Town of Mashpee

Community Resilience Building Workshop Summary of Findings

March 2020

PREPARED FOR:
Town of Mashpee
Planning Department
16 Great Neck Road North
Mashpee, MA 02649

PREPARED BY:
Woods Hole Group, Inc.
A CLS Company
107 Waterhouse Road
Bourne, MA 02532 USA

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1.0 OVERVIEW

The Town of Mashpee, like many communities throughout the Commonwealth, has experienced more frequent and more impactful climate-related natural hazards in recent years. Events such as the Blizzard of 2015, heavy rainfall in July 2017, and powerful Nor'easters in January and March 2018 exposed both strengths and vulnerabilities in the Town, and reinforced the urgent need to proactively plan and mitigate climate-related risks through a community driven process. Planning for current and future hazards through the engagement of a diverse cross-section of stakeholders in Mashpee will build on existing initiatives and develop new strategies to reduce climate-related vulnerabilities for the Town's citizens, infrastructure, and natural systems.

Acknowledging this need for proactive climate adaptation planning, the Town of Mashpee enrolled in the Municipal Vulnerability Preparedness (MVP) program, administered by the Massachusetts Executive Office of Energy and Environmental Affairs, which provided funding to conduct a Community Resilience Building (CRB) Workshop – a framework for community driven climate adaptation planning (https://www.communityresiliencebuilding.com/) developed by The Nature Conservancy.

The Mashpee Planning Department convened a core team – including representatives from Conservation, Board of Health, the Library, Police, Fire, and Natural Resources – to guide and organize the CRB process. This core team selected Woods Hole Group as the Town's Certified MVP Provider. Woods Hole Group and the core team collaborated on preparing for the CRB Workshop, including identifying stakeholders from a broad cross section of the community to invite to participate in the process.

The Woods Hole Group facilitated an 8-hour CRB Workshop for the Town of Mashpee on November 15, 2019. The 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 the Community; and
- Identify immediate opportunities to collaboratively advance actions to increase resilience.

There were 23 stakeholders in attendance at the CRB Workshop, comprised of Town employees, citizens engaged in relevant boards and committees, as well as representatives of the business community, residential associations, non-profits, and Mashpee Wampanoag Tribe. Town Manager Rodney Collins welcomed participants to the workshop and thanked them for giving their time to this important planning process. The CRB's Risk Matrix format, large-scale maps of the Town of Mashpee (Appendices A and B), and various datasets on natural hazards (Appendices C and D) were integrated into the workshop process to provide both decision support and risk visualization for workshop participants. The workshop included a combination of large group presentations and small group discussions. The large group presentation outlined the workshop process/goals, presented relevant hazard and community data, shared example actions, and provided an update on local planning efforts and initiatives. Participants also had an opportunity to work together in small groups consisting of approximately 8 people with different roles, responsibilities and expertise to foster an exchange of ideas and perspectives. Spokespersons from the small groups then reported their findings back to the larger group. This workshop process, rich with information, and experiences and dialogues from the participants produced the findings detailed in this summary report. This report provides an overview of the top hazards, current concerns and challenges, current strengths and vulnerabilities, and recommends actions to improve the Town of Mashpee's resilience to natural and climate-related hazards today and in the future.

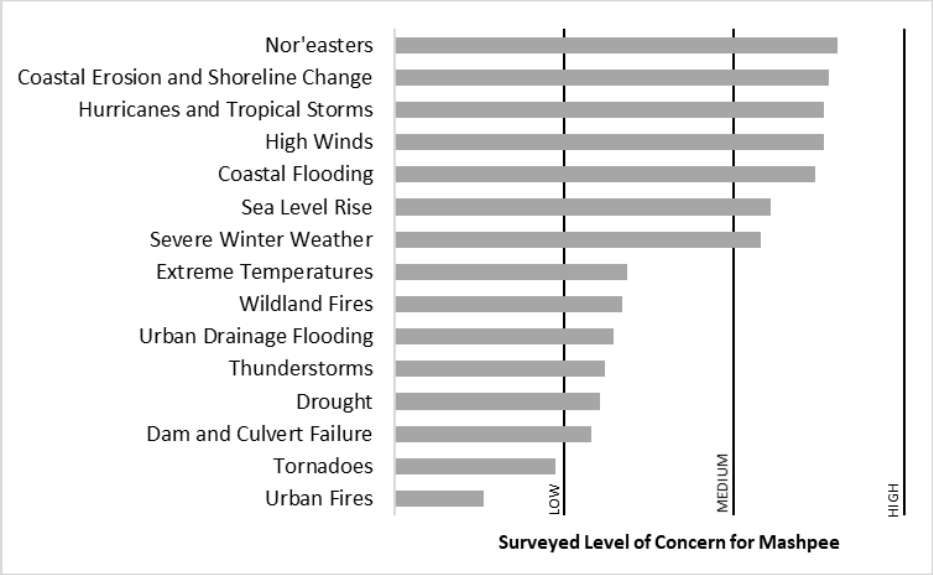
2.0 TOP HAZARDS AND VULNERABLE AREAS

The recently completed 2017 Draft Mashpee Hazard Mitigation Plan provided a sound basis from which to select top natural hazards for the Community Resilience Building Workshop. Prior to the Workshop on November 15, 2019, invited stakeholders were asked to identify the top natural hazards of concern for the Town of Mashpee based on past/present experience as well as anticipated future conditions.

		Climate Change Linkage
Highly Likely	Coastal Erosion and Shoreline Change	Yes
	Fire: Urban	Yes
	Fire: Wildland	Yes
	Flood: Coastal	Yes
	High Winds	Yes
	Hurricanes and Tropical Storms	Yes
	Nor'easters	Yes
	Sea Level Rise	Yes
	Severe Winter Weather: Snow, Blizzards, and Ice Storms	Yes
	Drought	Yes
	Thunderstorms	Yes
Likely	Flood: Urban Drainage	Yes
Possible	Tornadoes	Yes
	Extreme Temperatures	Yes
	Dam and Culvert Failure	Yes
	Landslides	
	Tsunami	
Unlikely	Earthquake	

Invitations to the workshop were distributed with a link to a pre-workshop online survey and RSVP page. Respondents first reviewed a ranked list of the hazards considered in the Hazard Mitigation Plan which was annotated to highlight those natural hazards with linkages to climate change. Next, the online survey provided a brief series of downscaled climate change projections for the Cape Cod region from the Massachusetts Climate Change Clearinghouse (resilient MA) – including temperature, precipitation, sea level rise, and storm surge. Following review of the climate change projections, respondents were asked to report their level of concern for each climate-related natural hazard considering current conditions and Mashpee's climate future. The results of the survey were used to select the top hazards for the Workshop.

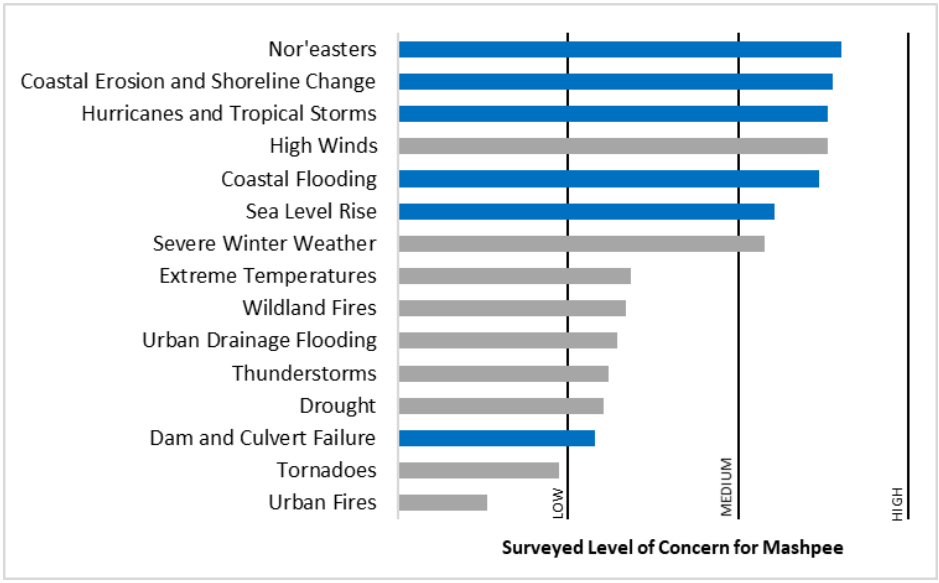
There were thirty-eight responses to the hazard survey. On average, stakeholder concern was highest for storms such as Nor'easters and hurricanes as well as severe winter weather, and coastal hazards such as flooding, sea level rise, coastal erosion, and high winds. As is true for many communities on Cape Cod, these coastal threats loom large in the collective consciousness of Mashpee stakeholders. Respondents also expressed concern about impacts from extreme heat, drought, fire, thunderstorms, and tornadoes – though to a lesser degree than the coastal hazards.



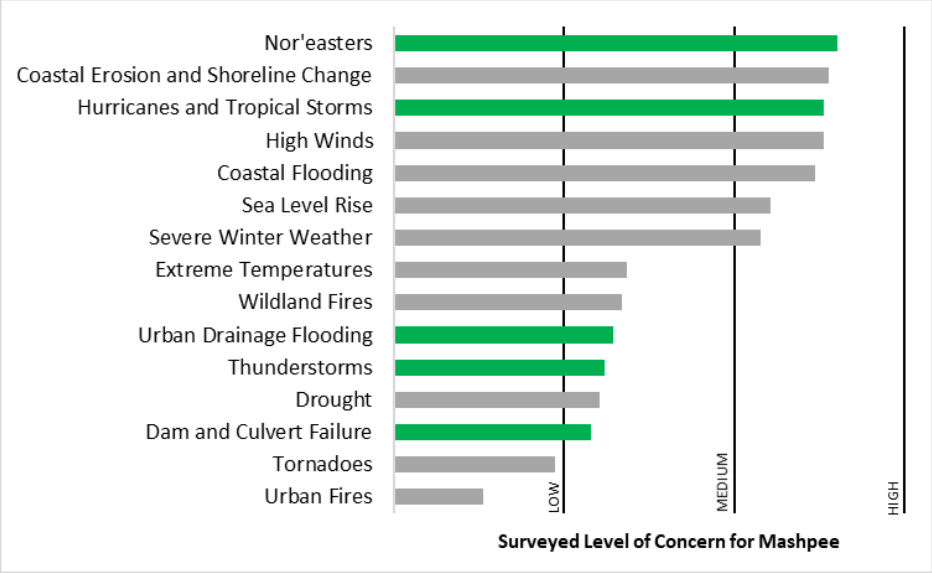
Top Hazards

After reviewing the survey results, and considering recent experience with the impacts of heat, heavy rain, snow and ice, and inland flooding due to precipitation events, the CRB Workshop Project Team grouped the hazards into four overarching Top Hazard categories:

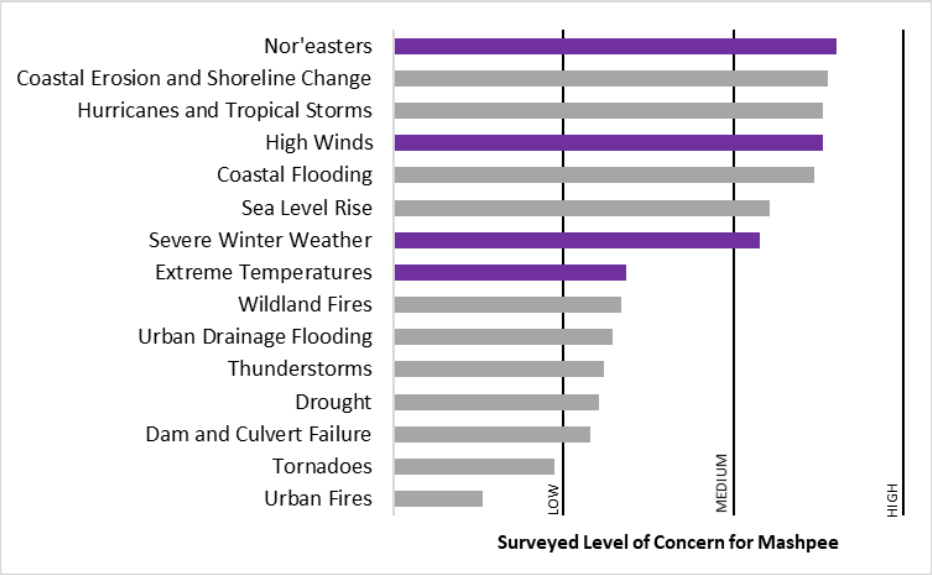
1. Coastal Flooding and Erosion – *Periodic and episodic flooding of coastal areas due to sea level rise and storm surge (e.g. hurricanes and Nor'easters) and the resultant changes to the landform.*



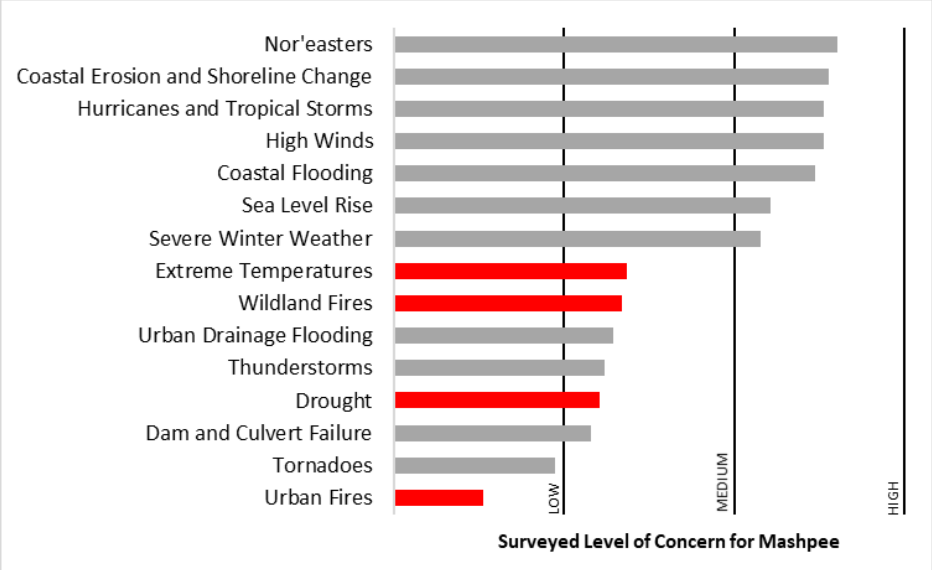
2. Inland Flooding – *Flooding of inland areas due to precipitation and high groundwater.*



3. Extreme Cold and Winter Storms – *Low temperatures coupled with wind, snow, sleet, and/or freezing rain associated with winter storms.*



4. Heat, Drought, and Fire – *High temperatures and associated impacts from drought and/or fire.*



Areas of Concern

Neighborhoods – Residential areas around ponds (Ashumet, John's, Mashpee/Wakeby, Santuit), Mashpee Commons, New Seabury, business districts

Populations – Senior citizens (senior communities, assisted living facilities, Mashpee Housing Authority), special needs and vulnerable communities, seasonal populations

Ecosystems and natural resources – Conservation lands, freshwater wetlands, freshwater ponds (Ashumet, John's, Mashpee/Wakeby, Santuit), rivers (Childs, Quashnet, Mashpee, Santuit) and herring runs, Waquoit Bay, Popponesset Bay, Beach and dune systems (Town Beach, South Cape Beach, Popponesset Beach and Spit), salt marsh ecosystems, shellfish beds and aquaculture

Transportation – Navigation channels, Low-lying roads and culvert crossings (Monomoscoy Causeway, Seconett Island Causeway, Red Brook Road), bridges (Popponesset Island)

Infrastructure – Communication lines and cell towers, septic systems and wastewater treatment facility, drinking water infrastructure, storm drains, utilities

Facilities – Town waterfront facilities and other municipal facilities, Popponesset Community Center, Mashpee Wampanoag Tribal Center, marinas and fueling stations, emergency shelters

3.0 CURRENT CONCERNS AND CHALLENGES PRESENTED BY HAZARDS

The Town of Mashpee has many concerns and faces multiple challenges stemming from the impacts of climate-related natural hazards. These concerns and challenges were highlighted at core team meetings, during pre-workshop interviews with municipal staff, and during the CRB Workshop; they were further corroborated by the 2017 Draft Mashpee Hazard Mitigation Plan.

In recent years, Mashpee has experienced a series of disruptive and damaging weather events – including Hurricane Sandy in 2012 (high winds and coastal storm surge), the Blizzard of 2015 (~30 inches of snow, widespread power outages, high winds and coastal storm surge), torrential rains in July 2017, and multiple large Nor'easters in January and March 2018 (heavy snow and rain, high winds, power outages, and coastal storm surge). These and other extreme weather events are occurring more frequently, and exact tremendous impacts on municipal budgets, infrastructure, environmental resources, and business continuity. Examples of the impacts from extreme weather include flash flooding (damaging infrastructure and property, requiring additional maintenance to stormwater infrastructure, impairing travel, and impacting pond water quality with a flush of nutrients), tree damage and widespread power outages (damaging property and utility infrastructure, disrupting business activity, and requiring resources to operate shelters), burdensome and expensive snow removal and road treatment activities, and coastal flooding and erosion (damaging property, infrastructure, beaches and dunes).

The frequency of the storms in March 2018 exacerbated the impacts, as the Town was still recovering from the last storm when the next one arrived. In Mashpee, these storms resulted in numerous downed trees (since high winds followed heavy rain and snow), damage to culverts and undermining of town roads, and damage to coastal resources and infrastructure. The magnitude and severity of the impacts of these storms produced a heightened level of awareness in Mashpee and provided additional motivation to comprehensively improve resilience and reduce local vulnerabilities to natural hazards.

In addition to these significant episodic events, Mashpee is experiencing more periodic impacts related to climate change, which are projected to increase in the future. For example, for many years, Santuit Pond has experienced algae blooms due to high nutrients and the Town installed circulators to mitigate the problem. However, heavy precipitation events in 2017 and 2019 have been reported to mobilize excess nutrients to the pond via stormwater runoff, overwhelming the Town's remedial efforts and reactivating the toxic cyanobacteria blooms in this eutrophic system. Such intense precipitation events will become more frequent as temperatures rise and activate energetic weather patterns. Sea level rise also has implications for the long-term viability of coastal assets. King Tides in October 2016 provided a glimpse of future shorelines and highlighted areas where rising waters will conflict with existing uses (e.g. overtopping roadways). These more regular impacts are high priority issues for the Town, since they are beginning to affect daily operation and maintenance, and the long-term usefulness of infrastructure.

There was consensus among Workshop participants that the Town of Mashpee is experiencing more intense and frequent storms, which has greatly exacerbated precipitation, coastal

inundation and erosion issues, as well as longer term shifts in temperature and sea level. It was clear from the Workshop that stakeholders in Mashpee are committed to addressing these concerns in ways that build long-term resilience throughout the community.

Specific Categories of Concerns and Challenges

Coastal Resources

Workshop participants acknowledged the important role coastal natural resources (salt marshes, beaches, dunes, coastal banks) play in the Town of Mashpee. Not only do these resources attract tourist activity for their recreational amenities and aesthetic value (and are therefore an essential economic driver) but they also provide critical ecosystem services (e.g. carbon sequestration, storm surge attenuation, pollutant filtration, and critical habitat). There was widespread concern for the sustainability of these important natural resources in the face of climate change, especially South Cape Beach and the Popponesset Spit. Challenges facing coastal green infrastructure include sea level rise outpacing salt marsh accretion, development impinging on the ability of salt marshes to migrate with sea level rise, and storm events eroding beaches, dunes, and coastal banks.

Inland Water Quality and Wastewater Issues

Stakeholders in Mashpee have grappled with water quality issues in the Town's freshwater ponds for many years. Some progress has been made in reducing nutrient loads and stormwater inputs, as well as mitigating the impacts of historical inputs with engineering and technological solutions. However, algae blooms in certain ponds have

persisted and/or re-emerged with more intense and more frequent rain events. Inland water bodies are important natural resource and recreational areas for Mashpee's residents and visitors; therefore, participants highlighted these water quality issues as a challenge of critical importance.

Vulnerability of Low-lying Roadways and Culverts

There was widespread concern among each of the working groups for the long-term viability of low-lying coastal and inland roadways, culvert crossings, and evacuation routes given the projected increases in sea level, coastal storms, and precipitation. Participants noted multiple roadways, causeways, and bridges that are or will be vulnerable to flooding and/or wash-out (e.g. Monomoscoy Causeway, Seconsett Island Causeway, Popponesset Island Bridge, Red Brook Road). Notably, there are many aging and undersized culverts that are vulnerable to wash-out and failure during coastal storms and/or large precipitation events.

Vulnerability of Municipal Infrastructure

Workshop participants also expressed concern for vulnerable infrastructure – including municipal facilities and buildings, waterfront infrastructure, shellfish propagation facilities, electrical and fuel utilities, drinking water infrastructure, and wastewater infrastructure. Potential impacts from all climate related hazards (including coastal flooding/erosion, inland flooding, winter storms, and extreme heat) were of concern.

Vulnerable Populations

There was concern among the Workshop participants for vulnerable populations, including low-income communities, senior citizens, and special needs communities. The Town is home to multiple continuing care and retirement communities. Additionally, Workshop participants noted that seasonal visitors and summer populations may require special attention during emergency situations. Specific challenges, especially for aging populations, include vulnerabilities to power outages (due to the need to keep medications refrigerated and medical equipment online), sensitivities to extreme heat and cold, and reduced abilities to cope with flooding (reduced mobility and ability to evacuate).

Wastewater Management

Wastewater management is an ongoing concern for the Town of Mashpee, as it is for many municipalities across Cape Cod. Apart from a few packaged wastewater treatment facilities at municipal facilities in private developments, the widespread use of traditional septic systems throughout Town contribute to eutrophication of coastal embayments and ponds, prompting the development of TMDLs for the multiple waterbodies of concern in Mashpee. There are ongoing initiatives to explore options for wastewater management in the Town. Considering sea level rise, increased frequency

and intensity of coastal storms, increased precipitation, and increasing groundwater tables, there was concern amongst Workshop participants for the potential impacts of climate change on wastewater management in the Town of Mashpee. Specific challenges for existing septic systems noted by Workshop participants included the potential for reduced functionality and failure due to saltwater intrusion and/or higher water tables, the potential for damage to coastal units due to erosion, and the potential for increased mobilization of nutrients due to increased precipitation.

Communication and Emergency Response

Stakeholders in the Town of Mashpee expressed concerns about the ability of citizens, businesses, municipal officials, and emergency responders to maintain effective communication and coordination when facing climate-related hazards. Equitable access to reliable internet and cellular service was cited as a specific challenge, which impedes residents (especially vulnerable populations), businesses, and visitors in Mashpee from effectively coping with the impacts of climate-related hazards. Workshop participants also recognized that town wide emergency plans should be updated to consider climate-related impacts.

4.0 CURRENT STRENGTHS AND ASSETS

Based on pre-Workshop interviews with core team members, and based on conversations among the Workshop participants, it was evident that two key strengths in the Town of Mashpee are its people and its significant focus on natural resource protection. When asked to describe the community's strengths, stakeholders cited a strong sense of community, and productive and collaborative working relationships among municipal staff and with the Mashpee Wampanoag Tribe. These community characteristics will provide Mashpee with a strong foundation on which to build resilience to climate change and extreme weather, leveraging nature-based solutions wherever possible.

Additionally, many workshop participants cited the Town's coastal and terrestrial natural resources as a key strength, noting especially a Town-wide commitment to conservation and natural resource protection. Nearly 50% of Mashpee's land is protected, either as Town-owned conservation and open space, State Park, National Wildlife Refuge, or private land trust holdings. Stakeholders acknowledged that natural resources are a primary driver for Mashpee's tourism economy, and also provide significant ecosystem services (including coastal storm protection, subsistence and commercial shellfishing, etc.). This tradition of protecting natural systems in Mashpee will help the Town leverage nature-based solutions for climate resilience.

Other strengths noted by participants in the CRB Workshop include:

- The Town of Mashpee (2017) and the Mashpee Wampanoag Tribe (2019) recently updated to their Hazard Mitigation Plans. Therefore, municipal departments and tribal leaders are keenly aware of the impacts natural hazards may have in the community, and have already developed plans for addressing these hazards and reducing risk.
- The Town and the Tribe have a history of success and collaboration on natural resource protection and restoration. Both the Town of Mashpee and the Mashpee Wampanoag Tribe have completed wetland restorations, herring run restorations, and water quality initiatives. Both entities have also secured the preservation of open space and natural resources through significant land protection. These initiatives, combined with a strong public support for conservation throughout Mashpee, will carry momentum into future initiatives to reduce climate vulnerability and increase resilience.
- Coastal morphology in some parts of Mashpee provide additional protection to inshore areas by intercepting wave action and constricting storm surge. For example, the Popponesset Spit protects the shorelines of Popponesset Bay by reducing wave action. Similarly, Dead Neck protects the shorelines of Waquoit Bay and its coastal ponds.
- Shellfish aquaculture is widely regarded as a strength to the community, since it improves water quality and provides a local food source.
- Strong ties within the community, evident among the Mashpee schools, business districts, faith-based organizations, Wampanoag Tribal centers, and senior centers, were cited as assets in the Town of Mashpee.

5.0 TOP RECOMMENDATIONS TO IMPROVE RESILIENCE

A common theme throughout the Workshop discussions (and in pre-workshop interviews with Core Team members) was a recognition of the importance of natural resources for the Town of Mashpee. As a Cape Cod community with significant coastal and inland natural resources, Mashpee relies on the quality of its natural environment to attract visitors and residents. The Town's infrastructure enables Mashpee to accommodate these populations safely, and there is increasing focus on implementing sustainable strategies to reduce human impacts on natural resources. Simultaneously, natural hazards have the capacity to impact all facets of the Town's character. Therefore, there was broad consensus among Workshop participants that there was a need to build resilience in environmental resources, societal resources, and infrastructure in the face of current and future hazards.

The following are the Top Priority Actions developed by each working group, and later aggregated by common themes. After each working group presented their top five priority actions, and these actions were grouped by similar themes, the large group voted on all priority actions (5 voting dots per workshop participant). These top priority actions are presented below in order of votes received.

1. Coastal Green Infrastructure

The sustainability of coastal green infrastructure is critical to the viability of Mashpee's coastal and embayment communities. Initiatives to plan, permit, fund and construct beach nourishment, dune restorations, and other living shoreline projects in Mashpee (especially those that beneficially reuse dredged materials) should be prioritized to build resilience in the Town's coastal and affected inland communities and simultaneously build resilience in these important natural systems.

2. Water Quality

Protecting and improving water quality throughout Mashpee's watersheds – including freshwater ponds, rivers, and estuaries – are of paramount importance given current conditions and potential future shifts in temperature, precipitation, sea level, and groundwater tables. The Town should prioritize efforts to protect and restore these natural resources so that they can provide essential ecosystem services now and into the future. Initiatives to build resilience in freshwater and coastal ecosystems may include implementation of the Mashpee Comprehensive Watershed Nitrogen Management Plan, further development infrastructure and monitoring programs to support shellfish aquaculture, enhanced monitoring of pollutants and invasive aquatic species, review and revision of local bylaws, and the development of public outreach and education.

3. Stormwater Infrastructure

Stormwater runoff impacts infrastructure and natural systems under current conditions in Mashpee, and projections for more frequent and intense precipitation were of particular concern to stakeholders. Stormwater design standards should be updated to account for anticipated future conditions, and stormwater control infrastructure should be constructed and/or upgraded to reduce vulnerability to increasing runoff and to protect natural resources from erosion and chemical/nutrient impacts.

4. Vulnerability Assessment for Municipal Facilities and Infrastructure

Mashpee's municipal facilities and infrastructure will be challenged by climate related hazards, and may impact the Town's ability to provide services. The Town should conduct a detailed vulnerability assessment to prioritize resilience actions for municipal infrastructure. This analysis should consider potential impacts to infrastructure from coastal inundation, but – given the concerns and priority hazards for Mashpee – could also be extended to consider inland inundation, winter storms, and/or heat. Stakeholders noted that a range of adaptation options should be considered (including elevation/protection, retro-fitting, green infrastructure, relocation and managed retreat) depending on location and criticality.

5. Emergency Management Planning and Communication

The Town (in coordination with the residential and business communities) should update and coordinate emergency planning considering all of Mashpee's projected climate-related hazard exposures and their potentially cascading impacts to the community. Initiatives may include building resilience in communications networks, developing/enabling energy resilience in critical municipal facilities and affordable housing, enhancing the capacity of local shelters and warming/cooling/charging stations, coordinating town services and emergency response, and developing climate-related outreach and education for Mashpee's residents, visitors, and businesses.

6. Low-lying Roadways and Culverts

Access to communities via causeways and low-lying roadways are a high concern for Mashpee stakeholders, given that overtopping and erosion are limiting access and impacting maintenance budgets under current conditions. With anticipated increases in sea level, coastal storms, and precipitation, the Town should evaluate alternatives for maintaining daily and emergency access to these areas as well as increasing resilience to the impacts of storms. After evaluating vulnerabilities along these access roadways (e.g. at Monomoscoy, Seconsett, Red Brook Road, and Daniels Island Road), the Town should prioritize roadway adaptations and culvert resizing projects to build resilience – especially where there are co-benefits such as natural resource restoration or invasive species management.

In addition to developing, grouping, and ranking these top priority actions, Workshop participants developed a larger suite of recommended actions. These additional recommended actions to build resilience in the Town of Mashpee were ranked by each working group in terms of their priority (High/Medium/Low).

High Priority Actions:

- South Cape Beach Parking - reduce parking lot size; shuttles; state beach; green infrastructure (sand, grass, fence, habitat enhancement); relocate & repair DNR facility.
- Explore/ identify retrofitting options and/or new locations for municipal buildings and infrastructure that are more resilient to maintain Town services.
- Dredging of Popponesset Inner Channel/Waquoit Channel (including permitting).
- Elevate Monomoscoy Causeway; evaluate culvert sizing; invasive species management; dredging; natural resource enhancement.
- Evaluate existing evacuation route infrastructure and upgrade to meet requirements and certifications.
- Assess vulnerabilities in communication lines and cell towers and determine options to increase resilience.
- Explore/understand current standards for stormwater design and plan for resiliency and identify specific vulnerable infrastructure.
- Review existing emergency management plan and update.
- Understand/develop a climate change preparedness and climate resilience project; communications, town services, emergency response.
- Develop community and neighborhood emergency response plan.
- Audit of zoning bylaws and regulation for resiliency; explore options of building resilient affordable housing
- Management plan; land acquisition; upwelling equipment; winter storage for shellfish.
- Feasibility study/implementation plan for sand mining as a source of sand to enhance South Cape and Popponesset beaches (involves permitting, dredge, construction).
- Seek funding to complete Phase II of Popponesset Spit work (dredging, sand, grasses).
- Pond (Santuit, John's, Mashpee, Ashumet) Diagnostic studies - pollutants; water sampling; public education; shellfish propagation; review local bylaws pertaining to water quality; SAV survey - invasive management plan.
- Implementation of the Mashpee Comprehensive Watershed Nitrogen Management Plan and funding for Santuit watershed actions.
- Construct stormwater control systems.

Medium Priority Actions:

- Complete study of climate change on Monomoscoy Causeway for feasibility of redesigning.
- Bury utility wires, tree maintenance, power maintenance, vulnerability assessment, copy of utility assessments.
- Groundwater Rise Modeling and Analysis for septic system impacts; sewer as necessary.
- Assessment of traffic and emergency response ability to determine possible alternatives to accommodate seasonal population surge.
- Implement town wide resiliency loan program to encourage/incentivize homeowners/businesses to install building features for special needs communities.
- Increase tree plantings and green space to prevent heat islands in vulnerable communities.
- Update Harbor Management Plan.
- Easements; inventory; SLAMM model; purchase land for protection/restoration/resilience.
- Dredging Popponesset navigation channels; beach nourishment/dune enhancement/plantings at the Popponesset Spit; hydrodynamic analysis; harbor management plan.
- Education campaign for importance of Popponesset Spit, function, environmental importance, available access.
- Coldwater fishery health; access; protecting endangered species.
- SLAMM Models; Herring run study.
- Acquisition of additional open space.
- Identify available parcels for conservation and obtain funding for acquisition.

Lower Priority Actions:

- Enhance community wide emergency response plan.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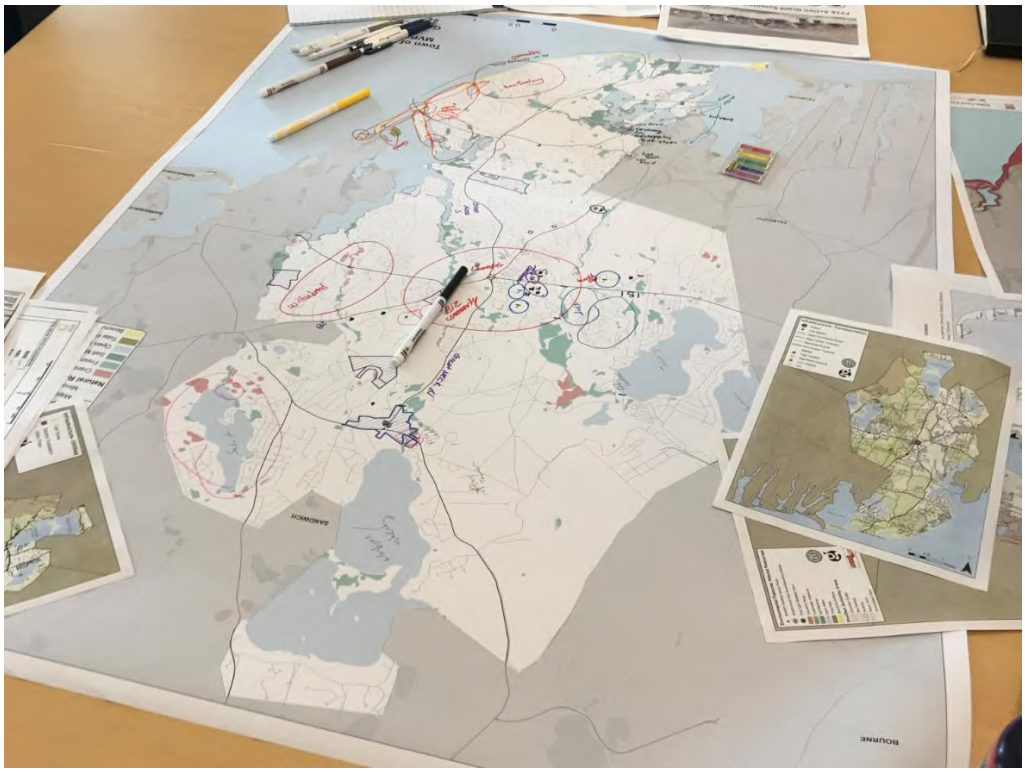
HARBORMASTER



6.0 CRB WORKSHOP PARTICIPANTS

The Town of Mashpee invited 47 Town employees, residents, and local business owners, as well as non-profit, tribe, state, and federal partners. All were invited to participate in a survey to select hazards of concern for the Town. In total, there were 38 responses to the survey, and 23 participants in the workshop on November 15, 2019.

Workshop Attendees

Workshop Participant	Town Affiliation
Evan Lehrer	Mashpee Planning Department
Mary Waygan	Mashpee Planning Board
John Malloy	Save Popponesset Bay
Virginia Scharfenberg	Mashpee Environmental Coalition
Patricia DeBoer	Mashpee Public Schools
Ken Bates	Mashpee Waterways Commission
Kathy Mahoney	Mashpee Public Library
John Phelan	Mashpee Fire Department
Bob Palermo	Mashpee Police Department
Jeff Smith	Mashpee Department of Natural Resources – Harbormaster Division
Rick York	Mashpee Department of Natural Resources
Dick Noonan	Mashpee Waterways Commission
Mary Lou Palumbo	Mashpee Chamber of Commerce
Mary Adams Oleksak	Save Popponesset Bay
Don MacDonald	Mashpee Waterways Commission
Ashley Fisher	Mashpee Department of Natural Resources – Shellfish Division
Drew McManus	Mashpee Conservation Department
Bob Hughs	Save Popponesset Bay / The Popponesset Beach Association
George Schmidt	Mashpee School Committee
Tom Fudala	Mashpee Water District / Mashpee Sewer Commission
Catherine Laurent	Mashpee Department of Public Works
Brad Sweet	Mashpee Conservation Commission
George Chuckie Green	Mashpee Wampanoag Tribe

Invited (unable to attend)

Invited Stakeholder	Affiliation
Andrew Gottlieb	Board of Selectmen
Dale McKay	Mashpee Conservation Commission
Ava Costello	Mashpee Citizen
Bill Blaisdell	Mashpee Zoning Board of Appeals
Katelyn Cadoret	Mashpee Conservation Department

Invited Stakeholder	Affiliation
Brian Baumgaertel	Mashpee Board of Health
Carol Sherman	Mashpee Board of Selectmen
John Falacci	New Seabury Properties
Charles Maintanis	Mashpee Building Department
David Weeden	Mashpee Board of Selectmen / Mashpee Wampangoag Tribe
Roy Reiss	Southport Condo Association
Richard Cook	Aquaculture License Holders
Elana Doyle	Mashpee Resident
Nelson Andrews	Mashpee Wampanoag Tribe
Glen Harrington	Mashpee Board of Health
Jan Aggerbeck	Cape Cod Coffee
Corey Hendricks	Mashpee Wampanoag Tribe
Tom Feronti	Mashpee Commons Limited
Joseph Cummings	Mashpee Planning Board
Michael Ronhock	Aquaculture License Holders
Mark Burtis	Aquaculture License Holders
Chris Burtis	Aquaculture License Holders
Lynne Waterman	Mashpee Council on Aging
Jeralyn Smith	South Cape Beach Advisory Committee
Barbara Nichols	Mashpee/Wakeby Lake Management Committee
Robert Warren	Trustees of Reservations
Michael Talbot	Environmental Oversight Committee, Mashpee Environmental Coalition
Mike Richardson	Peninsula Council
Mary Kay Fox	Mashpee National Wildlife Refuge
Richard J Santangelo	Mashpee Harbormaster Office
Tom Eagle	Mashpee National Wildlife Refuge
Robyn Simmons	Mashpee Economic Development and Industrial Corporation
Alan Waxman	Friends of Santuit Pond
Ernie Virgilio	Cape Cod Commission (Representative)
Stephanie Simpson	Community Garden Advisory Committee
Thomas Rose	Mashpee Police Dept.
(general inquiry)	Massachusetts Department of Conservation and Recreation
Jason Zimmer	Massachusetts Division of Fisheries and Wildlife
Wayne Taylor	Town of Mashpee

7.0 SUMMARY OF COMMUNITY FEEDBACK

The Town of Mashpee conducted a public listening session at the Mashpee Public Library on February 13, 2020 and solicited feedback on the draft of this report until February 28, 2020. Materials from the listening session are presented in Appendix E.

Areas of concern and recommended actions highlighted in these public comments that reiterate or expand on concerns addressed in the CRB workshop include:

- Areas of Concern
    - Coastal and/or stormwater flooding of low-lying roads and culverts (e.g. Red Brook Road crossing Red Brook, Great Oak Road adjacent to Jehu Pond)
    - Development in vulnerable floodplain areas
    - Effect of increasing heat on pollinators
    - Loss of native vegetation
- Recommended Actions
    - Cooperation with Falmouth on Waquoit Bay issues
    - Retreat from highly vulnerable areas, acquire coastal land
    - Promote sustainable transportation, including electric car charging stations
    - Develop initiatives to reduce heat island effect and install pollinator gardens
    - Promote native vegetation and increased open space for developments

8.0 CITATION

Town of Mashpee (2020) Community Resilience Building Workshop Summary of Findings. Mashpee Planning Department, Woods Hole Group. Mashpee, Massachusetts.

9.0 CRB WORKSHOP PROJECT TEAM

The CRB Workshop Project Team was composed of key Town of Mashpee staff (many of whom were involved in the development of the 2017 Mashpee Hazard Mitigation Plan) and MVP Providers from Woods Hole Group. Evan Lehrer, MPA (Town Planner) led the Project Team for Mashpee.

Town of Mashpee

Evan Lehrer, MPA	(Town Planner, Planning Department)
Ashley Fisher	(Shellfish Constable, Department of Natural Resources)
Glen Harrington	(Health Agent, Board of Health)
Kathy Mahoney	(Director, Public Library)
Drew McManus	(Conservation Agent/Herring Warden, Conservation Department)
John Phelan	(Deputy Chief, Fire Department)
Tom Rose	(Captain, Police Department)
Jeffrey Smith	(Harbormaster, Department of Natural Resources)
Wayne Taylor	(Town Manager)
Rick York	(Director, Department of Natural Resources)

Woods Hole Group

Joseph Famely	(Lead Facilitator)
Tara Marden	(Project Manager, Facilitator)
Brittany Hoffnagle	(Facilitator)
Joel Kubick	(Facilitator)
Kalinda Roberts	(Facilitator)

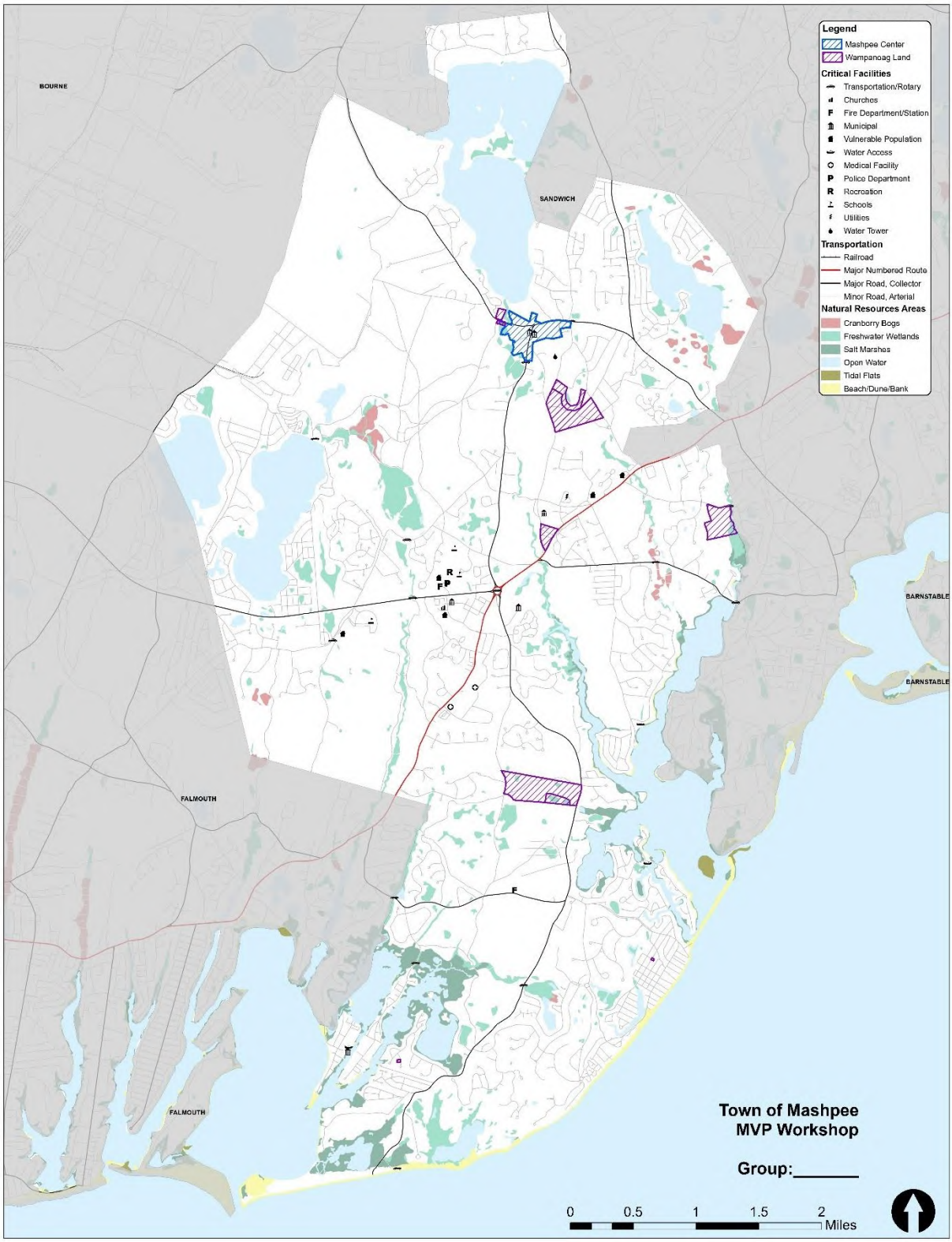
10.0 ACKNOWLEDGEMENTS

Special thanks to the dedicated and collaborative leaders from the Town of Mashpee for contributing their time, energy, and ideas to this process. In particular, we would like to thank Evan Lehrer, Ashley Fisher, Glen Harrington, Kathy Mahoney, Drew McManus, John Phelan, Tom Rose, Jeffrey Smith, Wayne Taylor, and Rick York for their time and effort organizing and preparing for the workshop. Thank you to Clay Nicholson, GIS Specialist for the Town of Mashpee, for providing GIS data.

The CRB Workshop was held at the Mashpee Public Library. Lunch and refreshments were provided by Cape Cod Coffee and Subway of Mashpee.

This project was made possible through funding from the Massachusetts Executive Office of Energy and Environmental Affairs' Municipal Vulnerability Preparedness (MVP) Grant Program, and the guidance provided by the Community Resilience Building framework.

APPENDIX A. WORKSHOP BASE MAP


Legend
Mashpee Center
Wampanoag Land
Critical Facilities
Transportation/Rotary
Churches
Fire Department/Station
Municipal
Vulnerable Population
Water Access
Medical Facility
Police Department
Recreation
Schools
Utilities
Water Tower
Transportation
Railroad
Major Numbered Route
Major Road, Collector
Minor Road, Arterial
Natural Resources Areas
Cranberry Bogs
Freshwater Wetlands
Salt Marshes
Open Water
Tidal Flats
Beach/Dune/Bank
BOURNE
SANDWICH
BARNSTABLE
BARNSTABLE
FALMOUTH
FALMOUTH
Town of Mashpee
MVP Workshop
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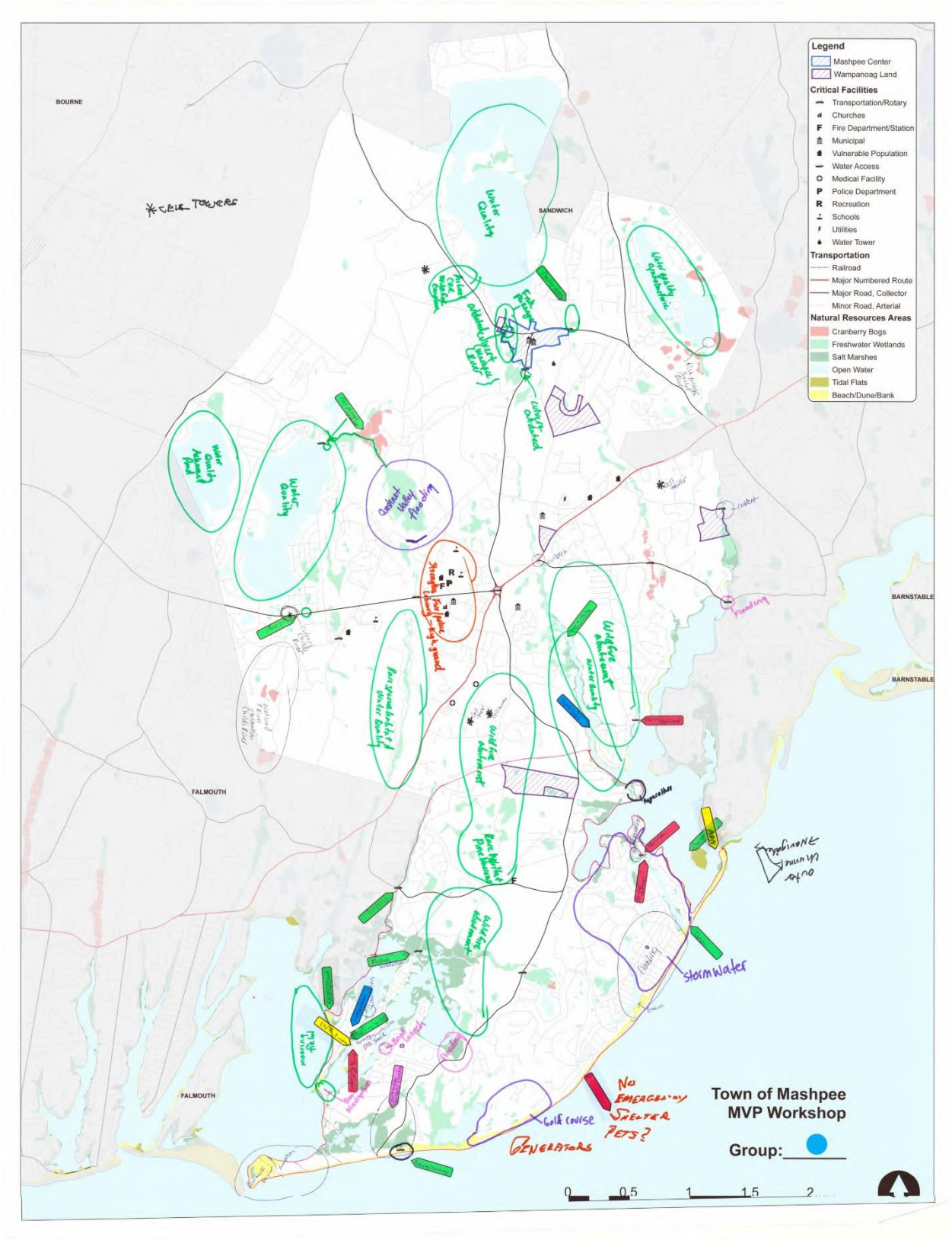
APPENDIX B. WORKSHOP RESULTS (MAPS / MATRICES / TOP ACTIONS)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SANDWICH
FALMOUTH
FALMOUTH
BARNSTABLE
BARNSTABLE
Cell Towers
Water Quality
Water Quality Adjacent Pond
Wildfire Adjacent
Coastal Flooding
Stormwater
Golf course
Generators
No Emergency Shelter Pets?
Town of Mashpee
MVP Workshop
Group:
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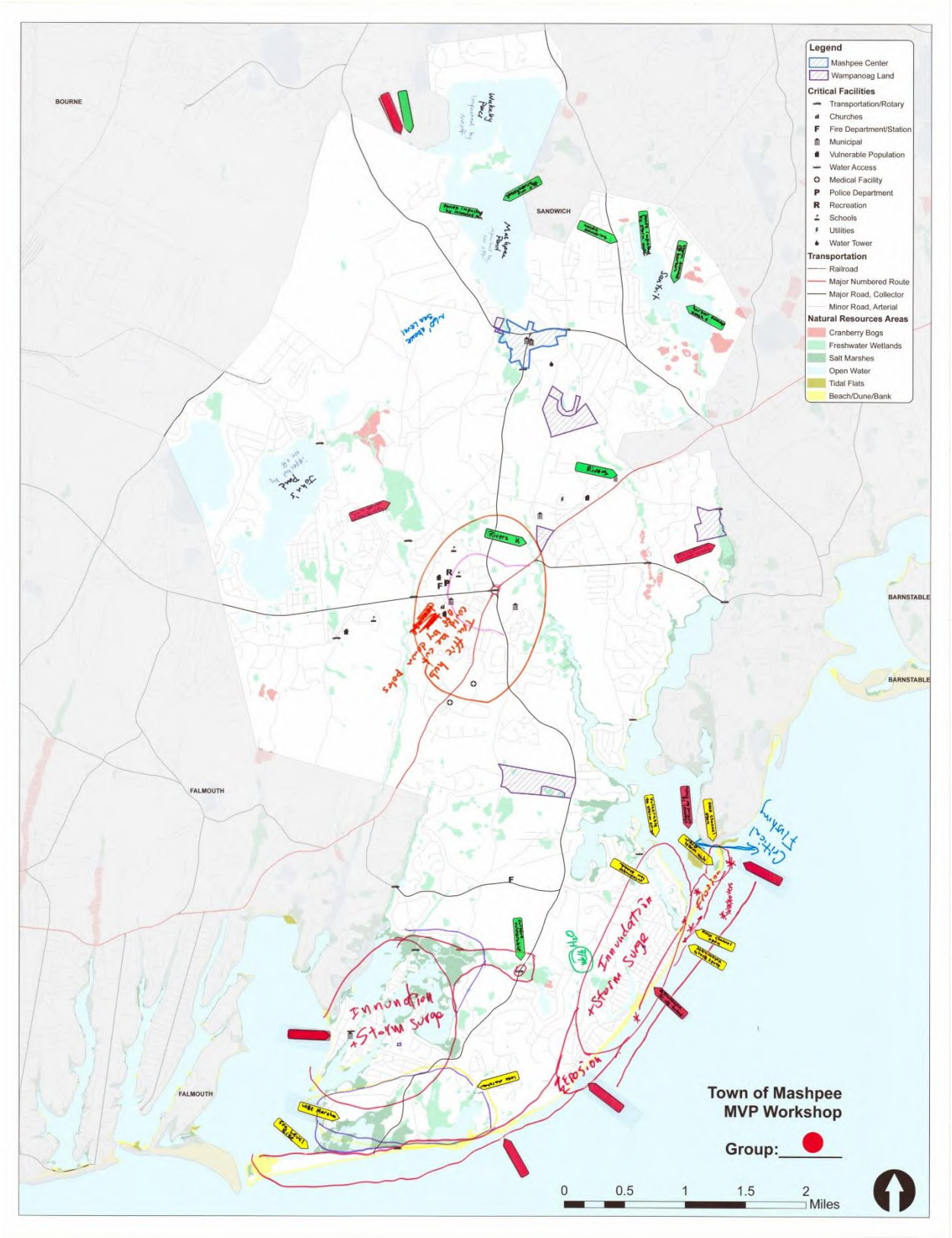
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BARNSTABLE
BARNSTABLE
FALMOUTH
FALMOUTH
Inundation +Storm Surge
Inundation +Storm Surge
Erosion
Town of Mashpee
MVP Workshop
Group:
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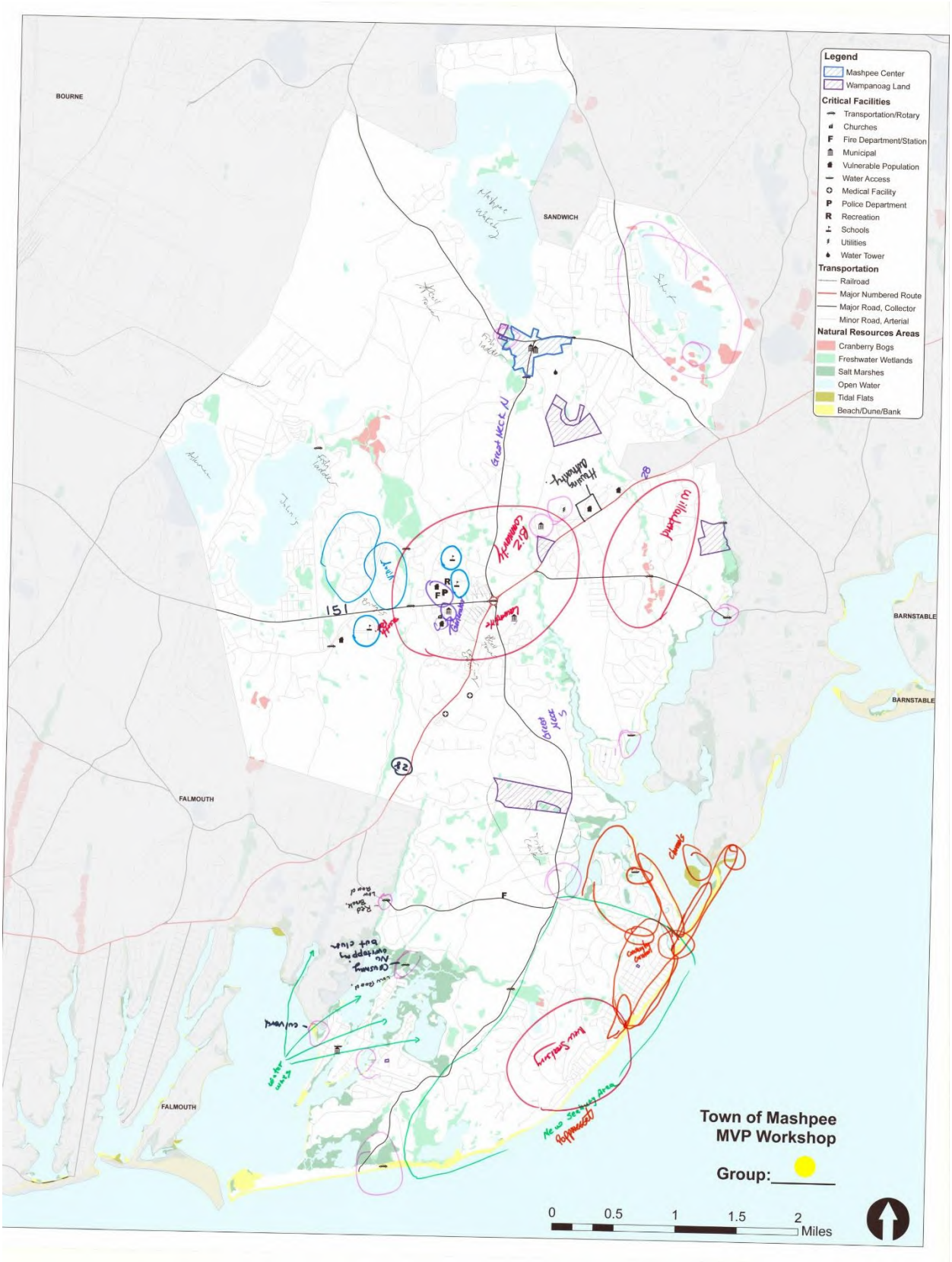
Miles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SANDWICH
FALMOUTH
BARNSTABLE
151
Town of Mashpee
MVP Workshop
Group:
0
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1
1.5
2
Miles

Town of Mashpee MVP Workshop Risk Matrix

V = Vulnerability S = Strength
Ownership Types
T = Town S = State F = Federal P = Private

Top Priority Hazards

A) Coastal Flooding and Erosion | B) Inland Flooding | C) Extreme Cold and Winter Storms | D) Heat, Drought, and Fire

Infrastructural Features	Ownership	V or S	Societal Features	Ownership	V or S	Environmental Features	Ownership	V or S
Low lying Crossings-culverts- Unimproved Rte Childs River, Mashpee River, Quashnet,	A,B T/S/F/P	V / S	Mashpee Commons Senior Center	C,D T/S/F/P	V / S	South Cape Beach	A,C T/S/F/P	V / S
Town Water front Facilities- South Cape Beach Parking lot	A,B,C T/S/F/P	V / S	NO Emergency Shelter	A,B,C,D T/S/F/P	V / S	Mashpee Town Beach	A,C T/S/F/P	V / S
Wastewater Treatment Facilities- not subject to flooding	T/S/F/P	V / S	Shellfish Impacts	A,C,D T/S/F/P	V / S	Herring Runs Flooding Decrease	A,B,C,D T/S/F/P	V / S
Harbor Master Facility Seconset Island	A, C T/S/F/P	V / S	Schools -A/C	D T/S/F/P	V / S	Shellfish - warmer water Peppercress Bay	A,C T/S/F/P	V / S
State Beach Parking lot	A, C T/S/F/P	V / S	Quashnet - wastewater near golf courses	A, B, D T/S/F/P	V / S	Wildfire - Urban Pine Barrens, - Forest John Pond Point	D T/S/F/P	V / S
Town Landings - Saltwater Great River, Quinn, Mashpee Neck	A, C T/S/F/P	V / S	Fishing Access	A, B, C, D T/S/F/P	V / S	Santuit Pond, Johns Pond, Mashpee Pond (Lower quality) Sediment pond	B, D T/S/F/P	V / S
Freshwater Landings -	B, C T/S/F/P	V / S	Marinas	A, B, C T/S/F/P	V / S	The Spit	A, C T/S/F/P	V / S
Monomoscoy Causeway Flooding	A, C T/S/F/P	V / S	Mashpee housing Authority - Housing - Elderly - Facility moved - Evacuation?	B, C, D T/S/F/P	V / S	Santuit Pond - Connection	B, D T/S/F/P	V / S
Seconsett Island Causeway Flooding	A, C T/S/F/P	V / S	Nursing home Private	C, D T/S/F/P	V / S	Open Space - Migration	A, B, D T/S/F/P	V / S
Red Brook Road Flooding	B T/S/F/P	V / S	Southport 75 Residence Not back up power but no flooding	B, C, D T/S/F/P	V / S	Beaches & Nurseries	A, C, D T/S/F/P	V / S
Cell Towers	B, C T/S/F/P	V / S	Mashpee Rotary - traffic during events	B, C, D T/S/F/P	V / S	Invasive species Management	B, D T/S/F/P	V / S
Gas Stations - No Power backup	C, D T/S/F/P	V / S		T/S/F/P	V / S	Navigation channels	A, C T/S/F/P	V / S
Power Grid Infrastructure - trees, powerlines	C T/S/F/P	V / S		T/S/F/P	V / S	Saltmarshes - Migration	A, C, D T/S/F/P	V / S
New Seabury Marina - flooding	A, C T/S/F/P	V / S		T/S/F/P	V / S	Aquaculture growers Town facility	A, C, D T/S/F/P	V / S
Navigation Channels - Shoaling	A, C T/S/F/P	V / S		T/S/F/P	V / S	Cotuit Oyster Fisheries	A, B, C, D T/S/F/P	V / S
Septic Systems - GW	A, B T/S/F/P	V / S		T/S/F/P	V / S	Cranberry Bogs - groundwater?	A, B, D T/S/F/P	V / S
		V / S		T/S/F/P	V / S	Upper Quashnet > Childs River	B, D T/S/F/P	V / S

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Infrastructural Features	Ownership	V or S	Societal Features	Ownership	V or S	Environmental Features	Ownership	V or S
Popponesset + Approach Channel	T/S/F/P	V/S	Emergency Shelter	T/S/F/P	V/S	Santuit Pond/Park	T/S/F/P	V/S
Popponesset + Inner Channel Waquoit Channel	T/S/F/P	V/S	Vulnerable Communities	T/S/F/P	V S	Kettle Ponds/Major Ponds	T/S/F/P	V/S
Freshwater Wells	T/S/F/P	V/S	Emergency Response Action/Access	T/S/F/P	V S	Estuaries	T/S/F/P	V/S
Waste Water/Septic Town	T/S/F/P	V/S	Police Department	T/S/F/P	V/S	Popponesset Spit/Beach	T/S/F/P	V/S
Town DNR Facility on Seaconset Island	T/S/F/P	V/S	DPW	T/S/F/P	V/S	Channels	T/S/F/P	V/S
Utilies - Electrical Lines - Water Lines	T/S/F/P	V/S	Fire Department	T/S/F/P	V/S	Upland Areas	T/S/F/P	V/S
Popponesset Island Bridge	T/S/F/P	V/S	Assited Living/Senior Communities	T/S/F/P	V/S	Open Spaces	T/S/F/P	V/S
Shore Drive/Mashpee Key Access Roads	T/S/F/P	V/S	Schools	T/S/F/P	V/S	South Cape Beaches	T/S/F/P	V/S
Evacuation Routes Routes	T/S/F/P	V/S	Seasonal Resident Population Surge/ Increase in Year Round Population	T/S/F/P	V/S	Wildlife Refuge	T/S/F/P	V/S
Marina + Boatyards	T/S/F/P	V/S	Traffic (Choke Points)	T/S/F/P	V/S	Rivers/Fish Runs	T/S/F/P	V/S
Local Homes	T/S/F/P	V/S	Joint Base Cape Cod	T/S/F/P	V/S	Shellfish Beds	T/S/F/P	V/S
Local Businesses	T/S/F/P	V/S	Commercial Center	T/S/F/P	V/S	Trails	T/S/F/P	V/S
Town Buildings	T/S/F/P	V/S	Home Owners Associations	T/S/F/P	V/S	Vernal Pools	T/S/F/P	V/S
Town Vehicles	T/S/F/P	V/S	Community Groups	T/S/F/P	V/S	Stormwater Infrastructure Systems	T/S/F/P	V/S
Communication Lines: Cell Towers	T/S/F/P	V/S	Mashpee Wampanoag Tribe	T/S/F/P	V/S		T/S/F/P	V/S
Emergency Shelters	T/S/F/P	V/S		T/S/F/P	V/S		T/S/F/P	V/S
Water Towers	T/S/F/P	V/S		T/S/F/P	V/S		T/S/F/P	V/S

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Infrastructural Features	Ownership	V or S	Societal Features	Ownership	V or S	Environmental Features	Ownership	V or S
Estuaries; Coastal landowners / buildings New Seabury Poppy	T/S/F/P	V / S	Business District Mashpee Commons Deer crossing 131	T/S/F/P	V / S	Poppy Spit	T/S/F/P	V / S
Town Building Infrastructure	T/S/F/P	V / S	Mashpee Public Library - shelter, storms resource	T/S/F/P	V / S	Poppy/South Cape Beaches erosion infrastructure associated - parking lots	T/S/F/P	V / S
Monomoscoy Causeway, Red Brook Rd	T/S/F/P	V / S	Schools - Local Emergency Shelter	T/S/F/P	V / S	Ponds · Stormwater temperature Water quality	T/S/F/P	V / S
Stormwater Drainage Town ag (New Seabury) Poppy - Flooding - aging	Town & Private	V / S	Senior Center	T/S/F/P	V / S	Herring Runs/Fish ladders ↑ temp, Flooding, aging infra. habitat/population	Not sure, To infrastructure T/S/F/P Tribal, Mashpee - land, mgmt Town	V / S
Utilities - all above ground electric	T/S/F/P	V / S	Emergency Response communication structure? - Fire/police - medical	T/S/F/P	V / S	Mashpee River/Bays/Rivers flushing, flooding, impaired	T/S/F/P	V / S
Communication cell towers	T/S/F/P	V / S	Blackboard Reverse 9-1-1 Towns effort to reach out to town residents (multilingual pop)	T/S/F/P	V / S	Aquaculture - water quality → shellfish.	Tribal T/S/F/P	V / S
Roads - Coastal Popponesset rd. (New Seabury) (how to evacuate)	T/S/F/P	V / S	Neighborhood Watch - how to mobilize - communication - facilitation of storm response plan?	T/S/F/P	V / S	Conservation Areas wildfire - trails - land	T/S/F/P	V / S
Poppy Community Center Bld	T/S/F/P	V / S	Christ the King - encourage to provide services?	T/S/F/P	V / S	Santuit - cyanobacteria - Temp increases.	T/S/F/P	V / S
Boat Ramps - Ocean SW / ponds FW	T/S/F/P	V / S	Transportation Network / Evacuation Plan	T/S/F/P	V / S	Waterways/channels - dredging	T/S/F/P	V / S
Waste Water Septic tanks New Seabury/Poppy	T/S/F/P	V / S	Seasonal Pop.	T/S/F/P	V / S	Mashpee River - material - non-dredgeable - flushing	T/S/F/P	V / S
Transfer Station	T/S/F/P	V / S	Elderly Pop - communication - technology	T/S/F/P	V / S	Salt marshes	T/S/F/P	V / S
Marinas - fuel tanks - access	T/S/F/P	V / S	Mashpee TV - communication - work w/ schools.	T/S/F/P	V / S	Estuaries	T/S/F/P	V / S
Poppy Island Bridge / Bridges School St bridge.	T/S/F/P	V / S	Sprawl/Zoning	T/S/F/P	V / S		T/S/F/P	V / S
Schools - no air conditioning	T/S/F/P	V / S	Special Needs Communities	T/S/F/P	V / S		T/S/F/P	V / S
Town Water Infrastructure Pumps generator, wells, Salt water intrusion contamination	T/S/F/P	V / S	Towns Response to mosquitoes + tick born illnesses	T/S/F/P	V / S		T/S/F/P	V / S
Fuel Stations/Generators	T/S/F/P	V / S		T/S/F/P	V / S		T/S/F/P	V / S
	T/S/F/P	V / S		T/S/F/P	V / S		T/S/F/P	V / S

Town of Mashpee MVP Workshop Risk Matrix

Priority Level:
H = High M = Medium L = Low
Time : S = Short L = Long O = Ongoing

WOODS HOLE GROUP

Top Priority Hazards

A) Coastal Flooding and Erosion | B) Inland Flooding | C) Extreme Cold and Winter Storms | D) Heat, Drought, and Fire

	Action Items	Hazards Addressed	Priority / Time
Infrastructural Features			
Septic Systems / DRINKING WELLS	- GROUNDWATER RISE MODELING & ANALYSIS - SEWER	A/B/C/D	H/M/L S/L/O
Causeways - Monomoscoy, Seconsett, Red Brook Road, Daniels Island Road	- RAISE roadway/up - evaluate culvert sizing - INVASIVE species management - dredging - natural/resource enhancement	A/B/C/D	H/M/L S/L/O
Town Waterfront Facilities - DNR facility - Scenario #13 South cape beach parking	SCB PARKING - reduce park lot size, shuttles, State Beach, green infrastructure - sand grass, habitat enhancement (dunes), fence DNR - relocate, raise up	A/B/C/D	H/M/L S/L/O
Power & Communication Facilities Grid (Cell Phone/Landlines)	- Bury wires - tree maintenance - power pole maintenance - vulnerability assessment - Copy of the utility assessments	A/B/C/D	H/M/L S/L/O
Societal Features			
Land Acquisition	- easements - inventory - SLAMM model - PURCHASE LAND FOR PROTECTION/RESTORATION	A/B/C/D	H/M/L S/L/O
Harbor Management Plan - Pleasant Bay - Waquoit	harbormanagement plan UPDATE	A/B/C/D	H/M/L S/L/O
Emergency Mgmt Plan - Shelters - traffic routes during evacuation - public education communication - roles/responsibilities during different events	review existing plans update	A/B/C/D	H/M/L S/L/O
Shellfish propagation Programs	- restocking plans - land acquisition - gather existing info - upwelling equip - management plans - winter storage for shellfish	A/B/C/D	H/M/L S/L/O
Environmental Features			
Water Quality - Ponds - Ashumet Santuit Johns Mashpee, Other Waterbodies Mashpee River	- Diagnostic Studies - Pollutants, - Shellfish Propagation - Water Sampling - reviews local bylaws pertaining to HDQ - Public education - SAV surveys - invasive mgmt plan	A/B/C/D	H/M/L S/L/O
Peppersett Spit & Bay - outer channel dredging Navigation Channel	- Dredging management plan - Hydrodynamic analysis - harbor mgmt plan - Beach Nourishment/Dune Enhancement - planting	A/B/C/D	H/M/L S/L/O
Wet land Restoration - Herring run study Cranberry restoration	SLAMM models Hemmingway Study	A/B/C/D	H/M/L S/L/O
FISHERIES	- GROUNDWATER FISHERY HEALTH - Access - PROTECTING ENDANGERED SPECIES	A/B/C/D	H/M/L S/L/O

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Action Items	Hazards Addressed	Priority / Time
Infrastructural Features		
Popponesset/Waquoit Channels	Dredging including permitting	A/B/C/D	H/M/L S/L/O
Stormwater Infrastructure	Construct stormwater control systems	A/B/C/D	H/M/L S/L/O
Emergency Shelters & Evacuation Routes	Evaluate existing infrastructure & upgrade to meet requirements/certifications	A/B/C/D	H/M/L S/L/O
Communication Lines & Cell Towers	Assess vulnerabilities in communication & determine options to increase resilience	A/B/C/D	H/M/L S/L/O
Societal Features		
Vulnerable Communities	Increase tree plantings & green space to prevent heat islands	A/B/C/D	H/M/L S/L/O
Seasonal Population Surge/Emergency Response	Assessment of traffic & emergency response ability to determine possible alternatives	A/B/C/D	H/M/L S/L/O
Community Groups & Home Owners Associations	Develop community & neighborhood emergency response plans	A/B/C/D	H/M/L S/L/O
Town Emergency Services Fire & Police Departments – DPW	Enhance community wide emergency response plan	A/B/C/D	H/M/L S/L/O
Environmental Features		
Southern Coast & Popponesset Spit	Beach Nourishment & funding	A/B/C/D	H/M/L S/L/O
Ponds & Estuaries (Bays)	Implementation of the Mashpee Comprehensive Watershed Nitrogen Management Plan & Funding (Phosphorous in Ponds)	A/B/C/D	H/M/L S/L/O
Open Space	Acquisition of additional open space	A/B/C/D	H/M/L S/L/O
		A/B/C/D	H/M/L S/L/O

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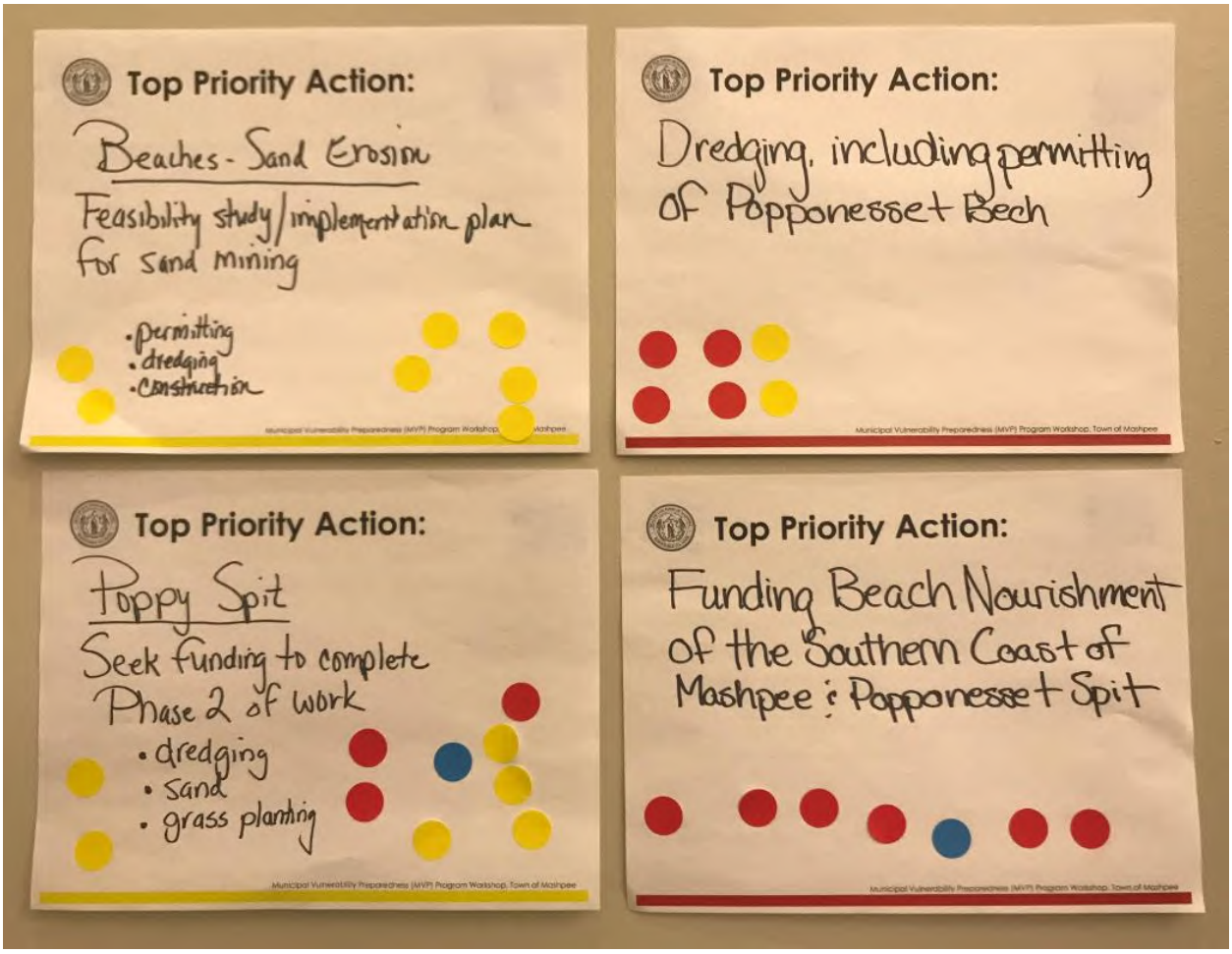
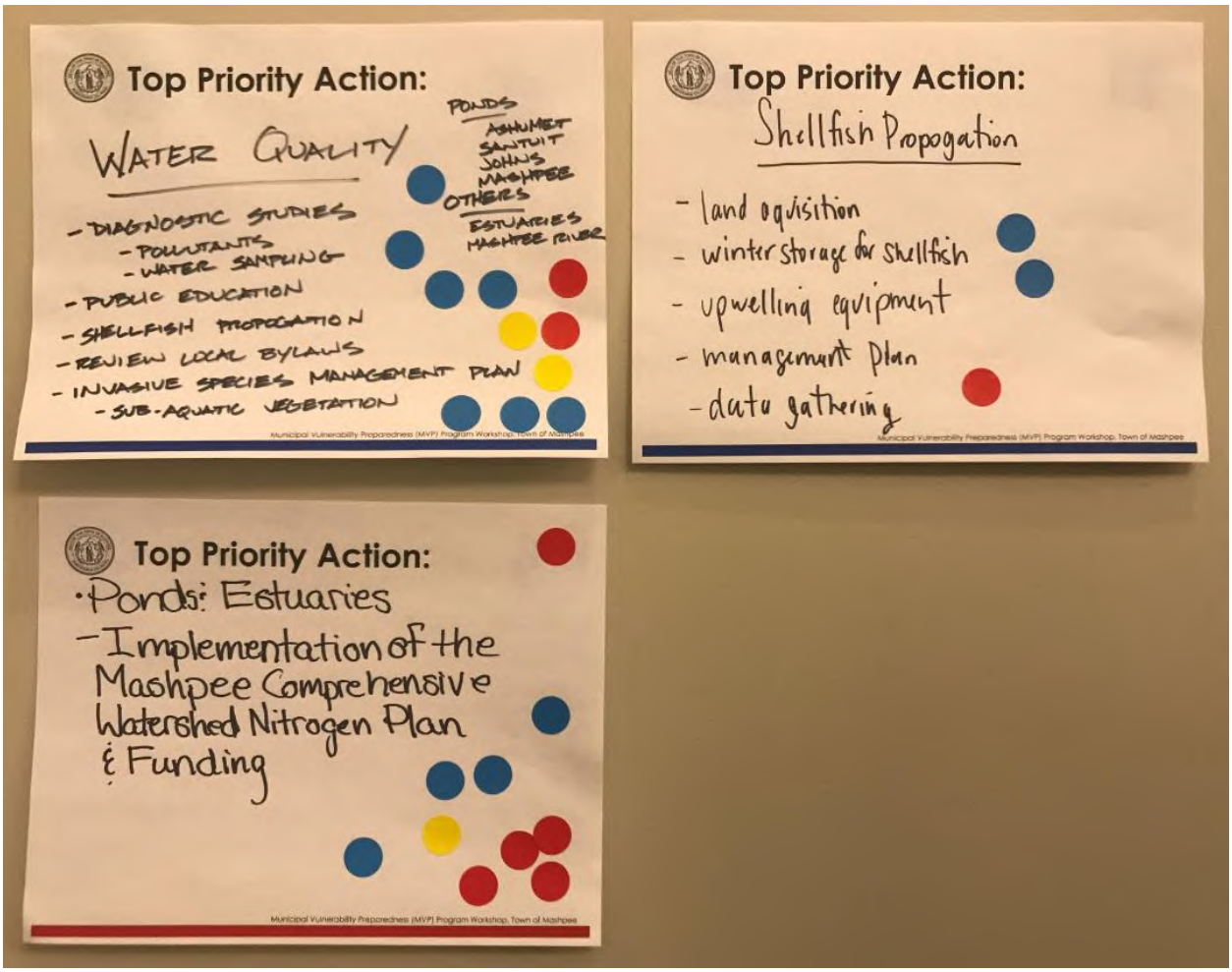
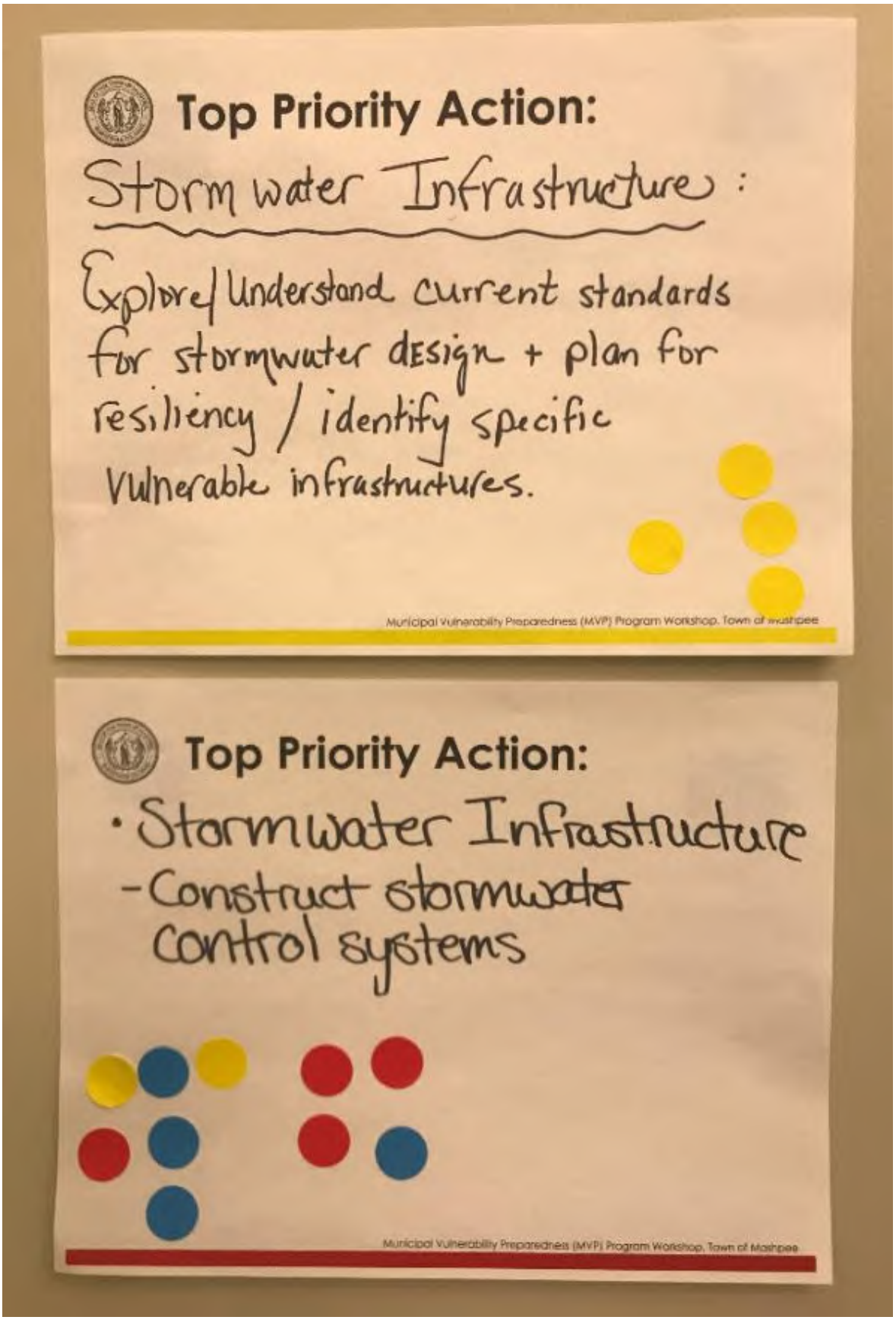
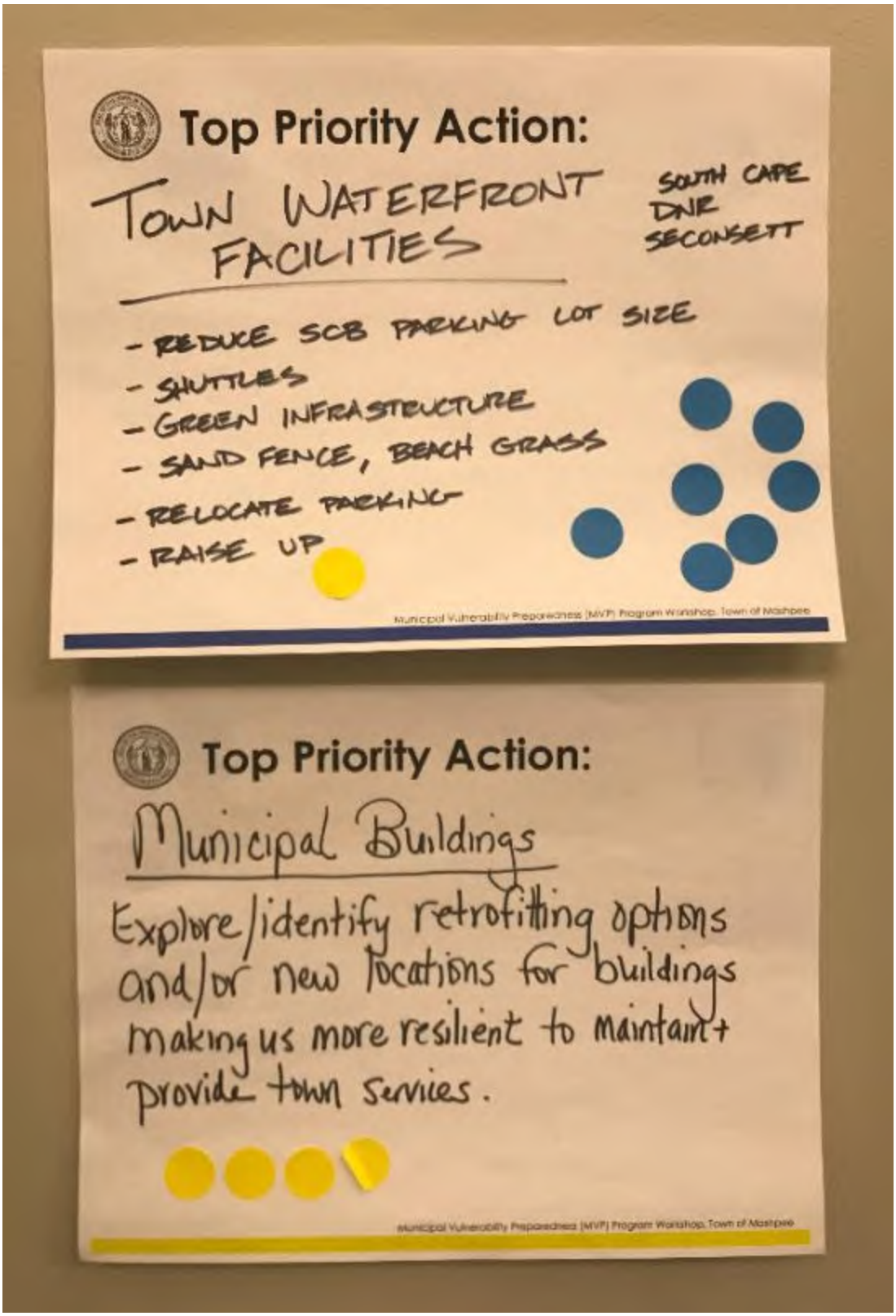
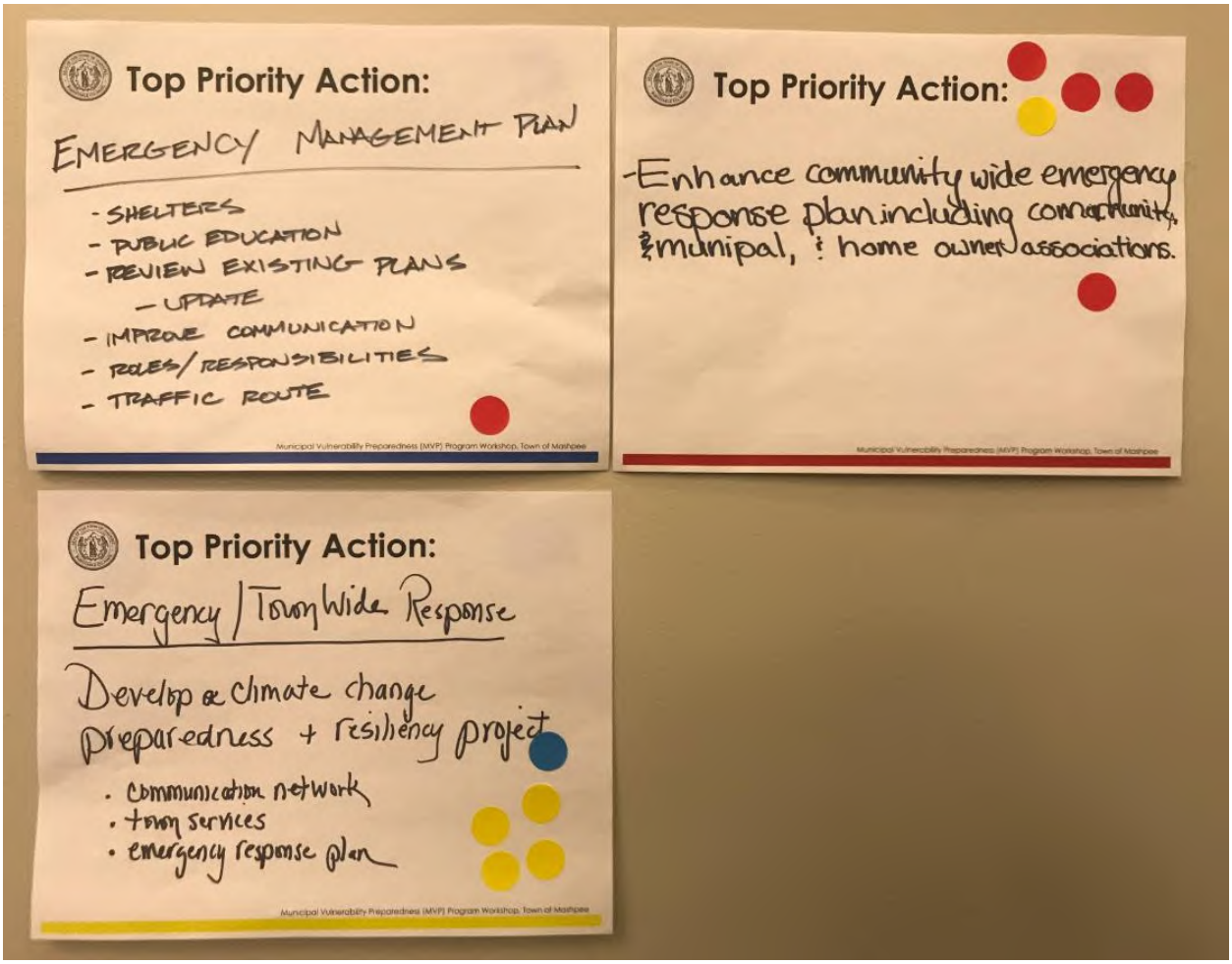
	Action Items	Hazards Addressed	Priority / Time
Infrastructural Features			
Causeways (culverts) - Monomoscoy & Seconsett & Red Brook Road	Complete study of cc on causeway for feasibility of redesigning.	A/B/C/D	H/M/L S/L/O
Stormwater Infrastructure	Explore/understand current standards for stormwater design. & plan for resiliency & identify specific vulnerable infrastructure	A/B/C/D	H/M/L S/L/O
Municipal Buildings	Explore (identify options) retrofitting options/and new locations for buildings that are more resilient to maintain town services.	A/B/C/D	H/M/L S/L/O
		A/B/C/D	H/M/L S/L/O
Societal Features			
SUB- Urban Sprawl / Zoning Reg	Audit of zoning Bylaws (& Town Regulations) – for resiliancy	A/B/C/D	H/M/L S/L/O
Emeregency / Town wide Response	Understand / develop a climate change preparedness & climate Resiliance project → Communications, town services, emergency Response ("Town Network")	A/B/C/D	H/M/L S/L/O
SUB- Urban Sprawl zoning / Affordable housing / (Vulnerable Pop)	Explore options of building resilient affordable housing	A/B/C/D	H/M/L S/L/O
Coastal landowners/homeowners / businesses.	Implement town wide resiliency loan program to encourage/incentivize homeowners/businesses to install building features.	A/B/C/D	H/M/L S/L/O
Environmental Features			
Poppy Spit	~~Educ~~ Education campaign for importance of poppy spit, function, environmental importance, available access	A/B/C/D	H/M/L S/L/O
Poppy Spit	Seek funding to complete Phase II of work -dredging -sand -grasses -	A/B/C/D	H/M/L S/L/O
Beaches - Sand Erosion	Feasibility Study/Implementation Plan for sand mining as a source of sand to enhance beaches → involves permitting, dredge, construction.	A/B/C/D	H/M/L S/L/O
Open space	Identify available parcels and obtain funding for aquisition	A/B/C/D	H/M/L S/L/O

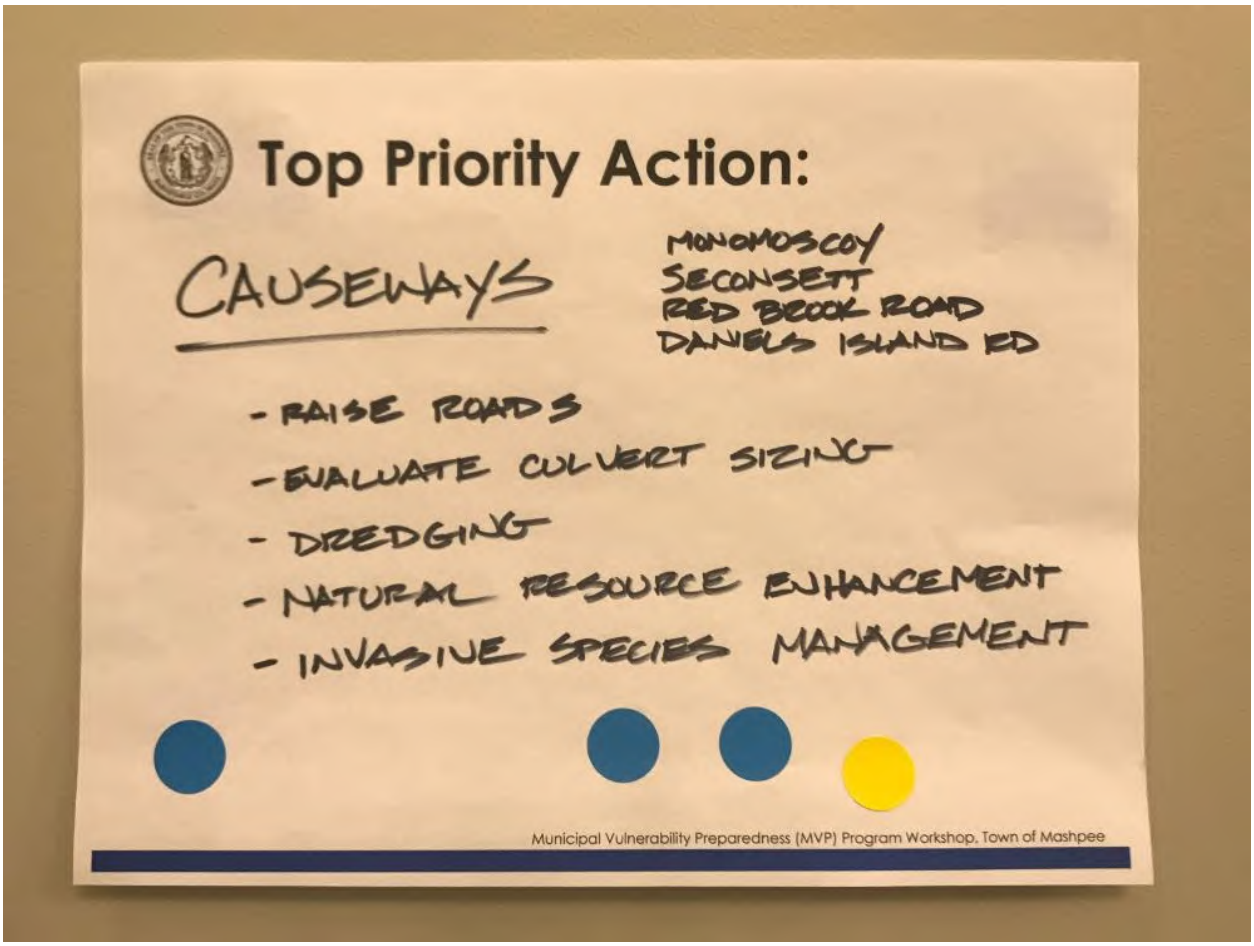

Top Priority Action:
Beaches - Sand Erosion
Feasibility study/implementation plan for sand mining
•permitting
•dredging
•construction
Top Priority Action:
Dredging, including permitting of Popponesset Bech
Top Priority Action:
Poppy Spit
Seek funding to complete Phase 2 of work
• dredging
• sand
• grass planting
Top Priority Action:
Funding Beach Nourishment of the Southern Coast of Mashpee: Popponesset Spit


Top Priority Action:
WATER QUALITY
- DIAGNOSTIC STUDIES
- POLLUTANTS
- WATER SAMPLING
- PUBLIC EDUCATION
- SHELLFISH PROPOGATION
- REVIEW LOCAL BYLAWS
- INVASIVE SPECIES MANAGEMENT PLAN
- SUB-AQUATIC VEGETATION
PONDS
AGAWAM
SANTUIT
JOHNS
MASHPEE
OTHERS
ESTUARIES
MASHPEE RIVER
Municipal Vulnerability Preparedness (MVP) Program Workshop, Town of Mashpee
Top Priority Action:
Shellfish Propogation
- land aquisition
- winter storage for shellfish
- upwelling equipment
- management plan
- data gathering
Municipal Vulnerability Preparedness (MVP) Program Workshop, Town of Mashpee
Top Priority Action:
•Ponds: Estuaries
-Implementation of the Mashpee Comprehensive Watershed Nitrogen Plan & Funding
Municipal Vulnerability Preparedness (MVP) Program Workshop, Town of Mashpee

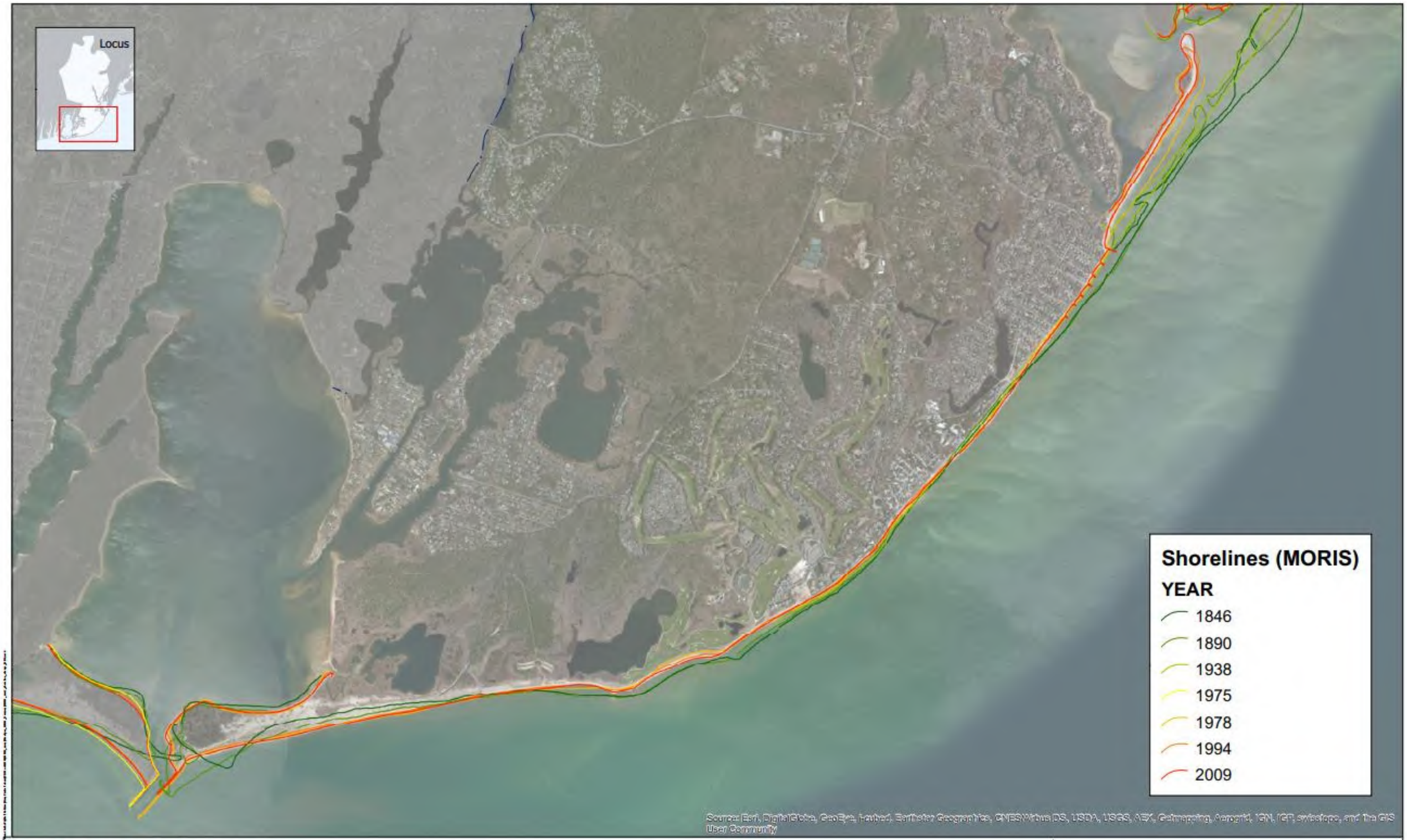

Top Priority Action:
Storm water Infrastructure:
Explore/Understand current standards for stormwater design + plan for resiliency / identify specific vulnerable infrastructures.
Municipal Vulnerability Preparedness (MVP) Program Workshop. Town of Mashpee
Top Priority Action:
• Stormwater Infrastructure
- Construct stormwater control systems
Municipal Vulnerability Preparedness (MVP) Program Workshop. Town of Mashpee


Top Priority Action:
TOWN WATERFRONT FACILITIES
SOUTH CAPE
DNR
SECONSETT
- REDUCE SCB PARKING LOT SIZE
- SHUTTLES
- GREEN INFRASTRUCTURE
- SAND FENCE, BEACH GRASS
- RELOCATE PARKING
- RAISE UP
Municipal Vulnerability Preparedness (MVP) Program Workshop, Town of Mashpee
Top Priority Action:
Municipal Buildings
Explore/identify retrofitting options and/or new locations for buildings making us more resilient to maintain+ provide town services.
Municipal Vulnerability Preparedness (MVP) Program Workshop, Town of Mashpee


Top Priority Action:
EMERGENCY MANAGEMENT PLAN
- SHELTERS
- PUBLIC EDUCATION
- REVIEW EXISTING PLANS
– UPDATE
- IMPROVE COMMUNICATION
- ROLES/RESPONSIBILITIES
- TRAFFIC ROUTE
Municipal Vulnerability Preparedness (MVP) Program Workshop, Town of Mashpee
Top Priority Action:
-Enhance community wide emergency response plan including community, municipal, & home owner associations.
Municipal Vulnerability Preparedness (MVP) Program Workshop, Town of Mashpee
Top Priority Action:
Emergency / Town Wide Response
Develop a climate change preparedness + resiliency project
• Communication network
• town services
• emergency response plan
Municipal Vulnerability Preparedness (MVP) Program Workshop, Town of Mashpee


Top Priority Action:
CAUSEWAYS
MONOMOSCOY
SECONSETT
RED BROOK ROAD
DANIELS ISLAND RD
- RAISE ROADS
- EVALUATE CULVERT SIZING
- DREDGING
- NATURAL RESOURCE ENHANCEMENT
- INVASIVE SPECIES MANAGEMENT
Municipal Vulnerability Preparedness (MVP) Program Workshop, Town of Mashpee

APPENDIX C. HAZARD AND FEATURE MAPS USED DURING WORKSHOP



Shoreline Change, Town of Mashpee

High Water Shorelines: MORIS/CZM from NOAA and USGS maps 2009.

This map is produced by the GIS Department of the Cape Cod Commission, a division of Barnstable County, 2014

The information depicted on these maps is for planning purposes only. It is notadequate for legal boundary definition, regulatory interpretation, or parcel level analysis. It should not substitute for actual on-site survey, or supersede deed research.

User: planner Date: 3/26/2015

0 0.125 0.25 0.5 0.75 1 Miles

CAPE COD COMMISSION

Shoreline Change, Town of Mashpee - South East Shore

High Water Shorelines: MORIS/CZM from NOAA and USGS maps 2009.

This map is produced by the GIS Department of the Cape Cod Commission, a division of Barnstable County, 2014
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User: gpratus Date: 4/16/2015

0 0.1 0.2 0.4 0.6 0.8 Miles

CAPE COD COMMISSION

Shoreline Change, Town of Mashpee - South West Shore

High Water Shorelines: MORIS/CZM from NOAA and USGS maps 2009.
This map is produced by the GIS Department of the Cape Cod Commission, a division of Barnstable County, 2014
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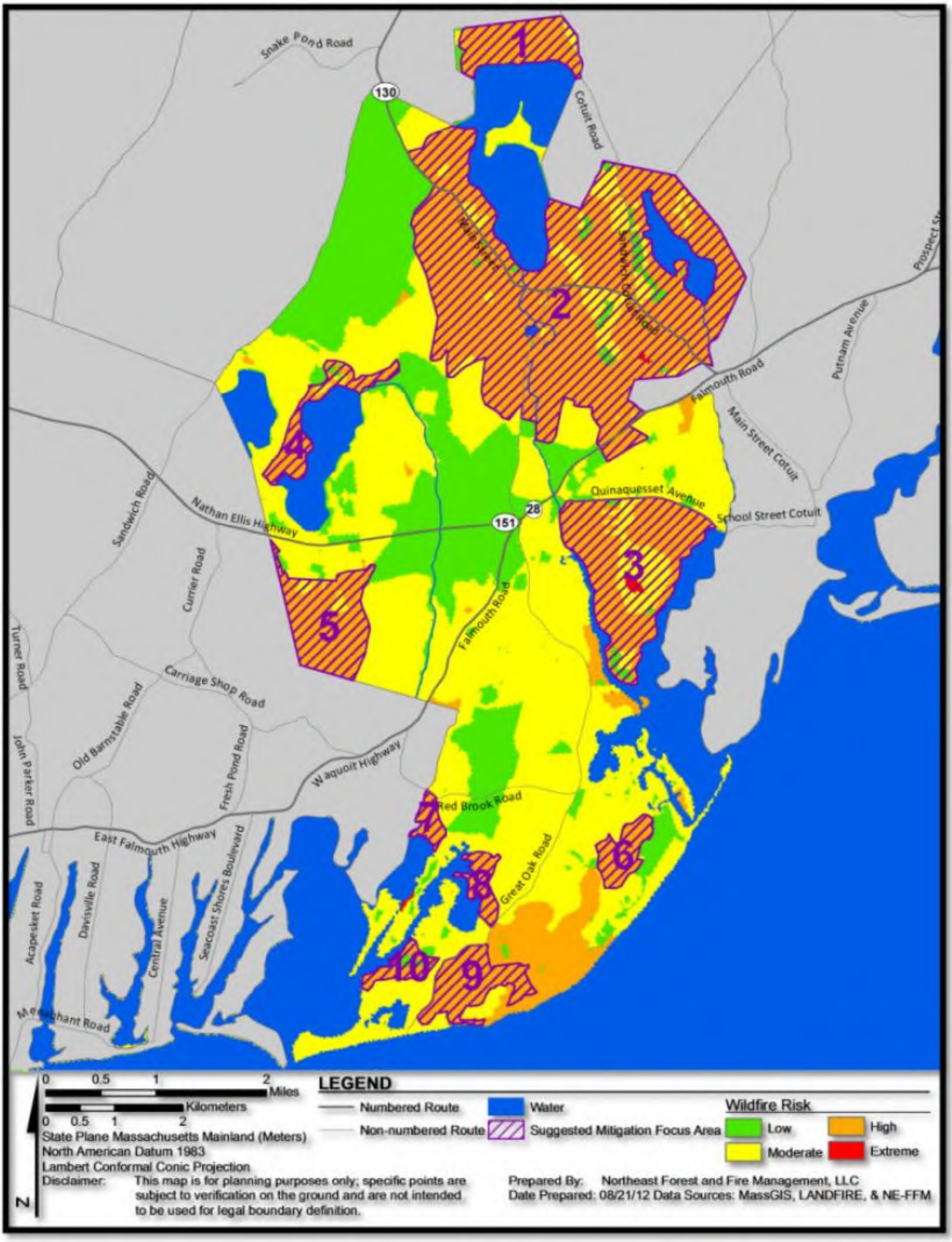
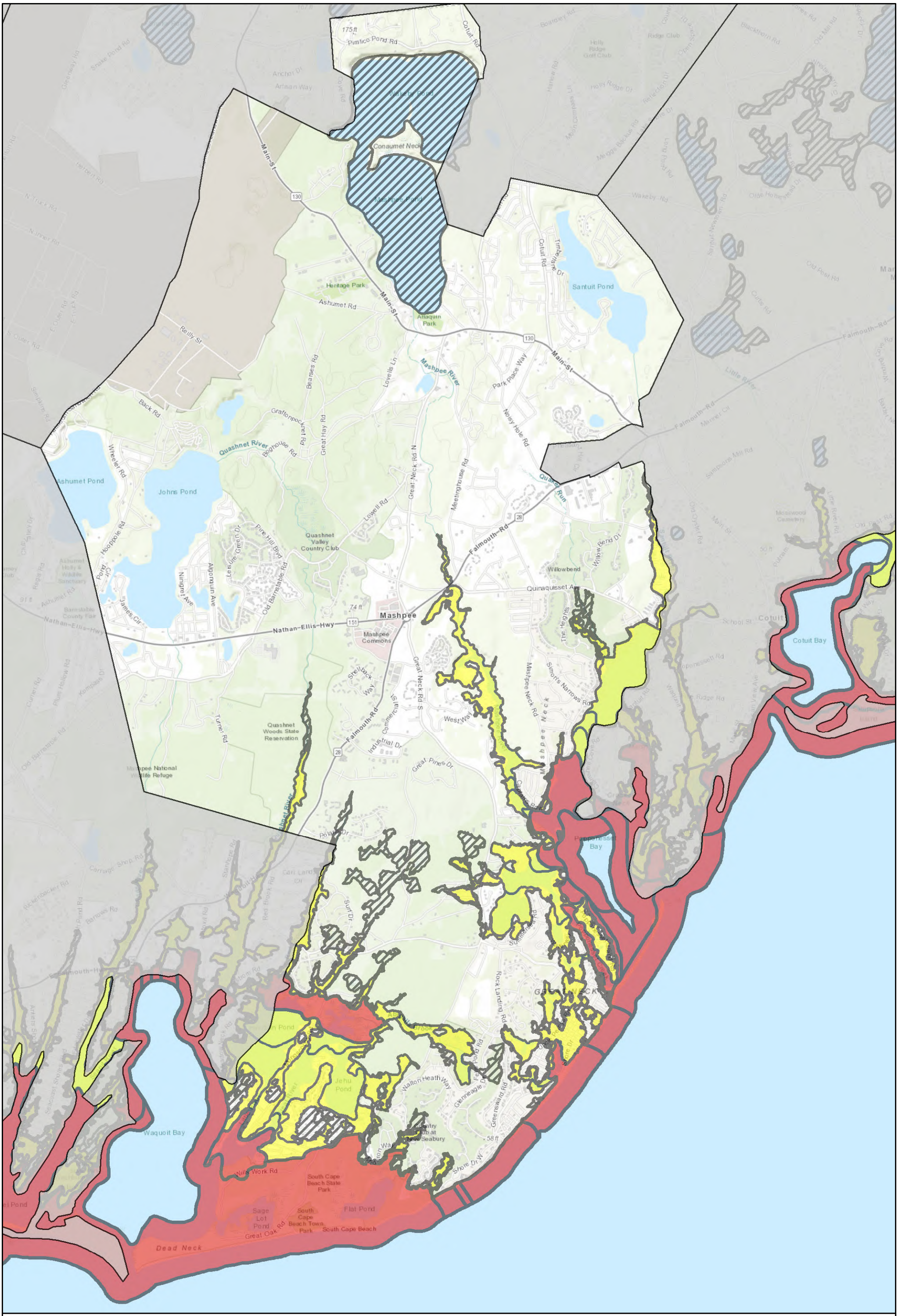
User: jgraham Date: 4/16/2015

TOWN OF MASHPEE WILDFIRE RISK MAP




Pimlico Pond Rd
Cotuit Rd
Wakeby Pond
Conaumet Neck
Mashpee Pond
Main St
130
Heritage Park
Ashumet Rd
Attaquin Park
Reilly St
Bearses Rd
Lovells Ln
Mashpee River
Park Place Way
Noisy Hole Rd
Timberlane Dr
Santuit Pond
Falmouth Rd
Back Rd
Graftonpoc Trail Rd
Great Hay Rd
Quashnet River
Boghouse Rd
Wheeler Rd
Ashumet Pond
Johns Pond
Hooppole Rd
Pond Cir
Ninigret Ave
Algonquin Ave
Leisure Green Dr
Pine Hill Blvd
Old Barnstable Rd
Quashnet Valley Country Club
Lowell Rd
Great Neck Rd N
Meetinghouse Rd
Quaker Run
28
Willowbend
Willow Bend Dr
Quinaquisset Ave
James Cir
Nathan Ellis Hwy
151
Mashpee
Mashpee Commons
74 ft
Stellback Way
Great Neck Rd S
Commercial St
Industrial Dr
West Way
Mashpee Neck Rd
Simoni's Narrows Rd
The Heights
Quashnet Woods State Reservation
Turner Rd
Mashpee National Wildlife Refuge
Great Pines Dr
Quinnet River
Cotuit
Cotuit Bay
Popponesset Bay
Waquoit Bay
Jehu Pond
Walton Heath Way
Glenneagle Dr
Greenward Rd
Rock Landing Rd
Shore Dr W
Nills Work Rd
South Cape Beach State Park
Sage Lot Pond
Great Oak Rd
South Cape Beach Town Park
South Cape Beach
Flat Pond
Dead Neck
58 ft
WOODS HOLE GROUP
A CLS COMPANY
FEMA
A Zone
AE Zone
AO Zone
VE Zone
X, 0.2 PCT
FEMA Flood Zones
N
0
0.5
1
Miles

Peters Pond
Upper Hog Pond
Snake Pond
Weeks Pond
Pimlico Pond
Mystic Lake
Middle Pond
130
Long Pond
Muddy Pond
Mashpee-Wakeby Pond
Santuit Pond
Lowells Pond
28
Moody Pond
Johns Pond
Quashnet Pond
Coonamessett Pond
Round Pond
151
Rushy Marsh Pond
Parker Road Pond
Fresh Pond
Flax Pond
Mill Pond
28
Flat Pond

Sea Level Rise

- 0-1 Foot
- 1-2 Feet
- 2-3 Feet
- 3-4 Feet
- 4-5 Feet
- 5-6 Feet

Sea Level Rise

Mashpee

Sources:
Sea Level Rise: MassGIS LIDAR data processed by CCC, 2013.
Base map features: MassGIS and Cape Cod Commission.
This map is produced by the GIS Department of the Cape Cod Commission, a division of Barnstable County 2014.

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User: gmahn

Date: 12/10/2014

0.2 0 0.2 0.4 0.6 0.8 1
Miles

CAPE COD COMMISSION

Peters Pond
Upper Hog Pond
Straier Pond
Weeks Pond
Pimpoo Pond
Mystic Lake
Middle Pond
130
Long Pond
Muddy Pond
Mashpee-Wakeby Pond
Sumit Pond
Lowells Pond
28
Muddy Pond
Johns Pond
Cotuit Pond
Coonamessett Pond
Round Pond
151
Parker Road Pond
Fresh Pond
Flax Pond
Mill Pond
28

Storm Surge (SLOSH)

- Category One Hurricane
- Category Two Hurricane
- Category Three Hurricane
- Category Four Hurricane

Storm Surge (SLOSH)

Mashpee

Sources:
Storm Surge (SLOSH): Army Corps of Engineers, 2013.
Base map features: MassGIS and Cape Cod Commission.
This map is produced by the GIS Department of the Cape Cod Commission, a division of Barnstable County, 2014.

The information depicted on these maps is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analysis. It should not substitute for actual on-site survey, or supersede deed research.

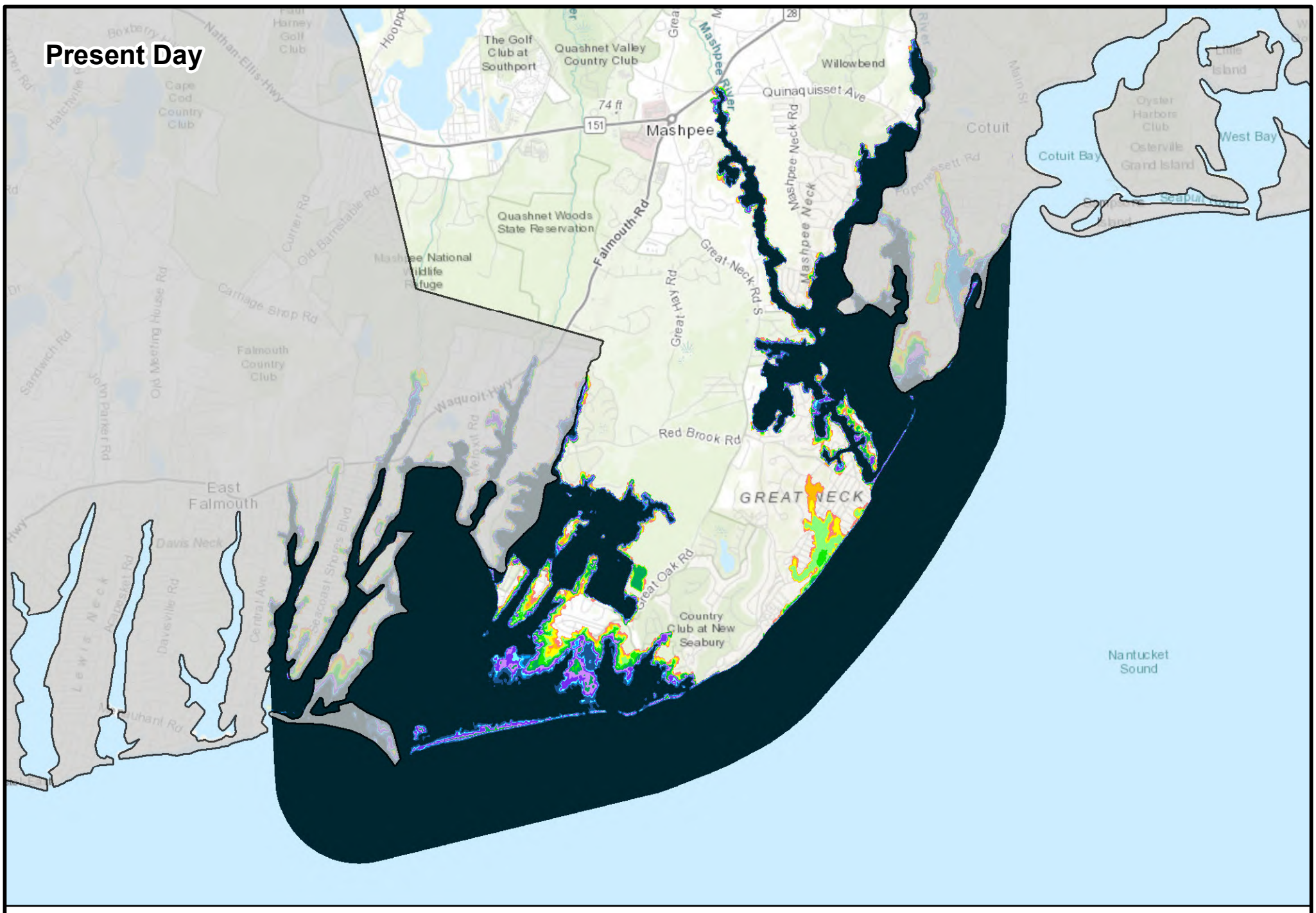
User: gpalm

Date: 12/10/2014

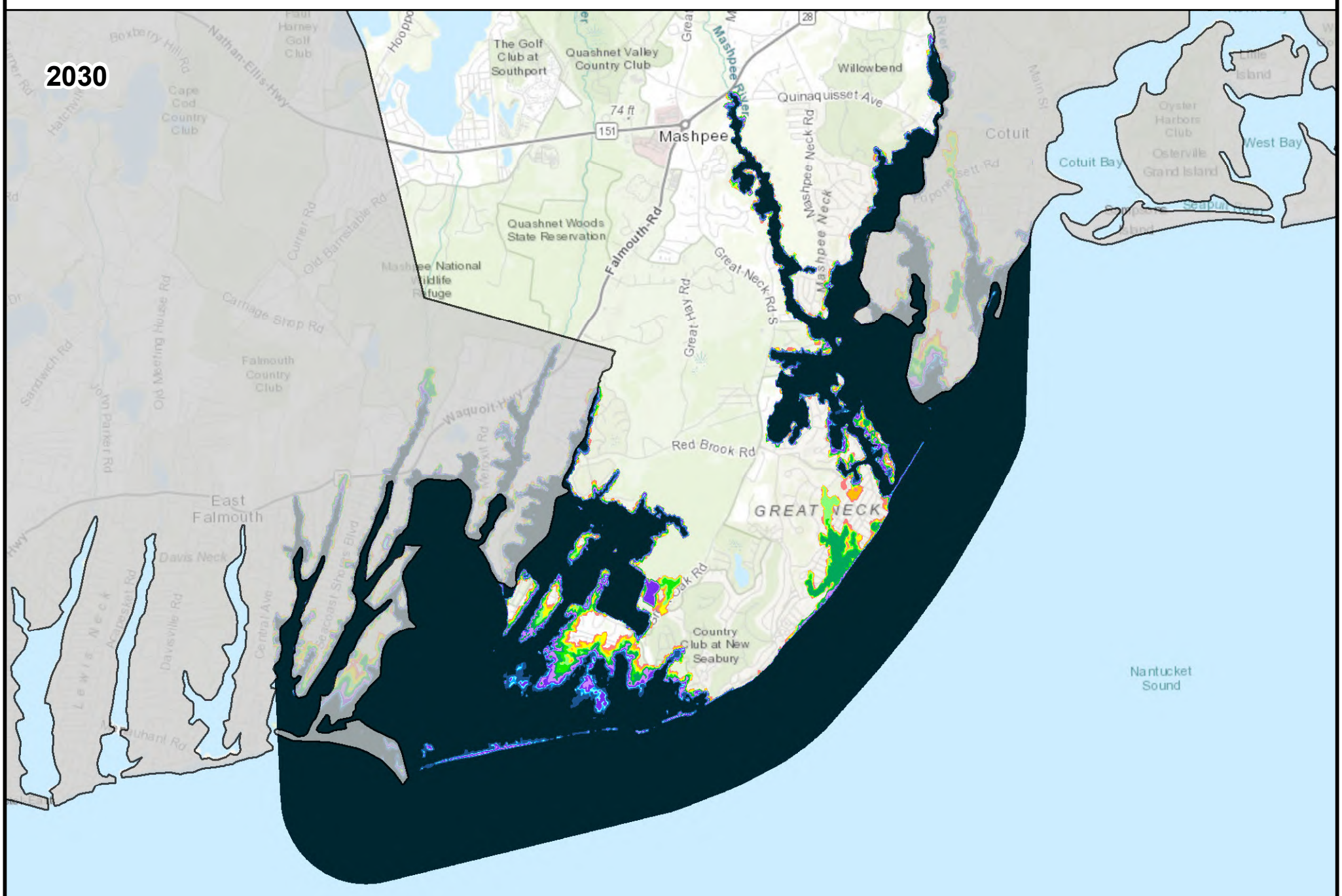
0.2 0 0.2 0.4 0.6 0.8 1
Miles

CAPE COD COMMISSION

Present Day



2030



Probability of Inundation

0.1% 0.2% 0.5% 1% 2% 5% 10% 20% 25% 30% 50% 100%

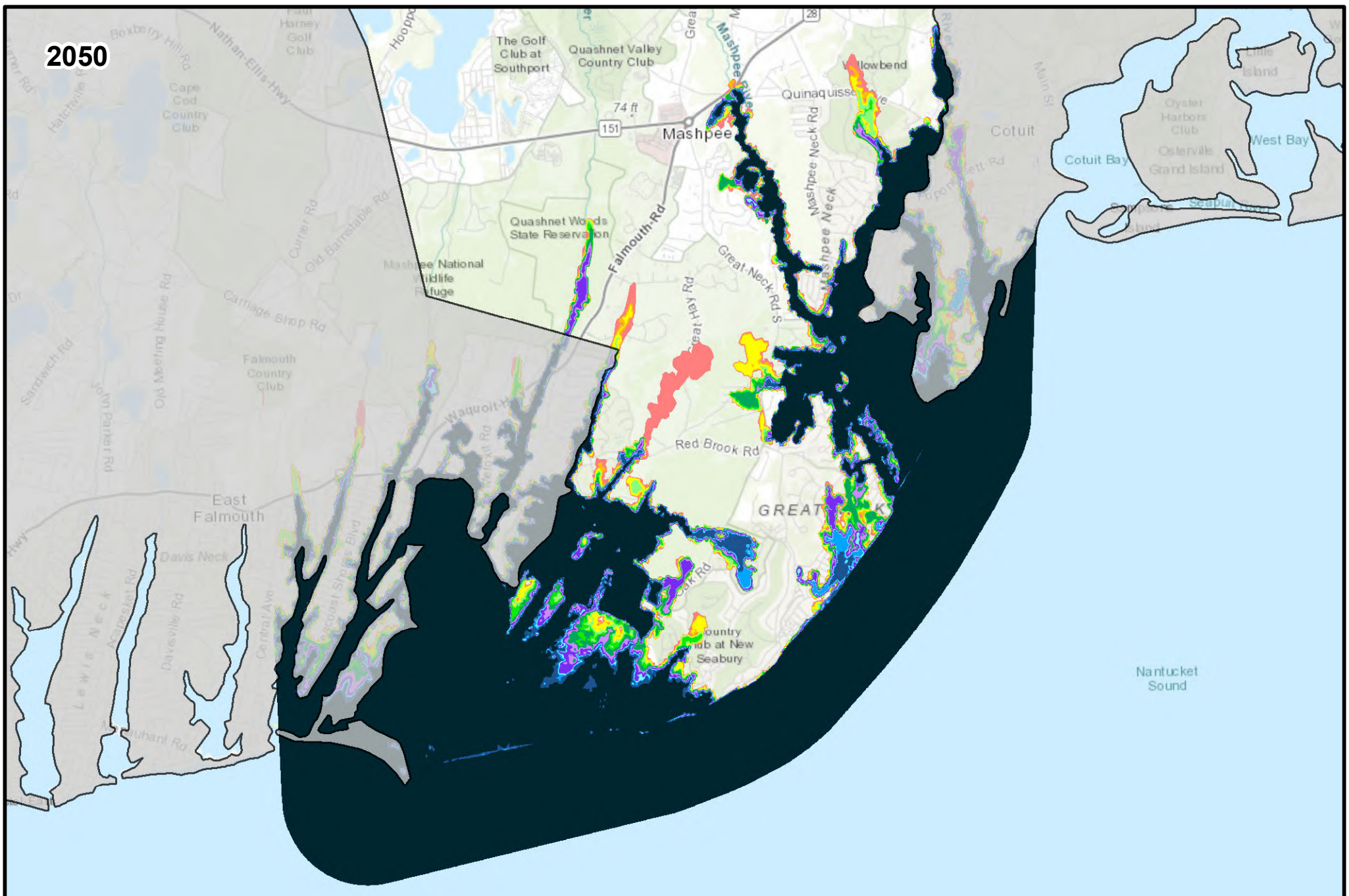
0 0.5 1 Miles

N

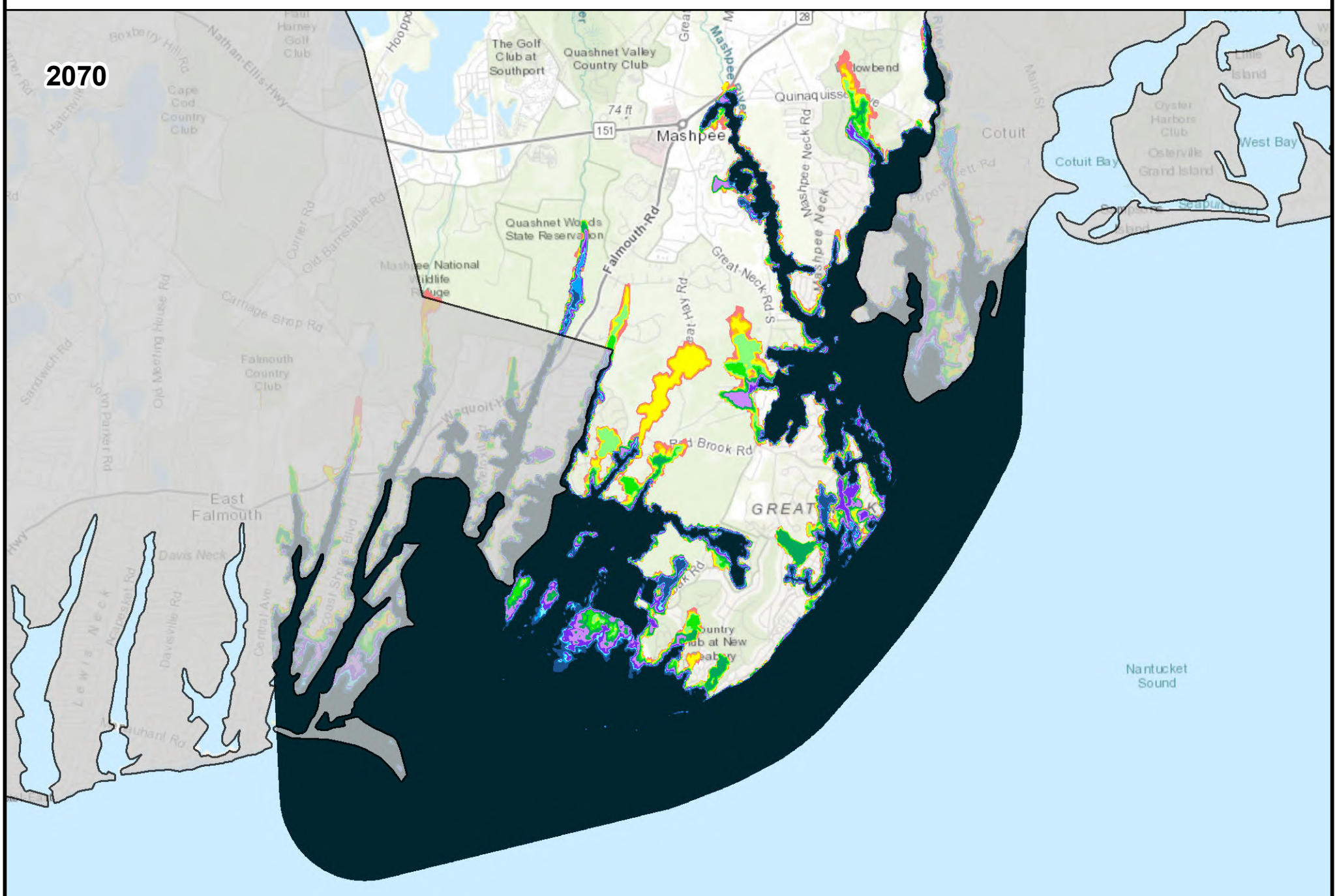
WOODS HOLE GROUP
A CLS COMPANY

massDOT
Massachusetts Department of Transportation

2050



2070



Probability of Inundation

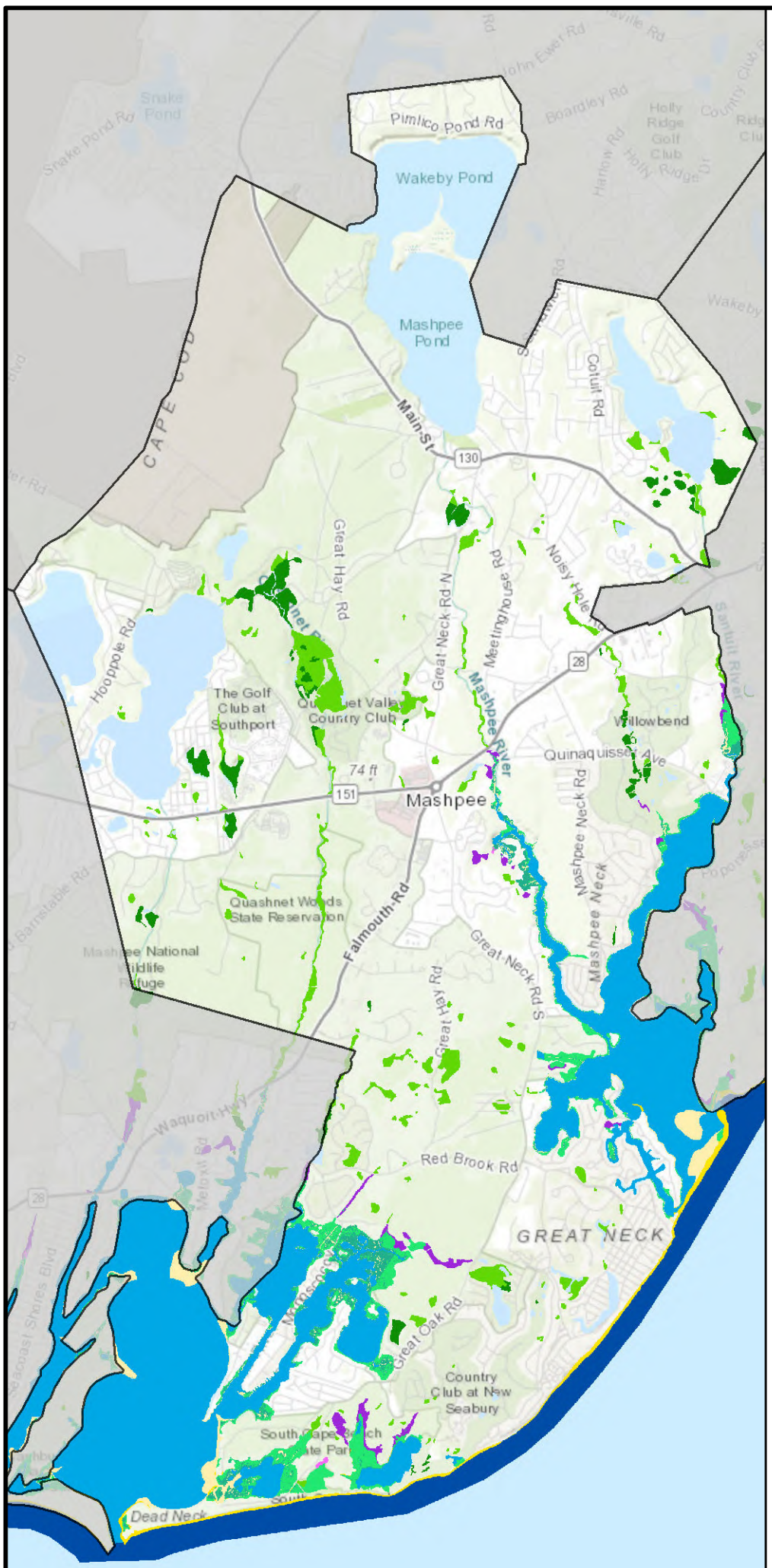
0.1% 0.2% 0.5% 1% 2% 5% 10% 20% 25% 30% 50% 100%

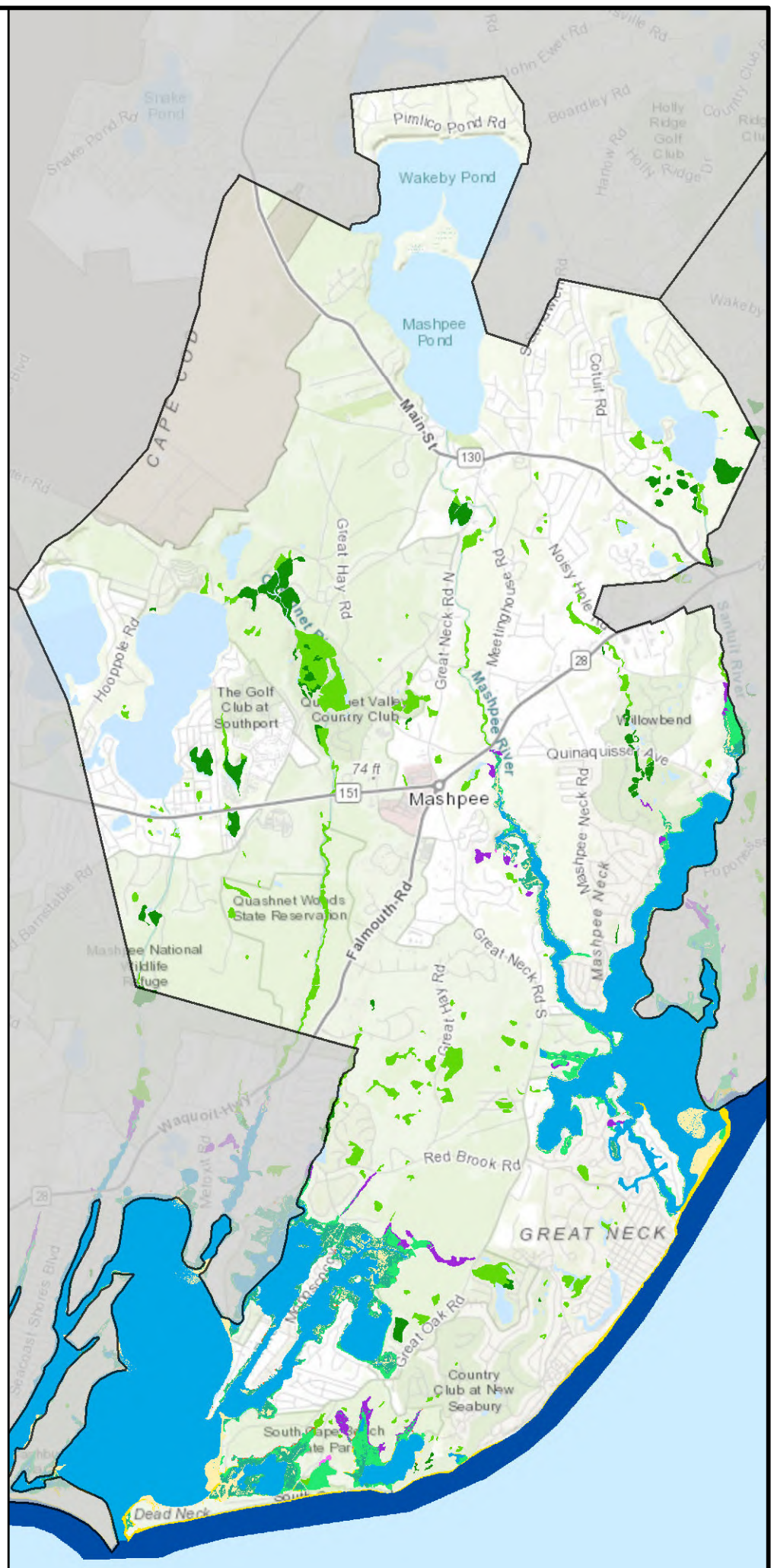
0 0.5 1 Miles

N

WOODS HOLE GROUP
A CLS COMPANY

massDOT
Massachusetts Department of Transportation





Sea Level and Marsh Migration (SLAMM)- Intermediate High

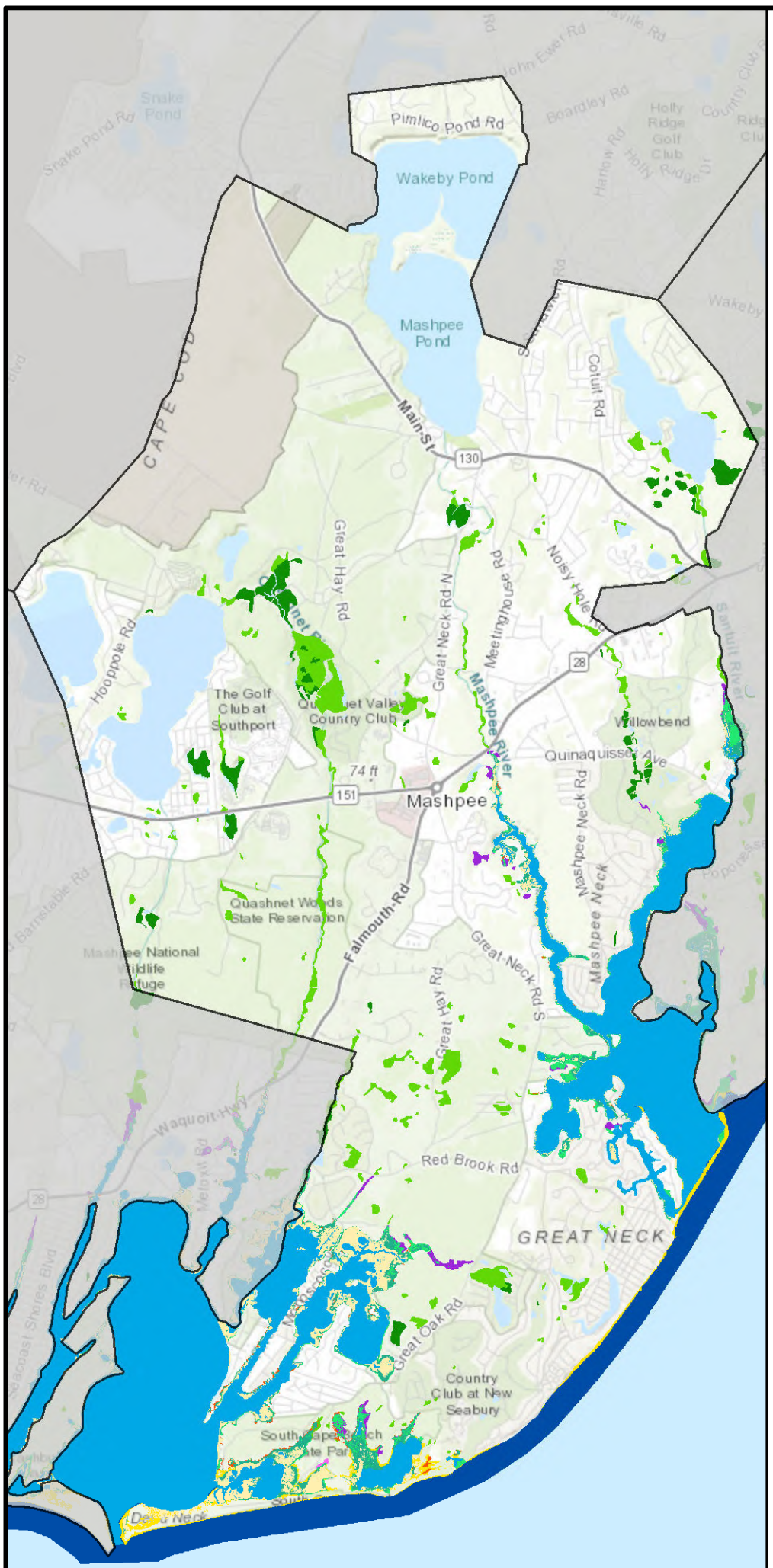
- Upland
- Nontidal Swamp
- Inland Fresh Marsh
- Tidal Fresh Marsh
- Transitional Marsh/Scrub-Shrub
- Regularly Flooded Marsh
- Estuarine Beach/Tidal Flat
- Ocean Beach
- Ocean Flat
- Rocky Intertidal
- Inland Open Water
- Riverine Tidal Open Water
- Estuarine Open Water
- Open Ocean
- Irregularly Flooded Marsh
- Inland Shore
- Tidal Swamp

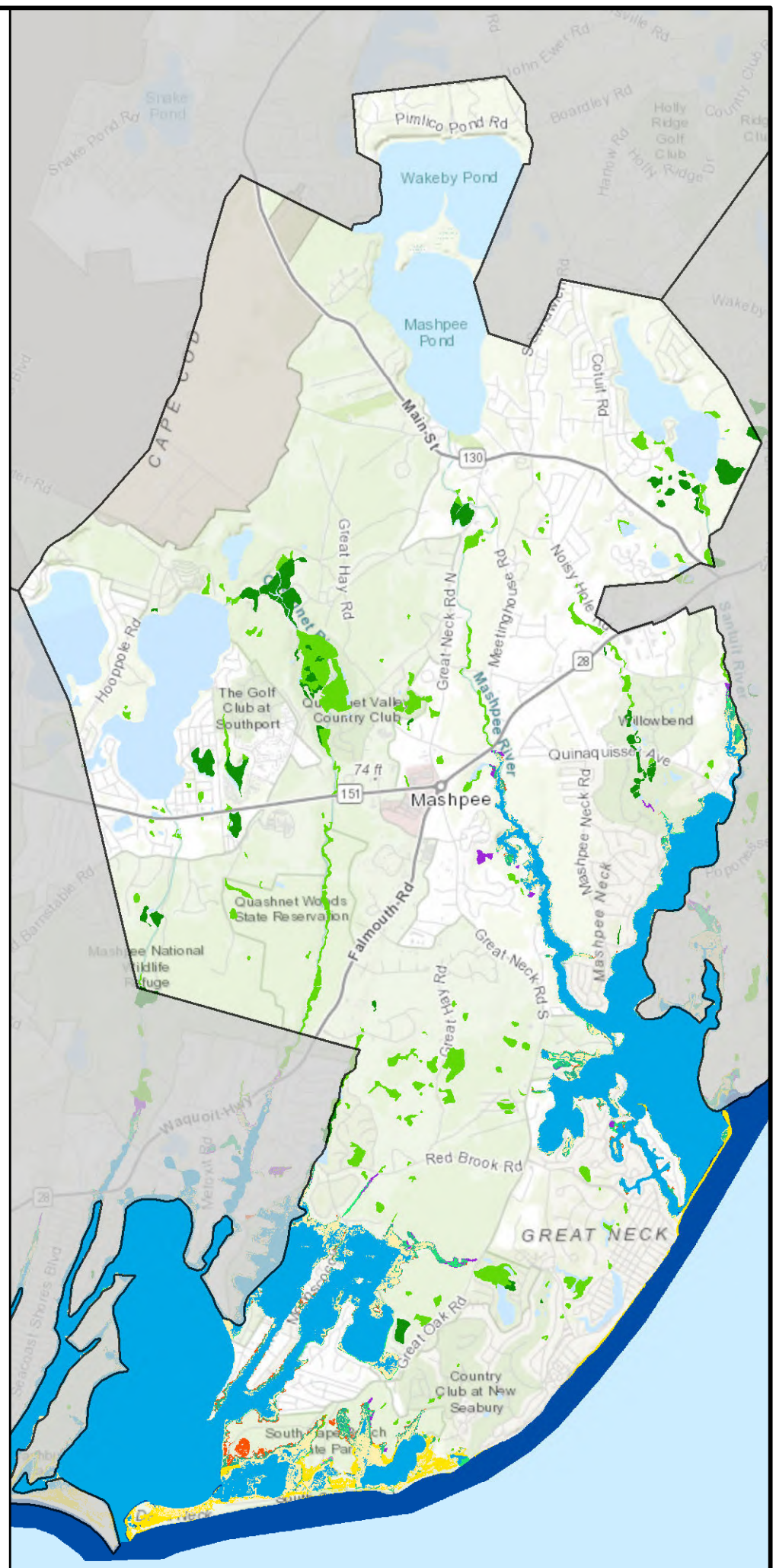
N

0 1 2 Miles

WOODS HOLE GROUP
A CLS COMPANY

MASSACHUSETTS OFFICE OF COASTAL ZONE MANAGEMENT





Sea Level and Marsh Migration (SLAMM)- Intermediate High

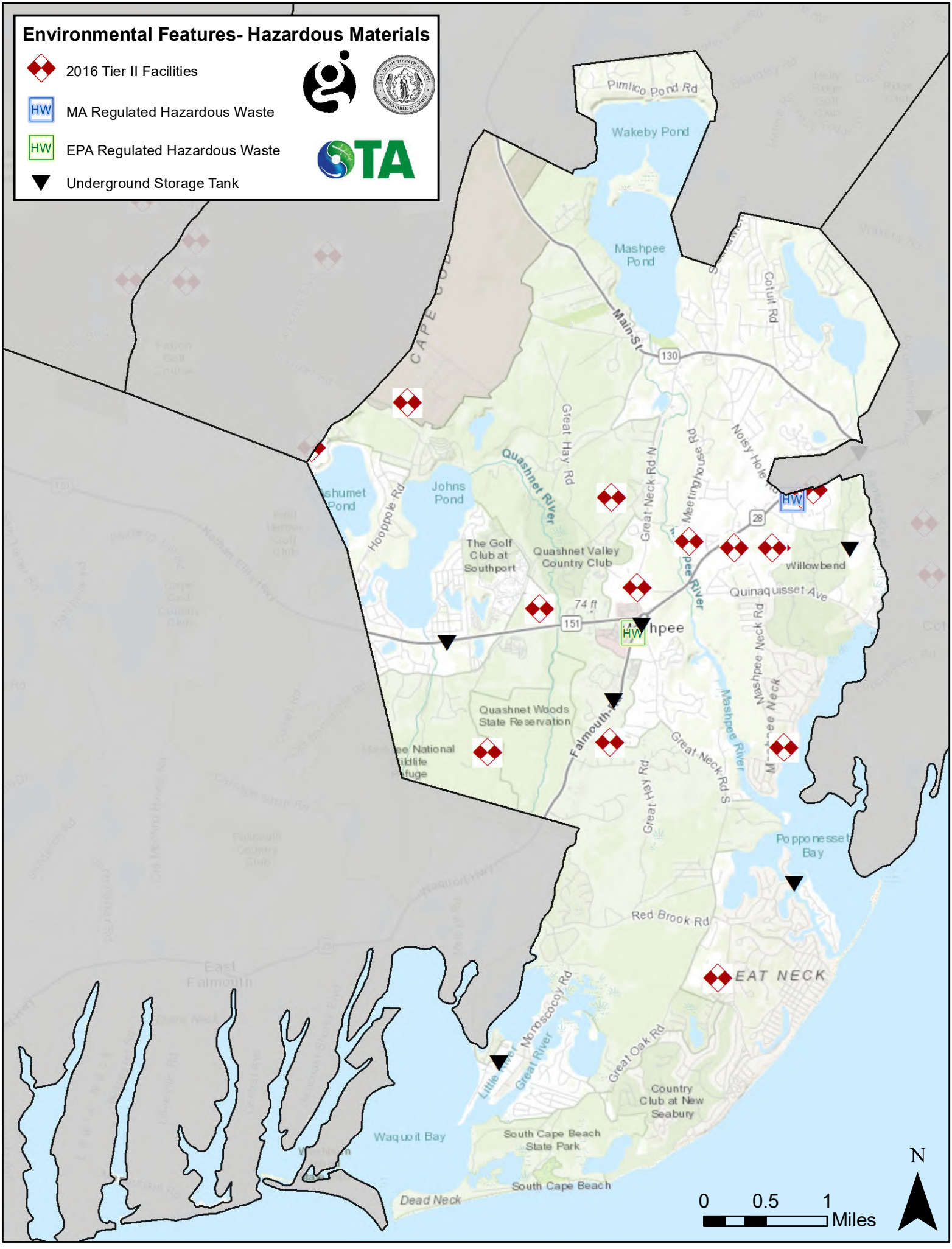
- Upland
- Nontidal Swamp
- Inland Fresh Marsh
- Tidal Fresh Marsh
- Transitional Marsh/Scrub-Shrub
- Regularly Flooded Marsh
- Estuarine Beach/Tidal Flat
- Ocean Beach
- Ocean Flat
- Rocky Intertidal
- Inland Open Water
- Riverine Tidal Open Water
- Estuarine Open Water
- Open Ocean
- Irregularly Flooded Marsh
- Inland Shore
- Tidal Swamp

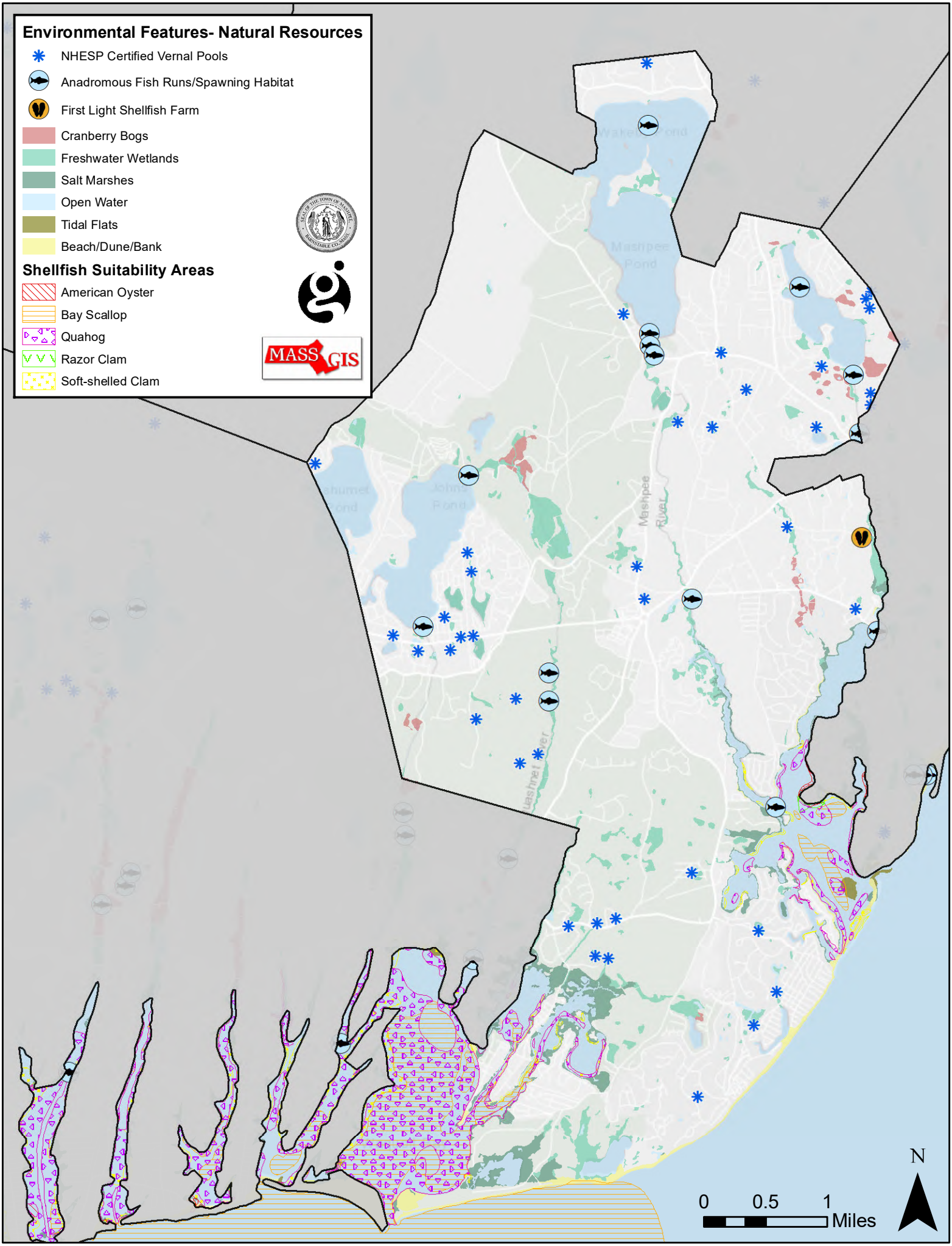
N

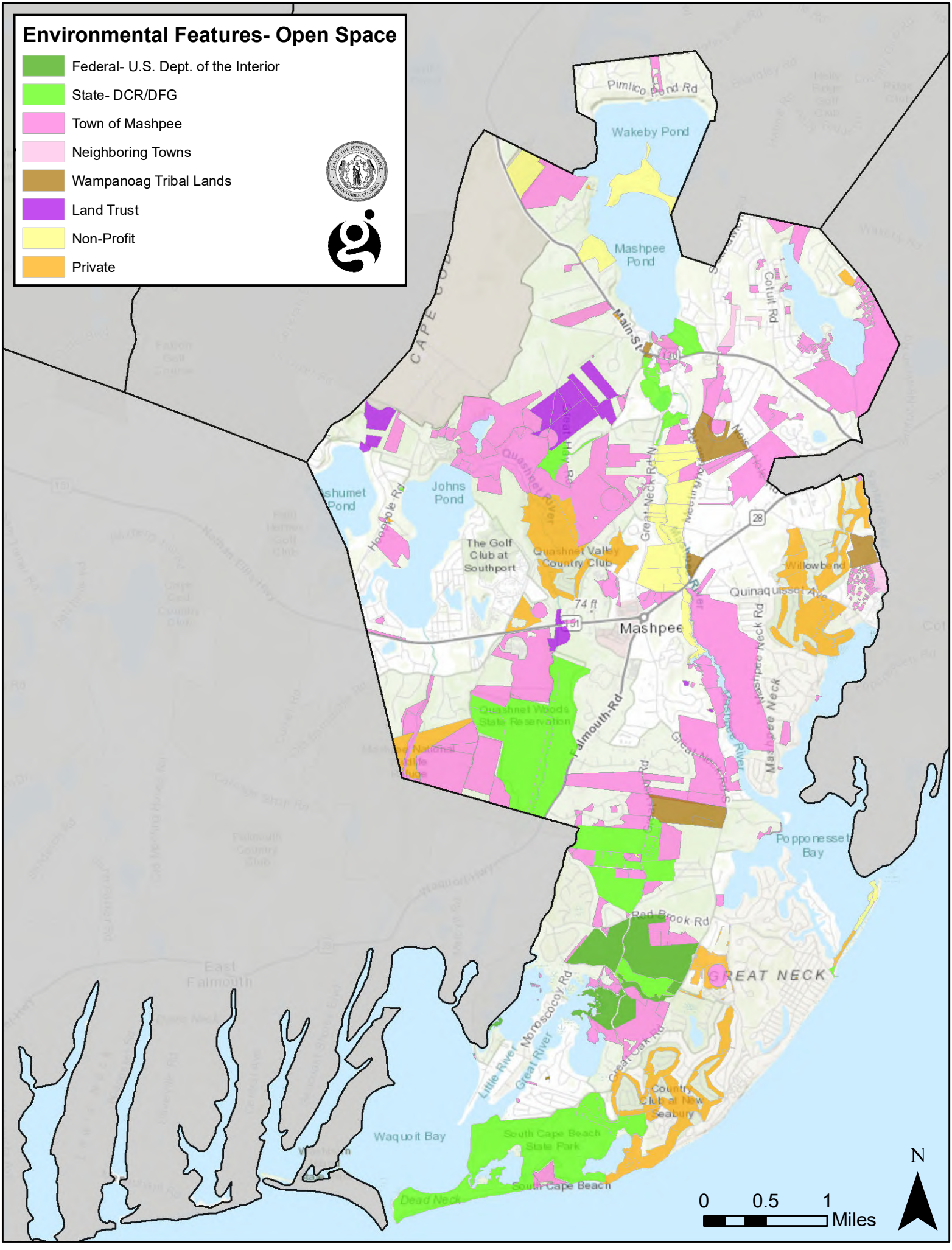
0 1 2 Miles

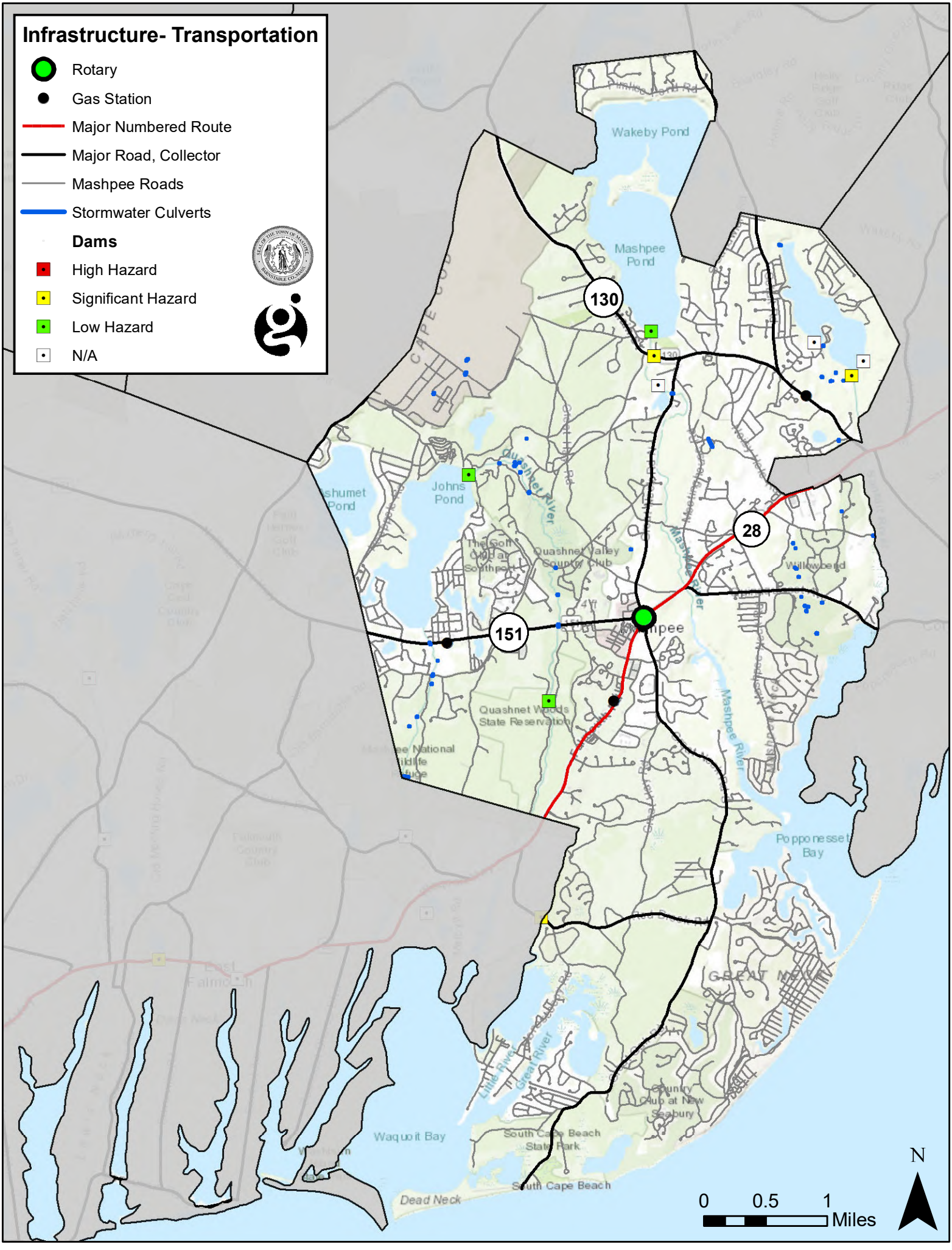
WOODS HOLE GROUP
A CLS COMPANY

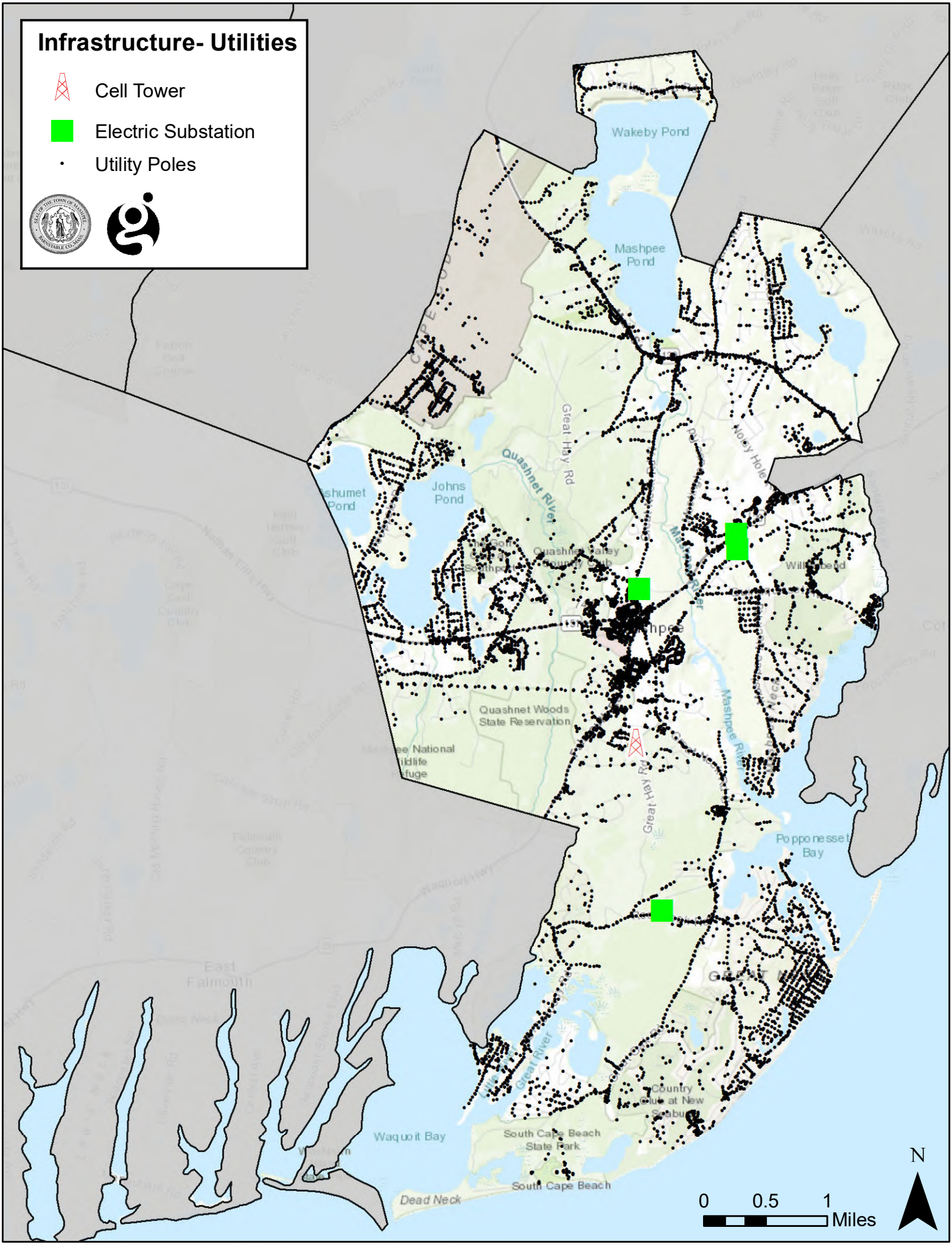
MASSACHUSETTS OFFICE OF COASTAL ZONE MANAGEMENT

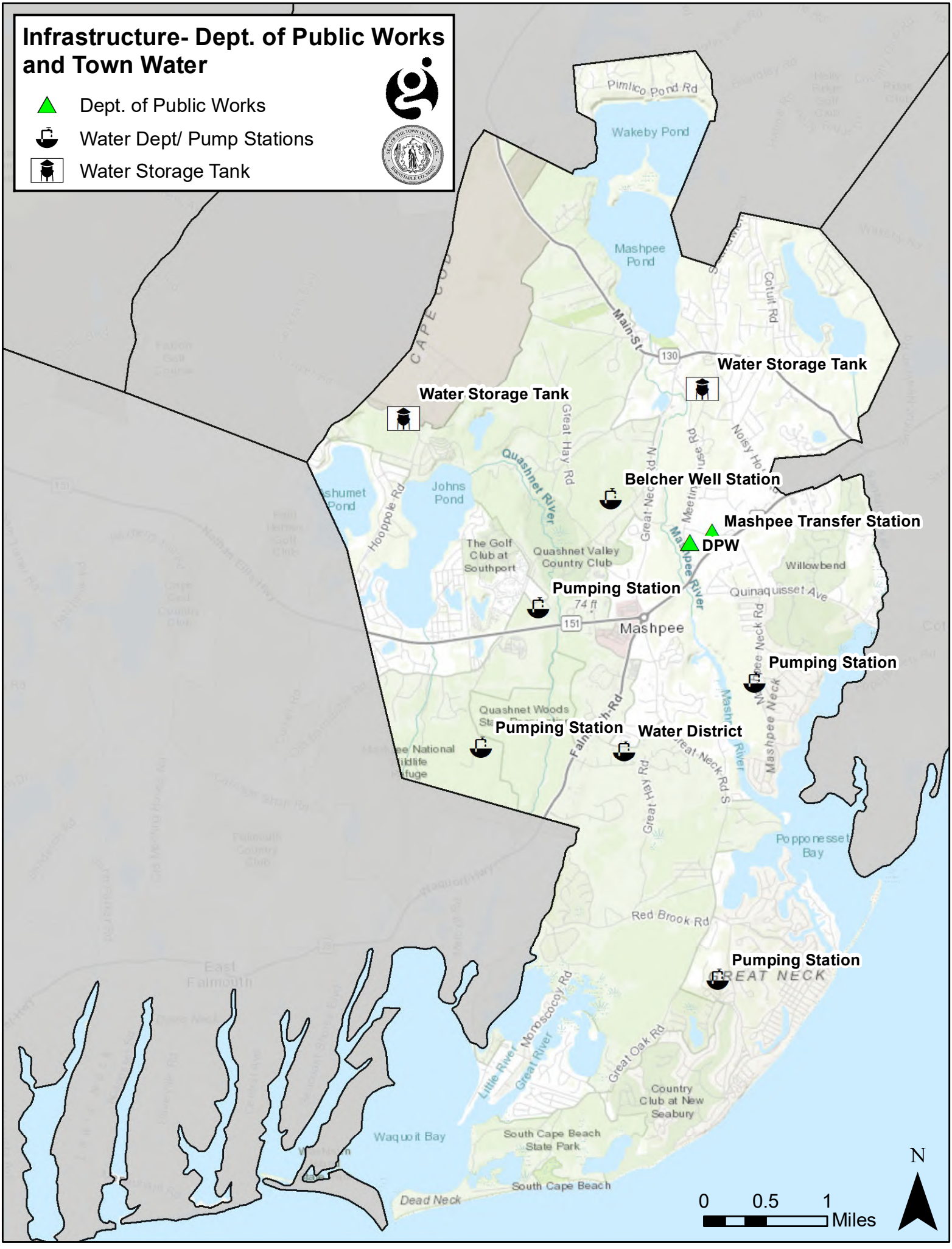

Environmental Features- Hazardous Materials
2016 Tier II Facilities
MA Regulated Hazardous Waste
EPA Regulated Hazardous Waste
Underground Storage Tank
HW
HW
TA
Pimlico Pond Rd
Wakeby Pond
Mashpee Pond
Cotuit Rd
Main St
130
CAPE COD
Great Hay Rd
Quashnet River
Great Neck Rd N
Meetinghouse Rd
Noisy Hollow Rd
Johns Pond
Hoopoe Rd
The Golf Club at Southport
Quashnet Valley Country Club
28
Willowbend
Quinaquisset Ave
74 ft
151
Mashpee
Mashpee River
Mashpee Neck Rd
Quashnet Woods State Reservation
Falmouth Rd
Great Neck Rd S
Great Hay Rd
Popponesset Bay
Red Brook Rd
EAT NECK
Great Oak Rd
Country Club at New Seabury
Waquoit Bay
South Cape Beach State Park
South Cape Beach
Dead Neck
East Falmouth
0
0.5
1
Miles
N

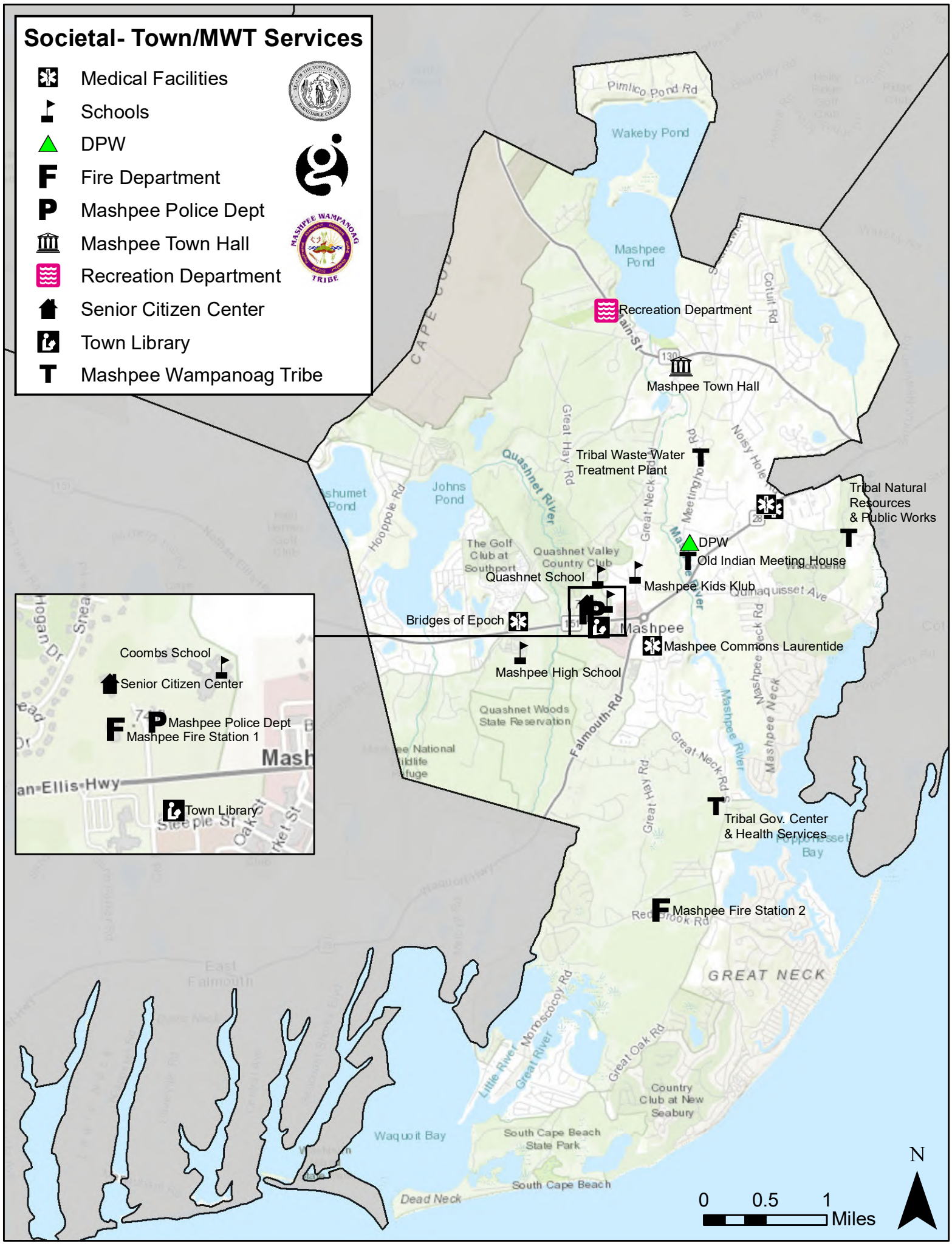

Environmental Features- Natural Resources
NHESP Certified Vernal Pools
Anadromous Fish Runs/Spawning Habitat
First Light Shellfish Farm
Cranberry Bogs
Freshwater Wetlands
Salt Marshes
Open Water
Tidal Flats
Beach/Dune/Bank
Shellfish Suitability Areas
American Oyster
Bay Scallop
Quahog
Razor Clam
Soft-shelled Clam
MASS GIS
Mashpee Pond
Mashpee River
Waquoit Bay
0
0.5
1
Miles
N

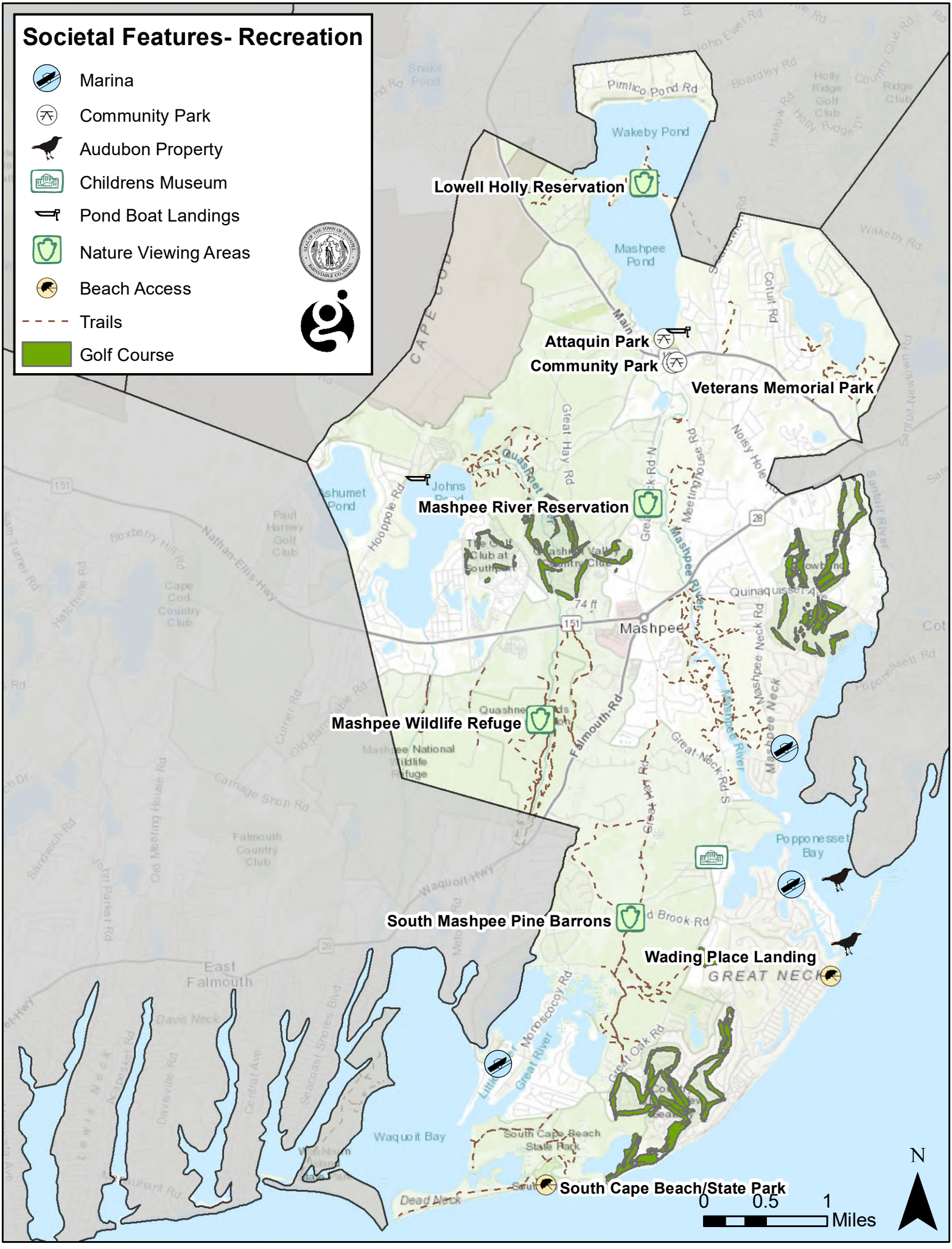

Environmental Features- Open Space
Federal- U.S. Dept. of the Interior
State- DCR/DFG
Town of Mashpee
Neighboring Towns
Wampanoag Tribal Lands
Land Trust
Non-Profit
Private
Pimlico Pond Rd
Wakeby Pond
Mashpee Pond
Main St
Cotuit Rd
Quashnet River
Great Neck Rd N
Johns Pond
Hooppole Rd
The Golf Club at Southport
Quashnet Valley Country Club
Willowbend
Quinaquisset Ave
74 ft
Mashpee
Falmouth Rd
Quashnet Woods State Reservation
Mashpee Neck Rd
Mashpee River
Popponesset Bay
Red Brook Rd
GREAT NECK
Nonscoscoy Rd
Great River
Little River
Great Oak Rd
Country Club at New Seabury
Waquoit Bay
South Cape Beach State Park
South Cape Beach
Dead Neck
East Falmouth
0
0.5
1
Miles
N

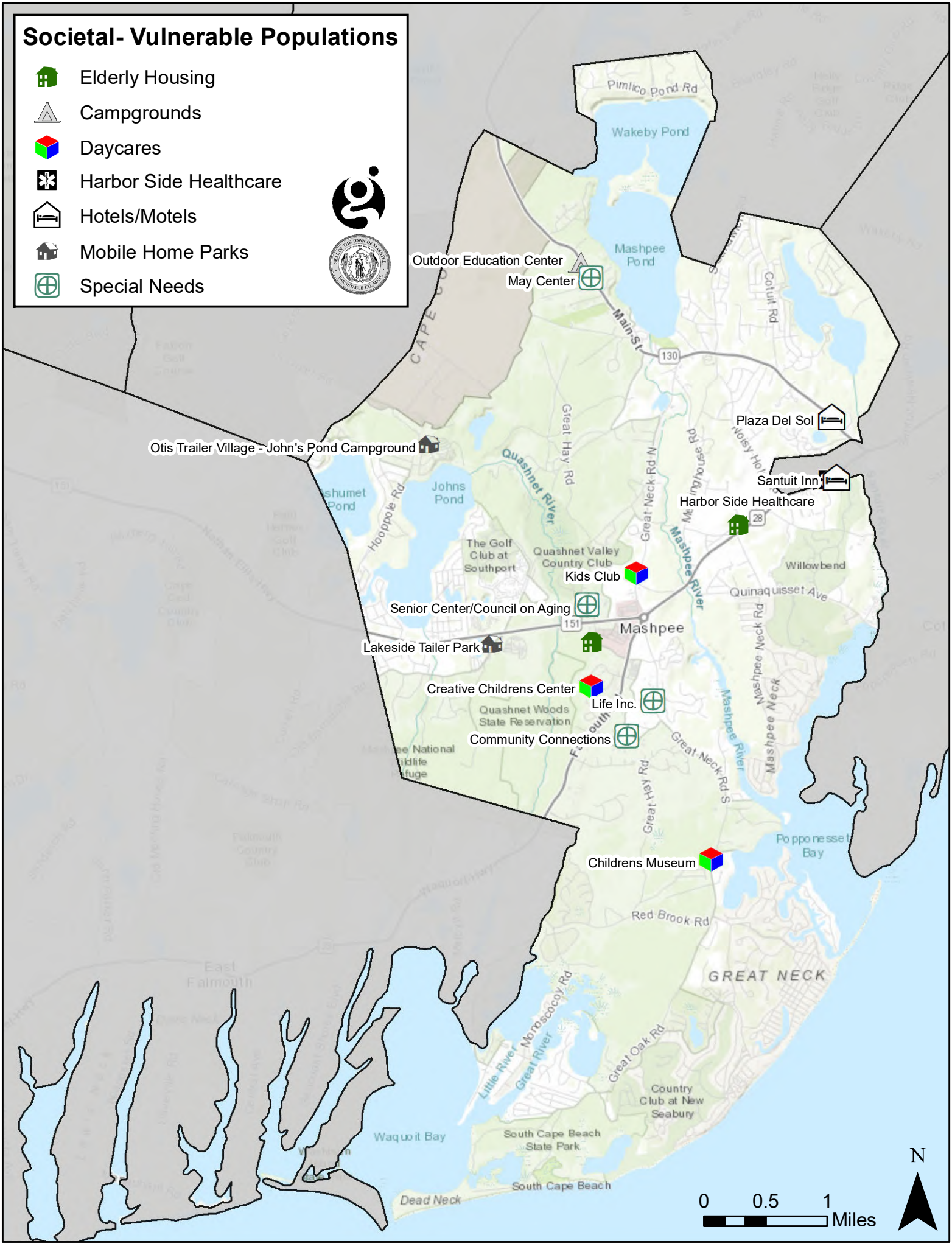

Infrastructure- Transportation
Rotary
Gas Station
Major Numbered Route
Major Road, Collector
Mashpee Roads
Stormwater Culverts
Dams
High Hazard
Significant Hazard
Low Hazard
N/A
Wakeby Pond
Mashpee Pond
Johns Pond
Quashnet River
Quashnet Valley Country Club
Willowbend
Quashnet Woods State Reservation
Mashpee River
Popponesset Bay
Waquoit Bay
South Cape Beach State Park
South Cape Beach
Dead Neck
Great River
Child River
130
28
151
0
0.5
1
Miles
N


Infrastructure- Utilities
Cell Tower
Electric Substation
Utility Poles
Wakeby Pond
Mashpee Pond
Johns Pond
Quashnet River
Great Hay Rd
Quashnet Woods State Reservation
Mashpee River
Popponesset Bay
Waquoit Bay
South Cape Beach State Park
South Cape Beach
Dead Neck
East Falmouth
0 0.5 1
Miles
N


Infrastructure- Dept. of Public Works and Town Water
Dept. of Public Works
Water Dept/ Pump Stations
Water Storage Tank
Water Storage Tank
Water Storage Tank
Belcher Well Station
Mashpee Transfer Station
DPW
Pumping Station
74 ft
Pumping Station
Pumping Station
Water District
Pumping Station
Pimlico Pond Rd
Wakeby Pond
Mashpee Pond
Main St
130
Cotuit Rd
Great Hay Rd
Quashnet River
Hooppole Rd
Johns Pond
Ashumet Pond
The Golf Club at Southport
Quashnet Valley Country Club
Mashpee River
Willowbend
Quinaquisset Ave
151
Mashpee
Mashpee Neck Rd
Quashnet Woods
Great Neck Rd S
Popponesset Bay
Red Brook Rd
GREAT NECK
Great Oak Rd
Country Club at New Seabury
Waquoit Bay
South Cape Beach State Park
South Cape Beach
Dead Neck
East Falmouth
0
0.5
1
Miles
N


Societal- Town/MWT Services
Medical Facilities
Schools
DPW
Fire Department
Mashpee Police Dept
Mashpee Town Hall
Recreation Department
Senior Citizen Center
Town Library
Mashpee Wampanoag Tribe
Pimlico Pond Rd
Wakeby Pond
Mashpee Pond
Cotuit Rd
Recreation Department
Main St
Mashpee Town Hall
Great Hay Rd
Quashnet River
Tribal Waste Water Treatment Plant
Noisy Hollow Rd
Meetinghouse Rd
Tribal Natural Resources & Public Works
Ashumet Pond
Johns Pond
Hoopapole Rd
Great Neck Rd
Mashpee River
DPW
Old Indian Meeting House
The Golf Club at Southport
Quashnet Valley Country Club
Quashnet School
Mashpee Kids Klub
Quinaquisset Ave
Bridges of Epoch
Mashpee
Mashpee Commons Laurentide
Mashpee High School
Mashpee Neck Rd
Mashpee Neck
Quashnet Woods State Reservation
Falmouth Rd
Great Neck Rd
Mashpee River
Great Hay Rd
Tribal Gov. Center & Health Services
Popponesset Bay
Mashpee Fire Station 2
GREAT NECK
Great Oak Rd
Country Club at New Seabury
Waquoit Bay
South Cape Beach State Park
South Cape Beach
Dead Neck
Coombs School
Senior Citizen Center
Mashpee Police Dept
Mashpee Fire Station 1
Town Library
Steeple St
Oak St
0
0.5
1
Miles
N


Societal Features- Recreation
Marina
Community Park
Audubon Property
Childrens Museum
Pond Boat Landings
Nature Viewing Areas
Beach Access
Trails
Golf Course
Lowell Holly Reservation
Attaquin Park
Community Park
Veterans Memorial Park
Mashpee River Reservation
Mashpee Wildlife Refuge
South Mashpee Pine Barrons
Wading Place Landing
South Cape Beach/State Park
Pimlico Pond Rd
Wakeby Pond
Mashpee Pond
Main St
Cotuit Rd
Great Hay Rd
Meeting House Rd
Noisy Hole Rd
Hooppole Rd
Johns Pond
Ashumet Pond
Quashnet River
Mashpee River
Mashpee
Quinaquisset Ave
Mashpee Neck Rd
Mashpee Neck
Great Neck Rd S
Great Neck Rd
Falmouth Rd
Waquoit Hwy
Popponesset Bay
Great River
Nonesscocy Rd
Great Oak Rd
Waquoit Bay
East Falmouth
Dead Neck
Nathan Ellis Hwy
Boxberry Hill Rd
Cape Cod Country Club
Paul Harney Golf Club
Falmouth Country Club
Carriage Shop Rd
Old Meeting House Rd
Sandwich Rd
John Parker Rd
Currier Rd
Old Barnstable Rd
Hatchville Rd
Davis Neck Rd
Lewis Neck Rd
Central Ave
Seacoast Shores Blvd
Quinaquisset Ave
Cotuit
Santuit-Newtown Rd
Santuit River
Popponesset Rd
Wakeby Rd
Holly Ridge Golf Club
Ridge Club
Harlow Rd
Country Club Rd
John Ewell Rd
Snake Pond
CAPE COD
74 ft
151
28
0
0.5
1
Miles
N


Societal- Vulnerable Populations
Elderly Housing
Campgrounds
Daycares
Harbor Side Healthcare
Hotels/Motels
Mobile Home Parks
Special Needs
Outdoor Education Center
May Center
Otis Trailer Village - John's Pond Campground
Plaza Del Sol
Santuit Inn
Harbor Side Healthcare
Kids Club
Senior Center/Council on Aging
Lakeside Tailer Park
Creative Childrens Center
Life Inc.
Community Connections
Childrens Museum
Mashpee
Pimlico Pond Rd
Wakeby Pond
Mashpee Pond
Main St
130
Cotuit Rd
Great Hay Rd
Quashnet River
Great Neck Rd N
Mashpee River
Noisy Hollow Rd
Willowbend
Quinaquisset Ave
Mashpee Neck Rd
Mashpee Neck
Great Neck Rd S
Johns Pond
Hoopole Rd
The Golf Club at Southport
Quashnet Valley Country Club
Quashnet Woods State Reservation
Popponesset Bay
Red Brook Rd
GREAT NECK
Great Oak Rd
Country Club at New Seabury
South Cape Beach State Park
South Cape Beach
Waquoit Bay
Dead Neck
East Falmouth
Little River
Great River
Nonamesset Rd
0
0.5
1
Miles
N

APPENDIX D. CLIMATE CHANGE PROJECTIONS

CAPE COD BASIN

MUNICIPALITIES WITHIN CAPE COD BASIN:

Barnstable, Bourne, Brewster, Chatham, Dennis, Eastham, Falmouth, Harwich, Mashpee, Orleans, Provincetown, Sandwich, Truro, Wellfleet, Yarmouth

Many municipalities fall within more than one basin, so it is advised to use the climate projections for the basin that contains the majority of the land area of the municipality.

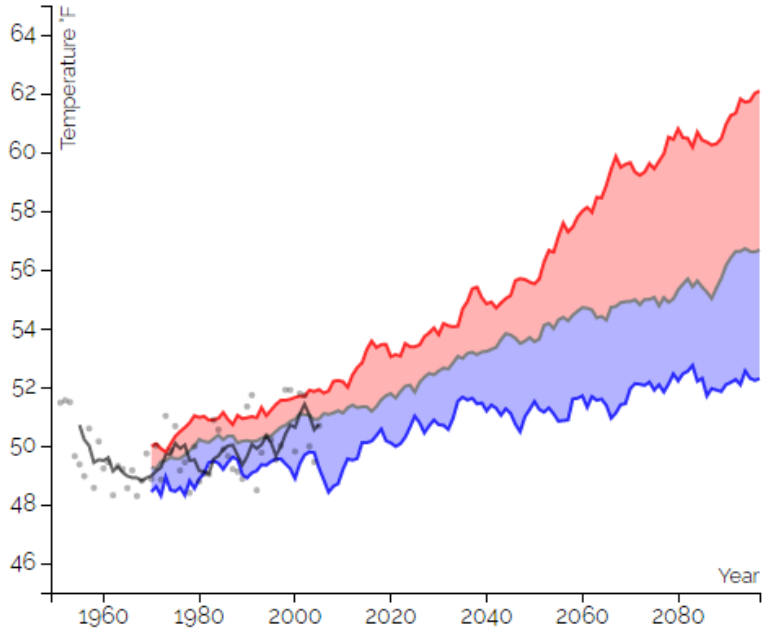
CAPE COD BASIN

Cape Cod 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	49.92	+1.78 to +3.41	+2.41 to +5.39	+2.74 to +7.78	+3.11 to +9.52
	Winter	31.92	+1.76 to +3.72	+2.50 to +5.70	+3.07 to +7.69	+3.35 to +9.20
	Spring	45.98	+1.73 to +3.23	+2.16 to +5.04	+2.59 to +6.74	+2.94 to +7.69
	Summer	68.15	+1.50 to +3.62	+2.08 to +5.66	+2.45 to +8.58	+3.03 to +10.43
	Fall	53.32	+1.92 to +3.83	+3.03 to +5.86	+2.85 to +8.29	+3.35 to +10.06
Maximum Temperature	Annual	57.74	+1.63 to +3.38	+2.19 to +5.23	+2.43 to +7.73	+2.82 to +9.26
	Winter	39.76	+1.52 to +3.60	+2.10 to +5.27	+2.60 to +7.27	+3.01 to +8.65
	Spring	53.74	+1.44 to +3.11	+1.92 to +4.80	+2.30 to +6.54	+2.62 to +7.55
	Summer	75.95	+1.35 to +3.48	+1.95 to +5.60	+2.29 to +8.47	+2.68 to +10.27
	Fall	61.24	+1.84 to +3.80	+2.81 to +5.83	+2.76 to +8.00	+3.08 to +9.97
Minimum Temperature	Annual	42.09	+1.92 to +3.53	+2.67 to +5.50	+3.06 to +7.84	+3.42 to +9.67
	Winter	24.08	+2.06 to +3.97	+2.90 to +6.16	+3.53 to +8.34	+3.81 to +9.85
	Spring	38.23	+1.74 to +3.47	+2.51 to +5.28	+2.71 to +6.93	+3.19 to +7.83
	Summer	60.35	+1.65 to +3.75	+2.23 to +5.72	+2.61 to +8.66	+3.32 to +10.64
	Fall	45.41	+1.92 to +4.01	+3.14 to +5.88	+2.96 to +8.49	+3.63 to +10.28

- The Cape Cod basin is expected to experience increased average temperatures throughout the 21st century. Maximum and minimum temperatures are also expected to increase throughout the end of the century. These increased temperature trends are expected for annual and seasonal projections.
- Seasonally, maximum summer and fall temperatures are expected to see the highest projected increase throughout the 21st century.
    - Summer mid-century increase of 2 °F to 5.6 °F (3-7% increase); end of century increase of 2.7 °F to 10.3 °F (4-14% increase).
    - Fall mid-century increase of 2.8°F to 5.8°F (5-10% increase); end of century increase by and 2.8 °F to 5.8 °F (5-16% increase).
- Seasonally, minimum winter and fall temperatures are expected to see increases throughout the 21st century.
    - Winter mid-century increase of 2.9 °F to 6.2 °F (12-26% increase); end of century increase by 3.8 °F to 9.9 °F (16-41% increase).
    - Fall mid-century of 3.1 °F to 5.9 °F (7-13% increase); end of century increase of 3.6 °F to 10.3 °F (8-23% increase).

Annual Average Temperature

Cape Cod



Download Data

Observed	°F
5-yr Mean	

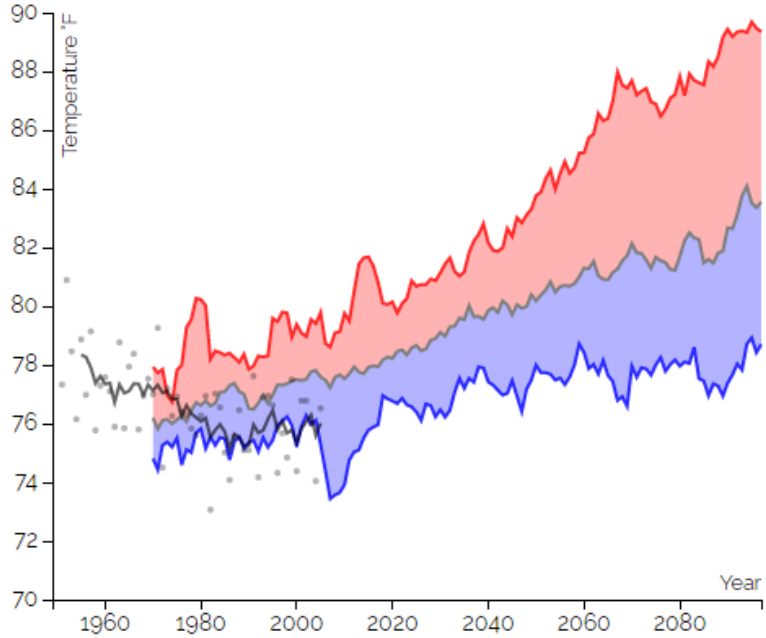
Modeled °F

Max	
Median	
Min	

Changes from 1971-2000 for:	
2020 - 2049	3.19°F
2040 - 2069	4.39°F
2060 - 2089	5.16°F
2080 - 2097	5.87°F

Summer Maximum Temperature

Cape Cod



Download Data

Observed	°F
5-yr Mean	

Modeled °F

Max	
Median	
Min	

Changes from 1971-2000 for:	
2020 - 2049	3.28°F
2040 - 2069	4.41°F
2060 - 2089	5.28°F
2080 - 2097	6.15°F

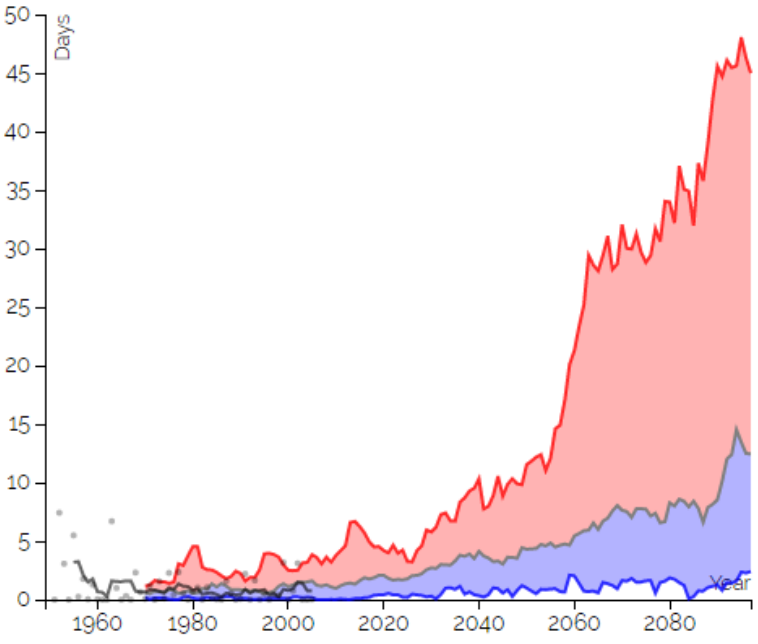
CAPE COD BASIN

Cape Cod 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	0.76	+1.17 to +3.89	+1.93 to +9.25	+2.46 to +21.33	+3.23 to +33.89
	Winter	0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00
	Spring	0.01	-0.02 to +0.09	-0.02 to +0.13	+0.00 to +0.20	+0.00 to +0.29
	Summer	0.73	+1.06 to +3.58	+1.79 to +8.62	+2.34 to +19.96	+3.04 to +31.61
	Fall	0.01	+0.06 to +0.28	+0.10 to +0.68	+0.13 to +1.26	+0.19 to +2.26
Days with Maximum Temperature Over 95°F	Annual	0.06	+0.08 to +0.63	+0.19 to +1.88	+0.25 to +4.51	+0.26 to +9.49
	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 +0.01	-0.00 to +0.02	+0.00 to +0.05	+0.00 to +0.08
	Summer	0.06	+0.07 to +0.61	+0.18 to +1.85	+0.25 to +4.32	+0.26 to +9.11
	Fall	0.00	+0.00 to +0.03	+0.00 to +0.06	+0.00 to +0.17	+0.00 to +0.42
Days with Maximum Temperature Over 100°F	Annual	0.00	+0.00 to +0.07	+0.00 to +0.31	+0.01 to +0.80	+0.03 to +1.71
	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 +0.00	+0.00 to +0.00	+0.00 to +0.01
	Summer	0.00	+0.00 to +0.07	+0.00 to +0.31	+0.01 to +0.80	+0.02 to +1.69
	Fall	0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.01	+0.00 to +0.04

- Due to projected increases in average and maximum temperatures throughout the end of the century, the Cape Cod basin is also expected to experience an increase in days with daily maximum temperatures over 90 °F, 95 °F, and 100 °F.
    - Annually, the Cape Cod basin is expected to see days with daily maximum temperatures over 90 °F increase by 2 to 9 more days by mid-century, and 3 to 34 more days by the end of the century.
    - Seasonally, summer is expected to see an increase of 2 to 9 more days with daily maximums over 90 °F by mid-century.
    - By end of century, the Cape Cod basin is expected to have 3 to 32 more days.

Summer Days with Maximum Temperature Above 90°F

Cape Cod



Download Data

Observed

days

5-yr Mean

Modeled days

Max

Median

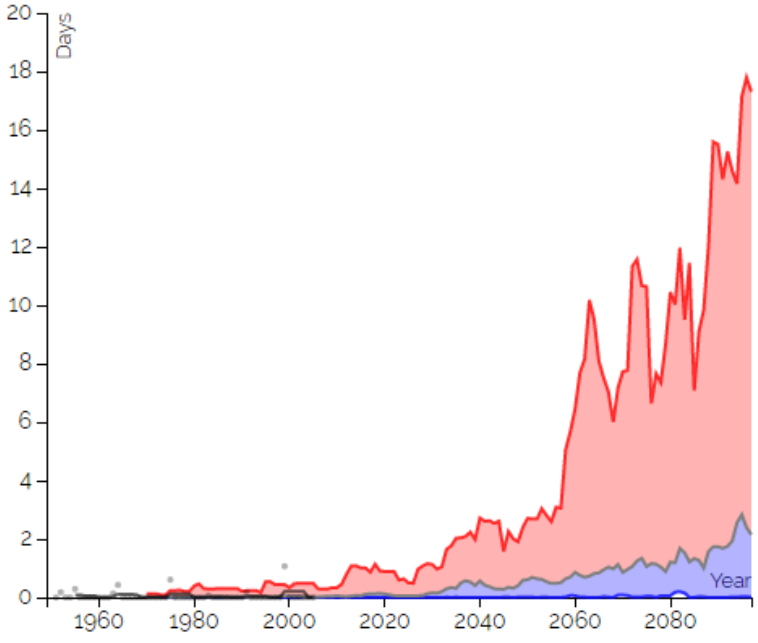
Min

Changes from 1971-2000 for:

2020 - 2049	2.59 days
2040 - 2069	4.20 days
2060 - 2089	7.13 days
2080 - 2097	8.04 days

Summer Days with Maximum Temperature Above 95°F

Cape Cod



Download Data

Observed

days

5-yr Mean

Modeled days

Max

Median

Min

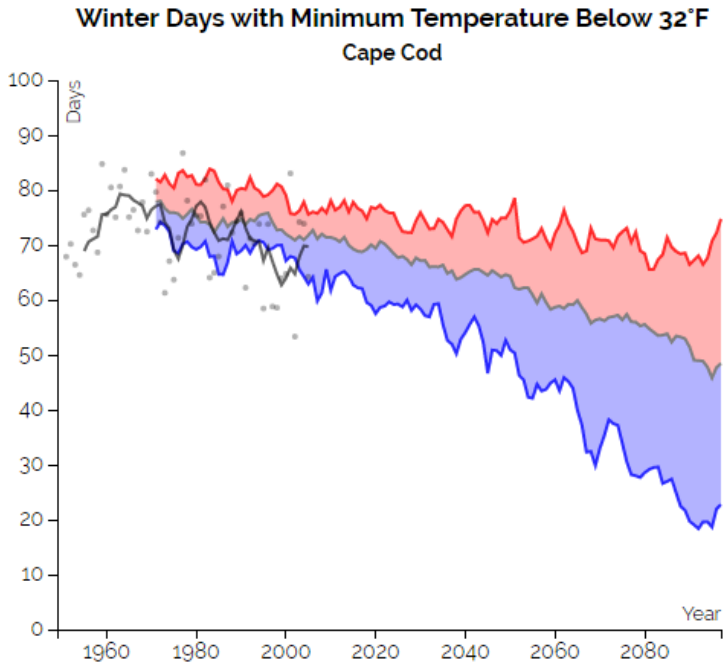
Changes from 1971-2000 for:

2020 - 2049	0.29 days
2040 - 2069	0.61 days
2060 - 2089	1.06 days
2080 - 2097	1.68 days

CAPE COD BASIN

Cape Cod 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	0.79	-0.08 to -0.37	-0.09 to -0.39	-0.14 to -0.4	-0.15 to -0.4
	Winter	0.79	-0.08 to -0.37	-0.09 to -0.39	-0.14 to -0.4	-0.15 to -0.4
	Spring	0.00	-0.01 to -0.00	-0.01 to -0.00	-0.01 to -0.00	-0.01 to -0.00
	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	104.75	-13.60 to -27.72	-19.29 to -41.91	-23.29 to -54.38	-24.54 to -66.71
	Winter	70.7	-5.68 to -12.20	-7.00 to -20.22	-10.21 to -29.71	-11.46 to -38.36
	Spring	23.8	-5.16 to -11.14	-7.22 to -14.64	-7.87 to -17.32	-9.50 to -18.96
	Summer	0.00	-0.05 to -0.00	-0.04 to -0.00	-0.04 to -0.00	-0.05 to -0.00
	Fall	10.16	-3.40 to -6.37	-4.69 to -8.2	-5.09 to -9.62	-5.34 to -10.71

- Due to projected increases in average and minimum temperatures throughout the end of the century, the Cape Cod basin is expected to experience a decrease in days with daily minimum temperatures below 32 °F and 0 °F.
- Seasonally, winter, spring and fall are expected to see the largest decreases in days with daily minimum temperatures below 32 °F.
    - Winter is expected to have 7 to 20 fewer days by mid-century, and 11 to 38 fewer days by end of century.
    - Spring is expected to have 7 to 15 fewer days by mid-century, and 10 to 19 fewer days by end of century.
    - Fall is expected to have 5 to 8 fewer days by mid-century, and 5 to 11 fewer days by end of century.



Download Data

Observed

days

5-yr Mean

Modeled days

Max

Median

Min

Changes from 1971-2000 for:

2020 - 2049	-5.79 days
2040 - 2069	-10.26 days
2060 - 2089	-15.50 days
2080 - 2097	-19.15 days

CAPE COD BASIN

Cape Cod 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	5956.64	-475.48 to -913.39	-685.90 to -1374.26	-773.67 to -1828.23	-854.04 to -2171.56
	Winter	2996.33	-164.51 to -347.77	-220.16 to -520.87	-277.06 to -697.53	-304.13 to -831.96
	Spring	1753.89	-152.01 to -285.19	-190.19 to -444.68	-229.91 to -584.74	-267.48 to -649.94
	Summer	94.49	-30.02 to -57.56	-41.95 to -69.89	-44.65 to -80.65	-44.99 to -85.45
	Fall	1105.61	-131.82 to -268.87	-226.73 to -393.30	-215.14 to -547.22	-242.01 to -619.87
Cooling Degree-Days (Base 65°F)	Annual	435.71	+144.74 to +364.43	+224.26 to +601.17	+250.48 to +965.18	+314.49 to +1226.21
	Winter	nan	+0.13 to +1.43	+0.38 to +3.50	+0.92 to +3.19	-0.34 to +3.91
	Spring	7.08	+3.48 to +9.44	+4.94 to +20.08	+5.86 to +34.34	+7.02 to +52.03
	Summer	384.03	+107.28 to +279.41	+148.81 to +457.16	+184.27 to +701.82	+229.32 to +875.35
	Fall	43.77	+30.85 to +80.41	+41.77 to +138.18	+48.96 to +224.33	+71.67 to +296.72
Growing Degree-Days (Base 50°F)	Annual	2421.38	+343.19 to +690.79	+460.30 to +1078.12	+519.05 to +1678.13	+617.96 to +2104.38
	Winter	4.84	+0.24 to +9.74	+0.28 to +15.26	+2.10 to +25.74	+4.23 to +35.89
	Spring	197.63	+50.56 to +105.22	+69.23 to +195.43	+77.64 to +277.13	+77.88 to +342.92
	Summer	1669.64	+137.95 to +332.36	+190.73 to +520.48	+224.93 to +789.31	+278.12 to +958.80
	Fall	546.41	+107.92 to +248.13	+174.67 to +396.65	+168.86 to +571.84	+215.05 to +716.85

- Due to projected increases in average, maximum, and minimum temperatures throughout the end of the century, the Cape Cod basin is expected to experience a decrease in heating degree-days, and increases in both cooling degree-days and growing degree-days.
- Seasonally, winter historically exhibits the highest number of heating degree-days and is expected to see the largest decrease of any season, but spring and fall are also expected to see significant change.
    - The winter season is expected to see a decrease of 220-521 degree-days by mid-century (a decrease of 7-17%), and a decrease of 304-832 degree-days by the end of century (a decrease of 10-28%).
    - The spring season is expected to decrease in heating degree-days by 11-25% (190-445 degree-days) by mid-century, and by 15-37% (267-650 degree-days) by the end of century.
    - The fall season is expected to decreases in heating degree-days by 21-36% (227-393 degree-days) by mid-century, and by and 22-56% (242-620 degree-days) by the end of century.
- Conversely, due to projected increasing temperatures, summer cooling degree-days are expected to increase by 39-119% (149-457 degree-days) by mid-century, and by 60-228% (229-875 degree-days) by end of century.

- Seasonally, summer historically exhibits the highest number of growing degree-days and is expected to see the largest decrease of any season, but the shoulder seasons of spring and fall are also expected to see an increase in growing degree-days.
    - The summer season is projected to increase by 11-31% (190.73-520.48 degree-days) by mid-century, and by 17-57% (278-959 degree-days) by end of century.
    - Spring is expected to see an increase by 35-99% (69-195 degree-days) by mid-century and 39-174% (78-343 degree-days) by end of century.
    - Fall is expected to see an increase by 32-73% (175-397 degree-days) by mid-century and 39-131% (215-717 degree-days) by end of century.

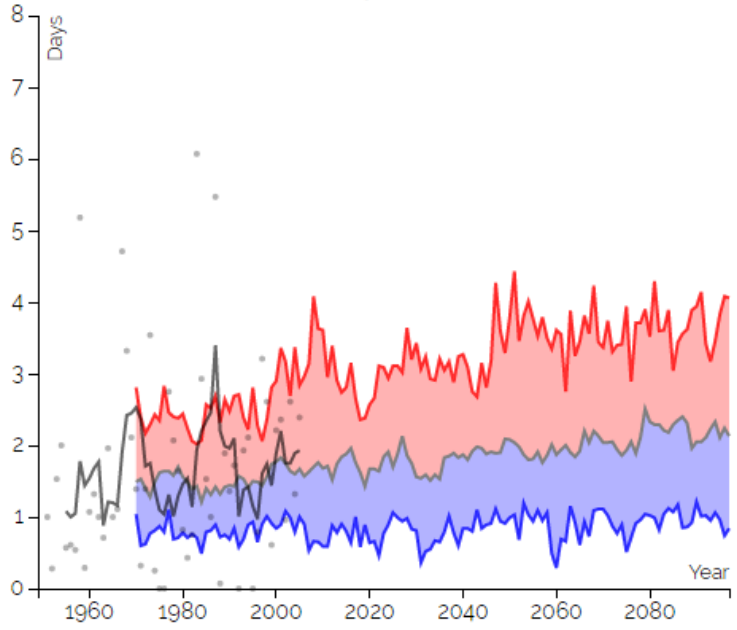
CAPE COD BASIN

Cape Cod 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	7.02	+0.16 to +1.76	+0.66 to +2.66	+0.45 to +2.92	+0.55 to +3.41
	Winter	1.45	-0.10 to +0.62	+0.08 to +0.67	+0.02 to +1.04	+0.09 to +1.35
	Spring	1.65	+0.08 to +0.65	+0.08 to +0.90	+0.22 to +1.05	+0.29 to +1.20
	Summer	1.92	-0.18 to +0.55	-0.13 to +0.78	-0.40 to +0.66	-0.46 to +0.58
	Fall	2.01	-0.23 to +0.62	-0.13 to +0.85	-0.31 to +0.94	-0.35 to +1.11
Days with Precipitation Over 2”	Annual	0.75	-0.04 to +0.43	+0.07 to +0.52	+0.08 to +0.71	+0.05 to +0.74
	Winter	0.09	-0.05 to +0.16	-0.02 to +0.15	-0.02 to +0.20	-0.02 to +0.27
	Spring	0.05	-0.03 to +0.13	+0.01 to +0.18	+0.02 to +0.19	-0.01 to +0.25
	Summer	0.33	-0.07 to +0.15	-0.05 to +0.23	-0.05 to +0.20	-0.05 to +0.22
	Fall	0.28	-0.04 to +0.13	-0.01 to +0.20	-0.01 to +0.23	-0.07 to +0.31
Days with Precipitation Over 4”	Annual	0.01	+0.00 to +0.03	+0.00 to +0.03	-0.01 to +0.05	-0.01 to +0.05
	Winter	0.00	+0.00 to +0.00	+0.00 to +0.01	-0.00 to +0.00	+0.00 to +0.00
	Spring	0.00	+0.00 to +0.01	+0.00 to +0.00	+0.00 to +0.01	+0.00 to +0.00
	Summer	0.00	-0.01 to +0.02	-0.01 to +0.02	-0.01 to +0.03	-0.01 to +0.03
	Fall	0.01	-0.00 to +0.02	+0.00 to +0.01	+0.00 to +0.02	+0.00 to +0.03

- The projections for expected number of days receiving precipitation over one inch are variable for the Cape Cod basin, fluctuating between loss and gain of days.
    - Seasonally, the winter season is generally expected to see the highest projected increase.
    - The winter season is expected to see an increase in days with precipitation over one inch of 0-1 days by mid-century, and by 0-1 days by the end of century.
    - The spring season is expected to see an increase in days with precipitation over one inch of 0-1 days by mid-century, and by 0-1 days by the end of century.

Spring Days with Precipitation > 1"

Cape Cod



Download Data

Observed

days

5-yr Mean

Modeled days

Max

Median

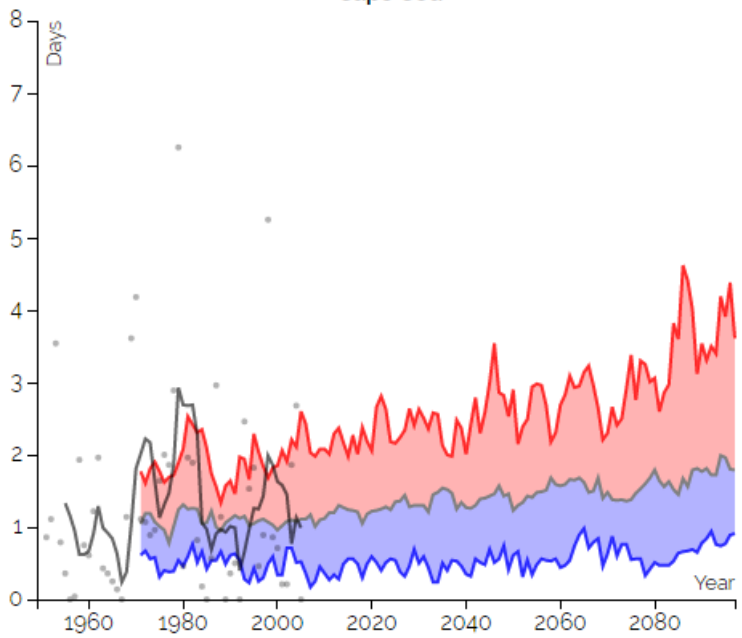
Min

Changes from 1971-2000 for:

2020 - 2049	0.39days
2040 - 2069	0.46days
2060 - 2089	0.59days
2080 - 2097	0.78days

Winter Days with Precipitation > 1"

Cape Cod



Download Data

Observed

days

5-yr Mean

Modeled days

Max

Median

Min

Changes from 1971-2000 for:

2020 - 2049	0.33days
2040 - 2069	0.45days
2060 - 2089	0.55days
2080 - 2097	0.73days

CAPE COD BASIN

Cape Cod 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	44.94	-1.08 to +3.47	-0.38 to +4.54	-0.78 to +5.79	-0.83 to +5.45
	Winter	11.63	-0.40 to +1.24	-0.22 to +1.59	-0.05 to +2.10	-0.04 to +3.13
	Spring	11.51	-0.04 to +1.48	-0.26 to +1.67	-0.21 to +2.08	+0.08 to +2.45
	Summer	10.24	-0.95 to +1.19	-1.05 to +1.73	-1.64 to +2.00	-2.22 to +1.66
	Fall	11.62	-0.96 to +0.90	-0.99 to +1.09	-1.40 to +1.64	-1.52 to +1.26

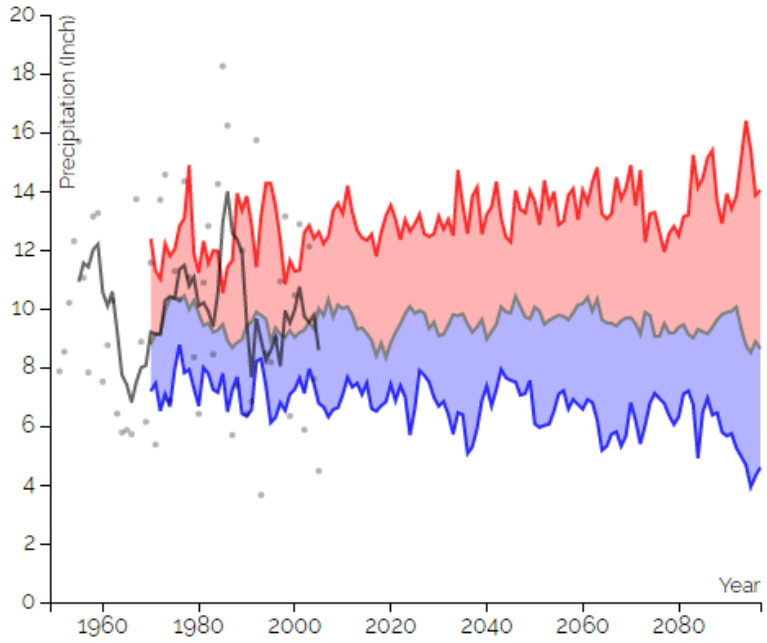
- Similar to projections for number of days receiving precipitation over a specified threshold, seasonal projections for total precipitation are also variable for the Cape Cod basin.
    - The winter season is expected to experience the greatest change with a decrease of 2% to an increase of 14% by mid-century, and an increase of 0-27% by end of century.
    - Projections for the summer and fall seasons are more variable, and could see either a drop or increase in total precipitation throughout the 21st century.
        - The summer season projections for the Cape Cod or basin could see a decrease of 1.1 to an increase of 1.7 inches by mid-century (decrease of 10% to increase of 17%), and a decrease of 2.2 to an increase of 1.7 inches by the end of the century (decrease of 22% to increase of 16%).
        - The fall season projections for the Cape Cod basin could see a decrease of -1 to an increase of 1.1 inches by mid-century (decrease of 9% to increase of 9%), and a decrease of 1.5 to an increase of 1.3 inches by the end of the century (decrease of 13% to increase of 11%).

Cape Cod 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	18.72	-1.06 to +1.99	-0.56 to +2.62	-0.34 to +3.63	-0.26 to +4.65
	Winter	10.19	-0.52 to +1.53	-0.44 to +1.46	-0.31 to +1.83	-0.94 to +1.97
	Spring	11.59	-0.99 to +1.21	-0.86 to +1.50	-1.00 to +1.48	-1.34 to +1.58
	Summer	15.38	-1.00 to +2.02	-0.83 to +2.61	-0.89 to +4.38	-1.03 to +5.26
	Fall	13.05	-0.57 to +2.45	-0.04 to +2.29	+0.17 to +2.82	+0.04 to +3.45

- Annual and seasonal projections for consecutive dry days, or for a given period, the largest number of consecutive days with precipitation less than 1 mm (~0.04 inches), are variable throughout the 21st century.
    - For all the temporal parameters, the Cape Cod basin is expected to see a slight decrease to an increase in consecutive dry days throughout this century.
    - Seasonally, the fall and summer seasons are expected to continue to experience the highest number of consecutive dry days.
        - The summer season is expected to experience a decrease of 1 day to an increase of 5 days in consecutive dry days by the end of the century.

Summer Total Precipitation

Cape Cod



Download Data

Observed

Inches

5-yr Mean

Modeled Inches

Max

Median

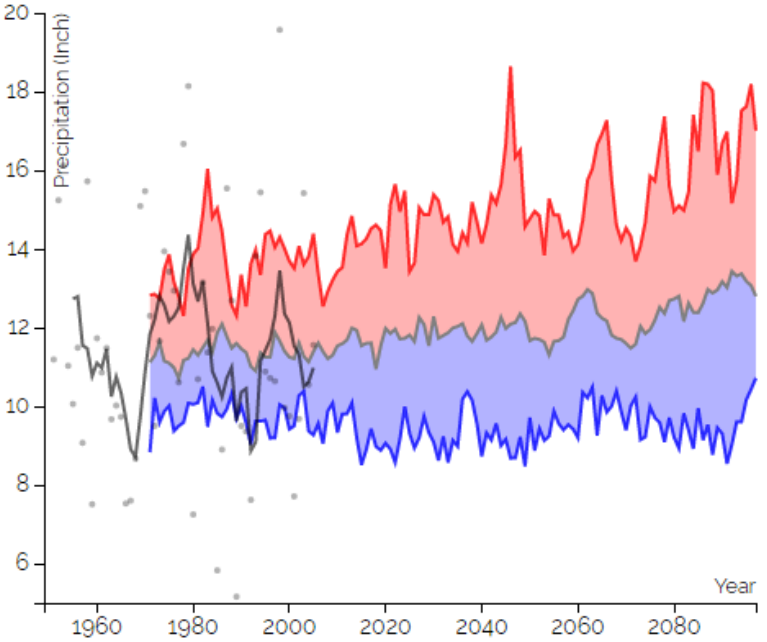
Min

Changes from 1971-2000 for:

2020 - 2049	-0.74"
2040 - 2069	-0.65"
2060 - 2089	-0.89"
2080 - 2097	-1.07"

Winter Total Precipitation

Cape Cod



Download Data

Observed

Inches

5-yr Mean

Modeled Inches

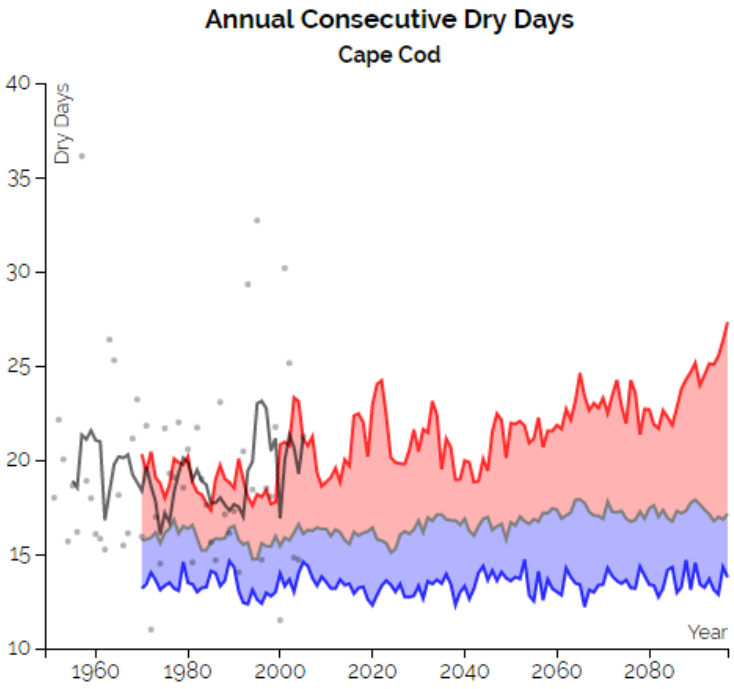
Max

Median

Min

Changes from 1971-2000 for:

2020 - 2049	0.80"
2040 - 2069	0.90"
2060 - 2089	1.25"
2080 - 2097	1.80"



Download Data

Observed

days

5-yr Mean

Modeled days

Max

Median

Min

Changes from 1971-2000 for:

2020 - 2049	-2.02days
2040 - 2069	-1.58days
2060 - 2089	-1.22days
2080 - 2097	-1.23days

Table 7, Figure 1: Relative (or local) mean sea level projections for the Boston, MA tide station based on four National Climate Assessment global scenarios with associated probabilistic model outputs from the Northeast Climate Science Center. Each of the scenarios—Intermediate, Intermediate-High, High, and Extreme—is cross-walked with two to three probabilistic model outputs. Modeling considered two future concentrations of greenhouse gas emissions (referred to as representative concentration pathways [RCP]) and two methods of accounting for Antarctic ice sheet contributions to sea level rise. A 19-year reference time period for sea level (tidal epoch) centered on the year 2000 was used to minimize biases caused by tidal, seasonal, and inter-annual climate variability. Sea level projections for the Boston tide station are referenced to the North American Vertical Datum of 1988 (NAVD88).

Relative mean sea level (feet NAVD88) for Boston, MA					
Scenario	**Probabilistic projections**	**2030**	**2050**	**2070**	**2100**
Intermediate	Unlikely to exceed (83% probability) given a high emissions pathway (RCP 8.5)	0.7	1.4	2.3	4.0
Intermediate- High	Extremely unlikely to exceed (95% probability) given a high emissions pathway (RCP 8.5)	0.8	1.7	2.9	5.0
High	Extremely unlikely to exceed (99.5% probability) given a high emissions pathway (RCP 8.5)	1.2	2.4	4.2	7.6
Extreme (Maximum physically plausible)	Exceptionally unlikely to exceed (99.9% probability) given a high emissions pathway (RCP 8.5)	1.4	3.1	5.4	10.2

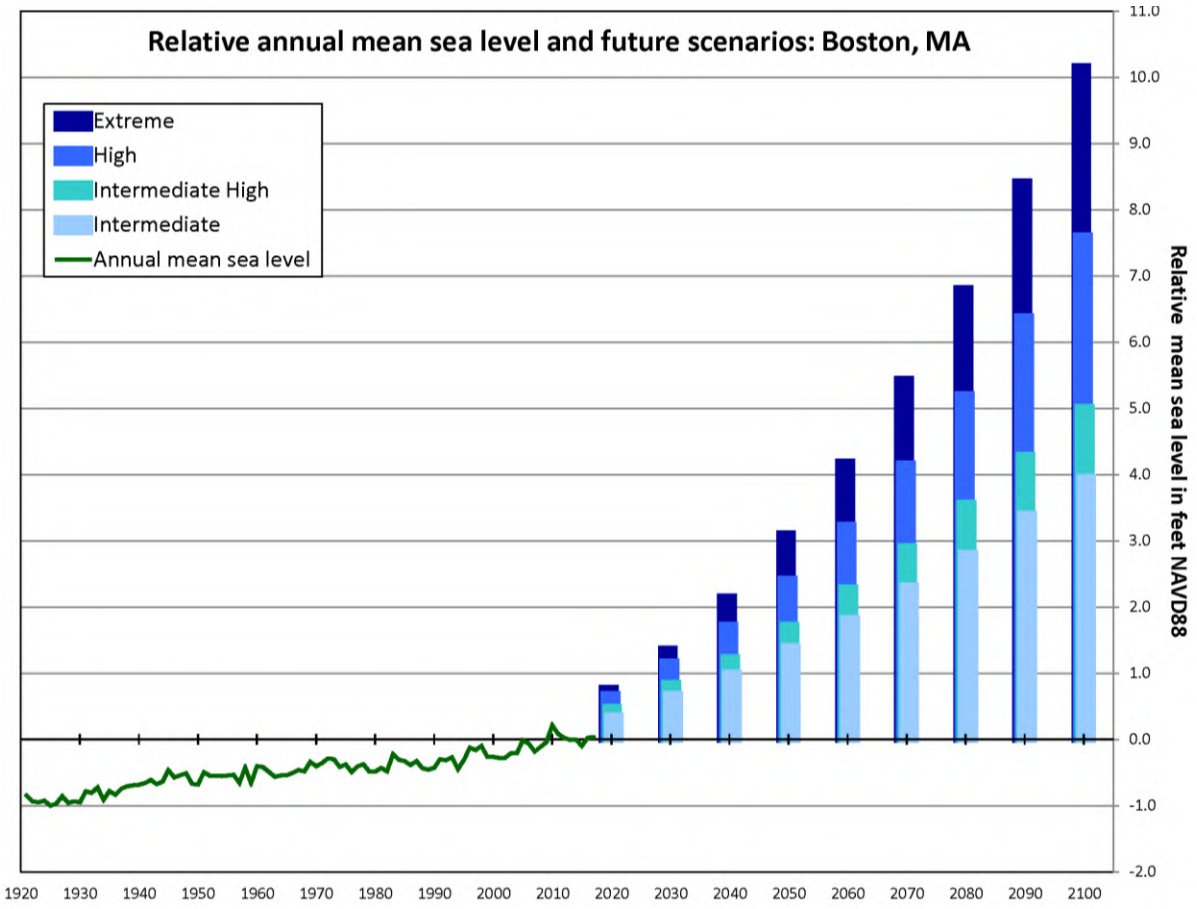
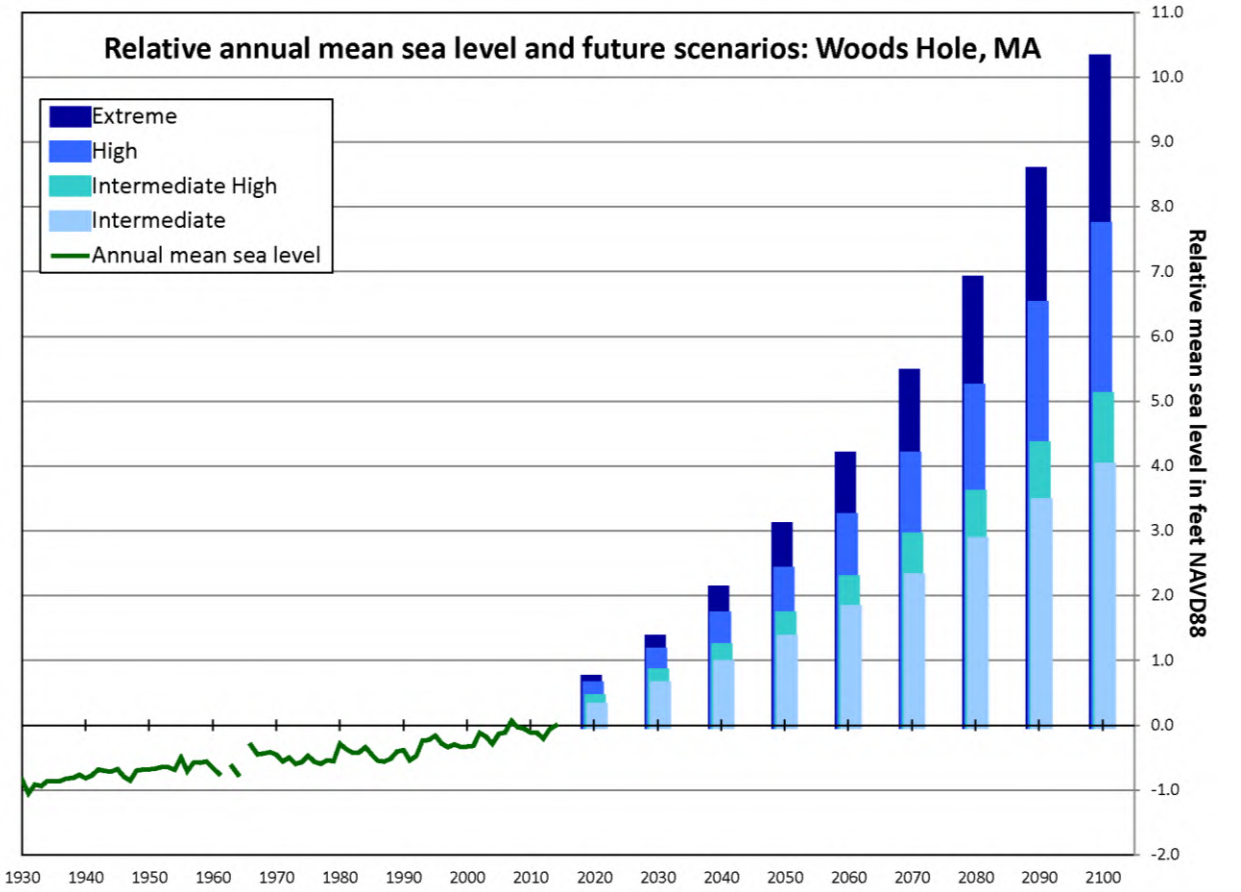
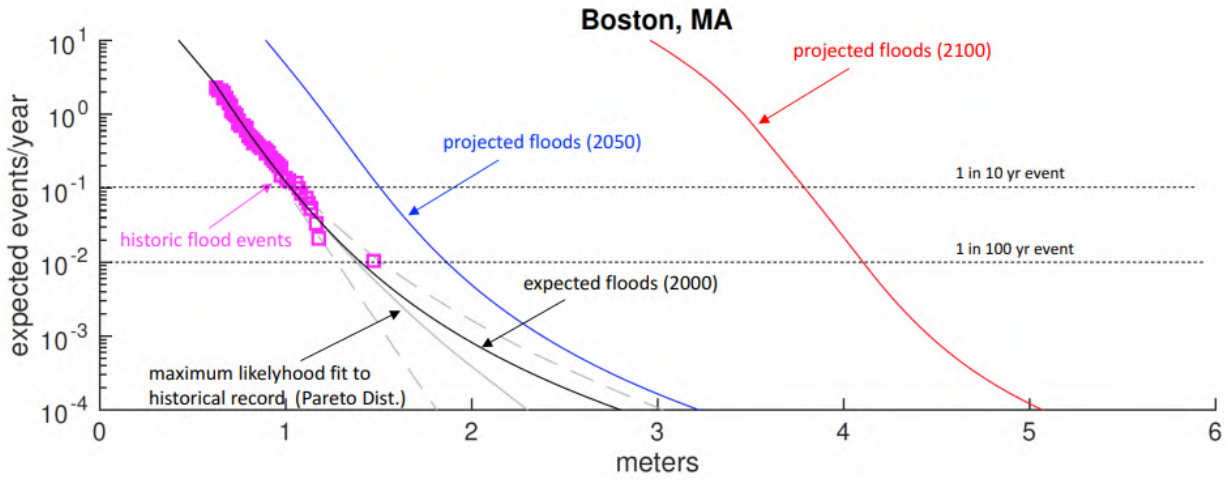


Table 8, Figure 2: Relative (or local) mean sea level projections for the Woods Hole, MA tide station based on four National Climate Assessment global scenarios with associated probabilistic model outputs from the Northeast Climate Science Center. Each of the scenarios—Intermediate, Intermediate-High, High, and Extreme—is cross-walked with two to three probabilistic model outputs. Modeling considered two future concentrations of greenhouse gas emissions (referred to as representative concentration pathways [RCP]) and two methods of accounting for Antarctic ice sheet contributions to sea level rise. A 19-year reference time period for sea level (tidal epoch) centered on the year 2000 was used to minimize biases caused by tidal, seasonal, and inter-annual climate variability. Sea level projections for the Woods Hole tide station are referenced to the North American Vertical Datum of 1988 (NAVD88).

Relative mean sea level (feet NAVD88) for Woods Hole, MA					
Scenario	**Probabilistic projections**	**2030**	**2050**	**2070**	**2100**
Intermediate	Unlikely to exceed (83% probability) given a high emissions pathway (RCP 8.5)	0.6	1.3	2.3	4.0
Intermediate- High	Extremely unlikely to exceed (95% probability) given a high emissions pathway (RCP 8.5)	0.8	1.7	2.9	5.1
High	Extremely unlikely to exceed (99.5% probability) given a high emissions pathway (RCP 8.5)	1.1	2.4	4.2	7.7
Extreme (Maximum physically plausible)	Exceptionally unlikely to exceed (99.9% probability) given a high emissions pathway (RCP 8.5)	1.3	3.1	5.4	10.3

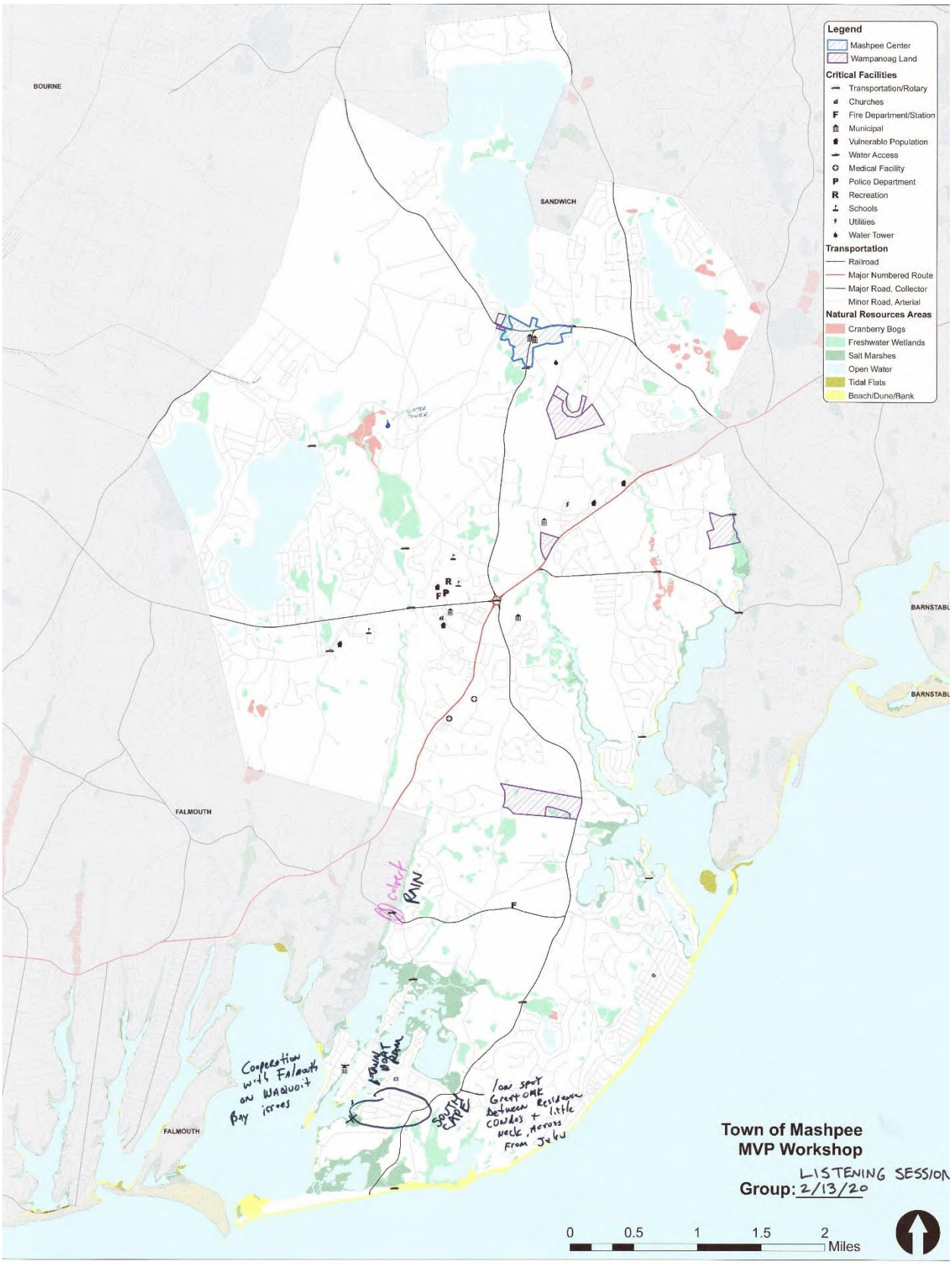




Recurrence frequencies were also provided for Nantucket, Woods Hole, and Newport, RI

after Buchanan et al., (2016)

APPENDIX E. LISTENING SESSION AND PUBLIC COMMENTS


Legend
Mashpee Center
Wampanoag Land
Critical Facilities
Transportation/Rotary
Churches
Fire Department/Station
Municipal
Vulnerable Population
Water Access
Medical Facility
Police Department
Recreation
Schools
Utilities
Water Tower
Transportation
Railroad
Major Numbered Route
Major Road, Collector
Minor Road, Arterial
Natural Resources Areas
Cranberry Bogs
Freshwater Wetlands
Salt Marshes
Open Water
Tidal Flats
Beach/Dune/Bank
BOURNE
SANDWICH
FALMOUTH
FALMOUTH
BARNSTABL
BARNSTABL
culvert
RAIN
Cooperation with Falmouth on WAQUOIT Bay issues
SOUTH CAPE
low spot Great OAK between Residences CONDOS + little NECK, Access from Jake
Town of Mashpee
MVP Workshop
LISTENING SESSION
Group: 2/13/20
0
0.5
1
1.5
2
Miles

Town of Mashpee MVP Workshop Risk Matrix

LISTENING SESSION 2/13/20

WOODS HOLE GROUP

Priority Level:
H = High **M** = Medium **L** = Low
Time : **S** = Short **L** = Long **O** = Ongoing

Top Priority Hazards

A) Coastal Flooding and Erosion B) Inland Flooding C) Extreme Cold and Winter Storms D) Heat, Drought, and Fire

Action Items	*Hazards Addressed*	*Priority / Time*
Infrastructural Features		
New Continued Development on Coast & in Flood Plain, continuing to add impervious surface and future debris during storms	(A)/B/C/D	(H)/M/L S/L/O
	A/B/C/D	H/M/L S/L/O
	A/B/C/D	H/M/L S/L/O
	A/B/C/D	H/M/L S/L/O
Societal Features		
Green transportation, especially charging stations	A/B/C/D	(H)/M/L S/L/O
	A/B/C/D	H/M/L S/L/O
	A/B/C/D	H/M/L S/L/O
	A/B/C/D	H/M/L S/L/O
Environmental Features		
Effect of sea level rise on aquatic pollinators - crop crop farming beehives	A/B/C/D	(H)/M/L S/L/O
Loss of Native Vegetation	(A)/B/C/D	(H)/M/L S/L/O
	A/B/C/D	H/M/L S/L/O
	A/B/C/D	H/M/L S/L/O