

# CHAPTER 5

## LIVABILITY AND THE 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.

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,

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<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.

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>

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<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.

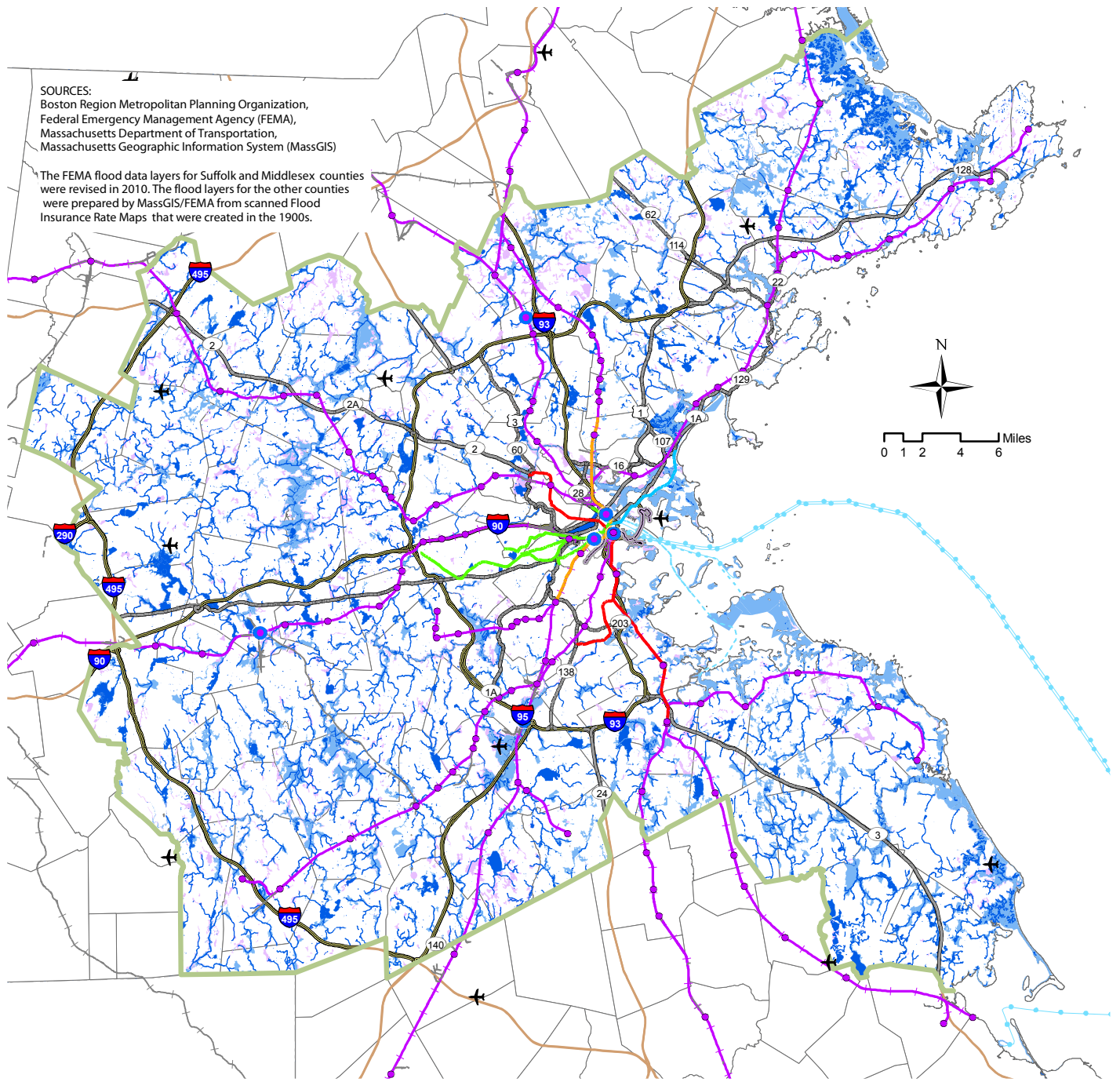
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<sup>4</sup> U.S. Energy Information Administration, *What are the major sources and users of energy in the United States?* [www.eia.doe.gov/energy\\_in\\_brief/major\\_energy\\_sources\\_and\\_users.cfm](http://www.eia.doe.gov/energy_in_brief/major_energy_sources_and_users.cfm), 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 1900s.

**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.

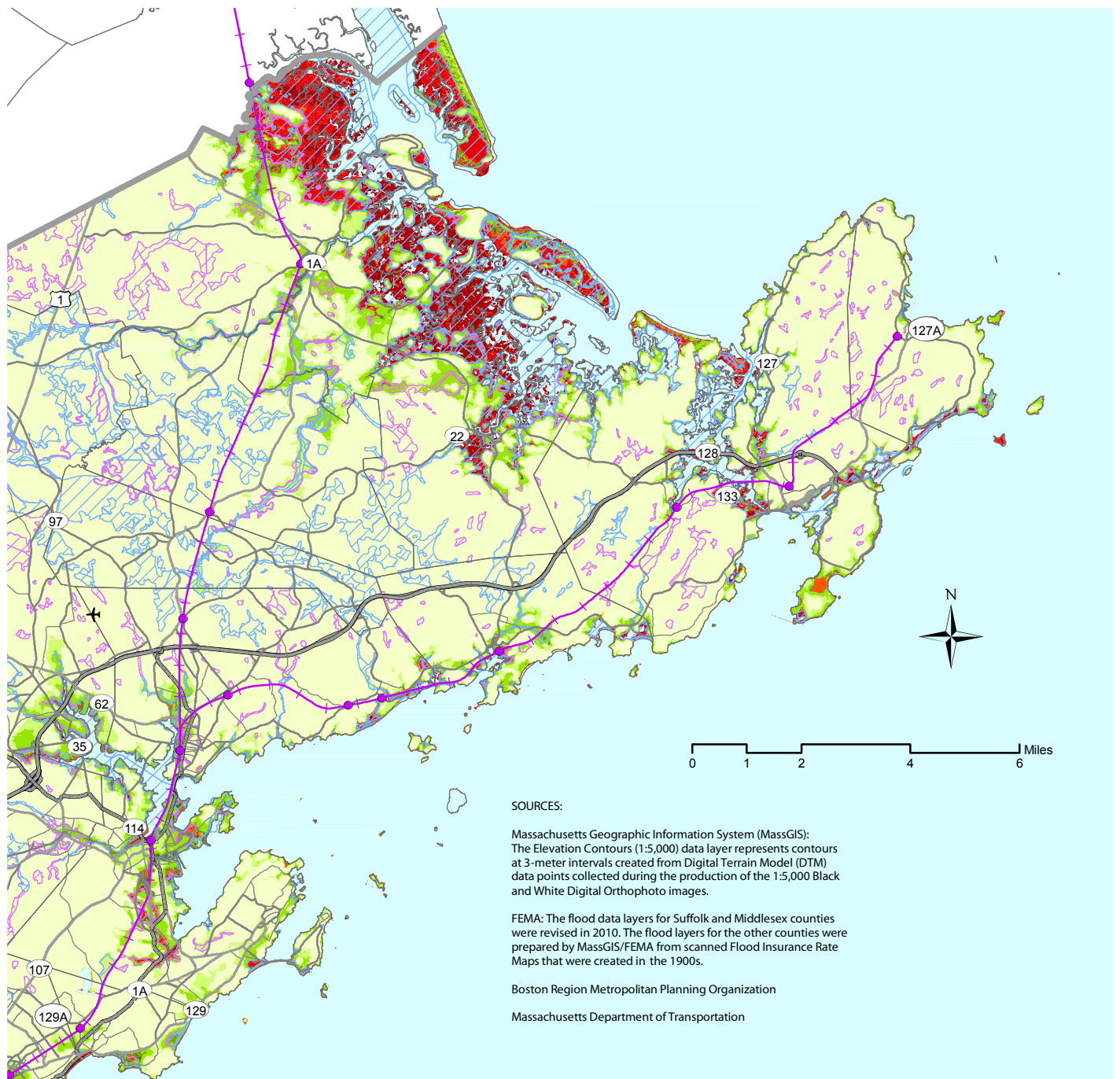
<sup>8</sup> The IPCC was established by the United Nations Environment Programme and the World Meteorological Organization.

<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**



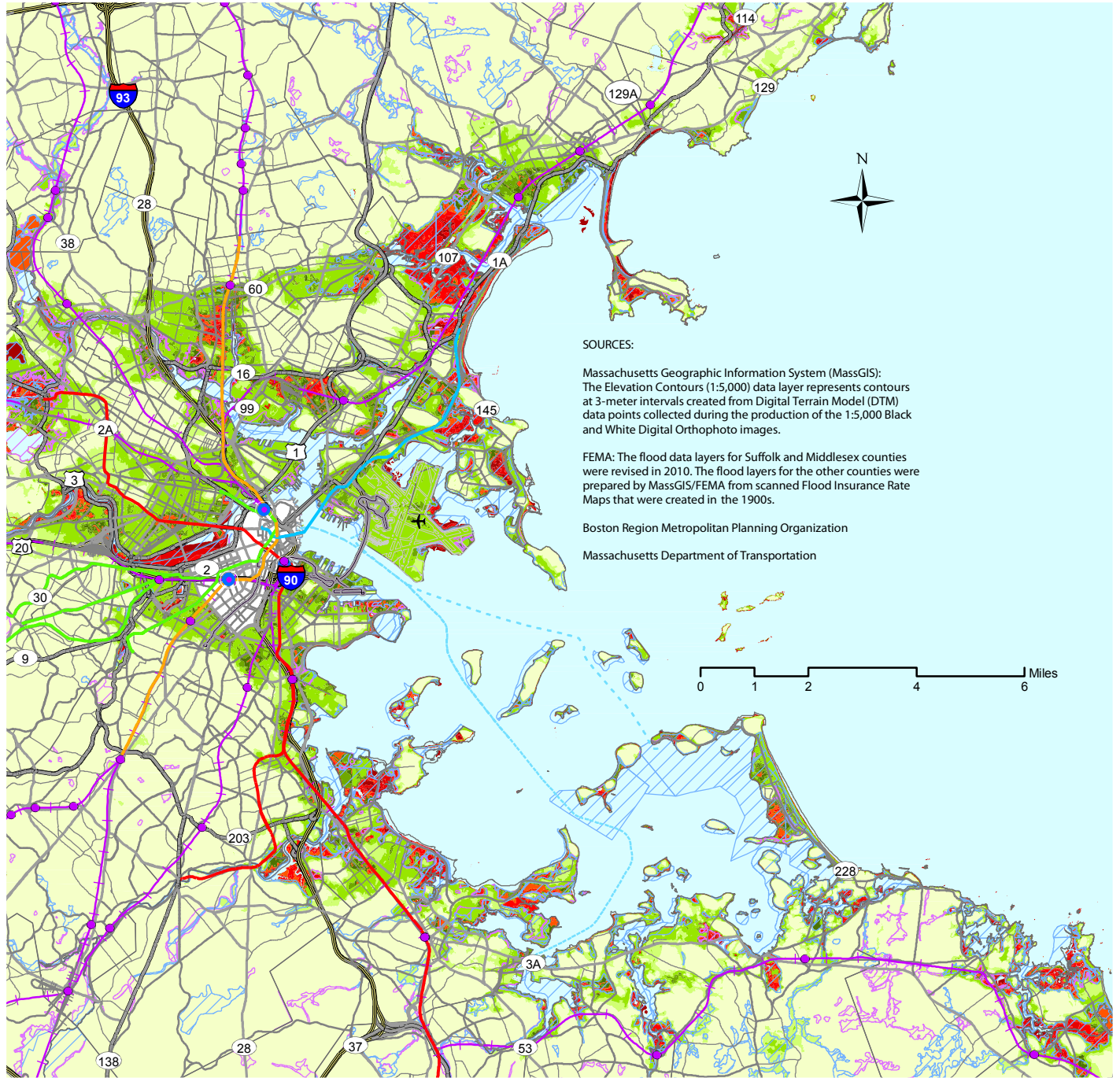
**FEMA Flood Hazard Areas**

-  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

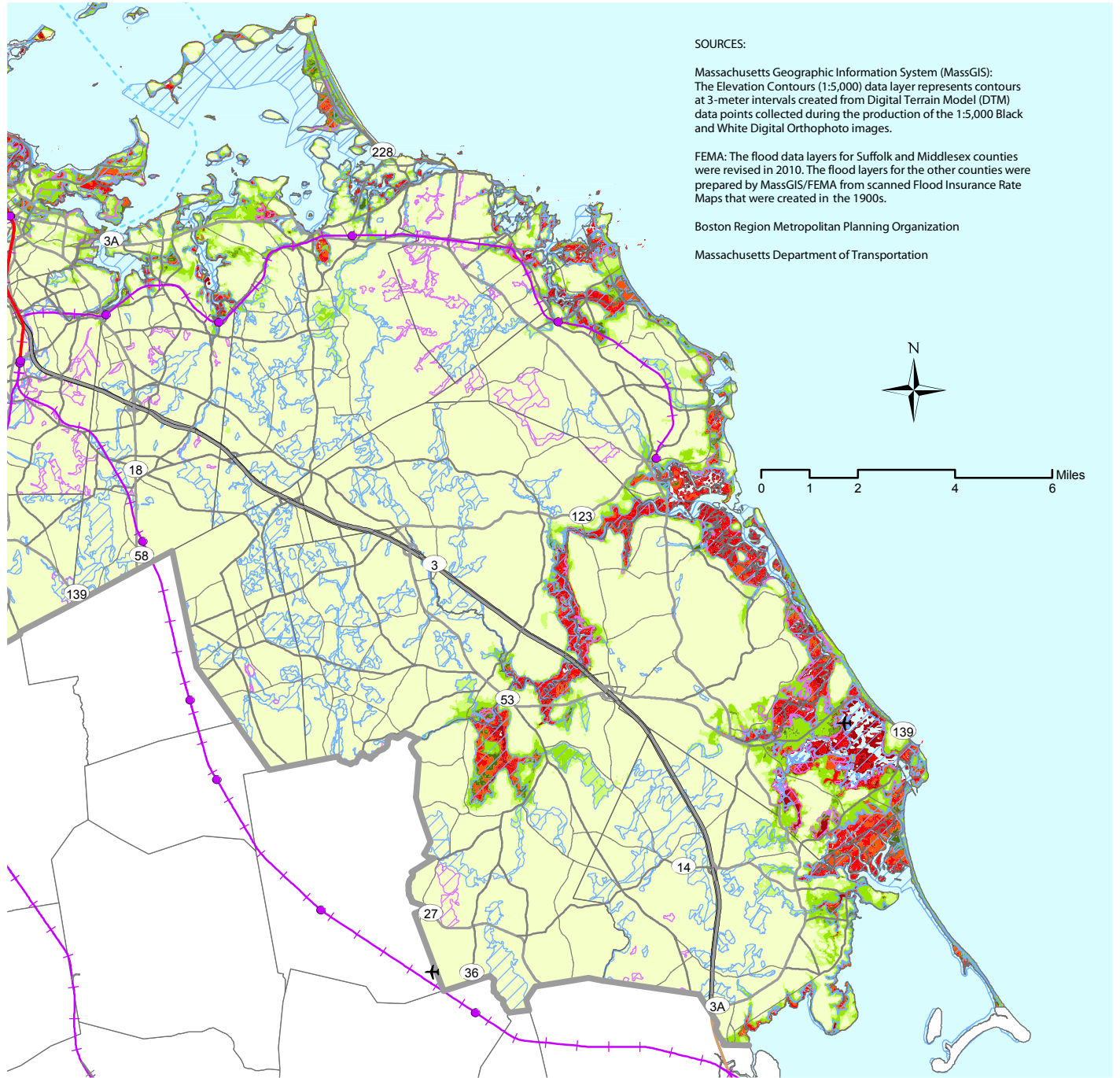
**FEMA Flood Hazard Areas**

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-  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

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)



## 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.

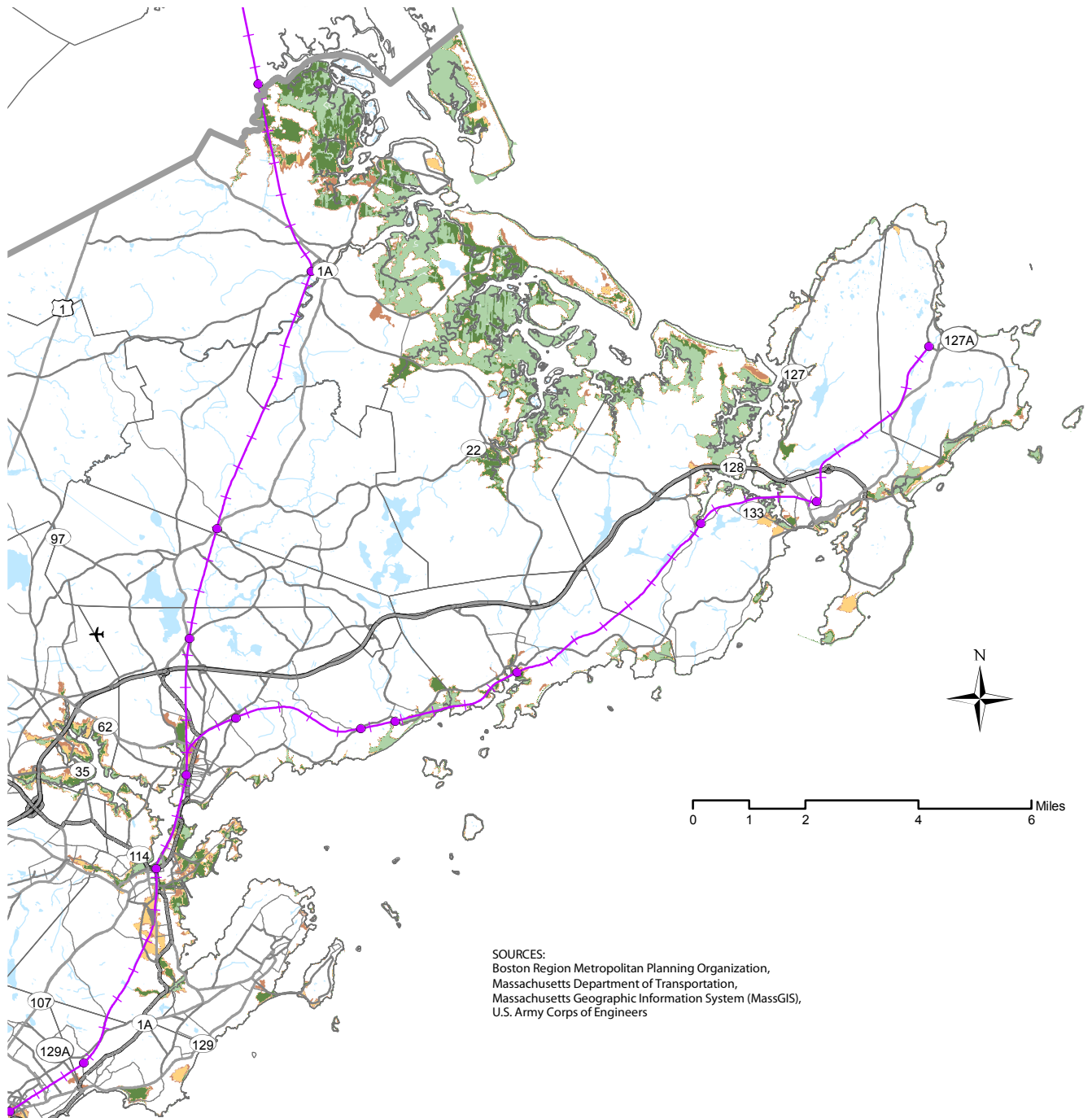
## The Boston Region MPO's Vision for Climate Change

*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

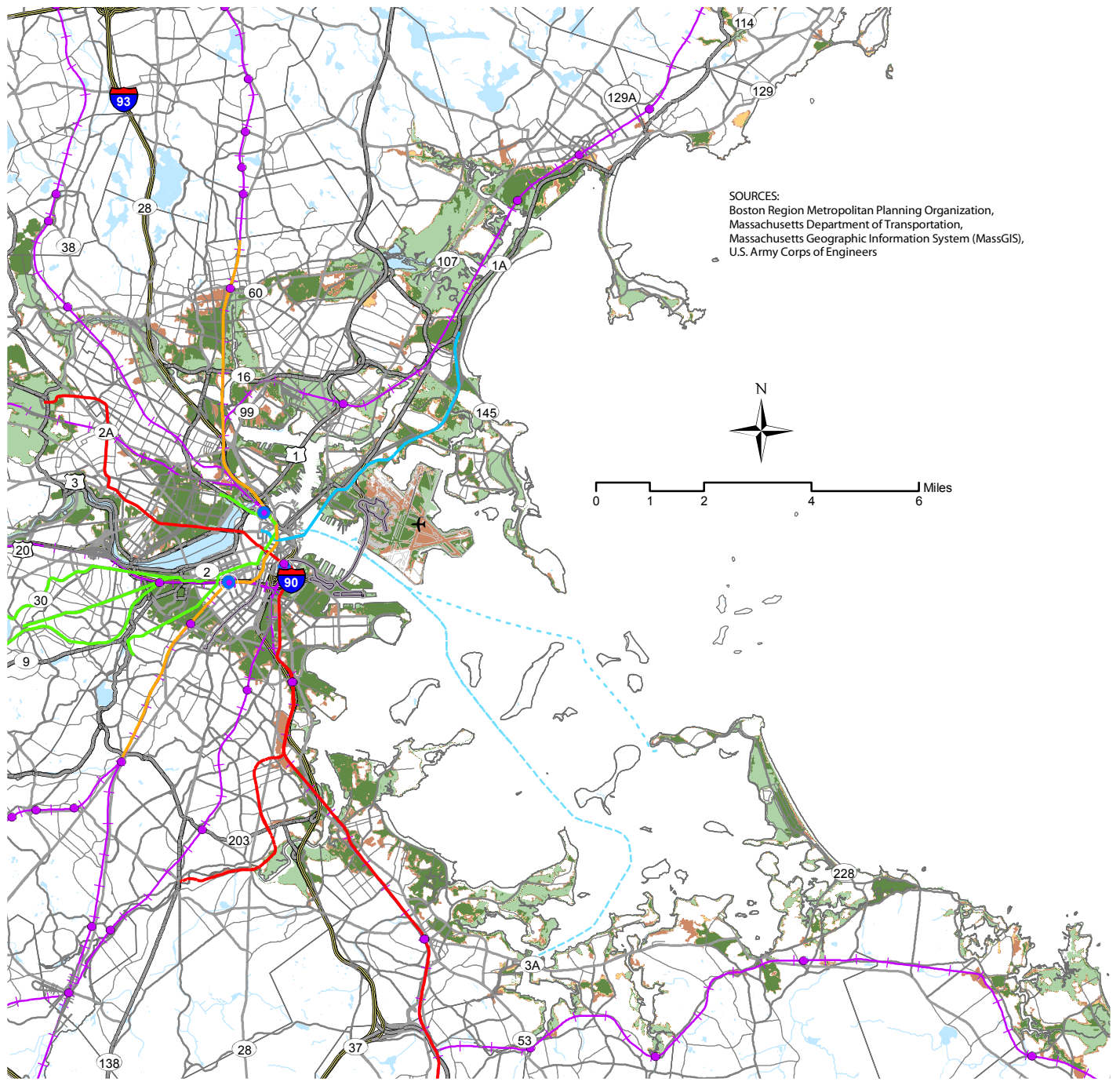
**FIGURE 5-5**  
**Hurricane Surge Inundation**  
**North Shore**



**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**

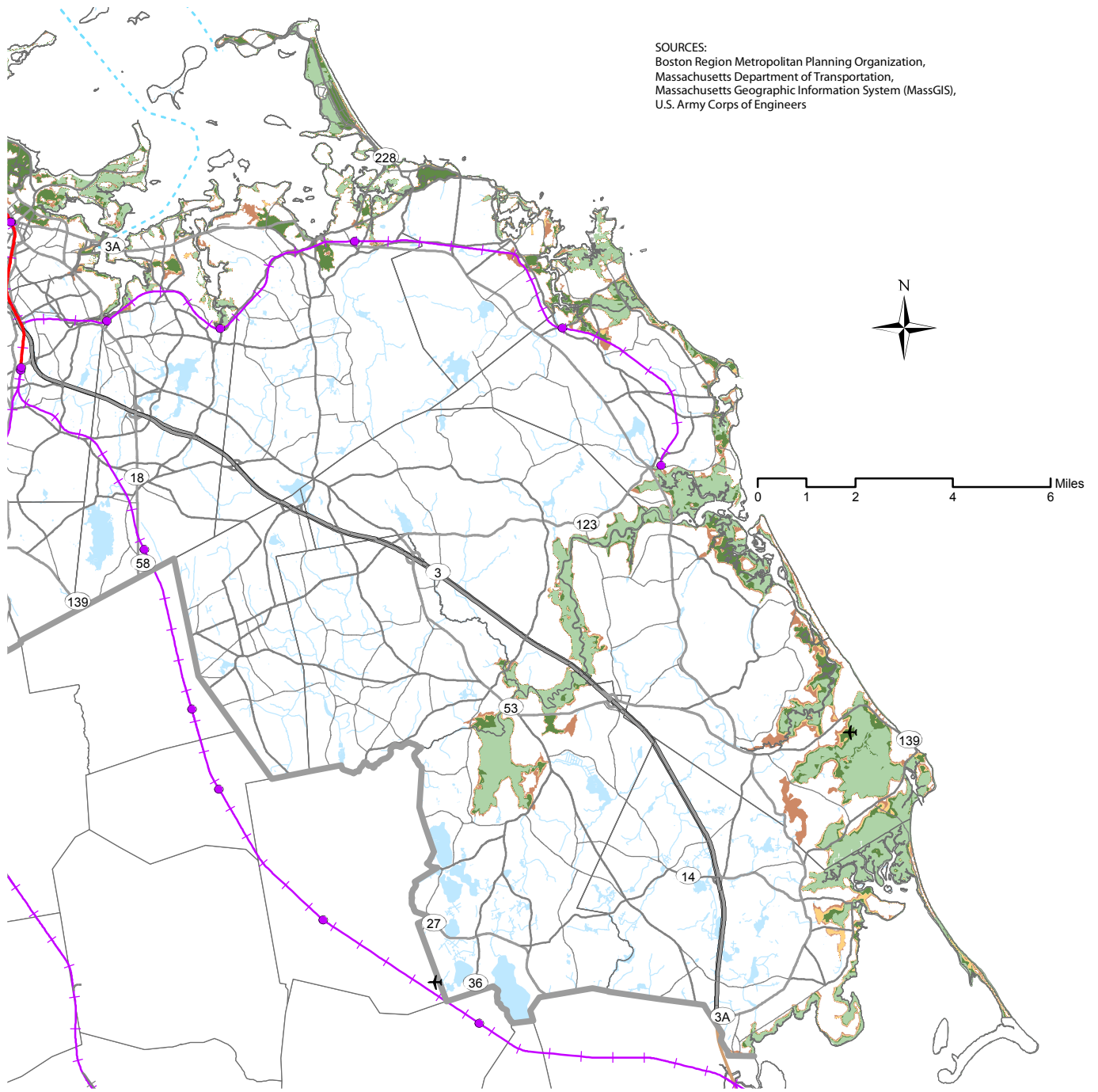


**Hurricane Surge Inundation in Massachusetts**  
**(Worst case flooding by hurricane category)**

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

# FIGURE 5-7 Hurricane Surge Inundation South Shore

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

## **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 of 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 uses its visions as criteria in its project selection process.

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 Fuels – The MPO funds the use of alternative fuels, which can release less GHG emissions than traditional fossil fuels. Alternative fuels are not specifically discussed below but are included within the context of the alternative modes of travel and reduction of vehicle-miles of travel and roadway congestion sections.

- 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.

### *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

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<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.

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 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 of its Congestion Mitigation and Air Quality (CMAQ) program, the MPO programs funds for 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, alternative-fuel 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.

#### 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.

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 MPO has estimated its CO<sub>2</sub> emissions resulting from its list of recommended projects in this LRTP, using its travel demand model. 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, with one exception. Emission factors approved by the EPA using the MOBILE 6.2 emission factor model are used for the conformity determination. Since a conformity determination is not yet required by EPA for CO<sub>2</sub>, the estimates developed for this LRTP used a newer emission factor model – MOVES.

The Massachusetts Clean Energy and Climate Plan for 2020 estimate of CO<sub>2</sub> emissions based on historic fossil fuel consumption for the 1990 baseline year. The 1990 Baseline is the year against which the 2020 and 2050 GHG emissions will be measured. Since the MPO does not have a 1990 baseline travel demand model for comparison purposes, VMT is used as a surrogate to calibrate transportation GHG emissions to overall state GHG emissions that have been estimated based on historic fuel consumption. The 1990 Highway Performance Monitoring System (described in detail in Chapter 10) data are analyzed to determine the 1990 VMT baseline and growth for the MPO over the period 1990 to 2007. This enables a comparison of the 1990 GHG baseline to GHG emission projections for other analysis years.

The 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 was modeled for both 2020 and 2035 using a Build/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 CO<sub>2</sub> emissions are provided below:

- 2020 No-Build –
- 2020 Build –
- 2035 No-Build –
- 2035 Build –

The MPO will be reporting on its actions to comply with the GWSA and to play its part in meeting the GHG reductions targets. As part of this activity, the MPO will provide public



information on the topic and will advocate for steps needed to accomplish the MPO's and state's goals for GHG reductions.

## 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

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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> 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."

all projects in Massachusetts.

#### 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.

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.

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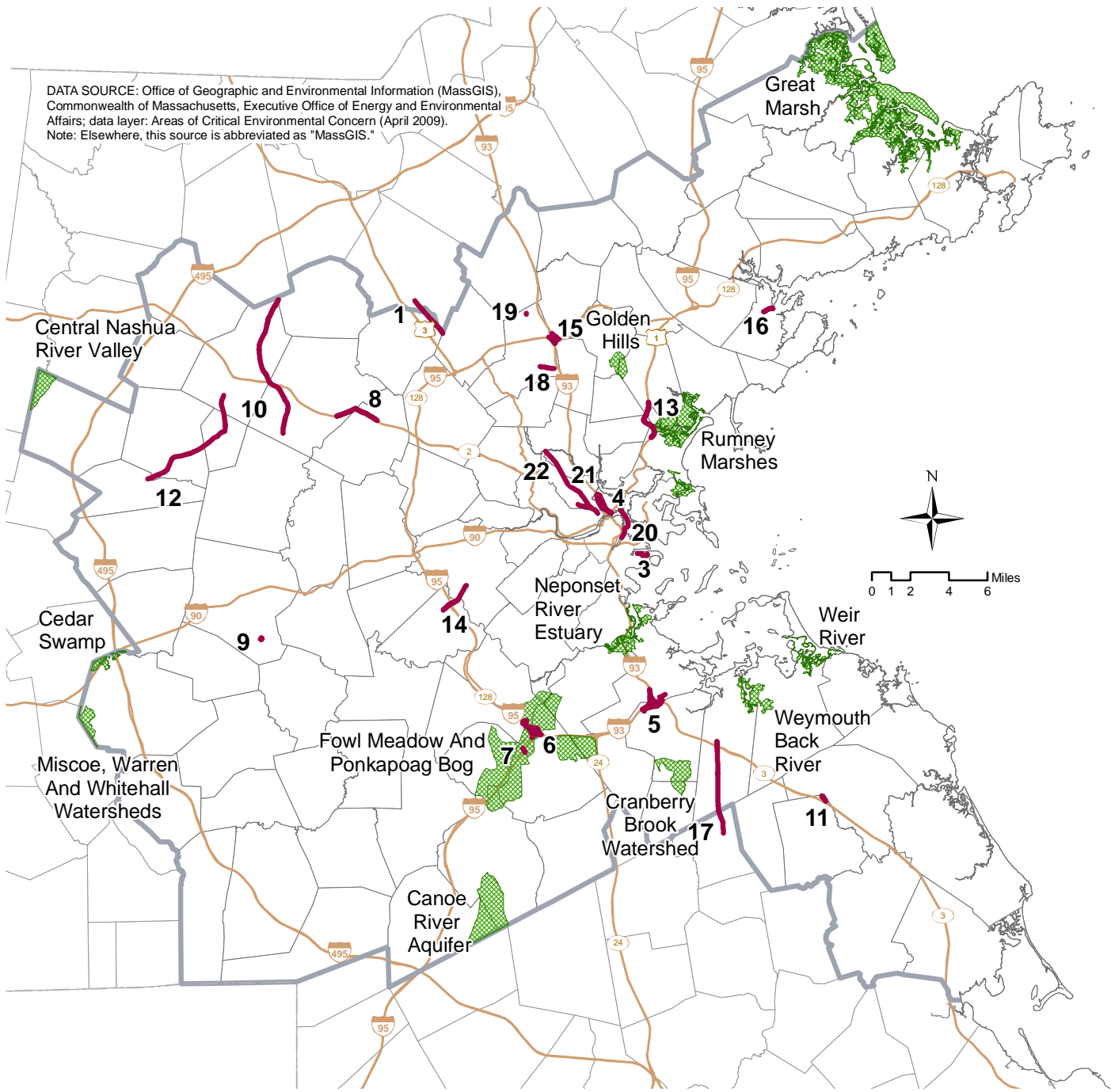
<sup>20</sup> U.S. Environmental Protection Agency’s (U.S. EPA) Envirofacts Warehouse, EnviroMapper layers for Brownfield facilities and Superfund sites, [www.epa.gov/emefdata/em4ef.home](http://www.epa.gov/emefdata/em4ef.home), accessed on 6/3/11.

TABLE 5-1

## List of Recommended Projects

Key Number on Figures	Highway Projects
1	Bedford, Billerica & Burlington: Middlesex Turnpike Improvements Phase III
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	Concord & Lincoln: Route 2/Crosby's Corner
9	Framingham: Route 126/135 Grade Separation
10	Concord to Westford: Bruce Freeman Rail Trail
11	Hanover: Route 53 Final Phase
12	Hudson to Acton: Assabet River Rail Trail
13	Malden, Revere, & Saugus: Route 1 Improvements
14	Needham & Newton: Needham Street/Highland Avenue
15	Reading & Woburn: I-93/I-95 Interchange
16	Salem: Bridge Street
17	Weymouth: Route 18 Capacity Improvements Project
18	Woburn: Montvale Avenue
19	Woburn: New Boston Street Bridge
Transit Projects	
20	Boston: Ferry Expansion: Russia Wharf Ferry Terminal
21	Somerville: Green Line Lechmere to College Avenue
22	Somerville: Green Line College Avenue to Mystic Valley Parkway (Route 16)

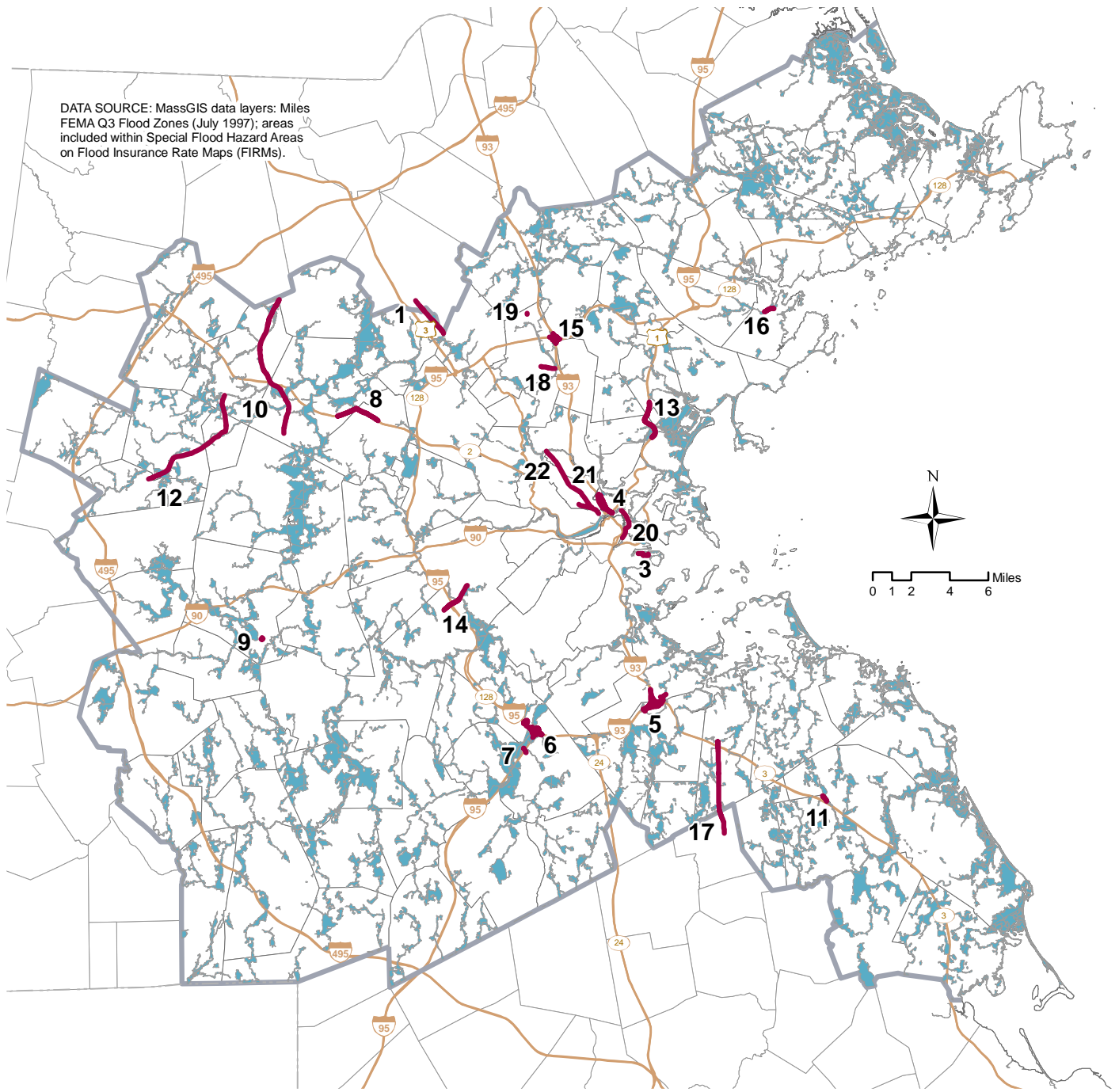
**Figure 5-8**  
**Areas of Critical Environmental Concern**



 Area of Critical Environmental Concern (ACEC)

 Recommended project

**Figure 5-9  
FEMA Q3 Special Flood Hazard Areas**



DATA SOURCE: MassGIS data layers: Miles FEMA Q3 Flood Zones (July 1997); areas included within Special Flood Hazard Areas on Flood Insurance Rate Maps (FIRMs).

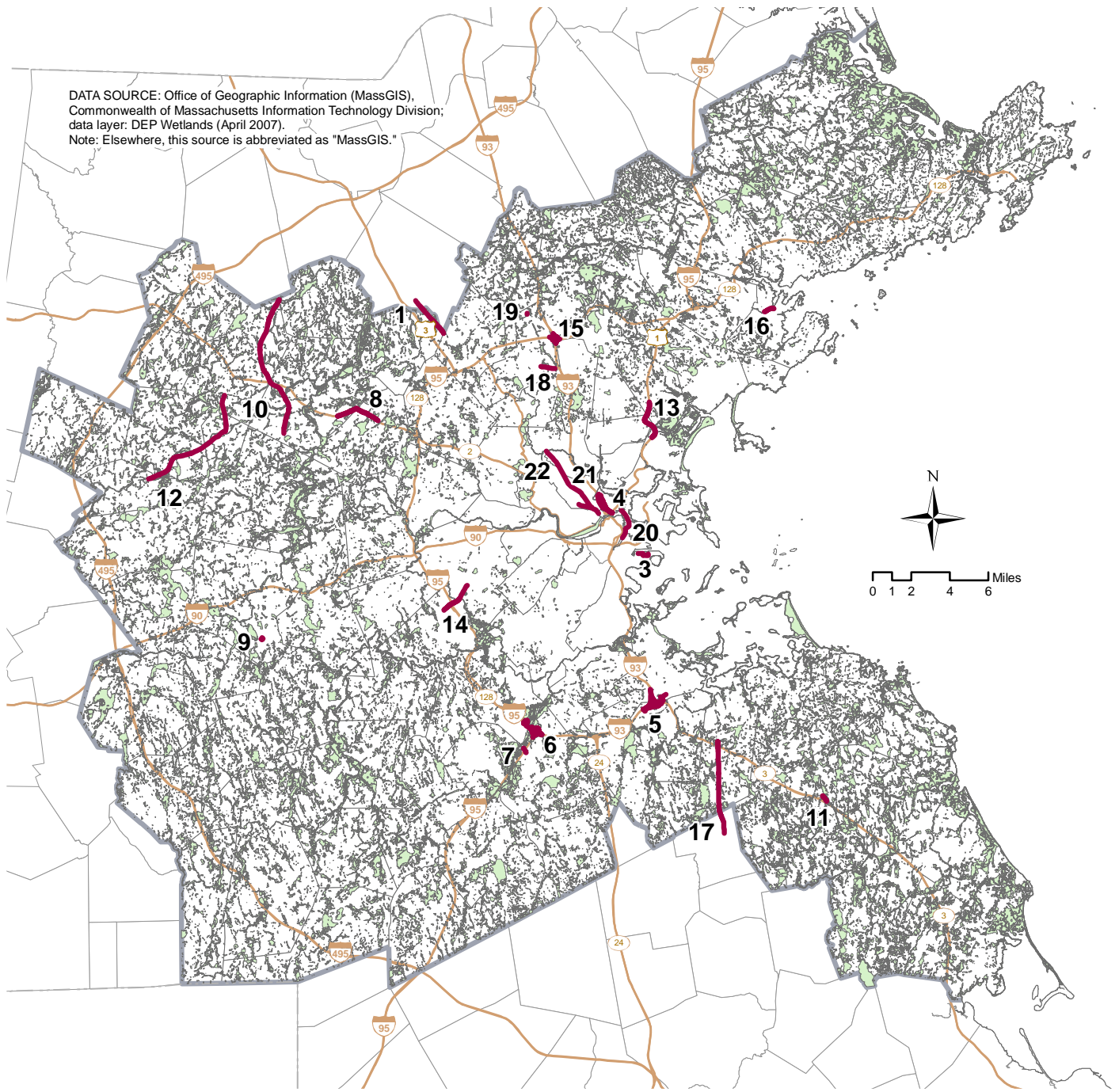
FEMA Q3 Flood Zones  
■ Special Flood Hazard Area

— 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**



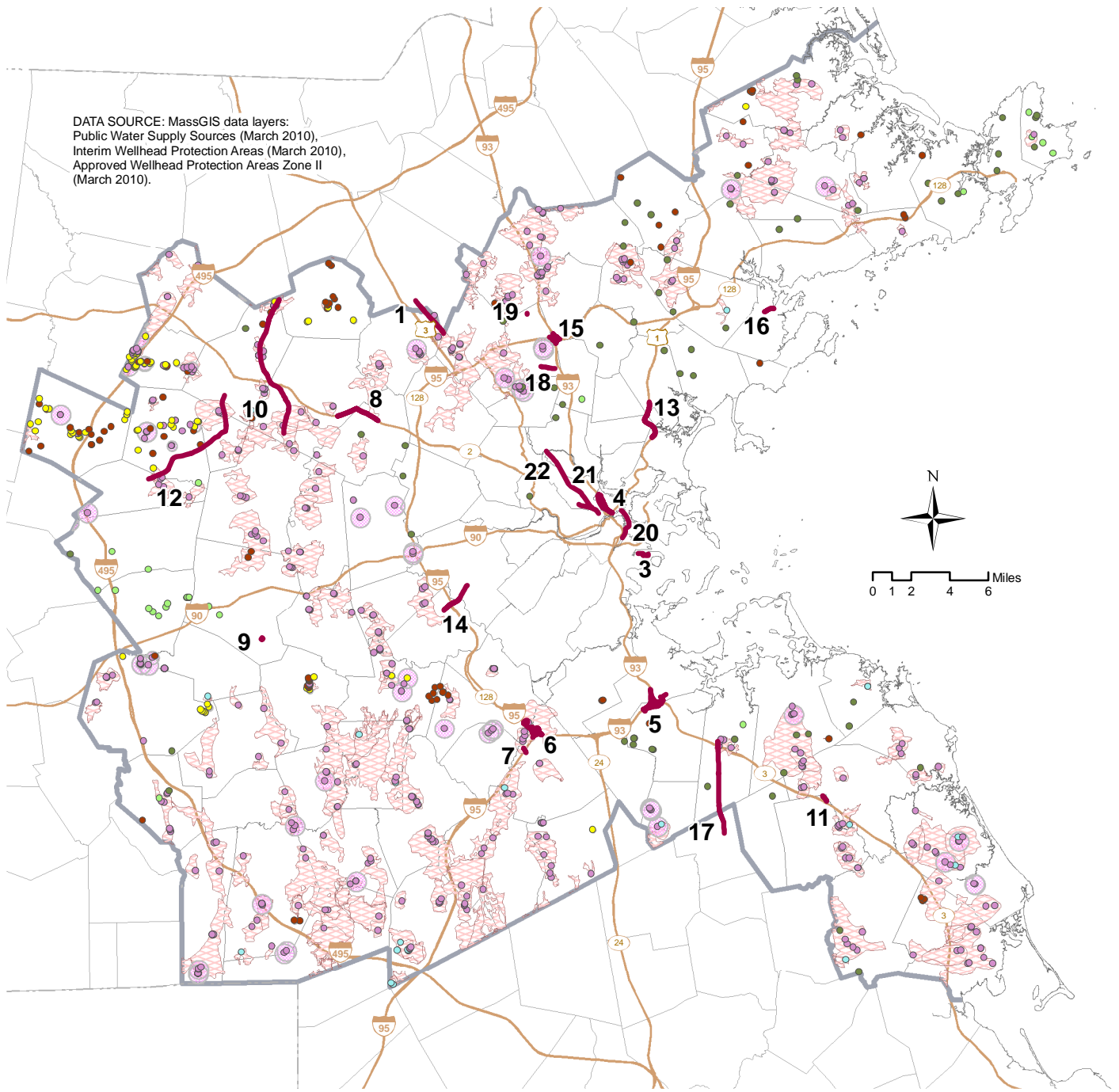
DATA SOURCE: Office of Geographic Information (MassGIS),  
Commonwealth of Massachusetts Information Technology Division;  
data layer: DEP Wetlands (April 2007).  
Note: Elsewhere, this source is abbreviated as "MassGIS."

DEP Wetlands  
 All categories

Recommended project

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

# Figure 5-11 Public Water Supplies



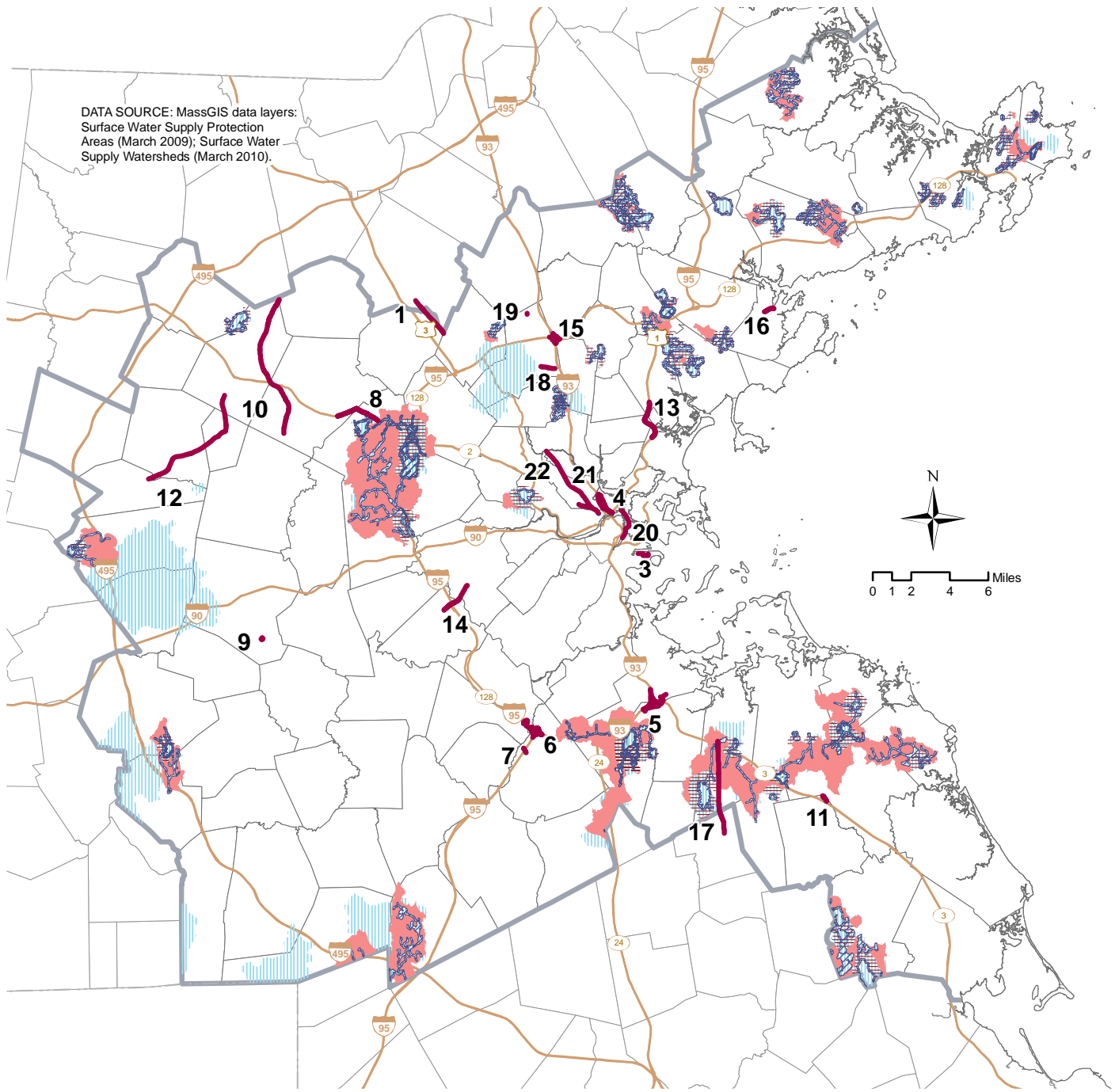
**Public Water Supplies**

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

**Recommended project**



# Figure 5-12 Surface Water Protection Areas



DATA SOURCE: MassGIS data layers:  
Surface Water Supply Protection  
Areas (March 2009); Surface Water  
Supply Watersheds (March 2010).

Surface Water Protection Areas

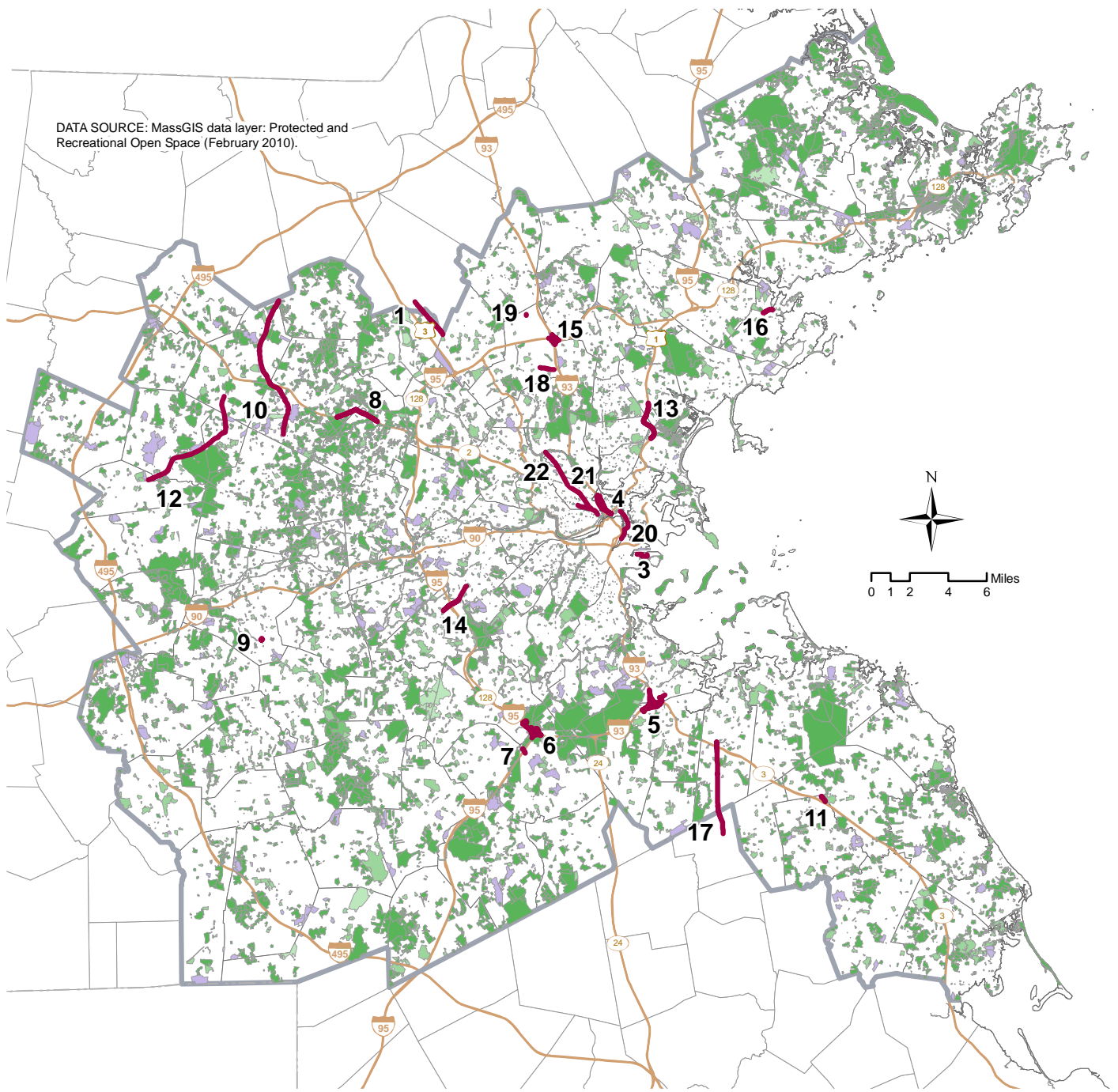
-  Zone A
-  Zone B
-  Zone C

Surface Water Supply

-  Watershed area

 Recommended project

# Figure 5-13 Protected Open Space



**Protected Open Space**

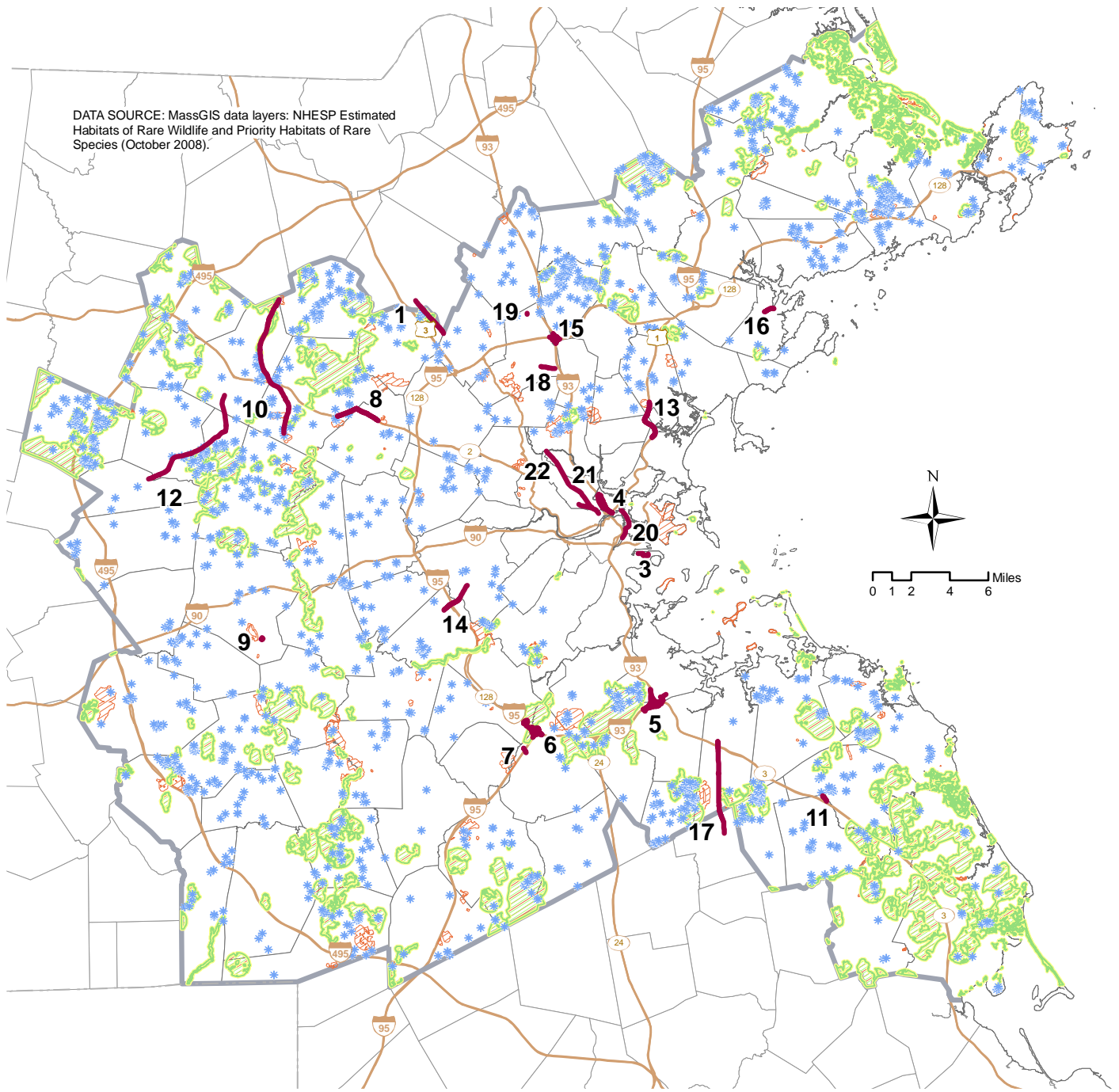
**Level of Protection**

- In perpetuity
- Temporary
- Limited
- Unknown
- None

**Recommended project**



# Figure 5-14 Natural Heritage and Endangered Species Program Priority Habitats



DATA SOURCE: MassGIS data layers: NHESP Estimated Habitats of Rare Wildlife and Priority Habitats of Rare Species (October 2008).

### 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.