

TOWN OF BROOKLINE

Department of Public Works
333 Washington Street
Brookline, MA 02445

Right Turn On Red Restriction

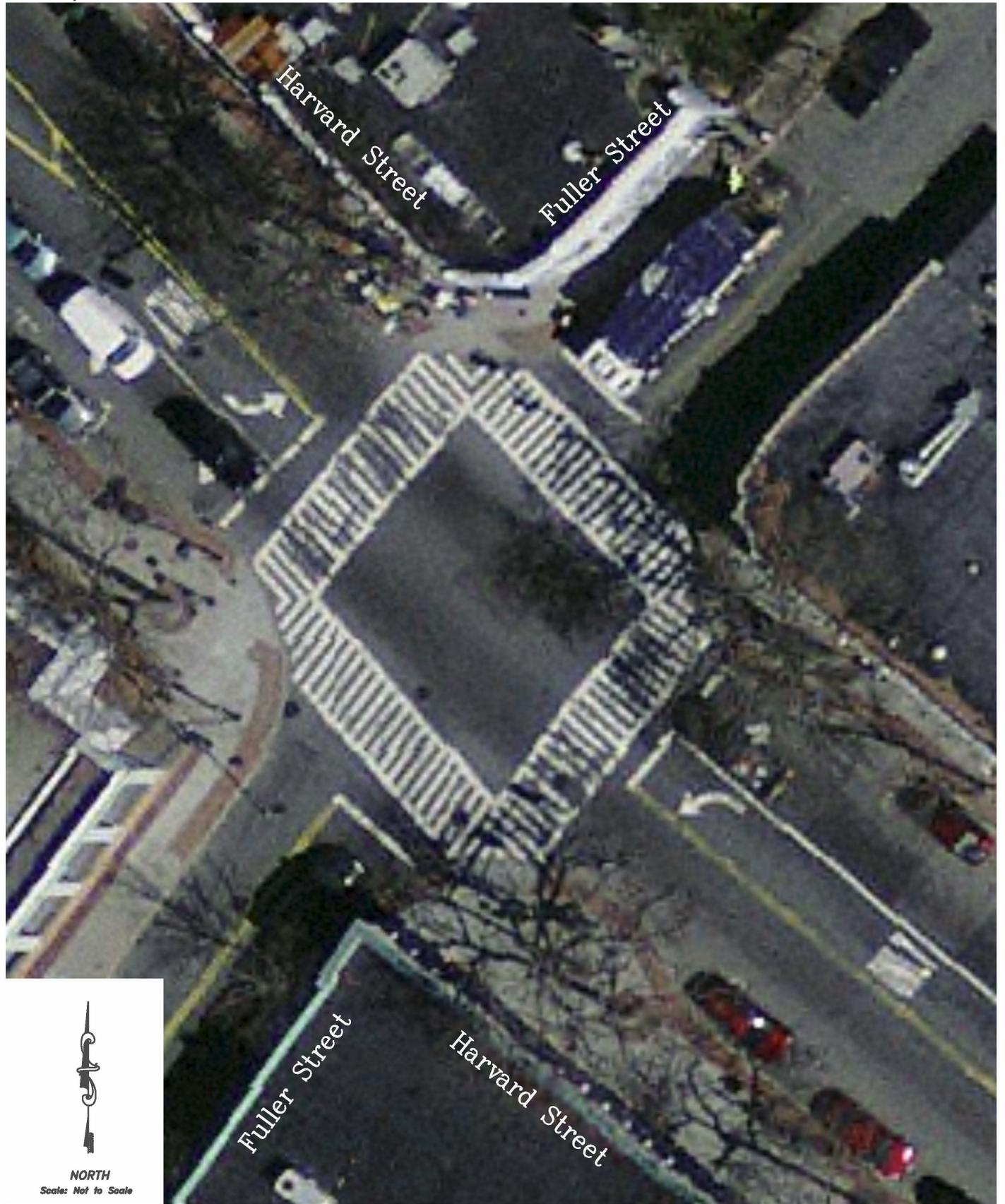
For

Harvard Street at Fuller Street

The purpose of this study is to determine if the right turn restriction on the approaches to the Harvard Street at Fuller Street intersection are warranted. The study location can be seen in **Figure 1**. Recommendations will be based on the guidelines found in the latest edition of the Manual of Uniform Traffic Control Devices (MUTCD). The MUTCD suggests the following factors should be considered for the implementation of a NO TURN ON RED restriction:

1. Sight distance of vehicles approaching from the left;
2. Geometric or operational characteristics of the intersection that might result in unexpected conflicts;
3. An exclusive (“Barn Dance”) pedestrian phase;
4. An unacceptable number of pedestrian conflicts with right-turn-on-red maneuvers, especially involving children, older pedestrians, or persons with disabilities;
5. More than three (3) right-turn-on-red accidents reported in a 12 month period for the particular approach.

According to our files the Transportation Board, or it’s predecessor the Traffic Council, implemented the NO TURN ON RED restriction based on the exclusive “barn dance” pedestrian phase.



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Figure 1

Study Location

SIGHT DISTANCE

The American Association of State and Transportation Officials (AASHTO) standards reference two types of sight distances which are relevant for the intersection at Harvard Street at Fuller Street: stopping sight distance (SSD) and intersection sight distance (ISD). Stopping sight distance pertains to roadway segments and intersection sight distance, as the name implies, relates specifically to intersections. Sight lines for right turning vehicle movements at the intersection of Harvard Street at Fuller Street are compared to minimum safe stopping sight distance (SSD) and intersection sight distance (ISD) guidelines for the regulatory speed limit below in **Table 1** below. Sight line calculations are provided in the **Appendix**.

Table 1
Sight Distance

Approach /Travel Direction	Available Sight Distance	AASHTO Recommended ¹ Posted Speed (30 mph)	
Stopping Sight Distance			
Fuller Street Eastbound	>400'	200'	
Fuller Street Westbound	320'	200'	
Harvard Street Northbound	240'	205'	
Harvard Street Southbound	230'	200'	
Intersection Sight Distance - Stop Control			
	Behind Stop line	At Crosswalk	
Fuller Street Eastbound	<100'	>400'	290'
Fuller Street Westbound	<100'	110'	290'
Harvard Street northbound	120'	160'	290'
Harvard Street Southbound	110'	220'	290'

¹Recommended sight distance based on A Policy on Geometric Design of Highways and Streets, AASHTO, 4th edition 2001. Based on driver height of eye of 3.5 feet to object height of 2.0 feet for SSD or 3.5 feet for ISD and adjustments for roadway grade.

The existing stopping sight distance is adequate on all approaches. All the approaches have deficient intersection sight distance. The MUTCD suggest restricting right turn on red movements when sight distance of vehicles approaching from the left is restricted.

GEOMETRIC AND OPERATIONAL CHARACTERISTICS

Harvard Street meets Fuller Street at 90 degrees to form a four way signalized intersection. The Harvard Street northbound approach provides one general purpose lane with on street parking. Harvard Street Southbound provides one general purpose travel lane with on street parking. Fuller Street eastbound provides one general purpose travel lane with no on street parking. Fuller Street westbound provides one general purpose travel lane with no on street parking. Land use at the intersection is primarily commercial.

PEDESTRAIN CONFLICTS AND SIGNAL PHASING

Pedestrian activity at the Fuller Street at Harvard Street intersection is high. The signal timing provides an exclusive pedestrian phase during which time all vehicles should be stopped so pedestrians can cross. The MUTCD recommends no turn on red when an exclusive pedestrian phase is used and when an unacceptable number of pedestrian conflicts is observed.

CRASH ANALYSIS

In order to identify accident trends and safety characteristics for the study intersection accident reports were obtained from MassDOT Highway Crash Database for a three-year period covering 2007 through 2009. This data can be found in the **Appendix**. A summary of the crash data for the study intersection is detailed in **Table 2**.

Table 2
Accident Summary

<u>Data Category</u>	<u>Fuller St at Harvard St</u>
Year:	
2007	2
2008	1
2009	<u>1</u>
Total	4
Type:	
Angle	0
Rear-End	2
Right-On-Red	0
Head-On	0
Sideswipe	0
Pedestrian	1
Unknown/Other	1
Severity:	
P. Damage Only	1
Personal Injury	1
Fatality	0
Unknown/Other	2
Conditions:	
Dry	2
Wet	1
Snow/Ice	0
Other/Unreported	1
Time:	
7:00 AM to 9 AM	0
4:00 AM to 6 PM	1
Rest of Day	3

As summarized in **Table 2**, a total of four crashes were reported Fuller Street at Harvard Street intersection for the three-year period studied from 2007 to 2009. None of the reported crashes were from vehicles making a right turn at the intersection. However right turn on red maneuvers are currently restricted on all approaches. The MUTCD warrants a right-turn-on-red restriction if three or more accidents were caused by right turn on red maneuvers within 12 months.

CONCLUSIONS

The approaches to Fuller Street at Harvard Street intersection have restricted sight lines; heavy pedestrian usage with an exclusive pedestrian phase at which time all vehicles should be stopped and pedestrians allowed to cross. Using the MUTCD guidelines 1, 3, and 4 the removal of the right turn on red restrictions would not be recommended.

Appendix

- Sight Line Calculations
- Accident Data

Sight Line Calculations

Fuller Street Westbound Approach

Intersection Sight Distance	Speed		
	<u>Posted</u>	<u>Average</u>	<u>85th</u>
<u>Looking North</u>			
Stop Control Left Turning	0	0	0
Stop Control Right Turning/Crossing	0	0	0
Yield Control Left Turning	0	0	0
Yield Control Right Turning/Crossing	0	0	0
<u>Looking South</u>			
Stop Control Left Turning	331	0	0
Stop Control Right Turning/Crossing	287	0	0
Yield Control Left Turning	353	0	0
Yield Control Right Turning/Crossing	309	0	0
Stopping Sight Distance	Speed		
	<u>Posted</u>	<u>Average</u>	<u>85th</u>
Northbound Stopping Sight Distance	197	0	0
Southbound Stopping Sight Distance	0	0	0

Inputs	North Bound			South Bound		
	Posted	Average	85th	Posted	Average	85th
Speed:	30					
Grade:						

Sight Distance Formulas - Source: AASHTO

$$\text{Intersection Sight Distance} = 1.47 \times V \times t$$

$$\text{Stopping Sight Distance} = (1.47 \times V \times s) + \frac{V^2}{(30 \times ((a/32.2) + (G/100)))}$$

Where:

s = Reaction Time (sec) = 2.5 s

V = Travel Speed (mph)

G = Roadway Grade

a = Deceleration Rate (ft/sec²) = 11.2 ft/s²

- t = Time Gap (sec) =
- Stop Control Left Turning = 7.5 s
 - Stop Control Right Turning = 6.5 s
 - Yield Control Left Turning = 8 s
 - Yield Control Right Turning = 7 s

Sight Line Calculations

Fuller Street Eastbound Approach

Intersection Sight Distance	Speed		
	<u>Posted</u>	<u>Average</u>	<u>85th</u>
<u>Looking North</u>			
Stop Control Left Turning	331	0	0
Stop Control Right Turning/Crossi	287	0	0
Yield Control Left Turning	353	0	0
Yield Control Right Turning/Crossi	309	0	0
<u>Looking South</u>			
Stop Control Left Turning	0	0	0
Stop Control Right Turning/Crossi	0	0	0
Yield Control Left Turning	0	0	0
Yield Control Right Turning/Crossi	0	0	0
Stopping Sight Distance	Speed		
	<u>Posted</u>	<u>Average</u>	<u>85th</u>
Northbound Stopping Sight Distan	0	0	0
Southbound Stopping Sight Distan	197	0	0

<u>Inputs</u> Speed: Grade:	North Bound			South Bound		
	Posted	Average	85th	Posted	Average	85th
				30		

Sight Distance Formulas - Source: AASHTO

Intersection Sight Distance = $1.47 \times V \times t$

Stopping Sight Distance = $(1.47 \times V \times s) + \frac{V^2}{(30 \times ((a/32.2) + (G/100)))}$

Where:

s = Reaction Time (sec) = 2.5 s

V= Travel Speed (mph)

G= Roadway Grade

a = Deceleration Rate (ft/sec²) = 11.2 ft/s²

- t= Time Gap (sec) =
- Stop Control Left Turning = 7.5 s
 - Stop Control Right Turning = 6.5 s
 - Yield Control Left Turning = 8 s
 - Yield Control Right Turning = 7 s

Sight Line Calculations

Harvard Street Northbound

Intersection Sight Distance	Speed		
	<u>Posted</u>	<u>Average</u>	<u>85th</u>
<u>Looking East</u>			
Stop Control Left Turning	0	0	0
Stop Control Right Turning/Crossi	0	0	0
Yield Control Left Turning	0	0	0
Yield Control Right Turning/Crossi	0	0	0
<u>Looking West</u>			
Stop Control Left Turning	331	0	0
Stop Control Right Turning/Crossi	287	0	0
Yield Control Left Turning	353	0	0
Yield Control Right Turning/Crossi	309	0	0
Stopping Sight Distance	Speed		
	<u>Posted</u>	<u>Average</u>	<u>85th</u>
Eastbound Stopping Sight Distance	197	0	0
Westbound Stopping Sight Distan	0	0	0

<u>Inputs</u> Speed: Grade:	East Bound			West Bound		
	Posted	Average	85th	Posted	Average	85th
	30					

Sight Distance Formulas - Source: AASHTO

Intersection Sight Distance = $1.47 \times V \times t$

Stopping Sight Distance = $(1.47 \times V \times s) + \frac{V^2}{(30 \times ((a/32.2) + (G/100)))}$

Where:

s = Reaction Time (sec) = 2.5 s

V= Travel Speed (mph)

G= Roadway Grade

a = Deceleration Rate (ft/sec²) = 11.2 ft/s²

- t= Time Gap (sec) =
- Stop Control Left Turning = 7.5 s
 - Stop Control Right Turning = 6.5 s
 - Yield Control Left Turning = 8 s
 - Yield Control Right Turning = 7 s

Sight Line Calculations

Harvard Street Southbound Approach

Intersection Sight Distance	Speed		
	<u>Posted</u>	<u>Average</u>	<u>85th</u>
<u>Looking East</u>			
Stop Control Left Turning	331	0	0
Stop Control Right Turning/Crossi	287	0	0
Yield Control Left Turning	353	0	0
Yield Control Right Turning/Crossi	309	0	0
<u>Looking West</u>			
Stop Control Left Turning	0	0	0
Stop Control Right Turning/Crossi	0	0	0
Yield Control Left Turning	0	0	0
Yield Control Right Turning/Crossi	0	0	0
Stopping Sight Distance	Speed		
	<u>Posted</u>	<u>Average</u>	<u>85th</u>
Eastbound Stopping Sight Distanc	0	0	0
Westbound Stopping Sight Distanc	197	0	0

<u>Inputs</u> Speed: Grade:	East Bound			West Bound		
	Posted	Average	85th	Posted	Average	85th
				30		

Sight Distance Formulas - Source: AASHTO

Intersection Sight Distance = $1.47 \times V \times t$

Stopping Sight Distance = $(1.47 \times V \times s) + \frac{V^2}{(30 \times ((a/32.2)+(G/100)))}$

Where:

s = Reaction Time (sec) = 2.5 s

V= Travel Speed (mph)

G= Roadway Grade

a = Deceleration Rate (ft/sec²) = 11.2 ft/s²

- t= Time Gap (sec) =
- Stop Control Left Turning = 7.5 s
 - Stop Control Right Turning = 6.5 s
 - Yield Control Left Turning = 8 s
 - Yield Control Right Turning = 7 s



MassHighway Crash Report for Brookline in the year 2007

Crash Number	City/Town Name	Crash Date	Crash Time	Crash Severity	Number of Vehicles	Total Nonfatal Injuries	Total Fatal Injuries	Manner of Collision	Vehicle Action Prior to Crash	Vehicle Travel Directions	Most Harmful Events	Vehicle Configuration	Road Surface Condition	Ambient Light	Weather Condition	At Roadway Intersection	Distance from Nearest Roadway Intersection	Distance from Nearest Milemarker	Distance from Nearest Exit	Distance from Nearest Landmark	Non Motorist Type
2344627	BROOKLINE	19-Jun-2007	12:00 PM	Property damage only (none injured)	2	0	0	Rear-end	V1: Parked / V2:Unknown	V1:Not reported / V2:Northbound	V1: Not reported / V2: Not reported	V1: Not reported / V2:Not reported	Dry	Daylight	Clear		420 HARVARD STREET / FULLER STREET				
2347106	BROOKLINE	07-Sep-2007	4:00 AM	Non-fatal injury	2	1	0	Not reported	V1: Slowing or stopped in traffic /V2:Travelling straight ahead	V1:Not reported / V2:Not reported	V1: Not reported / V2: Not reported	V1: Passenger car / V2:Passenger car	Not reported	Daylight	Clear	HARVARD STREET / FULLER STREET					

**MassHighway Crash Report for Brookline in the year 2008**

Crash Number	City/Town Name	Crash Date	Crash Time	Crash Severity	Number of Vehicles	Total Nonfatal Injuries	Total Fatal Injuries	Manner of Collision	Vehicle Action Prior to Crash	Vehicle Travel Directions	Most Harmful Events	Vehicle Configuration	Road Surface Condition	Ambient Light	Weather Condition	At Roadway Intersection	Distance from Nearest Roadway Intersection	Distance from Nearest Milemarker	Distance from Nearest Exit	Distance from Nearest Landmark	Non Motorist Type
2356478	BROOKLINE	06-Aug-2008	4:57 PM	Not Reported	2	0	0	Rear-end	V1: Travelling straight ahead / V2: Travelling straight ahead	V1: Southbound / V2: Southbound	V1: Collision with motor vehicle in traffic / V2: Collision with motor vehicle in traffic	V1: Passenger car / V2: Passenger car	Wet	Daylight	Cloudy	HARVARD STREET / FULLER STREET					



MassHighway Crash Report for Brookline in the year 2009

Crash Number	City/Town Name	Crash Date	Crash Time	Crash Severity	Number of Vehicles	Total Nonfatal Injuries	Total Fatal Injuries	Manner of Collision	Vehicle Action Prior to Crash	Vehicle Travel Directions	Most Harmful Events	Vehicle Configuration	Road Surface Condition	Ambient Light	Weather Condition	All Roadway Intersection	Distance from Nearest Roadway Intersection	Distance from Nearest Milemarker	Distance from Nearest Exit	Distance from Nearest Landmark	Non Motorist Type
2429951	BROOKLINE	08-Feb-2009	3:40 PM	Non-fatal injury	1	1	0	Single vehicle crash	V1: Turning left	V1:Northbound	V1: Collision with pedestrian	V1: Passenger car	Dry	Daylight	Clear	HARVARD STREET / FULLER STREET					P2:Pedestrian