

# NORTHERN MIDDLESEX TRANSPORTATION IMPROVEMENT PROGRAM (TIP) PROJECT REVIEW AND EVALUATION STUDY



Above: East Street/Dascomb Road at Shawsheen Street in Tewksbury/Andover with improvements programmed in the 2014 TIP.

Below: VFW Highway, Bridge Street and Lakeview Avenue in Lowell with improvements programmed in the 2014 TIP.



SEPTEMBER 2022

PREPARED FOR THE NORTHERN MIDDLESEX METROPOLITAN PLANNING ORGANIZATION (NMMPO)

BY THE NORTHERN MIDDLESEX COUNCIL OF GOVERNMENTS (NMCOG)



“By examining and quantifying the effectiveness of various improvement strategies and project types, the NMMPO, the regional partners, and state and federal transportation agencies will develop a better understanding of how to most effectively and efficiently allocate funding resources for transportation improvements in the future.”

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Boston, MA 02109  
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## PROJECT OVERVIEW

The Northern Middlesex MPO, in cooperation with the Massachusetts Department of Transportation (MassDOT) and member communities, has funded several improvement projects at high crash locations across the region aimed at improving overall safety. This report evaluates the effectiveness and impact of two projects funded through the Northern Middlesex Transportation Improvement Program (TIP). This study analyzes and compares the safety conditions before and after project completion to assess the effectiveness of these projects. Effectiveness can be measured by examining the total crashes as well as the severity of crashes at each location following the installation of improvements. By examining and quantifying the effectiveness of various improvement strategies and project types, the NMMPO, regional partners, state and federal transportation agencies will develop a better understanding of how to most effectively and efficiently allocate funding resources in the future.

The projects evaluated in this study include two intersections: (1) Intersection and signal improvements at East Street/Dascomb Road at Shawsheen Street in the Towns of Andover and Tewksbury; (2) Signal and intersection improvements at VFW Highway, Bridge Street & Lakeview Avenue. These projects were constructed using Federal Highway Safety Improvement Program (HSIP) funds through the TIP. Construction of intersection and signal improvements at East St/Dascomb Road at Shawsheen St project was funded in 2014 at a total federal participating cost of \$1,620,543, using Federal Surface Transportation Program (STP) and HSIP funding categories. The signal and intersection improvements at VFW Highway, Bridge Street & Lakeview Avenue project was programmed in 2014 at a total federal participating cost of \$1,097,665 using STP and HSIP funding categories.

*Table 1 Description of the two intersections selected for TIP before/after review study*

Project ID	Project Description	Community	Project Cost Programmed	HSIP Funding Programmed	TIP Year
606298	Intersection and signal improvements at East Street/Dascomb Road and Shawsheen Street	Tewksbury	\$1,620,543	\$1,620,543	2014
604964	Signal and intersection improvements at VFW Highway, Bridge St & Lakeview Avenue	Lowell	\$2,160,500	\$1,097,665	2014

### Monitoring TIP Project Safety: Measures of Effectiveness

In order to monitor how intersection improvement projects impact overall safety, three measures of effectiveness (MOE) were identified. These are quantifiable performance-based measures monitored by NMCOG and MassDOT over time that can be used to assess traffic safety conditions for each location. The MOEs utilized in this study include:

1. Total number of crashes;
2. Equivalent Property Damage Only (EPDO) Score; and
3. Intersection Crash Rate.

The Highway Safety Improvement Program (HSIP) is a core Federal Aid program designed to reduce traffic fatalities and serious injuries on all public roads. HSIP funds are utilized for the design and construction of highway projects that will reduce the number and severity of roadway crashes. Projects funded with HSIP resources must be programmed in the TIP. Funding eligibility is based on crash data and engineering assessments of identified hazardous locations. According to guidelines set by the State, an eligible cluster for HSIP funding must have a total number of EPDO crashes within the top 5% in a region. The formula for determining EPDO is as follows:

$$EPDO = (1 \times \text{Property Damage Only Crash}) + (5 \times \text{Crash Involving Injury}) + (10 \times \text{Crash involving Fatality})$$

To identify eligible HSIP clusters, MassDOT and the MPO compile crash locations or clusters into a list. These clusters are then assigned an Equivalent Property Damage Only (EPDO) value based on the number and severity of crashes, creating a ranking system. These rankings are then sorted and put into a list of top 200 crash locations for the state and top 100 crash locations for the region.

Crash Rates, or crashes per year measured against vehicle exposure (traffic volumes) are traditionally used in determining whether an intersection or roadway is considered safe. MassDOT maintains a database of signalized and unsignalized intersection crash rates, mainly submitted to the State as part of the design review process and for an Environmental Impact Report or Functional Design Report. With this data, the State develops average crash rates for each District and the Commonwealth as a whole.

$$\text{Crash Rate} = (\text{Average crashes per year} \times 1,000,000) / (\text{Total Peak Hourly Approach Volume} \times 365)$$

The MOE for this measure is a comparison of each intersection’s crash rate before and after improvements, as well as a comparison to each District average.

## TIP PROJECT: INTERSECTION AND SIGNAL IMPROVEMENTS AT EAST STREET/DASCOMB ROAD AT SHAWSHEEN STREET IN THE TOWNS OF ANDOVER AND TEWKSBURY

### Conditions Prior to Roadway Improvements

The T-intersection of Dascomb Road, East Street and Shawsheen Street borders the towns of Tewksbury and Andover. Prior to construction, Dascomb Road, East Street and Shawsheen Street were all two way, single-lane approaches to the intersection. Shawsheen Street, was under stop control, with East Street (west of the intersection) and Dascomb Road (east of the



Map 1. East Street/Dascomb Road at Shawsheen Street in Tewksbury, MA.

intersection) under free flow. This configuration resulted in delays for vehicles taking left turns westbound from Shawsheen Street to East Street. Sight distance was obstructed by the crest vertical curves present on East Street west of the intersection. There were sidewalks on the south side of East Street connecting to sidewalk on west side of Shawsheen Street, while no sidewalks were present on either side of Dascomb Road in spite of noted pedestrian activity in warmer seasons, noted by the Road Safety Audit (RSA) from 2011. There were connectivity issues between sidewalks, and between sidewalks and crosswalks. The pavement markings were faded and barely identifiable on Shawsheen Street and Dascomb Road. The properties that abut the property are mostly commercial and industrial. Near the intersection, the speed limit on East Street was 30 mph, Dascomb Road was 40 mph and Shawsheen Street was 25 mph. All three streets are functionally classified as Urban Minor Arterials and the intersection is owned by Tewksbury.

Shawsheen Street widened at the intersection. Dascomb Road also widened along the westbound approach at the intersection to provide room for a westbound through vehicle to pass a stopped vehicle waiting to turn left onto Shawsheen Street. As Shawsheen Street approached East Street, the pavement width widened to approximately 5 feet on the eastern approach and 5 feet on the western approach. The sight distance looking east of the intersection was obscured by a vertical curve on East Street making it deficient. The intersection met traffic signal justification warrants for eight-hour vehicular volume, four-hour vehicular volume and peak hour volume criteria.

The Dascomb Road, East Street and Shawsheen Street intersection was ranked within the top 5% of the regions' high crash location list. There were 21 reported crashes between 2007 and 2009, of which 8 were rear-end crashes and 3 were angle crashes. Nine crashes involved left-turning vehicles, with one of them involving a pedestrian. One crash was reported to be a head-on collision. The crash rate for the location (1.05 crashes per million entering vehicles) was noted to be higher than the MassDOT District 4 average rate (0.59) for a typical unsignalized intersection in the area. The most common type of crash was rear-end and angle crashes. Lack of a left turn lane could be a reason for the high number of rear-end crashes on Dascomb Road westbound approach. The high number of angle crashes between Dascomb Road westbound left turning vehicles and East Street through vehicles may be a result of drivers accepting a gap that is too short to safely complete a turn due to high volumes and long wait times.

### Improvement Project Description

A Road Safety Audit was held for the intersection of East Street, Dascomb Road, and Shawsheen Street on January 26, 2011 at the Tewksbury Police Department in Tewksbury, MA. This intersection was identified as a potential location for safety improvements using available Federal and/or State funding opportunities as it ranked within the top 5% of the regions' high crash location list.

*Table 2 Description of East Street/Dascomb Road at Shawsheen Street intersection in Tewksbury, MA.*

Community	Road Safety Audit Location	Year RSA Conducted	Year of TIP Programming	Construction completion
Tewksbury	East Street/Dascomb Road at Shawsheen Street	February 2011	2014	2016

Construction of improvements at the intersection was completed in 2016 and included the installation of a new fully actuated traffic signal, with improvements made to approaches, geometric design, lane markings, signage and added infrastructure for non-motorized users of the intersection. Specific changes made included the following:

- **Geometric changes**
  - Dascomb Road, East Street and Shawsheen Street were widened to provide an exclusive left/right turn lane in addition to the existing through lane.
  - Corner radii were adjusted to accommodate truck turning movements throughout the intersection.
  - Wheelchair ramps on three corners of the intersection were installed to meet current ADA/AAB access standards at the intersection
  - New crosswalks were installed on the East Street eastbound and Shawsheen Street northbound approaches
  - 4-foot shoulders were provided on all approaches
  - New sidewalks were installed on the north and south side of East Street, as well as the west and east side of Shawsheen Street.
  - Intersection sight distance east of the intersection was improved to >700 feet.
  
- **Traffic control improvements**
  - A new fully actuated traffic signal control system with appropriate timing and phasing for peak hour volume requirements were installed
  - As part of the signal, a protected lead phase for the Dascomb Road/East Street westbound approach was provided.
  - Provision of an exclusive pedestrian phase
  - Provision of emergency pre-emption for all approaches
  - Upgrading of existing regulatory signage and pavement markings throughout the intersection.

### TIP Project Effects on Overall Safety

After improvements were completed, the Dascomb Road, East Street and Shawsheen Street intersection saw a gradual decrease in crashes, declining from a high of 21 crashes in 2007-2009 down to 2 crashes in 2017-2019. Out of 21 crashes, crashes with property damage were 14 and non-fatal injury were 7. This drop in crashes also correlates to a drop in the overall EPDO score dropping from 49 in 2007-2010 to 2 in 2017-2019, a drop of 95.9%.

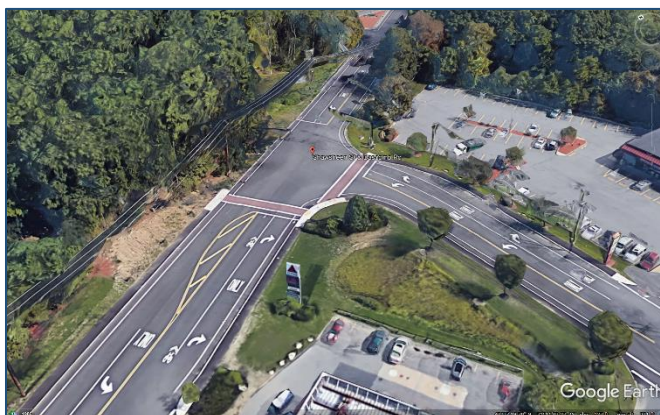


Photo 1. Top view of the intersection. Source: Google Earth (2022).

EPDO (2007-2009) = (1 x Property Damage Only Crash) + (5 x Crash Involving Injury) + (10 x Crash involving Fatality)



EPDO (2007-2009) = (1 x 14) + (5 x 7) + (10 x 0) = 49

EPDO (2017-2019) = (1 x Property Damage Only Crash) + (5 x Crash Involving Injury) + (10 x Crash involving Fatality) = (1 x 2) + (5 x 0) + (10 x 0) = 2

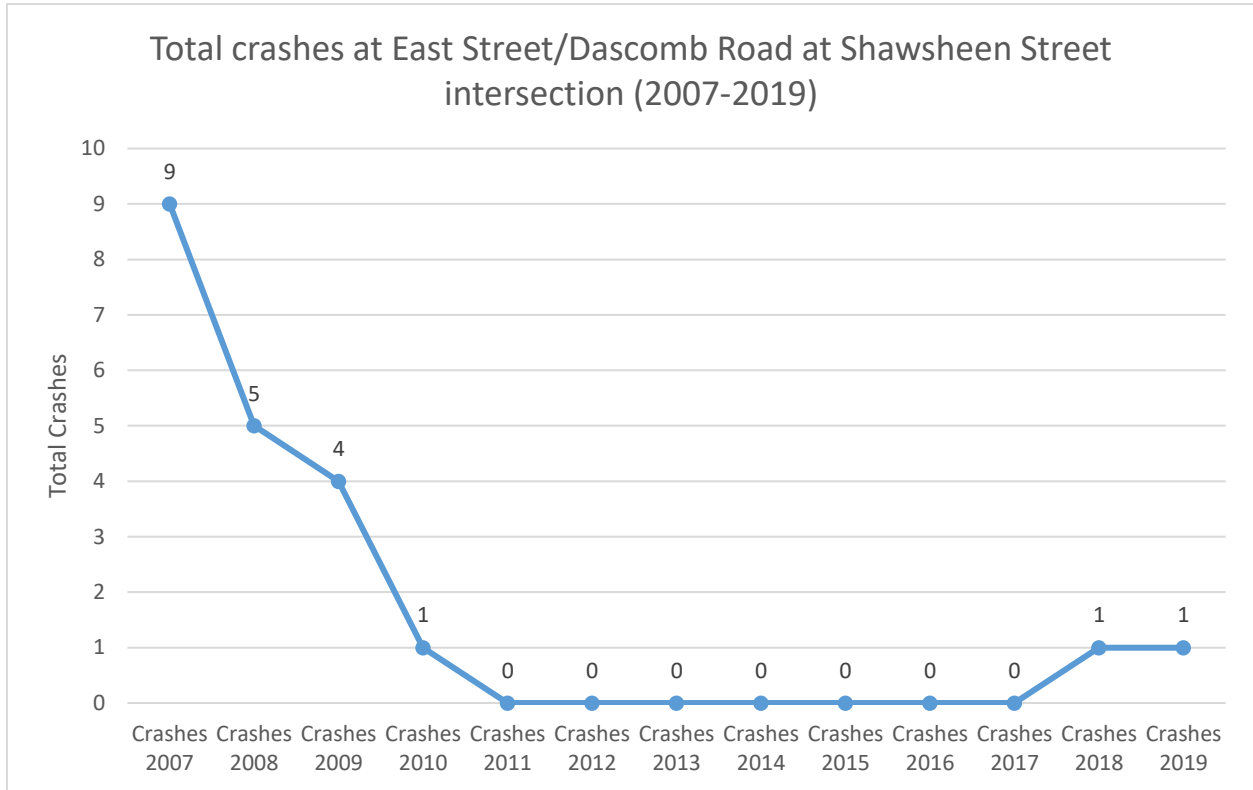


Figure 1 Total crashes at East Street/Dascomb Road at Shawsheen Street from 2007-2019.

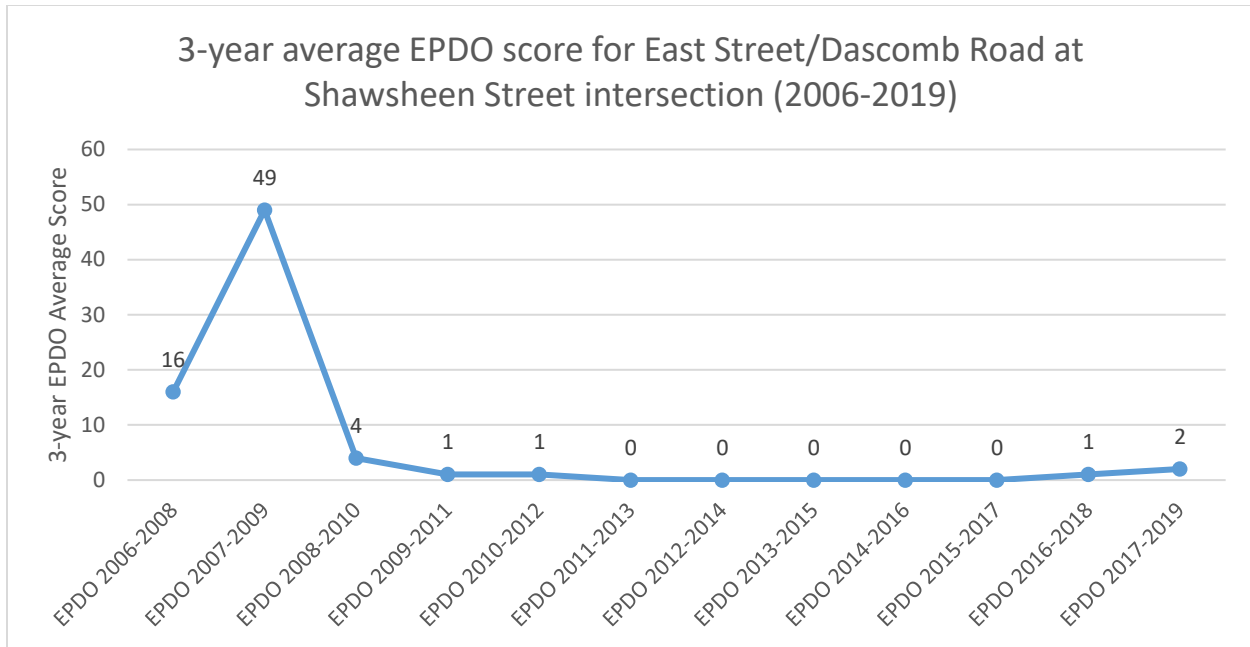


Figure 2 3-year Average EPDO Score of East Street/Dascomb Road at Shawsheen Street from 2006-2019.

### Crash Rate

Another effective tool used in measuring effectiveness of improvements on intersection safety is the crash rate per million entering vehicles (MEV). In the Functional Design Report of improvements at the intersection, this was calculated using the evening peak hour volumes from the TMCs and a calculated K-factor obtained from ATR counts. When the crash rates at each of the study area intersections were compared to the statewide and district-wide averages published by MassDOT in July 2011, it was observed that the statewide average for signalized intersections is 0.81 per MEV and the average crash rate in MassDOT District 4 for a signalized intersection is 0.78 crashes per MEV. The statewide average for unsignalized intersections is 0.61 per MEV and the District 4 average for unsignalized intersections is 0.59 per MEV.

$$\text{Crash Rate} = (\text{Average crashes per year} \times 1,000,000) / (\text{Total Peak Hourly Approach Volume} \times 365)$$

$$\text{Crash Rate (2011)} = 1.05$$

$$\text{Crash Rate (2017-19)} = 0.09$$

### Safety Improvement Summary

The intersection has experienced a marked increase in overall safety when analyzing the measures of effectiveness used in this study. Total crashes have decreased 90.5%. EPDO numbers have dropped 95.9% and the crash rate has decreased 91.4% with improvements made to the intersection.

## Before Improvements

Table 3 East Street/Dascomb Road at Shawsheen Street intersection characteristics before the improvements.

Street Name	Intersection control	Speed limit (August 2007)	Crash data (2007-2009)
East Street	Stop	35 mph	21
Dascomb Road		40 mph	
Shawsheen Street		25 mph	

## After Improvements

Table 4 East Street/Dascomb Road at Shawsheen Street intersection characteristics after the improvements.

Street Name	Intersection control	Speed limit (September 2019)	Crash data (2017-2019)
East Street	Signalized	35	2
Dascomb Road		40	
Shawsheen Street		35	

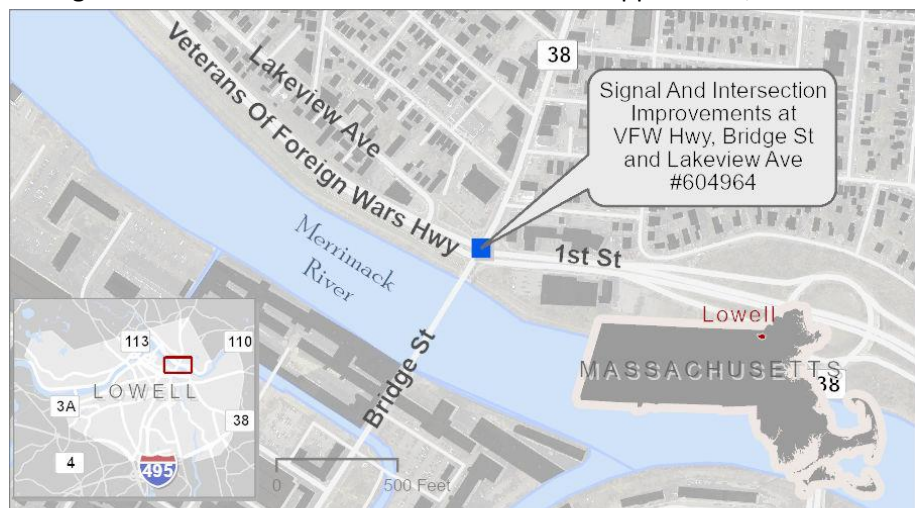
Table 5 East Street/Dascomb Road at Shawsheen Street intersection MOE Summary

	Prior to construction (2007-2009 for Total crashes and EPDO, 2011 for Crash Rate)	Latest data available post construction (2017-2019)	Percent change
Total crashes	21	2	-90.5%
EPDO	49	2	-95.9%
Crash rate	1.05	0.09	-91.4%

# TIP PROJECT: SIGNAL AND INTERSECTION IMPROVEMENTS AT VFW HIGHWAY, BRIDGE STREET AND LAKEVIEW AVENUE IN LOWELL

## Conditions Prior to Roadway Improvements

The VFW Highway, Bridge Street and Lakeview Avenue intersection was a five-legged signalized intersection prior to improvements. The geometry of the intersection itself was an issue due to proximity of Lakeview Avenue to VFW Highway as the 5<sup>th</sup> leg of the intersection. VFW Highway was an arterial with two lanes in each direction divided by a median. The westbound VFW Highway approach had a slip lane for right turns, two through lanes, and a dedicated left turn lane at the intersection. Bridge Street intersected VFW Highway, where Lakeview Avenue joined VFW Highway. All other approaches at the intersection were two lanes except northbound Bridge Street which had one through/right turn lane and a dedicated left turn lane. Sidewalks were present along all approaches. However, no pedestrian volume data was available for the intersection prior to TIP project. Crosswalks with pedestrian signals were present on all four sides of the intersection. Because of the width of VFW Highway, there was a long crossing distance across eastbound and westbound approaches, which resulted in the need for a 28 second exclusive pedestrian phase. An issue identified during the RSA indicated that because there were no indications of lane utilization, there was often confusion regarding movements permitted from lanes. There were no posted speed limits within the project limits. There were 200 crashes between 2003 to 2005 geolocated at this intersection, of which 2 were fatal and 58 were injury crashes. The most common type of crash was angle crashes between EB left turning vehicles and WB through vehicles and rear-end crashes across all four intersection approaches.



Sources: MassGIS/NIMCOG (roads, building footprints); 2020 Pictometry imagery  
Produced by NIMCOG: 7/13/2022

Map 2. VFW Highway, Bridge Street and Lakeview Avenue in Lowell, MA.

## Improvement Project Description

VFW Highway and Bridge Street intersection in Lowell, MA is a known high crash location. The intersection of VFW Highway and Bridge Street is a highly travelled intersection, and it was back then listed as the highest crash intersection in Massachusetts. The intersection of VFW Highway and Bridge Street was selected for a RSA because of the documented crash problem. The RSA was held on August 29, 2007 at the Lowell City Hall.



Photo 2. Top view of the intersection.  
Source: Google Earth (2022).

Table 6 Description of VFW Highway, Bridge Street and Lakeview Avenue in Lowell, MA.

Community	Road Safety Audit Location	Year RSA Conducted	Year of TIP Programming	Construction completion
Lowell	VFW Highway, Bridge Street and Lakeview Avenue	August 2007	2014	2017

The VFW Highway, Bridge Street and Lakeview Avenue intersection was altered to reduce the conflicts created by the 5<sup>th</sup> leg at the intersection. Lakeview Avenue was moved west of the intersection, the skew of the intersection was corrected, a dedicated left lane was introduced, signal phasing was modified, and signs/markings for lane utilization were installed. Project improvements included the following:

- **Geometric changes**
  - One major geometric change is the alignment of EB travel lanes in VFW Highway with the opposing WB travel lanes.
  - Another geometric change is the closing of Lakeview Avenue at the intersection and instead exit the traffic in Lakeview Avenue into EB VFW Highway.
  - Lane utilization related changes to address confusion among motorists which includes signage, pavement markings, and turn delineation markings.
  - Introduction of protected EB left turn movements.
  - Wide intersection resulted in large pedestrian crossing distance in East side of the intersection.
  - Curb cuts provided to be reconstructed to assure ADA compliance.
- **Traffic control improvements**
  - Traffic signal phasing for protected left turn phases for the WB and SB approaches and an exclusive pedestrian phase.
  - General visibility issues associated with pedestrian signal heads.

### TIP Project Effects on Overall Safety

After improvements were completed in 2017, the VFW Highway, Lakeview Avenue, and Bridge Street intersection saw a gradual decrease in crashes, declining from a high of 200 crashes in May 2003-September 2005 down to 95 in 2017-2019. Out of 95 crashes, there were 1 was fatal & serious injury crash, 17 were non-serious & possible injury crashes, and 77 were non-injury crashes. The EPDO score dropped from 285 in 2006-2008 to 221 in 2017-2019, decrease of 22.5%.

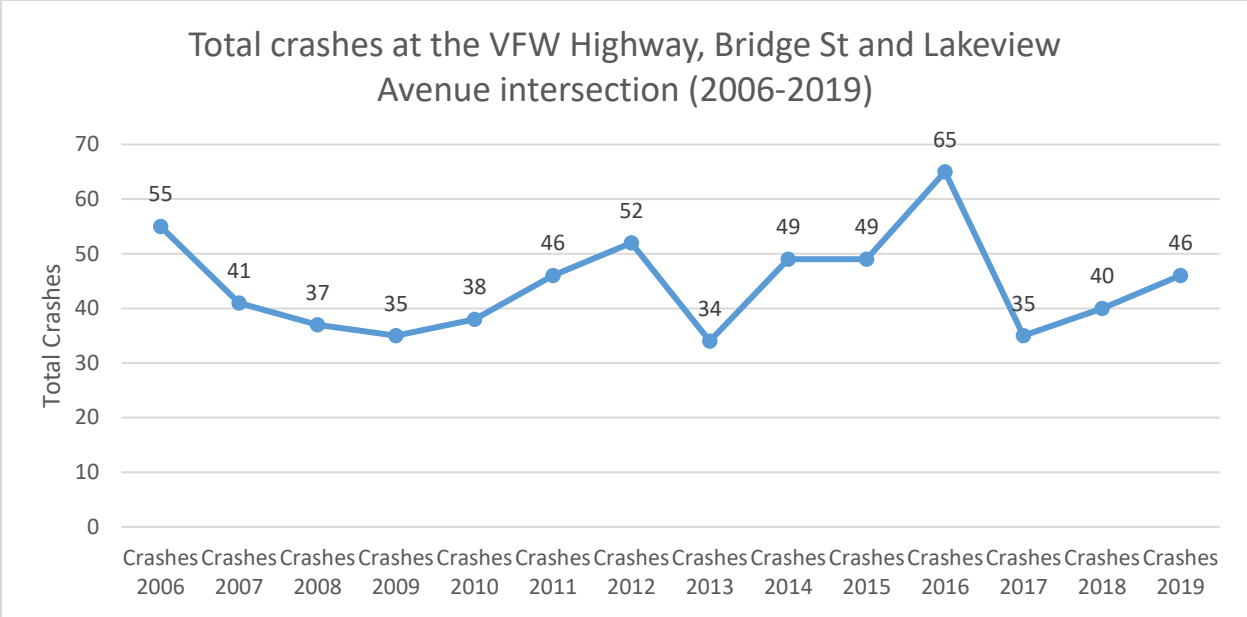


Figure 3 Total crashes at VFW Highway, Bridge Street and Lakeview Avenue from 2006-2019.

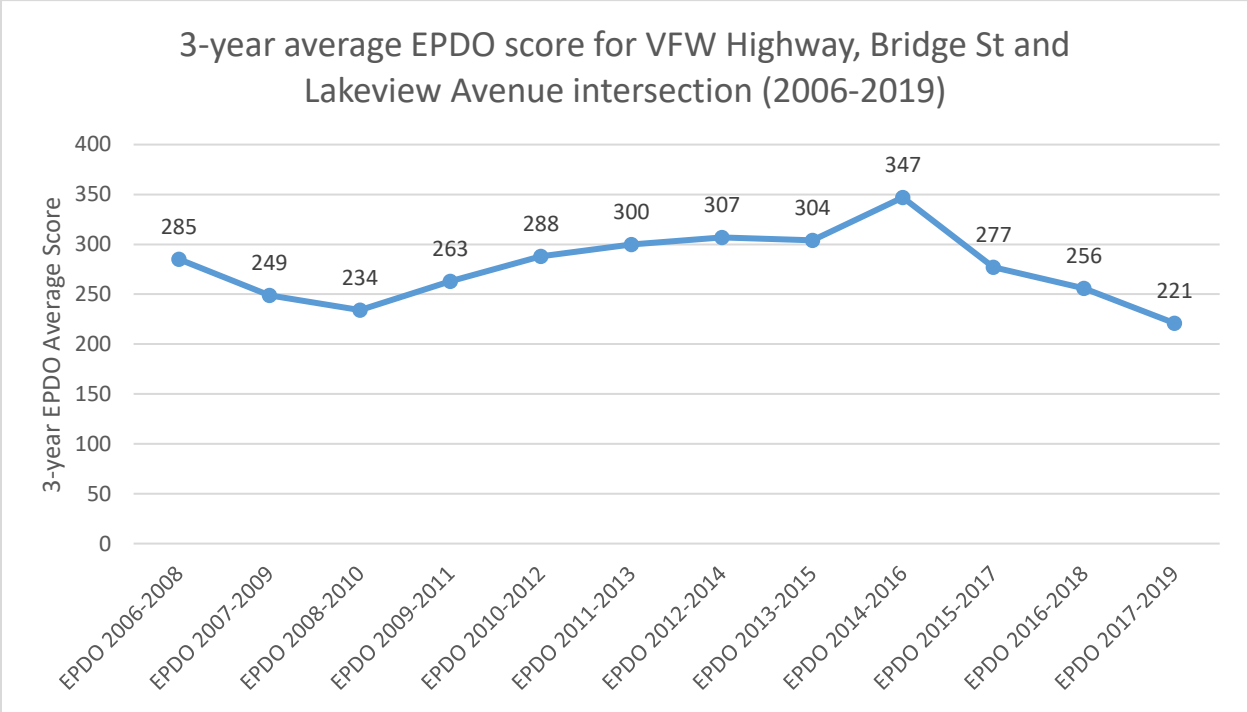


Figure 4 3-year Average EPDO Score of VFW Highway, Bridge Street and Lakeview Avenue from 2006-2019.

## Crash Rate

Another effective tool used in measuring effectiveness of improvements on intersection safety is the crash rate, reported as the number of crashes that occur per million vehicles entering an intersection (MEV).

In 2008, the crash rate at the intersection was 4.35 crashes per MEV. After project completion, the crash rate dropped to 2.2 crashes per MEV in 2017-2019, a considerable decrease of 49.4%. Furthermore, the average crash rate in MassDOT District 4 for a Signalized Intersection is 0.78 crashes per MEV. Therefore, the crash rate for the intersection after improvements (2.2 crashes per MEV) is higher than average rates for District 4 intersections.

Crash Rate = (Average crashes per year x 1,000,000) / (Total Peak Hourly Approach Volume x 365)

Crash rate (2008) = 4.35 crashes per MEV

Crash rate (2017-2019) = 2.2 crashes per MEV

## Safety Improvement Summary

The intersection has experienced a marked increase in overall safety when analyzing the measures of effectiveness used in this study. Total crashes have decreased 52.5%. EPDO numbers have decreased by 22.5% and the crash rate has decreased 49.4% with improvements made to the intersection.

## Before Improvements

Table 7 VFW Highway, Bridge Street and Lakeview Avenue intersection characteristics before the improvements.

Street Name	Intersection control	Speed limit (August 2007)	Crash data (2003-2005)
VFW Highway	Signalized	30 mph	200
Bridge Street		30 mph	
Lakeview Avenue		35 mph	

According to the MassDOT Top Crash Locations, this intersection is among the Top 200 crash clusters in years 2017-2019 with a crash count of 95, of which 1 is fatal & serious injury crash, 17 were non-serious & possible injury crashes, and 77 were non-injury crashes. This intersection is among Top 5% Town intersection Crash Locations 2017-2019.

## After Improvements

Table 8 VFW Highway, Bridge Street and Lakeview Avenue intersection characteristics after the improvements.

Street Name	Intersection control	Speed limit (September 2019)	Crash data (2017-2019)
VFW Highway	Signalized	30	95
Bridge Street		30	
Lakeview Avenue		35	

Table 9 VFW Highway, Bridge Street and Lakeview Avenue intersection MOE Summary

	Prior to construction (2003-2005 for Total crashes and EPDO, 2008 for Crash Rate)	Latest data available post construction (2017-2019)	Percent change
<b>Total crashes</b>	200	95	-52.5%
<b>EPDO</b>	285	221	-22.5%
<b>Crash rate</b>	4.35	2.2	-49.4 %

## CONCLUSIONS AND NEXT STEPS

After evaluating the TIP projects at Dascomb Road, East Street and Shawsheen Street in Tewksbury and VFW Highway, Bridge Street and Lakeview Avenue in Lowell, the following conclusions can be drawn:

- There is a considerable decrease in the measures of effectiveness (number of crashes, crash rate and EPDO) at Dascomb Road, East Street and Shawsheen Street in Tewksbury after intersection improvements.
- Given that VFW Highway, Bridge Street and Lakeview Avenue intersection in Lowell has high volume of traffic, the improvements resulted in a noticeable reduction in safety concerns like total crashes and crash rate by 50% and EPDO score by about 22% when compared to before improvement levels.

NMCOG staff will continue to monitor the intersections examined in this study, as well as others in the region, as part of the NMCOG safety program outlined in the region's work program. Future iterations of the before/after TIP Project study will include updates at these intersections, as well as assessments of additional intersection improvement projects.



## APPENDIX 1: BEFORE & AFTER PHOTOGRAPHS

### Dascomb Road, East Street and Shawsheen Street: Before & After Photographs



Photo 3. East St/Dascomb Rd at Shawsheen St (looking east before improvements). Source: Road Safety Audit.



Photo 4. East St/Dascomb Rd at Shawsheen St (looking east after improvements). Source: Site visit.



Photo 5. View of East St approach from Shawsheen St before improvements. Source: Road Safety Audit.



Photo 6. View of East St approach from Shawsheen St after improvements. Source: Site visit.



Photo 7. Potential conflict between turning vehicles and through vehicles before improvements. Source: Road Safety Audit.



Photo 8. Widened intersection after improvements to prevent potential conflict between turning vehicles and through vehicles. Source: Road Safety Audit.

## VFW Highway, Bridge Street and Lakeview Avenue: Before & After Photographs



Photo 9: VFW Highway at Bridge Street (looking east before improvements). Source: Road Safety Audit.



Photo 10: VFW Highway, Bridge Street and Lakeview Avenue (looking east after improvements). Source: Road Safety Audit.



Photo 11: VFW Highway, Bridge Street and Lakeview Avenue (looking west before improvements). Source: Road Safety Audit.



Photo 12: VFW Highway, Bridge Street and Lakeview Avenue (looking west after improvements). Source: Road Safety Audit.



Photo 13: VFW Highway, Bridge Street and Lakeview Avenue (looking north before improvements). Source: Road Safety Audit.



Photo 14: VFW Highway, Bridge Street and Lakeview Avenue (looking north after improvements). Source: Road Safety Audit.



Photo 15: View of Lakeview Avenue at VFW Highway and Bridge Street. Source: Road Safety Audit.



Photo 16: View of Lakeview Avenue at VFW Highway. Source: Road Safety Audit.



Photo 17: VFW Highway at Bridge Street (looking east before improvements). Source: Road Safety Audit.



Photo 18: VFW Highway at Bridge Street (looking east after improvements). Source: Road Safety Audit.

## APPENDIX 2: CRASH RATE WORKSHEETS

### Dascomb Road, East Street and Shawsheen Street (Before)



### INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : TEWKSBURY, MASSACHUSETTS COUNT DATE : NOVEMBER 2011

DISTRICT : 4 UNSIGNALIZED :  **YES** SIGNALIZED :

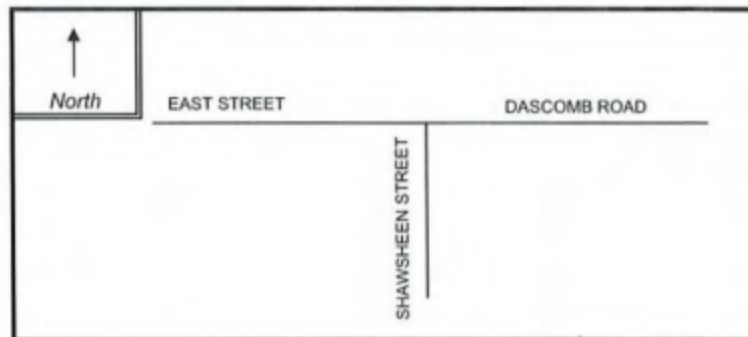
~ INTERSECTION DATA ~

MAJOR STREET : EAST STREET

MINOR STREET(S) : SHAWSHEEN STREET

DASCOMB ROAD

INTERSECTION  
DIAGRAM  
(Label Approaches)



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	EB	WB	NB			
PEAK HOURLY VOLUMES (PM) :	477	1,125	446			2,048

"K" FACTOR :  INTERSECTION ADT ( V ) = TOTAL DAILY APPROACH VOLUME :

TOTAL # OF CRASHES :  # OF YEARS :  AVERAGE # OF CRASHES PER YEAR ( A ) :

CRASH RATE CALCULATION :  RATE =  $\frac{(A * 1,000,000)}{(V * 365)}$

Comments : K DETERMINED FROM ATR ON DASCOMB ROAD - WEEKDAY EVENING

Project Title & Date: EAST STREET / SHAWSHEEN STREET / DASCOMB ROAD FUNCTIONAL DESIGN REPORT

Figure 5 Crash rate worksheet for before improvements of East St/Dascomb Rd at Shawsheen St Intersection.

## Dascomb Road, East Street and Shawsheen Street (After)



### INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : TEWKSBURY, MASSACHUSETTS      COUNT DATE : 2017-2019  
 DISTRICT : 4      UNSIGNALIZED :       SIGNALIZED :  YES

- INTERSECTION DATA -

MAJOR STREET : EAST STREET  
 MINOR STREET(S) : SHAWSHEEN STREET  
DASCOMB ROAD



PEAK HOUR VOLUMES						
APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :						
PEAK HOURLY VOLUMES (AM/PM) :						
* K * FACTOR :		INTERSECTION ADT ( V ) = TOTAL DAILY APPROACH VOLUME :				21253
TOTAL # OF CRASHES :	2	# OF YEARS :	3	AVERAGE # OF CRASHES PER YEAR ( A ) :		0.67

**CRASH RATE CALCULATION :** 0.09      RATE =  $\frac{(A * 1,000,000)}{(V * 365)}$

Comments : \_\_\_\_\_  
 Project Title & Date: TIP BEFORE/AFTER REVIEW: EAST STREET / SHAWSHEEN STREET / DASCOMB ROAD - 07-22-2022

VFW Highway, Bridge Street and Lakeview Avenue (Before)



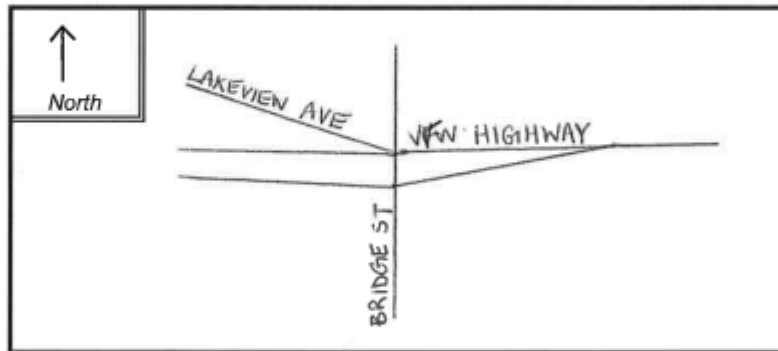
**INTERSECTION CRASH RATE WORKSHEET**

CITY/TOWN : Lowell COUNT DATE : 2008  
 DISTRICT : 4 UNSIGNALIZED :  SIGNALIZED :  YES

~ INTERSECTION DATA ~

MAJOR STREET : VFW HIGHWAY  
 MINOR STREET(S) : BRIDGE STREET  
LAKEVIEW AVENUE

INTERSECTION  
 DIAGRAM  
 (Label Approaches)



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :						
PEAK HOURLY VOLUMES (AM/PM) :						

"K" FACTOR :  INTERSECTION ADT ( V ) = TOTAL DAILY APPROACH VOLUME :

TOTAL # OF CRASHES :  # OF YEARS :  AVERAGE # OF CRASHES PER YEAR ( A ) :

CRASH RATE CALCULATION :  RATE =  $\frac{(A * 1,000,000)}{(V * 365)}$

Comments : \_\_\_\_\_

Project Title & Date: TIP BEFORE/AFTER REVIEW: VFW HIGHWAY, BRIDGE STREET AND LAKEVIEW AVENUE - 07/22/2022

Figure 7 Crash rate worksheet for before improvements of VFW Highway, Bridge Street and Lakeview Avenue Intersection.

VFW Highway, Bridge Street and Lakeview Avenue (After)



**INTERSECTION CRASH RATE WORKSHEET**

CITY/TOWN : Lowell COUNT DATE : Year 2017-2019

DISTRICT : 4 UNSIGNALIZED :  SIGNALIZED :  Yes

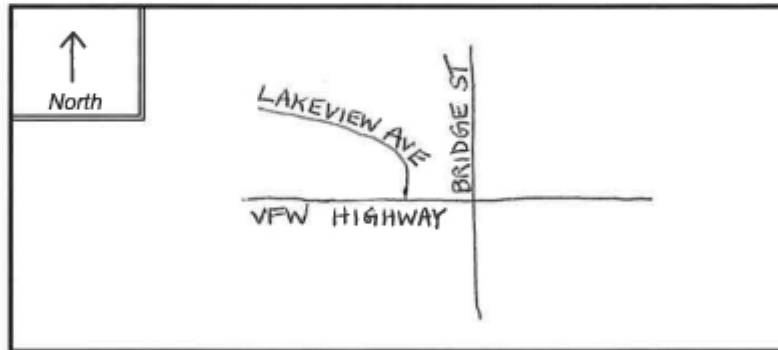
**- INTERSECTION DATA -**

MAJOR STREET : VFW Highway

MINOR STREET(S) : Bridge St

Lakeview Avenue

**INTERSECTION  
DIAGRAM**  
(Label Approaches)



**PEAK HOUR VOLUMES**

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :						
PEAK HOURLY VOLUMES (AM/PM) :						

" K " FACTOR :  INTERSECTION ADT ( V ) = TOTAL DAILY APPROACH VOLUME :  39677

TOTAL # OF CRASHES :  95 # OF YEARS :  3 AVERAGE # OF CRASHES PER YEAR ( A ) :  32

**CRASH RATE CALCULATION :**  = 2.2 RATE =  $\frac{(A * 1,000,000)}{(V * 365)}$

Comments : \_\_\_\_\_

Project Title & Date: TIP BEFORE/AFTER REVIEW: VFW HIGHWAY, BRIDGE ST AND LAKEVIEW AVE IN LOWELL - 07/19/2022

Figure 8 Crash rate worksheet for after improvements of VFW Highway, Bridge Street and Lakeview Avenue Intersection.