2023 Hazard Mitigation Plan Update

Town of Bristol, Rhode Island

PREPARED FOR

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July 2023

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RESOLUTION NO. XXXX-XX

A RESOLUTION OF THE TOWN COUNCIL OF THE TOWN OF BRISTOL AUTHORIZING THE ADOPTION OF THE 2022 BRISTOL HAZARD MITIGATION PLAN UPDATE

WHEREAS, the Town of Bristol recognizes exposure to natural hazards that increase the risk to life, property, environment, within our community; and

WHEREAS; pro-active mitigation of known hazards before a disaster event can reduce or eliminate long-term risk to life and property; and

WHEREAS, The Disaster Mitigation Act of 2000 (Public Law 106-390) established new requirements for pre and post disaster hazard mitigation programs; and

WHEREAS; the 2023 Plan identifies mitigation goals and actions to reduce or eliminate long-term risk to people and property in Bristol from impacts of future hazards and disasters; and

WHEREAS, adoption by the Town Council demonstrates their commitment to hazard mitigation and achieving goals outlined in the 2023 Bristol Hazard Mitigation Plan Update.

NOW, THEREFORE, BE IT RESOLVED that the Town of Bristol

1) Adopts in its entirety, the 2023 Bristol Hazard Mitigation Plan Update (the "Plan") as the jurisdiction's Natural Hazard Mitigation Plan and resolves to execute the actions identified in the Plan that pertain to this jurisdiction.

2) Will use the adopted and approved portions of the Plan to guide pre- and post-disaster mitigation of the hazards identified.
3) Will coordinate the strategies identified in the Plan with other planning programs and mechanisms under its jurisdictional authority.
4) Will continue its support of the Hazard Mitigation Committee as described within the Plan.
5) Will help to promote and support the mitigation successes of all participants in this Plan.
6) Will incorporate mitigation planning as an integral component of government and partner operations.
7) Will provide an update of the Plan every five years.

PASSED AND ADOPTED on [insert date]

_____

Nathan Calouro, Town Council Chairman, Town of Bristol

ATTEST: _____
Melissa Cordeiro, Town Clerk, Town of Bristol

Resolution

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Executive Summary

This Hazard Mitigation Plan (HMP) is a product of the Bristol Hazard Mitigation Committee (HMC). It has been approved by the Bristol Town Council, the Rhode Island Emergency Management Agency, and the Federal Emergency Management Agency in accordance with the Disaster Mitigation Act of 2000.

The HMC's overview of past natural hazard occurrences verifies that the Town is vulnerable to diverse events including hurricanes, Nor'easters, winter storms, flooding, high winds, and extreme temperatures. The discussion puts the likelihood of these events into historical perspective and recognizes that although the probability of thunderstorms and lightning events may be higher; the intensity and potential impacts from less likely events such as hurricanes can be far greater.

The risk assessment portion of the plan confirms that the Town has much to lose from these events. The identified vulnerabilities include flood prone drainage systems, streets and infrastructure, bridges, wastewater systems, water supply system, other services/utilities, communication towers, dams, critical municipal hazard response facilities, populations, businesses, schools, public buildings, recreation facilities, natural and historic resources.

To address these risks the 2023 HMP put forth a clear mission, a distinct set of goals and 22 specific mitigation actions. The Town's hazard mitigation mission is to protect public health and safety and create sustainable economic growth by limiting losses to lives, public and private and private property, and natural resources/systems.

To implement the plan, important goals must be met. The Town's mitigation strategy was created to help protect its citizens, visitors, businesses and property from the effects of various natural hazards.

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Introduction

Plan Purpose

The purpose of the Bristol Hazard Mitigation Plan Update is to set forth guidelines of short-term and long-term actions, which will reduce the actual or potential loss of life or property from natural hazardous events such as hurricanes, Nor'easters, flooding, and high wind. This plan was constructed using input from a variety of municipal and private stakeholders and the general public involved in the planning process. This plan serves as guidance to help the Town reduce their losses and vulnerabilities relating to natural hazards.

Hazard Mitigation and its Benefits

Hazard mitigation planning consists of a series of actions taken to identify specific areas that are vulnerable to natural and human-caused hazards within a town and seek to permanently reduce or eliminate the long-term risk to human life and property. It coordinates available resources and identifies community policies, actions, and tools for implementation that will reduce risk and the potential for future losses town-wide. The process of natural hazard mitigation planning sets clear goals, identifies appropriate actions, and produces an effective mitigation strategy that can be updated and revised to keep the plan current. In short, 'it's where we were, where we are and where we're going' in terms of hazard mitigation.

States and communities across the country are slowly, but increasingly, realizing that simply responding to natural disasters, without addressing ways to minimize their potential effect, is no longer an adequate role for government. Striving to prevent unnecessary damage from natural disasters through proactive planning that characterizes the hazard, assesses the community's vulnerability, and designs appropriate land-use policies and building code requirements is a more effective and fiscally sound approach to achieving public safety goals related to natural hazards.

In the past, Federal legislation has provided funding for disaster relief, recovery, and some hazard mitigation planning. The Disaster Mitigation Act of 2000 (DMA 2000) is the latest federal legislation to improve this planning process. It reinforces the importance of natural hazard mitigation planning and establishes a pre-disaster hazard mitigation program (PDM), Building Resiliency Infrastructure in Communities (BRIC) program, and new requirements for the national post-disaster Hazard Mitigation Grant Program (HMGP) or other annual funding opportunities. Section 322 of the Act specifically addresses mitigation planning at the state and municipal levels of government. It identifies new requirements that allow HMGP funds to be used for planning activities. As a result of this Act, states and communities must now have a FEMA-approved natural hazard mitigation plan in place prior to receiving post-disaster HMGP funds. In the event of a natural disaster, municipalities that do not have an approved natural hazard mitigation plan will not be eligible to receive post-disaster HMGP funding.

A **Natural Hazard** is defined as an extreme natural event. **Natural Disasters** occur when these extreme natural events come into contact with people and property.

Natural hazard mitigation is any sustained action taken to permanently reduce or eliminate long-term risk to people and their property from the effects of natural hazards.

Natural Hazard mitigation planning is a process undertaken by a community to analyze the risk from natural disasters, coordinate available resources, and implement actions to minimize the damage to property, and injury or loss of life of its citizens before disaster occurs.

The purpose of this Plan is to recommend actions and policies for the Town of Bristol to minimize the social and economic loss of hardships resulting from natural hazards. These hardships include the loss of life, destruction of property, damage to critical infrastructure and critical facilities, loss/interruption of jobs, loss/damage to businesses, and loss/damage to significant historical structures. To protect present and future structures, infrastructure and assets and to minimize the social and economic hardships, the Town of Bristol implements the following general actions and policies:

- Town's Comprehensive Community Plan
- Town's Capital Improvement Plan
- Stormwater Management Plan
- Various Watershed Plans
- Local building code review

The Town of Bristol also recognizes the important benefits associated with hazard mitigation, its interaction with municipal land use and infrastructure planning, and the need for a comprehensive planning approach, which accommodates these interdependencies. The Town's Comprehensive Community Plan (2016) addresses land use, housing, economic development and agriculture, natural, historic, and cultural resources, open space, conservation and recreation, circulation and transportation, and services and facilities. While the entire hazard mitigation plan will not be formally incorporated into the next revision of the Comprehensive Community Plan, certain, applicable mitigation actions will be incorporated during the update process. The Town recognizes coordination between the HMP and the Comprehensive Community Plan to be beneficial because it will ensure a unified planning approach into the future and ensure that risk reduction remains a critical element of

municipal planning. This is also in alignment with current goals of Rhode Island Division of Statewide Planning.

A second benefit of hazard mitigation allows for a careful selection of risk reduction actions through an enhanced collaborative network of stakeholders whose interests might be affected by hazard losses. Working side by side with this broad range of stakeholders can forge partnerships that pool skills, expertise, and experience to achieve a common goal. Proceeding in this manner will help the Town ensure that the most appropriate and equitable mitigation projects are undertaken.

A third benefit of hazard mitigation is endorsing a proactive planning approach focused on sustainability, whereby the Town of Bristol could minimize the social and economic hardships that have resulted from the occurrence of previous natural disasters. These social and economic hardships include: the loss of life/injuries, destruction of property, interruption of jobs, damage to businesses, and the loss of historically significant structures and facilities. This proactive planning approach would look for ways to combine policies, programs, and design solutions to bring about multiple objectives and seek to address and integrate social and environmental concerns. Linking sustainability and loss reduction to other goals can provide a framework within the state and local governments that will bring the comprehensive planning process full circle.

Lastly, the participation in a hazard mitigation planning process establishes funding priorities. The formal adoption and implementation of this plan will allow the Town of Bristol and its residents to become more involved in several programs offered by the Federal Emergency Management Agency (FEMA) including: the Community Rating System Program (CRS); the Pre-Disaster Mitigation Assistance Program (PDM); the Building Resilient Infrastructure in Communities (BRIC) Program; the Flood Mitigation Assistance (FMA) Program; and the Hazard Mitigation Grant Program (HMGP). Money spent today on preventative measures can significantly reduce the cost of post-disaster cleanup tomorrow.

Mission Statement and Goals:

The Town of Bristol will protect public health and safety and create sustainable economic growth by limiting losses to lives, public and private and private property, and natural resources/systems.

Goals

This mitigation strategy is adopted by the Town of Bristol to present actions which help protect its citizens, visitors, businesses and property from the effects of various natural hazards. It is the intent of the Town of Bristol to:

1. Protect the public health, safety and welfare;
2. Reduce property damages caused by hazard impact;
3. Minimize social dislocation and distress;
4. Reduce economic losses and minimize disruption to local businesses;
5. Protect the ongoing operations of critical facilities;
6. Reduce the dependence and need for disaster assistance funding after disasters;
7. Expedite recovery disaster mitigation efforts during the recovery phase; and,

8. Provide an ongoing forum for the education and awareness of natural hazard mitigation issues, programs, policies, and projects.

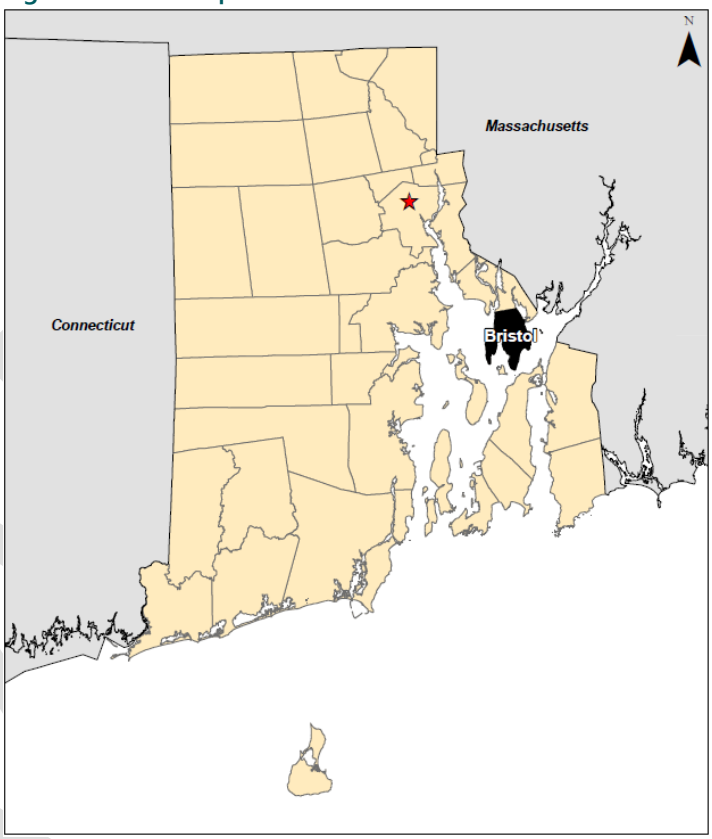
Background

The Town of Bristol is located in the eastern section of Rhode Island, bordered by the Town of Warren to the north, Mt. Hope Bay to the east, and Narragansett Bay to the west. The Town of Bristol occupies 10.1 square miles of a peninsula located near the Rhode Island/Massachusetts Boarder.

Bristol has an estimated population of 22,493[1] which puts it at #16 of the 39 cities and towns in Rhode Island for overall population count.

Bristol has a diverse yet predominantly residential land use pattern. Nearly 75% of Bristol's land is used for residential purposes, among which more than 50% of the total is classified as medium density residential with lot sizes ranging from a quarter to 2 acres; almost 15% is occupied by low density residential with lots larger than 2 acres; and 9.4% for high density residential with lots smaller than a quarter acre.

Figure 1 Locus Map



More than 10% of Bristol's land is used for open space, recreation, and other institutional uses. An additional 4.8% is considered as natural undisturbed land, with another 0.4% classified as open undeveloped land. Commercial and industrial uses account for 2.2% and 3.8% of Bristol respectively, while agricultural land taking up another 3% of Bristol.[2]

History

Bristol is a town in the historic county seat of Bristol County, Rhode Island, United States. Bristol, a deepwater seaport, is named after Bristol, England. Major industries include boat building (and related marine industries), manufacturing and tourism. The town's school system is united with neighboring Warren, Rhode Island (Bristol Warren Regional School District). Prominently non-

1 United States Census Bureau, 2020.

2 Town of Bristol 2016 Comprehensive Community Plan

Hispanic white, ethnic minorities in Bristol include Portuguese-Americans, mostly Azorean, and Italian-Americans.

The first battle of King Philip's War took place here in 1675; although Philip was eventually defeated, a variant of his Indian name, Metacomet, is now the shortened name of a main road in Bristol: Metacom Avenue (RI Route 136). King Philip made nearby Mount Hope (Montaup) his base of operations. "King Philip's Chair", a rocky ledge on the mountain, was a lookout site for enemy ships on Mount Hope Bay. After that war concluded, the town was settled in 1680 as part of Plymouth Colony. It was named after Bristol, England and was sold for £1100 to four Boston investors by the names of Byfield, Walley, Oliver, and Burton. It remained a part of Massachusetts until the British Crown transferred it to the Rhode Island Colony in 1747.

Bristol has the oldest continuously celebrated Independence Day festivities in the United States. The first mention of the celebration comes from July 1777, when a British officer noted sounds coming from across Narragansett Bay, but tradition suggests that the first observance was held on July 4, 1785. Until 1854, Bristol was one of the five state capitals of Rhode Island. Bristol is home to Roger Williams University, named for Rhode Island founder Roger Williams.

Demographics[3]

The Town of Bristol is a residential coastal community with a population of 22,493. Bristol's population is on average, similar to the State average of 40. The median age of our residents is 41.

Approximately 20% of the population is over 65. The population in Bristol is predominantly white at 93.4%, Hispanic or Latino 2.9%, Asians 2.0%, Black or African Americans make up 1.8%. A language other than English is spoken in 16% of the homes.

The 2020 American Community Survey 5-Year Survey Estimates reported an estimate of 9,412 housing units (8,097 of which are occupied) which is a decrease of 1% from the 2010 Census count. Approximately 26% of the housing units were built before 1939. Approximately 67% of the housing units are single family detached or attached (condo). The remaining 33% of the housing units are considered multi-family. The greatest concentration of high-density residential land use is at North Farm, an association of townhouse style condos, located in the northwest section of Town.

Economic Conditions

Bristol's economic success is largely dependent on heritage tourism, restaurants, museums, and shops. The Town's rich waterfront history is showcased in exhibits, and tours.

Key industries in Bristol include education, healthcare, marine trades, composites (used in boat building), construction, retail, hospitality, and tourism. By nature, marine trades such as boat builders set up their shops along the waterfront which is frequently threatened by flooding.

3 For the purpose of this element, the most comprehensive data set is from 2020 United States Census, 2020 ACS 5-Year Estimates https://data.census.gov/cedsci/table?q=bristol%20town,%20rhode%20island&tid=ACSDP5Y2020.DP05

In 2022, the unemployment rate in Bristol was 2.1% which is slightly lower than the state average of 3.3% in 2022. Unemployment rates statewide have been improving since the average of 15.8% in the second quarter of 2020 (COVID pandemic).[4]

About 66% of the 8,097 occupied housing units in Bristol are owner-occupied (compared to 60% for the state), and median family income ($74,097) is higher than the statewide median family income of $75,655. Six percent of the population in Bristol has income below the poverty level.

Table 1 Demographic Changes

	2010	2020	% Change
Housing Units (total)	9,537	9,412	-1.3%
Population	23,189	22,070	-4.8%
Owner-occupied housing units	5,975	5,320	-11%

Government

The Town of Bristol is governed by an elected Town Council with five (5) members, elected every two (2) years. The elected Town Administrator is responsible for the execution of laws and the administration of Town government. The Town Council is also responsible for adopting the current Hazard Mitigation Plan Update.

Land Use Patterns

Nearly 75% of Bristol's taxed land is used for residential purposes, among which more than 50% of the total is classified as medium density residential with lot sizes ranging from a quarter to 2 acres; almost 15% is occupied by low density residential with lots larger than 2 acres; and 9.4% for high density residential with lots smaller than a quarter acre.[5]

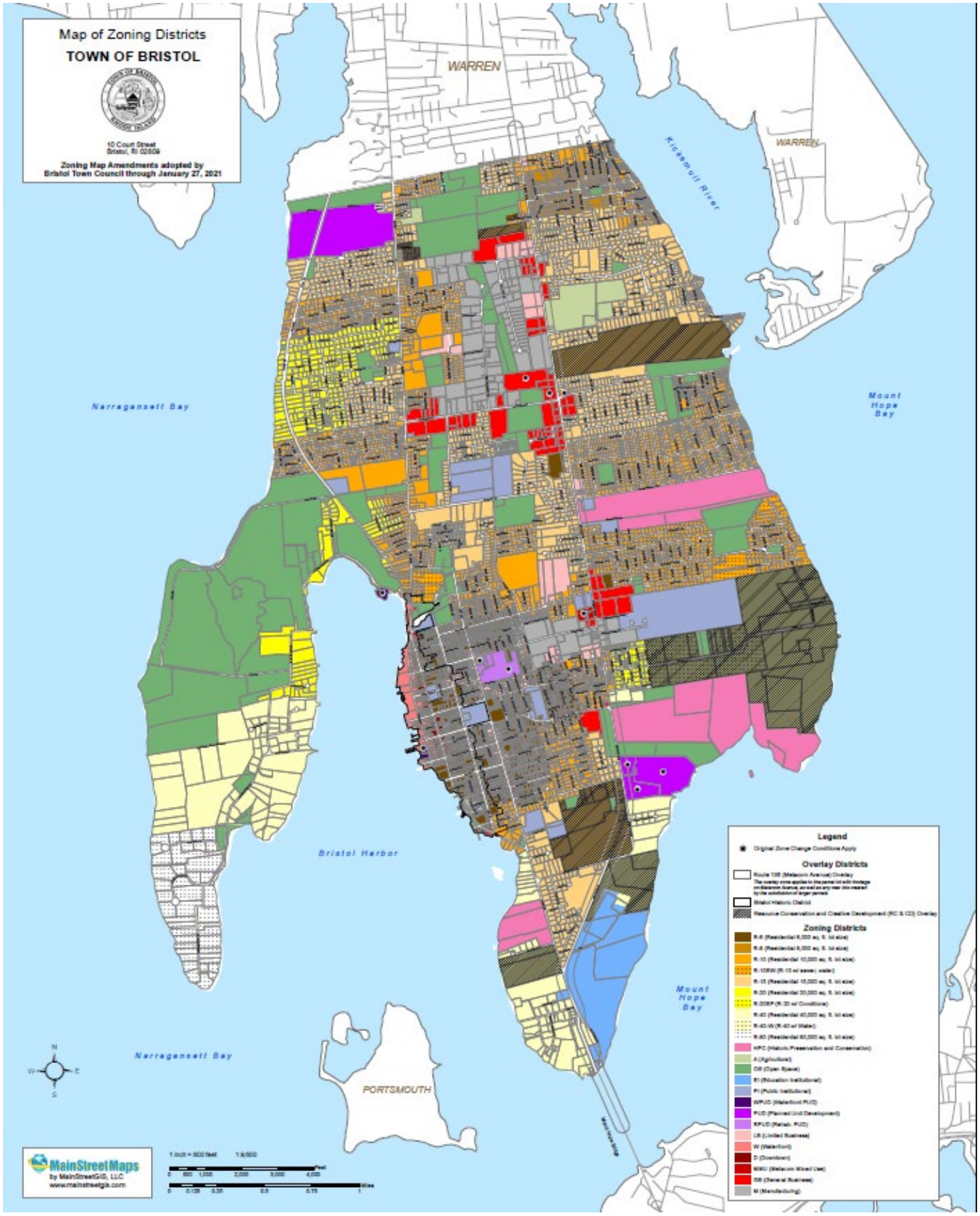
"Bristol is a suburban community whose landscape character consists predominantly of residential neighborhoods, industrial and commercial businesses, woodlands and urban forest, a few farms, and a long natural shoreline. Medium to high density residential neighborhoods and coastal cottage communities dominate the northern half of the town on both its east and west sides. The central-most areas of town consist of a mixture of commercial, manufacturing, and medium-density residential developments. To the southwest, the historic seaside downtown, with its mixture of high density residential and commercial establishments extends to the east. South-central areas located east of downtown consist of high-density residential and commercial areas with historic mills and manufacturing areas, many of which are undergoing redevelopment for commercial and residential uses. The town's southern tip and coastlines consist of a mixture of natural open space areas, low-density residential developments, and institutions. Poppasquash Neck, to the west of downtown, consists of low-density residential uses and open space".[6] See Figure 2.

4 State of Rhode Island Department of Labor and Training, Unemployment Rate/Labor Force Statistics Unemployment Rate/Labor Force Statistics (LAUS) | RI Department of Labor & Training, accessed February 2023.

5 Town of Bristol 2016 Comprehensive Community Plan

6 Open Space Plan of the Town of Bristol, RI, June 2008. https://www.bristolri.gov/wp-content/uploads/2020/08/2008-Open-Space-Plan.pdf

Figure 2 Zoning Map



Roads and Bridges

Bristol's location on a peninsula strongly defines the Town's circulation pattern. The only routes into Bristol from the north are Routes 136 and 114. From the south, only Route 136/114 via the Mount Hope Bridge serves the Town. There are no east–west transportation routes with the exception of the Prudence Island Ferry that docks at Bristol Harbor. The Town has a strongly defined street configuration due to the historic pattern of settlement established during colonization and the degree of development that has already occurred. There are approximately 120 miles of Town-maintained streets in Bristol. The state is responsible for maintenance of Metacom Avenue, Hope Street, Gooding Avenue, Franklin Street and Griswold Street.

The State has designated Route 114 (Hope Street and Ferry Road) as a Scenic Roadways under the State's Scenic Roadway Program. As a Scenic Roadway, the Scenic Roadways Board reviews all changes to the roads and controls tree trimming and other work.[7] All of Route 114 was also recently designated as a National Scenic Byway.

The low-lying bridges at Mill Gut Pond and Mill Pond in the Poppasquash neighborhood are susceptible to high tide coastal flooding.

The Mount Hope Bridge is a two-lane suspension bridge spanning Mount Hope Bay, connecting the southern end of Bristol to Portsmouth, Rhode Island. The bridge, owned and operated by the Rhode Island Turnpike and Bridge Authority, is closed to traffic when sustained winds exceed 70 mph or other dangerous winter weather conditions exist.[8]

Poppasquash Road, December 23, 2022

7 Town of Bristol 2016 Comprehensive Community Plan

8 RITBA Weather Restrictions | Rhode Island Turnpike and Bridge Authority (ritba.org)

Dams

In 2021 the Department of Environmental Management (DEM) identified three dams in the Town of Bristol, State Street Reservoir (Tanyard Reservoir), Mount Hope Farm Upper, and Mount Hope farm Lower. The State Street dam is classified as a significant hazard dam, the remainder are identified as low hazard dams.

High Hazard Dam – where failure or misoperation will result in probable loss of human life.

Significant Hazard Dam – where failure or misoperation will result in no probable loss of human life but can cause major economic loss, disruption of lifeline facilities or impact other concerns detrimental to the public's health, safety or welfare.

Low Hazard Dam – where failure or misoperation will result in no probable loss of human life and low economic losses.

Utilities

The Bristol County Water Authority (BCWA) provides water to approximately 16,900 customers in Barrington, Warren and Bristol, an area with a population of about 50,000 people. Over 85 percent of the connections are for residential uses. The supply system includes four surface water reservoirs, two treatment plants and the interconnections with Providence Water.[9]

Although the vast majority of homes and businesses in Bristol are serviced by public water supplied by BCWA, there are an undetermined number of properties that utilize private wells for their drinking water supply.

The Town of Bristol is serviced by public sewer. The Bristol Water Pollution Control Department is responsible for the maintenance and improvement of the sewer system and plant. The Bristol Wastewater Treatment Facility (WWTF) is located approximately 1,000 feet inland of Bristol Harbor. The WWTF has been impacted by localized flooding from the Tanyard Brook. Drainage improvements have been made at the WWTF to help it be more resilient to flooding events.

RI Energy is responsible for delivering natural gas and electricity throughout town. While regional gas, electric, and sewer utilities are regularly maintained by the entities that own them, the Town's public utility infrastructure is maintained as needed.

The Town of Bristol's communication equipment is located throughout the town. Private cellular towers are also located throughout the town.

Water Resources

Water resources including freshwater bodies, coastal waters and wetlands are important for the community. Wetlands provide a value to prevent flooding, purify the groundwater, and as a wildlife habitat. Coastal waters are also important as residents enjoy swimming, boating, and fishing in the coastal waters of Bristol.[10]

9 Town of Bristol 2016 Comprehensive Community Plan

10 Town of Bristol 2016 Comprehensive Community Plan

The most significant natural water features in Bristol are the Kickemuit River, Narragansett Bay, Bristol Harbor, and Mount Hope Bay. They define the town's land boundaries to the east, west, and south. The second largest water resource is the series of streams that crisscross the town. Two of note are Silver Creek and Tanyard Brook which run through developed areas.

Figure 3 Water Resources

Forest and Open Space

The community's dedication to open space preservation has led to the preservation of more than 96 acres of woodlands and active agricultural lands over the past five years. Town and state commitments have played a large role in the preservation of these properties.

The Town owns and manages approximately 200 acres of undeveloped open space. Additionally, the State of Rhode Island owns and manages approximately 590 acres of protected open space in Bristol;

the largest portion being Colt State Park. Although they are not permanently protected, approximately 375 acres of privately owned land is protected open space.[11]

Bristol's open space and recreation areas enhance the Town's character and provide for the passive and active recreational needs of residents.

Cultural and Historic Resources

Numerous churches, ethnic and social clubs, the historic State House, Blithewold, Bristol Historical and Preservation Society, Coggeshall Farm, Herreshoff Marine Museum, Linden Place Museum, Mount Hope Farm and The Audubon Society Environmental Education Center make up some notable significant cultural and historic resources.

The Town of Bristol has several National Register Historic Districts- Poppasquash Farms, Bristol Waterfront, Juniper Hill Cemetery, Mount Hope Farm, Blithewold Gardens and Arboretum, and the Mount Hope Bridge.

There are eleven sites listed on the National Register of Historic Places: Bristol County Jail, Blithewold, Bristol Ferry Lighthouse, Bristol County Court House, Bristol Customs House and Post office, Joseph Reynolds House, Benjamin Church Home, Longfield/Charles Dana Gibson House, Mount hope Farm/Governor William Bradford House, Mount Hope Bridge, and Juniper Hill Cemetery. See Appendix E.

Development Trends Since the 2016 Plan

Residential Development Trends

As of the 2020 census, Bristol has a population of 22,493 which was a 2% decline from the 2010 census. The Town has 9,412 housing units which was an increase of approximately 400 units since the 2010 census. The majority of new building permits have been for residential single-family dwellings. The off-campus student population of Roger Williams University also contributes to the number of households. Of the total residential units, 66% are owner occupied and 34% are renter occupied. A recent development trend has been the conversion of residential units to short-term rental housing units. These units are not currently regulated by the Town; however, the State Department of Business Regulations has 133 active short-term rentals, e.g AirBnB and Vrbo, registered in Bristol.[12] The housing in Bristol is almost split with 58% of the housing stock being single-family at 42% being multi-family (2 or more units). This has not impacted the Towns ability to recover from various natural hazards but there may be more visitors to the area that may be unaware of the hazards and potential flooding impacts. This presents an oppotunity to further public education for visitors.

[11] Town of Bristol 2016 Comprehensive Community Plan

[12] State of Rhode Island Department of Business Regulation https://dbr.ri.gov/real-estate-and-commercial-licensing/short-term-rentals

Commercial and Industrial Development Trends

The Town has a mix of residential (70%), commercial (20%) and industrial (10%) uses. Bristol has an active downtown historic waterfront comprised of mixed use residential and commercial buildings.

In the past decade, the Town has seen most new commercial developments occur through re-development, re-use or additions to existing commercial buildings.

Most notable is the recent re-habilitation of the historic former Kaiser Mill into a revitalized commercial and industrial space with restaurants, a brewery, and light manufacturing buildings which was completed in 2022. This property had been in a state of decline until the re-habilitation project which included renaming the mill as "Unity Park".

A former mixed-use property on Mt. Hope Avenue is currently being re-developed with a new 700-unit self-storage facility. The daycare that was on the property is also being re-located in a new stand-alone building which is also being built.

Commercial and manufacturing tradesman buildings are currently being built on Broadcommon Road in the East Bay Industrial Park. These units will be available as rental units for commercial/industrial businesses. This has not changed the Town's vulnerability to natural hazards.

Roger Williams University Development

Roger Williams University has continued to expand on their campus at Ferry Road under the Educational Institutional Master Plan. Recent improvements include a new residence hall ("Driftwood") and a new engineering school building (Richard L. Bready Applied Learning Laboratories). The University also acquired the adjacent James L. Maher Center, and it is now the home of the US Sailing Headquarters. The recent University Master Plan, approved in February of 2023, proposes future capital improvements including another new residence hall and student center and renovations to the existing residential and academic buildings. This has not changed the Town's vulnerability to natural hazards.

Natural, Historic and Cultural Development Trends

The Town's commitment to Open Space and Farmland Preservation has remained strong. Since 2014, the Town has preserved approximately 88 acres of open space which includes the preservation of 38 acres of prime agricultural land.

The Town also recently completed a project to restore water quality in the Silver Creek Watershed which included a renovation of the public golf course located in the East Bay Industrial Park. This was a significant improvement to restore the wetlands and habitat located on the course with planting of native plants and nature-based drainage improvements.

The Town is also planning several "end of road retrofits" to remove pavement where dead end roads terminate at the shoreline and place water quality basins and native plantings. Currently, the Town is working on the design and permitting on these projects at the end of Annawamscutt Drive, Sherman Avenue, and Narrows Road. In addition to water quality improvements, these projects will improve public access to the shore.

The Town has also recently completed a water quality project at the Police Department Parking Lot which was funded by a RIDEM 319 Grant. A project to address water quality in the State Street Parking Lot on the Town Common was also funded with a RIDEM 319 Grant and the engineering design will be starting soon. All of these natural, historic, and cultural resource projects have improved the Town's resiliency and reduced the vulnerability to natural hazards.

2

Planning Process

Overview

The Town of Bristol initiated the hazard mitigation planning effort in 2022 at the recommendation of the Town Director of Community Development. This Hazard Mitigation Plan Update is the result of a dedicated group of individuals working for nine months identifying natural hazards and proposing ways to improve Bristol's resiliency.

Bristol Hazard Mitigation Committee

This updated Hazard Mitigation Plan (HMP) is a product of the Bristol Hazard Mitigation Committee (HMC). The 2022/2023 Committee members include:

- Steven Contente, Town Administrator*
- Diane Williamson, Director of Community Development
- Michael DeMello, Fire Chief/Emergency Management Director*
- Kevin Lynch, Police Chief
- Roman Wozny, Police Lieutenant
- Brian Burke, Police Major*
- Jose DaSilvia, Director, Water Pollution Control*
- Chris Parella, Director, Department of Public Works
- Ed Tanner, Principal Planner*
- Gregg Marsili, Harbormaster*
- Steve Greenleaf, Building Official
- Warren Rensehausen, Director of Parks and Recreation*

* denotes Bristol resident.

The Planning Process

This 2023 HMP update is the result of a 7-step process that was initiated in June 2022 with the establishment of the HMC. Membership of the HMC consisted of town staff and positions that participated in the development of the previous Hazard Mitigation Plan completed in 2016, by invitation from the Director of Community Development. The Town hired a consultant to assist with this planning effort.

Step two started the plan development process and included the first meeting of the HMC on June 23, 2022. The HMC met virtually every month on Zoom.

The Town's previous plan was dated 2016, so the first meeting focused on re-ranking hazards and discussing the process for updating the plan. The Town had been conducting annual review meetings of the 2016 plan which was part of the first meeting review. Also at this initial meeting, the group reviewed a set of questions to be included in an online public survey. The purpose of the survey was to capture the local residents' perception of natural hazards.

The link to the survey was widely distributed on social media and on the Town's website. Over 60 people responded to the survey. See Appendix A for survey results.

Step three began with the HMC meeting on August 2, 2022. After reviewing the hazards of concerns and survey results, the HMC identified critical infrastructure and community assets within the town. Fifteen areas of vulnerability were identified: flood prone drainage systems/streets, or infrastructure; bridges; wastewater; water supply; other services/utilities; communication towers; dams; critical municipal hazard response facilities; populations; businesses; schools; recreational facilities; natural resources; and historic resources.

During this early phase, the Town's consultant reviewed the existing Community Plan, Community Resilience Building Summary of Findings, 2016 Hazard Mitigation Plan, local ordinances, and gathered information on current infrastructure projects going on within the town.

Current town capabilities were discussed at the meeting on October 5, 2022. Many different departments, committees, and programs already engage in activities that help Bristol become more resilient to a variety of hazards. It is important to highlight these capabilities and show how they support the Town's hazard mitigation efforts.

Step four was creating an updated list of mitigation actions to reduce the impact to the identified vulnerable areas. At the October meeting, the HMC reviewed goals and mitigation items that were proposed in the 2016 plan. Status updates were given for all the previous actions. The incomplete actions that were still important were rolled into the list of actions for this 2022 plan update. The HMC also began to brainstorm new mitigation actions at this meeting.

Step five was begun at the November 15, 2022 meeting where the group continued to with proposing new actions, establishing action timelines, costs, and identifying responsible parties.

Step six focused on the prioritization of the mitigation actions. This occurred towards the end of the December 7, 2022 meeting once the HMC had drafted a list of mitigation actions. After this meeting the consultant finished the draft of the plan for committee review.

Step seven furthered the public input and review process with the Bristol Town Council, and the general public for review and comment. See *Public Input* below.

Table 2 below provides a summary of the Committee's meeting dates and the activities that they conducted:

Table 2 Committee Meetings

Date	Meeting Summary
06/23/2022	› Kick off meeting with new contractor, VHB. HMC discussed the plan purpose and hazards of concern. Reviewed survey questions.
07/13/2022	› Hazards survey posted online.
08/02/2022	› The HMC reviewed the hazards of concern and listed critical infrastructure and community assets.
09/06/2022	› Review of community assets and discussion of current capabilities. › Review of 2016 goals.
10/05/2022	› Review status of 2016 actions.
11/15/2022	› Mitigation action discussion
12/07/2022	› Finalized mitigation actions and discussed prioritization
	› Plan review by the HMC
	› Distributed to Town Council and Town Administrator
	› Posted for public comment and sent neighboring towns
	› Received comments from public and Town Council
	› Sent to RIEMA for review
	› Sent to FEMA for approval
	› Plan adopted by the Town Council

Public Input

This hazard mitigation plan benefits from various distinct types of public input strategies that were utilized by the HMC during the drafting process and prior to its adoption by the Town Council. Public input for the updated Bristol Hazard Mitigation Plan was primarily collected through a public survey, public meetings and an invitation to comment.

Early in the planning process, the HMC promoted and distributed a "Hazard Perceptions" survey online. The purpose of the anonymous survey was to hear from residents the hazards and neighborhoods they are most concerned about. Overall, 68 individuals participated in the survey. Not surprisingly, most were concerned about high winds, winter storms, and Nor-easters. The survey also provided the HMC with a list of problematic areas that are susceptible to flooding. The HMC used the input from the survey to focus their mitigation planning efforts.

The 2022 HMC included town residents and municipal employees. The HMC's roles focused on reviewing the content of the risk assessment matrix to ensure proper classification of problems and estimates of potential impacts; formulation of mitigation actions and sequencing of primary tasks; and identification of feasible implementation methods and schedules. Their comments were incorporated into the final 2023 hazard mitigation plan.

Prior to public release of the 2022 HMP, the HMC drafted the plan through a series of committee meetings.

Another public input strategy was geared toward the general public as opposed to specific stakeholders. On XXXX, the Town Council received a presentation on the Hazard Mitigation Plan Update. Comments from the Council at this time centered around funding for the various mitigation actions and aligning the Town to be in good standing to receive additional FEMA grants.

Starting on XXX, during the draft review portion of the plan development, an electronic copy of the draft 2022 HMP was available on the Town's website and available at the Town Library for review. The public and neighboring communities were informed of this two-week review period via the Town's website and social media posts. Reviewers were encouraged to read the document and send any questions or suggested edits to the Director of Community Development. See Appendix B.

During the public review period, a one comment was received suggesting XXXX.

Review and comments from the Federal Emergency Management Agency and the Rhode Island Emergency Management Agency were also incorporated prior to adoption by the Town Council.

3

Natural Hazards

Hazards of Concern

The Rhode Island 2019 State of Rhode Island State Hazard Mitigation Plan Update, Bristol 2016 Hazard Mitigation Plan, and Municipal Resilience Program Community Resilience Building Workshop Summary of Findings August 2020 were used as a starting point for identifying hazards that pose the largest threat to the Town. The following table summarizes the hazards identified by the Bristol Hazard Mitigation Committee.

Table 3 Hazards Identified by the Bristol Hazard Mitigation Committee

Natural Hazards Identified by the State	Identified by the Bristol HMC	Notes
Severe Winter Weather		
Ice Storm	✓	Discussed as Winter Storms
Snow	✓	
Flood		
Riverine	✓	Combined all flooding as a hazard. Being a coastal community, flooding from inland waterways and the bay can have compounding effects.
Coastal	✓	
Flash	✓	
Urban/Street	✓	
High Wind	✓	
Extreme Heat	✓	
Hurricane and Tropical Storms		
Nor'easter	✓	
Storm Surge	✓	Included with flooding.
Extreme Cold	✓	
Thunderstorm	✓	
Hail	✓	
Lightning	✓	
Dam Failure	✓	

Table 3 Hazards Identified by the Bristol Hazard Mitigation Committee

Natural Hazards Identified by the State	Identified by the Bristol HMC	Notes
Fire		
Urban	–	Not covered by this natural hazard plan. While still a threat to Bristol, these are typically man-made disasters.
Wildfire/Brushfire	✓	
Sea Level Rise	–	The Bristol HMC considered the impacts from sea level rise as a flooding the hazard.
Infectious Disease	–	Not covered by this natural hazard plan. While still a threat to Bristol populations, disease is generally considered a biological event, not meteorological, environmental, or geological.
Drought	✓	
Earthquake	✓	
Tornado	✓	
Human-Caused Hazards		
Cyber Security	–	Not covered by this natural hazard plan.
Chemical Incident	–	Not covered by this natural hazard plan.
Terrorism	–	Not covered by this natural hazard plan.
Biological Incident	–	Not covered by this natural hazard plan.
Radiological Incident	–	Not covered by this natural hazard plan.
Civil Unrest	–	Not covered by this natural hazard plan.
Technological Hazards		
Infrastructure Failure	–	Not covered by this natural hazard plan

Other natural hazards such as landslides, volcanos, and tsunamis are not likely in Bristol due to the flat topography, lack of appropriate landforms.

History of Past Disaster Declarations in Bristol County

To date (May 1953 to December 2022) there have been 17 declared natural disasters in Bristol County, Rhode Island.

Table 4 Disasters

Declaration Date	Incident Type
02/07/1978	**Snowstorm**
02/16/1978	**Snowstorm**
10/15/1985	**Hurricane (Gloria)**
08/26/1991	**Hurricane (Bob)**
03/16/1993	**Snowstorm**
01/24/1996	**Snowstorm**

Table 4 Disasters

Declaration Date	Incident Type
02/17/2005	**Snowstorm**
03/29/2010	**Severe Storm**
03/30/2010	**Severe Storm**
08/27/2011	**Hurricane (Irene)**
09/03/2011	**Hurricane (TS Irene)**
10/29/2012 Emergency Declaration	**Hurricane (Sandy)**
11/03/2012 Disaster Declaration	**Hurricane (Sandy)**
03/22/2013	**Severe Storm**
04/03/2015	**Severe Storm**
08/21/2021	**Hurricane (Henri)**
05/12/2022	**Snowstorm**
12/23/2022	**Severe Storm**

Source: FEMA Disaster Declarations for States and Counties https://www.fema.gov/data-visualization/disaster-declarations-states-and-counties

Methodology

During the beginning phases of the planning process, the Hazard Mitigation Committee participated in an exercise that captured the frequency of various hazards, their potential damage extent, and their impacts (i.e. to populations, infrastructure, natural environment, etc.). The following scales were used during the analysis:

Probability of Future Occurrence	
Highly likely:	Near 100% probability within the next year;
Likely:	Between 10% and 100% probability within the next year or at least one chance in next 10 years;
Possible:	Between 1% and 10% probability within the next year or at least one chance in next 100 years;
Unlikely:	Less than 1% probability in next 100 years.
Damage Extent	
Low:	Some local property damage not town wide, minor injuries/ loss of life
Medium:	50% of property could be damaged and possible injuries/ loss of life
High:	Major town wide property damage, injuries and loss of life.
Level of Concern/Risk Rank	
Developed by the HMC to rank the various hazards based on frequency and damage potential.	
Low:	Not expected to occur with any frequency, damages will be limited.
Medium:	Will occur within the next 10 years but the Town has resources to reduce risks.
High:	Expected to occur within the next 5 years and is a major concern for the town. Town-wide impacts.

Based on a combination of probability of future occurrence, damage extent and impacts, the team assigned each hazard a Level of Concern. The table below summarizes the hazards of concern for the Town of Bristol, ranked from a high concern to low concern.

Table 5 Hazards Ranked

Hazard	Level of Concern/Risk Rank
Hurricane/Nor'easter	High
Winter Storms	High
Flooding (heavy rain, runoff, flash, inland, high tide, storm surge)	High
High Wind	Medium
Heat Wave	Medium
Extreme Cold	Medium
Lightning/Thunderstorms/Hail	Low
Drought	Low
Brushfires	Low
Dam Failures	Low
Tornadoes	Low
Earthquakes	Low

In this hazard mitigation plan, climate change is treated as an ongoing amplifier to the identified natural hazards, not profiled as an independent hazard. "Extreme weather events have become more frequent during the past half-century, and this trend is projected to continue.[13] For instance, more frequent intense precipitation events may translate into more frequent flooding episodes. The National Climate Assessment and Development Committee has documented that the average temperature across the United States has increased 1.5°F since 1895, with the majority of the increase since 1980. Weather events have and will continue to become more intense and frequent and will result in health and livelihood related impacts such as water supply, agriculture, transportation, and energy. The impact of dynamic storm events includes, but is not limited to, more frequent and intense heat waves, increases in ocean and freshwater temperatures, frost-free-days, heavy downpours, floods, sea level rising, droughts, and wildfires." [14]

Climate change impacts will be mentioned for each hazard.

The following subsections are organized by the level of risk as identified in Table 5, Hazards Ranked.

13 IPCC, 2012 - Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (Eds.) Available from Cambridge University Press, The Edinburgh Building, Shaftesbury Road, Cambridge CB2 8RU ENGLAND, 582 pp.

14 National Climate Assessment and Development Advisory Committee (NCADAC) January 2013 Draft Climate Assessment Report. http://ncadac.globalchange.gov/

Hurricanes

Description

Tropical cyclones, a general term for tropical storms and hurricanes, are low pressure systems that usually form over the tropics. These storms are referred to as "cyclones" due to their rotation. Tropical cyclones are among the most powerful and destructive meteorological systems on earth. Their destructive phenomena include very high winds, heavy rain, lightning, tornadoes, and storm surge. As tropical storms move inland, they can cause severe flooding, downed trees and power lines, and structural damage (Rhode Island State Hazard Mitigation Plan 2019).

There are three categories of tropical cyclones:

1. Tropical Depression: maximum sustained surface wind speed is less than 39 mph
2. Tropical Storm: maximum sustained surface wind speed from 39-73 mph
3. Hurricane: maximum sustained surface wind speed exceeds 73 mph

Once a tropical cyclone no longer has tropical characteristics it is classified as an extratropical system (Rhode Island State Hazard Mitigation Plan 2019).

Most Atlantic tropical cyclones begin as atmospheric "easterly waves" that propagate off the coast of Africa and cross the tropical North Atlantic and Caribbean Sea. When a storm starts to move toward the north, it begins to leave the area where the easterly trade winds prevail and enters the temperate latitudes where the westerly winds dominate. This situation produces the eastward curving pattern of most tropical storms that pass through the Mid-Atlantic region. When the westerly steering winds are strong, it is easier to predict where a hurricane will go. When the steering winds become weak, the storm follows an erratic path that makes forecasting very difficult (Rhode Island State Hazard Mitigation Plan 2019).

Hurricanes are categorized according to the Saffir/Simpson scale (Table 7) with ratings determined by wind speed and central barometric pressure. Hurricane categories range from one (1) through five (5), with Category 5 being the strongest (winds greater than 155 mph). A hurricane watch is issued when hurricane conditions could occur within the next 36 hours. A hurricane warning indicates that sustained winds of at least 74 mph are expected within 24 hours or sooner (Rhode Island State Hazard Mitigation Plan 2019).

The Saffir-Simpson scale (Table 6) is based primarily on wind speeds and includes estimates of barometric pressure and storm surge associated with each of the five categories. It is used to give an estimate of the potential property damage and flooding expected along the coast from a hurricane landfall.

Table 6 Saffir/Simpson Hurricane Wind Scale[15]

Wind Speed	Typical Effects
Category 1 – Weak 74-95 MPH (64-82kt)	*Minimal Damage:* Damage is primarily to shrubbery, trees, foliage, and unanchored mobile homes. No real damage occurs in building structures. Some damage is done to poorly constructed signs.
Category 2 – Moderate 96-110 MPH (83-95kt)	*Moderate Damage:* Considerable damage is done to shrubbery and tree foliage; some trees are blown down. Major structural damage occurs to exposed mobile homes. Extensive damage occurs to poorly constructed signs. Some damage is done to roofing materials, windows, and doors; no major damage occurs to the building integrity of structures.
Category 3– Strong 111-130 MPH (96-113kt)	*Extensive Damage:* Foliage torn from trees and shrubbery; large trees blown down. Practically all poorly constructed signs are blown down. Some damage to roofing materials of buildings occurs, with some window and door damage. Some structural damage occurs to small buildings, residences and utility buildings. Mobile homes are destroyed. There is a minor amount of failure of curtain walls (in framed buildings).
Category 4 – Very Strong 131-155 MPH (114-135kt)	*Extreme Damage:* Shrubs and trees are blown down; all signs are down. Extensive roofing material and window and door damage occurs. Complete failure of roofs on many small residences occurs, and there is complete destruction of mobile homes. Some curtain walls experience failure.
Category 5 – Devastating Greater than 155 MPH (135kt)	*Catastrophic Damage:* Shrubs and trees are blown down; all signs are down. Considerable damage to roofs of buildings. Very severe and extensive window and door damage occurs. Complete failure of roof structures occurs on many residences and industrial buildings, and extensive shattering of glass in windows and doors occurs. Some complete buildings fail. Small buildings are overturned or blown away. Complete destruction of mobile homes occurs.

Location

Bristol's close proximity to the Atlantic Ocean renders it particularly susceptible to hurricanes and the resulting loss of human life and property.

Probability of Future Occurrence

Likely.

Extent (Event Magnitude)

Hurricanes that likely make it up to Rhode Island are usually weak (Category 1) or downgraded tropical systems. The wind speeds may be less but the storms can still bring a lot of rain and storm surge which can cause extensive damage.

Impact and Damage Extent

Hurricane strength storms can cause coastal and inland flooding. Extensive rain and could damage homes, roads, and cripple the town. The high winds could down power lines and trees, and damage older structures. During extremely dangerous conditions, the Town may

15 National Weather Service, National Hurricane Center

elect to open shelters. Damage extent is dependent upon the size and timing of the storm. A slow-moving storm may bring more rain to the area than a fast-moving storm.

Impacts from Hurricane Irene in 2011 included heavy rain, inland flooding, and wind damage. In 2012, Hurricane Sandy caused extensive coastal erosion and town-wide power outages.

Climate Change Impacts

Warming global air and water temperatures may increase the intensity of hurricanes that travel along the Atlantic Coast.

History

Since 1851 Bristol has experienced 64 hurricanes of varying magnitude.[16]

In 1985, Hurricane Gloria left the town without power for three days. Along with the interruption of school and business activity, the roof of the Defiance Fire Station was destroyed.

In 2011, Hurricane Irene hit Bristol as a tropical storm. Despite the relatively low wind speeds, sustained winds over a 6 to 12-hour long duration resulted in widespread tree damage and resulted in power outages to roughly half a million customers throughout the state. Numerous trees, poles, and wires were downed throughout the area. Local roads were also flooded. The downtown business district lost power for 5 days as a result of downed trees and power lines. Collective effects throughout Massachusetts and Rhode Island resulted in 1 fatality, no injuries, and $127.3 million in property damage.[17]

In October 2012, Hurricane Sandy severely impacted coastal Rhode Island as it came ashore with Tropical Storm strength winds. Bristol was mainly impacted by high winds. Tree damage was widespread.

In October 2019, Hurricane Melissa which stayed offshore in the Atlantic basin caused coastal flooding and beach erosion in Bristol.

Tropical Storm Isaias (downgraded from a hurricane) knocked out power to tens of thousands of Rhode Island residents on the evening of August 4, 2020. Heavy rain and strong winds led to tree damage and downed wires throughout town.

Tropical Storm Henri (downgraded from a hurricane) brought heavy rain and strong winds (up to 70 mph) to the area on August 22, 2021.

Nor'easters

Description

A strong low-pressure system along the Mid-Atlantic and New England can form over land or over coastal waters. The storm radius is often as large as 1,000 miles, and the horizontal storm speed is about 25 miles per hour, traveling up the eastern United States coast.

16 NOAA Historical Hurricane Tracks (accessed January 2023) https://bit.ly/3XeAesS

17 NOAA Storm Event Database (accessed January 2023).

Sustained wind speeds of 10-40 MPH are common during a nor'easter, with short term wind speeds gusting up to 70 MPH. Typically a winter weather event, Nor'easters are known to produce heavy snow, rain and heavy waves along the coast. Unlike hurricanes and tropical storms, Nor'easters can sit offshore, wreaking damage for days.

Also called East Coast Winter Storms, Nor'easters are characterized by:

- A closed circulation.
- Located within the quadrilateral bounded at 45N by 65W and 70W, and at 30N by 85W and 75W.
- Show a general movement from the south-southwest to the north-northeast.
- Contain winds greater than 23 mph.
- The above conditions must persist for at least a 12-hour period[18].

The magnitude or severity of a severe winter storm or Nor'easter depends on several factors including a region's climatological susceptibility to snowstorms, snowfall amounts, snowfall rates, wind speeds, temperatures, visibility, storm duration, topography, and time of occurrence during the day (e.g., weekday versus weekend), and season.

The extent of a severe winter storm (including Nor'easters that produce snow) can be classified by meteorological measurements and by evaluating its combined impacts. For measuring wind effects, the Beaufort Wind Scale is a system that relates wind speed to observed conditions at sea or on land (See Table 11). The snow impact of a Nor'easter can be measured using NOAA's Regional Snowfall Index (See the section *Winter Storms*).

Location

Bristol's close proximity to the Atlantic Ocean renders it particularly susceptible to Nor'easters and the resulting damages and loss of human life and property.

Probability of Future Occurrence

Highly Likely.

Extent (Event Magnitude)

On average, Bristol experiences or is threatened by a Nor'easter every year or two.

Impact and Damage Extent

Most damage in Bristol would be to utilities, roads, stormwater infrastructure, personal property, trees, and snow loads on roofs. Debris in streams and streets would impair drainage and result in more flooding. Expected damages are similar to those from a hurricane but with maybe less storm surge. The Blizzard of 1978 was the largest Nor'easter on record. Many people in Rhode Island were without heat and electricity for over a week.

Climate Change Impacts

18 Hersher, et al. An East Coast Winter Storm Climatology. Northeast Regional Climate Center, Cornell University, Ithaca, NY, 2001.

Similar to hurricanes, changes in air and water temperatures may lead to stronger Nor'easters along the Atlantic Ocean. Bristol should expect stronger and more frequent severe storms.

History

Table 7 Nor'easter History[19]

Date	Comments
02/10/1969	Up to 20 inches of snow in parts of Rhode Island.
02/06/1978	Catastrophic snowstorm in Southern New England. 3' of snow reported in nearby Providence.
02/11/1994	Major Nor'easter in the region. School closed by noon, business and highway travel disrupted.
02/18/1998	Heavy rain and strong winds.
02/23/1998	Second Nor'easter to affect region in less than one week brought heavy rainfall and strong winds. 2" of rain fell over the eastern and northern part of the state. Wind gusts in nearby Tiverton were 52 mph.
03/21/1998	Spring nor'easter brought a mixture of snow, sleet, and rain to Rhode Island. Over the northern half of the state, snow accumulation was from 2 to 4.5 inches.
06/06/2000	Unusual June Nor'easter was felt most strongly along the coast where there were strong winds coupled with heavy rain. In Bristol County, 3.42 inches of rain was reported.
01/12/2011	Seven inches of snow reported in Bristol County from a winter Nor'easter. Coupled with other recent snow events, there was little chance for melting and municipalities were seeking permission to dump the snow in rivers and bays.

Winter Storms

Description

The majority of Rhode Island lies outside the heavy snow and ice regions of the northeast. Due to its maritime climate, Rhode Island generally experiences cooler summers and warmer winters than inland areas. However, snow and ice do occur and can be more than an inconvenience and cause extensive damage. The two major threats from these hazards are loss of power due to ice on electrical lines and snow loading on rooftops. Additionally, loss of power could mean loss of heat for many residents.

Winter storms vary in size and strength and can be accompanied by strong winds that create blizzard conditions and dangerous wind chill. There are three categories of winter storms. A blizzard is the most dangerous of the winter storms. It consists of low temperatures, heavy snowfall, and winds of at least 35 miles per hour. A heavy snowstorm is one which drops four or more inches of snow in a twelve-hour period. An ice storm occurs when moisture falls and freezes immediately upon impact.

19 NOAA Storm Event Database, Bristol County. https://www.ncdc.noaa.gov/stormevents/

Location

A severe winter storm could have a serious impact on private and public structures, as well as the general population throughout Bristol.

Probability of Future Occurrence

Highly Likely.

Extent (Event Magnitude)

On average, Bristol receives 37 inches of snow during the winter months. The average winter temperature (December-February) in Bristol is 40 degrees Fahrenheit.[20]

The Sperry–Piltz Ice Accumulation (SPIA) Index is a scale for rating ice storm intensity, based on the expected storm size, ice accumulation, and damages on structures, especially exposed overhead utility systems. The SPIA Index uses forecast information to rate an upcoming ice storm's impact from 0 (little impact) to 5 (catastrophic damage to exposed utility systems). Bristol expects at least a level 1- isolated or localized utility interruptions every year due to ice.

Figure 4 SPIA Index

The Sperry-Piltz Ice Accumulation Index, or "SPIA Index" – Copyright, February, 2009

ICE DAMAGE INDEX	* AVERAGE NWS ICE AMOUNT (in inches) *Revised-October, 2011	WIND (mph)	DAMAGE AND IMPACT DESCRIPTIONS
0	< 0.25	< 15	Minimal risk of damage to exposed utility systems; no alerts or advisories needed for crews, few outages.
1	0.10 – 0.25	15 - 25	Some isolated or localized utility interruptions are possible, typically lasting only a few hours. Roads and bridges may become slick and hazardous.
	0.25 – 0.50	> 15	
2	0.10 – 0.25	25 - 35	Scattered utility interruptions expected, typically lasting 12 to 24 hours. Roads and travel conditions may be extremely hazardous due to ice accumulation.
	0.25 – 0.50	15 - 25	
	0.50 – 0.75	< 15	
3	0.10 – 0.25	> = 35	Numerous utility interruptions with some damage to main feeder lines and equipment expected. Tree limb damage is excessive. Outages lasting 1 – 5 days.
	0.25 – 0.50	25 - 35	
	0.50 – 0.75	15 - 25	
	0.75 – 1.00	< 15	
4	0.25 – 0.50	> = 35	Prolonged & widespread utility interruptions with extensive damage to main distribution feeder lines & some high voltage transmission lines/structures. Outages lasting 5 – 10 days.
	0.50 – 0.75	25 - 35	
	0.75 – 1.00	15 - 25	
	1.00 – 1.50	< 15	
5	0.50 – 0.75	> = 35	Catastrophic damage to entire exposed utility systems, including both distribution and transmission networks. Outages could last several weeks in some areas. Shelters needed.
	0.75 – 1.00	> = 25	
	1.00 – 1.50	> = 15	
	> 1.50	Any	

(Categories of damage are based upon combinations of precipitation totals, temperatures and wind speeds/directions.)

20 U.S. Climate Data https://www.usclimatedata.com/

Impact and Damage Extent

The combination of wind, ice, and snow can have a crippling effect on the town. Heavy and/or excessive snowfall amounts can stress roofs and slow plowing efforts, as well as cause power outages. The local economy slows when businesses are closed due to winter weather. Heavy snow and ice can take down trees, knock out power, block roads, and cause structure damage. Falling trees have taken out power lines, damaged buildings, and essentially shut down the town. Flash freezes and icy roads from rain or high tides can also cause dangerous driving conditions.

Climate Change Impacts

Bristol may likely see less snowfall over the winter season but may see more intense blizzards when they do occur. If there is enough moisture in the atmosphere, it may fall as freezing rain, coating everything in ice. Bristol should expect more ice events.

History

Bristol has been subjected to annual snowstorms and Nor'easters. The Great Blizzard of 1978 blanketed Bristol County with 20 inches of snow and closed businesses for several days. More than 9,000 people in Rhode Island sought refuge in makeshift shelters, hotels, and movie theaters. Rhode Island was spared the brunt of the 2008 ice storm which affected more than a million people across New Hampshire, Vermont, Massachusetts, Maine, Connecticut, and New York. In February 2013, Winter Storm Nemo temporarily crippled the region. Power lines were downed, and heavy snow hampered driving conditions.

Table 8 History of Recent Significant Snow Events in Bristol County[21]

Date	Inches	Comments
02/02/2003	6	Winter storm brough fluffy light snow as temperatures dropped to the teens and 20s. Impacts to travel.
02/17/2003	14	Major snowstorm impacted travel conditions.
03/06/2003	8	Fast moving winter storm with heavy snow.
12/5/2003	15	Heavy snow caused major disruptions to traffic, minor accidents, and two fatalities in the region.
12/26/2004	8	Heavy snow totaled 8 inches in Bristol.
1/22/2005	21	Major winter storm with winds gusts of up to 60 mph. FEMA Emergency Declaration (EM-3202-RI) to supplement local efforts.
03/01/2005	6	Heavy snow and gusty winds.
0/12/2006	9-14	Nor'easter accompanied by heavy snow and high winds. Snow amounts varied throughout the region.
12/26/2010	6	Heavy snow, near blizzard conditions at times.
02/08/2013	4	Blizzard conditions. Hurricane gusts winds and heavy snow reported. Winter Storm Nemo.
01/26/2015	18	Historic winter storm brought blizzard conditions and resulted in a statewide travel ban. President Obama issued a federal disaster declaration for the State of Rhode Island for this storm.

21 Snow events impact the entire region but vary across the state. The NOAA history of events in Providence County is the most comprehensive resource. NOAA Storm Event Database www.ncdc.noaa.gov

Table 8 History of Recent Significant Snow Events in Bristol County[21]

Date	Inches	Comments
01/07/2017	10-12	Winter storm bringing snow and wind.
02/09/2017	10-12	Strong winds, heavy snow.
01/04/2018	12-17	Heavy snow and damaging winds.
01/29/2018	6-9	Coastal winter storm.
03/13/2018	10-13	Blizzard conditions reported during the storm.
03/03/2019	6-8	Heavy snowstorm.
01/28/2022	25	Blizzard conditions. Major Disaster Declaration (DR-4653-RI) for Bristol County.

Flooding (Heavy Rain, Runoff, Flash, Inland Flooding, High Tide and Storm Surge)

Description

Being a coastal community, Bristol experiences many types of flooding, none of which are independent from one another. The Bristol HMC has decided to treat all types of flooding as a singular hazard. See descriptions below.

According to the Rhode Island 2019 Hazard Mitigation Plan Update, "Flooding is a localized hazard that is generally the result of excessive precipitation. Flooding is the most commonly occurring natural hazard, due to the widespread geographical distribution of river valleys and coastal areas, and the attraction of human settlements to these areas. Floods are among the most frequent and costly natural disasters in terms of human hardship and economic loss."

"A flood, which can be slow or fast rising but generally develops over a period of days, is defined by the National Flood Insurance Program (NFIP) as:

- A general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties from: overflow of inland or tidal waters; unusual and rapid accumulation or runoff of surface waters from any source; or a mudflow; or
- The collapse or subsidence of land along the shore of a lake or similar body of water as a result of erosion or undermining caused by waves or currents of water exceeding anticipated cyclical levels that result in a flood as defined above."

Flooding due to **runoff** (sometimes called urban flooding) occurs when water runs over the land's surface impervious surfaces (paved areas, building subdivisions, and highways). Two major environmental modifications are primarily responsible for drastically altering the rain fall-runoff relationship.

1. Making the land surface impervious by covering it with pavement and construction work.
2. Installing storm sewer systems that collect urban runoff rapidly discharging large volumes of water into stream networks and/or freshwater wetland system.

FEMA maintains regulatory flood maps called Flood Insurance Rate Maps (FIRM). Insurance companies refer to these when providing coverage to homeowners. These maps are available for viewing at Town Hall and online at The FEMA Map Service Center https://msc.fema.gov. Please note that there is a process for the public to request a change in the flood zone designation for their property.

Riverine flooding occurs when heavy rainfall or snow melt causes the water in rivers and streams to flow over their banks. The severity of the flood depends on the saturation of the surrounding ground, the amount of precipitation, and duration of the event. Riverine flooding is most likely to occur in the late summer and early spring due to snow melt and spring rainfalls.

Simply put, **coastal flooding** occurs when seawater inundates the land. This can occur from a storm making landfall or just an unusually high tide (also called a King Tide, Spring Tide, or Moon Tide).[22] Because of development pressures and population increases on the coast, a greater number of structures are at risk to flooding.

FEMA maintains regulatory flood maps called Flood Insurance Rate Maps (FIRM). Insurance companies refer to these when providing coverage to homeowners. These maps are available for viewing at Town Hall and online at The FEMA Map Service Center https://msc.fema.gov. Please note that there is a process for the public to request a change in the flood zone designation for their property.

Table 9 Flood Zone Descriptions

Flood Zone	Description
VE	Coastal areas subject to inundation by the 1% annual-chance flood event with additional hazards due to storm-induced velocity wave action.
AE	1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Base Flood Elevation is provided.
AO	1% or greater chance of shallow riverine flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage
X (shaded)	Areas subject to inundation by the 0.2% annual-chance flood event.

[22] For more information on King Tides, visit https://www.savebay.org/king-tides-ri/ and The RI King Tides Initiative - MyCoast

Location

Low-lying areas around the coast, streams, and rivers are the most vulnerable to flooding.

Developed floodplain hazards of Bristol include the Bristol Waterfront Historic District, Poppasquash Road and Bristol Marine, Tanyard Brook Watershed and Silver Creek Watershed. Several coastal areas are protected by seawalls.

Probability of Future Occurrence

Flooding is highly likely, expected multiple times a year.

Extent (Event Magnitude)

The flood event which occurred in March 2010 was a 250 year +/- event with about 5 ½ inches of rain in a short period of time. In December 2023, an intense winter storm brought significant rainfall and coastal and inland flooding to Bristol and the surrounding area.

Impact and Damage Extent

Damages can be localized or extensive. In addition to inconveniencing populations, severe flooding can impact the wastewater infrastructure and local businesses.

Bridges along the flooded rivers can be compromised as waters rise and scour away at the foundations.

The flooding that occurred in March 2010 was the most memorable. Roads were closed, stormwater flooded the wastewater treatment plant and basements were being flooded. The stormwater infrastructure that was designed to drain the water was all underwater.

Climate Change Impacts

Changing climate conditions are likely to bring more rainfall events to Bristol and fewer snowstorms. More intense storms will stress the rivers and natural floodplains designed to carry floodwaters.

History

The most significant riverine flood in Bristol was in March 2010 when major rivers throughout the state crested their banks.

Most of the damage in Bristol County was from rainfall, water runoff, and wind damage. The Town of Bristol has two rain gauges that were collecting rainfall data during March 2010. The gauge located at the Silver Creek Pumping Station reported 16.67 inches of rain and the gauge located at the Mount Hope Pumping Station reported 14.72 inches of rain during this period. On April 2, 2010, the FEMA major disaster declaration for the State of Rhode Island was amended to include Bristol County.

The larger events in the county are outlined in the following table.

Table 10 Recent History of Flooding in Bristol [23]

Date	Comments
03/28/2005	Significant street flooding due to poor drainage.
06/07/2006	Coastal storm flooding led to the closure of Chestnut Street and Hope Avenue.
10/28/2006	Moderate coastal flooding. Smith Street was under 2 feet of water.
03/02/2007	2 to 3 inches of rainfall led to several road closures.
04/15/2007	Rainfall up to 5 inches, minor to moderate coastal flooding.
02/02/2008	Six inches of water reported in some backyards.
03/08/2008	Coastal flooding in Bristol, water crested over the seawall.
12/12/2008	Silver Creek in Bristol overflowed its banks flooding Route 114 and nearby roads, forcing them to close.
03/14/2010	Several streets flooded
03/30/2010	7 to 8 inches of rainfall. One house near Silver Creek was flooded and evacuated. The Bristol County Medical Center was forced to shut down for two days because of flooding in the electrical rooms. The Bristol Wastewater Pollution Control Department was overwhelmed with stormwater, both in the processing of wastewater and in the plant itself.
09/05/2012	3 to 4 inches of rainfall. Numerous road closures due to flooding. A portion of Woodlawn Avenue was washed out. Route 114 near the Sip-N-Dip on Hope Street was closed due to flooding.
10/29/2012	(Hurricane Sandy) Coastal flooding during Monday morning's high tide resulted in the collapse of a 30-foot section of seawall. This resulted in the erosion and undermining of Poppasquash Road in Bristol.
06/07/2013	2 to 5 inches of rain, several streets were closed.
03/30/2014	3 to 5 inches of rain caused flash flooding. Franklin, Chestnut, and Thames Streets were flooded. Route 114 near the Silver Creek Bridge and the Lobster Pot was closed due to flooding. Wood Street was flooded and closed. One house was evacuated at the end of the street. Several basements also were flooded.
07/15/2015	Several streets were flooded and impassable, including: Gooding Avenue, Chestnut, Tupelo, Thames, and Franklin Streets, and Brook Farm Drive. All of Thames Street was flooded in the Bristol Harbor area near Independence Park.
07/28/2015	In Bristol Annawamscutt Drive at Metacom Avenue/Route 136 was closed due to flooding.
07/16/2016	Chestnut Street was flooded and impassable.
12/23/2022	Severe storm brough heavy rain and widespread flooding to the coastal and inland streets.

High Winds

Description

Wind is the movement of air caused by a difference in pressure from one place to another. Local wind systems are created by the immediate geographic features in a given area such as mountains, valleys, or large bodies of water. National climatic events such as high gale winds,

[23] NOAA Storm Even Database www.ncdc.noaa.gov/stormevents

tropical storms, thunderstorms, nor'easters, hurricanes, and low-pressure systems produce wind events in Rhode Island. Wind effects can include blowing debris, interruptions in

Table 11 Beaufort Scale

Beaufort Number	Description	Wind Speed (km/h)	Observations
0	Calm	<1	Smoke rises vertically
1	Light Air	1-5	Smoke drifts slowly
2	Light Breeze	6-11	Leaves rustle, wind vanes move
3	Gentle Breeze	12-19	Leaves and twigs on trees move
4	Moderate Breeze	20-29	Dust picked up from ground
5	Fresh Breeze	30-38	Small trees sway in wind
6	Strong Breeze	39-51	Large branches move
7	Near Gale	51-61	Trees move, hard to walk
8	Gale	62-74	Twigs break off trees
9	Strong Gale	75-86	Branches break off trees
10	Whole Gale	87-101	Trees uprooted
11	Storm	102-120	Buildings damaged
12	Hurricane	>120	Severe building and tree damage

elevated power and communications utilities, and intensification of the effects of other hazards related to winter weather and severe storms.

The Beaufort Wind Scale is a 12-level scale used to describe wind speed and observed wind conditions at sea and on land. A wind classification of 0 has wind speeds of less than 1 mile per hour are considered calm. On the other end, a classification of 10 with wind speeds reaching 63 miles an hour will blow down trees and cause considerable damage.

Location

Wind events are expected throughout the year in Bristol.

Probability of Future Occurrence

Highly Likely.

Extent (Event Magnitude)

The windier part of the year lasts for 6.4 months, from October 15 to April 26, with average wind speeds of more than 7.3 miles per hour.[24]

Impact and Damage Extent

Strong wind gusts of 40 miles an hour (Beaufort Scale of 8) can blow twigs and small branches from trees. Occasional gusts and sustained winds at this speed (and above) are of concern to the Town. Damages from wind events range from power outages, property damage to vehicles and buildings and fallen trees/limbs. Previous wind events in Bristol have resulted primarily in power outages and downed tree limbs with minimal property damage. It is important that the Town of Bristol maintain their public tree trimming program that will reduce the likelihood of fallen trees/limbs from disrupting transportation routes, taking down power lines, and/or creating damage to the tree canopy.

Climate Change Impacts

Changes in atmospheric circulation are predicted to occur. See "Hurricanes and Nor'easters."

24 WeatherSpark https://weatherspark.com/y/26137/Average-Weather-in-Bristol-Rhode-Island-United-States-Year-Round

History[25]

Table 12 Recent History of High Winds in Bristol County

Date	Magnitude (mph)	Comments
02/25/2011	60	Heavy snow and wind. Wind gust of 60 mph in nearby Barrington.
12/27/2011	64	Heavy rain and strong, damaging winds. In neighboring Warren, large limbs and wires were down.
10/29/2012	73	Superstorm Sandy. Wind gusts of 73 mph reported in neighboring Warren.
12/21/2012	64	Tree damage was minimal, leaves had already been shed.
12/27/2012	60	Strong winds
01/31/2013	63	There was some tree damage and downed power lines in the region, with winds gusting to 60 to 70 mph.
10/29/2015	63	Strong winds resulted in local tree damage.
02/16/2016	63	Strong southerly winds.
12/15/2016	49	Winds brought down utility poles and wires on Hope Street in Bristol.
03/14/2017	58	Strong/damaging winds gusted to 45 to 60 mph across much of Rhode Island.
10/29/2017	62	A trained spotter in Bristol reported a sustain wind of 31 mph. Wires and trees down in neighboring Warren.
10/16/2019	61	A site in Bristol reported a wind gust of 58 mph. In neighboring Warren, a trained spotter reported a wind gust of 61 mph.
09/30/2020	55	Damaging winds on fully leafed trees.
11/30/2020	66	Rain and high winds.

Extreme Temperatures

Description

Extreme cold may accompany winter storms, be left in their wake, or can occur without storm activity. Extreme cold can lead to hypothermia and frostbite, which are both serious medical conditions. The definition of an excessively cold temperature varies according to the normal climate of a region. In areas unaccustomed to winter weather, near freezing temperatures are considered "extreme cold." In Rhode Island, extreme cold usually involves temperatures below zero degrees Fahrenheit.[26]

The wind chill index attempts to quantify the cooling effect of wind with the actual outside air temperature to determine a wind chill temperature that represents how cold people and animals feel, based on the rate of heat loss from exposed skin. A wind chill index of -5 indicates that the effects of wind and temperature on exposed flesh are the same as if the air temperature alone were five degrees below zero, even though the actual temperature could be much higher. The NWS issues a wind chill advisory when wind chill temperatures are potentially hazardous and a wind chill warning when the situation can be life-threatening[27].

25 NOAA Storm Event Database (2023)

26 Rhode Island State Hazard Mitigation Plan 2019

27 Rhode Island State Hazard Mitigation Plan 2019

The National Weather Service issues **extreme (or excessive) heat** warnings when the maximum expected heat index is expected to be 105° F or higher for at least 2 consecutive days and nighttime air temperatures are not expected to fall below 75°. In the northeast, these criteria are generally modified to a heat index of 92° for higher for 2 consecutive days.

The heat index is what the temperature of what the human body feels when the relative humidity is combined with air temperature.

Location

An extreme heat or cold event would be a regional issue affecting Bristol and significant portions of Southern New England.

Probability of Future Occurrence

Likely.

Extent (Event Magnitude)

The extent of extreme cold is measured by the Wind Chill Temperature Index, and extreme heat is generally measured through the Heat Index. Both indices provide a measure of how temperatures feel.

Impact and Damage Extent

Extreme temperatures could have a serious impact on private and public structures, as well as the general population throughout Bristol. During a heat wave, water supplies for drinking and firefighting may be stressed. There is added stress to the power grid and the natural environments.

Personal exposure to dangerous heat conditions may lead to heat cramps, heat exhaustion, and heat stroke. These are especially important to monitor in children, elderly, and vulnerable populations that are not able to move to cooler conditions.

Extreme cold conditions may occur during, after, or without any connection to a winter storm. During extended periods of extreme cold temperatures, there is a greater likelihood for frozen water pipes and services, higher fuel usage, and icy roads. Exposure to extreme cold can lead to hypothermia and frostbite.

Climate Change Impacts

Temperatures in Rhode Island have risen almost 4°F since the beginning of the 20th century.[28] Over the coming century, extremely hot days (over 90 degrees F) is projected to increase in New England.[29]

"Extreme cold in Rhode Island is projected to continue as extreme weather events experience an upswing due to climate change. The specific likelihood of extreme cold is unpredictable,

28 NOAA Centers for Environmental Information, State Climate Summaries 2022. https://statesummaries.ncics.org/chapter/ri/

29 Confronting Climate Change in the Northeast, by the Northeast Climate Impacts Assessment Group, July 2007

as days of frigid, arctic air and below freezing temperatures may be followed by days of mild temperatures in the 40s or 50s.."[30]

History[31]

NOAA's Storm Events Database does not have any records specifically for Bristol but reports at nearby T.F. Green Airport are usually available.

Table 13 Extreme Temperatures (Excessive Heat, and Extreme Cold/Wind Chill) at T.F. Green Airport[32]

Date	Temperature	Comments
05/09/2000	91	Third day in a row of high temps exceeding 90 degrees at nearby T.F. Green airport. Earliest heatwave on record since 1904.
05/03/2001	91	Record high for the day at T.F. Green Airport
05/04/2001	92	Third day of temperatures reaching 90 degrees or higher, making it the new earliest heat wave on record in greater Providence.
05/12/2001	90	The high temperature of 90 degrees at T.F. Green State Airport in nearby Warwick broke the record high for the date, which was 87 degrees set in 1959.
07/06/2010	105-106	Heat index values at the T.F. Green Providence Airport (KPVD) Automated Surface Observing System were 105 to 106 degrees.
07/22/2011	105-106	The Automated Surface Observing System at T.F. Green State Airport (KPVD) recorded heat indexes of 105 to 106 over an eight-hour period.
02/16/2015	-26	Wind chills as low as 26 below zero were reported at T.F. Green Airport
02/14/2016	-32	Wind chills as low as 32 below zero were reported at T.F. Green Airport

Lightning/Thunderstorms/Hail

Description

Thunderstorms are formed when the right atmospheric conditions combine to provide moisture, lift, and warm unstable air that can rise rapidly. Thunderstorms occur any time of the day and in all months of the year but are most common during summer afternoons and evenings and in conjunction with frontal boundaries. The National Weather Service (NWS) classifies a thunderstorm as severe if it produces hail at least one inch in diameter, winds of 58 MPH or greater, or a tornado. About 10 percent of the estimated 100,000 annual thunderstorms that occur nationwide are considered severe. Thunderstorms affect a smaller area compared with winter storms or hurricanes, but they can be dangerous and destructive for a number of reasons. Storms can form in less than 30 minutes, giving very little warning; they have the potential to produce lightning, hail, tornadoes, powerful straight-line winds, and heavy rains that produce localized flooding.

All thunderstorms contain lightning. Thunderstorms can occur singly, in clusters, or in lines. Therefore, it is possible for several thunderstorms to affect one location over the course of a

30 Rhode Island State Hazard Mitigation Plan 2019

31 Intellicast http://www.intellicast.com/Local/History.aspx?month=2

32 National Climate Data Center, 2021

few hours. Thunderstorms usually bring heavy rains (which can cause localized floods), strong winds, hail, lightning, and tornadoes. Lightning is caused by the attraction between positive and negative charges in the atmosphere, resulting in the buildup and discharge of electrical energy. Lightning is one of the most underrated severe weather hazards yet ranks as the second-leading weather killer in the United States. "Hundreds of people across the nation are injured annually by lightning, most commonly when they are moving to a safe place but have waited too long to seek shelter. Lightning strike victims often suffer long-term effects such as memory loss, sleep disorders, weakness and fatigue, chronic pain, depression and muscle spasms. Lightning has the potential to start both house fires and wildfires. Lightning causes an average of 55-60 fatalities, 400 injuries, and over $1 billion in insured losses annually nationwide." Lightning often strikes as far as 10 miles away from any rainfall.

In 2016 the Bristol Maritime Center on Thames Street was struck by lightning which caused electric systems in the building to short out.

"Hail is formed in towering cumulonimbus clouds (thunderheads) when strong updrafts carry water droplets to a height at which they freeze. Eventually, these ice particles become too heavy for the updraft to hold up, and they fall to the ground at speeds of up to 120 mph. Hail falls along paths called swaths, which can vary from a few square acres to up to 10 miles wide and 100 miles long. Hail larger than three-quarters (0.75)-inch in diameter can do great damage to both property and crops, and some storms produce hail over two (2)inches in diameter. Hail causes about $1 billion in damage annually in the U.S."[33]

Location

All of Bristol is susceptible to lightning/thunderstorms.

Probability of Future Occurrence

Highly Likely.

Extent (Event Magnitude)

The NWS classifies a thunderstorm as severe if it produces hail at least one (1) inch in diameter, winds of 58 mph or greater, or a tornado. Similar to modern tornado characterizations, lightning events are often measured by the damage they produce. Building construction, location, and nearby trees or other tall structures will have a large impact on how vulnerable an individual facility is to a lightning strike. A rough estimate of a structure's likelihood of being struck by lightning can be calculated using the structure's ground surface area, height, and striking distance between the downward-moving tip of the stepped leader (negatively charged channel jumping from cloud to earth) and the object. In general, buildings are more likely to be struck by lightning if they are located on high ground or if they have tall protrusions such as steeples or poles which the stepped leader can jump to.

[33] Rhode Island State Hazard Mitigation Plan 2019

When hail is produced by the storm, the initial criterion to determine severity is based on the diameter produced by the storm. The Tornado and Storm Research Organization (TORRO) hail intensity scale (Table 21) is a scale used to indicate the severity of a hail event.[34]

Table 14 TORRO Hailstorm Intensity Scale

Scale	Intensity category	Typical hail diameter (mm)	Typical damage impacts
H0	Hard hail	5	No damage
H1	Potentially damaging	5-15	Slight general damage to plants, crops
H2	Significant	10-20	Significant damage to fruit, crops, vegetation
H3	Severe	20-30	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
H4	Severe	25-40	Widespread glass damage, vehicle bodywork damage
H5	Destructive	30-50	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Destructive	40-60	Bodywork of grounded aircraft dented, brick walls pitted
H7	Destructive	50-75	Severe roof damage, risk of serious injuries
H8	Destructive	60-90	Severe damage to aircraft bodywork
H9	Super Hailstorms	75-100	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
H10	Super Hailstorms	>100	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

Impact and Damage Extent

Lightning can strike buildings and accessory structures, often causing structure fires. Electrical and communications utilities are also vulnerable to direct lightning strikes. Damage to these lines has the potential to cause power and communication outages for businesses, residencies, and critical facilities.

Electrical and communications utilities are also vulnerable to direct lightning strikes. Damage to these lines has the potential to cause power and communication outages for businesses, residencies, and critical facilities.

Human vulnerability is largely determined by the availability and reception of early warnings for the approach of severe storms, and by the availability of nearby shelter. Swimming, boating, and fishing are particularly dangerous during periods of frequent lightning strikes, which can also cause power outages, topple trees, and spark fires. Individuals who immediately seek shelter in a sturdy building or metal-roofed vehicle are much safer than those who remain outdoors. Early warnings of severe storms are also vital for aircraft flying through the area.

[34] The TORRO Hailstorm Intensity Scale, https://www.torro.org.uk/research/hail/hscale

Structural vulnerability to hail varies. Metal siding and roofing is better able to stand up to the damages of a hailstorm than many other materials, although it may also be damaged by denting. Glass windows and exposed vehicles are also susceptible to hail damage. Vegetation and crops are extremely susceptible to hailstorm damage.

Climate Change Impacts

Changing weather patterns may lead to more severe thunder and lightning storms which produce hail.

History

There has been no reported loss of human life in Bristol in the past 50 years due to lightning or hail.

Table 15 Lightning and Hail Events[35]

Date	Comments
06/22/1997	Hail and 81 mph winds
06/30/1998	Hail (nickel-sized) reported in nearby Barrington
07/02/2004	Hail (dime-sized) reported in nearby Barrington
06/24/2008	Hail and damaging winds; man struck by lightning
08/05/2009	Lightning struck a house and the ground at a sports field.
09/03/2013	Hail (quarter-sized) reported in Bristol
06/13/2022	Lightning caused a house fire in nearby Barrington
08/09/2022	Lightning caused a house fire on Metacom Avenue

[35] NOAA Storm Event Database (2023)

Drought

Description

Drought is characterized as a continuous period of time in which rainfall is significantly below the norm for a particular area over a multi-year period. The American Meteorology Society defines drought as a period of abnormally dry weather sufficiently long enough to cause a serious hydrological imbalance. Drought differs from other natural hazards in that they occur suddenly. Rather, a drought evolves over months or even years and, while causing very little structural damage, can have profound economic, environmental, and social impacts.

Drought in nearby Connecticut.
Source: Bob Luckey Jr./ Hearst Connecticut

There are four different ways that a drought can be defined:

1. **Meteorological** – A measure of departure of precipitation from normal. Due to climatic differences, what is considered a drought in one location may not be a drought in another location.
2. **Agricultural** – refers to a situation when the amount of moisture in the soil no longer meets the needs of a particular crop.
3. **Hydrological** – occurs when surface and subsurface water supplies are below normal.
4. **Socioeconomic** – refers to the situation that occurs when physical water shortage begins to effect people.

Characteristics and impacts of drought differ in many ways, so it is difficult to quantify drought. An existing index called the Palmer Drought Severity Index (PDSI) that used temperature and precipitation levels to determine dryness, measuring a departure from the normal rainfall in a given area. The advantage of the PDSI is that it is standardized to local climate, so it can be applied to any part of the country to demonstrate relative drought or rainfall conditions. A monthly PDSI value below -2.0 indicates moderate drought, and a value below -3.0 indicates severe drought.

The U.S. Drought Monitor tracks drought conditions in Rhode Island and in the rest of the nation. They create maps based on climate data, hydrologic and soil conditions, as well as reported impacts and observations from over 350 contributors nationwide.

Table 16 Drought Severity [36]

Severity	Category	PDSI Index Value	Drought Level	Possible Impacts
Exceptional Drought	D4	-5 or less	Emergency	Widespread crop/pasture losses, shortages of water creating water emergencies.
Extreme Drought	D3	-4 to -4.9	Warning	Major crop/pasture losses, widespread water shortages or restrictions.
Severe Drought	D2	-3 to -3.9	Watch	Crop or pasture losses likely, water shortages common, water restrictions imposed.
Moderate Drought	D1	-2 to -2.9	Advisory	Some damage to crops/pastures, developing water shortages, voluntary water-use restrictions requested.
Mild Drought/Abnormally Dry	D0	-1 to -1.9	Normal	Short term dryness slowing planting or crop growth.
Incipient Dry Spell		-0.9 or less	–	–

Rhode Island, as with most states within the United States, uses both the Palmer Drought Severity Index (PDSI) and the Crop Moisture Index (CMI) as indices for a drought occurrence. The CMI (a derivative of the PDSI) provides information on the short-term or current status of purely agricultural drought or moisture surplus. The PDSI is most effective for determining long-term drought conditions, while the CMI is effective at helping determine short-term drought.

The RI Drought Steering Committee assigns drought levels for the seven designated drought regions in the state, based on hydrological indices such as precipitation, groundwater, stream flow, and the PDSI, as well as on local supply indices such as static groundwater levels and reservoir levels. The Normal, Advisory, and Watch levels are issued statewide. The Warning and Emergency levels are issued on a regional basis and consider local conditions, source of water supply, and water storage capacity issues.

Location

According to the Rhode Island Water Resource Board the potential for a drought exists every eleven years in Rhode Island. Although temporary drought conditions may occasionally exist in Rhode Island, affecting Bristol, devastating long term drought conditions are not indicative of this temperate region.

Probability of Future Occurrence

Highly Likely.

36 http://droughtmonitor.unl.edu/AboutUs/ClassificationScheme.aspx

Extent (Event Magnitude)

According to The National Weather Service Rhode Island receives on average 39" to 54" of rain annually. Notwithstanding the same, the State experiences extended periods of dry weather. Some type of drought in Rhode Island occurs approximately once every 11 years.

Impact and Damage Extent

The main impacts of meteorological drought are periods of very high fire danger and low drinking water supplies. Bristol's drinking water is supplied by the Scituate Reservoir. Changes in water levels can impact not only the quantity of available water but also the quality.

Drought conditions have been known to trigger the rapid increase of the gypsy moth populations in the region. The extended period of dry weather (specifically in May and June) slows the fungus that usually keeps the gypsy moth caterpillars at bay. Denuded trees can have cascading effects on the local ecosystem.

Climate Change Impacts

Even though rain events may intensify due to climate change, the periods between them may be longer. Rhode Island expects longer periods of drought. According to the 2016 Rhode Island Hazard Identification and Risk Assessment, "Recent climate change studies[37] have indicated that although precipitation is projected to increase throughout this century, it will be in the form of short duration, intense, and less frequent events. In addition, it is projected by the Northeast Climate Impacts Assessment Group (NECIA) and the New York City Panel on Climate Change (NPCC) that most of this increased precipitation may occur during colder times of the year, such as winter, in the form of snow or ice. Furthermore, it is projected that the frequency and intensity of both long-term and short-term droughts throughout the Northeast will increase throughout the century with the impacts beginning to occur with a greater degree of frequency beginning in the mid-century (2050s)."

History

Extended droughts are rare in Rhode Island with a record of six major droughts (those lasting for more than one year) since 1929. The longest and most severe drought occurred in 1963-67 and affected most of the northeast. Water shortages affected most communities in Rhode Island and several municipal-supply wells were drilled to augment declining public supplies (USGS: Rhode Island Floods and Droughts). Very few drought events have occurred in Bristol County. The most recent event in 2012 occurred without the need for any drought declaration due to the above normal precipitation which followed.

37 Information derived from two recent studies: Confronting Climate Change in the Northeast, by the Northeast Climate Impacts Assessment Group, July 2007, and Climate Risk Information, by the New York City Panel on Climate Change, 2/17/09.

Table 17 History of Droughts in Rhode Island[38]

Date	Area Affected	Category	Remarks
1930-31	Statewide	D1/D2	Stream flow of 70% normal.
1941-45	Statewide	D1	Stream flow of 70% normal in Blackstone and Pawtuxet Rivers.
1949-50	Statewide	D1/D2	Stream flow of 70% normal.
1963-67	Statewide	D1-D3	Water restrictions/well replacements common.
1980-81	Statewide	D1	Groundwater deficient in eastern part of state. Considerable crop damage.
1987-88	Southern part of the state	D0/D1	$25 million crop damage.
1998-99	Statewide	D1-D3	Spring through summer the State experienced 75% of normal flow.
2012	Statewide	D2	January –April 2012. Meteorological drought due to precipitation levels one half of normal.
2016	Statewide	D2	August to November. Severe Drought due to below normal precipitation.
2020	Statewide	D3	September to November. Extreme Drought

Brushfire

Description

Brushfires are fueled by natural cover, including native and non-native species of trees, brush and grasses, and crops along with weather conditions and topography. While available fuel, topography, and weather provide the conditions that allow wildfires to spread, most wildfires are caused by people through criminal or accidental misuse of fire.

Brushfires pose serious threats to human safety and property in rural and suburban areas. They can destroy crops, timber resources, recreation areas, and habitat for wildlife. Wildfires are commonly perceived as hazards in the western part of the country; however, smaller brushfires are a growing problem in the wildland/urban interface of the eastern United States, including Rhode Island.

Brushfires are dependent upon the quantity and quality of available fuels. Fuel quantity is the mass per unit area. Fuel quality is determined by a number of factors, including fuel density, chemistry, and arrangement. Arrangement influences the availability of oxygen. Another important aspect of fuel quality is the total surface exposed to heat and air. Fuels with large area-to-volume ratios, such as grasses, leaves, bark and twigs, are easily ignited when dry.

38 USGS; RI Water Resources Board http://www.wrb.ri.gov/work_programs_drought/Drought_Facts_110607.html; and NOAA National Centers for Environmental Information https://droughtmonitor.unl.edu/AboutUSDM/AbouttheData/DroughtClassification.aspx

Climatic and meteorological conditions that influence wildfires include solar insulation, atmospheric humidity, and precipitation, all of which determine the moisture content of wood and leaf litter. Dry spells, heat, low humidity, and wind increase the susceptibility of vegetation to fire. In Rhode Island, common factors leading to large fires include short-term drought, humidity below 20%, and fuel type.

Various natural and human agents can be responsible for igniting brushfires. Natural agents include lightning, sparks generated by rocks rolling down a slope, friction produced by branches rubbing together in the wind, and spontaneous combustion.

Human-caused brushfires are typically worse than those caused by natural agents. Arson and accidental fires usually start along roads, trails, streams, or at dwellings that are generally on lower slopes or bottoms of hills and valleys. Nurtured by updrafts, these fires can spread quickly uphill. Arson fires are often set deliberately at times when factors such as wind, temperature, and dryness contribute to the fires' spread.

The temperate climate in Bristol is not set up to endure long periods of drought that lead to widespread vegetation loss. Destructive lightning fires in remote locations are rare but there is always a risk of fires from arson or careless fire use.

Location

The open fields, forested areas, and grassy areas throughout the town are most at risk. The Wildland Urban Interface (WUI)- the area where the built environment meets with the undeveloped wildlands is also vulnerable to fast spreading brushfires. In Bristol, these areas include woodland portions of the Town, particularly, the southern portion of Poppasquash, the Mt. Hope area, and the Town's open space land holdings north of the municipal golf course/Tupelo Street.

Probability of Future Occurrence

Likely.

Extent (Event Magnitude)

Brushfires average about one per year with a burn area of generally 5 acres. The extent has decreased over the years due to better response equipment, faster response time, and the widespread use of cell phones used to report fires. However, the wildland-urban interface is growing, potentially putting more infrastructure and lives at risk.

Impact and Damage Extent

Individual buildings may be more or less vulnerable to damage from brushfires based on factors such as the clear distance around the structure and the structure's construction materials. Brushfires primarily impacts timber and forest ecosystems, although the threat to nearby buildings is always present.

The likelihood of brushfires occurring and having widespread impacts has decreased over the years as fields and wooded areas are taken over by development.

Climate Change Impacts

Longer dry periods and droughts may increase the probability of brushfires but their extent has diminished over the years due to advances in detecting and firefighting technologies.

History

In April 2012 there was a significant brush fire that burned approximately six acres of woodlands on Poppasquash Point just south of Colt State Park. This fire brought to light the lack of water pressure and lack of fire hydrants in the area to fight this type of fire in an area of town with much wild vegetation interspersed with low density residential development.

Dam Failure

Description

Dams are classified as high hazard, significant hazard or low hazard. The classification is not based on whether a dam is deemed safe or unsafe. As of 2020, there are 95 high hazard dams, 81 significant hazard dams and 494 low hazard dams in the state.[39] Each dam's hazard classification determines the frequency of inspection. The higher the classification, the more frequently the inspection is conducted.

- A *High Hazard* dam is one whose failure or misoperation will result in a probable loss of human life.
- A *Significant Hazard* dam is one whose failure or misoperation results in no probable loss of human life but may cause major economic loss, disruption of lifeline facilities or impact other concerns detrimental to the public's health, safety or welfare.
- A *Low Hazard* dam is one whose failure or misoperation results in no probable loss of human life and low economic losses.

As part of each Rhode Island Department of Emergency Management (RIDEM) inspection, the major components of the dam are subjectively rated as good, fair or poor. The major components are the embankment, the spillway and the low-level outlet. Good means the dam meets the minimum Army Corps of Engineers (ACOE) guidelines. Fair means the dam has one or more components that require maintenance. Poor means a component of a dam has deteriorated beyond maintenance and is in need of repair.

Flood events call into question the structural integrity of dams that would affect Bristol. In 2021, RIDEM identified 3 dams in the Town of Bristol. One is classified as a significant hazard dam. The other two are considered low hazard. See Table 16.

Location

The State Street Reservoir is a Town-owned pond (or impoundment) that functions as a storm water detention basin located at the headwater of the Tanyard Brook. This historic mill pond has a dam and weir structure which is controlled by the Department of Public Works. This dam is inspected regularly and there is little chance of any dam failure.

39 2021 Annual Report to the Governor on the Activities of the Dam Safety Program. https://dem.ri.gov/sites/g/files/xkgbur861/files/2022-08/damrpt21.pdf

The Mount Hope Farm dams are located east of Metacom Avenue, between Tower Street and the coast.

Table 18 Dams in Bristol

Dam #	Name	Hazard Class	Ownership
409	State Street Reservoir	Significant	Town of Bristol
662	Mount Hope Farm Upper	Low	
663	Mount Hope Farm Lower	Low	

Probability of Future Occurrence

Unlikely.

Extent (Event Magnitude)

Two dam hazard classifications are represented in Bristol. The extent of a failure would vary. The Bristol Hazard Mitigation Committee has identified failure as a break in the dam, sending water downstream. The HMC is also concerned about dam failures further upstream in other municipalities that could impact their town.

Impact and Damage Extent

The Bristol Hazard Mitigation Committee recognizes that a dam failure is not a natural hazard in itself but several of the hazards listed in the hazard list could bring dam failure upon the Town of Bristol. Severe winter storms, flooding, and a hurricane could all bring enough rain and or snowfall to cause a dam failure in Bristol. The age of these dams also poses a risk to the structural integrity of these dams. A failure of the earth or masonry construction materials could cause loss of lives, property, the natural environment, and economy.

Climate Change Impacts

Related to flooding, more intense rain events may stress the structural integrity of dams which would lead to failure.

History

There has been no history of dam failure in Bristol.

Tornadoes

Description

A tornado is a violent windstorm with a twisting, funnel-shaped cloud. They are often spawned by thunderstorms or hurricanes. Tornadoes are produced when cool air overrides a layer of warm air, forcing the warm air to rise rapidly. The damage from a tornado is a result of the high wind velocity and wind-blown debris. Tornado season is generally March through August, although tornadoes can occur at any time of year. Over 80 percent of all tornadoes strike between noon and midnight. During an average year, about 1,000 tornadoes are reported across the United States, resulting in 80 deaths and over 1,500 injuries. The most violent tornadoes are capable of tremendous destruction with wind speeds of 250 mph or more. Damage paths can be in excess of one-mile-wide and 50 miles long.

Tornadoes are categorized according to the damage they produce using the Fujita Scale (F-scale). Below is the Enhanced Fujita (EF) Scale and the Old Fujita (F) Scale. An F0 tornado causes the least amount of damage, while an F5 tornado causes the most amount of damage. Relatively speaking, the size of a tornado is not necessarily an indication of its intensity. On August 7th, 1986, a rare outbreak of seven tornadoes occurred in New England. One such tornado, rated F2 on the Fujita Scale, carved its way through Cranston, RI, and Providence, RI, causing twenty injuries and $2,500,000 in damages. Table 14 highlights more tornado events that have affected, Rhode Island.

Table 19 Fujita Scale

Fujita Scale			Enhanced Fujita Scale		
F Number	Fastest ¼ mile (MPH)	3 Second Gust (MPH)	EF Number	3 Second Gust (MPH)	Damage Scale
0	40-72	45-78	0	65-85	Light damage. Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.
1	73-112	79-117	1	86-110	Moderate damage. Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.
2	113-157	118-161	2	111-135	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
3	158-207	162-209	3	136-165	Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
4	208-260	210-261	4	166-200	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown away some distance; cars were thrown and large missiles generated.
5	261-318	262-317	5	Over 200	Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters (109 yds); trees debarked; incredible phenomena will occur.

Probability of Future Occurrence

Unlikely.

Location

The Hazard Mitigation Committee recognizes that the risk of tornadoes is low for the State of Rhode Island but with the recent changing weather patterns and touchdowns of tornadoes, it would be unwise not to consider them a possible hazard.

Extent (Event Magnitude)

Historically, Bristol isn't known to be a hotbed of tornado activity. It is expected that future tornadoes will be 0 or 1 on the F-Scale of magnitude.

Impact and Damage Extent

Tornadoes can cause significant damage to buildings, trees and above ground utility lines. Flying debris can be cause injuries to residents.

Climate Change Impacts

It is uncertain how climate change will affect tornado outbreaks in Bristol.

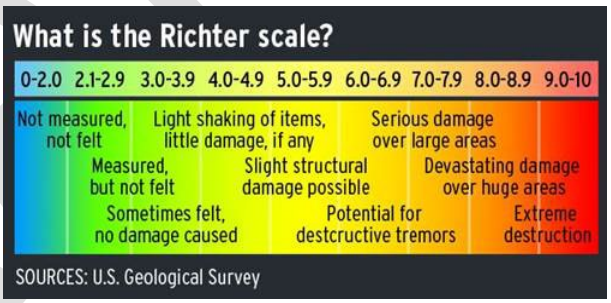
History

Table 20 Recent Tornado Events in Rhode Island[40]

Date	EF-Scale	Injuries	Damage	Location
8/16/2000	0	0	$0	Providence County
8/7/2004	0	0	$0	Kent County
7/23/2008	1	0	$47,987	Bristol County
8/10/2012	0	0	$50,000	Washington County
10/24/2018	1	0	unknown	North Providence and Lincoln

Earthquake

An earthquake (also known as a quake, tremor or temblor) is the result of a sudden release of energy in the Earth's crust that creates seismic waves. The seismicity or seismic activity of an area refers to the frequency, type and size of earthquakes experienced over a period of time. Earthquakes are measured with a seismometer. The size or magnitude is recorded on a device known as a seismograph. Earthquakes with a magnitude 3 or lower are mostly imperceptible (too low to recognize) and magnitude 7 earthquakes cause serious damage over large areas.



Although earthquakes are not considered to be a major problem in the Northeast United States, they are more prevalent than one might expect. Table 17 presents historical seismic activity for Rhode Island. It highlights the earthquake epicenter, the Richter magnitude at the epicenter, and the Mercalli Intensity Level. Richter magnitudes are technical quantitatively based calculations that measure the amplitude of the largest seismic wave recorded. Richter magnitudes are based on a logarithmic scale and are commonly scaled from 1 to 8. The higher the magnitude on the Richter Scale, the more severe the earthquake. Mercalli intensity levels are based on qualitative criteria that use the observations of the people who have experienced the earthquake to estimate the intensity level. The Mercalli scale ranges from I to XII. The higher the intensity level on the scale, the closer the person is to the epicenter.

Table 21 Mercalli Scale

Modified Mercalli Intensity	Description of Intensity Level
I	Not felt except by a very few under especially favorable circumstances.

40 Rhode Island Emergency Management Agency (RIEMA), Rhode Island 2014 Hazard Mitigation Plan Update

Table 21 Mercalli Scale

Modified Mercalli Intensity	Description of Intensity Level
II	Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration similar to the passing of a truck. Duration estimated.
IV	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Felt by all; many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Damage negligible in building of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motorcars.
VIII	Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
XII	Damage total. Lines of sight and level distorted. Objects thrown into the air.

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

- **Hard Rock:** Due to the geological makeup of New England's base rock, seismic energy is conducted on a greater scale (four (4)-10 times that of an equivalent Richter magnitude earthquake in California).
- **Soft Soil:** Many coastal regions of New England are made up of soft soils. These soils can magnify an earthquake as much as two times.
- **Structures:** The New England region, being one (1) of the first settled areas of the United States, has an abundance of older, unreinforced masonry structures that are inherently brittle and very vulnerable to seismic forces.
- **Low Public Awareness of Vulnerability:** Little public recognition of earthquake threat, and no established system of educating or informing the public of the threat or how to prepare for or respond during an earthquake. Therefore, higher losses will occur here than in other regions of the country.

Location

Rhode Island is located in the North Atlantic tectonic plate and is in a region of historically low seismicity. Only three (3) or four (4) earthquakes of Modified Mercalli Intensity Scale (MMI) V or greater have been centered in Rhode Island, including the 1951 South Kingstown earthquake of magnitude 4.6 on the Richter scale.

Probability of Future Occurrence

Possible.

Extent (Event Magnitude)

Due to the geological makeup of New England's base rock, seismic energy is conducted on a greater scale (four to 10 times that of an equivalent magnitude earthquake in California). Many coastal regions of New England are made up of soft soils. These soils can magnify an earthquake as much as two times.

Only a few earthquakes have had a measured intensity of V (Moderate) or greater on the MMI and been centered in Rhode Island. One past occurrence of note is the 1951 South Kingstown earthquake that had a magnitude of 4.7 on the MMI scale. Other past earthquakes were centered in Narragansett Bay and most significantly impacted Newport, Bristol, and Providence counties.

Impact and Damage Extent

The committee recognizes that the potential for an earthquake to strike the Town of Bristol is relatively low but the hazard could afflict town-wide damage, causing power outages, building collapses, water main breaks, dam failures, gas leaks, fires and injuries or deaths. Buildings that are most at risk from earthquakes are the historic structures.

Climate Change Impacts

It is uncertain how climate change will affect earthquake magnitude in and around Bristol.

History

No major earthquakes have happened in the Town of Bristol but have been felt in the state.

Figure 5 Rhode Island Earthquake Epicenters (1974 -2018)

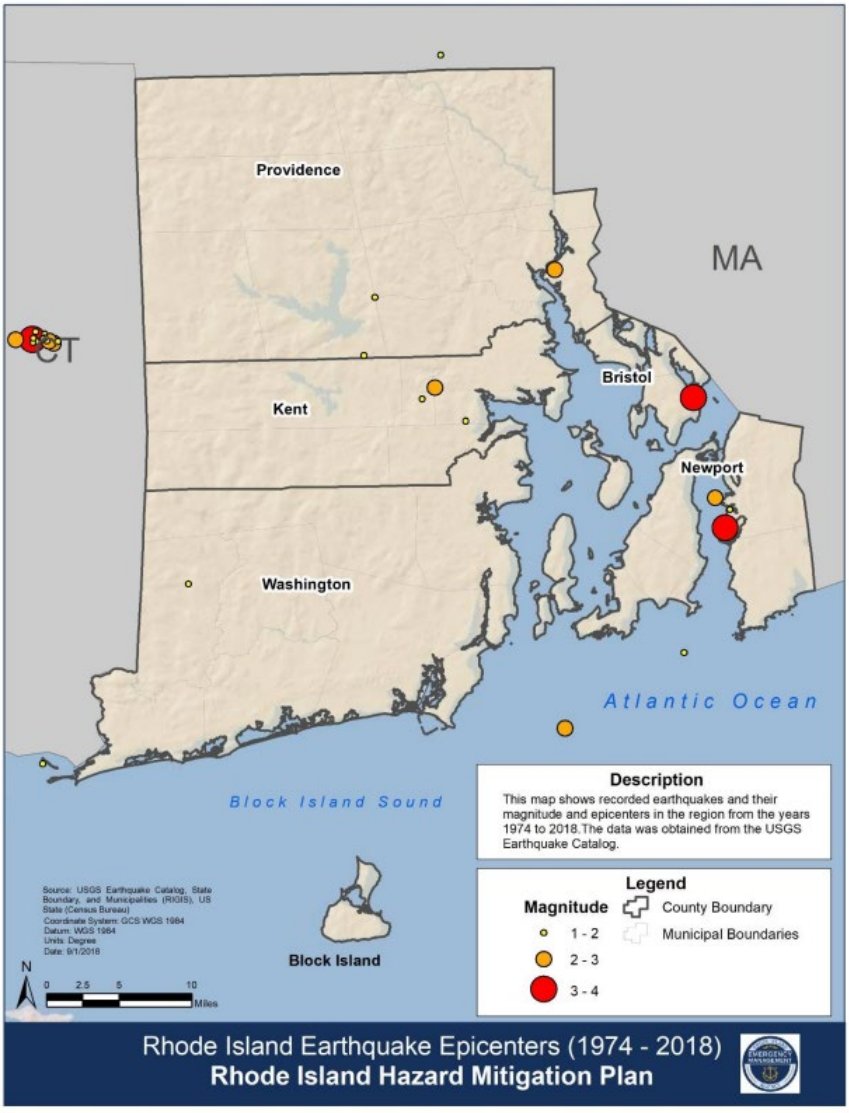


Table 22 Historic Seismic Activity in/near Rhode Island[41]

Date	Epicenter	Epicenter Magnitude	Mercalli Intensity Level
10/16/1963	Coastal MA	4.5	Caused some cracked plaster (MMI V) at Chepachet, Rhode Island.
6/14/1973	Western Maine	unknown	The intensities in Rhode Island were IV at Charlestown and I-III at Bristol, East Providence, Harmony, and Providence.
03/11/1976	Near Newport, RI	3.5	Intensity level VI shock effects felt throughout Southern New England. This earthquake has the distinction of being the largest earthquake to originate in Rhode Island.

41 United States Geologic Survey http//neic.usgs.gov/neis/states/rhode_island/rhode_island_history.html and Earthquake Hazards Program "*Did You Feel It*" Archives.

Table 22 Historic Seismic Activity in/near Rhode Island[41]

Date	Epicenter	Epicenter Magnitude	Mercalli Intensity Level
04/20/2002	Plattsburgh, NY	5.2	Intensity level II to III shock effects felt throughout Rhode Island.
03/11/2008	Central Connecticut	2.9	No data reported for Rhode Island.
06/23/2010	Ontario-Quebec	5.0	Felt throughout Rhode Island.
2011	Rhode Island	0.9	Felt locally.
2012	Rhode Island	1	Felt locally.
2013	Kingston, RI	Unknown	Felt locally.
04/04/2013	Hope Valley, RI	1.8	Felt locally.
01/12/2015	Wauregan, CT	3.3	Felt locally in RI.
07/22/2015	East Providence, RI	2.3	Felt locally in RI.
11/08/2020	Buzzards Bay	3.6	Felt locally in RI, likely in Bristol.
11/22/2020	Buzzards Bay	2.0	Felt locally in RI, likely in Bristol.
06/12/2022	Narragansett Bay	1.6	Felt locally in RI, epicenter between Bristol and Hog Island.

Climate Change

Changing climate patterns globally and in Rhode Island will worsen the effects of most natural hazards and affect future planning and mitigation efforts. Changes are already being observed and documented. In Bristol, climate change can be seen in sea level rise, high coastal flood waters, storm surges, and intense coastal storms. Long-term climate change is likely to cause the following impacts in Bristol:

- Heavier, more frequent precipitation events, which may cause more coastal and riverine flooding and flash flooding events.
- Longer periods of drought and heat waves which may affect water availability and increase the threat for wildfires.
- More frequent or intense high wind events such as hurricanes and Nor'easters which can damage trees, the electric grid, and property.

More frequent or severe flooding events can have widespread consequences in Bristol. Flooded or inaccessible property can lead to a decline in property values, increased number of foreclosures, and eventually vacant and blighted neighborhoods. These decreases in property values can lead to a reduction in local tax revenue and create budget shortfalls.

How rapidly these changes will be felt is debatable but there is certainty within the State that municipalities need to be prepared. The Town aims to become more adaptable/resilient to these changing conditions.

Through the exercise of creating this plan, the Town of Bristol is exploring ways to reduce their long and short-term risks to a variety of hazards. Any storm that comes up the eastern seaboard will likely impact the town. As climate conditions intensify, the HMC is prepared to update this plan accordingly.

4

Risk Assessment

Facilities/Resources Inventory

The first step in the assessment process was to create the inventory of facilities and resources of special concern to the Town. The HMC identified the following as community assets:

- Flood prone drainage systems, streets, or infrastructure
- Bridges
- Wastewater facilities
- Water supply systems
- Other services/utilities
- Communication towers
- Dams
- Critical municipal hazard response facilities
- Populations
- Businesses
- Schools
- Recreational facilities
- Natural resources
- Historic resources

During the review of these assets, the HMC came to the conclusion that not all of these are so vulnerable they require a new mitigation action within the next 5 years. For some assets, the Town will continue with ongoing actions. As infrastructure ages, and climate conditions change, the HMC will update this plan accordingly.

These most vulnerable assets are identified in the Community Assets Matrix located at the end of this section.

Hazard Mitigation Mapping

The Town's GIS database, including parcel data, orthophotography and FEMA flood zone information, were utilized to complete the assessment. The use of this system allowed the HMC to estimate potential fiscal and population impacts for individual parcels.

The final output of this exercise is the Town of Bristol Community Assets Map in Appendix C. The focus of the map is not to duplicate all of the spatial information generated through the inventorying process but rather to present the location of the identified risks as they relate to the Town's response facilities.

Fiscal Impact Analysis

Although wind and heavy snow can certainly rack up substantial damages, flooding is one of the hazards that most frequently affects area populations. The Town of Bristol's parcel data and FEMA's 1% annual chance floodplain data were utilized to generate estimates of potential fiscal impacts from natural hazard events such as flooding. The information utilized from the tax assessor's database and GIS included the improvement values, land usage, and unit counts. The analysis showed that Bristol is comprised of 6,464 acres of land, with about 114 acres in the regulatory floodplain. These 114 acres are largely located along the perimeter of the Town at the coast, through the middle of Colt State Park, and along Silver Creek and Tanyard Brook.

HAZUS-MH is a software tool that contains models for estimating potential losses from earthquakes, floods, and hurricanes. HAZUS-MH was used to further understand the potential risk from a large hurricane. For the purpose of this plan, a scenario was run that capture the Town's risk from hurricane damage. The table below summarizes some of the potential damages. The hurricane scenario model uses the same path as the hurricane which tracked west of Bristol.

In 1954 Hurricane Carol (Category 1, peak gusts at 105 mph) tore through Southern New England, causing extensive damage throughout Rhode Island. If this same storm were to strike again today, it would cause over $143 million dollars in total economic losses (property damage and business interruption loss) in Bristol. About 333 buildings are expected to be at least moderately damaged.[42] See Appendix D.

42 A representative analysis. No particular building is identified.

HAZUS Qualitative Damage Description

- No Damage or Very Minor Damage
- Little or no visible damage from the outside. No broken windows, or failed roof deck.
- Minimal loss of roof over, with no or very limited water penetration.

Minor Damage

- Maximum of one broken window, door or garage door. Moderate roof cover loss that can be covered to prevent additional water entering the building. Marks or dents on walls requiring painting or patching for repair.

Moderate Damage

- Major roof cover damage, moderate window breakage. Minor roof sheathing failure. Some resulting damage to interior of building from water

Severe Damage

- Major window damage or roof sheathing loss. Major roof cover loss. Extensive damage to interior from water.

Destruction

- Complete roof failure and/or, failure of wall frame. Loss of more than 50% of roof sheathing.

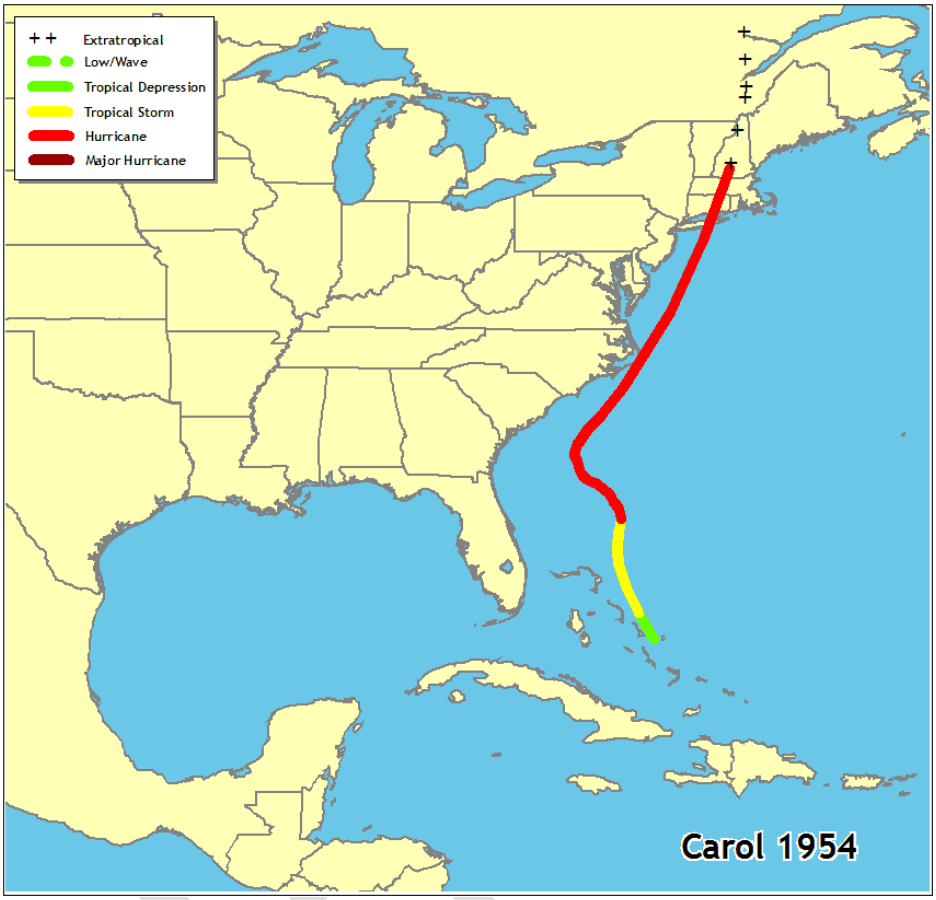
Table 23 HAZUS-MH Scenarios for Bristol, RI

1954 Hurricane Carol Scenario – If It Happened Today[43]

Estimated Damage	Amount
Debris generated	18,892 tons
Buildings destroyed	9
Buildings at least moderately damaged	333 (4% of total number of buildings)
Displaced households	85 households may be displaced. 40 people out of a population of 22,493 will seek temporary shelter in public shelters.
Essential Facility Damage (fire, police, schools)	7 facilities would expect to be non-operational for less than a day.
Residential Property (capital stock)	$128,352,000
Business interruptions	$15,007,000

43 HAZUS-MH Hurricane Global Risk Report, run March 2023.

Figure 6 Hurricane Carol Path



During non-cyclone events, flooding can still impact the Town. Table 22 displays potential damage estimates of property values of buildings within the Town's Special Flood Hazard Area (SFHA), or regulatory floodplain. The parcel information, using the best available data, provides the number of parcels in the SFHA, and values of the buildings on each property. Land value was not considered for this exercise. The values provided are an estimate only. This percentage was calculated in order to assist with identifying which areas are at greater risk. According to Table 22, the town-wide total potential building damages for these floodplain areas are nearly $5 million.

Approximately 79% of Bristol's revenue is generated from real estate taxes.[44] Should any of the properties forming the tax base be destroyed by a hazardous event, a causal effect would be those property owners whose parcels remain intact would carry an increased financial burden with regards to property taxes. It is an important course of action for the Town to protect both lives and property from natural disasters. However, as Bristol's population grows, the burden of protecting lives and property grows.

44 Town of Bristol, RI Town Administrator Recommended Budget for Fiscal Year Ending June 30, 2024.

Using data from the E-911 structure data from the RI Geographic Information System (RIGIS) and information from the Bristol Tax Assessor, the following table summarizes the value of the insurable buildings that are located within the Special Flood Hazard Areas.

The buildings that were located in each SFHA were first selected. The Town's parcel information for each building was then used to determine the building value. Parcels in the SFHA which do not have structures were not included in this assessment.

Table 24 2022 Property Values with Structures in Special Flood Hazard Areas by Flood Zone[45]

Flood Zone	# of Parcels	Total Acres	Building Value
VE	566	569.5	$260,800,000
AE	497	304.5	$116,202,900
TOTAL	**1,063**	**874**	**$377,002,900**

Table 25 2022 Property Values with Structures in Special Flood Hazard Areas by Zone Type

Land Use Type	# of Parcels	Total Acres	Building Value
Residential	503	336	$127,437,100
Waterfront	199	14	$106,940,200
Waterfront (Planned Unit Development)	25	1	$13,334,100
Planned Unit Development (PUD) such as condos	300	410	$112,575,700
Downtown	21	19	$14,521,900
General Business and Limited Business	11	3	$2,162,400
Manufacturing	2	0.7	$3,800
Open Space	1	23	$27,700
TOTAL	**1,063**	**874**	**$377,002,900**

Built Environment

According to HAZUS-MH, Bristol has over an estimated 8,000 buildings with a total replacement value (excluding contents) of $4.7 billion. Approximately 86% of the buildings and 64% of the value are associated with residential housing.

45 Based on RIFIS e911 Sites, FEMA 2014 Flood Insurance Rate Maps, and 2022 parcel information from the Town. This data is to be used for planning purposes only to prove estimate values.

Using the Rhode Island GIS e911 structure file, FEMA flood insurance rate maps, and the Town's GIS, it was determined that $447 million in building values are located in the floodplain. Most of those are residential properties.

There are 317 flood insurance policies in place for a town that has over 1,000 structures in the regulatory floodplain (VE and A-Zones). In the lower risk X-zones, 138 policies are in place, for added protection in case it floods. These polices are more affordable than those in the A and VE-Zones.

Table 26 Flood Insurance Information[46]

Total Number of Policies	317
Total Premiums	$241,833
Insurance in Force	$87,757,600
Total Number of Closed Paid Losses	206
$ of Closed Paid Losses	$1,518,973
Repetitive Loss Properties	13 (including SRL) residential
Severe Repetitive Loss Properties	1

Number of Policies in Each Zone:

Zone	Policies
A-Zone	165
VE-Zone	14
X-Zone (Standard)	137
X-Zone (Preferred)[1]	1

1 Preferred Risk Policies (PRP) are more affordable policies cover structures that were built in an X zone but due to new mapping, are now located in a Special Flood Hazard Area.

Areas that didn't experience flooding previously are now more vulnerable as riverine flood intensity and frequency increases The Town has been encouraging development away from flood areas but most of this development predates recent regulations requiring flood proofing, leaving many vulnerable areas unprepared to face a storm of any significance.

The HMC has identified critical infrastructure listed in the Community Asset Matrix (Table 27). The list includes flood prone drainage systems, streets or infrastructure; bridges; wastewater; water supply; services/utility

FEMA A-Zone vs. AE-Zone

Both are considered Special Flood Hazards Areas- areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage.

AE Zone: Base Flood Elevations (BFEs) are provided on the FEMA maps. Formerly A1-A30 numbered zones.

A Zones: Detailed studies have not been conducted which indicate depth or base flood elevation.

46 As per the State Hazard Mitigation Officer XXXX

facilities; public communication equipment; dams; critical municipal hazard response facilities; populations; businesses; schools; recreational facilities; and historic resources. All of these important community resources have the potential to be affected by natural disasters. The magnitude of the losses would be dependent upon the type, location, and extent of each unique hazard.

The Town's zoning laws help dictate future development while maintaining Bristol's unique character. Continued enforcement of Rhode Island State building codes and new regulations as required will lessen potential damage caused by a natural hazard event. The codes adopted by the Town of Bristol range from building codes and design standards, to zoning regulations.

Population Impact Analysis

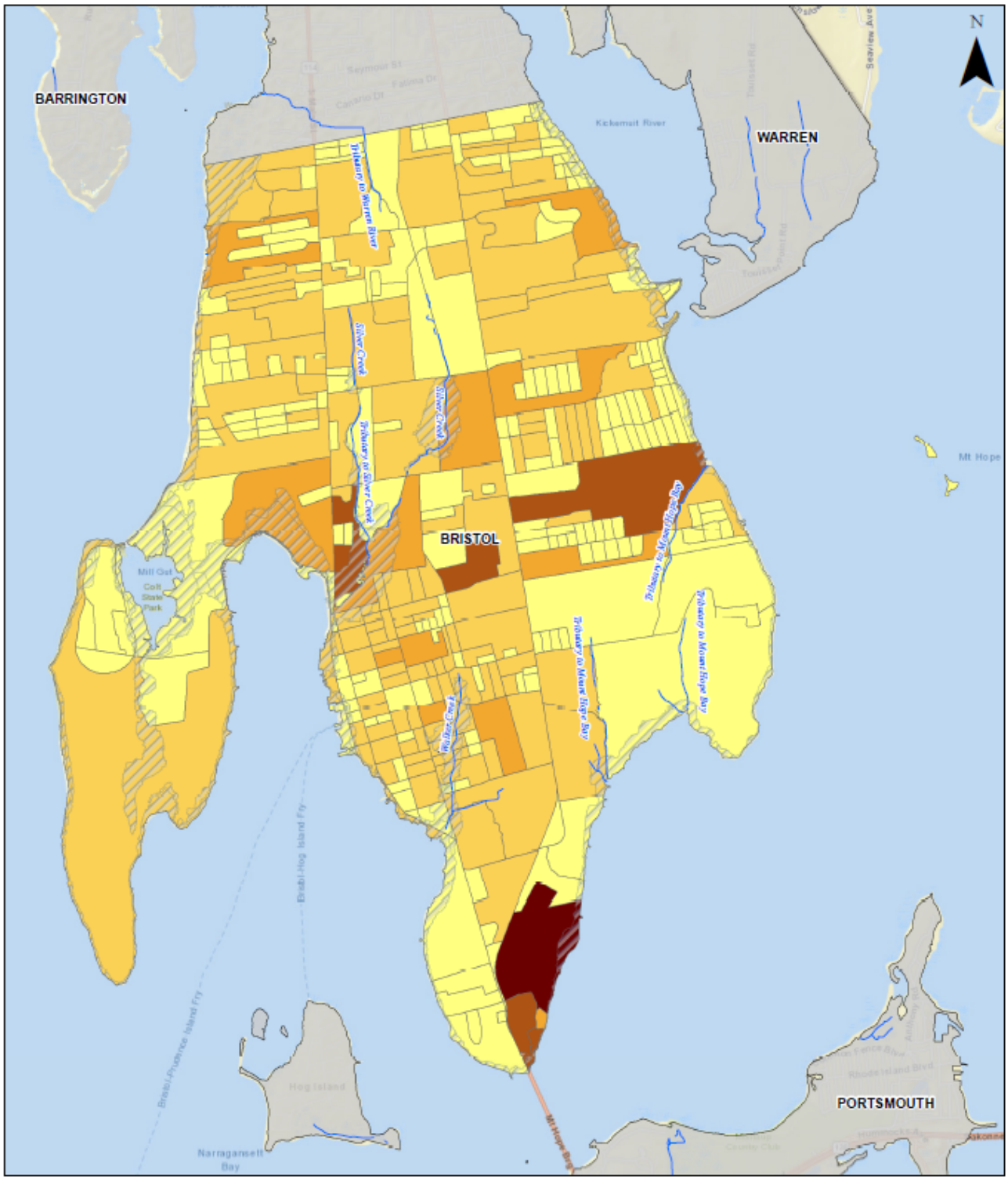
Of primary concern during a hazard event is protecting the health and safety of Bristol residents. In addition to knowing the total population, it's also important to estimate how many people would be impacted by loss of service or need to evacuate. According to the 2020 American Community Survey 5-Year Estimates, there are 9,412 housing units in Bristol supporting a population estimate of 22,224. The population in Bristol is generally clustered. The 2010 Population data was used in Figure 7 to estimate the most densely populated areas based on the best available data.

Vulnerable populations include elderly/senior citizens, special needs, disabled, Roger Williams University Students, visitors and tourists, business owners, veterans, low income residents, and the working waterfront community. The non-residents may be unfamiliar with evacuation routes, sheltering options, or flood risks. They also are unlikely subscribed to the Town's Code Red system which sends out automated emergency alerts.

Improving emergency response and educating these populations is important to the Town.

A significant hazard can significantly cripple the Town. In addition to direct damage to personal property, impacts can include the disruption of vital services, the loss of utilities, and the emotional strain from financial and physical losses. This is especially difficult when residents are forced to evacuate their homes.

Figure 7 2020 Population by Census Block



Natural Environment

The Bristol Comprehensive Community Plan and Open Space Plan identifies the following critical natural resources:

- Wetlands and salt marshes
- Creeks and brooks
- Floodplains
- Soils
- Habitats and endangered species
- Wooded areas
- Beaches

Rhode Island has experienced a significant increase in both flood frequency and flood severity over the past 80 years. Climate change is expected to result in more frequent heavy rains, affecting stream flow.[47]

Hurricanes, earthquakes, Nor'easters, floods or any weather-related hazard event will have particular impacts on the natural environment. Differences in storm size, speed of movement, wind speeds, storm surge heights, timing with respect to tides and landfall location relative to vulnerable resources makes for high variability in impacts and related costs.

When the natural environment is impacted there are both direct and indirect costs. Impacts of severe weather events to the natural environment include both direct (loss of habitat and salinization of land/ groundwater) and indirect costs (widespread inland damage to built environment, threats to ecosystems/ species, and contamination of potable water supply).

Vulnerability of Future Structures

Bristol is not uniformly vulnerable to natural hazards and climate change. Certain locations, resources, and populations have and will be affected to a greater degree than others. The Town's zoning districts helps to maintain these less densely developed areas. Growth should only occur when there is an available capacity for municipal services to absorb the growth, and there is a fiscal ability and community agreement to the expanded infrastructure required for growth.

Bristol's vulnerability to natural hazards is not expected to change dramatically over the next five years due to increased development. Enforcement of current building codes will ensure that development will be stronger and more resilient than some of the older, historic structures in Bristol.

47 Rhode Island's Environmental Climate Change Coordinating Council (EC4) Science and Technical Advisory Board, *Current State of Climate Science in Rhode Island,* May 1, 2016 Microsoft Word - STAB_Ann_Rpt_Final.docx (ri.gov)

Future Vulnerability

As climate conditions change, increased storm intensity or frequency may put considerable stress on the infrastructure in Bristol. Roads will flood more often and may eventually become unusable. Drainage infrastructure may be overwhelmed more often. Fire hydrants, pump stations, and sewer and water lines will be stressed or inaccessible by the rising streams and rivers. Areas that are not used to flooding may see flood waters inch closer to their property.

Community Assets Matrix

The matrix (Table 25): Critical Infrastructure/Community Assets represents the culmination of the risk assessment process and is the final product. Its purpose is to gather all the pertinent results in one place for ease of presentation and to serve as a starting point for discussion of specific mitigation actions. It not only lists the specific areas of concern, but provides detailed location information, summarizes the applicable hazard, problem, and mitigation benefits.

Table 27 Bristol's Critical Infrastructure/Community Assets

At Risk	Location	Hazard/Problem	Ongoing Actions	Mitigation Actions
Flood Prone Drainage Systems, Streets, or Infrastructure	Tanyard Brook Crossing Hope Street • (intersection of Hope St./Ferry Rd. northwest to Walley St…also serves as a section of the primary evacuation route) • (Burton St. northwest to Summer St.) Thames Street • (Constitution St. to just north of State St.) • (north of Bradford St. to the intersection with Washington St., then continuing north onto Hope St. to Poppasquash Rd.) Coggeshall Farm Road (Colt Rd. through to Colt Drive…also serves as a section of the primary evacuation route) Colt Drive (north along Asylum Rd.) Surf Drive (Beach Rd. to just north of Cliff Drive) Wood Street (intersection of Hope St. north to Woodlawn Ave. also serves as a section of the primary evacuation route) Slocum Street (Bristol Town Line south to Butterworth Ave.) Riverview Avenue (Butterworth Ave. to Franca Dr.)	Flooding: inland and coastal.	Sherman Avenue end of road drainage and public access improvements at $120K Narrows Road right of way at Mt. Hope Bay drainage improvements at $100K Annawamscutt Drive right of way drainage improvements at $136,000 Portside Drive drainage and right of way improvements at $48,000 Sunrise Drive right of way drainage improvements at $82,000 Church Street Dock sea wall repairs to improve resiliency Retrofit of paved parking areas within the Tanyard Brook and Silver Creek Watershed	1. Expand green stormwater infrastructure throughout town.

At Risk	Location	Hazard/Problem	Ongoing Actions	Mitigation Actions
	Everette Street (Franca Dr. south to terminus) Smith Street (Water St. to several inland segments) Wilcox lane (in its entirety) Harrison Street (in its entirety) Wood Street • (intersection of Hope St. north to Woodlawn Ave also serves as a section of the primary evacuation route) • (bisecting through residential areas north at Garfield St., Collins St., Cole St., Charles St., Richmond St., Prospect St., Catherine St., and Mt. Hope Ave.) • (Ferry St. north) Washington Street (Hope St. to High St. to intersection with Bayview Ave.) Monroe Avenue (north from Washington St. to Perry St.) Jones Street (in its entirety) Chestnut Street (at High School crossing) Gooding Avenue (multiple segments) Tupelo Street		Shoreline Management Program to retrofit dead end streets that taper into the water. Fox Hill Avenue drainage improvements were recently completed Summer 2023. Tanyard Brook Phase 3 recently completed Summer 2023. Sherry Avenue / Varnum Street (Silver Creek watershed) drainage study. In design. Leahy Pond /Sowams Drive /Annawamscutt Drive sub watershed drainage and water quality improvement study. In concept design. Mt. Hope High School drainage improvements. Concept designs and cost estimates completed. Future work pending proposed high school.	

At Risk	Location	Hazard/Problem	Ongoing Actions	Mitigation Actions
	Seawall at Poppasquash Road		Leila Jean Drive (Silver Creek) drainage improvements. Recently completed. Ongoing monitoring and maintenance. More work may be necessary. Bristol Police Station stormwater improvements. Recently completed Summer 2023. Tanyard Reservoir drainage and flood improvements. Recently completed.	
Bridges	Mill Pond Bridge (weight limit) Mt. Hope Bridge (Ferry Road) Silver Creek (Route 114) Poppasquash culverts flood Wooden bridge which provides pedestrian access through a wetland at Silver Creek cannot support a vehicle for emergency access.	Flooding/sea level rise High Wind (Mt. Hope Bridge) Severe storms Ice	Statewide Planning: 114 Corridor- resiliency planning currently ongoing in partnership with Statewide Planning and the Towns of Warren and Barrington.	2. Design and construct Wood Street Extension from Perry St. north to Chestnut St.
Wastewater	Mt. Hope Pump Station (in the floodplain) Silver Creek Pump Station (in the floodplain) Constitution Pump Station (in the floodplain) Ferry Road Pump Station (in the floodplain) Peter Road (near wetland)	Flooding/sea level rise	Ferry Rd anticipated to be abandoned to sea level rise.	3. Reinstate check valve retrofit program. 4. Seek alternative access to Sewer Plant.

At Risk	Location	Hazard/Problem	Ongoing Actions	Mitigation Actions
			Applied for grants to get a pump station generator. Incentives to disconnect sump pumps up to $1,000 to replumb the sump pumps. Reduces overflow of sewer plant. Mandate from EPA to reduce infiltration. In 2020 this was implemented with a public information program and Town inspections of all retrofits before and after. RI Infrastructure Bank (RIIB): provided loans to homeowners for lateral repairs. $10,000. Sewer lines being upgraded. Drainage improvements at Wastewater Treatment Facility.	
Water Supply Systems	Pump stations and lines. Bristol County Water. Water from Scituate. Back up in East Providence.	Drought Flooding/sea level rise	Water mains have been enlarged. Connectivity projects and water pressure projects are ongoing.	5. Coordinate with Bristol County Water to create water line redundancy.

At Risk	Location	Hazard/Problem	Ongoing Actions	Mitigation Actions
Other Services/Utilities	Prudence Island Ferry Terminal U.S. Coast Guard, Bristol Aids to Navigation Team Natural Gas RIPTA service (Hope Street/Route 60) Pedestrian access through wetlands Silver Creek wooden bridge cannot support a vehicle. No access on the east side for vehicle. Electrical Power	High winds Severe weather Flooding	Town mandates that new developments are required to bury electrical wires. Ri Energy is working to replace powerlines from the substation at Gooding Avenue along with clearing easements and access area.	6. Work with RI Energy to reinforce electrical system resiliency.
Communication Towers	Police Station Fire Station Cell Tower at Landfill St. Mary's Church Tupelo Street Peter Road Smoke Stack at Unity Park Library at RWU	Severe Weather Tornadoes High Winds Snow/ice	All up to date. Recently installed town-wide repeaters. State has 800 MW the Town can utilize. Town has installed OSHEAN fiberoptic mesh network for continuous operability. Installed, tested, and running. Expanding reach. Police Department is part of ATT First Network- first priority in the network.	None at this time.
Dams	State Street Reservoir (stormwater detention basin) Dam #409 (significant hazard)- not being rectified by Tanyard Brook Projects. Mount Hope Farm (earthen dam)	Flooding	The State Street Reservoir dam is inspected regularly. Prior to a storm event the weir is lowered to allow the reservoir to empty and then the weir is raised to allow maximum stormwater storage capacity.	7. Dredge the silt behind the dam at the high school to improve the capacity.

At Risk	Location	Hazard/Problem	Ongoing Actions	Mitigation Actions
	Mt. Hope High School has a small dam near Chestnut Street which takes flow from the east branch of the Silver Creek.		Recently the Town completed a water quality project that included improving land surrounding the reservoir. State Street Dam management plan has been approved.	
Critical Municipal Hazard Response Facilities	Bristol Town Hall (10 Court Street) Bristol Fire Eveready Station (193 Thames Street) Bristol Fire HQ and EOC on the corner of Annawamscutt and Metacom Bristol Police Department (395 Metacom Avenue) DPW Facility (111 Mount Hope Avenue) Dreadnaught Fire Station at 72 Church Street Defiance Fire Station at 1124 Hope Street Metacom Manor Health Center Maritime Center in former Armory on Church/Thames Animal Shelter which is approved as an emergency shelter for animals. Mt. Hope High School is the primary shelter Quinta-Gamelin Community Center has been used as a shelter and they have a generator.	All hazards	As part of a flood awareness program, the Town received a FEMA grant to install a plaque to show water levels during previous floods and install signage that represents historical flood information and photos. Installation of back-up generators at the trash collection facility at Minturn Farm Road and at the compost facility for debris management.	8. Acquire or establish a Memorandum of Understanding (MOU) for a mobile solar trailer. 18. Make showers at Quinta-Gamelin Community Center handicap accessible.

At Risk	Location	Hazard/Problem	Ongoing Actions	Mitigation Actions
Populations	Silver Creek Manor Nursing Home (in the floodplain) Dawn Hall (formerly St. Elizabeth's Nursing Home) Veteran's Home Franklin Court Assisted Living Benjamin Church Housing Authority Bristol Senior Center Various group homes	Flooding All Hazards		9. Expand town-wide tree planting. 10. Create a Neighborhood Resilience Plan to improve sustainability and resiliency in individual neighborhoods, including infrastructure and development improvements.
Businesses	Hope Street Thames Street Former gas station on Hope St. (Location in the floodplain has been a constraint for redevelopment at the corner of Washington Street.)	Flooding/sea level rise	Historic District vulnerability assessment. Outreach to small business community.	11. Prepare an "After the Storm Recovery" Plan for the business community. 12. Inspect and secure seawall along downtown coastal commercial facilities as necessary.
Schools	Guiteras School (access to the building is in the Silver Creek floodplain) Storyland Preschool Our Lady of Mt. Carmel School Rockwell School Mt. Hope High School Colt Andrews School Roger Williams University	Flooding Winter weather Extreme heat and cold	Enhanced remote learning. Each school has an evacuation plan. Police Department works with schools on assessments, emergency response plans.	13. Implement Mt. Hope High School drainage master plan.
Public Buildings	Town Hall Community Development offices in the former Reynolds School;			14. Equip more public buildings with

At Risk	Location	Hazard/Problem	Ongoing Actions	Mitigation Actions
	Historic Byfield and Walley Schools (decommissioned) on the Town Common			generators and air conditioning.
Recreation	Bike Path Harbors/Marinas Parks Town Beach Coastal Access Areas (rights of way to the shore) Sea wall	Severe storms Flooding Winter weather Storms can impact water quality	Sea wall maintenance. Currently end of road retrofits for improved water access. Quinta Gamelin Community Center center is heating/cooling center	15. Elevate the bike bath crossing at Silver Creek. 2. Design and construct Wood Street Extension from Perry St. north to Chestnut St. 16. Expand bicycle infrastructure and sidewalks. 17. Increase resiliency of the Independence Park boat ramp. 18. Make showers at Quinta-Gamelin Community Center handicap accessible. 12. Inspect and secure seawall along downtown coastal commercial facilities as necessary.
Natural Resources	Street trees Streams and rivers Open space	Severe storms High winds Drought	Healthy trees, tree preservation. Trail maintenance Steam channel maintenance Road sweeping	19. Reduce pollution in Bristol Harbor, Mount Hope Bay, and the Kickemuit River. 20. Encourage xeriscape (drought tolerant landscaping) and use of native vegetation. 21. Perform a hydrologic and hydraulic study of the

At Risk	Location	Hazard/Problem	Ongoing Actions	Mitigation Actions
			Enforcement of Soil Erosion and Runoff control ordinance. Water quality improvements at the end of roads that terminate at the shoreline. Preserve open space within the coastal flood zone.	lower end of Silver Creek and dredge as necessary. 22. Preserve open space within the flood zones. 9. Expand town-wide tree planting and preserve existing trees where necessary.
Historic Resources	See Appendix E. Downtown Historic District	Flooding	Vulnerability assessment for Bristol Historic District	10. Implement the Bristol Waterfront Historic District Vulnerability Assessment case by case.

5

Programmatic Capabilities

Purpose

This capability assessment examines the existing studies, plans, programs, and policies that have incorporated hazard mitigation and other pro-active tools into the Town system. The purpose of the capability assessment is to highlight successes, identify shortcomings, and to lay the groundwork for possible improvement. The Town of Bristol recognizes that the inclusion of mitigation initiatives not only benefits the community by reducing human suffering, damages and the costs of recovery, but also helps build and maintain the sustainability and economic health of the Town. This section details the Town's existing relevant plans, programs, and policies that were reviewed during the drafting of this plan.

Primary Plans, Regulations, and Departments

Capital Improvement Plan (CIP): The Town of Bristol, RI Capital Improvements Program 2023-2027 prioritizes Town projects while balancing public safety, recreation, community planning, infrastructure, and technology needs. Projects outlined in this plan generally cost over $5,000 and have a minimum five-year life. Examples include Silver Creek stream restoration and watershed drainage improvements, stormwater improvements, and end of road retrofits for shoreline access. Projects from this hazard mitigation plan will be considered for the next update of the CIP.

Comprehensive Community Plan: This plan provides for the protection, development, use and management of the land and natural resources. Locally adopted and State approved in 2017, the Comprehensive Community Plan outlines goals, policies, issues, and actions to manage growth within the Town. The Comprehensive Community Plan includes many of the mitigation actions included in the 2016 Hazard Mitigation Plan.

Further revisions of the Comprehensive Community Plan will reflect the mitigation actions set forth in this 2023 plan, as well as revisions of such, when setting goals for the Town, which will allow all Town plans to incorporate comprehensive mitigation planning for the Town. Natural hazards and climate change are incorporated into the current Comprehensive Community Plan as per State recommendations.

Land Use Element

Action Item LU8: Continue to protect the Silver Creek and Tanyard Brook Watersheds

Action Item LU9: Expand and implement the Silver Creek Watershed Drainage Study from the headwaters north of Gooding Avenue to the mouth at Bristol Harbor and complete the recommended Phase 2 Tanyard Brook improvements.

Housing Element

Goal 3/Policy B: The Town will pursue federal and/or state funds to purchase flood prone properties.

Action Item H-19: Continue to participate in the Community Rating System of the National Flood Insurance Program and amend as applicable to raise the Town's credit for increased discounts on Flood Insurance Policies. Work with the State of Rhode Island Emergency Management Agency (RIEMA) and the State Building Official's Office to change the State Building Code to allow more credits to the Town under the CRS Program.

Economic Development Element

Action Item ED31 – In conjunction with the recommendations of the Town's Hazard Mitigation Plan, consider public monies to assist in financing the demolition of some parts of the buildings along the waterfront that would make public access more feasible and reduce obstruction and bulk along the waterfront.

Services and Facilities Element

Action item SF6 – Move forward with the recommended for the Tanyard Brook and State Street Reservoir. Seek Federal and State grants to augment funding of this project to supplement the bond.

Open Space, Conservation, and Recreation Element

Action Item OSCR11 – Require Best Management Practices (BMPs) to preserve wetlands, flood plains, and other environmentally sensitive areas.

Natural, Historical, and Cultural Element

Action item NHC8 – Use federal, State, and local programs to purchase properties that are subject to frequent flood or storm damage.

Continuity of Operations Plan (COOP)/Continuity of Government (COG): Managed by the Police Department, the Bristol COOP/COG ensures the ability of the Bristol Police Department to continue to provide essential services and deliver core capabilities during a

disruption to routine operations. This plan provides guidance for alternative operational procedures and personnel policies needed to sustain essential functions.

Emergency Operations Plan/All Hazards Plan: The Bristol Police Department maintains an All Hazard Plan which establishes guidelines for Department members regarding rapid and well-coordinated responses to critical incidents (both man-made and natural). This plan follows the Incident Command System (ICS) protocols. The Police Department conducts annual training on these protocols for all officers.

Erosion and Sediment Control Plan and Stormwater Pollution Prevention Plan (SWPP): This bylaw was adopted to ensure that land disturbance activities do not increase stormwater run-off. Applicants must file an erosion and sediment control plan as well as a soil erosion and sediment control permit application. For disturbance areas greater than one acre, a stormwater pollution prevention plan (SWPP) must also be approved. Where applicable, a Rhode Island freshwater wetlands permit is required.

Harbor Management Plan and Harbor Ordinances: Last updated in 2021, the Harbor Plan Update guides the policies for the Town's waterways and provide a blueprint for future improvements and enhancements to the Town's waterfront for the enjoyment of residents, businesses, and visitors. The Harbor Plan is integrated into the Bristol Comprehensive Community Plan and is consistent with the plan as well as current zoning regulations. The storm preparedness section of the plan addresses emergency preparedness for hurricanes and other storms.

Policies:

A. The Town will maintain an ongoing, coordinated effort between citizens and the State Emergency Management Agency to be ready and prepared for storm events.

B. The Town will maintain communication and planning efforts between private and public agencies and groups that direct, control and support operations in an emergency situation.

C. The Town will continue to develop and update strategies that prepare for and respond to natural disasters.

Municipal Resilience Program Community Resilience Building Workshop, Summary of Findings- In spring of 2020, the Town of Bristol participated in the newly established Rhode Island Municipal Resilience Program. Through the community-driven process, participants identified a series of concerns and challenges from top hazards such as hurricanes, flooding (inland and coastal), and droughts and heatwaves. Recommended actions to improve resilience will be considered for this hazard mitigation plan update.

National Flood Insurance Program (NFIP): The Town of Bristol is an active and compliant member of the National Flood Insurance Program since 1982. As such, Bristol residents are able to purchase flood insurance to protect their property against flood losses. The Town of Bristol has adopted the most recent (July 2014) Flood Insurance Rate Maps (FIRM) and Flood Insurance Study (FIS). As a public service (free of charge), the Building Official and/or the Director of Community Development provide residents and businesses owners (upon request) with the following information regarding flood protection:

- Whether a property appears to be in or out of the Special Flood Hazard Area (SFHA) as shown on the current FIRM of the Town.
- Additional flood insurance data for a site, such as the FIRM zone and the base flood elevation or depth, if shown on the FIRM.
- The Town has a handout on the flood insurance purchase requirement that can help people who need a mortgage or loan for a property in the SFHA.
- The Town has copies of completed FEMA Elevation Certificates for buildings built in the floodplain since 2004; and, for some buildings completed prior to that, as well.

In May 2013, the Town was entered into the **Community Rating System** of the National Flood Insurance Program The Community Rating System provides a discount to all property owners who maintain flood insurance as required by the National Flood Insurance Program. The discount is based on a scoring for eligible activities to educate residents and mitigate damage from flooding including brochures, posting information on the Town's web site, and preservation of open space that is in the floodplain. The Town's discount is currently 15% (Class 7), saving Bristol homeowners an average of $247 annually on flood insurance premiums. The Director of the Department of Community Development became a Certified Floodplain Manager in 2013. A Certified Floodplain Manager is trained on the requirements for construction in the floodplain which is important in the review of permits for construction in the flood zone.

Floodplain Education*:* The NFIP Coordinator is available to answer questions that residents may have about flood insurance, compliance, or floodplains. There are also flood-related print materials available at the Building Official's office.

Flood Hazard Development Permit- Development Standards- In compliance with the requirements of the National Flood Insurance Act of 1968, the Town Council established a Flood Hazard Development Permit System and Review Procedures for development activities in the designated flood hazard areas of the Town. This system requires a Flood Hazard Permit prior to applying for a building permit in the areas of special flood hazard as identified by FEMA in the FIRM for the Town of Bristol. It also references Division 2 of Article IX of the Bristol Town Code of Ordinances, Sections 28-301 through 28-310 which includes additional floodplain management measures to ensure public safety; minimize hazards to persons and property from flooding; to protect watercourses from encroachment and to maintain capability of floodplains to retain and carry off floodwaters.

Open Space Plan: The Open Space Plan is another planning document intended to advise the Town Council on open space preservation and acquisition efforts, act as a resource for other agencies with open space concerns and advise the Planning Board on elements of the Comprehensive Community Plan. In June 2008, the Town adopted an updated Open Space Plan, which includes direct support for several mitigation actions included in the 2010 and 2016 Hazard Mitigation Plan, still relevant for this 2023 Update.

Revised Phase II Stormwater Management Program Plan: The Environmental Protection Agency's (EPA) Storm Water Phase II Final Rule is an effort to preserve, protect, and improve

the Nation's water resources from polluted storm water runoff. The Rule determined there are six Minimum Control Measures which need to be addressed for the Phase II National Pollutant Discharge Elimination System (NPDES) by implementing Best Management Practices (BMPs) appropriate for Bristol's community, including:

- Public Education and Outreach
- Public Participation/Involvement
- Illicit Discharge Detection and Elimination
- Construction Site Runoff Control
- Post-Construction Runoff Control
- Pollution Prevention/Good Housekeeping

The Town acting through the Department of Public Works continues to utilize a variety of BMPs, identified by the EPA, to minimize pollutant loads into the local waterways and waterbodies.

Soil Erosion, Runoff and Sediment Control Ordinance: The Town of Bristol has adopted regulations that provide detailed requirements for the submission of a soil erosion, runoff and sediment control plan for land disturbance of any existing vegetation, grades, or contours of land. This ordinance was adopted out of the findings that excessive quantities of soil are eroding from certain areas undergoing development for nonagricultural uses, such as storage/filling, housing developments, commercial construction, industrial areas, recreational facilities, and roads, as a direct result of poorly planned and implemented site grading and surface water runoff controls. These types of developments are required to submit a plan prepared by a professional engineer for approval and are subject to inspections during construction

Subdivision and Development Review Regulations: Amended in 2017, The Town's Subdivision and Development Review Regulations provide for additional protections in the form of Environmental Impact Statements (EISs) for subdivisions and development projects. Article 6.6 Impact Statements - In accordance with R.I.G.L. 45-23-60(3), in order to make a positive finding that there will be no significant negative environmental impacts, the Planning Board may require that an environmental impact statement be prepared by the applicant of any subdivision or development project. Section A Environmental Impact Statement - (3) An EIS required under this section shall be prepared by a qualified professional(s) and shall include research and documentation describing and assessing short and long-term cumulative environmental impacts, which may include but not be limited to impacts upon: (b) Flooding and drainage.

Also, under Appendix F Design and Construction Standards, B(2)cii, to facilitate functional and attractive development, minimize adverse impacts, and to ensure that a project will be an asset to the community, the Regulations state: The following specific areas shall be preserved as undeveloped open space or lot area, to the extent consistent with the reasonable utilization of land; and in accordance with the applicable State or Town regulations: Undeveloped lands in the flood plain, especially velocity floodplain, as defined in

Article IX of the Zoning Ordinance. Further, in section B(2)d, development shall be laid out to reduce cut and fill; to avoid unnecessary impervious cover; to prevent floodings; to provide adequate access to lots and sites; and to mitigation adverse effects of shadow, traffic, drainage and utilities on neighboring properties.

Tree Trimming Program: Under the jurisdiction of the Town Administrator, the Town of Bristol undertakes the maintenance and preservation of trees. The Town Administrator reviews requests for permission for planting, removal, or trimming of trees within any public right of way. The Town Administrator's Office coordinates with the DPW and Tree Warden to conduct tree inspection activities including trimming and pruning. The Town does not work near power lines. Trimming near power and utility lines are done by the various utilities using their own crews and equipment or contractors.

Vulnerability Assessment (National Register Historic District): In September 2022 the Town of Bristol. In cooperation with Preservation Strategies, analyzed the impact of 2 feet of sea level rise on the Bristol Waterfront Historic District. The report identified over 33 historically and architecturally significant properties in Bristol that are at high risk of loss due to a 2-foot increase in sea level rise. The total assessed value of these properties is approximately $40,000,000. The resulting report is incorporated into the Bristol Hazard Mitigation Plan Update and attached in Appendix E, thus ensuring that the community's cultural heritage resources worthy of preservation are included in future planning efforts.

Zoning Ordinance: Bristol's Floodplain Overlay District was created to minimize hazards to persons and property from flooding, to protect watercourses from encroachment and to maintain the capacity of floodplains to retain and carry off floodwaters. The special flood hazard areas (zones A, AE, AH, AO, A99, V, or VE) are established as a floodplain overlay district. All development in the district, including structural and non-structural activities, whether permitted by right or by special permit must comply with the Rhode Island State Building Code, Coastal Resources Management Act, Rhode Island Coastal Resources Management Council, Endangered Species Act, Rhode Island Department of Environmental Management, Freshwater Wetlands Act, Rhode Island Department of Environmental Management, Minimum Standards Related to Individual Sewage Disposal Systems, Rhode Island Department of Environmental Management, Water Quality Regulations, Rhode Island Department of Environmental Management..

Departments/Organizations

Bristol Warren Regional School District: In cooperation with Public Works, the school district is responsible for the maintenance of all school and municipal buildings and school grounds. This includes sand spreading, and snow and ice clearing from roofs and around storm drains. The Bristol Warren School District uses the ConnectEd service to distribute phone messages to staff and students.

Community Development: This department manages all functions of town government related to Planning, Zoning, Code Compliance, Building Inspection, Redevelopment and all other functions related to land use, housing, air pollution, and the protection of the natural environment within the town. The Director of Community Development has lead this Hazard Mitigation Plan effort.

The Town maintains an interactive online public mapping portal for viewing public data such as zoning, voting districts, land use, tree inventory, and flood zones.

Conservation Commission: The mission of the Conservation Commission is to promote and develop the natural resources and protect and preserve natural areas within the Town of Bristol including its watersheds, streams, wooded areas, coastal areas, wetlands, and green spaces. The Commission acts in an administrative or advisory capacity on environmentally sensitive project proposals, donations of private lands, green space plantings, and a variety of environmental issues. The Commission is currently working on developing a Town tree management plan.

Fire Department: Bristol businesses and residents are protected from fires, medical, hazardous material or environmental mishaps. The Town of Bristol is served by four fire stations. The mission of the Bristol Fire Department is to serve and protect the public from the loss of life, destruction of property, and mitigate hazards as efficiently as possible. To accomplish the mission, personnel work hard to ensure a well-trained, well equipped, and educated firefighting and EMS force are available that will provide the Town, and its neighbors when called upon, with the best emergency services possible.

The Fire Department's facilities include Hydraulion Engine & Hose Company No. 1 (Headquarters) at 4 Annawamscutt Drive. the Defiance Hose Company No. 1 is located at 1124 Hope Street. The Dreadnaught Hook, Ladder and Hose Company No. 1 is located in the historic downtown neighborhood at 72 Church Street. The Ever Ready Engine and Hose Company No. 2 is located at 193 Thames Street along the water. The Fire Department, like the Police Department, experiences a higher demand in the summer months when the summer population can increase.

The Town is served by 5 Fire Prevention, 2 Admin, and 84 volunteer firefighters. Overall equipment inventory includes:

- 5 pump engines
- 5 administrative vehicles
- 4 ambulances
- 3 ATVs
- 2 Watercraft (one with pump)
- 1 ladder truck
- 1 heavy rescue
- 1 brush truck
- 1 Mass Casualty Response Unit (State supported)

The permanently established Emergency Operations Center (EOC) is located the Fire Department headquarters located at 4 Annawamscutt Avenue. The EOC has a diesel generator servicing the entire building. The Fire Chief serves as the City's Emergency Management Agency (EMA) Director.

Harbor Department: The Harbormaster's position is full-time and is augmented by a full-time administrative assistant and thirty part-time employees. The Harbor Department coordinates and administers all activities taking place in the harbors and waterways contingent to the coastal shoreline of the Town of Bristol and within the town's boundaries.

These activities include patrolling of the harbors and waterways, enforcement of federal, state and local laws pertaining to activity on these waters, supervision of all moorings within town boundaries whether private or public, maintenance of all docks, wharfs, piers, marinas, moorings and similar structures owned by the Town, maintenance of vessels and vehicles owned by the town to carry out these functions, and collection and management of fees for public use of these facilities. The Harbor Department works in coordination with Federal and State Officials on security, immigration, and other joint responsibilities in addition to providing public safety services on the water in cooperation with the Bristol Police and Fire Departments; the Rhode Island Department of Environmental Management (RIDEM); and the United States Coast Guard.

Police Department: The Bristol Police Department works to prevent crime and disorder, reduce citizen fear of crime, provide for the safe and efficient flow of traffic, provide a variety of noncriminal activities and improve the quality of life of all community members. The Bristol Police Department is staffed by 42 sworn police officers and supported by 11 civilians (including 2 part time animal control officers), and 10 part-time retired officers.

The Department operates twenty-four hours a day and responds to all criminal complaints, calls for service and town-wide emergencies. In 2021, officers responded to over 26,000 calls. The Department is located at 395 Metacom Avenue and has the following equipment:

- 11 Marked front-line vehicles (SUV/Sedan)
- Marked detail vehicles (Sedan)
- 13 Unmarked Admin/Detective vehicles (SUV/Sedan)
- Unmarked traffic vehicle (SUV)
- Marked motorcycles
- Marked Animal Control vehicles (Van)
- Marked SRO vehicles (SUV)
- Marked Command Post vehicle
- Marked Special Operation vehicle (SUV)
- Marked Specialty/Show vehicle (SUV)
- Marked 2500 crew cab pick-up truck
- Marked UTV 6 passenger Polaris with dump bed and plow attachment
- Marked Boat- 27’ Safeboat

Additional watercraft include:

- Emergency boat
- Pump out boat
- 2 fire boats,
- 12-foot skiff
- multiple kayaks

Bristol uses the CodeRed emergency telephone notification system to distribute important emergency information. Recently the Town launched a cell phone and web-based application called tip411 which allows people to send anonymous tips to the Police Department.

The Bristol Police Department maintains and operates the Mobile Command Unit available to all departments and has two portable variable message boards for roadside deployment.

Public Works: The Department of Public Works is responsible for the maintenance and improvement of public facilities in the town as well as an array of town services. Public Works handles the following ongoing mitigation actions:

- street improvements
- street cleaning
- snow removal
- town sewer, and storm drainage system management
- tree inspection and removal
- public property maintenance,
- collection and disposal of garbage and recyclables.
- catch basin repair
- flushing of stormwater drain lines
- stormwater infrastructure maintenance

Water Pollution Control: This department is responsible for the maintenance and improvement of the Bristol sewer systems, treatment plant, and compost facility. The Town implemented an Industrial Pretreatment Program (IPP) to reduce the volume of pollutants discharged into the sewer system that could, in turn cause harm to the collection system, treatment plant, or facility employees. All businesses must meet local discharge limits. Dilution is not allowed as a means of meeting the discharge limits. Additional recent or ongoing mitigation projects include: improving the pump stations, collections to keep out inflow and/or infiltration, and installation of a generator at the composting facility.

Town Administrator: The Bristol Town Administrator is the elected chief executive officer of the Town, head of the administrative branch of Town government and ceremonial head of the Town.

Town Council: These 5 elected members are the legislative body responsible for setting town policy. Educating the Town Council members about the importance of hazard mitigation is not only beneficial for the Town's resiliency but also facilitates plan adoption.

Ability to Expand on Capabilities: Bristol has taken an informed and enthusiastic approach to reducing losses from current and future hazard risks. With this drive, the Town does have the ability to expand some of their departments and improve the Town's preparation for natural hazards. As explained further in Section 6, the HMC would like to better protect residents and businesses, especially along the waterfront as climate conditions change.

State Programs

Rhode Island Coastal Resources Management Council (CRMC): New development along coastal areas in Bristol is regulated by Rhode Island Coastal Resources Management Council (CRMC) and the Town of Bristol. One CRMC regulation requires a Coastal Buffer Zone, or a "land area adjacent to a Shoreline (Coastal) Feature that is, or will be, vegetated with native

shoreline species and which acts as a natural transition zone between the coast and adjacent upland development," on property within 200 feet of the inland edge of a coastal feature. The benefits of the Coastal Buffer Zone include protection of water quality, protection of coastal habitat, protection of scenic and aesthetic quality, erosion control, and flood control.

The CRMC has adopted shoreline change maps that delineate shoreline rates of change that will be applied to pertinent sections of the Council's regulatory programs to address issues including setbacks of activities from coastal features. These shoreline change maps detail erosion rates for the shoreline and are further detailed into shoreline segments for each map. In total there are 12 such maps for Bristol.

Rhode Island Department of Environmental Management (DEM) Division of Law Enforcement: The Rhode Island DEM Division of Law Enforcement serves to protect the natural resources and ensure compliance with all environmental conservation laws through law enforcement and education.

Rhode Island DEM Wetland Regulations: The Rhode Island Department of Environmental Management (DEM) is responsible for regulating alterations of the freshwater wetlands throughout the State. Since many floodplains are also wetlands, appropriately managing these resources help maintain proper floodplain function. These regulations ensure that actions in this plan which alter the physical landscape will not do so at the expense of wetlands.

Rhode Island Department of Health: The Rhode Island Department of Health (HEALTH), not only strives to prevent disease and increase health and safety, but they also promote the Special Needs Emergency Registry. By voluntarily enrolling in this list, local police, fire, and other local first responders can better prepare for and respond to an individual's needs during a disaster.

Rhode Island Department of Transportation: The Rhode Island Department of Transportation (RIDOT) designs, constructs, and maintains the state-owned surface transportation system. This includes not only roads and bridges but also the state's rail stations, tolling program, bike paths and ferry service.

Rhode Island Emergency Management Agency: The Rhode Island Emergency Management Agency (RIEMA) is the State agency assigned to reduce the loss of life and property for the whole community while ensuring that as a State we work together to build, sustain, and improve our capability to prepare for, protect against, respond to, recover from, and mitigate all natural, human-caused, and technological hazards. RIEMA is also the pass-through agency for FEMA mitigation funding.

Rhode Island Enhanced 9-1-1 Telephone System: Bristol utilizes the state's E-911 system which provides 24-hour public safety communication services from one answering point in North Scituate. Each call is routed to the appropriate response team. The system processes both landline and wireless 9-1-1 calls.

Rhode Island Executive Climate Change Coordinating Council: Established in 2014, the Executive Climate Change Coordinating Council (EC4) sets specific greenhouse gas reduction targets and incorporates consideration of climate change impacts into the powers and duties

of all state agencies. The legislation emphasizes the concept of resilience, building on our collective strength to develop practical solutions that allow Rhode Island to "weather the storm." The 13-member Council is chaired by RIDEM.

Rhode Island Infrastructure Bank: Established in 1989, the RI Infrastructure Bank provides fundings (loans, grants, etc.) to finance municipal infrastructure improvements related to water and wastewater, roads and bridges, energy efficiency and renewable energy, and brownfield restoration.

Rhode Island State Building Code: All municipalities within the State of Rhode Island share a single building code (RIGL 23-27.3-100 et. al.). The Code itself (which incorporates the International Building Code) was last amended in 2012 and provides comprehensive construction requirements designed to mitigate the impacts from natural hazards, such as high wind events. The Code is enforced by the Bristol Building Department and provides an additional layer of regulatory control to those discussed above.

Rhode Island State Fire Code Regulations: Bristol has adopted the Rhode Island Fire Safety Codes to safeguard life and property from the hazards of fire and explosives in accordance with safe practice. The Fire Code provides reasonable minimum requirements for fire prevention and protection. For existing structures, the Fire Code is enforced by the four fire districts for existing structures. The Building Official enforces the Fire Code for new structures.

Rhode Island State Dam Safety Program: The Town of Bristol participates in the State Dam Safety Program because of the significant hazard dam in Bristol. The State Dam Safety Program was created to facilitate the enforcement of the primary dam inspection law (RIGL 46-19, Inspection of Dams and Reservoirs). RIGL 46-19 states that dam owners are responsible for the safe operation, maintenance, repair, and rehabilitation of a dam, which are the essential elements in preventing dam failure; furthermore, dam owners are liable for the consequences of accidents or failures of their dams. According to the State of Rhode Island 2017 Dam Safety Program Report, the following have been identified as program limitations: unclear ownership of numerous high hazard dams, construction of buildings within inundation areas below dams, lack of funding to repair of remove privately owned dams, inadequate spillway capacities and engineering analyses, lack of Emergency Action Plans across the state, inadequate staffing, increase in rainstorm intensities.

Rhode Island Turnpike and Bridge Authority: The Rhode Island Turnpike and Bridge Authority (RITBA) operates and maintains the Mount Hope Bridge which connects the Town of Bristol to the Town of Portsmouth. The RITBA was created in 1954 by the Rhode Island General Assembly as a body corporate and politic, with powers to construct, acquire, maintain, and operate applicable bridge projects. Town coordination with this agency is important during severe weather when people may be evacuating Aquidneck Island and traveling through Bristol.

Other

United Way 2-1-1: United Way 2-1-1 in Rhode Island is a free, confidential service that provides information, referrals, and is available in multiple languages. This service connects

residents with community services they may need such as childcare, housing, health insurance, and tax preparation.

Rhode Island Energy (Electricity and Natural Gas): Rhode Island Energy is the major provider of natural gas and electricity in the state. Recent projects include:

- Improved tree trimming
- Various gas line replacements in conjunction with local paving projects.

Federal Programs

Federal Emergency Management Agency: The Federal Emergency Management Agency (FEMA), an agency of the U.S. Department of Homeland Security, coordinates disaster response when local and state resources are maxed out. The agency also provides grant funding for pre-and post-disaster mitigation projects.

6

Mitigation Actions

Mission Statement

Preserve and enhance the quality of life, property, and resources by identifying areas at risk from natural hazards and implementing priority hazard mitigation strategies to protect Bristol's citizens, infrastructure, and historical, cultural, and natural resources.

Mitigation Goals

To effectuate the mission statement, the Town establishes the following hazard mitigation goals, toward which all action must reach:

1. Protect the public health, safety and welfare;
2. Reduce property damages caused by hazard impact;
3. Minimize social dislocation and distress;
4. Reduce economic losses and minimize disruption to local businesses;
5. Protect the ongoing operations of critical facilities;
6. Reduce the dependence and need for disaster assistance funding after disasters;
7. Expedite recovery disaster mitigation efforts during the recovery phase; and,
8. Provide an ongoing forum for the education and awareness of natural hazard mitigation issues, programs, policies, and projects.

Status of Proposed 2016 Actions

Table 28 Status of Proposed 2016 Actions

Action	Status?	Reason why it is not complete (shift in focus, funding, etc.)	Other comments
Make Residents Aware of Emergency Response Plan	**Complete**		This action has been implemented through the Code Red program and the ongoing outreach to residents to enroll in this system. The Fire Department publishes and distributes emergency response information annually in May/June before the hurricane season. This information is also posted on the Town of Bristol website and Social media outlets. Additionally, the Fire Department conducts workshops with residents of vulnerable populations and in vulnerable areas. They have had workshops at the Senior Housing locations (Benjamin Church and Franklin Court) and at North Farm Condominiums which is a large residential area. This emergency response planning is ongoing.
Designate Alternative Evacuation Route for the Poppasquash Area through Colt State Park	**Complete**		The Town has an agreement with RIDEM for access through "Coggeshell Farm Road" including accessibility through the gate and maintenance during winter storms. This road can also be opened for residents, if needed. Director Parella confirmed that the DPW is familiar with this agreement and plows the road when needed.
Implement Mitigation Incentive Program	**Ongoing**		This action is ongoing. The Town continues to provide information to contractors and homeowners on the risks of building in hazard – prone areas and the benefits of building and renovating structures to current standards. The Town continues to seek out grant sources that could provide incentives to implement mitigation measures and this program is ongoing. Two homeowners have expressed interest.
Prepare an "After the Storm Recovery" Plan for the Community	**Not complete**		The action is in process and has not yet been completed. It was noted that the State Department of Business Regulations has brochures for businesses which the Town can link to their website. Move to 2023 Plan.
Acquire properties in the Special Flood Hazard and Repetitive Flood Loss Areas	**Ongoing**		This continues to be a priority for the Town and the Town continues to seek protection and acquisition of these areas for preservation when opportunities arise. Vacant land in the watershed has been acquired.

Table 28 Status of Proposed 2016 Actions

Action	Status?	Reason why it is not complete (shift in focus, funding, etc.)	Other comments
Preserve vacant open space within the coastal flood zones	**Ongoing**		This continues to be a priority for the Town and the Town continues to seek protection and acquisition of these areas for preservation when opportunities arise.
Develop a stand-alone Environmental and Historic Preservation Plan.	**Ongoing**		Created an inventory of buildings in the downtown historic district. FEMA looking at non-residential buildings for potential retrofits.
Bury electrical wires and other suspended cables	**Complete**		This is required of new developments. However this action has not been completed town-wide since it is presently not financially feasible. The Town continues to explore grant opportunities.
Reinforce wire-to-pole connections	**Not Complete**		This action has not yet been completed. The Town will continue to work toward this action with RI Energy and the Public Utilities Commission, as necessary.
Retrofit of paved parking areas within the Tanyard Brook and Silver Creek Watersheds	**Ongoing**		This action is ongoing. The Bristol Planning Board amended the Subdivision and Development Review Regulations to require Low impact Development Techniques in all applications for subdivision or developments.
Develop Shoreline Management Program			This action is in process. The Town partnered with the RI Coastal Resources Management Council for a grant to retrofit dead end streets that taper into the water. The grant will allow the Town to have engineered plans for the retrofit program that will be eligible for future grant funding to implement. Sunrise Drive is the street that was nominated for this program. Additionally, the Town has completed an end of road retrofit of San Miguel and Butterworth roads an dis currently working to complete end of road retrofits at Annawamscutt Narrows, Sherman, and Portside.
Public Information, Outreach – Signage	**Complete**		The Town installed signage along major access routes that flood indicating that the area is a flood area. The Town has also been designated a Storm Ready Community and the Fire Chief has posted this at headquarters. The Town is also working on a plan to update and reposition the signs for evacuation routes in Town.

Table 28 Status of Proposed 2016 Actions

Action	Status?	Reason why it is not complete (shift in focus, funding, etc.)	Other comments
Upgrade sewer lines where necessary	**Ongoing**		This action is ongoing as opportunities become present. Received a bid for $495,161 to replace 5,500 feet of sewer main, and rehab 44 manholes.
Conduct drainage improvements at the Wastewater Treatment Facility	**Complete**		This action has been completed with construction of the drainage line in Fairview Drive. Currently upgrading electrical, odor management system, and compost collection system.
Inspect and secure the seawall along downtown coastal commercial facilities, as necessary	**Ongoing**		This action is in progress. The Town has repaired a portion of the seawall along Rockwell Park. The Town has repaired the seawall at Independence Park Walley Beach. In addition, the Town the Prudence Ferry Dock has been repaired. The Town will be assessing the repairs needed at walls along the north and south sides of the State Street Boat Ramp and along the north side of the Maritime Center driveway as well as the wall along the ballfield at Guiteras School.
Establish fire lanes in the Mt. Hope area	**Complete**		This action has been completed. The National Grid has opened lanes for access to their equipment which can also serve as access for the Fire Department if needed.
Upgrade the Quinta Gamelin Community Center to be shelter compliant	**Complete**		This action is completed. The Center has a kitchen. A generator was also recently installed with a FEMA grant.
Promote installation of a check valve/backflow preventer	**Ongoing**		This action is ongoing as required by the Sewer permitting. All buildings with basement plumbing are required to have Backflow Preventers/Check Valves. This is ongoing
Expand the implementation of the Backflow Retrofit Program	**Complete**		All of the residents that were on the list have been completed and no residents are on a wait list. However, we will keep this action item for potential future issues and grant opportunities that may present

Additional Actions Since Last Plan Update

Additional actions since the last plan update of 2016:

- The Town has successfully completed many projects since the 2016 plan update that make the Town more resilient, including the following projects:
- Restoration of the seawall at Walley Beach/Halsey C. Herreshoff Park
- Restoration of the seawall at Independence Park

- Completion of the Tanyard Brook Culvert Replacement Project with Phase 3 completion this summer.
- State Street Reservoir improvements
- Installation of stormwater improvements at the Police Station
- Restoration of the East Branch of the Silver Creek
- Restoration of the wetlands at the Bristol Golf Course
- Completion of the Vulnerability Assessment for the Downtown Historic District
- End of Road Water Quality Improvements at Butterworth Avenue and San Miguel Drive
- Town Common Stormwater Master Plan
- Mt. Hope High School Stormwater Master Plan

Mitigation Actions

The Bristol Hazard Mitigation Plan Committee decided to propose actions that addressed certain vulnerabilities that were identified earlier in the planning process. See Chapter 4.

The worksheets below summarize the specific problem and proposed possible solution, details the primary tasks to be undertaken, identifies an appropriate lead and anticipates financing options. Each action was given a priority ranking of low, medium, or high as determined by the Committee. This helps to generally prioritize needs when funding becomes available or budgeted. Funding and staff time will be the determining factors on when various actions are completed. The Committee understands that implementation of many of these proposed actions require the Town to secure external funding.

This HMP includes actions which prevent or reduce the consequences of disaster (mitigation), planning and education (preparedness), improved response in the immediate aftermath of an event (response), and improved restoration efforts (recovery). Those which are true mitigation actions are noted as such. There are necessary planning elements that need to be completed before additional mitigation actions can be considered. The Committee has identified a range of actions below, some of which are planning activities. However, there is a mitigation action identified for each vulnerable area where applicable.

Priority Level

- **High:** Reduces the greatest risks, is important to accomplish first
- **Medium:** May need other actions to be completed first
- **Low:** Less of an impact on safety and property

Time Frame (from date of plan adoption)

- **Short Term:** within 1-3 years
- **Medium Term:** within 3-5 years
- **Long Term:** greater than 5 years

Goals

1. Protect the public health, safety and welfare;
2. Reduce property damages caused by hazard impact;
3. Minimize social dislocation and distress;
4. Reduce economic losses and minimize disruption to local businesses;
5. Protect the ongoing operations of critical facilities;
6. Reduce the dependence and need for disaster assistance funding after disasters;
7. Expedite recovery disaster mitigation efforts during the recovery phase; and,
8. Provide an ongoing forum for the education and awareness of natural hazard mitigation issues, programs, policies, and projects.

VULNERABLE AREA: Flood Prone Drainage Systems, Streets, or Infrastructure

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
1. Expand green stormwater infrastructure throughout town. • Parking Lot near Town Common • Promote installations in parking lots and front yards • Police Department (recently completed)	☐Local Plans and Regulations ☒Structure and Infrastructure ☒Natural Systems Protection ☐Education and Awareness	☐1 ☒2 ☐3 ☒4 ☒5 ☐6 ☐7 ☐8	☒High ☐Medium ☐Low **ACTION STATUS** New

RATIONALE- WHY IS THIS IMPORTANT?
Support water quality initiatives of the Town.

BENEFITS	OBSTACLES	
Reduces infiltration into the sewer system. Reduce street runoff. Reduce runoff into the Bay.		
LEAD/CHAMPION	**SUPPORT**	
Community Development	Public Works	
POTENTIAL FUNDING SOURCES	**ESTIMATED COST**	**TIMELINE**
RIIB Resiliency Non-point Source 319 RIDEM	$150,000 per project	☒Short Term (0-3 years) ☐Medium Term (3-5 years) ☐Long Term (more than 5 years)

OTHER NOTES

The Town sold Gooding Plaza but will encourage new owner to install green stormwater infrastructure in the parking lot.

The Police Department HQ is located in the in Tanyard Brook watershed. A project was recently completed to improve stormwater runoff and infiltration.

End of Road Retrofits in process to remove pavement and install drainage/water quality treatment systems at the end of roads: Annawamscutt, Narrows, and Sherman. Also water quality / drainage at the existing Portside walking path. With each of these projects, the access to the shore on the right of way will be improved.

VULNERABLE AREA: Bridges

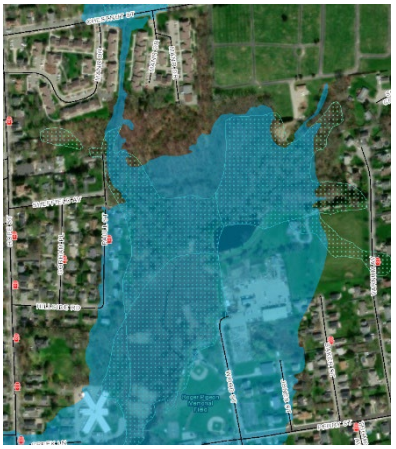
MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
2. Design and construct Wood Street Extension from Perry St. north to Chestnut St.	☐Local Plans and Regulations ☒Structure and Infrastructure ☐Natural Systems Protection ☐Education and Awareness	☒1 ☐2 ☐3 ☐4 ☐5 ☐6 ☒7 ☐8	☐High ☒Medium ☐Low **ACTION STATUS** New

RATIONALE- WHY IS THIS IMPORTANT?
This additional evacuation route will reduce pressure on Route114 which is impacted by sea level rise and flooding. There are only two north/south routes through Town currently – State Route 114 (also known as Hope Street and Ferry Road) and State Route 136 (also known as Metacom Avenue).

BENEFITS	OBSTACLES	
Public safety	Wetland crossings, public support	
LEAD/CHAMPION	**SUPPORT**	
Community Development	Public Works, Town Administrator, RIDOT	
POTENTIAL FUNDING SOURCES	**ESTIMATED COST**	**TIMELINE**
Infrastructure grant Town bond	$10 Million	☐Short Term (0-3 years) ☐Medium Term (3-5 years) ☒Long Term (more than 5 years)

OTHER NOTES

Construction of this for vehicle connection will be expensive and would be a long-term action. However, as a short-term action, the route could start as a bike/pedestrian access which could also be designed for emergency vehicles Planning and Design could be medium term.



VULNERABLE AREA: Wastewater

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
3. Reinstate check valve retrofit program. • Seek grants to finish check valve retrofits. • Promote the program throughout town.	☐Local Plans and Regulations ☒Structure and Infrastructure ☐Natural Systems Protection ☐Education and Awareness	☒1 ☒2 ☒3 ☐4 ☐5 ☒6 ☒7 ☒8	☐High ☐Medium ☒Low **ACTION STATUS** From 2016

RATIONALE- WHY IS THIS IMPORTANT?
To prevent flooding of homes from sewage as required by State permitting, all buildings with basement plumbing are required to have backflow preventers/check valves.

BENEFITS	OBSTACLES	
Protection of property. Uninterrupted services. Reduces sewer backflow during high water events.	Volunteers	
LEAD/CHAMPION	**SUPPORT**	
Sewer Superintendent		
POTENTIAL FUNDING SOURCES	**ESTIMATED COST**	**TIMELINE**
FEMA HMGP grant after floods of 2010.	$80,000	☒Short Term (0-3 years) ☐Medium Term (3-5 years) ☐Long Term (more than 5 years)

OTHER NOTES
This effort was initially done in 2010 and all those buildings were retrofitted. There does not seem to be a high need at this time; however, the Town continues to look for more volunteer property owners that would benefit.

VULNERABLE AREA: Wastewater

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
4. Seek alternative access to Sewer Plant.	☐Local Plans and Regulations ☒Structure and Infrastructure ☐Natural Systems Protection ☐Education and Awareness	☒1 ☒2 ☐3 ☐4 ☒5 ☐6 ☒7 ☐8	☐High ☐Medium ☒Low **ACTION STATUS** From 2016

RATIONALE- WHY IS THIS IMPORTANT?

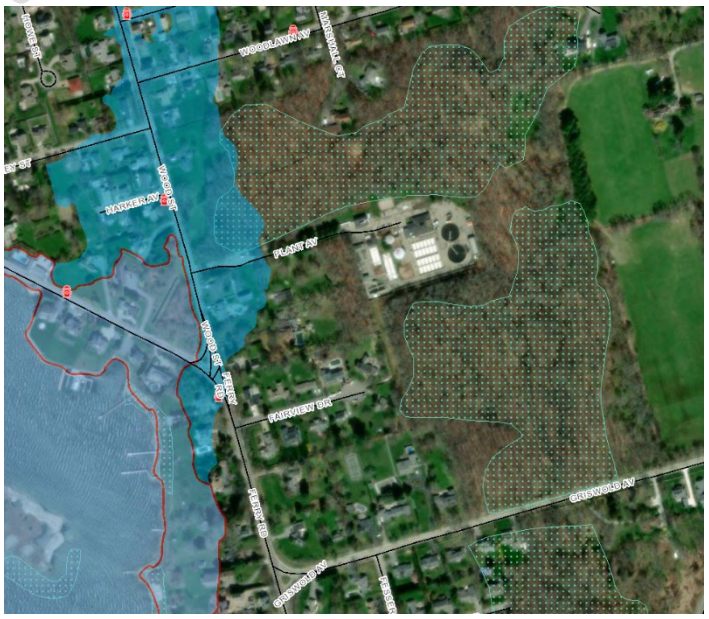
The current location is surrounded by wetlands and in a flood zone. Consider access via road/cul-de-sac.

BENEFITS	OBSTACLES	
Access redundancy to a critical facility	Finding a suitable location (neighborhood and wetlands)	
LEAD/CHAMPION	**SUPPORT**	
Sewer Department		
POTENTIAL FUNDING SOURCES	**ESTIMATED COST**	**TIMELINE**
Town Bond	$1 million	☐Short Term (0-3 years) ☐Medium Term (3-5 years) ☒Long Term (more than 5 years)

OTHER NOTES

Look to team with other projects like bike path projects.

Need a long-term feasibility study.



VULNERABLE AREA: Water Supply Systems

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
5. Coordinate with Bristol County Water to create water line redundancy.	☐Local Plans and Regulations ☒Structure and Infrastructure ☐Natural Systems Protection ☐Education and Awareness	☒1 ☐2 ☐3 ☒4 ☒5 ☐6 ☒7 ☐8	☒High ☐Medium ☐Low **ACTION STATUS** New

RATIONALE- WHY IS THIS IMPORTANT?

There is one water supply system transmission main connecting the communities of Bristol, Warren, and Barrington. Bristol County Water Authority (BCWA) has begun a project to improve redundancy.

BENEFITS	OBSTACLES	
Improves the resiliency of the water supply system.		
LEAD/CHAMPION	**SUPPORT**	
BCWA	Town Administrator	
POTENTIAL FUNDING SOURCES	**ESTIMATED COST**	**TIMELINE**
US Department of Agriculture US EPA Water Infrastructure Improvements for the Nation Act grants	Staff time to support this effort.	☒Short Term (0-3 years) ☐Medium Term (3-5 years) ☐Long Term (more than 5 years)

OTHER NOTES

In 2019 the Bristol County Water Authority (BCWA) experienced a failure in the sole water supply transmission main connecting the communities of Bristol, Warren, and Barrington to their source of supply in Providence. This failure highlighted the vulnerability of the water supply system and underscored the critical need for redundancy in the water supply system. In an effort to address this need, the BCWA Board of Directors voted to move forward with a major pipeline project to connect the BCWA water system to a second high quality water supply form the Pawtucket Water Supply Board (PaWSB). The project was envisioned to be completed in two phases. The first phase, which is now complete, involved installing a pipeline from the existing BCWA transmission main to the City of East Providence's water tank site. This first phase provides redundancy in supply for both the City of East Providence and the BCWA as the newly installed pipeline can supply a full daily water demand for each respective system. However, despite the improvements from the first phase project, both systems would still rely upon BCWA's and the City of East Providence's aging "cross bay pipelines" to connect to the City of Providence. The second phase of the pipeline project will add additional resiliency by connecting both systems to a completely

independent water supply from the PaWSB, mitigating the risk associated with the aging pipelines. The second phase, currently under design, is a complex project involving the installation of approximately 25,000 feet of large diameter pipe from the East Providence Tank Site north to the City of Pawtucket border. The sheer scale of the project and the complexities involved mean the project will have a significant cost. Additionally, given the scale of the project, along with current supply chain issues and economic climate, preliminary project cost estimates are approaching $50 million.

VULNERABLE AREA: Other Utilities

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
6. Work with Rhode Island Energy to reinforce electrical system resiliency.	☐Local Plans and Regulations ☒Structure and Infrastructure ☒Natural Systems Protection ☐Education and Awareness	☒1 ☒2 ☐3 ☒4 ☐5 ☐6 ☒7 ☐8	☐High ☒Medium ☐Low **ACTION STATUS** From 2016

RATIONALE- WHY IS THIS IMPORTANT?
Most of the town's electrical system is aboveground and susceptible to damage from downed trees.

BENEFITS	OBSTACLES
Smaller spacer cables reduce tree trimming. Improve dependability of the electrical system.	
LEAD/CHAMPION	**SUPPORT**
Town Tree Warden	Department of Community Development

POTENTIAL FUNDING SOURCES	ESTIMATED COST	TIMELINE
Preserve Rhode Island (www.preserveri.org) FEMA disaster funding Philanthropic funding	An estimate based on similar projects in other municipalities is $4M for 1.2 miles.	☐Short Term (0-3 years) ☐Medium Term (3-5 years) ☒Long Term (more than 5 years)

OTHER NOTES

Continue the requirements for subsurface utility lines in new subdivisions. On existing streets in the downtown, the aboveground utilities should be placed underground when replaced. Although not financially feasible at this time; it should be considered in the future, especially if the Town is eligible for federal disaster assistance after a storm event.

Preserve RI has funded other areas in the State. The *Scenic Third Beach Project* buried utility lines underground, removed 77 unsightly poles and restored the scenic landscape along a 1.2 mile stretch of Third Beach Road and Indian Avenue. https://www.newportthisweek.com/articles/paradise-valley-views-free-of-utility-poles/

RI Energy is doing a lot of tree work, Town is giving them access. This year many dead Ash trees were removed in a partnership with RI Energy and the RIDOT. The trees had been impacted by the Emerald Ash Borer.

VULNERABLE AREA: Dams

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
7. Dredge the silt behind the dam at the high school to improve the capacity.	☐Local Plans and Regulations ☐Structure and Infrastructure ☒Natural Systems Protection ☐Education and Awareness	☒1 ☒2 ☐3 ☐4 ☐5 ☐6 ☐7 ☐8	☐High ☒Medium ☐Low **ACTION STATUS** From 2016

RATIONALE- WHY IS THIS IMPORTANT?

Area behind dam is not able to hold floodwaters, it's too shallow; ducks walk on the bottom of the impoundment.

BENEFITS	OBSTACLES	
Improved floodplain function.	Dredge material disposal, especially if it's contaminated.	
LEAD/CHAMPION	**SUPPORT**	
Community Development		
POTENTIAL FUNDING SOURCES	**ESTIMATED COST**	**TIMELINE**
FEMA floodplain grants RIDEM water resources grants	$1 Million	☐Short Term (0-3 years) ☒Medium Term (3-5 years) ☐Long Term (more than 5 years)

OTHER NOTES

Part of Silver Creek.

Test soil for contamination.

**See also Mitigation Action #13

VULNERABLE AREA: Critical Municipal Hazard Response Facilities

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
8. Acquire or establish an MOU for a mobile solar trailer.	☐Local Plans and Regulations ☒Structure and Infrastructure ☐Natural Systems Protection ☐Education and Awareness	☒1 ☐2 ☐3 ☐4 ☒5 ☐6 ☐7 ☐8	☐High ☒Medium ☐Low **ACTION STATUS** New

RATIONALE- WHY IS THIS IMPORTANT?
Backup power to maintain continuity of operations.

BENEFITS	OBSTACLES	
Backup power during an emergency.		
LEAD/CHAMPION	**SUPPORT**	
Sewer Department		
POTENTIAL FUNDING SOURCES	**ESTIMATED COST**	**TIMELINE**
FEMA emergency management grant	$100,000	☐Short Term (0-3 years) ☒Medium Term (3-5 years) ☐Long Term (more than 5 years)

OTHER NOTES

This is a truck trailer filled with solar panels and batteries that can be tapped during an outage.

Not a priority now.

As a potential model to follow, the Town of Burrillville entered into an agreement with the vendor

For example: https://shop.rpssolarpumps.com/products/off-grid-power-plant-solar-battery-diesel-backup-trailer

VULNERABLE AREA: Populations

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
9. Expand town-wide tree planting and preserve existing trees where necessary.	☐Local Plans and Regulations ☐Structure and Infrastructure ☒Natural Systems Protection ☐Education and Awareness	☒1 ☐2 ☒3 ☐4 ☐5 ☒6 ☐7 ☐8	☒High ☐Medium ☐Low **ACTION STATUS** New

RATIONALE- WHY IS THIS IMPORTANT?
Wood Street neighborhood can benefit from more shade trees. Street trees are considered infrastructure and trees should be included and re-planted as part of any after storm restoration as part of the Town's infrastructure repairs.

BENEFITS	OBSTACLES
Maximize the canopy and provide increased cooling effects and beautification. Trees and vegetation can lower the surface air temperature by providing shade. Trees absorb the incoming solar rays and help mitigate poor air quality. Trees also help mitigate the effects of climate change by absorbing stormwater (at both the canopy and roots) and returning it to the earth.	Finding viable locations that don't compete with utilities, driveways, etc.
LEAD/CHAMPION	**SUPPORT**
Conservation Commission	Community Development

POTENTIAL FUNDING SOURCES	ESTIMATED COST	TIMELINE
RIDEM Division of Forest Management Town Public Works budget (tree planting)	$20,000 for neighborhood.	☒Short Term (0-3 years) ☐Medium Term (3-5 years) ☐Long Term (more than 5 years)

OTHER NOTES

See also *Rhode Island Guide for Developing Municipal Street Tree Ordinances* https://dem.ri.gov/sites/g/files/xkgbur861/files/programs/bnatres/forest/pdf/urban/ri-street-tree-ordinance-guide.pdf

See also the RIDEM Tree Management Plan

VULNERABLE AREA: Populations

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
10. Create a Neighborhood Resilience Plan to improve sustainability and resiliency in individual neighborhoods, including infrastructure and development improvements.	☒Local Plans and Regulations ☐Structure and Infrastructure ☐Natural Systems Protection ☒Education and Awareness	☒1 ☒2 ☒3 ☐4 ☐5 ☒6 ☐7 ☒8	☒High ☐Medium ☐Low **ACTION STATUS** New

RATIONALE- WHY IS THIS IMPORTANT?
Alignment with Comprehensive Community Plan Goal "Ensure that neighborhoods are livable places". Help communities build back better and quicker after a storm.

BENEFITS	OBSTACLES
Improve the capacity of neighborhoods exposed to extreme natural events to adapt to stress and change. Adaptation by resisting or changing, can help maintain an acceptable level of functioning.	Funding, other town priorities.
LEAD/CHAMPION	**SUPPORT**
Community Development	

POTENTIAL FUNDING SOURCES	ESTIMATED COST	TIMELINE
RI Department of Health U.S. Department of Housing and Urban Development/CDBG	$100,000	☒Short Term (0-3 years) ☐Medium Term (3-5 years) ☐Long Term (more than 5 years)

OTHER NOTES

Create a plan for each neighborhood (Northwest, North Central, Northeast, Highlands, Industrial Area, Kickemuit, State Park, Poppasquash, High School, The Narrows, Downtown Core, Downtown Neighborhood, Hopeworth, Mt, Hope, The Estates, and College).

Include street trees and end of road retrofits.

See *Community Resilience Planning Guide* https://www.nist.gov/community-resilience/planning-guide

VULNERABLE AREA: Businesses

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
11. Prepare an "After the Storm Recovery" Plan for the business community.	☒Local Plans and Regulations ☐Structure and Infrastructure ☐Natural Systems Protection ☐Education and Awareness	☐1 ☐2 ☐3 ☒4 ☐5 ☐6 ☒7 ☒8	☒High ☐Medium ☐Low **ACTION STATUS** From 2016

RATIONALE- WHY IS THIS IMPORTANT?
Get businesses up and running after a storm.

BENEFITS	OBSTACLES
Increased property protection, accelerated recovery, reduced losses/improved resiliency, community support of tax base.	
LEAD/CHAMPION	**SUPPORT**
EMA Director	Community Development

POTENTIAL FUNDING SOURCES	ESTIMATED COST	TIMELINE
FEMA BRIC U.S. Department of Housing and Urban Development/CDBG	$100,000	☒Short Term (0-3 years) ☐Medium Term (3-5 years) ☐Long Term (more than 5 years)

OTHER NOTES

Priority for businesses.

The Town to coordinate with CRMC and Statewide Planning to review the permitting process, develop and adopt an ordinance to streamline the process in the aftermath of a hazard impact including the process to allow homeowners to retrofit structures in order to reduce risk. Formalize the existing process, and also maintain current policy to waive permit fees for building permits to repair storm-damaged properties.

VULNERABLE AREA: Businesses

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
12. Inspect and secure seawall along downtown coastal commercial facilities as necessary.	☐Local Plans and Regulations ☒Structure and Infrastructure ☐Natural Systems Protection ☐Education and Awareness	☒1 ☒2 ☐3 ☒4 ☐5 ☐6 ☐7 ☐8	☒High ☐Medium ☐Low **ACTION STATUS** From 2016

RATIONALE- WHY IS THIS IMPORTANT?
This protective seawall which runs along between a commercial district and the water is showing signs of disrepair.

BENEFITS	OBSTACLES	
Increased property/recreational resource protection. Increased resiliency and reduced losses.	Some are State-owned properties	
LEAD/CHAMPION	**SUPPORT**	
Harbor Master	Department of Community Development	
POTENTIAL FUNDING SOURCES	**ESTIMATED COST**	**TIMELINE**
National Scenic Byway grant for areas along Route 114.		☒Short Term (0-3 years) ☐Medium Term (3-5 years) ☐Long Term (more than 5 years)

OTHER NOTES

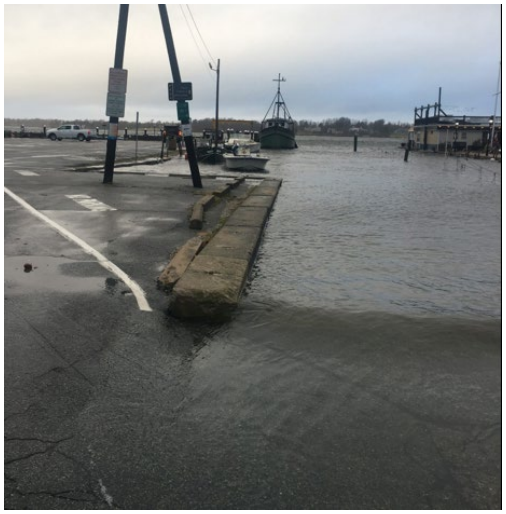
Areas of need: Hope Street (Route 114) Seawall, Maritime Center Driveway, State Street Boat Ramp, Guiteras School at the adjacent ballfield.

Retrofits should be made to withstand a 20 to 50-year storm in addition to the impacts of projected sea level rise.

Prudence Island Ferry dock: done.

Lower Independence Park: done.

Walley Beach and Halsey Herreshoff Park seawall: done.



State Street Boat Ramp. December 23, 2022.

VULNERABLE AREA: Schools

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
13. Update the Mt. Hope High School drainage master plan in coordination with the School District.	☐Local Plans and Regulations ☒Structure and Infrastructure ☒Natural Systems Protection ☐Education and Awareness	☐1 ☒2 ☐3 ☒4 ☐5 ☐6 ☐7 ☐8	☒High ☐Medium ☐Low **ACTION STATUS** From 2016

RATIONALE- WHY IS THIS IMPORTANT?

This will be in conjunction with a new Mt. Hope High or as a standalone project. The high school property is in the Silver Creek Watershed and has drainage issues.

BENEFITS	OBSTACLES	
Improve floodplain capacity and reduce flooding downstream.	Funding, Coordination with the Regional School Department.	
LEAD/CHAMPION	**SUPPORT**	
Community Development	BWRSD	
POTENTIAL FUNDING SOURCES	**ESTIMATED COST**	**TIMELINE**
RI Infrastructure Bank RI DEM Stormwater Program	Naomi/Chestnut intersection: $300,000	☒Short Term (0-3 years) ☐Medium Term (3-5 years) ☐Long Term (more than 5 years)

OTHER NOTES

Currently applying for funding.

Coordinate with the BWRSD Committee for the proposed new high school

Earlier in 2023, the School Committee voted to move forward with a plan and project to re-build the high school. However, many of the drainage actions are not included.

VULNERABLE AREA: Public Buildings

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
14. Equip more municipal buildings with generators and air conditioning. a) Identify which buildings need AC and generators. b) Prioritize. c) Apply for funding. d) Install generator and/or air conditioner.	☐Local Plans and Regulations ☒Structure and Infrastructure ☐Natural Systems Protection ☐Education and Awareness	☒1 ☐2 ☐3 ☐4 ☒5 ☐6 ☐7 ☐8	☒High ☐Medium ☐Low **ACTION STATUS** New

RATIONALE- WHY IS THIS IMPORTANT?

The Quinta-Gamelin Community Center is the only identified cooling center.

BENEFITS	OBSTACLES	
Protection from interrupted services and more comfortable environment.		
LEAD/CHAMPION	**SUPPORT**	
Bristol EMA		
POTENTIAL FUNDING SOURCES	**ESTIMATED COST**	**TIMELINE**
FEMA mitigation grants	Need to do an assessment.	☒Short Term (0-3 years) ☐Medium Term (3-5 years) ☐Long Term (more than 5 years)

OTHER NOTES

FEMA will not fund replacement generators.

VULNERABLE AREA: Recreation

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
15. Elevate the East Bay bike path crossing at Silver Creek.	☐Local Plans and Regulations ☒Structure and Infrastructure ☐Natural Systems Protection ☐Education and Awareness	☐1 ☒2 ☐3 ☐4 ☐5 ☒6 ☐7 ☐8	☒High ☐Medium ☐Low **ACTION STATUS** New

RATIONALE- WHY IS THIS IMPORTANT?
This location currently floods.

BENEFITS	OBSTACLES	
Reducing flooding inland. Eliminates the restriction to Silver Creek.	Coordinating with RIDOT and RIDEM	
LEAD/CHAMPION	**SUPPORT**	
RIDEM and RIDOT	Town Administrator	
POTENTIAL FUNDING SOURCES	**ESTIMATED COST**	**TIMELINE**
RIDOT Statewide funding RIDEM Land Revitalization	$1M	☐Short Term (0-3 years) ☒Medium Term (3-5 years) ☐Long Term (more than 5 years)

OTHER NOTES
Need to coordinate with other projects. Need CRMC permitting. Continue to coordinate with the RI Statewide Planning Agency on the Route 114 Resilience Plan.

VULNERABLE AREA: Recreation

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
16. Expand bicycle infrastructure and sidewalks.	☐Local Plans and Regulations ☐Structure and Infrastructure ☐Natural Systems Protection ☒Education and Awareness	☒1 ☐2 ☐3 ☐4 ☐5 ☐6 ☐7 ☒8	☒High ☐Medium ☐Low **ACTION STATUS** New

RATIONALE- WHY IS THIS IMPORTANT?
To promote health and alternative transportation, while encouraging residents to use sustainable transportations.

BENEFITS	OBSTACLES	
Improved sense of community		
LEAD/CHAMPION	**SUPPORT**	
Community Development	RIDOT and RIDEM	
POTENTIAL FUNDING SOURCES	**ESTIMATED COST**	**TIMELINE**
RIDOT grants RIDEM grants HUD/CDBG grants	At least $1.5m	☒Short Term (0-3 years) ☐Medium Term (3-5 years) ☐Long Term (more than 5 years)

OTHER NOTES
Currently doing a feasibility study (w RIDEM grant) to expand bike infrastructure and implement bike wayfinding in the downtown street network. The existing sidewalk expansion project of Monroe and Perry Street is being funded by HUD/CDBG and Town funds.

VULNERABLE AREA: Recreation

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
17. Increase resiliency of the Independence Park boat ramp. a) Design (underway) b) Build	☐Local Plans and Regulations ☒Structure and Infrastructure ☐Natural Systems Protection ☐Education and Awareness	☒1 ☒2 ☐3 ☒4 ☐5 ☐6 ☒7 ☐8	☒High ☐Medium ☐Low **ACTION STATUS** New

RATIONALE- WHY IS THIS IMPORTANT?

The boat ramp is in somewhat poor condition and may be problematic for trailered boats at low tide.

BENEFITS	OBSTACLES	
Safe access to Bristol Harbor		
LEAD/CHAMPION	**SUPPORT**	
Harbor Master	Department of Community Development	
POTENTIAL FUNDING SOURCES	**ESTIMATED COST**	**TIMELINE**
RI Infrastructure Bank Town Capital Funding (Harbor Master)	Boat ramp: $400K Area: $600K	☒Short Term (0-3 years) ☐Medium Term (3-5 years) ☐Long Term (more than 5 years)

OTHER NOTES

This is a two-lane cement slab boat ramp here that provides access to Bristol Harbor as well as a broad gravel beach suitable for launching hand-carried boats.

VULNERABLE AREA: Recreation

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
18. Make showers at Quinta-Gamelin Community Center handicap accessible.	☐Local Plans and Regulations ☒Structure and Infrastructure ☐Natural Systems Protection ☐Education and Awareness	☒1 ☐2 ☒3 ☐4 ☐5 ☐6 ☐7 ☐8	☒High ☐Medium ☐Low **ACTION STATUS** New

RATIONALE- WHY IS THIS IMPORTANT?
Quinta-Gamelin Community Center is a designated shelter location.

BENEFITS	OBSTACLES	
Greater access to shelter facilities by people of all abilities.		
LEAD/CHAMPION	**SUPPORT**	
Recreation Director		
POTENTIAL FUNDING SOURCES	**ESTIMATED COST**	**TIMELINE**
FEMA BRIC Town Capitol Project	Design: no cost Build: $200,000	☒Short Term (0-3 years) ☐Medium Term (3-5 years) ☐Long Term (more than 5 years)

OTHER NOTES
Roger Williams University Architecture students to provide design.

VULNERABLE AREA: Natural Resources

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
19. Reduce pollution in Bristol Harbor, Mount Hope Bay, and the Kickemuit River. *a)* Research latest trends and best practices for keeping roads driveable in sensitive coastal areas. *b)* Implement polices and best practices (i.e. restrict the overuse of road salt on Town roads).	☐Local Plans and Regulations ☐Structure and Infrastructure ☒Natural Systems Protection ☐Education and Awareness	☒1 ☐2 ☐3 ☐4 ☐5 ☐6 ☐7 ☐8	☒High ☐Medium ☐Low **ACTION STATUS** New

RATIONALE- WHY IS THIS IMPORTANT?

There are areas of degraded water quality.

BENEFITS	OBSTACLES	
Improved water quality		
LEAD/CHAMPION	**SUPPORT**	
Community Development and Public Works	Conservation Commission	
POTENTIAL FUNDING SOURCES	**ESTIMATED COST**	**TIMELINE**
RIDEM watershed grants.	$25,000	☐Short Term (0-3 years) ☒Medium Term (3-5 years) ☐Long Term (more than 5 years)

OTHER NOTES

Bristol Conservation Commission has produced the *Healthy Yards Healthy Waters* brochure on sustainable lawn care. This needs to continue to be promoted.
https://www.bristolri.gov/government/commissions/conservation-commission/

VULNERABLE AREA: Natural Resources

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
20. Encourage Xeriscape* and use of native vegetation.	☐Local Plans and Regulations ☐Structure and Infrastructure ☒Natural Systems Protection ☐Education and Awareness	☐1 ☐2 ☐3 ☐4 ☐5 ☐6 ☐7 ☒8	☐High ☒Medium ☐Low **ACTION STATUS** New

RATIONALE- WHY IS THIS IMPORTANT?

To reduce water usage and be more resilient during times of drought.

BENEFITS	OBSTACLES	
Less reliance on water for landscaping.		
LEAD/CHAMPION	**SUPPORT**	
Conservation Commission		
POTENTIAL FUNDING SOURCES	**ESTIMATED COST**	**TIMELINE**
Town Operating Budget Eastern RI Conservation District grants	$10,000	☐Short Term (0-3 years) ☒Medium Term (3-5 years) ☐Long Term (more than 5 years)

OTHER NOTES

*Xeriscape is a type of landscaping that uses low-water or drought tolerant plants that require little to no supplemental irrigation.

Examples might include: Rain barrel programs, incentives for homeowners, rain gardens, and design regulations.

Continue to lead by example with public landscaping areas for Nature at Work solutions.
Private: encouraging native vegetation and low maintenance vegetation
Public: use native vegetation and low maintenance vegetation.

VULNERABLE AREA: Natural Resources

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
21. Perform a hydrologic and hydraulic study of Silver Creek (lower end near the harbor) and dredge as necessary.	☒Local Plans and Regulations ☐Structure and Infrastructure ☒Natural Systems Protection ☐Education and Awareness	☒1 ☒2 ☐3 ☒4 ☐5 ☐6 ☐7 ☐8	☒High ☐Medium ☐Low **ACTION STATUS** New

RATIONALE- WHY IS THIS IMPORTANT?
Silver Creek floods adjacent roadways and neighborhoods. Need to improve watershed capacity.

BENEFITS	OBSTACLES	
Reduce flooding and better floodplain function.	Funding, obtaining state permits, possible contaminated soils, approving the process.	
LEAD/CHAMPION	**SUPPORT**	
Community Development		
POTENTIAL FUNDING SOURCES	**ESTIMATED COST**	**TIMELINE**
FEMA flood mitigation grants RIDEM watershed grants RIIB funds	$5M	☐Short Term (0-3 years) ☐Medium Term (3-5 years) ☒Long Term (more than 5 years)

OTHER NOTES

Beta did a Silver Creek Watershed Study 15 years ago. Been working up through the watershed to increase infiltration and flood storage. This can be connected to other projects.

Need a study in the Sherry Avenue and Varnum Avenue area, which is ongoing with our engineering consultant, between Hope St./114 and Metacom Avenue.

The US Army Corps of Engineers (ACOE) has received a Federal Earmark to conduct a study of Silver Creek including a hydrologic and hydraulic modeling. This study has not yet commenced.

Silver Creek and Bristol Harbor at the East Bay Bike Path. December 23, 2022

VULNERABLE AREA: Natural Resources

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
22. Preserve open space within the flood zones.	☐Local Plans and Regulations ☐Structure and Infrastructure ☒Natural Systems Protection ☐Education and Awareness	☐1 ☐2 ☐3 ☐4 ☐5 ☐6 ☐7 ☒8	☐High ☒Medium ☐Low **ACTION STATUS** New

RATIONALE- WHY IS THIS IMPORTANT?
Constant development pressures.

BENEFITS	OBSTACLES	
Provides natural storage for flood waters. Reduces infiltration into the sewer system. Reduce street runoff. Reduce runoff into the Bay.		
LEAD/CHAMPION	**SUPPORT**	
Conservation Commission		
POTENTIAL FUNDING SOURCES	**ESTIMATED COST**	**TIMELINE**
Town Operating Budget Eastern RI Conservation District grants	TBD	☐Short Term (0-3 years) ☒Medium Term (3-5 years) ☐Long Term (more than 5 years)

OTHER NOTES
This is an action that the Town is continually working on. Balancing economic growth, retaining residents, and protecting the natural environment is a constant consideration for Town officials.

VULNERABLE AREA: Historic Resources

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
23. Implement the Bristol Waterfront Historic District Vulnerability Assessment case by case.	☐Local Plans and Regulations ☒Structure and Infrastructure ☒Natural Systems Protection ☐Education and Awareness	☐1 ☒2 ☐3 ☐4 ☐5 ☒6 ☐7 ☐8	☒High ☐Medium ☐Low **ACTION STATUS** New

RATIONALE- WHY IS THIS IMPORTANT?

There are over 33 historically and architecturally significant "at-risk" historic resources in Bristol that are at high risk of loss due to a 2' increase in sea level rise in the 100-year flood zone of the Bristol Waterfront Historic District.

BENEFITS	OBSTACLES	
Economic value in historic preservation.		
LEAD/CHAMPION	**SUPPORT**	
Community Development	Rhode Island Historical Preservation and Heritage Commission	
POTENTIAL FUNDING SOURCES	**ESTIMATED COST**	**TIMELINE**
FEMA BRIC grant State historic preservation grants Philanthropic efforts	$20K to $100K based on the project.	☐Short Term (0-3 years) ☒Medium Term (3-5 years) ☐Long Term (more than 5 years)

OTHER NOTES

- Temporary Protective Measures
- Site and Landscape Adaptations
- Protect Utilities
- Fill the Basement
- Elevate on a New Foundation
- Elevate the Interior Structure
- Abandon the Lowest Floor
- Move the Historic Building

Silver Jackets/ RIHPC did a study of commercial buildings in the downtown historic district to look at opportunities for building specific flood prevention/protection measures. This report is currently under development as of July 2023.

7

Implementation and Adoption

Prioritization of Mitigation Actions

Implementing the Plan

The Town of Bristol and the Bristol Hazard Mitigation Committee realize that successful hazard mitigation is an ongoing process that requires implementation, evaluation, and updates to this plan. The Town also understands the importance of integrating appropriate sections of the plan into the Town's Comprehensive Community Plan, Emergency Operations Plan, and site plan review process. It is intended that this plan and the ongoing efforts of the HMC will preserve and enhance the quality of life, property, and resources for the Town of Bristol.

Adoption of this mitigation plan increases Bristol's eligibility for federal hazard mitigation grants. These grants originate from FEMA's Pre-Disaster Flood Mitigation Assistance (FMA), Pre-Disaster Mitigation (PDM), Building Resilient Infrastructure in Communities (BRIC) and post-disaster Hazard Mitigation Grant (HMGP) Programs.

Monitoring

The HMC, under the leadership of the Director of Community Development, will meet annually (or more frequently if necessary), to monitor and evaluate the actions contained in the plan. At each meeting, the committee members will discuss the actions assigned to them to ensure continual progress with mitigation efforts. The status of each mitigation action will be documented, and minutes recorded for the record. The HMC will also continue to re-evaluate membership on the committee to ensure effective engagement of the appropriate parties. New members may be invited to serve on the HMC as priorities shift.

Evaluation

At the annual meetings, the HMC will evaluate both the actions and the planning process. The HMC will base its evaluation on whether or not the actions have met the following criteria: increased public awareness/education, reduction in hazard damage, actions being implemented in the designated time frames, and actions staying within the cost estimate. The committee will document and report its findings to the Town Council. The HMC will involve the public in the action evaluation process by holding an annual advertised public meeting in order to review the evaluation and solicit input.

During the annual evaluation process, the plan will be promoted online for public review. Comments and suggests can be sent directly to the Director of Community Development or brought up at the advertised public meeting.

Revisions

Recognizing that this is a living document, the HMC will make changes to it after each annual revision or a disaster, as conditions warrant. These revisions will also reflect changes to priorities and funding strategies that may have been implemented.

A full revision of the plan will commence a year in advance of the current plan expiration date in order to ensure the Town always has an approved plan. The update will be completed every five years and will incorporate a formalized process for prioritizing actions and weighing the cost/benefit of such actions. All updates or revisions to the plan will be submitted to the RIEMA. The Town Council will involve the public in the plan revision process by holding an annual advertised public meeting to present recommended revisions and solicit input. Revised plans will also be sent to the neighboring communities for comment.

All future meetings will again be open to the public and it is the hope of the Hazard Mitigation Committee that once the public education and outreach actions begin, public involvement in the Plan will increase and will be reflected in future revisions. The Committee will involve the public in the annual meeting by posting it on the website, in the local library, and in the local newspaper to encourage involvement.

Adoption

After each evaluation cycle (every 5 years), the Bristol Hazard Mitigation Plan will be presented to and adopted by the Town Council. The associated ordinance documentation will be kept as part of this plan.

Appendix A: Survey Results

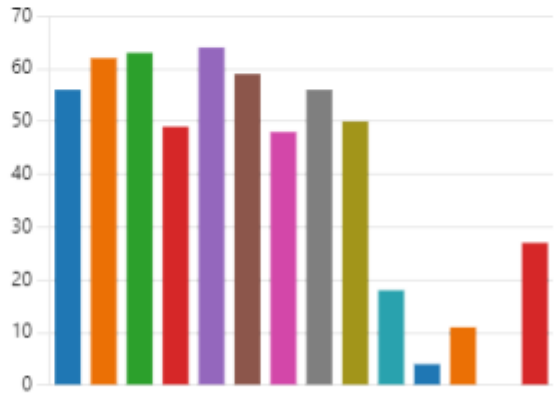
Full survey to be inserted.

Bristol Natural Hazard Mitigation Survey

68	27:47	Closed
Responses	Average time to complete	Status

1. **Which of the following hazard events have you experienced in the Town of Bristol?**

Hurricanes	56
Nor'easters	62
Winter Storms	63
Flooding (inland and coastal)	49
High Winds	64
Heat Wave	59
Extreme Cold	48
Lightning	56
Drought	50
Earthquakes	18
Tornadoes	4
Brushfires	11
Dam Failures	0
Hail	27

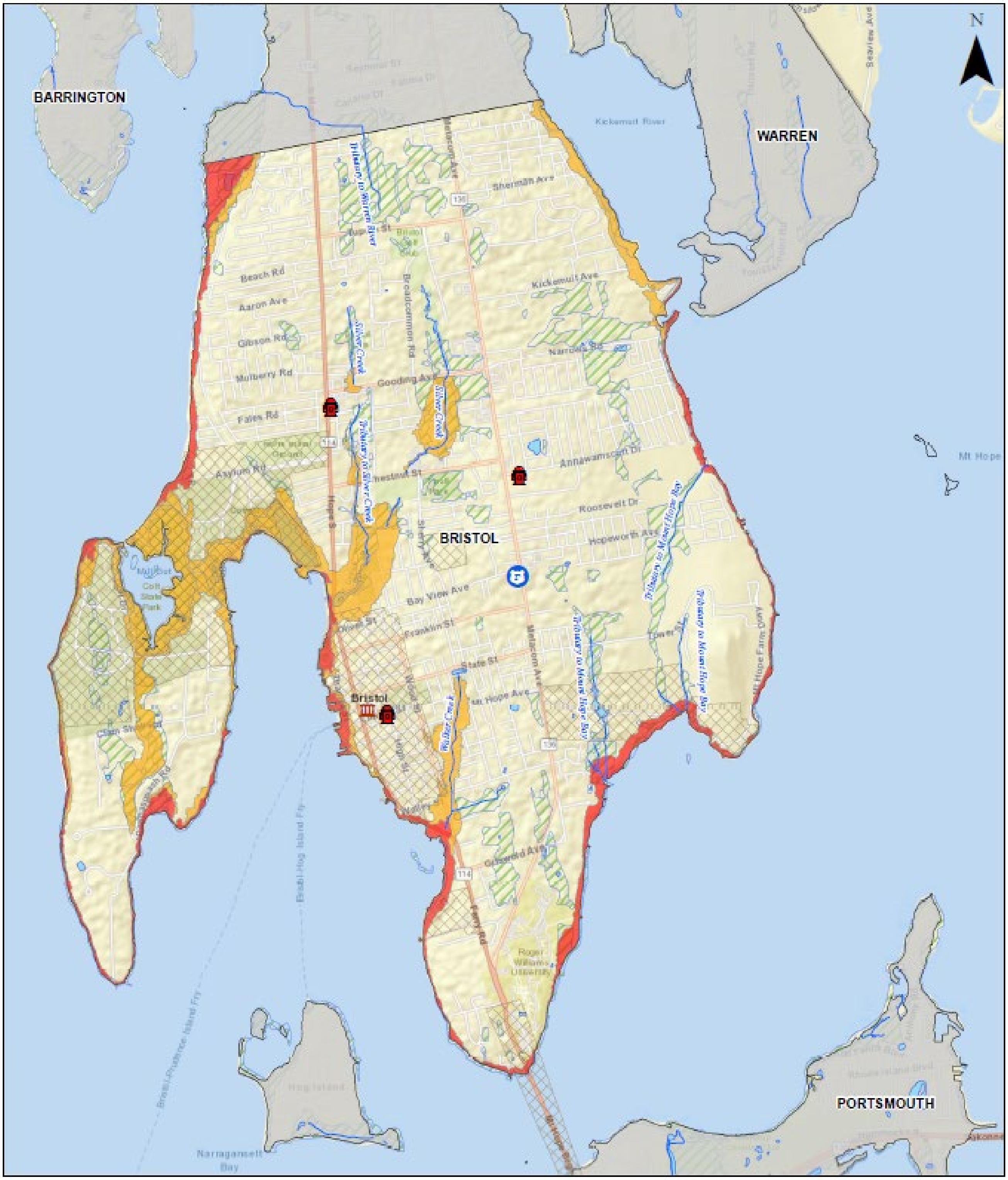


Appendix B: Public Outreach

Town Council Agenda to be inserted.

Public Notices to be inserted.

Appendix C: Community Assets Map



Legend

- Town Hall
- Fire Stations
- Police Stations
- Historic Districts

FEMA Floodzones

- AE
- AO
- VE

- Wetlands
- Ponds
- Rivers and Streams

Community Assets
Bristol, RI

0 0.375 0.75 1.5 Miles

Source: RI Geographic Information System, 2023

Appendix D: HAZUS Report

Full report to be inserted.

Hazus: Hurricane Global Risk Report

Region Name:	BristolRI2
Hurricane Scenario:	1954-CAROL
Print Date:	Tuesday, March 7, 2023

Appendix E:Historic Resources

Insert Appendix 10 of Historic Vulnerability Assessment Report (**"AT-RISK" HISTORIC RESOURCES IN STUDY AREA BY ADDRESS)**

Project #	STREET #	STREET	DATE	PLAT	LOT	% Risk of Future Flood Damage
30	711	Hope	1855	8	8	100%
88	494	Thames	1809	8	17	100%
93	484	Thames	1870	8	19	100%
87	474	Thames	1800	8	21	100%
13	11	Franklin	1807	8	24	100%
12	3	Franklin	1860	8	26	100%
14	14	Franklin	1760	9	3	100%
85	446	Thames	1920	9	4	100%
79	392	Thames	1785	9	12	100%
75.02	267	Thames	1810	9	50	100%
92.1	343-345	Thames	1942	9	13/24	100%
58	18-20	State	1870	10	5	100%
72	198	Thames	1850	10	18	100%
51	5	John	1920	10	19	100%
91.1	205	Thames	1859	10	20	100%
53	14	John	1800	10	25	100%
4	9	Church	1805	10	30	100%
70	135	Thames	n/a	10	33	100%
6	18	Church	1840	10	36	100%
5	12	Church	1807	10	37	100%
3	8	Church	1891 1903	10	38	100%
69	126	Thames	1807	10	39	100%
67	82	Thames	1780	10	45	100%
65	70	Thames	1840	10	49	100%
11	9	Constitution	1872	10	56	100%
61	34	Thames	1880	10	59	100%
68.1	127	Thames	1894	10	70	100%
68	125	Thames	1830 on	10	42/60/61/62/ 3	100%
38	730	Hope	1830	12	51	100%
21	129	Hope	1927	16	27	100%
17	119	Hope	1960	16	28	100%
19	124	Hope	1860	16	34	100%
24	169	Hope	1979	16	42	100%