

WALTHAM TRAFFIC COMMISSION

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MEETING 10/17/12

Agenda Item # 2B

TO: Waltham Traffic Commission
FROM: J. Michael Garvin, P.E., Traffic Engineer
SUBJECT: **Four-Way Stop Review**
DATE: October 12, 2012

REF: 12-070

ISSUE: Traffic Commission has requested Traffic Engineering to review all multi-way STOP controlled intersections in the City to determine whether they are warranted.

FACTS: See attached study.

ALTERNATIVES:

1. Approve the recommendations of the study and remove the STOP sign from School Avenue Northbound at Hardy Street/Parkers Lane, delete the following from Schedule 3 – Stop Streets in the Rules and Regulations:

DELETE: School Ave. at Hardy St./Parkers Ln., facing northbound traffic

AND

Request Traffic Engineering to conduct further studies at the intersections of Fairfax Rd/Longfellow Rd and Abbott Rd/Warwick Ave.

2. Deny this request.

RECOMMENDATION: Approve Alternative # 1

Traffic Engineering has completed a review of the all-way stop sign controlled intersections in the City, to determine whether they meet the warrants. There are 18 all-way stop sign intersections in the City. The following lists each location, and the date the Traffic Commission approved installation of all-way stop signs:

<u>Location</u>	<u>Date Approved</u>
1. Gore St/Grove St/Seyon St	11/87
2. Church St/Summer St	06/89
3. Bright St/Grove St	05/96
4. Fairfax Rd/Longfellow Rd	01/97
5. Harvard St/Russell St	06/97
6. Bedford St/Boynton St	09/98
7. Hardy St/Parkers Ln/School Ave	09/99
8. Abbott Rd/Warwick Ave	09/02
9. Church St/School St	09/02
10. Berkshire Rd/Brown St/Parmenter Rd	06/03
11. Cabot St/Winthrop St	11/05
12. Beal Rd/Candace Ave	05/07
13. Candace Ave/Mayall Rd	05/07
14. Riverview Ave/Rumford Ave/Woerd Ave	10/07
15. Beal Rd/Chaffee Ave	02/08
16. Adams St/Brown St	03/08
17. Curtis St/Sharon St	01/09
18. Hammond St/Plympton St	04/12

Figure 1 shows the locations of all 18 all-way stop controlled intersections in Waltham.



Figure 1
All-Way Stop Sign Locations

According to the Massachusetts Department of Transportation (MassDOT), multi-way stop signs “must meet the warrant criteria as outlined in Section 2B.07 of the 2009 MUTCD.” The MUTCD (Manual on Uniform Traffic Control Devices) includes Support, Guidance, and Option language in Section 2B.07. The intent of the MassDOT requirement is that a multi-way stop sign control is warranted if *any* of the criteria is met, as determined by an engineering study. If none of the criteria in the *Guidance* section is met, but an engineering study determines that one of the criteria in the *Option* section qualifies, then a multi-way stop sign may be warranted, if so determined by a Professional Engineer. The following quotes section 2B.07 in its entirety:

Support:

Multi-way stop control can be useful as a safety measure at intersections if certain traffic conditions exist. Safety concerns associated with multi-way stops include pedestrians, bicyclists, and all road users expecting other road users to stop. Multi-way stop control is used where the volume of traffic on the intersecting roads is approximately equal.

The restrictions on the use of STOP signs described in Section 2B.04 also apply to multi-way stop applications.

Guidance:

The decision to install multi-way stop control should be based on an engineering study.

The following criteria should be considered in the engineering study for a multi-way STOP sign installation:

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.

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.

C. Minimum volumes:

- 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*
- 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*
- 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.*

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.

Option:

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

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

The general approach to consider, therefore, when conducting an engineering study at a candidate for a multi-way stop sign location is any one of the following criteria:

- An interim measure at a location where a full traffic signal is warranted
- Accident history indicates a safety concern that can be addressed by multi-way stop sign installation (averaging five such accidents per year; or four accidents if traffic volumes are at least 240 on major street and 160 on minor street)
- Minimum traffic volumes (300 vph on major street approaches and 200 vph on minor street approaches; or 240/160 if average of at least four accidents per year)
- Left turning vehicle conflict concerns
- Pedestrian safety
- Sight distance (minimum stopping sight distance of 200 feet for 30 mph speed; 250 feet for 35 mph speed; or 305 feet for 40 mph speed)
- Traffic operations of an intersection of two residential collector streets, as determined by the engineer

Traffic Engineering has reviewed conditions at all 18 multi-way stop sign locations in the City. The following summarizes our findings:

Location 1 - Gore St/Grove St/Seyon St

The intersection volumes during the peak hours (counted on 10/11/12) are as follows:

	Gore St/Seyon St (both approaches)	Grove St (both approaches)
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7am – 8am	629	482
8am – 9am	724	475
4pm – 5pm	933	465
5pm – 6pm	975	589

According to Traffic Commission records from 1995, the four-way stop sign installation at this location was completed in November, 1987. This table from a 1995 Traffic Commission memo summarizes the annual number of accidents reported at this intersection before and after the improvements:

<u>Year</u>	<u>Accidents</u>
1985	19
1986	18
1987	26
1988	3
1989	8
1990	3
1991	3
1992	2
1993	2
1994	0

The above table clearly demonstrates the safety benefit of installing multi-way stop sign control at this location. The accident occurrence dropped considerably after installing the multi-way stop signs. Traffic volumes meet Criteria C1 and C2. Therefore, the multi-way stop sign control is warranted.

Location 2 - Church St/Summer St

The intersection volumes during the peak hours (counted on 10/3/12) are as follows:

	Summer St (both approaches)	Church St (both approaches)
7am – 8am	365	227
8am – 9am	326	241
4pm – 5pm	457	247
5pm – 6pm	498	300

According to Traffic Commission records from 1995, the four-way stop sign installation at this location was completed in June, 1989. This table from a 1995 Traffic Commission memo summarizes the annual number of accidents reported at this intersection before and after the improvements:

<u>Year</u>	<u>Accidents</u>
1985	8
1986	8

1987	12
1988	23
1989	12
1990	2
1991	1
1992	1
1993	2
1994	2

The above table clearly demonstrates the safety benefit of installing multi-way stop sign control at this location. The accident occurrence dropped considerably after installing the multi-way stop signs. Traffic volumes meet Criteria C1 and C2. Therefore, the multi-way stop sign control is warranted.

Location 3 - Bright St/Grove St

The intersection volumes during the peak hours (counted on 11/16/11) are as follows:

	Grove St (both approaches)	Bright St (both approaches)
7am – 8am	349	101
8am – 9am	341	100
4pm – 5pm	396	87
5pm – 6pm	373	92

Prior to installation on all-way stop control, the intersection was averaging two accidents per year.

Sight distance from the northbound Bright St approach, looking towards the west, is limited to only 61 feet, due to the house in the southwest corner of the intersection.

Since available sight distance on one of the minor street approaches is less than the minimum stopping sight distance, the multi-way stop sign control is warranted at this location.

Location 4 - Fairfax Rd/Longfellow Rd

The intersection volumes during the peak hours (counted on 5/2/12) are as follows:

	Fairfax Rd (both approaches)	Longfellow Rd (both approaches)
7am – 8am	88	25
8am – 9am	131	32
4pm – 5pm	132	20
5pm – 6pm	156	27

There was not a significant accident history prior to installation of the all-way stop signs.

On the Longfellow Road minor street approaches, the critical sight distance is on the northbound approach, looking towards the west. This sight distance is limited by a fence on the property in the southwest corner of the intersection, and was measured to be 220 feet. If stop signs were removed on the Fairfax Road approaches, it is estimated that the speed of approaching vehicles on Fairfax Road would be about 35 mph.

The available sight distance (220 feet) is close to the required minimum stopping sight distance for a speed of 35 mph (250 feet), making this a borderline case for warranting multi-way stop sign control. Therefore, we recommend that this location be studied further, including conducting a speed study to determine the actual 85th percentile speed along Fairfax Road.

Location 5 - Harvard St/Russell St

The intersection volumes during the peak hours (counted on 10/4/12) are as follows:

	Harvard St (both approaches)	Russell St (both approaches)
7am – 8am	267	106
8am – 9am	256	112
4pm – 5pm	439	186
5pm – 6pm	438	195

Prior to installation of multi-way stop sign control, this intersection was averaging 7 accidents per year. In the most recent three years, this intersection is averaging about 1 accident per year.

From the westbound approach stop line, the available sight distance towards the south was measured as 106 feet.

The accident occurrence dropped after installing the multi-way stop signs, and the available sight distance is less than the minimum stopping sight distance. Therefore, the multi-way stop sign control is warranted.

Location 6 - Bedford St/Boynton St

The intersection volumes during the peak hours (counted on 10/4/12) are as follows:

	Bedford St (both approaches)	Boynton St (both approaches)
7am – 8am	249	26
8am – 9am	332	21
4pm – 5pm	362	8
5pm – 6pm	377	9

There was not a significant accident history at this location prior to installation of the all-way stop control.

The critical sight distance is from the stop line for the southbound approach, looking west. This sight distance was measured as only 76 feet, due to a fence and shrubs in the northwest corner of the intersection.

Due to the limited sight distance for southbound vehicles, the multi-way stop sign control is warranted.

Location 7 - Hardy St/Parkers Ln/School Ave

The intersection volumes during the peak hours (counted on 9/27/12) are as follows:

	School Ave (both approaches)	Hardy St/Parkers Ln (both approaches)
7am – 8am	8	15
8am – 9am	7	9
4pm – 5pm	17	11
5pm – 6pm	15	16

In the three years prior to the multi-way stop sign installation, there were no accidents at this intersection.

A site visit did not reveal any sight distance deficiencies from either Hardy Street or Parkers Lane.

Given the very low traffic volumes, and the lack of any accident history or sight distance concern, it is the determination of Traffic Engineering that multi-way stop sign control is not warranted at this location. It should be noted that during the traffic count, we observed a compliance rate (people who stop at the northbound stop sign) of under 50 percent. We recommend removing the stop sign on the northbound School Ave approach, and retaining the stop signs on the eastbound Hardy St approach and the westbound Parkers Lane approach.

Location 8 - Abbott Rd/Warwick Ave

The intersection volumes during the peak hours (counted on 12/6/11) are as follows:

	Warwick Ave (both approaches)	Abbot Rd (both approaches)
7am – 8am	33	16
8am – 9am	110	76
4pm – 5pm	53	25
5pm – 6pm	42	24

The critical sight distance is from the stop line for the Abbot Road southbound traffic, looking to the east. The crest of a hill limits this sight distance, which was measured to be 178 feet. The speed of traffic along Warwick Avenue was estimated to be 30 mph.

The available sight distance (178 feet) is close to the required minimum stopping sight distance for a speed of 30 mph (200 feet), making this a borderline case for warranting multi-way stop sign control. Therefore, we recommend that this location be studied further, including conducting a speed study to determine the actual 85th percentile speed along Warwick Avenue.

Location 9 - Church St/School St

The intersection volumes during the peak hours (counted on 10/9/12) are as follows:

	Church St (both approaches)	School St (WB approach)
7am – 8am	416	205
8am – 9am	444	143
4pm – 5pm	468	143
5pm – 6pm	526	149

From a 1988 Traffic Engineering memo, this intersection was averaging 18 accidents per year prior to redesign of the intersection and installation of a multi-way stop sign control. In the last three years, with the multi-way stop control, this intersection has averaged 1 accident per year.

The critical sight distance at this intersection is from the westbound School Street stop line, looking towards the south. This sight distance is limited by the stone wall, shrubs, and building in the southeast corner of the intersection, and was measured to be only 46 feet.

Due to the dramatic reduction in the number of accidents, and due to the limited sight distance, the multi-way stop control is warranted at this location.

Location 10 - Berkshire Rd/Brown St/Parmenter Rd

The intersection volumes during the peak hours (counted on 12/7/11) are as follows:

	Parmenter Rd (both approaches)	Berkshire Rd/Brown St (both approaches)
7am – 8am	71	37
8am – 9am	95	45
4pm – 5pm	101	19
5pm – 6pm	110	41

Prior to the implementation of multi-way stop control, this location only averaged two accidents per year.

The critical sight distance at this intersection is from the eastbound Brown Street approach, looking north. This sight distance is limited by bushes, and was measured to be only 62 feet.

This intersection is located near the Whittemore Elementary School, and experiences a high volume of children crossing as pedestrians.

Since this intersection has limited sight distance, and since a high volume of children pedestrians cross at this intersection, the multi-way stop control is warranted.

Location 11 - Cabot St/Winthrop St

The intersection volumes during the peak hours (counted on 11/3/05) are as follows:

	Winthrop St (both approaches)	Cabot St (both approaches)
7:30am – 8:30am	86	141
2:30pm – 3:30pm	64	94

Prior to installation of the multi-way stop control, this intersection experienced an average of one accident per year.

The critical sight distance at this intersection is on the southbound Cabot Street stop line, looking east. This sight distance is limited by shrubs and a tree, and was measured to be 115 feet.

Due to the limited sight distance, multi-way stop control is warranted at this location.

Location 12 - Beal Rd/Candace Ave

The intersection volumes during the peak hours (counted on 12/13/11) are as follows:

	Candace Ave (both approaches)	Beal Rd (both approaches)
7am – 8am	88	56
8am – 9am	78	187

4pm – 5pm	94	59
5pm – 6pm	97	61

The critical sight distance at this intersection is at the northbound Beal Road stop line, looking towards the west. This sight distance is limited by bushes in the southwest corner of the intersection, and was measured to be only 71 feet.

Due to the limited sight distance at this location, multi-way stop sign control is warranted.

Location 13 - Candace Ave/Mayall Rd

The intersection volumes during the peak hours (counted on 12/14/11) are as follows:

	Candace Ave (both approaches)	Mayall Rd (both approaches)
7am – 8am	43	15
8am – 9am	57	30
4pm – 5pm	61	12
5pm – 6pm	66	12

The critical sight distance at this intersection is at the northbound Mayall Road stop line, looking towards the west. This sight distance is limited by a fence in the southwest corner of the intersection, and was measured to be only 74 feet.

Due to the limited sight distance at this location, multi-way stop sign control is warranted.

Location 14 - Riverview Ave/Rumford Ave/Woerd Ave

The intersection volumes during the peak hours (counted on 10/10/12) are as follows:

	Woerd Ave (both approaches)	Riverview Ave/Rumford Ave (both approaches)
7am – 8am	122	79
8am – 9am	142	112
4pm – 5pm	177	86
5pm – 6pm	156	77

The critical sight distance at this intersection is at the eastbound Riverview Avenue stop line, looking towards the south. This sight distance is limited by a stone wall and shrubs in the southwest corner of the intersection, and was measured to be only 52 feet.

Due to the limited sight distance at this location, multi-way stop control is warranted.

Location 15 - Beal Rd/Chaffee Ave

The intersection volumes during the peak hours (counted on 9/27/12) are as follows:

	Beal Rd (both approaches)	Chaffee Ave (both approaches)
7am – 8am	58	71
8am – 9am	111	93
4pm – 5pm	45	92
5pm – 6pm	57	74

Prior to installation of the multi-way stop control, this intersection experienced an average of about one accident per year.

The critical sight distance at this intersection is at the northbound Chaffee Avenue stop line looking towards the east. This sight distance is limited by bushes, and was measured to be only 65 feet.

Due to the limited sight distance at this location, multi-way stop control is warranted.

Location 16 - Adams St/Brown St

The intersection volumes during the peak hours (counted on 9/25/12) are as follows:

	Adams St (both approaches)	Brown St (EB approach)
7am – 8am	92	28
8am – 9am	114	24
4pm – 5pm	133	51
5pm – 6pm	193	90

Prior to installation of the multi-way stop control, this intersection experienced an average of about two accidents per year.

The critical sight distance at this intersection is at the Brown Street eastbound stop line looking towards the south. This sight distance is limited by bushes in the southwest corner of the intersection, and was measured to be 140 feet.

Due to the limited sight distance at this location, multi-way stop control is warranted.

Location 17 - Curtis St/Sharon St

The intersection volumes during the peak hours (counted on 10/11/12) are as follows:

	Curtis St (both approaches)	Sharon St (EB approach)
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7am – 8am	199	138
8am – 9am	364	165
4pm – 5pm	304	161
5pm – 6pm	367	250

Prior to installation of the multi-way stop control, this intersection was averaging about four accidents per year. Since installation of multi-way stop control, this intersection has averaged less than one accident per year.

The combination of traffic volumes and accident history at this location meets Criterion D from the MUTCD requirements. Therefore, the multi-way stop control is warranted.

Location 18 - Hammond St/Plympton St

The intersection volumes during the peak hours (counted on 11/17/11) are as follows:

	Hammond St (both approaches)	Plympton St (both approaches)
7am – 8am	52	66
8am – 9am	85	94
4pm – 5pm	79	126
5pm – 6pm	83	131

The critical sight distance at this intersection is at the westbound Plympton Street stop line, looking towards both the north and the south. Towards the north, sight distance is limited by a tree, and was measured to be only 86 feet. Towards the south, sight distance is limited by a fence, and was measured to be only 73 feet.

Due to the limited sight distance at this intersection, multi-way stop control is warranted.

Summary of Recommendations

The following table summarizes the recommendations of Traffic Engineering at all 18 multi-way stop controlled intersections in the City:

<u>Location</u>	<u>Recommendation</u>
1. Gore St/Grove St/Seyon St	Maintain multi-way stop control
2. Church St/Summer St	Maintain multi-way stop control
3. Bright St/Grove St	Maintain multi-way stop control
4. Fairfax Rd/Longfellow Rd	Requires additional study
5. Harvard St/Russell St	Maintain multi-way stop control
6. Bedford St/Boynton St	Maintain multi-way stop control
7. Hardy St/Parkers Ln/School Ave	Remove STOP on NB School Ave
8. Abbott Rd/Warwick Ave	Requires additional study
9. Church St/School St	Maintain multi-way stop control
10. Berkshire Rd/Brown St/Parmenter Rd	Maintain multi-way stop control
11. Cabot St/Winthrop St	Maintain multi-way stop control
12. Beal Rd/Candace Ave	Maintain multi-way stop control
13. Candace Ave/Mayall Rd	Maintain multi-way stop control
14. Riverview Ave/Rumford Ave/Woerd Ave	Maintain multi-way stop control
15. Beal Rd/Chaffee Ave	Maintain multi-way stop control
16. Adams St/Brown St	Maintain multi-way stop control
17. Curtis St/Sharon St	Maintain multi-way stop control
18. Hammond St/Plympton St	Maintain multi-way stop control