REGIONAL PROGRAMS AND ANALYSIS

VII

VII. REGIONAL PROGRAMS AND ANALYSIS

A. INTRODUCTION

Earlier Chapters have discussed the existing characteristics of the Central Massachusetts region, including population and employment trends, travel patterns, and land use and economic activity overviews; inventoried the current transportation infrastructure, including existing conditions and challenges; and outlined some of the environmental issues facing the region and the Commonwealth as a whole.

The materials in this Chapter will discuss some of the many ways in which needs are specifically analyzed and studied in order for the region to objectively uncover and prioritize project and policy needs. With available resources at levels much lower than those that would be required to properly address all the region's transportation issues, these programs and systems can assist in defining how needs can be met and can inform the difficult project choices ahead by adding factual and projected evaluations of infrastructure condition and reach.

With this information in mind, we can better fulfill the stated goals of the region's transportation planning effort, namely, the attainment of a safer, more secure and better-maintained system, the promotion of livable communities and improved air quality, and the development of a system that integrates and enhances the ability to use multiple travel modes.

B. TRAVEL DEMAND MODEL

The Regional Travel Demand Forecast Model is an important planning tool both for the evaluation of proposed regional transportation improvements and the projection of mobile source air emissions for significant regional projects. The model is the most effective and comprehensive way to project transportation needs within a twenty-year planning horizon as required by Federal regulation.

In the regional travel demand model, traffic volumes are forecast through the interaction of transportation demand and supply. Traffic zones are defined to encompass areas of development that represent the demand, while the actual road network represents the supply. A network is developed consisting of a series of points, or nodes, that graphically show locations of roadway intersections and other elements of the network. Connections between nodes are called links. Links represent highway segments and contain information such as speed and road capacity. Traffic zones contain demographic and employment information, and are represented by special nodes called centroids. Each zone is attached, or "loaded," onto the network by specialized links called centroid connectors.

Each traffic zone produces and attracts person trips based on its land use. Information entered into the model for each zone (such as population, households, income and employment) determines the amount of trips produced and attracted to that zone. Households are the primary producer of trips, while employment sites are the primary attractors. These productions and attractions are converted to vehicle trips that enter and leave each zone. The fact that people make trips for different purposes (work, shopping, school, personal business, recreation, etc.) – and have different vehicle occupancy rates in doing so – is also calculated into the model.

The regional travel demand model was used to generate the Daily Vehicle Miles Travelled and Total Daily Auto Person Trips for the current "2010" and Future "2035" years. Please see the table VII-1 below for comparison.

Table VII-1

Comparison of travel behavior Current Vs. Future			
	2010	**2035**	**Percent Growth**
Daily Vehicle Miles Travelled	16,039,842	20,052,704	25%
Total Daily Auto Person Trips	4,434,363	5,308,547	20%

The table above shows that there will be an increase of about 20% of daily auto person trips, and vehicle miles travelled increases by 25%. Given the increase in the both the daily person trips and the VMT it is very obvious that the congestion on the roadway network will only get worse in the year 2035. Please see the Figure VII-1 below to show the comparison of congested locations for current and future conditions. As mentioned above the major roadway network in the urban area of the region is completely congested by the year 2035.

Given the limited funding to expand the transportation system, there is a need to look at innovative ways to reduce congestion. Some of the initiatives that could help alleviate congestion are investing in increasing and promoting transit use and investing in programs that reduce single occupancy vehicle use such as MassRIDES, Park and Ride lots and Transportation Demand Management techniques. Intelligent Transportation Systems can also be used for both recurring and non-recurring congestion like construction and accident delays.

C. MANAGEMENT SYSTEMS AND INTEGRATION

C.1 Congestion Management Process (CMP)

The Congestion Management Process (CMP) is a systematic approach, collaboratively developed and implemented throughout a metropolitan region, that provides for the safe and effective management and operation of new and existing transportation facilities through the use of demand reduction and operational management strategies. The CMP provides information to decision-makers on system performance and the effectiveness of implemented strategies. Although major capital investments are still needed to meet the growing travel demand, the CMP also develops lower cost strategies that complement capital investment recommendations. The result is a more efficient and effective transportation systems, increased mobility, and a leveraging of resources. The CMP involves the following programs and activities:

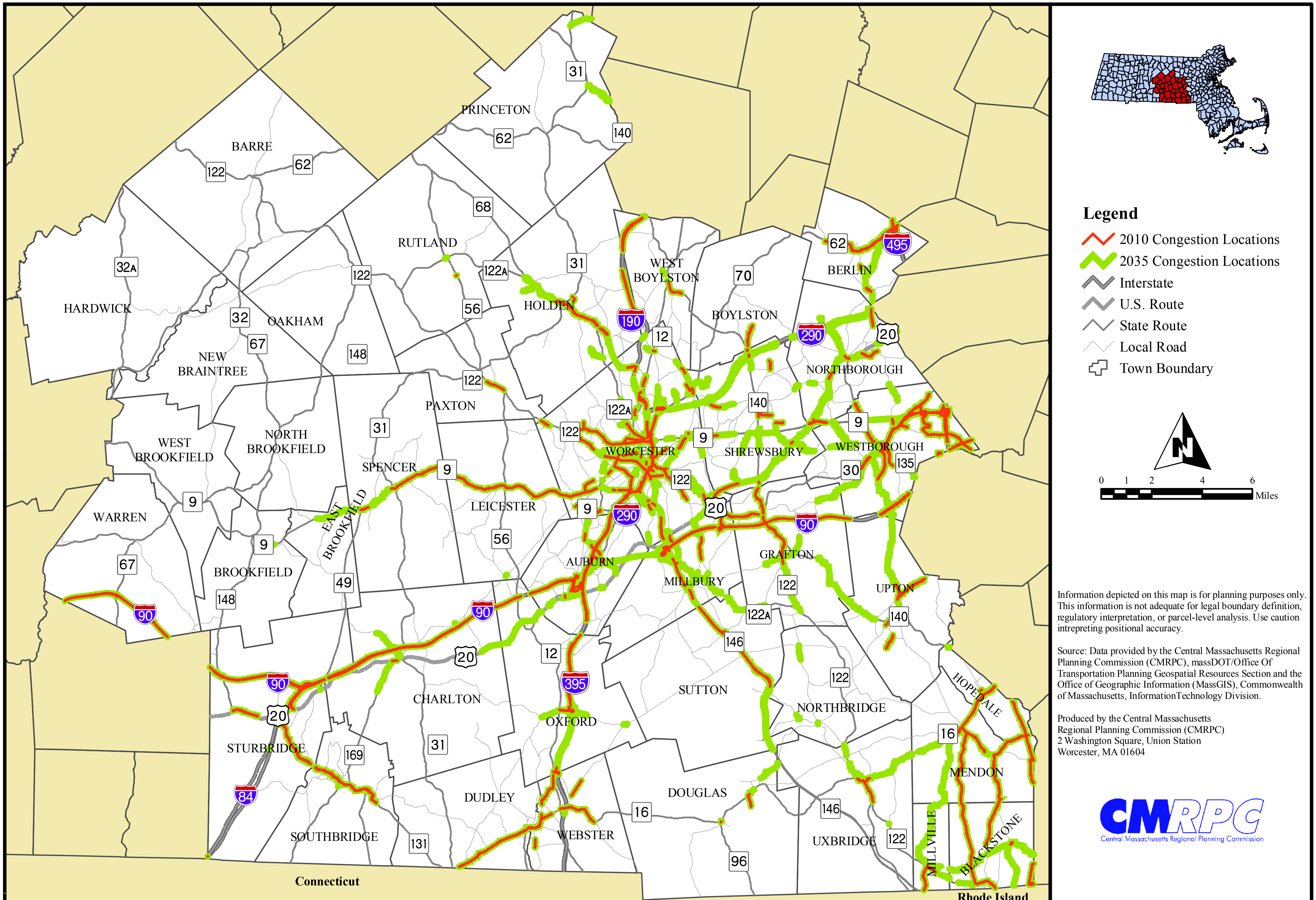


Figure VII-1 Current (2010) and Future No-Build (2035) Congestion Locations

C.1.1 Localized Bottleneck Reduction Program

C.1.1.1 Introduction

In November 2008 FHWA and FTA recommended that the MPOs *identify the top three (3) bottleneck areas in their regions. Based on the identification of these bottleneck areas, the MPOs should develop tasks to conduct studies to target low-cost countermeasures*. Based on the FHWA/FTA directive, a ***Localized Bottleneck Reduction Program*** pilot effort was developed to complement the region's established and ongoing Congestion Management Program (CMP). The region's entire federal-aid highway system, with a particular focus on the *"Vital Links"* established by the CMMPO, was screened as part of this effort.

C.1.1.2 Definition

A ***Traffic Bottleneck*** is defined by FHWA as a localized constriction of traffic flow, often on a highway segment that experiences reduced speeds and inherent delays, due to recurring operational influence or a nonrecurring impacting event. Further, a bottleneck is an area of poor LOS or high V/C ratio which *ends* at a *point,* has a *recurring cause*, and, maybe most importantly, *exhibits a return to free flow speeds* after the bottleneck end point.

FHWA further indicates that "a bottleneck has congestion, but congestion is often more than a bottleneck", citing an example of a wide highway with a narrow bridge that restricts traffic flow on a regular basis. It should also be noted for differentiation purposes that a road that has a high V/C or poor LOS for an extended length, or for its entire length, is *not* a bottleneck, but rather is considered a chronically congested roadway, where demand routinely exceeds capacity.

Elements that typically exist in a bottleneck situation include:

- A traffic queue upstream of the bottleneck
- A beginning point for the traffic queue
- Free flow traffic conditions downstream of the bottleneck
- A predictable recurring cause

At this time, the focus of the Local Bottleneck Reduction Program (LBRP) is operationally-influenced recurring bottlenecks.

The Transportation Management Systems, along with their respective GIS components, maintained by CMRPC (congestion, pavement, safety, freight planning, public transit planning) and MassDOT (bridge and pavement) have been referenced in attempting to determine the "root causes" of recurring Traffic Bottleneck locations. As indicated by FHWA, there are often other root causes, beyond congestion, that lead to recurring bottleneck conditions at various locations. *This is considered another component of the region's ongoing efforts to integrate the Management Systems.*

Other recently completed and ongoing work efforts in the region were also considered in the identification of Traffic Bottleneck locations. Notably, the recently completed Worcester Regional

Mobility Study (WRMS) was referenced as part of this effort, for Route 9 (Belmont Street) at I-290 interchange #17.

C.1.1.3 Location Identification

Building on the planning agency's extensive knowledge of the region's federal-aid highway system, the Localized Bottleneck Reduction Program considers all roadway segments and major intersections in the region's federal-aid highway system, with an emphasis on CMMPO indentified "Vital Links", or core federal-aid roadways.

The regional travel demand model was used to screen all roadway segments and major intersections seeking the "top three" Traffic Bottlenecks. Based on the Volume-to-Capacity (V/C) ratios calculated by the model, roadway segments and intersections where generated vehicular traffic volumes far exceed theoretical roadway capacities were identified.

Further, as part of the Localized Bottleneck Reduction Program, projects listed for information purposes on the CMMPO Endorsed TIP, yet to be programmed for regional target funding, were also considered. The Localized Bottleneck Reduction Program seeks to further support these eligible projects through observations in the field and subsequent planning analyses. Ongoing Management Systems activities and public outreach feedback were also considered in the development of the pilot program.

Based on the traffic bottleneck definition, staff has identified bottlenecks and their start and end points. Operationally recurring bottlenecks were identified at three (3) selected locations in the planning region: urban, suburban, and rural. The communities and locations are as follows:

URBAN: City of Worcester

Route 9 (Belmont Street) at I-290 Exit #17 interchange

SUBURBAN: Town of Northbridge

Route 122 (Providence Street)/Church Street intersection, aka "Plummer Corner"

RURAL: Town of Spencer ("Downtown")

Route 9 (Main Street) with Route 31 South (Maple Street) and Route 31 North (Pleasant Street)

C.1.1.4 Field Verification: Observations & Analyses

Observations in the field were used to verify the top three Traffic Bottleneck locations in the region. One evolving method utilized for the verification of Traffic Bottleneck conditions in the field is referred to as a "Congestion Audit". Congestion Audits were used to verify the Traffic Bottleneck locations indicated by the regional travel demand model and other available references. Model-identified locations were visited in the field in order to view congested conditions as well as to observe the *recurring* nature of the identified Traffic Bottlenecks.

Staff collected field data and conducted various planning analyses at each indentified Traffic Bottleneck location. These included:

- Intersection Turning Movement Counts (TMCs) during the peak travel periods
- Signalized intersection LOS analysis
- Travel Time & Delay Studies, GPS-based
- Intersection inventories including field-observed signal timing and phasing
- Digital photographs taken in the field (visualization purposes)
- Pictometry images of the identified locations (visualization purposes)

The Congestion Audits conducted in the field led to the development of a number of suggested improvement options for further consideration by MassDOT and the host communities.

C.1.1.5 Suggested Improvement Options

After reviewing the Localized Bottleneck Reduction Program analysis results for a given location, suggested improvement options aimed at reducing and eliminating the identified Traffic Bottlenecks were formulated for consideration by MassDOT and the host communities. *(Please refer to the Congestion Audit Summaries included on the following pages.)* Based on FHWA/FTA's call for "low-cost countermeasures" or solutions, a range of improvement options were considered, with the primary intent of identifying workable, low-cost Transportation System Management (TSM) improvements eligible for federal-aid funding. TSM improvements are "low-cost" by nature, ranging from $100,000 to $500,000, and can often be implemented within the existing right-of-way.

Other generalized approaches to reducing and eliminating bottleneck conditions include the following:

- Provide alternatives as to how, when, where and whether to travel
- Expand roadway capacity
- Improve management and operation of the system, including consideration of access management techniques

C.1.1.6 Next Steps: CMMPO TIP Development Process

The results of the Localized Bottleneck Reduction Program may lead to the development of projects funded through the CMMPO Transportation Improvement Program (TIP). These potential improvement projects would need to compete with others deemed eligible for programming on the TIP's highway-related project listing.

The intent of seeking low-cost solutions, as discussed, is that projects generated by the Localized Bottleneck Reduction Program could perhaps use the balance of any available regional federal-aid target funding. When the TIP project listing is developed and amended/adjusted, the CMMPO considers a range of factors, such as feasibility, cost and readiness, while being mindful of FHWA's emphasis on safety and congestion projects.

Certainly, depending on prevailing conditions, high-cost solutions may be the only viable improvement alternatives, based on screened and field-verified bottleneck conditions. The additions of general purpose travel lanes, for example, could require investments in excess of $1 million. Based on the conditions observed in the field, an initial priority could be assigned to the suggested improvements for later use in programming.

C.1.1.7 Bottleneck Location Findings

1. Route 9 (Belmont St)/I-290 Ramps Intersection - Worcester

Summary of Field Observations:

<u>Travel Time & Delay Study</u>
The data for this study was collected on Belmont Street from Lincoln Street to Hospital Drive (Figures VII-2 and VII-3). Belmont Street, in Worcester, is a heavily traveled route and is very congested. Along this road is a major hospital, an elementary school, and on/off ramps to I-290. There is also a considerable amount of pedestrian traffic along this focus segment as well. The intersections with the I-290 ramps and Belmont Street are considered a bottleneck area for this segment of road. A “bottleneck” is an obstructed portion of a roadway that is a hindrance to the progress of vehicles. In the easterly direction, there is a lane drop after the I-290 off ramp intersection and the roadway becomes one lane in each direction. Due to a concentration of vehicles entering/exiting I-290 and vehicles traveling to the hospital, this section can be very slow, especially during peak hours. Heading westbound in the AM, vehicle speeds start out near 40 mph, but by the time they reach Lincoln Street speeds drop to below 30 mph. There are a number of delay points between Skyline Drive and the I-290 ramps. Traveling eastbound is just as slow as westbound. Again, vehicle speeds are near 20 mph around the I-290 ramps and increase to near 40 mph just before Hospital Drive.
In the PM, delay is much worse, especially heading eastbound. Traveling westbound, the slowest vehicle speeds are between Skyline Drive and the I-290 ramps. There is also some delay before the Skyline Drive intersection, as well as just before Lincoln Street. Heading eastbound, there is a heavy amount of delay from the I-290 ramps to Skyline Drive. Vehicle speeds are below 20 mph for a good portion of this segment. For each of the runs is this direction, the data collection vehicle had to stop multiple times due to the steep incline of the roadway and slow moving buses or left turning vehicles.

<u>Critical Intersection Operations (1)</u>
The Belmont Street/Converse Street/I-290 EB Off Ramp intersection is signalized controlled. Converse Street is a one-way street for entering vehicles only. A turning movement count was completed at this location to determine the Level of Service (LOS). The count was conducted between 7 AM and 9 AM and between 4 PM and 6 PM. For the peak hour, there were over 2,700 vehicles in the morning and 2,500 vehicles in the afternoon. The overall LOS for this intersection is a “C” for both the AM and PM, with the I-290 Off Ramp as the worst lane group, having an average of a “D” and over 30 seconds of delay.

<u>Critical Intersection Operations (2)</u>
The intersection of Belmont Street with the I-290 WB On Ramp is also under signalized control. There is a church parking lot entrance near the intersection that sometimes slows down the flow of traffic. A turning movement count was conducted at this intersection during the same day and time as the adjacent

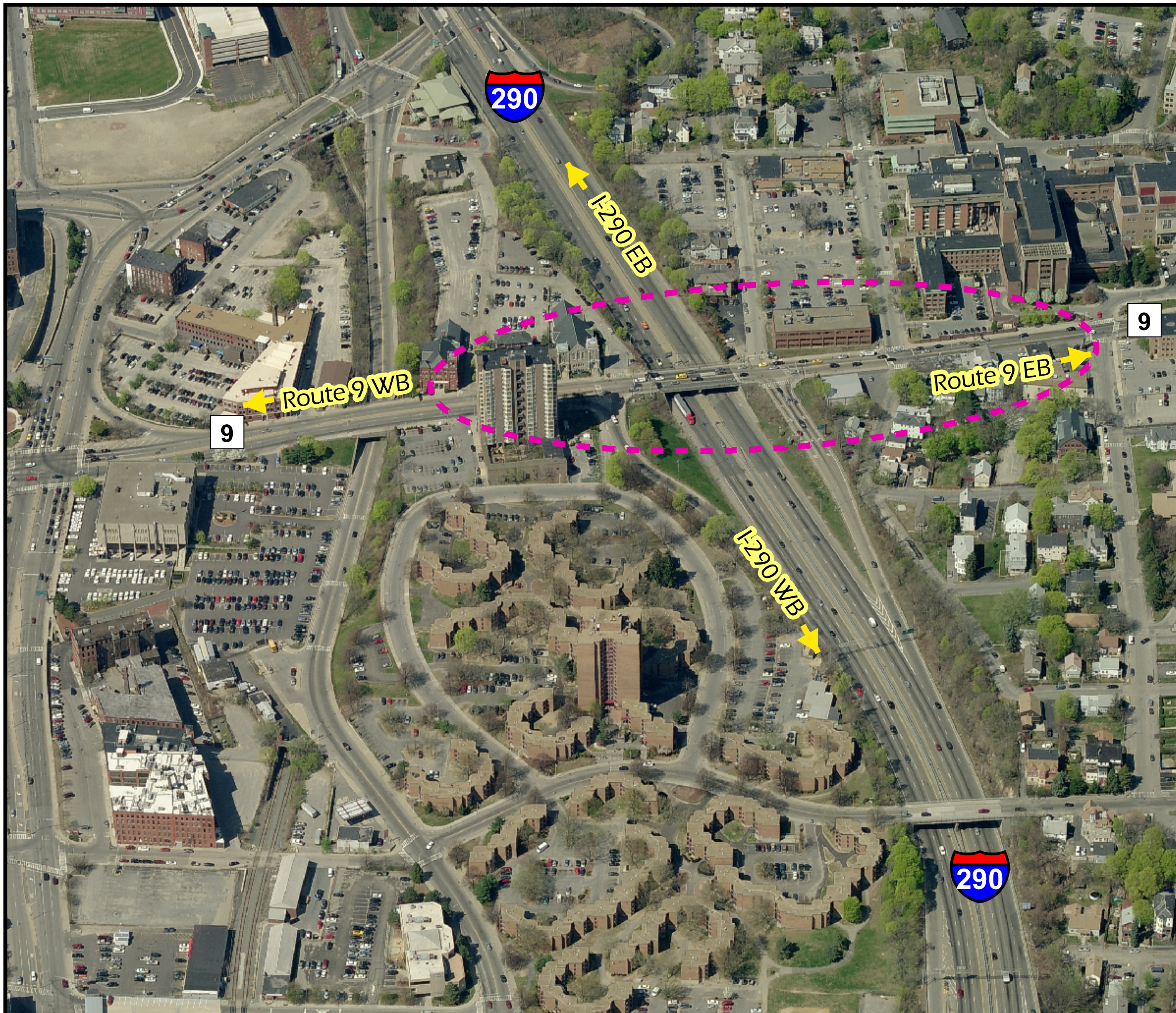
study intersection noted previously. The peak-hour volumes were very similar to the other intersection with the AM having over 2,500 vehicles and the PM being over 2,800. The overall intersection LOS is a "B" for both the AM and PM periods. The only approaches that are controlled by the signal are both directions of Belmont Street. The westbound direction has an LOS of "A" for both directions and has less than five seconds of delay. Heading eastbound, vehicles have over 30 seconds of delay and the LOS is a "D", as vehicles must be stopped in order to let westbound traffic have clear access to I-290 west.

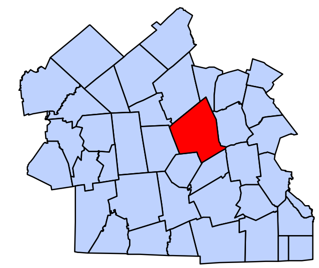
Potential Suggested Improvement Options for Host Community Consideration (Figure VII-4)

1) Reduce unnecessary weave maneuvers through signs and pavement markings, other potential modifications to Belmont Street weave areas.
2) Improved regulatory lane use signs in order to minimize vehicle weaves.
3) Perhaps consider overhead guide signs and lane use signs. Potential forthcoming improvements to (non-conforming) city-owned guide signs.
4) Route 9 on-street parking east of the bridge needs to be completely eliminated as suggested by MassDOT. Off-street parking opportunities in this area need to be emphasized to the benefit of local businesses. (Another option is peak period parking restrictions.)
5) Optimize traffic signal timing, phasing and coordination to be reactive to fluctuations in flows. Consider improvements to vehicle detection using mast mounted equipment (as opposed to failure-prone pavement loops).

Longer Term Improvement Concept

1) Reconstruction of the Route 9 bridge over I-290 (W-44-094) is planned, it has been determined by MassDOT to be "Structurally Deficient" with a rating of 34.0. (Built in 1958 and never rebuilt, this structure has the worst rating of any state highway bridge over I-290 in the City of Worcester.) When the bridge is replaced, an additional center left turn lane will be added. Bicycle and pedestrian accommodation will also be improved. Consider projected future traffic increases in design of replacement bridge structure.





N

Information depicted on this map is for planning purposes only. This information is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analysis. Use caution intrepreting positional accuracy.

Source: Data provided by Pictometry International Corp (c) Copywrite 2003

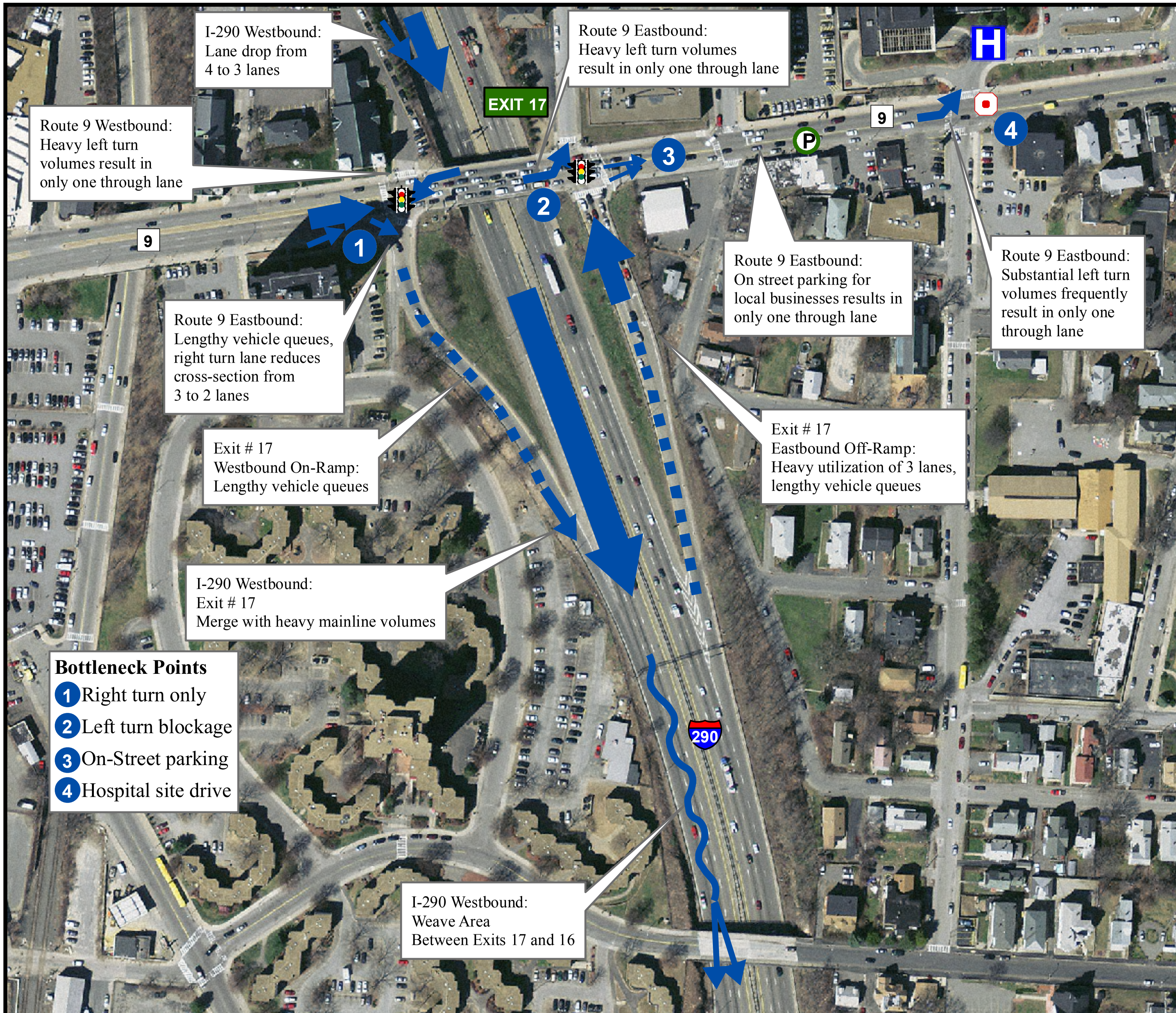
Produced by the Central Massachusetts Regional Planning Commission (CMRPC)
2 Washington Square, Union Station
Worcester, MA 01604

CMRPC
Central Massachusetts Regional Planning Commission

Figure VII-2 Bottleneck Reduction Program Belmont Street, Worcester

Figure VII-3 View of Evening Peak Hour Conditions at Bottleneck Location

Central Massachusetts Regional Planning Commission



Information depicted on this map is for planning purposes only. This information is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analysis. Use caution intrepreting positional accuracy.

Source: Data provided by the Central Massachusetts Regional Planning Commission (CMRPC) and the Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, InformationTechnology Division.

Produced by the Central Massachusetts Regional Planning Commission (CMRPC)
2 Washington Square, Union Station
Worcester, MA 01604

CMRPC Central Massachusetts Regional Planning Commission

Figure VII-4 Potential Suggested Improvement Options for Host Community Consideration

2. Route 122/Church Street Intersection (Plummer Corner) - Northbridge

Summary of Field Observations:

Travel Time & Delay Study (1)
The data for this study was collected on Route 122 from the Uxbridge town line to Sutton Street (Figure VII-5). Route 122 is a major north/south route in the Central Massachusetts region that stretches from Barre to Blackstone. Heading northbound, vehicle speeds are generally between 30 mph and 40 mph. Between the Uxbridge town line and Church Street, vehicle speeds occasionally are close to 50 mph. The heaviest delays are on the approach to the Church Street intersection. During a couple of the runs, the study vehicle had to stop at some point between Church Street and Benson Road, probably due to a turning vehicle. For the last half mile before Sutton Street, vehicle speeds drop 5 mph to 10 mph because of on-street parking and a narrower roadway width. Heading southbound, vehicle speeds and delays are very similar to the northbound direction. Again, speeds are slow near Sutton Street and delays still occur near the Church Street intersection.

In the PM, vehicle speeds and delays are similar to the AM, with just more delays. Heading northbound, there are delays on the approach to the Church Street intersection again. Between Church Street and Benson Road, vehicle speeds were as low as 20 mph for a couple of the runs during the data collection period. There was even one stop delay just before Benson Road, probably due to a turning vehicle. Heading southbound, vehicle speeds are slow again near Sutton Street and the Uxbridge town line. Delays are also still occurring at Church Street.

Travel Time & Delay Study (2)
The data for this study was collected on Church Street from the Upton town line to Cross Street. Church Street in the town of Northbridge is a local street that starts from the town center and continues all the way to Quaker Street, which travels into the town of Upton. It is a two-lane roadway and has a moderate amount of traffic. Heading eastbound in the AM, one of the runs had to stop multiple times between Cross Street and Route 122, possibly due to a school bus. Another run had to stop multiple times between Route 122 and Quaker Street, also possibly due to a school bus or general congestion. At the Quaker Street intersection, vehicles must stop at the stop sign before turning left or right. Vehicle speeds are at their highest between Quaker Street and the Upton town line. Traveling westbound, there are fewer delays compared to the eastbound. Vehicle speeds are still the highest from the Upton town line to Quaker Street. As vehicles make a right turn onto Church Street, from Quaker Street, speeds drop about 10 mph to 15 mph for about one tenth of a mile before speeding up again. This could be due to the tight turning radius at the Quaker Street/Church Street intersection. Vehicle delays are at their heaviest on the approach to the Route 122 intersection (Plummer Corner) for both directions.
In the PM, vehicle delays were at their heaviest heading westbound. Traveling eastbound, delays were present again around the Route 122 intersections, as well as, the first quarter mile pass Cross Street. Heading westbound, many of the vehicles are probably heading towards Route 146 at the western part of Northbridge. There are moderate delays approaching Route 122 and even heavier delays near Cross Street. Almost every single run had to stop numerous times before traveling past Cross Street. The last half mile of the focus segment, vehicle speeds were below 30 mph.

Critical Intersection Operations

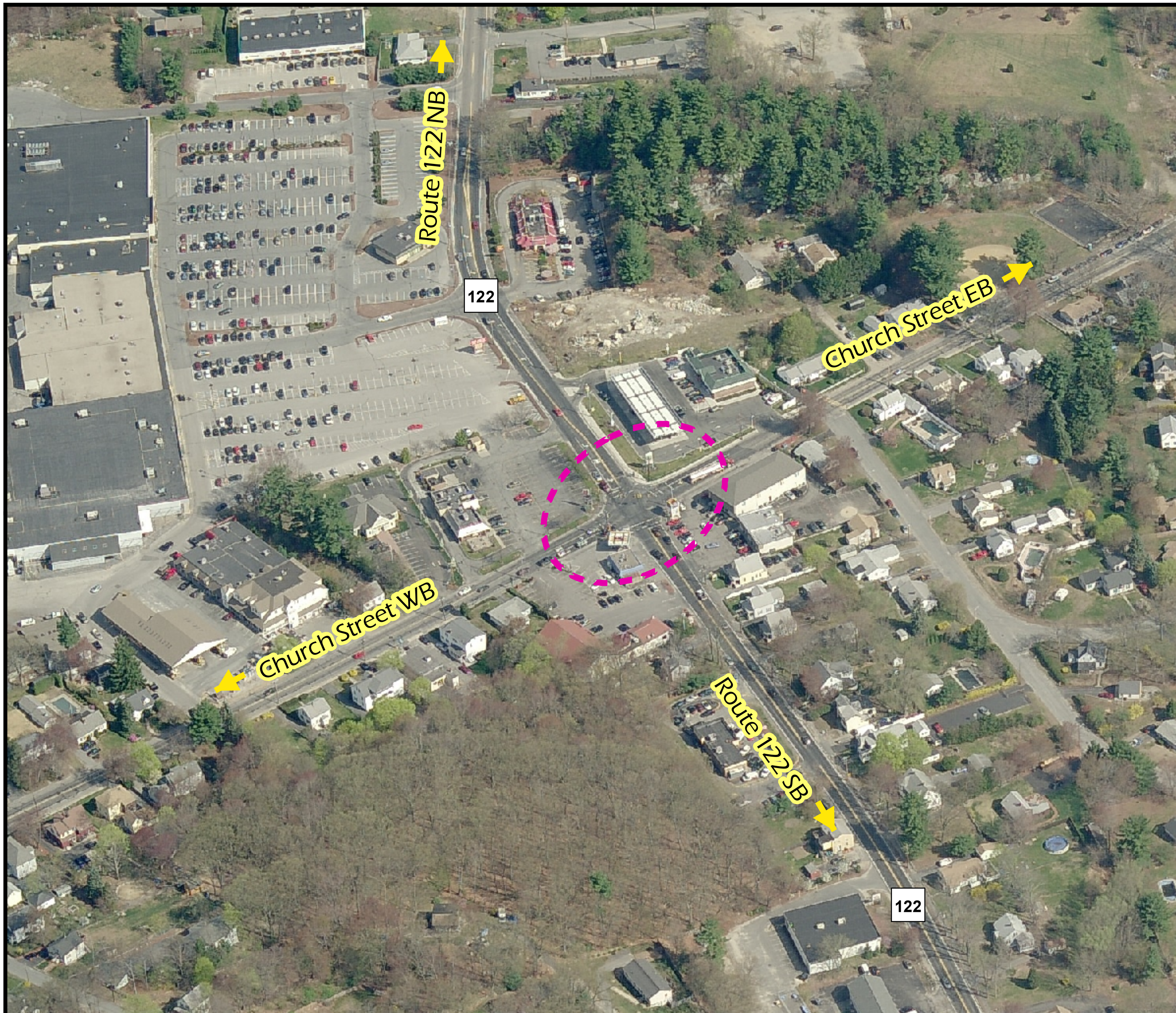
The intersection of Route 122 & Church Street (Plummer Corner) is a four-way signalized controlled intersection. A turning movement count was conducted at this location to determine the Level of Service (LOS). The count was conducted between 7 AM and 9 AM in the morning and between 4 PM and 6 PM in the afternoon. The peak-hour volume in the morning was 1,800 and the afternoon it was over 2,300. The highest volume percentages come from the east in the AM and the west in the PM. The truck percentages at this location were less than two percent in the AM and less than one percent in the PM. The overall LOS for this location was a “D” in the AM and an “E” for the PM. In the AM, the average intersection delay was 51 seconds. Route 122 northbound was the worst lane group with an average of over 100 seconds of delay. The other three approaches had between 10 and 15 seconds. In the PM, the average total intersection delay was over 60 seconds. With 500 more vehicles in the PM, delays were worse for all approaches. The westbound approach had the most delay with over 100 seconds.

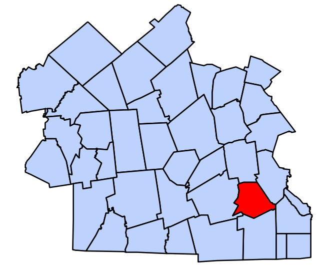
Potential Suggested Improvement Options for Host Community Consideration

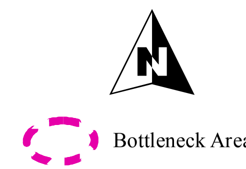
1) Work to improve operations of the existing signal
2) MassDOT Highway Division D-3 office recently implemented timing and phasing changes that appear to have improved conditions. Intersection monitoring effort is suggested.
3) Actuation needs to be reactive to fluctuations in flows.
4) Continue to be mindful of projected future traffic increases.
5) Improve regulatory lane use signs.
6) Continue to maintain pavement markings/traffic control signs, devices.
7) Continue to utilize access management techniques on each roadway approach to the intersection to limit the number of nearby curb cuts, especially those serving adjacent development on each of the four corners. Further, where applicable, consider left turn prohibitions.

Longer Term Improvement Concept

1) Consider additional intersection capacity through the installation of turn lanes where feasible. This would require land takings from adjacent development on each of the four corners.







Information depicted on this map is for planning purposes only. This information is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analysis. Use caution intrepreting positional accuracy.

Source: Data provided by Pictometry International Corp (c) Copywrite 2003

Produced by the Central Massachusetts Regional Planning Commission (CMRPC)
2 Washington Square, Union Station
Worcester, MA 01604

CMRPC
Central Massachusetts Regional Planning Commission

Figure VII-5 Bottleneck Reduction Program Route 122/Church Street (Plummer Corner), Northbridge

3. Route 9/Route 31 Intersections - Spencer

Summary of Field Observations:

Travel Time & Delay Study

The data for this study was collection for Route 9 from the Leicester town line to West Main Street (Figure VII-6). Route 9, through Spencer, is a two-lane roadway with a high volume of traffic. The downtown area, where Route 31 intersects with Route 9, is considered a bottleneck area. A “bottleneck” is a localized section of highway that experiences reduced speeds and inherent delays due to a recurring operational influence. Traffic becomes very congested through this segment, especially during the AM and PM peak periods. In the AM, vehicle speeds are generally between 35 mph and 45 mph for the entire segment, except for a few sections. Heading eastbound, there is much delay between West Main Street and the Route 31 intersections. For one of the runs, the data collection vehicle had to stop several times, possibly due to a school bus. For all of the runs traveling eastbound, there was stop delay approaching Route 31. Between Paxton Road and the Leicester town line, there were a couple of runs that had some delay and the rest of the runs the vehicle speeds were near 40 mph. Traveling westbound, most vehicles speeds are between 30 mph and 40 mph for the entire roadway. Similar to the eastbound direction, there was delay in the downtown area near Route 31. There are also slower speeds for a couple of the runs after the Paxton Road intersection, probably due to the school traffic from David Prouty High School.

In the PM, vehicle speeds are quite similar to the AM. Heading eastbound, there is less delay than in the AM, but vehicle speeds seem to be more variable throughout the entire roadway segment. Again, vehicle speeds slow down on the approach to Paxton Road, probably due to vehicles turning left onto Paxton Road. Traveling westbound, delays are at their heaviest near the downtown section, especially between both the Route 31 intersections. There are also a couple of runs that had some stop delay about a quarter mile after Paxton Road. Lastly, there was about a 15 mph drop in vehicle speeds just before West Main Street.

Critical Intersection Operations (1)

The intersection of Route 9 & Route 31 (Pleasant Street) is basically a three-way intersection with signalized control. There is a fourth approach, but it is a small parking lot with very little traffic entering or exiting. A turning movement count was completed at this intersection to determine its Level of Service (LOS). The count was conducted from 7 AM to 9 AM in the morning and between 4 PM and 6 PM in the afternoon. The total volume for the AM peak-hour was over 1,100 and near 1,700 vehicles in the PM peak-hour. There were minimal trucks traveling through this intersection with less than two percent in the AM and less than one percent in the PM. The overall average intersection delay was about 16 seconds in the AM and a little over 20 seconds in the PM. Route 9 carries the most vehicles through the intersection with about 80% of the total. The approach with the worst delay was Route 31 (Pleasant Street) and it had an average delay of 30 seconds in the AM and 40 seconds in the PM.

Critical Intersection Operations (2)

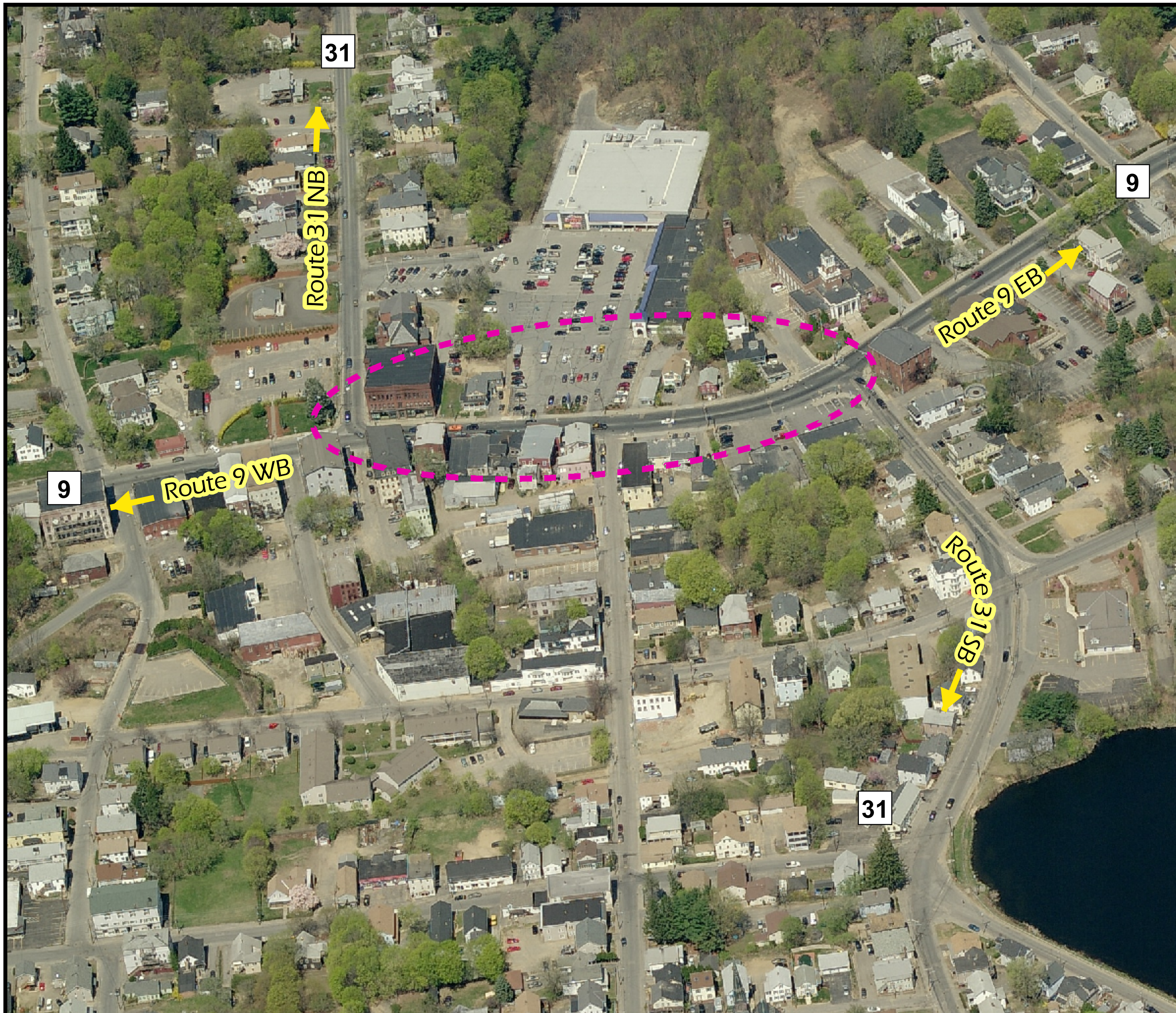
The intersection of Route 9 & Route 31 (Maple Street) is another three-way intersection with signalized control. There is also a fourth approach, but there was minimal vehicles entering or exiting the Spencer Town Hall parking lot. There was also a turning movement count conducted at this intersection during the same day and time as the previously mentioned intersection. The AM peak-hour volume for this intersection was about 1,200 and the PM peak-hour volume was above 1,600. The truck percentage at this intersection was over five percent in the AM and below three percent in the PM. The overall average intersection delay was 14 seconds in the AM and 16 seconds in the PM. Route 31 (Maple Street) was the worst approach lane at the intersection with over 20 seconds of delay for both the AM and PM.

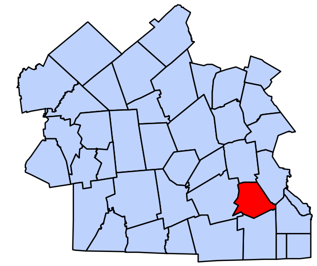
<u>Potential Suggested Improvement Options for Host Community Consideration</u>

1) Improved pavement markings, regulatory lane usage signs.
2) Optimize traffic signal operations at both Route 9/Route 31 locations; coordinate these signals to the extent possible to be reactive to fluctuations in flows, mindful of projected future traffic increases.
3) Consider improvements to vehicle detection using mast mounted equipment (as opposed to failure prone pavement loops).
4) Off-street parking alternatives in this area need to be emphasized to the benefit of local businesses. (Another option is peak period parking restrictions)
5) Recently completed Route 9 West Corridor Profile document prepared by CMRPC staff also includes a range of suggested improvement options for downtown Spencer.

<u>Longer Term Improvement Concept</u>

1) Based on previously completed consultant studies, consider implementation of “Downtown Spencer Bypass” concept. This idea helps minimize Route 31 through volumes on The Route 9 mainline. Route 31 North (Pleasant Street) at Route 9 would be made into a four-way intersection, with Route 31 continuing to Cherry Street (bypassing parallel Route 9), then joining Route 31 South (Maple Street) south of Route 9.





Bottleneck Area

Information depicted on this map is for planning purposes only. This information is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analysis. Use caution intrepreting positional accuracy.

Source: Data provided by Pictometry International Corp (c) Copywrite 2003

Produced by the Central Massachusetts Regional Planning Commission (CMRPC)
2 Washington Square, Union Station
Worcester, MA 01604

CMRPC Central Massachusetts Regional Planning Commission

Figure VII-6 Bottleneck Reduction Program Route 9/Route 31, Spencer

C.1.2 Reduction of Single Occupancy Vehicles

C.1.2.1 Rideshare Activities

MassRIDES is the Massachusetts Department of Transportation's free statewide travel options program. MassRIDES helps to reduce congestion and improve air quality across the Commonwealth by encouraging travelers to use options such as ridesharing, vanpooling, public transit, bicycling, and walking.

Programs and Services

- NuRide - The Massachusetts Department of Transportation (MassDOT) and MassRIDES have partnered with NuRide, the nation's largest commuter rewards program, to encourage healthier and more sustainable modes of travel while reducing traffic and emissions throughout the Commonwealth. The NuRide service is available free to anyone who lives or works in Massachusetts.

- Worksite Services - MassRIDES provides assistance to eligible Commonwealth employers who want to support their employees' use of alternative means of commuting. MassRIDES partners with over 400 organizations to help implement programs and services that save Massachusetts' commuters time and money, and help employers improve recruitment and retain employees.

- Emergency Ride Home - MassRIDES supports partner companies in providing transportation for employees in case of family or personal emergency. This service, which provides free taxi rides in case of emergency or unscheduled overtime to individuals who pre-register with MassRIDES and who regularly commute to work by means other than driving alone, is designed to provide transportation security when needed.

- Safe Routes to School Program –The Massachusetts Safe Routes to School program aims to create safe, convenient, and engaging opportunities for children to walk and bicycle to and from school, as part of the federally-funded nationwide SRTS program, and is administered by MassRIDES for the Massachusetts Department of Transportation.

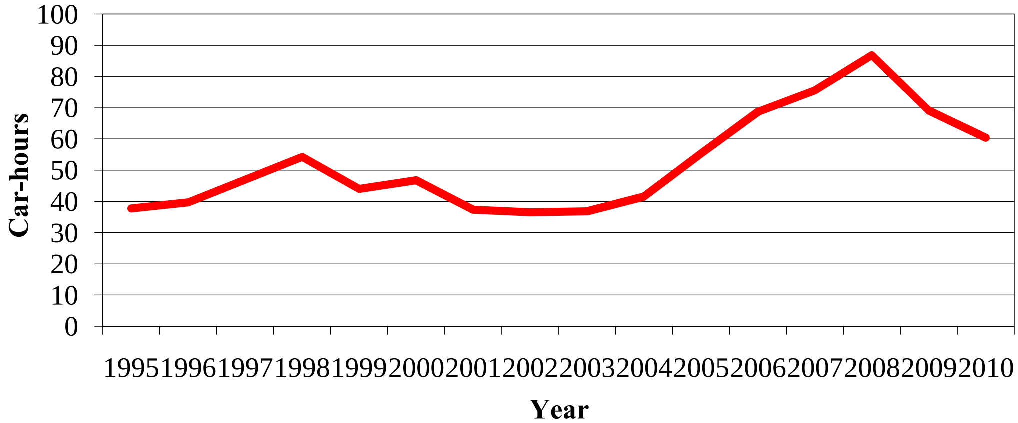
C.1.2.2 Park-and-Ride Lot Usage (Trends in Peak Hour Usage at the Berlin Park-and-Ride)

Usage at the MassDOT Park-and-Ride in Berlin has been summarized by counting and analyzing the number of vehicles that enter and exit the facility as well as the number that remain parked. Figure VII-7 shows the annual results using sample observation days over the past several years. The total usage shown in the charts is in car-hours, that is, the number of vehicles in the lot times the amount of time they remain there. These values are for the busier AM and PM peak travel periods when, presumably, most of the activity in addition or subtraction of parked vehicles occurs.

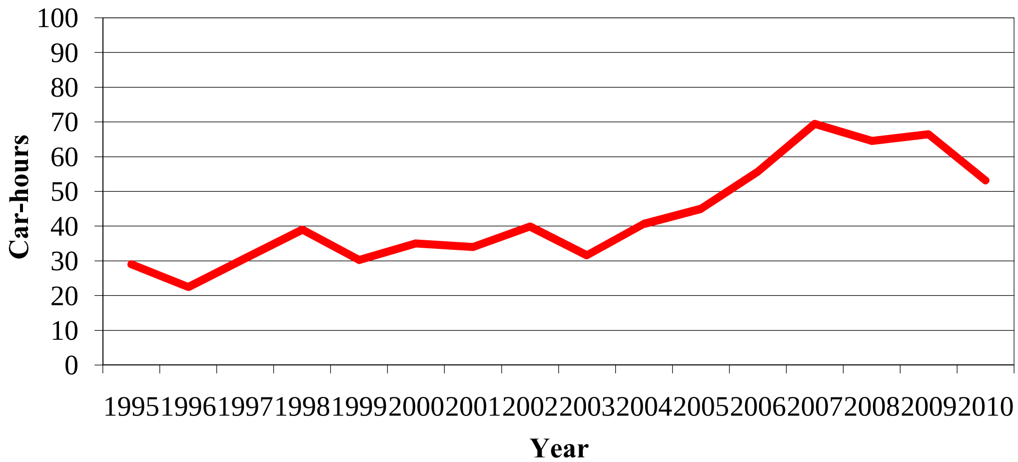
Trends have been about even by this measure in early study years; however there have been significant increases in peak period usage in the last five years. The notable uptick observed in the year 2005 continued for several years, during periods of both level and increasing fuel prices. We do note that the 2009 observation includes a dip in AM utilization and that usage in both AM and PM showed declines

Figure VII-7
Observed Usage at
MassDOT Maintained Park-and-Ride Lot
Town of Berlin, Route 62 @ I-495

Morning Peak Period (6:00-8:30)



Evening Peak Period (3:30-6:00)



LOT CAPACITY: 45 marked spaces

in 2010 as well. This is likely a continuing temporary aberration due to the state of the economy and the relative stability of fuel prices. The lot has approached maximum usage in recent years and this situation is likely to reoccur. We should consider whether there are available and appropriate additional parcels of land that could be used in a similar manner.

We note also that many of the trips to the lot and much of its usage are for the transfer of passengers. Many vehicles rendezvous and exchange riders that do not stay in the lot for any appreciable period of time. By its nature, that type of activity would not be counted in the car-hour measurement figures. However, it appears that this type of activity is still one to be worthy of support, as it is apparent that an increase in the utility of commuting vehicles is being attained.

C.1.2.3 Travel Demand Management

New Federal and State priorities aim at renewable energy generation and air quality improvement through greenhouse gas reductions and improved livability through promotion of alternative transportation modes. Feedback received by CMMPO staff during outreach for the RTP echoed much of that sentiment. Additionally, an increase in alternative transportation mode shares would provide congestion relief to regional roadways.

The CMMPO has taken a position that it will attempt to dedicate a set amount or percent of CMMPO's annual TIP target funds to a systematic program aimed at promoting changes in transportation demand by boosting use of alternative modes. Eligible projects would be those that improve mobility for people and freight, reduce congestion, and improve air quality through travel demand management.

Funding may come from Congestion Mitigation and Air Quality (CMAQ) funds, or the MPO may dedicate the percentage from the entire TIP target using other funding categories. Based on ongoing high system maintenance needs, the amount will initially be modest, such as $500,000 to start, and adjusted in future years based on response and success of program.

C.2 Public Transportation

The Regional Transportation Plan envisions a public transportation system that is safe, maintained in a state of good repair and expanded to areas that are not served under existing conditions. In addition, the vision for transit calls for more use in order to reduce automobile dependency and emissions causing climate change. Addressing the needs and problems identified below will promote the realization of the vision:

C.2.1 WRTA

C.2.1.1 Operating Funds and System Preservation

The most pressing need that the WRTA currently faces is providing funding for maintaining and expanding operations of the existing bus and paratransit system. Since 2004, the WRTA has cut a total of 10 routes from its system due to lack of funding from State Contract Assistance for operations and forcing the WRTA to cut night-time and weekend services to bare minimum levels. By acquiring additional operating dollars, the existing system will be preserved and potentially expanded to meet demand (see *Projected Growth*). In addition, improved coordination between local land use planning and transit planning would create expanded partnerships and convey more comprehensive planning.

C.2.1.2 Capital Asset Modernization and New Construction

Since 2008, the WRTA has upgraded almost half of its 47 bus fixed-route fleet with 23 new fixed route buses (four of which are hybrid buses) and its 50 van demand response fleet with 37 new demand response vans. The average age of the WRTA fixed-route fleet is 7.69 years. While FTA recommends an average age of 6.0 years, the WRTA is currently looking to continue its fleet upgrade. In 2012, the WRTA is expected to add an additional eight fixed-route buses (three of which are hybrid) to the fleet bringing the total of new buses to 31.

The WRTA is also in the process of building a new Maintenance and Operations facility to replace its current Maintenance and Operations facility built in 1933. The current facility was originally constructed as a trolley barn and retrofitted for transit bus operations in the mid-1940s. Over the years, significant environmental concerns have been identified at the current site and the WRTA has obtained federal funding to construct a new facility closer to Union Station in Worcester.

In addition to the Maintenance and Operations facility, the WRTA will also be constructing a new bus hub at Union Station to provide improved intermodal connections to MBTA commuter rail, Amtrak, Peter Pan/Greyhound buses, taxi service and its demand response fleet. This new “hub” will replace the existing one at City Hall, however City Hall will continue to be served as a major stop.

Further examples of capital asset modernization include, but are not limited to:
- Upgrading of some bus stops in Worcester to be made more accessible
- Installation of Transit Signal Priority (TSP) technology inside traffic signals on certain roadways for improved transit service operations in the Worcester area
- Replacement of the remaining 16 fixed-route buses after the 2012 buses are delivered and ongoing replacement of demand response vans
- Working with the City of Worcester and MassDOT to create improved access to bus stops, including sidewalk construction and crosswalk installation
- Creating “mini-hub” facilities in suburban communities to house transit vehicles and create passenger transfer centers between suburban routes
- Installation of Intelligent Transportation Systems (ITS) technology to improve efficiency and ease of passenger use

C.2.1.3 Mobility

Achieving and maintaining a state of good repair for the WRTA system is critical to mobility, as it will ensure that vehicles, infrastructure and access are available when and where they are needed to provide safe and reliable service that meets demand. Also of critical importance to transit mobility are alleviating system constraints, filling gaps in the existing system and expanding the system to meet growth in future demand.

C.2.1.4 Service Reliability/On-Time Performance

Reliability and on-time performance is a function of several factors including traffic congestion, fleet size, conditions of vehicles and physical infrastructure. In May 2011, current WRTA service had an on-time performance level of 85.5%, while the WRTA's *Service Standards for Fixed Route Operations* has identified a goal of 95% for on-time performance. Primary causes for this performance level cited were traffic congestion and equipment breakdowns due to aging rolling stock.

C.2.1.5 Infrastructure Constraints

A number of infrastructure constraints place limits on transit service operations and expansion including, but not limited to:

- Old traffic control devices on major arterials
- Crumbling pavement on heavily traveled roadways with transit service
- Missing or damaged shelters
- "Complete streets" and transit accommodations on bridges, corridor arterial roadways and

C.2.1.6 Gaps in Service

Although WRTA service covers a 35 community area over 960 square miles fixed route service remains limited. Some geographic areas and times of day could benefit from expanded or added service:

- In Worcester, service for third-shift workers, particularly at the area hospitals, distribution centers and 24-hour Wal-Mart stores, is non-existent
- For multi-community trips, connections to other RTAs and at suburban MBTA commuter rail stations are non-existent and would increase intermodality in the region
- In the towns of Southbridge and Webster, initial analyses have shown high potential for transit use between these two communities. Similarly, connections to transit service in Northeastern Connecticut also shows strong potential ridership increases.
- New transit routes/service in eastern towns of the WRTA service area, particularly Shrewsbury, Northborough and Westborough
- Fifteen minute frequency systemwide
- Weekend service improved and expanded back to pre-2004 levels
- Improved and expanded transit service outside of Worcester
- Improved connections and service to area colleges
- Improved connections and service to area employers
- "Shuttle"-type service between area hotels and local restaurants on Highland and Shrewsbury Streets in Worcester

C.2.1.7 Projected Growth

Ridership since 2007 has grown at least 2.5 percent annually (13% overall) and the WRTA has re-aligned some bus routes to provide service where other routes have been cut. With increases in ridership, a downed economy and two major increases in gasoline prices in three years, the WRTA is poised to add service where needed to meet demand, if operating resources can be identified.

C.2.2 Regional Passenger Rail

C.2.2.1 Operating Funds and System Preservation

Like the WRTA, the most pressing need that the regional passenger rail services currently face is also providing funding for maintaining operations of the MBTA commuter rail and Amtrak systems.

For the MBTA, their funding comes directly from sales tax revenues, however their debt service is in the multi-billion dollar range. Since MBTA commuter rail service came to Worcester in 1994, the number of runs has expanded and is currently at 13 inbound and 12 outbound trips. Maintaining this minimum number of runs is crucial or regional economic development and linking Boston and Worcester.

For Amtrak, funding comes from federal allocations set at the Congressional level. While under numerous threats to be defunded, Amtrak's Northeast corridor services are its most used providing both regional and long-distance service from Maine to Washington DC/Virginia.

C.2.2.2 Capital Asset Modernization and New Construction

The MBTA produces an Annual Capital Investment Plan (CIP) that identifies which capital assets it plans to upgrade and/or replace over a five year period. The current CIP is produced for Fiscal Years 2012-2016 and has identified the following commuter rail capital asset upgrades:

- **Commuter Rail Locomotives Midlife Overhaul:**
  - **F40PH-2C Midlife Overhaul (25) -** This effort funded a standard midlife overhaul for 25 F40PH-2C locomotives. The overhaul, which was completed in 2003, reconditioned the fleet for passenger safety and efficiency.
  - **F40PHM-2C Midlife Overhaul (12) -** This effort funded a standard midlife overhaul of 12 F40PH-2M locomotives. The overhaul, which was completed in 2004, reconditioned the fleet for passenger safety and efficiency.
- **Commuter Rail Locomotives Top-Deck Overhaul:**
  - **F40PH-2 Locomotives (18) -** This project funded a top-deck overhaul program for 18 F40PH-2 locomotives. The program, which was completed in 2004, reconditioned these vehicles for passenger safety and efficiency.
  - **GP40-MC Locomotives (25) -** This effort funds the overhaul of 25 GP40-MC locomotives. Work consists of replacing rotating equipment such as power assemblies, turbochargers, camshafts, fuel injectors, pump compressors and fans. The completion of this overhaul will improve the service reliability of these units, help maintain on-time performance standards, and increase operating efficiency by reducing the number of failures.
- **Coach Reliability and Safety Program (CRASP) -** This project funds the overhaul of key components of the coach fleet. To be included in this overhaul program are important safety components such as trucks, brakes, couplers, and draft gears, in addition to others such as air conditioning systems and toilets. The program encompasses approximately 270 coaches of the coach fleet.
- **Locomotive Procurement (28) -** This project funds the procurement of 28 locomotives, which will replace portions of the existing fleet while reducing emissions.

- **Coach Procurement (75) -** This project funds the procurement of 75 bi-level coaches. This project will allow the Authority to retire a portion of the coach fleet while increasing commuter rail passenger capacity.
- **CTC, BTC-4 Kawasaki Coach Overhaul (75) -** This project funds the full midlife overhaul of 75 bi-level Kawasaki coaches acquired in 1990-91. The overhaul work includes replacing and reconditioning trucks, couplers, HVAC system, electrical system, batteries and battery chargers, some interior fixtures and safety-emergency equipment.

In addition to MBTA equipment upgrades, improvements will also be made to the Framingham/ Worcester Line's track and right-of-way as part of the CSX freight rail yard expansion and the MBTA is working with the WRTA to create a compatible fare collection system that can be used between WRTA buses and MBTA commuter rail.

For Amtrak, the agency has produced the *Northeast Corridor Infrastructure Master Plan* (May 2010) which outlines capital improvements for the corridor including track, bridges, right-of-way, signals, rolling stock and stations. The projects outlined below will provide improved multimodal connections to other area:

- **Boston Terminal Storage and Capacity Improvements –** South Station and Southampton Yard are at capacity. Additional terminal capacity will be needed to accommodate 2030 service levels and equipment needs. These plans include initiating MBTA South Coast commuter service to Fall River and New Bedford and adding intercity trains to the "Inland Route" between Boston South Station and Springfield. Short-term plans call for adding up to six station tracks at South Station, undertaking a full Environmental Impact Statement (EIS) for the proposed North-South Rail Link and initiating a terminal capacity Study similar to those currently underway in New York and Washington. Projects in this program include:
    - Boston South Station – Track Capacity Improvements
    - Grand Junction Connection – Purchase
    - Boston – New Layover Yard Facility (Location TBD)
    - North-South Rail Link – Environmental Impact Statement
- **Station Improvements –** Station improvements are designed to bring facilities to a state of good repair and meet accessibility requirements under the Americans with Disabilities Act (ADA). While this program includes 10 projects between Boston and Westerly, Rhode Island, for the purposes of this report, only the projects in Massachusetts are listed below:
    - Boston South Station – ADA/SGR Improvements
    - Boston Back Bay Station – ADA/SGR Improvements
    - Route 128/Westwood Station - ADA/SGR Improvements
- **Positive Train Control –** Project includes installation of ACSES wayside transponders incorporating positive stop and civil speed control in areas of the corridor where ACSES is not currently installed (operating speeds greater than 150 mph) as mandated by the Federal Rail Safety Improvement Act of 2008 between Boston and Washington.
- **High Speed Rail Improvements/Other Corridor Wide –** Amtrak, the 11 states (Maine to Virginia) and commuter agencies have identified improvements necessary for 15-miniute trip time reductions between Boston and New York by 2015; and 30-minute reductions by 2028 after completion of State of Good Repair (SGR). Additional improvements above 30 minutes are also being explored. While this program includes a number of projects between Boston and

Washington, for the purposes of this report, only the projects with direct effects to Massachusetts are listed below:

- Long Term Power Consumption and Supply Study
- Protection of Freight Routes
- Major Terminal S&I Facility Improvements
- Storage Track and Facility Improvements
- Boston to New York – Bridge Rehabilitation Program
- Boston to New York – Facility Improvement Program
- Boston to New York – Right of Way Fencing above 150 MPH

C.2.2.3 Mobility

Achieving and maintaining a state of good repair for the regional rail system is critical to mobility as it will ensure that rolling stock, infrastructure and access are available when and where they are needed to provide safe and reliable service that meets demand. Also of critical importance to regional rail mobility are alleviating system constraints, filling gaps in the existing system and expanding the system to meet growth in future demand.

C.2.2.4Service Reliability/On-Time Performance

Reliability and on-time performance is a function of several factors including traffic congestion, fleet size, conditions of vehicles and physical infrastructure. In February 2011, MBTA Worcester Line commuter rail service had an on-time performance level of 74%, far below the MBTA's goal of 95% of trains being on-time. Primary causes for this performance level cited were severe winter weather and locomotive/equipment breakdowns due to aging rolling stock. Amtrak's *Lake Shore Limited* had an on-time performance level of 66% in May 2011. Primary causes for this performance level were due to its long route (Chicago to Boston), interference with various freight railroad trains, track and signals and passenger delays.

C.2.2.5 Infrastructure Constraints

A number of infrastructure constraints place limits on regional rail service operations and expansion including, but limited to:

- Old power supply substations
- Old signals/control devices
- Track, bridges, switches/interlockings, overhead wires and bridge/tunnel structures
- Non-ADA compliant areas at stations and terminals
- Outdated and/or deteriorating rolling stock and locomotives

C.2.2.6 Gaps in Service

Although the MBTA commuter rail service area covers 175 communities, some geographic areas and times of day could benefit from expanded or added service:

- In Worcester, expanded mid-day, night and weekend service to and from Boston would benefit reverse commuters, regional transit riders and recreation riders

- For multi-community trips, connections to other RTAs at suburban MBTA commuter rail stations are non-existent and would increase intermodality in the region
- Increased frequency of commuter rail service from Worcester to Boston with 20 trains per day
- Extension of commuter rail service from Worcester to Springfield
- Use of the Grand Junction branch for some Worcester commuter rail trains to access North Station
- Improved on-time performance
- Purchasing of newer and more reliable rolling stock and locomotives
- Station and parking lot security
- Station parking lot capacity

For Amtrak, some geographic areas and times of day could benefit from expanded or added service:
- Restoration of direct service to New York via the "Inland Route"
- For multi-community trips, connections to RTAs at Amtrak stations that are either non-existent or minimal would increase intermodality in the region and state

C.2.3 Regional Passenger Bus

C.2.3.1 Operating Funds and System Preservation

Like other public transportation, the most pressing need that the regional bus services currently face is also providing funding for maintaining operations. The region's two largest carriers are Peter Pan Bus Lines and Greyhound Bus Lines. Since 1999, both companies have partnered to create "pool service" which allows the companies to coordinate frequent departures, provide more non-stop service and set ticket prices more competitively. Funding for these services comes primarily from fare revenue and other fees, with some government subsidies. By acquiring additional operating dollars, whether public or private, both Peter Pan and Greyhound will be preserved and potentially expanded to meet demand.

C.2.3.2 Capital Asset Modernization and New Construction

Both Peter Pan and Greyhound's primary capital assets are their bus fleets. Since 2009, both Peter Pan and Greyhound have purchased new buses and developed new exterior paint schemes that show a streamlined and more modern fleet. In addition, these new buses also offer the latest in on-board, high-tech equipment that provides WiFi, electrical plug-ins and tray tables to keep up with customer needs and wants to stay connected when traveling, as well as on-board GPS and on-board ticket scanners for drivers.

Since both Peter Pan and Greyhound operate from Union Station, there are no current plans for expansion or construction of any new fixed-facilities in the near future.

C.2.3.3 Mobility

Achieving and maintaining a state of good repair for the regional bus system is critical to mobility as it will ensure that rolling stock, infrastructure and access are available when and where they are needed to provide safe and reliable service that meets demand. Also of critical importance to regional bus mobility are alleviating system constraints, filling gaps in the existing system and expanding the system to meet growth in future demand.

C.2.3.4 Gaps in Service

Although the Peter Pan and Greyhound service provide services to multiple cities nationwide, some geographic areas and times of day could benefit from expanded or added service in the region, such as:

- Increased service from Worcester to Providence
- Creating new alliances for increased bus service or new bus service to rural areas and other regional and national destinations

C.3 Bicycle and Pedestrian

The *Regional Transportation Plan* calls for linking bicycle and pedestrian in a network; increasing the use of sustainable modes and improving transportation options and accessibility for all modes as outlined the CMMPO's *2011 Regional Bicycle and Pedestrian Plan*. The needs include the following:

- Gaps in the bicycle network limit many users from safely connecting to their destinations, including bus stops, schools, recreation and commercial areas
- Lack of sidewalks in many suburban neighborhoods
- Poor condition of existing sidewalks in older neighborhoods that are impassable
- Lack of bicycle accommodations are key locations, such as bicycle racks, lockers or other amenities.
- Poor bicycle and pedestrian access to suburban commuter rail station (Grafton and Westborough)
- Of the MassDOT's Bay State Greenway corridors that travel through the region, limited portions of the Mass Central Rail Trail and Blackstone River Greenway have been constructed

Projects that will assist in remedying bicycle and pedestrian infrastructure needs:

- Completion of the Blackstone River Greenway from Worcester to the Rhode Island state line
- Completion of the Mass Central Rail Trail from West Boylston to Hardwick
- Completion of the various trails that make up the Titanic Rail Trail from Blackstone to Sturbridge
- Incorporation of improved sidewalks and/or bicycle infrastructure along roadways that are WRTA fixed-route bus corridors
- On-road bicycle connections along major corridor roadways is in Worcester to link off-road trails

C.4 Bridge Management System

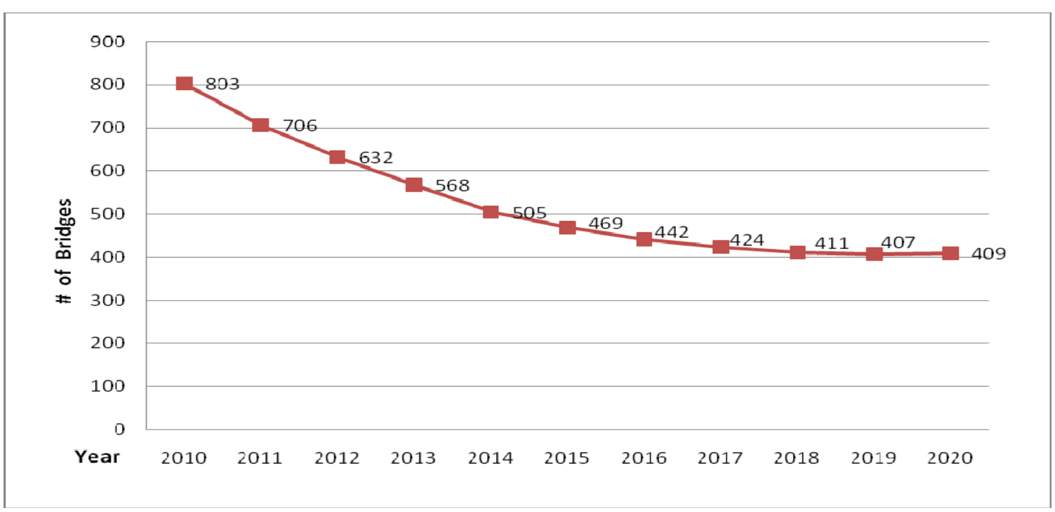
There are over 5,000 bridges in the Commonwealth, with approximately 3,500 owned by MassDOT and just over 1,500 under other agency or municipal jurisdiction. The Highway Division is the federally designated lead for bridges in the Commonwealth, responsible for achieving compliance with the National Bridge Inspection Standards (NBIS) and for ensuring the safe condition of all motor vehicle bridge, regardless of jurisdiction. The average age of all Highway Division bridges is 43 years, which means they are steadily nearing the end of their useful life. MassDOT will require greater investment just to maintain bridge condition, and significantly more investment will be needed to improve bridge conditions.

A bridge is rated as structurally deficient when the combination of its major components (Deck, substructure and superstructure) have measurably deteriorated to the point at which action is needed or when any individual component is rated at four or below on the nine-point scale (4=poor, 3=serious, 2=critical, 1=imminent failure, and zero=failed). These bridges are then prioritized for repair based upon the seriousness of the structural problems, the structure's regional and local importance, geographic equity and cost and budgetary considerations. In addition to repairing structurally deficient bridges, MassDOT also strives to appropriately maintain and preserve other bridges so that they do not fall into structural deficiency. When a bridge becomes structurally deficient, it is considered to have reached the end of its useful life and requires either a major rehabilitation or a full replacement.

By slowing the progression of bridges from the "fair" category to structural deficiency, substantial financial resources can be saved over the course of MassDOT's typical 20-year long-year planning horizon. Preservation projects generally add 20 years to the effective life span of a bridge. The Accelerated Bridge Program (ABP) has significantly reduced the number of structurally deficient bridges; however due to the continued aging of the bridge infrastructure, the relative number of structurally deficient bridges will not decrease over time without the allocation of additional funding for the Statewide (Non-ABP) bridge program.

MassDOT has set a goal to reduce the number of "fair" rated bridges to just over 400 (or 11 percent of all bridges) within ten years. The key to attaining this goal is to schedule preservation activities at the same rate at which bridges are expected to deteriorate into the fair category. This will have the effect of keeping Massachusetts bridges that are not already structurally deficient in the satisfactory and good categories. This level of effort will require funding of $155 million per year and will result in the trend depicted in Figure VII-8 below.

Figure VII-8
Forecasted Decrease in "Fair" Rated Bridges



Preservation spending does not, however, address repairs and rehabilitation of the close to 500 bridges that would remain structurally deficient. Consequently, any funding strategy must include substantial spending on fixing structurally deficient bridges. MassDOT's goal is to reduce the number of structurally deficient bridges to zero within 20 years. The funding required to achieve this goal is $150

million per year, in addition to the bridge preservation funding described above. Figure VII-9 below shows the results of this level of spending through 2020. As shown in the Table VII-2 below, this results in an overall five-year funding need of $305 million for bridges in the Commonwealth.

Figure VII-9
Forecasted Decrease in "Structurally Deficient" Rated Bridges

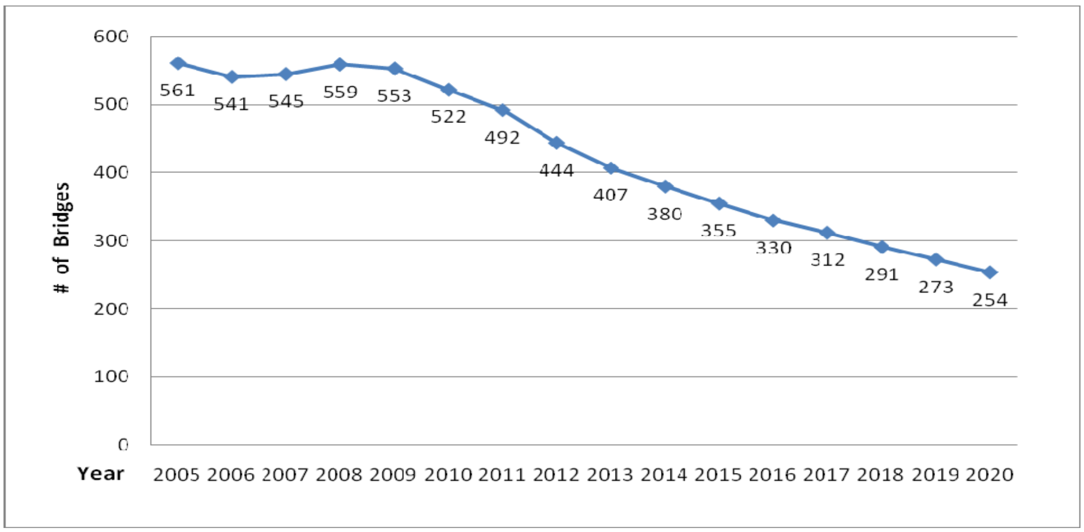


Table VII-2
Summary of Bridge Replacement/Rehabilitation and Preservation Needs

	Replacement/Rehabilitation	Preservation	Total Annual Need
Targeted Bridge Need	$150,000,000	$155,000,000	$305,000,000

C.5 Freight Planning

> *Transportation expenses represent a sizable portion of the cost of both raw materials and finished products. Accordingly, one major purpose of efforts to streamline regional freight flows is to reduce overall costs for local businesses and consumers alike.*

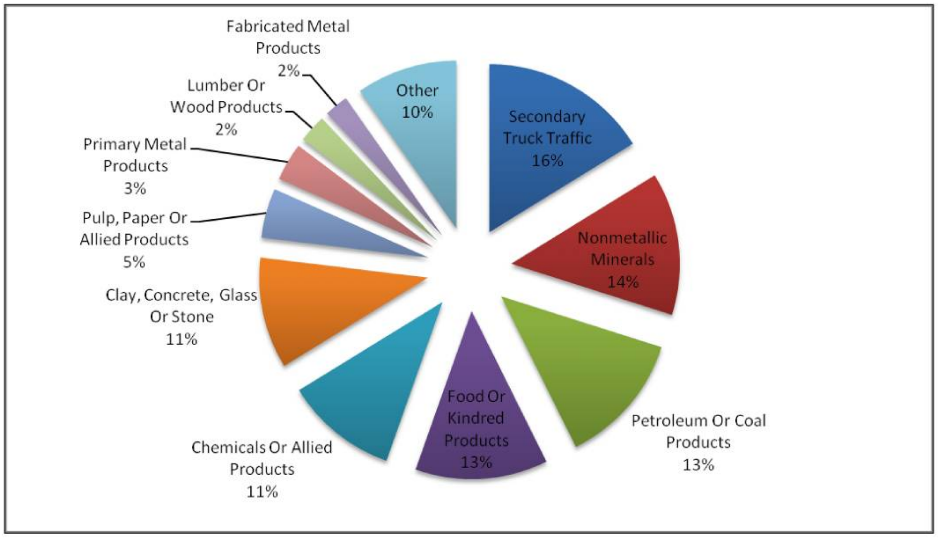
C.5.1 Greater Area Freight Flows

The recently-completed MassDOT Freight Plan revealed a great deal of current information with respect to freight flows in the Commonwealth. Much of the pertinent summarized fact is displayed in the charts and graphics in Figures VII-10 through VII-23. The many commodities which flow in and out of Massachusetts are displayed by mode of transit and my import/export status. Visuals that show a split of freight by region of origin and destination show that the Central Massachusetts area is second only to the greater Boston region with regard to shipping activity. Additionally, splits by mode of travel by region show that rail is a relatively large and growing share of the freight transport activity occurring locally, while, certainly, truck transport continues to capture the greatest share of all.

These facts and figures point out the need to keep vital road conditions maintained, and to persistently address congestion and bottlenecks, so that the lifeline of the region's supply chain, individual trucking, is not hobbled. Ideally, trucking concerns will share the responsibility to build an efficient future by working together with planners to describe and derive best routes and methods for their transport activities.

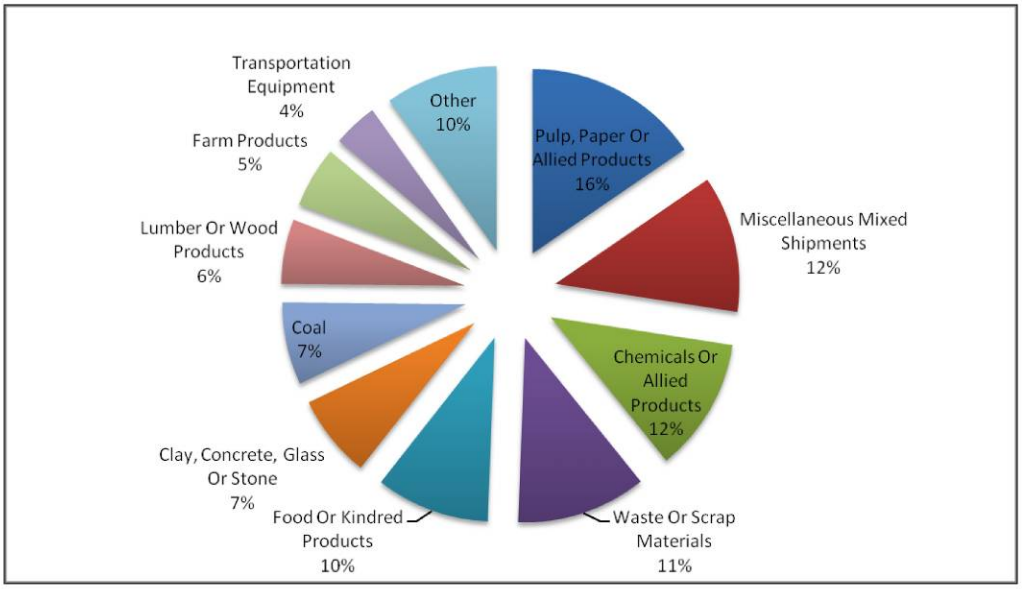
With freight rail becoming an increasingly important and more feasible, environmentally-friendly way of moving goods, the need to preserve and enhance rail links and potential intermodal interface areas is seen as an important part of building an improved, modern system of transportation for goods as well as for the commuters who consume them.

Figure VII-10
Top Ten Truck Movements by Commodity in Millions of Tons, 2007



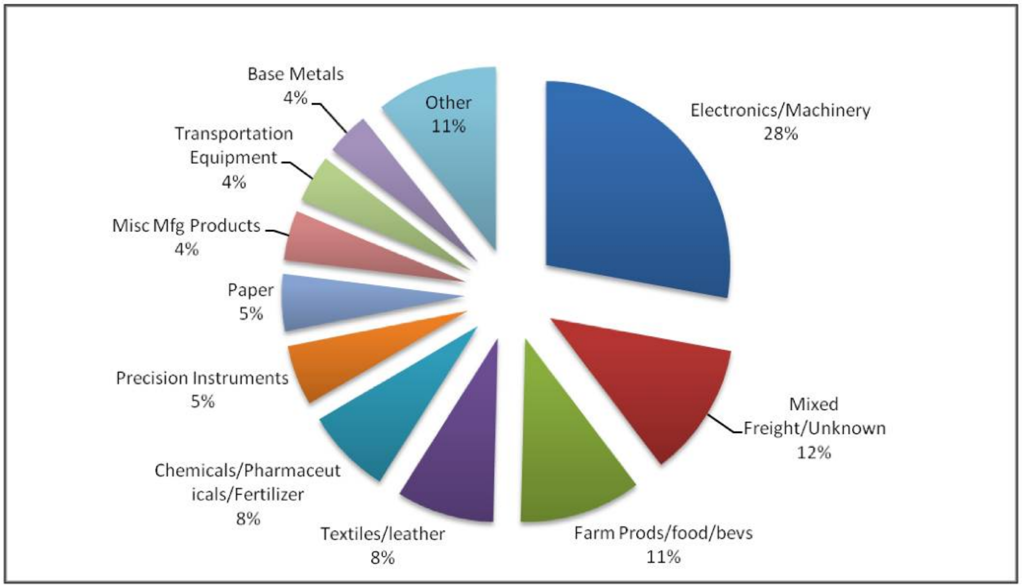
Commodity	Truck Tons	% Share
Secondary Truck Traffic	38.8	16.2%
Nonmetallic Minerals	32.8	13.7%
Petroleum Or Coal Products	30.6	12.8%
Food Or Kindred Products	30.5	12.7%
Chemicals Or Allied Products	25.9	10.8%
Clay, Concrete, Glass Or Stone	25.6	10.7%
Pulp, Paper Or Allied Products	11.4	4.8%
Primary Metal Products	8.7	3.6%
Lumber Or Wood Products	6.4	2.7%
Fabricated Metal Products	5.5	2.3%
Other	23.3	9.7%
TOTAL TONS	239.5	100.0%

Figure VII-11
Top Ten Rail Movements by Commodity in Thousands of Tons, 2007



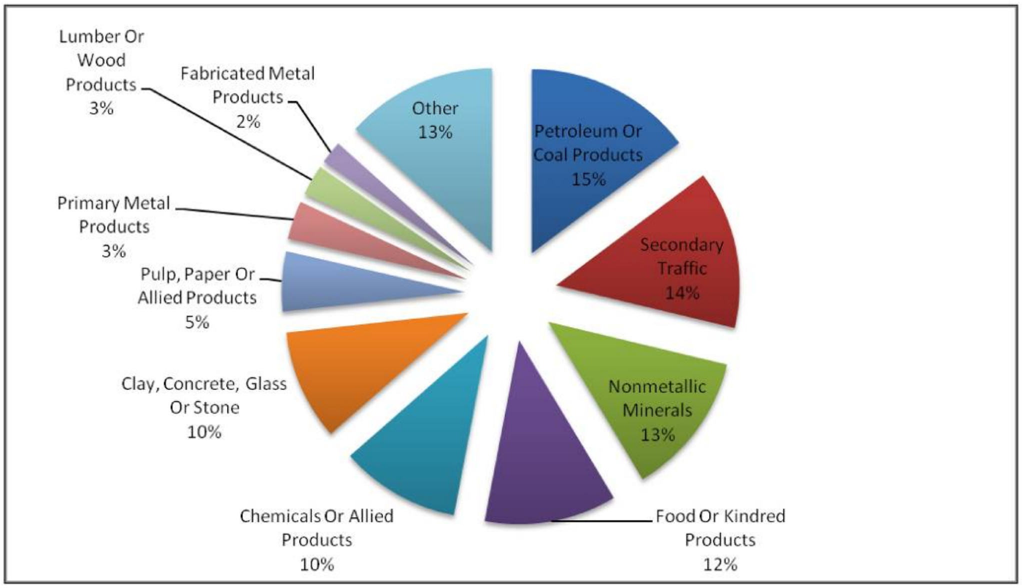
Commodity	Rail Tons	% Share
Pulp, Paper Or Allied Products	2,773	15.5%
Miscellaneous Mixed Shipments	2,148	12.0%
Chemicals Or Allied Products	2,108	11.7%
Waste Or Scrap Materials	2,049	11.4%
Food Or Kindred Products	1,800	10.0%
Clay, Concrete, Glass Or Stone	1,307	7.3%
Coal	1,301	7.3%
Lumber Or Wood Products	1,017	5.7%
Farm Products	958	5.3%
Transportation Equipment	705	3.9%
Other	1,776	9.9%
TOTAL TONS	17,942	100.0%

Figure VII-12
Top Ten Massachusetts Commodities by value in Millions of Dollars, 2007



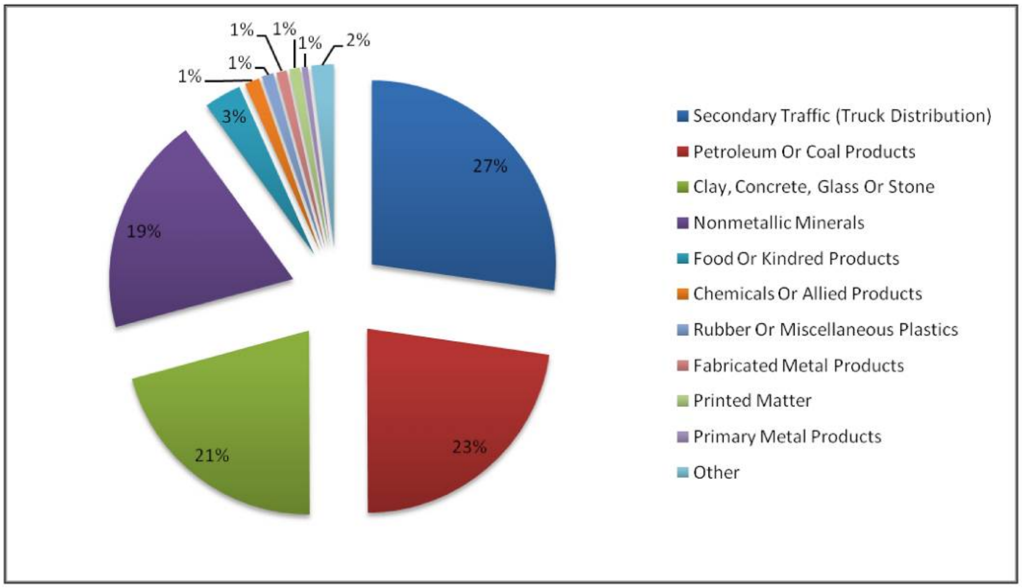
Commodity	Value	% Share
Electronics/Machinery	107,498	27.8%
Mixed Freight/Unknown	45,678	11.8%
Farm Prods/food/bevs	41,351	10.7%
Textiles/leather	33,135	8.6%
Chemicals/Pharmaceuticals/Fertilizer	29,298	7.6%
Precision Instruments	20,532	5.3%
Paper	19,439	5.0%
Misc Mfg Products	16,931	4.4%
Transportation Equipment	16,090	4.2%
Base Metals	14,717	3.8%
Other	41,323	10.7%
TOTAL VALUE	385,992	100.0%

Figure VII-13
Top Ten Massachusetts Commodities for All Modes in Millions of Tons, 2007



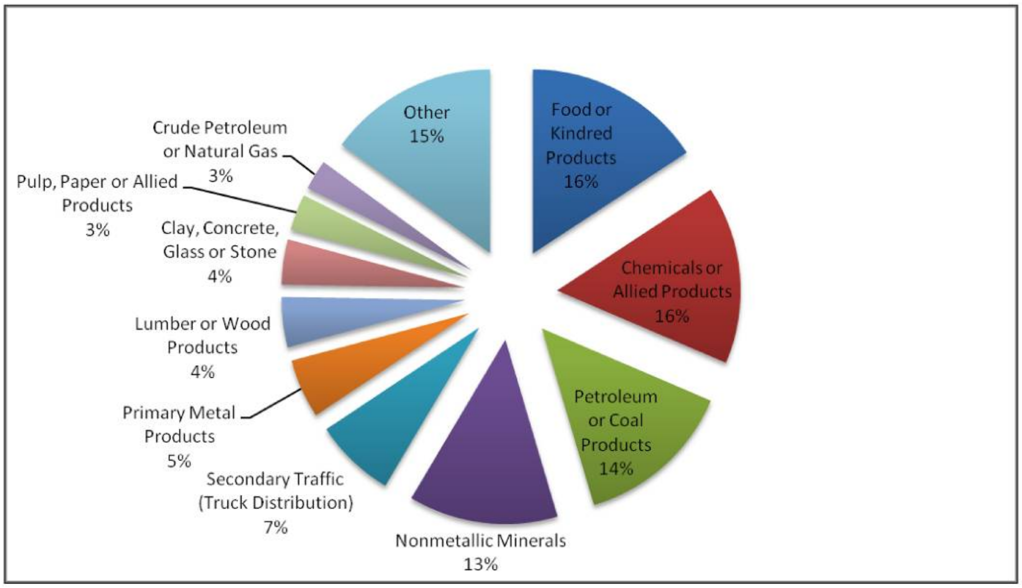
Commodity	Total Tons	% Share
Petroleum Or Coal Products	41.1	14.8%
Secondary Traffic	38.8	14.0%
Nonmetallic Minerals	35.2	12.7%
Food Or Kindred Products	32.3	11.6%
Chemicals Or Allied Products	29.3	10.5%
Clay, Concrete, Glass Or Stone	27.1	9.7%
Pulp, Paper Or Allied Products	14.7	5.3%
Primary Metal Products	9.4	3.4%
Lumber Or Wood Products	7.5	2.7%
Fabricated Metal Products	5.6	2.0%
Other	37.1	13.3%
TOTAL TONS	278.1	100.0%

Figure VII-14
Top Ten Commodities Internal to Massachusetts for All Modes (Millions of Tons), 2007



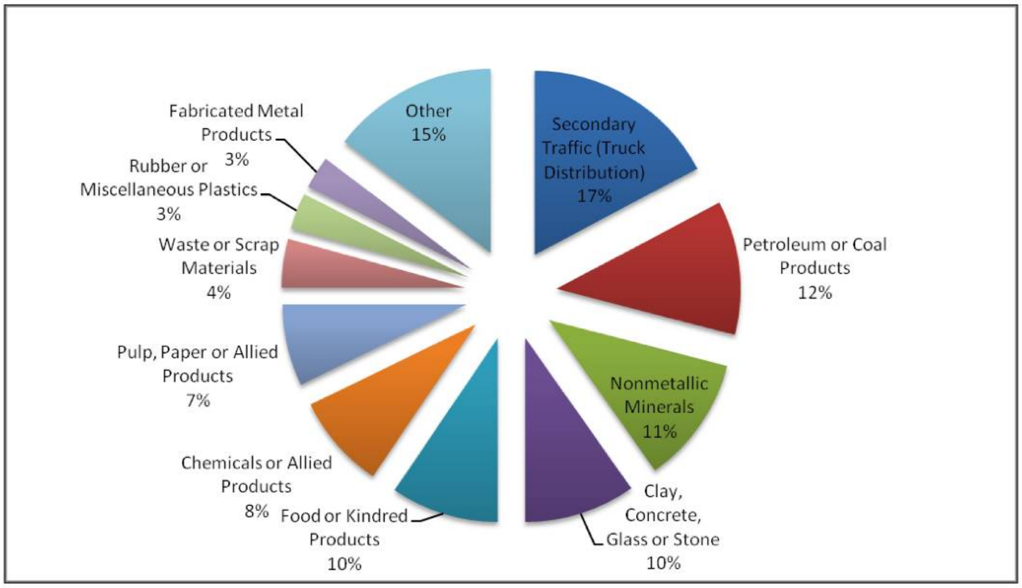
Commodity	Total Tons	% Share
Secondary Traffic (Truck Distribution)	20.8	27.3%
Petroleum Or Coal Products	17.3	22.7%
Clay, Concrete, Glass Or Stone	15.9	20.8%
Nonmetallic Minerals	14.7	19.3%
Food Or Kindred Products	2.5	3.3%
Chemicals Or Allied Products	1	1.3%
Rubber Or Miscellaneous Plastics	0.8	1.0%
Fabricated Metal Products	0.7	0.9%
Printed Matter	0.7	0.9%
Primary Metal Products	0.4	0.5%
Other	1.5	2.0%
Total Tons	76.3	100.0%

Figure VII-15
Top Ten Commodities Inbound from Massachusetts for All Modes (Millions of Tons), 2007



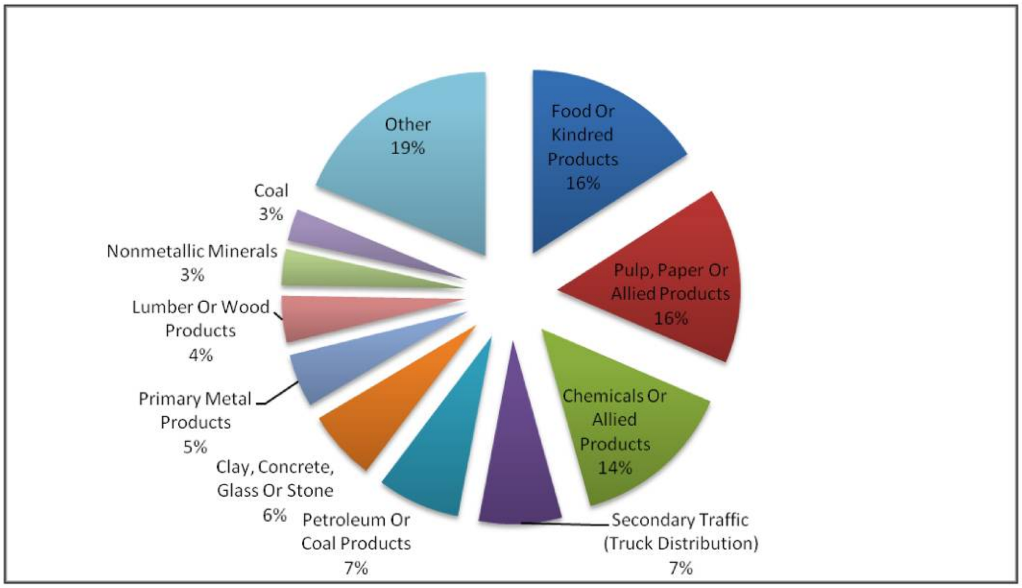
Commodity	Total Tons	% Share
Food or Kindred Products	17.9	15.8%
Chemicals or Allied Products	17.8	15.7%
Petroleum or Coal Products	15.9	14.0%
Nonmetallic Minerals	14.9	13.1%
Secondary Traffic (Truck Distribution)	8.1	7.1%
Primary Metal Products	5.9	5.2%
Lumber or Wood Products	5	4.4%
Clay, Concrete, Glass or Stone	4.5	4.0%
Pulp, Paper or Allied Products	3.6	3.2%
Crude Petroleum or Natural Gas	3	2.6%
Other	17	15.0%
Total Tons	113.6	100.0%

Figure VII-16
Top Ten Commodities Outbound from Massachusetts for All Modes (Millions of Tons), 2007



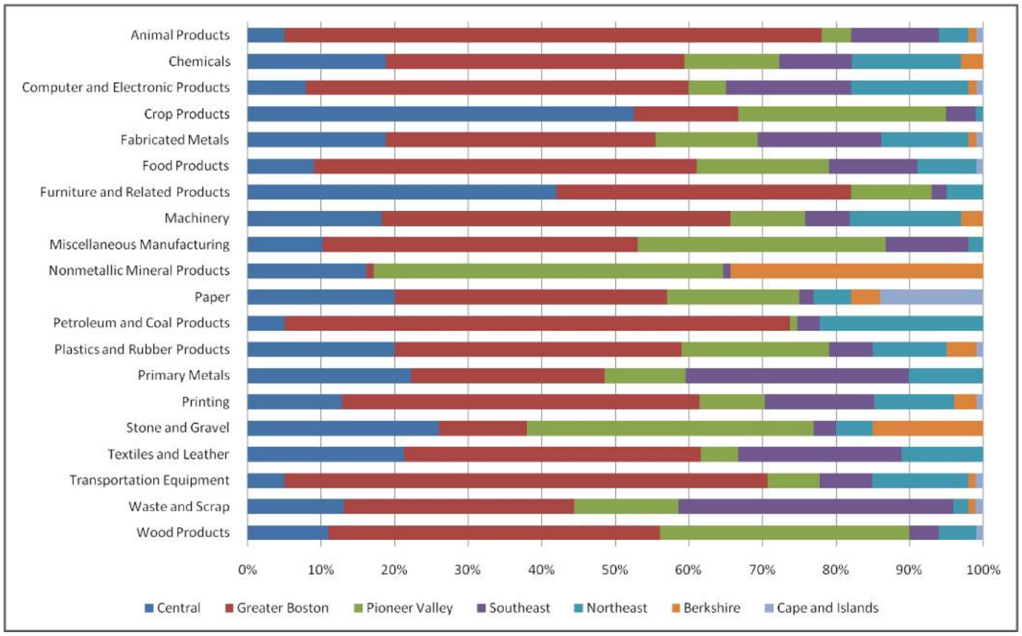
Commodity	Total Tons	% Share
Secondary Traffic (Truck Distribution)	6.0	17.2%
Petroleum or Coal Products	4.1	11.8%
Nonmetallic Minerals	3.9	11.2%
Clay, Concrete, Glass or Stone	3.4	9.8%
Food or Kindred Products	3.3	9.5%
Chemicals or Allied Products	2.9	8.3%
Pulp, Paper or Allied Products	2.5	7.2%
Waste or Scrap Materials	1.5	4.3%
Rubber or Miscellaneous Plastics	1.1	3.2%
Fabricated Metal Products	1.0	2.9%
Other	5.1	14.7%
Total Tons	34.8	100.0%

Figure VII-17
Top Ten Commodities Passing Through Massachusetts for All Modes (Millions of Tons), 2007



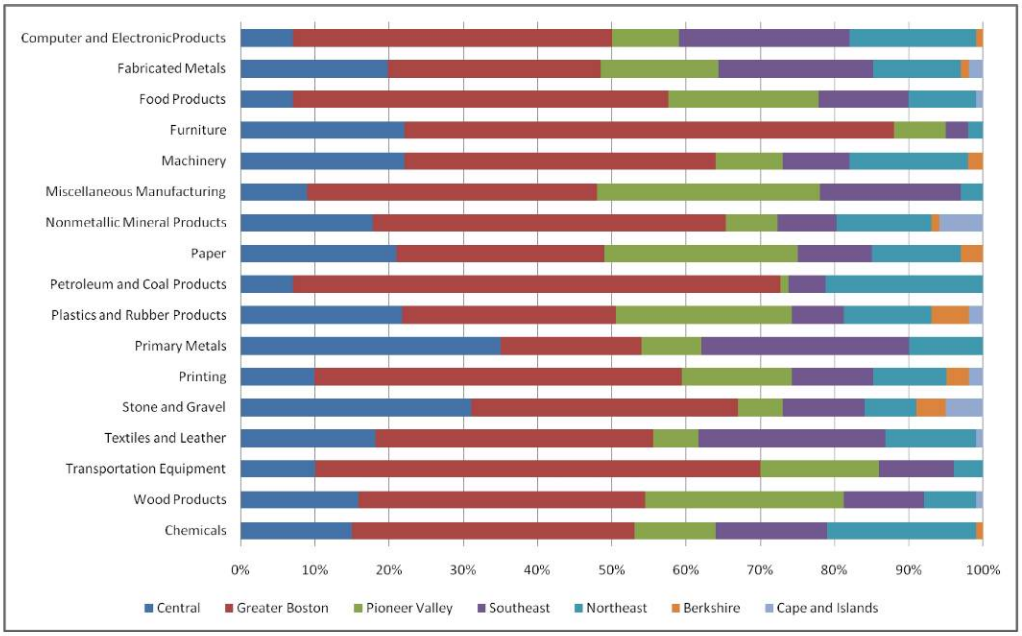
Commodity	Total Tons	% Share
Food Or Kindred Products	8.5	15.9%
Pulp, Paper Or Allied Products	8.3	15.5%
Chemicals Or Allied Products	7.6	14.2%
Secondary Traffic (Truck Distribution)	3.9	7.3%
Petroleum Or Coal Products	3.9	7.3%
Clay, Concrete, Glass Or Stone	3.3	6.2%
Primary Metal Products	2.5	4.7%
Lumber Or Wood Products	2.2	4.1%
Nonmetallic Minerals	1.7	3.2%
Coal	1.5	2.8%
Other	10	18.7%
Total Tons	53.4	100.0%

Figure VII-18
Outbound Shipments by Region of Origin (Percent by Commodity Tonnage)



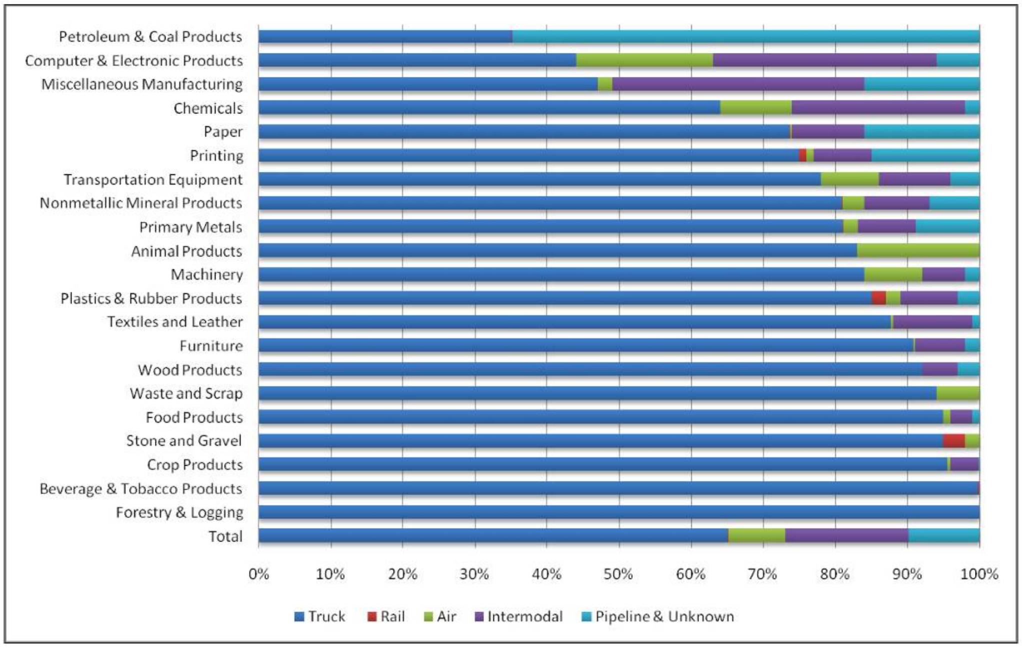
	Central	Greater Boston	Pioneer Valley	Southeast	Northeast	Berkshire	Cape and Islands
Wood Products	11%	45%	34%	4%	5%	0%	1%
Waste and Scrap	13%	31%	14%	37%	2%	1%	1%
Transportation Equipment	5%	65%	7%	7%	13%	1%	1%
Textiles and Leather	21%	40%	5%	22%	11%	0%	0%
Stone and Gravel	26%	12%	39%	3%	5%	15%	0%
Printing	13%	49%	9%	15%	11%	3%	1%
Primary Metals	22%	26%	11%	30%	10%	0%	0%
Plastics and Rubber Products	20%	39%	20%	6%	10%	4%	1%
Petroleum and Coal Products	5%	68%	1%	3%	22%	0%	0%
Paper	20%	37%	18%	2%	5%	4%	14%
Nonmetallic Mineral Products	16%	1%	47%	1%	0%	34%	0%
Miscellaneous Manufacturing	10%	42%	33%	11%	2%	0%	0%
Machinery	18%	47%	10%	6%	15%	3%	0%
Furniture and Related Products	42%	40%	11%	2%	5%	0%	0%
Food Products	9%	52%	18%	12%	8%	0%	1%
Fabricated Metals	19%	37%	14%	17%	12%	1%	1%
Crop Products	52%	14%	28%	4%	1%	0%	0%
Computer and Electronic Products	8%	52%	5%	17%	16%	1%	1%
Chemicals	19%	41%	13%	10%	15%	3%	0%
Animal Products	5%	73%	4%	12%	4%	1%	1%

Figure VII-19
Internal Commodities by Region of Origin



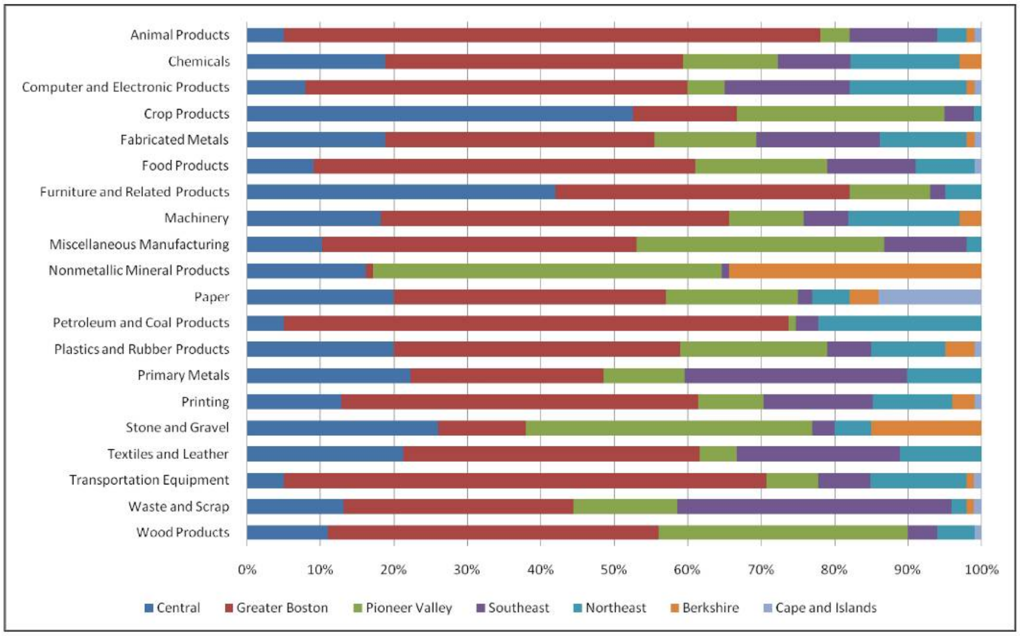
	Central	Greater Boston	Pioneer Valley	Southeast	Northeast	Berkshire	Cape and Islands
Chemicals	15%	38%	11%	15%	20%	1%	0%
Wood Products	16%	39%	27%	11%	7%	0%	1%
Transportation Equipment	10%	60%	16%	10%	4%	0%	0%
Textiles and Leather	18%	37%	6%	25%	12%	0%	1%
Stone and Gravel	31%	36%	6%	11%	7%	4%	5%
Printing	10%	50%	15%	11%	10%	3%	2%
Primary Metals	35%	19%	8%	28%	10%	0%	0%
Plastics and Rubber Products	22%	29%	24%	7%	12%	5%	2%
Petroleum and Coal Products	7%	65%	1%	5%	21%	0%	0%
Paper	21%	28%	26%	10%	12%	3%	0%
Nonmetallic Mineral Products	18%	48%	7%	8%	13%	1%	6%
Miscellaneous Manufacturing	9%	39%	30%	19%	3%	0%	0%
Machinery	22%	42%	9%	9%	16%	2%	0%
Furniture	22%	66%	7%	3%	2%	0%	0%
Food Products	7%	50%	20%	12%	9%	0%	1%
Fabricated Metals	20%	29%	16%	21%	12%	1%	2%
Computer and ElectronicProducts	7%	43%	9%	23%	17%	1%	0%

Figure VII-20
Domestic Outbound Shipments and International Exports (Percent Value by Mode)



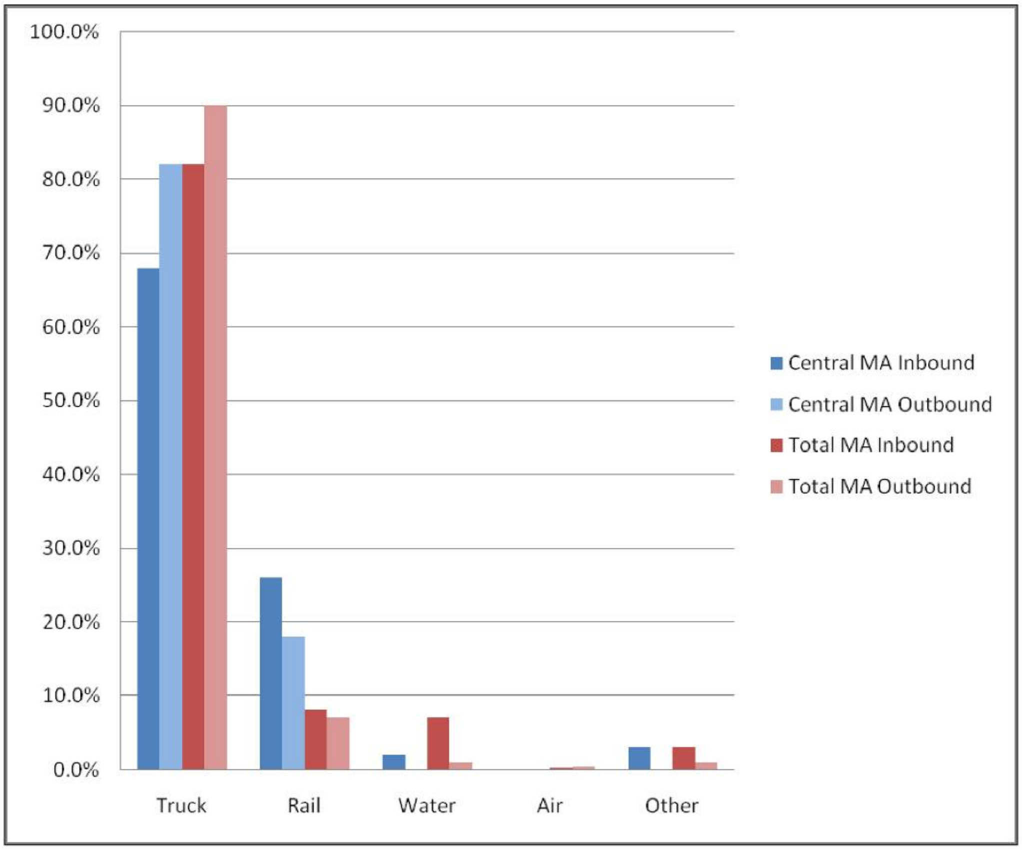
	Truck	Rail	Air	Intermodal	Pipeline & Unknown
Total	65.0%	0.1%	8.0%	17.0%	9.9%
Forestry & Logging	100.0%	0.0%	0.0%	0.0%	0.0%
Beverage & Tobacco Products	99.7%	0.2%	0.0%	0.1%	0.0%
Crop Products	95.5%	0.0%	0.4%	4.0%	0.1%
Stone and Gravel	95.0%	3.0%	2.0%	0.0%	0.0%
Food Products	95.0%	0.0%	1.0%	3.0%	1.0%
Waste and Scrap	94.0%	0.0%	6.0%	0.0%	0.0%
Wood Products	92.0%	0.0%	0.0%	5.0%	3.0%
Furniture	90.8%	0.0%	0.2%	7.0%	2.0%
Textiles and Leather	87.7%	0.0%	0.3%	11.0%	1.0%
Plastics & Rubber Products	85.0%	2.0%	2.0%	8.0%	3.0%
Machinery	84.0%	0.0%	8.0%	6.0%	2.0%
Animal Products	83.0%	0.0%	17.0%	0.0%	0.0%
Primary Metals	81.0%	0.1%	2.0%	8.0%	8.9%
Nonmetallic Mineral Products	80.9%	0.1%	3.0%	9.0%	7.0%
Transportation Equipment	78.0%	0.0%	8.0%	10.0%	4.0%
Printing	75.0%	1.0%	1.0%	8.0%	15.0%
Paper	73.6%	0.1%	0.3%	10.0%	16.0%
Chemicals	64.0%	0.0%	10.0%	24.0%	2.0%
Miscellaneous Manufacturing	47.0%	0.0%	2.0%	35.0%	16.0%
Computer & Electronic Products	44.0%	0.0%	19.0%	31.0%	6.0%
Petroleum & Coal Products	35.0%	0.0%	0.0%	0.2%	64.8%

Figure VII-21
Domestic Inbound Shipments and International Exports (Percent Value by Mode)



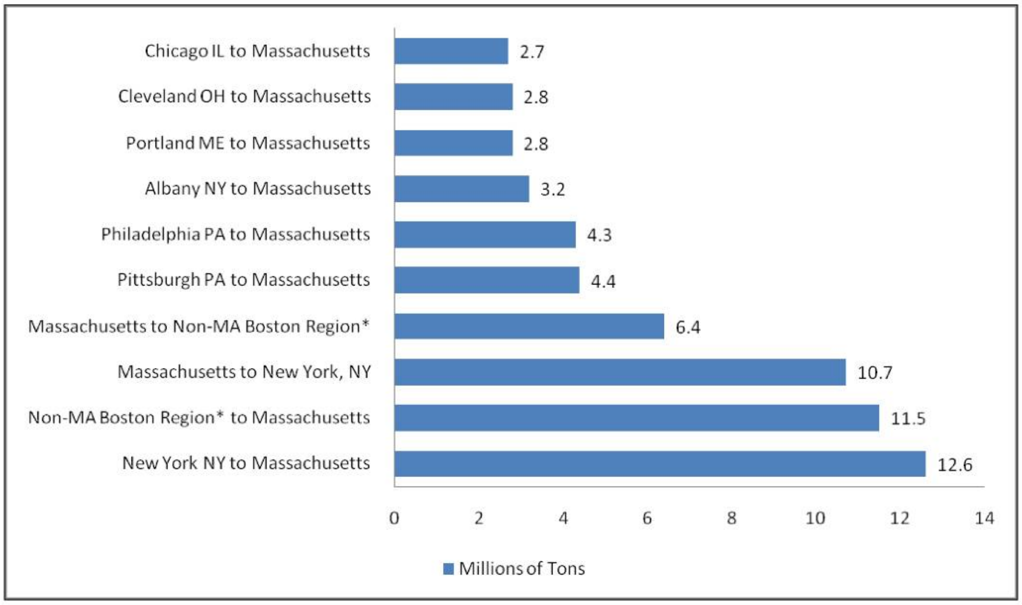
	Truck	Rail	Air	Intermodal	Pipeline & Unknown
Total	71.0%	2.0%	5.0%	14.0%	8.0%
Forestry & Logging	99.0%	0.0%	0.0%	0.0%	1.0%
Stone and Gravel	98.0%	2.0%	0.0%	0.0%	0.0%
Crop Products	95.0%	2.0%	1.0%	2.0%	0.0%
Food Products	95.0%	2.0%	0.1%	1.0%	1.9%
Animal Products	95.0%	0.0%	5.0%	0.0%	0.0%
Furniture	93.0%	0.3%	1.0%	5.0%	0.7%
Waste and Scrap	92.0%	0.0%	0.0%	5.0%	3.0%
Beverage & Tobacco Products	90.0%	2.0%	0.0%	8.0%	0.0%
Primary Metals	87.0%	3.0%	1.0%	7.0%	2.0%
Plastics & Rubber Products	84.0%	6.0%	1.0%	8.0%	1.0%
Machinery	83.0%	0.0%	6.0%	8.0%	3.0%
Nonmetallic Mineral Products	82.0%	1.0%	4.0%	7.0%	6.0%
Wood Products	81.0%	14.0%	1.0%	3.0%	1.0%
Printing	78.0%	3.0%	2.0%	12.0%	5.0%
Paper	78.0%	13.0%	0.2%	4.0%	4.8%
Chemicals	77.0%	2.0%	7.0%	12.0%	2.0%
Textiles and Leather	72.0%	0.0%	1.0%	26.0%	1.0%
Transportation Equipment	65.0%	7.0%	1.0%	17.0%	10.0%
Miscellaneous Manufacturing	60.0%	0.4%	8.0%	23.0%	8.6%
Computer & Electronic Products	39.0%	0.0%	16.0%	36.0%	9.0%
Petroleum & Coal Products	27.0%	0.2%	0.0%	0.1%	72.7%

Figure VII-22
Inbound/Outbound Shipments by Region



	Truck	Rail	Water	Air	Other
Central MA Inbound	68.0%	26.0%	2.0%	0.0%	3.0%
Total MA Inbound	82.0%	8.0%	7.0%	0.1%	3.0%
Central MA Outbound	82.0%	18.0%	0.0%	0.0%	0.0%
Total MA Outbound	90.0%	7.0%	1.0%	0.4%	1.0%

Figure VII-23
Top Ten Truck Origin-Destination Pairs (Millions of Tons), 2007



Origin Region	Destination Region	Truck Tons
New York NY	Massachusetts	12.6
Non-MA Boston Region*	Massachusetts	11.5
Massachusetts	New York, NY	10.7
Massachusetts	Non-MA Boston Region*	6.4
Pittsburgh PA	Massachusetts	4.4
Philadelphia PA	Massachusetts	4.3
Albany NY	Massachusetts	3.2
Portland ME	Massachusetts	2.8
Cleveland OH	Massachusetts	2.8
Chicago IL	Massachusetts	2.7

**Note: Non-MA Boston Region includes areas in New Hampshire and Rhode Island that are part of the Boston metropolitan region*

C.5.2 Review of Regional's Established National Highway System (NHS) Connectors

C.5.2.1 Freight Movement and the National Highway System (NHS)

Introduction

The needs of freight movement have long been considered as part of the Central Massachusetts region's transportation planning activities. The CMMPO is well aware that freight movement needs to be viewed in a context well beyond regional borders. Considering recent significant increases in fuel costs, the efficient movement of freight is ever more critical to the economic well being and quality of life in the greater region.

Well over a decade ago, CMRPC staff assisted MassDOT predecessor agencies in establishing the NHS Connectors serving the region's major intermodal facilities. Various incremental improvements have been observed over the years on these designated roadways. These improvements were funded in a variety of ways using federal, state and local resources.

The status of the established NHS Connectors was recently reviewed through an assessment of existing conditions along with the identification of suggested improvement options. As part of this review, working with MassDOT, the host communities, area freight providers and intermodal facility operators, staff has explored the concept of *NHS Connector Supplemental Guide Signs* linking key regional roadways with major intermodal terminals. Such guide signs would assist truckers and others not familiar with the region in accessing the NHS Connectors serving the various intermodal transfer facilities. The signs may also result in increased public awareness about the presence and importance of these freight facilities.

What is the NHS?

As defined by FHWA, the National Highway System (NHS) includes the Interstate Highway System as well as other major roads important to the nation's economy, defense, and mobility. The NHS consists of approximately 160,000 miles of roadway. The NHS includes the following subsystems* of roadways:

- **Interstate:** *The Eisenhower Interstate System of highways retains its separate identity within the NHS.*

- **Other Principal Arterials:** *These are NHS highways in rural and urban areas which provide access between an arterial and a major port, airport, public transportation facility, or other intermodal transportation facility.*

- **Strategic Highway Network (STRAHNET):** *This is a network of highways which are important to the United State's strategic defense policy and which provide defense access, continuity and emergency capabilities for defense purposes.*

- **Major Strategic Highway Network Connectors:** *These are highways which provide access between major military installations and highways which are part of the Strategic Highway Network.*

- **Intermodal Connectors:** *These highways provide access between major intermodal facilities and the other four subsystems making up the National Highway System.*

  **: Please note that a specific highway route may be on more than one subsystem.*

Established in the 1990's, NHS roadways serving the Central Massachusetts region include Interstates 84, 90 (MassPike), 190, 290, 395 and 495. Other important roadways that are part of the NHS include various segments of Routes 9, 20 and 146.

C.5.2.2 NHS Intermodal Connectors in Central Massachusetts

NHS Intermodal Connectors were established to complement the major highway facilities included in the NHS. The NHS Connectors are highways that provide direct access between the primary NHS and major intermodal freight and passenger facilities where goods and/or people transfer between various major modes of transportation-aviation, highway, railroad and watercraft. *FHWA has stated that, from origin to destination, "NHS Connectors tie the intermodal transportation system together."*

Originally, the CMMPO staff designated those roadways in the region serving major intermodal facilities that met the federally-established eligibility criteria as NHS Connectors. Essentially, various activity thresholds need to be reached in order to become a NHS Connector. Examples include the number of trucks generated by an intermodal railyard or the number of enplanements at a regional airport.

Review of Regional NHS Connectors
FHWA has indicated that the planning regions must periodically review the status of established NHS Connectors. This review typically includes an inventory of existing conditions, the identification of any of a variety of constraints or challenges as well as the suggestion of improvement options, as appropriate.

In the Central Massachusetts region, various incremental improvements on the NHS Connectors serving the area have been implemented over time. Notably, overhead clearance limitations were eliminated on one NHS Connector, Southbridge Street in the city of Worcester, by lowering the roadway grade beneath the long-established tracks of the Providence & Worcester Railroad.

The review of the region's established NHS Connectors included the following roadways:

Established NHS Connectors

Town of Westborough

- Computer Drive-Research Drive-Flanders Road-Walkup Drive *serving CSX*

City of Worcester

- Franklin Street *serving CSX*

- Southbridge Street *serving P&W/Intransit Container*
- McKeon Road Extension-Blackstone River Road *serving P&W/Intransit Container*
- Highland Street-Pleasant Street-Airport Drive *serving Worcester Regional Airport*

Each established NHS Connector in the region is previously shown on Figure III-2 in Chapter III. The figure shows the greater region's railroad network, NHS roadways and designated NHS Connectors along with aerial images of the intermodal freight yards located both on and off the NHS. This graphic was compiled so that the relationship of the established Connectors to the intermodal facilities could be easily perceived, and so that potential future Connectors and, possibly, intermodal sites could be envisioned.

NHS Connector Existing Conditions & Investment

For each established NHS Connector roadway in the planning region, a range of key aspects were reviewed. This review utilized regional Roadway Inventory File (RIF) information, a range of Geographic Information System (GIS) layers and the results of the Management Systems. Field visits were also conducted to view existing conditions along each of the region's established NHS Connectors.

The results of this review are summarized in Table VII-3, "NHS Connector Roadways: Facts and Observations". Further, a number of physical and situational challenges based on the observations made in the field and various analysis results are summarized in Table VII-4, "NHS Connector Roadways: Observed Deficiencies".

Suggested Improvement Options

In order to improve the federal-aid highway network serving the Central Massachusetts planning region's major - as well as the smaller - intermodal freight facilities, the following suggested improvement options have been compiled. Many of the suggested improvements will provide a direct benefit to area trucking activities. The improvement options are provided for further consideration by the host communities, area freight transportation providers, intermodal facility operators and the CMMPO through the ongoing Transportation Improvement Program (TIP) development process. *It must be specifically mentioned that the recommendations are considered "to-the-gate", aimed at improving the federal-aid highway system while leaving all potential on-site improvements to the discretion of the intermodal facility operators.*

- Prohibit on-street vehicle parking adjacent to and across from intermodal facility site drives.

- Keep site drive areas clear of all obstacles such as street furniture, utility poles and overgrown vegetation.

Table VII-3
NHS Connector Roadways: Facts and Observations

Community (Area type)	Terminal name	Facility Type	Facility ID	NHS Connector Description & mileage	Functional Class	Typical Daily Vol	Adjacent Land Use	Guide Signs	Bridges	BMS Ratings	CMP Segment	# Lanes	At Grade RR Crossings	PMS OCI	Safety: Crashes in 3-yr sample period
Westborough (Small Urban)	Westborough CSX Yard	Truck/Rail Facility	MA61R	R1: Yard to Flanders Rd to Computer Dr to Route 9 ramps (2.25 mi); R2: MA61R1 to Research Dr to Route 9 ramps (.15 mi)	Minor Arterial; Minor Collectr; Local	8000 VPD '07 HV: 8.3%	Industrial, manufacturing and warehousing; Other	Minimal	W-24-026 (Lyons St over Rt 9) (ON)	49.8	N/A	Varies; Two to Four	None	34; 82; 74 Avg= 57.7	Property damage = 25 Personal injury = 7 Fatalities = 0
Worcester (Urbanized)	Worcester CSX Yard - Franklin St	Truck/Rail Facility	MA70R	Yard to Franklin St to Grafton St (.35 mi)	Minor Arterial	7200 VPD '08 HV: 10.9%	High density business; Industrial, manufacturing and warehousing	None	W-44-082 (I-290 EB) (Over); W-44-082 (I-290 WB) (Over)	N/A	#27	Two	507885V (Currently Exempt)	65; 98; 36 Avg= 59.6	Property damage = 133 Personal injury = 61 Fatalities = 0
Worcester (Urbanized)	Worcester P&W Yard - Southbridge St (ICI)	Truck/Rail Facility	MA67R	R1: Yard to Southbridge St to cambridge St (.45 mi) R2: Yard to Southbridge St to Quinsigamond Ave (.3 mi)	Minor Arterial	14300 VPD '06 HV: 8.9%	High density business; High density residential	None	504176E (Over); 861586K (Over)	---	#24 & #45	Two	None	51; 99; 35; 96 Avg= 67.8	Property damage = 163 Personal injury = 84 Fatalities = 1
Worcester (Urbanized)	Worcester P&W Yard - Wiser Ave (ICI)	Truck/Rail Facility	MA68R	R1: Yard to Millbury St NB to Route 146 (.8 mi) R2: Yard to Millbury St SB to Route 146 (.25 mi)	Minor Arterial	4200 VPD '06 HV: 10.7%	Low density commercial; Industrial, manufacturing and warehousing; Low density residential	None	W-44-157 (Blackstone River Rd) (ON); W-44-161 (McKeon Rd) (ON)	96.6; 94.0	#37	Two	905790K; 871895A; 871893L; Add'l on Millbury St near Saint Anthony St	86; 85; 96 Avg= 87.9	Property damage = 31 Personal injury = 18 Fatalities = 0
Worcester (Urbanized)	Worcester Regional Airport	Airport	MA65A	Airport Drive to Bailey St to Pleasant St to Highland St to Rt 9/12/122A (4 mi)	Principal Arterial; Minor Arterial	18000 VPD '09 HV: 11.8%	High density commercial; High density residential	Numerous	W-44-094 (Belmont St) (ON); W-44-078 (Belmont St) (ON); W-44-073 Pleasant St) (ON)	34.0; 73.6; 74.4	#28 & #41	Varies; Two to Four	None	97; 91; 40; 66; 82; 67; 55; 60; 26; 45 Avg= 61.0	Property damage = 458 Personal injury = 198 Fatalities = 3

Table VII-4
NHS Connector Roadways: Observed Deficiencies

Community	Terminal name	Geometric/Physical Feature Deficiencies (relative extent of area)	Safety/Delay Deficiencies on Connector Roadway (AM/PM or Terminal peaks)	Safety/Delay Deficiencies at Connector/NHS Junction (AM/PM or Terminal peaks)
Westborough	Westborough CSX Yard	Tight turning radii at intersections (some) Road deterioration on Walkup Dr (most)	Heavy traffic/congested (AM/PM) Long delays at traffic signals (AM/PM) Pedestrian crossing markings faded (AM/PM)	Highly utilized interchange w/ Rte 9: Heavy traffic/congested (AM/PM) Long delays at traffic signals (AM/PM) Pedestrian crossing markings faded (AM/PM)
Worcester	Worcester CSX Yard - Franklin St	Tight turning radii at intersections (some) Pavement distress (some)	Heavy traffic/congested (AM/PM) On-street parking conflicts (AM/PM) Difficulty making turns (AM/PM) Lack of turning lanes at intersections (AM/PM)	Modern Washington Sq roundabout serves to alleviate peak period congestion: Heavy traffic/congested (AM/PM)
Worcester	Worcester P&W Yard - Southbridge St (ICI)	Tight turning radii at intersections (some) Narrow bridge underpass (one) Drainage/Flooding (most)	Roadway width varies (AM/PM) Heavy traffic/congested (AM/PM) Difficulty making turns (AM/PM, Term) Lack of turning lanes at intersections (AM/PM, Term)	Heavy traffic on mainline NHS (AM/PM) Tight turning radii at intersections (AM/PM) Lack of turning lanes (AM/PM)
Worcester	Worcester P&W Yard - Wiser Ave (ICI)	Surrounding roadway system essentially completely reconstructed as part of Rte 146 major infrastrcuture improvement project	Regional and local traffic flows now separated - congestion in area (AM/PM) reduced	Newly reconstructed roadways and interchanges need to be monitored for any new hotspots for congestion and/or safety
Worcester	Worcester Regional Airport	Tight turning radii at intersections (some) Pavement distress (some)	Heavy traffic/congested (AM/PM) Difficulty making turns (AM/PM) Lack of turning lanes at intersections (AM/PM)	Northern corridor east-west arterial mobility improvements planned to address safety and congestion

- Provide adequate truck turning radii at major intersections, optimally to fully accommodate the movement of tractors pulling 53 foot international intermodal containers.

- Address vertical clearance limitations beneath constrained bridge structures in the region to allow for the passage of tractors handling 9.5 foot high international intermodal containers.

- Maintain and resurface roadway pavement surfaces as deemed appropriate.

- Maintain all traffic control signs, signals and pavement markings. Consider the installation of "Supplemental Guide Signs" detailed below.

- Consider a regional study to identify and perhaps designate "Preferred Truck Routes" throughout the greater region.

- Consider a regional study for the location of modern rest areas capable of meeting the needs of the trucking industry. Such rest areas would provide a range of amenities, including the provision for truck hookups providing heat and air conditioning, thus reducing vehicle idling. The state's recently completed freight study suggests a location along the I-495 corridor.

Supplemental Guide Signs
The development of a "Supplemental Guide Sign" plan should be considered for the region's established NHS Connector roadways that provide access between the Interstate System, major regional highways and major intermodal terminals. Such Supplemental Guide Signs, as included in the Manual on Uniform Traffic Control Devices (MUTCD), would assist truckers and others unfamiliar with the region in following the established NHS Connectors to the intermodal freight facilities located in the town of Westborough and the city of Worcester. They could be considered "trail blazing" or "wayfarer" signs. Potential Supplemental Guide Sign examples are shown in Figure VII-24.

As indicated in the MUTCD, Supplemental Guide Signs can be used to provide information regarding destinations accessible from an interchange, over and above those shown on standard signing. No more than one would be used at any interchange approach, and they follow or come between standard advance guide signs. Each lists no more than two destinations. This suggested improvement option needs to be further explored with the host communities, intermodal facility operators, rail freight transportation providers and the CMMPO.

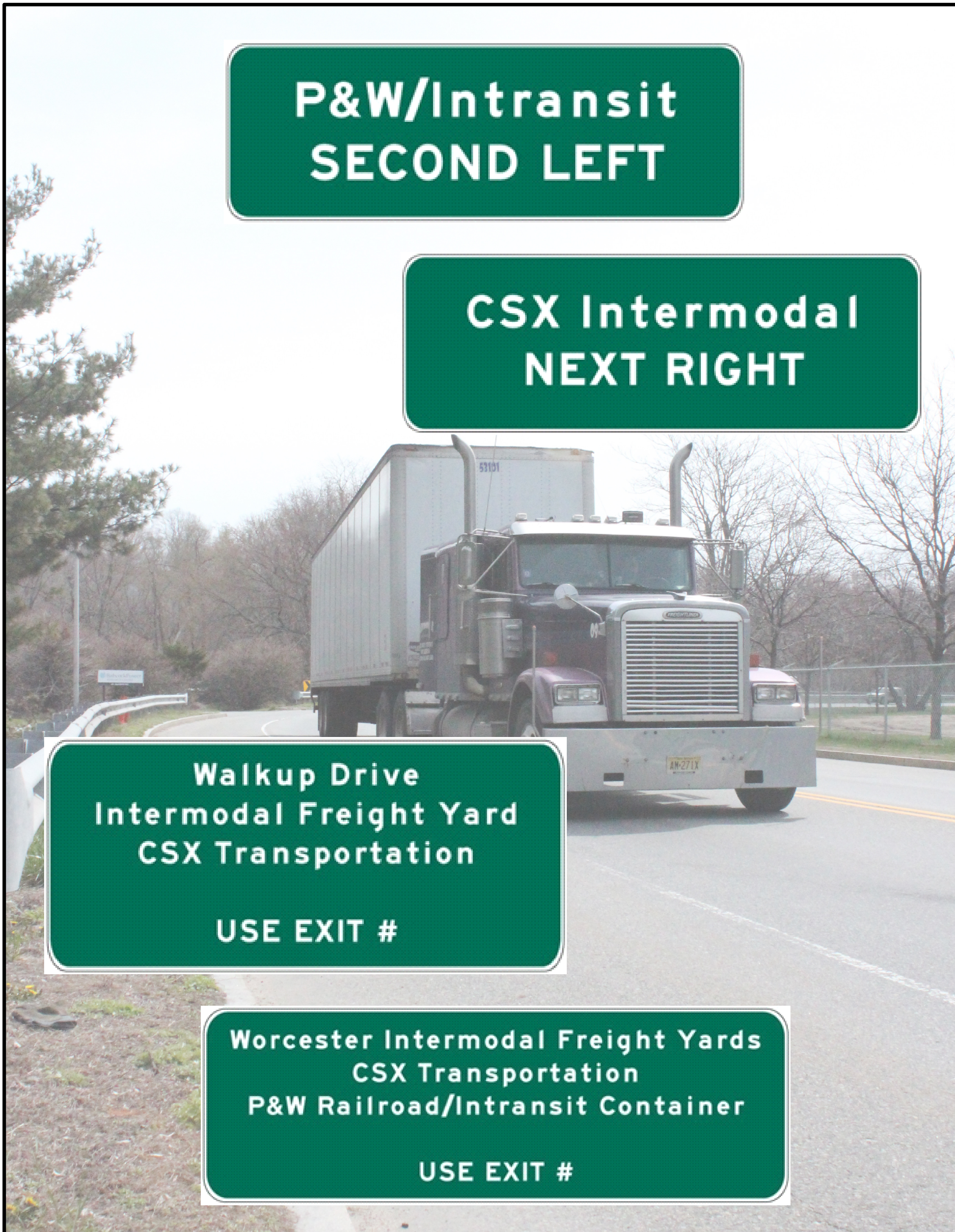


Figure VII-24 Supplemental Guide Sign Examples

Potential Future NHS Connectors
A number of other major highways within the planning region were also reviewed so as to be included in the consideration of potential Connectors that may obtain future official designation due to increasing volumes of freight moving over them. The other category considered, due to overall importance, was rural state numbered routes.

Potential future NHS Connector highways that have been identified in the planning region include the combination of state numbered Route 49 and U.S. Route 20 in the communities of Spencer, East Brookfield, and Sturbridge. This network of highways provides a link between state numbered Route 9 and the MassPike (I-90) interchange with I-84 in Sturbridge. These roadways serve the New England Automotive Gateway (NEAG) intermodal facility situated on the East Brookfield/Spencer town line.

Located on the CSX Boston Line, the NEAG site primary serves the automotive industry at the present time. Governed by the industry and captive to the economy, the distribution of new automotive products waned in both 2008 and 2009. However, a rebounded economy and the potential consideration of other freight types being distributed from this facility may eventually meet the thresholds for future NHS Connector designation.

Rural State Numbered Routes
State numbered routes in the town of Barre and adjoining communities have also been highlighted as part of this freight planning effort. Located in the northwest subregion, these highways, state numbered Routes 32, 62, 67 and 122, serve the primarily rural area in the vicinity of the South Barre village. The Wildwood Reload intermodal facility is located in South Barre at the site of a former woolen mill complex that is undergoing a revitalization effort. A new industrial park named Phoenix Plaza was recently established on this site. Rail transportation is provided by the MassCentral Railroad.

Site management has commented that they seek locally-hired trucking for "last mile" distribution services in this rural area. Although slowed by recent economic events, site management has indicated their intent to become established and expand as a break bulk, packaging, warehousing and distribution site for commodities such as agricultural supplies, rock salt and wood pellets. *Serving local needs in the Ware River Valley, this rurally-located, rail served intermodal distribution yard is of critical importance to this area of the region.*

C.6 Regional Airport

The New England Airport Regional System Plan - sponsored by the major New England airports, State transportation agencies and the FAA - was released in September of 2006. With regard to Worcester Airport, it recommended that essential aviation infrastructure be maintained and improved, including the rehabilitation of aging runway and taxiway pavements, installation of FAA compliant Runway Safety Areas on Runway 11-29, upgrade of the Category I Precision Approach to Category II/III standards, and [adding] an aircraft hold apron on the Runway 11 end. While not specifically recommending any non-airport projects, the plan did state that improved roadway access, additional signage and roadway infrastructure improvements would be of benefit to the airport.

Regardless, forecasts for Worcester passenger activity for the year 2020 range anywhere from a low of zero, to a moderate/most likely level of 275,000 passengers, to an aggressive one of nearly twice that. The majority of New England passengers will continue to travel through Boston. Although Worcester has a catchment area of significant size, airline financial problems as well as nearby competing catchment areas have conspired to severely limit growth. An alternative projection done in the NERASP that assumed no reluctance to duplicate service by the airlines indicated that up to 1.5 million passengers could make use of Worcester. Such an airline business choice is by and large a market one. In an ideal situation it would be beneficial to minimize leakage of passengers from Worcester and other regional airports to the Logan area, but again, this is a function of the services and products made available by the airlines and the prices assigned to them. The NERASP listed improved ground access as a specific challenge to the New England system in general, and noted that the City of Worcester had working with CMRPC and the CMMPO in order to address this need as part of recommended east-west travel improvements identified in the Worcester Regional Mobility Study. In the NERASP "moderate" Year 2020 projection, cutting access times by as little as ten minutes in the airport choice model resulted in an increase of 40% in Worcester passengers, to a total of about 400,000.

The airport Master Plan was released in March of 2008. It references the NERASP passenger projections and used them in its range of potential demand scenarios. The report noted that the following factors would strongly influence the airport's level of success:

- Investment in airport infrastructure
- Improved ground access
- Economic growth and vitality of the greater Worcester region
- Airline industry economics (cost of fuel, route structures, age and efficiency of planes)

It included a list of both maintenance and "demand-driven" projects to be undertaken, in the short- and long-term. Suggested "actions" for success include obtaining all possible infrastructure support funding, active marketing of the facility and its tenants, the continued pursuit of commercial service, pavement and instrument landing upgrades and an "access improvement strategy".

As the Worcester Regional Mobility Study (WRMS) moved into its final phases in early 2011, many of its listed and suggested options would result in such an access improvement strategy. One option in particular would add a new MassPike exit at Route 56 in Oxford, leading north to Leicester and then on to the northeast into Worcester. While in very preliminary conceptual form, its possible economic pluses and its feasibility, along with resultant enhanced access to the airport for travelers not familiar with Worcester, has left it on the short list of projects to be retained for future study. Overall, the WRMS recommendations focused on the fact that there is no single magic bullet to improve east-west travel. Given the built environment, coupled with the technology of GPS, improving east-west travel through the core of the region is highly dependent upon improving the many existing main routes. The WRMS defined and recommended improvements to a north, central and south corridor. Improvements to these corridors, coupled with the recent Massport signage improvement program, are likely to improve travel to the Airport. Additional study of the Route 56 / I-90 interchange alternative should also continue, incorporating the results of short- and mid-term east-west travel improvements.

C.7 Pavement Management System (PMS)

C.7.1 Existing Backlog

As part of the pavement management program, staff associated general costs per square yard with each of the pavement condition bands found in Table III-4 below. Staff based the unit costs for each recommended action upon material and labor costs provided by MassDOT District 3 in 2010. The costs are found in Table VII-6 and represent the pavement structure, police detail, and striping only. They do not include related repair costs for utilities, drainage, sidewalk, curbing, signals, and signs. Note that the cost per unit increases considerably from routine maintenance to base rehabilitation as recommended action demands greater resources.

Table III-5
Overall Condition Index Rating Range and Description

OCI Range	Pavement Condition	Recommended Action
0 - 24	**Very Poor**	**Base Rehabilitation** – represents roads that exhibit weakened pavement foundation base layers. Complete reconstruction and full depth reclamation fall in this category
25 - 47	**Poor**	**Structural Improvement** – when the pavement deteriorates beyond the need for surface maintenance applications, but the road base appears to be sound. These include structural overlays, shim and overlay, cold planeing and overlay, and hot in-place recycling.
48 - 67	**Fair**	**Preventive Maintenance -** slightly greater response to more pronounced signs of age and wear. This includes crack sealing, full-depth patching, and minor leveling, as well as surface treatments such as chip seals, micro-surfacing, and thin overlays.
68 - 87	**Good**	**Routine Maintenance -** used on roads in reasonably good condition to prevent deterioration from the normal effects of traffic and pavement age. This treatment category would include either crack sealing or local repair (pot hole, depression, poorly constructed utility patch, etc.), or minor localized leveling.
88 - 100	**Excellent**	**Do Nothing -** used when a road is in relatively perfect condition and prescribes no maintenance.

Table VII-6
Recommended Action Unit Cost

Recommended Action	Cost (in dollars) per square yard
Base Rehabilitation Arterial/Collector- Full depth Reconstruction	$50.00
Structural Improvement - Thick Overlay	$20.00
Preventive Maintenance - Thin Overlay or Surface Treatment	$8.00
Routine Maintenance - Crack Seal and/or Skin Patch	$.75

Using these costs in conjunction with the pavement data collected, staff estimates that the central Massachusetts planning region has a work backlog of $267,200,000. This backlog is the estimated cost of repairing all federal-aid eligible roads in the network in one year and bringing them to "excellent" condition (OCI range 88 – 100). The cost estimate consists of $3,200,000 in routine maintenance, $58,300,000 in preventive maintenance, $127,700,000 in structural improvement, and $78,000,000 in base rehabilitation. Figure VII-25 summarizes the costs by treatment band and Table VII-7 provides further detail on the costs by functional classification and jurisdiction. Note that base rehabilitation category accounts for over ¼ of the repair dollars though it comprises only 7% of the total network miles, and that routine maintenance accounts for only 1% of the backlog but comprises 1/5 of the total network miles.

Figure VII-25
Backlog Cost by Treatment Band

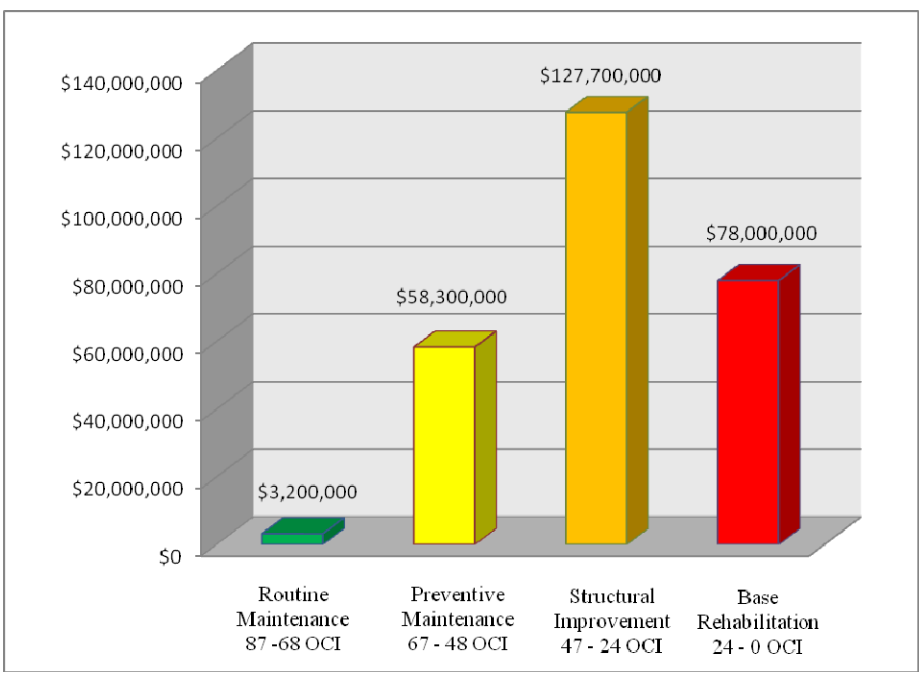


Table VII-7
Backlog Cost by Treatment Band by Jurisdiction & Functional Class

Treatment Band	MassDOT Maintenance Arterials	Municipal Maintenance Arterials	MassDOT Maintenance Collectors	Municipal Maintenance Collectors
Routine Maint	$705,000	$315,000	$380,000	$1,800,000
Prevent Maint	$8,700,000	$4,900,000	$3,700,000	$41,000,000
Struct Improv	$23,600,000	$8,800,000	$7,500,000	$87,800,000
Base Rehab	$16,600,000	$5,700,000	$5,350,000	$50,350,000
Total Cost	$49,605,000	$19,715,000	$16,930,000	$180,950,000

C.7.2 Pavement Management Budget Analysis

Based upon the information above, a budget plan was worked on to determine the funding required to maintain the existing network conditions for the next 25 years. As a starting point, the current condition was understood in terms of a 60.1 OCI score as well as a condition break down of approximately 1/3 of the roads in "good" condition, 1/3 of the roads in "fair" condition, and 1/3 of the roads in "poor" condition. To maintain the current condition, a budget must allocate funds to each of the recommended action categories above: routine maintenance, preventive maintenance, structural improvement, and base rehabilitation. It must also take into account that pavement management theory holds that "best first" treatment is the most effective, while also working to address roads that are in "poor" condition and in need of maintenance.

Based upon recommendations made by pavement management software, $750,000,000 investment in the next 25 years would maintain the existing OCI using "best first" practices. The investment necessary to improve the current network to a 78 OCI (the middle of the "good" category) is $850,000. However, these methods would not necessarily address the region's needs for each recommended action category. The funding strategy proposed in the 2007 Regional Transportation Plan was reviewed. At the time of the previous RTP, staff had recommended an annual pavement allocation of $20 million per year to maintain a system in "Good" condition over 25 years assuming level funding.

In the absence of target regional discretionary funding amounts, an assumed budget of $20 million per year based on the 2007 RTP. Funds were distributed between recommended action categories to determine how funds could be directed for the best maintenance results. Using an educated estimate, recommendations were made that responsible parties in the region spend the $20 million annually on pavement maintenance and rehabilitation with $4 million allocated to "routine maintenance," $6 million allocated to "preventive maintenance," $6 million allocated to "structural improvement," and $4 million allocated to "base rehabilitation," assuming level funding. This spending avenue shows a 2035 network

OCI of 53.4 with a condition breakdown of approximately 2/3 of the roads in “good” condition and 1/3 of the roads in “poor” condition.

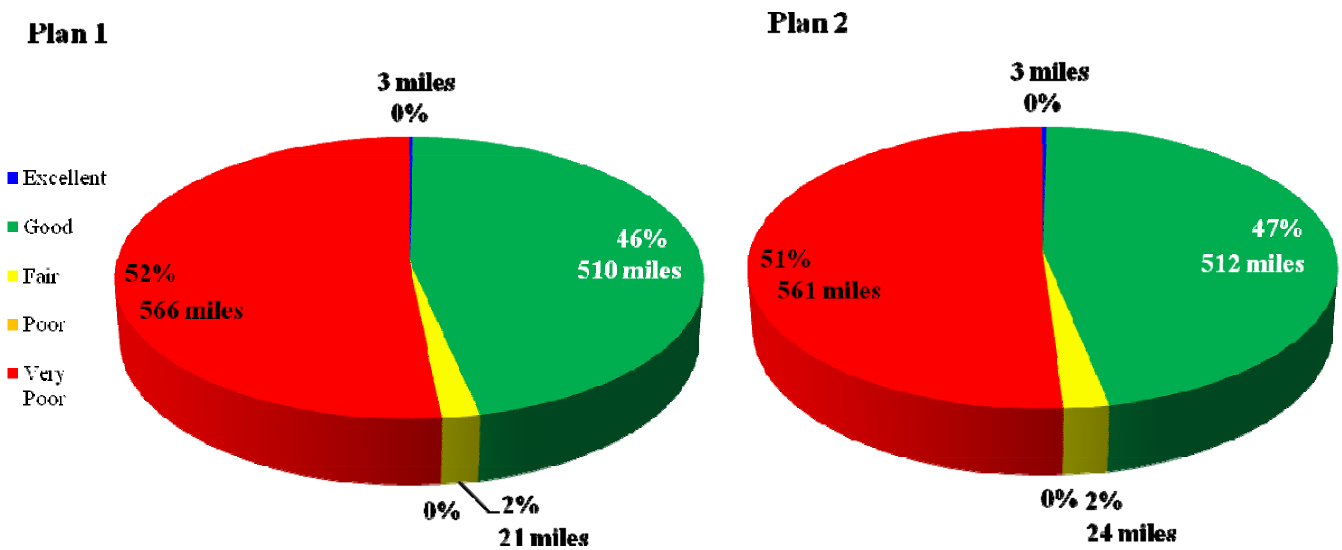
Because of thrusts from Federal Highway Administration and Massachusetts Department of Transportation for pavement maintenance, a scenario allocating $30 million dollars annually was also explored. This amount of funding could raise the network OCI to 67.8 with a condition breakdown of approximately 3/4 in “good” condition and 1/4 in “poor” condition.

The final target regional discretionary funding amounts from MassDOT was received in mid-April. It was clear that based upon the target funds, it would not be financially constrained to invest $30 million dollars annually in pavement preservation. Using the target funds, two future analysis scenarios were created to present to the Central Massachusetts Metropolitan Planning Organization (CMMPO). The first scenario (Plan 1) invested an average of 70% of total target funds in pavement preservation and the second (Plan 2) invested 80% of target funds in pavement preservation. Table VII-8 below details the percent of target funds allocated in pavement preservation in five-year increments until 2035 for each scenario. The pie charts in Figure VII-26 summarize the potential network pavement condition in 2035 based upon the investment scenarios. Upon viewing the results of the analysis, the CMMPO voted to recommend investing 80% of target funds in pavement preservation.

Table VII-8
Proposed Target Funds Investment for Pavement Preservation, 2011-2035

Years	% of Target Funds	Average 70% Target Funds	% of Target Funds	80% Target Funds
		Plan 1		*Plan 2*
2011 - 2015	84%	$51,930,480	80%	$49,457,600
2016 - 2020	75%	$72,142,500	80%	$76,952,000
2021 - 2025	72%	$98,092,800	80%	$108,992,000
2026 - 2030	69%	$116,203,590	80%	$134,728,800
2031 - 2035	65%	$121,002,420	80%	$148,925,600

Figure VII-26
2035 Federal-Aid Eligible Road Network Condition Comparison



Network OCI – 54.7

Network OCI – 55.34

Since the planning horizons are 25 years out, the pie charts above look very similar. The overall percentages in each category are very close. However, one should note that Plan 2 has 5 less road miles in "very poor" condition, and that the network OCI for Plan 2 is one point higher than that of Plan 1. It is evident that in 25 years the federal-aid eligible road network will likely be half in "good" condition and half in "very poor" condition, assuming reliable funding sources. With the proposed target funding investment for pavement management detailed in Table VII-8, the federal-aid eligible network will have likely lost 5 OCI points, dropping from 60 to 55.

It is clear that the proposed target funding cannot maintain the region's current pavement condition. Without an increase in funding, the region will continue to lose ground. This probable result is a combination of the pavement life cycle and limited available funds for pavement preservation. Pavements are designed to last between 20 and 25 years when properly maintained. This means that pavements laid today will have reached the end of their life in 2035. Limited funding contributes to limited road maintenance.

In conclusion, the realities mentioned in the above paragraph reinforce the importance of pavement management practice for central Massachusetts, as well as the need for increased funding for pavement preservation. With a funding stream that cannot meet the region's needs, it is all the more important to invest available resources into projects that will provide the greatest benefit for the region. In the upcoming year, work will be done to establish criteria and to prioritize pavement maintenance projects. This list will establish the target projects for investing the region's limited pavement rehabilitation resources in strategic and systematic ways.

C.8 Safety Planning

C.8.1 Statewide Top 200 Crash Cluster Locations

Annually, MassDOT releases a list of the top 200 high crash intersections throughout the Commonwealth for a three year period. There are 39 intersections in CMRPC listed on the statewide top 200 list for the period 2006-2008. By far the largest number of the top 200 intersections occurs in the City of Worcester which has 34. The Town of Shrewsbury has 2 and the Towns of Mendon / Spencer / Westborough all have 1 each. Figure VII-27 below illustrates the towns with top 200 intersections in the region. For more details on the exact location see Transportation Safety Planning Chapter V of the RTP for automobiles, pedestrian and bicycle clusters (Tables located at the end of the chapter). State Route 9 has several automobile crash clusters. 50% of the 34 intersections in the City of Worcester are located on State Route 9 from Lake Avenue to the intersection at Maywood Street.

C.8.2 The Regions Highest Ranked Crash Clusters

The regions highest ranked clusters all occur in the City of Worcester,

(a) AUTOMOBILE CLUSTERS

RANK 1- Lincoln Square / Main Street / Major Taylor Boulevard

RANK 2- Belmont Street / Oak Avenue

(b) PEDESTRIAN CLUSTERS

RANK 1- Main Street / Austin Street / Chandler Street

RANK 2- Main Street / Murray Avenue

(c) BICYCLE CLUSTERS

RANK 1- Interstate 290 / Belmont Street

RANK 2- Main Street / King Street

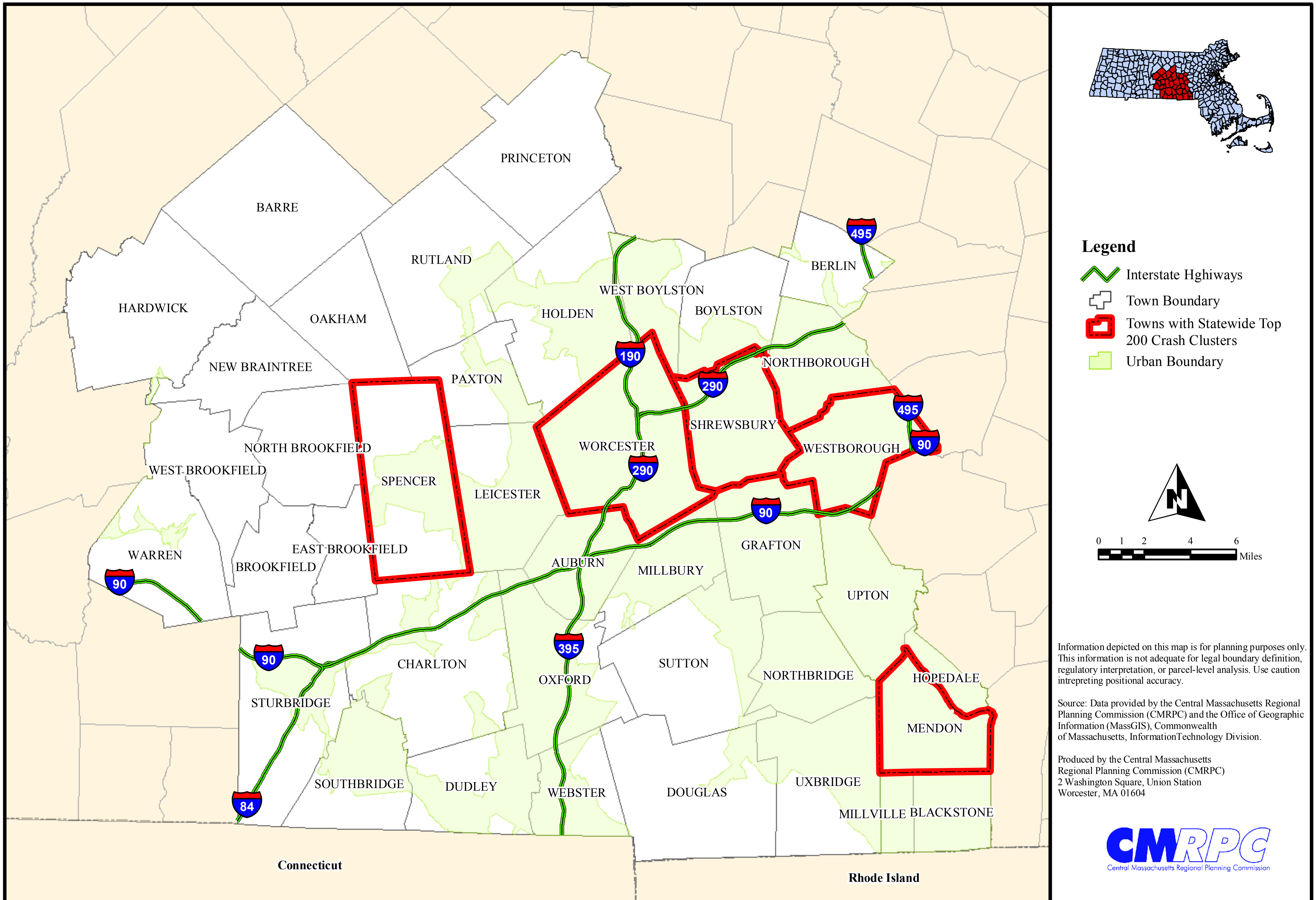


Figure VII-27 CMRPC Towns with Statewide Top 200 Crash Clusters

C.8.3 High Priority Safety Locations in the Region

As described earlier in Chapter V, the top 5% of clusters in the region for each category (automobile/ pedestrian / bicycle) are eligible for Highway Safety Improvement Program (HSIP) funding. A list of HSIP eligible projects for CMRPC was generated by selecting the top 5% of each type of crash cluster (ranked by EPDO). 204 automobile, 7 pedestrian and 4 bicycle clusters were found eligible for HSIP funding. Communities that wish to pursue this method of funding to improve safety at these locations will need to perform a Road Safety Audit (RSA) which is described later in this document. Communities may wish to contact CMRPC for futher assistance.

Tables at the end of chapter V identify locations where safety improvement projects may be eligible for HSIP funding.

- Region's Top 5% Automobile Crash Clusters (Table V-1) (see end of chapter)
- Region's Top 5% Bicycle & Pedestrian Clusters (Table V-2)
- Region's Top Crash Corridors (Table V-3)

C.8.3.1 Top 5% Automobile Crash Clusters

Among automobile crash clusters, 75% are on State Routes and 25% on local roads. 60% are located in the City of Worcester, 23% are on Route 9, 12% on Route 20. Remarkably the two highest ranked crash clusters are located on either side of Interstate 290 along Belmont Street (Route 9). Clusters at this location include,

a) Rank 1- crash cluster at Lincoln Square / Major Taylor Boulevard

b) Rank 2- crash cluster at Belmont Street /Oak Avenue is located near the UMass Memorial

c) Rank 5 – crash cluster at Belmont / Goldsberry Street is flanked by Rank 1 and Rank 2 crash clusters

d) Overlapping clusters Rank 1- bike cluster, Rank 2 - crash cluster and Rank 3- pedestrian cluster are all located at Belmont Street /Oak Avenue

e) In 2009, the traffic-tracking agency INRIX, which culls information nationwide, found that the one mile section of I-290 westbound, which includes the Route 9/Exit 17 and Route 70/Exit 18 ranked among the top 100 bottlenecks nationwide with 9 hours of weekly congestion with travel speeds slowing down to 21 mph during peak periods [1]

High congestion also leads to increased carbon emissions resulting in lower air quality. The traffic problems here will continue to grow as population is expected to increase over the next decade. Given the confluence of automobile, bicycle, and pedestrian clusters along Belmont Street / I-290 intersection, coupled with the most congested road segment in the region it would be prudent to examine alternative proposals that increase safety, decrease congestion, improve air quality and increase the efficiency of the transportation links at this location. The City of Worcester may be able to combine funding sources from the Highway Safety Improvement Program, Intelligent Transportation System and Congestion Mitigation and Air Quality to improve safety and congestion.

[1] http://scorecard.inrix.com/scorecard/pdf/NTSC09%20Full%20Report.pdf

C.8.3.2 Top 5% Bicycle and Pedestrian Clusters

Bike and pedestrian in the top 5% are listed in Table V-2. Nine of ten HSIP eligible bike and pedestrian clusters in the region are located in the City of Worcester and one is located in the Town of Spencer.

C.8.3.3 Top Crash Corridors

35 of the region's top 5% automobile, bicycle and pedestrian clusters are located in the City of Worcester (Table V-2 & Table V-3). The locations where multi modal crashes occurred were in close proximity to each other along Route 9, Route 122 and Main Street in the central business district. The geographic distribution showed that combined clusters occurred along specific road segments. These safety issues could be addressed more efficiently if they were studied in conjunction with each other rather than separately. The regions highest ranked automobile, pedestrian and bicycle clusters including several of the statewide top 200 clusters are located along the following corridors in the City of Worcester.

a) RANK 1 Crash Corridor -Belmont Street From Everard Street To Main Street

b) RANK 2 Crash Corridor -Chandler Street / Madison Street From Piedmont S. to Gold Street

c) RANK 3 Crash Corridor -Park Avenue From Elm Street To May Street

d) RANK 4 Crash Corridor -Main Street From May Street To Madison Street

C.9 Data Integration

The goal of the Data Integration Program is: *to provide timely and comprehensive transportation data in an easily-accessible format to:*

1. *CMRPC Transportation staff for use in its work program in support of the CMMPO transportation planning process;*
2. *All CMRPC staff for use in their work activities in support of the agency's member communities; and*
3. *CMRPC/CMMPO member communities to enhance their local planning efforts.*

The program uses Geographic Information Systems (GIS) technology to maintain, map, and analyze information from the transportation management systems.

GIS provides the platform for the spatial organization and analysis of the transportation performance measures determined by the CMMPO Congestion Management, Pavement Management, Transportation Safety Planning, and Traffic Monitoring programs. Access to this information through a geographic interface was used to support the development of the Regional Transportation Plan.

Figure VII-28 below showing critical locations was developed using the above mentioned data. The locations in yellow represent roadway segments with poor pavement condition and traffic volume greater than 5000 vehicles. The locations in orange represent roadway segments that are heavily congested and are high crash locations. The locations in red are a combination of all the "four" criterion mentioned above. The map was used as a tool to lead the discussion during the public outreach process to depict existing needs in the region.

In it envisioned that moving forward this analysis will be used to proactively discuss the needs as the MPO solicits for projects for future Transportation Improvement programs and other funding streams that might be available for transportation projects in the region.

More recent data integration efforts have begun to link multi-modal data, particularly transit demand data, in order to support an overall integrated multi-modal planning program. These efforts will continue to expand in the coming years.

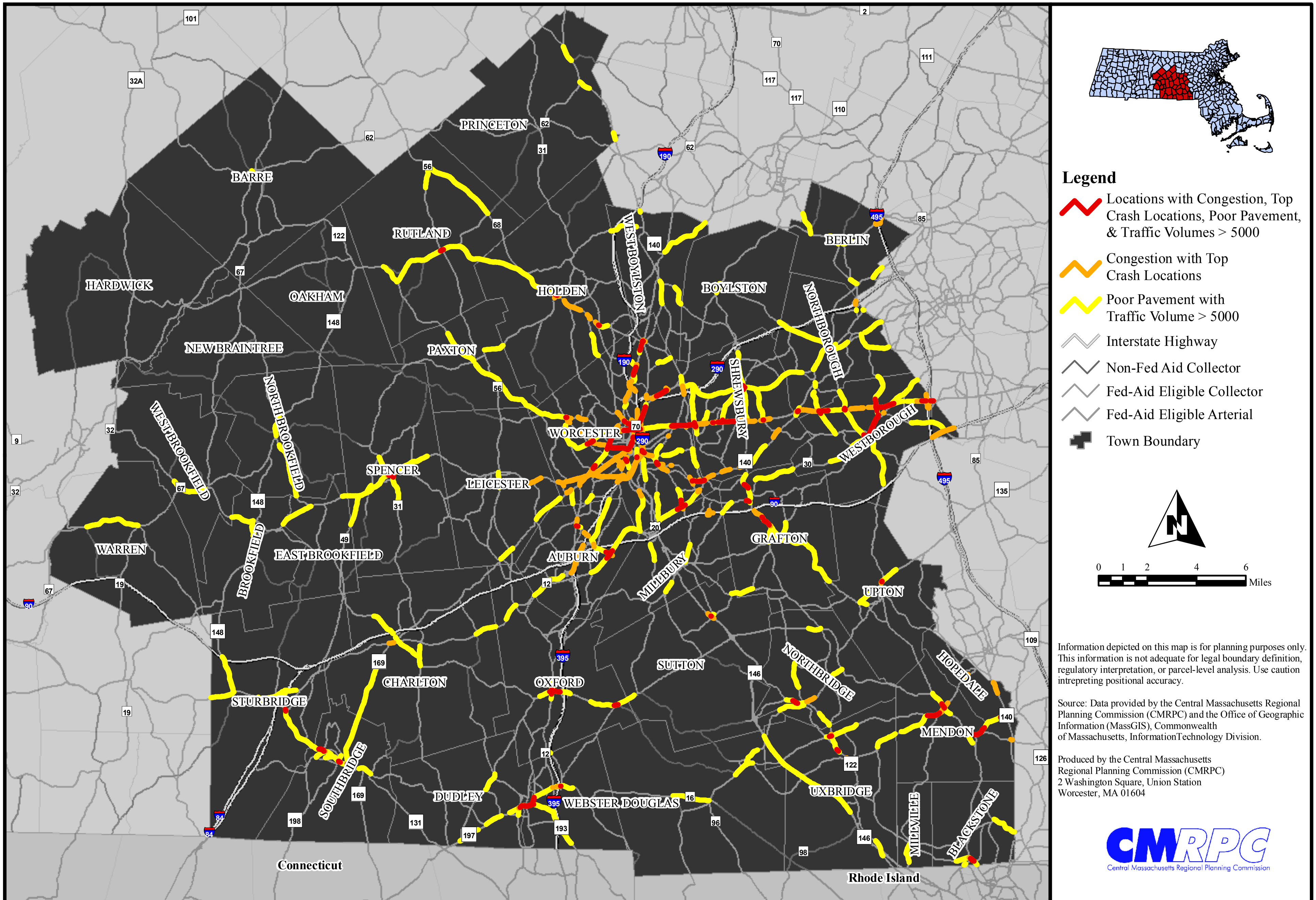


Figure VII-28   Central Massachusetts Regional Management Systems Coordination

D. OPERATIONS AND MAINTENANCE

D.1 Highway Operations and Maintenance

Maintenance is a key component of maintaining the Commonwealth's roadway infrastructure. As documented in the needs assessment of the MassDOT's capital investment plan the Highway Division estimates funding gaps in all the categories below

- ***Interstate Pavement Needs***: $128 million is needed annually over the next five years to achieve a Pavement Serviceability Index rating of 4.0 (excellent) on the Interstate System. Based upon funding included in the FFYs 2011-2013 existing STIP and extrapolating for FFYs 2014 and 2015, MassDOT expects to commit roughly $70 million per year over the five years of the plan. The annual funding gap between the identified need and available funding is, approximately $58 million per year.

- ***Non-Interstate (MassDOT maintained) Pavement Needs:*** $185 million annual over the next five years. At this level of commitment the Highway Division would achieve a target condition of 3.5 PSI (excellent) on Non-Interstate roadways. Based upon funding included in the FFYs 2011-2013 existing STIP and extrapolated for FFYs 2014 and 2015, MassDOT expects to commit roughly $18 million per year over the five years of the plan. The annual funding gap between the identified need and available funding is, approximately $167 million per year.

- ***Non-Federal Aid (MassDOT maintained) Maintenance Needs:*** $200 million is needed annually over the next five years for routine maintenance of the highway system. This includes emergency bridge repairs, distressed pavement replacement, safety upgrades, facility maintenance and upkeep, and miscellaneous activities. Based upon historic levels of funding, MassDOT expects to commit roughly $100 million per year over the five years of the plan. The annual funding gap between the identified need and available funding is, approximately $100 million per year.

Table VII-9 below provides the summary of operating and maintenance expenditures by MassDOT highway division in the Central Massachusetts region

Also as mentioned in the pavement needs assessment conducted by CMRPC on all federal aid eligible roadways in the region, approximately $30 million is needed annually over the next twenty-five years (2035) to maintain the current condition of the pavement in the region. Understanding the need for investment in maintaining the existing system, The CMMPO has committed to 80% of the available funding in the plan to address the pavement maintenance needs. This still leaves a funding gap of approximately $10 million per year.

In conclusion, the realities mentioned in the above paragraph reinforce the importance of pavement management practice for central Massachusetts, as well as the need for increased funding for pavement preservation. With a funding stream that cannot meet the region's needs, it is all the more important to invest available resources into projects that will provide the greatest benefit for the region. In the upcoming year, CMRPC staff will work to establish criteria to prioritize pavement maintenance projects. This list will establish the target projects for investing the region's limited pavement rehabilitation resources in strategic and systematic ways.

Table VII-9

Massachusetts Department of Transportation - Highway Division
Summary of Operating and Maintenance Expenditures
Central Mass - Part 1: Non-Federal Aid

Section I - Non Federal Aid Maintenance Projects - State Bondfunds

7/12/2011

Program Group/Sub Group	SFY 2009 NFA Expenditures	SFY 2010 NFA Expenditures	SFY 2011 NFA Expenditures
01 - Bridge Repair & Replacement			
New Bridge (Excluded)	n/a	n/a	n/a
Bridge Replacement (Excluded)	n/a	n/a	n/a
Bridge Reconstruction/Rehab	$329,885	$784,350	$9,920,554
Drawbridge Maintenance	$202,250	$314,069	$339,614
Structure Maintenance	$2,806,785	$5,966,693	$4,832,931
02 - Bridge Painting			
Painting - Structural	$110,721	$0	$0
03 - Roadway Reconstruction			
Hwy Relocation (Excluded)	n/a	n/a	n/a
Hwy Recon. - Added Capacity (Excluded)	n/a	n/a	n/a
New Construction (Excluded)	n/a	n/a	n/a
Hwy Reconstr - Restr and Rehab	$138,918	$19,623	$8,949
Hwy Reconstr - No Added Capacity	$180,397	$0	$140,043
Hwy Reconstr - Minor Widening	$468,352	$0	$0
Hwy Reconstr - Major Widening	$781	$0	$0
04 - Roadway Resurfacing			
Resurfacing	$1,176,203	$0	$959,954
05 - Intersection & Safety			
Impact Attenuators	$0	$0	$26,135
Safety Improvements	$627,113	$101,956	$0
Traffic Signals	$25,101	$0	$63,437
06 - Signs & Lighting			
Lighting and Electrical	$94,725	$105,998	$54,413
Sign Installation / Upgrading	$45,554	$0	$95,039
Structural Signing	$27,503	$0	$288
07 - Guardrail			
Guard Rail and Fencing	$65,153	$0	$282,864
08 - Maintenance			
Catch Basin Cleaning	$188,809	$0	$442,618
Crack Sealing	$134,515	$0	$39,597
Landscape and Roadside Develop	$105,344	$28,966	$73,187
Mowing and Spraying	$135,823	$316,228	$11,322
Pavement Marking	$221,454	$0	$257,959
Sewer and Water	$38,181	$0	$37,481
Process/Recycle/Trnsprt Soils	$0	$0	$0
Contract Hwy Maint.	$0	$0	$416,703
09 - Facilities			
Chemical Storage Sheds	$10,647	$283,936	$18,896
Vertical Construction			$245,940
10 - Bikeways (Excluded)	n/a	n/a	n/a
11 - Other			
Miscellaneous / No Prequal	$39,972	$0	$113,169
Asbestos Removal	$0	$0	$0
Demolition	$0	$0	$0
Drilling and Boring	$0	$0	$9,425
Hazardous Waste Remediation	$0	$0	$2,601
Utilities	$0	$0	$0
Change in Project Value	$0	$0	$0
Highway Sweeping	$0	$0	$0
Intelligent Transportation Sys	$0	$0	$0
Unknown	$0	$0	$24,430
Underground Tank Removal Replace	$0	$0	$0
Section I Total:	**$7,174,187**	**$7,921,819**	**$18,417,548**

Section II - Non Federal Aid Highway Operations - State Operating Budget Funding

12 - Snow and Ice Operations & Materials	$5,304,754	$3,408,023	$3,863,468
13 - District Maintenance	$1,173,255	$825,318	$904,738
(Mowing, Litter Management, Sight Distance Clearing, Etc.)			
Section II Total:	**$6,478,009**	**$4,233,341**	**$4,768,206**
Grand Total NFA:	$13,652,196	$12,155,160	$23,185,754

Massachusetts Department of Transportation - Highway Division
Summary of Operating and Maintenance Expenditures
Central Mass Region - Part 2: Federal Aid

Section I - Federal Aid Maintenance Projects

7/12/2011

Program Group/Sub Group	SFY 2009 Federal Aid Expenditures	SFY 2010 Federal Aid Expenditures	SFY 2011 Federal Aid Expenditures
01 - Bridge Repair & Replacement			
New Bridge (Excluded)	*n/a*	*n/a*	*n/a*
Bridge Replacement (Excluded)	*n/a*	*n/a*	*n/a*
Bridge Reconstruction/Rehab	$5,209,771	$1,023,236	$541,135
Structure Maintenance	$280,964	$0	$665,246
02 - Bridge Painting	$73,206	$0	$0
Painting - Structural			
03 - Roadway Reconstruction			
Hwy Relocation (Excluded)	*n/a*	*n/a*	*n/a*
Hwy Recon. - Added Capacity (Excluded)	*n/a*	*n/a*	*n/a*
New Construction (Excluded)	*n/a*	*n/a*	*n/a*
Hwy Reconstr - Restr and Rehab	$1,785	$0	$315,903
Hwy Reconstr - No Added Capacity	$25,539,835	$4,736,585	$735,855
Hwy Reconstr - Minor Widening	$1,335,221	$4,522,240	$5,107,528
Hwy Reconstr - Major Widening	$0	$0	$0
04 - Roadway Resurfacing			
Resurfacing	$11,585,484	$14,621,210	$23,447,504
05 - Intersection & Safety			
Impact Attenuators	$7,660	$0	$0
Safety Improvements	$0	$0	$0
Traffic Signals	$3,704,871	$2,827,893	$2,159,141
06 - Signs & Lighting			
Lighting and Electrical	$818,081	$0	$0
Sign Installation / Upgrading	$99,915	$401,922	$0
Structural Signing	$0	$0	$0
07 - Guardrail			
Guard Rail and Fencing	$119,881	$0	$233
08 - Maintenance			
Contract Highway Maintenance	$2,711	$0	$5,192
Landscape and Roadside Develop	$81,451	$0	$0
Pavement Marking	$78	$0	$0
Catch Basin Cleaning	$0	$0	$0
09 - Facilities			
Vertical Construction	$190,829	$0	$810
10 - Bikeways (Excluded)	*n/a*	*n/a*	*n/a*
11 - Other			
Intelligent Transportation Sys	$150,576	$0	$272,443
Miscellaneous / No prequal	$71,316	$0	$6,607
Reclamation	$162,550	$1,000,357	$558,328
Drilling & Boring	$0	$0	$1,074
Unknown	$0	$0	$29,557
Demolition	$0	$0	$0
Utilities	$0	$0	$0
Marine Construction	$0	$0	$5,911
Section I Total	**$49,436,182**	**$29,133,443**	**$33,852,467**

Section II - Federal Aid Highway Operations

11 - Other			
ITS Operations - I-93 HOV Lane Operation and Towing	$0	$0	$0
ITS Operations - Traffic Operations Center (South Boston)	$0	$0	$0
Section II Total	**$0**	**$0**	**$0**

Grand Total Federal Aid:	**$49,436,182**	**$29,133,443**	**$33,852,467**

D.2 Transit Operations and Maintenance

The most pressing need that the WRTA currently faces is providing funding for maintaining operations of the existing bus and paratransit system. The WRTA, similar to transit authorities throughout the country, operates at a substantial deficit. An issue facing the WRTA on a yearly basis is how to limit net operating costs such that the WRTA doesn't end the year with an unfunded net cost. Operations related inflation is the primary cause of fixed route and paratransit cost increases. Given that federal operating subsidies have been eliminated over time (although federal capital funds can be used for preventive maintenance and ADA) and the fact that local subsidies are constrained by Proposition 2 ½, there has been an increasing reliance on State Contract Assistance to fund WRTA operations. State Contract Assistance is typically capped between 50 and 75 percent, and is determined by the state legislature in arrears of the current fiscal year. Because an additional fiscal year goes by before operations are funded, predictable estimates for WRTA operating costs is extremely difficult to achieve.

The WRTA has faced continual reductions in service since the late 1990s. Since 2004, the WRTA has cut a total of 10 routes from its system due to lack of funds, and cut night-time and weekend services to bare minimum levels. Frequency of service has also been severely affected. Most of these cuts were the result of State Contract Assistance either declining or level funded. While state dollars have been more stable over the past couple of years, the system is still damaged in terms of route coverage, service hours and service frequency. Additional revenue is needed to meet the needs of second and third shift workers and to expand both frequency and route coverage to make the service more attractive to new and occasional users, whose demand for services has increased over the past several years. By acquiring additional operating dollars, either through existing or new funding sources that are forwarded funded, the WRTA system will be preserved and potentially expanded to meet regional transit demands while achieving a more fiscally constrained budget and control over increasing operational costs.

Table VII-10 below provides the Operations and Maintenance summary table for the Worcester Regional Transit Authority.

Table VII-10

Central Massachusetts Metropolitan Planning Organization
Operations & Maintenance Summary Table
Worcester Regional Transit Authority

The numbers below represent actual numbers for 2012 and projections for the out-years as used in the Program Preview meetings with the State. The figures provided are estimates and a forecast of projected funds necessary to meet the operating needs of the WRTA.

Operating Revenue	Fiscal Year 2012	Fiscal Year 2013	Fiscal Year 2014	Fiscal Year 2015
Farebox	3,371,410	3,438,838	3,507,615	3,577,767
Section 5307	4,126,923	4,197,003	4,527,876	4,698,625
Section 5311	43,597	43,597	43,597	43,597
Job Access Reverse Commute	200,000	225,000	250,000	275,000
New Freedom	42,678	42,678	42,678	42,678
Advertising & Interest Income	179,960	183,560	187,230	190,975
State Contract Assistance	8,698,546	8,829,024	8,961,460	9,095,881
Local Assessment	3,598,214	3,688,169	3,780,374	3,874,883
Other	133,924	134,536	135,160	135,797
Total Operating Revenue	**$20,395,252**	**$20,782,405**	**$21,435,990**	**$21,935,203**
Total Operating Expenses	**$20,395,252**	**$20,782,405**	**$21,435,990**	**$21,935,203**

E. REGIONAL INTELLIGENT TRANSPORTATION SYSTEMS (ITS) ANALYSIS

During the update to the Central Massachusetts Regional ITS Architecture in 2011, the regional transportation stakeholders identified key regional needs. These needs, specific to Central Massachusetts, are:

- Congestion Management
- Transit Efficiency
- Efficient Use of Existing Infrastructure
- Economic Development
- Safety and Security
- Communications Infrastructure
- Traveler Information
- Use of ITS Data

Multi-function Program Areas were also developed as part of the ITS Architecture Implementation Plan and they include:

- Event Reporting System – Currently in the early stages of deployment within the MassDOT system. Expected to expand to non-MassDOT entities.
- Video Integration System – A future initiative for traffic and transit management purposes.
- Roadway Monitoring – Future initiative to deploy devices to monitor traffic conditions, particularly along the I-290 corridor between I-90 and I-495, and also in other key locations experiencing roadway congestion.
- Roadway Control – Future initiative of centralized signal control for communities.
- Electronic Toll Collection Integration for Parking – Future initiative for MassDOT, MBTA, and community parking facilities that have controlled access.
- Regional Fare Card Integration for Parking – Future initiative for MassDOT, MBTA, and community parking facilities that have controlled access.
- CAD/AVL (Computer Aided Dispatch/Automated Vehicle Locator) for Transit Vehicles – Currently being deployed by the Worcester Regional Transit Authority (WRTA)
- Traffic Signal Priority – A future initiative for reducing congestion delays for WRTA buses.
- Regional Fare Card – A planned initiative for the WRTA and MBTA, expected to be deployed late 2011.
- 511 Traveler Information System – An existing initiative by MassDOT which can be expanded to include partnering agencies.
- Traffic Signal Preemption – Already in use by many communities for emergency vehicles.
- Planning Data Archive – A future planned initiative.

It is expected that the recently formed Regional ITS Planning and Coordinating Committee will be actively working to prioritize and explore implementation strategies for these Multi-function Program Areas.

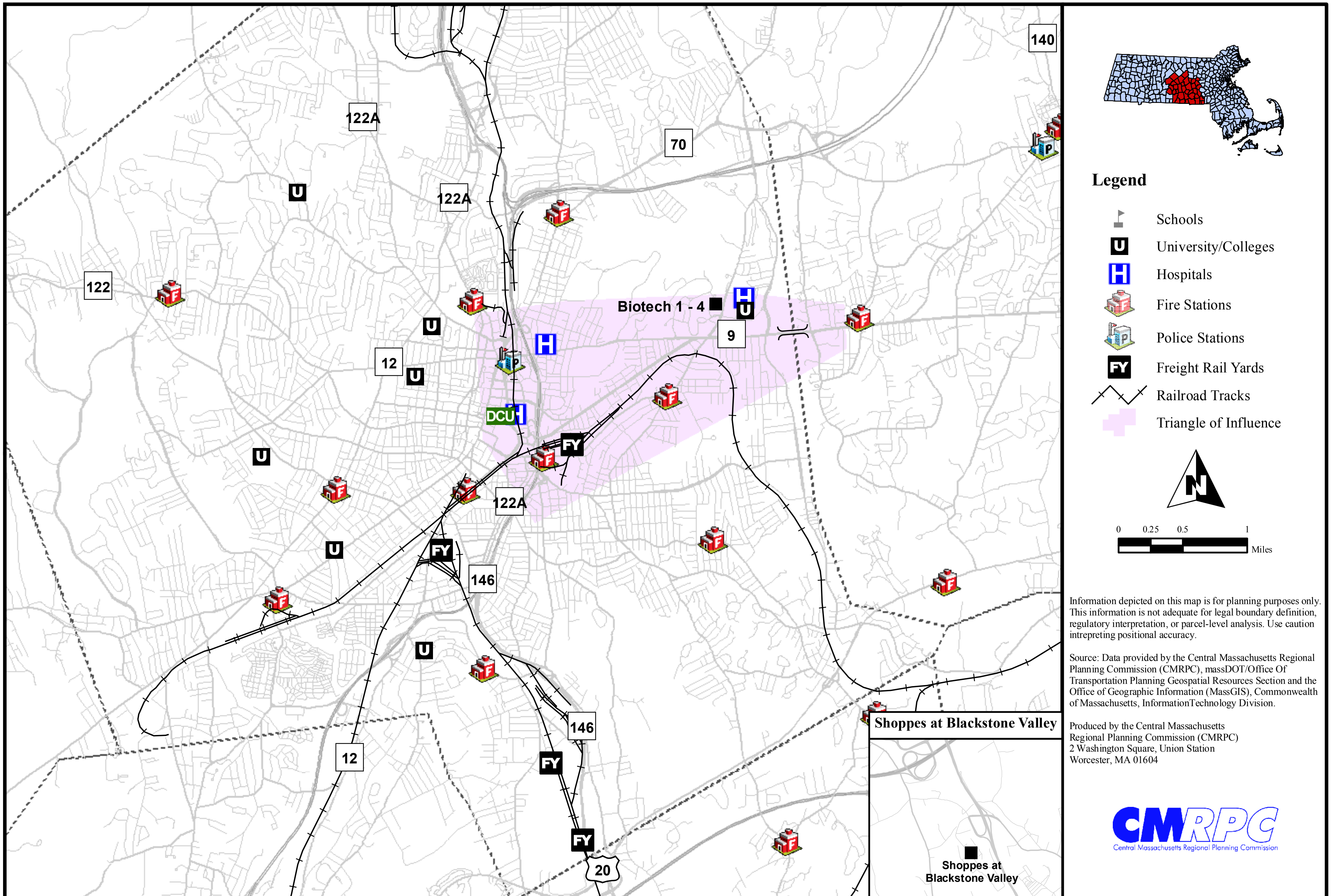
E.1 CMMPO ITS Highway Analysis

CMMPO staff mapped and analyzed various available transportation data to determine areas that might benefit from implementation of ITS technology. In particular, the analysis focused on areas where there is a concentration of activity by emergency vehicles, freight trucking, special events, and major employment. Figure VII-29 below identifies the initial ITS “Triangle of Influence”, a triangular area encompassed by Shrewsbury Street, Belmont Street and Major Taylor Boulevard, which includes three major hospitals, a central fire station, a central police station, a major freight rail yard, an event arena/convention center, major employers (including the bio-technology area), and major congested roadways.

Figure VII-30 shows the expanded area that might be considered for roadway ITS applications, including I-290, Cambridge Street, Park Ave and Highland Street to the South and the West, and Route 122 to Route 20 to the Southeast and I-290 and Route 70 to the Northeast. This potential expansion is based on the second step in the analysis process. Transportation data was overlaid on land use data, including travel time data to determine major delay, congestion data, and top crash location data (vehicle, bike, and pedestrian data) as can be seen in Figures VII-31 and VII-32.

E.2 ITS Roadway Priority Recommendations

As identified in the recently completed Worcester Regional Mobility Study, Transit Signal Priority (TSP) and Roadway Variable and Dynamic Message Signs (V/DMS) are valuable Intelligent Transportation Systems options for central Massachusetts’ urban core. Both TSP and V/DMS would help reduce vehicle emissions through more efficient bus system operations and added potential for drivers to avoid congested routes. More efficient (and potentially more expansive) bus service provides a benefit to EJ populations along routes where TSP is implemented. There are currently roadway segments in Worcester such as Park Avenue with limited to no bus service because of congestion. Businesses along these corridors could benefit from TSP implementation through added transit service.



Information depicted on this map is for planning purposes only. This information is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analysis. Use caution intrepreting positional accuracy.

Source: Data provided by the Central Massachusetts Regional Planning Commission (CMRPC), massDOT/Office Of Transportation Planning Geospatial Resources Section and the Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, InformationTechnology Division.

Produced by the Central Massachusetts Regional Planning Commission (CMRPC)
2 Washington Square, Union Station
Worcester, MA 01604

Figure VII-29 Triangle of ITS Influence

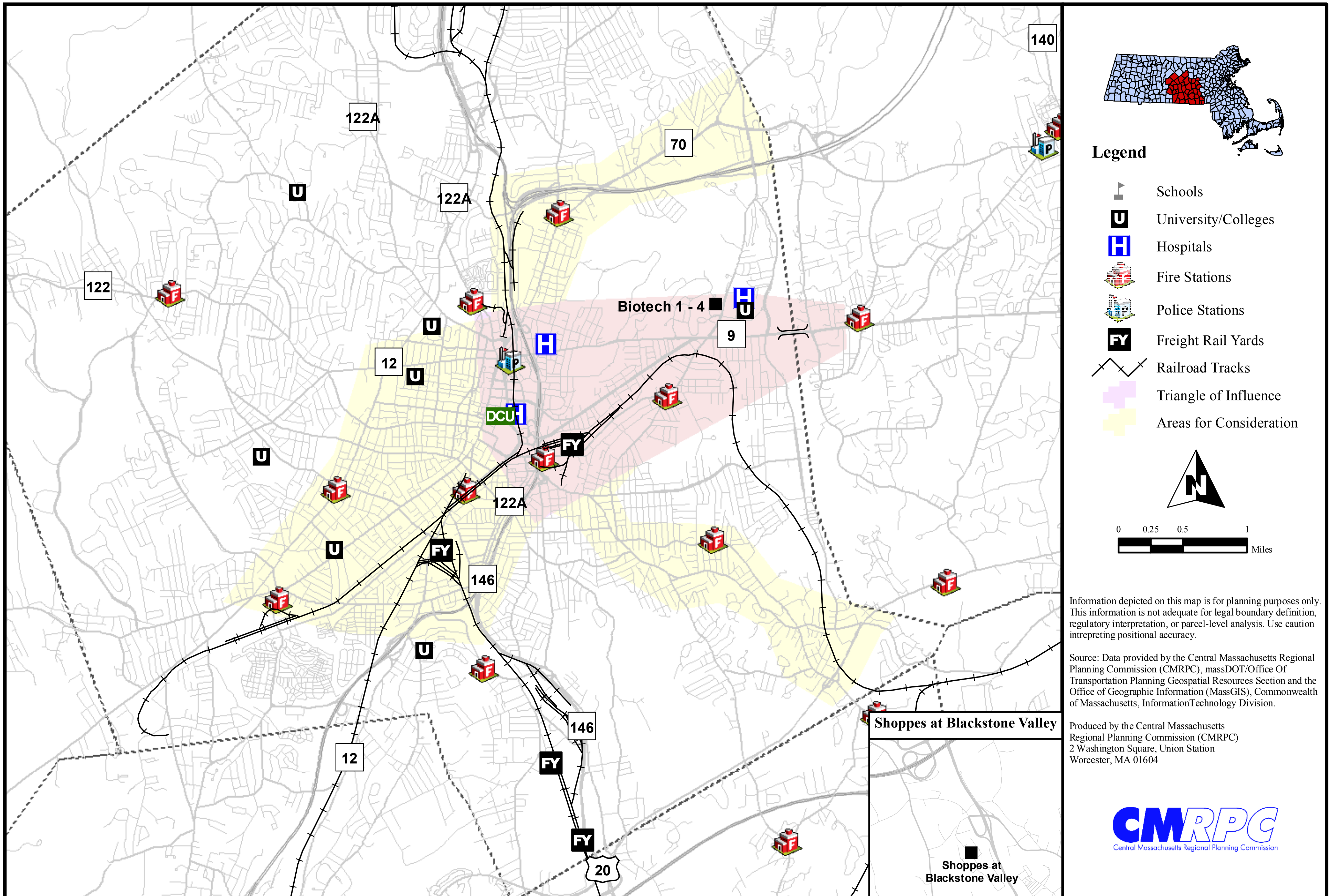


Figure VII-30 ITS Focus Area - Potential ITS Corridor

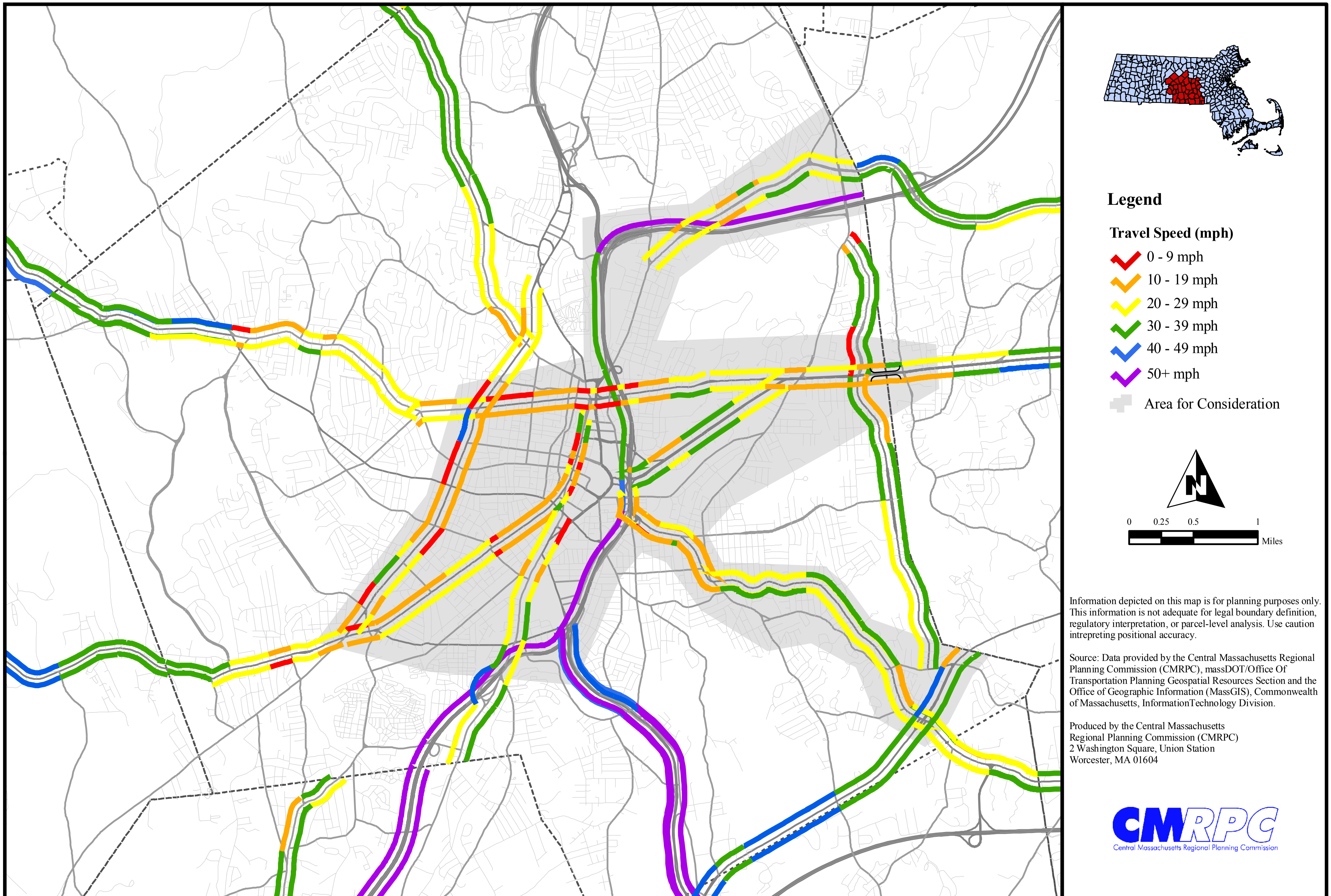


Figure VII-31 Available Travel Speed Data

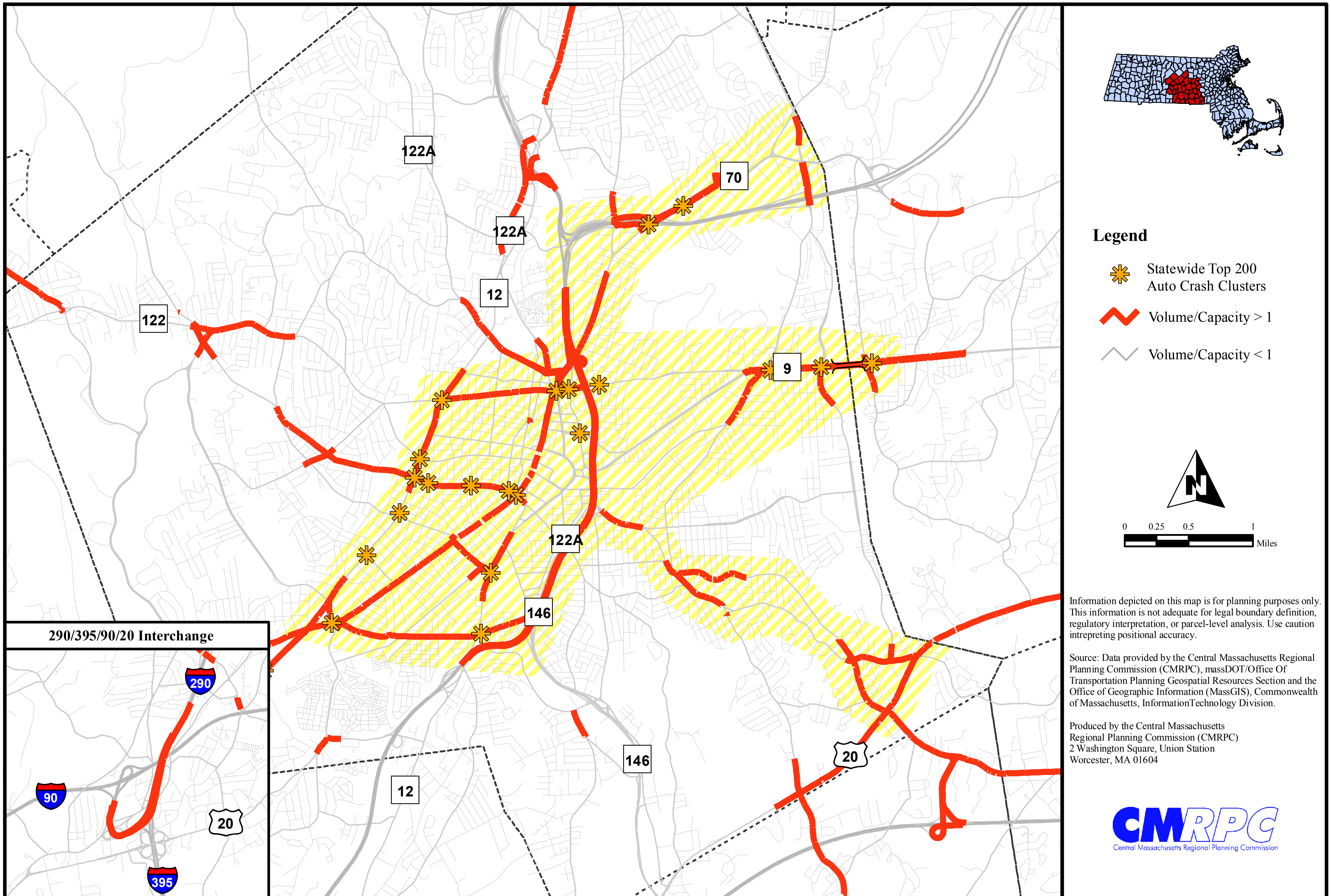


Figure VII-32 Volume to Capacity & Top Crash Cluster Locations

E.2.1 Variable Dynamic Message Signs

V/DMS are electronic traffic signs placed at strategic locations used to provide commuters with up-to-date information about special traveling circumstances, such as traffic congestion, accidents, road work, etc. By allowing drivers to divert, V/DMS can reduce the duration of congestion. Research has indicated that up to 30 percent of drivers are inclined to divert from their intended route when a V/DMS displays an incident or congestion ahead[2].

The Worcester Regional Mobility Study recommends that responsible parties identify candidate locations, communication methods, sign technology, and power options for overhead V/DMS in the short-term (0 to 5 years). Studies show that the existing V/DMS signs on I-290 are not positioned to adequately inform motorists of congestion at route decision points. An updated V/DMS system will dynamically display messages concerning delays, congested areas, and alternate route information to drivers on key roadways in the urban core with a focus on I-290. The system will be controlled by MassDOT, requiring improved coordination between Highway Operations Center and local officials, and would complement the statewide 511 system, which provides real-time traffic updates for major Massachusetts roadways, including routes and highways in Western Mass, Central Mass, and the South Coast. Current smart phone and GPS technology data sources would be used to help inform the V/DMS displays which provide drivers up-to-date information about the extent of the delay. The recommended V/DMS system needs to be partially automated, easily programmed, and low maintenance. In the mid-term (5 to 10 years), responsible parties should initiate design and construction for the V/DMS communication methods and sign structures (foundations and sign supports).

E.2.2 Transit Signal Priority Technology

TSP technology provides bus service the green light priority at signalized intersections using devices that communicate with each other. As a bus approaches an equipped signal, the green light time is extended or the red light time is reduced to minimize the time the bus is stopped at the signal. Signal priority can reduce bus travel times and open congested corridors for future transit service consideration.

Implementation of TSP in central Massachusetts' urban core will reduce bus travel times and open congested corridors up for consideration of new bus service. Recently completed before-after evaluations of TSP systems[3] revealed a reduction of bus travel times of 6 to 13 percent. On-time arrival rates at bus stops improved by 5 percent[4].

As recommended in the Worcester Regional Mobility Study, responsible parties should consider implementing TSP technology on WRTA buses and retrofit traffic signal equipment along the following corridors in the next five years: Shrewsbury Street (Worcester), Main Street (Worcester), Route 9 (Leicester), and Route 9/Park Avenue (Worcester). Park Avenue which may have potential for high ridership has limited to no transit service due to congestion. TSP technology could be used to introduce new bus routes along this corridor. However, more detailed corridor-level transit modeling is needed on

---

[2] *Investigating Limits of Benefits Provided by Variable Message Signs in Urban Network;* Transportation Research Record, A. Richards, M. McDonald; November 2007.

[3] *JTA ITS Signal Priority Program Study*; Jacksonville Transportation Authority; December 2007. *Transit Signal Priority Research Tools*; Federal Transit Administration; May 2008. ITE *Journal – Evaluation of TSP Using Observed and Simulated Data*; J. Zheng, et al; November 2009.

[4] *Transit Signal Priority Research Tools*; Federal Transit Administration; May 2008.

Park Avenue in Worcester to gauge the ridership gains from improved/new transit service along this corridor.

E.3 ITS Transit Priority Recommendations

The Regional Transportation Plan also envisions a public transportation system that uses state-of-the-art technologies to provide passengers with the latest information, improved service operations and enhanced passenger data collection to provide more reliable and predictable service. The ongoing WRTA ITS implementation addresses the needs and problems identified below and will promote the realization of the vision:

E.3.1 Technologies Related to Information Dissemination

Assuring that WRTA passengers are kept informed with the latest information and service updates is crucial to maintaining good public relations and attracting new passengers. These technologies will provide improved information dissemination to bus passengers and include the following:

- Automatic Vehicle Announcements (AVA) – AVA provides clear audio and visual messages for specific stops and locations along a bus route. These announcements can be broadcasted in multiple languages and assist passengers with hearing or visual impairments when riding the bus.
- Variable and Dynamic Message Signs (V/DMS) – The signs located at specific bus stops throughout the system provide real-time bus arrival notices to passengers waiting for a bus.
- Automatic Vehicle Locator (AVL) – The AVL system allows users with mobile device applications to see where their next bus is located on its route and when it will be arriving at their specific stop

E.3.2 Technologies Related to Improved System Operations

Passengers expect on-time service when using the WRTA. These technologies will provide for improved bus operations, on-time performance and reduction in passenger boarding times:

- Transit Signal Priority (TSP) – TSP technology, as previously noted, provides bus service green light priority at signalized intersections using devices that communicate with each other. TSP can reduce bus travel times, improve on-time performance and open congested corridors for future transit service consideration.
- Contactless Fare Collection – Contactless fare collection technology, known locally as “Charlie Card” technology, allows passengers to use pre-paid “smartcards” that can be read by a bus fare box to pay the fare, thereby reducing waiting times to board buses at stops.
- Automatic Vehicle Monitoring (AVM) – AVM measures, monitors, and reports the status of critical systems and components for every bus in the WRTA fleet, allowing the WRTA to meet increased ridership demands through greater operational efficiency.

In addition to the above, AVL technology can also improve operations performance. AVL allows dispatchers to see where buses are in relation to their schedule and dispatchers can then interact with drivers to help them maintain schedule.

E.3.3 Technologies Related to Passenger Data Collection

Obtaining data about the number of passengers on a bus is a crucial performance measure of a specific route. Obtaining this data manually is time consuming and labor intense. Using the following ITS technologies will allow the WRTA to obtain more accurate data more quickly, allowing for enhanced planning for improved bus operations:

- Automated Passenger Counting (APC) – APC technology counts the number of passengers that board or alight from a bus at a given stop along the route. APC data will allow WRTA planners and operations staff with more accurate passenger information by route over a daily, weekly, monthly and yearly period, as well as provide accurate passenger information for National Transit Database (NTD) reporting. This information, along with AVL and other operations data, will be used to determine the performance of a given route and where adjustments may need to occur.

E.3.4 Specific Locations for These Technologies

Most of the technologies outlined above will be installed on the WRTA's fleet of 47 buses by the end of 2012. These include AVA, AVL, AVM, APC and "Charlie Card" technologies. V/DMS technologies will be installed at the new Union Station "bus hub" when that project is completed and at specific location yet to be determined.

TSP has a longer planning horizon. Within the next five years, the WRTA, City of Worcester, the CMMPO and others will examine TSP implementation. A number of corridors in the region have been identified as potential candidates for TSP including:

- Shrewsbury Street (Worcester)
- Main Street (Worcester)
- Route 9/Park Avenue (Worcester)
- Route 9 (Leicester)

F. REGIONAL SECURITY PLANNING

In coordination with the Homeland Security council, in the coming years CMRPC will work with Montachusett Regional Planning Commission to develop the Worcester County Evacuation plan. Currently the scope for the first phase of the plan is being developed. The goal of phase one of the plan is to "Develop a data assessment/SWOT Analysis of existing conditions, to be used for the ultimate development of a county-wide evacuation plan".

This project will inventory and assess current data and conditions. A final report will identify data gaps and other information needs appropriate to a Phase II. Phase II is anticipated to include identification of evacuation scenarios, modeling of evacuation impacts against current conditions, and identification of recommendations for prioritization and implementation of a County-Wide Evacuation Plan. Phase III is anticipated to be development of a County-wide Evacuation Plan based on Phase II data and recommendations, as well as involvement of stakeholders. Phase III would include identification of routes, establishment of communications protocol, and implementation of publicity of such outcomes, including perhaps coded signage and development of standard messaging systems.

Phase I is primarily a data gathering experience. The project has been broken into several steps (Steps 1 through 3) as described below, and begun to articulate the data sets and considerations that lie within each task. This listing is intended to provide context and is not intended to be comprehensive.

The tasks will be conducted in a fairly linear manner. However, it is anticipated that the stakeholders identified in Task/Step 1 and a Stakeholder Group/Steering Committee may operate through this Phase I and even throughout the subsequent phases.

Step 1 – Stakeholders

- Identify key stakeholders
    - Homeland Security Council
    - American Red Cross
- Identify the role of the Stakeholder Group
- Identify key milestones for the stakeholder group

Step 2 – Inventory

- Assess Key demographics
    - Populations
        a) Identify and describe daytime and nighttime populations
        b) Population densities
        c) Special populations such as group quarters and EJ populations
    - Major employment centers
    - Hospitals
    - Natural Features such as Flood Plains and Critical Dams
- Assess Transport Systems
    - Overall Current Travel Patterns (to assess change needed in specific scenarios)
    - Private auto
        a) Roadway characteristics
        b) Congestion (Volume-to-capacity; Intersection Ratings)
        c) Bridge characteristics such as constraints and major water bodies
    - Transit (bus/rail/charter)
        a) Capacity
        b) Lines (rail has fixed routes)
        c) Private operators/charters
    - Communication Systems
        a) Inventory message boards, cameras, ITS

Step 3 - Data Analysis: Assessment of Significance for Evacuation Plan

- Shelter locations (Capacities/Vulnerabilities)
- Key travel corridors (Capacities/Vulnerabilities)

The data and analysis of all the three steps of Phase 1 mentioned above will be presented to the Homeland Security Council and the stakeholders identified as part of Step 1 of the process and working closely with the members potential evacuation scenarios would be identified and evacuations routes will be developed through travel demand modeling and GIS methods during the Phase 2 and 3 in the upcoming years.

G. PERTINENT STUDIES

Apart from the recommended federal programs and activities, various planning studies were performed in the last three years as part of the regular work program to assess various needs and provide recommendations to specific corridors in the region. Also, to address the mobility issues in the urban core of the central Massachusetts region, an extensive study through a partnership between CMRPC, CMMPO and MassDOT called the Worcester Regional Mobility Study was performed. The following are some of the highlights and the recommendations of the studies mentioned above.

G.1 Worcester Regional Mobility Study

The Worcester Regional Mobility Study (WRMS) is a partnership between the Central Massachusetts Metropolitan Planning Organization (CMMPO), the Central Massachusetts Regional Planning Commission (CMRPC), and the Massachusetts Department of Transportation (MassDOT). It is a comprehensive state-sponsored study of the transportation network within the greater Worcester area which includes the city of Worcester and the surrounding communities. The study's goal is to improve the movement of people and goods through the urban core of Central Massachusetts through:

- Reduced congestion;
- improved safety;
- improved transportation mode choice (transit, walking, bicycling opportunities);
- solutions that are environmentally-sensitive;
- strategies that support economic development;
- an open and inclusive study process;
- development of recommendations that target demonstrated needs; and
- development of a range of project-specific recommendations for priority areas that have long-term benefits.

Through analysis of existing and future demographic, land use, environmental, socioeconomic and transportation conditions, the study identified areas of the transportation network that require improvements, either infrastructure or system management improvements. A total of 21 alternatives were developed as part of this study to enhance regional mobility, out of which 13 were proposed for further consideration/study. These improvement alternatives were grouped as follows:

Group 1 – Regional Mobility Improvements

- **Alternative 4 -** New I-90/MassPike Interchange at Route 56 that follows Stafford Street
- **Alternative 7 -** Worcester "Central Corridor"
- **Alternative 8 -** Worcester "South Corridor"
- **Alternative 9 -** Route 9 Corridor Access Management

Group 2 – Solutions to Localized Intersection/Interchange Problem Areas

- **Alternative 13 -** Webster Square Improvements
- **Alternative 14 -** I-90/MassPike Interchange 10 Improvements
- **Alternative 15 -** I-290 Improvements
- **Alternative 16 -** Synchronize Traffic Signals along Key Corridors

Group 3 – Multimodal Improvements

- **Alternative 17 –** ITS Initiatives (Roadway and Transit)
- **Alternative 18 -** Commuter Rail Enhancements/Extensions
- **Alternative 19** - On-road Bike Lanes and Regional Bicycling Connections
- **Alternative 20** - Improved Pedestrian Mobility
- **Alternative 21 -** Freight System Enhancements

These alternatives are summarized in the Table VII-11 and map (Figure VII-33) below.
The study has also developed an operations and management plan to identify the recommended next steps for each of the varying types of improvements. The recommended list of projects was divided into two categories: transportation systems management and operations (TSM&O) and major infrastructure projects (MIP) (see "Comment" column in Table VII-11). TSM&O projects allow transportation agencies and municipalities to enhance the safety, reliability and operations of transportation systems in the *near term* without incurring the high cost associated with major infrastructure projects. Alternatives classified as major infrastructure projects will require significant more time and resources to proceed from inception to implementation. To varying degrees, each will need to progress through the environmental review process, as established by Federal and State agencies.

It is acknowledged that the recommendations presented herein represent a significant (greater than $100 million) investment in potential transportation-related infrastructure. These projects represent an investment in total that currently far exceeds available funding as presently programmed. The advancement of the recommendations developed as part of this study will require prioritization by regional planning organizations in order to address current fiscal constraints as related to transportation improvements.

Table VII-11 Summary of WRMS Recommendations

Short-term (0 to 5 years)	**Mid-term (5 to 10 years)**	**Long-term (over 10 years)**	**Cost (2010)***	**Comment**
		Alternative 4 New I-90/ MassPike Interchange at Route 56 that follows Stafford Street	$60-75M	**MIP** - Under a phased approach, Alternative 4 would be preceded by a series of short and mid-term alternatives while additional environmental review and community vetting occurs to determine the viability and need for this project given the significant investment that would be required
	Alternative 7 Worcester "Central Corridor"		$12-15M	**MIP -** Alternative 7 compliments Alternatives 16, 20, and 21
	Alternative 8 Worcester "South Corridor" Excluding the I-290/Hope Avenue Interchange	**Alternative 8** Worcester "South Corridor" I-290/Hope Avenue Interchange	$10-12M	**MIP -** Alternative 8 compliments Alternative 13; Engineering design is needed for the reconfigured I-290/Hope Avenue interchange and corridor upgrades to Hope Avenue and Webster Street
Alternative 9 Route 9 Corridor Access Management	**Alternative 9** Route 9 Corridor Access Management		$1-2M	**TSM&O*** -** Alternative 9 compliments Alternative 16 where traffic signals on Route 9 would be upgraded and synchronized.
	Alternative 13 Webster Square Improvements		$1.5-3M	**MIP -** Alternative 13 compliments Alternative 8; Engineering design and refinement of Alternative 13 is needed to account for the reconfigured I-290/Hope Avenue interchange recommended under Alternative 8
Alternative 14 I-90/MassPike Interchange 10 Improvements			$1M	**MIP -** Options considered to improve Interstate-to- Interstate connections and I-290 U-turns all involved additional elevated structures and were therefore not carried forward
Alternative 15 I-290 Traffic Flow/Safety Improvements			N/A	**MIP** -** During the fall of 2010, MassDOT implemented the restriping recommended under Option 15-3b; Mainline widening and ramp elimination is not recommended

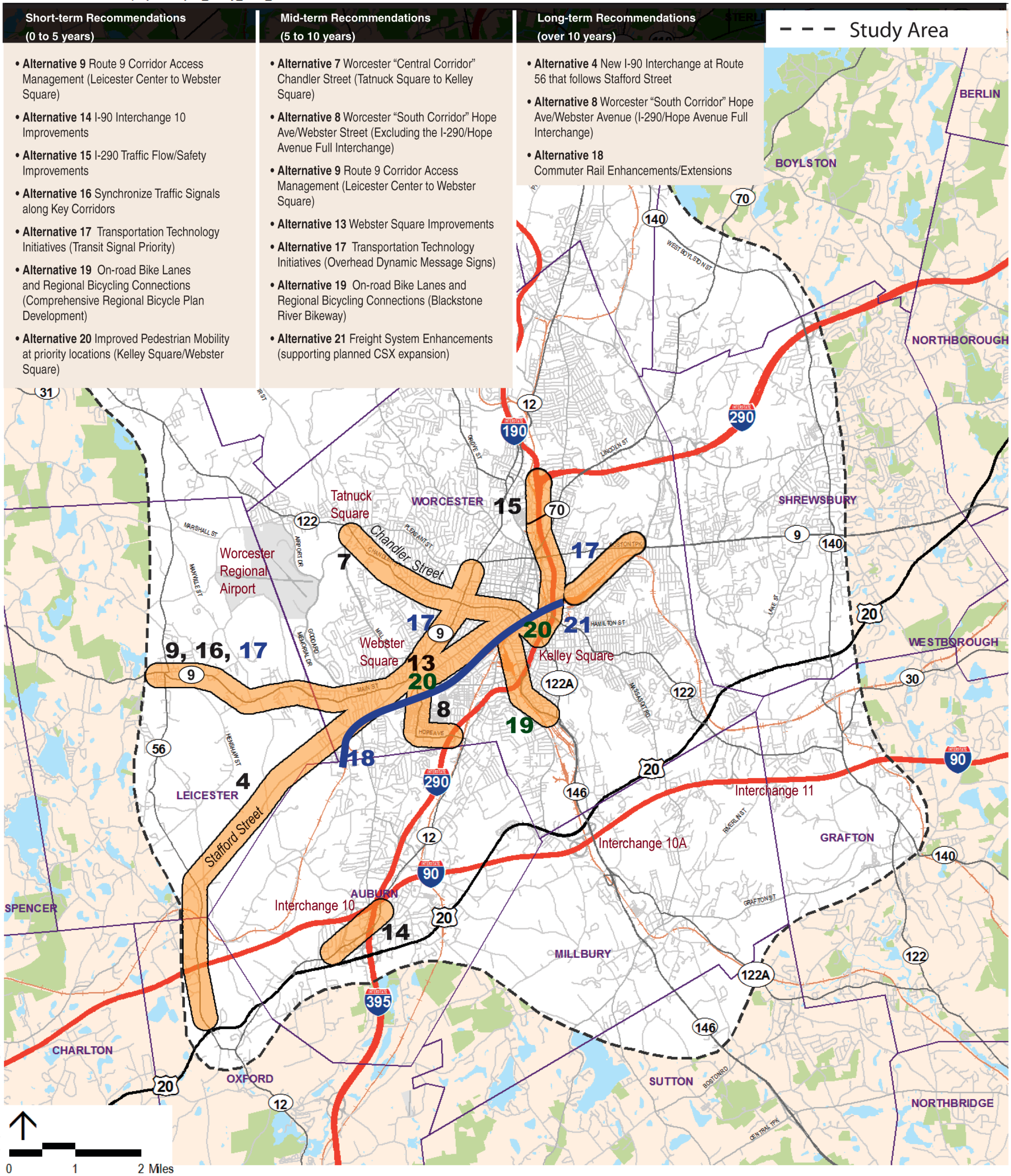
*Construction cost estimates based on 2010 pricing **MIP - Major Infrastructure Project
***TSM&O - Transportation Systems Management and Operations Project

Table VII-11 (cont.) Summary of WRMS Recommendations

Short-term (0 to 5 years)	Mid-term (5 to 10 years)	Long-term (over 10 years)	Cost (2010)*	Comment
Alternative 16 Synchronize Traffic Signals along Key Corridors			Varies by corridor ~ $30-50k per signal	**TSM&O*** -** Identify priority corridors and then inventory signal equipment (controllers and signal heads/mast arms) to develop synchronized timing/phasing plans (refinements to the corridors and limits are expected)
Alternative 17 ITS Initiatives (Roadway and transit)	**Alternative 17** ITS Initiatives (Roadway and transit)		Varies	**TSM&O -** Early action items can be initiated in the short-term, including the TSP implementation and the planning phase of the ITS elements, with construction of the VMSs following in the mid- term; Detailed transit modeling is recommended in the near-term on Park Ave in Worcester to gauge the ridership gains from improved/new transit service
		Alternative 18 Commuter Rail Enhancements/ Extensions	Further study needed	**MIP -** Additional trains between Worcester and Boston are expected to occur with the planned expansion of the CSX intermodal facility on Franklin Street; the feasibility of extending the existing commuter rail service further west should be revisited over the long-term as the region grows
Alternative 19 On-road Bike Lanes and Regional Bicycling Connections	**Alternative 19** On-road Bike Lanes and Regional Bicycling Connections		Individual projects vary Blackstone Bike Path Segment 7 $1.2 – 1.5M	**TSM&O -** The development of a comprehensive bike plan for each College/University in the Study Area and an updated City-wide bicycle plan for the City of Worcester could be initiated in the short-term; prioritize high crash areas
Alternative 20 Improved Pedestrian Mobility			Individual projects vary	**TSM&O -** Many of the priority areas could be addressed with low-cost improvements; others may require a longer-term approach
Alternative 21 Freight System Enhancements (Truck signage plan to complement CSX plans)	**Alternative 21** Freight System Enhancements (Kelley Square Bypass/Tandem- truck lot expansion)		Further study needed	**MIP -** Includes truck signage plan, Kelley Square bypass, and I-90/MassPike Interchange 11 Tandem-truck Lot Expansion

*Construction cost estimates based on 2010 pricing **MIP - Major Infrastructure Project ***TSM&O - Transportation Systems Management and Operations Project

\\Mawatr\ts\10640.00\GIS\project\Project_Study_Area_8x11.mxd



Vanasse Hangen Brustlin, Inc.

Figure VII-33

Study Recommendations

Source:
Office of Geographic and Environmental Information (MassGIS),
Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs

\\Vhb\proj\Wat-TS\10640.00\graphics\FIGURES\recommendations.indd

G.2 Corridor Profile - Transportation Management System

A *Corridor Profile* correlates the information generated by the transportation Management Systems along a particular highway corridor and analyzes performance-based data, suggests both operational and physical improvements, and may identify candidate projects for further study. Utilizing the range of data and analyses produced by the various transportation Management Systems maintained in an ongoing manner by the CMRPC staff and overseen by the CMMPO, Corridor Profile efforts allow for the comprehensive integration and consideration of a wide range of transportation planning factors along CMMPO selected segments of the region's federal-aid highway system. Ultimately, a number of suggested improvement options are compiled for the consideration of the host communities and MassDOT-Highway Division. When consensus is reached, proposed improvement projects have the potential to be selected by the CMMPO for programming in the annual Transportation Improvement Program (TIP) document.

Corridor Profile efforts include the analysis of a range of Management System data, including the following:

Traffic Counting: Daily Automatic Traffic Recorder (ATR) counts on roadway segments and MassDOT Permanent Count Station data and associated historical growth rates calculated in-house using the regional travel demand model

Congestion Management Process (CMP): Historical and current Travel Time & Delay studies; historical and current peak-hour Turning Movement Counts (TMCs) at focus intersections and associated Level of Service (LOS) analyses

Transportation Safety Planning Program: In-depth vehicle crash research in cooperation with local Police Departments utilizing a three-year history of reported crashes and subsequent analysis, including the compilation of collision diagrams and the calculation of crash rates

Freight Planning: Daily percentage of heavy vehicles utilizing the studied roadway segments and peak hour percentage of heavy vehicles utilizing focus intersections

Pavement Management System (PMS): Observation of pavement surface distress and extent in the field along with subsequent analysis and calculated Overall Condition Index (OCI) rating

Bridge Management System (BMS): Bridge condition data available through MassDOT, a GIS-based inventory of roadway drainage culverts as well as local observations in the field

Environmental Consultation: Recently added as another Corridor Profile component, the compilation of "Environmental Profile" maps using data provided by the Massachusetts Department of Conservation & Recreation (DCR), the Massachusetts Department of Environmental Protection (DEP) and the National Heritage & Endangered Species Program (NHESP) has proven useful in the identification of a range of environmental constraints and challenges. Focusing ½ mile on each side of the roadway corridor, the Environmental Profile maps allow major natural features to be viewed as systems, not simply as features adjacent to the roadway

Alternative Mode Analysis: A review of existing transit, bicycle and pedestrian conditions is provided, as well as an assessment of the potential to improve availability of alternative modes.

Depending on local sentiment and available funding, the technical work necessary to compile a Corridor Profile is supplemented by a proactive public outreach effort. This can range from basic meetings with local officials to the formation of a Task Force to guide the study and gauge the sentiment of the host community in a range of venues. All proceedings are documented in order to guide potential future design efforts.

The first *Corridor Profile* was prepared as part of the CMMPO's Transportation Management Systems program during the 2005 Program Year. Corridor Profile efforts completed to date are summarized in Table VII-12 and are also presented on a color coded map shown in Figure VII-34. As can be seen, Corridor Profile work has been completed in each of the CMRPC defined planning subregions. It should also be pointed out that work on the Route 122 Scenic Byway study was conducted with the Montachusett Regional Planning Commission (MRPC) and Franklin Regional Council of Governments (FRCOG). Similarly, the Route 140 Corridor Profile was managed cooperatively with the MRPC transportation staff. The Routes 12/16/197 Corridor Profile was also presented to the Northeastern Connecticut Council of Governments (NECCOG) for there use and reference.

Table VII-12
Integration of the Management Systems:
Recent "Corridor Profile" Studies

Route 9 East Corridor Profile: Shrewsbury-Northborough-Westborough (2005)

Route 20 West Corridor Profile: Auburn-Oxford (2006)

Route 9 West Corridor Profile: Worcester-Leicester-Spencer (2007)

Routes 12/16/197 Corridor Profile: Douglas-Webster-Dudley & Thompson, CT (2008)

Route 122 Scenic Byway Corridor Management Plan: Paxton to Petersham (2009), transportation sectional materials, *conducted with Montachusett Regional Planning Commission (MRPC) and Franklin Regional Council of Governments (FRCOG)*

Route 140 Corridor Profile: Princeton-Sterling-Westminster (2009-2010), *conducted with MRPC*

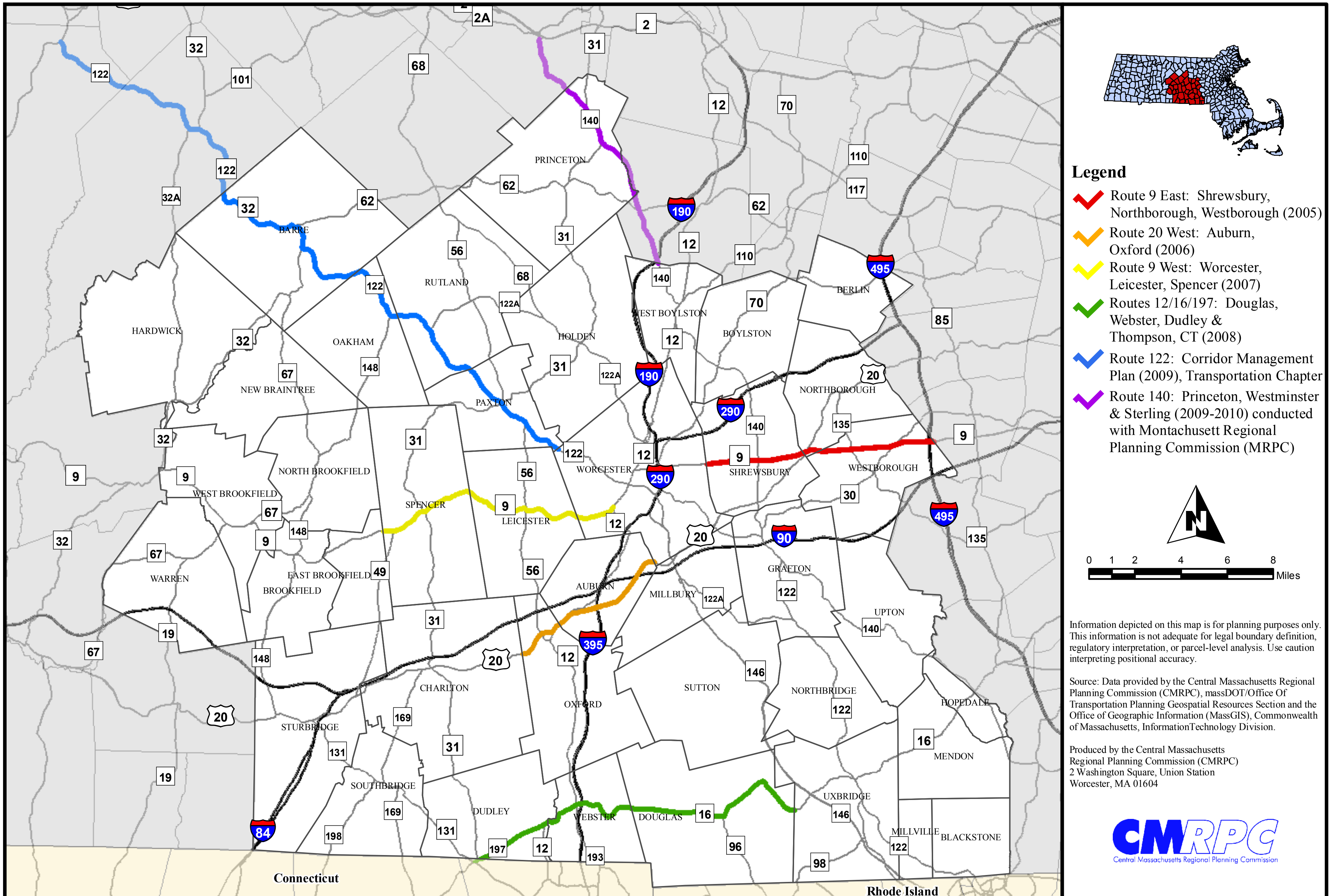


Figure VII-34 Recent Corridor Profile Studies

G.3 Access Management

In an effort to integrate transportation and landuse, access management plans were developed in three different corridors as discussed previously. Evaluation of the ability to safely access the existing or proposed land uses from the roadway and/or from adjacent parcels was done. The site design standards currently in place and their ability to provide for efficient vehicle, transit, bicycle, and pedestrian movement were reviewed. Guidelines and recommended standards are being developed to help ensure that communities and other regulating authorities consider both internal and external vehicle, transit, bicycle, and pedestrian access in the planning, design, permitting, and project approval stages. Some of the highlights and recommendations of the access management plans are listed below:

Highlights of previous work

- Access Consolidation and Elimination
    - Conducted site visits of the study corridor (Route 122A) in the town of Holden and selected parcels that had a potential to implement access consolidation and/or elimination. Discussed the observations and feasibility of each case with town officials and made mid-term improvement recommendations.

- Frontage Road
    - Identified the constraints for a potential frontage road in the eastbound commercial area on Route 9 in the town of Westborough and recommended an alternative frontage road.
    - Analyzed a potential frontage road on the westbound side of Route 9 between Route 135 and Lyman Street in the town of Westborough. During the study, CMRPC staff made recommendation of using Oak Street as a possible frontage road for Route 9.

- Land Development and Access Management
    - Studied existing and future land use pattern of study corridors and provided some sample policies that can be adapted to town zoning bylaw, subdivision regulations, site plan approval and development review.

- Interchange Area
    - Indentified access issues near the Route 9/Route 30 interchange area in the town of Westborough and provided both regulatory and non-regulatory methods that can be used to achieve access management objectives for interchange areas.

- Other Access Management Techniques
    - Median treatments, including two-way left-turn lanes and raised medians.
    - Access spacing, including spacing between signalized intersections and distance between driveways.
    - Driveway design elements (width & radii) based on driveway classifications.
    - Driveway throat lengths based on land use.
    - Transit and Bicycle/Pedestrian accommodations.

H. NEXT STEPS

H.1 Recommended Major Infrastructure Projects

As indicated earlier in the Regional Transportation Plan, priority areas were developed in cooperation with various decision makers and the stakeholders to address the Federal and State emphasis areas and locally based transportation issues. Suggested major infrastructure projects derived through the public process were evaluated using a evaluation matrix shown in Table VII-13. The priority areas of the matrix are listed below along with the questions each attempts to answer:

- ***Maintenance:*** Does the project aid in the preservation of existing systems (highway/transit/railroads)?
- ***Equity:*** Does the project distribute funds across various modes, communities and populations?
- ***Security:*** Does the project help to make the transportation system more secure? Is the project a vital link for evacuation in the event of an emergency?
- ***Congestion:*** Does the project alleviate congestion and delays?
- ***Safety:*** Does the project make the multi-modal system, safer for passengers?
- ***Access & Connectivity:*** Does the project fill a notable the gap in the transportation network or missing connection across various modes?
- ***Livability:*** Does the project provide access to multi-modal uses and promote sustainability through the coordination of economic development, housing, environment, and health?
- ***Climate Change:*** Does the project reduce green house gas (GHG) emissions or relate to facilities that would be affected by global climate change?
- ***Planning:*** Does the project involve public participation and foster sub-regional dialogue?
- ***Technology:*** Does the project involve use of technology to improve safety and efficiency of the transportation network?

As shown in the matrix all projects selected for inclusion by the CMMPO on the recommended major infrastructure projects listing rate favorably under the established priority criterion. The *WRTA – Transit Hub and the Commuter Rail Expansion* projects have an overall positive impact on all or most of the established criterion. On the other hand, widening of existing facilities such as *Route 20 widening* have a negative impact on air quality.

Table VII-13
Priority Areas Evaluation Matrix

Recommended Major Infrastructure Projects / Priority Areas	Maintenance	Equity	Security	Congestion	Safety	Access & Connectivity	Livability	Climate Change	Planning	Technology
Worcester - Route 20 Widening to 4 lanes	☑	⊖	⊖	☑☑	☑☑	☑☑	☑☑	☒	⊖	☑
Sutton - Route 146/Boston Rd Intersection improvements	⊖	⊖	⊖	☑☑	☑☑	⊖	☑	☑	⊖	⊖
Charlton, Oxford - Route 20 Widening to four lanes	☑☑	⊖	⊖	☑	☑	☑☑	⊖	☒	⊖	⊖
I495/Turnpike and I-495/Route 9 Intechange improvements	☑	☑	⊖	☑☑	☑☑	☑☑	☑☑	☑☑	☑☑	☑
Worcester - East/West Central Corridor. Rte 122/122A Madison/Chandler Street Intersection improvements	⊖	☑☑	⊖	☑	☑☑	☑☑	☑☑	☑	☑	☑
Worcester - East/West South Corridor. Full interchange at Hope Ave and related roadway improvements	⊖	☑☑	⊖	☑☑	☑☑	☑☑	☑☑	☑	☑	☑
Sutton - Route 146/Boston Rd New Interchange	⊖	⊖	☑☑	☑☑	☑☑	☑☑	⊖	☑	⊖	⊖
WRTA - Transit Hub	⊖	☑☑	☑☑	☑	☑☑	☑☑	☑☑	☑☑	☑☑	☑☑
WRTA - New Management & Operations Facility	☑☑	⊖	☑	⊖	☑	☑	☑	☑	☑☑	☑☑
Boston/Worcester Communter Rail Expansion	☑☑	☑☑	☑	☑☑	☑	☑☑	☑☑	☑☑	☑☑	☑

Key

⊖ Neutral Impact
☑☑ Very Positive Impact
☑ Positive Impact
☒ Negative Impact

H.2 Future Studies

Supplementing the major infrastructure needs previously described, a listing of potential planning studies and projects that the CMMPO anticipates to study/implement during the upcoming years. Capacity additions will be difficult to fund, and thus there is a need to reduce demand through implementation of new Transportation System Demand Management strategies.

Low cost strategies that reduce the need for larger capital projects will become more important. Such low cost strategies might be identified through Safety Audits, planning studies, or through greater use of technology. The CMMPO supports the use of target funding to perform engineering analyses that can lead to low cost strategy implementation, such as traffic synchronization analyses to mitigate congestion. Identification of a wide-range of implementation strategies for low cost improvements will be a major focus in the coming years.

In order to address some of the issues described above and to work on the new thrusts from Federal Highway Administration and MassDOT, the following studies/projects will be performed in the upcoming years.

- ***Park and Ride Study:*** Investigate the potential for park and ride lots at strategic locations in the region, serving to reduce Single Occupancy Vehicle (SOV) trips.

- ***Trucking (Freight) Analysis:*** Analysis of preferred highway trucking routes and intermodal connectivity.

- ***Worcester Regional Mobility Study:*** Implementation or further study of the Worcester Regional Mobility Study recommendations as appropriate.

- ***Livability/Sustainability/Climate Change/Greenhouse Gas Reduction strategies:*** Multi-faceted approach.

- ***Previous Annual Work Program Studies:*** Catalogue past recommended improvements for low cost options and facilitate implementation of recommendations.

- ***MassCentral Railroad Capital Improvement:*** **As deemed necessary, i**nvestigate the possibility of funding MassCentral Railroad track rehabilitation between Palmer and South Barre to keep the line serviceable (track also located in Pioneer Valley Metropolitan Planning Organization).

- ***ITS Technology Studies/Implementation:*** Work with regional ITS coordinating committee to effect implementation of regional ITS priorities, including I-290 congestion monitoring.

- ***Bicycle/Pedestrian Plan:*** Implementation of recommendations.

- ***Transit:*** Continue to investigate the ability to serve new employment markets and develop creative ways to serve lower density areas.

- ***Low cost Strategic Improvements:*** Identification of a wide-range of implementation strategies for low cost improvements (signal synchronization, signage plans, Roadway Safety Audits recommendations).