File #: REA-0316

Applicant: Johnson Woods Realty Corporation
8 Doaks Lane
Marblehead, MA 01945
(781) 639-1113

TRAFFIC IMPACT AND ACCESS STUDY

Johnson Woods Condominium
Reading, Massachusetts

September 2011

Hayes Engineering, Inc.

603 Salem Street
Wakefield, MA 01880
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TRAFFIC IMPACT AND ACCESS STUDY
JOHNSON WOODS CONDOMINIUM
READING, MASSACHUSETTS

September 14, 2011

INTRODUCTION

The purpose of this report is to identify the potential traffic impacts of the proposed second phase of the Johnson Woods Condominium complex located westerly of West Street, easterly of the Woburn Town line, on the southerly side of West Street in Reading, Massachusetts, as shown on ***Figure C1***. The complex has a total of 166 units approved in Phase I, and a new Phase II total of an additional 127 condominium units consisting of a mix of townhouses and flats.

EXISTING CONDITIONS

West Street is currently a two-lane roadway with a 28-foot wide pavement surface. The pavement is marked with a double yellow center line and solid white edge lines. There is granite curbing and sidewalk located on the southerly side of West Street.

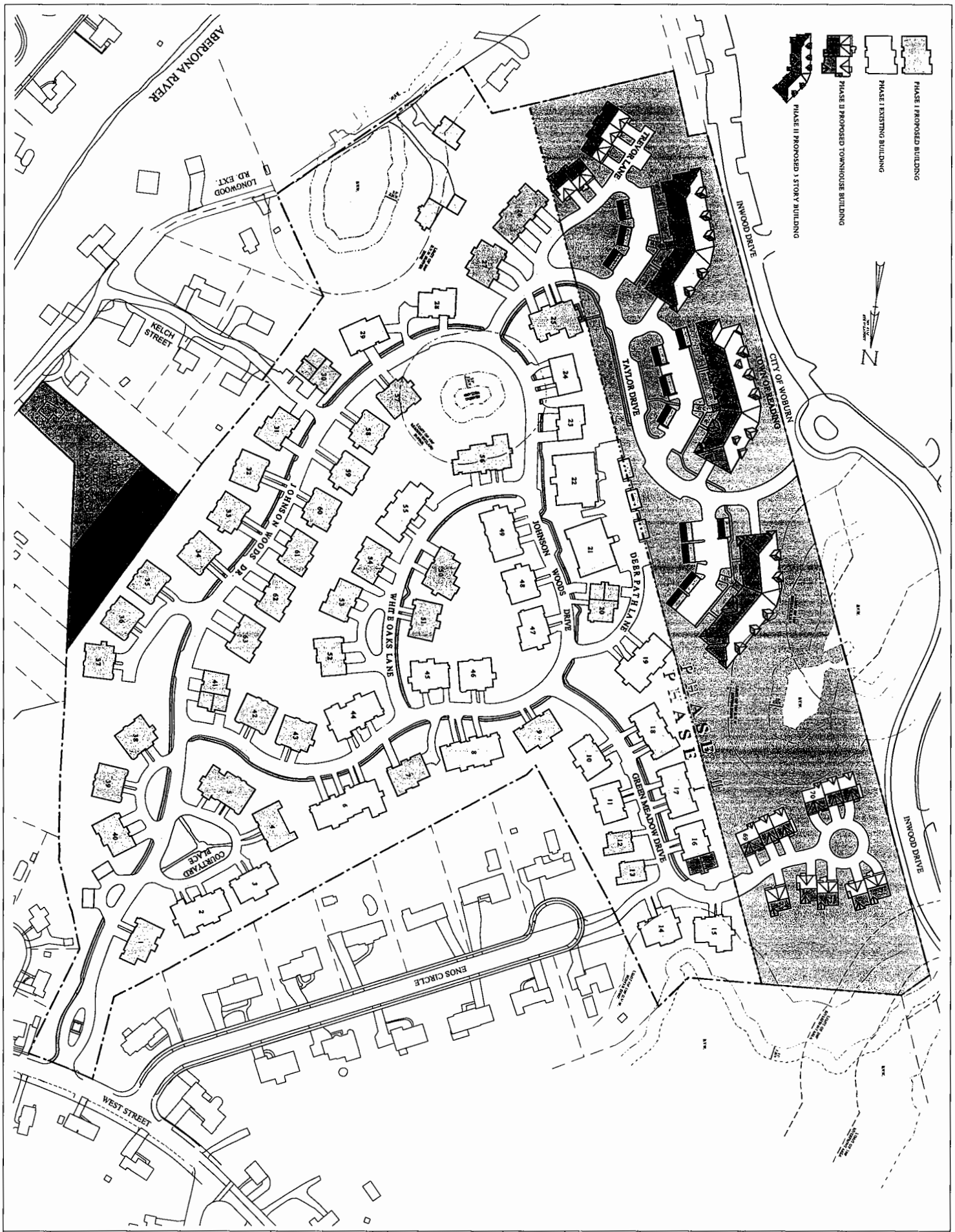
The section of West Street in the vicinity of the existing Johnson Woods Drive access is relatively level with a horizontal curve to the east and a horizontal curve to the west. West Street runs in a general north/south direction through Reading, connecting to Route 95 to the south and Route 129 (Lowell Street) and Route 93 to the north. The intersection of West Street and Lowell Street has undergone major reconstruction in the past two years as part of the Avalon Inwood project located in Woburn. The roadway has a posted speed of 30 MPH for the eastbound approach and 30 MPH for the westbound approach directions of travel.

TRAFFIC VOLUMES AND BACKGROUND INFORMATION

In order to develop a basis for the analysis, manual traffic counts were conducted at the existing intersection of Johnson Woods Drive and West Street on June 2, 2011 from 7:00 AM to 9:00 AM and from 2:00 PM to 6:00 PM. This day represents a standard school day, and the information is shown on **Exhibit 1**.

The existing counts taken in June of 2011 reflect the construction of 446 apartments at Inwood West, now owned by UDR. The site has been approved for an additional 34 apartment units, but there is no plan by the owner, UDR, to construct them at this time.

Other projects that have been constructed since the original traffic study was done include the Regency Place apartment complex on West Street in Wilmington, the Winsor Place assisted living facility on Lowell Street and the Reading Montessori School at 453 West Street. The West Street Apartment Complex located near the Woburn Town line and Route 95 was also completed.



SITE INDEX
JOHNSON WOODS
PLANNED UNIT DEVELOPMENT
READING, MASS.

Drawing No.: C1

Drawing Title

Scale: 1"=50'
0' 25' 50' 100'
Date: September 23, 2011

Sheet

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Owner / Applicant
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c/o Glenver Property Management, Inc.
8 Doyle's Lane
Marblehead, MA 01945

Prepared By:

Prepared For:

Additional Info:

SHEET 1 OF

Hayes Engineering, Inc.

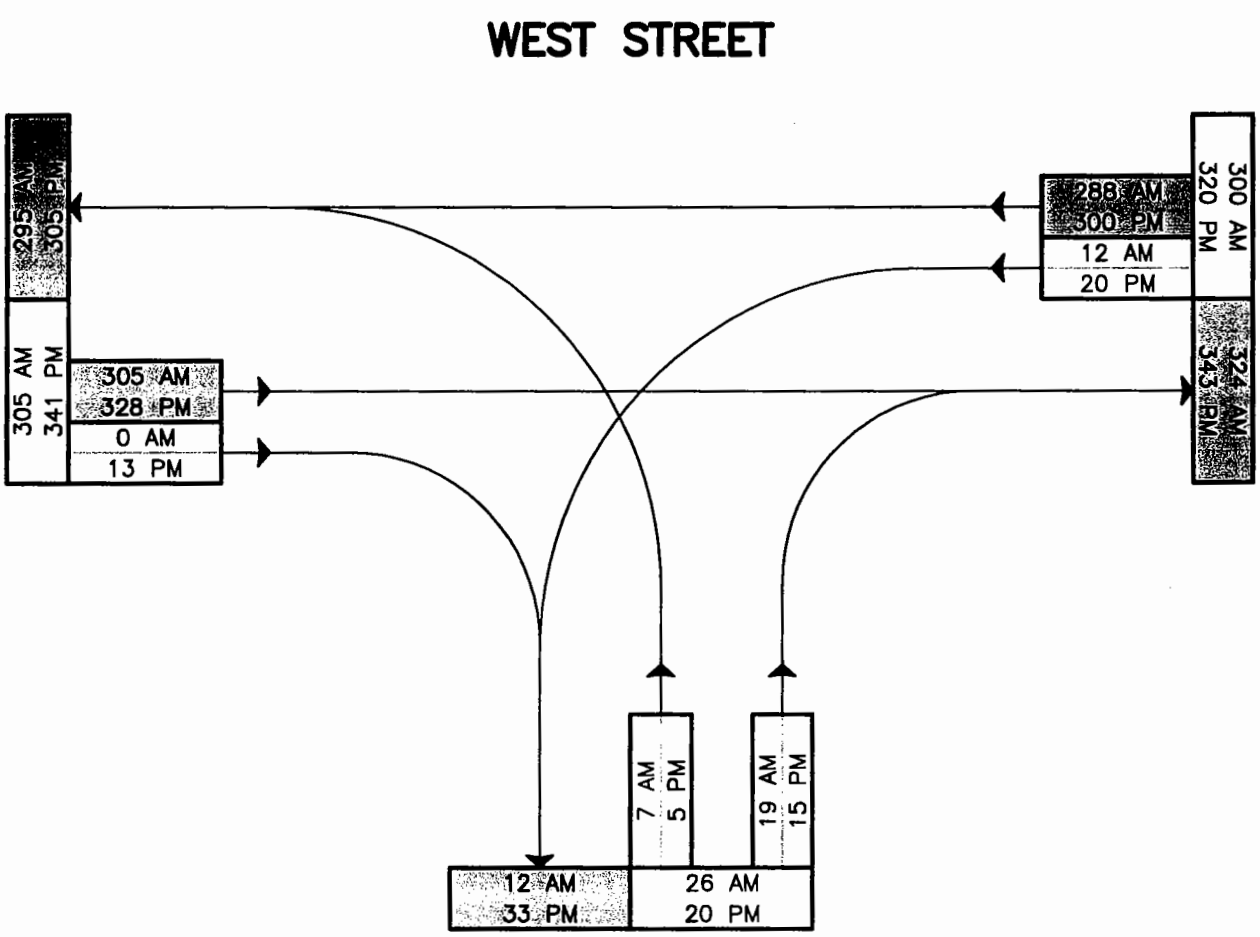

EXHIBIT 1

JOHNSON WOODS CONDOMINIUM WEST STREET READING, MASSACHUSETTS	EXISTING TRAFFIC JUNE 2, 2011

N

8/17/11

In addition, there have been significant traffic improvements to the Route 129 and West Street intersection, with lane widening and signal improvements, in addition to the actual Route 93 ramps.

West Street has been improved with new pavement and a new sidewalk in the vicinity of the site as part of the original project mitigation.

There still remains an unconstructed 95,000 square-foot office building owned by the Gutierrez Company, at Lowell Street and West Street in Wilmington, but the majority of that traffic will not have any significant impact at Johnson Woods Drive. Any impacts associated with that project and others will be accounted for with the use of the conservative June data and the 1% per year background growth.

The original Abend Associates' Technical Memorandum, dated April 11, 2002, was for the initial site development of 288 apartment units. The study added the potential area projects, as well as providing for a 1.6% per year growth for 5 years, to the year 2007. This included the full build out of the then approved 850,000 square-foot Inwood Office Park, located adjacent to Johnson Woods in Woburn and Wilmington. The projected 2007 No-Build traffic on West Street at Johnson Woods Drive was for an AM eastbound traffic of 285 vehicles and westbound of 763 vehicles. The PM No-Build counts were projected to be 632 vehicles for eastbound traffic and a westbound traffic of 311 vehicles.

The Avalon at Inwood Traffic Impact and Access Study done by Vanasse and Associates, Inc. projected the 2009 Build AM traffic to be 261 eastbound and 419 westbound. The PM Build traffic was projected to be 326 eastbound and 337 westbound. The projected and actual traffic from the Avalon project is shown in **TABLE I**.

TABLE I

	Projected			Actual		
	In	**Out**	**Total**	**In**	**Out**	**Total**
AM	50	176	226	27	174	201
PM	176	93	269	134	62	196

VEHICLE SPEEDS

Speed observations were conducted on July 11, 2011 between 11:15 AM and 12:15 PM on a sunny, dry day. There were no abnormal activities related to traffic in either direction during the observations. The observations made consisted of free-flowing vehicle speeds by traffic not encumbered by peak hour traffic and/or platooning effect that can occur.

The radar observations were taken in a concealed location to avoid the potential of adjusted normal driver speeds. The 50 speed counts taken for each direction were also reviewed throughout the observations to see if there was any sudden reduction of speed. There was no such reduction in the observations.

The results of the speed study indicated the mean speed for eastbound traffic was 33.9 MPH with an 85th percentile speed of 37 MPH. The results for the westbound traffic indicated a mean speed of 33.0 MPH with an 85th percentile speed of 37 MPH. The data is attached in the Appendix.

ACCIDENT INFORMATION

Accident information was obtained for the years 2007 to 2009 from the Massachusetts Highway Department. The data consists of accident records obtained from the Massachusetts Registry of Motor Vehicles and consists of the most available three (3) years of data.

The results of this review indicated that there was a total of three accidents in the vicinity of Johnson Woods Drive from Longwood Road to the Wilmington Town line on West Street, but no accidents at the actual Johnson Woods Drive and West Street intersection. The results are shown in **TABLE II.**

The results of this review indicate that there are no unusual accident problems with the adjacent West Street roadway system in the area of the Johnson Woods Condominium complex.

FUTURE NO-BUILD CONDITIONS

The seasonal factors for Station 4391 - Wilmington at Route I-93 north of Concord Street, Station 4803 – Woburn Route I-93 north of Route 95 interchange, Station 4097 – Woburn at Route I-93 south of Route 129 new interchange, and Station 4137 - Wakefield at Route I-95 north of North Avenue, were found to have traffic counts in June to be generally higher than the yearly average by approximately +5.1%. Therefore, no seasonal adjustment was made.

The Massachusetts Highway Department data also suggests that the background traffic growth for each of the four stations has actually experienced a decrease in traffic volumes. In order to project traffic volumes to the 2016 No-Build and Build conditions, it was assumed that there would be a 1% per year increase over the higher June traffic counts collected to conservatively estimate the future 2016 No-Build condition. The results of these projections are shown on **Exhibit 3**. The 2016 No-Build projection includes the full build out of the approved Phase I section of Johnson Woods.

TABLE II

Accident Summary – 2007 to 2009

	Vicinity of Johnson Woods Drive and West Street
Year	
2007	2
2008	1
2009	0
Total	**3**
Type	
Angle	1
Head-on	1
Rear-end	1
Single Vehicle	0
Total	**3**
Severity	
Property Damage	2
Personal Injury	1
Fatality	0
Unknown	0
Conditions	
Dry	2
Wet	0
Ice/Snow	1
Other	0
Unknown	0
Time of Day	
7:00 – 9:00 AM	0
4:00 – 6:00 PM	0
Remainder of day	3

Source: Massachusetts Highway Department Crash Data as obtained from the Registry of Motor Vehicles.

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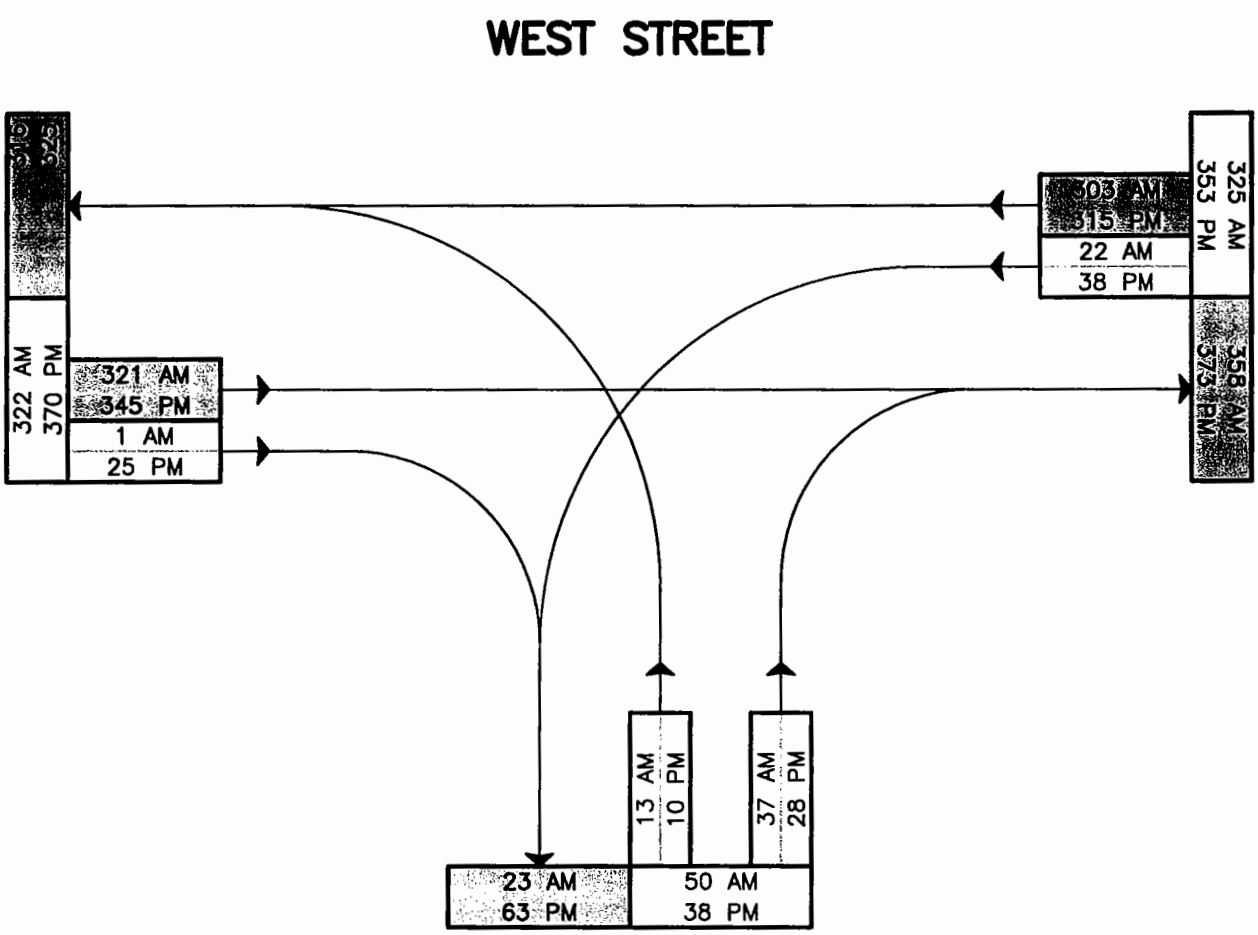

EXHIBIT 3

JOHNSON WOODS CONDOMINIUM WEST STREET READING, MASSACHUSETTS	JOHNSON WOODS PHASE I BUILT 2016	N 8/17/11

PROJECT-RELATED TRAFFIC

Traffic estimated to be generated by the completion of Johnson Woods Phase I and the proposed Phase II section was obtained by utilizing the technical information available in "Trip Generation", by the Institute of Transportation Engineers (ITE), 8th Edition, 2008. Land Use Code 230 – Condominium/Townhouse Residential is the relevant land use for the completion of the site. The ITE data was supplemented with actual counts taken at the current Johnson Woods Drive at West Street for the completed units. The results of this comparison strongly agree with the ITE data for the AM peak hour time period and were slightly higher for the PM peak hour time period. The higher generation rates were used for the 2016 projections, along with adjustment to the actual entrance/exit observations. The information is provided in the Appendix.

The method and procedures of estimating the traffic generated by the proposed Johnson Woods Condominium complex are summarized in **TABLE III**. The proposed method used for the projected new development will be the technical method utilizing ITE data by taking the adjusted average rate method outlined in the specific ITE Land Use Code. Therefore, the projected additional morning and evening peak hour traffic volumes obtained in the analysis were found to be approximately 35 vehicles and 48 vehicles, respectively, for the full build of the 79 condominiums in Phase I. It is estimated that of the new 35 vehicles in the morning, 11 vehicles will be entering the site and 24 vehicles will be exiting. Likewise, of the new 48 vehicles in the afternoon, it is estimated that 30 vehicles will be entering the site and 18 vehicles will be exiting.

These projected peaks were added to the existing morning and evening peak hour projected 2016 No-Build traffic volumes to provide a representative model of the projected traffic in the post-development condition, as shown on **TABLE III** and **Exhibits 3 and 4**.

TABLE III

ITE Land Use Code	AM (peak hour)			PM (peak hour)			ADT*
	in	out	total	in	out	total	
230 – LUC							
79 condo units - Phase I	11	24	35	30	18	48	459
127 condo units - Phase II	18	38	56	48	29	77	738
Total	**29**	**62**	**91**	**78**	**47**	**125**	**1,197**

* Average Daily Traffic

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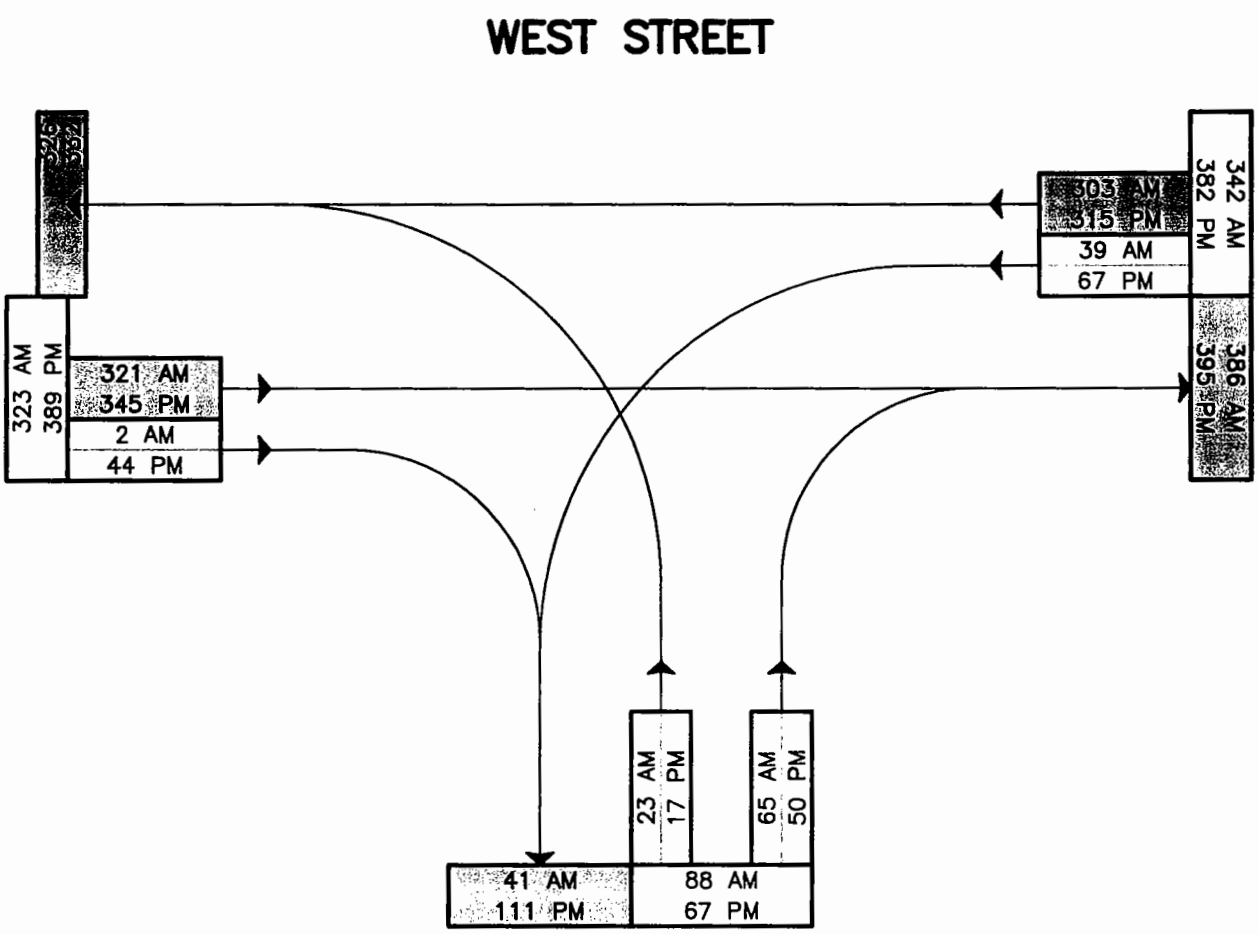


EXHIBIT 4

JOHNSON WOODS CONDOMINIUM WEST STREET READING, MASSACHUSETTS	JOHNSON WOODS PHASE I & II BUILT 2016 WITH BACKGROUND ADJUSTMENT

N

8/17/11

TRAFFIC DISTRIBUTION ASSIGNMENT

The traffic generated by the proposed Johnson Woods Condominium complex is expected to exhibit similar characteristics to the existing traffic patterns from the existing constructed section of the project to the roadways. The data collected during the manual traffic counts was used to project the directional distribution for the proposed site. The result of this analysis is shown on **Exhibit 2**. The projected new traffic estimated to be generated by Johnson Woods Condominium complex, based upon the traffic distribution, is shown on **Exhibit 4**.

CAPACITY ANALYSIS

The term "capacity" is a function of the prevailing conditions. These conditions are those that are determined by the physical features of the roadway, and those that are dependent upon the traffic using the roadway. The "capacity" may be defined as the maximum number of vehicles which has a reasonable expectation of passing over a given section of roadway during a given time period, under prevailing roadway and traffic conditions.

"Level of Service" (LOS) is a term which denotes any of an infinite number of differing combinations of operating conditions which can occur on a given lane or roadway when it is accompanying various traffic volumes.

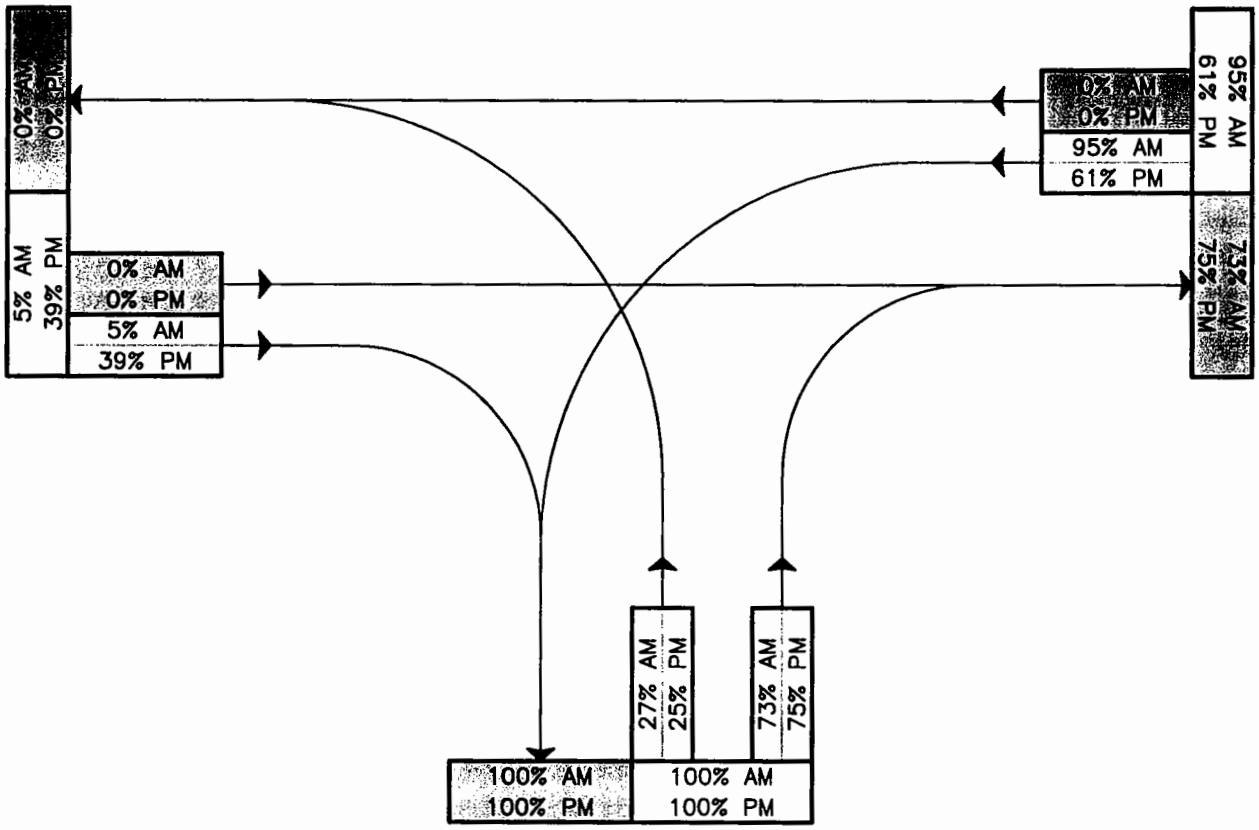
Service levels A through F, as shown in **TABLE IV**, define the full range of driving conditions from the best to the worst, in that order. These levels of service qualitatively measure the affect of such factors as travel time, speed, cost, and freedom to maneuver, which, in combination with other factors, determines the type of service that any given facility provides to the user under stated conditions.

It should be noted, however, that predictions of an average level of service C, for example, during a full hour, may include portions of the hour operating at level D or E, while other portions will operate at A or B. In addition, the levels of service experienced depend upon such other factors as time of day, day of the week, time of the year and other miscellaneous conditions which, in the aggregate, relate to the day to day normal traffic flow conditions.

An intersection capacity analysis was performed for the peak hours with the proposed additional site development traffic at the Johnson Woods Drive and West Street intersection. The capacity analysis procedure used was the 2010 Highway Capacity Manual, published by the Transportation Research Board ("Highway Capacity Manual"). It involves calculations for unsignalized intersections, with the results being presented as "Levels of Service". Each level of service corresponds to a certain level of traffic congestion, as outlined in **TABLE IV**.

Hayes Engineering, Inc.

WEST STREET



JOHNSON WOODS DRIVE

EXHIBIT 2		
JOHNSON WOODS CONDOMINIUM WEST STREET READING, MASSACHUSETTS	EXISTING DIRECTIONAL DISTRIBUTION	N 8/17/11

TABLE IV

LEVEL OF SERVICE CRITERIA FOR
UNSIGNALIZED INTERSECTIONS

Level of Service	Average Total Delay (sec./veh.)
A	≤ 10.0
B	> 10.1 and ≤ 15.0
C	> 15.1 and ≤ 25.0
D	> 25.1 and ≤ 35.0
E	> 35.1 and ≤ 50.0
F	> 50.0

The Highway Capacity Software (HCS) for Unsignalized and Signalized Intersections used for this analysis was developed by McTrans and approved by the Transportation Research Board (TRB) Committee on Highway Capacity and Quality of Service. The results of these analyses are summarized in the Intersection Level of Service Summary table, **TABLE V.** The results of the analysis indicate that the proposed project will have only minor impacts on the overall adjacent roadway system.

STOPPING SIGHT DISTANCE

Sight distance considerations are divided into two criteria: (1) Stopping Sight Distance (SSD) and (2) Intersection Sight Distance (ISD). Approach SSD is the distance required for an approaching vehicle to perceive and react accordingly to a driveway exiting vehicle or object. Stopping sight distances used for design is the sum of two distances: (A) the distance a vehicle travels after the driver sees an object and begins breaking, and (B) the distance it travels during breaking, as calculated for wet level pavement. When the main roadway is either on an upgrade or downgrade, grade correction factors are applied.

ISD is based upon a perception and reaction time, and time required to complete the desired exiting maneuver after the decision to do so has been made. Values for exiting ISD represent time required to turn left or right from a stop condition, to accelerate to the operating speed of the street without causing approaching vehicles to reduce speed by more than 70% of their initial/design speed and, upon turning left, to clear the near half of the street without conflicting with vehicles approaching from the left having to reduce their speed by more than 70% of their initial/design speed. The ISD, therefore, is considered to enhance the operation of the West Street traffic over and above the actual needs of the stopping sight distance that is needed for the safe operation of the intersection.

TABLE V
Intersection Level of Service Summary

Intersection	Existing 2011				Johnson Woods Phase I - Full Build* 2016				Johnson Woods Phase I & Phase II Build* 2016			
	AM		PM		AM		PM		AM		PM	
	LOS	Delay (sec.)	LOS	Delay (sec.	LOS	Delay (sec.)	LOS	Delay (sec.)	LOS	Delay (sec.)	LOS	Delay (sec.)
Unsignalized												
Johnson Woods Drive @ West Street												
Westbound L T	A	8.0	A	8.1	A	8.1	A	8.2	A	8.1	A	8.3
Northbound L R	B	11.2	B	11.3	B	12.1	B	12.4	B	12.8	B	13.1

* Includes background 1% per year growth rate.

Approach SSD is far more important, as it represents the minimum distance required for safe stopping, while the exiting ISD criteria is based only upon acceptable speed reductions to the approaching traffic streams. As noted in ASSHTO, "If the available sight distance for an entering or crossing vehicle is at least equal to the appropriate stopping sight distance for the major road, then drivers have sufficient sight distance to anticipate and avoid collisions". This would be, basically, the minimum criteria for the safe operation of an unsignalized intersection.

On July 11, 2011, a site inspection was conducted to identify the potential traffic safety problems that may be associated with the existing Johnson Woods Drive and West Street intersection relative to available sight distances, as well as review of the existing roadway conditions. The stopping sight distances measured in the field, 14.5 feet back from the existing travel lane, are summarized in **TABLE VI**.

TABLE VI

Stopping Sight Distance
(Wet Pavement)

Location	Posted Speed	85th Percentile Speed	Recommended SSD for Posted Speed	Recommended SSD for 85th Percentile Speed	Available SSD	ISD
Johnson Woods Dr. @ West Street						
Eastbound approach	30 mph	37 mph	200 ft.	267 ft.	630 ft.	408 ft.
Westbound approach	30 mph	37 mph	200 ft.	267 ft.	485 ft.	408 ft.

CONCLUSIONS AND RECOMMENDED IMPROVEMENTS

The proposed development of the Johnson Woods Condominium development is anticipated to have the following impacts.

* The proposed traffic from the completion of the 79 residential condominiums in Phase I, in addition to the 127 residential condominium units in Phase II, will result in no significant reduction in the existing levels of service for the adjacent traffic flows on West Street and the surrounding roadway network system within the Town of Reading.

* The existing intersection of Johnson Woods Drive and West Street provides for safe stopping sight distances for both directions, and meets or exceeds the geometric design standards required by the American Association of State Highway and Transportation Officials (AASHTO) for the observed 85th percentile speeds.

* The results of the current conditions confirm the fact that the previously-projected traffic conditions from surrounding projects and assumed background traffic growth were greatly over-estimated, principally due to the fact that the previously-approved Inwood Office Park reduced the average weekday traffic from 6,828 vehicle trips to 3,028 vehicle trips. More importantly, the Inwood Office Park was projected to generate 1,259 vehicle trips in the AM peak hour and 1,157 vehicle trips in the PM peak hour. The actual constructed Inwood West produces 184 vehicle trips in the AM peak hour and 175 vehicle trips in the PM peak hour. This drastic reduction in the projected traffic is evident since the projected Full Build of the Phase I and Phase II sections of Johnson Woods will provide a level of service of A and B for the AM and PM peak hours.

* The Phase II section will provide an additional emergency access to Inwood Drive. This access will be gated as the other two emergency access points to Enos Circle and Kelch Road are.

* The West Street, Lowell Street and Route I-93 interchange improvements in Wilmington are in place and certainly have had a positive impact to the roadway system.

* The Phase I approval included a $100,000.00 contribution to the Town of Reading for traffic improvements for the West / Willow / Summer Street intersection. This contribution has been made and is available for the Town to use.

Based on the foregoing, it can be stated that the proposed completion of Johnson Woods Phase I and Phase II will have little impact on the adjacent roadways, and no major traffic impact will be felt within the Town as a result of the proposed construction. The prior constructed improvements paid for by Johnson Woods to West Street for Phase I have enhanced the roadway safety and operation, in addition to the unused $100,000.00 supplemental mitigation fund Johnson Woods provided to make further enhancements to the intersection of West / Willow / Summer Street. The significant improvements by other projects in Woburn and Wilmington have also enhanced the roadway system in the area. Therefore, no further enhancements to this area are required at this time.

LIST OF ATTACHMENTS

* Manual Traffic Counts
* Massachusetts Continuous Counting Station Monthly Average Daily Traffic
* Seasonal and Annual Adjustment Data
* Vehicle Speed Survey
* Crash Data
* Crash Rate Worksheet
* Trip Generation Data
* Capacity Analysis Worksheets
* Stopping Sight Distance Calculations

Manual Traffic Counts

Massachusetts Highway Continuous Counting Station
Monthly Average Daily Traffic

Seasonal and Annual Adjustment Data

AM Peak Hour $\frac{38}{87}$ = .437 32% in PM = $\frac{53}{87}$ = .609 61% in
68% out 38% out 87 Units

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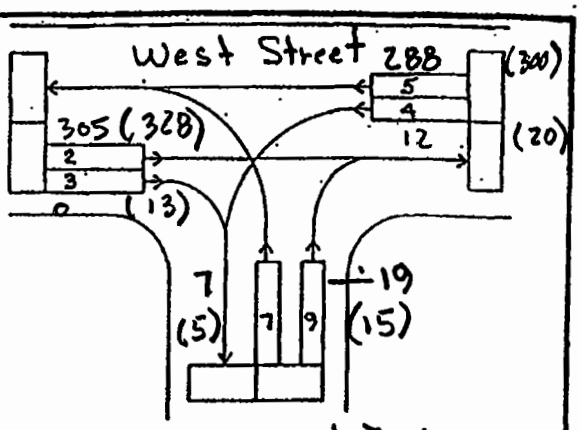

AM
in 12
out 26
38

PM
in (33)
out (20)
53

305/352 .86

Johnson Woods & West Street
Reading Ma
Thursday
Date: 6/2/2021 (Try Tue Wed / Thursday under dry weather conditions)

	2	3	4	5	7	9	
Time	→	↘	↙	←	↰	↱	
7:00-7:15	65	0	2	37	2	8	114
7:15-7:30	70	0	0	36	3	5	114
7:30-7:45	88	0	3	85	2	8	186
7:45-8:00	79	00	3	62	1	7	152
8:00-8:15	70	0	5	72	2	2	151
8:15-8:30	68	0	1	69	2	2	142
8:30-8:45	42	1	2	44	3	4	96
8:45-9:00	60	1	2	57	1	6	127
4:00→4:15	19	0	1	34	1	1	56
4:15-4:30	44	2	3	79	1	4	133
4:30-4:45	52	1	8	83	1	4	149
4:45-5:00	46	0	8	46	1	1	102
5:00-5:15	90	1	4	77	2	2	176
5:15-5:30	90	3	5	71	1	6	176
5:30-5:45	75	3	4	75	1	2	160
5:45-6:00	73	6	7	77	1	5	169

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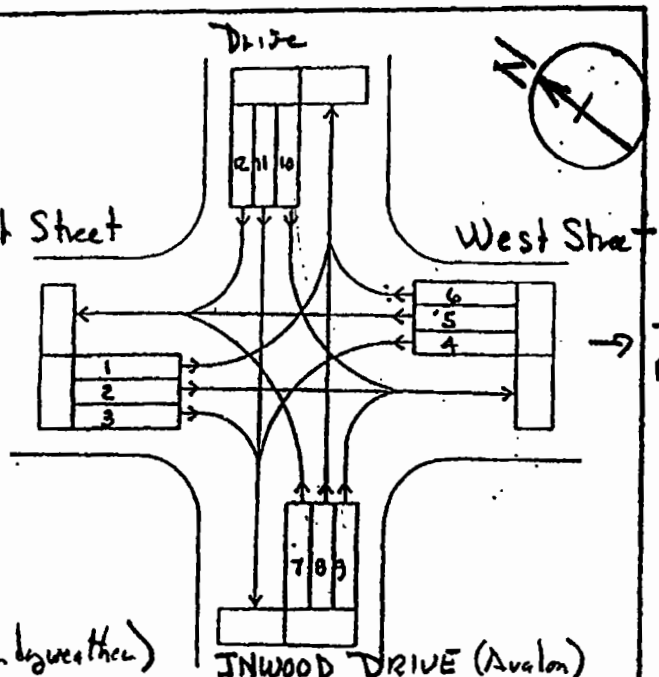


Avalon Apartment Complex
Inwood Drive at West Street
Wilmington Ma

Date 6/7/2011 (Tuesday Wed/Thursday when logger there)

Time	1	2	3	4	5	6	7	8	9	10	11	12	Σ
7:00-7:15	8	33	1	2	43	0	24	0	14	1	0	2	126
7:15-7:30	4	60	0	1	42	1	32	0	9	3	0	0	152
7:30-7:45	0	61	8	2	60	0	31	0	20	0	0	0	182
7:45-8:00	38	61	16	19	78	0	24	0	22	0	0	0	195
8:00-8:15	7	48	5	4	64	0	22	0	10	0	0	0	160
8:15-8:30	2	40	1	2	76	0	19	0	12	0	0	1	153
8:30-8:45	3	28	7	4	54	0	23	0	12	1	0	0	132
8:45-9:00	1	32	3	3	38	0	14	0	4	0	0	1	96
4:00-4:15	0	43	14	2	75	0	5	0	5	2	0	6	152
4:15-4:30	4	38	17	15	57	0	4	0	4	1	0	1	141
4:30-4:45	2	30	8	10	37	1	2	0	1	2	0	1	94
4:45-5:00	0	43	10	3	35	2	8	0	1	0	0	4	106
5:00-5:15	3	59	12	20	44	1	11	0	1	0	0	1	152
5:15-5:30	13	72	7	11	59	1	11	0	1	0	0	1	166
5:30-5:45	1	59	16	15	52	2	8	0	8	1	0	1	163
5:45-6:00	0	46	28	11	36	2	11	0	4	0	0	5	143

STATION 4164 - MARLBOROUGH - RTE.I-495 - SOUTH OF RTE.I-290

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
05	79,000	81,755	84,587	92,269	96,161	100,110	95,264	100,510	93,379	92,615	93,638	90,255	91,629
	3%	1%	2%	-7%	-6%	-4%	-2%	-1%	2%	1%	-5%	-7%	-2%
06	81,709	82,413	86,405	86,233	90,449	96,153	92,889	99,498	94,991	93,287	89,334	84,009	89,781
	0%	6%	3%	1%	2%	-4%	5%	2%	-1%	3%	0%	-5%	1%
07	81,359	*87,036*	88,601	87,201	92,467	92,014	97,474	101,137	94,027	95,651	89,108	80,171	90,521
	8%	1%	-3%	0%	-5%	0%	-7%	-9%	-6%	-8%	-8%	1%	-3%
08	87,565	*87,968*	85,500	86,831	88,261	91,613	90,668	92,227	88,209	88,415	82,077	80,721	87,505
	0%	0%	2%	-1%	0%	0%	0%	0%	5%	4%	12%	14%	3%
09	87,565	*87,565*	87,565	85,992	88,261	91,613	90,668	92,227	92,227	92,227	92,227	92,227	90,030

STATION 4170 - CHELMSFORD - RTE.I-495 - NORTH OF RTE. 4

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
06	100,000	102,000	102,000	104,000	103,243	108,638	117,000	117,356	105,105	102,950	98,868	92,481	104,470
	-8%	-7%	-8%	-8%	1%	1%	-3%	2%	1%	2%	-3%	-5%	-3%
07	91,950	94,873	94,099	95,258	103,802	109,192	113,808	120,103	106,428	105,467	95,598	*88,019*	101,550
	-10%	-6%	1%	1%	-4%	-4%	-5%	-7%	-3%	-3%	-3%	-2%	-4%
08	82,908	89,494	95,000	96,549	99,670	104,487	107,612	111,258	103,346	101,899	92,885	*86,352*	97,622
	4%	0%	-7%	1%	-1%	1%	3%	1%	0%	-1%	1%	4%	1%
09	86,006	89,523	88,806	97,307	98,894	105,468	111,003	112,512	103,316	100,554	94,083	*90,186*	98,138

STATION 4391 - WILMINGTON - RTE.I-93 - NORTH OF CONCORD ST.

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
05	142,000	144,887	147,080	149,780	150,721	159,857	150,673	155,329	153,971	146,469	146,421	140,689	148,990
1	1%	-1%	4%	-1%	-2%	-8%	-3%	1%	-1%	4%	1%	2%	0%
06	143,268	143,788	152,255	149,031	148,406	147,848	146,888	156,683	151,871	152,120	148,046	144,175	148,698
2	0%	-1%	-2%	-1%	3%	6%	4%	1%	0%	2%	-1%	-3%	1%
07	142,892	142,922	148,571	148,195	152,838	157,439	152,546	158,330	151,739	155,736	146,435	*139,469*	149,759
3	-2%	0%	0%	2%	-2%	-3%	-1%	-4%	-1%	0%	-2%	-2%	-1%
08	140,236	142,450	149,000	151,631	150,517	153,257	150,882	152,025	150,811	155,790	143,470	*136,622*	148,058
4	-8%	-6%	-11%	0%	0%	4%	2%	2%	2%	-1%	1%	4%	-1%
09	128,406	133,487	133,199	151,715	149,805	159,403	154,074	154,405	153,873	153,510	145,354	*142,073*	146,609

STATION 4423 - WAKEFIELD - RTE.I-95 (128) - NORTH OF RTE.129

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
05	117,071	124,586	124,146	136,753	138,412	146,682	147,640	149,661	138,495	134,936	133,287	128,075	134,979
	7%	2%	8%	-3%	-1%	-1%	-2%	-1%	-3%	5%	1%	3%	1%
06	124,874	126,472	134,205	132,777	136,883	144,840	145,340	148,400	134,914	141,167	134,869	131,313	136,338

159,857 / 148,990 +7.29

147,848 / 148,698 −0.57

157,439 / 149,759 +5.13

153,257 / 148,058 +3,51

159,403 / 146,609 +8.73

24.66 / 4 = 6.17

148,990
146,609 ↓ decrease 4yr

ITALICS = ESTIMATED DAT...
MADT

STATION 4797 - HOPKINTON - RTE.I-495 - AT MILFORD T.L.

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
05	74,000	76,224	77,268	81,544	85,469	92,805	90,277	93,593	85,748	81,814	80,814	76,234	82,983
	-1%	-3%	3%	-1%	-3%	-5%	-3%	-1%	1%	3%	3%	10%	0%
06	73,523	73,912	79,228	80,636	82,766	88,584	87,302	92,592	86,859	84,573	83,443	83,870	83,107

STATION 4798 - LEXINGTON - RTE. 2 - WEST OF PLEASANT ST.

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
05	57,027	66,995	72,196	77,189	74,222	74,735	66,931	69,361	77,829	76,238	*75,564*	72,282	71,714
07	*68,000*	68,616	72,673	74,017	78,084	77,591	72,321	*73,150*	*73,355*	79,113	74,842	*67,488*	73,271

STATION 4803 - WOBURN - RTE.I-93 - NORTH OF RTE. I-95(128) *NEW INTERCHANGE ADDED 2001 SEE STATION 4097

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
05	151,000	153,460	155,611	158,519	159,207	167,789	158,179	164,471	161,789	154,601	*154,616*	150,038	157,440
1	0%	-1%	3%	0%	-2%	-7%	-2%	0%	-1%	3%	1%	3%	0%
06	151,602	152,551	160,957	158,034	156,514	155,739	154,436	164,264	159,818	159,865	*156,499*	154,012	157,024
2	1%	1%	-2%	0%	3%	6%	4%	1%	0%	2%	0%	-7%	1%
07	152,882	*154,447*	*157,119*	157,256	161,183	165,812	160,428	166,710	160,154	163,828	*156,332*	143,191	158,279
3	-1%	-2%	-1%	0%	-7%	-3%	-6%	-6%	-1%	0%	-3%	1%	-3%
08	150,809	151,216	155,953	156,858	149,450	161,238	150,440	156,275	158,847	163,492	*151,860*	144,394	154,236
4	-6%	2%	-1%	2%	6%	2%	8%	4%	2%	-1%	1%	5%	2%
09	142,139	153,556	153,858	160,686	158,177	164,366	161,864	162,824	161,957	162,023	*154,059*	151,367	157,240

STATION 5007 - SALISBURY - RTE.I-95 - AT NEW HAMPSHIRE S.L.

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
05	71,874	77,279	76,746	83,585	89,692	101,283	115,491	116,510	93,543	87,182	*83,554*	78,300	89,587
	1%	-1%	4%	-1%	-3%	-7%	-4%	-4%	13%	19%	14%	21%	4%
06	72,916	76,258	80,057	82,834	86,971	94,538	110,757	112,107	105,409	104,000	*95,268*	94,970	93,007
	1%	1%	-3%	-2%	5%	8%	4%	8%	-7%	-13%	-12%	-19%	-2%
07	73,316	77,385	77,653	81,393	91,424	102,068	115,465	121,288	98,423	90,959	83,885	77,092	90,863
	-11%	-5%	-1%	-2%	-6%	-8%	-7%	-7%	1%	-5%	-6%	-8%	-5%
08	65,457	73,416	77,000	79,665	86,142	93,491	107,356	112,563	99,567	86,841	78,630	70,809	85,911
	-1%	0%	-6%	2%	2%	0%	2%	3%	-6%	0%	2%	0%	0%
09	64,526	73,454	72,731	81,568	87,930	93,330	109,976	115,536	93,917	86,958	80,492	70,523	85,912

167,789 / 157,440 +6.57

155,739 / 157,024 -0.81

165,812 / 158,279 +4.76

161,238 / 154,236 +4.54

164,366 / 157,240 +4.53

13.02

Ave +2.60

157,440
157,240 } 4 yrs no increase

ITALICS = ESTIMATED DATA
MADT

SECTION I - CONTINUOUS COUNTING STATION MONTHLY AVERAGE DAILY TRAFFIC

STATION 4118 - LEXINGTON - RTE.I-95 - NORTH OF RTE. 2A

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
06	156,000	158,000	158,611	157,414	160,279	161,390	159,906	164,944	165,971	164,465	158,286	151,556	159,735
	-1%	-3%	-2%	-1%	1%	1%	-1%	1%	-4%	0%	-3%	-8%	-2%
07	155,113	153,838	155,532	155,246	162,424	163,391	158,026	165,812	159,259	164,227	154,304	138,731	157,159
	-4%	-5%	0%	2%	-2%	-2%	0%	-5%	-1%	-2%	-4%	0%	-2%
08	148,307	146,065	155,000	157,894	158,459	159,757	157,487	157,557	157,046	160,802	147,668	138,475	153,710
	-1%	1%	-5%	-1%	-2%	1%	0%	1%	-5%	-1%	1%	6%	0%
09	146,747	148,146	147,704	156,341	155,155	161,371	158,076	158,995	149,923	159,664	149,557	146,893	153,214

STATION 4121 - WAKEFIELD - RTE.I-95 (128) - NORTH OF MAIN ST.,LYNNFIELD

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
05	121,000	123,706	126,123	131,584	133,994	141,724	141,915	144,207	132,848	129,681	127,645	120,655	131,257
	-1%	-2%	2%	-3%	0%	-2%	-1%	1%	3%	5%	2%	7%	1%
06	119,913	120,945	129,096	127,666	133,642	139,442	140,232	144,990	137,237	136,029	129,586	128,662	132,287
	3%	0%	-2%	2%	3%	1%	-1%	-1%	-1%	1%	0%	-8%	0%
07	123,351	120,806	126,808	129,816	137,203	140,469	139,311	143,711	136,527	136,892	129,084	118,600	131,882
	-3%	-1%	-5%	1%	-3%	-4%	-2%	-3%	-4%	-6%	-4%	3%	-3%
08	119,901	119,664	121,000	130,595	132,990	135,156	137,048	138,854	131,468	129,000	124,118	121,830	128,469
	4%	6%	2%	2%	1%	2%	1%	2%	3%	4%	8%	-5%	2%
09	124,527	126,780	123,641	132,958	133,890	137,601	138,343	141,803	135,433	134,159	134,042	116,082	131,605

STATION 4137 - WAKEFIELD - RTE.I-95 (128) - NORTH OF NORTH AVE.

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
05	118,727	126,910	129,258	136,509	136,783	145,778	144,912	148,291	137,450	133,920	132,474	127,126	134,845
	5%	-1%	4%	-1%	1%	-1%	-1%	1%	3%	5%	1%	3%	1%
06	124,459	125,589	133,858	134,582	137,621	143,836	144,029	149,082	141,313	140,199	134,165	131,263	136,666
	2%	0%	-2%	0%	3%	1%	0%	0%	0%	1%	0%	-7%	0%
07	127,096	125,439	131,570	134,687	141,920	145,302	143,828	148,817	141,304	141,239	134,058	121,771	136,419
	-2%	-1%	-3%	1%	-1%	-2%	-1%	-3%	-3%	-5%	-3%	0%	-2%
08	124,292	123,717	128,000	136,452	140,058	141,736	142,892	144,448	137,319	134,000	130,162	121,944	133,752
	-7%	4%	1%	2%	0%	1%	0%	2%	2%	3%	0%	-1%	0%
09	115,181	128,242	129,381	138,540	139,380	142,563	142,655	146,628	139,988	138,521	130,676	120,698	134,371

145,778 / 134,845 8.10

143,836 / 136,666 5.25

145,302 / 136,419 6.51

141,737 / 133,752 5.97

142,563 / 134,371 6.10

31.93 / 5 = 6.39

134,845 ↓ 4 yrs no increase
134,371

ITALICS = ESTIMATED DATA
MADT

STATION 4094 - TEWKSBURY - RTE.I-495 - SOUTH OF RTE. 133

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
07	102,351	102,627	106,577	110,198	118,938	121,809	127,805	133,457	119,013	118,605	*115,154*	*106,941*	115,290
	-1%	-2%	4%	2%	-4%	-1%	-3%	-6%	-4%	-2%	-8%	2%	-2%
08	101,374	101,031	111,000	112,165	114,506	120,016	123,483	125,679	114,656	116,648	*105,753*	*108,715*	112,919
	-5%	3%	-6%	2%	0%	2%	3%	2%	3%	-2%	1%	-7%	0%
09	96,811	103,712	104,446	114,001	115,035	122,117	127,687	128,491	118,421	113,868	*106,337*	*100,903*	112,652

STATION 4097 - WOBURN - RTE.I-93 - SOUTH OF RTE. 129 * NEW INTERCHANGE ADDED SEE STATION 4803

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
05	153,000	155,000	158,089	160,793	161,657	170,396	160,596	168,936	164,436	156,967	157,222	151,873	159,914
1	2%	0%	4%	0%	-2%	-7%	-2%	-1%	-1%	3%	1%	3%	0%
06	156,357	154,434	163,625	160,677	159,117	158,755	156,968	167,022	162,431	162,386	158,859	155,925	159,713
2	-2%	-1%	-2%	-2%	0%	0%	-1%	-1%	0%	2%	-6%	-7%	-2%
07	153,807	153,103	159,570	157,811	159,157	*159,000*	155,455	165,595	162,672	166,131	148,790	145,308	157,200
3	-13%	-1%	0%	4%	2%	4%	4%	-2%	0%	0%	5%	-1%	0%
08	134,321	151,511	160,000	163,384	162,410	*164,601*	161,241	162,327	161,867	166,591	156,641	143,959	157,404
4	6%	3%	-2%	0%	-1%	2%	3%	2%	2%	-1%	0%	3%	1%
09	142,567	156,529	156,860	163,948	161,519	*168,117*	165,329	166,314	165,463	164,797	157,195	148,136	159,731

STATION 4099 - STONEHAM - RTE.I-93 - SOUTH OF MONTVALE AVE.

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
06	171,528	178,881	190,667	192,317	194,120	197,904	191,957	198,180	191,898	188,480	185,825	169,929	187,641
	-3%	-5%	-5%	-4%	0%	0%	0%	0%	-1%	2%	-3%	-8%	-2%
07	166,271	169,612	181,820	184,903	193,484	197,685	192,709	198,375	190,088	192,885	181,107	156,435	183,781

STATION 4114 - CHELMSFORD - LOWELL CONNECTOR - SOUTH OF RTE.I-495

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
06	24,000	24,426	26,340	24,316	24,030	24,620	23,036	23,217	24,200	25,148	25,140	23,281	24,313
	-2%	-1%	-5%	2%	5%	1%	1%	6%	3%	6%	-1%	6%	2%
07	23,503	24,074	25,046	24,685	25,137	24,905	23,225	24,568	24,868	26,610	24,930	*24,633*	24,682
	14%	3%	4%	5%	0%	0%	4%	-2%	3%	0%	-3%	-3%	2%
08	26,823	24,798	26,000	26,021	25,223	24,987	24,237	23,980	25,730	26,585	24,120	*24,000*	25,209
	-14%	1%	-3%	-1%	-2%	2%	2%	-1%	2%	2%	5%	4%	0%
09	23,134	24,965	25,163	25,832	24,792	25,548	24,720	23,857	26,189	27,028	25,256	*24,945*	25,119

170,396 / 159,914 +6.55

158,755/159,713 -0.60

159,000/157,200 +1.15

164,606/157,404 +4.58

168,117/159,731 +5.25

17.53 / 4 = 4.38

159,914
159,731 ↓ 4 years No Increase

ITALICS = ESTIMATED DATA

MADT

HAYES ENGINEERING, INC.
603 SALEM STREET
WAKEFIELD, MA 01880
TEL: (781) 246-2800
FAX: (781) 246-7596

JOB FILE #: REA-0316
NAME: Johnson Woods Condominium
DATE: 6/9/11
MADE BY:

☐ MEMO
☑ CALCULATION

MHD Continuous Counting Stations

4097 Woburn Rte 93 South of Rt 129 New Interchange

4098	2005	159,914	
	2009	159,731	-0.11%

4137 Wakefield Rte I 95 North of North Ave

2005	134,845	
2009	134,371	-0.35%

4391 Wilmington Rte 93 North of Concord St

2005	148,990	
2009	146,609	-1.60%

4803 Woburn Rte 93 North of Rte 95 New Interchange

2005	157,470	
2009	157,240	-0.13%

MASS DOT data indicates decrease in traffic volume for the most current data for the closest 4 continuous counting stations

June 3.40
4.38
6.39
6.17
20.14/4 = +5.1% Ave Inc for CCS

Vehicle Speed Survey

SPEED SURVEY
PROJECT LOCATION: JOHNSON WOODS & WEST STREET,READING, MA.

PREPARED BY: WRB
JOB # REA-0316
DATE: 11-Jul-11

DAY OF WEEK: Monday
TIME OF DAY: 11:15 A.M.-12:15 P
WEATHER: Sunny, Dry, 88F

VEHICLE TRAVEL DIRECTION: Southbound

SPEED MEASUREMENT NUMBER	SPEED* (m.p.h)	SPEED MEASUREMENT NUMBER	SPEED* (m.p.h)
1	33	26	34
2	33	27	32
3	33	28	32
4	32	29	34
5	29	30	38
6	36	31	37
7	32	32	30
8	33	33	30
9	41	34	25
10	26	35	28
11	31	36	34
12	32	37	27
13	39	38	33
14	36	39	35
15	34	40	35
16	41	41	34
17	34	42	37
18	37	43	37
19	39	44	32
20	29	45	32
21	32	46	33
22	46	47	35
23	44	48	33
24	33	49	35
25	34	50	34

85th PERCENTILE SPEED (m.p.h.): 37

ARITHMETIC MEAN SPEED (m.p.h.): 33.9

MEDIAN SPEED (m.p.h.): 34

VEHICLE TRAVEL DIRECTION: Northbound

SPEED MEASUREMENT NUMBER	SPEED* (m.p.h)	SPEED MEASUREMENT NUMBER	SPEED* (m.p.h)
1	30	26	31
2	29	27	36
3	27	28	31
4	30	29	33
5	33	30	32
6	30	31	34
7	33	32	33
8	32	33	35
9	38	34	29
10	37	35	38
11	37	36	34
12	34	37	32
13	34	38	31
14	38	39	32
15	27	40	27
16	30	41	30
17	33	42	33
18	32	43	32
19	33	44	38
20	34	45	34
21	32	46	32
22	35	47	34
23	34	48	34
24	27	49	41
25	36	50	37

85th PERCENTILE SPEED (m.p.h.): 37

ARITHMETIC MEAN SPEED (m.p.h.): 33.0

MEDIAN SPEED (m.p.h.): 33

MassDOT Crash Data

Crash Rate Worksheet

July 12, 2011

William R. Bergeron, P.E.
Project Engineer
Hayes Engineering, Inc.
603 Salem Street
Wakefield, MA 01880

E-mail: bbergeron@hayeseng.com

CRASH DATA TRANSMITTAL

In accordance with your request, MassDOT is pleased to transmit the following crash data:

REQUEST NO.: 11-150

CITIES/TOWN(S): Reading

YEAR(S): 2007-2009

__X__ Via E-mail

_____ CD-ROM

_____ Paper Report

All files are Microsoft Excel except as noted. Please note that all crash locations are presented as "raw text" as received from the Registry of Motor Vehicles (RMV).

See the file named Support_Information_5-11.pdf for more information.

The submitted information is subject to the terms of 23 United States Code, Section 409, which provides that any reports, surveys, schedules, lists, or data compiled shall not be subject to discovery or admitted into evidence in a Federal or State court proceeding or considered for other purposes in any action for damages arising from any occurrence at a location mentioned or addressed in such reports, surveys, schedules, lists, or data.

Direct all questions and requests to:

Neil E. Boudreau
State Traffic Engineer
ATTN: Rosalynd Scott
Massachusetts Department of Transportation – Highway Division
Traffic Engineering Section
10 Park Plaza, Rm. 7210
Boston, MA 02116
E-mail: CrashDataRequest@MHD.state.ma.us

Support Information for Using Year 2002 through 2009 MassDOT (formerly MassHighway) Crash Data Files

As of 5/26/2011

Note: This document pertains only to year 2002 through year 2009 crash data. See the file named Support_Information_10-02a for crash data for earlier years.

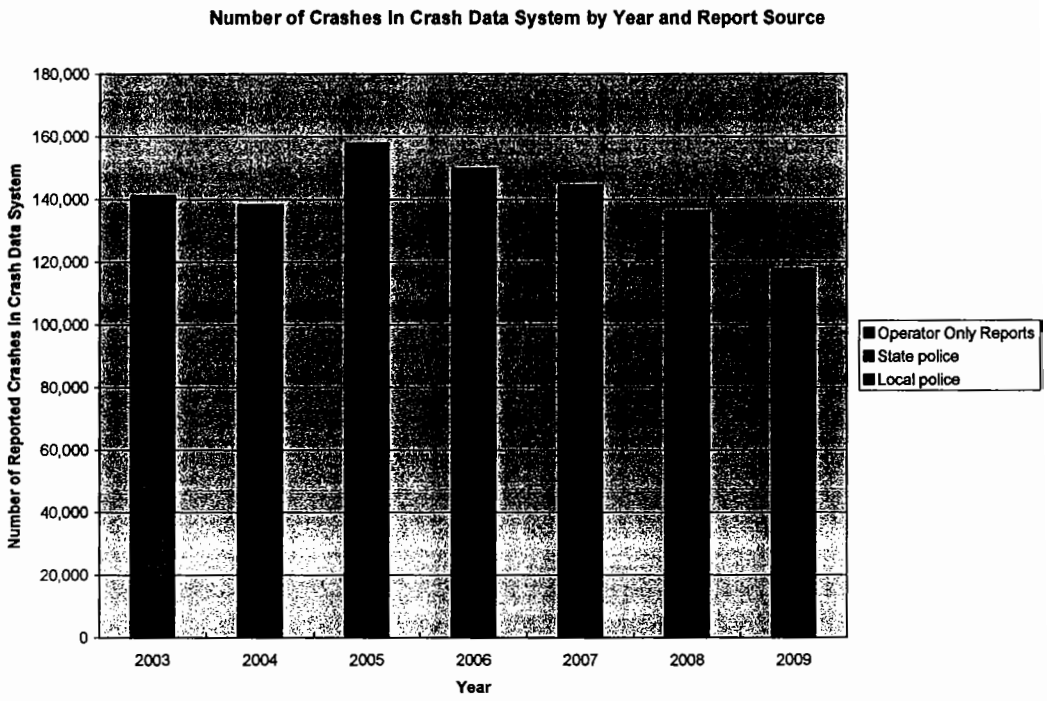
Crash data for years 2002 through 2009 are derived from the Registry of Motor Vehicles (RMV) Crash Data System (CDS). The RMV Division of MassDOT obtains crash reports from local police, State Police, other police agencies, and operators (motorists) who were involved in crashes, and enters the data into CDS. The reporting threshold is any crash involving an injury or fatality, or damage to any one vehicle or other personal property in excess of $1000. Crashes not on public ways are often, but not always, excluded.

The RMV is dependent upon the cooperation of police agencies and the public in sending crash reports in a complete and timely fashion. The Highway Division of MassDOT has geocoded (where possible) the RMV crash data and makes the crash data files available upon request.

The year 2009 Statewide crash data contain 117,762 crashes, compared to 136,384 crashes in 2008, 144,510 crashes in 2007, 149,860 crashes in 2006, 158,084 crashes in 2005 and 138,635 crashes in 2004. The decrease in the total number of crashes in recent years is in part attributable to different reporting rates by different police jurisdictions, but also to the declining number of operator-only reports (reports submitted by motorists who are involved in crashes, for which no police report was submitted) that were entered in CDS by the RMV in recent years. An Excel file named 'Total Crashes by Town and Year1990-2009.xls' is available to show the differences in total crash reports by city/town from year to year.

The chart on the next page shows that the number of operator-only reports that have been entered in the Registry's Crash Data System has been declining each year since 2005. This is not due to a decrease in the number of reports received, but is due to the number of reports that have actually been entered. In recent years not all operator reports that have been received have been entered. However, all police reports received (that have been determined by RMV to be reportable and valid) have been entered.

For cities/towns where local police regularly report all motor vehicle crashes to the RMV, the effects of missing operator-only reports is minimal. However, for those cities/towns where local police do not routinely submit crash reports, or underreport crashes to RMV, the effects of missing operator-only reports in the database is significant when comparisons of crash data are made between years.



As can be seen from the chart above, the total number of crashes reported by and entered from local and State police agencies has been reasonably consistent in recent years. However, due to limited data entry staff at RMV, there has been a significant decline in the number of operator-only reports entered by RMV within the past several years. It cannot be assumed that all operator-only reports are for property damage only crashes. In fact, approximately 25% of all crashes reported by operators and entered into the RMV Crash Data System were non-fatal injury crashes (which is nearly identical to the percentage of injury crashes reported by local police). On a Statewide level the percentage of reports that are property damage only has remained relatively constant in recent years (64.3% in 2009, 63.1% in 2008 and 62.2% in 2007) despite the declining number of operator reports that have been entered each year. However, this may not be the case in each city/town due to different levels of reporting by local police agencies.

Cities/towns with the lowest rates of local police crash reporting in 2009 are shown in the table below (In some cases, actions are being taken to increase reporting in subsequent years):

		NUMBER OF CRASHES REPORTED BY			
CITY/TOWN	Total Crashes	Operator-Only	State Police	Local Police	MBTA Police
BARNSTABLE	202	120	78	4	0
BOSTON	4626	1523	2109	952	42
DUXBURY	76	28	46	2	0
SPRINGFIELD	561	132	421	8	0
WINCHENDON	24	23	0	1	0
BOXBOROUGH	31	8	23	0	0

EASTHAMPTON	78	59	19	0	0
GROVELAND	9	9	0	0	0
LEE	31	13	18	0	0
WELLFLEET	15	15	0	0	0
WEST BRIDGEWATER	78	40	38	0	0
WHATELY	41	3	38	0	0

Some other cities/towns under-reported year 2009 crashes to a lesser degree. See the file named 'Police_Crosstabs_2002-2009 5-11-2011.xls' for further information on individual city/town crash data showing the percentages of crashes by source of report.

The year 2009 crash data files from the Highway Division of MassDOT are in the same format as the year 2007 and 2008 files. X and Y coordinates are included in the last two columns in the data files but note that these columns have been excluded from the default print range. For year 2009 about 94% and for 2008 about 88% of the records have X and Y coordinates. However these are Statewide averages and do not apply to particular crash locations.

Attempts have been made to prevent duplicate crashes from appearing in the crash data, however sometimes they occur. If the crash date, time and location are identical (or nearly identical), the crash may be a duplicate, but with a different crash number.

The data MassDOT Highway Division has supplied is in Microsoft Excel 2003 format. Sorting the data by location may be difficult because of the five different columns that may contain location data. Crash data are not completely standardized. Several different variations of a street name (or other field) may exist. Due to the format of the year 2002-2009 data, searching may be more useful than sorting. Search all five crash location columns for each occurrence of a street name. When selected records are found, they can be copied and pasted into another sheet in the same Workbook.

Explanation of columns and abbreviations in Excel Spreadsheets

A. ***Crash Number*** – Unique number used by Registry of Motor Vehicles to identify each crash. Each crash could have several reports: police, operator(s), so this is the master record ID number. There is no relationship between this number and police department incident numbers.

B. ***City/Town Name*** – The city or town in which the crash occurred. If the crash was reported as occurring in a locality (neighborhood name) within the city or town, this is shown in parentheses after the proper city/town name. However if the crash was just reported as occurring in the city/town (rather than in a locality/neighborhood), then the locality name is not shown. Therefore, searching/sorting by locality name will not identify all crashes that actually occurred in that locality.

C. ***Crash Date*** – Date of the Crash

D. ***Crash Time*** - Time of Crash

E. ***Crash Severity*** – Type of Crash

- Fatal injury
- Non-fatal injury

- Property damage only (none injured)
- Not Reported
- Unknown

F. ***Number of Vehicles*** – Total number of vehicles involved in the crash

G. ***Total Nonfatal Injuries*** - Number of persons injured in the crash excluding fatalities

H. ***Total Fatal Injuries*** - Number of persons killed in the crash

I. ***Manner of Collision*** - Manner of Collision or Collision Type
   - Angle
   - Head-on
   - Rear-end
   - Rear-to-Rear
   - Sideswipe, opposite direction
   - Sideswipe, same direction
   - Single vehicle crash
   - Unknown
   - Not reported

J. ***Vehicle Action Prior to Crash*** – The action that each vehicle was taking prior to the crash; V1 = Vehicle 1, V2 = Vehicle 2, etc.
   - Travelling straight ahead
   - Slowing or stopped in traffic
   - Turning right
   - Turning left
   - Changing lanes
   - Entering traffic lane
   - Leaving traffic lane
   - Making U-turn
   - Overtaking/passing
   - Backing
   - Parked
   - Other
   - Not reported
   - Unknown

K. ***Vehicle Travel Directions*** – Direction that each vehicle was traveling at time of the crash; V1 = Vehicle 1, V2 = Vehicle 2, etc.

L. ***Most Harmful Events*** – Most harmful event for each vehicle. *Only reported if the source of data was from a police report. Not reported if the only source of data was from an operator report.*
   - Collision with motor vehicle in traffic
   - Collision with parked motor vehicle
   - Collision with pedestrian
   - Collision with cyclist (bicycle, tricycle, unicycle)
   - Collision with animal – deer
   - Collision with animal – other
   - Collision with moped
   - Collision with workzone maintenance equipment

- Collision with railway vehicle (train, engine)
- Collision with other movable object
- Collision with curb
- Collision with tree
- Collision with utility pole
- Collision with light pole or other post/support
- Collision with guardrail
- Collision with median barrier
- Collision with ditch
- Collision with embankment
- Collision with highway traffic sign post
- Collision with overhead sign support
- Collision with fence
- Collision with mailbox
- Collision with impact attenuator/crash cushion
- Collision with bridge
- Collision with bridge overhead structure
- Collision with other fixed object (wall, building, tunnel)
- Collision with unknown fixed object
- Overturn/rollover
- Fire/explosion
- Immersion
- Jackknife
- Cargo/equipment loss or shift
- Other
- Other non-collision
- Unknown non-collision
- Unknown
- Reported but invalid

M. Vehicle Configuration – The type of each vehicle involved in the crash

- Passenger car
- Light truck (Van, mini-van, pick-up, sport utility)
- Motorcycle
- Bus (with seats for more than 15 people, including driver)
- Bus (with seats for 7-15 people, including driver)
- Single unit truck (2 axles, 6 tires)
- Single unit truck (3 or more axles)
- Truck/trailer
- Truck tractor (Bobtail)
- Tractor/semi-trailer
- Tractor/doubles
- Tractor/triples
- Unknown heavy truck
- Motor home/recreational

- Other
- Unknown

N. ***Road Surface Condition*** –The condition of the road's surface at the time of the crash

- Dry
- Wet
- Snow
- Ice
- Sand, mud, dirt, oil, gravel
- Water (standing, moving)
- Slush
- Other
- Unknown

O. ***Ambient Light*** – Light conditions

- Daylight
- Dawn
- Dusk
- Dark – lighted roadway
- Dark – roadway not lighted
- Dark – unknown roadway lighting
- Other
- Unknown

P. ***Weather Condition*** – A maximum of two weather conditions may be reported

- Clear
- Cloudy
- Rain
- Snow
- Sleet, hail, freezing rain
- Fog, smog, smoke
- Severe crosswinds
- Blowing sand, snow
- Other
- Unknown

Q. ***At Roadway Intersection*** – If crash location information was entered in the AT INTERSECTION side of the report, the route numbers and/or roadway names will appear in this column. The route/roadway where the crash occurred will appear first, followed by a slash (/), followed by up to two combinations of routes and/or roadway names.

R. ***Distance from Nearest Roadway Intersection*** – If crash location information was entered in the NOT AT INTERSECTION side of the report, and if the crash was referenced as occurring at some distance and direction from the nearest intersecting street, the crash location information will appear in this column. However, sometimes only a route and/or roadway name will appear, or other information such as address numbers may appear in this column.

S. ***Distance from Nearest Milemarker*** – If crash location information was entered in the NOT AT INTERSECTION side of the report, and if the crash was referenced as occurring at some distance and direction from the nearest milemarker, the crash

location information will appear in this column. However, sometimes only a route and/or roadway name will appear, or other information may appear in this column.

T. ***Distance from Nearest Exit*** – If crash location information was entered in the NOT AT INTERSECTION side of the report, and if the crash was referenced as occurring at some distance and direction from the exit or interchange, the crash location information will appear in this column. However, sometimes only a route number or other information may appear in this column.

U. ***Address/Distance from Nearest Landmark*** – If crash location information was entered in the NOT AT INTERSECTION side of the report, and if the crash was referenced as occurring at a street address or at a landmark, or at some distance and direction from them, the crash location information will appear in this column. However, sometimes only a roadway name, route number, or other information may appear in this column. There may be some data in this column that duplicates data in other crash location columns. Landmark text is limited to a maximum of 32 characters (the portion enclosed by parentheses). Beginning with year 2006 data, address information was eliminated from this column because it usually duplicated information that was already contained in column "P."

V. ***Non Motorist Type*** – For any Non Motorists that were reported as being involved in the crash, the Person Number (P1, P2, etc.) of the Non Motorist is shown, followed by that person's role: Pedestrian, Pedalcyclist (bicycle, tricycle, unicycle, pedal car), Skater, Railroad or Trolley Passenger, or Other non-motorist (wheelchair, etc.).

Crash location data as described above will only be shown in the format described above if it was correctly entered by police or operators and/or RMV. Offset and/or direction of offset may be missing, or the nearest intersecting street/milemarker/exit number may be missing.

W, X. Shown are ***X and Y coordinates for crashes that have been geocoded*** (located to a point) by the MassDOT Highway Division GIS (Geographic Information System) crash geocoding application. Coordinates are shown only for crashes that were successfully geocoded to a point or to an approximate point based on available crash location data. Users should be aware that for many crashes (especially ones located at or near an exit, highway interchange, rotary, etc.) these coordinates are only approximate, depending on the quality of the source crash location data. Crashes referenced by an exit number or interchange may in fact actually have occurred some distance from that exit or interchange. Coordinates are in Massachusetts Mainland State Plane NAD 83 meters. The X and Y coordinate columns have been excluded from the default print range in order to keep the font size of printed report pages reasonably legible.

MassHighway

CRASH RATE WORKSHEET

CITY/TOWN : Reading COUNT DAT June,11,2011

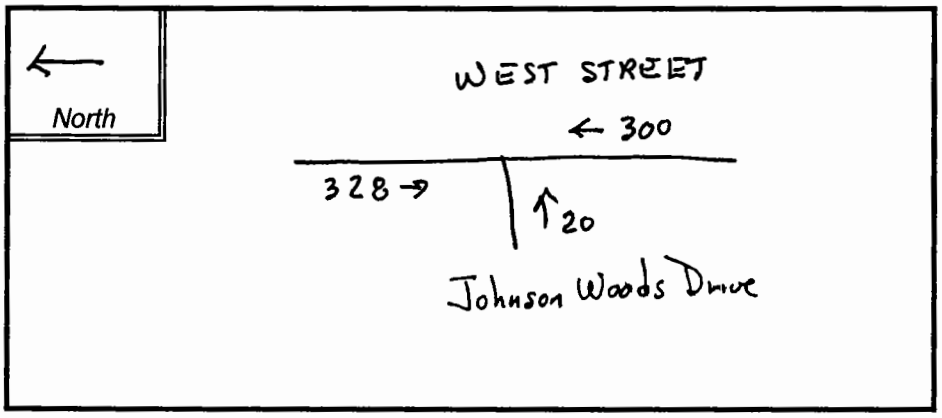
DISTRICT : 4 UNSIGNALIZED : Yes SIGNALIZED :

~ INTERSECTION DATA ~

MAJOR STREET : West Street

MINOR STREET(S) : Johnson Woods Drive

INTERSECTION DIAGRAM (Label Approaches)



Peak Hour Volumes

APPROACH :	1	2	3	4	5	Total Entering Vehicles
DIRECTION :	EB	WB	NB			
VOLUMES (AM/PM) :	328	300	20			648

" K " FACTOR : 0.090 APPROACH ADT : 7,200 ADT = TOTAL VOL/"K" FACT.

TOTAL # OF CRASHES :	3	# OF YEARS :	3	AVERAGE # OF CRASHES (A) :	1.00

CRASH RATE CALCULATION : 0.38 RATE = $\frac{(A * 1{,}000{,}000)}{(ADT * 365)}$

Comments : Accidents were not at drive but in general adjacent areas.

Project Title & Date: Johnson Woods Condominium

Institute of Transportation Engineers
Trip Generation, 8th Edition

Land Use: 230
Residential Condominium/Townhouse

Description

Residential condominiums/townhouses are defined as ownership units that have at least one other owned unit within the same building structure. **Both condominiums and townhouses are included in this land use.** The studies in this land use did not identify whether the condominiums/townhouses were low-rise or high-rise. Low-rise residential condominium/townhouse (Land Use 231), high-rise residential condominium/townhouse (Land Use 232) and luxury condominium/townhouse (Land Use 233) are related uses.

Additional Data

The number of vehicles and the number of residents had a high correlation with average weekday vehicle trip ends. The use of these variables was limited, however, because the number of vehicles and residents was often difficult to obtain or predict. The number of dwelling units was generally used as the independent variable of choice because it is usually readily available, easy to project and had a high correlation with average weekday vehicle trip ends.

The peak hour of the generator typically coincided with the peak hour of the adjacent street traffic.

The sites were surveyed between the mid-1970s and the 2000s throughout the United States and Canada.

Source Numbers

4, 92, 94, 95, 97, 100, 105, 106, 114, 168, 186, 204, 237, 253, 293, 319, 320, 321, 390, 412, 418, 561, 562, 583, 638

Residential Condominium/Townhouse
(230)

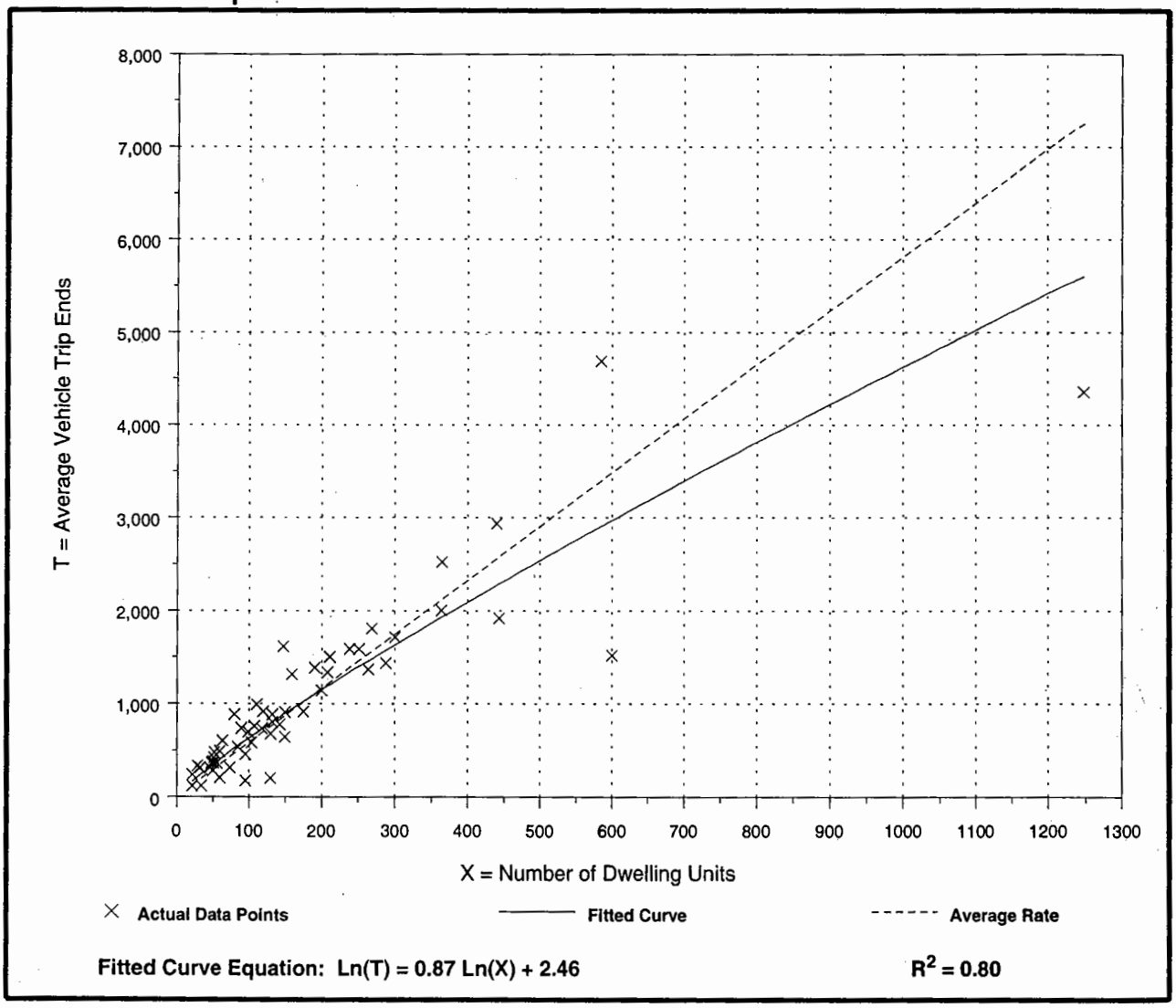
Average Vehicle Trip Ends vs: Dwelling Units
On a: Weekday

Number of Studies: 56
Avg. Number of Dwelling Units: 179
Directional Distribution: 50% entering, 50% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
5.81	1.53 - 11.79	3.11

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.87 Ln(X) + 2.46

R^2 = 0.80

Residential Condominium/Townhouse
(230)

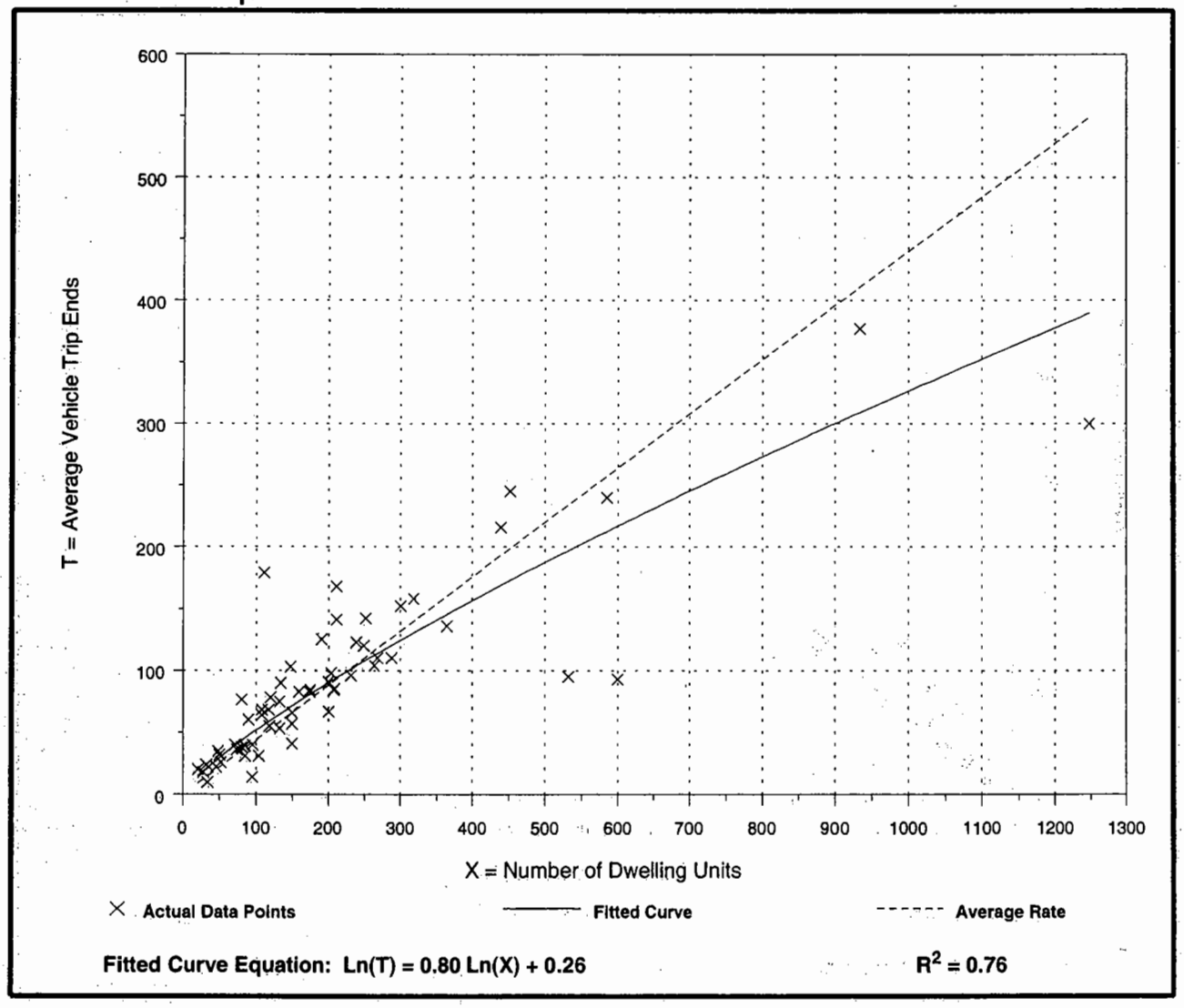
Average Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.

Number of Studies: 59
Avg. Number of Dwelling Units: 213
Directional Distribution: 17% entering, 83% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.44	0.15 - 1.61	0.69

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.80 Ln(X) + 0.26 $R^2 = 0.76$

Residential Condominium/Townhouse
(230)

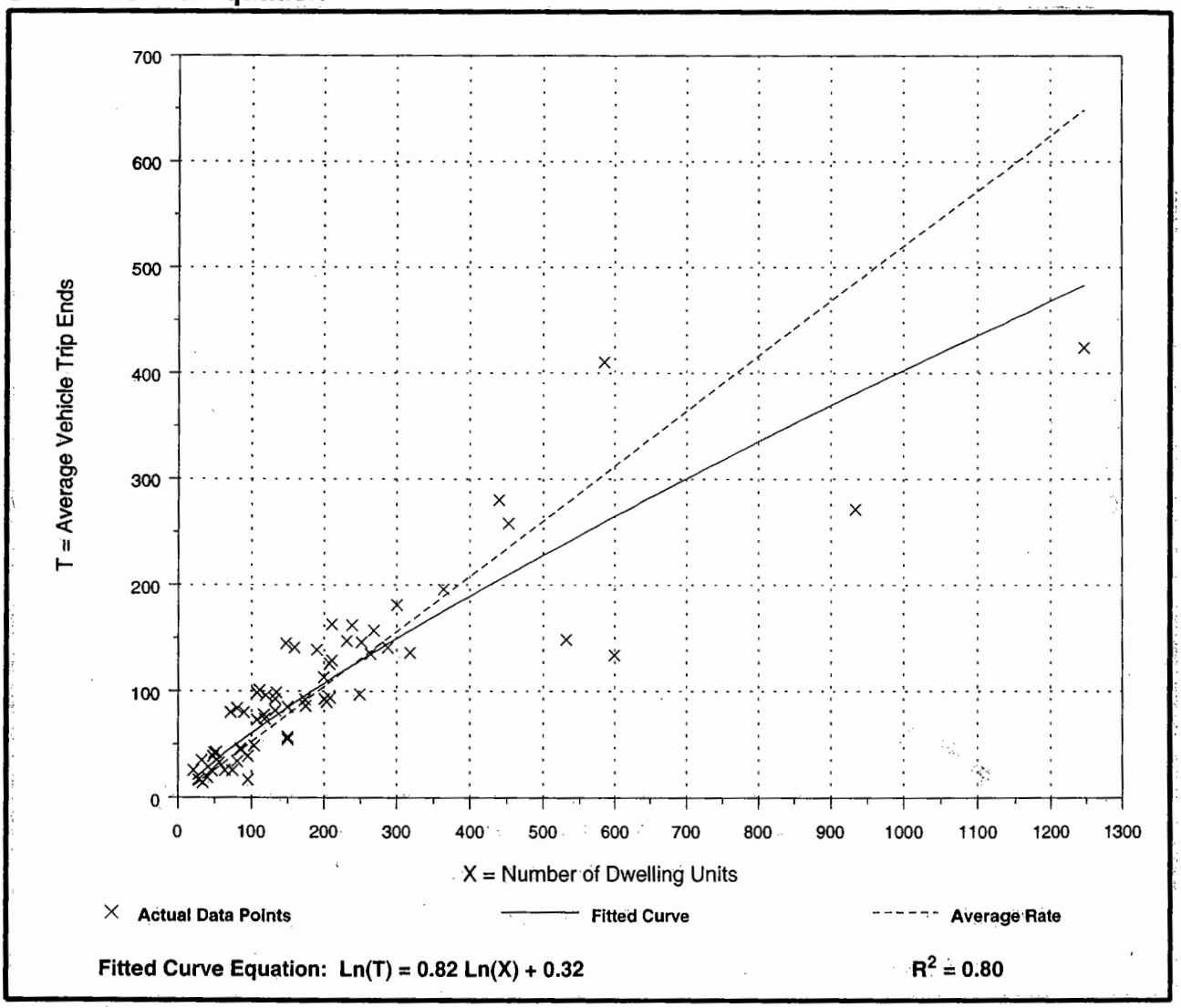
Average Vehicle Trip Ends vs: Dwelling Units
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.

Number of Studies: 62
Avg. Number of Dwelling Units: 205
Directional Distribution: 67% entering, 33% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.52	0.18 - 1.24	0.75

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.82 Ln(X) + 0.32

R^2 = 0.80

Capacity Analysis

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	WRB
Agency/Co.	Hayes Engineering, Inc.
Date Performed	8/16/2011
Analysis Time Period	AM Peak Hour 2011

Site Information

Intersection	Johnson Woods Drive and West S
Jurisdiction	Reading
Analysis Year	Existing Johnson Woods 2011

Project Description: Johnson Woods

East/West Street: West Street | North/South Street: Johnson Woods Drive

Intersection Orientation: East-West | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		305	0	12	288	
Peak-Hour Factor, PHF	1.00	0.86	1.00	1.00	0.97	1.00
Hourly Flow Rate, HFR (veh/h)	0	354	0	12	296	0
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration			TR	LT		
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	7		65			
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR (veh/h)	7	0	65	0	0	0
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT		LR				
v (veh/h)		12		72				
C (m) (veh/h)		1216		652				
v/c		0.01		0.11				
95% queue length		0.03		0.37				
Control Delay (s/veh)		8.0		11.2				
LOS		A		B				
Approach Delay (s/veh)	--	--	11.2					
Approach LOS	--	--	B					

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	WRB
Agency/Co.	Hayes Engineering, Inc.
Date Performed	8/16/2011
Analysis Time Period	PM Peak Hour 2011

Site Information

Intersection	Johnson Woods Drive and West S
Jurisdiction	Reading
Analysis Year	Existing PM 2011Johnson Woods

Project Description Johnson Woods

East/West Street: West Street | North/South Street: Johnson Woods Drive

Intersection Orientation: East-West | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		328	13	20	300	
Peak-Hour Factor, PHF	1.00	0.91	1.00	1.00	0.97	1.00
Hourly Flow Rate, HFR (veh/h)	0	360	13	20	309	0
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration			TR	LT		
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	5		20			
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR (veh/h)	5	0	20	0	0	0
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT		LR				
v (veh/h)		20		25				
C (m) (veh/h)		1197		596				
v/c		0.02		0.04				
95% queue length		0.05		0.13				
Control Delay (s/veh)		8.1		11.3				
LOS		A		B				
Approach Delay (s/veh)	--	--	11.3					
Approach LOS	--	--	B					

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*WRB*
Agency/Co.	*Hayes Engineering, Inc.*
Date Performed	*8/16/2011*
Analysis Time Period	*AM Peak Hour*

Site Information

Intersection	*Johnson Woods Drive and West S*
Jurisdiction	*Reading*
Analysis Year	*No-Build 2016(Phase I complete*

Project Description *Johnson Woods*

East/West Street: *West Street* | North/South Street: *Johnson Woods Drive*

Intersection Orientation: *East-West* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*321*	*1*	*22*	*303*	
Peak-Hour Factor, PHF	*1.00*	*0.86*	*1.00*	*0.60*	*0.97*	*1.00*
Hourly Flow Rate, HFR (veh/h)	*0*	*373*	*1*	*36*	*312*	*0*
Percent Heavy Vehicles	*0*	–	–	*0*	–	–
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration			*TR*	*LT*		
Upstream Signal		*0*			*0*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*13*		*37*			
Peak-Hour Factor, PHF	*0.88*	*1.00*	*0.59*	*1.00*	*1.00*	*1.00*
Hourly Flow Rate, HFR (veh/h)	*14*	*0*	*62*	*0*	*0*	*0*
Percent Heavy Vehicles	*0*	*0*	*0*	*0*	*0*	*0*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration		*LR*				

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*LT*		*LR*				
v (veh/h)		*36*		*76*				
C (m) (veh/h)		*1196*		*586*				
v/c		*0.03*		*0.13*				
95% queue length		*0.09*		*0.44*				
Control Delay (s/veh)		*8.1*		*12.1*				
LOS		*A*		*B*				
Approach Delay (s/veh)	--	--	*12.1*					
Approach LOS	--	--	*B*					

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	WRB
Agency/Co.	Hayes Engineering, Inc.
Date Performed	8/16/2011
Analysis Time Period	PM Peak Hour

Site Information

Intersection	Johnson Woods Drive and West S
Jurisdiction	Reading
Analysis Year	No-Build 2016 Phase I Built

Project Description: Johnson Woods

East/West Street: West Street | North/South Street: Johnson Woods Drive

Intersection Orientation: East-West | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		345	25	38	315	
Peak-Hour Factor, PHF	1.00	0.91	1.00	0.71	0.97	1.00
Hourly Flow Rate, HFR (veh/h)	0	379	25	53	324	0
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration			TR	LT		
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	10		28			
Peak-Hour Factor, PHF	0.83	1.00	0.63	1.00	1.00	1.00
Hourly Flow Rate, HFR (veh/h)	12	0	44	0	0	0
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT		LR				
v (veh/h)		53		56				
C (m) (veh/h)		1166		544				
v/c		0.05		0.10				
95% queue length		0.14		0.34				
Control Delay (s/veh)		8.2		12.4				
LOS		A		B				
Approach Delay (s/veh)	--	--	12.4					
Approach LOS	--	--	B					

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	WRB
Agency/Co.	Hayes Engineering, Inc.
Date Performed	8/16/2011
Analysis Time Period	AM Peak Hour

Site Information

Intersection	Johnson Woods Drive and West S
Jurisdiction	Reading
Analysis Year	Build 2016 Full build Phase II

Project Description Johnson Woods

East/West Street: West Street | North/South Street: Johnson Woods Drive

Intersection Orientation: East-West | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		321	2	39	303	
Peak-Hour Factor, PHF	1.00	0.86	1.00	1.00	0.97	1.00
Hourly Flow Rate, HFR (veh/h)	0	373	2	39	312	0
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration			TR	LT		
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	23		65			
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR (veh/h)	23	0	65	0	0	0
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT		LR				
v (veh/h)		39		88				
C (m) (veh/h)		1195		552				
v/c		0.03		0.16				
95% queue length		0.10		0.56				
Control Delay (s/veh)		8.1		12.8				
LOS		A		B				
Approach Delay (s/veh)	--	--	12.8					
Approach LOS	--	--	B					

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	WRB
Agency/Co.	Hayes Engineering, Inc.
Date Performed	8/16/2011
Analysis Time Period	PM Peak Hour

Site Information

Intersection	Johnson Woods Drive and West S
Jurisdiction	Reading
Analysis Year	Build 2016 Phase II

Project Description: Johnson Woods

East/West Street: West Street | North/South Street: Johnson Woods Drive

Intersection Orientation: East-West | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		345	44	67	315	
Peak-Hour Factor, PHF	1.00	0.91	1.00	1.00	0.97	1.00
Hourly Flow Rate, HFR (veh/h)	0	379	44	67	324	0
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration			TR	LT		
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	17		50			
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR (veh/h)	17	0	50	0	0	0
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT		LR				
v (veh/h)		67		67				
C (m) (veh/h)		1147		510				
v/c		0.06		0.13				
95% queue length		0.19		0.45				
Control Delay (s/veh)		8.3		13.1				
LOS		A		B				
Approach Delay (s/veh)	--	--	13.1					
Approach LOS	--	--	B					

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Stopping Sight Distance

HAYES ENGINEERING, INC.
603 SALEM STREET
WAKEFIELD, MA 01880
TEL: (781) 246-2800
FAX: (781) 246-7596

JOB FILE #: REA-0316
NAME: Johnson Woods Condominium
DATE: 8/19/11
MADE BY: WRB

☐ MEMO
☑ CALCULATION

Stopping Sight Distance

The 85% Percentile Speed observed was 37 MPH for each direction.

$$d = 1.47\,Vt + \frac{1.075\,V^2}{a} \qquad t = 2.5\ \text{sec}, \quad a = 11.2$$

@37MPH $\quad d = 1.47(37)(2.5) + \frac{1.075(37)^2}{11.2}$

$= 135.8 + 131.4 = 267.2$ Feet

$d_{25\,MPH} = 155$ Feet

$d_{30\,MPH} = 200$ Feet

$ISD = 1.47\,Vt_g \qquad t_g = 7.5$ sec

$ISD = 1.47(37)(7.5) = 408$ Feet