Appendix N: Environmental Coordination in Addressing the Impacts of Climate Change

Federal Transportation legislation established the requirements for the preparation of long-range transportation plans. These requirements lay out the framework under which it is necessary to consult with other federal, state, local, regional, and NGO’s in order to evaluate potential environmental mitigation strategies associated with proposed development and implementation activities. Specifically, this legislation requires more extensive consultation related to:

- Regulatory and resource agencies responsible for land use management, natural resources, environmental protection, conservation, and historic preservation concerning the development of the Transportation Plan (23 C.F.R. ss 450.322(g));
- Comparison of Transportation Plans to inventories of natural or historic resources (23 C.F.R. ss 450.322(g)(l));
- Comparison of Transportation Plans with State Conservation Plans or maps (23 C.F.R. ss 450.322(g)(2));
- Discussion of types of potential environmental mitigation activities and potential areas to carry out these activities, including activities that may have the greatest potential to restore and maintain the environmental functions affected by the (Transportation) plan. The discussion may focus on policies, programs, or strategies, rather than at the project level (23 C.F.R. ss 450.322(f)(7)).

SRPEDD’s Environmental Program has always relied on these types of partnerships and consultations. A list of the agencies, programs, and organizations that have partnered with SRPEDD’s Environmental Program, and an overview of the services they’ve provided, is summarized in Table N-1. These partnerships have allowed SRPEDD to become acutely aware of our region’s outstanding natural, cultural, and historic resources as well as to maximize the use of its staff and agency resources in developing studies, data, adaptation, mitigation, and resiliency strategies and projects throughout the region.
### Table N-1: Partnering Agencies and Organizations since 1999

<table>
<thead>
<tr>
<th>Name</th>
<th>GRRIP/Flood Hazard /Resiliency Task(s) and Partner Services</th>
<th>Type(s) of Assistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Massachusetts Geographic Information Systems (MassGIS)</td>
<td>Mapping/ongoing updates</td>
<td>All relevant state data layers</td>
</tr>
<tr>
<td>Department of Environmental Protection (DEP)</td>
<td>Mapping and initial review</td>
<td>Water resource, quality, and supply data</td>
</tr>
<tr>
<td>Coastal Zone Management (CZM)</td>
<td>Mapping and initial review</td>
<td>Coastal resources data</td>
</tr>
<tr>
<td>Division of Marine Fisheries (DMF)</td>
<td>Mapping and initial review; cooperative fieldwork; monitoring</td>
<td>Critical areas after storm event, coastal and riverine; anadromous fish runs, shellfish beds</td>
</tr>
<tr>
<td>MA Fish &amp; Game (DCR)</td>
<td>Mapping and periodic review</td>
<td>Coldwater fisheries data; statewide map of certified coldwater streams</td>
</tr>
<tr>
<td>MA Division of Ecological Restoration, (DER); U.S. Fish &amp; Wildlife</td>
<td>Mapping &amp; periodic review; cooperative fieldwork; project evaluation; monitoring</td>
<td>Dams and obstructions data; restoration project data and mapping</td>
</tr>
<tr>
<td>National Oceanic and Atmosphere Administration (NOAA)</td>
<td>Mapping and initial review; cooperative fieldwork</td>
<td>Rare or Sensitive species data; sea level rise data</td>
</tr>
<tr>
<td>Mass Dept. of Transportation (MassDOT)</td>
<td>Mapping and periodic review</td>
<td>All road, highway, and bridge data</td>
</tr>
<tr>
<td>United States Dept. of Agriculture (USDA), Natural Resource Conservation Service (NRCS)</td>
<td>Mapping and periodic review</td>
<td>All soils; agricultural program(s) related data</td>
</tr>
<tr>
<td>Name</td>
<td>GRRIP/Flood Hazard /Resiliency Task(s) and Partner Services</td>
<td>Type(s) of Assistance</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>The Nature Conservancy (TNC), Taunton River Watershed Alliance (TRWA), The Westport River Watershed Alliance (WRWA), Taunton River Stewardship Council (TRSC)(^1), Save the Bay (STB), Mass Audubon; Manomet; The Wildlands Trust; Old Colony Historical Museum; Nature Serve; North Atlantic Aquatic Connectivity Collaborative (NAACC) U.S. EPA; Narragansett Bay Project (NBEP); Buzzards Bay Project (BBP); National Park Service (NPS), Local officials</td>
<td>Mapping, cooperative fieldwork, ongoing and periodic review, site specific project origination, public meetings; monitoring; data development; model development; project evaluation; grants writing; site and structural assessment; planning support; public workshops; provide relevant local, regional, state, and federal planning documents</td>
<td>Data for GRRIP points; fish and wildlife obstructions and culvert, bridge, &amp; stream crossing mapping &amp; assessments; unique habitat; conservation lands; site specific land use data/concerns; marsh assessment mapping and rating ; cultural and historic resources; green infrastructure mapping &amp; assessment tools; resilient habitat mapping and ranking ; public education materials; evaluation of goals, objectives, challenges, and actions outlined in local, regional, state &amp; federal plans</td>
</tr>
</tbody>
</table>

**Air Quality**

Transportation planning for mobile air quality issues is largely tied into computer modeling and conformity attainment (adherence to standards). SRPEDD’s staff employs its transportation and traffic modeling, and air quality analysis tools in cooperation with federal, state, and local partners in planning for the region.

Massachusetts was the first state in the nation to set greenhouse gas emission standards for power plants in an attempt to reduce air pollution from stationary sources. Massachusetts is also part of the Regional Greenhouse Gas Initiative (RGGI), a cooperative effort of the Northeast

\(^1\) The TRSC is the entity created by public law concurrent with the federal designation of the Taunton River as Wild & Scenic. The TRSC membership includes representatives from ten (10) cities and towns located along the Taunton River as well as delegates from regional non-profits, the MA Executive Office of Energy and Environmental Affairs, the Inter-tribal Indian Council, SRPEDD, and the National Park Service.
and Mid-Atlantic states to reduce greenhouse gas emissions. (Massachusetts’ air quality is impacted by wind and weather in the northeast corridor from Pennsylvania to Massachusetts). The Massachusetts Department of Environmental Protection (DEP) also provides grants to cities and towns for work related to waste reduction, greenhouse gas emission reduction, energy saving measures, and other activities related to reducing emissions from stationary sources.

Massachusetts has also advanced other policies, programs and legislation in order to reduce our negative impact on air quality, such as: The Global Warming Solutions Act, a comprehensive regulatory program focused on greenhouse gases and climate change; the Toxics Use Reduction Act (TURA) and the state’s Office of Technical Assistance (OTA) have helped to reduce the amount of toxic air pollutants over the last two decades through improved industrial practices and pollution mitigation of stationary sources; the Transportation Emission Cap and Trade Interstate Agreement, with goals of reducing climate changing pollution; and Smart Growth initiatives promoted by the state to address mobile and stationary sources of pollution through improved land use, transit, and transportation planning.

According to the DEP’s most recent report on air quality trends, greenhouse gas emissions decreased by 20% between 1990 and 2016, from approximately 94 million metric tons (MMT) to 75 MMT. This trend is a result of many factors, including economic downturn, fuel prices, coal burning power plant closures, promotion of alternative energy sources (wind and solar), the implementation of energy efficiency measures, as well as the policies and practices mentioned above. A discussion of regional air quality prepared by MA DOT is included in Appendix C: Congestion Management.

**Stormwater: The Geographic Roadway Runoff Inventory Program (GRRIP)**

Federal, state, and local regulators have for years identified stormwater as a major source of pollution to all waterbody types throughout the United States. In Massachusetts and in southeastern Massachusetts in particular, we have only increased the magnitude of this problem during tremendous growth spurts in the 1980s, 1990s, and early 2000s in particular. During these periods of increased growth, we removed large areas of trees and vegetation, compacted soils, added large amounts of paved and other impervious surface, and disrupted natural hydrology. These development practices in turn affect absorption and infiltration of stormwater, as well as concentrating pollutants in the increased amounts of stormwater that flow overland into our rivers and streams. These increased stormwater flows compromise the integrity of our ecosystems and the environmental services that they provide to our watersheds.

SRPEDD’s Geographic Roadway Runoff Inventory Program (GRRIP) was created as a joint effort between the Transportation and Environmental Planning Programs in 1998. GRRIP was initially
created to provide an analysis of roadway drainage facilities, located in environmentally sensitive areas on state and local roads. The root assumption of the initial GRRIP study was that the majority of the current stormwater collection and treatment practices employed on our road systems are based on hydrological assumptions circa 1935-1965. With the rate of development during those years, coupled with the rapid development from the 1970s to the present, these existing stormwater facilities have become functionally obsolete due to the increased stormwater loads. In fact, these facilities may cause more harm to environmentally sensitive areas and greater concern for transportation safety because of polluted discharge and flooding when they become overwhelmed (such as collection systems and end-of-pipe stormwater treatment structures located in floodplains).

GRRIP is a computer based mapping product which includes twenty-two separate categories of environmental information (including all available natural, cultural, historic, open space data) and data with other base map layers, to create an overview of a town’s environmental and road network information. SRPEDD worked with numerous federal, state, local and non-profit organizations to compile our initial GRRIP database. We continue to update the GRRIP data with input from many of these same partners; in 2018, SRPEDD staff met with our colleagues from Central Massachusetts Regional Planning Commission (CMRPC) to affect a transfer of this model to the CMRPC Transportation staff.

Initial data reviewed includes roadway crossings, drainage facilities, and culverts that are located in environmentally sensitive areas that are determined by concentrations of environmental data, such as rare species habitat, public water supply area, etc. Sites are physically inventoried and photographed by SRPEDD staff. These sites are then map registered and verified by municipal contacts. An analysis of on-site drainage facilities, in terms of condition, type, location, and function, as well as the surrounding conditions and environmental attributes, is also recorded at each site.

Figure N-1 New culvert and elevated road on Pearse Road in Swansea, a GRRIP site since 2005.
To date, SRPEDD staff has inventoried and field checked approximately two hundred and twenty-five potential GRRIP sites in the region, over thirty of which have been addressed through mitigation or remediation including culvert replacement, tide gates, streambank-buffer area restoration, improved drainage facilities, dam removal, and signage. See Figure N-1.

**Stream Continuity and Critical Linkages: GRRIP/Stream Continuity Program**

The awareness of the importance of aquatic connectivity is critical in a holistic approach to regional transportation planning. Our rivers and streams, like our roadway systems, are in essence linear transportation networks that run through numerous and diverse habitats in their course of travel. Our roads and rail systems, as well as our land use development practices, can cause significant fragmentation in our river and stream ecosystems, primarily through the construction of roads, bridges, and culverts. New and retrofitted transportation infrastructure, if not designed with the surrounding habitat and its function in mind, can create barriers to natural hydrology, fish and wildlife passage and other critical ecosystem services. The intersection of our transportation infrastructure with sensitive environmental receptors (rivers, streams, critical habitat and landscapes), has been the focus of SRPEDD’s GRRIP site evaluations from the beginning.

After the first GRRIP effort was completed in 2000, subsequent versions of this program have evolved to incorporate new focus areas, data, and working partnerships. GRRIP 5 (2008) is an analysis of stream crossing, continuity, and fish/wildlife passage at culverts and bridges in concert with The Nature Conservancy (TNC) and Save The Bay (RI). GRRIP 6 (2011) is an analysis of dams/flood hazards in proximity to roads and bridges, as well as ecological restoration opportunities that also improve transportation safety and efficiency, in concert with the MA Division of Ecological Restoration (DER), NOAA, US Fish & Wildlife, and several others. The largest ongoing project with which this partnership is currently associated is the Mill River Dam Removal and Ecological Restoration Project in Taunton, MA (which also involved partnering with Mass DOT during the Morey’s Bridge and dam reconstruction). The final dam removal on the Mill River was completed in January of 2018 on West Britannia Street in Taunton, MA.

The culverts and stream crossings program was expanded to include Mass Audubon, Save The Bay, and the Taunton River Watershed Alliance in a working group to coordinate field work and analyze results. This group then merged data collected by the UMass Amherst Stream Continuity/Critical Linkages Project with its own local field data, MA Natural Heritage & Endangered Species Program (NH&ESP) data, TNC Critical Landscapes data, GRRIP data (including MA Bio Map II data), and programmed TIP data, in order to determine future priority sites and potential projects. These cooperative efforts led to the completion of surveys for over 500 stream crossings in the Taunton River watershed. The survey data was merged and mapped by
our partners at the EPA, and crossings were ranked and prioritized according to their scores. (See Table N-2.)

Working with new partners from Nature Serve and the North Atlantic Aquatic Connectivity Collaborative (NAACC), we will hopefully be able to improve stream flows, transportation safety, ecological restoration, and the preservation of our regional green infrastructure, all of which contribute to our regional resiliency.

Each structure represented on the map in Figure N-2 was assigned a score based upon the Index of Ecological Integrity (IEI), indicating its barrier to passage for aquatic organisms; it ranges from 0 to 1.0, where "0" indicates that the crossing provides no passage for organisms and "1.0" indicates full passage.

An "Impact" score for each identified crossing location was calculated from the Aquatic Scores and IEI scores from Conservation Assessment and Prioritization System (CAPS). The resulting raw Impact Score estimates the ecological restoration potential, i.e., the amount of improvement in the ecological health of a water body if a crossing structure in that location were removed or replaced. Higher Impact Scores indicate the greater potential for improvement at that site. To adjust for the highly skewed nature of the Critical Linkages results, "Impact ln" scores (a log-transformed version of the results) were created to make it easier to display and interpret the results. Crossings were assigned to one of five tiers based on their Impact Scores.

<table>
<thead>
<tr>
<th>Table N-2 Stream Crossing Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier 1: (highest potential)</td>
</tr>
<tr>
<td>Tier 2</td>
</tr>
<tr>
<td>Tier 3</td>
</tr>
<tr>
<td>Tier 4</td>
</tr>
<tr>
<td>Tier 5 (lowest potential)</td>
</tr>
</tbody>
</table>

Results of the first phase of the Critical Linkages analysis indicated that a relatively small proportion of culvert replacements or dam removals would result in substantial improvement in aquatic connectivity. There were 24 sites that were ranked as "Tier I" sites (greatest potential for ecological restoration) and 108 were ranked as "Tier 2." The Taunton River Stream Continuity Project focused on crossings ranked as Tiers I, 2 or 3.
The MA DER’s new Stream Continuity Coordinator has also been working through this group to survey local DPWs regarding culverts, existing conditions, and methods and means for potential culvert replacement. SRPEDD has been hosting regional workshops for the DER Culvert Replacement Grants Program since 2017, as well as helping to find locations/host sites to conduct regional culvert assessment trainings.

In the context of its GRRIP/Stream Continuity Program, SRPEDD has also been working to promote greater awareness of significant coldwater streams/fisheries. While always noted in SRPEDD’s GRRIP maps from the beginning, coldwater fisheries data was based upon field observation by SRPEDD staff and partnering groups and organizations. In October of 2014, the Massachusetts Division of Fisheries and Wildlife (DFW) provided communities with another important conservation planning tool, an online map of Coldwater Fisheries Resources (CFR). Coldwater streams are state classified as Critical Areas, and they are certified by DEP under its
“Outstanding Resource Water” Programs. These streams also provide important habitat for a number of species, including trout. Trout are a very important indicator species in gauging the health of a coldwater stream as they are typically more sensitive to changes in temperature, water quality, and stream flow within their resident streams. The CFR database is derived from fish samples collected annually by DFW staff biologists and technicians.

Threats to CFRs include roadway runoff, cutting of streamside vegetation, and other activities that can reduce the amount of shading or otherwise increase the stream’s temperature. An even greater threat to CFRs may be a general lack of awareness of where these critical resources are located within our communities. Through the GRRIP/Stream Continuity Program and in conjunction with our program partners, SRPEDD hopes to raise awareness of CFRs and to provide information to those involved with land use development, stormwater management and infrastructure planning.

A list of potential projects/areas for study and a map of priority project areas, developed by SRPEDD in conjunction with our partners at DER, TNC, RTWN, and local officials, can be found in the Figure N-3. This map was created not only to point out potential projects, but to encourage inter-municipal, interstate, and regional projects whenever and wherever feasible.
Figure N-3: River Restoration Priorities in the Taunton River Watershed

Flooding: Flood Inundation Hazard Studies

Low-lying coastal roads with inadequate drainage or drainage facilities could be affected by rising water, higher tides, and intense storms. As sea levels rise, our coastlines and estuaries could become subject to more frequent flood events and damage as undersized culverts create bottleneck flows or become completely overwhelmed and function like dams. In terms of our transportation infrastructure, this could lead to erosion of road beds, blowouts of undersized culverts, compromised bridges, and the loss of roadway. On tidal rivers, the consequences can be equally devastating at road crossings (culverts and older short span bridges) far inland and along tributaries (such as what happened in Rehoboth during the spring 2010 historic rain and flood events), particularly those roads located in potential high hazard areas indicated on the Flood Rate Insurance Maps (FIRMS). FIRMS are the official community maps upon which the Federal Emergency Management Agency, FEMA, has delineated special hazard areas and high
risk zones for flooding. A study released in 2012 by the United States Geological Survey reported that the sea level on a stretch of the Atlantic coast of North America, from Cape Hatteras, North Carolina to north of Boston, Massachusetts, is rising at a rate of up to four times faster than the global average. In light of this and subsequent studies of sea level rise, we must be very aware in our planning that elevations on FIRMs do not anticipate sea level rise, and that tidal events and storm surges can, and do, exceed high hazard/high risk elevations indicated on the FIRMs. (See Figure N-4.)

SRPEDD’s Flood Hazard Inundation Studies, Phases I–VI, began in 2011-12, and have been conducted in partnership with local, state, regional, and federal agencies and organizations. Our colleagues at DER, MA Coastal Zone Management, and the Buzzards Bay Project (National Estuary Program) were particularly helpful in the Buzzards Bay study. SRPEDD worked directly with our partners at Save The Bay, The Narragansett Bay (National Estuary Program) others on the Narragansett Bay study. This work was consistent with work prescribed in both the Narragansett Bay and Buzzards Bay Comprehensive Conservation Management Plans (CCMP).

The Flood Hazard studies look at sites, including past GRRIP sites, that meet one or more of the following criteria: coastal and inland areas of high public use; areas in proximity to recent public infrastructure investment; areas within the limit of tidal influence on coastal rivers; areas where
a convergence of factors (dams, channelization, river/stream crossing, culverts, at-grade bridges, poor drainage facilities) combine to create flood hazard/drainage problems during storm events. Beginning in 2011-2012, over two dozen sites have been observed during the new moon tides as it was felt that these conditions most closely approximated the anticipated normal sea level rise predicted in the study area over the next twenty to thirty years (based upon numerous models and studies dating as far back as the 1980s – Titus, EPA, 1984 – for example). These sites were also observed during moderate (light wind and rain) to heavy storm events. Written and pictorial records were collected for each site by SRPEDD staff, project partners, and citizen volunteers.

The results of the studies indicated that tidal encroachment is occurring on a regular basis at the sites observed in the upper Narragansett Bay (Swansea, Rehoboth, Somerset) and along the lower Taunton River/Mount Hope Bay estuary (Dighton, Freetown, Somerset). Tidal encroachment was less obvious in Buzzards Bay due to its geography and influence of Woods Hole and the Cape Cod Canal on tidal dynamics. Stormwater and the movement of water from inland areas into the estuary during intense storm events (when ocean water stacked against the coast and pushed up into the tidally influenced rivers) did cause severe flooding on highways and local roads. It was concluded that in some of these study areas, tidal encroachment could become a regular occurrence within twenty to thirty years. A study released by the Union of Concerned Scientists in October of 2014 looking at how sea level rise and tidal flooding will threaten East and Gulf Coast communities over the next thirty years, concluded that by 2030, 30 of the 52 communities that were studied, from Florida to Maine, will experience at least two dozen tidal floods per year.

The studies also looked at green infrastructure and storm water management projects that could be cost-effective for mitigating problems in flood prone areas (including land acquisition and ecological restoration, and marsh propagation, where appropriate). In certain areas, staff discussed other potential adaptation strategies including managed retreat/managed realignment (gradual, orderly, planned abandonment of sites that would eventually succumb to the impacts of sea level rise). These discussions remain open in both Buzzards Bay and Narragansett Bay study communities.

SRPEDD continues to work with a constantly expanding list of partners to identify and hopefully implement the most promising solutions that advance both ecological and economic wellbeing by protecting existing green infrastructure, promoting the integration of gray and green infrastructure where feasible, promoting ecological restoration, integrating climate change concerns, and supporting programs that use land and infrastructure efficiently.
Going forward, we would like to utilize a number of recently developed tools and programs in order to enhance our capabilities to serve our communities. Below is a list of strategies that we would like to pursue and resources that we would like to utilize in the next phase of our study.

**Strategies:**

- Because of the relatively flat profile of our watersheds, it is more useful to the process to compare change over time at a single point in each watershed than to attempt to compare patterns across various locations;
- Continue to use a multidisciplinary/partnership approach;
- Assist communities with local bylaw reviews to make sure that they are prepared and able to employ new techniques in flood hazard and stormwater mitigation;
- Assist communities with local vulnerability assessments and create a priority list of vulnerable roads and infrastructure;
- Work with communities to put projects in the Regional Transportation Plan and on the TIP;
- Look at the new Stream Crossings Report data (Mass Audubon, 2017) to help communities assess and prioritize potential culvert and bridge projects;
- Continue to work with the MA Division of Ecological Restoration (DER) to compile and assess dam removal and river restoration projects in our communities, particularly those in proximity to vulnerable transportation infrastructure;
- In conjunction with the above strategy, create new floodplain wherever and whenever feasible; and
- Work with Mass DOT and local communities to not only look at the resilience built into our gray infrastructure (bridges, culverts, etc.), but also at the resilience built into the landscape/natural infrastructure that surrounds it (consider the life-cycle costs of resiliency investments and the potential savings in the design).

**Resources/Tools:**

- The SRPEDD Regional Land Use/Build-Out Model – this model will involve future build-out projections and control totals down to the Transportation Analysis Zone (TAZ) level and will be able to factor in areas of potential climate change impact;
- EPA Watershed Management Optimization Support Tool (WMOST) – is a model used to project stormwater quality and quantity under future land use/build-out scenarios and suggest cost-effective best management practices (BMPs) options;
- NOAA Atlas 14 – provides the recurrence intervals (return periods) of threshold design storms at range and scale of magnitudes (*design storm refers to a storm whose magnitude, rate, and intensity do not exceed the design load for a storm drainage system or a flood protection project*). Updated from much older analyses (developed
decades ago and still the foundation of a great deal of the stormwater facilities design in the state), this data is available through an accessible map interface;

- The Northeast Regional Climate Center, and partners, (NRCC at Cornell) Precipitation Tools – provide a product similar to the NOAA Atlas 14 that differs slightly in its methodology (examples of both “changes in design calculations” appear in tables following this section of the report);

- Resilient Taunton Watershed Network (RTWN) Taunton River Green Infrastructure GIS Maps – developed by Manomet as part of the recent RTWN/EPA Healthy Communities Grant Project highlighting critical natural features that provide very important ecosystem services;

- NOAA/MA Coastal Zone Management Sea Level Affecting Marshes Model (SLAMM) – primarily a coastal tool, this can also be applied to tidal rivers, like the Lower Taunton, Lee, Coles, and the Palmer to help inform local plans of potential sea level rise impacts on marshes and wetlands and the need to retain areas of adjacent upland to accommodate marsh migration; and

- Coastal Emergency Risks Assessment website – allows viewers to see real-time observations at NOAA tide stations along with the forecast water levels when you turn on the site’s “gage stations”.

**SRPEDD-EPA-RTWN and the Watershed Management Optimization Tool: WMOST**

The EPA developed the Watershed Management Optimization Tool (WMOST), to help water resource managers and planners identify cost-effective, environmental and economically sustainable decisions to improve water quality and quantity.

WMOST supports integrated water management by allowing users to consider stormwater, drinking water, waste water, and land conservation management practices to find solutions. The newly released WMOST version 3 includes a water quality module that allows users to identify the most cost-effective management practices for reducing pollution. It also has a module that helps users reduce overflows from combined sewer systems, a common problem for these types of systems. EPA conducted two case studies to test and refine WMOST version 3.

**The Taunton River Watershed**

In the first case study, EPA researchers used WMOST to analyze two sub-watersheds in the upper Taunton River Watershed, the second largest watershed in Massachusetts. The watershed faces challenges such as flooding, storm surges, and sea level rise.
Researchers wanted to identify strategies to reduce phosphorous levels in lakes and flowing waters in the watershed, as well as nitrogen levels in Mt. Hope Bay, a portion of the Narragansett Bay estuary located at the mouth of the Taunton River. They also wanted to maintain a minimum low flow in streams throughout the watershed to create a stable water supply and support local fish populations.

To achieve these goals, EPA researchers considered "green" or nature-based watershed management options such as land conservation, green infrastructure, and riparian buffer restoration-planting trees along a stream. The team also considered "grey" or traditional infrastructure options like repairing water infrastructure leaks, upgrades to the wastewater treatment system, water conservation, and aquifer storage and recharge options. Researchers also employed the newly developed SRPEDD land use/growth model and supporting data, as integrated into SRPEDD’s regional transportation model.

SRPEDD’s model inputs include:

Build out model inputs:

- Future projections and control totals down to the Transportation Analysis Zone (TAZ) level.
- Future development scenarios ranging from small-scale zoning changes to big shifts due to factors such as climate change.
- SRPEDD's existing traffic model with more detailed, granular inputs for corridor studies.

Build out model Process:

- Build-out Estimates ("Supply"): create a parcel-by parcel build out for each town based upon existing zoning.
- Suitability Scoring ("Demand"): Examine every parcel from different perspectives to understand where development is more or less likely.
- Allocate Growth ("When and Where"): Combine MassDOT control totals, trends, current characteristics, and results from "Supply" and "Demand" to estimate growth projections.

After using WMOST to analyze the options, researchers found that infiltration basins—green infrastructure option for stormwater management—were the most cost-effective option to meet the watershed's water quality goals. The researchers are currently working with partners to identify the best options in the case of future growth and climate related effects. The
findings from this stage of the research will be shared with the communities before any of the options are implemented.

The Resilient Taunton Watershed Network (RTWN), is a partnership of regional, state, nonprofit, and federal representatives, including SRPEDD. RTWN will be one of the first groups applying WMOST version 3 to future growth and climate scenarios to identify the most cost-effective management actions. RTWN will share initial results from future growth scenarios with communities before considering potential management options. In addition, RTWN member Manomet, is taking part in a series of WMOST v3 trainings designed to support communities, states, tribes, and watershed organizations wishing to apply WMOST to their own case studies. Figure N-5 shows the Wading and Three Mile River Watershed Study Area.
Resiliency: The Resilient Taunton Watershed Network

For the past five years, SRPEDD has been working with and hosting meetings of The Resilient Taunton Watershed Network (RTWN). RTWN is a partnership of: Bridgewater State University; Horsley Witten Group; Manomet, Inc.; MA DEP; MA DER; MA Executive Office of Energy and Environmental Affairs; Mass Audubon; MAPC; Narragansett Bay Estuary Program; National Park Service; TNC; OCPC; Save The Bay; SRPEDD; Taunton River Watershed Alliance; US EPA Region I; US Geological Survey, and; The Wildlands Trust.

The goal of the RTWN is to promote the resiliency of the Taunton Watershed in the face of climate change and development, considering ecological outcomes as well as economic, social, and environmental justice issues. According to statistics from Mass Audubon’s Losing Ground: Planning for Resilience (2014), of Massachusetts thirty-two (32) major watersheds, between 2005 and 2013, the Taunton Watershed is ranked first in: total area of developed land; total area of new development; total amount of natural land converted to development and; total amount of open land converted to development. The RTWN also reviewed the Manomet’s Taunton River Watershed Climate Change Adaptation Plan (2013). All of these land use factors, as well as socioeconomic data, were considered by the RTWN partners when selecting the Taunton as a pilot study watershed for resiliency planning.

A resilient watershed is one that has the capacity to adjust to stresses and disturbances while still being able to provide valuable ecosystem services and functions, such as the provision of clean water and flood protection. RTWN is working together to identify and implement the most promising solutions that advance both ecological and economic wellbeing by protecting existing green infrastructure, promoting ecological restoration, integrating climate change concerns, and supporting programs that use land and infrastructure efficiently.

Some of the strategies that are being considered for the Taunton River Watershed include:

- Integrating regional green infrastructure considerations into local planning practices;
- Avoid new infrastructure investment in floodplain, floodway, and flood prone areas;
- Incorporate climate change data, adaptation, and mitigation strategies into transportation, open space, and master planning documents in order to adequately prepare for events related to climate change;
- Make necessary changes to zoning, health, and building codes in order to address projected climate change/climate change related conditions;
- Employ LID stormwater management design when and where appropriate;
- Restore ecosystems/natural hydrology in order to reduce flooding, increase recharge, and address public and environmental health and safety.

RTWN continues to look to SRPEDD’s Regional Transportation Plan and TIP for other future potential network projects.

**General Recommendations for Environmental Coordination in Transportation Planning**

SRPEDD offers the following recommendations to improve environmental coordination in our transportation planning efforts in the coming years:

- Continue field work in order to better track indicators of change predicted in various models and studies;
- Reassess our community Master Plans, Open Space Plans, Municipal Vulnerability Preparedness (MVP) Plans, Hazard Mitigation Plans, flood maps, and related land use and natural resource planning documents, in order to adequately plan for and address the needs of vulnerable areas and populations;
- Our ability to forge lasting partnerships is our strength. Continue to encourage strong multidisciplinary partnerships, when and where appropriate, in order to maximize our ability to confront the complex issues associated with tidal flooding, sea level rise, and climate change, as well as to maximize the impact of physical and financial resources that we allocate to these issues;
- Continue to take a holistic, watershed based, long-term approach to planning for resiliency, incorporating social, economic, and infrastructure investments and concerns into the process;
- Continue to support projects that will maintain and restore our critical landscapes in order to ensure long-term ecosystem health and enhance regional resiliency.