

ROAD SAFETY AUDIT

Bartlett Street

Town of Northborough

10/28/2021

Prepared For:
Town of Northborough



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Table of Contents

Contents

Background	1
Project Data	1
Project Location and Description	3
Audit Observations and Potential Safety Enhancements.....	31

List of Appendices

- Appendix A. RSA Meeting Agenda
- Appendix B. RSA Audit Team Contact List
- Appendix C. Detailed Crash Data
- Appendix D. Additional Information

List of Figures

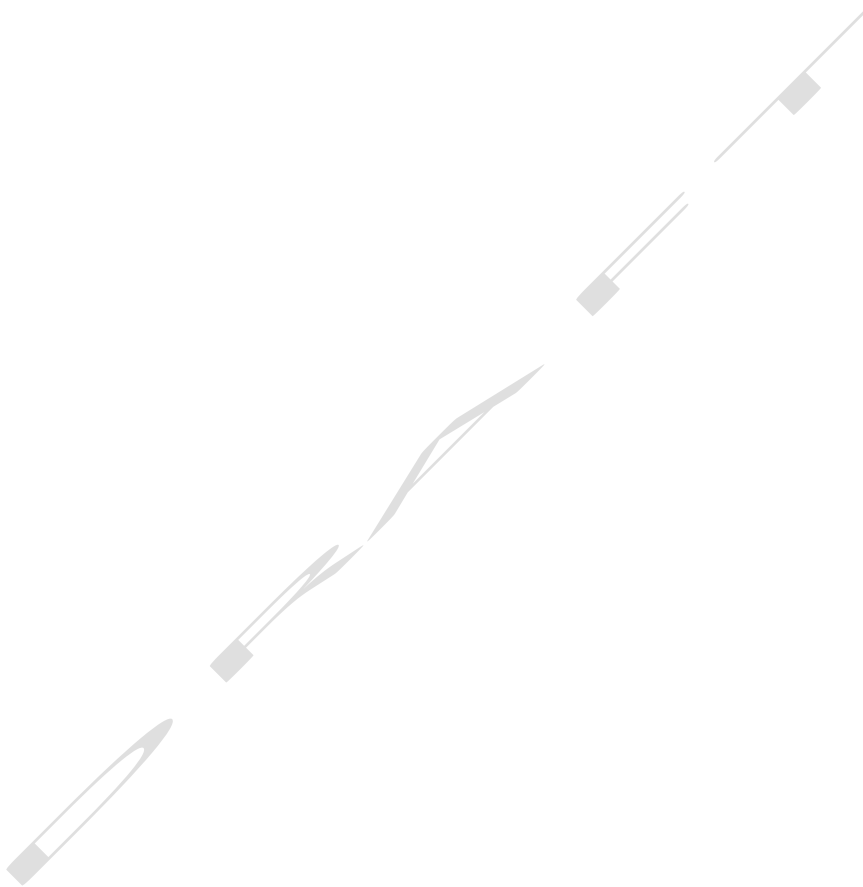
Figure 1: Bartlett Street Corridor	3
Figure 2: Bartlett Street Sidewalks	4
Figure 3: Bartlett Street Corridor Crosswalks.....	6
Figure 4: Bartlett Street Corridor Intersections.....	7
Figure 5: Tire Ruts on Bartlett Street.....	8
Figure 6: Controlled Pedestrian Signal	8
Figure 7: Vehicle Stopped Behind Line to Allow Truck Movement.....	9
Figure 8: Crashes at Bartlett/Main	10
Figure 9: Hemlock Drive Limited Sight Lines	11
Figure 10: Aqueduct Trail on Maple Street	12
Figure 11: Crosswalk on Maple Street.....	12
Figure 12: Truck Exclusion Sign and RRFB Crosswalk with New Curb Ramps at Bartlett/Maple.....	12
Figure 13: Bartlett Street, Maple Street, ARHS Driveway	13

Figure 14: Poor Sightline from Jenkins Drive as Bartlett Curves.....	14
Figure 15: Rock Placed by Town to Prevent Vehicles on Grass	15
Figure 16: Signage Informing of Lyman Intersection.....	15
Figure 17: Aqueduct Trail Signage.....	16
Figure 18: Bartlett Street Crosswalk with RRFB Signal	16
Figure 19: Signage at A Duie Pyle, Inc. Directing Drivers	17
Figure 20: Signage at 330/350 Bartlett	18
Figure 21: 330/350 Bartlett Driveway	18
Figure 22: Cedar Hill Road Geometry after Redesign.....	19
Figure 23: Pavement on Cedar Hill Road in Marlborough.....	19
Figure 24: Location of Traffic Counts and Turning Movement Counts	20
Figure 25: Bartlett Street 500' Buffer Zone	23
Figure 26: Crashes Involving Trucks on Bartlett Street Corridor.....	24
Figure 27: Crashes per Year on Bartlett Street	25
Figure 28: Bartlett Street Crashes after Amazon Opening.....	25
Figure 29: Bartlett Street Truck Crashes after Amazon Opening.....	25
Figure 30: Crashes Involving FHWA Class 8+ or Higher Vehicles.....	26
Figure 31: Bartlett Street Crashes Location.....	26
Figure 32: Bartlett Street Corridor Manner of Collision.....	27
Figure 33: Bartlett Street Corridor - First Harmful Event.....	27
Figure 34: Bartlett Street Corridor Crashes - Crash Severity	28
Figure 35: Bartlett Street Corridor Crashes - Max Injury Reported	28
Figure 36: Bartlett Street Corridor Crashes - Time of Crash.....	29
Figure 37: Bartlett Street Corridor Crashes - Light Conditions at Time of Crash.....	29
Figure 38: Bartlett Street Weather Conditions at Time of Crash.....	30
Figure 39: Bartlett Street Corridor Crashes - Road Surface Conditions	30
Figure 40: Corridor Improvements and Signage.....	32
Figure 41: Intersections Found Along Bartlett Street	32
Figure 42: Hemlock Street Looking onto Bartlett Street	32
Figure 43: The Aqueduct Trail is a Recreational Resource along the Corridor.....	32
Figure 44: Brush Impedes Line of Sight.....	32
Figure 46: Boulder Placed on Grass to Prevent Vehicles from Driving on Lawn.....	32
Figure 45: Signage for T-Intersection for Lyman.....	32
Figure 47: Pedestrian Improvements to Bartlett Street.....	32

List of Tables

Table 1: Participating Audit Team Members.....	1
Table 2: Observed Traffic Volumes 5/17/2021 - 6/1/2021	21
Table 3: Observed Heavy Vehicle Volumes 5/17/2021 - 6/1/2021	21
Table 4: Observed Vehicle Speeds 5/17/2021 – 6/1/2021	22

Table 5: Turning Movement Count Bartlett Street and 330/350 Bartlett Street 22



Background

The Federal Highway Administration (FHWA) defines a Road Safety Audit (RSA) as the formal safety examination of an existing or future road or intersection by an independent, multidisciplinary team. The purpose of an RSA is to identify potential safety issues and possible countermeasures to improve safety considering all roadway users. This audit evaluates the Bartlett Street corridor in Northborough, Massachusetts as shown in Figure 1. The Bartlett Street corridor has two distinct uses, with residential and institutional uses seen on the portion west of Lyman and commercial uses at the Rte.20/Bartlett St intersection and light industrial uses to the east of Lyman Street. This corridor is zoned for light industrial and commercial uses. There has been a rise in the development of warehouse facilities in the industrial zone causing concern regarding the possible increase in truck traffic and safety along the corridor.

Project Data

A Road Safety Audit was conducted for the Bartlett Street corridor on October 28, 2021 at Algonquin Regional High School (79 Bartlett Street, Northborough, MA 01532). As shown in Table 1 the audit team consisted of representatives from State, Regional and Local agencies, as well as representatives from both the local residential and industrial areas.

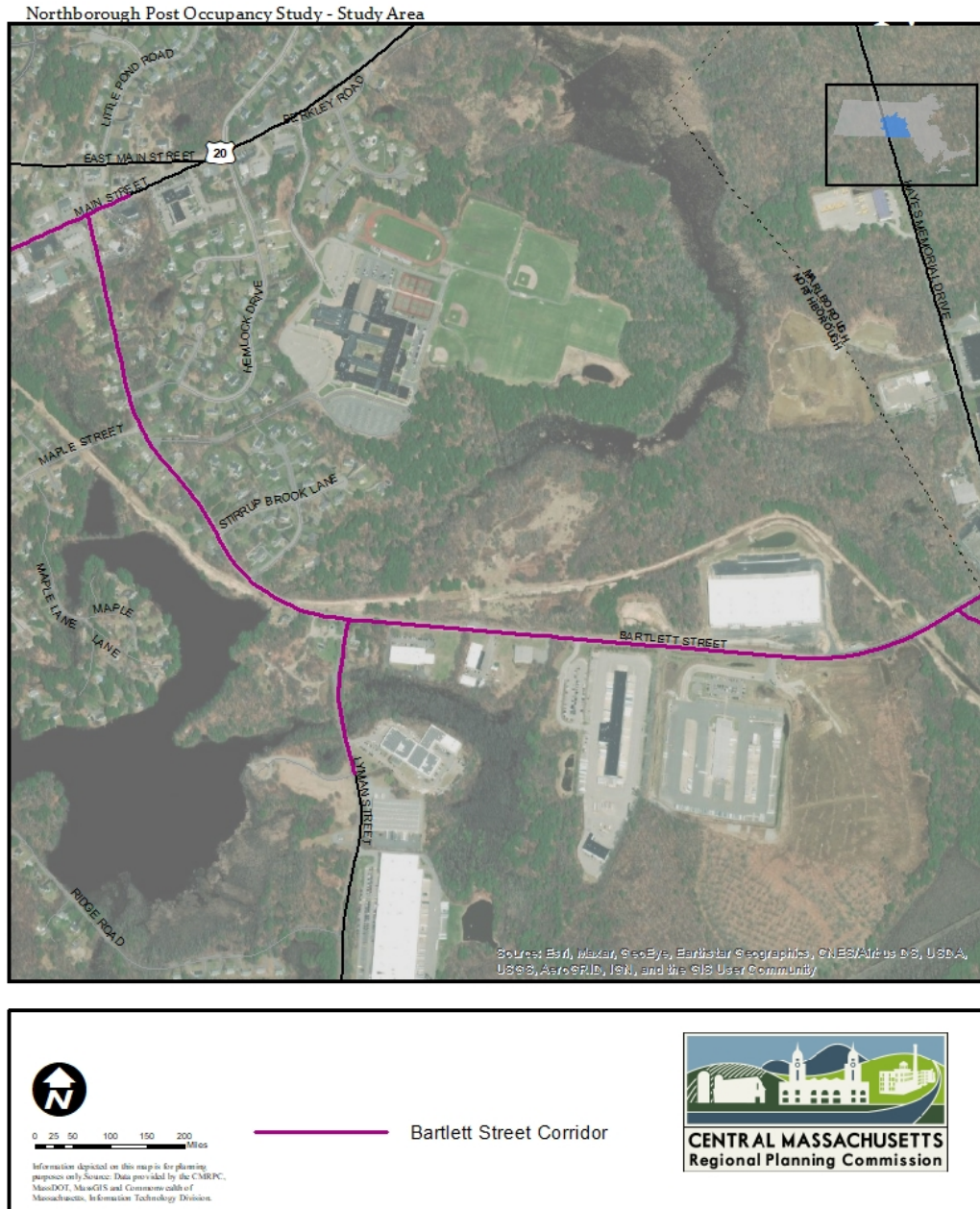
Table 1: Participating Audit Team Members

Audit Team Member	Agency/Affiliation
Sujatha Krishnan	CMRPC
Rob Raymond	CMRPC
Eric Gemperline	CMRPC
Faye Rhault	CMRPC
Janet Pierce	CMRPC
Janeen Callaghan	Northborough Resident
Rachel Armstrong	Northborough Resident
Amy Poretsky	Northborough Planning Board
Andrew McGowan	Algonquin Regional High School
Leslie Rutan	Northborough Board of Selectmen
Brian Griffin	Northborough Police Department

Kristen Wixted	Northborough Board of Selectmen
Lola Campbell	MassDOT
Lisa Maselli	Northborough Resident
William Pierce	
Robin Manning	
John Coderre	Northborough Town Administrator
Julianne Hirsh	Northborough Board of Selectmen
David Parenti	Northborough Fire Chief
Lori Hagen	Northborough Resident
Patrick Cavanagh	
William Lyver	Chief of Police, Northborough Police Department
Greg Martineau	Northborough Public Schools
Scott Charpentier	Northborough Public Works
Scott Rogers	Northborough Board of Selectmen

Project Location and Description

Figure 1: Bartlett Street Corridor

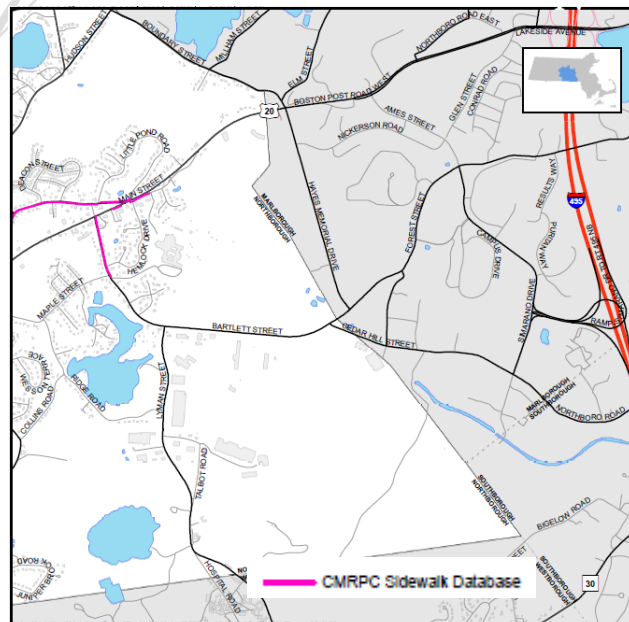


The Bartlett Street Corridor is a 1.5-mile urban collector roadway running from the intersection of Bartlett Street and Main Street in the northwest to the Northborough and Marlborough border to the southeast. For the purposes of this study/audit the study corridor is limited to Bartlett Street from Main Street (including the intersection) on the northwest to Cedar Hill Road (including the intersection) on the southeast. The Town of Northborough owns and maintains much of the corridor, however the western terminus involving the intersection of Bartlett Street and Main Street (MA-20) falls under the jurisdiction of the Massachusetts Department of Transportation (MassDOT) and is considered a Highway Safety Improvement Program (HSIP) eligible cluster. An eligible cluster is a location with crashes in the top 5% in the CMRPC region. The intersection of Bartlett Street and Lyman Street serves as the demarcation line for land-use along the corridor, with the land-use and zoning being primarily residential to the west of the intersection and industrial to the east. There are two educational institutions, Algonquin Regional High School and Saint Bernadette School, on the western half of the corridor. There is also commercial land-use abutting Main Street that has access to Bartlett Street.

The roadway varies in width from 32-40 feet, with the wider sections being found east of Lyman Street in the industrial zoned area. Shoulders vary from being non-existent to 5-feet wide along the corridor. The widest shoulders are found to the east of Lyman Street. Bartlett Street within the study area maintains one travel lane in each direction, except for two brief sections:

- The eastbound lane between Maple Street and the ARHS driveway, where an additional left turn only lane is present to help with the high volumes of traffic entering the school throughout the day.
- Bartlett Street and Cedar Hill Street intersection

Figure 2: Bartlett Street Sidewalks



where the eastbound lane between the power lines (just before Aqueduct crosswalk) and the Cedar Hill Street, where an additional turning right turn only lane is present to help facilitate the movement of vehicles onto Cedar Hill Street via a channelized island. The westbound lane between the Marlborough town line and Cedar Hill Street, where an additional left turn only lane is present to help facilitate movement for vehicles turning right/south onto Cedar Hill Street via a channelized island. Sidewalk exists on a small section of the corridor on the westbound section of Bartlett Street between Main Street and ARHS. There is currently no bicycle infrastructure on the corridor.

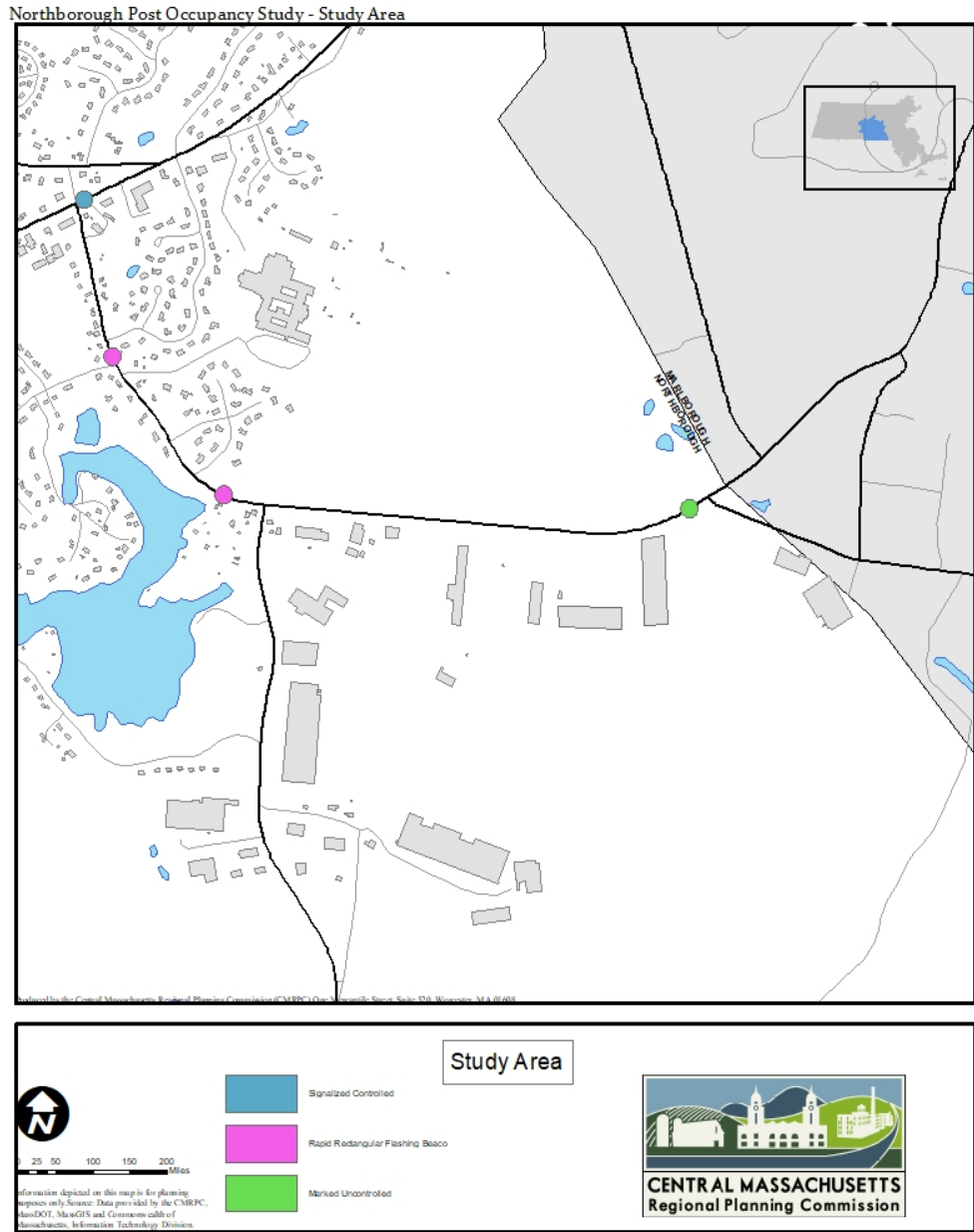
Four crosswalks exist along the study corridor, with one crossing MA-20 and the other three crossing Bartlett Street. The crosswalk at the intersection of Bartlett Street and Main Street is a signalized crosswalk that prioritizes pedestrian use. Two of the three crosswalks on Bartlett Street utilize

Rectangular Rapid Flashing Beacons (RRFB), which are blinking lights activated by the pedestrian to warn and control motorists at marked, un-signalized crosswalks. The remaining crosswalk is a marked uncontrolled crosswalk, with no additional lighting. It is important to note that the eastern crosswalks on Bartlett Street serve as crossings for the aqueduct trail.

Recent improvements have been made to the corridor, including the installation of RRFBs, enhanced signage for trucks leaving the Amazon and A. Duie Pyle, Inc. facilities, and a redesign of intersection and traffic island located at the Bartlett Street and Cedar Hill Street intersections.

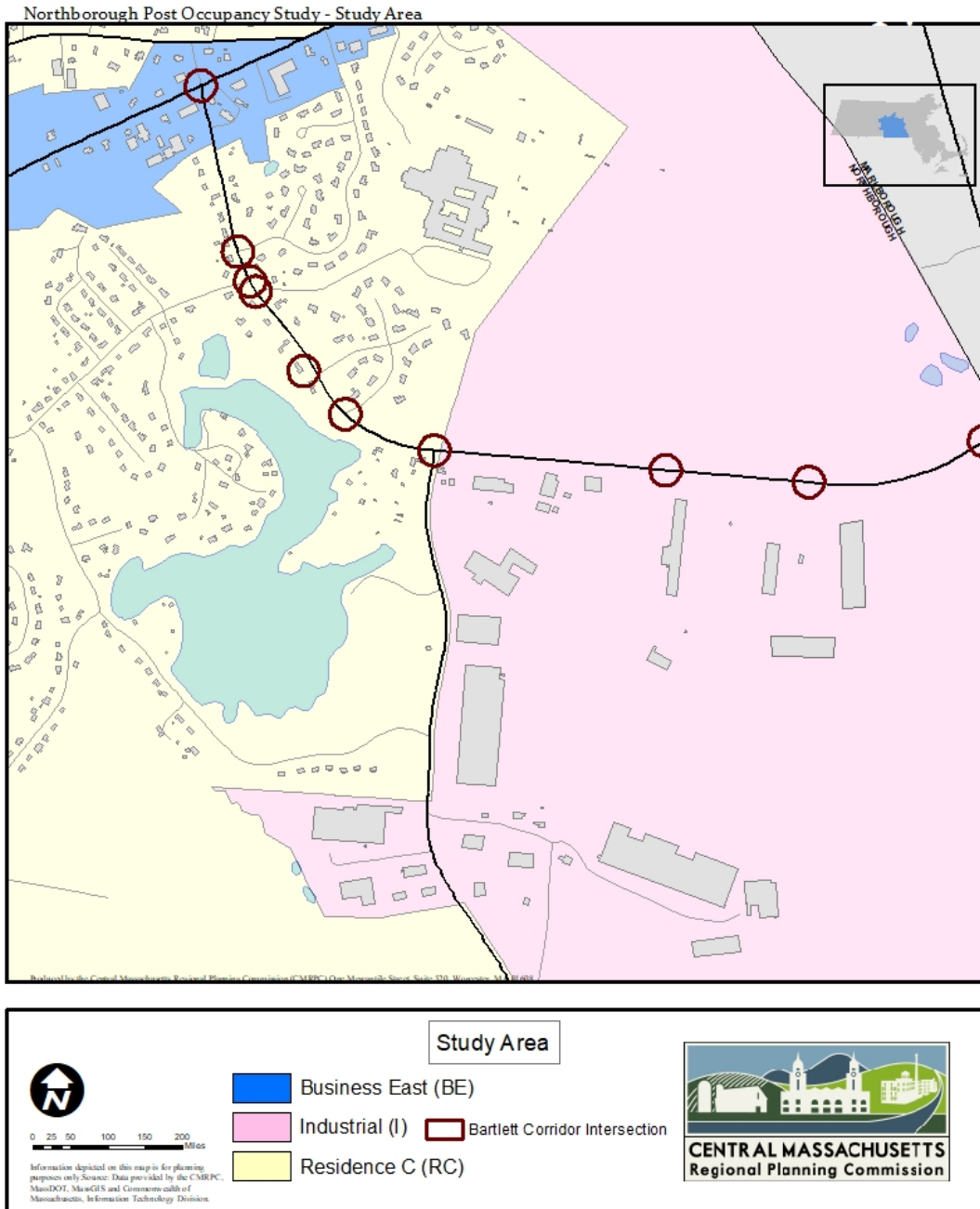
The corridor has seven intersections involving intersecting roadways and multiple intersections involving high-volume property driveways including the driveways for Algonquin Regional High School (ARHS), A. Duie Pyle, Inc., FedEx Freight, and Amazon. Except for the Bartlett Street and Main Street intersection, all roadway and driveway intersections are under the jurisdiction of the Town of Northborough with a functional classification as an urban collector. Speed limits on the roadway vary between 35 MPH in the residential portions of the corridor (Bartlett Street/Main Street to Lyman Street) and 45 MPH along industrial portions (Lyman Street east towards the Marlborough border). The increased speed limit corresponds with a change in land-use, from primarily residential to mainly commercial and industrial uses. The Town of Northborough has recently implemented a speed safety zone on Bartlett Street approaching ARHS from both directions. This speed safety zone will reduce the speed limit on Bartlett Street to 20 MPH during designated hours (7:00 – 8:30 AM and 2:00 – 9:00 PM).

Figure 3: Bartlett Street Corridor Crosswalks



Intersections

Figure 4: Bartlett Street Corridor Intersections



The following are the intersections from west to east:

Bartlett Street and Main Street – The only four-way intersection found in the corridor and HSIP high crash cluster location, representing a location in the top 5% of crashes in the region. Main Street (US MA-20) is a federal functional classified ‘Principal Arterial – Other’ under the jurisdiction of MassDOT. Main Street has two travel lanes in each direction for 350’ before merging into a single travel lane. Bartlett Street has one travel lane in each direction. Trucks turning onto Bartlett St. from both MA-20 EB and WB seem to have issues with the narrow turning radii at the intersection of Bartlett St. and Main St. Additionally, vehicles traveling westbound onto Bartlett Street with the intentions of making a righthand turn onto Main Street move and “inch” over the stop line to view approaching traffic. An observation made out in the field is that vehicles traveling west onto Bartlett Street at the MA-20 intersection may stop a cars length before the white stop line to allow for larger vehicles to make the left turn from Main Street onto Bartlett Street. There is a controlled signalized crosswalk crossing Main Street from the sidewalk located on the westbound travel lane sidewalk on Bartlett Street. This is the only controlled signalized crosswalk in the corridor. There is only one crosswalk for the four-way intersection.

Figure 5: Tire Ruts on Bartlett Street



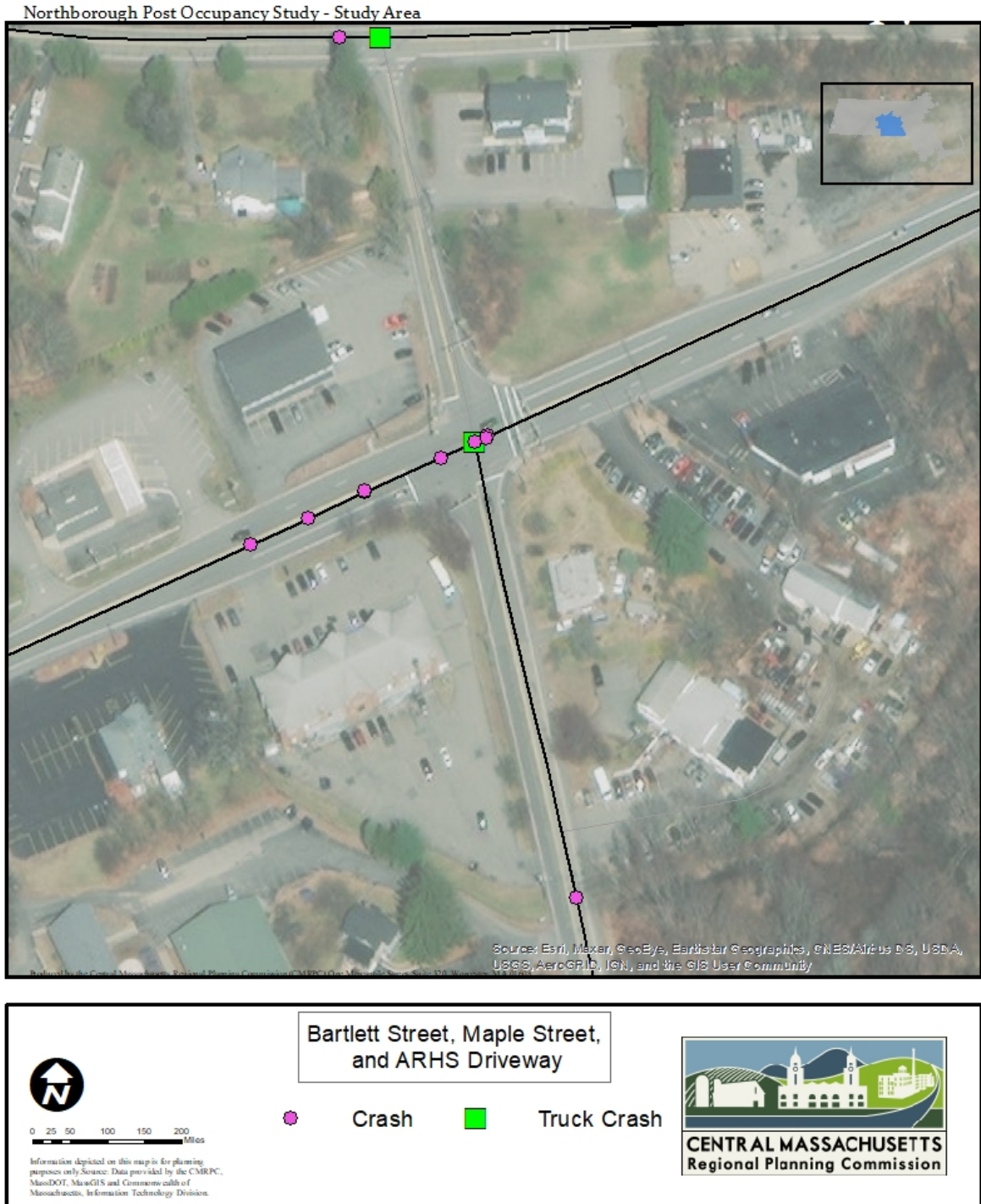
Figure 6: Controlled Pedestrian Signal



Figure 7: Vehicle Stopped Behind Line to Allow Truck Movement



Figure 8: Crashes at Bartlett/Main



Bartlett Street and Hemlock Drive – A T-intersection with both roads having one travel lane in each direction. There is a stop sign at the end of Hemlock Drive. Vegetation impedes the line of sight of motorists exiting Hemlock Drive on to Bartlett Street. The position of the stop line is set far back, and drivers must move past the stop line to observe traffic movements.

Figure 9: Hemlock Drive Limited Sight Lines



Bartlett Street and Maple Street – A T-intersection with Maple Street having two turning lanes, left and right, on to Bartlett Street. Maple Street has one lane of travel heading away from Bartlett Street. The Bartlett Street and Maple Street intersection has a lot of elements to it. There is a RRFB crosswalk immediately before Bartlett Street intersects with Maple Street heading east. Bartlett Street adds a second lane of travel for turning movements into ARHS right beyond Maple Street heading east. Maple Street has a truck exclusion. About 400’ east of the T-intersection on Maple Street is a crosswalk that connects to the Aqueduct trail. There are no sidewalks present to this crosswalk and trail access point.

Figure 10: Aqueduct Trail on Maple Street



Figure 11: Crosswalk on Maple Street



Figure 12: Truck Exclusion Sign and RRFB Crosswalk with New Curb Ramps at Bartlett/Maple



Figure 13: Bartlett Street, Maple Street, ARHS Driveway



Bartlett Street and the ARHS driveway – A T-intersection at the ARHS driveway with one lane of travel in each direction. Bartlett Street eastbound has two lanes, one travel lane and one turning lane. Bartlett Street westbound has one travel lane. The driveway to ARHS allows for wide turns into the campus.

Bartlett Street and Stirrup Brook Lane – A T-intersection with no marked lanes on Stirrup Brook Lane. Bartlett Street has one travel lane in each direction. Stirrup Brook Lane has a curb ramp leading to a sidewalk on the eastern side of the street. Bartlett Street widens after passing Stirrup Brook Lane heading east into a curve.

Bartlett Street and Jenkins Drive – A T-intersection with no marked lanes on Jenkins Drive. Bartlett Street has one travel lane in each direction. Bartlett Street curves at this intersection. There is a poor line-of-sight for vehicles turning onto Jenkins Drive from Bartlett Street heading east. Additionally, vehicles departing Jenkins Drive on Bartlett Street have a poor line-of-sight in both directions.

Figure 14: Poor Sightline from Jenkins Drive as Bartlett Curves



Bartlett Street and Lyman Street – A T-intersection with both roads having one travel lane in each direction. Lyman Street narrows to a total width of 26.4’ with six-inch shoulders on both sides. There is a stop sign on Lyman Street. Traffic on Bartlett Street has the right-of-way. The Town of Northborough placed a boulder on the corner of Bartlett Street and Lyman Street to prevent vehicles from traveling over the grass while making right-hand turns onto Lyman Street south. Approximately 400’ west of the Bartlett Street and Lyman Street intersection is the Aqueduct Trail crossing that has recently seen the installation of a RRFB system. No parking signs have been added along the Aqueduct Trail on Bartlett Street.

Figure 15: Rock Placed by Town to Prevent Vehicles on Grass



Figure 16: Signage Informing of Lyman Intersection



Figure 17: Aqueduct Trail Signage



Figure 18: Bartlett Street Crosswalk with RRFB Signal



Bartlett Street and the A. Duie Pyle, Inc. driveway – A T-intersection with one travel lane in each direction on Bartlett Street. The A. Duie Pyle, Inc. driveway does not have road markings. There is a directional road sign at the end of the driveway informing drivers of the preferred route to major roadways.

Figure 19: Signage at A Duie Pyle, Inc. Directing Drivers



Bartlett Street and the FedEx Freight/Amazon shared driveway – A T-intersection with one travel lane in each direction on Bartlett Street and one travel lane for the entrance of 330 Bartlett Street and two travel lanes for turning movements exiting the facility. Amazon has installed a directional road sign at the mouth of the driveway informing drivers of the preferred route to major roadways. A rumble strip is present at the driveway to deter Amazon drivers from making a left turn onto Bartlett Street.

Figure 20: Signage at 330/350 Bartlett



Figure 21: 330/350 Bartlett Driveway



Bartlett Street and Cedar Hill Street - A T-Intersection near the end of the Bartlett Street corridor approaching Marlborough. The intersection has recently been redesigned with two channelizing islands on Cedar Hill Street to help with traffic flow in the intersection. The channelizing islands create turning lanes that are 15 feet wide south onto Cedar Hill Street as well as east onto Bartlett Street. This intersection is the only one to have dedicated turn-only lanes in each direction of travel. Cedar Hill Street traveling south has poor pavement quality once the Marlborough town line is crossed. Pedestrian accommodations exist only as a crosswalk to the west on Bartlett Street servicing the Aqueduct Trail.

Figure 22: Cedar Hill Road Geometry after Redesign



Figure 23: Pavement on Cedar Hill Road in Marlborough

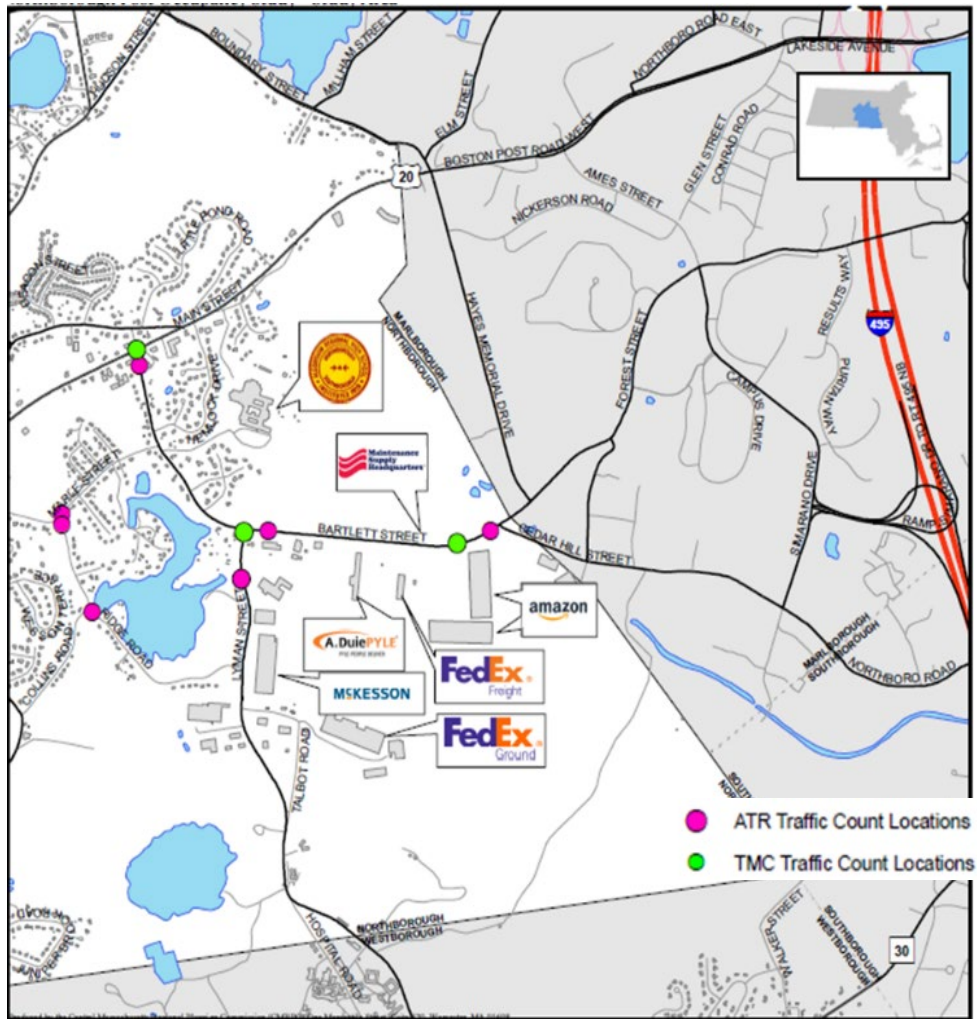


Traffic

Volume

To get an understanding of the traffic volume and volume type, CMPRC used prior studies and historic data to create a baseline traffic volume report. In addition, CMPRC performed eight automated traffic recorder counts between 5/17/2021 and 6/1/2021 at strategic locations to gather data on volume, speed, and classification.

Figure 24: Location of Traffic Counts and Turning Movement Counts



Traffic volumes were highest between MA-20 and Lyman Street with a Monday – Friday volume of 8,151 cars per day and a weekly average (including weekend days) of 6,587 cars per day. Traffic volumes were much higher on Bartlett Street than then surrounding side streets. Table 2 shows the observed volumes from the locations counted 5/17/2021 – 6/1/2021.

Table 2: Observed Traffic Volumes 5/17/2021 - 6/1/2021

Location	Mon - Fri Average Volume	Average Weekly Volumes
Bartlett Street between Route 20 and Lyman Street	8,151	6,587
Bartlett Street east of Lyman Street	6,378	5,332
Bartlett Street west of Cedar Hill Road	7,157	6,071
Brigham Street at 225 Brigham Street	2,175	1,965
Lyman Street South of Bartlett Street	4,875	4,069
Maple Street at 115 Maple Street	1,723	1,457
Ridge Road at 43 Ridge Road (North of Collins Road)	1,715	1,424
Ridge Road at 100 Ridge Road	1,446	1,186

Heavy vehicle volumes are highest on Bartlett Street west of Cedar Hill Road (East of 330/350 Bartlett Street) with a volume of 1,680 heavy vehicles, 707 of those being a FHWA Class 8 or higher vehicle (tractor trailer) indicating that solutions currently implemented may be working.

Table 3: Observed Heavy Vehicle Volumes 5/17/2021 - 6/1/2021

Heavy Vehicle Volumes	Heavy Vehicles (Class 4 - 12)	Vehicles Class 8 and above
Bartlett Street between Route 20 and Lyman Street	588	74
Bartlett Street east of Lyman Street	833	138
Bartlett Street between Amazon Driveway and Cedar Hill Road	1,680	707
Brigham Street at 225 Brigham Street	98	5
Lyman Street South of Bartlett Street	601	158
Maple Street at 115 Maple Street	73	7
Ridge Road at 43 Ridge Road (North of Collins Road)	103	4
Ridge Road at 100 Ridge Road	87	4

Speed

According to CMRPC automated traffic counters on Bartlett Street west of Cedar Hill Road had the highest average speed of 40 MPH and the posted speed limit in this section is 45 MPH. This stretch of the corridor had the highest heavy vehicle traffic and highest speeds. Speeds average 38.3 MPH on Bartlett Street corridor west of Lyman Street, which is higher than the posted limit of 35 MPH. Table 4 shows the average observed speeds from the locations counted 5/17/2021 – 6/1/2021. A previous speed study found the need for the speed safety zone around ARHS. This reduced speed zone will be in effect from 7:00 AM to 8:30 AM and from 2:00 PM to 9:00 PM.

Table 4: Observed Vehicle Speeds 5/17/2021 – 6/1/2021

Location	Average Speed
Bartlett Street between Route 20 and Lyman Street	37 mph
Bartlett Street east of Lyman Street	38 mph
Bartlett Street west of Cedar Hill Road	40 mph
Brigham Street at 225 Brigham Street	35 mph
Lyman Street South of Bartlett Street	38 mph
Maple Street at 115 Maple Street	30 mph
Ridge Road at 43 Ridge Road (North of Collins Road)	30 mph
Ridge Road at 100 Ridge Road	32 mph

Turning Movement Counts

CMRPC performed three Turning Movement Counts (TMC), two manual counts by CMRPC staff and one video recording count done by a consultant. The locations of the TMCs were Lyman Street/ Bartlett Street, Bartlett Street/ Main Street (Rte. 20) and Bartlett Street/330-350 Bartlett Street. All three counts were conducted on 9/23/2021. These turning movement counts captured all vehicle turning movements as well as general classifications. Table 5 shows the results of the TMC conducted at 330/ 350 Bartlett Street. From the Amazon driveway there were 6 single-unit trucks and 4 double-unit trucks turning left onto to Bartlett Street. The results of the TMCs conducted at Bartlett Street/Lyman Street and Bartlett Street/ Main Street (Rte. 20) will be attached to the appendix.

Table 5: Turning Movement Count Bartlett Street and 330/350 Bartlett Street

Movement	Cars	Single Unit Heavy	Multi Unit Heavy	Total
Right in from Bartlett Street	356	22	13	391
Left in from Bartlett Street	314	132	254	700
Right out to Bartlett Street	343	141	249	733
Left out to Bartlett Street	357	13	13	383
Total	1,370	308	529	2,207

Crashes

For this report, CMPRC utilized MassDOT's IMPACT data portal to analyze crash data on Bartlett Street. A 500' buffer zone was used to ensure crashes at intersections were included and analyzed. Crash data was cross-referenced with crash reports from the Northborough Police Department. The data spans from January 1, 2016, to September 30, 2021. The RSA team received data that included crashes on Lyman Street, for this report however only Bartlett Street and 500' buffer zone around Bartlett St. was considered.

Figure 25: Bartlett Street 500' Buffer Zone

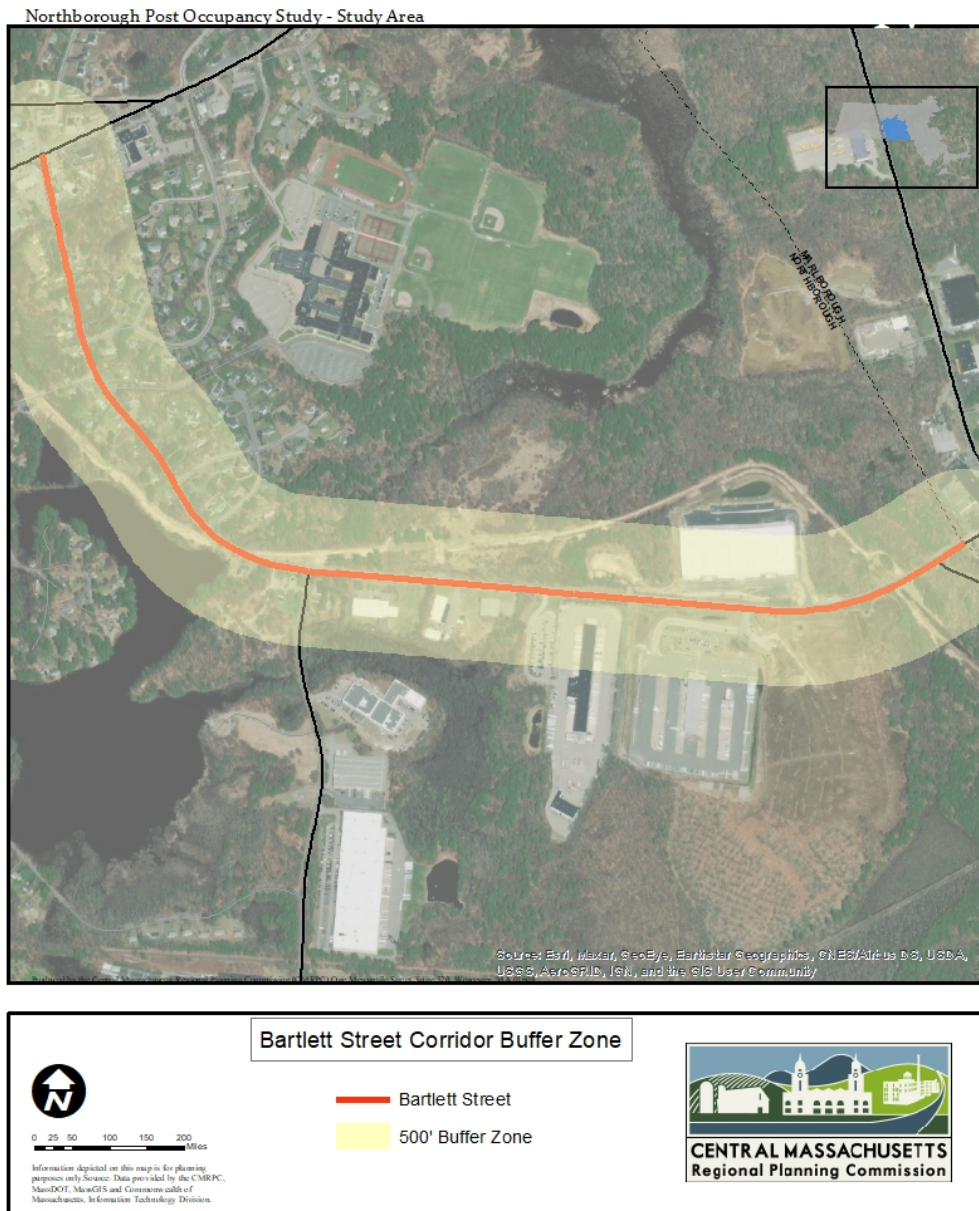
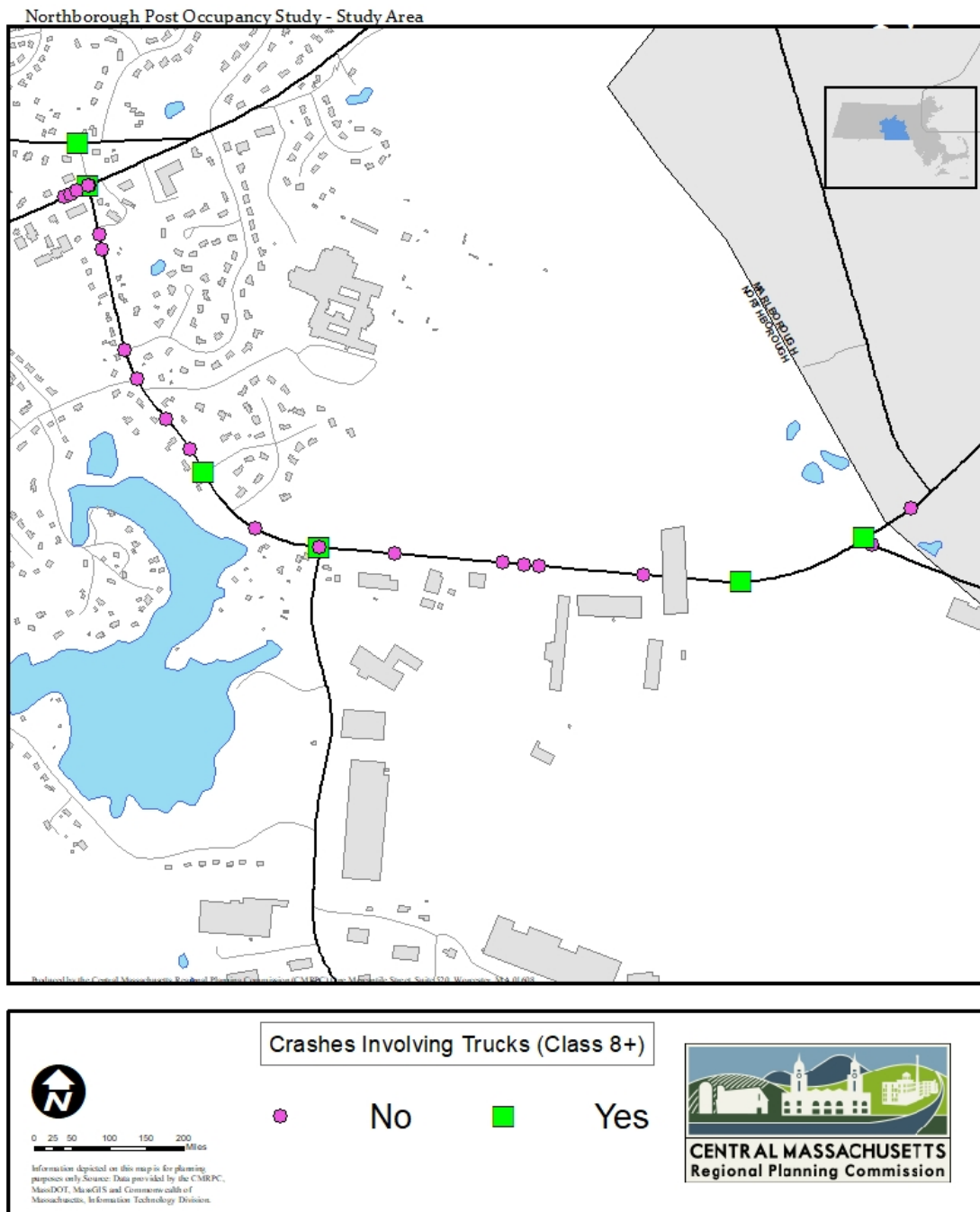
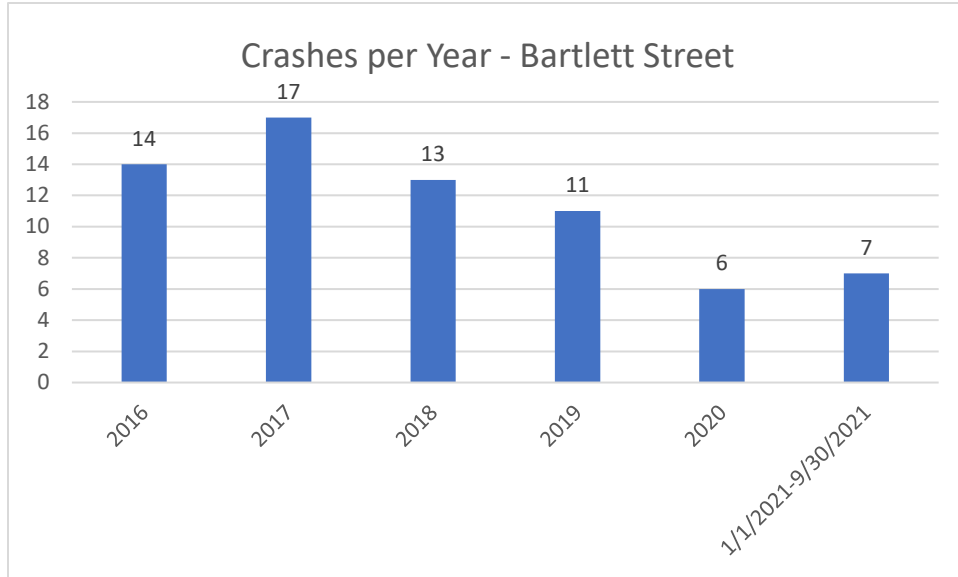


Figure 26: Crashes Involving Trucks on Bartlett Street Corridor



- *Total Crashes:* There were a total of 68 crashes at or near Bartlett Street in Northborough over the study period.

Figure 27: Crashes per Year on Bartlett Street



There has been a decrease in crashes on Bartlett Street during the study period. Nearly 81 percent of the crashes occurred from 2016 to 2019. The COVID-19 pandemic may have had an impact on these numbers. As tractor-trailer traffic is a concern with the residents, CMRPC examined crashes involving F WHA Class 8 or larger vehicles.

Figure 28: Bartlett Street Crashes after Amazon Opening

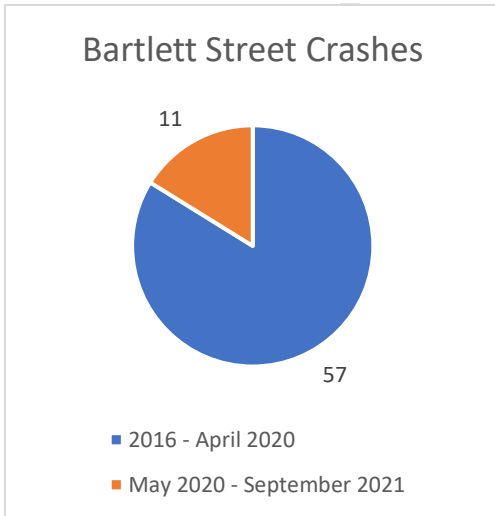
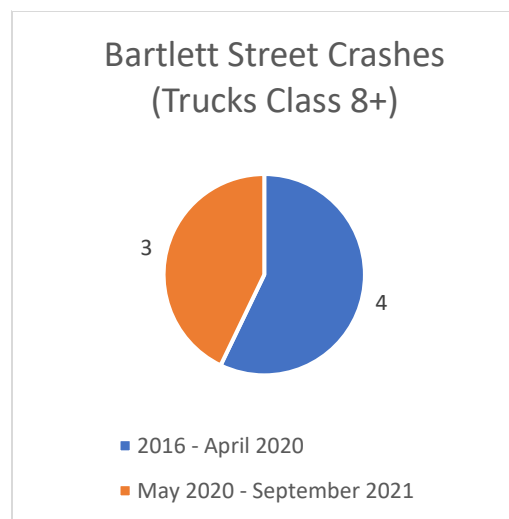
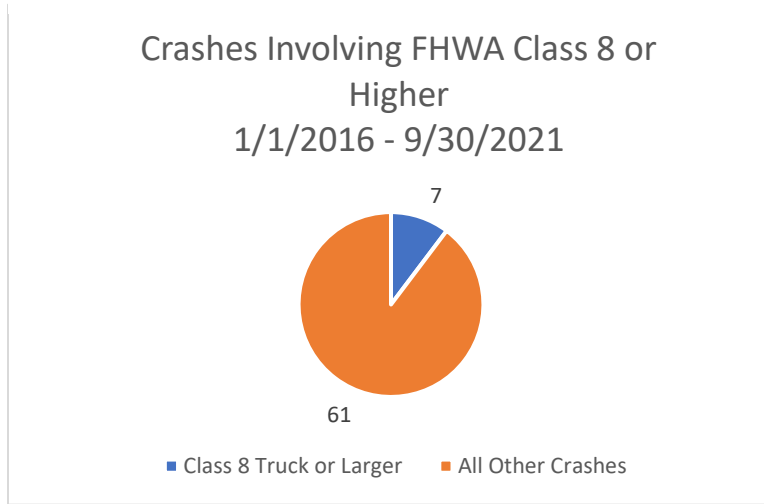


Figure 29: Bartlett Street Truck Crashes after Amazon Opening



There were seven crashes involving Class 8 or higher vehicles on Bartlett or within the 500' buffer. This represents just over ten percent of the total crashes in the corridor. Since the construction and opening of the Amazon facility, there has been an uptick in tractor-trailer crashes relative to all crashes.

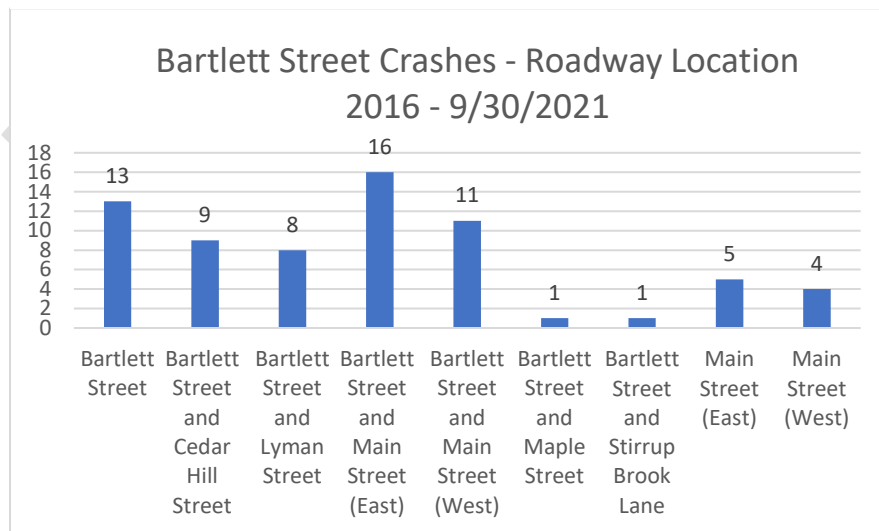
Figure 30: Crashes Involving FHWA Class 8+ or Higher Vehicles



Nearly 30% of crashes since May 2020 have involved tractor-trailers compared to 7% of crashes from 2016 to April 2020 making the crash rate jump nearly 27% in that time frame.

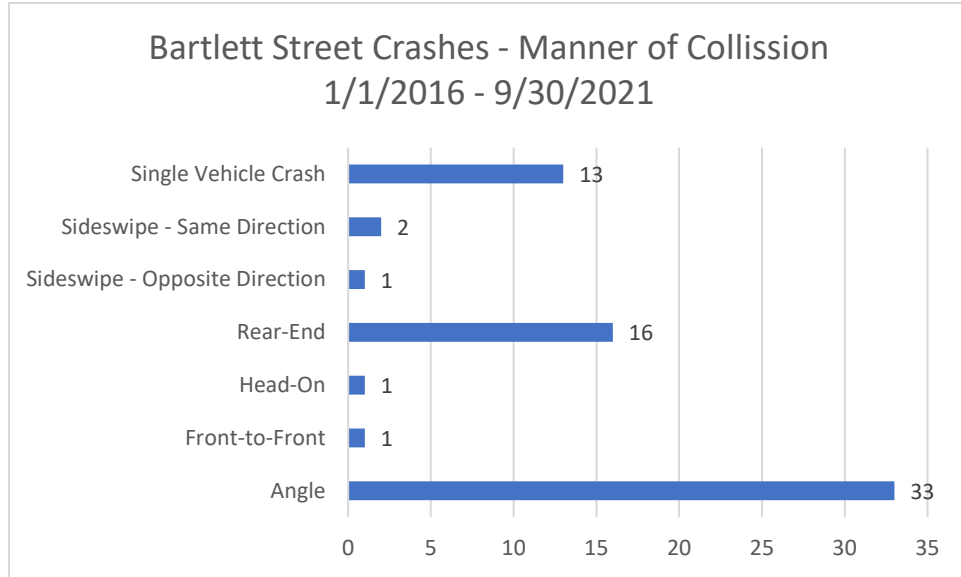
- HSIP Cluster:** The Bartlett Street and Main Street (MA-20) intersection is considered a Highway Safety Improvement Program (HSIP) eligible cluster. That is a crash cluster which has the total number of “equivalent property damage only” crashes in the area are within the top 5% of all clusters in that region. Being HSIP-eligible makes the location eligible for Federal Highway Administration (FHWA) and MassDOT funds to address the identified safety issues at these locations.

Figure 31: Bartlett Street Crashes Location



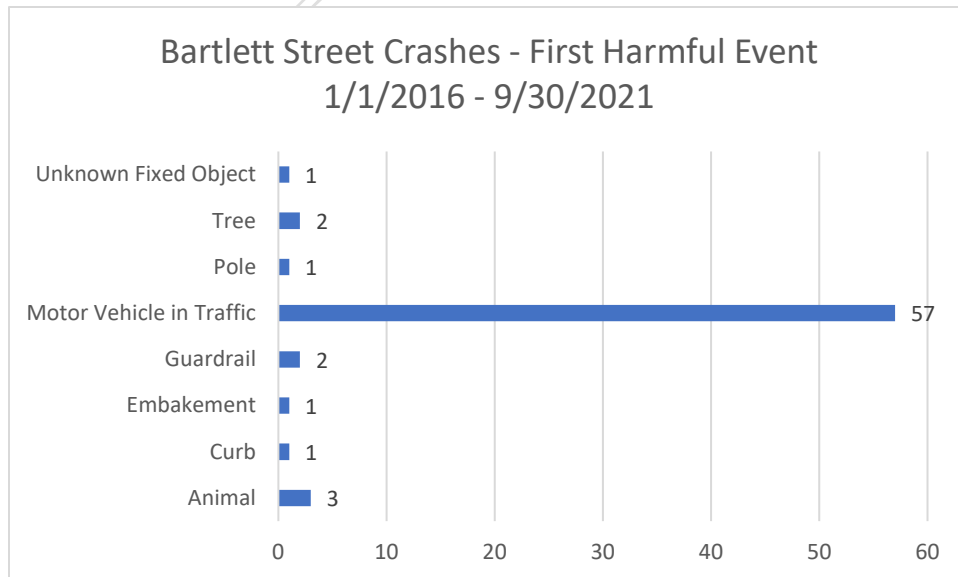
- *Crash Type*: Most of the reported crashes were ‘Angle’ collisions (48.5%), followed by ‘Rear-End’ collisions (23.5%) and ‘Single-Vehicle Crash’ (19%).

Figure 32: Bartlett Street Corridor Manner of Collision



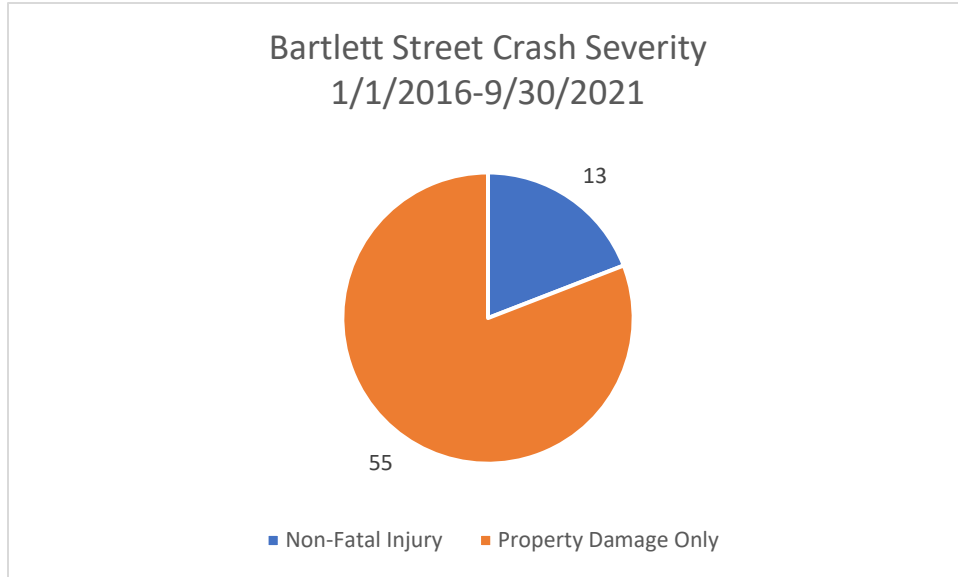
- *First Harmful Event*: In most cases, a collision with a motor vehicle (84%) was the first harmful event. All animal strikes involved deer and occurred in the eastern portion of the corridor.

Figure 33: Bartlett Street Corridor - First Harmful Event



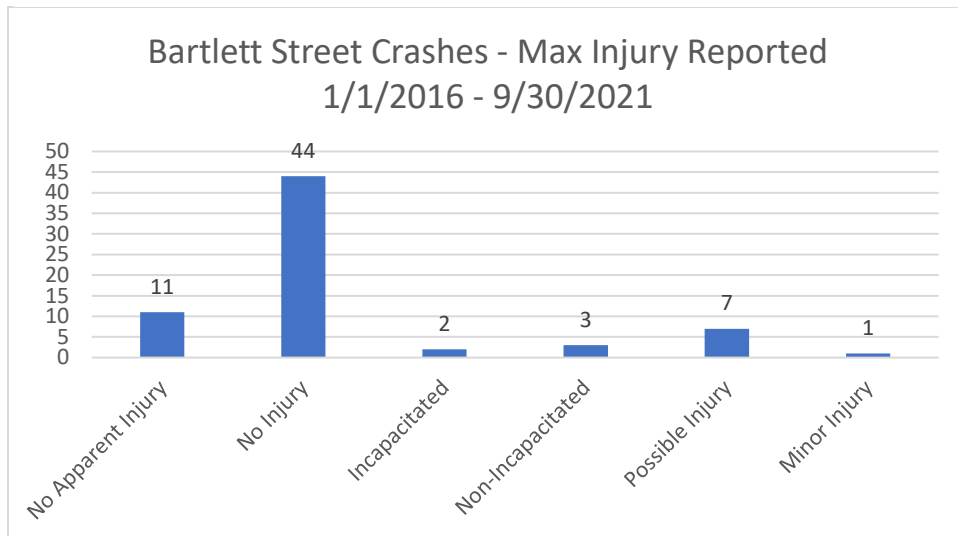
- Crash Severity:** Fortunately, there have been no fatalities on the Bartlett Street corridor during the study period. There have been 13 non-fatal injuries (19%) along the corridor and 55 crashes with reported property damage (81%).

Figure 34: Bartlett Street Corridor Crashes - Crash Severity



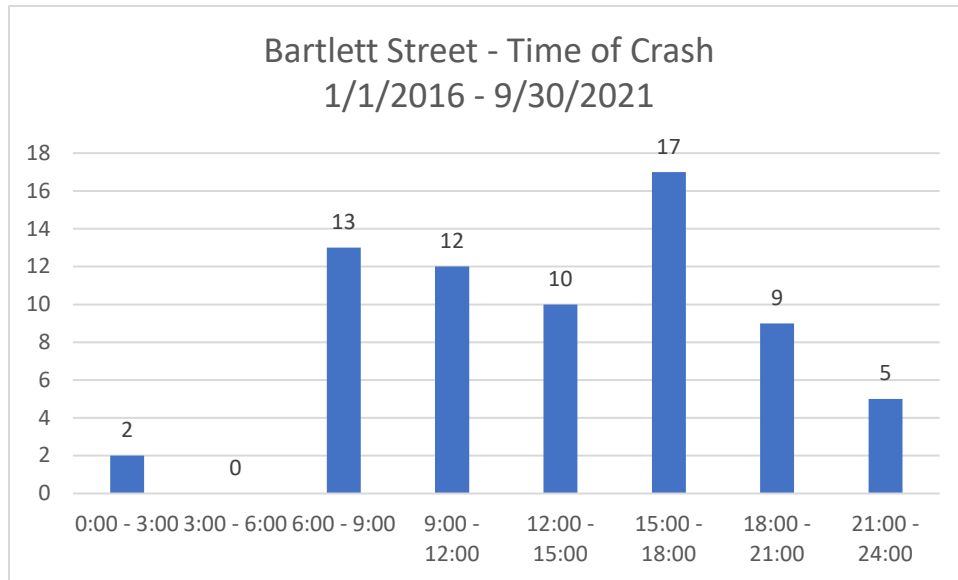
Of the 68 crashes, two were incapacitating (3%) and three were non-incapacitating (4.5%).

Figure 35: Bartlett Street Corridor Crashes - Max Injury Reported



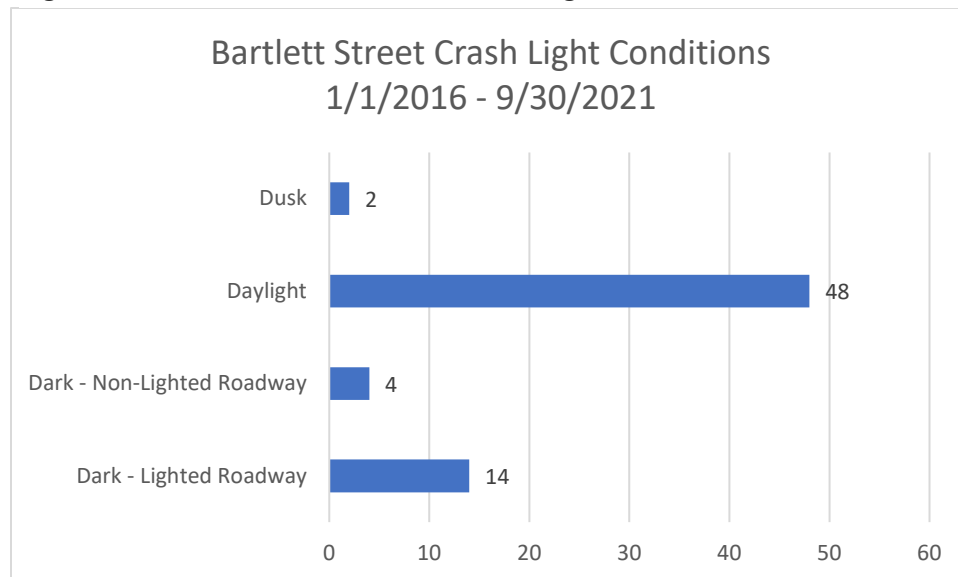
- Travel Time/Lighting:** Just under half of all crashes occurred in the two corresponding commuting windows, from 6:00 AM to 9:00 AM (19%) and from 3:00 PM to 6:00 PM (25%). Three quarters (76.4) of crashes occurred between 6 AM and 6 PM.

Figure 36: Bartlett Street Corridor Crashes - Time of Crash



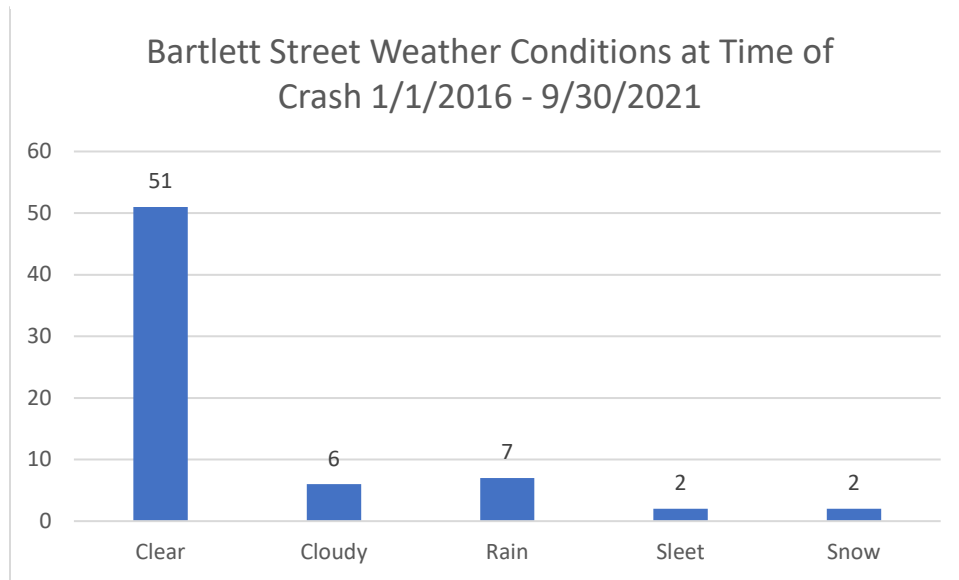
Corresponding with the time of reported crashes, 48 crashes (70%) occurred in the daylight. Additionally, when adding in crashes that occurred in the lighted section of the corridor, 62 (91%) crashes occurred in lighted conditions.

Figure 37: Bartlett Street Corridor Crashes - Light Conditions at Time of Crash



- Roadway Conditions: Most crashes occurred in clear conditions (75%) while 11 crashes (16%)

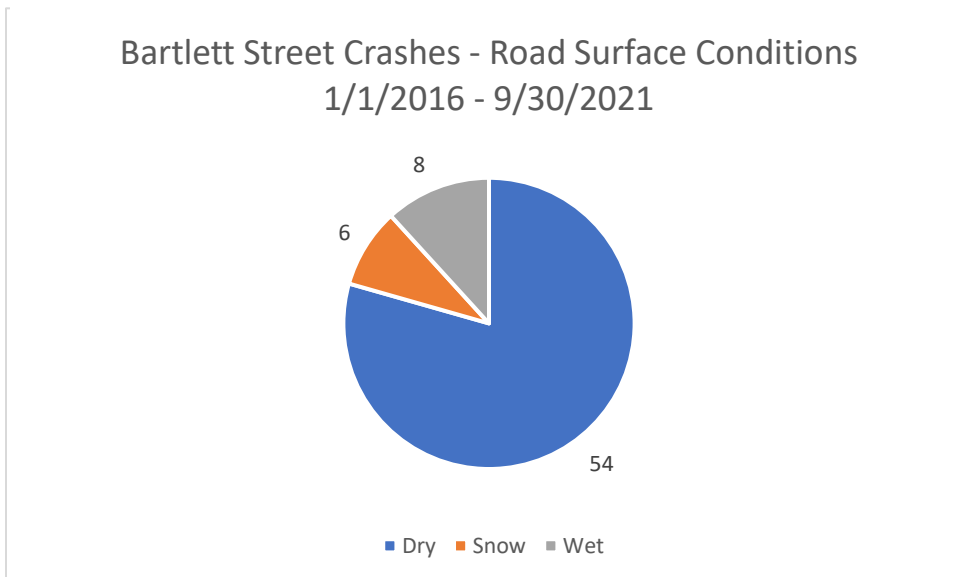
Figure 38: Bartlett Street Weather Conditions at Time of Crash



occurred in times of precipitation.

The road surface was dry for 54 crashes (79%) and wet for 14 crashes (21%).

Figure 39: Bartlett Street Corridor Crashes - Road Surface Conditions



Audit Observations and Potential Safety Enhancements

The RSA team participated in a presentation with information regarding the study location including existing land-use, traffic volumes, existing travel speeds, crash statistics, and videos and photographs of the corridor. The RSA was conducted on October 28, 2021, in person at the Black Box Theatre at Algonquin Regional High School in Northborough, Massachusetts where safety issues, observations, and concerns were discussed for the corridor. The group then walked the length of the corridor discussing issues and making observations throughout. After the walk, the group returned to ARHS to summarize observations and discuss high-level recommendations.

The subsequent sections of this report summarize the issues and potential improvements. The order of intersections will run west to east starting at Bartlett Street and Main Street (MA-20) and end at Bartlett and Cedar Hill Street. Each major intersection identified will list the observed issues summarized and offer potential enhancements. The following were major themes that we discussed for each of the intersection:

- Intersection turning radii and lanes should be examined at major intersections – Main St./Bartlett St and Lyman St./Bartlett St.
- Ensure there is adequate lighting and signage for each of the intersections.
- Provide more trailblazers/warning signs for trucks along the corridor.
- Improve pedestrian accommodations along the corridor.

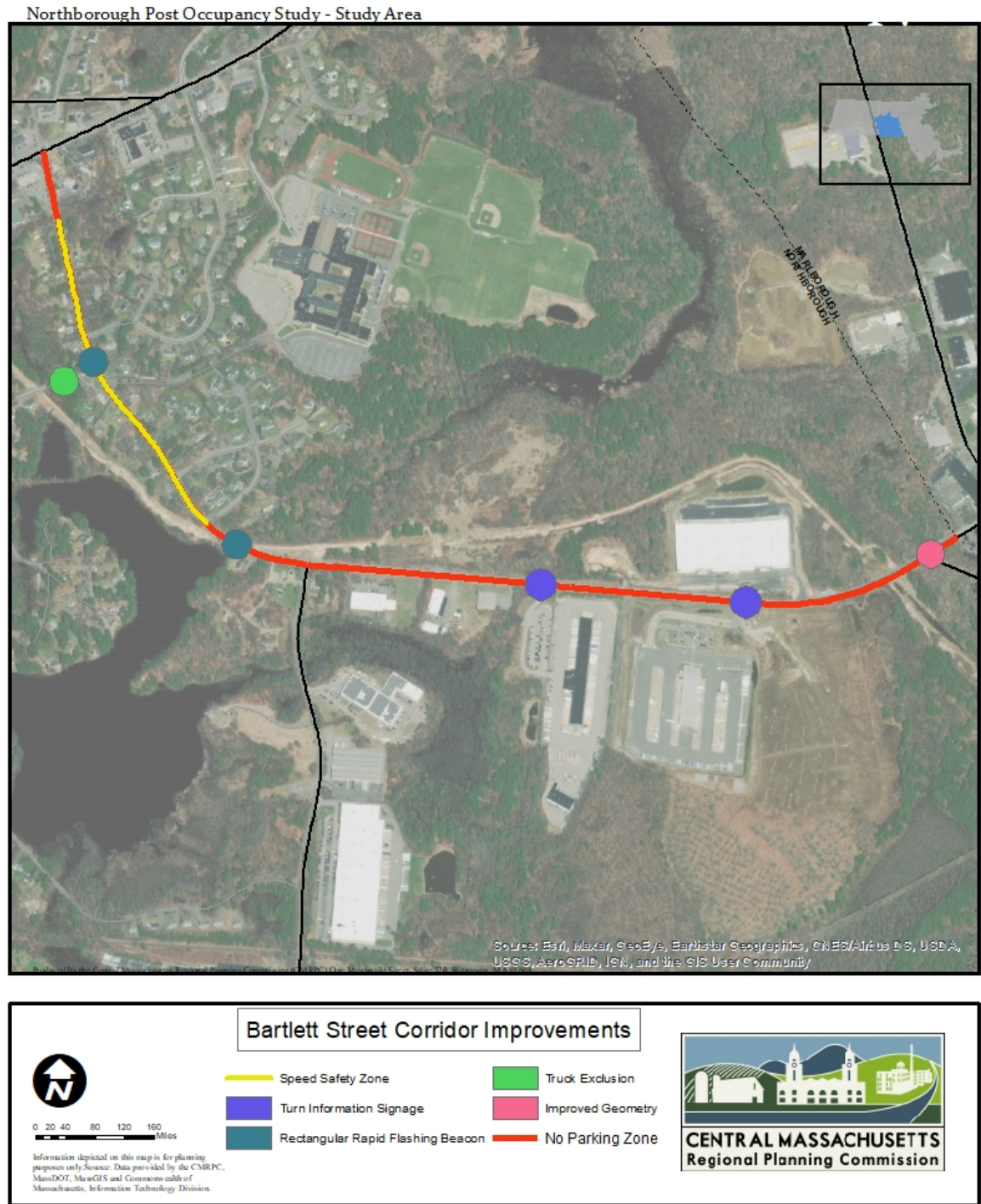
Northborough has been proactive and has already implemented the following mitigation measures:

- No Parking Zone throughout the Bartlett Street Corridor
- Installation of Rectangular Rapid Flashing Beacons at two crosswalks
- Truck exclusion on Maple Street
- Directional Signage at Amazon and A Duie Pyle, Inc. driveways

Figure 40: Corridor Improvements and Signage



Figure 41: Intersections Found Along Bartlett Street



The following are the observations and potential enhancements for each of the intersection along the study corridor.

Bartlett Street and Main Street:

This intersection under the jurisdiction of MassDOT and any improvements (short or long-term) needs to be coordinated with and have improvements made by MassDOT. The intersection is a top crash location and classified as Highway Safety Improvement Program (HSIP) location. HSIP eligible crash location is - *a cluster in which the total number of “equivalent property damage only” crashes in the cluster is within the top 5% of all clusters in a specific region*

Observations: It was observed that large vehicles such as tractor trailers or school buses had difficulty turning onto Bartlett Street from both sides of Main Street. This was made evident at the RSA as tire marks were observed over the curb in the grass from vehicles turning right on to Bartlett Street from Main Street (eastbound) (have photos). The RSA team also commented on lack of adequate pedestrian infrastructure given the high usage of high school students using the intersection to access their homes and retail establishments on both sides of Main Street. Among the four approaches to the intersection there is only one signalized crosswalk that is on the east side of the intersection. Residents voiced concerns that right-on-red turning movements are allowed and that many drivers do not pay attention to pedestrians in the crosswalk when attempting to make a right-turn maneuver from Bartlett Street onto EB Main Street. Additionally, there are only sidewalks on one side of Bartlett Street and no sidewalks on Main Street despite access to retail businesses and Saint Bernadette’s School at the intersection.

Potential Enhancements:

- Work with MassDOT to develop long term design recommendations for the intersection. The design should include accommodations for trucks turning in and out of Bartlett Street and pedestrian improvements at the intersection and access to retail businesses on Main Street.
- Work with MassDOT as a short-term measure to consider moving back the stop bar on Bartlett Street to allow for additional turning radii for trucks turning into Bartlett Street.
- Work with MassDOT to evaluate current signal timing with special attention for left turns onto Main Street.
- Work with MassDOT to evaluate short and/or mid-term improvement for right turns from Main Street EB into Bartlett Street SB and Bartlett Street NB to Main Street EB.

Bartlett Street and Hemlock Street:

Observations: Vegetation currently obstructs the line of sight for motorists exiting Hemlock Street on to Bartlett Street. It was observed that the current stop line is placed far back from the road and makes it difficult to observe motorists traveling on Bartlett Street towards Route 20. Hemlock Street's pavement shows signs of wear through alligator cracking at the intersection.

Potential Enhancements:

- Clear back brush that impedes sight lines
- Repaint stop line closer to Bartlett Street
- Repave or seal parts of Hemlock Street

Figure 42: Hemlock Street Looking onto Bartlett Street



Bartlett Street and Maple Street:

Observations: This intersection can be confusing with Maple Street having a left and right turning lanes onto Bartlett Street while simultaneously Bartlett Street changes to three lanes with the addition of a left-turn only lane in the eastbound direction just before ARHS. Maple Street has a truck exclusion sign present at the entrance from Bartlett Street, however residents report some truck drivers not following the sign. Recently new pedestrian improvements were made to Bartlett Street adjacent to/just west of Maple Street. The pedestrian improvements include a rectangular rapid flashing beacon (RRFB) crosswalk along with new curb ramps and a repaint of the existing crosswalk. There are no sidewalks on Maple Street to connect to the RRFB crosswalk.

Potential Enhancements:

- Combine the separate left and right turning lanes out of Maple Street turning onto Bartlett Street into one lane to allow for better sight distances for traffic exiting Maple Street.
- As a long-term recommendation, consider adding pedestrian accommodations along Maple Street corridor to the Complete Streets prioritization plan for the town. This will connect the residences to the High School and access to aqueduct trail crossing on Maple Street 400' south of Maple Street.
- Consider providing additional signage to discourage large tractor trailer truck from entering Maple Street. MassDOT has recently approved a fully heavy classification truck exclusion for Maple Street.

Figure 43: The Aqueduct Trail is a Recreational Resource along the Corridor



Bartlett Street and Algonquin Regional High School driveway

Observations: Despite the left-turn only lane on Bartlett into ARHS, the intersection continues to be a bottleneck during school start and end times each day. Over 300 students drive to ARHS, some students are dropped off by their parents and many school busses causing congestion and confusion on Bartlett Street during school drop-off and pick-up times.

Potential Enhancements:

- Encourage/enforce student drop-offs/pick-ups and drivers to utilize the back entrance on MA-20.
- Incentivize bus usage or deter student drop-offs/pick-ups in the school district to help reduce the total trips made along the corridor during morning commute hour.
- The town recently created and implemented a school safety zone to ensure safety around the school drop-off and pick-up times.

Bartlett Street and Jenkins Drive

Observations: The entrance and exit for Jenkins Drive is on a curve of Bartlett Street traveling west. The combination of the curve in the road and the vegetation limit sightlines for vehicles entering and exiting Jenkins Drive. Some residents use Stirrup Brook Lane to get onto Bartlett Street for better sightlines and improved safety. Right next to Jenkins drive there is a hidden driveway for an independent property that is not visible from Bartlett Street.

Potential Enhancements:

- Consider adding blind driveway signs on westbound lane after crosswalk warning vehicles of upcoming driveways and streets.
- Clear brush from side of road to increase visibility for all vehicles.

Figure 44: Brush Impedes Line of Sight



Bartlett Street and Lyman Street

Observations: The intersection of Bartlett Street and Lyman Street had some major concerns during the RSA. Despite a 'stop sign ahead' on Lyman St approaching Bartlett St., residents and observers at the RSA noted that the actual stop signs on Lyman Street at Bartlett Street seem to sneak up on drivers. There have been multiple accidents at this location. During the RSA, there was no longer a guardrail on Bartlett Street as two vehicles had recently crashed through it. There is a larger boulder at the end of the property on the Southeast corner of the T-intersection to prevent vehicles from driving over the grass and the property line. Another observation was that vehicles traveling on Bartlett Street predominantly WB occasionally stop although there is no stop sign on Bartlett Street (courtesy stops) for vehicles making a left turn onto Bartlett Street while exiting Lyman Street. This action often causes confusion for drivers behind the stopped vehicle on Bartlett Street causing hazardous driving behavior. There is signage directing traffic to Route 495 at the end of Lyman Street and the intersection has a streetlight.

Potential Enhancements:

- As a short-term measure consider adding reflectors on stop-sign pole and improve visibility/presence of the advance warning signs on Lyman Street.
- Long – term improvement should consider intersection geometry redesign and box widening at Lyman Street.
- Mid-term improvement should consider adding a flashing stop sign for Lyman Street.
- Consider adding flashing warning signs for Bartlett Street.
- Long term improvement should consider advisory shoulders to narrow the road.

Figure 46: Signage for T-Intersection for Lyman



Figure 45: Boulder Placed on Grass to Prevent Vehicles from Driving on Lawn



Bartlett Street and 330/350 Bartlett Street Driveway

Observations: Despite signage instructing Amazon drivers to turn right as they exit the property there are still a few tractor trailers that turn left onto Bartlett Street. Many enhancements have already been made including a channelizing rumble strip and ample signage directing drivers to make a right. Amazon representatives present at the audit stated that they will have flaggers in during the holiday season to enforce the right-turn only rule. Flaggers were successfully used in a test-pilot program during the summer of 2021. Additionally, Amazon has geofenced the ability for truck GPS to turn left out of the facility. There seems to be a certain percentage of trucks that are operated by third party users that may attribute to the left turn movements onto Bartlett St.

Potential Enhancements:

- Continue to monitor truck turning movements exiting the Amazon facility and provide continuous education to new and third-party truck drivers.
- Have open lines of communication between the residents and the business to address any persistence issues.
- Consider flaggers during peak hours and season periodically.

Bartlett Street and Cedar Hill Street

Observations: The intersection was recently designed with new channelized islands and geometry. Stakeholders and residents at the RSA were generally happy with the redesign. Participants at the RSA made note of the poor pavement condition of Cedar Hill Street in Marlborough. A representative of ARHS also stated that the pavement conditions on Cedar Hill Street in Marlborough was one of their biggest concerns for student (teen driver) safety. A lack of lighting was noted at the intersection. Pedestrian infrastructure exists west of the intersection on Bartlett and the Aqueduct trail.

Potential Enhancements:

- Improve lighting at intersection.
- Consider communicating with Marlborough to work out a repaving plan for Cedar Hill Street.

Corridor Wide Observations

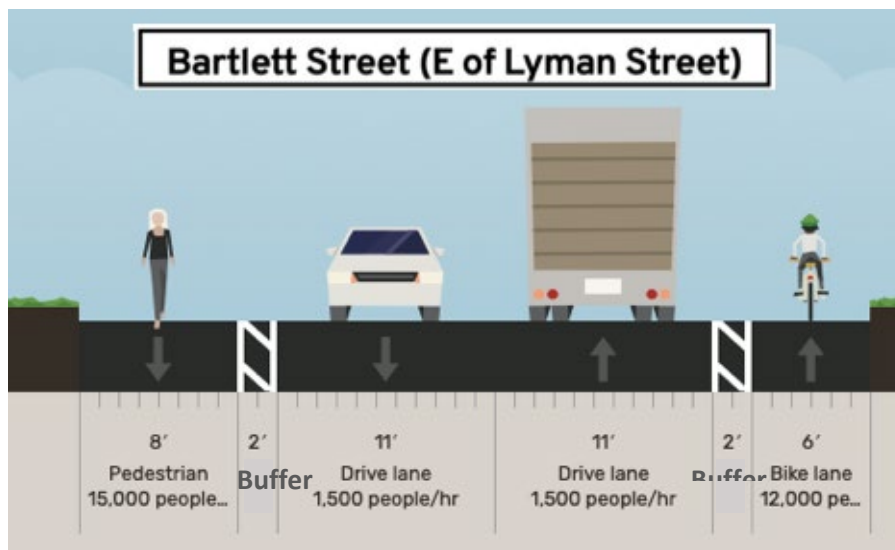
Bartlett Street is effectively split in two distinct uses at Lyman Street – light industrial/warehouse uses east of Lyman Street and Residential use west of Lyman Street. The roadway width on the residential section west of Lyman Street is narrower than the eastern section of the corridor that has commercial and light industrial uses permitted. Also, the speed limit changes from 45 mph to 35 mph west of Lyman Street. There have been three deer strikes on Bartlett Street on the eastern section. Of the truck crashes, 42 percent have occurred in the last 18 months, an average of one crash every six months. In the three years prior there had been four crashes involving trucks which would equivalent a crash occurring every 1.33 years. Data collected by CMRPC, cross-referenced by Northborough Police reports, show that speeding is not a problem along the corridor. Signage along the corridor varies in age and information.

Pedestrian and bicycle accommodations are very minimal on this corridor. Currently sidewalk exists on a small section on one side of Bartlett St. from the Main Street/Bartlett Street intersection to just south of ARHS entrance. The presence of two Aqueduct trail crosswalks along the corridor, the residential and High school use encourages decent amount of pedestrian and bicycle use on the corridor.

Potential Enhancements:

- Consider narrowing of the travel lanes along the corridor with consistent width to encourage vehicles to decrease their speed along the corridor and encourage other modes of travel. Data from automated traffic counters and the police department show that posted speeds are being followed.
- Look at the signage along the corridor and consider comprehensive updating of signage along the corridor.
- Consider signage on Bartlett Street West of Lyman Street informing drivers that they are entering a residential or thickly settled area.

Figure 47: Pedestrian Improvements to Bartlett Street



Recommendations for Bicycle and Pedestrian Accommodations:

Between Cedar Hill Street and Lyman Street the measured roadway width can accommodate bicycle and pedestrian facilities. It is important to note that while implementing these types of accommodations in an otherwise unconnected network could lead to potential conflicts at other locations. Currently, there are no separated bicycle or pedestrian facilities on Cedar Hill Street or Lyman Street.

It is recommended to incorporate temporary accommodations to include a 6-foot bike lane EB toward Marlborough and an 8-foot on-road path WB for use by bicyclists and pedestrians. There is also enough space to include a 2-foot painted barrier separating these facilities. These accommodations will create linkages to the intersecting portions of the Aqueduct Trail system and the existing bicycle lanes at the

Marlborough town line. This will require a lane narrowing to 11-foot lanes, which might deter non-essential truck flows on this section. FHWA standards require a minimum of 11-foot lanes minimum width for roads experiencing 10-30% of truck related traffic.

It is recommended that the Town in conjunction with other entities such as Complete Streets/Master Planning Implementation committees monitor the use of these accommodations to determine the need for permanent infrastructure in the future.

