



Transportation Improvement Program Review Study

An examination of the Westford
Route 110 (Littleton Road) and
Tadmuck Road Intersection Project

JUNE 2024

PREPARED FOR:

The Northern Middlesex Metropolitan Planning Organization

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Table Contents

Table of Figures	3
Project Overview and Funding	5
Prior Conditions	6
Project Overview	6
Project Need	6
Transportation Evaluation Criteria	7
Post-Construction Conditions	8
Current Conditions	9
Analysis	9
Emission Reduction	9
Crash Reductions	9
Conclusion and Recommendations	11
Future Development Considerations	12
Appendix A: TIP Project Review Study Presentation Slides	13

Table of Figures

Figure 1 Intersection Map, Route 110 and Tadmuck Road, Town of Westford.....	4
Figure 2 Route 110 and Tadmuck Road - Personal Injury Crashes	10
Figure 3 Route 110 and Tadmuck Road - Property Damage Crashes	11

In collaboration with the Massachusetts Department of Transportation (MassDOT) and member communities, the Northern Middlesex Metropolitan Planning Organization (NMMPO) supports the funding process for regional transportation improvement projects. Under 49 U.S.C. 5303(j), each Metropolitan Planning Organization (MPO) is required to develop a Transportation Improvement Program (TIP) annually. The TIP is a federally required certification document that lists upcoming transportation projects spanning at least four years, and must be fiscally constrained. The TIP must include all regionally significant projects receiving Federal Highway Administration (FHWA) and Federal Transportation Association (FTA) funds for which FHWA or FTA approval is required, in addition to non-federally funded projects consistent with an MPO's approved Metropolitan Transportation Plan (MTP). The 3C planning process (continuing, comprehensive, and cooperative) originated under the Federal-Aid Highway Act of 1962. The process is designed to engage the public and stakeholders in establishing shared goals and a vision for the community. 3-C planning requires that planners establish existing conditions and needs and review available funding resources. Under the 3C process, transportation professionals are tasked with establishing transportation performance measures, targets, and goals along with developing strategies to meet the prescribed goals. The information is documented in the Statewide Long-Range Transportation Plan (LRTP) and MTP. The Performance-Based Planning Process (PBPP) provides tools to establish system performance targets based on informed investment decisions, which are documented in the Statewide Transportation Improvement Program (STIP) at the State level and the Transportation Improvement Program (TIP) at the MPO level.¹

This report comprehensively evaluates the effectiveness and impact of TIP Project 607251, Intersection and Signal Improvements at Route 110 (Littleton Road) and Tadmuck Road in Westford, a project funded by the NMMPO through the TIP.

This study analyzes and compares the safety conditions before and after project completion to understand the project's impact. The effectiveness of the project was measured by examining the total number of crashes and the severity of crashes at this project location, as well as by reviewing the conditions at each project site before and after the construction improvements. Assessing the before and after conditions is vital to inform future infrastructure improvements for projects programmed on the TIP. The findings in this report will enable



Figure 1 Project Area Map, Route 110 (Littleton Road) and Tadmuck Road, Town of Westford April 2029

¹ **Module 2: Fundamentals of Transportation Planning**

the NMMPO, regional stakeholders, and state and federal transportation agencies to allocate funding in the future properly.

Project Overview and Funding

TIP project 607251 is located at Route 110 (Littleton Road) and Tadmuck Road in Westford, Massachusetts. The project was awarded funds and programmed in the 2016-2019 Northern Middlesex TIP document. The FY 2016-2019 TIP was endorsed in July 2015 and went into effect on October 1, 2015. As shown in Table 1, the total project cost was estimated at \$2,682,093.74. The project was advertised in 2016, and construction began in late 2016 or early 2017; the project was officially completed in 2019 when MassDOT consulted the final signal inspection.

PROJECT ID	PROJECT NAME	PROJECT DESCRIPTION	MUNICIPALITY	TOTAL PROJECT COST	AWARD YEAR
607251	Westford- Intersection & Signal Improvements at Route 110 (Littleton Road) and Tadmuck Road	The project involves roadway widening, signalization, turning lanes, sidewalks, crosswalks, retaining walls, stormwater management improvements, and culvert replacement.	Westford	\$2,682,093.74	2016 -2019

Each MPO's regional target funding comprises shares of the [Surface Transportation Program](#), [Congestion Mitigation and Air Quality Improvement Program](#) (CMAQ), [Highway Safety Improvement Program](#) (HSIP), and [Transportation Alternatives Program funding](#) (TAP). The total estimated project cost was \$2,682,093.74 of that total, \$344,990.00 consisted of TAP funds, \$2,336,353.74 were CMAQ funds, and \$750.00.00 were other state funds. The [Massachusetts Strategic Highway Safety Plan](#) (SHSP) is a statewide-coordinated safety document that provides a comprehensive framework for reducing highway fatalities and serious injuries on all public roads. The principal requirement from MassDOT is that HSIP funds be used for safety projects consistent with the SHSP. A principal requirement for HSIP eligibility is that HSIP funds be used for safety projects consistent with the SHSP and that selected projects aim to correct or improve hazardous road locations or features or address a highway safety problem.

The HSIP is a core Federal Aid program designed to reduce traffic fatalities and serious injuries on all public roads. The HSIP is legislated under Section 148 of Title 23, United States Code (23 U.S.C. 148) and regulated under Part 924 of Title 23, Code of Federal Regulations (23 CFR Part 924). Projects funded with HSIP resources must be programmed in the respective MPO TIP document. Funding eligibility for the HSIP is based on crash data and engineering assessments of hazardous locations.

The CMAQ program sponsors transportation projects designed to reduce traffic congestion and improve air quality, particularly in areas of the country that do not attain national air quality standards. Transportation energy use contributes to increased greenhouse gas concentrations in the atmosphere. Carbon dioxide (CO2) emissions, the major greenhouse gas, are rising throughout the US. Transportation accounts for about a third of CO2 emissions in the U.S., and transportation emissions are among the

fastest-rising emitting sectors (FHWA, 2023). A GHG assessment should be conducted for each TIP project; this assessment may be quantitative or qualitative, depending on the project type.

Prior Conditions

Project Overview

Route 110 is situated parallel in alignment with I-495 and is connected to I-495 via the signalized interchange located along Boston Road. This project included the intersection of Route 110 (Littleton Road) and Tadmuck Road. Route 110 is largely a two-lane, undivided roadway with one general-purpose travel lane provided in each direction supplemented by exclusive turn lanes at major intersections. MassDOT owns and maintains the Route 110 corridor, which the MassDOT Division classifies as a rural major collector/urban minor arterial. Littleton Road (Route 110), which operates in the east-west direction of the study area, is a major connector between Littleton Common and the Town of Westford. Route 110 is generally straight and level, except for an S-curve between Nixon Road and South Chelmsford Road and a grade change in Tadmuck Road. The intersection is on a 1.6-mile-long section of Littleton Road in MassDOT Highway District 3. Parcels abutting the intersection of Route 110 and Tadmuck are zoned Commercial Highway (Town of Westford 2023 Zoning Bylaw). The [Town of Westford 2017-2021 Housing Production Plan](#) discusses the existing and proposed housing developments adjacent to this project area.

Project Need

Several studies were conducted near the Route 110 and Tadmuck Road intersections. The first study, conducted in 2006 by MDM Transportation Consultants, was a full corridor study of Littleton Road (Route 110) in Westford, Massachusetts. This study reviewed the 1.6-mile-long section of Littleton Road. Following the 2006 study, two consulting firms conducted traffic-related studies near the TIP project area. The two studies mentioned had slightly different objectives and study areas.

The first study, conducted in July 2011 by Vanasse & Associates, was a Traffic Impact and Access Study for a proposed apartment community managed by Princeton Properties, a 200-unit residential apartment community to be located at 16 Littleton Road (Route 110), between Tadmuck Road and the Chelmsford Town Line, in Westford, Massachusetts. The project area for this study was contained within the two major roadways (Littleton Road and South Chelmsford Road) and the two primary intersections (Littleton Road at South Chelmsford Road and Littleton Road at Tadmuck Road), which provide access to the proposed development. A key finding of the 2011 study was that the intersection (Littleton Road and Tadmuck Road) satisfied four of the eight traffic warrants, qualifying the installation of a traffic signal.

Using the evidence from the 2011 study, the Town of Westford submitted a Project Need Form (PNF) to MassDOT District 3 in 2012 to request consideration of reconstructing the intersection of Route 110 and Tadmuck Road. As outlined on the PNF, the improvements requested included roadway widening, signalization, turning lanes, sidewalks, crosswalks, retaining walls, and stormwater management improvements. The overall project need was explained in the PNF as a reconstruction project to improve vehicular/pedestrian safety and reduce delays. The development of two residential areas, including the addition of 365 units, was mentioned in the PNF. The project included traffic control signals, pedestrian

crosswalks, ADA-compliant sidewalks, and expansion of the road shoulder. The Town Engineer, Paul Starratt, noted the traffic delays in the initial PNF. Traffic delay reductions at the intersection made Route 110 and Tadmuck Road a CMAQ-eligible project. The bicycle and pedestrian facilities and public transportation conditions in the intersection are mentioned to illustrate the conditions at the time of the project proposal. Before the design stage, the Town had organized several outreach meetings with the immediate abutters to build consensus on the project. In addition, Town staff met with Town officials and board members to review the proposed improvements.

In 2013, the consulting firm Vanasse Hagen Brustlin Inc. (VHB) conducted a Functional Design Report titled *Route 110 (Littleton Road) at Tadmuck Road Intersection Improvement Project (File No. 607251)*. The objectives of the report were to define and prepare plans for roadway and traffic control improvements at the intersection of Route 110 (Littleton Road) and Tadmuck Road to satisfy the MassDOT 25 percent design requirement for TIP projects. The project focused on improving traffic and roadway operations and providing pedestrian and bicycle accommodation at the intersection of Route 110 and Tadmuck Road. The Westford Housing Authority is located at 65 Tadmuck Road, near the project area. The proximity of senior housing supported the need for better pedestrian amenities and safer crossing conditions.

MassDOT obtains crash data from the Registry of Motor Vehicles to inform TIP Projects. The crash data is comprised of state and local police crash reports. Although this intersection was not found on the MassDOT Top 200 Crash Locations list in 2013, the crash rate exceeded the average for unsignalized intersections. Nevertheless, the 2013 consultant report assigned the Route 110 and Tadmuck Road intersection a Level of Service ranking of F, during the morning and evening peak hours, representing the lowest performance of roadways and transportation elements. Level of Service (LOS) is a qualitative measurement of the effect of several factors, including roadway geometry, speed, travel delay, freedom to maneuver, and safety. LOS is an index to operational qualities of a road segment or intersection, the letter designations range from A to F, the letter A represents the best operation condition, and F represents the worst. VHB used LOS based on the [Highway Capacity Manual](#) to denote the different operating conditions on Route 110 and Tadmuck Road under various traffic volumes. These findings demonstrated the project's need and secured the project's programming by demonstrating the need for roadway improvements.

Transportation Evaluation Criteria

Upon programming a new TIP project, NMMPO staff apply the TEC to assess a project's objectives with regional goals. A series of six standards are used for evaluation across the various subcategories—scores in each category range from -3 to +3. MAP-21 guidelines also require that the MPO perform a competitive process for Transportation Alternatives Program (TAP) funding allocation. The TEC addresses this competitive process by focusing the funding on the highest priority projects. NMMPO staff applied the Transportation Evaluation Criteria (TEC) to score all highway projects (except bridge projects) considered viable for FFY 2016-2019. The TEC score assigned to the Route 110 and Tadmuck Road intersection project was 6.5. TEC scores range from -18 for a project that would adversely impact the transportation system to +18 for a project with the highest priority. Aside from TEC scores, the design status and project readiness are considered.

The application of the evaluation criteria, each project was also assessed to ensure the following:

- That the project meets requirements outlined in MAP-21, the Clean Air Act and Amendments, and the Americans with Disabilities Act;
- Consistency with local, regional, and state plans; and
- Compliance with Title VI/Environmental Justice requirements.

Post-Construction Conditions

The Route 110 and Tadmuck Road intersection improvements included roadway widening, signalization, turning lanes, sidewalks, crosswalks, retaining walls, and stormwater management improvements. The project included traffic control signals, pedestrian crosswalks, ADA-compliant sidewalks, and expansion of the road shoulder. A comprehensive list of geometric and traffic control improvements identified in the 2013 Functional Design Report informed the implementation and advanced the project design. The recommended improvements listed were:

Proposed Geometric Improvements

- Provide new left-turn lanes on Route 110 (Littleton Road) to accommodate traffic volumes, providing vehicle storage;
Provide a new southbound right-turn lane on Tadmuck Road to accommodate heavy right-turn movement;
- Increase the corner radii at all four corners of the intersection to accommodate larger vehicles;
- Provide new sidewalks on the northern side of Route 110 and both sides of Tadmuck Road;
- Eliminate the Route 110 passing zones eastbound and westbound;
- Provide new catch basins with deep sumps, new drain lines, and new manholes, all of which will drain downgrade from the intersection into a drainage outfall with check dams;
- Provide new granite curbing within the project paving and sidewalk limits; and
- Provide five-foot shoulders on Route 110; however, these shoulders will be immediately transitioned back to match the existing cross-section on Tadmuck Road, as additional widening to accommodate wider shoulders will impact adjacent wetlands, an adjacent detention basin, and property that has a conservation restriction.

Proposed Traffic Control Improvements

- Install a new fully actuated traffic signal system with appropriate timing and phasing for peak-hour volume requirements to control all movements at this intersection (CMAQ benefit).
- Provide an exclusive pedestrian phase with countdown pedestrian heads and an Accessible Pedestrian Signal (APS) system (CMAQ benefit).
- Upgrade existing signals and pavement markings to meet the proposed design (CMAQ benefit).
- Provide bicycle detection on all approaches and the proposed 5-foot shoulders (CMAQ benefit).
- Provide emergency vehicle pre-emption on all approaches and the capability for future Transit Signal Priority (TSP).

Current Conditions

As a result of the programming of the Route 110 and Tadmuck Road Project, the intersection improvements were executed. The intersection now features a four-way traffic signal. The signals include new traffic signals, pedestrian signals, buttons, ADA-compliant curbs, crosswalk striping, signage, a guardrail, sharrows, directional signage, and other pavement markings. These enhancements have improved visibility and reduced traffic delays by assigning appropriate right-of-way to minimize conflicting movements at an intersection. The traffic enhancements have reduced congestion and decreased crash rates by relaying messages to motorists and pedestrians through alternating roads and improving efficiency.

Analysis

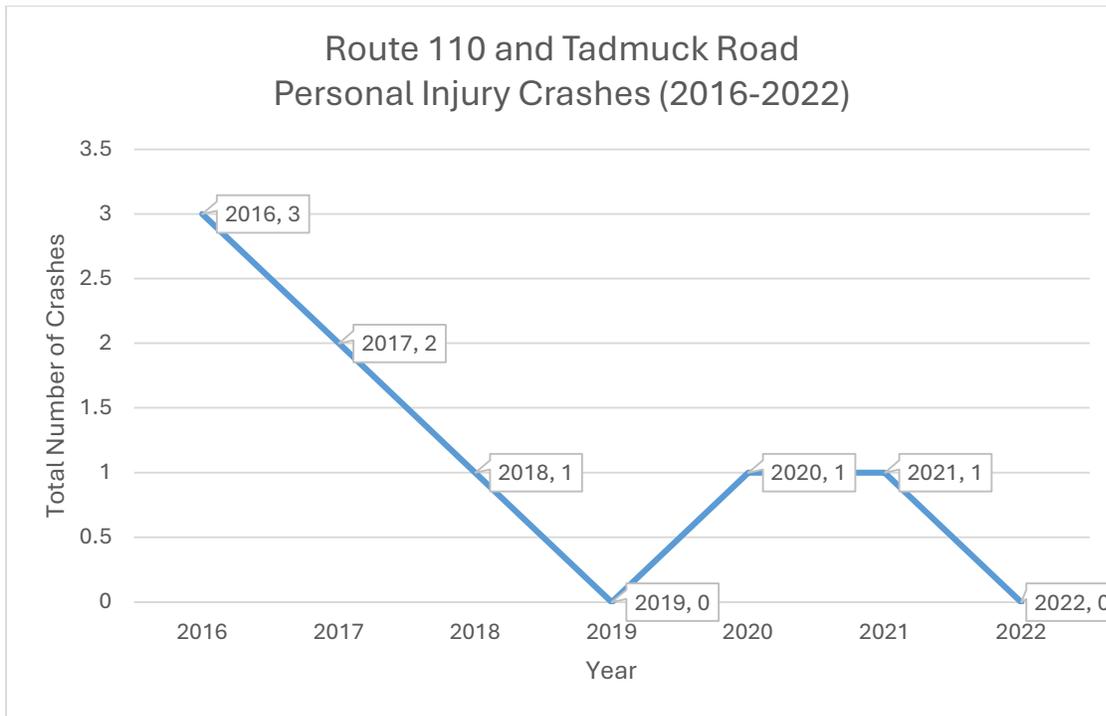
Emission Reduction

The Commonwealth's MPOs support the GHG reductions mandated under the Global Warming Solutions Act (GWSA). The MPOs are most directly involved in helping to achieve GHG emissions reductions through promoting healthy transportation modes by prioritizing and programming an appropriate balance of roadway, transit, bicycle, and pedestrian investments and assisting smart growth development patterns by creating a balanced multi-modal transportation system. The 2016-2019 Statewide Transportation Improvement Program lists the Route 110 and Tadmuck Roads project with a GHG Impact of 16,063, meaning the quantified decrease of GHG emissions was 16,063. This rating reflects vehicle tailpipe carbon dioxide (CO₂) emissions due to congestion mitigation at the intersection.

Crash Reductions

Crash data from 2016 to 2022 was evaluated to demonstrate crash rates in this section. **Figure 2** displays the total number of crashes that resulted in injuries from 2016 through 2022. The data shown is provided by MassDOT as reported by municipal and state emergency responders. As shown in Figure 2, the number of crashes decreased over time since the project was completed. The graph shows three injury crashes in 2016, two accidents in 2017, and one injury crash in 2018. There were no injury crashes in 2019, but in 2020 and 2021, there was one injury crash each year. Most recently, in 2022, there were no injury crashes along the intersection, demonstrating improved safety conditions by reconstructing the geometry and adding traffic signals.

Figure 2 Route 110 and Tadmuck Road - Personal Injury Crashes



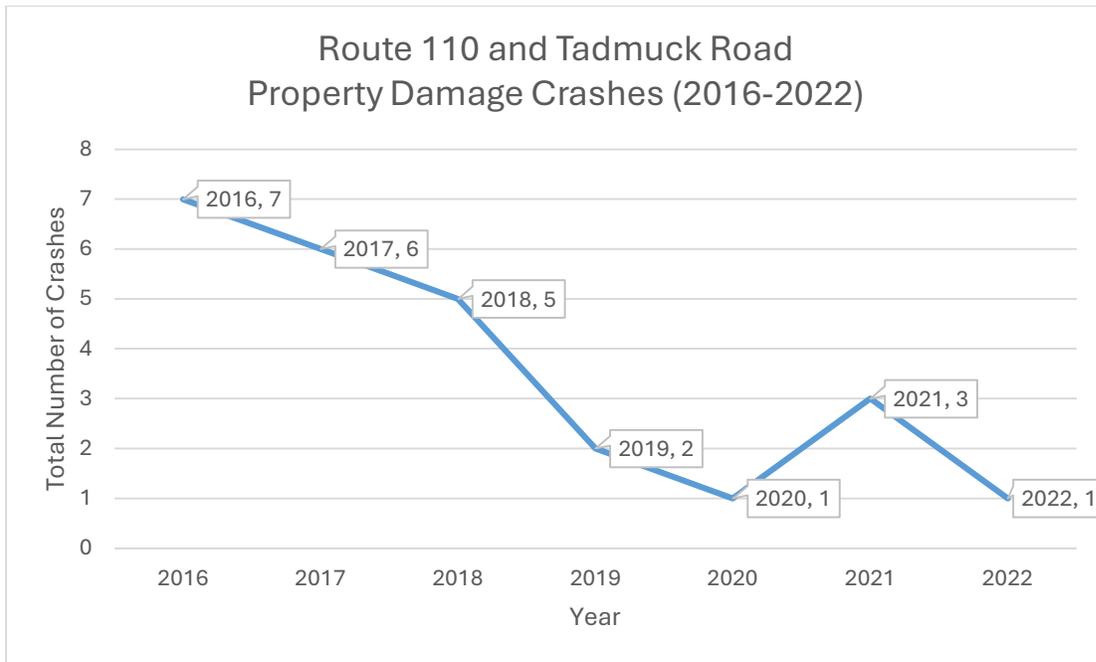
Source: MassDOT IMPACT Portal (2016-2022)

Although several injuries were reported between 2016 and 2022, the reported injuries were non-fatal injuries. The most serious injury was reported on January 8, 2020, when a male cyclist was struck along the intersection and endured a serious injury as a result of the crash. This was reported as a suspected serious injury. The US DOT defines a serious injury using the [MMUCC 4th Edition "Suspected Serious Injury \(A\)"](#) attribute found in the "injury status" data element. A suspected serious injury is defined in the MMUCC 4th Edition as any injury other than fatal that results in one or more of the following:

- Severe laceration resulting in exposure of underlying tissues/muscle/organs or resulting in significant loss of blood;
- Broken or distorted extremity (arm or leg);
- Crush injuries;
- Suspected skull, chest, or abdominal injury other than bruises or minor lacerations;
- Significant burns (second and third-degree burns over 10% or more of the body);
- Unconsciousness when taken from the crash scene;
- Paralysis.

Figure 3 displays crashes from 2016 through 2022. The chart illustrates crashes at the intersection of Route 110 and Tadmuck Road that resulted in property damage. Although the crashes shown did not result in personal injury, the crashes did result in property damage or damage to a motor vehicle, as reported by MassDOT and municipal first responders. Overall, since 2016 there has been a downward trend in property damage crashes.

Figure 3 Route 110 and Tadmuck Road - Property Damage Crashes



Source: MassDOT IMPACT Portal (2016-2022)

The reduction in injuries at the intersection of Route 110 and Tadmuck Road in Westford suggests that safety conditions have improved. Before implementing this TIP project, this intersection met one or more traffic warrants identified by VHB in 2011. Installing a signalized traffic light addressed the inadequacy and supports the warrant recommendation.

Conclusion and Recommendations

After evaluating the TIP projects at Route 110 Tadmuck Road in Westford, staff drew the following conclusions:

- The Route 110 Tadmuck Road project in Tewksbury resulted in a quick and noticeable improvement in safety, based on the data shown in **Figures 2 and 3**. The Route 110 Tadmuck Road project showed a decrease in overall crashes. There was a reduction in Personal Injury and Property Damage crashes.
- Crash rate comparisons have shown a noticeable increase in intersection safety despite the higher traffic volumes generated due to the increased growth.
- Continued collaboration, communication, and coordination between safety specialists and transportation planners to ensure the integration of safety into the transportation planning process. The Town of Westford worked closely with MPO staff, MassDOT District, and the MPO to receive funding to complete the infrastructure improvements over the years.

This TIP review study is one tool for evaluating the effectiveness of a Transportation Improvement Project.

Future Development Considerations

This project will require routine monitoring to address changes to the intersection and along Route 110 Corridor in Westford. Westford Town Meeting recently approved the inclusion of parcels near Route 110 and Tadmuck Road in their Multi-Family Overlay District (MCMOD) in compliance with the [Multi-family Zoning Requirement for MBTA Communities Act](#). In addition, a MassWorks Grant was awarded to the Town of Littleton to redevelop 550 King Street (Route 110), named King Street Common; the project will be a 41-acre property featuring housing, small businesses, office space, and recreational spaces.

Although Littleton is not in the NMCOG region, the proximity to the new development to the Town of Westford and potential MBTA Communities supports ongoing evaluation of traffic conditions and safety.

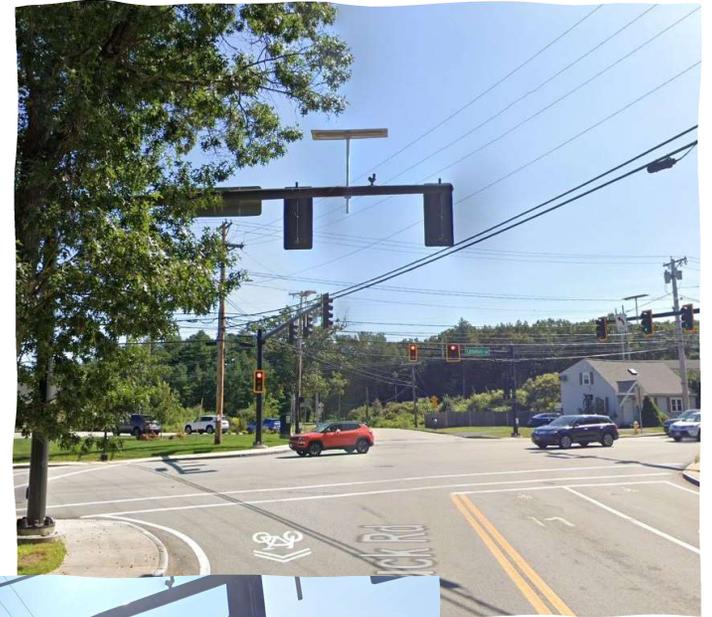
NMCOG staff will continue to monitor the intersections examined in this study and others in the region as part of the NMCOG safety program outlined in the region's work program. This will include ongoing coordination with MassDOT on traffic volumes and related corridor management. NMCOG conducts regular safety analyses and reports on traffic volume. NMCOG staff will continue to work with municipal and state partners to evaluate and monitor changes to the Route 110 Corridor.

Appendix A: TIP Project Review Study Presentation Slides

Transportation Improvement Program Review Study (FFY 2024)

Intersection and Signal Improvements at
(Route 110) Littleton Road & Tadmuck Road Westford

Project 607251



Prior Conditions

Pre-Construction Conditions

- There were two studies conducted that substantiated the project's need
 - 2011 Vanesse and Associates – Traffic Impact Analysis – related to a 200-unit new development on the adjacent Princeton Rd
 - 2013 VHB conducted a functional design report to meet MassDOT 25% design standards.

TEC Scored by MPO: 6.5

MPO Score Range -18 to +18 (highest)

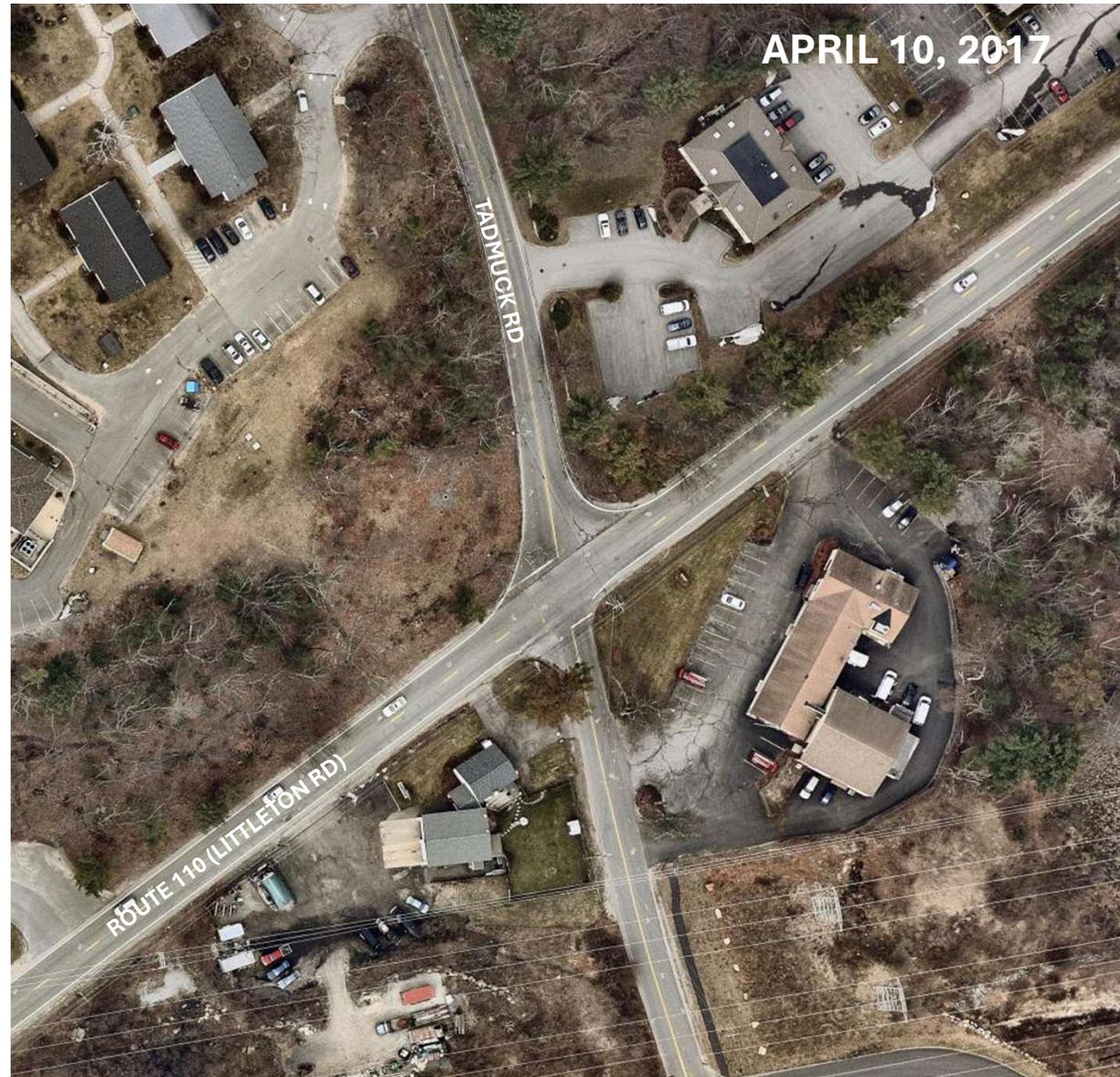
Cost Breakdown:

Total: \$2,682,093.74

TAP: \$344,990.00

CMAQ: \$2,336,353.74

\$750.00.00 were other state funds



Current Conditions

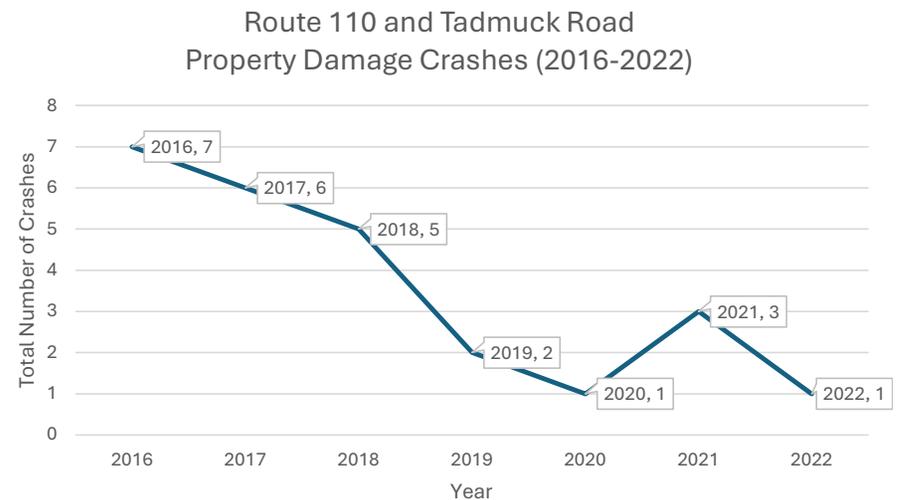
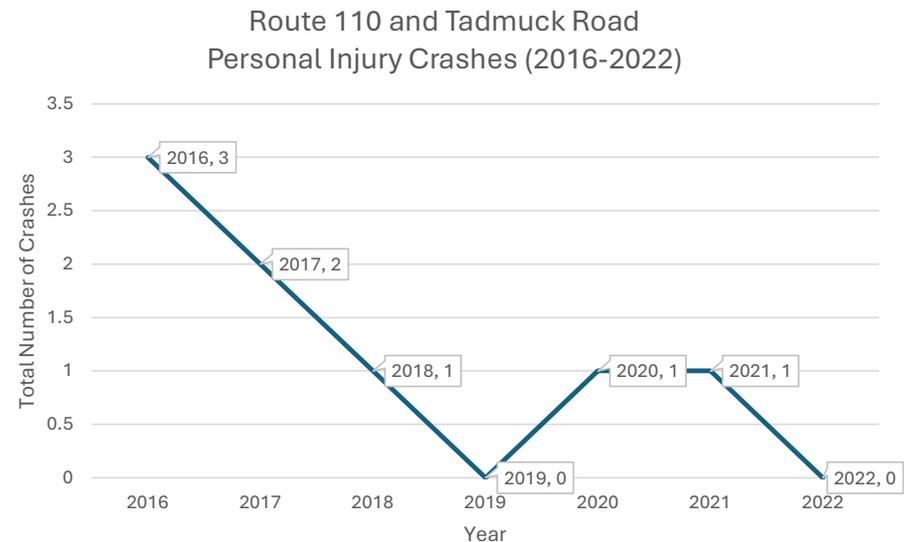
Post-Construction Conditions

- Geometric improvements
- ADA compliance
- New Striping
- Traffic control improvements



Crash data

- Personal injury crashes (2016-2022)
 - As shown in 2022, there were no injury crashes along the intersection, demonstrating improved safety conditions by reconstructing the geometry and adding traffic signals.
- Property damage crashes (2016-2022)
 - As shown, there has been a reduction in property damage-related crashes.



Before and After

Tadmuck Road facing south toward Rt 110



September 2007



September 2023

Before and After

Route 110 facing west
toward intersection

November 2012



September 2019



Future Considerations and Continued Monitoring

- **Continued** collaboration is needed between safety specialists and transportation planners to ensure the integration of safety into the transportation planning process.
- **MassWorks** King Street Commons, New Littleton, MA development
- **MBTA Communities Zoning** –Westford Town Meeting recently approved the inclusion of parcels near Route 110 and Tadmuck Road in their Multi-Family Overlay District (MCMOD) in compliance with the Multi-family Zoning Requirement for MBTA Communities Act.
 - 300 units in 2 apartment buildings – 219 Littleton Rd.

