



Multi-way Stop Warrant Analysis
Arthur Street and Dorchester Street intersection
April 24, 2023

Petition: Tara Berry et al. request installation of four-way stop sign at the intersection of Arthur St. and Dorchester St.
8g CC March 29, 2022

Scheduled Committee Hearing: April 26, 2023 Traffic & Parking Committee, Item 8a

Prepared by: Stephen S. Rolle, P.E., Commissioner

Summary

In response to a Council petition requesting multi-way stop control (aka all-way stop), The Department of Transportation & Mobility (DTM) has conducted an evaluation of conditions at the intersection of Arthur Street and Dorchester Street. Presently, the intersection operates with stop sign control on the minor street approaches of Arthur Street only.

Multi-way stop control can be an effective way to address intersection safety under certain conditions. These include conflicts between road users - including pedestrians, bicyclists, and motorists - who experience difficulty navigating an intersection safely due to opposing traffic volumes or limited sight distance. Stop signs are not appropriate or effective at controlling traffic speeds or discouraging use of a route and can reduce safety when applied in inappropriate conditions.

Installation of multi-way stop control is governed by criteria established by the Manual of Uniform Traffic Control Devices (MUTCD) and Massachusetts amendments to the manual promulgated by the Massachusetts Department of Transportation (MassDOT). The MUTCD is incorporated by reference in 23 Code of Federal Regulations (CFR), Part 655, Subpart F and is the national standard for all traffic control devices installed on any street, highway, bikeway, or private road open to public travel. Chapter 85 Section 2 of the Massachusetts General Laws further establishes that signs, traffic control signals, traffic devices, school zones, parking meters or markings on any way must be in conformance with the MUTCD, as amended.

Recommendation

Analysis of the intersection of Arthur Street and Dorchester Streets found that multi-way stop control warrants are not met, due primarily to very low traffic volumes on Arthur Street.

Given that more targeted proven safety countermeasures are available and multi-way stop control warrants are not satisfied, **DTM does not recommend installation of multi-way stop control** at this location.

Instead, DTM recommends that the following actions be taken:

Near-term

- Establish a School Speed Zone with 20 mph posted speed limit during school hours in accordance with Massachusetts General Laws Chapter 90 Section 17.
- Appropriately sign the School Speed Zone and all pedestrian crosswalks in accordance with the Massachusetts amended MUTCD.
- Daylight crosswalks by extending No Parking zones at crosswalks to 30 ft to improve sightlines and increase pedestrian safety an access.

Longer-term (pending funding)

- Upgrade sidewalks to incorporate curb extensions and establish ADA compliant curb ramps.
- Monitor usage over time and consider installation of a pedestrian actuated Rectangular Rapid Flashing Beacon (RRFB).

Background

Dorchester Street is a two-way, east-west street with a functional classification of Urban Collector. The street has one travel lane in each direction. Arthur Street has a north-south orientation and is classified as a Local street. Arthur Street accommodates two-way traffic north of Dorchester Street, but operates one-way northbound only (approaching the intersection) south of Dorchester Street. On-street parking is prohibited adjacent to the Worcester East Middle School on the north side of Dorchester Street (east of the intersection) and the east side of Arthur Street (north of the intersection), but is otherwise allowed on both streets. Parking is prohibited on a statutory basis within 20 ft of intersections. No Parking signs are present on Dorchester Street, but there are no other measures such as curb extensions or lane markings to reenforce this prohibition.

Crosswalks are present across all approaches¹. A midblock crosswalk is additionally located approximately 95 feet east of the intersection connecting the school to a playground on the south side of Dorchester Street². WRTA bus stops are located on Dorchester Street to the east of the intersection (near-side stop westbound, far-side stop eastbound).

Statutory speed limits govern both streets, meaning that for Thickly Settled and Business Districts such as this the speed limit is 30 mph. Despite being adjacent to Worcester East Middle School, neither street has a posted School Zone.

¹ ADA ramps are absent on the south side of the intersections.

² ADA ramps are absent at the midblock crosswalk.



Figure 1: Aerial view of Arthur St-Dorchester St intersection.



Figure 2: View westbound on Dorchester St approaching Arthur St (source: Google Streetview)

Traffic Characteristics and Data Sources

Traffic volumes and Speeds

Traffic volumes were acquired in April 2023 from Streetlight Insight, a transportation data and analytics platform, for the time period April-May and September-October 2019 in order to reflect pre-pandemic conditions. A cursory review of AADT estimates for 2019 through 2022 shows that traffic volumes have largely returned to pre-pandemic levels.

Traffic volumes were prepared using Streetlight’s single factor calibration index with available MassDOT traffic count data on nearby roadways used to calibrate volume estimates. Hourly

counts were further factored to match 2019 AADT reported by Streetlight InSight. Hourly volume summaries are tabulated in Appendix A. The reported 2019 AADT entering the intersection is 3,320 vehicles on eastbound Dorchester Street, 3,932 vehicles on westbound Dorchester Street, 348 vehicles on southbound Arthur Street and 233 vehicles on northbound Arthur Street.

Pedestrian volumes crossing Dorchester Street at Arthur Street were estimated using Streetlight InSight Origin-Destination analyses for walk trips occurring on opposite sides of the street. Additionally, DTM staff observed walk patterns at the end of a school day to confirm the reasonableness of reported peak period walk trips.

The reported 85th percentile speed on Dorchester Street ranges from 25 mph to 27 mph depending on the time period, less than the statutory speed limit of 30 mph.

Crash Data

Crash records for a five-year period from January 2018 through December 2022 were retrieved in April 2023 from the MassDOT IMPACT crash database. See Appendix B.

Sight distance and intersection configuration

Confirmed in the field and using city GIS imagery.

MUTCD

2009 edition incorporating revisions 1, 2, and 3, accessed online April 2023.

Massachusetts Amendments to MUTCD

2022 edition accessed online March 2023.

Warrant Evaluation

The MUTCD provides *guidance* that the decision to install multi-way stop control should be based on an engineering study that considers the criteria evaluated below. Massachusetts amendments add the *standard* (requirement) that YIELD or STOP signs shall not be used for speed control. Multi-way stop control may be considered for installation when one or more of the following warrants are met and installation of stop control has been determined through engineering judgement to be a preferred solution for addressing the identified issues.

Warrant A: Where traffic control signals are justified, the multi-way stop is an interim measure that can be installed quickly to control traffic while arrangements are being made for the installation of the traffic control signal.

Not met – the location is not a candidate for a traffic signal.

Warrant B. Five or more reported crashes in a 12-month period that are susceptible to correction by a multi-way stop installation. Such crashes include right-turn and left-turn collisions as well as right-angle collisions.

Not met – No 12-month period included 5 or more correctable crashes.

Warrant C. This warrant is satisfied when both criteria 1 and 2 are met below, or if applicable, criterion 3 is met.

Not met – The requirement to meet both C1 and C2 is not satisfied, and C3 is not applicable.

1. The vehicular volume entering the intersection from the major street approaches (total of both approaches) averages at least 300 vehicles per hour for any 8 hours of an average day; and

The major approach volume exceeds 300 vehicles per hour for 14 hours of the day, satisfying this criterion.

2. The combined vehicular, pedestrian, and bicycle volume entering the intersection from the minor street approaches (total of both approaches) averages at least 200 units per hour for the same 8 hours, with an average delay to minor-street vehicular traffic of at least 30 seconds per vehicle during the highest hour; but

The minor street approach total entering volumes averages 63 vehicles + crossing pedestrians for the eight highest hours, and this criterion is therefore not satisfied.

3. If the 85th-percentile approach speed of the major-street traffic exceeds 40 mph, the minimum vehicular volume warrants are 70 percent of the values provided in Items 1 and 2.

The 85th percentiles speed ranges from 25 to 27 mph. The 70% reduction is not applicable.

Warrant D. Where no single criterion is satisfied, but where Criteria B, C.1, and C.2 are all satisfied to 80 percent of the minimum values. Criterion C.3 is excluded from this condition.

Not met – Crashes and minor street volume to not meet thresholds.

80% of 5 crashes = 4 crashes. This criterion is not satisfied. While 4 total crashes did occur over a 12-month period in 2018, one or more crashes are of a type unlikely to benefit from all-way stop control.

80% of 300 vehicles = 240 vehicles. The major street approach exceeds 240 vehicles for 16 hours.

80% of 200 entering volume = 160 entering volume. The minor street approach averages 63 entering volume (vehicles + pedestrians) over the 8 highest hours.

Other Optional criteria that may be considered in an engineering study:

- A. The need to control left-turn conflicts;

N/A - Left turn conflicts are not a factor at this intersection.

- B. The need to control vehicle/pedestrian conflicts near locations that generate high pedestrian volumes;

Worcester East Middle School is a significant generator of pedestrian activity, and the neighborhood in general experiences considerable pedestrian activity. However, this activity is largely limited to school start/end times, and pedestrian crossings of Dorchester St were observed to be moderate.

Implementation of Safe Routes to Schools approaches to establish a School Zone and improve crosswalk signage is instead recommended.

- C. Locations where a road user, after stopping, cannot see conflicting traffic and is not able to negotiate the intersection unless conflicting cross traffic is also required to stop; and

Adequate sight lines are provided in all directions.

Recommend better daylighting of crosswalks through curb extensions and/or extending no parking zones near intersections.

- D. An intersection of two residential neighborhood collector (through) streets of similar design and operating characteristics where multi-way stop control would improve traffic operational characteristics of the intersection.

N/A – Streets are of different character, functional class, and Dorchester Street carries significantly higher traffic volume.

Prepared by: SSR 4-24-23

Reviewed by: TMK 4-24-23

Appendix A

Traffic Volume Estimates

	Major Street	Minor Street	
	Dorchester St (EB + WB)		Arthur St
	Entering veh volume		Entering total volume (includes crossing peds)
Midnight	54		
1:00 AM	44		
2:00 AM	37		
3:00 AM	19		
4:00 AM	50		
5:00 AM	104		
6:00 AM	314		
7:00 AM	486		79
8:00 AM	356		
9:00 AM	301		
10:00 AM	291		
11:00 AM	309		
Noon	351		
1:00 PM	424		99
2:00 PM	546		84
3:00 PM	532		56
4:00 PM	573		52
5:00 PM	584		71
6:00 PM	524		41
7:00 PM	413		22
8:00 PM	335		
9:00 PM	264		
10:00 PM	200		
11:00 PM	141		
Daily Total	7252	Avg Minor St 8-Hr Volume	63

	Major street approach exceeds 300 vhp
	Major street approach exceeds 240 vph (80% warrant)
	Major street approach exceeds 210 vph (70% warrant), if applicable

Highest 8-hrs in bold.

Notes:

1. Obtained from Streetlight InSight database March 2023
2. Calibrated to traffic count data retrieved from MassDOT Transportation Data Management System March 2023.

Appendix A Crash Summary

Crash Date	# of veh	Manner of Collision	First Harmful Event	Vehicle Actions
02/14/2018	2	Sideswipe, same direction	Collision with parked motor vehicle	V1: Parked / V2: Travelling straight ahead
02/25/2018	2	Head-on	Collision with motor vehicle in traffic	V1: Travelling straight ahead / V2: Travelling straight ahead
04/11/2018	1	Angle	Collision with pedalcycle	V1: Travelling straight ahead
02/05/2019	2	Angle	Collision with motor vehicle in traffic	V1: Travelling straight ahead / V2: Turning left
07/24/2019	1	Angle	Collision with pedalcycle	V1: Travelling straight ahead
03/05/2020	2	Angle	Collision with motor vehicle in traffic	V1: Travelling straight ahead / V2: Travelling straight ahead
12/15/2021	1	Single vehicle crash	Collision with pedestrian	V1: Travelling straight ahead
03/29/2022	2	Angle	Collision with motor vehicle in traffic	V1: Travelling straight ahead / V2: Travelling straight ahead
07/09/2022	2	Sideswipe, same direction	Collision with parked motor vehicle	V1: Parked / V2: Turning right

	Potentially correctable by installation of AWSC
	Unclear/unknown
	Unlikely to be correctable by installation of AWSC

Notes:

1. Retrieved from MassDOT IMPACT database March 17, 2023