

Chapter 11 - SAFETY



Chapter 11 – Safety

Introduction

Roadway safety is a problem in the MMPO region as described in this section. However, safety in the MMPO region should significantly improve at roadway locations where a high number of crashes, fatal crashes, and injury crashes occur as the improvements offered by complete street concepts are implemented. Complete streets concepts have routinely shown to improve safety at the majority of the locations where they have been implemented. This is especially true at locations where transit, pedestrian, and bicycles are significant forms of transportation.

MMPO High Crash Locations and Crash Severity

MassDOT 2010-2012 High Crash Locations within the MMPO region

The MRPC categorizes the MassDOT 2010-2012 High Crash Locations for MMPO region as follows:

- Aggregate Locations** – The most numerous, these are locations that experienced a high number of crashes over the 3-year period involving all types of crashes, all classes of motor vehicles, all crashes involving pedestrians, and all crashes involving bicycles. Many of these crashes resulted in at least 1 fatality or 1 injury.
- Pedestrian Locations** – Often a subset of Aggregate Locations, these are locations that experienced a high number of crashes involving pedestrians with all classes of motor vehicles and bicycles over a 10-year period. Pedestrian crashes that occurred during the 3-year period of the Aggregate Location category will also be in this category.
- Bicycle Locations** – Often a subset of Aggregate Locations, these are locations that experienced a high number of crashes involving bicycles with all classes of motor vehicles and pedestrians over a 10-year period. Bicycle crashes that occurred during the 3-year period of the Aggregate Location category will also be in this category.

2010-2012 MMPO Region Aggregate Locations Table

The 2010-2012 MMPO Region Aggregate Locations Table (Table) is comprised of all the Aggregate Locations in the MMPO region from 2010-2012 and compares them to the high crash locations used in the 2012 RTP which relied on MassDOT 2006-2008 high crash locations. The Aggregate Locations occurred at the interchanges, intersections, and on roadways in between the intersections and interchanges of the transportation network. There are 91 Aggregate Locations in 11 municipalities in the Table.

Table description:

- The Table is the source of most of the analysis in this section
- If applicable, the Table provides project status, road safety audit (RSA) status, primary improvement and project cost information
- Where more than 1 Aggregate Location can be found on a corridor they are categorized by Aggregate Location corridor (see Table 11-1A: Aggregate Location Corridors below)
 - Example: the 5 Aggregate Locations on John Fitch Highway are in the John Fitch Hwy Aggregate Location Corridor. There are 12 Aggregate Location corridors and 11 Isolated Aggregate Locations (see Table 11-1B: Isolated Aggregate Locations)



- Where an Aggregate Location had a counterpart high crash location in the 2006-2008 3-year period of the 2012 RTP they are acknowledged (see Tables 11-1A and 11-1B below)
 - Example: from 2010-2012, 3 Aggregate Locations occurred on the Elm/Green Street Aggregate Location Corridor in Gardner. Two of the Aggregate Locations had counterparts that were high crash locations during the 2006-2008 3-year period of the 2012 RTP which has been acknowledged in the Table. Eleven of the 12 Aggregate Location corridors had Aggregate Locations with counterparts in the 2006-2008 3-year period of the 2012 RTP
- The 4 MMPO region MassDOT 2012 *Top Crash Locations Report* intersections (see below) are included in the Table and are part of Aggregate Location corridors
- The Aggregate Location corridor portion of the 2010 – 2012 Aggregate Locations is provided
 - Example: the Route 12 Aggregate Location Corridor is the top corridor. 22% (20 of 91) of the total Aggregate Locations are in the corridor

Why Aggregate Location Corridors?

The goal of Aggregate Location corridors is to recognize that investment strategies to improve safety should address more than just one discrete location to improve safety when there are safety problems at other locations along a corridor. Safety improvement investment strategies should be developed along the full length of the corridor or at least over the roadway length of several Aggregate Locations. However, it must also be recognized that this may not always be possible due to various circumstances so that only projects at a discrete intersection or other location along an Aggregate Location corridor can be completed.

Table 11-1A: Aggregate Location Corridors (locations are mapped on Figure 2)

| AGL* Corridors | Municipalities | # of AGLs | | |
|--------------------------|----------------|-------------|-------------|------------------------------|
| | | 2010 - 2012 | 2006 - 2008 | % of Total AGLs: 2010 - 2012 |
| Electric Ave | FITCHBURG | 2 | | 2.2% |
| Elm/Green Street | GARDNER | 3 | 2 | 3.3% |
| John Fitch Hwy | FITCHBURG | 5 | 2 | 5.5% |
| Leominster Rd | STERLING | 2 | 1 | 2.2% |
| Pratt Road | FITCHBURG | 2 | 1 | 2.2% |
| Route 12 | FITCHBURG | 7 | 2 | 22.0% |
| | LEOMINSTER | 13 | 8 | |
| Route 13 | LEOMINSTER | 6 | 2 | 6.6% |
| Route 2 | FITCHBURG | 1 | 1 | 17.6% |
| | GARDNER | 2 | | |
| | HARVARD | 1 | 1 | |
| | LANCASTER | 2 | 2 | |
| | LEOMINSTER | 5 | 3 | |
| | WESTMINSTER | 5 | 2 | |
| Route 2A | FITCHBURG | 7 | 4 | 9.9% |
| | LUNENBURG | 2 | 2 | |
| Route 68 | GARDNER | 8 | 4 | 8.8% |
| Routes 12, 2A, 31 | FITCHBURG | 3 | 1 | 3.3% |
| South St/ Merriam Ave | FITCHBURG | 3 | 3 | 4.4% |
| | LEOMINSTER | 1 | | |

*AGL = Aggregate Location

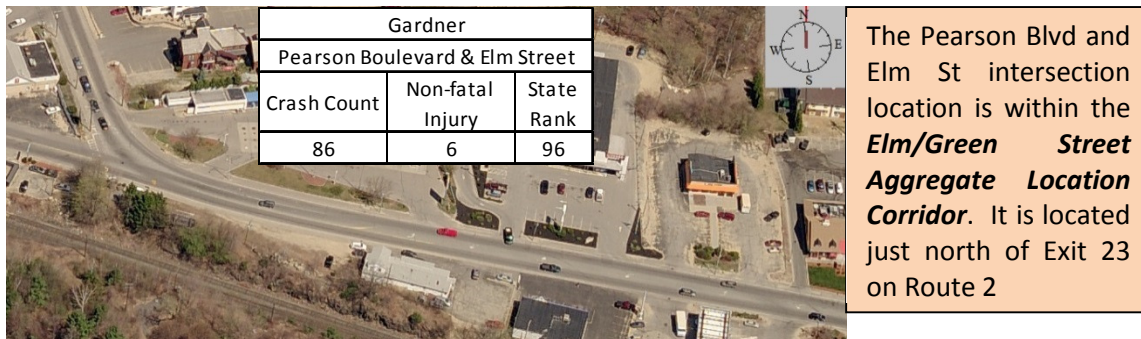


Table 1B: Isolated Aggregate Locations (locations are mapped on Figure 2)

| Municipalities | Isolated AGLs* at Intersections and Interchanges | | | | 2010 - 2012 | 2006 - 2008 |
|---------------------------|--|------|-------------------------|---|----------------|----------------|
| | Street 1 | Rt # | Street 2 | Rt # | | |
| ASHBURNHAM | CENTER STREET | 101 | WILLIAMS/COREY HILL RD | | X | X |
| ATHOL | S MAIN STREET | 2A | BROOKSIDE ROAD | | X | |
| FITCHBURG | AIRPORT ROAD | | BEMIS ROAD | | X | X |
| LANCASTER | OLD UNION TURNPIKE ** | | LUNENBURG ROAD ** | 70 | X | |
| LANCASTER | MAIN STREET | 117 | LUNENBURG ROAD | 70 | X | |
| LEOMINSTER | MILL STREET | | HAWS STREET | | X | X |
| LEOMINSTER | LEOMINSTER CONNECTR | | NASHUA STREET | | X | |
| LEOMINSTER | INTERSTATE 190, Exit 7 | I190 | RMP-RT 190 SB TO RT 117 | | X | |
| LEOMINSTER | WEST STREET | | PARK STREET | | X | X |
| STERLING | INTERSTATE 190, Exit 5 | I190 | RMP-RT 190 SB TO RT 140 | | X | |
| WINCHENDON | SPRING STREET | 12 | GARDNER ROAD | 140 | X | |
| *AGL = Aggregate Location | | | | **FYI, Crashes not applicable due to 2013 roundabout construction but location still included in analysis | | |

MassDOT: 2012 Top Crash Locations Report (Report)

The Report identifies the top 200 most unsafe non-interchange (or Exits) intersection locations in the entire State. Within the MMPO region there are 4 intersections in the Report that occurred in 3 municipalities. The intersections are duplicated in the *2010-2012 MMPO Region Aggregate Locations Table* and are analyzed in the sections below. They are not analyzed here. The intersections are illustrated below. At this time no plans have been brought forth to improve safety at these intersections.



(Intersections continued below)



The North Main Street & Hamilton Street intersection location and the North Main Street & Nelson Street intersection location are within the **Route 12 Aggregate Location Corridor**. They are located just south of Exit 31 on Route 2 and are approximately 500-700 feet apart

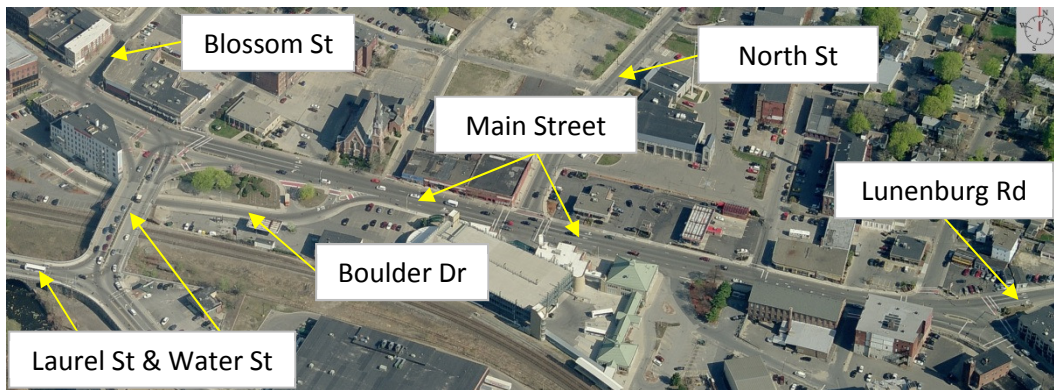


The Water Street and Central Plaza location is within the **Route 12 Aggregate Location Corridor**. It is located just south of the Water Street Bridge



Concurrent and Nearby: Aggregate Locations / Bicycle Locations / Pedestrian Locations

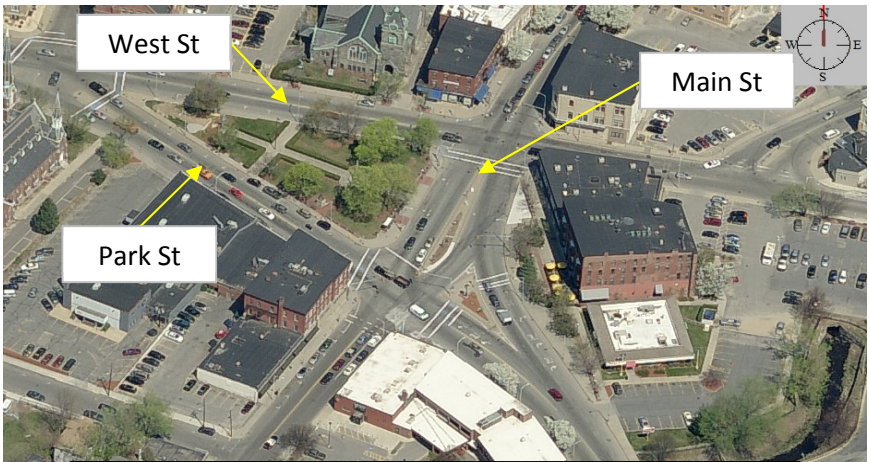
In downtown Fitchburg, a segment of Main Street from Blossom Street to Lunenburg Road, a distance of approximately 1/3 of a mile, experienced concurrent Aggregate Locations (5)/Bicycle Locations (2)/Pedestrian Location (1) and a nearby Aggregate Location occurred at the Water Street and Laurel Street intersection on the south side of the Water Street Bridge. The figure below shows the Main Street segment and the Water Street and Laurel Street intersection. This is the only road segment in the MMPO that experienced these events concurrently. The Main Street locations are within the **Route 2A Aggregate Location Corridor** while the Laurel Street location is within the **Route 12 Aggregate Location Corridor**. The table below provides crash info that includes the number of Fatal, Injury, and PDO crashes.



| Fitchburg | Street 1 | Street 1 Route # | Street 2 | Street 2 Route # | Total Crash Count | Fatal | Injury | PDO |
|---------------------|----------|------------------|-------------------------|------------------|-------------------------|-------|--------|-----|
| Locations | Main | 2A | North | | 34 | | 7 | 27 |
| | Main | 2A | Lunenburg | 2A | 35 | | 4 | 31 |
| | Main | 2A | | | 29 | | 4 | 25 |
| | Main | 2A | Water | 2A | 24 | | 4 | 20 |
| | Main | | Blossom | | 23 | | 3 | 20 |
| | Water | 12 | Laurel | 2A | 22 | | 3 | 19 |
| | | | | TOTALS | 167 | | 25 | 142 |
| | | | | | Bike Crash Count | | | |
| Bicycle Locations | Main | 2A | Lunenburg | 2A | 6 | | 4 | 2 |
| | Main | 2A | Boulder Dr | | 5 | | 3 | 2 |
| | | | | TOTALS | 11 | | 7 | 4 |
| | | | | | Ped Crash Count | | | |
| Pedestrian Location | Main | 2A | Boulder Dr to Lunenburg | 2A | 32 | | 20 | 12 |



Located in downtown Leominster, Monument Square experienced a concurrent Aggregate Location (1)/Pedestrian Location (1). The figure below shows Monument Sq. The table below provides the crash info. The Square is within the **Route 12 Aggregate Location Corridor**.



| | | | | | |
|------------------------|-----------------|-------------------------|-------|--------|-----|
| Leominster | Intersection | Total Crash Count | Fatal | Injury | PDO |
| Location | Monument Square | 32 | | 4 | 28 |
| | | Ped Crash Count | | | |
| Pedestrian Location | Monument Square | 7 | | 5 | 2 |

Over a distance of approximately 3/4 of a mile, downtown Gardner experienced concurrent Aggregate Locations (3)/Pedestrian Location (1), a nearby Aggregate Location, and a nearby Pedestrian Location. The Parker/ Pleasant Street nearby Pedestrian Location is shown below and is located just north of the concurrent Aggregate Locations (3)/Pedestrian Location (1) on Main Street. The table below provides the crash info.



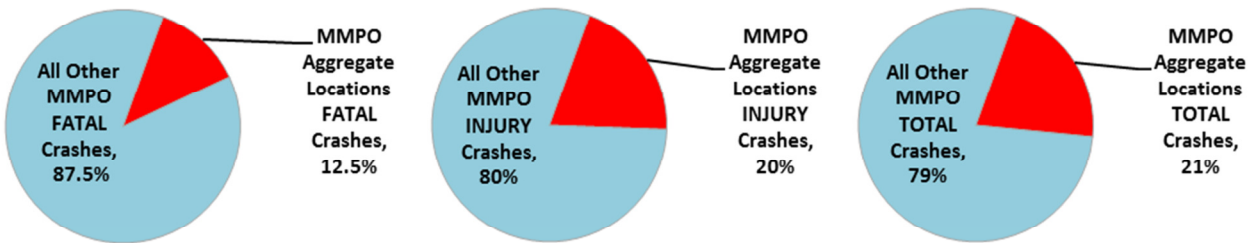
The Main/Pleasant Street Pedestrian Location is shown below and is located just south of the Parker/Pleasant Street Pedestrian Location and includes all the labeled roads shown below. The concurrent Aggregate Locations (3) are located on Main Street and Timpany Boulevard. The nearby Aggregate Location is located farther south on Timpany Boulevard at the American Legion Circle. The table below provides the crash info. These locations are within the **Route 68 Aggregate Location Corridor**.



| Gardner | Street 1 | Street 1 Route # | Street 2 | Street 2 Route # | Total Crash Count | Fatal | Injury | PDO |
|-------------------------|------------------------|---------------------|----------|---------------------|-------------------------|-------|--------|-----|
| Locations | Timpany | 68 | | | 52 | | 3 | 49 |
| | Main | 68 | Emerald | | 26 | | 7 | 19 |
| | Main | 68 | Willow | | 27 | | 4 | 23 |
| | American Legion Cir | 68 | | | 41 | | 7 | 34 |
| | | | | TOTALS | 146 | | 21 | 125 |
| | | | | | Ped Crash Count | | | |
| Pedestrian Locations | Main | 68 | Pleasant | | 14 | 0 | 12 | 2 |
| | Parker | | Pleasant | 68 | 9 | 1 | 4 | 4 |
| | | | | TOTALS | 23 | | 16 | 6 |



Crash Portions: MMPO Aggregate Location Crashes Portion of MMPO Fatal, Injury, and Total Crashes (Crash Data Source: MassDOT)



Analysis: For the 2016 RTP of the MMPO region, Aggregate Locations accounted for only 12.5% of the total Fatal Crashes; 20% of the total Injury Crashes; and 21% of the Total Crashes. Based on this finding, focusing improvements solely on Aggregate Locations will leave out addressing safety problems at the many locations where 87.5% of the Fatal Crashes, 80% of the Injury Crashes, and 79% Total Crashes are occurring. At a minimum, the safety problems at locations where Fatal and Injury Crashes have occurred should be improved.

MMPO Safety Comparison: 2016 RTP vs 2012 RTP

Changes in MassDOT Crash Data and Aggregate Locations for the MMPO Region

| Change in MMPO Region Crash Totals | | | | |
|------------------------------------|-----------|-----------|--------|----------|
| | 2006-2008 | 2010-2012 | Change | % Change |
| Fatal Crashes | 52 | 40 | -12 | -23% |
| Injury Crashes | 2,941 | 2,758 | -183 | -6% |
| Total Crashes | 12,604 | 12,713 | 109 | 1% |

Analysis:

1% increase in Total Crashes is offset significantly by the:

- **23% decrease in Fatal Crashes**
- **6% decrease in Injury Crashes**

Combined, both are significant and positive changes

| Changes to Aggregate Locations in MMPO Region | | | | |
|---|-----------|-----------|--------|----------|
| | 2006-2008 | 2010-2012 | Change | % Change |
| Municipalities | 14 | 11 | -3 | -21% |
| Agg Locations | 88 | 91 | +3 | 3% |
| Fatal Injury | 5 | 5 | 0 | 0% |
| Non-fatal Injury | 636 | 546 | -90 | -14% |
| Total Crashes | 2,503 | 2,682 | 179 | 7% |

Analysis of Crashes within Aggregate Locations:
7% increase in Total Crashes is moderately offset based on:

- The number of fatal crashes did not change
- **The 14% decrease in Injury Crashes is a significant and positive change**

Macro Analysis of Aggregate Locations:

- 3% increase in number of Aggregate Locations
- 21% decrease in number of municipalities that experienced Aggregate Locations

Combined, both are significant and negative changes due to the nature of the changes

See below for analysis by Municipality



Aggregate Location Changes by Municipality

Aggregate Location Changes from the 2012 RTP to the 2016 RTP

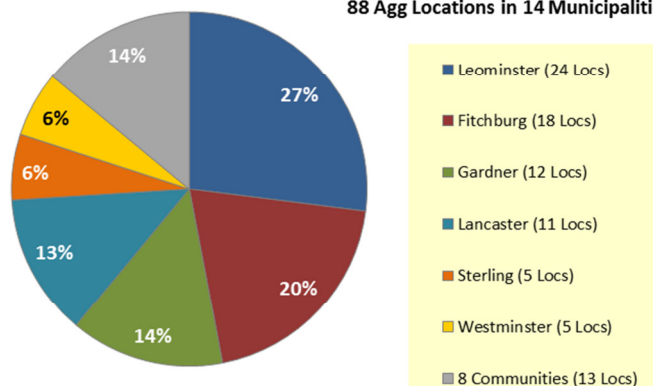
Aggregate Locations have become more concentrated into more densely populated urban areas since the completion of the 2012 RTP. This is illustrated below as the combined Aggregate Locations in the Cities of Fitchburg, Leominster, and Gardner have increased their share 6% - from 74% to 80% - since the completion of the 2012 RTP. For projects completed since 2008, please see Status of MMPO Completed Safety Improvement Projects since 2008 below

2012 RTP:

- Leominster's share was 27% (24 of 88)
- Fitchburg's share was 20% (18 of 88)
- Gardner's share was 13% (12 of 88)
- Lancaster's share was 12% (11 of 88)

The 4 municipalities accounted for 74% of the Aggregate Locations (65 of 88)

2012 RTP Crash Years 2006-2008
88 Agg Locations in 14 Municipalities

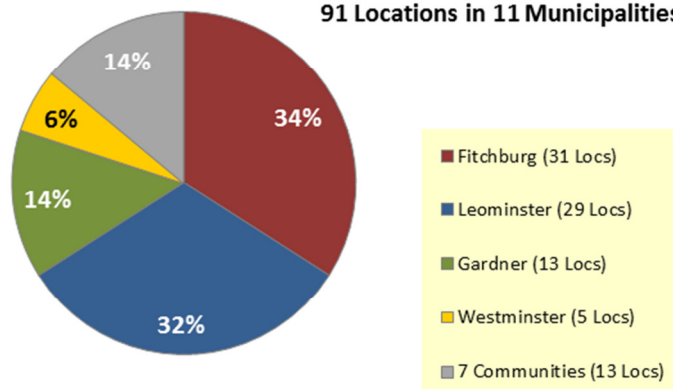


2016 RTP:

- Fitchburg's share **increased** to 34% (31 of 91)
- Leominster's share **increased** to 32% (29 of 91)
- Gardner's share **increased** to 14% (13 of 91)

The 3 municipalities accounted for **80%** of the Aggregate Locations (73 of 91)

2016 RTP Crash Years 2010-2012
91 Locations in 11 Municipalities



Number of Reoccurring (both 3-year periods) and New (2010-2012 period only) Aggregate Locations

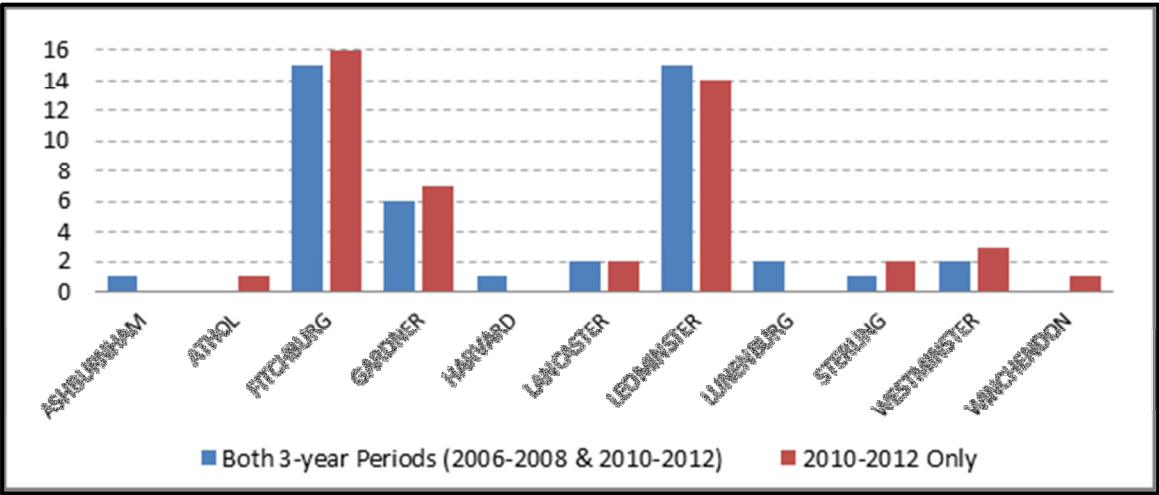


Chart analysis:

- Of the 91 Aggregate Locations in the **2016 RTP**, 49% occurred during **Both 3-year Periods** and 51% occurred during the **2010-2012 Only** period when they became concentrated into more densely populated urban areas
- For **Both 3-year Periods**, Fitchburg and Leominster each experienced the most reoccurring Aggregate Locations with 15 each followed by Gardner with 6 for a combined share of 80%
- For the **2010-2012 Only** period, Fitchburg experienced the most new Aggregate Locations with 16 followed by Leominster with 14 then Gardner with 7 for a combined share of 80%
- Athol was the only municipality that had **0** Aggregate Locations in 2006-2008 3-year period that added 1 in the 2010-2012 3-year period
- In Winchendon, the Aggregate Location changed to a different location for the **2010-2012 Only** period
- Clinton, Groton, Phillipston and Townsend had Aggregate Locations during the 2006-2008 3-year period but they dissipated for the **2010-2012 Only** period

Status of MMPO Completed Safety Improvement Projects since 2008

Pre-initiation of the Massachusetts Strategic Highway Safety Plan (MA SHSP)

Safety Status of Completed Projects that Included Safety Improvements

Prior to the initiation of the MA SHSP in 2008, the locations listed in Table 11-2 had significant safety problems and were often listed in pre-MA SHSP or MRPC high crash locations tables. Projects that incorporated safety improvement strategies in their design were developed for the



Route 12 intersections and for the John Fitch Highway and Ashby State Road intersection prior to the initiation of the MA SHSP. A roundabout was constructed at the John Fitch Highway and Ashby State Road intersection. The Route 12 improvements included realigning intersection approaches, installing new and upgraded traffic signals, adding auxiliary turn lanes, narrowing access points to businesses and adding new sidewalks on both sides of the roadway.

Table 11-2

| Aggregate Locations | | | | | 2010 - 2012 | | | 2006 - 2008 | | | Improvement | Project Status |
|--|-------------------------|---------------|----------------|---------------|-------------------|---------|------|--------------|---------|------|---|---------------------------|
| Corridor & Municipality | Street 1 | Street 1 Rt # | Street 2 | Street 2 Rt # | Crash Count | Injury | PDO | Crash Count | Injury | PDO | | |
| Route 12, Fitchburg | WANOOSNOC RD (BEMIS RD) | | WATER STREET | 12 | 35 | 9 | 26 | 48 | 12 | 36 | Signal upgrades, protected left turn lane | Project completed in 2010 |
| Route 12, Leominster | NORTH MAIN STREET | 12 | NICHOLS STREET | | 18 | 4 | 14 | 20 | 7 | 13 | Signal upgrades, unprotected left turn lane | |
| Route 12, Leominster | NORTH MAIN STREET | 12 | STATE STREET | | 11 | 5 | 6 | | | | Signal upgrades, unprotected left turn lane | |
| Former High Crash Location | | | | | April 2011 - 2012 | | | 2006 - 2008 | | | Improvement | Project Status |
| Corridor & Municipality | Street 1 | Street 1 Rt # | Street 2 | Street 2 Rt # | Crash Count* | Injury* | PDO* | Crash Count* | Injury* | PDO* | | |
| John Fitch, Fitchburg | JOHN FITCH HIGHWAY | | ASHBY STATE RD | 31 | 10 | 1 | 11 | 28 | 4 | 24 | Converted to a Roundabout | Project completed in 2011 |
| *not all crashes occurred in one location, totals are based on 4 locations all within about 400 feet of the intersection | | | | | | | | | | | | |

John Fitch Highway & Ashby State Road intersection. Fitchburg



Crash history before the roundabout for the 3-year period of 2002-2004:

- 35 total crashes occurred for a yearly average of nearly 12 crashes a year or about 1 crash per month
- 16 of them resulted in an injury crash for a yearly average of 5 a year or about 1 every 2 months
- Crash history from the time construction ended (April of 2011) to December 2012 (20 months):
 - 10 total crashes have occurred for a monthly average of about 1 crash every 2 months
 - Only 1 of the crashes has resulted in an injury crash



Results: Total crashes have decreased nearly 50% and Injury crashes decreased nearly 90%. Also, no injury crashes occurred in 2012 thereby resulting in PDO crashes for a full year. PDO result in no personal fatalities or injuries therefore physical loss was eliminated in 2012. A direct result of these reductions is that the intersection has been removed from the Table. A full 3-year period of post-construction crash data needs to be obtained before a final conclusion can be drawn as to whether or not safety has improved at any location. However, it is worth noting that the Fitchburg Police Department has mentioned that police responses to crashes at this intersection have reduced significantly since the completion of the roundabout.

The 3 Route 12 intersections remain listed in the Table and one more year of post-construction MassDOT crash data is needed to determine whether or not the project has improved safety at the Route 12 intersections. The 3 intersections fall within the **Route 12 Aggregate Location Corridor**.

Safety Status of Completed Projects where Crash Rate Analysis was the Primary Method used to Identify Locations with Safety Problems

Table 11-3 is a list of four intersections that were identified as having a safety problem by using crash rate analysis method. This was the method used by the MMPO to identify safety problem locations prior to the initiation of the MA SHSP and projects were developed that incorporated safety improvement strategies in their design.

Table 11-3

| Municipalities | Street 1 | Street 2 | Original Crash Rate Data Source | Most Recent MassDOT Crash Count | Fatal | Injury | PDO | Improvement | Project Status |
|----------------|---------------|-------------|---------------------------------|---------------------------------|-------|--------|-----|--|--|
| Athol | School Street | Main Street | MassDOT | 6 | | | 6 | Removal of horizontal and vertical alignment issues, and signage | Project completed in 2009 |
| Hubbardston | Route 68 | Route 62 | Local | 0 | | | | Realignment and removal of sight distance obstructions | Project completed in 2010 |
| Lancaster | Five Corners | | MassDOT | NA | NA | NA | NA | Converted to a 4-way intersection | Project completed in 2014 |
| Lancaster | High Street | Mill Street | MassDOT | 10 | | 4 | 6 | Signage | Project completed by Lancaster (no year) |

- The Athol intersection has seen a significant decrease in crash experience since project completion in 2009.
- Although the most recent MassDOT crash data covers only a 2-year period since the completion of a project at the Hubbardston intersection, the lack of any crashes occurring there during the 2-year period provides strong evidence that safety has improved significantly since project completion in 2010.



- It is too soon after the completion of a project at the Five Corners intersection in Lancaster to determine if crashes have decreased.
- The signage improvements at the High Street and Mill Street intersection in Lancaster have not significantly decreased the number of crashes since project completion. Further improvements are needed.

Although not considered high crash locations under the MA SHSP, safety has improved noticeably at the Athol and Hubbardston intersections and the reduction in crashes contributes to a decrease in overall MMPO region totals. Crashes of any type or severity above property damage have nearly become non-existent at these intersections. Also, motorists can feel safe using the intersections. The safety improvement at the Hubbardston location is particularly significant due to a fatality that occurred there that helped to drive the project from initiation to completion.

Post-initiation of MA SHSP Completed Safety Improvement Projects

Leominster - The Central Street and Willard Street Intersection

- This intersection was the first roadway project in the MMPO region to be completed under the MA SHSP to address safety problems.
- The project was completed during the summer of 2010.
- A before and after study was completed in 2013 by the MRPC when the 3-year post-construction period ended and locally sourced crash data (Leominster Police Department) became available.



- The findings of the before and after study have shown that the set of implemented improvements have combined to improve safety conditions at the intersection.
- Three of the most important safety conditions to be improved include reductions in the number of crashes (-43%), reductions in the number of injury crashes (-50%) and reductions in the number of angle crashes (-57%).
- A direct result of these reductions is that the intersection has been removed from the Table.
- For more on this study please contact the MRPC.

Study title:

Route 12 at Willard Street, Leominster, MA Safety Project Analysis Study



Table 11-4 below is a list of 5 other completed safety improvement projects completed under the MA SHSP. The implemented safety improvements range from low cost improvements such as signage to high cost improvements such as the roundabout. With the exception of the Gardner project, it is too soon after the completion of the 4 remaining projects to determine if safety has improved at those locations.

- Exit 31 was the top high crash location in the 2012 RTP.
- The new roundabout at the Lancaster intersection is the first one to be constructed in the Region to specifically improve safety.
- The Gardner project addressed lane departure crashes.
- The Westminster project addressed an extremely high crash total for a road segment that included a number of injury crashes.
- The Winchendon project addressed a significant increase in left turn crashes as a result of new commercial enterprises along Route 140. One of the left turn crashes was a fatal crash.



Table 11-4

| Municipalities | Intersections | | RSA Status (C = completed) | Improvement | Project Status |
|----------------|---|--------------------|--|---|----------------------------------|
| | Street 1 | Street 2 | | | |
| Lancaster | Lunenburg Street (Route 70) | Old Union Turnpike | RSA C | Converted to a roundabout | Project completed in 2013 |
| Leominster | Exit 31: Route 2 and Route 12 (North Main Street) | | NA | Ramps reconfigured, traffic signals installed, new raised bridge superstructure | Project completed in 2014 |
| | Road Segments | | | | |
| Gardner | Route 140 from Route 101 to Green Street | | RSA C | New guardrails with energy absorbing end terminals and retroreflective tabs, recessed retroreflective pavement markers, 6" wide pavement markings and edge line rumble strips | (ARRA) Project completed in 2010 |
| Westminster | South Street from Dawley Street to Main Street (Route 2A) | | RSA not required at project initiation | Repavement project included realigned intersection approaches, roadway widening, limited access points by installing sidewalks, upgraded signing and pavement markings | Project completed in 2013 |
| Winchendon | Route 140 from Gardner C.L. to Teel Road | | RSA C | Road widened to accommodate left turn lanes, limited access points by installing raised curbing along wide curb cut, improved passing, climbing and merging lanes and signage, installed retroreflective recessed pavement markings and markers | Project completed in 2014 |

Safety and Environmental Justice

This section follows up the 2012 RTP preliminary analysis of roadway safety problems that service and impact Environmental Justice (EJ) areas within the MMPO. This section provides analysis on the following safety issues that service and impact EJ areas:

- Completed safety improvements projects,
- Aggregate Location corridors and Isolated Aggregate Locations,
- Fatal, Injury, PDO crashes

Safety Improvement Projects on Roadways that Service EJ Areas

Table 11-5 is a list of the completed safety improvement projects and informs interested parties if a roadway project services an EJ area. For more details on the projects, see the Status of MMPO Completed Safety Improvement Projects since 2008 section above.

Figure 1 below shows the distribution of the projects within the MMPO region and their relationship to EJ areas.



Analysis:

Eight of the 14 completed safety improvement projects occurred on roadways that service EJ areas. This is a significant number as they account for 57% of the projects. It is also worth noting that the *Route 140 from Gardner CL to Teel Road* project connects EJ areas in Gardner and Winchendon.

Table 11-5

| Completed Safety Improvement Projects since 2008 | | | | | | |
|--|---|------|---------------------|------|-------------------|--------------|
| | INTERSECTIONS | | | | | Does Project |
| Municipalities | Street 1 | Rt # | Street 2 | Rt # | Service EJ Areas? | |
| ATHOL | SCHOOL STREET | | MAIN STREET | 2A | Yes | |
| FITCHBURG | WANOOSNOC RD (BEMIS RD) | | WATER STREET | 12 | Yes | |
| | JOHN FITCH HIGHWAY | | ASHBY STATE RD | 31 | Yes | |
| HUBBARDSTON | WORCESTER ROAD | 68 | OLD BOSTON TURNPIKE | 62 | No | |
| LANCASTER | HIGH STREET | 110 | CENTER BRIDGE ROAD | | No | |
| | HIGH STREET | 110 | MILL STREET | | No | |
| | LUNENBURG STREET | 70 | OLD UNION TURNPIKE | | No | |
| LEOMINSTER | NORTH MAIN STREET | 12 | NICHOLS STREET | | Yes | |
| | NORTH MAIN STREET | 12 | STATE STREET | | Yes | |
| | CENTRAL STREET | 12 | WILLARD STREET | | Yes | |
| | Exit 31: Route 2 and Route 12 (North Main Street) | | | | | Yes |
| | ROAD SEGMENTS | | | | | |
| GARDNER | Route 140 from Route 101 to Green Street | | | | Yes | |
| WESTMINSTER | South Street from Dawley Street to Main Street (Route 2A) | | | | No | |
| WINCHENDON | Route 140 from Gardner C.L. to Teel Road* | | | | No | |
| | *EJ areas exist north and south of this segment | | | | | |

Summary of the Types of Negative Impacts of Roadway Crashes

Crashes result in personal and societal emotional and fiscal damage. Another name for these damages is negative impacts. Fatal crashes create the highest negative impacts followed injury crashes then PDO crashes. For EJ areas, please note that it does not necessarily mean an individual involved in a crash that occurs within an EJ area belongs to a minority or low-income population or is a resident within an EJ area.

Some of the types of negative impacts include loss of life; loss of a loved one; loss of property; lifelong medical care and/or rehabilitation; loss of quality of life; increase in congestion especially at high crash occurrence locations; cost of corrective measures; loss of family income; the cost of the use of emergency services that includes medical, police, and fire services; for an employer - the loss of a valuable employee; and the development of a unsafe and negative perception of the intersection or roadway where the crashes occur.



Aggregate Location Corridors & Isolated Aggregate Locations that Impact EJ Areas

Table 11-6 is a list of Aggregate Location Corridors and Isolated Aggregate Locations and informs the reader if a location negatively impacts an EJ area. For more details on the locations, see Table 11-1A at the beginning of this section. Figure 2 below shows the distribution of the corridors and locations within the MMPO region and their relationship to EJ areas.

Analysis:

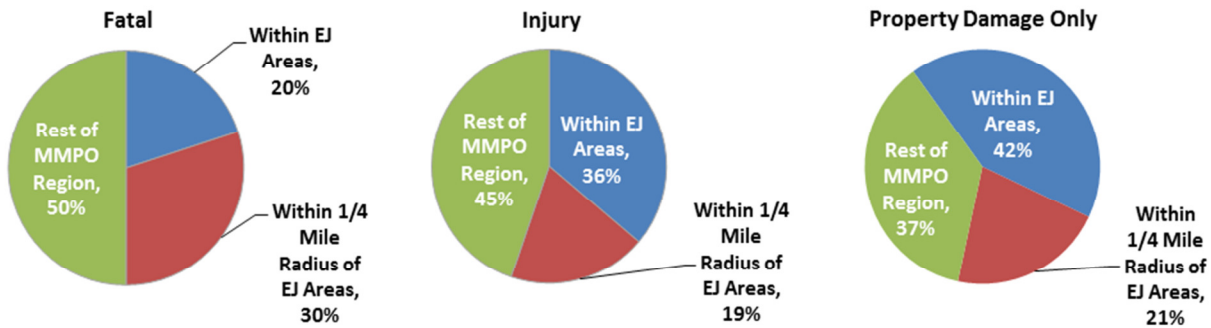
Of the combined total of 23 Aggregate Location corridors and Isolated Aggregate Locations, 16 of them negatively impact EJ areas. This is a significant number as they account for 70% of the total number of locations. Separately, 11 of the 12 Aggregate Location corridors (92%) and 5 of the 11 Isolated Aggregate Locations (45%) negatively impact EJ areas. See the section Future Safety Improvement Projects below for the locations listed in Table 11-6 that have mitigation measures developed or being developed to improve safety.

Table 11-6

| Aggregate Location Corridors / Isolated Aggregate Locations and Environmental Justice Areas | | | | | | | | | | |
|---|--|------|-------------------------|------|--------------------------------|----------|--|--|--|-----|
| Municipalities | Aggregate Location Corridors | | | | Does Location Impact EJ Areas? | | | | | |
| FITCHBURG | Electric Ave | | | | Yes | | | | | |
| GARDNER | Elm/Green Street | | | | Yes | | | | | |
| FITCHBURG | John Fitch Hwy | | | | Yes | | | | | |
| STERLING | Leominster Rd | | | | No | | | | | |
| FITCHBURG | Pratt Road | | | | Yes | | | | | |
| FITCHBURG | Route 12 | | | | Yes | | | | | |
| LEOMINSTER | | | | | | | | | | |
| LEOMINSTER | | | | | | Route 13 | | | | Yes |
| FITCHBURG | | | | | | | | | | |
| GARDNER | | | | | | | | | | |
| HARVARD | | | | | | | | | | |
| LANCASTER | Route 2 | | | | Yes | | | | | |
| LEOMINSTER | | | | | | | | | | |
| WESTMINSTER | | | | | | | | | | |
| FITCHBURG | | | | | | | | | | |
| LUNENBURG | Route 2A | | | | Yes | | | | | |
| GARDNER | Route 68 | | | | Yes | | | | | |
| FITCHBURG | Routes 12, 2A, 31 | | | | Yes | | | | | |
| FITCHBURG | South St/ Merriam Ave | | | | Yes | | | | | |
| LEOMINSTER | | | | | | | | | | |
| | Isolated AGL Locations at Intersections and Interchanges | | | | | | | | | |
| | Street 1 | Rt # | Street 2 | Rt # | | | | | | |
| ASHBURNHAM | CENTER STREET | 101 | WILLIAMS/COREY HILL RD | | No | | | | | |
| ATHOL | S MAIN STREET | 2A | BROOKSIDE ROAD | | No | | | | | |
| FITCHBURG | AIRPORT ROAD | | BEMIS ROAD | | Yes | | | | | |
| LANCASTER | OLD UNION TURNPIKE | | LUNENBURG ROAD | 70 | No | | | | | |
| LANCASTER | MAIN STREET | 117 | LUNENBURG ROAD | 70 | No | | | | | |
| LEOMINSTER | MILL STREET | | HAWS STREET | | Yes | | | | | |
| LEOMINSTER | LEOMINSTER CONNECTR | | NASHUA STREET | | Yes | | | | | |
| LEOMINSTER | INTERSTATE 190, Exit 7 | I190 | RMP-RT 190 SB TO RT 117 | | Yes | | | | | |
| LEOMINSTER | WEST STREET | | PARK STREET | | Yes | | | | | |
| STERLING | INTERSTATE 190, Exit 5 | I190 | RMP-RT 190 SB TO RT 140 | | No | | | | | |
| WINCHENDON | SPRING STREET | 12 | GARDNER ROAD | 140 | No | | | | | |



Fatal Crash / Injury Crash / PDO Crash Portions within EJ Areas and the MMPO Region



In this section, the portions of Fatal, Injury, and PDO crashes that occurred on the roadways within EJ areas, the areas within a one-quarter mile radius of EJ areas, and non-EJ areas within the MMPO region are examined. Figure 3 below shows the distribution of Fatal, Injury, and PDO crash locations within the MMPO region and their relationship to EJ areas.

Analysis:

- Injury crashes that occurred in EJ areas had the highest negative impacts on EJ areas as they accounted for:
 - 19% of Total crashes (997 of 5,174) that occurred in the EJ areas
 - It is also significant that Injury crashes within EJ areas accounted for 36% of all Injury crashes (997 of 2,758) that occurred in the entire MMPO region

Although PDO crashes were more numerous at 80.6% of total crashes (4,169 of 5,174) within EJ areas, they do not result in bodily harm and only property is damaged therefore resulting in considerably less negative impacts. In general terms, the negative impacts of an Injury crash are approximately 5 times worse than those for a PDO crash. To rephrase, the negative impacts of 1 Injury crash is equal to the negative impacts of 5 PDO crashes. Therefore, the total negative impacts from the 997 Injury crashes that occurred in EJ areas are as if 4,985 PDO crashes occurred. This is 20% higher (816 more crashes) than the PDO crash total.

- Injury crashes did not occur disproportionately in EJ areas:
 - 19% occurred on roadways within a ¼ mile radius of EJ areas
 - 45% occurred on roadways beyond a ¼ mile radius of EJ areas
- Fatal crashes also did not occur disproportionately in EJ areas:
 - While Fatal crashes (8) within EJ areas accounted for 20% of all the Fatal crashes that occurred in the MMPO region, they accounted for only 0.15% of the total crashes within EJ areas which severely limits their negative impacts
 - The Fatal crash percentage of total crashes within non EJ areas was 0.43% which is 64% higher than the EJ areas percentage



- 30% of the Fatal crashes (12) occurred on roadways within a ¼ mile radius of EJ areas
- 50% of the Fatal crashes occurred on roadways beyond a ¼ mile radius of EJ areas
- Of the PDO crashes that occurred within the MMPO region, EJ areas had the highest portion at 42% (4,169 of 9,915 PDO crashes)

These findings are most likely the result of the following:

- The EJ areas in the MMPO region are generally located in densely populated urban areas that generate high traffic volumes that produce slower vehicle travel speeds and traffic congestion. The traffic congestion creates many opportunities for crashes to occur but they tend to be less severe because of the slower travel speeds.
- The opportunities for crashes to occur in EJ areas are also due to:
 - A high number of intersections that provide access to a corridor
 - Driveways to points of interest
 - On street parking
 - Various types of distractions
 - Sight distance issues
 - and other conditions
- The non EJ areas in the MMPO region are located in significantly less densely populated suburban/rural areas that generate significantly lower traffic volumes that produce high vehicle travel speeds and traffic almost always flows freely. The lack of traffic congestion creates fewer opportunities for crashes to occur but the crashes are more severe because of the high travel speeds.
- In non EJ areas, the opportunities for crashes to occur due to intersections that provide access to a corridor, driveways to points of interest, on street parking, various types of distractions, sight distance issues, and other conditions are generally not as numerous or compact as in EJ areas.

Planned Safety Improvement Projects

There are 8 safety related TIP projects (Table 11-7 below) on the current draft 2016-2019 MMPO TIP. Five projects will address safety problems at 11 Aggregate Locations on 5 Aggregate Location corridors while the remaining 3 projects will address safety problems at 3 Isolated Aggregate Locations.



Table 11-7

| TIP Projects at AGL Corridors & Isolated AGLs | | | | | | | | | | | |
|---|-----------|----------------------|---------|--------------|------------------------|------|-------------------------------------|------|-------------|---------------------|---------------------|
| AGL Corridors or Isolated AGLs | # of AGLs | # of AGLs in Project | Percent | Municipality | Intersection Street 1 | Rt # | Intersection Street 2 | Rt # | RSA Status* | Primary Improvement | 2015 Estimated Cost |
| Leominster Rd | 2 | 1 | 50% | STERLING | LEOMINSTER ROAD | 12 | CHOCKSETT ROAD | | RSA C | geometric | \$4,700,000 |
| Route 12 | 13 | 2 | 15% | LEOMINSTER | CENTRAL STREET | 12 | LITCHFIELD STREET | | needs RSA | PD** | \$6,749,184 |
| | | | | | | | MONUMENT SQUARE | 12 | | | |
| Route 13 | 6 | 5 | 83% | LEOMINSTER | MAIN STREET | 13 | HAMILTON STREET | | RSA C | geometric | \$4,050,982 |
| | | | | | | | RIVER STREET | | | | |
| | | | | | | | MEAD (MILL) STREET | | | | |
| | | | | | | | between Hamilton & Prospect | | | | |
| | | | | | | | RT 2, Exit 32 (extends over bridge) | | | | |
| Route 2 | 16 | 1 | 6% | WESTMINSTER | E MAIN ST, Exit 25 | 2A | RP-RTS 2 EB/140 SB TO RTS 2A/140 | 140 | RSA C | geometric | \$2,040,000 |
| Route 2A | 7 | 1 | 14% | FITCHBURG | LUNENBURG STREET | 2A | JOHN FITCH HIGHWAY | | RSA C | geometric | \$2,024,755 |
| isolated AGL | 1 | 1 | 100% | ASHBURNHAM | CENTER STREET | 101 | WILLIAMS/COREY HILL ROAD | | RSA C | geometric | \$1,248,000 |
| isolated AGL | 1 | 1 | 100% | STERLING | INTERSTATE 190, Exit 5 | I190 | RAMP-RT 190 SB TO RT 140 | | needs RSA | PD | \$843,648 |
| TOTALS | 46 | 12 | 26% | | | | | | | | |

*for RSA Status, C = completed
 **project in Preliminary Design

The projects will address the following safety problems:

- On the Route 13 Aggregate Location Corridor in Leominster, safety problems at 5 of 6 Aggregate Locations (83%) will be addressed
- On the Leominster Road Aggregate Location Corridor in Sterling, safety problems at the 2 Aggregate Locations on the corridor (100%) will be addressed
- Three Aggregate Location corridors will have safety problems addressed at 4 Aggregate Locations which are discrete locations along the length of the corridors
- Safety problems at 3 of the 11 (19%) Isolated Aggregate Locations will be addressed

Road safety audits need to be conducted for 2 of the projects:

- In Leominster for the Route 12 Aggregate Location Corridor
- In Sterling for the I190 southbound ramp to Route 140 (Exit 5)

Future Safety Improvement Projects

After accounting for the planned safety improvement projects and other contributing factors, the remaining known safety problem locations should become future safety improvement project targets. Table 11-8 below provides the locations that need safety improvement:

- 66 Aggregate Locations fall within 10 Aggregate Location corridors in 7 municipalities
- 1 Bicycle Location and 1 Pedestrian Location on the Route 2A Aggregate Location Corridor in Fitchburg
- 1 Pedestrian Location on the Route 12 Aggregate Location Corridor in Leominster (at Monument Square)
- 2 Pedestrian Locations on the Route 68 Aggregate Location Corridor in Gardner
- 10 Isolated Aggregate Locations that are located in 6 municipalities of which 5 are located in Leominster



Table 11-8

| Future Safety Projects | | | | |
|------------------------|--|------|--------------------------|-----------|
| Municipalities | Aggregate Location Corridors | | | # of AGLs |
| FITCHBURG | Electric Ave | | | 2 |
| GARDNER | Elm/Green Street | | | 3 |
| FITCHBURG | John Fitch Hwy | | | 5 |
| FITCHBURG | Pratt Road | | | 2 |
| FITCHBURG | Route 12 | | | 7 |
| LEOMINSTER | | | | 11 |
| | Route 12 Total | | | 18 |
| FITCHBURG | Route 2 | | | 1 |
| GARDNER | | | | 2 |
| HARVARD | | | | 1 |
| LANCASTER | | | | 2 |
| LEOMINSTER | | | | 4 |
| WESTMINSTER | | | | 4 |
| | Route 2 Total | | | 14 |
| FITCHBURG | Route 2A | | | 6 |
| LUNENBURG | | | | 2 |
| | Route 2A Total | | | 8 |
| GARDNER | Route 68 | | | 8 |
| FITCHBURG | Routes 12, 2A, 31 | | | 3 |
| FITCHBURG | South St | | | 3 |
| | Isolated AGL Locations at Intersections and Interchanges | | | |
| | Intersection Street 1 | Rt # | Intersection Street 2 | Rt # |
| ATHOL | S MAIN STREET | 2A | BROOKSIDE ROAD | |
| FITCHBURG | AIRPORT ROAD | | BEMIS ROAD | |
| LANCASTER | MAIN STREET | 117 | LUNENBURG ROAD | 70 |
| LEOMINSTER | MILL STREET | | HAWS STREET | |
| LEOMINSTER | LEOMINSTER CONNECTR | | NASHUA STREET | |
| LEOMINSTER | INTERSTATE 190, Exit 7 | I190 | RAMP-RT 190 SB TO RT 117 | |
| LEOMINSTER | WEST STREET | | PARK STREET | |
| LEOMINSTER | MAIN STREET | 13 | MOORELAND AVENUE | |
| STERLING | LEOMINSTER ROAD | 12 | NORTH ROW ROAD | |
| WINCHENDON | SPRING STREET | 12 | GARDNER ROAD | 140 |

Safety improvement projects should be sought after along the full length of an Aggregate Location corridor. Although it is preferable and recommended, this may not be possible. It may only be possible to complete a safety improvement project at a portion of the Aggregate Locations.

Other future safety improvement project targets that should be addressed are the numerous locations where 87.5% of the Fatal Crashes and 80% of the Injury Crashes occurred to bring down the crash severity. Further analysis of these locations is required.

See the Financial Analysis chapter for the estimated cost of these projects.



Challenges

- How can we reduce the number and severity of all crashes throughout the region?
- How can we educate citizens on the importance of safety and safety rules and responsibilities?
- How can we ensure the maximum amount of safety improvement possible in the region?

Moving Forward – Addressing the Challenges

- Promote the benefits of low cost safety improvements to communities when applicable.
- Place a focus on improving safety when developing complete streets for Aggregate Location corridors and Isolated Aggregate Locations.
- Develop safety improvement projects from a systemic approach. This approach involves implementing safety improvements at various locations based on similar high-risk roadway features that correlate with specific crash severity types.
- Identify and implement corrective projects in top high incident locations in the region.
- Promote programs such as Safe Routes to School and other driver/pedestrian awareness efforts.
- Continue to document and assess problem areas in the region and utilize the maximum amount of funds available for improvements.

Improving safety is a key factor in building a transportation network that is safe for all users and sustainable well into the future. Safety is a very measurable concept and the Performance Measures set in this plan should be helpful in determining if we are meeting our goals and, if not, adjusting our efforts to make improvements. Mitigating hazards on our roadways is relatable to all and should be a priority to all users of our transportation network.

Action Items (below)

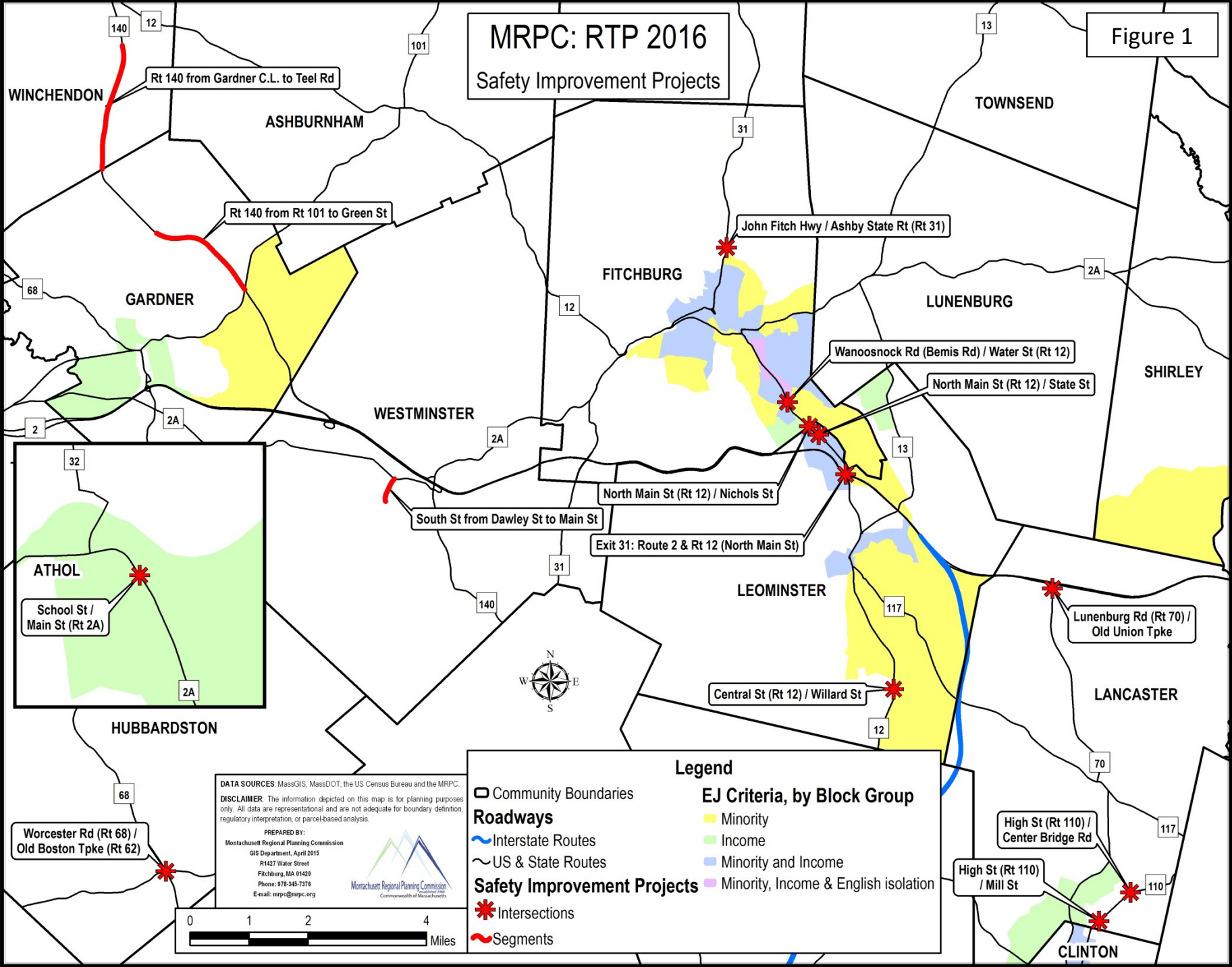


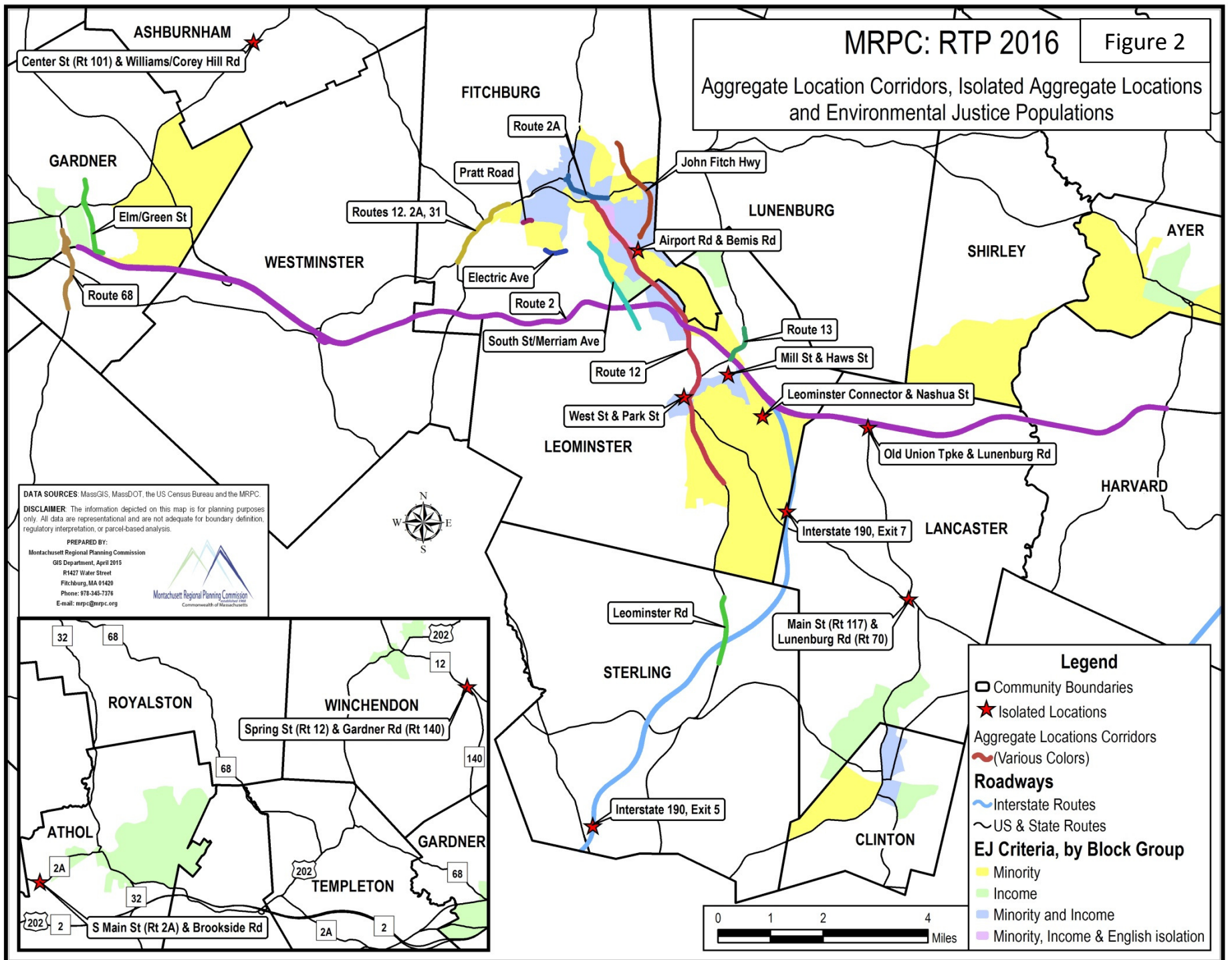
Action Items

| Action | Next Steps | Outcome |
|--|--|--|
| Complete planned safety improvements projects | Advance projects through TIP | Construction |
| Continue identifying and implementing future safety improvement projects | Tasks for current and future UPWP | Studies to identify potential projects to advance to TIP |
| Promote low cost safety improvements when applicable | Continue liaison with MassDOT Safety program; Inform locals | Locations that meet guidelines to implement |
| Place a focus on improving safety on complete street projects | Work with local communities regarding concepts and expand program outreach | Certified Complete Street Communities |
| Develop safety improvement projects from a systemic approach | Future UPWP tasks/Coordination with MassDOT | More robust data driven system |
| Promote driver/pedestrian safety awareness efforts | Work with MassDOT on training/concepts & possible future UPWP task | Training programs/brochures, etc. highlighting issues |
| Continue to document and assess safety problem areas | Continued implementation of data driven analysis procedures | Identification of priority locations for project development |
| Utilize the maximum amount of funds for safety improvement projects | Continue TIP programming efforts to utilize safety funds | Full allocation of safety funds within Region |



Figure 1





Fatal and Injury Crashes

Figure 3

