened by snowmelt. The presence of frozen ground can cause further concerns due to the reduction in infiltration and increased runoff. Water flowing down from the Narrow River during a severe rain event has adverse impacts to the surrounding properties located adjacent to the River.

Stormwater flooding is caused by the similar weather conditions as riverine flooding, in combination with a high percentage of impervious surfaces that prevent the water from infiltrating into soils. Drainage systems, which are designed to handle historic rain events, quickly become overwhelmed during high precipitation events with increased runoff. Properties along the Narrow River as well as low lying inland areas in Town are subjected to stormwater flooding.

Coastal flooding can also occur during a severe rain event as the stormwater drains that lead to the Ocean/Salt Pond/ Narrow River are overwhelmed during a high tide and cannot accept the volume stormwater, thereby backing up the drain to flood local streets/properties.

Additionally, dam failure can cause flooding in parts of the Town. The Town only has one dam named Sprague Pond Lower Dam. The dam was classified as Significant Hazard dam according to the National Inventory of Dams (NID). The last inspection on the dam occurred in July of 2005 (NID, 2018)

3.1.2 Previous Occurrences of Hazard Event(s)

The Town of Narragansett has experienced ongoing flood hazard events throughout recent history. Parts of the Town are flooded regularly. Since the 2019 HMP, there have been multiple instances of coastal, stormwater and riverine flooding. Notable events where it rained more than 2 inches are shown in the following table. Most of the flooding occurred when there was high intensity, short duration rain or when the raining continued for 3 or more consecutive days. In both cases, it oversaturated the Town’s existing infrastructure and caused significant flooding. Some of major flooding occurred due to the July 2023, December 2023, and January 2024 storm events.

Table 3-3: Major rainfall events in Narragansett since 2020

Year	Month	Day
2020	March	23
2020	December	5
2020	December	25
2021	April	1
2021	September	2
2022	December	23
2023	January	26



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Year	Month	Day
2023	February	28
2023	April	30
2023	May	20
2023	July	16
2023	December	18
2024	January	10
2024	January	13

Data source: National Weather Services



Figure 3.1. Flooding at Salty Brine State Beach in Narragansett, Monday, Dec. 18, 2023.

(Photo Courtesy: WJAR)

3.1.2.1 Extent

Precipitation flooding extent is defined as the range of anticipated intensity of the flooding. Before storm severity can be assessed, average conditions must be understood as the baseline for the Town. Stormwater infrastructure in Narragansett is designed for historic precipitation, which does not include increased precipitation that has been seen in recent years. Increases in intensity and duration of rainfall from the baseline conditions can overwhelm streambanks and stormwater infrastructure, not giving the systems time or capacity to infiltrate or collect the water, and thus causing flooding in the Town.

3.1.2.2 Frequency

There are some areas and properties that are more susceptible to flooding than others. As defined by FEMA, a repetitive loss property is any NFIP insured property which has been paid two or more flood



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claims of \$1,000 or more in any given 10-year period (FEMA, 2020). Therefore, repetitive loss data does not represent all losses due to flooding and the number of buildings that experience losses due to flooding is likely higher. Uninsured properties do not receive any aid from FEMA, with the exception of during a disaster declaration, when they may be able to receive a grant for individual assistance. Insured properties can apply for a mitigation grant while uninsured properties cannot.

The repetitive loss data below was provided by FEMA. Since 2019 Hazard Mitigation Plan, there have been 12 claims that were closed with a total payment of slightly more than \$50,000 and two claims were closed without payment. National Flood Insurance Report (NFIP) dataset for the Town reports 822 active policies and 22 repetitive loss structures as of December 07, 2023. The identified repetitive loss properties have received an aggregated total building payment of \$3951784.75 and contents payment of \$726245.35 from FEMA on 62 total losses. The following table (Table 3-4) shows the type of repetitive loss properties and associated payments.

Table 3-4: Number of Repetitive Loss properties by type

Occupancy Type	Cumulative Building Payment	Cumulative Contents Payment	Number of Repetitive Loss
Multi-Family (2-4)	\$1,310,742.79	\$5,000.00	4
Business Non-residential	\$949,317.06	\$621,967.85	9
Business Non-residential	\$388,693.81	\$25,703.11	2
Business Non-residential	\$22,261.19	\$0.00	2
Other Non-residential	\$526,048.68	\$0.00	3
Other Non-residential	\$50,180.82	\$0.00	2
Other Non-residential	\$164,588.90	\$14,900.00	2
Single Family	\$45,612.33	\$0.00	4
Single Family	\$15,183.43	\$0.00	4
Single Family	\$88,490.49	\$5,559.06	3
Single Family	\$69,534.22	\$19,504.95	2
Single Family	\$25,281.88	\$7,499.35	4
Single Family	\$14,902.12	\$0.00	2
Single Family	\$67,543.30	\$191.00	3
Single Family	\$17,505.89	\$0.00	2
Single Family	\$6,219.87	\$7,015.88	2
Single Family	\$14,961.36	\$3,155.33	2
Single Family	\$43,271.70	\$6,985.97	2
Single Family	\$10,002.22	\$6,770.27	2
Single Family	\$37,557.66	\$634.35	2
Single Family	\$10,587.10	\$0.00	2
Single Family	\$73,297.93	\$1,358.23	2



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3.1.2.3 Location

The FEMA National Flood Insurance Program's (NFIP) Flood Insurance Rate Maps (FIRMs) designate areas or Zones likely to experience flooding as Special Flood Hazard Areas (SFHA). All properties in the Special Flood Hazard Area (SFHA) with federally backed mortgages or those that have received federal disaster assistance are required to maintain flood insurance. Properties within moderate- to low- risk areas are not required, but are highly encouraged, to purchase flood insurance. Specific locations within Town in front of Town Beach, Jerusalem, and Field Cove Road are particularly susceptible. An example of FEMA Firmette map for the Town are shown below in Figure 3.2. The inset map shows the location where the FEMA map has been zoomed into. the Town have been noted to experience flooding frequently, for example Boston Neck.

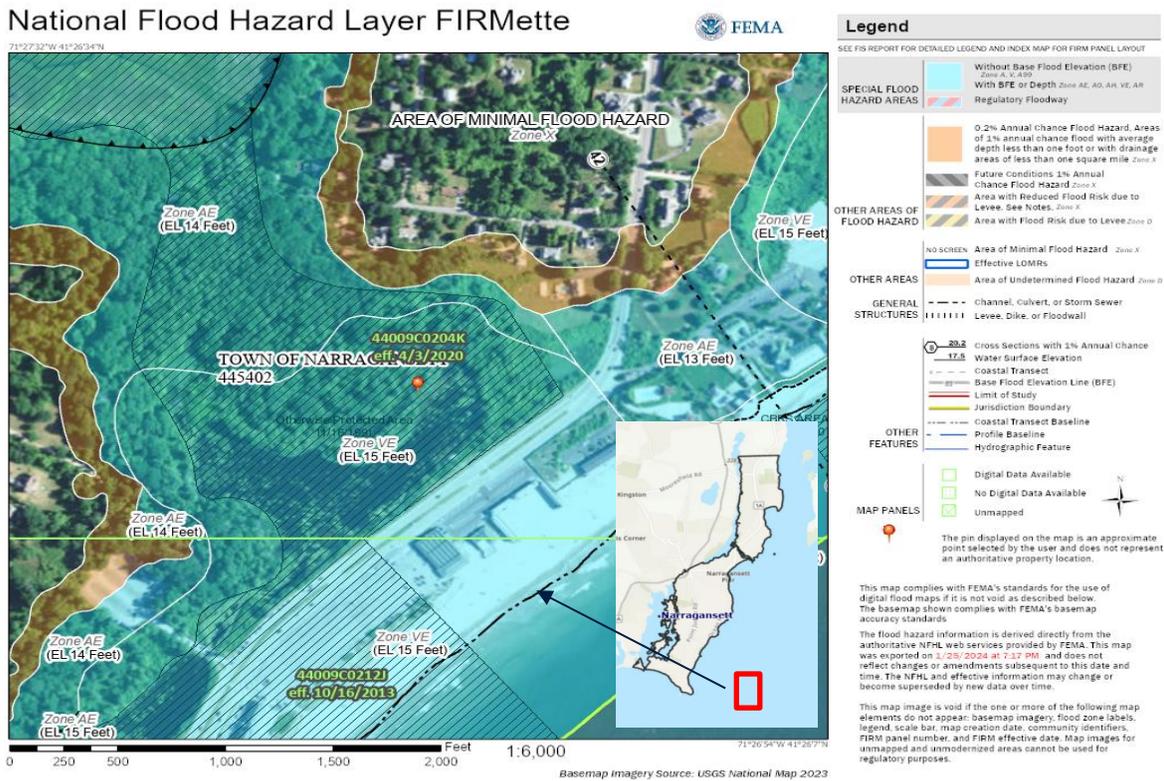


Figure 3.2. FEMA Flood Map for a section of the Town of Narragansett

The following Town-owned assets are flooded regularly under heavy rain:

- Boston Neck Rd at Town Beach
- Middlebridge Rd
- Sand Hill Cove Rd
- Great Island Rd



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- Marine Drive
- Foddering Farm Rd
- Bonnet Point Rd
- Bonnet Shores Rd
- Ocean Rd at Seawall
- Ocean Rd at South of Rt 108 intersection
- Ocean Rd at Scarborough Beach

3.1.3 Probability of Future Hazard Events Due to Climate Change

Precipitation is predicted to increase in RI in future years due to climate change. This is caused from multiple factors, including higher temperatures which increase the moisture-holding capacity of the atmosphere and increase evaporation rates. To date, precipitation patterns have shown a greater variability in annual precipitation, potentially falling over a few days, but that the precipitation will be more intense on those days when it occurs.

Climate change is predicted to impact precipitation patterns which will lead to increase in inland flooding. According to data from the Climate Explorer Tool developed by Federal Govt., the future total precipitation is projected to increase by 5% by mid-century and by around 8% by the end of the century.

Future projections show an increase in intensity and frequency of storm event. Design storms with higher return periods will become more frequent. Design storms are regularly used by engineers and planners to evaluate the performance of different systems and structures, such as drainage systems, flood control structures, and buildings, under extreme weather conditions. A 100-yr design storm has a 1% chance of occurrence in any given year and a 25-yr design storm has a 4% chance of occurrence in any given year.

3.2 Winter Storms / Nor'easters

3.2.1 Description

Severe winter weather is the primary hazard affecting Narragansett. These storms can include ice, heavy snow, blowing snow, and other extreme forms of precipitation. Severe winter storms are types of extratropical cyclones, which are formed when a cold mass of air meets with a warm mass of air and create a front.

The 2024 Rhode Island State Hazard Mitigation Plan defines the following effects of winter weather:

Ice Storm: an ice storm is used to describe occasions when damaging accumulations of ice are expected during freezing rain situations. Significant accumulations of ice pull down trees and utility lines



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resulting in loss of power and communication. These accumulations of ice make walking and driving extremely dangerous. Significant ice accumulations are usually accumulations of ¼ inch or greater.

Heavy Snow: this generally means snowfall accumulating to 4 inches or more in depth in 12 hours or less; or snowfall accumulating to 6 inches or more in depth in 24 hours or less.

Winter Storm: hazardous winter weather in the form of heavy snow, freezing rain, or heavy sleet. It may also include extremely low temperatures and increased wind.

Cold Wave/Extreme Cold: as described by NWS, a cold wave is a rapid fall in temperature within a 24-hour period requiring substantially increased protection to agriculture, industry, commerce, and social activities. As evidenced by past incidents across the U.S., extreme cold can cause impact to human life and property.

3.2.2 Previous Occurrences of Hazard Event(s)

Since the previous 2019 Hazard Mitigation Plan, the NOAA Storm Events Database lists six notable winter weather events. All these storm events caused heavy snowfall and storm in the Town.

- Heavy snow on December 16, 2020
- Winter storm on February 1, 2021
- Heavy snow on February 7, 2021
- Heavy snow on January 7, 2022
- Blizzard on January 28, 2022
- Heavy snow on February 27, 2023

3.2.2.1 Extent

With the exception of hurricanes, most severe storms in Narragansett occur between November and April, when the jet stream moves over the East Coast. This is when low-pressure systems are more frequent. Storms can last anywhere from a few hours to several days. Weather forecasting abilities will provide Narragansett, at minimum, a few hours warning prior to an extreme winter weather event.

Winter storms in Narragansett are likely to have a severity of minor to serious. While recent winter storms have been relatively short in duration, the impacts of the storm are often statewide. The main concern about a severe winter storm in Narragansett is the potential to isolate citizens and businesses if roads are blocked by snow and/or ice, or if interruptions in electricity occur. Power outages have a potential to cause widespread, permanent damage or great harm to residents and businesses alike. This may also cause some financial hardships for the Town associated with snow removal costs.

Severe winter storms are common in Narragansett. Snow and ice do occur but do not typically rise to the level of severe.



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3.2.2.2 Frequency

Narragansett does have an extensive history of winter storms. According to the 2024 Rhode Island State Hazard Mitigation Plan, the state averages about 25-75 inches of snowfall per year. The most recent storm that warranted a Presidential Disaster Declaration was Winter Storm Kenan which occurred in March of 2022. Winter Storm Kenan resulted in blizzard conditions with wind gusts reaching up to hurricane force in some areas. FEMA provided more than 2.6 million dollars to reimburse the Rhode Island Department of Transportation for road treatment and snow removal due to the storm (RISHMP 2024).

3.2.2.3 Location

When severe winter weather occurs, it typically impacts the entire state of Rhode Island. Therefore, the entire Town of Narragansett may be affected by a severe winter storm; however, microclimates within the Town may increase the vulnerability in specific areas.

3.2.3 Probability of Future Hazard Events Due to Climate Change

Predicting the probability of winter storm occurrences is challenging due to the large number of factors involved. Data from the National Center for Environmental Information indicates that Rhode Island can expect at least two winter storm events per year (RISHMP 2024). Climate change can lead to greater variability in precipitation patterns, which may result in more erratic and intense winter storms with periods of heavy snowfall followed by rain or freezing rain (RISHMP 2024). It's also possible that a generally warming climate may lead to more milder winters for Rhode Island. This could mean a decrease in the frequency of traditional snowstorms and an increase of winter storms that produce mixed precipitation, including freezing rain and sleet.

3.3 Hurricanes/Tropical Cyclones

3.3.1 Description

Hurricanes originate from tropical storms, which form rotating cloud systems, developing over tropical or subtropical waters. There are four classifications of these types of storms (tropical cyclones) (National Hurricane Center, NOAA):

- **Tropical Depression:** A tropical cyclone with maximum sustained winds of 38 mph (33 knots) or less.
- **Tropical Storm:** A tropical cyclone with maximum sustained winds of 39 to 73 mph (34 to 63 knots).
- **Hurricane:** A tropical cyclone with maximum sustained winds of 74 mph (64 knots) or higher. In the western North Pacific, hurricanes are called typhoons; similar storms in the Indian Ocean and South Pacific Ocean are called cyclones.
- **Major Hurricane:** A tropical cyclone with maximum sustained winds of 111 mph (96 knots) or higher, corresponding to a Category 3, 4 or 5 on the Saffir-Simpson Hurricane Wind Scale.



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Due to Narragansett’s geography, hurricane storm surge poses a tremendous threat on south and east facing shores. Wave run-up causes coastal flooding to commence as much as 6 hours before the eye comes ashore with the most significant surge occurring within one hour of landfall. Heavy rains from hurricanes can cause flooding in the low-lying areas of Narragansett, and hurricane winds can cause damage to property and infrastructure throughout the Town.

3.3.2 Previous Occurrences of Hazard Event(s)

Four notable hurricanes/tropical storms that created major damage in the Town since the 2019 Hazard Mitigation Plan are:

- August 22, 2021 – Tropical Storm Henri
- September 1, 2021 - Post-Tropical Cyclone Ida
- August 20, 2023 – Tropical Storm Franklin
- Sep 5, 2023 – Hurricane Lee

3.3.2.1 Extent

Hurricane season is from June 1 to November 30 each year. A direct hit by, especially by a higher category storm, could be catastrophic for the Town. The greater the strength of the hurricane, the more extensive the damage will be. The severity and speed of a hurricane will determine how long the storm impacts the Town and how extensive the damage will be. Table 3-5 below is the Saffir-Simpson Hurricane Scale as adapted from the National Hurricane Center (<https://www.nhc.noaa.gov/aboutsshws.php>).

Table 3-5: Saffir-Simpson Hurricane Scale

Category	Sustained Winds	Types of Damage Due to Hurricane Winds
1	74-95 mph	Some damage
2	96-110 mph	Extensive damage
3	111-129 mph	Devastating damage
4	130-156 mph	Catastrophic damage
5	157 mph or higher	Catastrophic damage

3.3.2.2 Frequency

Since the previous hazard mitigation plan in 2019, the Town of Narragansett has been affected by two tropical storms. The first occurred on August 4, 2020. The second occurred on August 22, 2021 and caused approximately 1 million dollars in damage (NOAA Storm Events Database). The Town has not been impacted by a hurricane since the previous hazard mitigation plan update. The most recent hurricane to result in a presidential disaster declaration was Hurricane Sandy in 2012.



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3.3.2.3 Location

The entire Town of Narragansett may be affected by a hurricane. Some areas will have more significant impacts such as low-lying areas, which includes the beaches.

3.3.3 Probability of Future Hazard Events Due to Climate Change

The 2024 Rhode Island State Hazard Mitigation Plan predicts the return period for a hurricane of any category on the Saffir-Simpson scale to be 17 years, and the return period for a major hurricane of Category 3 or higher to be 52 years. Climate change will likely result in increased storm intensity. This increased intensity is caused by warmer sea surface temperatures which provide more energy to the storm systems (RISHMP 2024). This can result in higher wind speeds and more rainfall, leading to more damage and more flooding.

3.4 Tornadoes

3.4.1 Description

Tornadoes are narrow, violently rotating columns of air that extend from the base of a thunderstorm to the ground. These windstorms develop when cool air overlays warm air, causing the warm air to rise rapidly. They are visible when dust and debris are collected in the rotating column.

Components that induce tornado formation include the following, Very strong winds in the mid and upper levels of the atmosphere.

- Clockwise turning of the wind with height (from southeast at the surface to west aloft)
- Increasing wind speed with altitude in the lowest 10,000 feet of the atmosphere (i.e., 20 mph at the surface and 50 mph at 7,000 feet.)
- Very warm, moist air near the ground with unusually cooler air aloft
- A forcing mechanism such as a cold front or leftover weather boundary from previous shower or thunderstorm activity

3.4.2 Previous Occurrences of Hazard Event(s)

Two tornadoes have occurred in Washington County since the previous 2019 HMP:

- November 13, 2021
- August 23, 2023

3.4.2.1 Extent

The intensity of a tornado is rated by the Enhanced Fujita Scale (EF-Scale), which incorporates 28 damage indicators and wind speed to determine a tornado's rating (National Weather Service, 2023). The EF-Scale is depicted in Table 3-6 below.



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Table 3-6: Enhanced Fujita Scale

EF-Scale	Class	Wind speed		Description
		mph	km/h	
EF-0	weak	65-85	105-137	Gale
EF-1	weak	86-110	138-177	Moderate
EF-2	strong	111-135	178-217	Significant
EF-3	strong	136-165	218-266	Severe
EF-4	violent	166-200	267-322	Devastating
EF-5	violent	>200	>322	Incredible

(NWS, 2023)

3.4.2.2 Frequency

Since the previous hazard mitigation plan update in 2019, there have only been two tornadoes that have been documented in Washington County (NOAA Storm Events Database). Both occurred on November 13, 2021, one as an EF-0 and one as an EF-1. The tornadoes made landfall and caused \$100,000 in damage.

3.4.2.3 Location

Tornadoes can strike anywhere in Rhode Island. The entire Town of Narragansett could be impacted or if it is a smaller tornado then it is possible that only a small portion of the Town could be impacted.

3.4.3 Probability of Future Hazard Events Due to Climate Change

The link between tornadoes and climate change is still being researched and at this point in time is not well understood. Tornadoes are small-scale, short-lived weather phenomena that can be influenced by a variety of atmospheric factors, such as temperature, humidity, wind patterns, and atmospheric instability (RISHMP 2024). Climate warming can lead to more extreme and variable weather patterns, and while this may not lead to an increase in the number of overall tornadoes, it may make them more severe and less predictable.

3.5 Earthquakes

3.5.1 Description

Earthquakes originate from a vibration in the Earth's surface, that results in a release of energy in the Earth's crust. This causes movement or trembling of the ground. Earthquakes generally occur along fault boundaries but can also be induced within interior portions of a plate.



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In addition to building collapse, earthquakes can cause structural damage to roadways, breakage of water and gas lines, and flooding and fires. Furthermore, landslides can be triggered by earthquakes.

3.5.2 Previous Occurrences of Hazard Event(s)

There have not been any earthquakes in Narragansett since the 2019 Hazard Mitigation Plan.

3.5.2.1 Extent

Earthquakes can range from minor, where they may not even be felt, to catastrophic, causing widespread destruction and devastation. Earthquakes are measured on the Richter scale of earthquake magnitude, shown in Table 3-7 below; retrieved from Britannica: <https://www.britannica.com/science/Richter-scale>).

Table 3-7: the Richter Scale

Magnitude Level	Category	Effects
Less than 1.0 to 2.9	micro	Generally not felt by people, but recorded on local instruments
3.0-3.9	minor	Often felt by many people, but no damage
4.0-4.9	light	Felt by all; minor breakage of objects
5.0-5.9	moderate	Some damage to weak structures
6.0-6.9	strong	Moderate damage in populated areas
7.0-7.9	major	Serious damage over large areas; loss of life
8.0 and higher	great	Severe destruction and loss of life over large areas

3.5.2.2 Frequency

There have not been any significant earthquakes in Narragansett since the previous hazard mitigation plan update and are not considered an impending threat.

3.5.2.3 Location

Rhode Island is located on the North Atlantic tectonic plate, which is an area of very low seismic activity (RISHMP 2024). However, areas surrounding Narragansett Bay have been identified as having Outwash Deposits, which can be prone to seismic amplification, increasing the intensity of the seismic event. An earthquake may be felt by all or part of the Town.

3.5.3 Probability of Future Hazard Events Due to Climate Change

Climate change is not expected to have a measurable impact on earthquake occurrences (RISHMP 2024).



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3.6 Landslides / Mudflows

3.6.1 Description

The U.S. Geological Survey describes landslides as including, “a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows.” When sloped material is subject to heavy rainfall or over-saturates in another way, debris or mud may flow. The resultant flow can be dangerous to trees, houses, cars, and built infrastructure. This effect can be exacerbated when erosion from rivers, glaciers, or waves create over steepened slopes.

3.6.2 Previous Occurrences of Hazard Event(s)

There have not been any landslides or mudflows documented in Narragansett since the 2019 Hazard Mitigation Plan.

3.6.2.1 Extent

Geologic hazards can range from minor to catastrophic.

3.6.2.2 Frequency

Landslides commonly occur shortly after other major natural disasters, such as extreme precipitation events, wildfire, earthquakes, and floods, which can slow response and recovery efforts, including emergency response, evacuations, debris removal, restoration of services, and stabilization efforts. Many landslide events occur in remote areas and are unobserved or reported, making it difficult to account for the frequency of landslides, the scale of such events, and the geographic range. In general, landslides are most likely during periods of higher-than-average rainfall, with the intensity of the rainfall being an important factor, as well as the health of the soil. Areas that have experienced disturbance due to wildfire, drought, invasive species, recent development, or vegetation or tree removal are more likely to experience landslides. There have been no landslides or mudflows reported in Narragansett.

3.6.2.3 Location

The location of future landslides or mudflows could most likely be in areas of elevation changes or higher slopes and in the coastal region due to loosen soil in the area. Since there have been no reported cases of landslides and mudflows in Narragansett, it is difficult to pinpoint their location.

3.6.3 Probability of Future Hazard Events Due to Climate Change

Impacts of climate change on the duration and intensity of rainfall events, wildfire, drought, and invasive species will result in an increase in the frequency of landslides and may result in an increase in the areas at risk from landslides. Another factor is the changes in the intensity and type of land uses in areas with high risk for landslides.



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3.7 Average / Extreme Temperatures

3.7.1 Description

Temperatures are considered extreme when they extend outside of the typical range of average conditions for acute or prolonged periods of time. Extremes can vary seasonally and occur in the form of either extreme cold or extreme heat. These temperature extremes can affect everyday life for the Town and its residents. Hazard events can trigger issues for public and environmental health, economic activities, electrical grids, and reliable transportation. While Rhode Island has a climate of four seasons with varying temperature averages, extremes outside of these seasonal fluctuations can cause major problems for the Town.

3.7.2 Previous Occurrences of Hazard Event(s)

- Extreme Heat

Extreme heat occurs when a system of high atmospheric pressure moves into an area. In such a high-pressure system, air from upper levels of our atmosphere is pulled toward the ground, where it becomes compressed and increase. The high concentration of pressure makes it difficult for other weather systems to move into the area, which is why a heat wave can last for several days or weeks. The longer the system stays in an area, the hotter the area becomes. The high-pressure inhibits winds, making them faint to non-existent. Because the high-pressure system also prevents clouds from entering the region, sunlight can become punishing, heating up the system even more. The combination of all these factors together creates the exceptionally hot temperatures. When the temperature stays above 90°F for three consecutive days or more it is commonly referred to as a heat wave.

Since 2019 hazard Mitigation Plan, there have been one reported heat wave in Narragansett area in July of 2020 (Data from National Weather Services). However, there have been 10 days when the maximum daily temperature went above 90° F.

- Extreme Cold

Extreme cold typically indicates temperatures are well below zero for an extended period of time. Excessive cold may be accompanied by winter storms, be left in their wake, or can occur without storm activity. Since 2019 hazard Mitigation Plan, there have been 55 days when the minimum daily temperature went below 32° F (Data from National Weather Services). The minimum reported temperature was 15° F on the February 4, 2022.



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3.7.2.1 Extent

- Extreme Heat

A heat wave usually occurs anytime between June and August. Temperatures that hover above 90°F for this region for three more consecutive days is called a heat wave.

- Extreme Cold

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. The NWS uses a Wind Chill Temperature Index to measure the current wind chill in the atmosphere and the speed at which frostbite will set in. 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.

3.7.2.2 Frequency

- Extreme Heat

Extreme temperatures are considered a medium-frequency event in RI. As defined by the 2024 RISHMP, these events occur between once in five years to once in 50 years (a 2% to a 20% annual chance of occurring).

- Extreme Cold

The number of days with temperatures at or below 0 degrees Fahrenheit averages one or less per year in Narragansett Bay and coastal areas and around five per year in the rest of the State (RISHMP 2024).

3.7.2.3 Location

- Extreme Heat

It is likely that extreme heat will impact the entire Town. Areas directly on the coast may feel slightly cooler temperatures than areas that are more inland.

- Extreme Cold

Extreme cold will impact the entire Town.

3.7.3 Probability of Future Hazard Events Due to Climate Change

- Extreme Heat

Recent climate modeling results indicate that extreme temperature events may become more common for Rhode Island, especially heat (RISHMP 2024). This is in part due to continued increase in greenhouse gas emissions, which drives the global temperature up. Rising average temperatures produce a more variable climate system which may result in an increase in the frequency and severity of extreme temperature events (RISHMP 2024). The Climate Explorer tool from the federal government provides



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future projection of days with a maximum temperature over 90 degrees Fahrenheit through the year 2099. In the near term, Narragansett will likely experience an average of ~7 days per year with a temperature greater than 90 degrees. This number is projected to increase to ~16 days per year by mid-century and to ~35 days per year by late century.

- **Extreme Cold**

Extreme cold in Rhode Island is projected to continue to decrease due to increased GHG emission. Based on the future projections, there is a likely probability that extreme cold will decrease but storm frequency may increase (RISHMP, 2024). The Climate Explorer Tool also provides projections of days per year with a minimum temperature less than 32 degrees Fahrenheit. In the near term, Narragansett will likely experience an average of 106 days per year with a temperature less than 32 degrees. This number is projected to decrease to ~86 days per year by mid-century and to ~65 days per year by late century.

3.8 Drought

3.8.1 Description

According to the 2024 RISHMP, drought is defined as an abnormally dry period lasting months or years when an area has a deficiency of water and precipitation in its surface and/or underground water supply. Drought differs from aridity, in which a region experiences low precipitation as a typical or permanent characteristic of the climate (i.e., a desert). Droughts can develop quickly and last a short period of time, exacerbated by extreme heat and/or wind, and there are other cases where drought spans multiple years. The 2024 Rhode Island State Hazard Mitigation Plan groups drought into four non-exclusive categories:

Agricultural: when the amount of moisture in the soil no longer meets the needs of previously grown crops

Hydrological: When surface and subsurface water levels are significantly below their normal levels

Meteorological: When there is a significant departure from the normal levels of precipitation

Socio-economic: When the water deficiency begins to significantly affect the population

3.8.2 Previous Occurrences of Hazard Event(s)

3.8.2.1 Extent

The Rhode Island Drought Steering Committee assigns drought warnings based on the Palmer Drought Index (PDI), the Crop Moisture Index (CMI), precipitation data, groundwater levels, stream flow, and surface water reservoir levels. Using these indices, the State of Rhode Island developed the following table (Table 3-8) to classify the extent of droughts (RISHMP 2024).



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Table 3-8: Drought Index by the State of Rhode Island

Drought Level	PDI	CMI	Precipitation	Ground Water	Stream Flow	Surface Water Reservoirs
Normal	-1.0 to -1.99	0.0 to -1.0; slightly dry	Slightly dry	1 month below normal	2 consecutive months below normal	Reservoir levels at or near normal for the time of year
Advisory	-2.0 to -2.99	-1.0 to -1.9; abnormally dry	2 months cumulative below 65% of normal	At least 2 out of 3 months below normal	3 consecutive months below normal	Small index reservoir below normal
Watch	-3.0 to -3.99	-2.0 to -2.9; excessively dry	1 of the following criteria met: 3-month cum. <65% or 6 months cum. <70% or 12 months cum. <70%	4-5 consecutive months below normal	At least 4 out of 5 consecutive months below normal	Medium index reservoir normal
Warning	-4.0 and below	>-2.9; severely dry	2 of 3 of the above criteria met; 3 months cum. <65% and 6 months cum. <65% and 12 months cum. <65% or 3 months cum. <65% and 12 months <65%	6-7 consecutive months below normal	At least 6 out of 7 months consecutive months below normal	Large index reservoir below normal
Emergency	-4.0 and below	>-2.9; severely dry	Same criteria as warning and previous month was a warning	7 months below normal observation wells recording monthly record lows	>7 months below normal	Continuation of previous month's conditions

An additional indicator of drought extent is provided by the U.S. Drought Monitor (RISHMP 2024) and shown in Table 3-9.

Table 3-9: U.S. Drought Monitor Drought Index

Rating	Described Condition
None	No drought conditions
D0	Abnormally dry
D1	Moderate drought



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Rating	Described Condition
D2	Severe drought
D3	Extreme drought
D4	Exceptional drought

3.8.2.2 Frequency

The 2024 Rhode Island Hazard Mitigation Plan used data from the U.S. Drought Monitor to provide a weekly estimate of the percentage of each Rhode Island County in each Drought Monitor category for the period of 2000-2023. This information is displayed in Table 3-10.

Table 3-10: Percentage of Drought Weeks for Washington County from 2000-2023

County	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Washington	73.4%	26.6%	12.2%	3.9%	0.9%	0.0%

3.8.2.3 Location

Typically, a drought will impact the entirety of the Town. It would be unusual for a drought to impact only portions of the Town.

3.8.3 Probability of Future Hazard Events Due to Climate Change

Annual average precipitation and extreme precipitation events are expected to decrease in Rhode Island due to climate change (RISHMP 2024). However, number of consecutive dry days are also projected to increase in addition to extreme temperature events (IPCC, 2022). Therefore, naturally occurring droughts are projected to be more intense due to higher temperatures increasing evaporation rates. This can contribute to soil moisture depletion and more rapid drying of surface water sources.

3.9 Changes in Groundwater

3.9.1 Description

Groundwater is a renewable, long-term resource that depends on an adequate quantity and quality of water to replenish it. The quantity and quality of groundwater reflects the cumulative effects of extraction, recharge, and contamination (Lall et al., 2020).

Groundwater challenges are caused or amplified by other hazards such as sea level rise, extreme temperatures and rising temperatures, drought, extreme precipitation, and other meteorological events and also caused by land use changes such as increase in impervious areas.

There are three primary categories of risk associated with groundwater in New England:

- Rise in groundwater levels
- Groundwater depletion



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- Changes in groundwater quality and characteristics

When variation of groundwater surpasses an elevation threshold or duration, changes in groundwater can affect human and natural systems. The disruption can generate long-term risk to human life and property. Changes in groundwater can result in interruption, loss, and risk due to human demands and impacts on the resource. Infrastructure is built using historical water conditions and parameters. When groundwater levels change outside historical ranges, this can affect critical infrastructure including drainage systems, septic systems, and building foundations.

3.9.2 Previous Occurrences of Hazard Event(s)

Narragansett has not experienced hazards related to changes in groundwater since the 2019 Hazard Mitigation Plan.

3.9.2.1 Extent

The severity of groundwater rise, depletion, and contamination depends heavily on the ability of the groundwater system to recharge (i.e., the balance between extraction and recharge), the timing of the recharge, and the quality of the water. Extraction can take place through human activity and natural discharge, which can increase when surface water levels drop—particularly during droughts. Water levels can increase during periods of high precipitation, snowmelt, and coastal and inland flood events. In coastal areas, groundwater levels will be affected by coastal conditions including meteorological events, coastal storms, tides, and sea level rise. Local characteristics including topography, hydrology, vegetation, soil conditions, and human activity also have significant impacts on the severity and intensity of groundwater changes. The following environmental factors can affect the severity and intensity of changes in groundwater and have been associated with hazardous conditions and disruption to human and environmental systems.

- Groundwater rise is driven by precipitation intensity, coastal and inland storms, sea level rise, and snow melt. Groundwater rise can result in flooding, salinity intrusion, contamination and pollution of groundwater and aquifers, and increased inundation of ecosystems, below ground and at grade assets and infrastructure.
- Groundwater depletion, which results in lower a water table and strained water resources, will be more intense when conditions for groundwater recharge are low. These conditions include increasing frequency of drought, a reduced snowpack, higher rates of evapotranspiration, reduced precipitation, diversion of precipitation away from groundwater recharge areas, and pressure from human consumption and natural discharge into surface water. Development patterns and river and stream flood management infrastructure also reduce opportunities for groundwater recharge.

3.9.2.2 Frequency

Changes in groundwater levels can be influenced by several factors associated with human actions, climate change, and natural variations. Groundwater levels fluctuate daily, weekly, and seasonally. Recent analysis has detected long-term variation in groundwater levels over the last 50 years, but the



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direction of change depends on complex interactions. While there are several studies that evaluate the changes in groundwater levels in specific locations and at the regional level, there is need for a statewide understanding of factors affecting groundwater.

3.9.2.3 Location

Being influenced by factors such as temperature, permeability, and hydrological interactions, groundwater is characterized by a region’s topographical, geological, and hydrological conditions.

3.9.3 Probability of Future Hazard Events Due to Climate Change

Climate change can affect the severity of groundwater rise, depletion, and contamination due to the following factors: changes in precipitation, groundwater recharge, impacts from sea level rise, and changing temperatures. The compound effect of these factors may have impact on groundwater levels and water quality. The extent of damage is being studied but has not been quantified.

3.10 Wildfires

3.10.1 Description

The National Weather Service defines a wildfire as any free burning uncontrollable wildland fire not prescribed for the area which consumes the natural fuels and spreads in response to its environment (RISHMP 2024). Wildfires can occur naturally, by accident, and on rare occasions, by human action. Wildfires are strongly influenced by multiple factors, including weather, topography, fuel type, fuel distribution, fuel moisture content, and drought conditions (RISHMP 2024).

3.10.2 Previous Occurrences of Hazard Event(s)

There have been numerous occurrences of wildfire since the 2019 Hazard Mitigation Plan. Since 2019, Washington County has experienced 118 wildfire events.

3.10.2.1 Extent

The Southern Wildfire Risk Assessment Summary Report provides a table, shown in Table 3-11, that details different intensities of wildfires.

Table 3-11: Wildfire Intensities as defined by the Southern Wildfire Risk Assessment

Class	Description
Class 1 – Very Low	Very small, discontinuous flames, usually less than 1 foot in length; very low rate of spread; no spotting. Fires are typically easy to suppress by firefighters with basic training and non-specialized equipment.
Class 2 – Low	Small flames usually less than two feet long; small amount of very short-range spotting possible. Fires are easy to suppress by trained firefighters with protective equipment and specialized tools.



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Class	Description
Class 3 - Moderate	Flames up to 8 feet in length; short-range spotting is possible. Trained firefighters will find these fires difficult to suppress without support from aircraft or engines, but dozer and plows are generally effective. Increasing potential for harm or damage to life and property.
Class 4 – High	Large flames, up to 30 feet in length, short-range spotting common; medium range spotting possible. Direct attack by trained firefighters, engines, and dozers is generally ineffective, indirect attack may be effective. Significant potential for harm or damage to life and property.
Class 5 – Very High	Very large flames up to 150 feet in length; profuse short-range spotting, frequent long-range spotting; strong fire-induced winds. Indirect attack marginally effective at the head of the fire. Great potential for harm or damage to life and property.

3.10.2.2 Frequency

Wildfires do occur frequently in Rhode Island but are typically small and quickly contained (RISHMP 2024). According to the Draft State of Rhode Island Hazard Mitigation Plan, Washington County had 118 wildfire events between 2019 and 2023. These events burned 81.4 acres and 13 structures and caused 6 injuries (RISHMP 2024). There were no fatalities during this period.

3.10.2.3 Location

Wildfires can occur anywhere if the conditions are right. All of Washington County is potentially at risk of wildfires.

3.10.3 Probability of Future Hazard Events Due to Climate Change

Climate change may result in a significant increase in the likelihood and severity of wildfires. The occurrence of longer lasting and more frequent droughts due to climate change can increase the availability of fuels for wildfire by drying out vegetation (RISHMP 2024). Higher temperatures and drier conditions can lead to more intense wildfires that burn hotter and spread more rapidly, making them more difficult to contain. Additionally, drought-tolerant invasive species that proliferate during periods of drought can provide quick-burning fuel for wildfires.

3.11 Coastal Erosion

3.11.1 Description

Coastal erosion is the process by which local sea level rise, strong wave action, and coastal flooding wear down or carry away rocks, soils, and/or sands along the coast (US Climate Resilience Toolkit <https://toolkit.climate.gov/topics/coastal-flood-risk/coastal-erosion>). Once removed from the shore, the sediment will not return to the shoreline but will be carried away into coastal lagoons, deposited on the back of coastal barriers, or swept offshore (http://www.cmc.ri.gov/samp_beach/cpg/RI-Coastal-Property-Guide.pdf). Coastal erosion occurs most commonly during storm events and can be



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exacerbated by strong waves and sea level rise. As sea levels rise, the action of waves at higher elevations increases the likelihood of extensive coastal erosion ([US Climate Resilience Toolkit](#)). It is possible for severe storms or hurricanes to remove wide beaches and sand dunes in a single event. Coastal erosion is responsible for roughly \$500 million per year in coastal property losses ([US Climate Resilience Toolkit](#)).

3.11.2 Previous Occurrences of Hazard Event(s)

Narragansett has coastal areas that are continuing to experience coastal erosion due to increased storm events in the recent past and sea level rise. Winter rainstorms that happened for consecutive three days in January 2024, created coastal erosion on the beaches including Town beach on Boston Neck Road.

3.11.2.1 Extent

Coastal erosion rates and impacts are highly localized. Urban shorelines with failing seawalls and no dry beach are the most susceptible to damage. The following figure shows the damage due to coastal erosion in the Roger Wheeler Beach in Narragansett. This specific coastal erosion was triggered by the January storm event discussed under Inland Flooding section.



Figure 3.3. Roger Wheeler State Beach Erosion

Picture Courtesy: NBC10 News from January 15, 2024



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3.11.2.2 Frequency

The frequency of coastal erosion mostly depends on the frequency of storm events. Severe storm events with wind and wave action can increase the rate of coastal erosion. Similarly, the rate of sea level rise will also impact the rate of coastal erosion.

3.11.2.3 Location

This hazard is limited to the coastal and beachfront areas of Narragansett.

3.11.3 Probability of Future Hazard Events Due to Climate Change

Both the frequency and intensity of storms and the rate of sea level rise are predicted to increase due to climate change (IPCC, 2021). More frequent, intense storms and increased rates of sea level rise will likely increase the rate and severity of coastal erosion.

3.12 Sea Level Rise

3.12.1 Description

Sea level rise is an increase in the ocean's surface height relative to the land in a specific location (RISHMP 2024). Sea level rise is primarily caused by the increased melting of the land-based ice/ ice sheets and the thermal expansion of ocean water. When water gets warmer, thermal expansion occurs and the volume of water increases. The water in Narragansett Bay has increased 3 degrees Fahrenheit in the last 100 years, contributing to an increase in thermal expansion (RISHMP 2024). The average temperature of the ocean has been rising due to an increase in greenhouse gases trapped in the Earth's atmosphere. This warm ocean water also erodes the ice caps from below the surface, accelerating their melting rate.

Another factor that contributes to sea level rise is coastal land subsistence, or sinking, that is often caused by natural geologic processes. It is estimated that Rhode Island has been sinking at a rate of four inches per 100 years (RISHMP 2024).

3.12.2 Previous Occurrences of Hazard Event(s)

Sea level rise is an ongoing phenomenon that continues to impact Narragansett since the 2019 Hazard Mitigation Plan.

3.12.2.1 Extent

Data from NOAA Tides and Current indicates that the sea level in Rhode Island coast has increased by 5 inches compared to what it was in 1956. This increase is mostly due to Rhode Island's sinking land. Its speed of rise has accelerated over the last ten years and it's now rising by over an inch every 8 years. This is significantly higher than the previously predicted average of one inch per decade over the past half century. It also notes that sea levels in the northeast have been increasing at a rate that is three to four times faster than the global average rate (IPCC, 2021).



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Sea Level Data and Projections: Newport, RI (8452660)

NOAA Tide Gauge

Feet above North American Vertical Datum of 1988
(1983-2001 epoch)

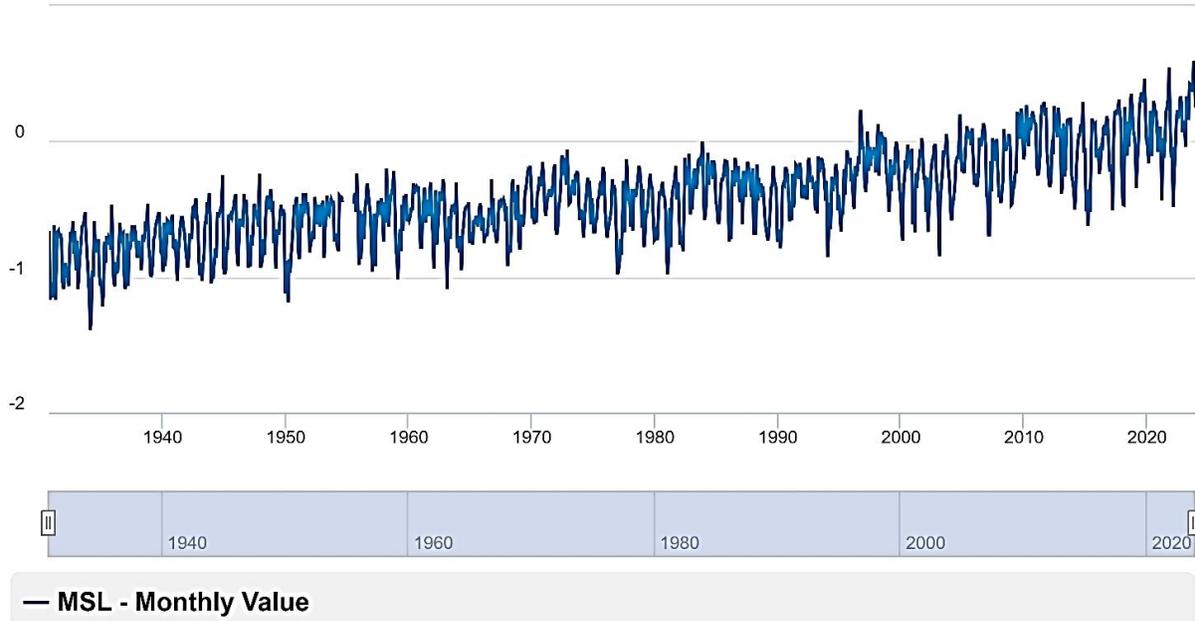


Figure 3.4: Sea Level Rise at the Newport Gauge in the past 93 years (1930-2023)

Picture Courtesy: Sea Level Analysis Tool (SLAT)

NOAA's Sea Level Rise Viewer allows users to visualize sea level rise under different scenarios. The images below in Figure 3.5 show Narragansett Beach after one foot of sea level rise versus after four feet of sea level rise. Areas of green represent particularly low-lying areas. Figure 3.6 shows the storm impact on coastal Narragansett during the December 18, 2023, storm event.



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Figure 3.5. Narragansett Beach after one foot of sea level rise (left) versus after four feet of sea level rise (right)



Figure 3.6: The storm ripped down this fence in Narragansett, Monday, Dec 18, 2023.
(Picture Courtesy: WJAR)



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3.12.2.2 Frequency

Data from two NOAA tidal gauges in Rhode Island show a steady increase in sea level over the past 90 years (RISHMP 2024). Inundation maps from the 2024 State of Rhode Island Hazard Mitigation Plan show that Washington County has the largest projected inundation area with potential vulnerability and losses in North Kingstown, Narragansett, South Kingstown, Charlestown, and Westerly.

3.12.2.3 Location

Narragansett has been identified as a vulnerable coastal community to sea level rise by Technical Paper 168, the Socioeconomics of Sea Level Rise, compiled by the Rhode Island Department of Administration Division of Planning. Sea level rise would impact the entire community but would impact areas directly adjacent to the ocean more drastically. **Probability of Future Hazard Events Due to Climate Change** Climate change continues to have a large impact on sea level rise in Rhode Island. Rhode Island is particularly vulnerable due to its substantial coastline and low-lying coastal areas. The state has seen an accelerated increase in sea levels in recent decades, which is consistent with the average global trend. This acceleration is due to combined impact of continued warming of the atmosphere, continued melting of the polar ice caps, and sinking coast of RI. Reducing greenhouse gas emissions remains critical to slowing the rate of sea level rise for Rhode Island and the world.

Figure 3.7 shows the Sea Level Projections for Newport, RI gauge developed by US Army Corps of Engineers and shown in their SLT tool. Based on the projections, sea level is going to increase by 2ft by mid-century and nearly 5ft by end-century under high emission scenarios. The trend shows continued increase beyond 2100 and an increase of up to 10ft by 2150.



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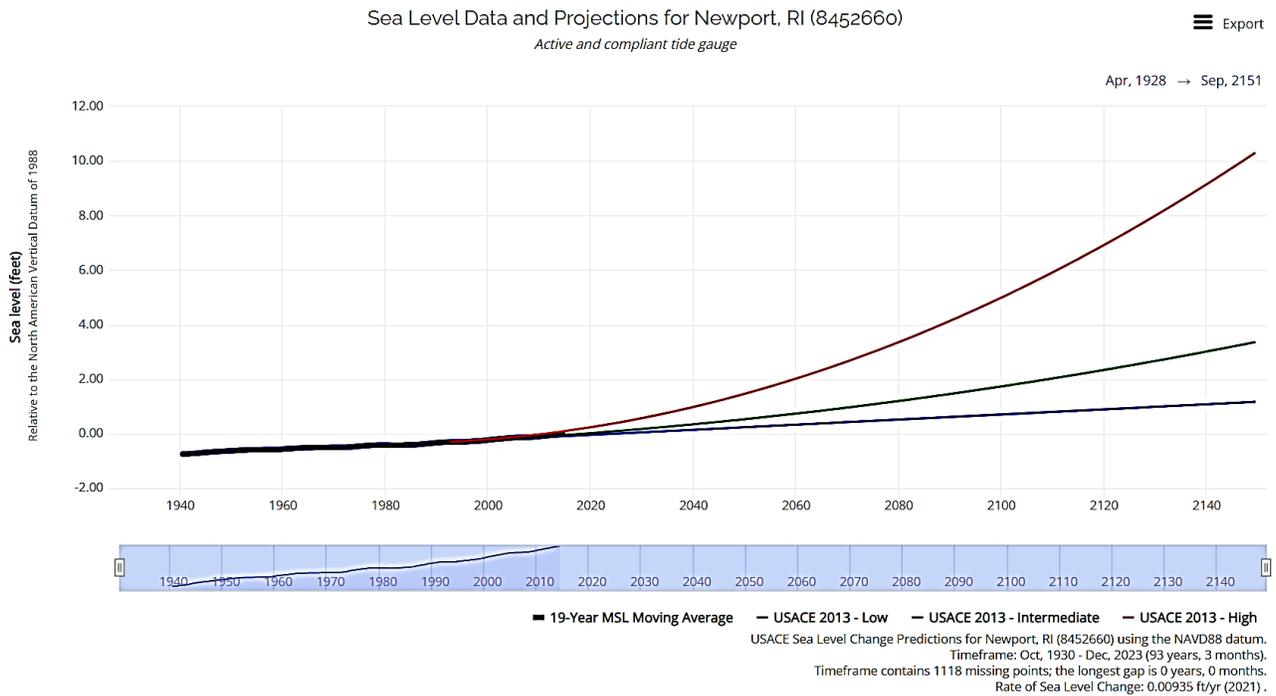


Figure 3.7: Sea Level Rise projections at the Newport, RI gauge
Picture Courtesy: Sea Level Analysis Tool (SLAT)

3.13 Severe Thunderstorm

3.13.1 Description

Thunderstorms are formed when atmospheric conditions combine to provide moisture, lift, and warm, unstable air that rises rapidly. Thunderstorms may 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. Thunderstorms affect a smaller area when compared to winter storms or hurricanes but can still be dangerous and destructive. Storms can form in less than 30 minutes, leaving very little warning or preparation time. They have the potential to produce lightning, hail, tornadoes, heavy rains, flash flooding, and powerful winds. Lightning is one of the most dangerous aspects of thunderstorms.

3.13.2 Previous Occurrences of Hazard Event(s)

Since the previous 2019 Hazard Mitigation Plan, Narragansett has experienced 17 days with severe thunderstorms based on NOAA storm event database.



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3.13.2.1 Extent

NOAA classifies types of thunderstorms as any of the following: single-cell, multi-cell, squall line, supercell, bow echo, mesoscale convective system, mesoscale convective complex, mesoscale convective vortex, and derecho, which are defined below:

Single-cell thunderstorms are small, brief, weak storms that grow and die within an hour or so. They are typically driven by heating on a summer afternoon. Single-cell storms may produce brief heavy rain and lightning.

A multi-cell storm is a common, garden-variety thunderstorm in which new updrafts form along the leading edge of rain-cooled air (the gust front). Individual cells usually last 30 to 60 minutes, while the system as a whole may last for many hours. Multi-cell storms may produce hail, strong winds, brief tornadoes, and/or flooding.

A squall line is a group of storms arranged in a line, often accompanied by “squalls” of high wind and heavy rain. Squall lines tend to pass quickly and are less prone to produce tornadoes than are supercells. They can be hundreds of miles long but are typically only 10 or 20 miles wide.

A supercell is a long-lived (greater than one hour) and highly organized storm feeding off an updraft (a rising current of air) that is tilted and rotating. This rotating updraft—as large as 10 miles in diameter and up to 50,000 feet tall—can be present as long as 20 to 60 minutes before a tornado forms. Scientists call this rotation a mesocyclone when it is detected by Doppler radar. The tornado is a very small extension of this larger rotation. Most large and violent tornadoes come from supercells.

A bow echo is a radar signature of a squall line that “bows out” as winds fall behind the line and circulations develop on either end. A strongly bowed echo may indicate high winds in the middle of the line, where the storms are moving forward most quickly. Brief tornadoes may occur on the leading edge of a bow echo. Often the north side of a bow echo becomes dominant over time, gradually evolving into a comma-shaped storm complex.

A Mesoscale Convective System (MCS) is a collection of thunderstorms that act as a system. An MCS can spread across an entire state and last more than 12 hours. On radar one of these monsters might appear as a solid line, a broken line, or a cluster of cells. This all-encompassing term can include any of the following storm types:

A Mesoscale convective complex (MCC) is a large, circular, long-lived cluster of showers and thunderstorms identified by satellite. It often emerges out of other storm types during the late-night and early-morning hours. MCCs can cover an entire state.

Mesoscale convective vortex (MCV) is a low-pressure center within an MCS that pulls winds into a circling pattern, or vortex. With a core only 30 to 60 miles wide and one to three miles deep, an MCV is often overlooked in standard weather analyses. But an MCV can take on a life of its own, persisting for up to 12 hours after its parent MCS has dissipated. This orphaned MCV will sometimes then become the seed of the next thunderstorm outbreak. An MCV that moves into tropical waters, such as the Gulf of Mexico, can serve as the nucleus for a tropical storm or hurricane.



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A **derecho** is a widespread, long-lived windstorm that is associated with a band of rapidly moving showers or thunderstorms. Although a derecho can produce destruction similar to that of tornadoes, the damage typically is in one direction along a relatively straight swath. As a result, the term “straight-line wind damage” sometimes is used to describe derecho damage. By definition, if the wind damage swath extends more than 240 miles (about 400 kilometers) and includes wind gusts of at least 58 mph (93 km/h) or greater along most of its length, the event may be classified as a derecho.

Any one of these types can be severe, which is defined by wind speeds of 58 mph or greater and/or hail 1.0 inches or greater in diameter.

3.13.2.2 Frequency

Rhode Island is not known to experience the same frequency of severe thunderstorms as the Midwest and Southeast. However, these storms still occur, particularly during the summer months. Washington County had 17 days with thunderstorm winds since the last hazard mitigation plan update in 2019 (NOAA Storm Events Database). The Draft State of Rhode Island Hazard Mitigation Plan indicates that the state can expect 18-27 thunderstorms per year (RISHMP 2024).

3.13.2.3 Location

Due to the size and geography of the Town there are no areas in Narragansett that are more susceptible to thunderstorms than others. In general, thunderstorms have a similar effect throughout the entire Town.

3.13.3 Probability of Future Hazard Events Due to Climate Change

Climate change can lead to increased temperatures and moisture levels in the atmosphere, which can provide favorable conditions for the development of severe thunderstorms (RISHMP 2024). This can result in an increase in both frequency and intensity of thunderstorms. Increased temperatures mean warmer air that can hold more moisture, leading to increased precipitation during thunderstorm events. This can elevate the risk of flash flooding. Changes in atmospheric circulation patterns associated with climate change can also lead to stronger winds within thunderstorms, which can result in more powerful gusts, increasing the risk of wind damage and downed trees and power lines (RISHMP 2024).



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4 ASSET INVENTORY

4.1 Asset Categories

Assets are defined by the Federal Emergency Management Agency (FEMA) Local Mitigation Planning Policy Guide (Released April 19, 2022, Effective April 19, 2023). Assets are "determined by the community and include but are not limited to people; structures; systems; natural, historic, and cultural resources; and/or activities that have value to the community" (FEMA, 2022).

4.1.1 Overarching Categories

There are five categories of assets:

- **People** (including underserved communities and socially vulnerable populations). "Assets that serve populations that are more vulnerable to disaster (e.g., elderly, children, visiting populations) and/or serve densely populated areas."
- **Structures** (including facilities, lifelines, and critical infrastructure). "Built facilities that provide community lifeline services. A community lifeline enables the continuation of critical government and business functions and is essential to human health and safety or economic security."
- **Systems** (including networks and capabilities). "A collection of components that perform a critical service for the community. Systems are linear type assets. Systems may include horizontal assets associated with linear type assets."
- **Natural resources**. "Natural Resources: Areas that provide protective function to reduce magnitude of hazard impact and increase resiliency. Areas of sensitive habitat that are vulnerable to hazard events, protection of areas that are important to community objectives, such as the protection of sensitive habitat, provide socio-economic benefits, etc."
- **Historical and Cultural Resources**: "Assets that possess historical, cultural, archaeological or paleontological significance, including sites, contextual information, structures, districts, and objects significantly associated with or representative of earlier people, cultures, maritime heritage, and human activities and events."
- **The economy and other activities that have value to the community**. These are defined as "Activities that benefit the community by increasing community morale and well-being. Activities may include education and knowledge transfer."



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4.1.2 FEMA's "Community Lifelines"

"Community Lifelines" is FEMA's term for assets of a community that the community cannot survive without. "A lifeline enables the continuous operation of critical government and business functions and is essential to human health and safety or economic security" (FEMA, 2020).

For the purposes of hazard mitigation planning and the asset inventory, community lifelines are used to categorize all assets in terms of these critical functions. Not all assets are community lifelines.

A subset of the Town of Narragansett's assets falls into one of eight lifelines that have been classified and described as follows (FEMA, 2019)



Law enforcement and government services, as well as the associated assets that maintain communal security, provide search and rescue, evacuations, and firefighting capabilities, and promote responder safety.



Support systems that enable the sustainment of life, such as water treatment, transmission, and distribution systems; food retail and distribution networks; and wastewater collection and treatment systems.



Infrastructure and service providers for medical care, public health, patient movement, fatality management, behavioral health, veterinary support, and health or medical supply chains.



Service providers for electric power infrastructure, composed of generation, transmission, and distribution systems, as well as gas and liquid fuel processing, transportation, and delivery systems. Disruptions can have a limiting effect on the functionality of other community lifelines.



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Infrastructure owners and operators of broadband internet, cellular networks, landlines, cable services, satellite communications services, and broadcast networks (radio and television). Communications systems encompass a large set of diverse modes of delivery and technologies, often intertwined but largely operating independently. Services include elements such as alerts, warnings, and messages, as well as 911 and dispatch. Also includes accessibility of financial services.



Multiple modes of transportation that often serve complementary functions and create redundancy, adding to the inherent resilience in overall transportation networks. Transportation infrastructure generally includes highways/roadways, mass transit, railway, aviation, maritime, pipeline, and intermodal systems.



Systems that mitigate threats to public health/welfare and the environment. This includes assessment of facilities that use, generate, and store hazardous substances, as well as specialized conveyance assets and efforts to identify, contain, and remove incident debris, pollution, contaminants, oil or other hazardous substances.



Systems for Potable Water and Wastewater Management. This includes potable water intake, treatment, storage, and distribution. It also includes Wastewater collection, storage, treatment, and discharge.

4.2 Changes Since 2019

There have been negligible changes in Land Use since the 2019 Hazard Mitigation Plan. Town developments and zoning amendments have been few as well.



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4.3 Town of Narragansett Assets

4.3.1 Structures Assets

Asset Type	Name	Address
Fire Stations	Narragansett Fire Department Station 1	40 Caswell Street
	Narragansett Fire Department Station 2	900 Point Judith Road
	Narragansett Fire Department Station 3	1170 Boston Neck Road
Town Offices	Narragansett Town Hall (Narragansett Municipal Building), Narragansett Water Division	25 Fifth Avenue
	Narragansett Public Works	260 Westmoreland Street
	Narragansett Community Center	53 Mumford Road
	Old Maury Loontjens Memorial Library	35 Kingstown Road
	New Narragansett Library	Pier Marketplace
Critical vehicle and equipment storage facilities	Narragansett Police & Fire Public Safety Building, Narragansett Police Department, Narragansett Fire Department	40 Caswell Street
	Narragansett Public Works	260 Westmoreland Street
	Avice Street Garage	45 Avice Street
	Police Garage/ Harbor Master	1175 Point Judith Road
	Parks and Recreation Garage	195 Kingstown Road
Emergency Operations Centers	Emergency Management Agency	25 Fifth Avenue
Dams	Sprague Pond Lower	179 Kingstown Road



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Asset Type	Name	Address
Schools and Daycares	Narragansett Public Schools Admin	25 Fifth Avenue
	Quest Montessori School	1150 Boston Neck Road
	Ocean Tides	635 Ocean Road
	St. Peters Pre School	72 Central Street
	Middlebridge School	333 Ocean Road
	Narragansett Elementary School	55 Mumford Road
	Narragansett Pier Middle School	235 South Pier Road
	Narragansett High School	245 South Pier Road
Elderly/Disabled Housing	Narragansett Housing Authority (Narragansett Municipal Building)	25 Fifth Avenue
	POAH/Driftwood	130 Caswell Street
	POAH/Southwinds	29 South Pier Road
	POAH/Beachwood	30 Kingstown Road
	Narragansett Housing Authority	8 Mansion Avenue
	Narragansett Housing Authority	10 Mansion Avenue

4.3.2 Systems Assets

Asset Type	Name	Address
Backup Land Mobile Radio Systems	North Repeater	1170 Boston Neck Road
	South Repeater	1 Old Point Judith Road



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Asset Type	Name	Address
Communication centers	Public Safety Building	40 Caswell Street
	Town Hall's Engineering Dept. breakroom.	25 Fifth Avenue
	Telecommunication tower	260 Westmoreland St
Utilities and power generating stations	Wind Turbine	Fishman's memorial campground
Public Transportation	Block Island Ferry	304 Great Island Road
	Narragansett (Salt Pond Plaza)	91 Point Judith Road
Water Storage Tank and Booster Station	North End Water Storage Tank	1170 Boston Neck Road
	Point Judith Water Storage Tank	1075 Point Judith Road
	Kinney Ave Water Storage Tank	1 Old Point Judith Road
	Route 108 Master Meter and Booster Pump Station	100 Point Judith Road
	North End Master Meter	Boston Neck Road
	West Bay Master Meter	121 West Bay Drive
	Scarborough Master Meter	Ocean Road
	Jerusalem Master Meter	Succotash Road
	Crest Avenue Storage Tank (Veolia)	23 Crest Avenue
Wastewater Pump Station	Regional Wastewater Treatment Facility	Westmoreland St
	Briggs Farm	15 Del Ray Drive
	Burnside Avenue	835 Ocean Road
	Galilee	335 Great Island Road



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Asset Type	Name	Address
	Pt. Judith	1192 Ocean Road
	Scarborough Wastewater Treatment Facility	990 Ocean Road
	Stanton Avenue	90 Stanton Avenue
	Congdon Street	141 Ocean Road
	Lakewood	39 Inez Street
	Mumford Road	49 Mumford Road
	Ouida Street	4 Caswell Street
	Seaport	54 Seaport Drive
	Baneberry	22 Baneberry Trail
	Bonnet	124 Allagash Trail
	Circuit Drive	50 Circuit Drive
	Industrial Park	1 Ray Trainor Drive
	Mettatuxet	10 South River Drive
	Pettaquamscutt (Wilson Dr)	106 Pettaquamscutt Avenue
	Sprague Bridge	316 Boston Neck Road
	Wolfe Road	44A Wolfe Road
	Winterberry	91 Woodsia Road
Culvert	Spring Brook	Bonnet Shores Road
	Bonnet Causeway	Bonnet Causeway
	South Pier Road	South Pier Road



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Asset Type	Name	Address
	West Bay Drive	West Bay Drive
	Secluded Drive	Secluded Drive
	Lee Ann Drive	Lee Ann Drive
	Boston Neck Road at Town Beach	Boston Neck Road
	Anne Hoxsie Lane at Town Beach	Anne Hoxsie Lane
	Kingstown Road at Sprague Park	Kingstown Road

4.3.3 Natural, Cultural, and Historic Resources Assets

Asset Type	Name	Address
Pier	Monaghan Dock	State Pier # 5
Historic Areas	Boston Neck	Boston Neck Road
	Point Judith Neck	Point Judith Road
Historic Districts	Towers Historic District	Ocean Road
	Sunset Farm	505 Point Judith Road
	The Camp	170 Clarke Road
	Central Street	Kingstown Road
	Earlscourt	18 Westmoreland St
	Narragansett Avenue	Narragansett Ave
	Ocean Road	Ocean Road
Memorial	Point Judith Fisherman's Memorial	1399 Ocean Road



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Asset Type	Name	Address
Recreation	Main Office and Recreation Building	170 Clarke Road
	Historic Windmill Building	Clarke Road
Beach	Scarborough State Beach	970 Ocean Road
	Narragansett Town Beach and facilities	39 Boston Neck Road
	Kelly Beach	20 Dunes Road
	Salty Brine State Beach	254 Great Island Road,
	Roger Wheeler State Beach	100 Sand Hill Cove Road

4.3.4 Private and State-Owned Assets

Asset Type	Name	Address
University	URI Bay campus	215 S Ferry Road
Research Nuclear Reactor	Nuclear Reactor owned by Rhode Island Atomic Energy Commission	URI Bay Campus
Grocery	Stop n Shop	66 Point Judith Road
Pier	Galilee Pier	138-198 Great Island Road
	URI Research Vessel Pier	Pier Road
Beach	Galilee Beach Club Beach	220 Sand Hill Cove Road
	Bonnet Shores Beach	175 Bonnet Point Road
	Little Beach	27 Col. John Gardner Road
	Dunes Club	Narragansett Beach Area



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5 VULNERABILITY & IMPACTS ASSESSMENT

5.1 Vulnerability Assessment

In hazard mitigation planning, risk is defined as the potential for damage or loss when natural hazards, described in Chapter 3, interact with assets, described in Chapter 4. For Narragansett, assets include people, structures, systems, natural, historic, and cultural resources, the economy, and valued activities. The risk assessment looks at two key factors: vulnerability and impact.

- Vulnerability is a description of which assets within locations identified to be hazard-prone are at risk from the effects of the identified hazard(s) (FEMA, 2022).
- Impacts are the consequences or effects of each hazard on the Town’s assets identified in the vulnerability assessment. (FEMA, 2022).

For each natural hazard described in Chapter 3, this chapter presents an overview of which assets are most at risk from the effects of that hazard and describes the consequences of that vulnerability.

5.2 Description of Assets

 People	People includes all citizens of the community, with special emphasis placed on those who are particularly vulnerable to natural hazards, such as the elderly, children, those with mobility issues, or those experiencing homelessness.
 Structures	Structures refers to the built environment; includes all buildings within the community, both commercial and residential
 Systems	Systems include networks and capabilities that allow Narragansett to function on a day-to-day basis. Examples of systems include utility infrastructure, public transportation infrastructure, communication lines, and roadways.
 Natural, Historic, and Cultural Resources	Natural Resources refers to the natural environment and local ecosystems that contain flora and fauna of the community, Historic and cultural resources include resources include areas of cultural importance, industries, historical landmarks, the economy, local events and activities, and anything that contributes to Narragansett’s way of life.



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Assets in place that benefit the community by increasing community morale and well-being

Activities that have value to the community

5.3 Vulnerability Assessment Overview

Two risk assessment methodologies were used in the formation of this vulnerability assessment. The first consists of a quantitative analysis that relies upon the best available data and technology, while the second approach consists of a qualitative analysis that relies on local knowledge and rational decision-making. To determine which of the assets identified in Chapter 4 are located within an area identified to be hazard-prone, either now or in the future, the natural hazard profiles presented in Chapter 3 were utilized.

5.4 Identification of Potential Impacts

There are three ways to analyze impacts:

- **Historical Analysis:** Historical analysis uses data on the impacts and losses of previous hazard events, which can be used to predict the anticipated impacts and losses for a similar future event.
- **Exposure Analysis:** An exposure analysis identifies the existing and future assets in known hazard areas. GIS is often used for this analysis and to make maps to visualize the risk. An exposure analysis can quantify the number, type, and value of structures, community lifelines, and other assets in areas of identified hazards. It can identify any assets exposed to multiple hazards. Exposure analysis can also help a community understand areas that may be vulnerable when buildings, infrastructure, and community lifelines are built in hazard-prone areas.
- **Scenario analysis:** A scenario analysis asks "what if" a certain event occurs. This kind of analysis uses a hypothetical situation to think through potential impacts and losses. A scenario analysis can be completed narratively by walking through a scenario with the planning team and documenting what could happen. It can also be completed using modeling. FEMA's Hazus program is one of the most common scenario analysis tools for hazard mitigation. For Narragansett, FEMA's Hazus-MH Version 2.2 SP1 was used to estimate potential losses from earthquakes and hurricanes.

Table 5-1, below, discusses general impacts that can be the result of natural hazards affecting Narragansett's assets. These impacts are discussed throughout this chapter.



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Table 5.1. Impacts of Natural Hazards

Impact	Examples
Loss of Life	<ul style="list-style-type: none"> • Death
Physical Injuries	<ul style="list-style-type: none"> • Cuts, bruises, broken bones, or amputations.
Public Health	<ul style="list-style-type: none"> • Spread of disease or vector-borne illnesses • Respiratory problems arising from air pollution
Property Damage	<ul style="list-style-type: none"> • Damage to physical structures • Damage to contents within homes and buildings • Damage to vehicles
Economic Impacts	<ul style="list-style-type: none"> • Lost wages • Closure of or interruption to businesses • Increased insurance premiums • Increased costs for repairs/rebuilding • Decreased property values • Disruption of industry and the transport of goods and services • Decreased tourism revenues
Displacement	<ul style="list-style-type: none"> • Forced abandonment of the home due to unsafe living conditions, either permanently or temporarily
Environmental Impacts- Contamination	<ul style="list-style-type: none"> • Air pollution from dust and debris • Transport of toxic chemicals by floodwaters • Release of hazardous materials into soil and water • Decreased water quality • Sewage release into waterways
Environmental Impacts- Ecological	<ul style="list-style-type: none"> • Loss of wildlife • Loss or destruction of habitat • Disruption to migratory patterns • Loss of biodiversity
Environmental Impacts- Geological	<ul style="list-style-type: none"> • Landslides • Erosion • Removal of topsoil • Debris deposit • Altered nutrient balance
Psychological Impacts	<ul style="list-style-type: none"> • Trauma • Anxiety • Stress • PTSD
Building Damage	<ul style="list-style-type: none"> • Structural damage to roofs, walls, or foundations • Collapse or destruction
Utility Infrastructure Damage	<ul style="list-style-type: none"> • Damage to power lines, communications towers, and water and gas mains resulting in power outages, loss of water or gas, and loss of communication, radio signal, or internet



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Table 5.1. Impacts of Natural Hazards

Impact	Examples
Transportation Infrastructure Damage	<ul style="list-style-type: none"> • Damage to or debris build-up on roads, bridges, railways, or airports that render them impassable or unsafe to use
Disruption to Lifelines	<ul style="list-style-type: none"> • Medical facilities, emergency services, or transportation networks are unable to provide essential services due to damage or debris
Impacts to Daily Life	<ul style="list-style-type: none"> • Cancellation or postponement of sporting or other events that are important to the community • Damage to parks, community centers, or public pools inhibits recreation • Destruction of historic or cultural landmarks

5.4.1 Flooding from Precipitation

Precipitation flooding includes stormwater flooding, riverine flooding, and flooding from dam overtopping. Riverine flooding is most likely to impact areas closest to bodies of water, while stormwater flooding can occur anywhere in the Town. Stormwater flooding is often concentrated to smaller areas including parking lots and roadways. Dam overtopping can impact areas adjacent to and downstream of the dam. Dams are categorized by DCR as “high hazard,” “significant hazard” and “low hazard.” Higher hazard dams post a greater risk to downstream populations. Narragansett has one dam that is rated as “significant hazard.”

Much of the infrastructure in Narragansett, including bridges, stormwater systems, and roadways were designed based on historical rain events. With increased frequency and severity of storm events, inland flooding could become an increased vulnerability for the Town to manage. Recently, more frequent occurrences of flood event larger than the historic have occurred and put vital infrastructure at risk.

An exposure analysis was utilized to assess potential impacts on the five sectors that were defined in above. Table 5.2 below lists likely impacts and the assets categories that may be impacted.

Table 5.2. Impacts from Precipitation Flooding

Asset Category	Likely Impacts
People	Impacts to people’s health, welfare, and safety, including underserved communities and socially vulnerable populations: <ul style="list-style-type: none"> • Physical injury or death



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Asset Category	Likely Impacts
	<ul style="list-style-type: none"> • Increase in physiological stressors • Displacement due to building damage • Isolation due to road closures • Mold and allergens from water damage creates an increased risk to people with existing respiratory damage • Increase in vector-borne diseases and bacterial infections • Increased rate of emergency room visits
Structures	<p>Impacts to buildings, facilities, lifelines, and critical infrastructure:</p> <ul style="list-style-type: none"> • Water damage to internal and external of buildings, including houses, governmental buildings, community lifelines, and critical infrastructure • Damage to facilities <p>The following Town-owned assets predicted to be impacted by flooding:</p> <ul style="list-style-type: none"> • Town beach facilities and its assets • Middlebridge conservation site and marina
Systems	<p>Impacts to transportation systems, and electricity and water systems:</p> <ul style="list-style-type: none"> • Disruption to roadways because of water and debris blocking routes and road washouts, making transportation networks impassible or unsafe • Damage to utility infrastructure • Bridge support scour • Dams are at higher risk of overtopping or experiencing damage from flooding <p>The following Town-owned assets predicted to be impacted by flooding:</p> <ul style="list-style-type: none"> • Boston Neck Rd at Town Beach • Middlebridge Rd • Sand Hill Cove Rd • Great Island Rd • Marine Drive • Foddering Farm Rd • Bonnet Point Rd



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Asset Category	Likely Impacts
	<ul style="list-style-type: none"> • Bonnet Shores Rd • Ocean Rd at Seawall • Ocean Rd at South of Rt 108 intersection • Ocean Rd at Scarborough Beach
Natural/Cultural/Historic Resources	<p>Impacts to ecosystems, natural habitats, community areas, historical facilities and locations, and cultural resources:</p> <ul style="list-style-type: none"> • Damage or destruction of the natural environment • Ecosystem degradation and reduced water quality due to increased sedimentation, nutrients, and contaminants from agriculture practices, stormwater runoff, and septic overflow. • Loss of habitat • Erosion • Changes in river and stream ecology • Forest health degradation • Damage to cultural resources and sites • Damage to historic buildings and sites • Parks and public spaces could experience damage or disruptions
Economic and Community Assets	<p>Impacts to people’s ability to work and make a living, and impacts to activities that benefit the community by increasing community morale and well-being:</p> <ul style="list-style-type: none"> • Business interruption • Limited patrons resulting in reduced revenue • Increased costs of maintenance • Increase in demand for municipal services • Increased cost for response and repairs • Temporary loss of community activities

Using Hazus information, the estimated damages that would occur in Narragansett from 100- and 500-year flood events were assessed. Past flooding events are known to have displaced significant numbers of residents. Related data are compiled in Appendix D.



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5.4.2 Severe Winter Storms / Nor'easters

Narragansett is often subjected to harsh winters. Winter storms and Nor'easters bring with them heavy precipitation, ice, high winds, and below-freezing temperatures. These storms can immobilize a Town and cause significant disruptions to daily life, causing a ripple effect in the local economy. Heavy precipitation and ice can bring road closures, travel delays and cancellations, business and school closures, and generally dangerous conditions. These storms also bring strong winds. High winds can cause structural damage to the built environment and bring down trees and power lines. This can cause severe and lasting power outages, which are especially dangerous during severe winter conditions as citizens may be unable to heat their homes.

While all citizens are potentially vulnerable to severe winter weather, those without shelter or heat are the most vulnerable. They are susceptible to severe life safety issues such as frostbite and hypothermia. Severe winter weather can cause dangerous travel conditions; this can result in car accidents, injuries, slips, falls, or even death. First responders are especially vulnerable to injury due to dangerous travel conditions such as icy roads or low visibility.

Severe winter weather has the potential to cause structural damage to homes and businesses. Snow loads can build up on roofs, causing them to cave in. High winds can cause structural damage to the built environment and bring down trees and power lines. This can cause severe and lasting power outages, which are especially dangerous during severe winter conditions as citizens may be unable to heat their homes. Below freezing temperatures can cause pipes to burst. High winds and heavy snows can bring down trees and power lines which can cause power outages across Narragansett.

Heavy snow build-up or icy conditions can immobilize public transportation systems or ground flights, impacting travel across Narragansett. Heavy precipitation can overwhelm drainage systems and cause flooding.

Furthermore, these storms can cause dangerous disruptions to emergency operations. First responders may be unable to respond to emergency situations due to adverse travel conditions. First responders themselves are potentially vulnerable to injury due to dangerous travel conditions such as icy roads or low visibility. Evacuation routes may be impassable.

A scenario analysis was utilized to assess potential impacts on the most vulnerable assets due to winter storms and nor'easters. Impacts from winter storms and nor'easters can be found in Table 5.3.



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Table 5.3 Impacts from Winter Storms and Nor'easters

Asset Category	Likely Impacts
People	Impacts to people’s health, welfare, and safety, including underserved communities and socially vulnerable populations: <ul style="list-style-type: none"> • Death and injury • Increased instances of frostbite and hypothermia • Stranded or isolated communities
Structures	Impacts to buildings, facilities, lifelines, and critical infrastructure: <ul style="list-style-type: none"> • Heavy snow loads may cause roof collapse • Increased heating demands • Frozen pipes • Assets such as beach side properties, piers are at higher risk of damage
Systems	Impacts to transportation systems, and electricity and water systems: <ul style="list-style-type: none"> • Power outages • Transportation disruptions due to low visibility, icy road conditions, or heavy snow • Communications disruptions from damaged infrastructure due to ice and freezing rain • Water supply interruptions caused by frozen pipes that burst
Natural/Cultural/Historic Resources	Impacts to ecosystems, natural habitats, community areas, historical facilities and locations, and cultural resources: <ul style="list-style-type: none"> • Historic buildings may not be capable of handling snow loads and may be more susceptible to roof collapse • Flooding may occur after rapid melting of snow • Chemicals used to treat roadways may contaminate natural environments and water bodies if used in large quantities
Economic and Community Assets	Impacts to people’s ability to work and make a living, and impacts to activities that benefit the community by increasing community morale and well-being: <ul style="list-style-type: none"> • Increased heating costs • Disruption of essential services



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Asset Category	Likely Impacts
	<ul style="list-style-type: none"> • Reduced economic activity • Expensive response and recovery costs • School closures

5.4.3 Hurricanes / Tropical Cyclones

Hurricane force winds can destroy buildings and mobile homes. Items that are not secured can quickly become airborne debris that can cause severe injury. Hurricanes can also spawn tornadoes. Heavy rain associated with hurricanes can cause extreme flooding. Hurricane rain and winds can result in downed trees and tree limbs, blocked roads, and downed telephone and power lines. This can severely disrupt transportation routes and communication channels. The elderly and those with mobility issues are of particular concern during hurricane or tropical storm events.

In order to provide the Town decision-makers with the best available information for estimating losses from Hurricanes, our team conducted a scenario analysis and utilized the Hazus Hurricane Loss Estimation Methodology to assess the potential impacts of a Category 2 and Category 4 Hurricane. We used Hazus-generated probabilistic Category 2 and 4 storms to understand direct physical damages (essential facilities, transportation, utility systems, general building stock), induced physical damages (debris), and direct economic/social losses. Hurricane features that were used in this analysis include wind pressure, windborne debris, rainwater penetration, tree blowdown, and storm surge. Past tropical storm events are known to have displaced significant numbers of residents. Related data are compiled in Appendix D. Table 5.4 describes the possible impacts from hurricanes and tropical cyclones.

Table 5.4: Impacts from Hurricanes and Tropical Cyclones

Asset Category	Likely Impacts
People	Impacts to people's health, welfare, and safety, including underserved communities and socially vulnerable populations: <ul style="list-style-type: none"> • Death and Injury • Mental health impacts such as anxiety or PTSD • Displacement • Loss of property
Structures	Impacts to buildings, facilities, lifelines, and critical infrastructure:



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Asset Category	Likely Impacts
	<ul style="list-style-type: none"> • Damage to buildings from high winds, flying debris, or flooding • Power outages • Damage to critical facilities is possible • Beach side properties, Town beaches and its assets, Beach side monuments and historical structures
Systems	<p>Impacts to transportation systems, and electricity and water systems:</p> <ul style="list-style-type: none"> • Damage to transportation infrastructure such as roads or bridges can impact emergency responses and daily travel • Damage to telecommunications infrastructure can disrupt communications • Widespread power outages can disrupt critical facilities, emergency response centers, water treatment plants, and hospitals • Water supply interruptions from flooding or damage to water treatment plants and pipelines • Flooding can overwhelm wastewater systems causing contamination and health risks • Utility services such as gas may be disrupted • Beach side roads
Natural/Cultural/Historic Resources	<p>Impacts to ecosystems, natural habitats, community areas, historical facilities and locations, and cultural resources:</p> <ul style="list-style-type: none"> • Historic buildings may not be able to withstand high winds • Increased coastal erosion • Potential for flash flooding and storm surge
Economic and Community Assets	<p>Impacts to people’s ability to work and make a living, and impacts to activities that benefit the community by increasing community morale and well-being:</p> <ul style="list-style-type: none"> • Decreased economic activity • Expensive response and recovery costs • Damage to businesses or business closures • School closures



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5.4.4 Tornadoes

Tornadoes can cause severe injury or even death. Tornadoes can destroy homes, businesses, and other structures, leaving people without shelter and their possessions destroyed or lost. Tornadoes can also cause economic impacts, such as lost wages, business interruption, and increased insurance premiums. Infrastructure such as power lines, communication towers, water mains, and gas mains are vulnerable to tornadoes. Damage to such infrastructure can cause power outages, disruptions to communication, and water contamination. Tornadoes can also disrupt transportation systems, including roads, railways, and airports, by blocking them with debris, making them impassable or unsafe to use. Table 5.5 describes possible impacts from tornadoes.

Table 5.5: Impacts from Tornadoes

Asset Category	Likely Impacts
People	Impacts to people’s health, welfare, and safety, including underserved communities and socially vulnerable populations: <ul style="list-style-type: none"> • Death or injury • Flying debris can cause death or injury • Mental health impacts such as anxiety or PTSD • Displacement
Structures	Impacts to buildings, facilities, lifelines, and critical infrastructure: <ul style="list-style-type: none"> • Damage to buildings and infrastructure from high winds and flying debris • Critical facility damage • Power outages • Beach side properties, Town beaches and its assets, Beach side monuments and historical structures
Systems	Impacts to transportation systems, and electricity and water systems: <ul style="list-style-type: none"> • Damage to roadways, bridges, and other transportation infrastructure can disrupt daily travel • Damage to telecommunications infrastructure can disrupt communications • Downed power lines can cause power outages • Damage to water treatment plants, pump stations, or water distribution systems can lead to a loss of clean drinking water and sanitation services



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Asset Category	Likely Impacts
	<ul style="list-style-type: none"> • Beach side roads
Natural/Cultural/Historic Resources	Impacts to ecosystems, natural habitats, community areas, historical facilities and locations, and cultural resources: <ul style="list-style-type: none"> • Uprooting or damaging trees • Destroyed vegetation or altered landscapes • Downed utility lines can cause wildfires
Economic and Community Assets	Impacts to people’s ability to work and make a living, and impacts to activities that benefit the community by increasing community morale and well-being: <ul style="list-style-type: none"> • Decreased economic activity • Business closures • School closures

5.4.5 Earthquakes

In addition to building collapse, earthquakes can cause structural damage to roadways, breakage of water and gas lines, and flooding and fires. Furthermore, landslides can be triggered by earthquakes. An area’s vulnerability to a devastating earthquake is based primarily on the following elements: the density of the population in the region, and the age of the region’s buildings and lack of earthquake proof design. Table 5.6 describes possible impacts from earthquakes.

Table 5.6: Impacts from Earthquakes

Asset Category	Likely Impacts
People	Impacts to people’s health, welfare, and safety, including underserved communities and socially vulnerable populations: <ul style="list-style-type: none"> • Loss of life or severe injury • Vehicle accidents • Injury from debris or falling objects • First responders are particularly at-risk
Structures	Impacts to buildings, facilities, lifelines, and critical infrastructure:



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Asset Category	Likely Impacts
	<ul style="list-style-type: none"> • Significant structural damage, especially if buildings are not constructed to withstand seismic forces or if there are insufficient evacuation plans • Critical facilities can be impacted or damaged from ground shaking and falling debris • Collapse of buildings or bridges
Systems	Impacts to transportation systems, and electricity and water systems: <ul style="list-style-type: none"> • Disruption of government operations • Seismic activity can damage communication infrastructure such as phone lines, cell networks, and data networks • Power outages from damaged electrical infrastructure • Disruption of gas lines, electric lines, or phone service
Natural/Cultural/Historic Resources	Impacts to ecosystems, natural habitats, community areas, historical facilities and locations, and cultural resources: <ul style="list-style-type: none"> • Potential to trigger secondary hazards such as fires, flash flooding, hazardous materials release, slope failure, dam failure, and tsunamis • Contamination of the environment from hazardous materials • Significant injury to animals or livestock • Historic buildings may not be able to withstand ground shaking due to outdated construction standards
Economic and Community Assets	Impacts to people's ability to work and make a living, and impacts to activities that benefit the community by increasing community morale and well-being: <ul style="list-style-type: none"> • Expensive response and recovery efforts can drain local resources • Closure of businesses due to damage • Disruption of delivery services due to dangerous transportation conditions

A scenario analysis was utilized to assess potential impacts on vulnerable assets due to earthquakes. The Hazus Earthquake Loss Estimation Methodology was used to assess the potential impacts of a



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Magnitude 5.0 and Magnitude 7.0 Earthquake. Specifically, Hazus-generated Magnitude 5.0 and 7.0 Earthquakes were evaluated to understand direct physical damages (essential facilities, transportation, utility systems, general building stock), induced physical damages (debris), and direct economic/social losses. This assessment assumes an earthquake epicenter at the center of Narragansett, which represents the worst-case scenario. All the Hazus data are compiled in Appendix D.

5.4.6 Landslides / Mudflows

Landslides or mudflows can cause significant damage to trees, structures, roadways, cars, and other built infrastructure. This damage can result in blocked transportation routes, road closures, general disruption to daily life, and costly repairs. Table 5.7 describes possible impacts from landslides or mudflows.

Table 5.7: Impacts from Landslides/Mudflows

Asset Category	Likely Impacts
People	Impacts to people’s health, welfare, and safety, including underserved communities and socially vulnerable populations: <ul style="list-style-type: none"> • Death or Injury • Loss of property
Structures	Impacts to buildings, facilities, lifelines, and critical infrastructure: <ul style="list-style-type: none"> • Collapse of buildings or other damage • Damage to critical infrastructure • Structures on a slope, beach side dunes
Systems	Impacts to transportation systems, and electricity and water systems: <ul style="list-style-type: none"> • Blocked or damaged roadways or bridges • Potential to impact utility services such as power, water, or gas lines • Road closures
Natural/Cultural/Historic Resources	Impacts to ecosystems, natural habitats, community areas, historical facilities and locations, and cultural resources: <ul style="list-style-type: none"> • Increased erosion



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Asset Category	Likely Impacts
Economic and Community Assets	Impacts to people’s ability to work and make a living, and impacts to activities that benefit the community by increasing community morale and well-being: <ul style="list-style-type: none"> • Cancellation of community events • Possible business or school closures

5.4.7 Average and Extreme Temperatures

Extreme temperatures can have severe impacts on the Town of Narragansett. During instances of extreme heat, the frequency of heat stroke, heat stress, or heat related illness is higher. High temperatures can cause people to lose fluids more quickly than usual, leading to dehydration. Dehydration can cause headaches, dizziness, and fatigue. This is especially true for individuals who work physically demanding jobs outside, such as landscapers or construction workers. These individuals should be considered vulnerable during episodes of extreme heat. Extreme heat can cause materials such as concrete, asphalt, and steel to expand and contract, leading to cracking, warping, and other forms of structural damage. High temperatures also increase the demand on the water supply, which can potentially lead to shortages. High temperatures also increase the risk of wildfires, which can cause significant damage to structures and infrastructure.

Extreme cold scenarios are equally impactful and more common in the state of Rhode Island. Extremely cold temperatures can impact public health, transportation, agriculture, energy, water resources, and infrastructure. The homeless, the elderly, and people with disabilities are especially vulnerable during instances of extreme cold. Cold weather can cause frostbite or hypothermia. Power outages during cold weather events may cause pipes to freeze and burst. Even underground pipes are subject to freezing and bursting, potentially leading to water main breaks. Power outages may also result in the inappropriate use of space heaters or generators in poorly ventilated areas, potentially leading to carbon monoxide poisoning. If extreme cold is accompanied by snow or ice, travel conditions can become extremely dangerous, and public transportation may shut down. Table 5.8 shows possible impacts from extreme temperatures.

Table 5.8: Impacts from Extreme Temperatures

Asset Category	Likely Impacts
People	Impacts to people’s health, welfare, and safety, including underserved communities and socially vulnerable populations:



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Asset Category	Likely Impacts
	<ul style="list-style-type: none"> • Increased risk of cold-related or heat-related death or illness (hypothermia, frostbite, heat stroke, heat exhaustion, etc.) • Most at-risk populations include children, the elderly, the homeless, and those that work outside
Structures	Impacts to buildings, facilities, lifelines, and critical infrastructure: <ul style="list-style-type: none"> • Extreme heat can lead to structural damage such as cracking or warping • Extreme cold can freeze and damage pipes leading to water leaks and flooding when temperatures rise
Systems	Impacts to transportation systems, and electricity and water systems: <ul style="list-style-type: none"> • Power grid strain from increased heating or air conditioning use, potentially resulting in power outages • Extreme heat can cause pavement to soften and buckle leading to road closures and transportation disruptions • Extreme cold can result in icy road conditions and reduced visibility, making travel hazardous
Natural/Cultural/Historic Resources	Impacts to ecosystems, natural habitats, community areas, historical facilities and locations, and cultural resources: <ul style="list-style-type: none"> • Potential increase of wildfires during extreme heat • Extreme temperatures may alter migrations, allow for invasive species, decrease crop yields, and adversely affect livestock
Economic and Community Assets	Impacts to people’s ability to work and make a living, and impacts to activities that benefit the community by increasing community morale and well-being: <ul style="list-style-type: none"> • Cancellation of community or sports events due to extreme temperatures

5.4.8 Drought

Narragansett’s main vulnerability to a severe long-term drought would be a potential reduction in the availability of water from the Town’s local water supplies.



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In a severe multi-year drought, it is possible that drinking water supply would be severely reduced, resulting in an impact that would affect the entire Town. This can affect not only drinking water supply, but also sanitation efforts and personal hygiene. Lack of access to safe drinking water can lead to dehydration, malnutrition, and water-borne illnesses, which can be especially harmful to children and vulnerable populations. Drought can also have an impact on food security since agriculture may be impacted. This can lead to increased food prices, reduced access to nutritious food, and potentially hunger or malnutrition. Droughts have other health impacts, such as respiratory illnesses due to increased prevalence of dust.

Drought can cause the soil to dry out, shrink, and crack, leading to settlement and subsidence of buildings. This can result in damage to foundations, walls, or other structural elements. Similarly, droughts can cause the ground to become unstable, leading to the cracking and deformation of roads and bridges, which can cause further impacts to transportation and emergency response. Droughts also increase the likelihood of wildfires, which can quickly spread to buildings and cause extensive structural damage.

The primary system impacted by droughts is the water supply system. However, droughts can also impact energy systems, particularly hydroelectric power plants, by reducing water flow and power generation capacity. This can lead to power outages and increased energy prices. Drought can also impact telecommunications systems by damaging infrastructure, such as fiber optic cables and cell towers, due to soil settlement and subsidence. This can lead to disruptions in communication networks and reduced capability to respond to emergencies.

Drought impacts natural resources in a variety of ways. Droughts result in an increased susceptibility to wildfires due to the lack of moisture in the ground cover. Firefighting capabilities are often severely reduced during times of drought. If a wildfire occurs, ground cover is severely reduced or completely destroyed, increasing the likelihood of erosive processes to occur due to lack of ground cover to hold soil in place. Other impacts include a severe decrease in soil moisture content, decreased stream and river flow, and decreased water levels in lakes and reservoirs. Drought impacts biodiversity by reducing the availability of water and food resources for plants and animals. This can lead to changes in habitat, migration patterns, and species distribution. Lastly, droughts can drastically impact air quality by increasing the prevalence of dust storms and wildfires. This can lead to respiratory health problems for many Narragansett citizens.

Drought can result in the implementation of water restrictions. This can impact activities in the home, such as personal hygiene, gardening, or lawn care. Droughts can also impact water-based recreational activities that depend on a certain water level or flow, such as paddling sports or fishing, boating activity. Construction and development can also be impacted by drought; the increased risk of soil settlement and subsidence leads to increased costs and delays. An insufficient supply of water can have general



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impacts on the social and emotional well-being of communities. Table 5.9 describes possible impacts from droughts.

Table 5.9: Impacts from Droughts

Asset Category	Likely Impacts
People	<p>Impacts to people's health, welfare, and safety, including underserved communities and socially vulnerable populations:</p> <ul style="list-style-type: none"> • Increased risk of dehydration, death, heat-related illness, and heat stroke (if the drought coincides with warmer months) • Dry soils and wildfires can increase the number of airborne particles such as pollen and smoke with can worsen chronic respiratory illness
Structures	<p>Impacts to buildings, facilities, lifelines, and critical infrastructure:</p> <ul style="list-style-type: none"> • Can cause power outages, especially in areas powered by hydroelectric power plants • Drying or cracking of sediments can cause foundation damage to structures or the settlement/ subsidence of buildings
Systems	<p>Impacts to transportation systems, and electricity and water systems:</p> <ul style="list-style-type: none"> • Reduced water availability can complicate firefighting efforts • Decrease in groundwater supplies may cause shortages or rationing of water • Waterways can recede which can limit the size of ship that can navigate shallower waters, potentially impacting the delivery of goods and services
Natural/Cultural/Historic Resources	<p>Impacts to ecosystems, natural habitats, community areas, historical facilities and locations, and cultural resources:</p> <ul style="list-style-type: none"> • Damage to wildlife habitat, degradation of air and water quality, wildfires, degradation of landscape quality, loss of biodiversity, soil erosion • Loss of wetlands, lakes, and vegetation • Impact on crop production and supplies of animal feed • Increased potential for fires



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Asset Category	Likely Impacts
Economic and Community Assets	Impacts to people’s ability to work and make a living, and impacts to activities that benefit the community by increasing community morale and well-being: <ul style="list-style-type: none"> • Waterways can recede which can limit the size of ship that can navigate shallower waters, potentially impacting the delivery of goods and services • Potential to drain state and local resources, which can have a significant fiscal impact on local government

5.4.9 Changes in Groundwater

Changes in ground water may cause reduced access to or increased cost of freshwater for drinking and other uses. It can cause damages via flooding in basements and below-grade living spaces, creating risk of contamination, mold, and injury. Changes in groundwater can cause damage to habitats, natural areas, and wetlands due to reduced freshwater supplies from groundwater recharge. It can cause the mobilization of contaminants into habitats, vegetation, and wetlands. It can increase the costs of water treatment facilities due to the potential need for desalination. Table 5.10 describes possible impacts from changes in groundwater.

Table 5.10: Impacts from Changes in Groundwater

Asset Category	Likely Impacts
People	Impacts to people’s health, welfare, and safety, including underserved communities and socially vulnerable populations: <ul style="list-style-type: none"> • Flooding and damage to basements or below grade living areas creating risk of mold and contamination • Septic system failure leading to water quality degradation in nearby waterways and increased bacterial exposure
Structures	Impacts to buildings, facilities, lifelines, and critical infrastructure: <ul style="list-style-type: none"> • Damage or loss to below-grade buildings and foundations of buildings due to flooding or unstable soils • Damage to building foundations from salinity intrusion
Systems	Impacts to transportation systems, and electricity and water systems:



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Asset Category	Likely Impacts
	<ul style="list-style-type: none"> • Damage or loss to below-grade or at-grade utilities, infrastructure, roads, and transit including power, heat, water, sewer, and stormwater services due to flooding or unstable soils
Natural/Cultural/Historic Resources	<p>Impacts to ecosystems, natural habitats, community areas, historical facilities and locations, and cultural resources:</p> <ul style="list-style-type: none"> • Damage to habitats, natural areas, and wetlands due to reduced freshwater supplies • Saltwater intrusion and inundation of aquifers, wetlands, and ecosystems that cannot adapt to new conditions due to sea level rise • Changes to groundwater temperature in urban environments which can amplify heat island effects and stress vegetation and urban trees
Economic and Community Assets	<p>Impacts to people’s ability to work and make a living, and impacts to activities that benefit the community by increasing community morale and well-being:</p> <ul style="list-style-type: none"> • Increased costs for alternative sources of water such as desalination • cost of damage from flooding, especially in areas of repetitive loss • disruption of utility and infrastructure creating travel delays or lack of water, power, or sewer service

5.4.10 Wildfires

Wildfires can impact people directly by causing injuries or death. They can impact people indirectly by causing displacement due to damage to the residence. Smoke and air pollution can be a health hazard, especially for those with respiratory conditions such as asthma or allergies. The most vulnerable members of the population are those who are unable to evacuate quickly, such as the elderly, households with young children, people with mobility limitations, and people of lower socioeconomic status. First responders and firefighters are also at risk. Wildfires and their destruction can also result in severe emotional trauma for those affected.



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Wildfires that spread to urbanized areas can cause extensive structural damage. Structures located in wildfire hazard areas are especially at risk and those without fire barriers are even more at risk. Wildfires can destroy homes and buildings, leading to displacement of individuals and expensive repair costs.

Wildfires can damage or destroy critical lifelines such as power lines, water treatment facilities, and transportation infrastructure. This can lead to disruptions in basic services such as electricity, clean water, and transportation. Wildfires can cause soil erosion and other changes to the landscape that can impact water quality. This can lead to contamination of drinking water supplies, which can impact the health and safety of individuals in affected communities. Wildfires can damage or destroy communication infrastructure such as cell towers, antennas, and other equipment. This can lead to disruptions in communication services such as phone and internet access. This can also cause reduced access to information; it also has the potential to cause disruptions to emergency services and emergency communication systems.

Wildfires can cause extensive damage to the landscape by burning acres of vegetation and displacing or killing wildlife. Wildfires can also contribute to erosion and flooding. They strip slopes of vegetation, thereby decreasing soil stability and exposing the slopes to higher rates of runoff which can cause severe erosion, ultimately increasing the chance of flooding. Subsequent rains can worsen this erosion as vegetation and ground cover has been severely reduced and soils remain unstable.

Wildfires can cause severe disruptions to daily life. They can cause closures of recreational areas, hiking trails, or parks. This can limit opportunities for outdoor recreation and impact local businesses that rely on tourism. Wildfires can disrupt community events such as outdoor festivals and fairs, as well as sporting events and other activities that rely on outdoor spaces. Table 5.11 describes possible impacts from wildfires.

Table 5.11: Impacts from Wildfires

Asset Category	Likely Impacts
People	Impacts to people’s health, welfare, and safety, including underserved communities and socially vulnerable populations: <ul style="list-style-type: none"> • Death or injury • Displacement or evacuation • Loss of property • Mental health impacts such as anxiety or PTSD • Worsening of chronic respiratory illnesses due to smoke and increased particles in the air



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Asset Category	Likely Impacts
Structures	Impacts to buildings, facilities, lifelines, and critical infrastructure: <ul style="list-style-type: none"> • Burning structures • Charring of exterior surfaces • Damage to roofs, walls, or windows • Heat generated by wildfires can weaken or melt building materials
Systems	Impacts to transportation systems, and electricity and water systems: <ul style="list-style-type: none"> • Wildfire can damage utility infrastructure, including power lines, gas pipelines, and water lines, leading to disruptions in services • Damage to infrastructure such as roads or bridges can disrupt travel and emergency responses
Natural/Cultural/Historic Resources	Impacts to ecosystems, natural habitats, community areas, historical facilities and locations, and cultural resources: <ul style="list-style-type: none"> • Wildfires can decimate habitats and harm or displace wildlife • Displacement of wildlife can lead to conflicts with human populations • Post-fire landscapes are vulnerable to colonization by invasive plant species which can outcompete native vegetation and disrupt ecosystem function
Economic and Community Assets	Impacts to people’s ability to work and make a living, and impacts to activities that benefit the community by increasing community morale and well-being: <ul style="list-style-type: none"> • Increased insurance claims • Reduced economic activity in areas affected by wildfire • Need for emergency shelters • Expensive response and recovery costs

5.4.11 Coastal Erosion

Coastal erosion can have many impacts to coastal communities like Narragansett. Coastal erosion can cause beaches to recede, leaving less room for recreational beach activities that are highly valued by the community. Similarly, coastal erosion can mean the loss of coastal habitats for various marine



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species of plants and animals. Coastal erosion can be detrimental to beachfront properties as it can erode the foundation of structures. It can also cause damage to roadways and bridges, resulting in transportation delays or blockages. Coastal erosion may cause communities to start retreating from the coast in order to better protect people and property. Table 5.12 describes possible impacts from coastal erosion.

Table 5.12: Impacts from Coastal Erosion

Asset Category	Likely Impacts
People	Impacts to people’s health, welfare, and safety, including underserved communities and socially vulnerable populations: <ul style="list-style-type: none"> • Loss of coastal property • Displacement
Structures	Impacts to buildings, facilities, lifelines, and critical infrastructure: <ul style="list-style-type: none"> • Coastal erosion can cause foundations of coastal structures to become unstable or even collapse • Property, homes, community assets, and neighborhoods may be lost to erosion and associated increased flood risk • Beach side properties, monuments, historical structures, Town beaches and its assets
Systems	Impacts to transportation systems, and electricity and water systems: <ul style="list-style-type: none"> • Erosion can occur under roads or bridges which can damage the infrastructure and make roadways impassable or unsafe • Damage, disruption, or loss to utilities, particularly those that are underground • Damage or loss of shoreline flood management infrastructure
Natural/Cultural/Historic Resources	Impacts to ecosystems, natural habitats, community areas, historical facilities and locations, and cultural resources: <ul style="list-style-type: none"> • Loss of coastal habitat • Increased sedimentation in waterways • Loss of wetland and salt marsh shoreline functions, including habitat for native species, filtering pollutants, trapping and retaining sediment, and buffering the shoreline from wind and wave energy • Beach side roads



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Asset Category	Likely Impacts
Economic and Community Assets	<p>Impacts to people’s ability to work and make a living, and impacts to activities that benefit the community by increasing community morale and well-being:</p> <ul style="list-style-type: none"> • Increased insurance premiums for coastal properties • Loss of recreational or beach area • Managed retreat from coastal areas • Cultural and archaeological resources are at risk of damage, disruption, or loss

5.4.12 Sea Level Rise

Sea level rise can have far reaching impacts on coastal communities in Rhode Island such as Narragansett. The severity of the impacts from sea level rise can vary based on the rate and extent of sea level rise in the area, and the effectiveness of local adaptation and mitigation measures. The first and most apparent impact from sea level rise is an increase in flooding events. Higher sea levels exacerbate coastal flooding during storms and high tides (RISHMP, 2024). These flooding events can damage homes, infrastructure, and agriculture. As these inundation events become more and more frequent, the instances of displacement and migration will increase.

Coastal areas may become uninhabitable due to the increased frequency of flooding and permanent inundation. This can result in climate-induced migration toward more inland areas. Sea level rise can result in a loss of coastal property, including homes, businesses, and critical facilities. This can further result in economic losses for coastal communities. Other economic impacts include impacts on tourism, fisheries, and ports. Additionally, property values may decline in coastal areas as sea levels continue to rise. Related to this, the availability and affordability of home and flood insurance may become a challenge in these areas.

Sea level rise can also have severe environmental impacts. It can result in coastal habitat loss. Coastal habitats like salt marshes that act as breeding and feeding grounds for various species are particularly vulnerable to sea level rise; the loss of these habitats can threaten biodiversity and disrupt ecosystems (RISHMP 2024). Saltwater intrusion can also occur from sea level rise. Rising seas can push saltwater into freshwater sources like rivers and aquifers, which can contaminate drinking water supplies and affect agriculture by making soils less fertile (RISHMP 2024). Flooding from sea level rise can also result in the release of pollutants stored in coastal areas, including industrial chemicals and sewage, which can have a drastic impact on marine ecosystems (RISHMP 2024). Flooding can also cause coastal erosion, which threatens dune systems, property, and infrastructure on the coast.



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Flooded roads and infrastructure impede the response to natural disasters and emergencies regularly. Table 5.16 describes possible impacts from sea level rise.

Table 5.13: Impacts from Sea Level Rise

Asset Category	Likely Impacts
People	<p>Impacts to people’s health, welfare, and safety, including underserved communities and socially vulnerable populations:</p> <ul style="list-style-type: none"> • Displacement and migration • Loss of coastal property • Social inequity
Structures	<p>Impacts to buildings, facilities, lifelines, and critical infrastructure:</p> <ul style="list-style-type: none"> • Water damage to internal and external of buildings, including houses, governmental buildings, community lifelines, and critical infrastructure • Damage to facilities <p>The following assets are predicted to be impacted by flooding are:</p> <ul style="list-style-type: none"> • Town beach facilities and its assets • Middlebridge conservation site and marina
Systems	<p>Impacts to transportation systems, and electricity and water systems:</p> <ul style="list-style-type: none"> • Flooding can disrupt transportation systems and cause road closures • Electrical infrastructure on the coast is at risk of damage due to flooding, saltwater exposure, or storm surge <p>The following assets are predicted to be impacted by flooding are:</p> <ul style="list-style-type: none"> • Boston Neck Rd at Town Beach • Middlebridge Rd • Sand Hill Cove Rd • Great Island Rd • Marine Drive • Foddering Farm Rd • Bonnet Point Rd • Bonnet Shores Rd • Ocean Rd at Seawall • Ocean Rd at South of Rt 108 intersection



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Asset Category	Likely Impacts
Natural/Cultural/Historic Resources	<ul style="list-style-type: none"> • Ocean Rd at Scarborough Beach <p>Impacts to ecosystems, natural habitats, community areas, historical facilities and locations, and cultural resources:</p> <ul style="list-style-type: none"> • Increased instances of high tide and sunny day flooding • Saltwater intrusion into freshwater resources and agricultural lands • Sea level rise can threaten cultural assets that are tied to a coastal location • Coastal habitat loss • Altered distribution and abundance of marine species, affecting fisheries • Increased coastal erosion
Economic and Community Assets	<p>Impacts to people’s ability to work and make a living, and impacts to activities that benefit the community by increasing community morale and well-being:</p> <ul style="list-style-type: none"> • Increased insurance costs • Decreased property values • Port facilities may be impacted which can disrupt trade and commerce • Impacts to tourism, fisheries, and ports can lead to job loss and economic downturn • Expensive response and recovery costs for local governments

5.4.13 Severe Thunderstorm

Severe thunderstorms can have a wide range of effects on people, structures, systems, and resources. First and foremost, in the absence of proper shelter, people are subject to serious injury or even death from hail, lightning, and high winds. Thunderstorms can cause power outages, which can disrupt daily life and impact essential services. They can also cause damage to electrical infrastructure, such as power lines, transformers, and substations (RISHMP 2024). Severe thunderstorms can also strain public safety resources, including emergency services, law enforcement, and medical facilities (RISHMP 2024) and cause wildfire (Town staff). Table 5.14 describes impacts from severe thunderstorms.

Table 5.14: Impacts from Severe Thunderstorms



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Asset Category	Likely Impacts
People	Impacts to people’s health, welfare, and safety, including underserved communities and socially vulnerable populations: <ul style="list-style-type: none"> • Death and injury • Mental health impacts such as anxiety and PTSD • Displacement
Structures	Impacts to buildings, facilities, lifelines, and critical infrastructure: <ul style="list-style-type: none"> • Falling objects, trees, or debris can damage buildings or critical infrastructure • Fallen power lines • High winds and hail can damage buildings or infrastructure
Systems	Impacts to transportation systems, and electricity and water systems: <ul style="list-style-type: none"> • Airport closures • Electrical infrastructure damage • Communications disruptions from damage to telecommunications infrastructure • Power outages • Transportation disruptions from heavy rain, strong winds, or flooding • Severe storms can overwhelm water treatment plants and wastewater facilities leading to contamination and water supply disruptions
Natural/Cultural/Historic Resources	Impacts to ecosystems, natural habitats, community areas, historical facilities and locations, and cultural resources: <ul style="list-style-type: none"> • Flash floods or riverine flooding • Potential for wildfire due to lightning strikes • Potential for tornadoes to form
Economic and Community Assets	Impacts to people’s ability to work and make a living, and impacts to activities that benefit the community by increasing community morale and well-being: <ul style="list-style-type: none"> • Severe storms may cause business closures • Cancellations of community or sporting events



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5.5 Vulnerability related to Private and State-Owned Assets

As shown in Section 4.3.4, Narragansett has numerous private and state-owned properties, including a research level nuclear reactor, that are susceptible to climate hazards. While the town lacks jurisdiction over these properties, the adverse effects of storms on these properties often disrupt residents' lives. Few examples of these properties are:

- Oceanfront roadways in the Town, such as Ocean Road, Boston Neck Road, Beach Street are particularly susceptible to coastal storms and flooding. The impacts incurred from high wind & surf, heavy rains, flooding, and storm surge inundation have led to repetitive damages and deterioration in the protective dunes, wall and bulkhead lining these roadways. As a result, excessive accumulation of rain, ocean tidal waters, storm inundation, deposits of sand, rock, and vegetative debris creates dangerous impassable roads. Consequently, these roads which function as primary north/south travels routes through our community require emergency closure and traffic detours. Street drains and culverts required debris to be cleared while the roadways require sand and debris to be plowed and/or moved from the immediate roadways until it can be removed and disposed. This results in a disruption in normal government and private business operations. The Town is essentially divided in half due to the closures of Route 1A/Boston Neck Rd in front of the town beach which connects the center of the community with our north-end of town. Motorists and emergency vehicles are temporarily re-routed to Route-1 in order to access roads north.
- Succotash Rd, when flooded due to abnormal high tide cuts off Jerusalem completely. When Middlebridge Road floods, it's in the marsh area between the Bridge and #25 Middlebridge Road, therefore cutting off access to South Kingstown. This is a major cut through for areas in the North End. Other areas that are pinch points are Ocean Road at Sakonnet Blvd. (high surf and tide) & Marine drive between Frank's Neck and Penguin Drive, and separately, Wild Goose Lane, only when there is an abnormal high tide.
- The Harbor of Refuge, situated off Narragansett's south coast, safeguards vessels navigating along the southern New England eastern seaboard and the southern beaches of Sand Hill Cove. While the eastern and western break walls have undergone repairs over time, the center wall, installed in the 1930s, has remained unchanged. Serving as the primary defense against southward wave action, the center wall has deteriorated significantly over the past century. This degradation became particularly apparent during recent storms, resulting in significant erosion of Sand Hill Cove Beaches. After the storms, established sand dunes were compromised causing erosion beneath existing structures, leading to partial collapse of some dwellings. Although the Harbor of Refuge is not owned by the Town, its importance in preserving the shoreline and supporting development along the southern end of the Town is acknowledged.



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6 CAPABILITY ASSESSMENT

This section of HMP addresses the Town's existing capability to manage hazard events.

6.1 Planning and Regulatory Capabilities

Planning and regulatory capabilities encompass a wide range of tools such as codes, bylaws, policies, laws, and programs that guide growth and development. These capabilities play a crucial role in either supporting risk reduction or creating areas that are more vulnerable to disasters. These strategies are aimed at breaking the cycle of disaster damage and reconstruction. Additionally, effective law and regulation for disaster risk reduction are critical in shaping choices for sustainable development and building resilience to disasters.

The regulations, zones, and districts outlined in Appendix A: Zoning ordinance for the Town align with a comprehensive plan established and updated in accordance with Rhode Island's Comprehensive Planning and Land Use Regulation Act. They serve purposes, including promoting public health, safety, and welfare, supporting agricultural and open space preservation, enhancing disaster resilience, encouraging quality design, and facilitating coordination among municipalities and agencies.

6.1.1 Building Code

A challenge for the capabilities of a community can be the use of an updated building code which reflects industry best practices and standard of care. Currently, the Town of Narragansett utilizes the latest State of Rhode Island's 2018 International Building Code which is included in Chapter 27.3 State Building Code. The scope of the International Building Code® (IBC®) includes all buildings except detached one- and two-family dwellings and townhouses up to three stories (<https://codes.iccsafe.org/content/IBC2018P6>). According to the ICC website, "The Rhode Island Building Code is approved and administered by the Building Code Standards Committee."

The State of Rhode Island has also adopted the 2018 International Residential to further safeguard new structures and additions in flood prone and high wind areas south of Bridgetown Road. Sheer wall blocking will prevent damage in coastal areas.

6.1.2 Overlay Districts

The Overlay Districts are directly related to natural hazard mitigation and climate change resilience. The overlay districts create overlay zones encompassing parts of the Town where inherent physical constraints make the land unfit for development without limitations. These zones comprise of coastal and freshwater wetlands, coastal waters and shorelines, areas with a high-water table or steep slopes, and flood-prone lands. Any development within these zones is considered a special case and necessitates scrutiny and approval through a site plan review process.



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6.1.2.1 Coastal and Freshwater Wetlands Overlay District

State of Rhode Island and the Town of Narragansett instituted this policy to preserve and protect coastal and freshwater wetlands in the interests of the public health, safety, and general welfare of the community. The coastal and freshwater wetlands overlay district encompasses a variety of wetland types, including swamps, marshes, ponds, and streams, serving critical ecological functions such as storm buffering, flood control, and wildlife habitat.

It extends to include lands within 150 feet of wetland edges as determined by experts, with a 50-foot extension in areas prone to storm flowage as per Rhode Island's Wetlands Act. Coastal wetlands include salt marshes bordering tidal waters, while freshwater wetlands cover various inland bodies of water and associated ecosystems, with adjustments made to minimum acreage requirements for certain types of wetlands under this ordinance.

In order to safeguard these sensitive ecosystems from contamination and degradation, the prohibited activities in this district include discharging pollutants, installing sewage disposal systems or sewer outfalls, and holding hazardous materials or solid waste. Similarly, a special use permit is necessary for activities not meeting development standards, requiring compliance with state coastal and environmental regulations. These activities include filling, construction, utility installation, wetland alteration, and any other actions that could significantly affect wetland conditions or functions. Additionally, there are strict development standards which include 100-foot setbacks for structures in certain areas with sewer and water services, 150-foot setbacks for sewage disposal systems and land disturbance elsewhere, ensuring protection of wetlands from flood obstruction, sedimentation, pollution absorption reduction, ecological degradation, and groundwater recharge reduction, as well as maintaining wetlands' value as habitats and spawning grounds.

6.1.2.2 Coastal Resources Overlay District

The Coastal Resources Overlay District encompasses tidal waters, coastal salt ponds, shoreline features like beaches, dunes, cliffs, and manmade shorelines, along with contiguous areas extending inland for 200 feet, as defined by the state coastal resources management council. These coastal resources hold significant commercial, industrial, recreational, ecological, and aesthetic value, all of which face the threat of destruction due to unplanned or poorly planned development. Therefore, it is the public policy of Rhode Island and the Town to safeguard and enhance these resources and their ecological systems for the overall well-being of the community in terms of public health, safety, hazard mitigation, and welfare.

Special use permit is required to perform activities include filling, dredging, constructing structures or utilities, installing shoreline protection measures, undertaking beach nourishment, managing pollutants, and disposing of solid waste. Proposed developments within the coastal resources overlay district must adhere to specific development standards to ensure minimal interference with public access,



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preservation of aesthetic and recreational values, protection of water quality and habitats, prevention of stormwater runoff and erosion, maintenance of storm buffers, and preservation of natural buffers. These standards also mandate minimal land alteration, avoidance of threats to public health and safety, and the establishment of natural undisturbed buffers.

6.1.2.3 High Water Table Limitations Overlay District

The High Water Table Limitations Overlay District encompasses areas where the water table is within three feet below the surface of the ground for significant periods, resulting in moderate to severe constraints on subsurface development. District "A" comprises areas where the water table is generally within 18 inches of the ground surface, designated by specific symbols on environmental inventory soils maps, while District "B" includes areas where the water table ranges from 18 inches to three feet below the surface. Underground fuel storage tanks are strictly prohibited in both districts, and special review is required for in-ground swimming pools and basements, with detailed plans certified by a professional engineer ensuring compliance with development standards, including proper grading to prevent stormwater runoff and limitations on the number of bedrooms for sewage disposal systems.

6.1.2.4 Steep Slope Overlay District

The Steep Slope Overlay District comprises areas where slopes exceed 15 percent, posing risks of severe soil erosion and construction challenges. Designated by specific symbols on environmental inventory soils maps, land within this district requires careful development planning to mitigate erosion and building installation difficulties. Special review permits may be granted by the building inspector, contingent upon submission of plans certified by a professional engineer or qualified land surveyor ensuring compliance with development standards, including minimizing cuts and fills, controlling runoff and erosion, aligning sewage disposal systems with land contours, preventing increases in runoff velocity, and ensuring stable footings for structures.

6.1.2.5 Special Flood Hazard Area Overlay District

The Special Flood Hazard Area aims to safeguard public safety, minimize flood-related hazards to individuals and property, protect watercourses from encroachment, and uphold floodplains' ability to contain and manage floodwaters. The Town of Narragansett chooses to adhere to the regulations outlined in the National Flood Insurance Act of 1968 to achieve these objectives. The special flood hazard area overlay district encompasses zones prone to recurrent flooding, including floodways and coastal high hazard areas, posing significant risks to the well-being and assets of town residents. The district, established as a floodplain overlay district, comprises areas designated as zone A, AE, AH, AO, A99, V, or VE on the Washington County Flood Insurance Rate Map (FIRM) and Digital FIRM issued by FEMA. Its boundaries are delineated by the 100-year base flood elevations shown on the FIRM and further detailed by the Washington County Flood Insurance Study report. Responsibility for floodplain management falls under the town manager's designee, with relevant documentation incorporated by reference and accessible through town offices.



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6.2 Integration with Existing Plans & Local Processes (Other Planning Mechanisms)

The Town of Narragansett has initiated many studies and activities over the years that have laid the foundation for the development of this mitigation strategy. The following plans not only address hazard mitigation, but they also refer to the 2019 HMP. For example, Comprehensive Plan refers to the HMP 15 times in the Road map and 5 times in the Action Plan. The Harbor Management Plan refers to the HMP 7 times. The other plans also have direct or indirect references to the HMP as well. These plans include:

- **Narragansett Emergency Operations Plan** – Updated in 2021, this plan and its associated HSAs contains interdisciplinary operation plans for all the assets located within the Town (includes all Town-, private-, and state-owned assets). This is an internal document and is used by the Emergency Departments such as Polic, Fire, DPW. The plan addresses both natural and man-made hazards. Some of the examples of hazards that are included in the plan are severe weather, radiological, hazardous materials etc.
- **Facilities Plan for Wastewater Management** – Adopted 2007 RIDEM jurisdiction – essentially a master plan for wastewater services. The plan serves as a capital improvement planning guide and contains list of wastewater infrastructure that are incorporated in the asset inventory.
- **Scarborough WWTF Operation & Maintenance Plan** – Updated in 2018; includes a specific O & M plan for the 2017 Scarborough WWTF Flood Proofing Project. Rehabilitation of the Groin was included as the action plan in 2019 HMP. Since then, substantial improvements have been made and the WWTF has been moved to a low priority action in this plan.
- **Water Supply System Management Plan** – Adopted 2006, updated 2011 – RIDOH and Water Resources Board jurisdiction – also a master plan, however, does include an emergency response section for natural and man-made hazards and threats. The plan contains list of the drinking water infrastructure that are incorporated in the asset inventory.
- **All Hazards Policy** – Adopted 2008, updated January 3, 2023. This is a policy of the Narragansett Police Department. The purpose of the policy is to establish guidelines for members of the Narragansett Police Department regarding rapid and well-coordinated responses to critical incidents such as natural and man-made disasters, civil disturbances, mass arrests, bomb threats, hostage/barricaded person situations, acts of terrorism and other unusual incidents.
- **Non-Emergency Memorandum of Understanding South Kingstown Police Department and North Kingstown Police Department** - Adopted 2004, re-affirmed 2017. Regards provisions for non-emergency mutual aid for the Towns of North and South Kingstown. For the purpose of providing reciprocal police services across jurisdictional lines during and after a natural hazard events.
- **Memorandum of Understanding (MOU) with the State** The Town of Narragansett has a Statewide MOU that covers every municipal police department and several educational institutions such as URI PD. The MOU provides the town additional assistance to recover from a natural disaster. The Town also has a Statewide Public Works MOU.



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- **Emergency Response Plan for the Town of Narragansett** – prepared in-house; essentially a directory of critical resources and contact information, as well as basic response plan action items in the event of a natural disaster; last updated in 2016. This plan is essential for safeguarding lives, protecting property, and ensuring the resilience of the Town in the face of natural disasters. It provides a structured framework for coordinated action, enabling the town to respond promptly and effectively to unforeseen emergencies while minimizing their impact on residents and the community as a whole.
- **Engineering and Public Works Departments Emergency Response Plan**– prepared in-house; essentially a directory of critical resources and contact information, as well as basic response plan action items in the event of a natural disaster – specifically tied to Engineering and DPW functions; last updated in 2016. This plan is in place to ensure the Town's resilience and ability to effectively respond to and recover from natural disasters by providing a coordinated and proactive approach to infrastructure management, emergency repairs, and public safety.
- **Emergency Operations Plan (EOP)** – The Town's Emergency Operations Plan was last updated in 2012. It was prepared in-house in partnership with Rhode Island Emergency Management Agency. The EOP aligns the Town's capabilities, resources, and strategic plan with a coordinated, all-hazards approach to local and regional incident management. The goal of this plan is to save lives and protect the Town and the region's communities by increasing the effectiveness and efficiency of incident management and coordination among Town entities, regional organizations, private sector entities, and state and federal partners, functional annexes, which describe the actions, roles, and responsibilities of participating organizations. The EOP has a Severe Weather and Terrorism Annex. It is currently going through a revision process.
- **Rhode Island Nuclear Safety Center (RINSC) Emergency Response Plan** – The Town has an ongoing response plan with RINSC for the small nuclear reactor at the URI Bay Campus. In case a natural disaster impacts the nuclear center, this plan will play a crucial role in helping the Town's Emergency departments coordinate with the State to ensure effective response measures to protect public safety and mitigate risks.
- **Medical Emergency Distribution System (MEDS) Plan** – The Town's MEDS Plan was last updated in 2018 in-house in partnership with the Rhode Island Department of Health. The plan serves to establish the necessary framework for the effective and efficient mass dispensing of pharmaceuticals or vaccines to the general public in the event of a public health emergency. This plan is essential for helping the Town during natural disasters by ensuring the effective distribution of medical supplies, resources, and services to protect public health and save lives in times of crisis.
- **Harbor Management Plan** – Current plan adopted 2016. The plan is a thorough examination of current uses and as a long-term guide for activities on or adjacent to the tidal waters of Narragansett. This plan identifies vulnerabilities, assess risks, integrates mitigation measures, protect coastal infrastructure, and promote resilient development to address climate change impacts.



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- **Town of Narragansett's Comprehensive Plan** Adopted on September 5, 2017. This plan informs and relate to HMP. The plan presents an opportunity for synthesized planning efforts. Action items found in the plans can and should be aligned with action items identified in the HMP, and vice versa.
- **Southern New England Fire Emergency Response Plan** – A statewide mutual-aid response system established by the Rhode Island Association of Fire Chiefs for the purpose of updating, expanding, and controlling Mutual-Aid in the State of Rhode Island. In the event of wildfire or other emergencies, the participating communities may request fire apparatus, personnel, or other necessary equipment for assistance.
- **Debris Management Plan** - The Plan is a structured document that outlines procedures for the effective management and disposal of debris generated during and after natural or man-made disasters. The plan plays a critical role in hazard mitigation planning by addressing the challenges associated with debris accumulation during and after disasters. By providing guidelines for prevention, emergency response coordination, resource allocation, public safety, and long-term recovery, the plan helps communities mitigate the impacts of debris-related hazards and build resilience to future disasters.
- **RIEMA Statewide Resource Typing Plan** – RIEMA is working with local municipalities to establish a statewide NIMS resource typing plan that supports a common language for the mobilization of resources (equipment, teams, units, and personnel) prior to, during, and after major incidents and natural disasters. Provides users at all levels with access to an easily searchable database of typed definitions to identify resources for planning, and incident operations, including mutual aid coordination.
- **StormReady Designation** – Narragansett Emergency Management Agency (NEMA) has worked collaboratively with RIEMA and the National Weather Service (NWS) in Taunton to obtain the designation – “StormReady.” The program encourages communities to take a new, proactive preparedness approach to improving local hazardous weather operations. StormReady helps the community with the communication and safety skills needed to save lives and property - before, during and after the event by providing emergency managers with clear-cut guidelines on how to improve their hazardous weather operations.
- **Street Tree Maintenance Schedule** – Prepared by the Department of Public Works, describes the type of care needed as well as a timeline for each step in the care process. DPW Staff use this schedule for tracking the care and maintenance of all trees located within the Public Right of Way. This is a proactive approach to hazard mitigation planning, helping communities reduce the risks associated with street trees and promote public safety. By implementing regular maintenance activities and addressing potential hazards in a timely manner, the schedule contributes to the resilience of communities and enhances their ability to withstand and recover from natural disasters and other emergencies.
- **Participation in the Community Rating System** - Narragansett implements and enforces the state building codes and currently participates in the CRS as well as the NFIP. The Town has



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participated in CRS since 1992 and currently has a rating of 7. All taxpayers receive fifteen percent (15%) off of their flood insurance due to the exercises performed under this program. To maintain their rating, the Town implements the following:

- o Maintain flood elevations certificates for properties that are new are or substantially improved in the SFHA,
- o Outreach program where the Town mails pamphlets and correspondence to people in a flood zone area,
- o Documentation that the community continues to preserve open space areas located in the SFHA,
- o Documentation that the community continues to enforce the higher regulatory standards,
- o Credit is provided for keeping the channels and retention basins of a community's drainage system clear of debris in order to maintain its flood carrying and storage capacity.

6.3 Types and Evaluation of Capabilities

6.3.1 Flood Insurance

The initial Flood Insurance Rate Map in the Town of Narragansett became effective on December 7, 1971 (<https://www.fema.gov/cis/RI.pdf>). The current effective FIRM date is April 3, 2020 (<https://www.fema.gov/cis/RI.pdf>). The Flood Insurance Rate Map was last updated for Narragansett on October 16, 2013 and April 3, 2020.

Building in the floodplain is regulated by the Town's Conservation Commission through the Wetlands Protection Act local bylaw. The Board of Health reviews any septic system construction in the flood plain. Monitoring and compliance throughout the construction process may be overseen by Conservation Commission, the Town's engineer, or the building inspector.

The Town of Narragansett currently has 822 active policies in effect with a total coverage of \$7,760,37. The Town has 22 repetitive-loss properties which are located throughout Town.

6.3.2 Shelter Facilities

Narragansett has identified three Red Cross approved emergency mass care facilities throughout the Town. Additionally, we have partnered with our neighbors of North Kingstown and South Kingstown to establish a Multi-Community Shelter Coordination Plan which utilizes the South Kingstown High School as a primary shared shelter site for the three communities. Disasters that affect multiple municipalities have the potential to cause a great need for sheltering. Coordination improves the services available to residents in shelters and increases the capacity to sustain sheltering operations that may last for an extended period of time.



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The American Red Cross (ARC) requires 40 square feet of usable space per person in each mass care facility. According to FEMA, in the event of a natural disaster that requires mass care facilities, twenty percent of an evacuated population will seek public mass care facilities. The mass care facilities are free of flood risk and the total mass care facility capacity is for short term accommodations.

The ARC mass care facilities in Narragansett are:

1. Narragansett High School- Capacity of 500- Primary
245 South Pier Road
Narragansett, RI 02882
2. Pier Middle School- Capacity of 350-Secondary
235 South Pier Road
Narragansett, RI 02882
3. Narragansett Elementary School- Capacity of 200- Overflow
55 South Munford Road
Narragansett, RI 02882
4. South Kingstown High School
215 Columbia Street
Wakefield, RI 02879

Narragansett looks for opportunities to improve other essential services and critical facilities. In addition to the three schools, critical facilities include the Town Hall, Department of Public Works garage, Fire Station #2 and Fire Station #3, the Scarborough Wastewater Treatment Facility, and the Regional Wastewater Treatment Facility. Many of these are the basic “centers of government activity” that host critical response efforts during and after disaster events.

6.3.3 Emergency Preparedness

The Town has a number of Emergency Preparedness measures in place including an automated mass emergency alert notification system – Code RED that was implemented in 2016. The Fire Department offers outreach programs, such as CPR/AED training and the Fire Marshal will visit the schools when requested. The Fire Department also hosts open houses to encourage participation from the general public and participates in the Boy Scouts of America – Learning for Life Program.



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7 MITIGATION ACTIONS

7.1 Overview of Mitigation Actions

The mitigation actions are one of the most important components of the Hazard Mitigation Plan. They serve as the blueprint for reducing the potential losses identified in the risk and vulnerability assessment. They can be a measure, project, plan, or activity proposed to achieve the Town's mission and goals and reduce current and future vulnerabilities described in the vulnerability assessment (Chapter 5).

There are many different types of hazard mitigation actions that generally fall into the following four categories (FEMA, Local Mitigation Planning Handbook, 2023):



Local Plans and Regulations: These actions include government authorities, policies or codes that influence the way land and buildings are developed and built.



Structure and Infrastructure Projects: These actions involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. This could apply to public or private structures as well as critical facilities and infrastructure.



Natural Systems Protection and Nature-based Solutions: This type of action can include green infrastructure and low-impact development, nature-based solutions, engineering with nature, and bioengineering to incorporate natural features or processes into the built environment.



Education and Awareness Programs: These types of actions keep residents informed about potential natural disasters. Many of these types of actions are eligible for funding through the FEMA Hazard Mitigation Assistance program.

Through the stakeholder and community engagement process discussed in Chapter 2, mitigation actions and an action plan for implementation were developed to help achieve the mitigation goals. This provides a framework to prioritize and implement actions to reduce risks from hazards. Chapter 7 outlines mitigation actions for Narragansett for the next five years.



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7.2 Mitigation Action and Adaptation Strategy for 2024-2029

This section discusses actions in the Town's HMPs and how these actions were identified as critical to the mitigation strategy. The status of the 2019 action items is attached in Appendix E.

7.2.1 Goals

1. The goals were restructured to better represent the current hazard mitigation efforts in Narragansett, create consistency with other climate resilience planning processes, and provide simplified messaging to the public.
2. Protecting the health, safety and general welfare of the Town's residents and visitors.
3. Implementing hazard mitigation actions in order to protect Narragansett's cultural, historical, structural, economic, and natural environment. Actions will include:
4. Protecting Narragansett's critical infrastructure.
5. Continuing to manage the development in hazard-prone areas to reduce economic loss.
6. Continuing to reduce flood losses through compliance with NFIP requirements.
7. Promoting educational opportunities to introduce residents and visitors to the risks of natural hazards and the various appropriate mitigation strategies that can be taken. Promotion of educational opportunities will include:
8. Continuing and expanding outreach efforts through various communication methods.
9. Continuing to work with residents on mitigation strategies.
10. Identify and seek funding for measures to mitigate or eliminate each known significant flood hazard area.
11. Integrate hazard mitigation planning as an integral factor in all relevant municipal departments, committees, and boards.
12. Encourage the business community, major institutions, and non-profits to work with the Town to develop, review and implement the HMP.
13. Work with surrounding communities, state, regional and federal agencies to ensure regional cooperation and solutions for hazards affecting multiple communities.
14. Ensure that future development meets federal, state, and local standards for preventing and reducing the impacts of natural hazards.
15. Take maximum advantage of resources from FEMA and RIEMA to educate Town staff and the public about hazard mitigation.
16. Consider the impacts of climate change and incorporate climate sustainability, mitigation, and resiliency into hazard mitigation and other Town plans and policies.

7.2.2 Methodology for Analysis and Prioritization of Actions

Municipal officials in Narragansett 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 (educational programs, preventing construction in high-hazard areas, enforcing regulations) to minimize the effect of future



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hazards. By creating this strategy and incorporating it into the Town’s comprehensive plan and the site plan review process, Narragansett has established an ongoing process that will continue to make hazard mitigation a routine part of municipal government.

The Town’s Comprehensive Community Plan update process provides an important mechanism for advancing hazard mitigation actions. It includes following policy statements:

- Monitor the implementation of the Narragansett Hazard Mitigation Plan (NH1.1).
- Protect critical public infrastructure that could be impacted by climate change, sea level rise and other natural hazards (NH1.2).
- Minimize the risks to public and private property from climate change, sea level rise, and other natural hazards (NH1.3).

In completing the risk and vulnerability analysis, the LHMC considered projects and actions that would reduce Narragansett’s vulnerability to the identified hazards. The Town conducted a survey of residents in December 2023 (see Appendix B for survey results) to help inform its understanding of risks and vulnerability with direct observations. The Risk Assessment Matrix is the basis for the mitigation actions. The LHMC considered the goals of this plan and prioritized the matrix and the associated actions based on historical damage, safety of the population, property protection, and consistency with Townwide goals and objectives. Objectives were aligned to public health risks, evacuation and mass care considerations, disruption of essential services, and potential economic losses to Narragansett.

Officials also considered the re-prioritization of actions based on the past progress of the 2019 plan. Mitigation actions in the previous planning cycle for the prior FEMA approved hazard mitigation plan are either completed, were modified to be included in the 2024 mitigation actions or have been removed. The vulnerabilities listed in the Risk Assessment Matrix are addressed in new hazard mitigation actions presented below.

Once the mitigation actions were identified, the LHMC members used FEMA’s recommended criteria, STAPLEE (which considers social, technical, administrative, political, legal, economic, and environmental constraints and benefits) to complete a cost.

Table 7.1 – STAPLEE Review and Selection Criteria

S	Social	Does the measure treat people fairly? Does it adversely affect one segment of the population? Will it cause Social Disruption?
T	Technical	Will it work? Does it create more problems than it solves? Is it the most useful action in light of the goals?
A	Administrative	Is there capacity to implement and manage the project? (staff, technical experts, funding) Is there an ongoing administrative requirement that will be required (who will maintain)?



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Table 7.1 – STAPLEE Review and Selection Criteria

P	Political	Is there political support to implement and maintain the action? Who are the stakeholders? Did they get to participate? Is there public support to implement and maintain the action?
L	Legal	Does your organization have the authority to implement? Is there a clear and legal basis or precedent for the activity? Are there liability implications and/or legal consequences?
E	Economic	Is it cost-beneficial? Is there funding? Does it contribute to the local economy or economic development? Does it reduce direct property losses or indirect economic losses?
E	Environmental	Does it comply with environmental regulations or have adverse environmental impacts?

The STAPLEE Benefit-Cost Review was used to prioritize the planning recommendations and mitigation actions. Each planning recommendation and mitigation action was scored against each of the STAPLEE criteria outlined above with a numerical score. These numbers were then totaled and developed into an overall priority score. The ranking of the Priority Score is a guideline for what order the Town should begin addressing the identified actions.

In accordance with the DMA requirements, an emphasis was placed on the importance of a benefit-cost analysis in determining project priority (the 'economic' factor of STAPLEE/E). Other criteria used to recommend what actions might be more important, more effective, or more likely to be implemented than another included:

- Does action protect lives?
- Does action address hazards or areas with the highest risk?
- Does action protect critical facilities, infrastructure, or community assets?
- Does action meet multiple objectives (Multiple Objective Management)?

The LHMC used a cost-benefit review in the prioritization process to maximize benefits. The LHMC prioritized the vulnerable areas in order of vulnerability which indicated that more damage could be sustained to these areas thus more costs could be incurred by the Town in damages and repairs. The mitigation actions identified would maximize the use of funding and reduce loss of people and property. This prioritization also included the mitigation actions that incorporated the NFIP. They are listed in order of priority within the Vulnerable Areas. The STAPLEE Prioritization for Narragansett, below, lists 2024 Action Item Numbers, the corresponding 2019 Action Item Numbers, Action Names, STAPLEE Scoring, and Priority (i.e., resulting from the scoring).

- Low 7-12
- Medium 13-15
- High 16-21



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Table 7.2 – STAPLEE Prioritization for Narragansett

2024 Action Item Numbers	2019 Action Item Numbers	Name of Action Items	STAPLEE Scoring								Priority	
			Social	Technical	Administrative	Political	Legal	Economic	Environmental	Total		
Critical Roads/Evacuation Routes												
1A	1*	Evacuation	1	1	1	1	1	1	1	1	7	Low
1B	1	Sheltering	1	1	1	1	1	1	1	1	7	Low
Shoreline Features												
2	2	Beach and Dune Replenishment	3	3	2	3	3	3	3	3	20	High
Water & Wastewater Infrastructure												
3	3	Bypass Sewer Main	3	3	3	3	3	3	3	3	21	High
4	4	Water Supply	2	2	2	2	1	2	3	3	14	Medium
5	5	Flood proof Pump Stations	1	1	2	2	2	2	2	2	12	Medium
6	6	Retrofit Sewer Pump Stations	3	3	3	2	3	3	3	3	20	High
7	7	Scarborough WWTF Groin Rehab	1	1	1	1	1	1	1	1	7	Low
Public/Town-owned Assets												
8A	8*	Underground Utilities	3	2	1	1	2	2	3	3	14	Medium
8B	8	Fire Alarm Communications	3	2	1	1	2	2	3	3	14	Medium
9	9	Town Tree Program	2	3	2	1	1	2	3	3	14	Medium
10	10	Tree Educational Program	1	1	1	1	1	1	1	2	8	Low
Causeways												
11	11	Causeways	3	2	2	2	3	2	3	3	17	High
Residential Areas												
12	12	Public Information, Outreach, and Incentive Program	3	2	1	1	2	3	3	3	15	Medium
13	13	Property Acquisition	1	2	2	1	2	3	3	3	14	Medium
14	14	Retrofit and Elevate, Relocate	1	2	2	1	2	3	3	3	14	Medium
15	15	Policy for Rebuilding	3	1	1	3	1	1	3	3	13	Medium
Natural Resources/Recreation Areas/Public Areas												
16	16	Open Space Acquisitions	3	1	2	1	2	3	3	3	15	Medium
Historic Structures/Signage												
17	17	Historic Flooding Signage Townwide	2	1	2	1	1	1	1	1	9	Low
18	18	Historic Flooding Informational Display for Town Hall	2	1	2	1	1	1	1	1	9	Low
Storm Water Assets												
19	19	Storm Water Projects	3	2	1	1	1	2	3	3	13	Medium

*Actions that are updated in the 2024 actions

The LHMC determined that the identified objectives could be met by considering actions aligned to the following:

- Planning and Regulations



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- Property Protection (including acquisition and elevation), Structural Projects, Maintenance, and Repair
- Public Information and Outreach, Incentive Programs
- Protection of Essential Services (including critical facilities)
- Post Disaster Opportunities

This committee has worked to set goals and objectives that are bound by a time frame and are compatible and consistent with state hazard mitigation goals. Upon submittal of this plan to RIEMA, the State Hazard Mitigation Committee (SHMC) is expected to review and approve these goals and objectives to ensure consistency with statewide goals and objectives. The time frames used for these strategies are as follows:

- Short Term = 0 to 6 Months
- Medium Term = 6 to 18 Months
- Long Term = 18 Months to 5 Years

7.3 Action Plan and Status Report of 2018 Actions

The actions are organized by type of action:

- Critical roads/evacuation routes
- Shoreline features
- Water and wastewater infrastructure
- Public/Town-owned assets
- Causeways
- Residential areas
- Natural resource/recreation areas/public areas
- Historic structures
- Stormwater assets

Generally, each action item is provided with the following information:

- Action item description
- Priority score
- Action item lead
- Supporting implementation parties
- Timeframe for completion
- Financing options
- Cost estimate
- Description of the action item benefit

7.3.1 Critical Roads/Evacuation Routes

Action 1A



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Evacuation

Evacuation routes have been established and are properly signed throughout Town. Maintenance of current evacuation routes and signage. Enhancement and promotion of evacuation zones to the public through additional “Know Your Zone” signage and online residential informational tools.

Hazard Addressed: Flood (inland, groundwater induced, and sea level rise induced), hurricane, earthquake, winter storm

Priority Score: Low

Action Type: Emergency Services

Lead: Fire Chief (local EMA director)

Supporting: Police Department, Public Works, RIEMA, and American Red Cross

Time frame: As needed

Financing Options: Town budget

Cost Estimate: Low

Benefit: Protection of life and property

2024 UPDATE: Evacuation Routes - The Town of Narragansett EMA conducted a comprehensive field investigation of the Hurricane Evacuation Sign/Route Assessment on July 12, 2021, at the request of the RIEMA Executive Director. The report was forwarded to RIEMA in August of 2021. Recommendations on additional signage and relocation or repositioning of signage were included in the report. Photos were taken of each individual location. Damaged or missing signage was fixed and/or replaced by our DPW Sign Division. Action to be completed – Follow up on suggested recommendations. Promote Know Your Zone, Know Your Home to the public through access to an interactive online residential informational tool via town website. Install additional color-coded signs with QR Codes that correspond to the geographical zone. 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.

Action 1B

Sheltering

The Town will continue to use existing tools to ensure timely emergency evacuation notices and efficient management of shelter resources.

Hazard Addressed: Flood (inland, groundwater induced, and sea level rise induced), storms (hurricane, tropical storms, tornadoes, winter storms), earthquake

Priority Score: Low

Action Type: Emergency Services

Lead: Fire Chief (local EMA director)

Supporting: Police Department, Public Works, RIEMA, and American Red Cross



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Time frame: As needed
Financing Options: Town budget
Cost Estimate: Low
Benefit: Protection of life and property

2024 UPDATE: Sheltering – The Town of Narragansett EMA has worked collectively with our partners of North Kingstown, South Kingstown, and the RI American Red Cross to update our existing Locally Initiated Multi-Community Sheltering (LIMS) agreement. The agreement consolidates the resources from multiple communities, providing full dietary, dormitory, and/or other FNSS required of congregate shelters. The designated primary shelter site is the Broad Rock Middle School located at 351 Broad Rock Road, Wakefield. In 2023 Narragansett EMA completed an update to the LIMS plan agreement. The revised agreement outlines the operational concepts, and clarifies the responsibilities, procedures, and organizational arrangements necessary to support participating municipalities sheltering during multi-community shelter activations. Narragansett Town Council approved/adopted the plan updates November 6, 2023. An introductory training workshop was conducted at the shelter site in coordination with the RI Red Cross on November 18, 2023. Municipal partners are planning functional exercises for 2024, update MOUs with vendors to support shelter and develop a Pet Sheltering Annex within the plan.

7.3.2 Shoreline Features

Action 2

Beach and Dune Replenishment

The Parks & Recreation and Engineering Departments are working with the University of Rhode Island to update the Beach Profile. The Town will use dredged material from an accepted source or will purchase sand to enhance the dune system and/or re-nourish the Town Beach. Along Colonel John Gardener Road at Little Beach, the existing roadway is routinely flooded and periodically damaged from storm surge and flooding. The Town will look for funding to repair the roadway along this beach area that serves to protect the nearby properties and reinforce the beach area.

Hazard Addressed: Coastal erosion, sea level rise induced flooding, landslides
Priority Score: High
Action Type: Natural Resource Protection and Property Protection
Lead: Engineering Department
Supporting: Parks & Recreation, Public Works, Community Development
Time Frame: Long term, or after major storms.
Financing Options: Beach Fund, Federal and State Hazard Mitigation assistance as available.
Cost Estimate: High.
Benefit: Protection of beach assets by dunes, protection of Boston Neck Road (State) by dunes, prolonged life of beach (important revenue driver for the Town). Woods Hole Group 2011 Report



NARRAGANSETT HAZARD MITIGATION PLAN 2024

will be used as the basis for the implementation of this project. Protection of infrastructure and residential properties.

2022 UPDATE: The Town awarded a contract for engineering services in August 2022, related to design and permitting proposed dredging at the Narrow River for Town Beach nourishment and project work commenced in October 2022. Final design and permitting schedule remain to be determined.

2024 UPDATE: *Dredging alternatives development has been completed. River sediment sampling was conducted in October 2023. Final design and permitting schedule remain to be determined pending consideration and selection of dredging alternative and results of sediment sample analysis.*

7.3.3 Water and Wastewater Infrastructure

Action 3

Bypass Sewer Main

Block (sandbags or air-inflated plugs placed in manholes) and then re-route sewage flow in damaged areas by use of trailer-mounted pumps and portable hoses. Scope is storm and damage dependent. The Town Engineer will develop a procedure for bypassing sewer mains where roads are compromised.

Hazard Addressed: Flood (inland, groundwater induced, sea level rise induced), storms (hurricane, tropical storms, tornadoes, winter storms), landslides

Priority Score: High

Action Type: Emergency Services

Lead: Engineering Department

Supporting: Wastewater Division

Timeframe: Long term, or after major storms.

Financing Options: Wastewater Enterprise Fund

Cost Estimate: Medium

Benefit: Protection of Life and Property

Action 4

Water Supply

Suspend water lines underneath the bridge and place hydrants on either side of the bridge (Middlebridge) where appropriate so that a suction hose can be floated between hydrants. The water line improvements to Great Island are complete because the Town installed the under-channel line. The water line under Middlebridge is owned by Veolia Water and the Town does not have any authority to complete this action item; however, it is a PUC regulated authority. The Town will work with Veolia to complete this task. The Town is developing a Standard Operating Procedure (SOP) for isolating critical water mains in coastal areas (areas prone to road washouts).



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Hazard Addressed: Flood (inland, groundwater induced, sea level rise induced), drought
Priority Score: Medium
Action Type: Emergency Services
Lead: Engineering Department, Police Department
Supporting: EMA Director, RI DOT, RIEMA
Timeframe: Medium-term
Financing Options: Town Budget, FEMA Grants
Cost Estimate: Medium
Benefit: Protection of Life and Property

Action 5

Floodproofing Pump Stations

A gravity sewer bypass has been installed for the Congdon Street pump. Staff have identified all potential flood water penetration points on the Galilee, Stanton Ave., Mettatuxet, and Allagash Trail Pump Station structures, and have surveyed each such point. During 2019, we anticipate issuing a construction contract to address each vulnerable penetration point. Flood proof sanitary sewer pump stations giving highest priority Bonnet Shores (Allagash).

Hazard Addressed: Flood (inland, groundwater induced, sea level rise induced)
Priority Score: Medium
Action Type: Property Protection
Lead: Engineering Department
Supporting: None
Timeframe: Long-term
Financing Options: Town Budget and FEMA Flood Mitigation Assistance Program
Cost Estimate: Medium
Benefit: Protection of Life and Property

2021 UPDATE: The Department will be accepting bids for the work in 2022.

2022 UPDATE: Scarborough WWTF manhole reinforcing project is under construction and scheduled to be completed by end of calendar year.

2024 UPDATE: *Manhole reinforcing project was substantially completed December 2022, final restoration was completed May 2023.*

Action 6

Retrofit Sewer Pumping Stations

Narragansett will consider retrofitting any sewage pumping stations that have been problematic during storms.



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Hazard Addressed: Flood (inland, groundwater induced, sea level rise induced), storms (hurricane, tropical storms, tornadoes, winter storms)

Priority Score: High

Action Type: Emergency Services

Lead: Engineering Department

Supporting: None

Timeframe: Medium-term

Financing Options: Town Budget and FEMA Flood Mitigation Grants

Cost Estimate: High

Benefit: Protection of Life and Property

Action 7

Scarborough WWTF Groin Rehabilitation

The Town has made substantial improvements to the existing riprap groin located southeast of the Scarborough WWTF. The groin serves a dual purpose; first, it helps to protect the existing plant outfall pipe in the shallow surf zone, and second it helps to protect the beach in front of the WWTF by reducing the rate of sediment transport (beach stabilization).

Hazard Addressed: Flood (inland, groundwater induced, sea level rise induced), coastal erosion, landslide

Priority Score: Low

Action Type: Structural Projects

Lead: Engineering Department

Supporting: None

Timeframe: Medium to Long term, dependent on funding.

Financing Options: Federal and State Hazard Mitigation assistance as available.

Cost Estimate: High.

Benefit: Property Protection, Structural Projects, and Maintenance – Scarborough WWTF Asset Protection.

2021 UPDATE: The Town was awarded the grant; however, it has not yet been accepted. It will go before Town Council on January 3, 2022, for acceptance.

2022 UPDATE: The Town had a revised construction cost estimate prepared for the project in February 2022. The Town authorized funding based upon the revised cost estimate and accepted the grant in July 2022. Final grant agreement and SRF loan financing application are in progress so that the project may proceed to bidding.



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2024 UPDATE: The Town Council awarded the bid for construction on April 4, 2023, and issued the Notice to Proceed to the contractor on May 24, 2023. The contractor has substantially completed the contract as of December 31, 2023. Final restoration deferred to spring 2024 planting season.

7.3.4 Public/Town-Owned Assets

Action 8A

Underground Utilities

The Town would like to study and implement a project to bury electrical wires and other suspended communication cables. The Town would like to take the above ground utilities and place them underground. This action is under consideration.

Hazard Addressed: Storms (hurricane, tropical storms, tornadoes, winter storm), wildfire, earthquake.

Priority Score: Medium

Action Type: Structural Projects

Lead: Engineering Department with assistance from National Grid

Supporting: Fire Department

Timeframe: Long Term or following a major storm

Financing Options: Federal or State Hazard Mitigation Assistance, FEMA Public Assistance, Town Capital Improvement Project planning, Utility Company funds

Cost Estimate: High

Benefit: This will help to ensure continuation of emergency notification and property protection by eliminating the more susceptible and costly cable system. This is not a project that is financially feasible at this time; however, it is a long-term goal especially if federal 60 funding becomes available to implement the project. This would eliminate property damage and protect life safety from downed utility lines, fire alarm cables, and protect from lightning storms. This would also reduce the impact from a tornado or earthquake. The Town would prioritize areas that are more susceptible to damage during a storm such as Route 1A Boston Neck Road and Ocean Road.

Action 8B

Fire Alarm Communications Upgrade

The overhead fire alarm cable and equipment which connects emergency notification services to our municipal fire alarm system will be converted to newer technology using radio signaling fire alarm boxes.

Hazard Addressed: Wildfire

Priority Score: Medium

Action Type: Structural Projects

Lead: Engineering Department, National Grid



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Supporting: Fire Department

Timeframe: Long Term or following a major storm

Financing Options: Federal or State Hazard Mitigation Assistance, FEMA Public Assistance, Town Capital Improvement Project planning, Utility Company funds

Cost Estimate: High

Benefit: The fire alarm cable and equipment which connects and services our municipal fire alarm system will be converted to newer technology which uses radio master boxes capable of delivering addressable device specific data to the central fire alarm receiving facility. This will eliminate the higher maintenance and labor costs associated with the current overhead copper cable system and provide both pre/post-alarm notification information for responding emergency personnel such as the specific type of device activated and location within the building.

2022 UPDATE: Phase 2 was implemented with the conversion of the remaining 148 private and/or publicly owned buildings or facilities containing a mandatory forced notification system.

2024 UPDATE: *The Town's overhead fire alarm cable and equipment which connects and services our municipal fire alarm system is undergoing conversion to newer technology using wireless radio signaling devices. This 5-year CIP project began September 2019 with Phase 1 - Upgrades to the Fire Department's receiving center located within the public safety building and conversion of 17 town buildings or facilities to new wireless radio fire alarm signaling devices. Subsequent phases will require the remaining 145 private and/or publicly owned buildings or facilities which contain a mandatory forced notification system or "Master Box" device to convert over a 5-year period at their cost. The essential upgrades to the receiving center within the public safety building were complete. All 17 required Town buildings have been converted to the new wireless radio fire alarm signaling devices and are operational. The Town's Fire Prevention & Protection ordinances have updated/revised and adopted by Town Council requiring the remaining private and/or publicly owned buildings or facilities which contain a mandatory forced notification systems or "Master Box" device to convert by January 1, 2025, at their cost. As of January 2024 - (43) of the 148 boxes have been converted. URI Bay Campus is expected to convert by Summer 2024. The Fire Marshal continues to contact property owners effected by ordinance with informational notices and reminders.*

Action 9

Town Tree Program

The Town of Narragansett will continue to work with utility companies to develop a program for regular tree trimming and coordinate internally to plant shade trees. Shade trees will help with urban heat island mitigation. The Town issues permit to the utility companies and property owners to trim trees in public right of ways. The Town's goal is to formalize a written standard operating procedure on tree trimming with the utility companies and trimming and planting with the property owners with assistance from the local tree board. Plan is still ongoing in development.



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Hazard Addressed: Storms (hurricane, tropical storms, tornadoes, winter storms), extreme heat
Priority Score: Medium
Action Type: Emergency Services
Lead: Public Works Department
Supporting: RI DOT, RIDEM and local utility companies, the Tree Board and Community Development
Timeframe: Medium-term
Financing Options: Town Budget and Donations from local utility companies
Cost Estimate: Low
Benefit: Protection of Life and Property

Action 10

Tree Educational Program

The Town of Narragansett will create a brochure for the public to use for referral to local ordinances as well as proper care and maintenance of trees on private parcels. This Brochure will dovetail with the "Town of Narragansett Urban Forestry Management Plan", which will include a program offered through the Town whereby the Town will supply and plant trees on private property that will be cared for and maintained by the property owner.

Hazard Addressed: Extreme heat, landslides
Priority Score: Low
Action Type: Public Education and Awareness
Lead: Public Works Department
Supporting: RI DOT, RI DEM, the Tree Board and Community Development
Timeframe: Medium-term
Financing Options: Town Budget and Donations for trees/supplies
Cost Estimate: Low
Benefit: Educational, Protection of Life and Property

7.3.5 Causeways

Action 11

Causeways

Keep causeways well maintained. Continue to seek funding through either FEMA grants, other grant opportunities or as part of another improvement project, causeways should be considered for elevation with culverts, or removed for bridges. Causeways include Bonnet Causeway, Harbour Island, Wood Hill, Marine Drive, Frank Neck Road, and Basin Road. The LHMC should consider this Action when funds are available in the future.



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Hazard Addressed: Sea Level Rise induced flooding, coastal erosion, storms (hurricane, tropical storms, tornadoes, winter storms), landslides

Priority Score: High

Action Type: Structural Projects: Natural Resource Protection

Lead: Planning Department, Engineering

Supporting: Public Works Department, CRMC/ RI DEM and local utility companies, Non-Profits

Timeframe: Long-term

Financing Options: FEMA, RIDOT, MRP, SNEP

Cost Estimate: High

Benefit: Protection of Life and Property as well as water quality and wetland preservation.

7.3.6 Residential Areas

Action 12

Public Information, Outreach, and Incentive Program

The Town will continue to educate the contractors and homeowners on the risks of living in hazard-prone areas and will strengthen and expand the appropriate development standards for the overlay districts. Property preservation should be encouraged through structural elevation techniques and retrofitting for wind damage. Narragansett will provide information to contractors and homeowners on risks of building in hazard-prone areas.

Additionally, homeowners and contractors should be educated on appropriate methods to reduce damage, make buildings more energy efficient, appropriate water usage to reduce drought impacts. The Town will implement targeted outreach campaigns to raise awareness about extreme heat and drought risks. These efforts will educate residents on appropriate actions and safety measures to take during periods of extreme heat. The goal is to enhance community preparedness and resilience in the face of these climate-related challenges. The Town should use FEMA publications or develop a town-specific list of appropriate techniques for homeowner self-inspection and suggest subsequent implementation of mitigation activities.

Hazard Addressed: Sea Level Rise induced flooding, coastal erosion, storms (hurricane, tropical storms, tornadoes, winter storms), landslides, extreme heat, drought

Priority Score: High

Action Type: Education and Awareness

Lead: Building Inspections/Zoning

Supporting: Community Development, Fire Chief (local EMA Director), Tree Board, and Institute for Business and Home Safety

Timeframe: Medium-term



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Financing Options: Town Budget
Cost Estimate: Low
Benefit: Protection of Life and Property

ONGOING: Every year the Town updates and distributes a brochure on Flood Zone hazards and safety measures. This brochure is distributed to all properties within the Special Flood Hazard Areas.

Action 13

Property Acquisition

The Town will work to acquire repetitive loss structures. The Town currently has approximately 23 repetitive loss properties.

Hazard Addressed: Flood (inland, groundwater induced, sea level rise induced), coastal erosion
Priority Score: Medium
Action Type: Property Protection
Lead: Building Official
Supporting: Town Planner
Timeframe: Long-term
Financing Options: FEMA grants, land acquisition bonds (state and municipal), land bank, and RI DEM
Cost Estimate: High
Benefit: Protection of Life and Property

Action 14

Retrofit and Elevate, Relocate

The Town has stricter policies within the flood zone by enforcing the State Code and the Local Floodplain Overlay Ordinance that has been in place since 1987. In the floodplain, elevate structures to the 100-year base flood elevation. Encourage maximum setbacks and/or relocation. While retrofitting for flood, light structural and non-structural projects can easily be done at the same time that could help protect a home from extreme heat, wind, and earthquake shaking, providing a greater benefit at a lower cost. FEMA manuals are available on construction practices for non-residential structures.

Hazard Addressed: Flood (inland, groundwater induced, sea level rise induced), storms (hurricane, tropical storms, tornadoes, winter storms), earthquake, extreme heat
Priority Score: Medium
Action Type: Prevention
Lead: Building Official
Supporting: Town Planner, Town Engineer
Timeframe: Long-term



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Financing Options: FEMA grants
Cost Estimate: High
Benefit: Protection of Life and Property

Action 15

Policy for Rebuilding

Continue to enforce FEMA regulations for Point Judith Pond shoreline regarding rebuilding following substantial damage. All new structures will be elevated to FEMA regulations and retrofitted to withstand future damages. This is part of the ongoing policy and standard practice for the Building Official by enforcing the State Building Code. The Town has an inordinate number of demolitions and rebuilds and whenever someone rebuilds, they must comply with all FEMA regulations. The LHMC feels this is still extremely important to keep within the plan, but it will virtually never be completed.

Hazard Addressed: Multi-hazard (Flood, Heat, Storm, Earthquake)
Priority Score: Medium
Action Type: Prevention
Lead: Building Official
Supporting: State Floodplain Manager, RIEMA and State Building Commission
Timeframe: Dependent on Storm Activity
Financing Options: Town Budget
Cost Estimate: Low
Benefit: Protection of Life and Property

7.3.7 Natural Resources/Recreation Areas/Public Areas

Action 16

Open Space Acquisitions

One of the best ways to prevent flood damage is to keep flood-prone areas undeveloped. The town will try to acquire open space in flood zones through the Land Conservancy Trust, the Bonnet Shores Land Trust, or Narrow River Land Trust. Special consideration should be given to erosion-prone areas or floodplains where there is a possibility of obtaining a bigger block of land (several adjoining lots) in the flood zone rather than a few separate smaller parcels. The Land Conservancy Trust (point of contact will be the Community Development Director) will pursue land for acquisition in flood-prone areas that would provide public access to coastal waters or that have experienced recurring flood damage. The open space acquisition will also reduce the impervious surface areas aiding to extreme heat, drought, and flood mitigation.

Hazard Addressed: Flood (inland, groundwater induced, sea level rise induced), extreme heat, drought, landslides



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Priority Score: Medium

Action Type: Natural Resource Protection

Lead: Land Conservancy Trust (Planning Department)

Supporting: Town Planner, Town Council, FEMA and RIEMA

Timeframe: Long-term

Financing Options: FEMA grants, land acquisition bonds (state and municipal), land bank, and RI DEM

Cost Estimate: High

Benefit: Protection of Life and Property

7.3.8 Historic Structures

Action 17

Historic Flooding Signage Town-wide

Use informational signs at areas of historic flooding showing the 1938 surge elevations along Ocean Road. These signs could be as simple as a painted blue ring around a telephone pole or a plaque indicating where floodwaters have reached. It is especially important to include inland areas where the risk is not as obvious.

Hazard Addressed: Flood (inland, groundwater induced, sea level rise induced), Storms (hurricane, tropical storms, tornadoes, winter storm)

Priority Score: Low

Action Type: Education and Awareness

Lead: Public Works Department

Supporting: RIEMA, Town Planner and the National Weather Service

Timeframe: Medium-term

Financing Options: FEMA grants, land acquisition bonds (state and municipal), land bank, and RI DEM

Cost Estimate: Low

Benefit: Protection of Life and Property

Action 18

Historic Flooding Informational Display in Town Hall

Create an interpretive display with photos and maps of prior flood damage. This display will be located in the Town Hall.

Hazard Addressed: Flood (inland, groundwater induced, sea level rise induced), Storms (hurricane, tropical storms, tornadoes, winter storm)

Priority Score: Low



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Action Type: Education and Awareness
Lead: Planning Department
Supporting: Historic District Commission
Timeframe: Medium-term
Financing Options: Town Budget
Cost Estimate: Low
Benefit: Protection of Life and Property

7.3.9 Stormwater Assets

Action 19

Stormwater Projects Critical storm water assets are slowly being threatened by sea level rise. The Town needs to take steps to retrofit these assets to prevent major damage and/or loss. The storm water assets are Stanton Ave. Outfall, Mettatuxet BMP, Petta. Terrace Level Spreader, Circuit Dr. BMP Ponds.

Hazard Addressed: Flood (inland, groundwater induced, sea level rise induced), Storms (hurricane, tropical storms, tornadoes, winter storm)
Priority Score: Medium
Action Type: Structural Projects
Lead: Public Works
Supporting: Engineering Department
Timeframe: Low – Medium
Financing Options: Town Funding, Grants
Cost Estimate: High
Benefit: Environmental protection of waterways

2021 UPDATE: The Indian Trail grant was awarded but not accepted because COVID prohibited the ability to provide matching funds.

2022 UPDATE: Neither the FEMA Pre-Disaster Mitigation funding, nor the Indian Trail Stormwater BMP grant application was awarded.



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8 PLAN MAINTENANCE

Hazard Mitigation Plans are intended to serve as living documents. In order to be impactful, they must be regularly updated to reflect the current state of hazards, vulnerabilities, goals, strategies, and public sentiment. The three main components of plan maintenance are: *monitoring*, *evaluating*, and *updating* the plan. This section discusses the Town's proposed approach to evaluating, maintaining and updating the HMP during the five-year term of the plan to make certain that it stays effective.

The LHMC realizes that successful hazard mitigation is an ongoing process that requires implementation, evaluation, and updated revisions to this plan. Also realized is the importance of integrating appropriate sections of the plan into the Town's Comprehensive Plan, Emergency Operations Plan, and site plan review process. It is intended that this plan and the ongoing efforts of the LHMC will preserve and enhance the quality of life, property, and resources for the Town of Narragansett.

Included in this chapter is a multi-pronged strategy to keep the Hazard Mitigation Plan as effective as possible at all times. Monitoring, evaluating, and updating the plan will be intertwined with public engagement, integration with other local, regional, and state planning mechanisms, and plan implementation. These processes will all run on an ongoing basis with the expectation there is coordination and collaboration between monitoring, evaluating, and updating the plan.

The Town Manager, will take ownership of monitoring, evaluating, and updating the plan. The Town Manager will:

- Track the progress of the HMP Mitigation Actions (see Section 8.1);
- Reconvene the LHMC annually to monitor, evaluate, update, and integrate the plan (see Section 8.1, 8.2, 8.3, and 8.4);
- Share HMP progress with the public, at least once a year (see Section 8.5);
- Make all monitoring information publicly available (see Section 8.1);
- Notify the public when new information has been posted or updated (see Section 8.5; and
- Provide the public opportunities to give input on this information (see Section 8.5).

8.1 Monitoring the Plan

According to FEMA, monitoring means tracking the implementation of the HMP over time.

Who: The Town Manager will take ownership of monitoring the plan.

How: The Town Manager will monitor the status of mitigation actions (Chapter 7) through an internal tracking system using Excel. This should be made publicly available.



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When: Monitoring will take place on an ongoing basis with annual meetings to formally update the status of Mitigation Actions. In advance of this meeting, the Town Manager will send out notices to LHMC that will include a shared document where all Committee members can collaborate to review status of mitigation actions and identify any new mitigation actions that may be under consideration or in progress as part of ongoing Town efforts.

8.2 Evaluating the Plan

According to FEMA, evaluating means assessing the effectiveness of the plan at achieving its stated purpose and goals.

Who and When: LHMC will meet annually to evaluate the effectiveness of the plan. LHMC may also be called to meet after a major event or storm to evaluate the effectiveness of the plan.

How: LHMC will:

- Review the 2023 HMP Goals; and
- Discuss how mitigation actions are or are not meeting 2023 HMP Goals and where improvements or adjustments may be needed (e.g., re-prioritization of projects, integrating with other planning processes more effectively, adding new data to climate projections, etc.

8.3 Updating the Plan

8.3.1 Plan Updates to Maintain FEMA Funding Eligibility

According to FEMA, updating means reviewing and revising the HMP at least once every five years.

Hazard Mitigation Plans expire five years from the date approved by FEMA. To maintain eligibility for certain types of non-emergency disaster assistance from FEMA, an entity such as the Town of Narragansett must have an approved active Hazard Mitigation Plan.

Hazard Mitigation Plans should be reviewed and updated at least every five years. The Town Manager will initiate the process to complete a comprehensive update to the HMP. As a best practice, the comprehensive update should be initiated approximately 18 months prior to this HMP's expiration. This process generally includes:

- Re-engaging the LHMC;
- Considering expansion of the LHMC;
- Confirming FEMA's and RIEMA's most recent requirements and guidance;
- Gathering updated information and relevant documents;
- Defining a list of stakeholders (such as the Stakeholders discussed in Chapter 2);
- Initiating an outreach and engagement process;



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- Undertaking the planning steps to prepare required Hazard Mitigation Plan sections; and
- Completing and reviewing the draft Plan and submitting for approval.

The Town may elect to complete this process in-house or with guidance from an outside contractor.

8.3.2 Plan Updates Due to Major Disaster Events or New Conditions

FEMA recommends that HMPs also be revisited and updated after a major disaster event (a State or Federally declared disaster) or if new conditions significantly change risk (such as new climate projections or local risk and vulnerability assessment efforts). The Town Manager will initiate the process to complete any updates needed in these circumstances. The decision to update the plan will be based on the annual monitoring and evaluation process.

8.4 Integrating the HMP

In order to be impactful, the HMP must be effectively integrated into other Town planning mechanisms. This will increase co-benefits of hazard mitigation projects, streamline planning and implementation activities, and help secure funding for HMP projects.

Integrating the ideas, information, and strategy of a mitigation plan into other planning mechanisms can be achieved through plan integration. Plan integration involves a two-way exchange of information and incorporation of ideas and concepts between hazard mitigation plans and other planning mechanisms. Some ways Narragansett can integrate the ideas, information, and strategy of a mitigation plan into other planning mechanisms are:



Building and Zoning Regulations: The local hazard mitigation plan can integrate with building and zoning regulations to ensure that new construction and development are designed to withstand potential hazards.



Community Plans: Community planning mechanisms can be integrated into hazard mitigation plans to ensure that community needs and concerns are considered when developing hazard mitigation strategies.



Emergency Management Plan: The local hazard mitigation plan can integrate with the emergency management plan to ensure that hazard mitigation strategies are coordinated with emergency response efforts.



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Partnerships: Developing strong partnerships between planners and emergency managers can help to fully integrate land use and hazard planning efforts

Integration will be a topic of discussion at each annual update meeting. HMP goals and mitigation actions will be integrated into other Town planning mechanisms. At each annual LHMC meeting, there will be an update on the progress of integration of mitigation actions into relevant planning mechanisms and a discussion of other planning mechanisms that should be integrated into the next five-year HMP update.

8.5 Public Participation throughout Plan Maintenance

Public engagement is a critical part of the plan maintenance process. Public input, education, and support are crucial to ensuring that the plan is effective, equitable, and impactful.

A coordinated public engagement effort will be led by the Town Manager, however, should be coordinated or delegated to community engagement staff to ensure alignment with other Town outreach efforts.

Below are four categories of engagement activities that will solicit different types of results.

- **Public Education** activities are solely focused on transparency and providing the public with information regarding the monitoring, evaluation, and implementation of the Plan. Additionally, providing supporting general education on how to make individualized hazard preparedness plans for households.
- **Public Input** activities are focused on soliciting feedback, ideas, concerns, and other input. These activities will aim to be as inclusive and accessible as possible. Public input should gather feedback from all communities, particularly those who are:
 - most affected by hazards
 - underheard
 - underserved
 - historically excluded.
- **Active Engagement** refers to LHMC's role to continue monitoring and adjusting to the effectiveness, performance, and equity of the HMP as it goes through maintenance, implementation, and integration with other planning mechanisms.

Reactionary Engagement refers to activities that directly follow a large storm or event. These activities will be particularly concerned with the safety of residents, performance of projects, and impacts on priority populations.

Below are activities in each of these categories that the Town may undertake, as appropriate for the situation, at the discretion of the Town Manager, and LHMC:



NARRAGANSETT HAZARD MITIGATION PLAN 2024

- **Public Education:** Provide website updates, flyers, presentations, social media posts, up to date GIS maps and data, as appropriate, in multiple languages and with accessibility considerations.
- **Public Input:** Host workshops, distribute surveys, facilitate public meetings, provide a presence at public events, solicit public comments, provide interactive maps, and/or interview community groups or local experts, all as determined by the LHMC at the annual meeting. Public input will include translation and interpretation as necessary and center accessibility.
- **Active Engagement:** Re-engage the Stakeholders, involve community groups, involve student groups, as appropriate. Training Town staff on how to work with residents who are experiencing hazards before an event occurs.
- **Reactionary Engagement:** Initiate surveys, hold public meetings, undertaking door-knocking. Incorporate feedback and engagement received to maintain a feedback loop of knowledge on the process and allow for flexibility to pivot ideas when needed.

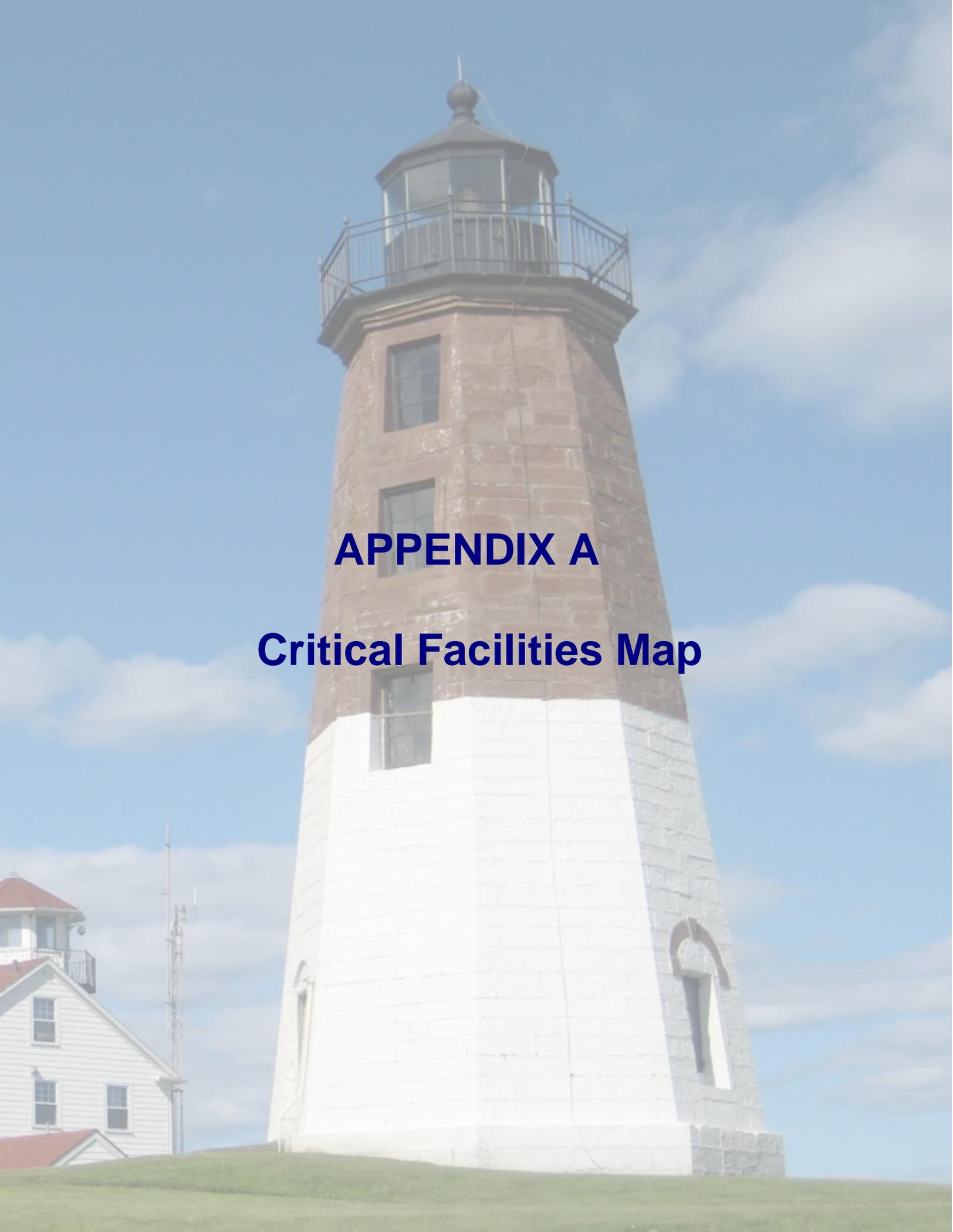
The Town is committed to developing equitable and impactful public participation. This means that greater attention will be paid to those who are most vulnerable to hazards and who do not have as many pathways for making their needs and opinions heard. The following steps will be taken to ensure that the HMP and its maintenance will be equitable:

- **Population:** Priority populations will be considered as a priority for outreach and engagement.
- **Projects/issues:** Issues or projects that are most valuable to these populations will be identified (through soliciting input or interviewing community groups/local experts).
- **Actions:** Findings will be incorporated into the implementation, monitoring, evaluation, updating of the plan, and integration with other planning processes. The Town Manager will be responsible for incorporating this information with support from the LHMC.

Public engagement activities will align with the annual evaluation, monitoring, and plan update meetings as well as with large storms or events.

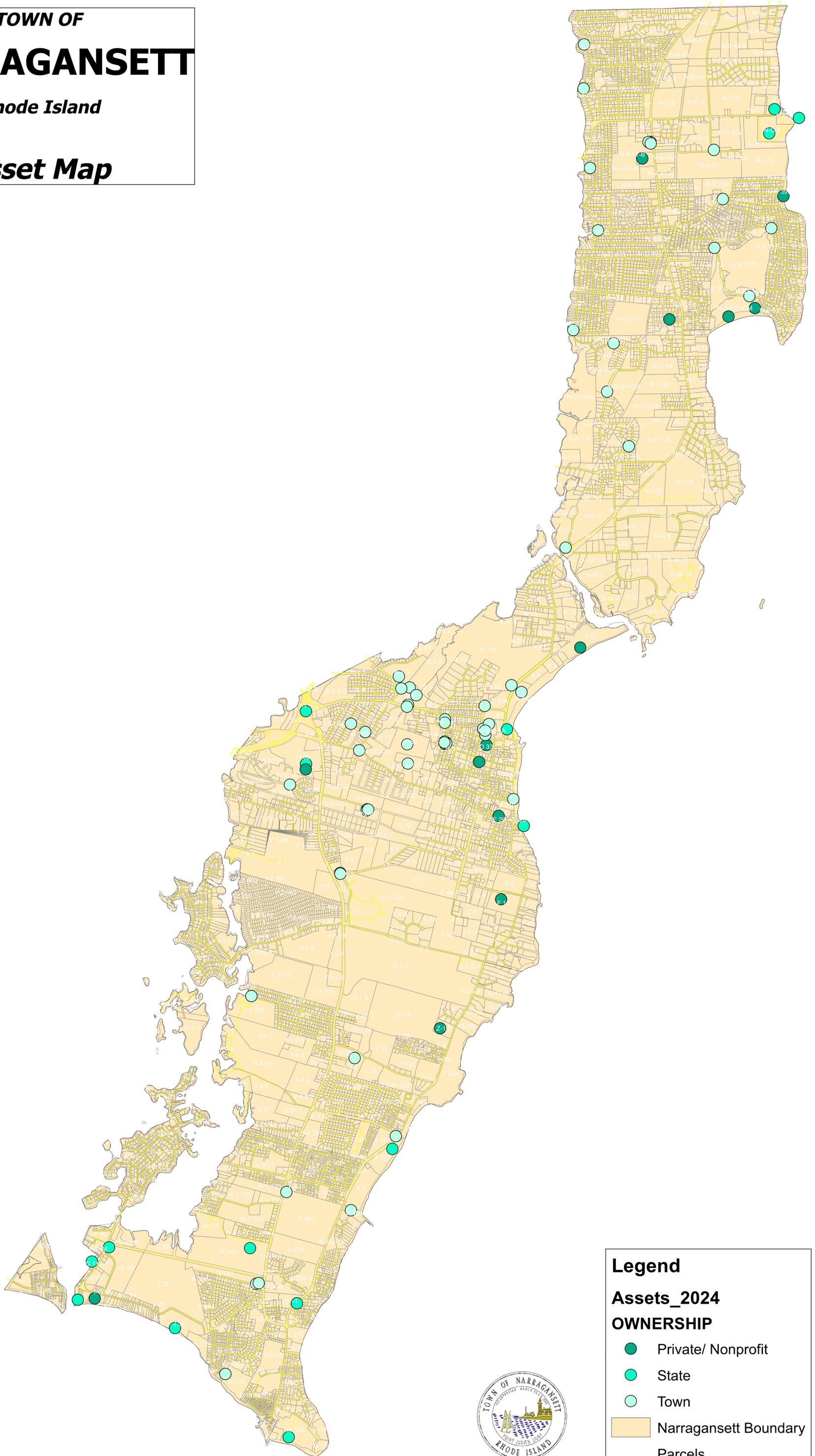


APPENDICES



APPENDIX A
Critical Facilities Map

TOWN OF
NARRAGANSETT
Rhode Island
Asset Map



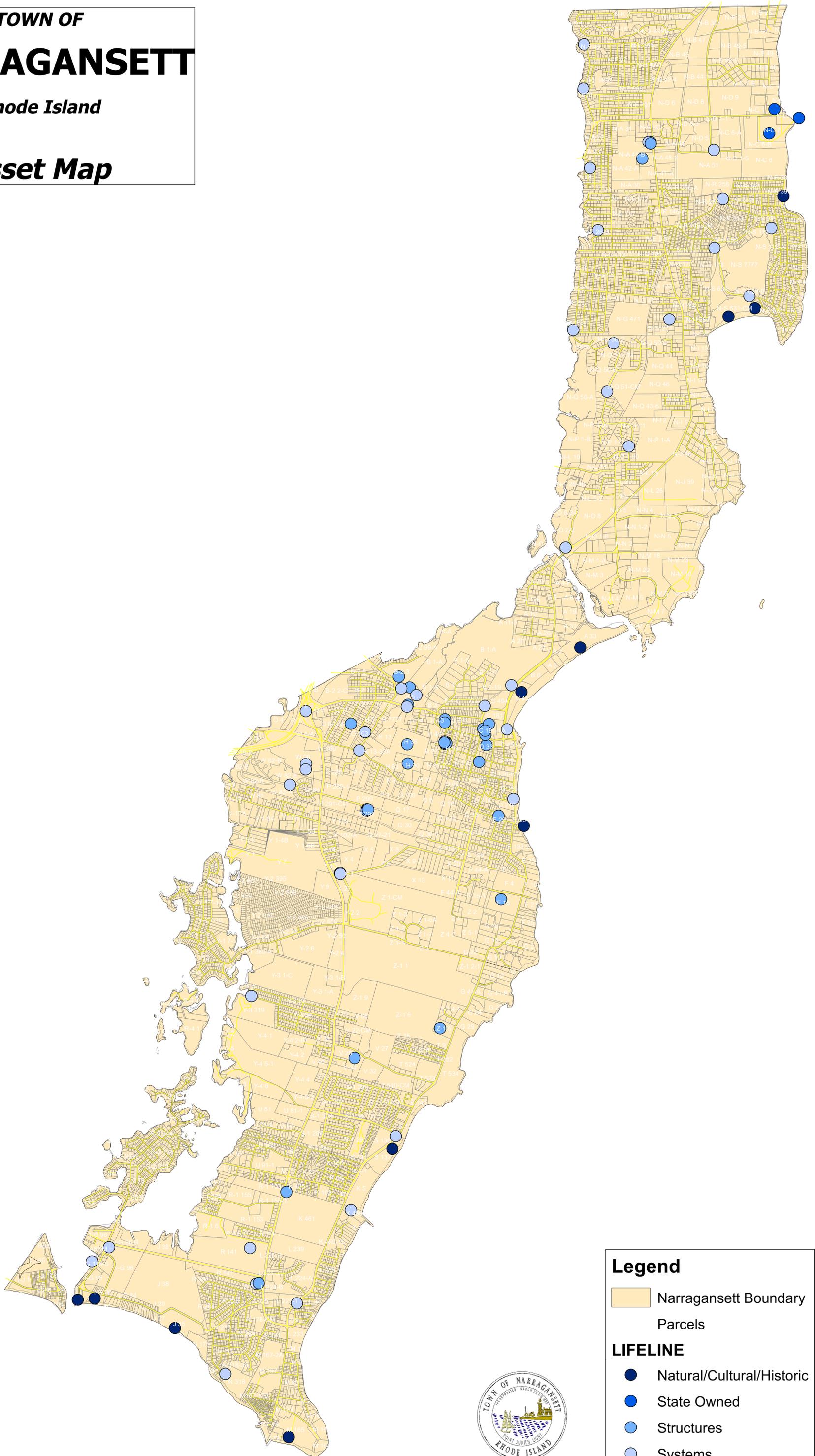
Legend

Assets_2024

OWNERSHIP

- Private/ Nonprofit
- State
- Town
- Narragansett Boundary
- Parcels

TOWN OF
NARRAGANSETT
Rhode Island
Asset Map



Legend

- Narragansett Boundary
- Parcels

LIFELINE

- Natural/Cultural/Historic
- State Owned
- Structures
- Systems

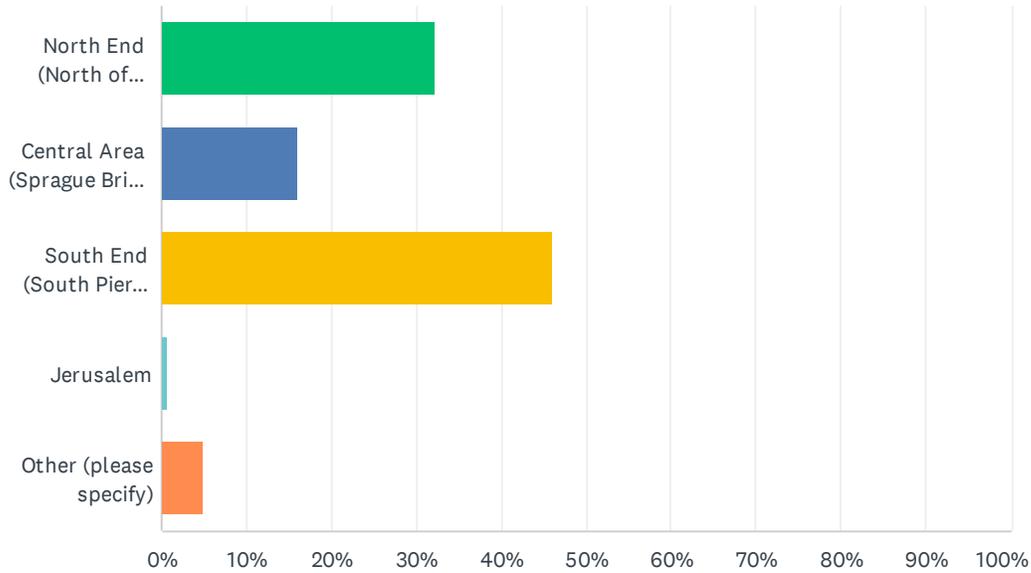




APPENDIX B
Survey Results

Q1 What part of Town do you live in?

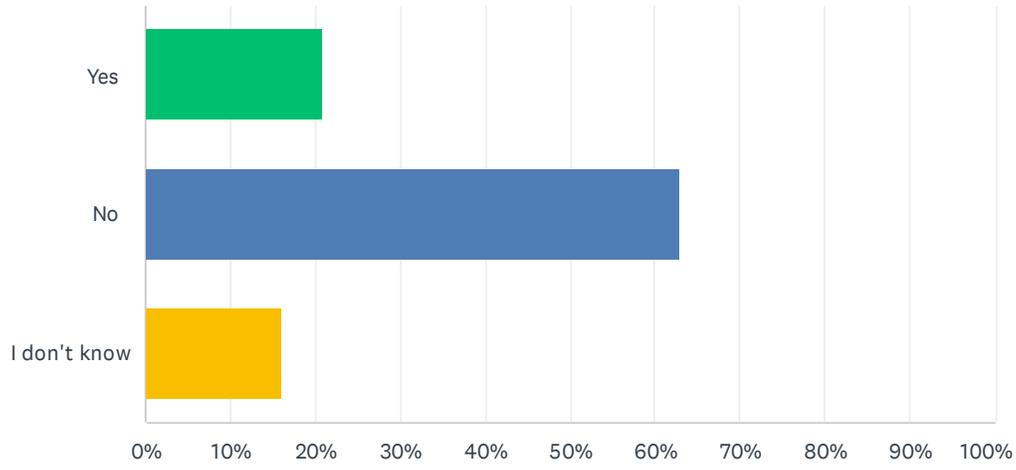
Answered: 143 Skipped: 1



ANSWER CHOICES	RESPONSES	
North End (North of Sprague Bridge)	32.17%	46
Central Area (Sprague Bridge to South Pier Road)	16.08%	23
South End (South Pier Road to Point Judith)	46.15%	66
Jerusalem	0.70%	1
Other (please specify)	4.90%	7
TOTAL		143

Q2 Is your property located in a floodplain?

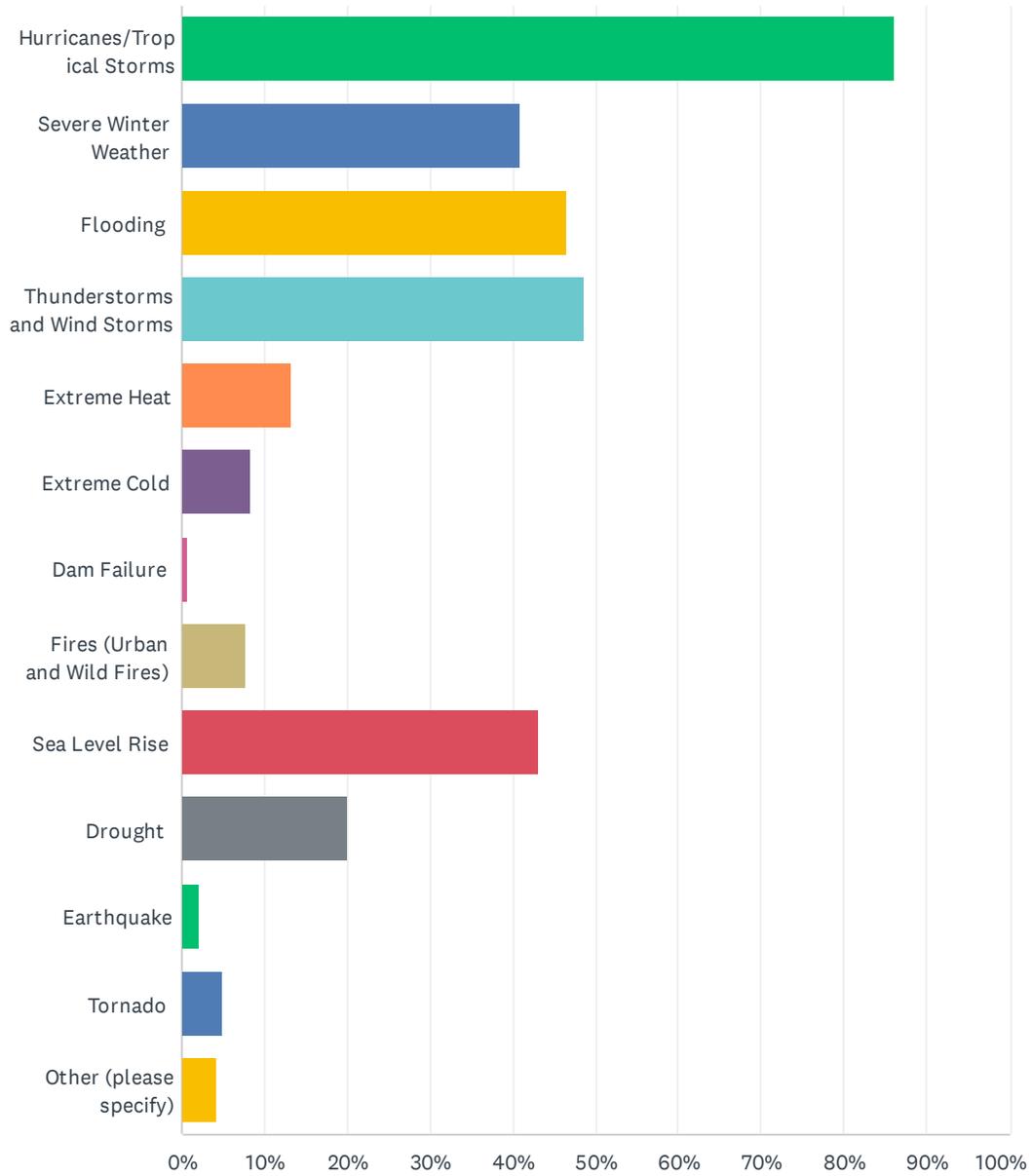
Answered: 143 Skipped: 1



ANSWER CHOICES	RESPONSES	
Yes	20.98%	30
No	62.94%	90
I don't know	16.08%	23
TOTAL		143

Q3 Which Natural Hazards are you most concerned with?

Answered: 144 Skipped: 0

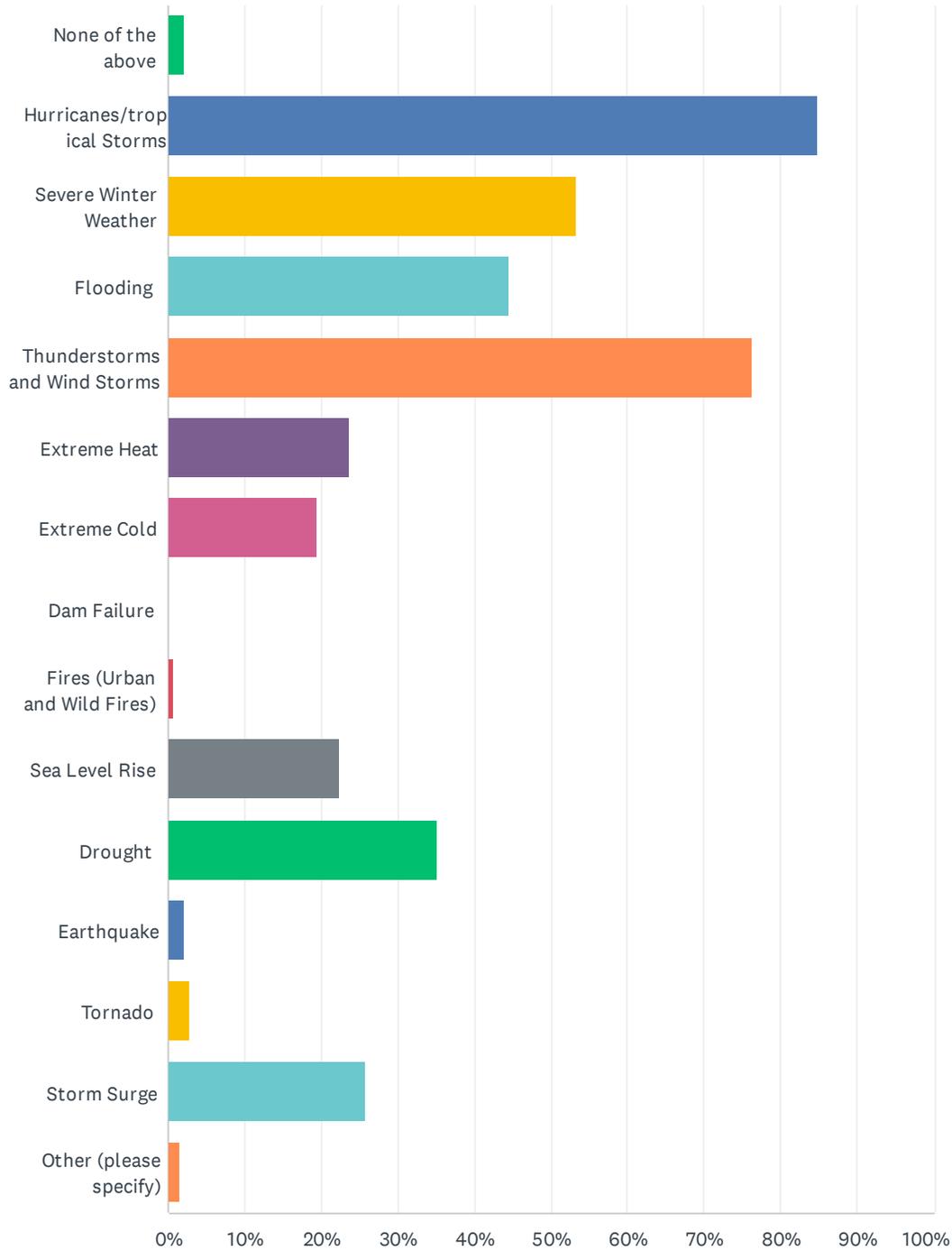


2024 Hazard Mitigation Plan Update

ANSWER CHOICES	RESPONSES	
Hurricanes/Tropical Storms	86.11%	124
Severe Winter Weather	40.97%	59
Flooding	46.53%	67
Thunderstorms and Wind Storms	48.61%	70
Extreme Heat	13.19%	19
Extreme Cold	8.33%	12
Dam Failure	0.69%	1
Fires (Urban and Wild Fires)	7.64%	11
Sea Level Rise	43.06%	62
Drought	20.14%	29
Earthquake	2.08%	3
Tornado	4.86%	7
Other (please specify)	4.17%	6
Total Respondents: 144		

Q4 If any, which Natural Hazards have you experienced in Narragansett?

Answered: 139 Skipped: 5



2024 Hazard Mitigation Plan Update

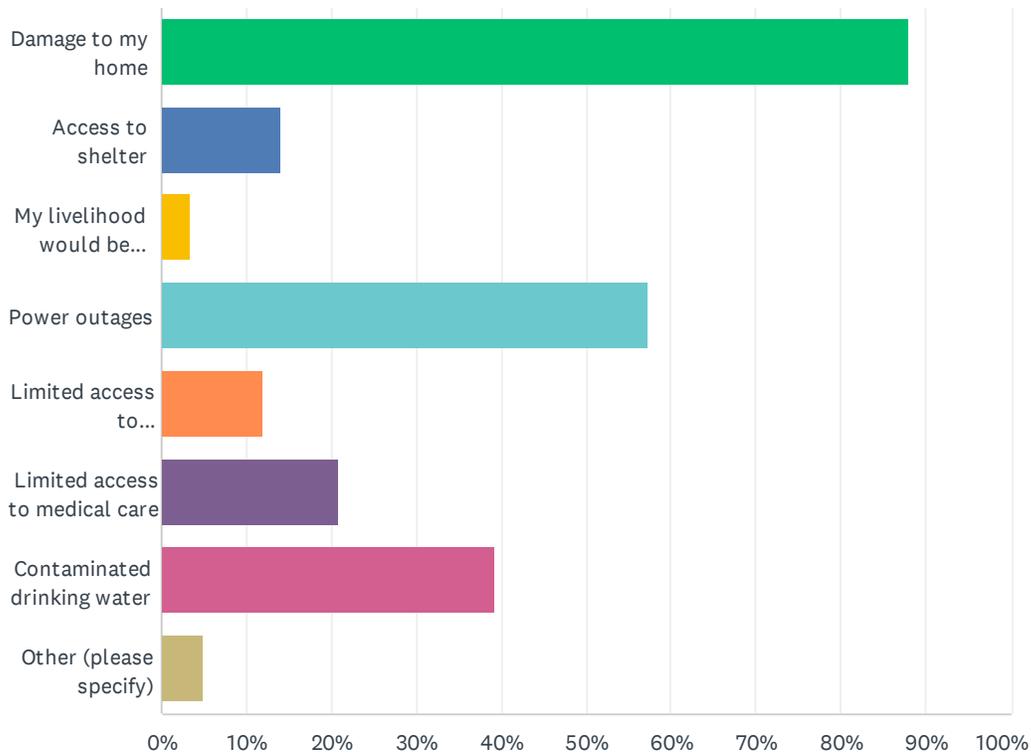
ANSWER CHOICES	RESPONSES	
None of the above	2.16%	3
Hurricanes/tropical Storms	84.89%	118
Severe Winter Weather	53.24%	74
Flooding	44.60%	62
Thunderstorms and Wind Storms	76.26%	106
Extreme Heat	23.74%	33
Extreme Cold	19.42%	27
Dam Failure	0.00%	0
Fires (Urban and Wild Fires)	0.72%	1
Sea Level Rise	22.30%	31
Drought	35.25%	49
Earthquake	2.16%	3
Tornado	2.88%	4
Storm Surge	25.90%	36
Other (please specify)	1.44%	2
Total Respondents: 139		

Q5 If yes to any of the above, what was the nature of the damage?

Answered: 112 Skipped: 32

Q6 What impacts from Natural Hazards most concerns you?

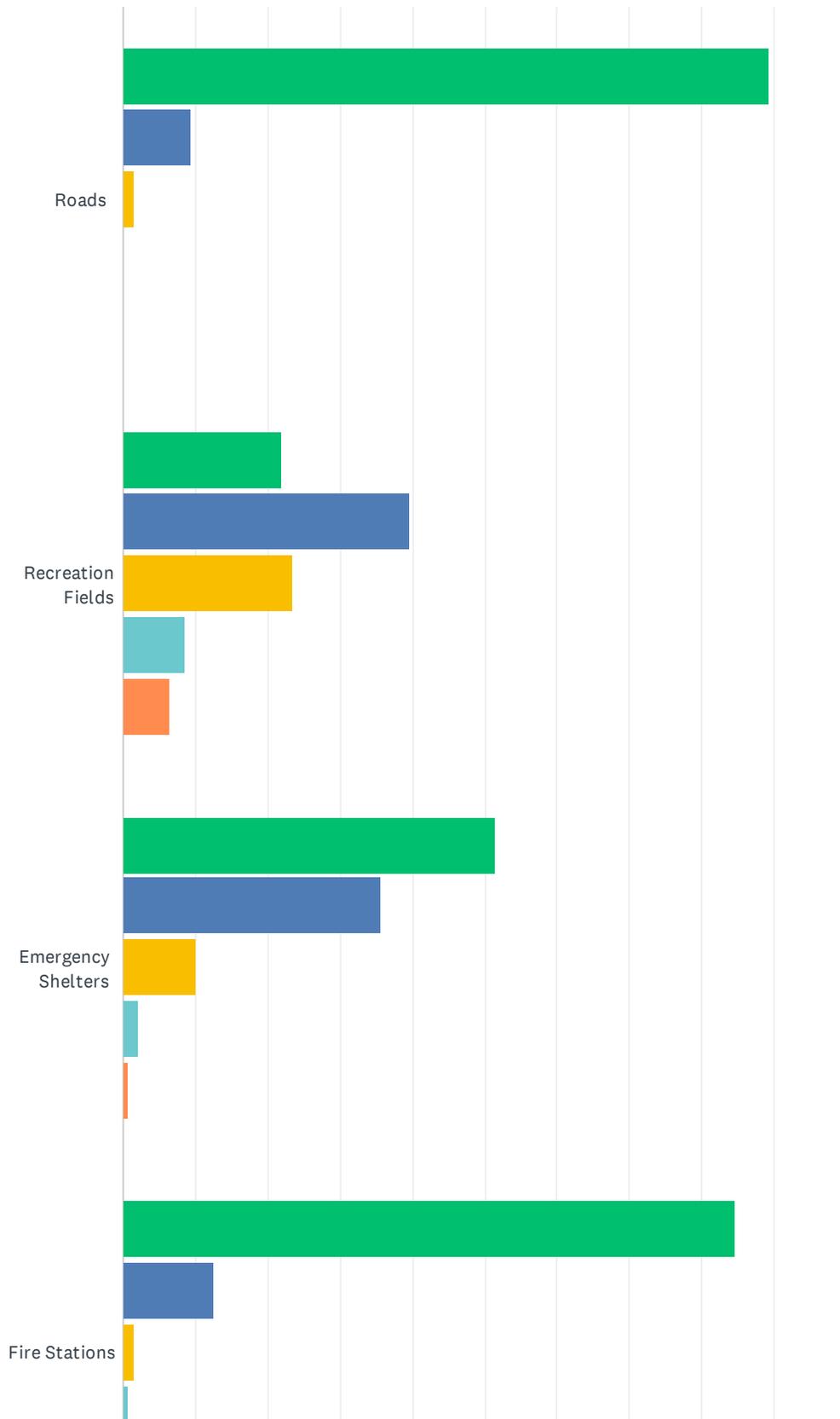
Answered: 143 Skipped: 1



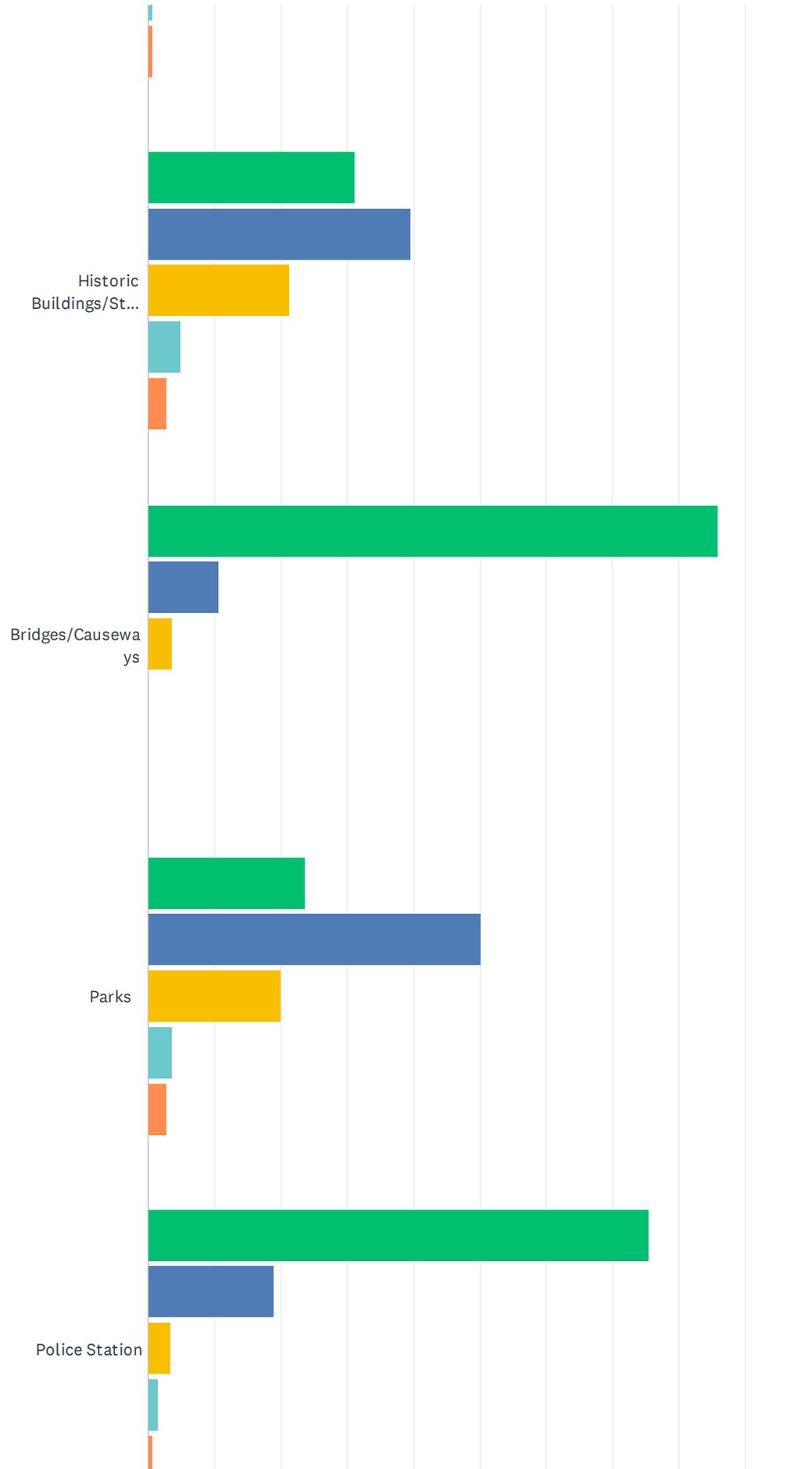
ANSWER CHOICES	RESPONSES	
Damage to my home	88.11%	126
Access to shelter	13.99%	20
My livelihood would be affected	3.50%	5
Power outages	57.34%	82
Limited access to transportation	11.89%	17
Limited access to medical care	20.98%	30
Contaminated drinking water	39.16%	56
Other (please specify)	4.90%	7
Total Respondents: 143		

Q7 In your opinion, how important are the community assets listed below.

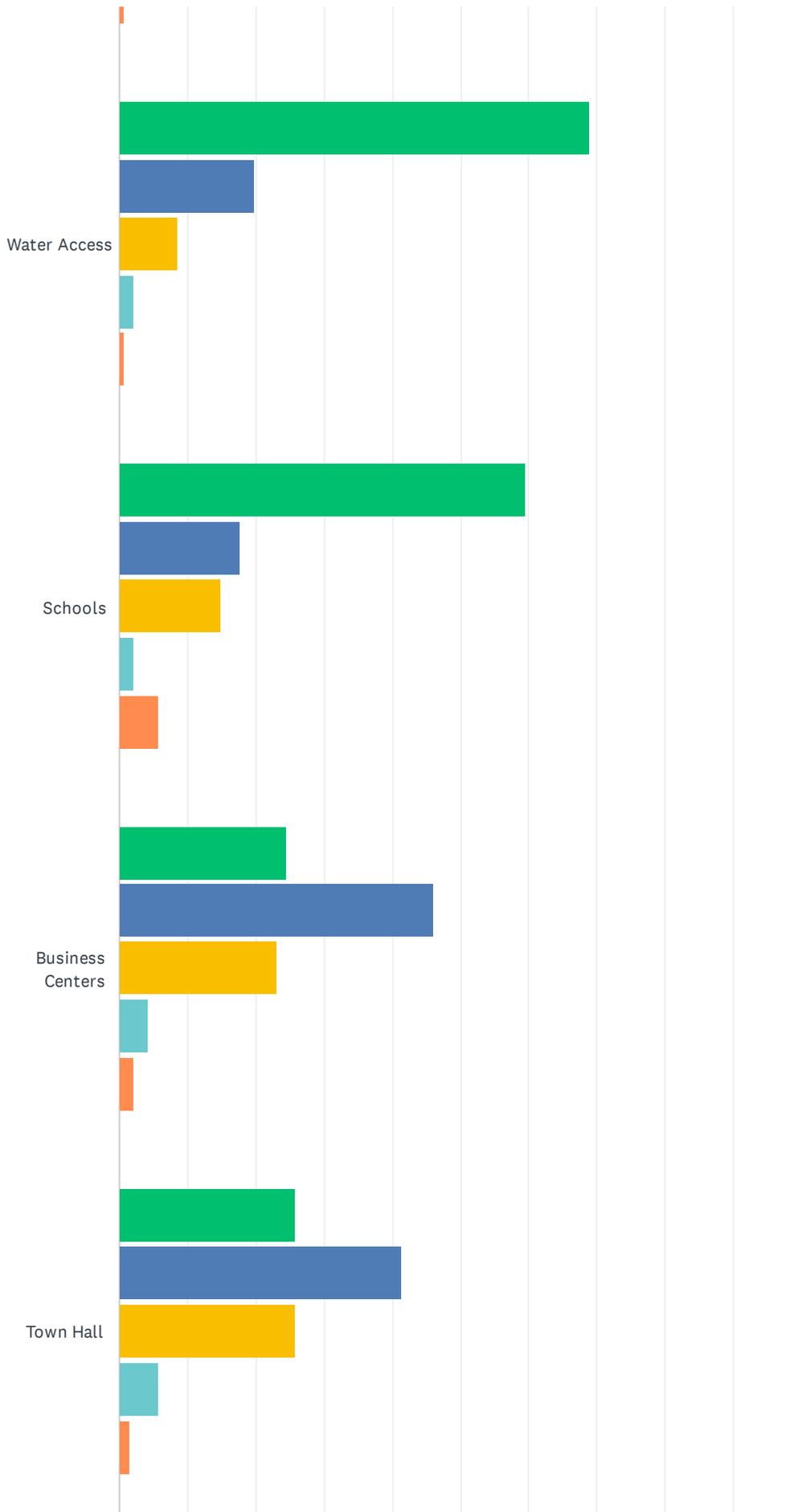
Answered: 144 Skipped: 0



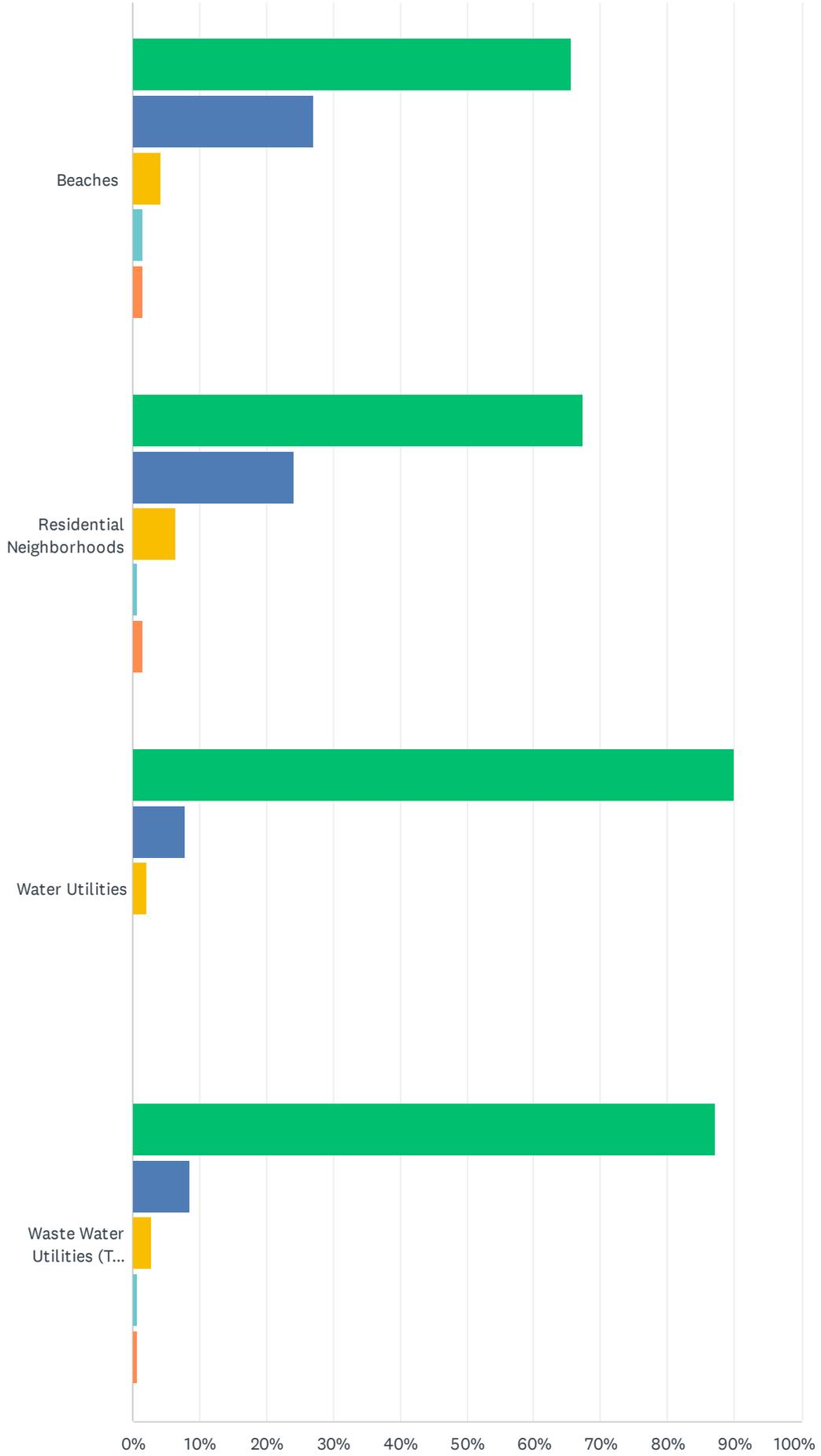
2024 Hazard Mitigation Plan Update



2024 Hazard Mitigation Plan Update



2024 Hazard Mitigation Plan Update



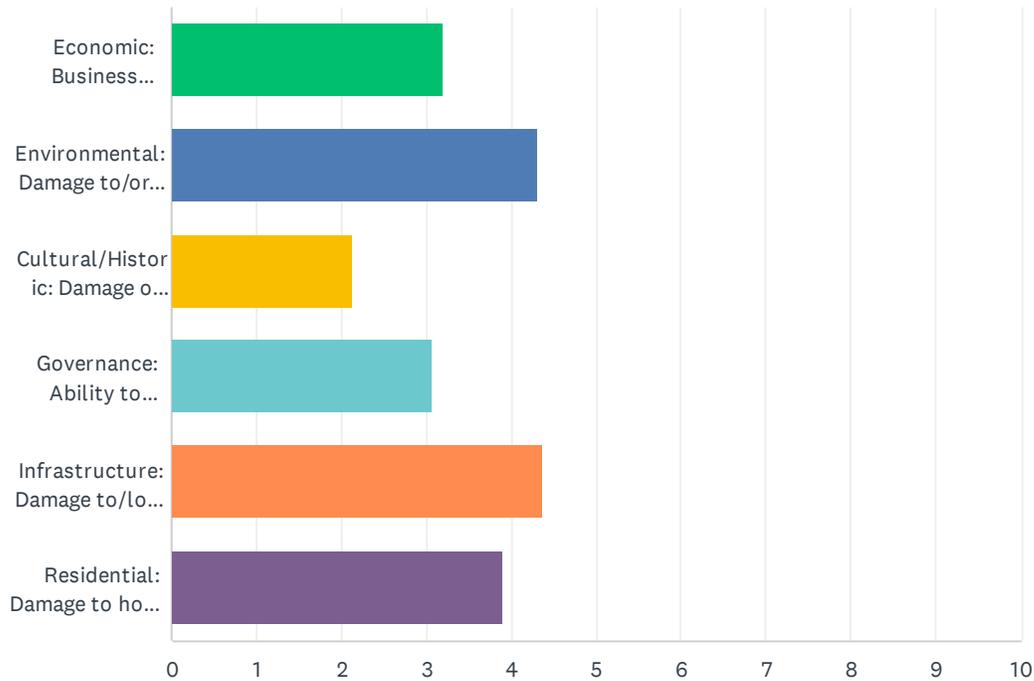
2024 Hazard Mitigation Plan Update

■ Very Import...
 ■ Somewhat I...
 ■ Neutral
 ■ Somewhat ...
■ Not import...

	VERY IMPORTANT	SOMEWHAT IMPORTANT	NEUTRAL	SOMEWHAT UNIMPORTANT	NOT IMPORTANT	TOTAL
Roads	89.29% 125	9.29% 13	1.43% 2	0.00% 0	0.00% 0	140
Recreation Fields	21.99% 31	39.72% 56	23.40% 33	8.51% 12	6.38% 9	141
Emergency Shelters	51.43% 72	35.71% 50	10.00% 14	2.14% 3	0.71% 1	140
Fire Stations	84.62% 121	12.59% 18	1.40% 2	0.70% 1	0.70% 1	143
Historic Buildings/Structures	31.21% 44	39.72% 56	21.28% 30	4.96% 7	2.84% 4	141
Bridges/Causeways	85.92% 122	10.56% 15	3.52% 5	0.00% 0	0.00% 0	142
Parks	23.57% 33	50.00% 70	20.00% 28	3.57% 5	2.86% 4	140
Police Station	75.52% 108	18.88% 27	3.50% 5	1.40% 2	0.70% 1	143
Water Access	68.79% 97	19.86% 28	8.51% 12	2.13% 3	0.71% 1	141
Schools	59.57% 84	17.73% 25	14.89% 21	2.13% 3	5.67% 8	141
Business Centers	24.46% 34	46.04% 64	23.02% 32	4.32% 6	2.16% 3	139
Town Hall	25.71% 36	41.43% 58	25.71% 36	5.71% 8	1.43% 2	140
Beaches	65.71% 92	27.14% 38	4.29% 6	1.43% 2	1.43% 2	140
Residential Neighborhoods	67.38% 95	24.11% 34	6.38% 9	0.71% 1	1.42% 2	141
Water Utilities	90.00% 126	7.86% 11	2.14% 3	0.00% 0	0.00% 0	140
Waste Water Utilities (Town Sewer System)	87.14% 122	8.57% 12	2.86% 4	0.71% 1	0.71% 1	140

Q8 In your opinion, which of the following categories are most susceptible to natural hazards in Narragansett? Please rank 1-6, 1 being the most important and 6 being the least important.

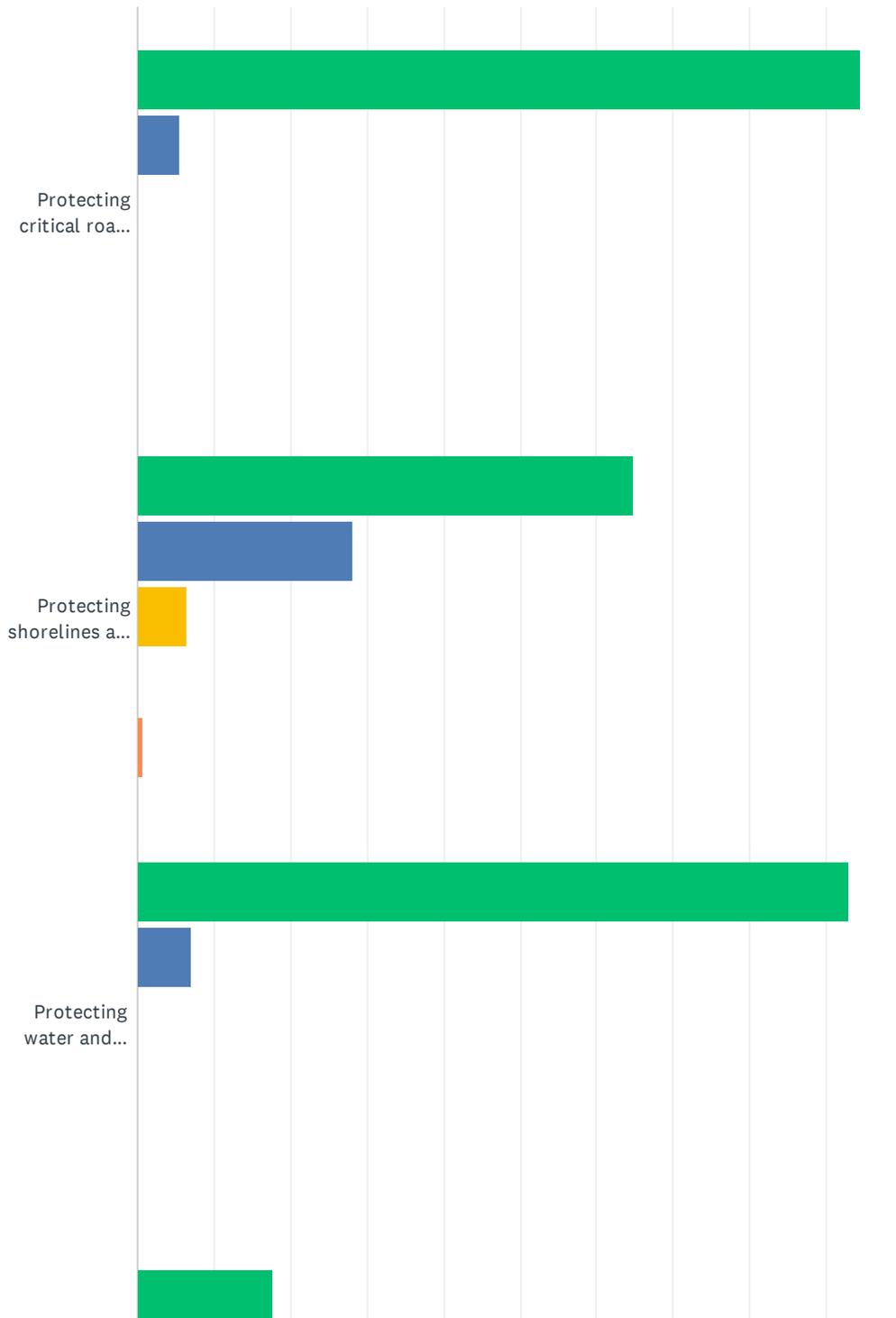
Answered: 142 Skipped: 2



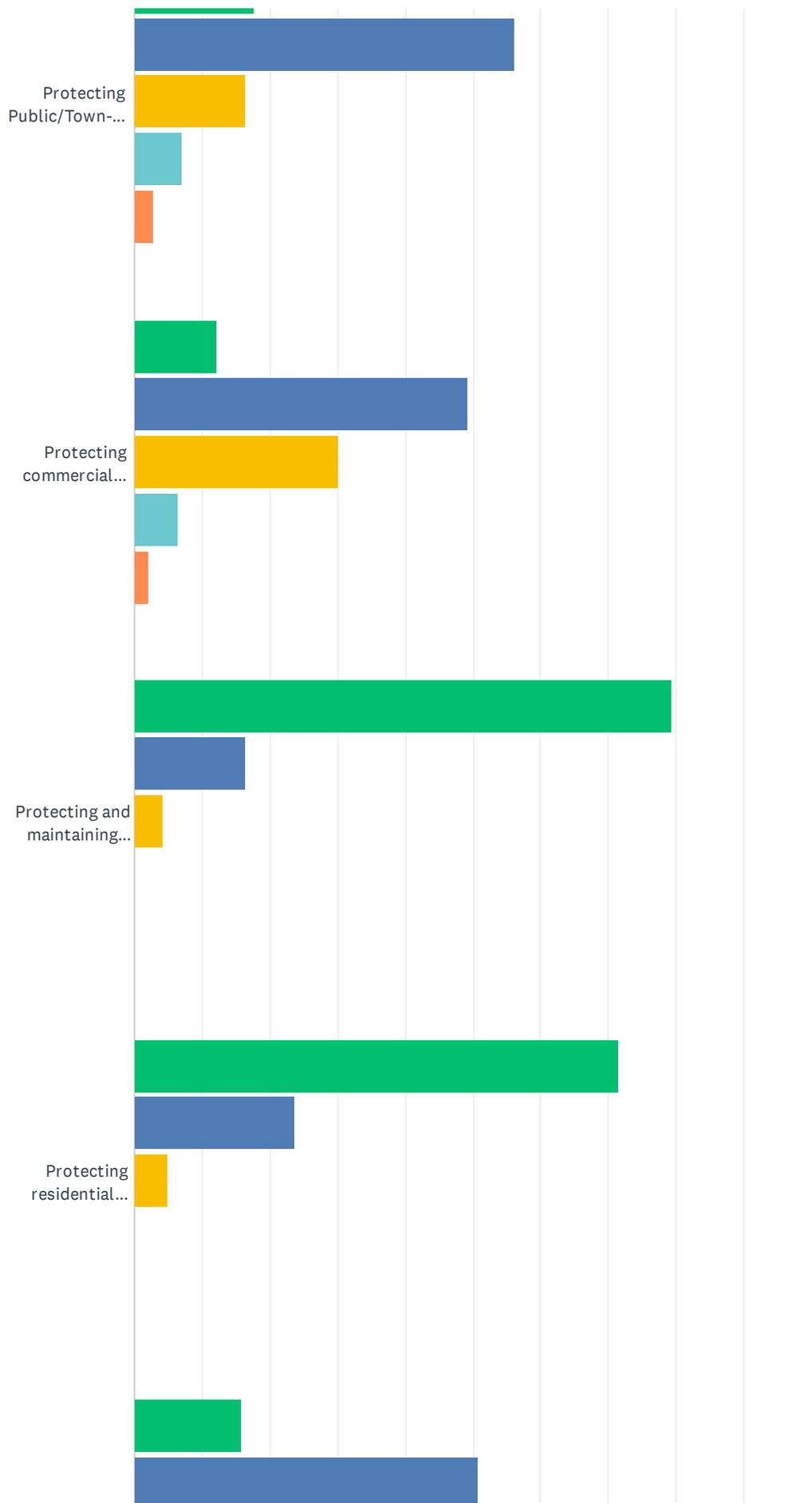
	1	2	3	4	5	6	TOTAL	SCORE
Economic: Business interruptions, closures, and job losses	9.15% 13	15.49% 22	14.08% 20	21.13% 30	27.46% 39	12.68% 18	142	3.20
Environmental: Damage to/or contamination of wetlands, waterways, beaches, natural undeveloped areas.	29.58% 42	19.72% 28	20.42% 29	14.79% 21	13.38% 19	2.11% 3	142	4.31
Cultural/Historic: Damage or loss of library, museum, historic structures and/or properties	1.41% 2	4.23% 6	11.97% 17	16.90% 24	19.01% 27	46.48% 66	142	2.13
Governance: Ability to maintain order and/or provide public amenities and services	7.75% 11	9.15% 13	17.61% 25	29.58% 42	21.13% 30	14.79% 21	142	3.08
Infrastructure: Damage to/loss of roads, utilities, bridges, causeways, schools	25.35% 36	35.92% 51	12.68% 18	9.15% 13	10.56% 15	6.34% 9	142	4.37
Residential: Damage to homes and/or property	26.76% 38	15.49% 22	23.24% 33	8.45% 12	8.45% 12	17.61% 25	142	3.91

Q9 Natural Hazards can have a significant impact on a community, and planning for these types of events can help us lessen the impacts. The following statements will help us to determine priorities regarding planning for natural disasters. Please indicate how important each statement is to you by filling in the appropriate circle below.

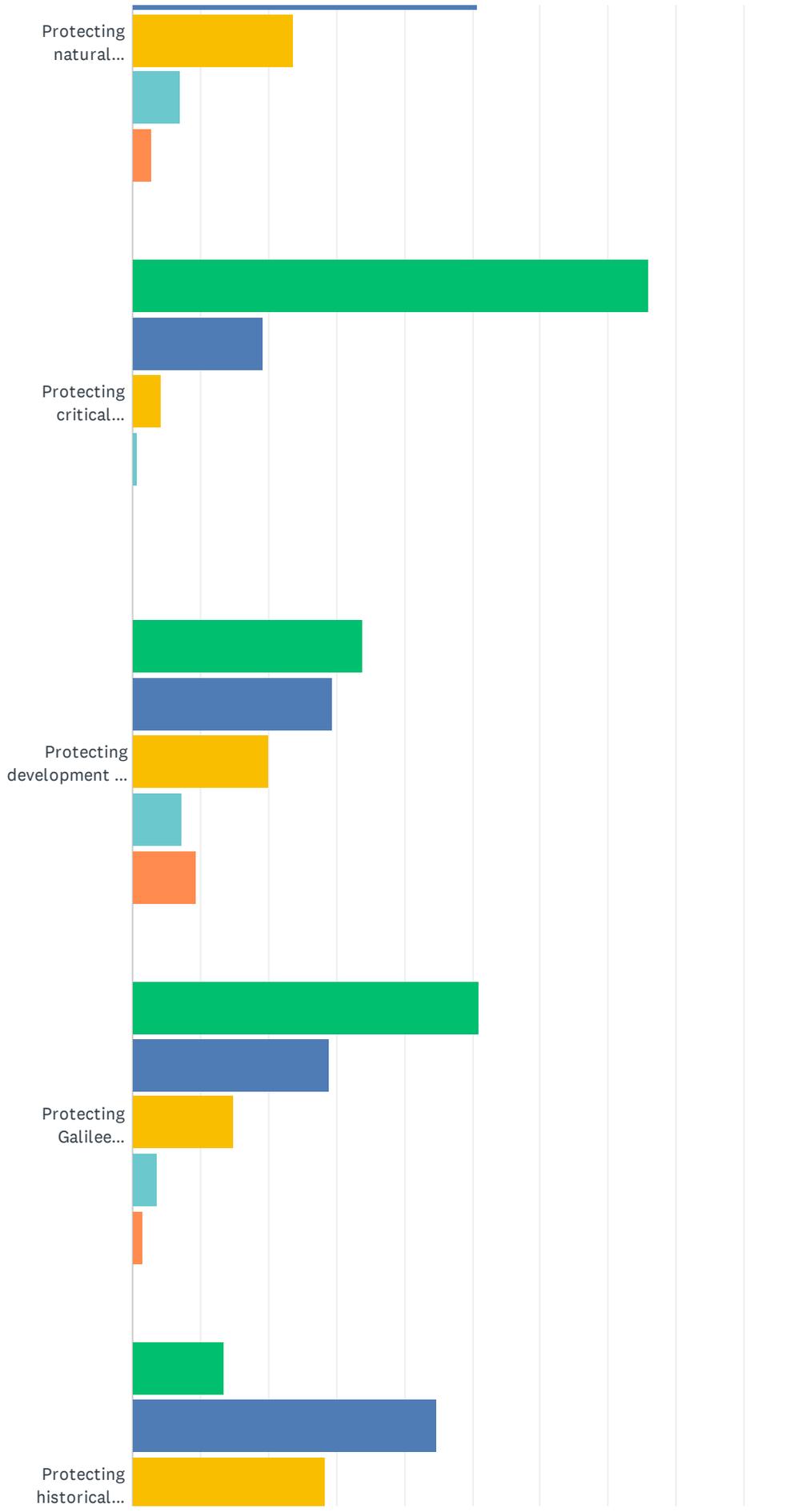
Answered: 142 Skipped: 2



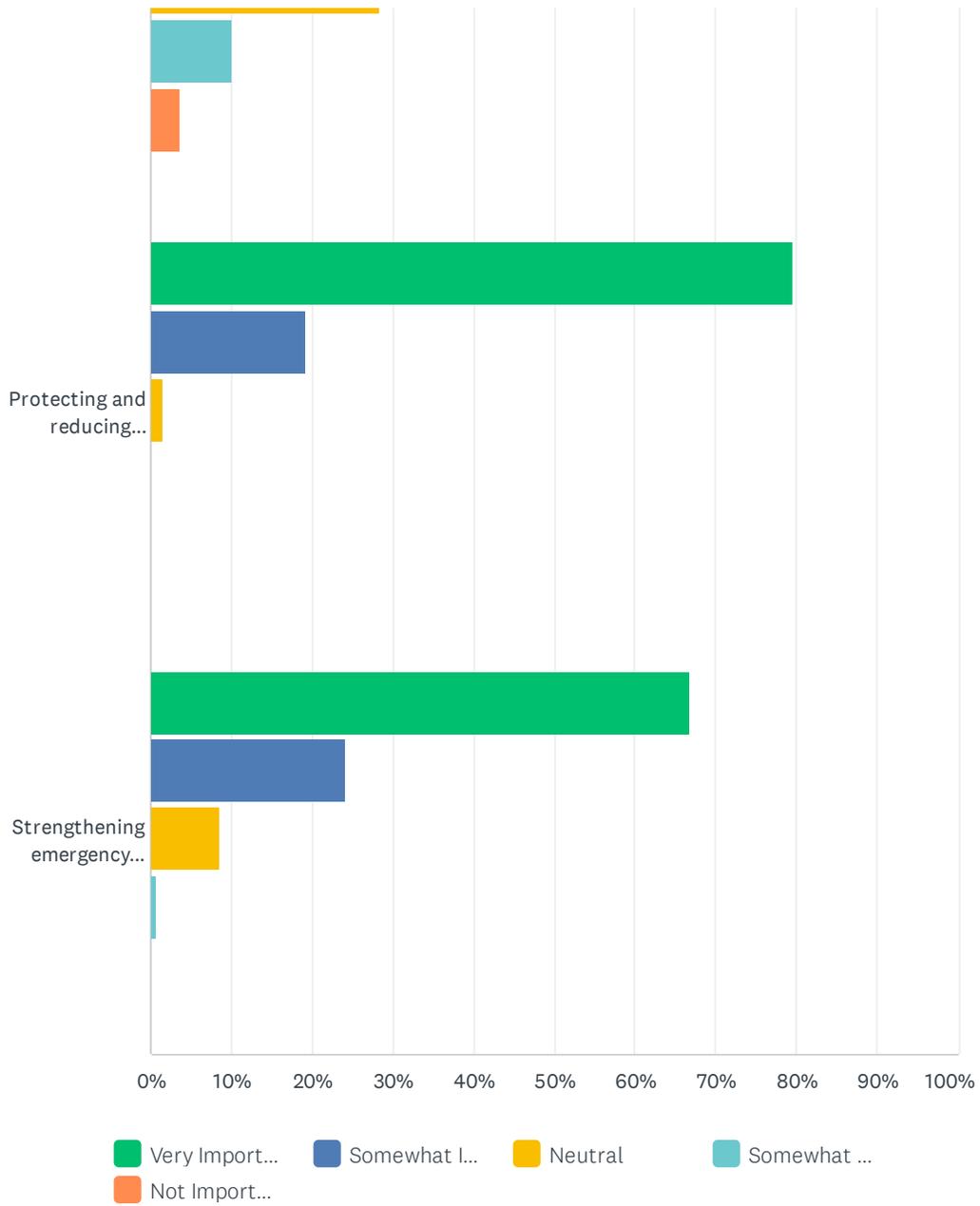
2024 Hazard Mitigation Plan Update



2024 Hazard Mitigation Plan Update



2024 Hazard Mitigation Plan Update

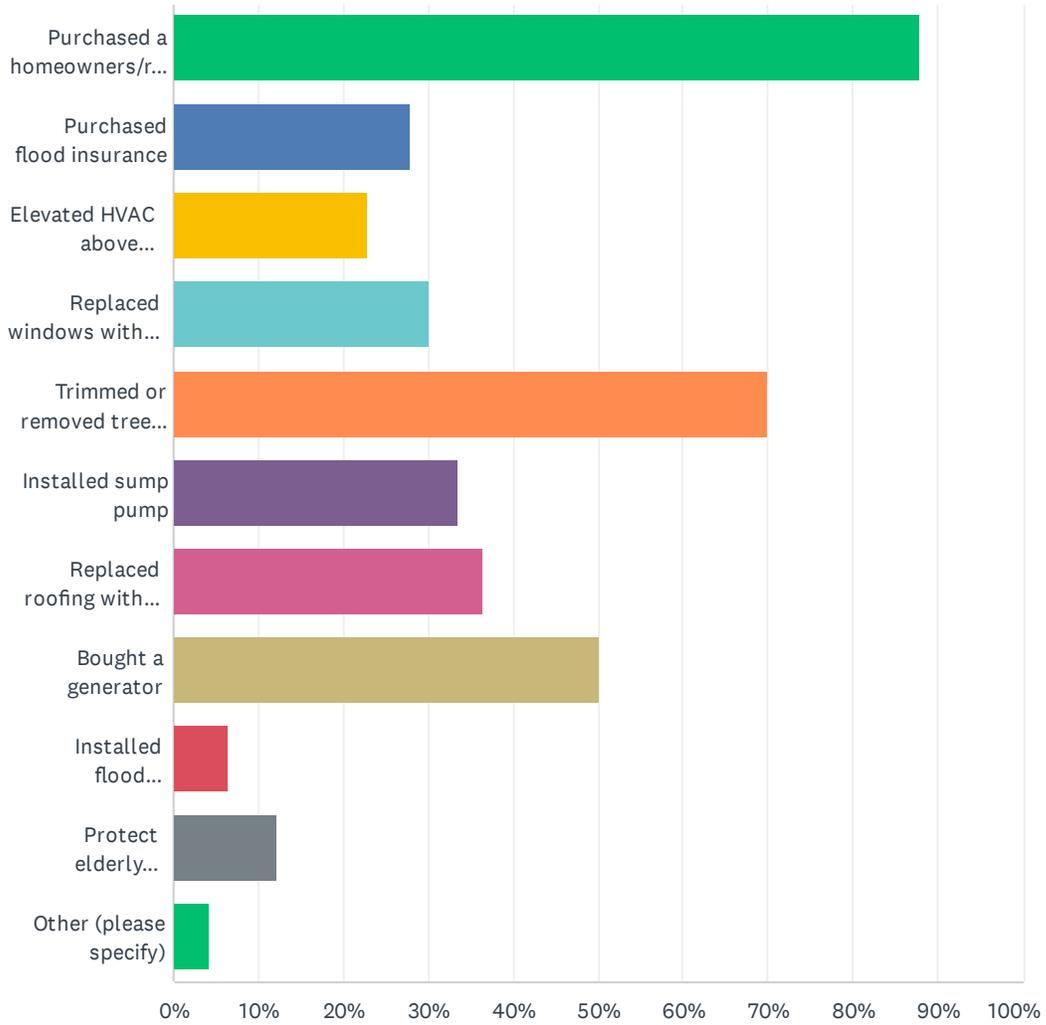


2024 Hazard Mitigation Plan Update

	VERY IMPORTANT	SOMEWHAT IMPORTANT	NEUTRAL	SOMEWHAT UNIMPORTANT	NOT IMPORTANT	TOTAL
Protecting critical roads and evacuation routes	94.37% 134	5.63% 8	0.00% 0	0.00% 0	0.00% 0	142
Protecting shorelines and shoreline features (beaches, seawall, dunes)	64.79% 92	28.17% 40	6.34% 9	0.00% 0	0.70% 1	142
Protecting water and wastewater infrastructure (pumping stations, treatment facilities, potable water)	92.91% 131	7.09% 10	0.00% 0	0.00% 0	0.00% 0	141
Protecting Public/Town-owned assets (Town Hall, Library, Community Center)	17.73% 25	56.03% 79	16.31% 23	7.09% 10	2.84% 4	141
Protecting commercial properties/assets	12.14% 17	49.29% 69	30.00% 42	6.43% 9	2.14% 3	140
Protecting and maintaining bridges sand causeways	79.29% 111	16.43% 23	4.29% 6	0.00% 0	0.00% 0	140
Protecting residential areas	71.43% 100	23.57% 33	5.00% 7	0.00% 0	0.00% 0	140
Protecting natural features, recreation areas, and public open spaces	15.71% 22	50.71% 71	23.57% 33	7.14% 10	2.86% 4	140
Protecting critical facilities (Police station, Fire stations)	75.89% 107	19.15% 27	4.26% 6	0.71% 1	0.00% 0	141
Protecting development in hazard areas	33.81% 47	29.50% 41	20.14% 28	7.19% 10	9.35% 13	139
Protecting Galilee business district/working waterfront	51.06% 72	29.08% 41	14.89% 21	3.55% 5	1.42% 2	141
Protecting historical structures and cultural landmarks	13.48% 19	44.68% 63	28.37% 40	9.93% 14	3.55% 5	141
Protecting and reducing damages to utilities	79.43% 112	19.15% 27	1.42% 2	0.00% 0	0.00% 0	141
Strengthening emergency services	66.67% 94	24.11% 34	8.51% 12	0.71% 1	0.00% 0	141

Q10 What actions have you taken to reduce the risk of Natural Hazards for your property?

Answered: 140 Skipped: 4

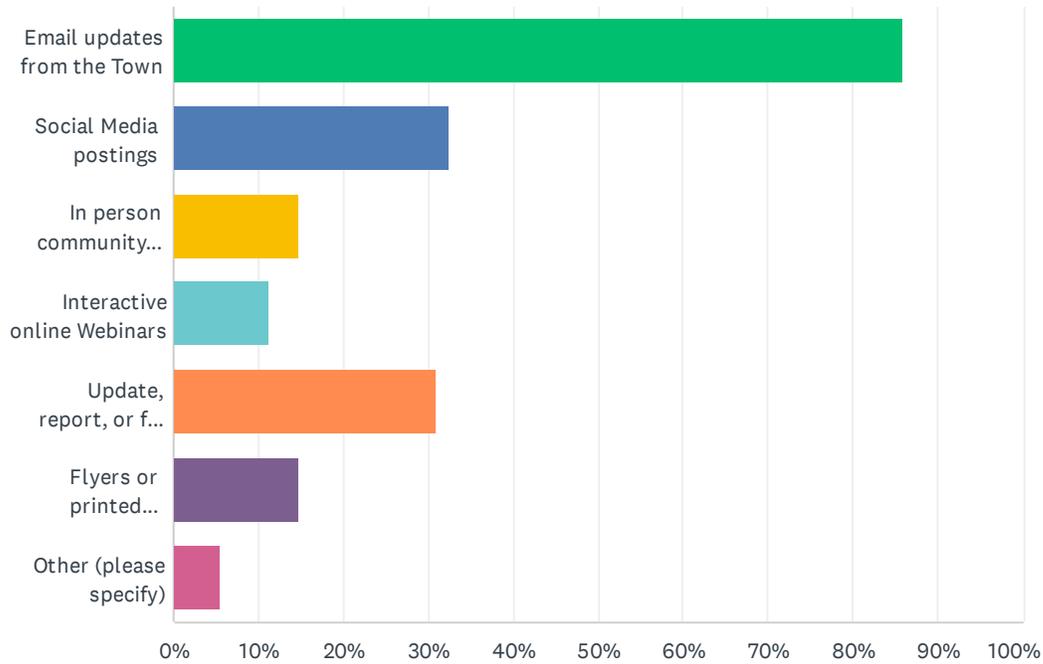


2024 Hazard Mitigation Plan Update

ANSWER CHOICES	RESPONSES	
Purchased a homeowners/renters insurance policy	87.86%	123
Purchased flood insurance	27.86%	39
Elevated HVAC above floodplain	22.86%	32
Replaced windows with impact rated glass	30.00%	42
Trimmed or removed trees close to house	70.00%	98
Installed sump pump	33.57%	47
Replaced roofing with high wind rated shingles	36.43%	51
Bought a generator	50.00%	70
Installed flood protection measures	6.43%	9
Protect elderly neighbors/other vulnerable populations	12.14%	17
Other (please specify)	4.29%	6
Total Respondents: 140		

Q11 How would you like to receive information about Hazard Mitigation planning in Narragansett?

Answered: 142 Skipped: 2



ANSWER CHOICES	RESPONSES	
Email updates from the Town	85.92%	122
Social Media postings	32.39%	46
In person community events	14.79%	21
Interactive online Webinars	11.27%	16
Update, report, or fact sheet PDFs available online	30.99%	44
Flyers or printed materials posted at public locations	14.79%	21
Other (please specify)	5.63%	8
Total Respondents: 142		



APPENDIX C
Public Engagement



Town of Narragansett, RI



Posts

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Town of Narragansett, RI

Dec 18, 2023 · 

The Town of Narragansett Needs Your Help!

We are currently updating our "Strategy for Reducing Risks From Natural Hazards in Narragansett, Rhode Island" (Hazard Mitigation Plan) and would like your feedback on Natural Hazards that effect Narragansett. This information will be used to help update the Plan for 2024 and set Action Items for the Town to pursue over the next five years. There are Three ways to help us!

1. Come to the Public Meeting on Wednesday, December 20, 2023 at 5PM in Town Hall. Learn about the Plan update and give the Town feedback on our vulnerabilities and assets.

2. Complete the Survey. Link Below.

<https://www.surveymonkey.com/r/8XDKFXJ>



Home



Video



Friends



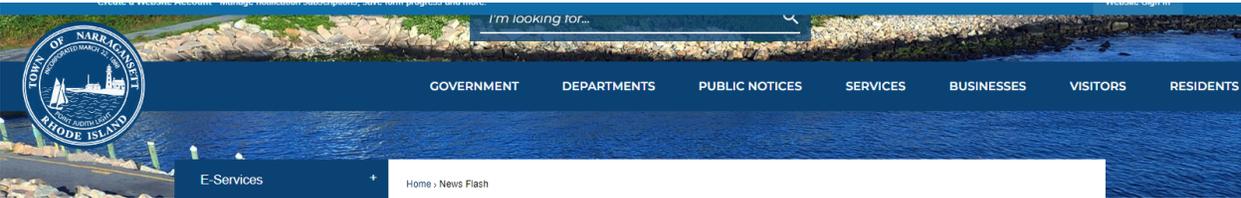
Marketplace



Notifications



Menu



I'm looking for...

- GOVERNMENT
- DEPARTMENTS
- PUBLIC NOTICES
- SERVICES
- BUSINESSES
- VISITORS
- RESIDENTS

- E- Services +
- About Us
- ADA compliance
- Bid Opportunities
- Employment
- Agendas & Minutes
- Surplus
- Evacuation Map
- Flood Protection Information

Home > News Flash

Town of Narragansett News

Posted on: January 2, 2024

The Town of Narragansett Needs Your Help!

The Town of Narragansett Needs Your Help!

We are currently updating our "Strategy for Reducing Risks From Natural Hazards in Narragansett, Rhode Island" (Hazard Mitigation Plan) and would like your feedback on Natural Hazards that effect Narragansett. This information will be used to help update the Plan for 2024 and set Action Items for the Town to pursue over the next five years. Please complete the survey if you haven't already, and use the QR code to locate area in Town that have been effected by a natural hazard.

The Public Comment period for this round closes on January 5, 2024 at noon.

1. Complete the Survey. Link Below.

<https://www.surveymonkey.com/r/8XDKFKJ>

2. Use the link to map areas in Town that have been effected natural hazards.

<https://arcg.is/11ynKt1>



Next =>

Library Construction Update From the Town Manager

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- Town of Narragansett News
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10:06

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< Narragansett Parks and Recr...  

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Narragansett Parks and Recreation's posts



Narragansett Parks and Recreation



3d · 

Just a reminder on this survey. The deadline for public comment in January 5, 2024, at noon.

We are currently updating our "Strategy for Reducing Risks From Natural Hazards in Narragansett, Rhode Island" (Hazard Mitigation Plan) and would like your feedback on Natural Hazards that effect Narragansett. This information will be used to help update the Plan for 2024 and set Action Items for the Town to pursue over the next five years. Please complete the survey if you haven't already, and use the QR code to locate area in Town that have been effected by a natural hazard.

The Public Comment period for this round closes on January 5, 2024 at noon.

1. Complete the Survey. Link Below.

<https://www.surveymonkey.com/r/8XDKFXJ>

2. Use the QR code or link to map areas in Town that have been effected natural hazards.

<https://arcg.is/11ynKr1>



survey123.arcgis.com

i





Hazard Mitigation Plan Update 2023

Public Meeting #1 December 20, 2023



1

AGENDA

-  Welcome & Introductions
-  Overview of Hazard Mitigation Planning
-  Scope
-  Schedule
-  Questions, Discussion, Action Items
-  Conclusion



2

WHAT IS HAZARD MITIGATION?



Effort to reduce impacts from natural hazards such as flooding, extreme temperatures, and winter weather...



...through planning, policy, education, infrastructure projects, and more

3

FEMA & RIEMA REQUIREMENTS

“The Disaster Mitigation Act of 2000 amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act (44 CFR Part 201), creating the framework for state, local, tribal and territorial governments to engage in hazard mitigation planning to receive certain types of non-emergency disaster assistance.”

FEMA updated *Local Mitigation Planning Policies and Guidance* (released April 2022, effective April 2023)

2022 Updates Include:

- ✓ Ensuring participation in the planning process.
- ✓ Consideration of climate change.
- ✓ Recognizing the role of adopting and enforcing building, land use, and development code.
- ✓ Facilitating stronger alignment with other FEMA mitigation programs.

4

KEY CHANGES



Federal

FEMA updated Local Mitigation Planning Policies and Guidance (released April 2022, effective April 2023)

State

State of Rhode Island State Hazard Mitigation Plan Update (Draft 2024)

Local

2019 Hazard Mitigation Plan Update
Comprehensive Plan Update 2017



5

PURPOSE OF HMPs



Publicly Accessible:

Easily understandable for people without a technical or planning background

Opportunity to streamline goals:

Consider goals designed to be easily communicated and consistent with other local planning initiatives

Identify Priorities to be Implemented:

Practical, integrated, and proactive mitigation actions

6

VALUE OF HAZARD MITIGATION PLANNING

- Eligibility for grant funding
- Preparedness planning
- Building public consensus for implementation
- Creating equitable outcomes

EVERY \$1 SPENT ON MITIGATION

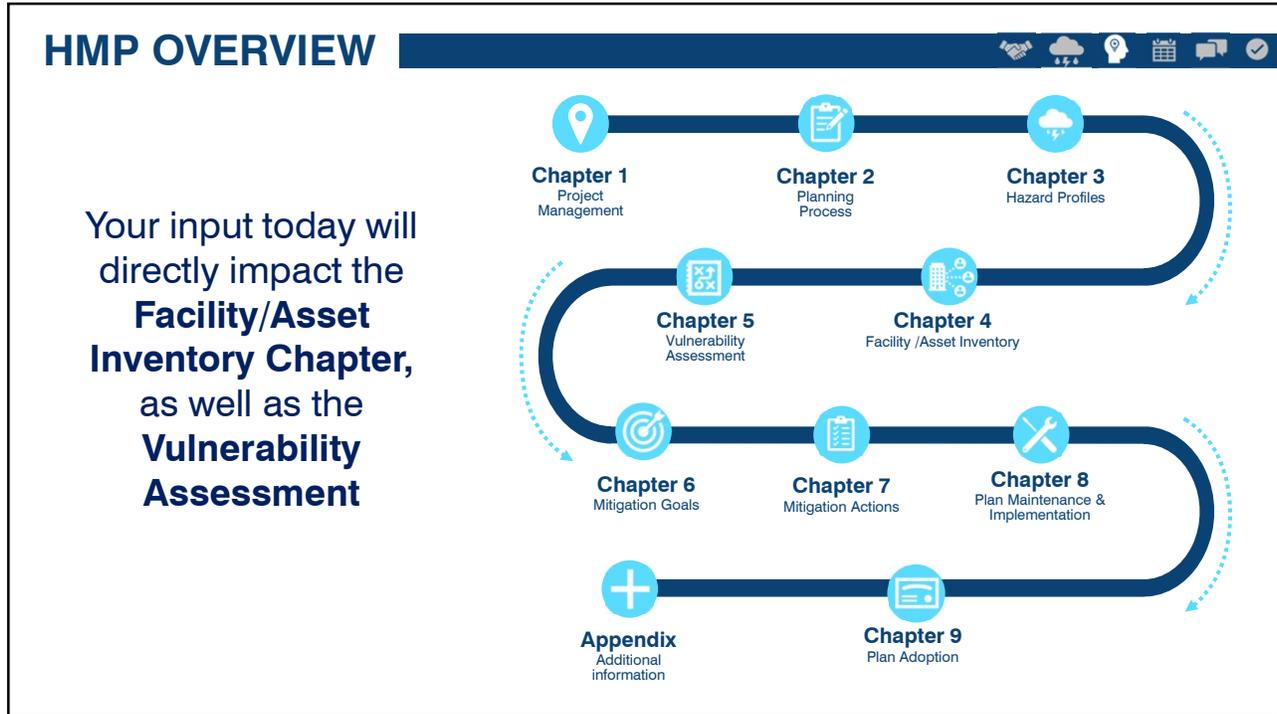
SAVES \$6 ON DISASTER RECOVERY

7

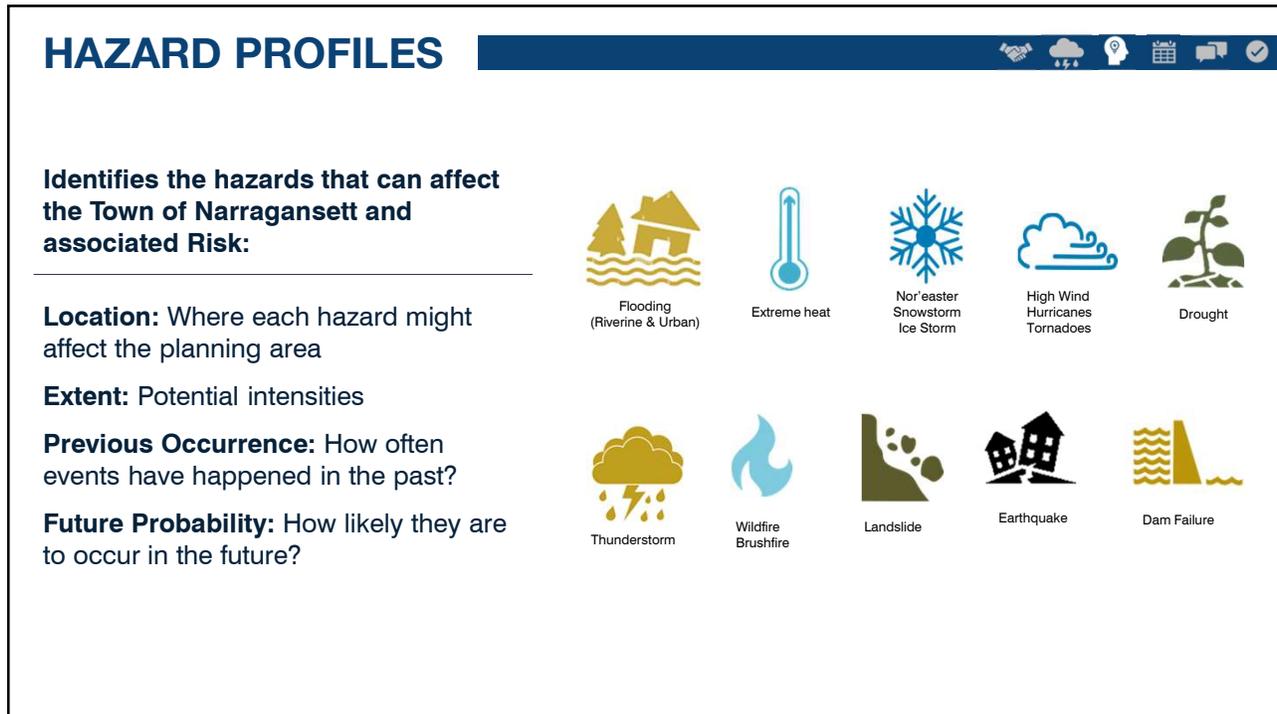
GROUPS

Town Contact	Stakeholders	Public
 Town	 HMP Committee	 Public Engagement
Town Representative for making final planning decisions. These meetings will guide the planning process, endorse draft Goals, and member will participate in Hazard Mitigation Planning Workshops.	Group of stakeholders bringing a wide range of local expertise and perspectives.	Public Meetings will be an opportunity to educate about the HMP, share progress, and gather feedback and ideas. Results from these meetings and other feedback will be integrated into the final report.

8



9



10

FACILITY / ASSET INVENTORY

Assets are determined by the community and include, but are not limited to:

Safety & Security

Health & Medical

Transportation

Food, Water, Shelter

Parks & Greenspace

Communications

Cultural, Historic, & Events

Energy

Hazardous Material Management

Critical Facilities

- Energy
- Transportation
- Water, wastewater, stormwater
- Telecommunication
- Emergency Response
- Hospitals and health care
- Municipal Buildings
- Community Resources
- Etc.

Repetitive Loss Structures

Land Use Changes & Future Potential Development

11

VULNERABILITY ASSESSMENT

Vulnerability is a description of which assets, including structures, systems, populations and other assets as defined by the community, within locations identified to be hazard prone, are at risk from the effects of the identified hazard(s).

Use information from Hazard Profiles and Facility/Asset Inventory

Define what parts of the community are most likely to be affected (vulnerability) and the potential consequences (impacts).

12

PUBLIC REVIEW OF DRAFT



Public Review

- Draft HMP for public comment will be posted on the Town's website.
- Draft plan will be finalized after the comment period
- One round of HMP Team comments is budgeted with revisions as needed prior to submission to RIEMA/FEMA.



13

RIEMA AND FEMA REVIEW, APPROVAL



Adoption by the local governing body demonstrates Town's commitment to the hazard mitigation goals and actions outlined in the plan.

Adoption authorizes responsible agencies to perform.

Without adoption, Town has not completed the mitigation planning process and will not be eligible for certain FEMA assistance, such as HMA or HHPD grant program funding for mitigation actions.

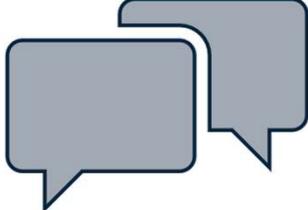
Step 1:
Draft Plan &
Review Internally

Step 2:
Submit to RIEMA

Step 3:
Address comments
& submit to FEMA

Step 4:
FEMA approval
and Town
Adoption

14



QUESTIONS/ANSWERS

15

THANK YOU

16




 TOWN OF NARRAGANSETT
 INCORPORATED MARCH 22, 1790
 RHODE ISLAND

**Hazard Mitigation
 Plan Update
 2024**

**LHMC Workshop #2
 February 1, 2024**

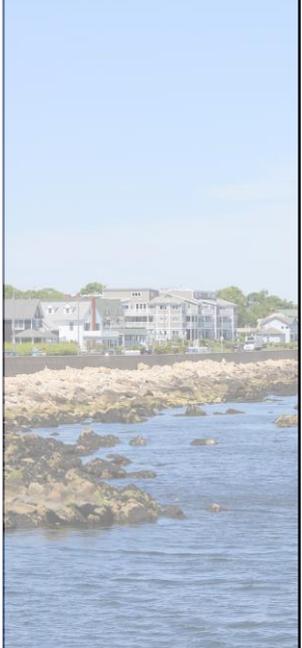

 Weston & SampsonSM

1

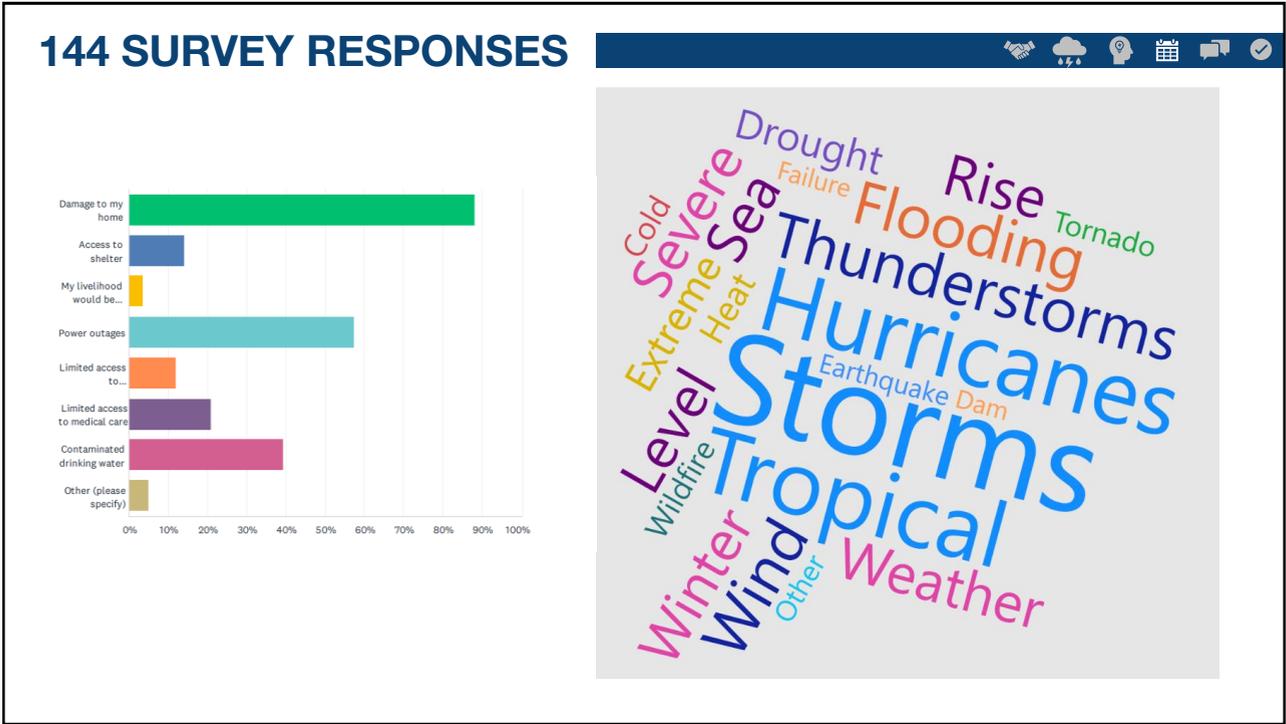
AGENDA



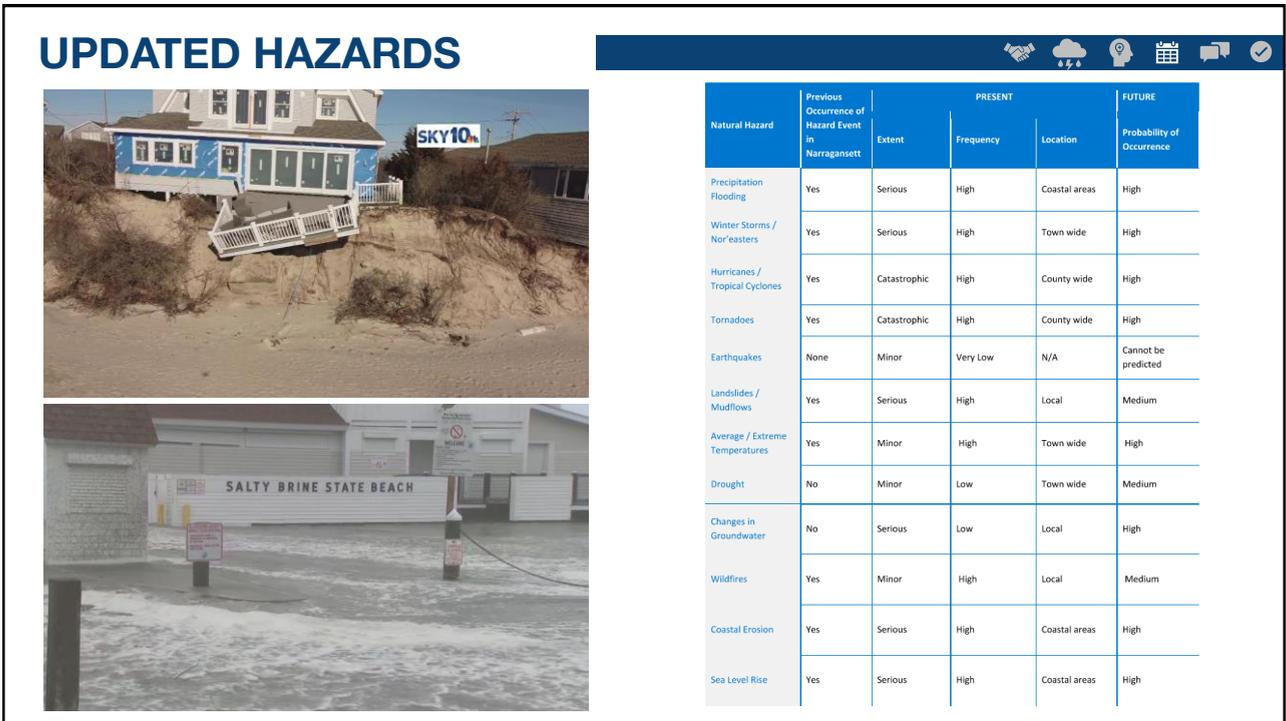
-  Meeting Opening
-  Review Status and Next Steps
-  Draft HMP Overview
-  Questions, Discussion, Action Items
-  Conclude



2



3



4

ASSETS



- 1. Structures Assets
- 2. Systems Assets
- 3. Natural, Cultural, and Historic Resources Assets
- 4. Public and State-Owned Assets

5

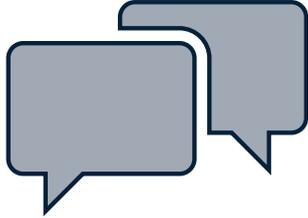
STAPLEE UPDATE NEEDED



2019 Action Item Numbers	Corresponding 2013 Action Item	Name of Action Items	STAPLEE Scoring								Total	Priority
			Social	Technical	Administrative	Political	Legal	Economic	Environmental			
Critical Roads/Evacuation Routes												
1	7	Evacuation and Sheltering	1	1	1	1	1	1	1	7	Low	
Shoreline Features												
2	17	Beach and Dune Replenishment	2	2	1	2	1	1	3	12	Medium	
Water & Wastewater Infrastructure												
3	22	Bypass Sewer Main	3	3	3	3	3	3	3	21	High	
4	36	Water Supply	2	2	2	2	1	2	3	14	Medium	
5	57	Flood proof Pump Stations	1	1	2	2	2	2	2	12	Medium	
6	59	Retrofit Sewer Pump Stations	3	3	3	2	3	3	3	20	High	
7	New	Scarborough WWTF Groin Rehab	3	3	3	2	3	3	3	20	High	
Public/Town-owned Assets												
8	14	Underground Utilities and Fire Alarm Communications	3	2	1	1	2	2	3	14	Medium	
9	45	Town Tree Trimming Program	2	3	2	1	1	2	3	14	Medium	
10	New	Tree Trimming Educational Program	1	1	1	1	1	1	2	8	Low	
Causeways												
11	37	Causeways	3	2	2	2	3	2	3	17	High	
Residential Areas												
12	5,47	Public Information, Outreach and Incentive Program	3	2	1	1	2	3	3	15	Medium	
13	12	Property Acquisition	1	2	2	1	2	3	3	14	Medium	
14	16,43	Retrofit and Elevate, Relocate	1	2	2	1	2	3	3	14	Medium	
15	42	Policy for Rebuilding	3	1	1	3	1	1	3	13	Medium	
Natural Resources/Recreation Areas/Public Areas												
16	1	Open Space Acquisitions	3	1	2	1	2	3	3	15	Medium	
Historic Structures/Signage												
17	21	Historic Flooding Signage Townwide	2	1	2	1	1	1	1	9	Low	
18	33	Historic Flooding Informational Display for Town Hall	2	1	2	1	1	1	1	9	Low	
Storm Water Assets												
19	New	Storm Water Projects	3	2	1	1	1	2	3	13	Medium	

6





QUESTIONS/ANSWERS

7

THANK YOU

8



**Hazard Mitigation
Plan Update
2024**

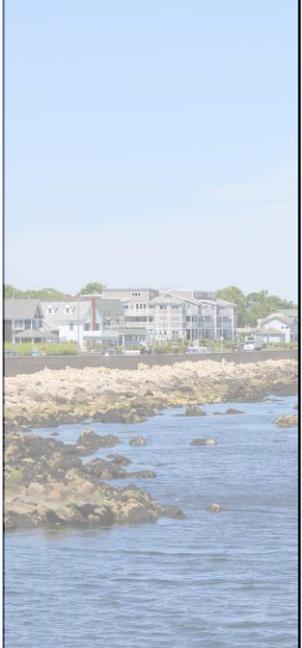
**Public Workshop #2
February 28, 2024**



1

AGENDA

-  Review Status of 2024 Hazard Mitigation Plan (HMP)
-  Draft HMP Overview
-  Questions and Comments



2

KEY CHANGES SINCE 2019 HMP



Local Mitigation Planning Policy Guide

FP 206-21-0002

Released April 19, 2022, Effective April 19, 2023

OMB Collection #1660-0062



State of Rhode Island Hazard Mitigation Plan

February 2024

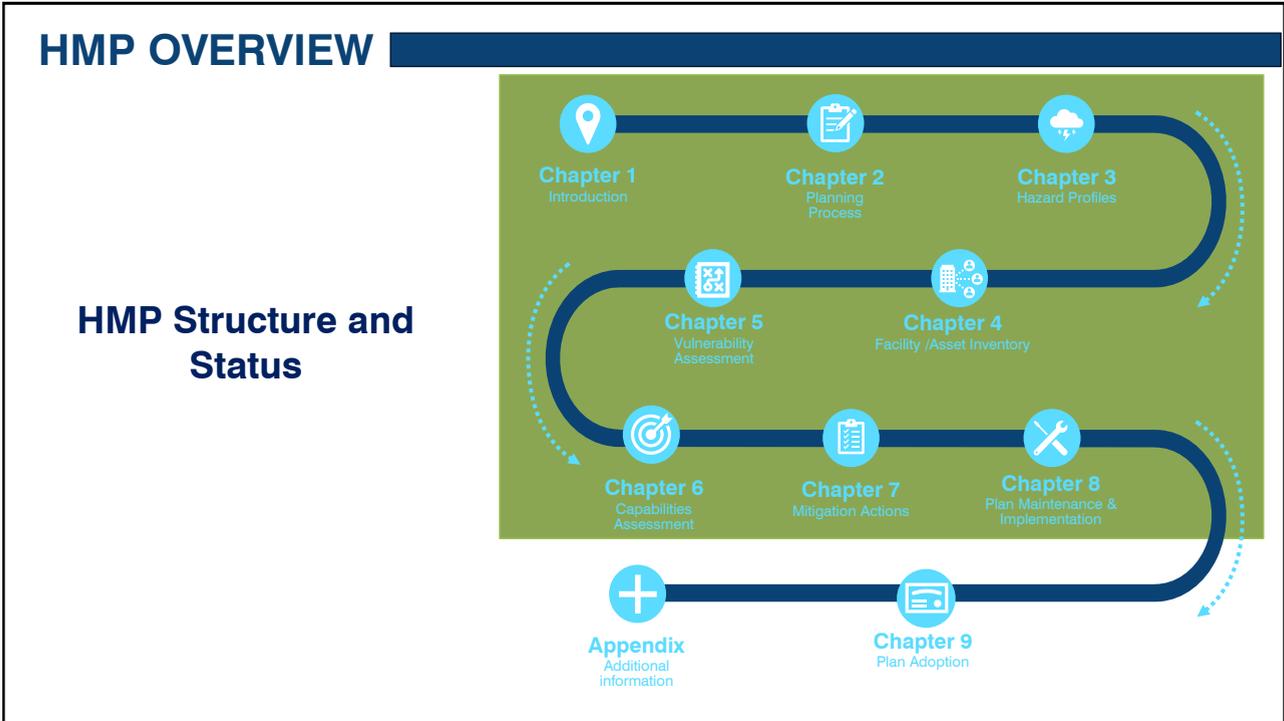


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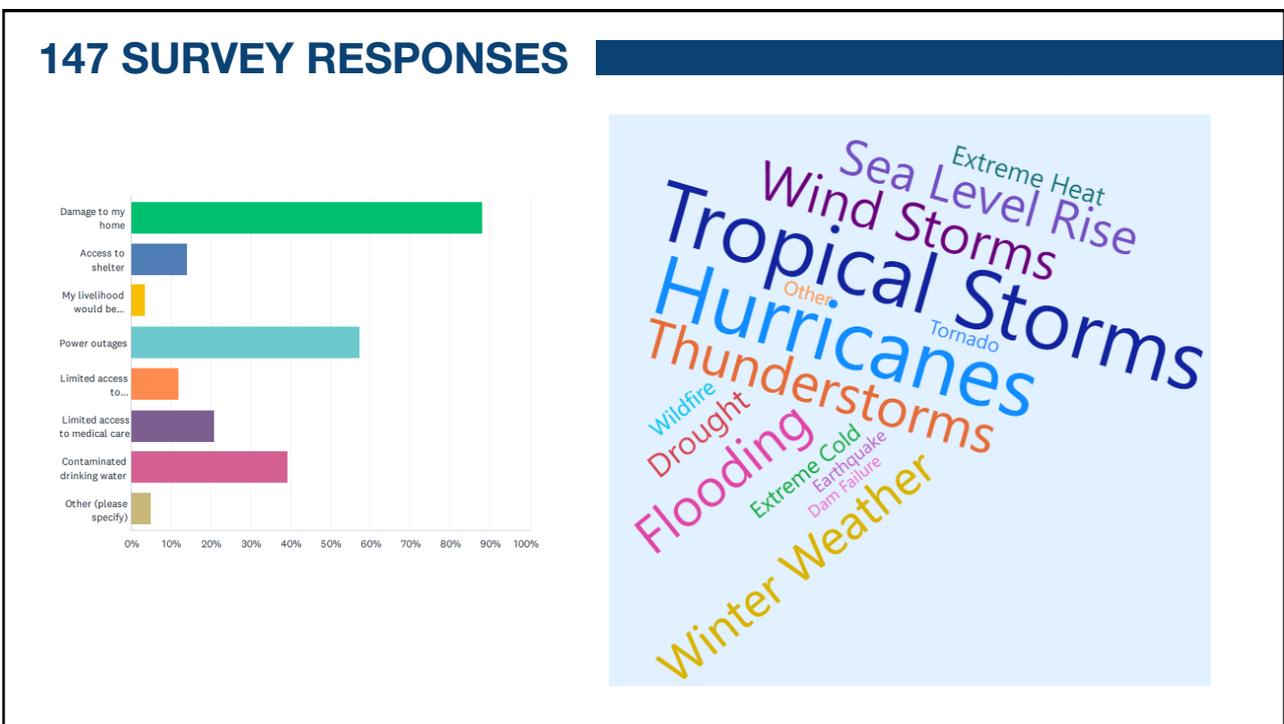
TENTATIVE SCHEDULE

TASK	2023				2024		
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Task 1 – Project Kickoff	█						
Task 2 – Comparison of the Existing Draft		█					
Task 3 – Review Meeting with the Guidance Committee		█					
Task 4 - Update the 2019 HMP		█					
Task 5 – Work Delegated by the Guidance Committee			█				
Task 6 - Mapping			█				
Task 7 – Monthly Progress Reports and Bimonthly Meetings	█	█	█	█	█	█	█
Task 8 Public Meetings						█	
Task 9 Address Public Comments							█

4



5



6

UPDATED HAZARDS

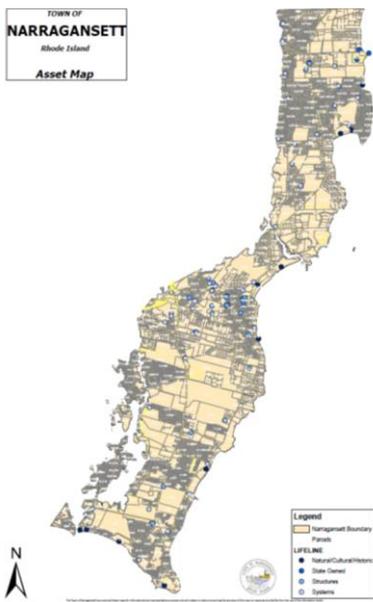


Natural Hazard	Previous Occurrence of Hazard Event in Narragansett	PRESENT			FUTURE
		Extent	Frequency	Location	Probability of Occurrence
Precipitation Flooding	Yes	Serious	High	Coastal areas	High
Winter Storms / Nor'easters	Yes	Serious	High	Town wide	High
Hurricanes / Tropical Cyclones	Yes	Catastrophic	High	County wide	High
Tornadoes	No	Serious	Very Low	N/A	Medium
Earthquakes	None	Minor	Very Low	N/A	Cannot be predicted
Landslides / Mudflows	No	Minor	Very Low	N/A	Medium
Average / Extreme Temperatures	Yes	Minor	High	Town wide	High
Drought	Yes	Minor	Low	Town wide	Medium
Changes in Groundwater	No	Serious	Low	Local	High
Wildfires	Yes	Minor	High	Local	Medium
Coastal Erosion	Yes	Serious	High	Coastal areas	High
Sea Level Rise	Yes	Serious	High	Coastal areas	High

7

CRITICAL ASSETS

TOWN OF NARRAGANSETT
Rhode Island
Asset Map



Structures Assets
(Town Hall)



Systems Assets
(Fuel Storage Tank)



Natural, Cultural, and Historic Resources Assets
(The Tower)



Private and State-Owned Assets
(URI, Narragansett Bay Campus)

Picture source: Town of Narragansett, Picture Gallery, URI website, W&S

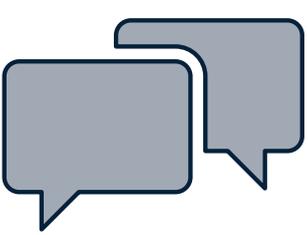
8

STAPLEE UPDATE

2024 Action Item Numbers	2019 Action Item Numbers	Name of Action Items	STAPLEE Scoring								Priority
			Social	Technical	Administrative	Political	Legal	Economic	Environmental	Total	
Critical Roads/Evacuation Routes											
1A	1	Evacuation	1	1	1	1	1	1	1	7	Low
1B	1	Sheltering	1	1	1	1	1	1	1	7	Low
Shoreline Features											
2	2	Beach and Dune Replenishment	3	3	2	3	3	3	3	20	High
Water & Wastewater Infrastructure											
3	3	Bypass Sewer Main	3	3	3	3	3	3	3	21	High
4	4	Water Supply	2	2	2	2	1	2	3	14	Medium
5	5	Flood proof Pump Stations	1	1	2	2	2	2	2	12	Medium
6	6	Retrofit Sewer Pump Stations	3	3	3	2	3	3	3	20	High
7	7	Scarborough WWTF Groin Rehab	1	1	1	1	1	1	1	7	Low
Public/Town-owned Assets											
8A	8	Underground Utilities	3	2	1	1	2	2	3	14	Medium
8B	8	Fire Alarm Communications	3	2	1	1	2	2	3	14	Medium
9	9	Town Tree Trimming Program	2	3	2	1	1	2	3	14	Medium
10	10	Tree Trimming Educational Program	1	1	1	1	1	1	2	8	Low
Causeways											
11	11	Causeways	3	2	2	2	3	2	3	17	High
Residential Areas											
12	12	Public Information, Outreach, and Incentive Program	3	2	1	1	2	3	3	15	Medium
13	13	Property Acquisition	1	2	2	1	2	3	3	14	Medium
14	14	Retrofit and Elevate, Relocate	1	2	2	1	2	3	3	14	Medium
15	15	Policy for Rebuilding	3	1	1	3	1	1	3	13	Medium
Natural Resources/Recreation Areas/Public Areas											
16	16	Open Space Acquisitions	3	1	2	1	2	3	3	15	Medium
Historic Structures/Signage											
17	17	Historic Flooding Signage Townwide	2	1	2	1	1	1	1	9	Low
18	18	Historic Flooding Informational Display for Town Hall	2	1	2	1	1	1	1	9	Low
Storm Water Assets											
19	19	Storm Water Projects	3	2	1	1	1	2	3	13	Medium

9

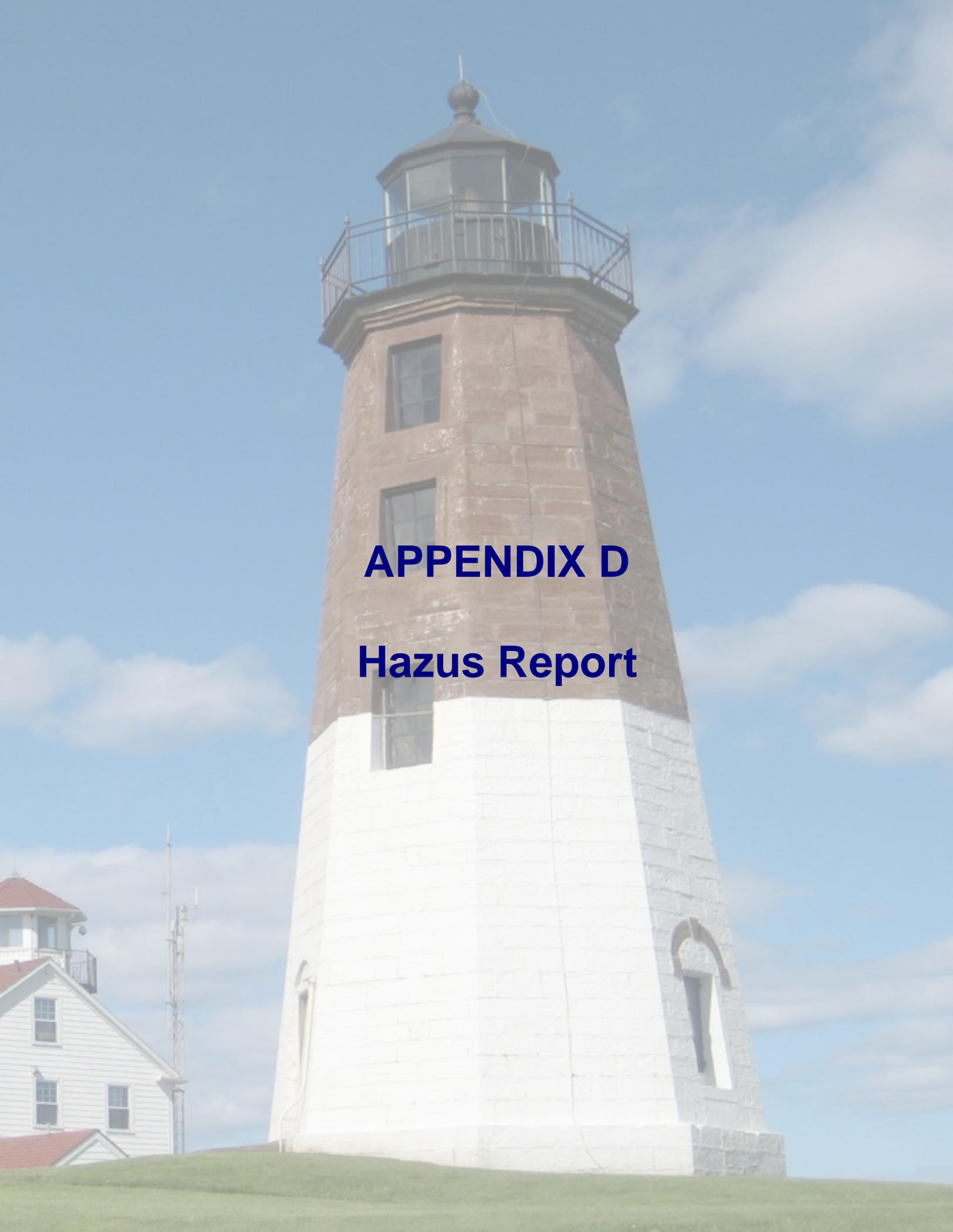
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QUESTIONS/ANSWERS

10





APPENDIX D

Hazus Report



Building Damage by Building Type

January 02, 2024

All values are in thousands of square feet

	Average Damage (%) Within Each Damage Range						
	< 1	1-10	11-20	21-30	31-40	41-50	Substantial
Rhode Island							
Washington							
Masonry	107.0	37.0	93.0	52.0	5.0	11.0	3.0
Concrete	16.0	14.0	26.0	8.0	1.0	3.0	0.0
Manuf Housing	0.0	0.0	0.0	0.0	0.0	0.0	9.0
Wood	1,467.0	276.0	759.0	619.0	277.0	107.0	181.0
Steel	76.0	54.0	175.0	63.0	12.0	15.0	11.0
Total	1,666.0	381.0	1,053.0	742.0	295.0	136.0	204.0
Total	1,666.0	381.0	1,053.0	742.0	295.0	136.0	204.0
Scenario Total	1,666.0	381.0	1,053.0	742.0	295.0	136.0	204.0

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Study Region: NarragansettRI
 Scenario: RiverineCoastal
 Return Period: 100



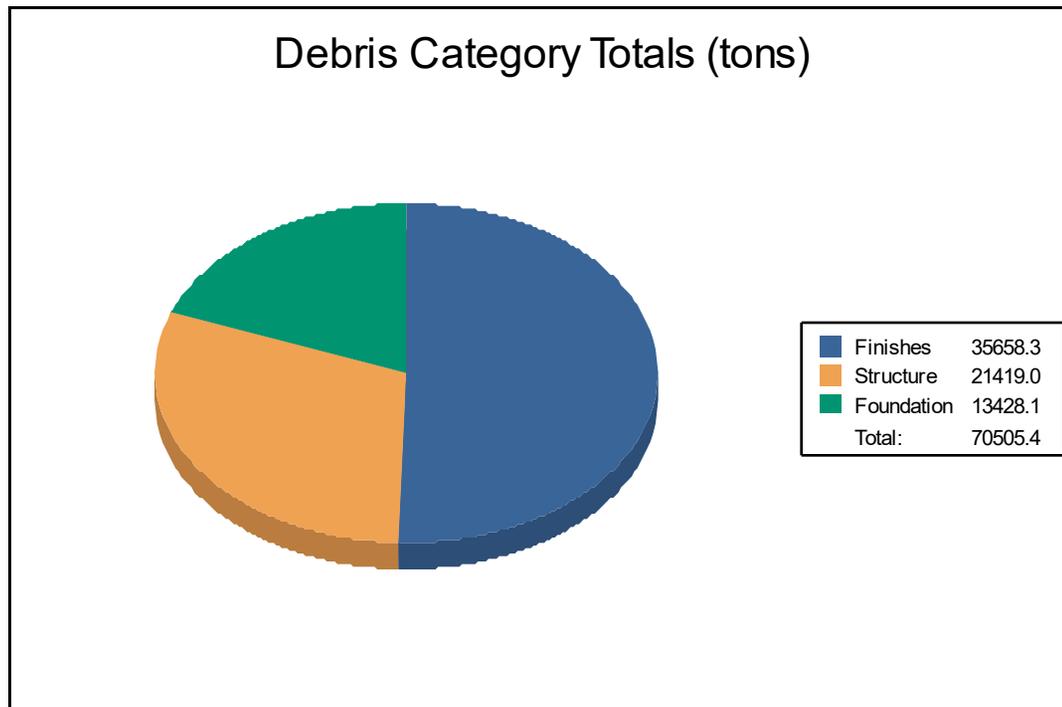
Debris Summary Report

January 02, 2024

All values are in tons.

	Finishes	Structures	Foundations	Total
Rhode Island				
Washington	35,658	21,419	13,428	70,505
Total	35,658	21,419	13,428	70,505
Scenario Total	35,658	21,419	13,428	70,505

Debris Summary Report



Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.



FEMA

Quick Assessment Report

RiskMAP
Increasing Resilience Together

January 2, 2024

Study Region : NarragansettRI
Scenario : RiverineCoastal
Return Period: 100
Analysis Option: 0

Regional Statistics

Area (Square Miles)	5
Number of Census Blocks	633
Number of Buildings	
Residential	5,842
Total	6,416
Number of People in the Region (x 1000)	15
Building Exposure (\$ Millions)	
Residential	2,044
Total	2,740

Scenario Results

Shelter Requirements

Displaced Population (# Households)	2,392
Short Term Shelter (# People)	472

Economic Loss

Residential Property (Capital Stock) Losses (\$ Millions)	255
Total Property (Capital Stock) Losses (\$ Millions)	369
Business Interruption (Income) Losses (\$ Millions)	292

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific flood. These results can be improved by using enhanced inventory data and flood hazard information.

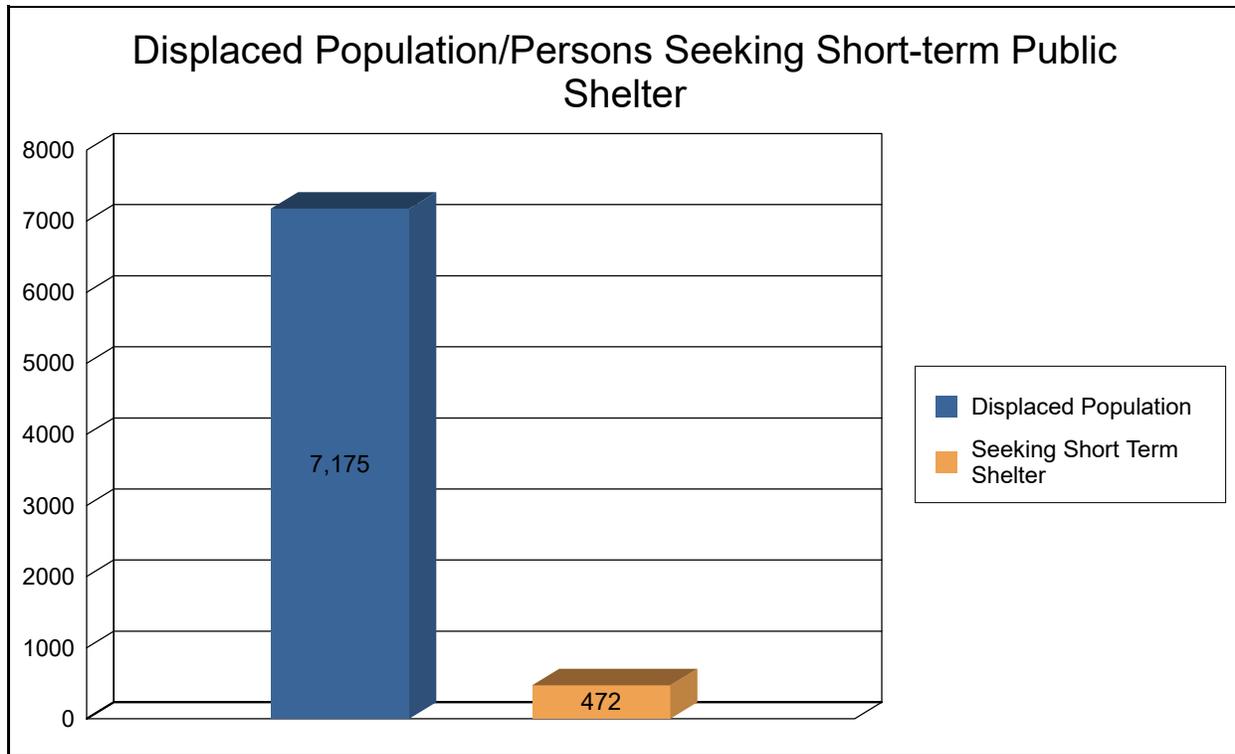


Shelter Summary Report



January 02, 2024

	# of Displaced People	# of People Needing Short Term Shelter
Rhode Island		
Washington	7,175	472
Total	7,175	472
Scenario Total	7,175	472



Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Study Region: NarragansettRI
 Scenario: RiverineCoastal
 Return Period: 100



Building Damage by Building Type

March 25, 2024

All values are in thousands of square feet

	Average Damage (%) Within Each Damage Range						
	< 1	1-10	11-20	21-30	31-40	41-50	Substantial
Rhode Island							
Washington							
Concrete	1.0	2.0	5.0	9.0	4.0	6.0	4.0
Wood	433.0	59.0	228.0	285.0	203.0	192.0	341.0
Manuf Housing	0.0	0.0	0.0	0.0	0.0	0.0	9.0
Masonry	27.0	8.0	19.0	27.0	17.0	28.0	20.0
Steel	22.0	17.0	37.0	65.0	40.0	47.0	45.0
Total	483.0	86.0	289.0	386.0	264.0	273.0	419.0
Total	483.0	86.0	289.0	386.0	264.0	273.0	419.0
Scenario Total	483.0	86.0	289.0	386.0	264.0	273.0	419.0

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Study Region: NarragansettRI
 Scenario: Narragansett RI Riverine and Coastal An
 Return Period: 500



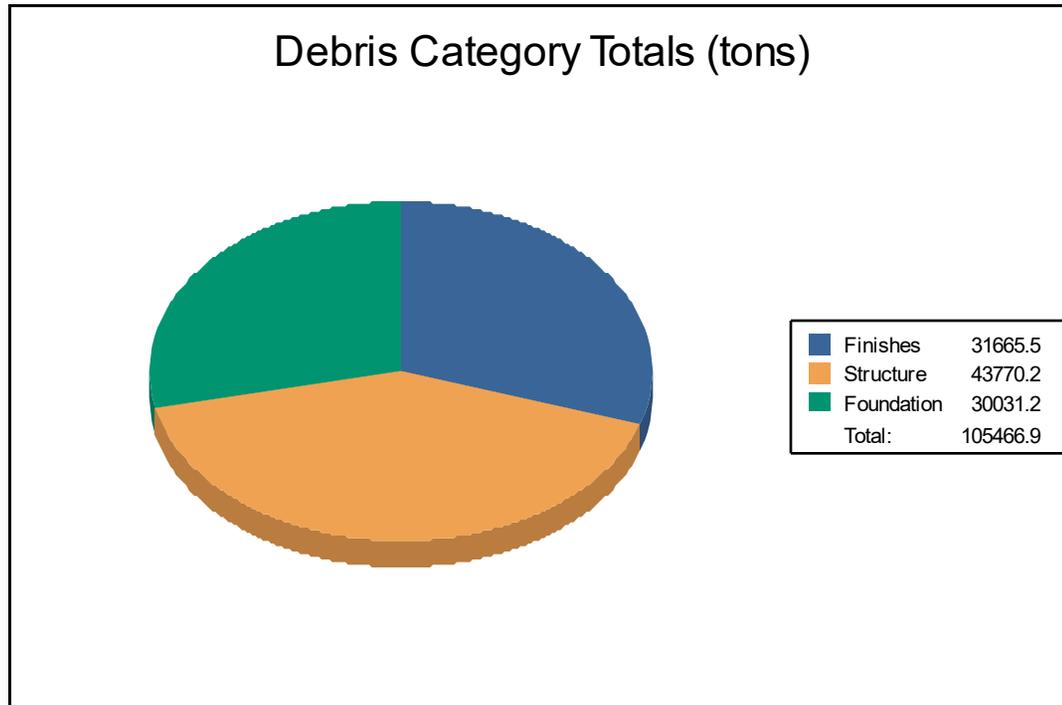
Debris Summary Report

March 25, 2024

All values are in tons.

	Finishes	Structures	Foundations	Total
Rhode Island				
Washington	31,666	43,770	30,031	105,467
Total	31,666	43,770	30,031	105,467
Scenario Total	31,666	43,770	30,031	105,467

Debris Summary Report



Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.



FEMA

Quick Assessment Report

RiskMAP
Increasing Resilience Together

March 25, 2024

Study Region : NarragansettRI
Scenario : Narragansett RI Riverine and Coastal
Return Period: 500
Analysis Option: 0

Regional Statistics

Area (Square Miles)	5
Number of Census Blocks	633
Number of Buildings	
Residential	5,842
Total	6,416
Number of People in the Region (x 1000)	15
Building Exposure (\$ Millions)	
Residential	2,044
Total	2,740

Scenario Results

Shelter Requirements

Displaced Population (# Households)	1,180
Short Term Shelter (# People)	282

Economic Loss

Residential Property (Capital Stock) Losses (\$ Millions)	209
Total Property (Capital Stock) Losses (\$ Millions)	330
Business Interruption (Income) Losses (\$ Millions)	232

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific flood. These results can be improved by using enhanced inventory data and flood hazard information.

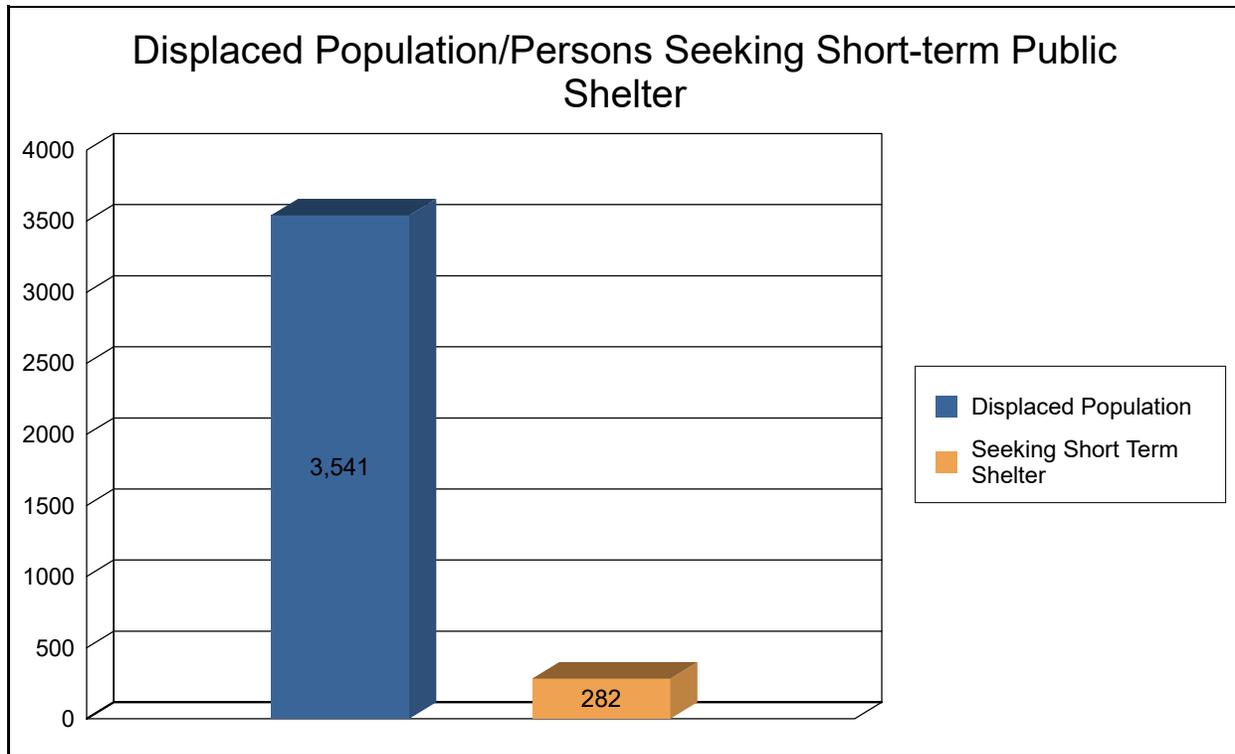


Shelter Summary Report



March 25, 2024

	# of Displaced People	# of People Needing Short Term Shelter
Rhode Island		
Washington	3,541	282
Total	3,541	282
Scenario Total	3,541	282



Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Study Region: NarragansettRI
Scenario: Narragansett RI Riverine and Coastal An
Return Period: 500



FEMA

RiskMAP
Increasing Resilience Together

Hazus: Hurricane Global Risk Report

Region Name: NarragansettRI

Hurricane Scenario: Probabilistic 100-year Return Period

Print Date: Monday, March 25, 2024

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.



Table of Contents

Section	Page #
General Description of the Region	3
Building Inventory	4
General Building Stock	
Essential Facility Inventory	
Hurricane Scenario Parameters	5
Building Damage	6
General Building Stock	
Essential Facilities Damage	
Induced Hurricane Damage	8
Debris Generation	
Social Impact	8
Shelter Requirements	
Economic Loss	9
Building Losses	
Appendix A: County Listing for the Region	10
Appendix B: Regional Population and Building Value Data	11



General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- Rhode Island

Note:

Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 15.46 square miles and contains 3 census tracts. There are over 6 thousand households in the region and a total population of 14,530 people. The distribution of population by State and County is provided in Appendix B.

There are an estimated 6 thousand buildings in the region with a total building replacement value (excluding contents) of 2,740 million dollars. Approximately 91% of the buildings (and 75% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 6,416 buildings in the region which have an aggregate total replacement value of Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides distribution of the building value by State and County.

Building Exposure by Occupancy Type

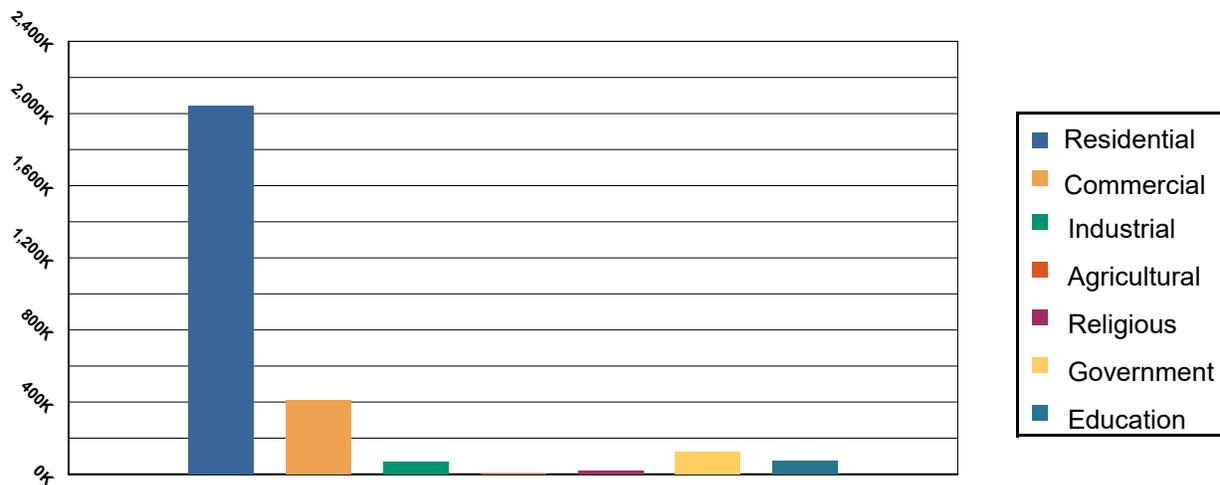


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure (\$1000)	Percent of Tot
Residential	2,043,967	74.59 %
Commercial	408,273	14.90%
Industrial	70,697	2.58%
Agricultural	1,916	0.07%
Religious	20,127	0.73%
Government	121,260	4.43%
Education	73,865	2.70%
Total	2,740,105	100.00%

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 4 schools, 3 fire stations, 1 police stations and 1 emergency operation facilities.



FEMA

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name: Probabilistic

Type: Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 309 buildings will be at least moderately damaged. This is over 5% of the total number of buildings in the region. There are an estimated 20 buildings that will be completely destroyed. The definition of the 'damage states' is provided in the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

Expected Building Damage by Occupancy

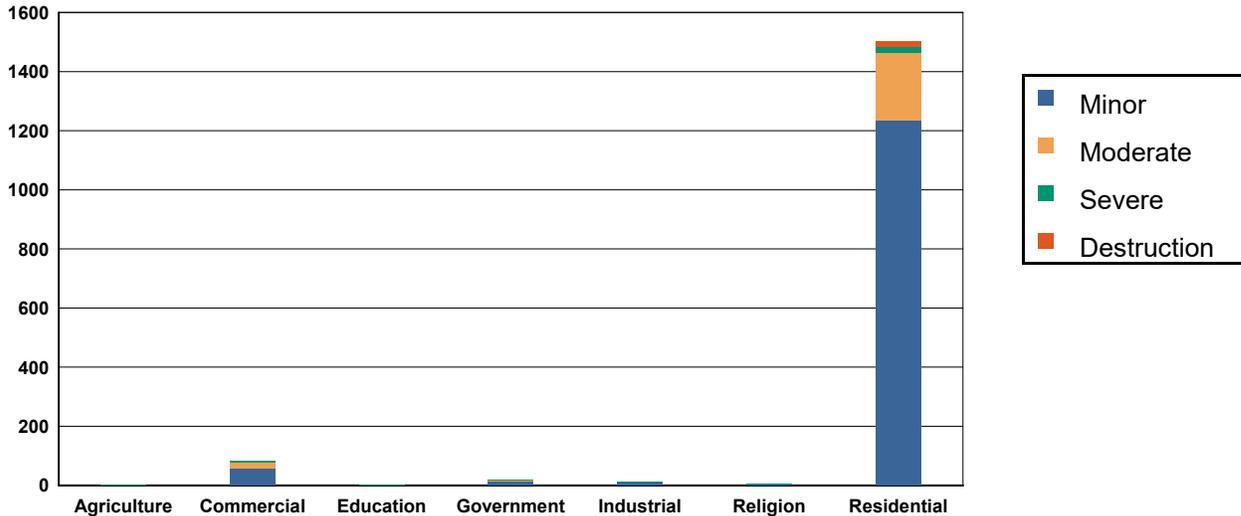


Table 2: Expected Building Damage by Occupancy : 100 - year Event

Occupancy	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	7.82	78.19	1.53	15.27	0.43	4.28	0.20	2.03	0.02	0.23
Commercial	296.55	78.04	56.26	14.80	22.35	5.88	4.81	1.27	0.03	0.01
Education	10.30	79.24	1.95	15.03	0.66	5.09	0.08	0.63	0.00	0.00
Government	71.29	80.10	12.62	14.18	4.50	5.06	0.59	0.67	0.00	0.00
Industrial	50.23	79.73	8.78	13.94	3.30	5.24	0.66	1.05	0.03	0.04
Religion	14.90	78.44	3.17	16.66	0.84	4.40	0.09	0.50	0.00	0.00
Residential	4,339.42	74.28	1,232.62	21.10	231.56	3.96	18.63	0.32	19.76	0.34
Total	4,790.51		1,316.93		263.65		25.07		19.84	



Table 3: Expected Building Damage by Building Type : 100 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	21	79.30	4	14.34	1	5.65	0	0.71	0	0.00
Masonry	139	73.74	30	16.05	18	9.43	1	0.74	0	0.04
MH	7	74.93	1	9.91	1	8.96	0	0.79	0	5.41
Steel	204	79.09	34	13.31	16	6.18	4	1.41	0	0.01
Wood	4,192	74.68	1,191	21.22	194	3.46	18	0.31	19	0.33



Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

Thematic Map of Essential Facilities

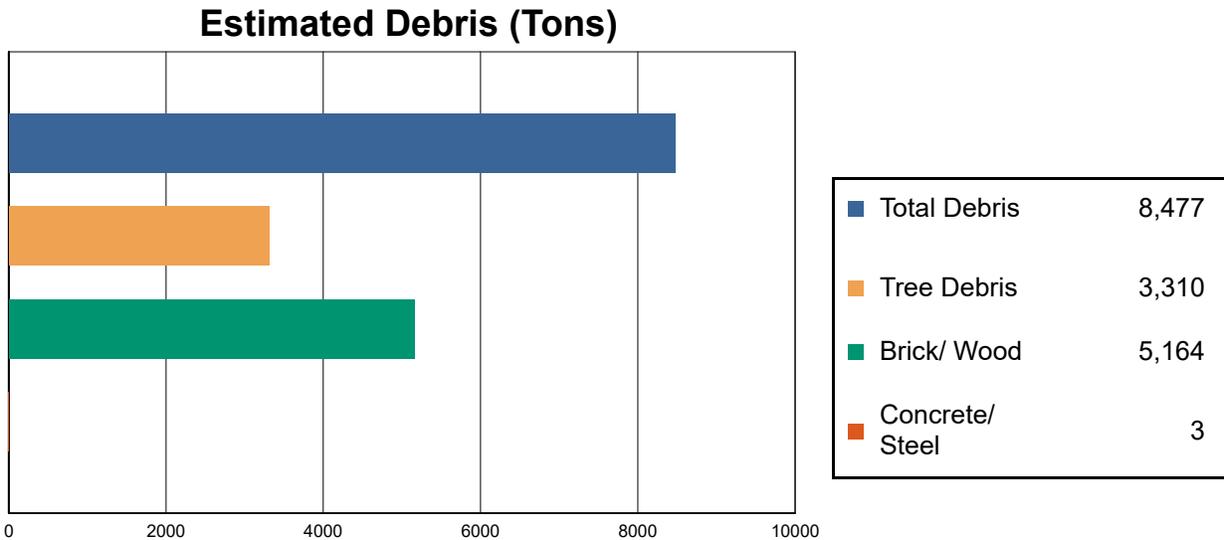


Table 4: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		Probability of at Least Moderate Damage > 50%	Probability of Complete Damage > 50%	Expected Loss of Use < 1 day
EOCs	1	0	0	1
Fire Stations	3	0	0	3
Police Stations	1	0	0	1
Schools	4	0	0	0

Induced Hurricane Damage

Debris Generation

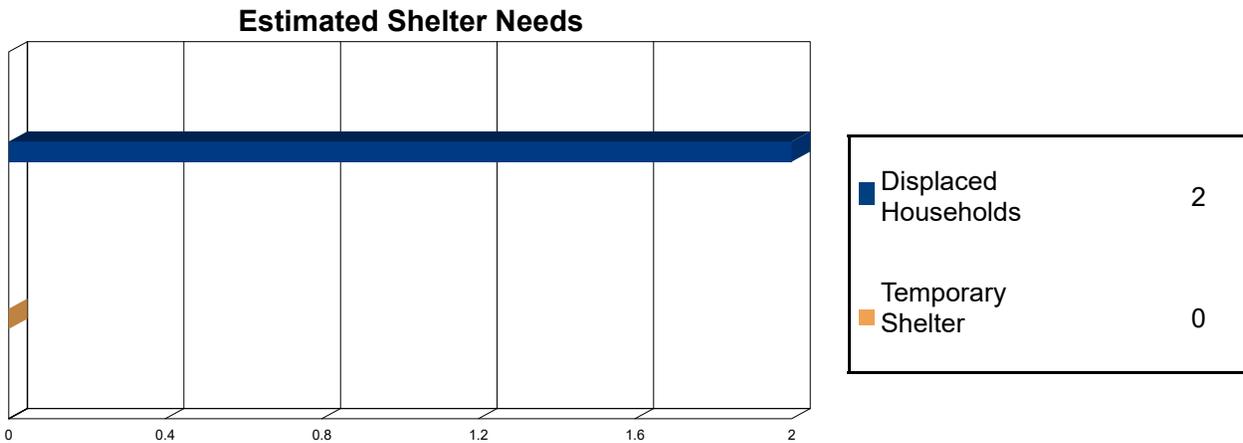


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 8,477 tons of debris will be generated. Of the total amount, 1,438 tons (17%) is Other Tree Debris. Of the remaining 7,039 tons, Brick/Wood comprises 73% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 207 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 1,872 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement



Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 2 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 14,530) will seek temporary shelter in public shelters.



Economic Loss

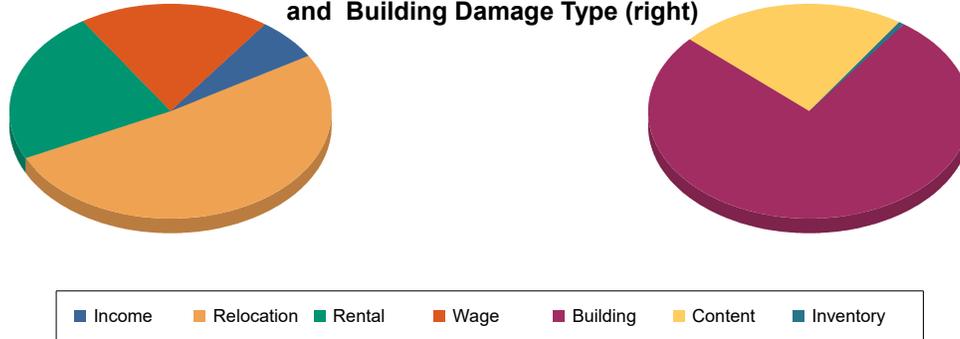
The total economic loss estimated for the hurricane is 76.0 million dollars, which represents 2.77 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 76 million dollars. 11% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 84% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.

Loss by Business Interruption Type (left) and Building Damage Type (right)



Loss Type by General Occupancy

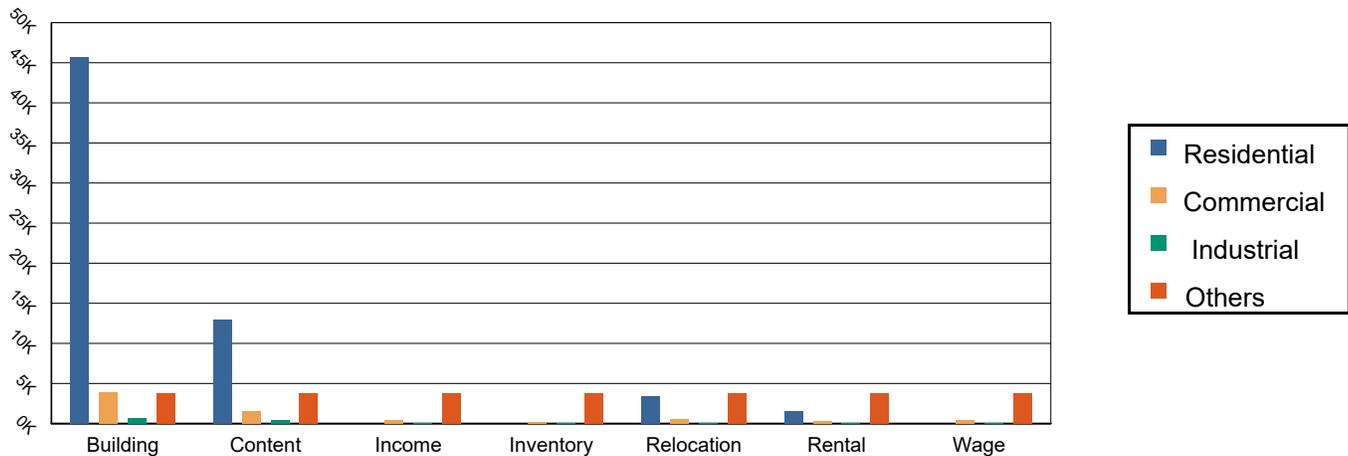


Table 5: Building-Related Economic Loss Estimates
(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	45,665.18	3,932.28	644.14	1,539.62	51,781.22
	Content	12,941.23	1,535.86	409.29	559.05	15,445.41
	Inventory	0.00	221.27	53.74	8.05	283.06
	Subtotal	58,606.41	5,689.40	1,107.17	2,106.71	67,509.69
Business Interruption Loss						
	Income	0.00	443.29	7.09	88.27	538.64
	Relocation	3,353.30	611.95	44.86	322.35	4,332.45
	Rental	1,547.62	339.64	6.11	71.73	1,965.11
	Wage	0.00	440.61	11.94	1,161.45	1,614.00
	Subtotal	4,900.92	1,835.48	70.00	1,643.80	8,450.20



FEMA

Total

Total	63,507.32	7,524.88	1,177.17	3,750.51	75,959.88
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Appendix A: County Listing for the Region

Rhode Island
- Washington



Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Rhode Island				
Washington	14,530	2,043,967	696,138	2,740,105
Total	14,530	2,043,967	696,138	2,740,105
Study Region Total	14,530	2,043,967	696,138	2,740,105



FEMA

RiskMAP
Increasing Resilience Together

Hazus: Hurricane Global Risk Report

Region Name: NarragansettRI

Hurricane Scenario: Probabilistic 500-year Return Period

Print Date: Monday, March 25, 2024

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.



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General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- Rhode Island

Note:

Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 15.46 square miles and contains 3 census tracts. There are over 6 thousand households in the region and a total population of 14,530 people. The distribution of population by State and County is provided in Appendix B.

There are an estimated 6 thousand buildings in the region with a total building replacement value (excluding contents) of 2,740 million dollars. Approximately 91% of the buildings (and 75% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 6,416 buildings in the region which have an aggregate total replacement value of Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides distribution of the building value by State and County.

Building Exposure by Occupancy Type

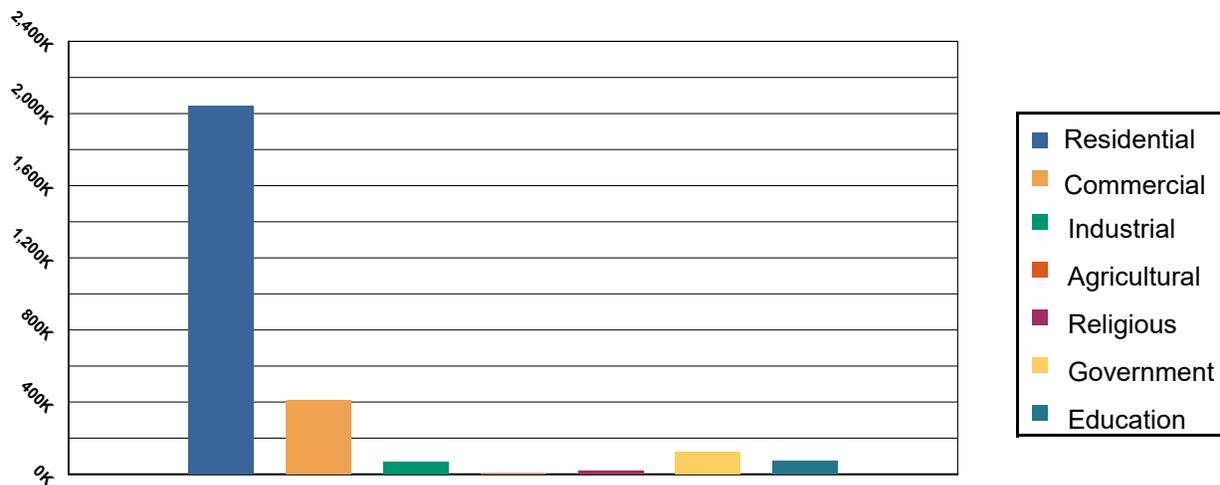


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure (\$1000)	Percent of Tot
Residential	2,043,967	74.59 %
Commercial	408,273	14.90%
Industrial	70,697	2.58%
Agricultural	1,916	0.07%
Religious	20,127	0.73%
Government	121,260	4.43%
Education	73,865	2.70%
Total	2,740,105	100.00%

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 4 schools, 3 fire stations, 1 police stations and 1 emergency operation facilities.



FEMA

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name: Probabilistic

Type: Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 1,323 buildings will be at least moderately damaged. This is over 21% of the total number of buildings in the region. There are an estimated 164 buildings that will be completely destroyed. The definition of the 'damage states' is provided in the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

Expected Building Damage by Occupancy

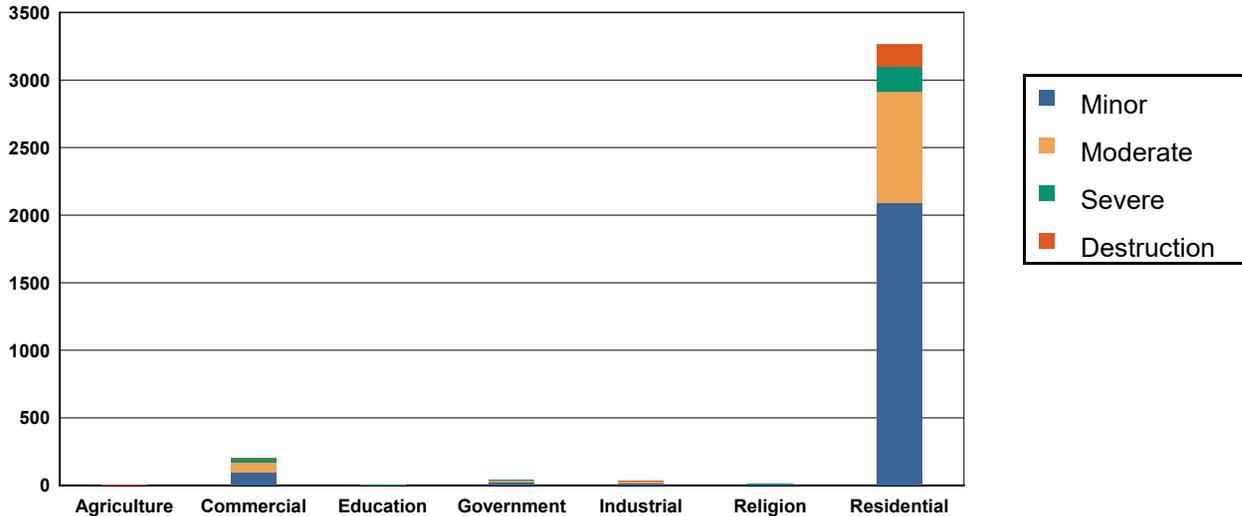


Table 2: Expected Building Damage by Occupancy : 500 - year Event

Occupancy	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	4.64	46.37	2.97	29.68	1.47	14.69	0.77	7.72	0.15	1.54
Commercial	179.25	47.17	95.89	25.23	73.96	19.46	30.51	8.03	0.39	0.10
Education	6.27	48.20	3.32	25.52	2.53	19.43	0.89	6.85	0.00	0.00
Government	44.12	49.58	21.55	24.21	17.08	19.19	6.25	7.02	0.00	0.00
Industrial	30.83	48.94	15.04	23.87	12.03	19.09	4.92	7.81	0.18	0.29
Religion	8.97	47.21	5.64	29.70	3.36	17.66	1.03	5.43	0.00	0.00
Residential	2,580.98	44.18	2,093.85	35.84	820.45	14.04	183.45	3.14	163.27	2.79
Total	2,855.07		2,238.25		930.88		227.82		163.99	



Table 3: Expected Building Damage by Building Type : 500 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	13	48.33	6	23.25	5	21.03	2	7.39	0	0.00
Masonry	84	44.45	46	24.32	48	25.37	10	5.54	1	0.32
MH	4	41.33	1	12.94	2	19.40	0	3.90	2	22.43
Steel	125	48.44	56	21.64	53	20.38	24	9.45	0	0.10
Wood	2,497	44.49	2,047	36.47	739	13.16	173	3.08	158	2.81



Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

Thematic Map of Essential Facilities

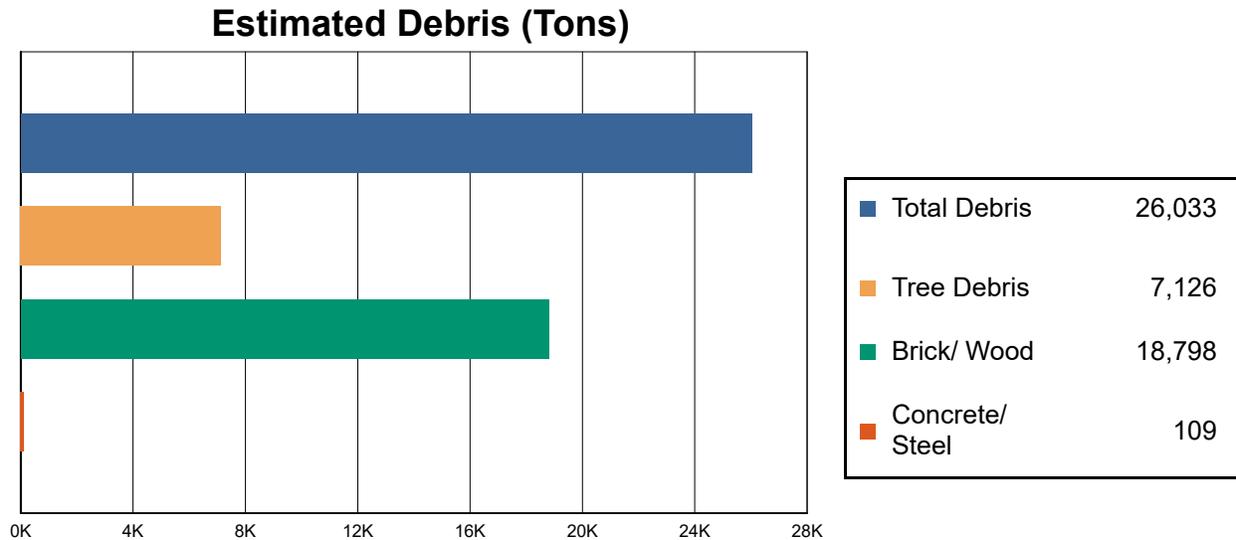


Table 4: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		Probability of at Least Moderate Damage > 50%	Probability of Complete Damage > 50%	Expected Loss of Use < 1 day
EOCs	1	0	0	1
Fire Stations	3	0	0	3
Police Stations	1	0	0	1
Schools	4	0	0	0

Induced Hurricane Damage

Debris Generation

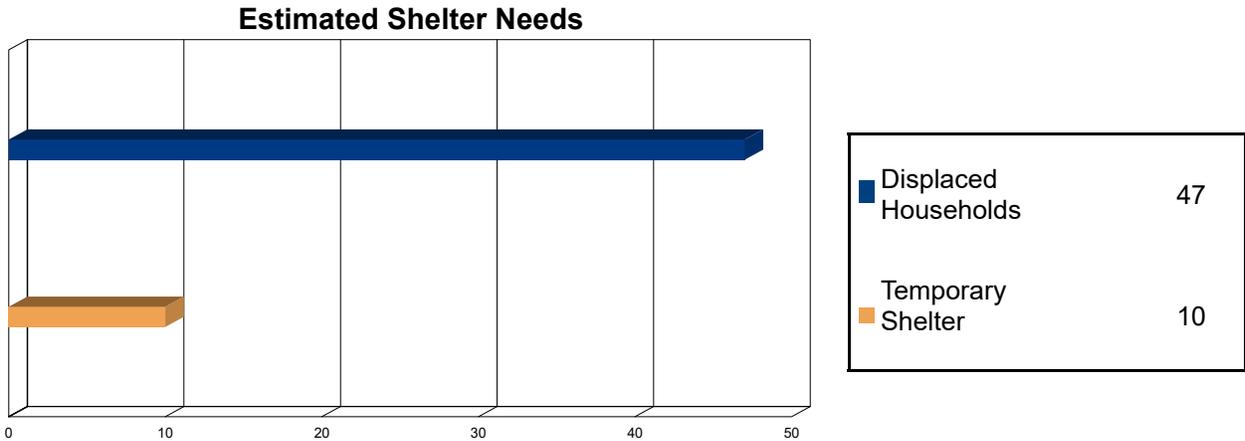


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 26,033 tons of debris will be generated. Of the total amount, 3,084 tons (12%) is Other Tree Debris. Of the remaining 22,949 tons, Brick/Wood comprises 82% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 756 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 4,042 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement



Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 47 households to be displaced due to the hurricane. Of these, 10 people (out of a total population of 14,530) will seek temporary shelter in public shelters.



Economic Loss

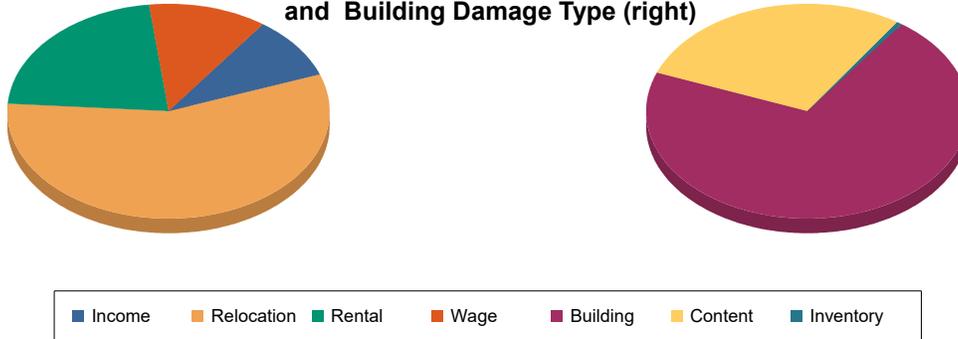
The total economic loss estimated for the hurricane is 322.4 million dollars, which represents 11.77 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 322 million dollars. 13% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 81% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.

Loss by Business Interruption Type (left) and Building Damage Type (right)



Loss Type by General Occupancy

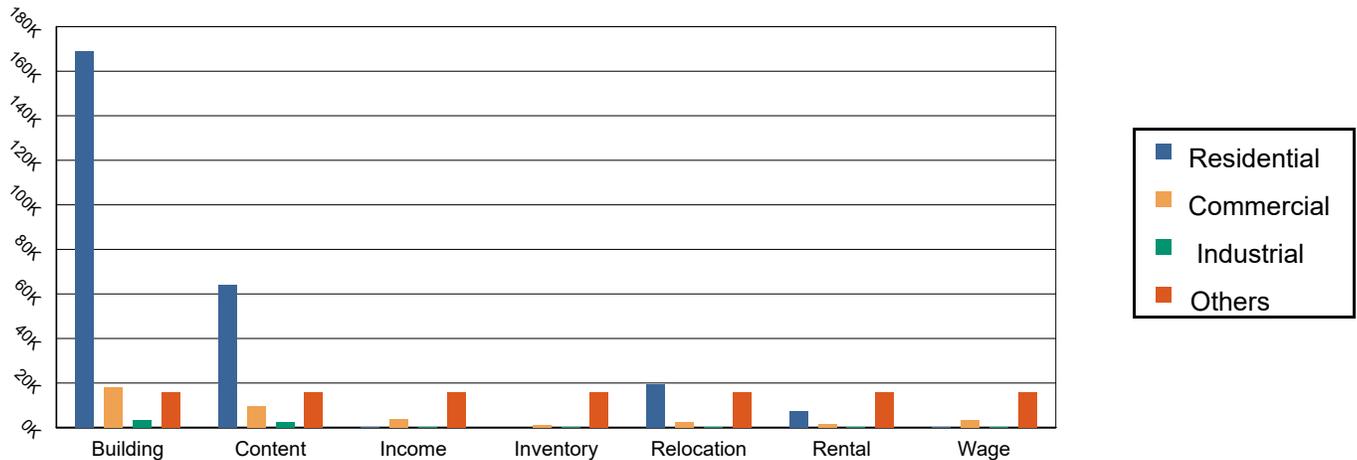


Table 5: Building-Related Economic Loss Estimates
(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	168,781.03	18,165.93	3,267.65	8,071.48	198,286.09
	Content	64,319.26	9,469.39	2,495.98	4,035.26	80,319.88
	Inventory	0.00	1,341.10	323.76	38.19	1,703.06
	Subtotal	233,100.29	28,976.42	6,087.40	12,144.93	280,309.03
Business Interruption Loss						
	Income	51.69	3,818.69	35.17	115.09	4,020.64
	Relocation	19,240.39	2,695.45	209.28	1,669.15	23,814.27
	Rental	7,212.69	1,574.22	31.02	394.84	9,212.77
	Wage	121.78	3,323.06	58.97	1,550.63	5,054.44
	Subtotal	26,626.54	11,411.43	334.44	3,729.71	42,102.13



FEMA

Total

Total	259,726.83	40,387.85	6,421.84	15,874.64	322,411.16
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Appendix A: County Listing for the Region

Rhode Island
- Washington



Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Rhode Island				
Washington	14,530	2,043,967	696,138	2,740,105
Total	14,530	2,043,967	696,138	2,740,105
Study Region Total	14,530	2,043,967	696,138	2,740,105



FEMA

RiskMAP
Increasing Resilience Together

Hazus: Earthquake Global Risk Report

Region Name NarragansettRI

Earthquake Scenario: Narragansett RI Earthquake Mag5

Print Date: March 25, 2024

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

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Appendix A: County Listing for the Region

Appendix B: Regional Population and Building Value Data



FEMA

General Description of the Region

Hazus-MH is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Rhode Island

Note:

Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 15.45 square miles and contains 3 census tracts. There are over 6 thousand households in the region which has a total population of 14,532 people. The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 6 thousand buildings in the region with a total building replacement value (excluding contents) of 2,740 (millions of dollars). Approximately 91.00 % of the buildings (and 75.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 605 and 470 (millions of dollars), respectively.



FEMA

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 6 thousand buildings in the region which have an aggregate total replacement value of 2,740 (millions of dollars) . Appendix B provides a general distribution of the building value by Total Region and County.

In terms of building construction types found in the region, wood frame construction makes up 89% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 0 hospitals in the region with a total bed capacity of beds. There are 4 schools, 3 fire stations, 1 police stations and 1 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes no hazardous material sites, no military installations and no nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 1,075.00 (millions of dollars). This inventory includes over 51.57 miles of highways, 9 bridges, 334.30 miles of pipes.

Table 1: Transportation System Lifeline Inventory

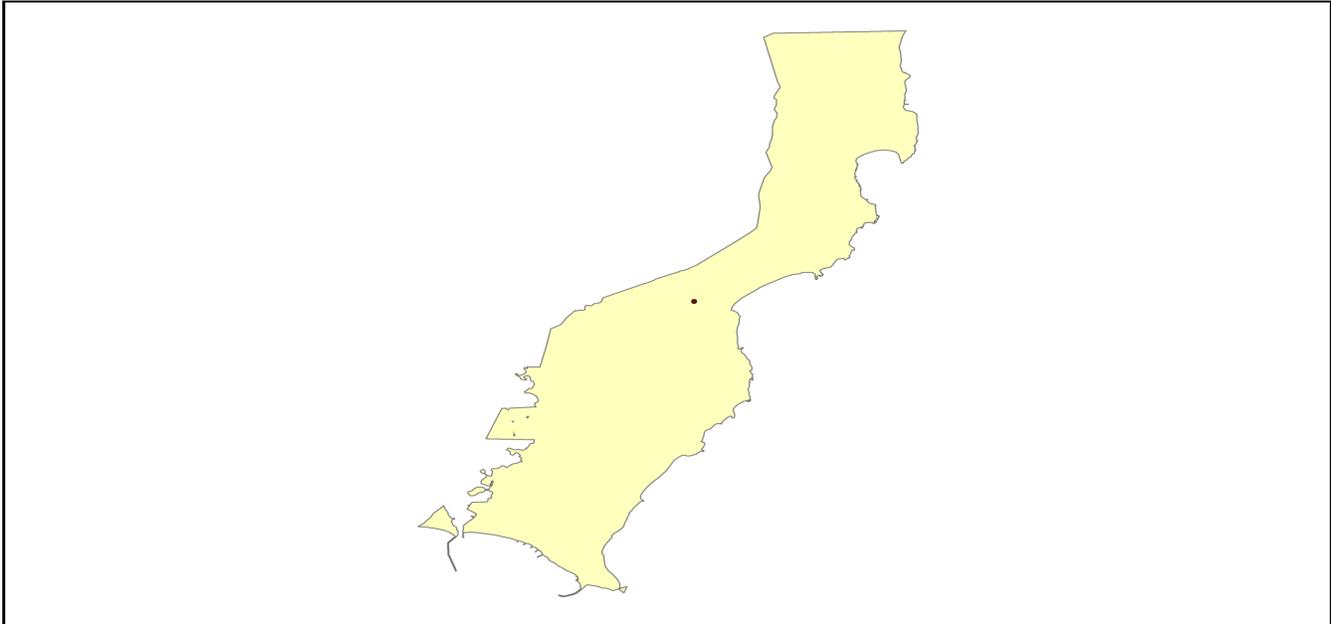
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	9	27.3334
	Segments	21	522.7847
	Tunnels	0	0.0000
	Subtotal		550.1181
Railways	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	0	0.0000
	Tunnels	0	0.0000
	Subtotal		0.0000
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	0	0.0000
	Tunnels	0	0.0000
	Subtotal		0.0000
Bus	Facilities	0	0.0000
	Subtotal		0.0000
Ferry	Facilities	1	1.3310
	Subtotal		1.3310
Port	Facilities	16	54.3439
	Subtotal		54.3439
Airport	Facilities	0	0.0000
	Runways	0	0.0000
	Subtotal		0.0000
		Total	605.80

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	5.3833
	Facilities	0	0.0000
	Pipelines	0	0.0000
	Subtotal		5.3833
Waste Water	Distribution Lines	NA	3.2300
	Facilities	3	459.6462
	Pipelines	0	0.0000
	Subtotal		462.8762
Natural Gas	Distribution Lines	NA	2.1533
	Facilities	0	0.0000
	Pipelines	0	0.0000
	Subtotal		2.1533
Oil Systems	Facilities	0	0.0000
	Pipelines	0	0.0000
	Subtotal		0.0000
Electrical Power	Facilities	0	0.0000
	Subtotal		0.0000
Communication	Facilities	1	0.1130
	Subtotal		0.1130
		Total	470.50

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.



Scenario Name	Narragansett RI Earthquake Mag5
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-71.46
Latitude of Epicenter	41.43
Earthquake Magnitude	5.00
Depth (km)	10.00
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	Central & East US (CEUS 2008)

Direct Earthquake Damage

Building Damage

Hazus estimates that about 1,217 buildings will be at least moderately damaged. This is over 19.00 % of the buildings in the region. There are an estimated 54 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Damage Categories by General Occupancy Type

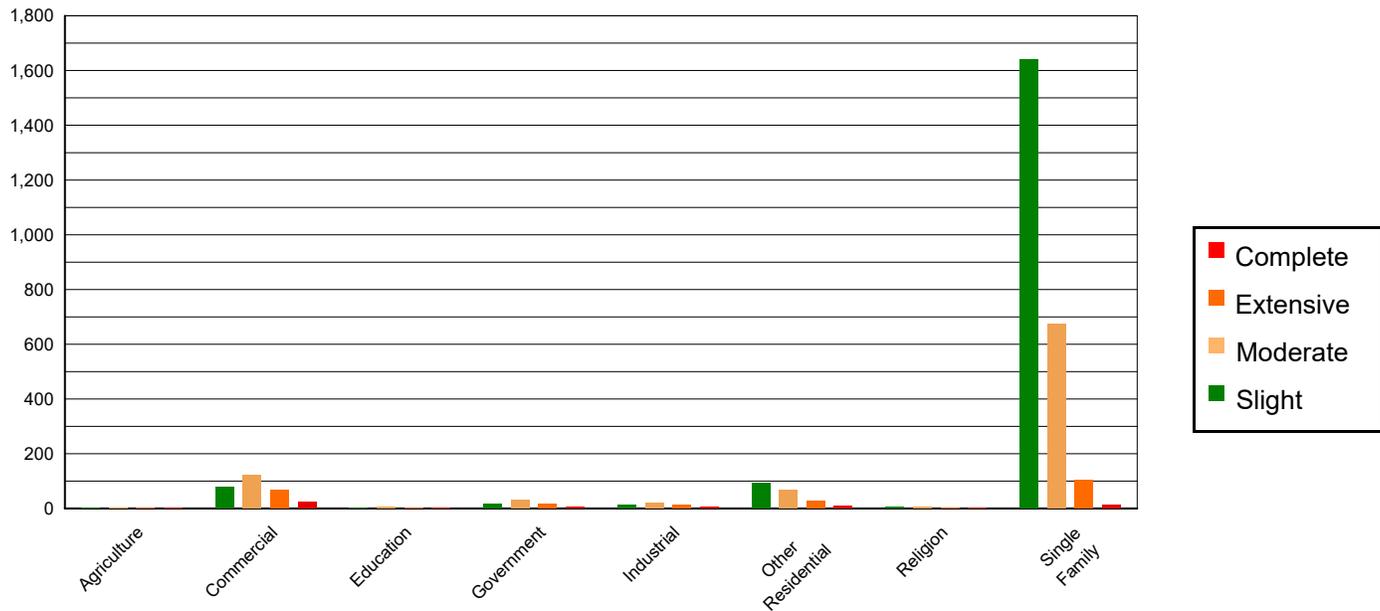


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	2.33	0.07	2.46	0.13	3.27	0.35	1.47	0.63	0.48	0.87
Commercial	88.21	2.64	79.64	4.30	122.89	13.25	67.10	28.55	22.16	40.47
Education	3.09	0.09	2.65	0.14	4.22	0.46	2.29	0.97	0.75	1.38
Government	19.47	0.58	16.70	0.90	29.59	3.19	17.46	7.43	5.78	10.55
Industrial	13.82	0.41	11.87	0.64	20.74	2.24	12.45	5.30	4.12	7.53
Other Residential	154.67	4.62	92.27	4.98	68.60	7.39	29.25	12.45	8.22	15.01
Religion	6.90	0.21	4.49	0.24	4.49	0.48	2.37	1.01	0.76	1.38
Single Family	3059.14	91.38	1640.91	88.65	673.87	72.64	102.60	43.66	12.48	22.80
Total	3,348		1,851		928		235		55	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	3176.37	94.88	1712.88	92.54	701.18	75.59	94.04	40.02	6.06	11.06
Steel	55.67	1.66	46.91	2.53	96.42	10.39	60.10	25.58	20.92	38.20
Concrete	8.93	0.27	7.87	0.43	18.21	1.96	11.59	4.93	3.41	6.22
Precast	3.14	0.09	2.20	0.12	5.52	0.59	5.39	2.29	1.56	2.85
RM	22.96	0.69	10.60	0.57	21.46	2.31	16.61	7.07	2.74	5.00
URM	79.24	2.37	68.84	3.72	81.58	8.79	45.07	19.18	19.54	35.68
MH	1.31	0.04	1.66	0.09	3.29	0.35	2.20	0.94	0.54	0.99
Total	3,348		1,851		928		235		55	

*Note:

- RM Reinforced Masonry
- URM Unreinforced Masonry
- MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had hospital beds available for use. On the day of the earthquake, the model estimates that only hospital beds (%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, % of the beds will be back in service. By 30 days, % will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	0	0	0	0
Schools	4	4	0	0
EOCs	1	1	0	0
PoliceStations	1	1	0	0
FireStations	3	2	0	1

Transportation Lifeline Damage

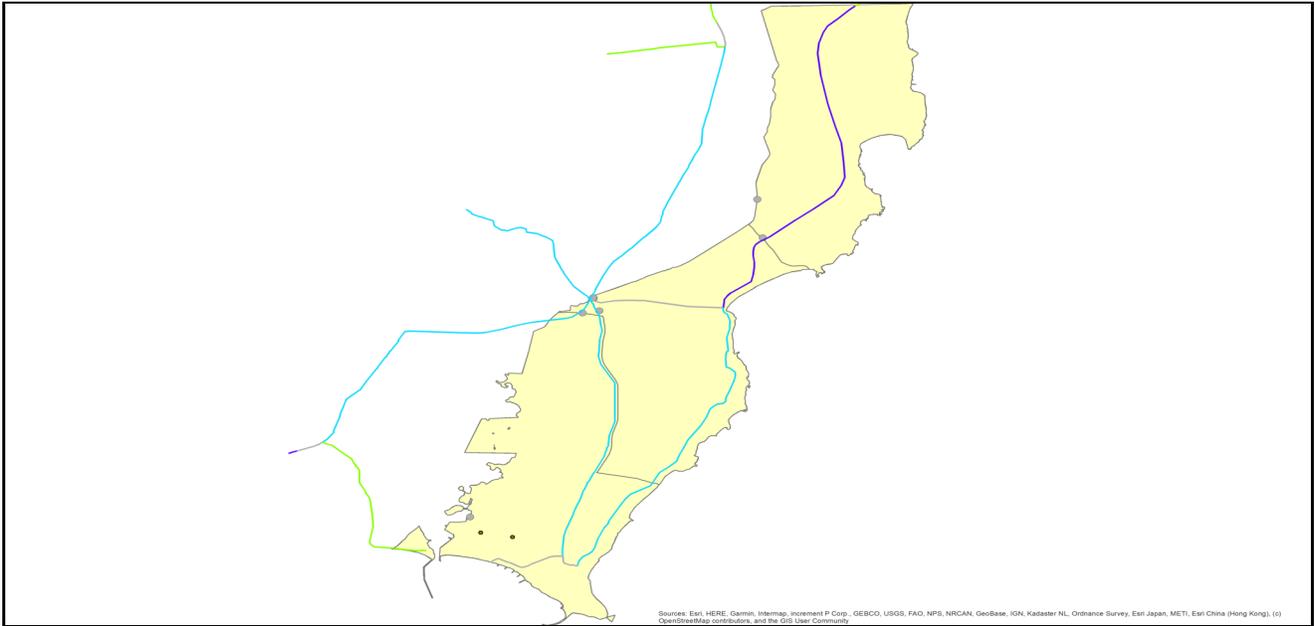


Table 6: Expected Damage to the Transportation Systems

System	Component	Locations/ Segments	Number of Locations_			
			With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	21	0	0	21	21
	Bridges	9	1	0	8	9
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	1	1	0	1	1
Port	Facilities	16	1	0	16	16
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Table 6 provides damage estimates for the transportation system.

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	3	3	0	0	3
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	1	1	0	0	1

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	167	42	11
Waste Water	100	21	5
Natural Gas	67	7	2
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	6,600	0	0	0	0	0
Electric Power		5,882	4,974	3,033	456	7

Induced Earthquake Damage

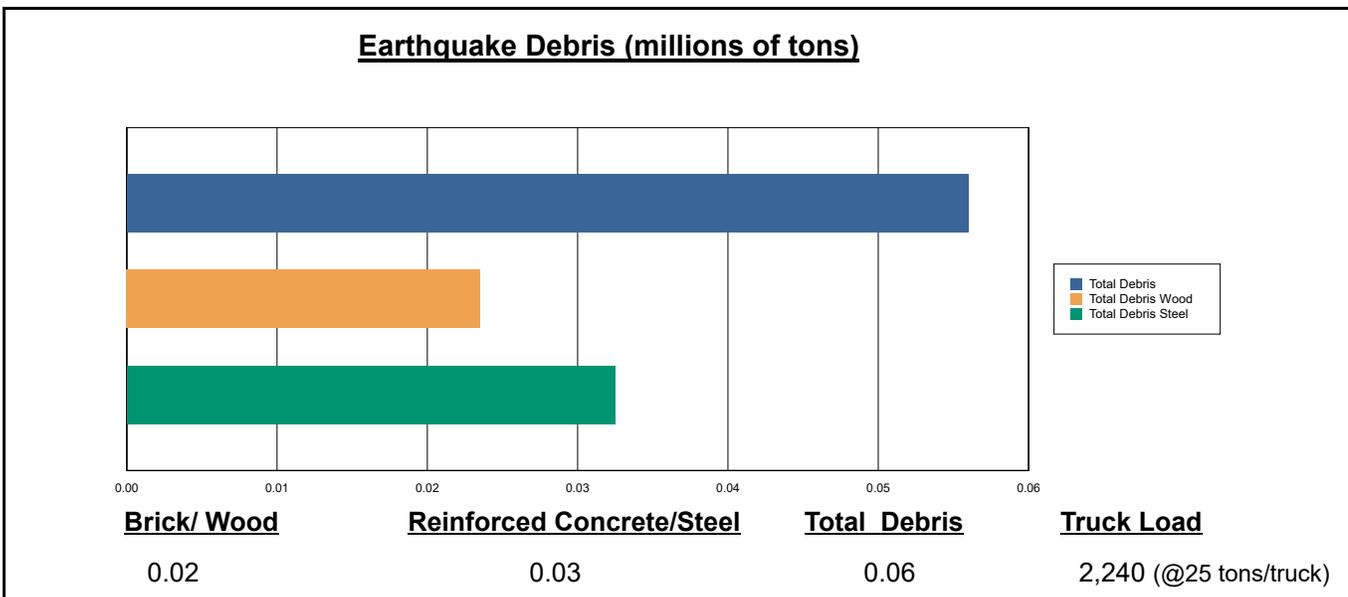
Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

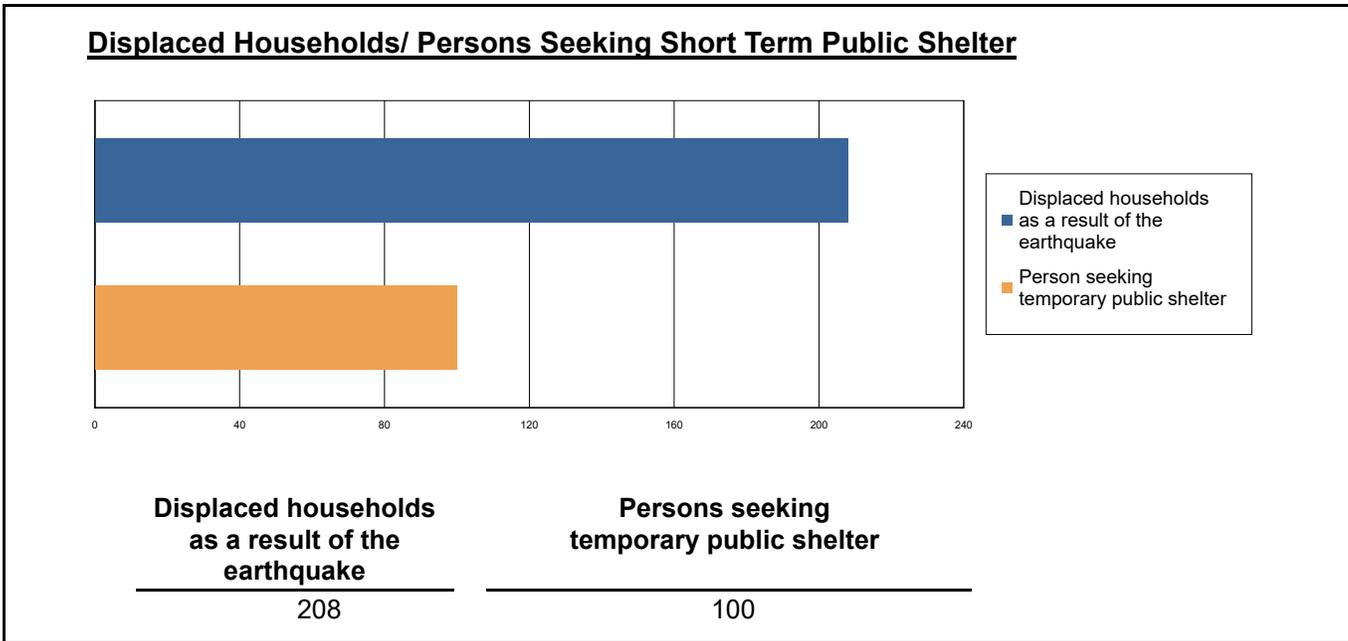
The model estimates that a total of 56,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 42.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 2,240 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.



Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 208 households to be displaced due to the earthquake. Of these, 100 people (out of a total population of 14,532) will seek temporary shelter in public shelters.



Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	1.07	0.26	0.04	0.07
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.63	0.16	0.02	0.04
	Other-Residential	10.10	2.44	0.35	0.69
	Single Family	12.70	1.83	0.15	0.29
	Total	24	5	1	1
2 PM	Commercial	73.17	18.04	2.51	4.87
	Commuting	0.02	0.02	0.04	0.01
	Educational	10.47	2.68	0.40	0.78
	Hotels	0.00	0.00	0.00	0.00
	Industrial	4.62	1.15	0.16	0.31
	Other-Residential	4.23	1.04	0.15	0.29
	Single Family	4.90	0.73	0.07	0.12
	Total	97	24	3	6
5 PM	Commercial	46.36	11.45	1.60	3.08
	Commuting	0.30	0.38	0.67	0.13
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	2.89	0.72	0.10	0.19
	Other-Residential	4.01	0.99	0.15	0.27
	Single Family	4.94	0.74	0.07	0.12
	Total	58	14	3	4



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Economic Loss

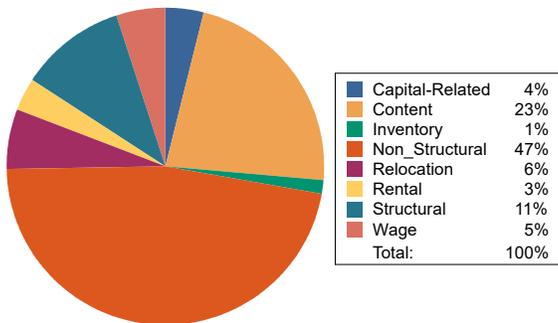
The total economic loss estimated for the earthquake is 532.65 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 375.06 (millions of dollars); 18 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 48 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Earthquake Losses by Loss Type (\$ millions)



Earthquake Losses by Occupancy Type (\$ millions)

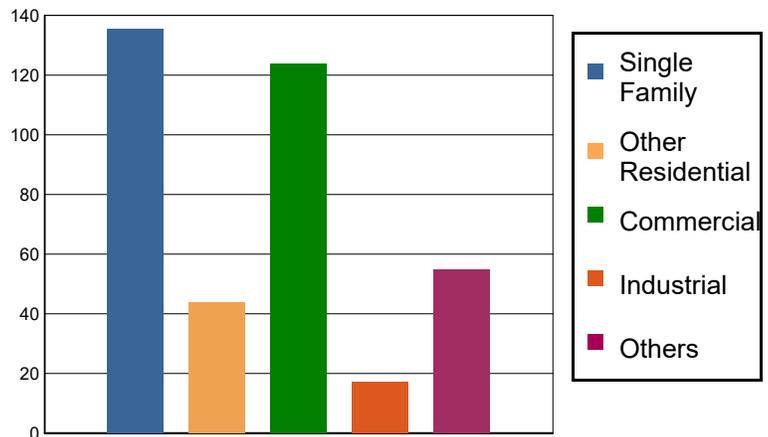


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	1.4666	13.7960	0.3295	2.8927	18.4848
	Capital-Related	0.0000	0.6226	13.1693	0.1938	0.2513	14.2370
	Rental	1.8195	3.2554	5.1958	0.1249	1.7251	12.1207
	Relocation	6.6869	1.5837	7.8835	0.5767	6.6978	23.4286
	Subtotal	8.5064	6.9283	40.0446	1.2249	11.5669	68.2711
Capital Stock Losses							
	Structural	12.2137	3.9384	15.1538	2.2641	7.5829	41.1529
	Non_Structural	77.3605	25.0997	41.9431	7.5488	23.5401	175.4922
	Content	37.4173	7.8222	22.4562	5.2273	12.0621	84.9851
	Inventory	0.0000	0.0000	4.1680	0.8912	0.0948	5.1540
	Subtotal	126.9915	36.8603	83.7211	15.9314	43.2799	306.7842
	Total	135.50	43.79	123.77	17.16	54.85	375.06

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	522.7847	0.0000	0.00
	Bridges	27.3334	1.1357	4.15
	Tunnels	0.0000	0.0000	0.00
	Subtotal	550.1181	1.1357	
Railways	Segments	0.0000	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	0.0000	0.0000	
Light Rail	Segments	0.0000	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	0.0000	0.0000	
Bus	Facilities	0.0000	0.0000	0.00
	Subtotal	0.0000	0.0000	
Ferry	Facilities	1.3310	0.5106	38.36
	Subtotal	1.3310	0.5106	
Port	Facilities	54.3439	14.6666	26.99
	Subtotal	54.3439	14.6666	
Airport	Facilities	0.0000	0.0000	0.00
	Runways	0.0000	0.0000	0.00
	Subtotal	0.0000	0.0000	
Total		605.79	16.31	

Table 13: Utility System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Line	5.3833	0.1903	3.54
	Subtotal	5.3833	0.1903	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	459.6462	140.9099	30.66
	Distribution Line	3.2300	0.0956	2.96
	Subtotal	462.8762	141.0055	
Natural Gas	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Line	2.1533	0.0328	1.52
	Subtotal	2.1533	0.0328	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	0.0000	0.0000	
Electrical Power	Facilities	0.0000	0.0000	0.00
	Subtotal	0.0000	0.0000	
Communication	Facilities	0.1130	0.0536	47.43
	Subtotal	0.1130	0.0536	
	Total	470.53	141.28	



FEMA

Appendix A: County Listing for the Region

Washington, RI

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Rhode Island	Washington	14,532	2,044	696	2,740
Total Region		14,532	2,044	696	2,740



FEMA

RiskMAP
Increasing Resilience Together

Hazus: Earthquake Global Risk Report

Region Name NarragansettRI

Earthquake Scenario: Narragansett, RI Earthquake Magnitude 7

Print Date: March 25, 2024

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

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Appendix A: County Listing for the Region

Appendix B: Regional Population and Building Value Data



FEMA

General Description of the Region

Hazus-MH is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Rhode Island

Note:

Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 15.45 square miles and contains 3 census tracts. There are over 6 thousand households in the region which has a total population of 14,532 people. The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 6 thousand buildings in the region with a total building replacement value (excluding contents) of 2,740 (millions of dollars). Approximately 91.00 % of the buildings (and 75.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 605 and 470 (millions of dollars), respectively.



FEMA

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 6 thousand buildings in the region which have an aggregate total replacement value of 2,740 (millions of dollars) . Appendix B provides a general distribution of the building value by Total Region and County.

In terms of building construction types found in the region, wood frame construction makes up 89% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 0 hospitals in the region with a total bed capacity of beds. There are 4 schools, 3 fire stations, 1 police stations and 1 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes no hazardous material sites, no military installations and no nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 1,075.00 (millions of dollars). This inventory includes over 51.57 miles of highways, 9 bridges, 334.30 miles of pipes.

Table 1: Transportation System Lifeline Inventory

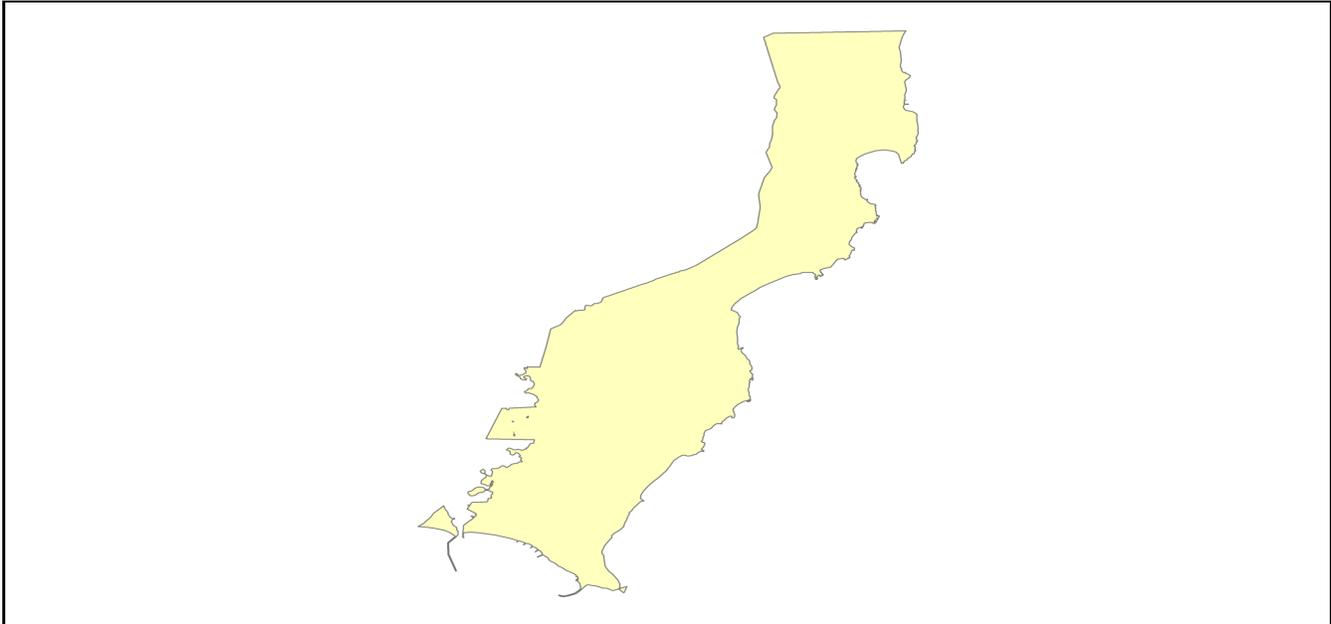
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	9	27.3334
	Segments	21	522.7847
	Tunnels	0	0.0000
	Subtotal		550.1181
Railways	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	0	0.0000
	Tunnels	0	0.0000
	Subtotal		0.0000
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	0	0.0000
	Tunnels	0	0.0000
	Subtotal		0.0000
Bus	Facilities	0	0.0000
	Subtotal		0.0000
Ferry	Facilities	1	1.3310
	Subtotal		1.3310
Port	Facilities	16	54.3439
	Subtotal		54.3439
Airport	Facilities	0	0.0000
	Runways	0	0.0000
	Subtotal		0.0000
		Total	605.80

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	5.3833
	Facilities	0	0.0000
	Pipelines	0	0.0000
	Subtotal		5.3833
Waste Water	Distribution Lines	NA	3.2300
	Facilities	3	459.6462
	Pipelines	0	0.0000
	Subtotal		462.8762
Natural Gas	Distribution Lines	NA	2.1533
	Facilities	0	0.0000
	Pipelines	0	0.0000
	Subtotal		2.1533
Oil Systems	Facilities	0	0.0000
	Pipelines	0	0.0000
	Subtotal		0.0000
Electrical Power	Facilities	0	0.0000
	Subtotal		0.0000
Communication	Facilities	1	0.1130
	Subtotal		0.1130
		Total	470.50

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.



Scenario Name	Narragansett, RI Earthquake Magnitude 7
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-71.46
Latitude of Epicenter	41.43
Earthquake Magnitude	7.00
Depth (km)	10.00
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	Central & East US (CEUS 2008)

Direct Earthquake Damage

Building Damage

Hazus estimates that about 5,969 buildings will be at least moderately damaged. This is over 93.00 % of the buildings in the region. There are an estimated 2,319 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Damage Categories by General Occupancy Type

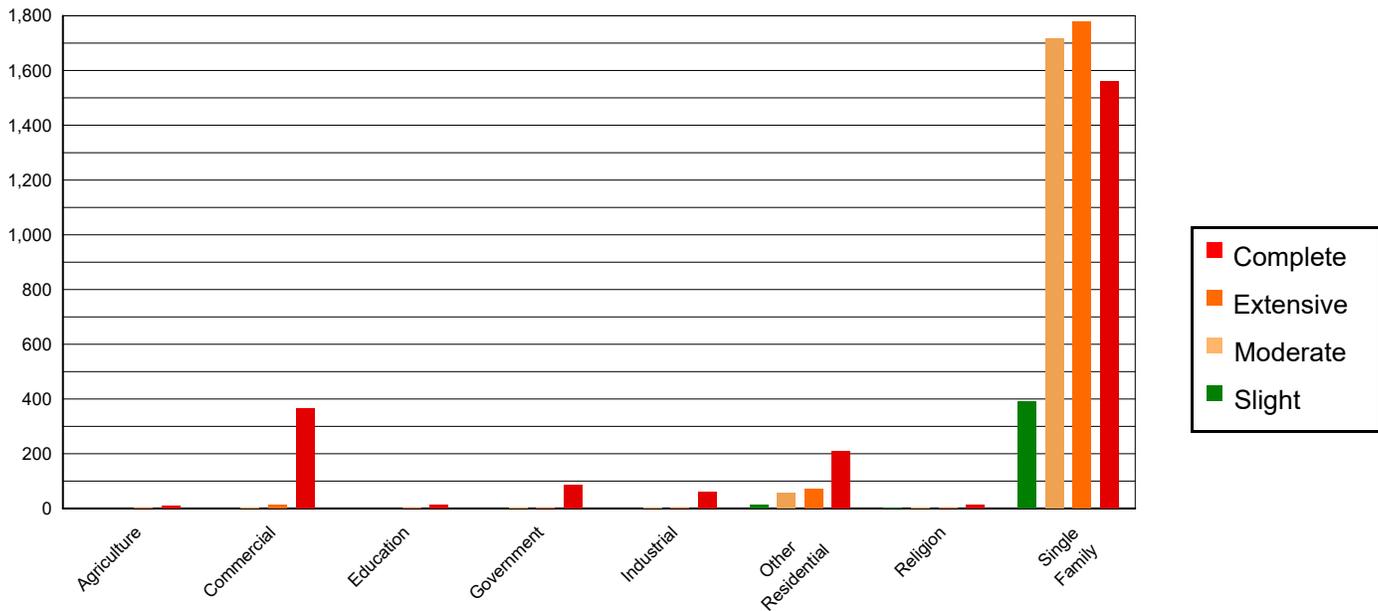


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0.00	0.00	0.00	0.00	0.06	0.00	0.59	0.03	9.35	0.40
Commercial	0.04	0.09	0.07	0.02	1.53	0.09	13.82	0.74	364.54	15.72
Education	0.00	0.00	0.00	0.00	0.04	0.00	0.41	0.02	12.55	0.54
Government	0.01	0.02	0.01	0.00	0.22	0.01	2.23	0.12	86.53	3.73
Industrial	0.01	0.02	0.01	0.00	0.18	0.01	1.72	0.09	61.09	2.63
Other Residential	1.14	2.68	11.59	2.87	58.56	3.29	72.52	3.88	209.20	9.02
Religion	0.03	0.07	0.33	0.08	1.82	0.10	2.52	0.13	14.30	0.62
Single Family	41.19	97.11	392.23	97.03	1716.64	96.49	1776.96	94.99	1561.97	67.34
Total	42		404		1,779		1,871		2,320	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	42.34	99.82	404.07	99.96	1776.41	99.85	1854.05	99.11	1613.67	69.57
Steel	0.03	0.07	0.01	0.00	0.23	0.01	5.02	0.27	274.74	11.84
Concrete	0.01	0.01	0.00	0.00	0.05	0.00	0.68	0.04	49.26	2.12
Precast	0.00	0.00	0.00	0.00	0.04	0.00	0.13	0.01	17.63	0.76
RM	0.01	0.03	0.02	0.00	0.35	0.02	1.09	0.06	72.90	3.14
URM	0.03	0.07	0.14	0.04	1.94	0.11	9.53	0.51	282.63	12.18
MH	0.00	0.00	0.00	0.00	0.03	0.00	0.26	0.01	8.71	0.38
Total	42		404		1,779		1,871		2,320	

*Note:

- RM Reinforced Masonry
- URM Unreinforced Masonry
- MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had hospital beds available for use. On the day of the earthquake, the model estimates that only hospital beds (%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, % of the beds will be back in service. By 30 days, % will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	0	0	0	0
Schools	4	4	4	0
EOCs	1	1	1	0
PoliceStations	1	1	1	0
FireStations	3	3	3	0

Transportation Lifeline Damage

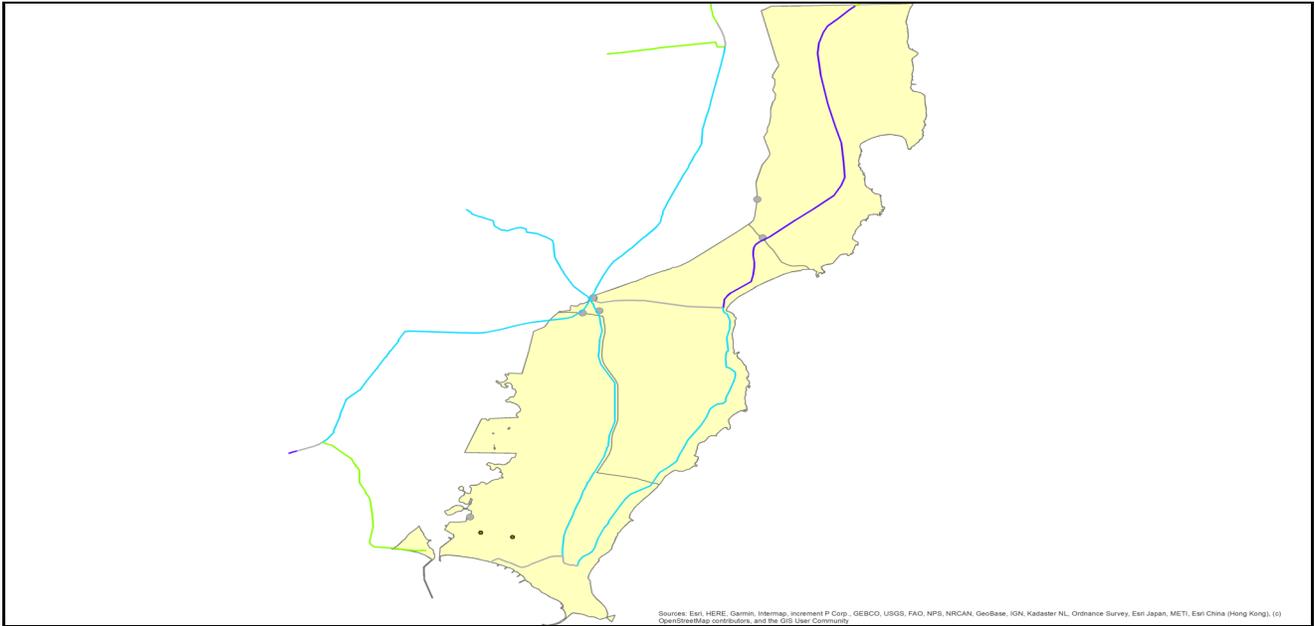


Table 6: Expected Damage to the Transportation Systems

System	Component	Locations/ Segments	Number of Locations_			
			With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	21	0	0	21	21
	Bridges	9	9	9	0	0
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	1	1	1	0	0
Port	Facilities	16	16	1	0	0
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Table 6 provides damage estimates for the transportation system.

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	3	3	3	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	1	1	1	0	0

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	167	1330	333
Waste Water	100	668	167
Natural Gas	67	229	57
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	6,600	6,586	6,573	6,475	0	0
Electric Power		6,422	6,341	6,078	3,177	7

Induced Earthquake Damage

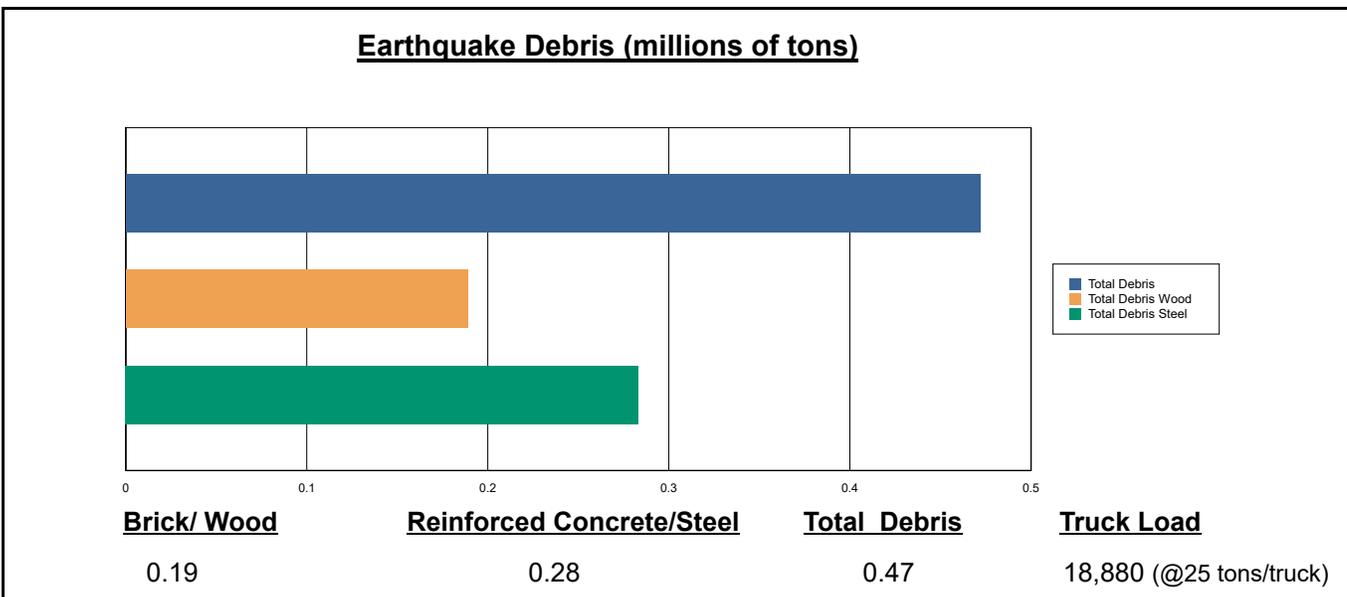
Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

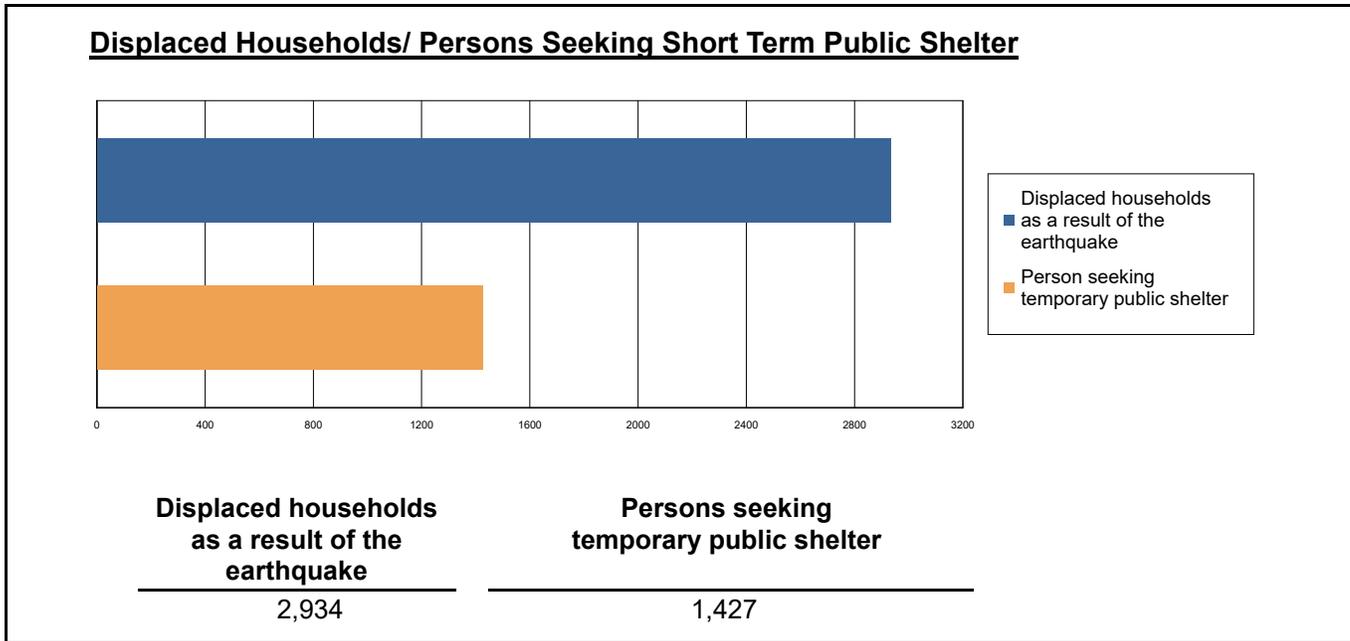
The model estimates that a total of 472,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 40.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 18,880 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.



Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 2,934 households to be displaced due to the earthquake. Of these, 1,427 people (out of a total population of 14,532) will seek temporary shelter in public shelters.



Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	11.06	3.55	0.57	1.12
	Commuting	0.06	0.09	0.15	0.03
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	5.97	1.94	0.31	0.62
	Other-Residential	133.15	41.03	6.09	11.87
	Single Family	325.74	78.20	5.90	10.19
	Total	476	125	13	24
2 PM	Commercial	759.45	243.68	39.20	76.49
	Commuting	0.57	0.83	1.31	0.26
	Educational	105.64	34.58	5.78	11.29
	Hotels	0.00	0.00	0.00	0.00
	Industrial	44.32	14.39	2.35	4.58
	Other-Residential	56.24	17.44	2.69	4.94
	Single Family	132.11	31.88	2.85	4.16
	Total	1,098	343	54	102
5 PM	Commercial	484.45	155.47	25.17	48.55
	Commuting	10.09	15.04	23.47	4.64
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	27.70	8.99	1.47	2.86
	Other-Residential	53.29	16.54	2.55	4.70
	Single Family	131.20	31.60	2.83	4.14
	Total	707	228	55	65



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Economic Loss

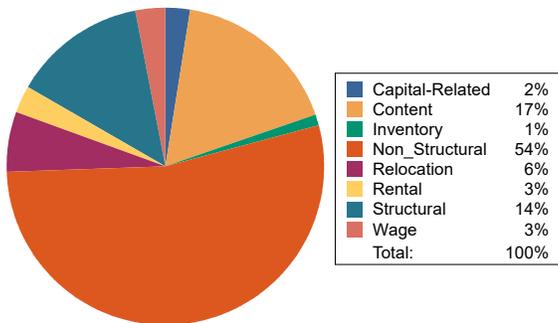
The total economic loss estimated for the earthquake is 3,077.25 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 2,638.54 (millions of dollars); 14 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 57 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Earthquake Losses by Loss Type (\$ millions)



Earthquake Losses by Occupancy Type (\$ millions)

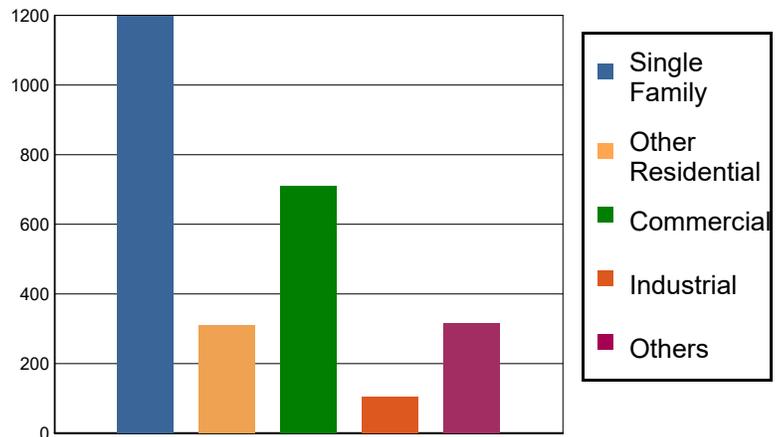


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	8.4209	61.0325	1.4539	11.0664	81.9737
	Capital-Related	0.0000	3.5746	59.3759	0.8477	1.0912	64.8894
	Rental	26.8903	22.7169	19.8483	0.4347	6.2939	76.1841
	Relocation	90.5706	10.6837	28.1192	1.6039	24.4605	155.4379
	Subtotal	117.4609	45.3961	168.3759	4.3402	42.9120	378.4851
Capital Stock Losses							
	Structural	196.8711	31.6290	79.9362	10.9281	39.0976	358.4620
	Non_Structural	715.1059	192.7325	293.8172	51.9324	159.8867	1,413.4747
	Content	168.3020	40.9354	141.1786	32.3539	73.1316	455.9015
	Inventory	0.0000	0.0000	26.0201	5.5544	0.6382	32.2127
	Subtotal	1080.2790	265.2969	540.9521	100.7688	272.7541	2260.0509
	Total	1197.74	310.69	709.33	105.11	315.67	2638.54

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	522.7847	0.0000	0.00
	Bridges	27.3334	13.8193	50.56
	Tunnels	0.0000	0.0000	0.00
	Subtotal	550.1181	13.8193	
Railways	Segments	0.0000	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	0.0000	0.0000	
Light Rail	Segments	0.0000	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	0.0000	0.0000	
Bus	Facilities	0.0000	0.0000	0.00
	Subtotal	0.0000	0.0000	
Ferry	Facilities	1.3310	1.1255	84.56
	Subtotal	1.3310	1.1255	
Port	Facilities	54.3439	40.8264	75.13
	Subtotal	54.3439	40.8264	
Airport	Facilities	0.0000	0.0000	0.00
	Runways	0.0000	0.0000	0.00
	Subtotal	0.0000	0.0000	
Total		605.79	55.77	

Table 13: Utility System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Line	5.3833	5.9872	111.22
	Subtotal	5.3833	5.9872	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	459.6462	372.8198	81.11
	Distribution Line	3.2300	3.0075	93.11
	Subtotal	462.8762	375.8273	
Natural Gas	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Line	2.1533	1.0304	47.85
	Subtotal	2.1533	1.0304	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	0.0000	0.0000	
Electrical Power	Facilities	0.0000	0.0000	0.00
	Subtotal	0.0000	0.0000	
Communication	Facilities	0.1130	0.0999	88.41
	Subtotal	0.1130	0.0999	
	Total	470.53	382.94	



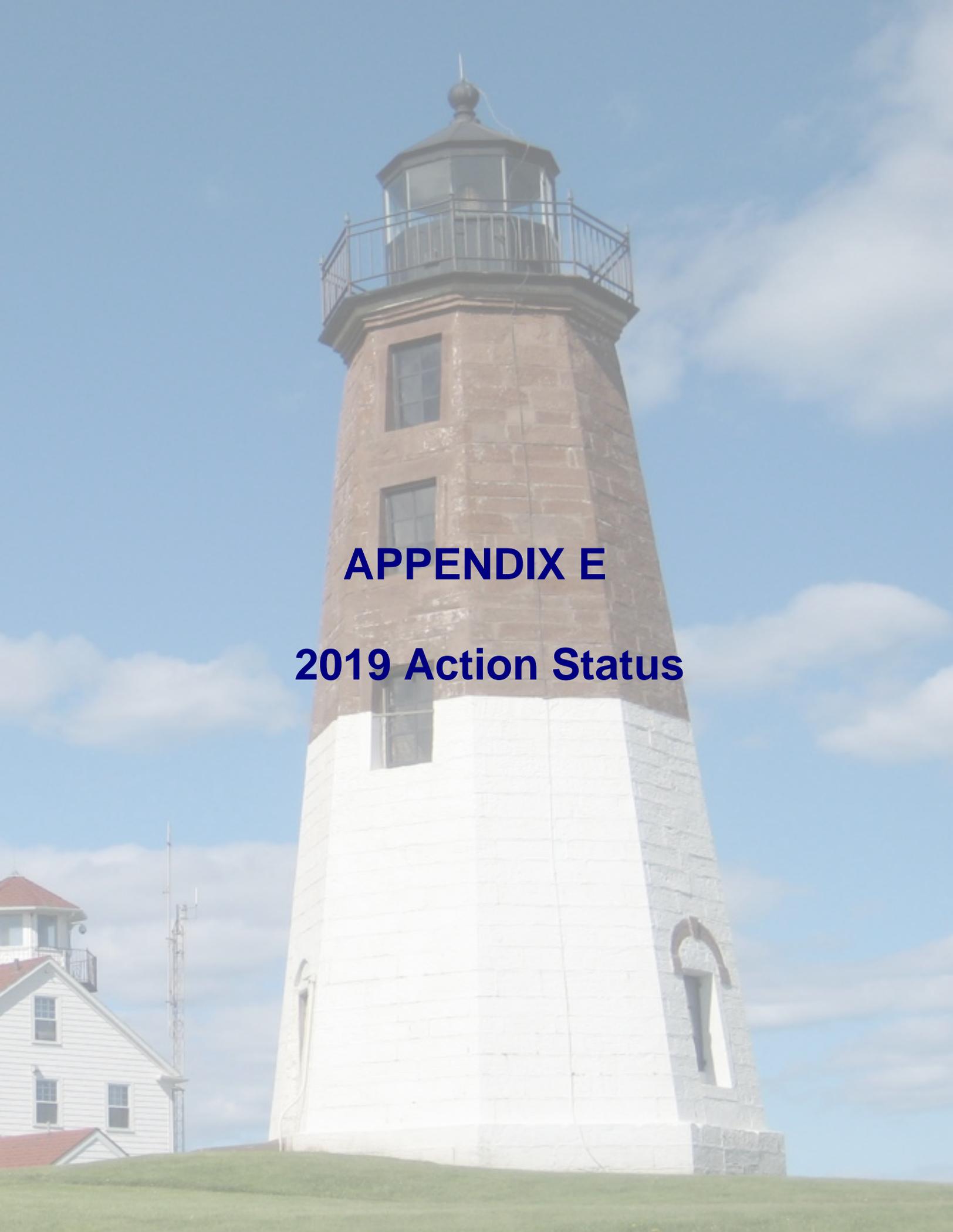
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Appendix A: County Listing for the Region

Washington, RI

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Rhode Island	Washington	14,532	2,044	696	2,740
Total Region		14,532	2,044	696	2,740



APPENDIX E
2019 Action Status

2019 Mitigation Plan Action Item Status Report

2019 Action Item Numbers	Name of Action Items	2024 Status
1	Evacuation and Sheltering	Partially Completed and updated in 2024 Plan and separated into two action items
2	Beach and Dune Replenishment	Partially Completed and updated in 2024 Plan
3	Bypass Sewer Main	Updated for 2024 Plan
4	Water Supply	Updated for 2024 Plan
5	Flood proof Pump Stations	Partially Completed and updated in 2024 Plan
6	Retrofit Sewer Pump Stations	Updated for 2024 Plan
7	Scarborough WWTF Groin Rehab	Partially Completed and updated in 2024 Plan
8	Underground Utilities and Fire Alarm Communications	Partially Completed and updated in 2024 Plan and separated into two action items
9	Town Tree Trimming Program	Ongoing and updated for 2024 Plan
10	Tree Trimming Educational Program	Updated for 2024 Plan
11	Causeways	Updated for 2024 Plan
12	Public Information, Outreach, and Incentive Program	Ongoing and updated for 2024 Plan
13	Property Acquisition	Updated for 2024 Plan
14	Retrofit and Elevate, Relocate	Updated for 2024 Plan
15	Policy for Rebuilding	Ongoing and updated for 2024 Plan

2019 Action Item Numbers	Name of Action Items	2024 Status
16	Open Space Acquisitions	Updated for 2024 Plan
17	Historic Flooding Signage Townwide	Updated for 2024 Plan
18	Historic Flooding Informational Display for Town Hall	Updated for 2024 Plan
19	Storm Water Projects	Ongoing and updated for 2024 Plan