

# MEMORANDUM

**TO:** Mr. John C. Dawley  
Northland Residential Corporation  
80 Beharrell Street, Suite E  
Concord, MA 01742

**FROM:** Scott W. Thornton, P.E. *and*  
Jennifer Conners  
Vanasse & Associates, Inc.  
35 New England Business Center Drive  
Suite 140  
Andover, MA 01810  
(978) 474-8800

**DATE:** April 16, 2021

**RE:** 8058

**SUBJECT:** Traffic Signal Warrants Analysis  
McLean Hospital Residential Development - Olmsted Drive  
Waltham, Massachusetts

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Vanasse & Associates, Inc. (VAI) has performed a detailed Traffic Signal Warrants Analysis (TSWA) for the intersection of Olmsted Drive at Pleasant Street in Belmont, Massachusetts, as part of the Mclean Hospital Zone 3 Residential Development to assess the warrants required to justify the installation of a traffic control signal at the subject intersection. This analysis was completed in accordance with the methodology and procedures outlined in the *Manual on Uniform Traffic Control Devices* (MUTCD)<sup>1</sup> and based on traffic counts and field measurements conducted in November 2020.

The traffic Signal Warrant Analysis (TSWA) has been conducted for the intersection of Pleasant Street at Olmsted Drive as required in the Traffic Monitoring and Mitigation Agreement (TMMA). The TMMA states that a traffic signal should be evaluated at this intersection along with traffic projections of the future McLean Zone 3 (Senior Housing subdistrict) and Zone 4 (Research & Development subdistrict). In order to project the impacts of the future development within the McLean Zones 3 and 4 District, the maximum level of permitted traffic for this District were reviewed, as stipulated in the TMMA. The TSWA is summarized below and provided in the Appendix.

## **EXISTING CONDITIONS**

### **Geometry**

***Olmsted Drive at Pleasant Street*** - Olmsted Drive intersects Pleasant Street from the north to form a three-way intersection that operates under STOP-sign control. The Pleasant Street eastbound approach provides an approximate 10-foot wide exclusive left-turn lane and an approximate 11-foot wide through/right-turn lane with an approximate 4-foot wide marked shoulder provided. The Pleasant Street westbound approach provides one approximate 11-foot wide general-purpose travel lane with an approximate 4-foot wide marked shoulder provided. The Olmsted Drive southbound approach provides an approximate 20-foot wide general-purpose travel lane. A sidewalk is provided along the eastern side of Pleasant Street at this location. Crosswalks are not provided for this intersection as there is no sidewalk along the north side of Pleasant Street or on Olmstead Drive. Land use in the vicinity of this intersection consists primarily of commercial uses and open space.

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<sup>1</sup>*Manual on Uniform Traffic Control Devices* (MUTCD); Federal Highway Administration; Washington, DC; 2009.



## **EXISTING TRAFFIC VOLUMES**

In order to perform an analysis a 12-hour TMC was conducted at Pleasant Street at Olmsted Drive in November 2020. In order to account for the reduction in traffic volumes caused by COVID-19 travel restrictions, historic traffic count data conducted in April 2018 and November 2019 in the same study area was reviewed. It is important to note that the 2018 data were obtained from the earlier town wide traffic study conducted by the Town of Belmont. Based upon this comparison, the November 2020 weekday morning and evening peak-hour volumes were found to be approximately 40 percent lower. The traffic counts that form the basis of this assessment were adjusted upward by 40 percent in order to provide an appropriate and conservative estimate of roadway operating conditions. It is important to note that in order to establish a 2021 Baseline condition, the November 2020 existing traffic volumes were grown by 1.0 percent per year.

## **FUTURE TRAFFIC VOLUMES**

### **General Background Traffic Growth**

Traffic-volume data compiled by MassDOT from permanent count stations and historic traffic counts in the area were reviewed in order to determine general background traffic growth trends. Based on a review of this data, it was determined that traffic volumes within the study area have fluctuated over the past several years. In order to be consistent with previous traffic studies in the area, a 1.0 percent per year compounded annual growth rate was used to account for general background traffic growth for weekday morning and evening peak hour.

### **No-Build Traffic Volumes**

The 2028 No-Build traffic-volume networks were developed by applying the 1 percent per year compounded annual background traffic growth rate to the 2021 baseline condition peak-hour traffic volumes plus the trips from identified background developments (1010 Pleasant Street - Proposed Marijuana Facility).

### **Project-Generated Traffic – Zone 3**

The development proposal entails construction of 40 for sale, age-restricted townhouse condominiums and 110 multi-family residences comprised of 53 age-restricted units and 57 non-age restricted units. In order to estimate the trip-generation characteristics of the proposed development, the Institute of Transportation Engineers (ITE) *Trip Generation* manual<sup>2</sup> for ITE Land Use Code (LUC) 221, *Multifamily Housing (Mid-Rise)* and LUC 252 *Senior Adult Housing* were used to project traffic volume of the Project. Adjustments were applied to account for transit usage.

The proposed 150 housing units are expected to generate approximately 610 vehicle trips on an average weekday (two-way, 24-hour volume), with 36 vehicle trips (11 vehicles entering and 25 exiting) expected during the weekday morning peak hour and 46 vehicle trips (26 vehicles entering and 20 exiting) expected during the weekday evening peak hour.

### **Build Traffic Volumes – Zone 3**

The proposed development trips were then added to develop volumes for the 2028 No-Build conditions in order to obtain the 2028 Build traffic signal warrant analysis.

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<sup>2</sup>*Trip Generation*, 10<sup>th</sup> Edition; Institute of Transportation Engineers; Washington, DC; 2017.



## **Build Traffic Volumes– Zone 4**

An additional condition was analyzed to include trips associated with the Zone 4 subdistrict. Based on the TMMA, Zone 4 entails construction of a research and development building and is expected to generate approximately 1,784 vehicle trips on an average weekday, with 206 vehicle trips expected during the weekday morning peak hour and 180 vehicle trips expected during the weekday evening peak hour. These Zone 4 trips were combined with the Zone 3 trips to obtain the 2028 Build with Zone 3 and Zone 4 volume scenario for the analysis.

## **TRAFFIC SIGNAL WARRANTS ANALYSIS**

The MUTCD<sup>3</sup> establishes nine (9) warrants or criteria to evaluate a location for the installation or retention of a traffic signal. At least one of the nine warrants should be satisfied in order to justify the installation of a traffic signal; however, satisfaction of a warrant in and of itself does not justify traffic signal control. An engineering evaluation of the location in question should indicate that the establishment of traffic signal control will improve the overall safety and/or operation of the intersection. Table 1 identifies the nine traffic signal warrants. Table 2 identifies the results of the TSWA for the study intersection under existing and Future conditions.

**Table 1**  
**TRAFFIC SIGNAL WARRANTS<sup>a</sup>**

Warrant No.	Description
1	Eight-Hour Vehicular Volume Condition A – Min. Vehicular Volume <sup>b</sup> Condition B – Interruption of Continuous Traffic <sup>c</sup>
2	Four-Hour Vehicular Volume
3	Peak Hour
4	Pedestrian Volume
5	School Crossing
6	Coordinated Signal System
7	Crash Experience
8	Roadway Network
9	Intersection near a Grade Crossing

<sup>a</sup>MUTCD; Federal Highway Administration; Washington, DC; 2009.

<sup>b</sup>A large number of intersecting traffic is the principal reason to consider installing a traffic control signal.

<sup>c</sup>Traffic volume on a major street is so heavy that traffic on a minor intersecting street suffer excessive delay in entering or crossing the major street.

<sup>3</sup>*Manual on Uniform Traffic Control Devices (MUTCD)*; Federal Highway Administration; Washington, DC; 2009.



**Table 2**  
**TRAFFIC SIGNAL WARRANTS ANALYSIS RESULTS**

Warrant No.	Description	Satisfied for 2021 Existing Conditions	Satisfied for 2028 No-Build Conditions	Satisfied for 2028 Build Conditions w/Zone 3	Satisfied for 2028 Build Conditions w/Zones 3 and 4
1	Eight-Hour Vehicular Volume				
	Condition A – Min. Vehicular Volume	No	No	No	No
	Condition B – Interruption of Continuous Traffic	No	No	No	No
2	Four-Hour Vehicular Volume	No	No	No	No
3	Peak Hour	No	No	No	No
4	Pedestrian Volume	No	No	No	No
5	School Crossing	No	No	No	No
6	Coordinated Signal System	No	No	No	No
7	Crash Experience	No	No	No	No
8	Roadway Network	No	No	No	No
9	Grade Crossing	No	No	No	No

As indicated in Table 2, under all conditions analyzed the intersection of Pleasant Street at Olmsted Drive does not meet any of the 9 warrant criteria. Accordingly, the installation of a traffic signal at this intersection is not recommended. The detailed TSWA worksheets are provided in the Appendix.

Of note, a review of motor vehicle crash data available from the Massachusetts Department of Transportation (MassDOT) for the subject intersection indicates that only one (1) motor vehicle crash was reported to have occurred at the subject intersection between 2013 and 2017 (the most recent 5-year period for which data is available).

**CONCLUSION**

VAI has completed a detailed Traffic Signal Warrants Analysis for the intersection of Pleasant Street at Olmsted Drive in Belmont, Massachusetts, as part of the Mclean Hospital Zone 3 Residential Development to assess the warrants required to justify the installation of a traffic control signal at the subject intersection. This analysis was performed in accordance with the criteria established in the MUTCD for conducting such analyses and has determined that the installation of a traffic control signal at the intersection is not warranted under any of the traffic volume conditions. In the event that the warrant criteria is not met and given the low incidence of motor vehicle crashes occurring at the intersection during the five-year review period, the MUTCD and MassDOT guidelines clearly note that a traffic signal shall not be installed.



## APPENDIX

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AUTOMATIC TRAFFIC RECORDER

SEASONAL ADJUSTMENTS

MOTOR VEHICLE CRASH DATA

GENERAL BACKGROUND TRAFFIC GROWTH

TRAFFIC SIGNAL WARRANT ANALYSIS (TSWA)

AUTOMATIC TRAFFIC RECORDER

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**Accurate Counts**  
978-664-2565

Location : Pleasant Street  
Location : East of Olmsted Drive  
City/State: Belmont, MA

8058VL01

Start Time	11/10/2022 Tue	EB		Hour Totals		WB		Hour Totals		Combined Totals	
		Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
12:00		5	69			1	64				
12:15		4	66			4	88				
12:30		1	52			2	76				
12:45		3	72	13	259	1	64	8	292	21	551
01:00		2	66			1	74				
01:15		2	90			4	61				
01:30		1	83			1	66				
01:45		1	77	6	316	1	70	7	271	13	587
02:00		4	67			0	72				
02:15		1	72			0	75				
02:30		2	78			1	99				
02:45		2	80	9	297	2	103	3	349	12	646
03:00		1	88			2	95				
03:15		2	88			3	75				
03:30		0	91			0	99				
03:45		4	94	7	361	4	97	9	366	16	727
04:00		2	113			1	90				
04:15		7	77			2	81				
04:30		3	113			5	97				
04:45		3	88	15	391	15	116	23	384	38	775
05:00		6	95			8	99				
05:15		5	92			9	106				
05:30		13	73			19	88				
05:45		22	77	46	337	26	65	62	358	108	695
06:00		17	76			41	66				
06:15		35	54			41	73				
06:30		54	56			57	56				
06:45		58	47	164	233	70	58	209	253	373	486
07:00		53	75			76	45				
07:15		62	49			71	37				
07:30		93	43			85	36				
07:45		81	35	289	202	84	52	316	170	605	372
08:00		79	45			86	31				
08:15		68	33			100	29				
08:30		72	25			72	30				
08:45		57	30	276	133	86	23	344	113	620	246
09:00		59	25			91	23				
09:15		54	33			62	22				
09:30		58	24			63	17				
09:45		62	18	233	100	74	22	290	84	523	184
10:00		57	21			69	16				
10:15		65	12			49	20				
10:30		61	18			68	17				
10:45		57	8	240	59	72	16	258	69	498	128
11:00		67	13			61	9				
11:15		65	13			57	11				
11:30		56	15			64	8				
11:45		70	5	258	46	68	4	250	32	508	78
Total		1556	2734			1779	2741			3335	5475
Percent		36.3%	63.7%			39.4%	60.6%			37.9%	62.1%



Accurate Counts  
978-664-2565

Location : Pleasant Street  
Location : East of Olmsted Drive  
City/State: Belmont, MA

8058VL01

Start Time	11/9/2020		Tue		Wed		Thu		Fri		Sat		Sun		Week Average	
	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
12:00 AM	*	*	13	8	6	15	*	*	*	*	*	*	*	*	10	12
01:00	*	*	6	7	5	10	*	*	*	*	*	*	*	*	6	8
02:00	*	*	9	3	9	9	*	*	*	*	*	*	*	*	9	6
03:00	*	*	7	9	3	5	*	*	*	*	*	*	*	*	5	7
04:00	*	*	15	23	8	18	*	*	*	*	*	*	*	*	12	20
05:00	*	*	46	62	30	51	*	*	*	*	*	*	*	*	38	56
06:00	*	*	164	209	132	162	*	*	*	*	*	*	*	*	148	186
07:00	*	*	289	316	223	234	*	*	*	*	*	*	*	*	256	275
08:00	*	*	276	344	214	282	*	*	*	*	*	*	*	*	245	313
09:00	*	*	233	290	207	277	*	*	*	*	*	*	*	*	220	284
10:00	*	*	240	258	283	289	*	*	*	*	*	*	*	*	262	274
11:00	*	*	258	250	289	304	*	*	*	*	*	*	*	*	274	277
12:00 PM	*	*	259	292	320	325	*	*	*	*	*	*	*	*	290	308
01:00	*	*	316	271	289	322	*	*	*	*	*	*	*	*	302	296
02:00	*	*	297	349	322	350	*	*	*	*	*	*	*	*	310	350
03:00	*	*	361	366	354	392	*	*	*	*	*	*	*	*	358	379
04:00	*	*	391	384	369	336	*	*	*	*	*	*	*	*	380	360
05:00	*	*	337	358	319	298	*	*	*	*	*	*	*	*	328	328
06:00	*	*	233	253	214	243	*	*	*	*	*	*	*	*	224	248
07:00	*	*	202	170	152	134	*	*	*	*	*	*	*	*	177	152
08:00	*	*	133	113	124	109	*	*	*	*	*	*	*	*	128	111
09:00	*	*	100	84	91	82	*	*	*	*	*	*	*	*	96	83
10:00	*	*	59	69	58	69	*	*	*	*	*	*	*	*	58	69
11:00	*	*	46	32	45	28	*	*	*	*	*	*	*	*	46	30
Lane Day	0	0	4290	4520	4066	4344	0	0	0	0	0	0	0	0	4182	4432
AM Peak	-	-	07:00	08:00	11:00	11:00	-	-	-	-	-	-	-	-	11:00	08:00
Vol.	-	-	289	344	289	304	-	-	-	-	-	-	-	-	274	313
PM Peak	-	-	16:00	16:00	16:00	15:00	-	-	-	-	-	-	-	-	16:00	15:00
Vol.	-	-	391	384	369	392	-	-	-	-	-	-	-	-	380	379

Comb. Total            0                    8810                    8410                    0                    0                    0                    0                    8614

ADT                    ADT 8,610                    AADT 8,610

**Accurate Counts**  
978-664-2565

Location : Pleasant Street  
Location : East of Olmsted Drive  
City/State: Belmont, MA

8058SP01

**EB**

Start Time	15	20	25	30	35	40	45	50	55	60	65	70	75	999	Total
11/10/20	0	0	0	4	5	4	0	0	0	0	0	0	0	0	13
01:00	0	0	0	0	5	1	0	0	0	0	0	0	0	0	6
02:00	0	0	0	3	4	2	0	0	0	0	0	0	0	0	9
03:00	0	0	1	2	0	4	0	0	0	0	0	0	0	0	7
04:00	0	0	1	4	8	0	2	0	0	0	0	0	0	0	15
05:00	0	0	1	19	18	8	0	0	0	0	0	0	0	0	46
06:00	0	2	12	40	85	24	1	0	0	0	0	0	0	0	164
07:00	0	2	17	67	144	56	2	1	0	0	0	0	0	0	289
08:00	0	0	16	83	122	49	6	0	0	0	0	0	0	0	276
09:00	0	2	10	69	112	39	1	0	0	0	0	0	0	0	233
10:00	0	2	17	83	117	16	5	0	0	0	0	0	0	0	240
11:00	0	1	20	100	109	28	0	0	0	0	0	0	0	0	258
12 PM	0	1	18	103	111	25	1	0	0	0	0	0	0	0	259
13:00	0	0	16	115	148	36	1	0	0	0	0	0	0	0	316
14:00	0	0	21	84	148	40	4	0	0	0	0	0	0	0	297
15:00	1	0	24	111	183	40	2	0	0	0	0	0	0	0	361
16:00	1	3	33	153	164	34	3	0	0	0	0	0	0	0	391
17:00	0	0	38	143	130	26	0	0	0	0	0	0	0	0	337
18:00	0	0	16	113	84	19	1	0	0	0	0	0	0	0	233
19:00	0	1	13	92	84	11	1	0	0	0	0	0	0	0	202
20:00	0	3	11	50	57	8	4	0	0	0	0	0	0	0	133
21:00	0	0	1	40	43	13	3	0	0	0	0	0	0	0	100
22:00	0	0	3	17	24	13	1	0	1	0	0	0	0	0	59
23:00	0	0	2	16	17	8	3	0	0	0	0	0	0	0	46
Total	2	17	291	1511	1922	504	41	1	1	0	0	0	0	0	4290

Daily

15th Percentile : 26 MPH  
50th Percentile : 30 MPH  
85th Percentile : 34 MPH  
95th Percentile : 38 MPH

Mean Speed(Average) : 31 MPH  
10 MPH Pace Speed : 26-35 MPH  
Number in Pace : 3433  
Percent in Pace : 80.0%  
Number of Vehicles > 30 MPH : 2469  
Percent of Vehicles > 30 MPH : 57.6%

Accurate Counts  
978-664-2565

Location : Pleasant Street  
Location : East of Olmsted Drive  
City/State: Belmont, MA

8058SP01

EB

Start Time	15	20	25	30	35	40	45	50	55	60	65	70	75	999	Total
11/11/20	0	0	0	3	2	1	0	0	0	0	0	0	0	0	6
01:00	0	0	0	2	2	1	0	0	0	0	0	0	0	0	5
02:00	0	0	2	3	3	1	0	0	0	0	0	0	0	0	9
03:00	0	0	1	0	1	1	0	0	0	0	0	0	0	0	3
04:00	0	0	0	2	5	1	0	0	0	0	0	0	0	0	8
05:00	0	0	5	9	11	3	2	0	0	0	0	0	0	0	30
06:00	0	3	7	35	60	24	3	0	0	0	0	0	0	0	132
07:00	0	1	13	62	108	35	3	1	0	0	0	0	0	0	223
08:00	0	0	12	62	102	31	5	2	0	0	0	0	0	0	214
09:00	0	0	9	59	111	24	4	0	0	0	0	0	0	0	207
10:00	1	2	15	76	143	44	2	0	0	0	0	0	0	0	283
11:00	0	1	12	119	115	36	6	0	0	0	0	0	0	0	289
12 PM	1	4	17	109	138	46	4	1	0	0	0	0	0	0	320
13:00	0	1	9	91	153	33	2	0	0	0	0	0	0	0	289
14:00	0	3	30	113	138	36	2	0	0	0	0	0	0	0	322
15:00	0	1	41	133	133	42	4	0	0	0	0	0	0	0	354
16:00	0	5	38	122	167	34	3	0	0	0	0	0	0	0	369
17:00	0	0	30	122	135	32	0	0	0	0	0	0	0	0	319
18:00	0	1	18	81	96	17	0	1	0	0	0	0	0	0	214
19:00	0	1	6	48	79	18	0	0	0	0	0	0	0	0	152
20:00	0	0	3	47	64	10	0	0	0	0	0	0	0	0	124
21:00	0	1	2	12	61	13	2	0	0	0	0	0	0	0	91
22:00	0	1	1	23	25	8	0	0	0	0	0	0	0	0	58
23:00	0	1	3	15	17	9	0	0	0	0	0	0	0	0	45
Total	2	26	274	1348	1869	500	42	5	0	0	0	0	0	0	4066

Daily  
 15th Percentile : 26 MPH  
 50th Percentile : 31 MPH  
 85th Percentile : 34 MPH  
 95th Percentile : 38 MPH  
 Mean Speed(Average) : 31 MPH  
 10 MPH Pace Speed : 26-35 MPH  
 Number in Pace : 3217  
 Percent in Pace : 79.1%  
 Number of Vehicles > 30 MPH : 2416  
 Percent of Vehicles > 30 MPH : 59.4%

Grand Total	4	43	565	2859	3791	1004	83	6	1	0	0	0	0	0	8356
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Overall  
 15th Percentile : 26 MPH  
 50th Percentile : 30 MPH  
 85th Percentile : 34 MPH  
 95th Percentile : 38 MPH  
 Mean Speed(Average) : 31 MPH  
 10 MPH Pace Speed : 26-35 MPH  
 Number in Pace : 6650  
 Percent in Pace : 79.6%  
 Number of Vehicles > 30 MPH : 4885  
 Percent of Vehicles > 30 MPH : 58.5%

**Accurate Counts**  
978-664-2565

Location : Pleasant Street  
Location : East of Olmsted Drive  
City/State: Belmont, MA

8058SP01

WB	Start Time	15	20	25	30	35	40	45	50	55	60	65	70	75	999	Total
	11/10/20	0	0	0	3	3	0	2	0	0	0	0	0	0	0	8
	01:00	0	0	0	0	4	2	1	0	0	0	0	0	0	0	7
	02:00	0	0	0	0	2	1	0	0	0	0	0	0	0	0	3
	03:00	0	2	1	2	2	2	0	0	0	0	0	0	0	0	9
	04:00	0	1	3	4	8	6	1	0	0	0	0	0	0	0	23
	05:00	0	0	2	11	27	20	1	1	0	0	0	0	0	0	62
	06:00	3	3	29	68	85	19	1	1	0	0	0	0	0	0	209
	07:00	1	2	30	100	130	45	6	0	1	0	0	0	0	1	316
	08:00	2	1	34	95	147	62	1	0	0	0	0	0	0	2	344
	09:00	2	0	15	79	124	65	4	0	0	0	0	0	1	0	290
	10:00	2	4	26	70	113	36	5	1	0	0	0	0	0	1	258
	11:00	1	2	25	73	111	34	4	0	0	0	0	0	0	0	250
	12 PM	3	1	28	85	122	50	2	0	0	0	0	0	0	1	292
	13:00	1	7	21	84	120	31	7	0	0	0	0	0	0	0	271
	14:00	1	2	26	106	159	49	4	1	1	0	0	0	0	0	349
	15:00	1	2	40	110	154	54	5	0	0	0	0	0	0	0	366
	16:00	1	4	62	138	139	31	7	2	0	0	0	0	0	0	384
	17:00	0	4	40	172	115	26	1	0	0	0	0	0	0	0	358
	18:00	1	3	30	113	87	16	2	1	0	0	0	0	0	0	253
	19:00	0	1	22	71	58	17	1	0	0	0	0	0	0	0	170
	20:00	1	3	21	40	34	12	2	0	0	0	0	0	0	0	113
	21:00	1	0	9	30	33	10	1	0	0	0	0	0	0	0	84
	22:00	0	0	4	30	27	7	0	0	1	0	0	0	0	0	69
	23:00	0	0	0	12	12	4	4	0	0	0	0	0	0	0	32
	<b>Total</b>	<b>21</b>	<b>42</b>	<b>468</b>	<b>1496</b>	<b>1816</b>	<b>599</b>	<b>62</b>	<b>7</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>5</b>	<b>4520</b>

Daily

15th Percentile : 25 MPH  
 50th Percentile : 30 MPH  
 85th Percentile : 34 MPH  
 95th Percentile : 38 MPH

Mean Speed(Average) : 31 MPH  
 10 MPH Pace Speed : 26-35 MPH  
 Number in Pace : 3312  
 Percent in Pace : 73.3%  
 Number of Vehicles > 30 MPH : 2493  
 Percent of Vehicles > 30 MPH : 55.2%

Accurate Counts  
978-664-2565

Location : Pleasant Street  
Location : East of Olmsted Drive  
City/State: Belmont, MA

8058SP01

WB

Start Time	15	20	25	30	35	40	45	50	55	60	65	70	75	999	Total
11/11/20	0	1	1	3	9	1	0	0	0	0	0	0	0	0	15
01:00	0	0	3	0	3	3	1	0	0	0	0	0	0	0	10
02:00	0	0	0	4	3	2	0	0	0	0	0	0	0	0	9
03:00	0	1	1	2	0	1	0	0	0	0	0	0	0	0	5
04:00	0	0	0	2	8	8	0	0	0	0	0	0	0	0	18
05:00	1	0	2	16	19	9	1	0	1	0	0	0	0	2	51
06:00	0	3	19	46	62	26	5	0	0	0	0	0	0	1	162
07:00	4	2	30	70	86	32	8	0	0	0	0	0	0	2	234
08:00	4	0	14	99	128	34	1	1	0	0	0	0	0	1	282
09:00	0	1	12	84	127	48	5	0	0	0	0	0	0	0	277
10:00	3	2	23	104	123	33	1	0	0	0	0	0	0	0	289
11:00	3	5	26	92	133	39	5	0	1	0	0	0	0	0	304
12 PM	2	1	27	97	140	54	4	0	0	0	0	0	0	0	325
13:00	3	3	27	107	142	36	4	0	0	0	0	0	0	0	322
14:00	3	9	43	134	129	28	3	1	0	0	0	0	0	0	350
15:00	1	3	43	152	145	45	2	1	0	0	0	0	0	0	392
16:00	3	2	46	155	106	23	1	0	0	0	0	0	0	0	336
17:00	0	3	42	139	89	24	1	0	0	0	0	0	0	0	298
18:00	0	1	31	88	107	13	3	0	0	0	0	0	0	0	243
19:00	1	4	23	42	52	10	2	0	0	0	0	0	0	0	134
20:00	2	4	6	47	38	12	0	0	0	0	0	0	0	0	109
21:00	0	1	8	30	31	10	2	0	0	0	0	0	0	0	82
22:00	0	2	4	36	22	4	1	0	0	0	0	0	0	0	69
23:00	0	0	3	10	12	3	0	0	0	0	0	0	0	0	28
Total	30	48	434	1559	1714	498	50	3	2	0	0	0	0	6	4344

Daily  
 15th Percentile : 25 MPH  
 50th Percentile : 30 MPH  
 85th Percentile : 34 MPH  
 95th Percentile : 38 MPH  
  
 Mean Speed(Average) : 31 MPH  
 10 MPH Pace Speed : 26-35 MPH  
 Number in Pace : 3273  
 Percent in Pace : 75.3%  
 Number of Vehicles > 30 MPH : 2273  
 Percent of Vehicles > 30 MPH : 52.3%

Grand Total	51	90	902	3055	3530	1097	112	10	5	0	0	0	1	11	8864
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Overall  
 15th Percentile : 25 MPH  
 50th Percentile : 30 MPH  
 85th Percentile : 34 MPH  
 95th Percentile : 38 MPH  
  
 Mean Speed(Average) : 31 MPH  
 10 MPH Pace Speed : 26-35 MPH  
 Number in Pace : 6585  
 Percent in Pace : 74.3%  
 Number of Vehicles > 30 MPH : 4766  
 Percent of Vehicles > 30 MPH : 53.8%

Location : Pleasant Street  
Location : East of Olmsted Drive  
City/State: Belmont, MA

8058SP01

EB, WB

Start Time	15	20	25	30	35	40	45	50	55	60	65	70	75	999	Total
11/10/20	0	0	0	7	8	4	2	0	0	0	0	0	0	0	21
01:00	0	0	0	0	9	3	1	0	0	0	0	0	0	0	13
02:00	0	0	0	3	6	3	0	0	0	0	0	0	0	0	12
03:00	0	2	2	4	2	6	0	0	0	0	0	0	0	0	16
04:00	0	1	4	8	16	6	3	0	0	0	0	0	0	0	38
05:00	0	0	3	30	45	28	1	1	0	0	0	0	0	0	108
06:00	3	5	41	108	170	43	2	1	0	0	0	0	0	0	373
07:00	1	4	47	167	274	101	8	1	1	0	0	0	0	1	605
08:00	2	1	50	178	269	111	7	0	0	0	0	0	0	2	620
09:00	2	2	25	148	236	104	5	0	0	0	0	0	1	0	523
10:00	2	6	43	153	230	52	10	1	0	0	0	0	0	1	498
11:00	1	3	45	173	220	62	4	0	0	0	0	0	0	0	508
12 PM	3	2	46	188	233	75	3	0	0	0	0	0	0	1	551
13:00	1	7	37	199	268	67	8	0	0	0	0	0	0	0	587
14:00	1	2	47	190	307	89	8	1	1	0	0	0	0	0	646
15:00	2	2	64	221	337	94	7	0	0	0	0	0	0	0	727
16:00	2	7	95	291	303	65	10	2	0	0	0	0	0	0	775
17:00	0	4	78	315	245	52	1	0	0	0	0	0	0	0	695
18:00	1	3	46	226	171	35	3	1	0	0	0	0	0	0	486
19:00	0	2	35	163	142	28	2	0	0	0	0	0	0	0	372
20:00	1	6	32	90	91	20	6	0	0	0	0	0	0	0	246
21:00	1	0	10	70	76	23	4	0	0	0	0	0	0	0	184
22:00	0	0	7	47	51	20	1	0	2	0	0	0	0	0	128
23:00	0	0	2	28	29	12	7	0	0	0	0	0	0	0	78
Total	23	59	759	3007	3738	1103	103	8	4	0	0	0	1	5	8810

Daily  
 15th Percentile : 25 MPH  
 50th Percentile : 30 MPH  
 85th Percentile : 34 MPH  
 95th Percentile : 38 MPH  
  
 Mean Speed(Average) : 31 MPH  
 10 MPH Pace Speed : 26-35 MPH  
 Number in Pace : 6745  
 Percent in Pace : 76.6%  
 Number of Vehicles > 30 MPH : 4962  
 Percent of Vehicles > 30 MPH : 56.3%

Location : Pleasant Street  
Location : East of Olmsted Drive  
City/State: Belmont, MA

8058SP01

EB, WB

Start Time	15	20	25	30	35	40	45	50	55	60	65	70	75	999	Total
11/11/20	0	1	1	6	11	2	0	0	0	0	0	0	0	0	21
01:00	0	0	3	2	5	4	1	0	0	0	0	0	0	0	15
02:00	0	0	2	7	6	3	0	0	0	0	0	0	0	0	18
03:00	0	1	2	2	1	2	0	0	0	0	0	0	0	0	8
04:00	0	0	0	4	13	9	0	0	0	0	0	0	0	0	26
05:00	1	0	7	25	30	12	3	0	1	0	0	0	0	2	81
06:00	0	6	26	81	122	50	8	0	0	0	0	0	0	1	294
07:00	4	3	43	132	194	67	11	1	0	0	0	0	0	2	457
08:00	4	0	26	161	230	65	6	3	0	0	0	0	0	1	496
09:00	0	1	21	143	238	72	9	0	0	0	0	0	0	0	484
10:00	4	4	38	180	266	77	3	0	0	0	0	0	0	0	572
11:00	3	6	38	211	248	75	11	0	1	0	0	0	0	0	593
12 PM	3	5	44	206	278	100	8	1	0	0	0	0	0	0	645
13:00	3	4	36	198	295	69	6	0	0	0	0	0	0	0	611
14:00	3	12	73	247	267	64	5	1	0	0	0	0	0	0	672
15:00	1	4	84	285	278	87	6	1	0	0	0	0	0	0	746
16:00	3	7	84	277	273	57	4	0	0	0	0	0	0	0	705
17:00	0	3	72	261	224	56	1	0	0	0	0	0	0	0	617
18:00	0	2	49	169	203	30	3	1	0	0	0	0	0	0	457
19:00	1	5	29	90	131	28	2	0	0	0	0	0	0	0	286
20:00	2	4	9	94	102	22	0	0	0	0	0	0	0	0	233
21:00	0	2	10	42	92	23	4	0	0	0	0	0	0	0	173
22:00	0	3	5	59	47	12	1	0	0	0	0	0	0	0	127
23:00	0	1	6	25	29	12	0	0	0	0	0	0	0	0	73
Total	32	74	708	2907	3583	998	92	8	2	0	0	0	0	6	8410

Daily  
 15th Percentile : 25 MPH  
 50th Percentile : 30 MPH  
 85th Percentile : 34 MPH  
 95th Percentile : 38 MPH  
  
 Mean Speed(Average) : 31 MPH  
 10 MPH Pace Speed : 26-35 MPH  
 Number in Pace : 6490  
 Percent in Pace : 77.2%  
 Number of Vehicles > 30 MPH : 4689  
 Percent of Vehicles > 30 MPH : 55.8%

Grand Total	55	133	1467	5914	7321	2101	195	16	6	0	0	0	1	11	17220
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Overall  
 15th Percentile : 25 MPH  
 50th Percentile : 30 MPH  
 85th Percentile : 34 MPH  
 95th Percentile : 38 MPH  
  
 Mean Speed(Average) : 31 MPH  
 10 MPH Pace Speed : 26-35 MPH  
 Number in Pace : 13235  
 Percent in Pace : 76.9%  
 Number of Vehicles > 30 MPH : 9651  
 Percent of Vehicles > 30 MPH : 56.0%

**TRAFFIC ADJUSTMENTS**

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Comment 1: N/S Street : Trapelo Road  
 Comment 2: E/W Street : Mill Street  
 Comment 3: City/State : Belmont, MA  
 Comment 4: Weather : Clear

Wednesday, April 11, 2018 6:00 AM

Tuesday, November 10 2020

Start Time	Mill St From North			Trapelo Rd From East			Trapelo Rd From West			Total	Peak	Start Time	Mill St From North			Trapelo Rd From East			Trapelo Rd From West			Total			
	Left	Right	Peds	Thru	Right	Peds	Left	Thru	Peds				Left	Right	Peds	Thru	Right	Peds	Left	Thru	Peds				
7:00:00 AM	30	124	0	108	76	0	149	34	0	521		7:00:00 AM	56	19	0	75	72	0	22	89	0	333			
7:15:00 AM	31	125	0	136	131	0	150	35	0	608		7:15:00 AM	93	24	0	70	77	0	30	103	0	397			
7:30:00 AM	43	105	0	131	141	0	170	29	0	619		7:30:00 AM	89	27	0	81	81	0	27	131	0	436			
7:45:00 AM	25	136	0	175	146	0	163	25	0	670	2418	7:45:00 AM	91	23	0	89	97	0	27	104	0	431	1597		
8:00:00 AM	50	150	0	162	147	0	150	34	0	693	2590	8:00:00 AM	89	22	0	105	103	0	18	114	0	451	1715		
8:15:00 AM	53	149	0	129	169	0	132	36	0	668	2650	8:15:00 AM	94	36	0	87	110	0	21	109	0	457	1775		
8:30:00 AM	69	142	0	152	150	0	138	19	0	670	2701	8:30:00 AM	91	26	0	91	113	0	15	102	0	438	1777		
8:45:00 AM	69	145	0	142	154	0	134	29	0	673	2704	8:45:00 AM	74	24	0	92	91	0	30	100	0	411	1757		
	370	1076	0	1135	1114	0	1186	241	0	5122	2704		677	201	0	690	744	0	190	852	0	3354	1777		
										Seasonal Adj 1 %	5173	2731										Comparison	1.57	1.57	
										2020 Adjusted 1% year	5277	2786										Say COVID Adj	1.57		
4:00:00 PM	52	169	0	121	166	0	123	47	0	678		4:00:00 PM	88	29	0	113	90	0	44	152	0	516			
4:15:00 PM	41	136	0	121	177	0	134	23	0	632		4:15:00 PM	109	39	0	123	92	0	24	113	0	500			
4:30:00 PM	37	148	0	93	177	0	166	35	0	656		4:30:00 PM	114	33	0	123	89	0	27	132	0	518			
4:45:00 PM	40	151	0	91	183	0	150	32	0	647	2613	4:45:00 PM	101	39	0	148	76	0	33	123	0	520	2054		
5:00:00 PM	55	128	0	91	170	0	156	36	0	636	2571	5:00:00 PM	95	21	0	143	70	0	22	132	0	483	2021		
5:15:00 PM	46	137	0	130	175	0	145	43	0	676	2615	5:15:00 PM	102	34	0	168	77	0	22	107	0	510	2031		
5:30:00 PM	33	140	0	100	190	0	163	35	0	661	2620	5:30:00 PM	85	20	0	97	71	0	26	99	0	398	1911		
5:45:00 PM	44	179	0	77	206	0	147	28	0	681	2654	5:45:00 PM	57	32	0	103	52	0	28	103	0	375	1766		
	348	1188	0	824	1444	0	1184	279	0	5267	2654		751	247	0	1018	617	0	226	961	0	3820	2054		
										Seasonal Adj 1 %	5320	2681										Comparison	1.42	1.33	
										2020 Adjusted 1% year	5427	2735										Say COVID Adj	1.40		
<b>TOTAL Peaks</b>											10704	5521	<b>TOTAL Peaks</b>											7174	3831
													Comparison											1.49	1.44
													Say COVID Adj											1.50	



**MOTOR VEHICLE CRASH DATA**

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Crash Number	City Town Name	Crash Date	Weekday	Crash Severity	Crash Time	Number of Vehicles	Age of Driver - Youngest Known	Driver Contributing Circumstances (All Drivers)	First Harmful Event	Light Conditions	Manner of Collision	Road Surface Condition	Vehicle Actions Prior to Crash (All Vehicles)	Vehicle Travel Directions (All Vehicles)	Weather Conditions	Latitude	Longitude	Street Number	Roadway	Near Intersection Roadway
<b>PLEASANT ST / OLMSTED DRIVE</b>																				
4380932	BELMONT	02/24/2017	Friday	Non-fatal injury	3:47 PM	1	35-44	D1: (Glare)	Collision with pedalcycle (bicycle, tricycle, unicycle, pedal car)	Dusk	Angle	Dry	V1: Turning left	V1: W	Clear	42.38902647	-71.19046006	PLEASANT STREET	OLMSTED DRIVE	

# MassHighway

## CRASH RATE WORKSHEET

CITY/TOWN : Belmont COUNT DATE : 2020

DISTRICT : 4 UNSIGNALIZED :  x  SIGNALIZED :

**MHD USE ONLY**

Source #

~ INTERSECTION DATA ~

MAJOR STREET : Pleasant Street

ST #

MINOR STREET(S) : Olmsted Drive

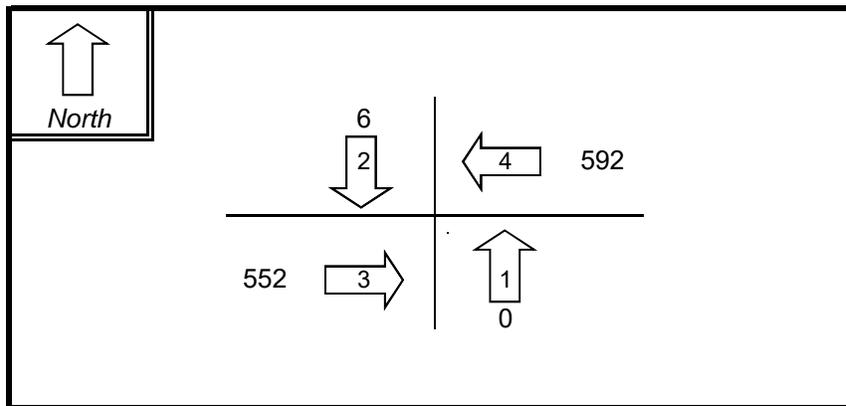
ST #

ST #

ST #

ST #

**INTERSECTION  
DIAGRAM**  
(Label Approaches)



INTERSECTION  
REF #

**Peak Hour Volumes**

APPROACH :	1	2	3	4	5	Total Entering Vehicles
DIRECTION :	NB	SB	EB	WB		
VOLUMES (PM) :	0	6	552	592		<b>1,150</b>

" K " FACTOR :  APPROACH ADT :  ADT = TOTAL VOL/"K" FACT.

TOTAL # OF ACCIDENTS :  # OF YEARS :  AVERAGE # OF ACCIDENTS ( A ) :

**CRASH RATE CALCULATION :**  RATE =  $\frac{(A * 1,000,000)}{(ADT * 365)}$

Comments : Accident Rate for District 6 signalized intersections = 0.73  
Accident Rate for District 6 unsignalized intersections = 0.57

Statewide Accident Rate for Signalized Inteserction = 0.78 and Unsignalized/Inteserction = 0.57

**GENERAL BACKGROUND TRAFFIC GROWTH**

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TRAFFIC SIGNAL WARRANT ANALYSIS (TSWA)

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Start Date: 6/13/2019  
 Start Time: 12:00:00 AM  
 Site Code: 82890001  
 Location : Boston Post Road  
 Location : West of Village Drive  
 City/State: Marlborough, MA

**2020 Raw**

Start Time	Olmsted Dr From North		Pleasant St From East		Pleasant St From West	
	Left	Right	Thru	Right	Left	Thru
7-8 AM	3	9	307	1	2	283
8-9 AM	2	2	344	2	2	272
9-10 AM	3	7	293	2	3	229
10-11 AM	3	10	252	6	6	241
11-12 PM	3	3	244	5	5	252
12-1 PM	3	8	291	2	3	256
1-2 PM	6	4	260	7	8	309
2-3 PM	2	5	355	0	5	294
3-4 PM	6	10	357	8	11	354
4-5 PM	2	5	391	1	6	387
5-6 PM	1	4	358	3	3	339
6-7 PM	7	7	243	5	9	232

**Covid Adj - 2020 Baseline Condition**

COVID adj 1.4

1% above no seasonal adjustment

Time	Olmsted Dr From North		Pleasant St From East		Pleasant St From West	
	Left	Right	Thru	Right	Left	Thru
7-8 AM	4	13	430	1	3	396
8-9 AM	3	3	482	3	3	381
9-10 AM	4	10	410	3	4	321
10-11 AM	4	14	353	8	8	337
11-12 PM	4	4	342	7	7	353
12-1 PM	4	11	407	3	4	358
1-2 PM	8	6	364	10	11	433
2-3 PM	3	7	497	0	7	412
3-4 PM	8	14	500	11	15	496
4-5 PM	3	7	547	1	8	542
5-6 PM	1	6	501	4	4	475
6-7 PM	10	10	340	7	13	325

**2021 Adjustment**

1 year 1.01

1 percent per year compounded annual background

Time	Olmsted Dr From North		Pleasant St From East		Pleasant St From West	
	Left	Right	Thru	Right	Left	Thru
7-8 AM	4	13	434	1	3	400
8-9 AM	3	3	487	3	3	385
9-10 AM	4	10	414	3	4	324
10-11 AM	4	14	357	8	8	340
11-12 PM	4	4	345	7	7	357
12-1 PM	4	11	411	3	4	362
1-2 PM	8	6	368	10	11	437
2-3 PM	3	7	502	0	7	416
3-4 PM	8	14	505	11	15	501
4-5 PM	3	7	552	1	8	547
5-6 PM	1	6	506	4	4	480
6-7 PM	10	10	343	7	13	328

### Hourly Distribution of Entering and Exiting Vehicle Trips by Land Use

Source: ITE Trip Generation Manual, 10th Edition

Land Use Code		882		Daily		303		303	
Land Use		Marijuana Dispensary		Daily		303		303	
Setting		General Urban/Suburban		Daily		303		303	
Time Period		Weekday		Daily		303		303	
Trip Type		Vehicle		Daily		303		303	
# Data Sites		4		303		303		303	
		% of 24-Hour Traffic		Entering		Exiting		Entering	
		Exiting		Entering		Exiting		Entering	
Time	Entering	Exiting							
12-1 AM	0	0	0.0	0.0	0	0	0	0	0
1-2 AM	0	0	0.0	0.0	0	0	0	0	0
2-3 AM	0	0	0.0	0.0	0	0	0	0	0
3-4 AM	0	0	0.0	0.0	0	0	0	0	0
4-5 AM	0	0	0.0	0.0	0	0	0	0	0
5-6 AM	0.1	0.1	0.3	0.3	0	0	0	0	0
6-7 AM	0.4	0.1	1.2	0.3	1	0	1	0	1
7-8 AM	1.4	0.2	4.2	0.6	4	1	12	11	11
8-9 AM	4.1	3.6	12.4	10.9	12	11	16	13	23
9-10 AM	5.3	4.3	16.1	13.0	16	13	25	23	24
10-11 AM	8.2	7.5	24.8	22.7	25	23	28	27	27
11-12 PM	8.1	7.9	24.5	23.9	25	24	25	24	24
12-1 PM	9.1	8.9	27.6	27.0	28	27	26	28	28
1-2 PM	8.3	8.0	25.1	24.2	25	24	30	29	29
2-3 PM	8.4	9.3	25.5	28.2	26	28	34	34	34
3-4 PM	9.9	9.6	30.0	29.1	30	29	38	38	38
4-5 PM	11.3	11.4	34.2	34.5	34	34	38	38	45
5-6 PM	12.4	12.4	37.6	37.6	38	38	38	38	45
6-7 PM	12.5	14.7	37.9	44.5	38	45	38	45	45
7-8 PM	0.2	1.6	0.6	4.8	1	5	0	1	1
8-9 PM	0.1	0.2	0.3	0.6	0	1	0	0	0
9-10 PM	0	0.1	0.0	0.3	0	0	0	0	0
10-11 PM	0	0	0.0	0.0	0	0	0	0	0
11-12 AM	0	0	0.0	0.0	0	0	0	0	0
					303	303			

Data obtained from the ITE General Urban/Suburban - Trips by time of day

Background Development						
Start Time	out			in		
	From North		From East	From West		
	Left	Right	Thru	Right	Left	Thru
%	0	0	0.65	0	0	0.65
7-8 AM	0	0	1	0	0	3
8-9 AM	0	0	7	0	0	8
9-10 AM	0	0	8	0	0	10
10-11 AM	0	0	15	0	0	16
11-12 PM	0	0	16	0	0	16
12-1 PM	0	0	18	0	0	18
1-2 PM	0	0	16	0	0	16
2-3 PM	0	0	18	0	0	17
3-4 PM	0	0	19	0	0	20
4-5 PM	0	0	22	0	0	22
5-6 PM	0	0	25	0	0	25
6-7 PM	0	0	29	0	0	25

2028 No- Build						
	7 year			1.01		
1 percent per year compounded annual background						
Start Time	Olmsted Dr		Pleasant St		Pleasant St	
	From North	From East	From East	From West	From West	
Start Time	Left	Right	Thru	Right	Left	Thru
7-8 AM	4	13	466	1	3	432
8-9 AM	3	3	529	3	3	421
9-10 AM	4	10	452	3	4	357
10-11 AM	4	14	398	8	8	381
11-12 PM	4	4	386	7	7	399
12-1 PM	4	11	459	3	4	406
1-2 PM	8	6	411	10	11	485
2-3 PM	3	7	556	0	7	463
3-4 PM	8	14	560	11	15	557
4-5 PM	3	7	614	1	8	608
5-6 PM	1	6	568	4	4	540
6-7 PM	10	10	397	7	13	377

### Hourly Distribution of Entering and Exiting Vehicle

Source: ITE *Trip Generation Manual*, 10th Edition

Land Use Code		221		Land Use Code		252									
Setting		Multifamily Housing (Mid-Rise)		Setting		Multifamily Housing - Attached									
Time Period		General Urban/Suburban		Time Period		Weekday		278		610					
Trip Type		Weekday		332		Trip Type		Vehicle		305		305			
# Data Sites		Vehicle		8		# Data Sites		1		Daily		Daily		Total	
		% of 24-Hour Traffic		166		166		% of 24-Hour Traffic		139		139			
Time	Entering	Exiting	Entering	Exiting	Entering	Exiting	Time	Entering	Exiting	Entering	Exiting	Entering	Exiting	Entering	Exiting
12-1 AM	0.7	0.3	1.2	0.5	1	0	12-1 AM	0.3	0.4	0.4	0.6	0	1	1	1
1-2 AM	0.3	0.2	0.5	0.3	0	0	1-2 AM	0.2	0.5	0.3	0.7	0	1	0	1
2-3 AM	0.2	0.2	0.3	0.3	0	0	2-3 AM	0	0.1	0.0	0.1	0	0	0	0
3-4 AM	0.4	0.3	0.7	0.5	1	0	3-4 AM	0.1	0.2	0.1	0.3	0	0	1	0
4-5 AM	0.3	0.8	0.5	1.3	0	1	4-5 AM	0.2	0.5	0.3	0.7	0	1	0	2
5-6 AM	0.6	2.7	1.0	4.5	1	4	5-6 AM	0.9	2.2	1.3	3.1	1	3	2	7
6-7 AM	1.5	6.5	2.5	10.8	2	11	6-7 AM	1.3	3.0	1.8	4.2	2	4	4	15
7-8 AM	2.8	12.1	4.6	20.1	5	20	7-8 AM	2.1	5.1	2.9	7.1	3	7	8	27
8-9 AM	3.5	8.8	5.8	14.6	6	15	8-9 AM	3.9	6.3	5.4	8.8	5	9	11	24
9-10 AM	2.9	5.7	4.8	9.5	5	10	9-10 AM	4.7	6.7	6.5	9.3	7	9	12	19
10-11 AM	2.7	4.7	4.5	7.8	5	8	10-11 AM	6.4	7.5	8.9	10.4	9	10	14	18
11-12 PM	4.5	4.5	7.5	7.5	7	8	11-12 PM	6.8	6.5	9.5	9.0	10	9	17	17
12-1 PM	4.8	4.6	8.0	7.6	8	8	12-1 PM	8.5	9.0	11.8	12.5	12	12	20	20
1-2 PM	4.1	4.8	6.8	8.0	7	8	1-2 PM	7.7	8.0	10.7	11.1	11	11	18	19
2-3 PM	5.8	5.0	9.6	8.3	10	8	2-3 PM	9.1	6.7	12.6	9.3	13	9	23	17
3-4 PM	6.7	4.9	11.1	8.1	11	8	3-4 PM	8.7	5.7	12.1	7.9	12	8	23	16
4-5 PM	10.6	6.2	17.6	10.3	18	10	4-5 PM	8.3	6.3	11.5	8.8	12	9	30	19
5-6 PM	12.6	7.7	20.9	12.8	21	13	5-6 PM	7.3	5.7	10.1	7.9	10	8	31	21
6-7 PM	9.3	6.6	15.4	11.0	15	11	6-7 PM	6.3	5.2	8.8	7.2	9	7	24	18
7-8 PM	7.8	4.8	12.9	8.0	13	8	7-8 PM	5.8	5.2	8.1	7.2	8	7	21	15
8-9 PM	7.0	3.3	11.6	5.5	12	6	8-9 PM	4.8	4.1	6.7	5.7	7	6	19	12
9-10 PM	5.5	2.2	9.1	3.7	9	4	9-10 PM	3.1	2.2	4.3	3.1	4	3	13	7
10-11 PM	3.6	1.9	6.0	3.2	6	3	10-11 PM	2.5	1.8	3.5	2.5	3	3	9	6
11-12 AM	2.0	1.1	3.3	1.8	3	2	11-12 AM	0.8	1.1	1.1	1.5	1	2	4	4
					166	166						139	139	305	305

Data obtained from the ITE General Urban/Suburban - Trips by time of day

e Trips by Land Use

**Trip Generation**

Time	out		in		in	
	From North		From East		From West	
	Left	Right	Thru	Right	Left	Thru
%	0.4	0.6	0	0.4	0.6	0
7-8 AM	11	16	0	3	5	0
8-9 AM	10	14	0	4	7	0
9-10 AM	8	11	0	5	7	0
10-11 AM	7	11	0	6	8	0
11-12 PM	7	10	0	7	10	0
12-1 PM	8	12	0	8	12	0
1-2 PM	8	11	0	7	11	0
2-3 PM	7	10	0	9	14	0
3-4 PM	6	10	0	9	14	0
4-5 PM	8	11	0	12	18	0
5-6 PM	8	13	0	12	19	0
6-7 PM	7	11	0	10	14	0

**2028 Build Zone 3**

Start Time	Olmsted Dr From North		Pleasant St From East		Pleasant St From West	
	Left	Right	Thru	Right	Left	Thru
7-8 AM	15	29	466	4	8	432
8-9 AM	13	17	529	7	10	421
9-10 AM	12	21	452	8	11	357
10-11 AM	11	25	398	14	16	381
11-12 PM	11	14	386	14	17	399
12-1 PM	12	23	459	11	16	406
1-2 PM	16	17	411	17	22	485
2-3 PM	10	17	556	9	21	463
3-4 PM	14	24	560	20	29	557
4-5 PM	11	18	614	13	26	608
5-6 PM	9	19	568	16	23	540
6-7 PM	17	21	397	17	27	377

### Hourly Distribution of Entering and Exiting Vehicle Trips by Land Use

Source: ITE Trip Generation Manual, 10th Edition

Land Use Code 710  
 Land Use General Office Building  
 Setting General Urban/Suburban  
 Time Period Weekday  
 Daily number obtained from TMA

Time	Entering	Exiting	Daily		Daily	
			Entering	Exiting	Entering	Exiting
			892	892	892	892
12-1 AM	0.2	0.1	1.8	0.9	2	1
1-2 AM	0	0.1	0.0	0.9	0	1
2-3 AM	0	0	0.0	0.0	0	0
3-4 AM	0	0.1	0.0	0.9	0	1
4-5 AM	0.1	0.2	0.9	1.8	1	2
5-6 AM	0.4	0.1	3.6	0.9	4	1
6-7 AM	4.6	0.5	41.0	4.5	41	4
7-8 AM	13.1	1.9	116.9	16.9	117	17
8-9 AM	14.4	3.5	128.4	31.2	129	31
9-10 AM	6.4	4.3	57.1	38.4	57	38
10-11 AM	5.4	5.9	48.2	52.6	48	52
11-12 PM	6.2	10.3	55.3	91.9	55	92
12-1 PM	10.2	10.4	91.0	92.8	91	93
1-2 PM	9.0	6.7	80.3	59.8	81	60
2-3 PM	8.2	6.5	73.1	58.0	73	58
3-4 PM	7.4	8.5	66.0	75.8	66	76
4-5 PM	5.5	15.2	49.1	135.6	49	135
5-6 PM	4.2	15.6	37.5	139.2	38	139
6-7 PM	1.7	2.9	15.2	25.9	15	26
7-8 PM	0.9	2.2	8.0	19.6	8	20
8-9 PM	0.7	1.3	6.2	11.6	6	12
9-10 PM	0.5	1.5	4.5	13.4	4	13
10-11 PM	0.3	2.0	2.7	17.8	3	18
11-12 AM	0.4	0.2	3.6	1.8	4	2
					892	892

Data obtained from the ITE General Urban/Suburban - Trips by time of day

Time	Trip Generation					
	out		in		in	
	From North	From East	From West	From North	From East	From West
%	0.4	0.6	0	0.4	0.6	0
7-8 AM	7	10	0	47	70	0
8-9 AM	12	19	0	52	77	0
9-10 AM	15	23	0	23	34	0
10-11 AM	21	31	0	19	29	0
11-12 PM	37	55	0	22	33	0
12-1 PM	37	56	0	36	55	0
1-2 PM	24	36	0	32	49	0
2-3 PM	23	35	0	29	44	0
3-4 PM	30	46	0	26	40	0
4-5 PM	54	81	0	20	29	0
5-6 PM	56	83	0	15	23	0
6-7 PM	10	16	0	6	9	0

Note: Same distribution of the zone 3 was assumed for zone 4 Developments

Start Time	2028 Build - w/ Zone 3 and 4					
	Olmsted Dr From North	Pleasant St From East	Pleasant St From West	Left	Right	Thru
7-8 AM	22	39	466	51	78	432
8-9 AM	25	36	529	59	87	421
9-10 AM	27	44	452	31	45	357
10-11 AM	32	56	398	33	45	381
11-12 PM	48	69	386	36	50	399
12-1 PM	49	79	459	47	71	406
1-2 PM	40	53	411	49	71	485
2-3 PM	33	52	556	38	65	463
3-4 PM	44	70	560	46	69	557
4-5 PM	65	99	614	33	55	608
5-6 PM	65	102	568	31	46	540
6-7 PM	27	37	397	23	36	377

# HCS7 Warrants Report

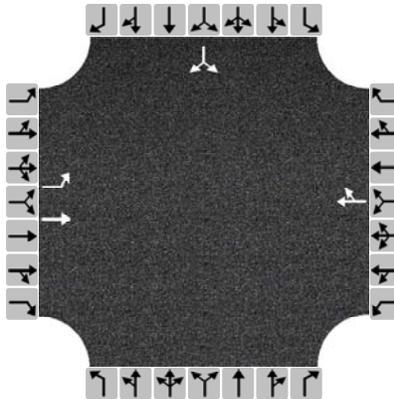
## Project Information

Analyst	JC	Date	1/4/2021
Agency	VAI	Analysis Year	2021
Jurisdiction	McLean Hospital Residential Development - Belmont MA	Time Period Analyzed	2021 Existing Condition
Project Description	Pleasant Street at Olmsted Drive		

## General

Major Street Direction	East-West	Population < 10,000	No
Starting Time Interval	7	Coordinated Signal System	No
Median Type	Undivided	Crashes (crashes/year)	1
Major Street Speed (mi/h)	25	Adequate Trials of Crash Exp. Alt.	No
Nearest Signal (ft)	360		

## Geometry and Traffic



Approach	Eastbound			Westbound			Northbound			Southbound		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Number of Lanes, N	1	1	0	0	1	0	0	0	0	0	0	0
Lane Usage	L	T			TR						LR	
Vehicle Volumes Averages (veh/h)	7	406	0	0	435	4	0	0	0	4	0	8
Pedestrian Averages (peds/h)	0			0			0			0		
Gap Averages (gaps/h)	0			0			0			0		
Delay (s/veh)	0.0			0.0			0.0			0.0		
Delay (veh-hrs)	0.0			0.0			0.0			0.0		

## School Crossing and Roadway Network

Number of Students in Highest Hour	0	Two or More Major Routes	Yes
Number of Adequate Gaps in Period	0	Weekend Counts	No
Number of Minutes in Period	0	5-year Growth Factor (%)	0

## Railroad Crossing

Grade Crossing Approach	None	Rail Traffic (trains/day)	0
Highest Volume Hour with Trains	Unknown	High Occupancy Buses (%)	0
Distance to Stop Line (ft)		Tractor-Trailer Trucks (%)	0

# HCS7 Warrants Report

## Volume Summary

Hour	Major Volume	Minor Volume	Total Volume	Peds/h	Gaps/h	1A (100%)	1A (80%)	1B (100%)	1B (80%)	2 (100%)	3A (100%)	3B (100%)	4A (100%)	4B (100%)
07 - 08	838	17	855	0	0	No	No	No	No	No	No	No	No	No
08 - 09	878	6	884	0	0	No	No	No	No	No	No	No	No	No
09 - 10	745	14	759	0	0	No	No	No	No	No	No	No	No	No
10 - 11	713	18	731	0	0	No	No	No	No	No	No	No	No	No
11 - 12	716	8	724	0	0	No	No	No	No	No	No	No	No	No
12 - 13	780	15	795	0	0	No	No	No	No	No	No	No	No	No
13 - 14	826	14	840	0	0	No	No	No	No	No	No	No	No	No
14 - 15	925	10	935	0	0	No	No	No	No	No	No	No	No	No
15 - 16	1032	22	1054	0	0	No	No	No	No	No	No	No	No	No
16 - 17	1108	10	1118	0	0	No	No	No	No	No	No	No	No	No
17 - 18	994	7	1001	0	0	No	No	No	No	No	No	No	No	No
18 - 19	691	20	711	0	0	No	No	No	No	No	No	No	No	No
Total	10246	161	10407	0	0	0	0	0	0	0	0	0	0	0

## Warrants

<b>Warrant 1: Eight-Hour Vehicular Volume</b>														
A. Minimum Vehicular Volumes (Both major approaches --and-- higher minor approach) --or--														
B. Interruption of Continuous Traffic (Both major approaches --and-- higher minor approach) --or--														
80% Vehicular --and-- Interruption Volumes (Both major approaches --and-- higher minor approach)														
<b>Warrant 2: Four-Hour Vehicular Volume</b>														
Four-Hour Vehicular Volume (Both major approaches --and-- higher minor approach)														
<b>Warrant 3: Peak Hour</b>														
A. Peak-Hour Conditions (Minor delay -- and-- minor volume --and-- total volume) --or--														
B. Peak-Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)														
<b>Warrant 4: Pedestrian Volume</b>														
A. Four Hour Volumes --or--														
B. One-Hour Volumes														
<b>Warrant 5: School Crossing</b>														
Gaps Same Period --and--														
Student Volumes														
Nearest Traffic Control Signal (optional) <span style="float: right;">✓</span>														
<b>Warrant 6: Coordinated Signal System</b>														
Degree of Platooning (Predominant direction or both directions)														
<b>Warrant 7: Crash Experience</b>														
A. Adequate trials of alternatives, observance and enforcement failed --and--														
B. Reported crashes susceptible to correction by signal (12-month period) --and--														
C. 80% Volumes for Warrants 1A, 1B, --or-- 4 are satisfied														
<b>Warrant 8: Roadway Network</b>														
A. Weekday Volume (Peak hour total --and-- projected warrants 1, 2, or 3) --or--														
B. Weekend Volume (Five hours total)														
<b>Warrant 9: Grade Crossing</b>														
A. Grade Crossing within 140 ft --and--														
B. Peak-Hour Vehicular Volumes														

# HCS7 Warrants Report

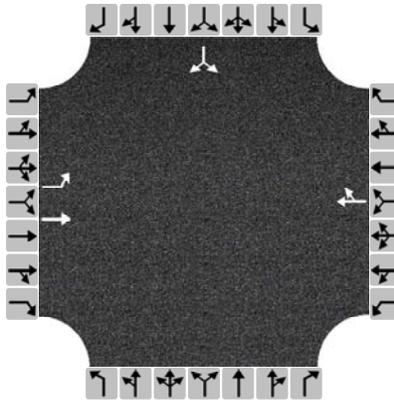
## Project Information

Analyst	JC	Date	1/4/2021
Agency	VAI	Analysis Year	2028
Jurisdiction	McLean Hospital Residential Development - Belmont MA	Time Period Analyzed	2028 No-Build Condition
Project Description	Pleasant Street at Olmsted Drive		

## General

Major Street Direction	East-West	Population < 10,000	No
Starting Time Interval	7	Coordinated Signal System	No
Median Type	Undivided	Crashes (crashes/year)	1
Major Street Speed (mi/h)	34	Adequate Trials of Crash Exp. Alt.	No
Nearest Signal (ft)	360		

## Geometry and Traffic



Approach	Eastbound			Westbound			Northbound			Southbound		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Number of Lanes, N	1	1	0	0	1	0	0	0	0	0	0	0
Lane Usage	L	T			TR						LR	
Vehicle Volumes Averages (veh/h)	7	452	0	0	483	4	0	0	0	4	0	8
Pedestrian Averages (peds/h)	0			0			0			0		
Gap Averages (gaps/h)	0			0			0			0		
Delay (s/veh)	0.0			0.0			0.0			0.0		
Delay (veh-hrs)	0.0			0.0			0.0			0.0		

## School Crossing and Roadway Network

Number of Students in Highest Hour	0	Two or More Major Routes	Yes
Number of Adequate Gaps in Period	0	Weekend Counts	No
Number of Minutes in Period	0	5-year Growth Factor (%)	0

## Railroad Crossing

Grade Crossing Approach	None	Rail Traffic (trains/day)	0
Highest Volume Hour with Trains	Unknown	High Occupancy Buses (%)	0
Distance to Stop Line (ft)		Tractor-Trailer Trucks (%)	0

# HCS7 Warrants Report

## Volume Summary

Hour	Major Volume	Minor Volume	Total Volume	Peds/h	Gaps/h	1A (100%)	1A (80%)	1B (100%)	1B (80%)	2 (100%)	3A (100%)	3B (100%)	4A (100%)	4B (100%)
07 - 08	902	17	919	0	0	No	No	No	No	No	No	No	No	No
08 - 09	956	6	962	0	0	No	No	No	No	No	No	No	No	No
09 - 10	816	14	830	0	0	No	No	No	No	No	No	No	No	No
10 - 11	795	18	813	0	0	No	No	No	No	No	No	No	No	No
11 - 12	799	8	807	0	0	No	No	No	No	No	No	No	No	No
12 - 13	872	15	887	0	0	No	No	No	No	No	No	No	No	No
13 - 14	917	14	931	0	0	No	No	No	No	No	No	No	No	No
14 - 15	1026	10	1036	0	0	No	No	No	No	No	No	No	No	No
15 - 16	1143	22	1165	0	0	No	No	No	No	No	No	No	No	No
16 - 17	1231	10	1241	0	0	No	No	No	No	No	No	No	No	No
17 - 18	1116	7	1123	0	0	No	No	No	No	No	No	No	No	No
18 - 19	794	20	814	0	0	No	No	No	No	No	No	No	No	No
Total	11367	161	11528	0	0	0	0	0	0	0	0	0	0	0

## Warrants

<b>Warrant 1: Eight-Hour Vehicular Volume</b>														
A. Minimum Vehicular Volumes (Both major approaches --and-- higher minor approach) --or--														
B. Interruption of Continuous Traffic (Both major approaches --and-- higher minor approach) --or--														
80% Vehicular --and-- Interruption Volumes (Both major approaches --and-- higher minor approach)														
<b>Warrant 2: Four-Hour Vehicular Volume</b>														
Four-Hour Vehicular Volume (Both major approaches --and-- higher minor approach)														
<b>Warrant 3: Peak Hour</b>														
A. Peak-Hour Conditions (Minor delay -- and-- minor volume --and-- total volume) --or--														
B. Peak-Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)														
<b>Warrant 4: Pedestrian Volume</b>														
A. Four Hour Volumes --or--														
B. One-Hour Volumes														
<b>Warrant 5: School Crossing</b>														
Gaps Same Period --and--														
Student Volumes														
Nearest Traffic Control Signal (optional) <span style="float: right;">✓</span>														
<b>Warrant 6: Coordinated Signal System</b>														
Degree of Platooning (Predominant direction or both directions)														
<b>Warrant 7: Crash Experience</b>														
A. Adequate trials of alternatives, observance and enforcement failed --and--														
B. Reported crashes susceptible to correction by signal (12-month period) --and--														
C. 80% Volumes for Warrants 1A, 1B, --or-- 4 are satisfied														
<b>Warrant 8: Roadway Network</b>														
A. Weekday Volume (Peak hour total --and-- projected warrants 1, 2, or 3) --or--														
B. Weekend Volume (Five hours total)														
<b>Warrant 9: Grade Crossing</b>														
A. Grade Crossing within 140 ft --and--														
B. Peak-Hour Vehicular Volumes														

# HCS7 Warrants Report

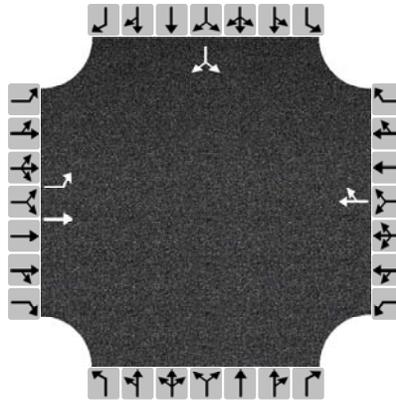
## Project Information

Analyst	JC	Date	1/4/2021
Agency	VAI	Analysis Year	2028
Jurisdiction	McLean Hospital Residential Development - Belmont MA	Time Period Analyzed	2028 No-Build Condition
Project Description	Pleasant Street at Olmsted Drive		

## General

Major Street Direction	East-West	Population < 10,000	No
Starting Time Interval	7	Coordinated Signal System	No
Median Type	Undivided	Crashes (crashes/year)	0
Major Street Speed (mi/h)	25	Adequate Trials of Crash Exp. Alt.	No
Nearest Signal (ft)	360		

## Geometry and Traffic



Approach	Eastbound			Westbound			Northbound			Southbound		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Number of Lanes, N	1	1	0	0	1	0	0	0	0	0	0	0
Lane Usage	L	T			TR						LR	
Vehicle Volumes Averages (veh/h)	18	452	0	0	483	12	0	0	0	12	0	20
Pedestrian Averages (peds/h)	0			0			0			0		
Gap Averages (gaps/h)	0			0			0			0		
Delay (s/veh)	0.0			0.0			0.0			0.0		
Delay (veh-hrs)	0.0			0.0			0.0			0.0		

## School Crossing and Roadway Network

Number of Students in Highest Hour	0	Two or More Major Routes	Yes
Number of Adequate Gaps in Period	0	Weekend Counts	No
Number of Minutes in Period	0	5-year Growth Factor (%)	0

## Railroad Crossing

Grade Crossing Approach	None	Rail Traffic (trains/day)	0
Highest Volume Hour with Trains	Unknown	High Occupancy Buses (%)	0
Distance to Stop Line (ft)		Tractor-Trailer Trucks (%)	0

# HCS7 Warrants Report

## Volume Summary

Hour	Major Volume	Minor Volume	Total Volume	Peds/h	Gaps/h	1A (100%)	1A (80%)	1B (100%)	1B (80%)	2 (100%)	3A (100%)	3B (100%)	4A (100%)	4B (100%)
07 - 08	910	44	954	0	0	No	No	No	No	No	No	No	No	No
08 - 09	967	30	997	0	0	No	No	No	No	No	No	No	No	No
09 - 10	828	33	861	0	0	No	No	No	No	No	No	No	No	No
10 - 11	809	36	845	0	0	No	No	No	No	No	No	No	No	No
11 - 12	816	25	841	0	0	No	No	No	No	No	No	No	No	No
12 - 13	892	35	927	0	0	No	No	No	No	No	No	No	No	No
13 - 14	935	33	968	0	0	No	No	No	No	No	No	No	No	No
14 - 15	1049	27	1076	0	0	No	No	No	No	No	No	No	No	No
15 - 16	1166	38	1204	0	0	No	No	No	No	No	No	No	No	No
16 - 17	1261	29	1290	0	0	No	No	No	No	No	No	No	No	No
17 - 18	1147	28	1175	0	0	No	No	No	No	No	No	No	No	No
18 - 19	818	38	856	0	0	No	No	No	No	No	No	No	No	No
Total	11598	396	11994	0	0	0	0	0	0	0	0	0	0	0

## Warrants

<b>Warrant 1: Eight-Hour Vehicular Volume</b>														
A. Minimum Vehicular Volumes (Both major approaches --and-- higher minor approach) --or--														
B. Interruption of Continuous Traffic (Both major approaches --and-- higher minor approach) --or--														
80% Vehicular --and-- Interruption Volumes (Both major approaches --and-- higher minor approach)														
<b>Warrant 2: Four-Hour Vehicular Volume</b>														
Four-Hour Vehicular Volume (Both major approaches --and-- higher minor approach)														
<b>Warrant 3: Peak Hour</b>														
A. Peak-Hour Conditions (Minor delay -- and-- minor volume --and-- total volume) --or--														
B. Peak-Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)														
<b>Warrant 4: Pedestrian Volume</b>														
A. Four Hour Volumes --or--														
B. One-Hour Volumes														
<b>Warrant 5: School Crossing</b>														
Gaps Same Period --and--														
Student Volumes														
Nearest Traffic Control Signal (optional) <span style="float: right;">✓</span>														
<b>Warrant 6: Coordinated Signal System</b>														
Degree of Platooning (Predominant direction or both directions)														
<b>Warrant 7: Crash Experience</b>														
A. Adequate trials of alternatives, observance and enforcement failed --and--														
B. Reported crashes susceptible to correction by signal (12-month period) --and--														
C. 80% Volumes for Warrants 1A, 1B, --or-- 4 are satisfied														
<b>Warrant 8: Roadway Network</b>														
A. Weekday Volume (Peak hour total --and-- projected warrants 1, 2, or 3) --or--														
B. Weekend Volume (Five hours total)														
<b>Warrant 9: Grade Crossing</b>														
A. Grade Crossing within 140 ft --and--														
B. Peak-Hour Vehicular Volumes														

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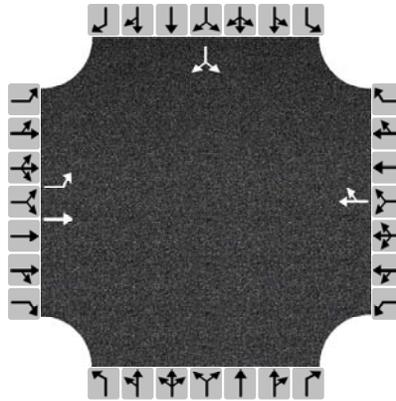
## Project Information

Analyst	JC	Date	1/4/2021
Agency	VAI	Analysis Year	2028
Jurisdiction	McLean Hospital Residential Development - Belmont MA	Time Period Analyzed	2028 Build Condition Zone 3 and Zone 4
Project Description	Pleasant Street at Olmsted Drive		

## General

Major Street Direction	East-West	Population < 10,000	No
Starting Time Interval	7	Coordinated Signal System	No
Median Type	Undivided	Crashes (crashes/year)	0
Major Street Speed (mi/h)	25	Adequate Trials of Crash Exp. Alt.	No
Nearest Signal (ft)	360		

## Geometry and Traffic



Approach	Eastbound			Westbound			Northbound			Southbound		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Number of Lanes, N	1	1	0	0	1	0	0	0	0	0	0	0
Lane Usage	L	T			TR						LR	
Vehicle Volumes Averages (veh/h)	59	452	0	0	483	39	0	0	0	39	0	61
Pedestrian Averages (peds/h)	0			0			0			0		
Gap Averages (gaps/h)	0			0			0			0		
Delay (s/veh)	0.0			0.0			0.0			0.0		
Delay (veh-hrs)	0.0			0.0			0.0			0.0		

## School Crossing and Roadway Network

Number of Students in Highest Hour	0	Two or More Major Routes	Yes
Number of Adequate Gaps in Period	0	Weekend Counts	No
Number of Minutes in Period	0	5-year Growth Factor (%)	0

## Railroad Crossing

Grade Crossing Approach	None	Rail Traffic (trains/day)	0
Highest Volume Hour with Trains	Unknown	High Occupancy Buses (%)	0
Distance to Stop Line (ft)		Tractor-Trailer Trucks (%)	0

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07 - 08	1027	61	1088	0	0	No	No	No	Yes	No	No	No	No	No
08 - 09	1096	61	1157	0	0	No	No	No	Yes	No	No	No	No	No
09 - 10	885	71	956	0	0	No	No	No	Yes	No	No	No	No	No
10 - 11	857	88	945	0	0	No	No	No	Yes	No	No	No	No	No
11 - 12	871	117	988	0	0	No	No	No	Yes	No	No	No	No	No
12 - 13	983	128	1111	0	0	No	Yes	Yes	Yes	No	No	No	No	No
13 - 14	1016	93	1109	0	0	No	No	Yes	Yes	No	No	No	No	No
14 - 15	1122	85	1207	0	0	No	No	Yes	Yes	No	No	No	No	No
15 - 16	1232	114	1346	0	0	No	No	Yes	Yes	Yes	No	No	No	No
16 - 17	1310	164	1474	0	0	Yes	Yes	Yes	Yes	Yes	No	No	No	No
17 - 18	1185	167	1352	0	0	Yes	Yes	Yes	Yes	Yes	No	No	No	No
18 - 19	833	64	897	0	0	No	No	No	Yes	No	No	No	No	No
Total	12417	1213	13630	0	0	2	3	6	12	3	0	0	0	0

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