Town of Carver

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Community Resilience Building Workshop

Summary of Findings

May, 2018

FUSS & O'NEILL

Project No. 20170390.B50

Town of Carver

Community Resilience Building Workshop

Summary of Findings

Overview

Extreme weather and natural and climate-related hazards are an increasing concern for the communities of Massachusetts, and there is a clear need to involve municipalities, corporations, organizations, and the State in increasing resilience at all levels. Recent storm events affecting the region have highlighted many of the vulnerabilities that towns and cities face. Hurricane Irene and Superstorm Sandy brought intense flooding to many municipalities and threatened (or destroyed) infrastructure across the state. Extreme temperatures at both ends of the spectrum have pushed the limits of communities' preparedness to protect both infrastructure and people. In coastal communities, the impacts of sea level rise are felt daily and further exacerbate the impacts of other extreme events. Current climate modeling indicates that all of these hazards are expected to increase in frequency and scale over the coming decades. The Municipal Vulnerability Preparedness (MVP) program provides support and a prescribed process for cities and towns in Massachusetts to plan proactively for resiliency and implement key climate change adaptation actions.

In 2017, the Town of Carver was awarded a $15,000 MVP grant to fund the planning stage of this process. The Town partnered with Fuss & O'Neill, a state certified MVP Provider, to complete a comprehensive, baseline climate change and natural hazard vulnerability assessment and develop a list of priority actions for the Town. This process involved the development of an MVP Core Team, which met on April 19, 2018 to determine initial concerns and worked to identify stakeholders within the municipality and set goals for the process. Those stakeholders were then invited to participate in a Community Resilience Building (CRB) workshop on April 30, 2018, engaging in a day-long, tried and tested process developed by The Nature Conservancy. The CRB methodology is an "anywhere at any scale" format that draws on stakeholders' wealth of information and experience to foster dialogue about the strengths and vulnerabilities within the Town. Workshop participants interacted at both large and small group levels, using an iterative process to gather input, synthesize ideas across groups, and ultimately develop a set of priority resilience and adaptation actions.

The CRB workshop's central objectives were to:

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

Top Hazards and Vulnerable Areas

During the Community Resilience Building workshop, participants were asked to identify the top four natural hazards of concern for the Town of Carver. Discussion of the top hazards built on earlier conversations that took place at the MVP Core Team Meeting, as well as Town conversations that have formed the basis for the Town's Hazard Mitigation Planning. The impacts of wind were identified as one of the Town's top hazards. Wildfire was recognized as a second hazard, particularly due to the presence of Myles Standish State Forest within the Town boundaries. Impacts of unpredictable precipitation, either excess rain or extended drought, were identified as a third hazard. Finally, extreme temperatures, including the increase in both extremely hot days (over 90 degrees F) and extremely cold weather, were seen as a fourth major hazard. These four hazards have already had demonstrated impacts on the Town, and as climate change progresses, these hazards are expected to have ever greater consequences for infrastructure and environment, as well as for various societal elements. Specific areas of concern are identified below.

Top Hazards

- Wind
- Wildfire
- Excessive Precipitation or Drought
- Extreme Temperatures

Areas of Concern

While many impacts are expected to be felt Town-wide, certain elements, locations, or community groups present particular concerns.

Neighborhoods/Communities
Mobile home parks (Cranberry Village, Pine Tree Village, Waterview Village, South Meadow Village, Meadow Woods), neighborhoods built on filled wetlands

Events/Theme Parks
King Richard's Faire, Edaville Family Theme Park

Ecosystems
Myles Standish State Forest, Sampson's
Pond, cranberry bogs, 3 main perennial rivers (Weweantic River, Winnetuxet River,Wankinco River), smaller perennial streams (e.g., South Meadow Brook, Crane Brook, Muddy Pond Brook, King Phillip's Brook, Beaver Dam Brook, Doten Brook, Horseneck Brook, Herring Brook), several Great Ponds (Sampson's's Pond, John's Pond, Vaughn's Pond/Crystal Lake, Dunham Pond, Muddy Pond, Cooper's Pond, Bates Pond), waterways that manage the cranberry industry's water for irrigation and pest/frost control

Infrastructure
Three Town wells supplying limited portions of Town, private wells, emergency communications towers, fire suppression/protection system, private dams/flumes that belong to individual cranberry growers

Current Concerns and Challenges Presented by Hazards

Major storm events have been a recurring threat to Carver throughout its history, including the notable 1938 and 1954 hurricanes. In much more recent memory, the Town experienced extensive rain and some accompanying flooding impacts during spring 2010 when they were hit with two 100-year storms. While the Town's Emergency Management Director indicated that the Town fared quite well overall, impacts were particularly severe for certain neighborhoods that had been built on filled wetlands and therefore sat on high groundwater. Despite the fact that Carver has historically drained well, more intense storms delivering higher volumes of precipitation in a single event are expected to put significant pressure on dams, culverts, and other drainage infrastructure that were designed to handle smaller storms with more consistent distributions of precipitation.

While excess water can sometimes be a problem in Carver, too little water is of greater concern. Carver has worries about water supply both for drinking water and firefighting. The extended drought during summer 2016 emphasized the need to increase the public water supply to ensure adequate access during longer droughts, as the two Town wells were drawn down during that summer and a number of private wells dried up. Workshop participants also noted that freshwater springs in Sampson's Pond dried up during the drought and the water level dropped eighteen inches. Drought conditions also exacerbated problems with algal blooms in several of the Town's ponds, including Sampson's Pond.

Over the past several decades there have been numerous wildfires in and around Myles Standish State Forest, with impacts ranging from 100 acres to 1,000 acres. Along with Plymouth, Carver is one of two Towns responsible for managing fires that break out in Myles Standish, and the stakes for fire control have risen considerably in recent decades as neighborhoods have been developed on the fringes of the state forest land. During the CRB workshop, the Fire Chief noted that Myles Standish is considered the third most combustible forest in the United States; a dubious title for the Towns charged with preventing catastrophic wildfires. In the absence of a Town-wide public water supply, access to water for firefighting is dependent in large part on private surface ponds, which can be prone to drying up during periods of drought. Simultaneously, an increase in severe storms and an influx of new pests and diseases, both of which are linked to climate change, are resulting in a higher volume of dead wood in forest systems. Dead wood translates to additional fuel, thereby increasing the risk of wildfire at the same time that water supply for firefighting is becoming a concern.

The impacts of wind are another source of concern in Carver. Shelter use is increasing dramatically in Carver, largely due to power outages brought on by storms bringing intense wind. Workshop participants pointed out that it used to be common for the emergency shelters to go five years without being opened at all. In the last year, however, the shelters had to be opened five separate times. Some of the current wind damage can be traced back to roots in the 1938 hurricane. At that time, Carver was particularly hard hit, with nearly all its trees wiped out. The pine trees that regrew are shallow-rooted, and form a primarily single-aged stand of forest in Carver. The combination of shallow-rooted pines and old trees makes these forests especially susceptible to blowdowns, with corresponding impacts for the Town's electrical infrastructure. Wind impacts have led to two significant power outages already this year; in March, the Town saw an outage of 5 days, followed by another that lasted an additional 4 days.

The Town's primary agricultural industry, cranberry production, is also impacted by climate change impacts on a much larger geographic scale, as any number of changing climate conditions can trigger global economic disruptions with potentially serious effects on the cranberry industry. This implies a need to provide economic resiliency for the Town as well, to buffer against severe impacts to the Town from geographically distant events.

Specific Categories of Concerns and Challenges

Infrastructural

Town Wells

The Town has three wells, two of which are relatively new (2011), and, as noted above, the wells are subject to drawdown during periods of extended drought. The water supply from the existing wells contains iron and manganese, and the wells are expensive to maintain because of these quality issues. At least two of the wells communicate between one another, and any contamination would likely affect both.

Water Supply for Fire Suppression

The Town relies on scattered surface water for firefighting, and while mapping exists of potential water sources, it is unknown whether these ponds will actually contain sufficient water during a time of need. Further complicating the situation, the surface ponds are prone to algal blooms, especially during droughts. This makes the water even harder to access for fire suppression, as pumping equipment can easily become clogged with algae.

Culverts and Stormwater Conveyances

Culverts and stormwater infrastructure are recognized as a potential concern Town-wide. Workshop participants noted certain culverts that had washed out in the spring 2010 rains, and there is a general recognition that many culverts were designed to accommodate historic patterns of precipitation and runoff, which are rapidly transforming as a result of climate change. As precipitation events become more intense and less predictable, undersized culverts are expected to pose a greater threat of failure and flooding. Similarly, the Town's Assistant DPW Director noted that the Town's aging stormwater infrastructure and lack of maintenance funds exacerbates flooding potential during heavy rains.

Public Safety Communications Towers

The Town is fortunate to have three communication towers, however these are subject to wind damage and were in fact knocked out of service in early March 2018. The repair process was hindered by additional downed trees which restricted access to the towers, extending the time necessary to re-align the towers and bring them back into service.

Dams

Carver has 60 registered dams, many of which are small dams (also known as flumes) associated with active cranberry bogs. The Town also has numerous debris dams which form from accumulated pine needles and leaves and can cause ponding for several days. The water control provided by the flumes is generally considered to be a strength for the Town, but there is a degree of unpredictability associated with the debris dams and these could cause unforeseen problems during heavy precipitation, when flooding occurs in unexpected locations.

Environmental

Myles Standish State Forest

Myles Standish is an asset to the Town in terms of open space and unique ecosystems, notably the globally-restricted pitch pine-scrub oak communities and the globally-restricted Coastal Plain Pond communities. However, it presents multiple vulnerabilities in terms of climate change. As already discussed, Myles Standish is considered the third most combustible forest in the United States, posing a unique threat to surrounding neighborhoods in Carver, particularly when compounded with the Town's

water supply issues. The forest's combustible nature is largely due to its composition, which is primarily pitch pine. The fact that most of the pines are regrowth from after the 1938 hurricane means that the forest is now largely in a uniform state of decline due to age and disease. Dying trees create additional fuel for fires, further exacerbating the potential risks. Encroaching development threatens both the forest's environmental value and the safety of residents living near a potential wildfire source.

Open Space

Open space provides ecosystem services that help buffer the effects of climate change, from sequestering carbon, to increasing groundwater recharge, to modulating local temperature. Open space is also critical in floodplains for providing a buffer and increased flood storage, near public water supplies to maintain high water quality and promote recharge, and to maintain overall habitat connectivity that will be vital to allowing ecosystems and individual species to adapt to a changing climate. Maintaining open space is particularly important in Carver where nearly 50% of the landscape consists of some type of wetland. Replacing these wetlands with developed land uses can have severe impacts on drainage and flooding, as has been demonstrated in neighborhoods that were built on filled wetlands.

Cranberry Bogs

The Town's extensive network of cranberry bogs plays a key role in the Town's economy, but also the environment. These bogs are now increasingly threatened by new pests, including cranberry scale insects and footprint disease, as well as by water supply problems. One of the workshop participants indicated that he was having to move his own cranberry operation to a new location because the water supply that services his current bog was no longer sufficient due to new development that was drawing down that supply. Cranberry farmers are also coping with changes in temperature and precipitation that are causing their fields to behave differently than they have in decades past.

Sampson's Pond

Sampson's Pond experienced three severe algal blooms during the 2016 drought. The lake level dropped an unprecedented eighteen inches between June and September, and the springs that feed the pond stopped flowing. At the same time, water was being drawn down from the pond to maintain the cranberry bogs and the sluiceway was lowered to keep a continuous outgoing flow downstream of the pond and prevent the brook from drying up. Collectively, this resulted in fish kills in the pond, recreation impacts, and negative health effects. Other ponds in Town experienced similar conditions. Sampson's Pond has also seen increasing nutrient pollution, driven in part by land use change around the pond. Where the pond's edges used to be forested, there are now many residential lawns leading right down to the water without any buffer to trap and filter nutrients.

Societal

King Richard's Faire & Edaville Family Theme Park

King Richard's Faire is a renaissance festival that takes place several weekends each fall, and the Edaville Family Theme Park draws visitors throughout the summer, on weekends, and during school vacation periods. By their nature as places that bring together large numbers of people, these sites pose special challenges in dealing with the increasingly unpredictable storms and temperature extremes that accompany climate change. Exceedingly hot days are of particular concern since these are outdoor events and cooling opportunities while enjoying these venues are limited.

Vulnerable Populations

Workshop participants acknowledged the challenges of identifying and reaching vulnerable individuals, especially those who may no longer have a land-line telephone, or who may not self-identify as vulnerable.

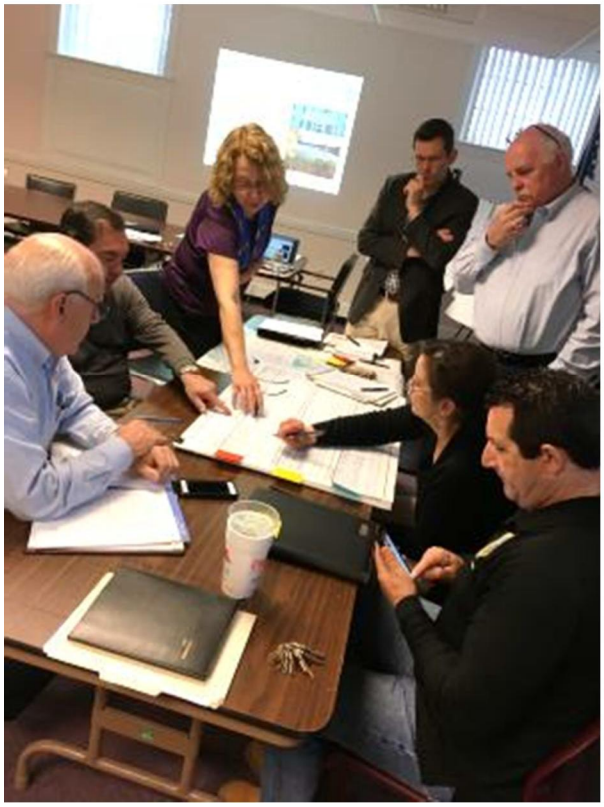
Certain populations, especially seniors, are known to be at higher risk during hazard events and may require support beyond emergency notifications. Workshop participants expressed concerns about seniors' ability to obtain food and medical supplies during hazard events, as well as the challenges involved in getting seniors to leave their homes (and sometimes their pets) in order to seek shelter elsewhere. Better understanding what these needs are and how the Town can best prepare to proactively support its entire population are areas that require more exploration.

Vulnerable Neighborhoods

Particular neighborhoods in Carver are at risk from flooding due to the fact that neighborhoods were developed on top of filled wetlands, and the high water table remains beneath the surface. Some of these homes took on approximately a foot of water during the spring 2010 rains. Workshop participants also noted that the grocery and pharmacy in Town are all concentrated in the northwest corner of Town, where municipal water is available. This could mean that blocked roads would cut off many more neighborhoods from access to food and medical supplies.

Mobile Home Parks

Due to their very nature as semi-permanent structures, mobile homes can be particularly vulnerable to storm events and high winds. Carver has five mobile home parks, including South Meadow Village, Cranberry Village, Pine Tree Village, Waterview Village, and Meadow Woods. Notably, four of the mobile home parks in Carver are specifically geared toward over 55 populations (Pine Tree Village is the exception). This combination makes for especially vulnerable populations, since the residents themselves may need additional support to deal with extreme temperatures or storms, but their residences may also be vulnerable to the impacts of wind and other hazards in a way that traditional construction would not be.

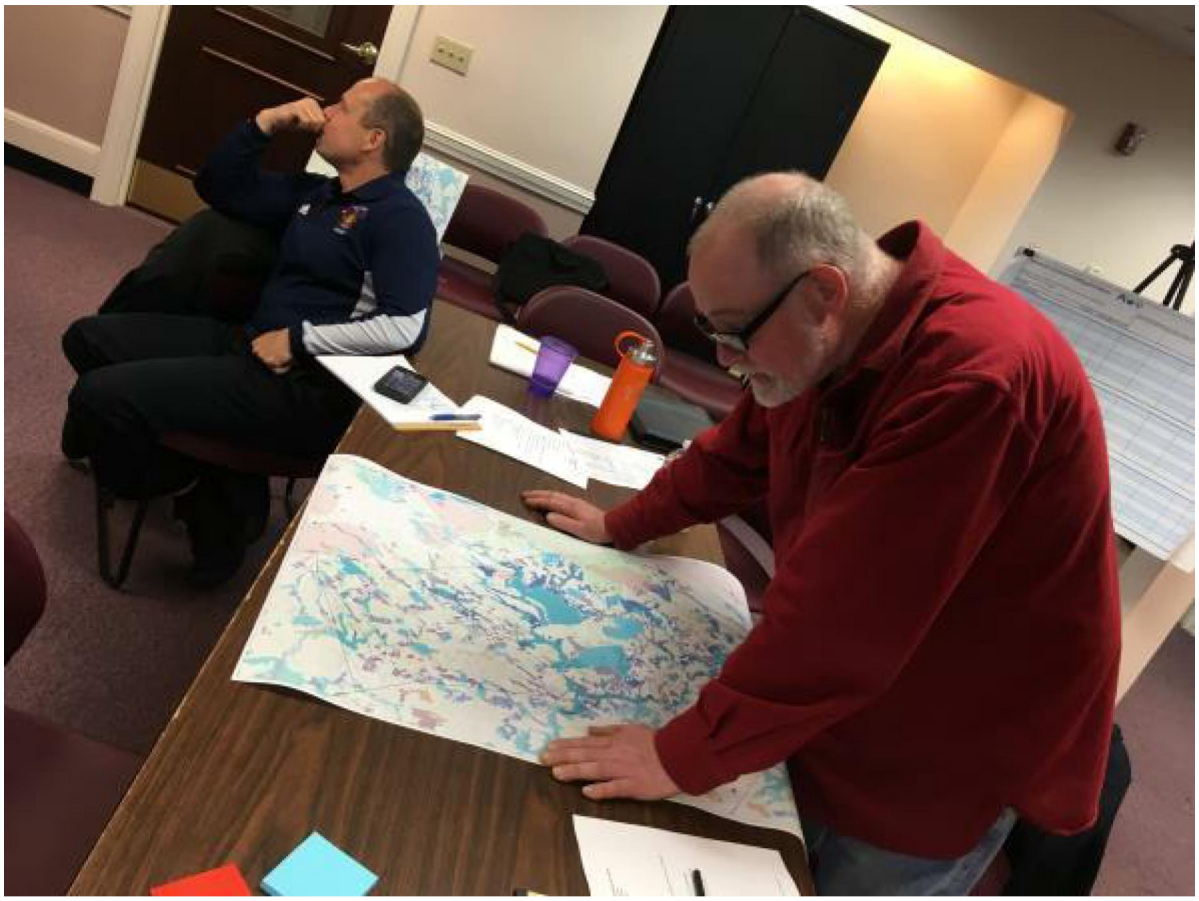


Pests and Disease Control

Climate change is affecting pests and disease vectors both through changing precipitation conditions and changing temperature conditions. Warmer, wetter conditions lead to increased mosquito populations, while the absence of sufficient periods of cold means that pest populations that would historically have been killed off or reduced are able to survive the winter and emerge in greater numbers the following season (ticks are a prime example of this). Further, as the Massachusetts climate begins to look more like the climate of the mid-Atlantic and southern states, we are seeing new types of diseases show up in existing pests (e.g. mosquitoes carrying West Nile Virus or Zika and ticks carrying Rocky Mountain Spotted Fever). These changes present a major public and animal health challenge in terms of education, prevention, and treatment. Carver also faces challenges from cranberry-specific pests, including footprint disease and scale insects.

Stress on Emergency Services

Carver's Fire and Police departments bear much of the burden of responding to the increased human threats that result from climate-induced hazards. In order to provide those services, however, an ever larger percentage of the departments' time and resources are being devoted to efforts to keep roads passable after storms and wind create blockages.



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Current Strengths and Assets

While the Town recognized a number of vulnerabilities, workshop participants identified key strengths as well. Carver's facilities are relatively well positioned for resilience. The Town updated its Hazard Mitigation Plan three years ago, and the Town benefits from extensive open space.

- Whereas flooding is a prime concern for many towns, Carver is relatively well draining aside from certain areas of concern.
- The Town is served by the Plymouth/Carver Sole Source Aquifer, which contains approximately 500 billion gallons.
- Carver generally has few problems with failing septic systems due to the nature of its soils.
- The Town has existing maps of water supply for firefighting that identify approximately 200 sources, including GPS coordinates, although condition of these sources is often unknown.
- The Town's Hazard Mitigation Plan was revised in 2015, making Carver eligible for FEMA funding.
- Approximately 600 acres of protected open space exists in Carver, although significant portions of that land is in Chapter 61 and thus not yet permanently protected.
- The Town's extensive cranberry bogs add to Carver's open space and associated flumes provide some flood control.
- Myles Standish State Forest is a tremendous open space asset managed by the state which benefits the Town. Communication with state forest managers is generally good.
- Wetland resources provide recharge and filtration, helping to maintain water quality and recharge the underlying aquifer.
- The Town's High School doubles as an emergency shelter.
- The North Carver Water District currently has a $58,230 GAP II grant to upgrade and right-size the generator system at its plant.
- The North Carver Water District is linked to a solar installation on Route 44, although it currently lacks battery storage.
- The Town benefits from county-level mosquito spraying programs that are available to residents on an opt-in basis.
- The Town has already addressed road flooding issues where they were once a problem.
- The Town has claimed reserved space on newer cell towers to utilize for emergency communications if necessary.
- Carver's schools are newer and well sited on high ground, clear of potential hazard trees.

- The Town's three fire stations operate and respond independently, allowing for redundancy in case one is cut off from access to a particular part of town. The stations are also spaced out along the Town's north/south axis.

- A baseline tree inventory already exists for the Town as part of the Open Space Plan.

- The Town's rural character is a strength and local farmers are cooperative and supportive of one another.

Top Recommendations to Improve Resilience in Carver

Participants at the CRB workshop identified a number of recommendations to address vulnerabilities and increase resiliency in three main topic areas: infrastructure, environment, and society. Management of water, particularly risk assessment and management of water for fire suppression, was a primary concern that emerged in both the small and large group discussions, as was maintaining sufficient, safe water supply during drought or other hazards. A second theme centered around providing services to the Town's residents during hazard events, with particular attention to vulnerable populations.

Highest Priority

- Conduct a detailed vulnerability and risk assessment of surface water supply, with particular focus on water to support fire suppression activities, maintain successful agricultural (cranberry) production, and ensure high surface water quality. Individual source ponds already identified as potential water sources should be inspected, physical problems noted, and possible solutions identified. Education and outreach should be a critical component of the risk assessment, particularly as many source water supplies are located on private lands. Addressing algal blooms, which have been exacerbated by drought conditions in recent years, should also be a key point, particularly for the several great ponds in the Town, including Sampson's Pond.

- Purchase a new water tanker to facilitate transport of water for firefighting purposes and increase the Town's resiliency by decreasing the need to rely on water supplies within close proximity to fire hazards.

- Study the possibility of relocating or expanding the existing well in North Carver to produce more water, alleviate concerns with drawdown, and support additional business development in the existing North Carver business area.

- Assess green infrastructure opportunities for stormwater management to develop a list of specific priorities, assess feasibility and cost, rank priority projects in terms of climate resilience potential, and develop concept designs for key projects. Review Town regulations and update as necessary to support green infrastructure and low-impact development and encourage green infrastructure to be incorporated into all roadway projects.

- Support cranberry farmers in pursuing sufficient clean water supply for irrigation; managing new pests and diseases, such as cranberry scales and footprint disease; applying new techniques

like "late water" that are designed to improve resilience to pests and other hazards; and exploring secondary income sources for their land as the cranberry market shifts.

- Develop battery storage infrastructure to support key locations during outages and enable the Town to purchase power at night when it is cheaper and then feed energy to the grid during the day.

- Assess mosquito, tick, and other pest control options, including determination of future risks due to increase in type and quantity of pests/disease vectors due to climate change, and development of an education and outreach program. Develop strategies to prevent stagnation of water sources, including management of private sluiceways, canals, and other infrastructure associated with cranberry bogs.

- Increase resiliency of mobile home parks to safeguard residents' homes against wind and other storm impacts. Ensure that all homes are adequately anchored, introduce retrofits to strengthen the park, and promote education and outreach among residents. Focuses should be on providing protection against wind, and ensuring continuity of power and heat.

- Target waterfront properties along Sampson's Pond and other major ponds with outreach aimed at educating residents and property owners about the impacts of nutrient pollution and best practices for reducing pollution and maintaining high water quality in the pond.

- Complete Town-wide dam education and outreach among private dam/flume owners. Develop cooperative system for maintaining downstream flow and minimizing stagnant water that breeds pest populations and/or algal blooms.

- Develop a comprehensive tree and forests management program to identify, remove, and replace problem trees, preserve intact forests, and provide guidance and resources to help transition Carver's forests toward more resilient community composition in terms of both species and age structure. Emphasize species that will tolerate the warmer temperatures associated with climate change.

Moderate Priority

- Pursue opportunities to fund open space acquisition that will mitigate the effects of increased storm events.

- Conduct education and outreach related to open space preservation to build knowledge about the positive effects of open space on climate resiliency, the basis for prioritizing certain open space parcels, and why this topic is relevant to a diversity of audiences in Town.

- Seek improved communications between the Town and Eversource, the Town's electric utility. Eversource currently has internal communications flaws which make it difficult for the Town to get detailed information from Eversource community liaisons during hazard events. For instance, liaisons are generally unable to provide information regarding the location or expected arrival of repair trucks, and sometimes cannot even obtain accurate information about the extent and location of outages.

- Provide storm-hardening for emergency communications antennas to prevent further storm damage and facilitate robust communications capabilities during hazard events.

- Establish guidelines for solar siting to handle unique situations such as proposed solar arrays on active cranberry bogs or "floatovoltaics" installations proposed for floating installation on the Atwoods Reservoir.

Lower Priority

- Clarify emergency response and evacuation plans for King Richard's Faire and Edaville that address how to protect both people and property, including contingencies for a variety of potential hazards.

- Establish a formal drought plan to detail appropriate actions to be taken during times of extended drought.

- Increase services of emergency shelters by installing additional emergency generation capacity that will supply the entire high school with back-up power rather than only key areas.

- Address potential failure points in Town dams through management of the muskrat population which is known to burrow into the sides of structures, creating weak points.

CRB Workshop Participants

All workshop invitees are listed below; attendees are indicated with an asterisk.

Name	Position/Organization
Art Borden	Carver Health Board
Stephen Cole*	Director of Planning and Community Development
Kevin Forgue*	Board of Health Agent
Gary Garretson	Local Grower
Sarah Hewins*	Board of Selectman
Carol Julius	COA Director
Dave Lawrence	Local Grower
Brooke Monroe*	Conservation Agent
Savory Moore*	Redevelopment Authority
Jim Nauen	Conservation Commission
Michael Paduch	Local Grower
Dave Siedentopf	Director of Facilities, Carver Public Schools
Kevin Tracey*	North Carver Water District
Tom Walsh*	Emergency Management Director
Craig Weston*	Fire Chief
Brian Wick	Cranberry Growers Association
John Woods*	Carver DPW

* indicates attendees

Citation

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CRB Workshop Project Team: Organization, Name, Role

Name	Organization	Role
Stephen Cole	Director of Planning and Community Development	Project Coordinator/Core Team Member
Kevin Forgue	Board of Health	Core Team Member
Brooke Monroe	Conservation Agent	Core Team Member
Dave Siedentopf	Director of Facilities, Carver Public Schools	Core Team Member
Kevin Tracey	North Carver Water District	Core Team Member
Tom Walsh	Emergency Management Director	Core Team Member
Mary Monahan	Fuss & O'Neill	MVP Lead Facilitator
Julianne Busa	Fuss & O'Neill	Facilitator/Scribe
Shawn Martin	Fuss & O'Neill	Facilitator
Tom Collins	MTC OPS, LLC	Facilitator

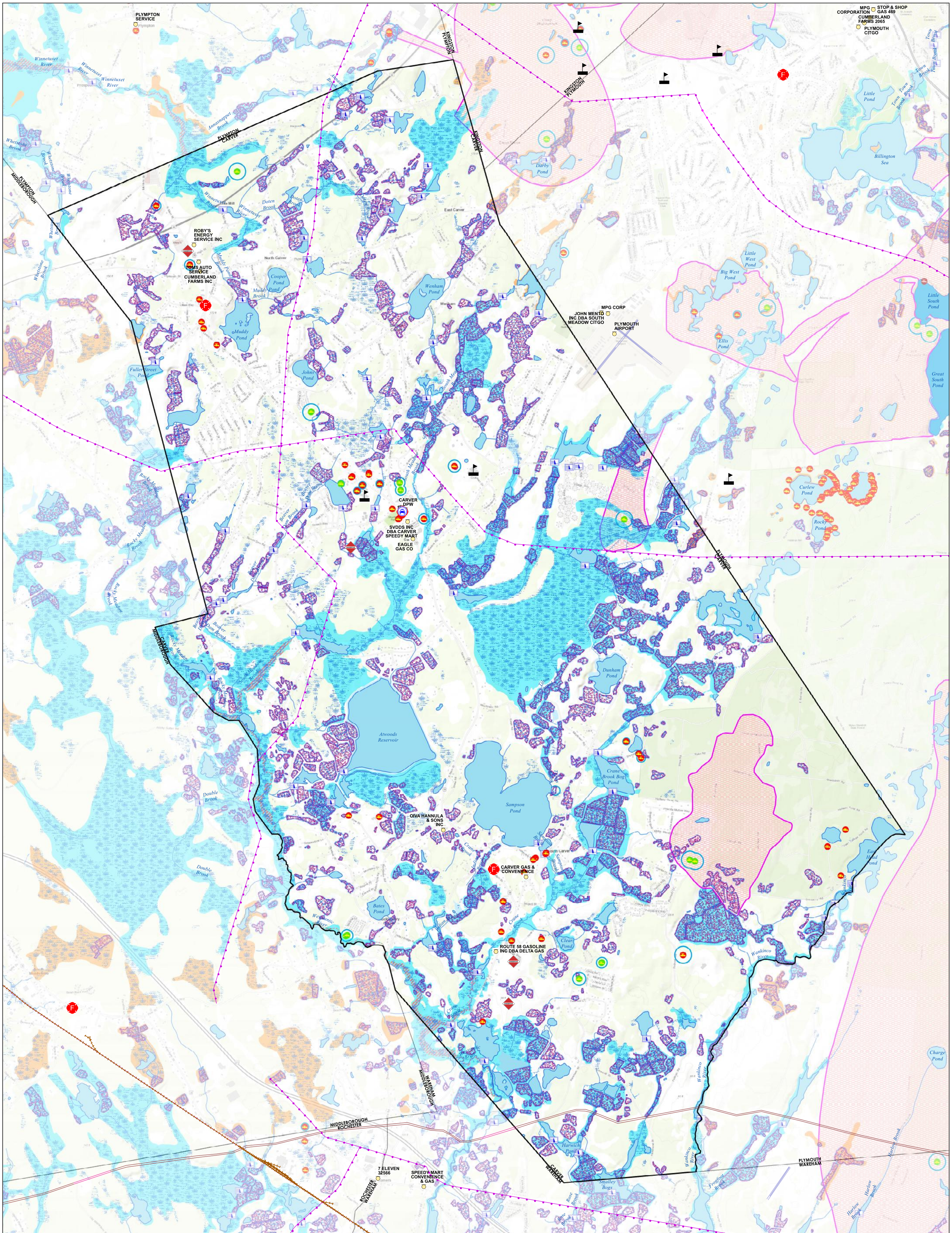
Acknowledgements

Many thanks to the MVP Core Team members, CRB workshop participants, and to Stephen Cole who acted as the local Project Coordinator. Thanks to the Town of Carver for providing a meeting space for the Core Team Meeting and CRB Workshop and coordinating the CRB Workshop.

Funding for the CRB Workshop was provided through a Massachusetts MVP grant.

Appendix A

CRB Workshop Base Map



Town Hall
Police Station
Fire Station
School
Community Groundwater Source
Non-Community Groundwater Source
Emergency Surface Water
MassDEP Major Facilities
Underground Storage Tanks
Dams

Infrastructure

Railroads - Active Service
MBTA Irregular Service
Pipeline
Pipeline Arbitrary Extension
Powerline
Powerline Arbitrary Extension
Landing Strip/Airport

Waterbodies

Shoreline
Ditch/Canal
Intermittent Stream
Perennial Stream
Pond, Lake, Ocean
Reservoir
Wetland
Submerged Wetland
Cranberry Bog

Wellhead Protection Zone I
Wellhead Protection Zone II

Flood Zone Designations

1% Annual Chance of Flooding
Regulatory Floodway
0.2% Annual Chance of Flooding

N E S W

0 0.5 1 1.5
Miles

Data sources:
MassGIS - Infrastructure, Hydrology, and Administrative Data
ESRI - World Topographic Map - Base Map

CARVER, MA

MUNICIPAL VULNERABILITY PREPAREDNESS PROGRAM

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Appendix B

CRB Workshop Outputs:
Participatory Mapping Exercise & Risk Matrices

CARVER, MA

MUNICIPAL VULNERABILITY PREPAREDNESS PROGRAM

Data sources:
MassGIS - Infrastructure, Hydrology, and Administrative Data
ESRI - World Topographic Map - Base Map

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Town Hall	**Infrastructure**	**Waterbodies**	Wellhead Protection Zone I
Police Station	Railroads - Active Service	Shoreline	Wellhead Protection Zone II
Fire Station	MBTA Irregular Service	Ditch/Canal	**Flood Zone Designations**
School	Pipeline	Intermittent Stream	1% Annual Chance of Flooding
Community Groundwater Source	Pipeline Arbitrary Extension	Perennial Stream	Regulatory Floodway
Non-Community Groundwater Source	Powerline	Pond, Lake, Ocean	0.2% Annual Chance of Flooding
Emergency Surface Water	Powerline Arbitrary Extension	Reservoir	
MassDEP Major Facilities	Landing Strip/Airport	Wetland	
Underground Storage Tanks		Submerged Wetland	
Dams		Cranberry Bog	

0 0.5 1 1.5
Miles

Data sources:
MassGIS - Infrastructure, Hydrology, and Administrative Data
ESRI - World Topographic Map - Base Map

CARVER, MA

MUNICIPAL VULNERABILITY PREPAREDNESS PROGRAM

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Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.com

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	Wildfire	PRECIP— + DROUGHT	WIND	TEMP.	Priority H - M - L	Time Short Long Ongoing
Infrastructural									
WATER QUALITY + QUANTITY			S/V						
FIRESUPPRESSION/WATER SUPPLY STUDY - Depth of Reservoirs + Ponds	TOWN-WIDE								
STORMWATER MANAGEMENT ASSESSMENT < MS4 Plan; H2O Quality + Quantity	TOWN-WIDE		V						
EVERSOURCE TO DEVELOP w/in ITS OWN COMMUNICATION INFRASTRUCTURE BETTER INFORMATION/COMMUNICATION w/ TOWN	TOWN-WIDE		V						
NEED WATER TANKER — we have only 1 w/ almost 40 sq. mi. town	TOWN-WIDE		V						
Societal									
MOSQUITOES/TICKS	TOWN-WIDE		V						
MANUFACTURED HOME VILLAGES < WIND + NO POWER; HEAT (No)	5 villages; 4 are 55+		V						
TRANSPORTATION TOWN-OWNED	TOWN-WIDE		S						
HAZARD MITIGATION PLAN — TARGETS POPULATIONS @ RISK	TOWN-WIDE		S						
Environmental									
CRANBERRY BOGS PESTS; DROUGHT; CLEAN H2O	TOWN-WIDE	Private	S/V						
WATER QUANTITY + QUALITY	TOWN-WIDE	mostly Private	S/V						
OPEN SPACE PROTECTION < H2O Quality; Keeps taxes down; Aquifer Recharge	TOWN-WIDE (≈40 sq. mi.)	mostly private; 600 acres are protected/town-owned	S/V						
Myles Standish State Forest — FIRE DEPT. COOPERATES WELL WITH SOUTH CARVER			S/V						
LARGE # OF PRIVATE DAMS (called "Flumes") w/ COOPERATIVE WATER CONTROL AMONG CRANBERRY GROWERS	TOWN-WIDE		S						

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.com

H-M-L priority for action over the Short or Long term (and Ongoing)
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	WIND	WILDFIRE	PRECIP/ DROUGHT	TEMP	Priority H-M-L	Time Short Long Ongoing
Infrastructural									
Public Water Supply — North Carver Water District			V						
Public Water Supply — Individual, Separated e.g. for Cranberry Village, Carver municipal buildings			V						
Fire Protection System — cisterns, open waters, intakes, hydrants, access routes, GIS map			V/S						
Emergency Communications Towers — 3 damaged			V	- Two towers damaged 3/2-3/18 - Access hindered by downed trees					
Emergency Generators for critical municipal facilities (propane)			S						
Societal									
Vulnerable populations (age, economic disadvantage) eg Cranberry Village, Pine Tree Village			V	* Access, Power loss	* dense, access, water supply	* water supply	* heat stress		
High School — Used for emergency shelter. No real issues/concerns identified.			S						
Shopping, Medical services, pharmacy — limited to North Carver primarily or out of town			V						
King Richard's Fair & Edaville — tourism, stress on water supply			V						
Environmental									
Standing Water — mosquitoes & flooding. Blockages (down trees in bog canals)									
Sampson's Pond (and) others — having issues with algal blooms, lower water levels, etc.						*	*		
Forest fires (wildfire) — primarily Miles Standish but elsewhere									
Pests — Ticks, mosquitoes, gypsy moths, "footprint disease" (bogs), decline of pollenators									
Renewable Energy — backup power by fossil fuels has PPA for solar at ~~N. Carver landfill~~ Rt 44 runs ~~Also~~ NCWD; Paddock (sp?) solar array power to Town			S						

Appendix C

CRB Workshop Presentation Materials

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Boston Firefighters, January 4, 2018 (Reuters)

Cambridge Reservoir, Lincoln, MA (Boston Globe)

Municipal Vulnerability Protection Program
Community Resilience Building Workshop
Town of Carver

April 30, 2018

Community Resilience Building Workshop

Agenda

- CRB Team and participant introductions
- Introduction to Massachusetts Municipal Vulnerability Preparedness Program (MVP)
- Introduction to Climate Change and the Town of Carver
- Discussion by Carver representatives on status of current planning
- Introduction to CRB Workshop process
- Large group
  - Determine top four hazards
- Small work groups (Using Risk Matrix)
  - Identify Carver's vulnerabilities and strengths
  - Prioritize response actions
- Lunch
- Large group
  - Report out from small groups
  - Determine overall priority actions for the Town
- Discussion on next steps
- Conclusion

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Fuss & O'Neill Overview

At Fuss & O'Neill, we place great emphasis on collaboration; both within the company and with our clients. We are guided by what is best for the client and the project – in identifying client champions, naming project leaders, building project teams, and providing responsive service and quality deliverables.

We strive to partner with our clients to understand their businesses and to be stewards of their resources as if they were our own, and aim to develop services and solutions that anticipate evolution of their unique business needs.

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MVP Project Team

Mary Monahan

Mary is a municipal public works specialist well-versed in issues related to stormwater management; wastewater collection and treatment; drinking water supply, treatment, and distribution; solid waste management; and sustainable operations. Mary serves as a liaison between the public works project owner and the design team.

Kurt Mailman

Kurt manages diverse wastewater and stormwater management projects from evaluation of pumping systems to capital improvement plans, funding, assessment, and design of challenging hydraulic conveyance systems and training of operations staff. He is adept at managing all aspects of complex multidisciplinary projects from project initiation through construction and commissioning of facilities.

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MVP Project Team

Shawn Martin

Shawn's diverse project experience in land development includes surveying, land planning, environmental site assessments, stormwater management, water distribution, and wastewater collection and treatment systems. He is expert at the application of low-impact development strategies for a broad range of project types, including Brownfields sites with complex environmental conditions.

Julie Busa

Julie is an environmental scientist in the Water Environment and Natural Resources group of Fuss & O'Neill. She has over 10 years of experience in the areas of global biodiversity and forest conservation, sustainability, and ecological modelling.

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Carver MVP Program - $15,000

- Grant Supports Climate Change Vulnerability Assessments and Resiliency planning
  - Comprehensive Approach
    - o Infrastructure
    - o Society
    - o Environment
  - Scope and Process Use the Guidance in the Community Resilience Building Workshop Guide
  - Municipalities That Complete This Process Will Be Designated Municipal Vulnerability Preparedness (MVP) Municipalities

MVP Designation May Lead to Enhanced Standing in Future Funding Opportunities

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MVP Action Grant NEW

- Grant supports priority actions identified at Community Resilience Building Workshop
- $10,000 - $400,000 available
- Local match of 25% - can be in-kind
- Priority given to projects that propose nature-based solutions, green infrastructure, and enhancement of natural systems
- Phased approach encouraged
- Application deadline May 18
- Project award early June
- Next funding round anticipated early in FY19

Only those communities which have completed the CRB workshop are eligible to apply

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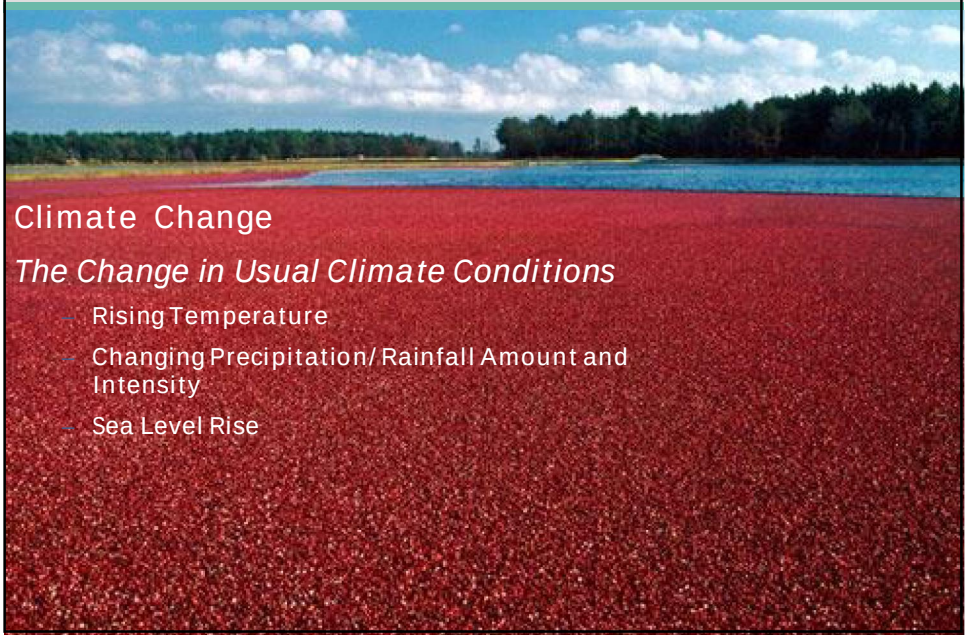
Terminology



Climate Change

The Change in Usual Climate Conditions

- Rising Temperature
- Changing Precipitation/ Rainfall Amount and Intensity
- Sea Level Rise

Town of Carver – Buzzards Bay Basin

Rising Temperature

Buzzards Bay Basin	Observed Baseline 1971-2000	Projected Change in 2030s	Projected Change in 2050s	Projected Change in 2070s	Projected Change in 2090s
Average Annual Temperature (°F)	50.67	1.93 to 3.63	2.56 to 5.85	2.96 to 8.49	3.28 to 10.34
Annual Days with Maximum Temperature over 90°F (Days)	4.41	3.20 to 9.238	4.20 to 20.84	5.88 to 39.91	8.16 to 55.00
Annual Days with Minimum Temperature below 0°F (Days)	1.7	-0.32 to -0.75	-0.40 to -0.97	-0.48 to -0.89	-0.45 to -0.94

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Town of Carver – Buzzards Bay Basin

Changing Precipitation

Buzzards Bay Basin	Observed Baseline 1971-2000	Projected Change in 2030s	Projected Change in 2050s	Projected Change in 2070s	Projected Change in 2090s
Total Annual Precipitation (Inches)	47.76	-0.68 to 3.87	0.33 to 5.43	0.70 to 6.13	0.28 to 6.76
Annual Consecutive Dry Days (Days)	17.49	-0.43 to 1.86	-0.28 to 2.26	-0.65 to 3.31	-0.21 to 4.08

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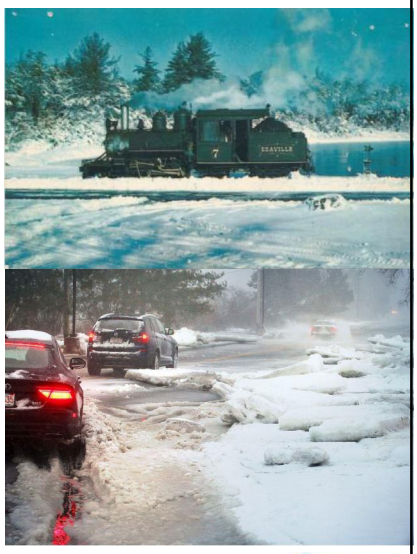
Climate Change Impacts - Temperature

- Economic
  - Winter Recreation
  - Snow and Ice
- Agricultural
  - Longer Growing Season
- Health
  - Increased Pests
  - Heat Stroke
- Infrastructure
  - Road Buckling
  - More Potholes
  - Power Outages
- Environment
  - Change in Habitat



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Climate Change Impacts - Precipitation

- Economic
  - Dangerous Floods
  - Lost work time
- Agricultural
  - Excessively Wet Spring
  - Drought
- Health
  - Flood/High Water-related Deaths
  - Emergency Response Delays
- Infrastructure
  - Road Washout
  - Environment
  - Sewer System Overflows
  - Compromised Bridges
- Changes in Habitat

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Stakeholder Updates

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Risk Matrix

Community Resilience Building Risk Matrix www.CommunityResilienceBuilding.com

H-M-L priority for action over the Short or Long term (and Ongoing)
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					Priority H - M - L	Time Short Long Ongoing
Infrastructural									
Societal									
Environmental									

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MVP Program

- Identify Top Four Hazards
  - Review MVP Sectors
  - Maps as tool
  - List infrastructure, societal, environmental feature
  - Determine whether a vulnerability or strength
  - Identify actions to reduce vulnerability or reinforce strength
  - Prioritize actions
  - Report Out
- Finalize Prioritization Plan

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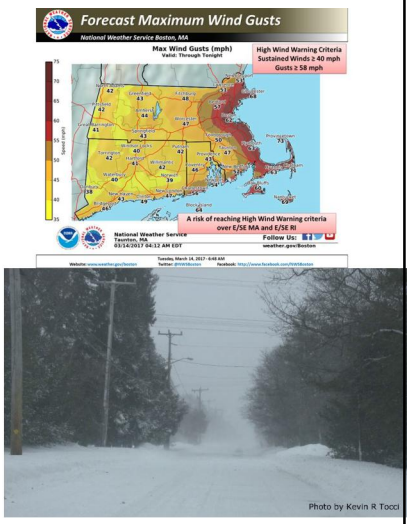
Climate Change Hazards

- Flooding
- Extreme Precipitation Events
- Heat Waves
- Drought
- Snow/Ice
- Wildfire
- Tornadoes
- Hurricanes
- Nor'easters
- Other



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MVP Sectors

- Infrastructure
  - Evacuation routes
  - Schools
  - Roads, bridges, dams
  - Water and wastewater
  - Septic systems
  - Hospitals
  - Commercial Buildings, churches
  - Utilities: electric, gas
  - Factories
  - Emergency management facilities

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MVP Sectors

- Societal
  - Emergency shelters
  - Senior housing
  - Schools and campuses
  - Economically challenged populations
  - Evacuation plans
  - Animal shelters
  - Hospitals, pharmacies
  - Grocery stores
  - Utilities: electric, gas
  - Homeless
  - Other

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MVP Sectors

- Environmental
  - Drinking water supply
  - Rivers and streams
  - Parklands
  - Agriculture
  - Title V systems
  - Stormwater management
  - Open spaces
  - Flood plains
  - Forest
  - Other

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Community Resilience Building Workshop

Next Steps:

Public Review of Priorities
Monitor and Update
Annual Review

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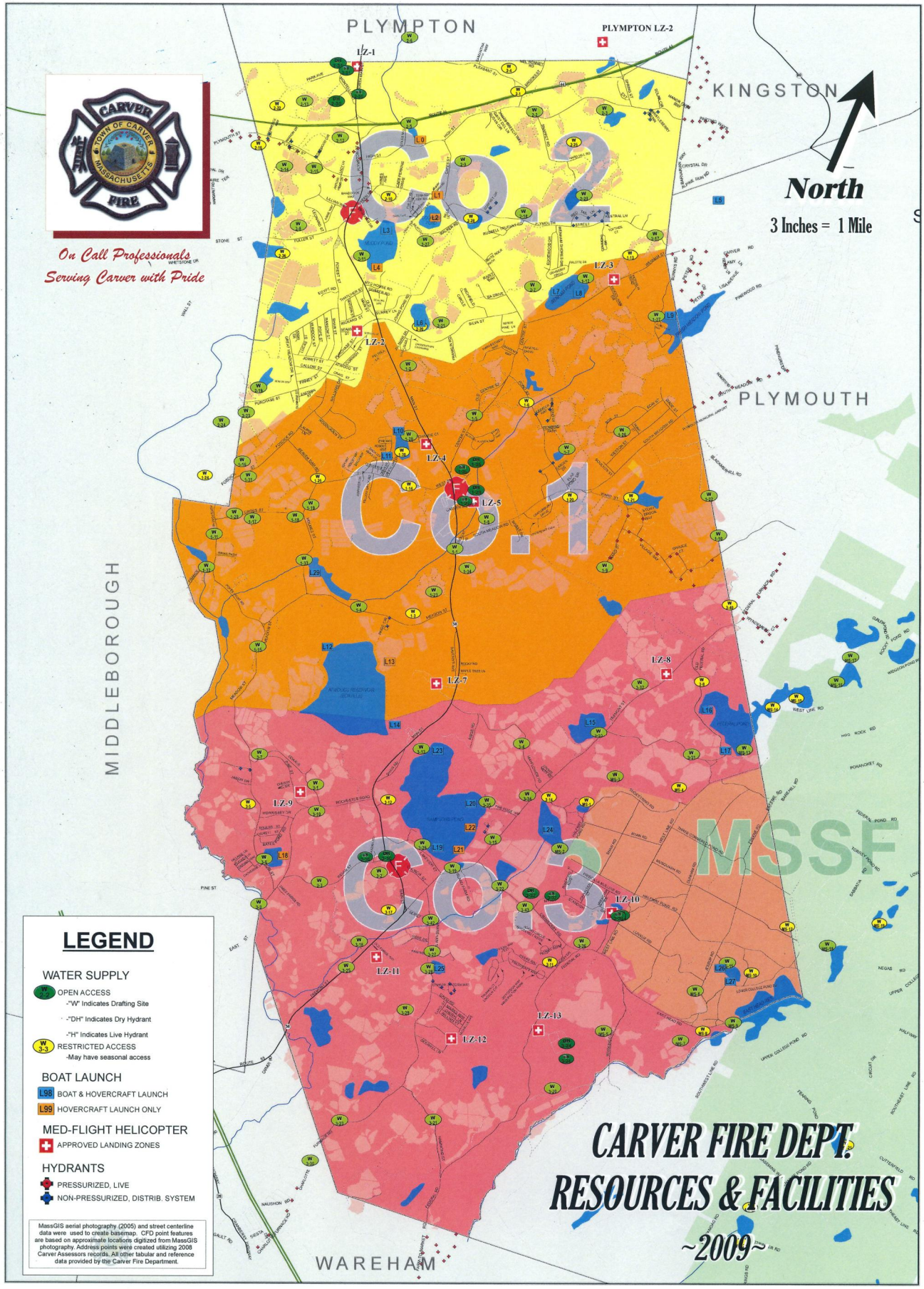
Questions?

Appendix D

Supporting Risk Maps


PLYMPTON
PLYMPTON LZ-2
LZ-1
KINGSTON
North
3 Inches = 1 Mile
CARVER
TOWN OF CARVER
MASSACHUSETTS
FIRE
On Call Professionals
Serving Carver with Pride
Co 2
Co 1
Co 3
MSSF
LZ-3
LZ-2
LZ-4
LZ-5
LZ-7
LZ-8
LZ-9
LZ-10
LZ-11
LZ-12
LZ-13
PLYMOUTH
MIDDLEBOROUGH
WAREHAM
LEGEND
WATER SUPPLY
OPEN ACCESS
-"W" Indicates Drafting Site
-"DH" Indicates Dry Hydrant
-"H" Indicates Live Hydrant
RESTRICTED ACCESS
-May have seasonal access
BOAT LAUNCH
L98 BOAT & HOVERCRAFT LAUNCH
L99 HOVERCRAFT LAUNCH ONLY
MED-FLIGHT HELICOPTER
APPROVED LANDING ZONES
HYDRANTS
PRESSURIZED, LIVE
NON-PRESSURIZED, DISTRIB. SYSTEM
MassGIS aerial photography (2005) and street centerline data were used to create basemap. CFD point features are based on approximate locations digitized from MassGIS photography. Address points were created utilizing 2008 Carver Assessors records. All other tabular and reference data provided by the Carver Fire Department.
CARVER FIRE DEPT.
RESOURCES & FACILITIES
~2009~