



## LIVABILITY AND ENVIRONMENT

### INTRODUCTION

The Boston Region MPO's Central Vision states that the region will work to maintain its high quality of life in part due to its healthy and pleasant environment that includes transit, bicycle, and pedestrian modes to reduce environmental impacts and to improve air and environmental quality.

This chapter will address how the MPO will be moving toward this central vision through three of its major vision topic areas – Climate Change, the Environment, and Livability.

Climate Change is a new emphasis area in the MPO planning process and will be presented first because it is a larger-scale issue that is affecting not only the MPO but the Commonwealth, the nation, and the world as a whole. The International Panel on Climate Change states, "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level."<sup>1</sup> The United States Department of Transportation emphasizes that MPOs shall consider projects and strategies that protect and enhance the environment, promote energy conservation, and improve the quality of life. The MPO recognizes that climate change will likely have significant impacts on the Boston region if climate trends continue as projected.

The environment is presented next and continues to be an area of emphasis; outlining the major environmental issues that the MPO must consider when selecting its projects and programs for inclusion in the LRTP, and, ultimately, in the Transportation Improvement Program (TIP). The impacts on air quality are the major environmental factor that the MPO addresses; however, the MPO also reviews a project's impacts on other environmental factors, such as wetlands and protected open space.

<sup>1</sup> Climate Change 2007: Synthesis Report, Summary for Policymakers, International Panel on Climate Change, p. 2, [www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4\\_syr\\_spm.pdf](http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf), November 2007.

Of all the fossil fuels consumed by humanity overall, we have consumed half in the last two decades.

Finally, livability is also a new emphasis area in the MPO planning process and outlines programs that will help in promoting livable communities that provide its residents with convenient access to opportunities and resources. Affordable housing, access to services, employment opportunities, and shopping in close proximity all contribute to the livability of a community, as do safe, affordable, and healthy options for getting around.

The following sections provide further detail on the three topic areas by identifying major issues, the MPO's visions and policies, and describing MPO actions taken to address those issues. Finally, a section on the development of performance measures outlines the next steps that the MPO will take to ensure that the region is moving toward its visions.

## CLIMATE CHANGE

### What is climate change?

Climate change refers to any significant change in measures of climate, such as changes in temperature, precipitation, or wind, lasting for an extended period of time. Increases in certain gases – carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), fluorocarbons, and water vapor) – are causing a greenhouse effect, which is the trapping and build-up of heat in the atmosphere near the earth's surface. The term greenhouse gas (GHG) is used because the same effect occurs in greenhouses: the glass allows sunrays in, but much of the heat from those rays is trapped inside the structure. If the atmospheric concentrations of GHGs rise, the average temperature of the lower atmosphere will gradually increase.

Atmospheric GHGs are necessary for our survival. Without them, all of the heat generated from the earth would be released. The average temperature of our planet would not be just under 60°F, as it is now, but about 10°F.<sup>2</sup> These gases act like an earthly blanket, or like a greenhouse, and, until recently, were retaining just enough heat but not too much.

The balanced transfer of heat to the earth and back out to space is undermined by the current and increasing overabundance of these GHGs. Carbon dioxide and certain other gases hold heat and increase the temperature of the atmosphere. The heated atmosphere not only heats the land and the ocean, but also is able to hold more moisture, or water vapor, increasing the GHG effect.

Although global warming can occur as a result of a variety of natural causes, humans are having a major effect on the climate. While we emitted CO<sub>2</sub> in past decades through industrial and mobile sources, the amount of CO<sub>2</sub> that we put into the atmosphere in the early years of the past century is dwarfed by what we are emitting today. Of all the fossil fuels consumed by humanity overall, we have consumed half in the last two decades.<sup>3</sup>

<sup>2</sup> National Oceanic and Atmospheric Administration, National Climatic Data Center: Global Surface Temperature Anomalies, [www.ncdc.noaa.gov/cmb-faq/anomalies.html](http://www.ncdc.noaa.gov/cmb-faq/anomalies.html), accessed May 5, 2011. The time of human habitation, a million years, represents about 0.02 percent of the life of the earth. If the time of the earth were represented as a day, humans would occupy the last two minutes.

<sup>3</sup> Geology.com, [geology.com/nasa/human-carbon-dioxide/](http://geology.com/nasa/human-carbon-dioxide/), Human Carbon Dioxide: Understanding the Sources of Rising Carbon Dioxide. NASA news release from January 13, 2009.

## The Transportation System's Share of GHGs

For the year 2009, about 38 percent of the GHGs produced in the United States came from electricity production and 29 percent came from buildings – residential, commercial, and industrial, with 27 percent from the transportation sector.<sup>4</sup> Light-duty vehicles (passenger cars and light trucks) accounted for nearly three-fifths of that total.<sup>5</sup> In Massachusetts, transportation also accounts for about a third of GHGs, up slightly from 31 percent of 1990 emissions and estimated to rise to 38 percent by 2020.<sup>6</sup>

## Impacts of Climate Change

There are many effects, collectively referred to as climate change, from an increase in atmospheric carbon. Three effects that particularly have an impact on transportation infrastructure and services in our region are discussed here: sea level rise, flooding, and hurricane impacts.

Our region is confronted with the question of what to do about the facilities that appear at risk for flooding and other weather impacts. In order to minimize the losses, the MPO can take steps to decrease our carbon footprint and to simultaneously adapt our transportation system to minimize damage.

### Flooding

As discussed above, one of the impacts of climate change is an increase in temperatures. Warmer air can hold more moisture, so storms can carry more precipitation. The most recent flood zone data and maps were obtained from the Federal Emergency Management Agency (FEMA). FEMA revised the flood information for Suffolk and Middlesex counties in 2010, but the information for the other counties in the region dates from the 1990s.

FEMA flood zones are based on rainfall data. Areas at high risk for 100-year and 500-year floods are shown on the maps. A 100-year flood is an event that has a 1.0 percent chance of being equaled or exceeded in any given year, and a 500-year flood has a 0.2 percent chance of being equaled or exceeded in any given year. Figure 5-1 shows the 100-year and 500-year flood zones along with major transportation infrastructure located in these areas that could be affected.

In Massachusetts, transportation also accounts for about a third of GHGs, up slightly from 31 percent of 1990 emissions and estimated to rise to 38 percent by 2020.

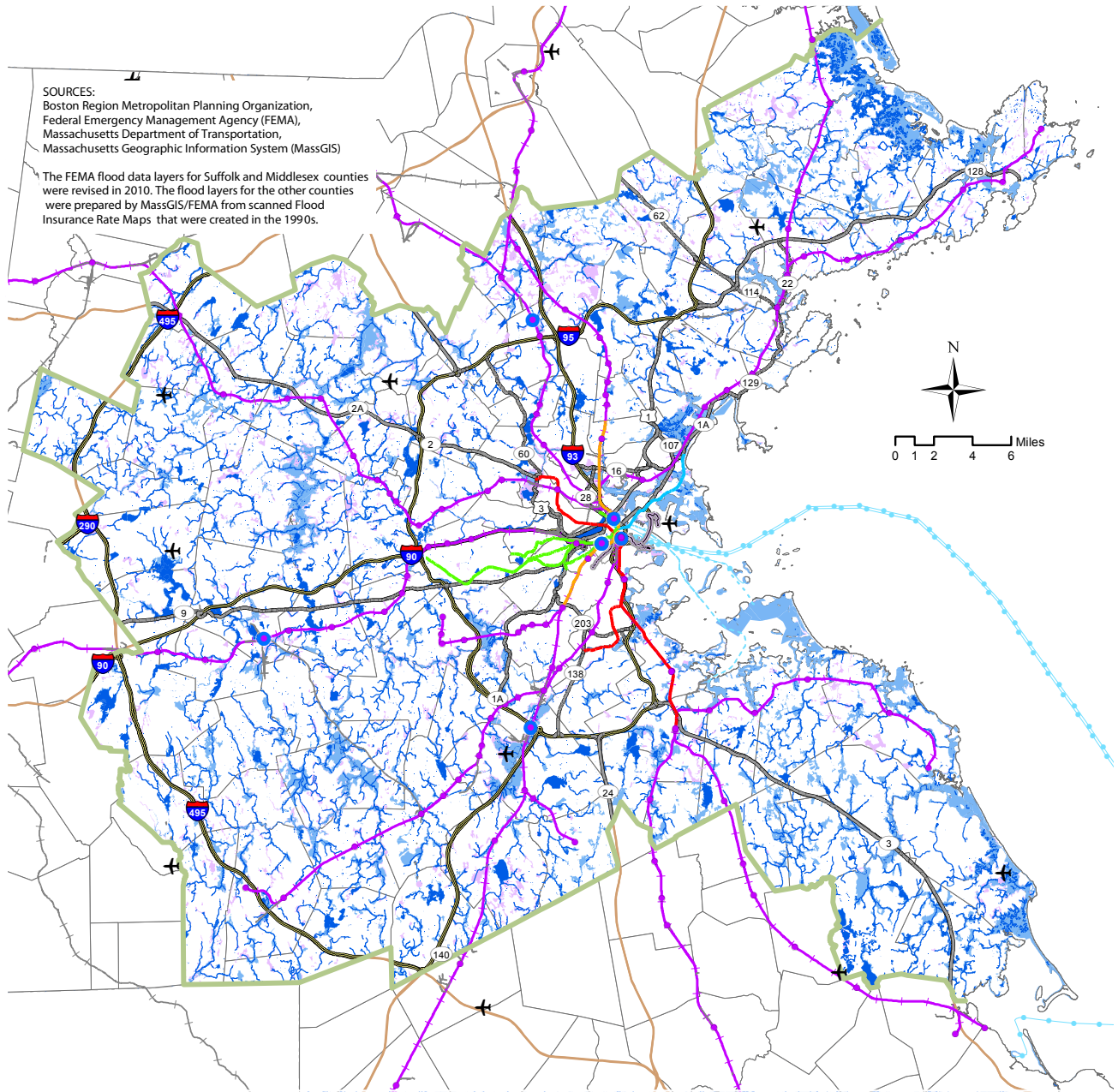
<sup>4</sup> U.S. Energy Information Administration, *What are the major sources and users of energy in the United States?* [www.eia.doe.gov/energy\\_in\\_brief/major\\_energy\\_sources\\_and\\_users.cfm](http://www.eia.doe.gov/energy_in_brief/major_energy_sources_and_users.cfm), June 28, 2011.

<sup>5</sup> *Reducing Greenhouse Gas Emissions from U.S. Transportation*, prepared for the Pew Center on Climate Change, January 2011, p. vii.

<sup>6</sup> Massachusetts Department of Transportation, *Reducing Transportation Greenhouse Gas Emissions Through the GreenDOT Policy*, [www.eot.state.ma.us/downloads/90\\_DayReport/GreenDOT\\_070710.pdf](http://www.eot.state.ma.us/downloads/90_DayReport/GreenDOT_070710.pdf), July 7, 2010.

FIGURE 5-1

FLOOD HAZARD AREAS



SOURCES:  
Boston Region Metropolitan Planning Organization,  
Federal Emergency Management Agency (FEMA),  
Massachusetts Department of Transportation,  
Massachusetts Geographic Information System (MassGIS)

The FEMA flood data layers for Suffolk and Middlesex counties were revised in 2010. The flood layers for the other counties were prepared by MassGIS/FEMA from scanned Flood Insurance Rate Maps that were created in the 1990s.

**Ponds**

■ Pond within normal banks

**Flood Zones**

- Areas at high risk for 100-year flood (1% annual chance of being equaled or exceeded in any given year)
- Areas at high risk for 500-year flood (0.2% annual chance of being equaled or exceeded in any given year)



## Sea Level Rise

In the Boston region, sea level has increased just under 0.3 meters (one foot) over the past century. Data from the Boston tide gauge station show that the sea level in Boston Harbor rose an average of 2.4 millimeters (0.09 inches) per year from 1921 to 2007, with an overall increase of 26 centimeters (10 inches) during those years.<sup>7</sup>

Climate models offer varying estimates of sea level rise, some projecting a sea level rise as high as 2 meters (6.5 feet) by the end of this century. The Intergovernmental Panel on Climate Change (IPCC)<sup>8</sup> predicts that there could be a global average sea level rise of 0.18 to 0.59 meters (0.6 to 1.9 feet) by 2100.<sup>9</sup> These estimates are not the upper bounds of a potential sea level rise, however, because they do not factor in the possibility of increased flows from ice sheets and glaciers. A higher-end estimate projects a sea level rise of 0.75 to 1.9 meters (2.5 to 6.2 feet) for the period 1990 to 2100.<sup>10</sup>

The red shading on Figures 5-2 through 5-4 defines the land areas that are within 2 meters (6.5 feet) of elevation from the shoreline as a hazard zone for sea level rise during this century along with major transportation infrastructure that are located in these areas. Half-meter increments up to the 2-meter mark (the higher-end estimate for sea level rise) are delineated to show where the sea level rise may occur based on the range of levels predicted.

According to the IPCC, it is very likely that heavy precipitation events will be more frequent in high latitudes, and likely that tropical cyclones (hurricanes in the Atlantic Ocean) will become more intense.<sup>11</sup> In either case, coastal areas can expect more severe and frequent flooding events. For that reason, these maps also show the high-risk areas for 100-year and 500-year floods.

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<sup>7</sup> National Oceanic and Atmospheric Administration, "Permanent Service for Mean Sea Level," [www.pol.ac.uk/psmsl](http://www.pol.ac.uk/psmsl), and Sea Levels Online. , <http://tidesandcurrents.noaa.gov/sltrends>, accessed May 3, 2011.

<sup>8</sup> The IPCC was established by the United Nations Environment Programme and the World Meteorological Organization.

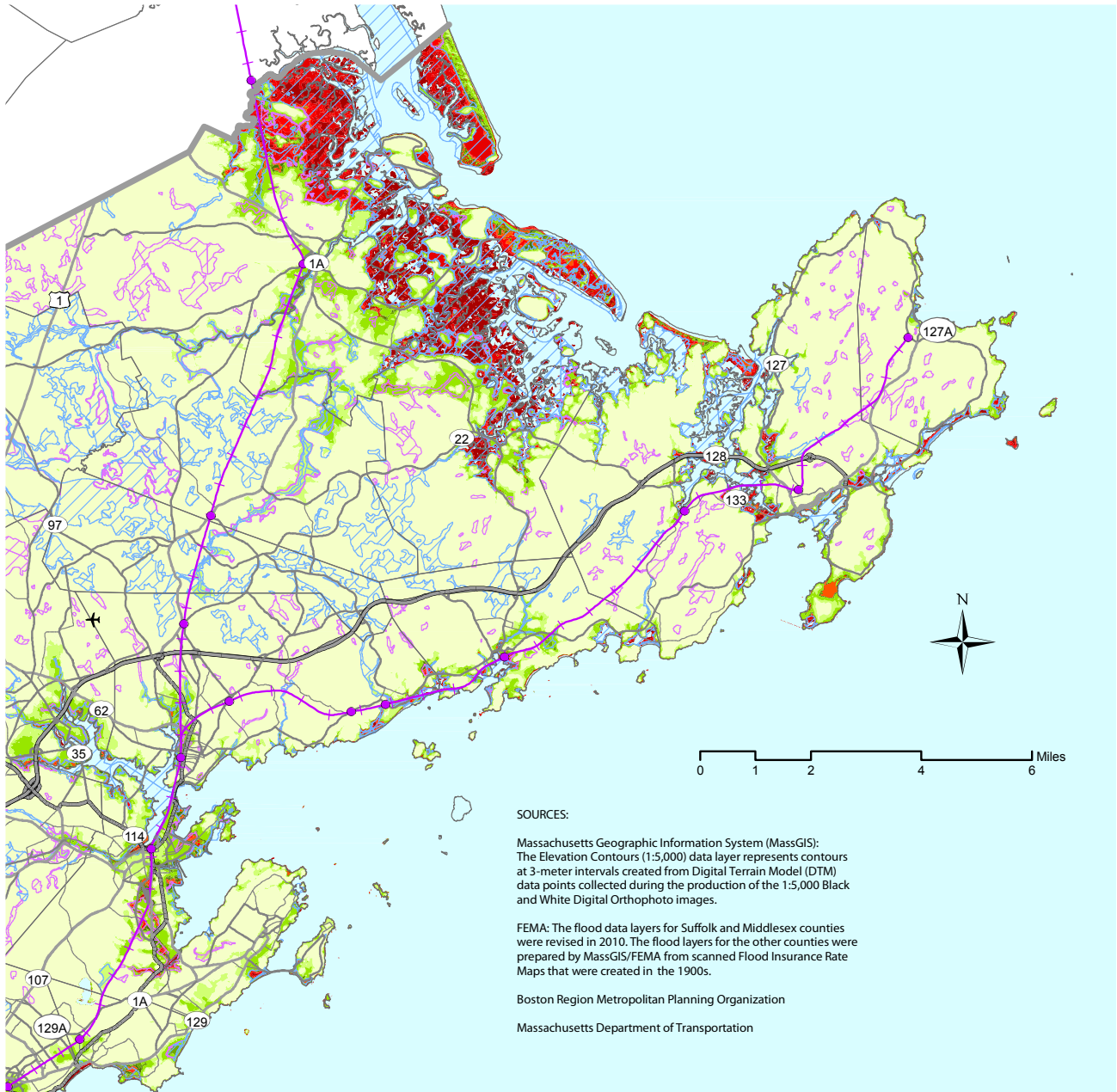
<sup>9</sup> Intergovernmental Panel on Climate Change, *Climate Change 2007: Synthesis Report*, 2007.

<sup>10</sup> Martin Vermeer and Stefan Rahmstorf, *Global Sea Level Linked to Global Temperature*, 2009.



<sup>11</sup> Intergovernmental Panel on Climate Change, *Climate Change 2007: Synthesis Report*, 2007.

FIGURE 5-2











COASTAL VULNERABILITY TO SEA LEVEL RISE – NORTH SHORE



**FEMA Flood Hazard Areas**

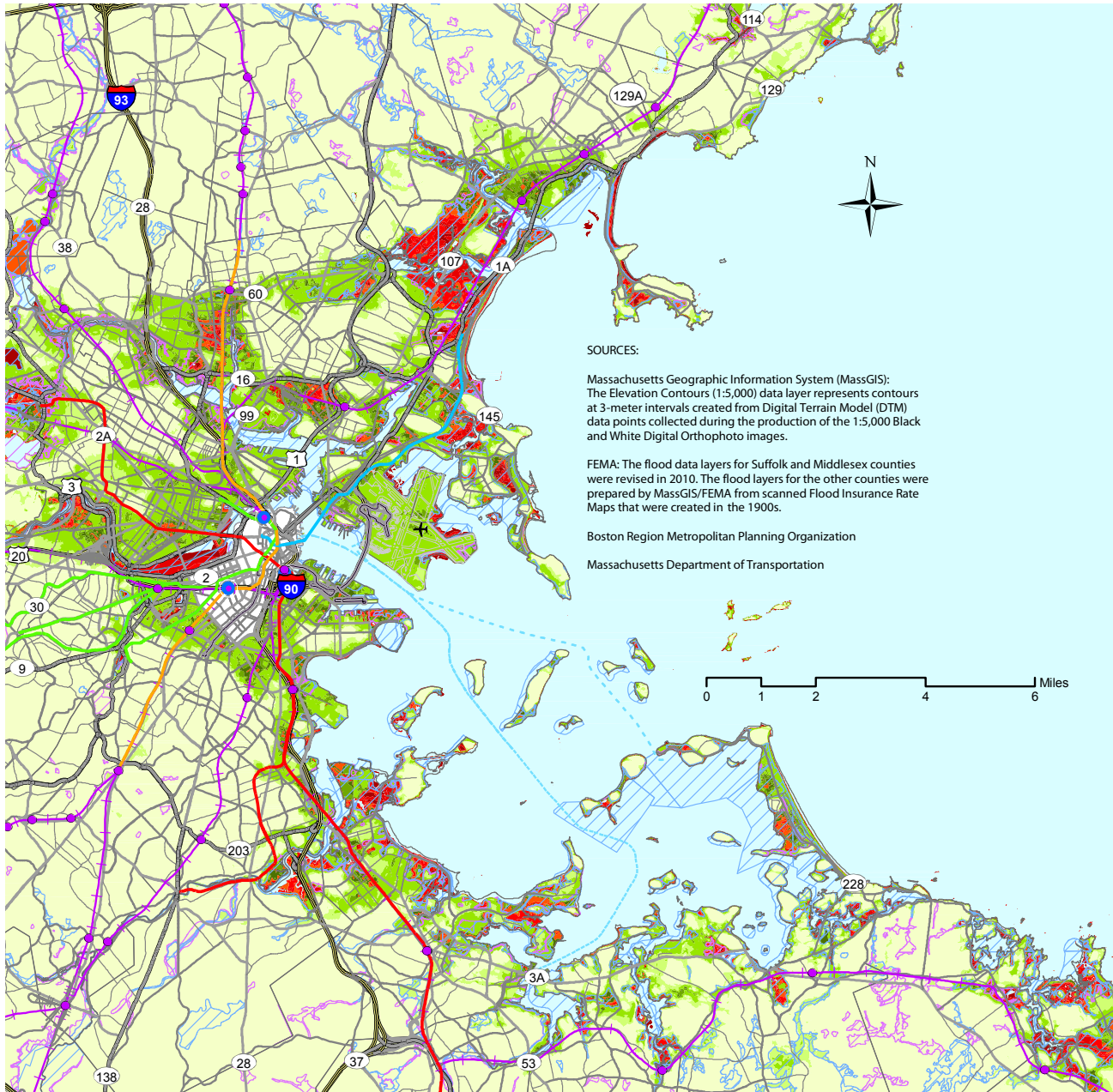
-  Areas at high risk for 100-year flood (1% annual chance of being equaled or exceeded in any given year)
-  Areas at high risk for 500-year flood (0.2% annual chance of being equaled or exceeded in any given year)

**Elevation**

-  0 meter or (seaLevel)
-  0.1 to 0.5 meter (0.3 to 1.6 feet)
-  0.6 to 1 meter (1.7 to 3.3 feet)
-  1.1 to 1.5 meters (3.4 to 4.9 feet)
-  1.6 to 2 meters (5.0 to 6.5 feet)
-  2.1 to 2.5 meters (6.6 to 8.2 feet)
-  2.6 to 3 meters (8.3 to 9.8 feet)
-  4 to 6 meters (10 to 19 feet)
-  7 to 9 meters (20 to 30 feet)
-  10 to 289 meters (31 to 948 feet)

**FIGURE 5-3**

**COASTAL VULNERABILITY TO SEA LEVEL RISE – CENTRAL COASTAL AREA**



**SOURCES:**


Massachusetts Geographic Information System (MassGIS): The Elevation Contours (1:5,000) data layer represents contours at 3-meter intervals created from Digital Terrain Model (DTM) data points collected during the production of the 1:5,000 Black and White Digital Orthophoto images.


FEMA: The flood data layers for Suffolk and Middlesex counties were revised in 2010. The flood layers for the other counties were prepared by MassGIS/FEMA from scanned Flood Insurance Rate Maps that were created in the 1900s.

Boston Region Metropolitan Planning Organization


Massachusetts Department of Transportation

**FEMA Flood Hazard Areas**

 Areas at high risk for 100-year flood (1% annual chance of being equaled or exceeded in any given year)

 Areas at high risk for 500-year flood (0.2% annual chance of being equaled or exceeded in any given year)

**Elevation**

 0 meter or (seaLevel)

 0.1 to 0.5 meter (0.3 to 1.6 feet)


 0.6 to 1 meter (1.7 to 3.3 feet)


 1.1 to 1.5 meters (3.4 to 4.9 feet)

 1.6 to 2 meters (5.0 to 6.5 feet)

 2.1 to 2.5 meters (6.6 to 8.2 feet)

 2.6 to 3 meters (8.3 to 9.8 feet)

 4 to 6 meters (10 to 19 feet)

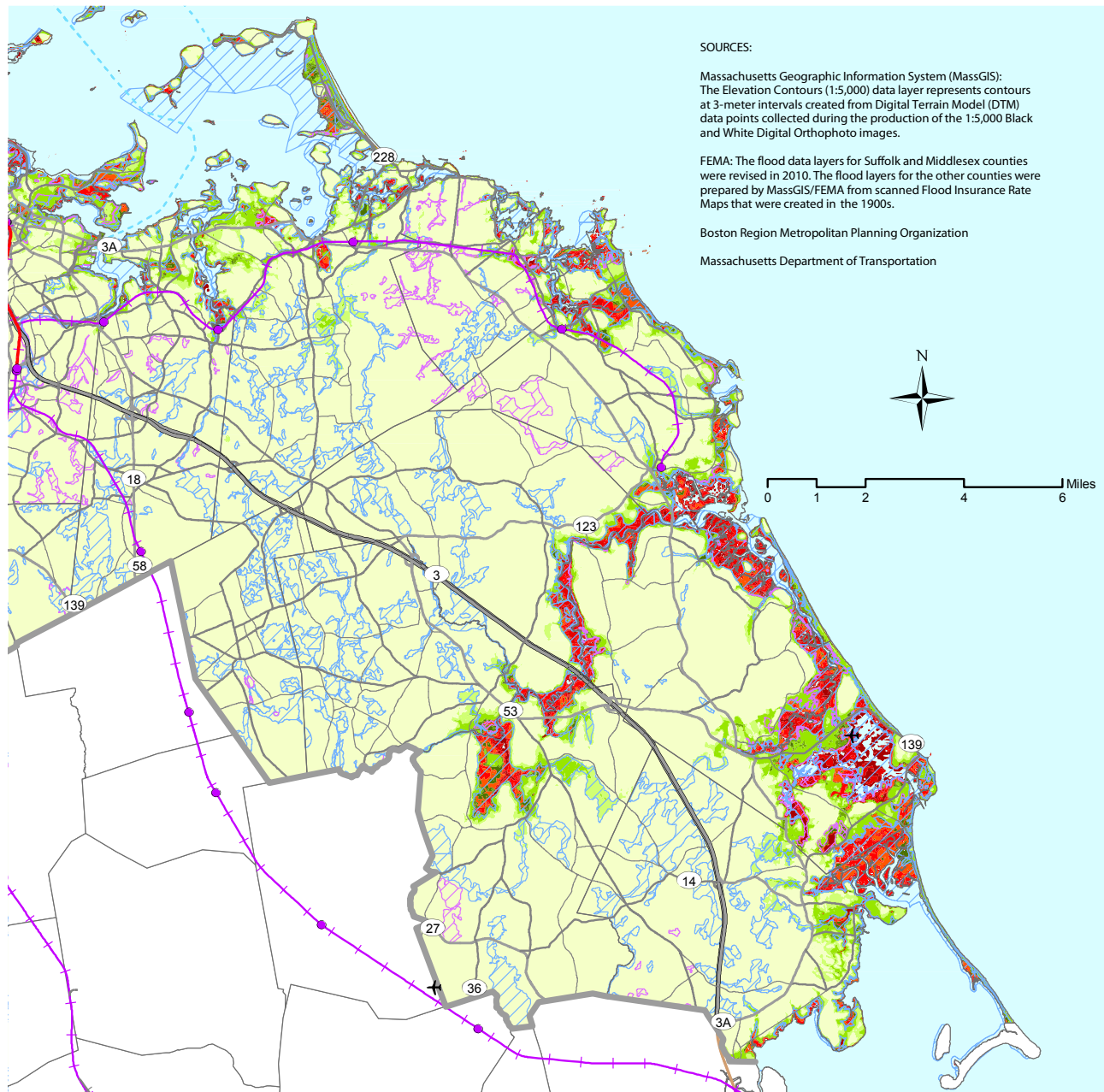
 7 to 9 meters (20 to 30 feet)

 10 to 289 meters (31 to 948 feet)





**FIGURE 5-4**

**COASTAL VULNERABILITY TO SEA LEVEL RISE – SOUTH SHORE**













**SOURCES:**  
 Massachusetts Geographic Information System (MassGIS): The Elevation Contours (1:5,000) data layer represents contours at 3-meter intervals created from Digital Terrain Model (DTM) data points collected during the production of the 1:5,000 Black and White Digital Orthophoto images.  
 FEMA: The flood data layers for Suffolk and Middlesex counties were revised in 2010. The flood layers for the other counties were prepared by MassGIS/FEMA from scanned Flood Insurance Rate Maps that were created in the 1900s.  
 Boston Region Metropolitan Planning Organization  
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**FEMA Flood Hazard Areas**

-  Areas at high risk for 100-year flood (1% annual chance of being equaled or exceeded in any given year)
-  Areas at high risk for 500-year flood (0.2% annual chance of being equaled or exceeded in any given year)

**Elevation**

-  0 meter or (seaLevel)
-  0.1 to 0.5 meter (0.3 to 1.6 feet)
-  0.6 to 1 meter (1.7 to 3.3 feet)
-  1.1 to 1.5 meters (3.4 to 4.9 feet)
-  1.6 to 2 meters (5.0 to 6.5 feet)
-  2.1 to 2.5 meters (6.6 to 8.2 feet)
-  2.6 to 3 meters (8.3 to 9.8 feet)
-  4 to 6 meters (10 to 19 feet)
-  7 to 9 meters (20 to 30 feet)
-  10 to 289 meters (31 to 948 feet)



## Hurricane Impacts

Climate change introduces two major factors into our weather system: imbalance and strengthened force. A warmer ocean temperature allows larger hurricanes and tropical storms to form. Increased storm strength, coupled with increased sea levels, means areas once immune from storm surges will be affected, and damage will be intensified in areas that are already flood-prone.

Hurricane damage could be substantial, from destroyed infrastructure and equipment to fallen trees blocking rail lines and highways. Figures 5-5 through 5-7 are hurricane surge maps showing the areas and infrastructure at risk for seawater inundation during Category 1 through Category 4 hurricanes. This information was obtained from the U.S. Army Corps of Engineers, which provides data from the National Weather Service's SLOSH (Sea, Lake, and Overland Surges from Hurricanes) model. The SLOSH model provides estimates of potential maximum storm-surge inundation for various categories of hurricanes.

## The Boston Region MPO's Vision for Climate Change

**Vision:** The production of GHG emissions by the transportation sector in this region will be reduced to levels that contribute appropriately to the statewide targets set by the Massachusetts Global Warming Solutions Act. The MPO region will have joined with other entities in Massachusetts and the Northeast to slow and perhaps prevent the onset of serious climate change effects. The MPO, in consultation and cooperation with state and federal agencies planning action on GHG reduction, will have adopted GHG reduction goals and taken the steps necessary to meet them. Critical elements of the region's transportation infrastructure that may be vulnerable to the impacts of climate change will have been identified and protected.

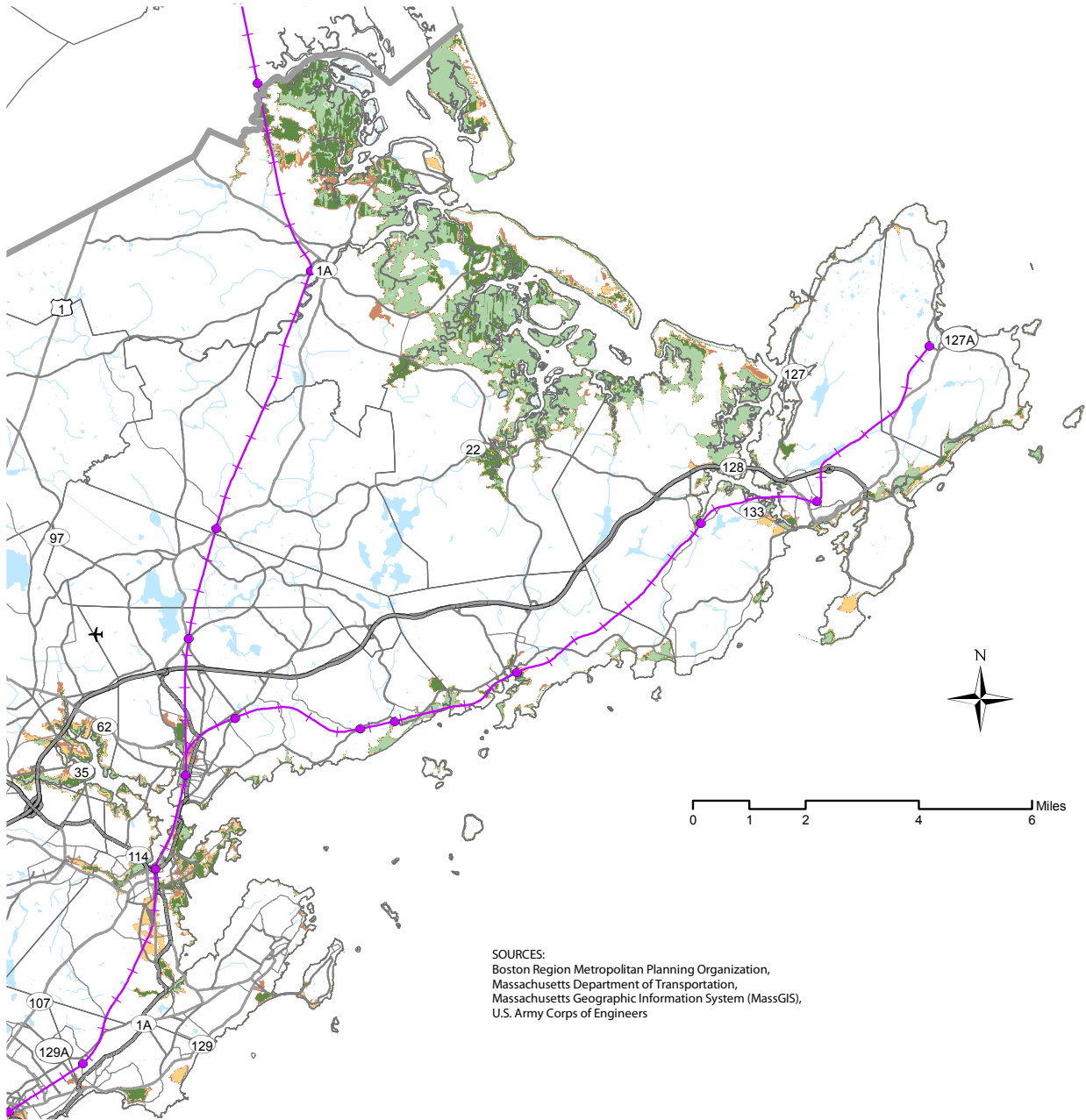
**Policies:** To meet the targets for reducing GHG emissions, the MPO will put a priority on programs, services, and projects that:

- Implement action to meet defined targets for reducing vehicle-miles traveled (VMT) by tying transportation funding to VMT reduction
- Support stronger land use and smart growth strategies
- Increase transit, bicycle, and pedestrian options
- Invest in adaptations that protect critical infrastructure from effects resulting from climate change
- Encourage strategies that utilize transportation demand management
- Promote fleet management and modernization, idling reduction, and alternative-fuel use
- Contribute to reduced energy use in the region; energy use will be part of the environmental impact analysis of all projects

Increased storm strength, coupled with increased sea levels, means areas once immune from storm surges will be affected, and damage will be intensified in areas that are already flood-prone.

FIGURE 5-5

HURRICANE SURGE INUNDATION – NORTH SHORE

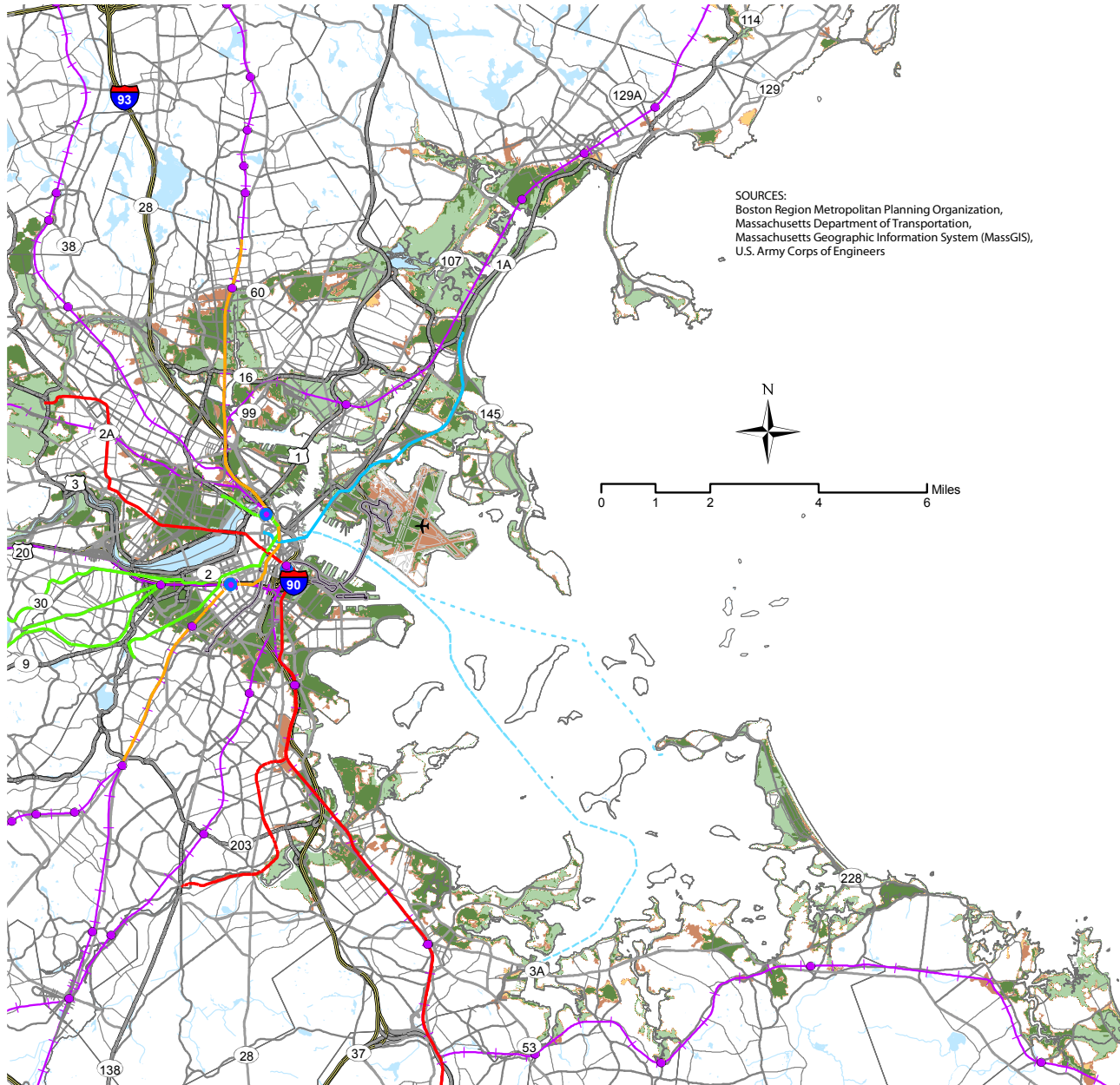


**Hurricane Surge Inundation in Massachusetts  
(Worst case flooding by hurricane category)**

- Category 1
- Category 2
- Category 3
- Category 4

FIGURE 5-6

HURRICANE SURGE INUNDATION – CENTRAL COASTAL AREA



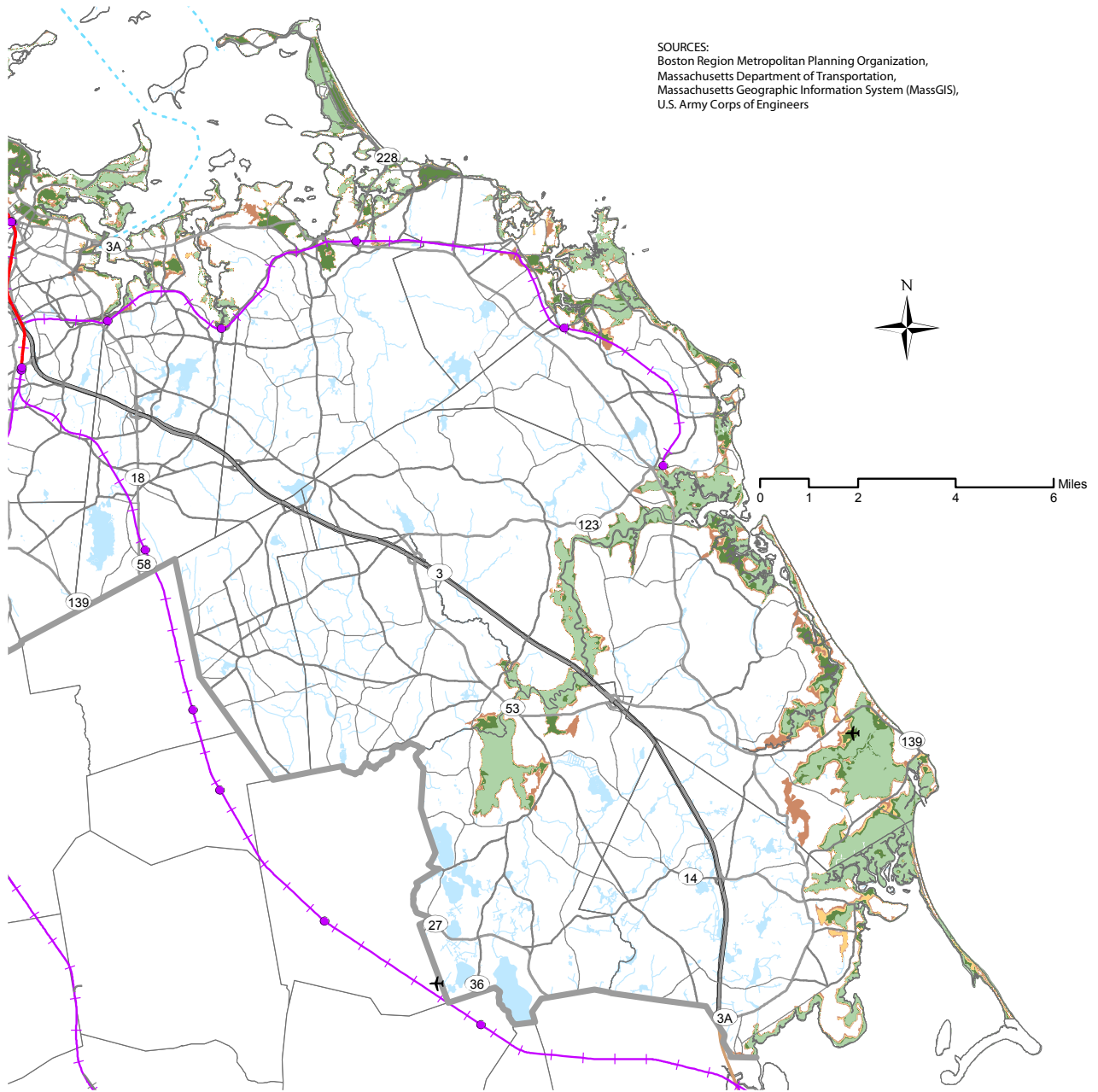
SOURCES:  
Boston Region Metropolitan Planning Organization,  
Massachusetts Department of Transportation,  
Massachusetts Geographic Information System (MassGIS),  
U.S. Army Corps of Engineers

**Hurricane Surge Inundation in Massachusetts  
(Worst case flooding by hurricane category)**

- Category 1
- Category 2
- Category 3
- Category 4

FIGURE 5-7

HURRICANE SURGE INUNDATION – SOUTH SHORE



**Hurricane Surge Inundation in Massachusetts  
(Worst case flooding by hurricane category)**

- Category 1
- Category 2
- Category 3
- Category 4



## The MPO's Actions to Achieve Climate Change Vision

Governor Patrick signed the Global Warming Solutions Act (formally called the Climate Protection and Green Economy Act) in August 2008. The Act requires reductions of GHG emissions below 1990 levels between 10 to 25 percent by 2020, and 80 percent reduction by 2050. As part of the Global Warming Solutions Act (GWSA), the Executive Office of Energy and Environmental Affairs developed the Massachusetts Clean Energy and Climate Plan for 2020 that outlines programs to attain 25 percent reduction by 2020. In that plan, a 7.6 percent reduction will be attributed to state transportation programs. One of the programs in the Massachusetts Clean Energy and Climate Plan is MassDOT's sustainability initiative, also known as GreenDOT. The GreenDOT Policy directive was developed in accordance with the GWSA. Its three goals are:



1. To reduce GHG emissions by reducing emissions from construction and operations, using more efficient fleets, implementing travel demand management programs, encouraging eco-driving, and providing mitigation for development projects.
2. To promote healthy transportation modes by improving pedestrian, bicycle, and public transit infrastructure and operations.
3. To support smart growth development by making transportation investments that enable denser, smart growth development patterns that can support reduced GHG emissions.

The Boston Region MPO will be involved in helping to achieve the GreenDOT goals. The MPO will be most directly involved in helping to achieve reductions through prioritizing and programming an appropriate balance of roadway, transit, bicycle, and pedestrian investments, and will assist in the third goal – supporting smart growth development patterns through the creation of a balanced multimodal transportation system. Two of its visions – climate change and livability – will help in selecting projects to further the GreenDOT goals and reduce GHG emissions.

The MPO is contributing to the statewide implementation of GreenDOT in a number of other ways:

- Alternative Modes of Travel – The MPO funds projects that provide people with transportation options other than single-occupancy vehicles (SOVs). Alternative modes to SOVs include transit, bicycling, walking, and carpooling.
- Reduction of Vehicle-Miles of Travel and Roadway Congestion – The MPO funds projects that reduce the need to drive and ease roadway congestion, therefore reducing emissions.

- Alternative Fuel Sources – The MPO funds the use of alternative fuel sources, which can release less GHG emissions than traditional fossil fuels.
- Smart Growth Policies – The MPO promotes Smart Growth Policies through its project selection criteria.
- Public Outreach – The MPO can also help by educating the public through its many avenues of outreach and by supporting future federal and state programs that reduce GHG emissions.

## Alternative Modes of Travel

### Transit

One person living in the United States using mass transit for an entire year, instead of driving to work, can keep an average of over 5,000 pounds of CO<sub>2</sub> from being discharged into the air. One full, 40-foot bus takes 58 cars off the road.<sup>12</sup> A 10 percent nationwide increase in transit ridership would save 135 million gallons of gasoline a year and prevent 2.7 billion pounds of CO<sub>2</sub> from being added to the atmosphere (one gallon of gasoline creates 20 pounds of CO<sub>2</sub>).<sup>13,14</sup>

The Massachusetts Bay Transportation Authority (MBTA) is a significant part of the Boston region's transportation system, operating buses, subways, trains, ferries, and maintenance and operations vehicles throughout the region. It is also a significant element of the MPO's approach to reducing GHGs; the system provides people with an alternative to SOV travel. The MPO allocates approximately \$285 million of formula funding to transit projects annually through its Transportation Improvement Programs and LRTP. This funding is used to maintain, improve, and expand the existing transit system. The MPO also allocates Congestion Mitigation and Air Quality (CMAQ) and transit funds for cleaner transit vehicles.

68 percent of us live within two miles of a transit station; and 31 percent of us live within one mile of a shared-use path.

### Bicycle and Pedestrian Projects

Nonmotorized (bicycle and pedestrian) transportation produces no emissions. According to the Regional Bicycle Plan, 66 percent of the trips in the MPO region, by any mode of transportation, are less than five miles; 68 percent of us live within two miles of a transit station; and 31 percent of us live within one mile of a shared-use path.<sup>15</sup> Despite these relatively short distances, bicycling remains a marginal transportation choice for work and errands, comprising less than 1 percent of trips in our region.<sup>16</sup>

The MPO allocates funding for bicycle and pedestrian projects in the region to make the use of these modes of transportation safer, more attractive, and more viable as a mode choice. The MPO also funds a bicycle parking program and conducts studies and workshops to improve bicycling and walking conditions throughout the region in an effort to get more people to use these modes for traveling to work and running errands.

Massachusetts requires state agencies to accommodate bicyclists and pedestrians

<sup>12</sup> National Safety Council, "Auto Emissions Fact Sheet," [www.nsc.org/ehc/mobile/mse\\_fs.htm](http://www.nsc.org/ehc/mobile/mse_fs.htm), accessed: April 16, 2007.

<sup>13</sup> Ibid.

<sup>14</sup> United States Department of Energy and the U.S. Environmental Protection Agency, "How can a gallon of gasoline produce 20 pounds of carbon dioxide?" [www.fueleconomy.gov/feg/co2.shtml](http://www.fueleconomy.gov/feg/co2.shtml), April 2007.

<sup>15</sup> Metropolitan Area Planning Council and Boston Region MPO, "Regional Bicycle Plan." March 2007: 90 pages.

<sup>16</sup> Ibid.

into the design and construction of every project. This requirement is reflected in MassDOT's Project Development and Design Guide (2006). The design guide provides for the accommodation of pedestrians and bicyclists in line with Chapter 87 of the Commonwealth's Acts of 1996. By integrating these guidelines into their design, new roadway projects will accommodate both bicyclists and pedestrians.

MassDOT recently released its Bay State Greenway 100 implementation plan that identifies priority shared-use paths (or segments of paths) that make additional connections to urban centers, extend existing paths, and maximize the transportation utility of the network. The MPO will consider improvements to this bicycle and pedestrian network as well as to other portions of the network it identifies in its bicycle and pedestrian studies. The MPO's mobility policies include the intention to both close gaps in the existing networks and expand the bicycle and pedestrian network.

### **Reduction of Vehicle-Miles of Travel and Roadway Congestion**

Through its Clean Air and Mobility program, the MPO funds projects that help improve air quality and reduce traffic congestion. Projects eligible for funding under this program include public transportation improvements, traffic flow improvements (usually at intersections and interchanges), travel demand management, bicycle and pedestrian projects, inspection and maintenance programs, intermodal freight transportation, public education and outreach, idle-reduction technology, and intelligent transportation systems. Two examples of this type of project recently funded in the program are the construction of sidewalks linking housing and commercial activity centers to commuter rail stations in a suburban municipality, and a study to update signal timing in congested high-traffic intersections in a densely populated municipality near Boston.

### **Alternative Fuel Sources**

The MPO's Clean Air and Mobility Program also funds projects that support the use of alternative fuel sources. The Cambridge Clean Cabs project received funds to cover the incremental cost of upgrading cab fleets to hybrid vehicles. This investment helps reduce greenhouse gas emissions that are associated with climate change. In summer 2011, Massachusetts Energy and Environmental Affairs awarded 105 electric vehicle charging stations to 25 cities and towns throughout the Commonwealth. Municipalities within the Boston Region that received stations include Boston, Brookline, Cambridge, Hanover, Hopkinton, Lexington, Newton, and Salem. The estimated cost is \$2,500 for a single charging station and \$3,000 for a multi-car charging station, and a full charge allows vehicles to drive between 80 and 100 miles. This state initiative will facilitate the use of alternative sources by providing the infrastructure needed to make electric cars a viable option here in Massachusetts.

### **Smart-Growth Policy Packages**

Additional smart growth would make it easier for households and businesses to decrease the number and distance of vehicle trips, thus reducing vehicle-miles traveled (VMT) and the associated emissions. Massachusetts already has several policies promoting smart growth. The Metropolitan Area Planning Council has taken the lead in advancing smart growth, through MetroFuture, its current long-range plan for land use, housing, economic development, and environmental preservation in the Boston region.

Additional smart growth would make it easier for households and businesses to decrease the number and distance of vehicle trips.

MetroFuture comprises both a vision for the region’s future and a set of strategies to achieve that future. The MPO has adopted the MetroFuture land use plan assumptions and associated socioeconomic projections, which are used in the MPO’s travel demand model. MetroFuture seeks to create a more sustainable future for the region by focusing growth in areas where it already exists, in order to make better use of existing infrastructure and reduce the need for new highways, interchanges, and other infrastructure.

**Documenting the MPO’s GHG-Emissions Reduction for GreenDOT Implementation**

The Boston Region MPO and MassDOT, using the Boston MPO and the statewide travel demand models, have estimated CO<sub>2</sub> emissions resulting from the collective list of all recommended projects in all of the Massachusetts MPO’s LRTPs combined. Emissions are estimated in the same way as the criteria pollutants (volatile organic compounds, nitrogen oxides, and carbon monoxide) whose reduction is required for the air quality conformity determination, which is described in Chapter 10. However, the CO<sub>2</sub> emissions shown here are part of an effort separate from the conformity analysis and are not part of those federal standards and reporting requirements.

The Massachusetts Global Warming Solutions Act (GWSA) legislation requires reductions by 2020 and further reductions by 2050, relative to the 1990 baseline. The project mix from this LRTP (and all other LRTPs) was modeled for both 2020 and 2035 using a Build vs. No-Build analysis to determine the CO<sub>2</sub> emissions attributed to the MPO’s mix of projects and smart-growth land use assumptions. The estimates of the modeled CO<sub>2</sub> emissions are provided below:

**TABLE 5-1**  
**MASSACHUSETTS STATEWIDE CO<sub>2</sub> EMISSIONS ESTIMATES**  
 (ALL EMISSIONS IN TONS PER SUMMER DAY)

YEAR	CO <sub>2</sub> BUILD EMISSIONS	CO <sub>2</sub> NO-BUILD EMISSIONS	DIFFERENCE (ACTION MINUS BASE)
2010	101,514.4	101,514.4	n/a
2020	105,747.5	105,856.4	-108.9
2035	115,034.1	115,028.0	6.1

As shown above, collectively, all the projects in the LRTPs in the 2020 Build scenario provide a statewide reduction of nearly 109 tons of CO<sub>2</sub> per day compared to the base case. However, the 2035 Build scenario estimates an increase of about 6 tons of CO<sub>2</sub> emissions compared to the No-build case. It should be noted that this current analysis measures only projects that are included in the travel demand model. Many other types of projects that cannot be accounted for in the model (such as bicycle and pedestrian facilities, shuttle services, intersection improvements, etc.) will be further analyzed for CO<sub>2</sub> reductions in the next Transportation Improvement Program development cycle. This information will be updated and reported at that time.

Working closely with MassDOT, the Boston Region MPO will continue to report on its actions to comply with the GWSA and to help meet the GHG reductions targets. As part of this activity, the MPO will provide further public information on the topic and will advocate for steps needed to accomplish the MPO’s and state’s goals for greenhouse gas reductions.



The MPO also acknowledges the importance of adaptation measures to moderate potential damage from climate change impacts. Two of its visions – climate change and safety and security – will help in selecting projects that improve the ability of the transportation system to withstand extreme conditions. Projects that improve an evacuation route or an access route to an emergency support location earn higher ratings in the project evaluation process. Similarly, the evaluation process rewards projects that address sea level rise and flooding, meet current seismic design standards, or protect critical infrastructure. These criteria will help identify future transportation investments to address the impacts of climate change.

## ENVIRONMENT

### The Boston Region MPO's Vision for the Environment

**Vision:** Human and environmental health are considered in transportation decision-making. With transportation investments targeted to areas of existing development, many greenfields will be preserved, many brownfields will be restored and reused, and water and sewer infrastructure and other utilities will be more cost-effectively maintained. Air quality will be improved as the full range of regulated vehicle emissions (carbon monoxide, nitrogen oxides, volatile organic compounds, and particulates) and carbon dioxide are reduced to required and/or targeted levels. The transportation project design process will avoid or minimize negative impacts to wetlands, soil, water, and other environmental resources. Context-sensitive design principles will be implemented to protect communities' cultural, historic, and scenic resources, community cohesiveness, quality of life, and aesthetic environments.

**Policies:** To protect the environment and minimize impacts from transportation, the MPO will put a priority on programs, services, and projects that:

- Improve transportation in areas of existing development, which will reduce pressure to develop greenfields and possibly support development that will clean up brownfields for productive use
- Promote energy conservation, fleet management and modernization, and high-occupancy travel options to reduce fuel consumption and emissions of pollutants
- Protect community character and cultural resources
- Protect natural resources by planning early to avoid or mitigate impacts on stormwater or groundwater and on other resources
- Protect public health by reducing air pollutants, including fine particulates; avoid funding projects that increase exposure of at-risk populations to ultrafine particulates
- Lower life-cycle costs from construction to operation.
- Increase mode share for transit and nonmotorized modes
- Promote energy conservation and use of alternative energy sources
- Promote a context-sensitive design philosophy, consistent with the MassDOT Highway Division's design guidelines

Transportation agencies will work with environmental and cultural resource agencies to achieve these ends.

### **MPO Actions to Achieve Visions**

The MPO's policies determine which projects of regional significance are programmed in the LRTP. Guided by the nine policies described above, the MPO considers environmental effects as it assigns ratings to potential projects, with the goal of favoring projects that either maintain or improve the environmental status.

In *Paths to a Sustainable Region*, a project's environmental effects are assessed at the macro level for the LRTP. The detailed study and review of a project's specific effects on the environment occur during the design phase and prior to the project's being programmed in the TIP. Environmental oversight is conducted by others, including agencies, municipalities, and other project proponents, and occurs at the federal, state, and local levels. The National Environmental Policy Act (NEPA) guides federal oversight.<sup>17</sup> Conservation commissions provide local guidance and permitting.

The primary mechanism for state environmental review is the Massachusetts Environmental Policy Act (MEPA) process. The level of analysis required for a given project is determined by a series of triggers, some of which are directly related to transportation.<sup>18</sup> If a project meets certain criteria, for example, an environmental impact report (EIR) is required. A transportation project, however, may trigger MEPA review in other ways, related to wetland impacts, for example. Findings may result in the identifying the need for mitigation of environmental impacts. Examples of mitigation measures to minimize impacts on adjacent areas are narrowing a roadway or increasing a slope. A trail might be built on a boardwalk to minimize impacts on wetlands or wildlife, or additional land might be set aside to replace an impacted floodplain.

In the Boston region, environmental reviews for projects are conducted by the proponent transportation agency or municipality, not the MPO. The MPO signatory operating agencies, MassDOT, the MBTA, and Massport, have procedures for environmental reviews. The MassDOT Highway Design Guide contains a very detailed description of the MEPA process.<sup>19</sup> While this description applies specifically to Highway Division projects, it gives an excellent overview of the procedures and requirements involved in the environmental review process for all projects in Massachusetts.

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<sup>17</sup> The National Environmental Policy Act of 1969, as amended (Pub. L.91-190, 42 U.S.C. 4321-4347, January 1, 1970, as amended by Pub.L.94-52, July 3, 1975, Pub. L. 94-83, August 9, 1975, and Pub. L. 97-258 §4(b), Sept. 13, 1982).<sup>18</sup> The National Environmental Policy Act of 1969, as amended (Pub. L.91-190, 42 U.S.C. 4321-4347, January 1, 1970, as amended by Pub.L.94-52, July 3, 1975, Pub. L. 94-83, August 9, 1975, and Pub. L. 97-258 §4(b), Sept. 13, 1982).

<sup>18</sup> Major transportation projects such as new interchanges, new rapid transit lines, new airports, or new runways trigger an Environmental Notification Form (ENF) and a mandatory Environmental Impact Review (EIR). Other triggers in this category include the generation of 3,000 or more new average-daily-traffic volumes at a single location or construction of 1,000 or more new parking at a single location.

An ENF would be required for a new airport taxiway, new roadways at least one-quarter mile long, widening of a roadway by four feet or more for one-half mile or more, cutting of five or more public shade trees of 14 or more inches in diameter at breast height, eliminating 300 or more feet of stonewall, etc.

<sup>19</sup> Massachusetts Highway Department Project Development and Design Guide, 2006. See especially Chapter 2, "Project Development."

## ***Environmental Factors Addressed by the MPO***

The environmental factors (other than air-related factors) that the MPO reviews during its project selection process include the following:

- 1) Areas of Critical Environmental Concern (ACEC) – 28 Areas of Critical Environmental Concern (ACECs) in Massachusetts are recognized for their unique, significant natural and cultural resources. Individual communities nominate candidates for ACEC designation, and the Secretary of Energy and Environmental Affairs determines whether to designate the area as an ACEC. The ACEC designation helps to ensure that any activities undertaken in or near the ACEC have minimal negative impacts. Statewide, the 28 ACECs, located in 73 towns, cover almost a quarter of a million acres; 12 of these areas are located at least partially in the Boston Region MPO area.
- 2) Special flood hazard areas (FEMA Q3 floodplains) – A simplified definition of these areas is that they are within 100-year floodplains. There are 20 FEMA classifications, 13 of which are included in the Special Flood Hazard category. An example of a classification is Base Flood Elevation Determinations (BFEDs). BFEDs are the computed elevations to which floodwater is anticipated to rise during the base flood. Federal, state, and local policies direct proponents of most transportation projects to minimize construction and implement mitigation measures in areas categorized as being within a 100-year floodplain.
- 3) Wetlands – Wetlands fall into the following categories: marsh/bog, wooded marsh, cranberry bog, salt marsh, open water, reservoir (with Public Water System Identification), tidal flats, and beach/dune.
- 4) Water supply and wellhead protection areas – These are surface water protection areas, as well as those associated with wells. The three categories for surface water protection refer to proximity to water: zone A is closest, zone B is farther, and zone C is farther still, but somewhere within the watershed. The wellhead protection areas include the recharge areas for wells.
- 5) Protected open space – There are four levels of protection: perpetuity, limited, term-limited, and none. The first category, perpetuity, means that the parcel can never be developed. No protection means that the land is available for development. The middle two categories are not as clearly defined. In general, limited protection implies that there are extra impediments to development. The level and type of extra protection varies. Term-limited protection means the land is protected now, but not necessarily in the future. This includes term conservation restrictions and term deed restrictions.
- 6) Natural Heritage and Endangered Species Program Priority Habitats – Three categories are presented: NHESP Certified Vernal Pools, NHESP Estimated Habitats of Rare Wildlife, and NHESP Priority Habitats of Rare Species. Priority Habitats of Rare Species are the habitats of state-listed rare species, both plants and animals. Estimated Habitats of Rare Wildlife is a subset of Priority Habitats that shows habitats for state-listed rare wildlife, but not those for plants.

Although vehicles and fuels are getting cleaner, people are driving more, which is counteracting some of the progress towards attaining clean air that could be achieved through technology.

Vernal pools, also defined by NHESP, are not permanent bodies of water. Because they are devoid of fish, they provide safe breeding grounds for many amphibians and invertebrates. A vernal pool typically fills in the autumn and is completely dry by mid- or late summer. Some may not dry up every year, but often enough to prevent fish habitats from developing.

- 7) Air quality – Reducing air pollutants is a goal for the MPO in its selection of transportation projects and programs. In addition to the criteria pollutants (volatile organic compounds, nitrogen oxides, and carbon monoxide) that are required to be addressed through the federal Clean Air Act, two additional pollutants, particulate matter and carbon dioxide, are of concern to the MPO. The MPO has begun to focus on ways it can help in reducing these two pollutants and will continue to do so throughout the time frame of this LRTP.

Particulate matter is a mixture of microscopic solids and liquid droplets suspended in air. Fine particulates can be emitted directly or formed in the atmosphere from mobile-source emissions. These particles can get deep in the lungs, and some may even get into the bloodstream. Recent research suggests that individuals—particularly the elderly, children, or those with diabetes or preexisting cardiac or pulmonary disease—living in close proximity to major roads face a significantly higher risk of cardiopulmonary problems than those with less exposure to vehicle emissions.

In particular, emissions of particulate matter from motor vehicles are receiving increased attention as a potential public health risk. One initiative underway in Massachusetts is the school bus retrofit project sponsored by the state Department of Environmental Protection, which is being undertaken and funded as a Congestion Mitigation and Air Quality program. This project will retrofit the state’s school bus fleet, significantly reducing particulates, hydrocarbons, and carbon monoxide. In addition, if more of the freight currently moved by truck could be carried by freight rail in the region, the resulting reductions in both congestion and truck emissions could have a positive air quality impact. Although vehicles and fuels are getting cleaner, people are driving more, which is counteracting some of the progress towards attaining clean air that could be achieved through technology. Policy and planning steps are necessary to address the threat to public health, since technology alone cannot resolve this issue.

The MPO is also concerned with carbon dioxide (CO<sub>2</sub>) as discussed in the previous Climate Change section.

- 8) Brownfield and Superfund Sites – Brownfields are properties that may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. Cleaning up and reinvesting in these properties protects the environment, reduces blight, and takes development pressures off green spaces and working agricultural lands. A superfund site is an uncontrolled or abandoned place where hazardous waste is located, possibly affecting local ecosystems or people. Some common hazardous-waste sites include abandoned warehouses, manufacturing facilities, processing plants, and landfills. According to the Environmental Protection Agency (EPA), EnviroMapper, an online mapping tool that provides



information about environmental activities that may affect air, water, and land, there are over 180 brownfield sites and more than 130 Superfund sites in the Boston region. These data and more can be accessed through EPA’s EnviroMapper at [www.epa.gov/emefdata/em4ef.home](http://www.epa.gov/emefdata/em4ef.home).<sup>20</sup>

Projects that have been recommended in this LRTP are listed in Table 5-1 and included on Figures 5-8 through 5-14 that display the environmental factors described above.

**TABLE 5-2**

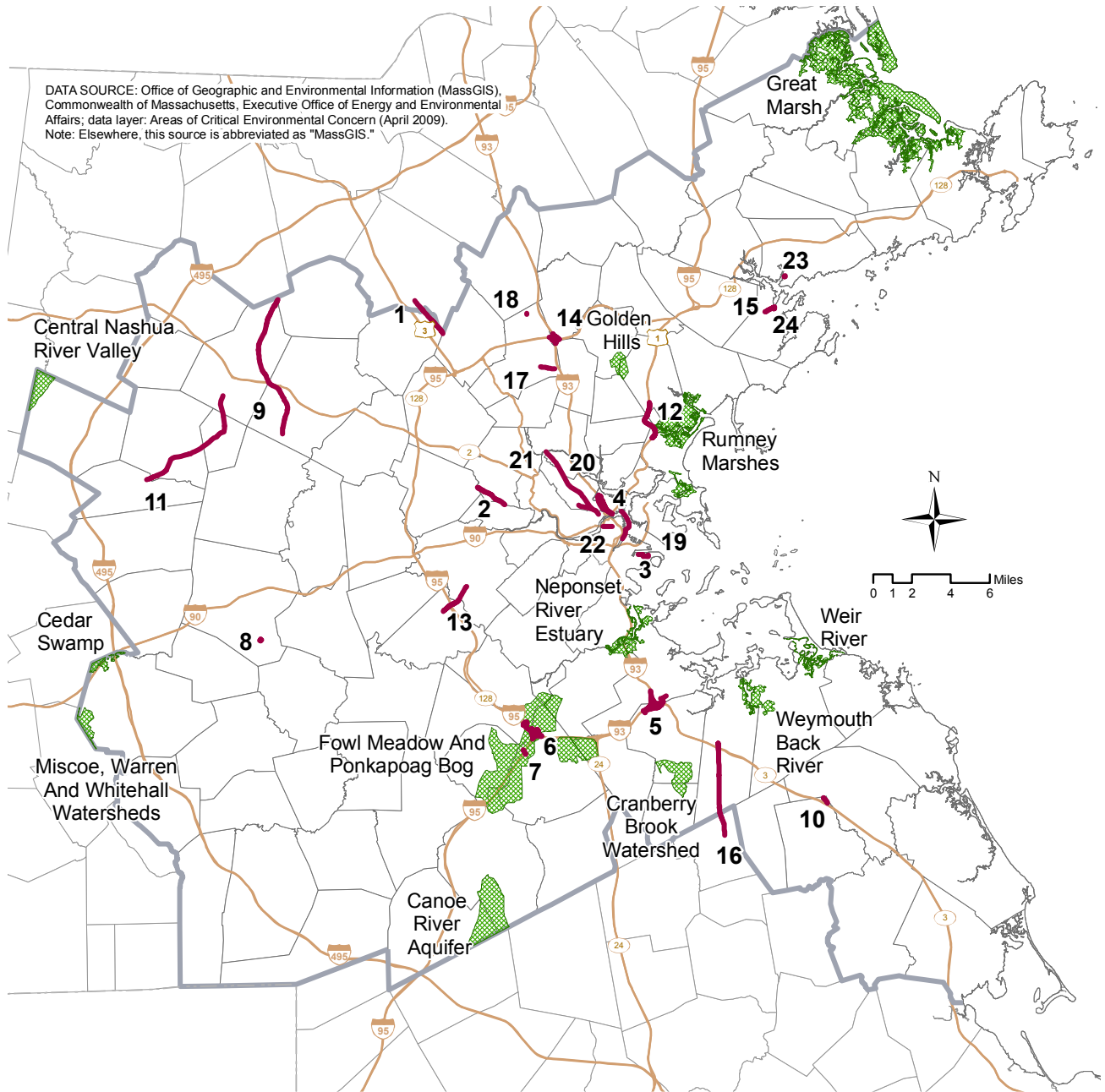
**LIST OF RECOMMENDED PROJECTS**

KEY # ON FIGURES	HIGHWAY PROJECTS
1	Bedford, Billerica & Burlington: Middlesex Turnpike Improvements Phase III
2	Belmont: Trapelo Road
3	Boston: Conley Haul Road
4	Boston: Sullivan Square/Rutherford Avenue
5	Braintree: Braintree Split
6	Canton: Interstate 95/Interstate 93 Interchange
7	Canton: I-95 Northbound/Dedham Street Corridor
8	Framingham: Route 126/135 Grade Separation
9	Concord to Westford: Bruce Freeman Rail Trail
10	Hanover: Route 53 Final Phase
11	Hudson to Acton: Assabet River Rail Trail
12	Malden, Revere, & Saugus: Route 1 Improvements
13	Needham & Newton: Needham Street/Highland Avenue
14	Reading & Woburn: I-93/I-95 Interchange
15	Salem: Bridge Street
16	Weymouth: Route 18 Capacity Improvements Project
17	Woburn: Montvale Avenue
18	Woburn: New Boston Street Bridge
	<b>TRANSIT PROJECTS</b>
19	Boston: Ferry Expansion: Russia Wharf Ferry Terminal
20	Somerville: Green Line Lechmere to Medford Hillside (College Avenue) / Union Square
21	Somerville: Green Line Medford Hillside (College Avenue) to Mystic Valley Parkway (Route 16)
22	Boston: Red-Blue Connector
23	Beverly: Additional Parking Spaces
24	Salem: Additional Parking Spaces

<sup>20</sup> U.S. Environmental Protection Agency’s (U.S. EPA) Envirofacts Warehouse, EnviroMapper layers for Brownfield facilities and Superfund sites, [www.epa.gov/emefdata/em4ef.home](http://www.epa.gov/emefdata/em4ef.home), accessed on 6/3/11.

FIGURE 5-8

AREAS OF CRITICAL ENVIRONMENTAL CONCERN

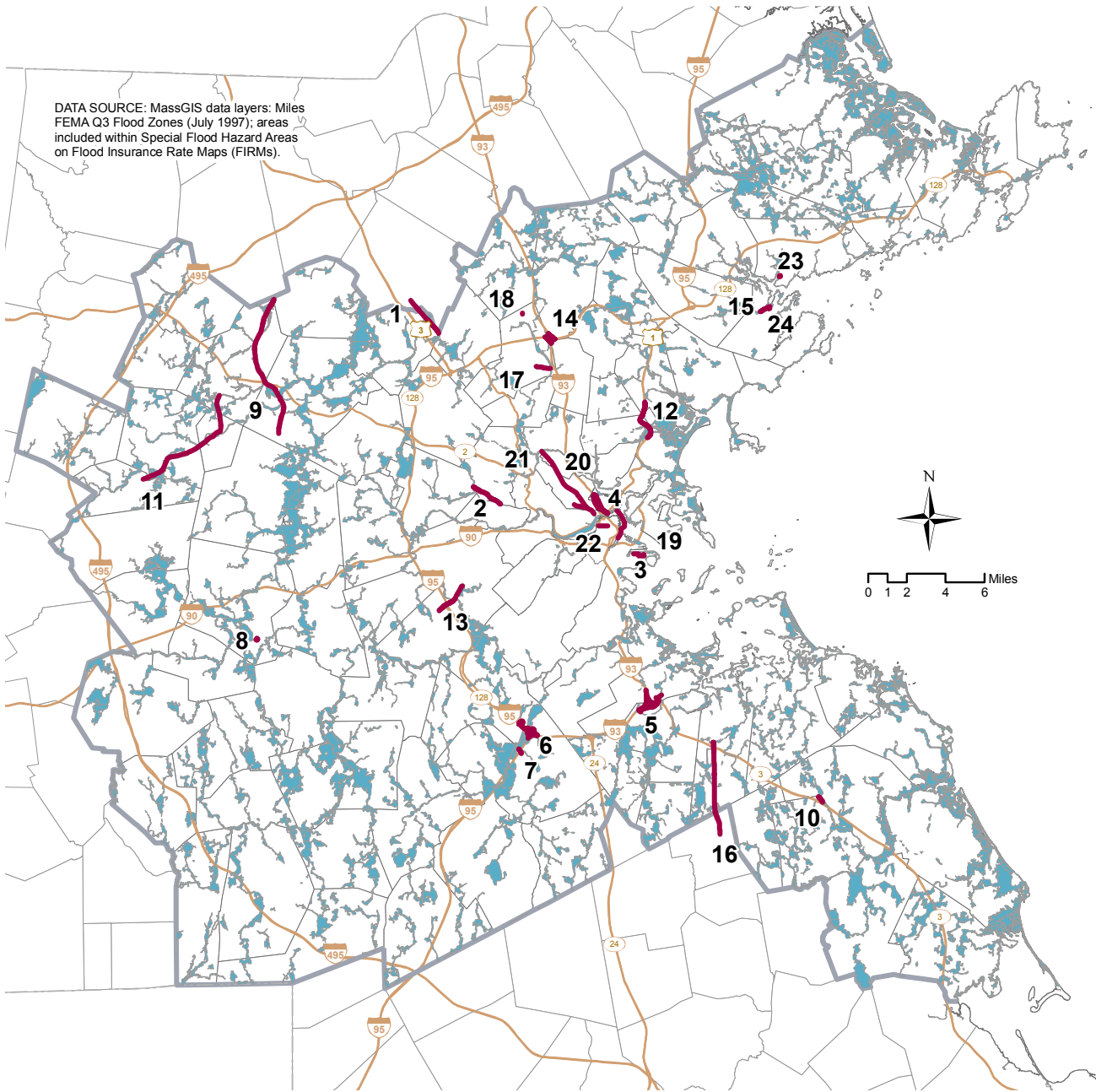


 Area of Critical Environmental Concern (ACEC)

 Recommended project

FIGURE 5-9

FEMA Q3 SPECIAL FLOOD HAZARD AREAS



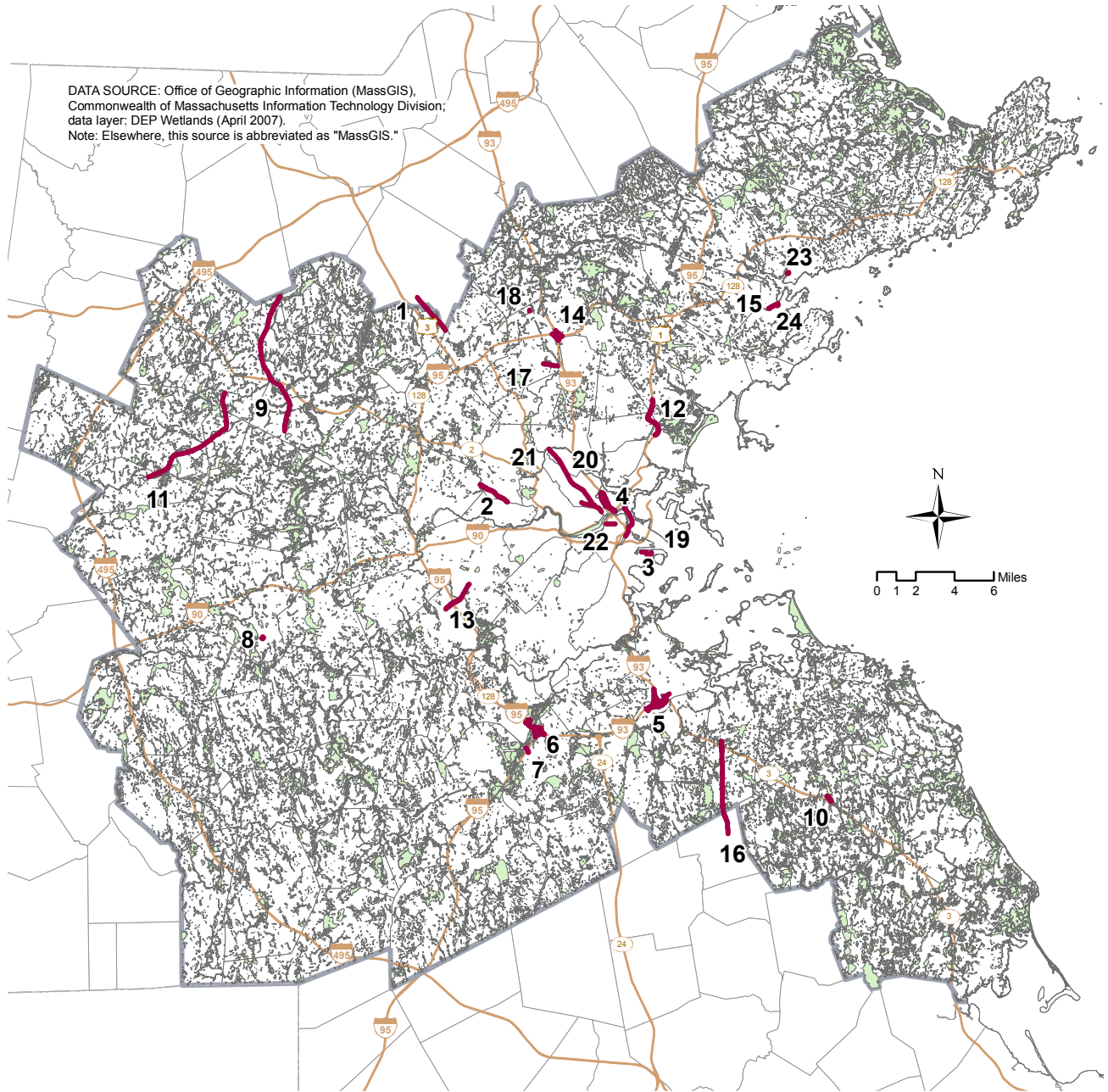
**FEMA Q3 Flood Zones**  
 Special Flood Hazard Area

Recommended project

Special Flood Hazard Areas (SFHAs) are areas subject to inundation by a flood having a 1% or greater probability of being equaled or exceeded during any given year. This flood, which is referred to as the 1% annual chance flood (or base flood), is the national standard on which the floodplain management and insurance requirements of the National Flood Insurance Program are based.

FIGURE 5-10

WETLANDS



**DEP Wetlands**

All categories

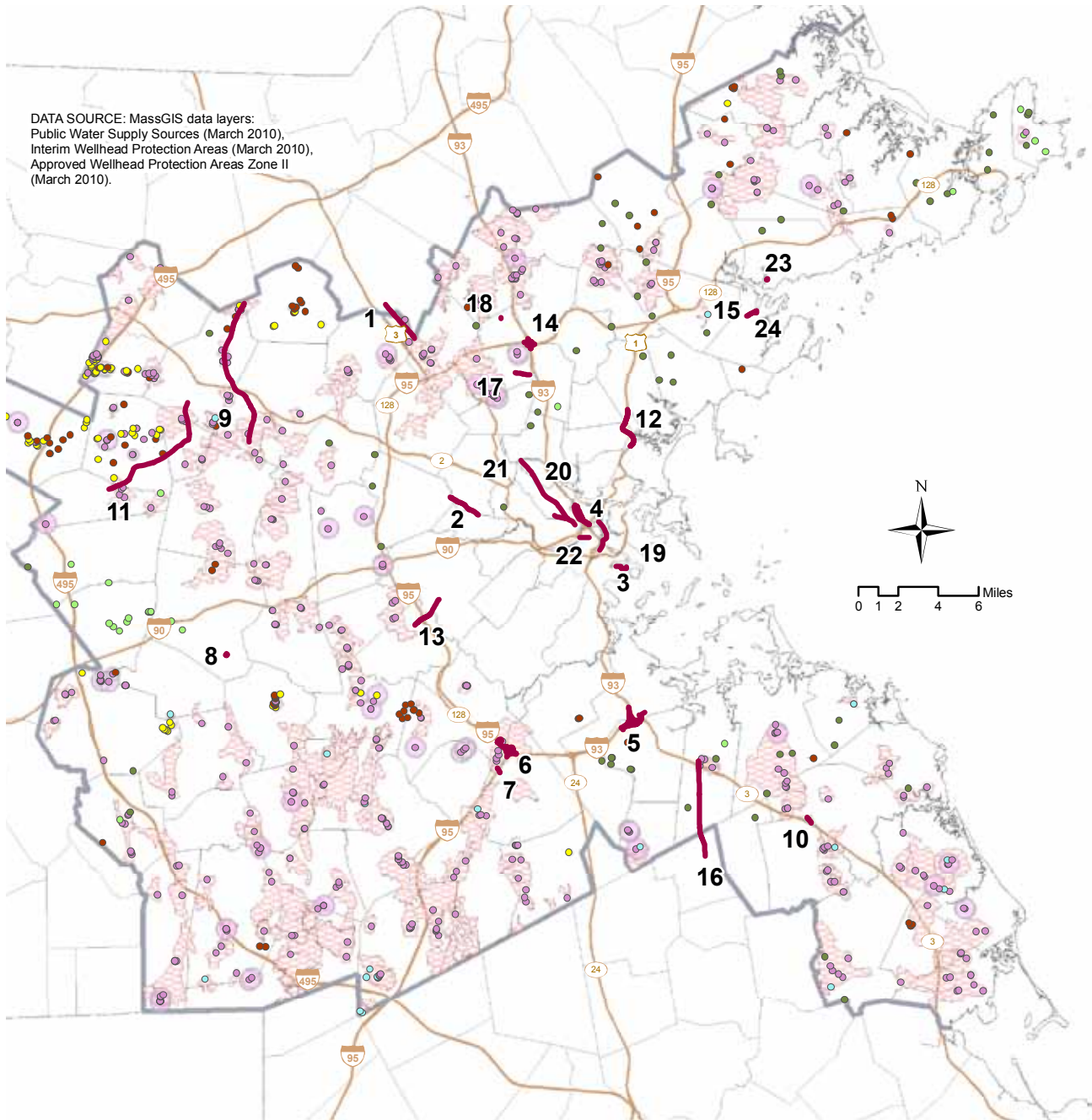
Massachusetts Department of Environmental Protection (DEP), Wetlands Conservancy Program

**Recommended project**

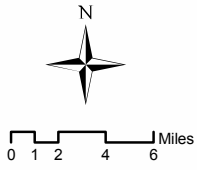


**FIGURE 5-11**

**PUBLIC WATER SUPPLIES**



DATA SOURCE: MassGIS data layers:  
 Public Water Supply Sources (March 2010),  
 Interim Wellhead Protection Areas (March 2010),  
 Approved Wellhead Protection Areas Zone II  
 (March 2010).



**Public Water Supplies**

- Groundwater
- Transient noncommunity
- Nontransient noncommunity
- Surface water
- Emergency surface water
- Proposed well
- Wellhead protection area Zone II

**Recommended project**

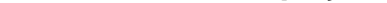
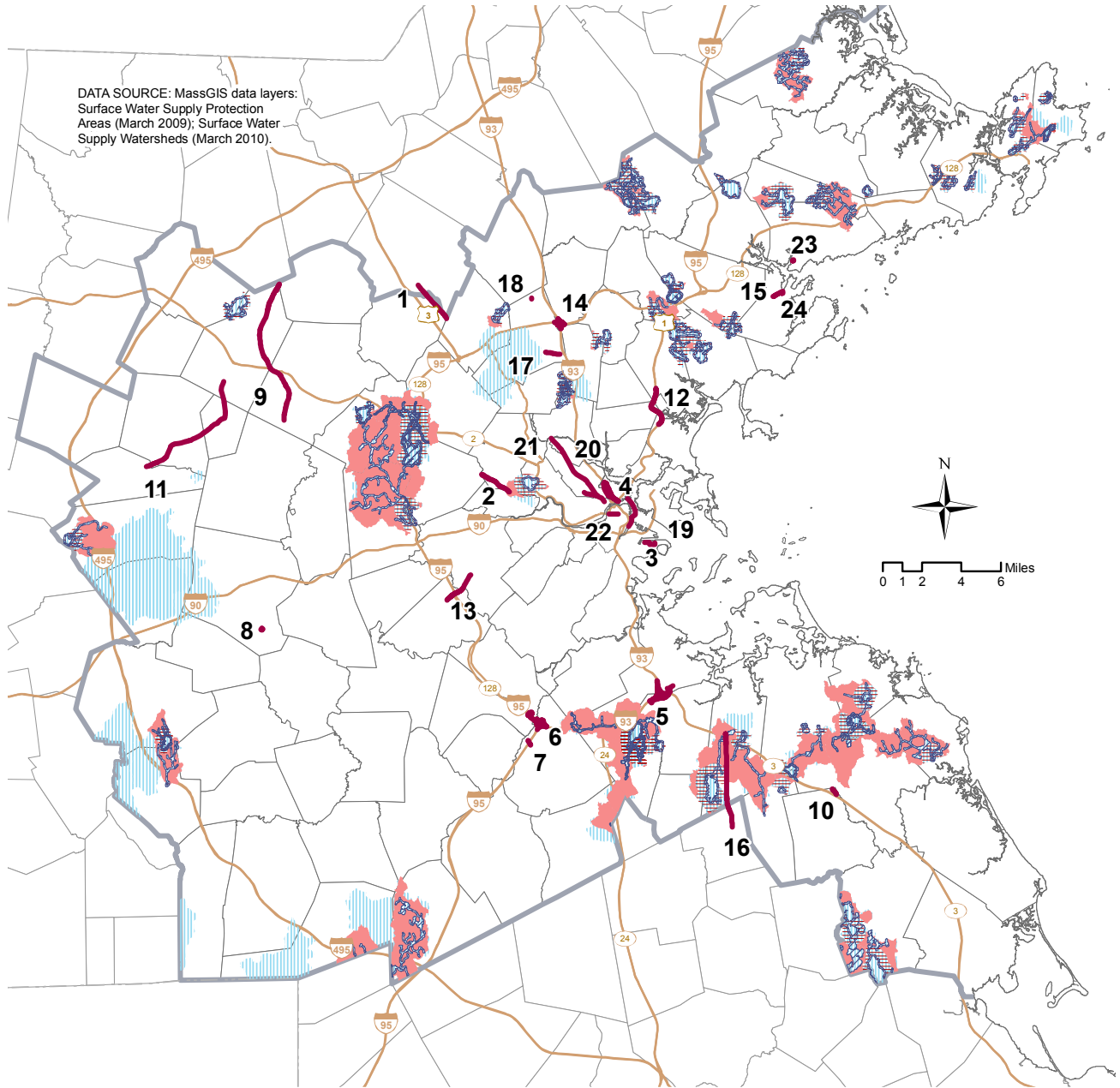




FIGURE 5-12

SURFACE WATER PROTECTION AREAS



**Surface Water Protection Areas**

- Zone A
- Zone B
- Zone C

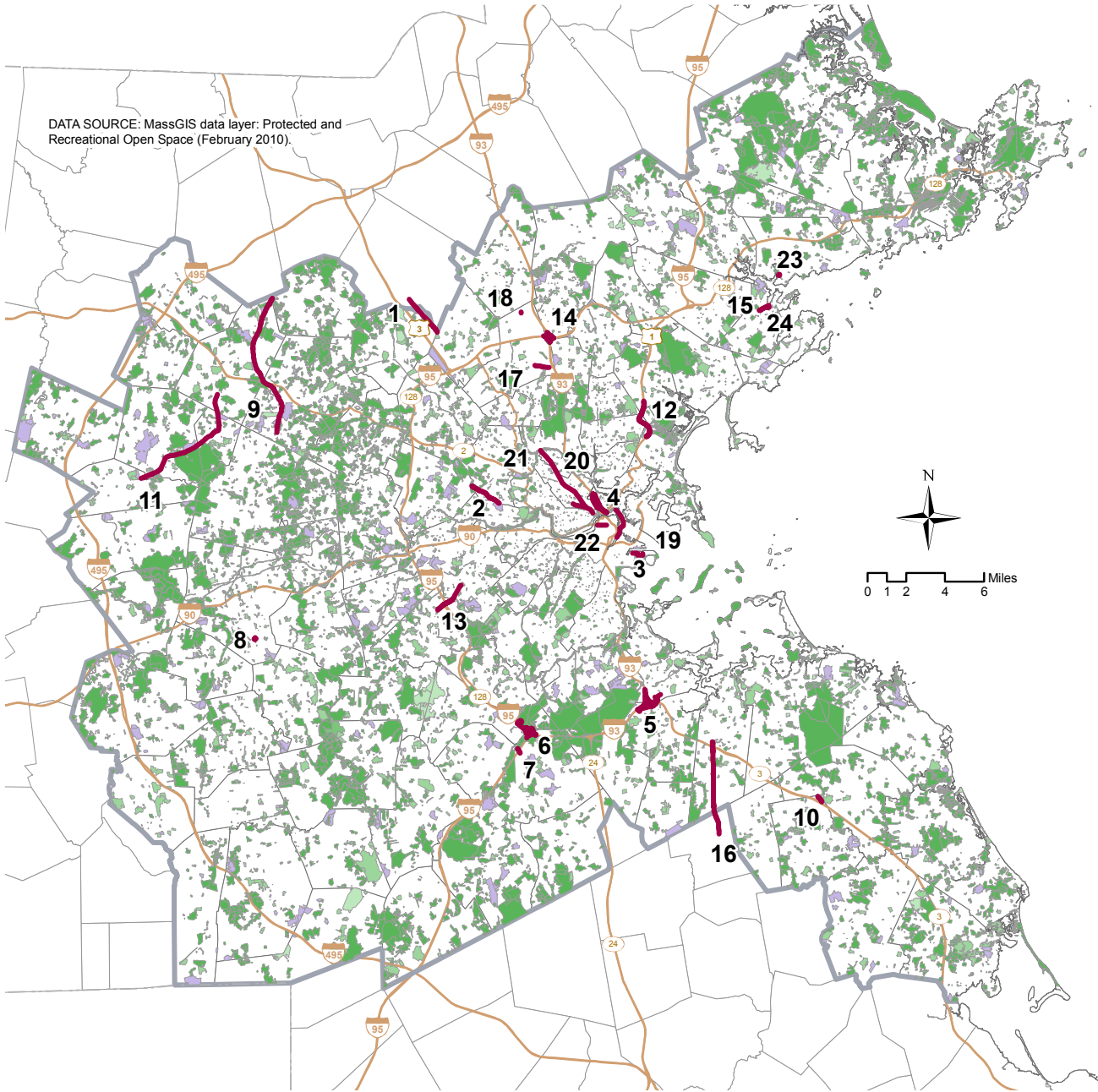
**Surface Water Supply**

- Watershed area

**Recommended project**

FIGURE 5-13

PROTECTED OPEN SPACE



**Protected Open Space**

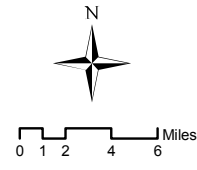
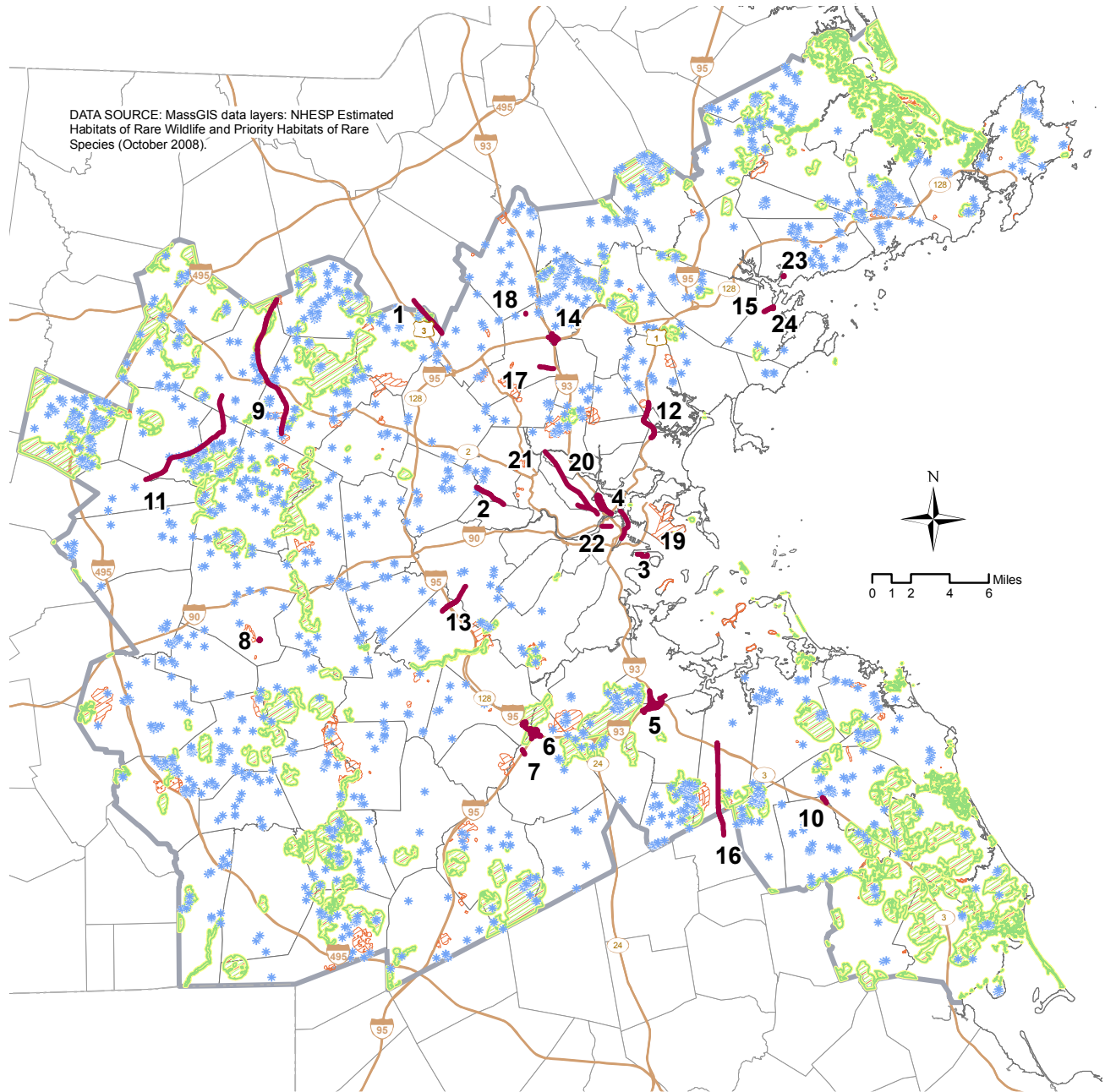
Level of Protection

- In perpetuity
- Temporary
- Limited
- Unknown
- None

**— Recommended project**

FIGURE 5-14

NATURAL HERITAGE AND ENDANGERED SPECIES PROGRAM PRIORITY HABITATS



**NHESP Priority Habitats**

- \* Certified vernal pool
- Estimated habitat of rare wildlife
- Rare species habitat

**Recommended project**

Natural Heritage and Endangered Species Program (NHESP) is a part of the Massachusetts Division of Fish and Wildlife.

## LIVABILITY

### What Is Livability?

A livable community is one that provides its residents with convenient access to opportunities and resources. Affordable housing, varied-level schools, nearby employment opportunities, community resources, healthy and affordable food options and entertainment in close proximity all contribute to the livability of a community, as do safe, affordable, and healthy options for getting around.

Extensive highway transportation investments have enabled most individuals with an automobile to maintain access to a variety of opportunities, including housing, schools, jobs, medical facilities, and shopping centers. Advancements in automobiles coupled with substantial investments in highway transportation infrastructure continue to allow us to travel farther and faster, and in less time, and have supported sprawling development patterns. Automobile transportation is often the fastest and most convenient mode of travel from any origin to any destination. However, this pattern of travel is not without some significant trade-offs. Although infrastructure investments and automobile improvements have allowed people greater flexibility in where they live, work, play, learn, and shop, it has come at the expense of affordability, health, and safety.

### Livability Challenges and Gaps

#### Affordability

Auto ownership and vehicle-miles traveled (VMT) have increased over the past few decades. The automobile remains the primary mode of transport for a majority of the region's residents, as the average person drives over 6,000 miles annually, and driving alone accounts for 67 percent of the region's commute trips. Figure 5-15 compares VMT from 1990–2008 across the U.S., Massachusetts, and the Boston region.<sup>21</sup> It indicates that the typical Boston region resident drives 30–35 percent less than the typical American drives, and 21–23 percent less than the typical Massachusetts resident. The Boston region's notably lower VMT is indicative of its higher density and extensive public transportation system.

Despite lower VMT per capita, the Boston region remains increasingly vulnerable to fluctuations in energy prices. According to the Massachusetts Clean Energy and Climate Action Plan for 2020, the average Massachusetts household spent about \$5,200 on energy costs in 2008, with about \$2,200 devoted to gasoline. Gas prices fluctuated substantially from \$2.60 a gallon in fall 2010 to \$4.00 a gallon in spring 2011, resulting in more than 50 percent higher fuel expenses for the typical Massachusetts household.<sup>22</sup> Gas price increases have a more severe impact on more auto-dependent communities, such as North Reading, Norwell, Wrentham, and Hopkinton, that typically have, respective, daily travel mileages of 75, 86, 89, and 93 miles per household. In addition, the vulnerability of these communities is further exacerbated by the state's heavy reliance on imported energy.

Gas prices fluctuated substantially from \$2.60 a gallon in fall 2010 to \$4.00 a gallon in spring 2011, resulting in more than 50 percent higher fuel expenses for the typical Massachusetts household.

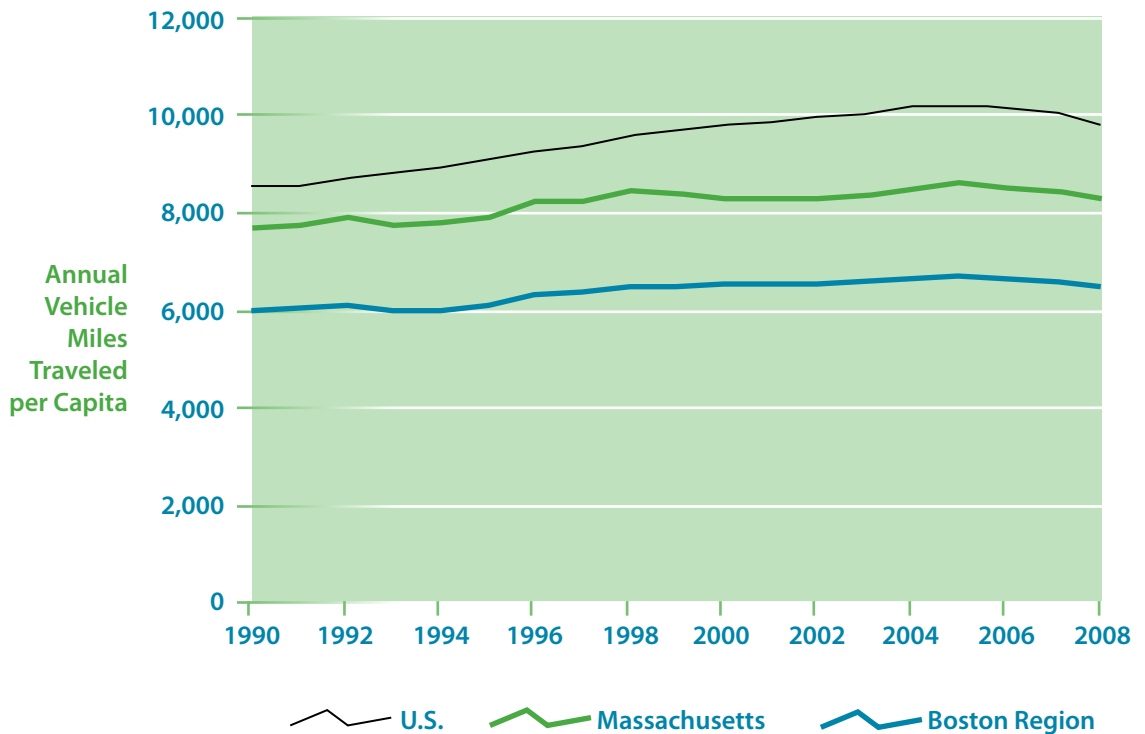
<sup>21</sup> MassDOT Highway Performance Monitoring System for Daily VMT and FHWA (VM-2) Highway Statistics Report, BTS 2009. Boston Region VMT estimates based on percentage of annual statewide VMT.

<sup>22</sup> U.S. Energy Information Administration website, <http://www.eia.gov/oog/info/gdu/gasdiesel.asp>, "Gasoline and Diesel Fuel Update," accessed on 5/25/11.



FIGURE 5-15

ANNUAL VEHICLE MILES TRAVELED PER CAPITA (1990-2008)



While none of the region's communities had drive-alone commute shares above 78 percent in 1980, there were 55 communities above 78 percent by 2000.

The Clean Energy and Climate Action Plan acknowledges that all of the state's fossil-based energy sources, including oil, natural gas, and coal, come from other regions of the country and other parts of the world, which demonstrates the region's susceptibility to fluctuations in the global market. Given the threat that automobile dependency poses to transportation affordability, more affordable transportation options need to become feasible. In addition to the cost of fuel, automobile ownership entails other costs, including maintenance, insurance, registration, and parking expenses. According to the American Automobile Association (AAA), the annual costs for the average driver of a typical medium-sized sedan that logs 15,000 miles per year is more than \$8,500, or 57 cents per mile.<sup>23</sup>

**Health**

The region's existing travel patterns have also had tremendous impact on our population's health, especially in regard to physical activity and air quality. The typical household utilizes the car for a majority of trips, including the work trip, which accounts for nearly 30 percent of total VMT. In addition, an increasing percentage of the region's commuters drive alone to work. While none of the region's communities had drive-alone commute shares above 78 percent in 1980, there were 55 communities above 78 percent by 2000.<sup>24</sup> Yet, the preference for the automobile has compromised other travel options and diminished opportunities to engage in physical activity.

<sup>23</sup> American Automobile Association, "Your Driving Costs," 2011 Edition.

<sup>24</sup> U.S. Census Bureau, Journey-to-Work data, 1980-2000.



One notable decline is evident in how children travel to and from school. According to MassRIDES' Safe Routes to School Program, roughly 42 percent of students bicycled or walked to school in 1969, compared to less than 16 percent of children today. Similarly, fewer adults incorporate physical activity into their commute, as walking and bicycling only account for 6.3 percent of the region's transportation mode split, and half of Massachusetts adults do not participate in regular physical activity. As opportunities for physical activity within daily travel are minimized, the health of the region suffers. According to the Massachusetts Executive Office of Health and Human Services (EOHHS), more than half of the adults and a quarter of the high school students in Massachusetts are overweight or obese. In addition to effects on personal health, the economic impacts are significant: health care costs associated with obesity totaled approximately \$1.8 billion statewide in 2003.<sup>25</sup>



The transportation sector has also contributed to health impacts associated with air quality. The transportation sector is largely responsible for increases in emissions statewide, and its heavy reliance on fossil fuels has local and regional impacts on air quality. "The Clean Energy and Climate Action Plan notes that exposure to ozone (O<sub>3</sub>) emissions can irritate the respiratory system and aggravate asthma, and exposure to fine particulate matter (PM) is associated with aggravation of respiratory and cardiovascular disease." These linkages between transportation and health are difficult to ignore as asthma becomes more common in the commonwealth. According to EOHHS, the prevalence of asthma is higher in Massachusetts than in most other states, and the number of adults with asthma increased by 16 percent between 2000 and 2007. Approximately 10 percent of the state's residents have asthma, and statewide asthma expenses total over \$690 million annually.<sup>26</sup>

### Safety

According to the Massachusetts Department of Public Health (DPH), motor vehicle crashes are the second leading cause of injury death in Massachusetts. DPH also notes that in 2005, motor vehicle crashes in Massachusetts were the third leading cause of hospitalizations, and caused the death of 446 people and injury to nearly 90,000. In addition to the human costs, the economic implications are substantial, as costs

According to EOHHS, the prevalence of asthma is higher in Massachusetts than in most other states, and the number of adults with asthma increased by 16 percent between 2000 and 2007.

<sup>25</sup> Massachusetts Department of Public Health: Mass In Motion, *Health of Massachusetts: Impact of Overweight and Obesity*, (1998-2007), 2009.

<sup>26</sup> Rosanna Coffey, Karen Ho, David Adamson, Trudi Matthews, and Jenny Sewell, *Asthma Care Quality Improvement: A Resource Guide for State Action*, updated October, 2009, Table 1-3.

A pedestrian has a 95 percent chance of surviving a crash with a vehicle traveling 20 mph, but the likelihood of surviving a crash with a vehicle traveling 40 mph is only 15 percent.

associated with motor vehicle crashes in Massachusetts were estimated at over \$6.4 billion in 2005.<sup>27</sup>

These safety impacts are widespread, but they disproportionately impact pedestrians and young motorists. Massachusetts crash data indicate that the 75 pedestrian fatalities in 2008 accounted for 20 percent of all traffic-related fatalities, which is highly disproportionate to the percentage of trips made by pedestrians.<sup>28</sup> Automobile speed has a significant impact on crash severity for pedestrians. According to the Federal Highway Administration (FHWA), a pedestrian has a 95 percent chance of surviving a crash with a vehicle traveling 20 mph, but the likelihood of surviving a crash with a vehicle traveling 40 mph is only 15 percent.<sup>29</sup>

Similarly, young drivers also account for a higher proportion of motor vehicle crashes than older drivers. According to the DPH, drivers 20–24 years old had the highest rates of motor vehicle traffic deaths, and motor vehicle crashes accounted for more fatalities among young adults ages 15–24 than any other cause. There are also safety factors such as higher speeds that affect all motorists. According to the FHWA, the severity of injuries from a crash increase exponentially with vehicle speed. For example, a 30 percent increase in speed results in a 69 percent increase in the kinetic energy of a vehicle.<sup>30</sup> The overwhelming majority of evidence suggests that reductions in speed limits reduce vehicle speeds and crashes.

### Livability Potential

The Boston region possesses a strong foundation to promote livability. The region's higher density and extensive public transportation system provide options in many places to take transit, walk, and bike. The livable places in the Boston region effectively link land use and transportation, and exist in various settings. In the urban setting, examples include Harvard Square in Cambridge, Coolidge Corner in Brookline, Centre Street in Jamaica Plain, Roslindale Village, downtown Salem, and Davis Square in Somerville. In the inner suburbs, Winchester Center, Newton Centre, and Wellesley Square provide livable environments. Livable places are also located in outer suburbs, and include downtown Franklin, and Main Street in the communities of Concord, Milford, and Gloucester. In addition to transportation choices, these livable places tend to have mixed-use neighborhoods, community resources, jobs, and sometimes, affordable housing.

Figure 5-16 shows the transit coverage (rapid transit and bus) in relation to population density. Figure 5-16 demonstrates that some of the conditions associated with livable places (identified above) are higher population density and good transit access.

In addition, livable places also are generally associated with good sidewalk coverage, and often associated with good bicycle coverage. Table 5-2 shows the relationship between

<sup>27</sup> Massachusetts Executive Office of Health and Human Services (EOHHS) website, [http://www.mass.gov/?pageID=eohhs2terminal&L=5&LO=Home&L1=Consumer&L2=Prevention+and+Wellness&L3=Injury+Prevention&L4=Transportation+Safety&sid=Eeohhs2&b=terminalcontent&f=dph\\_com\\_health\\_injury\\_c\\_transportation\\_traffic&csid=Eeohhs2](http://www.mass.gov/?pageID=eohhs2terminal&L=5&LO=Home&L1=Consumer&L2=Prevention+and+Wellness&L3=Injury+Prevention&L4=Transportation+Safety&sid=Eeohhs2&b=terminalcontent&f=dph_com_health_injury_c_transportation_traffic&csid=Eeohhs2), "Traffic and Motor Vehicle Safety," accessed on 5/20/11. This information is provided by the Injury Prevention and Control Program within the Department of Public Health. This figure only accounts for acute medical care and does not include rehabilitation costs.

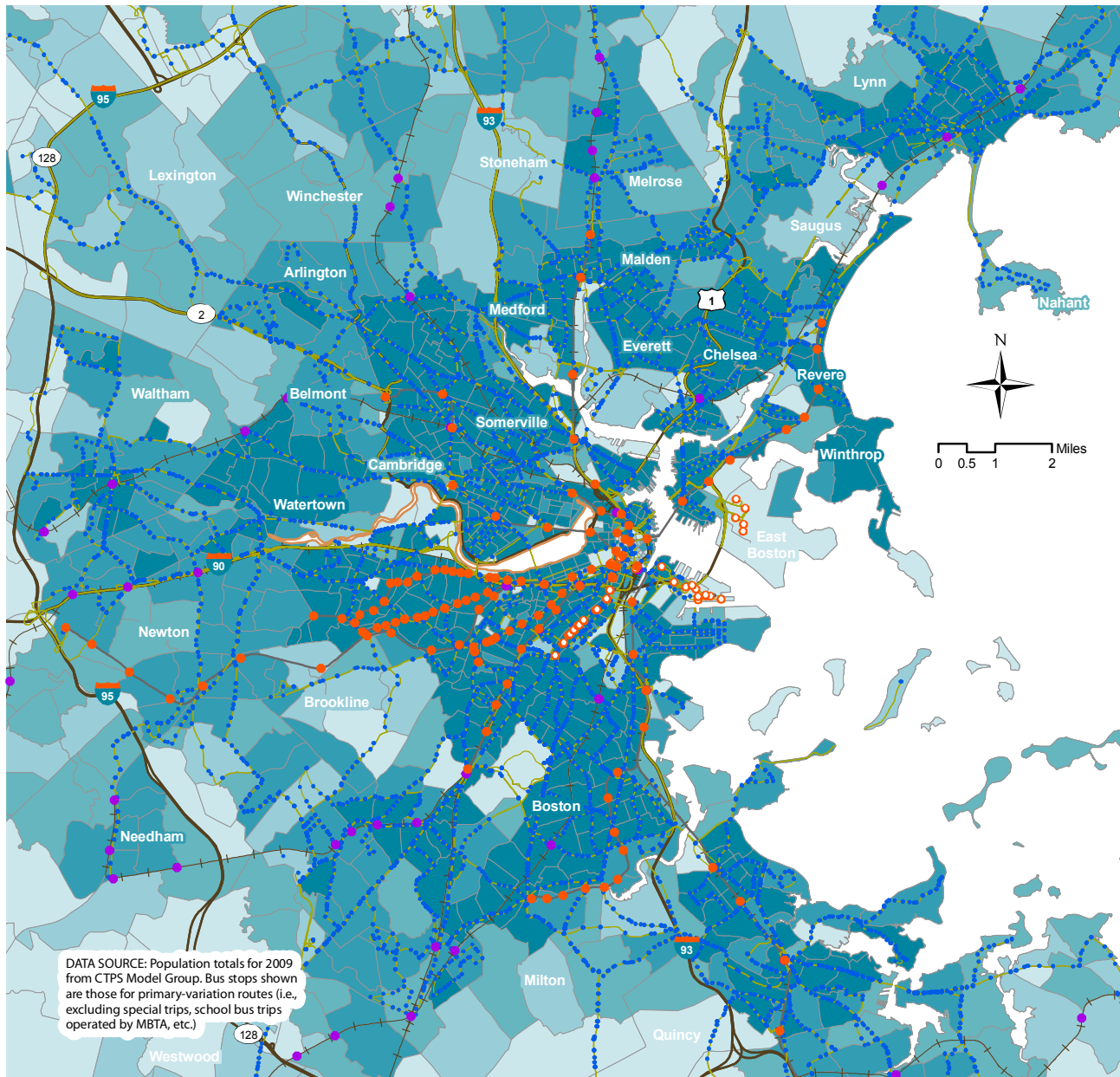
<sup>28</sup> Massachusetts Executive Office of Public Safety and Security (EOPSS) website, [http://www.mass.gov/?pageID=eopsterminal&L=3&LO=Home&L1=Crime+Prevention+%26+Personal+Safety&L2=Traffic+Safety&sid=Eeops&b=terminalcontent&f=programs\\_ghsb\\_2006\\_2008\\_crash\\_statistics&csid=Eeops](http://www.mass.gov/?pageID=eopsterminal&L=3&LO=Home&L1=Crime+Prevention+%26+Personal+Safety&L2=Traffic+Safety&sid=Eeops&b=terminalcontent&f=programs_ghsb_2006_2008_crash_statistics&csid=Eeops), "2006-2008 Massachusetts Crash Statistics," accessed on 5/20/11.

<sup>29</sup> Federal Highway Administration (FHWA), *Speed Concepts: Informational Guide*, September 2009.

<sup>30</sup> Ibid.

FIGURE 5-16

TRANSIT COVERAGE IN RELATION TO POPULATION DENSITY BY CENSUS TRACT



**Existing Transit Services and Catchment Areas**

- Rapid transit station
- Silver Line stop
- Commuter rail station
- MBTA bus stop

**2009 Population per Sq. Mi.**

- Less than 1,000
- 1,001 - 2,000
- 2,001 - 4,000
- 4,001 - 8,000
- More than 8,000

livability indicators (measures associated with livability) across different community types. Table 5-2 indicates that there is significant variation of livability indicators within community types, and that higher population density tends to be associated with higher sidewalk coverage, lower automobile ownership, and lower daily vehicle-miles traveled.

**TABLE 5-3**

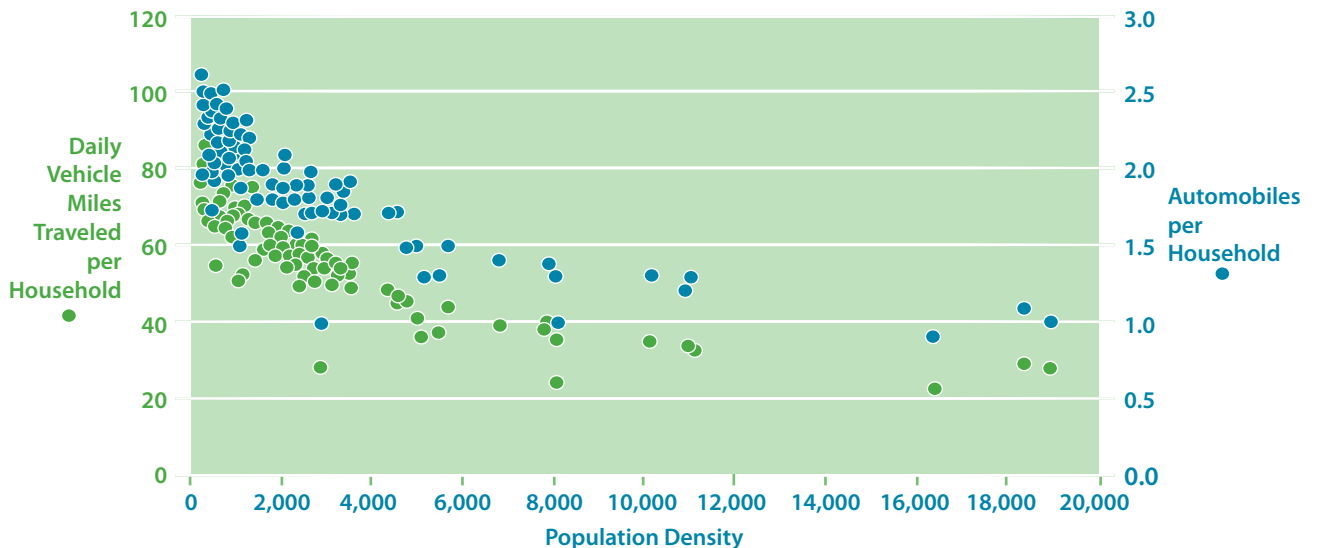
**INDICATORS OF LIVABILITY ACROSS COMMUNITY TYPES**

COMMUNITY TYPE	COMMUNITY	POPULATION DENSITY	EMPLOYMENT DENSITY	SIDEWALK COVERAGE	BICYCLE COVERAGE	AUTOS PER HH	DAILY VMT PER HH
Inner Core	Somerville	18,436	5,027	90%	3.5%	1.1	29
	Melrose	5,690	1,349	70%	0.9%	1.5	44
Regional Urban Center	Salem	5,091	2,290	77%	2.2%	1.3	36
	Framingham	2,583	1,761	49%	3.0%	1.7	53
Maturing Suburb	Stoneham	3,492	1,274	58%	1.7%	1.7	49
	Burlington	2,115	3,181	22%	0.0%	2.1	64
Developing Suburb	Hudson	1,703	862	45%	2.1%	2.0	66
	Bellingham	859	294	32%	2.2%	2.2	80

One notable trend across the community types is the variation in automobile usage. Figure 5-17 shows the relationship between population density and daily vehicle-miles traveled and automobiles per household across the MPO region’s 101 cities and towns. Figure 5-17 indicates that as population density increases, automobile usage generally declines. A household in the Town of Bolton (with a population density of 227 per square mile) typically drives over 100 miles per day and typically owns more than two automobiles, while a household in the City of Cambridge (population density of 16,425) typically drives less than 25 miles per day and tends to own less than one car.

**FIGURE 5-17**

**CAR USAGE BY POPULATION DENSITY BY 101 CITIES AND TOWNS**

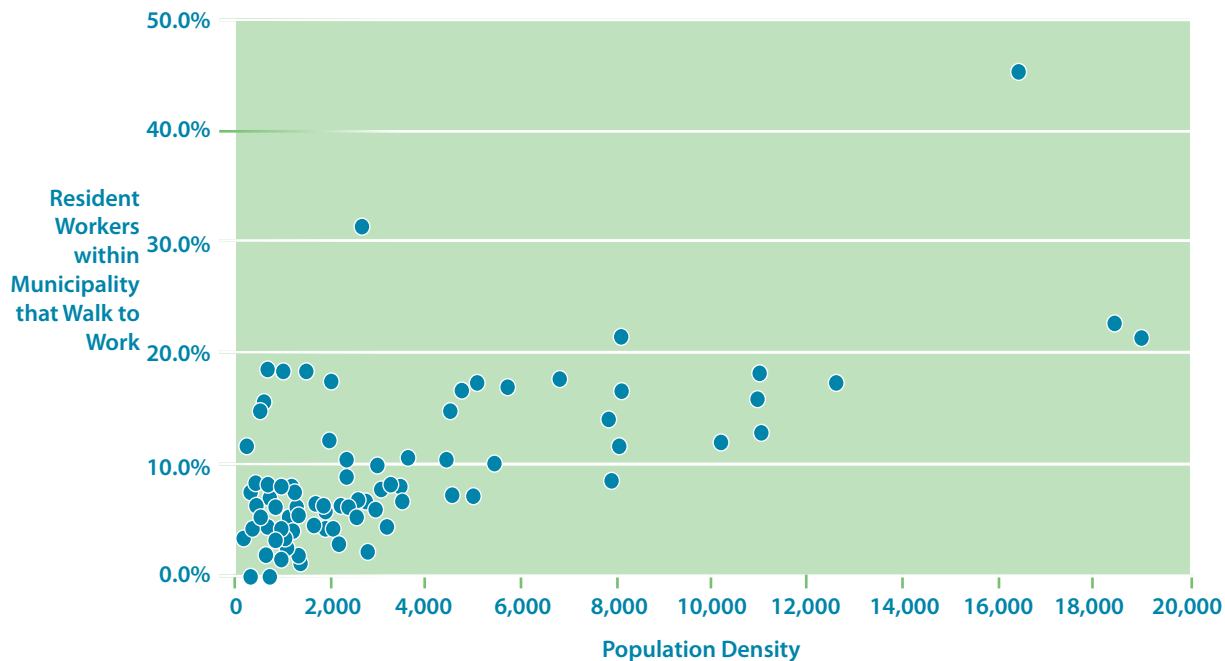


These trends are supported by the Center for Neighborhood Technology’s Housing and Transportation Affordability Index, a tool that provides a more accurate cost of housing based on its location.<sup>31</sup> According to the Center for Neighborhood Technology, places that cluster schools, parks, shopping, and transit are able to create location efficiencies that lower transportation costs. In the Boston region, these benefits are realized by residents of Cambridge, Boston, Somerville, Brookline, and other places with location efficiency that have lower annual transportation costs than the regional average. For example, the annual household transportation costs for residents in Somerville are \$3,850 less than those in Braintree, which demonstrates that compact communities can provide cost savings for residents.

Because of the sprawling development patterns that are more prevalent outside the urban core, residents who live there are more reliant on automotive travel, but this also limits the impact of bicycle and pedestrian travel. Figure 5-18 show the relationship between population density and resident workers that walk to work by the 101 municipalities in the region. This figure indicates that communities with higher population density are associated with higher resident worker walk shares. Poor connectivity of the bicycle and pedestrian network with transit service, and the possible absence of these bicycle and pedestrian infrastructure, prevent some bicyclists and pedestrians from safely traveling between their origins and destinations, and greater trip distances that favor driving over bicycling or walking.

FIGURE 5-18

RESIDENT WORKER WALK SHARE BY POPULATION DENSITY BY 101 MUNICIPALITIES



<sup>31</sup> Center for Neighborhood Technology: Housing and Transportation Affordability Index, <http://htaindex.cnt.org>, accessed on 5/31/11.



## The Boston Region MPO's Vision for Livability

**Vision:** All residents will have the capability of moving affordably between where they live, work, get services, and play using healthy transportation options that promote a healthy lifestyle. Multimodal transportation will serve business, residential, and mixed-use centers. Transportation investments will focus on existing activity centers, including sites of economic activity and adequate public infrastructure, where density will be encouraged. These centers of community activity will grow in population density and diversity of uses. This density and mixed-use activity will better support new and increased transit services. Investments in bicycle and pedestrian facilities and in accessibility improvements will support healthy lifestyle choices and increased mobility for everyone, including people with disabilities. Community centers will thrive with the implementation of “complete streets” and context-sensitive design principles; urban design changes in community centers will create more human-scale and aesthetically pleasing community environments. The design of the transportation network will protect cultural, historical, and scenic resources, community cohesiveness, and quality of life.

The transportation network will play its part as a foundation for economic vitality. Energy use will be managed efficiently and alternative energy sources used.

**Policies:** To make livability a hallmark of communities in the MPO region and to achieve mobility, foster sustainable communities, and expand economic opportunities and prosperity, the MPO will put a priority on programs, services, and projects that:

- Are consistent with MetroFuture land use planning; this means supporting transportation projects serving the following: already-developed locations of residential or commercial/industrial activity; locations with adequate sewer and water infrastructure; areas identified for economic development by state, regional, and local planning agencies and departments; and areas with a relatively high density of development
- Support health-promoting transportation options, such as bicycle and pedestrian modes, and activities that reduce single-occupant-vehicle use and overall vehicle-miles traveled
- Expand, and close gaps in, the bicycle and pedestrian network; promote a complete-streets philosophy
- Support transportation design and reasonably priced enhancements that protect community cohesiveness, identity, and quality of life

The MPO has been working over the past several years to advance livability principles through a variety of its programs, projects, and studies. MPO planning activities range from conducting studies and providing technical assistance to municipalities, to advancing awareness of transportation issues vital to the livability of a community. Other initiatives provide funding for projects and programs that improve livability. These initiatives are described below.

## MPO Actions to Achieve Livability Vision

### MPO Planning Activities

- **Livability Program** – In federal fiscal year 2011, this program was established to support livability throughout the region by way of three components: regional forums, workshops, and a website of resources. The forums allow for in-depth discussions on various aspects of livability and allow input from a broad range of participants. The workshops provide an opportunity to focus on issues at the level of a particular neighborhood or community. The website provides a variety of resources and an online database to serve as a source of information on livability for all, from state, regional and municipal staff members to individual residents. This program builds on the MPO's popular Walkable Community Workshop program that supports local pedestrian mode planning and improved walking conditions. Similarly, the Livability Program hosts community workshops, and incorporates additional elements of livability to include bicycling, transit, land use, parking, environment, health, and economic-development issues.
- **Support to the MPO and its Subcommittees** – This ongoing program consists of gathering information and initiating discussions with the MPO and members of the public on livability through the various channels that include meetings, workshops, and information published in the MPO's newsletter, TRANSREPORT and posted on the MPO's website.
- **Bicycle and Pedestrian Support Activities** – This program allows staff to study and assist cities and towns in improving bicycle and pedestrian conditions in the region. These activities include conducting studies on how to improve access to transit and within downtown centers in both urban and suburban settings. Other studies focus on the feasibility of potential rail trails. Staff also coordinates, conducts, and analyzes bicycle and pedestrian counts at key locations in the region that are available on the MPO's count database and available for viewing on the MPO's website. These planning activities promote livability throughout the region by improving and expanding opportunities to use nonmotorized modes of transportation.
- **Community Technical Assistance Program** – This program allows MPO staff engineers and planners to provide technical assistance to municipalities seeking advice about local transportation issues. Issues often relate to traffic flow, traffic calming, parking, and walking and bicycling, and almost all of staff's recommendations incorporate opportunities to improve safety or expand access for nonmotorized modes.



- **Transit Service Planning** – The Transit Service Planning Group identifies efficient, cost-effective, and equitable transit service to support the MPO’s efforts to address the mobility and accessibility needs of those who live or work in the region and those who visit. The group monitors the performance of existing services operated by transit providers in the Boston Region MPO service area, identifies areas that are unserved or underserved by transit, evaluates potential improvements, and develops plans for their implementation.
- **Disability Access Support** – The MPO provides support services for the MBTA Access Advisory Committee to the MBTA, and focuses on accessibility of the transit system for persons with disabilities.
- **Transportation Equity Program** –The MPO conducts outreach to low-income, minority, and elderly populations, and populations for whom English is a second language. This work often highlights transportation and accessibility needs and impediments to transportation access within communities.
- **Land Use Development Project Reviews** – The MPO funds Metropolitan Area Planning Council (MAPC) reviews of significant development projects. The MAPC staff reviews these proposals for their impacts on the transportation system, as well as consistency with MetroFuture, the Commonwealth’s sustainable-development principles, and smart-growth principles.
- **Alternative-Mode Planning and Coordination** – The MPO funds MAPC work to advance bicycle and pedestrian planning and to encourage the use of transit. Two recent products are the MPO’s Regional Bicycle Plan, in 2007, and the Regional Pedestrian Plan, in 2010. It also supports technical assistance to municipalities for closing gaps in the regional bicycle network. The MPO funds project review and technical assistance work in the Transportation Enhancement Program. This project has also produced several tool kits that support livability principles and practices: sustainable mobility (which provides guidelines and best practices for sustainable methods for getting around), local parking, and development mitigation. A complete-streets tool kit is in development.



### **MPO Infrastructure Investments**

- **Clean Air and Mobility Program** – In 2010, the MPO established a dedicated funding stream for transit, infrastructure, and transportation demand management and transportation systems management projects that improve air quality and mobility and that reduce congestion in the region using federal Congestion Mitigation and Air Quality (CMAQ) funds. Projects funded in 2010 include Cambridge Clean Cabs, which supports hybrid cab fleets, MetroWest RTA bus routes, which provide suburban transit service, MBTA Bikes on Buses, which strengthens transit connections for bicyclists, and Hubway, Boston’s Bike Share

to make 600 rental bikes available at 61 stations around the city. Projects programmed for future funding include the Cochituate Rail Trail in Framingham to implement sidewalks, fences, benches, landscaping, and other trail amenities, and sidewalk installation and improvements in Scituate to provide pedestrian access to the commuter rail station. These projects promote livability in the communities they serve by improving mobility and promoting alternative modes of transportation.

- **MBTA Accessibility Programs** – The MBTA funds ongoing programs to improve accessibility to and at transit stations. These programs include the MBTA Station Rehabilitation, Station Accessibility, Elevator Replacement and Rehabilitation, and Enhancement programs. These programs are responsible for improved transit access and accessibility at Winchester Station on the Lowell Commuter Rail Line, Arlington Station on the Green Line, and Maverick Station on the Blue Line. The MBTA has also made tremendous strides in expanding bicycle parking at stations. Ninety-five percent of MBTA stations now have bicycle racks, and secure bicycle parking facilities, known as Pedal-and-Park stations, exist at Alewife in Cambridge, Forest Hills in Jamaica Plain, and South Station in downtown Boston. In addition, five more facilities are planned for Davis Square in Somerville, Ashmont in Dorchester, Quincy Center, Braintree Station, and Oak Grove in Malden.



- **LRTP and TIP Livability Criteria** – In 2011, the MPO updated the TIP project selection criteria to include a livability scoring category that evaluated each project on its ability to provide complete streets, provide multimodal access to an activity center, reduce auto dependency, serve a targeted redevelopment site, provide for development consistent with the compact-growth strategies of MetroFuture, and improve the quality of life. The MPO also evaluated the LRTP's Universe of Projects based on the established livability visions to determine each project's ability to address livability goals in the project selection process. These criteria will help ensure that future transportation investments continue to incorporate livability.
- **Livability Projects** – Recent transportation capital investments that support livability include the North Bank Bridge in Cambridge and Charlestown, bicycle facilities in Belmont, Cambridge, and Somerville, and improvements to North Green in Ipswich.
  - The North Bank Bridge will provide a bicycle and pedestrian connection over commuter rail tracks that links East Cambridge to City Square in Charlestown along the Charles River waterfront.



- o The Bikeway Construction at Alewife Station will construct a bicycle path from Somerville to Belmont to link the Somerville Community Path to the Minuteman Commuter Bikeway, at Alewife Station in Cambridge, to other paths in the vicinity. This facility will also extend to Brighton Road in Belmont by crossing over a new bridge over the Alewife Brook.
- o Improvements to North Green in Ipswich will provide enhancements to the Meeting House Green Historic area through improved roadways, sidewalks, landscaping, and streetscape elements.

The MPO's visions and policies to advance livability in the region will build on past and ongoing livability initiatives and policies at the federal, state, and local levels of government.

### ***Federal Livability Initiatives***

The HUD-DOT-EPA Sustainable Communities Partnership is a federal policy directive that unites the Department of Transportation, the Environmental Protection Agency, and the Department of Housing and Urban Development to work together to promote and implement policies and programs that help address climate change and protect the environment while advancing the federal goals for transportation and housing. This partnership recognizes that solving problems in any one of those three areas is related to and dependent on policies and actions in the other two. The partnership also promotes a set of livability principles to their constituencies to generate and support the kinds of planning and investments needed for our transportation and housing patterns to evolve in a way that improves access to affordable housing and transportation options. The partnership's planning and investment programs already underway include:

- **HUD Sustainable Communities Regional Planning Grant Program** – Provides grants for projects that support metropolitan and multijurisdictional planning efforts that integrate housing, land use, economic and workforce development, transportation, and infrastructure investments. MAPC received a \$4 million grant through this program and has formed the Metro Boston Consortium for Sustainable Communities to implement the grant's planning work.
- **EPA Sustainable Communities Building Blocks Program** – Provides quick, targeted technical assistance to communities using a variety of tools to implement development approaches that protect the environment, improve public health, create jobs, expand economic opportunity, and improve overall quality of life.
- **HUD Community Challenge Planning Grants** – Awards \$40 million in grants to foster reform and reduce barriers to achieving affordable, economically vital, and sustainable communities. The City of Somerville received a \$1.8 million Community Challenge Planning Grant to plan for new development around its new Green Line T stations, prepare new citywide zoning ordinances, and streamline the city's permitting process. It will also provide funds for an affordable housing land bank.
- **FTA Bus and Urban Circulator Livability Programs** – Provides grants to support livability through investments in projects that provide a transportation option that connects urban destinations and fosters the redevelopment of urban spaces into walkable mixed-use, high-density environments. Hubway, a new bike share program

throughout the Boston metropolitan area received a grant of over \$3 million. It will make thousands of bicycles available throughout the Boston metropolitan area with the swipe of a card.

- **DOT Transportation Investments Generating Economic Recovery (TIGER) II** – Provides \$600 million in grants for TIGER II capital investment in surface transportation projects, of which \$267.5 million is for projects that focus on livability and sustainability improvements. The first round of TIGER, awarded in February 2009, granted \$1.5 billion for 50 innovative transportation projects across the country, including 22 projects that improve communities’ quality of life while advancing broader transportation goals.
- **EPA Brownfields Area-Wide Planning Grants** – Provides assistance to 23 communities to facilitate community involvement in developing an area-wide plan for brownfields assessment, cleanup and subsequent reuse.

### **State Livability Initiatives**

- **GreenDOT** – MassDOT’s comprehensive environmental responsibility and sustainability initiative that will make MassDOT a national leader in “greening” the state transportation system. GreenDOT will be driven by three primary goals: to reduce GHG emissions, to promote the healthy transportation options of walking, bicycling, and public transit, and to support smart-growth development.
- **Healthy Transportation Compact** – Coordination of the Secretaries of Transportation, Health and Human Services, and Energy and Environmental Affairs, and the MassDOT Highway Administrator, MassDOT Rail & Transit Administrator, and Commissioner of Public Health, to facilitate transportation decisions that balance the needs of all transportation users, expand mobility, improve public health, support a cleaner environment, and create stronger communities.
- **Global Warming Solutions Act (GWSA)** – Comprehensive regulatory program to address climate change by requiring the Executive Office of Energy and Environmental Affairs (EOEEA), in consultation with other state agencies and the public, to set economy-wide GHG emissions reduction goals for Massachusetts. These goals expect to achieve reductions of 25 percent below the statewide 1990 GHG emission levels by 2020, and 80 percent below the statewide 1990 GHG emission levels by 2050. To ensure that these goals will be met, the GWSA requires the Commonwealth to:
  - o Establish regulations requiring the reporting of GHG emissions
  - o Establish a baseline assessment of statewide GHG emissions in 1990
  - o Develop a projection of the likely statewide GHG emissions for 2020
  - o Establish target emission reductions that must be achieved by 2020
  - o Analyze strategies and make recommendations for adapting to climate change

- **Mass In Motion** – A multifaceted approach to promote wellness and to prevent obesity in Massachusetts with a particular focus on the importance of healthy eating and physical activity. The program awards grants to cities and towns to make wellness initiatives a priority at the community level. Recipients of communities within the region include Everett, Gloucester, Revere, and Weymouth.

### **Local Livability Initiatives**

- **Boston Complete Streets** – New initiative that aims to improve the quality of life in Boston by creating streets that are both great public spaces and sustainable transportation networks. It embraces innovation to address climate change and promote healthy living. The objective is to ensure that Boston’s streets put pedestrians, bicyclists, and transit users on an equal footing with motor-vehicle drivers.
- **Boston Bikes** – Initiative launched three years ago with the goal of transforming Boston into a world-class bicycling city. The City has made tremendous gains since 2007 by improving its ranking from worst cycling city, according to Bicycling Magazine, to one of the leading bike-friendly cities in the country, with the 10th-highest ridership levels of the 70 largest U.S. cities.
- **City of Cambridge** – The city is a leader in creating programs to support and encourage walking, bicycling, and using transit to improve the quality of life in the city; to meet climate and environmental goals; and to preserve the limited roadway capacity and parking supply. Figure 5-19 shows Cambridge’s bicycle network, which consists of 16 miles of bicycle lanes and another 16 miles of bike paths. The number of people bicycling in the city more than doubled between 2002 and 2008.<sup>32</sup>
- **City of Somerville** – Recent investments by the City have a strong focus on livability by enhancing transit, bicycle, and pedestrian options for its residents. In May 2011, the League of American Bicyclists recognized the City’s efforts by naming them a bronze-level Bicycle Friendly Community.

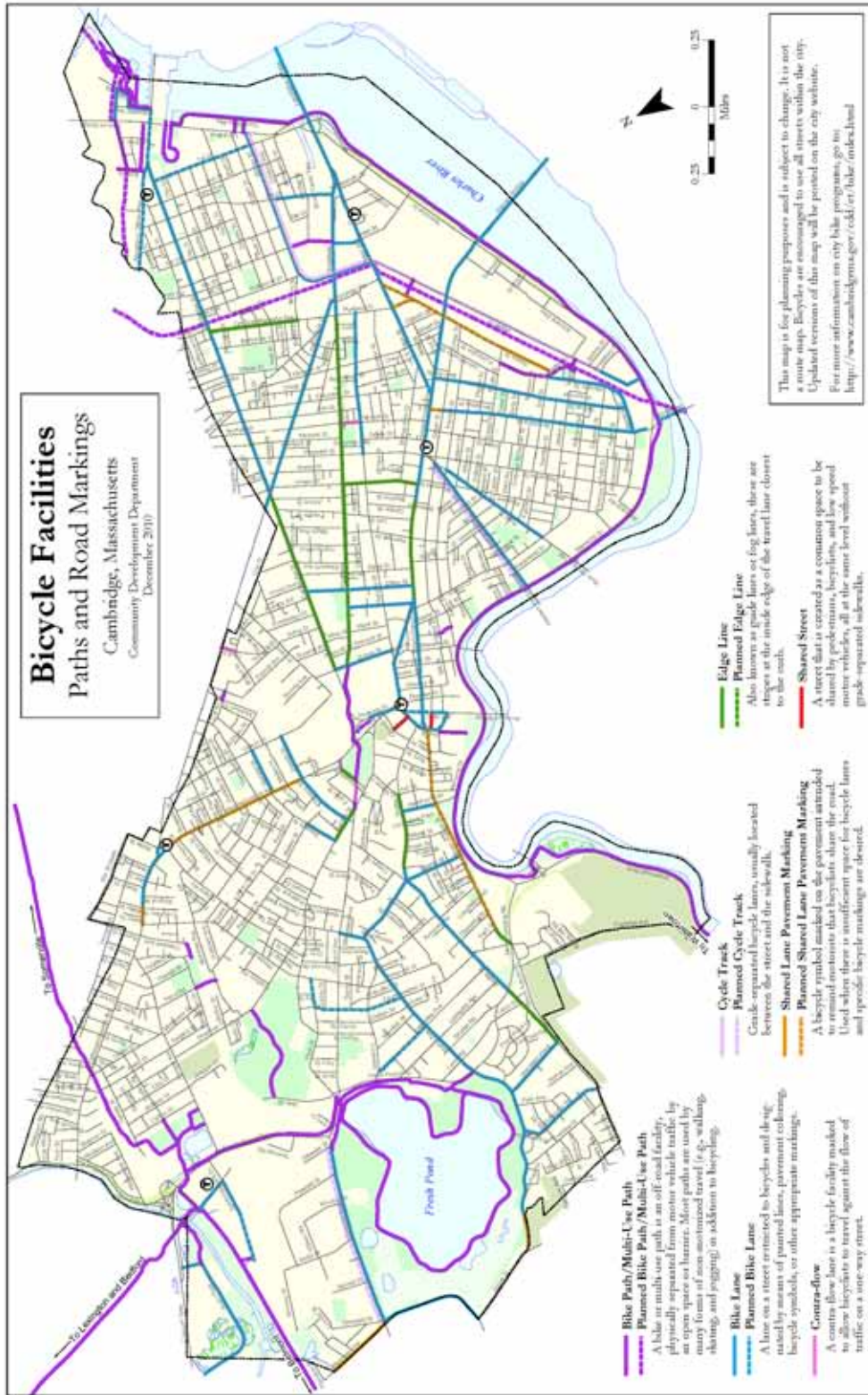
### **Limitations to Livability Implementation**

These initiatives demonstrate the progress that has been made regarding livability in the Boston region; however, ongoing obstacles and limitations remain. The conditions necessary for livable communities are sometimes challenging and possess marginal community support. Some of the obstacles and limitations include:

- Low-density land use patterns require users to travel longer distances, which is less conducive to nonmotorized trips such as walking and bicycling.
- More affordable housing opportunities tend to be found on the outskirts of the region in communities with low-density land use and few public transportation options.
- A majority of Americans prefer to live in single-family, detached housing that requires low-density land use.
- Livability-focused projects often have to compete with large-scale highway

<sup>32</sup> Cambridge Community Development Department, “Bicycle Trends in Cambridge,” April 2010.

FIGURE 5-19  
CITY OF CAMBRIDGE BICYCLE NETWORK





Ongoing documentation of the region's transportation investments and its impact on the system are necessary to track progress toward the MPO's goals as well as inform future decisions.

investments for limited funding. In the FFYs 2011-14 TIP, the Massachusetts Avenue project in Arlington competes with the Route 128 Add-A-Lane project in Dedham, Needham, Wellesley, and Westwood for MPO discretionary funds.

- The current bicycle network does not provide safe and continuous access for a majority of the population. On-road bicycle accommodations, such as bicycle lanes, shoulders, and shared-use lanes indicated by “sharrows” (markings on a road indicating that bikes and motor vehicles need to share the road), only provide enough comfort to attract 1–5 percent of the population to bicycling regularly. The multi-use path network in the region is limited, and may not be utilized for all of a trip.
- Local residents may prioritize improved motor-vehicle traffic conditions over improved bicycle and pedestrian facilities.

## NEXT STEPS – THE DEVELOPMENT OF PERFORMANCE MEASURES

The MPO will continue to work with state agencies to advance the goals of reducing GHG emissions to lessen the impacts of climate change. Environmental issues will continue to be considered in the MPO project selection process. Livability initiatives at the federal, state, regional, and local levels have expanded safe, affordable, and healthy transportation options in the Boston region by increasing the number of miles of bicycle facilities, enhancing pedestrian accommodations, and improving transit service and access.

The MPO's visions and policies will continue to guide UPWP studies and programs aimed at advancing climate change, environment, and livability objectives. In addition, the MPO's TIP and LRTP project selection criteria will implement the projects and programs needed to achieve these goals. Ongoing documentation of the region's transportation investments and its impact on the system are necessary to track progress toward the MPO's goals as well as inform future decisions. To conduct this monitoring requires the development of performance measures that can indicate how well objectives are being addressed.

The MPO will develop performance measures to guide investments toward the desired outcomes. The Needs Assessment of the LRTP documents the existing condition of the transportation system, and it may be utilized as a baseline for initial performance measures. Yet, in the development of performance measures, there are likely to be some measures that do not yet have the necessary data to conduct analysis. Addressing these data gaps will require future data collection and analysis at the municipal, corridor, and regionwide level. These activities will become components of the ongoing Congestion Management Process or future Unified Planning Work Program studies. The MPO's performance measures have the potential to adhere to defined targets, and possess the ability to effectively communicate the needs of the region and reinforce the value of

investment decisions.

Climate change, environment, and livability performance measures to advance MPO visions and policies may include:

CLIMATE CHANGE		
GOAL	FACTOR	PERFORMANCE MEASURES
Reduce GHG emissions to Global Warming Solution Act levels	GHG emissions	GHG emissions (regionwide)
	Vehicle Miles Traveled	VMT (per capita, per household, regionwide)
	Fleet modernization	MBTA fleet within useful lifespan (mode, systemwide)
	Transit/TDM/Bike/Ped options	Mode share split (community type, regionwide)
Protect transportation infrastructure	MetroFuture land use	Transportation investments and MetroFuture targeted growth areas (map)
	Critical infrastructure	TIP projects that improve response to extreme conditions

ENVIRONMENT		
GOAL	FACTOR	PERFORMANCE MEASURES
Preserve greenfields and facilitate brownfield development	Greenfield development	Transportation investments that facilitate greenfield development (regionwide)
	Brownfield facility development	Transportation investments within 1/2 mile of brownfield development (regionwide)
Promote energy conservation	Fleet modernization	MBTA fleet within useful lifespan (mode, systemwide)
	HOV travel	HOV lane miles, HOV V/C ratio
	Transit/TDM/Bike/Ped options	Mode share split (community type, regionwide)
	Air quality	CO <sub>2</sub> (regionwide)
	GHG emissions	GHG emissions (regionwide)
Minimize or avoid impacts to wetlands, soil, water, and other environmental resources	Wetlands	Transportation investments within wetlands (regionwide)
	Water supply and well head protection areas	Transportation investments within water supply and well head protection areas (regionwide)
	Areas of Critical Environmental Concern (ACEC)	Transportation investments within ACEC (regionwide)
	Special flood hazard areas	Transportation investments within special flood hazard areas (regionwide)

LIVABILITY		
GOAL	FACTOR	PERFORMANCE MEASURES
Reduce energy use	Vehicle Miles Traveled	VMT (per capita, per household, regionwide)
	GHG emissions	GHG emissions (regionwide)
	Air quality	CO2 (regionwide)
Increase alternative energy use	Electric charging stations	Electric charging stations (regionwide)
	Hybrid and electric vehicle	Hybrid and electric vehicle (regionwide)
Improve accessibility for persons with disabilities	ADA compliant transit stations	ADA compliant transit stations (regionwide)
	ADA compliant intersections	ADA compliant intersections (regionwide)
Implement complete streets and context-sensitive design	Complete street coverage	Walk, bike, and transit coverage (regionwide)
	Bicyclist crash rate	Bicyclist crash rate (per capita, corridor, regionwide)
	Pedestrian crash rate	Pedestrian crash rate (per capita, corridor, regionwide)
Increase economic vitality by effectively moving goods and people	Transit accessibility	Accessible essential destinations within 40 minutes by transit
	Transit reliability	MBTA Scorecard performance metrics (by mode, by route)
	Roadway traffic congestion	Vehicle hours of delay (by route, regionwide)
	Travel time	Average commute time (motor vehicle, transit, bike, walk)
Improve multimodal access between existing activity centers and transportation facilities	Connectivity of the bike/ped network	Gaps closed
	Access to transit	Bicycle and pedestrian LOS within 1/2 mile of transit station
	Park and ride lot utilization	Percentage of spaces occupied
	HOV coverage and utilization	HOV lane miles, HOV V/C ratio
Link transportation and land use to facilitate healthy and affordable options	Implementation of MetroFuture	Map projects funded and MetroFuture targeted growth areas
	Transportation affordability	Annual transportation costs (municipal, corridor, regionwide)
Support smart growth development	Transit access	Population and employment within 1/2 mile of transit station
	Mode split	Percentage of trips by mode
	Housing affordability	Affordable housing units within 1/2 mile of transit station