

# NORTHERN MIDDLESEX REGIONAL TRANSPORTATION PLAN FFY 2020-2040

JULY 2019

PREPARED FOR THE NORTHERN MIDDLESEX METROPOLITAN  
PLANNING ORGANIZATION

BY THE NORTHERN MIDDLESEX COUNCIL OF GOVERNMENTS



## FFY 2020-2024 TRANSPORTATION IMPROVEMENT PROGRAM

(OCTOBER 1, 2019 – SEPTEMBER 30, 2024)

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(978) 454-8021  
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Boston, MA 02109  
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If this information is needed in another language, please contact the NMCOG Title VI Specialist at 978-454-8021.

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THE PREPARATION OF THIS DOCUMENT WAS FUNDED THROUGH A CONTRACT WITH THE MASSACHUSETTS DEPARTMENT OF TRANSPORTATION, SUPPORTED IN PART WITH FUNDS FROM THE FEDERAL HIGHWAY ADMINISTRATION AND THE FEDERAL TRANSIT ADMINISTRATION, U.S. DEPARTMENT OF TRANSPORTATION. ITS CONTENTS DO NOT NECESSARILY REFLECT THE OFFICIAL VIEWS AND POLICIES OF THE US DOT.

**ENDORSEMENT OF THE FFY 2020 – 2040 REGIONAL TRANSPORTATION PLAN FOR THE NORTHERN MIDDLESEX REGION**

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This document certifies that the Northern Middlesex Metropolitan Planning Organization hereby endorses the FFY 2020-2040 Regional Transportation Plan (RTP) for the Northern Middlesex Region. The RTP is being endorsed in accordance with the 3C Transportation Planning Process and complies with the requirements in the Fixing America’s Surface Transportation Act (FAST).

Air Quality Conformity

Whereas, the 1990 Clean Air Act Amendments (CAAA) require Metropolitan Planning Organizations within non-attainment areas and/or attainment areas with maintenance plans to perform air quality conformity determinations prior to the approval of transportation plans and transportation improvement programs, and at such other times as required by regulation;

Whereas, the air quality conformity analysis prepared for the FFY 2020-2024 Transportation Improvement Program demonstrates air quality conformity of the Northern Middlesex Regional Transportation Plan, and that all regionally significant transportation projects in the FFY 2020-2024 Transportation Improvement Program are contained in the Regional Transportation Plan, and that all regionally significant projects in the 2020 to 2024 timeframe of the Regional Transportation Plan are modeled in the FFY 2020-2024 Transportation Improvement Program’s air quality conformity analyses;

Whereas, the Northern Middlesex MPO has completed its review in accordance with Section 176(c) (4) of the Clean Air Act as amended in 1990 [42 U.S.C. 7251 (a)], and hereby certifies that the FFY 2020-2040 RTP is financially constrained and that the implementation of the Northern Middlesex Regional Transportation Plan satisfies the conformity criteria specified in both 40 CFR Part 51 and 93 (8/15/1997) and 310 CMR 60.03 (12/30/1994). Based on the results of the conformity analyses, the Northern Middlesex Regional Transportation Plan is consistent with the air quality goals of, and in conformity with, the Massachusetts State Implementation Plan.

Therefore, in accordance with 23 CFR Part 450.322 (Development and content of the Metropolitan Transportation Plan) and the Northern Middlesex MPO Regional Public Participation Plan (23 CFR 450.316 (a)), the MPO hereby endorses the FFY 2020-2040 Regional Transportation Plan.

  
Stephanie Pollack, Secretary and CEO  
Massachusetts Department of Transportation  
Date 07/24/15

  
Pat Wojtas, Town of Chelmsford  
Chair, Northern Middlesex Council of Governments  
Date 7-24-2015

  
Kevin O’Connor, Town of Tyngsborough  
LRTA Advisory Board NMMPO Representative  
Date 7/24/2019

\_\_\_\_\_  
Edward Kennedy  
NMMPO Representative - Lowell City Council  
Date

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Ron Keohane, Town of Tyngsborough  
NMCOG MPO Representative  
Date

\_\_\_\_\_  
Tom Bomil, Town of Dracut  
Chair, Lowell Regional Transit Authority  
Date

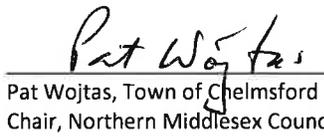
**310 CMR 60.05: GLOBAL WARMING SOLUTIONS ACT REQUIREMENTS FOR THE TRANSPORTATION SECTOR AND THE MASSACHUSETTS DEPARTMENT OF TRANSPORTATION**

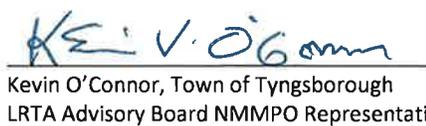
*Self-Certification Compliance Statement for Metropolitan Planning Organizations*

This will certify that the FFY 2020-2040 Regional Transportation Plan (RTP) for the Northern Middlesex Metropolitan Planning Organization (NMMPO) complies with all applicable requirements in the State Regulation 310 CMR 60.05: Global Warming Solutions Act Requirements for the Transportation Sector and the Massachusetts Department of Transportation. The regulation requires the Metropolitan Planning Organizations (MPOs) to:

1. 310 CMR 60.05, 5(a)(1): Evaluate and report the aggregate transportation GHG emissions and impacts of RTPs and TIPs;
2. 310 CMR 60.05, 5(a)(2): In consultation with MassDOT, develop and utilize procedures to prioritize and select projects in RTPs and TIPs based on factors that include aggregate transportation GHG emissions impacts;
3. 310 CMR 60.05, 5(a)(3): Quantify net transportation GHG emissions impacts resulting from the projects in RTPs and TIPs and certify in a statement included with RTPs and TIPs pursuant to 23 CFR Part 450 that the MPO has made efforts to minimize aggregate transportation GHG emissions impacts;
4. 310 CMR 60.05, 5(a)(4): Determine in consultation with the RPA that the appropriate planning assumptions used for transportation GHG emissions modeling are consistent with local land use policies, or that local authorities have made documented and credible commitments to establishing such consistency;
5. 310 CMR 60.05, 8(a)(2)(a): Develop RTPs and TIPs;
6. 310 CMR 60.05, 8(a)(2)(b): Ensure that RPAs are using appropriate planning assumptions;
7. 310 CMR 60.05, 8(a)(2)(c): Perform regional aggregate transportation GHG emissions analysis of RTPs and TIPs;
8. 310 CMR 60.05, 8(a)(2)(d): Calculate aggregate transportation GHG emissions for RTPs and TIPs;
9. 310 CMR 60.05, 8(a)(2)(e): Develop public consultation procedures for aggregate transportation GHG reporting and related GWSA requirements consistent with current and approved regional public participation plans;
10. 310 CMR 60.05, 8(c): Prior to making final endorsements on the RTPs, TIPs, STIPs, and projects included in these plans, MassDOT and the MPOs shall include the aggregate transportation GHG emission impact assessment in RTPs, TIPs, and STIPs and provide an opportunity for public review and comment on the RTPs, TIPs, and STIPs.
11. 310 CMR 60.05, 8(a)(1)(c): After a final GHG assessment has been made by MassDOT and the MPOs, MassDOT and the MPOs shall submit MPO-endorsed RTPs, TIPs or projects within 30 days of endorsement to the Department for review of the GHG assessment.

 07/24/19  
Stephanie Pollack, Secretary and CEO Date  
Massachusetts Department of Transportation

 7-24-2019  
Pat Wojtas, Town of Chelmsford Date  
Chair, Northern Middlesex Council of Governments

 7/24/2019  
Kevin O'Connor, Town of Tyngsborough Date  
LRTA Advisory Board NMMPO Representative

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Edward Kennedy Date  
NMMPO Representative - Lowell City Council

\_\_\_\_\_  
Ron Keohane, Town of Tyngsborough Date  
NMCOG MPO Representative

\_\_\_\_\_  
Tom Bomil, Town of Dracut Date  
Chair, Lowell Regional Transit Authority

## SELF-CERTIFICATION OF THE 3C PLANNING PROCESS

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This certifies that the Comprehensive, Continuing, Cooperative Transportation Planning Process being undertaken by the Northern Middlesex Metropolitan Planning Organization is addressing major issues facing the region and is being conducted in accordance with the requirements of:

1. 23 U.S.C. 134, 49 U.S.C. 5303, and this subpart;
2. Sections 174 and 176 (c) and (d) of the Clean Air act, as amended (42 U.S.C. 7504, 7506 (c) and (d) and 40 CFR part 93;
3. Title VI of the Civil Rights Act of 1964, as amended (42 U.S.C. 2000d-1) and 49 CFR part 21;
4. 49 U.S.C. 5332, prohibiting discrimination on the basis of race, color, creed, national origin, sex, or age in employment or business opportunity;
5. Section 1101(b) of the FAST Act (Pub. L. 114-357 ) and 49 CFR part 26 regarding the involvement of disadvantaged business enterprises in USDOT funded projects;
6. 23 CFR 230, regarding the implementation of an Equal Employment Opportunity Program on Federal and Federal- aid Highway construction contracts.
7. The provisions of the Americans with Disabilities Act of 1990 (42 U.S.C. 12101 et seq.) and 49 CFR parts 27, 37, and 38;
8. The Older Americans Act, as amended (42 U.S.C. 6101) prohibiting discrimination on the basis of age in programs or activities receiving Federal financial assistance;
9. Section 324 of title 23 U.S.C. regarding the prohibition of discrimination based on gender; and
10. Section 504 of the Rehabilitation Act of 1973 (29 U.S.C. 794) and 49 CFR part 27 regarding discrimination against individuals with disabilities.

The currently endorsed Unified Planning Work Program, Regional Transportation Plan, and Transportation Improvement Program, together with any amendments, were developed in accordance with FHWA/FTA regulations governing the implementation of FAST, and EPA regulations governing the implementation of the Clean Air Act Amendments of 1990, and fully incorporate the applicable requirements of the Civil Rights Act of 1964 and the Americans with Disabilities Act of 1990.



07/24/19

Stephanie Pollack, Secretary and CEO  
Massachusetts Department of Transportation

Date



7-24-2019

Pat Wojtas, Town of Chelmsford  
Chair, Northern Middlesex Council of Governments

Date



7/24/2019

Kevin O'Connor, Town of Tyngsborough  
LRTA Advisory Board NMMPO Representative

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NMMPO Representative - Lowell City Council

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Chair, Lowell Regional Transit Authority

Date

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## REGIONAL TRANSPORTATION PLAN EXECUTIVE SUMMARY

### OVERVIEW

The Northern Middlesex Regional Transportation Plan (RTP) identifies and analyzes transportation infrastructure and service improvement needs for the region’s transportation system, and serves as the framework for future investment in highways, bridges, public transportation, bicycle and pedestrian paths and trails, and transportation-related air quality improvement projects. The RTP is the region’s long-range plan and includes recommendations to meet identified transportation needs through 2040. The plan includes nine communities located in the northern portion of Middlesex County in Massachusetts: the City of Lowell, and the Towns of Billerica, Chelmsford, Dracut, Dunstable, Pepperell, Tewksbury, Tyngsborough and Westford.



The Regional Transportation Plan is one of three federally required certification documents that the Northern Middlesex Metropolitan Planning Organization (NMMPO) must develop and maintain. The other key document used for programming project funding is the Transportation Improvement Program (TIP). The projects programmed for funding in the early years of the RTP are generally comprised of the projects listed in the TIP, as these are the projects that are most likely to move into the construction phase during that time period.

*The Endorsed RTP is available on the NMMCOG website at:*  
<http://www.nmcog.org/regional-transportation-plan>

### REGIONAL GOALS AND OBJECTIVES

Goals and objectives are extremely useful in the regional planning process as they provide the necessary direction and basic framework upon which future decisions can be made. The overarching vision of the RTP remains the same as in previous plans, with a focus on *“developing a balanced, multi-modal, cost-effective, energy efficient transportation system connecting points inside and outside the Northern Middlesex Region”* by:

- Determining the current and projected transportation needs of the region’s residents, businesses, and institutions over the next nearly 25 years;
- Assessing the ability of the existing transportation system to meet these needs; and
- Identifying a set of fiscally constrained strategies that best fill the gap between the capabilities of the existing transportation system and current and projected transportation needs.

The RTP was developed with input from residents, businesses, and community organizations. The first round of public involvement meetings were held between February and April 2019 to review and gather input on opportunities and issues facing the region, and to discuss potential transportation alternatives aimed at addressing transportation needs. A second round of public involvement meetings was held in July 2019 to solicit comments on the Draft RTP document.

The RTP goals, performance measures and recommendations are summarized in the sections below.

#### TRANSPORTATION PLANNING FRAMEWORK

The RTP goals and objectives have been developed in coordination with federal transportation planning factors set forth in the Fixing Americas Surface Transportation (FAST) Act. It also identifies performance measures, or the metrics used to monitor changes in the performance of the regional transportation system in order to gauge progress toward addressing identified needs. The performance measures address the following categories: safety, infrastructure condition, congestion reduction and system reliability, economic vitality, environmental sustainability and livability, and transportation equity and accessibility. Each performance measure category is presented in the following pages.

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#### GOAL 1: IMPROVE THE SAFETY OF THE TRANSPORTATION SYSTEM FOR ALL USERS

Traffic crashes result in economic loss from damaged vehicles and goods, personal pain and suffering due to injury, and occasionally the catastrophic loss of life. Facility improvements that benefit safety must be highly valued. The RTP strives to reduce and minimize the risk of crashes occurring on the roadway network, and encourages the integrated consideration of roadway, vehicle and driver elements in design of future improvements.

Objectives aimed at achieving goals include supporting projects, program and policies that:

- Advance safe travel;
- Reduce the number and severity of crashes for all modes of transportation; and
- Promote the use of technology for projects aimed at improving safety at high crash locations.

Table ES-1 outlines safety performance measures and targets used to quantify progress toward achieving goals. The NMMPO has adopted statewide performance measures and targets for 2019. | The

NMMPO has also adopted a long-term target of achieving a 20% reduction in injuries and fatalities by 2040. The fatality and incapacitating rates for the region are consistently below state averages.

**Table ES-1: Safety Performance Measures and Targets**

Goal Area	Performance Measures	Current Performance - Rolling Five-Year Average 2012-2016	CY 2019 Performance Target - Rolling Five-Year Average 2015-2019*	Regional Rolling Five-Year Average 2012-2016	2040 Regional Target (20% reduction)
Safety	Fatalities	364	353	61	49
	Rate of Fatalities per 100 million VMT	0.61	0.58	0.44	0.35
	Incapacitating Injuries	3,146	2,801	632	506
	Rate of Incapacitating Injuries per 100 million VMT	5.24	4.37	4.57	3.66
	Total Number of Non-Motorized Incapacitating Injuries and Fatalities	541	541	90	72

\*Statewide Target adopted by NMMPO 2/27/19

**GOAL 2: EFFICIENTLY MANAGE EXISTING TRANSPORTATION ASSETS AND INFRASTRUCTURE**

The RTP places an emphasis on maximizing the efficiency of existing facilities, rather than constructing new ones. Maintenance is one of the most cost-effective strategies outlined in the Plan. A relatively small investment is needed to keep the system in good condition, compared to what is required to completely rebuild it. Deferred maintenance may save money in the short-run, but will be far more costly over the long-term, when compared with regular preventive maintenance. Regular maintenance provides better service, improves safety, extends equipment life and results in fewer breakdowns.

This plan addresses the issue of aging infrastructure and deferred maintenance and the associated impacts on safety, equipment life and the economic health of the region and its communities, by supporting the following projects, programs, and policies:

- Prioritize projects that maintain and modernize existing capital assets;
- Monitor the condition of existing infrastructure and identifying critical needs;
- Prioritize ongoing maintenance to avoid the added cost of deferred maintenance activities;
- Improve the condition of bridge structures;
- Improve the pavement conditions on the region’s multimodal travel network;

- Maintain and improve service reliability, through regular route and service evaluations, and proper preventative maintenance practices;
- Maintain and upgrade all transit facilities , including Gallagher Intermodal Center, commuter rail parking garages, Kennedy Bus Hub and operation and maintenance centers
- Ensure that the LRTA Bus and Paratransit fleets are safe, accessible and in a state of good repair;
- Continued participation in MassDOT programs, plans and policies including the Statewide Bridge Program, the Complete Streets funding program and Chapter 90; and
- Continuing to participate in the State ITS program.

Table ES-2 outlines the Roadway Infrastructure performance measures and targets aimed at achieving adopted goals. The NMMPO, at its October 24, 2018 meeting, voted to adopt statewide targets for pavement and bridge conditions and at its February 27, 2019, meeting adopted Lowell Regional Transit Authority (LRTA) assets (Table ES-3). This RTP shows a regional long-term target of achieving a 10% reduction in poor pavement and bridge conditions by 2040.

**Table ES-2: Pavement and Bridge Performance Measures and Targets**

Performance Measures	Current Statewide Condition 2017	2020 Statewide Performance Target	2022 Statewide Performance Target	2040 Regional Target (10% reduction poor)
<b>Interstate Pavement Condition</b>				
% of pavement in Good Condition	74.20%	70%	70%	NA
% of pavement in Poor Condition	0.10%	4%	4%	0.09%
<b>Non-Interstate Pavement Condition</b>				
% of pavement in Good Condition	32.90%	30%	30%	NA
% of pavement in Poor Condition	31.40%	30%	30%	28.3%
<b>Bridges</b>				
% of Bridges in Good Condition	15.22%	15%	16%	NA
% of Bridges in Poor Condition	12.37%	13%	12%	11.1%

The Federal Transit Administration’s (FTA) Final rule (49 CFR Part 625) outlined a requirement for transit providers to implement performance management through Transit Asset Management Plans. LRTA, as a

Tier II Provider<sup>1</sup>, adopted their respective TAM Plan on August 28, 2018. The NMMPO reviewed and adopted the performance measures outlined in the Plan on February 27, 2019. The TAM Plan covers a horizon period of Federal Fiscal Years 2018-2022. The purpose of the plan is to:

- Provide implementation actions that offer enabling support and direction for management of transit assets; and
- Provide direction and expectations for asset class owners and department managers regarding lifecycle management planning and processes.

The TAM Plan uses transit asset condition to guide the management of capital assets and prioritizations of funding to improve/maintain a State of Good Repair (SGR). SGR performance measures and targets were set for rolling stock, equipment and facilities. Table ES-3 outlines the NMMPO-adopted TAM performance measures and targets.

**Table ES-3: Transit Asset Management Performance Measures and Targets**

Asset Category -Performance Measure	Asset Class	2019 Target	2020 Target	2021 Target	2022 Target	2023 Target
<b>REVENUE VEHICLES</b>						
Age -% of revenue vehicles within a particular asset class that have met or exceeded their Useful Life Benchmark	BU -Bus	12%	20%	10%	5%	3%
	CU -Cutaway Bus	11%	24%	35%	13%	4%
<b>EQUIPMENT</b>						
Age -% of vehicles that have met or exceeded their Useful Life Benchmark	Non-Revenue/Service Automobile	50%	0%	0%	0%	0%
	Trucks and other Rubber Tire Vehicles	70%	70%	70%	70%	70%
	Maintenance Equipment*	30%	30%	22%	22%	10%
	Facilities Equipment*	0%	0%	0%	0%	0%
<b>FACILITIES</b>						
Condition -% of facilities with a condition rating below 3.0 on the FTA Transit Economic Requirements Model (TERM) Scale	Administration	0%	0%	0%	0%	0%
	Maintenance	0%	0%	0%	0%	0%
	Parking Structures	0%	0%	0%	0%	0%
	Passenger Facilities	50%	50%	0%	0%	0%

<sup>1</sup> Tier II Provider: 100 or fewer vehicles across all fixed routes.

### GOAL 3: IMPROVE TRAVEL TIME AND RELIABILITY FOR PEOPLE AND GOODS

Congestion results in increased travel time, poor air quality, increased greenhouse gas emissions, and frustration on the part of the traveling public. Improved methods of providing information about roadway conditions is essential in helping drivers plan trips and be aware of alternative routes and modes.

In order to achieve this goal, the NMMPO strives to support projects, programs, and policies that:

- Improve the performance of the existing transportation facilities to reduce congestion;
- Eliminate critical highway bottlenecks;
- Increase reliability and on-time performance of the transit system;
- Increase bicycle parking capacity, pedestrian facilities and access to transit stations in order to encourage mode shift; and
- Improve incident management.

As part of the FAST Act's performance-based planning process, FHWA passed a systems performance measure rule aimed at improving the efficiency of the system and freight movement, reducing traffic congestion, and reducing emissions. In October 2018 the NMMPO adopted MassDOT set targets for the following measures:

- **Level of Travel Time Reliability (LOTRR):** the consistency or dependability in travel times, as measured from day-to-day and/or across different times of the day.
- **Level of Truck Travel Time Reliability (TTTR):** the consistency or dependability in truck travel times, as measured from day-to-day and/or across different times of the day.

The Northern Middlesex MPO planning area includes communities in the Boston Urbanized Area (UZA). As a signatory to the 2018 Boston UZA Memorandum of Understanding (Boston UZA MOU), the NMMPO has adopted two-year (2020) and four-year (2022) Boston UZA-wide congestion performance measure targets. Targets were developed in coordination with state Departments of Transportation and neighboring MPOs with planning responsibility for portions of the Boston UZA.

- **Percentage of Non-Single Occupancy Vehicle (SOV) Travel:** The metric is based on the percentage of people commuting to work using a mode other than a single occupancy vehicle (e.g. carpool, van, public transit, walking, bicycling, or telecommuting).
- **Peak Hour Excessive Delay (PHED):** a measurement of annual hours of excessive delay per capita on the National Highway System (NHS) between 6 am and 10 am, and 3 pm and 7 pm, divided by the total UZA population.
- **Emissions Reductions:** The on-road mobile source emissions measure is calculated by summing two-and four-year totals of emissions reductions in kilograms per day.

In October 2018, the NMMPO voted to adopt two-year (2020) and four-year (2022) statewide reliability, congestion, and emissions performance measures and targets set by MassDOT. Table ES-4 summarizes each system performance measure and target adopted by the NMMPO. The 2040 regional targets represent a reduction of 20%, continuing the targets set in the 2016 Regional Transportation Plan.

**Table ES-4: System Performance Measures and Targets**

Performance Measures	2017 Current Conditions (State)	2017 Current Conditions (Region)	2020 Target	2022 Target	2040 Regional Target
<b>Percentage of Travel Time Reliability</b>	68% Interstate	66.9% Interstate	68% Interstate	68% Interstate	80%
	80% Non-Interstate	80.6% Non-Interstate	80% Non-Interstate	80% Non-Interstate	97%
<b>Level of Truck Travel Time Reliability</b>	1.85	2.48	1.85	1.85	1.98
<b>Peak Hour Excessive Delay (annual hours per capita – Boston UZA)</b>	18.31	18.31	18.31	18.31	14.65
<b>Non-SOV Travel (Boston UZA)</b>	33.60% (2016)	33.60%	34.50%	35.10%	40.3%
<b>CO Benefit (kg/day)</b>	24.452 kg/day (State baseline condition)	11.76 kg/day (FFY14-17 regional baseline);	0.00 (FFY 18-19 regional target) 1,596.514 (State target)	0.00 (FFY 2018-2022 regional target) 1,596.514 (State target)	FFY 2036-2040 Regional TIP
<b>NOx Emissions Reduction (kg/day)</b>	0.742 (FFY 14-17 Obligated STIP Projects using CMAQ Funding)		0.5	1.6	
<b>VOC Emissions Reduction (kg/day)</b>	1.667 (FFY 14-17 Obligated STIP Projects using CMAQ Funding)		0.6	0.9	
<b>Ozone (kg/day)</b>	FFY 14-17 baseline condition		497.9	1.1	

#### GOAL 4: ENSURE THAT THE TRANSPORTATION NETWORK SUPPORTS ECONOMIC DEVELOPMENT NEEDS AND ACCOMMODATES FUTURE ECONOMIC GROWTH

An efficient, safe, and reliable transportation system is critical to the economic vitality of the region. Sufficient road, rail, and transit connections allow businesses to transport goods and services to markets and allow workers to get to job centers. The RTP strives to reduce the time and cost of commuting, goods movement, and other travel activities. Transportation supports economic development by improving access to priority development areas, and increasing transportation options in economically disadvantaged communities.

In order to achieve the economic vitality goal, the NMMPO support projects, programs, and policies that:

- Advance corridor and community development and redevelopment opportunities to improve the region's economy and enhance quality of life;
- Prioritize transportation investments that serve targeted development sites;
- Advance strategies to support connections between key employment origins and destinations;
- Expand transit service to regional employment markets that are either underserved or not currently served;
- Improve bicycle and pedestrian access to employment, educational, health, and recreational opportunities; and
- Connect multi-family and affordable housing with employment and educational opportunities.

This 2020 Regional Transportation Plan continues to support the goals outlined in the 2016 version, by monitoring the following performance measures:

- Number of new businesses formed;
- Number of Affordable Housing facilities served by transit;
- New jobs created;
- Number of new or expanded transit routes to serve employment centers, health care facilities, and educational facilities; and
- Percentage of population and places of employment within ¼ mile of a transit station or route.

Targets aimed at achieving this goal include the following:

- Increase percentage of population and places of employment within ¼ mile of transit station or route by 5% as compared to 2016; and
- Increase percentage of population and places of employment within ½ mile of bicycle facilities by 15% as compared to 2016.

## GOAL 5: MINIMIZE AND MITIGATE THE IMPACTS OF THE TRANSPORTATION SYSTEM ON THE ENVIRONMENT, INCLUDING AIR QUALITY, WATER QUALITY, WILDLIFE HABITAT, AND CLIMATE CHANGE

Transportation affects the environment by producing air pollution (including greenhouse gases), creating runoff that affects soils and drinking water, consuming land, and by generating noise and visual impacts. Air quality can be improved by encouraging the use of modes that reduce the amount of emissions per passenger per mile. Ridesharing, transit, bicycling and walking are beneficial in this regard, compared to using the single occupant automobile. Alternative fuels, electric vehicles and new engine technologies also offer hope for the future.

Design and construction of facilities should assure that materials used in operations and maintenance, such as road salt, will not have negative impacts on drinking water. In planning new facilities, sensitivity to design issues can also minimize adverse impacts on communities through appropriate treatments, such as landscaping and noise barriers. Future transportation improvements should be designed and constructed in a way that minimizes the disruption of existing neighborhoods, and preserves prime farmland, natural resources and open spaces.

Transportation system management measures enhance mobility and strengthen corridor efficiency by reducing overall travel time delay. Deploying and adapting Intelligent Transportation Systems (ITS), such as vehicle flow treatments, real-time system information programs, transit monitoring systems and real time automated incident detection technologies, can also improve the reliability and efficiency of the transportation system.

The most efficient modes of transportation save energy by using fewer vehicles to carry a given number of people. As vehicle occupancy rates increase, the amount of energy used per passenger mile decreases. The use of the most energy efficient modes, such as transit, ridesharing, bicycling and walking, should be encouraged wherever practical. Minimizing the use of energy resources will also help to lower greenhouse gas emissions. This plan supports MassDOT's Healthy Transportation Compact, which outlines the State's mode shift goal, and the Global Warming Solutions Act, which focuses on reduction of greenhouse gas emissions, by prioritizing projects aimed to achieve their goals. The Commission on the Future of Transportation, established under Executive Order 579, recommends electrification of the Commonwealth's transportation system. Electric vehicles produce far fewer emissions than conventional vehicles, and their use is supported by the NMMPO.

Transportation and land use policies have a symbiotic relationship –each is dependent upon the other. Transportation facilities should be constructed to serve areas with existing demand, and the land should be developed most intensively where there are adequate transportation facilities. Transportation planning decisions should incorporate sound local and regional land use planning objectives. Compact,

mixed-use development brings jobs, housing and shopping closer together, and, thereby, improves livability.

To achieve the environmental sustainability and livability goal, the NMMPO supports projects, programs, and policies that:

- Encourage mode shift and reduce VMT;
- Provide multimodal, active transportation options that improve public health and reduce air pollution;
- Maintain national ambient air quality standards;
- Create a connected network of bicycle and pedestrian facilities by expanding existing facilities and closing gaps;
- Promote the use of alternative fuel vehicles, such as compressed natural gas (CNG), electric and hybrid electric;
- Provide additional electric vehicle charging facilities;
- Protect critical transportation infrastructure from the effects of climate change;
- Promote sustainable design principles that minimize the region’s carbon footprint;
- Consider sensitive environmental resources, such as wetlands and wildlife habitat, in planning and designing transportation improvements; and
- Address stormwater runoff and flooding concerns.

**Table ES-5: Environmental Sustainability and Livability Performance Measures and Targets**

<b>Goal 5: Environmental Sustainability and Livability</b>	
<b>Performance Measures</b>	<b>Roadways</b>
	On-road mobile source emissions (carbon dioxide, nitrogen oxides, volatile organic compounds, greenhouse gases).
	Number of projects implemented that benefit air quality
	Number of stormwater improvement projects implemented by local communities and MassDOT
	<b>Transit</b>
	Transit fleet mix (alternative fueling technologies)
	Number of electric vehicle charging stations added
	<b>Active Transportation</b>
	Bicycle and Pedestrian mode share
Miles of bike lanes, sidewalks and off road multi use trails	
<b>Targets</b>	<b>By 2040:</b>
	Reduce transportation-related carbon dioxide emissions below 1990 levels by 25% as compared to 2010
	Increase electric or compressed natural gas (CNG) transit fleet by 15% as compared to 2016

**Table ES-5: Environmental Sustainability and Livability Performance Measures and Targets**

<b>Goal 5: Environmental Sustainability and Livability</b>	
	Double bicycling and walking mode share as compared to 2016.
	Increase miles of bike lanes and sharrows by 25% as compared to 2016.
	Increase miles of sidewalks and trails by 15% as compared to 2016.
	Increase the number of electric vehicle charging stations by 20% as compared to 2016

In order to achieve these targets, the NMMPO will continue to work with local, regional, state and Federal partners to:

- Ensure that transportation construction projects respect the environment and are adequately mitigated;
- Promote alternative modes of transportation;
- Work with local communities to address pollution from stormwater runoff, limit deicing chemicals, and protect wildlife habitat; and
- Work to protect critical infrastructure from impacts of climate change.

**GOAL 6: PROVIDE FAIR AND EQUAL TRANSPORTATION ACCESS AND SERVICE QUALITY TO ALL COMMUNITIES AND NEIGHBORHOODS, REGARDLESS OF INCOME, RACE OR LEP STATUS.**

An equitable transportation system can produce many benefits including economic equity, social justice and equality. The RTP strives to provide mobility and accessibility to the transportation system for all people, particularly those who are transportation disadvantaged, and to minimize transportation barriers for mobility-limited people. Transit and paratransit services and systems must be accessible to persons with physical or other disabilities, in accordance with the Americans with Disabilities Act.

Transportation decision-making should be made through an open and accessible public participatory process that includes broad representation of interested individuals and groups, including minority and low-income populations. Environmental justice should be fostered through the maintenance of a planning process that does not unfairly affect any one segment of our community. Early and continuing opportunities for public engagement in transportation plans, projects and programs should be provided, particularly for those in the communities traditionally underserved by the transportation planning process.

To provide fair and equal transportation access and service quality to all communities and neighborhoods regardless of income, race or LEP status, the NMMPO supports projects, programs and policies that:

- Maximize benefits and minimize burdens of transportation investments for low-income and minority neighborhoods;
- Meet non-traditional transportation and transit-dependent needs of the region’s population, including those of the elderly and persons with disabilities; and
- Ensure that low-income, minority and Non-English speaking persons have ample opportunities to participate in the transportation planning process and share in the decision-making process.

**Table ES-6: Transportation Equity and Accessibility Performance Measures and Targets**

<b>Goal 6: Transportation Equity and Accessibility</b>	
<b>Performance Measures</b>	Monitor transportation projects and investments (number of projects and dollars of investment) that ensure that low-income and minority neighborhoods share equally in the benefits and burdens
	Monitor transit improvement projects to ensure that low-income and minority neighborhoods receive equitable service levels and equipment
<b>Targets</b>	By 2040:
	Provide long-term documentation demonstrating that low income, minority and Non-English speaking persons share equally the benefits and burdens of transportation improvements and investments

To achieve the long-range target, the NMMPO will continue the following efforts:

- Actively engaging minority and low income neighborhoods;
- Review and expand the regional public participation process;
- Monitor changes in demographics; and
- Routinely evaluate transportation projects and programs to assess impacts on low-income and minority populations through the Transportation Improvement Program and the Unified Planning Work Program.

**PUBLIC OUTREACH**

Chapter 2 describes the public participation process used to develop the RTP. Public meetings, a survey, and social media were used to gather input from residents on the transportation needs and opportunities in the region. Chapter 3 highlights the role of the NMMPO in transportation policy, planning, and investment decision making, including the organizational structure and current members of the NMMPO.

**CURRENT TRANSPORTATION SYSTEM**

Chapter 4 discusses the existing and projected demographic and economic conditions along with land use and commuting patterns in the region. Chapters 5 through 8 provide an overview of the regional

transportation system by mode, including highways and bridges, public transportation, bicycling and walking. Intelligent Transportation Systems (ITS) initiatives across the region are also discussed.

Chapter 9 provides information on transportation safety and security considerations in the region. The congestion management process is presented in Chapter 10, as a means to provide practical tools to identify and implement strategies that improve the mobility of people and freight. This chapter emphasizes coordinated corridor-level and region-wide solutions that address existing and future sources of congestion that result in excess travel delays.

### OPPORTUNITIES AND ISSUES IN TRANSPORTATION PLANNING

Chapters 11 through 14 address a number of transportation planning topics that the MPO investigates and analyzes over the next 21 years. The issues are as follows:

- **Freight Movement:** Opportunities and challenges related to improving freight transportation by truck and rail are discussed.
- **Economic Development:** An overview of regionally significant development projects and related transportation infrastructure is presented.
- **Environmental Sustainability and Livability:** A preliminary analysis of the potential environmental impacts associated with the projects contained in the RTP is provided.
- **Transportation Equity and Accessibility:** An assessment of the region's environmental justice population and an analysis of the environmental justice impacts of the projects in the RTP are provided.

### PLAN RECOMMENDATIONS

Federal requirements mandate that the RTP include a financial plan that demonstrates how the recommendations can be implemented based on system-level estimates of costs and reasonably expected revenues. Chapter 15 presents plan recommendations to address existing and future needs, which can be implemented using the financial resources that are reasonably expected to be available through 2040. The recommendations will lead to the projects and programs that best address regional transportation needs, while focusing on the preservation and maintenance of the transportation system. The anticipated costs of implementing transportation projects and programs, and the federal revenues that can be reasonably expected to be available over the period covered by the RTP. The following tables summarize the recommendations of the RTP for both highway and transit projects. The projects recommended in the RTP must be within expected targets available to the Northern Middlesex MPO for programming.

**Table ES-7: FFY 2020-2024 Northern Middlesex RTP Recommendations - Highway**

City/Town	Project Name	MassDOT ID	Construction Cost Estimate	RTP/TIP Program Year	NMMPO Investment Program Category	Year of Expenditure Cost
Chelmsford	Intersection improvements at Boston Road and Concord Road	608375	\$2,440,923	2020	Intersection Improvements / Safety	\$2,440,923
Tewksbury	Intersection Improvements at Andover Street (Route 133) and River Road	609038	\$3,518,633	2020	Intersection Improvements / Safety	\$3,518,633
Tewksbury	Resurfacing and Sidewalk Reconstruction on Route 38 Beginning at Colonial Drive North to the Intersection of Old Boston Road	608297	\$4,200,000	2021	Roadway/ Corridor Improvements	\$4,368,000
Dunstable	Route 113 Improvements from Pleasant Street to 750 Ft. East of Westford Street	608603	\$4,894,986	2021	Roadway/ Corridor Improvements	\$5,090,785
Billerica	Rehabilitation on Boston Road (Route 3A) from Floyd St to Billerica Town Center	605178	\$2,144,306	2022	Roadway/ Corridor Improvements	\$2,319,281
Westford	Bridge Rehabilitation - Beaver Brook Road over Beaver Brook (W-26-014)	608830	\$1,620,000	2022	Bridge Rehabilitation/ Reconstruction	\$1,752,192
Dracut	Improvements on Nashua Road	608350	\$5,210,395	2022	Roadway/ Corridor Improvements	\$5,635,563
Billerica	Rehabilitation on Boston Road (Route 3A) from Floyd St to Billerica Town Center	605178	\$8,766,519	2023	Roadway/ Corridor Improvements	\$9,861,142
Chelmsford	Traffic Signal Installation at Route 110 and I-495 (2 Locations)	607401	\$1,172,500	2024	Intersection Improvements / Safety	\$1,371,659
Westford	Westford - Rehabilitation of Boston Road	609035	\$6,095,000	2024	Roadway/ Corridor Improvements	\$7,130,288
<b>Estimated Costs</b>						<b>\$43,488,467</b>
<b>Regional Discretionary Funding Available</b>						<b>\$48,513,053</b>
<b>Unprogrammed Funding</b>						<b>\$5,024,586</b>

Table ES-8 includes recommended RTP projects that are currently programmed to be funded through statewide programs outside of the MPO's regional allocation. These projects are currently listed in the FFY 2020-2024 Transportation Improvement Program (TIP) for the Northern Middlesex Region.

**Table ES-8: FFY 2020-2024 Northern Middlesex RTP Recommendations – Highway State Program Projects**

City/Town	Project Name	MassDOT ID	Construction Cost Estimate	RTP/TIP Program Year	NMMPO Investment Program Category	Year of Expenditure Cost
Billerica	Yankee Doodle Bike Path Construction (Phase 1)	608227	\$9,673,932	2024	Bicycle and Pedestrian Improvement Program	\$11,317,132
Lowell	Pedestrian Walkway & Bicycle Connection at Pawtucket Falls Overlook, from Vandenberg Esplanade to School Street	607885	\$2,232,100	2021	Bicycle and Pedestrian Improvement Program	\$2,321,384
Lowell/ Tewksbury	Route 38 Intersection Improvements	608774	\$3,000,000	2023	Intersection Improvements/ Safety	\$3,374,592
Westford	Bridge Replacement, W26-002, Stony Brook Road over Stony Brook	608861	\$2,205,120	2022	Bridge Rehabilitation/ Reconstruction	\$2,385,058
<b>Estimated Costs</b>						<b>\$19,398,166</b>

Table ES-9 lists projects recommended in the FFY 2025-2029 time period. These projects have been approved by MassDOT and are eligible to be programmed in the Northern Middlesex TIP. These projects are currently in the preliminary design phase and are expected to be programmed for construction in the between 2025 and 2029.

**Table ES-9: FFY 2025-2029 Northern Middlesex RTP Recommendations - Highway**

City/Town	Investment Program/Project Name	MassDOT ID	Construction Cost Estimate	RTP Program Year	NMMPO Program	Year of Expenditure Cost
Lowell	Reconstruction and Related Work on VFW Highway	605966	\$6,215,865	2025	Roadway/ Corridor Improvements	\$7,562,550
Billerica	Intersection Improvements to Boston Rd/ Glad Valley Dr/ Lexington Rd	609250	\$3,003,500	2026	Intersection Improvements/ Safety	\$3,800,386
Lowell	Connector Reconstruction from Thorndike Street to Gorham Street	604694	\$3,409,870	2026	Roadway/ Corridor Improvements	\$4,314,573
Chelmsford	Improvements on Chelmsford Street (Route 110)	609317	\$5,625,000	2027	Intersection Improvements/ Safety	\$7,402,116

**Table ES-9: FFY 2025-2029 Northern Middlesex RTP Recommendations - Highway**

City/Town	Investment Program/Project Name	MassDOT ID	Construction Cost Estimate	RTP Program Year	NMMPO Program	Year of Expenditure Cost
Chelmsford	Improvements on Chelmsford Street (Route 110)	609317	\$5,625,000	2028	Intersection Improvements/Safety	\$7,698,201
Lowell	Church Street 2 Way Conversion	609050	\$3,050,000	2029	Roadway/Corridor Improvements	\$4,341,101
Billerica	Middlesex Canal Enhancement	602945	\$3,003,500	2029	Bicycle and Pedestrian Improvements	\$4,274,917
<b>Estimated Costs</b>						<b>\$39,393,844</b>
<b>Regional Discretionary funding Available</b>						<b>\$55,620,728</b>
<b>Unprogrammed Funding</b>						<b>\$16,226,884</b>

Table ES-10 lists funding allocation for the four highway investment programs presented by the NMMPO during RTP development. During development of this Plan, NMMPO staff compiled a universe of projects and based on that database, the percentage of investment program spending was determined. Each project in the universe has been categorized into one of these programs.

**Table ES-10: FFY 2030-2040 Investment Program Recommendations - Highway**

City/Town	Investment Program/Project Name	MassDOT ID	% Allocation	FFY 2030-2034	FFY 2035-2039	FFY 2040
Region	Intersection Improvements and Safety Investment Program	NA	33%	\$22,537,366	\$24,979,307	\$5,313,050
Region	Roadway/Corridor Investment Program	NA	42%	\$28,683,921	\$31,791,846	\$6,762,064
Region	Bicycle and Pedestrian Improvement Investment Program	NA	22%	\$15,024,911	\$16,652,872	\$3,542,033
Region	Bridge Rehabilitation/Reconstruction Investment Program	NA	3%	\$2,048,851	\$2,270,846	\$483,005
<b>Estimated Costs</b>				<b>\$68,295,049</b>	<b>\$75,694,871</b>	<b>\$16,100,152</b>
<b>Regional Discretionary Funding Available</b>				<b>\$68,295,049</b>	<b>\$75,694,871</b>	<b>\$16,100,152</b>
<b>Unprogrammed Funding</b>				<b>\$0</b>	<b>\$0</b>	<b>\$0</b>

Tables ES-11 and ES-12 present transit recommendations determined through collaboration with the Lowell Regional Transit Authority.

**Table ES-11: LRTA Capital Project Recommendations**

Category	2020-2024	2025-2029	2030-2034	2035-2039	2040	Total
<i>Bus Replacement</i>						
Fixed Route Buses over 35 ft.	\$7,413,250	\$9,191,400	\$14,045,521	\$11,510,142	\$0	\$42,160,313
Fixed Route Buses Under 35 ft.	\$787,500	\$1,003,811	\$901,000	\$400,000	\$215,000	\$3,307,311
Paratransit	\$0	\$0	\$0	\$0	\$0	\$0
Support Vehicles	\$0	\$80,000	\$95,000	\$100,000	\$40,000	\$315,000
Preventive Maintenance	\$10,004,848	\$10,955,309	\$11,996,063	\$13,135,689	\$2,627,136	\$48,719,045
<i>Facility Updates and Improvements</i>						
LRTA Admin Office	\$100,000	\$20,000	\$20,000	\$20,000	\$20,000	\$180,000
Gallagher Intermodal Transportation Center	\$500,000	\$100,000	\$100,000	\$100,000	\$10,000	\$810,000
Gallagher Parking Garage Facilities	\$320,000	\$100,000	\$100,000	\$100,000	\$20,000	\$640,000
100 Hale Street Fixed Route Operations & Maintenance Facility	\$0	\$250,000	\$250,000	\$250,000	\$50,000	\$800,000
Robert B. Kennedy Bus Hub/ Transfer Center	\$400,000	\$100,000	\$50,000	\$100,000	\$10,000	\$660,000
Roadrunner Paratransit Operations and Maintenance	\$0	\$100,000	\$25,000	\$50,000	\$10,000	\$185,000
Spare Parts, Equipment and Miscellaneous	\$1,703,125	\$600,000	\$600,000	\$600,000	\$40,000	\$3,543,125
Fareboxes and Communication	\$0	\$2,000,000	\$0	\$0	\$0	\$2,000,000
<b>Total Capital</b>	<b>\$21,228,723</b>	<b>\$24,500,520</b>	<b>\$28,182,584</b>	<b>\$26,365,831</b>	<b>\$3,042,136</b>	<b>\$103,319,794</b>

**Table ES-12: LRTA Operations Improvements Recommendations**

Description	2020-2024	2025-2029	2030-2034	2035-2039	2040	Total
Realign Rte 01 - Christian Hill	Implementation Cost Neutral	No Additional Cost	No Additional Cost	No Additional Cost	No Additional Cost	\$0
Realign Routes through Downtown Lowell	Implementation Cost Neutral	No Additional Cost	No Additional Cost	No Additional Cost	No Additional Cost	\$0
Realign Rte 16 (Chelmsford) and Rte 17 (North Chelmsford)	Implementation Cost Neutral	No Additional Cost	No Additional Cost	No Additional Cost	No Additional Cost	\$0
LRTA Route 12 Rerouting on Main Street in Tewksbury	No Additional Cost	No Additional Cost	No Additional Cost	No Additional Cost	No Additional Cost	\$0
Addition of Sunday Service (State Contract Assistance Pilot Program)	\$325,000	\$0	\$0	\$0	\$0	\$325,000

## CHAPTER 1 INTRODUCTION

The Regional Transportation Plan (RTP) is a planning guide that identifies and analyzes transportation infrastructure and service improvement needs in the Northern Middlesex Region through the year 2040. The Plan encompasses nine communities in the northern section of Middlesex County, located in eastern Massachusetts. The communities comprising this area include the Towns of Billerica, Chelmsford, Dracut, Dunstable, Pepperell, Tewksbury, Tyngsborough, and Westford, and the City of Lowell (see Map 1.1 on page 3).

All transportation projects that will be funded under Title 23, U.S.C. or with Federal Transit Act funds must be included in the RTP. In addition, projects requiring FHWA or FTA approval, but not funded under Title 23, U.S.C. or with Federal Transit Act funds, must also be listed in the RTP. Similarly, transportation projects funded with federal funds from other federal agencies, as well as projects funded with local and private monies, should be described in the document for informational purposes and to reflect the integrated and intermodal nature of the metropolitan transportation planning process.

The Plan includes:

1. An overview of transportation infrastructure;
2. An assessment of environmental issues related to transportation;
3. A discussion of transportation policies, goals and objectives, and performance measures;
4. An evaluation of transportation needs for all transportation modes;
5. An overview of anticipated future financial resources;
6. An analysis of the environmental justice and civil rights implications of transportation decisions; and
7. A list of recommended transportation projects and programs, taking into account anticipated financial constraints.

### FEDERAL TRANSPORTATION PLANNING REQUIREMENTS

On December 4, 2015, President Obama signed into law the federal transportation funding bill entitled Fixing America's Surface Transportation Act (FAST). The FAST Act funds the nation's surface transportation program – including, but not limited to, Federal Aid highways – at over \$305 billion for fiscal years 2016 through 2020. The Moving Ahead for Progress in the 21<sup>st</sup> Century Act (MAP-21), enacted in 2012, included provisions to make the Federal surface transportation system more streamlined, performance-based, and multimodal to address the many challenges facing the U.S. transportation system. These challenges include seven national goal areas: improving safety; maintaining infrastructure condition; reducing traffic congestion; improving reliability of the system; freight movement and economic vitality; environmental sustainability; and reducing delays in project delivery. The objective of the performance- and outcome-based program is to invest resources in projects that collectively advance the achievement of the national goals.

FAST did not significantly change the eight Federal planning factors initiated MAP-21 and it continues to address the many challenges facing our transportation system, such as improving safety, reducing congestion, increasing connectivity between modes and protecting the environment, as shown in Table 1.1.

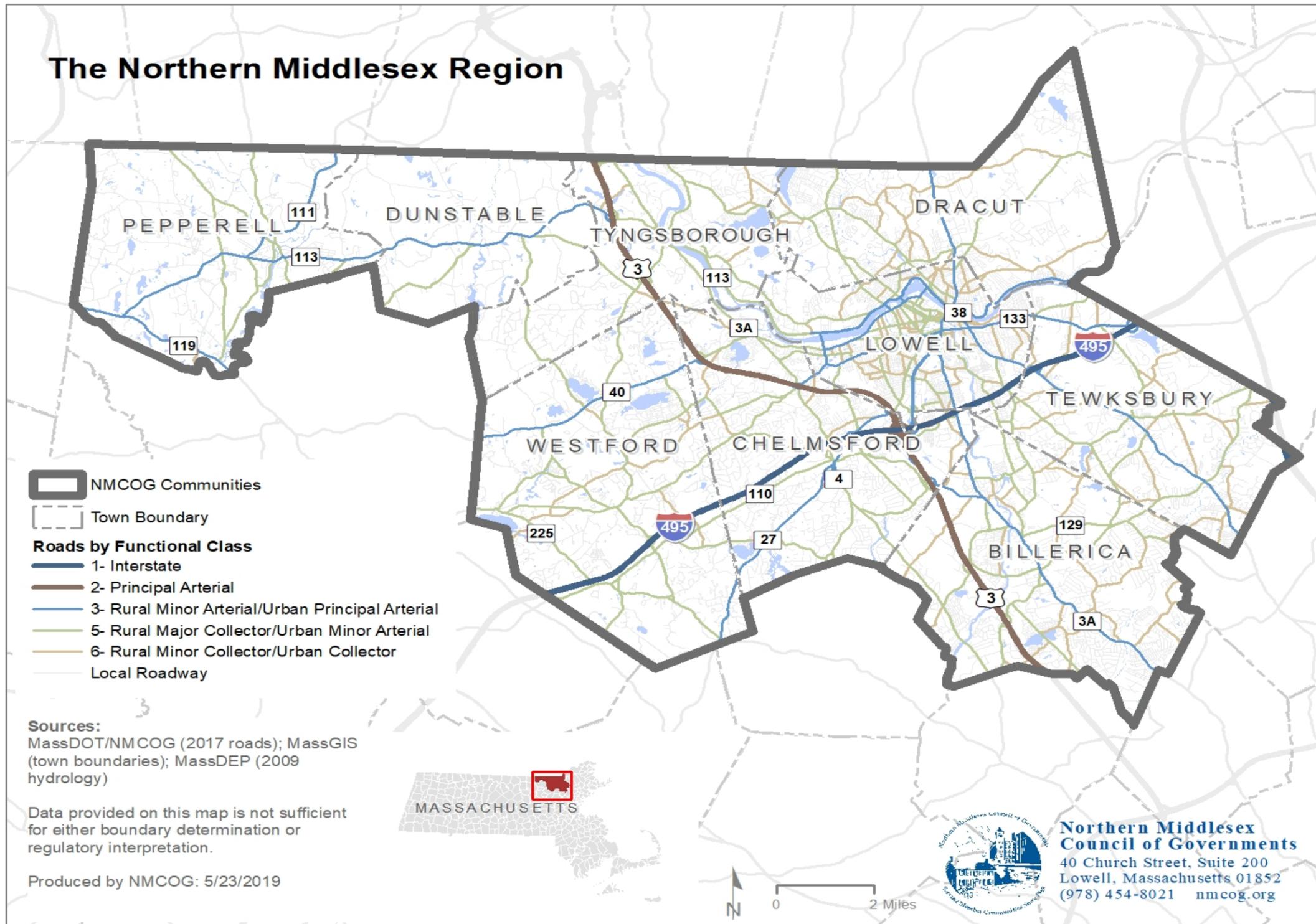
The nation and the region continue to make progress on increasing transportation options, working closely with stakeholders to ensure that local communities are able to build multimodal, sustainable projects. By setting the course for transportation investment in highways, FAST continues to advance the following national goals:

- **Strengthen America’s Highways:** FAST expanded the National Highway System (NHS) to incorporate principal arterials that were not previously included. In addition, more than half of the highway funding in the Act was devoted to preserving and improving the most important highways through the National Highway Performance Program.
- **Establish a Performance-based Program:** Under MAP-21, performance management transformed Federal highway programs and provided for more efficient investment of Federal transportation funds, by focusing on national transportation goals, increasing the accountability and transparency of the Federal highway programs, and improving transportation investment decision-making through performance-based planning and programming. The FAST Act continues the use of performance-based programs.
- **Create jobs and support economic growth:** FAST authorized Federal funding for road, bridge, bicycling, and walking improvements vital to economic sustainability and growth. In addition, FAST enhanced innovative financing and encouraged private sector investment, through a substantial increase in funding for the Transportation Infrastructure Finance and Information Act (TIFIA) program. It also included a number of provisions designed to improve freight movement by establishing a National Freight Highway Network and new freight funding programs.

**Table 1.1: FAST Act National Planning Factors**

Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency.
Increase the safety of the transportation system for motorized and non-motorized users.
Increase the security of the Transportation system for motorized and non-motorized users.
Increase accessibility and mobility of people and freight.
Protect and enhance the environment, promote energy conservation, improve the quality of life, and promote consistency between transportation improvements and State and local planned growth and economic development patterns.
Enhance the integration and connectivity of the transportation system across and between modes people and freight. Promote efficient system management and operation.
Emphasize the preservation of the existing transportation system.

Map 1.1: The Northern Middlesex Region



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- **Support USDOT’s aggressive safety agenda:** FAST continues the successful Highway Safety Improvement Program (HSIP), funding for infrastructure safety, strengthening the linkage among modal safety programs, and creating a positive agenda for reducing highway fatalities. It also continues to build upon other aggressive safety efforts, including the USDOT’s fight against distracted driving and its push to improve transit and motor carrier safety.
- **Improving Transportation System Resiliency and Reliability:** FAST expands the scope of the metropolitan planning process to focus on overall reliability of the system. By providing accurate and reliable information to users of the system, mobility will be enhanced.
- **Accelerate Project Delivery and Promote Innovation:** FAST continues to ensure the timely delivery of transportation projects by improving innovation and efficiency during the development of projects and throughout the planning and environmental review processes, to project delivery.
- **Mitigation of Stormwater Impacts on Surface Transportation:** FAST looks to prioritize and fund projects aimed at reducing or mitigating the impacts of stormwater runoff on the transportation system and on the environment.
- **Enhancing Travel and Tourism:** FAST focuses on the role of intermodal transportation in facilitating mobility with respect to travel and tourism activities.

## MEASURING PLAN EFFECTIVENESS THROUGH PERFORMANCE MANAGEMENT

As discussed above, the FAST Act continues many of the policies of the Moving Ahead for Progress in the 21<sup>st</sup> Century Act (MAP-21), which created a performance-based and outcome-based program to address the many challenges facing the transportation system. The objective of the performance-based program is to invest resources in projects that collectively advance the achievement of national goals.

The USDOT continues to develop performance goals for each emphasis area. MassDOT and the NMMPO are currently developing performance measures and targets to include in project evaluation and prioritization. The TIP development process considers these performance measures in making transportation investment decisions that address the achievement of performance goals.

FHWA has released Final Rules establishing performance measures relative to safety, pavement condition, bridge condition, the National Highway System, Freight Movement, Congestion, and Congestion Mitigation Air Quality (CMAQ), as shown in Table 1.1. Each rule has an effective date. Once the Final Rules for these measures became effective, MassDOT established performance targets for each national performance measure. The NMMPO then worked with MassDOT and its regional partners to establish regional targets, by either adopting state targets or developing new goals.

**Table 1.1: National Performance Management Rules and Performance Measures**

National Performance Management Rule	National Performance Measures	Final Rule Effective Date
National Performance Management Measures to Assess Safety (PM1: 23 CFR 490.207)	# of Fatalities	14-Apr-16
	Rate of Fatalities per 100 million VMT	
	# of Serious Injuries	
	Rate of Serious Injuries per 100 million VMT	
	# of Non-motorized Fatalities and Serious Injuries	
National Performance Management Measures to Assess Pavement Condition (PM2: 23 CFR Part 490.307)	Percentage of pavements of the Interstate System in Good Condition	20-May-17
	Percentage of pavements of the Interstate System in Poor Condition	
	Percentage of pavements of the non-Interstate NHS in Good condition	
	Percentage of pavements of the non-Interstate NHS in Poor condition	
National Performance Management Measures to Assess Bridge Condition (PM 2: 23 CFR 490.407)	Percentage of NHS bridges classified as being in Good condition	20-May-17
	Percentage of NHS bridges classified as being in Poor condition	
Performance of the National Highway System (PM 3: 23 CFR 490.507)	Interstate Travel Time Reliability Measure: Percent of person-miles traveled on the Interstate that are reliable	20-May-17
	Non-Interstate Travel Time Reliability Measure: Percent of person-miles traveled on the non-Interstate NHS that are reliable	
	Greenhouse Gas Measure: Percent change in tailpipe CO2 emissions on the NHS compared to the calendar year 2017 level	
Freight Movement on the Interstate System (PM 3: 23 CFR 490.607)	Freight Reliability Measure: Truck Travel Time Reliability (TTTR) Index	20-May-17
Measures to Assess the CMAQ Program - Traffic Congestion (PM 3: 23 CFR 490.707)	Peak Hour Excessive Delay (PHED) Measure: Annual Hours of Peak Hour Excessive Delay (PHED) per Capita	20-May-17
	Non-Single Occupancy Vehicle Travel (SOV) Measure: Percent of Non-Single Occupancy Vehicle (SOV) Travel	

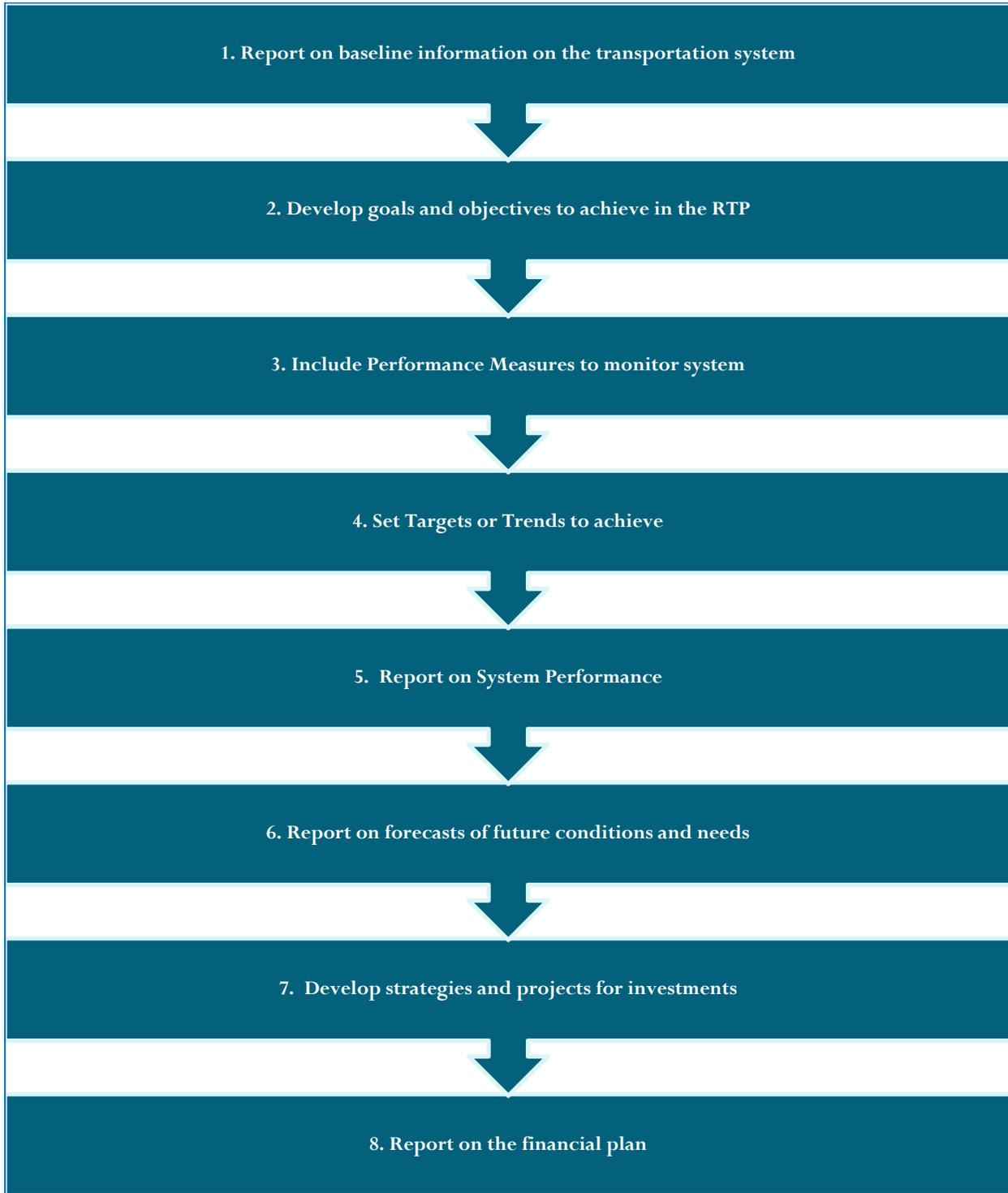
**Table 1.1: National Performance Management Rules and Performance Measures**

National Performance Management Rule	National Performance Measures	Final Rule Effective Date
Measure to Assess the CMAQ Program - On-Road Mobile Source Emissions (PM 3: 23 CFR 490.807)	Emissions Measure: Total Emission Reductions	20-May-17

Prior to establishment of the final rulemakings, the NMMPO worked with MassDOT on performance management activities. The Unified Planning Work Program (UPWP) includes a task on development and assessment of performance measures. The 2016 Regional Transportation Plan outlined initial performance measures aimed at achieving targets and is further refined in this plan. Other regional activities in performance-based planning are categorized under Safety, Travel Time Reliability and Peak Hour Excessive Delay, Bridge Performance, Pavement Condition, Air Quality, and State of Good Repair.

As displayed in Figure 1.1 on the next page, development of a performance-based transportation plan encompasses all key elements of the transportation planning process. The RTP includes system performance measures to track issues such as congestion, pavement management, safety, and transit operations. These performance measures are used to set clear policies, analyze trend data and guide investments and operational decisions. Performance measurement provides the following benefits, which lead to a more robust and transparent transportation planning and decision-making process:

- Addresses the public’s desire for accountability and transparency;
- Provides more informed decision-making and solutions to increasing challenges;
- Enhances public sector responsiveness to transportation issues and deficiencies;
- Ensures compliance with legislative mandates and regulatory requirements;
- Improves internal management;
- Facilitates refinement of programs and services; and
- Sets benchmarks for comparison of results.



**Figure 1.1: Steps involved in a performance-based approach to the Regional Transportation Plan**

A performance-based transportation plan not only addresses national goals and performance measures, but is also driven by State and regional priorities. The performance measures and targets outlined throughout the RTP have been adopted by the NMMPO over the past four years.

## REGIONAL GOALS, OBJECTIVES, PERFORMANCE MEASURES AND TARGETS

Goals and objectives are extremely useful in the regional planning process as they provide the necessary direction and basic framework upon which future decisions can be made. The overarching objective of the RTP remains the same as in previous plans, with a focus on *“developing a balanced, multi-modal, cost-effective, energy efficient transportation system connecting points inside and outside the Northern Middlesex Region”* by:

- Providing safe, secure and convenient transportation service to all area residents, especially transit dependent groups, such as the elderly, low income and individuals with disabilities;
- Maximizing energy conservation, improving air quality, minimizing traffic congestion, and reducing greenhouse gas (GHG) emissions as a means to address climate change;
- Encouraging development patterns that advance livability, promote a healthy lifestyle and are consistent with local and regional land use policies; and
- Increasing the number of travel choices for people and freight.

The goals outlined in this plan address both national and regional emphasis areas to promote a more balanced transportation system.

### GOAL 1: IMPROVE THE SAFETY OF THE TRANSPORTATION SYSTEM FOR ALL USERS

Traffic crashes result in economic loss from damaged vehicles and goods, personal pain and suffering due to injury, and occasionally the catastrophic loss of life. Facility improvements that benefit safety must be highly valued. The RTP strives to reduce and minimize the risk of crashes occurring on the roadway network, and encourages the integrated consideration of roadway, vehicle and driver elements in design of future improvements.

Objectives aimed at achieving goals include supporting projects, program and policies that:

- Advance safe travel;
- Reduce the number and severity of crashes for all modes of transportation; and
- Promote the use of technology for projects aimed at improving safety at high crash locations.

In the post September 11, 2001 era, the Plan also recognizes the need to assess security issues to ensure safe transportation facilities. The RTP calls for coordination with safety and security agencies to ensure safe and secure transport routes throughout the region and connectivity with routes beyond the region.

Table 1.2 outlines the safety performance measures and targets. The NMMPO has adopted statewide performance measures and targets for 2019. The NMMPO has also adopted a long-term target of

achieving a 20% reduction in injuries and fatalities by 2040. The 2016 Northern Middlesex Regional Transportation Plan set a goal of a 20% reduction in fatalities and injuries by 2040 and this plan continues to support that goal. The fatality and incapacitating rates for the region are consistently below state averages. MassDOT does not provide specific targets to 2040, aside from the long-term goal of zero roadway deaths.

**Table 1.2: Safety Performance Measures and Targets**

Goal Area	Performance Measures	Current Performance - Rolling Five-Year Average 2012-2016	CY 2019 Performance Target - Rolling Five-Year Average 2015-2019*	Regional Rolling Five-Year Average 2012-2016	2040 Regional Target (20% reduction)
Safety	Fatalities	364	353	61	49
	Rate of Fatalities per 100 million VMT	0.61	0.58	0.44	0.35
	Incapacitating Injuries	3,146	2,801	632	506
	Rate of Incapacitating Injuries per 100 million VMT	5.24	4.37	4.57	3.66
	Total Number of Non-Motorized Incapacitating Injuries and Fatalities	541	541	90	72

\*Statewide Target adopted by NMMPO 2/27/19

## GOAL 2: EFFICIENTLY MANAGE EXISTING TRANSPORTATION ASSETS AND INFRASTRUCTURE

The RTP places an emphasis on maximizing the efficiency of existing facilities, rather than constructing new ones. Maintenance is one of the most cost-effective strategies outlined in the Plan. A relatively small investment is needed to keep the system in good condition, compared to what would be required to completely rebuild it. Deferred maintenance may save money in the short-run, but will be far more costly over the long-term, when compared with regular preventive maintenance. Regular maintenance provides better service, improves safety, extends equipment life and results in fewer breakdowns.

This plan addresses the issue of aging infrastructure and deferred maintenance and the associated impacts on safety, equipment life and the economic health of the region and its communities, by supporting the following projects, programs, and policies:

- Prioritize projects that maintain and modernize existing capital assets;
- Improve the condition of bridge structures;
- Improve the pavement conditions on the region's multimodal travel network;
- Promote the use of technologies for infrastructure improvement projects;
- Promote proper design of infrastructure;

- Maintain and improve service reliability, through regular route and service evaluations, and proper preventative maintenance practices;
- Maintain and upgrade all transit facilities , including Gallagher Intermodal Center, commuter rail parking garages, Kennedy Bus Hub and operation and maintenance centers; and
- Ensure that the LRTA Bus and Paratransit fleets are safe, accessible and in a state of good repair.

Tables 1.3 outlines the Roadway Infrastructure performance measures and targets. The NMMPO has adopted statewide performance measures and targets for pavement condition, bridge condition and Lowell Regional Transit Authority assets. The NMMPO, at its October 24, 2018 meeting, voted to adopt statewide targets for pavement and bridge conditions. This RTP continues the 2016 RTP goal of achieving a 10% reduction in poor pavement and bridge conditions by 2040.

**Table 1.3: Pavement and Bridge Performance Measures and Targets**

Performance Measures	Current Statewide Condition 2017	2020 Statewide Performance Target	2022 Statewide Performance Target	2040 Regional Target (10% reduction poor)
<b>Interstate Pavement Condition</b>				
% of pavement in Good Condition	74.20%	70%	70%	NA
% of pavement in Poor Condition	0.10%	4%	4%	0.09%
<b>Non-Interstate Pavement Condition</b>				
% of pavement in Good Condition	32.90%	30%	30%	NA
% of pavement in Poor Condition	31.40%	30%	30%	28.3%
<b>Bridges</b>				
% of Bridges in Good Condition	15.22%	15%	16%	NA
% of Bridges in Poor Condition	12.37%	13%	12%	11.1%

The Federal Transit Administration’s (FTA) Final rule (49 CFR Part 625) outlined a requirement for transit providers to implement performance management through Transit Asset Management Plans. LRTA, as a Tier II Provider<sup>1</sup>, adopted their respective TAM Plan on August 28, 2018. The NMMPO reviewed and adopted the performance measures outlined in the Plan on February 27, 2019. The TAM Plan covers a horizon period of Federal Fiscal Years 2018-2022. The purpose of the plan is to:

- Provide implementation actions that offer enabling support and direction for management of transit assets; and

<sup>1</sup> Tier II Provider: 100 or fewer vehicles across all fixed routes.

- Provide direction and expectations for asset class owners and department managers regarding lifecycle management planning and processes.

The TAM Plan uses transit asset condition to guide the management of capital assets and prioritizations of funding to improve/maintain a State of Good Repair (SGR). SGR performance measures and targets were set for rolling stock, equipment and facilities. Table 1.4 outlines the NMMPO-adopted TAM performance measures and targets.

**Table 1.4: Transit Asset Management Performance Measures and Targets**

Asset Category -Performance Measure	Asset Class	2019 Target	2020 Target	2021 Target	2022 Target	2023 Target
<b>REVENUE VEHICLES</b>						
Age -% of revenue vehicles within a particular asset class that have met or exceeded their Useful Life Benchmark	BU -Bus	12%	20%	10%	5%	3%
	CU -Cutaway Bus	11%	24%	35%	13%	4%
<b>EQUIPMENT</b>						
Age -% of vehicles that have met or exceeded their Useful Life Benchmark	Non-Revenue/Service Automobile	50%	0%	0%	0%	0%
	Trucks and other Rubber Tire Vehicles	70%	70%	70%	70%	70%
	Maintenance Equipment*	30%	30%	22%	22%	10%
	Facilities Equipment*	0%	0%	0%	0%	0%
<b>FACILITIES</b>						
Condition -% of facilities with a condition rating below 3.0 on the FTA Transit Economic Requirements Model (TERM) Scale	Administration	0%	0%	0%	0%	0%
	Maintenance	0%	0%	0%	0%	0%
	Parking Structures	0%	0%	0%	0%	0%
	Passenger Facilities	50%	50%	0%	0%	0%

In order to achieve these goals, the NMMPO strives to address infrastructure issues by:

- Monitoring the condition of existing infrastructure and identifying critical needs;
- Prioritizing ongoing maintenance to avoid the added cost of deferred maintenance activities;
- Continued participation in MassDOT programs, plans and policies including the Statewide Bridge Program, the Complete Streets funding program and Chapter 90; and
- Continuing to participate in the State ITS program.

### GOAL 3: IMPROVE TRAVEL TIME AND RELIABILITY FOR PEOPLE AND GOODS

Congestion results in increased travel time, poor air quality, increased greenhouse gas emissions, and frustration on the part of the traveling public. Existing facilities can be enhanced by operational improvements and better intermodal connections. Other options, such as reducing travel demand through employer based ridesharing and telecommuting, can play a role in relieving congestion. Expanding existing facilities is often the most direct way to alleviate congestion, although not always the most cost-effective. Improved methods of providing information about congestion trouble spots to commuters may make travelers aware of alternative routes and modes.

In order to achieve this goal, the NMMPO strives to support projects, programs, and policies that:

- Improve the performance of the existing transportation facilities to reduce congestion;
- Eliminate critical highway bottlenecks;
- Increase reliability and on-time performance of the transit system;
- Increase bicycle parking capacity, pedestrian facilities and access to transit stations in order to encourage mode shift; and
- Improve incident management.

As part of the FAST Act's performance-based planning process, FHWA passed a systems performance measure rule aimed at improving the efficiency of the system and freight movement, reducing traffic congestion, and reducing emissions. In May 2018, MassDOT adopted targets for the following measures:

- **Level of Travel Time Reliability (LOTTR):** the consistency or dependability in travel times, as measured from day-to-day and/or across different times of the day. LOTTR is based on the amount of time it takes to drive the length of a road segment and is the percentage of person-miles traveled that are "reliable". LOTTR is calculated by dividing the 80<sup>th</sup>/50<sup>th</sup> percentile travel time. If it falls below 1.50, the segment is "reliable". The percentage of road segments that are "reliable" is used as the target.
- **Level of Truck Travel Time Reliability (TTTR):** the consistency or dependability in truck travel times, as measured from day-to-day and/or across different times of the day. TTTR is based on the amount of time it takes trucks to drive the length of a road segment and is an index of 50<sup>th</sup>/95<sup>th</sup> percentile travel times. The TTTR index is reported as a weighted average of the largest period for each segment.

The Northern Middlesex MPO planning area includes communities in the Boston Urbanized Area (UZA). As a signatory to the 2018 Boston UZA Memorandum of Understanding (Boston UZA MOU), the NMMPO has adopted two-year (2020) and four-year (2022) Boston UZA-wide congestion performance measure targets. These performance measures are the percentage of non-single occupancy vehicle (SOV) travel and the Peak Hour Excessive Delay (PHED). Targets were developed in coordination with state Departments of Transportation and neighboring MPOs with planning responsibility for portions of the Boston UZA.

- **Percentage of Non-Single Occupancy Vehicle (SOV) Travel:** The metric is based on the percentage of people commuting to work using a mode other than a single occupancy vehicle (e.g. carpool, van, public transit, walking, bicycling, or telecommuting). The targets are determined from available Census journey to work data in the Boston UZA, where the proportion of non-SOV travel has been steadily increasing and is projected to continue increasing at a rate of 0.32% annually.
- **Peak Hour Excessive Delay (PHED):** a measurement of annual hours of excessive delay per capita on the National Highway System (NHS) between 6 am and 10 am, and 3 pm and 7 pm, divided by the total UZA population. At the time when the target was set, there was only one year of data available. Therefore, the performance targets have been set flat until further data is available. The threshold is based on the travel time at 20 miles per hour or 60% of the posted speed limit, whichever is greater.
- **Emissions Reductions:** The on-road mobile source emissions measure is calculated by summing two-and four-year totals of emissions reductions in kilograms per day. Emissions reduction targets are measured as the sum total of all emissions reductions anticipated through CMAQ-funded projects in non-attainment or air quality maintenance areas (currently the cities of Lowell, Springfield, Waltham, and Worcester, and the town of Oak Bluffs) identified in the Statewide Transportation Improvement Program (STIP). This anticipated emissions reduction is calculated using the existing CMAQ processes.

The NMMPO is required to report on performance of vehicle emission reductions for carbon monoxide because of Lowell's maintenance area status and has done so in an October 2018 CMAQ Congestion and Emissions Performance report.

In October 2018, the NMMPO voted to adopt two-year (2020) and four-year (2022) statewide reliability, congestion, and emissions performance measures and targets set by MassDOT. Table 1.5 summarizes each system performance measure and target adopted by the NMMPO. The 2040 regional targets represent a reduction of 20%, continuing the targets set in the 2016 Regional Transportation Plan.

**Table 1.5: System Performance Measures and Targets**

Performance Measures	2017 Current Conditions (State)	2017 Current Conditions (Region)	2020 Target	2022 Target	2040 Regional Target
Percentage of Travel Time Reliability	68% Interstate	66.9% Interstate	68% Interstate	68% Interstate	80%
	80% Non-Interstate	80.6% Non-Interstate	80% Non-Interstate	80% Non-Interstate	97%
Level of Truck Travel Time Reliability	1.85	2.48	1.85	1.85	1.98
Peak Hour Excessive Delay (annual hours per capita – Boston UZA)	18.31	18.31	18.31	18.31	14.65
Non-SOV Travel (Boston UZA)	33.60% (2016)	33.60%	34.50%	35.10%	40.3%
CO Benefit (kg/day)	24.452 kg/day (State baseline condition)	11.76 kg/day (FFY14-17 regional baseline);	0.00 (FFY 18-19 regional target) 1,596.514 (State target)	0.00 (FFY 2018-2022 regional target) 1,596.514 (State target)	FFY 2036-2040 Regional TIP
NOx Emissions Reduction (kg/day)	0.742 (FFY 14-17 Obligated STIP Projects using CMAQ Funding)		0.5	1.6	
VOC Emissions Reduction (kg/day)	1.667 (FFY 14-17 Obligated STIP Projects using CMAQ Funding)		0.6	0.9	
Ozone (kg/day)	FFY 14-17 baseline condition		497.9	1.1	

**GOAL 4: ENSURE THAT THE TRANSPORTATION NETWORK SUPPORTS ECONOMIC DEVELOPMENT NEEDS AND ACCOMMODATES FUTURE ECONOMIC GROWTH**

An efficient, safe, and reliable transportation system is critical to the economic vitality of the region. Sufficient road, rail, and transit connections allow businesses to transport goods and services to markets and allow workers to get to job centers. The RTP strives to reduce the time and cost of commuting, goods movement, and other travel activities. Transportation supports economic development by improving access to priority development areas, and increasing transportation options in economically disadvantaged communities.

In order to achieve the economic vitality goal, the NMMPO support projects, programs, and policies that:

- Advance corridor and community development and redevelopment opportunities to improve the region's economy and enhance quality of life;
- Prioritize transportation investments that serve targeted development sites;
- Advance strategies to support connections between key employment origins and destinations;
- Expand transit service to regional employment markets that are either underserved or not currently served;
- Improve bicycle and pedestrian access to employment, educational, health, and recreational opportunities; and
- Connect multi-family and affordable housing with employment and educational opportunities.

This 2020 Regional Transportation Plan continues to support the goals outlined in the 2016 version, by monitoring the following performance measures:

- *Number of new businesses formed;*
- *Number of Affordable Housing facilities served by transit;*
- *New jobs created;*
- *Number of new or expanded transit routes to serve employment centers, health care facilities, and educational facilities; and*
- *Percentage of population and places of employment within ¼ mile of a transit station or route.*

Targets aimed at achieving this goal include the following:

- *Increase percentage of population and places of employment within ¼ mile of transit station or route by 5% as compared to 2016; and*
- *Increase percentage of population and places of employment within ½ mile of bicycle facilities by 15% as compared to 2016.*

The NMMPO strives to continue its work coordinating economic development projects and transportation infrastructure, as well as working to connect employment sites, educational institutions, and health facilities with the region's neighborhoods.

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## GOAL 5: MINIMIZE AND MITIGATE THE IMPACTS OF THE TRANSPORTATION SYSTEM ON THE ENVIRONMENT, INCLUDING AIR QUALITY, WATER QUALITY, WILDLIFE HABITAT, AND CLIMATE CHANGE

Transportation affects the environment by producing air pollution (including greenhouse gases), creating runoff that affects soils and drinking water, consuming land, and by generating noise and visual impacts. Air quality can be improved by encouraging the use of modes that reduce the amount of emissions per passenger per mile. Ridesharing, transit, bicycling and walking are beneficial in this regard,

compared to using the single occupant automobile. Alternative fuels, electric vehicles and new engine technologies also offer hope for the future.

Design and construction of facilities should assure that materials used in operations and maintenance, such as road salt, will not have negative impacts on drinking water. In planning new facilities, sensitivity to design issues can also minimize adverse impacts on communities through appropriate treatments, such as landscaping and noise barriers. Future transportation improvements should be designed and constructed in a way that minimizes the disruption of existing neighborhoods, and preserves prime farmland, natural resources and open spaces.

Transportation system management measures enhance mobility and strengthen corridor efficiency by reducing overall travel time delay. Deploying and adapting Intelligent Transportation Systems (ITS), such as vehicle flow treatments, real-time system information programs, transit monitoring systems and real time automated incident detection technologies, can also improve the reliability and efficiency of the transportation system.

The most efficient modes of transportation save energy by using fewer vehicles to carry a given number of people. As vehicle occupancy rates increase, the amount of energy used per passenger mile decreases. The use of the most energy efficient modes, such as transit, ridesharing, bicycling and walking, should be encouraged wherever practical. Minimizing the use of energy resources will also help to lower greenhouse gas emissions. This plan supports MassDOT's Healthy Transportation Compact, which outlines the State's mode shift goal, and the Global Warming Solutions Act, which focuses on reduction of greenhouse gas emissions, by prioritizing projects aimed to achieve their goals. The Commission on the Future of Transportation, established under Executive Order 579, recommends electrification of the Commonwealth's transportation system. Electric vehicles produce far fewer emissions than conventional vehicles, and their use is supported by the NMMPO.

Transportation and land use policies have a symbiotic relationship –each is dependent upon the other. Transportation facilities should be constructed to serve areas with existing demand, and the land should be developed most intensively, where there are adequate transportation facilities. Transportation planning decisions should incorporate sound local and regional land use planning objectives. Compact, mixed-use development brings jobs, housing and shopping closer together, and, thereby, improves livability.

Future transportation facilities and services should be consistent with adopted community land use plans, water quality management plans, housing plans, economic development plans and open space and recreation plans. Communities should consider the impacts of future development projects on the transportation network.

To achieve the environmental sustainability and livability goal, the NMMPO supports projects, programs, and policies that:

- Encourage mode shift and reduce VMT;

- Provide multimodal, active transportation options that improve public health and reduce air pollution;
- Maintain national ambient air quality standards;
- Create a connected network of bicycle and pedestrian facilities by expanding existing facilities and closing gaps;
- Promote the use of alternative fuel vehicles, such as compressed natural gas (CNG), electric and hybrid electric;
- Provide additional electric vehicle charging facilities;
- Protect critical transportation infrastructure from the effects of climate change;
- Promote sustainable design principles that minimize the region’s carbon footprint;
- Consider sensitive environmental resources, such as wetlands and wildlife habitat, in planning and designing transportation improvements; and
- Address stormwater runoff and flooding concerns.

Table 1.6 below outlines Environmental Sustainability and Livability performance measures and targets.

**Table 1.6: Environmental Sustainability and Livability Performance Measures and Targets**

<b>Goal 5: Environmental Sustainability and Livability</b>	
<b>Performance Measures</b>	<b>Roadways</b>
	On-road mobile source emissions (carbon dioxide, nitrogen oxides, volatile organic compounds, greenhouse gases).
	Number of projects implemented that benefit air quality
	Number of stormwater improvement projects implemented by local communities and MassDOT
	<b>Transit</b>
	Transit fleet mix (alternative fueling technologies)
	Number of electric vehicle charging stations added
	<b>Active Transportation</b>
	Bicycle and Pedestrian mode share
Miles of bike lanes, sidewalks and off road multi use trails	
<b>Targets</b>	<b>By 2040:</b>
	Reduce transportation-related carbon dioxide emissions below 1990 levels by 25% as compared to 2010
	Increase electric or compressed natural gas (CNG) transit fleet by 15% as compared to 2016
	Double bicycling and walking mode share as compared to 2016.
	Increase miles of bike lanes and sharrows by 25% as compared to 2016.
	Increase miles of sidewalks and trails by 15% as compared to 2016.
Increase the number of electric vehicle charging stations by 20% as compared to 2016	

In order to achieve these targets, the NMMPO will continue to work with local, regional, state and Federal partners to:

- Ensure that transportation construction projects respect the environment and are adequately mitigated;
- Promote alternative modes of transportation;
- Work with local communities to address pollution from stormwater runoff, limit deicing chemicals, and protect wildlife habitat; and
- Work to protect critical infrastructure from impacts of climate change.

#### GOAL 6: PROVIDE FAIR AND EQUAL TRANSPORTATION ACCESS AND SERVICE QUALITY TO ALL COMMUNITIES AND NEIGHBORHOODS, REGARDLESS OF INCOME, RACE OR LEP STATUS.

An equitable transportation system can produce many benefits including economic equity, social justice and equality. The RTP strives to provide mobility and accessibility to the transportation system for all people, particularly those who are transportation disadvantaged, and to minimize transportation barriers for mobility-limited people. Transit and paratransit services and systems must be accessible to persons with physical or other disabilities, in accordance with the Americans with Disabilities Act.

Transportation decision-making should be made through an open and accessible public participatory process that includes broad representation of interested individuals and groups, including minority and low-income populations. Environmental justice should be fostered through the maintenance of a planning process that does not unfairly affect any one segment of our community. Early and continuing opportunities for public engagement in transportation plans, projects and programs should be provided, particularly for those in the communities traditionally underserved by the transportation planning process.

To provide fair and equal transportation access and service quality to all communities and neighborhoods regardless of income, race or LEP status, the NMMPO supports projects, programs and policies that:

- Maximize benefits and minimize burdens of transportation investments for low-income and minority neighborhoods;
- Meet non-traditional transportation and transit-dependent needs of the region's population, including those of the elderly and persons with disabilities; and
- Ensure that low-income, minority and Non-English speaking persons have ample opportunities to participate in the transportation planning process and share in the decision-making process.

Table 1.7 presents performance measures and targets for Transportation Equity and Accessibility.

**Table 1.7: Transportation Equity and Accessibility Performance Measures and Targets**

<b>Goal 6: Transportation Equity and Accessibility</b>	
<b>Performance Measures</b>	Monitor transportation projects and investments (number of projects and dollars of investment) to ensure that low-income and minority neighborhoods share equally in the benefits and burdens
	Monitor transit improvement projects to ensure that low-income and minority neighborhoods receive equitable service levels and equipment
<b>Targets</b>	By 2040:
	Provide long-term documentation demonstrating that low income, minority and Non-English speaking persons share equally the benefits and burdens of transportation improvements and investments

To achieve the long-range target, the NMMPO will continue the following efforts:

- Actively engaging minority and low income neighborhoods;
- Review and expand the regional public participation process;
- Monitor changes in demographics; and
- Routinely evaluate transportation projects and programs to assess impacts on low-income and minority populations through the Transportation Improvement Program and the Unified Planning Work Program.

**RELATIONSHIP BETWEEN REGIONAL AND NATIONAL GOALS**

In developing the RTP, the NMMPO has considered how the regional goals address each of the national planning factors. Table 1.8 lists the national planning factors set out in FAST and the regional goals associated with each factor. Some planning factors include multiple regional goals, which will be discussed throughout the Plan.

**Table 1.8: National Planning Factors and Regional Goals**

<b>Federal Planning Factors</b>	<b>Regional Goals supporting National Planning Factors</b>
Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency.	Improve the safety of the transportation system for all users
	Efficiently manage existing transportation assets and infrastructure
	Improve travel time and reliability for people and goods
Increase the safety of the transportation system for motorized and non-motorized users.	Ensure that the transportation network supports economic development needs and accommodates future economic growth
	Improve the safety of the transportation system for all users

**Table 1.8: National Planning Factors and Regional Goals**

Federal Planning Factors	Regional Goals supporting National Planning Factors
Increase the security of the Transportation system for motorized and non-motorized users.	<p>Improve travel time and reliability for people and goods</p> <p>Improve the safety of the transportation system for all users</p>
Increase accessibility and mobility of people and freight	<p>Ensure that the transportation network supports economic development needs and accommodates future economic growth</p> <p>Improve travel time and reliability for people and goods</p>
Protect and enhance the environment, promote energy conservation, improve the quality of life, and promote consistency between transportation improvements and State and local planned growth and economic development patterns.	<p>Minimize and mitigate the impacts of the transportation system on the environment, including air quality, water quality, wildlife habitat, and climate change</p> <p>Ensure that the transportation network supports economic development needs and accommodates future economic growth</p>
Enhance the integration and connectivity of the transportation system across and between modes people and freight.	<p>Efficiently manage existing transportation assets and infrastructure</p> <p>Improve travel time and reliability for people and goods</p>
Promote efficient system management and operation.	<p>Efficiently manage existing transportation assets and infrastructure</p>
Emphasize the preservation of the existing transportation system.	<p>Improve travel time and reliability for people and good</p> <p>Efficiently manage existing transportation assets and infrastructure</p>

## OVERVIEW OF THE RTP DOCUMENT

The Regional Transportation Plan serves as the guide for moving the region's transportation system forward in a way that provides enhanced mobility while respecting the sustainability challenges that confront our region and the nation. The document contains fifteen chapters, including this introductory section, which comprises **Chapter 1**.

**Chapter 2** provides an overview of the Public Participation process that was utilized for the RTP planning process. This section includes a summary of the input received through: the RTP website and social media; the regional public input sessions; meetings with stakeholders and special interest groups; and input collected through an online survey for residents and stakeholders.

**Chapter 3** outlines the transportation planning process. It describes the federal and state requirements, the composition of the Northern Middlesex Metropolitan Planning Organization (NMMPO), the role of the municipalities and other stakeholders, and outlines the transportation decision-making process. It

also outlines how local and regional planning, policies and programs are integrated into the RTP document.

**Chapter 4** provides an overview of the region's development and land use trends. A demographic profile of the region is also provided, including data on income, population, and housing. Demographic projections through the year 2040 are contained within this chapter, along with information on commuting patterns and mode choice.

**Chapter 5** describes the region's roadway network and bridge infrastructure and identifies the condition of these transportation assets. It also provides an overview of some of the large infrastructure and transportation system deficiencies that will need to be addressed over the life of the plan, such as the replacement of the temporary Rourke Bridge, improvements along I-495 and I-93, and the completion of Exit 36 on Route 3.

**Chapter 6** provides an overview of transit services available to the region, including services operated by LRTA, MBTA, and non-profit and private transit service providers. This section outlines the transit needs of the region and provides an overview of transit improvements that have been put in place since completion of the previous RTP.

**Chapter 7** provides an overview of the Active Transportation network in the region. This chapter describes the region's bicycle and pedestrian facilities, outlines state initiatives to promote bicycling and walking, such as Complete Streets and Safe Routes to School, and details the challenges and opportunities for expanding active transportation in the region.

**Chapter 8** provides information on emerging technologies at the federal, state and local level. Such initiatives impact all modes of transportation, with a focus on improving efficiency, travel times and safety. The Regional ITS architecture is also summarized in this section.

**Chapter 9** outlines the safety and security issues impacting the region's transportation infrastructure and services. This chapter outlines the roles and responsibilities of the state and federal agencies charged with protecting our transportation system, describes recent safety and security initiatives impacting the region and the state, as well as steps taken by the LRTA to enhance the safety of its customers.

**Chapter 10** evaluates transportation system reliability and congestion. The region's Congestion Management Process is reviewed, summarizing the levels of congestion found on the roadway system, transit network and at park and ride lots. Travel demand management and transportation system management strategies are discussed.

**Chapter 11** discusses national freight policy and state initiatives. This section also provides an overview of the region's freight facilities and network, and describes current freight movement. Opportunities and challenges related to improving freight transportation are also discussed.

**Chapter 12** describes the interaction between the growth of the region’s economy and the transportation network needed to support and sustain the region’s economic health. An overview of regionally significant development projects and related transportation infrastructure needs is presented.

**Chapter 13** focuses on environmental sustainability and livability. Air quality, water quality, stormwater and climate change are addressed in this section. A preliminary analysis of the potential environmental impacts associated with the projects contained in the RTP is also provided in this chapter.

**Chapter 14** addresses the issues of accessibility, social equity and environmental justice. An assessment of the region’s environmental justice population is provided, along with an analysis of the environmental justice impacts of the projects outlined in the RTP.

**Chapter 15** outlines the project recommendations and financial analysis of the plan. This section also summarizes the projects that have been implemented since the 2016 RTP was completed. The demonstration of financial constraint is presented in this chapter to ensure that costs of the recommendations do not exceed the anticipated resources available.

## CHAPTER 2 PUBLIC PARTICIPATION PROCESS

Public participation plays an important role in a wide array of transportation-related activities including planning, policymaking, program and service design, and system evaluation. It is essential that the NMMPO provide adequate opportunities for residents, workers and public officials to be involved and engaged in the development of the RTP. Such critical input plays a major role in developing transportation programs and strategies that meet the region's current and future needs. Public involvement improves technical decision-making in that so-called non-experts bring their real-life experiences to the table, which provides a greater in-depth understanding of the issues that affect the everyday lives of the traveling public. An open and effective planning process also helps to ensure that transportation decisions fit each community's vision for future growth and development.

During the RTP development, the transportation planning team undertook an extensive public involvement effort. Interactive forums were held that were designed to obtain feedback regarding acceptable and effective ways to improve the transportation system. These public participation forums allowed the public to be directly involved in the regional transportation planning process leading to the development of the RTP. Many other strategies were used to engage stakeholders as discussed in the following sections of this chapter.

The NMMPO strives to ensure that all residents are given multiple opportunities to participate in the transportation planning process regardless of race, color, religion, income status, national origin, age, gender, gender identity, disability, marital status, or political affiliation. Furthermore, it is critical that the public involvement process include population groups that historically have not been involved or well-represented in the transportation planning process. These groups include minorities, transit dependent individuals, low income individuals, and persons with disabilities. Public outreach efforts were designed to ensure that the planning process was inclusive and accessible to all members of the community and followed specific strategies that relate to Title VI and Executive Orders 12898 and 13166.

### PUBLIC PARTICIPATION PLAN

In 2016, the Northern Middlesex Metropolitan Planning Organization (NMMPO) adopted a Public Participation Plan (PPP), which is utilized throughout the transportation planning process. The public participation plan includes activities utilized in development of the Regional Transportation Plan Update. A copy of the document is included in Appendix A.

### RTP STAKEHOLDERS

The following stakeholders, representing a diverse cross-section of the region, were invited to participate in public input process, in order to help foster communication, promote public involvement, and to help formulate facts and recommendations for inclusion in the RTP:

- Lowell neighborhood groups and organizations
- Community Teamwork, Inc.
- United Teen Equality Center
- Greater Lowell Chamber of Commerce
- Greater Lowell CEDS Committee
- MassHire Greater Lowell Workforce Development Board and I Career Center
- Middlesex 3 Coalition
- Cambodian Mutual Assistance Association
- Coalition for a Better Acre
- Municipal bicycle and pedestrian committees
- Councils on Aging
- Lowell Regional Transit Authority
- UMass Lowell
- Middlesex Community College
- National Park Service
- Public safety officials
- Housing authorities
- Veterans' organizations
- Organizations representing the disabled community
- Northern Middlesex Stormwater Collaborative
- Planning Boards
- Conservation Commissions
- Conservation Agents
- Energy committees
- Environmental advocacy groups
- Town engineers, planners, managers, selectmen and City Councilors
- Non-profit organizations

WEBSITE AND SOCIAL MEDIA

The NMMPO developed a *Northern Middlesex Transportation Plan Update for 2040* page on the NMCOG website, <http://www.nmcog.org/regional-transportation-plan>, where visitors could learn more about the RTP update, take a survey, and stay up-to-date on public input opportunities throughout the region. The RTP update process also had a social media presence on Facebook and Twitter.



Image 2.1: RTP Public Input Session Flyer

PUBLIC INPUT SESSIONS

Regional public input sessions were held in Lowell, Tewksbury, and Westford during the development of the RTP. The goal of the sessions was to tap into the special knowledge of the region’s residents and officials relative to transportation issues. A detailed account of the public comments and input obtained during the public input sessions is provided in Appendix B. Business, Community, and Neighborhood Meetings

NMCOG held twenty (20) public outreach meetings with community members, neighborhood stakeholders and municipal staff throughout the region to gather unique insight on transportation issues that affect them. Individual meetings were held with town engineers and planners from all nine communities in the region. In addition to the individual meetings with municipalities, NMCOG held a total of six (6) public meetings with individual neighborhood groups located within the City of Lowell, and three region-wide public meetings, as discussed earlier. A meeting was also held with representatives from UMass Lowell. Details on the organizations, dates, and locations of the meetings are listed in Table 2.1 below. A detailed account of the public comments and input obtained during the community and neighborhood meetings is provided in Appendix B.

Table 2.1: RTP Public Outreach Meetings

Date	Community	Person/Group
1/15/2019	Chelmsford	Chelmsford Municipal Meeting
1/17/2019	Westford	Westford Municipal Meeting
1/17/2019	Tyngsborough	Tyngsborough Municipal Meeting
1/24/2019	Tewksbury	Tewksbury Municipal Meeting

**Table 2.1: RTP Public Outreach Meetings**

Date	Community	Person/Group
1/27/2019	Dunstable	Dunstable Municipal Meeting
1/28/2019	Dracut	Dracut Municipal Meeting
1/29/2019	Lowell	Lowell Municipal Meeting
1/29/2019	Region	UMass Lowell
2/1/2019	Billerica	Billerica Municipal Meeting
2/4/2019	Lowell	Pawtucketville Neighborhood Association
2/11/2019	Lowell	Lower Highlands Neighborhood Group
2/13/2019	Lowell	Belvidere Neighborhood Association
2/25/2019	Lowell	Lowell Downtown Neighborhood Association
2/26/2019	Pepperell	Pepperell Municipal Meeting
2/28/2019	Region	Regional Public Input Session - Westford
3/7/2019	Region	Regional Public Input Session - Lowell
3/14/2019	Region	Regional Public Input Session - Tewksbury
3/18/2019	Lowell	Centralville Neighborhood Group
4/17/2019	Lowell	ACTION (Acre Neighborhood Group)
6/12/2019	Chelmsford	Chelmsford Traffic Forum

## MEETING SUMMARY

The public input sessions and organizational meetings identified the needs and concerns of area residents related to traffic and congestion, roadways and bridges, bike and pedestrian issues, and public transit. While detailed notes on each meeting can be found in the appendices, the major themes that emerged are discussed here by category.

## ROADWAYS AND BRIDGES

Many residents expressed a desire to see improvements made to regional roadways. Concerns cited relative to travel conditions on area roadways included:

- Gorham Street/Bridge Street in Lowell
- Rogers Street in Lowell
- Route 38 in Tewksbury
- Route 110/113 in Dracut/Methuen

The most common concern cited among residents was the need for a new, permanent Rourke Bridge to replace the temporary bridge that currently exists. Some residents also feel that there is a need for an

additional bridge over the Merrimack River or for the expansion of existing bridges. There was concern from stakeholders on the condition and safety of bridges over I-495 as well.

## TRAFFIC AND CONGESTION

Peak hour congestion at the Merrimack River crossings in Lowell, particularly around the Rourke Bridge and on Bridge Street in Lowell, were top issues raised by residents. There was strong support for improvements to the intersections of VFW Highway and Bridge Street, as well as the Beaver Brook Bridge. General congestion in Downtown Lowell, particularly during peak hours, was frequently raised. Several residents asked about the impact of the Lord Overpass realignment on traffic.

Issues raised for areas outside of Lowell included congestion on Route 110 and Route 113 approaching the new interchange at I-93 in Methuen. In Chelmsford, operations at a quarry near the Westford/Chelmsford town line are increasing, resulting in additional truck activity that is disturbing residential areas.

## BICYCLE AND PEDESTRIAN FACILITIES

Residents in almost all communities would like more sidewalks and improved sidewalk conditions. Representatives from such groups as the Chelmsford Bicycle Coalition and the Lowell Bicycle Coalition suggested recommendations for incentivizing walking and cycling, and for improving roadway safety for all users. Increased bicycle usage was suggested as an option for reducing congestion, but there was a general sense that roadways are often not safe enough for cyclists and pedestrians. Bicyclists often have a hard time navigating around potholes on roads and bridges.

Lowell residents raised concerns about the conditions of sidewalks and the impact poor sidewalks have on disabled people and the elderly.

Many residents would like to see more bicycle lanes and off-street bicycle paths throughout the region. There was a recommendation to link the Bruce Freeman Rail Trail to Downtown Lowell and the Gallagher Terminal, and there was interest in creating bicycles amenities on Appleton Street near the Gallagher Terminal.

## PUBLIC TRANSIT

There was a general sense that public transportation is inadequate in the region. Principal concerns included inadequate bus service to supermarkets, the need for additional parking at MBTA stations, and limited bus service in the evenings and on weekends.

Residents consistently mentioned the need to expand commuter rail to New Hampshire and bus service to shopping centers in Nashua. They felt these expansions would not only benefit the economy, but the quality of life for residents as well. Residents would also like to see an extension of bus service hours in the evenings and on weekends. Commuter rail riders do not have the option of taking the bus after 8:00

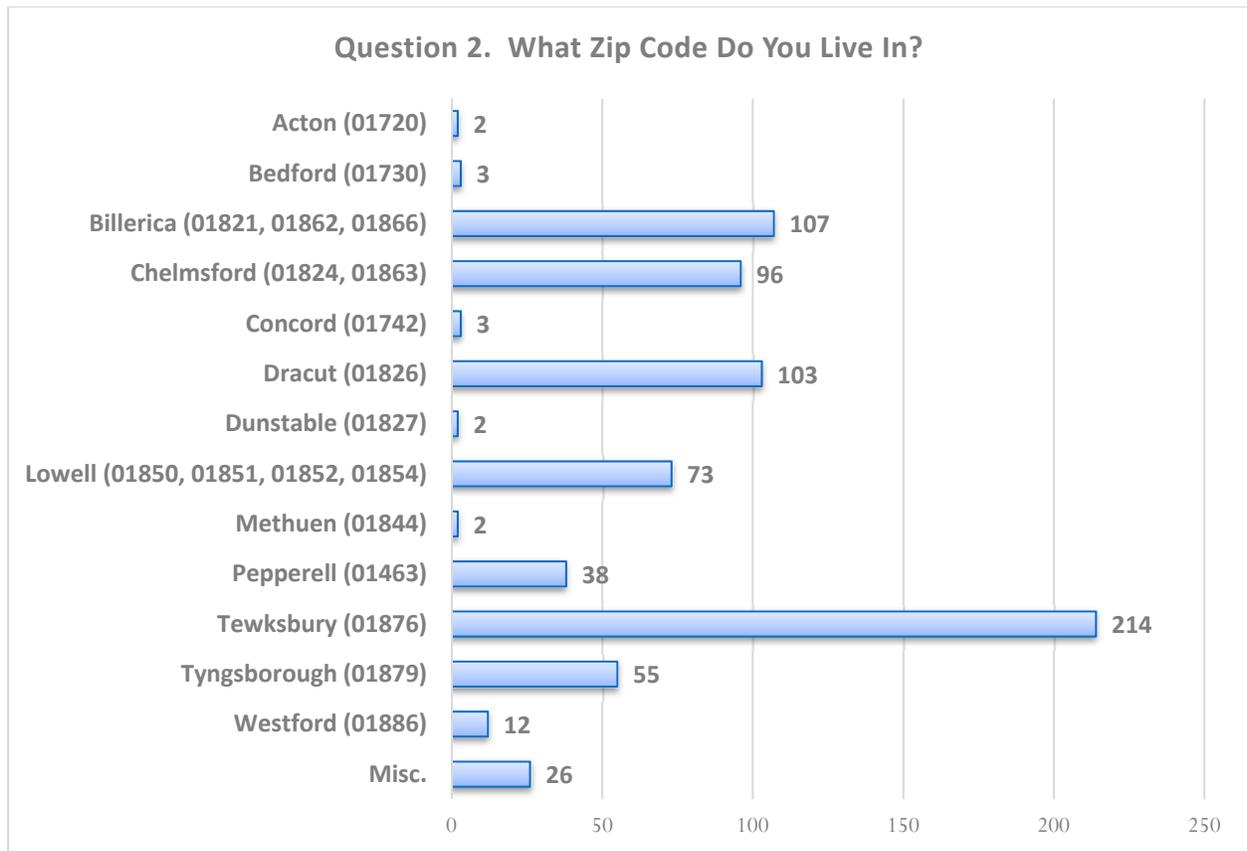
p.m. and must use taxis or other comparatively expensive alternatives. Some residents had concerns with the current LRTA Route Shout App and felt that it did not provide accurate location data.

**SURVEYING THE REGION’S TRANSPORTATION NEEDS**

As part of its public outreach effort, the NMMPO developed an online survey to gather input on transportation issues, such as commuting, parking, roadway conditions, public transit service, and bicycle and pedestrian facilities (see Appendix B). The survey was available online and print versions were available in English, Spanish, Khmer, Vietnamese, Portuguese and Chinese. The NMMPO collected 745 responses, which were submitted from all across the study area.

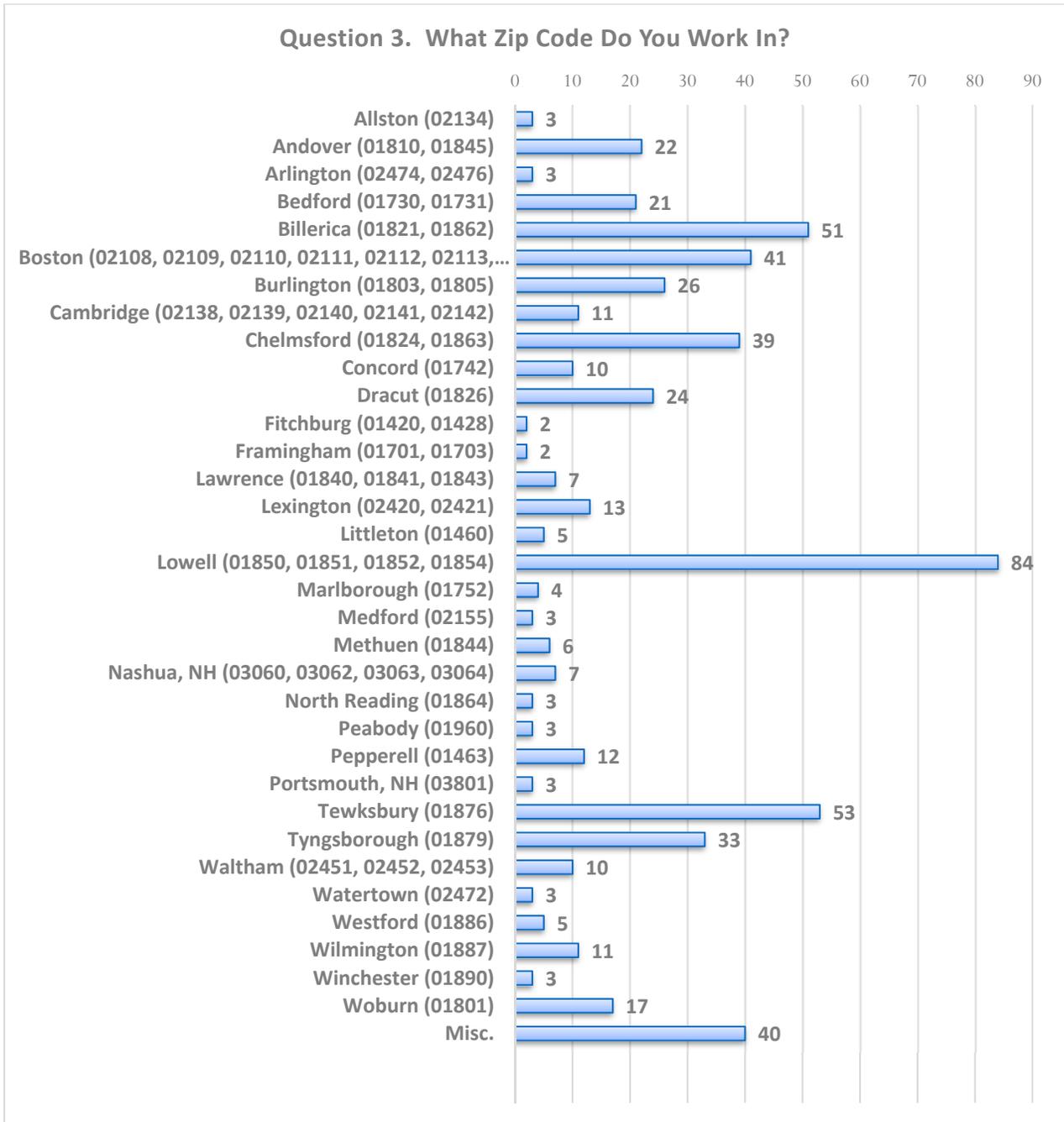
The majority of respondents (66%) were between the ages of 21 and 59 years old, while 33% were 60 years or older. One percent (1%) of survey respondents were under 21 years old. Table 2.2 shows that, of the respondents who answered Question 2, the largest percent (29%) were from Tyngsborough, followed by 14% from Dracut, 11% from Billerica, and 10% from Lowell. In addition to residents of the Northern Middlesex region, 12% of the respondents were from outside of the region.

**Figure 2.1: Places of Residence for Survey Respondents**



As illustrated in Figure 2.2 below, the largest number of respondents worked in Lowell (84), followed by Tewksbury (53), Billerica (51), and Boston (50). Approximately 52% of the respondents work outside of the Northern Middlesex region.

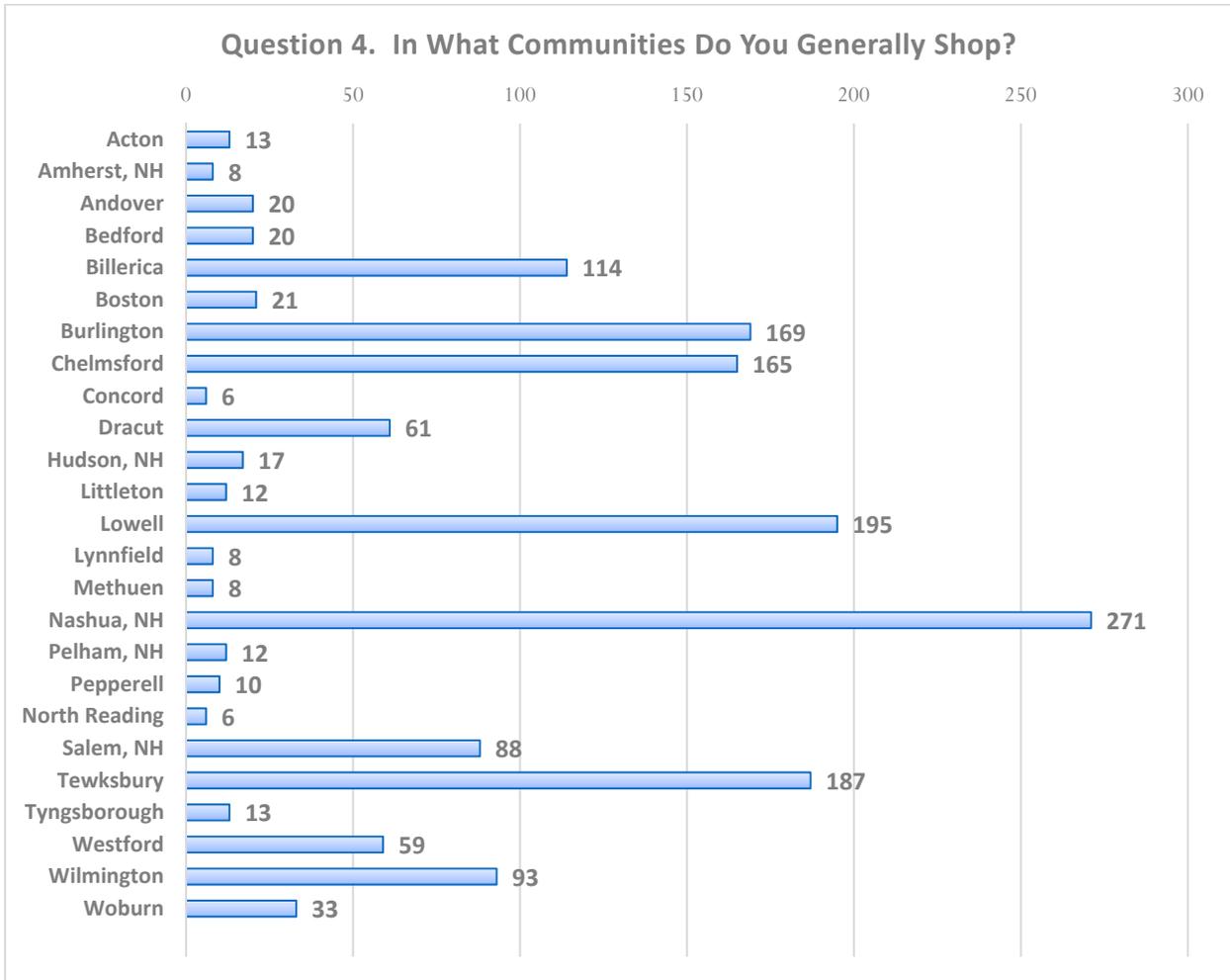
**Figure 2.2: Places of Work for Survey Respondents**



In terms of shopping, individual respondents typically identified multiple communities where they shop both inside and outside of the Northern Middlesex region. A significant number of respondents (271)

frequently shop across the border in Nashua. The most popular shopping locations within the region were Lowell (195 responses), Tewksbury (187 responses), and Chelmsford (165 responses). As with shopping, many respondents identified multiple communities where they receive medical services. The most common community selected was Lowell with 236 responses, followed by Chelmsford with 169 responses, and Burlington with 120 responses.

**Figure 2.3: Where Respondents Generally Shop**



**COMMUTING**

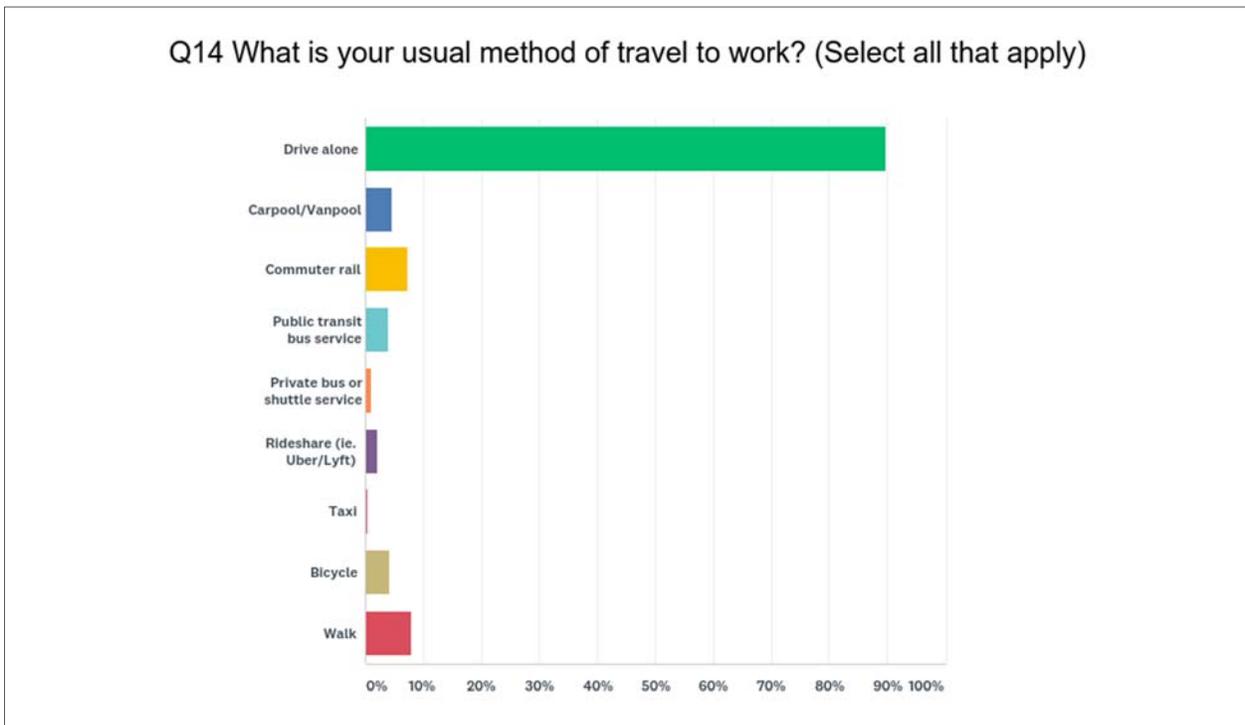
Most respondents (84%) leave home to go to work between 5 a.m. and 9 a.m., while another 8% leave home between 9 a.m. and 12 p.m. Similarly, 77% of respondents leave work to return home between 3 p.m. and 7 p.m. Approximately 9% leave work between 12 p.m. and 3 p.m., while 6% leave work after 7 p.m.

Twenty-six percent (26%) of respondents have less than a 5-mile commute one-way to work, while 22% have more than a 20-mile commute one-way to work. The remaining (52%) have between a 5- and 20-mile commute one-way to work. In addition, 52% of respondents have a one-way commute that is less than 30 minutes. Thirty-six percent (36%) of commuters have a one-way commute that takes between 30 and 60 minutes, and 12% of respondents have a one-way commute that takes more than 60 minutes.

The majority of respondents (90%) drive alone to work, while 5% carpool with others. Alternative transportation modes, such as public transit bus service (4%), commuter rail (7%), walking (8%), and bicycling (4%), are also used by commuters in the Northern Middlesex region. Rideshare (e.g. Uber or Lyft) is used by 2% of the population, while private bus or shuttle services are used by approximately 1% of the population. Respondents were asked to select all that apply, so the total adds up to more than 100%.

Ten percent (10%) of respondents reported having lost a job or being unable to work due to a lack of transportation options.

**Figure 2.4: Mode of Travel to Work among Survey Respondents**



**PARKING**

A number of respondents felt that parking is not an issue within the Northern Middlesex region. Most respondents who had an issue mentioned difficulty finding parking in Downtown Lowell, both on-street and in the parking garages, and at commuter rail stations in Lowell and North Billerica. Respondents also

mentioned lack of parking at the park and ride lot in Tyngsborough. In general, town centers, transit stations, rail trails, grocery stores and shopping plazas, public buildings such as city and town halls, schools and libraries, senior centers, and medical buildings were most frequently cited as having parking issues.

## ROADWAYS

When respondents were asked if they avoid certain streets or intersections in the Northern Middlesex region because they feel unsafe, most cited traditionally congested areas in the region. Table 2.2 provides a summary of most commonly named locations.

**Table 2.2: Frequently Identified Congested Areas**

Community	Intersections
Billerica	Route 3A at Lexington/Glad Valley Drive
Billerica	Route 129/Grey Street
Chelmsford	Vinal Square
Chelmsford	Drum Hill Square
Chelmsford	Chelmsford Center
Dracut	Mammoth Road at Lakeview Avenue
Dracut	Lakeview Avenue at Nashua Road
Lowell	Drum Hill Road/Wood Street/ Rourke Bridge
Lowell	Pawtucket Street at School Street
Lowell	Merrimack Street at Central Street
Lowell	I-495/Route 3 at Lowell Connector
Pepperell	Main Street at Park/Elm Street
Pepperell	Canal Street/Mill Street at Main Street
Tewksbury	Route 133 at River Road
Tewksbury	Town Center
Tyngsborough	Middlesex Road at Kendall Road
Westford	Westford Center
Westford	Minot's Corner

Respondents were also asked if they avoid certain streets or intersections because they are too congested. All bridges crossing the Merrimack River were commonly mentioned. Bridge Street in Lowell was very often noted as being congested. Other Lowell streets often cited were Middlesex Street, Merrimack Street, Thorndike Street, Wood Street, and Broadway Street. The Lowell intersections at Nesmith Street and Andover Street, Lowell Connector and Gorham Street, the Lakeview Avenue-VFW Highway-Aiken Street area, and Mammoth Road and Pawtucket Boulevard were often noted as congested. Congested streets and intersections outside Lowell often noted were Billerica Center, Route 38 in Tewksbury, Drum Hill Road in Chelmsford, Chelmsford Center, Tyngsborough Center,

Tyngsborough Bridge, North Chelmsford, and Minot's Corner in Westford. US Route 3 and I-495 were also noted for their congested conditions.

When asked about poor pavement or potholes, numerous respondents replied that there are too many streets throughout the region with these conditions to mention. Results of the survey proved the statement, with no real consensus of specific locations determined. Of those mentioned, the Lowell Connector and VFW Highway in Lowell were noted frequently. Regionally, Route 38 in Tewksbury, Route 3A in Billerica, Mammoth Road in Dracut, Route 133 at Andover Street in Tewksbury, and Route 4 in Chelmsford were notable locations.

## Public Transit

The majority of respondents (64%) do not use public transit, as shown in Figure 2.5. Thirty percent (30%) use commuter rail, while others use the MBTA subway (23%), commuter buses such as Boston Express, Peter Pan, or Greyhound Lines (8%), and the LRTA bus service (8%).

**Figure 2.5: Public Transit Usage among Survey Respondents**

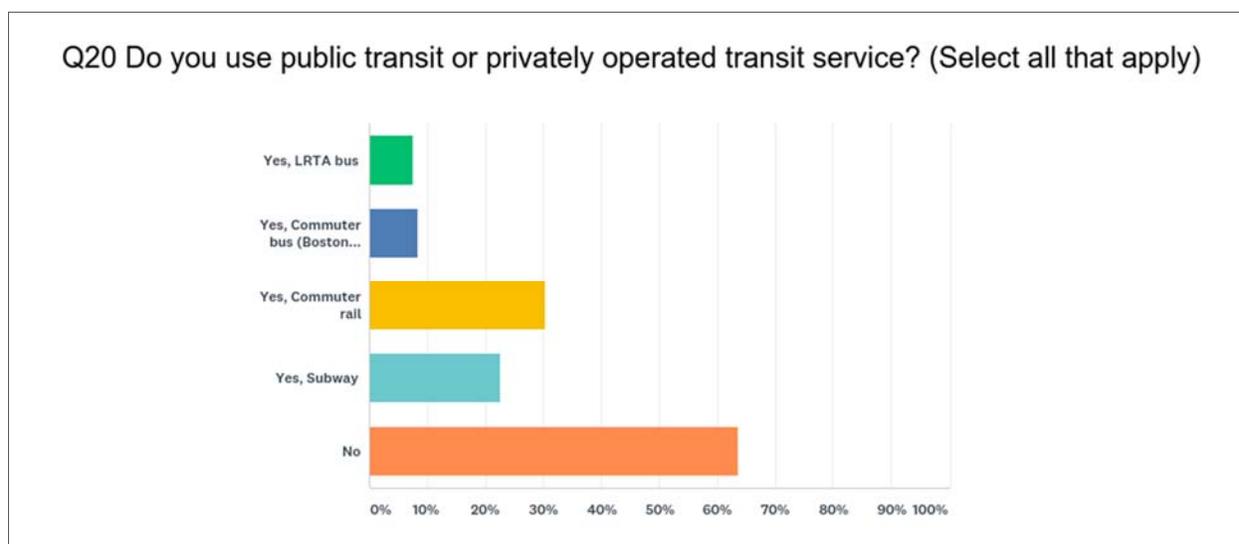
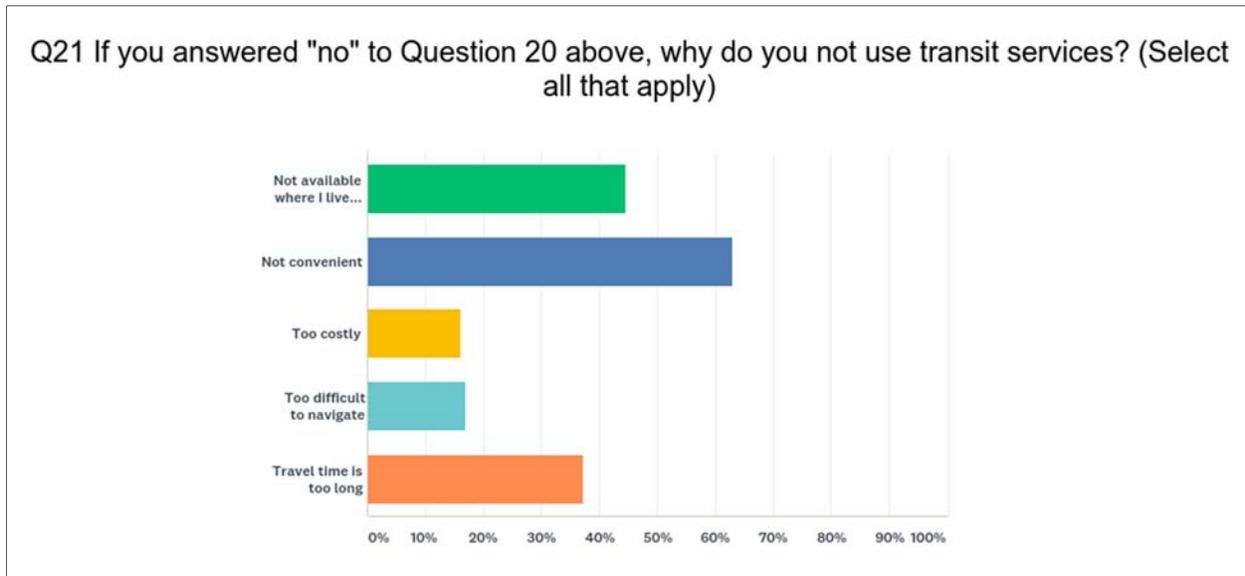


Figure 2.6 on the following page shows the main reasons that respondents do not use public transit. These include inconvenience (63%) and lack of availability near home or work (45%). Others identified long commute times (37%), difficulty navigating (17%) and cost (16%) as reasons that they do not use transit services.

**Figure 2.6: Reasons for Not Using Public Transit**

Of those respondents using public transit, most (69%) use it to access recreational destinations, shopping or dining (43%), and employment (34%). Others use it to go to medical appointments (26%), visit friends or relatives (24%), run errands (12%), and attend school (8%) or church (2%).

Sixty-eight percent (61%) of respondents feel that public transit services currently offered are not adequate to meet their needs. When asked about additions and enhancements to transit service that would make it a more attractive option, the following improvements were often cited:

- Improved bus service (expanded early morning, late evening and weekend hours; more frequent service; coordinated with commuter rail schedule; additional routes serving towns beyond Lowell);
- Reduced delays, wait times, and crowded conditions on trains and subways;
- Expanded commuter rail service and additional stations beyond Lowell (particularly Chelmsford and Nashua, New Hampshire);
- Additional parking and lower cost parking at transit stations;
- Reasonably priced train fares;
- Easy and convenient access to Downtown Lowell from transit stations;
- Additional transit options (local light rail or trolley, expanded options for handicapped);
- Improved information and communication about options; and  
Gallagher Terminal enhancements (cleanliness, safety, convenience).

## Active Transportation

Sixty percent (60%) of respondents feel that improved bicycle facilities (bicycle lanes, racks, signage, and shared use paths) are needed in the Northern Middlesex region. According to respondents, the following general locations could benefit from improved bicycle facilities, connectivity, and accessibility:

- Transportation facilities (parking garages, transit stations);
- Public buildings (City/Town Halls, libraries, school campuses, and post offices);
- Shopping centers
- Key business and employment nodes; and
- Along bridges and bicycle paths.

While a few respondents indicated that additional bicycle lanes, sharrows, and shared use paths are not necessary, the majority would like a continuous, connected network of these facilities at particular locations to better accommodate bicyclists. There were a wide variety of locations suggested in each town throughout the region, for both on street bike lanes and off-street paths. The most popular locations noted were:

- Downtown Lowell;
- Near Gallagher Terminal;
- UMass Lowell;
- Fill in gaps/create links between existing bike routes;
- Routes 3A, 27, 38, 40, 110, 113, 225;
- Bruce Freeman Rail Trail.

Additional bicycle facility improvements suggested by survey respondents included bicycle storage, installation of dedicated bike lanes/cycle tracks, improved signage, traffic control devices, pavement markings, wider roadway shoulders, the development of bicycle routes, and improved maintenance of roadways and shared use paths. Several respondents also strongly encouraged “rules of the road” education and enforcement to improve bicycle safety.

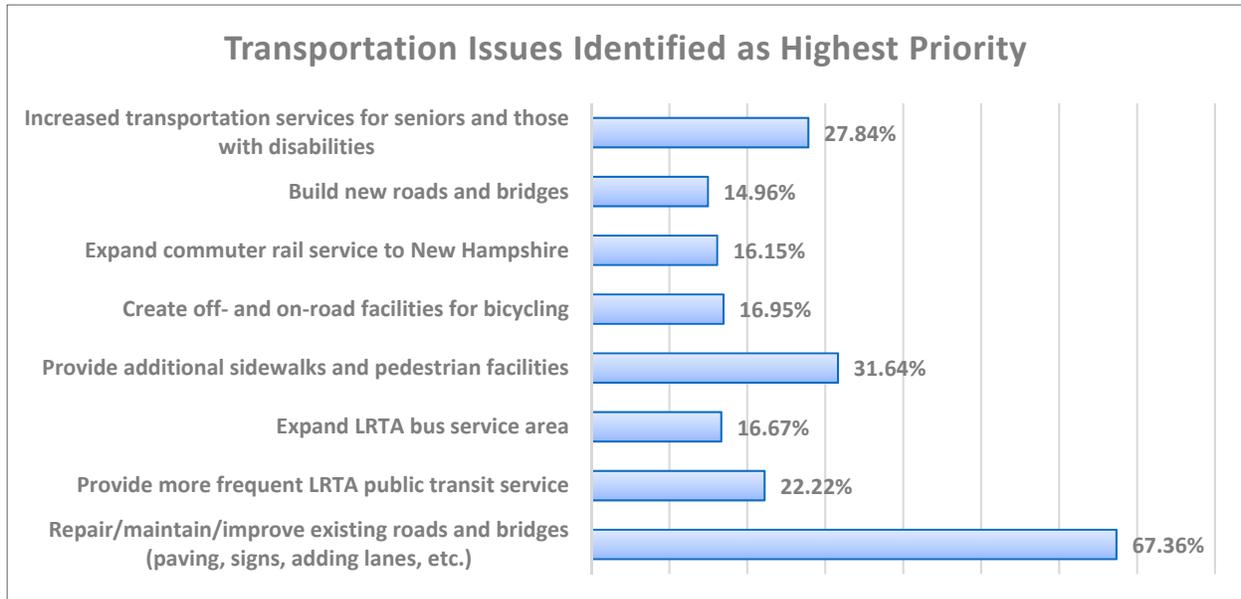
A majority of respondents (82%) feel that improved pedestrian facilities are needed in the Northern Middlesex region. Respondents identified numerous locations where additional pedestrian facilities were needed across the region. The most common locations included:

- Sidewalks and other pedestrian facilities near schools and hospitals;
- Along Routes 3A, 27, 38, 110 and 129;
- In and near town centers;
- Throughout Downtown Lowell, especially on Dutton Street, Thorndike Street, near Gallagher Terminal, and around UMass;
- Chelmsford Center, North Chelmsford, Vinal Square, and Drum Hill Road;
- Near bus stops; and
- Lakeview Avenue.

Transportation Priorities

Respondents were asked to prioritize transportation issues specific to the Northern Middlesex region. Table 2.7 identifies the top transportation priorities among respondents. Note that the repair, maintenance and improvement of existing roads and bridges was identified as the highest priority by most respondents.

**Table 2.7: Top Transportation Priorities in the Northern Middlesex Region**



MPO ENDORSEMENT PROCESS

The Draft 2020-2040 RTP was released for a 21-day public comment period by vote of the NMMPO on June 26, 2019, as required by federal regulations. Copies of the Draft RTP were distributed to all interested parties, including the region’s elected officials, local communities, the Lowell Regional Transit Authority, MassDOT, the Federal Highway Administration, the Federal Transit Administration and regional stakeholders, as identified in the Public Participation Plan. The draft plan was posted on the NMCOG website, and the public was able to submit comments electronically through the website. The 21-day comment period was also announced in the *Lowell Sun*, the *Khmer Post*, and posted in City/Town Halls.

A public meeting on the Draft RTP was held on July 16, 2019. A summary of public comments received on the draft document can be found in Appendix C. The NMMPO met on July 24, 2019 to discuss the public comments received, review the response to comments and discuss the final document. A summary of the response to comments can also be found in Appendix C. Subsequently the NMMPO voted to endorse the final document.

## CHAPTER 3 TRANSPORTATION PLANNING PROCESS

Transportation planning is a collaborative process that involves government agencies, non-profit organizations, elected officials, advocacy and special interest groups, the business community and the public. Key transportation planning activities that are undertaken on an ongoing basis include the following:

- Monitoring existing operating conditions;
- Tracking demographic trends, including population, employment, income, race, age, gender and persons with special transportation needs;
- Identifying current and future transportation needs for all modes of transportation;
- Completing planning studies that analyze transportation problems and propose solutions;
- Developing capital improvement programs and operational strategies that address transportation needs;
- Assessing the impacts of transportation improvements on the environment and climate change;
- Evaluating transportation equity for low-income, Limited English Proficiency (LEP) and minority populations;
- Evaluating the public health and social impacts of transportation decisions, projects and priorities;
- Integrating local planning and economic development initiatives with the regional transportation planning process; and
- Soliciting public input throughout the planning process.

*The U.S. Department of Transportation (USDOT), Federal Highway Administration must certify that a 3C planning process is being carried out on all transportation projects receiving federal funding. Part of the certification involves the preparation of three documents: the Unified Planning Work Program (UPWP), the Long Range Regional Transportation Plan (RTP), and the Transportation Improvement Program (TIP). NMCOG staff carries out the administrative and technical functions related to the NMMPO.*

In metropolitan areas with more than 50,000 people, the Metropolitan Planning Organization (MPO) provides the forum for collaboration and decision-making on transportation issues. The Northern Middlesex Metropolitan Planning Organization (NMMPO) is the policymaking body for the Greater Lowell area, and is required by federal law to carry out a continuing, cooperative and comprehensive planning process that is called the 3C planning process. These three elements of the 3C planning process are described as follows:

- Continuing: Planning must be maintained as an ongoing activity and should address both short-term needs and the long-term vision for the region;

- Cooperative: The process must involve a wide variety of interested parties through a public participation process; and
- Comprehensive: The process must cover all transportation modes and be consistent with regional and local land use and economic development plans.

The membership of the NMMPO consists of the membership outlined in Figure 3.1. The Secretary of MassDOT acts as Chairman of the NMMPO. A copy of the region’s MPO Memorandum of Understanding (MOU) is included in Appendix D.

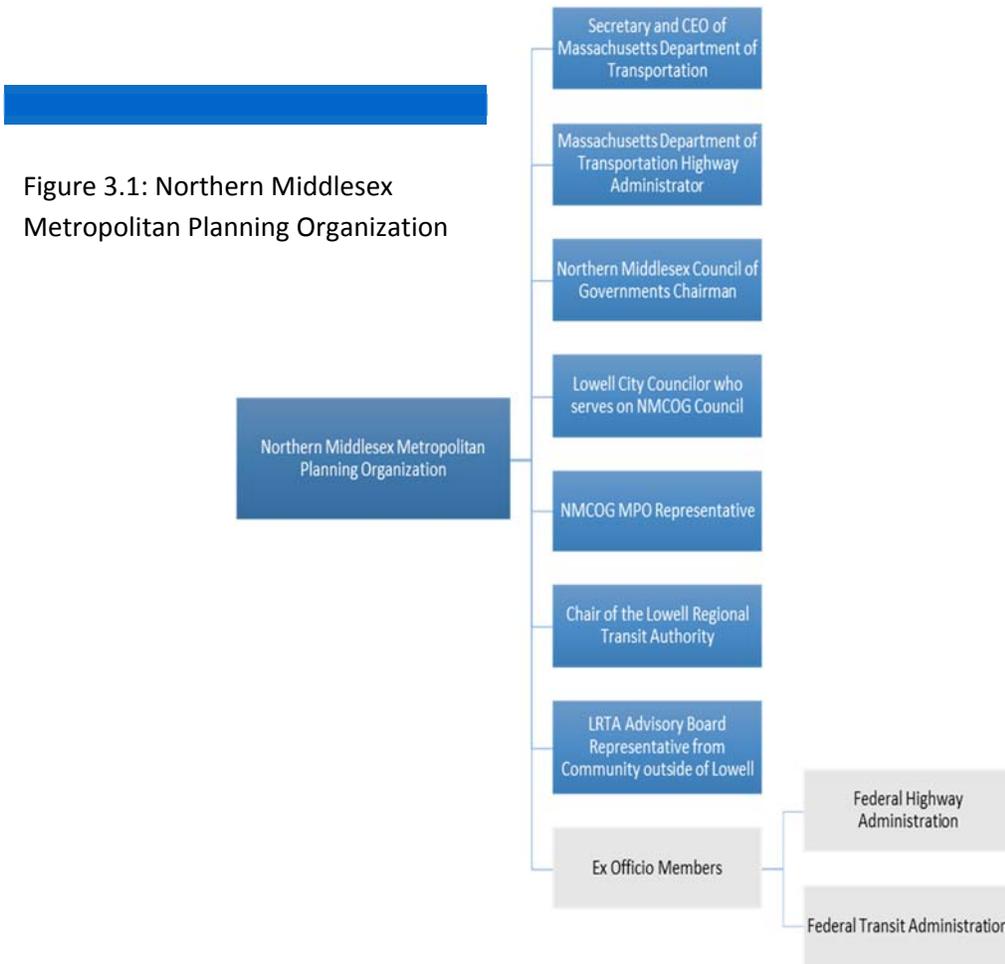


Figure 3.1: Northern Middlesex Metropolitan Planning Organization

## ROLES AND RESPONSIBILITIES OF PARTICIPATING AGENCIES

The following sections discuss the primary agencies involved in the transportation planning process for the Northern Middlesex region. These agencies comprise the NMMPO membership and function at the regional, state and federal levels of government to ensure that the transportation needs of the region are met for all modes of transportation.

### NORTHERN MIDDLESEX COUNCIL OF GOVERNMENTS

The Northern Middlesex Council of Governments (NMCOG) was created under Chapter 40B of the General Laws of Massachusetts and is one of thirteen regional planning agencies (RPAs) in the Commonwealth. NMCOG serves its member communities in an advisory capacity by studying and making recommendations regarding transportation, economic and community development, housing, land use, historic preservation, municipal service delivery, zoning, environmental and energy issues, and public safety. NMCOG's policy-making body, comprised of three members from each community (one Planning Board member, a Board of Selectmen member or City Councilor, and an alternate), provides local representation and policy guidance to the Council's staff of professional planners. The Council's planning district includes Billerica, Chelmsford, Dracut, Dunstable, Lowell, Pepperell, Tewksbury, Tyngsborough and Westford (see Map 1.1 on Page 1-3). NMCOG functions as the regional transportation planning agency for the Greater Lowell area and serves as technical staff to the NMMPO.



### LOWELL REGIONAL TRANSIT AUTHORITY

The Lowell Regional Transit Authority (LRTA) has statutory responsibility for providing mass transportation under the provisions of Chapter 161B of the Massachusetts General Laws. The LRTA service area includes the following communities: Acton, Billerica, Carlisle, Chelmsford, Dracut, Dunstable, Groton, Lowell, Maynard, Pepperell, Tewksbury, Townsend, Tyngsborough and Westford (see Map 6.1 in Chapter 6, page 6-3). A chief elected official or designee from each member community serves on the LRTA Advisory Board.



## MASSACHUSETTS DEPARTMENT OF TRANSPORTATION



In June 2009 Chapter 25 of the Acts of 2009, “An Act Modernizing the Transportation Systems of the Commonwealth of Massachusetts” was signed into law. The transportation reform legislation integrated all Massachusetts transportation agencies and authorities into a new MassDOT. A five-member Board of

Directors appointed by the Governor oversees the organization. MassDOT is administered by a Secretary of Transportation, who is appointed by the Governor to serve as the agency’s Chief Executive Officer. MassDOT is comprised of four divisions: Highway, Mass Transit, Aeronautics and the Registry of Motor Vehicles (RMV), in addition to an Office of Planning and Programming.

## FEDERAL HIGHWAY ADMINISTRATION AND FEDERAL TRANSIT ADMINISTRATION

An annual certification process through FHWA and FTA ensures that the State and the NMMPO are adhering to the 3C transportation planning process in accordance with federal requirements. Approval of federally-aided transportation projects requires the planning process to be “cooperative, comprehensive, and continuing.” As previously discussed, the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) are ex-officio non-voting members of the NMMPO.



## RELATIONSHIP BETWEEN THE RTP, TIP AND UPWP

The Regional Transportation Plan (RTP) is one of three federally required certification documents produced by the NMMPO. The other two documents are the Unified Planning Work Program (UPWP) and Transportation Improvement Program (TIP). The UPWP describes the planning studies and activities to be performed by the NMMPO each fiscal year. RTP projects and recommendations are often proposed as solutions to transportation problems or deficiencies identified through a study performed as part of the UPWP.

The Transportation Improvement Program (TIP) is a financially-constrained five-year listing of all federally-funded and regionally significant projects with the region. TIP projects must be drawn from a conforming RTP. In Massachusetts, the TIP is updated annually.

## STATE POLICIES

The 2009 restructuring of transportation agencies in Massachusetts led to a comprehensive re-evaluation of statewide policies and initiatives that impact transportation decision-making. The information below outlines the policy initiatives that have been implemented by MassDOT and other state agencies, such as the Executive Office of Energy and Environmental Affairs (EOEEA), the Executive Office of Health and Human Services (EOHHS), and the Executive Office of Housing and Economic Development (EOHED).

### WEMOVE MASSACHUSETTS INITIATIVE

In 2014, MassDOT released *weMove Massachusetts: Planning for Performance* (WMM), the Commonwealth's Long Range Transportation Plan. The Plan summarized MassDOT's new approach to multimodal capital planning and the use of scenario planning. WMM contains a Planning for Performance tool that incorporates important MassDOT policy initiatives, such as mode shift and sustainability, into the capital planning process. The tool can be used to calculate the performance outcomes resulting from different funding levels available to MassDOT. It also allows customers and stakeholders to understand the impacts of investment or disinvestment in the transportation system.

### MASSDOT CAPITAL INVESTMENT PLAN

The MassDOT Capital Investment Plan (CIP) is a five-year plan that outlines investments in the transportation infrastructure that serves residents and businesses across the Commonwealth. The CIP is funded from a mix of federal and state sources and investments are designed to address three priority areas: System Reliability; Asset Modernization; and Capacity Expansion. The Plan is developed annually in coordination with federal state, regional, and municipal partners, and with input from the public. It includes investments that improve reliability, safety and resiliency of the transportation system.

### REGIONAL PARTNERSHIPS

The Draft FFY 2020-2024 CIP includes investments of \$18.3 billion dollars in transportation improvement projects for both MassDOT and MBTA. The CIP identifies all sources of transportation funding available to Massachusetts, including federal funding through the metropolitan planning and process. The Northern Middlesex MPO programs federal funding through the Regional Transportation Plan (RTP) and the Transportation Improvement Program (TIP). The Northern Middlesex TIP programs projects in the Massachusetts Statewide Transportation Improvement Program (STIP), which directly feeds into the Capital Investment Plan. Projects recommended in this Regional Transportation Plan will likely be included as recommendations of the Capital Improvement Plan at some point in time. The FFY 2020-2024 CIP includes project recommendations for the first five years of the region's RTP, which also mirrors the FFY 2020-2024 TIP and STIP.

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## MUNICIPAL PARTNERSHIPS

The 2020–2024 CIP includes several different programs that provide state and federal funds through either direct grants or reimbursements to cities and towns, and/or by leveraging private investment in support of economic growth. These programs and funding sources are described below:

- **Chapter 90** reflects the Administration's commitment to local transportation infrastructure for all 351 cities and towns across the Commonwealth. Chapter 90 funding is established by the Legislature on an annual basis and allocated by a legislatively established formula. The funding program reimburses cities and towns for costs incurred for eligible transportation infrastructure projects.
- The **Complete Streets Program** provides funding and technical assistance to communities that demonstrate a commitment to providing safe and accessible options for all modes of travel. There have been 198 approved Complete Streets policies approved, 146 technical assistance grants awarded, and 95 municipal projects approved as part of the program, since its launch in 2016. The 2020-2024 CIP estimates \$40.5 million in spending for this program over the five years.
- The **Municipal Small Bridge Program**, begun by the Baker-Polito Administration in SFY2017, assists municipalities in replacing and repairing town-owned bridges that are less than 20 feet long and are not eligible for federal funding. A total of \$42.5 million has been awarded for 91 municipal small bridge projects to date. The current CIP assumes \$56.2 million in spending over the next five years.
- A new grant program initiated in 2019, the **Workforce Transportation Options Program**, will be administered by the Rail and Transit Division. The program uses federal Congestion Mitigation Air Quality (CMAQ) funds to leverage private and other non-state funds to improve options for workforce transportation. This program replaces the Commonwealth's MassRides program, which ended on June 30, 2019. Approximately \$1.975 million is anticipated to be spent annually.
- Under the **Mobility Assistance Program**, state and federal funds are provided for the purchase of vans and related equipment to provide transportation services for elderly persons and individuals of all ages with disabilities. The program is administered by the Rail and Transit Division and uses funds provided through the regional Councils on Aging, the Regional Transit Authorities, and non-profit organizations. The CIP has assumed \$50.2 million in state and federal funds will be available to support this program.
- The **Industrial Rail Access Program** uses state funds to leverage private investment in private sector rail lines that will increase freight rail usage or that will modernize an active line to increase the utility of that line to customers. The Rail and Transit Division annually programs \$3 million (\$15 million over five years) to leverage private investment funds.

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## GLOBAL WARMING SOLUTIONS ACT

The Global Warming Solutions Act (GWSA) of 2008 mandates the reduction of greenhouse gas (GHG) emissions to 80 percent below 1990 levels by 2050. It also requires the Secretary of Energy and Environmental Affairs to set a legally enforceable GHG emissions limit for 2020 of between 10 percent and 25 percent below 1990, and to issue a plan for achieving those reductions, while growing the clean energy economy.

The Commonwealth set the GHG emissions limit at the statutory maximum of 25 percent and released the *Clean Energy and Climate Plan for 2020*, which contained a portfolio of policies designed to meet the limit. The portfolio included established and new measures that reduce energy waste, save money, and stimulate the adoption of clean energy technologies, thereby creating jobs at the same time GHG emissions are being reduced. It estimated that 42,000 to 48,000 jobs will result from full implementation of the plan in 2020. As of 2018, 110,000 jobs were created in Massachusetts in the area of clean energy, far surpassing expectations.<sup>1</sup>

Massachusetts is a member of the Multi-state Zero Emission Vehicle (ZEV) Task Force and is committed to increasing the share of ZEVs in the Commonwealth. The Massachusetts Offers Rebates for Electric Vehicles (MOR-EV) program by the Department of Energy Resources (DOER) and the Clean Cities Coalition has issued or reserved over \$23 million in consumer rebates for over 11,000 ZEV purchases or leases since 2014. In December 2018, the MOR-EV program was extended through June 30, 2019 with additional funding to sustain this popular program. The Massachusetts Electric Vehicle Incentive Program (MassEVIP) through the Department of Environmental Protection (MassDEP) has given \$2.66 million to Massachusetts municipalities, state agencies, and public colleges and universities to acquire 267 electric vehicles and 92 publicly accessible charging stations, and \$1.35 million to employers to acquire 543 electric charging stations at 265 separate locations. The 15,111 electric vehicles registered in the Commonwealth as of September 2018 have resulted in net reductions of 33,150 metric tons of CO<sub>2</sub>e in 2018.<sup>2</sup>

The latest statewide GHG inventory by MassDEP shows that GHG emissions in 2016 were 21.4% below the 1990 baseline level. The decrease in GHG emissions comes despite a 13% growth in population and 24% growth in vehicle miles traveled (VMT). Significant GHG emissions reduction from the electric sector since 2005 has been a major contributor to the drop in gross GHG emissions, and vehicle standards have

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<sup>1</sup> Global Warming Solutions Act: Ten-Year Progress Report, 2018, Executive Office of Energy and Environmental Affairs.

<sup>2</sup> <https://www.mass.gov/files/documents/2019/04/02/GWSA-10-Year-Progress-Report.pdf>

lowered the carbon intensity of each VMT while energy efficiency measures in buildings helped control energy demand despite increased economic growth and variable weather conditions.<sup>3</sup>

Massachusetts continues to be involved with regional and national organizations to address the issue of transportation GHG emissions. For example, the Transportation and Climate Initiative, a collaboration of transportation, energy, and environmental agencies from the Northeast and Mid-Atlantic states, seeks to develop the clean energy economy and reduce GHG emissions from the transportation sector. In December 2018, Massachusetts and other participating states and jurisdiction announced their agreement to work together over the course of 2019 to study the feasibility of a potential program that would reduce climate changing pollution from transportation, create economic opportunity, and improve transportation equity for currently underserved and overburdened populations. At the conclusion of the policy development process, all member states will decide whether to adopt and implement the policy.

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## COMPREHENSIVE ENERGY PLAN

On September 16, 2016, Governor Baker issued Executive Order No. 569 Establishing an Integrated Climate Change Strategy for the Commonwealth. The Executive Order included a directive for the Secretary of EEA to publish “a comprehensive energy plan which shall include and be based upon reasonable projections of the Commonwealth’s energy demands for electricity, transportation, and thermal conditioning, and include strategies for meeting these demands in a regional context, prioritizing meeting energy demand through conservation, energy efficiency, and other demand-reduction resources in a manner that contributes to the Commonwealth meeting [GHG] limits.” The objective of the Comprehensive Energy Plan (CEP) is to analyze competing pathways going forward and to provide strategy recommendations for achieving a clean, affordable, resilient energy future for the Commonwealth.

The CEP Comprehensive Energy Plan was completed in 2018 and found that reductions of emissions from the use of gasoline and diesel in the transportation sector are needed to meet GWSA goals. The transportation sector is primarily dependent on consumer choices and remains highly dependent on fossil fuel to power vehicles. Emissions from the transportation sector have remained relatively similar to 1990 levels. The Plan puts forth recommendation for transportation electrification through increased deployment of EVs and charging infrastructure. It also suggests the development of a biofuels industry to provide alternative transportation fuels.

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<sup>3</sup> Ibid.

## SUSTAINABLE DEVELOPMENT PRINCIPLES

The Commonwealth of Massachusetts has adopted ten sustainable development principles to care for the built and natural environment through integrated energy and environment, housing and economic development, and transportation policies, programs, investments, and regulations. The Commonwealth encourages the coordination and cooperation of all agencies in investing public funds in “smart growth” and equitable development, giving priority to investments that will create good jobs and wages and provide access to transit, housing and open space. Furthermore, the Commonwealth strives to advance these principles in partnership with regional and municipal governments, non-profit organizations, businesses and other stakeholders. The ten principles are listed in Table 3.1.

**Table 3.1: Sustainable Development Principles for the Commonwealth**

Sustainable Development Principles	Descriptions
<b>Concentrate Development and Mix Uses</b>	Support the revitalization of city and town centers and neighborhoods by promoting development that is compact, conserves land, protects historic resources, and integrates uses. Encourage remediation and reuse of existing sites, structures, and infrastructure rather than new construction in undeveloped areas. Create pedestrian friendly districts and neighborhoods that mix commercial, civic, cultural, educational, and recreational activities with open spaces and homes.
<b>Advance Equity</b>	Promote equitable sharing of the benefits and burdens of development. Provide technical and strategic support for inclusive community planning and decision-making to ensure social, economic, and environmental justice. Ensure that the interests of future generations are not compromised by today's decisions.
<b>Make Efficient Decisions</b>	Make regulatory and permitting processes for development clear, predictable, coordinated, and timely in accordance with smart growth and environmental stewardship.
<b>Protect Land and Ecosystems</b>	Protect and restore environmentally sensitive lands, natural resources, agricultural lands, critical habitats, wetlands and water resources, and cultural and historic landscapes. Increase the quantity, quality and accessibility of open spaces and recreational opportunities.
<b>Use Natural Resources Wisely</b>	Construct and promote developments, buildings, and infrastructure that conserve natural resources by reducing waste and pollution through efficient use of land, energy, water, and materials.
<b>Expand Housing Opportunities</b>	Support the construction and rehabilitation of homes to meet the needs of people of all abilities, income levels, and household types. Build homes near jobs, transit, and where services are available. Foster the development of housing, particularly multifamily and smaller single-family homes, in a way that is compatible with a community's character and vision and with providing new housing choices for people of all means.

**Table 3.1: Sustainable Development Principles for the Commonwealth**

Sustainable Development Principles	Descriptions
<b>Provide Transportation Choice</b>	Maintain and expand transportation options that maximize mobility, reduce congestion, conserve fuel and improve air quality. Prioritize rail, bus, boat, rapid and surface transit, shared-vehicle and shared-ride services, bicycling, and walking. Invest strategically in existing and new passenger and freight transportation infrastructure that supports sound economic development consistent with smart growth objectives.
<b>Increase Job and Business Opportunities</b>	Attract businesses and jobs to locations near housing, infrastructure, and transportation options. Promote economic development in industry clusters. Expand access to education, training, and entrepreneurial opportunities. Support the growth of local businesses, including sustainable natural resource-based businesses, such as agriculture, forestry, clean energy technology, and fisheries.
<b>Promote Clean Energy</b>	Maximize energy efficiency and renewable energy opportunities. Support energy conservation strategies, local clean power generation, distributed generation technologies, and innovative industries. Reduce greenhouse gas emissions and consumption of fossil fuels.
<b>Plan Regionally</b>	Support the development and implementation of local and regional state and interstate plans that have broad public support and are consistent with these principles. Foster development projects, land and water conservation, transportation and housing that have a regional or multi-community benefit. Consider the long-term costs and benefits to the Commonwealth.

Source: Massachusetts Executive Office of Energy and Environment

## THE HEALTHY TRANSPORTATION COMPACT

The Healthy Transportation Compact is an interagency initiative whose members include the Secretaries of Transportation, Health and Human Services, and Energy and Environmental Affairs, as well as the MassDOT Highway and Transit Administrators, and the Commissioner of Public Health. As a key requirement of the 2009 transportation reform legislation, the Compact is designed 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.

The Compact focuses on the following tasks:

- Promote interagency cooperation to implement state and federal policies and programs;
- Reduce greenhouse gas emissions, improve access to services for persons with mobility limitations and increase opportunities for physical activities;
- Increase bicycle and pedestrian travel and facilitate implementation of the Bay State Greenway Network;

- Work with the Massachusetts Bicycle and Pedestrian Advisory Board (MABPAB) to effectively implement a policy of complete streets for all users, consistent with the current edition of the Project Development and Design Guide;
- Implement health impact assessments for use by planners, transportation administrators, public health administrators and developers;
- Expand service offerings for the Safe Routes to School program;
- Initiate public-private partnerships that support healthy transportation with private and non-profit institutions;
- Establish an advisory council with private and non-profit advocacy; and
- Develop goals for the Compact and measure progress toward these goals.

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## MASS IN MOTION

Mass in Motion is a program administered by the Executive Office of Health and Human Services (EOHHS) that promotes wellness by stressing the importance of sound nutrition and physical activity. The program awards grants to communities to undertake wellness initiatives through measures such as developing policies and regulations that support nutrition and physical activity, creating a healthier environment for residents, and working with schools to promote a healthier lifestyle for youth.

## REGIONAL PLANS AND POLICIES

Transportation issues are regional in nature and cannot always be addressed by a single jurisdiction. The development of the Regional Transportation Plan has considered the policy recommendations and projects outlined in the region's primary planning documents, including the *Regional Strategic Plan for Greater Lowell*, the *Greater Lowell Comprehensive Economic Development Strategy*, and the region's *Hazard Mitigation Plan*.

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## REGIONAL STRATEGIC PLAN

In 2011, NMCOG adopted the *Regional Strategic Plan for Greater Lowell*, utilizing funding provided by the Executive Office of Housing and Economic Development. The Regional Strategic Plan (RSP) assists NMCOG and its member communities in planning for future development initiatives and for the preservation of important natural resources and open space. The RSP offers recommendations relative to housing, economic development and the protection of open space and environmentally sensitive resource areas. The RSP focuses on smart growth and sustainable development principles that promote compact growth in those areas with available infrastructure, and which foster the protection and preservation of the region's most valuable environmental and cultural resources. The Plan identifies locations in each community where growth is appropriate based on zoning, infrastructure, access and environmental impacts.

The goals of the RSP are outlined below and the Regional Transportation Plan has been developed to ensure consistency with these goals:

### LAND USE GOALS

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- Use land efficiently and protect sensitive resource areas by directing growth to priority development areas and locations with adequate infrastructure;
- Support the transformation of key underutilized lands, such as “brownfields”, to productive uses that complement the community and enhance existing neighborhoods;
- Incentivize redevelopment activities through land use tools, streamlined permitting and economic incentives;
- Minimize the environmental impact of future development by encouraging mixed-use and compact development patterns, and by promoting the use of low impact development techniques; and
- Use capital facilities and infrastructure efficiently and in a manner that is consistent with the region’s natural features, respectful of the character of its communities and neighborhoods, and that builds upon the economic strengths of each community.

### ECONOMIC DEVELOPMENT GOALS

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- Create a regional economic development framework that supports the efforts of private industry, local communities and agencies, educational institutions, federal and state agencies and private foundations to create jobs and improve the quality of life in the region;
- Create higher-skilled, higher wage jobs within industry clusters – biotech, nanotech, high technology, “green” industries, and emerging technology – to diversify the regional economy and focus on the global economy;
- Utilize a combination of economic development and redevelopment strategies that reflects the character of each community and address infrastructure barriers (roads, wastewater capacity, telecommunications, etc) to future economic growth; and
- Increase the supply of skilled workers for industry in the region through the integration of economic development and workforce development strategies.

### HOUSING GOALS

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- Create more affordable and market-rate housing throughout the region to ensure that businesses can expand and relocate to the region with the assurance that their workforce will be able to own, lease or rent quality housing;
- Encourage mixed-use development that ties together residential and commercial uses in city and town centers and mill districts throughout the region;

- Increase housing options available to families, young couples, single adults, seniors, artists, students, the disabled, veterans, and other groups so that they may live and work in the Greater Lowell region;
- Address expiring affordability restrictions<sup>4</sup> as a means of maintaining the region’s stock of affordable housing; and
- Encourage the location of future housing in areas served by public transit.

#### NATURAL, CULTURAL AND ENVIRONMENTAL RESOURCES GOALS

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- Care for the natural environment by protecting and restoring natural systems, conserving habitat, improving water quality, and reducing air pollution, thereby ensuring that all residents, regardless of social and economic status, live in a healthy environment;
- Promote the use of innovative, environmentally-sensitive development practices, including design, materials, construction, and on-going maintenance;
- Encourage the use of low impact development techniques and other best management practices (BMPs) for managing stormwater;
- Preserve, protect and enhance the region’s remaining agricultural lands;
- Support agricultural, farmland and aquatic uses that enhance the local food system and increase its capacity to produce fresh and minimally processed foods;
- Preserve significant historic, visual and cultural resources, including public views, landmarks, archaeological sites, historic and cultural landscapes, and areas of special character;
- Improve public access to the region’s waterways, water bodies and open spaces; and
- Promote the production and use of alternative energy.

#### GREATER LOWELL COMPREHENSIVE ECONOMIC DEVELOPMENT STRATEGY

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In 2014, NMCOG adopted the *Greater Lowell Comprehensive Economic Development Strategy (CEDS) Update for 2010-2013*. This document built upon previous five-year economic development “blueprints” for the Greater Lowell region. The 2010-2013 CEDS Update included Comprehensive Needs Analysis, Vision, Action Plan and Evaluation sections required by the Economic Development Administration (EDA) of the U.S. Department of Commerce (DOC). The CEDS provided new information regarding current economic conditions, past activities in terms of project development, goal attainment and capacity building, a revised project priority list and new activities for the next program year.

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<sup>4</sup> Affordability restrictions are often established for 15-30 years and expire over time.

The connection between transportation and economic development is woven throughout the 2010-2013 CEDS Update. A discussion of topics such as alternative transportation modes and facilities, such as bicycle and pedestrian paths, and environmental issues, such as air quality, closely ties the CEDS to the RTP and TIP. In addition, many of the TIP projects are included on the CEDS Priority Project List. The transportation projects listed in the CEDS are essential to upgrading the infrastructure in the region, in order to encourage economic growth and the maintenance of the region's quality of life. The Evaluation section outlines the criteria by which progress on the CEDS "grass-roots" planning process, goal attainment and project development will be assessed on a qualitative and quantitative basis.

NMCOG recently received a grant from the Economic Development Administration of the U.S. Department of Commerce to develop the 2019-2022 CEDS. With each new CEDS document, NMCOG strives to integrate the transportation and economic development planning processes, to identify and promote regional economic development and transportation projects, and to support local economic development and transportation initiatives. These efforts have resulted in the creative use of the limited federal, state, local and private funding sources to further the economic development and transportation goals and objectives for the region.

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#### HAZARD MITIGATION PLAN FOR THE NORTHERN MIDDLESEX REGION

The development of a regional mitigation plan before disaster strikes results in the most efficient and effective means of reducing the loss of life and property. Mitigation helps to minimize or prevent damage to structures, infrastructure, and other resources. The regional nature of the Plan helps to ensure that mitigation initiatives, measures and strategies are coordinated across municipal boundaries. Ultimately, such regional integration improves the ability of the local communities to implement post-disaster recovery projects in a cooperative and coordinated manner.

The *Hazard Mitigation Plan for the Northern Middlesex Region* identifies several mitigation projects that are transportation-related, such as the reconstruction of structurally deficient bridges, traffic improvements along evacuation routes and near critical facilities, and improvements to reduce roadway flooding. It is important that the RTP consider the Hazard Mitigation Plan recommendations in order to protect the region's residents and infrastructure in the event of a natural disaster.

NMCOG prepared the 2015 *Hazard Mitigation Plan*, which contains an inventory and assessment of natural hazard risks, a vulnerability analysis based on the geographic location of critical infrastructure and facilities, and an existing protection matrix for the region and its nine member communities. This Plan takes into account the potential impacts of climate change. Through discussions with local officials and the region's Multi Hazard Community Planning Team, a list of hazard mitigation actions and projects has

been developed for future implementation. The Plan was approved for a five-year period and will need to be updated in 2020.

## LOCAL PLANS AND POLICIES

Data and project information used to develop the Regional Transportation Plan was drawn from municipal Master Plans, Open Space and Recreation Plans, GIS sources, Housing Production Plans, local bylaws and ordinances, the UMass Lowell Transportation Master Plan and local Economic Development Plans and Strategies. The primary purpose of transportation is to move people and goods from one place to another, but transportation systems also affect community character, the natural and human environment, and economic development patterns. A transportation system can improve the economy, shape development patterns, and influence quality of life and the natural environment.

Development density and location influences the regional travel patterns, and access to the transportation system can influence land use and development trends. For example, a connected system of streets in an area with high residential densities and a mix of land uses can facilitate pedestrian and bicycle travel, and provide the critical population threshold needed to efficiently operate public transportation. However, low-density dispersed land use patterns can encourage travel by single-occupancy vehicles.

The projects and policies set forth in the Regional Transportation Plan have been reviewed for consistency with goals and recommendations established in local plans and policy documents, as described above. The NMMPO and the local communities have a shared interest in managing the region's transportation resources and promoting livable communities.

## CHAPTER 4 REGIONAL PROFILE AND DEMOGRAPHICS

The Greater Lowell region consists of the City of Lowell and its eight suburbs – Billerica, Chelmsford, Dracut, Dunstable, Pepperell, Tewksbury, Tyngsborough and Westford – and has a land area of approximately 196 square miles and an inland water area of 5.76 square miles. The City of Lowell serves as the central city and economic center of the region. According to the U.S. Census Bureau, the Greater Lowell region had a population of 286,901 in 2010, which represented an increase of 2.2% since 2000. This growth rate was one-third of what the region experienced between 1990 and 2000.

The region is tied together by the Merrimack River and is located in the northeastern section of Massachusetts, abutting the New Hampshire state line. Lowell is approximately forty-five minutes from the Boston and Manchester, New Hampshire and an hour from Worcester and Portsmouth, New Hampshire.

### POPULATION CHARACTERISTICS

According to the 2010 U.S. Census, Lowell accounts for 37% of the region's population and continues to have the highest population density, at over 7,325 persons per square mile. Billerica, Chelmsford, Dracut and Tewksbury, the early suburbanized communities with population densities over 1,000 persons per square mile, collectively account for 46% of the region's population. The remaining communities, where much of the development activity occurred during the 1990s, account for 17% of the region's population. Table 4.1 on the next page summarizes the population characteristics of the region's communities.

The 2013-2017 American Community Survey (ACS), undertaken by the U.S. Census Bureau, estimates that the region's population has increased by 5.1% over a seven-year period. It is important to note that ACS consists of a five-year average based on a limited sample size. The margin of error for the ACS is much greater than the decennial census, due to the relatively small sample size.

**Table 4.1: Population by Community**

Community	2000 Population	2010 Population	% Change 2000-2010	2013-2017 Population Estimate	% Change between 2010 Census and 2013-2017 ACS estimate
<b>Billerica</b>	38,981	40,243	3.24	42,791	5.95
<b>Chelmsford</b>	33,858	33,802	-0.17	35,067	3.61
<b>Dracut</b>	28,562	29,457	3.13	31,113	5.32
<b>Dunstable</b>	2,829	3,179	12.37	3,337	4.73
<b>Lowell</b>	105,167	106,519	1.29	110,964	4.01
<b>Pepperell</b>	11,142	11,497	3.19	12,049	4.58
<b>Tewksbury</b>	28,851	28,961	0.38	30,666	5.56
<b>Tyngsborough</b>	11,081	11,292	1.9	12,232	7.68
<b>Westford</b>	20,754	21,951	5.77	24,087	8.87
<b>Total</b>	<b>281,225</b>	<b>286,901</b>	<b>2.02</b>	<b>302,306</b>	<b>5.10</b>

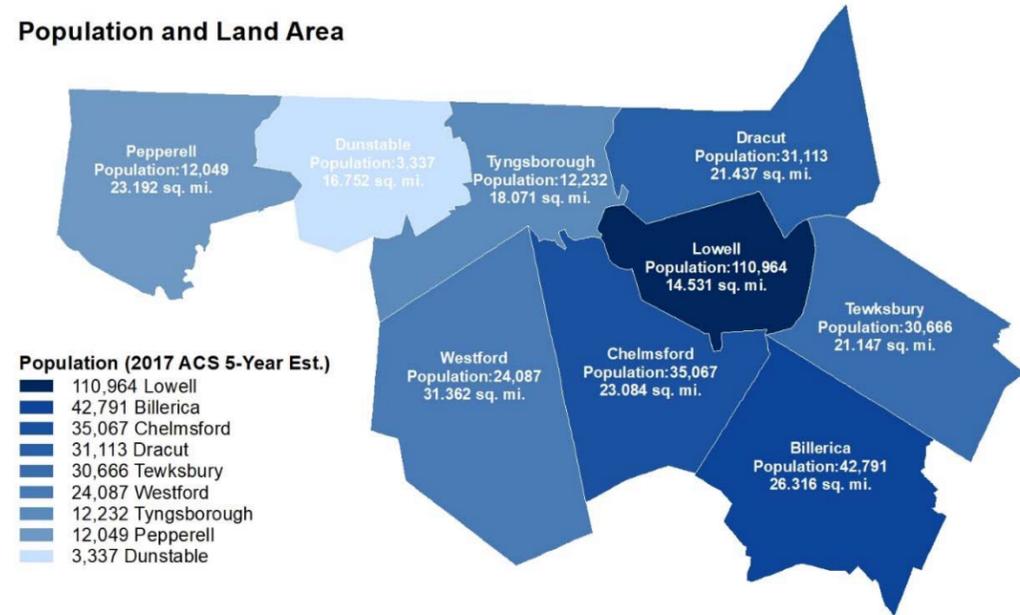
Source: U.S. Census Bureau, 2000, 2010, and 2013- 2017 ACS 5-Year Estimate

When reviewing the demographic statistics for our region, it helps to review land area, population density, median age and average household size. Map 4.1 on the next page graphically compares population and land area, population density, median age, and household size within the region's communities. The City of Lowell is the region's most populated community with an estimated population of 110,964, while the Town of Dunstable has the fewest residents with an estimated of 3,337, according to the 2013-2017 American Community Survey (ACS). In terms of land area, Westford is the largest community in the region with a land area of thirty-one (31) square miles, while Lowell is geographically the smallest community at fourteen (14) square miles. With its large population and comparatively small land area, Lowell has the highest population density at 7,636 residents per square mile, while Dunstable has the lowest population density at 199 residents per square mile. Dunstable has the largest average household size at 2.93 persons per household, while Chelmsford has the smallest at 2.55 persons per household.

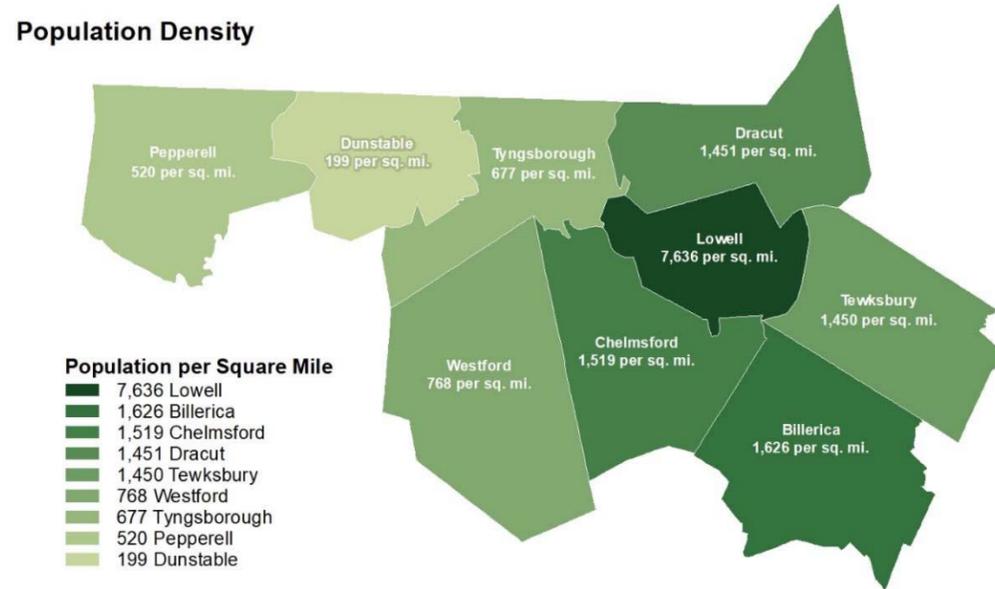
In terms of median age, the oldest population resides in the Town of Dunstable (median age 45.5 years), while the City of Lowell's population has the youngest median age at 33.3 years. Such data has implications for transportation planning. As the population ages, there is an increased need for transportation modes and services other than the automobile. As the region's population cohorts shift to include a higher percentage of residents age 65 and older, the demand for paratransit and other transportation services will continue to increase.

### Map 4.1: Population Characteristics of the Northern Middlesex Region

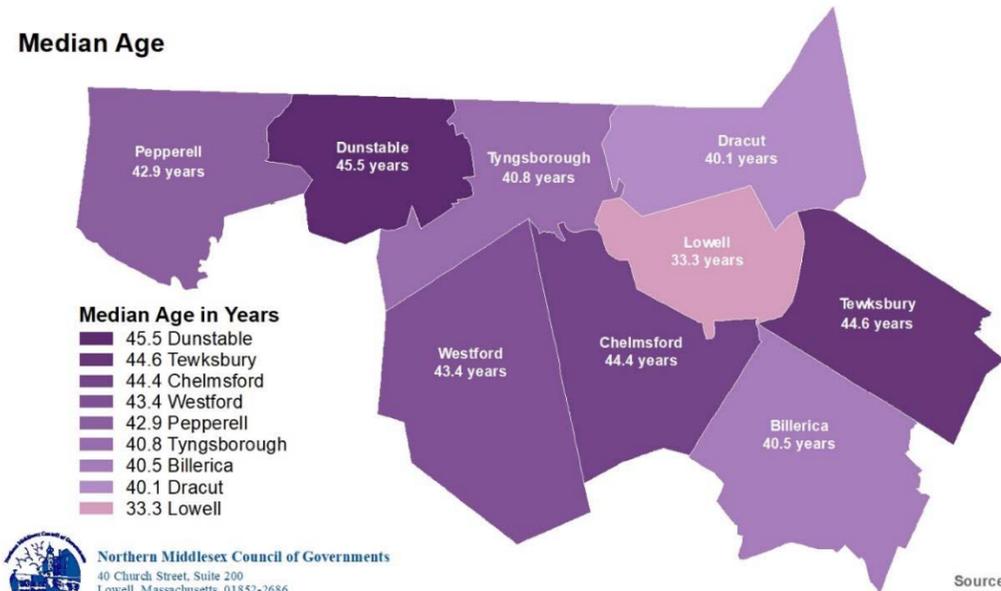
Population and Land Area



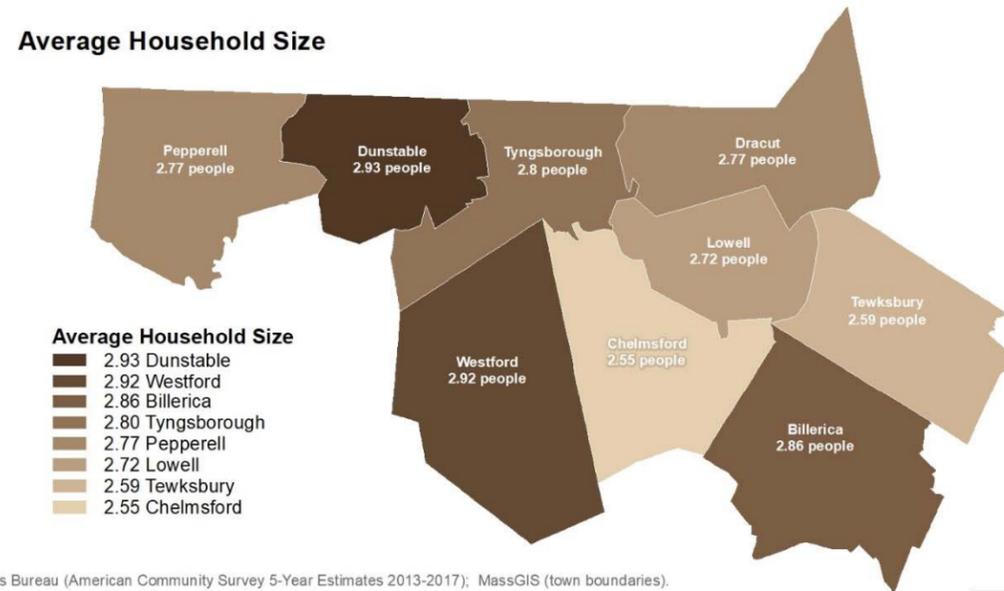
Population Density



Median Age



Average Household Size



Sources: US Census Bureau (American Community Survey 5-Year Estimates 2013-2017); MassGIS (town boundaries).  
Data provided on this map is not sufficient for regulatory interpretation.  
Produced 5/24/2019 by NMCCOG.



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## HOUSING OVERVIEW

The total number of housing units in the region increased from 99,342 units in 2000 to 109,446 units in 2010, an increase of 9.9%. According to the 2013-2017 ACS estimates, it is estimated that the region has approximately 112,971 housing units, which represents a 3.12% increase since 2010. As can be seen in Table 4.2 below, housing density has continued to increase as the region's population has grown and new household formation has continued to accommodate an aging population, empty nesters and young families. As previously discussed, housing density is highest in the City of Lowell (2,853.4 units per square mile), according to the 2013-2017 ACS estimates, and lowest in Dunstable (70.1 units per square mile), which is reflective of the town's rural nature.

**Table 4.2: Northern Middlesex Regional Housing - Total Units and Density**

Community	No. of Housing Units (2000 Census)	No. of Housing Units (2010 Census)	No. of Housing Units (2013-2017 ACS)	Land Area (Sq. Mi.)	2000 Housing Unit Density (Per Sq. Mi.)	2010 Housing Unit Density (Per Sq. Mi)	2013-2017 Housing Unit Density (Per Sq. Mi)
Billerica	12,919	14,481	14,974	26.38	489.73	548.94	567.6
Chelmsford	12,812	13,807	14,147	23.28	550.34	593.08	607.7
Dracut	10,451	11,351	11,543	21.36	489.28	531.41	540.4
Dunstable	923	1,098	1,174	16.74	55.14	65.59	70.1
Lowell	37,887	41,431	41,489	14.54	2,605.70	2,849.45	2,853.4
Pepperell	3,847	4,348	4,665	23.17	166.03	187.66	201.3
Tewksbury	9,964	10,848	11,911	21.06	473.12	515.10	565.6
Tyngsborough	3,731	4,206	4,431	18.5	201.67	227.35	239.5
Westford	6,808	7,876	8,637	31.33	217.3	251.39	275.7
<b>Total</b>	<b>99,342</b>	<b>109,446</b>	<b>112,971</b>	<b>196.36</b>	<b>505.91</b>	<b>557.37</b>	<b>575.3</b>

Source: US Census and American Community Survey Data

## DEMOGRAPHIC FORECASTS

Demographic factors and land use activities are primary considerations in the transportation planning process. The intensity and geographic distribution of vehicular trip generation is estimated on the basis of socio-economic factors.

Population projections are based upon the calculation of a statewide control total, and a specific share of the population total is then assigned to each Metropolitan Planning Organization (MPO) region and its member communities. NMCOG staff has worked with MassDOT to adjust these numbers to reflect known

development patterns within each municipality, while maintaining the MassDOT assigned control totals for the region.

As shown in Table 4.3 below, population growth is expected to continue throughout the region over the upcoming decades, with the region's population increasing by 2.8% between 2010 and 2040. The region's population is estimated to reach 299,617 by 2020, 298,889 by 2030 and 295,041 by 2040. While population growth rates are expected to be highest in the less densely developed communities of Dunstable, Tyngsborough and Westford, the highest number of additional residents will likely reside in the communities of Billerica, Lowell and Chelmsford. Population growth in these areas could put a strain on the transportation network, leading to new demands for improved transportation infrastructure and services. While the growth rates in Dunstable and Tyngsborough appear high, this can be misleading given the relatively low base populations in these communities.

**Table 4.3: Population Growth in the Northern Middlesex Region**

Community	2010	2020	2030	2040		% Change 2010-2040
	Population	Population Projections	Population Projections	Population Projections	Regional Share	
<b>Billerica</b>	40,243	42,664	42,501	42,010	14%	4.4
<b>Chelmsford</b>	33,802	34,394	34,037	33,548	11%	-0.8
<b>Dracut</b>	29,457	31,859	32,190	32,071	11%	8.9
<b>Dunstable</b>	3,179	3,417	3,541	3,675	1%	15.6
<b>Lowell</b>	106,519	108,699	108,183	107,224	36%	0.7
<b>Pepperell</b>	11,497	12,295	12,354	12,335	4%	7.3
<b>Tewksbury</b>	28,961	29,980	29,574	28,818	10%	-0.5
<b>Tyngsborough</b>	11,292	12,595	12,731	12,487	4%	10.6
<b>Westford</b>	21,951	23,714	23,778	22,873	8%	4.2
<b>Northern Middlesex Region</b>	<b>286,901</b>	<b>299,617</b>	<b>298,889</b>	<b>295,041</b>	<b>100%</b>	<b>2.8</b>

Source: 2010 U.S. Census and 2020, 2030, and 2040 projections by MassDOT with input from NMCOG

Following completion of the population projections for 2020, 2030, and 2040, MassDOT and NMCOG developed household projections for the Greater Lowell region. The U.S. Census defines households as being equivalent to "occupied housing units." According to the projections for 2020, 2030 and 2040, the number of households in the Greater Lowell region will increase by 18.0% from 104,022 households in 2010 to 122,740 households in 2040, as summarized in Table 4.4 on the following page.

**Table 4.4 Household Projections in Northern Middlesex Region**

Community	2010 Households	2020 Household Projections	2030 Household Projections	2040 Household Projections		% Change 2010-2040
				Number	% Share	
<b>Billerica</b>	14,034	15,885	16,617	16,753	13.6	19.4
<b>Chelmsford</b>	13,313	14,394	14,962	15,063	12.3	13.1
<b>Dracut</b>	10,956	12,543	13,306	13,595	11.1	24.1
<b>Dunstable</b>	1,063	1,200	1,314	1,412	1.2	32.8
<b>Lowell</b>	38,470	41,427	42,388	42,867	34.9	11.4
<b>Pepperell</b>	4,197	5,136	5,720	5,973	4.9	42.3
<b>Tewksbury</b>	10,492	11,623	12,043	11,975	9.8	14.1
<b>Tyngsborough</b>	3,999	5,020	5,505	5,622	4.6	40.6
<b>Westford</b>	7,498	9,042	9,704	9,480	7.7	26.4
<b>Northern Middlesex Region</b>	104,022	116,270	121,559	122,740	100.0	18.0

Source: 2010 U.S. Census and 2020, 2030, and 2040 projections by MassDOT with input from NMCOG

MassDOT has developed updated employment projections for the Greater Lowell region, as shown in Table 4.5 on the following page. MassDOT applied a “top-down” approach that utilizes employment projections for the state as a whole, and then assigns shares of these figures to the MPO regions and individual communities within those regions. Based upon this approach, the employment projections at the state level are more accurate than those for the region or individual communities. Nevertheless, there is merit in understanding the projected employment numbers that have been calculated for the nine communities in the Greater Lowell region.

The highest employment growth, from 2010-2040, is anticipated in the communities of Westford (27.2%), Chelmsford (21.4%) and Tyngsborough (13.0%). The employment growth will have impacts on every community in the Northern Middlesex region, and may require additional infrastructure – roads, bridges, sewer, water lines, telecommunications, and public transit services. Such investments will be needed to support the local and regional economies and to maintain the area’s economic competitiveness.

**Table 4.5: Local and Regional Employment Projections, 2010-2040**

Community	2010 Employment	2020 Employment Projections	2030 Employment Projections	2040 Employment Projections	% Change 2010-2040
<b>Billerica</b>	25,070	26,190	25,983	25,975	3.6
<b>Chelmsford</b>	19,603	24,005	23,813	23,806	21.4
<b>Dracut</b>	5,334	6,005	5,958	5,956	11.7
<b>Dunstable</b>	321	300	298	298	-7.2
<b>Lowell</b>	38,411	37,005	36,708	36,699	-4.5
<b>Pepperell</b>	2,052	1,600	1,588	1,587	-22.7
<b>Tewksbury</b>	14,570	16,000	15,872	15,867	8.9
<b>Tyngsborough</b>	4,212	4,800	4,762	4,760	13.0
<b>Westford</b>	9,759	12,515	12,416	12,411	27.2
<b>Greater Lowell Region</b>	<b>119,332</b>	<b>128,420</b>	<b>127,398</b>	<b>127,359</b>	<b>6.7</b>

Source: U.S Census Bureau, 2010 Census and projections by UMass Donohue Institute, MAPC, MassDOT and NMCOG

## LAND USE CHARACTERISTICS

Transportation, land use and economic activity are interrelated and dependent on one another. The NMMPO must consider this interrelationship during the transportation decision-making process in order to meet the region's needs today and in the future. The transportation infrastructure must support local and regional economic activity and be capable of moving supplies, workers and finished products efficiently. Congestion on the transportation network results in serious economic consequences in the way of lost productivity, and higher costs for the delivery of goods and services. Figure 4.1 on the next page provides an overview of the change in land uses within the Greater Lowell region between 1971 and 2005, based on McConnell land use data provided by the University of Massachusetts. A more detailed look at land use statistics by community can be found in Appendix E. Although more recent land use data has been made available for some communities, the 2005 data was utilized as it provides the most recent information base that is comparable across community boundaries, as shown on Map 4.2.

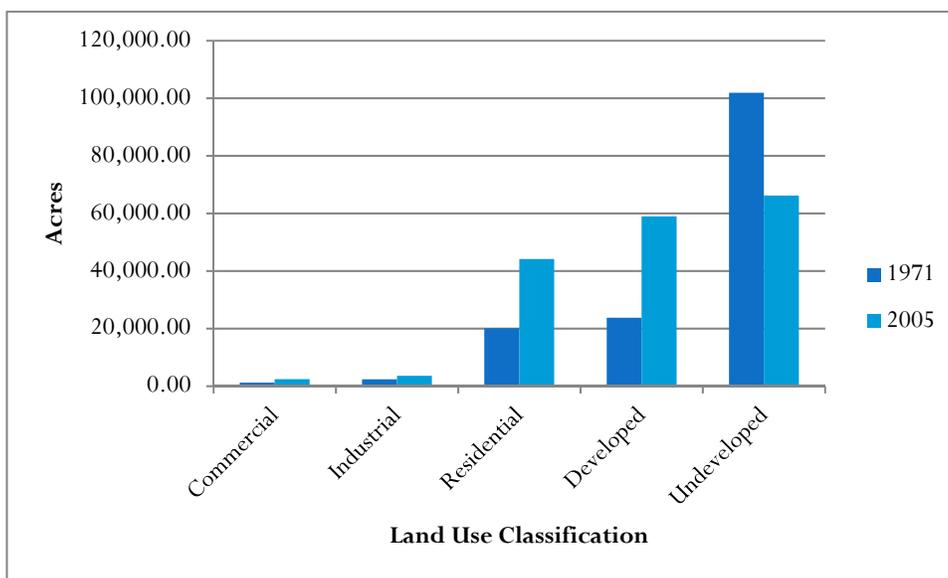
In 1971, 18.9% of the land within the region was developed. Approximately 5.3% of the developed land was devoted to commercial purposes, while 10% was utilized for industrial purposes, and 84.8% was devoted to residential uses. By 2005, the acreage of developed land across the region increased by 148%, with commercially utilized land increasing by 97%, industrially used land growing by 52% and residentially used land increasing by 119%.

By 2005, 47.1% of the land within the Greater Lowell region was developed. Even though industrial uses increased from 1971 to 1990, the region lost 27% of its industrial uses between 1991 and 2005. Between

1971 and 2005, the amount of undeveloped land in the region diminished by approximately 35%. Map 4.2 on page 65 shows land uses across the region in 2005.

Between 1971 and 2005, the following communities experienced an increase in developed land area that exceeded the regional average increase of 148%: Dunstable (365%), Tyngsborough (363%), Pepperell (288%), Tewksbury (208%), Westford (165%), and Chelmsford (150%). The Town of Billerica had the lowest increase (86%), while Lowell (143%) and Dracut (121%) were below the regional average. In terms of the loss of undeveloped land area, Lowell (-80%), Chelmsford (-51%), Billerica (-40%) and Tewksbury (-39%) exceeded the region's average loss at 35%.

**Figure 4.1: Land Use in the Northern Middlesex region, 1971-2005 (in acres)**



Source: McConnell Land Use Data

## LAND USE PATTERNS AND TRENDS

The communities of Lowell, Billerica, Chelmsford and Tewksbury had the greatest acreage devoted to commercial use in 2005, followed by Dracut, Tyngsborough and Westford. Of the nine Greater Lowell communities, the Town of Billerica had the largest land area used for industrial purposes (1,071 acres), followed by Lowell (632 acres), Tewksbury (586 acres), Chelmsford (561 acres) and Westford (416 acres). In 2005, the overall region had 2,470 acres of land utilized for commercial development and 3,612 acres devoted to industrial development. One-quarter of the region's commercially and industrially developed land (1,491 acres) was located within the Town of Billerica. This land use pattern was quite different from

that seen in 1971, when the City of Lowell had the largest land area devoted to commercial and industrial uses, and reflects the continued suburbanization of employment centers.

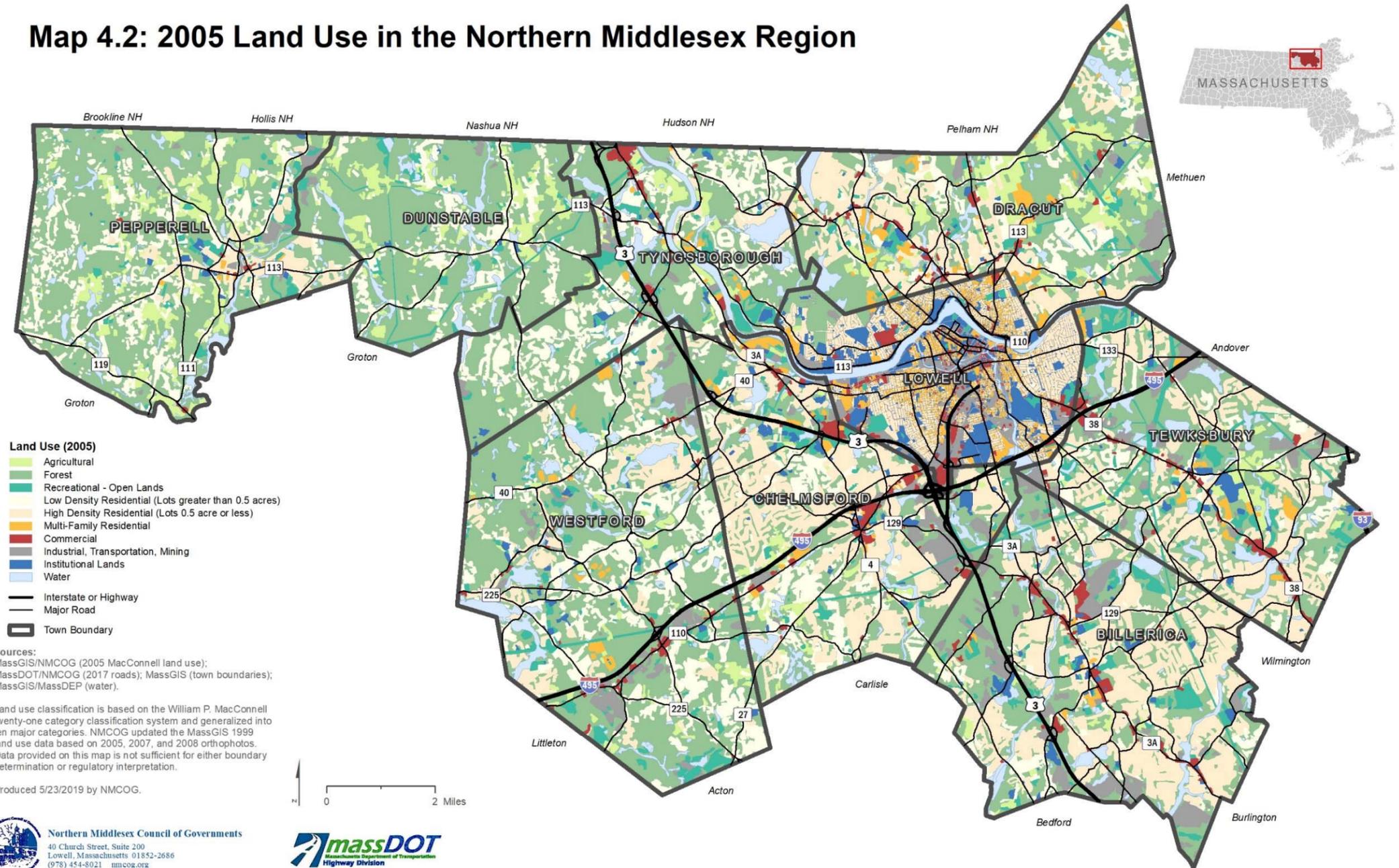
As noted in Figure 4.1, the Northern Middlesex region experienced a significant increase in residential land use (119.12%) between 1971 and 2005, while the amount of commercial and industrial land remained relatively constant. Dunstable experienced the largest growth in residential land use (368.1%) from 1971 to 2005.

The largest category of developed land use in the region is residential. This includes all residential dwelling types, from large lot, single-family homes to multi-family apartments and condominiums. Recent development across the region has been largely in the form of large lot, single-family subdivisions, although there have been several multi-family projects constructed under Chapter 40B. A significant amount of undeveloped land remains, although it is not evenly distributed throughout the region. Undeveloped land includes land that is vacant and developable, as well as land that may be classified as undevelopable due to various development constraints, such as wetlands.

Land consumption will likely continue at an alarming rate as long as large lot zoning remains the norm in the suburbs. Commercial development continues to be dispersed beyond traditional centers to locations along state numbered routes and major travel corridors, such as Route 110 in Lowell, Chelmsford and Westford, Route 3A and Concord Road in Billerica, Lakeview Avenue and Route 113 in Dracut, Route 38 in Tewksbury, and Middlesex Road in Tyngsborough. The greatest concentration of industrial areas tends to be in technology parks built near highway interchanges and along major corridors, such as Route 110 in Westford, Route 129 in Chelmsford and Billerica, Concord Road and the Middlesex Turnpike in Billerica, and Route 133 in Tewksbury. Such industrial parks are often built in a campus-like setting with large fields of paved parking, resulting in higher land consumption rates than would occur in an urban or compact development setting where higher floor area ratios are typically allowed.

The continued development of land in the Northern Middlesex region provides an increased need for transportation facilities and services to meet the demands generated by new residential, commercial and industrial uses. The highway system in the region will be impacted as more automobiles and trucks serve new development, further straining the basic transportation network which must already meet the demands of background traffic growth. The bridge and roadway infrastructure in the region must be properly maintained to accommodate future economic growth and development. Congestion levels and operating conditions must be monitored in order to ensure public safety, to determine if the current system can be managed and operated within its present configuration, and to assess whether system expansion is needed.

**Map 4.2: 2005 Land Use in the Northern Middlesex Region**

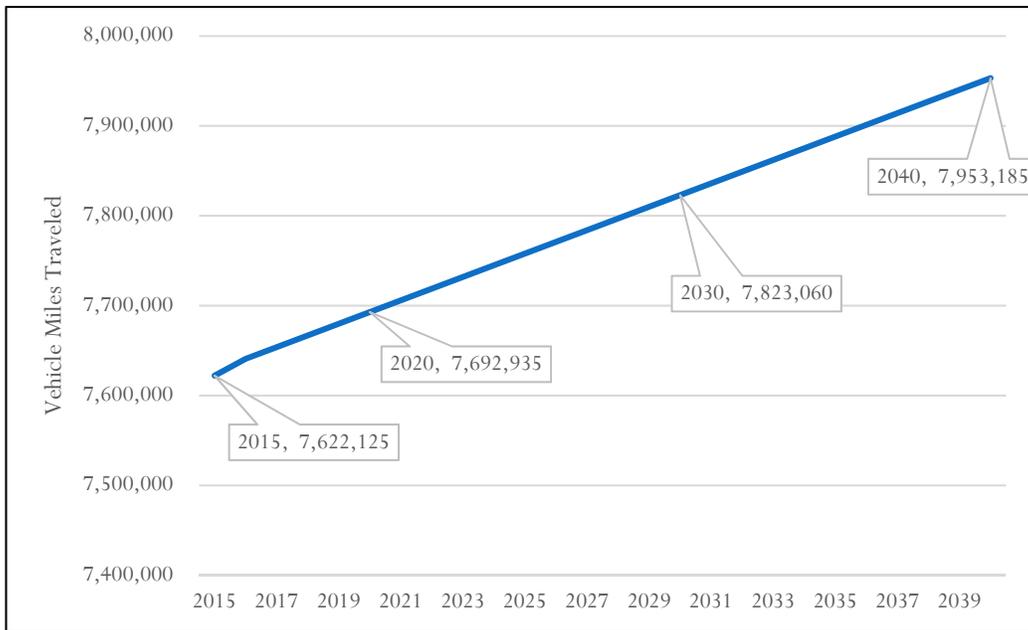


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**TRAVEL DEMAND PROJECTIONS**

Regional travel demand increases over the life of the RTP, impacting travelers’ ability to flow through the region’s transportation network. Future demand on the system impacts safety, congestion, and overall economic vitality of the region. Vehicle miles of travel (VMT) is used as a performance measure to indicate overall demand on the system. The MassDOT travel demand model outlines the regional demand in average daily VMT, which is shown in Figure 4.1 below. Between 2015 and 2040, VMT increases 4% throughout the region.

**Figure 4.1: Northern Middlesex Regional Daily Vehicle Miles Traveled**



Source: MassDOT VMT Projections

**COMMUTING CHARACTERISTICS**

The suburban communities in the Northern Middlesex region have been impacted increased development, traffic and congestion. There is a large exchange of traffic across the Massachusetts-New Hampshire State line for employment, entertainment and shopping purposes. Table 4.6 below shows the percentage of residents working outside of Middlesex County and the State, according to the 2013 - 2017 ACS 5-Year estimate. The Towns of Dunstable, Pepperell and Tyngsborough contain the largest percentages of residents who work out of state, which one would expect given their close proximity to

New Hampshire. In addition, the Town of Tewksbury contains the largest percentage of residents who work within Massachusetts, but outside the county (24.3%).

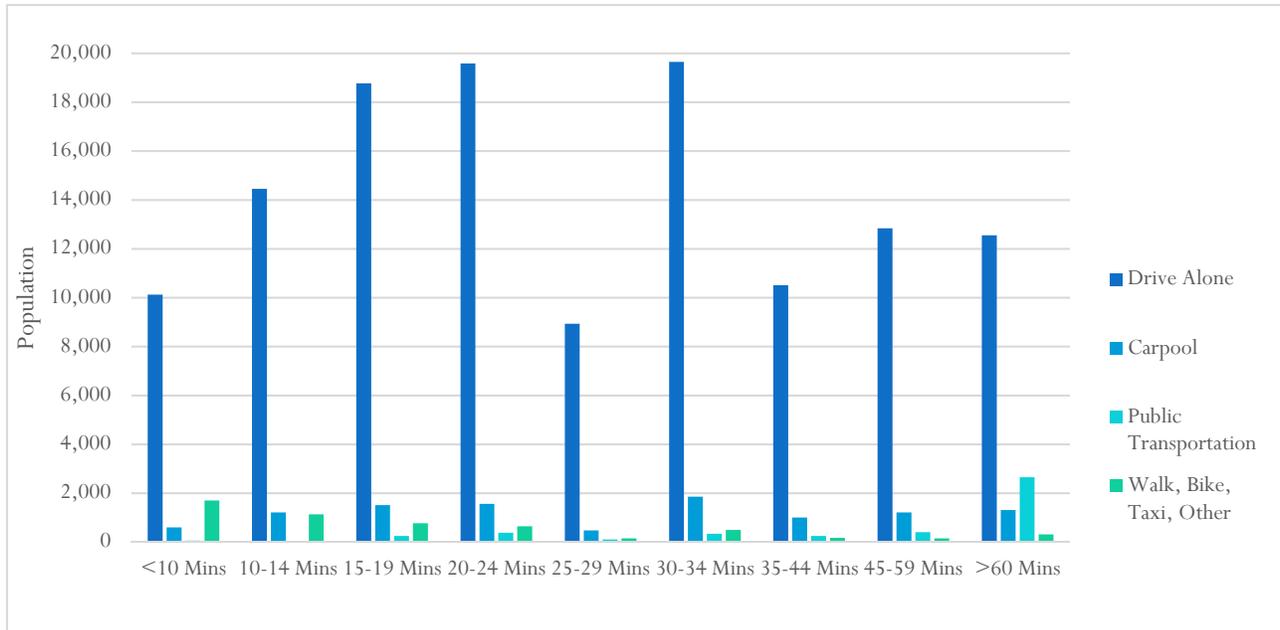
**Table 4.6: Commuter Patterns by Residential Community in the Northern Middlesex Region**

Community	% working in State of residence	% working in County of residence	% working outside of County of Residence	% working outside State of Residence (% of Residents)
<b>Billerica</b>	97.4	78.3	19.1	2.6
<b>Chelmsford</b>	94.7	80.0	14.7	5.3
<b>Dracut</b>	91.6	71.8	19.8	8.4
<b>Dunstable</b>	85.9	75.7	10.2	14.1
<b>Lowell</b>	94.2	77.7	16.5	5.8
<b>Pepperell</b>	84.5	66.9	17.6	15.5
<b>Tewksbury</b>	96.9	72.6	24.3	3.1
<b>Tyngsborough</b>	86.2	72.6	13.6	13.8
<b>Westford</b>	95.0	78.4	16.5	5.0

Source: 2013 - 2017 ACS 5- Year Estimates.

Figure 4.2 on the following page displays the average commute time by mode of travel, according to the 2013-2017 ACS 5-Year Estimate. The most common commuting time for residents who drove alone or carpooled was 30 - 34 minutes, while public transit users spent 60 minutes or longer commuting to work. This is due, in part, to commuters who work in Boston using commuter rail to get to and from work each day. It may also be due to multiple bus transfers for commuters, which could potentially slow down a commute. The majority of residents who walked and biked to work spent less than 10 minutes commuting.

**Figure 4.2: Number of Commuters by Average Commute Time by Mode of Travel**



Source: 2013 - 2017 ACS 5-Year Estimate

As shown in Table 4.7 on the following page, the U.S. Census Bureau estimates that almost 83% of the region’s commuters drive alone to their place of work, while 7% carpool, 2.5% walk, 0.2% bicycle, 2.9% use public transportation (excluding taxis), 4% work from home and 0.9% arrive by taxi, motorcycle or other means.

**Table 4.7: Commuter Mode Choice by Community**

Community	Total Workers (16 years and over)	Mode Choice													
		Drive Alone		Carpool		Public Transportation (excluding taxi cabs)		Walked		Bicycle		Taxi, motorcycle or other means		Worked at home	
		Workers	%	Workers	%	Workers	%	Workers	%	Workers	%	Workers	%	Workers	%
Billerica	23,247	20,201	86.9	1,162	5.0	813	3.5	139	0.6	70	0.3	163	0.7	697	3.0
Chelmsford	18,214	15,172	83.3	1,111	6.1	546	3.0	219	1.2	36	0.2	109	0.6	1,020	5.6
Dracut	16,614	14,221	85.6	1,196	7.2	299	1.8	199	1.2	33	0.2	133	0.8	548	3.3
Dunstable	1,877	1,571	83.7	128	6.8	18	1.0	9	0.5	0	0.0	0	0.0	150	8.0
Lowell	52,276	39,625	75.8	4,913	9.4	1,986	3.8	3,032	5.8	104	0.2	836	1.6	1,673	3.2
Pepperell	6,296	5,471	86.9	334	5.3	76	1.2	25	0.4	0	0.0	18	0.3	378	6.0
Tewksbury	16,496	14,137	85.7	957	5.8	445	2.7	148	0.9	16	0.1	49	0.3	742	4.5
Tyngsborough	7,018	6,168	87.9	463	6.6	70	1.0	63	0.9	14	0.2	14	0.2	217	3.1
Westford	12,330	10,825	87.8	481	3.9	210	1.7	37	0.3	25	0.2	37	0.3	703	5.7
<b>Total</b>	<b>154,368</b>	<b>127,391</b>	<b>82.5</b>	<b>10,745</b>	<b>7.0</b>	<b>4,463</b>	<b>2.9</b>	<b>3,871</b>	<b>2.5</b>	<b>298</b>	<b>0.2</b>	<b>1,359</b>	<b>0.9</b>	<b>6,128</b>	<b>4.0</b>

Source: ACS 2013-2017, Table: S0801

## CHAPTER 5 REGIONAL ROADWAY INFRASTRUCTURE

Highway and roadway infrastructure is vital to our region’s economic growth and development. It is the fundamental system we rely on to transport people and goods, and our emergency management and public safety services depend on it. Crumbling, outdated and inefficient infrastructure can create serious barriers to economic growth and mobility. The Nation’s investment in highway infrastructure has not kept pace with growing demands, presenting a number of challenges, particularly as we plan for the region’s future. Extending the service life of existing highway infrastructure, and building, rebuilding and rehabilitating our roadway network, will be challenging without additional resources. Adapting to the impacts of climate change will also add to the cost of maintenance and repair, as we strive to protect our transportation assets and critical infrastructure from the likelihood of increased flooding, severe storms and rising temperatures.

The Northern Middlesex region is served by an extensive highway network with over 1,300 centerline miles of roadway, of which 95 miles are under state jurisdiction, and the remainder is under local jurisdiction. Interstates 93 and 495, as well as US Route 3, serve as the major limited access highways, providing connections between the region and New Hampshire, Maine, New York, Connecticut, Rhode Island and other locations throughout New England, Canada and the mid-Atlantic states. This section of the Regional Transportation Plan principally focuses on our roadway and bridge infrastructure by examining existing conditions, identifying deficiencies in the system, and outlining tools and programs that will play a role in addressing these issues in the future.

### FUNCTIONAL CLASSIFICATION

The USDOT’s Federal Highway Administration (FHWA) classifies our nation’s urban and rural roadways by road function. Each functional class is based on the type of service the road provides to the motoring public, and the designation is used for data and planning purposes. Design standards are also tied to functional class, with each class having a range of allowable lane widths, shoulder widths, and curve radii. The amount of mobility and land access offered by these road types differs greatly.

In 1974, the Federal Highway Administration published the manual, *Highway Functional Classification - Concepts, Criteria and Procedures*, which was revised in

### CHAPTER 5 REGIONAL HIGHWAY NETWORK



**Image 5.1: I-495 is classified as an urban interstate**

2013. The manual defines the different functional systems, discusses the general concepts and characteristics used to identify each, and explains the procedures to follow in designating a system.

Functional Classification is divided into rural and urban systems. The urban functional classification system covers all streets, roads, and highways located within urban boundaries as designated by the U.S. Census Bureau. The Census Bureau defines two types of urban areas based on population. Small urban areas are urban places with a population of 5,000 or more and not located within any urbanized area. An urbanized area is an area with a population of 50,000 or more. As might be expected, the rural functional classification system covers all other streets, roads, and highways that are not located within the boundaries of small urban and urbanized areas.

While urban and rural areas differ in terms of the density of land use and intensity of traffic and travel, the same general functional concepts apply to both systems. Streets and roads are ranked according to their purpose or function in meeting the demands for mobility and land access. The principal difference between the two systems is the length of trips, both in time and distance.

As traffic flows do not change their characteristics at municipal boundaries, road classification is organized on a regional and then state-by-state basis. Each street is classified according to its function utilizing the following classification system, from highest to lowest mobility:

- Interstates
- Other freeway and Expressways
- Other Principal Arterials
- Minor Arterials
- Collectors
- Local Roads

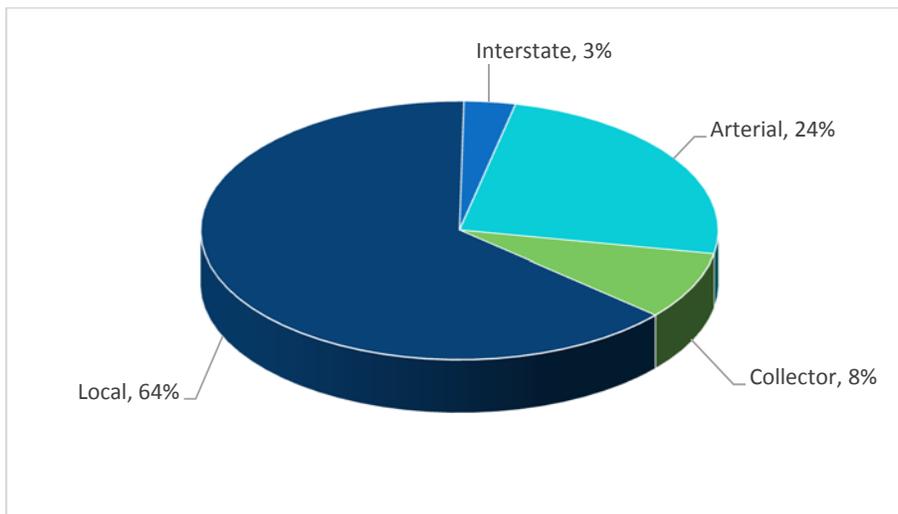
Map 5.1 on Page 5-4 depicts the Northern Middlesex regional roadway network according to functional classification. There are 2,798 lane miles and 1,399 centerline miles in the region. Figures 5.1 and 5.2 on the next page show the percentage of lane and centerline miles in the NMCOC region by functional classification.<sup>1</sup> Figure 5.3 provides a summary of regional and local roadway centerline and lane miles by functional classification, using MassDOT's Roadway Inventory File, which differs from the Federal Classification system in that it categorizes the network into six categories: Interstates, Principal Arterials,

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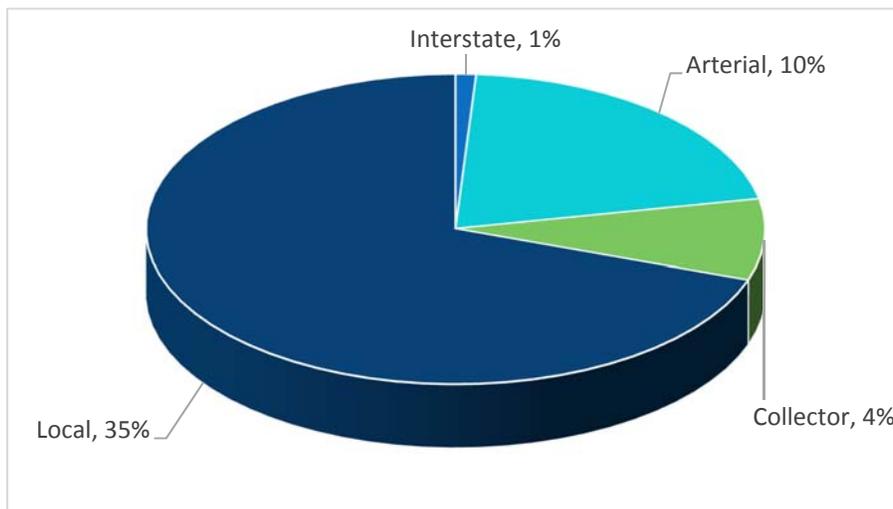
<sup>1</sup> Data compiled from MassDOT Road Inventory Year End Report for 2017

Rural Minor Arterials/Urban Principal Arterials, Rural Major Collectors/Urban Minor Arterials, Rural Minor Collectors/Urban Collectors and local roadways.

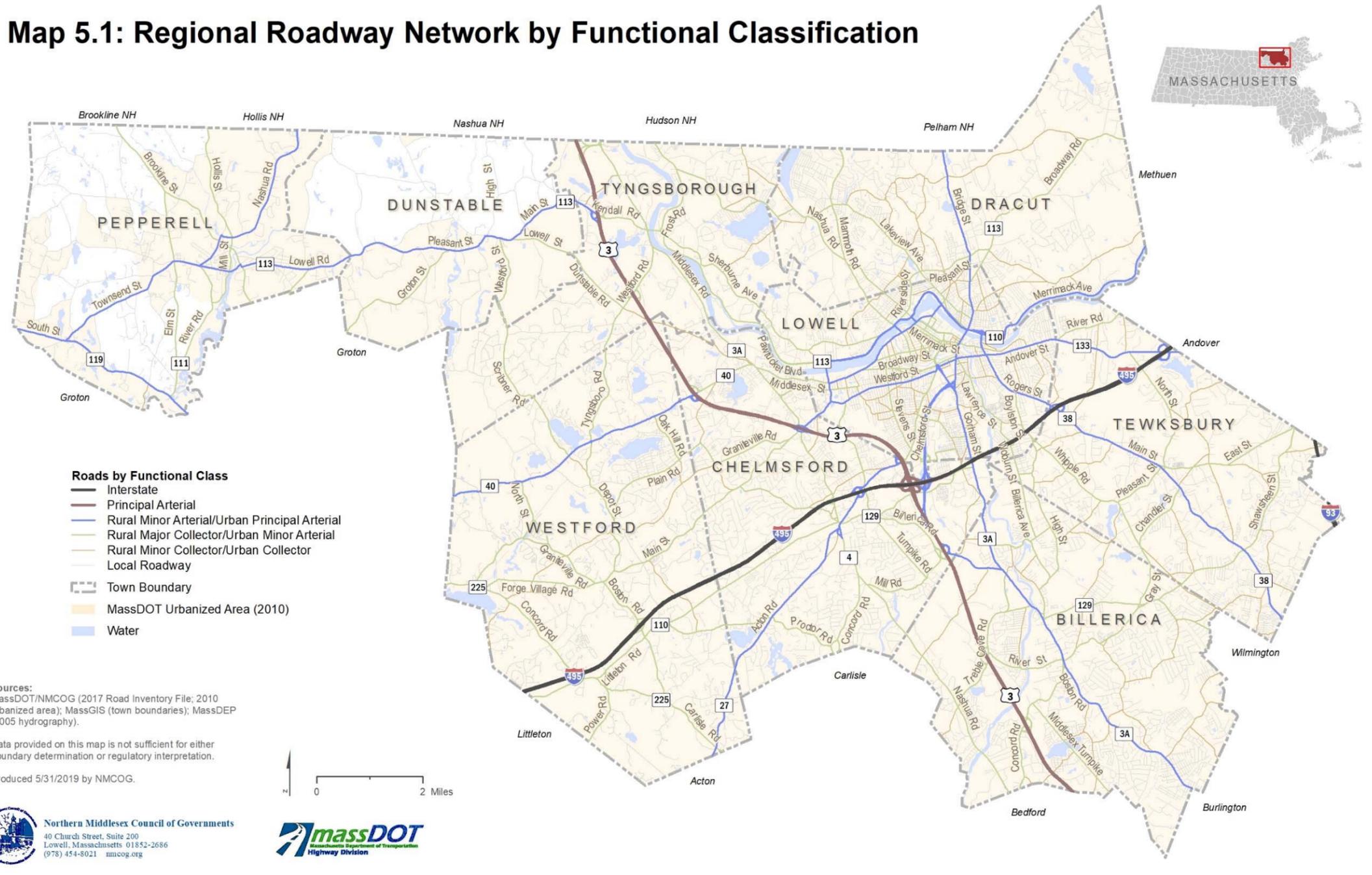
**Figure 5.1: Northern Middlesex Percentage of Lane Miles by Functional Classification**



**Figure 5.2: Northern Middlesex Percentage of Centerline Miles by Functional Classification**

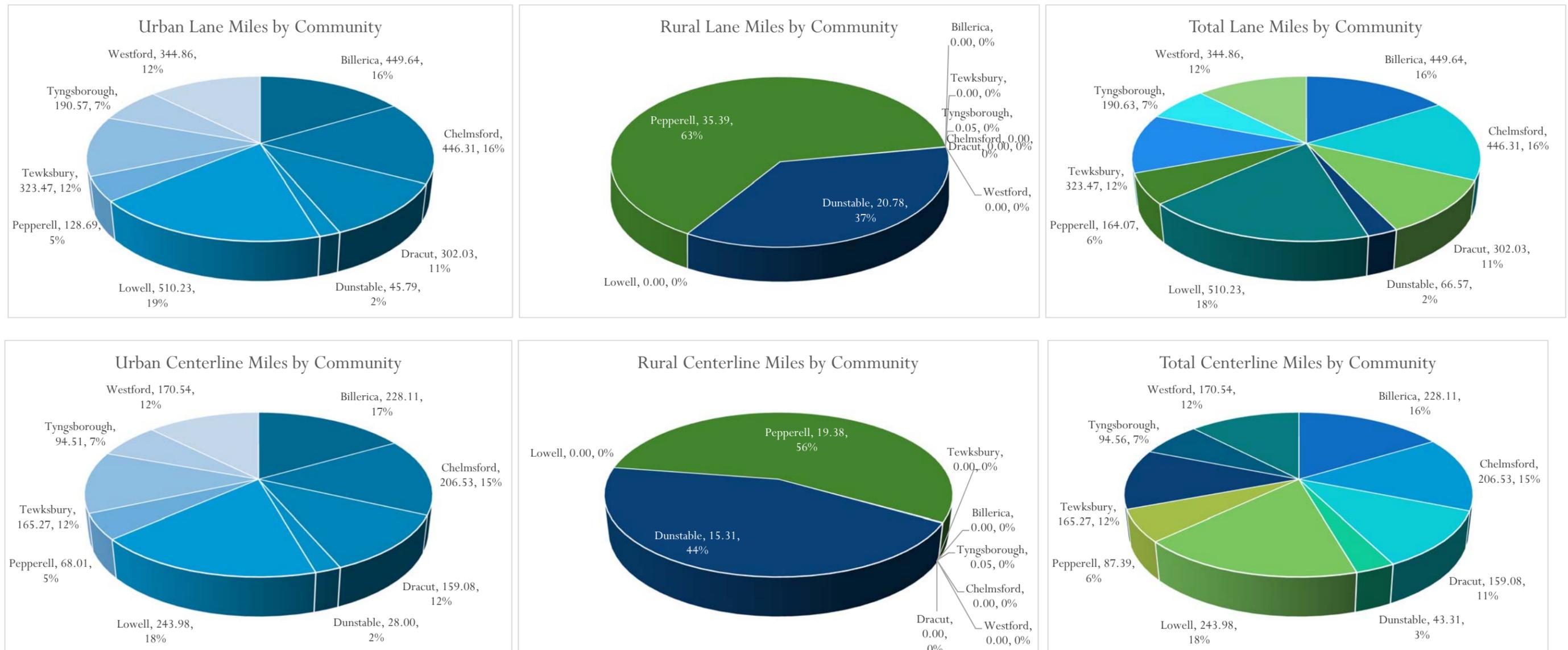


### Map 5.1: Regional Roadway Network by Functional Classification



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Figure 5.3: Centerline and Lane Miles of Roadway by Community



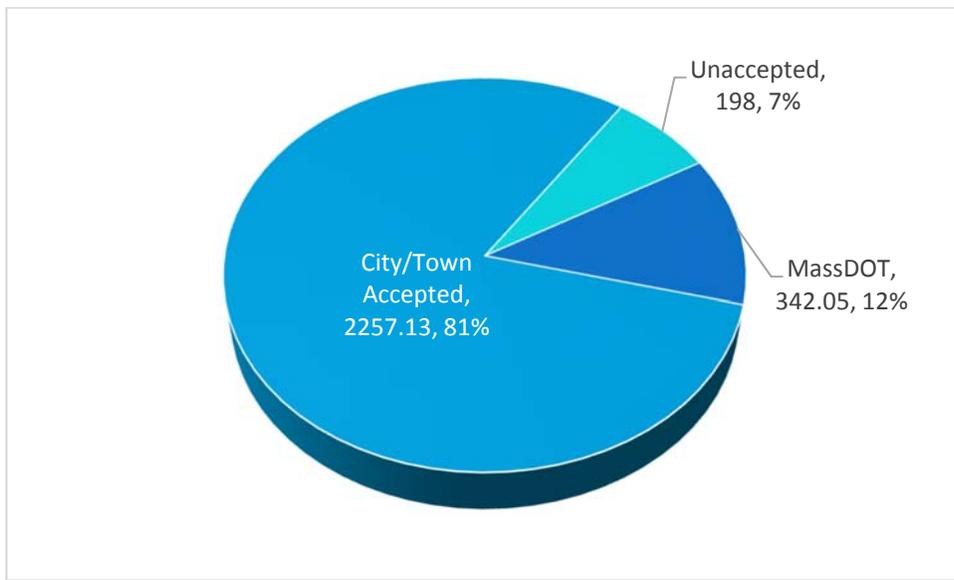
Source: 2018 MassDOT Road Inventory Year End Report

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**ROADWAY JURISDICTION**

Northern Middlesex roadways can be further categorized by jurisdiction. Jurisdiction refers to the agency that claims ownership or administrative authority over the roadway. Thirteen percent of the region’s roadways are under state ownership, while 78% are municipally-owned. The nine percent of streets that are unaccepted are either privately owned or currently have no identified ownership attributed to the roadway. Figure 5.4 below provides a summary of roadway jurisdiction in the region.

**Figure 5.4: Percentage of Lane Miles by Jurisdiction in Northern Middlesex Region**



Source: MassDOT Roadway Inventory File

**ROADWAY MAINTENANCE**

All roads need a certain level of maintenance to be able to withstand the daily demands of modern traffic and to extend their life for as long as possible. Timely and appropriate maintenance is even more important today as construction costs rise and government agencies fiercely compete for funds. In addition, overused, poorly maintained, inadequately lit and badly signed and striped roads pose a safety hazard. Many crashes could be prevented if road safety features were installed and upgraded.

Poor maintenance has social and economic costs. Road maintenance ensures the longevity and long-term sustainability of road infrastructure. Such maintenance activities include:

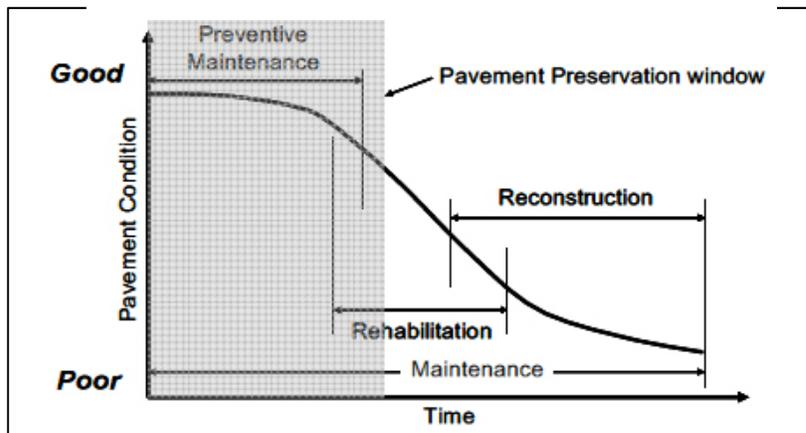
- Winter maintenance
- Preservation (resurfacing, which can be carried out in the context of a preventive maintenance strategy, and crack filling)
- Pavement markings, signs, safety barriers, etc.
- Pavement rehabilitation (restructuring without upgrading nominal load capacity)
- Pavement upgrading (increasing load capacity, widening, environmental features, and applying low cost measures)
- Structural maintenance (bridges, tunnels, etc.)
- Peripheral maintenance (embankments, drainage, shoulders, etc.)

## PAVEMENT MANAGEMENT AND PRESERVATION

Paved roadways represent one of the largest capital investments in any modern highway system. Maintaining the paved surface of a large highway system typically involves complex decision-making about how and when to apply surface treatments to keep the highway performing and operating with the funding available.

As Figure 5.5 depicts, pavement management is a key component to the development of a successful preservation, maintenance and rehabilitation program. A pavement management system consists of the collection and analysis of pavement condition data for use in identifying and implementing the most cost-effective treatments. The development of a pavement management system allows a

**Figure 5.5: Pavement Maintenance Life Cycle**



jurisdiction to maximize the funding available for pavement maintenance and preservation. MassDOT uses such a system to manage roadways on the federal-aid system under their jurisdiction. Roadways under local jurisdiction are the responsibility of the municipalities. Locally controlled arterials and collectors are eligible for federal-aid funding providing that the communities fund design, permitting and acquisition of any rights-of-way necessary.

The cost of pavement repairs increases dramatically if not completed at the appropriate time. While it is less expensive to properly maintain a sound roadway system, municipalities have not had the resources to keep up with the normal deterioration of pavement. If that could be accomplished, fewer tax dollars

would be needed to maintain the road network over the long term. However, this has been fiscally and physically impossible under the current funding constraints.

*Pavement preservation* is a program aimed at preserving investments in the highway system, enhancing pavement performance, extending pavement life, and meeting the motorists' needs. Analysis from the pavement management systems is used to identify pavement preservation opportunities. Preservation is the sum of all activities undertaken to provide and maintain serviceable roadways; this includes corrective and preventive maintenance, as well as minor and major rehabilitation. It excludes capacity improvements and new or reconstructed pavement. An effective pavement preservation program encompasses a full range of maintenance strategies, as well as rehabilitation treatments, with the goal of enhancing pavement performance (ride quality, safety, service life, etc.) in a cost-effective and efficient manner.

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#### PERFORMANCE BASED APPROACH TO PAVEMENT MANAGEMENT

FHWA released Final rules establishing performance measures involving pavement condition of National Highway System (NHS) roadways with an effective date of May 20, 2017. This rule (23 CFR Part 490.307) established the following performance measures:

- Percentage of pavement of the Interstate in Good Condition;
- Percentage of pavement of the Interstate in Poor Condition;
- Percentage of pavement of the non-interstate system in Good Condition; and
- Percentage of pavement of the non-interstate system in Poor Condition.

Once FHWA established the final rulemaking, MassDOT adopted these performance measures and established statewide targets. The NMMPO then had 180 days to either adopt statewide performance measures and targets or develop their own regional set. Table 5.1 outlines the timeline for adoption of pavement performance measure and targets.

In setting these targets, MassDOT has followed FHWA guidelines by measuring pavement condition using the International Roughness Index (IRI); the presence of pavement rutting; and the presence of pavement cracking. Two-year and four-year targets were set for four individual performance measures: percent of Interstate pavement in good condition; percent of Interstate pavement in poor condition; percent of non-Interstate pavement in good condition; and percent of non-Interstate pavement in poor condition. All of the above performance measures are tracked in detail in MassDOT's Transportation Asset Management Plan (TAMP), which will be finalized in July 2019.

**Table 5.1: Pavement Management Performance Measure Adoption Timeline**

National Performance Management Rule	National Performance Measures	FHWA Final Rule Effective Date	MassDOT Establishment of Pavement Performance Measures and Target Date	NMMPO Adoption of Pavement Performance Measure and Target Date
National Performance Management Measures to Assess Pavement Condition (PM2: 23 CFR Part 490.307)	Percentage of pavements of the Interstate System in Good Condition	May-17	May-18	Oct-18
	Percentage of pavements of the Interstate System in Poor Condition			
	Percentage of pavements of the non-Interstate NHS in Good condition			
	Percentage of pavements of the non-Interstate NHS in Poor condition			

Performance targets for pavement-related performance measures were based on a single year of data collection, and thus were set to remain steady under the guidance of FHWA. These performance measures will be revisited at the two-year mark (2020), once three years of data are available allowing for more informed target setting.

MassDOT continues to measure pavement quality and to set statewide short-term and long-term targets in the MassDOT Performance Management Tracker using the Pavement Serviceability Index (PSI), which differs from IRI. These measures and targets are used in conjunction with federal measures to inform program sizing and project selection.

At its October 24, 2018 meeting, the NMMPO voted to adopt the pavement performance measures and targets set by the State, as allowed by federal regulation. Table 5.2 describes the pavement measures and targets adopted.

**Table 5.2: Pavement Condition Performance Measures and Targets Adopted by NMMPO**

Performance Measures	Current Condition 2017	2020 Performance Target	2022 Performance Target
<b>Interstate Pavement Condition</b>			
% of pavement in Good Condition <sup>2</sup>	74.2%	70%	70%
% of pavement in Poor Condition	0.1%	4%	4%
<b>Non-Interstate Pavement Condition</b>			
% of pavement in Good Condition	32.9%	30%	30%
% of pavement in Poor Condition	31.4%	30%	30%

The communities in the Northern Middlesex region use a variety of methods to manage the pavement condition on the roadways under their jurisdictions. NMCOG performs its own pavement condition data collection and analysis of NHS roadways in six of the nine communities (Chelmsford, Dracut, Dunstable, Pepperell, Tewksbury, and Tyngsborough) utilizing the *IWORQ* pavement management software. The other communities (Billerica, Lowell, and Westford) employ a consultant to address their pavement management issues, as budgets allow. MassDOT monitors roadways as part of its Pavement Management Program. The program focuses on Interstates and principal arterials.

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<sup>2</sup> Pavement condition on National Highway System Roads is based on International Roughness Index (IRI) value and one or more pavement distress metrics. FHWA sets thresholds to determine whether metric value is good or poor.

## NMCOG PAVEMENT MANAGEMENT PROGRAM

For each roadway segment evaluated by NMCOG staff, the severity and extent of pavement distress was rated for the following:

- Fatigue Cracking (Alligator Cracking)
- Longitudinal Cracking
- Transverse Cracking
- Edge Cracking
- Patching and Potholes
- Roughness

The above defects were assigned one of three levels for severity and extent – resulting in a rating of one to nine (with zero indicating no defects). A value for remaining service life (RSL) was determined based on the type and severity of defects observed for each roadway segment. The pavement remaining service life rating is a common method of gauging pavement condition in the transportation industry and is generally defined as the anticipated number of years that pavement will be functionally and structurally acceptable with only routine maintenance. This method assumes that a properly constructed paved road will have a service life of twenty years, without any preventative measures or maintenance, before the pavement reaches an unacceptable condition and requires construction intervention. Regular maintenance will significantly increase a pavement’s lifespan beyond twenty years, but the RSL rating, an integer number of years from zero to twenty, is estimated based on the current condition assuming no preventative measures. Table 5.3 outlines repair method and recommended treatments based on RSL ratings in IWorQ.

**Table 5.3: Repair Methods based on Remaining Service Life of Pavement**

Repair Method	Remaining Service Life (RSL) in years	Recommended Treatments
Major Rehabilitation	0-4	Rebuild/Thick Overlay
Minor Rehabilitation	>4-8	Overlay
Preventative Maintenance	>8-10	Chip Seal/Crack Seal
Routine Maintenance	>10-12	Crack Seal
No maintenance needed at this time	>12-20	None

Source: IWORQ Pavement Management Software

Three Hundred and nine (309) federal aid eligible centerline miles of roadway were monitored in the region, with NMCOG staff collecting data for 111.38 miles. Comparing RSL to the FHWA performance measure categories involves categorizing the RSL repair methods into “Good” or “Poor” condition. For

purposes of reporting in this plan, RSLs lower than eight are considered “poor” condition and RSLs greater than 8 are considered to be in “good” condition. As of 2018, 73.3 miles (66%) were found to be in “good” condition, while 38.1 miles (34%) were determined to be in “poor” condition.

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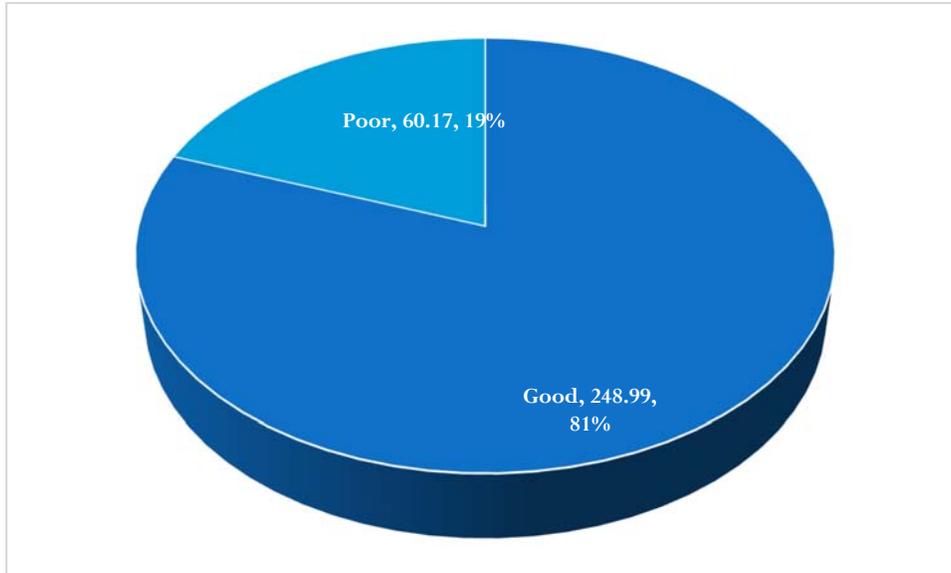
#### MASSDOT PAVEMENT MANAGEMENT PROGRAM

MassDOT collects pavement condition data on regional interstate and arterial roadways as part of its pavement management program. As of 2017, a total of 197.7 miles of roadway were monitored by MassDOT. Of the 197.7 miles of roadway monitored, 175.7 miles (89%) were considered to be in “good” condition, with 22.1 miles (11%) categorized as “poor”.

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#### NORTHERN MIDDLESEX REGIONAL PAVEMENT ASSESSMENT

Because pavement monitoring in the region is conducted by several agencies, reporting the overall health of the infrastructure involves combining several approaches to pavement condition assessment. Combining NMCOG and MassDOT efforts proves difficult because of differences in data collection procedures. NMCOG uses a windshield survey method, while MassDOT employs an automated vehicle known as ARAN that utilizes technology to collect pavement condition data on a continuous basis. The overall number of miles considered to be in “good” condition adds up to over 80% of the roadways monitored. The infrastructure conditions are constantly changing due to wear and tear and construction, so this assessment represents a snapshot of conditions within the region. Figure 5.5 provides a summary of the regional pavement monitoring efforts by both NMCOG and MassDOT.

**Figure 5.5: Existing Pavement Conditions, NMCOG and MassDOT Monitored Roadways**

Source: NMCOG Pavement Monitoring Program and MassDOT Road Inventory File 2017

NMCOG staff calculated the total estimated cost of bringing “poor” condition roads to “good” levels at approximately \$13.2 million. While it is unrealistic to expect such high levels of funding for the region’s pavement system, maintaining a pavement management system and utilizing pavement preservation techniques on roadways that are in acceptable condition will minimize the resources needed in the future to reconstruct and rebuild our highway network. As the region continues to expand its pavement management program, opportunities for lower cost preservation projects will be identified. Map 5.2 visually combines the NMCOG and MassDOT pavement conditions ratings throughout the region.

#### FUNDING SOURCES FOR ROADWAY MAINTENANCE

In order to efficiently utilize limited transportation resources, the existing transportation system must be maintained and preserved. Pavement preservation/rehabilitation type projects are initiated by the communities or MassDOT, in a similar fashion to all other federal aid projects. Roadway reconstruction and maintenance projects follow the same procedures for project initiation and approval as other projects programmed on the TIP. The funding programs that can be utilized for such projects are outlined in the following section and are intended to ensure sound maintenance and management of the existing transportation infrastructure and facilities.

## CHAPTER 90 PROGRAM

The Chapter 90 Program is funded through the State Transportation Bond Bill and administered by MassDOT. The program supports local roadway and construction projects implemented by municipalities. The funds are apportioned by formula based on local roadway mileage, employment and population. The Chapter 90 FY 2019 allocations for the communities in the Northern Middlesex region are outlined in Table 5.4 below.

**Table 5.4: FY 2019 Chapter 90 Apportionments by Community**

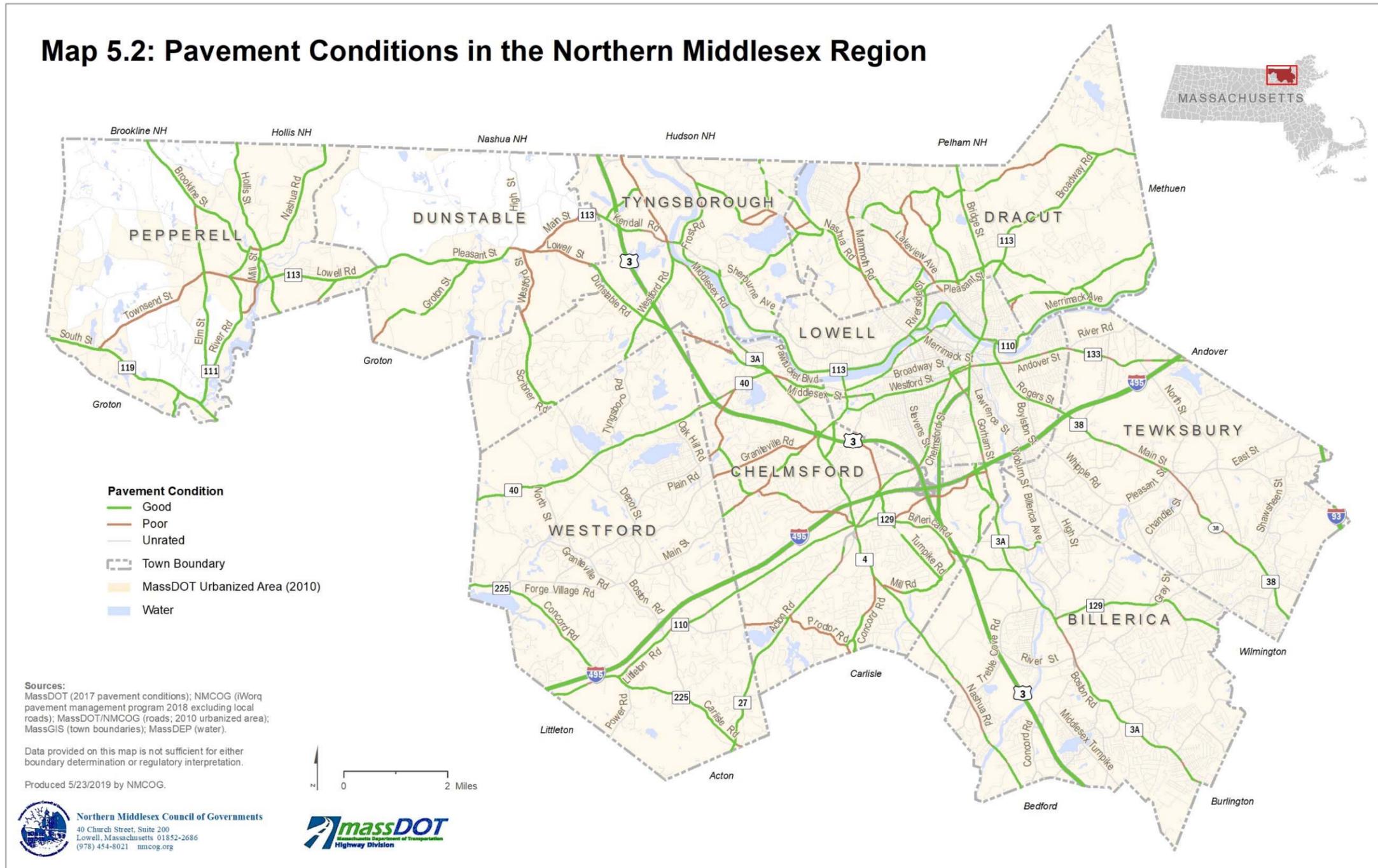
Municipality	MassDOT District	2017 Roadway miles	2010 Population	2017 Employment	FY 2019 Apportionment
Billerica	4	189.09	40,243	24,850	\$1,297,509
Chelmsford	4	172.01	33,802	23,395	\$1,171,946
Dracut	4	136.43	29,457	5,893	\$794,267
Dunstable	3	40.89	3,179	309	\$184,599
Lowell	4	188.29	106,519	36,843	\$1,860,170
Pepperell	3	83.27	11,497	1,564	\$419,132
Tewksbury	4	138.71	28,961	16,027	\$921,787
Tyngsborough	4	77.36	11,292	4,730	\$432,637
Westford	3	151.92	21,951	12,535	\$887,154
Regional Total		1,177.97	286,901	126,146	\$7,969,201

Source: MassDOT

Chapter 90 funds must be allocated to roadway projects, such as resurfacing and related work, and other incidental work, such as preliminary engineering, State Aid/Consultant Design Agreements, right-of-way acquisition, shoulders, side road approaches, landscaping and tree planting, roadside drainage, structures (including bridges), sidewalks, traffic control, service facilities, and street lighting (excluding operating costs).

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**Map 5.2: Pavement Conditions in the Northern Middlesex Region**



## INTERSTATE MAINTENANCE

MassDOT oversees the federal Interstate Maintenance program, which is aimed at ensuring that the interstate system is adequately maintained and managed. Work typically performed with these funds includes reconstruction, resurfacing, sign replacement and construction, striping and other necessary maintenance items. Interstate maintenance funds can only be expended on the interstate highway system and are intended for the rehabilitation (including approved preventive maintenance measures) of existing main lines, structures and interstate frontage roads. Interstate maintenance funds can also be used to build high occupancy vehicle (HOV) lanes or auxiliary lanes on interstate highways. However, funds cannot be used to add lanes for single occupancy vehicles.

## SURFACE TRANSPORTATION BLOCK GRANT (STBG) PROGRAM

Federal Surface Transportation Block Grant Program (STBG) funding may be used by States and localities for projects that preserve or improve conditions and performance on any Federal-aid highway or bridge, or for bike and pedestrian facilities, transit capital projects and public bus terminals and facilities. In general, STBG funding may be used for transportation projects on any roadways classified as minor collectors or higher.

FAST established the STBG program [FAST Act Section 1109(a)] (23 USC 133), replacing the long standing Surface Transportation Program (STP), acknowledging that this program has the most flexible eligibilities among all Federal-Aid highway programs and aligning the program's name with how FHWA has historically administered it. The STBG program promotes flexibility in State and local transportation decision making and provides flexible funding to best address State and local transportation needs. STBG funds are 80% federal monies requiring a 20% state match.



**Contra-flow lanes on I-495 during I-495 Bridge Bundle Project in Lowell.**

## NORTHERN MIDDLESEX INFRASTRUCTURE - BRIDGES

There are 201 bridges in the Northern Middlesex Region. These bridges include many different types of crossings including interstates, major river crossings over the Merrimack River, Shawsheen River, Nashua River or Concord River, minor stream crossings like Beaver Brook, and over the many canals in the City of Lowell. These bridges are key to moving both people and goods throughout the region and it is imperative that these structures remain sound.

## PERFORMANCE BASED APPROACH TO BRIDGE CONDITIONS

The final rule on bridge condition performance measures (PM2) was made effective on May 20, 2017 (23 CFR Part 490 Subparts A, C and D), with Massachusetts setting targets in May of 2018. In setting these targets, MassDOT followed FHWA guidelines by measuring bridges using the 9-point National Bridge Inventory Standards (NBIS). Two-year and four-year targets were set for two individual performance measures: percent of bridges in good condition and percent of bridges in poor condition. These performance measures are tracked in detail in MassDOT's Transportation Asset Management Plan (TAMP), which will be finalized in July 2019.

Targets for bridge-related performance measures were determined by identifying which bridge projects are programmed and projecting at what rate bridge conditions may deteriorate. The bridge-related performance measures analyze the percentage of deck area in poor condition, rather than the total number of bridges that are considered structurally deficient across the State.

The NMMPO considered and adopted statewide performance measures and targets at the October 24, 2018 meeting, agreeing to program projects aimed at achieving the State's goals. Table 5.5 describes the bridge condition measures and targets adopted.

**Table 5.5: Bridge Condition Performance Measures and Targets**

Performance Measures	Current Condition 2017	2020 Performance Target	2022 Performance Target
<b>Bridges</b>			
% of Bridges in Good Condition <sup>3</sup>	15.22%	15%	16%
% of Bridges in Poor Condition	12.37%	13%	12%

## BRIDGE CONDITION RATINGS

MassDOT utilizes inspection and rating standards developed by the American Association of State Highway and Transportation Officials (AASHTO) to evaluate all bridges in Massachusetts based on their condition. Two hundred and one (201) bridges in the Northern Middlesex region have been evaluated by

<sup>3</sup> Bridge Condition on National Highway System roads is based on condition ratings of deck, superstructure and substructure. National Bridge Inventory data is used to rate these components. The worst component rating is the overall rating of the bridge.

MassDOT and rated on a scale of 0 to 100, with 100 being the best condition possible. Bridges that score low on the scale are classified as structurally deficient. Map 5.3 provides a summary of bridge conditions throughout the region. Map 5.4 provides bridge condition information for the City of Lowell.

A structurally deficient classification indicates a deterioration of significant bridge elements, which may require a restriction in the load capacity of the bridge. It does not necessarily mean the bridge is unsafe, but indicates that repairs should be made before the condition deteriorates further. Table 5.6 identifies the region's fourteen structurally deficient bridges, based on MassDOT's most recent inspection and the corresponding ratings. This table shows that 7% of the region's bridges are considered structurally deficient. Four structurally deficient bridges are currently under construction and two more were advertised in FFY 2019. Two bridges in Westford are scheduled for reconstruction starting in Federal Fiscal Year 2020 and are currently programmed in the TIP. Both the Beaver Brook Road Bridge over Beaver Brook, which is structurally deficient, and the Stony Brook Road Bridge over the Stony Brook, which is not classified as structurally deficient, are programmed for construction in 2022.

**Table 5.6: Structurally Deficient Bridges in Northern Middlesex Region, 2018**

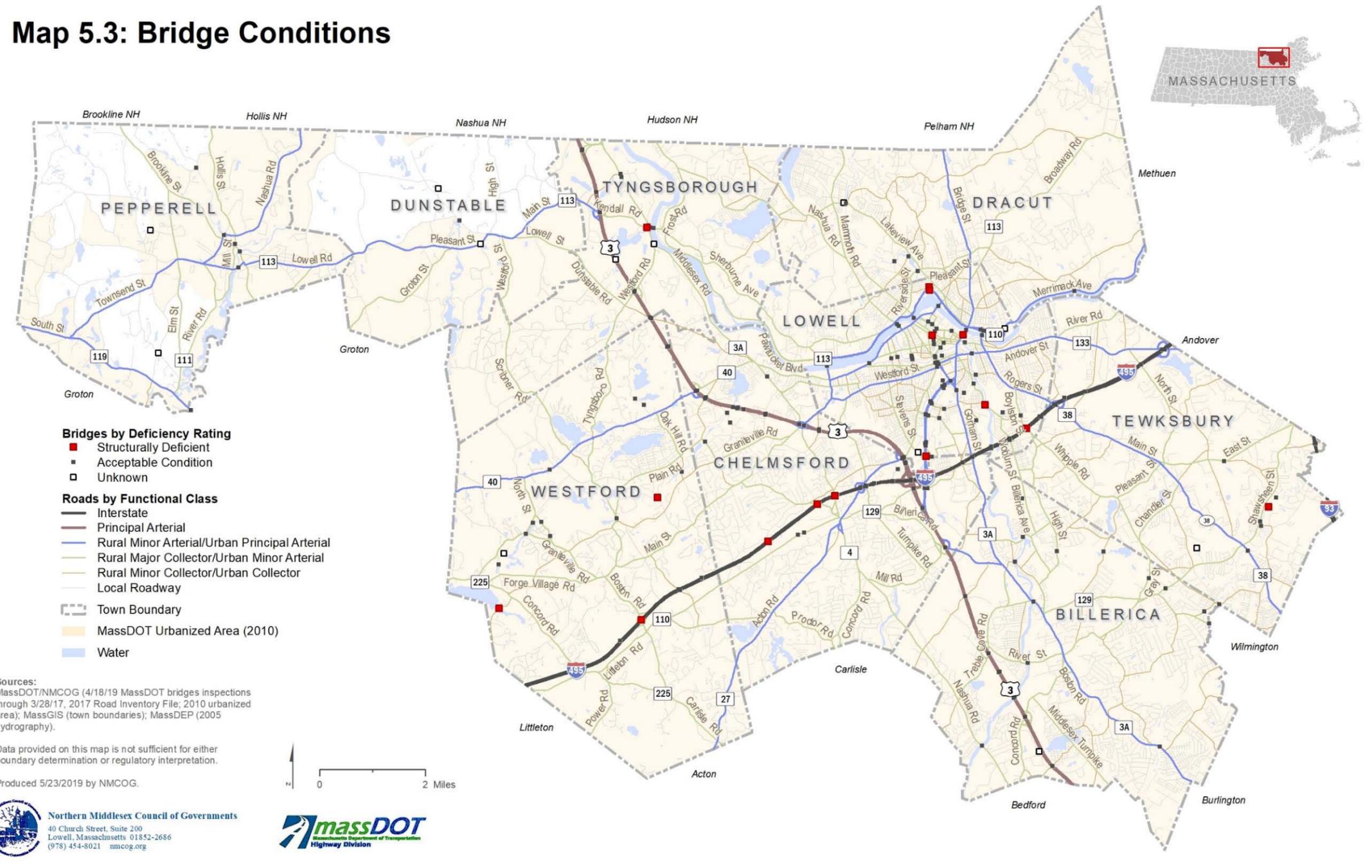
Community	Facility	Owner	Functional Class	Year Built	AASHTO Rating	Design/ Construction Underway?
Chelmsford	Route 3A (Gorham Street) over I-495	MassDOT	Urban Arterial	1962	54.8	No
Chelmsford	Lowell Connector over I-495	MassDOT	Freeway/ Expressway	1959	78.7	No
Chelmsford	Westford Street over I-495	MassDOT	Urban Minor Arterial	1961	62.4	No
Chelmsford	Route 4 (North Street) over I-495	MassDOT	Urban Minor Arterial	1959	74.7	Under Construction
Lowell	Bridge Street over the Eastern Canal	MassDOT	Urban Arterial	1937	48.9	No
Lowell	Beaver Street over Beaver Brook	City	Urban Collector	1971	26.9	No
Lowell	Market Street over the Western Canal	City	Urban Minor Arterial	1920	27.5	Under Construction
Lowell	Lawrence Street over the Concord River	City	Urban Minor Arterial	1850/ 1951	59.6	Under Construction

**Table 5.6: Structurally Deficient Bridges in Northern Middlesex Region, 2018**

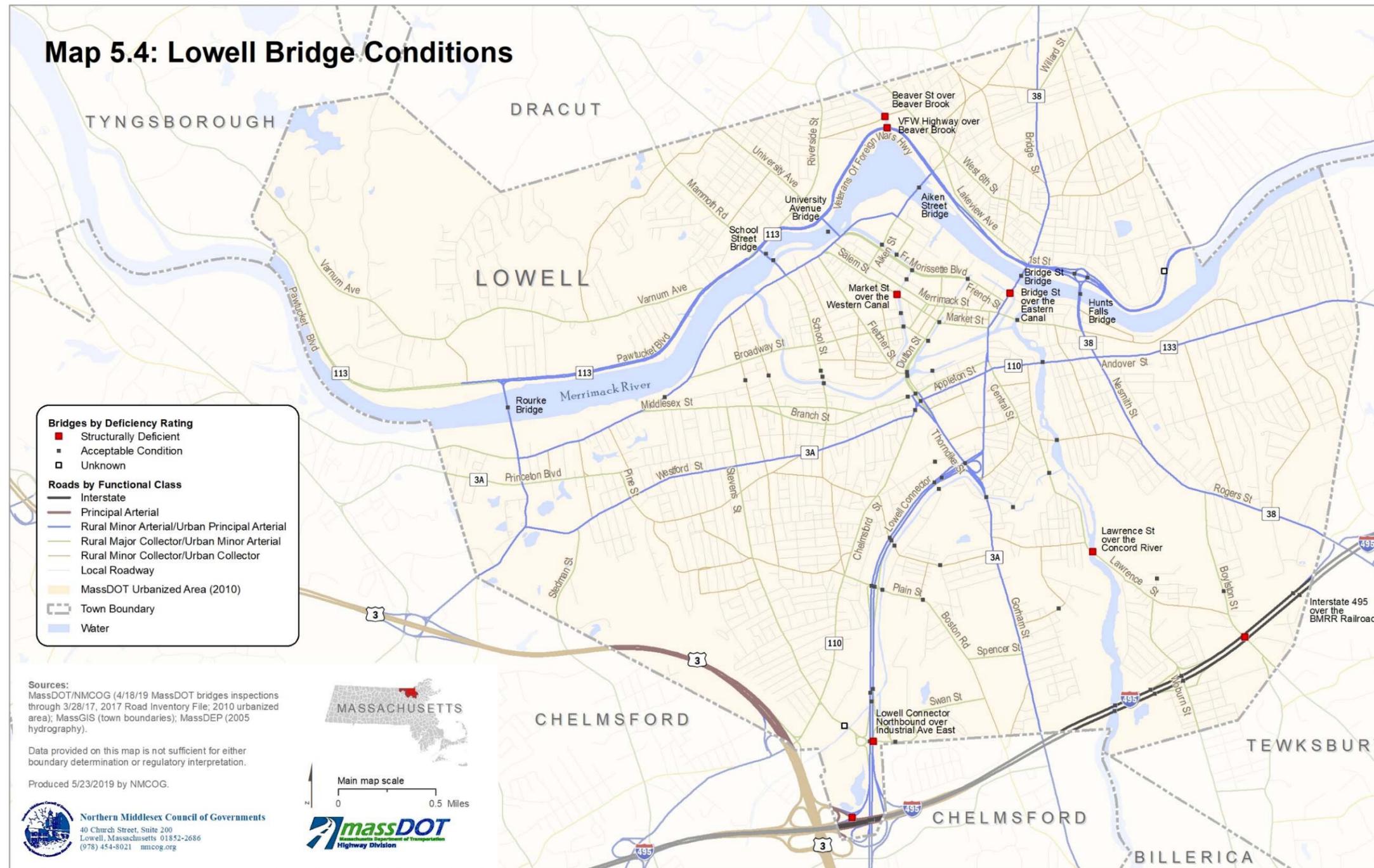
Community	Facility	Owner	Functional Class	Year Built	AASHTO Rating	Design/ Construction Underway?
Lowell	Lowell Connector over Industrial Avenue	MassDOT	Freeway/ Expressway	1960	69.2	Advertised for Construction 2019
Lowell	VFW Highway over Beaver Brook	MassDOT	Urban Arterial	1949	19	Under Construction
Tewksbury	Mill Street over Shawsheen River	Town	Urban Local	1998	59.9	Advertised for Construction 2019
Tewksbury	I-495 NB over Andover Street	MassDOT	Urban Interstate	1961	49.1	No
Tewksbury	I-495 SB over Andover Street	MassDOT	Urban Interstate	1961	52.1	No
Westford	Beaver Brook Road over Beaver Brook	Town	Urban Collector	1957	51	Design (Programmed in 2022 TIP)

Source: MassDOT

### Map 5.3: Bridge Conditions



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**PROGRESS IN ADDRESSING BRIDGE DEFICIENCIES**

The three structurally deficient bridges that were listed in the 2016 Regional Transportation Plan have been improved or reconstructed over the past four years, as shown in Table 5.7 below.

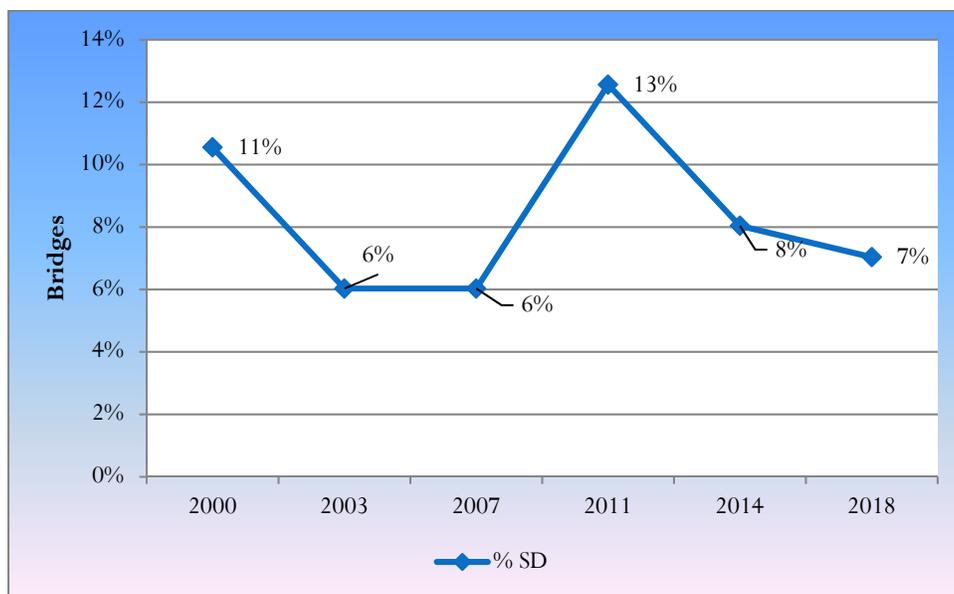
**Table 5.7: Improvement Projects completed since 2016 RTP to Address Structurally Deficient Bridges**

Community	Facility	Owner	Functional Class	Year Built	AASHTO Rating
Chelmsford	Hunt Road over I-495	MassDOT	Urban Local	1961	79.1
Chelmsford	Route 3A/Gorham Street over I-495	MassDOT	Urban Arterial	1962	61.5
Lowell	I-495 over the B&M Railroad	MassDOT	Urban Interstate	1961	87.3

Source: MassDOT

As shown in Figure 5.6 below, since 2000 the number of structurally deficient bridges in the region has remained fairly constant, ranging between 6% and 13%.

**Figure 5.6: Percent Structurally Deficient (SD) Bridges in the Northern Middlesex Region**



**LOWELL’S CANAL BRIDGES**

The City of Lowell is unique in that there are eight bridges crossing the canal system that were previously owned and/or controlled by Enel Green Power, a multi-national power company, until the City took ownership in July 2017. Prior to the City assuming ownership, Enel repaired two of the bridges –Broadway Street over the Pawtucket Canal and Kearney Square over the Eastern Canal. The remaining six bridges were in various states of disrepair or deterioration, resulting in closures or weight restrictions. This adversely affected public safety, commerce, economic development, traffic congestion, and transportation efficiency. Buses, fire apparatus, and larger commercial vehicles were prohibited from crossing these spans and had to detour around them. In 2015, the City of Lowell was awarded a TIGER Grant for \$13,389,750 to address the repair of the six bridges. This work has been overseen by MassDOT in conjunction with the City of Lowell. The design and engineering was completed in 18 months. Due to funding constraints, the superstructure replacement at the Suffolk Street over the Northern Canal was removed from the original project scope and the City will seek additional funds to complete that project. Project bids for the five remaining bridges were opened on February 21, 2018 and awarded to the low bidder in March 2018. Construction began on July 1, 2018 with final construction anticipated on April 1, 2022. The status of the five bridges as of April 2019 was as follows:

Canal Bridges in Lowell
Pawtucket Street over the Pawtucket Canal
Pawtucket Street over the Northern Canal
Broadway Street over the Pawtucket Canal
Central Street over the Lower Pawtucket Canal
Suffolk Street over the Northern Canal
Merrimack Street over the Western Canal
Merrimack Street over the Merrimack Canal
Kearney Square over the Eastern Canal

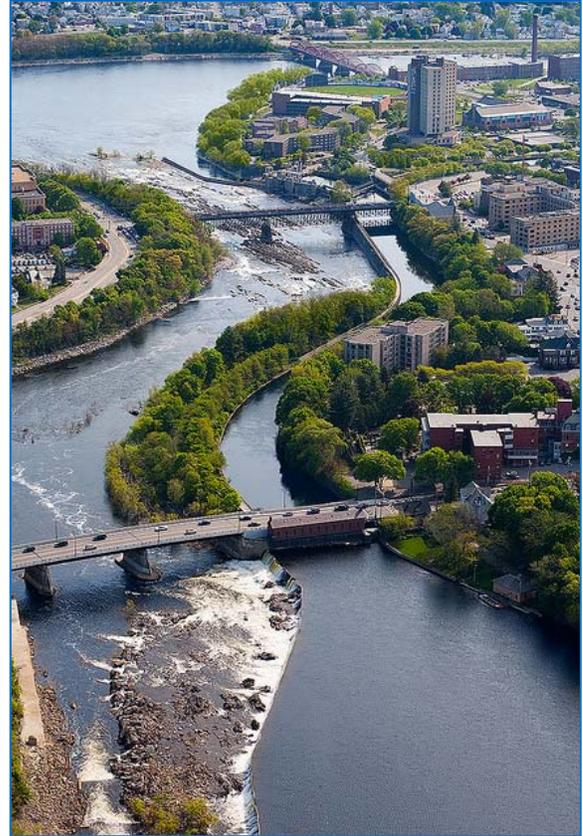
- 1) **Pawtucket Street over the Pawtucket Canal** – Utility relocation underway. Closed for one lane of traffic inbound to Lowell beginning in mid-May 2019. Bridge completion is anticipated by April 2022.
- 2) **Pawtucket Street over the Northern Canal** - Construction underway and closed to vehicular traffic (open to pedestrian traffic). Bridge completion is expected by November 2020.
- 3) **Central Street over the Lower Pawtucket Canal** – Construction work began in early April 2019. Bridge completion is anticipated by September 2021.
- 4) **Merrimack Street over the Western Canal** – Under construction. Bridge completion is anticipated by October 2019.
- 5) **Merrimack Street over the Merrimack Canal** – Project complete.

## MERRIMACK RIVER CROSSING ISSUES - LOWELL

Much of the City of Lowell's traffic congestion results from bottlenecks that occur at the six bridge crossings over the Merrimack River. Such deficiencies have been identified and noted in the region's Congestion Management Process.

In the morning peak travel period, nearly half of the traffic originating north of the river is bound for Chelmsford and other points south of Lowell, while more than half of the northbound traffic in the evening peak period is destined for areas beyond Lowell. Since these vehicles largely represent commuters, the through movement consists mainly of people who live north of Lowell travelling to and from their jobs south of Lowell. The Lowell Connector and U.S. Route 3 serve as the primary collectors-distributors south of Lowell, and Mammoth Road performs this function north of the river.

These regional traffic patterns, with heavy southbound flow in the mornings and northbound flow in the evenings, coupled with internal traffic movements in Lowell, a limited number of river crossings, and Lowell's 19<sup>th</sup> century street network, have resulted in severe peak hour congestion at the Lowell bridge approaches.



**Image 5.2: The Merrimack River in Lowell with Bridge Crossings at Aiken, University and School Street**

Public outreach during the development of this plan showed that residents have an interest in studying the possibility of constructing another bridge over the Merrimack River between Hunts Falls Bridge in Lowell and I-93 in Methuen, a distance of approximately six miles. Residents are also interested in a permanent bridge where the temporary Rourke Bridge now stands.

In 1976 a Draft Environmental Impact Study (DEIS) considered a number of alternatives for a new river crossing in Lowell, all within a 1.5-mile corridor extending from the Drum Hill Rotary in Chelmsford, through western Lowell and over the Merrimack River and then through southern Dracut to Route 113. The highway was assumed to be a six-lane, limited access roadway with an eight-lane river crossing. The

preferred alignment met with considerable opposition because of the land takings required and the barrier effect it would create.

In response to the disagreements generated by the DEIS, in 1978, the Federal Highway Administration, through MassDOT (then known as the Massachusetts Highway Department), funded a *Corridor Planning Study* (CPS) undertaken by the Northern Middlesex Council of Governments. The purpose of the study was to analyze the feasibility of a smaller scale project than that considered in the DEIS, and to examine additional alternatives to effectively address existing traffic problems.

The *Corridor Planning Study* drew numerous conclusions based on traffic characteristics and projections, and determined that a limited access highway was not justified. Three alternatives for a new river crossing were identified as being equally appropriate for alleviating congestion on the existing bridges. All of these connected Route 3 east of Drum Hill Rotary in Chelmsford with Mammoth Road in Dracut, providing a new bridge in western Lowell.

Upon completion of the CPS, MassDOT contracted with Parsons Brinckerhoff Quade & Douglas to undertake an environmental analysis, based on the conclusions and recommendations of the CPS. The DEIS was completed in 1985. However, it was never accepted by FHWA as it was based on 1982 data, which was considered outdated. The project has not moved forward since.

In developing the 2007 Regional Transportation Plan, a survey was distributed to each community asking officials to identify and rank the transportation priorities within their respective communities. City of Lowell officials identified the river crossing deficiencies as being of high priority. The City requested that a new, updated feasibility study be undertaken examining the potential for replacing the temporary Rourke Bridge with a larger, permanent structure. Former Congressman Marty Meehan earmarked \$562,439 in High Priority Project funds through SAFETEA-LU for a new feasibility study, and in the fall of 2011, NMCOG issued an RFP for a consultant.

Vanasse Hangen Brustlin Inc. (VHB) was retained and charged with analyzing options for replacing the temporary Rourke Bridge and for addressing traffic and safety issues in the vicinity of the bridge, and along Wood Street/Westford Street and Drum Hill Road in Chelmsford.

The intent of the feasibility study was two-fold: (1) to develop short-term recommendations for addressing the severe congestion and safety issues that exist along the corridor between Drum Hill Square and Pawtucket



**Image 5.3: Rourke Bridge in Lowell**

Boulevard; and (2) to reassess the feasibility of constructing a permanent replacement for the temporary Rourke Bridge, which in 2012 carried 28,000 vehicles per day<sup>4</sup>. Immediate-term, short-term, and long-term recommendations were developed using both quantitative information from analyses and also qualitative feedback provided by working committees and the public. In some cases, municipalities involved in the overall study process have been pro-active in starting to address identified traffic issues and have implemented some of the study recommendations.

Several alternatives for a new bridge were identified, with three following alternatives ultimately selected for further analysis through the environmental process:

- Alternative 2: Maintain the existing alignment and construct a 4-lane bridge
- Alternative 4: A 4-lane Western Bypass Alignment
- Alternative 6: A 4-lane Skewed Bypass Alignment

A project was initiated in 2018 by MassDOT to replace the Rourke Bridge. Funding for preliminary design and environmental permitting of the project has been identified. A consultant has been brought on board to bring the design plans up to 25% completion. Funding for complete design and construction is currently being considered.

#### MERRIMACK RIVER CROSSING ISSUES - TYNGSBOROUGH

The Tyngsborough Bridge, originally constructed in 1932 and reconstructed in 2013, provides the only crossing of the Merrimack River for the residents of Tyngsborough and neighboring communities of Chelmsford, Dracut, Dunstable and Westford. The next river crossing is located approximately five miles to the north and six miles to the south. Increased traffic congestion on and around the bridge, from local and regional growth, has resulted in

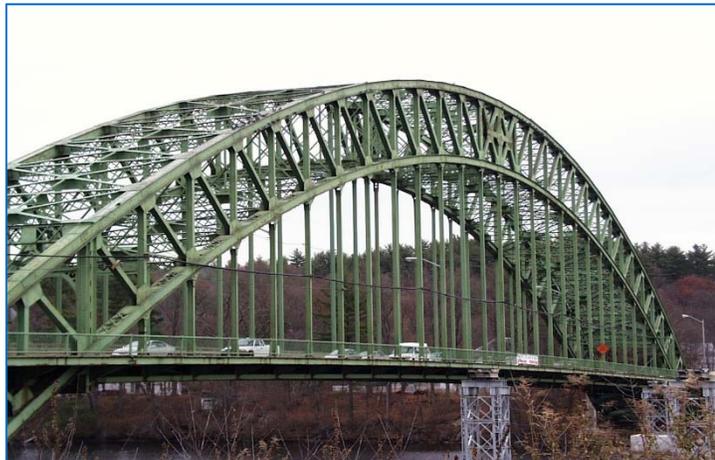


Image 5.4: The Tyngsborough Bridge over the Merrimack River

<sup>4</sup> ATR count as part of Corridor Study and Feasibility Analysis for Rourke Bridge, Wood Street, Westford Street, and Drum Hill Road, August 2013.

significant congestion and delays. The bridge carries approximately 23,000 vehicles per day. The high volume of traffic not only creates delays for commuters and residents, but also presents safety concerns for emergency and public safety personnel. As development continues in the area, vehicular demand will increase and additional river crossing capacity will be needed.

In February 2002, the *New Tyngsborough Bridge Transportation Study, Feasibility Study, and Conceptual Design for a Second Bridge Crossing of the Merrimack River* was published by MassDOT. The purpose of the study was to assess the need for and feasibility of a second bridge across the Merrimack River. The first part of the study evaluated 14 different alternative crossing locations. The feasibility study indicated that alternatives 5/6 and 14 best met the goals of the study with the least environmental impact.

Alternative 5/6 uses the regional access and natural terrain advantages of Westford Road. It connects Westford Road, on the west side of the River, with a relocated Pawtucket Boulevard on the east side of the river via a four-lane bridge and access road. Traffic projections have shown that this alternative will attract approximately 23,500 vehicles on a daily basis in the year 2020 and is one of the most effective alternatives in drawing traffic away from the existing bridge. Alternative 14 capitalizes on the regional connection to Route 3 via Exit 36. This alternative connects Middlesex Road at the Exit 36 Access Ramp on the east side of the river to Frost Road on the west side of the river, via a four-lane bridge and access road.

An Environmental Notification Form was filed with MEPA on September 25, 2002. The Massachusetts Secretary of Energy and Environmental Affairs issued a Certificate on November 22, 2002 requiring that an Environmental Impact Report (EIR) be prepared for the proposed project. The EIR would assess the environmental impacts of each of the preferred alternatives. The selection, design, permitting and construction of the additional river crossing would take several years to complete.

## ROUTE 3 EXIT 36 SOUTHBOUND RAMP STUDY

In 2014, the Northern Middlesex Council of Governments, Nashua Regional Planning Commission (NRPC), the Town of Tyngsborough, Massachusetts and the City of Nashua, New Hampshire completed a feasibility and planning study to assess the impacts and benefits of adding a southbound off ramp at Exit 36 on Route 3. The project area straddles the Massachusetts/New Hampshire border and directly impacts the City of Nashua and the Town of Tyngsborough. The area is an economic center for both the NMCOG and NRPC regions due to the significant amount of commercial, retail and high-



Image 5.5: Route 3 in Tyngsborough MA

density residential development. In addition, the expansion of Route 3 in Massachusetts has provided additional untapped economic development opportunities for this area.

The goals of the study included the following:

- Improve the operation of the major roads in the vicinity of the proposed Exit 36 Southbound;
- Create safer roads for all modes of transportation;
- Provide efficient access to services and local and regional job centers;
- Generate opportunities for sustainable growth and economic development;
- Support existing and initiate new opportunities for innovative financing and public/private partnerships; and
- Develop a plan for mitigating traffic congestion and greenhouse gas emissions associated with the transportation sector.

In addition to analyzing the impacts of constructing a new southbound off ramp, the Exit 36 study evaluated the following:

- Opportunities for transit-oriented development, including design recommendations that would accommodate a regional transit center serving rail and intercity bus;
- Improvements to pedestrian and bicycle connectivity and safety;
- Recommendations for improving local and regional transit service: Construction of Exit 36S will facilitate improved transit service to south Nashua and Tyngsborough, and express service from Downtown Nashua to the Pheasant Lane Mall and other retail destinations may also be possible, as well as connecting transit services between Nashua and Lowell.

Traffic congestion and the lack of a well-coordinated development strategy across municipal and state boundaries have impeded economic growth and development in some portions of the project area. Currently, southbound Route 3 motorists, who want to access the businesses on Middlesex Road in Tyngsborough and along the southern section of the Daniel Webster Highway in Nashua, must either exit Route 3 at Exits 1 or 2 in Nashua or at Exit 35 in Tyngsborough. NRPC has estimated that 13,300 vehicles per weekday divert to Exit 1 in New Hampshire, leading to considerable congestion on both sides of the interchange.

There has been discussion for a number of years regarding the potential extension of MBTA commuter rail service from Lowell to New Hampshire. A multi-modal transportation facility is being considered as part of that project at a location along the Daniel Webster Highway in South Nashua. Potentially,

commuter rail riders could access the new station via Exit 36. The study found that the construction of a southbound ramp at Exit 36 would improve overall operating conditions in the study area, by relieving traffic congestion and delay, reducing greenhouse gas emissions, improving travel time, and decreasing lost productivity. The project would also enhance the efficiency of public transportation and support future passenger rail service. The benefits to economic development are significant, as the project would also generate opportunities for business investment and serve as catalyst for future sustainable development.

The Exit 36 Southbound project has been included in the NRPC Long Range Transportation Plan (LRTP) for many years and is widely accepted as having significant benefit for a relatively small investment. The project was also recommended as part of the Daniel Webster Highway and Spit Brook Road Corridor Study completed in 2002. Most recently, the City of Nashua Transportation Task Force included Exit 36 Southbound (Exit 36S) in its report to the Mayor as a high priority project for the City – citing congestion relief and economic development opportunities to the City. In 2015, the Tyngsborough Board of Selectmen voted unanimously to support the project given the economic development benefits along the northern section of Middlesex Road. The bi-state nature of the project provides exceptional opportunities for innovative financing, interstate cooperation and public/private partnerships.

#### I-495 CORRIDOR TRANSPORTATION STUDY

Completed in 2008, the *I-495 Corridor Transportation Study* was initiated by MassDOT to identify existing and future transportation problems and to develop reasonable solutions. The project study area extended forty miles from Westford north to Salisbury, and included twenty-five (25) interchanges, thirteen (13) communities, and two (2) regional planning districts. Within the Northern Middlesex region, the study included interchanges in Westford, Chelmsford, Lowell, and Tewksbury.

The study evaluated a full range of transportation improvement alternatives, including interchange, highway, and non-highway improvements, as well as multi-modal options. Overall, the corridor study found that travel on the mainline is congested at times, and that the majority of congestion is directly related to traffic operations at the interchanges. Interchange operations, both at the junction of interchange ramps with the mainline and with local intersecting streets, are critical to the overall functioning of the network. Potential improvements were outlined to alleviate existing and future traffic operational deficiencies along the corridor. These strategies were



**Image 5.6: I-495 Northbound in Chelmsford  
MA**

categorized into near-term (0-2 years), mid-term (3-8 years), and long-term (>8 years) improvements. Near-term improvements are described as relatively simple, inexpensive, and quickly implemented. Examples include traffic signal retiming or pavement re-striping. Near-term improvement projects recommended along I-495 in the Northern Middlesex region include adjusting traffic signal timing at Exit 38 NB at Route 38 in Tewksbury and adjusting traffic signal timing at Exit 39 SB at Route 133 in Tewksbury.

Mid-term improvement projects are more complicated and expensive to plan, design, and put into service. Some examples of mid-term improvements include installation of a new traffic signal, lengthening acceleration/deceleration lanes at interchanges, and intersection reconfiguration. Table 5.8 provides a list of mid-term improvements recommended within the Northern Middlesex region, and quantifies their corresponding benefits to traffic operations along the corridor.

**Table 5.8: Interchange Near and Mid Term Recommendations of the I-495 Study**

Interchange	AM/PM Travel Period	Movement	Current LOS	Study Recommendation	Time Period	Improved LOS
33	Both	I-495 NB Left Turns	F	Signal Installation	Mid-Term	B, A
34	PM	I-495 NB Left Turns	F	Traffic Signal Installation and add Left Turn Lane on Rte 110	Mid - Term	B
	PM	I-495 SB Left Turns	F	Traffic Signal Installation and add Left Turn Lane on Rte 110	Mid-Term	A
37	Both	I-495 NB Left/Through	F	Signal Installation and add Left Turn Lane from Woburn St SB to Christman Ave	Mid-Term	B, C
	Both	I-495 SB Left Turns	F	Signal Installation and add Left Turn Lane from Woburn St NB to I-495 SB Ramp	Mid - Term	B, B
38	PM	I-495 NB Left Turns	E	Retime Existing Traffic Signal	Near-Term	C
39	AM	Rte 133 WB L	E	Retime Existing Traffic Signal	Near-Term	C
	AM	I-495 SB Through	E	Retime Existing Traffic Signal	Near-Term	D
	PM	I-495 SB Left Turns	F	Retime Existing Traffic Signal	Near-Term	C

A new traffic signal is being installed at the exit 33 ramp to North Road in Chelmsford. A second traffic signal installation project at Exit 34 (Route 110) is programmed in the TIP in 2024. The Exit 37 signal installation is listed in the universe of projects in Appendix F of this document. Exit 38 signal retiming will be included in project 608774, intersection improvement along Route 38 in Tewksbury, currently programmed in FFY 2023.

Long-term improvements are usually in response to expected future problems that do not currently exist. In the I-495 corridor study, these improvements would be implemented more than ten years in the future and include widening the mainline I-495, redesigning some interchanges, installing traffic signals, and ramp reconstruction.

An additional travel lane in each direction is recommended from Exit 32 to 40, exclusive of the section between Exits 35 and 36, for a total distance of 15 miles. All widening would occur within the highway's median. While the study did not discuss the impacts the widening would have on bridges in the corridor, presumably the bridges and interchanges ramps would be impacted. The widening is anticipated to improve the level of service on all links both east and west bound, although it was noted that two weave movements within the widened section would continue to experience operational problems during peak periods. The study suggested that only the relocation or a major redesign of the effected interchanges would improve the level of service. The study added that similar conditions would presumably continue on the I-495 corridor to the west of the study area, and suggested that consideration be given to widening the corridor west toward the Route 2 interchange.

The study also made long-term recommendations at interchanges in the Northern Middlesex region, including expanding the off ramps to two lanes at Exit 32 (Boston Road) in Westford, allowing a yield right turn movement at the end of the ramp and changing the overall configuration from a free flow movement to a signalized movement. This recommendation was implemented as part of the mitigation for the Cornerstone Square development project completed in 2015.

## IMPLEMENTING RECOMMENDATIONS FOR IMPROVING ROADWAY AND BRIDGE INFRASTRUCTURE

Currently, the NMMPO pavement management program covers approximately 24% of federal-aid eligible roadways in the region. The NMMPO staff will continue to expand the pavement condition data collection to include all federal-aid eligible roadways. Some communities in the region have their own pavement management program in place. Including this data with the regional program would allow the NMMPO to develop more accurate cost estimates for maintaining the region's roadway network.

The state's regional planning agencies are working collaboratively on establishing a process for utilizing MassDOT's pavement condition data. To improve overall data quality and compatibility, the RPAs and MassDOT should work together to develop a universal reporting methodology or to develop a bridging software that would improve compatibility. Reactivating the now dormant Pavement Management Users Group would be useful in moving forward with this process.

The MassDOT Accelerated Bridge Program expired in 2016, but the State is repaying the bonds for this program until 2028. A continuation of the program, or the establishment of a new funding source to address the State's bridge infrastructure, will be needed to keep pace with needed repairs and make continued progress in reducing the number of structurally deficient bridges in the region and across the Commonwealth.

As outlined in this section of the Plan, there are a number of major infrastructure projects needed in the region, including the replacement of the temporary Rourke Bridge over the Merrimack River, improvements on I-495, and the Exit 36 southbound ramp on Route 3. These projects will be expensive to undertake and the NMMPO does not have a federal funding target that is adequate to fund these initiatives. Alternative funding sources, such as the BUILD grant program or other federal discretionary programs, state resources provided through the legislature, or creative financing tools, such as design-build, will need to be utilized to bring these projects to fruition. It should be noted that funding of the Exit 36 southbound ramp project is to be borne by New Hampshire, although most of the construction would take place in Massachusetts.

## CHAPTER 6 REGIONAL TRANSIT SYSTEM

Transit benefits the region's overall travel conditions by helping to reduce single-occupant vehicle (SOV) travel. Public transportation plays a major role in providing travel alternatives, improving personal mobility, alleviating congestion, and improving air quality. In addition, transit benefits our economy. According to the American Public Transportation Association (APTA), the following financial and economic development benefits are derived from transit investments<sup>1</sup>:

- Every \$1 invested in public transportation generates approximately \$4 in economic returns;
- Every \$1 billion invested in public transportation supports and creates more than 50,000 jobs;
- Every \$10 million in capital investment in public transportation yields \$30 million in increased business sales; and
- Home values performed 42 percent better on average if they were located near public transportation with high-frequency service.

Public transportation provides access to job opportunities for people of all abilities and from all walks of life. This section of the Regional Transportation Plan (RTP) assesses and analyzes the region's transit assets and needs.

### LRTA FIXED ROUTE SERVICE

The Lowell Regional Transit Authority (LRTA), through a contractual agreement with Lowell Transportation Management, Inc., provides fixed route bus service for the general public in the City of Lowell and the Towns of Billerica, Chelmsford, Dracut, Tewksbury, Tyngsborough and Westford. All fixed routes originate and end in Lowell. The LRTA service area population is 343,355, according to the 2010 U.S. Census, while the fixed route service area population is 272,225 persons, as depicted in Map 6.1 on the following page.

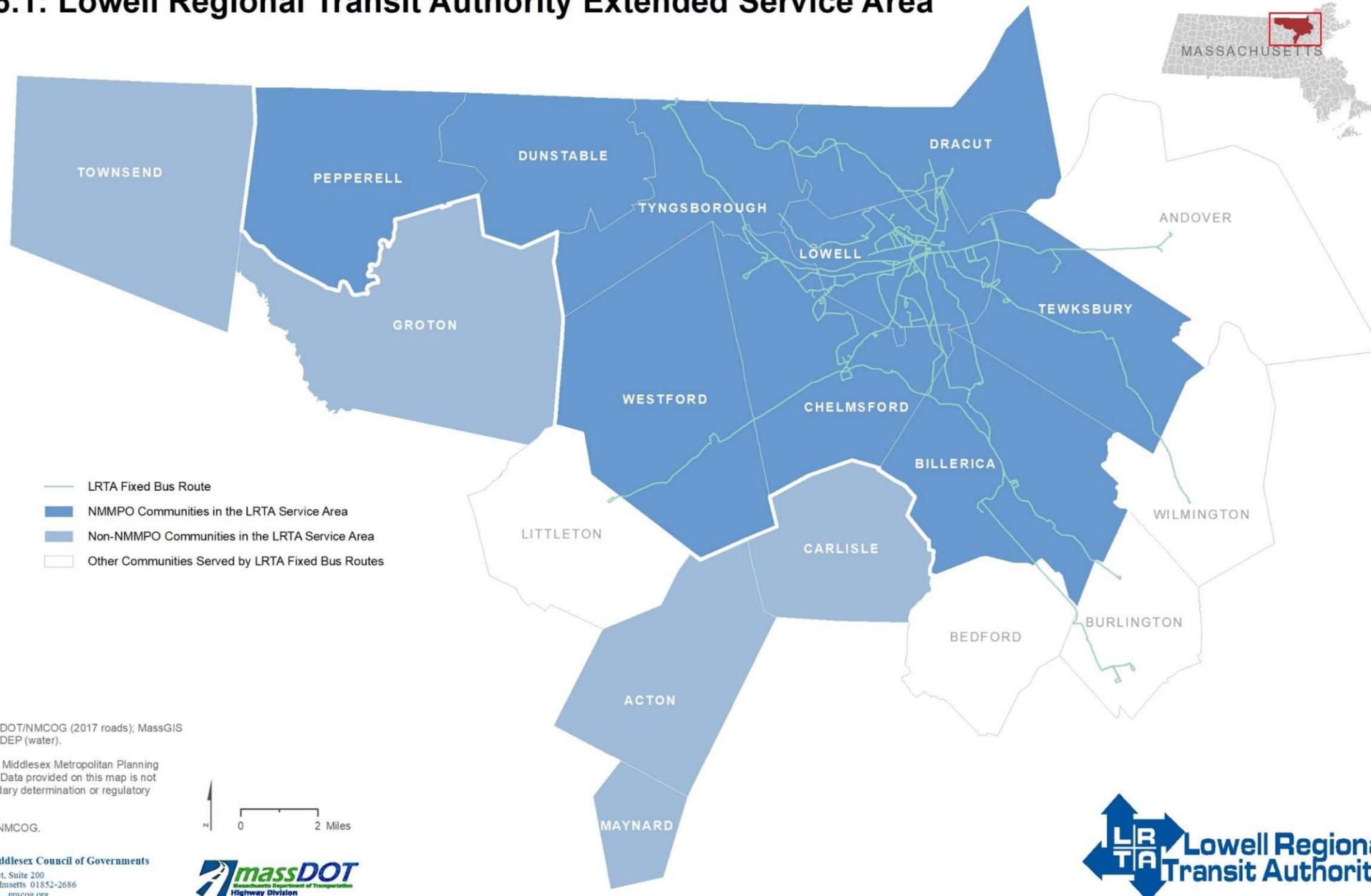
The Kennedy Bus Transfer Center at the Gallagher Intermodal Center in Lowell is the central hub for the LRTA bus route system. This location allows for easy connections between the LRTA regional bus system, MBTA commuter rail to Boston, Merrimack Valley Transit Authority's (MVTA) Lawrence bus and the Vermont Transit interstate bus service.

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<sup>1</sup> <http://www.apta.com/mediacenter/ptbenefits/Pages/default.aspx>

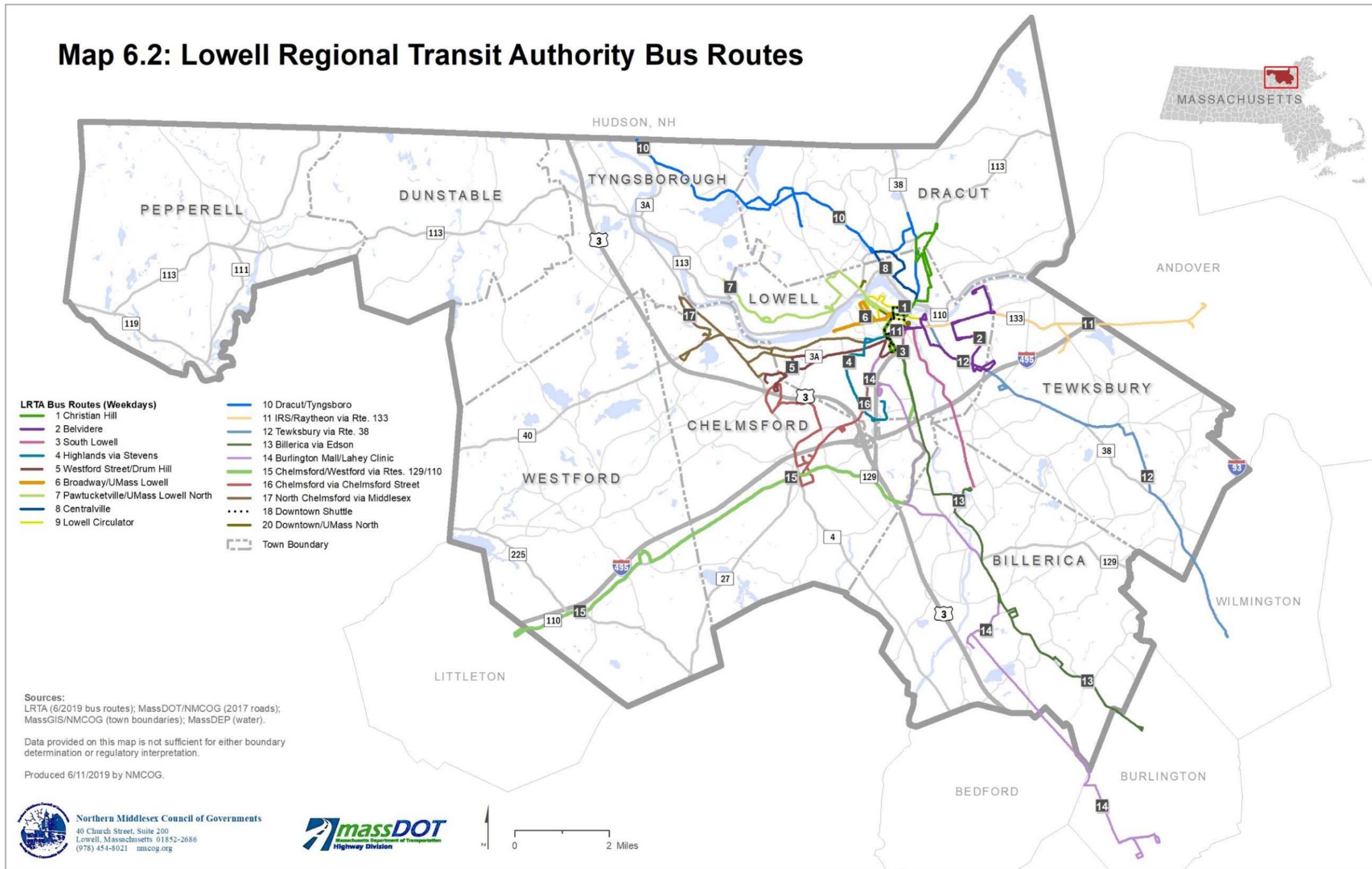
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### Map 6.1: Lowell Regional Transit Authority Extended Service Area



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**Map 6.2: Lowell Regional Transit Authority Bus Routes**



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The LRTA fixed route system operates twenty bus routes (Map 6.2, page 6-5), with twelve exclusively serving the residents of Lowell. Furthermore, all of the bus routes, including the suburban routes, travel through the City, bringing the total number of bus routes for the overall system to nineteen.

Billerica is served by three bus routes that operate Monday through Saturday (#13, #14, and #03). Chelmsford is also served by three routes that operate Monday through Saturday. Two of those routes (#16 and #17) operate between Chelmsford and Lowell, and the # 15 route travels along Routes 129 and 110 through Chelmsford and Westford, terminating at the Littleton IBM facility. The towns of Tyngsborough and Dracut are served by one connecting bus route that operates Monday through Saturday. Tewksbury is served by two routes, the #11 route, which operates Monday through Friday, and the #12 route, which operates Monday through Saturday.

Service is provided five days a week from 6:00 a.m. to 9:30 p.m., and on Saturdays from 7:00 a.m. to 7:00 p.m. (depending on the route). The LRTA operates a Saturday level bus service on the following five holidays: Martin Luther King Day, Presidents' Day, Patriots' Day, Columbus Day and Veterans' Day. The LRTA does not provide bus service on the following holidays: New Years' Day, Memorial Day, Independence Day, Labor Day, Thanksgiving and Christmas. Additionally, the LRTA was recently awarded a State grant to operate ten bus routes on Sundays for a nine-month trial period beginning on June 16, 2019. Upon completion of the nine-month pilot, the State and LRTA will review the effectiveness of the service to determine whether the Sunday service will be continued.

## LRTA RIDERSHIP

Table 6.1 on the following page shows the ridership totals for the LRTA fixed route system for Fiscal Years 2006 through 2018. It is important to note that significant changes to the route system were undertaken prior to FY 2006, when the transit hub was relocated from the Lowell central business district to the Kennedy Center at Gallagher Intermodal Transportation Center. This change made comparisons of ridership prior to 2006 difficult. Since 2006, total ridership has increased by more than 9 percent. Ridership peaked in 2015 at 1,536,250 passengers, but has declined 8.29% over the past three fiscal years. This decline is consistent with trends observed nationally.

**Table 6.1: LRTA Fixed Route Ridership (FY 2006-2018)**

Fiscal Year	Number of Passengers	% change from previous year
2006	1,297,914	----
2007	1,253,811	-3.37
2008	1,308,482	4.42
2009	1,404,112	7.31
2010	1,338,892	-4.64
2011	1,314,472	-1.82
2012	1,398,381	6.38
2013	1,401,984	0.26
2014	1,496,175	6.72
2015	1,536,250	2.68
2016	1,516,841	-1.26
2017	1,425,640	-6.01
2018	1,411,149	-1.02

Source: Lowell Regional Transit Authority

## LRTA VEHICLE FLEET

As of July 1, 2018, the LRTA fixed route bus fleet was comprised of forty-nine (49) vehicles (42 full size buses and 7 minibuses). During afternoon peak hour service, forty-two (42) buses are required to operate service, while the off-peak hours require thirty-three (33) buses. On Saturdays and holidays twenty-two (22) vehicles are required.

The composition of the LRTA bus fleet is detailed in Table 6.2. The LRTA operates five (5) hybrid vehicles, as part of its initiative to become greener and more environmentally responsible. In addition, the LRTA is planning to add twelve to fourteen new fixed route vehicles as part of its ongoing bus fleet replacement program. The LRTA fixed route fleet is 100% accessible to persons with disabilities.

**Table 6.2: LRTA Fleet Characteristics**

Model Year	Quantity	Make	Length (Feet)	Seating Capacity	Fuel	Average Lifetime (miles)
2005	1	Gillig	30	26	Diesel	351,349
2007	12	Gillig	35	32	Diesel	317,579
2008	6	Gillig	35	32	Diesel	262,174
2008	2	Gillig	35	32	Diesel/ Electric	304,900
2009	2	Gillig	35	32	Diesel/ Electric	247,590
2012	1	Gillig	35	32	Diesel/ Electric	207,631
2013	1	Elkart	25	16	Gasoline	104,766
2015	6	Gillig	29	26	Diesel	113,551
2015	4	Eldorado	25	16	Gasoline	98,186
2015	2	Elkhart	25	16	Gasoline	71,676
2016	12	Gillig	29	26	Diesel	70,797

Source: Lowell Regional Transit Authority (July 1, 2018)

**LRTA FARE STRUCTURE**

The LRTA fare structure increased for the first time in sixteen (16) years on July 1, 2018. The fare review and increase was prompted by State policy. Fares will be reviewed every two or three years going forward. The current fare structure is outlined below.

**Fare Categories:**

- *Regular:* Persons 13 through 59 years of age
- *Reduced:* Senior Citizen - 60 years or older with I.D.
- *Reduced:* Disabled - With Statewide Transportation Access Pass (TAP) or a Medicare card
- *Reduced:* Children between 6 and 12 years of age

**Bus Fares:**

- *Regular:* within one community: \$1.25
- *Reduced:* within one community: \$.60
- *Regular Suburban:* two or more communities: \$1.85
- *Reduced Suburban:* two or more communities: \$.90

**Transfers:**

- Transfers within one community- regular fare: \$.25
- Transfers within one community- reduced fare: \$.10
- Transfers between two or more communities-regular fare: \$.50
- Transfers between two or more communities-reduced fare: \$.25

*LRTA bus passes are valid for unlimited travel on all City and Suburban routes during the term specified on the pass.*

**Pass System:**

- LRTA regular category "Passport": \$44.00 per month
- LRTA reduced category "Gold Pass": \$25.00 per month
- LRTA through high school "Student Pass": \$25.00 per month

**ADDRESSING LRTA SYSTEM PERFORMANCE SINCE THE 2016 RTP**

The LRTA most recently examined the performance and efficiency of its system through the *2015 Lowell Regional Transit Authority Transit Service Study*. Upon completion of the study, the LRTA has undertaken several improvements that resulted in a positive impact on ridership. It is anticipated that over the next several years, the continued growth in ridership will result in positive performance.

The following summarizes system improvements undertaken since completing the previous RTP:

- **Downtown/ UMass North Service:** In August 2017, the LRTA began operating the #20 Downtown/ UMass North bus route. The route offers direct connections between UMass North Campus, Downtown Lowell and UMass Lowell Inn and Conference Center, and operates on weekdays from 7:15 a.m. to 11:00 a.m. throughout the school year. Available to the general public, the #20 route enables direct connection for those north of the Merrimack River to Downtown Lowell, without having to transfer at the Kennedy Bus Hub.
- **Pilot Sunday Bus Service:** In early 2019, the LRTA was awarded a State grant to begin a nine-month Sunday service pilot. The service will begin on June 16, 2019 with ten bus routes operating between 10:00 a.m. and 6:00 p.m. The new fixed route bus, as well the complementary Road Runner demand response services, will greatly benefit current LRTA customers and will likely increase ridership overall.

Service productivity measures the ridership generated per unit of service through a metric called revenue hours of service. This provides an understanding of the effectiveness of a route or transit network. The LRTA productivity was 16.8 passengers per revenue hour in FY 2014, 17.0 passengers per revenue hour in FY 2015 (LRTA peak ridership year), and 16.6 passengers per revenue hour in FY 2016. FY 2017 and FY 2018 passengers per revenue hour ratio was 15.7. The lower productivity in FY 2016-2018 is attributable to a reduction in ridership, due to the strong economy and the increase in the use of ride-hailing services, such as Uber and Lyft.

Financial performance is often measured by the farebox recovery ratio, which is defined as the ratio of fare revenue to operating cost. Higher ratios indicate higher cost-effectiveness and measure the portion

of operating cost covered by passenger fares. The higher the farebox recovery ratio, the lower the subsidy a route needs to operate, leaving more revenue available to operate more service.

A decline in financial performance follows a decline in service productivity. The LRTA average farebox recovery ratio was 17.2% in FY 2016, and 16.1% in both FY 2017 and 2018. The decrease in farebox recovery correlates with the reduction in ridership in those two fiscal years.

Mechanical failures are used as a measure of how well a transit system is maintaining its equipment. However, the mechanical failures also reflect the age of a transit fleet, i.e. older vehicles break down with greater frequency than do newer vehicles. This information is measured in miles between major mechanical failures.

The LRTA miles between mechanical failures were generally stable from the previous Regional Plan and in line with national regional transit authority (RTA) averages. The LRTA reported miles between major mechanical failures was 62,303 miles in FY 2016, 70,341 miles in FY 2017, and 59,666 miles in FY 2018. These figures represent twenty-one (21) failures in FY 2016, nineteen (19) failures in FY 2017, and twenty-two (22) failures in FY 2018.

## LRTA TRANSIT SYSTEM SERVICE PLAN

The Lowell Regional Transit Authority completed a Transit Service Plan in 2015. Several of the regional transit authorities contracted with the consulting firm URS Corporation to assist in developing the plan, which examined the individual bus route alignments and productivity. The completed Plan recommended changes directed at better serving the changing needs of populations within Lowell and the surrounding communities.

The plan proposed changes to six routes, the elimination/consolidation of two routes, and the development of three new bus routes. The proposed route changes are to be phased in over three time periods (phase one: 1 to 2 years; phase two: 3 to 5 years; and phase three: 6 or more years). It is anticipated that the implementation of phase one will be cost neutral. Following a lengthy review of the proposed changes, the LRTA identified eight specific changes that would be beneficial. The following summarizes the recommended changes accepted by the LRTA:

- 01 Christian Hill modification – The route would also travel both inbound and outbound along Beacon Street. (phase one)
- 06 Broadway – Combine 06 and 09 into a single circulator route. This can only be undertaken when the Pawtucket Street Bridge is replaced. (phase one)
- 09 Circulator – Eliminate and combine with the 06 bus route. (phase one)

- 16 Chelmsford Center – Truncate the route at Chelmsford Center and add a new Chelmsford Center to Drum Hill bus route. (phase one)
- 17 North Chelmsford – Split the route into two routes, one covering from Chelmsford Center to Drum Hill and the second traveling from Kennedy Center to Tyngsborough and Pheasant Lane Mall. (phase one)
- 20 Middlesex Street – Route 20 will be created to serve the Middlesex Street corridor in Lowell, which will lose service with the realignment of the Route 17, as described above. Additionally, this route will exist for only phase two and will be eliminated in phase three with the establishment of the Route 19, as described below. (phase two)
- 19 Tyngsborough/Pheasant Lane Mall – Add a new route six days per week (phase two).
- 22 Bedford VA/Middlesex Community College – Add a new route from the Kennedy Center to the Bedford VA. The proposed service would operate six days per week (phase three).

As envisioned, this plan is being implemented as resources become available. Full implementation may take up to fifteen years.

## LRTA PARATRANSIT SERVICE

The LRTA service area population, according to the 2010 U.S. Census, was 343,355, of which 53,891 persons were over the age of 60 years. The service area population age 65 and over was 37,167, of which 10,250 persons were considered to have a mobility or self-care limitation. Additionally, nearly 11,000 individuals aged 16-64 reported a similar mobility and/or self-care limitation. It is this client population that the LRTA seeks to serve by providing Demand Response (paratransit) service for its member communities.

Demand Response service is available for those residents over 60 years of age or individuals with disabilities. Through agreements with the private transportation carrier Lowell Transit Management Corp, Inc. (LTA) and community councils on aging, the LRTA currently provides demand response “Road Runner” services for the elderly and disabled in ten communities.

The Lowell Regional Transit Authority has entered into agreements with the Councils on Aging (CoA) in Billerica, Carlisle, Chelmsford, Dracut, Groton, Maynard, Pepperell, Townsend, Tyngsborough and Westford, as well as the Town of Acton, to provide service for elderly and individuals with disabilities residing within these communities. All demand response services offer dial-a-ride and prescheduled transportation on a 24- to 48-hour advanced call basis within specified hours of operation. Currently, the provided services not only operate within each town, service is also provided to contiguous towns. The LRTA’s plans for paratransit expansion call for additional inter-community trips. A large number of the transportation from suburban communities include trips to Lowell. Those towns that do not include

Lowell in their service area (Acton, Groton Pepperell and Townsend) are located in the western section of the LRTA district and gravitate, economically and socially, more to Fitchburg than Lowell. The Lowell-based “Road Runner”, operated by LTM, Inc., is primarily responsible for the America with Disabilities Act (ADA) transportation service. By the Federal statute, the ADA requires transit authorities to provide demand response service, within three-quarter miles of any fixed route bus line, to individuals who are unable to ride on fixed route buses because of a disability. For the LRTA member communities, this area includes all of the City of Lowell as well as significant portions of Billerica, Chelmsford, Dracut, Tyngsborough and Westford. Additionally, portions of the non-member communities of Andover, Bedford, Burlington, Littleton and Wilmington are also included. All trip purposes are accommodated, including medical, nutritional, shopping, recreational, social, and others.

#### PARATRANSIT VEHICLES

The Lowell Regional Transit Authority contracts for the operation of twenty-two (22) demand response vehicles with Lowell Transit Management Corp, Inc. and seventeen (17) demand response vehicles to the Town of Acton and the Councils on Aging in the communities of Billerica, Carlisle, Chelmsford, Dracut, Groton, Maynard, Pepperell, Townsend, Tyngsborough and Westford. Twelve (12) of these vehicles serve the ADA service area: Billerica, Chelmsford, Dracut, Lowell, Tewksbury, Tyngsborough and Westford. All of the paratransit vehicles are wheelchair lift equipped.

#### PARATRANSIT RIDERSHIP STATISTICS

Table 6.3 below summarizes the passenger trips for LRTA paratransit services in Fiscal Year 2018, during which time forty-four (44) vehicles serving twelve communities made 111,166 trips.

**Table 6.3: LRTA Paratransit Operations for FY 2018**

Program	Number of Vehicles	Passenger Trips
Lowell Transit Mgt Corp, Inc. (Road Runner)	20	51,867
Town of Acton	2	8,691
Billerica CoA	2	5,263
Carlisle CoA	3	2,067
Chelmsford CoA	3	6,062
Dracut CoA	3	8,486
Groton CoA	2	2,819
Maynard CoA	2	6,737
Pepperell CoA	1	3,418
Townsend CoA	1	2,974
Tyngsborough CoA	2	3,969
Westford CoA	3	8,813
<b>Total</b>	<b>44</b>	<b>111,166</b>

## MOBILITY AND AMERICANS WITH DISABILITIES ACT COMPLIANCE

Mobility is largely a function of one's personal lifestyle choices, physical and social limitations, and resources. Most people have an automobile at their disposal but many others depend on public transportation for commuting and other travel. Table 6.4 on the following page shows the number of vehicles per household in each community throughout the region. In the City of Lowell, over fifteen percent (15%) of households have no vehicle and rely on public transportation. The LRTA works with Community Teamwork (the region's ACTION agency), the Councils on Aging, and other social service agencies and providers to tailor transportation services to best meet the needs of the transit dependent population.

Fixed-route and paratransit services offered by both public and private carriers are fully described elsewhere in this document, but a few general points should be made regarding mobility issues. Fixed-route service is obviously limited by its point-to-point nature and linkages with other transportation modes. The LRTA has transitioned from lift-equipped buses to low-floor buses with front access ramps. The advantage is that the bus driver can pull up to a waiting wheelchair passenger, deploy the ramp, and the passenger can simply roll into the bus, saving time and increasing the independence of the disabled passenger.

**Table 6.4: Vehicle Availability in the Northern Middlesex Region**

Community	Number of Households by Number of Vehicles Available							
	No Vehicle	%	One Vehicle	%	Two Vehicles	%	Three or More Vehicles	%
Billerica	579	2%	3,443	24%	6,550	45%	3,902	27%
Chelmsford	729	2%	3,794	28%	6,178	45%	2,992	22%
Dracut	600	3%	3,060	27%	4,990	44%	2,584	23%
Dunstable	17	5%	122	11%	599	53%	400	35%
Lowell	7,176	2%	15,795	41%	10,987	28%	5,007	13%
Pepperell	135	4%	1,149	26%	1,878	43%	1,184	27%
Tewksbury	512	2%	3,342	29%	5,282	46%	2,431	21%
Tyngsborough	129	4%	1,047	24%	1,880	43%	1,304	30%
Westford	80	2%	1,472	18%	4,767	58%	1,925	23%

Source: U.S. Census, American Community Survey, 2013-2017

As discussed earlier, paratransit service is available and has been used extensively by the elderly and disabled populations of the Northern Middlesex region. The LRTA has received an average of four to six new wheelchair lift-equipped paratransit vehicles each year, helping to maintain a safe, clean and reliable fleet. The LRTA has been in full compliance with the provisions of the Americans with Disabilities

Act (ADA) since January 1996. The LRTA will continue to strive to maintain full accessibility of the public transit system. This will require a regular replacement schedule for all accessible vehicles.

#### PARATRANSIT SERVICE PROVIDED BY OTHERS

A survey of private transit providers in the Greater Lowell area was conducted by the Northern Middlesex Council of Governments as part of the Coordinated Plan Update. Included in the survey were bus charter companies, taxi companies, and ambulance and wheelchair transportation companies. None of the bus charter companies surveyed handled individuals with disabilities, while all the taxi companies said they occasionally serve individuals with disabilities. The individuals with disabilities, however, must be able to get into the cab from the wheelchair with little or no help from the driver, and the wheelchair must fit into the trunk or in the back seat of the cab.

Several ambulance and wheelchair transportation companies were also contacted as part of the survey. In general, they restrict eligibility to some form of mobility impairment. Most of the companies require a one-day notice, with same day service provided when vehicles are available. About half of the companies restrict the trips to medical purposes only, while others have no restrictions. Most ambulance and wheelchair companies operate at least five days a week, although a limited number operate seven days per week. The per-passenger charge ranges from around \$50 to \$70+ for round-trip service. This price is based upon a minimum Medicare published rate.

#### COORDINATED HUMAN SERVICES TRANSPORTATION PLAN

The FAST Act requires a five-year review and update of the *Metropolitan Planning Organization's Coordinated Public Transit-Human Services Transportation Plan*, and maintained the requirement that all transit projects be derived from a Coordinated Human Services Transportation Plan in order to receive federal funding. The Plan must be “developed and approved through a process that includes participation by seniors, individuals with disabilities, representatives of public, private and non-profit transportation and human service providers and other members of the public”.

The *NMMPO Coordinated Public Transit-Human Services Transportation Plan* was adopted by the Northern Middlesex Metropolitan Planning Organization (NMMPO) in January 2015. The Plan serves as a framework for improved coordination of transportation services among both public and private providers, in order to enhance transportation services for disadvantaged, disabled and senior populations. The document was developed to meet the federal requirements outlined in FTA Circular 9070.1G for “a locally developed, coordinated human services transportation plan” that includes the following elements:

- “An assessment of available services that identifies current public, private and non-profit providers;
- An assessment of transportation needs for individuals with disabilities and older adults;
- Strategies, activities and/or projects to address identified gaps in current services and needs, as well as opportunities to achieve efficiencies in service delivery; and
- Priorities for implementation based on available resources (from multiple program sources), time, and feasibility for implementing specific strategies and/or activities identified.”

Copies of the *2014 Coordinated Public Transit-Human Services Transportation Plan* are available on the NMCOG website at: [www.nmcog.org](http://www.nmcog.org).

Since 2008, the LRTA has implemented seven service improvements to address service gaps identified in the *Coordinated Public Transit-Human Services Transportation Plans*. The projects have expanded access to service sector employment sites by increasing service days, operating hours or areas served. The following summarizes the improvements already implemented:

- **Holiday Fixed Route Service:** The LRTA, like many regional transit authorities, did not previously offer any service on holidays. In 2008, the LRTA received a Job Access/Reverse Commute (JARC) grant to initiate a “Saturday level” of service on five holidays when many service sector employees are required to work: Martin Luther King Day, Presidents’ Day, Patriots’ Day, Columbus Day and Veterans’ Day. Following the first year, the #15 Chelmsford bus route was included in this program at the request of a group of Chelmsford business employees. Overall, this service has proven to be quite successful.
- **Tewksbury Bus Route 12 Saturday Service:** The #12 Tewksbury route ran on a weekday only schedule. The route ran along Route 38 from Lowell through Tewksbury to the Wilmington town line. Route 38 is a densely developed state road with a large number of retail and service employment opportunities. In 2009, the LRTA was awarded a JARC grant to extend the bus route to the Wilmington MBTA commuter rail station and to operate service on Saturdays. The #12 route expansion has proven to be very successful, growing to one of the busiest bus routes on Saturday. The Saturday service expansion greatly increased access for the disabled within the Town of Tewksbury.
- **Westford Bus Route 15 Extension:** With the help of a 2009 JARC grant, the LRTA extended the #15 bus route along State Route 110, from Chelmsford through Westford to the IBM facility on the Littleton/Westford line. The Route 110 corridor is filled with high tech businesses, retail establishments and service industries. The #15 route has experienced steady growth in ridership since the route extension was implemented. Furthermore, the service expansion greatly increased access for the disabled community within the Town of Westford.

- **Tyngsborough Holiday Service:** In order to address the lack of access to seasonal employment opportunities, the LRTA was awarded a 2010 JARC grant to run seasonal service along State Route 3A and Middlesex Road in Tyngsborough, to the southern end of the Pheasant Lane Mall, which lies within Massachusetts adjacent to the New Hampshire border. The route not only reaches job opportunities along the corridor and at the mall, it also connects with the Nashua Transit system, enabling access to the entire Nashua area. The route has proven to be one of the most successful services offered by the LRTA.
- **Expanded Saturday Service:** The LRTA expanded Saturday service in January 2013. The service change increased the number of individual bus trips by 53, by running hourly headways on routes that had previously had 90- to 120-minute headways. As a direct result of this service improvement, the Saturday LRTA ridership has increased by approximately 80%.
- **Expanded Weekday Service Hours:** The LRTA received a JARC grant to extend service hours on fourteen of the eighteen bus routes. The service, which began in August 2013, enabled greater connectivity between the suburban routes and the Lowell city routes. Since this service expansion was implemented, the LRTA has seen an overall increase in ridership throughout the system, and is currently reviewing the successes of each route separately.
- **Westford Bus Route 15 Saturday Service:** In April 2014, the LRTA began operating the #15 Westford bus route on Saturdays, enabling access to the bustling State Route 110 area. As a result, Saturday service is now available to all of the LRTA fixed route service area communities, increasing access to the disabled community.
- **Sunday Bus Service:** The LRTA received a Massachusetts State grant to establish a nine-month pilot Sunday service in the LRTA region. The service will begin on June 16, 2019 and will operate from 10:00 a.m. to approximately 6:00 p.m. on ten of the nineteen LRTA bus routes. A review of the effectiveness of the service will be undertaken to determine whether the service will be extended beyond the pilot period.

## PRIVATE AND NON-PROFIT TRANSPORTATION SERVICES

In addition to the public fixed route service, the Lowell Regional Transit Authority provides in the Northern Middlesex Region, there are several private carriers operating charter, rental and other special bus services, as well as taxi service and ride share services. A number of non-profit entities also provide transportation services within the region. A list of these private and non-profit providers is provided in Table 6.5.

**Table 6.5: Private and Non-Profit Transportation Providers Operating in LRTA Service Area**

Transportation Providers	Address	Telephone
<b>Bus Line Providers</b>		
First Student Bus	Ward Way, North Chelmsford	(978) 251-4901
Boston Express	7 Langdon Street, Concord, NH	(603) 845-1999
Tewksbury Transit, Inc.	555 Whipple Road, Tewksbury	(978) 851-9863
Vermont Transit	101 Thorndike Street, Lowell	(978) 459-7101
A&F Bus Company, Inc.	16 Wyman Road, Billerica	(978) 663-8145
Bedford Charter Service	11 Railroad Avenue, Bedford	(978) 257-9524
Fiore Bus Service	3 Plank Street, Billerica	(978) 667-1114
Dunbar Bus Company	33 Middlesex Road, Tyngsborough	(978) 649-7401
Plaza Transportation	410 Woburn Street, Tewksbury	(978) 459-9600
Buckingham Bus Company	40 Station Avenue, Groton	(978) 448-6057
Dee Bus Service, Inc.	30 Town Farm Road, Westford	(978) 392-8639
Lessard Bus Company, Inc.	210 D.W. Highway, Nashua, NH	(978) 897-1244
North Reading Transit	55 Hampshire Road, Methuen, MA	(978) 681-4100
Trombly Motor Coach	1480 Broadway Road, Dracut	(978) 937-3422
<b>Taxi Service</b>		
Yellow Cab	50 Payne Street, Lowell	(978) 458-6861
Wilmington Taxi	253 Woburn Street, Wilmington	(978) 658-3859
A&M Taxi	1326 Merrimack Ave, Dracut	(978) 944-0674
Luna Cab Company	11 White Street, Lowell	(978) 421-6321
A-1 Taxi	18 Chambers Street, Lowell	(978) 970-2909
J&N Taxi	115 Congress Street, Lowell	(978) 454-5661
Lowell Cab Company	310 Merrimack Street, Lowell	(978) 441-0011
Carib Tour Taxi	239 Lincoln Street, Lowell	(978) 458-1155
Checker Taxi	35 Maple Street, Lowell	(978) 441-9700
Planet Coach	Billerica	(781) 249-5565
Apollo Cab	30 Corporate Drive, Burlington	(781) 350-5561
<b>Non-Profit Organizations</b>		
Community Teamwork, Inc.	155 Merrimack Street, Lowell	(978) 459-0551
Elder Services of the Merrimack Valley	280 Merrimack Street, Lawrence	(978) 683-7747
Cambodian Mutual Assistance Association	465 School Street, Lowell	(978) 454-6400
Coalition for a Better Acre	517 Moody Street, Lowell	(978) 970-0600
<b>Ride Share Services</b>		
Uber	Uber.com	
Lyft	Lyft.com	

## LRTA MAINTENANCE NEEDS

The maintenance needs of the LRTA are primarily in the area of capital facilities and equipment. The Transit Authority maintains the following facilities: the Charles A. Gallagher Intermodal Transportation Center, the Hale Street Operations Center for its fixed route buses, and the North Billerica Commuter Rail Station. The cost of maintaining the three facilities was approximately \$690,400 in FY 2019. Individually, Gallagher Intermodal Transportation Center, including the Kennedy Bus Transfer Center, maintenance cost was \$310,680 (35%), the Hale Street Operations Center was \$241,640 (35%) and the North Billerica Commuter Rail Station maintenance cost was approximately \$138,080 (20%).

The annual maintenance of the Charles A. Gallagher Intermodal Transportation Center is projected to cost approximately \$1,063,000 annually by the year 2030 and \$1,573,000 by 2040. The Hale Street Operations Center is projected to cost approximately \$478,000 annually by the year 2030 and \$708,000 by 2040. While the North Billerica Commuter Rail Station is projected to be approximately \$372,000 by 2030 and \$315,000 by 2040. These cost projections are based upon a 4% annual inflation rate.

Additionally, the Transit Authority must bear the cost of vehicle maintenance. The current cost of maintaining the fixed route bus fleet is approximately \$938,000 annually. Paratransit vehicle maintenance costs are \$235,000 annually. The LRTA currently owns forty-two (42) heavy-duty buses and eight (8) Minibuses (cut-a-ways) in the fixed-route bus fleet. The useful life of heavy-duty motor buses is defined under FTA Standard 9030-112 as twelve (12) years or 500,000 miles. The useful life of a Minibus is the same as a Paratransit vehicle at seven (7) years or 150,000 miles.

The replacement of both fixed-route and paratransit vehicles is an ongoing activity for the Lowell Regional Transit Authority. Vehicle maintenance will increase over time with annual vehicle maintenance reaching roughly \$1,806,000 by 2030, and increasing to \$2,673,000 by the year 2040.

Future fixed-route and paratransit vehicle acquisitions will be costly. If purchases are made on a strict schedule under the FTA useful life standards, roughly eighteen (18) full-sized buses and five (5) minibuses would require replacing every five (5) years. Fixed-route vehicle replacements between the years 2020 and 2030 could total nearly \$9,500,000 for twelve (12) new heavy-duty diesel, two (2) new heavy-duty Hybrid and six (6) new light-duty vehicles. Vehicle replacements of the twelve (12) heavy duty and ten (10) light duty vehicles between 2030 and 2040 could be an additional \$14,553,000. An ambitious replacement schedule for paratransit vehicles would mean the replacement of four (4) vehicles per year between the years 2020 and 2040, costing \$8,160,000, assuming a 4% inflation factor per year as outlined in Table 6.6.

**Table 6.6: LRTA Vehicle Replacement Needs (assumed 4% inflation per year)**

Category	Vehicle Type	2020-2024	2025-2029	2030-2034	2035-2040
Fleet Replacement Expense	42 Fixed Route, Heavy Duty Buses and 7 Fixed Route, Light Duty Buses	\$8,200,750	\$10,195,210	\$14,946,520	11,571,640
	Paratransit Fleet (Minibuses @ \$65,000 each)	\$1,725,000	\$1,780,000	\$2,170,000	\$3,230,000
Vehicle Maintenance Expense	Fixed Route Buses	\$6,222,000	\$6,428,000	\$7,821,000	\$11,653,000
	Paratransit Vehicles	\$1,559,000	\$1,611,000	\$1,959,000	\$2,920,000

Source: LRTA

## LRTA TRANSIT ASSET MANAGEMENT PLAN

In 2018, the LRTA developed a Transit Asset Management Plan (TAM Plan) which was adopted by the NMMPO in January of 2019. As a recipient of Federal Transit Administration funds, the LRTA is required to develop and maintain a Transit Asset Management Plan per FTA's Final Rule at 49 CFR Part 625. A Transit Asset Management (TAM) plan is a business model that uses asset condition as a guide for managing capital assets and prioritizing funding in order to achieve or maintain transit systems in a State of Good Repair (SGR).

The preparation of the TAM Plan was based on identifying the transit assets which the LRTA owns and for which it has direct capital responsibility, and to address the performance measures included in the Final Rule that relate to these identified assets. The completed TAM Plan was required by September 30, 2018. The LRTA is considered a Tier II Transit Provider as defined in the Final Rule. Tier II is defined as follows:

*“Tier II Provider: Means a recipient that owns, operates, or manages (1) one hundred (100) or fewer vehicles in revenue service during peak regular service across all non-rail fixed route modes or in any one non-fixed route mode, (2) a subrecipient under the 5311 Rural Area Formula Program, (3) or any American Indian tribe.”*

The benefits of implementing a TAM plan include:

- Improved transparency and accountability for safety, maintenance, asset use, and funding investments;
- Optimized capital investment and maintenance decisions;
- Data-driven maintenance decisions; and
- System safety & performance outcomes.

The consequences of an asset not being in a SGR include:

- Safety risks (Accidents per 100,000 revenue miles);
- Decreased system reliability (On-time performance);
- Higher maintenance costs; and/or
- Lower system performance (Missed runs due to breakdown).

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### Transit Asset Management (TAM) Policy

The purpose of the LRTA TAM plan is to provide: (1) Implementation actions that offer enabling support and direction for the management of transit assets across all asset classes and services; and (2) Direction and expectations for asset class owners and department managers regarding lifecycle management planning and processes.

The LRTA has developed the processes within the TAM plan to aid in: (1) Assessment of the current condition of capital assets; (2) determine what the condition and performance of its assets should be (if they are not currently in a State of Good Repair); (3) identify the unacceptable risks, including safety risks, in continuing to use an asset that is not in a State of Good Repair; and (4) deciding how to best balance and prioritize reasonably anticipated funds (revenues from all sources) towards improving asset condition and achieving a sufficient level of performance within those means.

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### LRTA Agency Overview

The LRTA provides both fixed route bus and on demand and paratransit public transportation services to approximately 1.6 million passengers annually. The LRTA's core inventory of capital assets includes:

- Service fleet:
  - 50 Fixed Route buses;
  - 47 Paratransit service vehicles;
- Passenger and parking facilities:
  - Intermodal passenger center and bus hub;
  - Passenger parking garage adjacent to the Intermodal center;
- Administrative and maintenance facilities:
  - Centrally-located administration facility;
  - Fixed Route operations/vehicle storage/refueling & maintenance facility; and
  - Paratransit operations/vehicle storage/refueling & maintenance facility.

Service is provided Monday through Friday from 5:30 AM to 9:30 PM, and on Saturdays from 7:00 AM to 7:00 PM. The operating climate conditions in the service area may have SGR impacts on revenue vehicles during the winter and summer months. On average, the risk is present for four to five months

out of the year for both cold/snowy winter weather conditions and high-heat/summer weather conditions.

The LRTA has maintained an asset management approach for fleet replacement and facility maintenance, replacing vehicles that have meet their State/Federal useful life requirements and making facility upgrades and repairs as needs arise and funding becomes available. The 2018 TAM Plan will further aid the LRTA in assessing the condition of its existing assets and determining its needs over time to maintain the system in a state of good repair. The TAM Plan Performance Measures are listed in Chapter 1 (Table 1.4) of this document.

## MBTA COMMUTER RAIL

Commuter rail transportation has long provided an important link between the Greater Lowell communities and Greater Boston. Ridership has fluctuated over the years, but for many travelers commuter rail remains an efficient, convenient, and inexpensive alternative to private transportation. The following sections provide an overview of the commuter rail service offered in the Greater Lowell area, includes information on commuter rail fare structure, and provides a history of changes in service features that have affected ridership over the years.

Present commuter rail service between Gallagher Terminal in Lowell and North Station in Boston consists of twenty-one (21) daily inbound trains leaving on the half-hour between 5:35 A.M. and 9:15 A.M., and departing hourly after that time, with the last train to Boston leaving the station at 10:35 P.M.

Rail service to Lowell from North Station also consists of twenty-one (21) daily outbound trains operating between the hours of 5:45 A.M. and 12:10 A.M., with half-hour service during the evening "rush hour". In addition to the station in Lowell, the MBTA trains stop at North Billerica, Wilmington, Anderson/Woburn, Mishawum, Winchester, Wedgemere and West Medford. Weekend and holiday rail service consists of eight (8) trains daily, both inbound and outbound, serving the same stations as weekday service. The ticket office at Gallagher Terminal sells one-way, round-trip and multiple-ride tickets, as well as monthly rail passes.

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## MBTA RAIL VISION

The MBTA in conjunction with MassDOT Planning has undertaken a study of its existing Commuter Rail System to identify strategies to cost effectively transform the system into one that better supports improved mobility and economic competitiveness. Beginning in 2018, the MBTA evaluated costs, ridership potential and operational feasibility of alternatives to develop a vision for the future of Commuter Rail. In 2019, conversations with the public, both riders and non riders, were held to inform

that vision. As a result of surveys and public meetings, proposals for alternatives were developed looking into how the system could reduce overall travel times, increase frequency of service and improve connectivity. The Rail Vision Committee is evaluating the costs and benefits of seven alternatives:

1. **Optimizing the current system** – Focus is on improving the current system by providing predictable, frequent service;
2. **Regional Rail to Key Stations (Diesel)** – high frequency service to Key Stations including Lowell on Diesel Locomotives;
3. **Regional Rail to Key Stations (Electric)** – High frequency service to Key Stations including Lowell on Electrified System using self-powered electric trains that operate more like subway trains;
4. **Urban Rail (Diesel)** – High frequency service to inner core stations using diesel multiple units (similar to subway). Service to outer stations would be equal to or better than current levels;
5. **Urban Rail (Electric)** – High frequency service to inner core stations using electric multiple units;
6. **Full Transformation** – This alternative uses electric multiple units to provide service every 15 minutes to key stations and inner core stations all day and to other stations during peak travel times; and
7. **Hybrid System** – This alternative provides varying levels of service throughout the network depending on needs of each area.

With Commuter rail service along the Lowell line, the Northern Middlesex region would benefit greatly from increased service frequency to the region. More information on the MBTA Rail Vision can be found here: <https://www.mbta.com/projects/rail-vision>.

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#### MBTA COMMUTER RAIL FARE STRUCTURE

For the purpose of making fares equitable, the MBTA divides each of its commuter rail lines into "zones". Travel to or between zones is assessed according to the number of zones traversed by the commuter. When considering commuter rail fares, one should note that MBTA conductors add a \$1.00 (non-peak hour) and \$2.00 (peak hour) surcharge to tickets purchased on board the train, when tickets are available for purchase at the boarding station. All fares described below do not include this surcharge.

Commuter rail service fares have seen significant changes over the years. In February 1981, the cost of a one-way ticket from Lowell-Boston was \$2.25, while a 12-ride ticket cost \$22.50. A calendar monthly rail pass offering unlimited rail service with access to MBTA Rapid Transit cost \$68.00. By December 1982, the MBTA had revised its zone structure and Lowell became a Zone 6 station, resulting in a fare increase. Fare increases were moderate between 1982 and 2011, however, in July 2012, a significant fare increase

of approximately 40% was implemented for commuter rail. Presently, the cost of a one-way ticket from Lowell to Boston is \$9.25. The calendar monthly pass costs \$289 for unlimited monthly service. A 10-ride ticket for Zone 6 can be purchased for \$92.50.

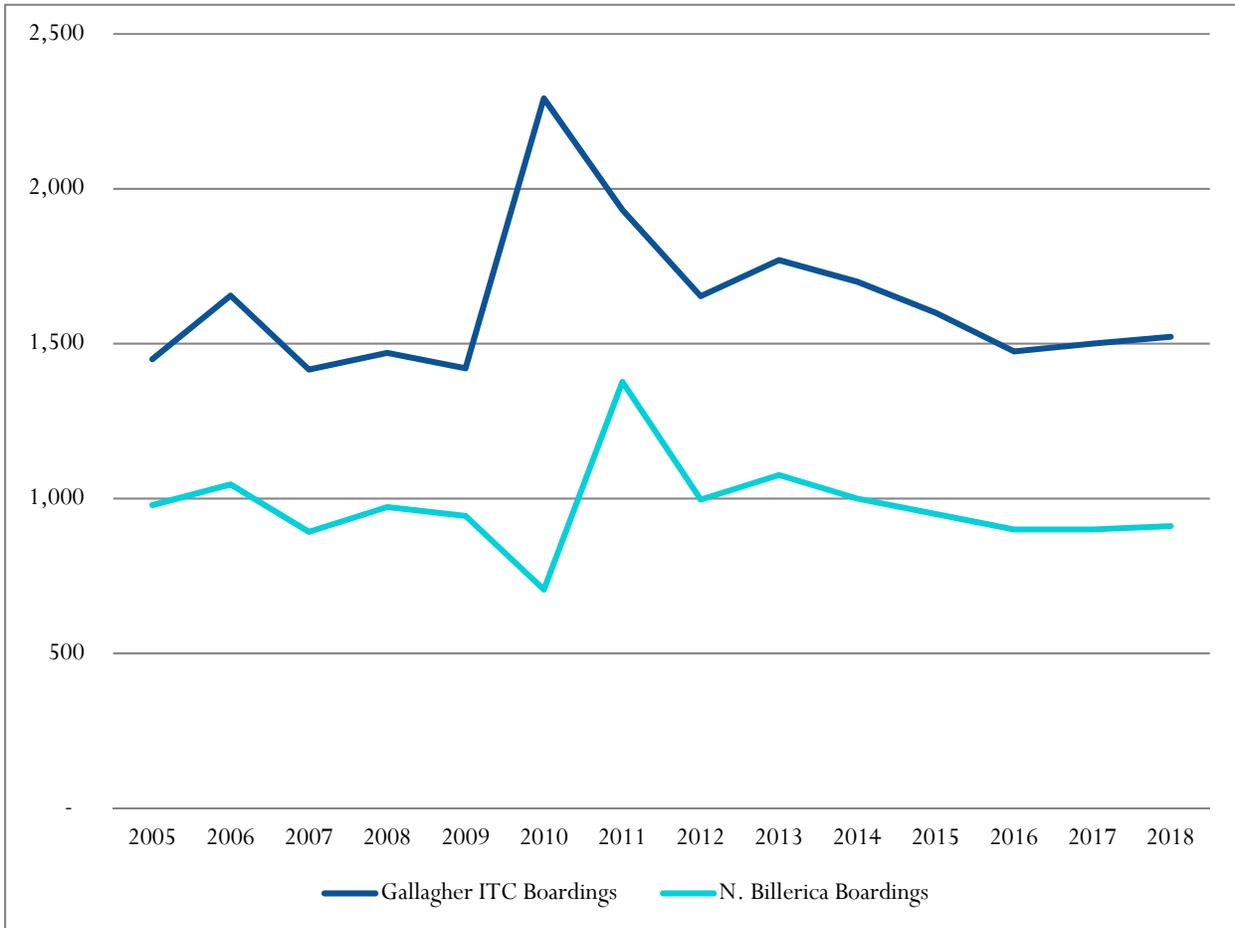
The cost of commuter rail service between North Billerica and Boston has followed much the same pattern. Between 1981 and 1982, the cost of a one-way ticket to Boston was \$2.00. By December 1982, it had increased to \$2.25, as North Billerica became a Zone 5 rather than a Zone 4 station. Likewise, the cost of the 12-ride ticket increased from \$20.00 to \$24.75 and the calendar monthly pass increased from \$61.00 to \$74.00. Currently, the MBTA fare for a one-way ticket between North Billerica and Boston is \$8.50, the 10-ride ticket is \$85.00 and the monthly pass is \$265.00.

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#### MBTA COMMUTER RAIL RIDERSHIP

The opening of the Kennedy Bus Hub at Gallagher Terminal in August 2005 ended the use of all surface parking lots, aside from several van spaces for individuals with disabilities. As a result, the Gallagher Intermodal Center currently contains garage-parking capacity of 955 spaces (Gallagher 1 – 330 spaces, Gallagher 2 – 231 spaces and Rourke – 394 spaces). Commuter rail ridership on the Lowell-Boston line has been affected over the past few years by various external factors. Figure 6.1 on the following page provides ridership statistics from 2005 to 2018. Inbound boardings at Gallagher Terminal increased to an all-time high of 1,778 in spring 2006, while ridership increased to its peak of 1,256 at North Billerica station in the fall of 2006. Ridership declined due to an economic downturn to an average of approximately 1,350 inbound boardings at Lowell and 800 inbound boardings at North Billerica in 2010. Commuter rail ridership has not rebounded from the 2006 peak. In 2018, there were 911 daily boardings at North Billerica station and 1,522 daily boardings in Lowell, as shown in Figure 6.1 on the following page.

Figure 6.1: MBTA Commuter Rail Service Daily Inbound Ridership (2005-2018)



**PROPOSED NEW HAMPSHIRE CAPITAL CORRIDOR COMMUTER RAIL EXTENSION**

In March 1999, the Nashua Regional Planning Commission (NRPC) commissioned a study to examine the feasibility of extending commuter rail service on the MBTA’s Lowell line to the southern New Hampshire region. This study focused on an incremental approach to restoring service along a 30.4-mile section of the former B&M New Hampshire mainline rail corridor between Lowell and Manchester, NH. The last regularly scheduled commuter rail service to Nashua and Manchester was operated in June 1967. A 13-month demonstration project offered a limited schedule of service in 1980 and 1981. The former double track mainline corridor has been reduced to a single-track route with passing sidings, except for a 3.5-mile segment between Lowell Station and Chelmsford Wye.

As proposed, rail service would connect southern and central New Hampshire locations with the current terminus of MBTA operations in Lowell and with the most northerly terminus located in Concord, NH. Early in 2013, the New Hampshire Department of Transportation (NHDOT), working in concert with Massachusetts, completed the Capitol Corridor Alternatives Analysis with support and funding from the Federal Railroad Administration (FRA) and Federal Transit Administration (FTA). The Study evaluated rail and bus options for improving connectivity in the corridor by leveraging existing transportation infrastructure and integrating transportation and land use planning.

The study results indicated extensive positive economic development impacts of expanding passenger rail including new jobs, commercial and residential real estate growth, and millions of dollars in reinvested worker earnings. According to the analysis, the Manchester Regional Rail alternative serving two stations in Nashua, one in downtown Manchester and one at the Manchester-Boston Regional Airport, would offer the greatest economic benefit with moderate construction investment. This alternative would draw an average of 668,000 weekday riders annually, with the potential to generate more than 3,600 new residential units and nearly two million square feet of commercial space supporting 5,600 permanent jobs by the year 2030.

In 2001 the Town of Chelmsford held a public meeting to gauge the level of support for constructing a new commuter rail station in North Chelmsford should New Hampshire decides to extend service from Lowell. The Chelmsford Board of Selectmen voted to pursue the development of a new station in the North Chelmsford area if the project moves forward.

The MBTA and CTPS completed a feasibility study in 2002 that identified two preferred locations for such a station and assessed the potential demand for each location. The locations include the North Chelmsford Auto Parts site north of Vinal Square and the industrial complex at the end of Wotton Street in North Chelmsford. The cost of construction was estimated at \$3.7 million for a 400-car lot and \$4.9 million for a 725-car lot. This issue was revisited when the town completed its most recent Master Plan in 2010. The Master Plan recommends that the Town continue to participate in the planning for the project, assuming that the traffic impacts of a new commuter rail station can be successfully mitigated. A traffic study performed by NMCOG in 2013 evaluated the impacts of a commuter rail station on the Wotton Street site and outlined the mitigation measures that would be needed should the project go forward.

In 2014, the NHDOT released [a detailed analysis](#) of proposed options for bringing rail to the NH Capitol Corridor. The preferred first step is to extend the existing Boston-Lowell commuter rail line to Nashua and Manchester. A future project would eventually extend the line to Concord. The Manchester Regional Commuter Rail line, as it is now known, would run eight (8) round trips between Manchester and Boston and seventeen (17) to Nashua. The total cost estimate for the project in 2014 was \$246

million. The scope of the project would include replacing the tracks, building sidings, construction of stations and crossings, and upgrading bridges. Construction is expected to take four years. Four years ago, the MBTA was willing to provide the train cars and a locomotive, and waive the fees for the track rights given the benefits to traffic on both the Route 3 and I-93 corridors, and the traffic reduction would help lower greenhouse gas emissions by 25 percent.

The next step for this project is the completion of the project development and engineering phases, which include the environmental assessment, engineering plans, the creation of a detailed financial plan, and drafting potential third-party agreements with the MBTA. This work would be funded by the State of New Hampshire using FTA funds.

The City of Nashua has been very actively pursuing passenger rail for many years. In addition to advocating for the NH Capitol Corridor Rail project, the City has been in talks with the [Boston Surface Railroad Company](#) that is purposing to run a train from Bedford, NH, at the Manchester Airport to Worcester, MA, and Providence, RI. Commuters would be able to transfer at the Lowell rail station to the Boston line.

#### I-93 TRANSIT INVESTMENT STUDY

The I-93 Transit Investment Study was initiated in 2006 to outline a long-term vision for transit investments that will accommodate future travel demand in the I-93 corridor from Boston to Manchester, New Hampshire. These improvements included rail, bus, and ride-sharing alternatives. The Transit Investment Study focused on two options for commuter service in the I-93 corridor: reactivation of rail service on the Manchester and Lawrence (M&L) right-of-way, and express bus service on the shoulder of I-93 (BOS).

Average daily traffic has grown steadily in the I-93 corridor. Historic trends revealed a 5 percent annual growth rate in average daily traffic for the segment north of the metropolitan Boston area. The heaviest traffic volumes along I-93 occur in southbound traffic in the morning peak period and northbound in the evening peak period. Peak hour traffic volumes reflect the commuter orientation of the corridor.

The bus on shoulder option was the primary alternative evaluated for cost and feasibility. This



**Image 6.1: Example of Bus on Shoulder Service**

alternative was ultimately estimated to cost \$88 million, with a relatively short time period required to phase in implementation. The M&L rail alternative was estimated at \$197 million and would require converting an existing bike trail back to rail usage. The bus on shoulder alternative, however, would be politically difficult to implement in Massachusetts in the near horizon.

In New Hampshire, approximately 60 percent of the traffic flow is southbound in the morning peak hour, and northbound in the evening peak hour. Analysis of the monthly variations in average daily traffic along the I-93 corridor indicates that the summer season has the highest traffic volume on a daily basis. August is the peak month with an average daily traffic volume of 77,500 vehicles per day.

In Massachusetts, during the morning and evening commuter periods, traffic speeds are reduced due to traffic congestion on I-93, and heavy exiting and entering volumes at some of the interchanges. In the southbound direction during the morning peak period, recurrent congestion occurs at Exit 45 (River Road in Andover), Exit 44 (I-495 in Andover) and Exit 42 (Dascomb Road in Tewksbury). Congestion is even heavier at these locations during the northbound evening commute.

## PUBLIC TRANSPORTATION ISSUES AND OPPORTUNITIES

As discussed in Chapter 2, many comments were received during the public outreach process relative to LRTA bus service and the needs of the traveling public. The following section summarizes the main concerns and issues expressed throughout the outreach process.

- Sunday Service:** One of the most frequent requests that the LRTA receives is for transportation services on Sundays. Beginning June 16, 2019, the LRTA will operate 10 routes on Sundays through a State-funded nine-month pilot. Evaluations of ridership demand and effectiveness of the Sunday service will be on-going throughout the nine months of the trial. If the service was effective and the LRTA can secure additional funding, the Sunday service would be extended beyond the term of the pilot project.

- **Extension of Service Times:** Over the last several years, the LRTA has added several early and late hour trips to all key routes. When financial resources are available to implement additional hours, the LRTA will do so.
- **LRTA/UMass Lowell Coordination of Bus Service and Scheduling:** The LRTA and UMass Lowell have continued to coordinate transit services. In August 2017, the LRTA established the #20 Downtown/UMass North Route. LRTA operated service is available to UMass students, faculty and the general public from 7:45 a.m. to 11:45 a.m., and the University operates service for UMass students and faculty from noon into the evening. Additionally, the LRTA has rerouted the #7 and #9 bus routes to service the University Crossing bus hub. In combination with these bus routings, the LRTA has enabled the fareboxes to accept the UMass Lowell student ID cards for payment, and the University reimburses the transit authority at the end of each month.
- **Enhance LRTA/MBTA Coordination of Buses and Commuter Rail:** LRTA regularly reviews the MBTA schedules and adjusts the bus service to facilitate easier transfers between the two transit agencies. In addition, during peak travel hours, the LRTA will hold buses up to five minutes to meet inbound afternoon trains when there are commuter rail delays.
- **Additional service to Burlington Mall:** The LRTA currently provides bus service to the Burlington Mall via the #14 bus route. Burlington Mall service operates on a one-hour frequency six days per week. Several participants at the public input sessions would like to see increased headways and service provided on Sundays. The LRTA is studying the potential extension of the #13 Billerica Route south on Route 3A to connect with the #14 at the Burlington Mall. The proposal, identified in the Middlesex 3 Transportation Study, would provide ½ hour headways and would enable customers on the Middlesex Turnpike corridor to take a single-seat ride to the Route 3A corridor, and vice versa.
- **Full Service to Middlesex Road in Tyngsborough:** A seasonal bus route currently serves the Pheasant Lane Mall, located at the north end of Middlesex Road, on Saturdays between Thanksgiving and January 15th. The public and Tyngsborough representatives felt strongly that service should be provided six days per week on a year-round basis. The expanded bus route is included in the LRTA Transit Service Plan for future implementation.

## Chapter 7 ACTIVE TRANSPORTATION NETWORK

The Northern Middlesex MPO encourages safe walking and bicycling as viable alternative transportation modes. Accommodating the needs of pedestrians and cyclists improves the quality of life for area residents and fosters a more livable environment in our communities and neighborhoods. Bicycling and walking are often the only modes available to the “transportation disadvantaged” (the young, the elderly, and the poor). Increased bicycling and walking throughout the region will help:

- Reduce traffic congestion;
- Reduce air and noise pollution;
- Reduce wear and tear on our roads;
- Reduce consumption of fossil fuel;
- Reduce vehicle crashes;
- Reduce the need for additional roads, travel lanes and parking; and
- Improve the health and well-being of our residents through regular exercise.

While bicycling and walking cannot replace the automobile for all trips, they can be practical modes for many trip purposes including:

- Trips to work or school;
- Visits to friends and relatives;
- Errands; and
- Trips combined with other modes, such as walking to a bus stop or riding a bicycle to a carpool or park-and-ride facility.

Bicycle and pedestrian stakeholders – residents, schools, parks, businesses, local bicycle and pedestrian clubs, and municipal officials – are important to the planning process as they can help to identify transportation needs and opportunities regarding the current bicycle and pedestrian network. During the preparation of this Plan, input from stakeholders was gathered through an online survey, public meetings, and meetings with community organizations.

### INITIATIVES TO PROMOTE BICYCLING AND WALKING

On March 15, 2010, the US Department of Transportation (USDOT) issued a *Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations*. It read: “The DOT policy is to incorporate safe and convenient walking and bicycling facilities into transportation projects. Every transportation agency, including DOT, has the responsibility to improve conditions and opportunities for walking and bicycling and to integrate walking and bicycling into their transportation systems. Because of the numerous individual and community benefits that walking and bicycling provide – including health, safety, environmental, transportation, and quality of life – transportation agencies are

encouraged to go beyond minimum standards to provide safe and convenient facilities for these modes.”

Several state initiatives that support bicycle and pedestrian transportation – such as weMove Massachusetts, the Healthy Transportation Compact, and Mass in Motion – were discussed earlier in this document. In addition to these initiatives, the following policies, programs, and projects have been developed and advanced by the Commonwealth of Massachusetts.

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## MASSACHUSETTS STATEWIDE BICYCLE PLAN

In 2019, MassDOT updated the [Massachusetts Bicycle Transportation Plan](#) with the vision that biking in Massachusetts will be a safe, comfortable, and convenient option for everyday travel. To realize this vision, the following goals have been set:

- Eliminate bicyclist fatalities and serious injuries; and
- Increase the percentage of everyday trips made by bicycling.

A series of initiatives have been recommended to help achieve the goals and the (I?)vision articulated within the Plan, as outlined below:

1. Build connected, safe, and comfortable bicycle networks.
2. Provide local, regional, and state partners with the tools needed to integrate the safety, comfort, and convenience of people biking into their transportation and development projects.
3. Increase roadway safety for people currently bicycling, potential everyday bicyclists, and people driving.
4. Increase access to bicycles and the convenience of bicycling as an everyday travel option for people of all ages and abilities.
5. Launch the development of a year-round maintenance and operations plan for MassDOT-owned bikeways and support municipalities to do the same.
6. Invest in data collection and evaluation to inform/track the progress of Initiatives 1 through 5.

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## MUNICIPAL RESOURCE GUIDE FOR BIKEABILITY

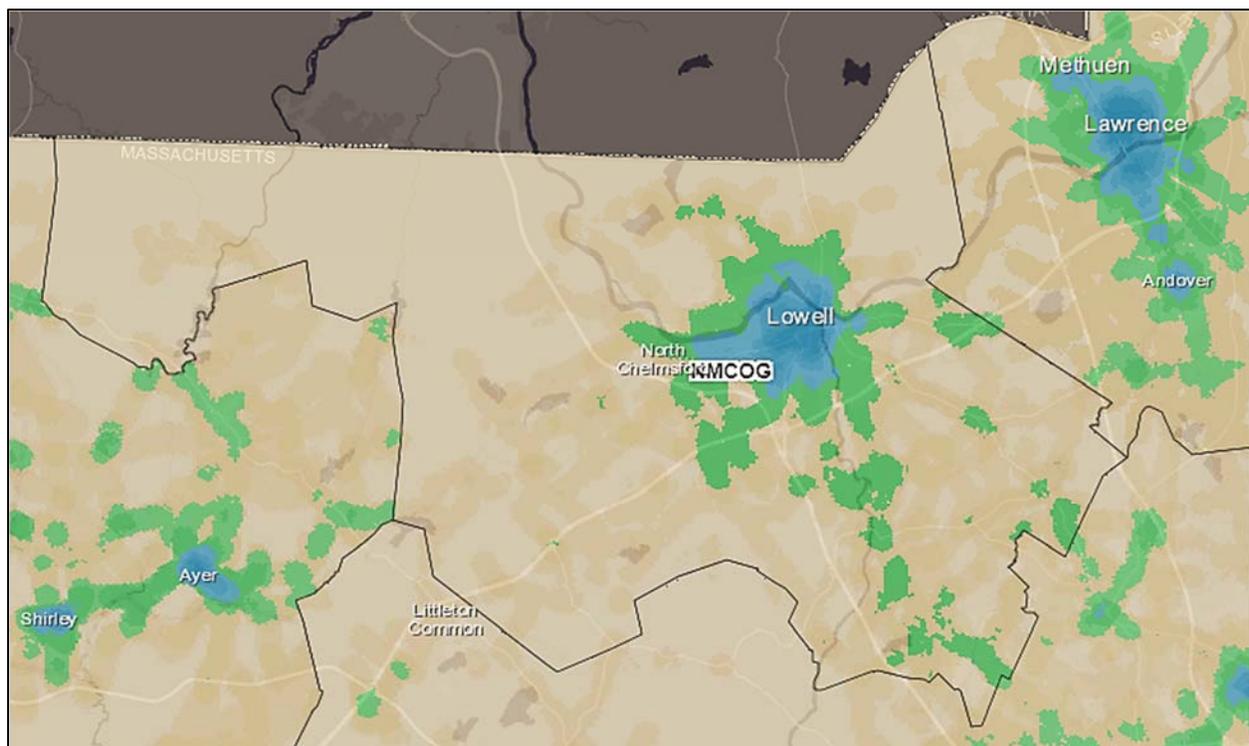
As part of the Statewide Bicycle Plan, MassDOT developed the [Municipal Resource Guide for Bikeability](#). [The Guide is intended to educate](#) staff, elected officials, community members on the concepts of enhancing bikeability and to direct them to additional resources. This guide describes the Potential for Everyday Biking concept and introduces the principles of connected bike networks.

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## POTENTIAL FOR EVERYDAY BIKING

The Potential for Everyday Biking Analysis is one of the first steps in the Massachusetts Statewide Bicycle Plan. In Massachusetts, 52% of all trips are three miles or less, a typical biking distance. Eighty percent (80%) of these trips are made in vehicles. The Potential of Everyday Biking concept notes that the majority of people would consider using bicycles to make shorter trips if the facilities were in place to provide a safe, comfortable and convenient route. The analysis identifies streets and areas in every region where people are most likely to bike on an everyday basis, if convenient bikeways and bicycle amenities are provided. Map 7.1 illustrates such areas (areas shaded in blue are most bikeable followed by areas shaded in green). As can be seen in the map, within the Northern Middlesex Region, Central Lowell, including Downtown, has the most biking potential. This is followed by some outer neighborhoods of Lowell and select tracts in Billerica, Tewksbury, Chelmsford, and Dracut. It is important that bicycle planning focuses on these select streets and areas, because doing so would create an initial network of popular bicycle trails and routes, which would encourage bicyclists from all levels to cycle more often in a safe and comfortable environment. Additionally, because many of these potential bicycle corridors are situated in environmental justice communities, persons from all economic, social and ethnic backgrounds would be able to benefit from an enhanced bicycle network.

**Map 7.1: Potential for Everyday Biking - NMCOG Region**



Source: Massachusetts Bicycle Plan

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## MASSACHUSETTS STATEWIDE PEDESTRIAN PLAN

The [2019 Massachusetts Pedestrian Transportation Plan](#) serves as a guide to state, regional, and local transportation planning aimed at better serving walkers. The plan envisions a State in which all people have a safe and comfortable walking option for short trips. The plan's recommendations are directed at achieving the following goals:

- Eliminate pedestrian fatalities and serious injuries; and
- Increase the percentage of short trips made by walking.

A series of initiatives have been recommended to help achieve the goals and overall vision articulated within the Plan, as outlined below:

1. Complete prioritized pedestrian-specific projects on MassDOT-owned roadways and bridges that address safety, critical gaps in connectivity, and accessibility.
2. Incorporate pedestrian safety, comfort, and convenience in investment decision-making and project development.
3. Slow vehicle speeds and improve visibility of people walking.
4. Improve pedestrian accessible paths of travel to transit.
5. Launch a year-round maintenance and operations plan for MassDOT-owned pedestrian facilities and support municipalities to do the same.
6. Invest in data collection and evaluation to inform Initiatives 1 through 5 and to measure performance.

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## MUNICIPAL RESOURCE GUIDE FOR WALKABILITY

The [Municipal Resource Guide for Walkability](#) is a compendium to the Massachusetts Pedestrian Transportation Plan, provides an introduction to the core concepts of walkability, and outlines additional resources that are available. The guide discusses the benefits of walkable communities, and examines mobility, safety, health and wellness, economic development, environment and equity for all users of the system.

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## COMPLETE STREETS

A complete street is one that provides safe and accessible options for all travel modes – walking, biking, transit, automobile – and for all ages and abilities. While many existing roadways are designed to optimize automobile travel, the complete streets design requirement has sought to increase the role of non-motorized and transit options by providing continuous sidewalks, bicycle lanes, or wide shoulders. Instead of simply focusing on main streets or downtown corridors, a complete streets policy creates a safe, accessible environment throughout a transportation network. By increasing the recognition and importance of the pedestrian, bicyclist and public transit rider in roadway design and operation

standards, complete streets policies are meant to ensure that safe travel options exist for all users. MassDOT's *Project Development and Design Guide*, which was published in 2006, embraces this approach to roadway design, and serves as a useful guide on how to implement the Complete Streets design approach.

In 2013, MassDOT strengthened its Complete Streets



**Image 7.1: Example of a Complete Street**

approach by unveiling a Healthy Transportation Policy Directive that requires all state transportation projects to increase bicycling, transit, and walking options. The directive is intended to build a healthy, sustainable transportation system and to promote multimodal access for transportation customers.

The directive builds on MassDOT's mode shift goal, which calls for tripling the share of travel in Massachusetts by bicycling, transit, and walking by 2030. Together, these initiatives seek to improve service to transportation customers while improving the health of the public and natural environment.

As part of the policy directive implementation, MassDOT reviews all projects currently in design to ensure they are consistent with the directive goals. Other elements of the directive include:

- All MassDOT facilities consider adjacent land uses and are designed to include wider sidewalks, landscaping, crossing opportunities, and other features to enhance healthy transportation options;
- Reviews of cluster crash sites where incidents have occurred with healthy transportation users are conducted; and
- MassDOT provides a guide to assist communities proposing shared use paths on or along rail beds in order to accelerate the path design process.

## THE COMPLETE STREETS FUNDING PROGRAM

The Complete Streets Funding Program was created with the intent of rewarding municipalities that demonstrate a commitment to embedding Complete Streets in policy and practice. The program assists eligible local communities in implementing and constructing bicycle and pedestrian facilities. In order to be eligible, a community must adopt a Complete Streets Policy and complete and submit a Complete Streets Prioritization Plan to the state. The process of achieving eligibility follows a three-tiered system, the completion of which will allow the community to receive Complete Streets funding for a project. The three tiers are:

1. Tier 1: The municipality demonstrates commitment by adopting a Complete Streets Policy by its highest elected official or board.
2. Tier 2: The municipality develops a Complete Streets Prioritization Plan, examining priorities that align with local and regional planning efforts. By completing Tiers 1 and 2, the Municipality is considered eligible to receive Complete Streets funding.
3. Tier 3: The Municipality identifies projects for competitive funding. MassDOT selects approved projects to be funded through the program.

The communities in the Greater Lowell Region have been very active in this program, with all of communities participating as of 2019. Dracut and Pepperell have approved policies, and Billerica and Dunstable have approved Prioritizations Plans. Five of the nine communities (Tewksbury, Lowell, Tyngsborough, Chelmsford, and Westford) have been approved or will be approved for project funding.

Since 2016, eight Complete Streets grants have been awarded to the five communities in the Northern Middlesex Region. Table 7.1 describes the projects that have been funded and the amount of the grant awards.

**Table 7.1: Complete Streets Funding Program - Grant Awards**

Year	City/Town	Project Name	Project Description	Grant
2016	Lowell	Complete Streets Needs Assessment	NA	\$400,000
2016	Westford	Town Center Pedestrian Improvements	Construction of new sidewalk connection along Main Street and Boston Road to a new pedestrian crossing to the Town Common. Construction of a bumpout with ADA compliant wheelchair ramps to provide traffic calming at the intersection of Lincoln Street and Boston Road. Construction of pedestrian crossing safety improvements and ADA compliant wheelchair ramps at the entrance to Town Hall.	\$200,000
2016	Westford	Concord Road Sidewalk Construction	Construction of approximately 600' of sidewalk along Concord Road from an existing sidewalk to the Robinson School front door. ADA compliant wheelchair ramps and safety improvements at the intersection of Robinson Road. Construction of pedestrian safety improvements and ADA compliant wheelchair ramps at Concord Road/ Kelly Road intersection.	\$200,000
2017	Chelmsford	Crosswalk across North Road at Parkhurst	One additional crosswalk to line up with existing sidewalks on adjacent streets. Changes to traffic island, new ramps, changes to the signal cycle and additional pedestrian heads for the existing signal.	\$35,000
2017	Chelmsford	Billerica Road Sidewalk	Sidewalk and ADA improvements from Chelmsford Center School.	\$108,000

**Table 7.1: Complete Streets Funding Program - Grant Awards**

Year	City/Town	Project Name	Project Description	Grant
2017	Chelmsford	Richardson Road Multimodal Improvements	Sidewalk construction from Edgelawn Ave. to Princeton Street (Route 3A).	\$185,000
2018	Tewksbury	East Street – Chandler Street Sidewalk Improvements	East Street at Chandler Street intersection plus approximately 500 feet west and 300 feet east along East Street, and 200 feet north and south along Chandler Street	\$400,000
2018	Tyngsborough	Kendall Road (Rte. 3A) Improvement Project	Construction of ADA compliant sidewalks and curb ramps. Installation of a shared use path and rectangular rapid flashing beacons at upgraded pedestrian crossings, and intersection reconstruction to reduce travel speed and enhance pedestrian safety in the Town Common area.	\$396,631

## SAFE ROUTES TO SCHOOL

Massachusetts Safe Routes to School (SRTS) program is funded by the Federal Highway Administration (FHWA) under the FAST Transportation Alternatives Program (TA). It is a key initiative of the Healthy Transportation Compact. The program



provides funding to improve the ability of primary and middle school students to walk and bicycle to school. Increasing the number of students who walk and bicycle improves students' health, reduces traffic congestion, and improves air quality. In 2009, 31 percent of children in grades K-8 lived within one mile of school. Of those, only 35% of these children usually walked or bicycled to school.<sup>1</sup> According to the US Department of Transportation, fewer than 16 percent of children walk or bicycle to classes. At the same time, school-related traffic can contribute more than 10 percent of morning rush hour traffic volumes in some communities, as well as significant air pollution.<sup>2</sup>

<sup>1</sup> National SRTS Center, 2011;

[http://guide.saferoutesinfo.org/introduction/the\\_decline\\_of\\_walking\\_and\\_bicycling.cfm](http://guide.saferoutesinfo.org/introduction/the_decline_of_walking_and_bicycling.cfm)

<sup>2</sup> Pedestrian and Bicycle Information Center, *Safe Routes to School Guide*, 2007

As shown in Table 7.2, the communities of Chelmsford, Dracut, Lowell, Tewksbury, Tyngsborough and Westford currently participate in the SRTS program.

**Table 7.2: Safe Routes to School Participating Communities and Schools**

Community	School
Chelmsford	Byam Elementary School
	Center Elementary School
	Charles D. Harrington Elementary School
	South Row School
Dracut	Brookside Elementary School
	George H. Englesby Elementary School
	Greenmont Avenue School
	Joseph A. Campbell Elementary
Lowell	Abraham Lincoln
	Kathryn P. Stoklosa Middle School
	McAuliffe Elementary School
	Moody Elementary School
	Rogers STEM Academy
Tewksbury	Heath-Brook
	Loella F. Dewing Elementary School
	Louise Davy Trahan
	North Street
Tyngsborough	Tyngsborough Elementary
	Tyngsborough Middle
Westford	Abbot Elementary
	Blanchard Middle
	Crisafulli Elementary School
	Day Elementary School
	John Robinson Elementary School
	Nabnasset Elementary School
	Rita Edwards Miller Elementary
	Stony Brook Middle School

Source: Massachusetts Safe Routes to School Program

In Lowell, approximately 1,400 feet of new sidewalk was added along the entrance and exit driveways of McAuliffe Elementary School using SRTS funding. In addition, a 100-foot section of sidewalk was constructed along Beacon Street to create a connection with the primary pedestrian crossing to the school, along with a 300-foot section of new sidewalk along the west side of June Street, between the school's exit driveway and Thirteenth Street. The school entrance and exit driveways were striped to include 5-foot wide bike lanes. New ADA accessible wheelchair ramps, pavement markings, traffic signs, pedestrian warning signs, and minor drainage modifications were also included.

## ACTIVE TRANSPORTATION PLANNING

The benefits of walking and bicycling are extensive as shown in Table 7.3. Such benefits include enhanced social equity, air quality improvement, improved public health, reductions in traffic congestion, and economic development benefits.

**Table 7.3: Benefits of Bicycling and Walking**

Benefit Category	Description
<b>Social equity</b>	<ul style="list-style-type: none"> <li>Available to all users, regardless of age or economic status</li> <li>Provides access to essential services and activities, such as healthcare, education, employment, shopping, and social activities for those who do not drive or have access to a vehicle</li> </ul>
<b>Environmental and energy</b>	<ul style="list-style-type: none"> <li>Positively impacts air quality by reducing trips made by Single Occupant Vehicles.</li> <li>Increases energy efficiency per passenger mile</li> </ul>
<b>Transportation</b>	<ul style="list-style-type: none"> <li>Reduced automobile traffic lessens congestion</li> <li>Can potentially promote greater use of transit by providing sidewalk and bicycle facilities between home, work, and public transit</li> <li>Reduces roadway construction, maintenance, and operating costs</li> </ul>
<b>Economic development</b>	<ul style="list-style-type: none"> <li>Helps achieve personal and community economic goals, such as increased quality of life, access to employment, education and health care</li> <li>Affordable transportation for low-wage workers</li> <li>Tourists and new residents are attracted to “bikeable” and “walkable” communities, making locations more competitive in terms of attracting a talented workforce and spurring investments in private and public infrastructure</li> </ul>
<b>Land Use</b>	<ul style="list-style-type: none"> <li>Encourages compact, mixed use development</li> </ul>
<b>Health</b>	<ul style="list-style-type: none"> <li>Helps to combat obesity, diabetes, heart disease and other health issues</li> </ul>
<b>Livability</b>	<ul style="list-style-type: none"> <li>Provide opportunities for social interaction, resulting in greater sense of community, place, and security</li> </ul>

Establishing walkways and bikeways along roadways is only part of what is needed to create a pedestrian- and bicycle-friendly environment. There are many improvements that make a transportation system more accessible and hospitable to pedestrians and bicyclists. Some of these issues can be dealt with by transportation officials, but others require support from government agencies, non-profits and citizens in order to bring about change. Such measures include amending land use regulations, enforcing traffic laws and an overall community commitment to creating a more human-scale urban and suburban landscape. The NMMPO supports the federal and state goals for increased bicycle and pedestrian activity and safety, by including bicycle and pedestrian elements in its transportation plans and programs. It also encourages municipalities to consider these issues within the context of local master plans and development regulations.

The *Unified Planning Work Program (UPWP)* for the Northern Middlesex region contains a task focused on planning for region-wide bicycle and pedestrian initiatives, in order to make bicycling and walking safe and convenient for traveling to work, school, shopping and recreational opportunities.

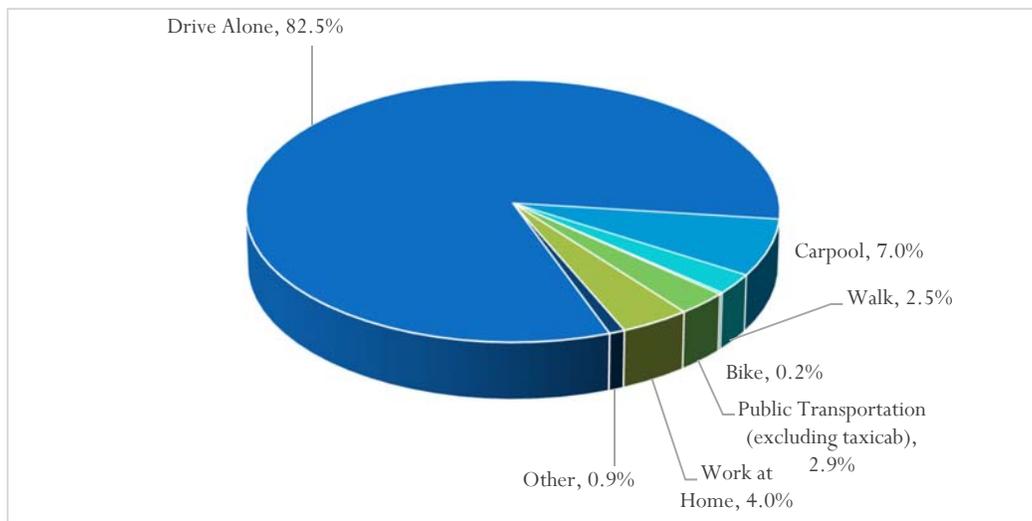
The NMMPO supports the safe accommodation of bicyclists and pedestrians as part of its evaluation, prioritization and programming of projects in the *Transportation Improvement Program (TIP)* and the *Regional Transportation Plan*. All highway infrastructure improvement projects programmed into the Northern Middlesex TIP, including highway reconstruction and rehabilitation, signalization projects, and intersection improvement projects, have active transportation components and benefits. All projects must follow MassDOT's Healthy Transportation policies and take a Complete Streets approach to design.

### STATISTICS ON ACTIVE TRANSPORTATION IN THE REGION

The 2013-2017 American Community Survey 5-Year Estimate provides some basic information about walking and bicycling, focusing on the trip to work. Region-wide, 2.7% of the working population (4,169 people) bicycles or walks to work. The City of Lowell is the only community that exceeds the regional average, with 6.0% of its working population biking or walking to work. The overall mode choice for commuters throughout the region is shown in Figure 7.1 on the following page. Approximately 82% of the region's commuters travel to work in a single-occupant motor vehicle.

Comparing mode shares from the 2009-2013 ACS Five-Year Estimate with the 2013-2017 ACS Five-Year Estimate, bike/walk commuting population in the region has grown from 3,441 to 4,169 people, for an overall mode share increase of 0.38%.

**Figure 7.1: Northern Middlesex Regional Commuter Mode Choice**



Source: 2013-2017 American Community Survey 5-Year Estimate

Some of the key groups that may be likely to walk or bike in the Northern Middlesex region include:

- **Non-Drivers:** Residents who do not possess a driver’s license could benefit from improvements to bicycling and walking options.
- **Households with no vehicle available:** Workers in households without a vehicle are more likely to walk to work than the overall population. Table 7.3 on the following page shows the number of housing units in each community without access to a vehicle . Overall, zero-vehicle housing units make up 9.2 % of all occupied housing units in the region. The City of Lowell is the only community that exceeds the regional average, with 18.4% of its occupied housing units lacking access to a vehicle.
- **Youth and Seniors:** Combined, these young and older populations represent over one-quarter (25%) of the Northern Middlesex population. As Table 7.4 on the following page indicates, over 22% of the region’s population is under age 18. This represents over 66,000 people, most of whom are too young to drive. The Towns of Dracut, Dunstable, Pepperell, and Westford exceed the regional average of persons under the age of 18.

Approximately 14% of the region’s population is age 65 and older. The Towns of Billerica, Chelmsford, Dracut, and Tewksbury exceed the regional average percent of population age 65 and older, as shown in Table 7.5. This senior subgroup often desires and appreciates alternatives to driving, including walking.

**Table 7.4: Households in the Northern Middlesex Region with No Vehicle Available**

Community	Occupied Housing Units	Households with No Vehicle Available	% Households with no Vehicle Available
Billerica	14,474	579	4%
Chelmsford	13,693	729	5%
Dracut	11,234	600	5%
Dunstable	1,138	17	1%
Lowell	38,965	7,176	18%
Pepperell	4,346	135	3%
Tewksbury	11,567	512	4%
Tyngsborough	4,360	129	3%
Westford	8,244	80	1%
<b>Region</b>	<b>108,021</b>	<b>9,957</b>	<b>9%</b>

Source: 2013-2017 ACS 5-Year Estimate

**Table 7.5: Youth and Senior Populations in the Northern Middlesex Region**

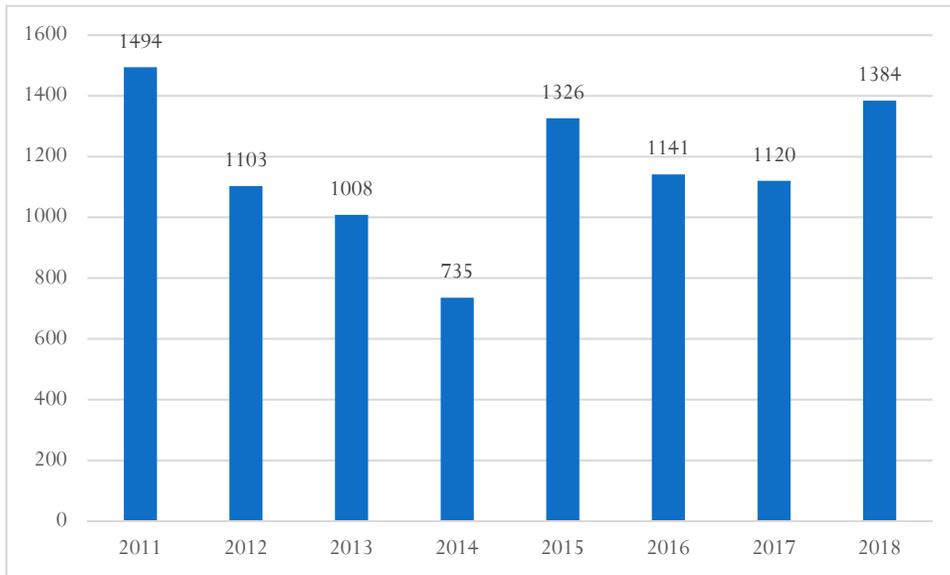
Community	Total Population	Percentage of Population Under Age 18	Percentage of Population Age 65 and Over
<b>Billerica</b>	42,791	20%	15%
<b>Chelmsford</b>	35,067	20%	20%
<b>Dracut</b>	31,113	22%	15%
<b>Dunstable</b>	3,337	24%	14%
<b>Lowell</b>	110,964	23%	11%
<b>Pepperell</b>	12,049	24%	13%
<b>Tewksbury</b>	30,066	20%	18%
<b>Tyngsborough</b>	12,232	21%	10%
<b>Westford</b>	24,087	28%	12%
<b>Region</b>	<b>298,372</b>	<b>22%</b>	<b>14%</b>

Source: 2013-2017 ACS 5-Year Estimate

Except for the limited ACS 5-Year Estimate data, there is sparse hard data available on how many people are bicycling and walking in the Northern Middlesex region. NMCOG staff, the Chelmsford Bicycle and Pedestrian Advisory Committee, and the Friends of the Bruce Freeman Rail Trail have completed trail counts along two regional multi-use trails: the Bruce Freeman Rail Trail (BFRT) and the Nashua River Rail Trail (NRRT).

#### BRUCE FREEMAN RAIL TRAIL COUNTS

The Chelmsford Bicycle and Pedestrian Advisory Committee and the Friends of the Bruce Freeman Rail Trail (FBFRT) monitor bicycle and pedestrian traffic along the BFRT on an annual basis, typically collecting data on the first Saturday of September in Chelmsford Center. Figure 7.2 summarizes counts collected at this location over the past eight years.

**Figure 7.2: Bruce Freeman Rail Trail Counts - Cushing Place**

Source: Chelmsford Bicycle and Pedestrian Advisory Committee

Mid- to-late Saturday afternoons are the most popular times for using the BFRT. The following types of users were noted at the Cushing Place location within Chelmsford Center during the 2018 count:

- 67% of users were bicyclists
- 30% were walkers and runners
- 3% of users had strollers or bicycle trailers, or were in-line skaters, wheelchair users, skateboarders, etc.

## NASHUA RIVER RAIL TRAIL COUNTS

The most recent Nashua River Rail trail counts were completed in May and July of 2014 by NMCOG staff at Railroad Square in the Town of Pepperell. The counts were conducted during the morning, afternoon, and evening on a weekday (Thursday) and a weekend (Saturday). Table 7.6 on the following page compares the Saturday trail counts at Railroad Square in Pepperell from 2007 and 2014. Overall, Saturday trail usage at this location increased by 15% from 2007 to 2014.

**Table 7.6: Saturday NRRT Trail Usage at Railroad Square in Pepperell, 2007 and 2014**

Time of Day	Number of Users in 2007*		Number of Users in 2014*		Percent Change
		%		%	
8:00 a.m. – 9:00 a.m.	84	14.5%	54	6.9%	-21.7%
9:00 a.m. – 10:00 a.m.	111	19.2%	78	9.9%	-17.5%
10:00 a.m. – 11:00 a.m.	112	19.4%	155	19.7%	16.1%
11:00 a.m. – 12:00 p.m.	92	15.9%	134	17.1%	18.6%
12:00 p.m. – 1:00 p.m.	92	15.9%	138	17.6%	20.0%
1:00 p.m. – 2:00 p.m.	42	7.3%	106	13.5%	43.2%
2:00 p.m. – 3:00 p.m.	45	7.8%	120	15.3%	45.5%
<b>Total</b>	<b>578</b>	<b>100%</b>	<b>785</b>	<b>100%</b>	<b>15.2%</b>

Source: NMCOG Trail Counts (2014), Friends of Bruce Freeman Rail Trail website (2007)

[www.brucefreemanrailtrail.org](http://www.brucefreemanrailtrail.org)

Based on the count data collected, the “peak hour” Saturday trail usage in both 2007 and 2014 occurred between 10:00 a.m. and 11:00 a.m. As shown in Table 7.7 below, bicyclists frequented the NRRT more than any other type of user in both 2007 (78.6%) and 2014 (90%). Joggers have increased their presence most significantly, more than doubling in number from 2007 to 2014.

**Table 7.7: Saturday NRRT Trail Users at Railroad Square, Pepperell by User Type, 2007 and 2014**

Trail User Type	2007		2014		Percent Change
	Count	%	Count	%	
Baby Carriage	4	0.6%	2	0.2%	-33.3%
Bicycle	485	78.6%	822	90.0%	25.8%
Jogger	17	2.8%	36	3.9%	35.8%
Roller Blader (Skater)	17	2.8%	5	0.5%	-54.5%
Walker	83	13.5%	48	5.3%	-26.7%
Wheelchair	5	0.8%	0	0.0%	-100%
Other	6	1.0%	0	0.0%	-100%
<b>Total</b>	<b>617</b>	<b>100%</b>	<b>913</b>	<b>100%</b>	<b>19.3%</b>

Source: NMCOG Trail Counts (2014), Friends of Bruce Freeman Rail Trail website (2007)

[www.brucefreemanrailtrail.org](http://www.brucefreemanrailtrail.org)

## REGIONAL BICYCLE FACILITIES

Having appropriate bicycle facilities is an integral component of encouraging the public to bicycle for utilitarian and recreational purposes. The availability of such facilities and good design practices affects the experience, enjoyment, safety, and comfort for bicyclists. Within the Northern Middlesex region, there are several types of bicycle facilities:

- **Shared roadway with regular lane width:** Bicyclists share the existing road with other vehicle traffic (the majority of road mileage in the region falls into this category);
- **Wide curb lane:** Bicyclists share a wide outside curb lane with other vehicle traffic;
- **Bike lane:** Bicyclists have dedicated road space that is adjacent to but separated from other vehicle traffic lanes;
- **Protected bike lane/Cycle track:** Bicyclists have a dedicated lane in the right of way, separated from the vehicular travel lane by a physical barrier; and
- **Separated path or lane:** Bicyclists have dedicated paths or trails that offer significant separation from vehicle traffic.

A description of the region's bicycle facility network is provided in the following sections.

### ON-ROAD BICYCLING FACILITIES

Bicyclists' skills, confidence, and preferences vary significantly. Some bicyclists are comfortable riding wherever they are legally allowed to operate, including space shared with motorized vehicles. Some bicyclists prefer to use roadways that provide space separated from motorists. Although children may be confident bicyclists and have some level of bicycle handling skills, they most often do not have the experience of adults nor the training or background in traffic laws necessary to operate safely on the road. Bicycle facilities should be planned in a way that provides continuity and consistency for all types of bicyclists.

On-road bicyclists have many of the same rights and responsibilities as automobile drivers. Under Massachusetts General Law, Chapter 85 section 11B, *“Every person operating a bicycle upon a way, as defined in section one of chapter ninety, shall have the right to use all public ways in the commonwealth except limited access or express state highways where signs specifically prohibiting bicycles have been posted, and shall be subject to the traffic laws and regulations of the commonwealth...”*

Existing streets are often difficult for bicyclists to use for several reasons:

- Some roadways have high traffic volumes and speeds;
- Busy intersections can be difficult for bicyclists to cross;
- Existing bicycle facilities may be absent, inadequate, discontinuous or poorly maintained; and
- Local streets are often disconnected, requiring a person to take a circuitous route.

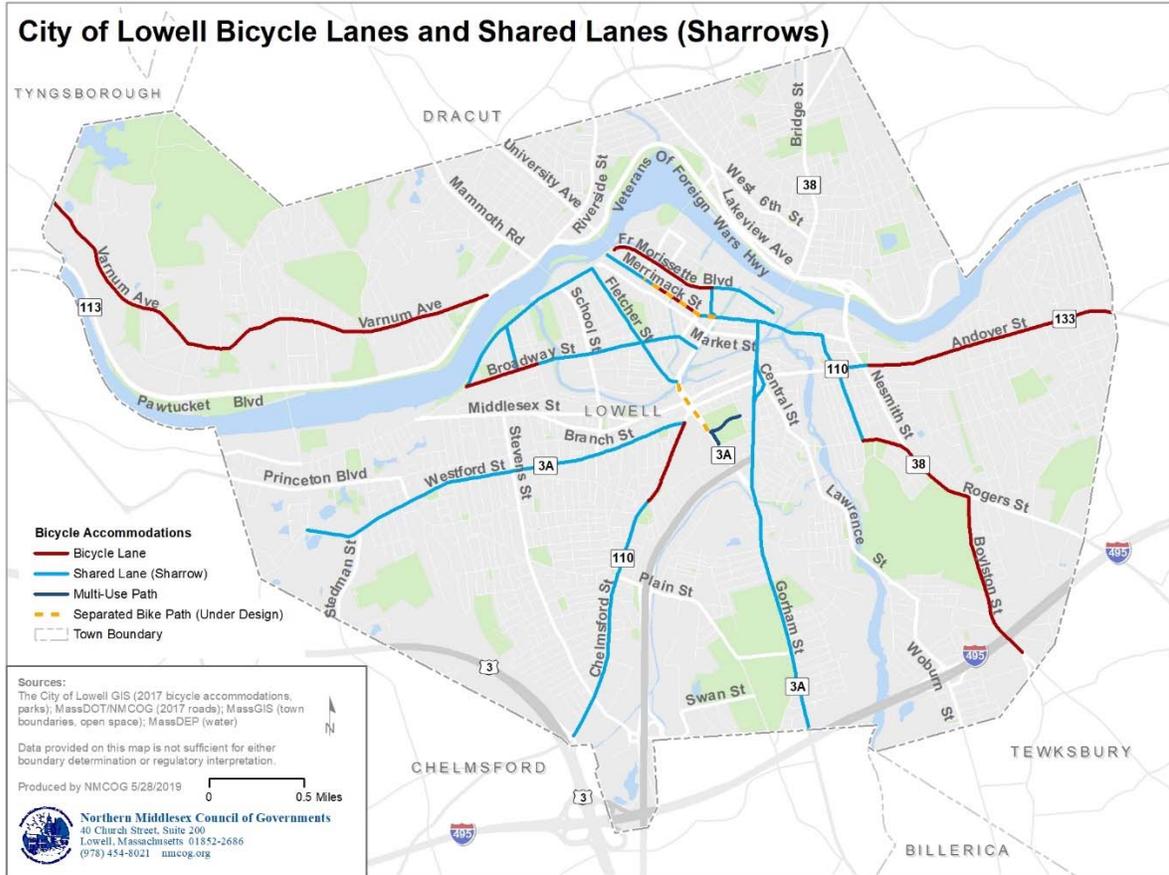
With the exception of the City of Lowell, there are no designated bicycle lanes along functionally classified roadways in most of the Northern Middlesex region. Most of the existing on-road bicycle accommodations primarily consist of “Share the Road” signs along selected routes. Transportation improvement projects funded with State and/or Federal monies will need to meet the requirements of the state’s Healthy Transportation policy, which includes bicycle and pedestrian accommodations such as sidewalks, wide shoulders and bike lanes. Other design features that are important for accommodating bicyclists include bicycle safe drainage grates and bridge expansion joints, improved railroad crossings, smooth pavements, adequate sight distances, and signal timing and detector systems that respond to bicycles.

In built-up urban environments, there is often little opportunity to add bikeways by widening roadways, because rights-of-way are often fully used and building setbacks are shallow. However, the City of Lowell has installed bicycle lanes and shared lane markings (also known as “sharrows”) on seventeen City streets (see Map 7.2). The City painted 56,450 feet of sharrows along select portions of twelve roadways, and installed appropriate signage to inform and educate bicyclists and motorists. Seven four-foot bike lanes have also been added, totaling approximately 35,100 linear feet. The locations and lengths of the bike lanes and sharrows are outlined in Table 7.8 below.

**Table 7.8: Existing Bicycle Lanes and Sharrows in Lowell**

Location/Street(s)	Length of Bicycle Lane (feet)	Length of Shared Lane (feet)
Andover Street	7,000	750
Arcand Drive		700
Boylston Street	5,400	
Broadway Street	1,400	5,200
Chelmsford Street	2,400	7,100
East Merrimack Street/Kearney Square/Merrimack Street	1,400	5,000
Fletcher Street		4,100
French Street		1,800
Gorham/Central Street		11,500
High Street		3,100
Pawtucket Street		5,000
Rogers Street	3,500	
Varnum Avenue	14,000	
Westford Street		11,000
Wilder Street		1,200

Map 7.2: City of Lowell Bicycle Lanes and Sharrows



OFF-ROAD/MULTI-USE FACILITIES

Multi-use paths and greenways offer opportunities not provided by the road system and can serve as direct commute routes. Multi-use paths may also help to close gaps in the bicycle network caused by cul-de-sacs, railroads, freeways, and interstates or natural barriers. Off-street facilities reduce vehicular conflicts, accommodate recreation and commuting bicycle riders, and allow young, unskilled bicyclists to safely ride away from traffic.

Within the Northern Middlesex region, there are several off-road, multi-use facilities that have either already been constructed or at various stages of the planning/design/construction process. A general description of each facility is provided in Table 7.9 on the following pages, and the location of each is shown on Maps 7.3 and 7.4 on pages 7-22 and 7-24.

**BICYCLE PARKING**

Providing bicycle parking encourages people to use their bicycles as a form of transportation. Without adequate parking facilities, bicyclists are forced to chain their bikes to poles, trees, or similar random and stationary objects. This random bicycle parking often creates barriers for pedestrians and increases the potential for accidents. Secure bicycle parking should be provided wherever demand is present, such as transit stations, shopping centers, schools, restaurants, retail establishments, office buildings, recreational areas, employment sites, and municipal facilities.

**BIKE SHARE FACILITIES**

Bike share is a mobility service in which users can rent available bicycles for point-to-point trips. Bikeshare is typically implemented by a municipality or by an institution, such as UMass Lowell. Bike share has proven to be an effective low-cost option for trips less than 3 miles in length. Bike share services are generally used to connect to transit, to commute, or for social/recreation type trips. There are different types of systems, e.g., either docked or dockless. A docked system requires users to pick up and drop off bicycles at stations, where bicycles in dockless systems can be picked up and dropped off anywhere. UMass Lowell provides a free docked bike share service for students and faculty around their campus. In 2019, the City of Lowell partnered with VeoRide to launch a dockless bike share system providing a new mobility option for trips throughout the City.



**Image 7.2: VeoRide Bike Share Program in the City of Lowell**

**Table 7.9: Off-Road/Multi Use Facilities in the Northern Middlesex Region**

Facility	Description	Status
<b>Nashua River Rail Trail</b>	A 12.5 mile paved, multi-use rail trail which begins in Ayer, follows the course of the Nashua River through Groton, Pepperell, and Dunstable, and ends approximately one mile over the Massachusetts/New Hampshire line in Nashua.	Complete
<b>Bay State Greenway</b>	A proposed 740-mile, seven-corridor bicycle transportation network that will be comprised of both off-road and on-road bicycle facilities.	Ongoing

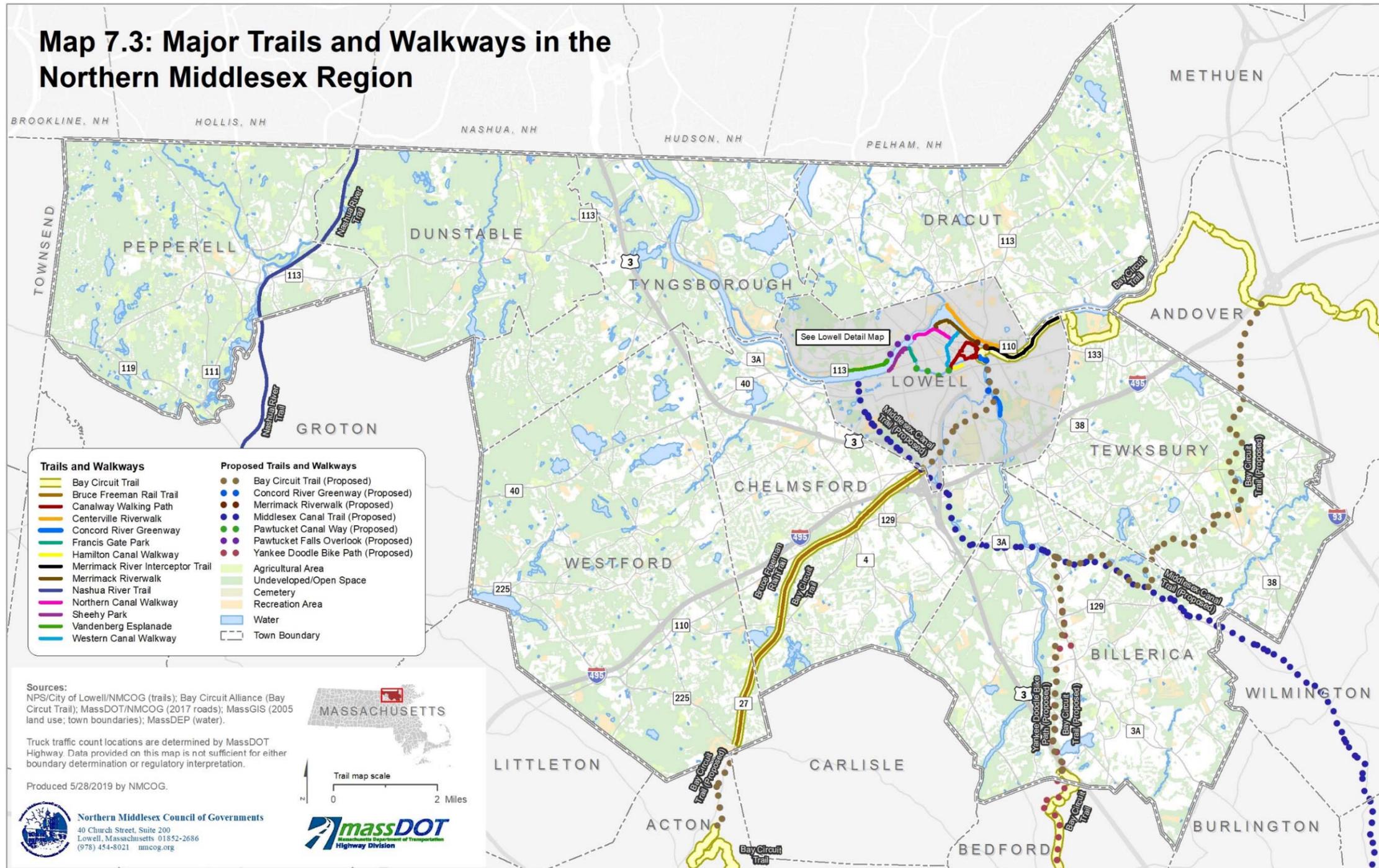
**Table 7.9: Off-Road/Multi Use Facilities in the Northern Middlesex Region**

Facility	Description	Status
<b>Bay Circuit Trail</b>	When complete, the 200-mile trail will link many of the outlying suburbs of Boston, extending from Plum Island in Newburyport to Kingston Bay in Duxbury. Some portions of this trail are complete, while others are still in the planning and design stages. Within the Northern Middlesex region, the trail crosses Tewksbury, Billerica, Lowell, Chelmsford and Westford	Ongoing
<b>Bruce Freeman Rail Trail</b>	As currently envisioned, the Bruce Freeman Rail Trail will extend approximately 24.5 miles in its entirety, passing through seven communities from Chelmsford to Framingham. Phase 1, extending from Lowell to Westford is complete. Phase 2A opened in 2018. Phase 2B is under design and Phase 2C is expected to open summer 2019.	Ongoing
<b>Concord River Greenway</b>	A 1.75-mile multi-purpose trail extending along the eastern bank of the Concord River in the City of Lowell. The Greenway connects Lowell's largest parks, Rogers Fort Hill Park and Shedd Park, with the Riverwalk and ultimately with a network of trails throughout the City. It also fills a missing link in the 200-mile Bay Circuit Trail and will eventually link to the Bruce Freeman Rail Trail. Phase 1 of the project is complete. The City of Lowell has received \$1,350,000 to complete the Concord River Greenway Park. A new bridge at the end of Lawrence Street section, crossing over the Concord River to Centennial Island is currently under construction.	Ongoing
<b>Tewksbury Rail Trail</b>	Consultants have worked with Tewksbury Rail Trails (TRT) Committee on creating a trail along abandoned railroad beds that cross the town, and on identifying, marking, and developing portions of the Bay Circuit Trail that traverse the town. The feasibility study is complete and the Town has been in contact with MPO staff to learn about funding opportunities.	In feasibility study stage
<b>Yankee Doodle Bikeway</b>	A proposed bikeway located along an abandoned railroad right-of-way, extending from Iron Horse Park in North Billerica to the Bedford town line. The 2008 Statewide Bicycle Plan includes the Yankee Doodle Bike Path as an important link within the Bay Circuit Greenway system. The project was approved by MassDOT in February 2016 for TIP funding eligibility and is currently programmed in FFY 2024 of FFY 2020-2024 TIP. The project is currently at 25% Design.	In design stage
<b>Middlesex Canal</b>	A trail network is planned along the towpath of the canal, with design work being advanced on the section of the canal adjacent to the Concord River/Mill Pond area of North Billerica.	In planning and design phases

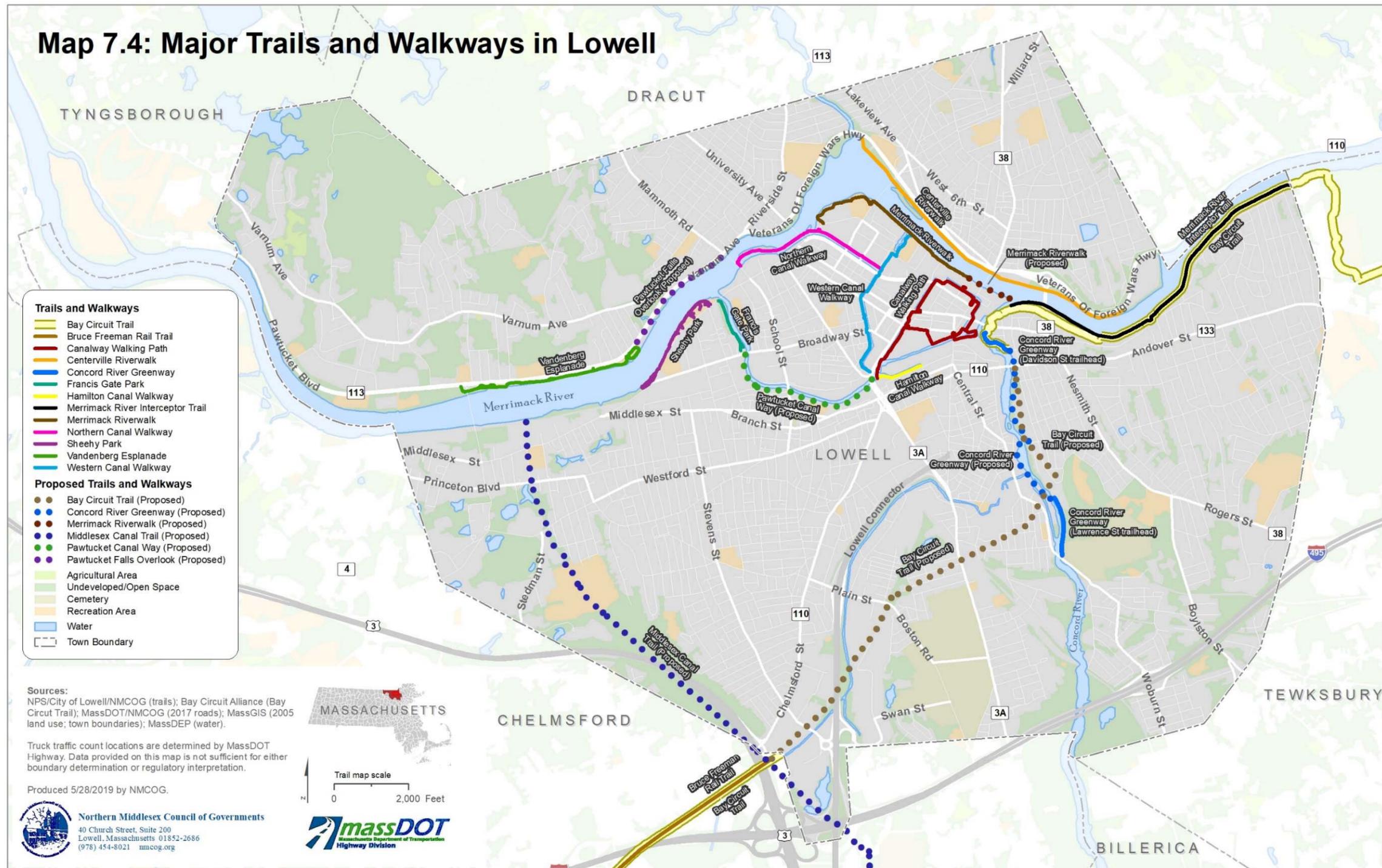
**Table 7.9: Off-Road/Multi Use Facilities in the Northern Middlesex Region**

<b>Facility</b>	<b>Description</b>	<b>Status</b>
<b>Merrimack River Trail</b>	A proposed 50-mile multimodal on- and off-road recreational trail system along the Merrimack River, which will ultimately connect six cities and eleven towns from Tyngsborough to Newbury.	In design phase
<b>Dunstable Pathways</b>	The Town of Dunstable has developed conceptual plans for a pedestrian pathway along Main Street, connecting destinations in the Town Center with the Town Library. The Town is currently seeking funding for design and planning to apply for Complete Street funding.	In design phase
<b>Chelmsford Center Brook Walk</b>	As part of an overall town center improvement plan, the Town of Chelmsford is seeking to establish a walkway along River Meadow Brook, connecting destinations within the Town Center.	In design phase
<b>Northern Canal Island and Great River Wall Walkway</b>	Reestablishment of walkways and landscaping along an island and river wall separating the Merrimack River and Northern Canal.	Complete
<b>Western Canal</b>	Development of three reaches – Acre, Western Canal Park, and Suffolk Street – to enhance pedestrian circulation along the Western Canal.	Complete
<b>Red Cross River Reach</b>	Conversion of an overgrown lot into a small park, which opens access to and view of the historic Pawtucket Canal.	Complete
<b>Hamilton Walkway</b>	An element of the revitalization of Hamilton Canal District, the project involves rehabilitation and reconstruction of pedestrian bridges, installation of new utilities, sidewalks, lighting, and landscaping.	Complete
<b>Upper Pawtucket Canalway</b>	The Lowell National Historical Park has secured design funds for a multi-use path between Dutton Street and Broadway on the southern side of the Pawtucket Canal. The trail route was designed in 2008 and confirmed constructable. Next steps in FFY 2020 will be engineering two MBTA railroad underpasses, environmental testing, updating designs and completing compliance and permitting for construction. Preliminary discussion of TIP funding availability has occurred.	In design phase
<b>Pawtucket Falls Overlook</b>	Creation of a 5/6-mile linear park and walkway extending from Vandenberg Esplanade to School Street Bridge. This project is currently programmed in the NMMPO TIP for 2021 using Statewide CMAQ funding and is at the 25% design stage.	In design phase
<b>Merrimack Riverwalk</b>	Phase I of the project is complete. Phase II extends the Riverwalk from the historic Boott Mills to the east side of Bridge Street, crossing the Concord River and connecting to existing walkways at the Lowell Memorial Auditorium and the Concord River Greenway. A FLAP award has been programmed in the NMMPO TIP and the project is scheduled to be advertised for construction in August 2019.	In design phase

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## PEDESTRIAN FACILITIES

Walking is the oldest, most affordable, and environmentally-friendly form of transportation. Transit riders must walk to eventually reach their destinations, drivers walk from the parking lot to the front door, and cyclists walk to their destination after parking their bicycles. Walking also helps to build a sense of community, by providing an opportunity for neighbors to get to know one another. Walking is also an easy way to improve our mental and physical health. Nearly everyone is a pedestrian at some point in time.

A connected system of safe and accessible pedestrian facilities is necessary to encourage walking as an alternative mode of transportation. An improved pedestrian network would contribute to the overall health of residents by offering attractive, safe, accessible places to walk, hike, jog, skate, and enjoy scenery. In short, an enhanced pedestrian network would create better opportunities for active lifestyles. The availability of well-designed pedestrian facilities impacts people's ability to reach the 30 minutes of daily moderate physical activity (60 minutes for youth) recommended by public health experts.

Key factors associated with safe walking include accessible pedestrian facilities, continuity of facilities, on-road intersection design that accommodates pedestrian use, intermodal linkages and maintenance of facilities. Communities in the Northern Middlesex region are actively participating in the MassDOT Complete Streets program, developing prioritization plans to build or repair sidewalk facilities and other pedestrian infrastructure.

### PLANNING FOR PEDESTRIAN FACILITIES IN THE NORTHERN MIDDLESEX REGION

Sidewalks, provided on both sides of a street, are generally the preferred pedestrian facility. They provide the greatest degree of comfort for pedestrians and the presence of sidewalks has been associated with increased safety for pedestrians. Decisions on whether to provide a sidewalk should not be based on existing pedestrian volumes because they are not a reliable indication of pedestrian demand. Individuals tend to walk in locations where continuous connections are provided. A lack of pedestrian activity in a location with discontinuous sidewalks is, therefore, not necessarily an indication of a lack of pedestrian demand.

Sidewalks, shared use paths, street crossings, pedestrian signals, signs, street furniture, transit stops and facilities, and all connecting pathways should be designed, constructed, operated and maintained so that all pedestrians, including people with disabilities, can travel safely and independently. A lack of sidewalks or a gap in the sidewalk system is a significant obstacle to pedestrians, especially those with limited mobility.

Quite often, pedestrian crossings at intersections are not adequately provided for through crosswalks and pedestrian actuated signals. All sidewalks should include curb cuts with sloped access to streets or

at-grade crossings. Pedestrian crosswalks at intersections provide a defined space where pedestrians can cross and where motorists are made aware of the potential of pedestrians in the roadway.

## ACTIVE TRANSPORTATION NETWORK CHALLENGES AND OPPORTUNITIES

Table 7.10 outlines many potential barriers to bicycling and walking, which include travel time, safety concerns, poor community design, weather, topography, lifestyle, lack of funding for infrastructure, and convenience. Overcoming these barriers is a long-term issue requiring public education, lifestyle changes, a change in planning regulations and policies, and increased funding for bicycle and pedestrian infrastructure.

**Table 7.10: Potential Barriers to Bicycling and Walking**

Barrier	Description
<b>Travel time</b>	Bicycling and walking tend to be slower modes than driving, and may not be considered viable options for commuters with tight schedules
<b>Distance</b>	Long distances may limit bicycle and pedestrian trips as these travel modes lend themselves to shorter trips.
<b>Safety barriers</b>	Traffic safety is an important concern for some bicyclists and pedestrians, especially children and older adults. Poor roadway conditions and a lack of bicycle and pedestrian accommodations may deter individuals from commuting by bicycle or foot.
<b>Poor planning and design considerations</b>	Zoning and community design standards often create large distances between residential and commercial districts
	Bicycling and walking may be less common in areas that lack: <ul style="list-style-type: none"> <li>• Attractive features (trails, greenery, landscaping, architectural diversity)</li> <li>• Street lighting, which could affect user perceptions of safety and security</li> <li>• Sidewalks, bicycle lanes, sharrows, designated crossings, properly timed signals, low traffic speeds and light vehicle volumes, and right turn lane protections</li> </ul>
<b>Weather</b>	Inclement weather, such as hard rain, heavy snow, and extreme temperatures, reduces the use of bicycling and walking
<b>Topography</b>	Steep hills may be a potential deterrent to bicycling and walking to those who are not in outstanding physical conditions
<b>Physical condition</b>	Some people, especially older adults, may be physically incapable of bicycling and walking, and therefore, dismiss them as viable transportation options
<b>Family lifestyle</b>	Family needs, such as dropping off children at school or daycare, and the number of available vehicles, may lead to driving as the preferred travel mode.
<b>Convenience</b>	The convenience factor, which could include comfort, reliability, preference, habits, time spent traveling, or ease of access, may influence mode choice. As an example, bicycling and walking may be perceived as less convenient for running multiple errands than driving.

**Table 7.10: Potential Barriers to Bicycling and Walking**

Barrier	Description
<b>Cost</b>	The individual costs associated with bicycling and walking (equipment, clothing, footwear, and routine maintenance) may be factored into mode choice
	Municipal costs to install bicycle and pedestrian facilities may be a factor in creating the necessary infrastructure and amenities for making these modes attractive to residents and workers

Width is often a critical factor affecting the ability of a roadway to accommodate bicycle traffic. Many communities in the Northern Middlesex region are urban or suburban in nature and providing adequate right-of-way for a bicycle lane may not be possible on many roadways. In order for bicycles and motor vehicles to share the road without compromising the level of service and safety, the roadway must provide sufficient pavement width to accommodate both modes. In locations where right-of-way is unavailable, providing wide outside paved shoulders may be possible. Paved shoulders should be at least 4 feet in width. However, where 4-foot widths cannot be achieved, any additional shoulder width is better than none at all. Shoulder width of five (5) feet is recommended from the face of guardrail, curb or other roadside barriers. Increasing the width of the shoulder is desirable if high bicycle usage is expected.

Wide curb lanes for bicycle use are usually preferred when shoulders are not provided, such as in restrictive urban areas on roadways without designated bike lanes. An outside curb lane wider than 12 feet can better accommodate both bicycles and motor vehicles in the same lane. Fourteen (14) feet of useable lane width is recommended for shared use in a wide curb lane. On stretches of roadway with steep grades, where bicyclists need more maneuvering space, the wide curb lane should be slightly wider, where practicable. Fifteen (15) feet is preferred. The 15-foot width may also be necessary in areas where there are drainage grates, raised reflectors on the right hand side of the road, or in areas with on-street parking, as the parking may effectively reduce the available lane width.

Through the public input process, a number of policy recommendations have emerged related to improving bicycle and pedestrian travel in the region:

- Include pedestrian circulation, bicycling and multimodal connections in the development permitting process by incorporating easements and rights of way, creating additional sidewalk connections, and creating connections to transit stops, where appropriate. As part of the site plan review process for commercial and industrial uses, opportunities for providing pedestrian and bicycling amenities, such as bike racks and showers, should be explored as part of the project approval process.

- Continue development of the multi-use regional trail networks, by securing easements and rights-of-way, and looking for opportunities to connect with the local trail systems and open space lands.
- Encourage local communities to continue participating in the Complete Streets funding program.
- Provide safety education for pedestrians, bicyclists and motorists, and increase enforcement of traffic laws.
- Improve the level of maintenance along the region’s sidewalk network to address poor pavement condition, lack of signage and other safety issues.
- Improve bicycle and pedestrian connections between neighborhoods, retail centers, employment centers, educational facilities, public transit and recreational areas.

## PERFORMANCE MEASURES

Active Transportation falls under multiple goal areas outlined in this plan. Developing bike lanes and sharrows serves to improve transportation infrastructure connectivity, reduces congestion by providing alternatives to single occupancy vehicles, and improves overall environmental sustainability by reducing emissions from motorized vehicles. Building sidewalks provides connectivity and livability to an area, by allowing better access to jobs, schools, shopping, medical care and entertainment. Investments in walking and biking enhance economic development, improve quality of life, protect public health, improve aesthetics, and benefit social justice.

Measuring performance of how policies and investments contribute to these goals is critical to ensuring progress. On the Federal level, the focus has been on the safety of users of the system and on improving overall air quality. Regionally, NMCOG strives to consider all goal areas and works to develop sets of performance measures that address the overall goals of the Plan. Table 7.11 displays performance measures for active transportation that were developed by the NMMPO. In 2018, the NMMPO adopted Statewide performance measures for bicycle and pedestrian safety, as well as a percentage of Non-Single Occupancy Vehicle travel, of which bicycling and walking are included.

**Table 7.11: Active Transportation Performance Measures**

Goal Area	Performance Measure
Safety	Number of bicycle and pedestrian incapacitating injuries and fatalities (NMMPO Adopted State Targets)
Congestion Reduction and System Reliability	Percent of Non-SOV Travel (NMMPO adopted State Targets)

Safety performance measures and targets are discussed in Chapter 9 of this plan. Congestion performance measures were recently adopted by the NMMPO and staff is currently working to refine

the methodology for projecting Non-SOV travel in the region. It is expected that these performance measures will be refined periodically as new data becomes available, in order to most effectively determine the need for bicycle and pedestrian enhancements and improvements, and to improve transportation planning overall. NMMPO staff will utilize these performance measures to gauge how effectively the recommendations in this Plan are implemented over the upcoming years.

## CHAPTER 8 INTELLIGENT TRANSPORTATION SYSTEMS (ITS)

Intelligent Transportation Systems (ITS) enables people and goods to move more safely and efficiently through a state-of-the-art multi-modal transportation system. ITS programs incorporate the application of advanced sensor, computer and communication technologies and management strategies to increase the safety and efficiency of the surface transportation system. ITS technologies are utilized to:

- Collect and transmit information on traffic conditions and transit schedules for travelers before and during their trips;
- Decrease congestion by reducing the number of traffic incidents, clearing them more quickly when they do occur, rerouting traffic flow around them, and automatically collecting tolls and fees;
- Improve the productivity of commercial, transit, and public safety fleets by using automated tracking, dispatch and weigh in motion systems; and
- Assist drivers in reaching a desired destination with navigation systems enhanced with path find or route guidance.

To fully maximize the potential of ITS technologies, ITS deployment requires an approach to planning, implementation, and operations that emphasizes collaboration between relevant entities and compatibility/interoperability of individual systems. At the core of this process is an architecture that provides overall guidance to ensure coordination and integration of individual ITS deployment projects, without limiting design options.

### REGIONAL ITS ARCHITECTURE

In 2010, the MassDOT Office of Transportation Planning (OTP) conducted a formal update of the Regional ITS Architectures for all four regions across the Commonwealth. The regional architecture developed for Metropolitan Boston included the area generally within I-495, encompassing the Northern Middlesex region. Development of a regional ITS architecture offers three important benefits to the region: improved interagency coordination, cost savings for transportation operations, and better services for the traveling public. The regional architecture was developed through a four-step process that included a needs analysis, actual architecture development, an operational concept, and an implementation plan.

As part of the update process for the regional architecture, the latest versions of the RTP and TIP were reviewed. A series of meetings were held to allow stakeholders for each region to comprehensively update their ITS inventory, identifying the ITS-related initiatives that have already been deployed, those ready for implementation, and those still in the planning stages. During the needs analysis process,

stakeholders also re-examined the broad transportation needs and priorities for their respective regions. The Final Report for each region included an updated Operational Concept that reflects changes in interagency interfaces. The Implementation Plan chapter in each Final Report was also revised to reflect the current status of planned ITS initiatives. The architecture and the Final Report will guide future regional and statewide ITS strategic planning efforts.

All ITS projects funded from the Highway Trust Fund (which includes transit projects funded from the Mass Transit account) must be in conformance with the National and Regional ITS Architecture. Therefore, it is vital that project proponents use the architecture as a guideline during project development, as FHWA and FTA will be using the architecture when reviewing the project.

Examples of ITS projects include interconnecting traffic signals, transit signal priority systems, traffic signal control software, variable message signs, closed-circuit television cameras, electronic fare payment systems, and automatic passenger counters. It is important to note, however, that a project does not have to be exclusively concerned with ITS to be subject to the federal requirements. A project that has any ITS component, such as a roadway widening project that includes the installation of CCTV cameras, is considered an “ITS Project” and must meet federal requirements.

Traveler information services provide real-time information on traffic conditions and travel times to motorists and transit users on upcoming arrival times. These strategies can help to improve traveler decision-making by providing critical information, such as downstream congestion, incidents, travel times, next-bus arrival times, and cautionary alerts from adverse weather conditions. This information is made available to roadside devices, websites, or mobile apps. Some ITS applications that are suitable for this region include the following:

- **Network surveillance systems** that monitor traffic, transit, and roadway conditions and convey a wide range of information ranging from travel conditions and alerts for travelers to system status and performance for the managing agencies. Devices include visual tools, such as closed circuit television (CCTV), and passive data collection devices, like traffic sensors using microwave, inductive micro loops, or Bluetooth frequency from mobile devices.
- **Advanced transportation management and arterial operations systems** focus directly on roadway and signal control to improve traffic operations in real time. Typically focused at locations where disruptions may be greatest, they generally result in improved safety and flow.
- **Regional transportation and transit management/dispatch centers** bring together many ITS services in one facility to coordinate responses to traffic incidents and travel emergencies, through adjustments in signal timing, issuance of traveler information, and communications with emergency responders. A co-location facility shared by multiple agencies promotes data sharing and the coordination of response. Such facilities also improve coordination of signal

timing on corridors that involve multiple agencies. Data archiving is also important in ITS planning and can be streamlined through regional transportation management centers.

- **Incident detection and emergency management** improves roadway operations by connecting dispatch with network surveillance and traveler information systems, to reduce response times and to ensure that correct equipment can be dispatched based on actual needs and conditions.
- **Roadside weather information** provides valuable alerts to travelers on the environmental conditions that affect the roadway surface and driving conditions. Information on ambient conditions (i.e., visibility, temperature, wind, and precipitation, as well as road-surface conditions, such as ice, moisture and/or flooding) is disseminated via traveler information and roadway maintenance services.
- **Public transportation operations and management** benefits from ITS deployment through services that provide real-time monitoring of transit vehicle operations and dispatch services, trip planning information, and real time bus location/arrival time information available immediately to the user via mobile apps. Transit station security is also supported via the deployment and remote monitoring of surveillance cameras at transit stations.
- **Commercial vehicle/freight management** relies on ITS to ensure efficient movement of truck freight. Automated Vehicle Inspections (AVI) reduce delays with passive inspection-station certification capabilities that allow responder-equipped freight traffic to eliminate costly inspection stops. In effect, a “bypass” of these stations is allowed while adhering to necessary permitting requirements.
- **Work zone/construction management** serves to minimize the impacts of construction zones by alerting travelers to anticipated delays, detouring, and other cautionary actions needed to avoid hazards in the construction zone.
- **Bicycle ITS** includes installing bicycle detection at traffic signals, modifying signal timings for bicycles, and modifying traffic signals to support bicycle lanes and sharrows.

## STATEWIDE ITS STRATEGIC PLAN

In 2014, MassDOT completed a Statewide ITS Strategic Plan. NMMPO staff participated in this process as a project stakeholder. The plan is intended to deliver user friendly Intelligent Transportation Systems and solutions, addressing the following goals:

- **Coordination:** To create a seamless system, coordination of activities among partner organizations is essential;

- **Safety and Security:** A core function of government and transportation organizations is to ensure public safety and to secure the total system against natural and man-made catastrophes.
- **Reliability and Efficiency:** This goal focuses attention on developing and deploying devices and systems that enable both business and travel reliability and efficiency.
- **User-friendly:** Equity, access, and quality are essential to providing a user-friendly transportation experience to enhance quality of life in Massachusetts.

The ITS Strategic Plan was developed to coordinate the implementation and use of technology throughout the state's transportation network. The Plan has a ten-year horizon and will be updated periodically. Based on the four goals outlined above, forty-six strategies were developed to serve as the roadmap for meeting the Plan's mission. The strategies were refined into tangible action plans, which identify lead agencies, key stakeholders, time frames, costs and the expected outputs that will result from implementing the actions. The details contained in this Action Plan provide the basis for the implementation process, and the level of effort that will be required to execute the forty-six strategies. To help facilitate the initial Action Plan, a task force was created to ensure that proposed actions were aligned with the correct agencies.

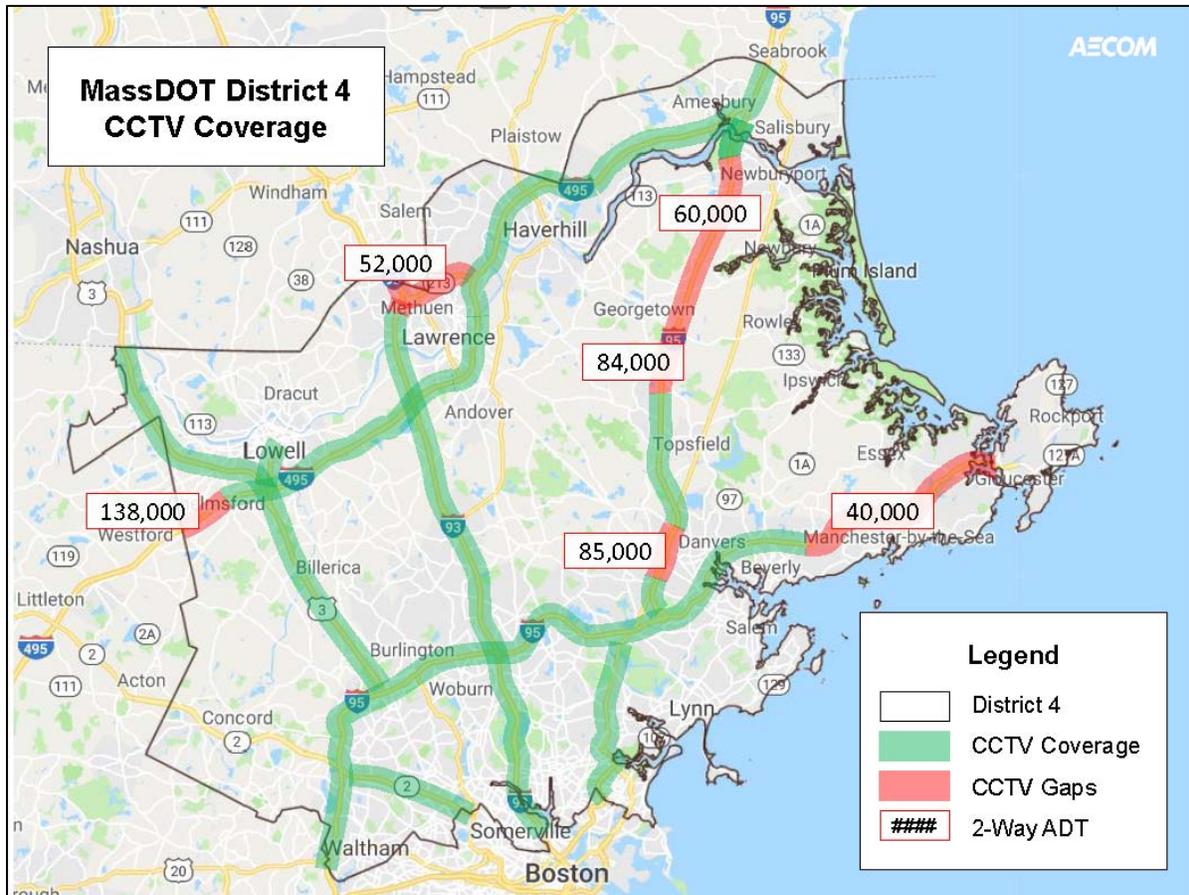
## ITS DEVELOPMENT IN THE NORTHERN MIDDLESEX REGION

The National Intelligent Transportation Systems (ITS) program is focused on the development and deployment of "user services," the individual tools used by travelers and transportation providers. Twenty-nine user services have been defined as part of the national program planning process. The users of a particular service will vary and could include travelers of any mode, operators of transportation management centers, transit operators, Metropolitan Planning Organizations (MPOs), commercial vehicle owners and operators, state and local governments, and many others who ultimately may take advantage of ITS. ITS user services are in various stages of development and will be deployed according to different schedules. ITS technologies deployed in the Northern Middlesex region are discussed below.

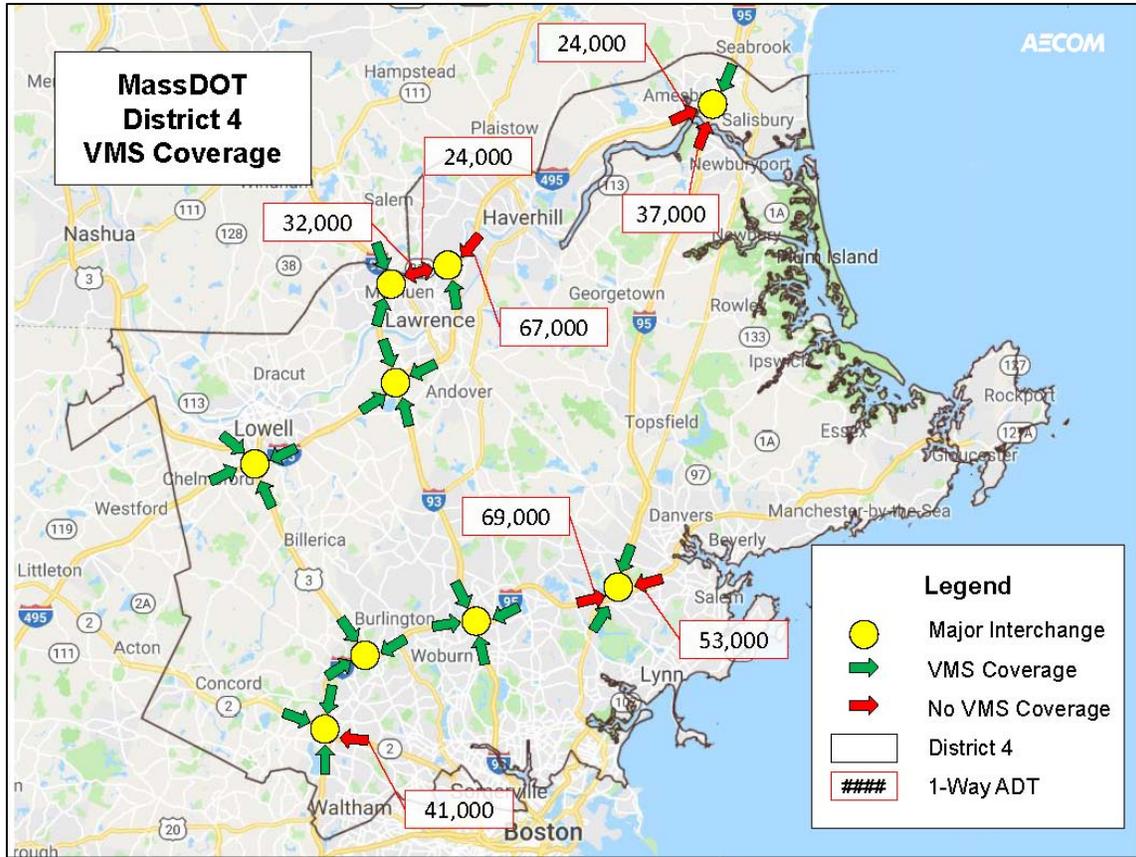
### ITS AND THE HIGHWAY NETWORK

There are a number of ITS technology applications that have been deployed within the state and the region. ITS technology is being integrated into regional highways via closed circuit cameras, variable message signs and real time travel time signs along I-495 and I-93. These serve to help users of the transportation system make informed decisions along their travel routes. The ITS technologies also help responders monitor congestion and improve incident response times. Variable message boards are unique in that they can notify motorists of emergencies, traffic incidents along the corridor, construction, or hazardous weather conditions. Maps 8.1 and 8.2 show the coverage of closed circuit cameras and variable message signage along the highways in the Northern Middlesex region.

Map 8.1: Closed Circuit Camera Coverage in the Northern Middlesex Region

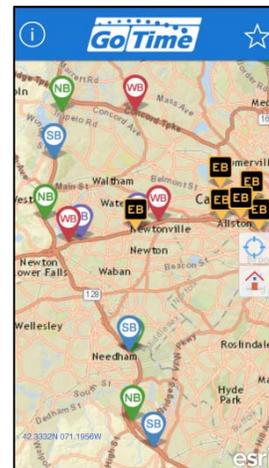


**Map 8.2: Variable Message Sign Locations in the Northern Middlesex Region**



The Mass511 service monitors real-time information regarding traffic conditions and transit operations for the Commonwealth of Massachusetts, including the Northern Middlesex region. This service, developed by the IBI Group using INRIX technology, went into operation in 2013. Information provided by Mass511 is collected through surveillance cameras, mobile monitoring that reports to the operations center, monitoring of hundreds of radio frequencies used by emergency vehicles, and direct contact with the State Police, MassDOT and the MBTA.

MassDOT has launched an App (GoTime) displaying real time travel conditions along Commonwealth roadways to complement the roadside travel time signs. The App can display over 130 locations to better plan trips along highways in the State.



**Image 8.1: MassDOT GoTime App**

## ITS AND THE LRTA

The Lowell Regional Transit Authority (LRTA) currently posts service advisories, schedule and vehicle location information on its website. In 2011, the LRTA began operation of the Charlie Card fare collection system. The Scheidt and Bachmann system, presently used by the MBTA and several other Massachusetts regional transit authorities, enables riders to seamlessly travel between systems without having to change payment cards.

Each Charlie Card can store up to three regional transit passes and up to \$200 in prepaid debit. The Charlie Cards are preprogrammed for either full fare or senior and disabled half fares. The correct fare is then deducted from the available card fund balance. The Scheidt and Bachmann system also maintains accurate ridership information, which is available to transit operators for performance analysis. This information can be sorted by vehicle, route, direction, time, and payment type. In 2017, the LRTA partnered with UMass Lowell on a program where students can use their college IDs on the LRTA system. The University covers the fees related to student use of the LRTA.



Image 8.2: Farebox Collection Systems are available on LRTA buses

The LRTA rolled out the automatic vehicle location system (AVL) on their fixed-route bus fleet in 2015. The AVL system, developed by Route Match Software, Inc., enables riders to determine where each bus is located along the route, and provides an estimated time of arrival. The system can be accessed from any computer or smart phone. It also provides real-time arrival estimates for the next bus via the Route Shout App. The data generated by the AVL system is an important element in the transit performance analysis. The data provides on-time performance statistics for each route and run. Additionally, six of the buses are equipped with automatic passenger counters (APC), allowing for greater analysis ridership trends.

## ITS AND THE MBTA

With service in the region, the Massachusetts Bay Transit Authority (MBTA) provides traveler information on its website, and next trip information for the MBTA system may also be accessed via the internet. Real-time vehicle location has been implemented for both the fixed-route bus system and subway lines, to provide information to users of the system relative to where buses and trains are located and when they will arrive. This information can be accessed via web applications for smart phones and tablets.

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## FUTURE DEPLOYMENT OF ITS TECHNOLOGIES

Other technologies outlined in the Regional ITS Architecture that may be suitable for future deployment in the region include the following:

- Installation of signal priority equipment on key commuter routes;
- A truck information service to optimize freight routing and management;
- Centralized signal control in area communities; and
- Emergency call boxes for the LRTA.

## CHAPTER 9 TRANSPORTATION SAFETY AND SECURITY

Local, state, and federal transportation, law enforcement, and emergency response agencies work cooperatively to construct, maintain, and monitor transportation networks, and assist travelers in need, but each transportation user must be vigilant when traveling to help ensure their own safety and security. Similar to other issues that are linked to the construction and operation of transportation facilities (e.g., air quality and economic development,), travel safety is clearly an issue that can be affected by how the transportation system is designed, constructed, operated, and maintained. Given that transportation-planning leads to changes in the transportation system, safety and security should be thoroughly integrated into the planning process. This section of the RTP examines transportation safety and security conditions across the Northern Middlesex region. Ensuring the safe and secure travel of the public is one of the most important goals of this plan.

Before one can identify the types of strategies or investments that can improve safety, safety issues and challenges must first be understood. This means not only understanding the “big picture” from the perspective of numbers and incidence of road-related fatalities and major injuries, but also analyzing the leading contributing factors. The best examples of safety conscious planning have begun with a comprehensive analysis of data. Over the past decade, NMMPO staff has worked with MassDOT, FTA and the LRTA to identify safety issues that need to be addressed, and has strived to prioritize projects with safety benefits.

Assessments of regional safety conditions often lead to future detailed studies of top crash locations through the region’s Unified Planning Work Program (UPWP), MassDOT’s Roadway Safety Audit (RSA) Program, and the Highway Safety Improvement Program (HSIP). NMMPO staff provides technical assistance to its local communities in determining the causes of identified safety problems. In addition, NMMPO assigns priority to projects that address safety when developing the region’s Transportation Improvement Program (TIP) and Regional Transportation Plan (RTP).

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### HIGHWAY SAFETY IMPROVEMENT PROGRAM AND STRATEGIC HIGHWAY SAFETY PLAN

Congress established the Highway Safety Improvement Program under SAFETEA-LU and continued it through FAST, in order to achieve a significant reduction in traffic fatalities and serious injuries on all public roads. The HSIP requires a data-driven, strategic approach to improving highway safety on all public roads that focuses on performance. The Highway Safety Improvement Program (HSIP) requires states to develop and implement a strategic highway safety plan, and to submit annual reports to the U.S. Secretary of Transportation that describe at least 5% of the state’s most hazardous locations, show progress in implementing highway safety improvement projects, and evaluate the effectiveness of the projects in reducing injuries and fatalities.

A Massachusetts HSIP Task Force was established to develop guidelines for HSIP-eligible projects and programs. The Task Force consists of FHWA, MassDOT Highway, MassDOT Planning and the Regional Planning Agencies. In 2009, Massachusetts began obligating funds from the HSIP funding category and is now in the eleventh year of an active HSIP program.

In September 2018, the Commonwealth of Massachusetts updated its Strategic Highway Safety Plan (SHSP), which provides the framework, and specific goals and objectives for reducing highway fatalities and serious injuries on all public roads. The SHSP is a data-driven, comprehensive plan that integrates the four E's - engineering, education, enforcement and emergency medical services (EMS). The SHSP is developed in consultation with Federal, State, local and private sector safety stakeholders. Since the development of the first SHSP in 2006, highway fatalities in the Commonwealth have dropped by 19% and serious injuries have dropped by 44%. The Commonwealth's long-range goal is known as Vision Zero, which envisions zero fatalities on the State's roadways. The interim goals for 2022 are to reduce five-year average fatalities by 12% and serious injuries by 21%.

The primary goal of the SHSP is to decrease traffic-related fatalities and injuries through improvements in the following fourteen (14) strategic emphasis areas, each representing at least ten (10) percent of annual fatalities or severe injuries on Massachusetts roadways:

- Lane departures;
- Impaired driving;
- Occupant protection;
- Speeding/aggressive driving;
- Intersection crashes;
- Pedestrians;
- Older drivers;
- Motorcycles;
- Young drivers
- Truck/bus-involved crashes;
- Driver distraction;
- Bicycles;
- At-grade rail crossings; and
- Safety of persons working on roadways.

In addition to strategies for emphasis areas, five policies are recommended by the SHSP to help reduce the frequency and severity of roadway crashes. These are legislative measures designed to address the interconnected nature of crashes, focusing on speeding, driver distraction and impaired driving. These include hands free laws, primary seat belts laws, work zone safety laws, ignition interlock for all OUI offenders, truck side guards, and automated enforcement authority for municipalities.

**SAFETY PERFORMANCE MEASURES AND TARGETS**

The NMMPO’s safety performance measures are consistent with the emphasis area goals outlined in the Massachusetts SHSP. The NMMPO has adopted statewide performance measures and targets for 2019. Included in Table 9.1 is a long-term target for the region out to 2040. MassDOT does not provide specific targets to 2040 beyond the long-term goal of zero roadway deaths. The 2016 Northern Middlesex Regional Transportation Plan set a goal of a 20% reduction in fatalities and injuries by 2040 and this plan continues to support that goal. The fatality and incapacitating rates for the region are consistently below state averages.

**Table 9.1: Safety Performance Measures and Targets**

Goal Area	Performance Measures	Current Performance - Rolling Five Year Average 2012-2016	CY 2019 Performance Target - Rolling Five Year Average 2015-2019*	Regional Rolling Five Year Average 2012-2016	2040 Regional Target (20% reduction)
Safety	Fatalities	364	353	61	49
	Rate of Fatalities per 100 million VMT	0.61	0.58	0.44	0.35
	Incapacitating Injuries	3,146	2,801	632	506
	Rate of Incapacitating Injuries per 100 million VMT	5.24	4.37	4.57	3.66
	Total Number of Non-Motorized Incapacitating Injuries and Fatalities	541	541	90	72

\*Statewide Target adopted by NMMPO 2/27/19

NMMPO’s safety program incorporates the following actions to achieve the goals set out in the program:

- High crash location identification;
- Determination of project eligibility for HSIP funding; and
- Programming of safety-related projects into the regional RTP and TIP documents.

ADDRESSING PERFORMANCE MEASURES AND TARGETS

FATALITIES

In the Northern Middlesex region, sixty-one (61) fatalities occurred as a result of motor vehicle crashes during the most recent five-year period for which data is available, 2012-2016. The regional target of achieving a 20% reduction by the 2036-2040 year would result in 49 fatalities. The long-term goal of zero deaths on roadways in the Commonwealth is also the standard, which this Plan strives to achieve. The MPO has adopted statewide targets, as shown in Figure 9.1

Figure 9.1: Total Fatalities and Fatality Rates in Massachusetts

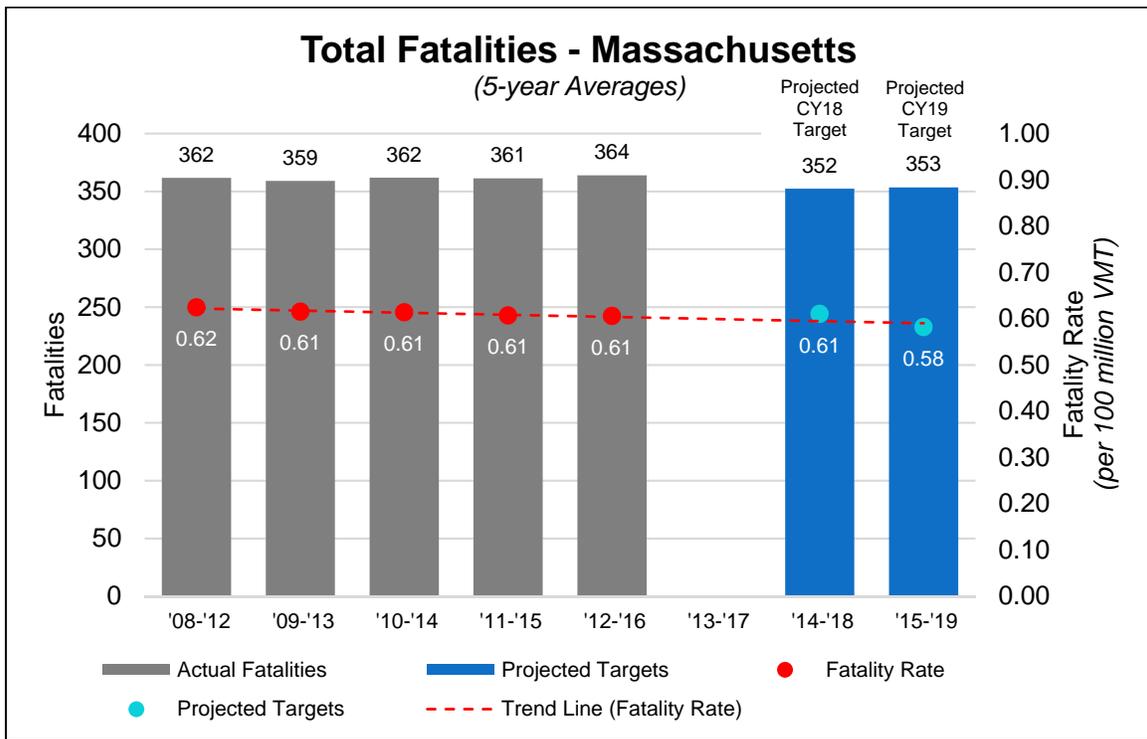
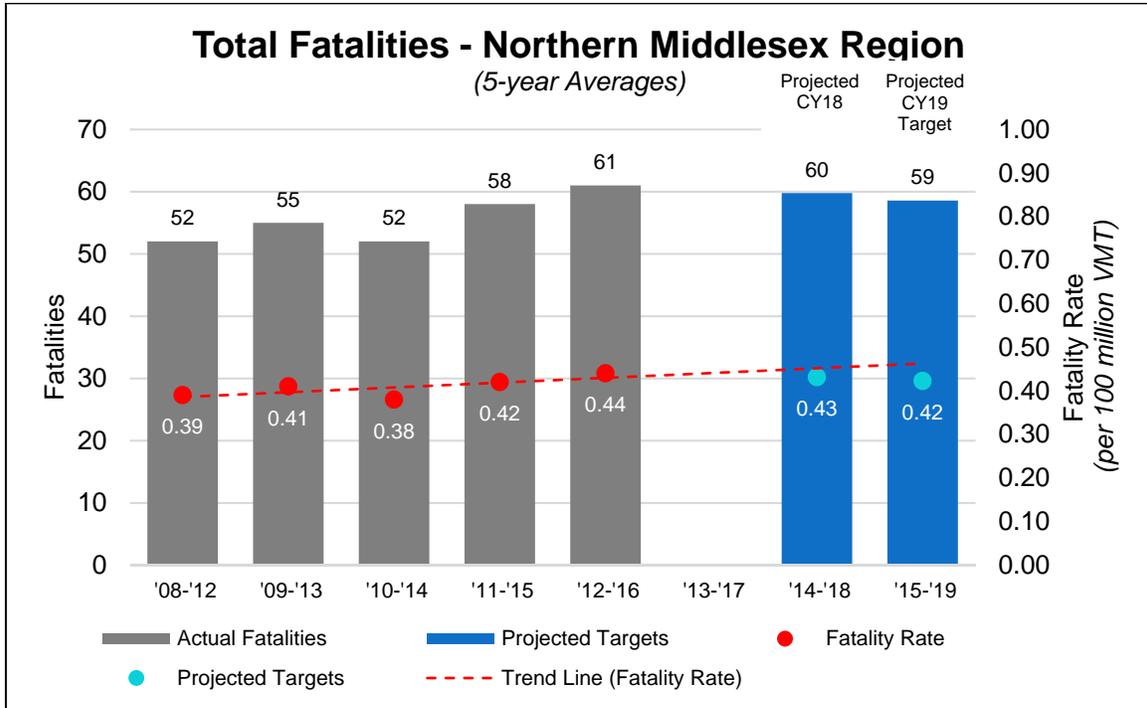


Figure 9.2 shows total fatalities and fatality rates, as well as projected targets for calendar years 2018 and 2019, for the region based on the RTP long-term target of achieving a 20% reduction in fatalities by 2036-2040.

Figure 9.2: Total Fatalities and Fatality Rates in the Northern Middlesex Region



**INCAPACITATING INJURIES**

In the Northern Middlesex region, six hundred thirty two (632) incapacitating injuries occurred as a result of motor vehicle crashes during the latest five-year period for which data is available, 2012-2016. There were a total of 3,146 reported incapacitating injuries in the Commonwealth during the same time period. The regional target of achieving a 20% reduction by the 2036-2040 year would result in 506 incapacitating injuries. The MPO has adopted statewide targets for incapacitating injuries, as shown in Figure 9.3.

Figure 9.3: Total Incapacitating Injuries and Injury Rates in Massachusetts

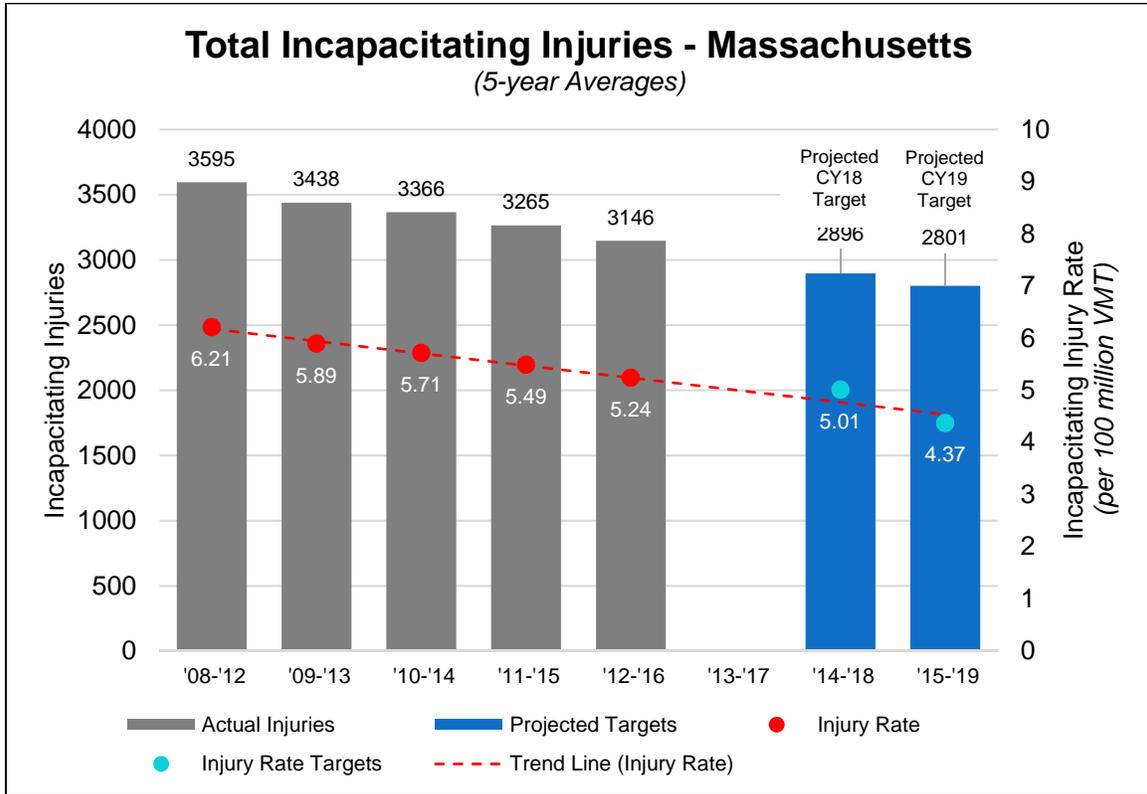
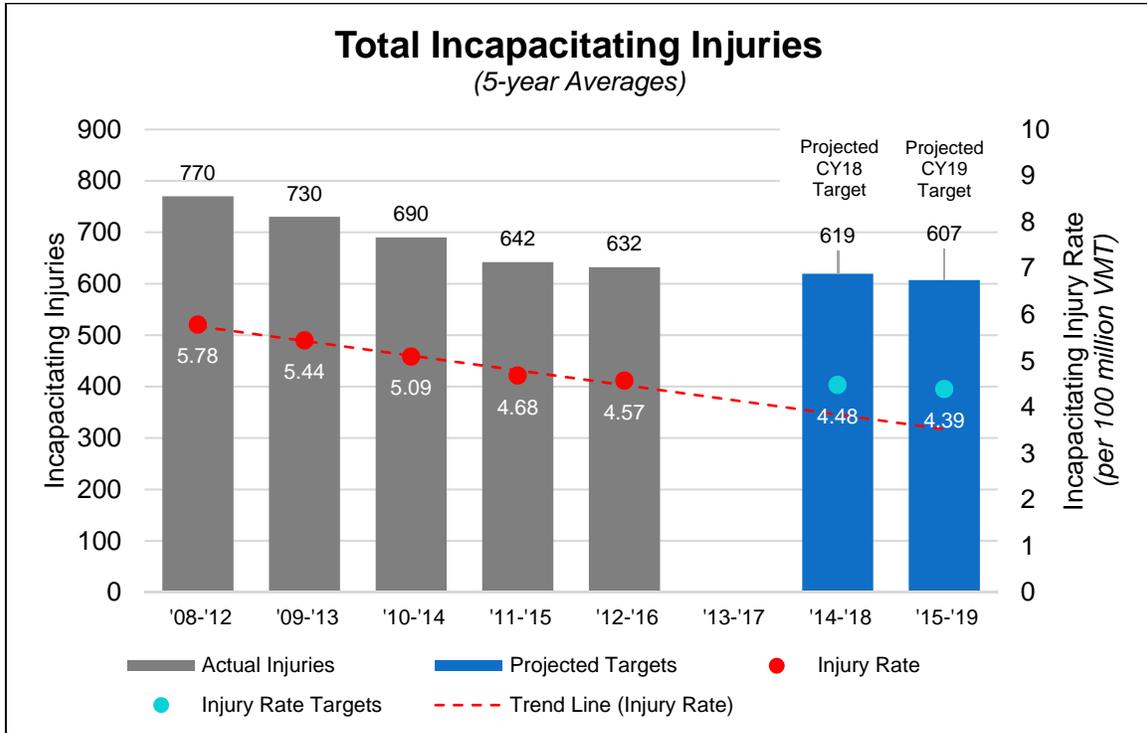


Figure 9.4 shows total incapacitating injuries and injury rates, as well as projected targets for calendar years 2018 and 2019, for the region based on the RTP long-term target of achieving a 20% reduction in these types of incidents by 2036-2040. Injuries and injury rates have steadily declined in the region and the NMMPO will strive to continue this trend.

Figure 9.4: Total Incapacitating Injuries and Injury Rates for the Northern Middlesex Region



**TOTAL NUMBER OF NON-MOTORIZED INCAPACITATING INJURIES AND FATALITIES**

In the Northern Middlesex region, ninety (90) non-motorized incapacitating injury and fatal crashes occurred from 2012 through 2016. There were a total of 541 such crashes reported in the Commonwealth during the same time period. The regional target of achieving a 20% reduction by 2036-2040 would result in a goal of 72 crashes. The MPO has adopted the statewide targets, as shown in Figure 9.5.

Figure 9.5: Total Combined Non-Motorized Injuries and Fatalities in Massachusetts

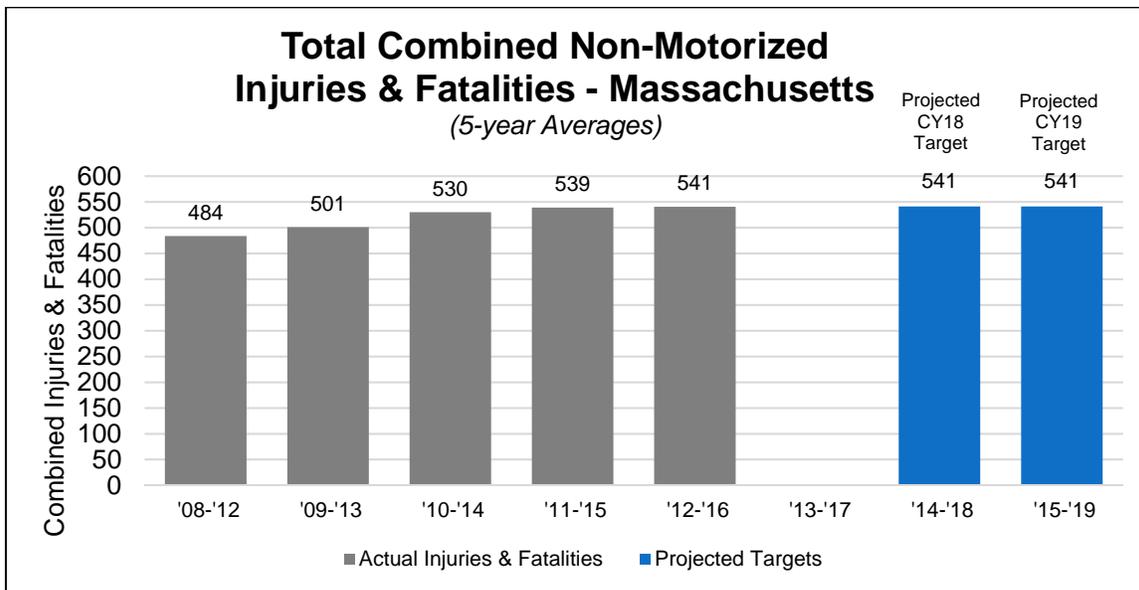
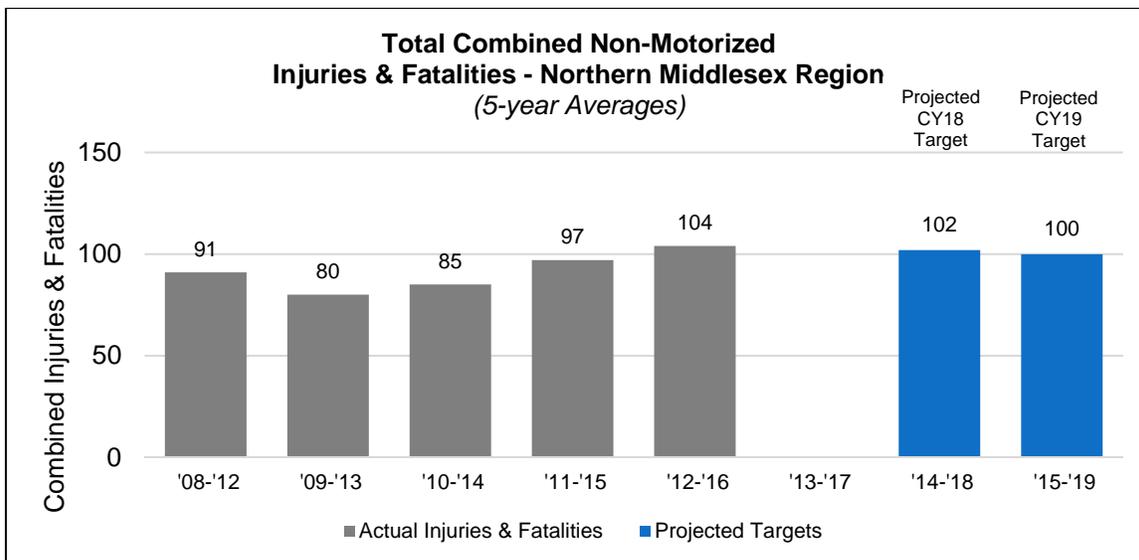


Figure 9.6 shows total non-motorized incapacitating injuries and fatalities, as well as projected targets for calendar years 2018 and 2019, for the region based on the RTP long-term target of achieving a 20% reduction in these types of incidents by 2036-2040.

Figure 9.6: Total Combined Non-Motorized Injuries and Fatalities in the Northern Middlesex Region



## IDENTIFYING REGIONAL HIGH CRASH LOCATIONS

As part of its overall traffic safety program, the NMMPO has developed four principal goals:

- Identify locations with transportation safety problems;
- Notify local and state officials, and the public of safety problems and concerns;
- Provide technical assistance to local communities in determining the cause of the crashes at problem locations; and
- Identify strategies for addressing and mitigating identified safety deficiencies.

In Massachusetts, crash data is collected by MassDOT and the Massachusetts Registry of Motor Vehicles (RMV). The NMMPO uses this data to determine the Top 100 most hazardous intersections within the region over a three-year period. The data is also used to assess the need for safety improvements at locations deemed to be problematic. The most recent data available through the Commonwealth covers calendar years 2014 through 2016. In accordance with FHWA safety performance measures, the following narrative compares crash rates from 2014-2016 with past periods.

From 2014 through 2016, there were 20,753 reported crashes within the nine communities comprising the region. Table 9.2 summarizes the total number crashes by year and severity. Twenty-three percent (23%) of the crashes resulted in non-fatal injuries, and unfortunately, thirty-seven (37) fatal crashes reported.

**Table 9.2: Motor Vehicle Crashes by Severity in the Northern Middlesex Region, 2014-2016**

Severity of Crash	2014	2015	2016	2014-2016
Property Damage Only	4,362	4,787	4,842	13,991
Crashes with Non-Fatal Injury	1,542	1,507	1,675	4,724
Fatal Crashes	11	12	14	37
Severity Not Reported	748	619	634	2,001
<b>Total</b>	<b>6,663</b>	<b>6,925</b>	<b>7,165</b>	<b>20,753</b>

Source: MassDOT/RMV Crash Data

When comparing the number of crashes from 2010-2012 with those reported in 2014-2016, there was a 10% increase. Injury crashes increased by 14% during these same timeframes, while the number of fatalities increased by 27%, as shown in Table 9.3.

**Table 9.3: Crash Data Trends in the Northern Middlesex Region**

Severity of Crash	2010-2012	2014-2016	Total Change	% Change
Property Damage Only/ Not Reported	14,533	15,992	1,459	9%
Crashes with Non-Fatal Injury	4,061	4,724	663	14%
Fatal Crashes	27	37	10	27%
<b>Totals</b>	<b>18,621</b>	<b>20,753</b>	<b>2,132</b>	<b>10%</b>

Source: NMMPO Crash data, 2010-2012 and 2014-2016

### THE TOP 100 HIGH CRASH INTERSECTIONS IN THE NORTHERN MIDDLESEX REGION

The Top 100 crash intersections were determined using three years of crash data, to account for annual variations caused by construction, road closures, or discrepancies in crash reporting practices of local police departments and the RMV. The RMV receives the crash reports from local and state police departments, and the data is used to create a database for the entire state. MassDOT uses the database to map the crashes using Geographic Information Systems (GIS). The data is then provided to the NMMPO staff.

The NMMPO staff flags intersections that experience fifteen (15) or more crashes in a three-year period as candidate locations for the Top 100 list. A detailed review of each record associated with each candidate intersection is performed. The high crash intersection ranking system is based on the Equivalent Property Damage Only (EPDO) methodology. Each crash is assigned a numeric value based on reported severity. Property damage only crashes are assigned one (1) point, injury crashes are assigned five (5) points, and fatal crashes are assigned ten (10) points. The points assigned to each crash at a given location are added to determine the intersection's EPDO value.

Table 9.4 provides a summary of the total crashes within each community from 2014-2016, and identifies the number of intersections that are ranked in the Top 100. With 49% of the region's share, the City of Lowell had the greatest number of crashes (10,100) between 2014 and 2016, and had the largest number of intersections (71) on the Top 100 High Crash List. The City is by far the most urbanized and densely populated community in the region and has the greatest number of roadways per square mile when compared to other municipalities. This provides more opportunities for vehicle conflicts and crashes than one would typically find in a suburban or rural community. Due to its rural nature and limited roadway miles, the Town of Dunstable recorded the fewest number of crashes of the communities within the region.

**Table 9.4: Crashes per Community**

Community	2014 Crashes	2015 Crashes	2016 Crashes	Total Crashes 2014-2016	Number of Intersections in Regional Top 100
Billerica	635	674	709	2,018	8
Chelmsford	696	742	727	2,165	6
Dracut	384	420	353	1,157	4
Dunstable	45	35	57	137	0
Lowell	3,250	3,427	3,423	10,100	71
Pepperell	173	165	219	557	0
Tewksbury	663	646	760	2,069	6
Tyngsborough	278	325	343	946	3
Westford	539	491	574	1,604	3

Source: MassDOT and Massachusetts Registry of Motor Vehicles data

Table 9.5 identifies the top high crash intersection location within each community for the 2014-2016 reporting period. The intersection of VFW Highway at Route 38 in Lowell, with 163 crashes and an EPDO of 347, ranked as the top high crash intersection. The NMMPO will continue to monitor this location, as safety upgrades are now complete. Locations in Dunstable and Pepperell are not listed in the Top 100 region or as a MassDOT HSIP cluster. Thus, there are no locations in either Town eligible for HSIP funding.

**Table 9.5: Highest Crash at Grade Intersection by Community, 2014-2016**

Community	Intersection	Total Crashes at Intersection	EPDO	Regional Rank
Billerica	Route 129 (Salem Road) at Pond Street	49	121	13
Chelmsford	Drum Hill Road at Parkhurst Road	37	82	31
Dracut	Lakeview Avenue at Mammoth Road	22	58	60
Dunstable	Route 113 (Main St) at Forest Street	3	15	309
Lowell	VFW Highway at Bridge Street	163	347	1
Pepperell	Groton Street at Mill Street	13	37	255
Tewksbury	Salem Street at South Street	50	98	19
Tyngsborough	Route 113 (Kendall Road) at Route 3A (Middlesex Road)	84	204	4
Westford	Route 110 (Littleton Road) at Boston Road	97	137	7

Source: MassDOT and Massachusetts Registry of Motor Vehicles data; EDPO analysis by NMMPO

Table 9.6 contains the Top 100 high crash intersection list for the region based on 2014-2016 data. Seventy-one percent (71%) of the intersections on the Top 100 list are located in the City of Lowell, including seven (7) of the top ten (10) crash locations. There were no intersections in the Town of Dunstable listed in the Top 100. Map 9.1 shows the location of each intersection listed in the Top 100, while Map 9.2 provides a more detail view of locations within the City of Lowell.

It should be noted that this data does not reflect the impact of improvements made since 2016. For example, safety upgrades made to the VFW Highway/Bridge Street intersection in Lowell were not complete until 2017, thus the data in this table reflects the previous roadway configuration.

**Table 9.6: Northern Middlesex Top 100 High Crash Intersection List (At Grade/Non Interchange) 2014-2016**

Regional Rank	Intersection	Community	Intersection Control	Total Crashes	Property Damage Only Crashes	Injury Crashes	Fatal Crashes	EPDO Score 2014-2016
1	VFW Highway at Bridge St	Lowell	Traffic Signal	163	117	46	0	<b>347</b>
2	Appleton St/Church St at Central St	Lowell	Traffic Signal	107	71	36	0	<b>251</b>
3	VFW Highway/Varnum Ave at School St/Mammoth Rd	Lowell	Traffic Signal	123	98	25	0	<b>223</b>
4	Rte 113 (Kendall Rd) at Rte 3A (Middlesex Rd)	Tyngsborough	Traffic Signal	84	54	30	0	<b>204</b>
5	Wood St at Middlesex St	Lowell	Traffic Signal	112	92	20	0	<b>192</b>
6	VFW Highway at Aiken St	Lowell	Traffic Signal	63	41	22	0	<b>151</b>
7	Rte 110 (Littleton Rd) at Boston Rd	Westford	Traffic Signal	97	87	10	0	<b>137</b>
8	Rte 38 (Main St) at Shawsheen St	Tewksbury	Traffic Signal	60	41	19	0	<b>136</b>
9	Rte 38 (Nesmith St) at Rte 133 (Andover St)	Lowell	Traffic Signal	73	58	15	0	<b>133</b>
10	Gorham St at Elm St/Highland St	Lowell	Traffic Signal	66	51	15	0	<b>126</b>
10	Plain St at Manufacturers St	Lowell	Stop	66	51	15	0	<b>126</b>
12	Broadway at Fletcher St	Lowell	Traffic Signal	50	32	18	0	<b>122</b>
13	Rte 129 (Salem Rd) at Pond St	Billerica	Stop	49	31	18	0	<b>121</b>
14	Dutton St at Fletcher St	Lowell	Traffic Signal	62	48	14	0	<b>118</b>
15	Gorham St at Appleton St	Lowell	Traffic Signal	41	24	17	0	<b>109</b>
16	VFW Highway at University Ave	Lowell	Traffic Signal	51	37	14	0	<b>107</b>
17	VFW Highway at Riverside St	Lowell	Stop	53	41	12	0	<b>101</b>
18	Rte 3A (Thorndike St) at Gallagher Terminal	Lowell	Traffic Signal	60	50	10	0	<b>100</b>
19	School St at Pawtucket St	Lowell	Traffic Signal	55	44	11	0	<b>99</b>

**Table 9.6: Northern Middlesex Top 100 High Crash Intersection List (At Grade/Non Interchange) 2014-2016**

Regional Rank	Intersection	Community	Intersection Control	Total Crashes	Property Damage Only Crashes	Injury Crashes	Fatal Crashes	EPDO Score 2014-2016
19	Appleton St at South St	Lowell	Stop	35	19	16	0	99
19	Salem St at South St	Tewksbury	Stop	50	38	12	0	98
19	School St at Branch St	Lowell	Traffic Signal	42	28	14	0	98
23	Rte 3A (Princeton St) at Wood St	Lowell	Traffic Signal	41	27	14	0	97
23	Rte 3A (Thorndike St) at YMCA Dr/Hale St	Lowell	Traffic Signal	57	47	10	0	97
25	Rte 110 (Chelmsford St) at Plain St/Powell St	Lowell	Traffic Signal	59	50	9	0	95
26	Rte 3A (Thorndike St) at Highland St	Lowell	Traffic Signal	54	44	10	0	94
27	Rte 3A (Westford St) at Wilder St	Lowell	All Way Stop	49	38	11	0	93
28	Rte 110 (Chelmsford St) at Rte 3A (Westford St)	Lowell	Traffic Signal	34	20	14	0	90
29	Andover Rd/Shawsheen St at Whipple Rd	Billerica/Tewksbury	Stop	36	23	13	0	88
30	Wood St at Rte 113 (Pawtucket Blvd)	Lowell	Traffic Signal	49	40	9	0	85
31	Drum Hill Rd at Parkhurst Rd	Chelmsford	Traffic Signal	37	27	9	1	82
32	Rte 110 (Chelmsford St) at Lincoln St	Lowell	Traffic Signal	45	36	9	0	81
33	Mammoth Rd at Fourth Ave	Lowell	Stop	42	33	9	0	78
33	Middlesex St at School St	Lowell	Traffic Signal	30	18	12	0	78
33	Rte 110 (Chelmsford St) at Stedman St	Chelmsford	Traffic Signal	30	18	12	0	78
36	Rte 110 (Chelmsford St) at Stevens St/Industrial Ave	Lowell	Traffic Signal	41	32	9	0	77
37	Rte 38 (Main St) at Astle St/Pike St/Veranda Ave	Tewksbury	Traffic Signal	35	25	10	0	75
37	Rte 38 (Nesmith St) at East Merrimack St	Lowell	Traffic Signal	47	40	7	0	75
39	Rte 113 (Riverside St) at University Ave	Lowell	Traffic Signal	46	39	7	0	74

**Table 9.6: Northern Middlesex Top 100 High Crash Intersection List (At Grade/Non Interchange) 2014-2016**

Regional Rank	Intersection	Community	Intersection Control	Total Crashes	Property Damage Only Crashes	Injury Crashes	Fatal Crashes	EPDO Score 2014-2016
40	Central St at Warren St	Lowell	Stop	48	42	6	0	<b>72</b>
41	Central St at Middlesex St/Green St	Lowell	Traffic Signal	46	40	6	0	<b>70</b>
41	East Merrimack St at High St	Lowell	Stop	42	35	7	0	<b>70</b>
43	Wood St at Westford St	Lowell	Traffic Signal	37	29	8	0	<b>69</b>
44	Bridge St/Prescott St at Merrimack St (Kearney Square)	Lowell	Traffic Signal	42	36	6	0	<b>66</b>
44	Westford St at Stedman St	Lowell	Stop	30	21	9	0	<b>66</b>
44	Rte 3A (Boston Rd) at Treble Cove Rd	Billerica	Traffic Signal	34	26	8	0	<b>66</b>
47	Church St at Lawrence St	Lowell	Stop	36	29	7	0	<b>64</b>
47	Rte 3A (Westford St) at School St	Lowell	Traffic Signal	32	24	8	0	<b>64</b>
47	Dutton St at Broadway St	Lowell	Traffic Signal	32	24	8	0	<b>64</b>
47	Route 113 (Riverside St) at Sparks St	Lowell	Stop	28	19	9	0	<b>64</b>
47	Central St at Market St	Lowell	Traffic Signal	32	24	8	0	<b>64</b>
52	Route 38 (Main St) at Capitol Ave	Tewksbury	Stop	27	18	9	0	<b>63</b>
52	Rte 3A (Princeton St) at Baldwin St	Lowell	Traffic Signal	23	13	10	0	<b>63</b>
52	Rte 3A (Westford St) at Stevens St	Lowell	Traffic Signal	27	18	9	0	<b>63</b>
55	Lakeview Ave at Aiken St	Lowell	Traffic Signal	34	27	7	0	<b>62</b>
56	Fletcher St at Cross St	Lowell	Stop	29	21	8	0	<b>61</b>
56	Lawrence St at Rogers St	Lowell	Traffic Signal	25	16	9	0	<b>61</b>
58	Andover St at High St	Lowell	Traffic Signal	36	30	6	0	<b>60</b>
59	Fletcher St at Bowers St	Lowell	Stop	31	24	7	0	<b>59</b>
60	Lakeview Ave at Mammoth Rd	Dracut	Traffic Signal	22	13	9	0	<b>58</b>
60	Rte 38 (Bridge St) at Rte 113 (Arlington St)	Dracut	Traffic Signal	25	18	6	1	<b>58</b>

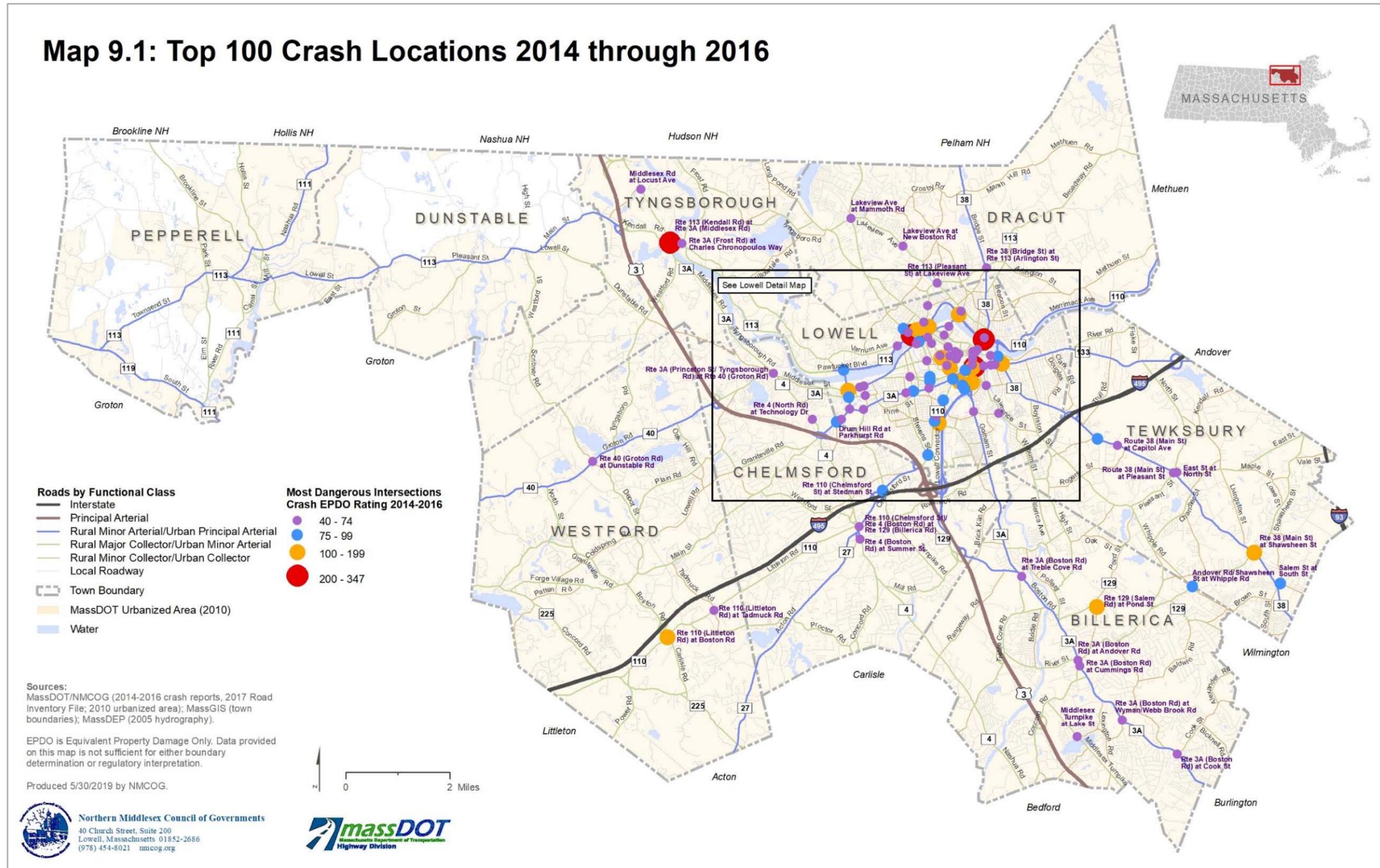
**Table 9.6: Northern Middlesex Top 100 High Crash Intersection List (At Grade/Non Interchange) 2014-2016**

Regional Rank	Intersection	Community	Intersection Control	Total Crashes	Property Damage Only Crashes	Injury Crashes	Fatal Crashes	EPDO Score 2014-2016
60	Rte 3A (Boston Rd) at Cook St	Billerica	Traffic Signal	22	13	9	0	58
63	Bridge St at French St	Lowell	Traffic Signal	33	27	6	0	57
64	Middlesex St at Wilder St	Lowell	All Way Stop	31	25	6	0	55
64	Rte 113 (Pawtucket Blvd) at Varnum Ave	Lowell	Traffic Signal	23	15	8	0	55
64	Dutton St at Market St	Lowell	Traffic Signal	31	25	6	0	55
67	Broadway at School St	Lowell	Traffic Signal	34	29	5	0	54
67	East St at North St	Tewksbury	Stop	26	19	7	0	54
69	Father Morissette Boulevard at Aiken St	Lowell	Traffic Signal	29	23	6	0	53
69	Rte 110 (Chelmsford St) at Parker St	Lowell	Stop	29	23	6	0	53
71	Rte 3A (Boston Rd) at Cummings Rd	Billerica	Traffic Signal	36	32	4	0	52
71	Rte 4 (North Rd) at Technology Dr	Chelmsford	Traffic Signal	16	7	9	0	52
73	Rte 113 (Pleasant St) at Lakeview Ave	Dracut	Traffic Signal	31	26	5	0	51
73	Route 38 (Main St) at Pleasant St	Tewksbury	Traffic Signal	19	11	8	0	51
73	Rte 38 (Bridge St) at Second St	Lowell	Stop	39	36	3	0	51
73	Rte 110 (Littleton Rd) at Tadmuck Rd	Westford	Stop	27	21	6	0	51
77	Pawtucket St at Fletcher St	Lowell	Stop	38	35	3	0	50
77	Rte 110 (Chelmsford St)/Rte 4 (Boston Rd) at Rte 129 (Billerica Rd)	Chelmsford	Traffic Signal	22	15	7	0	50
77	Mammoth Rd at Second Ave	Lowell	Stop	34	30	4	0	50
80	Rte 3A (Princeton St/ Tyngsborough Rd) at Rte 40 (Groton Rd)	Chelmsford	Traffic Signal	17	9	8	0	49
80	Lawrence St at Moore St	Lowell	Stop	21	14	7	0	49
82	Rte 3A (Gorham St) at Moore/Dix St	Lowell	Traffic Signal	36	33	3	0	48

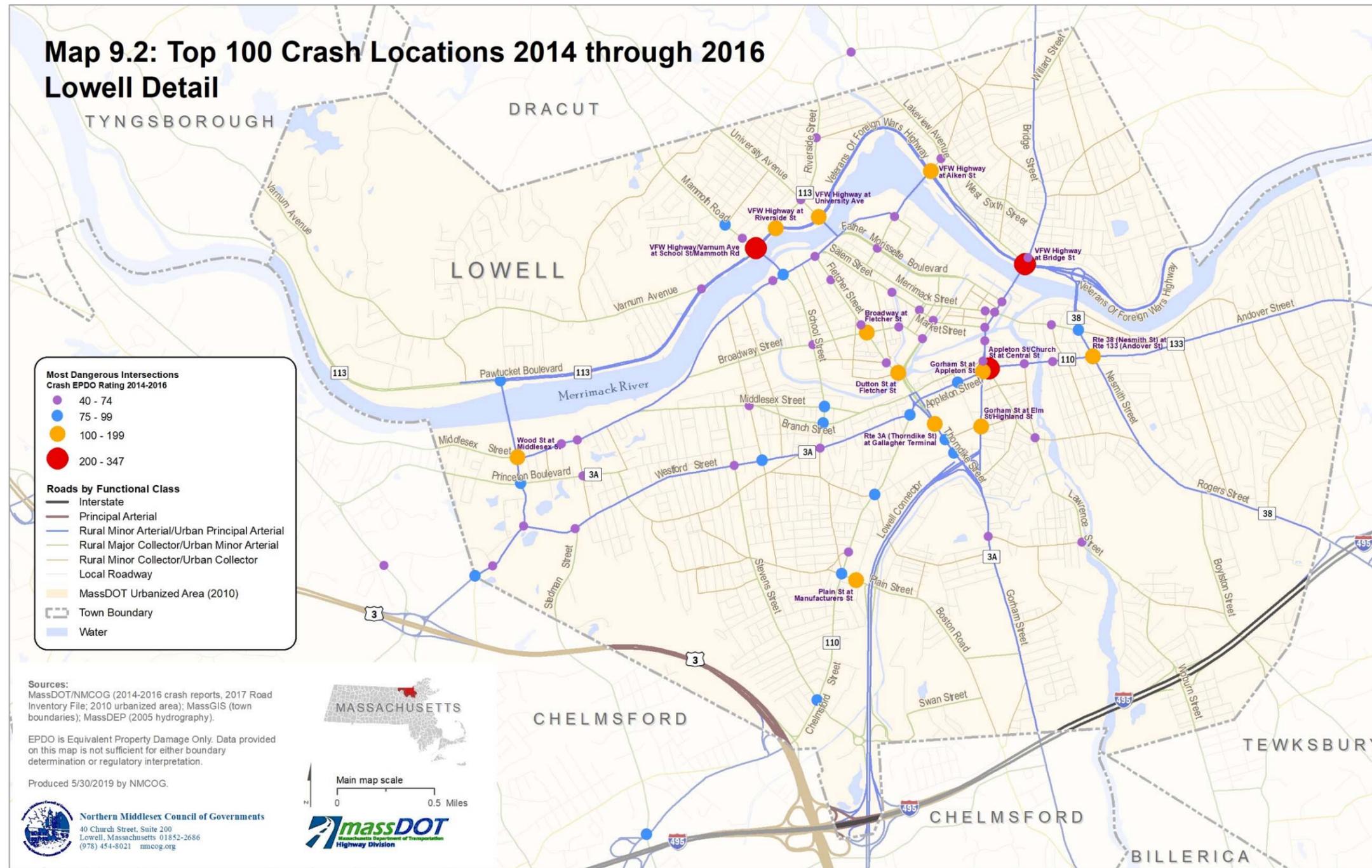
**Table 9.6: Northern Middlesex Top 100 High Crash Intersection List (At Grade/Non Interchange) 2014-2016**

Regional Rank	Intersection	Community	Intersection Control	Total Crashes	Property Damage Only Crashes	Injury Crashes	Fatal Crashes	EPDO Score 2014-2016
82	Rte 3A (Boston Rd) at Andover Rd	Billerica	Traffic Signal	24	18	6	0	48
82	Fletcher St at Rock St/Suffolk St	Lowell	Traffic Signal	24	18	6	0	48
85	Middlesex St at Baldwin St	Lowell	Stop	23	17	6	0	47
86	Andover St at Concord St	Lowell	Stop	26	21	5	0	46
86	Pawtucket St at Wannalancit St	Lowell	Stop	18	11	7	0	46
86	Merrimack St at Central St	Lowell	Traffic Signal	22	16	6	0	46
89	Rte 3A (Boston Rd) at Wyman/Webb Brook Rd	Billerica	Traffic Signal	29	25	4	0	45
89	Rte 40 (Groton Rd) at Dunstable Rd	Westford	Stop	29	25	4	0	45
91	Westford St at Technology Dr	Lowell	Stop	32	29	3	0	44
91	Broadway at Suffolk St	Lowell	Stop	20	14	6	0	44
91	Market St at Dummer St	Lowell	Stop	16	9	7	0	44
91	Market St at Suffolk St	Lowell	Stop	16	9	7	0	44
91	Rte 4 (Boston Rd) at Summer St	Chelmsford	Stop	20	14	6	0	44
96	Middlesex St at Pratt Ave	Lowell	Stop	11	3	8	0	43
96	Middlesex Rd at Locust Ave	Tyngsborough	Traffic Signal	27	23	4	0	43
96	Aiken St at Perkins St	Lowell	Stop	19	13	6	0	43
96	Middlesex Turnpike at Lake St	Billerica	Stop	19	13	6	0	43
96	Lakeview Ave at New Boston Rd	Dracut	Stop	15	8	7	0	43
96	Rte 3A (Frost Rd) at Charles Chronopoulos Way	Tyngsborough	Traffic Signal	19	13	6	0	43

**Map 9.1: Top 100 Crash Locations 2014 through 2016**



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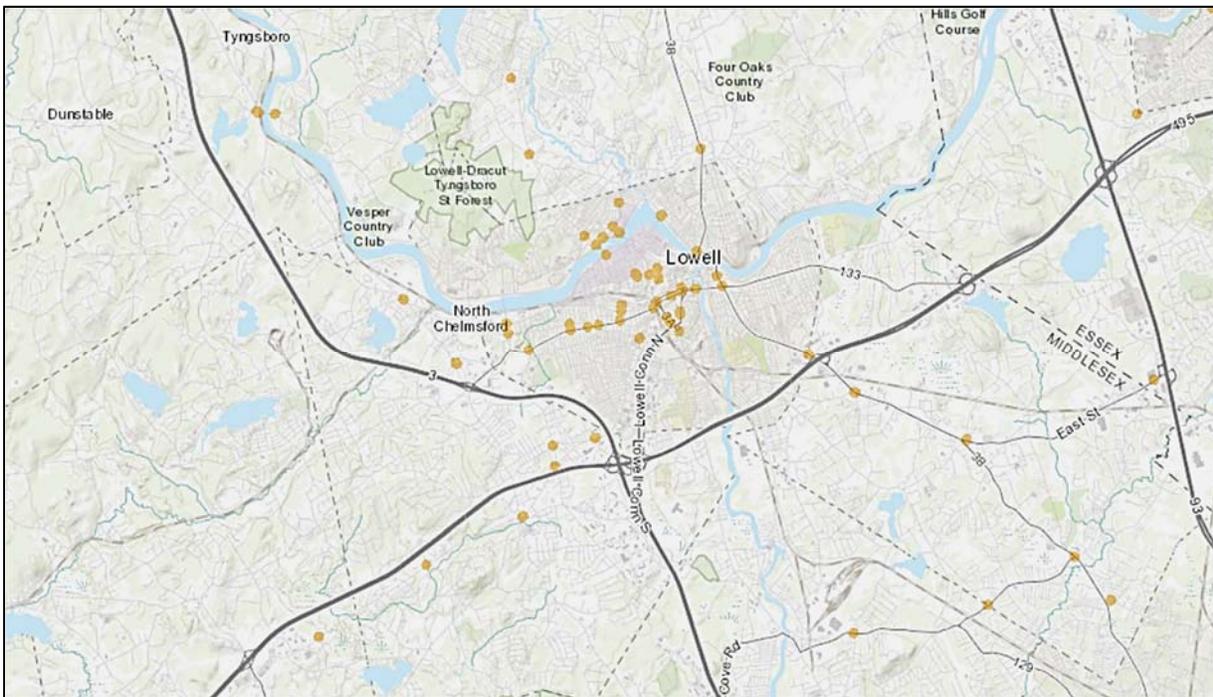


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## MASSDOT'S HIGH CRASH CLUSTER METHOD FOR DETERMINING HSIP FUNDING ELIGIBILITY

MassDOT maintains an interactive map displaying the vehicular crash locations throughout the entire Commonwealth. The map is used by MassDOT to identify locations that are eligible for Federal assistance through the Highway Safety Improvement Program (HSIP). An HSIP-eligible location is a “crash cluster” that ranks within the top 5% within each region, based on a combination of factors, including crash incidence and severity. According to the MassDOT *2016 Top Crash Locations Report*, crash clusters are determined using a 25-meter (82-foot) fixed search distance around each crash and merging nearby crashes together to create clusters. Map 9.3 displays the crash clusters throughout the Northern Middlesex region. These locations are eligible for Highway Safety Improvement Program funding through the Northern Middlesex Transportation Improvement Program.

**Map 9.3: Regional HSIP Crash Clusters**



Source: MassDOT

MassDOT maintains a “Top 200” list of high crash locations around the Commonwealth. There are thirteen locations shown in the rankings that lie within the Northern Middlesex region, as presented in Table 9.7. Each of these locations is also listed in the regional Top 100, and is eligible for HSIP funding.

**Table 9.7: Northern Middlesex Regional Locations in MassDOT "Top 200" List, 2014-2016**

Intersection	Community	Intersection Control
VFW Highway at Bridge St	Lowell	Traffic Signal
Appleton St/Church St at Central St	Lowell	Traffic Signal
VFW Highway/Varnum Ave at School St/Mammoth Rd	Lowell	Traffic Signal
Rte 113 (Kendall Rd) at Rte 3A (Middlesex Rd)	Tyngsborough	Traffic Signal
VFW Highway at Aiken St	Lowell	Traffic Signal
Rte 38 (Nesmith St) at Rte 133 (Andover St)	Lowell	Traffic Signal
Gorham St at Elm St/Highland St	Lowell	Traffic Signal
Rte 129 (Salem Rd) at Pond St	Billerica	Stop
Gorham St at Appleton St	Lowell	Traffic Signal
Salem St at South St	Tewksbury	Stop
School St at Branch St	Lowell	Traffic Signal
Andover Rd/Shawsheen St at Whipple Rd	Billerica/Tewksbury	Stop
Central St at Middlesex St/Green St	Lowell	Traffic Signal

Source: MassDOT

## ROADWAY SAFETY AUDITS ROLE IN HSIP FUNDING DETERMINATION

The Federal Highway Administration (FHWA) defines a Road Safety Audit (RSA) as the formal safety examination of an existing or future road or intersection by an independent, multidisciplinary team. The purpose of an RSA is to identify potential safety issues and possible opportunities for safety improvements considering all roadway users. The RSA program was implemented in 2007, in accordance with the Commonwealth's role as a Lead State in preventing lane departure crashes, in conjunction with the SHSP. Since then, RSAs have become an integral part of the HSIP program in Massachusetts and the region.

HSIP guidelines state that "all HSIP candidate locations will require an accompanying RSA report, or an engineering or planning report to determine eligibility." Thus, the RSA program has expanded to encompass any location in the State identified as a high crash location. Additionally, if all or a portion of a project area is considered HSIP-eligible, an RSA must be conducted prior to submitting 25% design plans. The RSAs described in Table 9.8 on the following page resulted in improvement projects that are programmed into the NMMPO TIP, under construction, or are complete.

**Table 9.8: Road Safety Audits in the Northern Middlesex Region**

RSA Location	RSA Completion Date	Project Status
US Route 3 in Billerica and Chelmsford	2007	Construction Complete
Intersection of VFW Highway and Bridge Street in Lowell	2007	Construction Complete
VFW Highway Corridor in Lowell	2010	RTP Project recommendation FFY 2025-2029; Preliminary Design
Route 38 in Lowell	2010	Advertised for Construction 2018.
East Street at Livingston Street in Tewksbury	2011	Construction complete
Boston Road at Route 110 in Westford	2011	Construction complete
East Street/Dascomb Road at Shawsheen Street in Tewksbury	2011	Construction Complete
Route 40 at Oak Hill Road in Westford	2013	Construction Underway
Forge Village Road at Cold Spring Road in Westford	2014	Planning study underway by Town of Westford
Route 40 at Dunstable Road in Westford	2014	Construction Underway
Route 3A and Charnstaffe Lane in Billerica	2014	Construction Complete
Lowell Connector at Gorham Street in Lowell	2016	RTP Project recommendation FFY 2025-2029; Preliminary Design
Route 225 and Carlisle, Griffin Road in Westford	2016	Town response to residents complaining of cut through traffic.
Pawtucket Boulevard at Wood Street (Rourke Bridge)	2017	Improvements made in conjunction with Rourke Bridge Replacement project
Bridge Street in Lowell	2017	In conjunction with City resurfacing project between VFW Highway and Sixth Street.
Church Street in Lowell	2018	RTP Project Recommendation FFY 2025-2029. Preliminary Design
South/Salem/Main Street in Tewksbury	2018	Scheduled to be advertised for Construction July 2019
Route 38 in Tewksbury	2018	Programmed on TIP for Construction in FFY 2023
University Avenue in Lowell	2019	RTP Universe of Projects

## ROADWAY SAFETY ISSUES AND OPPORTUNITIES

NMMPO staff continues to study high crash locations in greater detail as part of the traffic safety program. In addition to work carried out at the regional level, local highway department personnel should be trained to collect information in the following areas, which can be utilized to make maintenance decisions and prioritize safety projects:

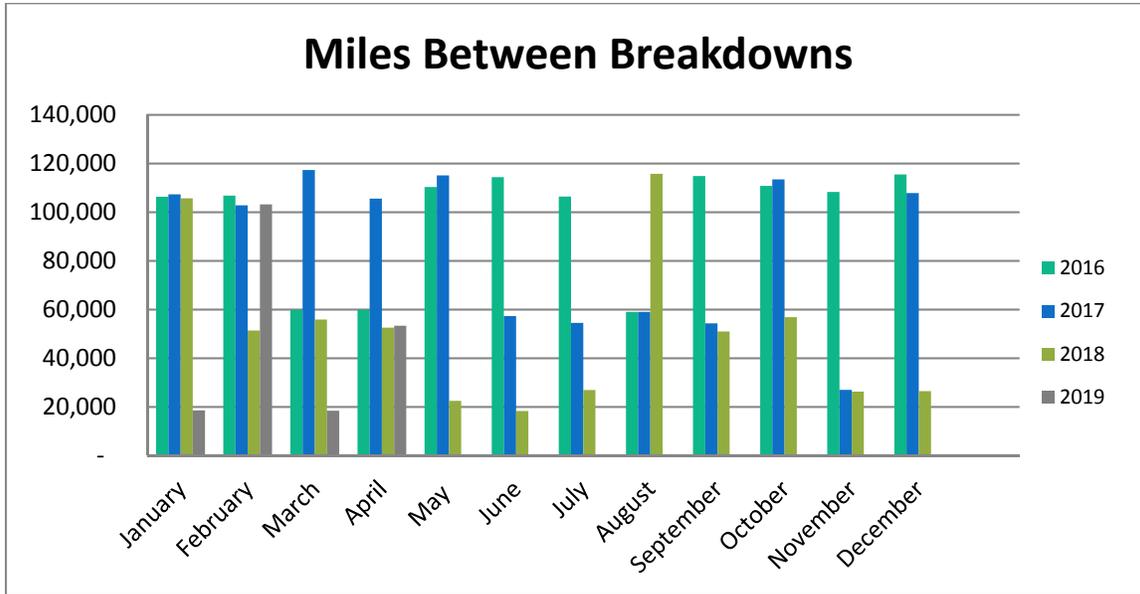
- Identify and report hazardous shoulder drop-offs;
- Identify and report vegetation in highway rights-of-way, such as brush and shrubs that limit motorist sight distances;
- Identify and report degraded signs and pavement markings;
- Identify and report damaged, missing, or obsolete safety hardware such as guard rail or attenuation barriers;
- Establish priorities and response times for inspecting, repairing, upgrading or replacing damaged hardware;
- Develop temporary or emergency actions to mitigate the effects of damaged hardware; and
- Provide and implement work zone traffic control plans.

## TRANSIT SAFETY AND SECURITY FOR THE LRTA SYSTEM

The Lowell Regional Transit Authority (LRTA) is focused on providing safe public transportation systems and facilities for its riders and users. For the riding public, the LRTA maintains one of the newest bus fleets in the State. Vehicle maintenance is a priority and the addition of low-floor buses makes the service comfortable for senior and disabled passengers, while eliminating most of the mechanical problems associated with lifts for individuals with disabilities. Additionally, the vehicles are equipped with on-board video surveillance for added safety and security.

Figure 9.7 compares the total vehicle miles travelled between major mechanical failures for the LRTA fixed route bus system for 2016 and 2019. The figure shows that reliability and safety have increased since 2016, as vehicle miles between breakdowns generally decreased through the monitored years. .

Figure 9.7: Vehicle Miles Traveled between LRTA Bus Major Mechanical Failures



Source: LRTA

All of the LRTA fixed route and demand response vehicles are equipped with video and audio surveillance equipment, which records all activity in and around the vehicles. LRTA will continue to work with the state transportation and public safety agencies in this regard. The LRTA examined ITS technologies and continues to implement several systems that will improve security, as well as result in cost efficiencies and improved customer service. ITS strategies that have either already been implemented or are currently being implemented include computer aided dispatch (CAD), automatic vehicle location (AVL), automatic passenger counts (APC) and automatic voice annunciations (AVA). Additionally, variable message signs, interactive voice response telephone systems, and traffic signal priority for transit vehicles are being reviewed for future funding.

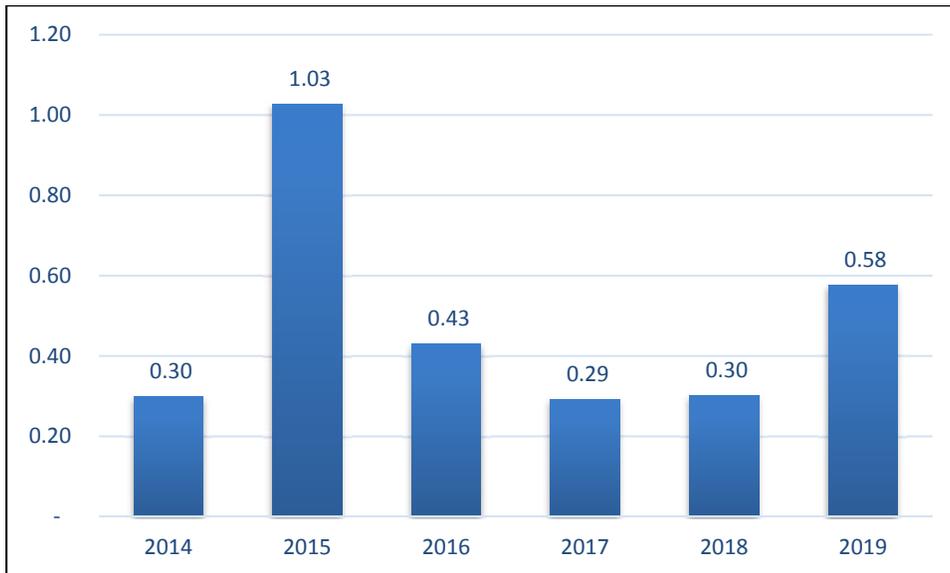
The LRTA is working to implement the Department of Transportation’s stated goal to “identify (the) technological and operational means of enhancing the security of public surface transportation systems and facilities against crime and malicious attacks.” As part of ongoing regional security efforts, the LRTA is a member of the Greater Lowell Emergency Planning Committee and participates in Seabrook Nuclear Power Station evacuation plans.

The LRTA provides 24-hour security at the Charles A. Gallagher Intermodal Transportation Center (ITC), the main intermodal transportation facility under its jurisdiction. In recent years, security patrols have increased significantly during daylight hours to thwart car thieves and vandals, monitor any suspicious activity, and to allow security personnel to do maintenance and landscaping duties around the ITC.

Surveillance cameras have been upgraded, providing greater security for both LRTA and MBTA passengers. The Lowell Police Department is constructing a substation in the adjacent multiuse facility in the event of a safety or security incident. The MBTA, PanAm Railways, and the State Police also provide response services. The facility has recently undergone significant renovations to the parking decks, eliminating potholes that were dangerous to drivers and pedestrians alike.

LRTA tracks preventable accidents per 100,000 miles as a safety performance measure. The National Safety Council defines a preventable accident as “one in which the driver failed to do everything that they reasonably could have done to avoid the accident”. Figure 9.8 shows preventable accident data for the LRTA from 2014-2019. In general, preventable accidents occur more often during the winter months, when city streets are narrowed by the snow banks and cars are parked further into the roadway than is the case during the spring, summer and fall. In 2015, the severity of the winter season led to a higher than typical accident rate. Transit system security statistics are reported annually to the Federal Transit Administration through the National Transit Database submission and to the State through the Black-Cat reporting system.

**Figure 9.8: LRTA Fixed Route Service - Preventable Accident Rate per 100,000 miles**



Source: LRTA

The City of Lowell, in cooperation with the Lowell Regional Transit Authority, has improved pedestrian access to the Gallagher ITC with the installation of new sidewalks, crosswalks and signage along Thorndike Street (Route 3A). The improved access enables better pedestrian connections between the intermodal center, the Hamilton Canal District and the City’s Central Business District.

The North Billerica Commuter Rail Station is maintained by the Lowell Regional Transit Authority. The LRTA has upgraded the lighting at the facility in order to improve safety and security. Additionally, an LRTA security employee is on site at the train station during regular business hours.

Both McDonald Transit Associates, Inc., the management entity for the LRTA fixed route bus system, and MV Transportation, Inc., the contractor for the LRTA paratransit services, provide driver safety and security training for LRTA employees. These safety trainings range from Safe Driver and Terrorism Awareness courses to Passenger Sensitivity courses.

### RAIL GRADE CROSSING SAFETY

In Massachusetts, there are 1,431 highway-rail grade crossings with 835 active crossings on public roads. Safety at railroad grade crossings is a major priority for the railroad industry. From 2011 to 2017, 11 people were killed from crashes occurring at highway-rail grade crossings in Massachusetts. North America's freight railroads are founding sponsors of Operation Lifesaver, a national non-profit education and awareness program dedicated to ending tragic collisions, fatalities and injuries at highway-rail grade crossings and rights of way. Individual railroads each have active programs to help prevent grade crossing accidents by working with state departments of transportation to close as many grade crossings as possible, install active warning devices, and engage community leaders, schools and law enforcement in grade crossing safety programs.

The Massachusetts Department of Public Utilities (DPU) has responsibility and regulatory authority for grade crossing safety at all public highway-railroad grade crossings. Federal funds are available under Section 130 of the federal surface transportation law to assist in eliminating or mitigating hazards at public highway-railroad grade crossings. MassDOT Highway Division administers these funds and works with the railroads and communities to identify and construct priority projects.

The MassDOT Freight Program focuses on improving safety at existing highway-railroad grade crossings primarily through the installation of warning devices. Such devices include: standard signs and pavement markings; installation or replacement of active warning devices (flashers and gates); upgrading active warning devices, including track circuitry improvements and interconnections with highway traffic signals; crossing illumination; crossing surface improvements; and general site improvements. The at-grade crossings are distributed across the region as displayed in Table 9.9.

**Table 9.9: At-Grade Railroad Crossings in the Northern Middlesex Region**

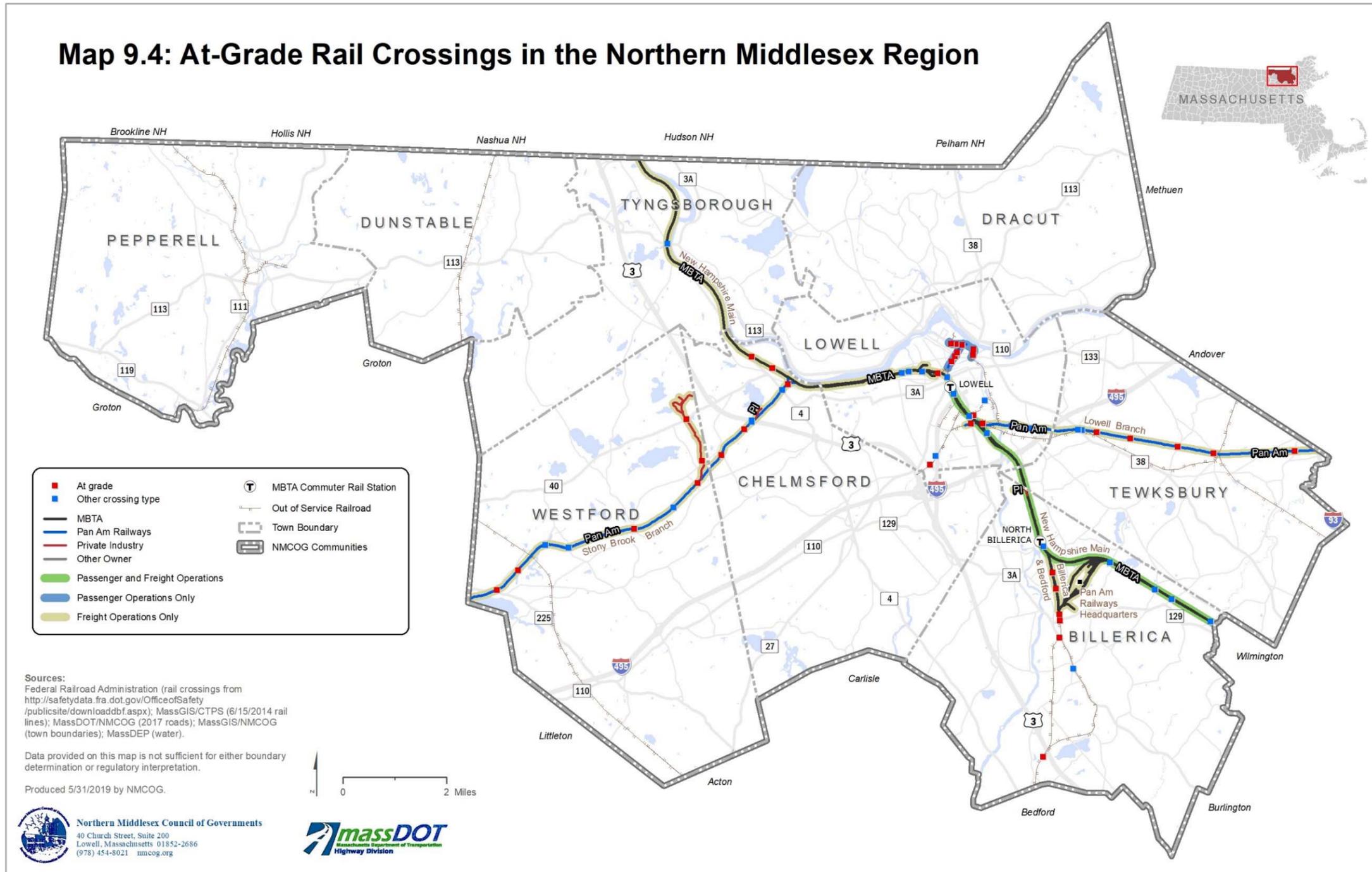
Community	Number of At-Grade Crossings	Percentage of At-Grade Crossings
Billerica	11	13%
Chelmsford	15	18%
Lowell	33	39%
Tewksbury	10	12%
Tyngsborough	5	6%
Westford	10	12%
<b>Total</b>	<b>84</b>	<b>100%</b>

Source: Federal Railroad Association, Office of Safety Analysis

Lowell contains the largest number (33) of at-grade railroad crossings. Maps 9.5 and 9.6 display the at-grade railroad crossings in the Northern Middlesex region.

The Federal Railroad Association (FRA) data reports that between 2015 and 2018, there were two highway rail accidents in the Northern Middlesex region, none involving motor vehicles or pedestrians and no reported injuries.

### Map 9.4: At-Grade Rail Crossings in the Northern Middlesex Region



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The safest option for addressing highway-rail grade crossing issues is to eliminate the crossings through grade separation. However, this option may be too costly to be practical. It has been the policy of Massachusetts transportation officials to reduce, whenever possible, the number of highway-railroad grade crossings on public roadways. Maintenance and repair of highway-railroad grade crossing warning device equipment is the responsibility of the railroad owner. The FRA has established minimum inspection requirements for railroad maintenance of warning systems, and each operating railroad is responsible for inspecting crossing system signals and equipment.

## BICYCLE AND PEDESTRIAN SAFETY

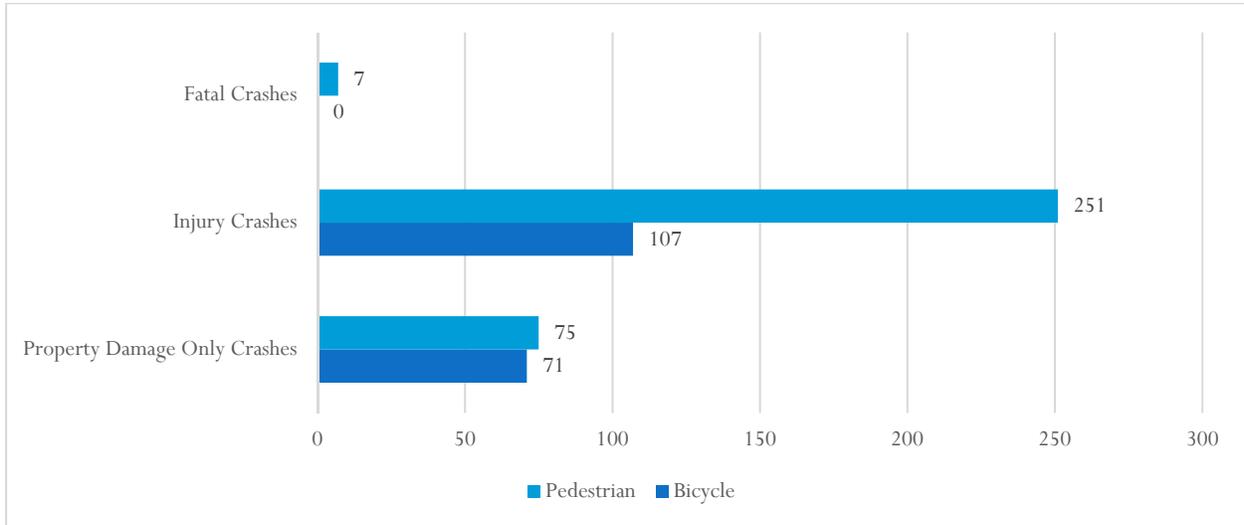
According to FHWA, each year bicycle and pedestrian fatalities comprise about 16 percent of all traffic fatalities and there are approximately 5,000 pedestrian and 800 bicyclist deaths. Another 65,000 pedestrians and 48,000 bicyclists are injured in roadway crashes annually.<sup>1</sup> It is important that the planning, design, operation and maintenance of transportation facilities consider the needs of bicyclists and pedestrians. MassDOT Directive E-98-003, which was adopted in 1998, requires that design engineers use sound engineering practices in making reasonable provisions for the accommodation of bicycles and pedestrians in project design.

Between 2014 and 2016, there were a total of 355 crashes involving pedestrians and 190 crashes involving bicyclists within the Northern Middlesex region. Of the pedestrian crashes, 251 or 71% resulted in injury and seven (7) were reported fatal. There were 107 injury-related bicycle crashes (56%) with no reported fatal crashes between 2014 and 2016. Figure 9.9 shows the number of pedestrian and bicycle crashes based on severity.

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<sup>1</sup> [http://safety.fhwa.dot.gov/ped\\_bike/](http://safety.fhwa.dot.gov/ped_bike/)

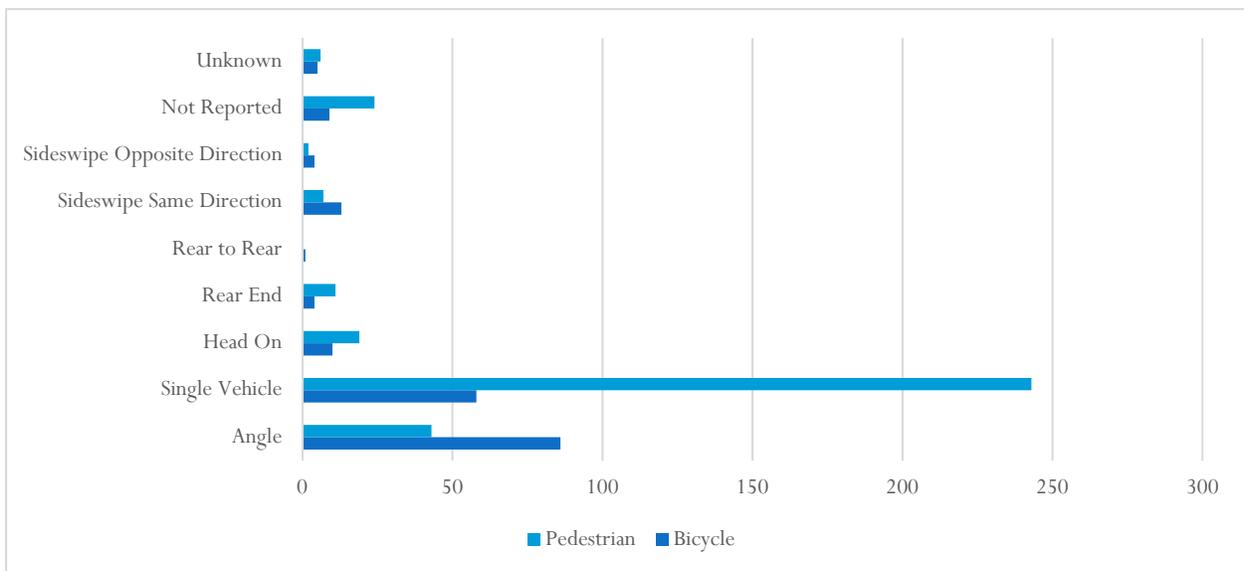
**Figure 9.9: Number of Bicycle and Pedestrian Crashes in the Region by Severity, 2014-2016**



Source: MassDOT and RMV Crash Database

Figure 9.10 indicates that in the Northern Middlesex region the most common type of crash involving pedestrians involved a single-vehicle incident with a pedestrian. The most common bicycle related crash was an angle incident.

**Figure 9.10: Number of Bicycle and Pedestrian Crashes by Type of Collision, 2014-2016**



Source: MassDOT and RMV Crash Database

**Table 9.10: Motor Vehicle Crashes Involving Pedestrians by Community, 2014 – 2016**

Community	Total Crashes	Property Damage Only Crashes	Injury Crashes	Fatal Crashes	Not Reported/Unknown
Billerica	15	4	9	2	0
Chelmsford	20	1	18	1	0
Dracut	11	0	11	0	0
Dunstable	0	0	0	0	0
Lowell	265	58	183	2	22
Pepperell	5	0	5	0	0
Tewksbury	26	5	20	1	0
Tyngsborough	4	1	2	1	0
Westford	9	6	3	0	0
<b>Total</b>	<b>355</b>	<b>75</b>	<b>251</b>	<b>7</b>	<b>22</b>

Source: MassDOT and the Massachusetts Registry of Motor Vehicles

Tables 9.10 above and 9.11 below summarize pedestrian and bicycle accident statistics by community for the years 2014 through 2016. The City of Lowell had the highest incidence of pedestrian and bicycle-related crashes in the region, accounting for 75% of all pedestrian crashes and 73% of all bicycle crashes.

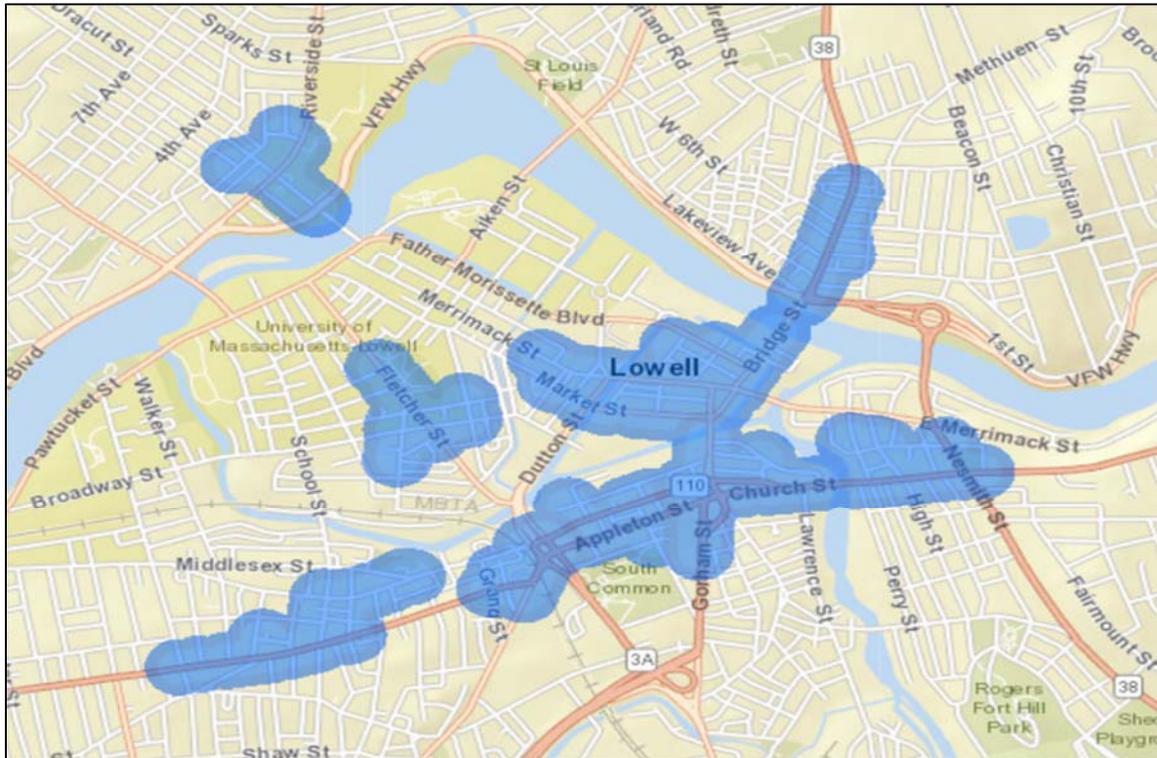
**Table 9.11: Motor Vehicle Crashes Involving Bicyclists by Community, 2014 – 2016**

Community	Total Crashes	Property Damage Only Crashes	Injury Crashes	Fatal Crashes	Not Reported/Unknown
Billerica	15	6	9	0	0
Chelmsford	6	0	6	0	0
Dracut	8	3	5	0	0
Dunstable	1	0	1	0	0
Lowell	138	57	69	0	12
Pepperell	2	1	1	0	0
Tewksbury	10	2	8	0	0
Tyngsborough	3	2	1	0	0
Westford	7	0	7	0	0
<b>Total</b>	<b>190</b>	<b>71</b>	<b>107</b>	<b>0</b>	<b>12</b>

Source: MassDOT and the Massachusetts Registry of Motor Vehicles

Map 9.6 and Table 9.12 detail pedestrian related “crash clusters” for 2007-2016, as identified by MassDOT. Improvements at these locations are eligible for HSIP funding. All of the “crash clusters” are located within the City of Lowell.

Map 9.6: Pedestrian HSIP Crash Clusters, 2007-2016



Source: MassDOT

Table 9.12: Pedestrian Related HSIP “Crash Clusters” in Lowell, 2007-2016

Location	Total Crashes	Cluster Pedestrian EPDO	Fatal Crashes	Injury Crashes	Property Only Crashes
Merrimack Street/Central Street	98	326	8	39	51
Appleton Street/Central Street	62	219	1	37	24
Andover Street/High Street	45	140	3	17	25
Bridge Street/VFW Highway	43	190	3	30	10
Westford Street/Pine Street	39	149	2	23	14
Lord Overpass/Thorndike Street	29	120	3	16	10
University Avenue/Riverside Street	26	106	4	11	11
Fletcher Street/Broadway Street	24	99	3	12	9
Middlesex Street/South Street	23	100	5	8	10

Source: MassDOT

Map 9.7 and Table 9.13 on the following page detail bicycle-related “crash clusters” for 2007 through 2016, as identified by MassDOT. Improvements at these locations are eligible for HSIP funding. All of the “crash clusters” are located within the City of Lowell.

**Map 9.7: Bicycle HSIP Clusters in the Northern Middlesex Region, 2007-2016**



Source: MassDOT

**Table 9.13: Bicycle Related HSIP “Crash Clusters” in Lowell, 2007-2016**

Location	Total Crashes	Cluster Bicycle EPDO	Fatal Crashes	Injury Crashes	Property Only Crashes
Bridge Street/VFW Highway	24	106	2	16	6
Merrimack Street/John Street	16	57	1	8	7
Lord Overpass/Thorndike Street	15	43	0	7	8
Gorham Street/Thorndike Street	14	42	0	7	7
Middlesex Street/Jackson Street	12	53	1	8	3
Central Street/Gorham Street	11	48	1	7	3

Source: MassDOT

According to the above MassDOT data, there are multiple pedestrian- and bicycle-related “crash clusters” identified within the City of Lowell. Analysis indicates several locations where both pedestrian and bicycle safety should be emphasized. The Bridge Street-Market Street-Central Street-Merrimack Street and the Bridge Street-VFW Highway clusters deserve particular attention based on their cluster EPDOs.

## SECURITY OF THE TRANSPORTATION SYSTEM

There are many important transportation assets that are potentially vulnerable to security threats, including components of the transit, highway and intermodal freight system. Emergency response procedures are built largely from natural disasters and experience in responding to special disasters, such as the attacks of 9/11 and the Boston Marathon bombing. The response to terrorism occurs at many levels of government including local, regional, state and federal. Immediately after the terrorists’ attacks on September 11, 2001, travel experience and behavior was forever altered. Transportation officials continue to evaluate ways to include security measures into the planning, design, implementation and operation of transportation facilities and services.

One of the most important lessons learned from past incidents is that effective and reliable communication among all levels of government is essential in responding to such disasters. Key agencies must work together to protect critical transportation assets, such as bridges and highway interchanges, enhance the region’s traffic management capabilities and improve emergency response.

Terrorists’ objectives are assumed to be focused upon political, economic, or social disruption of our society through destruction and public demoralization. Transportation facilities could be targeted for

attack, which would play a vital role in disaster response. Terrorists tend to select targets with symbolic value, with a history of targeting transportation vehicles, such as buses and trains, with explosives or gunfire. The tactics of terrorists continue to evolve, from isolated bombings to coordinated acts that create massive casualties. The World Trade Center attacks, as well as the attacks on Madrid's Commuter Rail system and London's Underground Subway systems are a few notable examples.

Transit and rail systems are regarded by law enforcement officials to be more likely terrorist targets than highway structures. Terrorist threats to the transportation system could include:

- Structural/functional damages from explosives or fire;
- Casualties from explosion or fire;
- Facility or system shut down due to exposure or contamination from biological, radiological or chemical weapons;
- Collateral damage to other services or infrastructure such as telecommunications, power and pipelines carried along roadways or bridges.

The Northern Middlesex Council of Governments worked with the Federal Emergency Management Agency (FEMA), Massachusetts Emergency Management Agency (MEMA) and the Massachusetts Department of Conservation and Recreation to develop a Regional Hazard Mitigation Plan to identify disaster risks and develop strategies for mitigation. The Plan focuses primarily on natural hazards, although it does address non-natural hazards as well. While the cause of a disaster may differ, there are many similarities in emergency response to natural disasters and acts of terrorism.

NMCOG implemented a "Pre-Disaster Mitigation Plan" for the region in 2006, which was revised and updated in 2015 and approved by FEMA. The plan outlines actions that could be taken to reduce the impacts of a natural disaster when and if they were to occur. Many of these mitigation measures would also help reduce the impacts of a possible terrorist attack. This plan could be modified to include additional supporting emergency operations plans for responding to security threats and incidents. In either a natural disaster or terrorism related event, the transportation network will be called upon to accommodate the following functions:

- Evacuate the population in the area of the event;
- Provide emergency access to the site of the incident;
- Allow the public to bypass the affected area; and
- Respond to the impacts of restrictions to access in the affected area.

NMCOG assisted the Northeast Homeland Security Council in updating the Regional Homeland Security Plan, which included work in identifying critical infrastructure and evacuation routes within each community. As the refined emergency management plans continue to be developed, the Regional Transportation Plan may be amended to reflect identified priorities.

## FREIGHT SECURITY ISSUES

In the past, concerns about security relative to the freight industry focused primarily on theft and contraband. The use of commercial aircraft in the attacks of September 11th and the more recent attempts to hide explosives inside planes changed that. The focus is now increasingly on preventing terrorism and enhancing security while keeping freight moving.

Several freight security priorities have emerged over the past several years. Containers used for shipping cargo in international trade are of the highest priority. Domestically, major attention is paid to hazardous material transport, which utilizes highways and railroads primarily. The Hazardous Waste Common Carrier Agreement, which was created by the Interstate Commerce Commission (now the Surface Transportation Board), the U.S. Department of Transportation, the Nuclear Regulatory Commission, and other sources, ensures that rail operators do not refuse hazardous materials for transport. The requirement, which covers radioactive and hazardous waste transported through heavily populated areas, creates considerable security concerns for those communities located along rail lines.

Information concerning the ownership and integrity of containers is vital to improving security. Federal authorities have developed a reliable system for tracking containers and identifying shippers. A major challenge for transportation officials is to balance security needs with freight efficiency and productivity.

The U.S. government is working with its trade partners to adopt international data and technology standards. This effort was initiated through the International Standards Organization, the World Customs Organization, the International Electro-technical Commission, the United Nation's Economic Commission, and the International Telecommunications Union.

On March 25, 2003, the U.S. D.O.T., Research and Special Programs Administration (RSPA) published a final rule in the Federal Register. In developing the final rule, RSPA assessed the security risk associated with the transportation of different classes and quantities of hazardous materials. RSPA concluded that the most significant security risks involve the transportation of certain radioactive materials, explosives, materials that are poisonous by inhalation, certain infectious and toxic substances, and bulk shipments of materials, such as flammable and compressed gases, flammable liquids, flammable solids, and corrosives. Based on this risk assessment, the final rule requires persons, who offer for transportation or transport hazardous materials, to develop and implement security plans using placarding thresholds.

On November 26, 2008, the USDOT Pipeline and Hazardous Materials Safety Administration published in the Federal Register the final rules for enhancing rail transportation safety and security for hazardous materials shipments. These enhanced rules were intended to fulfill the requirements of the implementing recommendations of the 9/11 Commission Act of 2007.

At the state level, the Massachusetts State police, through patrol and enforcement activities, provide security for the trucking industry. In addition, the MassDOT Commercial Vehicle Center, issues permits to trucks to operate temporarily at various over-loaded levels, sets requirements for escorts, signs, and/or flags, sets liability insurance requirements, and determines restricted travel times and locations. The Massachusetts State Police Commercial Vehicle Enforcement Section enforces these permit requirements, as well as hazardous material regulations.

Since September 11, 2001, freight railroads have been on heightened alert. Under a comprehensive security plan developed by the industry with the assistance of counterterrorism experts, the freight railroads established a progressive series of counterterrorism measures based on the level of threat. Such actions include cyber security, restricted access to railcar location data, spot employee identification checks, increased tracking and inspection of certain shipments, new encryption technology for selected data communications, increased security of physical assets, and increased employee training to ensure that railroad personnel serve as the “eyes and ears” of the security effort. The industry also created a Department of Defense certified, twenty-four hour operations center that links the railroads with the appropriate national security intelligence officials.

#### AGENCIES RESPONSIBLE FOR SECURING OUR TRANSPORTATION INFRASTRUCTURE

The United States Department of Homeland Security (DHS) has the primary responsibility for the overall security of our transportation network. DHS’ primary purpose is to protect the country from attacks through border and transportation security; emergency preparedness and response; chemical, biological, radiological, and nuclear countermeasures; and informational analysis and infrastructure protection. DHS provides guidance and support for transportation security through the National Response Plan. This plan incorporates best practices and procedures from various incident management disciplines such as emergency management, law enforcement, firefighting and first response, public works, and emergency medical services. The DHS increased this effort in 2008 with the National Response Framework. The Framework is a guide on how the Nation conducts “all hazard” emergency response.

DHS administers the Transit Security Grant Program, funded through the Department of Homeland Security Appropriations Act of 2005. This grant program funds security related projects for passenger and freight rail, and mass transit.

In September 2007, a revised version of the Massachusetts State Homeland Security Strategy was released, which re-evaluated the Commonwealth’s homeland security vision, goals and objectives to more effectively address security issues.

Security planning for the Northern Middlesex region’s transportation system is conducted by multiple federal, state, regional and local entities, including the following:

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**FEDERAL**

- Federal Highway Administration
- Federal Transit Administration
- Federal Motor Safety Carrier Administration
- National Highway Traffic Safety Administration
- Federal Emergency Management Agency
- Department of Homeland Security

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**STATE**

- Massachusetts Department of Transportation
- Massachusetts Emergency Management Agency
- Massachusetts Governor’s Highway Safety Bureau
- Massachusetts State Police
- Homeland Security Executive Committee
- Executive Office of Public Safety and Security
- Interoperability Working Group
- Regional Transit Security Working Group
- Homeland Security Advisory Council

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**REGIONAL**

- Northern Middlesex Metropolitan Planning Organization
- Lowell Regional Transit Authority
- Northern Middlesex Council of Governments
- Department of Public Health Regional Office
- Department of Environmental Protection Regional Office
- Northeast Homeland Security Advisory Council
- Regional Transit Security Working Group
- Greater Lowell Emergency Planning Committee (LEPC)

The Federal Highway Administration (FHWA) provides guidance on planning for transportation security that advocates the “Four Ds of Defense”: deter, deny, detect and defend. The guidance suggests the installation of visible security measures such as closed circuit television cameras and intrusion alarms, routine security patrols, lighting improvements, controlled lock and key systems, and fencing at critical locations.

The Massachusetts Emergency Management Agency's (MEMA) Operations Division manages and coordinates emergency response efforts for the Commonwealth. MEMA also operates the Commonwealth's Emergency Operations Center (EOC) that monitors emergencies on a statewide basis around the clock.

MEMA's Emergency Management Team is prepared and trained by the Operations Division. The Team is comprised of federal, state, local, private and volunteer organizations. The Operations Division is also responsible for maintaining and publishing the Governor's Emergency Notification Roster and assuring that MEMA maintains a high degree of preparedness. In addition, MEMA has a Disaster Recovery Division to assist disaster victims and provide guidance during recovery efforts.

The Massachusetts Statewide Anti-Terrorism Unified Response Network (SATURN) is an information sharing and first responder network created to enhance the existing public security delivery system. SATURN brings together fire, emergency management, and police personnel from each municipality, and provides a process for receiving and exchanging information during a terrorist threat.

The Commonwealth maintains a fusion center, which is defined by the Global Justice Information Sharing Initiative as "a collaborative effort of two or more agencies that provide resources, expertise, and/or information to the center with the goal of maximizing the ability to detect, prevent, apprehend and respond to criminal and terrorist activity." The Commonwealth Fusion Center operates around the clock and provides terrorist-related intelligence and public safety and security information to state, local and federal public safety interests. The CFC also serves as a clearinghouse for information and information requests between the state's public and private safety and security entities, as well as DHS.

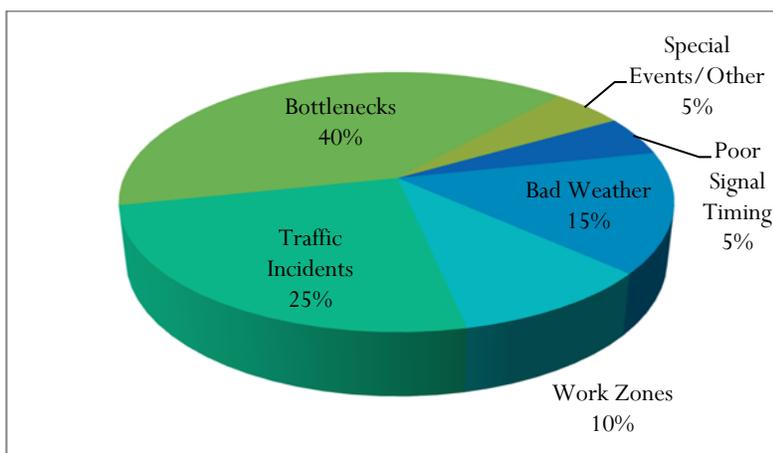
MassDOT's Highway Operations Center is located in South Boston and is responsible for traffic incident management throughout the state. At the HOC, reports on traffic incidents are relayed to the appropriate MassDOT Highway Division District Office that assigns the necessary personnel and equipment required to mitigate the incident. There are several different systems that the HOC utilizes for real-time information about the highway system including loop detectors, video cameras, remote traffic microwave sensor radar units, variable message signs, motorist assistance Care vans and the Massachusetts Traffic and Emergency Response System. A back-up HOC is located at the Massachusetts State Police Headquarters in Framingham.

Any regional transit agency wishing to receive funding through the Transit Security Grant Program is required to participate in a Regional Transit Security Working Group (RTSWG). The primary purpose of the RTSWG is to develop a Regional Transit Security Strategy.

## CHAPTER 10 CONGESTION AND SYSTEM RELIABILITY

From an economic perspective, the main impact of traffic congestion is the lost productivity from time spent traveling rather than working; foregoing interactions among other human beings due to long travel times; and spending more time to accomplish tasks than would be necessary if our highway network operated at free-flow speeds. One of the most harmful effects of traffic congestion is its impact on the environment. Despite the growing number of hybrid vehicles on the road, idling vehicles due to traffic delays produce large volumes of harmful emissions. These emissions contribute to global warming, cause short-term and localized air quality problems, such as smog, and impact public health.

**Figure 10.1: National Sources of Congestion**



Source: FHWA<sup>1</sup>

Traffic congestion can be broken down into two categories: recurring congestion and non-recurring congestion. Figure 10.1 above shows the national prevalence of each source of congestion, both recurring and non-recurring. Recurring congestion is usually the result of traffic demand being greater than available infrastructure capacity. This type of congestion relies on the physical attributes of the roadway, including the number of lanes, curvature of the road, side clearances, and/or interchange/intersection design characteristics. A poorly designed roadway can result in bottlenecks, or areas where the capacity of the roadway is restricted. Bottlenecks can lead to vehicles being “funneled”

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[http://www.fhwa.dot.gov/planning/congestion\\_management\\_process/cmp\\_guidebook/chap01.cfm#sec1.1](http://www.fhwa.dot.gov/planning/congestion_management_process/cmp_guidebook/chap01.cfm#sec1.1)

into a limited area, causing congestion. Non-recurring congestion is often caused by events, including vehicular crashes, construction, poor weather conditions, or poorly timed traffic signals.

The reliability of a transportation facility is based on its level of consistency. For example, if there is recurring congestion along a corridor, one might ask if it occurs at the same time each day at around the same location. If the answer is yes, then the transportation facility is considered to be reliable. Reliability is important to drivers because it determines when and where they access a facility. Performance measures that assess the reliability of a facility include average speed and average delay. Certain types of non-recurring congestion, including crashes, construction, or adverse weather, can cause a facility to be unreliable.

## CONGESTION MANAGEMENT PROCESS

According to the FHWA, “congestion management is the application of strategies to improve transportation system performance and reliability by reducing the adverse impacts of congestion on the movement of people and goods”<sup>2</sup>. A congestion management process (CMP) is a systematic approach for managing congestion that provides accurate, up-to-date information on transportation system performance and assesses alternative strategies for congestion management that meet state and local needs. The CMP is intended to move these congestion management strategies into the funding and implementation stages.

The CMP must be developed and implemented as an integral part of the metropolitan planning process in Transportation Management Areas (TMAs), urbanized areas with a population over 200,000, or any area where designation as a TMA has been requested. The Northern Middlesex region was designated as a TMA following the 2000 U.S. Census.

## CONGESTION MANAGEMENT AND AIR QUALITY CONFORMITY

In TMAs designated as ozone or carbon monoxide non-attainment areas, the CMP takes on a greater significance. In non-attainment areas, federal guidelines prohibit projects that increase capacity for single occupant vehicles unless they are derived from a CMP. In 2012, the US EPA designated most of Massachusetts, including the Northern Middlesex region, as “unclassifiable/attainment” for the 2008 standard, thereby eliminating the requirement for a conformity determination on the NMMPO’s RTP. A limited maintenance plan for Lowell for carbon monoxide (CO) was approved, as the City was re-designated “in attainment” in 2002.

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Ibid.

However, on February 16, 2018, the United States Court of Appeals for the District of Columbia Circuit in *South Coast Air Quality Mgmt. District v. EPA* (“*South Coast II*,” 882 F.3d 1138) held that transportation conformity determinations must be made in areas that were either nonattainment or maintenance for the 1997 ozone NAAQS and attainment for the 2008 ozone NAAQS when the 1997 ozone NAAQS was revoked. These conformity determinations are required in these areas after February 16, 2019. On November 29, 2018, EPA issued *Transportation Conformity Guidance for the South Coast II Court Decision* (EPA-420-B-18-050, November 2018) that addresses how transportation conformity determinations can be made in areas. According to the guidance, both Eastern and Western Massachusetts, along with several other areas across the country, are now defined as “orphan nonattainment areas” – areas that were designated as nonattainment for the 1997 ozone NAAQS at the time of its revocation (80 FR 12264, March 6, 2015) and were designated attainment for the 2008 ozone NAAQS in EPA’s original designations rule for this NAAQS (77 FR 30160, May 21, 2012).

After February 16, 2019, as a result of the court ruling and the subsequent federal guidance, transportation conformity for the 1997 NAAQS – intended as an “anti-backsliding” measure – now applies to both of Massachusetts’ orphan areas. Therefore, this conformity determination is being made for the 1997 ozone NAAQS on the Northern Middlesex FFY 2020-2024 Transportation Improvement Program and 2020-2040 Regional Transportation Plan.

The transportation conformity regulation at 40 CFR 93.109 sets forth the criteria and procedures for determining conformity. The conformity criteria for TIPs and RTPs include: latest planning assumptions (93.110), latest emissions model (93.111), consultation (93.112), transportation control measures (93.113(b) and (c)), and emissions budget and/or interim emissions (93.118 and/or 93.119).

For the 1997 ozone NAAQS areas, transportation conformity for TIPs and RTPs for the 1997 ozone NAAQS can be demonstrated without a regional emissions analysis, per 40 CFR 93.109(c). This provision states that the regional emissions analysis requirement applies one year after the effective date of EPA’s nonattainment designation for a NAAQS and until the effective date of revocation of such NAAQS for an area. The 1997 ozone NAAQS revocation was effective on April 6, 2015, and the *South Coast II* court upheld the revocation. As no regional emission analysis is required for this conformity determination, there is no requirement to use the latest emissions model, or budget or interim emissions tests.

Therefore, transportation conformity for the 1997 ozone NAAQS for the Northern Middlesex FFY 2020-2040 Regional Transportation Plan can be demonstrated by showing that remaining requirements in 40 CFR 93.109 have been met.

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## THE NORTHERN MIDDLESEX CONGESTION MANAGEMENT PROCESS

The Northern Middlesex CMP is an integral part of the overall planning process. By developing congestion management objectives, developing performance measures to support these objectives, collecting data,

analyzing problems, identifying solutions, and evaluating the effectiveness of implemented strategies, the CMP provides a framework for responding to congestion in a consistent, coordinated fashion. The CMP both informs and receives information from other elements of the planning process, including the Regional Transportation Plan (RTP) and Transportation Improvement Program (TIP). As outlined by FHWA, the CMP is an “8-step” process consisting of the following:

1. Develop Congestion Management Objectives;
2. Identify Area of Application;
3. Define System or Network of Interest;
4. Develop Performance Measures;
5. Institute System Performance Monitoring Plan;
6. Identify and Evaluate Strategies;
7. Implement Selected Strategies and Manage Transportation System; and
8. Monitor Strategy Effectiveness.

A CMP takes a systematic approach to managing traffic congestion and provides information on transportation system performance. A CMP must:

- Measure multi-modal transportation system performance;
- Identify the causes of congestion;
- Assess alternative actions;
- Implement cost-effective actions; and
- Evaluate the effectiveness of implemented actions.

## REGIONAL HIGHWAY NETWORK MONITORING

System monitoring is undertaken on regionally significant roadways determined to have mobility issues. The process initially begins with input from the statewide travel demand model, past and current transportation studies, traffic volume counts, crash data, local knowledge, and feedback provided by local communities. To measure the severity of congestion, NMCOG compiles and analyzes regional travel time and speed data from the National Performance Management Research Data Set (NPMRDS). Data is used by the State and NMCOG to assist in establishment of performance measures and targets and in reporting on progress. The NPMRDS data set covers both passenger and commercial freight performance on National Highway System roads and is used as the dataset for federal congestion and freight performance regulation. The NMMPO, at its October 24, 2018 meeting, voted to adopt statewide system performance measures and targets for 2020 and 2022. These include Level of Travel Time Reliability, Level of Truck Travel Time Reliability, Peak Hour Excessive Delay and Percent of Non-Single Occupancy Vehicle travel in the Boston urbanized area. Table 10.5 summarizes the specific travel time performance measures and targets adopted by the NMMPO. Regional levels for travel time reliability are on par with statewide conditions. Truck Travel Time reliability for the region is considered high when compared to Statewide

conditions, most likely due to the high volume of trucks on I-495 and the congestion noted along the Route. Peak Hour Excessive Delay figures for the region are set at the same level as the Boston urbanized area. The adopted short-term targets are to remain at consistent level of delay, making it a more reliable system. The long-term goal for the NMMPO is to develop projects and programs to reduce the delay. The percentage of non-single occupancy vehicle travel is at 33.6% for the Boston urbanized area, of which the NMMPO is included. Short-term targets adopted by the NMMPO show a slight increase in reliability for 2020 and 2022. Long term goals continue the trend of increases out to 2040.

**Table 10.1: System Performance Measures and Targets**

Performance Measures	2017 Current Conditions (State)	2017 Current Conditions (Region)	2020 Target	2022 Target	2040 Regional Target
Level of Travel Time Reliability	68% Interstate	66.9% Interstate	68% Interstate	68% Interstate	80%
	80% Non-Interstate	80.6% Non-Interstate	80% Non-Interstate	80% Non-Interstate	97%
Level of Truck Travel Time Reliability	1.85	2.48	1.85	1.85	1.98
Peak Hour Excessive Delay (annual hours per capita – Boston UZA)	18.31	18.31	18.31	18.31	14.65
Non-SOV Travel (Boston UZA)	33.60% (2016)	33.60%	34.50%	35.10%	40.3%

Source: NMMPO CMP Performance Measures

## NMCOG CONGESTION MONITORING

A total of 273 miles of roadway in the region are monitored through the NPMRDS data set. These include highways, arterial and collectors on the National Highway System (NHS) and this data is used to assess performance and congestion. Speed data was compiled in order to measure roadway network performance through development of a speed index. A speed index measure calculates the ratio of average speed for the study period and compares that speed with the free flow speed during non-peak periods of the day. Once the speed index is determined, congestion is calculated by categorizing the data into indices. Table 10.2 outlines the threshold speed index values for congested and acceptable roadway operations. A value of less than 0.70 is considered “congested.” Segments rated between 0.70 and 0.90 experience some congestion, but traffic flows through these areas at a higher relative speed than in congested areas. Segments with indices greater than 0.90 experience acceptable traffic operations during the monitored time period.

**Table 10.2: Roadway Performance via Speed index during Peak Periods**

Condition	Speed Index Threshold	AM Peak		PM Peak	
		Miles	% Total	Miles	% Total
Acceptable Conditions	>0.90	95.8	35%	84.1	31%
Somewhat Congested	0.71-0.89	136.8	50%	127.3	47%
Congested Conditions	<.70	40.7	15%	61.9	23%
<b>Grand Total</b>		<b>273.3</b>	<b>100%</b>	<b>273.3</b>	<b>100%</b>

Key congested roadways in the region include I-495, US Route 3, Route 38, Route 3A, Gorham Street, Thorndike Street and Wood Street.

In general, factors often affecting congestion and mobility along roadways include:

- Lack of traffic signal coordination, actuation, and inefficient signal timing;
- Many signalized intersections lacked adequate signage and pavement markings to indicate lane assignments;
- Inadequate river crossing capacity within the City of Lowell impacts operations along arterials providing access to the bridge approaches; and
- Many locations lack directional signage, street name signs and route designations.

## INTERSECTION MONITORING

In conjunction with travel time monitoring efforts, key congested intersections throughout the region are routinely identified. Map 10.3 shows congested intersections identified through the CMP process. Table 10.3 lists congested intersections along with its status within the TIP and RTP.

**Table 10.3: Congested Intersections with Construction Status/RTP Recommendation**

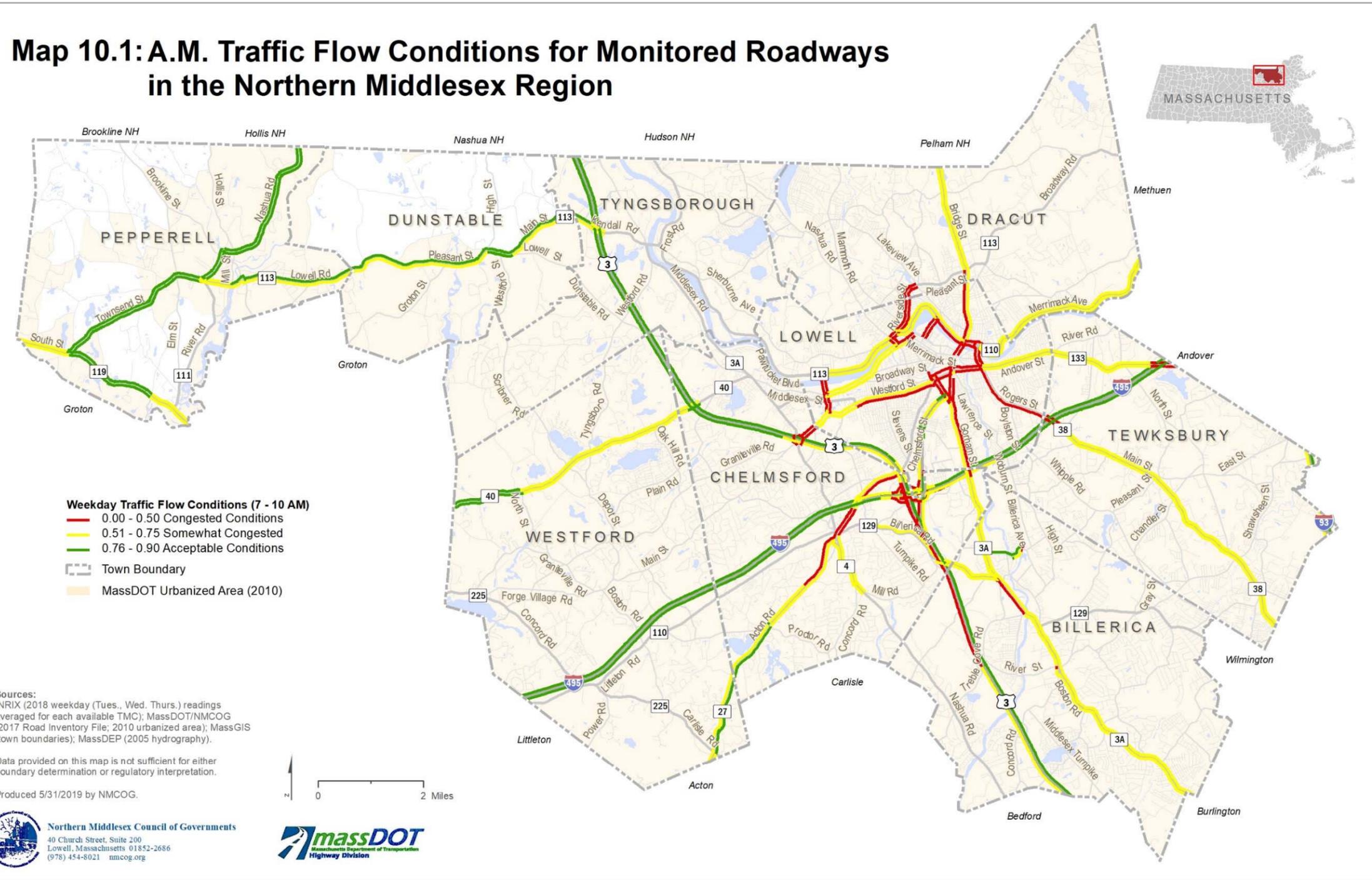
Intersection	Community	RTP Recommendation/ TIP Status
Route 38 (Bridge Street) at Route 113 (VFW Highway)	Lowell	Construction Complete 2017.
Aiken Street at VFW Highway	Lowell	FFY 2018 TIP Project. Under Construction
School Street/Mammoth Road at Riverside Street/ Varnum Avenue	Lowell	FFY 2018 TIP Project. Under Construction
Route 38 (Nesmith Street) at Andover Street	Lowell	FFY 2019 TIP Project Advertised for Construction
Route 38 (Nesmith Street) at East Merrimack Street	Lowell	FFY 2019 TIP Project Advertised for Construction
Route 38 (Rogers Street) at Boylston Street	Lowell	FFY 2019 TIP Project Advertised for Construction
Route 38 at South Street	Tewksbury	FFY 2019 TIP Project Advertised for Construction

**Table 10.3: Congested Intersections with Construction Status/RTP Recommendation**

Intersection	Community	RTP Recommendation/ TIP Status
Route 38 (Main Street) at I-495 NB Ramps	Tewksbury	FFY 2023 RTP - Route 38 Intersection Improvements
Route 38 (Main Street) at I-495 SB Ramps	Tewksbury	FFY 2023 RTP - Route 38 Intersection Improvements
Boston Road at Main Street	Westford	FFY 2024 RTP - Rehabilitation of Boston Road
Gorham Street at Highland Street/Elm Street	Lowell	FFY 2026 RTP - Connector Reconstruction
Lowell Connector at Gorham Street	Lowell	FFY 2026 RTP- Connector Reconstruction
Route 129 at Route 110	Chelmsford	FFY 2027/2028 RTP- Improvements on Chelmsford Street
Gorham Street/Central Street at Appleton Street/Church Street	Lowell	FFY 2029 RTP- Church Street 2 Way Conversion

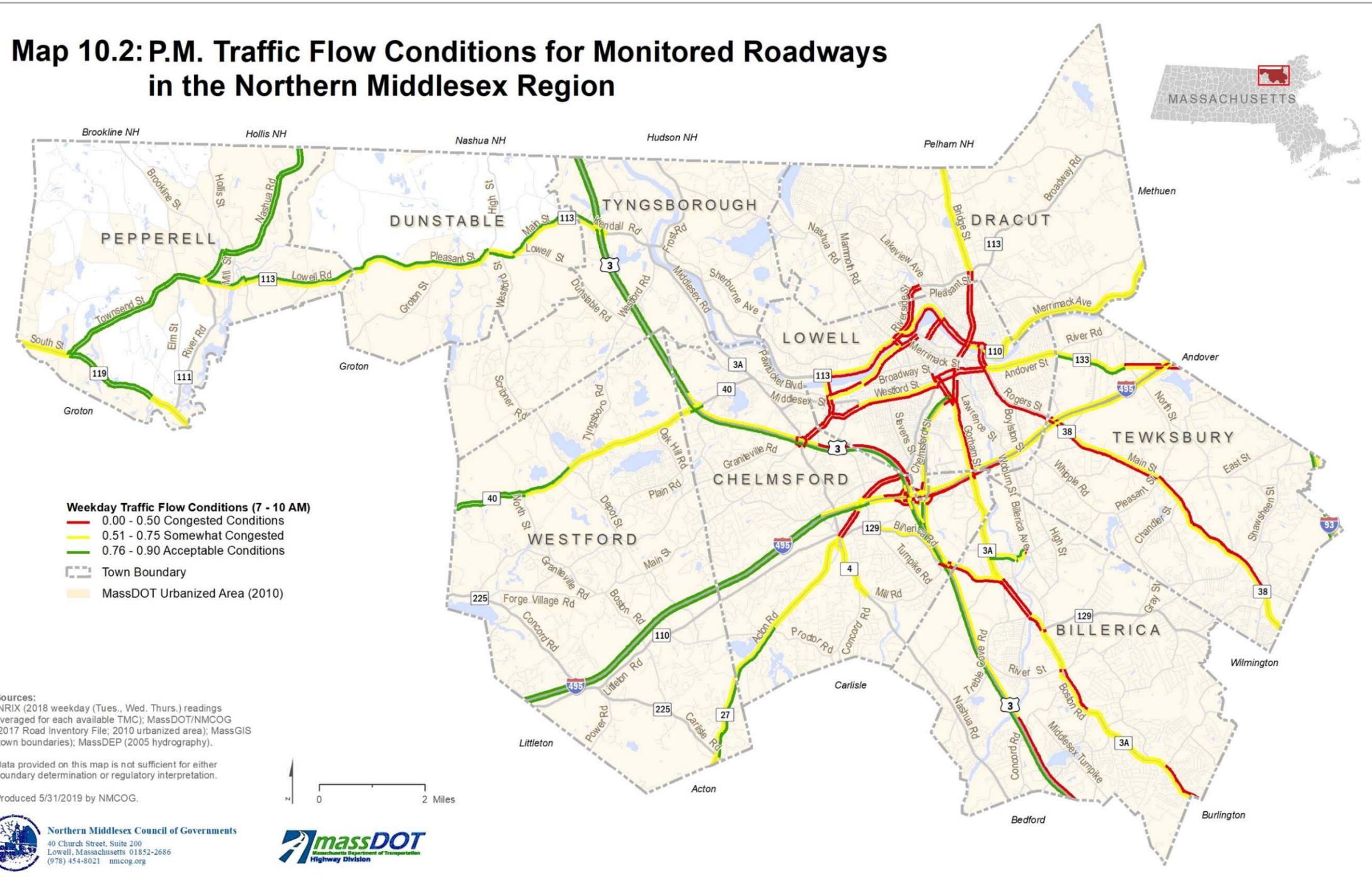
Source: NMMPO Roadway Monitoring

### Map 10.1: A.M. Traffic Flow Conditions for Monitored Roadways in the Northern Middlesex Region

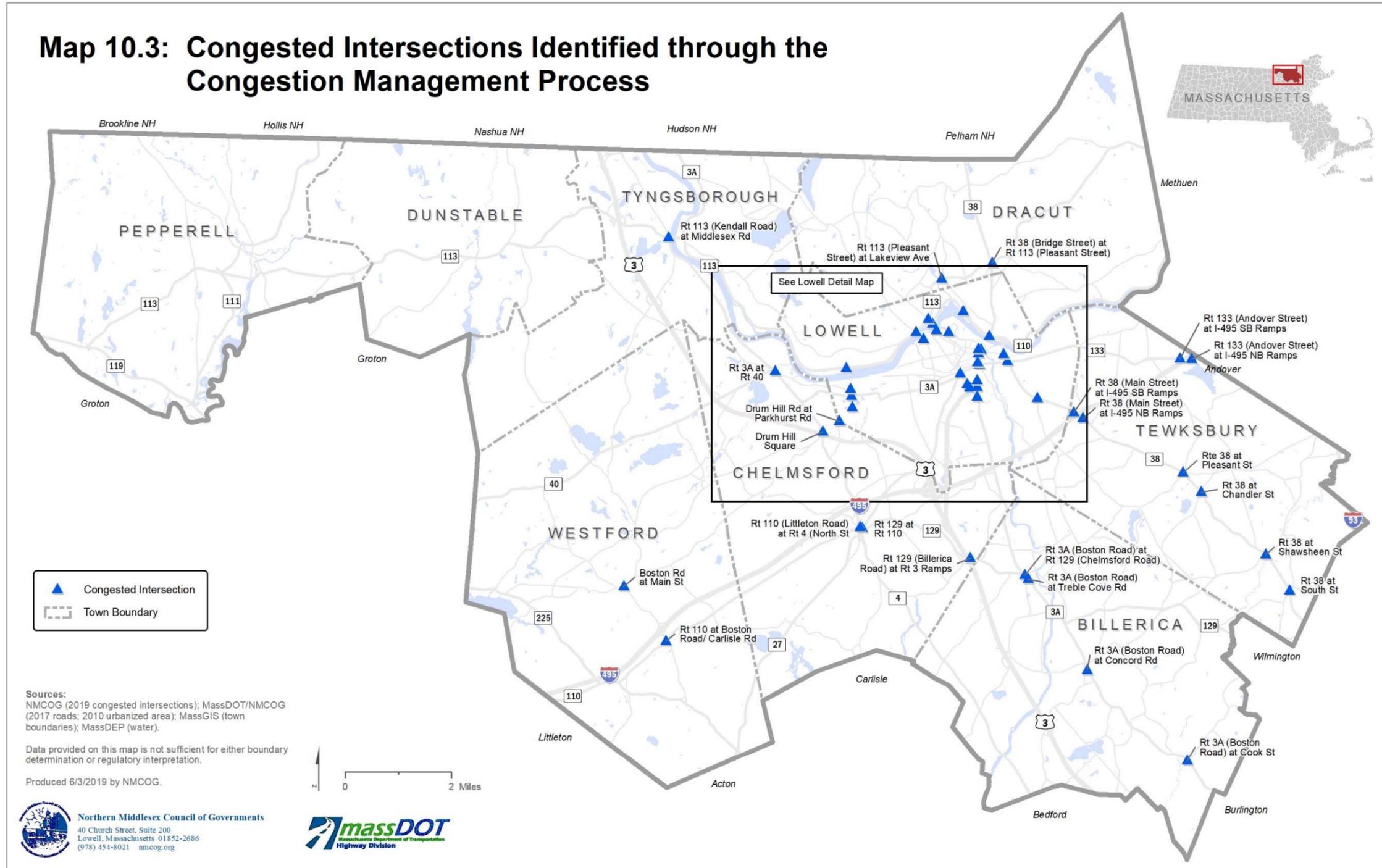


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### Map 10.2: P.M. Traffic Flow Conditions for Monitored Roadways in the Northern Middlesex Region



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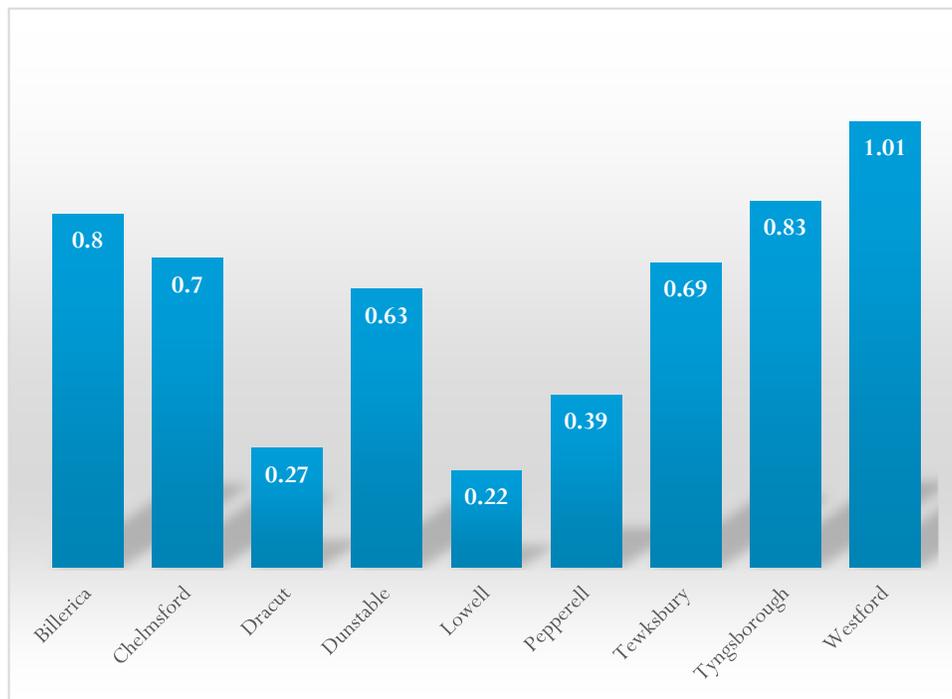
## TRAFFIC VOLUMES AND TRENDS

Traffic volume data provides information on the movement of vehicles along a roadway. Knowledge of the physical capacity of a roadway, along with data on the volume of traffic utilizing the roadway, is essential to identifying recurring congestion. In addition, historical traffic count data is analyzed to determine seasonal adjustment factors, and to assess traffic growth trends.

NMCOG conducts its traffic counting program in conjunction with MassDOT's statewide traffic counting program. NMCOG counts over one hundred locations each year. Over the years, NMCOG and MassDOT have collected traffic volume data for over eight hundred (800) locations across the region. Map 10.5 shows the traffic counts conducted between 2016 and 2018.

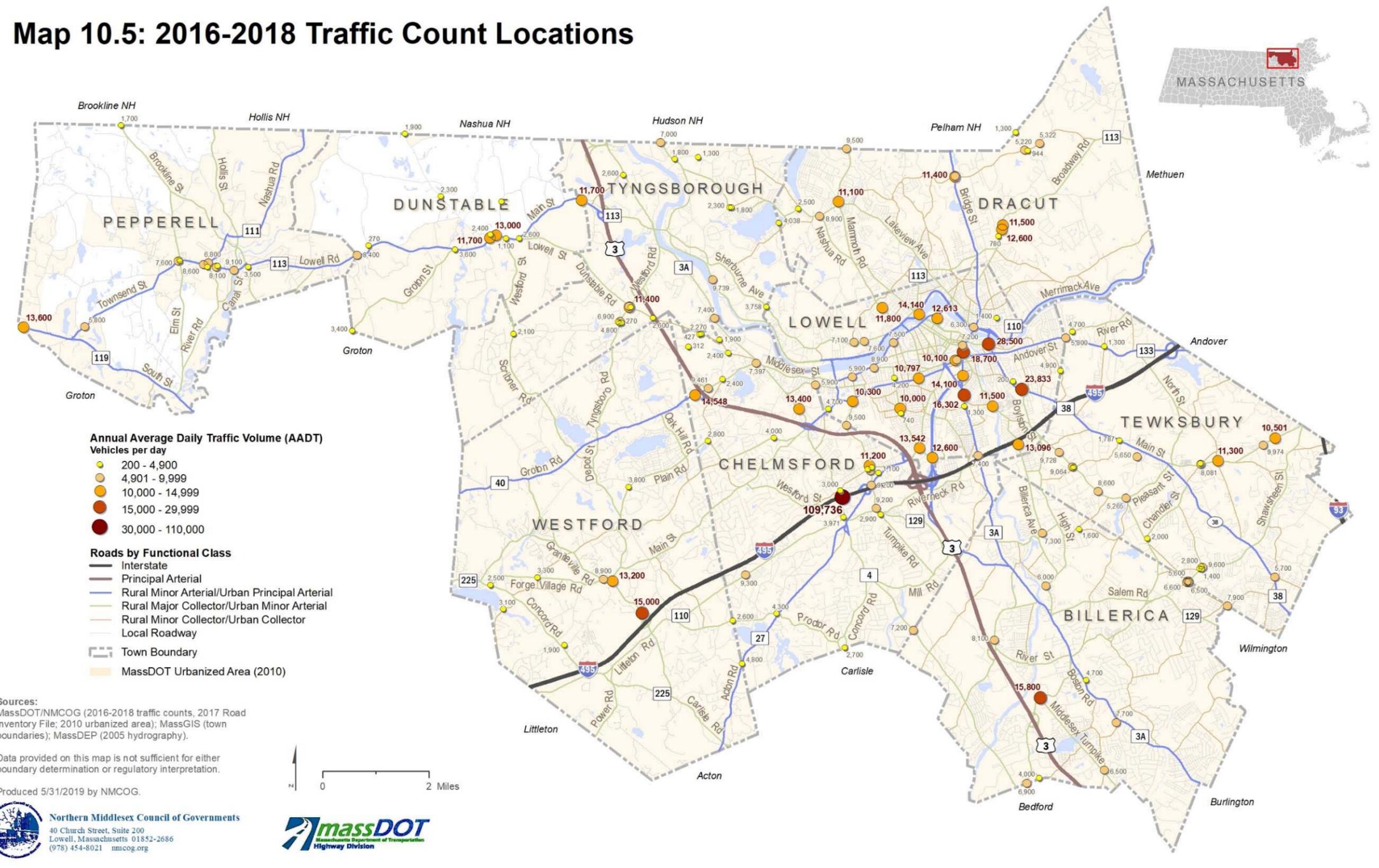
NMMPO staff utilizes both the continuing count locations and historic traffic volume data from one hundred-eighty (180) locations to evaluate annual traffic growth rates for each municipality and the region. Figure 10.2 below summarizes annual traffic growth rates for each community from 2008 - 2018. The Northern Middlesex region overall has experienced a traffic growth rate of 5.73% between 2008 and 2018.

**Figure 10.2: Annual Traffic Growth Rate (% growth) in Northern Middlesex Communities, 2018**



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Map 10.5: 2016-2018 Traffic Count Locations



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## TRANSIT FACILITY MONITORING

Determining ridership on the LRTA fixed route system helps to identify any congested or overcrowded conditions on the buses. Since fixed route buses are subject to roadway congestion, it is important to promote the use of transit as an alternative to single occupancy vehicle travel, in order to reduce congestion and free up capacity on the roadway network.

Fixed route bus ridership has decreased nationally and that trend is reflected in the regional ridership data. The LRTA has experienced a 7% reduction in monthly ridership from FY 2014 to FY 2018, resulting in a fixed route ridership of 1,411,149 in FY 2018. Monthly ridership decreased from 124,700 trips in 2014 to 115,670 trips in 2018, as shown in Table 10.4 below.

**Table 10.4: LRTA Fixed Route Bus Ridership Comparisons**

Route #	Route Name	2014 Average Monthly Ridership	2018 Average Monthly Ridership	2014-2018 Change in Monthly Ridership	Percent Change
1	Christian Hill	4,340	2,900	-1,440	-33%
2	Belvidere	7,930	8,920	990	12%
3	South Lowell	4,280	5,350	1,070	25%
4	Stevens Street	5,700	5,550	-150	-3%
5	Westford Street	14,000	12,850	-1,150	-8%
6	Broadway/UMass	3,270	2,600	-670	-20%
7	Pawtucketville	15,870	15,500	-370	-2%
8	Centerville	5,700	5,150	-550	-10%
9	Downtown Circulator	4,000	2,000	-2,000	-50%
10	Dracut/ Tyngsborough	2,840	3,600	760	27%
11	IRS via Route 133	520	400	-120	-23%
12	Tewksbury via Route 38	6,800	7,750	950	14%
13	Billerica/Edson	6,670	5,850	-820	-12%
14	Burlington/Lahey	9,670	10,000	330	3%
15	Westford via Route 129	3,150	3,650	500	16%
16	Chelmsford via Chelmsford St	5,910	5,400	-510	-9%
17	North Chelmsford	7,930	6,700	-1,230	-16%
18	Shuttle	16,120	11,500	-4,620	-29%
<b>Total</b>		<b>124,700</b>	<b>115,670</b>	<b>-9,030</b>	<b>-7%</b>

Source: LRTA and NMCOG CMP

Fixed route bus ridership congestion occurs when passenger volumes exceeds bus passenger load capacity. This overcrowding leads to standing for some passengers. When this occurs, the passenger may

no longer feel that transit is the best mode choice and may seek alternatives. The performance measure used in determining transit facility performance is the percent capacity utilized by riders on each bus route. The Highway Capacity Manual provides guidance in determining passenger load level of service (LOS), as detailed in Table 10.5 below.

**Table 10.5: Passenger Load Level of Service (LOS) Guidelines**

Passenger Load LOS	Passenger/Seat	Percent Capacity	Comments
<b>A</b>	0.00-0.50	0-50	No passenger needs to sit next to another
<b>B</b>	0.51-0.75	51-75	Passengers can choose where to sit
<b>C</b>	0.76-1.00	76-100	All passengers can sit
<b>D</b>	1.01-1.25	101-125	Comfortable loading for standees
<b>E</b>	1.26-1.50	126-150	Maximum schedule load
<b>F</b>	>1.50	>150	Crush loads

Source: Highway Capacity Manual, 2000, Exhibit 27-5.

The fixed route bus service in the Northern Middlesex region operates at a LOS A, with each route running well below capacity during an average month. Table 10.6 provides a more detailed view of capacity for individual routes on a monthly basis, and shows bus load capacity and passenger load level of service.

**Table 10.6: LRTA Fixed Route Transit Capacity and Level of Service (LOS) Analysis**

Route #	Route Name	Bus Capacity	Monthly Trips	Monthly Bus Capacity	Percent Capacity	LOS
1	Christian Hill	25	709	17,725	16%	A
2	Belvidere	32	1,307	41,824	21%	A
3	South Lowell	32	793	25,376	21%	A
4	Stevens Street	32	819	26,208	21%	A
5	Westford Street	32	1,370	43,840	29%	A
6	Broadway/UMass	16	882	14,112	18%	A
7	Pawtucketville	32	1,307	32,675	47%	A
8	Centerville	25	777	19,425	27%	A
9	Downtown Circulator	25	924	23,100	9%	A
10	Dracut/Tyngsborough	25	667	10,672	34%	A
11	IRS via Route 133	16	168	4,200	10%	A
12	Tewksbury via Route 38	25	667	16,925	46%	A
13	Billerica/Edson	32	730	23,360	25%	A
14	Burlington/Lahey	32	688	22,016	45%	A
15	Westford via Route 129	16	511	8,176	45%	A
16	Chelmsford via Chelmsford St	32	709	22,688	24%	A
17	North Chelmsford	32	714	22,848	29%	A
18	Shuttle	32	2,949	94,368	12%	A

The LRTA monitors the On-Time Performance of each bus route on a monthly basis. System-wide data is also maintained and released quarterly to the State. The on-time performance data is produced via the Route Match dispatch software system. Previous on-time performance data was developed manually by way of LRTA dispatch reported departure times. The dispatch data recorded only the outbound times leaving the Kennedy Bus Hub and did not account for inbound departures. The Route Match data includes all outbound and inbound departures, resulting in a more accurate account of transit system performance. The overall system average on time performance in 2018 was 81%.

**Table 10.7: 2018 On Time Performance - LRTA Fixed Route System**

Route #	Route Name	2018 On-Time Performance Percentage				
		Average	Winter	Spring	Summer	Fall
1	Christian Hill	86%	87%	92%	83%	83%
2	Belvidere	82%	80%	84%	79%	84%
3	South Lowell	91%	91%	91%	91%	90%
4	Highlands Via Stevens	91%	93%	93%	90%	86%
5	Westford Street	85%	88%	88%	83%	82%
6	Broadway / UMass South	95%	96%	96%	92%	96%
7	Pawtucketville	91%	92%	92%	94%	86%
8	Centralville	86%	89%	91%	87%	76%
9	Circulator	76%	79%	82%	81%	64%
10	Dracut / Tyngsborough	78%	85%	83%	76%	68%
11	Tewksbury / IRS Via Rte. 133	80%	84%	82%	76%	80%
12	Tewksbury Via Rte. 38	68%	79%	73%	63%	57%
13	Billerica Via Edson	86%	91%	88%	86%	78%
14	Burlington Mall / Lahey Clinic	73%	75%	74%	71%	71%
15	Chelmsford / Westford	90%	94%	95%	91%	81%
16	Chelmsford Center	75%	72%	75%	69%	82%
17	North Chelmsford	83%	81%	86%	88%	76%
18	Shuttle	96%	97%	97%	95%	97%
20	Downtown / UMass North	68%	56%	62%	N/A	87%
01/08	Christian Hill / Centralville Loop	68%	73%	70%	57%	72%
03/04	South Lowell / Highlands Loop	77%	80%	84%	70%	76%
06/09	Broadway / Circulator Loop	57%	61%	55%	57%	58%
<b>System Average</b>		<b>81%</b>				

## PARK AND RIDE FACILITIES

As part of the CMP, NMCOG collects data at three park and ride locations on a quarterly basis: two commuter rail parking facilities, in Lowell and North Billerica respectively, and one park and ride surface lot in Tyngsborough. Data is collected between peak periods of a typical weekday, in order to determine occupancy levels and assess the availability of parking at these locations.

The utilization level is measured by inventorying the number of spaces and determining what percent of the spaces are occupied at any given time. The following classification system is used to categorize lot occupancy:

- Full: 85 % or more of capacity
- Utilized: 50-85% of capacity
- Underutilized: <50% of capacity

The following section summarizes the existing park and ride facilities in the region and their utilization levels.

## PARK AND RIDE LOCATIONS

There is one designated park and ride lot in the Northern Middlesex region. This lot, located at the US Route 3 interchange with State Route 113 (Kendall Road) at Exit 34 in Tyngsborough, was opened in 2006 as mitigation for the Route 3 expansion project.

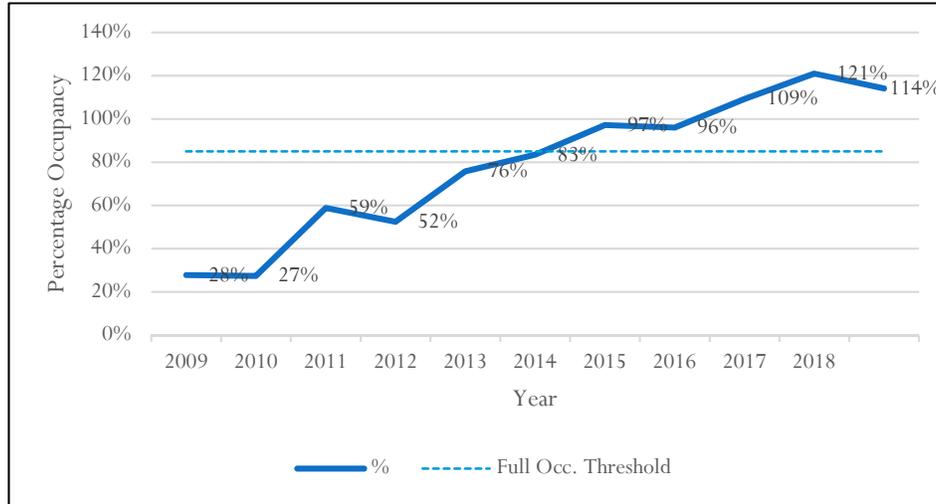
In November 2010, Boston Express, a private commuter bus company, began providing service



**Image 10.1: Route 113 Park and Ride Lot, Tyngsborough, MA.**

between Nashua, New Hampshire and Boston, with a stop at the Tyngsborough park and ride lot. Latest monitoring results show that occupancy is routinely over 100% and the lot is classified as “Full”. The Town of Tyngsborough, NMCOG and MassDOT are working collaboratively on possible expansion of the lot to handle the increased demand at this location. Figure 10.1 provides a summary of occupancy growth at the Route 113 Park and Ride lot (average spring weekday occupancy) from 2009 to present.

**Figure 10.1: Tyngsborough Route 113 Park and Ride Occupancy**

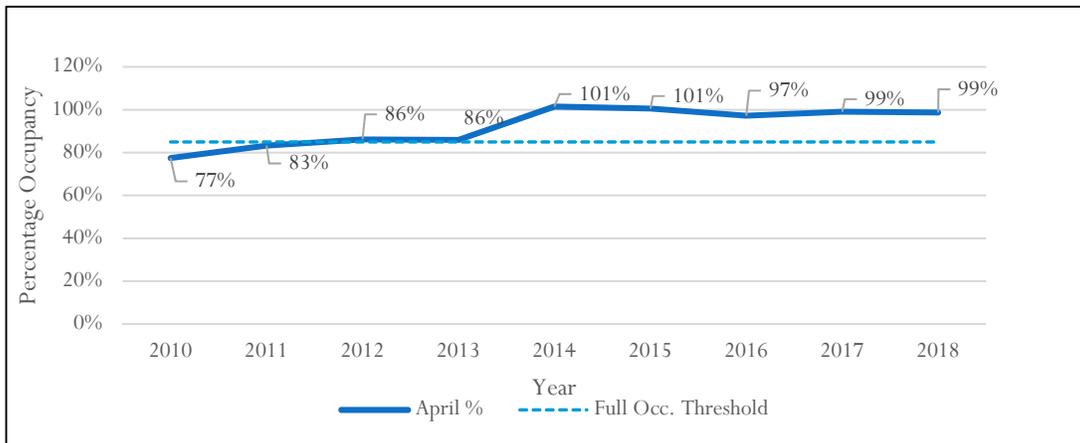


Given its proximity to New Hampshire and Route 3, the Route 113 park and ride lot the majority (65%) of vehicles parked at the lot have New Hampshire license plates on a typical weekday.

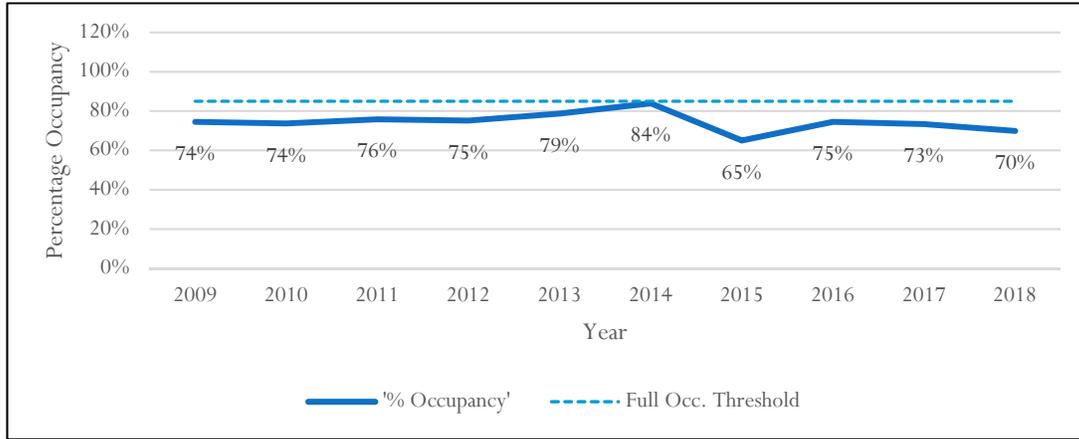
**MBTA COMMUTER RAIL STATIONS**

As part of the MBTA commuter rail system, the Lowell Line provides service between Boston and the Northern Middlesex region. There are two commuter rail stations within the region; one is located in North Billerica and the other in Lowell. The North Billerica station includes two open parking lots, while the Lowell station includes two parking garages, the Gallagher Terminal, and the LRTA bus hub. Figure 10.3 shows that the parking at North Billerica has been at or over capacity since 2014. In contrast, Gallagher Terminal has consistently been at about 75% of capacity since 2009, as shown in Figure 10.4.

**Figure 10.2: North Billerica Parking Occupancy, 2010-2018**



**Figure 10.3: Lowell Gallagher Terminal Parking Occupancy, 2009-2018**



Source: NMCOG Monitoring

As shown in Table 10.8, the North Billerica parking lots range from 90-100% occupancy, thus classified as “full”. The Lowell Commuter Rail station parking garages range from 72-76% occupied and is classified as “utilized”.

**Table 10.8: Occupancy Rates at Park and Ride Locations in the Northern Middlesex Region, 2018.**

		2018 Occupancy							
		January		April		July		October	
Location	Total Spaces	Total Vehicles	% Full	Total Veh.	% Full	Total Vehicles	% Full	Total Vehicles	% Full
North Billerica Commuter Rail Station Lot	541	503	93%	534	99%	535	99%	534	99%
Lowell Commuter Rail Parking Garage	870	624	72%	612	70%	623	72%	659	76%
Route 113 Park and Ride Lot	248	237	96%	300	121%	255	103%	254	102%

Source: NMCOG Monitoring

**TRANSPORTATION DEMAND MANAGEMENT (TDM)**

Transportation Demand Management (TDM) consists of programs and facilities that are meant to change demand on the transportation system. TDM measures reduce traffic congestion by changing user

behavior. TDM programs include information and incentives to encourage employees to travel by means other than the single occupant vehicle during peak travel periods. TDM facilities are sometimes constructed to complement TDM programs. Examples of TDM measures include flexible work hours, ridesharing, and preferential parking for those who rideshare. Examples of TDM facilities include carpool and vanpool staging areas, transit shelters, bicycle lockers and showers. The following measures were determined to be appropriate for the Northern Middlesex region.

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## EMPLOYER-BASED TRANSPORTATION DEMAND MANAGEMENT MEASURES

The following employer-based TDM measures have been identified as having some applicability to the region. NMCOG is committed to working with area employers and local communities to provide assistance and promote TDM whenever possible.

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### TRANSPORTATION ALLOWANCES

Transportation allowance programs are established by employers to subsidize employee travel. The purpose is to encourage employees to shift from driving alone to ridesharing or public transportation. Travel allowances include transit fare subsidies, vanpool and carpool fare allowances, parking allowances and general allowances which may be used for any purpose an employee chooses.

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### PARKING PRICING

Parking pricing has proven to be an effective strategy for reducing commuter automobile use. The effectiveness of parking pricing depends on current pricing levels, changes in the pricing levels, and the attractiveness of travel and parking alternatives. In suburban settings, employers can best reduce solo driving through a combination of pricing strategies and alternative mode programs such as carpool and transit incentives. The best localities for pricing strategies are those where some amount of parking pricing is already in place. It is difficult to impose prices where public or private parking is free. Excellent candidates for parking pricing are public garages where rates have fallen behind commercial parking rates and localities where these rates offer no differentials for ride sharers.

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### PREFERENTIAL PARKING POLICIES FOR HIGH OCCUPANCY VEHICLES

Preferential parking programs reserve proximal and attractive spaces for high occupancy vehicles. This strategy is predominantly applied in central business districts or large activity centers where there is a shortage of easily accessible and convenient all-day parking, the walking distance from the parked car to work is time consuming, and/or the parking rates are high. The impact of preferential parking on traffic congestion and air quality depends on the number of carpools and vanpools formed as a result of implementation and the previous mode of travel that was used.

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## VARIABLE WORK HOURS

Employer policies regarding work hours can influence mode choice and peak hour traffic volumes. Variable work hours include such measures as staggered work hours, compressed work weeks and flextime.

Staggered work hours are varied starting work times set by employers. This strategy serves to spread peak hour traffic. This option is practical for office and piece manufacturing but cannot be applied to line manufacturing where workers are interdependent.

Compressed work week allows an employee to work more hours in fewer days than the typical five day work week. Typically, an employee may elect to work four 10-hour days. This option serves to reduce vehicle miles of travel and encourages workers to arrive and leave work during off-peak travel periods.

Flextime permits employees to set their own work hours within a specified block of time. Such a policy allows workers to avoid travel during hours of severe congestion. Some studies have shown that flexible hours also result in increased ride sharing. Flextime is not practical in administrative office environments and is least practical for shift workers or assemblers.

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## TELECOMMUTING

Telecommuting reduces commuter travel by allowing employees to work at home. Table 10.9 outlines the number of employees working at home in each community according to the 2012-2017 American Community Survey (ACS) of the US Census Bureau. This includes people telecommuting remotely into their jobs. In the Northern Middlesex region, approximately 4% of employees work from home, with the largest percentages being in Dunstable (8% of the Towns workforce) and Pepperell (6%). Billerica (3%) and Tyngsborough (3.1%) have the least percentages of workers staying at home. As an alternative, employees may also work at neighborhood or regional satellite centers, rather than the traditional commute into a centralized location.

**Table 10.9: Total Employees Working at Home by Community**

Community	Total Workers (16 years and over)	Total Employees Working at home (Telecommute)	
		Workers	%
Billerica	23,247	697	3.0
Chelmsford	18,214	1,020	5.6
Dracut	16,614	548	3.3
Dunstable	1,877	150	8.0
Lowell	52,276	1,673	3.2
Pepperell	6,296	378	6.0
Tewksbury	16,496	742	4.5
Tyngsborough	7,018	217	3.1
Westford	12,330	703	5.7
<b>Total</b>	<b>154,368</b>	<b>6,128</b>	<b>4.0</b>

Source: ACS 2013-2017, table: S0801

## TRANSPORTATION MANAGEMENT ASSOCIATIONS

A transportation management association is an organization formed so that employers, developers, local governments and others can work together and collectively establish policies, programs and services to address local transportation programs. TMAs work to solve transportation problems by providing services directly to members or by providing a means for private sector involvement in public sector planning, decision making and projects. Services provided by TMAs can include the following:

- Rideshare matching;
- Guaranteed ride home program;
- Shuttle service;
- Coordinating alternative work hour programs; and
- Producing informational materials.

Currently, the Middlesex 3 TMA serves the Northern Middlesex region. Middlesex 3 has recently begun new service between Lowell and Burlington, providing transportation options for second and third shift workers commuting along the Route 3 corridor.

## TRANSPORTATION SYSTEMS MANAGEMENT (TSM)

Transportation Systems Management (TSM) applies to low cost transportation measures which, by themselves or in conjunction with other measures, increase the operational efficiency and safety of the existing transportation system. The goals of implementing TSM measures are to:

- Foster the safe and efficient flow of passenger and freight vehicles along heavily traveled corridors;
- Minimize the costs of improving the existing transportation infrastructure;
- Minimize the environmental impacts associated with congestion; and
- Promote and improve public transit ridership.

TSM is an administrative process carried out to select improvement strategies for the existing transportation network. Transportation agencies and public officials continually evaluate the transportation systems through surveillance and data collection procedures such as transit ridership counts, traffic counts, accident reports and field reconnaissance. Table 10.10 provides a synopsis of TSM strategies and actions that may be applicable in addressing transportation issues in the region.

**Table 10.10: TSM Strategies and Potential Actions**

Strategy	Potential Actions
<b>Roadway upgrades to improve flow</b>	Roadway reconstruction
	Intersection reconstruction
	Install turning lane(s)
	Turning movement/land use restrictions
	One-way street pattern
<b>Improve traffic flow through signalization</b>	Install signal
	Create exclusive left turn phase
	Adjust signal timing
	Interconnect and coordinate signals
<b>Improve traffic flow through parking management</b>	Eliminate on-street parking in some locations (particularly near intersections)
	Create off-street parking areas
	Limit duration of on-street parking to increase turnover
	Provide preferential parking for ridesharing
<b>Encourage non-motorized transportation</b>	Provide pedestrian actuated signals
	Install/widen sidewalks
	Where possible, provide bike lanes, routes and paths
	Promote bike share services
	Install secure bicycle parking
<b>Improve transit use</b>	Make route and schedule adjustments as needed
	Transit marketing program
	High level of vehicle maintenance and fleet improvements
	Possible express and dial-a-ride services
	Improved shelters and schedule information

**Table 10.10: TSM Strategies and Potential Actions**

Strategy	Potential Actions
<b>Increase vehicle occupancy</b>	Encourage carpool/vanpool matching services or ridesharing programs
<b>Encourage inter-modalism</b>	Promote the expansion/development of park and ride lots
	Provide multimodal facilities such as bike lanes or multi use trails
	Coordinate schedules between various modes such as commuter rail and regional bus service

### CMP STRATEGY TOOLBOX

Once congested areas have been identified in the CMP monitoring plan, a toolbox of potential mitigation strategies can be used to alleviate recurring congestion in the affected locations. These strategies are categorized into five programs:

1. **Transportation Demand Management:** Primary goal is to reduce the number of single occupancy vehicles on the road network by providing alternative mobility options.
2. **Traffic Operational Improvements:** Primary goal is to improve existing roadway infrastructure in an effort to enhance traffic operations and capacity of the existing roadway network, rather than construct new capacity.
3. **Management of Construction and Maintenance Projects:** Primary goal is to ensure maintenance and construction projects are completed in a timely manner with minimal impact to existing roadway operations.
4. **Incident Management:** Primary goal is to promote traveler assistance programs and strive to reduce incident response and clearance time.
5. **Other Strategies:** Primary goal is to promote alternative modes of travel in an effort to mitigate congestion; includes expansion of multimodal systems to manage and improve access.

Selection of appropriate strategies and tools is critical in utilizing effective congestion management practices. Each roadway facility monitored in the Northern Middlesex region is unique in that it presents distinct issues and challenges. Table 10.11 provides a summary of tools that are considered in the selection of appropriate strategies for mitigating congestion. Each tool has several specific measures that can be used, depending on the characteristics of each location and the nature of the problem being addressed.

**Table 10.11: Congestion Management Process Toolbox**

CMP Tool Type	Strategy Category	Measures
Transportation Demand Management	Alternative work program	<ul style="list-style-type: none"> <li>- Telecommuting</li> <li>- Compressed work week</li> <li>- Flex time</li> <li>- Staggered work hours</li> </ul>
	Ridesharing	<ul style="list-style-type: none"> <li>-Rideshare matching</li> <li>-TMAs</li> </ul>
	Carpools/vanpools	<ul style="list-style-type: none"> <li>- Carpool/vanpool parking discounts</li> <li>- Subsidized vanpool service</li> </ul>
	Parking management	<ul style="list-style-type: none"> <li>- Park and ride lots</li> <li>- Preferred car/vanpool parking</li> <li>- Increased parking fees for SOVs or discounts for car/vanpools</li> </ul>
Traffic Operational Improvements	Traffic signal improvements	<ul style="list-style-type: none"> <li>- Signal retiming</li> <li>- Signal coordination</li> <li>- Removal/installation of traffic signals</li> </ul>
	Geometric improvements	<ul style="list-style-type: none"> <li>- Turn lanes</li> <li>- Intersection widening</li> <li>- Channelization</li> <li>- Turn restrictions</li> </ul>
	Intelligent Transportation Systems (ITS)	<ul style="list-style-type: none"> <li>- Advanced traffic management systems</li> <li>- Video monitoring</li> <li>- Advanced traveler information systems</li> </ul>
	Highway capacity expansion	<ul style="list-style-type: none"> <li>- Additional capacity when needed</li> <li>- Additional acceleration/deceleration lanes</li> <li>- Construction of new facilities</li> <li>- Interchange improvements</li> </ul>
Management of Construction and Maintenance Projects	Alternative work scheduling	<ul style="list-style-type: none"> <li>- Staggered work hours</li> <li>- Non peak construction schedule</li> </ul>
	Information sharing	Creation of project website with construction schedule provided
Incident Management	Promote assistance programs	<ul style="list-style-type: none"> <li>- 511 traveler information</li> </ul>
	Encourage ITS usage	Advanced traveler information system
Other Strategies	Transit improvements	<ul style="list-style-type: none"> <li>- Capital</li> <li>- Operational</li> <li>- Fleet expansion</li> <li>- Increased frequency of service/hours of operation</li> </ul>

**Table 10.11: Congestion Management Process Toolbox**

CMP Tool Type	Strategy Category	Measures
Congestion Management		<ul style="list-style-type: none"> <li>- Route expansion/modification</li> <li>- Park and ride facilities</li> <li>- Fare incentives</li> <li>- Vehicle replacement/upgrades</li> <li>- Traffic signal pre-emption</li> <li>- Transit vehicle management system</li> <li>- Transit information management</li> <li>- Transit centers</li> </ul>
	Non-motorized modes of travel	<ul style="list-style-type: none"> <li>- Promotion of bike lanes, paths, shared use</li> <li>- Bike racks at key locations</li> <li>- Transit vehicle bike carriers</li> <li>- Sidewalk management programs</li> <li>- Crosswalk management</li> </ul>
	Growth management	<ul style="list-style-type: none"> <li>- Land use policies</li> <li>- Zoning regulations</li> <li>- Access to jobs</li> <li>- Redevelopment incentives</li> <li>- Transit-oriented development</li> </ul>
	Access management	<ul style="list-style-type: none"> <li>- Driveway policies and standards</li> <li>- Curb cut and median controls</li> <li>- Frontage roads</li> <li>- Bi-directional turn lanes</li> </ul>

Source: Northern Middlesex CMP

## CHAPTER 11 FREIGHT MOVEMENT

Freight movement plays a major role in the economic vitality and quality of life in the Northern Middlesex region. The region is traversed by I-495, a major truck route in the northeastern United States. Railroad lines also cross the region carrying commodities throughout the northeast. A freight system that promotes the efficient movement of goods, safety and security, economic competitiveness, and environmental sustainability is of great importance. The continued globalization of our economy and an increasing reliance on international trade highlights the need for a safe, reliable, and secure freight transportation system.

The FAST act established the **National Highway Freight Network (NHFN)** to better direct resources and policies toward improved performance of highway portions of the US freight transportation system. The NHFN includes a subsystem of roadways including:

- **Primary Highway Freight System (PHFS)** – a network of highways identified as the most critical highway portions of the US freight transportation system. In the Northern Middlesex Region, I-495 and I-93 are labeled as PHFS corridors.
- **Other Interstate portions not on the PHFS** – highways that consist of the remaining portion of Interstate roads not included in the PHFA, but important to continuity and access for freight movement. The Lowell Connector is designated in this category.
- **Critical Rural Freight Corridors (CRFC)** – Roads not in urbanized areas that provide access and connection to the PHFS. The NMMPO has designated a portion of Route 113 in Pepperell as a CRFC.
- **Critical Urban Freight Corridors (CUFC)** – Roads within an urbanized area that provide access and connection the PHFS system. East Street in Tewksbury is an example of a CUFC.

Discussion of determination of CRFC and CUFC roads in the Northern Middlesex region is included later in this chapter.

Freight traffic, by most any measure, is growing faster than passenger travel. In addition, freight is highly intermodal and cannot be addressed in modal pieces as it often crosses over modal boundaries. The commodities, modes, and origins and destinations of freight movement in the region are expected to change little. Highway-based modes are expected to continue to dominate other modes. Trucks carry nearly 90 percent of freight in the State (measured in tons). In October 2018, The NMMPO adopted State performance measures and targets for Level of Truck Time Reliability, as described below:

- **Level of Truck Travel Time Reliability (TTTR):** the consistency or dependability in truck travel times, as measured from day-to-day and/or across different times of the day. TTTR is based on the amount of time it takes trucks to drive the length of a road segment and is an index of

50<sup>th</sup>/95<sup>th</sup> percentile travel times. The TTTR index is reported as a weighted average of the largest period for each segment.

Monitoring progress toward achievement of these targets will be a priority to address freight needs and growth in the region and the Commonwealth.

Monitored conditions for 2017, show a regional TTTR index at 2.48, a number higher than the statewide index of 1.85. While the target for the statewide index for 2020 and 2022 is to remain at the 1.85 level, the region's long-term goal is to decrease the regional index by 20%, to 1.98 by 2040. Projects aimed at improving overall TTTR include: replacement of the Rourke Bridge in Lowell; Route 38 improvements along Route 38 in Tewksbury; Rehabilitation of Route 3A in Billerica; and signaling the I-495 ramps at Route 110 in Chelmsford. The widening of mainline I-495 is a long-term project without an identified funding source presently. The project is included in the RTP as a regionally significant for illustrative purposes.

The Commonwealth of Massachusetts is a major freight destination nationally. With five maritime ports (Fall River, New Bedford, Boston, Salem, and Gloucester), Massachusetts exported \$151 billion dollars of goods and imported \$177 billion dollars of goods in 2017 according to FHWA statistics.<sup>1</sup> The regional highways in Eastern Massachusetts, including those in the Greater Lowell Region, such as I-93, I-95, and I-495, are classified by the FHWA Office of Freight Management and Operations as Primary Highway Freight System corridors carrying over 8,500 trucks daily.

The following challenges to freight transportation will need to be addressed over the next twenty years:

- Poor highway performance;
- Inadequate access to freight handling facilities;
- Transportation network constraints; and
- The need for higher security.

Freight mobility is restricted by limitations on the region's infrastructure for accommodating modern freight transportation operations. Freight movements over both rail and highway systems are restricted in locations where inadequate dimensional envelopes prevent the passage of modern rail cars or truck trailers, e.g. double stacking of rail containers. As a result, logistical companies are required to reroute freight shipments, thereby increasing costs and community impacts. These transportation deficiencies can

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<sup>1</sup> <https://faf.ornl.gov/fafweb/Extraction0.aspx>

also result in higher prices for goods and services, which can affect business location decisions, reduce the profitability of existing companies, and otherwise hamper the region's economic vitality.

### NATIONAL MULTIMODAL FREIGHT POLICY

The FAST Act includes several provisions to improve the condition and performance of the national freight network and to support investment in freight-related surface transportation projects. Specifically, the FAST Act:

- Establishes a National Multimodal Freight Policy that includes national goals to guide decision-making.
- Requires the Development of a National Freight Strategic Plan to implement the goals of the new National Multimodal Freight Policy. The National Freight Strategic Plan will address the conditions and performance of the multimodal freight system, identify strategies and best practices to improve intermodal connectivity and performance of the national freight system, and mitigate the impacts of freight movement on communities.
- Creates a new discretionary freight-focused grant program that will invest \$4.5 billion over 5 years. This new program allows States, Metropolitan Planning Organizations (MPOs), local governments, tribal governments, special purpose districts and public authorities (including port authorities), and other parties, to apply for funding to complete projects that improve safety and hold the greatest promise to eliminate freight bottlenecks and improve critical freight movements.
- Establishes a National Highway Freight Program. The Act provides \$6.3 billion in formula funds over five years for States to invest in freight projects on the National Highway Freight Network. Up to 10 percent of these funds may be used for intermodal projects.
- Includes new authorities and requirements to improve project delivery and facilitate innovative finance. The FAST Act includes provisions intended to reduce the time it takes to break ground on new freight transportation projects, including by promoting best contracting practices and innovating financing and funding opportunities, and by reducing uncertainty and delays with respect to environmental reviews and permitting.
- Collects performance measures for leading U.S. maritime ports. The FAST Act requires the Bureau of Transportation Statistics (BTS) to collect and annually report performance measures for the nation's top twenty-five (25) ports, as measured by three methods (total tonnage, containers, and dry bulk tonnage).

### MASSACHUSETTS FREIGHT PLAN

In September 2018, MassDOT adopted a comprehensive multi-modal freight evaluation, known as the *Massachusetts Freight Plan*. An important aspect of this Plan was to create a unifying vision, and establish a set of goals and objectives that could be linked to performance measures and evaluation criteria. The

goals for the Massachusetts freight system, developed in the context of other MassDOT initiatives and its overall strategic plan, are outlined as follows:

- Promote the preservation and improvement of the freight system infrastructure in all modes;
- Facilitate appropriate freight system capacity and redundancy, enhance operational efficiency, and achieve a balanced mix of capacity and connections across all modes;
- Facilitate freight transportation system improvements, policies, and investment strategies that will enhance economic development opportunities and manage consumer costs; and
- Ensure that the freight system preserves the environment and contributes to the quality of life in Massachusetts.

To fulfill these goals, the Plan focused on providing transportation infrastructure and services in Massachusetts that: (1) facilitate the movement of goods to consumers efficiently and cost effectively; and (2) support economic prosperity for Massachusetts businesses and a strong quality of life for Massachusetts residents. The recommended investments and policies of the Plan were developed using a cost-benefit analysis with the following evaluation criteria:

- Congestion reduction and improved transportation system operations;
- Operational costs;
- Last mile connection to intermodal, seaport, and airport facilities;
- Economic development and land use benefits (e.g., jobs and supporting smart growth);
- Environmental considerations, including emissions;
- Local support and consistency with transportation plans;
- Safety and security;
- Partnership and linkage to regional initiatives; and
- Availability of funding from federal, local, and private sources.

As part of development of the State Freight Plan, MassDOT collaborated with the Commonwealth's MPOs, including the NMMPO, to identify important freight corridors in urban and rural areas for inclusion in the National Highway Freight Network (NHFN).

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## CRITICAL FREIGHT CORRIDORS

The NMMPO adopted four corridors within the Greater Lowell Region for designation as Critical Freight Corridors, as part of the NHFN. Three of the corridors were designated as Critical Urban Freight Corridors (CUFCs) including:

- East Street between Whittemore Street and the Andover Town Line (0.76 miles) in Tewksbury.
- Brick Kiln Road and Route 129 from the UPS Center Entrance to U.S. Route 3 interchange (0.8 miles) in Chelmsford

- Industrial Avenue between Route 110 (Chelmsford Street) and Industrial Avenue East (1.38 miles) in Lowell

Route 113 (Townsend Street) From Bancroft Street to Prides Crossing (0.79 miles) was designated as a Critical Rural Freight Corridor (CRFC). With these designations, projects along these corridors are eligible for National Highway Freight Program (NHFP) funding through the TIP. NMCOG will continue to work with MassDOT and the FHWA to refine and expand on freight corridors in the region.

## MASSACHUSETTS STATE RAIL PLAN

The 2018 *Massachusetts State Rail* outlines the Commonwealth's long-term plan for the statewide rail system, and provides information on the existing rail system, the role of rail in the overall transportation system, system financing, and short-and long-term priorities and investment strategies. The plan is intended to:

- Set forth Commonwealth policy involving freight and passenger rail transportation;
- Establish policies, priorities and strategies to enhance rail services in the Commonwealth that provide benefits to the public;
- Serve as the basis for Federal and State rail investments within Massachusetts;
- Establish the means and mechanisms to coordinate with adjoining States, private parties and the Federal government in projects of regional and national significance, including corridor planning and investment strategies; and
- Meet the planning requirement established by the Federal Railroad Administration (FRA).

## RAIL CORRIDORS

Greater Lowell was at one time a major center for freight rail operations. While the total number of active freight railroads diminished with the closure of factories and mills, there still is a sizeable freight rail operation in the region. Pan American (Pan-AM) Railways is the region's main freight rail operator and its main line runs through Lowell. Pan Am Railways (PAR) is a privately held Class II/regional rail carrier with operations in five New England states and New York. Its operational headquarters are located in North Billerica. Pan Am has connections to the New England Central Railroad in Montague and Northfield, and the Providence and Worcester Railroad in Gardner and Worcester. Pan Am exchanges traffic with CSX Corporation in Worcester. PAR also connects with Pan Am Southern (PAS) in Ayer. It should be noted that CSX does not service Ayer directly; CSX trains from Worcester may be operated by PAS/Springfield Terminal Railroad (ST) crews traveling to Ayer. Norfolk Southern, via the Patriot Corridor, interchanges with PAR/PAS in Ayer. PAR also interchanges with CSX in Worcester.

The PAR/PAS owns approximately 216 miles of active railroad right-of-way in Massachusetts but operates on over 373 miles in the state (some via trackage rights). Rail ownership and operations of PAR are carried

out by its subsidiaries, the Boston and Maine Corporation (B&M), which is the property owner, and ST, which operates the railroad and in joint ownership with Norfolk Southern (NS) and Pan Am Southern. The PAR operates via haulage or trackage rights on MBTA-owned tracks and rights-of-way in Lowell and Tyngsborough. Trackage rights allow one railroad to use another railroad's track via a contract that pays the host railroad a fee for the use. Haulage rights are basically the same, but the host railroad supplies the train crew.

There are three principal freight rail corridors operating in the Northern Middlesex region. The freight main line which runs from Boston northwestward through the region into the Devens area has approximately six trains that operate daily, each carrying between 60 and 75 rail cars. The PAR/PAS Freight Main Line is the railroad's most important line within the Commonwealth. It runs 475 miles from northern Maine to eastern New York. The freight main line between New Hampshire and Boston is owned by the MBTA. The New Hampshire main line, which branches off from the freight main line in Lowell and runs through Concord, New Hampshire, has approximately four trains traveling in both directions daily, and trains run in both directions from the western portion of the state through Tewksbury and into New Hampshire. Actual figures for tonnage being moved are not available as the rail company is a private entity and considers the data proprietary.

## REGIONAL FREIGHT PLANNING ACTIVITIES

The Northern Middlesex MPO supports the national freight policy and MassDOT's statewide freight goals for improving infrastructure and promoting the efficient movement of goods along the transportation networks. The UPWP for the Northern Middlesex region contains a freight-planning task, which was established to enhance the regional freight system, both within the region and with outside connections to other freight movement networks. Regional freight planning is an ongoing process of system evaluation, supported by data collection activities such as traffic counting and pavement management programs. This system evaluation is used in the development of the RTP and in the identification of projects in the regional TIP.

Many of the infrastructure improvement projects recommended in this plan benefit the freight network and efficient goods movement. Examples of improvement projects along arterials affecting goods movement in the region include:

- **The Rourke Bridge Replacement project:** will serve to improve congestion on a major arterial connecting US Route 3 and the North side of the Merrimack River in Lowell.
- **Intersection Improvements at Andover Road (Route 133) and River Road in Tewksbury:** will improve overall traffic flow for freight movements between Lowell, I-93 and I-495 to the east.
- **Resurfacing of Route 38:** will improve pavement conditions and address access management, serving to reduce congestion along the main arterial in Tewksbury.

- **Route 113 Improvements in Dunstable:** will improve pavement conditions and realign skewed intersections to enhance traffic flow.
- **Rehabilitation of Route 3A:** will serve to improve traffic flow between Route 129, Route 3A and River Street in Billerica Center.
- **Traffic Signal Installation at I-495 and Route 110 in Chelmsford:** will improve overall safety and reduce congestion along Route 110 and at the interchange intersections.
- **Rehabilitation of Boston Road:** will improve roadway travel conditions between I-495, Route 110 and Westford Town Center.

## REGIONAL FREIGHT NETWORK

In Massachusetts, 225 million tons of goods are moved on an annual basis, with truck movements representing almost 90% of all freight movements in and out the state.<sup>2</sup> Whether freight arrives in Massachusetts or leaves the state by rail, ship or air, trucks typically provide the final link between freight terminals, manufacturers or distributors. Table 11.1 provides an overview of how goods are moved through the Commonwealth.

**Table 11.1: Freight Movement by Mode throughout Massachusetts**

Freight Mode	Within Massachusetts		Outbound from Massachusetts		Inbound to Massachusetts	
	Tons	%	Tons	%	Tons	%
Truck	118,681,122	99.0%	34,728,531	82.0%	45,799,603	72.3%
Rail	596,424	0.5%	1,483,652	3.5%	5,898,425	9.3%
Water	86,072	0.1%	3,233,252	7.6%	356,969	0.6%
Air	0	0.0%	136,166	0.3%	282,910	0.4%
Multiple Modes and Mail	185,534	0.2%	1,171,672	2.8%	2,550,927	4.0%
Pipeline	203,169	0.2%	1,604,489	3.8%	8,457,631	13.4%
Other	77,759	0.1%	2,228	0.0%	694	0.0%
<b>Total</b>	<b>119,830,079</b>	<b>100%</b>	<b>42,359,989</b>	<b>100%</b>	<b>63,347,159</b>	<b>100%</b>

Source FHWA Freight Analysis Framework Version 4.4

Nearly all in-state freight is transported by trucks and large percentages of freight shipped in and out of the state (72% and 82% respectively) are transported by trucks. Truck mobility tends to be most important during the early morning and midday hours, between the commute peak periods. The spreading of peak period congestion and delays due to traffic incidents also affects trucking operations. Table 11.2 details the top ten truck movements by commodity within Massachusetts in 2017.

<sup>2</sup> FHWA Freight Analysis Framework, 2017 Dataset.

**Table 11.2: Top Commodities moved by Trucks within Massachusetts Destinations**

Commodity	Truck Tons	% Share
Gravel	25,784,283	21.7%
Gasoline	24,316,546	20.5%
Nonmetal min. prods.	12,745,296	10.7%
Waste/scrap	12,517,086	10.5%
Fuel oils	8,273,627	7.0%
Natural sands	6,924,748	5.8%
Coal-n.e.c.	5,120,659	4.3%
Mixed freight	3,845,792	3.2%
Wood prods.	3,571,055	3.0%
Other foodstuffs	2,335,261	2.0%
<b>Total Tons</b>	<b>118,681,122</b>	<b>88.8%</b>

Source: FHWA Freight Analysis Framework. 2017

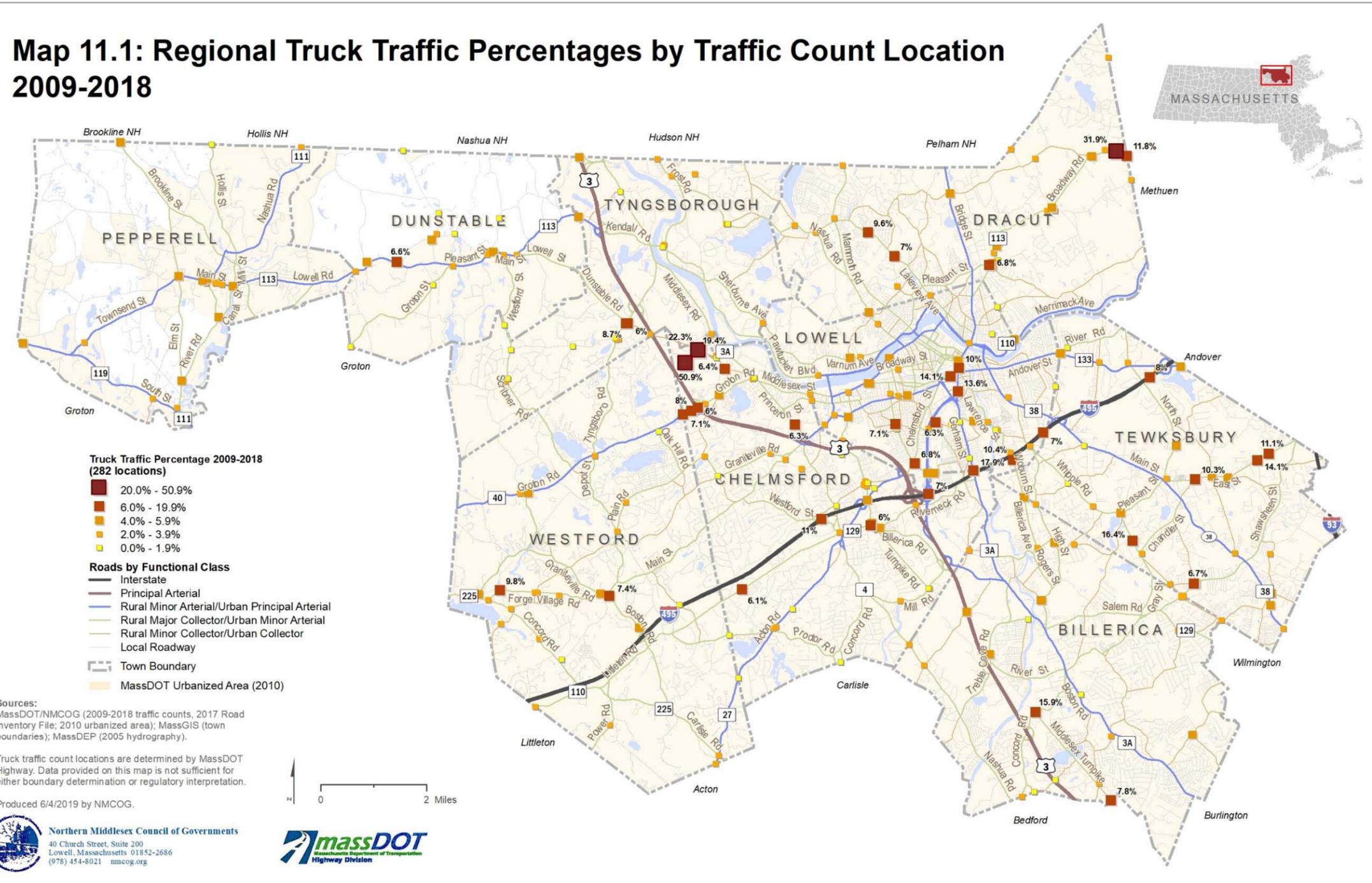
In the Northern Middlesex region, I-495 and US Route 3 carry the highest percentage of truck traffic. I-495 is a limited access highway that serves as an outer circumferential ring around the Boston area and allows trucks to access New Hampshire and Maine without traveling through the congested city of Boston. US Route 3 provides north-south truck access from I-95 in Burlington to major cities in New Hampshire, including Nashua, Manchester, and Concord.

## HEAVY VEHICLE MONITORING PROGRAM

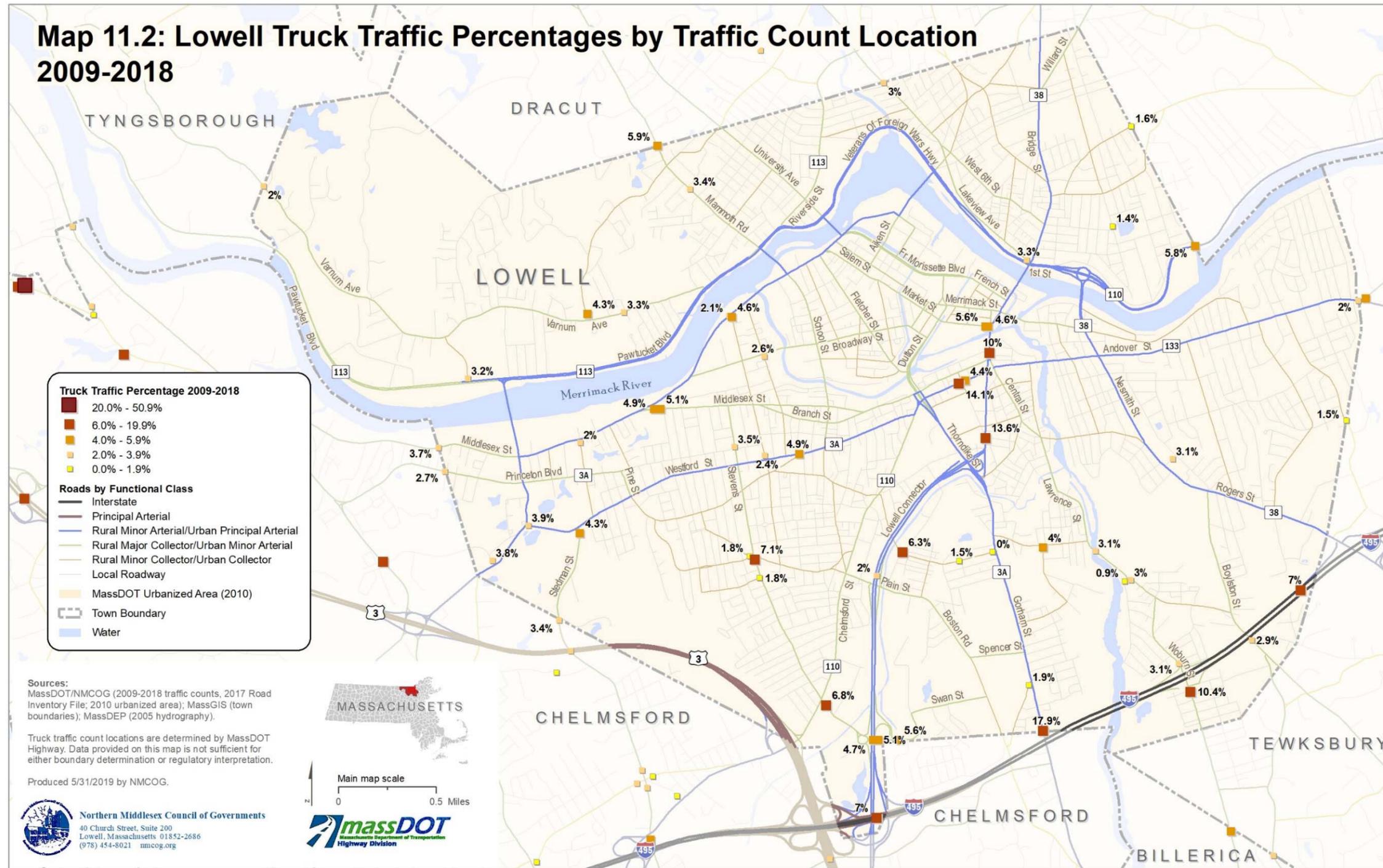
Vehicle classification counts are the basis for understanding freight movements on area roadways. Determining how many heavy vehicles travel on a roadway is key to identifying freight corridors in the region. NMCOG has collected vehicle classification data since 2005. Prior to 2005, MassDOT maintained the classification database, providing information to the MPOs as needed. MassDOT and NMCOG staff use the Federal Highway Vehicle Classification Scheme F Report to determine truck percentages at specific locations. Map 11.1 provides an overview of truck volumes on monitored roadways throughout the Northern Middlesex Region.

Ledge Road in Chelmsford carries the most trucks with 50.9 percent of its total traffic comprised of heavy vehicles. This roadway is functionally classified as a local, mostly residential road, but provides the only access to LeMeasureir Granite Quarry, located at the end of the road. Thus, high percentages of heavy vehicles traverse the road during the day. The Town of Chelmsford requested that NMCOG monitor the roadway for increases in heavy vehicular traffic. Commercial Drive in Dracut also carries high percentages (30.9%), mainly due to several freight companies as well as a school bus company located along this road. The region's interstate highway, I-495, experiences heavy vehicle traffic between 11% in Chelmsford and 17.9% in Tewksbury. U.S. Route 3, designated as a limited access principal arterial in the Northern Middlesex Region, actually has relatively low truck volumes, with trucks representing approximately 4-6 percent of the average daily traffic along the highway.

### Map 11.1: Regional Truck Traffic Percentages by Traffic Count Location 2009-2018



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## WEIGHT RESTRICTED BRIDGES

Many older bridges were designed for loads that no longer meet modern freight demands. As a result, weight restrictions have been placed on the use of these bridges to prevent premature structure failure or excessive damage. Weight restrictions, insufficient vertical clearance, and reduced speed limits on bridges often negatively affect the movement of freight and goods through the region. Beyond the economic impacts, freight drivers must find alternate routes, which extends travel time, uses more fuel, and harms the environment.

Currently, eighteen bridges in the Northern Middlesex region are posted as weight restricted, which represents approximately 8% of all bridges. As shown in Table 11.3 below, eleven of the weight-restricted bridges are located in the City of Lowell, including the canal bridges that are currently under construction. Additionally, twenty-two (22) bridges (11%) in the Northern Middlesex region have posted vertical clearances.

**Table 11.3: Weight Restricted Bridges in the Northern Middlesex Region, 2017**

Community	Bridge	Under Bridge
Billerica	Boston Rd. (Rte.3A)	Shawsheen River
Billerica	Faulkner St.	Concord River
Billerica	Route 129 (Salem Road)	Shawsheen River
Chelmsford	Meadowbrook Rd.	Canal
Chelmsford	Westford St	I-495
Dracut	Parker Ave	Beaver Brook
Lowell	Appleton St	Thorndike St.
Lowell	Beaver St	Beaver Book
Lowell	Father Morrissette Blvd	Western Canal
Lowell	French St	Merrimack Canal
Lowell	Lincoln St	Meadow Brook
Lowell	Market St	Merrimack Canal
Lowell	Market St	Western Canal
Lowell	Middlesex Rd	Thorndike St
Lowell	Pawtucket St	Pawtucket Canal
Lowell	VFW Highway	Beaver Brook
Lowell	Wood St. Extension (Rourke Bridge)	Merrimack River and Boston & Maine Railroad
Tewksbury	North St	I-495

Source: MassDOT

Certain vehicles, such as LRTA and UMass Lowell buses, fire trucks and commercial vehicles, are prohibited from using these spans and must find alternative routes, which can be difficult at times.

## FREIGHT RAIL

Historically, truck competition and burdensome economic regulations led to a decline in railroad service and, in the case of many northeastern railroads, bankruptcy. However, with the passage of the Staggers Act in 1980, which substantially deregulated the industry, the railroads have made a comeback, hauling 40% more traffic than they did during World War II on over 44% less track. According to the Association of American Railroads (AAR), there were 562 railroads of all sizes in the United States operating over 172,101 miles of track in 2008. Fourteen freight railroads operate in Massachusetts, the largest of which are CSX Transportation, Pan Am Railways, Providence and Worcester Railroad, and New England Central Railroad. These companies provide the major rail connections to the national system along the following corridors:

- The southern east-west route along the CSX Boston line, which connects to the CSX national system in Selkirk, NY, is the most heavily used freight rail corridor in Massachusetts.
- The northern east-west route, operated by Pan Am, connects to the Norfolk Southern Class 1 rail network in Mechanicville, New York, through a major rail yard in Ayer and with connections to New Hampshire and Maine.
- The most heavily used north-south route owned by NECR and P&W connects to the Canadian National rail network through Connecticut and Vermont.
- Short-line railroads such as the Housatonic, Pioneer Valley, Mass Central, and Mass Coastal provide key linkages to rail customers from longer-distance rail corridors.

MassDOT has responsibility for the care and custody of a portfolio of railroad properties, including one hundred (100) miles of active rail, thirty-five (35) miles of inactive right-of-way and eighty (80) acres of railroad property. Massachusetts acquired these properties in the 1980s to preserve rail service and freight lines that otherwise would have been abandoned. Currently, MassDOT has license and operating agreements in place with two railroads for two separate lines. Both of these lines lie outside of the region.

Rail is typically used to ship heavier bulk commodities and other goods over long distances. The delivery of such goods is generally not time-sensitive. Increasingly, many rail companies are able to provide on-time delivery, and these companies are expanding into the intermodal container and perishable goods markets. Goods moved by rail account for 6.5% of all freight movements in Massachusetts, according to the *Massachusetts Freight Plan*.

Pan Am Railways (PAR) directly serves the Northern Middlesex Region. In general, the region serves as the major connection for freight movement by rail between New Hampshire and Massachusetts, and both raw and completed materials pass through to their final destinations. Table 11.4 and Map 11.3 detail the active rail lines in the Northern Middlesex region.

**Table 11.4: Rail Lines in Northern Middlesex Region**

Rail Line	Location	Distance (miles)
<b>Active Rail Lines Owned by Pan Am</b>		
Former Lowell Secondary Track (out of service)	Lowell CBD to Industrial Avenue	3.8
Former Tewksbury Branch	Wamesit to Tewksbury Center	1.9
Billerica Branch (out of service)	Billerica Center to North Billerica	2.4
Stony Brook Freight Main Line	Willows (Ayer) to North Chelmsford	13.2
NH Route Branch	North Chelmsford to Lowell	3.2
Lowell Branch	Bleachery to Lowell Junction	7.9
NH Route Branch	Bleachery to Lowell	0.7
Northern Main Line	North Chelmsford to NH line	5.6

Source: MassDOT State Rail Plan

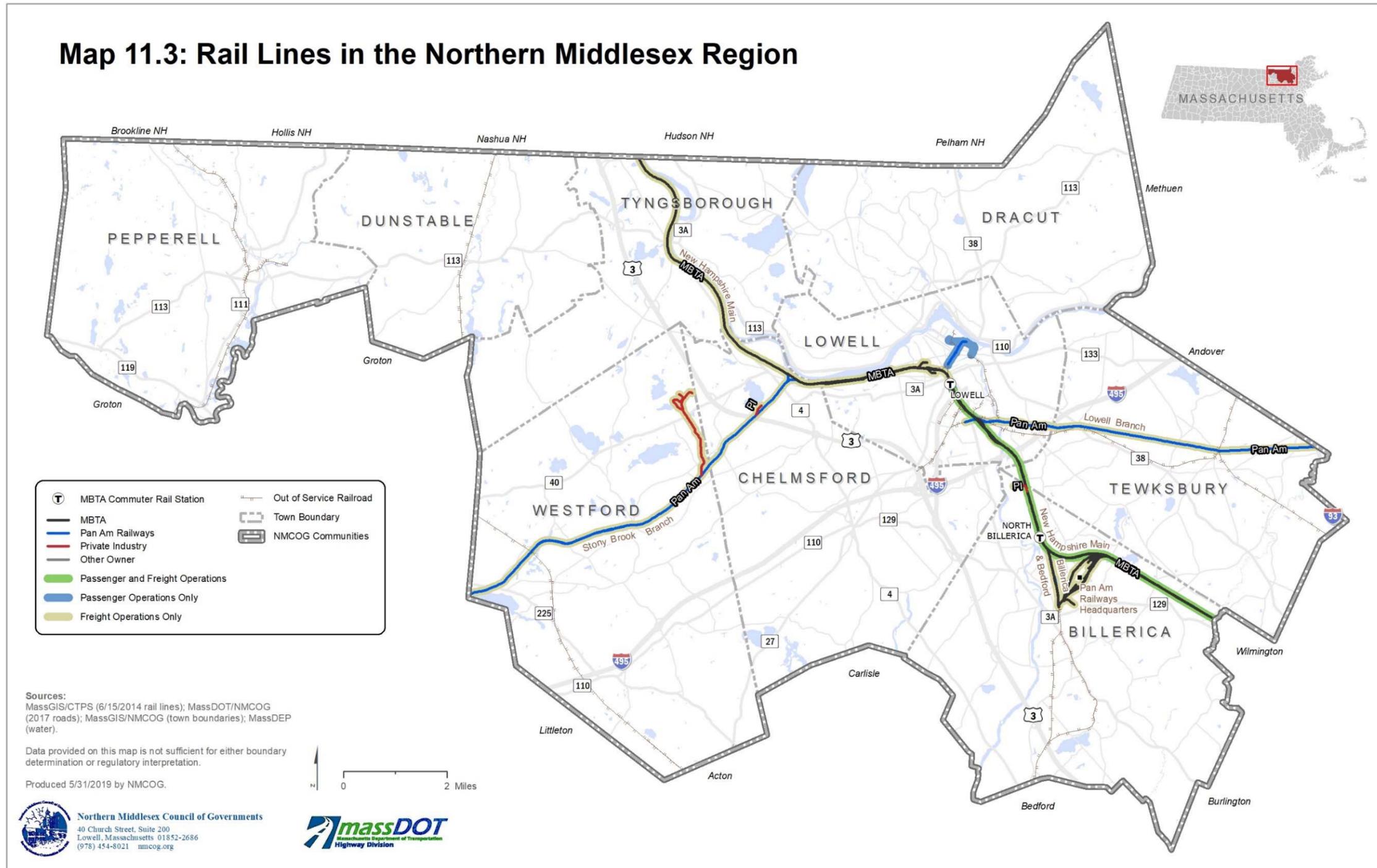
Existing freight railroad yards in the region are shown in Table 11.5 below. Currently there are no distribution or intermodal freight facilities that serve more than one user. There are many companies throughout the area that use rail for distribution; however, each facility serves only one company. There are few large (over 100 acres) sites available for freight activity inside the I-495 corridor.

**Table 11.5: Existing Freight Yards and Facilities**

City/ Town	Name of Facility	General Function	Other Information
Lowell	Turnout Yard	Merchandise Freight	Several tracks near Gallagher Transportation Center used for block swapping and local freight.
North Billerica	Shop Yard	Merchandise Freight	A number of consignees use various tracks in the old yard where the former B&M shops are located.

Source: MassDOT Rail Plan

### Map 11.3: Rail Lines in the Northern Middlesex Region



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Beyond the region, Ayer has proven to be an excellent location for intermodal transportation and distribution. The implementation of the Patriot Corridor, a joint venture between Norfolk Southern (NS) and Pan Am, will provide infrastructure upgrades such as intermodal facilities in Ayer and Mechanicville, NY. The upgrades significantly improve rail connections with the NS system and the rest of the United States. These improvements will increase competition with CSX and its Boston-Worcester-Selkirk, NY main line. This arrangement also created the Pan Am Southern Railroad, which is operated by Springfield Terminal Railroad (ST), a fully owned subsidiary of Pan Am. This new transportation system and facility benefits freight rail service throughout Massachusetts and helps this region compete with the major facilities in New York, Philadelphia, and Baltimore.

## MARITIME AND PORT FACILITIES

The major Massachusetts ports of Boston, Salem, Gloucester, New Bedford and Fall River ship and receive a variety of commodities both domestically and internationally. Goods moved by water account for 4.9 percent of all freight movements in Massachusetts, with the majority of goods consisting of petroleum and coal products. The ports of Boston and Portsmouth, New Hampshire are the major maritime facilities closest to the Northern Middlesex region. The ports are accessible to all Atlantic Ocean sea routes. The principal inland market areas associated with these ports are the mid-Atlantic, northeastern and mid-western states.

The marine terminals in Boston include both publicly and privately owned and operated facilities. The Massachusetts Port Authority (MassPort) is responsible for the overall management, safety, operation, and marketing of these facilities. The principal types of cargo handled by Massachusetts ports include:

- Petroleum and other fuels;
- Dry bulk cargo, such as waste, cement, scrap metal, gypsum, salt and stone;
- Containerized cargo including machinery, frozen fish and electronics;
- Non-fuel liquids, such as vegetable oils and chemicals; and
- General cargo including automobiles, fresh fruit, waste paper, iron and steel.

Conley Terminal, located in South Boston, serves three of the world's top ten container lines and handles nearly 1.5 million metric tons of cargo each year.

## NATURAL GAS PIPELINES

The U.S. natural gas pipeline network is a highly integrated transmission and distribution grid that can transport natural gas to and from nearly any location in the continental U.S. There is currently one major interstate pipeline located in the region.

The Maritimes & Northeast Pipeline delivers natural gas from the Sable Offshore Energy Project to markets in Atlantic Canada and the Northeast United States. The Maritimes pipeline system consists of a

670-mile underground pipeline running from Goldboro, Nova Scotia, through Nova Scotia and New Brunswick, to the Canadian-U.S. border near Baileyville, Maine. The pipeline continues through Maine and New Hampshire into Massachusetts, where it connects with the existing North American pipeline grid in Dracut. With the completion of the Maritimes Phase III project, the pipeline now extends from Methuen to Beverly, interconnecting with the Algonquin Gas Transmission Company system. Maritimes is owned by Spectra Energy Partners, ExxonMobil Corporation and Emera, Inc.

## AIR FREIGHT FACILITIES

Air freight is a small but growing mode of transport in Massachusetts, often used for carrying high-value and time-sensitive cargo. Given that the state and the region are centers of high-tech manufacturing in such sectors as biotechnology, nanotechnology, pharmaceuticals, defense and information technology, air freight is critical to future economic prosperity. Air freight is projected to grow more quickly than other modes of goods transport.

All major air freight activities in Massachusetts are handled at Boston's Logan Airport. In 2018, Logan Airport moved 704,200,557 tons of cargo (including mail), making it the one of the busiest airports in the U.S in terms of cargo.<sup>3</sup> While there are no major airports in the Northern Middlesex region, both Logan Airport and Boston-Manchester Regional Airport are within an hour drive. These airports, along with a general aviation airport at Hanscom Field in Bedford, MA, provide air freight connections for the region. Manchester, New Hampshire and Boston are served by major air freight carriers, including FedEx and UPS.

There is one small private airport in the Northern Middlesex region located in Pepperell. It is owned by the Pepperell Airport Trust and prior permission is required for landing.

## CURRENT FREIGHT MOVEMENTS

Goods in Massachusetts are typically delivered by truck, rail, air or ship. Massachusetts is a destination for freight given its large consumer markets, relatively high per capita income, and the dominant role of service and high-tech industries. A well performing freight system is essential for the state's industries, particularly given the importance of receiving bulk products by rail or sea, and shipment of high-value goods to domestic and international markets.

Freight is typically measured by weight in tons; however, the value of freight is also a major consideration. In Massachusetts, as in the nation overall, the value of freight tends to increase more quickly than its weight. Both the value and the weight increase over time as the economy grows. Freight

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<sup>3</sup> MassPort

can also be measured in ton-miles, which is the weight multiplied by the miles traveled. When this measure increases more quickly than weight, it indicates that more goods are being shipped further away and that markets are expanding.

A major freight planning challenge at the regional level is the collection of new and robust localized data specific to the region. More specifically, some of the limitations related to local freight data collection include:

- Difficulty in obtaining proprietary data from private sources;
- Privately-maintained data sets are costly and require extensive analysis;
- Publicly available data often lacks industry detail due to privacy concerns;
- Inaccurate or nonexistent local-level commodity flow data;
- Inconsistency of data across different modes of transportation;
- Limitations in local applicability of national data, which typically results in less than robust data; and
- Discontinuation of certain current data collection processes that could provide critical data at various geographic levels.

As a result of the above limitations, NMMPO staff analyzed commodity flow data for Massachusetts available through FHWA's Freight Analysis Framework. This data tabulation tool integrates data from a variety of sources to create a comprehensive picture of freight movement among states by all modes of transportation. Total flows include those between domestic origins and destinations and includes both domestic and foreign shipments.

Appendix G presents information on Massachusetts freight shipments by weight and mode for 2012 and 2017, and provides projections through 2040. It also provides information by value and mode for the same years. This data indicates that trucks move the vast majority of the weight and value of freight within, from and to Massachusetts. High rates of growth in freight movement indicate continued need for transportation investments. In the future, the majority of commercial goods are likely to move by truck, while some will move by rail. Attention to rail capacity and investment in major highways will be needed to support continued economic growth. High growth in freight shipped abroad is expected, suggesting an increasing importance for establishing intermodal facilities.

Appendix G also details the top commodity groups shipped to, from and within Massachusetts for all modes in 2012, 2017, and projected to 2040, by weight and value. Gravel was the top commodity shipped by weight within the state, gasoline from the state, and coal to the state in 2017. Gasoline was the top commodity shipped within Massachusetts by value, at \$25 billion dollars in 2017. Electronics was the top valued commodity shipped from Massachusetts in 2017, at approximately \$21 billion. Mixed freight was the top valued commodity shipped to the state in 2017, at approximately \$24 billion. Projecting to 2040, the growth in the consumer market, the volume of through traffic, and the

specialized shipping needs of high value-added goods could lead to increased goods movement in Massachusetts.

## FREIGHT MOVEMENT CHALLENGES AND OPPORTUNITIES

Regional freight mobility is driven by broad national and international trends. These include federal deregulation of the carrier industries and related international trade trends. New technologies are being used for container shipping. Business and manufacturing efficiencies now rely on outsourcing such that final assembly of products depends upon precise and reliable delivery schedules.

As the Massachusetts and regional economies become more service-based, freight is increasingly concentrated on high-value, low weight products that are shipped in smaller packages and require faster delivery. Despite a drop in the share of jobs within the manufacturing sector, manufacturing output has increased over the past decade. Much of this growth has been in high-value, low weight products such as electronic instruments and medical devices. This fast growth in value of smaller shipments is supported by just-in-time inventory systems, which reduce inventory carrying costs and overall logistics costs.

Freight concerns largely involve mobility and access issues. Mobility issues focus on efficient and reliable traffic conditions on the region's highways and major arterials, as well as grade crossings on freight railroad lines. Access issues deal with roadway geometrics, intermodal interchanges, bridge clearances, and the need to provide efficient connections to major freight facilities.

According to FHWA, several key challenges face the freight transportation industry including:

1. Congestion and expanding capacity;
2. Improving systems operations;
3. Planning and financing freight projects;
4. Safety and environmental effects of freight transport;
5. National security; and
6. Building professional capacity in the freight sector.

The transportation network capacity has not increased at a rate equivalent to the growth in travel and commerce. When demand exceeds supply, the resulting congestion can have a highly negative effect on freight transportation speed and dependability. This can be devastating for businesses that increasingly rely on tightly integrated operations, limited inventory, and just-in-time manufacturing and retailing.

Existing barriers to and potential opportunities for the efficient movement of goods by highway and rail in the Northern Middlesex region and throughout Massachusetts, as outlined in the *Massachusetts Freight Plan*, include the following:

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## AGING INFRASTRUCTURE

The age of infrastructure within Massachusetts and the region has resulted in a need for significant improvements to accommodate existing freight movements and to support the heavier loads that are becoming standard in the freight industry. The Association of American Railroads (AAR) estimates that \$148 billion is needed nationally for freight rail investment. Support for funding such freight infrastructure projects remains challenging.

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## BRIDGE DEFICIENCIES

Bridges are a critical link in the highway network. In the Northern Middlesex region, there are (thirteen) 13 bridges listed as structurally deficient. Bridge weight limits, overweight route restrictions, municipally imposed truck exclusions, and hazardous material restrictions can result in longer truck routes or the use of less appropriate streets. The MassDOT Accelerated Bridge program has reduced the number of structurally deficient bridges statewide, but in the Northern Middlesex region, the number of structurally deficient bridges has remained constant since the 2016 RTP.

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## LOW VERTICAL CLEARANCE

Many rail corridors do not meet sufficient vertical clearance (20'8") to support second-generation double-stack intermodal container traffic. Containers are now the dominant form of moving finished goods internationally via container ship. There are currently no double stack container routes within Massachusetts. If clearances were to improve, it would make rail more competitive in Massachusetts by increasing efficiency and capacity per trip. According to the *Massachusetts Freight Plan*, full double-stack vertical clearance on the Pan Am Southern line was identified to have produced a high return on investment.

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## WEIGHT

Over the years, freight railroads have shifted their weight-on-rail from the traditional standard of 263,000 pounds to a heavier gross weight of 286,000 pounds for individual rail cars. The shift increases competitiveness by allowing for more efficient and cost effective transportation of heavy bulk goods.

Only three railroads in the state have been approved for 286,000 lbs. The entire CSX Boston Line is rated to carry cars weighing up to 315,000 lbs. (although secondary tracks are generally rated at 263,000 lbs). The entire Housatonic Railroad and limited sections of the Providence and Worcester line are rated to carry 286,000 lb. cars.

All other railroad lines in the state, including those in the Northern Middlesex region, are currently rated at 263,000 lbs. However, the creation of PAS (as part of the Patriot Corridor project) is anticipated to

increase the allowed weight on this rail line from 263,000 lbs to 286,000 lbs from Mechanicville, New York to Ayer, Massachusetts.

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## RAILROAD GRADE CROSSINGS AND FREIGHT SAFETY

Railroad grade crossings present a safety problem throughout Massachusetts. Unsafe or inadequate crossings can increase the risk of train and vehicle collisions resulting in potential loss of life, equipment, goods and time. Prior studies have shown that about half of the accidents occur at crossings that are equipped with active warning device, bells, gates and lights (AAR). From 2014 to September 2017, there have been a total of 43 incidents at highway-rail crossings in Massachusetts, of which 8 were fatal.<sup>4</sup>

On a national level, FHWA is actively working to address issues related to grade crossing accidents. As of December 2018, the United States had 211,256 at-grade rail crossings. Of the public crossings, 130,822 have gates, 52,208 have other activated crossing such as signals or bells, and 18,270 have passive warnings such as signage. In 2018, there were 2,211 incidents at public highway-rail crossings in the United States resulting in 265 deaths, and 834 injuries<sup>5</sup>.

In Massachusetts, the Department of Public Utilities (DPU) has responsibility and regulatory authority for grade crossing safety. Federal funds are available under Section 130 of federal surface transportation law to assist in eliminating or mitigating hazards at public highway-railroad grade crossings. The MassDOT Highway Division administers these funds and works with the railroads and communities to identify and construct priority projects. The MassDOT Grade Crossing Program focuses on improving safety at existing highway-railroad grade crossings primarily through the installation of warning devices. Such devices include: standard signs and pavement markings; installation or replacement of active warning devices (flashers and gates); upgrading active warning devices, including track circuitry improvements and interconnections with highway traffic signals; crossing illumination; crossing surface improvements; and general site improvements.

Maintenance and repair of highway-railroad grade crossing warning device equipment are the responsibility of the railroad owner. The FRA has established minimum inspection requirements for railroad maintenance of the warning systems, and each operating railroad is responsible for inspecting crossing system signals and equipment.

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<sup>4</sup> [https://www.mass.gov/files/documents/2018/01/26/2018PubComm\\_1.pdf](https://www.mass.gov/files/documents/2018/01/26/2018PubComm_1.pdf)

<sup>5</sup> Source: Federal Railroad Administration, Office of Safety Analysis

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## TRAFFIC CONGESTION, DELAY, AND BOTTLENECKS

The trucking industry is hindered by the same traffic congestion that affects automobile traffic. Congestion, delays, and “bottlenecks” that occur along roadways and at intersections adversely impact travel time and air quality. It also affects the cost and efficiency of truck transport and, subsequently, the reliability required for just-in-time delivery. Congestion is occurring at a time when the need for reliable truck travel is likely to increase significantly.

According to the *Massachusetts Freight Plan*, traffic congestion continues to grow with over 93 million hours of person delay on Massachusetts highways. Trucks are rarely more than 15 percent of traffic volume on Massachusetts highways and are estimated to be less than 9 percent of all traffic on key Northern Middlesex area highways<sup>6</sup>. Traffic bottlenecks with heavy truck and automobile volumes in the region include sections of I-495, Route 3, and the Lowell Connector.

Traffic congestion and delay will continue to increase as the region’s traffic volumes grow. Massachusetts moves a high volume of goods by truck and a relatively low volume by rail. Although geographic and market characteristics limit the potential for significant mode shifts, a more diverse multi-modal system would help relieve some roadway congestion problems. In addition, shifting some future freight growth from the highway to rail could produce environmental benefits and reduce energy consumption.

In order to improve freight operations, emphasis is now being placed on better management of public infrastructure and the use of intelligent transportation system (ITS) technologies. As a part of highway and trucking operations, ITS is used to monitor traffic conditions and provide information on traffic incidents. In the Northern Middlesex region, infrastructure such as variable message signs, closed circuit cameras, and real time travel time signs are being put into place on I-495, Route 3, the Lowell Connector and I-93. This is important as federal, state, and local policymakers, as well as the private sector, are making major capital investments to eliminate freight bottlenecks and ensure capacity for future growth.

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## TRAFFIC DESIGN

Traffic design issues often contribute to a less reliable freight network. For example, turning radii on narrow roads or encroachment of structures may be an issue for shippers and motor freight carriers. Common roadway design considerations for truck activities include intersection design, cross-section and geometric design, signalization, and grade separation.

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<sup>6</sup> 2017 NMCOG Traffic Volume Report

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## TRUCK IMPACTS ON ROADWAYS

The high truck volumes associated with freight transport significantly impact pavement and bridge conditions, require more energy per ton-mile traveled, and result in greater emissions as compared to freight shipped by rail. Improving and preserving conditions along existing freight routes would prevent wear and tear on roadways that are not designed to handle such loads, and would lessen community and environmental impact.

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## LACK OF TRUCK STOP FACILITIES

A lack of rest areas (or truck stops) can impact safety as a result of driver fatigue. It can also impact logistics due to overcrowding at existing truck stop facilities. Truck parking demand at some rest areas tends to exceed supply, which may also lead to trucks parking in unsafe, poorly lit areas. The Northern Middlesex region contains two rest areas along I-495 in Chelmsford (one SB and one NB) and there are no truck weigh stations within the region.

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## RAIL NETWORK DEMAND

While the rail network in Massachusetts represents only 25 percent of the entire rail network in New England, it carries more than 40 percent of all freight moving through New England. There are increasingly clear benefits to moving goods by rail versus alternative modes. Relatively high fuel prices tend to make freight rail more competitive with trucks as rail has “per ton mile” advantages of lower shipping costs, greater energy efficiency, and less air emissions. Diverting freight to rail will reduce trucks on roadways, which will relieve highway congestion, reduce the number of highway crashes, and lessen pavement damage.

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## RAIL ACCESS

Development pressures on land adjacent to rail have reduced the potential pool of rail-served businesses. Many existing businesses along rail lines need to build or upgrade the rail sidings that serve them. Additionally, new industrial sites often lack rail access. This infrastructure expense is generally far higher than most highway connections and thus limits opportunities to ship by rail.

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## SHARED USE RAIL NETWORKS

In Massachusetts, much of the freight rail system operates on corridors that also have commuter and/or intercity rail passenger service. While shared use rail operations allow for cost sharing benefits, they also create challenges with finances, liability, scheduling and dispatch, safety, and the need for suitable switching and signal equipment. Shared use operations often require investment to install double-tracking and passing sidings for the most heavily traveled routes such as on the Northeast Corridor,

Worcester-Boston route and the Down-easter route. Privately owned freight rail providers generally finance rail improvements through current cash flow based on expectations of future demand. As passenger and freight rail needs exceed capacity, conflicts with shared corridors may become more apparent.

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## INTERMODAL CONNECTION

Principal intermodal shipments to the state and region are related to container/trailer movements via rail cars. The purpose of these types of shipments is to allow a container/trailer to move from origin to destination without opening the container/trailer for re-handling or repacking. Within Massachusetts, there is a need for improved “last mile” connections to other modes – rail, air, and maritime.

Even though there are no intermodal facilities located in the Northern Middlesex region, the rail-to-truck intermodal traffic generated in Worcester has increased heavy truck traffic along I-495 through the region.

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## LAND USE CONFLICTS

For freight system users and operators, access to transportation and freight facilities (e.g., warehouses, distribution centers, intermodal yards, and other facilities) is very important and will frequently dictate where and how they locate. Freight system users often locate where transportation corridors converge. Communities could work to guide warehouse and distribution center development to appropriate locations for sustainable freight movement by taking into account modal accessibility needs and adjacent land uses. Freight transportation activity often conflicts with other land uses. Implementing regulatory changes with sustained policy incentives to preserve and strategically locate freight activities has been challenging.

The *Massachusetts Freight Plan* recommends a policy to provide collaborative guidance and support to MPOs and local governments in integrating freight, distribution and loading into their planning and zoning and land use decision-making processes. Research notes that increasing freight traffic, decreasing popular familiarity with the supply chain, growth in the US population, and downward cost pressure have contributed to a need for good neighbor policies between freight users and local communities. Key components of this recommendation include strategies to address:

1. Communication;
2. Traffic flow and congestion;
3. Safety;
4. Economic Development; and
5. Environment and quality of life.

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## PUBLIC-PRIVATE PARTNERSHIP CHALLENGES

Most freight transportation issues are linked to passenger transportation. Many rail corridors are subject to complex ownership and operation agreements between private freight railroads and public passenger services by Amtrak or the MBTA. This shared usage of tracks presents the challenge of scheduling to avoid bottlenecks but also provides an opportunity for public-private partnerships to fund improvements.

# CHAPTER 12 LINKING TRANSPORTATION AND ECONOMIC DEVELOPMENT

The economic competitiveness of the Greater Lowell region depends largely on the quality of our transportation system. The Northern Middlesex region is well served by the highway network provided through I-495, I-93 and Route 3, as well as the local street network. The widening of Route 3 generated economic benefits for the region, while addressing critical traffic and safety issues. Transportation infrastructure improvements in the region have encouraged private investment in our member communities, thus generating state and local taxes and creating valuable private sector jobs. Private businesses are able to access labor, supply and customer markets through this efficient transportation network. Further public and private investment in the transportation network, including locally initiated projects such as the Middlesex Turnpike, fuels the growth of the Greater Lowell economy.

## SUPPORTING ECONOMIC DEVELOPMENT THROUGH TRANSPORTATION DEVELOPMENT

Within the introduction of this document, the goal established for the Economic Vitality component of the Regional Transportation Plan (RTP) reads as follows: *Ensure that the transportation network supports economic development needs and accommodates future economic growth.* This RTP supports projects, programs and policies that:

- Advance corridor and community development and redevelopment opportunities to improve the region's economy and enhance the quality of life;
- Prioritize transportation investments that serve targeted development sites;
- Advance strategies to support connections between key employment origins and destinations;
- Expand transit service to regional employment markets that are either underserved or not currently served;
- Improve bicycle and pedestrian access to employment, educational, health care, and recreational opportunities; and
- Connect multi-family and affordable housing with employment and educational opportunities.

At the federal level, there has been increased discussion of tying together the transportation, economic development, community development, workforce development and environmental planning programs undertaken by regional planning agencies, MPOs, and local communities. The Economic Development Administration (EDA), for instance, has outlined measures by which regional planning agencies can tie together their planning efforts in other functional areas, so that there is a more comprehensive approach to planning for sustainable development. The NMMPO has long recognized the need to support the transportation and economic development initiatives by combining these components within a single element in the UPWP.

This chapter provides an overview on how each transportation and economic development component supports the region’s efforts to increase employment opportunities and enhance the quality of life. A summary of the economic development planning processes that the region follows in working with the *Regional Strategic Plan for Greater Lowell*, the Greater Lowell Comprehensive Economic Development Strategy (CEDS) and with local communities will be provided, along with a description of how those activities support the Economic Goals and Objectives within this RTP. Additionally, there is discussion on how the initiatives and projects undertaken through the region’s economic development planning initiatives, particularly the *Greater Lowell Comprehensive Economic Development Strategy (CEDS) Update for 2020-2024* and the *Regional Strategic Plan for Greater Lowell*, are implemented and how they rely on transportation projects and programs. The implementation of these initiatives relies on numerous federal, state and local funding sources, including the federal and state highway and transit funds, public works funds from EDA, and the Commonwealth’s MassWorks and District Local Technical Assistance (DLTA) programs.

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## ECONOMIC DEVELOPMENT PERFORMANCE MEASURES AND TARGETS

In order to determine whether the transportation initiatives under the RTP meet the Economic Development Goals and Objectives, specific performance measures and targets have been established as follows:

- Number of businesses formed;
- Number of Affordable Housing facilities served by transit;
- New jobs created;
- Number of new transit routes to serve employment centers, health care facilities, and educational facilities;
- Increase in population residing within ¼ mile of a transit station or route by 5%, as compared to 2016;<sup>1</sup> and
- Increase in population residing within ½ mile of bicycle facilities by 15%, as compared to 2016.<sup>2</sup>

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<sup>1</sup> The 2016 RTP included places of employment within one quarter of a mile of a transit route and a half-mile of bicycle facilities as performance measures and targets. However, the data source for the physical locations of places of employment contained significant inaccuracies. Therefore, places of employment has been removed from the 2020 RTP performance measures and targets, while NMCOG assesses the availability of another data source.

<sup>2</sup> Ibid.

## NUMBER OF BUSINESSES FORMED

The Northern Middlesex region has attracted a substantial number of new businesses since the end of the 2008 recession. As shown in Table 12.1 below, between 2010 and 2018 the region saw a 29.4% increase in the number of businesses, with over half of the business creation (1,445) occurring in Lowell. Similarly, the period from 2014 to 2018 saw a 15.5% growth in the number businesses, with over half of the new businesses (789) locating in Lowell. Compared with other communities in the region, Lowell experienced the largest percentage increase during both periods, with 72.4% growth between 2010 and 2018 and 29.8% growth between 2014 and 2018. Lowell has the greatest level of transit coverage in the region and is home to one of the region’s two MBTA rail stations.

**Table 12.1: Number of Businesses Formed 2010-2018**

Community	2010	2014	2018	New Businesses 2010 to 2018	Percent Change 2010 to 2018	New Businesses 2014 to 2018	Percent Change 2014 to 2018
Billerica	1,160	1,213	1,305	145	12.50%	92	7.60%
Chelmsford	1,098	1,136	1,198	100	9.10%	62	5.50%
Dracut	571	625	684	113	19.80%	59	9.40%
Dunstable	61	61	79	18	29.50%	18	29.50%
Lowell	1,995	2,651	3,440	1,445	72.40%	789	29.80%
Pepperell	231	233	263	32	13.90%	30	12.90%
Tewksbury	838	841	909	71	8.50%	68	8.10%
Tyngsborough	361	364	388	27	7.50%	24	6.60%
Westford	651	678	745	94	14.40%	67	9.90%
<b>Total</b>	<b>6,966</b>	<b>7,802</b>	<b>9,011</b>	<b>2,045</b>	<b>29.40%</b>	<b>1,209</b>	<b>15.50%</b>

Source: Massachusetts Executive Office of Labor and Workforce Development, [www.mass.gov/orgs/labor-market-information](http://www.mass.gov/orgs/labor-market-information), accessed 5/30/2019.

## NUMBER OF AFFORDABLE HOUSING FACILITIES SERVED BY TRANSIT

As of February 2019, there were 9,121 housing units in 162 facilities identified by the Department of Housing and Community Development as Chapter 40B Subsidized Housing within one-half mile of a transit route. This number will be used as a baseline for tracking future progress in providing transit service to affordable housing facilities in the region. For the purpose of this analysis, transit routes include LRTA bus routes, MBTA commuter rail stations, MBTA bus routes, Merrimack Valley Regional Transit Authority bus routes, and Nashua Transit System bus routes.

## NEW JOBS CREATED

The Northern Middlesex region has experienced significant job growth since the end of the last recession. As shown in Table 12.2 below, between 2010 and 2018 the number of jobs in the region increased by 15.2%, with more than one-third of the job growth (5,138) occurring in Lowell and more than one-quarter of the job growth (4,627) occurring in Billerica. Between 2014 and 2018, the region

experienced an 8.4% increase in jobs, with over half (4,569) of new jobs locating in Lowell and more than one-quarter (2,509) locating in Billerica. As mentioned above, Lowell has the most extensive level of transit route coverage in the region. MBTA commuter rail stations are located in the City of Lowell and in North Billerica.

**Table 12.2: New Jobs Created 2010-2018**

Community	2010	2014	2018	New Jobs 2010 to 2018	Percent Change 2010 to 2018	New Jobs 2014 to 2018	Percent Change 2014 to 2018
Billerica	18,024	20,142	22,651	4,627	25.7%	2,509	12.5%
Chelmsford	19,979	21,194	20,801	822	4.1%	(393)	-1.9%
Dracut	4,212	5,502	5,215	1,003	23.8%	(287)	-5.2%
Dunstable	153	153	245	92	60.1%	92	60.1%
Lowell	27,118	27,687	32,256	5,138	18.9%	4,569	16.5%
Pepperell	1,186	1,314	1,405	219	18.5%	91	6.9%
Tewksbury	13,222	12,752	14,295	1,073	8.1%	1,543	12.1%
Tyngsborough	3,587	4,068	4,018	431	12.0%	(50)	-1.2%
Westford	10,340	11,209	11,838	1,498	14.5%	629	5.6%
<b>Total</b>	<b>97,821</b>	<b>104,021</b>	<b>112,724</b>	<b>14,903</b>	<b>15.2%</b>	<b>8,703</b>	<b>8.4%</b>

Source: Massachusetts Executive Office of Labor and Workforce Development, [www.mass.gov/orgs/labor-market-information](http://www.mass.gov/orgs/labor-market-information), accessed 5/30/2019.

#### NUMBER OF NEW TRANSIT ROUTES TO SERVE EMPLOYMENT CENTERS, HEALTH CARE FACILITIES, AND EDUCATIONAL FACILITIES

In August 2017, the LRTA began operating the #20 Downtown/UMass North bus route. This route offers direct connections between UMass North Campus, Downtown Lowell and the UMass Lowell Inn and Conference Center on weekdays from 7:15 a.m. to 11:00 a.m. throughout the school year. Open to the general public, the #20 route enables a direct connection from north of the Merrimack River to Downtown Lowell, without requiring a transfer at the Kennedy Bus Hub. The Downtown Lowell route served by route #20 encompasses much of central business district, a significant employment center. In addition, UMass Lowell is the largest higher educational facility in the region and is also a major employer. Middlesex Community College’s principal facilities in Lowell and the Lowell General Hospital Saints Campus are within a quarter mile of the route.

Since the 2016 RTP, the LRTA has altered the routes #7, #9 and #20 to include the University Crossing stop at UMass Lowell, thereby improving the interconnectedness of the Downtown Lowell routes. In 2017, the LRTA and UMass Lowell collaborated on a transit program whereby the LRTA charges the University directly for rides taken by UMass students. The students are allowed to ride LRTA buses without paying a fee, significantly increasing the number of potential riders served by the LRTA system.

In early 2019, the LRTA was awarded a state grant to begin a nine-month Sunday service pilot. The new service will begin on June 16, 2019 with ten bus routes operating between 10:00 a.m. and 6:00 p.m. At

the end the nine-month pilot, the State and LRTA will analyze the effectiveness of Sunday service to determine whether it will be continued.

**POPULATION AND PLACES OF EMPLOYMENT INCREASE WITHIN ¼ MILE OF A TRANSIT STATION OR ROUTE, BY 5% AS COMPARED TO 2011**

As illustrated in Table 12.3 below, population within a quarter mile of a transit station or route grew by 4.1% between 2011 and 2016. However, the number of businesses within a quarter mile of a transit station or route shrank by 0.5%, or by 24 businesses, during the same time period.<sup>3</sup> This slight decline in businesses occurred despite a corresponding region-wide growth in the number of businesses, as discussed on page 12-3. . For the purpose of this analysis, transit routes include LRTA bus routes, MBTA commuter rail stations, MBTA bus routes, Merrimack Valley Regional Transit Authority bus routes, and Nashua Transit System bus routes.

**Table 12.3: Population and Places of Employment within One-Quarter Mile of a Transit Station or Bus Route**

	2011	2016	2011 to 2016 Change	2011 to 2016 Percent Change
Population residing within 0.25 miles of a transit station or route	131,501	136,953	5,452	4.1%
Businesses located within 0.25 miles of a transit station or route	7,070	7,036	(34)	-0.5%

Source: 2011 and 2016 American Community Survey and 2011 and 2016 InfoGroup

**INCREASE IN POPULATION AND PLACES OF EMPLOYMENT WITHIN ½ MILE OF BICYCLE FACILITIES-BY 15% AS COMPARED TO 2011**

The population residing within a half-mile of a bicycle facility grew by 5.0% between 2011 and 2016, as illustrated in Table 12.4. However, despite the regional growth in businesses since 2010 described above, the number of businesses within a half mile of bicycle facilities actually shrank by 1.0%, or 47 businesses, during the same time period. For the purpose of this analysis, bicycle facilities include paved off-street bike trails across the region, as well as Lowell’s bike lanes, sharrows and shared use bike lanes.

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<sup>3</sup> 2016 is the most recent data available for the physical locations of businesses

**Table 12.4: Population and Places of Employment Located within 1/2 Mile of a Bicycle Facility**

	2011	2016	2011 to 2016 Change	2011 to 2016 Percent Change
Population residing within 0.5 miles of a bicycle facility	118,956	124,916	5,960	5.0%
Businesses located within 0.5 miles of a bicycle facility	4,774	4,727	(47)	(1.0%)

Source: 2011 and 2016 American Community Survey and 2011 and 2016 InfoGroup

## REGIONAL STRATEGIC PLAN FOR GREATER LOWELL

NMCOG received funding from the Massachusetts Executive Office of Housing and Economic Development (EOHED) to develop and complete a Regional Strategic Plan (RSP) for the Northern Middlesex region. This state initiative to “increase local and regional planning capacity in the areas of economic development, housing and resource preservation” helped NMCOG update its previous regional policy plan, *2020 Vision: Planning for Growth in the Northern Middlesex Region*, which was completed in 1999. The RSP provides guidance to local and regional decision-makers on land use, infrastructure investment, environmental resource protection and housing and economic development policy. Within the document, there are various strategies for advancing housing initiatives and economic development through cooperative efforts between local, state and regional levels of government, as well as increased interaction and coordination with federal agencies.

The RSP fully supports the Sustainable Development Principles established by the Commonwealth as follows:

1. Concentrate Development and Mix Uses
2. Advance Equity
3. Make Efficient Decisions
4. Protect Land and Ecosystems
5. Use Natural Resources Wisely
6. Expand Housing Opportunities
7. Provide Transportation Choice
  - a) *Maintain and expand transportation options that maximize mobility, reduce congestion, conserve fuel and improve air quality. Prioritize rail, bus, boat, rapid and surface transit, shared-vehicle and shared-ride services, bicycling, and walking. Invest strategically in existing and new passenger and freight infrastructure that supports sound economic development consistent with smart growth objectives.*
8. Increase Job and Business Opportunities

- b) *Attract businesses and jobs to locations near housing, infrastructure, and transportation options. Promote economic development in industry clusters. Expand access to education, training and entrepreneurial opportunities. Support the growth of local businesses, including sustainable natural resource-based businesses, such as agriculture, forestry, clean energy technology and fisheries.*

9. Promote Clean Energy

10. Plan Regionally

The development of the RSP involved a public input process that included two Visioning Sessions. The first session was held at the UMass Lowell Inn and Conference Center. This session provided attendees with an overview of the planning project and with information regarding the proposed Land Use Reform Act (LUPA). In addition, a SWOT Analysis (Strengths, Weaknesses, Opportunities and Threats) was performed as a means of gathering input and ideas to be used in the formulation of the RSP goals. Draft goals were developed and discussed at the second SWOT session, held in Tewksbury, and input was received on the priority development and priority preservation areas in the region.

In addition to the public visioning sessions, numerous meetings with local officials and municipal staff were held to collect data, and receive input and feedback relative to the identification of the priority development and preservation areas. The RSP was also discussed at several meetings of the NMCOG Council. Based on input received throughout the plan development process, goals were formulated and organized into four subject areas: land use, economic development, housing and natural, cultural and environmental resources. The specific economic development goals were as follows:

1. Create a regional economic development framework that supports the efforts of private industry, local communities and agencies, educational institutions, federal and state agencies, and private foundations to create jobs and improve the quality of life in the region;
2. Create higher-skilled, higher wage jobs within industry clusters – biotech, nanotech, high technology, “green” industries, and emerging technology – to diversify the regional economy and focus on the global economy;
3. Utilize a combination of economic development and redevelopment strategies that reflects the character of each community and addresses infrastructure barriers (roads, wastewater capacity, telecommunications, etc.) to future economic growth; and
4. Increase the supply of skilled workers for industry in the region through the integration of economic development and workforce development strategies.

Once the final RSP was developed, presentations were made before the Lowell City Council and the Boards of Selectmen in each of the suburban communities. By early 2012, every community had approved and adopted the RSP. The *Regional Strategic Plan for Greater Lowell* can be accessed at <http://www.nmcog.org/regional-strategic-plan> .

## GREATER LOWELL COMPREHENSIVE ECONOMIC DEVELOPMENT STRATEGY (CEDS)

The partnership between NMCOG and the Economic Development Administration (EDA) began with the submission of the *Greater Lowell Comprehensive Economic Development Strategy (CEDS) for 2004-2008*. This document represented the Five-Year CEDS for the Greater Lowell region and was followed by subsequent Annual Updates that built upon the initial document. The economic development framework for the Greater Lowell region was established through the development and implementation of this CEDS document. Initially, NMCOG staff held a Kick-Off Session at Lowell City Hall and nine additional public meetings to receive input from economic development stakeholders in the region. Six CEDS Committee meetings were subsequently held for additional input and feedback on the draft Needs Analysis, Vision and Action sections of the CEDS document. Goals and Objectives related to Economic Development, Workforce Development, Education, Affordable Housing, Racial and Ethnic Diversity, Pockets of Distress, Regional Transportation System, Quality of Life, Technology and Financial Investments were established. NMCOG staff then identified short-term (up to 18 months), intermediate (2-4 years) and long-term (5+ years) CEDS Priority Projects that supported these goals and objectives. Chief among these projects were the highway and transit projects identified within the Transportation Improvement Program (TIP) and Regional Transportation Program (RTP). It was generally recognized that the development of infrastructure, particularly related to transportation, was a critical component to a growing economy.

When the five-year period had ended, NMCOG received another Short-Term Planning grant from EDA to develop the *Greater Lowell Comprehensive Economic Development Strategy (CEDS) for 2009-2013*. This document built upon the initial work that the previous CEDS activities had fostered. In order to gather public input, NMCOG staff held two SWOT (Strengths, Weaknesses, Opportunities and Threats) sessions and six CEDS Committee meetings. A new set of Goals and Objectives was approved by the Greater Lowell CEDS Committee and established as follows:

1. **Economic Development** – Develop a regional economic development framework that supports the efforts of private industry, local communities and agencies, educational institutions, federal and state agencies and private foundations to create jobs and improve the quality of life in the region.
2. **Workforce Development** – Increase the supply of skilled workers for industry in the region through the integration of the economic development and workforce development systems.
3. **Education** – Increase the educational and workforce skills of primary, secondary, and college students to meet the current and future needs of industry.
4. **Affordable Housing** – Create more affordable and market-rate housing throughout the region to ensure that businesses can expand and relocate to the region with the assurance that their workforce will be able to own, lease, or rent quality housing.
5. **Regional Transportation System** – Develop the infrastructure needed to build upon the strengths of the regional highway system and the public transportation networks to enhance access to the economic centers of the region.

6. **Infrastructure** – Build upon the existing sewer, water, telecommunication and public utility infrastructure to increase capacity so that private businesses and homeowners can grow in the future.
7. **Financial Investments** – Target federal, state, local, non-profit and private funds to those projects that create jobs and improve the quality of life in the neighborhoods.
8. **Quality of Life** – Maintain the community character in the region by preserving and protecting the region’s natural, cultural and historic resources and encouraging concentrated development.

As with the previous Five-Year CEDS documents, NMCOG staff identified major regional development projects, as well as specific short-term (up to 18 months), intermediate (2-4 years) and long-term (5+ years) CEDS Priority Projects that supported these goals and objectives. The major development projects included Hamilton Canal, Lowell Junction, District Local Technical Assistance (DLTA) projects, Tyngsborough Town Center Revitalization, Downtown Lowell Renaissance Plan, Pepperell Paper Mill Site Redevelopment Project, Middlesex Turnpike Corridor Development and Woburn Street Corridor. For the most part, each of these major development projects had a transportation component as part of the project. The CEDS Priority Projects provided an update on the status of these projects since the *Greater Lowell Annual CEDS Update for 2008* was completed and identified an updated list of the short-term, intermediate and long-term projects that advanced the Goals and Objectives identified in the Five-Year CEDS.

The *Greater Lowell Comprehensive Economic Development Strategy Update for 2010-2013* was built off the Five-Year CEDS document for 2009-2013. While the same Goals and Objectives were utilized, there were different major development projects and CEDS Priority Projects in the updated document. The major regional development projects in 2013 were the Middlesex Village/Wood Street – Rourke Bridge Study, Tewksbury Master Plan, Hamilton Canal, Hamilton Crossing, Tanner Street Initiative, Middlesex Turnpike, five corridor studies (Woburn Street in Billerica, Lowell and Tewksbury; Route 38 in Tewksbury; Route 133 in Tewksbury; East Street in Tewksbury; and Minot’s Corner/Route 110 in Westford), the MassWorks projects, the Chelmsford and Dracut Town Center Studies and the UMass Lowell projects. The Hamilton Canal Development District and Tanner Street Initiative (now the Ayer City Urban Renewal Plan) in Lowell, Middlesex Turnpike Phase 3 in Billerica, and the Route 38 Corridor Improvements in Tewksbury stand out as examples of the strong link and interdependency between transportation and economic development. The implementation of these four projects is likely to result in more than 4,000 permanent jobs. In addition to these major projects, the *Greater Lowell CEDS Update for 2010-2013* identified 70 short-term priority projects.

NMCOG has been awarded a grant from the EDA effective April 30, 2019 to complete the *Greater Lowell CEDS for 2020-2024*. This Five-Year CEDS will build upon the previous work in the *Greater Lowell CEDS Update for 2010-2013*, and will incorporate an extensive public and stakeholder input process to identify new Goals, Objectives and projects to address current conditions. NMCOG’s collaborative partners, stakeholders and the region’s municipalities use the planning process to articulate their own economic and transportation priorities in the regional context and to explore opportunities for cooperation. The

CEDS planning process provides the framework for a number of related local and regional activities – transportation, expedited permitting, affordable housing, etc. – to be addressed collectively in order to provide a stronger base for economic development.

In addition, there are a number of economic development projects under the District Local Technical Assistance (DLTA) program funded by the Department of Housing and Community Development (DHCD) that have integral transportation components. These regional development projects, combined with the CEDS Priority Projects, provide the means to address overlapping transportation and economic development goals.

## CREATING ECONOMIC OPPORTUNITY

As previously discussed, the region’s transportation network must be well managed and maintained to ensure the continued economic vitality of the region. Transportation support clusters and agglomerations, enhances employment and labor market accessibility, opens new markets for businesses and improves supply chain efficiency. It results in healthy main streets, downtowns and town centers. Transportation projects create jobs and can be linked to workforce development programs that help underserved populations obtain employment. Given the importance that Millennials place on mobility and their desire to forego car ownership, access to employment and recreation in walkable, bikeable, and transit-accessible areas is becoming a key factor for recruiting this critical workforce group.

The USDOT recognizes that transportation and economic opportunity are interconnected: one of the four strategic goals of the USDOT Strategic Plan for FY 2018-2022 is to “Invest in Infrastructure to Ensure Mobility and Accessibility and to Stimulate Economic Growth, Productivity and Competitiveness for American Workers and Businesses.” Transportation costs are the second largest expense for American households, and low-income households are less likely to own a car compared to higher income households. A lack of transportation options, unreliable transit and unsafe streets can interfere with access to jobs and other essential services.

The USDOT and FHWA promote policies and activities that encourage economic development through transportation. This concept is strongly tied to Environmental Justice, as transportation has the potential to improve economic opportunities for minority and low-income communities. The NMMPO strongly supports these initiatives and is committed to working with its transportation and economic development partners to ensure that the region’s low income and minority communities are afforded access to the programs that facilitate access to employment, education and other essential services.

The NMMPO will continue to work with providers of public transportation, as part of the transportation planning process, to identify transportation connectivity gaps in accessing essential services. Through the UPWP tasks, the NMMPO staff will continue to identify gaps in the connectivity of the transportation system and outline infrastructure and operational solutions that provide the public, especially the traditionally underserved populations, with adequate access to employment, education and health care. The effectiveness of the public participation process for engaging transportation disadvantaged

communities in the transportation decision-making process is evaluated in the Public Participation Plan. The Section 5310 Coordinated Human Service Public Transportation Plan will be updated during FY 2020 and NMMPO staff will continue to assess the safety and condition of pedestrian and bicycle facilities, including compliance with the Americans with Disabilities Act.

## TRANSPORTATION AND ECONOMIC DEVELOPMENT PRIORITIZATION AND COORDINATION

The link between transportation and economic development in the Northern Middlesex region is well documented. The economic vitality of the Northern Middlesex region depends upon the active implementation of transportation projects throughout our communities. For these reasons, the NMMPO has established a Transportation and Economic Development Prioritization and Coordination Task as part of the annual UPWP. To illustrate the tie-ins between the aforementioned economic development documents and the transportation work plan for our region, the following projects have been identified under this year's work element:

- **Hamilton Canal District (Lowell)**

NMCOG staff will continue to work with the City of Lowell on the Hamilton Canal Innovation District project. The City of Lowell, with the assistance of NMCOG staff, received an additional \$2.482 million in EDA Public Works grant funds for the construction of 450 feet of new roadway, a new canal bridge and utilities to support the planned development of more than 203,000 square feet of office/R&D space, 21,800 square feet of retail space, a municipal parking garage funded by a \$35 million investment by the City, and up to 68 new housing units. Construction on the canal bridge is expected to be completed in July 2019. The Judicial Center has been largely constructed and is expected to open for business in 2020. The City previously received \$4,572,000 in MassWorks funds as a match for the EDA Public Works grant.

The City received \$2 million in MassWorks funds in 2016 to upgrade a section of Thorndike Street adjacent to the Gallagher Intermodal Transportation Center in support of the mixed-use, transit oriented Thorndike Exchange project. Construction of this project began in spring 2018. NMCOG staff continued to work with the City of Lowell to ensure that the \$15 million in State funds awarded in April 2014 for off-site traffic improvements needed to accommodate the Hamilton Canal development project, such as the Lord Overpass improvements, were included on the State's Capital Investment Program.

NMCOG staff continues to work with the City of Lowell on the planning and design of these vehicular, transit and pedestrian improvements. The combination of multiple transportation and economic development funding sources provide for the improvement of the multimodal corridor along Thorndike Street, from its junction with the Lowell Connector to Gallagher Terminal and the Hamilton Canal Innovation District.

- **Ayer City Urban Renewal Plan (Lowell)**

During the past five years, NMCOG staff have assisted the City of Lowell in the development of the Ayer's City Industrial Park Urban Revitalization and Renewal Plan (ACIP). Through the redevelopment of a blighted industrial district located between the Lowell Connector and Tanner Street, the Urban Renewal Plan called for the implementation of several transportation improvements, including the de-elevation of the section of the Lowell Connector extending from Plain Street to Gorham Street; the relocation and redesign of the intersection of the Lowell Connector ramps, Tanner Street and Plain Street; pedestrian improvements along Tanner Street; and the construction of a pedestrian greenway along River Meadow Brook (as outlined in the River Meadow Brook Greenway Feasibility Study completed by NMCOG under the FFY 2014 UPWP). The Urban Renewal Plan was approved by DHCD in 2014. MEPA certification for the ACIP Plan was received in February 2016.

The City has been working with Watermark Engineering to produce final design and engineering documents for the realignment of Tanner Street. It is expected that 100% design plans for the project will be completed this summer. The new roadway will create a new 4-way intersection at the Target Plaza and extend up to Montreal Street, which will be extended a short distance to connect to the new Tanner Street. Additionally, the new Tanner Street will connect with the existing Tanner Street at the intersection with West London Street. The City will be working with an appraiser to determine the value of the properties to be taken by eminent domain due to the new road alignment. The City will apply for MassWorks funds in order to construct the project. NMCOG staff will continue to work with the City to advance the transportation components of the urban renewal plans.

- **Thorndike Street Improvement Project (Lowell)**

The Thorndike Street widening project works in conjunction with a number of other infrastructure projects, including the recently completed South Common Redevelopment Phase 1 project, the redevelopment of the Lord Overpass, and the future improvements to the end of the Lowell Connector. The project was completed by S&R Corporation in October 2018. The project added a left turn lane into the Gallagher Terminal property and a left-turn lane onto Highland Street. Construction documents for the Lord Overpass are being finalized and it is anticipated the project will be bid by the end of May 2019 with construction to start in the fall 2019. The Thorndike Exchange project, which is a \$50 million TDI project dependent upon these infrastructure improvements, is expected to be completed over the next two to three years. Phase I is near completion, but needs tenant fit up for the commercial units. Phase II has received a foundation permit and has submitted a structural application, thus anticipating a 2-3 year period for completion. NMCOG staff will work with the City staff to support the completion of the Thorndike Street Improvement Project and the Thorndike Exchange project.

- **Rourke Bridge (Lowell)**

The replacement of the temporary Rourke Bridge in Lowell has been a priority for the region for many years. The Rourke Bridge is located on Wood Street, which serves as a major arterial between Route 3 at Drum Hill Square and the north side of the Merrimack River at Pawtucket Boulevard. The current bridge is located along the most congested corridors in the region. During peak travel periods, the bridge cannot physically accommodate the movement of emergency vehicles, requiring emergency responders to find alternate routes, which increases response times and places patients at undue risk. In 2014, NMCOG used a \$500,000 earmark to study replacing the temporary bridge with a more permanent structure. NMCOG staff worked with MassDOT, the City of Lowell and the Towns of Chelmsford and Dracut to hire a consultant (Vanasse Hangen Brustlin, Inc.) to lead the study. The results of the feasibility study identified several alternatives for a new crossing, along with recommendations for improvements to nearby roads and intersections. The cost of replacing the bridge ranges from \$50-70 million, depending on the alignment that is ultimately selected.

In 2015, the Lowell City Council voted to move three alternatives forward into the design phase. In 2018, MassDOT provided funding for the preliminary design and environmental permitting for a new bridge. The design will include an expansion of the bridge from two to four lanes and include upgraded bicycle and pedestrian facilities. Funding for the final design and construction has not yet been identified. Due to the importance of this corridor for regional traffic flow, emergency response, and economic development, NMCOG will continue to pursue funding for the construction of a new bridge. The high priority of this project cannot be overstated.

- **Route 38 Corridor Improvements (Tewksbury)**

The Route 38 project in Tewksbury provides an opportunity to attract increased private investment through the improvement of travel and safety conditions along the corridor. The Route 38 Corridor Study, completed by NMCOG staff, identified the need for extensive transportation improvements to address congestion, safety and pedestrian facilities throughout the corridor. The results of the study were intended to assist the Town in making informed decisions regarding land use and development, based on the capacity of the roadway and projected operating conditions along the corridor. The study was conducted to assess current and future operating conditions, define the development thresholds at which it becomes necessary to implement specific levels of travel mitigation in order to accommodate anticipated development, and project traffic conditions along the corridor over twenty years, based on high, medium and low development scenarios. The Tewksbury Economic Development Committee identified several sites along the Route 38 corridor that have potential for new development or redevelopment.

Full build-out of the underdeveloped and vacant properties has the potential to generate several thousand additional trips per day, creating significant impacts along an already overburdened corridor.

The implementation of the Route 38 improvements will require collaboration between the NMMPO, the Town, MassDOT and private sector partners. Established economic development and transportation partnerships in the region will be leveraged to advance the transportation recommendations through inclusion in the TIP, Regional Transportation Plan, Congestion Management Program and the new *Greater Lowell CEDS for 2020-2024*. Multiple funding sources will be needed, given the large cost of the project.

The proposed improvements include two projects programmed in the regional TIP – (1) Salem/South/Main in FFY 2019 and (2) the resurfacing of Route 38 and sidewalk reconstruction between Colonial Drive North to the intersection of Old Boston Road in FFY 2021. The Town is in the process of reviewing an extension of this project further southward to Victor Drive. A new project submission could include Route 38 from Colonial Drive to Victor Drive or Livingston Street. Route 38 intersection improvements from the Lowell line to Pike/Astle Streets was outside the TIP target projects, but is programmed for FFY 2023 utilizing Statewide HSIP funding.

With the increased focus on Route 38, several private investment redevelopment projects have been completed or are in the process of being completed. The development of 192 housing units at Balsam Place and the 13,500-square foot Lowell General Hospital (LGH) urgent care facility/patient service center have been completed. This \$51 million development project created fourteen full-time jobs and numerous construction jobs.

The Tewksbury Town Center Master Plan Committee completed the Town Center Master Plan in April 2016. The principal focus of the Town Center Master Plan was on traffic and circulation, a façade improvement program, streetscape improvements, signage and wayfinding, land use and zoning improvements and public and private investment projects. The Town voted two years ago to replace the Fire Station in the Town Center, which will have an economic impact upon this area. Construction will begin by January 2020 and take 14 months to be completed.

- **Boston Road Phase 2 Revitalization Project (North) (Billerica)**

The Town applied for \$2 million in MassWorks funds in 2017 to support three commercial development projects: the construction of a 4,950 square foot commercial facility at 328 Boston Road to include Sal’s Pizza and two other retail tenants; the construction of a 7,500 square foot retail facility at 324-326 Boston Road to include a restaurant, retail shop and café; and the potential development of an independent living/assisted living facility on Boston Road. Private investors will provide \$3 million as matching funds to the MassWorks grant, while the State and Town are already investing \$176 million in the new Billerica High School in this immediate area.

The Town did not receive MassWorks funding for this project, but has decided to move forward with the project. This project is programmed in FFY 2022 and 2023 of the FFY 2020-2024 Northern Middlesex TIP. The Town submitted the 25% design documents to MassDOT in October 2018 and is still awaiting feedback. The project will help create 50 part-time and 18 full-time jobs, in addition to construction jobs.

- **Vinal Square and Town Center Improvements (Chelmsford)**

NMCOG staff completed the Strategic Action Plan for the Town of Chelmsford in January 2015. This Plan included the implementation of the transportation improvements recommended in the Vinal Square Traffic Study, completed by NMCOG under the FFY 2014 UPWP. It also included recommendations relative to streetscape improvements, lighting, signage, parking, and pedestrian connectivity. The plan was designed to encourage reinvestment in the Vinal Square neighborhood. NMCOG staff has continued to assist the Town with the implementation of the recommendations. All of the roadways within the Square (Route 40, Route 3A and Route 4) are on the federal aid system and most are owned and controlled by MassDOT. Collaboration between the Town, MassDOT, residents and the business community will be needed to advance the recommendations. The Town has invested some funds to begin the streetscape improvements through an initial ground study. NMCOG staff also worked with the Town on a Visioning Project to determine alternative uses for the UMass Lowell West campus in North Chelmsford. UMass Lowell recently sold the West campus to a private developer.

NMCOG staff will continue to assist the Town in implementing the recommendations outlined in the Chelmsford Center Village Pedestrian and Parking Plan completed six years ago. The Town of Chelmsford received a MassWorks grant of \$370,000 in 2016 to construct a portion of the Beaver Brook Walk, build a pocket park and provide public parking and landscaping along the Bruce Freeman Rail Trail. These public improvements were to be matched by \$15 million in private investment to construct the 54-unit market-rate rental project entitled the Grist Mill Apartments in the Town's Center Village Overlay District. Due to some delays in the development project, the Town requested an one-year extension from DHCD on its MassWorks grant. DHCD extended the project until June 30, 2019. The Grist Mill Apartments are under construction and will be completed by October 2019. The Town has also been approved for TIP eligibility for a Route 110 improvement project in the Town Center with proposed improvements to access, parking, and bicycle and pedestrian facilities. This project is included in the RTP recommendations and it will be considered in future TIP programming.

- **Lowell's Canal Bridges (Lowell)**

The City of Lowell is unique in that there are eight bridges crossing the canal system that were previously owned and/or controlled by Enel Green Power, a multi-national power company, until the City took ownership in July 2017. Prior to the City taking ownership, Enel repaired two of the bridges – Broadway Street over the Pawtucket Canal and Kearney Square over the Eastern Canal. The remaining six bridges were in various states of disrepair or deterioration, resulting in closures or weight restrictions. This adversely affected public safety, commerce, economic development, traffic congestion, and transportation efficiency. Buses, fire apparatus, and larger commercial vehicles were prohibited from crossing these spans, and had to detour around these bridges. In 2015, the

City of Lowell was awarded a TIGER Grant for \$13,389,750 to address the repair of these six bridges. This work has been overseen by MassDOT in conjunction with the City of Lowell. The design and engineering of the six bridges was completed in 18 months. Due to funding constraints, the superstructure replacement at the Suffolk Street over the Northern Canal was removed from the original project scope and the City will seek additional funds to complete the project. Project bids for the five remaining bridges were opened on February 21, 2018 and awarded to the low bidder in March 2018. Construction began on July 1, 2018 with final construction anticipated on April 1, 2022. The status of the five bridges as of April 2019 was as follows:

1. Pawtucket Street over the Pawtucket Canal – Utility relocation underway. Closed for one lane of traffic inbound to Lowell beginning in mid-May 2019. Bridge completion is anticipated by April 2022.
  2. Pawtucket Street over the Northern Canal - Construction underway and closed to vehicular traffic (open to pedestrian traffic). Bridge completion is expected by November 2020.
  3. Central Street over the Lower Pawtucket Canal – Construction work began in early April 2019. Bridge completion is anticipated by September 2021.
  4. Merrimack Street over the Western Canal – Under construction. Bridge completion is anticipated by October 2019.
  5. Merrimack Street over the Merrimack Canal – Project complete.
- **Route 3 Exit 36 Southbound Ramp Study (Tyngsborough)**

In 2014, NMCOG, the Nashua Regional Planning Commission (NRPC), the Town of Tyngsborough, Massachusetts and the City of Nashua, New Hampshire completed a feasibility and planning study to assess the impacts and benefits of adding a southbound off ramp at Exit 36 on Route 3. The project area straddles the Massachusetts/New Hampshire border and directly impacts the City of Nashua and the Town of Tyngsborough. The area is an economic center for both the NMCOG and NRPC regions due to the significant amount of commercial, retail and high-density residential development. In addition, the expansion of Route 3 in Massachusetts has provided additional untapped economic development opportunities for this region.

Traffic congestion and the lack of a well-coordinated development strategy across municipal and state boundaries have impeded economic growth and development in some portions of the project area. There has been discussion for a number of years regarding the potential extension of MBTA commuter rail along the Daniel Webster Highway in South Nashua. Potentially, commuter rail riders could access the new station via Exit 36.

The study found that the construction of a southbound ramp at Exit 36 will improve overall operating conditions in the study area by relieving traffic congestion and delay, reducing greenhouse gas emissions, improving travel time, and decreasing lost productivity. The project would also enhance the efficiency of public transportation and support future passenger rail service.

The benefits to economic development are significant as the project would also generate opportunities for business investment and serve as catalyst for future sustainable development.

The Exit 36 Southbound project has been included in the NRPC Long Range Transportation Plan (LRTP) for many years and is widely accepted as having significant benefit for a relatively small investment. The project was also recommended as part of the Daniel Webster Highway and Spit Brook Road Corridor Study completed in 2002. Most recently, the City of Nashua Transportation Task Force included Exit 36 Southbound (Exit 36S) in its report to the Mayor as a high priority project for the City – citing congestion relief and economic development opportunities to the City. In 2015, the Tyngsborough Board of Selectmen voted unanimously to support the project given the economic development benefits along the northern section of Middlesex Road. The bi-state nature of the project provides opportunities for innovative financing, interstate cooperation, and public/private partnerships.

The project is still awaiting funding approvals from New Hampshire. Tyngsborough has expressed renewed interest in this project due to its focus on developing a new town center. Several buildings have been identified as the core of the new town center – Old Town Hall, Winslow School, the First Parish Meeting House and the Littlefield Library - and there needs to be an overall plan to tie these buildings together. The connections will largely be accomplished through road and sidewalk improvements that make the area more accessible to residents, visitors and shoppers. The Town needs to address its goal of making the area a commercial destination in order to complement the historical and institutional buildings in the area. NMCOG staff will continue to work with the Town to assess the interests of its residents in establishing a new town center and to develop streetscape and transportation improvements that would make the area more attractive, particularly for pedestrians. There will also need to be a focus on business incentives to attract private investment to the area.

- **Route 110 and Route 40 Corridor Improvements (Westford)**

Over the past six years, NMCOG staff has assisted the Town of Westford in advancing improvements along the Route 110 corridor in Westford, which is the town’s fastest growing business corridor. One million square feet of new development have been permitted along the corridor, necessitating the need to expand transportation infrastructure. The Town has also considered the establishment of multifamily zoning along this corridor to address their affordable housing goals.

The Town has completed intersection improvements at Route 110 and Tadmuck Road. In order to access the Route 110 corridor, visitors and customers utilizing Route 495 need to travel via Boston Road. This road has been described as the “gateway” to the Route 110 corridor and the Town Center and is need of improvement in the future. Upgrades to Boston Road between I-495 and Main Street are currently recommended in this RTP and the Boston Road project is programmed in FFY 2024 of the FFY 2020-2024 Northern Middlesex TIP, which was endorsed by the NMMPO in May 2019.

NMCOG staff also assisted the Town with the planning and project initiation processes for improvements along the Route 40 corridor. This corridor contains some of the few remaining industrially zoned parcels in the community. Improvements at two intersections along the corridor were programmed on the FY 2018-2022 TIP. The intersection improvement at Route 40 and Oak Hill Road were begun in April 2018 and is anticipated that construction will be completed in Fall 2019. The intersection improvements at Groton Road and Dunstable Road were started in March 2019 and are expected to be completed by Spring 2020. Both of these locations were on the region's high crash list.

- **Appleton, Middlesex and Jackson Streets (Lowell) And Route 113 (Pepperell) Corridor Studies**

NMCOG staff has worked closely with the City of Lowell and Town of Pepperell to address traffic, land use, and economic development issues related to Appleton, Middlesex and Jackson Streets (Lowell) and Route 113 (Pepperell). The work related to Appleton, Middlesex and Jackson Streets, addressed the connections between Appleton Street and the Lord Overpass, as well as the tie-ins with Central and Church Streets, to provide more efficient traffic flow and pedestrian safety. The draft corridor study for Appleton Street also addressed the land use and economic development issues, as a means to encourage more private investment along the corridor. The corridor study was expanded to Middlesex and Jackson Streets in order to complement the City's efforts to be designated as a Transformative Development Initiative (TDI). NMCOG staff has collected data for Middlesex and Jackson Streets similar to that developed for Appleton Street as part of its partnership responsibilities. NMCOG staff will work with the City staff to review and update the draft Appleton, Middlesex and Jackson Streets corridor study over the coming months.

In terms of the Route 113 Corridor Study, NMCOG staff built upon the previous work in Railroad Square and along the corridor to encourage additional private investment. Private businesses located along the corridor sought to address various transportation issues - congestion, parking, pedestrian traffic, bike lanes, etc. The Town also wanted to encourage additional investment and provide the support services and infrastructure that these businesses need. These actions are related to the reuse of the former Pepperell Paper Mill building site and the review of zoning changes to address the needs of the business community. The initial draft corridor study will be incorporated within the Economic Development section of the updated Master Plan in late 2019.

- **Route 129 Corridor (Chelmsford)**

The Town of Chelmsford has focused on the need to support the businesses along the Route 129 corridor and to attract more private investment to the area. NMCOG staff had worked with the Town of Chelmsford to survey the business community on the need for an overlay district that would allow business amenities along Route 129. The adoption of the Route 129 Business Amenity Overlay District (BADO) by Chelmsford Town Meeting in 2016 has provided new opportunities for business amenities and multifamily housing NMCOG staff worked last year with the Chelmsford

Economic Development Commission to develop a Permitting Handbook and an additional business survey to improve the overall business climate in Chelmsford.

The Town applied for funding under the MassWorks program to address road, sidewalk and bicycle infrastructure issues in the Route 129 Corridor. Identified as the Chelmsford Route 129 Billerica Road Enhanced Mobility project, these infrastructure improvements were designed to support a \$6 million private two-building mixed-use development that included a 4,300 square foot 200-seat restaurant and 8,000 square feet of retail and service space at the corner of Billerica Road and Scientia Drive. The Route 129 area would be enhanced by a Mass Housing Choice Capital Grant request for \$250,000 to develop 3,400 linear feet of new sidewalks along Turnpike Road and a MassDOT TIP project scheduled for FFY 2019 to realign the Billerica Road intersection, reconstruct the bridge/culvert adjacent to River Meadow Brook and provide new sidewalks and bike lanes. The project would create 100 construction jobs, 10 full-time jobs and 60 part-time jobs. Unfortunately, the Town only received funding under the Housing Choice Capital Grant program.

With funding from MassDevelopment's Site Readiness Program, the Town of Chelmsford was able to hire Camoin Associates and Howard Stein Hudson to complete an analysis on repositioning the Chelmsford Cross Roads at Route 129 Business Park for the future. The study entitled *Chelmsford Cross Roads at 129: Repositioning a Suburban Office Park for a New Era* was released in May 2019. This study focused on several areas: Existing Conditions Analysis, Market Analysis, Stakeholder Strategy Session, Suburban office park case studies, Strategy recommendations for repositioning the park, Conceptual visualizations of the future of the park, and the final presentation to stakeholders, conducted on May 14, 2019. This study provides a blueprint for the Chelmsford Economic Development Commission to move forward in addressing the needs of the current businesses and in attracting new private investment in the Route 129 corridor. As noted in the previous discussion, the need for transportation infrastructure improvements in this area is an important component for future economic success.

- **Working Cities Challenge (WCC)/Smart Growth America Project (Lowell)**

Four years ago, the City of Lowell was chosen as one of six cities in Massachusetts to be designated as a Working Cities Challenge (WCC) community by the Federal Reserve Bank of Boston. This designation was made as a result of the unique partnerships established by the City and the Coalition for a Better Acre (CBA) to address the barriers facing Acre residents in accessing employment and educational opportunities to improve their quality of life. A significant barrier to the Acre residents is access to transportation options in order to get to work or to attend classroom training. The WCC Board and staff have continued to work directly with the Federal Reserve Bank of Boston to focus on the economic development, cultural and educational needs of Acre residents. Within this year's DLTA program, NMCOG agreed to work with the City of Lowell to address pedestrian and bicycle issues related to the City's Complete Streets Program in downtown and the Acre. The Economic Development Work Group of the WCC has adopted the Smart Growth America

recommendations as part of its work plan for 2019 and Jeanne D’Arc Credit Union has allocated \$200,000 in small business loan funds for Acre businesses.

## TRAVEL AND TOURISM LINKS TO ECONOMIC DEVELOPMENT

As the Commonwealth’s third largest industry, tourism contributes more than \$20 billion annually in direct spending alone. More than 27 million annual visitors sustain an industry that supports nearly 150,000 jobs statewide.<sup>4</sup> The transportation needs of the tourism and recreational industries differ from commuter travel, with tourism generally seen as a generator of travel demand and transportation as the key to accessing major tourist attractions. Transportation is a critical element in the operation of visitor attractions and in supporting activities, such as national and state parks, performance venues, sport arenas, museums and recreational facilities. Effective transportation planning can help balance the needs of different groups during peak tourism seasons or special events. Meeting these needs requires consideration of the following factors:

- Alleviating traffic congestion and parking concerns near visitor attractions;
- Creating better access and mobility to meet the needs of those traveling to various attractions and venues;
- Improving traveler information resources;
- Linking existing but separate tourist attractions; and
- Establishing an ongoing collaborative process between the NMMPO, local communities, and organizations representing tourism interests.

While transportation facilities span all modes of travel, recreation and tourist facilities can have special transportation needs. Travel to tourism and recreation sites is often concentrated in certain seasons or on weekends. Visitors to tourism and recreation sites often need guidance on how to access those facilities, as well as suggestions on routing and mode choices. Such needs can be served through information kiosks, websites, 511 traveler information, specialized maps, and signage.

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### NMMPO TOURISM AND TRANSPORTATION ACTIVITIES

The NMMPO has included a work task in the UPWP entitled “Enhancing Travel and Tourism”. Through this task, an inventory of tourist sites and attractions was developed for the entire region. This information can be accessed on the NMCOG website: <http://www.nmcog.org/enhancing-travel-and-tourism>. NMCOG worked with the Greater Merrimack Valley Convention and Visitors Bureau to solicit input on development of the inventory and on identifying the needs of the tourist industry in the

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<sup>4</sup> <https://www.massvacation.com/travel-trade/getting-around/stats-reports/>

Northern Middlesex region. The inventory includes the following types of sites, facilities, venues and events:

- Museums
- Festivals and Fairs
- Sporting Events and Related Sites
- Art Galleries
- Parks and Open Space
- Historic Building and Sites
- Music Venues
- Theaters
- Entertainment Complexes

Accessing these cultural, recreational, and educational assets is critical to the economic strength of the region. NMMPO staff have collaborated with the LRTA to identify transit facilities near each site. An interactive map showing the location of each site or event and its proximity to nearby transit facilities, bus stops and parking facilities, will be available on the NMCOG website by July 2019. The NMMPO will continue to coordinate with tourism and recreation stakeholders across the region to address transportation needs, and to collaborate on planning activities relative to tourist attractions and upcoming special events.

The NMMPO has a long history of working with the National Park Service to improve transportation access to and within the Lowell National Historical Park. This collaborative process included the design and construction of the Merrimack Riverwalk, the development of the Lowell Canal walkway system, future extension of the tourist trolley system, and planning for special events, such as the Lowell Folk Festival and Summer Concerts in the Park series. Most recently, NMMPO staff has been working the National Park Service and the City of Lowell on the design of the Pawtucket Falls Overlook, a pedestrian project located on the north bank of the Merrimack River adjacent to the VFW Highway. This facility will overlook the historic Pawtucket Dam and falls, which supplied the waterpower that led to development of textile mills in the City of Lowell and was ultimately responsible for the American Industrial Revolution.

## CONCLUSION

Many of the above economic development initiatives have been discussed in greater detail in previous sections of this document. NMMPO staff will continue to work with its member communities to target the Opportunity Zones, Priority Development Areas, Economic Opportunity Areas, Priority Development Sites and other state and federally designated economic development areas for transportation infrastructure support. These transportation investments will provide direct connections between employment centers and employees, facilitate the delivery of goods and services, and allow businesses to efficiently transport their goods to market. NMCOG and the NMMPO staff will build upon the corridor studies previously developed and identify community development and redevelopment

opportunities that enhance economic growth. Transit service in the region will continue to be examined to determine whether changes are needed to better serve the changing regional employment markets. Bicycle and pedestrian access to employment, educational, healthcare and recreational opportunities will be improved. Residents of multi-family and affordable housing in the region will be better connected with employment and educational opportunities in order to improve their economic condition and quality of life.

## CHAPTER 13 ENVIRONMENTAL SUSTAINABILITY AND LIVABILITY

Transportation vehicles and the construction of infrastructure impact the environment in the Northern Middlesex Region through the production of greenhouse gas emissions, stormwater runoff, and habitat fragmentation. Vehicles that run on fossil fuels contribute to air pollution and climate change, while runoff from roadways can pollute surrounding water resources including rivers, streams and drinking water supplies. In addition, transportation infrastructure consumes land and resources, generates noise and creates visual impacts. The NMMPO's goal is to minimize and mitigate the impacts of the transportation system on the environment, including air quality, water quality, wildlife habitat, and climate change. The NMMPO also works to create livable and sustainable communities. To achieve this goal, the following objectives have been developed:



**Image 13.1: Heart Pond Boat Launch**

- Objective 1: Promote transportation alternatives and techniques that reduce air pollution and greenhouse gases;
- Objective 2: Promote the protection of critical environmental resources;
- Objective 3: Protect critical transportation infrastructure from the effects of climate change and flooding; and
- Objective 4: Promote livability by strategically utilizing transportation facilities to increase access to good jobs, affordable housing, quality schools, and safer streets and roads.

This Chapter discusses how the NMMPO will address its environmental goals and objectives through the transportation planning process.

### PERFORMANCE MANAGEMENT APPROACH TO ENVIRONMENTAL SUSTAINABILITY

In order to achieving its environmental goals, the NMMPO has adopted and reported on Congestion Mitigation and Air Quality (CMAQ) performance measures and targets set by MassDOT. Given that Lowell is in a maintenance area for carbon monoxide, the NMMPO is required to develop a CMAQ Performance Plan, in conjunction with the MassDOT biennial baseline period performance report for the overall 4-year performance period. Elements included within this performance plan meet the requirements of 23 CFR 490.107(c) and 23 USC 149(l). These regulations state that MPOs in non-

attainment or maintenance areas for ozone, carbon monoxide (CO), or particulate matter National Ambient Air Quality Standards (NAAQS), must set targets for on-road mobile source emissions and develop a CMAQ Performance Plan.

As of April 22, 2002, the City of Lowell was designated as being in attainment for CO with an EPA approved limited maintenance plan. In October 2017, FHWA released a report on an applicability determination for CMAQ traffic congestion and on-road mobile source emissions measures<sup>1</sup> where it required the NMMPO to develop a CMAQ Performance Plan. Contents of this plan include the following key components<sup>2</sup>:

- A baseline level of condition at the beginning of the performance period for CMAQ measures including Total On-Road Source Emission, Peak Hour Excessive Delay, and Non-Single Occupancy Vehicle Travel;
- MPO-established two- and four-year targets for the applicable CMAQ performance measures;
- A description of projects scheduled for CMAQ funding that will contribute to achieving the established targets; and
- An assessment of progress showing how listed projects contribute toward achieving set targets within the mid- and full-period performance reports.

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## PERFORMANCE BASELINE CONDITIONS AND NMMPO TARGET SETTING

### SYSTEM PERFORMANCE MEASURES

The FHWA Final Rule on system performance measures<sup>3</sup> applies to urbanized areas that contain National Highway System (NHS) mileage and have a population over 200,000, as well as to non-attainment and maintenance areas for air pollution. MPOs and State DOTs must coordinate on a single unified target for both peak hour excessive delay (PHED) per capita and non-single occupancy vehicle (non-SOV) travel across the urbanized area. For the emissions measure, MassDOT is reporting on the combined total emissions reductions for all projects in maintenance and nonattainment areas, while MPOs must adopt a target only for the nonattainment or maintenance areas within their planning boundaries.

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<sup>1</sup> FHWA, “Applicability Determination: CMAQ Traffic Congestion and CMAQ On-Road Mobile Source Emissions Measures (23 CFR 490.707 and 490.807), October 1, 2017.

<sup>2</sup> 23 CFR Part 490.107(c)(3)

<sup>3</sup> 23 CFR 490.703

CMAQ TRAFFIC CONGESTION MEASURES

PEAK HOUR EXCESSIVE DELAY (PHED) MEASURE

In order to set a target for the Boston UZA, MassDOT, with consultant support, calculated the PHED using the National Performance Measurement Research Dataset (NPMRDS). It is critical to note that the computation methodology for all NPMRDS speed data changed for 2017 with version 2.0 when the FHWA contract changed vendors, resulting in significant shifts in the metrics for that year due to changes in the calculation of path speeds compared to spot speeds on arterials.

PHED per capita for the UZA was calculated as:

$$PHED_{UZA} = \frac{\sum_{Segments} PHED_{Segment}}{Population_{UZA}}$$

UZAs are defined by the US Census Bureau as collections of census blocks. Annual estimates of population are provided by the American Community Survey (ACS) on five-year rolling averages for years up to 2016, on the block group level. While the Census Bureau provides ACS population estimates for UZAs, the lack of NPMRDS data for Rhode Island means that the population must be limited to Massachusetts and New Hampshire to ensure consistency in the computations. The PHED per capita for 2017 is estimated in the Table 13.1:

**Table 13.1: Boston UZA Baseline Conditions for Peak Hour Excessive Delay per Capita**

2017	Total PHED   UZA (Annual Hours)	ACS Population (2012-2016 Five-Year Estimates)	PHED per Capita (Annual Hours)
	80,053,183	4,371,476	18.3

Since only one year of data from the NPMRDS version 2.0 was available at the time of measure development, and since federal guidance advised that MassDOT use only PHED 2017 data to develop targets, the 2020 and 2022 targets for PHED reflect the 2017 PHED figure shown in Table 13.2. The targets reflect the goal for no increase in PHED, but as more data becomes available, these targets may be refined for future reporting periods.

**Table 13.2: Boston UZA PHED: Baseline Condition and 2- and 4- Year Targets**

Baseline Condition (Annual Hours/Capita)	2020 Target (Annual Hours/Capita)	2022 Target (Annual Hours/Capita)
18.3	18.3	18.3

**NON-SINGLE OCCUPANCY VEHICLE (NON-SOV) TRAVEL**

The metric for non-SOV travel is based on the percentage of individuals within the Boston UZA commuting to work using a mode other than a single occupancy vehicle (e.g. carpool, van, public transit, walking, bicycling, or telecommuting).

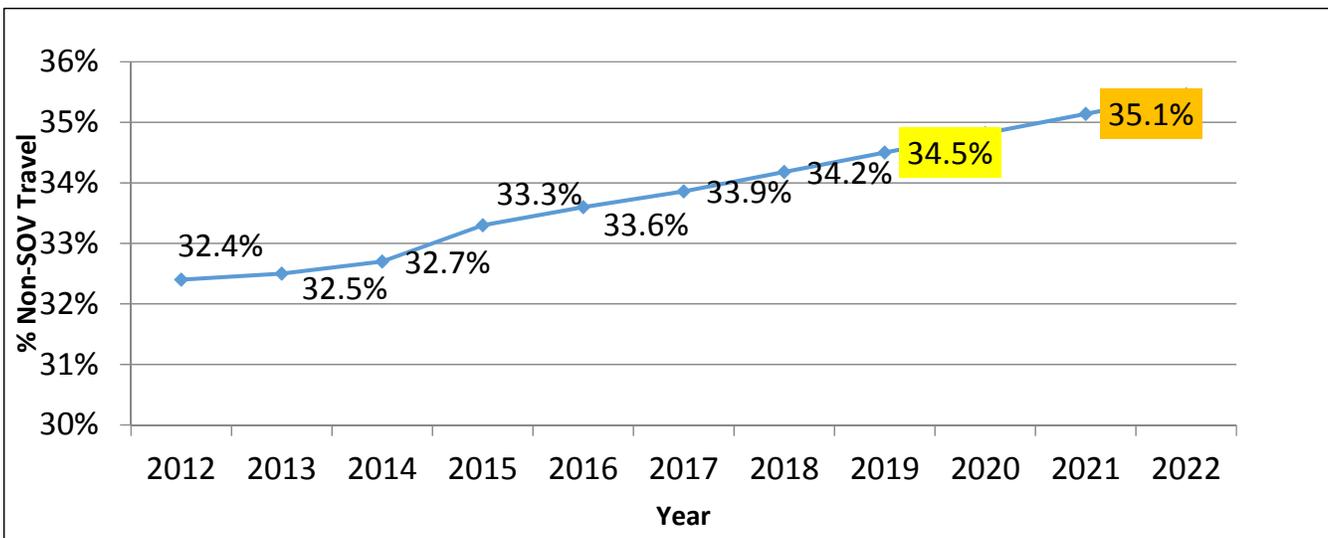
Following federal guidance, MassDOT used 5-year estimates from the American Community Survey (ACS 2012-2016) for data within the Census table entitled, “Means of Transportation to Work” (also known as Journey to Work). In this table, the Census reports the percentage of individuals within the urbanized area who drive alone to work. To develop the baseline condition MassDOT used the 2016 data point for the percentage of individuals who drive to work alone (66.44%), which was the most recent data point available, and took the inverse (33.6%).

To develop the 2- and 4-year non-SOV travel targets, MassDOT, with assistance from CTPS, used Journey to Work Census data between 2012 and 2016 to establish a trend line, which was projected out to determine the 2020 and 2022 figures, which were used as targets, as shown in Table 13.3 and Figure 13.1.

**Table 13.3: Non-SOV Travel: Boston UZA Baseline Condition and 2- and 4-Year Targets**

Baseline Condition	2020 Target	2022 Target
33.6%	34.5%	35.1%

**Figure 13.1: Percentage of Non-SOV Travel in Boston UZA with 2- and 4- Year Targets**



### ON-ROAD MOBILE SOURCE EMISSIONS REDUCTION MEASURE

The emissions reduction measure requires states and MPOs to measure and establish targets for the total emissions reduction of on-road mobile source emissions. The measure applies to states and MPOs whose geographic boundaries include any part of a nonattainment or maintenance area for ozone, carbon monoxide, or particulate matter. States and MPOs must establish separate targets for each of these applicable criteria pollutants and precursors.

Massachusetts contains four nonattainment areas for carbon monoxide: Waltham, Lowell, Springfield, and Worcester. With the Lowell designation in place, the Northern Middlesex MPO has developed baseline conditions and regional targets for the CO emission reduction measure.

To establish the Northern Middlesex MPO's baseline conditions, a review was conducted for obligated CMAQ funded projects in Federal Fiscal Years 2014-2017. In this review, one project was identified in the City of Lowell: intersection improvements at VFW Highway/Bridge Street and Lakeview Avenue. Table 13.4 summarizes the baseline condition for the emissions measure.

**Table 13.4: Northern Middlesex MPO Baseline Condition for On-Road Mobile Source Emissions Performance Measure**

Performance Measure	Baseline Data Set	Baseline Condition (kg/day)
CO Emissions Reduction (kg/day) from CMAQ funded projects in Northern Middlesex MPO	FFY 2014-2017 Obligated TIP projects using CMAQ funding	11.76

In this initial reporting period, the Northern Middlesex MPO is required to set two- (FFY 2018-2019) and four-year (FFY 2018-2021) targets aimed at reducing CO emissions in Lowell. In setting these targets, TIP programmed projects using CMAQ funds in Lowell were identified. While staff identified the Pawtucket Falls Overlook project (FFY 2020) as a potential emissions reducing CMAQ project in Lowell, quantitative numbers have not been made available as of this baseline reporting period. Results of quantitative emissions analysis of the project will be included in the mid-period report. There are no CMAQ funded projects programmed in Lowell in the 2-year target range. Thus, the 2- and 4-year targets have been set at zero kg/day. Table 13.5 lists the reduction targets set for the NMMPO.

**Table 13.5: Northern Middlesex MPO CO Emissions 2 and 4 year Targets for On-Road Mobile Source Emissions Performance Measure**

Performance Measure	Baseline Data Set	Baseline Condition (kg/day)	2-Year Target (kg/day) (FFY 2018-2019)	4-Year Target (kg/day) (FFY 2018-2021)
CO Emissions Reduction (kg/day) from CMAQ funded projects in Northern Middlesex MPO	FFY 2014-2017 Obligated TIP projects using CMAQ funding	11.76	0.00	0.00

Within the nonattainment/maintenance areas of the State, known emissions reductions from projects that are anticipated to receive CMAQ funding over the next five federal fiscal years were compiled to develop statewide targets. The statewide targets for CO and ozone precursors are compilations of all emissions reductions from each maintenance or nonattainment area as shown in Table 13.6.

**Table 13.6: Massachusetts Statewide Baseline Conditions, 2 and 4 Year Targets for On-Road Mobile Emission Measures**

Performance Measure	Baseline Data Set	Baseline Condition (kg/day)	2-Year Target (kg/day) (FFY 2018-2019)	4-Year Target (kg/day) (FFY 2018-2021)
CO Emissions Reduction (kg/day)	FFY 2014-2017 Obligated STIP projects using CMAQ funding	24.452	1,596.514	1,596.514
NOx Emissions Reduction (kg/day)		0.742	0.500	1.600
VOC Emissions Reduction (kg/day)		1.667	0.600	0.900

## EVALUATION AND REPORTING OF STATEWIDE GREENHOUSE GAS REDUCTIONS IN TRANSPORTATION

This section documents recent progress made by MassDOT and the MPOs in working to help achieve greenhouse gas (GHG) reduction goals as outlined in state regulations applicable to Massachusetts. This “progress report” estimates future carbon dioxide (CO<sub>2</sub>) emissions from the transportation sector as part of meeting the GHG reduction goals established through the Commonwealth’s Global Warming Solutions Act (GWSA).

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## GWSA TRANSPORTATION STATUS: FUTURE CARBON DIOXIDE EMISSIONS REDUCTIONS

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The Global Warming Solutions Act of 2008 requires statewide reductions in greenhouse gas (CO<sub>2</sub>) emissions of 25 percent below 1990 levels by the year 2020, and 80 percent below 1990 levels by 2050.

The Commonwealth's thirteen metropolitan planning organizations (MPOs) are involved in helping to achieve greenhouse gas reductions mandated under the GWSA. The MPOs work closely with the Massachusetts Department of Transportation (MassDOT) and other involved agencies to develop common transportation goals, policies, and projects that would help to reduce GHG emission levels statewide, and meet the specific requirements of the GWSA regulation – *Global Warming Solutions Act Requirements for the Transportation Sector and the Massachusetts Department of Transportation (310 CMR 60.05)*. The purpose of this regulation is to assist the Commonwealth in achieving their adopted GHG emission reduction goals by:

- Requiring each MPO to evaluate and report the aggregate GHG emissions and impacts of both its Regional Transportation Plan (RTP) and Transportation Improvement Program (TIP).
- Requiring each MPO, in consultation with MassDOT, to develop and utilize procedures to prioritize and select projects in its RTP and TIP based on factors that include GHG emissions and impacts.

Meeting the requirements of this regulation is being achieved through the transportation goals and policies contained in the 2020 RTPs, the major projects planned in the RTPs, and the mix of new transportation projects that are programmed and implemented through the TIPs.

The GHG evaluation and reporting processes enable the MPOs and MassDOT to identify the anticipated GHG impacts of the planned and programmed projects, and also to use GHG impacts as a criterion in prioritizing transportation projects. This approach is consistent with the greenhouse gas reduction policies of promoting healthy transportation modes through prioritizing and programming an appropriate balance of roadway, transit, bicycle and pedestrian investments; as well as supporting smart growth development patterns through the creation of a balanced multi-modal transportation system. All of the MPOs and MassDOT are working toward reducing greenhouse gases with “sustainable” transportation plans, actions, and strategies that include (but are not limited to):

- Reducing emissions from construction and operations
- Using more fuel-efficient fleets
- Implementing and expanding travel demand management programs
- Encouraging eco-driving
- Providing mitigation for development projects
- Improving pedestrian, bicycle, and public transit infrastructure and operations (healthy transportation)

- Investing in higher density, mixed use, and transit-oriented developments (smart growth)

**REGIONAL GHG EVALUATION AND REPORTING IN RTPS**

MassDOT coordinated with MPOs and regional planning agency (RPA) staffs on the implementation of GHG evaluation and reporting in development of each MPO’s 2012 and 2016 RTPs. This collaboration has continued for the MPOs’ 2020 RTPs and 2020-24 TIPs. Working together, MassDOT and the MPOs have attained the following milestones:

- Modeling and long-range statewide projections for GHG emissions resulting from the transportation sector, as a supplement to the 2020 RTPs. Using the newly updated statewide travel demand model, GHG emissions have been projected for 2020 no-build (base) and build (action) conditions, and for 2040 no-build (base) and build (action) conditions (see the chart in this section for the results of this modeling).
- All of the MPOs have addressed GHG emission reduction projections in their RTPs (including the statewide estimates in the chart that follows), along with a discussion of climate change and a statement of MPO support for reducing GHG emissions from transportation as a regional goal.

MassDOT’s statewide estimates of CO<sub>2</sub> emissions resulting from the collective list of all recommended projects in all of the Massachusetts RTPs combined are presented in the table 13.7 below. Emissions estimates incorporate the latest planning assumptions including updated socio-economic projections consistent with the 2020 RTPs:

**Table 13.7: Massachusetts Statewide Aggregate CO<sub>2</sub> Estimated Emissions Impacts from Transportation**

Year	CO <sub>2</sub>	CO <sub>2</sub>	Difference (Action – Base)
	Action Emissions (tons/summer day)	Base Emissions (tons/summer day)	
2016	86,035.60	86,035.60	n/a
2020	75,675.60	75,865.90	-190.3
2040	54,484.20	54,702.20	-218

This analysis includes only those larger, regionally significant projects that are included in the statewide 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.), are covered in each MPO region’s RTP with either “qualitative” assessments of likely CO<sub>2</sub> change, or actual quantitative estimates listed for each project.

As shown above, collectively, all the projects in the RTPs in the 2020 Action scenario provide a statewide reduction of over 190 tons of CO<sub>2</sub> per day compared to the base case. The 2040 Action scenario estimates a reduction of 218 tons per day of CO<sub>2</sub> emissions compared to the base case.

These results demonstrate that the transportation sector is expected to continue making positive progress in contributing to the achievement of GHG reduction targets consistent with the requirements of the GWSA. MassDOT and the MPOs will continue to advocate for steps needed to accomplish the Commonwealth's long-term goals for greenhouse gas reductions.

### NORTHERN MIDDLESEX REGION CMAQ FUNDED PROJECTS

This section presents regional projects designed to decrease greenhouse gas emissions and assist in achieving targets outlined for reducing peak hour excessive delay and single occupancy vehicle travel. Table 13.8 provides a summary of projects included in the recommendations of the Plan that have identified CMAQ funding sources. The Pawtucket Falls Overlook project quantitative analysis, which will directly work toward the achievement of CO emissions reduction targets, has not been made available for the baseline reporting period. This analysis will be included in the mid period CMAQ performance report in FFY 2021.

**Table 13.8: Summary of CMAQ Funded Projects in Northern Middlesex MPO**

Project	Description of Project	Year Anticipated for CMAQ Obligation	VOC Benefit (kg/day)	NOx Benefit (kg/day)	CO Benefit (kg/day)	PHED Reduction	NON SOV Travel Benefit
Pawtucket Falls Overlook Construction, Lowell	New/Improved sidewalk and multipurpose trail	2020	N/A	N/A	N/A	No	Yes – Increased use of Non-SOV through expansion of Bike/Ped Facilities
Main Street Improvements, Dunstable	New sidewalk and shoulders as part of improvement project	2021	0.1	0.0	1.3	Yes – Reduced PHED on NHS Roadway	Yes – Increased use of Non-SOV through expansion of sidewalk facilities

**Table 13.8: Summary of CMAQ Funded Projects in Northern Middlesex MPO**

Project	Description of Project	Year Anticipated for CMAQ Obligation	VOC Benefit (kg/day)	NOx Benefit (kg/day)	CO Benefit (kg/day)	PHED Reduction	NON SOV Travel Benefit
Yankee Doodle Bike Path Construction, Billerica	New Multipurpose trail	2023	13.3	36.0	930.2	No	Yes – Increased use of Non-SOV with new bike path.

**ENVIRONMENTAL CONSULTATION**

In compliance with FAST requirements, the NMMPO conducted an environmental consultation session, to identify resources that will need to be considered as the projects advance through the project development and permitting processes, and where possible, to discuss possible strategies to avoid, minimize and mitigate such impacts. In addition to the Conservation Commissions and Historical Commissions in each community, over forty stakeholder groups were invited to the consultation session including the following:

**Land Trusts and Open Space Stewards**

- Chelmsford Land and Conservation Trust
- Dracut Land Trust
- Dunstable Rural Land Trust
- Lowell Parks and Conservation Trust
- Nashoba Conservation Trust
- Westford Conservation Trust
- Westford Land Preservation Foundation, Inc.
- Sudbury Valley Trustees
- Chelmsford Open Space Stewards

**State Stakeholders**

- MassDEP
- MA Natural Heritage and Endangered Species Program

**Federal Stakeholders**

- EPA NE Headquarters (Region 1)
- US National Park Service
- US Fish and Wildlife Service New England Field Office

**Non-Profits**

- Merrimack River Watershed Council
- Nashua River Watershed Association
- Chelmsford Historical Society

- MA Department of Conservation and Recreation
- MA Division of Fisheries and Wildlife

**CLIMATE CHANGE, AQUATIC AND TERRESTRIAL RISK ANALYSIS**

As part of the consultation process, project recommendations were analyzed to determine their potential impact to aquatic and terrestrial habitats. Project locations were mapped and a 100-foot buffer was applied around each limit of work to estimate the project impact area (See Map 13.1 on page 13-12). Each project was then examined to see if its boundaries intersected with the following environmental resource areas: wetlands, the wetlands 100-ft buffer, the Rivers Protection Act 200-ft Riverfront Area, vernal pools, and the Natural Heritage and Endangered Species Program (NHESP) Priority Habitats for State-Listed Rare Species. Through this process, thirteen recommended financially constrained projects emerged as having a high impact on environmental resources, as they intersect with at least one of the four resource areas. These include projects listed in Table 13.8 and are shown on climate change risk analysis

Project recommendations were reviewed to see if they would be at risk from climate change and flooding. Each project was mapped to see if it fell within 100 feet of FEMA’s 1% annual chance floodplain (Table 13.9). Nine project recommendations (financially constrained) are located within 100 feet of the floodplain (Map 13.2 on page 13-14). Adaptation and mitigation strategies will be needed to ensure these projects will not be affected by future flooding.

**Table 13.9: RTP Financially Constrained Recommended Projects with a High Anticipated Impact to Aquatic and Terrestrial Resources**

Community	Project Description	Within 100 feet of a Floodplain	Within 100 feet of Wetland	Within 100 feet of the Wetlands Buffer	Within 100 feet of Rivers Protection Act Buffer Zone	Within 100 feet of Vernal Pool	Within 100 feet of NHESP Priority Habitat
Billerica	Intersection Improvements to Boston Rd/ Glad Valley Dr/ Lexington Rd	Yes	No	Yes	No	No	No
Billerica	Middlesex Canal Enhancement	Yes	Yes	Yes	Yes	No	No
Billerica	Rehabilitation on Boston Road (Route 3A) from Floyd St to Billerica Town Center	No	No	Yes	No	No	No

**Table 13.9: RTP Financially Constrained Recommended Projects with a High Anticipated Impact to Aquatic and Terrestrial Resources**

Community	Project Description	Within 100 feet of a Floodplain	Within 100 feet of Wetland	Within 100 feet of the Wetlands 100 ft Buffer	Within 100 feet of Rivers Protection Act Buffer Zone	Within 100 feet of Vernal Pool	Within 100 feet of NHESP Priority Habitat
<b>Billerica</b>	Yankee Doodle Bike Path, Design and Construction	Yes	Yes	Yes	No	No	No
<b>Chelmsford</b>	Intersection Improvements at Boston Road and Concord Road	No	No	No	Yes	No	No
<b>Dracut</b>	Improvements on Nashua Rd	No	No	Yes	No	No	No
<b>Dunstable</b>	Route 113 Improvements on Main Street (Route 113) from Pleasant Street to 750 Ft East of Westford Street	Yes	Yes	Yes	Yes	No	No
<b>Lowell</b>	Pedestrian Walkway and Bicycle Connection at Pawtucket Falls Overlook, from Vandenberg Esplanade to School Street	No	No	No	Yes	No	No
<b>Lowell</b>	Reconstruction and related Work on VFW Highway	Yes	Yes	Yes	Yes	No	Yes
<b>Tewksbury</b>	Resurfacing and Sidewalk Reconstruction on Route 38 beginning at Colonial Drive North of the Intersection of Old Boston Road Approximately 1.5 miles	Yes	Yes	Yes	Yes	No	No
<b>Tewksbury</b>	Route 38 Improvements	Yes	No	Yes	Yes	No	No

**Table 13.9: RTP Financially Constrained Recommended Projects with a High Anticipated Impact to Aquatic and Terrestrial Resources**

Community	Project Description	Within 100 feet of a Floodplain	Within 100 feet of Wetland	Within 100 feet of the Wetlands Buffer	Within 100 feet of Rivers Protection Act Buffer Zone	Within 100 feet of Vernal Pool	Within 100 feet of NHESP Priority Habitat
Westford	Bridge Rehabilitation Beaver Brook Road over Beaver Brook	Yes	Yes	Yes	No	Yes	No
Westford	Bridge Replacement, W26-002, Stony Brook Road over the Stony Brook	Yes	Yes	Yes	No	No	No

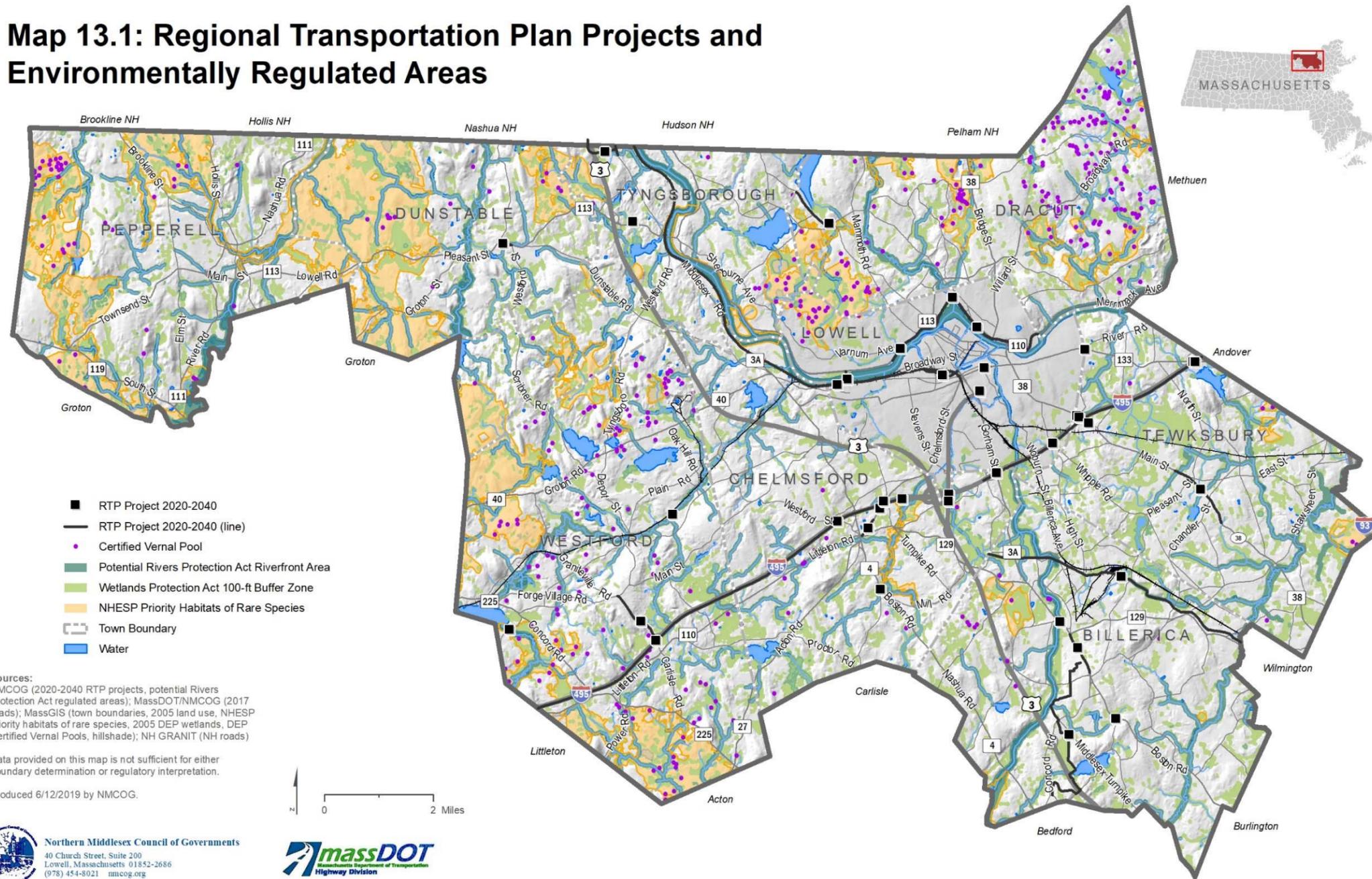
#### HISTORIC RESOURCES RISK ANALYSIS

Projects were mapped to determine whether they are located within 100 feet of a local historic district, National Register Historic District, or a Massachusetts Historical Commission Historical Site (Map 13.3 on page 13-16). Twenty-two sites intersected with all three of the historic resource areas, indicating they are likely to impact a historic resource area (Table 13.10).

**Table 13.10: RTP Project Recommendations with a High Anticipated Impact to Historical Resources**

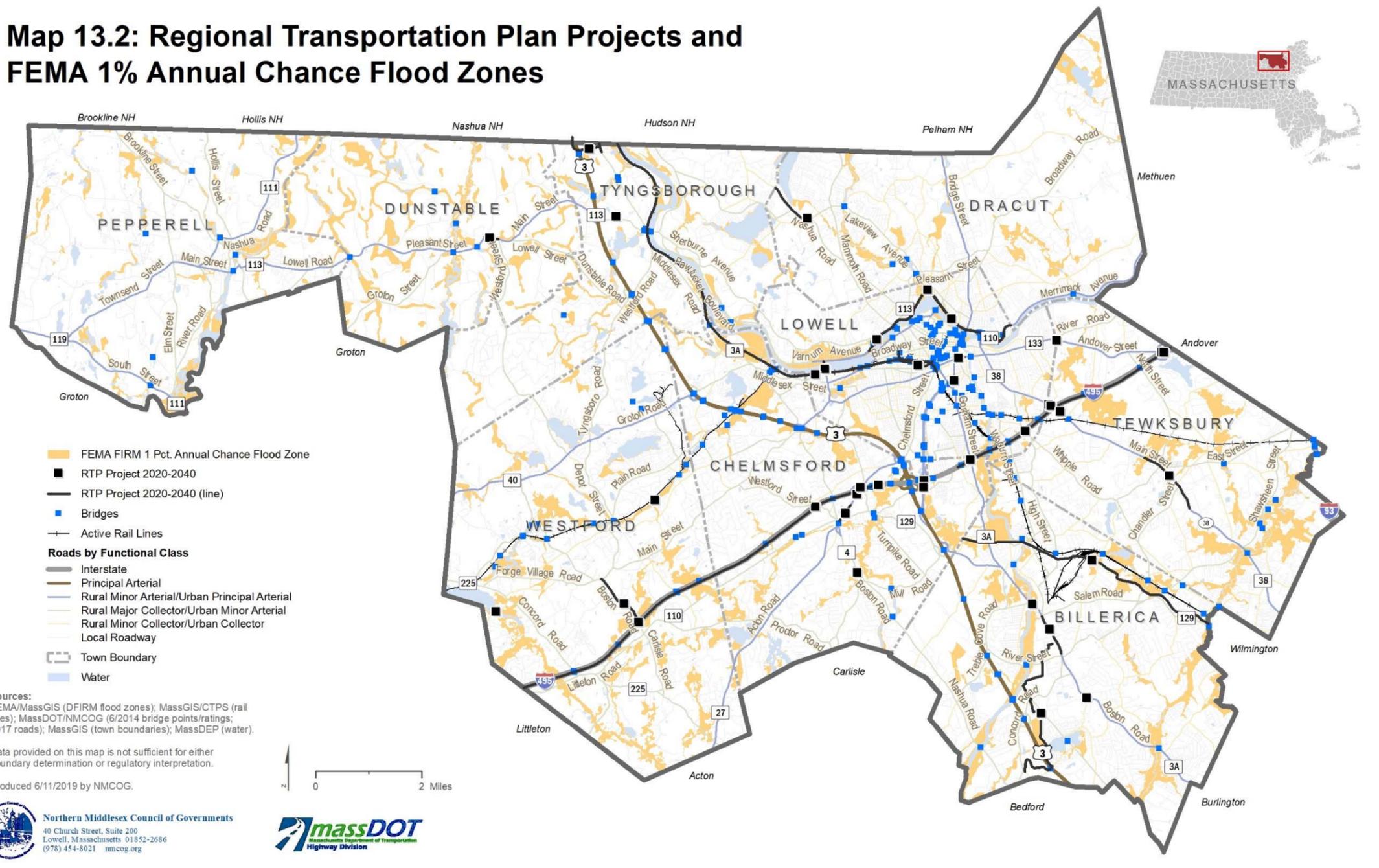
<b>Community</b>	<b>Project Description</b>	<b>Within 100 feet of Local Historic District</b>	<b>Within 100 feet of National Register Historic District or Property</b>	<b>Within 100 feet of Mass. Historical Commission Historic Site</b>
<b>Billerica</b>	Intersection Improvements to Boston Rd/ Glad Valley Dr/ Lexington Rd	No	No	Yes
<b>Billerica</b>	Rehabilitation on Boston Road (Route 3A) from Floyd St to Billerica Town Center	Yes	Yes	Yes
<b>Billerica</b>	Yankee Doodle Bike Path Construction (Phase 1)	Yes	Yes	Yes
<b>Billerica</b>	Middlesex Canal Enhancement	No	No	Yes
<b>Chelmsford</b>	Improvements on Chelmsford Street (Route 110)	No	No	Yes
<b>Lowell</b>	Church Street 2 Way Conversion	Yes	Yes	No
<b>Lowell</b>	Connector Reconstruction from Thorndike Street to Gorham Street	No	No	Yes
<b>Lowell</b>	Pedestrian Walkway & Bicycle Connection at Pawtucket Falls Overlook, from Vandenberg Esplanade to School Street	Yes	Yes	No
<b>Lowell</b>	Reconstruction and related Work on VFW Highway	Yes	Yes	No
<b>Tewksbury</b>	Route 38 Intersection Improvements	No	No	Yes
<b>Westford</b>	Bridge Replacement, W26-002, Stony Brook Road over the Stony Brook	No	No	Yes

### Map 13.1: Regional Transportation Plan Projects and Environmentally Regulated Areas



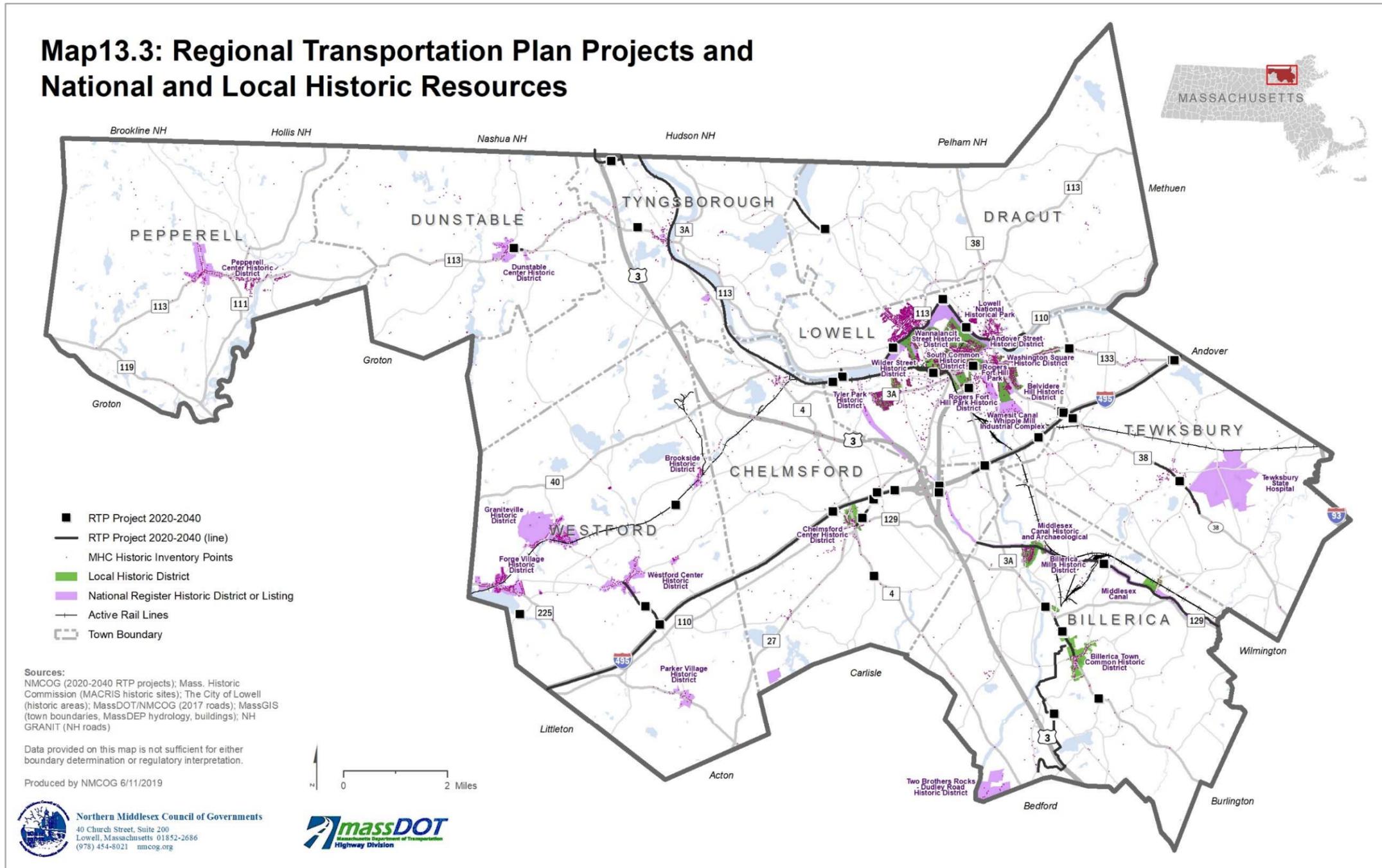
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### Map 13.2: Regional Transportation Plan Projects and FEMA 1% Annual Chance Flood Zones



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### Map13.3: Regional Transportation Plan Projects and National and Local Historic Resources



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**PROMOTE TRANSPORTATION ALTERNATIVES AND TECHNIQUES THAT REDUCE AIR POLLUTION AND GREEN HOUSE GASES**

The earth's climate is predicted to change over time, in part because human activities are altering the chemical composition of the atmosphere through the buildup of greenhouse gases - primarily carbon dioxide, methane, and nitrous oxide. Within the United States, transportation is the largest source of greenhouse gas (GHG) emissions after electricity generation.



**Image 13.2: Tyngsborough Bridge over the Merrimack River**

Transportation contributes over 40% of Massachusetts' greenhouse gas emissions, and is the largest source of air pollution of any sector of the state's economy. Extreme heat may cause heat stress in materials like asphalt and increase the frequency of repairs and replacements. Peaks in power demand during hotter summer days could cause outages that affect electrified public transit. Flooding caused by heavier downpours may damage roads and stormwater infrastructure like undersized culverts. More nuisance ponding on roads may slow commutes and commerce. Rapid freeze thaw cycles may cause damage to road surfaces.

The Massachusetts' Global Warming Solutions Act of 2008 (GWSA) established a statewide goal to reduce greenhouse gas emissions to a level 25% below the 1990 level by the year 2020, and 80% below the 1990 level by the year 2050. In 2010, the State released the *Massachusetts Clean Energy and Climate Plan*. The Plan outlined how the State intends to achieve the reductions in GHG emissions. Transportation was identified as one of four areas where GHG reductions can be accomplished. The *Clean Energy and Climate Plan* includes an analysis of GHG emissions reductions based on the implementation of policy recommendations and established targets for reduction in the transportation sector. The analysis indicates that with the implementation of the transportation related policies, the transportation sector emission reductions could account for 7.6% of the 25% goal by 2020. The Plan recommends implementation of the following transportation policies to achieve this goal:

- Federal and California vehicle efficiency and GHG emissions standards;
- Federal emissions and fuel efficiency standards for Medium and Heavy Duty vehicles;
- Federal renewable fuel standards and regional low carbon fuel standard;
- Clean car consumer incentives;
- Pay As You Drive (PAYD) auto insurance;
- Sustainable Development Principles; and

- Smart growth policy package.

In 2015, the Commonwealth released the *2020 Clean Energy and Climate Plan for 2020*, which showed that passenger vehicles are the dominant source of emissions from the transportation sector, with significant contributions also coming from diesel trucks and aviation. Emissions from fuel combustion are determined by the efficiency and usage of vehicles (as measured in “vehicle miles traveled,” or “VMT”), and characteristics of fuels. Between 2015 and 2020, significant improvements in vehicle efficiency will occur as the stringency of vehicle GHG standards increases. Analysis showed reductions in the range of 3–4 MMTCO<sub>2</sub>e from fuel use in vehicles in Massachusetts between 2013 and 2020, driven by increases in vehicle efficiency. Other policies will have positive impacts by supporting the use of alternative transportation modes (such as transit and walking) and fuel switching (to electricity and possibly advanced low carbon biofuels). However, recognizing the historic increase in VMT from 1990 to 2013 of 22%, it remains possible that an increase in VMT will offset some or all of these benefits.

The Commonwealth has set an ambitious zero emission vehicle (ZEV) target, and offers a variety of policies and programs encouraging the purchase and use of efficient vehicles. The Commonwealth signed a memorandum with seven states to coordinate ZEV adoption efforts, and with these states is implementing a “Multi-State ZEV Action Plan” that includes 11 key actions. Massachusetts has initiated several programs funded from state and federal sources to provide charging infrastructure, incentives and education. Examples include a program offering rebates to consumers to purchase more fuel-efficient models, a clean vehicle grant program for medium and heavy-duty alternative fuel vehicles, and funding to communities and institutions of higher education to purchase plug-in electric vehicles and install charging stations.

The NMMPO is actively working to carry out the greenhouse gas emissions reduction goals by prioritizing projects that achieve an appropriate balance of mode choice, and by supporting smart growth development and resiliency principles.

## AIR QUALITY CONFORMITY DETERMINATION

The 1990 Clean Air Act Amendments (CAAA) require metropolitan planning organizations within nonattainment and maintenance areas to perform air quality conformity determinations prior to the approval of Long-Range Transportation Plans (LRTPs) and Transportation Improvement Programs (TIPs), and at such other times as required by regulation. Clean Air Act (CAA) section 176(c) (42 U.S.C. 7506(c)) requires that federally funded or approved highway and transit activities are consistent with (“conform to”) the purpose of the State Implementation Plan (SIP). Conformity to the purpose of the SIP means that Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) funding and approvals are given to highway and transit activities that will not cause or contribute to new air quality violations, worsen existing violations, or delay timely attainment of the relevant NAAQS or any interim milestones (42 U.S.C. 7506(c)(1)). EPA’s transportation conformity rules establish the criteria and procedures for determining whether metropolitan transportation plans, transportation improvement

programs (TIPs), and federally supported highway and transit projects conform to the SIP (40 CFR Parts 51.390 and 93).

A nonattainment area is one that the U.S. Environmental Protection Agency (EPA) has designated as not meeting certain air quality standards. A maintenance area is a nonattainment area that now meets the standards and has been re-designated as maintaining the standard. A conformity determination is a demonstration that plans, programs, and projects are consistent with the State Implementation Plan (SIP) for attaining the air quality standards. The CAAA requirement to perform a conformity determination ensures that federal approval and funding go to transportation activities that are consistent with air quality goals.

## LEGISLATIVE AND REGULATORY BACKGROUND

The entire Commonwealth of Massachusetts was previously classified as nonattainment for ozone, and was divided into two nonattainment areas. The Eastern Massachusetts ozone nonattainment area included Barnstable, Bristol, Dukes, Essex, Middlesex, Nantucket, Norfolk, Plymouth, Suffolk, and Worcester counties. Berkshire, Franklin, Hampden, and Hampshire counties comprised the Western Massachusetts ozone nonattainment area. With these classifications, the 1990 Clean Air Act Amendments (CAAA) required the Commonwealth to reduce its emissions of volatile organic compounds (VOCs) and nitrogen oxides (NO<sub>x</sub>), the two major precursors to ozone formation to achieve attainment of the ozone standard.

The 1970 Clean Air Act defined a one-hour national ambient air quality standard (NAAQS) for ground-level ozone. The 1990 CAAA further classified degrees of nonattainment of the one-hour standard based on the severity of the monitored levels of the pollutant. The entire commonwealth of Massachusetts was classified as being in serious nonattainment for the one-hour ozone standard, with a required attainment date of 1999. The attainment date was later extended, first to 2003 and a second time to 2007.

In 1997, the EPA proposed a new, eight-hour ozone standard that replaced the one-hour standard, effective June 15, 2005. Scientific information had shown that ozone could affect human health at lower levels, and over longer exposure times than one hour. The new standard was challenged in court, and after a lengthy legal battle, the courts upheld it. It was finalized in June 2004. The eight-hour standard is 0.08 parts per million, averaged over eight hours and not to be exceeded more than once per year. Nonattainment areas were again further classified based on the severity of the eight-hour values. Massachusetts as a whole was classified as being in moderate nonattainment for the eight-hour standard, and was separated into two nonattainment areas—Eastern Massachusetts and Western Massachusetts.

In March 2008, EPA published revisions to the eight-hour ozone NAAQS establishing a level of 0.075 ppm, (March 27, 2008; 73 FR 16483). In 2009, EPA announced it would reconsider this standard because it fell outside of the range recommended by the Clean Air Scientific Advisory Committee.

However, EPA did not take final action on the reconsideration so the standard would remain at 0.075 ppm.

After reviewing data from Massachusetts monitoring stations, EPA sent a letter on December 16, 2011 proposing that only Dukes County would be designated as nonattainment for the new proposed 0.075 ozone standard. Massachusetts concurred with these findings.

On May 21, 2012, (77 FR 30088), the final rule was published in the Federal Register, defining the 2008 NAAQS at 0.075 ppm, the standard that was promulgated in March 2008. A second rule published on May 21, 2012 (77 FR 30160), revoked the 1997 ozone NAAQS to occur one year after the July 20, 2012 effective date of the 2008 NAAQS.

Also on May 21, 2012, the air quality designations areas for the 2008 NAAQS were published in the Federal Register. In this Federal Register, the only area in Massachusetts that was designated as nonattainment is Dukes County. All other Massachusetts counties were designated as attainment/unclassified for the 2008 standard. On March 6, 2015, (80 FR 12264, effective April 6, 2015) EPA published the Final Rulemaking, "Implementation of the 2008 National Ambient Air Quality Standards (NAAQS) for Ozone: State Implementation Plan Requirements; Final Rule." This rulemaking confirmed the removal of transportation conformity to the 1997 Ozone NAAQS.

However, on February 16, 2018, the United States Court of Appeals for the District of Columbia Circuit in *South Coast Air Quality Mgmt. District v. EPA* ("South Coast II," 882 F.3d 1138) held that transportation conformity determinations must be made in areas that were either nonattainment or maintenance for the 1997 ozone NAAQS and attainment for the 2008 ozone NAAQS when the 1997 ozone NAAQS was revoked. These conformity determinations are required in these areas after February 16, 2019. On November 29, 2018, EPA issued *Transportation Conformity Guidance for the South Coast II Court Decision* (EPA-420-B-18-050, November 2018) that addresses how transportation conformity determinations can be made in areas. According to the guidance, both Eastern and Western Massachusetts, along with several other areas across the country, are now defined as "orphan nonattainment areas" – areas that were designated as nonattainment for the 1997 ozone NAAQS at the time of its revocation (80 FR 12264, March 6, 2015) and were designated attainment for the 2008 ozone NAAQS in EPA's original designations rule for this NAAQS (77 FR 30160, May 21, 2012).

After February 16, 2019, as a result of the court ruling and the subsequent federal guidance, transportation conformity for the 1997 NAAQS – intended as an "anti-backsliding" measure – now applies to both of Massachusetts' orphan areas. Therefore, this conformity determination is being made for the 1997 ozone NAAQS on the Northern Middlesex FFY 2020-2024 Transportation Improvement Program and 2020-2040 Regional Transportation Plan.

The transportation conformity regulation at 40 CFR 93.109 sets forth the criteria and procedures for determining conformity. The conformity criteria for TIPs and RTPs include: latest planning assumptions (93.110), latest emissions model (93.111), consultation (93.112), transportation control measures (93.113(b) and (c), and emissions budget and/or interim emissions (93.118 and/or 93.119).

For the 1997 ozone NAAQS areas, transportation conformity for TIPs and RTPs for the 1997 ozone NAAQS can be demonstrated without a regional emissions analysis, per 40 CFR 93.109(c). This provision states that the regional emissions analysis requirement applies one year after the effective date of EPA's nonattainment designation for a NAAQS and until the effective date of revocation of such NAAQS for an area. The 1997 ozone NAAQS revocation was effective on April 6, 2015, and the *South Coast II* court upheld the revocation. As no regional emission analysis is required for this conformity determination, there is no requirement to use the latest emissions model, or budget or interim emissions tests.

Therefore, transportation conformity for the 1997 ozone NAAQS for the Northern Middlesex FFY 2020-2024 Transportation Improvement Program and 2020-2040 Regional Transportation Plan can be demonstrated by showing that remaining requirements in Table 1 in 40 CFR 93.109 have been met. These requirements, which are laid out in Section 2.4 of EPA's guidance and addressed below, include:

- Latest planning assumptions (93.110)
- Consultation (93.112)
- Transportation Control Measures (93.113)
- Fiscal Constraint (93.108)

#### LATEST PLANNING ASSUMPTIONS:

The use of latest planning assumptions in 40 CFR 93.110 of the conformity rule generally apply to regional emissions analysis. In the 1997 ozone NAAQS areas, the use of latest planning assumptions requirement applies to assumptions about transportation control measures (TCMs) in an approved SIP (See following section on Timely Implementation of TCMs).

#### CONSULTATION:

The consultation requirements in 40 CFR 93.112 were addressed both for interagency consultation and public consultation. Interagency consultation was conducted with FHWA, FTA, US EPA Region 1, MassDEP, and the other Massachusetts MPOs, with the most recent conformity consultation meeting held on March 6, 2019 (this most recent meeting focused on understanding the latest conformity-related court rulings and resulting federal guidance). This ongoing consultation is conducted in accordance with the following:

- Massachusetts' Air Pollution Control Regulations 310 CMR 60.03 "Conformity to the State Implementation Plan of Transportation Plans, Programs, and Projects Developed, Funded or Approved Under Title 23 USC or the Federal Transit Act"
- The Commonwealth of Massachusetts Memorandum of Understanding by and between Massachusetts Department of Environmental Protection, Massachusetts Executive Office of Transportation and Construction, Massachusetts Metropolitan Planning Organizations

concerning the conduct of transportation-air quality planning in the development and implementation of the state implementation plan"

Public consultation was conducted consistent with planning rule requirements in 23 CFR 450 in accordance with the region's public participation plan ([www.nmcog.org/public-participation](http://www.nmcog.org/public-participation)).

Title 23 CFR Section 450.324 and 310 CMR 60.03(6)(h) requires that the development of the RTP, and related certification documents provide an adequate opportunity for public review and comment. Section 450.316(b) also establishes the outline for MPO public participation programs. The Northern Middlesex MPO's Public Participation Plan was formally adopted in 2016. The Public Participation Plan ensures that the public will have access to the RTP and all supporting documentation, provides for public notification of the availability of the RTP and the public's right to review the document and comment thereon, and provides a 21-day public review and comment period prior to the adoption of the RTP and related certification documents.

#### TIMELY IMPLEMENTATION OF TRANSPORTATION CONTROL MEASURES:

Transportation Control Measures (TCMs) have been required in the SIP in revisions submitted to EPA in 1979 and 1982. All SIP TCMs have been accomplished through construction or through implementation of ongoing programs. All of the projects have been included in the Region's Transportation Plan (present or past) as recommended projects or projects requiring further study.

DEP submitted to EPA its strategy of programs to show Reasonable Further Progress of a 15% reduction of VOCs in 1996 and the further 9% reduction of NOx toward attainment of the National Ambient Air Quality Standards (NAAQS) for ozone in 1999. Within that strategy there are no specific TCM projects. The strategy does call for traffic flow improvements to reduce congestion and, therefore, improve air quality. Other transportation-related projects that have been included in the SIP control strategy are listed below:

- Enhanced Inspection and Maintenance Program
- California Low Emission Vehicle Program
- Reformulated Gasoline for On- and Off-Road Vehicles
- Stage II Vapor Recovery at Gasoline Refueling Stations
- Tier I Federal Vehicle Standards

#### *Fiscal Constraint:*

Transportation conformity requirements in 40 CFR 93.108 state that TIPs and transportation plans and must be fiscally constrained consistent with DOT's metropolitan planning regulations at 23 CFR part 450.

As of April 22, 2002, the city of Lowell was re-designated as being in attainment for carbon monoxide (CO) with an EPA-approved limited maintenance plan. In areas with approved limited maintenance plans, federal actions requiring conformity determinations under the transportation conformity rule are considered to satisfy the "budget test" (as budgets are treated as not constraining in these areas for the

length of the initial maintenance period). Any future required "project level" conformity determinations for projects located within this community will continue to use a "hot-spot" analysis to assure that any new transportation projects in this CO attainment area do not cause or contribute to carbon monoxide non-attainment.

## PROMOTE THE PROTECTION OF CRITICAL ENVIRONMENTAL RESOURCES

Many roads are located along rivers, through wetlands, or in valleys to avoid steep grades and minimize construction costs. In recent years, habitat loss and water quality pollution has created the need for transportation agencies to address potential impacts to aquatic and terrestrial resources. Transportation related problems stem from a variety of culprits including stormwater runoff from roads, snow and ice removal and the creation of new roads and infrastructure, which can disrupt habitats and can cause connectivity issues. The NMMPO describes below the methods it will use to protect these sensitive resources in planning and designing transportation improvements.

### AQUATIC RESOURCES

Stormwater runoff, including runoff from highways, carries compounds that can contribute to the degradation of water quality in receiving water bodies. For example, solids, nutrients, heavy metals, oil and grease may be found in stormwater runoff associated with highway construction, operation and maintenance activities. The Federal Phase II Stormwater Rule published by EPA in December 1999 required operators of municipal separate storm sewer systems ("MS4s") to develop and implement six *minimum* stormwater management measures:

- Public education and outreach;
- Public participation and involvement;
- Illicit discharge detection and elimination;
- Construction site runoff control;
- Post-construction runoff control; and
- Stormwater pollution prevention/municipal good housekeeping.



**Image 13.3: Micozzi Beach in Billerica**

Successful implementation of these six measures requires a detailed knowledge of the location, function, and condition of urbanized areas' municipal storm drainage infrastructure – storm drains, manholes, catch basins, and outfall pipes – as well as of the receiving waters.

Proper policies and procedures for roadway project design, including deep sump catch basins, and best management practices, such as roadway sweeping and the regular cleaning of catch basins, must be followed to prevent the contamination of water resources. MassDOT Highway Division has incorporated new stormwater standards into its specifications for construction projects in order to meet the requirements of recent regulatory changes, and to implement best management practices for attenuating pollution from highway traffic. The state has also developed a priority list of sites for remediation of existing problem locations. Best management practices (BMPs) must be utilized in controlling the quantity and quality of stormwater. BMPs are continually evolving based on the latest technologies and innovations. Structural BMPs include:

- Storage controls such as detention and retention basins;
- Infiltration practices such as infiltration basins and trenches, and porous pavements;
- Vegetative controls such as grassed swales and vegetative filter strips; and
- Wetland replication.

Structural BMPs operate by physically trapping run-off until contaminants settle out or are filtered through the underlying soils. The basic mechanisms for contaminant removal are gravity settling, infiltration of soluble nutrients through soils or filters, or biological and chemical processes. Non-structural BMPs are source control practices such as street sweeping, land use planning, vegetated buffer areas, and fertilizer application controls. Non-structural BMPs may reduce the need for costly structural controls.

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## STORMWATER MANAGEMENT

On May 10, 2018, the U.S. Environmental Protection Agency (“EPA”) issued a new Municipal Stormwater Sewer System (“MS4”) general permit for small MS4s. The permit replaces the MS4 permit that was issued in 2003. The new permits includes the following six “minimum control measures”:

- Public Education and Outreach;
- Public Participation;
- Illicit Discharge Detection and Elimination;
- Management of Construction Site Runoff;
- Management of Post-Construction Site Runoff; and
- Good Housekeeping in Municipal Operation.

In general, the new permit is substantially more robust, detailed, and prescriptive than the 2003 permit. For example, permittees will be required to demonstrate the effectiveness of their public education and outreach efforts and promptly modify their methods as needed. More extensive measures must be taken by MS4s that discharge to impaired waters, both those with an EPA-approved Total Maximum Daily Load (“TMDL”) and those without an approved TMDL. In addition, the new permit requires inspection and sampling under both dry and wet weather conditions, including monitoring and

sampling of stormwater outfalls. All of the communities in the Northern Middlesex region are subject to the permit.

NMCOG provides Stormwater Management technical assistance to its communities through the Northern Middlesex Stormwater Collaborative (NMSC) and the stormwater management task outlined in the NMMPO's Unified Planning Work Program (UPWP). NMCOG designs and conducts local and regional workshops to train municipal personnel (public works and highway departments, conservation commissions, health boards, and municipal engineers) on the state and federal stormwater requirements. Past training topics have included stormwater infrastructure inventorying and mapping, illicit discharge detection and elimination, municipal operations best management practices, and stormwater management program (SWMP) financing options, and public education and outreach.

Relevant stormwater management documents and associated public outreach materials that are customizable for each community have also been provided as part of the public education process. The stormwater management activities in every community are critical to reducing the volume and pollutant loads of uncontrolled stormwater that enters local drainage systems, waterways, and groundwater. Building on previous infrastructure mapping work, NMCOG continues to collect and review drainage plans, maps, and reports, and consults with knowledgeable local DPW and highway department personnel in order to map the locations of local stormwater infrastructure for communities. The emphasis has been on inventorying and mapping drainpipe locations as well as catch basins and the catchment areas of outfall pipes.

#### SNOW AND ICE REMOVAL

MassDOT Highway Division conducts ongoing research and development aimed at reducing or eliminating the effects of snow and ice control on water quality. A number of steps have been taken to limit the use of sodium chloride on state highways, including mixing salt with sand, improving the calibration of spreaders, and establishing zones where no salt or limited salt is used in order to protect groundwater aquifers. A weather forecasting and in-pavement monitoring system has also been implemented to improve the targeted application of de-icing materials.



**Image 13.4: Nissistissit River in Pepperell**

MassDOT has a Clean Wells Initiative to remedy situations where residential water supplies have been compromised due to salt runoff from state highways. The program is focused on replacing those wells that have been contaminated. Experience has shown that the number of salt complaints is dynamic from year-to-year and depends on such factors as winter severity, adherence to Standard Operating

Procedures, and public awareness of salt remediation programs. An additional goal of the Clean Wells Initiative is to provide continued funding to allow the construction of up to 20 replacement wells per year. Other program elements include:

- Assessment of the state’s Salt Management Program relative to salt storage sheds;
- Training of employees to increase awareness of salt sensitive areas and emphasize proper procedures and practices;
- Continued use of designated reduced salt zones, where appropriate;
- Use of wetting agents to reduce the amount of salt applied;
- Exploration of other feasible and cost-effective de-icing agents to reduce dependence on sodium chloride; and
- Use of weather data and GIS information to improve operations.

MassDOT coordinates the investigation and remediation of public water supplies with the appropriate regional office of the Massachusetts Department of Environmental Protection (DEP). For Non-Community Water Systems, MassDOT will evaluate a salt contamination complaint that is from a water supplier that documents full compliance with 310 CMR 22 for at least one year. This compliance must be confirmed by the appropriate DEP regional office before MassDOT can institute remedial action. Prior to implementation of any remedial action, MassDOT requires an opportunity to review the monthly data provided by the water supplier. Due to the size of a public water supply system, the investigation of these matters is considerably more complex than a private well, and may result in the designation of a reduced salt area or modifications to highway drainage, if it is determined that MassDOT significantly contributed to the sodium and chloride concentrations in the public water supply.



**Image 13.5: Stone Arch Bridge in Westford**

MassDOT works closely with the property owner when assessing a private well for potential salt contamination. The DEP recommended guideline for sodium concentrations in drinking water supplies is 20 milligrams per liter (mg/l), and the secondary maximum contaminant level (MCL) for chloride is 250 mg/l. These recommended contaminant levels are referenced in DEP's *Private Well Guidelines*. The guideline for sodium is intended to be protective of individuals on a 1,000 milligram per day (mg/d) sodium-restricted diet, while the chloride MCL is an aesthetic value solely for taste. Investigations are performed in accordance with Standard Operating Procedures (SOP) pertaining to Salt Contamination Complaints.

In addition to MassDOT's progressive approach for the investigation and remediation of water supplies potentially contaminated by road salt due to winter maintenance operations, MassDOT takes a proactive approach in ensuring that environmental stewardship is a priority when dealing with matters of this nature. To that end, MassDOT has implemented a series of initiatives aimed at promoting the effective and efficient use of deicing chemicals.

- **Snow and Ice Material Usage Committee:** In conjunction with MassDOT Operations personnel, the Environmental Services Section has formed a committee to review, evaluate, and potentially revise the Reduced Salt Policy, on an annual basis. The Committee is also responsible for the review and revision of current deicing chemical application policies, Best Management Practices (BMPs) and assessment of potential alternative deicing chemicals.
- **Unionized and Privatized Forces Training:** This program initiative provides additional training to unionized and privatized forces for the proper management and application of deicing chemicals. MassDOT and privatized personnel are trained on an annual basis on different aspects of snow and ice control.
- **Salt Storage and Housekeeping BMPs:** There is an existing SOP for the management of sand and deicing chemicals at MassDOT facilities, ENV-01-08-1-000. However, a new SOP for the proper management of sand and deicing chemicals at MassDOT facilities after storm events or materials deliveries is under development. In conjunction with the materials management SOP, MassDOT will implement a salt storage and management program that will review the locations and condition of existing storage structures. Criteria for evaluating storage facilities are being developed in order to review each salt storage location and prioritize facilities for new construction or repair. Based on a shed's location and condition, MassDOT can prepare and implement the necessary facility upgrades (i.e., construction of a new gambrel style shed, drainage modifications or repairs, minor repairs to the existing structure, etc.).
- **Use of Alternative Deicing Chemicals:** MassDOT is currently using a corrosion inhibited magnesium chloride ( $MgCl_2$ ) along roadway segments on a trial basis.

NMCOG will work with the municipalities in the region to encourage the proper snow and ice removal techniques, as discussed above, to ensure protection of our local streams, lakes and rivers.

## TERRESTRIAL RESOURCES

While roadways connect communities, they can also alter and fragment natural habitat. The introduction of a roadway can cause wildlife-vehicle collisions, habitat loss, habitat fragmentation, and a decrease in habitat quality. In Massachusetts, reptiles and amphibians are more likely to be affected than other species, primarily because they depend on both wetland and upland habitat, which are frequently separated by roads. Studies have shown that female Blanding's turtles may travel up to a mile in search of a suitable nest site, and are likely to cross at least one road to do so. To minimize or mitigate the potential impacts to important species, the NMMPO will advocate for a variety of techniques including the following:



**Image 13.6: Tewksbury Wildlife and Butterfly Sanctuary**

- Wetland replication;
- Vegetated berms;
- Native plantings;
- Responsive mowing regimes;
- “Living fences”;
- Wildlife crossings; and
- Sloped curbing.

These techniques will encourage movement of reptiles and amphibians, and other wildlife and can be incorporated into transportation projects for both new and reconstructed roadways and transportation corridors.

## PROTECT CRITICAL TRANSPORTATION INFRASTRUCTURE FROM THE AFFECTS OF CLIMATE CHANGE AND FLOODING

### CLIMATE CHANGE ADAPTATION

There are many effects resulting from climate change, including rising sea level, flooding, and an increase in the occurrence of severe weather events. Warmer air can hold more moisture, so storms produce greater amounts of precipitation. Therefore, damage will be likely intensified in areas already prone to flooding. Climate change will have significant impacts on transportation, affecting the way transportation professionals plan, design, construct, operate, and maintain infrastructure. Decisions

made today, particularly those related to the redesign and retrofitting of existing infrastructure, or the location and design of new transportation infrastructure, will affect how well the system can adapt to climate change in the future.

**HIGH HAZARD DAMS**

Dam infrastructure will be particularly vulnerable to the effects of climate change. As part of NMCOG’s updated Hazard Mitigation Plan, ninety-seven areas of repetitive flooding were identified by the nine communities in the region, with all communities except Westford and Dunstable having at least one area, and Billerica having the most areas at fifty. Dam failure during a flood event can pose a serious threat to downstream properties by releasing a surge of water that was stored behind the dam prior to its failure. There are four high hazard dams in the region, defined as one where failure would result in potential catastrophic loss in both life and property (Table 13.11). These dams should be inspected every two years.

**Table 13.11: High Hazard Dams in the Northern Middlesex Region**

Community	Dam Name	Impoundment Name	Downstream Population
Lowell	Lowell Reservoir Dam	Lowell Reservoir	400
Pepperell	Turner Dam	Nissitissit River	0
Tewksbury	Ames Pond	Ames Pond	5,000
Tewksbury	Dike A	Ames Pond	5,000

Source: NMCOG 2015 Regional Hazard Mitigation Plan

**ADAPTATION AND MITIGATION TECHNIQUES**

In an effort to reduce GHG emissions, the NMMPO has identified projects which could result in a reduction in GHG emission for those benchmark years. Table 13.12 lists projects in the Northern Middlesex Region RTP that have been analyzed and expect to contribute to a reduction in GHG emissions upon completion of construction.

**Table 13.12: Project Recommendations expected to reduce GHG Emissions**

Community	Project Type/ Project ID #	Project Description	Year of Expenditure Cost*	GHG Reduction (kg/yr)
Lowell	607885	Lowell- Pedestrian Walkway & Bicycle Connection At Pawtucket Falls Overlook, From Vandenberg Esplanade To School Street	\$2,321,280	4,669
Billerica	608227	Billerica- Yankee Doodle Bike Path Construction (Phase I)	\$11,221,761	147,642
Dunstable	608603	Dunstable-Improvements On Main Street (Route 113), From Pleasant Street To 750 Ft East Of Westford Street	\$4,894,986	203.9
Tewksbury	609038	Tewksbury - Andover Road (Route 133)/ River Road Intersection Improvements	\$3,518,633	979,262

*Note: GHG analysis can only be completed for projects that have advanced to 25% design*

In order to reduce GHG and mitigate the impacts of climate change, the NMMPO will work to advance projects that accomplish the following objectives:

- Reduce VMT and roadway congestion;
- Support smart growth development strategies and plans;
- Increase the use of alternative modes of transportation;
- Address adaptation of critical infrastructure based on estimated climate change impacts; and
- Reduce energy consumption and encourage use of zero emission and alternative fuel vehicles.

**PROMOTE LIVABILITY BY SUPPORTING TRANSPORTATION TECHNIQUES THAT IMPROVE QUALITY OF LIFE AND SUSTAINABILITY**

The concept of livability is used to describe a range of initiatives aimed at improving community quality of life while supporting broader sustainability goals. Livability encompasses multi-dimensional issues relative to community design, land use, environmental protection and enhancement, mobility and accessibility, public health, and economic well-being. Incorporating livability into transportation planning, programs, and projects is not a new concept. Communities, developers, advocacy groups, businesses, and neighborhood residents have been working for generations to make places more livable through transportation initiatives, with varying degrees of support from local, regional, State, and

Federal agencies. These initiatives have used a range of terms to describe an overlapping set of objectives and strategies—livability, sustainability, community impact assessment, scenario planning, land use and transportation, smart growth, walkable communities, new urbanism, healthy neighborhoods, active living, transit-oriented development (TOD), complete streets, context-sensitive solutions (CSS), and many others. While advocates for each approach or “brand name” might find differences, most transportation practitioners understand the key concept behind livability in transportation: transportation planning is a process that must consider broader community goals.



**Image 13.7: The Esplanade Walkway in Lowell MA**

The U.S. Department of Transportation (DOT), the U.S. Department of Housing and Urban Development (HUD), and the U.S. Environmental Protection Agency (EPA) formed the Sustainable Communities Partnership to bring livability into the planning process. The tri-agency partnership developed the following Livability Principles to guide their efforts:

- **Provide more transportation choices.** Develop safe, reliable, and economical transportation choices to decrease household transportation costs, reduce our nation’s dependence on foreign oil, improve air quality, reduce greenhouse gas emissions, and promote public health.
- **Promote equitable, affordable housing.** Expand location-and energy-efficient housing choices for people of all ages, incomes, races, and ethnicities to increase mobility and lower the combined cost of housing and transportation.
- **Enhance economic competitiveness.** Improve economic competitiveness through reliable and timely access to employment centers, educational opportunities, services, and other basic needs by workers, as well as expanded business access to markets.
- **Support existing communities.** Target Federal funding toward existing communities—through strategies like transit oriented, mixed-use development, and land recycling—to increase community revitalization and the efficiency of public works investments and safeguard rural landscapes.
- **Coordinate and leverage Federal policies and investment.** Align Federal policies and funding to remove barriers to collaboration, leverage funding, and increase the accountability and effectiveness of all levels of government to plan for future growth, including making smart energy choices such as locally generated renewable energy.
- **Value communities and neighborhoods.** Enhance the unique characteristics of all communities by investing in healthy, safe, and walkable neighborhoods—rural, urban, or suburban.

Livability is about tying the quality and location of transportation facilities to broader opportunities such as access to good jobs, affordable housing, quality schools, and safe streets. This includes addressing safety and capacity issues on roads through better planning and design, maximizing and expanding new technologies such as ITS and the use of quiet pavements, and using Travel Demand Management approaches to system planning and operations.

As changing demographics and evolving markets increase demand for compact, walkable neighborhoods with a range of housing choices, transportation planning, programming, management and operations can help ensure that walking, biking, and transit are safe, convenient, and realistic choices for more people, making transportation systems more accessible, efficient and equitable.

By increasing multimodal mobility and access in the existing system, the overall costs of moving people, goods, and services can be reduced, enhancing economic competitiveness. Transportation investments that support community livability can have multiple benefits. Compact, connected communities encourage regular walking, bicycling, and transit use, reducing the need for auto travel—while making trips shorter for those who choose to drive. Less driving helps reduce greenhouse gases (GHGs) and other pollution, lowering energy use and reducing dependence on foreign oil. Compact, connected development patterns require less land and pavement, reducing storm water runoff, groundwater pollution, and loss of wildlife habitat, fields, and forests. The daily exercise associated with more active transportation choices has been shown to improve human health, reduce obesity and health care costs, and encourage community social interactions.

The region's existing travel patterns and reliance on the automobile have impacted the health of its residents, primarily due to the lack of physical activity. Livable communities are often associated with good sidewalk coverage and bicycling facilities. A long-term goal of the region's transportation planning process is to provide residents with the ability to utilize healthy transportation choices in their day-to-day lives. Investing transportation resources in areas with existing activity and employment centers is one mechanism for working toward the achievement of this goal. Investments in bicycle and pedestrian facilities and in public transit will support healthy lifestyle choices and increase mobility. Livability is a relatively new emphasis area for the NMMPO. The Regional Transportation Plan outlines programs and projects that will help promote livability within the region's communities.

## CHAPTER 14 TRANSPORTATION EQUITY AND ACCESSIBILITY

This chapter provides information and analysis of transportation policies and services necessary to assess the Northern Middlesex Metropolitan Planning Organization compliance with Title VI of the 1964 Civil Rights Act (42 U.S.C. 2000d) and USDOT's implementing regulations. Title VI provides that:

*"No person in the United States shall, on the ground of race, color or national origin, be excluded from participation in, be denied benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance."*

Title VI prohibits discrimination by recipients of Federal financial assistance on the basis of race, color, and national origin, including the denial of meaningful access for Limited English proficient (LEP) persons. Under DOT's Title VI regulations, recipients of Federal financial assistance are prohibited from using "criteria or methods of administering its program which have the effect of subjecting individuals to discrimination based on their race, color, or national origin".

### REHABILITATION ACT OF 1973 – SECTION 504

Section 504 of the Rehabilitation Act of 1973 (Section 504), 29 U.S.C. § 701 et seq., states, in relevant part, that:

*"...no otherwise qualified individuals with a disability in the United States shall, solely by reason of his or her disability, be excluded from the participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance."*

This requirement applies to each recipient of Federal financial assistance from the United States Department of Transportation (USDOT) and to each program or activity that receives or benefits from such assistance.

### AMERICANS WITH DISABILITIES ACT (ADA) OF 1990

The Americans with Disabilities Act (ADA) was enacted on July 26, 1990, and provides comprehensive civil rights protections to persons with disabilities in the areas of employment, state and local government services, and access to public accommodations, transportation, and telecommunications. The ADA is companion civil rights legislation to the Civil Rights Act of 1964 and Section 504 of the Rehabilitation Act of 1973.

### CIVIL RIGHTS RESTORATION ACT AND APPLYING TITLE VI

The Civil Rights Restoration Act of 1987 clarified the broad, institution-wide application of Title VI. Title VI encompasses all of the operations and programs of covered entities without regard to whether specific portions of the covered program or activity are federally funded. Recipients are responsible for ensuring that all activities comply with Title VI.

### ENVIRONMENTAL JUSTICE

Environmental justice (EJ) requires identifying and addressing disproportionately high and adverse effects of the NMMPO's programs, policies, and activities on minority and low-income populations to achieve an equitable distribution of benefits and burdens. This includes the full and fair participation by all potentially affected communities in the transportation decision-making process. In 1994, President Clinton issued Executive Order 12898, which mandated that each Federal agency develop an agency-wide EJ strategy that identifies and addresses disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. A Federal agency's EJ strategy must list programs, policies, planning, and participation processes that, at a minimum:

- Promote enforcement of all health and environmental authorities in areas with minority and low-income populations;
- Ensure greater public participation;
- Improve research and data collection relating to the health and environment of minority and low-income populations; and
- Identify differential patterns of consumption of natural resources among minority and low-income populations.

In 2000, President Clinton signed Executive Order 13166, Improving Access to Services for Persons with Limited English Proficiency. This order directs Federal agencies and recipients of Federal funds to improve access to services for persons who do not speak English as their primary language and have limited ability to read, speak, write, or understand English. The order references Title VI and is relevant to Environmental Justice because some minorities may not speak English as a first language.

In August 2011, Federal agencies signed a Memorandum of Understanding on Environmental Justice and Executive Order 12898 (EJ MOU), reinforcing and reinvigorating the Federal Government's commitment to EJ. The new EJ MOU required agencies to revise their EJ strategies, as appropriate, and to publicize the revisions. As a result, the U.S. Department of Transportation (USDOT) developed a new EJ Strategy and a revised EJ Order in 2012, and the operating administrations developed compatible guidance.

### MASSDOT ADA/SECTION 504 TRANSITION PLAN

In 2017, MassDOT published an ADA/Section 504 Transition Plan for Public Rights of Way aimed at guiding changes to planning and implementation of necessary programs, activities and facilities over the next several years. This transition plan expands on previous work and reflects the reorganization of MassDOT into a single transportation organization. Given the complexity and need for a deliberate effort to follow through on the agency's self-evaluation, the document sets forth all of the elements necessary to establish a final and executable multi-year transition plan. The plan commits MassDOT to the cultivation and maintenance of policies, programs, and facilities that ensure equal access to all who work, reside in, or visit the Commonwealth of Massachusetts.

### NMMPO COMPLIANCE WITH TITLE VI AND ENVIRONMENTAL JUSTICE

Agencies that receive Federal funding - such as MPOs, State DOTs, and public transit operators - are responsible for involving traditionally underserved and underrepresented populations in transportation planning, and complying with relevant Federal agency guidance. Federal funding recipients can incorporate EJ into their planning activities through a variety of ways, but some common methods include:

- Developing EJ procedures, goals, and performance measures relating to the agency's mission;
- Enhancing public involvement activities to ensure the meaningful participation of minority and low-income populations; and
- Analyzing and documenting how policies, processes, and planning products impact minority and low-income populations.

The NMMPO complies with these requirements through its Public Participation Plan, Limited English Proficiency Plan, and its submittals to MassDOT and the federal transportation agencies under Title VI. The preparation of this RTP involved extensive outreach to the low income and minority communities throughout the region, as discussed in previous sections of this plan.

The NMMPO reviews all projects with an appreciation for the benefits and burdens they provide to individual communities, low-income residents and minority populations. Where there is a change to the way services are provided, there has been a major effort by the NMMPO to reach out to the business community, political establishment, civic groups, special interest groups, neighborhood groups, social service agencies, economic development stakeholders and residents to solicit feedback. The Northern Middlesex Metropolitan Planning Organization maintains a log of all complaints received by the agency. To date, the NMMPO has not received any complaints nor has it been named in any lawsuits that claim discrimination on the base of race, color, or national origin.

## ENVIRONMENTAL JUSTICE ANALYSIS

Environmental justice as related to transportation planning can be defined by three overriding principles:

1. Avoid, minimize, or mitigate disproportionately high and adverse human health and environmental effects, including social and economic effects, on minority populations and low-income populations;
2. Ensure the full and fair participation by all potentially affected communities in the transportation decision-making process; and
3. Prevent the denial of, reduction, or significant delay in the receipt of benefits by minority and low-income populations.

The NMMPO integrates these environmental justice principles into its comprehensive, cooperative and continuing (3-C) transportation planning process by identifying low-income and minority population areas and examining proposed transportation projects within these areas. In order to address the three environmental justice principles, the following policy statement has been developed by the NMMPO, in accordance with federal guidelines relative to Environmental Justice, Title VI and Limited English Proficiency requirements:

“In order to comply with 49 CFR Section 21.9(d), the NMMPO posts information for the public regarding their Title VI obligations and the protections against discrimination afforded to the public by Title VI. All meetings are posted in accordance with the Massachusetts Open Meeting Law. Notices of meetings, document availability, and public comment periods are posted with each City/Town Clerk, advertised in regional newspapers, and distributed via the mailing list outlined in the Public Participation Plan. This information is also posted on the NMCOG website, [www.nmcog.org](http://www.nmcog.org).

The NMMPO conducts an ongoing consultation process with low-income and minority residents and with groups representing their interests, such as Community Teamwork, Inc. (CTI), the Cambodian Mutual Assistance Association (CMAA) and the Coalition for a Better Acre (CBA). NMMPO staff also meets regularly with economic development organizations, workforce development entities and other groups charged with providing community support, job training, housing, employment placement and other services for low-income and minority residents. The input provided through this process is incorporated into the transportation planning process and considered during the development of the certification documents.

The RTP for the Northern Middlesex Region outlines the process utilized by the NMMPO to ensure compliance with federal requirements. Title VI and Environmental Justice concerns are also considered during project development and permitting, as well as during the planning process.

The following measures are undertaken in the Northern Middlesex region to ensure conformity to Title VI and Environmental Justice requirements:

- A demographic profile of the metropolitan area is developed that includes identification of socio-economic groups, including low-income and minority populations, as covered by the Executive Order on Environmental Justice and Title VI provisions.
- An assessment relative to the distribution of transportation policy and project impacts on affected socio-economic groups is undertaken for the required federal certification documents, utilizing racial/ethnic information from the U.S. Census and income information from the most recent American Community Survey. The objective of the analysis is to ensure that the needs of low-income and minority populations are identified in the planning process for the region.

The region's Public Participation Plan includes strategies for engaging minority and low-income populations in the transportation decision-making process. In the event a proposed improvement is found to have negative impacts, appropriate mitigation is developed to offset any adverse effects."

On October 30, 1997, the Office of Management and Budget (OMB) issued Policy Directive 15, Revisions to the Standards for the Classification of Federal Data on Race and Ethnicity, which established the minimum categories for data on race and ethnicity to be used in Federal statistics programs, administrative reporting, and civil rights compliance. The six (6) minimum categories are American Indian or Alaskan Native, Asian, Black or African American, Hispanic or Latino, Native Hawaiian or Other Pacific Islander, and White.

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## 2010 POPULATION BY RACE AND ETHNICITY

Table 14.1 on the following page highlights the change in the racial and ethnic composition of the Greater Lowell region between 2000 and 2010. The number of white residents decreased by 4.85% between 2000 and 2010, and their overall share of the region's population decreased by nearly six percentage points from 85.05% in 2000 to 79.33% in 2010. Black or African American residents in the Greater Lowell region increased by 71.19%, from 5,709 in 2000 to 9,773 in 2010. This racial group's overall share of the regional population increased from 2.03% in 2000 to 3.41% in 2010. The relatively small racial cohort of American Indians or Alaska Natives increased by 18.2% between 2000 (434) and 2010 (513), but its overall share of the total population increased slightly from .15% to .18%. The Asian population in the Greater Lowell region increased by 41.85%, from 22,597 in 2000 to 32,054 in 2010, and its overall share of the region's total population increased by three percentage points from 8.04% to 11.17%. The smallest racial group in the Greater Lowell region, Hawaiian or Pacific Islander, decreased from 75 residents in 2000 to 69 residents in 2010, a decline of 8%. Other or Multiple Races increased by 27.87% between 2000 and 2010 and currently represent 5.89% of the Greater Lowell population. The Hispanic or Latino population in Greater Lowell increased from 17,028 residents in 2000 to 22,704

residents in 2010, thereby increasing by one-third and representing 5% of the region's population in 2010.

In terms of racial and ethnic breakout, the City of Lowell remains the most diverse community in the region. While more than 60% of its population is comprised of white residents, the City has significant Black/African American (6.8%), Asian (20.2%); other and two or more races (12.38%) populations, as well as a sizable Latino/Hispanic (17.27%) community. In 2010, the City of Lowell comprised 37.1% of the total population in the Greater Lowell region and was home to 28.2% of the region's white population. The City of Lowell is an immigrant community and home to a large percentage of the region's minority population – Black/African American (74.1%), American Indian (56.9%), Asian (67.1%), Hawaiian (63.8%), 'Other' and 'Two or More races' (78%) and Latino/Hispanic (81%). Within the suburban communities, there were a greater number of minority residents in Billerica, Chelmsford, Dracut and Westford in 2010 than in 2000. Table 14.2 on the following page summarizes the 2000 and 2010 populations by race and Hispanic/Latino origin in each community.

**Table 14.1: Population Change in Greater Lowell by Race and Hispanic Origin**

Race/Origin	2000 Population	% of Total	2010 Population	% of Total	% Change
<b>White</b>	239,190	85.05%	227,587	79.33%	-4.85
<b>Black or African American</b>	5,709	2.03%	9,773	3.41%	71.19
<b>American Indian or Alaska Native</b>	434	0.15%	513	0.18%	18.2
<b>Asian</b>	22,597	8.04%	32,054	11.17%	41.85
<b>Hawaiian or Pacific Islander</b>	75	0.03%	69	0.02%	-8
<b>Other Race or Two or More Races</b>	13,220	4.70%	16,905	5.89%	27.87
<b>TOTAL</b>	281,225	100.00%	286,901	100.00%	2.02
<b>Hispanic or Latino</b>	17,028	6.10%	22,704	7.91%	33.33

Source: U.S. Census Bureau, 2000 and 2010 U.S. Census

**Table 14.2: 2010 Population by Race and Hispanic/Latino Origin**

Community	Total Population	Race						Origin
		White	Black or African American	American Indian or Alaska Native	Asian	Native Hawaiian or Other Pacific Islander	Other Race/ Two or More races	Hispanic or Latino (any race)
Billerica	40,243	36,285	849	59	2,194	8	848	1,035
Chelmsford	33,802	29,944	358	35	2,846	2	617	686
Dracut	29,457	26,610	737	40	1,186	7	877	1,149
Dunstable	3,179	3,031	7	3	98	4	36	44
Lowell	106,519	64,240	7,238	292	21,513	44	13,192	18,396
Pepperell	11,497	11,082	60	20	134	2	199	194
Tewksbury	28,961	27,327	321	32	786	1	494	602
Tyngsborough	11,292	10,390	120	14	535	0	233	265
Westford	21,951	18,678	83	18	2,762	1	409	333
<b>Total</b>	<b>286,901</b>	<b>227,587</b>	<b>9,773</b>	<b>513</b>	<b>32,054</b>	<b>69</b>	<b>16,905</b>	<b>22,704</b>

Source: 2010 U.S. Census

In evaluating the minority populations by Census Tract, the average percentage population for each racial and ethnic group in the region was compared to the percentages within each Census Tract. Based upon this analysis, the areas with significant concentrations of minority racial and ethnic groups were located and mapped. The average regional percentage for each minority racial or ethnic group was as follows, according to the 2010 U.S. Census:

- Black/African American – 3.25%
- American Indian – 0.17%
- Asian – 10.47%
- Native Hawaiian – 0.02%
- Other and Two or More races – 5.43%
- Hispanic/Latino – 7.26%

Twenty-four (24) of the twenty-five (25) Census Tracts in the City of Lowell and the several Census Tracts in the suburban communities exceed the regional average for at least one racial or ethnic group. The areas within the suburban communities are detailed in Table 14.3 on the following page, and include the entire towns of Dunstable and Westford. In total, nineteen (19) of the thirty-six (36) Census Tracts within in the region’s suburbs contain concentrations of minority populations. These areas are also shown on Maps 14.1 to 14.7 on the following pages.

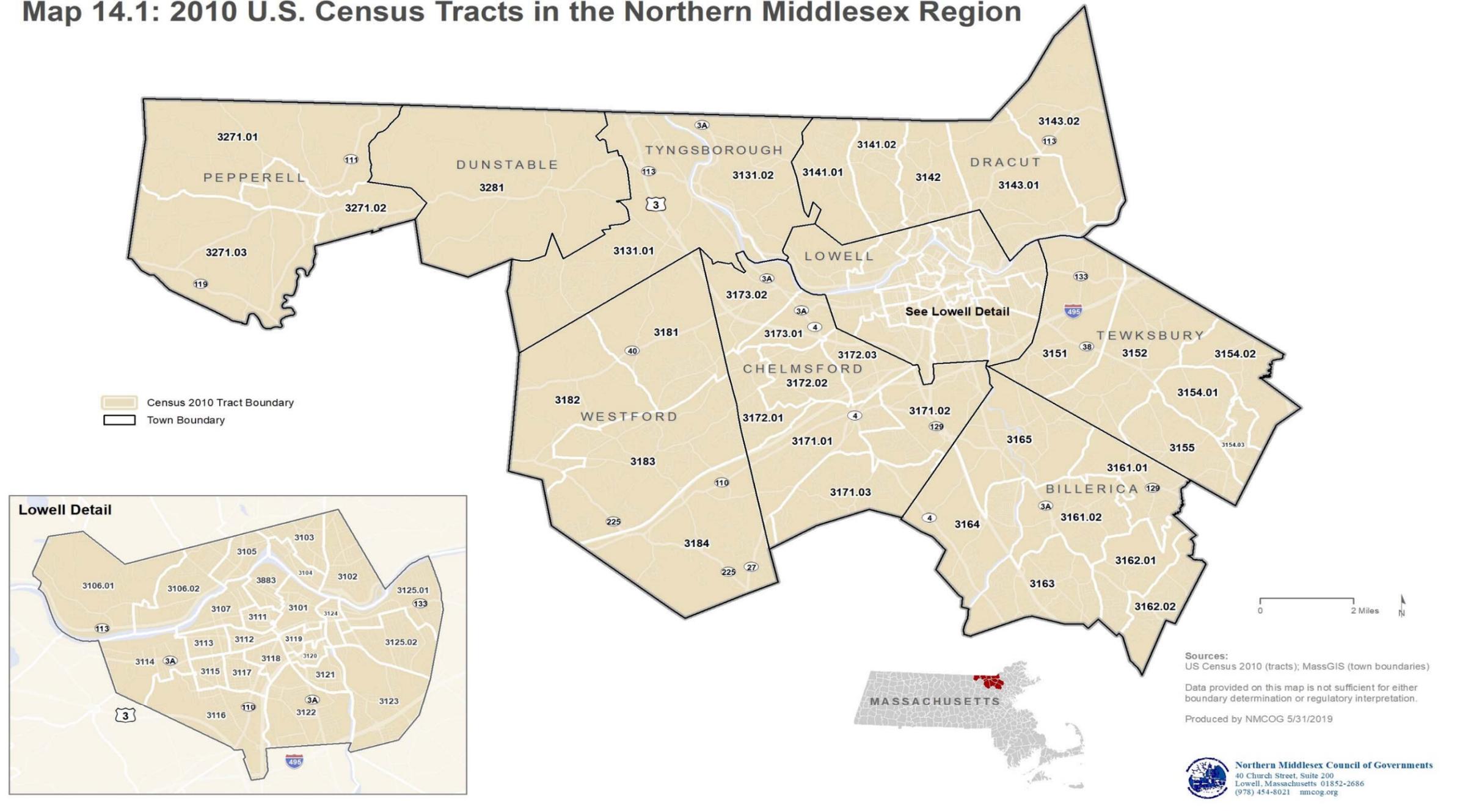
**Table 14.3: Census Tracts with Minorities or Ethnic Groups Greater than the Regional Average**

Community	Census Tract	Race/Origin	Percentage
<b>Billerica</b>	3162.01	American Indian	0.19%
	3162.02	American Indian	0.19%
		Hawaiian	0.05%
	3164	Black/African American	4.58%
		American Indian	0.21%
3165	Hawaiian	0.05%	
<b>Chelmsford</b>	3171.02	Asian	10.82%
	3172.01	American Indian	0.21%
		Hawaiian	0.04%
3173.01	Asian	14.92%	
<b>Dracut</b>	3141.01	Black/African American	4.01%
		American Indian	0.20%
	3142	Hawaiian	0.06%
	3143.01	Hawaiian	0.05%
3143.02		American Indian	0.24%
<b>Dunstable</b>	Town-wide	Hawaiian	0.13%
	3281	Hawaiian	0.13%
<b>Pepperell</b>	3271.01	American Indian	0.22%
	3271.02	American Indian	0.18%
	3271.03	Hawaiian	0.03%
<b>Tewksbury</b>	3154.02	American Indian	0.27%
<b>Westford</b>	Town-wide	Asian	12.58%
	3181	Asian	16.84%
	3183	Asian	10.99%
	3184	Asian	11.00%

Source: U.S. Census Bureau, 2010 U.S. Census

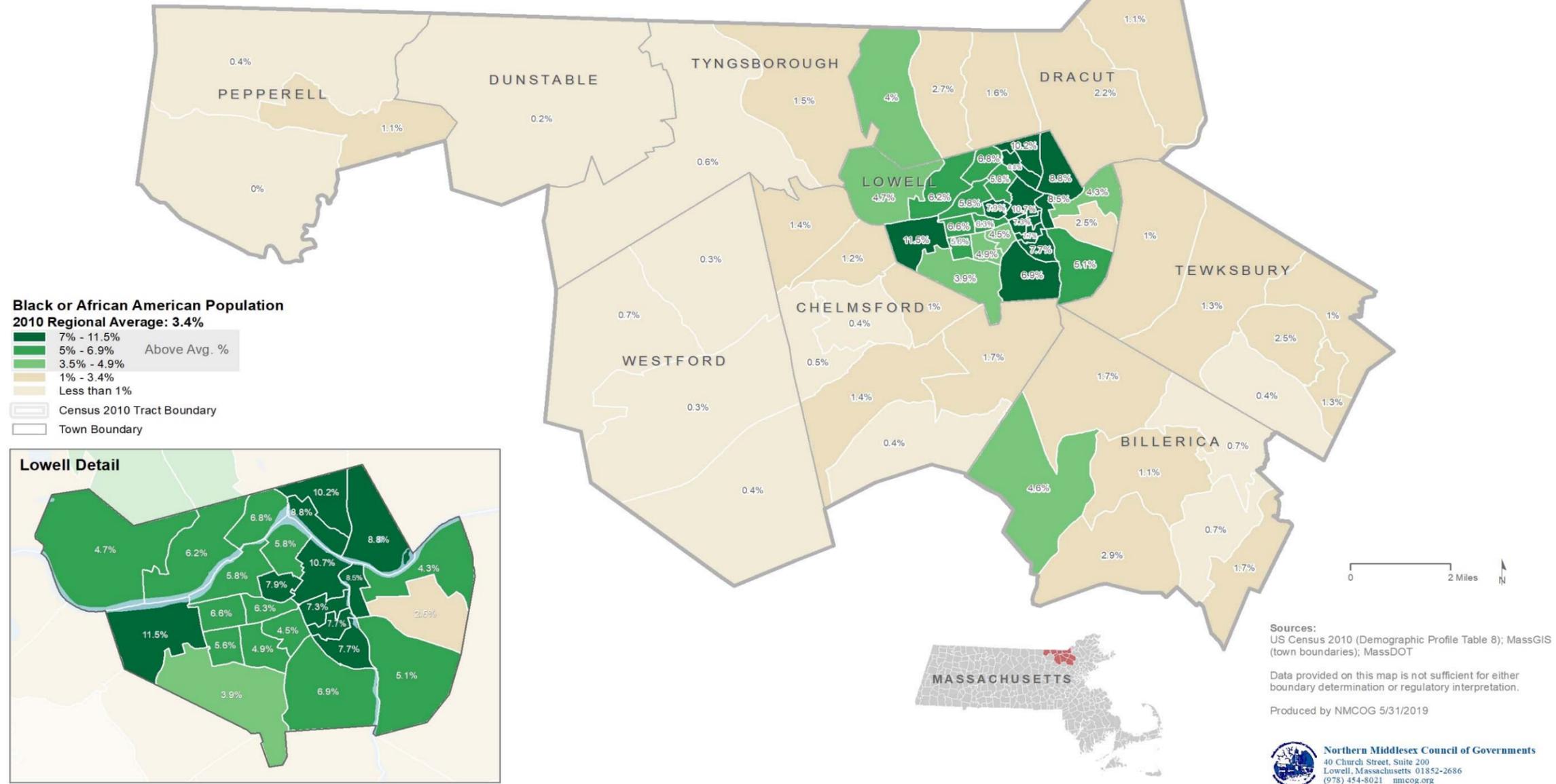
Note: Regional averages exceeded all Lowell Census Tracts

### Map 14.1: 2010 U.S. Census Tracts in the Northern Middlesex Region



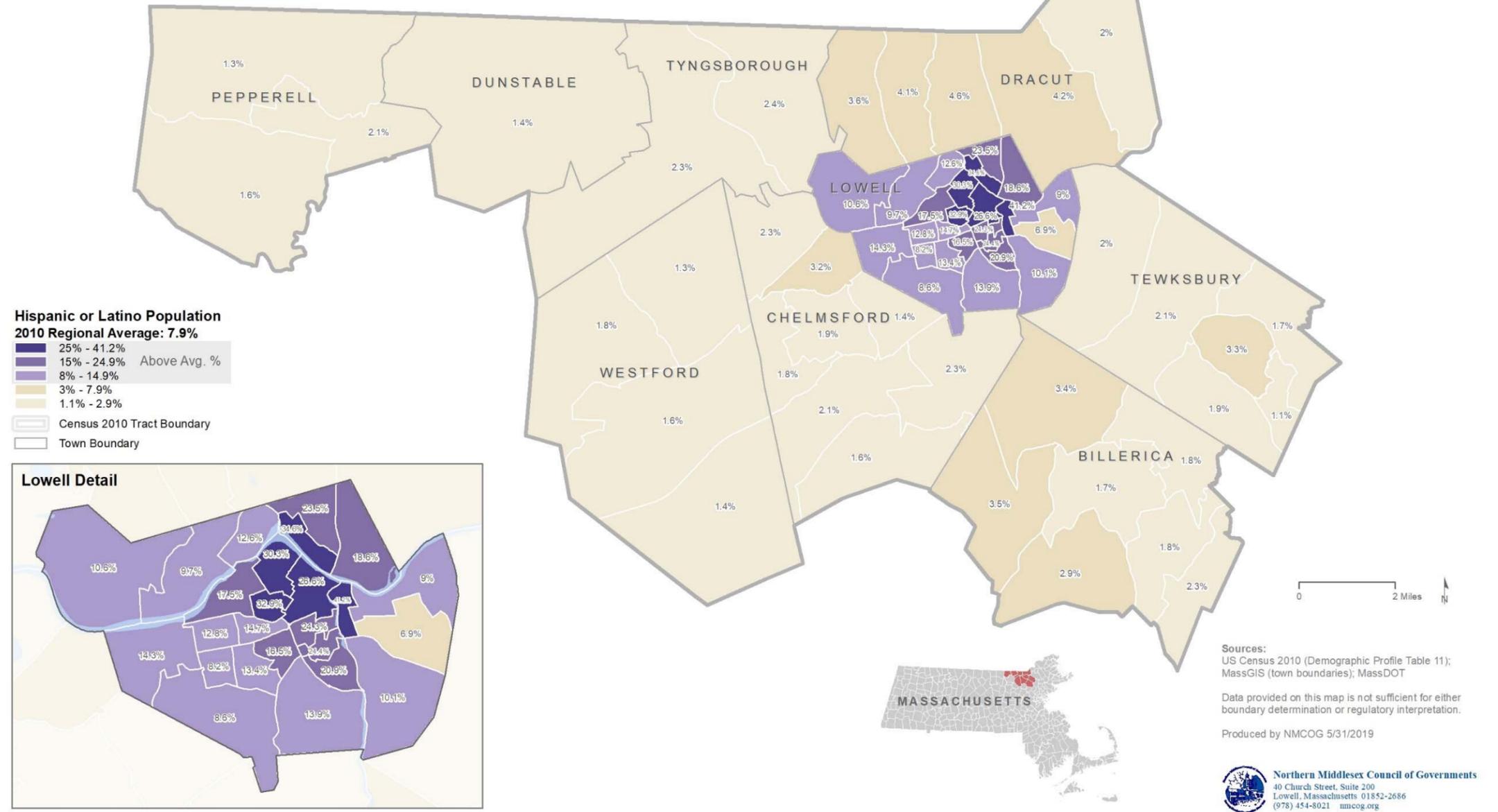
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**Map 14.2: Black or African American Population in the Northern Middlesex Region**



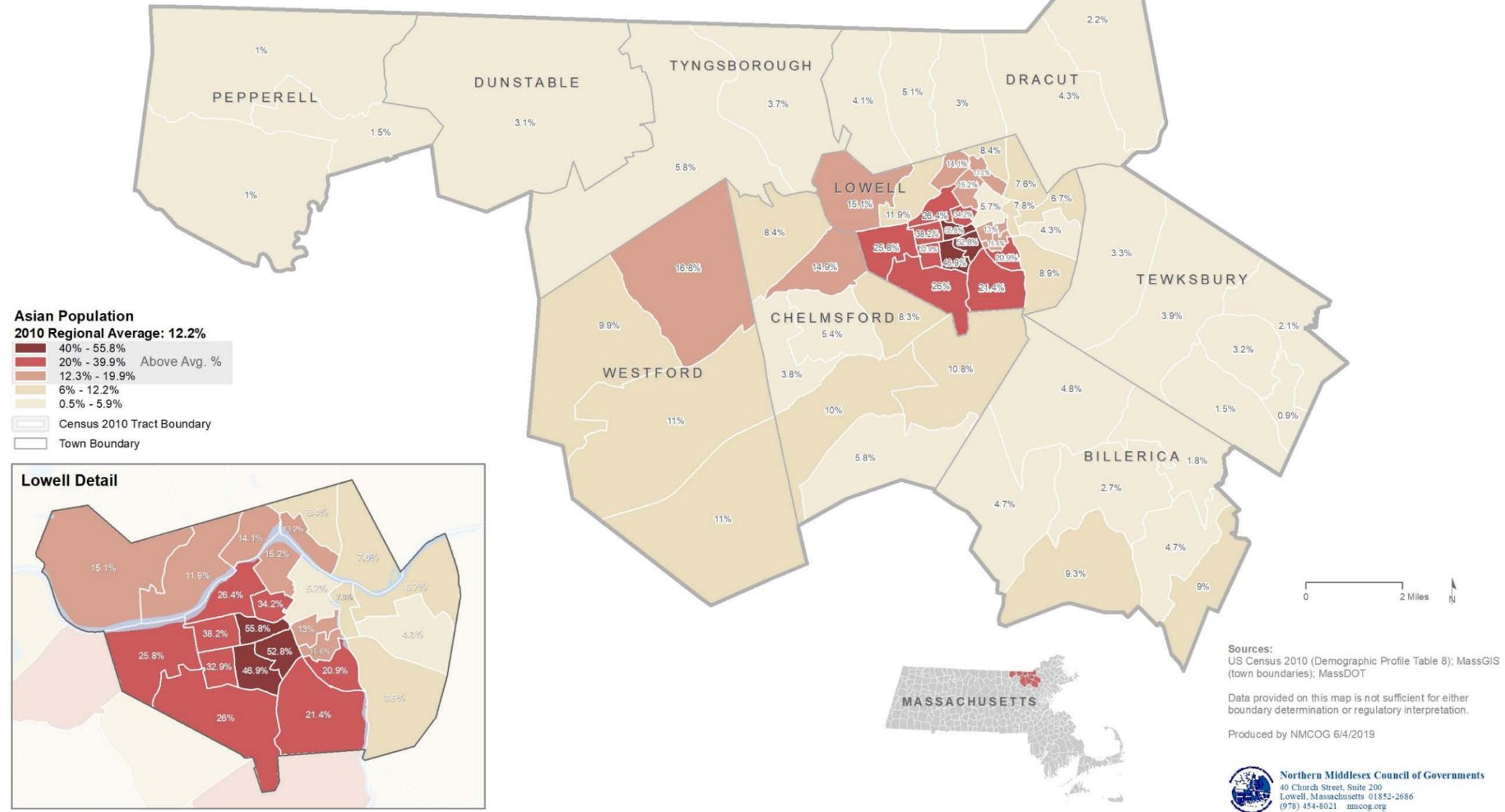
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**Map 14.3: Hispanic or Latino Population in the Northern Middlesex Region**



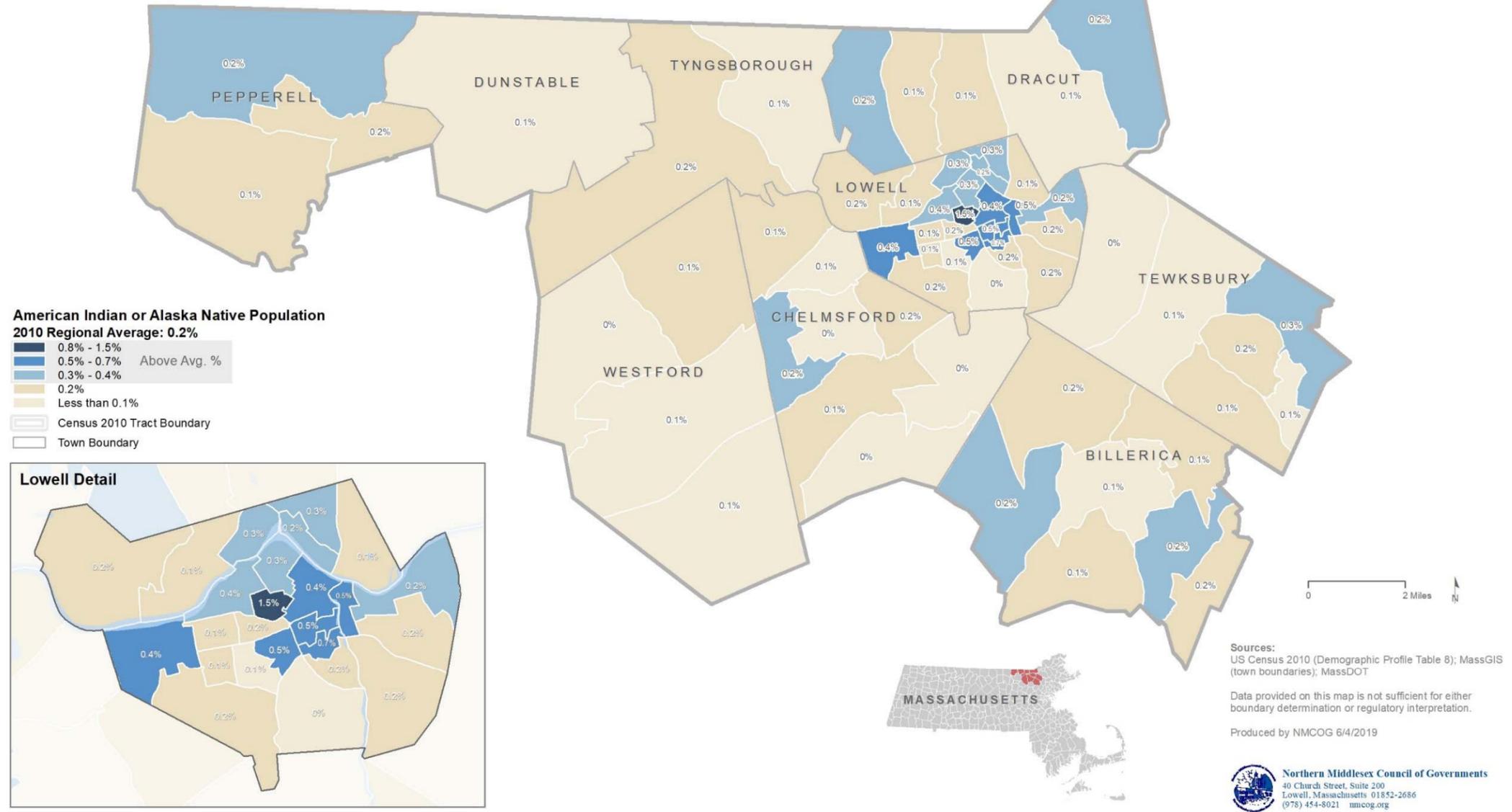
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**Map 14.4: Asian Population in the Northern Middlesex Region**



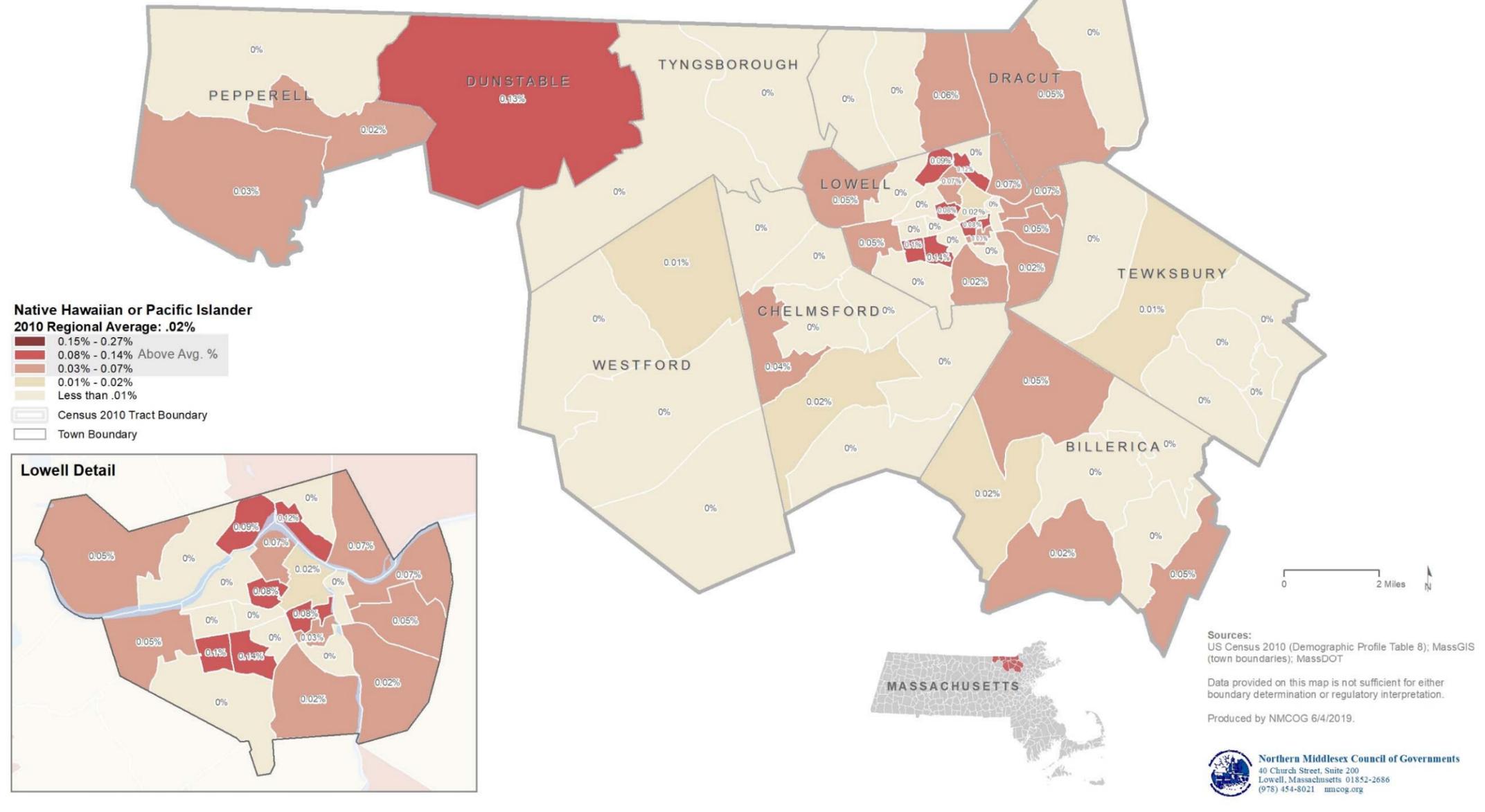
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**Map 14.5: American Indian or Alaska Native Population in the Northern Middlesex Region**



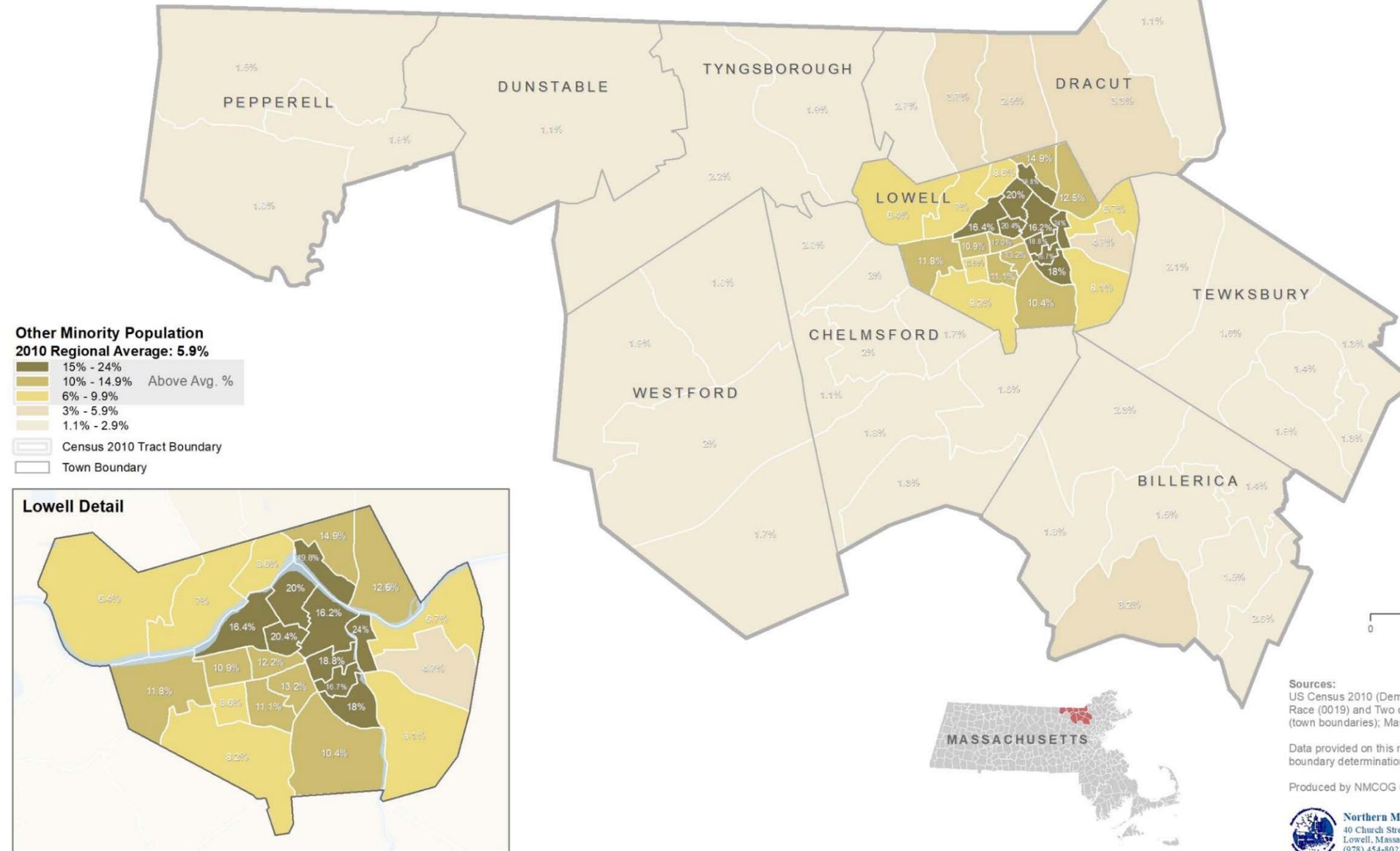
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### Map 14.6: Native Hawaiian or Pacific Islander Population in the Northern Middlesex Region



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**Map 14.7: Population of Other Races or Two or More Races in the Northern Middlesex Region**



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## LOW-INCOME POPULATIONS

In comparing the regional income figures in the Greater Lowell region, staff utilized the *2009-2013 and 2013-2017 American Community Surveys* developed by the U.S. Census Bureau. Three major income indices were examined: Per Capita Income, Median Household Income and Median Family Income, as well as poverty data. This data was used to compare the Greater Lowell region with statewide and national averages.

### PER CAPITA INCOME

The Per Capita Income for the Northern Middlesex region increased from an average of \$31,065 in 2009-2013 to \$37,016 in 2013-2017, an increase of 19%. Per capita income in the Greater Lowell region increased at a greater rate than the United States (15%), and was on par with the Commonwealth's growth. While the per capita income in the Greater Lowell region continues to exceed the per capita income at the national level (\$31,177), it lags behind incomes for Massachusetts (\$39,913).

Within the Northern Middlesex region, four communities experienced per capita income growth rates higher than the regional growth rate – Billerica (21.1%), Chelmsford (22.9%), Dunstable (43.2%), and Tewksbury (24.7%). The City of Lowell had the lowest per capita income in the region at \$23,768 in 2017, which is 76% of the national per capital income. The highest per capita income figures were in Westford (\$51,526) and Dunstable (\$57,005).

The per capita income figures for 2009-2013 and 2013-2017 in the Greater Lowell region, individual communities, United States, and Massachusetts are summarized in Table 14.4.

**Table 14.4: Per Capita Income Trends in the Northern Middlesex Region**

Community/ Region	2009-2013	2013-2017	% Change
Billerica	\$31,659	\$38,383	21.2%
Chelmsford	\$40,340	\$49,564	22.9%
Dracut	\$31,243	\$36,323	16.3%
Dunstable	\$39,799	\$57,005	43.2%
Lowell	\$22,831	\$23,768	4.1%
Pepperell	\$35,671	\$40,919	14.7%
Tewksbury	\$33,045	\$41,193	24.7%
Tyngsborough	\$36,789	\$43,787	19.0%
Westford	\$44,872	\$51,526	14.8%
<b>Region</b>	<b>\$31,065</b>	<b>\$37,016</b>	<b>19.1%</b>
<b>Massachusetts</b>	<b>\$33,460</b>	<b>\$39,913</b>	<b>19.2%</b>
<b>United States</b>	<b>\$27,041</b>	<b>\$31,177</b>	<b>15.3%</b>

Source: U.S. Census 2009-2013 and 2013-2017 American Community Survey

## MEDIAN HOUSEHOLD INCOME

The median household income for the region increased by 9% from \$74,336 in 2009-2013 to \$81,061 in 2013-2017. This percentage increase was below both the national (12.1%) and the state (32.40%) averages during this time period. The median household income for the region (\$81,061) in 2013-2017 was greater than the State (\$74,167) and the nation (\$57,652). Median household income grew in each community, with the exception of Lowell where it declined by 2.5%. Dunstable (\$138,700) had the highest median household income in 2013-2017, while the City of Lowell had the lowest median household income at \$48,581.

The median household income figures for 2009-2013 and 2013-2017 in the Greater Lowell region and individual communities, United States and Massachusetts are summarized below in Table 14.5.

**Table 14.5: Median Household Income Trends in the Northern Middlesex Region**

Community/ Region	2009	2017	% Change
Billerica	\$87,048	\$99,453	14.3%
Chelmsford	\$89,022	\$106,432	19.6%
Dracut	\$71,480	\$86,697	21.3%
Dunstable	\$109,333	\$138,700	26.9%
Lowell	\$49,816	\$48,581	-2.5%
Pepperell	\$88,185	\$90,029	2.1%
Tewksbury	\$83,709	\$93,817	12.1%
Tyngsborough	\$98,413	\$101,303	2.9%
Westford	\$119,081	\$138,006	15.9%
<b>Region</b>	<b>\$74,336</b>	<b>\$81,061</b>	<b>9.0%</b>
<b>Massachusetts</b>	<b>\$64,496</b>	<b>\$74,167</b>	<b>15.0%</b>
<b>United States</b>	<b>\$51,425</b>	<b>\$57,652</b>	<b>12.1%</b>

Source: U.S. Census 2009-2013 and 2013-2017 American Community Survey

## MEDIAN FAMILY INCOME

The median family income in the region increased by 15.5%, from an average of \$87,096 in 2009-2013 to \$100,581 in 2013-2017. This increase in median family income outpaced the 13.6% increase at the national level, but lagged behind the 16.4% increase in the State. The greatest percentage change reported was in Dunstable (33.9%). The City of Lowell (1.1%) and Town of Pepperell (0.9%) experienced little growth in family income. Similar to the median household income, Westford (\$152,239) and Dunstable (\$155,231) had the highest median family incomes in the region, while the City of Lowell had the lowest median family income at \$57,091.

The median family income figures for 2009-2013 and 2013-2017 for the Greater Lowell region and individual communities, United States, and Massachusetts are summarized in Table 14.6.

**Table 14.6: Median Family Income Trends in the Northern Middlesex Region**

Community/ Region	2009-2013	2013-2017	% Change
Billerica	\$94,346	\$107,454	13.9%
Chelmsford	\$108,494	\$133,677	23.2%
Dracut	\$86,881	\$99,591	14.6%
Dunstable	\$115,964	\$155,231	33.9%
Lowell	\$56,494	\$57,091	1.1%
Pepperell	\$103,320	\$104,265	0.9%
Tewksbury	\$96,059	\$111,449	16.0%
Tyngsborough	\$104,303	\$120,579	15.6%
Westford	\$127,210	\$152,239	19.7%
<b>Region</b>	<b>\$87,096</b>	<b>\$100,581</b>	<b>15.5%</b>
<b>Massachusetts</b>	<b>\$80,822</b>	<b>\$94,110</b>	<b>16.4%</b>
<b>United States</b>	<b>\$62,363</b>	<b>\$70,850</b>	<b>13.6%</b>

Source: U.S. Census 2009-2013 and 2013-2017 American Community Survey

## POVERTY LINE

Between 2009-2013 and 2013-2017, the number of residents living below the poverty line in the Greater Lowell region increased 56%, with Tyngsborough increasing by 267%. During the same time period, the number of residents living below the poverty line decreased in Chelmsford (-6.4%) and Dunstable (-59%), as shown in Table 14.7.

**Table 14.7: Northern Middlesex Region - Residents Below Poverty Line**

Community/ Region	Population (2009-2013)	Residents below poverty line		Population (2013-2017)	Residents below poverty line		% change 2009 to 2017
		(2009- 2013)	% below poverty line		(2013- 2017)	% below poverty line	
Billerica	40,932	946	2.3%	42,791	1,779	4.2%	88.1%
Chelmsford	34,199	1,346	3.9%	35,067	1,260	3.6%	-6.4%
Dracut	29,968	852	2.8%	31,113	2,221	7.1%	160.7%
Dunstable	3,255	173	5.3%	3,337	70	2.1%	-59.5%
Lowell	107,466	17,550	16.3%	110,964	23,776	21.4%	35.5%

**Table 14.7: Northern Middlesex Region - Residents Below Poverty Line**

Community/ Region	Residents below poverty line			Residents below poverty line			% change 2009 to 2017
	Population (2009-2013)	(2009- 2013)	% below poverty line	Population (2013-2017)	(2013- 2017)	% below poverty line	
Pepperell	11,645	342	2.9%	12,049	674	5.6%	97.1%
Tewksbury	29,429	1,072	3.6%	30,666	1,621	5.3%	51.2%
Tyngsborough	11,675	234	2.0%	12,232	860	7.0%	267.5%
Westford	22,458	248	1.1%	24,087	552	2.3%	122.6%
<b>Region</b>	<b>291,027</b>	<b>22,763</b>	<b>7.8%</b>	<b>302,306</b>	<b>35,532</b>	<b>11.8%</b>	<b>56.1%</b>

Source: U.S. Census 2009-2013 and 2013-2017 American Community Survey

**PROJECT ANALYSIS**

The projects recommended in the RTP were analyzed in relation to their impacts on the minority and low-income communities. Analysis of potential impacts relied on the three (3) criteria mentioned at the beginning of the chapter:

- Disproportionately high and adverse human health and environmental impacts to low-income/minority areas;
- Minimizing/blocking access of minority/low-income areas to the transportation system; and
- Neglect of the transportation system in minority/low-income areas or a reduction or delay in the receipt of benefits to those areas.

As part of the public outreach process for the RTP Update, NMCOG staff met with local organizations to identify the transportation needs of the minority and low-income populations. Key findings reported through this outreach effort include the following:

- There is a need for longer hours of bus service and more frequent service, especially during the evenings and on weekends;
- Many low-income residents are employed in the service and retail sectors and would benefit from Sunday bus service and service on holidays;
- There is a need to extend service to new areas, including the Pheasant Lane Mall and along Pawtucket Boulevard in Lowell, as well as to improve connectivity to neighboring transit providers;
- There is a need for improved bicycle and pedestrian facilities, including additional bike racks and sidewalks that are ADA accessible; and

- Public communication and access to information should be improved through the use of social media networks.

An evaluation of the Lowell Regional Transit Authority (LRTA) fixed route bus system found that the system serves the areas with the highest population density, including areas with concentrations of minority and low-income residents. In terms of the distribution of routes, hours of operation, equipment condition, and other operational characteristics, minority and low-income neighborhoods are served as well as the rest of the service area. Additionally, the equipment is rotated throughout the system so that the older equipment is utilized on all routes equally.

A similar analysis of the highway projects and programs recommended in the RTP showed that the condition of existing facilities and the future capital projects contained in the plan are equitable throughout the region. It has been determined that these projects do not have a disproportionate negative impact on low-income or minority neighborhoods.

NMMPO staff delineated the RTP project recommendations on a regional map to identify those projects in the designated environmental justice or low income areas. A project was considered to be within an environmental justice area if 50% or more of the project length or service area was within the environmental justice or low income area boundary or if a project was on the boundary of the environmental justice or low income area. Table 14.8 on page 14-28 provides a list of the recommended projects within the environmental justice areas, and Maps 14.8 and 14.9 show the location of these projects in relation to the environmental justice areas.

RTP projects and their associated costs were compared in order to assess the equity of project distribution across the region. The current RTP identifies nineteen (19) fiscally constrained projects, of which ten (10) or 53% are located in low income and/or minority population environmental justice areas. The total funding for the financially constrained project recommendations outlined in the RTP is \$87,108,150, of which \$51,605,974 (59%) is recommended for projects within the environmental justice areas.

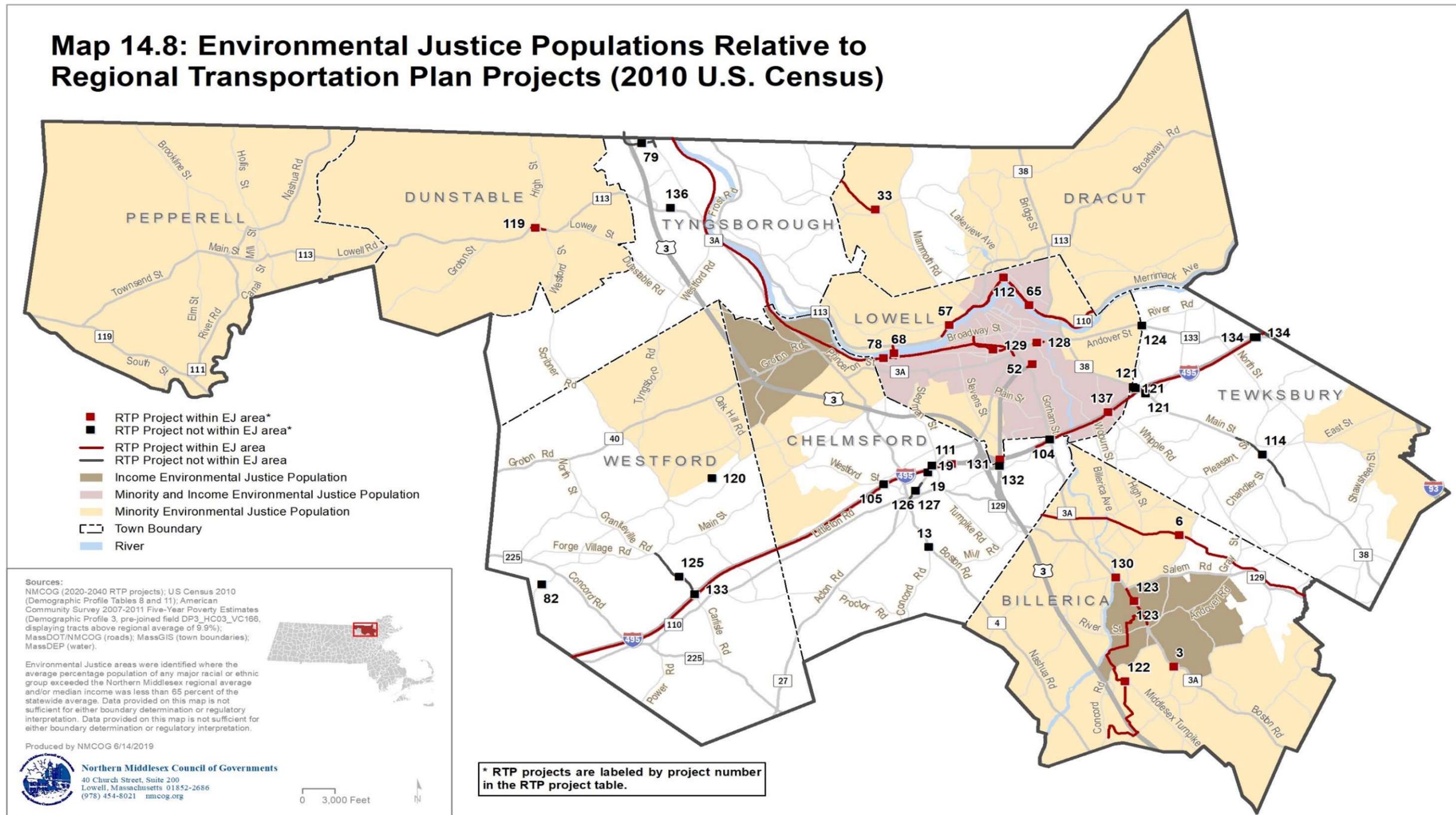
In addition, eight regionally significant projects, outside of the financially constrained portion of the Plan, are located in environmental justice areas, as shown in Table 14.8 and on Maps 14.8 and 14.9. This includes major infrastructure projects like the Rourke Bridge Replacement project in Lowell and the extension of commuter rail to New Hampshire.

**Table 14.8: RTP Recommended Projects located in Minority and/or Low Income EJ areas**

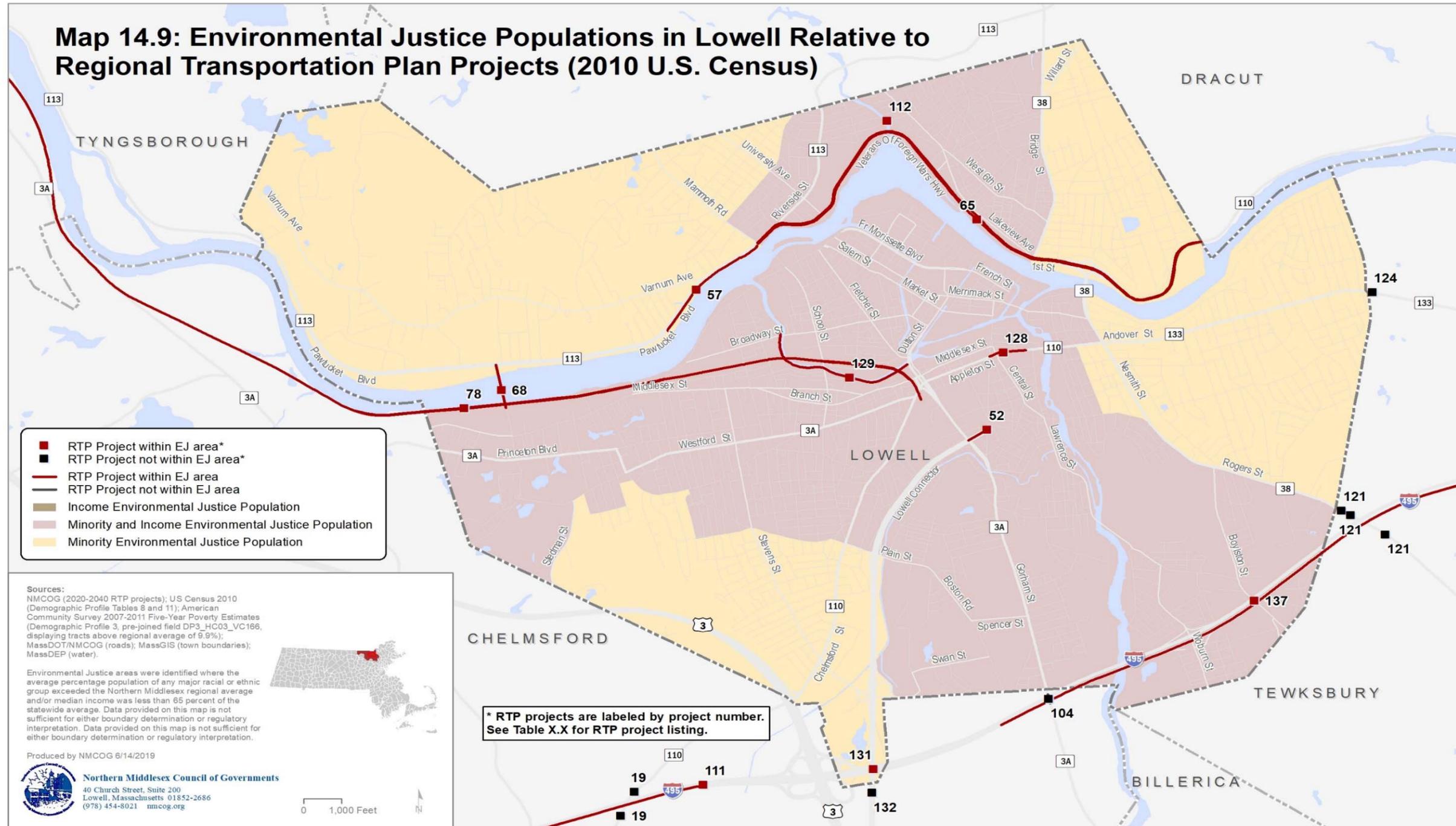
Community	MassDOT Project #	NMCOG Project ID	Project Description	Project Cost	RTP Rec
<b>Financially Constrained Recommendation</b>					
Dunstable	608603	119	Dunstable-Improvements On Main Street (Route 113), From Pleasant Street To 750 Ft East Of Westford Street	\$4,895,986	2021
Lowell	607885	57	Lowell-Pedestrian Walkway & Bicycle Connection At Pawtucket Falls Overlook From Vandenberg Esplanade To School Street (Statewide CMAQ)	\$2,232,100	2021
Dracut	608350	33	Dracut- Improvements On Nashua Road	\$5,210,396	2022
Billerica	605178	123	Billerica- Rehabilitation On Boston Road (Route 3a) From Billerica Town Center To Floyd Street	\$10,910,825	2022 / 2023
Billerica	608227	122	Billerica-Yankee Doodle Bike Path Construction (Phase I)	\$9,673,932	2024
Lowell	605966	65	Lowell-Reconstruction & Related Work On VFW Highway	\$6,215,865	2025
Billerica	609250	3	Billerica-Intersection Improvements At Boston Road (Route 3a), Lexington Street And Glad Valley Road	\$3,003,500	2026
Lowell	604694	52	Lowell- Connector Reconstruction, From Thorndike Street To Gorham Street	\$3,409,870	2026
Billerica	602945	6	Billerica-Middlesex Canal Enhancement	\$3,003,500	2029
Lowell	609050	128	Lowell-Church Street 2-Way Conversion	\$3,050,000	2029
<b>Regionally Significant Recommendation (Illustrative, not constrained)</b>					
Lowell	NA	129	Upper Pawtucket Canalway Construction	\$9,000,000	2030-2034
Billerica	605503	130	Bridge Rehabilitation, B-12-003, ST 3A (Boston Road) over Concord River	\$4,140,000	2025-2029
Lowell	607887	68	Rourke Bridge Replacement, L-15-088, Wood Street Extension over Boston and Maine Railroad and Merrimack River	\$69,000,000	2030-2034
Chelmsford	NA	131	Lowell Connector Bridge over I-495 B-11	\$5,000,000	2034-2039
Lowell	NA	112	Beaver Street Bridge over Beaver Brook Rehabilitation	\$4,000,000	2034-2039
Lowell	NA	137	Boylston Street Bridge Rehab over I-495	\$8,000,000	2034-2039
Lowell/ Chelmsford/ Tyngsborough	NA	136	Extension of Commuter Rail to Nashua with new station and area roadway Improvements	\$120,000,000	2034-2039
Westford/ Chelmsford/ Lowell/ Tewksbury	NA	111	I-495 Mainline Widening from Westford to Tewksbury	\$100,000,000	2034-2039

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### Map 14.8: Environmental Justice Populations Relative to Regional Transportation Plan Projects (2010 U.S. Census)



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## LIMITED ENGLISH PROFICIENCY

The NMMPO developed and adopted a Limited English Proficiency Plan (LEP) in 2014. The intent of the LEP plan is to ensure that residents of the region who do not speak, understand or read English proficiently have access to the planning process and published information, and that public notification is provided to these individuals. The production of multilingual publications and documents and/or interpretation at meetings/events is provided upon request, based on current laws and regulations.

Strong evidence of compliance with Title VI under the LEP “Safe Harbor” provision involves providing written translations of vital documents for each language group of LEP persons that constitutes 5% of the population or 1,000 persons, whichever is less, eligible to be served or likely to be affected or encountered by the recipient. If that 5% is comprised of less than 50 persons, then translation of vital documents can be provided orally. Also, under the “Safe Harbor” provision, oral translation of non-vital documents is deemed sufficient to meet the requirements of Title VI.

As a recipient of federal funding, the NMMPO takes reasonable steps to ensure meaningful access to information and services. A four factor analysis was undertaken by the NMMPO to determine the level and extent of language-assistance measures needed to ensure meaningful access to programs, activities and services taking into account the following:

1. The number and percent of LEP persons in the region who are served by the program;
2. The frequency with which LEP persons come in contact with the program;
3. The importance to the LEP person of accessing the particular program or service; and
4. The resources available to the NMMPO and the costs involved.

In order to understand the language assistance needs within the region, an analysis of U.S. Census Bureau American Community Survey data was performed. Within the Northern Middlesex region, 16% of individuals five years of age or older speak Spanish, Vietnamese, Portuguese, Chinese or Khmer at home.

The analysis indicates that region-wide, 10% individuals age five and over speak English less than “very well”. Of those residents who speak Spanish at home, 40% speak English less than “very well”. Of those who speak Vietnamese at home, 61% speak English less than “very well”. For those individuals who speak Portuguese at home, 44% speak English less than “very well”, and for those individuals that speak Khmer at home, 43% speak English less than “very well”. Of those who speak Chinese at home, 43% speak English less than “very well”.

Lowell’s population is known for its rich cultural and linguistic diversity. Clearly, the greatest need for language assistance is within the City, where 35% of the population five years of age or older live in a household where Spanish, Portuguese, Chinese, Vietnamese or Khmer are spoken. Of these individuals,

approximately 50% report that they speak English less than “very well”. Of those residing in a household that speaks Spanish, 44% speak English less than “very well”. For those individuals who speak Portuguese, at home 52% speak English less than “very well”. Of those individuals residing in a household where Khmer is spoken, 52% report that they speak English less than “very well”. Of those individuals residing in a Vietnamese-speaking household, 65% speak English less than “very well”. For those residing in a household where Chinese is spoken, 54% speak English less than “very well”.

Based upon the analysis, frequency of contact with LEP individuals and resources available to the NMMPO, and associated costs, it was determined that language assistance will be provided for LEP individuals through the translation of some key materials, as well as through oral language interpretation when necessary and possible. Translation of all NMMPO plans and materials is not possible due to cost restrictions. However, the NMMPO will provide the following translatable written materials:

**NMCOG WEBSITE** - This free service, powered by Google Translate program, allows the NMMPO and NMCOG website to be translated for users into 80 languages including the five NMMPO regional language groups of, Spanish, Portuguese, Khmer, Vietnamese and Chinese.

**CERTIFICATION DOCUMENTS** - An Executive Summary for the following key documents will be made available in Spanish, Portuguese Khmer, Vietnamese and Chinese:

- The Regional Transportation Plan;
- The Unified Planning Work Program; and
- The Transportation Improvement Program.

**OUTREACH MATERIALS** – Spanish, Portuguese Khmer, Vietnamese and Chinese language outreach materials will be utilized whenever possible.

**ORAL TRANSLATION SERVICES** - The NMMPO will provide limited oral language services to Spanish, Portuguese Khmer, Vietnamese and Chinese speaking LEP individuals upon request. In order to provide these services, the Language Access Coordinator will do the following:

- Maintain a list of the points of contact where a LEP person interacts with the organization. At this time, it is anticipated that the key points of contact for LEP individuals are the front-desk receptionist and the NMMPO transportation staff performing outreach activities.
- Inventory staff language capabilities.

**TRAINING** - In order to establish meaningful access to information and services for LEP individuals, employees in public contact positions, and those who will serve as translators or interpreters will be properly trained. Such training will be developed to ensure that staff is fully aware of LEP policies and

procedures and are effectively able to work in person and/or by telephone with LEP individuals. NMMPO staff will be included in this training, even if they do not interact regularly with LEP persons, to ensure that they are fully aware of and understand the plan so they can reinforce its importance and ensure its implementation by staff.

**PROVIDING NOTICE OF AVAILABLE LANGUAGE SERVICE TO LEP PERSONS-** The NMMPO has established the following methods to inform Spanish, Portuguese, Khmer, Vietnamese and Chinese speaking LEP individuals, supporting organizations, as well as the general public, of available no-fee LEP services:

- **POSTING SIGNS** – A sign, in Spanish, Portuguese, Khmer, Vietnamese and Chinese, will be posted at the front-desk reception area to notify LEP individuals of any available services and how to obtain these services.
- **OUTREACH DOCUMENTS** – Key NMMPO outreach documents will include a notice that some language assistance services are available. This notice will be listed in English, Spanish, Portuguese, Khmer, Vietnamese and Chinese.
- **COMMUNITY ORGANIZATIONS** – The NMMPO staff will notify area community-based organizations and other stakeholders of available language assistance services.
- **PUBLIC NOTICES** – The NMMPO will periodically issue notices, in English, Spanish, Portuguese, Khmer, Vietnamese and Chinese about available LEP services. All public meeting notices will contain the following language:

“Individuals requiring special accommodations under the Americans with Disabilities Act or requiring translation services (free of charge) should contact (insert name of designated staff member) at (978) 454-8021 ten work days in advance of the Public Meeting.”

## ACCESSIBILITY

Issues related to transportation accessibility are discussed throughout the RTP. Whether it is ADA accessibility in the regional transit system, the “walkability” of our communities and neighborhoods, or public access to the many business areas, parks, trails and open spaces within the Northern Middlesex region, the NMMPO strives to improve access to all residents, workers and visitors. Paying attention to design elements that accommodate those with disabilities is essential to ensuring that our infrastructure is as accessible as possible. For example, curb design, ramps and crossing signals designed for the hearing- and sight-impaired facilitate safe travel for all ages and abilities.

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## COORDINATED HUMAN SERVICES TRANSPORTATION PLAN

Federal transit law requires that projects selected for funding under the Enhanced Mobility for Individuals and Individuals with Disabilities (Section 5310) Program be "included in a locally developed, coordinated public transit-human services transportation plan," and that the plan be "developed and approved through a process that included participation by seniors, individuals with disabilities, representatives of public, private, and nonprofit transportation and human services providers and other members of the public" utilizing transportation services. These coordinated plans identify the transportation needs of individuals with disabilities, older adults, and people with low incomes, provide strategies for meeting these needs, and prioritize transportation services for funding and implementation.

The NMMPO, through an annual task in the Unified Planning Work Program, develops and maintains a coordinated human services transportation plan. The *NMMPO Coordinated Public Transit-Human Services Transportation Plan* was adopted by the Northern Middlesex Metropolitan Planning Organization (NMMPO) in January 2015. The Plan serves as a framework for improved coordination of transportation services among both public and private providers in order to enhance transportation services for disadvantaged, disabled and senior populations. The document has been developed to meet the federal requirements outlined in FTA Circular 9070.1G for "a locally developed, coordinated human services transportation plan" that includes the following elements:

- "An assessment of available services that identifies current public, private and non-profit providers;
- An assessment of transportation needs for individuals with disabilities and older adults;
- Strategies, activities and/or projects to address identified gaps in current services and needs, as well as opportunities to achieve efficiencies in service delivery; and
- Priorities for implementation based on available resources (from multiple program sources), time, and feasibility for implementing specific strategies and/or activities identified."

Copies of the *2014 Coordinated Public Transit-Human Services Transportation Plan* are available on the NMCOG website at: [www.nmcog.org](http://www.nmcog.org). A more in depth discussion of service improvements from recommendations of the plan can be found in Chapter 6.

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## LRTA ADA ACCESSIBILITY

Transit accessibility is delivered by the LRTA, which operates twenty (20) fixed bus routes in seven (7) of the Northern Middlesex communities. The LRTA fixed route bus fleet is 100% wheelchair accessible with low-floor buses that eliminate any special lift treatment and instead allow the wheelchair customer to maneuver directly into the bus through the front door. In addition to the accessible fixed route fleet, the

LRTA provides complementary ADA paratransit service throughout the region within  $\frac{3}{4}$  miles of all fixed bus routes. All ADA paratransit service is available with 24 hour advance notice and operates during the same hours as the fixed route bus service.

The LRTA further provides senior/paratransit van service to all of the Northern Middlesex communities (with the exception of Dunstable). These services are provided either by the Lowell-based Road Runner or by the LRTA-funded Council on Aging Road Runner service. These local services are generally available Monday through Friday from 8:30 a.m. – 4:30 p.m.

LRTA maintains an application process to determine paratransit eligibility for those individuals who apply, including an application form and verification of eligibility. The verification of eligibility is based on a Certification by the person’s physician, health care professional, or rehabilitation professional.

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#### LRTA PARATRANSIT ELIGIBILITY CRITERIA

The LRTA eligibility requirements include the following:

- “Any individual with a disability who is unable, as a result of a physical or mental impairment (including a vision impairment), and without the assistance of another individual (except the operator of a wheelchair lift or other boarding assistance device), to board, ride, or disembark from any vehicle on the system which is readily accessible to and usable by individuals with disabilities.”
- “Any individual with a disability who needs the assistance of a wheelchair lift or other boarding assistance device and is able, with assistance, to board, ride, and disembark from any vehicle which is readily accessible to and usable by individuals with disabilities of the individual wants to travel on a route of the system during the hours of operation of the system at a time, or within a reasonable period of such time, when such a vehicle is not being used to provide designated public transportation on the route.”
- “Any individual who has a specific disability who has a specific impairment-related condition which prevents such individual from traveling to a boarding location or from a disembarking location on the system.”

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#### LRTA CLASSIFICATION OF ELIGIBILITY

LRTA classifies an individual’s eligibility into one of three categories:

1. UNCONDITIONAL/PERMANENT ELIGIBILITY - An individual will be classified with unconditional eligibility when the rider needs paratransit for all trips.
2. CONDITIONAL ELIGIBILITY - An individual will be classified with conditional eligibility when the rider needs paratransit for some trips but can use fixed route service for other trips.
3. TEMPORARY ELIGIBILITY - An individual will be classified as temporary if he/she is unable to use the Fixed-Route Bus system for a short time.

LRTA makes the determination of eligibility within 21 days of receiving a complete application.

## Chapter 15 PLAN RECOMMENDATIONS AND FINANCIAL CONSTRAINT

The recommendations outlined this Plan have been developed utilizing the goals, objectives, and identified needs outlined in previous chapters. Input received during the public participation process has also been considered. The presentation of recommendations is formatted differently from previous RTPs in that MassDOT approved projects are programmed through the first ten years of the Plan. These projects are most likely to go to construction. The remaining eleven years focus on setting aside funding for categories of transportation investments, rather than presenting an exhaustive list of projects, which may or may not be programmed for funding throughout the twenty-one-year long-range planning horizon.

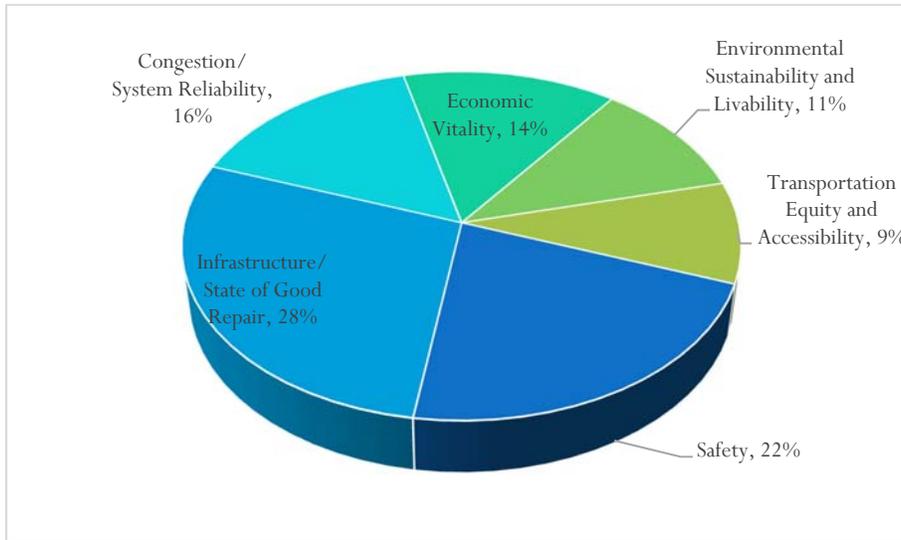
In order to identify the universe of potential projects for the RTP, NMMPO staff met with each municipality and conducted an extensive public outreach process. Appendix F contains a listing of the universe of projects identified during RTP development. Over \$530 million dollars in projects were identified, well over the discretionary funding available to the NMMPO. Many of these projects are conceptual presently, and given the long-term nature of the RTP, it is anticipated that some projects may not go forward. Creating transportation investment program categories with specific allocations of funding within each five-year period, was determined to be a more practical and meaningful method for addressing regional needs beyond the first five years of the RTP. Accordingly, each project in the RTP is categorized under one of five NMMPO investment programs, as described below.

- **Intersection Improvement/Safety Investment Program** – This category funds safety and mobility improvements for intersections throughout the region. Improvements include adding/upgrading traffic signals, intersection redesigns, and bicycle accommodations, adding curb cuts and improving sidewalks.
- **Roadway/Corridor Improvements Investment Program** – This category is aimed at enhancing, modernizing or addressing capacity issues on Federal Aid-eligible roadways. Projects in this program will use a complete streets approach to improve the mobility, accessibility and safety for of all users of the system. Improvements involve corridor upgrades including roadway rehabilitation, added/upgraded traffic signals along a corridor, new/upgraded sidewalks, and new/upgraded bicycle accommodations.
- **Bicycle and Pedestrian Investment Program** – This addresses expansion or the addition of bicycle and pedestrian facilities, in order to improve accessibility and safety for non-motorized users of the roadway network. Projects include construction of multi-use trails, off- and on-road bicycle facilities, and new sidewalks.
- **Bridge Rehabilitation/Reconstruction Investment Program** – This category includes improvements to area bridges, in order to reduce congestion, address functionality, or improve

safety throughout the region. Improvements include rehabilitation or replacement of structurally deficient or regionally significant priority bridges.

- **Transit Facility Investment Program** – This category funds improvements to transit facilities and services, and the modernization of the Lowell Regional Transit Authority vehicle fleet.

**Figure 15.1: Percentage of RTP Recommendations by Goals Addressed**



## FFY 2020-2040 REGIONAL TRANSPORTATION PLAN RECOMMENDATIONS – FINANCIAL CONSTRAINT

The RTP outlines projects and strategies that the NMMPO hopes to implement over the next twenty-one years with its limited financial resources. Because the RTP is a fiscally constrained document, the project listings reflect the funding targets that were provided to the NMMPO by MassDOT, through a consultative process with FHWA. Total transportation expenditure levels identified within the RTP must not exceed the total revenues reasonably expected to be available for the region over the life of the plan; this includes existing revenues and new revenue sources that are reasonably anticipated.

The project cost estimates were developed with the best available information and it anticipated that the costs will need to be adjusted in the future, as each project advances through the project development and design process. Cost estimates have been provided by the local communities, MassDOT, and NMMPO staff. For projects that have not advanced through a design or cost estimating process, estimates were based on projects costs for previous projects with similar scopes.

## FUNDED PROJECTS PROGRAMMED IN THE 2016 REGIONAL TRANSPORTATION PLAN

As Plan recommendations were formalized, the NMMPO assessed the success of the implementation of actions within the previous RTP. Table 15.1 contains a list of the recommended projects from the *2016-2040 Regional Transportation Plan* that were either constructed, are now under construction, or are expected to be under construction by the end of the current fiscal year. The fifteen projects reflect over \$75 million in investment in the region's transportation infrastructure.

**Table 15.1: 2016 RTP Recommendations Completed or Under Construction**

Community	Project Type/ Project ID #	Project Description	Cost	Year Complete/ Estimated Year of Completion
Bedford/ Billerica	29492	Middlesex Turnpike Improvements*	\$1,000,000	2023
Billerica	608181	Billerica-Intersection and Signal Improvements at Route 3A (Boston Road) and Allen Road	\$2,862,595	2020
Billerica	601426	Billerica-Reconstruction of Allen Road, from Route 3A to Webb Brook Road	\$6,081,026	2018
Chelmsford	607421	Chelmsford-Bridge Deck Replacement, C-08-037, including Intersection Improvements at Route 4 & I-495 (Exit 33)	\$4,220,484	2020
Chelmsford	608344	Chelmsford-Intersection Improvements at Route 129 and Riverneck Road	\$5,736,167	Scheduled to be Advertised for Construction: June 2019
Lowell	606189	Lowell-Improvements on Route 38 at Four Intersections	\$4,557,488	Contract awarded Feb. 2019
Lowell	607752	Lowell-Intersection & Signal Improvements at 2 Locations: SR 113 (Varnum Avenue & VFW Highway) at Mammoth Road & VFW at Aiken Street	\$2,028,261	2019
Lowell	604537	Lowell-Bridge Replacement , L-15-045, Market Street over the Western Canal	\$4,563,347	2019
Lowell	602932	Lowell-Bridge Replacement, L-15-058, VFW highway over Beaver Brook	\$18,189,151	2020
Lowell	608420	Lowell-Reconstruction and Rehabilitation of Five Bridges (Enel Bridges) TIGER Grant	\$13,389,749	2022
Tewksbury	608346	Tewksbury-Intersection Improvements at Main Street, Salem Road and South Street	\$3,778,724	Scheduled to be Advertised for Construction: July 2019
Tewksbury	607534	Tewksbury-Bridge Preservation, T-03-003, Mill Street over Shawsheen River	\$483,332	2020
Westford	607251	Westford-Intersection & Signal Improvements @ Route 110 & Tadmuck Road	\$2,383,284	2018

**Table 15.1: 2016 RTP Recommendations Completed or Under Construction**

Community	Project Type/ Project ID #	Project Description	Cost	Year Complete/ Estimated Year of Completion
Westford	608036	Westford-Intersection Improvements @ Groton Road (Route 40) & Oak Hill Road, Includes New Bridge W 26-027	\$3,333,581	2019
Westford	608037	Westford-Intersection Improvements @ Groton Road (Route 40) & Dunstable Road	\$3,123,167	2020

\* Middlesex Turnpike Improvements Total Cost: \$34,495,275 funded through Boston MPO.

### FFY 2020-2040 RTP RECOMMENDATIONS - HIGHWAY

The first five years of the 2020-2040 Regional Transportation Plan includes projects programmed in the FFY 2020-2024 Northern Middlesex Transportation Improvement Program (TIP). Table 15.2 contains the highway recommendations funded through the target portion of the RTP.

**Table 15.2: FFY 2020-2024 Northern Middlesex RTP Recommendations - Highway**

City/Town	Project Name	MassDOT ID	Construction Cost Estimate	RTP/TIP Program Year	NMMPO Investment Program Category	Year of Expenditure Cost
Chelmsford	Intersection improvements at Boston Road and Concord Road	608375	\$2,440,923	2020	Intersection Improvements/Safety	\$2,440,923
Tewksbury	Intersection Improvements at Andover Street (Route 133) and River Road	609038	\$3,518,633	2020	Intersection Improvements/Safety	\$3,518,633
Tewksbury	Resurfacing and Sidewalk Reconstruction on Route 38 Beginning at Colonial Drive North to the Intersection of Old Boston Road	608297	\$4,200,000	2021	Roadway/Corridor Improvements	\$4,368,000
Dunstable	Route 113 Improvements from Pleasant Street to 750 Ft. East of Westford Street	608603	\$4,894,986	2021	Roadway/Corridor Improvements	\$5,090,785
Billerica	Rehabilitation on Boston Road (Route 3A) from Floyd St to Billerica Town Center	605178	\$2,144,306	2022	Roadway/Corridor Improvements	\$2,319,281
Westford	Bridge Rehabilitation -Beaver Brook Road over Beaver Brook (W-26-014)	608830	\$1,620,000	2022	Bridge Rehabilitation/Reconstruction	\$1,752,192
Dracut	Improvements on Nashua Road	608350	\$5,210,395	2022	Roadway/Corridor Improvements	\$5,635,563
Billerica	Rehabilitation on Boston Road (Route 3A) from Floyd St to Billerica Town Center	605178	\$8,766,519	2023	Roadway/Corridor Improvements	\$9,861,142

**Table 15.2: FFY 2020-2024 Northern Middlesex RTP Recommendations - Highway**

City/Town	Project Name	MassDOT ID	Construction Cost Estimate	RTP/TIP Program Year	NMMPO Investment Program Category	Year of Expenditure Cost
Chelmsford	Traffic Signal Installation at Route 110 and I-495 (2 Locations)	607401	\$1,172,500	2024	Intersection Improvements/Safety	\$1,371,659
Westford	Westford - Rehabilitation of Boston Road	609035	\$6,095,000	2024	Roadway/Corridor Improvements	\$7,130,288
<b>Estimated Costs</b>						<b>\$43,488,467</b>
<b>Regional Discretionary Funding Available</b>						<b>\$48,513,053</b>
<b>Unprogrammed Funding</b>						<b>\$5,024,586</b>

Table 15.3 provide a summary of projects that have identified non-target funding and are included in the FFY 2020-2024 TIP. These projects are funded through state programs, such as Statewide CMAQ, Bridge, and HSIP.

**Table 15.3: FFY 2020-2024 Northern Middlesex RTP Recommendations – Highway Non Target Projects**

City/Town	Project Name	MassDOT ID	Construction Cost Estimate	RTP/TIP Program Year	NMMPO Investment Program Category	Year of Expenditure Cost
Billerica	Yankee Doodle Bike Path Construction (Phase 1)	608227	\$9,673,932	2024	Bicycle and Pedestrian Improvement Program	\$11,317,132
Lowell	Pedestrian Walkway & Bicycle Connection at Pawtucket Falls Overlook, from Vandenberg Esplanade to School Street	607885	\$2,232,100	2021	Bicycle and Pedestrian Improvement Program	\$2,321,384
Lowell/ Tewksbury	Route 38 Intersection Improvements	608774	\$3,000,000	2023	Intersection Improvements/Safety	\$3,374,592
Westford	Bridge Replacement, W26-002, Stony Brook Road over Stony Brook	608861	\$2,205,120	2022	Bridge Rehabilitation/Reconstruction	\$2,385,058
<b>Estimated Costs</b>						<b>\$19,398,166</b>

Table 15.4 lists program category investments recommended in FFY 2025-2029 of the RTP. Investment program percentages are based on the value of projects estimated to be ready for programming in years 2025-2029 of the TIP document.

**Table 15.4: FFY 2025-209 Northern Middlesex RTP Project Recommendations - Highway**

City/Town	Investment Program/Project Name	MassDOT ID	Construction Cost Estimate	RTP Program Year	NMMPO Investment Program Category	Year of Expenditure Cost
Lowell	Reconstruction and Related Work on VFW Highway	605966	\$6,215,865	2025	Roadway/ Corridor Improvements	\$7,562,550
Billerica	Intersection Improvements to Boston Rd/ Glad Valley Dr/ Lexington Rd	609250	\$3,003,500	2026	Intersection Improvements/ Safety	\$3,800,386
Lowell	Connector Reconstruction from Thorndike Street to Gorham Street	604694	\$3,409,870	2026	Roadway/ Corridor Improvements	\$4,314,573
Chelmsford	Improvements on Chelmsford Street (Route 110)	609317	\$5,625,000	2027	Intersection Improvements/ Safety	\$7,402,116
Chelmsford	Improvements on Chelmsford Street (Route 110)	609317	\$5,625,000	2028	Intersection Improvements/ Safety	\$7,698,201
Lowell	Church Street 2 Way Conversion	609050	\$3,050,000	2029	Roadway/ Corridor Improvements	\$4,341,101
Billerica	Middlesex Canal Enhancement	602945	\$3,003,500	2029	Bicycle and Pedestrian Improvements	\$4,274,917
<b>Estimated Costs</b>						<b>\$39,393,844</b>
<b>Regional Discretionary funding Available</b>						<b>\$55,620,728</b>
<b>Unprogrammed Funding</b>						<b>\$16,226,884</b>

Table 15.5 summarizes the program category investments for FFY 2030-2034 years of the RTP. The percentages are based on the estimated value of projects estimated to be ready for programming on the TIP in years 2030 through 2034.

**Table 15.5: Northern Middlesex RTP Recommendations: 2030-2034**

City/Town	Investment Program/Project Name	MassDOT ID	Construction Cost Estimate	RTP Program Year	NMMPO Investment Program Category	Year of Expenditure Cost
Region	Intersection Improvements and Safety Investment Program	NA	22%	2030-2034	Intersection Improvements/ Safety	\$15,024,911
Region	Roadway/Corridor Investment Program	NA	70%	2030-2034	Roadway/ Corridor Improvements	\$47,806,534
Region	Bicycle and Pedestrian Improvement Investment Program	NA	8%	2030-2034	Bicycle and Pedestrian Improvements	\$5,463,604
Region	Bridge Rehabilitation/ Reconstruction Investment Program	NA	2%	2030-2034	Bridge Rehabilitation/ Reconstruction	\$1,365,901
<b>Estimated Costs</b>						<b>\$68,295,049</b>
<b>Regional Discretionary funding Available</b>						<b>\$68,295,049</b>
<b>Unprogrammed Funding</b>						<b>\$0</b>

Table 15.6 summarizes program category investment estimated for FFY 2035-2039. The percentages for each investment program are based on the value of projects estimated to be ready for programming in the TIP in years 2035 through 2039.

**Table 15.6: Northern Middlesex RTP Recommendations: 2035-2039**

City/Town	Investment Program/Project Name	MassDOT ID	Construction Cost Estimate	RTP Program Year	NMMPO Investment Program Category	Year of Expenditure Cost
Region	Intersection Improvements and Safety Investment Program	NA	37%	2035-2039	Intersection Improvements/ Safety	\$28,007,102.27
Region	Roadway/Corridor Investment Program	NA	43%	2035-2039	Roadway/ Corridor Improvements	\$32,548,794.53
Region	Bicycle and Pedestrian Improvement Investment Program	NA	20%	2035-2039	Bicycle and Pedestrian Improvements	\$15,138,974.20
Region	Bridge Rehabilitation/ Reconstruction Investment Program	NA	0%	2035-2039	Bridge Rehabilitation/ Reconstruction	\$0.00
Estimated Costs						\$75,694,871
Regional Discretionary funding Available						\$75,694,871
Unprogrammed Funding						\$0

Table 15.7 summarizes program category investments in FFY 2040. The percentages for each investment program category are based on the value of projects estimated to be ready for programming in the FFY 2040 element of the TIP.

**Table 15.7: Northern Middlesex RTP Recommendations: FFY 2040**

City/Town	Investment Program/Project Name	MassDOT ID	Construction Cost Estimate	RTP Program Year	NMMPO Investment Program Category	Year of Expenditure Cost
Region	Intersection Improvements and Safety Investment Program	NA	37%	2040	Intersection Improvements/ Safety	\$5,957,056.24
Region	Roadway/Corridor Investment Program	NA	43%	2040	Roadway/Corridor Improvements	\$6,923,065.36
Region	Bicycle and Pedestrian Improvement Investment Program	NA	20%	2040	Bicycle and Pedestrian Improvements	\$3,220,030.40
Region	Bridge Rehabilitation/ Reconstruction Investment Program	NA	0%	2040	Bridge Rehabilitation/ Reconstruction	\$0.00
Estimated Costs						\$16,100,152
Regional Discretionary Funding Available						\$16,100,152
Unprogrammed Funding						\$0

## REGIONALLY SIGNIFICANT PROJECTS WITH NO IDENTIFIED FUNDING SOURCE

There are several major infrastructure and regionally significant projects in the region that have no identified funding source at this point. These projects are listed in Table 15.8 and include bridge projects, which are typically funded through the Statewide Bridge Program, as well as other major infrastructure projects likely to be funded through competitive grants or through statewide funding programs. The replacement of the Rourke Bridge is currently an illustrative project because no construction funding has been identified as of yet. This will most likely be funded by the Statewide Bridge Program. Preliminary design work is scheduled to begin in July 2019. Of note, there are two projects that will be initiated by the New Hampshire Department of Transportation: construction of a new Exit 36 SB Ramp on Route 3 and the extension of Commuter Rail from Lowell to New Hampshire.

**Table 15.8: RTP Recommendations - Regionally Significant Projects with No Identified Funding Source**

City/Town	Project Name	MassDOT ID	NMMPO Program	Current Total Federal Participating Construction Cost Estimate
Lowell	Upper Pawtucket Canalway Construction (CMAQ)	NA	Bicycle and Pedestrian Improvements	\$9,000,000
Billerica	Bridge Rehabilitation, B-12-003, ST 3A (Boston Road) over Concord River	605503	Bridge Rehabilitation/ Reconstruction	\$4,140,000
Chelmsford	Bridge Betterment C-08-036, Westford Street over I-495	605645	Bridge Rehabilitation/ Reconstruction	\$12,851,020
Chelmsford	Bridge Replacement, C-08-039, Gorham Street (Route 3A) over I-495	607681	Bridge Rehabilitation/ Reconstruction	\$14,341,305
Lowell	Rourke Bridge Replacement, L-15-088, Wood Street Extension Ove Boston and Maine Railroad and Merrimack River	607887	Bridge Rehabilitation/ Reconstruction	\$69,000,000
Chelmsford	Lowell Connector Bridge over I-495 B-11	NA	Bridge Rehabilitation/ Reconstruction	\$5,000,000
Lowell	Beaver Street Bridge over Beaver Brook Rehabilitation	NA	Bridge Rehabilitation/ Reconstruction	\$4,000,000
Lowell	Bridge Rehabilitation Lowell Connector B-10 over Lowell Connector Ramp B-8	NA	Bridge Rehabilitation/ Reconstruction	\$8,000,000
Lowell	Boylston Street Bridge Rehab over I-495	NA	Bridge Rehabilitation/ Reconstruction	\$8,000,000
Westford	I-495 SB Bridge over Boston Road (Exit 32)	NA	Bridge Rehabilitation/ Reconstruction	\$8,000,000

**Table 15.8: RTP Recommendations - Regionally Significant Projects with No Identified Funding Source**

City/Town	Project Name	MassDOT ID	NMMPO Program	Current Total Federal Participating Construction Cost Estimate
Tewksbury	I-495 NB and SB Bridges over Route 133 (Exit 39)	NA	Bridge Rehabilitation/ Reconstruction	\$16,000,000
Lowell/ Chelmsford/ Tyngsborough	Extension of Commuter Rail to Nashua with new station and area roadway Improvements*	NA	Transit Facility	\$120,000,000
Tyngsborough	Route 113 Park and Ride Lot Expansion (CMAQ)	NA	Roadway/Corridor Investment Program	\$1,500,000
Tyngsborough/ Nashua NH	Route 3 Exit 36 SB Ramp and Middlesex Road Improvements*	NA	Roadway/Corridor Investment Program	\$16,000,000
Westford/ Chelmsford/ Lowell/ Tewksbury	I-495 Mainline Widening from Westford to Tewksbury	NA	Roadway/Corridor Investment Program	\$100,000,000
<b>Estimated Costs</b>				<b>\$395,832,325</b>

\* New Hampshire DOT would be proponent of Commuter Rail Extension and Exit 36 SB Ramp Projects

**FFY 2020-2040 REGIONAL TRANSPORTATION PLAN RECOMMENDATIONS – HIGHWAY FISCAL CONSTRAINT**

**ESTIMATED HIGHWAY PROGRAM REVENUES**

The FAST Act requires that the Regional Transportation Plan be fiscally constrained and that the costs of Plan improvements not exceed reasonably expected revenues. The financial element must demonstrate that the projects contained in the Regional Transportation Plan can be implemented using the revenue forecasts contained in the Plan. Forecasting the amount of federal and state revenues that can reasonably be expected over a twenty-one year planning horizon is difficult at best. Changes in administration and policies at the state and federal levels, new federal transportation legislation, and new transportation bond bills are just a few of the factors that will influence transportation spending over time. MassDOT has provided information regarding anticipated funding levels for the Statewide Road and Bridge Program to the MPOs.

Table 15.10 provides an estimate of the total amount of highway funding that is anticipated for the state and region, grouped in five-year increments over the life of the RTP. These estimates are based on the following assumptions:

- Federal funding (OA and redistribution) and state match for the period of 2020 – 2024 reflects current STIP allocations.
- Deductions for statewide items that cannot be allocated individually to the MPOs, including the Central Artery and Accelerated Bridge Program (APB) Grant Anticipation Note (GAN) repayments are taken from the total available funding, leaving the amount of available federal funding to be allocated in the regional plans.
- The Balance Available for Statewide Programs is a function of the other assumptions made in the state’s financial plan and represents federal funding after deducting statewide line items and GANS repayments. For 2020-2024, this amount reflects the regional targets provided in the STIP; from 2025 to 2040, the forecast grows based upon the assumed 2.2% growth in revenue.
- The distribution of Federal highway funds to the NMMPO is made according to a formula that is primarily based on the region’s road mileage and population. The formula was developed by the Massachusetts Association of Regional Planning Agencies (MARPA) and is known as the “MARPA formula.” The Northern Middlesex region receives approximately 3.9% of the total highway funding available to the MPOs within Massachusetts;
- Funding assumed for the NHS/IM Program is allocated based upon the regional share of National Highway System mileage (3.81% for interstate maintenance and 3.54% for Non Interstate NHS roads in the Northern Middlesex Region); and
- Amounts assumed for the Bridge Program are allocated based upon each region’s percentage of bridges (2.88% for the Northern Middlesex Region).
- Recommended projects in the plan have a 4% Year of Expenditure (YOE) applied to current cost estimates. These cost estimates are developed from consultation with Communities, MassDOT and NMCOG. Communities and/or MassDOT may provide cost estimates for most RTP projects. For those projects without a given cost estimate, NMCOG may use historical projects with similar scopes to determine and initial cost estimate.

**Table 15.9: Statewide Highway Funding Estimates (FFY 2020-2040)**

	Estimated Highway Federal Funding					
	2020-2024	2025-2029	2030-2034	2035-2039	2040	Total
Base OA in today's dollars w/ 2.2% increase starting in 2025	\$3,293,408,790	\$3,682,804,768	\$4,106,134,546	\$4,578,125,088	\$976,932,805	\$16,637,405,997
August Redistribution	\$250,000,000	\$250,000,000	\$250,000,000	\$250,000,000	\$50,000,000	\$1,050,000,000
Less GANs Repayments	\$449,050,000	\$385,089,744	\$0	\$0	\$0	\$834,139,744
<b>Funding less GANs Repayments</b>	\$3,094,358,790	\$3,547,715,024	\$4,356,134,546	\$4,828,125,088	\$1,026,932,805	\$16,853,266,253
<b>Funding w/non-Federal match</b>	\$3,867,948,488	\$4,434,643,781	\$5,445,168,183	\$6,035,156,362	\$1,283,666,006	\$21,066,582,820
Statewide Items	\$2,627,078,496	\$3,011,973,235	\$3,698,313,019	\$4,099,028,089	\$871,855,293	\$14,308,248,132
Funding Available for MPOs	\$1,240,869,989	\$1,422,670,545	\$1,746,855,165	\$1,936,128,271	\$411,810,713	\$6,758,334,683
Northern Middlesex Available Target Funding (MARPA Formula 3.9096%)	\$48,513,053	\$55,620,728	\$68,295,049	\$75,694,871	\$16,100,152	\$264,223,853
Category	Statewide Funding Potentially for NMMPO Highway Assets					
	2020-2024	2025-2029	2030-2034	2035-2039	2040	Total
Statewide Interstate Maintenance	\$6,151,829	\$7,768,096	\$9,538,216	\$10,571,689	\$2,248,578	\$36,278,408
Statewide NHS	\$12,810,094	\$15,248,892	\$18,723,664	\$20,752,387	\$4,413,992	\$71,949,029
Statewide Bridge Program	\$28,376,820	\$32,280,745	\$39,636,574	\$43,931,227	\$9,344,086	\$153,569,452
NFA Bridge Preservation	\$19,548,000	\$19,978,056	\$20,417,573	\$20,866,760	\$4,265,166	\$85,075,555
Remaining Statewide Programs	\$43,882,039	\$49,316,846	\$60,554,700	\$67,115,848	\$14,275,410	\$235,144,843

Source: MassDOT

Table 15.11 shows the estimated highway costs for recommendations versus expected allocation to the Northern Middlesex MPO. These funding targets are grouped into five-year increments (with the exception of year 2040) and show the Regional Transportation Plan's Financial Constraint.

**Table 15.10: NMMPO Estimated Highway Project Costs vs. Available Funding (2020-2040)**

	2020-2024	2025-2029	2030-2034	2034-2039	2040	Total
Committed Target Funds	\$43,488,467	\$55,620,278	\$68,295,049	\$75,694,871	\$16,100,152	\$259,198,817
Estimated NMMPO Target Funds Hwy	\$48,513,053	\$55,620,278	\$68,295,049	\$75,694,871	\$16,100,152	\$264,223,403
Uncommitted Hwy Target funds	\$5,024,586	\$0	\$0	\$0	\$0	\$5,024,586
Financial Constraint	Yes	Yes	Yes	Yes	Yes	Yes

#### FFY 2020-2040 REGIONAL TRANSPORTATION PLAN RECOMMENDATIONS – TRANSIT

Table 15.12 outlines the Lowell regional Transit Authority capital project recommendations for the time period 2020-2040, categorized into five-year increments. This information was generated in consultation with the Lowell Regional Transit Authority and MassDOT. The first five-year time frame represents transit funding programmed in the FFY-2020-2024 TIP for the Northern Middlesex region.

**Table 15.11: LRTA Capital Project Recommendations**

Category	2020-2024	2025-2029	2030-2034	2035-2039	2040	Total
<i>Bus Replacement</i>						
Fixed Route Buses over 35 ft.	\$7,413,250	\$9,191,400	\$14,045,521	\$11,510,142	\$0	\$42,160,313
Fixed Route Buses Under 35 ft.	\$787,500	\$1,003,811	\$901,000	\$400,000	\$215,000	\$3,307,311
Paratransit	\$0	\$0	\$0	\$0	\$0	\$0
Support Vehicles	\$0	\$80,000	\$95,000	\$100,000	\$40,000	\$315,000
Preventive Maintenance	\$10,004,848	\$10,955,309	\$11,996,063	\$13,135,689	\$2,627,136	\$48,719,045
<i>Facility Updates and Improvements</i>						
LRTA Admin Office	\$100,000	\$20,000	\$20,000	\$20,000	\$20,000	\$180,000
Gallagher Intermodal Transportation Center	\$500,000	\$100,000	\$100,000	\$100,000	\$10,000	\$810,000
Gallagher Parking Garage Facilities	\$320,000	\$100,000	\$100,000	\$100,000	\$20,000	\$640,000
100 Hale Street Fixed Route Operations & Maintenance Facility	\$0	\$250,000	\$250,000	\$250,000	\$50,000	\$800,000

**Table 15.11: LRTA Capital Project Recommendations**

Category	2020-2024	2025-2029	2030-2034	2035-2039	2040	Total
Robert B. Kennedy Bus Hub/ Transfer Center	\$400,000	\$100,000	\$50,000	\$100,000	\$10,000	\$660,000
Roadrunner Paratransit Operations and oMaintenance	\$0	\$100,000	\$25,000	\$50,000	\$10,000	\$185,000
Spare Parts, Equipment and Miscellaneous	\$1,703,125	\$600,000	\$600,000	\$600,000	\$40,000	\$3,543,125
Fareboxes and Communication	\$0	\$2,000,000	\$0	\$0	\$0	\$2,000,000
<b>Total Capital</b>	<b>\$21,228,723</b>	<b>\$24,500,520</b>	<b>\$28,182,584</b>	<b>\$26,365,831</b>	<b>\$3,042,136</b>	<b>\$103,319,794</b>

Table 15.13 identifies the LRTA operational project recommendations for the time period 2020-2040, categorized in five-year increments. The LRTA operation improvements were developed as part of the 2015 Transit Service Study and the 2018 Middlesex 3 Corridor Study. The implementation of Sunday service is currently in a 9-month pilot program to determine whether the service is feasible. The LRTA has appropriated \$325,000 to implement the pilot service. If the service were to be continued, the LRTA would use State Contract Assistance to cover full service operations on an annual basis. The full service costs have no identified funding source, so the full project is listed as an illustrative recommendation in Table 15.14.

**Table 15.12: LRTA Operations Improvements Recommendations**

Description	2020-2024	2025-2029	2030-2034	2035-2039	2040	Total
Realign Rte 01 - Christian Hill	Implementation Cost Neutral	No Additional Cost	No Additional Cost	No Additional Cost	No Additional Cost	\$0
Realign Routes through Downtown Lowell	Implementation Cost Neutral	No Additional Cost	No Additional Cost	No Additional Cost	No Additional Cost	\$0
Realign Rte 16 (Chelmsford) and Rte 17 (North Chelmsford)	Implementation Cost Neutral	No Additional Cost	No Additional Cost	No Additional Cost	No Additional Cost	\$0
LRTA Route 12 Rerouting on Main Street in Tewksbury	No Additional Cost	No Additional Cost	No Additional Cost	No Additional Cost	No Additional Cost	\$0
Addition of Sunday Service (State Contract Assistance Pilot Program)	\$325,000	\$0	\$0	\$0	\$0	\$325,000

Table 15.14 outlines operational improvements identified through a 2015 LRTA Transit Study and the 2018 Middlesex 3 Corridor Study. In addition, the public input gathered for this Plan was considered.

These recommendations do not have identified funding sources as of yet and are listed as illustrative projects.

**Table 15.13: LRTA Operations Improvements without Identified Funding Source**

Description	2020-2024	2025-2029	2030-2034	2035-2039	2040	Total
LRTA Route 13 Extension to Burlington Mall		\$50,500	\$50,500	\$50,500	\$10,100	\$161,600
LRTA Route 14 late night fixed route service		\$2,232,400	\$2,232,400	\$2,232,400	\$446,480	\$7,143,680
New Service to Bedford VA Hospital and Middlesex Community College		\$1,860,000	\$1,860,000	\$1,860,000	\$372,000	\$5,952,000
Service to Pheasant Lane Mall		\$1,150,000	\$1,150,000	\$1,150,000	\$230,000	\$3,680,000
Addition of Sunday Service	\$3,450,000	\$6,100,000	\$7,413,000	\$9,019,000	\$1,196,000	\$27,178,000
<b>Totals</b>	<b>\$3,775,000</b>	<b>\$11,392,900</b>	<b>\$12,705,900</b>	<b>\$14,311,900</b>	<b>\$2,256,620</b>	<b>\$44,440,280</b>

#### REGIONAL TRANSPORTATION PLAN RECOMMENDATIONS - TRANSIT FISCAL CONSTRAINT

Estimates of available transit revenues were provided by MassDOT and the LRTA. In order to prove fiscal constraint, these revenues were compared to expected capital and operating costs for the LRTA. Table 15.15 shows that for each five-year increment over the lifespan of the RTP, the LRTA transit program is financially constrained.

**Table 15.14: Anticipated LRTA Revenues and Expenses (2020-2040)**

Description	2020-2024	2025-2029	2030-2034	2034-2039	2040	Total
<i>Federal Programs - Source: MassDOT and LRTA</i>						
Urbanized Area Formula (5307)	\$25,482,711	\$23,675,218	\$26,133,011	\$28,845,953	\$6,042,144	\$110,179,037
Capital Fixed Guideway Program (5309)	\$0	\$0	\$0	\$0	\$0	\$0
Elderly & Disabled (5310)	\$0	\$0	\$0	\$0	\$0	\$0
Non-Urbanized Area Formula (5311 & 5340)	\$0	\$0	\$0	\$0	\$0	\$0
Section 5339	\$920,000	\$4,481,133	\$6,127,785	\$3,219,702	\$0	\$14,748,620
<b>Subtotal</b>	<b>\$26,402,711</b>	<b>\$28,156,351</b>	<b>\$32,260,796</b>	<b>\$32,065,655</b>	<b>\$6,042,144</b>	<b>\$124,927,657</b>
<i>Commonwealth Programs - Source: LRTA</i>						
State Capital Investment	\$4,169,650	\$7,000,000	\$8,050,000	\$8,170,750	\$2,500,000	\$29,890,400
State Contract Assistance for Operations	\$21,316,389	\$23,529,304	\$25,971,950	\$28,668,173	\$6,170,734	\$105,656,550
MAP	\$0	\$0	\$0	\$0	\$0	\$0
<b>Subtotal</b>	<b>\$25,486,039</b>	<b>\$30,529,304</b>	<b>\$34,021,950</b>	<b>\$36,838,923</b>	<b>\$8,670,734</b>	<b>\$135,546,950</b>
<i>Lowell Regional Authority Revenues - Source LRTA</i>						
Local Assessments	\$15,796,550	\$17,436,435	\$19,246,562	\$21,244,603	\$4,572,834	\$78,296,984
Farebox Revenue	\$7,979,075	\$8,807,406	\$9,721,728	\$10,730,969	\$2,287,273	\$39,526,451
Other Revenue	\$986,659	\$1,047,204	\$1,111,464	\$1,179,668	\$246,656	\$4,571,651
Parking Revenues	\$4,997,699	\$5,304,375	\$5,629,871	\$5,975,340	\$1,249,380	\$23,156,665
<b>Subtotal</b>	<b>29,759,983</b>	<b>32,595,420</b>	<b>35,709,625</b>	<b>39,130,580</b>	<b>8,356,143</b>	<b>145,551,751</b>
<b>Total All Anticipated Revenues</b>	<b>\$81,648,733</b>	<b>\$91,281,075</b>	<b>\$101,992,371</b>	<b>\$108,035,158</b>	<b>\$23,069,021</b>	<b>\$406,026,358</b>
<b>Total All Anticipated Expenses (Capital + Operating)</b>	<b>\$81,648,732</b>	<b>\$91,281,075</b>	<b>\$101,992,371</b>	<b>\$107,943,745</b>	<b>\$23,069,021</b>	<b>\$405,934,944</b>
<b>Difference</b>	<b>\$1</b>	<b>\$0</b>	<b>\$0</b>	<b>\$91,413</b>	<b>\$0</b>	<b>\$91,414</b>

Tables 15.16 and 15.17 provide a breakdown and comparison of anticipated revenues/funding assistance and the cost of service for the LRTA, for both operations and capital programs. As shown, expenses do not exceed anticipated revenues; therefore, the Regional Transportation Plan is financially constrained.

**Table 15.15: Anticipated LRTA Operating Revenues and Cost of Service (2020-2040)**

Revenue Assistance	2020-2024	2025-2029	2030-2034	2035-2039	2040	Total
State Contract Assistance	\$21,316,389	\$23,529,304	\$25,971,950	\$28,668,173	\$6,170,734	\$105,656,550
Local Assessments	\$15,796,550	\$17,436,435	\$19,246,562	\$21,244,603	\$4,572,834	\$78,296,984
Farebox Revenues	\$7,979,075	\$8,807,406	\$9,721,728	\$10,730,969	\$2,287,273	\$39,526,451
Other Revenues	\$986,659	\$1,047,204	\$1,111,464	\$1,179,668	\$246,656	\$4,571,651
\$5307 Preventive Maintenance	\$17,217,861	\$19,005,297	\$20,978,292	\$23,156,109	\$4,984,280	\$85,341,839
\$5307 ADA	\$1,576,899	\$1,740,601	\$1,921,298	\$2,120,753	\$456,485	\$7,816,036
Parking Revenue	\$4,997,699	\$5,304,375	\$5,629,871	\$5,975,340	\$1,249,380	\$23,156,665
<b>Total Operating Revenue</b>	<b>\$69,871,132</b>	<b>\$76,870,622</b>	<b>\$84,581,165</b>	<b>\$93,075,615</b>	<b>\$19,967,642</b>	<b>\$344,366,176</b>
<b>Estimated Cost of Service</b>	<b>\$60,420,009</b>	<b>\$66,780,557</b>	<b>\$73,809,787</b>	<b>\$81,577,914</b>	<b>\$19,889,567</b>	<b>\$302,477,834</b>

Source: LRTA

**Table 15.16: Transit Capital Expenditures vs. Available Revenues**

Category	2020-2024	2025-2029	2030-2034	2035-2039	2040	Total
<i>Bus Replacement</i>						
Fixed Route Buses over 35 ft.	\$7,413,250	\$9,191,400	\$14,045,521	\$11,510,142	\$0	\$42,160,313
Fixed Route Buses Under 35 ft.	\$787,500	\$1,003,811	\$901,000	\$400,000	\$215,000	\$3,307,311
Paratransit	\$0	\$0	\$0	\$0	\$0	\$0
Support Vehicles	\$0	\$80,000	\$95,000	\$100,000	\$40,000	\$315,000
Preventive Maintenance	\$10,004,848	\$10,955,309	\$11,996,063	\$13,135,689	\$2,627,136	\$48,719,045
<i>Facility Updates and Improvements</i>						
LRTA Admin Office	\$100,000	\$20,000	\$20,000	\$20,000	\$20,000	\$180,000
Gallagher Intermodal Transportation Center	\$500,000	\$100,000	\$100,000	\$100,000	\$10,000	\$810,000
Gallagher Parking Garage Facilities	\$320,000	\$100,000	\$100,000	\$100,000	\$20,000	\$640,000
100 Hale Street Fixed Route Operations & Maintenance Facility	\$0	\$250,000	\$250,000	\$250,000	\$50,000	\$800,000
Robert B. Kennedy Bus Hub/ Transfer Center	\$400,000	\$100,000	\$50,000	\$100,000	\$10,000	\$660,000
Roadrunner Paratransit Operations and Maintenance	\$0	\$100,000	\$25,000	\$50,000	\$10,000	\$185,000
Spare Parts, Equipment and Miscellaneous	\$1,703,125	\$600,000	\$600,000	\$600,000	\$40,000	\$3,543,125
Fareboxes and Communication	\$0	\$2,000,000	\$0	\$0	\$0	\$2,000,000
<b>Total Capital Expenditures</b>	<b>\$21,228,723</b>	<b>\$24,500,520</b>	<b>\$28,182,584</b>	<b>\$26,365,831</b>	<b>\$3,042,136</b>	<b>\$103,319,794</b>
<b>Available Capital Revenues</b>	<b>\$21,228,723</b>	<b>\$24,500,520</b>	<b>\$28,182,584</b>	<b>\$26,365,831</b>	<b>\$3,042,136</b>	<b>\$103,319,794</b>

Source: LRTA Transit Projections