Town of Stow

Community Resilience Building Workshop Summary of Findings

June 2018

Prepared By:

Geosyntec consultants

289 Great Road, Suite 202
Acton, Massachusetts, 01720
(978) 263-9588

Prepared For:

Town of Stow
380 Great Road
Stow, Massachusetts 01775

TABLE OF CONTENTS

Report Contents:

This report has been prepared in accordance with the Community Resilience Building (CRB) Guide and Municipal Vulnerability Program (MVP) "Summary of Findings Template Guidance" provided by the Massachusetts Executive Office of Energy and Environmental Affairs (MA EEA).

1. OVERVIEW

The need for municipalities, regional planning organizations, states, and federal agencies to increase resilience and adapt to extreme weather events and climate change is strikingly evident amongst the communities of Massachusetts. Impacts to communities resulting from flooding, power outages, drought, and other natural hazard-related events have spurred support of resiliency and collaboration to identify vulnerabilities. Massachusetts Governor Baker's Executive Order 569 aims to provide communities with technical support, climate change data, and planning tools to identify hazards and develop strategies to improve resilience. This resulted in the Massachusetts Municipal Vulnerability Preparedness (MVP) program, which provides communities with funding to identify vulnerabilities and develop plans to specifically increase resilience to climate change.

2. COMMUNITY RESILIENCY BUILDING WORKSHOP

The Town of Stow (Stow) received funding through the Massachusetts Executive Office of Energy and Environmental Affairs (MA EEA) administered MVP program to conduct a Community Resiliency Building (CRB) workshop. The goal of the workshop was to complete a baseline climate change and natural hazard vulnerability assessment and to develop specific actions for addressing priority hazards in Stow. The intention of this process is to foster collaboration between community stakeholders that will advance the education, planning, and implementation of solutions to address priority hazards. Prior to the workshop, interviews were conducted with select community representatives to preemptively identify potential strengths and vulnerabilities of Stow (See Section 4 for a summary). The workshops central objectives were to:

- Define prioritized local natural and climate-related hazards of concern;
- Identify existing and future strengths and vulnerabilities;
- Develop prioritized actions for Stow; and
- Identify immediate opportunities to collaboratively advance actions to increase resilience.

The workshop was conducted in accordance with CRB guidance[1] in May 2018 over the course of two days. The workshop was organized/attended by members of Stow's Climate Change Working Group which consists of staff from the Stow Planning and Conservation Departments, the Energy Working Group, the Conservation Commission, and the Fire Department (see Section 7 for a complete list of attendees). Geosyntec Consultants facilitated the workshop with assistance from Regina Villa Associates. Approximately 25 community members and stakeholders attended the two-day workshop.

The first day of the workshop focused on identifying top hazards, vulnerabilities, and strengths. The second day of the workshop focused on prioritizing actions. The CRB workshop process used a unique "anywhere at any scale", community-driven process to organize input from stakeholders through use of a Risk Matrix. The workshop included introductory presentations on climate change projections in Massachusetts developed by the Climate Change Clearing House for the Commonwealth (CCC)

1. CRB Guidance: www.communityresiliencebuilding.com

(www.resilientma.org) and potential nature-based solutions to address vulnerabilities (i.e. green infrastructure) (See **Appendix A**).

Parts of the Risk Matrix were completed first in smaller teams (i.e., breakout groups) and then together with all stakeholders in order to efficiently consolidate information (See **Appendix B** for completed risk matrices). Stakeholders were also provided with a series of basemaps with critical information such as infrastructure (e.g., stormwater pipes, hydrants, firefighting cistern locations, etc.), floodplains, public water supply areas, and conservation land within Stow (**Appendix C**). The combination of the Risk Matrix and basemaps provided decision-support and risk visualization to enable stakeholders to effectively identify both existing strengths and vulnerabilities and prioritize actions to further reinforce strengths or mitigate vulnerabilities. The process resulted in a workshop that was highlighted by informative input, shared experiences, and dialogue.

This report provides an overview of the top hazards, current concerns, challenges, and strengths, and potential actions to improve the community's resilience to natural and climate-related hazards today and in the future. The summary of findings described in this report, including those that concern the evolving nature of risk assessment and associated action, are compiled from comments, corrections, and updates from the workshop stakeholders. The leadership in Stow will benefit from the continuous and expanding participation of all those concerned.

Workshop participants identify top hazards (Blue Team)

3. TOP HAZARDS AND VULNERABLE AREAS

During the workshop, stakeholders were divided into teams to identify Stow's top natural hazards. The teams then shared and discussed their conclusions with the overall group.

Top Hazards

- Drought
- Strong Storms
- Extreme Temperatures

Drought was clearly the hazard of highest concern to Stow, as past drought conditions had impacted local water supply wells and firefighting capabilities. Extreme weather events like strong winter storms and heavy rainfall with high winds were another concern due to their potential for infrastructural impacts, flooding, and other physical and environmental consequences. Approximately two months prior to the workshop, Winter Storm Quinn had caused significant tree damage resulting in electrical power outages

across Stow, along with many other Massachusetts communities[2]. Extreme temperatures in the winter and summer were also a concern of the stakeholders, as the potential for frost or wildfires could impact the local farming industry or the large proportion of conservation land in Stow. Other hazards discussed included flooding, indirect impacts of sea level rise (i.e., potential for resulting population influx), and disease vectors; however, it was agreed that drought, strong storms, and extreme temperatures presented the highest risk. These hazards present direct and indirect risks to the infrastructural, societal, and environmental resources of Stow.

Areas of Concern

Areas of concern identified during the workshop were grouped into the following categories:

- **Neighborhoods and Other Private Parcels:** Lake Boon, Village Centers (Town Center, Lower Village, Gleasondale Village), farms, golf courses
- **Public Amenities:** Schools, senior and assisted living facilities, Pompositticut Community Center, Stow Fire Department, Stow Police Headquarters
- **Transportation:** Bridges/stream crossings, Arterial roads (specifically Great Road, single access streets, Minuteman Air Field
- **Infrastructure:** Water supply (private and public wells and firefighting cisterns), stormwater management system, electrical network (Hudson Light & Power), Lake Boon Dam
- **Ecosystems:** All local conservation areas (Gardner Hill Conservation Area, Marble Hill Conservation Area, Captain Sargent Conservation Area, Red Acre Woodlands, Flagg Hill, etc.), Assabet River National Wildlife Refuge, Lake Boon, Assabet River, Elizabeth Brook

4. CURRENT CONCERNS AND CHALLENGES PRESENTED BY HAZARDS

Stow faces multiple challenges related to the impacts from natural hazards as demonstrated by several areas of concern. In recent years, the community has experienced a series of highly disruptive and damaging weather events, including Tropical Storm Irene (August 2011), Tropical Storm Sandy (October 2012), winter Nor'easter Nemo (February 2013), and the recent winter Nor'easter Quinn (March 2018). These storms brought heavy rain-induced inland flooding, wind damage to trees, and snow that caused widespread damage to many Massachusetts communities. The magnitude and intensity of these events in Massachusetts has increased awareness of natural hazards and climatic change, while motivating communities like Stow to comprehensively assess and improve resilience at the local level.

These recent storms are corroborated by climate change projections published by the CCCC

2. It should be noted that storms mentioned in this report are provided for context. This report does not imply that a specific storm (or storms) are a result of a climate change.

(www.resilientma.og). The following climate-change specific impacts are expected to affect Stow:

- The average daily temperature, currently 49º F, is expected to increase by up to 4.37º F by 2050 and by up to 10.94º F in 2100. This increase is expected to occur during all seasons. Similarly, the number of days above 90º F, currently eight (8) days on average, is expected to increase to up to 35 days in 2050 and up to 76 days in 2100 (See **Appendix A** for introductory presentation materials).
- Average annual precipitation, currently 45 inches, is expected to increase by up to six (6) inches (13% increase) by 2050 and up to eight (8) inches (18% increase) by 2100. Increases will potentially result from significant storms – it is expected that the number of days with significant precipitation of greater than one (1) inch, currently seven (7) days, are expected to increase by up to three (3) days in 2050 and by up to four (4) days in 2100. Further, it is possible that the largest proportion of increased precipitation will occur in the spring and winter (i.e., snow); precipitation may slightly decrease in the summer and fall (See **Appendix A** for introductory presentation materials).

The relatively recent series of extreme weather events and the potential for impacts resulting from climate change, highlights the diversity of Stow's vulnerabilities in its infrastructural, societal, and environmental resources. Prior to the workshop, interviews were conducted with key stakeholders to proactively identify Stow's primary vulnerabilities and strengths. Interviewees indicated that as a community whose water supply comes primarily from well water and not from a public water supply system, drought and increased temperatures are a concern for residential, firefighting, and agricultural water usage. The farming community is not only vulnerable to a limited water supply, but to the potential damage to crops that extreme weather could cause. While Stow does have an Emergency Operations Plan (2009) and a Hazard Mitigation Plan (2002), interviewees indicated that it is outdated and does not address climate change (i.e., the plan focuses on terrorism). These challenges require comprehensive, yet specific, actions for mitigating risks in Stow.

During the workshop, the smaller breakout groups identified vulnerabilities and strengths to natural hazards in the community and then shared their results with the group at large. The workshop stakeholders were generally in agreement that Stow is experiencing more intense and frequent storm events. The impacts of these storms have affected the daily activities of residents during both winter and summer seasons. There was general concern about the need and challenges of being prepared with contingency plans for worst case scenarios during different times of the year, particularly in the late fall/winter versus summer due to more intense winter storms (Nor'easters) and loss of electricity and heat during cold winter months.

Specific Categories of Concerns and Challenges

Water Supply (Infrastructure)

Workshop participants categorize vulnerabilities (Red Team)

Stow's water supply depends solely on groundwater produced from private and public wells. Stow does not have a central water supply system; instead, most homes and other private and public parcels (e.g., farms, schools, etc.) maintain individual wells of varying depths, which require electricity to operate.

This represents a significant vulnerability, particularly for residential water supply, which may be limited by the depth of a resident's well and the productivity of the underlying aquifer. There is no infrastructure in place to supplement the water supply by shared sources in times of need. Residents have experienced dry wells in the past, mostly recently in the 2016 drought, when bottled water was made available to those without water supply to their homes. Homes in the Lake Boon/Gleasondale area were identified to have the shallowest wells and are therefore most likely to be subject to drought; however, participants agreed that comprehensive data on well depth and type in Stow is not readily available. Loss of power also means a loss of water to residences, unless the owner has a backup generator.

The lack of a central water supply also has a significant impact on firefighting capabilities. Very few hydrants are available, so water must be transported via fire trucks and stored in cisterns and constructed fire ponds. Stow has invested in cisterns with water stored for firefighting use; however, their capacity and locations are limited and require expansion. When groundwater sources are low, the fire department draws water from surface water bodies or requests assistance from neighboring communities.

It became clear during the workshop that Stow-specific data and information on current water usage rates and recharge rates was not available. General concern was expressed that the long-term viability of the aquifer that provides water to Stow is unknown.

Stormwater Management System (Infrastructure)

During the workshop, it was discussed that Stow is reliant on groundwater/aquifer recharge. Therefore, it was discussed that an increase in implementation of Low Impact Development (LID) techniques (see **Appendix A** for introductory presentation) could be beneficial to encourage decentralization of stormwater management systems which can lead to additional recharge and infiltration. It was noted that it would be particularly important to create incentives to incorporate LID into all new development.

In addition, it was discussed that the aging or otherwise unknown condition of infrastructure in Stow has

left many culverts in need of rehabilitation. Stronger storms with more localized and intense rainfall is often associated with climate change. During the workshop, concern was raised over the ability of Stow's existing infrastructure to manage these changes in rainfall patterns and the potential for future localized flooding. For example, it was unclear if existing infrastructure is adequately sized to handle larger and more intense storms.

High Priority Hazard Bridges/Dams (Transportation)

Bridges and dams in Stow are of various ages and are potentially in need of repairs. The Gleasondale Road bridge is currently open to only one lane of traffic until repairs have been made. Workshop stakeholders expressed concern over the lack of knowledge of the condition of dams and bridges in Stow, such as the Lake Boon Dam. This was particularly important when considering that select bridges are vital connections between Stow's town center (the Great Road Corridor) and outlying neighborhoods. These bridges are key to connecting residents with emergency services, including the community center located along the Great Road Corridor (Pompositticut Community Center).

Farming Community (Private Parcels)

Many farms and orchards are located in Stow, making it a vibrant agricultural community and one of the main attraction for tourists to visit the area. One of the key concerns discussed during the workshop was the long-term viability of these farms and their ability to maintain continued crop viability. Water supply is further impacted by crop demands for water. In a community that already struggles with water supply, drought conditions have the potential to not only impact residents and firefighting, but also the agricultural community. In addition, farms are vulnerable to strong storms. Frost, wind, flooding, hail, extreme heat, and other severe weather conditions all can impact farming practices; potentially decreasing crop yields or eroding soils. Stow has also experienced an increase in pest populations, which can potentially decrease crop yields. As severe weather conditions become more frequent, the long-term impacts on farms and their viability could be significant. Farming plays an important role in the local economy in Stow, so their success is of importance to the entire community.

Isolation and Emergency Access (Neighborhoods and Ecosystems)

Many neighborhoods in Stow have limited access points. Strong storms could cause fallen trees or flooding that could restrict or completely block access to these areas, isolating residents from emergency services. A high priority for stakeholders was to ensure that all neighborhoods have multiple access points, insofar as feasible.

In addition, Stow has many forested areas and conservation land; however, access in the form of fire roads is not maintained as much as it was in the past due to private land ownership issues. Brush and dead trees have potential to ignite and spread fire if adequate access is not available. Ensuring not only that emergency access roads are maintained but that the town has adequate equipment (off-road vehicles, etc.) to access remote areas is a high priority. While Hudson Light & Power was considered a strength as a responsive, local utility, some participants expressed concern that even with town support, it might be understaffed for right-of-way maintenance and emergency response.

Hazard Preparation and Planning

While Stow does have a hazard mitigation plan, concerns were raised during the workshop that the plan was outdated and did not sufficiently address the scope of concerns that threaten the community (i.e., the plan focuses on terrorism). Stakeholders discussed that the plan does not account for climate change and the potential for an increase in more severe natural hazards. Additionally, stakeholders were concerned about the lack of emergency support services and emergency communication for vulnerable populations. Stow does have a Swift Reach system and other communication plans; however, there is concern about reaching vulnerable populations that need the information to take advantage of emergency services.

Staffing Resources

Finally, general concern was voiced at the workshop over the strain that adaptation to climate change could put on the Highway Department and other Town departments. Currently, the Highway Department and other departments have limited staff that are required to manage many projects of varying complexity. In addition, Stow does not employ a town engineer. Implementation of many of the recommendations discussed in this report would likely require additional staffing support.

5. CURRENT STRENGTHS AND ASSETS

Due to recent experiences with extreme weather, workshop participants were aware of Stow's strengths and how they relate to its vulnerabilities. It was a clear priority to continue to reinforce and expand these strengths, to increase preparedness and resiliency in the community, and to adapt these strengths to address potential impacts of climate change.

Emergency Services

- The Town of Stow maintains a multi-use community center that functions as a shelter during emergencies. The center is equipped to shelter displaced residents in the event of drought, power outage, flooding, etc., with its own back-up power supply and air conditioning that could provide relief from extreme heat for vulnerable populations. The community center has previously acted as the base for emergency services by providing a warming center during snow storms and passing out water to residents during drought. Local schools are also available for emergency use, if needed. The Pompositticut Community Center is located along the Great Road Corridor, centralized near other essential buildings.

- Emergency response in Stow has historically worked well with good communication between departments and with the community. Stow has an active Medical Reserve Corps (MRC), an emergency preparedness plan, and a recently updated sheltering plan.

- Minute Man Air Field provides Stow with the ability to receive supplies via air transportation, if necessary, although the airport is not central to Stow and is located within the floodplain to Heath Hen Meadow Brook.

- Firefighting cisterns are available in Stow, although their total capacity and reach is limited. As Stow does not have a public water supply (very few hydrants are available), significant effort has been devoted to ensuring that there is adequate water available for firefighting. Surface water sources have also been retrofitted to serve as firefighting water supplies, as needed.

Conservation Areas

The Town of Stow includes approximately 4,000 acres of conservation/recreation land (approximately 35% of the town is zoned as conservation/recreation). Conservation areas include Assabet River National Wildlife Refuge, Gardner Hill Conservation Area, Marble Hill Conservation Area, Captain Sargent Conservation Area, Red Acre Woodlands, and others. These protected lands provide large areas of pervious surface that facilitate groundwater infiltration and aquifer recharge, reinforcing water supplies. They also contain wetland areas that help mitigate the potential impacts from flooding by providing natural overflow storage for the Assabet River, Heath Hen Brook, and Elizabeth Brook.

Electrical Supply

The electrical distribution network in Stow is serviced by a local municipal electrical department (Hudson Light & Power). A local company is potentially more responsive in the event of an outage, as it serves fewer customers than the major state-wide energy providers. In the past, Hudson Light & Power has shown itself to be a valuable partner for the Town of Stow. It was clear during the workshop that Stow is committed to maintaining this partnership.

Regional Health Services

Health services for Stow are planned at a regional scale. Expanding health services planning to include other types of planning (resiliency, emergency services, etc.) was a suggestion that could be beneficial to Stow. Maintaining regional health services is a strength for Stow to combat the emergence of increased disease vectors associated with warmer temperatures, such as exposure to Lyme disease, and other tick-borne diseases. Collaboration and strengthening relationships with neighboring communities is a key to providing strong health services that could be applied to resiliency to climate change.

Community

Stow is made up of involved residents, committed to their community values. There is an active Council on Aging, neighborhood brigades, a climate change action group, Sustainable Stow, and many other programs invested in improving the community.

6. RECOMMENDATIONS TO IMPROVE RESILIENCE

In small groups, workshop stakeholders developed recommended actions based on identified vulnerabilities. Recommended actions were then discussed as a large group to agree on the most important recommendations to benefit the community. Consensus was reached on: 1) conducting a water supply vulnerability assessment and educating the public on water supply, 2) updating the hazard mitigation plan, 3) developing a hazard transportation and communication plan, and 4) developing

programs to increase the resiliency of the local farming community. These four recommendations were chosen as the top recommendations from the workshop and are discussed in more detail below. Other recommendations proposed by the small groups are also listed, ranked by priority. Refer to **Appendix B** for completed risk matrices that were used by workshop stakeholders to develop and prioritize recommendations.

Top Recommendations

Conduct a Water Supply Vulnerability Assessment and Educate the Public on Water Supply

Water supply was one of the most significant vulnerabilities identified by the workshop stakeholders. A water supply vulnerability assessment was the top recommendation to understand the status of Stow's water resources. The assessment would evaluate the status of Stow's water supply (including usage rates, recharge rates, etc.), prioritize concerns to be addressed, and identify other potential sources of water. Outcomes of such a study could include recommendations to implement water conservation efforts in the form of bylaws, water management programs/educational programs, greywater reuse programs, emergency water supply plans, or cistern installation plans. Additional actions could include a plan to communicate drought conditions to home owner associations (HOAs), civic institutions and other large water users in the area which could increase cooperation in conserving water during dry seasons.

Update the Hazard Mitigation Plan

It was discussed that Stow's current Hazard Mitigation Plan is out of date and does not include measures that take climate change and natural hazards into consideration (i.e., the current plan focuses on terrorism). While efforts to update the plan are ongoing, significant progress has not yet been made. It was a priority of the workshop stakeholders to update the plan to increase Stow's preparedness and ensure that the community remains eligible for federal emergency funding.

Develop a Hazard Transportation and Communication Plan

Development of a Hazard Transportation and Communication Plan was a high priority of workshop stakeholders to increase the effectiveness of emergency services. The plan would target vulnerable populations such as the elderly, the sick, children, people with disabilities, etc. and have specific procedures for high-priority institutions, like schools. The plan would include an emphasis and outreach on the use and availability of tools such as "reverse 911" or Amateur Radio Emergency Service (ARES) ham radio alerts, a transportation plan to move residents to the community center, and functional support services to make sure that displaced or in-place residents receive the resources they need in an emergency. (Note: It was also discussed that this plan could potentially be combined and included as a component of the Hazard Mitigation Plan.)

Develop Programs to Increase Resiliency of the Farming Community

As previously discussed, farming plays a significant role in Stow's community culture and economy. In the past, local crops have been damaged by drought and ice, decreasing crop yields. This raises the concern

that increased frequency of extreme weather events (i.e., increases in significant precipitation events and temperature) could become a hardship on the farming community. In other words, when discussing the challenges of climate adaptation, long-term farm viability is at the core of that challenge.

It was recommended during the workshop that partnerships with existing agricultural organizations, agencies, and institutions be prioritized to determine how local assistance can augment State and Federal programs and be leveraged to benefit local farmers. For example, it was recommended that the Town work with the Middlesex Conservation District's expertise when working with local farms that fall under the Conservation Commission's jurisdiction. Such partnerships could inform farmers of available assistance to enable them to develop plans to adapt to climate change and increase resiliency. It was also recommended that the Town review and implement action items noted in the Minuteman Advisory Group on Interlocal Coordination (MAGIC) Comprehensive Agricultural Planning Program previously prepared by the Metropolitan Area Planning Council.

Potential program suggestions that could arise from these partnerships and recommendations from the MAGIC Plan include: low interest loans or state aid programs to enable farmers to afford resilient technology, encouraging a diversity of crops that can cope with changing conditions, and researching alternative, more reliable water sources to supply needs during times of drought. Stow could also consider applying for and utilizing Community Preservation Coalition (CPA) funds to provide an adaptation technology grant program to augment state energy and agricultural technical assistance programs.

Workshop participants discuss priority vulnerabilities (Green Team)

Other Prioritized Recommendations

Professional judgement was used to reach consensus on priority for cases in which a recommendation was assigned different priority levels by different small groups.

Highest Priority

- **Perform a stormwater infrastructure assessment:** An infrastructure assessment would focus on culverts and road crossing/bridges to identify undersized/aging culverts and prioritize areas subject to flooding and/or in need of repairs. An infrastructure assessment would also help meet requirements of the Massachusetts Municipal Separate Storm Sewer System (MS4) permit to inventory and map MS4 stormwater outfalls.
- **Encourage LID implementation.** It was recommended during the workshop that a Town bylaw be created that incorporates Low Impact Development (LID) techniques into all types of development, not just subdivisions and other large developments that trigger erosion and

sediment control permits. The bylaw should be developed with additional incentives for applicants/developers to decentralize stormwater management systems as feasible. Additional measures can also be taken to encourage LID implementation throughout the Town, such as an increased focus on school education programs, community raingarden competitions, or incorporation of LID practices into the Complete Streets program.

- **Assess and make repairs to high priority hazards dams.** Dams should be assessed for safety and needed repairs. If privately owned, assessment would be contingent on cooperation with the property owner. Stakeholders indicated that an assessment of Lake Boon dam was ongoing at the time of the workshop.
- **Decrease isolation of neighborhoods by adding bylaws requiring multiple access points to new developments, in the event of road closures.** Isolated neighborhoods, such as residences of Sylvan Drive and Dunster Drive, should be identified. Isolation could also be minimized by coordinating with neighboring towns on emergency routes and planning. Stow could also consider implementing bylaws requiring emergency generators that are capable of servicing a development for longer than 48 hours, given reliance on individual small water systems.
- **Continue to maintain and improve the health of wetlands, streams, and water bodies.** Strategies could include:
    - Several large, undeveloped parcels, such as Rock Bottom Farm and land located on Gates Lane could have a major impact on the health of nearby water bodies, including the Assabet River and Elizabeth Brook if developed without conservation directed land use controls. Such controls could include the use of Planned Conservation Development practices in subdivisions, rezoning to less intense land uses and utilizing decentralized stormwater mitigation techniques. Revising zoning on priority parcels could ensure compatibility with surrounding resources.
    - Creating a bylaw to reduce tree cutting.
    - Increasing LID installations near waterways.
    - Restricting water usage from surface water bodies to maintain adequate baseflow throughout the year to encourage aquifer recharge.
    - Identifying opportunities to combat thermal pollution by conducting a study of potential sources and mitigation techniques and retrofitting culverts to comply with state storm crossing standards would provide additional information on the risk of waterways.
    - Education programs for the public and schools could also bring awareness to conservation efforts and could be integrated with MS4 outreach efforts.
- **Increase resiliency and redundancy of the electrical distribution network.** This would require working with the local electrical supplier, Hudson Light & Power, to identify areas at risk for power outage and encouraging that power lines be buried, while maintaining a strong relationship with the supplier. A right of way maintenance plan and a demand management plan would help minimize electrical power outages. Investigation into alternative energy sources, such as solar energy, and potential incentives to invest in those sources could also lessen the dependence on

the electrical network. Active tree management is also an important consideration to maintaining power during strong storms.

Moderate Priority

- **Improve water supply for firefighting.** Additional cisterns would improve distribution of water and would decrease reliance on surface waters during drought conditions. This would include an assessment of locations for cistern installation, improvements to existing cisterns, and a review of the cistern policy. A requirement for new developments to implement wet ponds or cisterns for firefighting water sources would also supplement supply.
- **Increasing resiliency of the Great Road Corridor.** Many of Stow's emergency services are located along Great Road. Increasing the ability of the area to withstand natural hazards by implementing LID, alternative energy, tree management, and stormwater management will ensure that those emergency services are not needed as frequently during large storm events.
- **Continuing to improve/expand emergency shelters.** The community center is a strength of Stow; however, cisterns could also be installed at schools in case of drought and generators should be supplied to all public buildings, in case of emergency. It was also suggested that a micro-energy grid be installed to ensure that these essential shelters maintain power despite natural hazards.
- **Decrease tree damage sustained by ice/wind.** This would require active tree management and strategic plantings. Educational programs on tree benefits and appropriate species for the area would increase tree resiliency. These programs would best be developed by partnering with relevant organizations with specialty in forest management. In addition, burying power lines would remove some of the hazard posed by overhanging trees.
- **Increase groundwater recharge throughout Stow.** This would require implementation of LID practices and planting of vegetation in areas with bare soils. LID practices could be incentivized through local bylaws. Utilize small scale techniques such as parking area rain gardens as well as larger landscape level recharge techniques where available.
- **Increase forest management.** This would be accomplished by implementing an emergency tree management plan to address disease/vectors, tinder/brush management, minimum emergency access requirements, and maintaining communication between the Conservation Commission and the Fire Department. Encouraging planting to supplement forested areas is also a priority.
- **Decrease risk to disease/vectors.** Continue to offer education of the public on appropriate clothing and products to minimize risk, assess deer/wildlife management in Stow. Education on products that minimize environmental impacts may also encourage use. Increasing awareness and improving public health could be accomplished by providing education on risks and methods of decreasing impacts to disease/vectors and by providing water and sanitation services where needed.

Lower Priority

- **Increase conservation land to mitigate potential build-out and subsequent increase in impervious areas.** In addition, prioritize habitat and greenway linkage with new conservation lands.
- **Maintain habitat for aquatic/terrestrial species.** This would require additional effort to conserve land within Stow. It could also be supported by implementing a mandatory alternative conservation subdivision plan and by upgrading culverts to allow for wildlife passage.
- **Mitigate impacts of climate change on commercial development.** Encouraging LID, alternative energy (such as solar panels on rooftops or over parking lots), and LEED-certified building techniques will help commercial development to adapt to potential impacts of climate change.

As previously discussed, this list of prioritized recommendations was developed by workshop stakeholders based on identified vulnerabilities. It is recommended that the Town create a committee or working group to implement recommendations from this plan. Specifically, the committee or working group would develop an anticipated timeline, determine potential funding requirements, then apply for local and State grant opportunities to implement prioritized recommendations.

7. SUPPORTING INFORMATION

Report Citation

Geosyntec Consultants (2018). Community Resiliency Building Workshop Summary of Findings. Town of Stow, Massachusetts.

CRB Workshop Stakeholders

Name	Department/Committee	Position
Jacquie Goring	Town of Stow - Conservation Assistant	Red Team
Vicki Blake	Stow Community Housing Corp.	Red Team
Laura Greenough	Town of Stow- Recreation Department	Red Team
Mike Clayton	Town of Stow- Superintendent of Streets	Red Team
Rebecca Quinones	Mass Wildlife	Red Team
Marcia Rising	Board of Health	Red Team
Arnie Epstein	Energy Working Group	Green Team
Rosemary Monahan	Gleasondale Subcommittee	Green Team
Carol Lynn	Sustainable Stow	Green Team
Jim Salvie	Board of Selectmen	Green Team
Rick Lent	Elders for Climate Action	Blue Team
Sharon Brownfield	Sustainable Stow	Blue Team
Merrily Evdokimoff	Board of Health	Blue Team
Joe Landry	Town of Stow- Fire Chief	Blue Team
Kathy Sferra	Town of Stow - Conservation Coordinator	Red Team
Sandra Grund	Town of Stow- Conservation Commission	Red Team
Alison Field-Juma	OARS	Red Team
Ashley Davis	Sudbury Valley Trustees	Green Team
George Peterman	Energy Working Group	Blue Team
Rebecca Stadolnik	Medical Reserve Corps	Blue Team

Day 1 Workshop Participants

Day 2 Workshop Participants

CRB Workshop Project Team

Name	Organization	Role
Jesse Steadman	Town of Stow – Planning Department	Project Lead
Valerie Oorthuys	Town of Stow – Planning Department	Principal Contact
Kathy Sferra	Town of Stow – Conservation Coordinator	Core Team
Sandra Grund	Town of Stow – Conservation Commission	Core Team
Jacquie Goring	Town of Stow – Conservation Assistant	Core Team
Andrea Braga	Geosyntec Consultants	Lead Facilitator
David Roman	Geosyntec Consultants	Table Facilitator
Hayley O'Grady	Geosyntec Consultants	Table Facilitator
Kate Barrett	Regina Villa Associates	Table Facilitator

Acknowledgements

Special thanks to the Town of Stow for their willingness to embrace this process and provide the facilities to convene the workshop, and to the participants for their invaluable input about the community.

This project was made possible through funding by the Climate Change Municipal Vulnerability Preparedness Program from the Massachusetts Executive Office of Energy and Environmental Affairs.

APPENDIX A: INTRODUCTORY PRESENTATION MATERIALS

Geosyntec consultants

Town of Stow Municipal Vulnerability Preparedness Program

Community Resiliency Workshop

Day 1: 11 May 2018, 8am to 12pm
Day 2: 17 May 2018, 8am to 12pm

Welcome!

- Welcome
  - Jesse Steadman, Town Planner
- Core Team and Facilitation Team Introduction
  - Valerie Oorthuys, Assist. Planner
  - Jacquie Goring, Conservation Agent

Workshop Overview

Objective: To frame the issue in context of local, regional risk and resiliency.

Geosyntec consultants

Municipal Vulnerability Preparedness (MVP)



State and local partnership to build resiliency to climate change

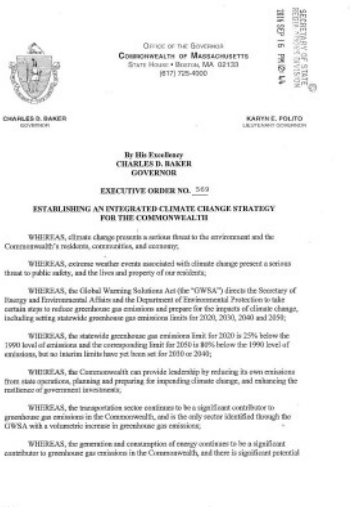
1. Engage Community
2. Identify CC impacts and hazards
3. Complete assessment of vulnerabilities & strengths
4. Develop and prioritize actions
5. Take Action

Empowering Communities & Informing Statewide Action

- **Community-led process**
- **Accessibility**
- **Partnerships** and leveraging existing efforts
- **Communities** as local innovators
- **Frame** coordinated statewide efforts.

1. Engage Community
2. Identify CC impacts and hazards
3. Complete Assessment of Vulnerabilities & Strengths
4. Develop & Prioritize Actions
5. Take Action

The MVP Process



By His Excellency
CHARLES D. BAKER
GOVERNOR

EXECUTIVE ORDER NO. 569

ESTABLISHING AN INTEGRATED CLIMATE CHANGE STRATEGY FOR THE COMMONWEALTH

WHEREAS, climate change presents a serious threat to the environment and the Commonwealth's residents, communities, and economy;

WHEREAS, extreme weather events associated with climate change present a serious threat to public safety, and the lives and property of our residents;

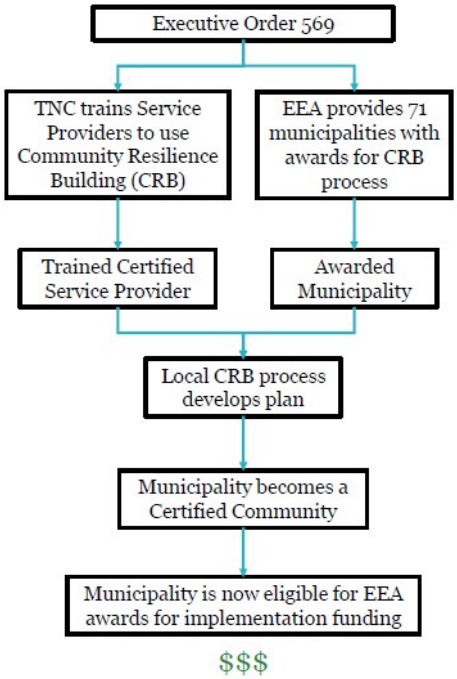
WHEREAS, the Global Warming Solutions Act (the "GWSA") directs the Secretary of Energy and Environmental Affairs and the Department of Environmental Protection to take certain steps to reduce greenhouse gas emissions and prepare for the impacts of climate change, including setting statewide greenhouse gas emissions limits for 2020, 2030, 2040 and 2050;

WHEREAS, the statewide greenhouse gas emissions limit for 2020 is 25% below the 1990 level of emissions and the corresponding limit for 2050 is 80% below the 1990 level of emissions, but no interim limits have yet been set for 2030 or 2040;

WHEREAS, the Commonwealth can provide leadership by reducing its own emissions from state operations, planning and preparing for impending climate change, and enhancing the resilience of government investments;

WHEREAS, the transportation sector continues to be a significant contributor to greenhouse gas emissions in the Commonwealth, and is the only sector identified through the GWSA with a volumetric increase in greenhouse gas emissions;

WHEREAS, the generation and consumption of energy continues to be a significant contributor to greenhouse gas emissions in the Commonwealth, and there is significant potential



Gov. Baker's Executive Order 569

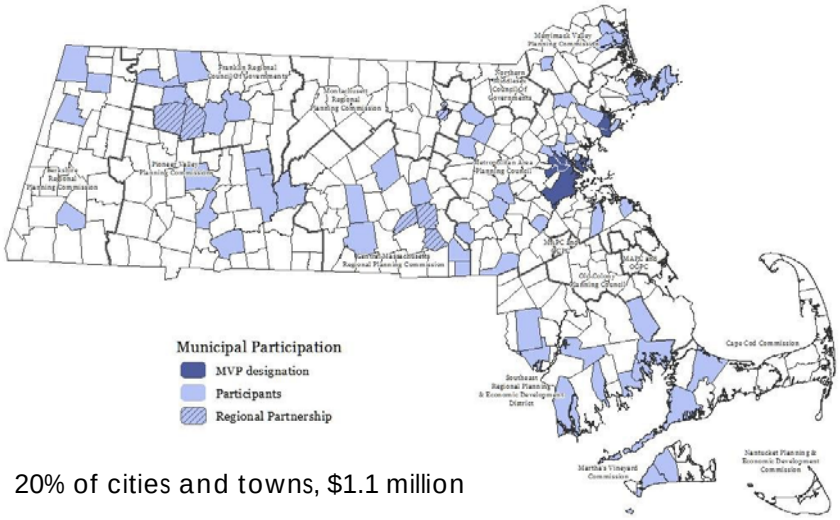
- *Establishing an Integrated Climate Change Strategy for the Commonwealth*
- Lays out a comprehensive approach to further reduce greenhouse gas emissions, safeguard residents, municipalities and businesses from the impacts of climate change, and build a more resilient Commonwealth
- Over $1 million in grant funding and designation status was awarded to 71 towns and cities across the state for this program. Provides communities with technical support, climate change data and planning tools to identify hazards and develop strategies to improve resilience.

Workshop Purpose

Complete a baseline climate change and natural hazard vulnerability assessment, and to develop specific actions for dealing with priority hazards using the Community Resilience Building (CRB) workshop guide

IV. MVP Program

Municipal Vulnerability Preparedness (MVP) Program 2017-2018



20% of cities and towns, $1.1 million

MVP Aspirations and Next Steps

- **Increase capacity of municipalities and providers**: Over 250 vendors will be trained as state service providers
- **Mobilize:** local knowledge, climate change data and existing plans to identify vulnerabilities and strengths and prioritize action steps
- **Incentivize**: Designated communities will receive advanced standing in EEA grant programs
- **Mainstream:** Incorporate climate change into existing municipal planning frameworks
- **National Model:** The Nature Conservancy is looking to MVP as a national model and EEA is sharing through U.S. Climate Alliance

Nuts and Bolts: 2017-2018

- Responses to the RFR for communities may be submitted by any Massachusetts municipality or groups of municipalities
- All projects are required to provide quarterly reporting as well as a Final Report

IV. Criteria

MVP Program Eligibility Criteria

- An in-kind staff time match is required of approximately 80 hours
- Municipalities must work with a state-certified technical service provider

All Proposals Must Provide the Following

- A **signed letter of support** from the chair of the board of selectmen, mayor, a town administrator, or similar city or town official;
- A **short statement of the community's commitment** to taking on this grant and planning for the impacts of climate change in the city or town;
- The name of a qualified employee of the municipality, committee member or volunteer who can serve as the **local project manage**r and point of contact for the grant;
- A summary of **community support** and any project partners and letters of support
- A description of any **ongoing planning efforts** such as local hazard mitigation plans, open space plans, master plans, etc.;
- A description of any **ongoing climate-change related proj**ects within the community or region;

Payment

All communities were granted an initial sum of $10,000. Up front payment was intended to help municipalities:

1. Organize a core team
2. Procure a vendor
3. Collect relevant background materials
4. Plan workshops and work with provider to assemble materials
5. Run workshop

Final payment will be made upon delivery of final summary report.

MVP Contracts

Led by a local project lead, a core team from the municipality, and the MVP provider, communities will gather available background information on hazards, vulnerabilities and strengths, conduct interviews with staff and volunteers, and plan two 4-hour workshops or one 8-hour workshop.

Workshops

In the workshop approximately 30 town staff, residents and volunteers will work to:

- Understand connections between ongoing community issues, hazards, and local planning and actions in the municipalities.
- Identify and map vulnerabilities and strengths to develop infrastructure, societal, and natural resource risk profiles for the municipalities.
- Develop and prioritize actions and clearly delineated next steps for the municipalities, local organizations, businesses, private citizens, neighborhoods, and community groups.
- Identify opportunities to advance actions that further reduce the impact of hazards and increase resilience across and within municipalities.

Contract

After appropriate local procurement, the municipality will conduct the following tasks, working with the contracted MVP provider:

- Prepare for the workshop(s):
- Characterize hazards:
- Identify Community Vulnerabilities and Strengths
- Identify and Prioritize Community Actions
- Determine the Overall Priority Actions
- Put it All Together
- Move Forward

Upon successful completion of Steps 1-6 of the CRB process and clearly defined efforts to begin Step 7 including conducting at least 1 public session, municipalities will be designated as a "Municipal Vulnerability Preparedness Program Climate Community," or "MVP Climate Community" which may lead to increased standing in future funding opportunities and follow-on opportunities.

MVP contracts

REPORT: All workshop outputs and background materials must be compiled into an easily accessible Community Resilience Building final report or summary of findings, based on a template provided by the state.

LISTENING SESSIONS: As an immediate next step, each community must complete at least one public listening session with the whole community invited and should have a clearly articulated list of priority next steps and actions and how to implement these.

Maintaining MVP Designation

Each municipality must provide the Commonwealth with a yearly progress report outlining the steps they have taken towards implementing their priority actions. Steps may include (but are not limited to):

1. applying for grant funding
2. working to implement local changes to policies or bylaws
3. updating existing local plans using the outcomes of the workshop, etc.

A progress report template will be provided to the municipality to help them complete this requirement.

Municipal Staff Commitment: 80 hours

The municipality must provide sufficient staff time (estimated at 80 hours) to assuring completion of this planning exercise and community engagement. Staff time provided by the municipality will include the following activities:

- Procure a state certified MVP provider
- Establish a core team within the town or region to steer the project;
- Coordinate, schedule, send invitations and attend planning meetings and several workshops;
- Work with MVP service provider to identify and engage stakeholders;
- Help coordinate staff interviews to collect information prior to the workshops;
- Help the MVP provider find relevant data and other information useful to conducting the planning exercise
- Provide access to relevant planning documents, budget information, and other information as needed;
- Commit to working to continue municipal outreach and engagement, use the completed plan to inform existing planning and project activities, and secure additional data and information needed to improve the plan.
- Find volunteers to serve as scribes during the sessions

Provider Tasks: Total Time Estimate = 120-140 hours

1. Meet with Municipal Project Manager to set out project scope, timeline, and compile list of data needs; help with stakeholder mapping; set schedule for workshops
2. Meet with Community Core team 1x to help plan for workshop and collect information
3. Conduct several interviews with key municipal staff
4. Prepare materials for workshop including:
   - Basemaps of town with critical layers
   - Climate change data relevant to the town and summary of potential impacts
   - Relevant planning documents and other existing town information about current hazards
   - Risk matrix
5. Serve as the lead facilitator during workshop and bring 4-5 lower level staff to assist as table facilitators. Designate town leads to be scribes at each table
6. Document all workshop outcomes and prepare final risk matrix and summary reports.
7. Work with town to submit all materials to Commonwealth.

State Certified Service Providers

- **Municipal experience** in Massachusetts
- **Community planning/facilitation** experience
- Experience working on **climate change vulnerability assessments**, risk assessment or hazard mitigation
- **GIS**

Please partner to fill any gaps!

Integrated with A State Website

1. State website provides critical structure for process
2. Provides climate data
3. Provides geospatial data at the town level
4. Runs vulnerability assessment
5. Connects to adaptation actions and grant opportunities
6. Specifically designed for cities and towns

Overview of Stow's Hazard Mitigation Plan

Joe Landry, Stow Fire Chief

Geosyntec consultants

Day 1 Agenda

- Workshop Overview ✓
- Presentation on Science and Resources
- Instructions for Small Team Exercise
- Small Group Exercise – Characterize Hazards
- Report Outs
- Small Group Exercise – Identify Vulnerabilities and Strengths: Infrastructure, Societal, Environmental
- Report Outs
- Summary Discussion
- Wrap Up

Overview Presentations – Day 1

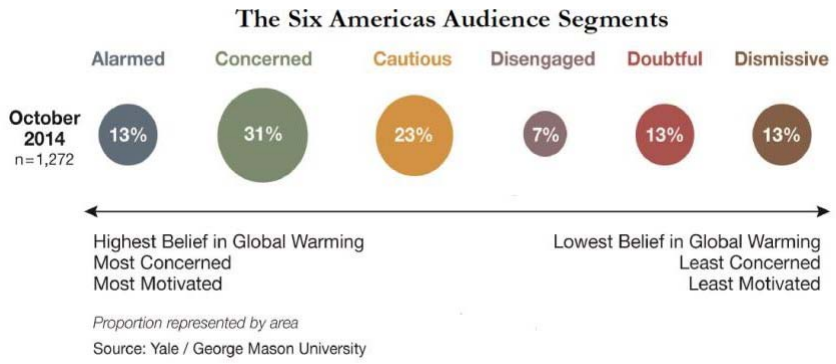
Climate Change 101
Stow-Specific Climate Projections
Workshop Map Resources
Stakeholder Interview Results

Geosyntec consultants

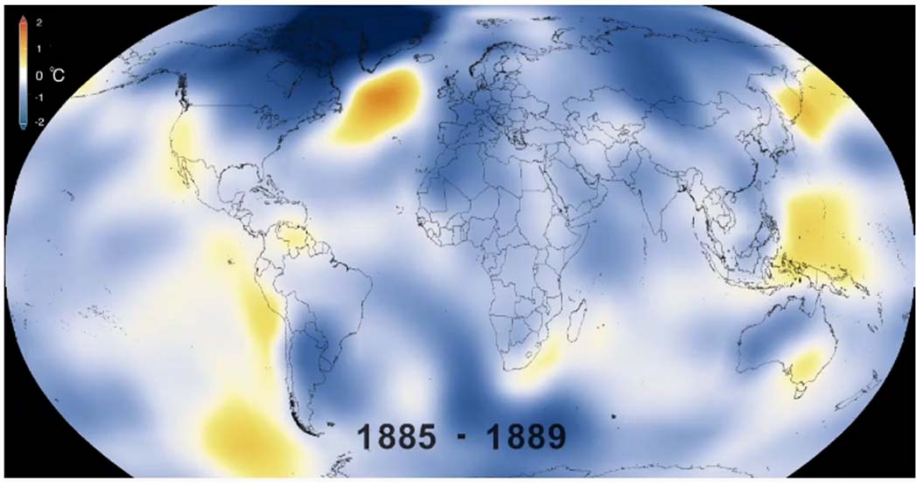
Climate Change 101

Geosyntec consultants

There is an enormous range of perceptions around climate change.



Observed Change: Temperature



Source: https://svs.gsfc.nasa.gov/4419

Finding Common Ground on Climate Change

Common Values:

- ***Protect*** our natural resources for *future generations* and *public health*.
- ***Responsibly manage*** our natural and fiscal resources.
- ***Sense of place*** encourages people to invest locally and overcome challenges.

Preparing for climate change through low-impact development satisfies each of those values.

Recommended Resources: Yale Project on Climate Communication, Frameworks Institute, Center for Research on Environmental Decisions – Columbia University

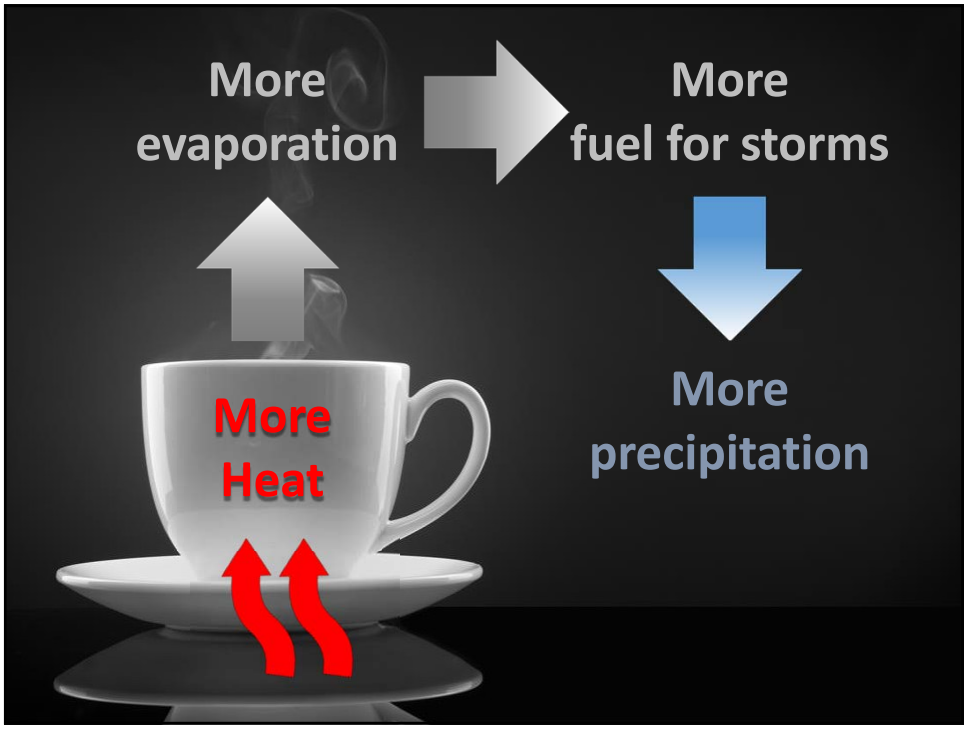
There are real solutions.

One of the best adaptation practices is preserving natural areas.

How Does Climate Change Work?

The heat-trapping blanket metaphor.

- The atmosphere is like a blanket that surrounds the earth.
- When we burn fossil fuels like coal and oil for energy, we add too much carbon dioxide to the atmosphere, which is like making the blanket thicker.
- The blanket has become too thick. It's trapping in too much heat, and the planet is warming up too fast.



More Precipitation

Total annual precipitation has increased by:

15%

***1.2 trillion more gallons* of water or equivalent snow falling on Massachusetts each year.**

~9,700 filled Prudential Towers

Changes are calculated from a linear regression of annual totals from 1895-2015, 1901-2000 reference period.

Source: NOAA

Massachusetts
Key Observed Climate Changes

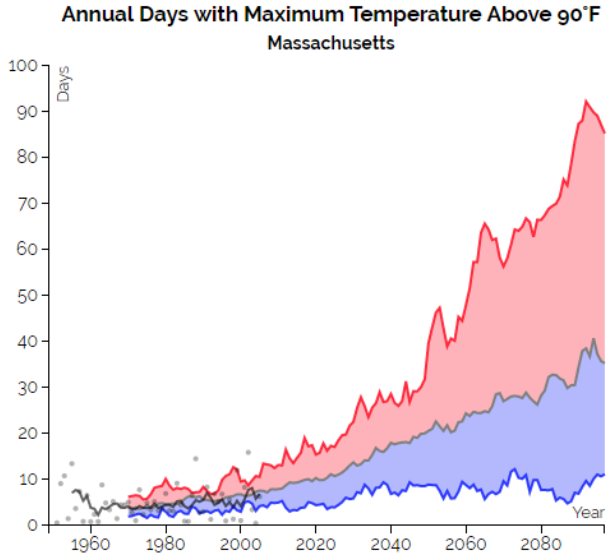
Temperature: **2.8°F** Since 1895

Growing Season: **10 Days** Since 1950

Sea Level Rise: **10.4 inches** Since 1922

Strong Storms: **71%** Since 1958

Days Greater than 90 Degrees



GEOSYNTEC CONSULTANTS

Stow-Specific Climate Projections

Geosyntec consultants

Resilient MA

- Climate Change Clearing House for the Commonwealth
  - http://resilientma.org/

Stow Specific Climate Projections

Average Temperature

- Baseline:
  - 49ºF
- Expected Increase by 2050:
  - 2.88 to 4.37ºF
- Expected Increase by 2100
  - 3.76 to 10.94º F
- Increases expected all seasons

GEOSYNTEC CONSULTANTS

Temperature 1

SuAsCo Basin		Observed Baseline 1971-2000 (°F)	Projected Change in 2030s (°F)	Mid-Century Projected Change in 2050s (°F)	Projected Change in 2070s (°F)	End of Century Projected Change in 2090s (°F)
Average Temperature	Annual	48.73	+2.18 to +4.37	+2.88 to +6.32	+3.47 to +9.03	+3.76 to +10.94
	Winter	27.35	+2.23 to +4.90	+2.83 to +7.25	+3.57 to +8.89	+4.01 to +10.23
	Spring	46.84	+1.67 to +3.46	+2.49 to +5.67	+2.66 to +7.92	+3.23 to +9.63
	Summer	69.51	+2.09 to +4.40	+2.74 to +6.91	+3.20 to +10.16	+3.73 to +12.69
	Fall	50.81	+2.21 to +5.02	+3.66 to +6.59	+3.47 to +9.49	+3.97 to +11.74
Maximum Temperature	Annual	59.59	+2.02 to +4.11	+2.66 to +6.28	+3.16 to +9.08	+3.42 to +10.87
	Winter	37.25	+1.85 to +4.42	+2.46 to +6.73	+2.97 to +8.13	+3.37 to +9.36
	Spring	57.9	+1.58 to +3.43	+2.26 to +5.59	+2.59 to +8.04	+3.17 to +9.71
	Summer	80.73	+1.90 to +4.46	+2.62 to +7.06	+3.10 to +10.46	+3.57 to +12.97
	Fall	62.05	+2.37 to +4.79	+3.56 to +6.83	+3.32 to +9.62	+3.81 to +12.13
Minimum Temperature	Annual	37.86	+2.27 to +4.64	+3.13 to +6.41	+3.77 to +8.96	+4.10 to +11.01
	Winter	17.45	+2.49 to +5.47	+3.25 to +7.76	+4.12 to +9.62	+4.55 to +10.91
	Spring	35.79	+1.76 to +3.71	+2.66 to +6.02	+2.81 to +7.74	+3.29 to +9.51
	Summer	58.28	+2.11 to +4.49	+2.86 to +7.18	+3.30 to +9.86	+3.91 to +12.40
	Fall	39.56	+2.11 to +5.16	+3.60 to +6.56	+3.62 to +9.26	+4.14 to +11.62

GEOSYNTEC CONSULTANTS

Days Greater than 90 Degrees

- Baseline
  - 8 days
- Expected Increase by 2050:
  - 10 to 35 days
- Expected Increase by 2100
  - 15 to 76 days
- Most increases expected in summer

GEOSYNTEC CONSULTANTS

Temperature 2

SuAsCo Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Days with Maximum Temperature Over 90°F	Annual	8.07	+7.24 to +20.03	+10.13 to +35.14	+12.20 to +56.37	+14.48 to +76.25
	Winter	0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00
	Spring	0.5	+0.05 to +0.77	+0.28 to +1.74	+0.35 to +2.97	+0.23 to +5.00
	Summer	7.21	+6.54 to +17.38	+8.50 to +29.80	+10.77 to +45.90	+12.66 to +59.87
	Fall	0.36	+0.42 to +2.15	+0.79 to +4.79	+0.58 to +8.98	+1.10 to +12.13
Days with Maximum Temperature Over 95°F	Annual	0.75	+2.02 to +8.21	+3.06 to +16.75	+3.91 to +31.59	+5.51 to +48.44
	Winter	0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00
	Spring	0.03	+0.03 to +0.24	+0.02 to +0.47	+0.05 to +1.08	+0.06 to +1.95
	Summer	0.71	+1.86 to +7.70	+2.75 to +15.30	+3.44 to +28.30	+5.16 to +42.21
	Fall	0.01	+0.07 to +0.61	+0.09 to +1.24	+0.14 to +3.25	+0.24 to +4.72
Days with Maximum Temperature Over 100°F	Annual	0.02	+0.20 to +2.03	+0.32 to +4.87	+0.58 to +11.71	+0.60 to +21.91
	Winter	0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00
	Spring	0.00	+0.00 to +0.02	+0.00 to +0.04	+0.00 to +0.20	+0.00 to +0.45
	Summer	0.02	+0.21 to +1.91	+0.29 to +4.70	+0.52 to +10.99	+0.60 to +20.34
	Fall	0.00	+0.00 to +0.08	+0.00 to +0.21	+0.00 to +0.55	+0.00 to +1.01

GEOSYNTEC CONSULTANTS

Days Less than 32 Degrees

- Baseline
  - 143 days
- Expected Decrease by 2050:
  - 19 to 40 days
- Expected Decrease by 2100
  - 24 to 64 days
- Most decreases expected in winter and fall

GEOSYNTEC CONSULTANTS

Temperature 3

SuAsCo Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Days with Minimum Temperature Below 0°F	Annual	5.96	-1.61 to -3.54	-2.03 to -4.25	-2.23 to -4.57	-2.25 to -4.73
	Winter	5.93	-1.63 to -3.34	-2.00 to -4.05	-2.22 to -4.42	-2.23 to -4.57
	Spring	0.03	-0.26 to +0.03	-0.01 to -0.27	-0.01 to -0.32	-0.01 to -0.29
	Summer	0.00	-0.00 to -0.00	-0.00 to -0.00	-0.00 to -0.00	-0.00 to -0.00
	Fall	0.00	-0.00 to -0.00	-0.00 to -0.00	-0.00 to -0.00	-0.00 to -0.00
Days with Minimum Temperature Below 32°F	Annual	143.36	-11.90 to -27.94	-19.26 to -39.80	-22.36 to -55.02	-24.35 to -64.94
	Winter	83.01	-2.19 to -6.66	-3.27 to -11.19	-4.93 to -19.68	-5.77 to -24.53
	Spring	33.93	-3.32 to -11.44	-6.76 to -14.98	-8.06 to -19.33	-8.67 to -20.34
	Summer	0.00	-0.04 to -0.00	-0.04 to -0.00	-0.05 to -0.00	-0.05 to -0.00
	Fall	26.38	-5.23 to -11.1	-8.40 to -13.61	-8.58 to -17.66	-8.19 to -19.77

GEOSYNTEC CONSULTANTS

Temperature 4

SuAsCo Basin		Observed Baseline 1971-2000 (Degree-Days)	Projected Change in 2030s (Degree-Days)	Mid-Century Projected Change in 2050s (Degree-Days)	Projected Change in 2070s (Degree-Days)	End of Century Projected Change in 2090s (Degree-Days)
Heating Degree-Days (Base 65°F)	Annual	6534.66	-543.72 to -1137.18	-749.60 to -1586.93	-872.65 to -2093.75	-983.52 to -2459.88
	Winter	3406.17	-193.54 to -454.48	-250.62 to -669.31	-316.34 to -807.48	-368.77 to -941.56
	Spring	1694.75	-136.54 to -293.20	-206.58 to -473.07	-225.41 to -619.25	-284.35 to -726.21
	Summer	90.35	-29.17 to -55.74	-40.30 to -72.21	-47.07 to -80.96	-48.42 to -83.98
	Fall	1340.41	-166.26 to -374.01	-279.18 to -460.66	-262.08 to -639.19	-276.44 to -731.23
Cooling Degree-Days (Base 65°F)	Annual	585.03	+216.39 to +456.32	+284.68 to +771.17	+342.54 to +1196.87	+397.57 to +1581.57
	Winter	nan	-0.64 to +2.13	+0.04 to +2.24	+0.81 to +3.49	+1.52 to +3.80
	Spring	25.38	+12.29 to +31.14	+20.23 to +61.91	+23.71 to +105.36	+22.14 to +143.39
	Summer	505.04	+158.00 to +349.52	+197.02 to +569.20	+238.23 to +859.80	+281.63 to +1086.27
	Fall	49.33	+29.98 to +95.36	+43.76 to +159.37	+51.78 to +253.82	+77.28 to +341.21
Growing Degree-Days (Base 50°F)	Annual	2592.31	+407.83 to +821.76	+546.41 to +1274.32	+642.32 to +1976.40	+729.06 to +2475.28
	Winter	6.27	-0.58 to +10.51	+0.41 to +14.62	+4.00 to +22.78	+3.32 to +28.60
	Spring	314.11	+66.08 to +145.31	+91.86 to +251.45	+108.38 to +398.05	+120.48 to +500.08
	Summer	1794.81	+192.32 to +404.30	+251.12 to +635.57	+293.25 to +934.43	+342.08 to +1166.70
	Fall	469.32	+113.10 to +302.42	+180.27 to +412.20	+170.27 to +621.20	+217.49 to +791.63

Average Precipitation

- Baseline Precipitation:
  - 45 inches
- Expected Increase by 2050:
  - Up to 6 inches (13%)
- Expected Increase by 2100
  - Up to 8 inches (18%)
- Potential decrease in summer and fall

Precipitation 1

SuAsCo Basin		Observed Baseline 1971-2000 (Inches)	Projected Change in 2030s (Inches)	Mid-Century Projected Change in 2050s (Inches)	Projected Change in 2070s (Inches)	End of Century Projected Change in 2090s (Inches)
Total Precipitation	Annual	45.44	+0.16 to +4.84	+0.56 to +6.06	+1.53 to +7.79	+1.23 to +8.01
	Winter	11.15	-0.38 to +2.08	+0.07 to +2.56	+0.45 to +3.20	+0.38 to +4.05
	Spring	11.57	-0.14 to +2.36	+0.02 to +2.08	+0.28 to +2.58	+0.22 to +2.55
	Summer	10.76	-0.18 to +1.53	-0.47 to +2.20	-0.64 to +2.40	-1.13 to +2.15
	Fall	11.97	-1.19 to +1.08	-1.27 to +1.70	-1.78 to +1.57	-1.54 to +1.35

Days with Precipitation > 1 Inch

- Baseline
  - 7 days
- Expected Increase by 2050:
  - 1 to 3 (mostly in winter)
- Expected Increase by 2100
  - 1 to 4 (mostly in winter and spring)
- Potential decrease in summer and fall

Precipitation 2

SuAsCo Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Days with Precipitation Over 1"	Annual	6.84	+0.23 to +1.99	+0.64 to +3.35	+1.29 to +2.88	+1.15 to +4.16
	Winter	1.55	-0.08 to +0.85	+0.19 to +1.18	+0.30 to +1.53	+0.40 to +1.83
	Spring	1.49	-0.08 to +0.72	-0.03 to +0.95	+0.11 to +1.17	+0.13 to +1.33
	Summer	1.59	-0.13 to +0.56	-0.02 to +0.92	-0.10 to +0.79	-0.20 to +0.71
	Fall	2.22	-0.25 to +0.76	-0.13 to +0.96	-0.27 to +0.78	-0.38 to +0.96
Days with Precipitation Over 2"	Annual	0.61	-0.05 to +0.41	+0.07 to +0.52	+0.04 to +0.49	+0.09 to +0.64
	Winter	0.05	-0.02 to +0.07	-0.02 to +0.08	-0.01 to +0.09	-0.01 to +0.13
	Spring	0.04	-0.02 to +0.12	+0.01 to +0.15	-0.02 to +0.17	-0.01 to +0.29
	Summer	0.27	-0.08 to +0.15	-0.03 to +0.22	-0.08 to +0.17	-0.06 to +0.22
	Fall	0.25	-0.09 to +0.27	-0.07 to +0.26	-0.04 to +0.21	-0.10 to +0.24
Days with Precipitation Over 4"	Annual	0.04	-0.03 to +0.07	-0.02 to +0.07	-0.04 to +0.07	-0.04 to +0.15
	Winter	0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00
	Spring	0.00	+0.00 to +0.00	+0.00 to +0.01	+0.00 to +0.00	+0.00 to +0.01
	Summer	0.01	-0.02 to +0.04	-0.01 to +0.04	-0.01 to +0.05	-0.02 to +0.06
	Fall	0.02	-0.03 to +0.07	-0.03 to +0.05	-0.03 to +0.05	-0.03 to +0.09

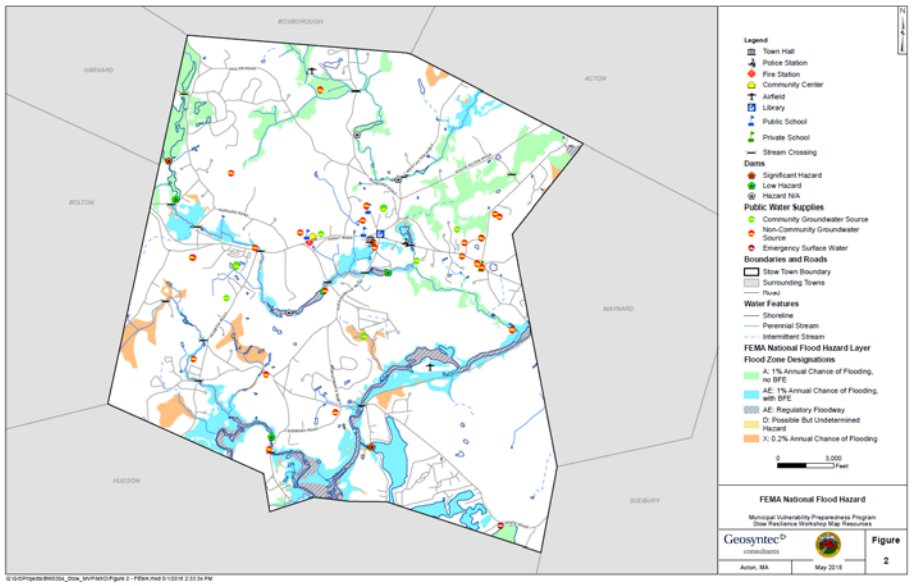
Precipitation 3

SuAsCo Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Consecutive Dry Days	Annual	16.83	-0.55 to +1.41	-0.40 to +1.98	-0.88 to +2.26	-0.72 to +2.5
	Winter	11.64	-0.90 to +1.21	-0.74 to +1.39	-1.05 to +1.70	-1.13 to +1.70
	Spring	11.04	-1.16 to +0.81	-1.20 to +0.96	-1.46 to +1.09	-1.17 to +0.83
	Summer	12.34	-0.81 to +1.60	-0.74 to +2.42	-1.26 to +2.73	-0.99 to +2.06
	Fall	12.22	-0.01 to +1.94	-0.19 to +2.65	-0.27 to +3.05	-0.03 to +3.13

Workshop Map Resources

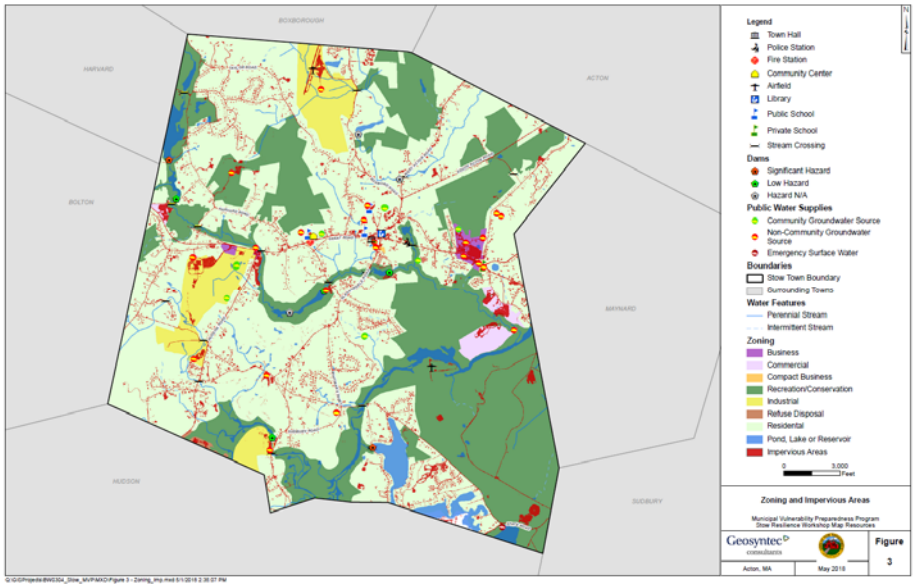
Geosyntec consultants

FEMA Flood Hazard Layer



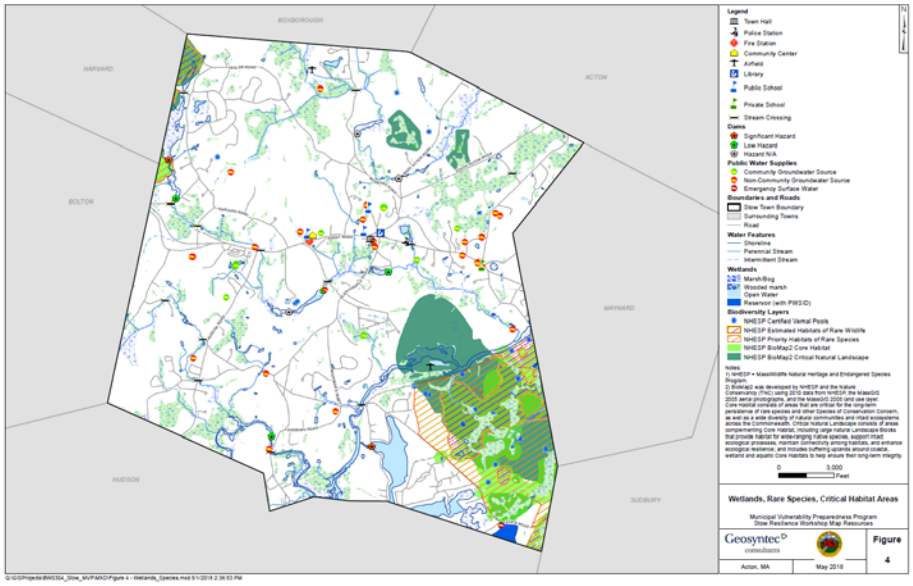
GEOSYNTEC CONSULTANTS

Zoning / Impervious Areas



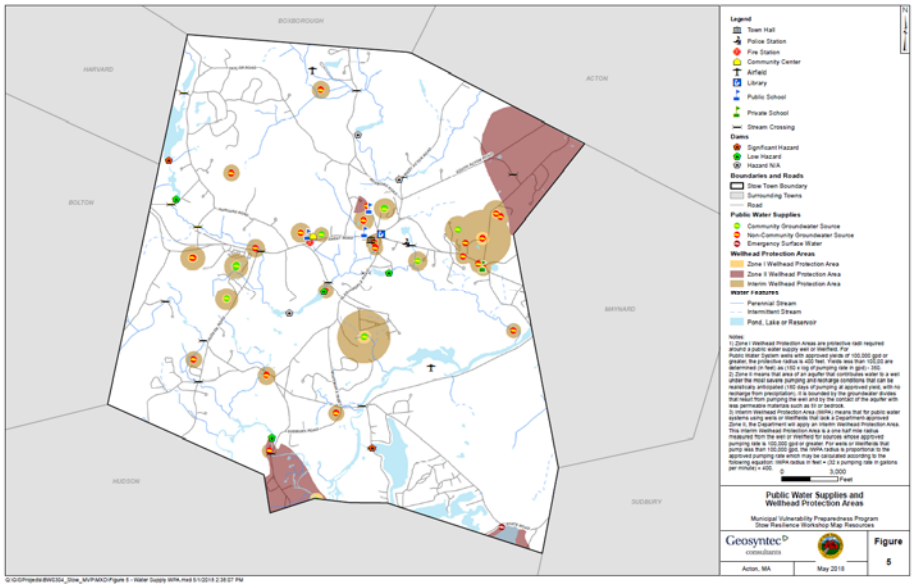
GEOSYNTEC CONSULTANTS

Critical Habitat Areas



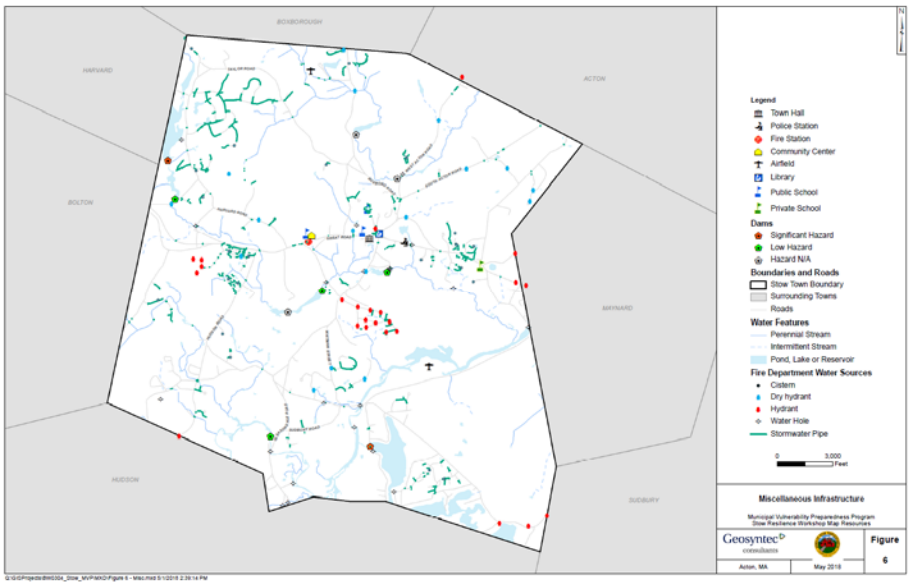
GEOSYNTEC CONSULTANTS

Public Water Supply Protection Areas



GEOSYNTEC CONSULTANTS

Misc. Infrastructure



GEOSYNTEC CONSULTANTS

Stakeholder Interview Results

Geosyntec consultants

Stakeholder Interview Results

- Vulnerabilities:

Water Supply
- Dry Wells
- Fire Fighting Capacity

Infrastructure
- Power outages

Flooding
- Isolation of some areas

Agriculture
- Extreme Events – Drought, Untimely Frost, etc.

Stakeholder Interview Results

- Strengths:

Conservation Land
- Preserve & Protect!

Emergency Response
- Communication

Small Team Exercise

Objective: To provide overview of small team exercise (Steps B – C).

Geosyntec consultants

Characterize Hazards (Step B)

- *Objective: Develop top **three hazards** for facilitated discussions on vulnerabilities and strengths of the community's people, infrastructure, departments, supply chain, and natural resources among others.*
- Table introductions, identify team spokesperson, review Risk Matrix and maps
- Identify Top 3 Hazards
  - Time: ~10-15 min
- Report out to large group
  - Time: ~10-15 min
- Break

GEOSYNTEC CONSULTANTS

Identity Vulnerabilities and Strengths (Step C)

- *Objective: Develop **comprehensive understanding** or profile of the community's infrastructural, societal, and environmental **components that are impacted by the Top 3 Hazards.***

1. Begin in first row/column of sector (i.e., infrastructure, societal, environmental) and identify vulnerability (e.g., port facility, neighborhood, wetland) and strengths (e.g., new Emergency Operation Center, generators, wetlands).
2. Determine location of vulnerability/strength and list on Risk Matrix and mark on Base Map.
3. Identify ownership of issue or place.
4. Identify if feature/asset is a strength and/or vulnerability.

GEOSYNTEC CONSULTANTS

Identity Vulnerabilities and Strengths (Step C)

Examples of Vulnerabilities:

- Main road floods during storms, blocking emergency response.
- Power outages during heat waves lead to health concerns.
- Wildfire and high winds resulting in supply chain interruptions.
- Sewer pump stations become submerged and inoperable.
- Compromised rail system due to heat-related warping of tracks.

Examples of Strengths:

- Critical road elevated and passable by emergency management.
- Hurricane roof installed at school with improved sheltering capacity.
- Hardened utility lines reduce outages due to ice storms.
- Undersized culvert replaced to reduce flooding in key intersection.
- Improvement to communication systems during extreme weather.

GEOSYNTEC CONSULTANTS

Identity Vulnerabilities and Strengths (Step C)

- Complete Risk Matrix Elements
  - Time: ~60-80 min
- Break
- Report out to large group
  - Time: ~20-25 min
- Summary Discussion

GEOSYNTEC CONSULTANTS

Ground Rules!

- Contribute
- Let everyone participate
- Listen with an open mind
- Stay on point and on time
- Attack the problem, not the person!

Table Facilitators

- David Roman – Geosyntec Consultants, Inc.
- Hayley O'Grady – Geosyntec Consultants, Inc.
- Kate Barrett – Regina Villa Associates

Small Group Exercise

Geosyntec consultants

Wrap Up and Next Steps

- **Next Workshop:** 17 May 2018, 8 am to 12 pm
- **Agenda:**
  - Registration
  - Welcome & Introductions
  - Workshop Overview
  - Presentation on Low Impact Development
  - Group Break Out - Identify and Prioritize Actions
  - Summary Discussion and Wrap-Up

Thank you for your time! See you next week!

MVP Workshop Day 2

Geosyntec consultants

Welcome!

- Welcome
  - Jesse Steadman, Town Planner
- Core Team and Facilitation Team Introduction
  - Valerie Oorthuys, Assist. Planner
  - Jacquie Goring, Conservation Agent

Workshop Overview

Objective: To frame the issue in context of local, regional risk and resiliency.

Geosyntec consultants

Municipal Vulnerability Preparedness (MVP)



State and local partnership to build resiliency to climate change

1. Engage Community
2. Identify CC impacts and hazards
3. Complete assessment of vulnerabilities & strengths
4. Develop and prioritize actions
5. Take Action

Empowering Communities & Informing Statewide Action

- **Community-led process**
- **Accessibility**
- **Partnerships** and leveraging existing efforts
- **Communities** as local innovators
- **Frame** coordinated statewide efforts.

1. Engage Community
2. Identify CC impacts and hazards
3. Complete Assessment of Vulnerabilities & Strengths
4. Develop & Prioritize Actions
5. Take Action

Workshop Purpose

Complete a baseline climate change and natural hazard vulnerability assessment, and to develop specific actions for dealing with priority hazards using the Community Resilience Building (CRB) workshop guide

GEOSYNTEC CONSULTANTS

Revisit Day 1

- Workshop Overview
- Stow Hazard Mitigation Plan Overview
- Presentation on Science and Resources
  - Climate Change 101
  - Stow-Specific Climate Projections
  - Workshop Map Resources
  - Stakeholder Interview Results
- Identified our Top 3 Priority Hazards (Step B)
- Characterized Vulnerabilities and Strengths: Infrastructure, Societal, Environmental (Step C)

Day 2 Agenda

- Workshop Overview ✓
- Presentation on Low Impact Development
- Instructions for Small Team Exercise
- Small Group Exercise – Identify and Prioritize Community Actions (Step D)
- Report Outs
- Identify Top Priorities as a Large Group (Step E)
- Wrap Up

Overview Presentations – Day 2

Introduction to Low Impact Development

Geosyntec consultants

Overview of Green Infrastructure and other Nature-Based Solutions



Geosyntec consultants

Overview

1. Nature Based Solutions Overview
2. Green Infrastructure Practices & Examples
3. Other Nature Based Solutions

Nature-Based Solutions

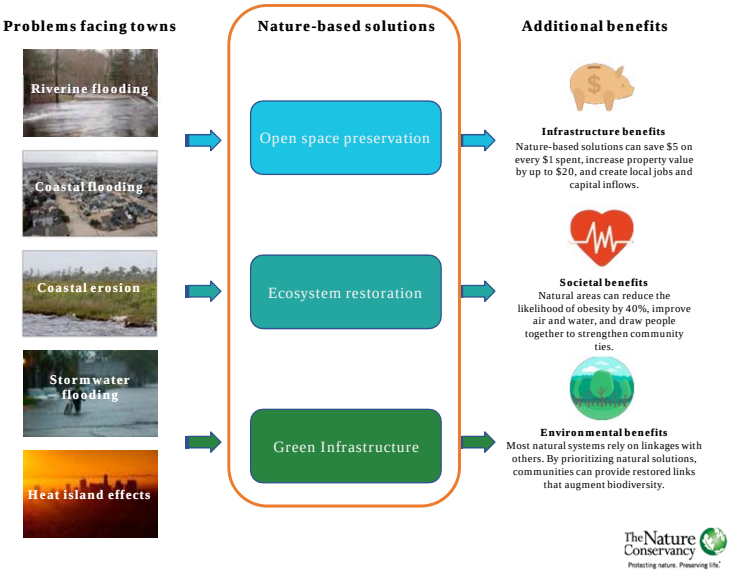
Nature-Based Solutions

Nature-Based Solutions *use* natural systems, *mimic* natural processes, or *work in tandem with* traditional approaches to address natural hazards like flooding, erosion, drought, and heat islands.

Incorporating nature-based solutions in local planning, zoning, regulations, and built projects can help communities reduce their exposure to these impacts, resulting in reduced costs, economic enhancement, and safer, more resilient communities.

The Nature Conservancy
Protecting nature. Preserving life.

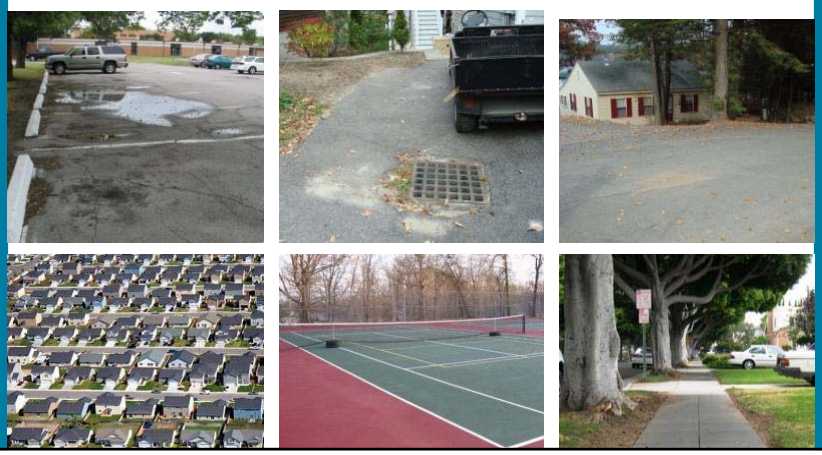
Nature-Based Solutions



Green Infrastructure (GI)

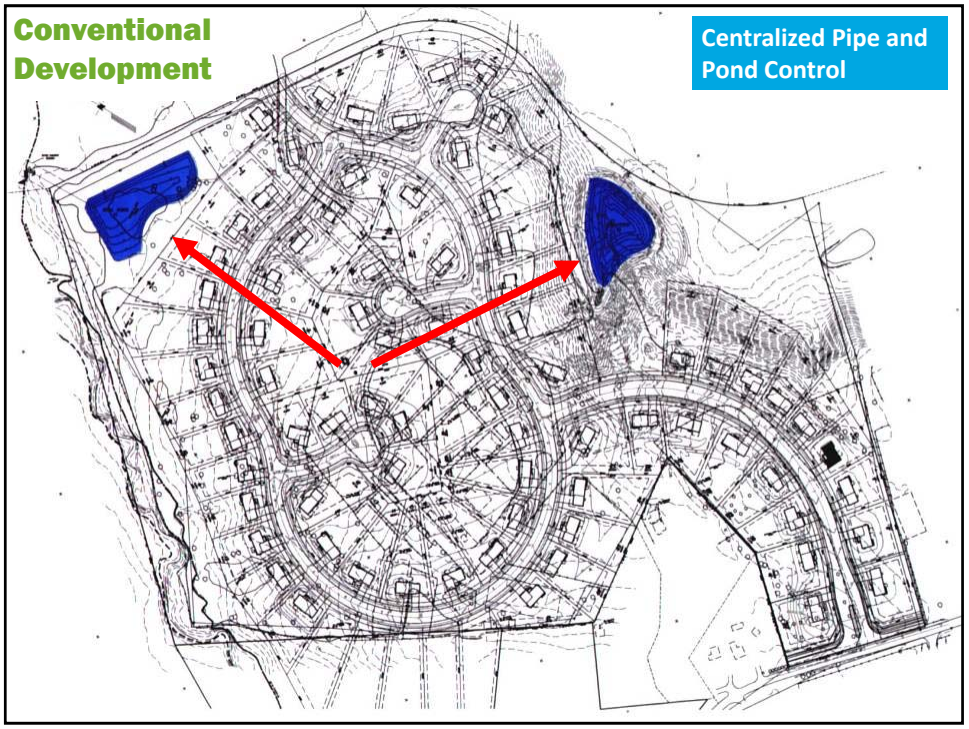
An ecosystem-based approach to land development and stormwater management

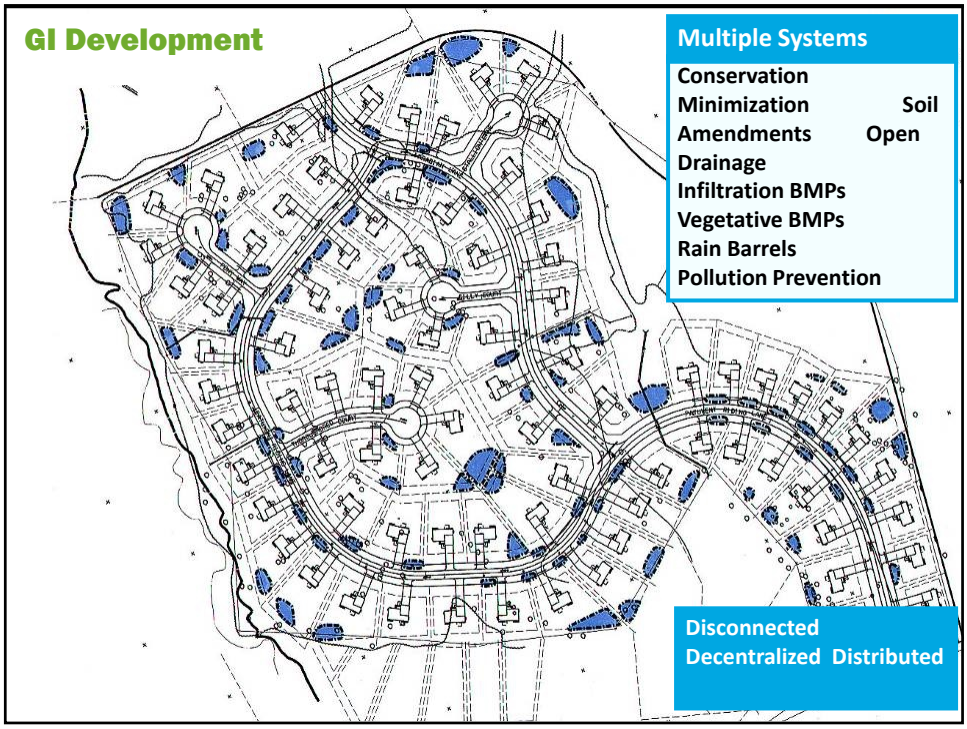
Mimic pre-development site hydrology



Basic GI Principals

- Conserve natural areas
- Minimize development impacts
- Maintain site runoff rate
- Use integrated stormwater management practices
- Implement pollution prevention, proper maintenance and public education programs





2. GI Practices & Examples

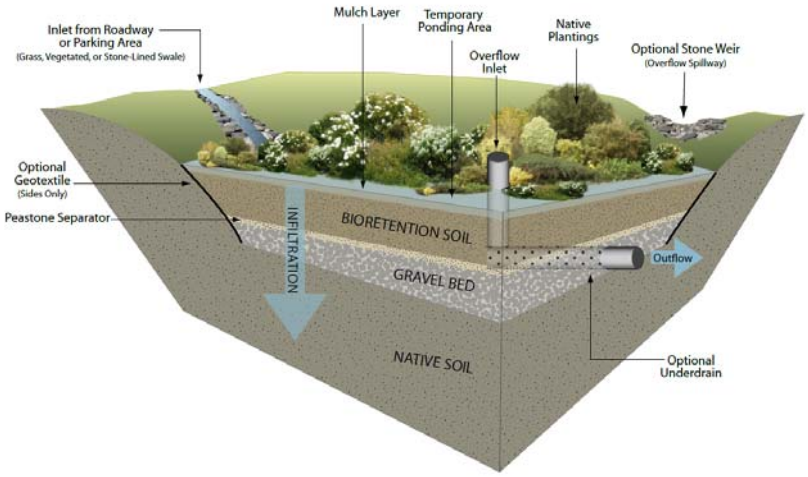
Raingardens

A bowl-shaped garden designed to capture and absorb stormwater.

Bioretention

Similar to raingarden, more highly engineered:

- underdrain/riser pipe
- gravel bed
- engineered soils




SEP 14 2005


KIVLIN
MOORE
09.15.2005 10:50


SEP 14 2005


AUG 1 2005

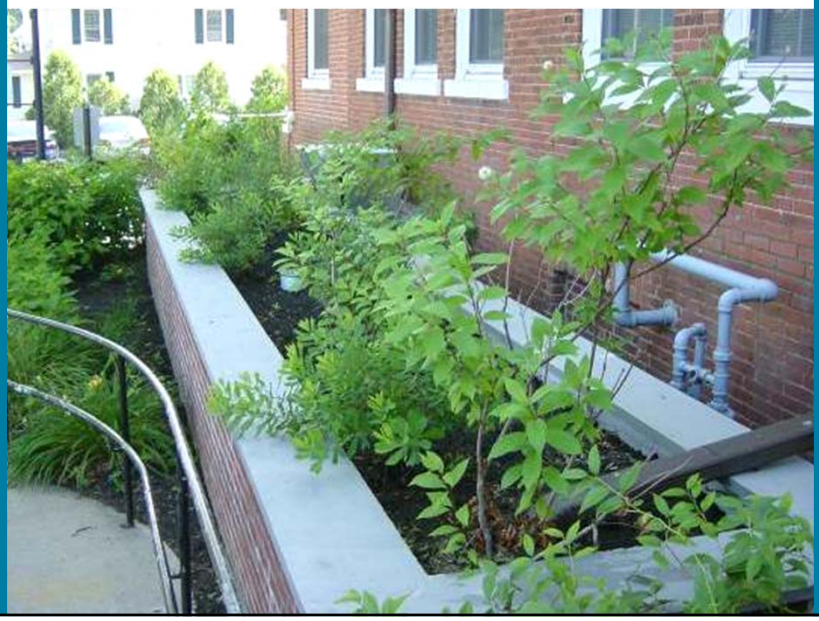

Bioretention cell with overflow

Vegetated Buffers

- Pollutant Uptake /Filtering
- Habitat / Wildlife Food Source
- Shading
- Aesthetics
- Physical deterrent to geese

Lake Shirley, Lunenburg, MA

Infiltrating Planter Box for Roof Runoff (Plymouth, MA)



Rain Barrels

- For capture/re-use of roof runoff
- Most barrels average 60 gallons and cost $75 - $125
- Cisterns are much larger systems, often involving pumps and drywell structures.

Porous Pavements (Wilmington MA)

- Interlocking Concrete Pavers
- Porous Asphalt / Concrete
- Flexipave

3. Other Techniques

Floodplain Buyout:Woloski Park, Middleborough,MA

- 10 homes in Taunton River floodplain
- Buyout funded by FEMA's Hazard Mitigation Grant Program (HMGP). Total cost ~$1,003,745, with FEMA grant covering 75%
- Resilience benefits:
  -Avoided emergency evacuation and property recovery costs.
- Additional benefits
  -High quality habitat is restored, floodplain and ecosystem services recovered.

The Nature Conservancy
Protecting nature. Preserving life.

Swansea Marsh and Habitat Preservation: Conservation

http://wildlandstrust.org/news/2016/3/1/publicprivate-partnership-saves-22-acr

- 37 Acres purchased and conserved by the Town of Swansea, Wildlands Trust, and Blount Fine Foods in the Palmer River Corridor for $110,000.
- Major storms in 2010 and 2012 damaged stormwater and transportation infrastructure.
- Resilience Benefits:
  - Dissipated energy from storm, tide, and flood events
  - Avoided cost of infrastructure repair and replacement
- Additional Benefits:
  - Protected water quality
  - Future marsh migration

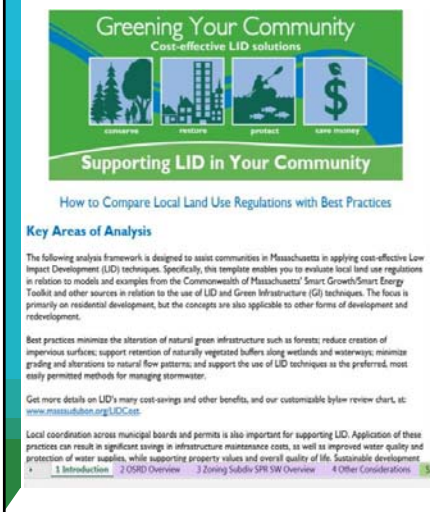
The Nature Conservancy
Protecting nature. Preserving life.

Mill River: Whittenton Dam Removal, Taunton, MA

Whittenton Mill Dam was removed in 2013

- Costs
  - Estimated Cost of Dam Repair = $1.9 Million
  - Ongoing Cost of Dam maintenance = variable
  - 2005 Evacuation Costs = $1.5 Million
  - Dam Removal Costs = $440,000
- Benefits
  - Increased revenue from river based recreation
  - Increased Property Values
  - Water quality benefits

The Nature Conservancy
Protecting nature. Preserving life.



Review bylaws, ordinances, zoning, and other considerations for overall site design, LID project standards, and maintenance and operations considerations.

The Nature Conservancy
Protecting nature. Preserving life.

The power of a bylaw: Westford

- Adopted a Conservation Subdivision bylaw in 1978
- Requires conservation and conventional plans

Benefits

- 1,700 Acres of land Protected
- Preserved local habitat and water resources
- Created 13 miles of hiking trails & public recreation
- Town saved millions of dollars

The Nature Conservancy
Protecting nature. Preserving life.

Thanks for your time!

Any questions?

Geosyntec consultants

engineers | scientists | innovators

Small Team Exercise

Objective: To provide overview of small team exercise (Steps D - E).

Geosyntec consultants

Identity and Prioritize Actions (Step D)

- *Objective: Identify and prioritize actions **to help reduce vulnerability or reinforce strengths** for each of the Top 3 Hazards.*
- Table introductions, identify team spokesperson, review Risk Matrix and maps
- Step C - Revisit agreement reached on vulnerabilities and strengths, locations on Base Map and ownership of features/assets identified in Workshop #1.
- Step D - For Infrastructure – Societal – Environmental begin on the right side of risk matrix – "actions".
  - Under Hazards column identify the actions needed to reduce the vulnerability or reinforce the strength represented by each feature/asset.
  - Fill in rows **leaving the final two columns of the Risk Matrix (Priority and Time) empty until end.**

Identity and Prioritize Actions (Step D/E)

- Complete Risk Matrix Elements (Step D)
  - Time: ~50-60 min
- Break
- Complete Risk Matrix Elements - Step D (continued) and Step E
  - Time: ~40 min
- Break
- Report out to large group
  - Time: ~20-25 min
- Summary Discussion – Identify Top Priorities

Ground Rules!

- Contribute
- Let everyone participate
- Listen with an open mind
- Stay on point and on time
- Attack the problem, not the person!

Table Facilitators

- David Roman – Geosyntec Consultants, Inc.
- Hayley O'Grady – Geosyntec Consultants, Inc.
- Kate Barrett – Regina Villa Associates

Examples

More examples of actions:

- Improved access in high-risk locations
- Reduce housing stock in vulnerable areas
- Prioritize development in low-risk areas
- Integrate future risks in capital improvement plans
- Flood-proof manhole covers
- Secure new generators for critical facilities

Small Group Exercise

Geosyntec consultants

Determine the Overall Priority Actions (Step E)

- *Objective: Develop **agreement on the highest priority actions across profiles** that help reduce vulnerability or reinforce strength resulting in greater community resilience.*
- Final Step D: In the last two columns identify the priority (High, Medium, Low) and the urgency (ongoing, short-term, long-term) for each action.
  - Consider the priority and urgency of each potential action in the context of the full suite of potential actions originated by the small team.
- Step E: Identify 3-4 priority actions for small team.

Examples

When prioritizing, consider factors such as:

- Funding availability and terms
- Agreement on outstanding impacts from recent hazard events
- Necessity for advancing longer-term outcomes
- Contribution towards meeting existing local and regional planning objectives

Examples of urgency:

- Current project to install hurricane-proof roof on school is an ongoing **(O)** action.
- Ensuring evacuation procedures are updated annually is considered a short-term **(S)** action.
- Reducing housing stock in high-risk areas, elevating a road, or replacing a bridge are long-term **(L)** actions.

Identify Top 3 Priority Actions
Large Group Exercise

Geosyntec consultants

Summary Discussion

- Next Steps
  - Develop Report
  - Hold Listening Session
  - Become MVP Community!!
- MVP process is not static!
  - Make progress towards your goals
  - Submit yearly progress reports

APPENDIX B: COMPLETED RISK MATRICES

Small Group Risk Matrix – Blue Team

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.org

H-**M**-**L** priority for action over the **S**hort or **L**ong term (and **O**ngoing)
V = Vulnerability **S** = Strength

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

Features	Location	Ownership	V or S	Drought	Strong Storms	Extreme Temperatures	-	Priority H - M - L	Time S hort L ong O ngoing
Infrastructural									
Fire Fighting Cisterns (certified vs. noncertified) & Surface Water Sources	Townwide	Town of Stow	V/S	Wet ponds for new devel. Improve distribution	N/A	-		M	L
Private Drinking Water Wells (no backup supply)	Townwide	Private	V	Identify comm. Point person	Study to ID & prioritize vulnerable wells	N/A		H	S
Road Closures, Isolated Neighborhoods, Trees Down	Multiple	Town of Stow/ Private	V	N/A	Town bylaws to connect roads	N/A		H	O/S
Local Electrical Power (mutual aide)	Townwide	Town of Stow	S	N/A	Maintain strong partnership	N/A		M	O
Nuisance Flooding (beaver dams, grades)	Lower Village/ Beaver Dams	Town of Stow/ Private	V	N/A	LID integration to complete streets	N/A		L	L
Critical Road Crossing/Bridges	Multiple	Town/State/ Private	V	N/A	Townwide infrastructure assessment (culverts)	N/A		H	S
Societal									
Long Term Viability of Farms	Multiple	Town of Stow/ Private	V	Program to implement new tech. (mitigate frost)	Partner w/ Middlesex Con. Comm.	Low interest loans or state aid		H	O
Elderly Citizens (alerts for storms/warm weather & shelters)	Townwide	Private	V	-	Swift reach education COA partnership	Contact network for HOAs		H	S/O
Aging Populations (demographics)	Townwide	Private	V	-	Functional support services (age friendly)	ARES - communication ham radio locator		H	S/O
Potential Population Influx (buildout)	Townwide	Private	V	Increase cons. land to mitigate build out	-	-		L	L
Regionalized Health Services	Townwide/ Multiple	Town of Stow	S	Expand regional planning to other items (resiliency)	-	-		M	O
Environmental									
Surface Water & Aquifer Depletion (drinking water)	Multiple	Town of Stow	V	Educate public & schools on water management	-	N/A		H	O
Groundwater Recharge	Townwide	Town of Stow/ Private	S	-	Incentives for LID in bylaws	N/A		M	O
Forest Management (tinder, uniform age)	Townwide	Town of Stow/ Private	V	Improved fire road access and commication	Minimum access plan (when, where)	Emergency tree manage. Plan (disease/vectors)		M	L/O
Protected Conservation Land	Multiple	Town of Stow	S	Prioritize habitat and greenway linkage with new conservation Land				L	O
Health Issues (ticks, poison ivy, disease/vectors)	Townwide	Town of Stow/ Private	V	-	-	Deer/wildlife mngmt. And education		H	O
Assabet & Elizabeth Brook (protects upstream wwtp outfalls)	Assabet/ Elizabeth	Town of Stow/ Private	V/S	Rezone Rock Bottom Farm from indust. to conserve.	Gates Lane develop. Emphasize open space	-		M	O

Small Group Risk Matrix – Green Team

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.org

H-**M**-**L** priority for action over the **S**hort or **L**ong term (and **O**ngoing)
V = Vulnerability **S** = Strength

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

Features	Location	Ownership	V or S	Drought	Extreme Temperatures	Strong Storms	-	Priority H - M - L	Time Short Long Ongoing
Infrastructural									
Water Supply for Fire Fighting	Townwide	Town of Stow	V	Cisterns Water Conserv. Bylaws	Additional Fire Hydrants Tree Planting	Low Impact Dev. (LID) GW Source Assessment		H	O
Water Supply for Residents	Lake Boone/ Gleasondale	All Residents/ Town	V	Cistern Educ./Demo Greywater Reuse	Conserve. Bylaws/LID Education Programs	GW Source Assessment		H	L
Resiliency and Redundancy of the Electrical Network	-	Hudson Light & Power	V/S	N/A	Solar on Large Develop. Energy Cons. Incentives	Bury Power Lines Tree Management		M	L
Stromwater Management System	Townwide	Town of Stow	V	LID Bylaws/Incentives School Educ. Programs	"Green" measures to parking lots	Culvert Analysis Raingarden Compete		H	O
Accessibility/Isolation	Gleasondale bridges/stream	Town of Stow State of MA	V/S	N/A	N/A	Plan w/ neighbor towns		L	S/L
Hazard Mitigation Plan	Townwide	Town of Stow	V/S	Update Plan	Update Plan	Update Plan		H	S/L
Societal									
Farm Impacts	Townwide	Private	V	Listen/Inform. Session Water Usage Bylaws	Grant Programs for Ag. BMPs	Partner with Farms		M	O
Impacts on Commercial Development	Lower/West Village/Airport	Private/Town of Stow	V/S	LEED Cert. Buildings	Solar on Buildings/ Parking	LID/min. number of spaces in parking		M	O
Great Road Corridor	Great Road	Town of Stow	V/S	LID/Solar BMPs	-	Tree & Stormwater Management		M	L
Emergency Shelters	Comm. Center Meeting House	Town of Stow	S/V	Cisterns for schools	-	Micro Energy Grid Generators/Alt. Energy		M	O
Vulnerable Populations	Arbor Glen Meeting House	Gleasondale Villages	V	Emergency Planning for assisted living	Alt. Comm. Pathways	Sharing avail. info across departments		M	S
Disease & Vectors	Townwide	Federal Gov't/ Town of Stow	V	N/A	Education Programs Enviro-friendly deterents			L	L
Environmental									
Wetlands/Streams/Water Bodies	Boone/Assabet /Elizabeth	All Residents	V	Water Usage Restrictions	-	Tree management/ reduce cutting/LID		H	O
Aquatic/Terrestrial Species	Boone/Assabet /Elizabeth	All Residents	V	Mandatory alt. conserve. subdivision plan	Land Conservation	Upgrade culverts for wildlife passage		M	L/S
Fires in Isolated Areas	All Conserve. Areas	Town of Stow	V	Forest Mngmt. & controlled burns	Sufficient emergency vehicles to reach areas	N/A		L	O
Ice/Wind Tree Damage	Townwide	Public/Private	V	N/A	Education on tree benefits & species	Tree mngmt./strategic plantings/bury power		M	S
Erosion	Townwide	Public/Private	V	N/A	N/A	LID/tree plantings		M	O

Small Group Risk Matrix – Red Team

Community Resilience Building Risk Matrix

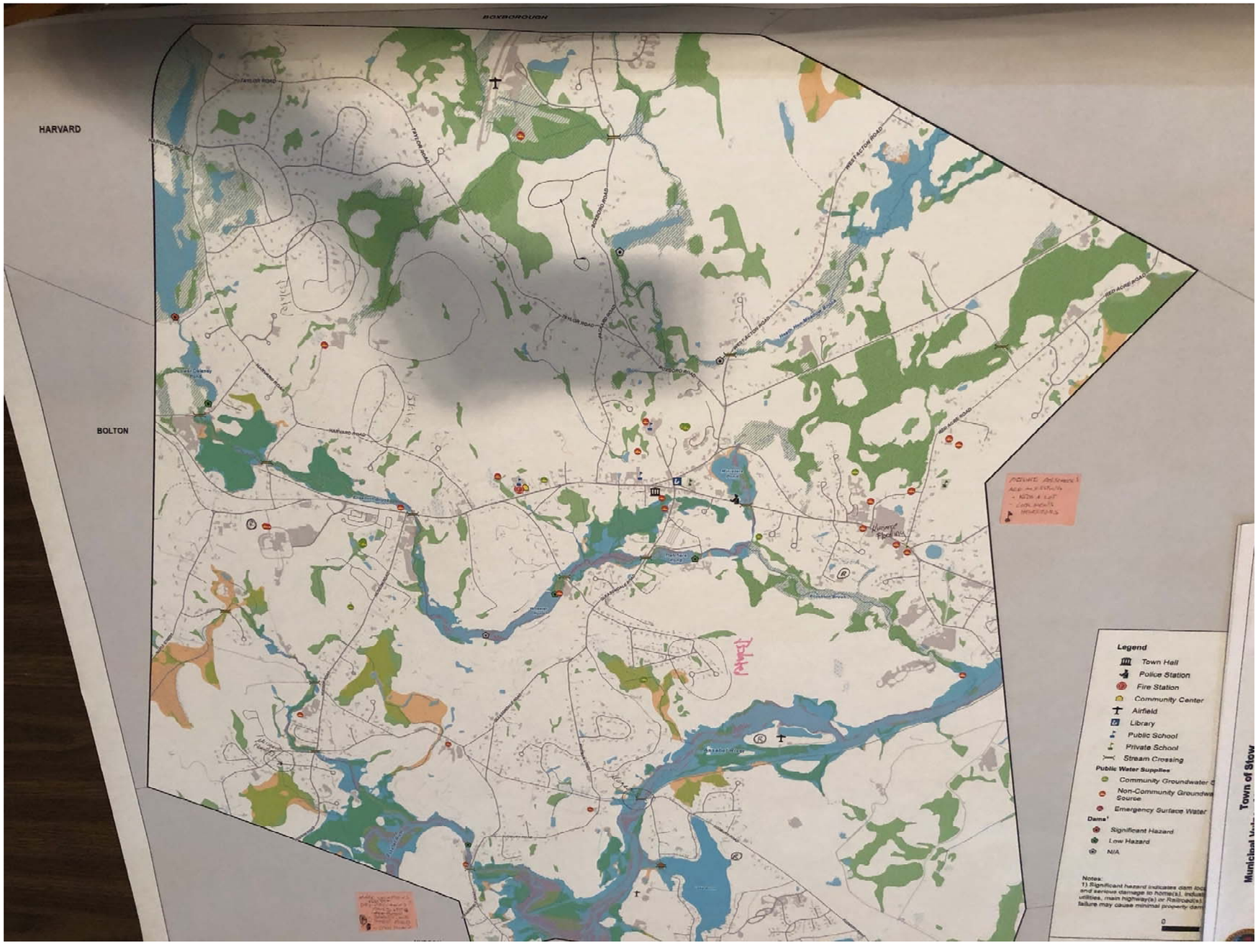
www.CommunityResilienceBuilding.org

H-**M**-**L** priority for action over the **S**hort or **L**ong term (and **O**ngoing)
V = Vulnerability **S** = Strength

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

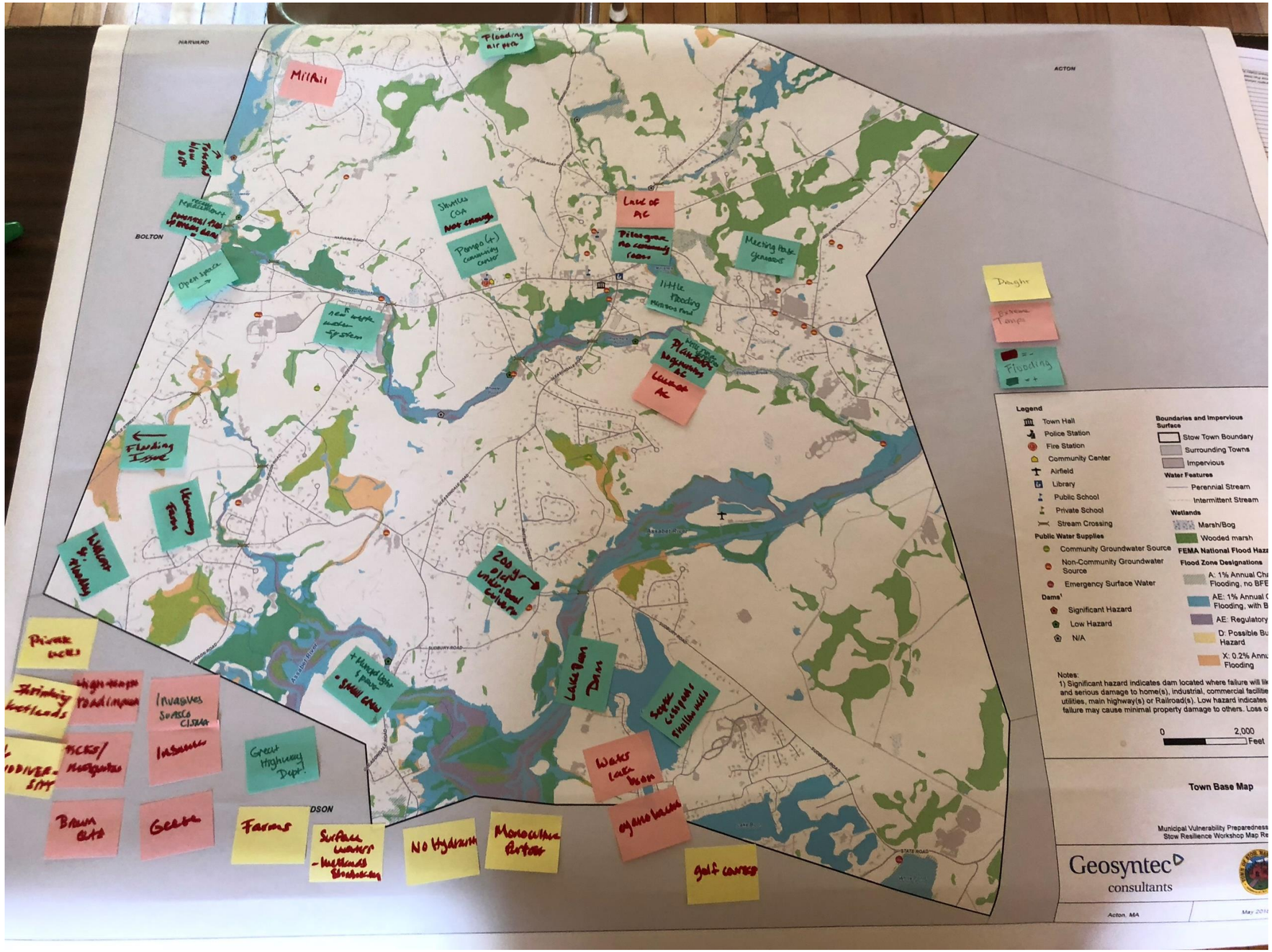
Features	Location	Ownership	V or S	Strong Storms	Extreme Temps	Drought	-	Priority H - M - L	Time S hort L ong O ngoing
Infrastructural									
Roads	Townwide	Town of Stow	V	Inventory of high risk areas for flooding	Investiage other materials when repairing	N/A		H/M	L
Dams/Culverts	Townwide	Private/Public/ Town of Stow	V	Evaluate/repair and identify cost	N/A	Assess low flow passage		H	O
Schools	Town Center	Town of Stow	S	Develop transport. Plan	N/A	Assess well capacity (back up plan)		L	L
Community Center	Town Center	Town of Stow	S	Develop transport. Plan	Develop transport. Plan	Assess well capacity (back up plan)		H	S
Wells	Townwide	Private	V	Develop plan for addl. Sources of power	Develop plan for well management	ID other water sources message to reduce		H	O/L
Power Grid	Townwide	Hudson Light & Power	V/S	Right of way maintenance plan	Demand management plan	N/A		M	O
Societal									
Low Income/Senior	Multiple	Private	V	Transport. And comm. Plan	Access to AC & reserve power	assess well capacity		H	O
Disability Community	Multiple	Private	V	Transport. And comm. Plan	Access to AC & reserve power	assess well capacity		H	O
COA/Neighbor Brigade/Networks	Multiple	Private	S	Comm./coord. Plan development	ID high risk/outreach	plan development for water delivery		M	O
Public Health	Multiple	Town of Stow/ State of MA	V/S	Develop plan for trans. To medical care	Develop plan for trans. To medical care	N/A		M	O/S
Emergency Response	Multiple	Town of Stow	S	N/A	N/A	N/A		-	-
Hazard Mitigation Plan	Multiple	Town of Stow/ Fire Dept.	V/S	Update Plan	Update Plan	Update Plan		H	S
Environmental									
Wetlands/Waterways	Multiple	Multiple	V/S	Assess dam removal reassess use of berms	ID oppor. For thermal pollution	Comply w/ state stream corssing standards		M	L
Species Diversity	Multiple	?	V	Develop plan to introduce/ encourage use	Tree planting	Tree planting		M	L
Open Space/Forests	Multiple	Multiple	V/S	Develop plan to introduce/ encourage use	Tree planting	Tree planting		M	L
Farms	Multiple	Private/Town of Stow	V	Use Ag. Comm. To get farmer input on needs	encourage diversity of crops	develop alt. water sources & soil mngmt.		H	L/S
Public Health	Multiple	Town of Stow/ State of MA	V/S	N/A	Education on risks & solutions	Access to water & distribution		M	S
Beach/Recreation Fields	Townwide	Town of Stow	V	Develop erosion control plan & ID use opport.	Manage access to water	Diversify/resilient grass		M/L	L

APPENDIX C: BASE MAPS



Base Map Markup (Blue Team)

Base Map Markup (Green Team)



Example Base Map Markup (Red Team)

Town of Stow
Municipal Vulnerability Preparedness Program

Climate Change and Natural Hazard Vulnerability Assessment

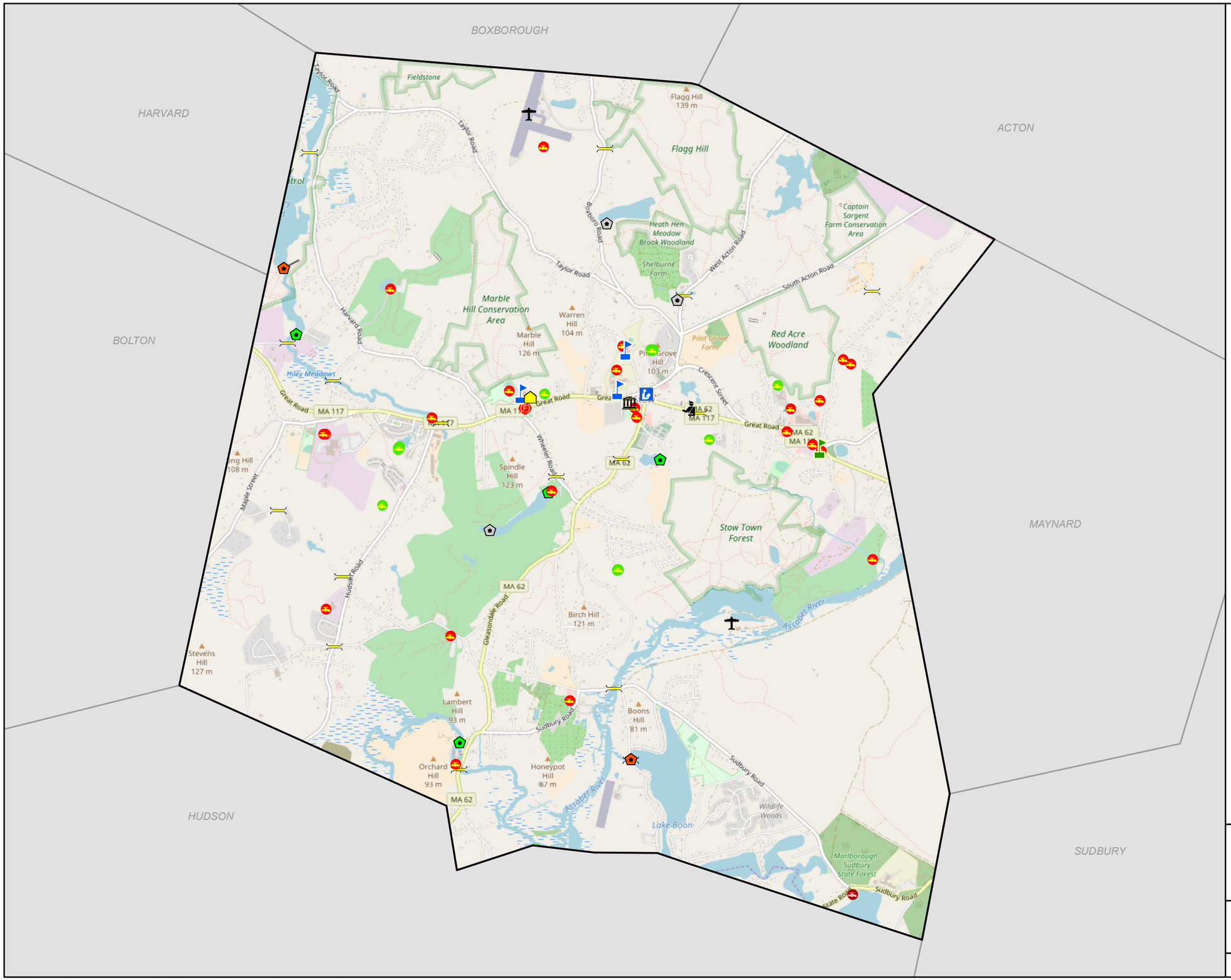
WORKSHOP MAP PACKAGE – MAY 2018

LIST OF MAPS

MAP NUMBER.	TITLE
1	BASE MAP
2	FLOODING
3	ZONING & IMPERVIOUS AREAS
4	WETLANDS AND CRITICAL HABITAT
5	WATER SUPPLY AND PROTECTION
6	MISC. INFRASTRUCTURE

LIST OF DATA LAYERS

Layer Name	Source Number
FEMA National Flood Hazard Layer	1
Fire Station	1
Impervious Surface	1
Interim Wellhead Protection Area	1
Library	1
NHESP BioMap2 Core Habitat	1
NHESP BioMap2 Critical Natural Landscape	1
NHESP Certified Vernal Pools	1
NHESP Estimated Habitats of Rare Wildlife	1
NHESP Priority Habitats of Rare Species	1
Police Stations	1
Public Water Supplies	1
Schools	1
Stow Town Boundary	1
Surrounding Towns	1
Town Hall	1
Water Features	1
Wetlands	1
Zone I Wellhead Protection Area	1
Zone II Wellhead Protection Area	1
Airfields	2
Fire Department Water Sources	2
Key Crossing	2
Building Footprints	3
Dams	3
Roads	3
Stormwater Pipe	3
Zoning	3
Sources:	
1. Massachusetts Bureau of Geographic Information (Dates Vary)	
2. MAGIC Climate Change Resilience Plan (MAPC, 2017)	
3. Town of Stow Planning Department (Dates Vary)	



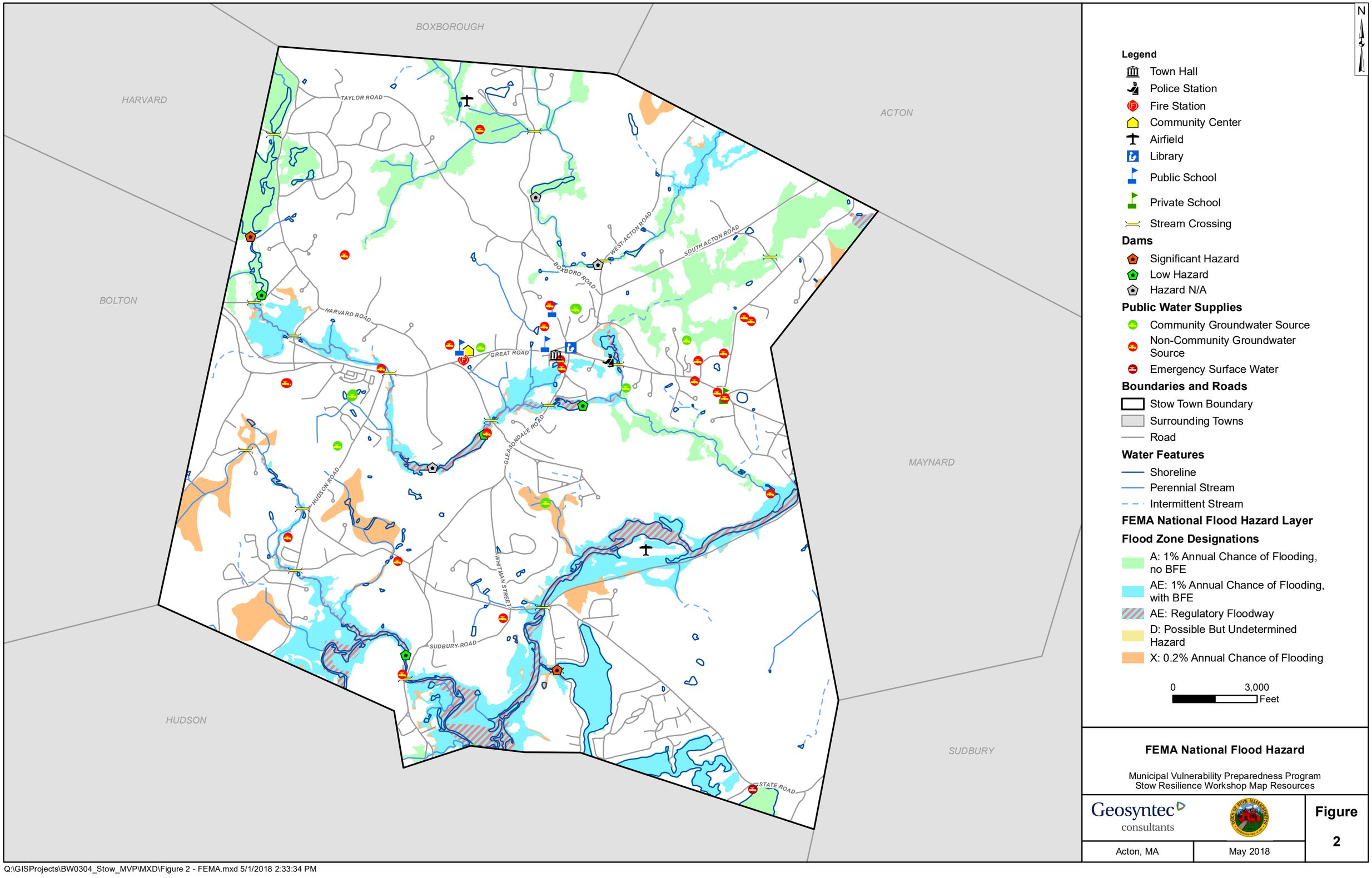
Town Base Map

Municipal Vulnerability Preparedness Program
Stow Resilience Workshop Map Resources

Geosyntec consultants

Acton, MA	May 2018	Figure 1

Q:\GISProjects\BW0304_Stow_MVP\MXD\Figure 7 - Base.mxd 5/1/2018 2:40:47 PM



FEMA National Flood Hazard

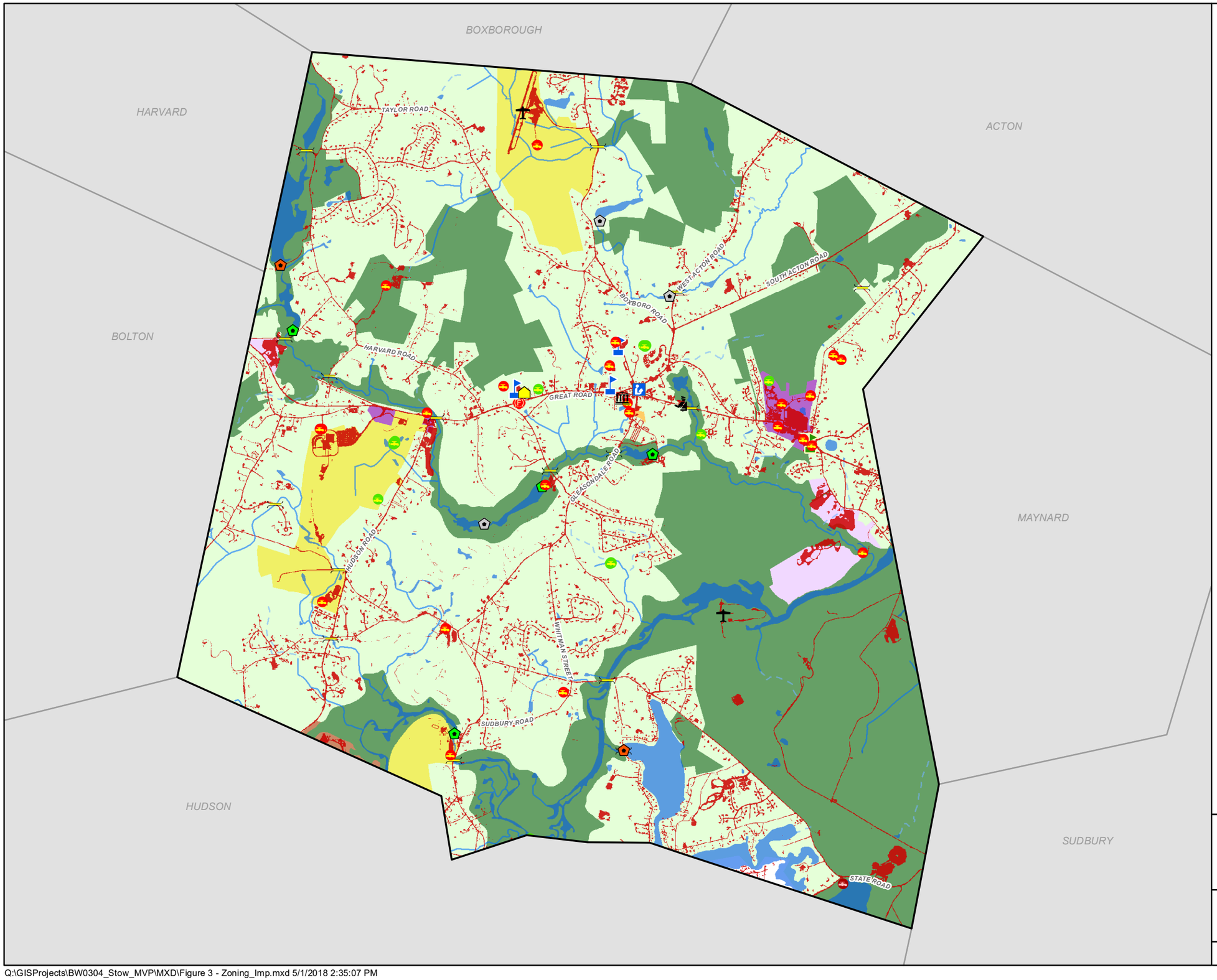
Municipal Vulnerability Preparedness Program
Stow Resilience Workshop Map Resources

Geosyntec consultants

Acton, MA | May 2018

Figure 2

Q:\GISProjects\BW0304_Stow_MVP\MXD\Figure 2 - FEMA.mxd 5/1/2018 2:33:34 PM



Legend

- Town Hall
- Police Station
- Fire Station
- Community Center
- Airfield
- Library
- Public School
- Private School
- Stream Crossing

Dams

- Significant Hazard
- Low Hazard
- Hazard N/A

Public Water Supplies

- Community Groundwater Source
- Non-Community Groundwater Source
- Emergency Surface Water

Boundaries

- Stow Town Boundary
- Surrounding Towns

Water Features

- Perennial Stream
- Intermittent Stream

Zoning

- Business
- Commercial
- Compact Business
- Recreation/Conservation
- Industrial
- Refuse Disposal
- Residental
- Pond, Lake or Reservoir
- Impervious Areas

0 3,000 Feet

N

Zoning and Impervious Areas

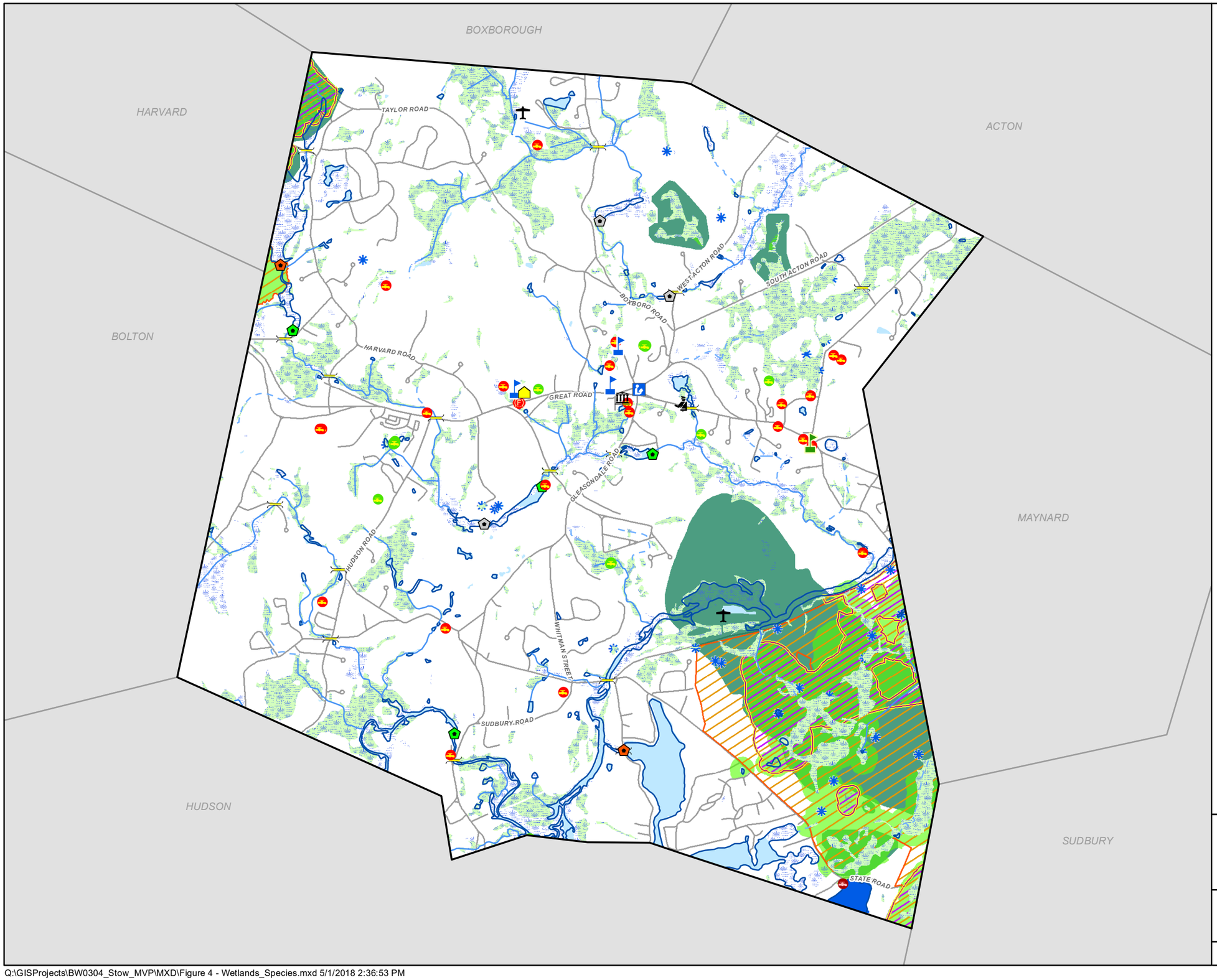
Municipal Vulnerability Preparedness Program
Stow Resilience Workshop Map Resources

Geosyntec consultants

Acton, MA | May 2018

Figure 3

Q:\GISProjects\BW0304_Stow_MVP\MXD\Figure 3 - Zoning_Imp.mxd 5/1/2018 2:35:07 PM



Legend

- Town Hall
- Police Station
- Fire Station
- Community Center
- Airfield
- Library
- Public School
- Private School
- Stream Crossing

Dams

- Significant Hazard
- Low Hazard
- Hazard N/A

Public Water Supplies

- Community Groundwater Source
- Non-Community Groundwater Source
- Emergency Surface Water

Boundaries and Roads

- Stow Town Boundary
- Surrounding Towns
- Road

Water Features

- Shoreline
- Perennial Stream
- Intermittent Stream

Wetlands

- Marsh/Bog
- Wooded marsh
- Open Water
- Reservoir (with PWSID)

Biodiversity Layers

- NHESP Certified Vernal Pools
- NHESP Estimated Habitats of Rare Wildlife
- NHESP Priority Habitats of Rare Species
- NHESP BioMap2 Core Habitat
- NHESP BioMap2 Critical Natural Landscape

Notes:
1) NHESP = MassWildlife Natural Heritage and Endangered Species Program.
2) BioMap2 was developed by NHESP and the Nature Conservancy (TNC) using 2010 data from NHESP, the MassGIS 2005 aerial photographs, and the MassGIS 2005 land use layer. Core Habitat consists of areas that are critical for the long-term persistence of rare species and other Species of Conservation Concern, as well as a wide diversity of natural communities and intact ecosystems across the Commonwealth. Critical Natural Landscape consists of areas complementing Core Habitat, including large natural Landscape Blocks that provide habitat for wide-ranging native species, support intact ecological processes, maintain connectivity among habitats, and enhance ecological resilience; and includes buffering uplands around coastal, wetland and aquatic Core Habitats to help ensure their long-term integrity.

0 3,000 Feet

N

Wetlands, Rare Species, Critical Habitat Areas

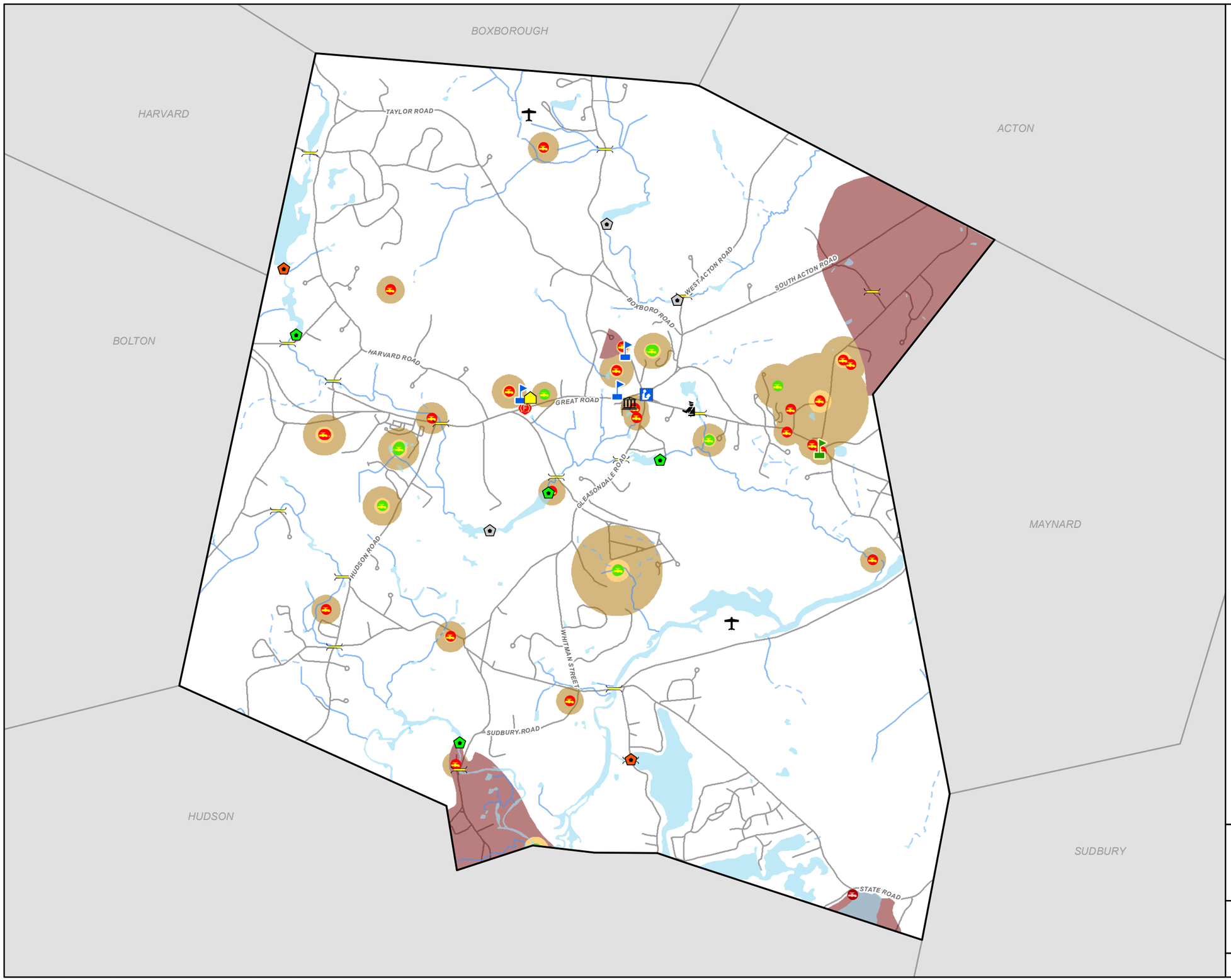
Municipal Vulnerability Preparedness Program
Stow Resilience Workshop Map Resources

Geosyntec consultants

Acton, MA | May 2018

Figure 4

Q:\GISProjects\BW0304_Stow_MVP\MXD\Figure 4 - Wetlands_Species.mxd 5/1/2018 2:36:53 PM



Legend

- Town Hall
- Police Station
- Fire Station
- Community Center
- Airfield
- Library
- Public School
- Private School
- Stream Crossing

Dams

- Significant Hazard
- Low Hazard
- Hazard N/A

Boundaries and Roads

- Stow Town Boundary
- Surrounding Towns
- Road

Public Water Supplies

- Community Groundwater Source
- Non-Community Groundwater Source
- Emergency Surface Water

Wellhead Protection Areas

- Zone I Wellhead Protection Area
- Zone II Wellhead Protection Area
- Interim Wellhead Protection Area

Water Features

- Perennial Stream
- Intermittent Stream
- Pond, Lake or Reservoir

Notes:
1) Zone I Wellhead Protection Areas are protective radii required around a public water supply well or Wellfield. For Public Water System wells with approved yields of 100,000 gpd or greater, the protective radius is 400 feet. Yields less than 100,00 are determined (in feet) as (150 x log of pumping rate in gpd) - 350.
2) Zone II means that area of an aquifer that contributes water to a well under the most severe pumping and recharge conditions that can be realistically anticipated (180 days of pumping at approved yield, with no recharge from precipitation). It is bounded by the groundwater divides that result from pumping the well and by the contact of the aquifer with less permeable materials such as till or bedrock.
3) Interim Wellhead Protection Area (IWPA) means that for public water systems using wells or Wellfields that lack a Department-approved Zone II, the Department will apply an Interim Wellhead Protection Area. This Interim Wellhead Protection Area is a one half mile radius measured from the well or Wellfield for sources whose approved pumping rate is 100,000 gpd or greater. For wells or Wellfields that pump less than 100,000 gpd, the IWPA radius is proportional to the approved pumping rate which may be calculated according to the following equation: IWPA radius in feet = (32 x pumping rate in gallons per minute) + 400.

0 3,000 Feet

Public Water Supplies and Wellhead Protection Areas

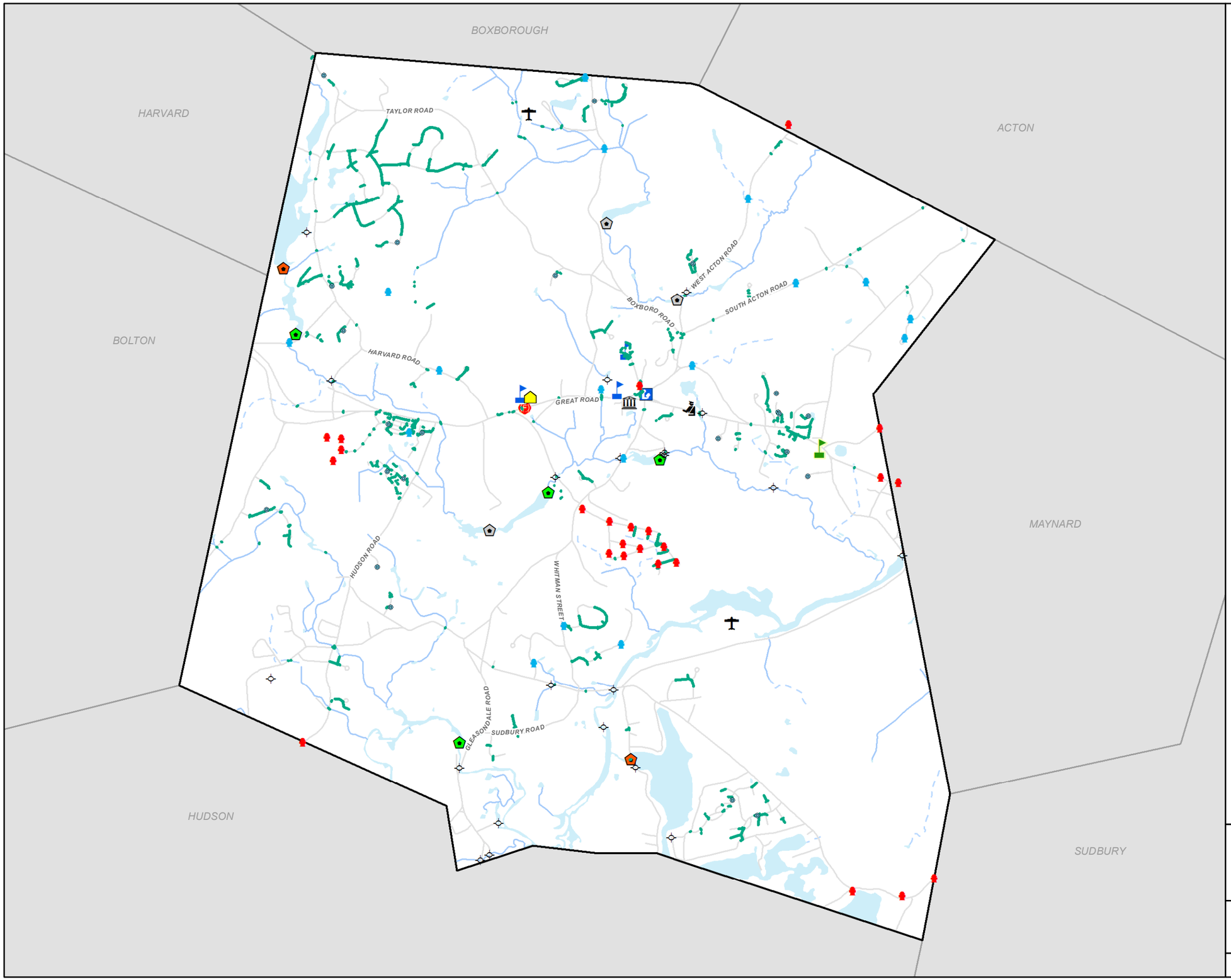
Municipal Vulnerability Preparedness Program
Stow Resilience Workshop Map Resources

Geosyntec consultants

Figure 5

Acton, MA | May 2018

Q:\GISProjects\BW0304_Stow_MVP\MXD\Figure 5 - Water Supply WPA.mxd 5/1/2018 2:38:07 PM



N

Legend

- Town Hall
- Police Station
- Fire Station
- Community Center
- Airfield
- Library
- Public School
- Private School

Dams

- Significant Hazard
- Low Hazard
- Hazard N/A

Boundaries and Roads

- Stow Town Boundary
- Surrounding Towns
- Roads

Water Features

- Perennial Stream
- Intermittent Stream
- Pond, Lake or Reservoir

Fire Department Water Sources

- Cistern
- Dry hydrant
- Hydrant
- Water Hole
- Stormwater Pipe

0 3,000 Feet

Miscellaneous Infrastructure

Municipal Vulnerability Preparedness Program
Stow Resilience Workshop Map Resources

Geosyntec consultants

Acton, MA | May 2018

Figure 6

Q:\GISProjects\BW0304_Stow_MVP\MXD\Figure 6 - Misc.mxd 5/1/2018 2:39:14 PM

We are
engineers, scientists
and innovators.

Geosyntec
consultants

engineers | scientists | innovators

Offices in Principal Cities of the United States and Select International Locations

geosyntec.com