

# TIP PROJECT REVIEW STUDY

## BILLERICA (ROUTE 129) & RIVERNECK ROAD INTERSECTION IMPROVEMENT PROJECT

June 2025

Prepared for the Northern Middlesex Metropolitan Planning Organization



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MOVING THE REGION SINCE 1976

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## **PROJECT OVERVIEW**

The Northern Middlesex MPO, in cooperation with the Massachusetts Department of Transportation (MassDOT) and member communities, has funded infrastructure improvement projects at high crash locations across the region aimed at improving overall safety. This report evaluates the effectiveness and impact of a project completed 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 the selected project. 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, and state and federal transportation agencies will develop a better understanding of how to most effectively and efficiently allocate funding resources in the future.

The project evaluated in this study involves intersection improvements at Route 129 and Riverneck Road in Chelmsford (MassDOT Project 608344). The project received a Transportation Evaluation Criteria (TEC) score of 6.65 out of 18 and was accepted by MassDOT and programmed into the NMMPO's TIP for December 2016. The project was funded through three federal sources: the Surface Transportation Program (STP), the Congestion Mitigation and Air Quality Program (CMAQ), and the Transportation Alternatives Program (TAP). The total federal participating construction cost amounted to \$5,723,038.

## MONITORING TIP PROJECT SAFETY: MEASURES OF EFFECTIVENESS

As part of this TIP project review study, NMCOG evaluated the safety performance of Billerica Road (Route 129) at Riverneck Road intersection both before and after construction. To ensure a consistent, data-driven approach, three Measures of Effectiveness (MOEs) were selected. These MOEs used by both NMCOG and MassDOT are quantifiable, performance-based indicators that provide an objective means of assessing changes in traffic safety conditions over time. Their application in this study supports informed decision-making for future project prioritization, funding eligibility (e.g., through the Highway Safety Improvement Program), and post-construction evaluation. The MOEs used in this assessment include:

1. Total number of crashes
2. EPDO (Equivalent Property Damage Only) Score
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 support the design and construction of highway projects that are expected to lower the number and severity of roadway crashes. To be eligible for HSIP funding, projects must be included in the TIP and supported by crash data and engineering assessments that identify safety concerns at the proposed location. A critical component of the HSIP eligibility process is the use of the EPDO scoring method, which quantifies crash severity using the following formula:

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

This weighted system enables transportation agencies to evaluate crash clusters not only by frequency but also by severity. To identify eligible locations, MassDOT and Metropolitan Planning Organizations (MPOs) compile crash data to create ranked lists of crash clusters. These clusters are assigned EPDO values based on the number and severity of recorded crashes. Locations with the highest EPDO scores are sorted into the top 200 crash locations statewide and the top 100 crash locations regionally, guiding the prioritization of safety improvement investments.

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 (FDR). With this data, MassDOT develops average crash rates for each district and the Commonwealth as a whole. The crash rate is calculated using the following formula:

$$\text{Crash Rate (per MEV)} = \frac{(\text{Number of Crashes} \times 1,000,000)}{(\text{Number of Entering Vehicles} \times \text{Number of Years})}$$

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: ROUTE 129 AND RIVERNECK ROAD IN CHELMSFORD

### Conditions Prior to Roadway Improvement

The intersection of Billerica Road (Route 129) and Riverneck Road is in the eastern portion of Chelmsford, Massachusetts. Billerica Road is an important regional transportation facility that connects Chelmsford center to Route 3 with access to Interstate 495 to the north and Interstate 95 to the south.

Billerica Road (Route 129) and Riverneck Road are both classified as urban minor arterials. Prior to the TIP-funded improvements, Billerica Road featured two 12-foot travel lanes with narrow shoulders and a substandard sidewalk on the south side. Riverneck Road had two 11-foot lanes with no formal sidewalks. Adjacent land uses included public property (e.g., Pine Ridge Cemetery), as well as commercial, industrial, and residential areas.

The posted speed limit on Billerica Road was 30 mph eastbound, with a regulated limit of 35 mph (MassDOT Regulation No. 7110). Riverneck Road lacked special speed regulations. Sight distance analysis using observed 85th percentile speeds showed that both stopping, and intersection sight distances exceeded AASHTO requirements, including at the proposed midblock pedestrian crossing.

Between 2010 and 2014, six crashes were reported at the intersection, primarily rear-end collisions under dry conditions. The crash rate was 0.18 crashes per million entering vehicles, below the district 4 average, but indicative of the need for safety and operational improvements.

### Project Description

The intersection improvement project at Billerica Road (Route 129) and Riverneck Road, completed in 2022, included the addition of auxiliary left turn lanes, realigned intersection approaches on Billerica Road,



*Photo 1: Project Area of Billerica (Route 129) & Riverneck Road. Source: MassDOT design presentation (2018)*



*Photo 2: Intersection of Billerica (Route 129) and Riverneck Road (Pre Construction). Source: Near map imagery (2025)*



*Photo 3: Billerica Road (Route 129). Source: Near map imagery (2025)*

enhanced signage and visibility, a midblock crosswalk with pedestrian signals, ADA-compliant sidewalks and ramps, bridge reconstruction, and accommodations for bicyclists and pedestrians. The project featured geometric realignments, bicycle and pedestrian accommodations, and signal and RRFB improvements as outlined below:

### Geometric Improvements

- Realignment of the intersection to a “T” configuration to simplify vehicle movements and reduce conflict points.
- Addition of dedicated left-turn lanes on Billerica Road to accommodate turning movements more safely.
- Modified curb radii and lane widths to improve vehicle tracking and safety.
- Pavement reconstruction and resurfacing for smoother traffic operations.
- Improved drainage infrastructure to reduce hydroplaning risk and pavement damage.



*Photo 4: Intersection of Billerica (Route 129) and Riverneck Road. Source: Near map imagery (2025)*

### Bicycle and Pedestrian Accommodations

- Installation of ADA-compliant sidewalks on both Billerica Road and Riverneck Road were previously absent or substandard.
- Construction of curb ramps at all corners of the intersection to enhance accessibility.
- Inclusion of a midblock pedestrian crosswalk with appropriate signage and visibility enhancements.
- Provision of bicycle accommodation through shared roadway markings and shoulder widening in selected areas.



*Photo 5: Dedicated Pedestrian Lane on Billerica (Route 129) Road. Source: staff site visit.*

### Signal and RRFB Improvements

- Installation of Rectangular Rapid Flashing Beacons (RRFBs) at midblock pedestrian crossing locations to increase driver awareness and pedestrian safety.
- Upgrade of signage and pavement markings throughout the corridor to improve visibility and guide driver behavior.



*Photo 6: RRFB on Billerica (Route 129) Road. Source: staff site visit.*

## TIP PROJECT EFFECTS ON INTERSECTION SAFETY

### Total Crashes (2015–2024)

To assess the safety impacts of the completed intersection improvements, NMCOG staff conducted a review of crash records using the MassDOT IMPACT crash portal and police reports obtained from the Chelmsford Police Department. Staff analyzed crash data within a 200-foot buffer of the Billerica Road (Route 129) and Riverneck Road intersection across consecutive three-year periods to evaluate long-term trends. Crash totals

remained steady at five during the 2013–2015 and 2016–2018 periods, then declined to two crashes from 2019–2021. Most notably, only one crash was recorded during the most recent post-construction period of 2022–2024. This investigation confirmed that most of the post construction crashes were rear-end collisions occurring under dry conditions, an issue consistent with the observations cited in the FDR.

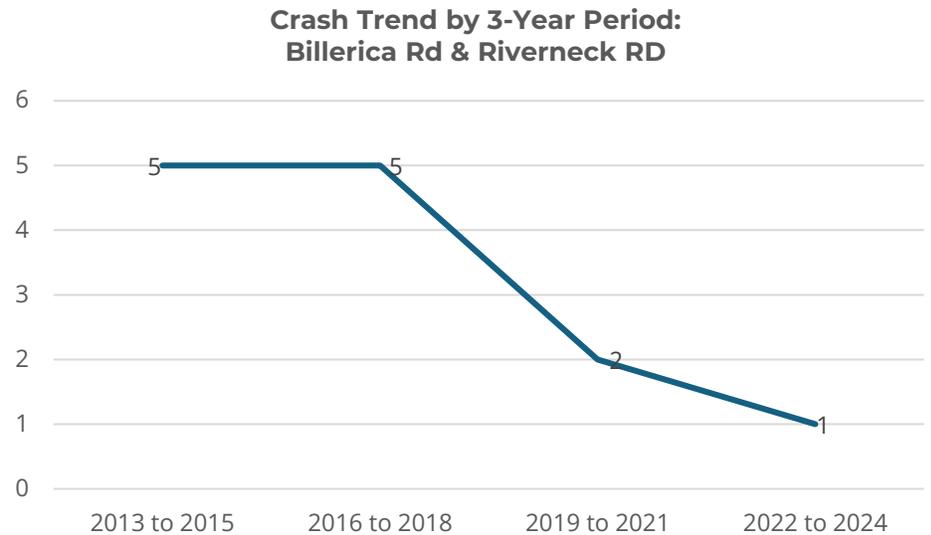


Figure 1: Crash Trend by 3 - Year period at the intersection of Billerica (Route 129) and Riverneck Road

The reduction in crashes to a single recorded incident during the 2022–2024 period following the completion of the intersection improvement project suggests that the implemented geometric and operational enhancements have contributed to improved safety performance. Notably, the introduction of a dedicated auxiliary left-turn lane has separated traffic from through movements, thereby mitigating rear-end crash risks. In addition, the reconfiguration of the intersection into a conventional “T” layout has enhanced turning clarity and reduced driver uncertainty, supporting more predictable vehicular movements. These modifications appear to have effectively reduced conflict points and improved overall traffic operations at this location.

Staff verified that the single post-construction crash occurred in 2023 and involved a vehicle attempting a left turn from Billerica Road onto Riverneck Road without sufficient time or space, resulting in a collision with oncoming traffic. This incident, documented in Chelmsford Police Department records, underscores the importance of driver decision-making even where infrastructure has been improved. While the project has successfully reduced crash frequency and severity, this case highlights the ongoing need for targeted driver education and enforcement to support the full benefits of capital investments in roadway safety.

Staff also investigated the manner of collision for crashes occurring within a 200-foot radius of the Billerica Road (Route 129) and Riverneck Road intersection. Prior to construction (2010–2022), a total of 11 rear-end crashes were recorded, all under dry roadway conditions, indicating issues related to queuing, limited lane definition, or delayed turning movements. As shown in Figure 2, these types of collisions were the predominant crash pattern before the intersection improvements.

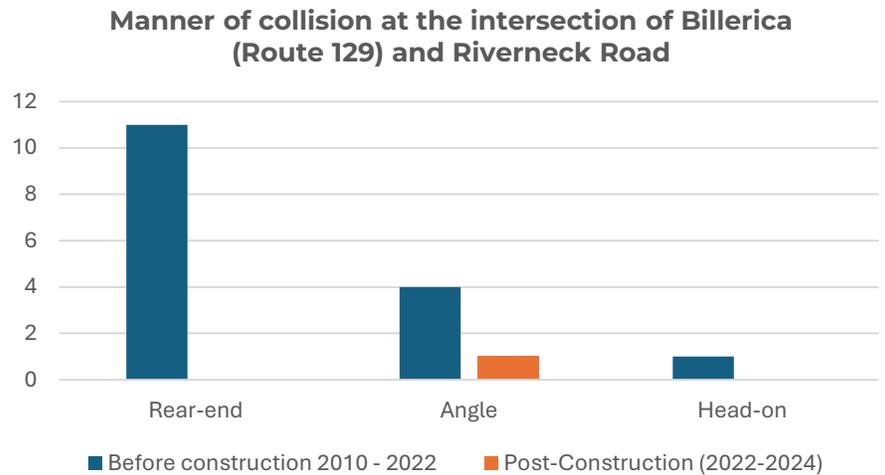


Figure 2: Manner of collision at the intersection of Billerica (Route 129) and Riverneck Road

Post-construction data from 2022 to 2024 shows no rear-end crashes, demonstrating a clear safety benefit attributable to the installation of a dedicated auxiliary left-turn lane and improved intersection geometry. This shift in crash profile underscores the value of evidence-based design strategies in addressing location-specific safety concerns and reducing conflict points that typically result in rear-end collisions.

### Equivalent Property Damage Only (EPDO) Score

The 3-Year Average EPDO Score chart illustrates a improvement in safety performance at the intersection over time. From 2010 to 2018, average EPDO scores steadily increased, peaking at 5.67 during the 2013–2015 period, indicating a higher frequency of crashes involving injuries.

In contrast, the period following 2022 shows a dramatic decline in average EPDO scores, dropping to 0.33, the lowest level recorded throughout the study. This substantial reduction reflects a long-term improvement in both crash frequency and severity, consistent with the implementation of safety-focused infrastructure upgrades. This post-construction safety improvement aligns with the implementation of

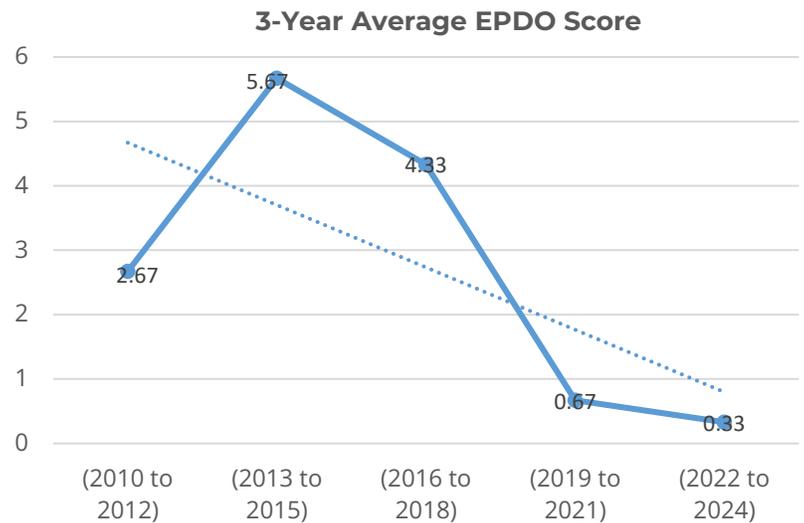


Figure 3: Billerica Road (Route 129) and Riverneck Road intersection 3 - Year Average EPDO Score

key countermeasures, including auxiliary turn lanes, geometric realignment, enhanced sight distances, and clearer lane delineation.

The downward trend confirms that the TIP-funded improvements have been successful in addressing historical crash patterns. It also demonstrates how evidence-based infrastructure investments can deliver measurable, long-term safety benefits at complex suburban intersections.

### Intersection Crash Rate – Billerica Road (Route 129) and Riverneck Road

Another effective metric used to evaluate the impact of infrastructure improvements on safety is the intersection crash rate, which measures the number of crashes per million vehicles entering the intersection (MEV).

In 2014, prior to construction, the crash rate at the intersection of Billerica Road and Riverneck Road was 0.18 crashes per MEV. Based on the most recent post-construction data (2022–2024), the crash rate has decreased significantly to 0.06 crashes per MEV.

This reduction indicates an improvement in operational safety at the intersection and suggests that the project has been effective in addressing historical crash patterns. Furthermore, the current rate of 0.06 is substantially lower than the latest MassDOT average crash rate for unsignalized intersections, which stands at 0.57 crashes per MEV for both District 4 and the statewide average. This comparison highlights the intersection’s performance well below regional and state benchmarks, reinforcing the success of the design interventions in enhancing safety.

### Safety Improvement Summary

To evaluate the safety benefits resulting from the Billerica Road (Route 129) and Riverneck Road intersection improvement project, staff conducted a comparative analysis of key Measures of Effectiveness (MOEs) from the pre-construction period (2015–2017) and the most recent post-construction period (2022–2024). The analysis revealed measurable improvements in intersection safety performance: total crashes declined by 83%, the EPDO score dropped by 95.7%, and the crash rate decreased by 66.7%. These substantial reductions underscore the effectiveness of the targeted safety enhancements implemented through the project.

Measure	Pre-Construction (2015 - 2017)	Post- construction (2022 - 2024)	Percent Change
<b>Total Crashes</b>	6	1	-83.33%
<b>EPDO</b>	23	1	-95.65%
<b>Crash Rate</b>	0.18	0.06	-66.67%

Table 1: Intersection of Billerica (Route 129) and Riverneck Road MOE Summary

## TIP PROJECT EFFECT ON SPEED CONDITIONS AND MOBILITY

Pre-construction speed data from the FDR indicated that the average travel speed along Billerica Road was 30.4 mph, with an 85<sup>th</sup> percentile speed of 38.5 mph approximately one to five miles per hour above the regulated speed limit, particularly in the eastbound direction. These speeds exceeded the regulated speed limit of 35 miles per hour (as established by MassDOT Special Speed Regulation No. 7110). The pre-construction conditions included wide travel lanes, limited pavement markings, and an undefined intersection geometry, all of which contributed to risky driver behavior and operational inefficiencies. These challenges, along with the absence of pedestrian and bicycle infrastructure, reinforced the need for the Billerica Road and Riverneck Road improvement project.

Period	Speed Limit (mph)	Average Speed (mph)	85th Percentile Speed (mph)
<b>Pre-Construction (2014)</b>	35	30.4	38.5
<b>Post-Construction (2022–2024)</b>	35	36.5	42.69

Table 2: Pre- and Post-Construction Speed Characteristics on Billerica Road

Post-construction speed data collected through MassDOT’s MS2 platform for the period 2022–2024 indicate that the average speed along Billerica Road has *increased* to 36.5 miles per hour, while the 85<sup>th</sup> percentile speed has risen to 42.69 miles per hour, more than seven miles per hour above the regulated speed limit (35 miles per hour). Most notably, 71.1% of vehicles are now traveling above the speed limit of 35 miles per hour. This increase may be partially attributed to improved roadway geometry, smoother traffic operations, upgraded pavement conditions, and the addition of defined auxiliary turning lanes. However, these same geometric enhancements designed in accordance with a 40-miles per hour design speed, as noted in the FDR, may have inadvertently created an environment that supports and encourages higher speeds.

Speed Performance Comparison: Billerica Road (Pre vs. Post Construction)

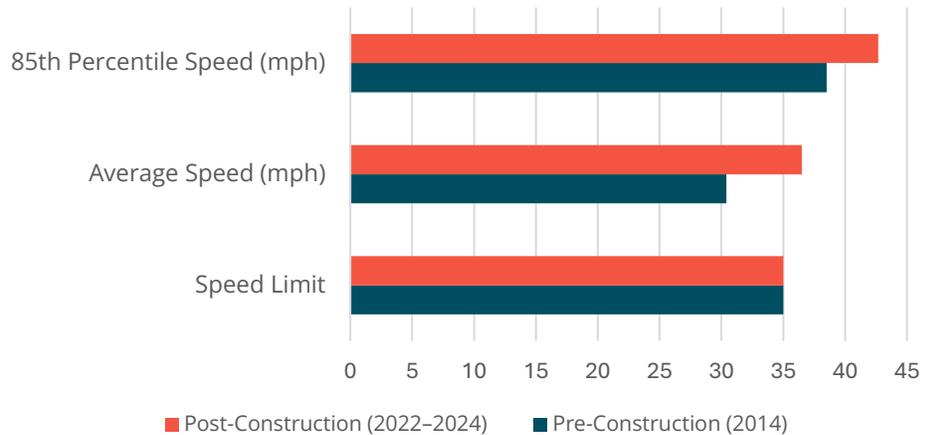


Figure 4: Speed performance and comparison of Billerica Road (Pre vs. post construction).  
Source: MS2

From a road safety perspective, the elevated 85<sup>th</sup> percentile speed reflects reduced driver friction and increased operating comfort, particularly in the absence of active speed-moderating elements.

While the improvements have enhanced mobility and operational flow, they underscore the need to complement physical upgrades with targeted speed management strategies, such as enforcement, gateway treatments, and signage. Such measures are essential to maintain safe travel behavior and align driver speeds with the intended function and regulatory expectations of the corridor.

## STAKEHOLDER FEEDBACK

As part of the TIP Project Review Study for the Billerica Road (Route 129) and Riverneck Road Intersection Improvement Project, staff conducted a stakeholder survey to assess perceptions of the project’s impact on safety, mobility, and accessibility. The survey targeted roadway users, nearby property owners, municipal and agency staff, and project consultants.

As shown in the graph below, of the 17 total respondents, 76% identified as project abutters or roadway users. Another 6% each were MassDOT staff and project consultants, while 12% selected “Other,” including representatives from the police and fire departments. These results indicate that the feedback was primarily community-driven, offering firsthand perspectives on how the improvements are functioning in practice. These perspectives complement technical findings and help identify both benefits realized and any remaining concerns. edit

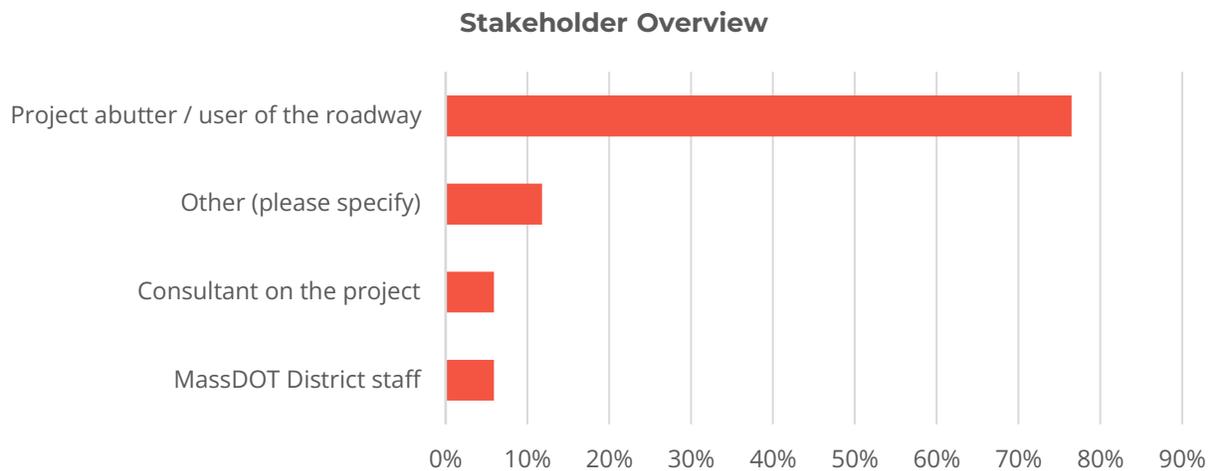


Figure 5: Stakeholder overview

## Safety Perception and Impact

Nearly 87% of respondents perceived an improvement in overall traffic safety compared to pre-construction conditions, with 47% stating that safety had “significantly improved” and 40% reporting it had “somewhat improved.” Only 13% were unsure, and no respondents indicated that safety remained unchanged or worsened, suggesting that the project successfully addressed prior safety deficiencies. This strong consensus reflects a clear public

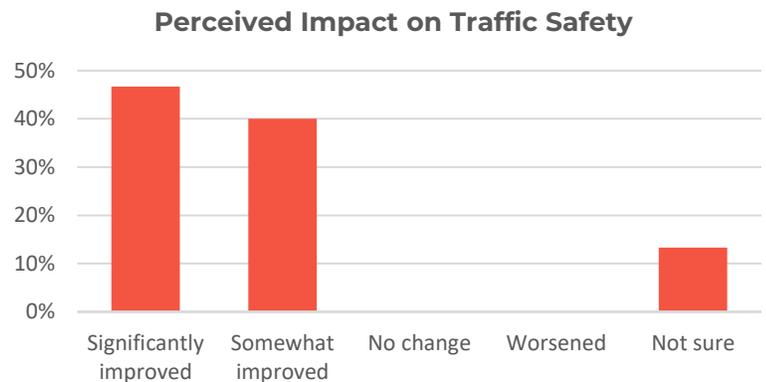


Figure 6: Perceived Impact of the Project on Traffic Safety

perception that the intersection is now safer than it was before the improvements were implemented.

Safety emerged as the dominant theme across responses. 87% of stakeholders reported improved traffic safety post-construction, with nearly half (47%) describing the improvement as significant. Respondents particularly highlighted the installation of dedicated turn lanes (80%), intersection realignment (67%), and enhanced signage (67%) as the most impactful safety improvements.

### Stakeholder Perceptions on Most Effective Safety Improvements

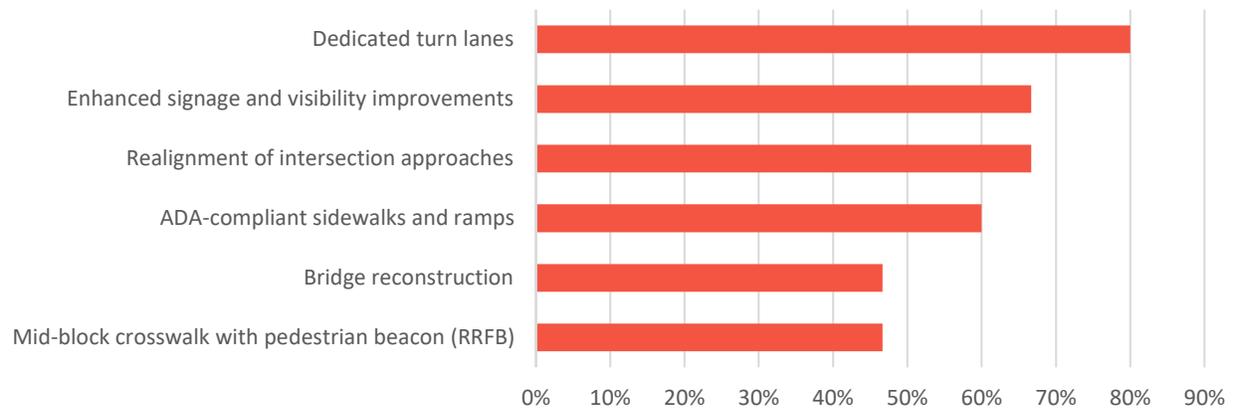


Figure 7: Most Effective Safety Improvements – Stakeholder Responses

Based on responses highlighting turn lanes as a key safety improvement, one could infer that abutters observed better control and predictability in driver behavior.

Stakeholders also acknowledged the presence of ADA-compliant ramps and sidewalks (60%), indicating improved safety for vulnerable road users. These outcomes align with crash modification factors outlined in the Highway Safety Manual (HSM2), where left-turn channelization and pedestrian upgrades are known to reduce conflict points.

### Mobility and Reliability

Stakeholder feedback indicates strong satisfaction with the intersection’s post-construction operational performance. 77% of respondents affirmed that the location has functioned reliably, and no concerns were raised about congestion or signal delay. This perception aligns with the project’s goals of improving level of service through geometric realignment, dedicated turning lanes, and upgraded signal infrastructure. From a user standpoint, the intersection feels more orderly and efficient, likely reflecting tangible gains in throughput and reduced friction at conflict points.

However, empirical speed data introduces an important counterpoint. While stakeholders reported improved reliability, post-construction monitoring shows the 85<sup>th</sup> percentile speed has increased to 42.69 miles per hour, exceeding the regulatory limit by over seven miles per hour. This suggests that the design changes which improved flow such as wider lanes, clearer geometry, and smoother surfaces may also be contributing to higher operating speeds and reduced driver caution. The

discrepancy between perceived reliability and observed speeding highlights a critical nuance: improved mobility can inadvertently reduce “driver friction,” creating an environment that feels efficient but may compromise safety, especially for pedestrians and cyclists.

Thus, while stakeholders experienced the benefits of operational enhancements, their feedback does not reflect the emerging speed management challenge a common post-construction dynamic in corridor upgrades. To ensure that mobility improvements remain sustainable and safe, targeted interventions (e.g., speed feedback signs, visual narrowing, or gateway treatments) may be required to reinforce appropriate driving behavior and align perceived reliability with actual compliance to speed regulations.

### **Accessibility and Pedestrian Comfort**

Stakeholder assessment of accessibility was favorable: over half (53%) rated improvements as “Excellent,” and an additional 33% rated them as “Good.” This reflects the perceived benefit of ADA ramps, continuous sidewalks, and clearer pedestrian crossing paths. The integration of ADA-compliant elements directly supports federal accessibility mandates and MassDOT’s Healthy Transportation Policy Directive.

### **Bicycle and Pedestrian Accommodation**

Two-thirds (67%) of respondents affirmed that the project fully met its bicycle and pedestrian accommodation goals. However, one abutter raised a concern about the misuse of the bike lane by turning vehicles: “Drivers on Riverneck Road tend to use the bike lane as a right-hand turning lane...”

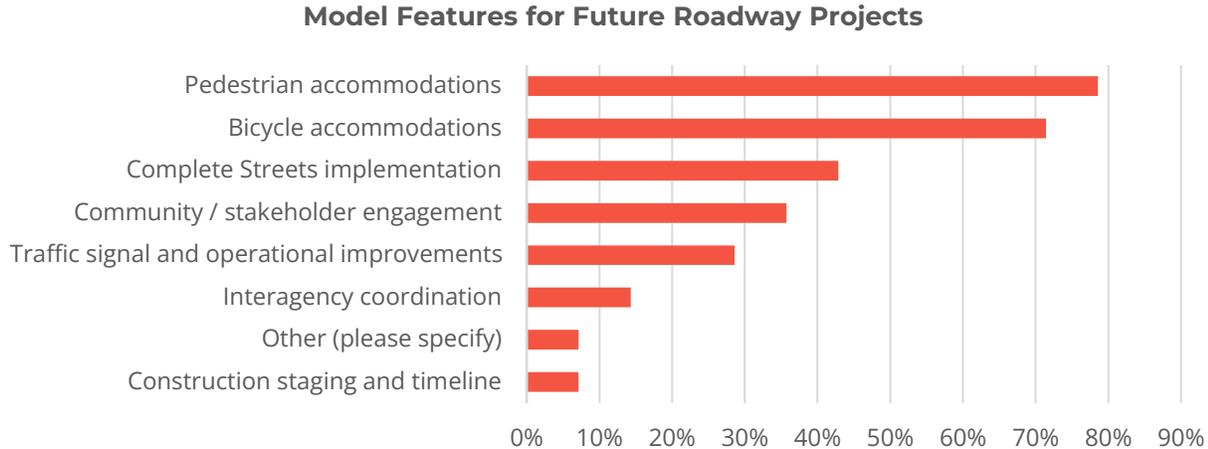
This comment suggests a potential issue not with the infrastructure itself, but with user interpretation and behavior. Staff conducted a follow-up site visit and verified that appropriate pavement markings and signage are present, consistent with the project’s Complete Streets design approach. Given this, the concern appears to reflect driver unfamiliarity or non-compliance, rather than a deficiency in physical design.

As part of a comprehensive Complete Streets implementation, it is recommended that such infrastructure improvements be supported by targeted public education, community outreach, and, where appropriate, enforcement to reinforce proper multimodal lane usage. These behavioral strategies are essential to achieving the intended safety and accessibility outcomes, particularly where user adaptation to new design features is still evolving.

### **Infrastructure Quality and Model Features**

Most stakeholders (79%) viewed pedestrian accommodation as a model for future TIP projects, followed closely by bicycle infrastructure (71%) and Complete Streets implementation (43%). Enhanced signalization, signage, and mid-block crossings were also mentioned as exemplary features.

Figure 8: Stakeholder-Identified Model Features for Future Roadway Projects



Such feedback reinforces that the project succeeded in integrating multimodal design best practices, enhancing both safety and user experience. Moreover, 36% cited the community engagement process as a strength, underscoring the importance of participatory planning.

### Unintended Consequences and Persistent Challenges

While most respondents (57%) reported no major unintended issues, a subset of comments pointed to localized concerns involving modal interactions and behavioral adaptation. Approximately 14% of respondents cited confusion at crosswalks, while another 14% identified conflicts at right-turn locations, particularly relating to bike lane encroachment.

One stakeholder observed, “the widened street at the entrance of Riverneck has a lot of people making U-turns,” suggesting potential uncertainty around access or increased maneuvering space leading to unexpected turning behavior.

In addition, one abutter expressed concern about accessing the cemetery: “A bit more complicated to get to the cemetery without fear of being rear-ended.”

Although this comment implies ongoing apprehension, no rear-end crashes have been recorded at this location post-construction. In contrast, rear-end collisions were among the most common crash types at the intersection prior to the project, as documented in the FDR. The comment may reflect residual driver perception shaped by past conditions, rather than current operational safety. This points to the importance of user re-acclimation and confidence-building following infrastructure changes

Collectively, these insights indicate that while the project has reduced documented crash risks, especially for vehicle-to-vehicle interactions, some users are still adjusting to the new design and may benefit from additional outreach, educational signage, or follow-up evaluation to ensure the intended safety outcomes are fully realized.

### **Forward-Looking Recommendations**

When asked about refinements for similar future projects, stakeholder feedback highlighted specific opportunities for improvement. Approximately 31% of respondents recommended a stronger focus on the design of pedestrian and bicycle accommodations, reinforcing the need for continued emphasis on user comfort and safety across all modes. In addition, 15% suggested more adaptive or responsive signal controls, indicating support for context-sensitive signal timing strategies that better reflect real-time traffic conditions.

Other suggestions included streamlined permitting processes, additional safety monitoring post-construction, and enhanced stakeholder engagement, each noted by approximately 8% of respondents. Notably, 38% selected “None of the above,” suggesting general satisfaction with the project and its outcomes. Overall, these insights support the integration of user-centered design, dynamic traffic operations, and iterative evaluation in future roadway improvement projects.

**APPENDIX 1: BEFORE & AFTER PHOTOGRAPHS**



Photo 7: Billerica (Route 129) Rd (looking East Road before improvements. Source near map imagery (2025).



Photo 8: Billerica (Route 129) Rd (looking east Road After improvements. Source site visit.



Photo 9: Riverneck Rd (looking North Road before improvements. Source near map imagery (2025).



Photo 10: Riverneck Rd (looking North Road After improvements. Source site visit.



Photo 11: Billerica Rd (looking West Road before improvements. Source near map imagery (2025).



Photo 12: Billerica Rd (looking West Road After improvements Source: Site

**PRE-CONSTRUCTION CONDITIONS – BILLERICA ROAD & RIVERNECK ROAD (SOURCE: NEARMAP IMAGERY, 2016)**



**POST-CONSTRUCTION CONDITIONS – BILLERICA ROAD & RIVERNECK ROAD (SOURCE: NEARMAP IMAGERY, 2016)**



**APPENDIX 2: CRASH RATE WORKSHEETS**

**BillERICA Road (Route 129) at Riverneck Road Intersection (Before)**



**INTERSECTION CRASH RATE WORKSHEET**

CITY/TOWN : Chelmsford, MA COUNT DATE : Sep-14

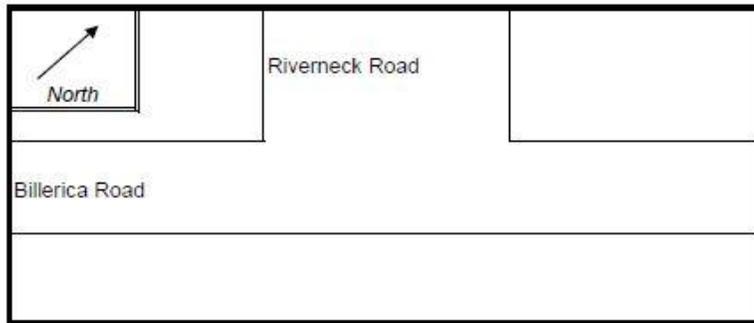
DISTRICT : 4 UNSIGNALIZED :  SIGNALIZED :

~ INTERSECTION DATA ~

MAJOR STREET : BillERICA Road

MINOR STREET(S) : Riverneck Road

INTERSECTION  
DIAGRAM  
(Label Approaches)



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	EB	WB	SB			
PEAK HOURLY VOLUMES (AM/PM) :	468	928	234			1,630

"K" FACTOR : 0.090 INTERSECTION ADT ( V ) = TOTAL DAILY APPROACH VOLUME : 18,111

TOTAL # OF CRASHES : 6 # OF YEARS : 5 AVERAGE # OF CRASHES PER YEAR ( A ) : 1.20

CRASH RATE CALCULATION : **0.18** RATE =  $\frac{(A * 1,000,000)}{(V * 365)}$

Comments : Crash Rate Worksheet (2010-2014) from the Functional Design Report for the BillERICA Road (Route 129) at Riverneck Road Intersection Improvement Project.

**APPENDIX 3: CRASH RATE WORKSHEETS**

**Billerica Road (Route 129) at Riverneck Road Intersection (After)**

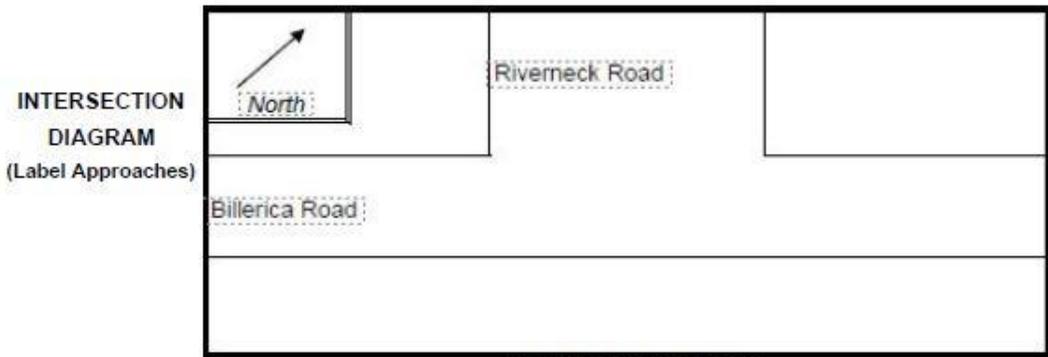


**INTERSECTION CRASH RATE WORKSHEET**

CITY/TOWN : Chelmsford MA      COUNT DATE : 2022-2024  
 DISTRICT : 4      UNSIGNALIZED :       SIGNALIZED :

~ INTERSECTION DATA ~

MAJOR STREET : Billerica Road (Route 129)  
 MINOR STREET(S) : Riverneck 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 :				14,657
TOTAL # OF CRASHES :	1	# OF YEARS :	3	AVERAGE # OF CRASHES PER YEAR ( A ) :		0.33

CRASH RATE CALCULATION : **0.06**      RATE =  $\frac{(A * 1,000,000)}{(V * 365)}$

Comments : \_\_\_\_\_  
 Project Title & Date: \_\_\_\_\_