GZA GeoEnvironmental, Inc.

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Town of Somerset

Natural Hazard Mitigation Plan

Somerset, Massachusetts

Local Natural Hazard Mitigation Plan

Prepared in accordance with the requirements presented in the FEMA Local Mitigation Plan Review Guide and the Local Mitigation Handbook

Prepared by:
GZA GeoEnvironmental, Inc.

Prepared For:
The Town of Somerset, Massachusetts
Planning Department

November 7, 2018

GZA GeoEnvironmental, Inc.

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Board of Selectmen

Town Office Building
140 Wood Street
Somerset, MA 02726
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Certificate of Adoption Resolution

Town of Somerset, Massachusetts

BOARD OF SELECTMEN

A RESOLUTION ADOPTING THE *SOMERSET MULTI-HAZARD MITIGATION PLAN*

WHEREAS, the Town of Somerset recognizes the threat that natural hazards pose to people and property within the Town of Somerset; and

WHEREAS, the Town of Somerset established a Local Planning Team to prepare the Hazard Mitigation Plan; and

WHEREAS, Town of Somerset has prepared a multi-hazard mitigation plan, hereby known as the *SOMERSET MULTI-HAZARD MITIGATION PLAN* dated November 7, 2018 in accordance with the Disaster Mitigation Act of 2000; and

WHEREAS, the *SOMERSET MULTI-HAZARD MITIGATION PLAN* dated November 7, 2018 identifies mitigation goals and several potential future projects to mitigate impacts from natural hazards including climate-related hazards in the Town of Somerset; and

WHEREAS, a duly-noticed public meeting was held by the Town of Somerset on August 29, 2018 for the public and municipality to review prior to consideration of this resolution; and

WHEREAS adoption by the BOARD OF SELECTMEN demonstrates their commitment to the hazard mitigation and achieving the goals outlined in the SOMERSET *MULTI-HAZARD MITIGATION* PLAN dated November 7, 2018; and

WHEREAS, the Town of Somerset authorizes responsible departments to execute their responsibilities demonstrated in the plan; and

NOW, THEREFORE, BE IT RESOLVED that the Town of Somerset BOARD OF SELECTMEN, formally approves and adopts the *MULTI-HAZARD MITIGATION PLAN,* in accordance with M.G.L. c. 40.

ADOPTED AND SIGNED this 7th day of November 2018.

SOMERSET BOARD OF SELECTMEN

By: _____
Henry McNamara, Chairperson

By: _____
Steven Moniz, Clerk

By: _____
David Berube, Board of Health Chair

QUICK PLAN REFERENCE GUIDE

The following provides a Quick Reference Guide to the Town of Somerset Natural Hazard Mitigation Plan:

STEP 1: UNDERSTAND THE PLANNING PROCESS

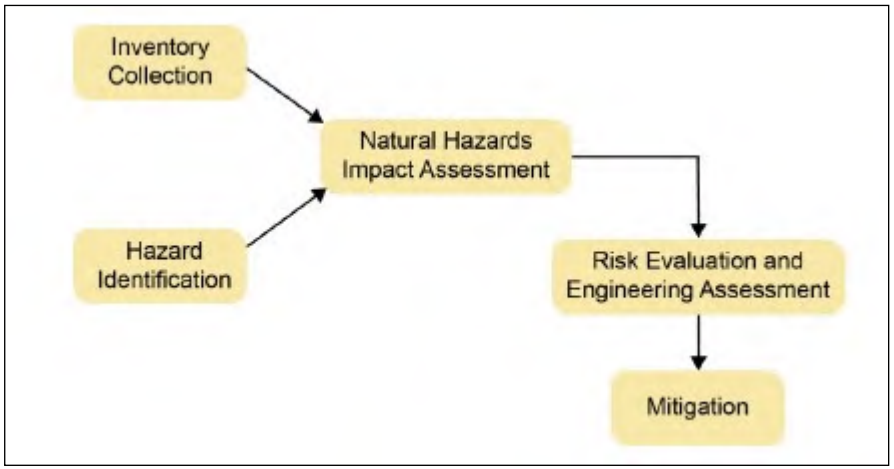
Section 2 - Planning Process describes the planning process and identifies the members of the Local Planning Team (LPT) that participated in the Plan development. **Attachment 6** presents public meeting documentation for the two public meetings.

STEP 2: INVENTORY TOWN ASSETS (COMMUNITY PROFILE)

Section 3 - Community Profile presents a brief overview of the Town assets. **Attachment 1** provides a detailed description of these assets, including the Town population, and an inventory of Essential and Lifeline Systems, High Potential Loss Facilities, Transportation Infrastructure, and Town Facilities and Zoning Districts and General Building Stock.

STEP 3: IDENTIFY NATURAL HAZARDS

Section 4 - Natural Hazard Risk identifies and summarizes the natural hazards applicable to the Town. **Attachment 2** provides the detailed description of relevant natural hazards. The hazards are characterized including past hazard events and expected probability of occurrence. Future climate-related changes to severe weather and climate-related hazards are also presented based on the current available science.



Conceptual Steps in Assessing and Mitigating Losses due to Natural Hazards (FEMA)

STEP 4: ASSESS NATURAL HAZARD IMPACTS AND RISK

Section 4 - Natural Hazard Risk also presents the results of an assessment of the vulnerability of the Town to the natural hazards. **Attachment 3** provides a detailed hazard vulnerability assessment. FEMA HAZUS-MH simulations were performed for Hurricane (probabilistic), flood (1% and 0.2% Annual Exceedance Probability [AEP] floods), and earthquake (2% in 50 years). The simulation results are presented in **Attachment 4**.

STEP 5: MITIGATION PLAN AND IMPLEMENTATION

Sections 5, 6 and 7 present mitigation strategies and actions, regional and intercommunity considerations and plan implementation details. **Attachment 3** provides the basis for ranking natural hazard priorities. **Attachment 5** presents state and federal hazard mitigation and response grant funding sources. References and resources, and key contacts are presented in **Attachments 7** and **8.**

UNDERSTANDING NATURAL HAZARD RISK

This Natural Hazard Mitigation Plan is intended to provide the Town of Somerset with a risk-based approach to making planning decisions. In simple terms...

Risk = the probability of an event occurring x the consequences of that event

Risk can be assessed qualitatively or quantitatively. The evaluation of the risks associated with Somerset's natural hazards required: 1) identifying the type of natural hazard(s) applicable to Somerset; 2) evaluating their probability of occurrence; and 3) evaluating their consequences. For example, a coastal flood could impact Somerset resulting in damage to property, injury or death and/or other economic or natural resource impacts. Different coastal flood conditions (water level, limit of flooding, wave height, etc.) are associated with different probabilities of occurrence and different degrees of consequences. By characterizing the hazard, evaluating its probability and evaluating the consequences, the likelihood that these consequences will be experienced is determined. Once the consequences are understood in this way, value and risk-based planning decisions can be made.

Quantitative Risk Assessment

Quantitative assessment of natural hazard risk typically defines hazard probability in terms of Annual Exceedance Probabilities (AEP). The AEP refers to the probability that an event (e.g. , a specific flood water level) will be experienced or exceeded in any given year. For example, the 1% AEP event has a 1 in 100 chance of being met or exceeded in any given year. This probability is often described in terms of a recurrence interval. The recurrence interval is also a statistical indication of the probability of an event and can be considered as the "expected" frequency of an event, on average and over a long period of time. The 100-year recurrence interval is consistent with a 1% AEP. Estimates of AEP are typically presented as "mean" values and have uncertainty represented by lower and upper bounds.

Quantitative estimates of natural hazard probabilities, to be statistically meaningful, require long periods of record of actual historical hazard data or use of other statistical methods. Certain natural hazards such as coastal flooding and earthquakes have been defined quantitatively by the federal government (FEMA, USGS and/or the US Army Corps of Engineers), and these values have been used for this Plan. For other natural hazards (e.g., Hail), this Plan has used limited historical data to extrapolate probabilities. While not statistically valid, the extrapolated estimates are useful in categorizing likelihood of occurrence (e.g., high to very low). Even though these "quantitative" value are presented in the Plan, the reader should be aware that they are not statistically meaningful due to the limited period of record of historical data.

Evaluating Consequences

This Plan evaluates the consequences associated with natural hazards in several different ways. The FEMA HAZUS-MH software is used to calculate losses (e.g. building damage) associated with Hurricanes (high winds), Coastal Flooding and Earthquakes. For the other natural hazards, the consequences were extrapolated from available historical data. Similar to the estimated probabilities for these hazards, this approach is not statistically valid; however, it is useful for categorizing the consequences (minor to catastrophic).

Risk Over Time

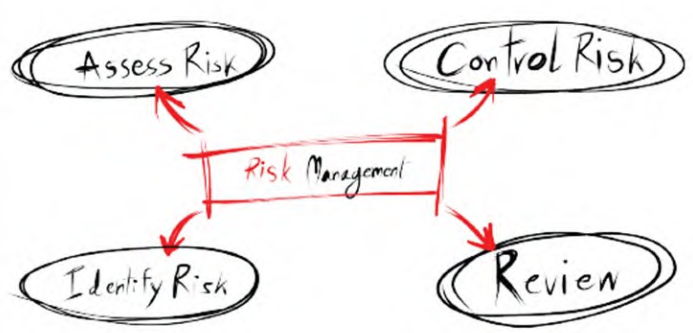
While AEPs and recurrence intervals define the annual risk (i.e., risk in any given year), the risk of experiencing that same hazard event at least once will increase when longer periods of time are considered. For example, the 1% AEP flood has a 1 in 4 chance (25%) of occurring at least once over a 30-year period.

Climate Change

Climate change can effect the risk of severe weather and climate-related hazards. For example, a flood level that has a 1% AEP today may have a much higher probability of occurrence in the future due to sea level rise.

Low Probability is not the Same as Impossible

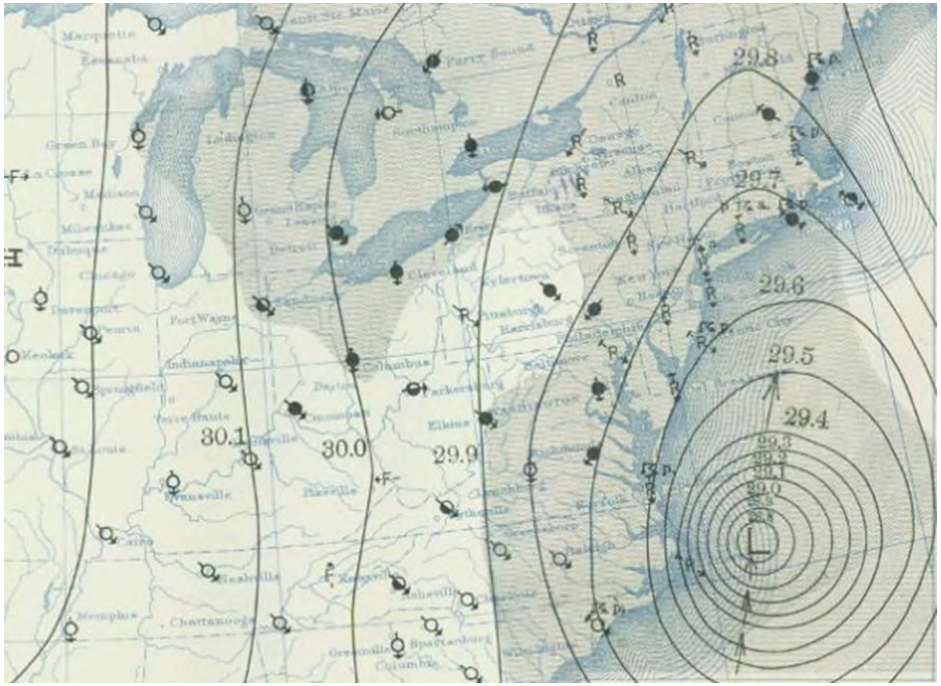
Even though a hazard is predicted to have a low probability of occurrence, that does not mean it cannot happen. For example, a major tornado is unlikely to occur at Somerset based on the available historical data, but it could happen - it is just predicted to be a low probability for planning purposes.



Risk Management Planning Process

Section 1: Plan Introduction

SECTION 1- INTRODUCTION



Historical Surface Weather Map of the Hurricane of 1938 on September 9, 1938

PURPOSE OF PLAN

The following presents the Natural Hazard Mitigation Plan for the Town of Somerset, Massachusetts. The Town of Somerset is a suburban waterfront community of about 18,000 residents, located 40 miles south of Boston and 20 miles northeast of Providence, Rhode Island. The Town is situated as a peninsula within Mount Hope Bay, an embayment within the larger Narragansett Bay. The Town's eastern border is located on the west bank of the Taunton River.

As a coastal New England town, Somerset is vulnerable to coastal storms, intense rainfall and extreme wind. The Town is also vulnerable to other severe weather hazards, climate-related hazards (e.g., extreme heat and cold) and geologic hazards (e.g., earthquakes). The Town has developed this Plan to identify the risks and vulnerabilities associated with natural disasters and to develop long-term strategies for protecting people and property from future hazard events.

Ultimately, the goal of the Plan is to enable action to reduce loss of life and property by lessening the impact of natural disasters.

The development of the Plan enables the Town to:

- Increase education and awareness about the Town's vulnerability to natural hazards;
- Build partnerships for risk reduction involving government, organizations, businesses, and the public;
- Identify long-term, broadly-supported strategies for risk reduction;
- Align risk reduction with other state, tribal, or community objectives;
- Identify implementation approaches that focus resources on the greatest risks and vulnerabilities; and
- Communicate priorities to potential sources of funding.

PLAN REQUIREMENT

In addition, FEMA requires state, tribal, and local governments to develop and adopt hazard mitigation plans as a condition for receiving certain types of non-emergency disaster assistance, including funding for mitigation projects. Jurisdictions must update their hazard mitigation plans and re-submit them for FEMA approval every five years to maintain eligibility.

The Commonwealth of Massachusetts encourages local municipalities to take ownership of the multi-hazard mitigation planning process by pursuing and developing local multi-hazard mitigation plans (MHMP).

Section 2: Planning Process

SECTION 2 - PLANNING PROCESS

The FEMA planning process includes the following steps:

1. Organize the Planning Process and Resources

At the start, focus on assembling the resources needed for a successful mitigation planning process. This includes securing technical expertise, defining the planning area, and identifying key individuals, agencies, neighboring jurisdictions, businesses, and/or other stakeholders to participate in the process. The planning process for local and tribal governments must include opportunities for the public to comment on the plan.

2. Assess Natural Hazard Risks

Identify the characteristics and potential consequences of hazards. It is important to understand what geographic areas each hazard might impact and what people, property, or other assets might be vulnerable.

3. Develop Mitigation Strategies

Develop long-term strategies for avoiding or minimizing the undesired effects of disasters. The mitigation strategy addresses how the mitigation actions will be implemented and administered.

4. Adopt and Implement the Plan

Once FEMA has received the adoption from the governing body and approved the plan, the state, tribe, or local government can bring the mitigation plan to life in a variety of ways, ranging from implementing specific mitigation projects to changing aspects of day-to-day organizational operations. To ensure success, the plan must remain a relevant, living document through routine maintenance. The state, tribe, or local government needs to conduct periodic evaluations to assess changing risks and priorities and make revisions as needed.

The Town of Somerset followed this process, including:

- Organizing a diverse local planning team.
- Retaining GZA to provide technical and planning expertise.
- Providing opportunities for the public to comment on drafts of the plan prior to final plan approval.
- Providing opportunities for neighboring communities and local and regional agencies involved in natural hazard mitigation activities that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process.
- Reviewing and incorporating applicable existing plans, studies, reports, and technical information into the plan.

Figure credit FEMA/Jenny Burmester – Aug 21, 2017

The Town assembled a Local Planning Team (LPT) with critical Town leadership responsibilities. The LPT was tasked with providing oversight and guidance in developing the Plan.

LOCAL PLANNING TEAM MEMBERS

- Town Administrator, Richard Brown
- Building Department – Paul Boucher, Building Commissioner/ Zoning Enforcement Officer
- Highway Department – Brian J. Martin, Highway Department Superintendent
- Fire Department/Emergency Management – Scott Jepson, Chief
- Conservation Commission – Tim Turner, Commissioner
- Police – George M. McNeil, Chief

SECTION 2 - PLANNING PROCESS cont.

The LPT conducted four working group meetings to provide input and guidance in developing the plan throughout the planning process. The meetings were held on 03/02/2017, 07/10/2017, 12/12/2017, 04/06/2018, and 08/27/2018. The purpose each working group meeting is summarized below:

- Working Group Meeting No. 1: Reviewed, discussed and finalized the inventory of Town assets as presented in Section 3 and **Attachment 1**. LPT members also provided details on previous natural hazard occurrences that impacted the Town.
- Working Group Meeting No. 2: Reviewed and discussed natural and climate change related hazard characterizations with respect to Somerset as presented in Section 4 and **Attachment 2**.
- Working Group Meeting No. 3: Reviewed, discussed the HAZUS Risk Assessment results for coastal flooding, hurricane-wind and earthquake hazards. Based on a review of the HAZUS results and hazard characterizations the LPT ranked hazards for the Town using a consistent criteria as presented in Section 4 and **Attachment 3**.
- Working Group Meeting No. 4: Discussed and prepared the hazard mitigation strategy for Somerset including goals and specific mitigation actions by hazard. The LPT then conducted a benefit-cost review of each mitigation action using a consistent criteria as in Sections 4 and 5.
- Working Group Meeting No. 5: LPT members provided input on final revisions based on reviews of the Draft Plan. GZA documented the revisions for inclusion in the Final Draft Plan for submission to MEMA. The LPT provided input to GZA on the approach to facilitating the second public meeting on 08/29/2018.

The Town conducted two public meetings that provided residents, community stakeholders, business, neighboring communities, state agencies, regional planning authorities, and Town officials, including the LPT members the opportunity to participate during the planning process. The purpose of these meetings was to solicit input during the planning process for consideration and integration into the development of the Plan. The meetings were held at the Somerset Public Library and publicized on the Town's website and through a formal press release. At the first public meeting, a presentation was given to provide background on Hazard Mitigation Planning and to describe the Town's assets inventory, hazards characterization, and risk assessment. The list of participants who attended the public meetings is included in **Attachment 6**. The Town hosted the meetings on the following dates: July 24, 2017 and September 29, 2018.

EXISTING PLAN REVIEW

Several existing plans, reports and regulatory programs were reviewed by GZA and relevant details (e.g. future development areas as outlined in the Somerset Master Plan) were incorporated as part of this Natural Hazard Mitigation Plan, including:

- State of Massachusetts Natural Hazard Mitigation Plan, 9/2013
- Somerset Master Plan Volume 1, 2006
- Somerset Master Plan Volume 2, 2007
- Somerset Community Preservation Act Plan, June 2015
- Somerset Reservoir Emergency Action Plan Update 2014
- Somerset Zoning By-Law (including all amendments), May 18, 2015
- Somerset Rules and Regulations Relating to the Subdivision of Land, June 2004
- Southeastern Massachusetts Metropolitan Planning Organization (SMMPO) Regional Transportation Plan, 2016
- Somerset Power Plant Reuse Study, 2015

Section 3: Community Profile

SECTION 3 - COMMUNITY PROFILE OVERVIEW

The Town of Somerset is a suburban waterfront community located 40 miles south of Boston and 20 miles northeast of Providence, Rhode Island (see **Figure 1**). The Town's eastern border is located on the west bank of the Taunton River and the southern border faces Mount Hope Bay. The Town is bordered on the west by Swansea and to the north by Dighton. The Town has a total area of 12 square miles that includes 8.1 square miles of land and 3.9 square miles of water. Somerset was incorporated as a Town in 1790 and is a jurisdiction of Bristol County, the sixth largest county in the Commonwealth of Massachusetts.

The Town is governed by a three-member Board of Selectmen, Town Administrator and traditional New England Open Town Meeting. The Town is also one of twenty-seven cities and towns within the Southeastern Regional Planning and Economic District (SRPEDD), supporting regional land use, transportation, economic and natural resource management planning. SRPEDD cities and towns include 600,000 residents and an area of 808 square miles.

Attachment 1 provides a detailed description of Town's community profile including population, building stock, essential facilities and lifeline systems and natural resources. The following pages provide a brief overview.

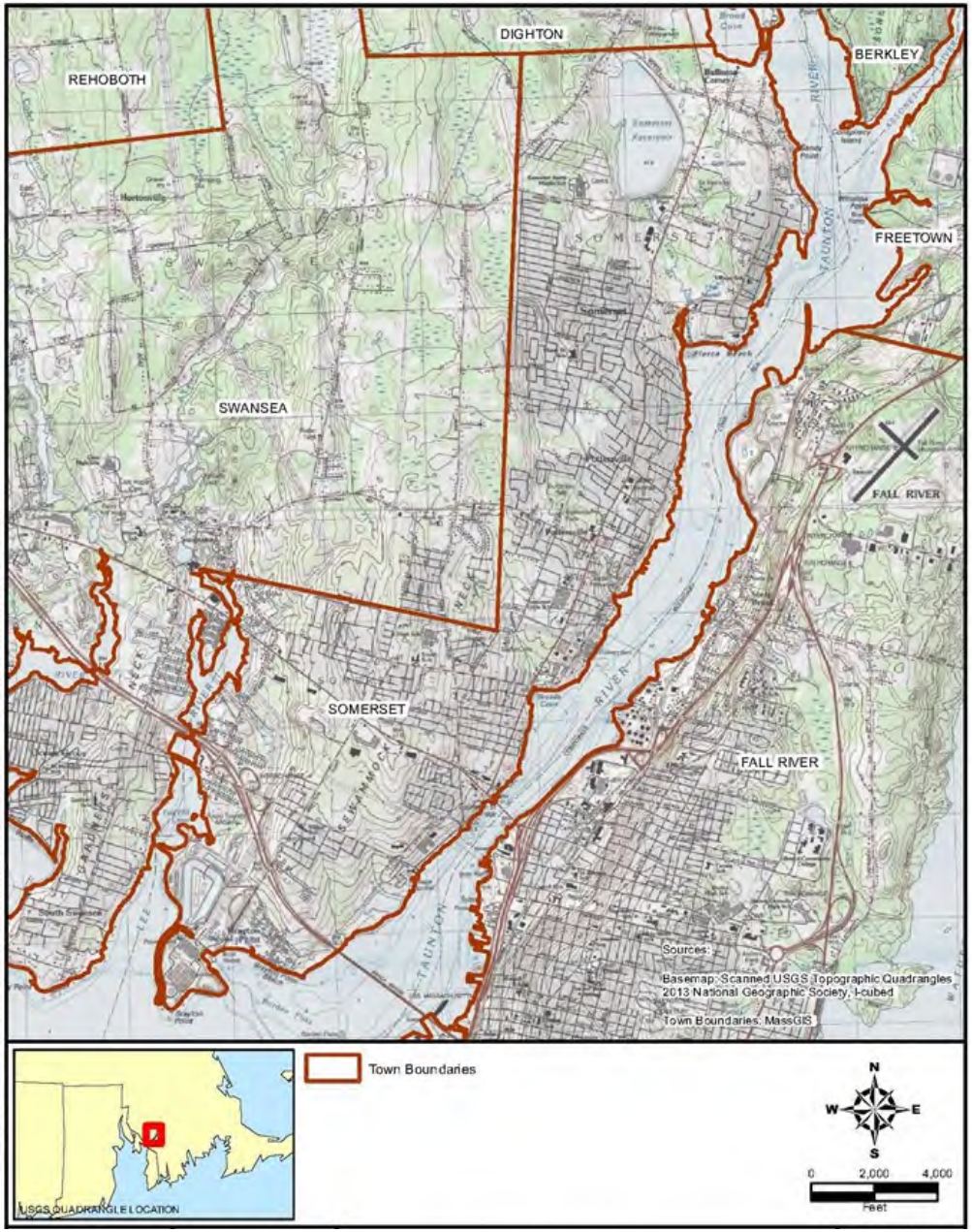


Figure 1: Somerset Site Locus and Town Limits

Community Profile Snapshot:

Per the 2010 United States Census:

Age and Sex:

Population:	18,165
Population change since 2000:	69 (+/- 0.4%)
Percent female/male:	50.7%/49.3%
Age:	
persons <5 years:	3.6%
persons <18 years:	18.2%
persons ≥ 65 years:	23.3%

Race:

White alone:	97.5%
Black or African Amer. alone:	0.3%
Amer. Indian or Alaska Native alone:	0%
Asian alone:	0.7%
Two or more races:	0.8%
Hispanic or Latino:	0.6%
White alone, not Hispanic or Latino:	97.1%

Health:

With disability, under 65 years:	11.6%
Persons w/o health insurance, under 65 years:	3.7%

Education:

High school graduate or higher, greater 25 years:	85.5%
Bachelor's degree or higher, greater 25 years:	23.7%

Economy:

In civilian labor force, total, greater 16 years: (2012 to 2016)	60.6%
In civilian labor force, female, greater 16 years: (2012 to 2016)	58.6%

Income and Poverty:

Median household income: (2012 to 2016; 2016$)	$68,900
Per capita income: (2012 to 2016; 2016$)	$31,544
Persons in poverty:	7.3%

Family and Living Arrangements:

Households (2012 to 2016):	6,935
Persons per Household:	2.6
Language spoken at home other than English, greater than 5 years:	17.1%
Median house cost:	$270,500
Percent owner-occupied:	80%

Population Density:

2,300/sq. mile

Social Vulnerability Index:

Somerset's Overall Social Vulnerability: medium; Social Vulnerability Flags only include Persons aged 65 and older. For this category Somerset ranks in the upper 82nd to 92nd percentile of all U.S. census tracts.

Community Profile Snapshot:

Building Stock: 6,929 Buildings

- 84% Residential (building exposure: $1.75B)
- 11.5% Commercial (building exposure: $239M)
- 1.6% Industrial (building exposure: $33M)
- Total building exposure: $2.1B (see Attachment 4 for more details)

Support, High Occupancy and Vulnerable Population Facilities:

- 14 Facilities including Daycare, Assisted Living, Nursing Homes, Schools and Primary Care

Land Use: 7,377 Parcels:

- 46% Residential
- 5% Commercial
- 3% Industrial
- 2% Agricultural
- 9.5% Undeveloped Land

Districts:

- Business
- Limited Business
- Industrial
- Light Industrial
- Residential
- Open recreation
- Park

Future Development:

- 9 future development sites currently planned

Historic Districts:

- 1 property on National Register of Historic Places

Transportation Infrastructure:

- Town and State Roads
- 5 Bridges
- No Rail

Essential Facilities:

- Emergency Management
- Emergency Communications
- Police
- Fire and Rescue
- Designated Shelter

Lifeline Systems:

- Town Water Supply System (Somerset Water Department, reservoir and well sources)
- Sanitary Wastewater Treatment (Somerset Water Pollution Control Facility; 92% of buildings in Somerset are connected to the public system)
- Electricity (National Grid)
- Natural Gas (Liberty Utilities)
- Telecommunications (Comcast and Verizon)
- Separate Stormwater and Sanitary Infrastructure

Hazardous Materials:

- 10 Large Quantity Generators

High Potential Loss Facilities:

- Somerset Reservoir High Hazard Dam

Natural Resources:

- Two regional watersheds (Narragansett Bay and the Taunton River)
- Natural Heritage and Endangered Species (MA NHESP)
- Forest Stewardship Program

Section 4: Natural Hazard Risk

SECTION 4 - NATURAL HAZARD RISK OVERVIEW

A Natural Hazard Risk Assessment was conducted by GZA to evaluate the potential consequences of natural hazards to the people, economy, and built and natural environments of the Town of Somerset. The FEMA Multi-Hazard HAZUS-MH program was used to evaluate economic losses due to seismic, flood and hurricane hazards. The HAZUS-MH simulation results are presented in **Attachment 4**. The hazards were ranked (on a scale with 1 being the top ranking and 9 the lowest) using a scoring system based on the likelihood/frequency, severity/magnitude, and potential impact area (see **Table 1**). Each hazard category was provided a score based on the criteria shown in **Attachment 3**. For each hazard, the product of the points from each category was determined and the hazards ranked from highest value to lowest. The details of the risk assessment and how the hazards were ranked are presented in **Attachments 2 and 3.**

The top ranked hazards include:

- Flooding due to Coastal Storm Surge  **1**

  Although the extent of coastal storm surge is limited to the shoreline areas of Town, it is the top-ranked hazard due to: 1) flood inundation impacts to the Town's Water Pollution Control Facility; and 2) impacts to transportation infrastructure, including Routes 103 and 6. Extensive damage to the Water Pollution Control Facility would be catastrophic due to loss (for an extended time) of that key lifeline service. It would also result in economic impact including effecting the Town's municipal bond rating.

- Hurricanes/Tropical Storms  **2**

  Severe wind, and related damages during hurricanes is ranked second due to its relatively high probability of occurrence, its coincidence with coastal flooding and its potential for wide-spread damage. In particular, a hurricane strike at or near Somerset with a 1% probability of occurrence (100-year recurrence interval) would be catastrophic (similar to the 1938 and 1954 hurricanes). In addition to high winds, hurricanes will also create large storm surges and waves and heavy rainfall.

- Severe Winter Weather  **3**

  Severe winter weather (greater than 10-inches snowfall) most frequently occur during nor'easters, coincident with high winds, cold temperatures and blizzard conditions. Winter storms present risks due to transportation impacts (limited use of roadways), cold temperatures (including wind chill) and the potential for structure damage (roof failures). Their relative high probability of occurrence makes severe winter weather as a high ranked hazard.

- Somerset Reservoir Dam **3 (tied)**

  Failure of the high-hazard Somerset Reservoir Dam due to a dam-breach is a high ranked hazard due to the potential extent of flood inundation and potential loss of life and damage to property. The high rank reflects its categorization as the only High Potential Loss Facility located in or near the Town. An Emergency Action Plan (EAP) is in place for the dam.

Table 1: Somerset Natural Hazard Ranking based on the hazard frequency of occurrence, severity and extent of impact area.

Severe Weather Hazards:	**Rank**
Severe Wind:	
Hurricanes/Tropical Storms	**2**
Thunderstorms	5
Tornadoes	4
Lightning	8
Intense Rainfall	6
Hail	6
Flood:	
Storm Surge	**1**
Sea Level Rise	5
Urban Drainage Flooding	6
Severe Winter Weather:	
Snowfall	**3**
Ice Storms	6
Climate-Related Hazards:	
Extreme Temperature:	
Heat	7
Cold	7
Drought	7
Wildfire	9
Geologic Hazards:	
Earthquake	6
Landslides	0
Tsunami	0
Secondary Hazard:	
Dam Failure	**3**

SECTION 4 - NATURAL HAZARD RISK OVERVIEW

Table 2 presents a summary of the predicted hazard likelihood of occurrence/frequency, severity/magnitude and impact area for each natural hazard that is relevant to Somerset. The hazard probability of occurrence (frequency) is characterized as:

Frequency:

Very Low: Events that occur less frequently than once in 1,000 years (less than 0.1% per year).

Low: Events that occur from once in 100 years to once in 1,000 years (0.1% to 1% per year)

Medium: Events that occur from once in 10 years to once in 100 years (1% to 10% per year).

High: Events that occur more frequently than once in 10 years (greater than 10% per year).

The hazard impact in part is characterized as follows:

Severity:

Minor: Limited and scattered property damage; no damage to public infrastructure (roads, bridges, trains, airports, public parks, etc.); contained geographic area (i.e., 1 or 2 communities); essential services (utilities, hospitals, schools, etc.) not interrupted; no injuries or fatalities.

Serious: Scattered major property damage (more than 50% destroyed); some minor infrastructure damage; wider geographic area (several communities); essential services are briefly interrupted; some injuries and/or fatalities.

Extensive: Consistent major property damage; major damage to public infrastructure (up to several days for repairs); essential services are interrupted from several hours to several days; many injuries and fatalities.

Catastrophic: Property and public infrastructure destroyed; essential services stopped, thousands of injuries and fatalities.

Climate change will have an effect on Severe Weather Hazards and Climate-Related Hazards. **Table 3** compares key components of Somerset's climate today to changes predicted by the year 2050. The impact of certain climate change effects on the Town such as sea level rise and coastal flooding are predictable. The impact of other effects such as the increase in the frequency and duration of Heat Waves are less predictable. However, these Climate-Related hazards are predicted to become a high priority for Somerset over the next decade.

Natural Hazard	Likelihood/Frequency	Severity/Magnitude	Impact Area
SEVERE WEATHER HAZARDS			
Severe Wind:			
Hurricanes/Tropical Storms/ Nor'easters	• High Wind Warning (>40mph): +/- 100% AEP (1-year recurrence interval); **High**	Minor	Town-wide
	• Hurricane Wind Warning (>74mph): 1% AEP (100-year recurrence interval); **Medium to Low**	Extensive	
	• Extreme Wind Warning (>115 mph) <0.2% AEP (>500-year recurrence interval); **Very Low**	Catastrophic	
Thunderstorms (wind >58 mph)	• Within Bristol County: 56% AEP or minimum of 1-year to 2-year recurrence interval (29 years with 1 or more events over 52 years); Probability of occurrence within Somerset is likely lower; **Medium to High**	Minor	Town-wide or portions of Town
Tornadoes	• Tornadoes within Bristol County: 9% AEP or 11-year recurrence interval (6 years with 1 or more events over 68 years); **Medium**		
	• Major tornado within Bristol County: 1.5% AEP or 70-year recurrence interval; **Low**		
	• Based on the proportional land area, the Somerset tornado AEP is about 0.2% and the Somerset major tornado AEP is very low (less than 0.2%). **Very Low**	Serious to Catastrophic	Town-wide or portions of Town
Lightning	• Events resulting in fatality, injury and/or damage within Bristol County: 58% AEP or 2-year recurrence interval; **High**	Minor (fatality risk is very low)	Town-wide or portions of Town
	• Within Somerset: 5% AEP or 20-year recurrence interval); **Medium to High**		
Intense Rainfall	• 4% AEP or 25-year recurrence; **Medium**	Minor Major (potential impacts to Reservoir Dam)	Town-wide or portions of Town
Hail (≥ 3/4 inch)	• 45% AEP or 2 year recurrence interval (20 years with 1 or more events over 44 years); Probability of occurrence within Somerset is likely lower; **Medium to High**	Minor to Serious	Town-wide or portions of Town

Table 2: Somerset Natural Hazard Overview

Natural Hazard	Likelihood/Frequency	Severity/Magnitude	Impact Area
SEVERE WEATHER HAZARDS			
Flooding:			
Coastal Flooding	• Stillwater elevation (SWEL) = 8.4 feet NAVD88: 10% AEP (10-year re-currence interval); **Medium**	Minor	Portions of Town
	• Stillwater elevation (SWEL) = 12.3 feet NAVD88: 2% AEP (50-year re-currence interval); **Medium to Low**	Minor to Serious	
	• Stillwater elevation (SWEL) = 13.9 feet NAVD88: 1% AEP (100-year re-currence interval); **Low**	Serious to Catastrophic (Water Pollution Control Facility	
	• Stillwater elevation (SWEL) = 17.6 feet NAVD88: 0.2% AEP (500-year recurrence interval); **Very Low**	Serious to Catastrophic (Water Pollution Control Facility	
Urban Flooding	• 4% AEP or 25-year recurrence; **Medium**	Minor to Serious	Town-wide or portions of Town

Town impact due to coastal flooding:

- 161 buildings are predicted to be impacted during to the 1% AEP flood. This number represents 2% of the total number of Somerset buildings.
- 223 buildings are predicted to be impacted during to the 0.2% AEP flood. This number represents 3% of the total number of Somerset buildings.
- 1 Lifeline System (Water Pollution Control Facility) is predicted to be impacted during to the 1% AEP and 0.2% AEP flood.
- 15 Town/State Roads impacted. Sections of Routes 103 and 6 during floods of <2% AEP (>50-year recurrence interval).
- Town boat ramp and building impacted during floods of < 10% AEP (>10-year recurrence interval).
- Several Town industrial districts impacted during to the 1% AEP and 0.2% AEP flood.
- Several commercial facilities impacted during floods of <10% AEP (>10-year recurrence interval). Two marinas impacted during higher probability floods.

Table 2 cont.: Somerset Natural Hazard Overview

Natural Hazard	Likelihood/Frequency	Severity/Magnitude	Impact Area
SEVERE WEATHER HAZARDS			
Severe Winter Weather:			
Snowfall	• 90% AEP or 1-year recurrence interval Heavy Snowfall; **High**	Minor to serious	Town-wide
Ice Storms	• The data indicate that the probability of Ice Storms at and near Somerset (Taunton - New Bedford) is low. Available data is insufficient to estimate probabilities. **Medium to Low**	Minor to serious	Town-wide or portions of Town

Town snowfall estimates (upper bound monthly snowfall estimates inferred from Boston area):

- 10 to 15 snow days per year
- Average annual snowfall of 28 to 33 inches
- 90% AEP or 1 year recurrence interval Heavy Snowfall (19 years with 1 or more events over 21 year record)
- Reasonable estimate of average monthly snowfall: 15 to 20 inches
- Reasonably conservative monthly snowfall upper bound: 40 inches (maximum monthly upper bound of 60 inches)

Table 2 cont.: Somerset Natural Hazard Overview

Natural Hazard	Likelihood/Frequency	Severity/Magnitude	Impact Area
CLIMATE-RELATED HAZARDS			
Extreme Temperatures:			
Heat	• Excessive Heat (multi-day period with higher than normal Heat Index) near Somerset (Bristol County): 25% AEP or 1 event every 4 years. **Medium**	Minor to Serious (in particular for more vulnerable populations)	Town-wide
Cold	• Available data is insufficient to estimate probabilities. **Assumed Medium**	Minor	Town-wide
Drought	• Drought Warnings are expected in the Massachusetts Drought Southeast Region which includes Somerset: 10% to 30% AEP or 8 to 10-year recurrence interval; **Medium** • Massachusetts experiences extended, multi-year droughts about every 20 years; **Medium**	Minor (due to limited agricultural economy in Town; could be Serious if affects Town Water Supply)	Town-wide
Wildfire	• The historical data indicates that the probability of wildfire within Somerset is low. Quantitative probabilities of occurrence are not available. **Low**	Minor	16% of Town area is forest

Town climate considerations:

Periods of colder temperatures occur at Somerset and can cause wind chill conditions. Wind chill conditions example:

- 0° F and 25 mph sustained wind speeds, 30-minute exposure
- 5° F and 55 mph sustained wind speeds, 30-minute exposure

The severity and magnitude of extreme heat events at Somerset is, in part, dependent upon: 1) demographics; and 2) the capability of residents to get cool (e.g. air conditioners in homes). Somerset's demographic data indicates that about 35% of the population may be at a greater than average vulnerability.

- 24% of Somerset's population is older than 65 years
- 4% of Somerset's population is less than 5 years
- 7% of Somerset's population is at the poverty level

Table 2 cont.: Somerset Natural Hazard Overview

Natural Hazard	Likelihood/Frequency	Severity/Magnitude	Impact Area
GEOLOGIC HAZARDS			
Earthquake	• 2% in 50 years PGA (2,500-year recurrence interval; Maximum Considered Earthquake) in the vicinity of Somerset is 0.14g **Very Low**	Serious	Town-wide
	• 10% in 50 years PGA (500-year recurrence interval) in the vicinity of Somerset is 0.03g **Very Low**	Minor	Town-wide
Landslide	Landslide conditions do nor exist within the Town. Local areas of shoreline bluff may experience sloughing or slope stability failure due to coastal erosion. **Low to Medium (only local shoreline bluff failures)**	Minor	Town-wide
Tsunami	The probability of a significant tsunami affecting Somerset is **Very Low.**	Minor to Catastrophic	Town-wide

About earthquakes and tsunamis at Somerset:

1. The direct earthquake risk to Somerset is due to the ground motion that results during the earthquake. The Seismic Design Category for the majority of Somerset is A or B indicating a low seismic hazard. The 10% in 50 years (500-year recurrence interval) ground motion would be experienced as light to moderate perceived shaking and none to very light damage. The 2% in 50 years (2,500-year recurrence interval) ground motion would be experienced as very strong perceived shaking and moderate damage. Based on HAZUS-MH simulations of Somerset, 661 buildings are predicted to experience damage, ranging from slight to complete, from the 2,500-year (2% in 50 years) recurrence interval earthquake. The estimated economic losses are about $22 million for the 2,500-year event.
2. Given its coastal setting, there is some risk of a tsunami reaching Somerset. However, the risk of a significant tsunami is generally believed to be very low. There are two primary tsunami sources that could affect the Southern New England coast: 1) a tsunami generated by an earthquake along the Puerto Rican trench (located in the Caribbean); and 2) a slope failure of the continental shelf off of New England (likely to an earthquake). A landslide of the Cumbre Viejo in the Azores is also a potential New England tsunami source. If these occurred, and a tsunami reached the mouth of Narragansett Bay, it would have to propagate as a tidal bore within Narragansett Bay to reach Somerset, further reducing Somerset's risk.

Table 2 cont.: Somerset Natural Hazard Overview

Climate Change and Somerset

Somerset Climate Today	Somerset Climate 2050
Temperature: The average temperature is about 50°F. • The average low temperature in Winter (December, January and February) ranges from 18°F to 23°F, with the coldest temperature occurring during January. • The average high temperature in Summer (July and August) ranges from 83°F to 81°F, with the coldest temperature occurring during January. • Days above 90°F (based on state-wide data): 10 to 12 days • Heat Index above 105°F(based on state-wide data): 5 to 8 (lower in Somerset - about 1 event every 4 years)	Temperature: The average temperature could be between 2°F and 8°F higher than today. • Average Summer temperature (based on state-wide data): could be between 2°F and 8°F higher than today. • Days above 90°F (based on state-wide data): 20 to 40 days • Heat Index above 105°F(based on state-wide data): 16 (lower in Somerset, but still expected to increase relative to today to at least 1 event per year) • Spring will arrive sooner, summers will grow hotter, and the weather will becoming more extreme with swings between above-average winter temperatures to extreme cold with large snowfall events.
Intense Precipitation: • The 25-year recurrence interval, 24-hour rainfall at Somerset: 6.11 inches	Intense Precipitation: Within the Northeast U.S., from 1996 to 2014, the amount on intense rainfall (heaviest 1% of all daily events) was about 50% higher than the period of 1901 to 1995. The frequency and intensity of intense rainfall is expected to increase.
Sea Levels and Coastal Flooding: • 10% AEP Flood Stillwater Elevation: 8.4 feet NAVD88 • 2% AEP Flood Stillwater Elevation: 12.3 feet NAVD88 • 1% AEP Flood Stillwater Elevation: 13.9 feet NAVD88 • 0.2% AEP Flood Stillwater Elevation: 17.6 feet NAVD88	Sea Levels and Coastal Flooding: There is very high confidence that sea levels near Somerset will increase by about 1 foot (relative to the year 2000). A reasonable planning upper bound is 1.7 feet (relative to the year 2000). Assuming 1.7 feet increase: • 10% AEP Flood Stillwater Elevation: 10.1 feet NAVD88 • 2% AEP Flood Stillwater Elevation: 14 feet NAVD88 • 1% AEP Flood Stillwater Elevation: 15.6 feet NAVD88 • 0.2% AEP Flood Stillwater Elevation: 19.3 feet NAVD88

Table 3: Climate Change and Somerset

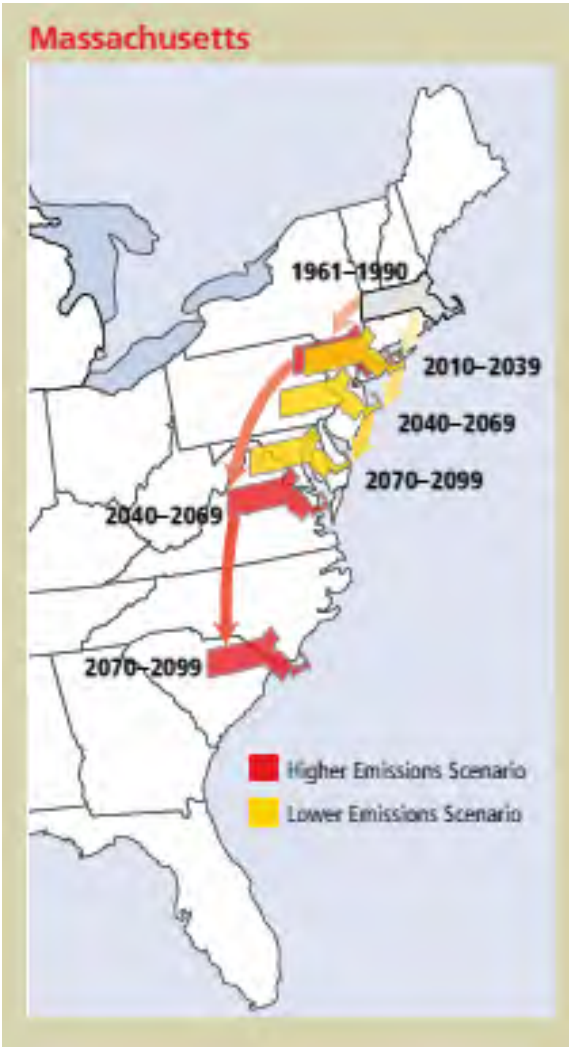


Figure 2: Latitudinal Changes in Regional Climate (source Union of Concerned Scientists)

Section 5: Natural Hazard Mitigation Strategies

SECTION 5 - NATURAL HAZARD MITIGATION STRATEGIES

HAZARD RISK MITIGATION GOALS

The Somerset Local Planning Team (LPT) met on April 6, 2018 to review proposed hazard mitigation goals. The following eight goals were endorsed by the team.

Mitigation Goals

1. Prevent and reduce the loss of life, injury, public health impacts and property damage resulting from all high-ranked natural hazards.
2. Identify and seek funding for measures to mitigate or eliminate each known significant flood hazard area.
3. Integrate hazard mitigation planning as an integral factor in all relevant municipal departments, committees and boards.
4. Prevent and reduce the damage to public infrastructure resulting from natural hazards.
5. Ensure that future development meets federal, state and local standards for preventing and reducing the impacts of natural hazards including impacts from climate change.
6. Encourage the business community, major institutions and non-profits to work with the Town to develop, review and implement the hazard mitigation plan.
7. Take maximum advantage of resources from FEMA and MEMA to educate Town staff and the public about hazard mitigation.
8. Work with surrounding communities, regional, the Commonwealth and federal agencies to ensure regional cooperation and solutions for hazards affecting multiple communities.

Somerset has an organization structure in-place to plan for and respond to natural disasters (see Key Contacts in **Attachment 8**). **Table 4** presented on the following two pages summarizes existing hazard mitigation measures already in place in Somerset. Because of the number of existing public and private entities involved in natural hazard mitigation, the LPT used this list as a starting point for a more comprehensive inventory of future mitigation measures.

HAZARD RISK MITIGATION MEASURES

Prioritization

During the LPT Working Group Meeting on April 6, 2018, mitigation measures were prioritized based on a benefit/cost review process based on local knowledge of the hazard areas, cost information, timeline estimate for implementation and an assessment of benefits and costs.

The LPT evaluated various approaches for prioritizing local mitigation actions including those outlined in FEMA's March 2013 *Local Mitigation Planning* Handbook, other local plans and FEMA's STAPLEE method. The LPT developed an approach based on FEMA's March 2013 *Local Mitigation Planning Handbook (*that includes elements derived from the City of Portland Oregon's 2016 Mitigation Action Plan). This approach utilizes a qualitative benefit/cost analysis (although less detailed than used for FEMA's Hazard Mitigation Assistance Grants Programs). The approach qualitatively rates benefit and costs in terms of: high, medium and low, as follows:

Benefits

- **High:** Action will support compliance with a legal mandate or, once completed, will have an immediate impact on the reduction of risk exposure to life and property.
- **Medium:** Once completed, action will have a long-term impact on the reduction of risk exposure to life and property, has a substantial life safety component, or project will provide an immediate reduction in the risk exposure to property.
- **Low:** Long-term benefits of the action are difficult to quantify in the short term.

Costs

- **High:** Would require an increase in revenue via an alternative source (i.e., municipal bonds, grants, fee increases) to implement. Existing funding levels are not adequate to cover the costs of the proposed project.
- **Medium:** Could budget for under existing capital budget but would require a reapportionment of the budget or a budget amendment, or the cost of the project would have to be spread over multiple years.
- **Low:** Possible to fund under existing budget. Project is or can be part of an existing ongoing program or would not require substantial effort to initiate or appropriate funds.

EXISTING CAPABILITY	DESCRIPTION
GENERAL MULTI-HAZARDS	
Enforcement of the State Building Code	The 9th Edition of the Massachusetts State Building Code contains many detailed regulations regarding wind loads, earthquake resistant design, flood resistant design, flood-proofing and snow loads.
Comprehensive Emergency Management Plan	Every community in Massachusetts is required to have a Comprehensive Emergency Management Plan. These plans address mitigation, preparedness, response and recovery from a variety of natural and man-made emergencies. These plans contain important information regarding flooding, dam failures and winter storms. Therefore, the CEMP is a mitigation measure that is relevant to many of the hazards discussed in this plan. The CEMP is available online through secure access for town personnel.
Subdivision Review	Multiple departments, such as the Town Administrator, Zoning, Planning Board, Building Inspector, Health, Highway, Fire, Police, and Conservation, review all subdivision and site plans prior to approval.
Portable Water Pumps	Rivers and ponds in town are available to be tapped into if necessary for fire-fighting support.
FEMA Resources	A tanker task force is available through State Fire mobilization. FEMA has 8-12 tankers that can be deployed anywhere in the US within 72 hours.
Emergency Generators	The Town has invested in backup emergency generators for its public safety facilities. These generators give the town the ability to sustain operations during the event of an emergency
Centralized Public Safety Dispatch	The Town utilizes joint communications and dispatch for public safety.
FLOOD-RELATED HAZARDS	
Participation in the National Flood Insurance Program (NFIP)	Somerset participates in the National Flood Insurance Program. NFIP provides access to funds in the case of flood related damages.
Somerset Reservoir Dam Emergency Action Plan (EAP)	The 2016 Somerset Reservoir Dam Emergency Action Plan (2016 EAP) establishes the guidelines and procedures for addressing emergency conditions identified at the dam in time to take mitigative action such as notifying the appropriate emergency management officials of potential, impending, or active failing of the dam.

Table 4: Existing Hazard Mitigation Capabilities

EXISTING CAPABILITY	DESCRIPTION
FLOOD-RELATED HAZARDS	
Street Sweeping	The Somerset Highway Department conducts street sweeping annually in the spring and summer. The Highway Department begins street sweeping as soon as possible each spring.
Catch Basin Cleaning	All Town catch basins are cleaned out once a year.
Leaf Removal	The Somerset Highway Department has a scheduled yard waste program.
The Massachusetts Stormwater Policy	This policy is applied to developments within the jurisdiction of the Conservation Commission.
SEVERE WEATHER HAZARDS	
Roadway Treatments: Minimize use of road sand to prevent drainage system clogging	The Town uses only salt to treat the roads when needed for winter storms. This is done to eliminate the amount of sand that enters catch basins and streams.
Tree Trimming	The Somerset Tree Warden and local electric company, National Grid, conducts regular tree trimming. The town responds to downed tree limbs caused by winds, lightning strike reports and other weather-related incidents.
FIRE-RELATED HAZARDS	
Permits Required for Outdoor Burning	The Fire Department requires a written permit for outdoor burning that is permitted from January 15 thru May 1 each year. The property-owner must come into the Fire Station and fill out a form.
Fire Hydrant Regulations	The Somerset Water Department regulates that fire hydrants be installed at all new developments at the expense of the developer. Hydrants are spaced / located as directed by the Somerset Fire Department.
Subdivision Review	The Somerset Fire and Building Departments is involved in reviewing subdivision plans from conceptual design through occupancy to ensure that there is adequate access for fire trucks and an adequate water supply.

Table 4 cont.: Existing Hazard Mitigation Capabilities

Using this approach, projects with positive benefit versus cost ratios (such as high over high, high over medium, medium over low, etc.) are considered cost-beneficial and are prioritized accordingly. To support the benefit/cost review, the LPT also estimated the length of time and project costs for each mitigation action as follows:

Estimated Cost

To support the benefit/cost review the LPT used the following estimated cost categories:

Low: Less than $50,000

Medium: Between $50,000 - $100,000

High: Over $100,000

Estimated Timeline

For actions where funding is already available the action or strategy is identified as "ongoing." Since most of the actions were identified as a part of preparing this initial plan, most do not currently have funding. Therefore, length of time for implementation of each mitigation action are based on the amount of time it would take upon receiving funding. The estimated timeframes included:

- 1-2 years,
- 3-5 years,
- 5+ years, and
- ongoing.

MITIGATION ACTION PRIORITIZATION

Based on an evaluation of the results of the benefit/cost review, the LPT prioritized each mitigation action and strategy using the following qualitative rating system of high, medium and low.

High Priority: An action that has benefits that exceed cost, has funding secured or is an ongoing project. High priority actions can be completed in the short-term or mid-term (1 to 5 years) or are projects that are long-term projects that can be initiated in the short-term and will have large positive impacts once completed.

Medium Priority: An action that has benefits that exceed costs, and for which funding has not yet been secured, but is eligible for funding. Actions can be completed in the short- or mid-term, once funding is secured, or are projects that are long-term projects that can be initiated in the short-term and will have large positive impacts once completed.

Low Priority: An action that will mitigate the risk of a hazard that has benefits that do not exceed the costs or are difficult to quantify, for which funding has not been secured, that is not eligible for grant funding, and for which the time line for completion is long-term or uncertain. Low priority actions may be eligible for grant funding from other programs that have not yet been identified. Financing is unknown, and they can be completed over the long term.

The LPT prioritized the mitigation action plan based on the results of the benefit/cost review of the proposed actions as presented in **Table 5** on the next five pages. In addition to the benefit/cost review results based on the elements outlined above, **Table 5** provides details for each action relative to the agencies responsible for leading and coordinating the implementation of each action and potential funding sources.

MITIGATION ACTIONS	Benefits	Costs	Timeline	Estimated Project Costs	Priority	Responsible Agencies	Potential Funding Sources
MULTIPLE HAZARDS							
Action 1. Implement Local Hazard Mitigation Plan	High	Low	Ongoing	Low	High	Planning Department (Lead), All Town Departments and Town Administrator	Town of Somerset
Action 2. Identify potential hazards include climate change to Town-owned facilities before major repairs, or the construction of new facilities, to minimize future impacts from natural hazards, particularly flooding, storm damage, erosion, and high winds	Medium	Medium	Ongoing	Low	High	Town of Somerset	Town of Somerset
Action 3. Identify electrical back-up generator needs in critical facilities such as Town Hall, High School, etc. (A generator is currently located at the high school)	Medium	Low	1-2 years	Low	Medium	HWY Department, Town Administrator, Planning Dept., Building Dept., Water & Sewer, Police, Fire, and Emergency Services	MEMA FEMA MA Department of Conservation and Recreation (DCR), MA Coastal Zone Management (CZM) Town of Somerset
Action 4. Update town-wide evacuation plan (Including vulnerable populations and that includes a plan for evacuation Somerset Housing Authority Units). See State Evacuation Plan	Medium	Low	1-2 years	Low	Medium	Fire and Police Departments, Emergency Services, Planning Department, Housing Authority	MEMA FEMA Town of Somerset
Action 5. Review Water Pollution Control Facility (WPCF) operations and maintenance plan to ensure the plan is up to date and has protocols to keep the plant operations and pumping stations safely running during natural hazard storm events. Conduct a flood vulnerability assessment of the WPCF and identify flood mitigation alternatives for improving the level of flood protection at the WPCF, if needed.	High	Low	1-2 years	Low - Medium	High	Water & Sewer Board	Town of Somerset

Table 5: Natural Hazard Mitigation Action Matrix & Prioritization

MITIGATION ACTIONS	Benefits	Costs	Timeline	Estimated Project Costs	Priority	Responsible Departments	Potential Funding Sources
MULTIPLE HAZARDS							
Action 6. Review and Update Current Mutual Aide agreements	Medium	Low	2-3 years	Low	Medium	Fire and Police Departments, Emergency Services	MEMA Town of Somerset
FLOOD HAZARDS							
Action 7. Culvert Improvement Projects for the Town: 1) Almy Road;	Medium	Low	Ongoing	High	Medium	Highway Dept., Water Department	FEMA, Town of Somerset
Action 8. Develop an Emergency Operations Plan regarding potential coastal flooding	Medium	High	2-3 years	Medium	Medium	Highway Dept., Police and Fire Departments, Planning Dept.	Town of Somerset CZM DCR MEMA EOEEA
Action 9. Use 2014 MA Coastal Infrastructure Inventory and Assessment Report Update as a guide to develop a coastal structures action plan for identifying and prioritizing coastal structure improvements. The 2014 Update includes 13 structures, including 6 bulkhead/seawalls, 6 revetments, and a coastal beach.	Medium	Medium	1-2years	Low	High	Highway Dept.	Town of Somerset Silver Jackets (US Army Corps of Engineers (USACE))
Action 10. Participate in reviews of regulatory floodplain maps updates and revisions.	High	Medium to High	Ongoing	Low	High	Town Administrator, Planning Dept. Fire and Police HWY Dept., Floodplain Manager, Building Dept., Board of Selectmen	FEMA

Table 5 cont.: Natural Hazard Mitigation Action Matrix & Prioritization

MITIGATION ACTIONS	Benefits	Costs	Timeline	Estimated Project Costs	Priority	Responsible Agencies	Potential Funding Sources
FLOOD HAZARDS							
Action 11. Evaluate publicly owned and managed outfalls and outlets along the shoreline of Somerset to identify infrastructure that would benefit from the installation of backflow prevention (e.g. tide gates, check valve)	Medium	Low	1 year	Low	Medium	Somerset Water Department, Highway Dept.	Town of Somerset
Action 12. Continue to participate in National Flood Insurance Program (NFIP) (or other) training offered by the State and/or FEMA that addresses flood hazard planning and management	High	Low	Ongoing	Low	High	Town Administrator, Planning Dept. Building Dept., Floodplain Manager	FEMA MEMA DCR Town of Somerset
Action 13. Incorporate the procedures for tracking high water marks following a flood into emergency response plans.	Medium	Low	Ongoing	Low	Medium	Highway Dept., Police/Fire	FEMA Silver Jackets (USACE) Town of Somerset
Action 14. Enhance communication with neighboring municipalities on water resources across Town borders	Medium	Low	Ongoing	Low	Low	Somerset Water Department	SRPEDD Town of Somerset Town of Dighton Town of Swansea
Action 15. Town-wide GIS Mapping: Acquire GIS software and mapping technology to create an inventory of water, drainage, transportation, and sewer infrastructure	Medium	Medium	1-2 years	Low to Medium	High	Town Assessors Office	Town of Somerset MA Grants

Table 5 cont.: Natural Hazard Mitigation Action Matrix & Prioritization

MITIGATION ACTIONS	Benefits	Costs	Timeline	Estimated Project Costs	Priority	Responsible Agencies	Potential Funding Sources
FLOOD HAZARDS							
Action 16. Evaluate "green infrastructure" program to link, manage, and expand existing parks, preserves, greenways, etc.	Medium	Medium	3-5 years	Low to Medium	Low	Conservation Commission	EPA, EOEEA, Town of Somerset
Action 17. Purchase wetlands and other flood prone open space to enhance natural resources while improving coastal resiliency and flood retention	High	Medium/ High	Ongoing	High	Medium	Conservation Commission; Town Administrator; Planning Dept. , CPC	EOEEA, DCR, Town of Somerset
Action 18: Evaluate the possibility of participating in FEMA's Community Rating System (CRS) program that would result in reducing the cost of NFIP premiums while improving coastal flood resiliency.	Medium	Medium	2-3 years	Low	Low	Town Administrator; All Departments	NFIP DCR MEMA Town of Somerset
SEVERE WEATHER							
Action 19. Protect Vulnerable Populations by, 1) Organize outreach to vulnerable populations, including establishing and promoting accessible heating or cooling centers in the community; and 2) Educate citizens on the dangers of extreme heat and cold, and the steps they can take to protect themselves when extreme temperatures occur.	High	Medium	2-3 years	Medium	Medium	Town of Somerset	FEMA, EOEEA (MVP Program) MEMA, Town of Somerset
Action 20. Maintain adequate supply of sand other road treatment materials.	High	Low	Annually	Low	High	Highway Dept.	Town of Somerset

Table 5 cont.: Natural Hazard Mitigation Action Matrix & Prioritization

MITIGATION ACTIONS	Benefits	Costs	Timeline	Estimated Project Costs	Priority	Responsible Agencies	Potential Funding Sources
CLIMATE RELATED HAZARDS							
Action 21: If necessary, consider conducting a Town-wide climate change vulnerability assessment that includes a study to identify ways for businesses and residents to reduce their vulnerability to future impacts from Climate Change	High	Low to Medium	Ongoing	Low to Medium	Medium	Town Administrator and all Town agencies and departments	MA EEA, Town of Somerset
Action 22(A). Review the potential risk to ground water well located in Dighton to sea-level-rise.	High	Low	3-5 years	Low	Medium	Somerset Water Department and Town of Dighton	Towns of Dighton and Somerset
Action 22 (B). Consider integrating climate change considerations into design and plan review process for future development and redevelopment projects	Medium	Low	Ongoing	Low	Medium	Building Department	MA EEA, MEMA, Town of Somerset
SECONDARY HAZARDS: DAM FAILURE							
Action 23. Review and update annually Somerset Reservoir Emergency Action Plan (EAP) and Maintenance and Operations Plans to ensure the plans are up to date and have protocols in place to maintain safe operations of the Dam during natural hazard events	High	Low	1-2	Low	High	Somerset Water Department	MA Office of Dam Safety, Town of Somerset
Action 24. Dam repairs (i.e. minor repairs including brush clearing and repair of gates) as identified in the Emergency Action Plan and Phase 1 Report (see Attachment 3).	High	Medium	3-5 years	Low to Medium	High	Somerset Water Department	MA Office of Dam Safety, Town of Somerset

Table 5 cont.: Natural Hazard Mitigation Action Matrix & Prioritization

Section 6: Regional and Inter-community Relationships

SECTION 6 - REGIONAL AND INTERCOMMUNITY CONSIDERATIONS

Some hazard mitigation issues are strictly local. The problem originates primarily within the municipality and can be solved at the municipal level. Other issues are inter-community issues that involve cooperation between two or more municipalities. There is a third level of mitigation which is regional; involving a state, regional or federal agency or an issue that involves three or more municipalities.

The Somerset Planning Board is the primary Town agency responsible for regulating development in town. Feedback to the Planning Board was ensured through the participation of the Conservation Commission agent who is also a Planning Board Member on the Local Working Group. As a part of developing this new natural hazards mitigation plan, the Town coordinated with the Massachusetts Department of Conservation and Recreation to update pertinent repetitive loss property and NFIP claims related details for the Town. Local, regional and state entities were provided an opportunity to participate and provide input at the two public meetings held in July of 2017 and May of 2018. The Town will continue to collaborate with local, regional and state agencies as a part of the implementation of actions outlined in this plan. Below is a more detailed overview of the regional and intercommunity considerations for this plan.

REGIONAL PARTNERS

In many communities, mitigating natural hazards, particularly flooding, is more than a local issue. The drainage systems that serve these communities are a complex system of storm drains, roadway drainage structures, sanitary pump stations and other facilities owned and operated by a wide array of agencies including but not limited to the Town of Somerset, the Taunton River Watershed Alliance (TRWA), the Department of Conservation and Recreation (DCR), the Army Corps of Engineers, Massachusetts Highway Department (MHD) and the Massachusetts Bay Transportation Authority (MBTA). The planning, construction, operations and maintenance of these structures are integral to the flood hazard mitigation efforts of communities. These agencies must be considered the Somerset's regional partners in hazard mitigation. These agencies also operate under the same constraints as communities do including budgetary and staffing constraints and numerous competing priorities. In the sections that follow, the Plan includes recommendations for activities to be undertaken by these other agencies. Implementation of these recommendations will require that all parties work together to develop solutions.

REGIONAL FACILITIES WITHIN SOMERSET

Major facilities owned, operated and maintained by federal, state, regional or private entities in Somerset include: I-195, and State Routes 6, 103 and 138 (MassDOT), Prima Care Somerset/Swansea Medical Center, Clifton Rehabilitation Nursing Center, Clifton Assisted Living Community, Somerset Ridge Center, and National Grid substations located in Somerset.

INTERCOMMUNITY CONSIDERATIONS

Somerset, as well as its surrounding communities are close to build-out, but some parcels may undergo significant re-development in the future. To avoid impacts from any residential and commercial development, communication between Somerset and the surrounding communities, including input in the review processes, is vital.

Maintaining adequate drainage, floodplains, and water quality of the Taunton River is an important consideration for Somerset and the surrounding communities. Below is a description of the Taunton River Watershed as presented by the Taunton River Watershed Alliance (TRWA) at http://savethetaunton.org/the-taunton-river-and-its-watershed/.

> *The watershed of the Taunton River and all of its tributaries covers 562 square miles. Twenty cities and towns lie entirely within the watershed, and portions of twenty-three others. The Taunton River begins at the confluence of the Matfield and Town Rivers in Bridgewater and runs over forty miles to Mount Hope Bay. It is considered "tidal" (with salt-water intrusion) for the last eighteen miles and is characterized by a gentle gradient, dropping only twenty feet in elevation over its forty-mile course. With forty miles of free-flowing water, the Taunton is the longest undammed coastal river in New England. 500,000 people live and work here, and the watershed includes densely or moderately developed areas of homes, schools, businesses and other workplaces and roadways. (TRWA 2018)*

The Somerset Reservoir Dam and groundwater well located in Dighton are important regional considerations. These sources serve residents and businesses in Somerset as well as small areas of Dighton and Swansea. The dam resides in Somerset and is owned and operated by the Town.

Section 7: Plan Adoption and Implementation

SECTION 7- PLAN ADOPTION AND IMPLEMENTATION

Adopting, implementing, monitoring, evaluating, and updating the Town's Local Natural Hazard Mitigation Plan are necessary steps to sustaining a viable plan that will assist the community in becoming more resilient to natural hazards long into the future. An overview of how the Town will carry out each of these tasks is outlined in the following sections.

PLAN ADOPTION

The Draft Plan was provided to the Town on August 14, 2018 for review and distribution to the public, and local, regional and state stakeholders. The Town posted the Draft Plan on the Town website on August 15, 2018 for public review and input. A public meeting was held on August 29, 2018 at the Somerset Public Library to: 1) present the Draft Plan and 2) solicit input and feedback on the Draft Plan from the public. Based on feedback provided at the public meeting and received from the public online, the Draft Plan was revised on September 14, 2018. The Town then submitted the Draft Plan to the Massachusetts Emergency Management Agency (MEMA) and the Federal Emergency Management Agency (FEMA) for review. Upon receiving conditional approval of the plan by FEMA, the plan was presented and approved by the Somerset Board of Selectmen on **ADD MONTH XX, 2018**. A copy of the plan adoption letter is included in the front of this plan.

PLAN IMPLEMENTATION

The implementation of the Plan commences upon its formal adoption by the Board of Selectmen and official approval by MEMA and FEMA. Section 5 details the mitigation strategy that prioritizes the various actions identified to reduce the impacts from future natural hazards. A local hazard mitigation working group (including the LPT) will be responsible for overseeing the implementation of the plan.

In addition, the Local Planning Team (LPT), that includes Town officials as presented in Section 2, will identify existing planning documents and regulations where relevant policies and actions outlined in this Plan may be incorporated to improve the potential for the implementation of mitigation actions across related programs and agencies. Relevant programs, policies, and/or regulations may include updates to existing polices and regulations such as the following:

- Updates to the Local Building Code based on changes outlined in the new 9th Edition of the Massachusetts building Code
- Master Plan Update (2019/2020 underway)
- Somerset Reservoir Dam Emergency Action Plan Update (forthcoming in 2018)
- Somerset Community Preservation Act Plan
- Somerset Integrated Water Resources Management Plan (2019 underway)
- Somerset Economic Development Plan (forthcoming)
- Town Ordinances, Open Burning Regulations
- Zoning By-Laws, 2015, including Section 9.2, Water Resource Protection District
- Zoning By-Laws, 2015, including Section 9.5, Slade's Ferry Crossing District

During November, 2017, the Town of Somerset received a $550,000 grant under the Economic Development Administration Assistance to Coal Communities (ACC) program. The award provides funding for four projects including the development of an Integrated Water Resource Management Plan (IWRMP), establishment of a wastewater district, update of the Somerset Master Plan, and preparation of an economic development plan. The Town will integrate the findings presented in the local MHMP as a part of developing each of these projects as noted in the list of plans and programs outlined above. Work on these projects will extend through the fall of 2020.

PLAN MONITORING AND EVALUATION

On an annual basis, the LPT led by the Town Administrator, will coordinate a meeting to review the Plan progress over the last year. This Plan review will include an evaluation of hazard mitigation activities such as ongoing projects, changes in developing new mitigation actions resulting from a natural disaster event, changes in local, State and federal regulations that may impact the implementation of future projects, and modification of existing actions. As a part of this process, the working group will evaluate and assess the effectiveness the action items outlined in the plan have been in achieving the plan goals and objectives. The results of this evaluation will be posted to the Town website to gather public input on the progress of the Plan as well as to provide the public with the opportunity to provide additional mitigation activities for the working group's consideration.

A review and evaluation of the Town's Plan will be conducted on a 5-year basis in compliance with the 2000 Disaster Mitigation Act and Part 201.6 of 44 Code of Federal Regulations (CFR). In the event of a major disaster event impacting the Town of Somerset, the Town may update the plan at that time with actions to address unexpected impacts resulting from the damages to the community, if needed.

FEDERAL AND STATE FUNDING SOURCES

Several of the proposed hazard mitigation projects and actions may be eligible activities for funding under the three FEMA Hazard Mitigation Assistance (HMA) Grant Programs. The FEMA HMA Grant Programs include two non-disaster mitigation grant programs that include the Pre-Disaster Mitigation and Flood Mitigation Assistance grant programs, and one disaster mitigation grant program that is the Hazard Mitigation Grant Program (HMGP). State and federal Funding source details are presented in **Attachment 5.**

Attachment 1: Community Profile

Community Profile Overview

This section of the Plan presents details about the Town assets which categorically include:

- People
- Support, High Occupancy and Vulnerable Population facilities;
- Essential Facilities including emergency response, police, fire, hospitals, etc.;
- Lifeline Systems including water, wastewater, electrical power, etc.;
- High Potential Loss Facilities, including high hazard dams; and
- Transportation Infrastructure.

Demographic Overview

Per the 2010 United States Census:

Age and Sex:

Population:	18,165
Population change since 2000:	69 (+/- 0.4%)
Percent female/male:	50.7%/49.3%
Age:	
persons <5 years:	3.6%
persons <18 years:	18.2%
persons ≥ 65 years:	23.3%

Race:

White alone:	97.5%
Black or African Amer. alone:	0.3%
Amer. Indian or Alaska Native alone:	0
Asian alone:	0.7%
Two or more races:	0.8%
Hispanic or Latino:	0.6%
White alone, not Hispanic or Latino:	97.1%

Health:

With disability, under 65 years:	11.6%
Persons w/o health insurance, under 65 years:	3.7%

Education:

High school graduate or higher, greater 25 years:	85.5%
Bachelor's degree or higher, greater 25 years:	23.7%

Economy:

In civilian labor force, total, greater 16 years: (2012 to 2016)	60.6%
In civilian labor force, female, greater 16 years: (2012 to 2016)	58.6%

Income and Poverty:

Median household income: (2012 to 2016; 2016$)	$68,900
Per capita income: (2012 to 2016; 2016$)	$31,544
Persons in poverty:	7.3%

Family and Living Arrangements:

Households (2012 to 2016):	6,935
Persons per Household:	2.6
Language spoken at home other than English, greater than 5 years:	17.1%
Median house cost:	$270,500
Percent owner-occupied:	80%

Population Density: 2,300/sq. mile

The Town has a total area of 12 square miles that includes 8.1 square miles of land and 3.9 square miles of water. As noted in the 2014 Massachusetts Coastal Infrastructure Report, the estimated length of shoreline that is directly exposed to open ocean waves is 6.6 miles with the remaining shoreline semi-protected by offshore structures and landforms.

Demographics

Based on the 2010 U.S. Census, the population per square mile is 2,299, which is higher than the average for Massachusetts as a whole (839) and Bristol County (991). (**Figure 1-1**)

The number of residents has decreased from 18,234 in the 2000 US Census to 18,165 in 2010. Somerset includes a largely white population, representing about 98% of all residents. Hispanics or Latinos make up the largest single minority group at 0.5% of all residents.

The population includes 20.4% of residents under the age of 18, 6.2% between the ages of 18 to 24, 26.2% between the ages of 25 to 44, 26.2% between the ages of 45 to 64, and 21% who are 65 years or older.

There are 6,987 households, with an average household size of 2.57 and average family size of 2.98

The median household income in Somerset was $70,502, which is above the median averages of $68,563 for the Commonwealth and $56,842 for Bristol County. Poverty is at 8% which is lower than the Commonwealth and County rates of 10.4% and 12.6%, respectively.

Housing costs are $270,500 for the median value, owner-occupied housing unit compared to the Commonwealth at $333,100 and Bristol County at $273,100. More than 80% of the housing units are owner-occupied compared to 62.1% for Massachusetts and Bristol County.

Social Vulnerability

The term Social Vulnerability describes how resilient a community is to external stresses, such as natural hazards, on human health. The Social Vulnerability Index (SVI) employs U.S. Census Bureau variables to identify neighborhoods that may need additional support in preparing for hazards or recovering from disasters, and is a useful tool for emergency response planners and public health officials. U.S. Census Bureau data to determine the social vulnerability of every census tract (census tracts are subdivisions of counties for which the Census Bureau collects statistical data). The SVI ranks each tract on 15 social factors, including poverty, lack of vehicle access, and crowded housing, and groups them into four related themes: 1) Socioeconomic; 2) Household Composition/Disability; 3) Each tract receives a separate ranking

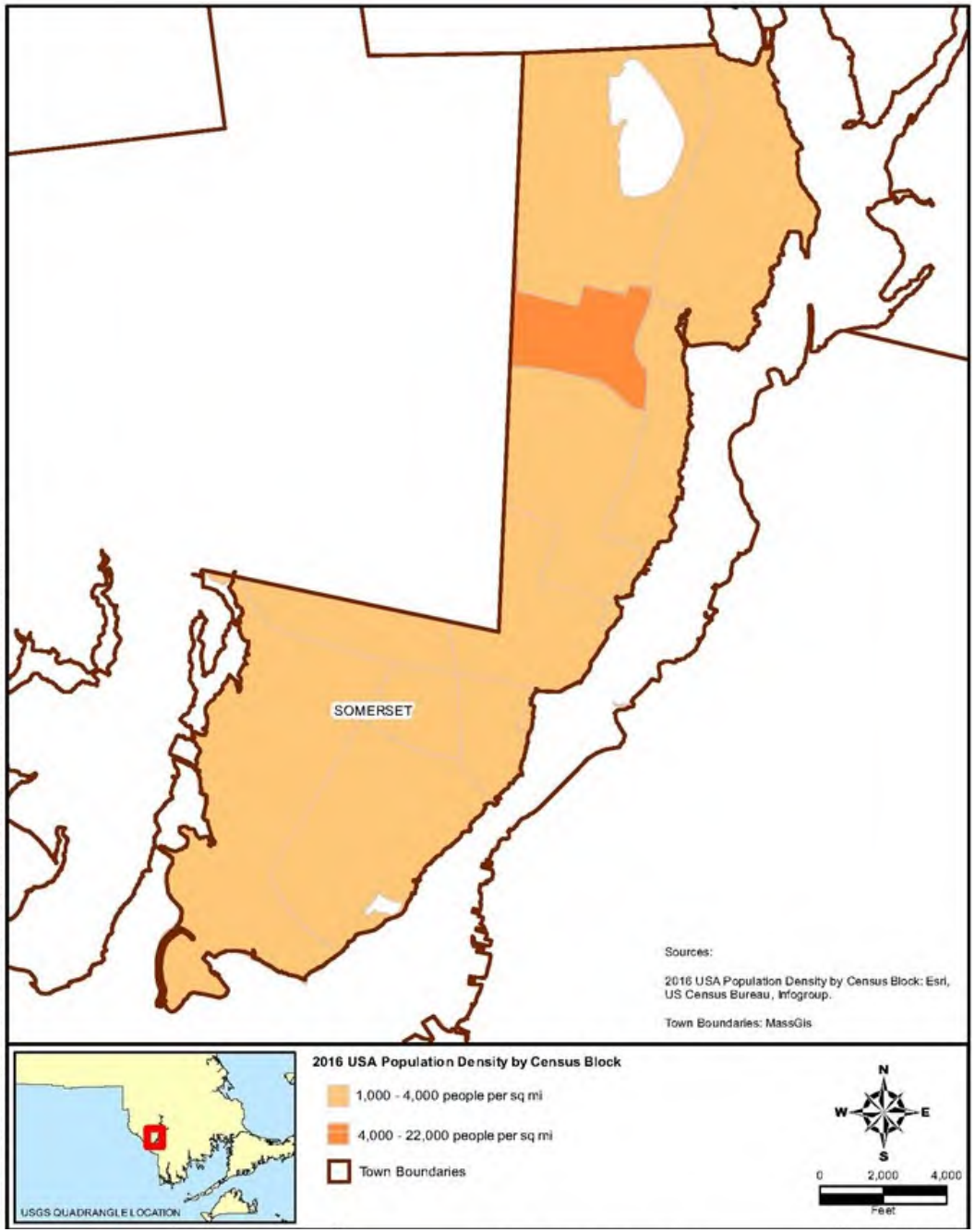


Figure 1-1: Population Density

The SOVI for the Town is categorized as Medium High for the southern portion of the Town and Medium for the northern portion of the Town, as shown in **Figure 1-2**.

A detailed risk profile, by census tract within the Town was performed using the ATSDR SVI Dashboard https://svi.cdc.gov/map.aspx. The resulted are presented in **Table 1-1**.

While the demographics are relatively uniform throughout the Town, there are subtle demographic differences that contribute to a slightly higher social vulnerability in the southern half of Town (U.S. Census Tract 644200), including a higher number of people below poverty, higher unemployment rate, and greater number of adults with no high school degree.

This analysis identified only one Social Vulnerability Index flag: Household Composition - Persons aged 65 and older. For this category, Somerset ranks in the top 82nd to 92nd percentile of all US Tracts, with approximately 24% of Somerset's population meeting this category. Somerset's overall vulnerability ranks between the 27th percentile (the two northern tracts) to 55th percentile (southern tract) among all US Tracts.

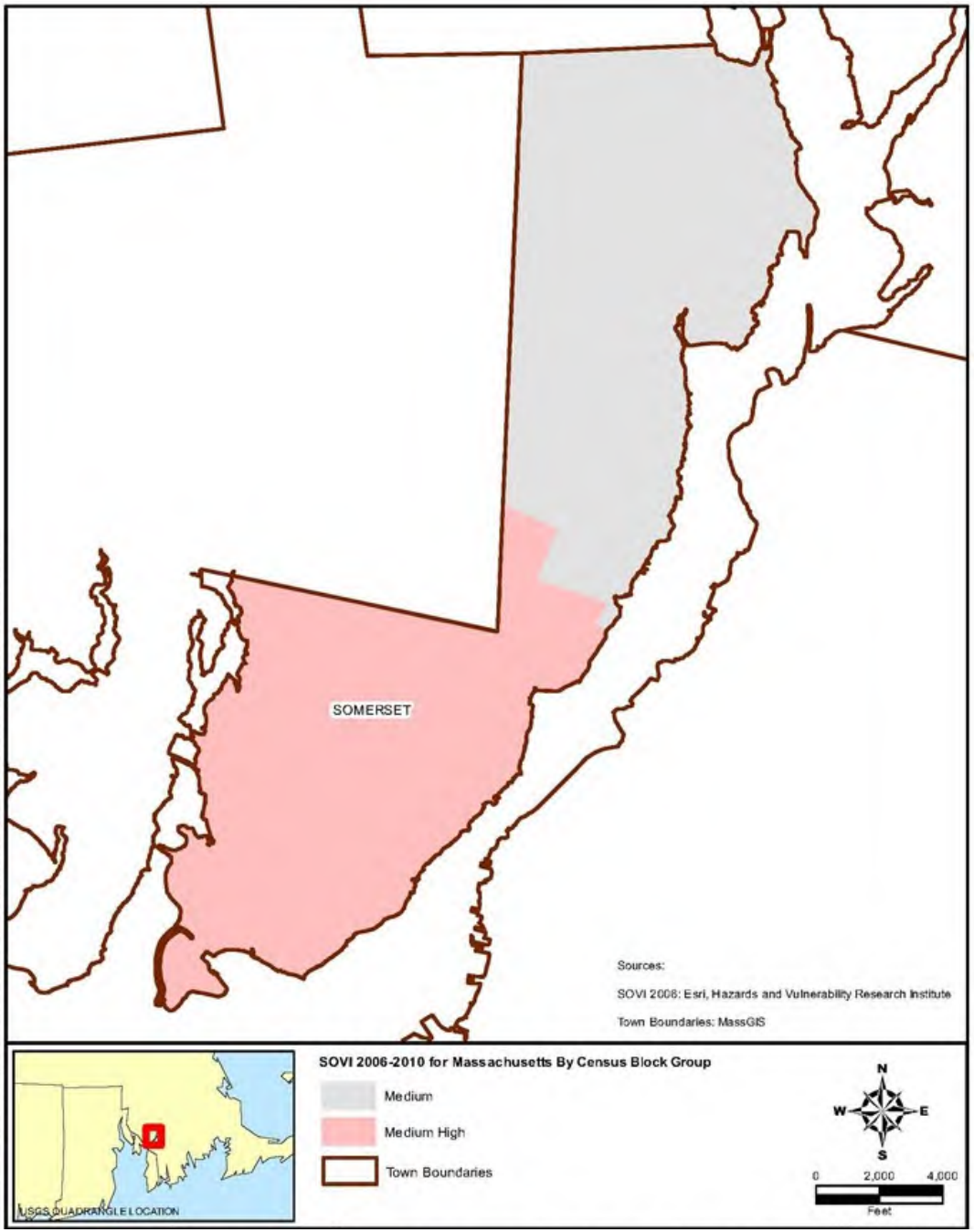
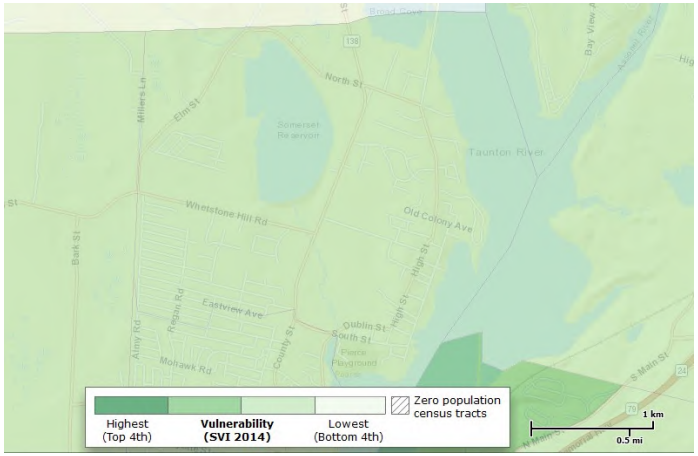
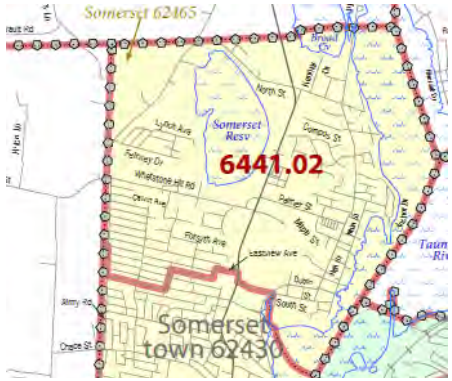


Figure 1-2: Social Vulnerability Index

Attachment 1: Community Profile

US Census Tract 644102





Socioeconomic Theme						
Measure	Number	Number MOE	Percentage	Percentage MOE	Percentile Rank (among all US tracts)	SVI Flags
Persons below poverty estimate, 2010-2014 ACS	305	167	6.1%	3.2%	20th	No
Civilian (age 16+) unemployed estimate, 2010-2014 ACS	184	78	6.7%	2.6%	33rd	No
Per capita income estimate, 2010-2014 ACS*	$37,632	$4,623			18th	No
Persons (age 25+) with no high school diploma estimate MOE, 2010-2014 ACS	379	95	10.3%	2.4%	45th	No
SOCIOECONOMIC DOMAIN SUMMARY					25th	0
* Per capita income is the average income per person in each tract. Unlike the other variables for which a high percentage indicates potentially higher social vulnerability, a higher per capita income is associated with lower social vulnerability.						

Household Composition/Disability Theme						
Measure	Number	Number MOE	Percentage	Percentage MOE	Percentile Rank (among all US tracts)	SVI Flags
Persons aged 65 and older estimate, 2010-2014 ACS	974	76	19.4%	1.5%	82nd	No
Persons aged 17 and younger estimate, 2010-2014 ACS	1,000	133	19.9%	133.0%	29th	No
Civilian noninstitutionalized population with a disability estimate	614	114	12.2%	2.3%	50th	No
Single parent household with children under 18 estimate, 2010-2014 ACS	117	60	6.4%	3.3%	35th	No
HOUSEHOLD COMPOSITION/DISABILITY DOMAIN SUMMARY						

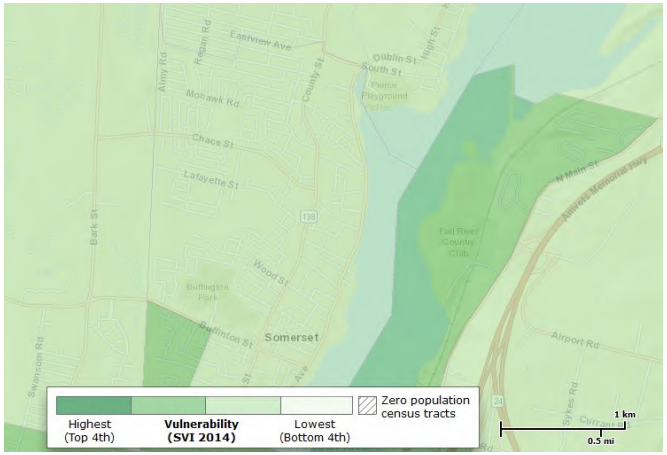
Minority Status/Language Theme						
Measure	Number	Number MOE	Percentage	Percentage MOE	Percentile Rank (among all US tracts)	SVI Flags
Minority (all persons except white, non-Hispanic) estimate, 2010-2014 ACS	271	384	5.4%	7.6%	12th	No
Persons (age 5+) who speak English "less than well" estimate, 2010-2014 ACS	70	71	1.4%	1.5%	51st	No
MINORITY STATUS/LANGUAGE DOMAIN SUMMARY					29th	0

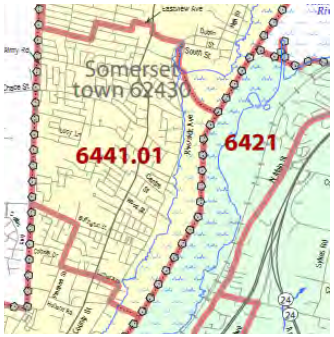
Housing/Transportation Theme						
Measure	Number	Number MOE	Percentage	Percentage MOE	Percentile Rank (among all US tracts)	SVI Flags
Housing in structures with 10 or more units estimate, 2010-2014 ACS	102	37	5.4%	1.9%	54th	No
Mobile homes estimate, 2010-2014 ACS	0	17	0.0%	1.8%	0th	No
At household level, more people than rooms estimate, 2010-2014 ACS	0	24	0.0%	1.3%	0th	No
Households with no vehicle available estimate, 2010-2014 ACS	67	44	3.6%	2.4%	34th	No
Persons in institutionalized group quarters estimate, 2010-2014 ACS	4	10	0.1%	0.2%	36th	No
HOUSING/TRANSPORTATION DOMAIN SUMMARY					11th	0

Table 1-1: Somerset Social Vulnerability Profile Analysis
https://svi.cdc.gov/map.aspx

Attachment 1: Community Profile

US Census Tract 644101





Additional Data				
Measure	Number	Number MOE	Percentage	Percentage MOE
Uninsured in the total civilian noninstitutionalized population estimate, 2010-2014 ACS	252	194	4.2%	3.2%
Estimated daytime population, LandScan 2012	3,514			

Additional data: 252 individuals within census tract 64401 are predicted to be uninsured. (4.2% of tract population)

Table 1-1 cont.: Somerset Social Vulnerability Profile Analysis
https://svi.cdc.gov/map.aspx

Socioeconomic Theme						
Measure	Number	Number MOE	Percentage	Percentage MOE	Percentile Rank (among all US tracts)	SVI Flags
Persons below poverty estimate, 2010-2014 ACS	352	379	5.8%	6.1%	19th	No
Civilian (age 16+) unemployed estimate, 2010-2014 ACS	232	109	7.5%	3.5%	41st	No
Per capita income estimate, 2010-2014 ACS*	$33,419	$3,640			25th	No
Persons (age 25+) with no high school diploma estimate MOE, 2010-2014 ACS	706	257	15.2%	5.3%	63rd	No
SOCIOECONOMIC DOMAIN SUMMARY					35th	0

* Per capita income is the average income per person in each tract. Unlike the other variables for which a high percentage indicates potentially higher social vulnerability, a higher per capita income is associated with lower social vulnerability.

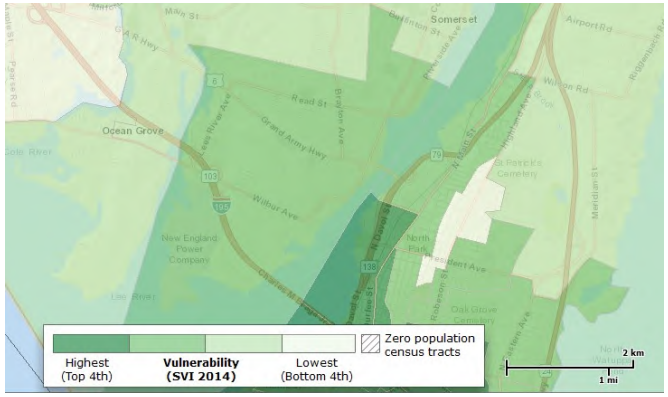
Household Composition/Disability Theme						
Measure	Number	Number MOE	Percentage	Percentage MOE	Percentile Rank (among all US tracts)	SVI Flags
Persons aged 65 and older estimate, 2010-2014 ACS	1,417	171	23.5%	3.1%	92nd	Yes
Persons aged 17 and younger estimate, 2010-2014 ACS	980	181	16.2%	181.0%	13th	No
Civilian noninstitutionalized population with a disability estimate	863	293	14.3%	4.4%	64th	No
Single parent household with children under 18 estimate, 2010-2014 ACS	112	85	4.9%	3.7%	23rd	No
HOUSEHOLD COMPOSITION/DISABILITY DOMAIN SUMMARY						

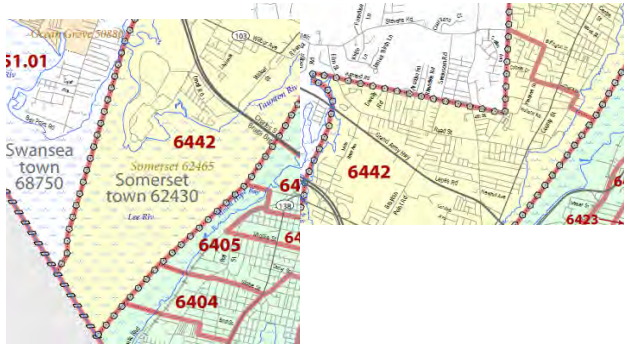
Minority Status/Language Theme						
Measure	Number	Number MOE	Percentage	Percentage MOE	Percentile Rank (among all US tracts)	SVI Flags
Minority (all persons except white, non-Hispanic) estimate, 2010-2014 ACS	378	605	6.3%	10.0%	14th	No
Persons (age 5+) who speak English "less than well" estimate, 2010-2014 ACS	196	158	3.4%	2.7%	68th	No
MINORITY STATUS/LANGUAGE DOMAIN SUMMARY					40th	0

Housing/Transportation Theme						
Measure	Number	Number MOE	Percentage	Percentage MOE	Percentile Rank (among all US tracts)	SVI Flags
Housing in structures with 10 or more units estimate, 2010-2014 ACS	0	24	0.0%	1.0%	0th	No
Mobile homes estimate, 2010-2014 ACS	11	17	0.5%	0.7%	45th	No
At household level, more people than rooms estimate, 2010-2014 ACS	17	32	0.7%	1.4%	31st	No
Households with no vehicle available estimate, 2010-2014 ACS	95	59	4.1%	2.6%	39th	No
Persons in institutionalized group quarters estimate, 2010-2014 ACS	8	7	0.1%	0.1%	41st	No
HOUSING/TRANSPORTATION DOMAIN SUMMARY					19th	0

Attachment 1: Community Profile

US Census Tract 644200





Additional Data				
Measure	Number	Number MOE	Percentage	Percentage MOE
Uninsured in the total civilian noninstitutionalized population estimate, 2010-2014 ACS	295	173	4.3%	2.4%
Estimated daytime population, LandScan 2012	8,290			

Additional data: 295 individuals within census tract 64401 are predicted to be uninsured. (4.3% of tract population)

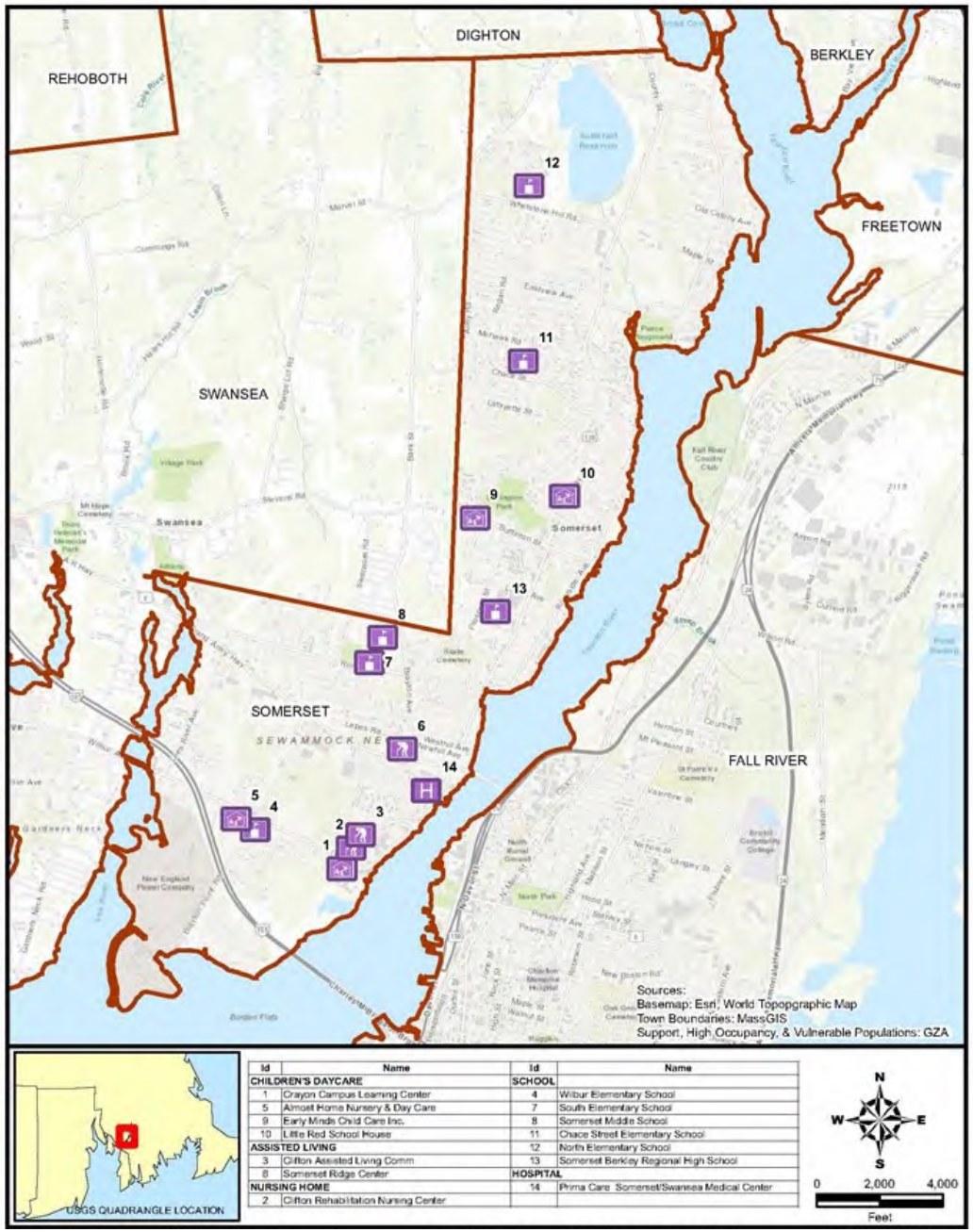
Table 1-1 cont.: Somerset Social Vulnerability Profile Analysis
https://svi.cdc.gov/map.aspx

Socioeconomic Theme						
Measure	Number	Number MOE	Percentage	Percentage MOE	Percentile Rank (among all US tracts)	SVI Flags
Persons below poverty estimate, 2010-2014 ACS	759	321	11.0%	4.6%	41st	No
Civilian (age 16+) unemployed estimate, 2010-2014 ACS	547	221	15.5%	6.1%	85th	No
Per capita income estimate, 2010-2014 ACS*	$27,015	$2,775			43rd	No
Persons (age 25+) with no high school diploma estimate MOE, 2010-2014 ACS	1,211	238	22.6%	3.9%	80th	No
SOCIOECONOMIC DOMAIN SUMMARY					66th	0
* Per capita income is the average income per person in each tract. Unlike the other variables for which a high percentage indicates potentially higher social vulnerability, a higher per capita income is associated with lower social vulnerability.						

Household Composition/Disability Theme						
Measure	Number	Number MOE	Percentage	Percentage MOE	Percentile Rank (among all US tracts)	SVI Flags
Persons aged 65 and older estimate, 2010-2014 ACS	1,666	202	23.2%	2.7%	91st	Yes
Persons aged 17 and younger estimate, 2010-2014 ACS	1,365	276	19.0%	276.0%	24th	No
Civilian noninstitutionalized population with a disability estimate	1,185	274	17.1%	4.0%	78th	No
Single parent household with children under 18 estimate, 2010-2014 ACS	286	147	10.6%	5.4%	63rd	No
HOUSEHOLD COMPOSITION/DISABILITY DOMAIN SUMMARY						

Minority Status/Language Theme						
Measure	Number	Number MOE	Percentage	Percentage MOE	Percentile Rank (among all US tracts)	SVI Flags
Minority (all persons except white, non-Hispanic) estimate, 2010-2014 ACS	225	620	3.1%	8.6%	5th	No
Persons (age 5+) who speak English "less than well" estimate, 2010-2014 ACS	264	144	3.8%	2.1%	70th	No
MINORITY STATUS/LANGUAGE DOMAIN SUMMARY					36th	0

Housing/Transportation Theme						
Measure	Number	Number MOE	Percentage	Percentage MOE	Percentile Rank (among all US tracts)	SVI Flags
Housing in structures with 10 or more units estimate, 2010-2014 ACS	97	80	3.3%	2.7%	46th	No
Mobile homes estimate, 2010-2014 ACS	0	17	0.0%	1.2%	0th	No
At household level, more people than rooms estimate, 2010-2014 ACS	0	24	0.0%	0.9%	0th	No
Households with no vehicle available estimate, 2010-2014 ACS	119	71	4.4%	2.6%	41st	No
Persons in institutionalized group quarters estimate, 2010-2014 ACS	288	134	4.0%	1.8%	87th	No
HOUSING/TRANSPORTATION DOMAIN SUMMARY					25th	0



Id	Name	Id	Name
CHILDREN'S DAYCARE		SCHOOL	
1	Crayon Campus Learning Center	4	Wilbur Elementary School
5	Almost Home Nursery & Day Care	7	South Elementary School
9	Early Minds Child Care Inc.	8	Somerset Middle School
10	Little Red School House	11	Chace Street Elementary School
ASSISTED LIVING		12	North Elementary School
3	Clifton Assisted Living Comm	13	Somerset Berkley Regional High School
6	Somerset Ridge Center	HOSPITAL	
NURSING HOME		14	Prima Care Somerset/Swansea Medical Center
2	Clifton Rehabilitation Nursing Center		

Figure 1-3: Support, High Occupancy and Vulnerable Population Facilities

Support, High Occupancy and Vulnerable Populations

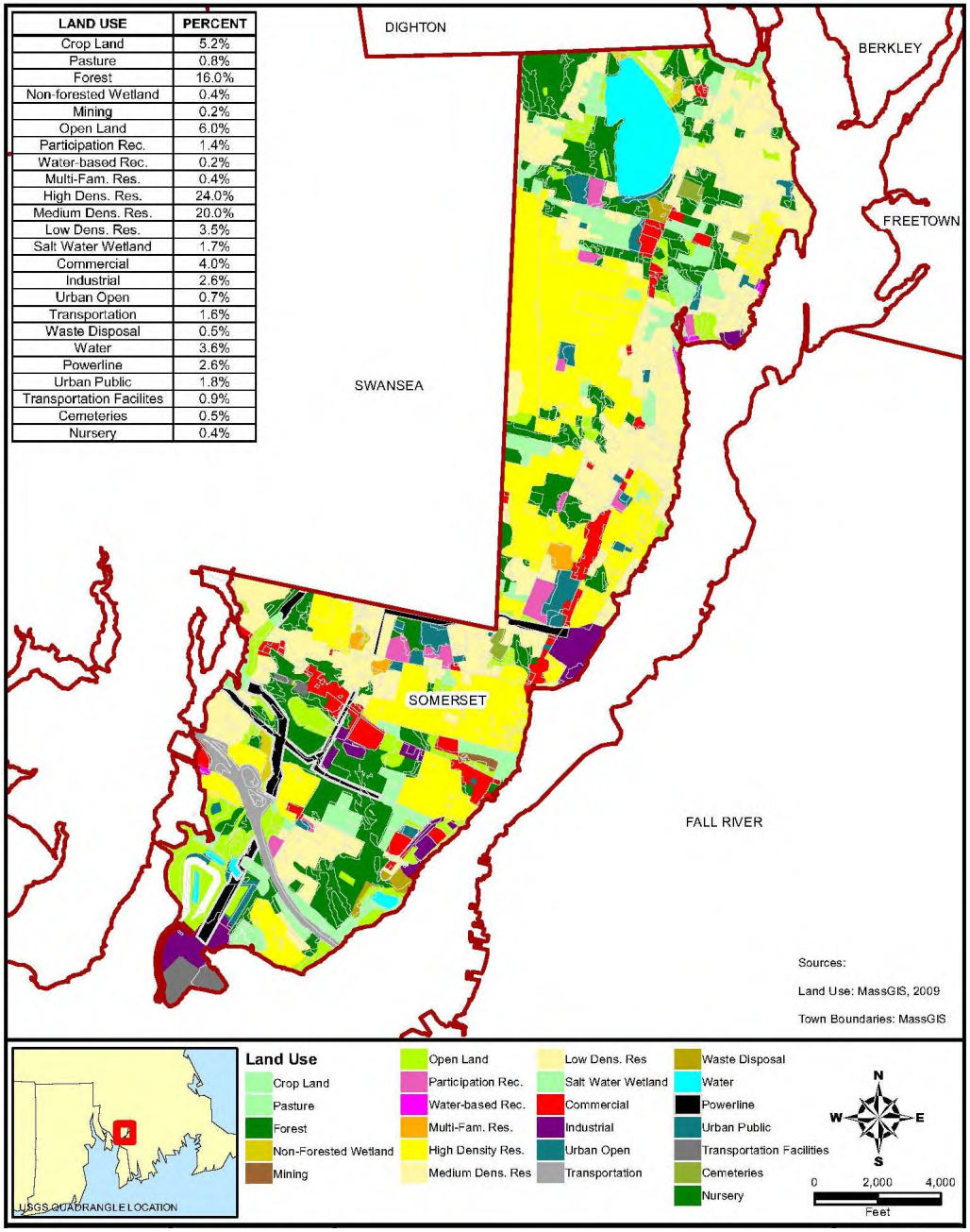
Support, High Occupancy, and Vulnerable Populations in Somerset are shown on **Figure 1-3**. These include elderly housing, long-term care facilities, schools, and children's daycare centers, as well as the Somerset Regional Medical Center.

Land Use (Existing)

According to the Town's 2007 Master Plan, Somerset has 7,377 land parcels, broken down by general land use category as shown in **Table 1-2** and presented in **Figure 1-4**. Land use trends show a steady growth and urbanization of the Town. Just over 50% of the developed land is residential (or more than 87% of the parcels). Land that has the potential for future development makes up close to 14% of the total land acreage in Town. The 2007 Master Plan also notes that around 77 acres of land remain in agricultural use.

Open Space located adjacent to Low Density Residential area in Somerset

Figure 1-4: Existing Land Use



Land Use	Parcel Numbers	Parcels (%)	Acres Total	Acres (%)
Residential:				
Single-Family	5,979	81.0%	2,015	46.1%
Other Residential	469	6.4%	223	5.1%
Commercial	178	2.4%	224	5.1%
Industrial	19	0.3%	120	2.7%
Agricultural	8	0.1%	77	1.8%
Recreation	4	0.1%	16	0.4%
Public & Non-Profit:				
Town of Somerset	270	3.7%	786	18.0%
Other	61	0.8%	201	4.6%
Vacant Land:				
Developable	201	2.7%	410	9.4%
Potentially Developable	24	0.3%	217	5.0%
Undevelopable	164	2.2%	80	1.8%
TOTAL	7,377	100.0%	4,369	100.0 %

Table 1-2 Land Use by Parcel Type

Open Space: The Town owns approximately 350 acres of open space, recreation and conservation lands as shown on **Figure 1-5**. Of that total, there are approximately 122.5 acres of Conservation Land within the town under the jurisdiction of the Conservation Commission and Department of Public Works including 13 distinct conservation land areas. The conservation land areas range in size from 0.25 acres to 53 acres. The largest five conservation land areas include:

- Fastino/Holy Ghost Land: 8.5 Acres
- Mello Farm: 9 Acres
- Morris Preserve: 10 Acres
- Broad Cove: 26 Acres
- Elm Street Acres: 53 Acres

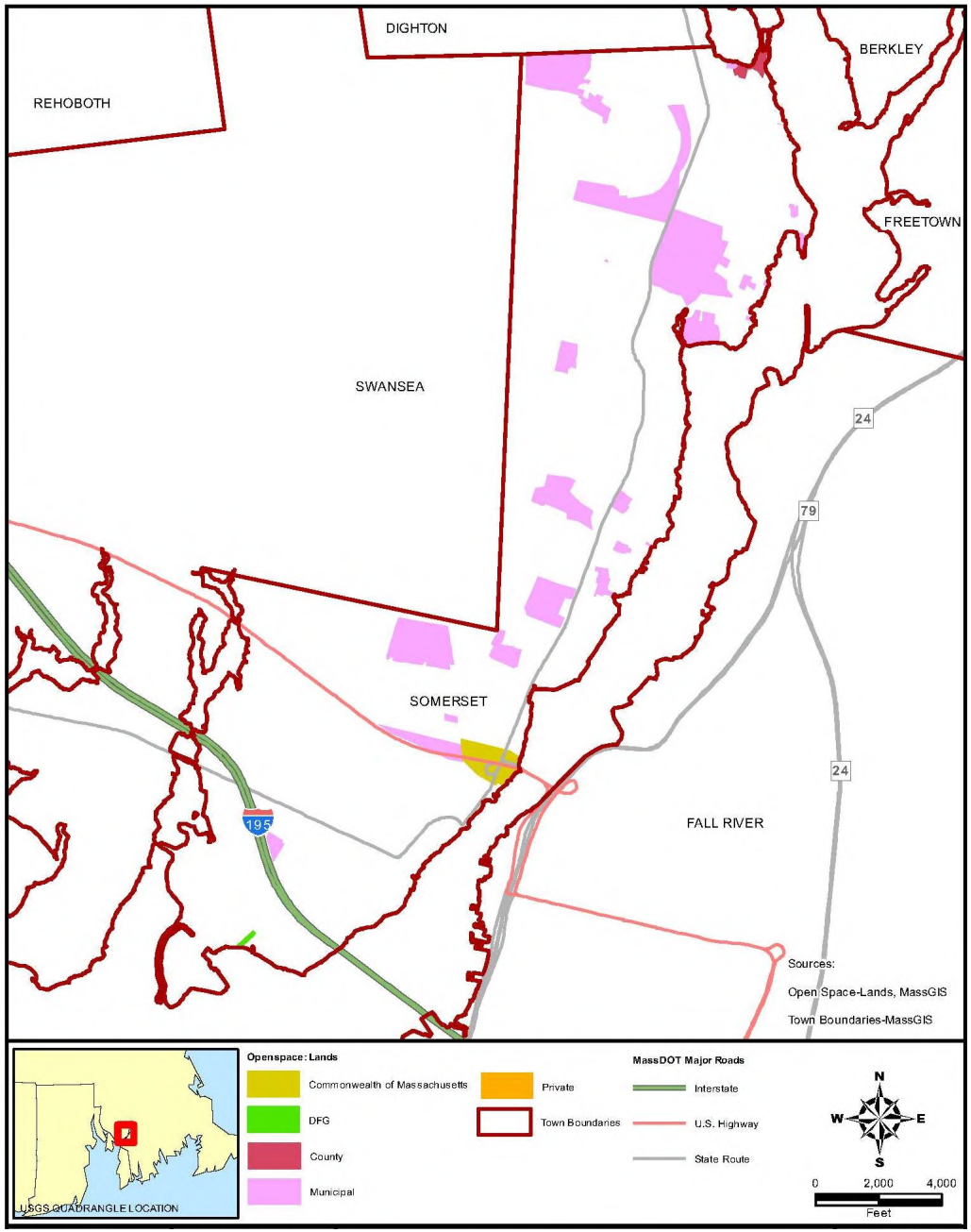


Figure 1-5: Open Space

The Town of Somerset is divided into six zoning districts as shown on **Figure 1-6**. Zoning that include Residential, Business, Limited Business, Light Industrial, Open Recreation, and Industrial. The Town also includes the following three special districts based on the most recently adopted

- Watershed Protection District
- Water Resources Protection District
- Flood Plain District

Land Use (Future)

The Town's 2007 Master Plan included a build-out scenario for the Town prepared by the Southeastern Regional Planning and Economic District (SRPEDD) and based on a Massachusetts Executive Office of Environmental Affairs (EEA) 2000 Study. SRPEDD estimated that 1,157 acres of land are available for development, which is considerably higher than the 704 acres of agricultural, developable land and potentially developable land identified in the Town's assessor's database. **Table 1-3** provides an overview of the proposed build-out projections based on the size of the population, number of households and students, relative to the year 2000. These numbers should only be considered for planning purposes and provide more of an illustration of the top-end buildout potential for Somerset with an understanding that the numbers may be higher than what will likely be developed in the future.

	2000	Buildout Projections (SRPEDD)	Net Increase at Buildout
Population	18,234	22,281	4,047
Households	6,987	9,269	2,282
Students	2,808	3,584	776

Table 1-3 Somerset Build-Out Impacts

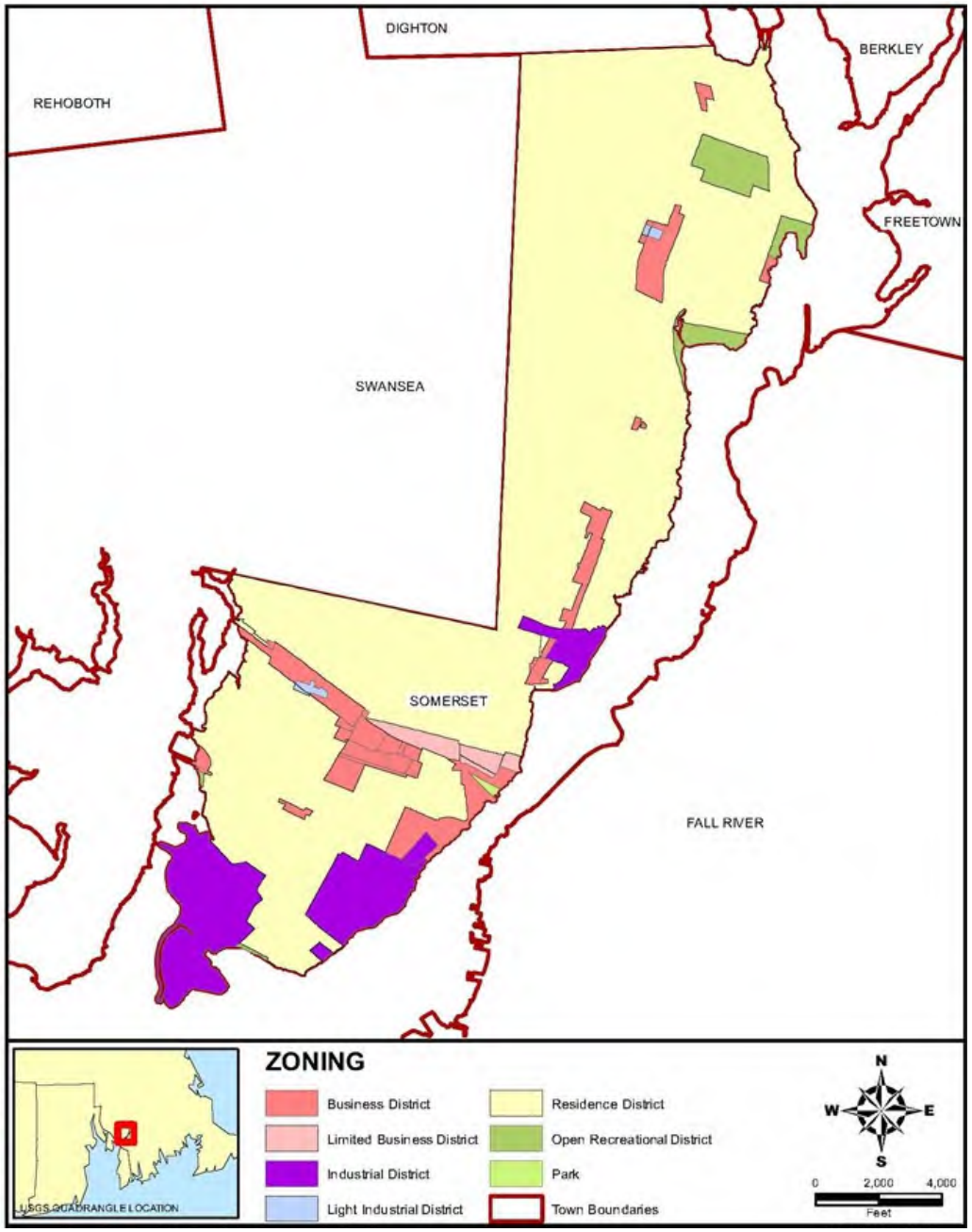


Figure 1-6: Zoning Map

Future Development Opportunities: The 2007 Master Plan identifies opportunities for economic development and new housing. The 2015 Somerset Power Plants Reuse Study also presents redevelopment approaches for both the Montaup and recently-closed Brayton Point Power Plant sites that consider these areas as key opportunities for future redevelopment. Both site include large areas of land that are located in the FEMA Special Flood Hazard Area (SFHA). Proposed future development areas are presented on **Figure 1-7.**

Future Development Areas:

Area 1: Slades Ferry Redevelopment (Housing and Economic Development)

The Slades Ferry area encompasses about 120 acres of land that extends to the shores of the Taunton River. The land includes aging and/or vacant buildings on Slades Ferry Avenue, parking areas, streets and a considerable amount of open space. The 2007 Master Plan recommends that the revitalization would require a coordinated program including the realignment and redesign of the local street system, relocation of the exiting commuter park-and-ride lot, development of public amenities including riverfront parks, boardwalk and recreation paths, and private development. Areas along the waterfront are also within the FEMA SFHA.

Area 2: Town Center (Housing and Economic Development)

New Town Center zoning districts have been proposed, and a Design Guidebook has been prepared support the new zoning. Both promote more intensive, mixed-use redevelopment of the Town Center that will assist in revitalizing this aging area. It is envisioned that public-private partnerships could assist in the revitalization efforts that would include redevelopment of the existing strip plaza that currently includes the Post Office and adjacent structures on West County Street (also known as Corn Street).

Area 3: Route 6 Commercial Corridor (Housing and Economic Development)

This area includes vacant land along Route 6 that could serve as areas of commercial infill development.

Area 4: Additional Senior Housing in Northern Somerset (Housing and Economic Development)

There is some vacant land in Northern Somerset that could serve as new housing.

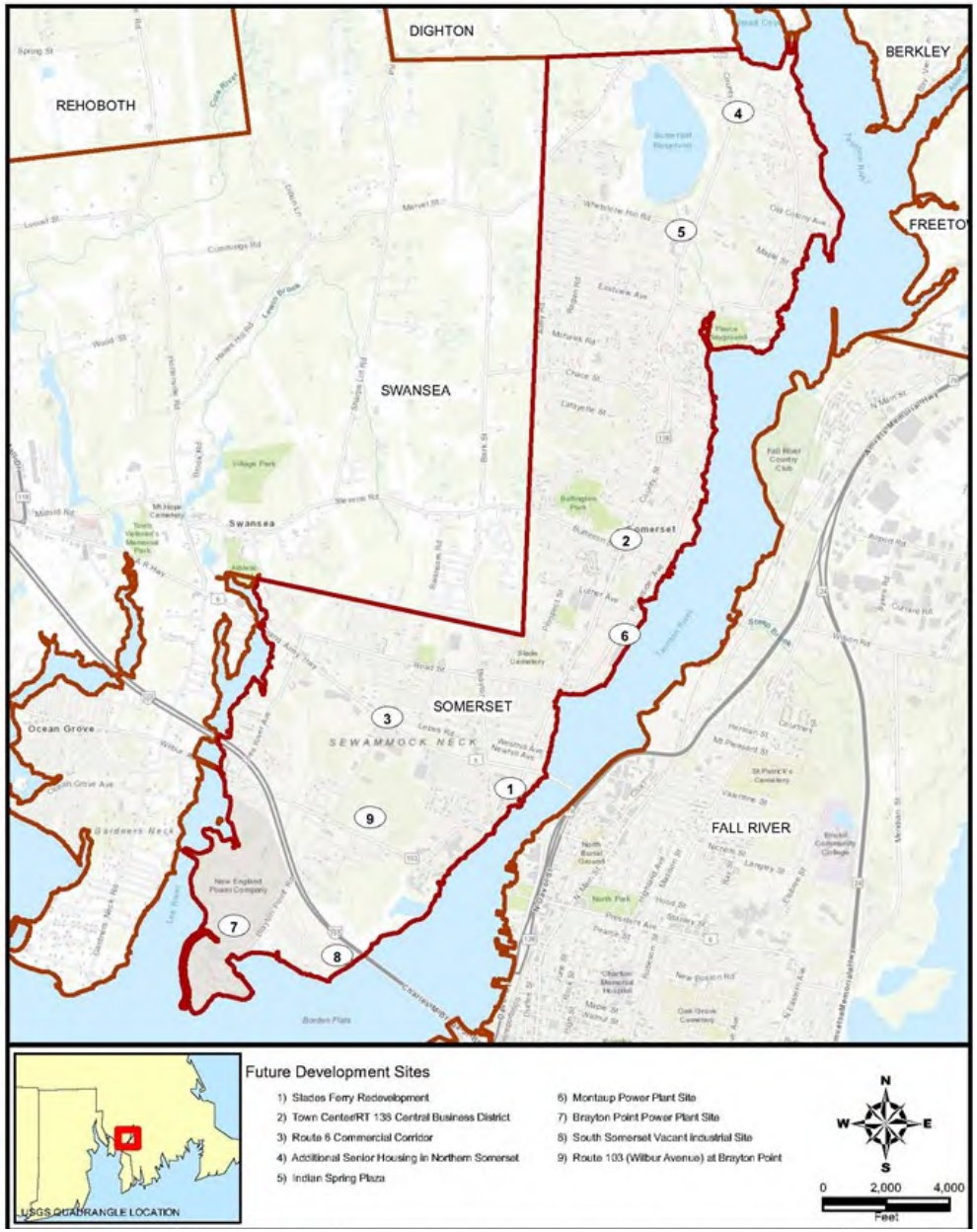


Figure 1-7: Planned Future Development Areas

Area 5: Indian Spring Plaza (Economic Development)

A growing residential area (Whetstone Hill Road and North Farms) and North School surround this commercial retail area, increasing the potential for expanding the market for higher quality retail uses in the future.

Area 6: Montaup Power Plant Site (Economic Development)

The Montaup site includes 26 acres with portions of the site along the Taunton River. In 2015, National Grid acquired a portion of the site. The 2015 Somerset Power Plants Reuse Study identified two potential redevelopment alternatives that included: 1) Break Bulk Cargo; and 2) Green Energy. The 2015 Somerset Power Plants Reuse Study identified three potential redevelopment alternatives that included: 1) Natural Gas Conversion; 2) Green Energy Hub; and 3) Marine Industrial Park. Any future development or redevelopment will need to account for various regulatory factors including but not limited to: 1) Zoning, 2) Wetlands, 3) Regulated Tidelands (Chapter 91), 4) Waste, and 5) Massachusetts Building Code. With respect to potential impacts from future natural hazards, portions of the site to the south and west are within FEMA's special flood hazard area and within the Town's Flood Overlay District. Therefore, new construction would be allowed only by issuance of a special permit from the Town that must also comply with the new 9th edition of the Massachusetts Building Code for coastal hazard areas.

Area 7: Brayton Point Power Plant Site (Economic Development)

The Brayton Point site includes 365 acres located at the mouths of the Taunton and Lee Rivers. The site includes some adjacent freshwater wetlands, salt marsh and coastal barrier beach. The 2015 Somerset Power Plants Reuse Study identified three potential redevelopment alternatives that included: 1) Natural Gas Conversion; 2) Green Energy Hub; and 3) Marine Industrial Park. Any future development or redevelopment will need to account for the various regulatory factors outlined above for the Montaup site as well as the regulatory considerations for development within a SFHA and the Town's Flood Overlay District.

Area 8: South Somerset Vacant Industrial Site (Economic Development)

This site was proposed in a Waterfront Study for development as an industrial park site. The study recommended that the vacant land north of Clifton that was formerly owned by the Montaup Electric should be used as an Industrial Park because there is only a small amount of land available for this use in the rest of Town.

Area 9: Route 103 (Wilbur Avenue) at Brayton Point (Economic Development)

The Town purchased a 120-acre lot on Wilbur Avenue in 2006. The Town is evaluating options for re-use including economic development and senior housing combined with open space. Other entities have suggested the land could be used for a municipal golf course or as athletic fields. The land extends to the Clifton Rehabilitation Center that could also serve as a connection towards the Taunton River waterfront and Slades Ferry.

Overview of Montaup Power Plant Site (source: 2015 Somerset Power Plant Reuse Study)

Overview of Brayton Point Power Plant Site (source: 2015 Somerset Power Plant Reuse Study)

Transportation Infrastructure

The road transportation network in Somerset includes an Interstate Highway (I-195), State Routes, and local, non-numbered roadways. I-195 crosses the Taunton River over the Charles M. Braga, Jr. Memorial Bridge into Somerset near the southern boundary of Town with two exit/entrance ramps located within the Town at Exit 4a and 4b onto State Routes 103 and Lees River Avenue. State Routes 6, 103 and 138 pass through Somerset, which connect Somerset to surrounding communities in south-eastern Bristol County. Numerous bridges and culvert crossings are located within Town. Major bridges are listed as follows in **Table 1-4** and shown on **Figure 1-8**.

Figure ID	Bridge Name
1	Route 6 (Grand Army Highways) Bridge – Over the Lee River
2	Route 6 (Grand Army Highways) Bridge – Over the Taun-ton River
3	Charles M. Braga, Jr. Memorial Bridge
4	I-195 Bridge
5	103 Veterans Memorial

Table 1-4 Major Bridges in Somerset

The Southeastern Regional Transit Authority (SRTA) bus serves Somerset and nine other communities in Southeastern Massachusetts, including Acushnet, Dart-mouth, Fairhaven, Fall River, Freetown, Mattapoisett, New Bedford, Somerset, Swansea, and Westport. SRTA also connects persons with disabilities, seniors and veterans to various medical facilities in Boston via the Hospital Shuttle.

The nearest regional airport to Somerset is in New Bedford, 18 miles away. The near-est international airport is the T.F. Green Airport in Warwick, Rhode Island, 27 miles away; and Boston Logan International Airport is located 53 miles away.

No rail systems currently provide commuter or other types of freight service to Somer-set. The nearest commuter rail stops are in Attleboro (by distance) and Middleboro/ Lakeville (by estimated travel time). The proposed South Coast Rail will offer com-muter rail service across the Taunton River in Fall River.

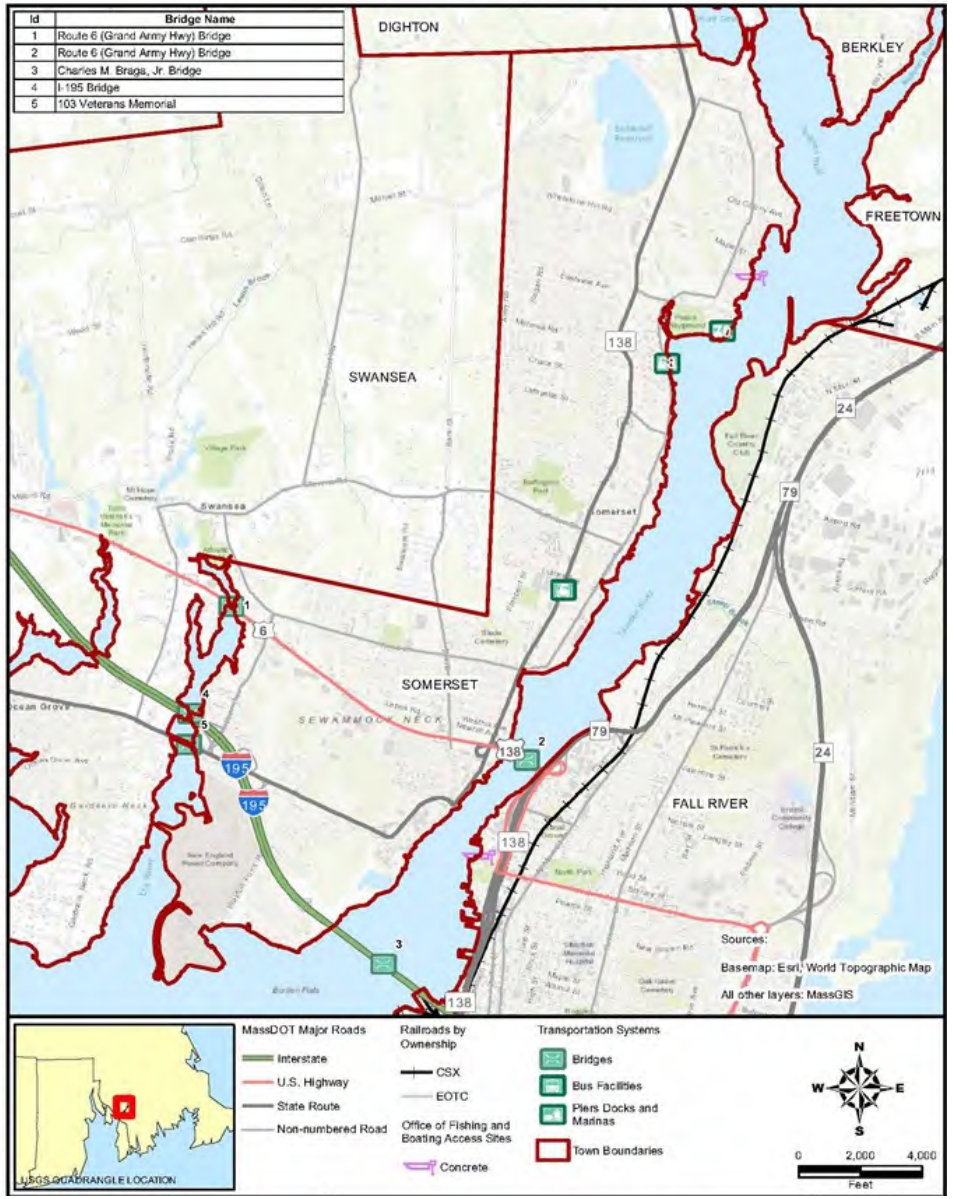


Figure 1-8: Transportation Infrastructure

Essential Facilities and Lifeline Systems

Essential Facilities and Lifeline Systems in Somerset are presented in **Figure 1-9**. Essential facilities include facilities that provide critical services including public safety (e.g. police, fire, emergency shelters), health care, and town and regional services necessary for response during and after natural disasters. More information about these services are described below. Lifeline Systems include power generation and transmission, communication systems, potable water supply and sanitary wastewater treatment.

Public Safety and Health Care

Public safety within the Town of Somerset is the responsibility of the local Police Department, Fire Department, Emergency Management Agency and Highway Department. The Somerset Police and Fire Department Headquarters are co-located at 465/475 County Street in Somerset. The Town's Emergency Management Agency is located at 2435 Riverside Avenue.

The Police Department consists of 31 full-time officers, who are also assisted by 24 reserve police officers. All officers are supported by 15 public safety dispatchers, a part -time records clerk and a building maintenance employee. The Department equipment includes marked patrol cars, a motor cycle, police mountain bicycles, two portable radar trailers, a state of the art police / fire boat (used to patrol the Taunton River), a special response vehicle as well as unmarked cars. The Department is engaged in several mutual aid agreements with other municipalities and entities. Some of these agreements allow the Department to rapidly supplement the Somerset patrol force in the case of a large- scale emergency.

The Fire Department includes 31 full-time personnel (all of whom are Emergency Medical Technicians (EMT)) and one civilian Administrative Assistant. The full-time fire staff include the Fire Chief (also a Paramedic), Deputy Fire Chief (also an EMT-Basic), 6 Lieutenants (4 are Paramedics, 1 is an EMT-Intermediate and 1 is an EMT-Basic), 19 Firefighter/Paramedics and 4 Firefighter/EMT's. The Department is tasked with providing fire protection (fire prevention and fire extinguishing), emergency medical response, search and rescue, fire education and a host of other services. The station has 3 fire trucks, 1 ladder truck, 2 ambulances, and a stall for a utility truck and rescue boat.

The Police and Fire Departments share the dispatch center in a combined police/fire/EMS/9111 call center. The primary emergency communications system is located at the Reed Street Water Tower, and the backup system is located at the Police Street Tower. Somerset also has secondary emergency communications systems located in Fall River at Cardinal Medeiros Towers, and in Dighton at the Dighton Water Tank. The Town has a community emergency notification system. The entire Town is considered one single emergency service zone, which is serviced by the Somerset Police Department.

The Highway Department, located at 1263 Brayton Point Road, is responsible for maintaining the Town's roadways, parks, playgrounds, and town cemeteries. The Highway Department also maintains all 120 town vehicles and fuels the vehicles from pumping stations located on site of the Highway Department building.

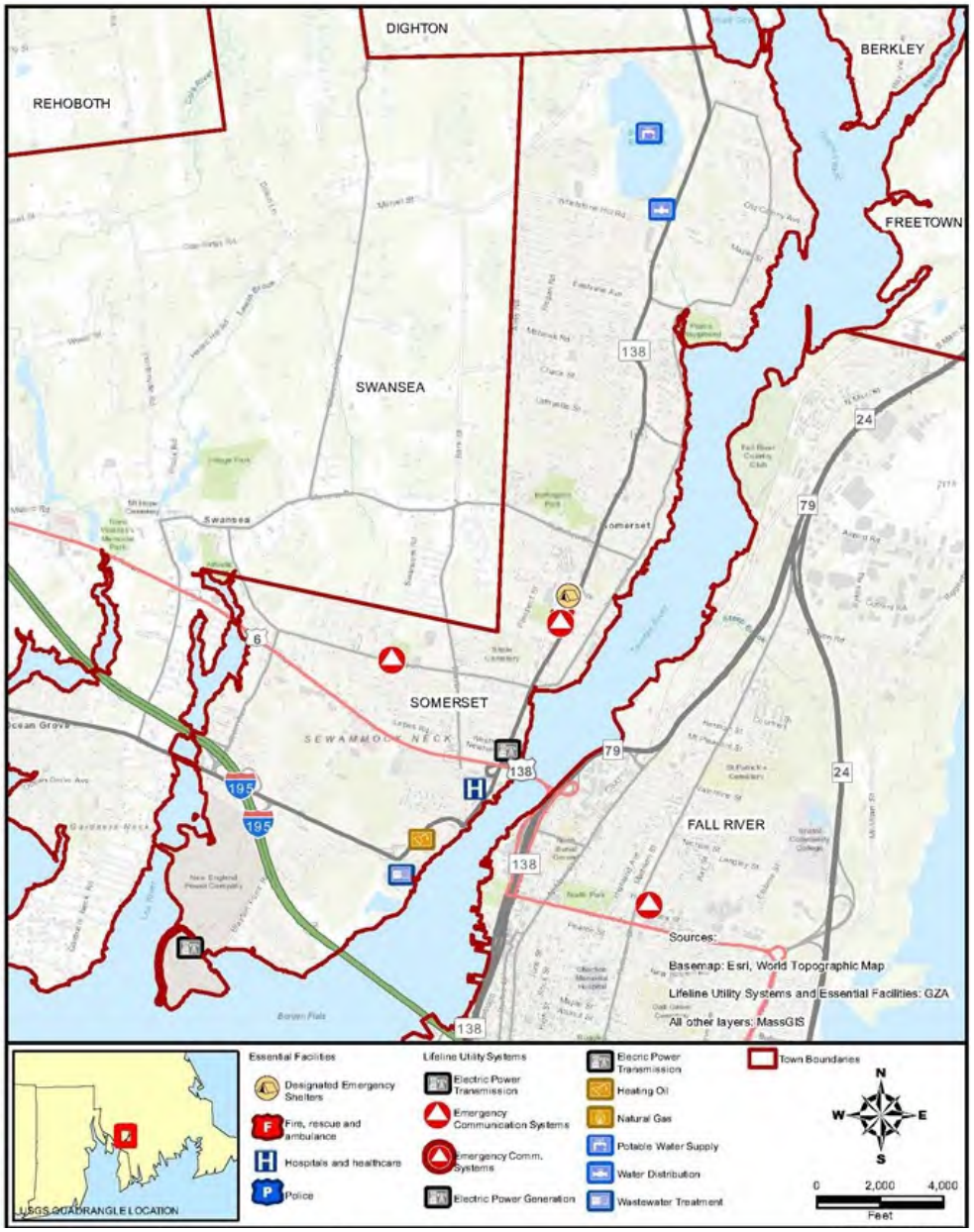


Figure 1-9: Essential Facilities and Lifeline Systems

The community emergency shelter is located at Somerset-Berkley Regional High School at 625 County Road in Somerset.

Prima Care Somerset/Swansea Medical Center (Prima Care) is a part of a larger private medical service provider system with 150 providers, and facilities in Fall River, Somerset, Westport, Dartmouth, and Tiverton. Prima CARE facilities provide a full range of medical services including primary care physicians and specialists as well as full diagnostic services. Prima Care has the only dual-accredited (Nuclear and echocardiogaphy) Cardiac Testing Laboratory in the state, and their Vascular Lab has been awarded accreditation by the ICAVL. The Somerset Facility also provides laboratory services as well as X-rays and a Sleep Disorders Center at our 18,000 square foot Somerset location.

Utilities

National Grid is the electric provider in Somerset, and gas service is provided by Liberty Utilities. Comcast and Verizon provide cable and telecommunications services, respectively.

Water Supply

The Somerset Water Department (SWD) headquartered at 3249 County Street supplies most of the Town with water. Somerset has two drinking water sources: the ground water well located in Dighton; and 2) the Somerset Reservoir. These sources serve residents and businesses in Somerset, as well as small areas of Dighton and Swansea.

The Labor-in-Vain Brook flows into Somerset Reservoir. The watershed extends into Dighton and Swansea. The Reservoir is supplemented with water pumped from the Segregansett River in Dighton. The Segregansett River's watershed extends into Dighton and Taunton. The ground water well, located in Dighton, is approximately 40 feet deep. The primary recharge area for this well (Zone II) is in Dighton and Berkley.

The quantity of water available for residential and commercial use is adequate; however, in terms of addressing future water needs the current water system, the 4.42 million gallons per day (MGD) permitted withdrawal exceeds the projected 2020 (4.37 MGD) average demands. The 2007 Master Plan noted that the safe yields from the Segregansett River and Somerset Reservoir may be increased to 6 MGD with improvements to the Segregansett River Transfer Station. Public water supplies, water protection areas, and surface water supply watersheds are presented on **Figure 1-10.** Water demand will decrease with the closure of the Brayton Point power plant.

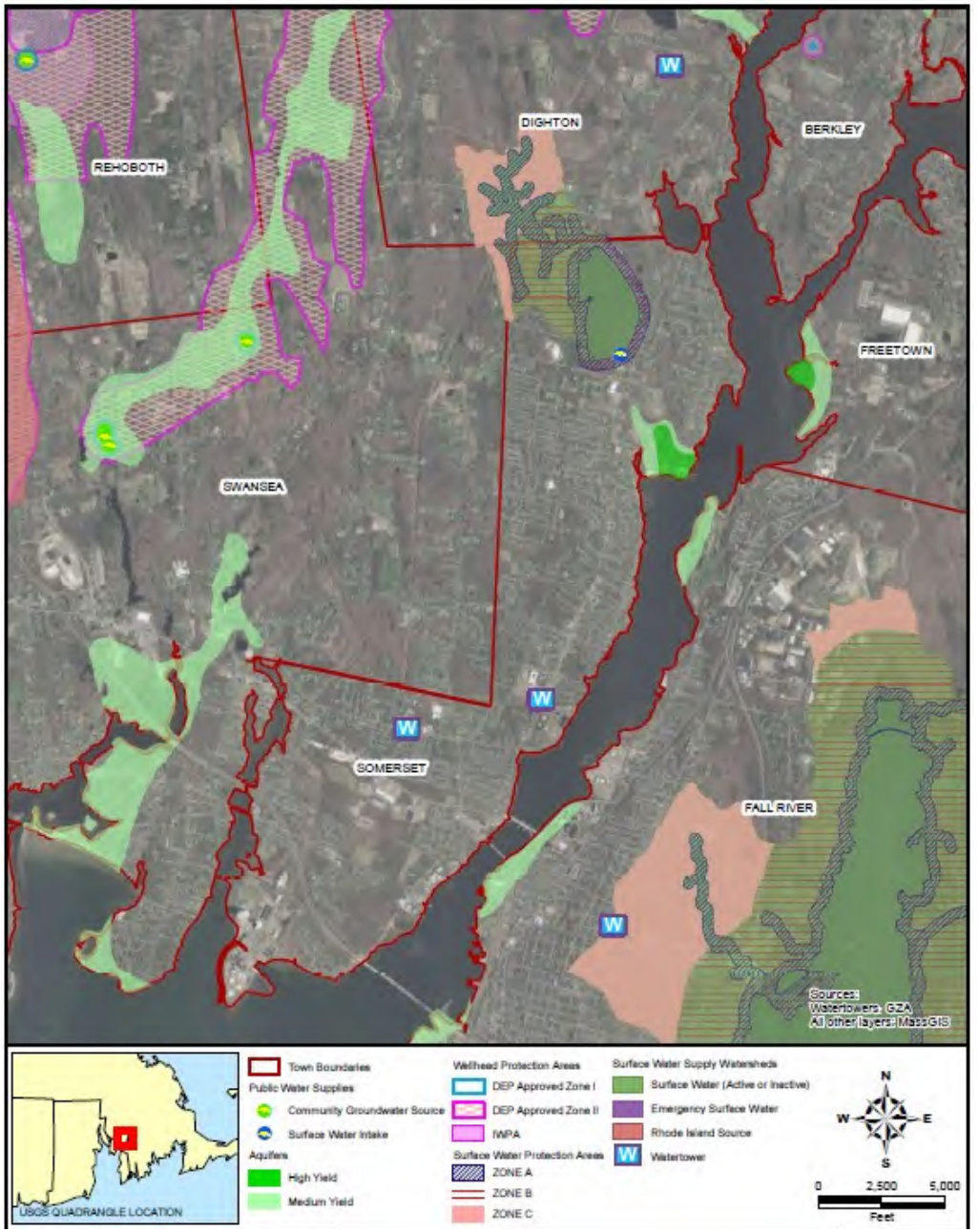


Figure 1-10: Water Supply Facilities

Water Pollution Control Facility

The Town of Somerset has a wastewater treatment plant to treat the Town's waste water at 116 Walker Street in the southern-most part of Town. The majority of the Town (approximately 95%) is connected to the Town sanitary sewer system. The remaining 5%, include 300 homes, are on independent septic systems. The treatment plant has a design capacity of 4.2 MGD average, which is about half a million gallons more than what the plant currently processes per day. **Figure 1-11** shows the location of the Water Pollution Control Facility and sanitary pump stations.

The sanitary wastewater treatment system utilizes pump stations located throughout Town, including:

- Pleasant Street
- Pilot Drive
- 300 Waterfront Park
- Dublin Street
- Luther Avenue
- Foley Avenue
- Lees River Avenue
- Route 6 near the Somerset Creamery
- Angus Street
- Grove Street

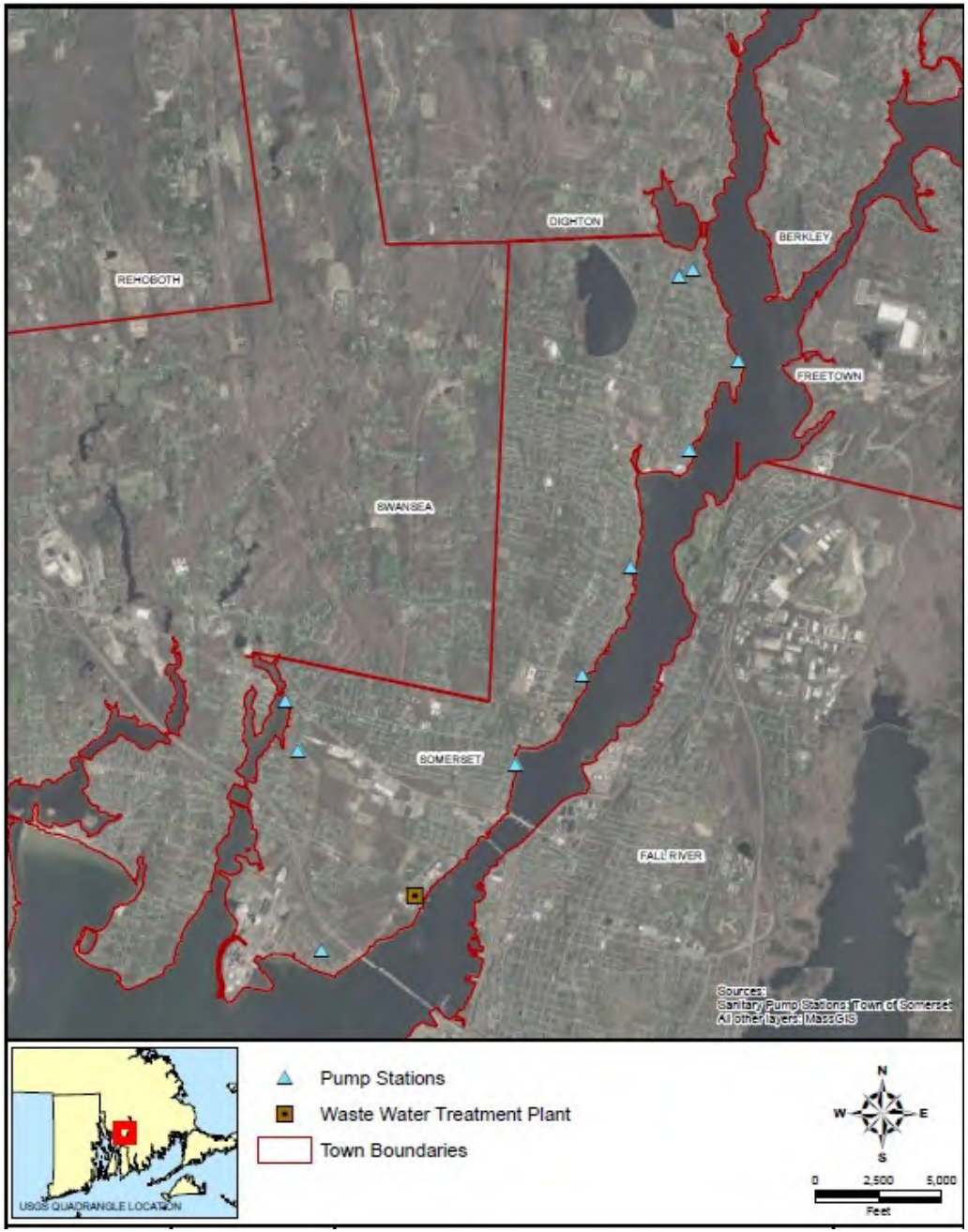


Figure 1-11: Location of Somerset Reservoir Dam

High Potential Loss Facilities: Dams

Somerset Reservoir Dam: The Somerset Reservoir water is retained by a large High Hazard earthen dam. The dam located east of County Street and north of Whetstone Hill Road (**Figure 1-12**). This dam is owned and operated the Somerset Water Department. This dam is a High Hazard Dam. A dam breach would potentially inundate properties near the dam as well as the Water Department located at 3249 County Street.

The dam length is about 6,700 linear feet and the dam height is about 45 feet. The dam is regulated by the Massachusetts Department of Environmental management

Swansea Mill Works Dam: A second, Low Hazard dam, is located at the border of Somerset and Swansea, just north of Route 6 and the Lee River. This dam is a Low Hazard Dam.

Somerset Reservoir and Dam (in red)

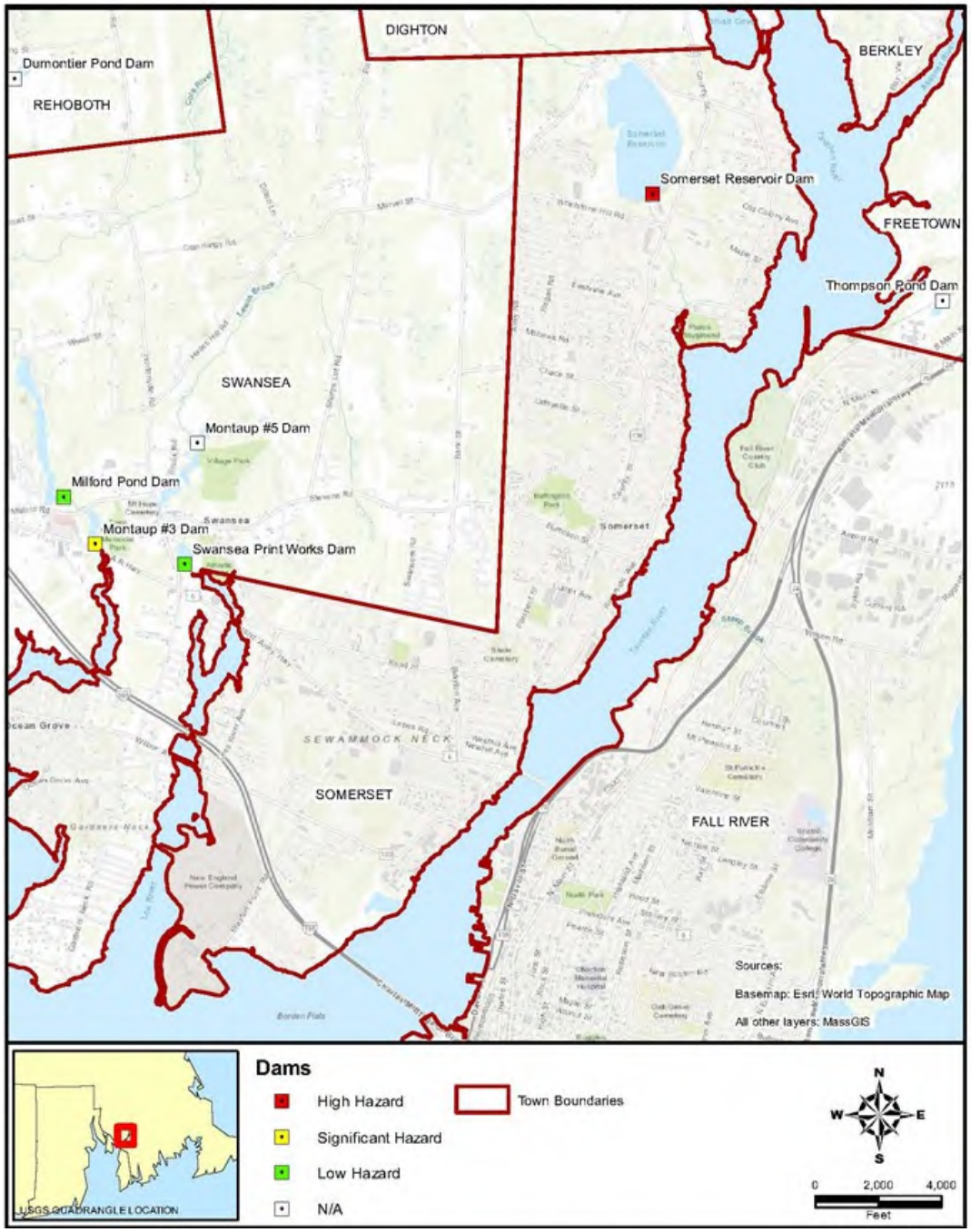


Figure 1-12: Sanitary Wastewater Treatment

Stormwater Management

The Somerset Water Department maintains a separate (from sanitary flow) stormwater system to collect and convey stormwater runoff from municipal roadways and properties. The system includes a network of catch basins, manholes, stormwater drainage pipes, and outfalls. Some pre-treatment of runoff is provided prior to discharge to adjacent surface water bodies. The most recently available mapping of the Town's drainage pipes and outfalls is presented in **Figure 1-13.** The system serves to manage local drainage and minimize flooding of roadways and municipal properties. The stormwater system is a gravity system and does not utilize stormwater pump stations.

Hazardous Materials Facilities and Landfills

Facilities regulated by MassDEP's Bureau of Air and Waste, formerly the Bureau of Waste Prevention (DEP BWP Major Facilities) located in Somerset are shown in **Figure 1-14.** These include facilities with Air Operating Permits (AIR), Hazardous Waste Recyclers (HWR), Large Quantity Generators of MA-regulated Hazardous Waste (LQG_MA), Large Quantity Generators of EPA/RCRA-regulated Hazardous Waste (LQG_RCRA), and Large Quantity Toxic Users (LQTU).

Natural Resources

Somerset lies within two regional watersheds, the Taunton River watershed and the Narragansett Bay watershed (see **Figure 1-15**). The majority of land area in Somerset lies within the Taunton River watershed extending from the northern border to Brayton Point to the east of Brayton Point Road. The land area west of Brayton Point Road extending to the border with Swansea is within the Narragansett Bay watershed.

Endangered and Priority Habitats associated with the Massachusetts Natural Heritage and Endangered Species Program (MA NHESP) are associated with Lee River adjacent to Brayton point, the Taunton River north of Sandy Point Road and the northwest corner of Somerset on the border of Dighton and Swansea extending south into Elm Street Acres, as shown on **Figure 1-16**. Priority Habitat is based on the known geographical extent of habitat for all state-listed rare species, both plants and animals, and is codified under the Massachusetts Endangered Species Act (MESA). Habitat alteration within Priority Habitats may result in a take of a state-listed species and is subject to regulatory review by the Natural Heritage & Endangered Species Program. Estimated Habitats are a sub-set of the Priority Habitats, are based on the geographical extent of habitat of state-listed rare wetlands wildlife and is codified under the Wetlands Protection Act (WPA), which does not protect plants. State-listed wetland wildlife species are protected under the Massachusetts Endangered Species Act as well as the Wetlands Protection Act.

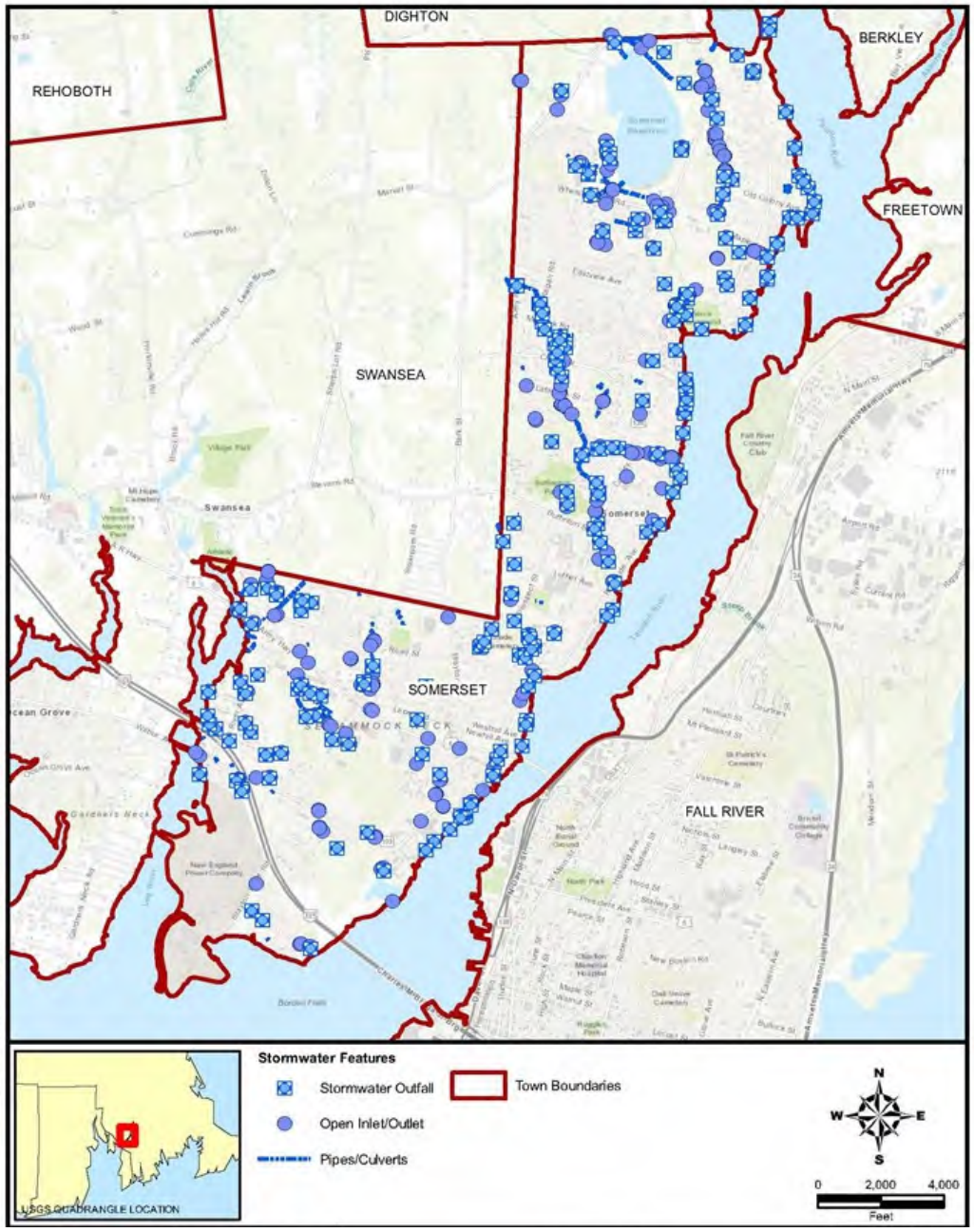


Figure 1-13: Stormwater Management System

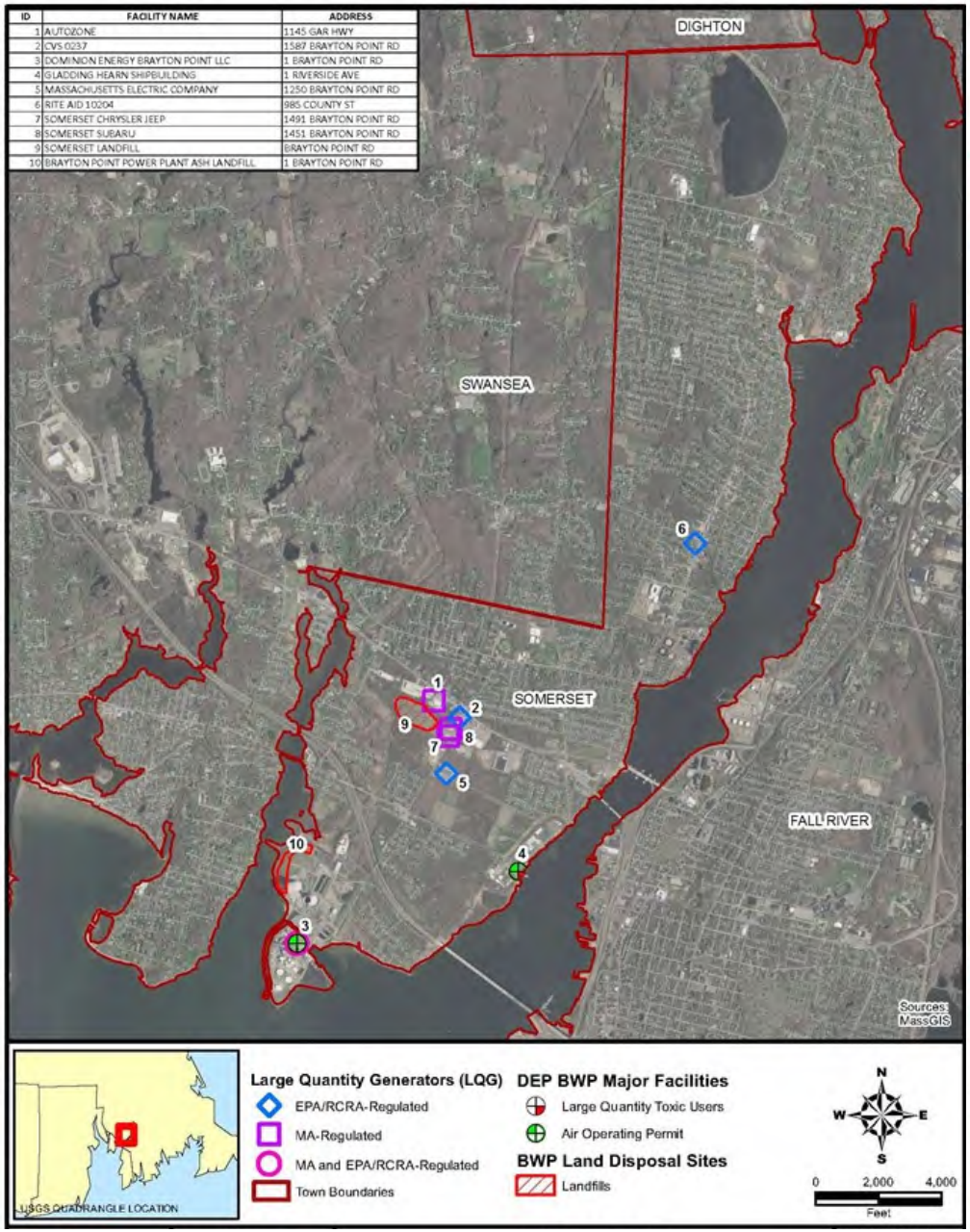


Figure 1-14: Hazardous Materials Facilities and Landfills

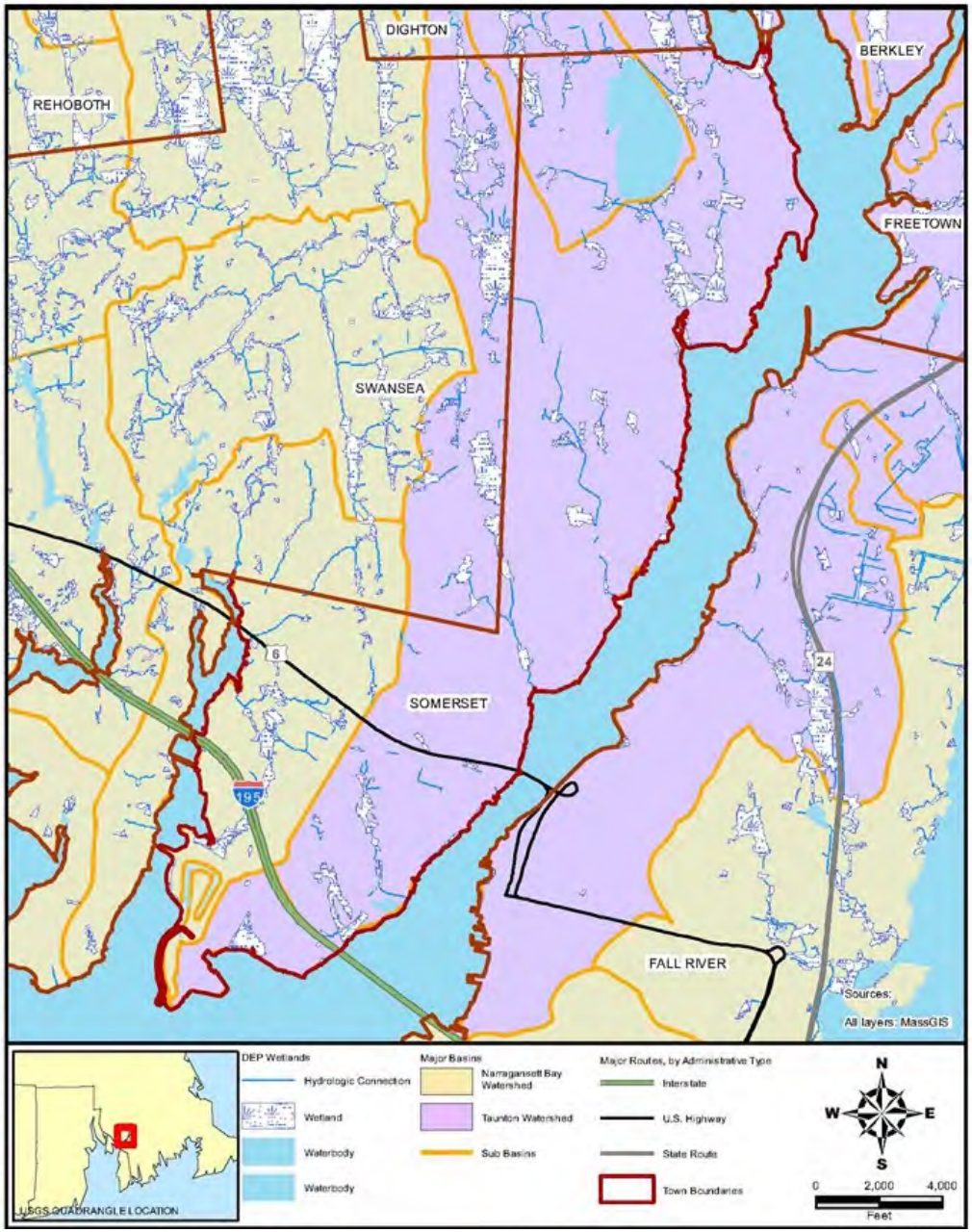


Figure 1-15: Water Resources

Cultural and Historic Sites

There is one property within the Town that is listed on the National Register of Historic Places. This property is the Swansea Friends Meeting House and Cemetery located at 223 Prospect Street. The Swansea Friends Meetinghouse is one of only nineteen Quaker meetinghouses inventoried in the state of Massachusetts. It is the oldest such structure with building components dating back to 1702.

There are no National Register listed Historic Districts in Somerset; however, the Massachusetts Historical Society has encouraged the Town to pursue designation for the Somerset Village District located along Main and High streets running between Euclid and Old Colony avenues.

Swansea Friends Meetinghouse and Cemetery

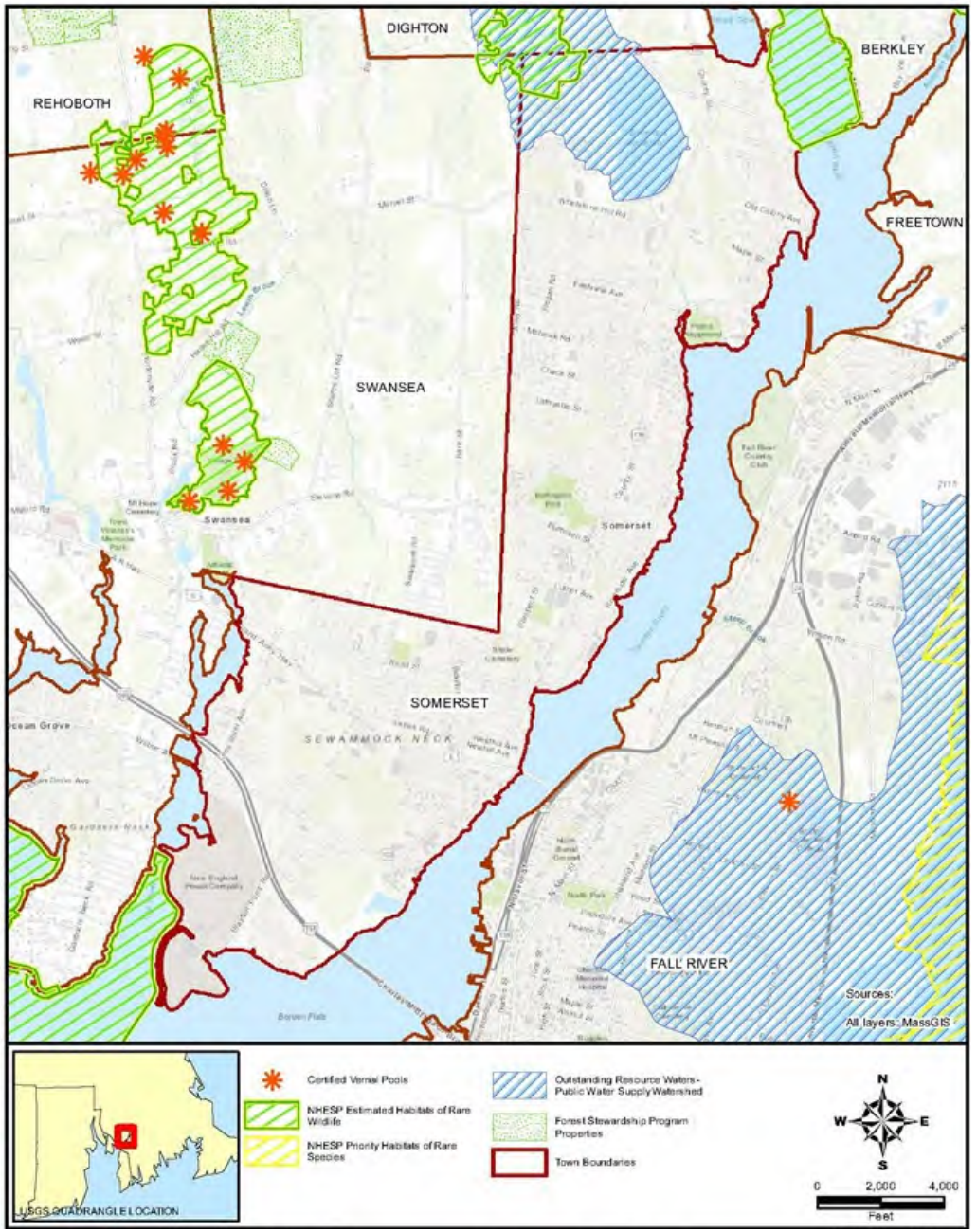


Figure 1-16: Natural Resources/Endangered Species

Attachment 2: Natural Hazards

Attachment 2: Natural Hazards

NATURAL HAZARDS OVERVIEW

Natural hazards are **natural events** that threaten lives, property, and other assets. Within Massachusetts, natural hazards typically include:

- Severe Weather Hazards such as Hurricanes and Tropical Storms, Nor'easters, Lighting, Intense Rainfall, Hail, Heavy Snowfall and Ice Storms.
- Climate-Related Hazards such as extreme heat and cold, drought and wildfire.
- Geologic Hazards such as earthquakes, landslides and tsunamis.

Severe weather hazards, including hurricanes, tropical storms and nor'easters can result in coastal flooding (storm surge and waves). These flood events will become worse in the future due to climate-related changes to sea level rise and, perhaps, storm intensity. Coastal flooding can result in the secondary hazard of shoreline change. Severe weather hazards can also result in high winds, lightning, hail, intense rainfall and tornadoes.

Coastal Massachusetts is also vulnerable to tsunamis, a geologic hazard; however, the likelihood of a significant tsunami impacting coastal Massachusetts is considered very low.

Localized intense rainfall can result in urban flooding where existing stormwater management capacity is exceeded. It can also result in flash flooding of streams and rivers and exceedance of water reservoir dam capacity.

Hazard Probability

Natural hazards can often be predicted, including predicting their likelihood of occurrence. The probability of a specific natural hazard occurring is typically defined in terms of its annual exceedance probability (AEP). This refers to the probability that a hazard condition will be met or exceeded in any given year. In lieu of the AEP, the term recurrence interval (in years) is often used.

Climate Change

Climate change, a result of increased greenhouse gas emissions and secondary effects, will significantly impact certain natural hazards. There is high scientific consensus that coastal flooding in Massachusetts will become worse due to sea level rise. Storm intensity may also increase, resulting in increased flood elevations. There is high scientific consensus that climate change will result in increased rainfall intensity within Massachusetts as well as the frequency of extreme rainfall events. There is also scientific consensus that climate change will result in in extended periods of extreme heat (heat waves) and cold.

SOMERSET NATURAL HAZARDS

GZA performed an analysis of multiple natural hazards and identified those hazards that are relevant to the Town of Somerset. These are presented in **Table 2-1**. These hazards are characterized in detail in the following pages.

Severe Weather Hazards:
Severe Wind:
Hurricanes/Tropical Storms
Thunderstorms
Tornadoes
Lightning
Intense Rainfall
Hail
Flood:
Storm Surge
Sea Level Rise
Urban Drainage Flooding
Shoreline Change
Severe Winter Weather:
Snowfall
Ice Storms
Climate-Related Hazards:
Extreme Temperature:
Extreme Heat
Extreme Cold
Drought
Wildfire
Geologic Hazards:
Earthquake

Table 2-1: Natural Hazards applicable to Somerset

Severe Weather Hazards: Severe Wind

SEVERE WIND

Severe wind (including high to extreme wind) will typically occur in the Town as a result of: 1) tropical storms and hurricanes; 2) extratropical nor'easters; 3) severe thunderstorms; and 4) tornadoes. Severe thunderstorms and tornadoes are convective weather events. Extreme "straight line" convective wind events include microbursts, macrobursts and derechos. Derechos are widespread, long-lived, and violent convectively-induced "straight-line" windstorms associated with a fast moving band of severe thunderstorms,. "Thunderstorm winds", arising from convection are winds with speeds greater than 58 mph or winds of any speed producing, damage, injury or fatality.

Severe wind poses a threat to life, building structures, and essential facilities (e.g., electrical utilities) due to the effects of wind loads, flying debris, and/or downed trees and power lines. Severe wind will typically cause the greatest damage to lightly-constructed structures, in particular manufactured homes. Downed tree limbs can also cause property and vehicle damage, impact roadways, and in rare instances, cause loss of life. These storms may be accompanied by lightning, which can spark fires. During hurricanes and tropical storms, high winds can also occur coincident with intense rainfall and during nor'easters, high winds can occur coincident with snow (blizzards), rain and a snow/rain mix.

Wind speeds are categorized by the National Weather Service based on potential for structure damage and public health risk, with a distinction between sustained (1-minute duration) wind speeds and gust (3 second duration) wind speeds:

- Wind Advisory: 1) sustained winds of 31 to 39 mph for an hour or more; and/or 2) wind gusts of 46 to 57 mph for any duration.
- High Wind Watch/Warning: 1) sustained winds of 40 mph for one hour or more; or 2) wind gusts of 58 mph or higher for any duration.
- Hurricane Warning: sustained winds of 74 mph or higher or frequent (for more than 2 hours) gusts of 74 mph or greater associated with a tropical cyclone.
- Extreme Wind: 1) surface winds of 115 mph or greater associated with a derecho or sustained hurricane winds.
- Severe Thunderstorm Watch/Warning: winds of 58 mph or higher and/or hail 1-inch in diameter or larger.

The 9th edition of the Massachusetts State Building Code (using ASCE 7-10) utilize wind gusts as the basis for structure design. The regulatory 3 second gust speeds applicable to Somerset (**Table 2-2**). GZA performed an extreme value statistical analysis of historical wind data (sustained 1 minute, 10-meter wind speeds) at T.F. Green Airport in nearby Warwick, R.I. (this airport has the longest historical wind data record in the region). The results are presented in **Figure 2-1**.

Mean Recurrence Interval (yrs)	3-second Gust (mph)
10	80
25	91
50	100
100	110
300	126
700	136
1,700	147

Table 2-2: ASCE 7-10 Wind speed Mean Recurrence Intervals (3-second peak gust in mph)

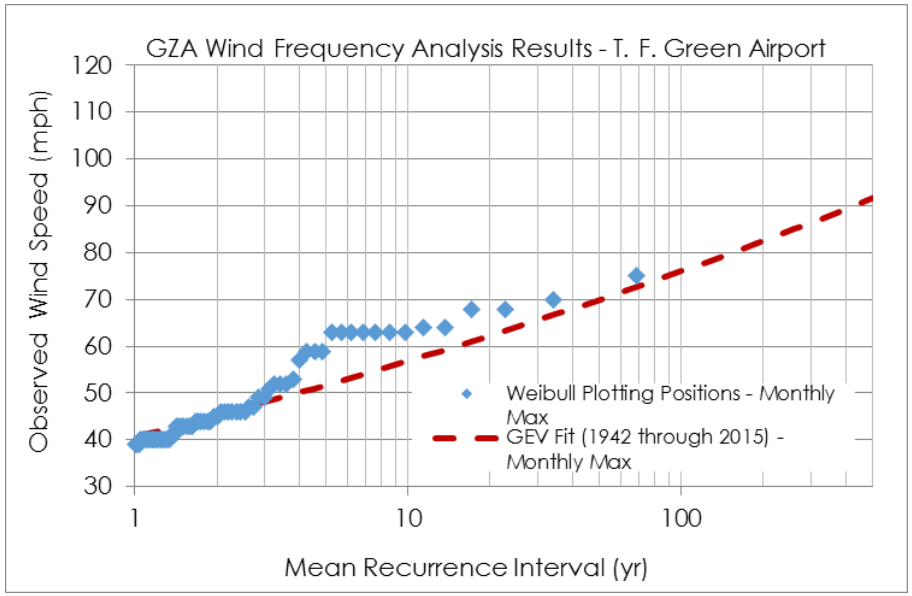


Figure 2-1: Mean 1-minute sustained wind speed based on GZA Extreme Value Analysis of T.F. Green Airport Wind Data (1942 through 2015)

SEVERE WIND cont.

Somerset Design Wind Speeds for Buildings and Other Structures

The 9th edition of the Massachusetts State Building Code wind speed design requirements (in terms of 3-second gust) are:

- Risk Category I: 126 mph - 300 year recurrence interval;
- Risk Category II: 136 mph - 700 year recurrence interval; and
- Risk Categories III-IV: 147 mph - 1,700 year recurrence interval.

Risk categories are based on occupancy and use and are described in **Table 2-3**.

Historical Occurrence at Somerset and Vicinity

During 1996 to 2018, Bristol County experienced 70 days of High Wind events with estimated gusts of about 58 to 80 mph resulting in about $3M in property damage and no deaths. During 1950 and 2018, Bristol County and surrounding areas had 70 days with Thunderstorm (convective) winds resulting in 1 death and $640M damage. Thirteen of these events were in Bristol County.

(Source: NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/)

Estimated Probability of Occurrence at and near Somerset

The results indicate the following severe wind probabilities at and near Somerset:

- High Winds: near 100% AEP or 1 year recurrence interval
- Hurricane wind speeds or greater: 1.2% AEP or 80-year recurrence interval (about 1/80 in any given year). Note that the Hurricane of 1938 was not included in the airport data set, which would increase the chance of experiencing sustained Hurricane wind speeds or greater to about 2.5% AEP or 40-year recurrence interval
- Extreme Wind: less than 0.2% AEP or 500-year recurrence interval

TABLE 1604.5
RISK CATEGORY OF BUILDINGS AND OTHER STRUCTURES

RISK CATEGORY	NATURE OF OCCUPANCY
I	Buildings and other structures that represent a low hazard to human life in the event of failure, including but not limited to: • Agricultural facilities. • Certain temporary facilities. • Minor storage facilities.
II	Buildings and other structures except those listed in Risk Categories I, III and IV
III	Buildings and other structures that represent a substantial hazard to human life in the event of failure, including but not limited to: • Buildings and other structures whose primary occupancy is public assembly with an occupant load greater than 300. • Buildings and other structures containing elementary school, secondary school or day care facilities with an occupant load greater than 250. • Buildings and other structures containing adult education facilities, such as colleges and universities, with an occupant load greater than 500. • Group I-2 occupancies with an occupant load of 50 or more resident care recipients but not having surgery or emergency treatment facilities. • Group I-3 occupancies. • Any other occupancy with an occupant load greater than 5,000 [a]. • Power-generating stations, water treatment facilities for potable water, waste water treatment facilities and other public utility facilities not included in Risk Category IV. • Buildings and other structures not included in Risk Category IV containing quantities of toxic or explosive materials that: Exceed maximum allowable quantities per control area as given in Table 307.1(1) or 307.1(2) or per outdoor control area in accordance with the *International Fire Code*; and Are sufficient to pose a threat to the public if released [b].
IV	Buildings and other structures designated as essential facilities, including but not limited to: • Group I-2 occupancies having surgery or emergency treatment facilities. • Fire, rescue, ambulance and police stations and emergency vehicle garages. • Designated earthquake, hurricane or other emergency shelters. • Designated emergency preparedness, communications and operations centers and other facilities required for emergency response. • Power-generating stations and other public utility facilities required as emergency backup facilities for Risk Category IV structures. • Buildings and other structures containing quantities of highly toxic materials that: Exceed maximum allowable quantities per control area as given in Table 307.1(2) or per outdoor control area in accordance with the *International Fire Code*; and Are sufficient to pose a threat to the public if released [b]. • Aviation control towers, air traffic control centers and emergency aircraft hangars. • Buildings and other structures having critical national defense functions. • Water storage facilities and pump structures required to maintain water pressure for fire suppression.

Table 2-3: Building Code Risk Categories of Buildings and Other Structures
See Massachusetts State Building Code for additional detail.

Climate Change Effects and Severe Wind Occurrence

The attribution of high wind events to climate change is uncertain. There is moderate scientific consensus, that the intensity and frequency of intense hurricanes could increase within southern New England due primarily to the increase in sea water temperature along the East Coast. There is lower confidence, and less understanding, in the attribution of increased extratropical nor'easters and thunderstorms frequency and intensity to climate change.

HURRICANES

Hurricanes, tropical storms and tropical depressions are tropical cyclones - rotating low pressure weather systems that have organized thunderstorms but no pressure fronts (a boundary separating two air masses of different densities). Tropical cyclones with maximum sustained surface winds of less than 39 miles per hour (mph) are called tropical depressions. Those with maximum sustained winds between 39 mph and 73 mph are tropical storms. Hurricanes are tropical cyclones with sustained wind speeds of 74 mph or higher.

East Coast hurricanes originate in the Atlantic basin, which includes the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico. A six-year rotating list of names, updated and maintained by the World Meteorological Organization, is used to identify these storms. "Hurricane Season" begins on June 1 and ends on November 30, although hurricanes can, and have, occurred outside of this time frame (NOAA National Ocean Service).

The Saffir-Simpson Hurricane Wind Scale is a 1 to 5 rating, or category, based on a hurricane's maximum sustained winds. The higher the category, the greater the hurricane's potential for property damage (NOAA National Ocean Service). A major hurricane (Categories 3, 4 and 5) has sustained wind speeds of 111 mph or higher on the Saffir-Simpson Hurricane Wind Scale.

Historic hurricane and tropical storm tracks which have passed within 100 nautical miles of Somerset are presented in **Figure 2-2**. Historic hurricane tracks which have passed within 100 nautical miles of Somerset are presented in **Figure 2-3**. A distance of 100 nautical miles (in particular, storms tracking to the west of Narragansett Bay) is a reasonable representation of hurricanes that have the potential to cause flooding within Narragansett Bay, including Mount Hope Bay. The Hurricane of 1938 had sustained wind speeds of about 100 mph and a 3-second gust speed of about 125 mph at Providence, Rhode Island. Eighteen hurricanes have tracked within 100 nautical miles during NOAA's period of record, including:

Donna, 1960; Cat 2 at landfall	Hurricane of '38; 1938; Cat 3 at landfall
Edna, 1954: Cat 2 at landfall	Unnamed Hurricane, 1944; Cat 2 at landfall
Gloria, 1985; Cat 1 at landfall	Ten hurricanes between 1858 and 1936; Cat 1 to Cat 2 at landfall

Table 2-4: Hurricane tracks within 100 miles of Somerset

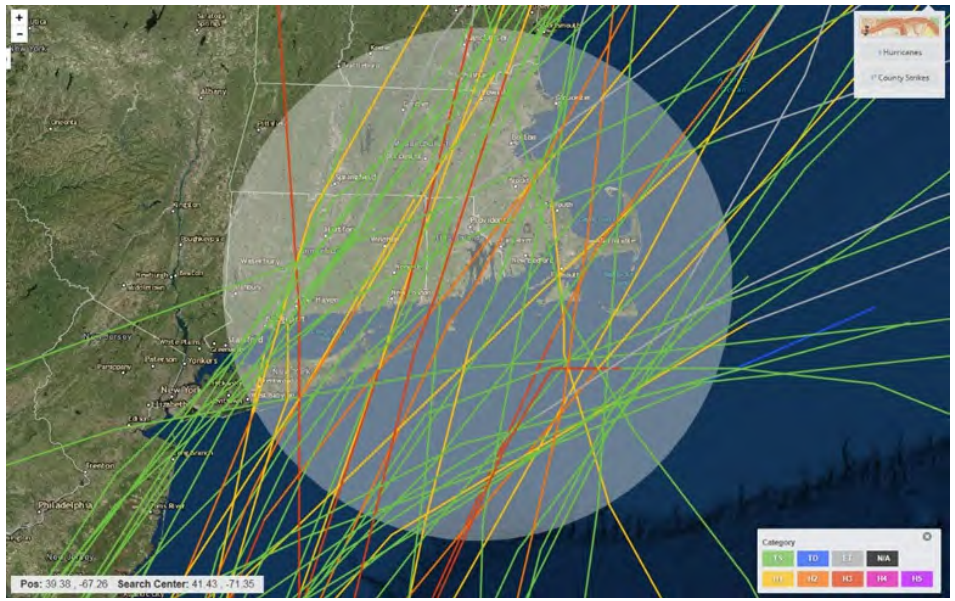


Figure 2-2: Hurricanes and Tropical Storms within 100 miles of Somerset

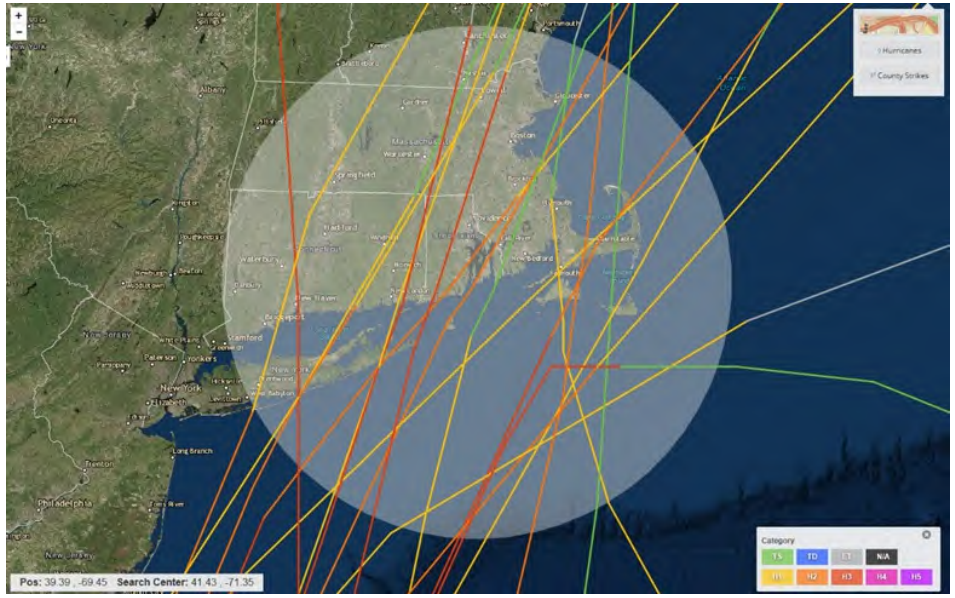


Figure 2-3: Hurricanes within 100 miles of Somerset

Hurricane recurrence intervals reflect the frequency at which hurricanes can be expected to occur within a given distance of a given location. The total number of hurricane strikes within county limits near Narragansett Bay during 1900 and 2010 is about 2 to 3 (**Figure 2-4**). **Figures 2-5 and 2-6** shows hurricane recurrence intervals (aka return periods) for hurricanes passing within 50 miles of various locations. In the vicinity of Somerset, the hurricane passing recurrence interval is about 17 years. In simpler terms, this means that a hurricane is likely to strike or pass near Somerset, on average, about 6 to 8 times per 100 years. In the vicinity of Somerset, the recurrence interval for major hurricanes striking or passing near (Cat 3 and above) is about 52 to 62 years. **Figure 2-7** shows the zones of origin and tracks for different months during the hurricane season. These figures depict average conditions. Hurricanes can originate in different locations and travel much different paths from the average. Regardless, they provide a good sense of the general pattern of hurricane tracks near Narragansett Bay. The likelihood of a hurricane striking near Somerset is much greater during the months of August through October.

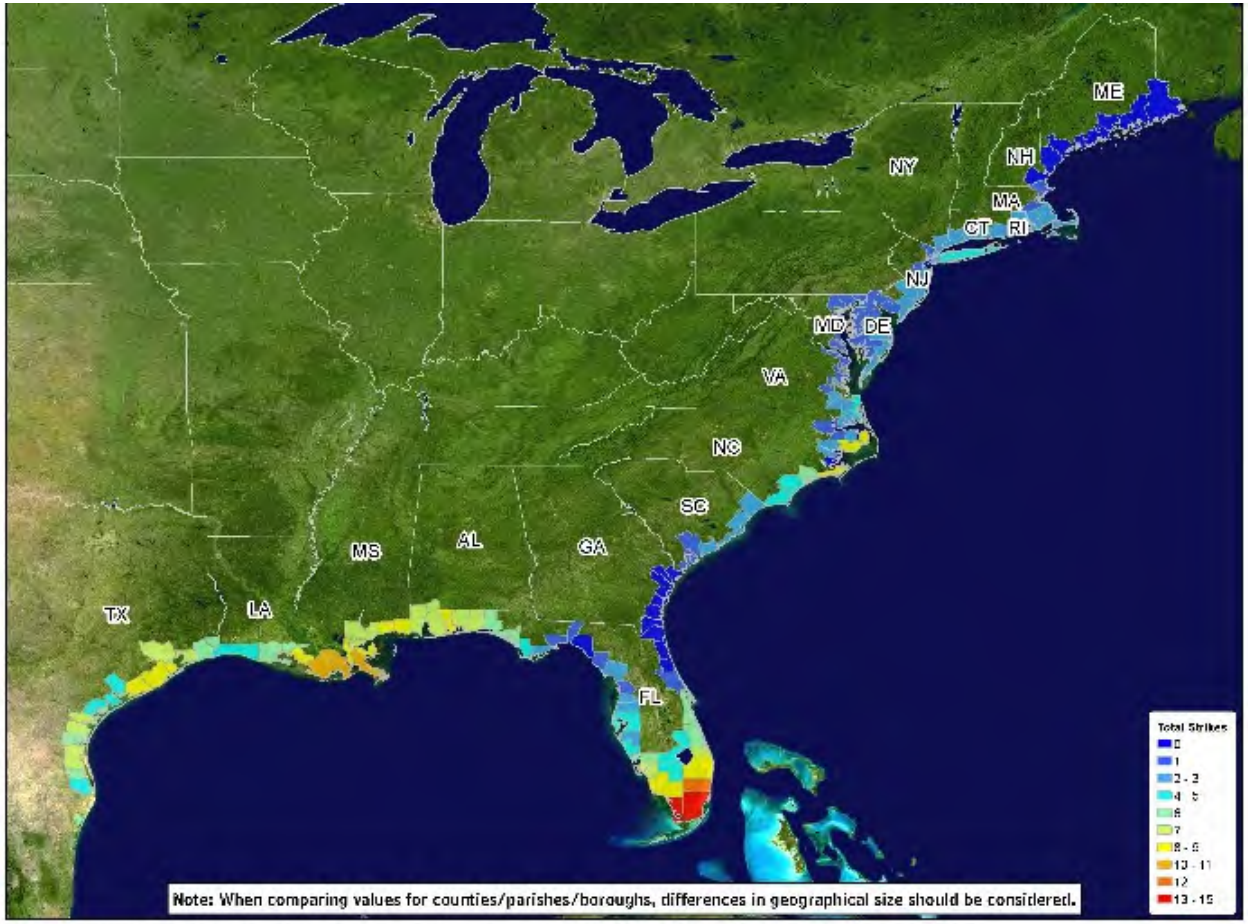
Historical Occurrence at Somerset and Vicinity

In the vicinity of Somerset, the hurricane recurrence interval of the hurricane passing or striking in the vicinity of Somerset is about 13 to 17 years. In the vicinity of Somerset, the recurrence interval for major hurricanes (Cat 2 and above) is about 52 to 62 years.

Estimated Probability of Occurrence at and near Somerset

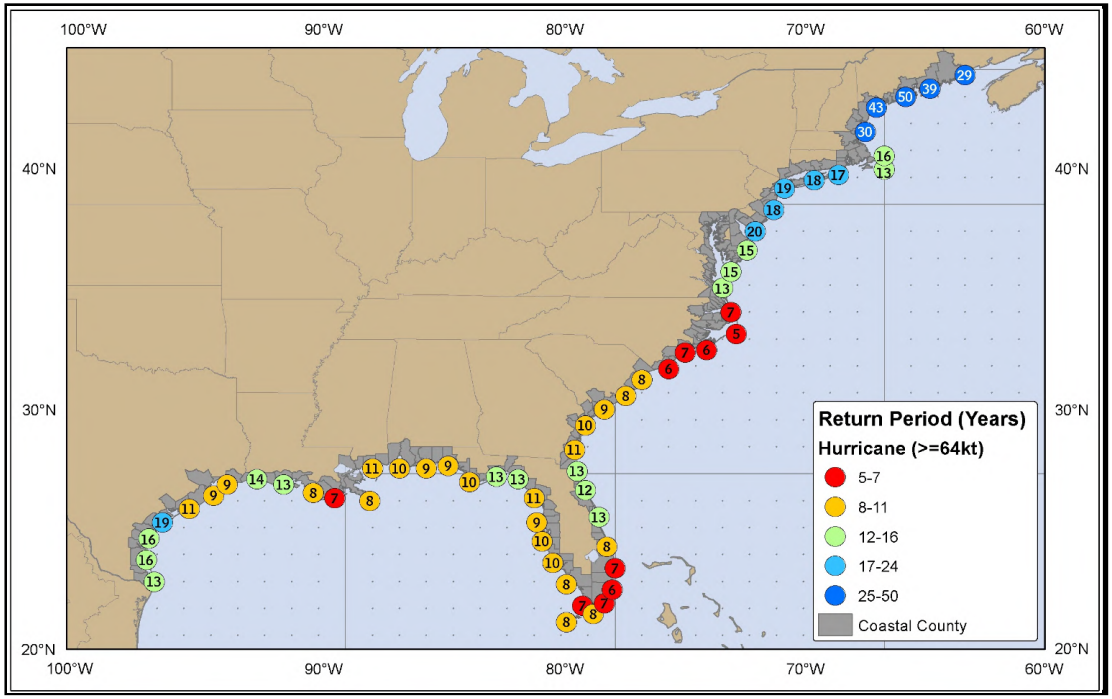
The results indicate the following hurricane strike probability at and near Somerset:

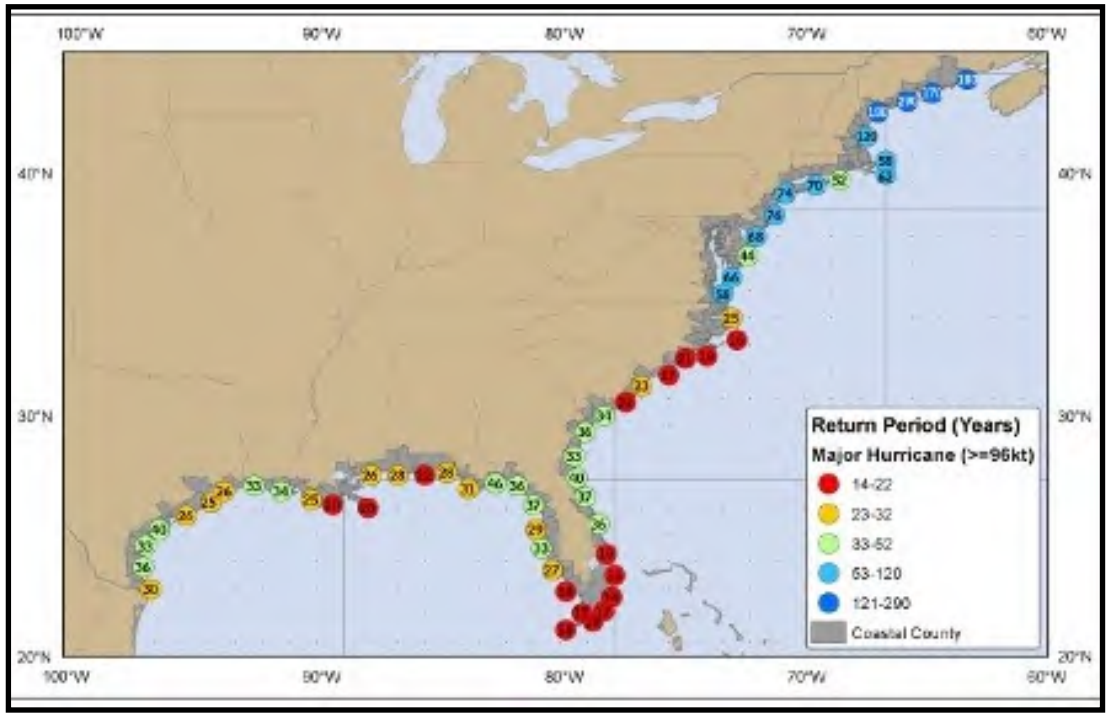
- All Hurricanes: 7% AEP or 15-year recurrence interval
- Major (≥ Cat 3) Hurricanes: 2% or 50-year recurrence period



Total number of major hurricane strikes by counties/parishes/boroughs, 1900-2010

Figure 2-4: Hurricane Strikes (source - NOAA)





Figures 2-5 and 2-6: Hurricane Recurrence Interval (all hurricanes - top and major hurricanes - bottom)
(Source: (Source: https://www.nhc.noaa.gov/climo/#bac

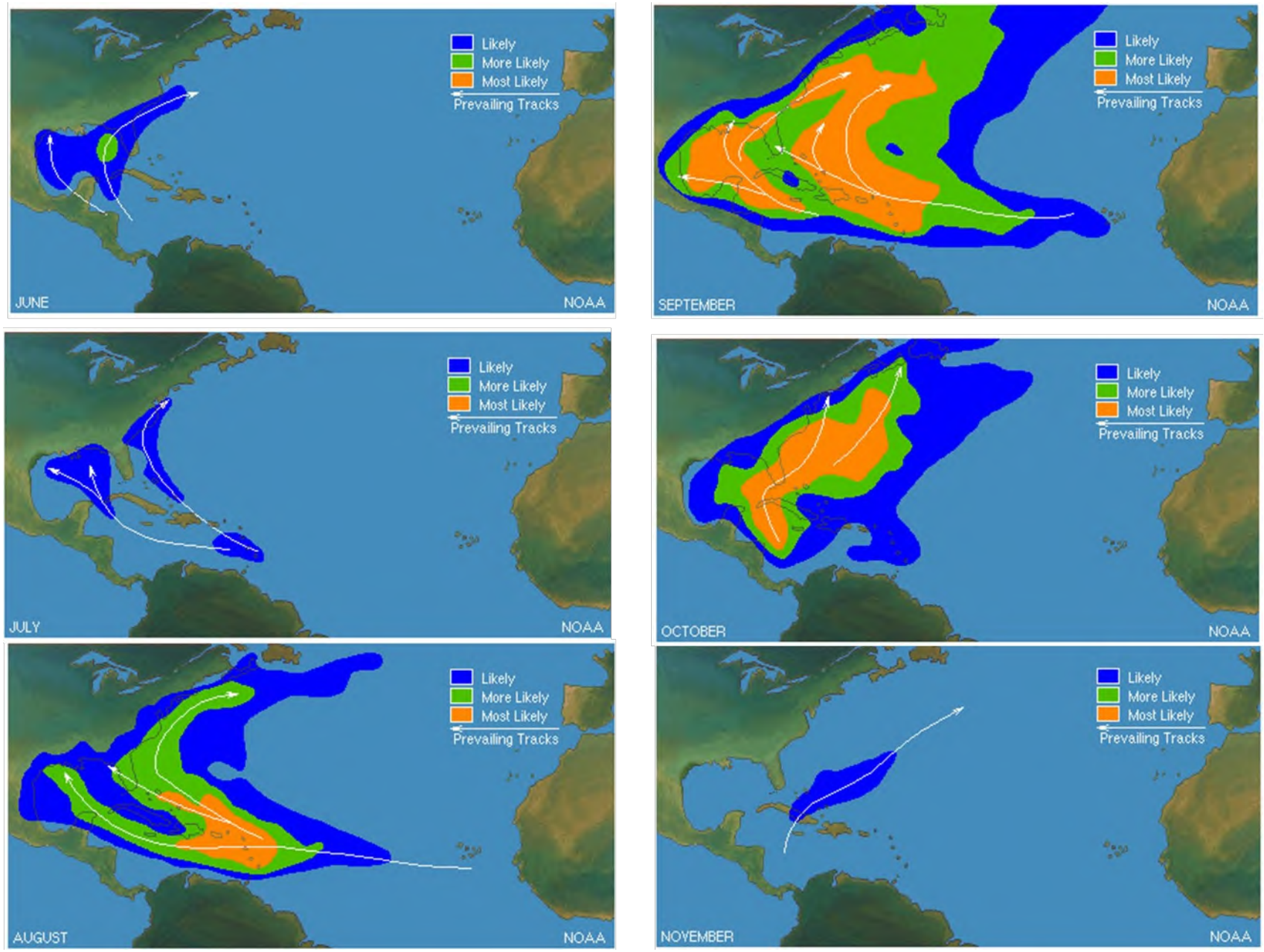


Figure 2-7: Hurricane Origin and Track Probability by Month

THUNDERSTORMS

A thunderstorm is characterized by lightning and thunder and usually produces gusty winds, heavy rain, and sometimes hail. Cumulonimbus clouds produce lightning, which locally heats the air to 50,000 degrees Celsius, which in turn produces an audible shock wave, known as thunder. Tornadoes can also be generated during these events. Three basic ingredients are required for a thunderstorm to form: moisture, rising unstable air (air that keeps rising when given a nudge), and a lifting mechanism. Every thunderstorm has an updraft (rising air) and a downdraft (sinking air). Sometimes strong downdrafts known as downbursts can cause tremendous wind damage, similar to that of a tornado. A small (< 2.5-mile path) downburst is known as a "microburst" and a larger downburst is called a "macroburst."

The peak season for severe thunderstorms in the Northeast U.S. is June through August, although thunderstorms also occur in the Spring and Fall, and thunder can occur during winter snow storms. Hazards from thunderstorms include high to extreme winds, lightning, torrential downpours, and hail. Thunderstorms can spawn tornadoes and cause flash floods, downed trees and power lines, power outages, and mudslides. Roads may become impassable due to flooding, downed trees, or a landslide. Power lines may be downed due to high winds, and services such as water or phone may not be able to operate without power. Lightning can cause severe damage and injury. Fatalities are uncommon, but can occur.

Lightning strikes primarily occur during the summer months. There were 16 lightning deaths in the U.S. in 2017, none of which occurred in Massachusetts (http://www.lightningsafety.noaa.gov/fatalities.shtml).

Figure 2-8 shows the average number of thunderstorm days throughout the U.S. Massachusetts, including Bristol County, experiences between 20 and 30 thunderstorm days each year.

An average thunderstorm is 15 miles across and lasts 30 minutes; severe thunderstorms can be much larger and longer. According to the National Weather Service:

- a severe thunderstorm is a thunderstorm that produces a tornado, winds of at least 58 mph (50 knots or ~93 km/h), and/or hail at least 1" in diameter; and
- An approaching severe thunderstorm is a thunderstorm with winds equal to or greater than 40 mph (35 knots or ~64 km/h) and/or hail of at least ½"

Observed structural wind damage may imply the occurrence of a severe thunderstorm. Hail of 1" or greater can damage property such as plants, roofs and vehicles. http://www.weather.gov/bgm/severedefinitions

Derechos: Based on climatology, Massachusetts is located in a zone where derechos are predicted to occur about 1 every four years (typically during April to August).

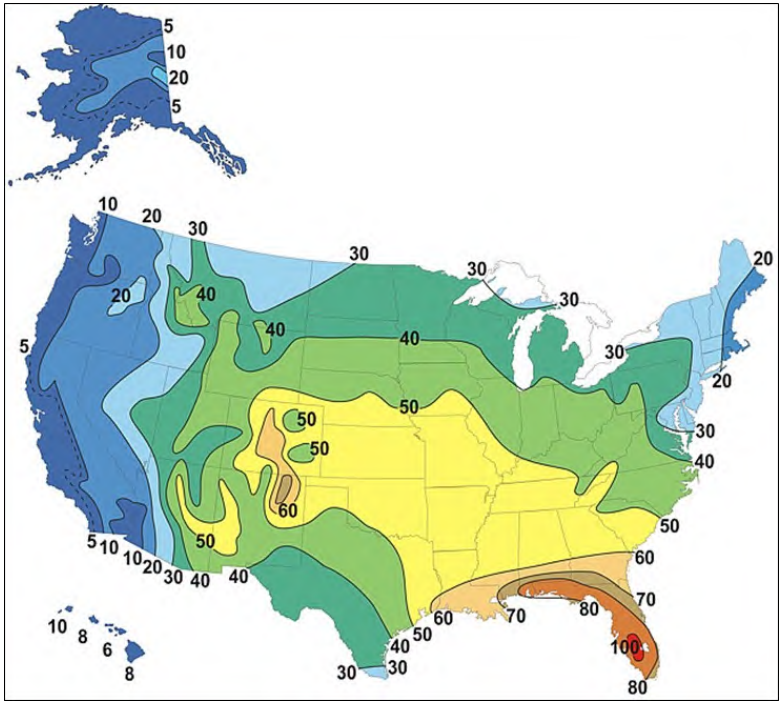


Figure 2-8: Average Annual Number of Thunderstorms in U.S.
(Source: http://www.srh.noaa.gov/jetstream/tstorms/tstorms_intro.html)

Historical

Occurrence at Somerset and Vicinity

One hundred and twenty-eight thunderstorm wind events have occurred in Bristol County from 1966 to 2017, resulting in about $640k in property damage (about $11,000 per event) and 1 death. Forty of these events resulted in damage and 1 event resulted in death or injury. Of these, three thunderstorm events impacted the Town of Somerset, all of which occurred in 2008. The most severe thunderstorm, resulting in $6K in wind damages, occurred on July 23, 2008. Other severe thunderstorms were reported in Somerset on March 5, 2008. Ref. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/ For this database, thunderstorm winds are defined as speeds of at least 58mph or of any speed producing a fatality, injury or damage.

Estimated Probability of Occurrence at and near Somerset

The results indicate the following thunderstorm wind probability at and near Somerset (within Bristol County):

- Thunderstorm Winds within Bristol County: 56% AEP or minimum of 1-year to 2-year recurrence interval (29 years with 1 or more events over 52 years)
- Based on proportional land area, the estimated AEP at Somerset is about 1

TORNADOES

A tornado is a violently rotating column of air that has contact with the ground and is often visible as a funnel cloud. The destruction caused by tornadoes ranges from light to catastrophic depending on the intensity, size, and duration of the storm. Typically, tornadoes cause the greatest damage to structures of light construction, including residential dwellings and particularly manufactured homes. Tornadoes are more likely to occur during the months of March through May and tend to form in the late afternoon and early evening.

Since 2007, tornadoes have been categorized according to the Enhanced Fujita scale:

Scale	Wind speed estimate		Potential damage
	mph	km/h	
EF0	65–85	105–137	Minor damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e., those that remain in open fields) are always rated EF0.
EF1	86–110	138–177	Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111–135	178–217	Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF3	136–165	218–266	Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations are badly damaged.
EF4	166–200	267–322	Devastating damage. Well-constructed and whole frame houses completely leveled; cars and other large objects thrown and small missiles generated.
EF5	>200	>322	Incredible damage. Strong-framed, well-built houses leveled off foundations are swept away; steel-reinforced concrete structures are critically damaged; tall buildings collapse or have severe structural deformations; some cars, trucks, and train cars can be thrown approximately 1 mile (1.6 km).

Table 2-5: Enhance Fujita Scale for Tornadoes

Prior to 2007, tornadoes were categorized according to the Fujita Tornado Intensity Scale:

Scale	Wind Speed Estimate (mph)	Potential Damage
Category F0:	Gale tornado (40-72 mph)	Light damage. Some damage to chimneys; break branches off trees; push over shallow-rooted trees; damage to sign boards.
Category F1	Moderate tornado (73-112 mph)	Moderate damage. The lower limit is the beginning of hurricane wind speed; peel surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads.
Category F2	Significant tornado (113-157 mph)	Considerable damage. roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated.
Category F3	Severe tornado (158-206 mph)	Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off ground and thrown.
Category F4	Devastating tornado (207-260 mph)	Devastating damage. Well-constructed houses leveled; structure with weak foundation blown off some distance; cars thrown and large missiles generated.
Category F5	Incredible tornado (261-318 mph)	Incredible damage. Strong frame houses lifted off foundations and carried considerable distance to disintegrate; automobile sized missiles fly through the air in excess of 100 yards; trees debarked; incredible phenomena will occur.

Table 2-6: Original Fujita Tornado Intensity Scale

Tornadoes can also occur anywhere in Massachusetts, although relatively infrequently. Between 1950 and 2018, there were 171 tornado events within Massachusetts including 103 days with damage, 23 days with injury or death and 8 days with deaths., resulting in $534M damages. The data for this period for the State is presented below:

Magnitude	No of Days with Event	No. of Injuries	No. of Deaths	Property Damage
F0/EF0	27	6	1	$391,000
F1/EF1	54	37	1	$6,707,000
F2/EF2	27	9	2	$16,043,000
F3/EF3	5	221	4	$235,900,000
F4/E4	3	1288	97	$275,000,000

Magnitude	Avg. No of Events/year	Avg. No. of Injuries/Event	Avg. No. of Deaths/Event	Avg. Property Damage/ Event
All	1.7	13.4	1	-
F0/EF0	0.4	0.2	0.04	$14,481
F1/EF1	0.8	0.7	0.02	$124,204
F2/EF2	0.4	0.3	0.07	$594,185
F3/EF3	0.07	44.2	0.8	$47,180,000
F4/E4	0.04	429.3	32.3	$91,666,667

Table 2-7 Massachusetts Tornado Data for the period of 1950 to 2018

Tornado risk is calculated from the destruction path that has occurred within 30 miles of the location. Details for Bristol County are presented in **Table 2-8.** The tornadoes were generally weak. The 1953 tornado, however, was a severe tornado of relatively long duration. A total of 7 days with tornadoes were reported in Bristol County for the period of record between 1950 and 2018, according to the NOAA Storm Events Database. **Figure 2-9** shows the start and end points and tracks of the Bristol County tornadoes. These tornadoes ranged in severity from F0 to F3, with more recent tornadoes rated under the EF scale at EF0. These tornadoes occurred between the months of June and August. There have been 20 tornadoes (F1 and F2) in the last 75 years near (within about 30 miles) Somerset.

Date	County, State	Fujita	Fatalities	Injuries	Length(miles)
6/9/1953	Bristol, Massachusetts	F3	0	17	28
8/9/1968	Bristol, Massachusetts	F1	0	4	0.1
8/9/1968	Bristol, Massachusetts	F1	0	0	1
8/2/1970	Bristol, Massachusetts	F1	0	0	2
8/28/1970	Bristol, Massachusetts	F2	0	0	1
9/14/1972	Bristol, Massachusetts	F0	0	0	4.1
8/6/1997	Bristol, Massachusetts	F0	0	0	0.1
7/23/2008	Bristol, Massachusetts	F1	0	0	4.28
7/23/2008	Bristol, Massachusetts	F1	0	0	2.97
7/23/2008	Bristol, Massachusetts	0	0	0	1.31

Table 2-8: Bristol County, Massachusetts Tornado Data for the period

Historical Occurrence at Somerset and Vicinity

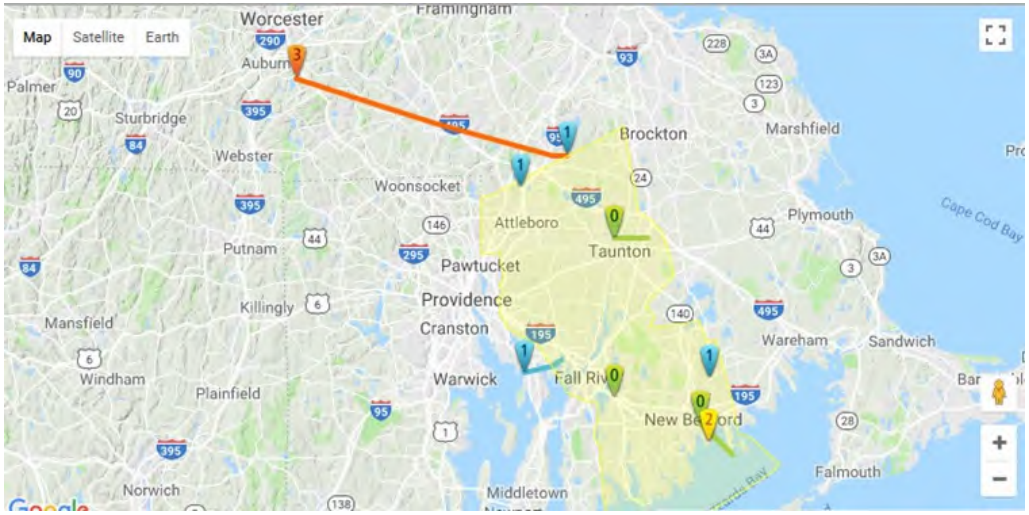
Of the 7 tornadoes in Bristol County, the F3 tornado during June, 1953 resulted in the largest degree of damages at $2.6 Million and one injury. The 6 other tornadoes combined accounted for less than $60 thousand in total damages where most of the tornadoes ranged in severity from F0 to F1; however, four injuries (the most for any tornado event) resulted from a single tornado that occurred August of 1968. Ref. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/

Estimated Probability of Occurrence at and near Somerset

The results indicate the following tornado probability at and near Somerset (within Bristol County):

- Tornadoes within Bristol County: 9% AEP or 11-year recurrence interval (6 years with 1 or more events over 68 years)
- Major tornado within Bristol County: 1.5% AEP or 70-year recurrence interval
- Based on the proportional land area, the Somerset tornado AEP is about 0.2% and the Somerset major tornado AEP is very low (less than 0.2%).

Figure 2-9: Location of Bristol County Tornadoes
http://www.tornadohistoryproject.com/tornado/Massachusetts/Bristol/



Severe Weather Hazards: Lightning

LIGHTNING

Lightning is the second most common storm-related killer in the United States. It causes several billion dollars in property damage each year and kills several dozen people. It is a frequent cause of wildfires and costs airlines billions of dollars per year in extra operating expenses.

Lightning is a giant spark of electricity in the atmosphere between clouds, the air, or the ground. In the early stages of development, air acts as an insulator between the positive and negative charges in the cloud and between the cloud and the ground. When the opposite charges builds up enough, this insulating capacity of the air breaks down and there is a rapid discharge of electricity that we know as lightning. The flash of lightning temporarily equalizes the charged regions in the atmosphere until the opposite charges build up again. Lightning can occur between opposite charges within the thunderstorm cloud (intra-cloud lightning) or between opposite charges in the cloud and on the ground (cloud-to-ground lightning).

Massachusetts, including Bristol County, has a moderate risk associated with Lightning strikes relative to other states. **Figures 2-10** and **2-11** show the number of fatalities and relative fatality rates by state. Collectively (considering Rhode Island and Massachusetts), there have been 9 Lightning fatalities during the period of 2005 and 2014 (an average of 1 per year).

Historical Occurrence at Somerset and Vicinity

Since 1997, Bristol County has experienced 31 Lightning events and 23 days with Lightning resulting in about $378k in property damage, 4 injuries and no deaths. One event occurred within Somerset, resulting in $5k damage and no injuries or fatalities.

NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/

Estimated Probability of Occurrence at and near Somerset

The results indicate the following Lightning probability at and near Somerset (within Bristol County):

- Lightning Events resulting in fatality, injury and/or damage within Bristol County: 58% AEP or 1.8-year recurrence interval (12 years with 1 or more events over 21 years)
- Lightning Events resulting in fatality, injury and/or damage within Somerset: 5% AEP or 20-year recurrence interval (1 year with 1 or more events over 21 years)

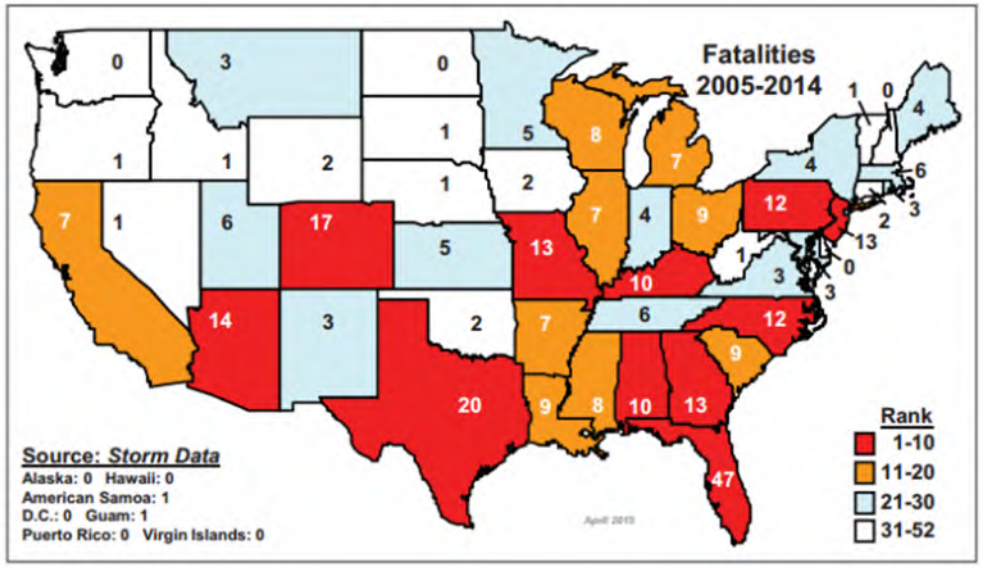


Figure 2-10: Lightning Fatalities by State, 2005-2014; (Source: Vaisala)

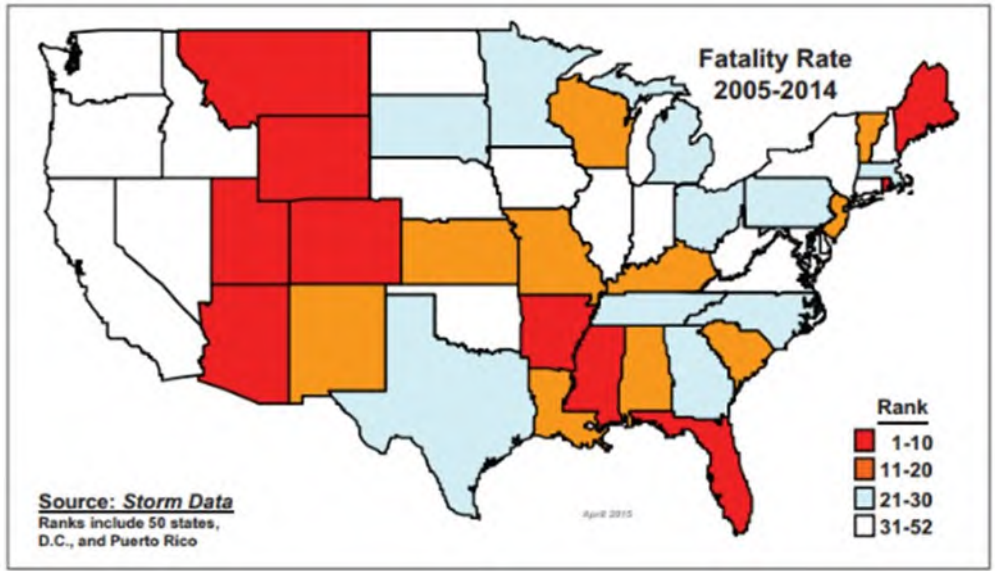


Figure 2-11: Lightning Fatalities Weighted by Population, 2005-2014; (Source: Vaisala)

Severe Weather Hazards: Intense Rainfall

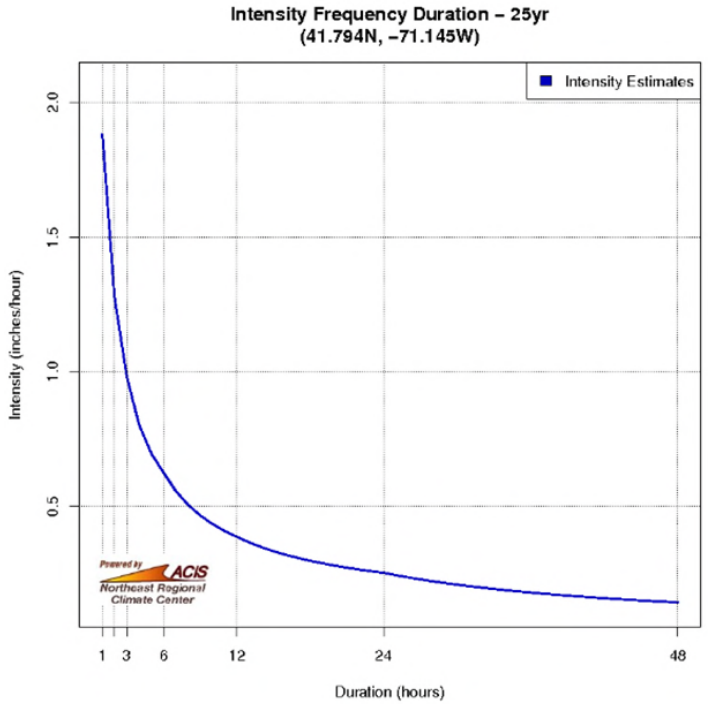
INTENSE RAINFALL

Intense, heavy rainfall can result in localized flooding including flash flood events. Several factors contribute to intense precipitation flooding including rainfall intensity and duration. Other factors include the presence of streams and rivers, soil type, ground cover, drainage and the capacity of stormwater infrastructure. **Table 2-9** presents precipitation projections for Bristol County developed by the Northeast Regional Council Climate Center.

Extreme Precipitation Estimates

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.30	0.45	0.56	0.74	0.92	1.16	1yr	0.79	1.11	1.34	1.69	2.14	2.72	3.06	1yr	2.41	2.94	3.35	4.09	4.73	1yr
2yr	0.36	0.56	0.70	0.92	1.16	1.45	2yr	1.00	1.36	1.68	2.10	2.63	3.28	3.63	2yr	2.91	3.49	3.97	4.72	5.36	2yr
5yr	0.43	0.68	0.85	1.14	1.45	1.84	5yr	1.25	1.71	2.14	2.67	3.32	4.11	4.59	5yr	3.64	4.41	5.01	5.88	6.61	5yr
10yr	0.49	0.78	0.98	1.33	1.73	2.21	10yr	1.50	2.03	2.57	3.21	3.96	4.87	5.49	10yr	4.31	5.28	5.99	6.95	7.75	10yr
25yr	0.58	0.93	1.18	1.64	2.18	2.81	25yr	1.88	2.55	3.27	4.08	5.02	6.11	6.95	25yr	5.40	6.68	7.58	8.67	9.56	25yr
50yr	0.67	1.08	1.38	1.93	2.60	3.37	50yr	2.24	3.03	3.92	4.88	5.98	7.24	8.31	50yr	6.41	8.00	9.06	10.26	11.21	50yr
100yr	0.77	1.24	1.60	2.27	3.10	4.04	100yr	2.68	3.60	4.71	5.85	7.14	8.60	9.95	100yr	7.61	9.57	10.83	12.13	13.15	100yr
200yr	0.88	1.44	1.87	2.68	3.70	4.84	200yr	3.19	4.29	5.65	7.01	8.52	10.22	11.92	200yr	9.04	11.46	12.95	14.36	15.43	200yr
500yr	1.07	1.77	2.30	3.34	4.68	6.15	500yr	4.04	5.40	7.19	8.90	10.77	12.84	15.14	500yr	11.36	14.56	16.42	17.96	19.07	500yr

Table 2-9: Predicted Rainfall Intensity by Duration and Recurrence Interval for Bristol County



While there is no specific, single set of criteria that defines "intense rainfall", the rainfall intensities associated with a 25-year recurrence interval are a reasonable benchmark (a 1 in 4 chance of being met or exceeded in any given year). These are presented for Massachusetts including Bristol County in **Figure 2-12**. This figure indicates short duration intensities on the order of 1.5 to 2 inches per hour and longer duration intensities on the order of an average 0.25 inch per hour over 24 hours (one and two day total rainfall amounts of about 6 and 7 inches, respectively).

Historical Occurrence at Somerset and Vicinity

During the period between 1995 and 2008, Bristol County experienced 32 days with Heavy Rain events, an average of about 2.5 event days per year, with no documented property damages, injuries or death. Ref. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/

Estimated Probability of Occurrence at and near Somerset

The results indicate the following intense rainfall probability at and near Somerset (within Bristol County):

- Intense Rainfall within Bristol County: 4% AEP or 25-year recurrence

Figure 2-12: Bristol County Rainfall Intensity-Duration for the 25-year Recurrence Interval Rainfall

Severe Weather Hazards: Hail

HAIL

Hailstorms are a potentially damaging outgrowth of severe thunderstorms. Hailstorms frequently accompany thunderstorms, so their locations and spatial extents overlap. Large hail (greater than 1 inch in diameter) can be destructive. Hail can cause substantial damage to vehicles, roofs, landscaping, and other areas of the built environment. U.S. agriculture is typically the resource most affected by hail storms, which cause severe crop damage even during minor events. A recent risk, due to the widespread use of solar panels, is hail-related damage to solar panels.

Hail storms are fairly common in Massachusetts, including Somerset. For this period of 1990 to 2018, Massachusetts hail data indicates:

- 1990-2004: 127 days (an average of 8 event per year), with 0 injuries, 0 deaths and $222K property damage (average property damage of $1,800 per event)
- 2005-2009: 78 days (an average of 16 events per year), with 0 injuries, 0 deaths and $269K property damage (average property damage of $3,500 per event)
- 2010-2018: 81 days (an average of 9 events per year), with 0 injuries, 0 deaths and $3.03M property damage (average property damage of $37,500 per event)

Per HomeAdvisor.com, the average per building cost, nationally, to repair hail, wind or storm damage is $6,640 ranging from $400 to $30,000.

The Hail Risk Score (**Table 2-10**) provides a short-to-medium term view of future hail risk based on the last 10 years of ultra-high resolution radar data. The score is based on a scale of 1 to 10, with the lowest score of 1 representing Very Low hail risk (damaging hail unlikely in the next 5-10 years) and the highest score of 10 representing Extreme hail risk (damaging hail very likely every year).

The Hail Risk Score for the Somerset area (based on scores for Providence, Rhode Island, Rehoboth, Massachusetts and New Bedford, Massachusetts – reference stormersite.com) is 1.

Hail Risk Score	Hail Risk	Hail Risk Guidance
1	Very low	Damaging Hail unlikely in next 5-10 years
2	Very Low to Low	Damaging Hail likely every 5 years
3	Low	Damaging Hail likely every 2-4 years
4	Low to Moderate	Damaging Hail likely every 2-3 years
5	Moderate	Damaging Hail likely every other year
6	Moderate	Damaging Hail very likely every other year
7	Moderate to High	Damaging Hail likely every 1-2 years
8	High	Damaging Hail very likely every 1-2 years
9	Very High	Damaging Hail likely every year
10	Extreme	Damaging Hail very likely every year

Table 2-10: Hail Risk Score Classifications

Historical Occurrence at Somerset and Vicinity

For the period of 1974 to 2018, there have been 71 hail events in Bristol County including 32 days with hail days, 1 hail day with damage (resulting in $5K property damage; average property damage of about $150 per event) and no fatalities. None of these events occurred in Somerset. Ref. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/

Estimated Probability of Occurrence at and near Somerset

The results indicate the following hail probability at and near Somerset (within Bristol County):

- 45% AEP or 2 year recurrence interval (20 years with 1 or more events over 44 years)

Severe Weather Hazards: Flood

FLOOD

A flood is the partial or complete inundation of normally dry land. The various types of flooding include riverine flooding, coastal flooding, and shallow flooding. Common impacts of flooding include damage to personal property, buildings and infrastructure; bridge and road closures; service disruptions; and injuries or even fatalities.

The Town is vulnerable to:

- **Coastal storm surge.** Due to its low-lying coastal setting on Mount Hope Bay and the Taunton and Lee Rivers, the nearshore portions of Somerset are vulnerable to coastal flooding including flood inundation and waves. The Taunton and Lee Rivers are estuaries subject to tides and storm surge and the principal cause of flooding of these rivers is due to coastal storm surge.
- **Rainfall events.** Inland (urban) flooding associated with large rainfall events, in particular within areas with impervious surfaces, poor drainage and inadequate stormwater management.

The Town is not vulnerable to other types of flooding including:

- **Nuisance flooding (aka coastal shallow water flooding)**. Coastal, frequent shallow water flooding due to astronomical high tides is not currently a significant flood issue within Somerset.
- **River Flooding**. No inland rivers are present within Somerset.

Coastal Flooding

Coastal floods in Massachusetts are due to tropical cyclones (hurricanes and tropical storms) and extratropical nor'easters. The top ten highest water levels recorded at the NOAA tide stations (as of 1930/1938 to April, 2017) located in the vicinity of Somerset (the NOAA tide stations at Providence and Newport) are presented in **Table 2-11**.

More than ten major coastal flood events have occurred in Massachusetts over the last 50 years. Several of this resulted in minimal-to-moderate damage to Bristol County. The Hurricane of 1938 is the largest coastal flood event on record in the area of Somerset. Hurricane Gloria in September 1985 arrived at low tide and resulted in storm surges of about 5 feet above normal, which did not result in extensive damage to the coastline. Hurricane Bob in August 1991 made landfall over Block Island, RI and crossed into Massachusetts primarily affecting southeastern Massachusetts, Cape Cod and the islands. An unnamed coastal storm in October 1991 (aka the Perfect Storm) joined up with the remains of Hurricane Grace and resulted in the 7th highest floods near Somerset. In August 2011, Hurricane Irene, weakened to a tropical storm, flooded numerous roads throughout Bristol County. Peak storm tides of 5 to 7 feet above Mean Lower Low Water (MLLW) were recorded at the Cities of Fall River and Taunton.

Table 2-11: Top Ten Coastal Floods near Somerset
Note: Water levels are referenced to feet above MHHW with no adjustment for sea level rise.

Station	1	2	3	4	5
8452660 Newport	Hurricane of 38 9/21/1938 9.46 feet	Hurricane Carol 8/31/1954 6.76 feet	Perfect Storm 10/29/2012 4.21 feet	Hurricane Bob 8/19/1991 3.98 feet	Great Atlantic Hurricane 9/14/1944 3.96 feet
	6	7	8	9	10
	Nor'easter 1/9/1978 3.60 feet	Perfect Storm 10/31/1991 3.26 feet	Blizzard of 1978 2/7/1978 3.25 feet	Nor'easter 11/30/1963 3.25 feet	Nor'easter 12/2/1974 3.24 feet
	1	2	3	4	5
8454000 Providence	Hurricane of 38 9/21/1938 12.67 feet	Great Atlantic Hurricane 9/14/1944 5.87 feet	Hurricane Bob 8/19/1991 5.15 feet	Nor'easter 1/9/1978 4.91 feet	Hurricane Donna 9/12/1960 4.77 feet
	6	7	8	9	10
	Nor'easter 11/30/1963 4.67 feet	Perfect Storm 10/29/2012 4.35 feet	Hurricane Gloria 9/27/1985 4.31 feet	Nor'easter 1/2/1987 4.28 feet	April Nor'easter 4/16/2007 4.07 feet

Coastal flooding at Somerset occurs due to storm surge and waves within Narragansett Bay, Mount Hope Bay and the Taunton river. Coastal storm surges will also propagate up waterways that are hydraulically connected with Mount Hope Bay and the Taunton river. An assessment of the coastal flood frequency applicable to the Town was performed based on the following data sources. Flood frequency is characterized in terms annual exceedance probability (also recurrence interval).

- The current FEMA FIRMs and Flood Insurance Studies (FIS). The current FEMA FIS is the Bristol County, Massachusetts (All Jurisdictions) study, revision date July 16, 2015, Flood Insurance Study Number 25005CV001C.
- The results of the Army Corps of Engineers (USACE) North Atlantic Coast Comprehensive Study (NAACS). This study was performed by the USACE after Hurricane Sandy to characterize coastal flood hazards in areas impacted by Hurricane Sandy (from the Chesapeake Bay to New Hampshire). The study included statistical analysis and computer modeling of storm surge and waves. The study provides nearshore storm surge and wave hazard data at several locations along the Somerset shoreline.

FEMA Flood Hazard Determination

Through FEMA's flood hazard mapping program, Risk Mapping, Assessment and Planning (MAP), FEMA identifies flood hazards, assesses flood risks and partners with states and communities to provide accurate flood hazard and risk data to guide them to mitigation actions. Flood hazard mapping is an important part of the National Flood Insurance Program (NFIP), as it is the basis of the NFIP regulations and flood insurance requirements. FEMA maintains and updates data through Flood Insurance Rate Maps (FIRMs) and risk assessments. FEMA coastal transects provide detailed flood data around Somerset and are summarized in **Table 2-12**. Flood elevations are presented in **Table 2-12** for: 1) the stillwater elevation, which is the water level in the absence of waves; 2) the Total Water Level which includes the stillwater elevation and the effects of wave setup; and 3) the Base Flood Elevation (BFE). The BFE is the flood having a one percent chance of being equaled or exceeded in any given year. This is the regulatory standard also referred to as the "100-year flood" and includes the Total Water Level plus wave plus wave runup. The elevation datum is feet, NAVD88.

Transect	Stillwater Elevation (SWEL)				Total Water Level	Wave Crest Elevation	FEMA Flood Zone	Base Flood Elevation
	10%	2%	1%	0.2%	1%	1%		
Mount Hope Bay								
62 (Lee River)	8.4	12.3	13.9	17.6	15.5	22.5	VE AE	18 NA
63 (Brayton Point)	8.4	12.3	13.9	17.6	15.4	22.3	VE AE	18 NA
64 (Southwest of Braga Bridge)	8.4	12.3	13.9	17.6	16.6	22.1	VE AE	19 17
Taunton River								
65 (South of Slades Ferry Ave.)	8.4	12.3	13.9	17.6	15.5	18.4	VE AE	18 15-16
66 (North of Route 6)	8.4	12.3	13.9	17.6	14.4	17.6	VE AE	16 15
67 (Buffington Street)	8.4	12.3	13.9	17.6	14.6	17.6	VE AE	17 NA
68 (near Pierce Playground)	8.4	12.3	13.9	17.6	15.1	18	VE AE	19 NA
69 (Clark Steert and Main)	8.4	12.3	13.9	17.6	14.9	17.9	VE AE	18 NA

Table 2-12: FEMA Coastal Transect Data around Somerset
Note: Water levels are referenced to feet, NAVD88

North Atlantic Coast Comprehensive Study

Table 2-13 presents flood stillwater levels and wave heights at representative save points, as predicted by the USACE NACCS study. Figure 2-13 shows the locations of the NACCS save points. The save point locations correspond to the FEMA transect locations in **Table 2-12**. The values presented below represent mean values. The range of uncertainty (95% confidence intervals) associated with the stillwater levels at the 1% and 0.2% floods is about 4 feet. The NACCS predicted values differ somewhat from FEMA due to the difference in methodologies used. Consistent with FEMA, the NACCS-predicted 1% wave heights indicate high velocity (VE) zones along Somerset's shorelines.

Historical Occurrence at Somerset and Vicinity

For the period of 1997 to 2018, there have been 7 coastal flood events in Bristol County, including 5 days with property damage (resulting in $525k of damage), no injuries and no deaths. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/

Estimated Probability of Occurrence at and near Somerset

The results indicate the following coastal flood probability at and near Somerset (within Bristol County):

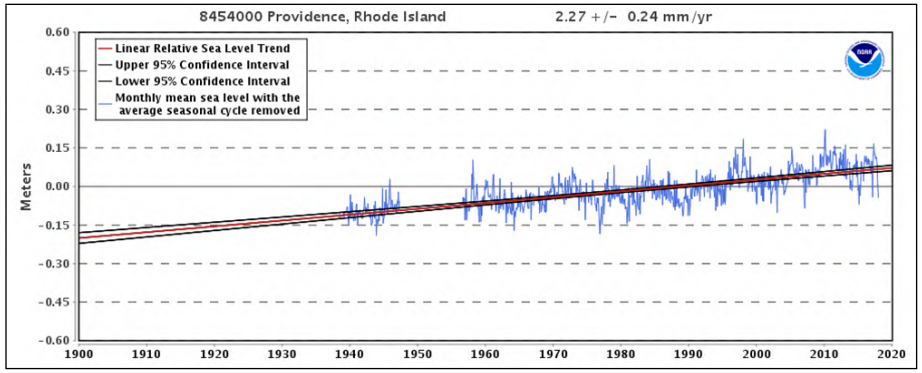
- See Tables 2-12 and 2-13.

NACCS Save Point	Mean Stillwater Elevation (SWEL)							Mean 1% Wave Height, ft.
	100%	50%	20%	10%	2%	1%	0.2%	
Mount Hope Bay								
8674	4.4	5.1	6.1	7.0	10.5	12.0	15.4	5.0
8704	4.4	5.1	6.0	7.0	10.3	11.7	15.0	6.4
8677	4.4	5.1	6.0	7.0	10.3	11.8	15.2	5.5
Taunton River								
8680	4.4	5.1	6.1	7.0	10.3	11.7	15.0	4.2
8681	4.4	5.1	6.1	7.0	10.4	11.8	15.0	3.9
8683	4.5	5.2	6.2	7.1	10.6	12.1	15.4	3.9
8684	4.5	5.2	6.2	7.2	10.7	12.2	15.6	3.5
8685	4.5	5.2	6.2	7.2	10.8	12.4	15.9	3.5

Table 2-13: NACCS Save Point Data around Somerset
Note: Water levels are referenced to feet, NAVD88

Climate Change Effects and Coastal Flood Occurrence

There is high confidence, within the scientific community, that the frequency and elevations of coastal flooding will increase within southern New England due primarily to the increase in relative sea level rise. There is lower confidence, and less understanding, in the attribution of increased intensity of coastal storms that may effect future coastal flood levels.



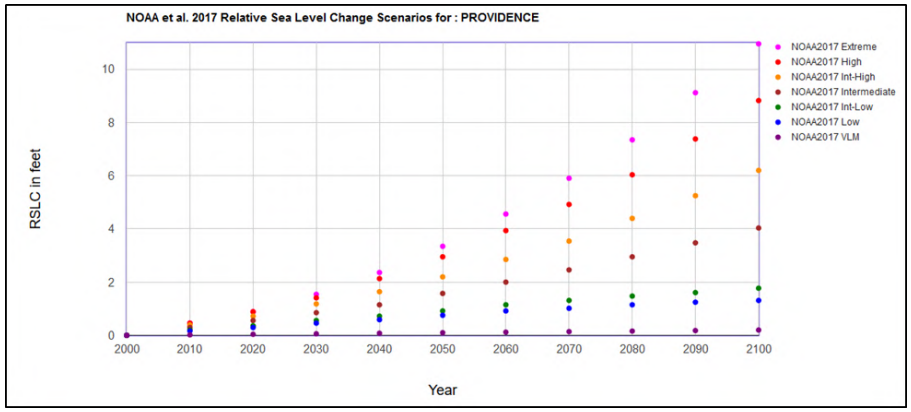


Figure 2-14: Observed (top) and Projected (bottom) Sea Level Rise at NOAA Providence Tide Station

Figure 2-13: NACCS Save Point Locations near Somerset

Figure 2-14 shows the observed sea level rise at the NOAA Providence tide station. On average, over the last +/- 80 years the observed mean rate of sea level rise at the Providence, tide gage has been about 2.27 millimeters per year (about 0.09 inch/year or about 9 inches in 100 years). **Figure 2-14** also shows the NOAA 2017 sea level rise projections (relative to the year 2000) for Providence. The NOAA 2017 Intermediate-Low projection has a high likelihood of occurrence (50% to near 100%) and the Intermediate projection is a reasonable planning upper bound. This means that (relative to the year 2000), sea levels will rise by 0.92 to 1.57 feet by the year 2050 and 1.77 to 4.04 feet by the year 2100. For planning purposes, the predicted sea level rise can be added linearly to the predicted flood levels presented in **Tables 2-12 and 2-13**. The assumed 1% AEP flood stillwater in 2050 is about Elevation 13.6 feet NAVD88 and is about 16 feet NAVD88 in the year 2100.

Intense Rainfall and Urban Flooding

Intense, heavy rainfall can result in localized flooding including flash flood events. Risks due to intense rainfall is predominantly associated with flash flooding and are typically related to the capacity of the existing stormwater infrastructure to manage stormwater run-off. High velocity stormwater flow can also occur during these events. Damages can include localized flooding, damage to property and vehicles and potentially safety risk to the public.

Historical Occurrence at Somerset and Vicinity

- During the period between 1996 and 2003, Bristol County experienced 32 days with Heavy Rain events, an average of about 3 to 4 event days per year, with no documented property damages, injuries or death. Ref. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/
- During the period between 1998 and 2016, Bristol County experienced 24 days with Flash Flood events, an average of about 1 event day per year, with no documented property damages, injuries or death. Ref. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/
- Flooding occurred along County Street (Route 138) (Figure 2-15 facing) at the intersection with Buffinton Street (located downslope from Buffinton Park, several wetland areas and Lewis Brook) during March, 2010. A slow moving low pressure system, combined with a Canadian high and southerly upper jet created a deep plume of moisture and record rainfalls in SE Massachusetts and Rhode Island. Somerset experienced 6 to 8 inches of total rainfall between March 29 and 31, 2010. This storm was preceded by two other major rain events: March 22 to 23, 2010; and March 13 to 15, 2010. The March 29 to 31 event was consistent with a 25-year to 50-year recurrence interval rain event.

Estimated Probability of Occurrence at and near Somerset

The results indicate the following urban flooding probability at and near Somerset (within Bristol County):

- Urban Flooding due to Intense Rainfall within Bristol County: 4% AEP or 25-year recurrence

Effects of Climate Change

The attribution of rainfall intensity and frequency has high confidence. Average annual precipitation in the Northeast increased 10 percent from 1895 to 2011, and precipitation from extremely heavy storms has increased 70 percent since 1958. During the this century, average annual precipitation and the frequency of heavy downpours are likely to keep rising. Average precipitation is likely to increase during winter and spring, but not change significantly during summer and fall.

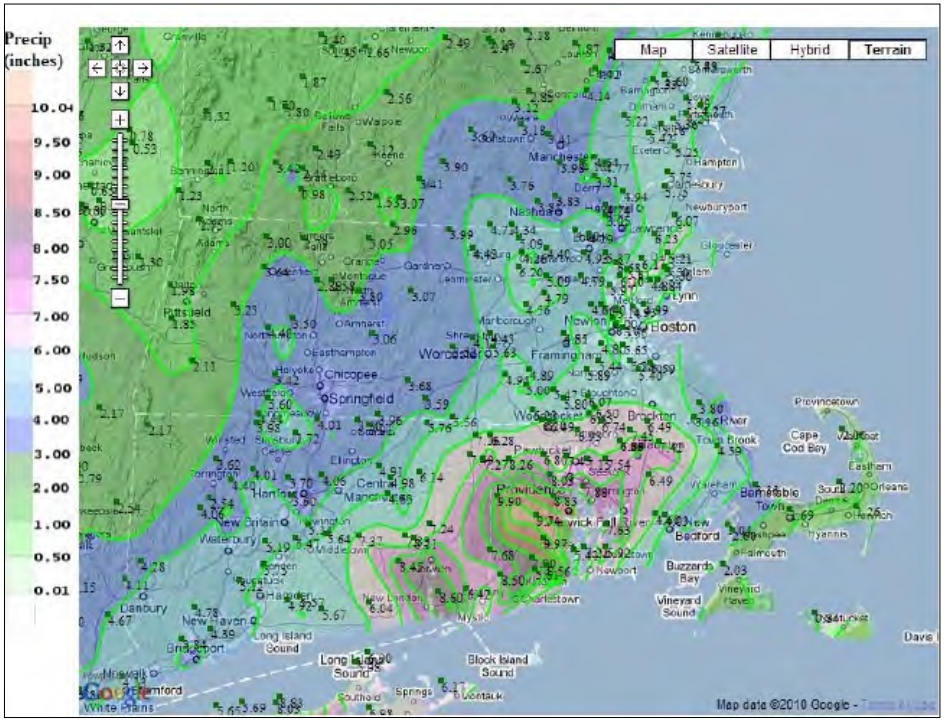


Figure 2-15: March 30,2010 Total Rainfall and area photographs during storm

Shoreline Change

Shoreline Change

Shoreline change is the accretion or erosion of shoreline, resulting in a long-term net increase or decrease in land area. Shoreline change is a function of: 1) the shoreline topography and geology; 2) availability of sediment within the nearshore environment; 3) the presence of coastal structures; and 4) hydraulic factors including water level, waves, sea level rise and alongshore currents. Shoreline change occurs as a result of: 1) long term environmental conditions; and 2) short term, episodic changes that occur during coastal storms. Shoreline change is a significant issue in many parts of coastal Massachusetts, in particular areas consisting of barrier beaches (e.g., Plum Island). It can also be a significant issue along shorelines consisting of glacial bluffs, that experience mass stability failure (and significant land loss) when exposed to storm surges and waves.

The Massachusetts Coastal Zone Management (CZM) established an agreement with the U.S. Geological Survey (USGS), the Woods Hole Oceanographic Institution Sea Grant Program, and the Cape Cod Cooperative Extension to produce the 1994 shoreline and calculate shoreline change rates. However, this shoreline change analysis is currently only performed for the ocean-facing shorelines of Massachusetts. Also, no information was included for Somerset as a part of the Massachusetts Coastal Erosion Commission's December 2015 *Report of the Massachusetts Coastal Erosion Commission.* Therefore, documented shoreline change data for Somerset is not currently available.

Historical Occurrence at Somerset and Vicinity

Not documented.

Estimated Probability of Occurrence at and near Somerset

Data is not currently available to develop quantitative estimates of shoreline change.

Considerations for Shoreline Change in Somerset

Considerations for shoreline change along Somerset shoreline include:

1. All of Somerset's shoreline is within the FEMA VE zone indicating, with BFE's ranging from 17 feet NAVD88 to 18 feet NAVD88, indicating that it is exposed to elevated water levels and significant waves during coastal storm events.
2. With the exception of the southern peninsula (Brayton's Point), the geologic depots along the Somerset shoreline consist of shallow glacial till and bedrock. The southern peninsula consist of sand and gravel deposits.
3. The shoreline topography is variable ranging from beach to bluff.
4. Much (about 40% +/-) of the shoreline is hardened with coastal structures (revetments and sea walls).

Based on this limited assessment, the potential for long term shoreline erosion at Somerset appears to range from low to moderate and will vary locally.

Figure 2-16: Representative Somerset Shorelines: sand beach with groin (top); coastal revetment shoreline protection (bottom)

Severe Weather Hazards: Winter Weather

SEVERE WINTER WEATHER: SNOWFALL

Severe winter weather includes large snow events, blizzards and ice storms. As defined by the National Weather Service, a blizzard is a snowstorm with sustained winds or frequent gusts of 35 miles an hour or greater and considerable falling and/or blowing snow (i.e., reducing visibility frequently to less than a quarter of a mile) for a period of 3 hours or longer. NOAA's National Centers for Environmental Information produces the Regional Snowfall Index (RSI) for significant snowstorms that impact the eastern two thirds of the U.S. The RSI ranks snowstorm impacts on a scale from 1 to 5, as shown in **Table 2-14**. RSI is based on the spatial extent of the storm, the amount of snowfall, and the juxtaposition of these elements with population density and societal impacts. Currently, the index uses population data based on the 2000 Census. A similar storm index is the Northeast Snowfall Impact Scale (NESIS), also shown below. Reference NOAA; https://www.ncdc.noaa.gov/snow-and-ice/rsi/

Severe winter weather in Massachusetts is almost always associated with nor'easters. Table **2-15** presents Boston average snowfall distribution by month. **Table 2-16** summarizes the major nor'easters that occurred between the 1880's and now in the Northeast U.S. and includes RIS and NESI values (if available). Ref. https://gis.ncdc.noaa.gov/maps/ncei/rsi

Figure 2-17 indicates the average annual snowfall amounts for the Northeast U.S. The average snowfall per year near Somerset (Taunton – New Bedford) is 28 to 33 inches per year with an average of 10 to 15 snow days.

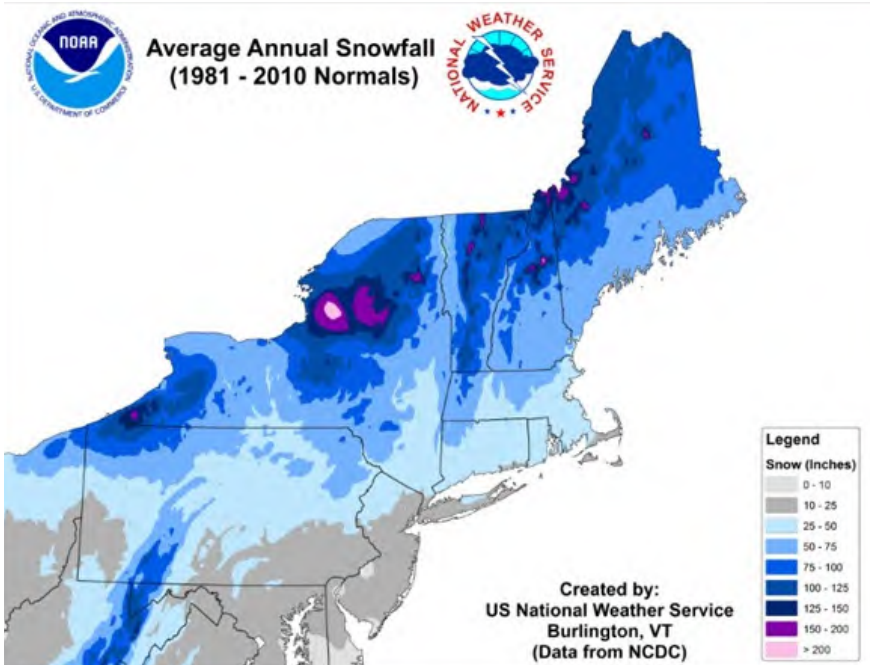


Figure 2-17: Average Annual Snowfall (http://www.weather.gov/btv/winter)

Category	RSI Value	Description
1	1-3	Notable
2	3-6	Significant
3	6-10	Major
4	10-18	Crippling
5	18+	Extreme

Category	NESIS Value	Description
1	1-2.5	Notable
2	2.5-4	Significant
3	4-6	Major
4	6-10	Crippling
5	10+	Extreme

Table 2-14: Regional Snowfall Index (RSI) and Northeast Snowfall Impact Scale

Month	1-inch	3-inches	5 inches	10-inches
January	3.6	1.5	0.8	0.1
February	2.4	1.1	0.7	0.2
March	2.2	0.9	0.5	0
April	0.3	0.1	0.1	0.1
November	0.4	0.2	0	0
December	2	0.9	0.6	0.1
Year	10.9	4.7	2.7	0.5

Table 2-15: Number of days per month on average with snowfalls of at least 1, 3, 5 or 10 -inches (Boston)

Table 2-16: Major Historical Nor'easters in the New England Region (Bold indicates est. snowfall near Somerset > 6" to12")

Event	Northeast Category/RSI Value	Boston Top 10	Date	Description
Great Blizzard of 1888	NA		March 11-14, 1888	One of the worst blizzards in U.S. history. Dropped 40–50 inches (100–130 cm) of snow, killed 400 people, mostly in New York.
Great Appalachian Storm of November 1950	4/14.5		November 24-30, 1950	A very severe storm that dumped more than 30 inches (76 cm) of snow in many major metropolitan areas along the eastern United States, record breaking temperatures, and hurricane-force winds. The storm killed 353 people.
The Blizzard of'58	**3/7.9**	**10**	February 16-17, 1958	This coastal storm brought heavy snow and strong winds to the Northeast and resulted in 19.4 inches of snow in Boston.
	0/0	9	March 3-5, 1960	This wind-driven snowstorm brought whirling snow from Virginia to New York, before blowing into New England. Left 19.8 inches of snow in Boston.
Ash Wednesday Storm of 1962	1/1.8		March 5-9, 1962	Caused severe tidal flooding and blizzard conditions from the Mid-Atlantic to New England, killed 40 people.
February Blizzard	**5/34.0**	**3**	February 24-27, 1969	This storm lasted several days and left 26.3 inches of snow in Boston.
Eastern Canadian Blizzard of March 1971	4/10.8		March 3-5, 1971	Dropped over 32 inches (81 cm) of snow over areas of eastern Canada, killed at least 30 people.
Groundhog Day Gale of 1976	NA		February 1-5, 1976	Caused blizzard conditions for much of New England and eastern Canada, dropping a maximum of 56 inches (140 cm) of snow.
January Blizzard	**2/5.4**	**8**	January 20-21, 1978	The January blizzard occurred just a couple of weeks before the infamous Blizzard of '78 and left 21.4 inches of snow in Boston.
Northeastern United States blizzard of 1978	**5/18.4**	**2**	February 5-7, 1978	A catastrophic storm, which dropped over 27 inches (69 cm) of snow in areas of New England, killed a total of 100 people, mainly people trapped in their cars on metropolitan Boston's inner beltway and in Rhode Island. $500M property damage in Massachusetts.
1991 Perfect Storm (the "Perfect Storm," combined Nor'easter/ hurricane)	0/0		October 28-November 2, 1991	Very unusual storm which evolved into a hurricane, tidal surge caused severe damage to coastal areas, especially Massachusetts, killed 13 people.
December 1992 nor'easter	2/4.7		December 10-12, 1992	A powerful storm which caused severe coastal flooding throughout much of the northeastern United States.
1993 Storm of the Century	5/22.1		March 12-15, 1993	A superstorm which affected the entire eastern U.S., parts of eastern Canada and Cuba. It caused 6.65 billion (2008 USD) in damage, and killed 310 people.
Christmas 1994 nor'easter	NA		December 22-26, 1994	An intense storm which affected the east coast of the U.S., and exhibited traits of a tropical cyclone.
North American Blizzard of 1996	**5/21.8**		January 6-10, 1996	Severe snowstorm which brought up to 4 feet (120 cm) of snow to areas of the mid-Atlantic and northeastern U.S.
April Fools Storm	2/4.7	4	March 31-April 1, 1997	This April Fools storm dropped more than 2 feet of snow in Boston.

Table 2-16: Major Historical Nor'easters in the New England Region cont. (Bold indicates est. snowfall near Somerset > 6" to12")

Event	Northeast RSI/ NESIS Category	Boston Top 10	Date	Description
North American Blizzard of 2003	**4/14.7**	**1**	February 14-22, 2003	Dropped over 2 feet (61 cm) of snow in several major cities, including Boston, and New York City, affected large areas of the Northeastern and Mid-Atlantic U.S., and killed a total of 27 people.
North American Blizzard of 2005	**NA**	**7**	January 20-23, 2005	Brought blizzard conditions to southern New England and dropped over 40 inches (100 cm) of snow in areas of Massachusetts.
North American Blizzard of 2006	**2/5.0**		February 11-13, 2006	A powerful storm that developed a hurricane-like eye when off the coast of New Jersey. It brought over 30 inches (76 cm) of snow in some areas and killed 3 people.
April 2007 nor'easter	0/1.0		April 13-17, 2007	An unusually late storm that dumped heavy snow in parts of Northern New England and Canada and heavy rains elsewhere. The storm caused a total of 18 fatalities.
November 2009 nor'easter	0/0		November 11-17, 2009	Formed from the remnants of Hurricane Ida, produced moderate storm surge, strong winds and very heavy rainfall throughout the mid-Atlantic region. It caused US$300 million (2009) in damage, and killed six people.
December 2009 North American blizzard	**1/2.8**		December 16-20, 2009	A major blizzard which affected large metropolitan areas, including New York City, Philadelphia, Providence, and Boston. In some of these areas, the storm brought up to 2 feet (61 cm) of snow.
March 2010 nor'easter	0/0.3		March 12-16, 2010	A slow-moving nor'easter that devastated the Northeastern United States. Winds of up to 70 miles per hour (110 km/h) snapped trees and power lines, resulting in over 1 million homes and businesses left without electricity. The storm produced over 10 inches (25 cm) of rain in New England, causing widespread flooding of urban and low-lying areas. The storm also caused extensive coastal flooding and beach erosion.
December 2010 North American blizzard	**2/3.4**		December 5, 2010-January 15, 2011	A severe and long-lasting blizzard which dropped up to 36 inches (91 cm) of snow throughout much of the eastern United States.
January 8–13, 2011 North American blizzard and January 25–27, 2011 North American blizzard	**2/3.4**		January 8-13 and January 25-27, 2011	In January 2011, two nor'easters struck the East Coast of the United States just two weeks apart and severely crippled New England and the Mid-Atlantic. During the first of the two storms, a record of 40 inches (100 cm) was recorded in Savoy, Massachusetts. Two people were killed.

Table 2-16: Major Historical Nor'easters in the New England Region cont. (Bold indicates est. snowfall near Somerset > 6" to12")

Event	Northeast RSI/ NESIS Category	Boston Top 10	Date	Description
2011 Halloween nor'easter	1/2.6		October 28-November 1, 2011	A rare, historic nor'easter, which produced record breaking snowfall for October in many areas of the Northeastern U.S., especially New England. The storm produced a maximum of 32 inches (81 cm) of snow in Peru, Massachusetts, and killed 39 people. After the storm, the rest of the winter for New England remained very quiet, with much less than average snowfall and no other significant storms to strike the region for the rest of the season.
November 2012 nor'easter	0/0.3		November 7-10, 2012	A moderately strong nor'easter that struck the same regions that were impacted by Hurricane Sandy a week earlier. The storm exacerbated the problems left behind by Sandy, knocking down trees that were weakened by Sandy. It also left several residents in the Northeast without power again after their power was restored following Hurricane Sandy. Highest snowfall total from the storm was 13 inches (33 cm), recorded in Clintonville, Connecticut.
Late December 2012 North American storm complex	3/9.2		December 17-31, 2012	A major nor'easter that was known for its tornado outbreak across the Gulf Coast states on Christmas day as well as giving areas such as northeastern Texas a white Christmas. The low underwent secondary cyclogenesis near the coast of North Carolina and dumped a swath of heavy snow across northern New England and New York, caused blizzard conditions across the Ohio Valley, as well as an ice storm in the mountains of the Virginia and West Virginia.
Early February 2013 North American blizzard	**3/NA**	**5**	February 7-18, 2013	An extremely powerful and historic nor'easter that dumped heavy snow and unleashed hurricane-force wind gusts across New England. Many areas received well over 2 feet (61 cm) of snow, especially Connecticut, Rhode Island, and eastern Massachusetts. The highest amount recorded was 40 inches (100 cm) in Hamden, Connecticut, and Gorham, Maine, received a record 35.5 inches (90 cm). Over 700,000 people were left without power and travel in the region came to a complete standstill. The storm killed 18 people. Left 24.9 inches of snow in Boston and 22.8 inches in Providence.

Table 2-16: Major Historical Nor'easters in the New England Region cont. (Bold indicates est. snowfall near Somerset > 6" to12")

Event	Northeast RSI/ NESIS Category	Boston Top 10	Date	Description
March 2013 nor'easter	1/1.6		March 1-21, 2013	A large and powerful nor'easter that ended up stalling along the eastern seaboard due to a blocking ridge of high pressure in Newfoundland and pivoted back heavy snow and strong winds into the Northeast United States for a period of 2 to 3 days. Many officials and residents were caught off guard as local weather stations predicted only a few inches (several centimeters) of snow with a change to mostly rain. Contrary to local forecasts, many areas received over one foot (30 cm) of snow, with the highest amount being 29 inches (74 cm) in Milton, Massachusetts. Several schools across the region, particularly in the Boston, Massachusetts, metropolitan area, remained in session during the height of the storm, not knowing the severity of the situation. Rough surf and rip currents were felt all the way southwards towards Florida's east coast.
January 2015 North American Blizzard	**3/6.2**	**6**	January 23-31, 2015	Unlike recent historical winter storms, there was no indication that a storm of this magnitude was coming until about 3 days in advance. The Blizzard began as an Alberta Clipper in the Midwestern States, which was forecast to transfer its energy to a new, secondary Low Pressure off the coast of the Mid Atlantic and move northeastward and pass to the south and east of New England. Several reports of over 30 inches (76 cm) across the State of Massachusetts, breaking many records. A maximum of 36 inches (91 cm) was recorded in at least four towns across Worcester County in Massachusetts and the city of Worcester itself received 34.5 inches (88 cm), marking the city's largest storm snowfall accumulation on record. The city of Boston recorded 24.6 inches (62 cm), making it the largest storm snowfall accumulation during the month of January and the city's sixth largest storm snowfall accumulation on record. On the coast of Massachusetts, Hurricane Force gusts up to around 80 mph (130 km/h) along with sustained winds between 50 and 55 mph (80 and 89 km/h) at times, were reported. The storm also caused severe coastal flooding and storm surge. The storm bottomed out to a central pressure of 970 mb (970 hPa). By January 28, the storm began to pull away from the area.
October 2015 North American storm complex	0/0		September 29-October 2, 2015	In early October, a low pressure system formed in the Atlantic, Tapping into moisture from Hurricane Joaquin, the storm dumped a huge amount of rain, mostly in South Carolina.

Table 2-16: Major Historical Nor'easters in the New England Area cont.

Event	Northeast RSI/ NESIS Category	Boston Top 10	Date	Description
January 2016 United States blizzard (also known as Winter Storm Jonas, Snowzilla, or The Blizzard of 2016 by media outlets)	4		January 19-29, 2016	This system dumped 2 to 3 feet (61 to 91 cm) of snow in the East Coast of the United States. States of Emergencies were declared in 12 States in advance of the storm as well as by the Mayor of Washington D.C. The blizzard also caused significant storm surge in New Jersey and Delaware that was equal to or worse than Hurricane Sandy. Sustained damaging winds over 50 mph (80 km/h) were recorded in many coastal communities, with a maximum gust to 85 mph (137 km/h) on Assateague Island, Virginia. A total of 55 people died due to the storm.
February 2017 United States blizzard (also known as Winter Storm Niko and The Blizzard of 2017 by media outlets)	**4.17.8**		February 6-11, 2017	Forming as an Alberta clipper in the northern United States on February 6, the system initially produced light snowfall from the Midwest to the Ohio Valley as it tracked southeastwards. It eventually reached the East Coast of the United States on February 9 and began to rapidly grow into a powerful nor'easter, dumping 1 to 2 feet (30 to 61 cm) across the Northeast Megapolis. The storm also produced prolific thunder and lightning across Southern New England. Prior to the blizzard, unprecedented and record-breaking warmth had enveloped the region, with record highs of above 60 °F (16 °C) recorded in several areas, including Central Park in New York City. Some were caught off guard by the warmth and had little time to prepare for the snowstorm.
October 2017 nor'easter	0/0		October 28-31, 2017	An extratropical storm absorbed the remnants of Tropical Storm Philippe. The combined systems became an extremely powerful nor'easter that wreaked havoc across the Northeastern United States and Eastern Canada. The storm produced sustained tropical storm force winds along with hurricane force wind gusts. The highest wind gust recorded was 93 mph (150 km/h) in Popponesset, Massachusetts. The storm caused over 1,400,000 power outages. Damage across New England, especially in Connecticut, Massachusetts, and Rhode Island, was extreme. This was due to the combination of the high winds, heavy rainfall, saturated ground, and most trees still being fully leaved. Some residents in Connecticut were without power for nearly a week following the storm. Heavy rain in Quebec and Eastern Ontario, with up to 98 mm (3.9 in) in the Canadian capital region of Ottawa, greatly interfered with transportation.

Table 2-16: Major Historical Nor'easters in the New England Region cont. (Bold indicates est. snowfall near Somerset > 6" to12")

Event	Northeast RSI/ NESIS Category	Boston Top 10	Date	Description
January 2018 North American blizzard	**4/17.8**		January 2-6, 2018	A powerful blizzard that caused severe disruption along the East Coast of the United States and Canada. It dumped snow and ice in places that rarely receive wintry precipitation, even in the winter, such as Florida and Georgia, and produced snowfall accumulations of over 2 feet (61 cm) in the Mid-Atlantic states, New England, and Atlantic Canada. The storm originated on January 3 as an area of low pressure off the coast of the Southeast. Moving swiftly to the northeast, the storm explosively deepened while moving parallel to the Eastern Seaboard, causing significant snowfall accumulations. The storm received various unofficial names, such as Winter Storm Grayson, Blizzard of 2018 and Storm Brody. The storm was also dubbed a "historic bomb cyclone".
March 1-3, 2018 nor'easter (also known as Winter Storm Riley or False Tropical Storm Riley by media outlets)	2/4.4		March 1-5, 2018	A very powerful nor'easter that caused major impacts in the Northeastern, Mid-Atlantic and Southeastern United States. It originated as the northernmost low of a stationary front over the Midwest on March 1, which moved eastward into the Northeast later that night. A new low pressure system rapidly formed off the coast on March 2 as it slowly meandered near the coastline. It peaked later that day and began to gradually move out to sea by March 3. Producing over 2 feet (24 in) of snow in some areas, it was one of the most significant March snowstorms in many areas, particularly in Upstate New York. In other areas, it challenged storm surge records set by other significant storms, such as Hurricane Sandy. It also produced widespread damaging winds, with gusts well over Hurricane force strength in some areas across Eastern New England as well as on the back side in the Mid-Atlantic via a sting jet. Over 2.2 million cus-
March 6-8, 2018 nor'easter (also known as Winter Storm Quinn by media outlets)	1/2.2		March 2-9, 2018	A powerful nor'easter that affected the Northeast United States. It came just days after another nor'easter devastated much of the Northeast. Frequent cloud to ground Thundersnow as well as snowfall rates of up to 3 inches (7.6 cm) an hour were reported in areas around the Tri-State Area, signaling the rapid intensification of the storm. Late in the afternoon, an eye-like feature was spotted near the center of the storm. It dumped over 2 feet of snow in many areas across the Northeast, including many areas in New England where the predominant precipitation type was rain for the previous storm. Over 1 million power outages were reported at the height of the storm due to the weight of the heavy, wet snow on trees and power lines. Many people who lost power in the previous storm found themselves in the dark again.

Table 2-16: Major Historical Nor'easters in the New England Region cont. (Bold indicates est. snowfall near Somerset > 6" to12")

Event	Northeast RSI/ NESIS Category	Boston Top 10	Date	Description
March 12-14, 2018 nor'easter (also known as Winter Storm Skylar by media outlets)	1/2.2		March 11-14, 2018	A powerful nor'easter that affected portions of the Northeast United States. The storm underwent rapid intensification with a central millibaric pressure dropping down from 1001 mb to 974 mb in just 24 hours. This was the third major storm to strike the area within a period of 11 days. The storm dumped over up 2 feet of snow and brought Hurricane force wind gusts to portions of Eastern New England. Hundreds of public school districts including, Boston, Hartford, and Providence were closed on Tuesday, March 13.
March 20–22, 2018 nor'easter (also known as Winter Storm Toby by media outlets)	1/1.6		March 20-22, 2018	A powerful nor'easter that became the fourth major nor'easter to affect the Northeast United States in a period of less than three weeks. It caused a severe weather outbreak over the Southern United States on March 19th before moving off of the North Carolina coast on March 20th and spreading freezing rain and snow into the Mid-Atlantic States after shortly dissipating later that night. A new low pressure center then formed off of Chesapeake Bay on March 21st and then became the primary nor'easter. Dry air prevented most of the precipitation from reaching the ground in areas in New England such as Boston, Hartford, and Providence, all of which received little to no accumulation, in contrast with what local forecasts had originally predicted. In Islip, New York at the height of the storm, snowfall rates of up to 5 inches per hour were reported. 8 inches was reported at Central Park and over 12 inches was reported in many locations on Long Island as well in and around New York City and in parts of New Jersey.

Historical Occurrence at Somerset and Vicinity

Between 1996 and 2018, there were a total of 86 Heavy Snow events including 55 days in Bristol County, 5 days with property damage and no injuries or fatalities. Heavy Snow in the NOAA database is defined as snow accumulation meeting or exceeding locally/regionally 12 and/or 24 hour warning criteria: typically 4, 6 or 8 inches or more within 12 hours or 6, 8 or 10 inches or more in 24 hours.

From December 2010 through February 2011, southern New England, including Bristol County, saw a series of winter storms that led to record snowfall for the season. The City of Attleboro snowfall total was over 60 inches. Heavy snow, combined with rain led to numerous flooding problems across the county, roof collapses, and downed trees and utility lines. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/

Estimated Probability of Occurrence at and near Somerset

The results indicate the following Snowfall probability at and near Somerset (Taunton - New Bedford):

- 10 to 15 snow days per year
- Average annual snowfall of 28 to 33 inches
- 90% AEP or 1 year recurrence interval Heavy Snowfall (19 years with 1 or more events over 21 years)
- Reasonably conservative monthly snowfall upper bound: 40 inches (maximum monthly upper bound of 60 inches)

Effects of Climate Change

The attribution of Heavy Snowfall events to climate change and understanding is moderate. High sea surface temperatures, increased atmospheric moisture and polar vortex conditions may result in an increased frequency of Heavy Snowfall.

SEVERE WINTER WEATHER: ICE STORMS

Ice storms are an occasional component of severe winter weather. Rain that falls and freezes on contact with cold surfaces is called freezing rain, while sleet is precipitation that freezes in the air before hitting the ground in the form of ice pellets. Heavy accumulations of ice can bring down trees or tree branches that may damage utility wires, causing power and communications outages, which may take days to repair. Ice can increase the weight of branches by 30 times. A 1/2-inch accumulation on power lines can add 500 lbs. of weight. Even slight accumulations of ice result in slippery conditions for motorists and pedestrians.

The National Weather Service issues:

- an Ice Storm Warning for a quarter-inch or more o ice accumulation
- a Freezing Rain Advisory for ice accumulation of less than one quarter-inch

Ice storms are relatively rare events in Massachusetts, including Somerset.

Historical Occurrence at Somerset and Vicinity

There were no ice storms recorded in the NOAA Storm Events Database for Bristol County between 1950 and 2017. Between 1990 and 2018, there were a total 6 days with ice storm events in Massachusetts (an average of 0.3 event per year), resulting in 1 injury and $45.4M property damage.

Estimated Probability of Occurrence at and near Somerset

The results indicate that the probability of Ice Storms at and near Somerset (Taunton - New Bedford) is low. Quantitative probabilities are not available.

Effects of Climate Change

The attribution of Heavy Snowfall events to climate change and understanding is low to moderate. High sea surface temperatures, increased atmospheric moisture and polar vortex conditions may result in an increased frequency of Ice Storms.

Extreme Winters

While the average annual snowfall at Somerset is on the order of 28 to 33 inches, there are often years with much greater snowfall amounts. For example, during 2015 Massachusetts experience exceptional snowfall amounts (Boston cumulative snowfall was 108.6 inches), however, statistical analysis of historical snowfalls indicate that 2015 monthly snowfall rate (about 94 inches) was an extremely low probability event.

Based on statistical analysis, and using Boston as a conservative proxy for snowfall at Somerset, a reasonably conservative upper bound monthly snowfall rate 40 inches with a maximum monthly rate of about 60 inches. reference http://www.minitab.com/en-us/Published-Articles/A-Statistical-Analysis-of-Boston-s-2015-Record-Snowfall/

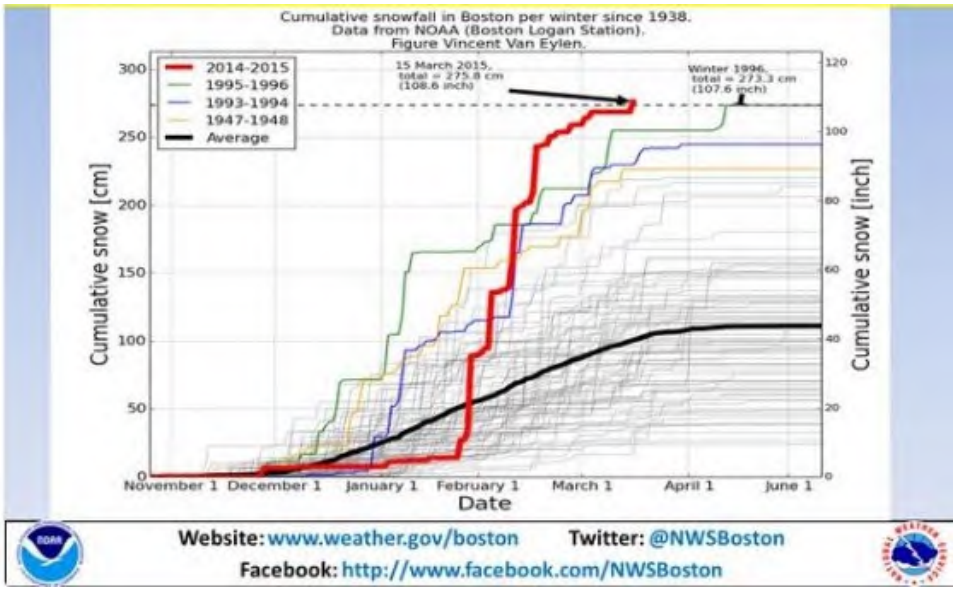


Figure 2-18: Graphical Display of Boston Snow Statistics since 1938 by Month

Example Winter Storm

Winter storms that impact Somerset are almost always nor'easters and these can range from wintry mix of rain and snow to heavy snowfall blizzards. These storms typically also create storm surge and high winds . The March 1, 2018 nor'easter is an example of a typical winter storm (**Figure 2-19**) is a typical storm. Somerset and surrounding areas experienced 2 to 3 inches of rain (with risk of urban flooding) changing over to snow, accumulating to 2 to 3 inches. The storm had high winds with gusts of up to 50 to 60 mph and a small storm surge.

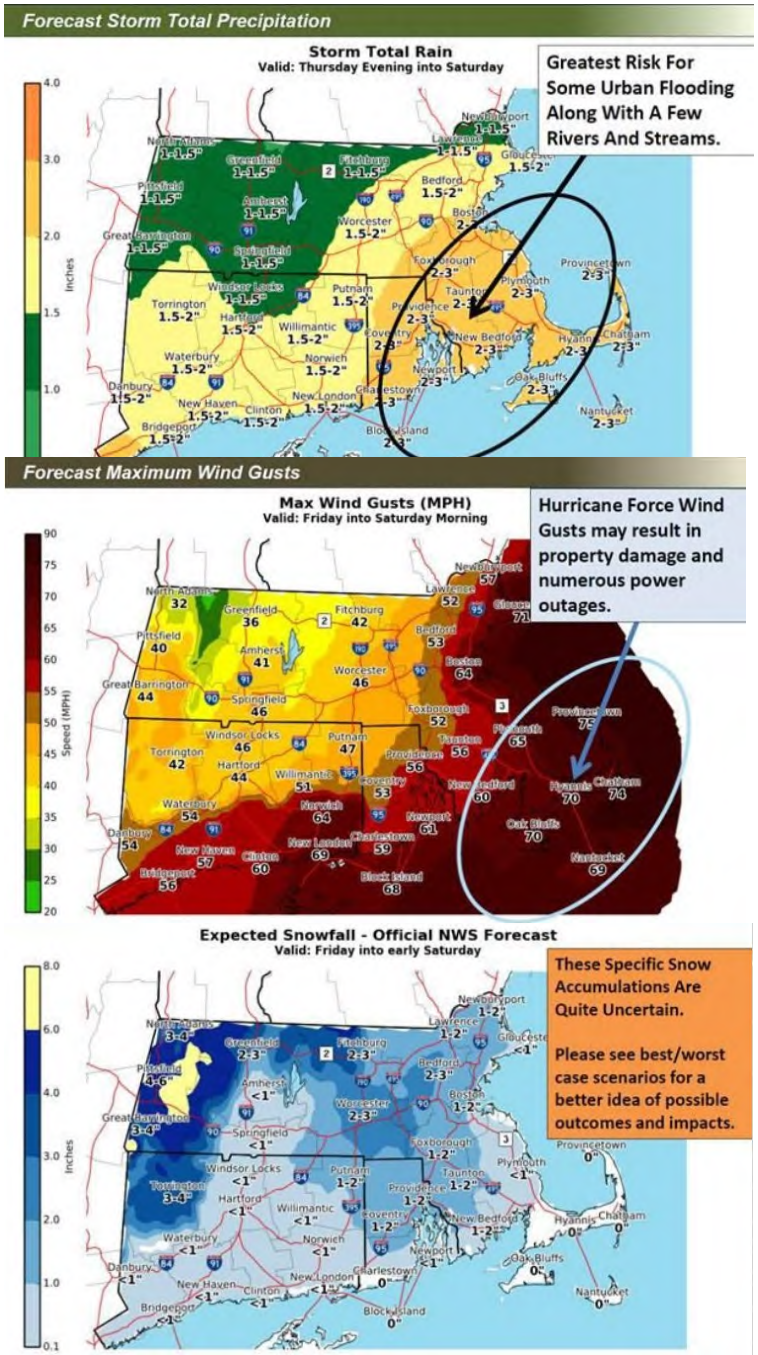
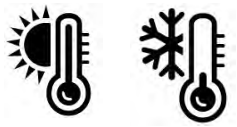


Figure 2-19: National Weather Forecast March 1, 2018

Extreme Temperatures



EXTREME TEMPERATURE: HEAT

The National Weather Service in Taunton issues:

- Excessive Heat Warnings when the daytime heat indices reach 105° F or greater for 2 or more hours
- A Heat Advisory is issued when the daytime heat indices reach 100-104°F for 2 or more hours
- A Heat Wave is defined as 3 or more days of temperatures of 90° F or above.

Heat Index

The Heat Index, also known as the Apparent Temperature, is a subjective measure of what it feels like to the human body when relative humidity is factored into the actual air temperature. Relative humidity is a measure of the amount of water in the air compared with the amount of water that air can hold at the current temperature. The body cools itself through the evaporation of perspiration or sweat. However, when the relative humidity is high, the increased moisture content in the air decreases the evaporation of perspiration or sweat. For example, a hot and very humid air mass with a temperature of 94 degrees and a relative humidity of 45 percent yields an apparent temperature of 100 degrees. Holding the temperature constant and increasing the relative humidity to 60 percent yields an apparent temperature of 110° F.

The National Weather Service will initiate alert procedures when the Heat Index is expected to exceed 104° F to 104° F (depending on local climate). Under these conditions, sunstroke and heat exhaustion are likely, and physical activity or being outside for long periods is risky, potentially leading to heat stroke.

These dangerous heat days pose the greatest threat to kids and the elderly, and to people who don't have easy access to air conditioning. The Heat Index values were derived for shady, light wind conditions, and exposure to full sunshine can increase heat index values by up to 15°F. (http://www.nws.noaa.gov/om/heat/heat_index.shtml).

From 1979-2014, excessive heat exposure caused in excess of 8,000 deaths in the United States (EPA, May 2014). During this period, more people in this country died from extreme heat than from hurricanes, lightning, tornadoes, floods, and earthquakes combined.

The highest temperature recorded in Massachusetts was 107°F on August 2, 1975, in Chester and New Bedford. According to the 2013 State Plan, there have been 43 warm weather events since 1995, ranging from Record Warmth/ Heat to Excessive Heat events. During the period from 1985 to 2016, the heat-related mortality rate was about 2.9 per 100,000 people in Boston (Climate Ready Boston Executive Summary, December 2016).

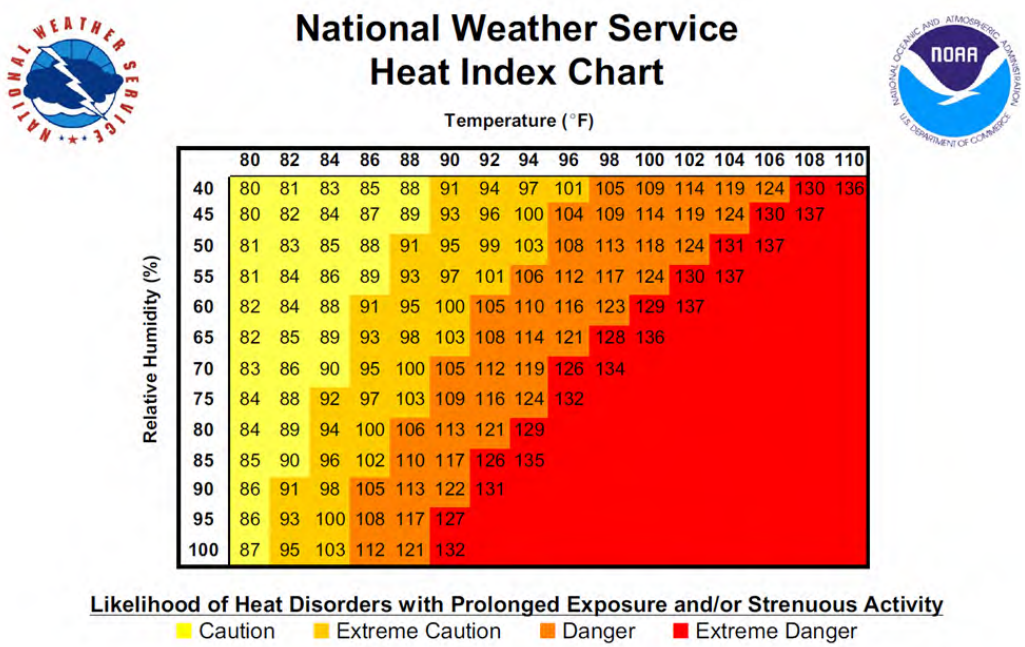


Figure 2-20: Heat Index Chart

Historical Occurrence at Somerset and Vicinity

Between 2010 and 2018, there were a total of 3 events with Excessive Heat, including 2 days with Excessive Heat events in Bristol County and no fatalities or injuries. These included July 6, 2010 and July 22, 2011. Ref. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/

Estimated Probability of Occurrence at and near Somerset

The results indicate that the probability of Excessive Heat near Somerset (Bristol County) is:

- 25% AEP or 1 event every 4 years.

Additional Heat Effects

In addition to the Heat Index, air quality is a significant issue related to extreme temperature. Summers in the U.S. bring more than just searing, dangerously hot days. When the air is stagnant and there is little air circulation, hot weather can trigger high levels of air pollution that can have health consequences. High temperatures on sunny days make ground-level ozone (a major component of smog) form much more readily. An EPA study looking at more than 20 years of measurements across most of the rural areas in the eastern U.S. found that harmful ozone concentrations increased nearly linearly as temperatures increased and named the effect the "climate penalty on ozone."

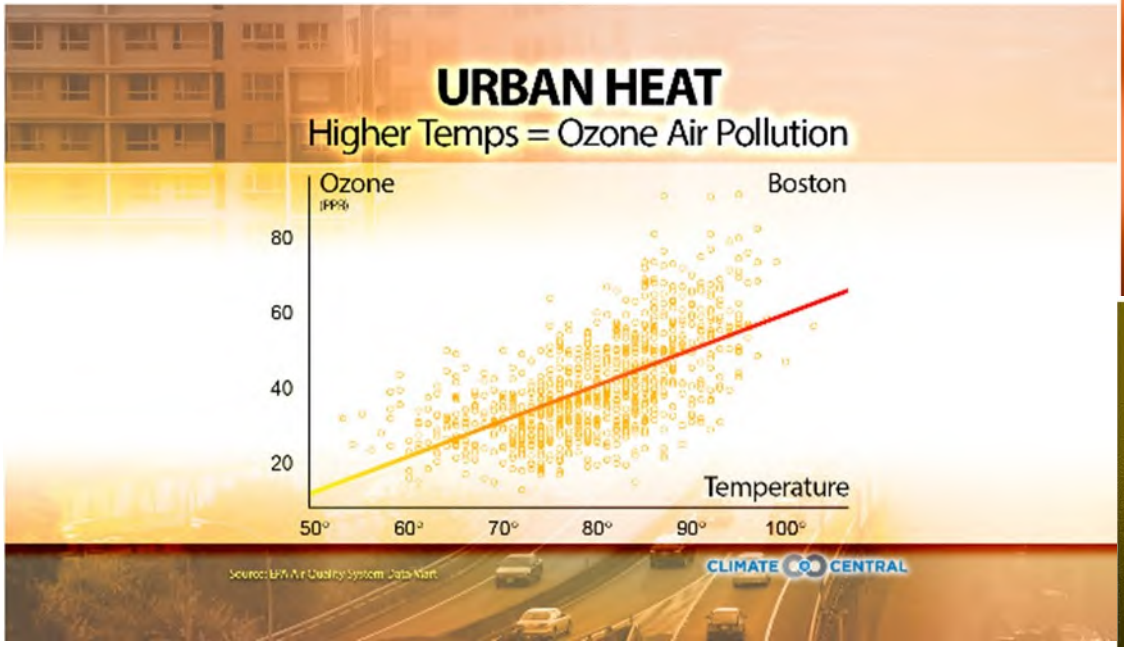
Effects of Climate Change

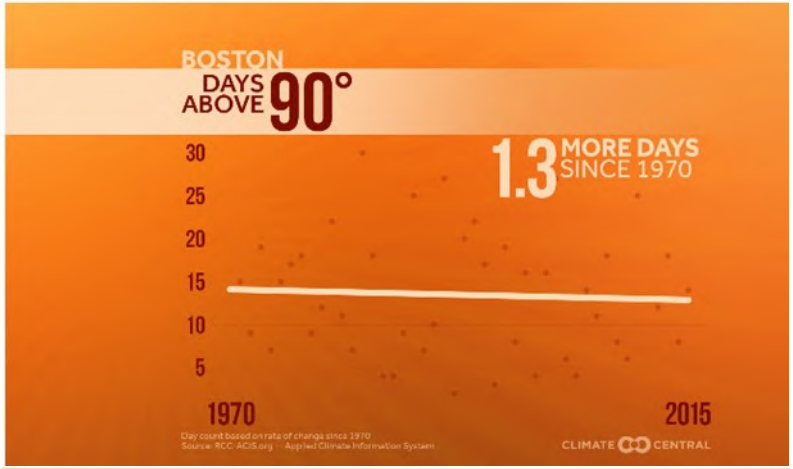
The confidence of attribution of Excessive Heat to climate change, and understanding, is high. High global temperatures are effecting temperatures at the local level, including Somerset.

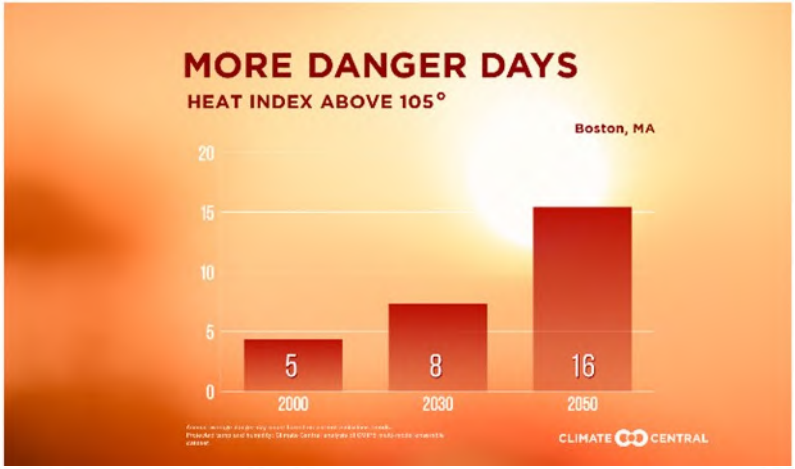
The Boston area currently experiences about 12 days above 90° F per year. Massachusetts currently experiences between 5 and 8 days per year when the Heat Index is expected to exceed 105° F. By 2050, that number could grow to 16 days per year. The number of Heat Wave days in Massachusetts is expected to increase from about 11 to 30 days per year (the period of 2000 to 2030) to about 40 days per year by the year 2050. **Figure 2-21**shows the increase in days above 90° F. The number of days over 90° F will increase in Massachusetts in the future. **Figure 2-25** shows the predicted range of days above 90° F for Boston and Hartford. Southeast Massachusetts is expected to fall within the predicted values for these two cities.

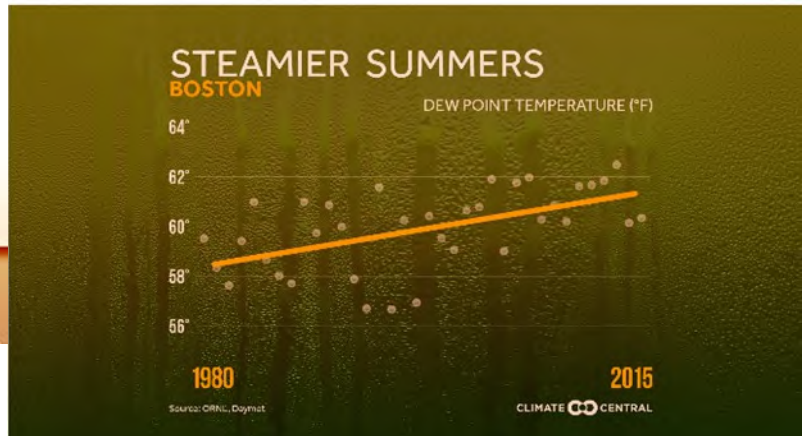
As summers get hotter from the increase in greenhouse gases, they are also getting stickier. More evaporation occurs in a warming atmosphere, and on a world where water covers nearly three-quarters of the surface, it means an increase in water vapor in the air. During the period of 980 to 2015, the dew point temperature increased from about 59 ° F to 62 ° F.

Figure 2-19 Urban Heat (Ozone)









Figures 2-21 through 2-24: Days Above 90 degrees (top); Days with Heat Index above 105 degrees (middle); Dew Point Temperature

Effects of Climate Change

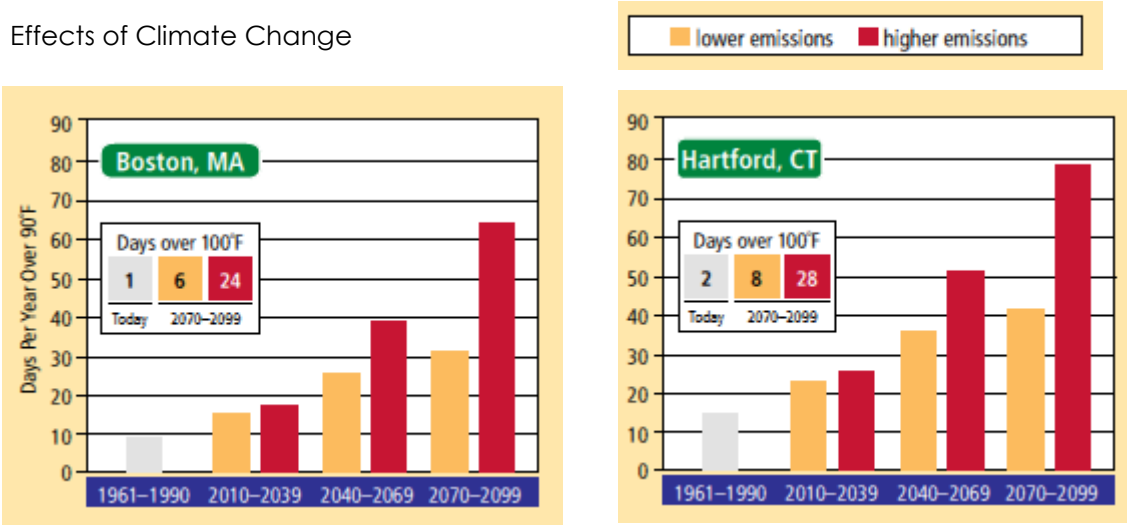


Figure 2-25: Predicted Days above 90° F and 100° F (source Union of Concerned Scientists)

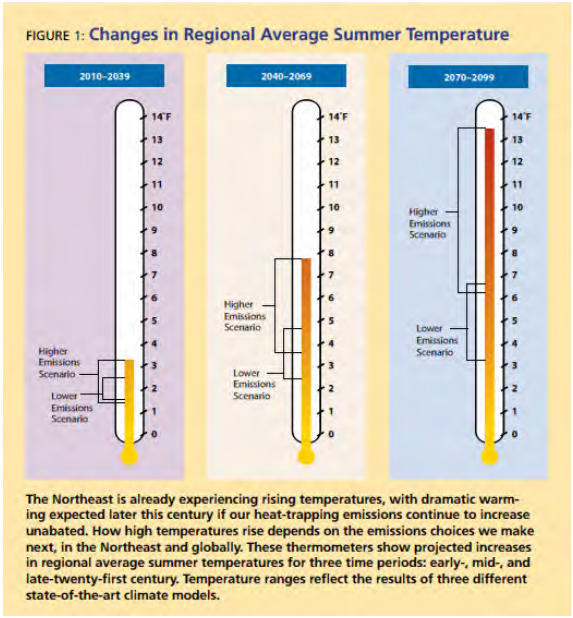


Figure 2-26: Predicted Rise in Average Northeast U.S. Temperatures (source Union of Concerned Scientists)

In addition to the effect of climate change on extreme heat events, the overall increase in global and local temperature averages will significantly change climate patterns within the Northeast U.S., including Somerset. Spring will arrive sooner, summers are growing hotter, and the weather is becoming more extreme with swings between above-average winter temperatures to extreme cold with large snowfall events. Per the Union of Concerned Scientists summary reports, if global greenhouse gas emissions continue, the Northeast can expect dramatic temperature increases and other climate changes within the next several decades. Recent observations indicate that these effects are already underway, including within southeastern Massachusetts. Average summer temperatures may increase between 6° F and 14° F by 2100 (see **Figure 2-26**). The overall effect will be a shift in the Massachusetts climate equivalent to that historically experienced in lower latitudes, ranging between the Chesapeake Bay area to South Carolina. (see **Figure 2-27**)

With its coastal setting, Somerset benefits from cooling summer sea breezes, which are the result of warming of the land area during the day (relative to the cooler water temperatures). Even these may change due to changes in both water and land temperatures.

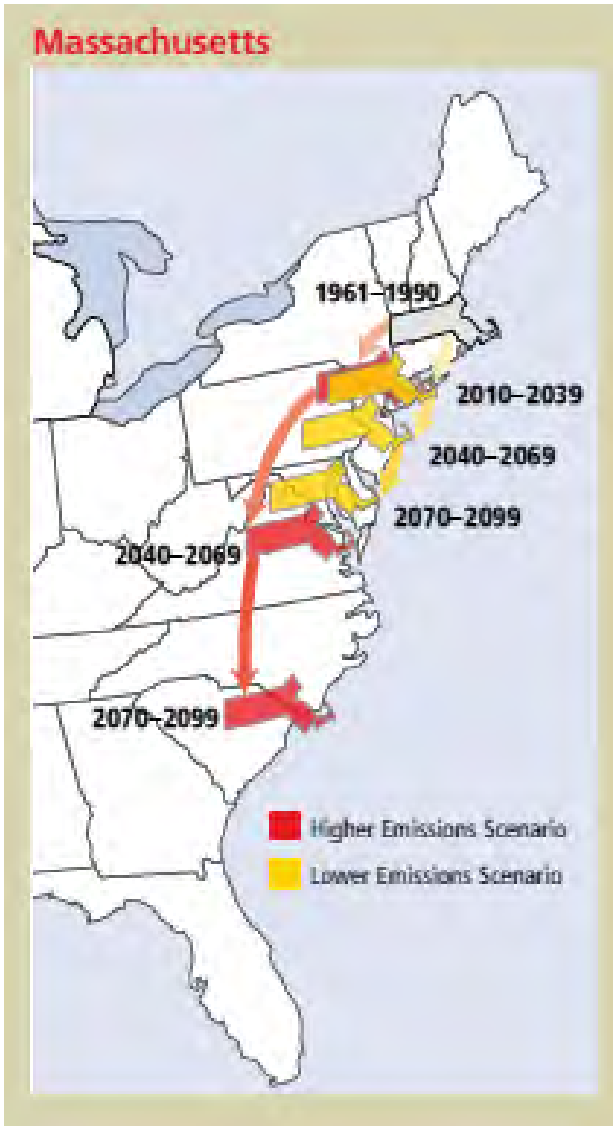


Figure 2-27: Latitudinal Changes in Regional Climate (source Union of Concerned Scientists)

EXTREME TEMPERATURE: COLD

Extreme cold events are generally defined as a prolonged period of excessively cold weather. Extreme cold conditions are often, but not always, part of winter storms. Winter in Massachusetts almost always includes periods of extreme cold weather. Exposure to cold can cause frostbite or hypothermia and has the potential to become life-threatening. Although anyone can suffer from cold-related health issues, some people are at greater risk than others, such as:

- Older adults
- Young children
- Those who are sick; and
- Those without adequate shelter

Heating sources can be impacted by power failures due to winter storms. Infants and the elderly are more at risk of serious or life-threatening health problems from extreme cold. Secondary hazards may include risk of fires or carbon monoxide poisoning from space heaters, generators, inadequately cleaned or vented fireplaces, or use of candles.

The following extreme cold warnings and advisories are issued by the National Weather Service (NWS):

- Freezing Warning – When minimum shelter temperature drops to 32° F or lower during the growing season.
- Frost Advisory – Issued under clear, light wind conditions with forecast minimum shelter temperature at 33-36° F during the growing season.
- Wind Chill Warning – Wind chill index is -25° F or lower for at least three hours using only sustained wind.
- Wind Chill Advisory - Wind chill index is between -15° F and -24° F for at least three hours using only sustained wind.

The National Weather Service Wind Chill Chart indicates the amount of time in which frostbite may occur on exposed skin based on temperature and wind speed. The National Weather Service maintains a Wind Chill Calculator, which calculated wind chill based on temperature and wind speed, as A period of extremely low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined warning criteria (typical value around -35° F or colder). Ref. http://www.wpc.ncep.noaa.gov/html/windchill.shtml.

The lowest temperature recorded in Massachusetts was -35° F on January 5, 1904 in nearby Taunton, February 15, 1943 in Coldbrook, and January 12, 1981 in Chester, according to NOAA (https://www.ncdc.noaa.gov/extremes/scec/records).

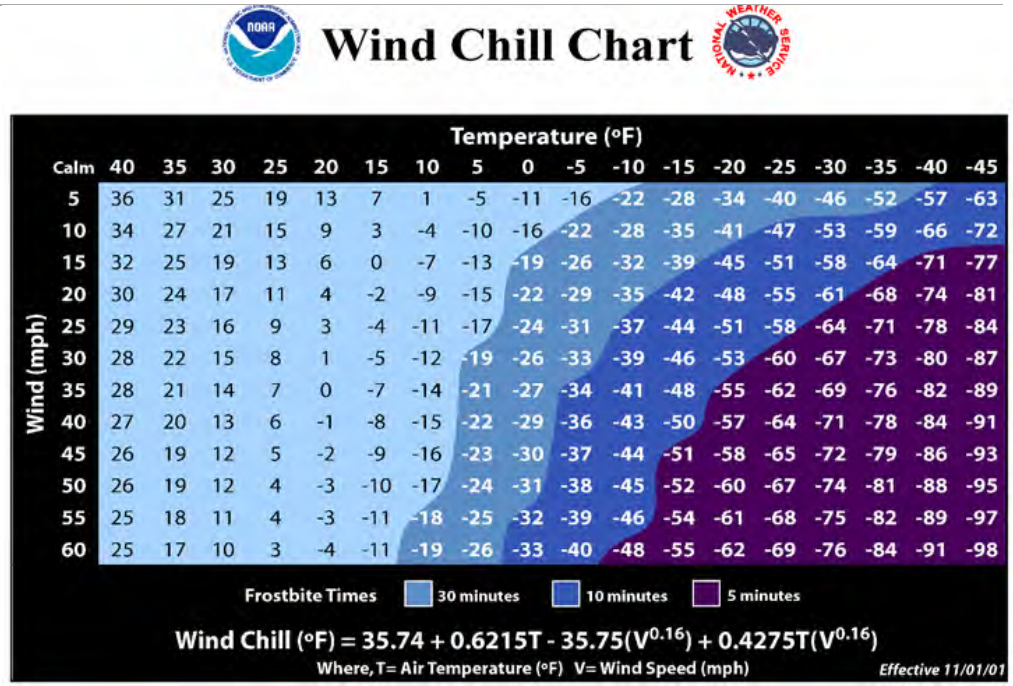


Figure 2-28: Wind Chill Chart

Nationally, there have been 887 recorded cold fatalities since 1988, with a 10 year average of 33 fatalities/year. http://www.nws.noaa.gov/om/hazstats/resources/weather_fatalities.pdf

Historical Occurrence at Somerset and Vicinity

Bristol County has experienced 1 day (February 14, 2016) with an Extreme Cold/Wind Chill event resulting in no fatalities or injuries. Ref. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/

Estimated Probability of Occurrence at and near Somerset

- The average low temperature during January (the average coldest month) at Somerset is 18°F.
- Quantitative probability data for Extreme Cold events is not available.

Effects of Climate Change

The confidence of attribution of Extreme Cold to climate change, and understanding, is moderate. It appears that warming trends have weakened polar vortex winds resulted in meandering of these winds. This condition allows cold Arctic air to dip further south, resulting in a variable New England winter with temperatures varying from above-average warm to periods of extreme cold.

Drought

DROUGHT

Droughts occur when there has not been enough rainfall and water levels get low, in particular when precipitation and other water resources fall below expectations but the demand for water remains. They can happen anywhere in the United States, and droughts increase the risk of other hazards like wildfires, flash floods, and possible landslides or debris flows. Drought is a slow-onset hazard that can last for months or years. Droughts are generally classified into different types including:

- meteorological drought - lack of precipitation
- agricultural drought - lack of soil moisture
- hydrologic drought - reduced streamflow or groundwater levels.

As a hazard, it has the potential to impact many aspects of life, including two of our most important needs: drinking water and food. Because of the long duration of droughts, the impacts last for years and can ripple through a community over time.

Drought is an important issue in Massachusetts and the Town due to effects on agricultural and water resources. Both of the Town's drinking water sources (the Dighton groundwater well and the Somerset Reservoir) can be effected by drought.

Massachusetts maintains a Drought Management Plan and five levels of drought are used to characterize drought severity and response: Normal; Advisory; Watch; Warning; and Emergency. A determination of drought level in Massachusetts is based on seven indices: Standardized Precipitation Index (SPI); Crop Moisture Index; Keetch-Byram Drought Index (KBDI); Precipitation Index; Groundwater Level Index; Stream Flow Index; and Reservoir Index. Additional climatological indices used nationally include: Standardized Precipitation-Evapotranspiration Index (SPEI), Palmer Drought Severity Index (PDSI) and Rainfall Deciles are standard climatological drought indices. Drought levels are declared on a regional basis. Massachusetts has identified six statewide drought regions. The Town is located within the Southeast Region.

During the summer of 2002, one-third of the U.S., including Massachusetts, experienced drought conditions. Based on historical Palmer Drought Severity Indices, Massachusetts has experienced multi-year drought periods in 1879-83, 1910-19, 1928-39, 1964-69, and 1985-95. The most severe drought on record in the northeastern United States was during 1961-69. For the period of 1895 to 1995, Massachusetts experienced low PDSIs (indicating drought conditions) about 6 to 10 percent of the time, indicating the relative probability of drought. Water supplies and agriculture were affected because of the severity and long duration of the drought. Precipitation was less than average beginning in 1960 in western Massachusetts and beginning in 1962 in eastern Massachusetts. Based on the Drought Management Plan data, the Massachusetts Southeast Region recently experienced a Drought Advisory or Watch in 2001, 2002, 2014 and 2017. Drought Warnings were experienced during 2016 and 2017 (the months of August 2016 through January 2017). While many surrounding Towns had mandatory or voluntary water bans during 2016, Somerset did not.

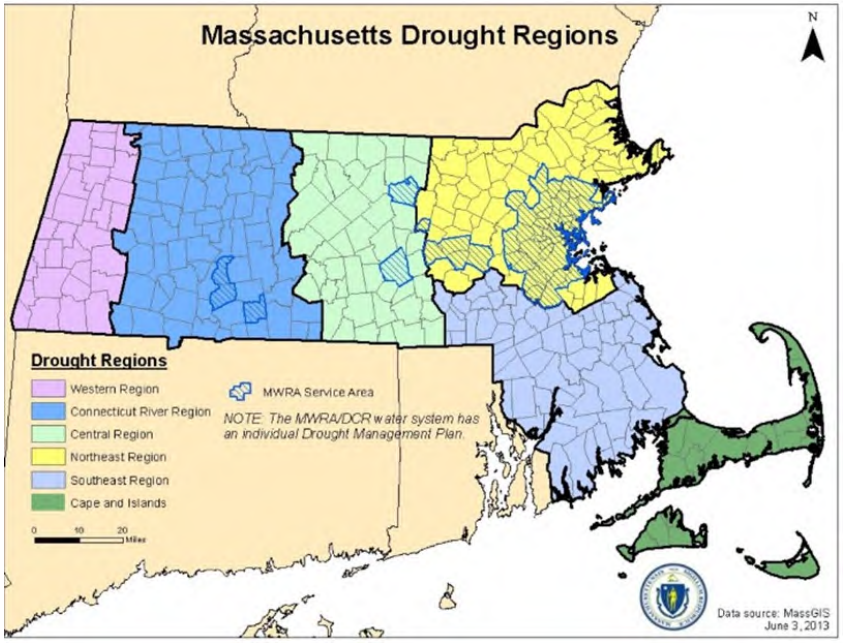


Figure 2-29: Massachusetts Drought Regions

Historical Occurrence at Somerset and Vicinity

Since 1996 to 2018, Bristol County has experienced 9 days with drought events resulting in no fatalities, injuries or loss. The events occurred during April and May, 2012, August through December, 2016 and January, 2017.

Estimated Probability of Occurrence at and near Somerset

Based on recent drought history (2001 to 2017), the Southeast Region has had a Drought Advisory during 6 of the 16 years; a Drought Watch during 3 of the 16 years; and a Drought Warning during 2 of the 16 years. Based on this limited data:

- Drought Warnings are expected in the Southeast Region: 10% to 30% AEP or 8 to 10-year recurrence interval
- Massachusetts experiences extended, multi-year droughts about every 20 years

Effects of Climate Change

The confidence of attribution of Drought to climate change is moderate. Increased air temperatures and evapotranspiration can increase drought potential. In the Northeast U.S, the relationship between increased rainfall intensity and drought is uncertain.

Wildfire

WILDFIRE

A wildfire is a non-structure/vehicle fire that occurs in undeveloped, wildland vegetated areas, including grass, brush/shrub, and forested areas. Wildfires occur when natural vegetation is ignited naturally, such as by lightning, or by human activity. Sometimes, wildfires are set intentionally for management of vegetation or to limit accidental fire risk. Wildfires may be unnoticed at first. Unnoticed fires often can spread to the urban-wildland interface and threaten developed areas.

About 16% of Somerset consists of non-contiguous forest, which presents only a limited area for wildfire to occur. The Local Planning Team identified no significant brush fire hazard areas. There were 9,100 brush, trash, and other outside fires in Massachusetts in 2014. Of those fires, 4,627 fires were trees, grass, and brush fires (Ostroskey, 2014).

In Somerset during 2015, there were 11 "other" fires, which included brush fires and outside fires (Ostroskey, 2015). There have been no reports of significant property damage or deaths related to brush fires or wildfire. Apparatus listed on the Somerset Fire Department's website indicates that the Town has all-terrain vehicles capable of fighting remote brush fires located off existing roadways.

Historical Occurrence at Somerset and Vicinity

The most recent wildfire in Massachusetts occurred on July 22, 2016 on Joint Base Cape Cod in Barnstable County, according to the NOAA Storm Events Database. The fire was started by lightning and was contained to 125 acres after 36 hours. The NOAA Storm Events database lists zero (0) wildfires as having occurred in Bristol County from 1950 to 2017.

Estimated Probability of Occurrence at and near Somerset

The historical data indicates that the probability of wildfire within Somerset is low. Quantitative probabilities of occurrence are not available. The number of brush fires each year is variable and usually increases during years of dry spring and summer (Ostroskey, 2014).

Effects of Climate Change

The confidence of attribution of Wildfire to climate change is low. Increased air temperatures and evapotranspiration can increase Wildfire potential.

Earthquake

EARTHQUAKE

Earthquakes occur as the result tectonic activity. An earthquake is sudden ground motion or trembling caused by an abrupt release of accumulated strain acting on the tectonic plates that comprise the Earth's crust along faults. Although earthquakes have caused much less economic loss annually in the United States than other hazards such as floods, they have the potential for causing great and sudden loss. Within 1 to 2 minutes, an earthquake can devastate part of an area through ground-shaking, surface fault ruptures, and ground failures. The location of an earthquake is commonly described by the geographic position of its epicenter and by its focal depth. The focal depth of an earthquake is the depth from the surface to the region where the earthquake's energy originates (the focus). The epicenter of an earthquake is the point on the Earth's surface directly above the focus. The effects of earthquakes are: 1) ground shaking; 2) ground displacement; and 3) loss of soil strength (liquefaction). Ground shaking is represented by the Peak Ground Acceleration (PGA) and spectral acceleration (SA) response. The PGA reflects the ground acceleration at the top of bedrock. Thick deposits of soil over bedrock will modify (typically increase) the acceleration, resulting in ground surface accelerations that are greater than the PGA. Liquefaction is a function of soil type and density. Earthquake intensity is characterized by: 1) the Richter Scale; and 2) the Modified Mercalli Scale. Seismic hazards include damage to structures and infrastructure, landslides and tsunamis.

The National Seismic Hazard Maps (NSHM) (and the hazard model from which they are derived) are used by engineers who construct buildings need to know how strongly a particular site might be shaken by earthquakes. The NSHMs compile known earthquake sources, their distance from the site in question, and other seismological and geological information to project potential maximum expected ground motions at a site over a particular period of time (50 years).

Soil deposits above bedrock are classified based on shear wave velocity according to Site Class. Site Class Definitions are presented in **Table 2-18**. **Figures 2-32 through 2-34** present the surficial geology, Site Classes and estimated shear wave velocity at Somerset. The geologic data indicates that the majority of Somerset consists of shallow glacial till or bedrock and shear wave velocities on the order of 1,200 to 2,500 ft/s, corresponding to a Site Class of B/C. Shoreline areas consist of deposits of sandy till over sand, representing Site Class D. Localized areas of floodplain alluvium are also present, representing Site Class E.

Figure 2-31 presents the 2% probability of exceedance in 50 years PGA. The 2% in 50 years PGA in the vicinity of Somerset is 0.14g, where g is the acceleration of gravity (32.2 ft/sec^2).

Building response is evaluated using the mapped seismic coefficients Ss and S_1. Ss is the mapped 5% damped spectral response acceleration at short periods. S_1 is the 5% damped spectral response acceleration at a period of 1 second. S_{DS} and S_{D1} are the design 5% damped spectral accelerations at short and 1 second periods respectively. S_{MS} and S_{M1} are the MCE 5% damped spectral accelerations at short and 1 second periods respectively, where MCE is the Maximum Considered Earthquake.

Richter Scale	Earthquake Effects
2.5 or less	Not felt or felt mildly near the epicenter, but can be recorded by seismographs
2.5 to 5.4	Often felt, but only causes minor damage
5.5 to 6.0	Slight damage to buildings and other structures
6.1 to 6.9	May cause a lot of damage in very populated areas
7.0 to 7.9	Major earthquake; serious damage
8.0 or greater	Great earthquake; can totally destroy communities near the epicenter

Table 2-17: Richter Scale

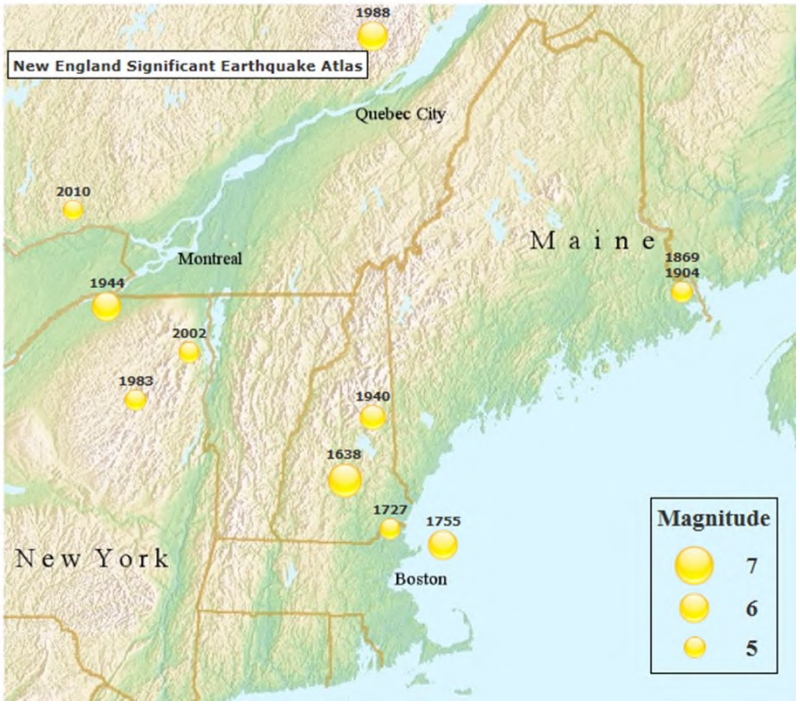


Figure 2-30: Significant Earthquakes in New England http://aki.bc.edu/quakes_historical.htm

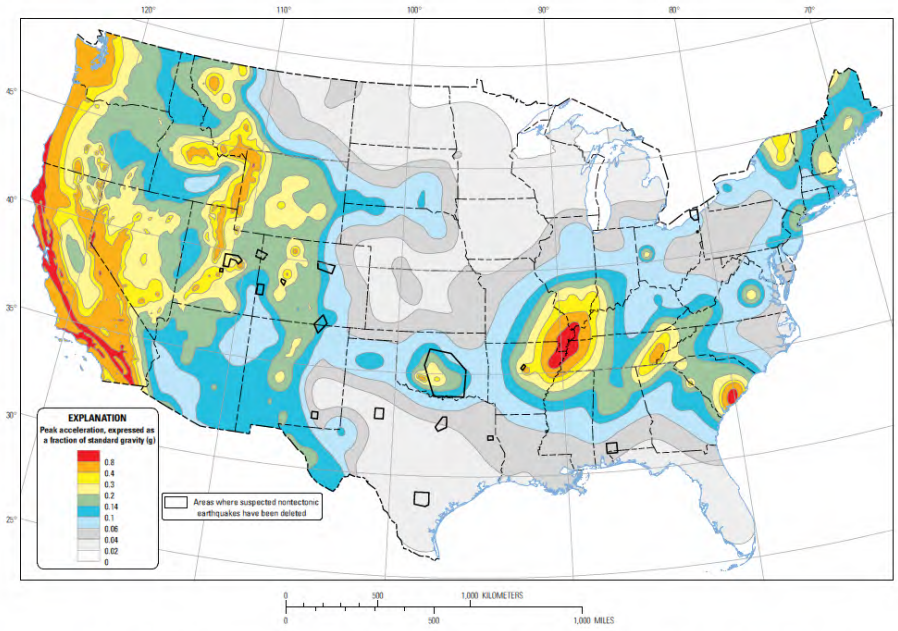


Figure 2-31: 2% probability of exceedance in 50 years Map of Peak Ground Acceleration

2010 ASCE-7 Standard – Table 20.3-1
SITE CLASS DEFINITIONS

Site Class	$\bar{v}_s$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index PI > 20, • Moisture content w ≥ 40%, and • Undrained shear strength $\bar{s}_u$ < 500 psf		
F. Soils requiring site response	See Section 20.3.1		

Table 2-18: Site Class Definitions

USGS Design Maps Summary Report

User–Specified Input

Report Title	Somerset Seismic hazard Thu August 2, 2018 02:50:16 UTC
Building Code Reference Document	2012/2015 International Building Code (which utilizes USGS hazard data available in 2008)
Site Coordinates	41.7481°N, 71.1442°W
Site Soil Classification	Site Class C – "Very Dense Soil and Soft Rock"
Risk Category	IV (e.g. essential facilities)

USGS–Provided Output

S_S =	0.177 g	S_{MS} =	0.213 g	S_{DS} =	0.142 g
S_1 =	0.060 g	S_{M1} =	0.103 g	S_{D1} =	0.069 g

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.

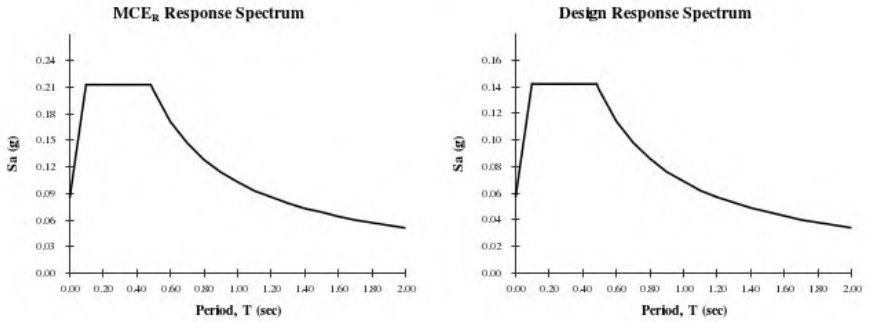


Table 2-17: USGS Seismic Hazard Report for Somerset

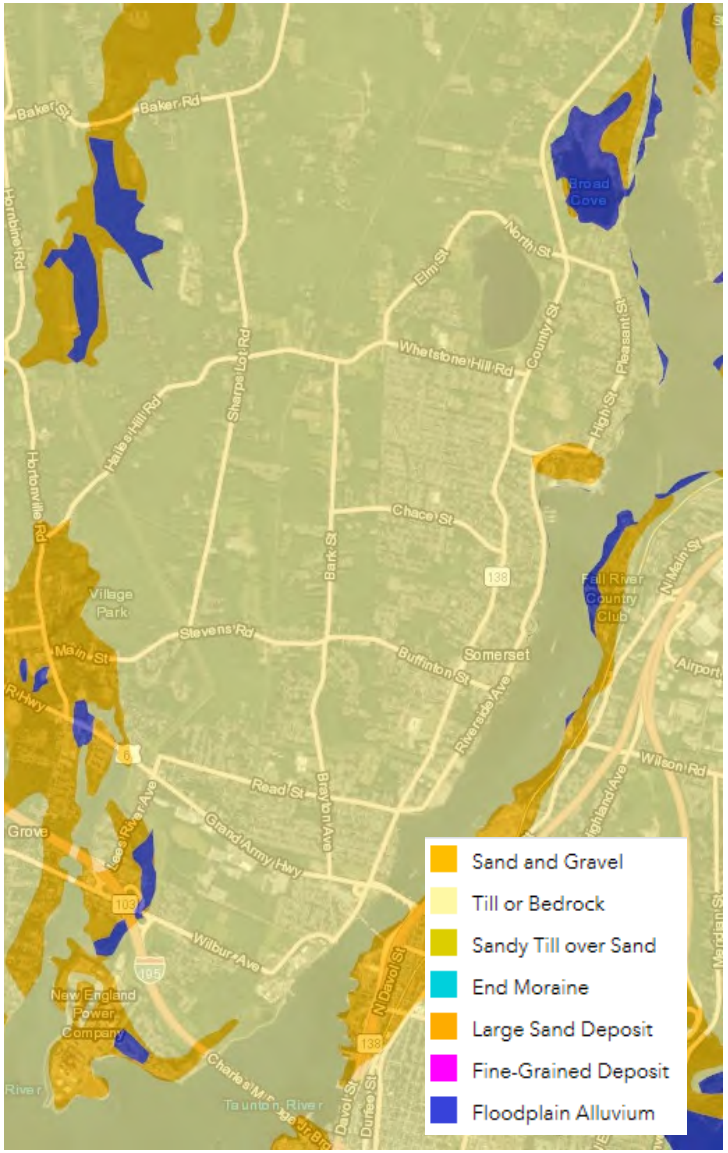


Figure 2-32: Surficial Geology of Somerset

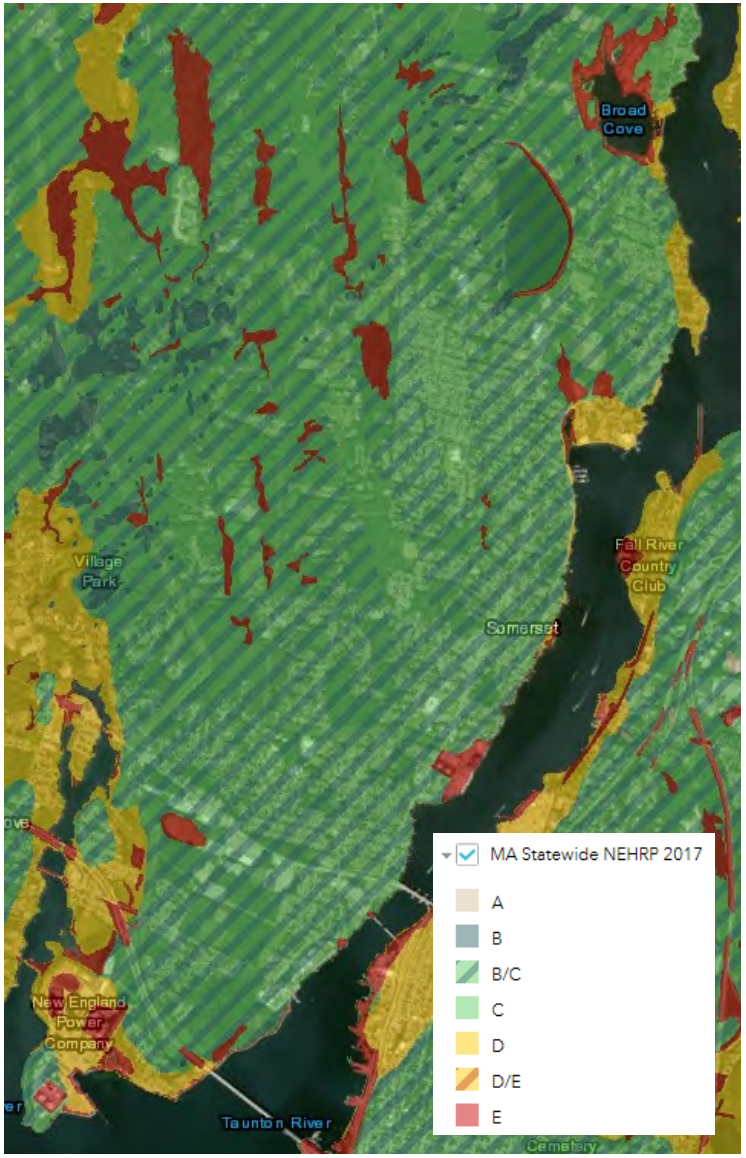


Figure 2-33 Site Class within Somerset

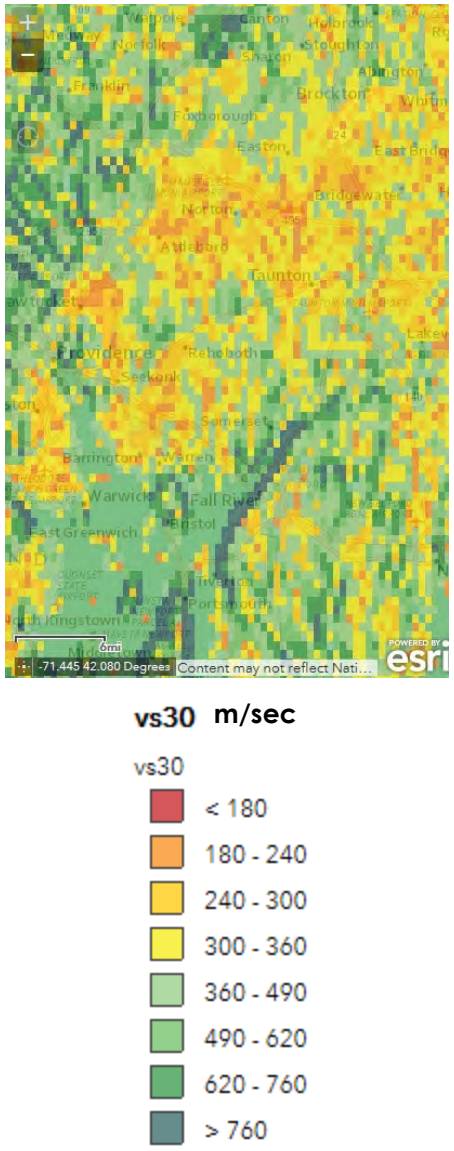


Figure 2-34: Estimated Soil Shear Wave Velocities within Somerset

Historical Occurrence at Somerset and Vicinity

According to the USGS Earthquake Catalog data search, there have been 20 earthquakes of magnitude 2.5 or greater which have occurred in Massachusetts or off the coast since 1974. The largest was a magnitude 3.7 which occurred near the Quabbin Reservoir in 1994. There was one aftershock of magnitude 3.3 associated with this earthquake. (https://earthquake.usgs.gov/earthquakes/search/ As show in **Figure 2-21**, there have historically been significant (Richter magnitudes between 5 and 7) earthquakes in the vicinity of Massachusetts.

Estimated Probability of Occurrence at and near Somerset

Based on the National Seismic Hazard Maps included in the Massachusetts State Building Code:,

- 2% in 50 years PGA (2,475 years recurrence interval; Maximum Considered Earthquake) in the vicinity of Somerset is 0.14g
- 10% in 50 years PGA (500 years recurrence interval) in the vicinity of Somerset is 0.03g
- Per the Massachusetts State Building Code, the values of Ss and S_1 at Somerset are 0.178g and 0.061g, respectively.
- the values of S_{DS} and S_{D1} at Somerset are 0.142g and 0.069g, respectively (for Essential Facilities; Site Class C)
- the values of S_{MS} and S_{M1} at Somerset are 0.213g and 0.103g, respectively for Site Class C (the majority of Somerset)
- the values of S_{DS} and S_{D1} at Somerset are 0.189g and 0.097g, respectively (for Essential Facilities; Site Class D)
- the values of S_{MS} and S_{M1} at Somerset are 0.284g and 0.145g, respectively 0.142g and 0.103g for Site Class D (certain Somerset shoreline areas)
- the values of S_{DS} and S_{D1} at Somerset are 0.296g and 0.141g, respectively 0.142g and 0.069g (for Essential Facilities; Site Class E)
- the values of S_{MS} and S_{M1} at Somerset are 0.443g and 0.212g, respectively for Site Class E (localized Somerset areas of floodplain alluvium)
- See Massachusetts State Building Code for application of the Seismic Coefficients
- The occurrence of historic earthquakes, PGA, Site Class and applicable seismic coefficients indicate that the seismic risk at Somerset is low. Amplified ground motion may occur within localized areas within Somerset classified as Site Classes D and E. These areas my also be susceptible to liquefaction.

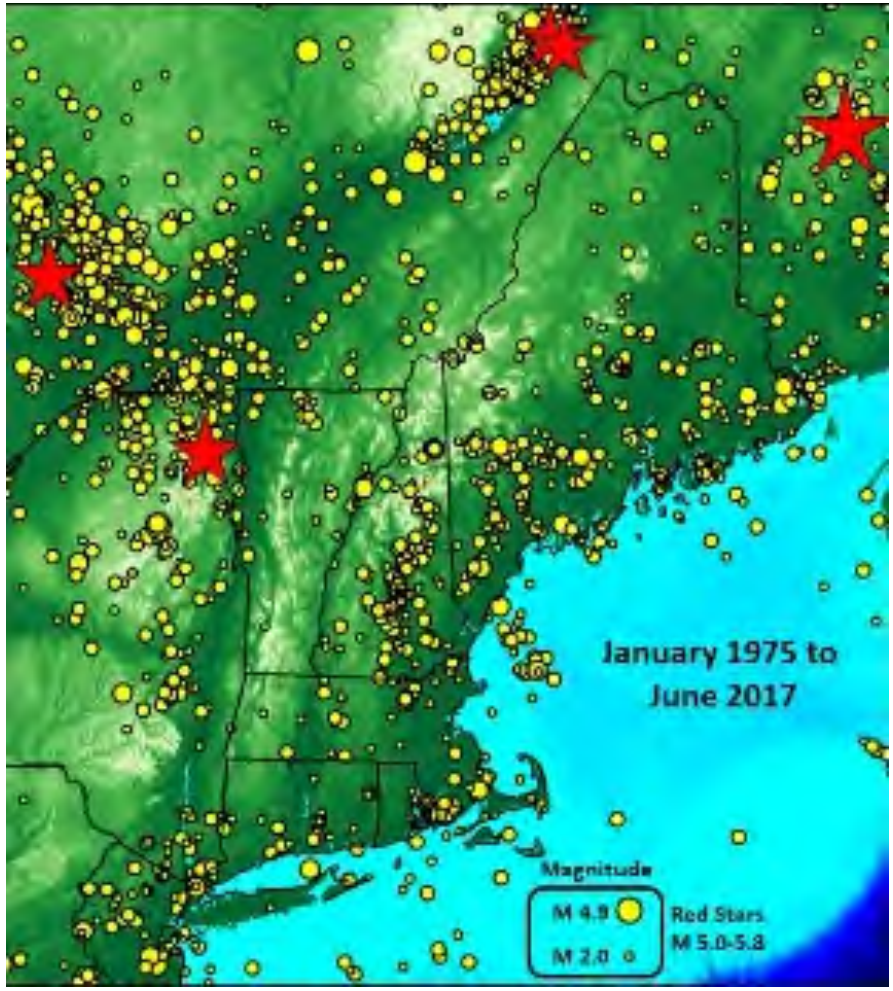


Figure 2-36: Area Earthquakes during January 1975 and June 2017
Source: Weston Observatory website

Attachment 3: Natural Hazard Risk

Attachment 3: Natural Hazard Risk

Overview

A Natural Hazard Risk Assessment was conducted by GZA to evaluate the potential consequences of natural hazards to the people, economy, and built and natural environments of the Town of Somerset. The risk assessment was performed based on guidance provided by the FEMA Local Mitigation Planning Handbook, and included the Local Planning Team (LPT). Four planning meetings were held on March 2, 2017, July 10, 2017, December 12, 2017 and April 6, 2018.

The Natural Hazard Risk Assessment evaluates the effects of the relevant natural hazards (described in Attachment 2) on the community assets (identified in Attachment 2). The methodology assesses risk in terms of: 1) the likelihood (i.e., frequency) of the natural hazard occurring; 2) the predicted effects (damages, losses, etc.); and 3) the consequences (e.g., costs) associated with those effects.

A vulnerability analysis was performed based on historical data and by on spatially comparing the hazard data to the community assets. In particular, the vulnerability of the Town to flooding was assessed by identifying which assets are located within the FEMA flood zones (Special Flood Hazard Areas).

The FEMA Multi-Hazard MH-HAZUS program was used to evaluate losses due to seismic, flood and hurricane hazards. The hazards were ranked using a scoring system. The scoring system is based on the likelihood/frequency, severity/ magnitude, and potential impact area. A similar scoring process was performed, independently and qualitatively, by the LPT to assess the Town's current "perceived" risk. Each member of the LPT assigned point values within each category to each hazard, as described above, and the values were averaged among the total point scores from the six members of the LPT.

Historical Hazard Events

Previous federal Presidential Disaster Declarations in Massachusetts and in Bristol County were reviewed. FEMA Repetitive Loss Property data within the Town was also evaluated.

Presidential Disaster Declarations:

Under the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C. §§ 5121-5207 (the Stafford Act), a Governor of a State affected by an emergency or a disaster can submit a request for a declaration by the President of the United States that a major disaster exists. The President can declare a major disaster for any natural event, including any hurricane, tornado, storm, high water, wind -driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, or drought, or, regardless of cause, fire, flood, or explosion, that the President determines has caused damage of such severity that it is beyond the combined capabilities of state and local governments to respond.

A major disaster declaration provides a wide range of federal assistance programs for individuals and public infrastructure, including funds for both emergency and permanent work (FEMA, "The Disaster Declaration Process", https://www.fema.gov/disaster-declaration-process).

Disaster	Declaration Date
Severe Winter Storm & Flooding (DR-4372)	June 25, 2018
Severe Winter Storm, Snowstorm & Flooding (DR-4214)	April 13, 2015
Severe Winter Storm, Snowstorm & Flooding (DR-4110)	April 17, 2013
Hurricane Sandy (DR-4097)	December 19, 2012
Tropical Storm Irene (DR-4028)	September 3, 2011
Severe Storm & Flooding (DR-1895)	March 29, 2010
Severe Storm & Flooding (EM-3264)*	October 19, 2005
Severe Storms & Flooding (DR-1614)	November 10, 2005
Severe Storms & Flooding (DR-1364)	April 10, 2001
Heavy Rain, Flooding (DR-1224)	June 23, 1998
Blizzard (DR-1090)	January 24, 1996
Severe Coastal Storm (DR-920)	October 4, 1991
Hurricane Bob (DR-914)	August 26, 1991

*Emergency Declaration for Bristol County

Table 3-1: Disaster Declarations in Massachusetts 1991 to 2018

Table 3-1 presents disaster declarations which have been made since 1991 in Massachusetts (current through March 30, 2018). These disaster declarations included Bristol County. Based on the occurrence rate, the expected frequency of disaster declarations is about 1 every 2 years. Based on past declarations, the most common natural disasters were Severe Weather Hazards, including flooding, winter storms, snowstorms; and hurricanes and tropical storms.

Attachment 3: Natural Hazard Risk

Ranking Hazards

The natural hazards were ranked based on impacts to the Town based on likelihood/frequency, severity/magnitude, and potential impact area. Each hazard category was provided a score based on the criteria as shown in **Table 3-2**. For each hazard, the product of the points from each category was determined and the hazards ranked from highest value to lowest. The hazard rankings are presented in **Table 3-3.** The details of each natural hazard are presented in **Attachment 2**, including the expected probability of occurrence (i.e. Likelihood/Frequency). A Hazard Vulnerability Assessment was performed to evaluate the expected consequences (i.e., the Severity/Magnitude and Impact Area) of the top ranked hazards. The results of the vulnerability assessment are presented in this Attachment, in order of the hazard rank.

Likelihood/Frequency		
Point Value	Category	Characteristics and Frequency
1	Very Low	Events that occur or are exceeded less often than once in 100 years (less than 1% probability)
2	Low	Events that occur or are exceeded from once in 50 years to once in 100 years (1% to 2% probability)
3	Medium	Events that occur or are exceeded from once in 5 years to once in 50 years (2% to 20% probability)
4	High	Events that occur or are exceeded more frequently than once in 5 years (greater than 20% probability)
Severity/Magnitude		
Point Value	Category	Characteristics
1	Minor	Limited and scattered property damage; no damage to public infrastructure (roads, bridges, trains, airports, public parks, etc.); contained geographic area (i.e., 1 or 2 communities); essential services (utilities, hospitals, schools, etc.) not interrupted; no injuries or fatalities.
2	Serious	Scattered major property damage (more than 50% destroyed); some minor infrastructure damage; wider geographic area (several communities); essential services are briefly interrupted; some injuries and/or fatalities.
3	Extensive	Consistent major property damage; major damage to public infrastructure (up to several days for repairs); essential services are interrupted from several hours to several days; many injuries and fatalities.
4	Catastrophic	Property and public infrastructure destroyed; essential or lifeline services stopped, thousands of injuries and fatalities.
Impact Area Assessment		
Point Value	Category	Characteristics
1	Small	In localized, unpopulated or lightly areas of Town, without structures or critical facilities
2	Medium	Impacting only portions of the Town
3	Large	Town-wide and/or essential and lifeline facilities

Table 3-2: Natural Hazard Ranking Classification

Severe Weather Hazards:	Rank
Severe Wind:	
Hurricanes/Tropical Storms	2
Thunderstorms	5
Tornadoes	4
Lightning	8
Intense Rainfall	6
Hail	6
Flood:	
Storm Surge	1
Sea Level Rise	5
Urban Drainage Flooding	6
Severe Winter Weather	
Snowfall	3
Ice Storms	6
Climate-Related Hazards:	
Extreme Temperature:	
Hot	7
Cold	7
Drought	7
Wildfire	9
Geologic Hazards:	
Earthquake	6
Landslides	0
Tsunami	0
Secondary Hazard:	
Dam Failure	3

Table 3-3 : Natural Hazard Ranking Results for Somerset

Table 3-3 presents the results of the hazard ranking for the Town. The top ranked hazards include: 1) coastal storm surge; 2) hurricanes (severe wind and related effects); 3) a dam failure (breach) of the Somerset Reservoir; and 4) severe winter weather (large snowfall event).

Although the extent of coastal storm surge is limited to the shoreline areas of Town, it is the top-ranked hazard due to: 1) flood inundation impacts to the Town's Water Pollution Control Facility; and impacts to transportation infrastructure, including Routes 103 and 6. Extensive damage to the Water Pollution Control Facility would be catastrophic due to loss (for an extended time) of that key lifeline service.

Severe wind and related damages during hurricanes is ranked second due to its relatively high frequency, its coincidence with coastal flooding and its potential for wide-spread damage. In particular, a hurricane strike at or near Somerset with a 1% probability of occurrence (100-year recurrence interval) would be catastrophic (similar to the 1938 and 1954 hurricanes).

Severe winter weather (including greater than 10-inches snowfall) most frequently occur during Nor'easters, coincident with high winds, cold temperatures and blizzard conditions. They present risks due to transportation impacts (limited use of roadways), cold temperatures (including wind chill) and the potential for structure damage (roof failures). Its relative high probability of occurrence makes severe winter weather as a high ranked hazard.

Failure of the high-hazard Somerset Reservoir due to a dam breach is a high ranked hazard due to the potential extent of flood inundation and potential loss of life.

Certain hazards currently rank low, but are expected to become more impactful in the future due to climate change. In particular, these include:

- Urban flooding due to intense local precipitation. The intensity and frequency of rainfall events is expected to increase (significantly) in the future. This will effect the capacity of the Town's stormwater infrastructure to adequately provide drainage during intense events.
- Extreme temperatures. The frequency and intensity of heat waves is expected to increase in the future. Although Somerset is located in a coastal environment, typically cooled by sea breezes, its relatively high elderly population will be vulnerable to extended periods of extreme heat. Overall warming will also increase the northern migration of disease vectors such as West Nile Virus and increase the duration and intensity of tick-borne diseases such as Lyme's Disease.
- Drought. Droughts are expected to increase in the future with potential impacts to the Town's water supply.

For comparison of Somerset's hazard ranking with the Commonwealth in general, **Table 3-4** summarizes the hazard risks for the Commonwealth based on the state hazard mitigation plan. The Town's hazard ranking is generally consistent with the Commonwealth.

		SEVERITY			
Hazard	Frequency	Likely Level	Potential Worst-Case	Area of Impact	Area of Occurrence
Natural Hazards					
Flood (including ice jam)	**High**	**Serious**	**Catastrophic**	**Regional**	**Statewide**
Dam Failure	Very Low	Extensive	Catastrophic	Local	Regional
Coastal Hazards	**High**	**Serious**	**Extensive**	**Regional**	**Regional**
Hurricane/Tropical Storms	**Medium**	**Serious**	**Catastrophic**	**Widespread**	**Statewide**
Nor'easter	**High**	**Minor**	**Extensive**	**Widespread**	**Statewide**
Earthquake	Very Low	Serious	Catastrophic	Regional	Statewide
Landslide	Low	Minor	Extensive	Local	Statewide
Snow & Blizzard (Severe Winter Weather)	**High**	**Minor**	**Extensive**	**Widespread**	**Statewide**
Ice Storm (Severe Winter Weather)	Medium	Minor	Extensive	Regional	Statewide
Wildland Fire	Medium	Minor	Extensive	Local	Regional
Major Urban Fires	Low	Minor	Serious	Isolated	Statewide
Thunderstorms (Severe Weather)	**High**	**Minor**	**Extensive**	**Regional**	**Statewide**
High Wind (Severe Weather)	**High**	**Minor**	**Extensive**	**Regional**	**Statewide**
Tornado (Severe Weather)	**Medium**	**Serious**	**Extensive**	**Local**	**Statewide**
Drought (Severe Weather)	Low	Minor	Serious	Widespread	Statewide
Extreme Temperature (Severe Temperature)	Medium	Minor	Serious	Widespread	Statewide
Tsunami	Very Low	Extensive	Catastrophic	Widespread	Regional

Table 3-4: Massachusetts State Hazard Assessment - Natural Hazards of Greatest Concern

Note: Hazards indicated in bold represent the greatest risk based on frequency, severity and range of impact.

Table 3-4 Definitions

Frequency:

Very Low: Events that occur less frequently than once in 1,000 years (less than 0.1% per year).

Low: Events that occur from once in 100 years to once in 1,000 years (0.1% to 1% per year)

Medium: Events that occur from once in 10 years to once in 100 years (1% to 10% per year).

High: Events that occur more frequently than once in 10 years (greater than 10% per year).

Severity:

Minor: Limited and scattered property damage; no damage to public infrastructure (roads, bridges, trains, airports, public parks, etc.); contained geographic area (i.e., 1 or 2 communities); essential services (utilities, hospitals, schools, etc.) not interrupted; no injuries or fatalities.

Serious: Scattered major property damage (more than 50% destroyed); some minor infrastructure damage; wider geographic area (several communities); essential services are briefly interrupted; some injuries and/or fatalities.

Extensive: Consistent major property damage; major damage to public infrastructure (up to several days for repairs); essential services are interrupted from several hours to several days; many injuries and fatalities.

Catastrophic: Property and public infrastructure destroyed; essential services stopped, thousands of injuries and fatalities.

Hazard Vulnerability Assessment

As indicated by the past Presidential Disaster Declarations, Somerset (like most of Bristol County and much of Massachusetts) is principally vulnerable to the following frequent severe weather hazards: 1) coastal flooding that occurs during hurricanes, tropical storms and nor'easters; 2) severe winds due primarily to hurricanes, which can occur coincident with coastal flooding; and 3) heavy snowfall during winter nor'easters, which can occur coincident with coastal flooding. Climate change has the potential to amplify the intensity and frequency of each of these hazards.

Although less frequent (or effecting less area), Somerset is also vulnerable to: 1) tornadoes; and 2) localized intense precipitation, resulting in localized urban flooding. The attribution of climate change to tornadoes frequency and intensity has not been established. Climate change effects on precipitation are well understood and significant, with the frequency and magnitude of intense precipitation events expected to increase significantly in the near future.

The population of Somerset is also vulnerable to extreme heat events. Climate change effects on the frequency and intensity of extreme heat events is well-understood and significant, with the frequency and duration of heat waves expected to increase.

Although earthquakes are infrequent in the vicinity of Somerset, their potential impacts are high. As discussed below, certain areas of Somerset are more vulnerable to earthquake effects than others due to geologic soil conditions.

The Somerset Reservoir Dam presents a dam failure hazard.

Coastal Flood Vulnerability

The Town is vulnerable to coastal  flood events. Due to the relatively high ground surface elevation present throughout most of the Town area, coastal flood inundation is limited to the shoreline areas along the Lee River, Mount Hope Bay and the Taunton River. **Attachment 2** presents details about Somerset's coastal flood hazard.

The vulnerability of Somerset to coastal flooding is a function of the elevation of the ground surface relative to predicted flood elevations. **Figure 3-1** presents the Somerset topography (ground elevation). The left-most figure indicates the elevation throughout Somerset, which ranges form about Elevation 250 feet + to 0 feet NAVD88, with much of Somerset at high elevations relative to coastal flooding. The right-most figure indicates areas with ground surface elevations of 20 feet NAVD88 or lower (a reasonable elevation upper bound for coastal flooding). As shown on this figure, coastal flood inundation is limited to narrow sections of Somerset shoreline.

Figure 3-2 through **3-5** present the FEMA special flood hazard areas within Somerset, starting from the northeast corner of Somerset (Somerset/Dighton boundary). Consistent with the ground surface elevation discussed above, coastal flood inundation is limited to the shoreline and coastally-connected streams and coves and the Lee River.

A screening level assessment of flood vulnerability relative to the FEMA 100-year ad 500-year recurrence interval floods (1% and 0.2% AEP, respectively) special flood areas indicates:

Essential Facilities:

- Police: Not vulnerable
- Fire and Ambulance: Not vulnerable
- Emergency Operations Centers: Not vulnerable
- National Shelter System: Not vulnerable
- Healthcare: Not vulnerable
- Public Health Department: Not vulnerable

Lifeline Systems:

- Water Pollution Control Facility: Vulnerable
- Power Generation and Transmission: Generally not vulnerable; one substation located within 500-year recurrence interval flood at Brayton Point
- Natural Gas and Heating Oil: Not vulnerable
- Potable water: Not vulnerable
- Communications: Not vulnerable; several wireless and mobile towers located within special flood hazard areas

Note that the inactive Montaup power plant is also located within the FEMA flood zone, but is not included here as a Lifeline Facility since it is no longer operable. The former power station at Brayton Point is also located within the FEMA flood zone, but is not included here as a Lifeline Facility since it is no longer operable.

Figure 3-6 presents the FEMA special flood hazard areas at the Somerset Water Pollution Control Facility. **Figure 3-7** presents the detailed topography at the Water Pollution Control Facility. The ground surface within the inundated plant area ranges from about Elevation 12 feet to 14 feet NAVD88. The FEMA 1% AEP stillwater elevation is 13.9 feet NAVD88, the BFE is Elevation 15 feet NAVD88 and the FEMA 2% (500-year recurrence interval flood) stillwater elevation is 17.6 feet NAVD88. Per the building code and industry guidance (TRE-16 Guide for Wastewater Treatment Works), the Water Pollution Control Facility should be flood-protected to the FEMA BFE+2 feet or the 500-year recurrence interval flood, whichever is greater. Therefore, the existing plant grades are about 3.5 to 5.5 feet below flood protection levels.

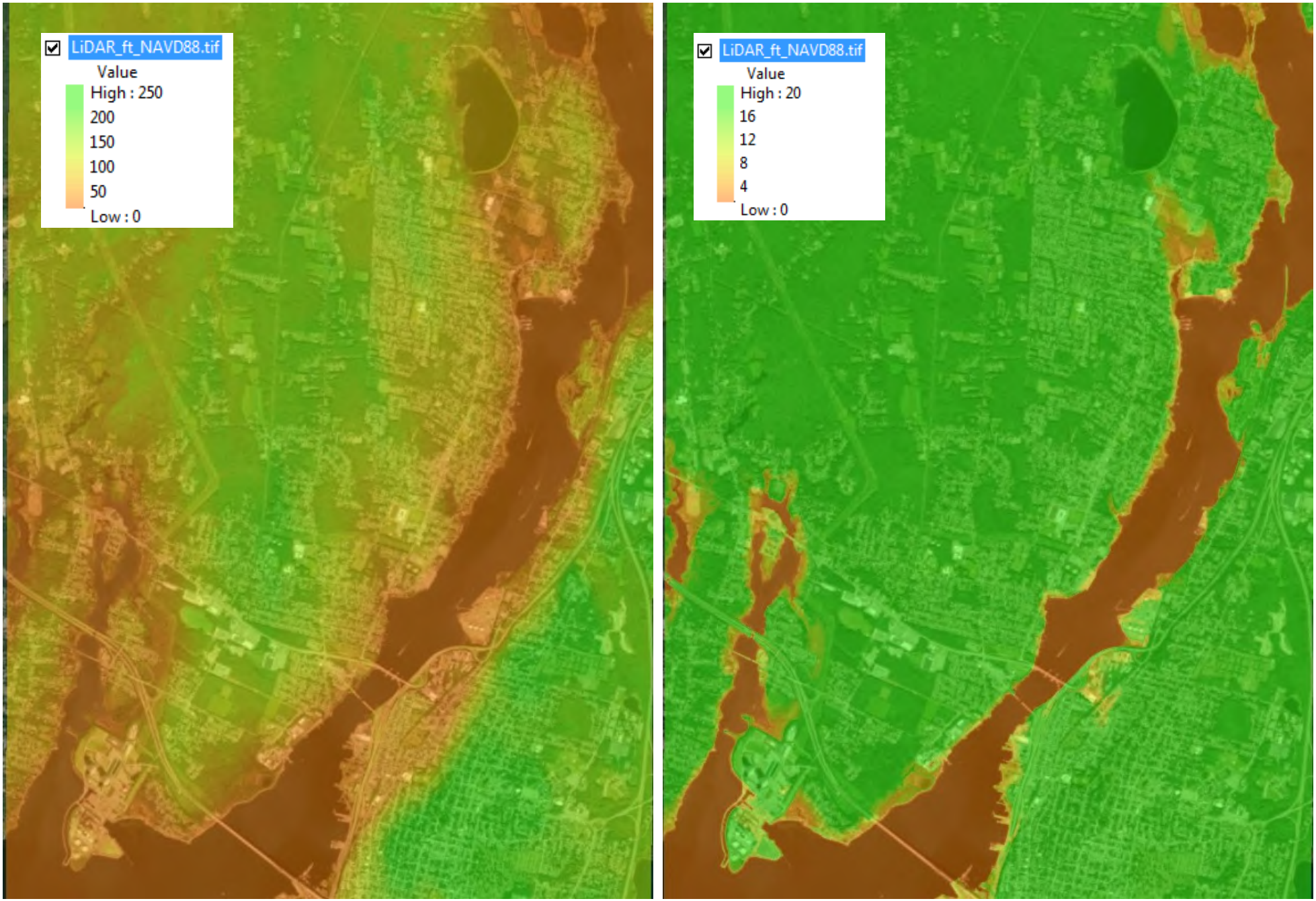


Figure 3-1: Ground Surface Elevation at Somerset (in feet, NAVD88; Elevation 29 feet and below - right)

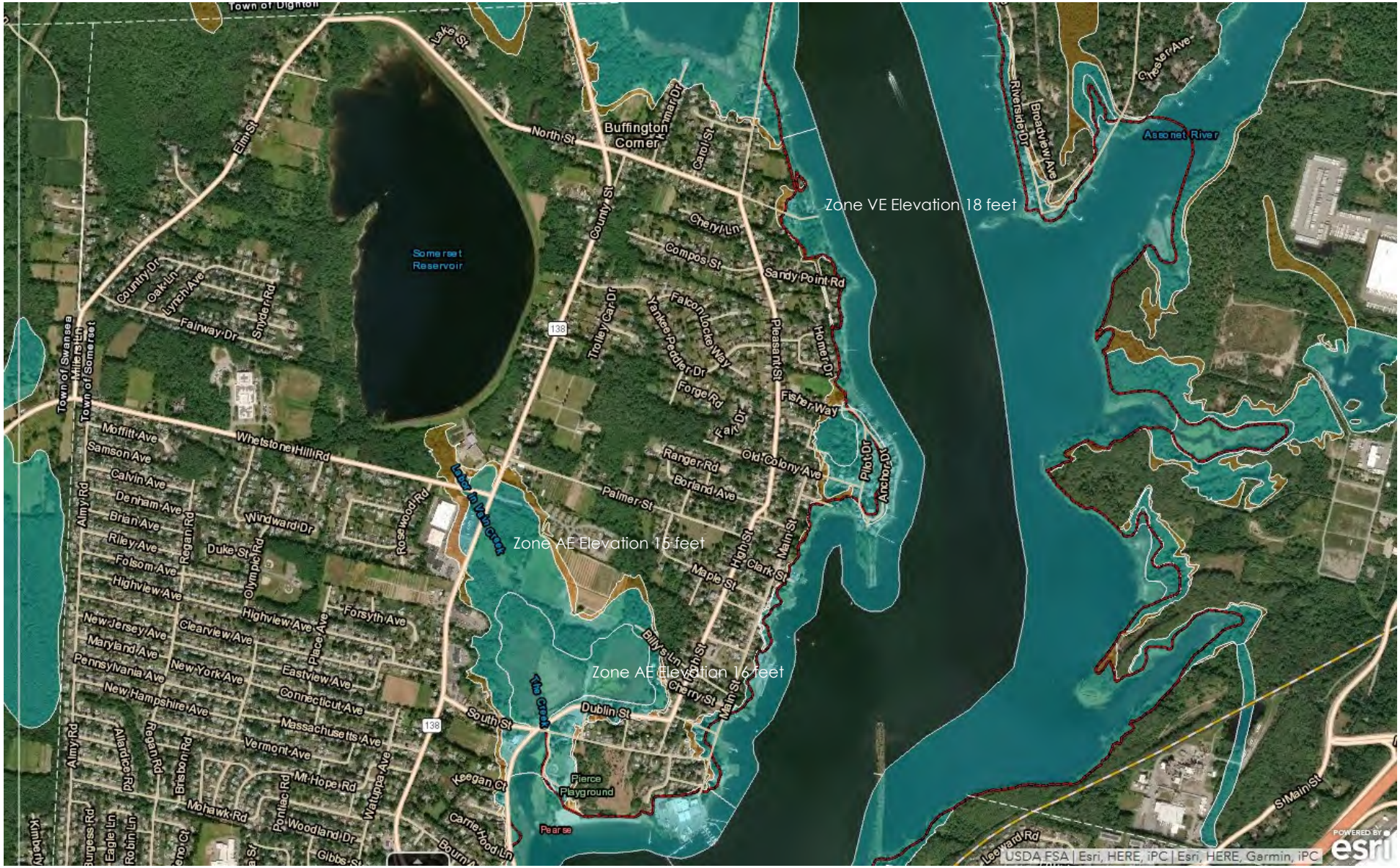


Figure 3-2: FEMA Special Flood Hazard Areas (SFHAs)

Legend: Green shaded areas indicates FEMA Base Flood inundation area (100-year recurrence interval)
Brown shaded area indicates FEMA 500-year recurrence interval flood area
Red line indicates Limit of Moderate Wave Action (wave heights greater than 1.5 feet
VE zone indicates high velocity zone (wave heights greater than 3 feet)

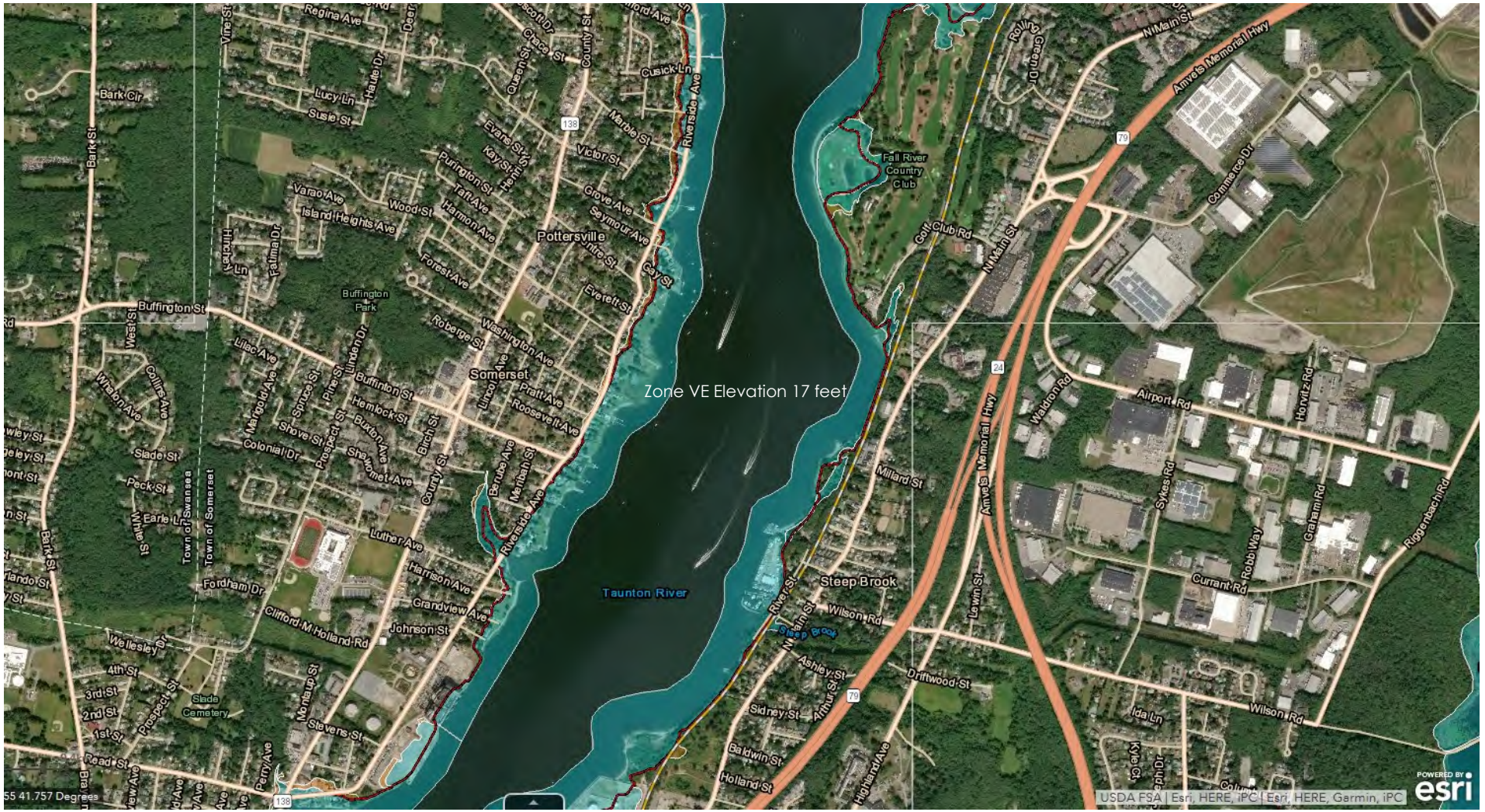


Figure 3-3: FEMA Special Flood Hazard Areas (SFHAs)

Legend: Green shaded areas indicates FEMA Base Flood inundation area (100-year recurrence interval)
Brown shaded area indicates FEMA 500-year recurrence interval flood area
Red line indicates Limit of Moderate Wave Action (wave heights greater than 1.5 feet
VE zone indicates high velocity zone (wave heights greater than 3 feet)

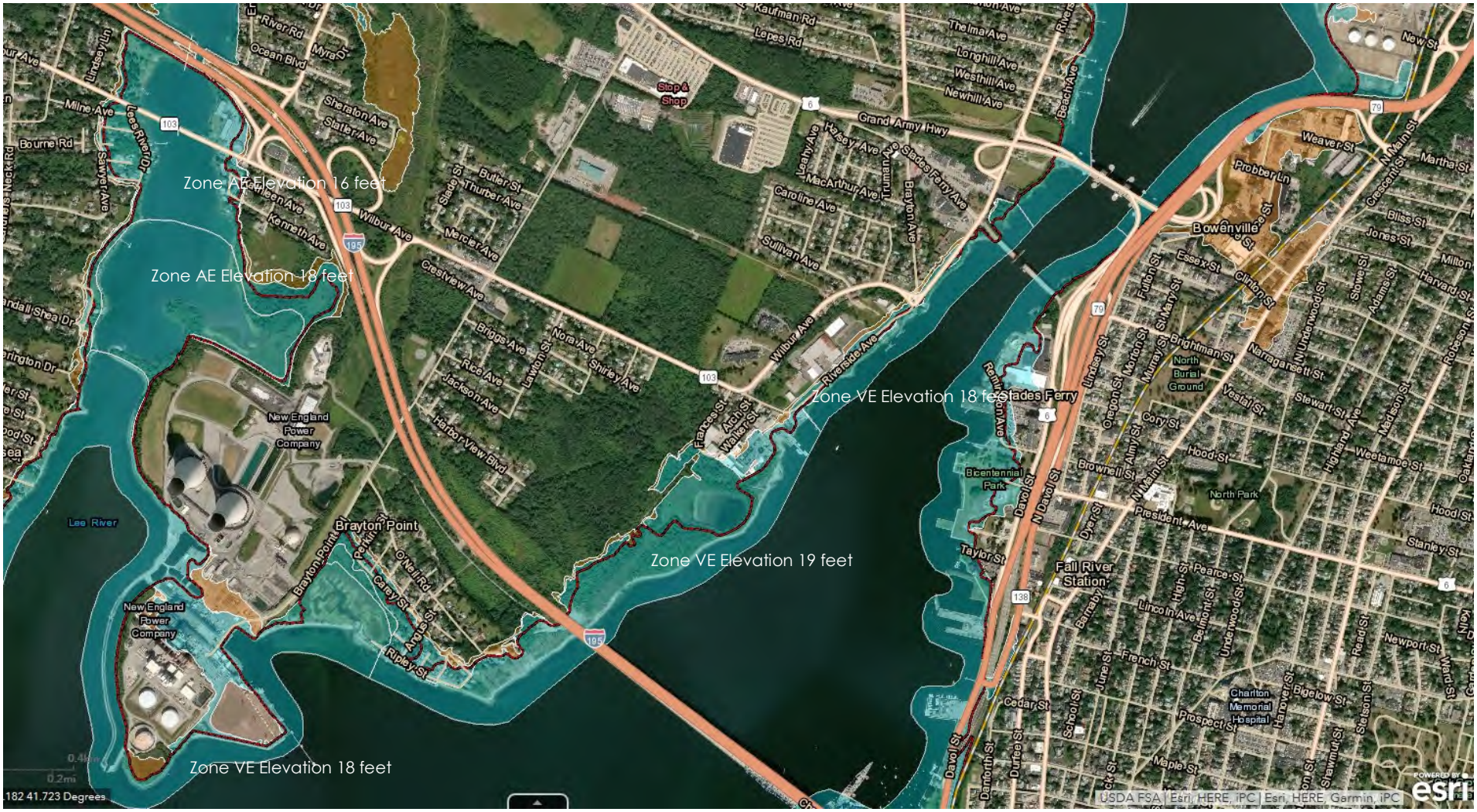


Figure 3-4: FEMA Special Flood Hazard Areas (SFHAs)

Legend: Green shaded areas indicates FEMA Base Flood inundation area (100-year recurrence interval)
Brown shaded area indicates FEMA 500-year recurrence interval flood area
Red line indicates Limit of Moderate Wave Action (wave heights greater than 1.5 feet
VE zone indicates high velocity zone (wave heights greater than 3 feet)

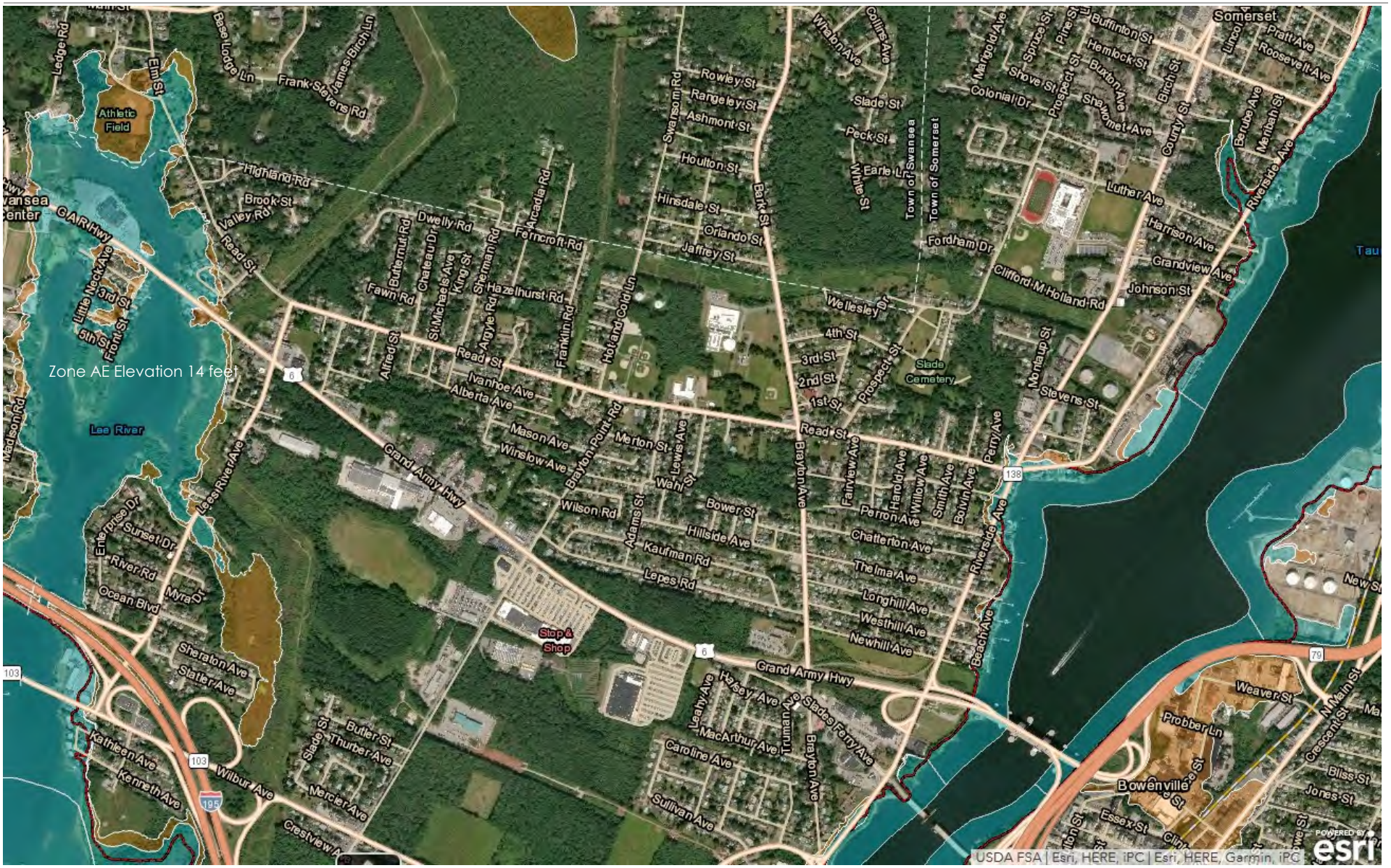


Figure 3-5: FEMA Special Flood Hazard Areas (SFHAs)

Legend: Green shaded areas indicates FEMA Base Flood inundation area (100-year recurrence interval)
Brown shaded area indicates FEMA 500-year recurrence interval flood area
Red line indicates Limit of Moderate Wave Action (wave heights greater than 1.5 feet
VE zone indicates high velocity zone (wave heights greater than 3 feet)

The treatment system includes the following units:

1. Headworks w/ flow equalization option
2. Primary Clarifiers
3. Aeration Tanks
4. Secondary Clarifiers
5. Chlorine Disinfection
6. Dechlorination
7. Outfall

Figure 3-6: FEMA Special Flood Hazard Areas (SFHAs) at the Somerset Water Pollution Control Facility

Legend:
- Green shaded areas indicates FEMA Base Flood inundation area (100-year recurrence interval)
- Brown shaded area indicates FEMA 500-year recurrence interval flood area
- Red line indicates Limit of Moderate Wave Action (wave heights greater than 1.5 feet
- VE zone indicates high velocity zone (wave heights greater than 3 feet)

Flood Vulnerability:

Based on the effective FEMA Flood Insurance Rate Map (FIRM), the plant is substantially within the FEMA BFE and the 500-year recurrence interval flood limits, indicating a potentially high vulnerability to coastal flooding. The minimum flood protection criteria for water pollution control facilities is the FEMA BFE + 2 feet or the 500-year recurrence interval flood elevation, whichever is greater. Critical equipment protected against damage up to water elevation equal to BFE + 3 feet.

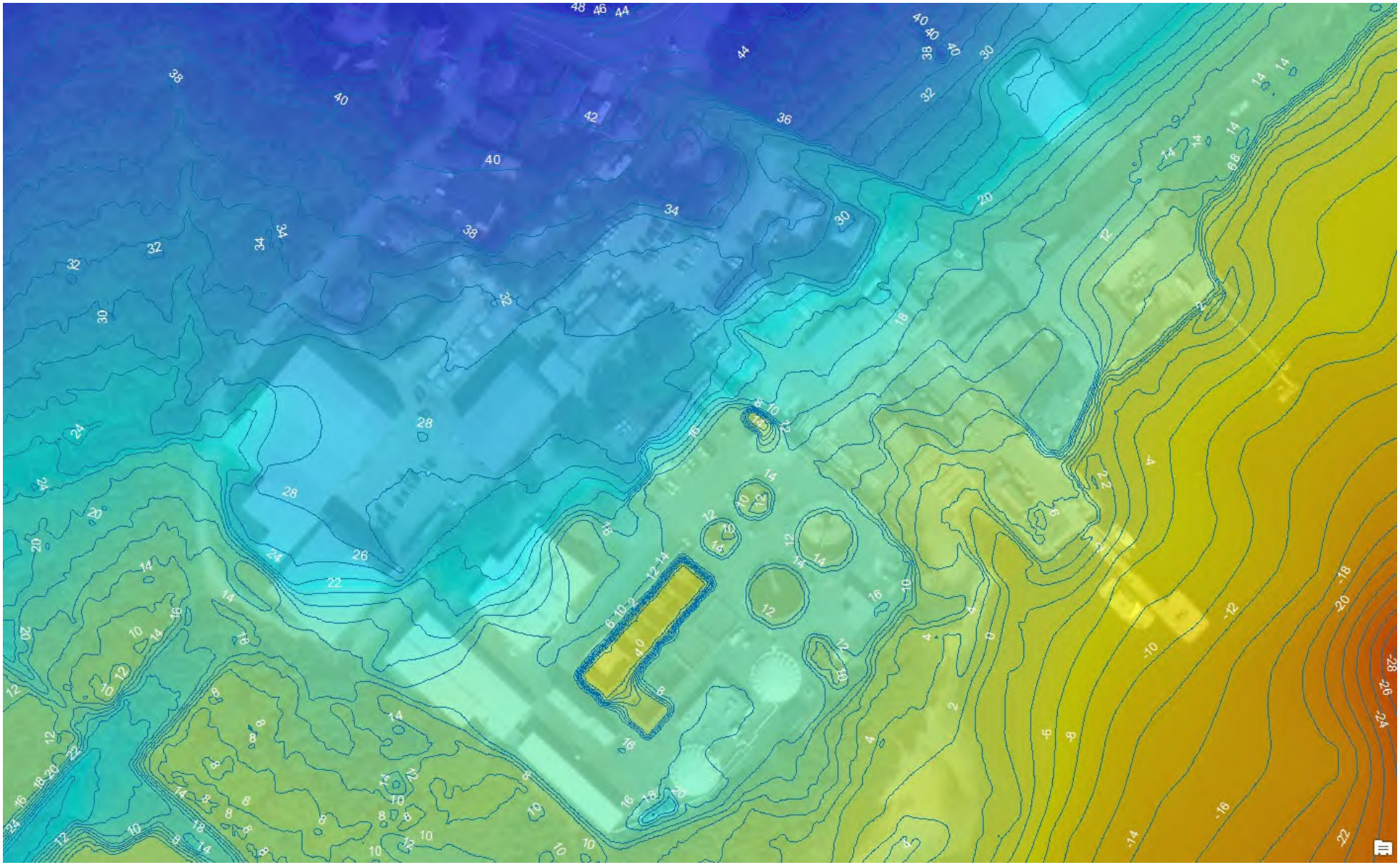


Figure 3-7: Ground Surface Elevation at Water Pollution Control Facility (in feet, NAVD88)

Screening Level Hazard Vulnerability Assessment cont.

Coastal Flood Vulnerability cont.

Transportation Infrastructure:

- Airports: None present
- Public Transit Stations: Not vulnerable
- Roads and Bridges: Vulnerable (Certain structures. See below)

Based on the effective FEMA Flood Insurance Rate Map (FIRM), certain Town and Commonwealth roads are vulnerable to coastal flooding including:

- Anchor Drive
- Pilot Drive
- Old Colony Avenue
- County Street (Route 138) and Whetstone Hill Road Intersection
- Main Street (at Poplar Road)
- Riverside Avenue (multiple sections)
- Massasoit Street
- Ripley Street
- Swan Street
- August Street
- Brayton Point Road
- Randolph Street
- Wilbur Avenue (Route 103)
- Grand Army Highway (Route 6)
- Evergreen Street

Figures 3-10 and **3-11** present the FEMA special flood hazard areas at Route 103 and Route 6, respectively. Google Earth street views are presented in **Figures 3-12 and 3-13**.

High Potential Loss Facilities:

- Somerset Reservoir Dam: Not vulnerable to coastal flooding; dam failure risk discussed in separate section of plan

Figure 3-8: Route 103 Causeway

Figure 3-9: Route 6 at Culvert

Figure 3-10: FEMA Special Flood Hazard Areas (SFHAs) at Route 103 Causeway

Legend:
Green shaded areas indicates FEMA Base Flood inundation area (100-year recurrence interval)
Brown shaded area indicates FEMA 500-year recurrence interval flood area
Red line indicates Limit of Moderate Wave Action (wave heights greater than 1.5 feet
VE zone indicates high velocity zone (wave heights greater than 3 feet)

Flood Vulnerability:

Based on the effective FEMA Flood Insurance Rate Map (FIRM), the causeway elevation (+/- Elevation 9 feet NAVD88) is substantially lower than the FEMA BFE (Elevation 16 feet NAVD88). The low elevation of the causeway also makes it susceptible to flooding during 20 to 50-year recurrence interval floods.

Figure 3-11: FEMA Special Flood Hazard Areas (SFHAs) at Route 6 Culvert

Legend: Green shaded areas indicates FEMA Base Flood inundation area (100-year recurrence interval)
Brown shaded area indicates FEMA 500-year recurrence interval flood area
Red line indicates Limit of Moderate Wave Action (wave heights greater than 1.5 feet
VE zone indicates high velocity zone (wave heights greater than 3 feet)

Flood Vulnerability:

Based on the effective FEMA Flood Insurance Rate Map (FIRM), the Route 6 culvert crossing elevation (+/- Elevation 6 to 13 feet NAVD88) is substantially lower than the FEMA BFE (Elevation 16 feet NAVD88). The low elevation of the causeway also makes it susceptible to flooding during 10 to 50-year recurrence interval floods. Adjacent sections of Route 6 are also within the FEMA special flood hazard areas.

Screening Level Hazard Vulnerability Assessment cont.

Coastal Flood Vulnerability cont.

Town Facilities:

- Somerset Boat Ramp: Vulnerable (see **Figures 3-14 and 3-15**; FEMA BFE is a high velocity V zone Elevation 18 feet NAVD88; existing ground surface elevations range from Elevations 0 to +/- 20 feet NAV-D88)
- Watershed Protection District: Not vulnerable
- Water Resource Protection District: Certain waterways are hydraulically connected to the Bay or Taunton River and are exposed to coastal storm surge and waves

Town Zoning Districts:

- Open Recreation Districts: Certain shoreline areas are vulnerable to coastal flooding
- Industrial Districts: Several industrial district areas are located within the FEMA flood hazard zones. See **Figures 3-15 through 3-18**)

Figure 3-17 presents the FEMA special flood hazard areas at the former Brayton Point property (zoned industrial district), showing that portions of the former plant site are vulnerable to coastal flooding. The existing ground surface elevations within those areas are presented in **Figure 3-18**.

Commercial Facilities:

- Marinas:
  a) Bristol Marine: Vulnerable; see **Figure 3-19**
  b) Somerset Marina and Yacht Sales: Vulnerable; see **Figure 3-20**
- Somerset Creamery: Vulnerable, see **Figure 3-21**
- Castigliegos Seafood: Vulnerable, see **Figure 3-21**
- Riverview Inn & Suites: Vulnerable, see **Figure 3-22**
- Jillian's Sports Pub: Vulnerable, see **Figure 3-22**
- Liquor Store: Vulnerable, see **Figure 3-22**

Note: Note that all Somerset commercial facilities were not included in this assessment. The ones listed above were readily identified as being within a coastal flood zones. Other commercial facilities may also be within flood zones, but are not identified in this Plan.

Figure 3-13: Somerset Boat Ramp FEMA Flood Zones

Figure 3-14: Somerset Boat Ramp Ground Surface Elevations

Screening Level Hazard Vulnerability Assessment cont.

Coastal Flood Vulnerability cont.

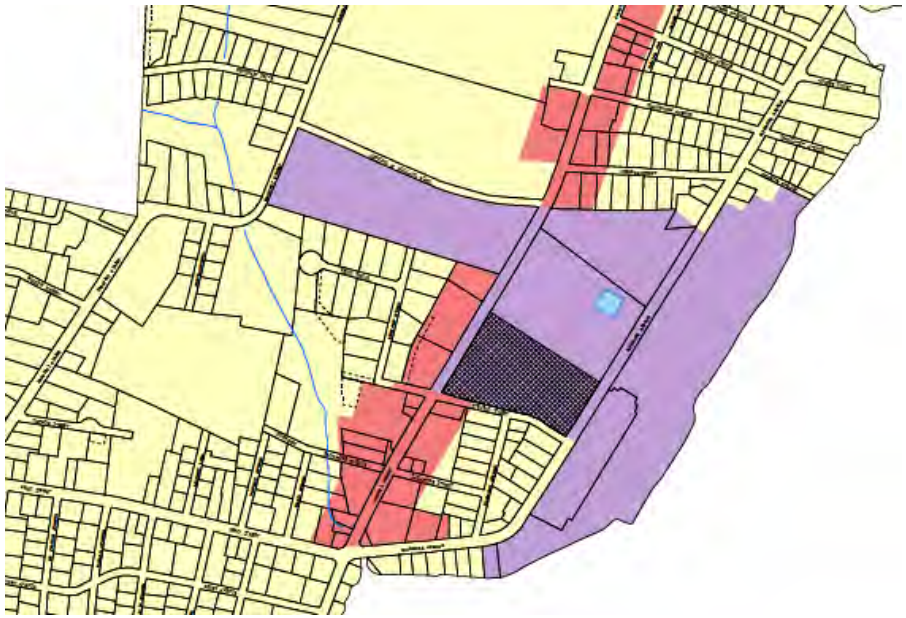


Figure 3-15: Somerset Boat Ramp FEMA Flood Zones

Screening Level Hazard Vulnerability Assessment cont.

Coastal Flood Vulnerability cont.

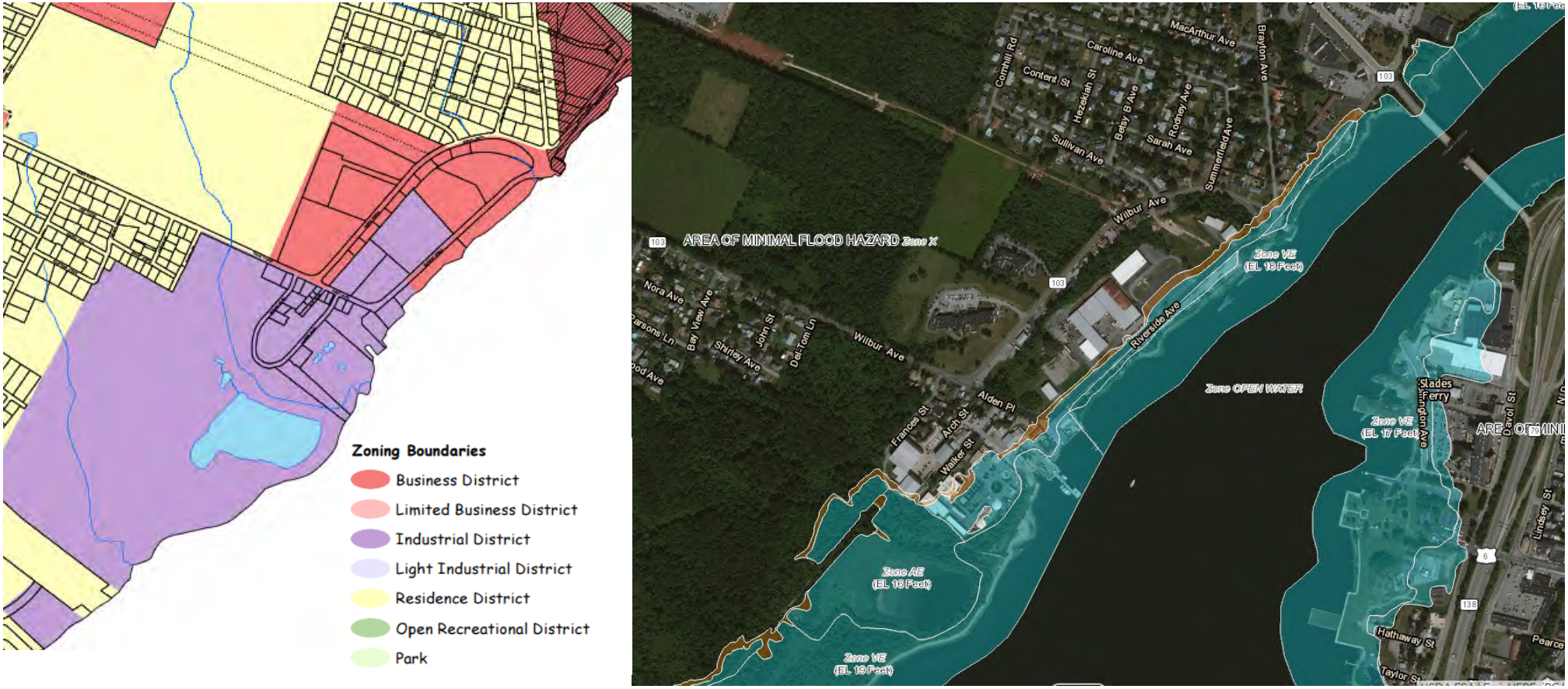


Figure 3-16: Somerset Boat Ramp FEMA Flood Zones

Figure 3-17: FEMA Special Flood Hazard Areas (SFHAs) at the Brayton Point

Legend:
Green shaded areas indicates FEMA Base Flood inundation area (100-year recurrence interval)
Brown shaded area indicates FEMA 500-year recurrence interval flood area
Red line indicates Limit of Moderate Wave Action (wave heights greater than 1.5 feet
VE zone indicates high velocity zone (wave heights greater than 3 feet)

Flood Vulnerability:

Based on the effective FEMA Flood Insurance Rate Map (FIRM), low-lying areas on the plant property are within the FEMA BFE (100-year recurrence interval flood) and the 500-year recurrence interval flood.

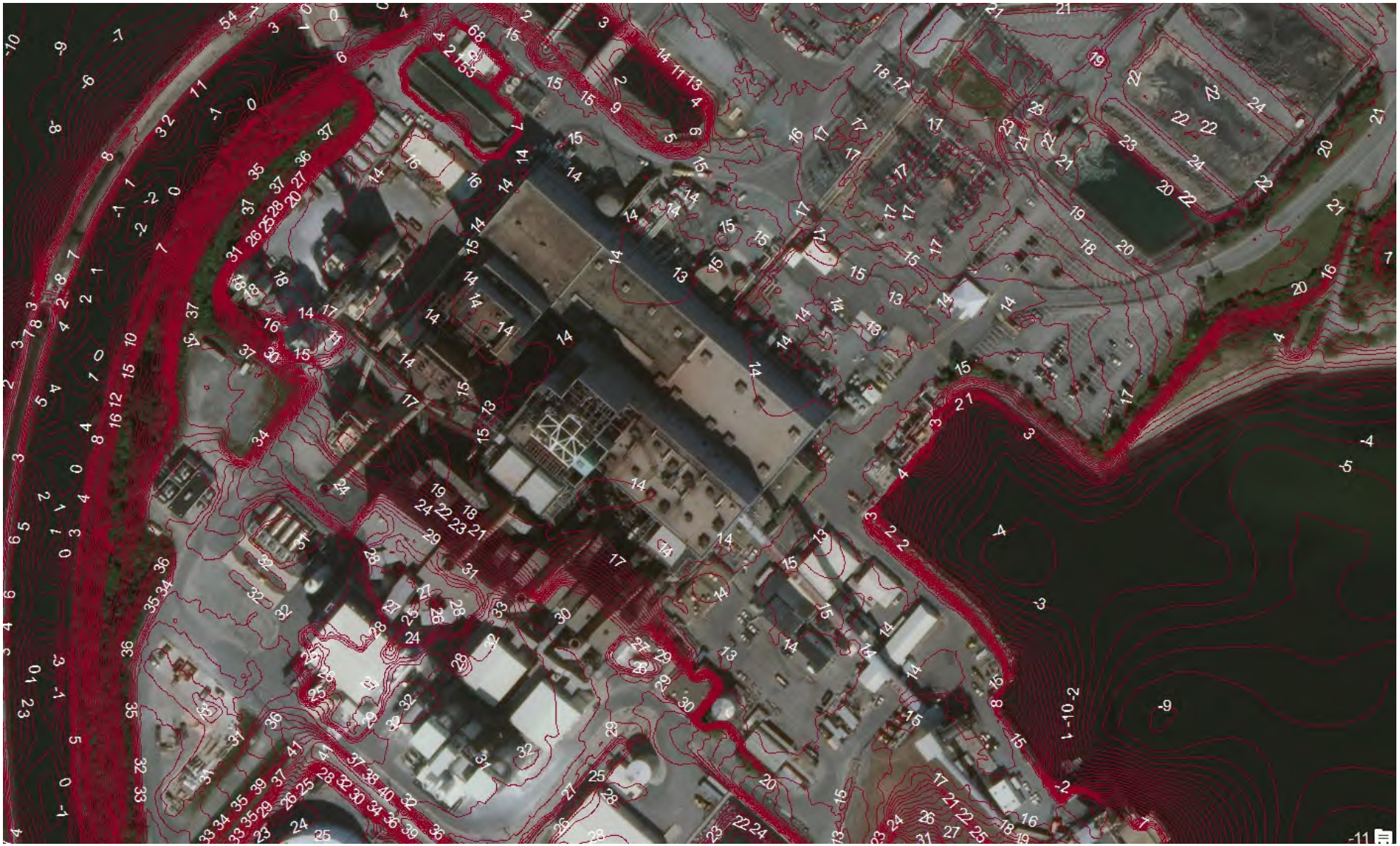


Figure 3-18: Ground Surface Elevation at Flood-Inundated Areas of the Brayton Point Power Plant (in feet,

Figure 3-19: FEMA Special Flood Hazard Areas (SFHAs) at Bristol Marine

Legend:
Green shaded areas indicates FEMA Base Flood inundation area (100-year recurrence interval)
Brown shaded area indicates FEMA 500-year recurrence interval flood area
Red line indicates Limit of Moderate Wave Action (wave heights greater than 1.5 feet
VE zone indicates high velocity zone (wave heights greater than 3 feet)

Flood Vulnerability:

Based on the effective FEMA Flood Insurance Rate Map (FIRM), the marine facility is located within the FEMA BFE (100-year recurrence interval flood) and the 500-year recurrence interval flood. BFE is a VE zone, Elevation 19 feet NAVD88. Existing site grades range from about Elevation 3 feet to 8 feet NAVD88.

Figure 3-20: FEMA Special Flood Hazard Areas (SFHAs) at the Somerset Marine and Yacht Sales

Legend:
interval)

Green shaded areas indicates FEMA Base Flood inundation area (100-year recurrence

Brown shaded area indicates FEMA 500-year recurrence interval flood area
Red line indicates Limit of Moderate Wave Action (wave heights greater than 1.5 feet
VE zone indicates high velocity zone (wave heights greater than 3 feet)

Flood Vulnerability:

Based on the effective FEMA Flood Insurance Rate Map (FIRM), the marine facility is located within the FEMA BFE (100-year recurrence interval flood) and the 500-year recurrence interval flood. BFE is a VE zone, Elevation 19 feet NAVD88. Existing site grades range from about Elevation 8 feet to 10 feet NAVD88.

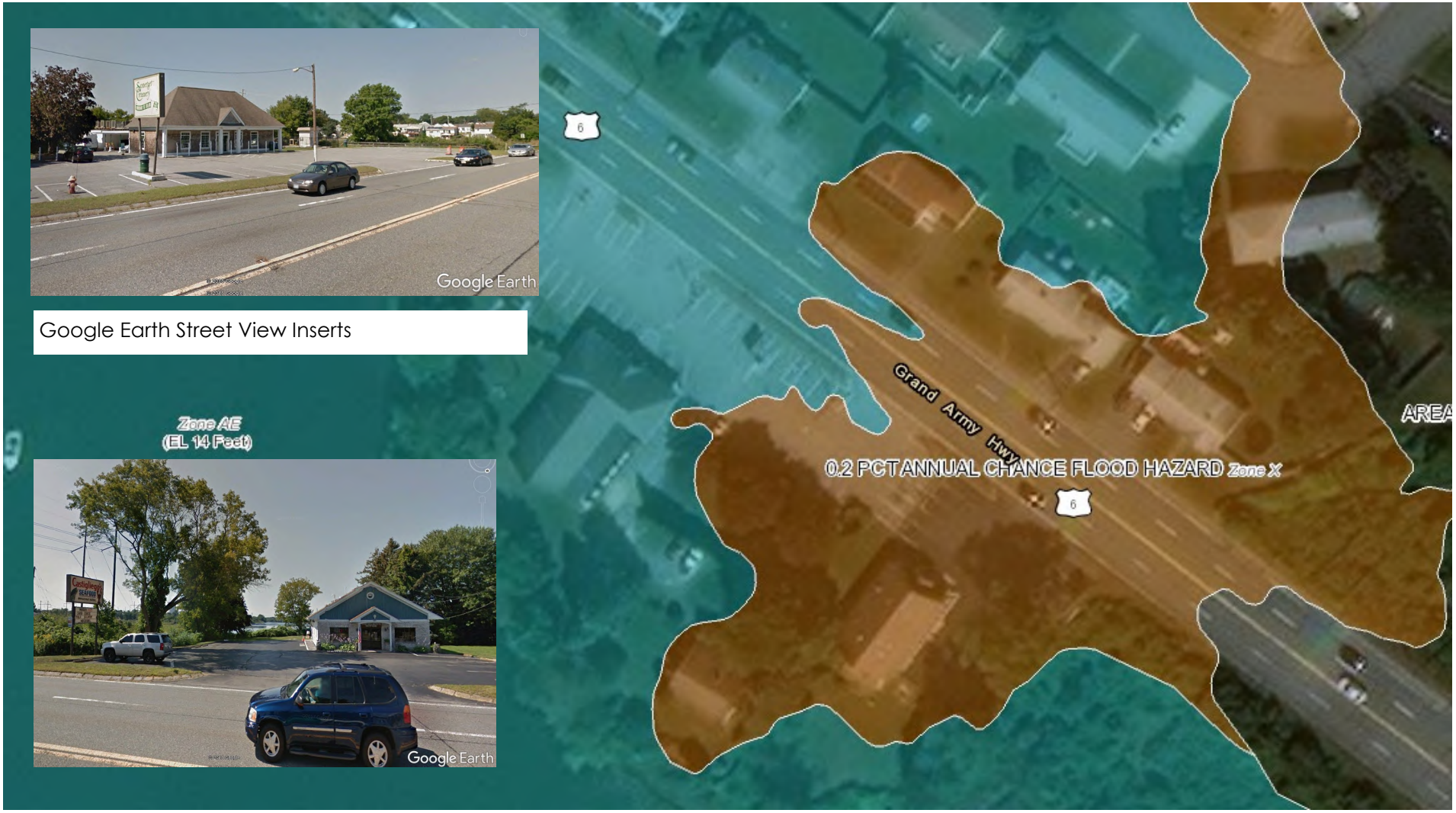


Figure 3-21: FEMA Special Flood Hazard Areas (SFHAs) at Somerset Creamery and Castigliegos Seafood

Legend: Green shaded areas indicates FEMA Base Flood inundation area (100-year recurrence interval)
Brown shaded area indicates FEMA 500-year recurrence interval flood area

Flood Vulnerability:

Based on the effective FEMA Flood Insurance Rate Map (FIRM), the marine facility is located within the FEMA BFE (100-year recurrence interval flood) and the 500-year recurrence interval flood. BFE is a VE zone, Elevation 16 feet NAVD88. Existing site grades range from about Elevation 6 feet to 15 feet NAVD88.

Figure 3-22: FEMA Special Flood Hazard Areas (SFHAs) at the Riverview Inn, Jillian's Sports Pub and Liquor Store

Legend:
Green shaded areas indicates FEMA Base Flood inundation area (100-year recurrence interval)
Brown shaded area indicates FEMA 500-year recurrence interval flood area
Red line indicates Limit of Moderate Wave Action (wave heights greater than 1.5 feet
VE zone indicates high velocity zone (wave heights greater than 3 feet)

Flood Vulnerability:

Based on the effective FEMA Flood Insurance Rate Map (FIRM), the marine facility is located within the FEMA BFE (100-year recurrence interval flood) and the 500-year recurrence interval flood. BFE is a VE zone, Elevation 16 feet NAVD88. Existing site grades range from about Elevation 7 feet to 13 feet NAVD88.

National Flood Insurance Program (NFIP) Repetitive Losses

According to the FEMA Flood Insurance Manual, Effective April 1, 2017, a Repetitive Loss Structure is defined as a National Flood Insurance Program (NFIP)-insured structure that has had at least 2 paid flood losses of more than $1,000 each in any 10-year period since 1978, and a Severe Repetitive Loss Building is any building that:

1. Is covered under a Standard Flood Insurance Policy made available under this title;
2. Has incurred flood damage for which:
    - 4 or more separate claim payments have been made under a Standard Flood Insurance Policy issued pursuant to this title, with the amount of each such claim exceeding $5,000, and with the cumulative amount of such claims payments exceeding $20,000; or
    - At least 2 separate claims payments have been made under a Standard Flood Insurance Policy, with the cumulative amount of such claim payments exceed the fair market value of the insured building on the day before each loss.

As of 10/31/2017, there are three (3) Repetitive Loss Property (RLP) and no Severe Repetitive Loss Properties (SRLP) within the Town of Somerset, as provided by the Massachusetts NFIP Coordinator. The 3 RLPs are single-family residential homes located in the FEMA Special Flood Hazard Area. The addresses of the RLPs is protected under the Privacy Act of 1974, 5 U. S. C. section 552(a); however, it may be noted that flooding of the 3 properties is likely associated with the Taunton River.

Table 3-5 provides an overview of NFIP information for the Town of Somerset. FEMA maintains a database on these flood insurance policies and claims, which can be found at https://www.fema.gov/policy-claim-statistics-flood-insurance. Overall, as of the 2010 Plan, the number of flood insurance policies, as well as coverage and premiums, losses, and total payments have increased.

Item	(as of 9/30/17)
Flood insurance policies in force	185
Coverage amount of flood insurance policies	$44,261,000
Premiums paid	$307,877
Total losses (all losses submitted regardless of the status)	64
Closed losses (Losses that have been paid)	36
Open losses (Losses that have not been paid in full)	0
CWOP losses (Losses that have been closed without payment)	28
Total payments (Total amount paid on losses)	$139,637.49

Table 3-5: Somerset Flood Insurance Policies and Claims

Coastal Flood Risk Summary

Due to the topographic setting of Somerset, the effects of coastal flooding are limited to the nearshore areas, only impacting structures within these areas. As presented on the previous pages, several Town facilities and districts are located within coastal flood zones. The Town topography will also minimize the effects of sea level rise; specifically, coastal flood elevations will bet higher and flood depths deeper, but the later extent of flood inundation will not increase greatly.

Likelihood/Frequency:

While coastal flooding occurs frequently at Somerset (at least once per year), significant coastal flood events are associated with the 1% and 0.2 AEP.

Severity/Magnitude

As part of the Plan preparation, GZA completed a Level 1 HAZUS-MH damage analysis for flood scenario (based on FEMA flood hazard delineation). The results are presented at the end of this Attachment. The results predict about $143M to $222M building and content damage for the 1% AEP (100-year recurrence interval) and the 0.2% (500-year recurrence interval flood, respectively. As discussed below, these estimates do not include impacts to the Town Wastewater Pollution Control Facility.

Coastal flooding is the top-ranked hazard due to: 1) flood inundation impacts to the Town's Water Pollution Control Facility; and impacts to transportation infrastructure, including Routes 103 and 6. Extensive damage to the Water Pollution Control Facility would be catastrophic due to loss (for an extended time) of that key lifeline service. Based on available topographic data, the plant flood vulnerability appears to exceed that considered acceptable by the Massachusetts State Building Code an industry guidance. Other factors contributing to the high rank of coastal flooding include the financial effect on property insurance.

As noted in **Table 3-5**, there are currently 185 NFIP-subsidized flood insurance policies in place. The Level 1 HAZUS scenario analyses identified 161 and 223 buildings vulnerable to flood damage (ranging from slight to substantial) for the 1% AEP and 0.2% AEP, respectively. Substantial damage will trigger specific flood regulations within the State Building Code, requiring that building repair or replacement be in compliance with current flood regulation.

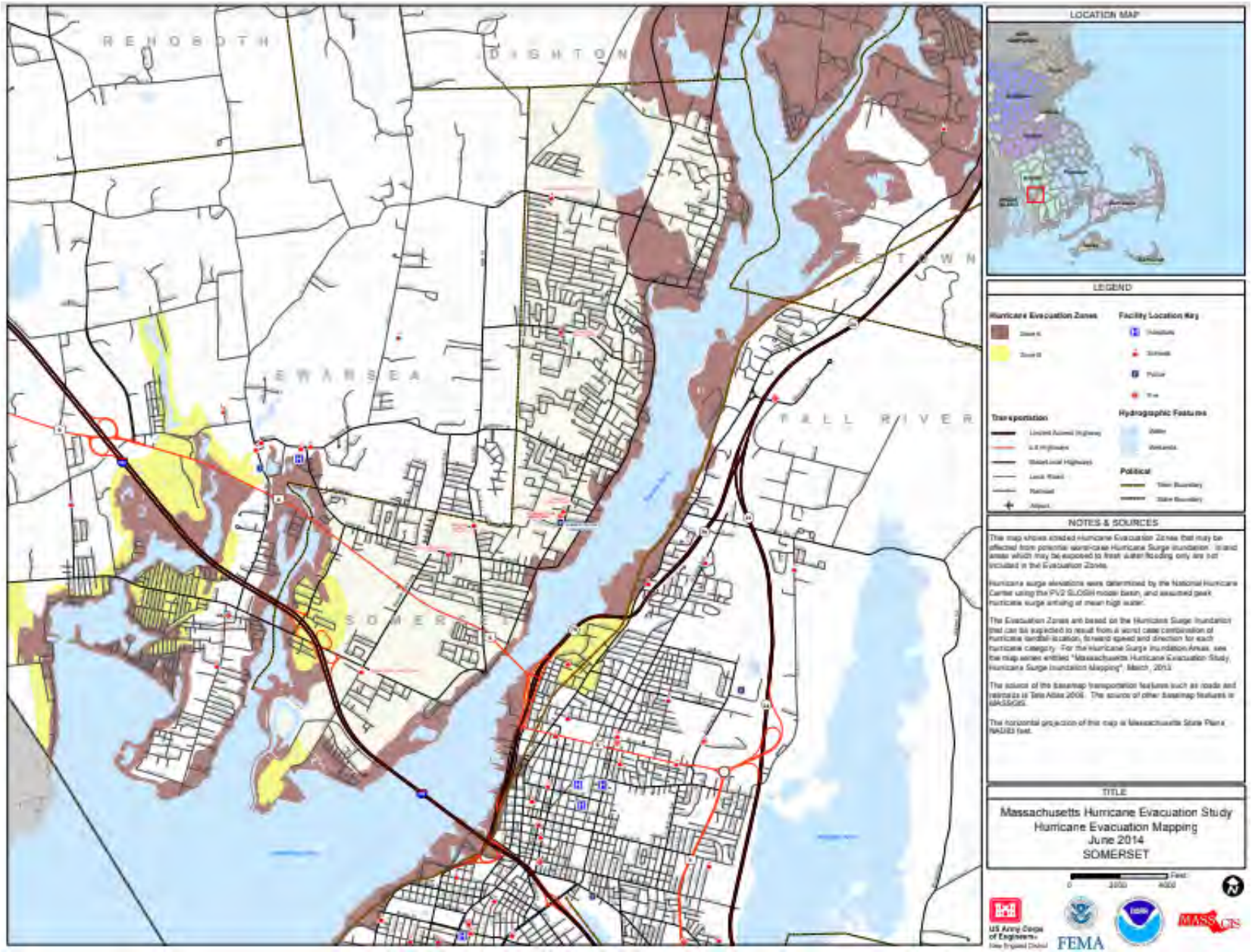
Impact Area:

- 161 buildings are predicted to be impacted during to the 1% AEP flood. This number represents 2% of the total number of Somerset buildings.
- 223 buildings are predicted to be impacted during to the 0.2% AEP flood. This number represents 3% of the total number of Somerset buildings.

Attachment 3: Natural Hazard Risk

Coastal Flood Risk Summary

- Somerset Hurricane/Coastal Flood Evacuation Map:



Severe Winds

Somerset is vulnerable to severe wind events due to hurricanes and tropical storms, nor'easters, thunderstorms and tornadoes. **Attachment 2** presents details about Somerset's wind hazards. Severe winds at Somerset occur most frequently due to hurricanes and tropical storms which can occur coincident with coastal floods and heavy precipitation. Severe winds can also occur at Somerset, although rarely, during tornadoes and more frequently during severe thunderstorms. High winds can also occur, frequently, during nor'easters (along with heavy rain and snow).

Likelihood/Frequency

The annual exceedance probability of experiencing sustained winds of 74 mph or greater at Somerset is about 1.5% (+/-70-year recurrence interval). High wind events (defined as sustained winds of 40 mph and gusts of 58 mph) are expected to occur at least once a year at Somerset.

Severity/Magnitude

Damages due to severe winds include: 1) damage to trees, often resulting in power outages and also potentially fatal accidents related to treefalls; 2) structure damage. **Table 3-6** presents the typical physical effects associated with different wind speeds. As shown on **Table 3-6**, significant, widespread damage can be expected due to sustained wind speeds of about 74 mph or greater.

The Massachusetts State Building Code requires that structure be constructed in Somerset to larger wind speeds (minimum wind gust for Risk Category I structures is 126 mph, the 0.3% AEP gust speed), so all recently constructed structures should expect minimal wind damage. Older, out-of-compliance structure may experience wind damage. As discussed in **Attachment 2**, since 1990, Bristol County has experienced 70 days of "High Wind" events (an average of about 2.5 events per year) resulting in about $3M in property damage and no deaths.

As part of the Plan preparation, GZA completed a Level 1 HAZUS-MH damage analysis for hurricane scenario. The results are presented at the end of this Attachment. The results predict about $35M to $164M building and content damage for the 1% AEP (100-year recurrence interval) and the 0.2% (500-year recurrence interval flood, respectively.

Impact Area:

The Level 1 HAZUS scenario analyses identified 941 buildings (15% of total buildings) and 2,231 buildings (32.2% of total buildings) vulnerable to flood damage (ranging from minor to destroyed) for the 1% AEP and 0.2% AEP, respectively.

Other Extreme Wind Events

Thunderstorms contribute to Somerset's wind risk. One hundred and twenty-eight thunderstorm wind events have occurred in Bristol County from 1966 to 2017, resulting in about $640k in property damage (about $11,000 per event) and 1 death. Forty of these events resulted in damage and 1 event resulted in death or injury. Of these, three thunderstorm events impacted the Town of Somerset, all of which occurred in 2008. The most severe thunderstorm, resulting in $6K in wind damages, occurred on July 23, 2008. Other severe thunderstorms were reported in Somerset on March 5, 2008. Based on proportional land area, the estimated AEP at Somerset is about 1 to 2% (+/- 50 year recurrence interval), with expected damage on the order of $5K to $10K per event. This risk is significantly less than the risk associated with hurricane winds.

Seven tornadoes occurred in Bristol County, the F3 tornado during June, 1953 resulted in the largest degree of damages at $2.6 Million and one injury. The 6 other tornadoes combined accounted for less than $60 thousand in total damages where most of the tornadoes ranged in severity from F0 to F1; however, four injuries (the most for any tornado event) resulted from a single tornado that occurred August of 1968. Based on proportional land area, the estimated tornado AEP at Somerset is about 0.2% (+/- 500 year recurrence interval), with expected damage on the order of $10K per event. This risk is significantly less than the risk associated with hurricane winds. Somerset would experience much greater damages during a major tornado; however, the probability of a major tornado tracking through Somerset appears to be very low (less than 0.2% AEP). Somerset's tornado wind risk appears to be is significantly less than the risk associated with hurricane winds.

Sustained Wind Speed	Annual Recurrence Interval (years)	Physical Effects
6-38 kts (30-44 mph)	<1	Trees in motion. Light-weight loose objects (e.g., lawn furniture) tossed or toppled.
39-49 kts (45-57 mph)	2 to 10	Large trees bend; twigs, small limbs break, and a few larger dead or weak branches may break. Old/weak structures (e.g., sheds, barns) may sustain minor damage (roof, doors). Building partially under construction may be damaged. A few loose shingles removed from houses. Carports may be uplifted; minor cosmetic damage to mobile homes and pool lanai cages.
50-64 kts (58-74 mph)	10 to 70	Large limbs break; shallow rooted trees pushed over. Semi-trucks overturned. More significant damage to old/weak structures. Shingles, awnings removed from houses; damage to chimneys and antennas; mobile homes, carports incur minor structural damage; large billboard signs may be toppled
65-77 kts (75-89 mph)	70 to 300	Widespread damage to trees with trees broken/uprooted. Mobile homes may incur more significant structural damage; be pushed off foundations or overturned. Roof may be partially peeled off industrial/commercial/warehouse buildings. Some minor roof damage to homes. Weak structures (e.g., farm buildings, airplane hangars) may be severely damaged.
78+ kts (90+ mph)	>300	Many large trees broken and uprooted. Mobile homes severely damaged; moderate roof damage to homes. Roofs partially peeled off homes and buildings. Moving automobiles pushed off dry roads. Barns, sheds demolished.

Table 3-6: Physical Effects associated with different wind speeds

Dam Failure

The Somerset Reservoir Dam is a High Hazard Dam. The following details for the Somerset Reservoir Dam are based review of the 2016 Somerset Reservoir Phase I Dam Inspection Report (Phase I Report) and Emergency Action Plan (2016 EAP).

Dam Location: According to the Massachusetts Department of Conservation and Recreation's (DCR) Office of Dam Safety (ODS), the Somerset Reservoir Dam (National ID MA00792/State ID 6-3-273-1) is the only dam within or on the boundaries of Somerset. The Somerset Reservoir Dam is located north of Whetstone Hill Road, west of County Street (Route 138), south of North Street and impounds water along Labor-In-Vain-Brook to form the Somerset Reservoir.

Description of Dam and Appurtenances: The dam is currently owned, operated and maintained by the Town of Somerset. The dam is an approximately 6,700-foot-long earthen embankment with an intake tower for water supply and low-level control, and an auxiliary spillway. There is no primary spillway for the dam; however, the treatment plant intake, inclusive of the low-level outlets, serves to maintain the normal pool elevation. The dam is located along the northeastern, eastern and southeastern sides of the impoundment. According to the Phase I Dam Inspection Report (Phase I Report) the earthen embankment is a homogenous structure reportedly constructed of compacted glacial till with a central core wall. The maximum height of the embankment is approximately 48 feet and the crest of the dam, set near 59.5 feet MSL, varies from 8 to 20 feet in width. The upstream and downstream slopes are 2H:1V. There is a 6-foot wide berm on the downstream slope at elevation 25 feet MSL at the highest section of the embankment. The upstream slope is covered with dumped riprap placed on screened gravel bedding.

The drainage area for the Somerset Reservoir Dam is approximately 1.6 miles and extends approximately 2 miles northwest of the dam within the Town of Somerset.

DCR Hazard Classification: The Somerset Reservoir Dam is located upstream of numerous residents, a shopping plaza and a water filtration plant. The report stated that it appears that a failure of the dam at maximum pool will likely cause loss of life and serious damage to homes, industrial and commercial facilities, important public utilities and highways. Based on this assessment and in accordance with Commonwealth of Massachusetts dam safety rules and regulations Somerset Reservoir is classified as a High hazard potential dam. Because the dam is a High hazard potential dam, the Town is required by the Massachusetts Office of Dam Safety to have a Phase I Report prepared for the dam every two years.

Hydraulic/Hydrologic (H&H) Data: The dam is currently classified as a large size, Class I (High) hazard potential structure. Therefore, in accordance with state regulations, the spillway design flood (SDF) for the site is one-half (1/2) of the probable maximum flood (PMF).

In 2016 the DCR ODS requested an evaluation of the adequacy of the outlet works at the Somerset Reservoir Dam to accommodate the ½ PMF spillway design based on available information relevant to the adequacy of the outlet works. Based on a review of H&H analysis for the ½ PMF included in the 2006 EAP, Pare Corporation determined that it is unknown if the Somerset Reservoir Dam outlet has adequate capacity to accommodate the ½ PMF storm event. Base on Pare Corporation's recommendation that a formal H&H analysis be performed as presented in the 2016 Phase I Report, the Town is in the process of receiving a formal H&H analysis.

Structural and Seepage Stability: at the time of the inspection in 2016, there were no immediate indications of immediate instability of the embankment or non-embankment structures. In addition, there were no observed indications of seepage deficiencies.

Dam Condition Assessment: The dam's overall physical condition was found to be in Fair condition. A rating of Fair condition is based on findings of significant operational and maintenance deficiencies, no structural deficiencies, and/or potential deficiencies may exist under unusual loading conditions that may realistically occur.

The Phase I Report identified the following deficiencies:

- Areas of settled, sloughed, and irregularly placed riprap throughout the upstream slope.
- Areas of unwanted and overgrown woody vegetation up to 4 inches in diameter within the upstream slope and upstream of the crest.
- Areas of unwanted vegetation along the toe and downstream slope.
- Undulations and potential areas of settlement throughout the crest.
- Areas of vehicle ruts along the crest and downstream toe.
- Animal borrows up to 12 inches in diameter and 38 inches deep.
- Areas of missing stone and mortar throughout the upstream and downstream walls of the inlet/outlet culvert.
- Debris, fallen trees, and irregular riprap are present within the channel both downstream and upstream of the inlet/outlet culvert.
- The toe drain outlet/Brook by-pass is clogged with iron flocculate.

Recommendations: The 2016 Phase I Report presented the following recommendations will to address the deficiencies:

- Clear the dam of all trees, brush, and other unwanted vegetation.
- Clear/Repair toe drain system.

Dam Failure

- Perform a study to evaluate the condition of the tow drain system and repair as necessary.
- Repair settled and sloughed areas of the upstream riprap and monitor for future movement.
- Perform a seepage analysis in accordance with 302 CMR 10.14(9).
- Fill eroded/depressed areas along the top of the dam and regrade to a uniform design elevation.
- Strip and repaint the intake tower catwalk grating.
- Rehabilitate the auxiliary spillway (i.e. inlet/outlet culvert) stone masonry walls.
- Complete a detailed H&H analysis to assess the dam's ability to accommodate a spillway design flood (SDF) event.
- Pending results of the H&H analysis for the SDF, develop alternatives for increasing the hydraulic capacity of the dam to accommodate the SDF. Alternatives may include raising the crest of the dam, increasing the capacity of the twin culverts and auxiliary spillway at the north end of the dam, or increasing the capacity outlets at the intake tower.
- Pending the results of the H&H analysis for the SDF, update the EAP to reflect the updated results. Also, review and update the EAP to verify that contact information for emergency response personnel remains accurate. Revise evacuee contact information as necessary. Complete periodic training.

EAP Purpose: The 2016 Somerset Reservoir Dam Emergency Action Plan (2016 EAP) establishes the guidelines and procedures for addressing emergency conditions identified at the dam in time to take mitigative action such as notifying the appropriate emergency management officials of potential, impending, or active failing of the dam. Emergency conditions are generally identified by dam inspections (formal or casual) or triggered by unusual rainfall events or an earthquake. Identification of hazardous condition should be reported to the Superintendent of Water or alternate to initiate the notification process based on the Notification Flowchart (NFC) listing the personnel to be called and their phone numbers in case of emergency.

Notification Flowchart and Emergency Level Determination: The NFC indicates the chain of communication to be followed in the event of an emergency. The NFC indicates a Phase I and Phase II type of notification to be implemented depending on the emergency classification level (Condition I or II) as determined necessary based on the judgement of the personnel monitoring the emergency condition at the dam. The two emergency conditions outlined in the EAP are as follows:

- Condition I: "Potential failure situation is developing": This is a situation where a failure may eventually occur if left unattended. This situation will require Phase I response with continuous monitoring.
- Condition II: "Failure is imminent or has occurred": This is a situation where a failure has occurred, is occurring, or is just about to occur. This situation will require Phase I and II responses that will proceed with evacuation procedures.

General Responsibilities: The EAP includes specific emergency response actions for each emergency Condition (see page 7-11 for detailed actions) to be carried out by the responsible local and state authorities All decisions that are made should be made in accordance with the Incident Command Structure outlined in the EAP. Notification of local authorities is primarily the responsibility of the Water Division Superintendent depending on the identified emergency Condition as outlined in Section 5 of the EAP.

Evacuation Lists: Due to the length of the dam, different downstream areas will be flooded depending on the location of the failure along the dam. Therefore, the listings of residences in the downstream inundation areas are divided into the North Flood Zone and South Flood Zone. These flood zones were based on the Inundation Map resulting from the 2006 H&H analysis performed by Fay, Spofford & Thorndike. The North Flood Zone includes approximately 237 occupants8 in residences and businesses located on Rosewood Road (46 occupants), Jon Ester Road (32 occupants), Red Fox Trail (33 occupants), Highridge Road (33 occupants), and Windward Drive (93 occupants). The South Flood Zone includes approximately 264 occupants* in residences and businesses located on County Street (95 occupants), Palmer Street (5 occupants), Whetstone Road (5 occupants), South Street (30 occupants), Marsh Street (9 occupants), Peterson Street (2 occupants), High Street (9 occupants), Cherry Street (11 occupants), Riverside Avenue (15 occupants), and Dublin Street (38 occupants). It is important to note that upon completion of the updated H&H analysis for the for the ½ PMF currently development, the flood zones and locations of property at risk will need to be updated in the next EAP and Phase I Report.

*As noted in the 2016 EAP, the number of occupants in the North and South Flood Zones are approximate numbers and should only be used as a guide.

Preparedness: The most important part of the EAP is the identification of a problem at the dam. The EAP notes that problem identification will be much easier if the dam is monitored closely by knowledgeable personnel. Water Department personnel must continue to monitor the dam on a regular basis. This is especially important during high rainfall events and during spring conditions when a large amount of snow melting occurs.

Refer to Somerset Reservoir Emergency Action Plan 2014 Update

Severe Winter Weather

Somerset is vulnerable to frequent snowstorms, usually associated with nor'easters. The U.S. Northeast annually experiences about 20 to 40 nor'easters. Beginning in October and ending in April, the nor'easter season runs for seven months. Out of the 20 to 40 annual storms, at least two are severe. **Attachment 2** presents details about Somerset's severe winter weather hazards.

Damages due to severe winter weather include: 1) damage to trees, often resulting in power outages and also potentially fatal accidents related to treefalls; 2) structure damage, including roof collapse; and 3) roadway issues including access limitations and vehicular accidents.

Likelihood/Frequency

Between 1996 and 2018, there were a total of 86 Heavy Snow events including 55 days in Bristol County, 5 days with property damage and no injuries or fatalities. Estimated Somerset snowfall frequency:

- 10 to 15 snow days per year
- Average annual snowfall of 28 to 33 inches
- 90% AEP or 1 year recurrence interval Heavy Snowfall (19 years with 1 or more events over 21 years)
- Reasonable estimate of average monthly snowfall: 15 to 20 inches
- Reasonably conservative monthly snowfall upper bound: 40 inches (maximum monthly upper bound of 60 inches)

Severity/Magnitude

The severity/magnitude of severe winter weather is a function of the type of vulnerability. Snowfall vulnerabilities generally include: 1) building damage (e.g., roof collapse) due to snow weight; 2) branch fall and power line failure due to snow and ice weight and wind; and 3) snow roadway clearance capabilities relative to snow fall rates.

Building Damage: The Massachusetts State Building Code requires that structures be constructed in Somerset, at a minimum, to snow loads of 30 pounds per square foot (psf). The relationship of snow load to snow depth is a function of the water content of the snow (i.e., wet snow is heavier) and can be variable. In general, 30 psf snow loads correlates to about 24 inches of snow. For weight snow events (saturated snow = +/- 2 pcf), 30 psf correlates to about 15 inches of snow. During periods of cold, snow will not melt on roofs and will accumulate due to multiple snowfall events. Ref. https://www.mutualbenefitgroup.com/insurance-101/storm-center/prevent-roof-collapse-on-your-home/

Tree and Powerline Damage: 1/2" of ice can add 500 pounds load on power lines and trees, resulting in extensive damage. Similarly, greater than 6 to 8 inches of heavy snow accumulation on tree branches can result in significant tree damage.

Roadway Clearance Requirements: the vulnerability of Somerset's transportation system to snowstorms is a function of the Town's snow removal capabilities. Snowfall frequency data provides insight to the minimum recommended capability necessary to reduce the Town's vulnerability. Based on a limited analysis by GZA for purposes of Plan preparation, the Town's snowfall removal capabilities should include:

- Equipment and operator availability to remove snow for 20 days per year;
- Equipment, material and operator availability to sand/salt for 20 days per year; all paved roads;
- Equipment capability to remove up to 24 inches in 24 hours;
- Equipment and operator capability to remove up to 40 inches per month;
- Equipment, operator and communications capability to remove snow in blizzard conditions (i.e., high wind, drifting and low visibility);
- Back-up equipment and operator capability to remove up to 60 inches per month; and
- Service or close flooded roads. Assume coincident coastal storm surge along shoreline areas for roads at Elevation 9 and lower.

Impact Area: Townwide

Other Severe Winter Weather Events

Other Somerset severe winter events include ice storms and extreme cold. **Attachment 2** presents details for each of these.

Somerset's vulnerability to ice storms is primarily loss of power and tree fall. The probability of damaging ice storms is low.

The vulnerability of Somerset residents to extreme cold during cold spells (polar vortex) and winter storms can be moderate to high in consideration of wind chill. The NWS issues Wind Chill Warnings when the wind chill index is expected to be -25° F or less. This can occur over a range of wind speed and temperature combinations. The average Winter low temperature at Somerset is about 18°F, which will not cause wind chill conditions. Periods of colder temperatures occur at Somerset and can cause wind chill conditions. Wind chill example conditions:

- 0° F and 25 mph sustained wind speeds, 30-minute exposure
- 5°F and 55 mph sustained wind speeds, 30-minute exposure

Extreme Temperature - Heat

The residents of Somerset are vulnerable to the effects of excessive heat. Heat effects include heat cramps, heat stroke, and death. Extreme heat also exacerbates preexisting chronic conditions, such as various respiratory, cerebral, and cardiovascular diseases. These serious health consequences usually affect more vulnerable populations such as the elderly, children, and those with existing cardiovascular and respiratory diseases. Socioeconomic factors, such as economically disadvantaged and socially isolated individuals, are also at risk from heat-related burdens.

Likelihood/Frequency

Excessive Heat Warnings are issued when the daytime heat indices reach 105° F or greater for 2 or more hours. A Heat Advisory is issued when the daytime heat indices reach 100-104°F for 2 or more hours. A Heat Wave is defined as 3 or more days of temperatures of 90° F or above. Massachusetts currently experiences between 5 and 8 days per year when the Heat Index is expected to exceed 105° F. Between 2010 and 2018, there were a total of 3 events in Bristol County with Excessive Heat, including 2 days with Excessive Heat and no fatalities or injuries. These included July 6, 2010 and July 22, 2011. A Heat Advisory was most recently issued for Somerset on July 1, 2018, with a Heat Index of about 101°F.

The results indicate that the probability of Excessive Heat near Somerset (Bristol County) is:

- 25% AEP or 1 event every 4 years.

As described in **Attachment 2**, the number of days over 90°F and frequency of Heat Waves is expected to significantly increase in the near future due to climate change. By 2050, the number of Massachusetts Heat Wave days may increase to about 40 per year. By 2050, the number of days with a Heat Index above 105° F could increase to 16 days per year. This may indicate that by the year 2050, the frequency of Excessive Heat events at Somerset may increase from 1 ever 4 years on average to at least 1 per year.

Severity/Magnitude

The severity and magnitude of extreme heat events at Somerset is in part dependent upon: 1) demographics; and 2) the capability of residents to get cool (e.g. air conditioners in homes). Somerset's demographic data indicates that about 35% of the population may be at a greater than average vulnerability.

- 24% of Somerset's population is older than 65 years
- 4% of Somerset's population is less than 5%
- 7% of Somerset's population is at the poverty level

Impact Area: Townwide

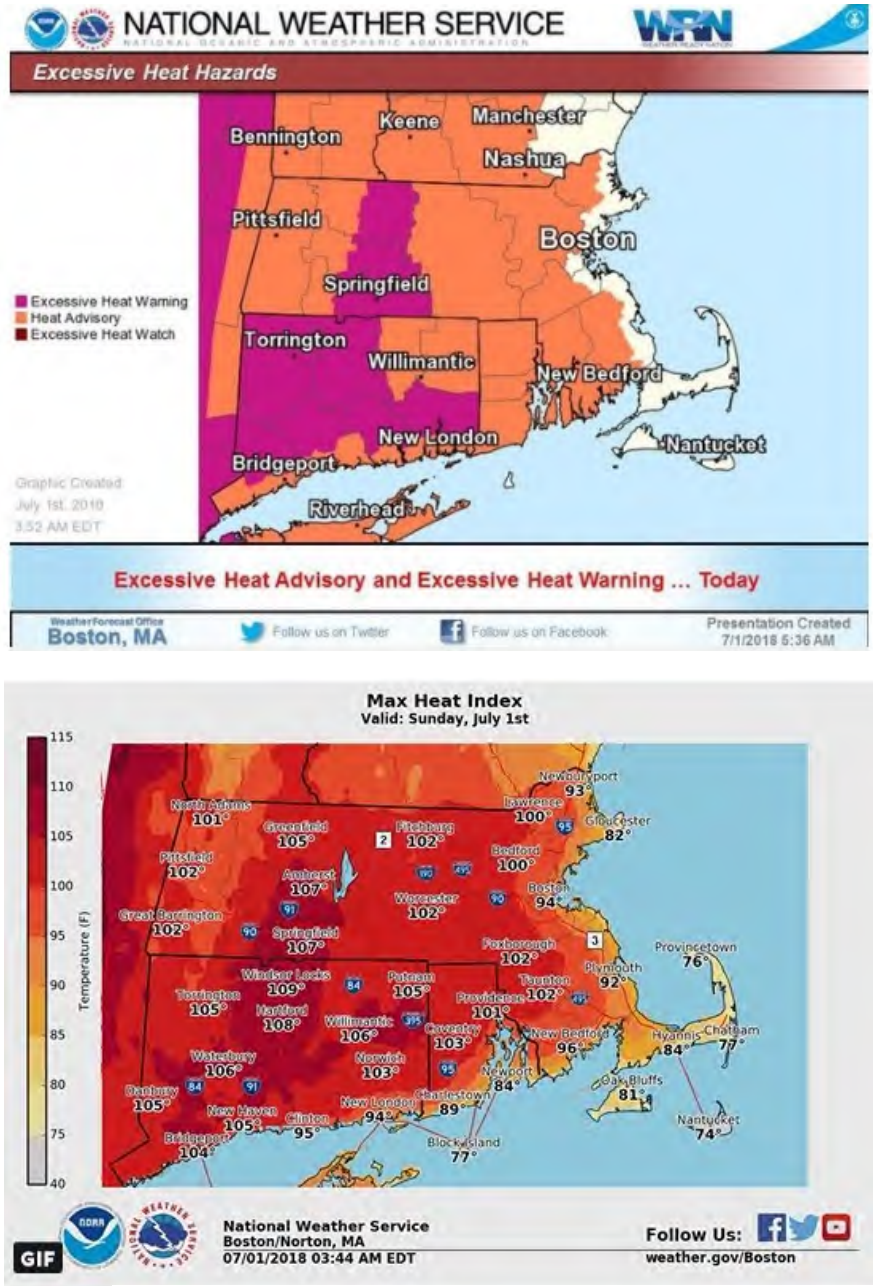


Figure 3-23: Heat Advisory at Somerset, Ma during the first week of July, 2018, reference NWS

Earthquake

Somerset is vulnerable to the effects of earthquakes. However, it is located in an area of relatively low predicted earthquake ground motion. The peak ground acceleration (acceleration on the bedrock surface) associated with the maximum Considered Earthquake for building design - the 2% in 50 years probability (about a 2,500-year recurrence interval) is 0.14g (where g equals the acceleration of gravity). In terms of felt effects and damage, ground motion at the level of several percent of gravity corresponds to the threshold of damage to buildings and houses (an earthquake intensity of approximately V). For comparison, reports of "dishes, windows and doors disturbed" corresponds to an intensity of about IV, or about 0.02g. Reports of "some chimneys broken" corresponds to an intensity of about VII, or about 0.10% to 0.20% of gravity. However, the seismic risk is not equally distributed throughout Somerset. The presence of deposits of loose and/or soft soil above the bedrock will cause an increase in ground acceleration at the ground surface relative to the ground motion felt at the bedrock (i.e., MCE peak accelerations will be greater than 0.14g). Loose soils can also experience a secondary earthquake effect, called liquefaction, which causes these soils to lose their shear strength during earthquakes. The red areas shown on **Figure 3-24** (NEHRP Site Class E) represent floodplain alluvium soils that are that are low strength and will significantly amplify the bedrock motion and may be susceptible to liquefaction. The yellow areas represent stiff sand soil that may amplify ground motion and also be susceptible to liquefaction. The areas in green are rock/very stiff soils.

Historical Occurrence

- Although rare, significant earthquakes (magnitude 6 or greater) have occurred near Somerset, (within about 100 miles) over the last 350 years. These earthquakes would have resulted in moderate to strong ground motion in Somerset.

Likelihood/Frequency

- 2% in 50 years PGA (2,475-year recurrence interval; Maximum Considered Earthquake) in the vicinity of Somerset is 0.14g
- 10% in 50 years PGA (500-year recurrence interval) in the vicinity of Somerset is 0.03g

Severity/Magnitude

The Seismic Design Category for the majority of Somerset is A or B indicating a low seismic hazard. The 10% in 50 years (500-year recurrence interval) ground motion would be experienced as light to moderate perceived shaking and none to very light damage. The 2% in 50 years (2,500-year recurrence interval) ground motion would be experienced as very strong perceived shaking and moderate damage. Based on HAZUS-MH simulations of Somerset, 661 buildings are predicted to experience damage, ranging from slight to complete, from the 2,500-year (2% in 50 years) recurrence interval earthquake. The estimated economic losses are about $22 million for the 2,500-year event..

Impact Area: Townwide

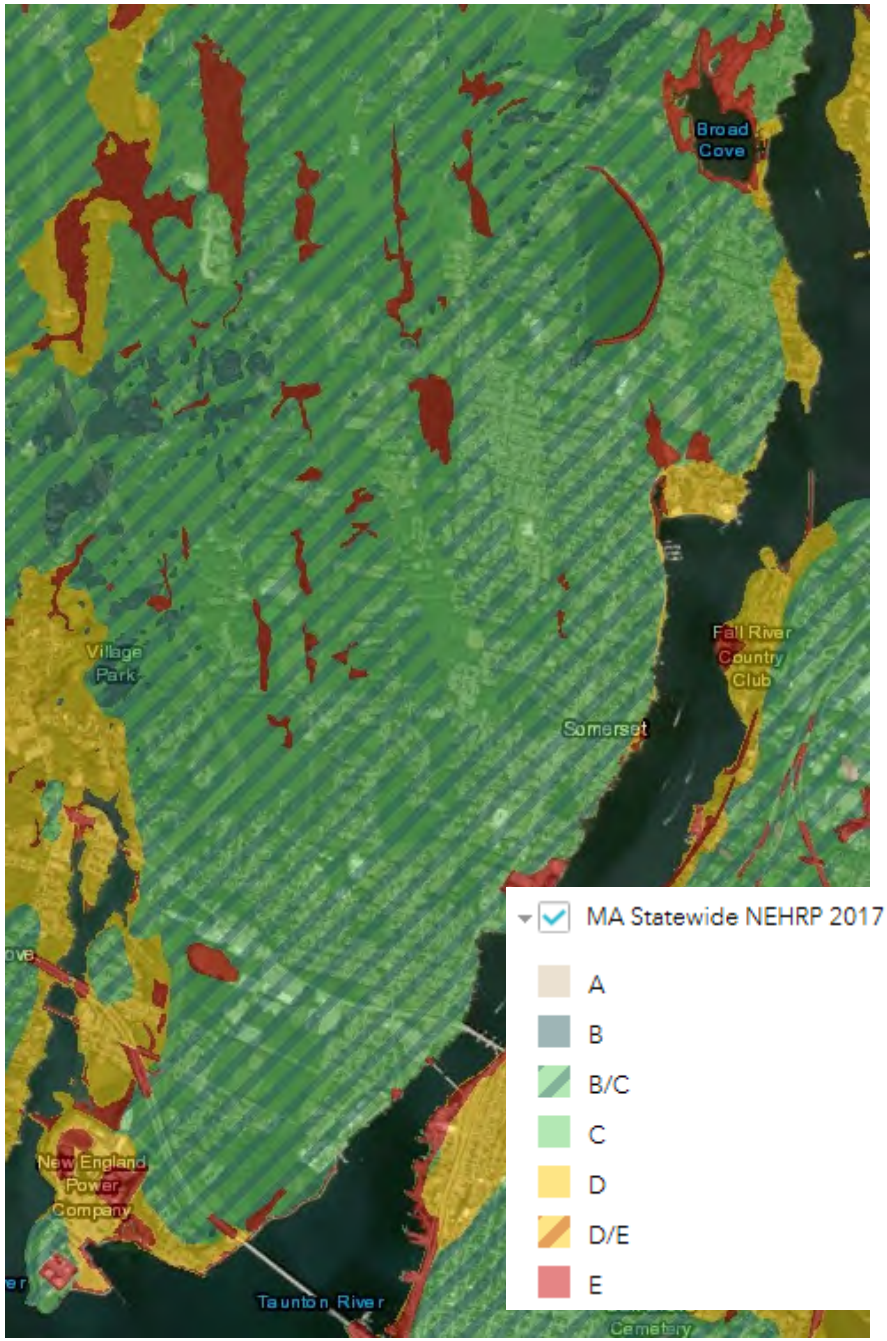


Figure 3-24: NEHRP 2017 Soil Site Classes at Somerset

Attachment 4: FEMA HAZUS-MH Simulation Results

FEMA HAZUS-MH HAZARD SCENARIO ANALYSES

Scenario analyses predict the impacts of an event or particular type of an event. This level of analysis considers potential impacts to infrastructure, people, and cost, as well as likelihood or frequency of the event. Scenario analyses were performed using the FEMA Multi-Hazard HAZUS-MH software.

Level 1 HAZUS analyses were performed using the HAZUS Flood, Hurricane and Earthquake modules. A Level 1 HAZUS analysis calculates basic estimates of earthquake, flood and hurricane wind losses based on national databases and expert -based analysis parameters included in the HAZUS software. The data used for this analysis included the HAZUS "default" data included in the HAZUS software and 2010 US Census Data. Level 1 analyses are appropriate for initial loss estimation at the planning level, and is not intended for establishing the flood, earthquake, or hurricane related risk of any specific parcel or property.

Potential losses estimated by HAZUS include:

- **Physical damage,** to residential and commercial buildings, schools, critical facilities, and infrastructure;
- **Economic loss**, including lost jobs, business interruptions, repair, and reconstruction costs;
- **Social impacts**, including estimates of shelter requirements, displaced households, and population exposed to scenario floods, earthquakes, and hurricanes

https://www.fema.gov/HAZUS

There are 6,929 buildings in Somerset (2010 census), with a total building replacement value (excluding contents) of $2,076 million (2010 dollars). **Table 4-4** presents the total building value in Somerset. Approximately 93% of the buildings (representing about 84% of the total value) are residential. **Table 4-5** provides an overview of the expected damage and loss categories that will be the focus of this scenario analysis based on the results generated from the Earthquake, Flood and Hurricane HAZUS module runs.

Occupancy	Exposure ($1000)	Percent of Total
Residential	1,745,489	84%
Commercial	238,833	11.5%
Industrial	33,393	1.6%
Agricultural	4,363	<1%
Religion	22,693	1%
Government	8,477	<1%
Education	23,363	1%
Total	2,076,611	100%

Table 4-4: Somerset Building Exposure and Occupancy Type

DIRECT DAMAGE
General Building Stock
Essential Facilities
DIRECT LOSSES
Shelter Needs
INDIRECT LOSSES
Economic Loss
Property Damage Business Interruption

Table 4-5: Damage and Loss Categories

Flood Scenario

The Town is vulnerable to coastal flood events. The flood scenario analysis used the default building stock from HAZUS as presented categorically in **Table 4-5** and the FEMA-defined flood hazard zones and flood depths. **Table 4-6** presents the estimated damages and losses for the 100-year (1%), and 500-year (0.2%) flood events for: 1) buildings; 2) essential facilities; 3) displaced people and sheltering; and 4) Economic Losses.

Building Damages

One hundred and sixty-one (161) Somerset buildings would experience at least moderate damage from a 100-year recurrence interval flood event and 223 buildings would experience at least moderate damage from a 500-year recurrence interval flood event. Of these, 57 buildings (100-year event) and 114 buildings (500-year event) are predicted to experience substantial damage.

The associated economic losses (including business interruption) range from $143 million (100-year event) to $223 million (500-year event).

Essential Facilities

None of the essential facilities are expected to be impacted or lose functionality during either the 100-year and 500-year recurrence interval flood events.

Sheltering Requirements

Based on the HAZUS flood analysis, 337 households would be displaced and 779 people would require shelter for the 100-year flood event and 463 households would be displaced and 1,050 people would require shelter for the 500-year flood event.

	100-Yr	**500-Yr**
Building Damages (# of Buildings)		
# of Buildings with Slight Damage (1-10%)	0	0
# of Buildings with Moderate Damage (11-50%)	104	109
# of Buildings with Substantial Damage (>50%)	57	114
TOTAL	**161**	**223**
Essential Facilities Building Damages (Lose of Use > 1 Day)	100-Yr	500-Yr
Emergency Operations Center	0	0
Fire	0	0
Hospitals	0	0
Police	0	0
Schools	0	0
TOTAL	**0**	**0**
Sheltering Requirements	100-Yr	500-Yr
Displaced Households (# Households)	337	463
Short-Term Shelter (# People)	776	1,050
Economic Losses (in $1,000s of dollars)	100-Yr	500-Yr
Residential Property	$57,700	$89,150
Total Property	$85,260	$133,380
Business Interruption	$17	$25
Total	**$142,977**	**$222,555**

Table 4-6: HAZUS Flood Scenario Results

Hurricane Wind Scenario

The Town will likely experience increasing order of magnitude impacts from hurricane wind events with increasing intensity that have a lower probability of occurrence especially from hurricanes with storm tracks that move directly through or in close proximity to Somerset. **Table 21** below shows the estimated damages for the 100-year (1%), and 500-year (0.2%) hurricane-wind events for: 1) buildings, 2) essential facilities, 3) displaced people and sheltering, and 4) Economic Losses from the 100-year and 500-year hurricane-wind events.

Building Damages

In Somerset, 1,068 buildings and 3,188 buildings are predicted to experience damage, ranging from minor to destroyed, from a 100-year and 500-year recurrence interval wind event, respectively. The majority of damage is predicted to be minor.

The estimated economic losses are about $34 million and 164 million, for the 100-year and 500-year events, respectively.

Essential Facilities

None of the essential facilities are expected to be impacted or lose functionality during either the 100-year and 500-year recurrence interval wind events.

Sheltering Requirements

Based on the HAZUS wind analysis, 30 households would be displaced and 7 people would require shelter for the 100-year flood event and 199 households would be displaced and 41 people would require shelter.

	100-Yr	500-Yr
Building Damages (# of Buildings)		
# of Buildings with Minor Damage	941	2,231
# of Buildings with Moderate Damage	118	752
# of Buildings with Severe Damage	6	127
# of Buildings Destroyed	3	78
TOTAL	**1,068**	**3,188**
Essential Facilities Building Damages (Lose of Use > 1 Day)	100-Yr	500-Yr
Emergency Operations Center	0	0
Fire	0	0
Hospitals	0	0
Police	0	0
Schools	0	1
TOTAL	**0**	**1**
Sheltering Requirements	100-Yr	500-Yr
Displaced Households (# Households)	30	199
Short-Term Shelter (# People)	7	41
Economic Losses (in $1,000s of dollars)	100-Yr	500-Yr
Residential Property	$23,396	$131,620
Total Property	$31,843	$146,473
Business Interruption	$2,146	$17,657
Total	**$33,990**	**$164,130**

Table 4-7: HAZUS Hurricane Wind Scenario Results

Earthquake Scenario

This earthquake analysis was conducted assuming a magnitude 5 earthquake on the Richter scale. **Table 4-8** summarizes the estimated damages for the 1,000-year and 2,500-year recurrence interval earthquakes for: 1) buildings, 2) essential facilities, 3) displaced people and sheltering, and 4) Economic Losses from the 1000-year and 2500-year earthquake events.

Building Damages

In Somerset, 230 buildings and 661 buildings are predicted to experience damage, ranging from slight to complete, from a 1,000-year (aka 5% in 50 years) and 2,500 - year (aka 2% in 50 years) recurrence interval earthquake, respectively. The majority of damage is predicted to be slight.

The estimated economic losses are about $6 million and $22 million, for the 1,000-year and 2,500-year events, respectively.

Essential Facilities

None of the essential facilities are expected to be impacted or lose functionality during either the 1,000-year and 2,500-year recurrence interval earthquake events.

Sheltering Requirements

Based on the HAZUS earthquake analysis, 4 households would be displaced and 2 people would require shelter for the 1,000-year flood event and 14 households would be displaced and 7 people would require shelter.

	1,000-Yr	2,500-Yr
Building Damages (# of Buildings)		
# of Buildings with Slight Damage	189	524
# of Buildings with Moderate Damage	37	121
# of Buildings with Extensive Damage	4	15
Complete	0	1
TOTAL	**230**	**661**
	1,000-Yr	2,500-Yr
Essential Facilities Building Damages (Lose of Use > 1 Day)		
Emergency Operations Center	0	0
Fire	0	0
Hospitals	0	0
Police	0	0
Schools	0	0
TOTAL	**0**	**0**
	1,000-Yr	2,500-Yr
Sheltering Requirements		
Displaced Households (# Households)	4	14
Short-Term Shelter (# People)	2	7
Economic Losses (in $1,000s of dollars)	1,000-Yr	2,500-Yr
Residential Property	$3,800	$15,430
Total Property	$4,770	$19,400
Business Interruption	$900	$2,640
TOTAL	**$5,670**	**$22,040**

Table 4-8: HAZUS Earthquake Scenario Results

Attachment 5: Potential State and Federal Funding Sources

Several of the proposed hazard mitigation projects and actions may be eligible activities for funding under the three FEMA Hazard Mitigation Assistance (HMA) Grant Programs. The FEMA HMA Grant Programs include two non-disaster mitigation grant programs that include the Pre-Disaster Mitigation and Flood Mitigation Assistance grant programs, and one disaster mitigation grant program that is the Hazard Mitigation Grant Program. An overview of each program is outlined as follows.

Pre-Disaster Mitigation (PDM)

The purpose of PDM is to reduce overall risk to communities and structures from future hazard events including coastal flooding, while also assisting communities in recovering more quickly from future natural disasters. PDM funds mitigation planning and project grants designed to reduce future losses in advance of potential disaster. Funding for PDM and FMA is appropriated by Congress annually and awarded on a nationally competitive basis. Many of the proposed hazard mitigation projects and actions are eligible activities for funding under PDM. https://www.fema.gov/pre-disaster-mitigation-grant-program (02/28/18)

Flood Mitigation Assistance (FMA)

The purpose of the FMA program is to reduce or eliminate insurance claims under the National Flood Insurance Program (NFIP). FMA provides funding to States, Territories, federally-recognized tribes and local communities for projects that reduce or eliminate long-term risk of flood damage to structures insured under the NFIP. FMA funding is available for flood hazard mitigation projects, plan development and management costs. Funding for PDM and FMA is appropriated by Congress annually and awarded on a nationally competitive basis. https://www.fema.gov/flood-mitigation-assistance-grant-program (02/28/18)

Hazard Mitigation Grant Program (HMGP)

FEMA's HMGP provides funding to municipalities, states, regional planning entities, and other eligible applicants to help communities implement hazard mitigation measures following a Presidential major disaster declaration. The most recent disaster declaration in Massachusetts was announced on April 13, 2015 - Massachusetts Severe Winter Storm and Snowstorm (DR-4214). A declaration typically opens up a host of disaster recovery and mitigation programs to assist states in recovering from and mitigating the future impacts from all-natural hazards.

The funding for FEMA's HMGP is 15% of the total assessed damages for a given disaster for states that meet FEMA's standard Mitigation Plan requirements, which applies to the state of Massachusetts. The HMGP application period is open for one year from the disaster declaration date. To date there have been over $81.8 Million in Public Assistance (PA) Grants obligated, which is a FEMA Recovery grant program resulting in an additional $12.27 Million in HMGP funding available to the State for DR-4214. https://www.fema.gov/hazard-mitigation-grant-program (02/28/18)

All three HMA programs are managed by MEMA with support from Department of Conservation and Recreation (DCR).

All three HMA programs are managed by MEMA with support from Department of Conservation and Recreation (DCR).

There are currently no open disasters in Massachusetts under HMGP. The application period for the Fiscal Year (FY) 2017 PDM and FMA grant programs closed on October 16, 2017. The application process for PDM and FMA is conducted through an online application process using FEMA's eGrants system. It is expected that the application period for FY 2018 PDM and FMA will open sometime in June of 2018.

HUD Disaster Recovery and Resiliency Grants

Community Development Block Grant – Disaster Recovery (CDBG-DR)

Similar to FEMA's HMGP, HUD provides disaster recovery grants to help municipalities like Somerset and the State recover from Presidentially-declared disasters, especially in low-income areas. The goal of these grants is to rebuild the impacted areas and provide critical funding to start the recovery process. The CDBG-DR program allows for the funding of a wide range of recovery activities including planning activities that aide communities and neighborhoods that may otherwise not recover because of a lack of resources. Funds from this program support owner-occupied housing, multi-family housing, infrastructure, small business express, and planning.

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US Department of Agriculture's (USDA) and other Federal Grants

Natural Resources Conservation Services (NRCS)

The NRCS is the US Department of Agriculture's (USDA) leading agency providing voluntary technical and financial assistance to conservation districts, private landowners, tribal governments, and other organizations to help sustainably manage, conserve and improve natural resources at the local level. Two financial programs that offer funding support in response to natural hazards are outlined as follows.

Emergency Watershed Protection Program (EWP)

Congress established the EWP to assist public and private landowners in response to emergencies resulting from natural hazards including coastal flooding and storms. The mission of the EWP program is to assist people and conserve natural resources by reducing the future impacts to public safety and property caused by floods, coastal storms and other natural hazards. The NRCS is the managing agency for the EWP program that includes two focus areas which are: EWP-Recovery and EWP-Floodplain Easement (FPE).

The EWP-Recovery provides recovery assistance to public and private landowners as a result of a natural disaster that requires a 25% local match with the NRCS providing a 75% match for the construction cost for emergency measures. The EWP-FPE provides assistance to privately-owned lands or lands owned by a local or state government that have been damaged by flooding at least once within the previous calendar year or have been subject to flood damage at least twice within the previous ten years.

Watershed & Flood Prevention Operations (WFPO) Program

The Watershed Protection and Flood Prevention Act of 1954 authorizes the NRCS to provide technical and financial assistance to states, local and tribal governments (project sponsors) for the planning and implementation of approved watershed plans. The NRCS works with local sponsors to protect and restore watersheds from damage caused by erosion, floodwater and sediment, to conserve and develop water and land resources, and to solve natural resource and related economic problems on a watershed basis. In Massachusetts, the project sponsor for watershed projects is the Massachusetts Department of Conservation and Recreation (MA DCR). The MA DCR provides assistance for the implementation of measures outlined in approved plans, and is focusing their efforts on reducing flood damages.

Commonwealth of Massachusetts Grants

Coastal Resilience Grant Program

The Massachusetts Office of Coastal Zone Management (CZM) administers the Coastal Resilience Grant Program to provide financial and technical support for local efforts to increase awareness and understanding of climate impacts, identify and map vulnerabilities, conduct adaptation planning, redesign vulnerable public facilities and infrastructure, and implement non-structural (or green infrastructure) approaches that enhance natural resources and provide storm damage protection. Managed through CZM's StormSmart Coasts program, grants are available for a range of coastal resilience approaches—from planning, public outreach, feasibility assessment, and analysis of shoreline vulnerability to design, permitting, construction, and monitoring.

The Coastal Resilience Grant Program is open to the 78 municipalities located within the Massachusetts coastal zone. Certified 501(c)(3) nonprofit organizations with vulnerable coastal property that is open and accessible to the public are also eligible for funding for natural storm-damage protection (or green infrastructure) projects.

In Fiscal Year (FY) 2019, CZM expects to award up to $2,500,000 in total funding for projects. Applicants may request up to $500,000 in funding.

Eligible projects must fall under one (or more) of the following five categories:

1. **Vulnerability and Risk Assessment** - Projects that map and evaluate vulnerable community facilities and infrastructure using best available techniques and climate projections. Proposals to model flooding and erosion from future coastal storms, taking into account sea level rise, waves, and natural systems, and evaluate the socioeconomic impacts of coastal storms are strongly encouraged. Communities interested in assessing other extreme weather, natural, and climate-related hazards, are encouraged to apply to the Commonwealth's new Municipal Vulnerability Preparedness (MVP) Program.
2. **Public Education and Communication** - Projects that increase public understanding of climate impacts and develop support for management measures and other actions to address coastal impacts. Creative communication products that provide ongoing benefits and can be adopted by other communities are strongly encouraged.
3. **Local Bylaws, Adaptation Plans, and Other Management Measures** - Projects to develop, amend, and implement community-based resilience plans, local ordinances, bylaws, standards, and other management measures to reduce coastal storm damages and climate impacts. Projects that result in formal local adoption are strongly encouraged.
4. **Redesigns and Retrofits** - Engineering and construction projects that produce designs and plans, and retrofit existing community facilities and infrastructure (e.g., coastal structures, wastewater treatment plants, pump stations, and critical roadways/ evacuation routes) to function properly given higher tides, greater storm surges, and more intense precipitation. Projects that evaluate and implement removal or relocation of facilities and infrastructure outside of hazardous areas, where feasible, are strongly encouraged.
5. **Natural Storm-Damage Protection Techniques** - Coastal green infrastructure projects that evaluate, design, permit, implement, and monitor non-structural approaches to enhance or create natural erosion and flood protection services provided by public beaches, dunes, coastal banks, salt marshes, shellfish, and other habitat types. Projects must specifically address documented erosion and flooding issues that impact community facilities and infrastructure.

https://www.mass.gov/service-details/coastal-resilience-grant-program

Municipal Vulnerability Preparedness (MVP) Grant Programs

As part of the Baker-Polito Administration's commitment to combat and prepare for climate change, Governor Baker recently filed legislation to authorize over $1.4 billion in capital allocations for investments in safeguarding residents, municipalities and businesses from the impacts of climate change, protecting environmental resources, and investing in communities. The legislation would put into law essential components of Governor Baker's Executive Order 569, which established an integrated strategy for climate change adaptation across the Commonwealth, including the Municipal Vulnerability Preparedness (MVP) program and the Statewide Hazard Mitigation and Adaptation Plan – a blueprint to protect residents, communities, and local economies. The funding available through these grant programs builds upon the Baker-Polito Administration's ongoing efforts to mitigate and adapt to climate change.

The Municipal Vulnerability Preparedness Grant Program provides direct funding and support to cities and towns to complete a community-driven process that will bring together climate change information and local knowledge to identify top hazards, current challenges, and community strengths and then to develop priority actions to improve the municipality's resilience to all natural and climate-related hazards using a flexible, tested approach called the Community Resilience Building (CRB) workshop guide. The program provides access to a pool of state-certified MVP providers, a standardized toolkit for assessing climate change vulnerability and developing strategies, and access to the best available statewide climate projections and data.

Upon successful completion of the CRB process, municipalities will be designated as a "Municipal Vulnerability Preparedness (MVP) program community," or an "MVP Community" which enables communities to participate in the MVP Action Grants for program implementation, leads to increased standing in future state funding opportunities and indicates the community's commitment to preparing for climate change. Completion of the program will ensure that as municipalities make investments, set policy, and implement climate change adaptation projects they have a thorough understanding of their risk and vulnerabilities from climate change impacts and how these impacts specially affect their residents, community, local economy and natural resources.

https://www.mass.gov/municipal-vulnerability-preparedness-mvp-program

MVP Planning Grants

Funding is to support municipalities who are completing climate change vulnerability assessments and resiliency planning using the Community Resilience Building workshop guide, and to allow them to procure an MVP certified provider (chosen from a list provided by the Commonwealth), to assess vulnerability to a full range of climate change impacts, including temperature changes, extreme weather, sea level rise, inland flooding, changes in precipitation, and other impacts, across multiple sectors of the municipality.

Attachment 6: Public Meeting Documentation

Hazard Mitigation Plan - Public Meeting

POSTED ON: JULY 12, 2017 - 12:35PM

Attachment	Size
hazard_mitigation_plan_-_public_meeting.docx	16.6 KB

Town of Somerset Multi-Hazard Mitigation Plan
Public Meeting
July 24, 2017

SIGN-IN SHEET

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The Herald News

Somerset continues outlining hazard mitigation plans

By Michael Holtzman
Herald News Staff Reporter
Posted Jul 24, 2017 at 11:52 PM
Updated Jul 24, 2017 at 11:59 PM

SOMERSET — The reason the town is developing a hazard mitigation plan is to identify and determine how vulnerable its assets are and how to better protect them, a consulting specialist said at the first of two required public hearings Monday night at the town library.

Samuel Bell, a specialist in the field for GZA GeoEnvironmental Inc., presented an update to members of the town planning team and several citizens.

That team, headed by Town Administrator Richard Brown, has focused on those issues during three meetings in November, March and two weeks ago in order to meet state and federal requirements.

In a waterfront town with sizable portions bordering the Taunton River and bridges linking state roads and Interstate 195, Bell outlined "seven critical tasks" they are undertaking in a sequential process.

About midway through those tasks, they include public initiation last fall, public outreach and education, data collection and identification of hazard impacts, vulnerability and risk assessment, preparing the town hazardous mitigation plan, revision and the town adopting the plan.

That last stage entails the Massachusetts then the Federal Emergency Management Agencies issuing their recommendations and, subsequently, approvals.

The goal, Bell said, is to have the plan wrapped up and issued to MEMA/FEMA for approval by early next year.

When he talked about the town's assets, Bell's PowerPoint presentation identified and showed mapping that included natural resources, utility generation and transmission — including water supplies and wastewater systems — transportation and buildings.

Bell said the town maintains 11 pumping stations that are critical for town life and assets. "You really want to make sure they are high and dry during a flooding event," he said.

He noted resources like the Taunton River and Pierce Beach can provide buffers to assets, although the strongest chances for impacts of a 100-year storm — one calculated to occur over such a period — are from the Taunton River and Lees River.

Bell, who said he managed crews at FEMA forming evacuation plans, named protection of business, residential and community assets as vital to plan for.

During their planning team meetings, the department heads named 17 town roads as areas of concern, Bell said. Highway Department Superintendent Brian Martin, Health Agent Tim Turner and Building Inspector Paul Boucher joined Brown at the meeting. Fire Chief Scott Jepson and Police Chief George McNeil are also members.

While Somerset's topography generally is "a great gift" with rising elevations away from the rivers," Bell said among 10 assets identified as important to protect from flooding impacts include Waterfront Park off Main Street, its bridges, Brayton Point beach, Somerset Marina and St. Patrick's Parish Center — the sole building identified for such vulnerability.

Using historic data analysis that requires updating as a key feature of this program, Bell identified 10 of the worst cost impacts since 1972 as including Hurricane Sandy on Dec. 19, 2012, and Hurricane Gloria on Oct. 28, 1985.

In another category using town assessor and state records, and that will need updating, it showed $2 billion of potential building/economic loss. Of that, 84.1 percent is residential, 11.5 percent commercial and 1 to 2 percent each educational and industrial.

The few questions asked of Bell included two town citizens questioning shelters and evacuation routes.

Matthew Paquin of Pocasset Street wanted to know if evacuation routes would be identified. Bell told him that was not a focus of the hazard mitigation plan but would be included.

Jack Fernandes of Compos Street, a Fall River firefighter that helped with logistical support in Westport while serving in the National Guard when Hurricane Bob struck in 1991, questioned using solely the high school as an emergency shelter.

He noted the senior housing complexes are near an elementary school but far from the high school.

Brown said when the town puts its resources into a shelter it is committed to that building being best used for such emergencies.

He agreed under certain conditions the town should open any of its buildings with heat and light capacity. "You're right," he told Fernandes of such circumstances. "That's why they call them disasters."

The next steps for the planning team working with Bell and his associate Daniel Stapleton are to complete the hazardous risk assessment, develop risk strategies and draft the initial plan.

That plan must be in place in order for the town to qualify for grant funds to help rectify damage from natural disaster events.

Anyone with comments or questions regarding this process can contact Brown at his office, 508-646-2800.

Email Michael Holtzman at mholtzman@heraldnews.com or call him at 508-676-2573.

Project Consulting Team

GZA at a glance…

About us

28 offices, 600 Engineers, Scientists, Planners and Technical Specialists providing expert , risk-informed and pragmatic advice and solutions in the following ***Core Service*** *areas….*

Public Meetings

- ✓ Today's Meeting
  - Project Overview
  - Planning Process
  - Natural Hazards Risk Assessment
    - 3 Step Process
  - Next Steps
- ✓ Second Public Meeting

Project Overview

Development of the Natural Hazard Mitigation Plan

Goals:

- Identify assets
- Characterize and assess natural hazard risks
- Provide public education and outreach
- Develop strategies to mitigate the hazard risks

Project Overview

Local Hazard Mitigation Plan

1. Project Initiation
2. Public Outreach and Education
3. Hazard Identification and Data Collection
4. Vulnerability and Risk Assessment
5. Develop Mitigation Strategies
6. Prepared Hazard Mitigation Plan
7. Plan Reviews/Revisions/Plan Adoption

HAZARD MITIGATION PLANNING BACKGROUND

PURPOSE: Hazard Mitigation planning is a proactive effort to identify actions that can reduce the dangers to life and property from natural hazard events, such as hurricanes, tornadoes, winter storms and earthquakes.

REQUIREMENTS: The Federal Disaster Mitigation Act of 2000 requires all municipalities that wish to be eligible to receive FEMA funding for hazard mitigation grants, to adopt a local multi-hazard mitigation plan and update this plan in five year intervals.

(Image Ref. MEMA and MA DCR 2013)

Planning Process

Somerset Planning Team and Meetings

Local Planning Team	
Town Administrator	Richard Brown
Building Commissioner	Paul Boucher
Highway Superintendent	Brian Martin
Conservation Commissioner	Tim Turner
Chief of Police	George McNeil
Fire Chief	Scott Jepson

Planning Team Meetings	Date
Project Initiation Meeting	11/08/16
Working Group Meeting	03/02/17
Working Group Meeting	7/10/17

Public Meetings

PUBLIC MEETINGS	Date
Meeting #1	TODAY
Meeting #2	September/October 2017

Natural Hazard Risk Assessment

Assessment Approach

3-Step Approach

1. Inventory Assets
2. Characterize Natural Hazards
3. Assess Vulnerabilities and Impacts to Assets


Snowfall impacts on Maple Street in Somerset from the Blizzard of 1978 (Image Ref. Catherine Colon Sheesovine)

Natural Hazards Risk Assessment

Step 1 – Inventory Town Assets:

- ✓ Essential Facilities
- ✓ Lifeline Utilities
- ✓ Transportation
- ✓ High Potential Loss Facilities
- ✓ Hazardous Material Facilities
- ✓ High Occupancy/Vulnerable Population Facilities
- ✓ Private and commercial property
- ✓ Natural Resources

Somerset Berkley Regional High School

Somerset Water Pollution Control

Somerset– Assets and Infrastructure

1. Essential Facilities
2. Hazardous Material Facilities
3. High Potential Loss Facilities
4. Transportation Systems
5. Lifeline Utility Systems
6. Support, High Occupancy and Vulnerable Populations
7. Natural Resources
8. Shoreline Structures

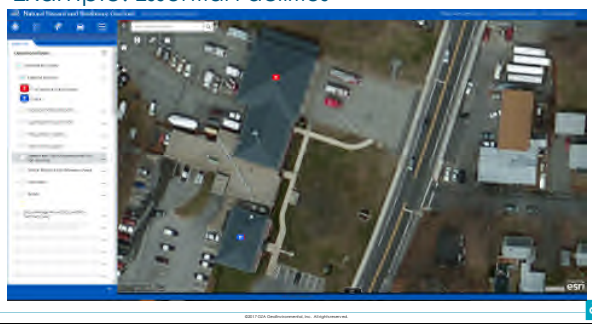
Essential Facilities

1. Hospitals/Healthcare
2. Emergency Shelters
3. Fire and Rescue
4. Police
5. Emergency Vehicle Garages

Somerset Police and Fire

Prima Care Somerset/Swansea Medical Center

Example: Essential Facilities



Lifeline Facilities:

- Electric Power Generation
- Electric Power Transmission
- Natural Gas
- Wastewater Treatment
- Potable Water Supply
- Sanitary Pump Stations

Example: Lifeline Systems

Transportation

- Roadways – 22 Total
  - 1 Federal (I-195)
  - 3 State (Routes 6, 103, 138)
  - 17 Local Roads
- Bridges – 5 Total
  - Grand Army HWY Rte. 6
  - Charles M. Braga, Jr.
  - I-195
  - Rte. 103 Veterans Memorial

Support, High Occupancy and Vulnerable Population

- Community Centers
- Fueling Stations
- Hotels and Inns
- Museums and Galleries
- Pre-school and Childcare Facilities
- Religious Institutions
- Schools
- Theaters
- Town Administration Buildings

Example: Natural/Ecological Resources

Mallard Point on the Taunton River in Somerset (Image Ref. City-Data.com)

Buffington Park (Image Ref. yelp.com)

Buffington Park (Image Ref. yelp.com)

Pierce Beach in Somerset (Image Ref. http://mapio.net/pic/p-5520718/)

Example: Property (Assessor Data)

Natural Hazards Risk Assessment

Step 2 – Characterize Natural Hazards:

- ✓ Coastal Erosion and Shoreline Change
- ✓ Dam Failure
- ✓ Earthquake
- ✓ Fire
- ✓ Flood
- ✓ Hurricanes and Tropical Storms
- ✓ Landslide
- ✓ Severe Weather
- ✓ Tsunami
- ✓ Climate Change

Take Away 2

Accurate, scientifically sound and probabilistic characterization of coastal hazards is important

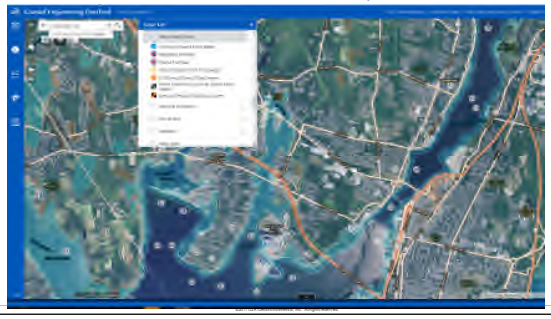
Flooding on Route 138 in Spring 2010 (Image Ref. *Herald News* 03-30-2010)

FLOODING

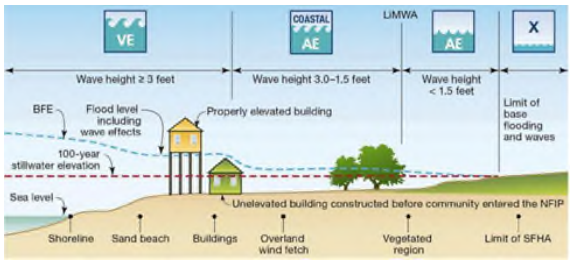
- Riverine
- Coastal
- Intense Precipitation

Flooding on Route 138 in Spring 2010 (Image Ref. *Herald News* 03-30-2010)

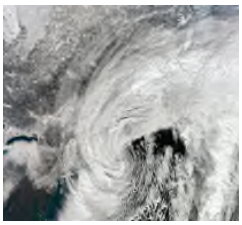
FEMA Flood Insurance Rate Map: Base Flood



FEMA Flood Hazard Zones



NOR'EASTERS & WIND



2013 Image of Nemo: NASA's Earth Observatory 2013

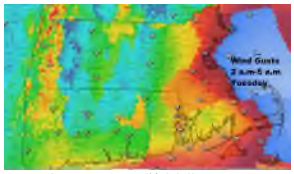


Image Source: Dave Epstein, Boston Globe 01-24-2017

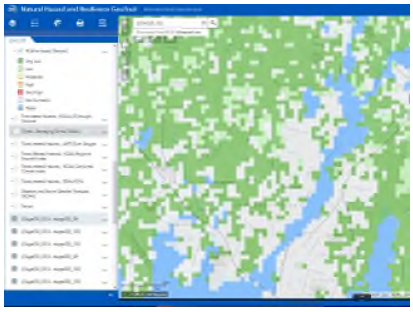
SEVERE WINTER WEATHER

- Snow and Blizzards
- Ice Storms
- Extreme Cold

By NOAA Central Library, Silver Spring, Maryland - NOAA Central Library Data Imaging Project,

FIRE

- Urban
- **Wildfire**

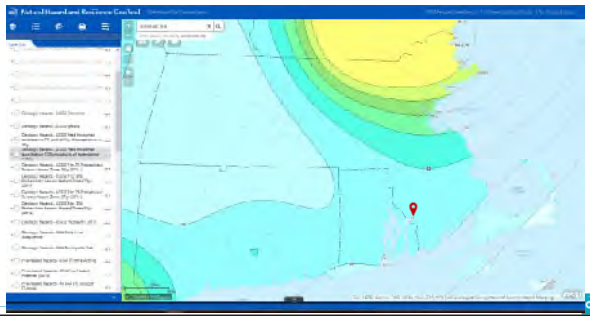


FIRE

- **Urban**
- Wildfire

Fire at Commonwealth Firearms and Sporting Goods (Image Ref. Southern New England Aerial Photography)

EARTHQUAKE

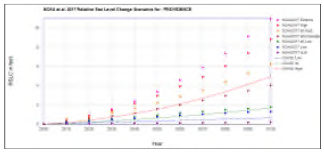


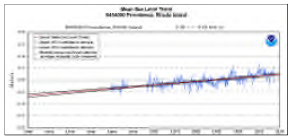
Sea Level Rise

Sea Level Rise

Projected Sea Level Rise Near Somerset
2040: 0.08 to 2.36 feet
2060: 0.12 to 4.56 feet
2100: 0.20 to 10.46 feet

Rate of Change Near Somerset
2.25 +/- 0.25 mm/yr





Temperature Changes

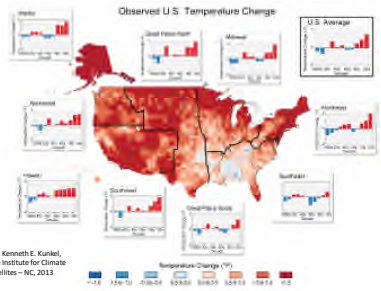


Image Ref: Kenneth E. Kunkel, Cooperative Institute for Climate and Satellites – NC, 2013

Precipitation Changes

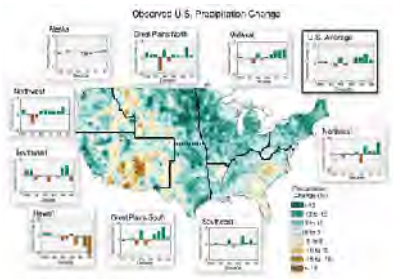


Image Ref: Peterson et. al. 2013

Natural Hazards Risk Assessment

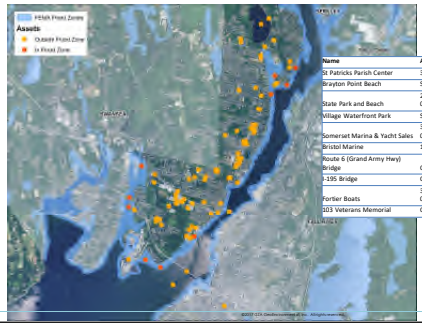
Step 3 – Characterize Vulnerability/Impacts:

- ✓ Essential Facilities
- ✓ Lifeline Utilities
- ✓ Transportation
- ✓ High Potential Loss Facilities
- ✓ Hazardous Material Facilities
- ✓ Neighborhoods
- ✓ High Occupancy/Vulnerable Population Facilities
- ✓ Private and commercial property
- ✓ Natural Resources

Natural Hazards Assessment

- Exposure Analysis
- Historical Analysis
- Scenario Analysis

Exposure Analysis- Flooding



Name	Address	Type
St Patricks Parish Center	306 South St, Somerset, MA 02726	Religious Institutions
Brayton Point Beach	Somerset, MA 02726	Beaches
State Park and Beach	2-98 Massasoit St, Somerset, MA 02725	Beaches
Village Waterfront Park	Somerset, MA 02726	Parks
Somerset Marina & Yacht Sales	3828 Riverside Ave, Somerset, MA 02726	Marinas
Bristol Marine	1 Main St, Somerset, MA 02726	Marinas
Route 6 (Grand Army Hwy) Bridge	Over the Lee River	Bridges
I-195 Bridge	Over the Lee River	Bridges
Fortier Boats	34 Riverside Drive, Somerset, MA 02726	Marinas
103 Veterans Memorial	Over the Lee River	Bridges

Historical Analysis- State Disaster Declarations

Disaster	Date
Severe Winter Storm, Snowstorm & Flooding	April 13, 2015
Severe Winter Storm, Snowstorm & Flooding	April 19, 2013
Explosions	April 17, 2013
Hurricane Sandy	December 19, 2012
Hurricane Sandy	October 28, 2012
Severe Storm & Snowstorm	January 6, 2012
Severe Storm	November 1, 2011
Tropical Storm Irene	September 3, 2011
Hurricane Irene	August 26, 2011
Severe Storms & Tornadoes	June 15, 2011
Severe Winter Storm & Snowstorm	March 7, 2011
Hurricane Earl	September 2, 2010
Water Main Break	May 3, 2010
Severe Storm & Flooding	March 29, 2010
Severe Winter Storm & Flooding	January 5,2009
Severe Winter Storm	December 13, 2008
Severe Storms & Inland Coastal Flooding	May 16, 2007
Severe Storms & Flooding	May 25, 2006
Severe Storms & Flooding	November 10, 2005
Severe Storms & Flooding	October 19, 2005

Historical Analysis- Bristol County Disaster Declarations

Disaster No.	Disaster Type	Date	Incident Period
DR-4027	Hurricane Sandy	12/19/2012	10/27/2012 – 11/8/2012
DR-4028	Tropical Storm Irene	09/03/2011	08/27/2011 – 08/29/2011
DR-1895	Severe Storms and Flooding	3/29/2010	03/12/2010 – 04/26/2010
DR-1614	Severe Storms and Flooding	11/10/2005	10/7/2005 – 10/16/2005
DR-1364	Severe Storms and Flooding	04/10/2001	3/5/2001 – 4/16/2001
DR-1224	Heavy Rain and Flooding	06/23/1998	6/13/1998 – 7/6/1998
DR-1090	Blizzard	1/25/1996	1/7/1996 – 1/13/1996
DR-751	Hurricane Gloria	10/28/1985	9/27/1985
DR-546	Coastal Storms, Flood, Ice, Snow	02/10/1978	2/6/1978 – 2/8/1978
DR-357	Toxic Algae in Coastal Waters	09/28/1972	09/28/1972

Historical Analysis: Repetitive Loss Analysis

Historical Analysis - Repetitive Loss Properties

A Repetitive Loss (RL) property is any insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by the NFIP. Currently there are over 122,000 RL properties nationwide.

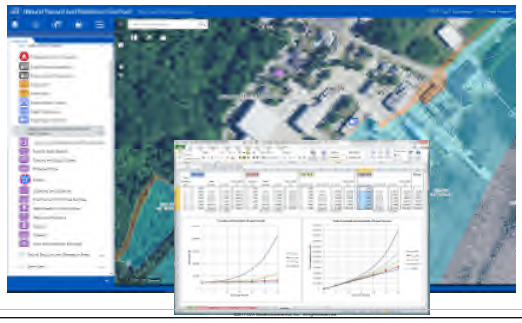
Identify number of RL properties in Somerset.

Quantify Loss: Cumulative Community Assets

POTENTIAL LOSS ESTIMATES ANALYZED IN HAZUS :

- ✓ **DIRECT COSTS**
  - **Physical damage** to critical facilities and infrastructure.
- ✓ **CONSEQUENTIAL COSTS**
  - **Economic loss** including lost jobs, business interruptions, repair and reconstruction costs;
  - **Social impacts**, including estimates of shelter requirements and displaced households
  - **Environmental impacts**, including loss of wetlands, riparian and open space.

Quantify Loss: Individual Asset Loss



Somerset Building Economic Loss Exposure

Occupancy	Loss Exposure ($1000)	Percent of Total
Residential	1,745,489	84.1%
Commercial	238,833	11.5%
Industrial	33,393	1.6%
Agricultural	4,363	0.2%
Religion	22,693	1.1%
Government	8,477	.4%
Education	23,363	1.1%
Total	**2,076,611**	**100%**

Take Away 3

Accurate characterization of prevented losses is necessary for evaluating the benefits of proposed resiliency measures

Next Steps

Next Steps

1. Complete Hazards Risk Assessment
2. Develop Mitigation Strategies
3. Draft Hazard Mitigation Plan
4. Public Workshop No. 2
5. Submit Draft Plan to MEMA/FEMA
6. Make Revisions and Finalize Plan
7. Plan Adoption

Thank you for attending!

Questions? Comments?

Samuel J. Bell: samuel.bell@gza.com
O: 781.278.3847 or M: 781.223.7091
Daniel C. Stapleton: daniel.Stapleton@gza.com
O: 781.278.5743 or M:617.999.3610

Public Meeting Notice

Town's Draft Local Natural Hazard Mitigation Plan

POSTED ON: AUGUST 14, 2018 - 3:47PM

See attached flyer for details

Attachment	Size
hazard_mitigation_plan_public_meeting_no_2_flyer.pdf	240.54 KB

Town Hall, 140 Wood St, Somerset, MA 02726
Town Administrator 508-646-2800
Town Clerk 508-646-2818
Monday – Friday – 8:30 am – 4:00 pm

SouthCoastTODAY

Special

Public meeting to be held on natural hazard mitigation plan

By George Austin
Editor
Posted Aug 22, 2018 at 3:01 AM

SOMERSET — A public meeting will be held on Aug. 29 about the town's proposed natural hazard mitigation plan.

The plan contains strategies and actions that the town would take to reduce the loss of life and property from natural hazards, including, but not limited to, coast flooding, severe wind resulting from hurricanes and sewer winter weather.

There will be a review of the plan at the meeting and anyone from the public who would like to make comments or suggestions will be allowed to do so at the meeting that will start at 6 p.m. on Aug. 29 at the Somerset Public Library, located at 1464 County.

"It's the final draft and we want to make sure the public has the opportunity to comment and review on the actions and strategies that have been laid out in the plan," Somerset Town Planner Nancy Durfee said.

The town's proposed natural hazard mitigation plan is over 200 pages long and can be viewed online on the town's website at townofsomerset.org. Durfee said the first 35 pages provide the crux of the plan, with more details being provided in the rest of the plan. The plan is intended to provide the town with a risk-based approach to making planning decisions.

All comments from the public will be documented and considered for inclusion in the plan.

According to the plan, top ranked natural hazards in Somerset, based on frequence of occurrence, severity, and extent of impact area, is lightning, followed by intense rainfall, ice storms, hail and urban drainage flood, that are all tied for second, sea level rise, thunderstorms, tornadoes, snowfall, hurricanes/tropical storms and storm surge. According to the proposed plan, the likelihood of a storm with less than 40 mile per hour winds in Somerset on a one-year reoccurrence in Somerset is high, of severe snowfall is high, of ice storms is medium to low, a hurricane wind warning of less than 74 miles per hour is medium to low, thunderstorms with winds of less than 58 mile per hour winds is medium to high, tornadoes is very low, fatalities, injuries and/or damage from lightning is medium to high, intense rainfall is medium, of hail is medium to high, of an earthquake in Somerset is very low, there is a medium likelihood of extreme temperatures of excessive heat and cold, there is a high likelihood of heavy snowfall and a medium to low likelihood of ice storms.

The plan says that rivers and ponds in town are available to be tapped into, if necessary, for firefighting support, a tank task force is available through state fire mobilization and the Federal Emergency Management Agency has eight to 12 tanks that can be deployed anywhere in the United States within 72 hours. The town has invested in backup emergency generators for its public safety facilities that give the town the ability to sustain operations during the event of an emergency. The town utilizes joint communications and dispatch for public safety.

Support, high occupancy and vulnerable populations in Somerset are identified as elderly housing, long term care facilities, schools, children's daycare centers and the Somerset Regional Medical Center.

This will be the second public meeting that the town has held about the plan.

Durfee said this will be Somerset's first hazard mitigation plan. Durfee, who started working for the town 2 1/2 weeks ago, praised Fire Chief Scott Jepson, Police Chief George McNeil, Highway Superintendent Brian Martin, Health Agent Timothy Turner and Town Administrator Richard Brown for their work on the plan.

"And it opens up the doors to hazard mitigation funds for the town," Durfee said. "It was very fortuitous of them to have a hazard mitigation plan put in place."

Work on the current natural disaster hazard mitigation plan was paid for with grant money from the Federal Emergency Management Agency.

TOWN OF SOMERSET HAZARD MITIGATION PLAN PUBLIC MEETING II 1 of 2

SIGN IN SHEET

AUGUST 29, 2018
SOMERSET PUBLIC LIBRARY
6:00

NAME:	CONTACT:
Carissa Mills	UHB cmills@uhb.com
George Austin	gnewsman@gmail.com
Lloyd Mendes	Mendes_Lloyd@hotmail.com
Richard Brooks	rbrooks@town.somerset.ma.us
SCOTT JEPSON	CHIEFJEPSON@SOMERSETFIRE.ORG
Nancy Durfee	ndurfee@somerset.ma
SAM BELL	samuel.bell@gza.com

2 of 2

TOWN OF SOMERSET HAZARD MITIGATION PLAN PUBLIC MEETING II

SIGN IN SHEET

AUGUST 29, 2018
SOMERSET PUBLIC LIBRARY
6:00

NAME:	CONTACT:
PAUL BOUCHER	
Holly McNamara	508-617-0539 selectmanchollymac.com
Brian Martin	Highway Dept
Cheryl Crossley-Simmons	508 673 1015 (resident)
Donald G. Simmons	508 673-1015 Carpenter
Joyce Wilkinson	508-673-6294 85 Victor St (add to mailing)

Natural Hazard Mitigation Plan
Somerset, Massachusetts

Sam Bell, CFM
Senior Hazard Mitigation Specialist
Hazard Risk Management and Resilience Planning Lead

Overview

- Natural Hazard Mitigation Plan Components
- Risk Assessment Results
- Mitigation Strategy and Actions
- Next Steps

Natural Hazard Mitigation Plan Components

Plan Components

Table of Contents

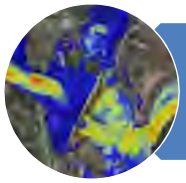
Quick Plan Reference Guide

Planning Process

Planning Process:

2. Assess Risk:
   - Community Demographics/Social Vulnerability
   - Asset Inventory
   - Natural Hazards Characterization
   - Risk Assessment
3. Mitigation Strategy and Actions
4. Plan Adoption and Maintenance

Figure credit FEMA/Jenny Burmester – Aug 21, 2017



Risk Assessment Results

Natural Hazards

- 19 natural hazards identified as applicable to Town
- Four hazard categories:
  - ✓ Severe Weather Hazards
  - ✓ Climate-Related Hazards
  - ✓ Geologic Hazards
  - ✓ Secondary Hazards
- Top-ranked hazards include:
  1. Flooding due to coastal storms
  2. Hurricanes (Severe Wind)
  3. Severe Winter Weather
  3. Somerset Reservoir Dam

Severe Weather Hazards:	Rank
Severe Wind:	
Hurricanes/Tropical Storms	2
Thunderstorms	5
Tornadoes	4
Lightning	8
Intense Rainfall	6
Hail	6
Flood:	
Storm Surge	1
Sea Level Rise	5
Urban Drainage Flooding	6
Severe Winter Weather	
Snowfall	3
Ice Storms	6
Climate-Related Hazards:	
Extreme Temperature:	
Heat	7
Cold	7
Drought	7
Wildfire	9
Geologic Hazards:	
Earthquake	6
Landslides	0
Tsunami	0
Secondary Hazard:	
Dam Failure	3

Natural Hazard Classification and Ranking

1. Likelihood/Frequency
2. Severity/Magnitude
3. Impact Area

Natural Hazard Characterization and Ranking

Frequency:

Very Low: Events that occur less frequently than once in 1,000 years (less than 0.1% per year).

Low: Events that occur from once in 100 years to once in 1,000 years (0.1% to 1% per year)

Medium: Events that occur from once in 10 years to once in 100 years (1% to 10% per year).

High: Events that occur more frequently than once in 10 years (greater than 10% per year).

Natural Hazard Characterization and Ranking

Severity:

Minor: Limited and scattered property damage; no damage to public infrastructure (roads, bridges, trains, airports, public parks, etc.); contained geographic area (i.e., 1 or 2 communities); essential services (utilities, hospitals, schools, etc.) not interrupted; no injuries or fatalities.

Serious: Scattered major property damage (more than 50% destroyed); some minor infrastructure damage; wider geographic area (several communities); essential services are briefly interrupted; some injuries and/or fatalities.

Extensive: Consistent major property damage; major damage to public infrastructure (up to several days for repairs); essential services are interrupted from several hours to several days; many injuries and fatalities.

Catastrophic: Property and public infrastructure destroyed; essential services stopped, thousands of injuries and fatalities.

Natural Hazard Characterization and Ranking

Likelihood/Frequency		
Point Value	Category	Characteristics and Frequency
1	Very Low	Events that occur or are exceeded less often than once in 100 years (less than 1% probability)
2	Low	Events that occur or are exceeded from once in 50 years to once in 100 years (1% to 2% probability)
3	Medium	Events that occur or are exceeded from once in 5 years to once in 50 years (2% to 20% probability)
4	High	Events that occur or are exceeded more frequently than once in 5 years (greater than 20% probability)
Severity/Magnitude		
Point Value	Category	Characteristics
1	Minor	Limited and scattered property damage; no damage to public infrastructure (roads, bridges, trains, airports, public parks, etc.); contained geographic area (i.e., 1 or 2 communities); essential services (utilities, hospitals, schools, etc.) not interrupted; no injuries or fatalities.
2	Serious	Scattered major property damage (more than 50% destroyed); some minor infrastructure damage; wider geographic area (several communities); essential services are briefly interrupted; some injuries and/or fatalities.
3	Extensive	Consistent major property damage; major damage to public infrastructure (up to several days for repairs); essential services are interrupted from several hours to several days; many injuries and fatalities.
4	Catastrophic	Property and public infrastructure destroyed; essential or lifeline services stopped, thousands of injuries and fatalities.
Impact Area Assessment		
Point Value	Category	Characteristics
1	Small	In localized, unpopulated or lightly areas of Town, without structures or critical facilities
2	Medium	Impacting only portions of the Town
3	Large	Townwide and/or essential and lifeline facilities

Example – Severe Wind

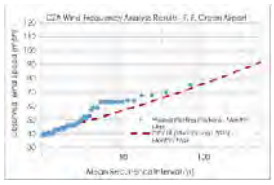


Figure 2-1: Mean 1-minute sustained wind speed based on GZA Extreme Value Analysis of T.F. Green Airport Wind Data (1942 through 2015)

Mean Recurrence Interval (yrs)	3-second Gust (mph)
10	80
25	91
50	100
100	110
300	126
700	136
1,700	147

Table 2-2: ASCE 7-10 Wind speed Mean Recurrence Intervals (3-second peak gust in mph)

Example – Severe Wind

Tropical Cyclones: Tropical Storms and Hurricanes

Tornadoes

Thunderstorms: macrobursts and microbursts

Example – Severe Wind

- **Wind Advisory**: 1) sustained winds of 31 to 39 mph for an hour or more; and/or 2) wind gusts of 46 to 57 mph for any duration.
- **High Wind Watch/Warning**: 1) sustained winds of 40 mph for one hour or more; or 2) wind gusts of 58 mph or higher for any duration.
- **Hurricane Warning**: sustained winds of 74 mph or higher or frequent (for more than 2 hours) gusts of 74 mph or greater associated with a tropical cyclone.
- **Extreme Wind:** 1) surface winds of 115 mph or greater associated with a derecho or sustained hurricane winds.

Example – Severe Wind

Natural Hazard	Likelihood/Frequency	Severity/Magnitude	Impact Area
SEVERE WEATHER HAZARDS			
Severe Wind:			
Hurricanes/Tropical Storms/ Nor easters	• High Wind Warning (>40mph): +/- 100% AEP (1-year recurrence interval): **High**	Minor	Town-wide
	• Hurricane Wind Warning (>74mph): 1% AEP (100-year recurrence interval): **Medium to Low**	Extensive	
	• Extreme Wind Warning (>115 mph) <0.2% AEP (>500-year recurrence interval): **Very Low**	Catastrophic	
Thunderstorms (wind >58 mph)	• Within Bristol County: 56% AEP or minimum of 1-year to 2-year recurrence interval (29 years with 1 or more events over 52 years); Probability of occurrence within Somerset is likely lower: **Medium to High**	Minor	Town-wide or portions of Town
Tornadoes	• Tornadoes within Bristol County: 9% AEP or 11-year recurrence interval (6 years with 1 or more events over 68 years): **Medium**		
	• Major tornado within Bristol County: 1.5% AEP or 70-year recurrence interval: **Low**		
	• Based on the proportional land area, the Somerset tornado AEP is about 0.2% and the Somerset major tornado AEP is very low (less than 0.2%). **Very Low**	Serious to Catastrophic	Town-wide or portions of Town

Top-Ranked Hazards

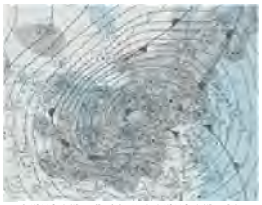
- ✓ Flooding due to coastal storms
- ✓ Hurricanes (Severe Wind)
- ✓ Severe Winter Weather
- ✓ Somerset Reservoir Dam — High Loss Potential Facility

Coastal Flooding

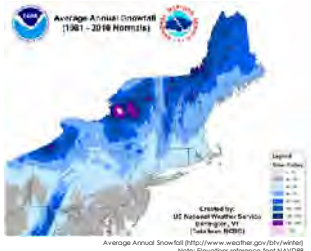
- ✓ Water Pollution Control Facility
- ✓ 15 Town and Commonwealth roads
- ✓ Several commercial facilities and marinas
- ✓ Several industrial districts
- ✓ Several key economic development parcels
- ✓ +/- 160 to 223 properties impacted
- ✓ $143M to $223M losses (1% and 0.2% AEP)

Severe Winter Weather

- ✓ Snowfall
- ✓ Extreme Cold
- ✓ Ice Storms



By NOAA Central Library, Silver Spring, Maryland - NOAA Central Library Data Imaging Project



Average Annual Snowfall (http://www.weather.gov/btv/winter)
Note: Elevations reference feet NAVD88

Severe Winter Weather

Snowfall statistics:

- 10 to 15 snow days per year
- Average annual snowfall of 28 to 33 inches
- 90% AEP or 1 year recurrence interval Heavy Snowfall (19 years with 1 or more events over 21 years)
- Reasonable estimate of average monthly snowfall: 15 to 20 inches
- Reasonably conservative monthly snowfall upper bound: 40 inches (maximum monthly upper bound of 60 inches)

Climate Change and Somerset

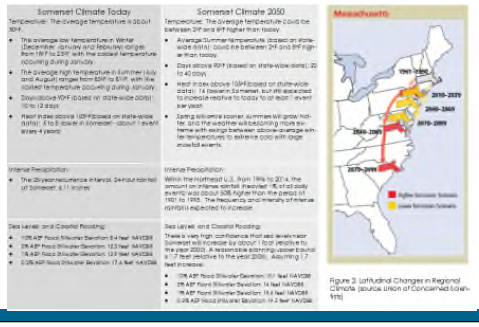


Figure 3. Latitudinal Changes in Regional Climate (source Union of Concerned Scientists)

Hazard Mitigation Strategy & Actions

Existing Town Hazard Mitigation Capabilities

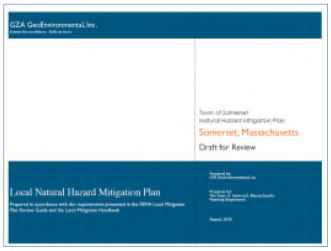
- ✓ Identified 18 existing programs already in place
- ✓ Highlights
  - ✓ Comprehensive Emergency Management Plan
  - ✓ Enforcement of State Building Code
  - ✓ Emergency Generators for Critical Facilities
  - ✓ National Flood Insurance Program (NFIP) Participation
  - ✓ Somerset Reservoir Emergency Action Plan (EAP)
  - ✓ Tree-Trimming
  - ✓ Subdivision review

Strategy and Actions

- ✓ 8 overarching goals
- ✓ 24 mitigation actions
  - ✓ Benefit cost review to prioritize actions
  - ✓ Timeline
  - ✓ Estimated project costs
  - ✓ Priority
  - ✓ Responsible Department(s)
  - ✓ Potential Funding Sources

High Priority Actions

- ✓ Implement actions outlined in the Plan
- ✓ Increase flood protection at the Water Pollution Control Facility
- ✓ Improve vulnerable coastal structures
- ✓ Integrate natural hazard mitigation into upgrades of vulnerable Town properties
- ✓ Implement culvert improvement projects



Federal Funding Opportunities

- **FEMA Hazard Mitigation Assistance Grants**
  - Hazard Mitigation Grant Program (HMGP)
    - **- $7 Million (Massachusetts)**
  - Flood Mitigation Assistance (FMA)
    - **FY18 - $160 Million**
  - Pre-Disaster Mitigation (PDM)
    - **FY18- $90 Million**
- **HUD Disaster Recovery and Resiliency Grants**
  - Community Development Block Grant (CDBG) Disaster Recovery

Commonwealth Funding Opportunities

Environmental Bond Bill, March 15, 2018

- $1.4 billion bond bill with focus on climate change resiliency
- $300 million for climate adaptation
- Codifies EO 569

Governor Baker announcing the Environmental Bond Bill at the Scituate Lighthouse (Image Ref.: Twitter 2018)

State and Additional Funding Opportunities

- Massachusetts Resilience Programs
  - **Municipal Vulnerability Preparedness** Program (MVP) - $75 Million
  - **Dams Sea Walls** - $170 Million
  - **Implementation of State Hazard Mitigation and Climate Adaptation Plan** - $60 Million
  - **Community Resilience Program** - $3-4 Million
- Local and State Tax Revenue
- Tax Increment Financing
- Resilience Bonds

Next Steps

1. Revise Draft Hazard Mitigation Plan
2. Submit Draft Plan to MEMA/FEMA
3. Make Revisions and Finalize Plan
4. Plan Adoption

https://www.townofsomerset.org/home/news/draft-hazard-mitigation-plan

Questions? Comments?

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Attachment 7: References and Resources

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Attachment 7: References and Resources

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Attachment 8: Key Contacts

KEY CONTACTS

MASSACHUSETTS EMERGENCY MANAGEMENT AGENCY (MEMA)

MEMA Headquarters
400 Worcester Road (Route 9 East), Framingham, MA 01702-5399

David Woodbury (MEMA Somerset Contact)
Hazard Mitigation Grants Coordinator

David.Woodbury@MassMail.State.MA.US

MEMA Headquarters & 24x7 Communications Center
508-820-2000

MEMA Region I Office
978-328-1500

MEMA Region II Office
508-427-0400

MEMA Region III & IV Office
413-750-1400

MEMA Training & Exercise
508-820-2028

https://www.mass.gov/orgs/massachusetts-emergency-management-agency\
https://www.mass.gov/topics/mema-resources-for-public-officials

TOWN OF SOMERSET EMERGENCY MANAGEMENT AGENCY

Town Emergency Management Agency
Town Hall, 140 Wood Street, Somerset, Ma 02726

Staff Contact: Mr. Scott Jepson, Fire Chief

508-646-2811
https://www.townofsomerset.org/emergency-management-agency

- Emergency Management Agency
  1238 Brayton Point Road
  Somerset, MA 02726
  508-679-2138

- Fire Department HQ
  475 County Street
  Somerset, MA 02726
  508-646-2810

- Police Department
  465 County Street
  Somerset, MA 02726
  508-679-2138

911

- Highway Department
  1263 Brayton Point Road
  Somerset, MA 02726
  508-646-2835 508-646-2836

- Highway Department
  1263 Brayton Point Road
  Somerset, MA 02726
  508-646-2835 508-646-2836

- Somerset Water Department
  3249 County Street
  Somerset, MA 02726
  Robert Lima, Supervisor
  508-674-4215

KEY CONTACTS

FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA):

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99 High St.
Boston, MA 02110
1-877-336-2734

fema-r1-info@fema.dhs.gov

Melissa A. Surette, Senior Planner
Risk Analysis Branch, Mitigation Division

Melissa.Surette@fema.dhs.gov
Office: 617.956.7559
Cellular: 617.794.0292

DEPARTMENT OF CONSERVATION AND RECREATION (DCR)

DCR Division of Water Supply Protection (DWSP)

Main Office
251 Causeway St., Suite 900, Boston, Ma
617-626-1250

State National Floodplain Insurance Coordinators

Joy Duperault
MA Dept. of Conservation & Recreation, Flood Hazard Mgmt.
251 Causeway Street, Suite 700
Boston, MA 02114
(617) 626-1406
Fax: (617) 626-1349
joy.duperault@state.ma.us

AMERICAN RED CROSS:

Massachusetts Contacts

101 Station Landing
Suite 510
Medford, 02155

1-781-410-3670
800-564-1234 (24/7)
http://www.redcross.org/local/massachusetts/disaster-services

SALVATION ARMY

Massachusetts Emergency Disaster Relief

290 Bedford Street
Fall River, Massachusetts
508-679-7900
kimberly.belanger@use.salvationarmy.org
shaun.belanger@use.salvationarmy.org

http://www.salvationarmyma.org/fallriver