TECHNICAL APPENDIX

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APARTMENT TRIP GENERATION DATA
RETAIL TRIP GENERATION COMPARISON DATA
SATURDAY COUNT COMPARISON DATA
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REVISED CAPACITY ANALYSIS SUMMARY TABLES
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REVISED GARAGE PLANS

CRASH TABLE

REPORTS

Date	Time	Type	Surface	Location	Cause	Personal Injury
10/31/14	0910	Sideswipe	Dry	409 Harvard Street	MV1 hit MV2 during parking	No
6/7/14	1250	Pedestrian	Dry	Harvard/Coolidge	MV1 hit pedestrian in crosswalk	Yes
2/4/15	0920	Sideswipe	Slush	103 Winchester Street	MV1 hit parked MV2	No
2/5/16	1642	Angle	Snow	Winchester/Fuller	MV2 hit moving MV1	Yes

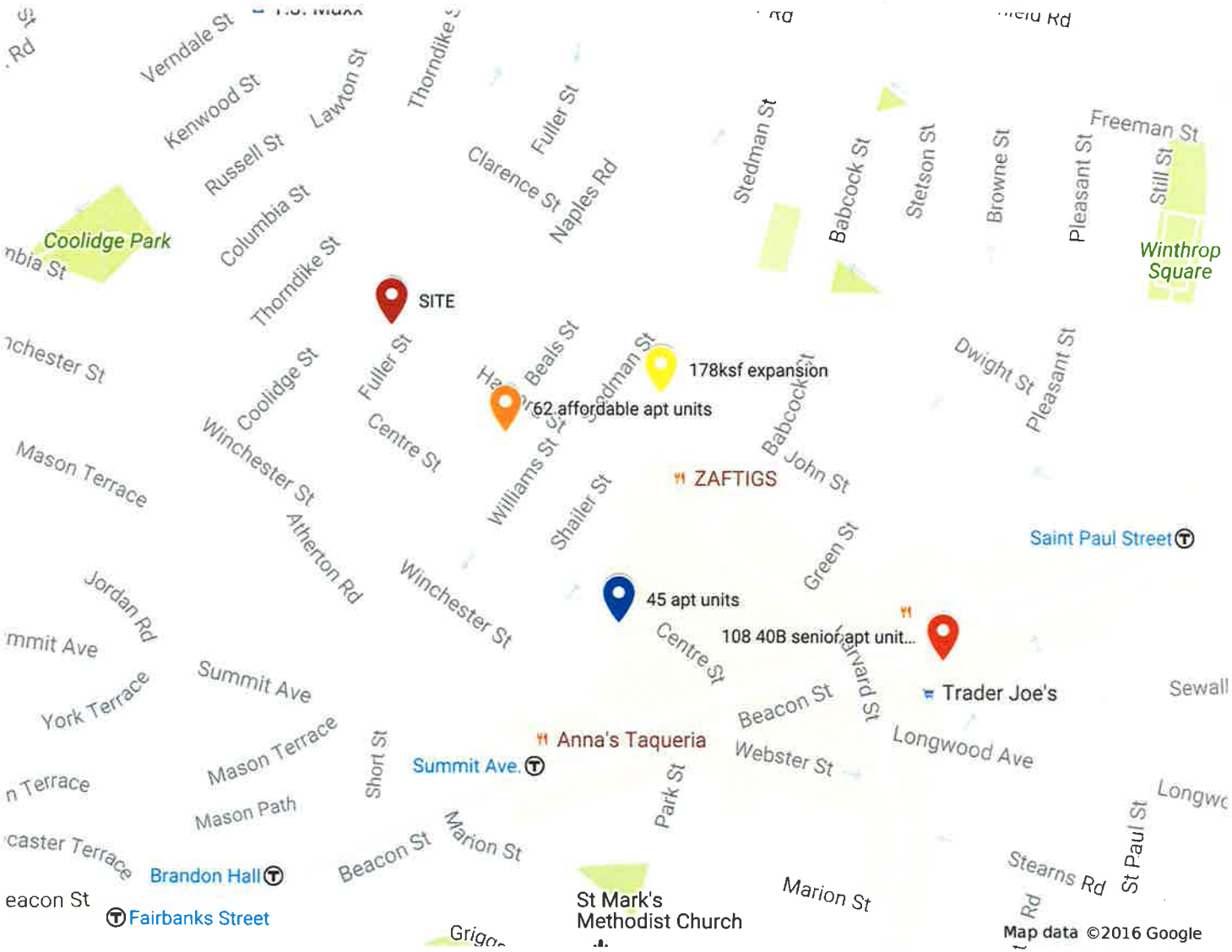
ABSTRACTS

Date	Time	Type	Surface	Location	Cause	Personal Injury
2/8/14				Coolidge/Harvard	MV1 hit MV2	No
5/8/14				404 Harvard	MV1 hit pedestrian	No
7/8/14				Fuller/Centre	MV1 hit parked MV2	No
7/10/14				Harvard/Fuller	MV1 hit MV2	No
8/15/14				Harvard/Fuller	Bicyclist hit MV1	No
9/1/14				Harvard/Coolidge	Bicyclist and MV1	No
10/9/14				Harvard/Fuller	MV1 hit MV2	No
11/21/14	N/A	N/A	N/A	414 Harvard	MV1 hit MV2	No
1/14/15				Harvard/Coolidge	MV1 hit MV2	No
1/26/15				Harvard/Fuller/Mun. Lot	MV1 hit MV2	No
4/2/15				Harvard/Coolidge	MV1 hit MV2	No
5/3/15				Harvard/Fuller	MV1 hit MV2	No
2/10/16				Winchester/Fuller	MV1 hit MV2	No
3/29/16				30 Fuller St.	No cause listed	No
5/3/16				26 Fuller St.	No cause listed	Yes
5/4/16				Harvard/Fuller	MV1 hit parked MV2	No
5/29/16				Harvard/Fuller	MV1 hit MV2	No

420 Harvard St Background Projects

Projects

- 1299 Beacon St
- 345 Harvard St
- 384 Harvard St
- 40 Centre St
- 420 Harvard St



Background development 384 Harvard Street 350 St Nelson

Institute of Transportation Engineers (ITE)
Trip Generation, 9 th Edition
Land Use Code (LUC) 252 - Senior Adult Housing - Attached

Average Vehicle Trips Ends vs: Dwelling Units
Independent Variable (X): 62

AVERAGE WEEKDAY DAILY

T = 2.98 * (X) +21.05
T = 2.98 * 62 +21.05
T = 205.81
T = 206 vehicle trips
with 50% (103 vph) entering and 50% (103 vph) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.20 * (X) - 0.13
T = 0.20 * 62 - 0.13
T = 12.27
T = 12 vehicle trips
with 34% (4 vph) entering and 66% (8 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.24 * (X) +1.64
T = 0.24 * 62 + 1.64
T = 16.52
T = 17 vehicle trips
with 54% (9 vph) entering and 46% (8 vph) exiting.

SATURDAY DAILY

T = 2.61 * (X)
T = 2.61 * 62
T = 161.82
T = 162 vehicle trips
with 50% (81 vph) entering and 50% (81 vph) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

T = 0.31 * (X) +0.46
T = 0.31 * 62 +0.46
T = 19.68
T = 20 vehicle trips
with 57% (11 vph) entering and 43% (9 vph) exiting.[1]

Background Development Renovation School Expansion 545 Harvard Street

1000 feet from Site

Future Condition

Institute of Transportation Engineers (ITE)
***Trip Generation, 9*th Edition**
Land Use Code (LUC) 520 - Elementary School

Average Vehicle Trips Ends vs: Students
Independent Variable (X): 1,044

AVERAGE WEEKDAY DAILY
T = 1.29 * (X)
T = 1.29 * 1,044
T = 1346.76
T = 1,346 vehicle trips
with 50% (673 vph) entering and 50% (673 vph) exiting.

WEEKDAY MORNING PEAK HOUR
T = 0.45 * (X)
T = 0.45 * 1,044
T = 469.80
T = 470 vehicle trips
with 55% (259 vph) entering and 45% (211 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF GENERATOR
T = 0.28 * (X)
T = 0.28 * 1,044
T = 292.32
T = 292 vehicle trips
with 45% (131 vph) entering and 55% (161 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC
T = 0.15 * (X)
T = 0.15 * 1,044
T = 156.60
T = 157 vehicle trips
with 49% (77 vph) entering and 51% (80 vph) exiting.

Background Development Devotion School Expansion

345 Harvard Street

1000 feet from Site

Present condition

Institute of Transportation Engineers (ITE)
Trip Generation, 9 th Edition
Land Use Code (LUC) 520 - Elementary School

Average Vehicle Trips Ends vs: Students
Independent Variable (X): 846

AVERAGE WEEKDAY DAILY

T = 1.29 * (X)
T = 1.29 * 846
T = 1091.34
T = 1,092 vehicle trips
with 50% (546 vph) entering and 50% (546 vph) exiting.

WEEKDAY MORNING PEAK HOUR

T = 0.45 * (X)
T = 0.45 * 846
T = 380.70
T = 381 vehicle trips
with 55% (210 vph) entering and 45% (171 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF GENERATOR

T = 0.28 * (X)
T = 0.28 * 846
T = 236.88
T = 237 vehicle trips
with 45% (107 vph) entering and 55% (130 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.15 * (X)
T = 0.15 * 846
T = 126.90
T = 127 vehicle trips
with 49% (62 vph) entering and 51% (65 vph) exiting.

Background Development 40 Centre Street 15051 Fountain

Institute of Transportation Engineers (ITE)
*Trip Generation, 9*th Edition
Land Use Code (LUC) 220 - Apartment

Average Vehicle Trips Ends vs: Dwelling Units
Independent Variable (X): 45

AVERAGE WEEKDAY DAILY

T = 6.65 * (X)
T = 6.65 * 45
T = 299.25
T = 300 vehicle trips
with 50% (150 vpd) entering and 50% (150 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.51 * (X)
T = 0.51 * 45
T = 22.95
T = 23 vehicle trips
with 20% (5 vph) entering and 80% (18 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.62 * (X)
T = 0.62 * 45
T = 27.90
T = 28 vehicle trips
with 65% (18 vph) entering and 35% (10 vph) exiting.

SATURDAY DAILY

T = 6.39 * (X)
T = 6.39 * 45
T = 287.55
T = 288 vehicle trips
with 50% (144 vpd) entering and 50% (144 vpd) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

T = 0.52 * (X)
T = 0.52 * 45
T = 23.40
T = 23 vehicle trips
with 53% (12 vph) entering and 47% (11 vph) exiting.
(same distribution split as ITE LUC 210 during the Saturday midday peak hour of generator)

Background Development 1299 Beacon St and @ 2500 St [illegible]

Institute of Transportation Engineers (ITE)
*Trip Generation, 9*th Edition
Land Use Code (LUC) 252 - Senior Adult Housing - Attached

Average Vehicle Trips Ends vs: Dwelling Units
Independent Variable (X): 108

AVERAGE WEEKDAY DAILY

T = 2.98 * (X) +21.05
T = 2.98 * 108 +21.05
T = 342.89
T = 342 vehicle trips
with 50% (171 vph) entering and 50% (171 vph) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.20 * (X) - 0.13
T = 0.20 * 108 - 0.13
T = 21.47
T = 21 vehicle trips
with 34% (7 vph) entering and 66% (14 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.24 * (X) +1.64
T = 0.24 * 108 + 1.64
T = 27.56
T = 28 vehicle trips
with 54% (15 vph) entering and 46% (13 vph) exiting.

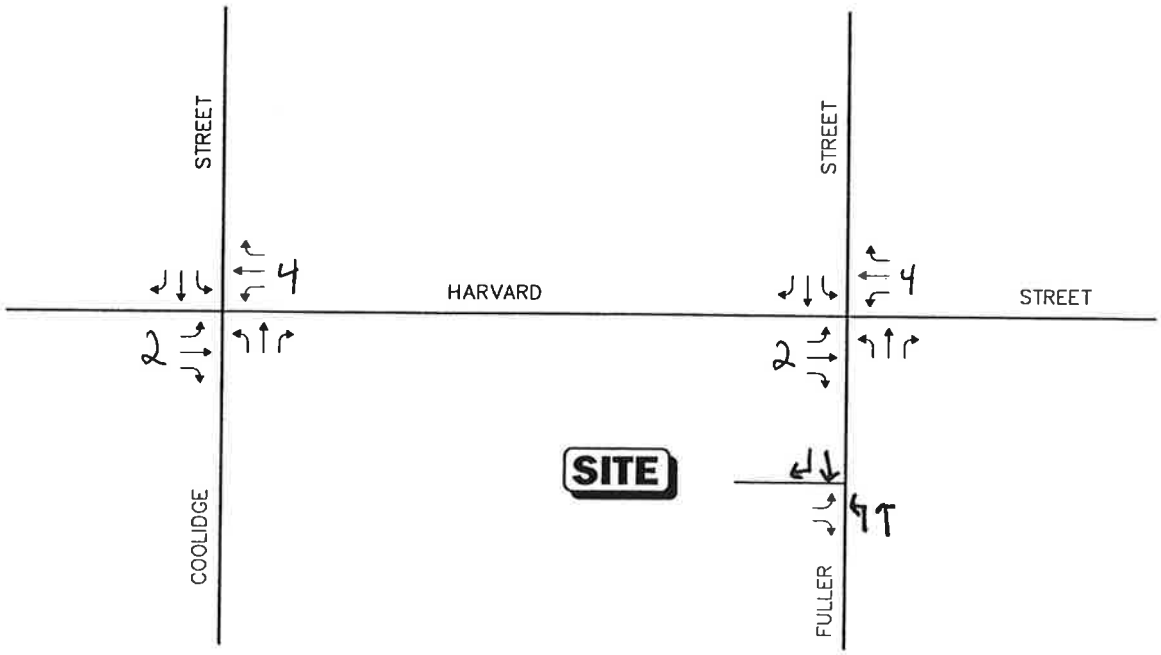
SATURDAY DAILY

T = 2.61 * (X)
T = 2.61 * 108
T = 281.88
T = 282 vehicle trips
with 50% (141 vph) entering and 50% (141 vph) exiting.

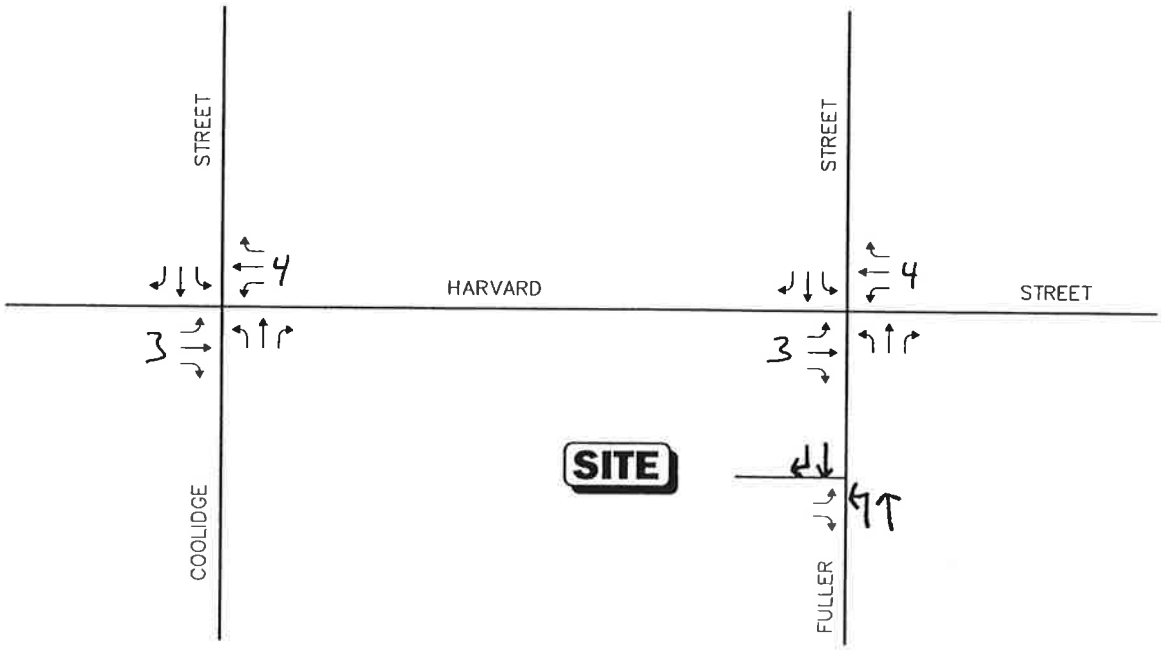
SATURDAY MIDDAY PEAK HOUR OF GENERATOR

T = 0.31 * (X) +0.46
T = 0.31 * 108 +0.46
T = 33.94
T = 34 vehicle trips
with 57% (19 vph) entering and 43% (15 vph) exiting.[1]

WEEKDAY MORNING PEAK HOUR



WEEKDAY EVENING PEAK HOUR



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Not To Scale

Figure -

Vanasse & Associates, Inc.
Transportation Engineers & Planners

: 384 Harvard Street
Background Development

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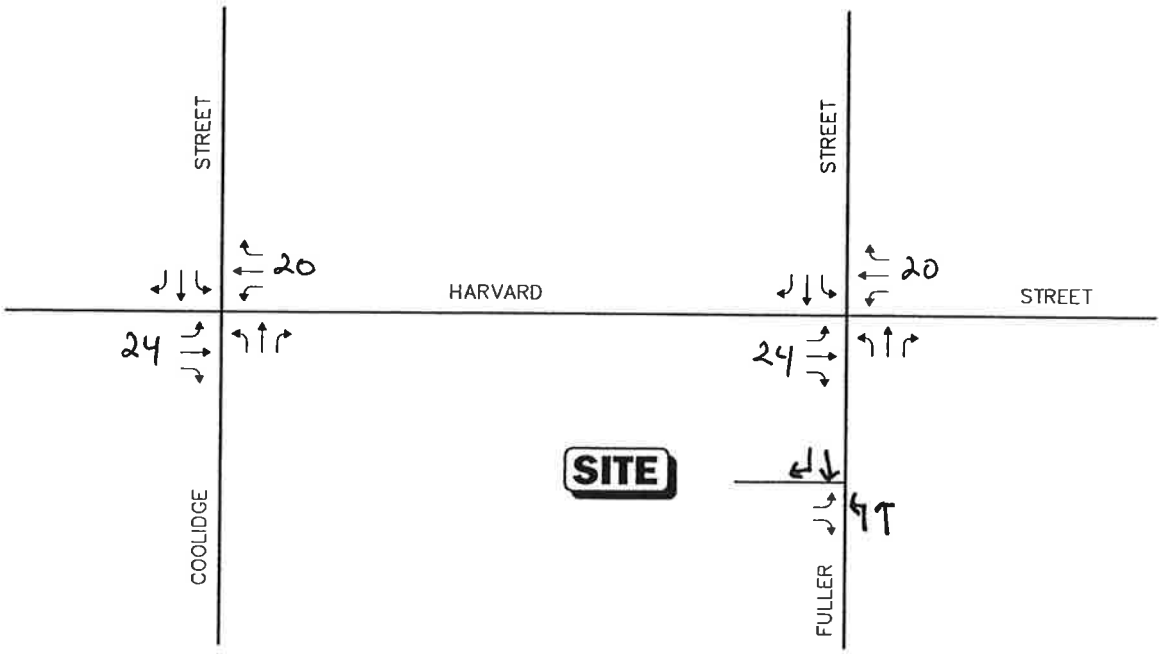
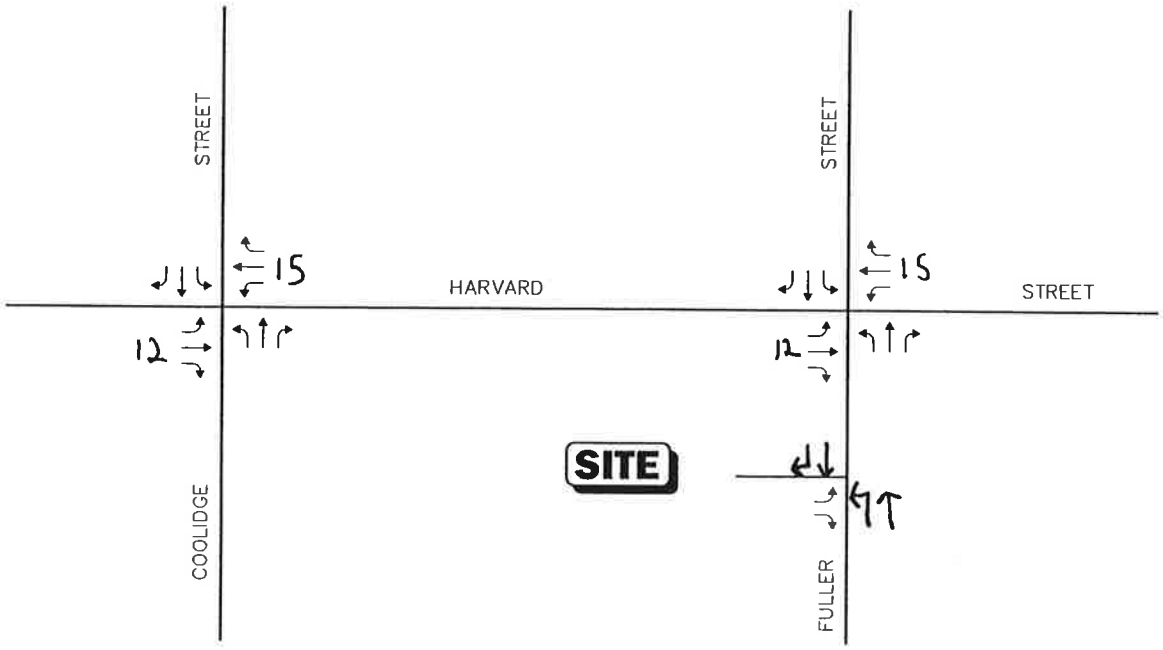
WEEKDAY MORNING PEAK HOUR



WEEKDAY EVENING PEAK HOUR



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Not To Scale

Figure -

- 345 Harvard Street
- Background Development

Vanasse & Associates, Inc.
Transportation Engineers & Planners

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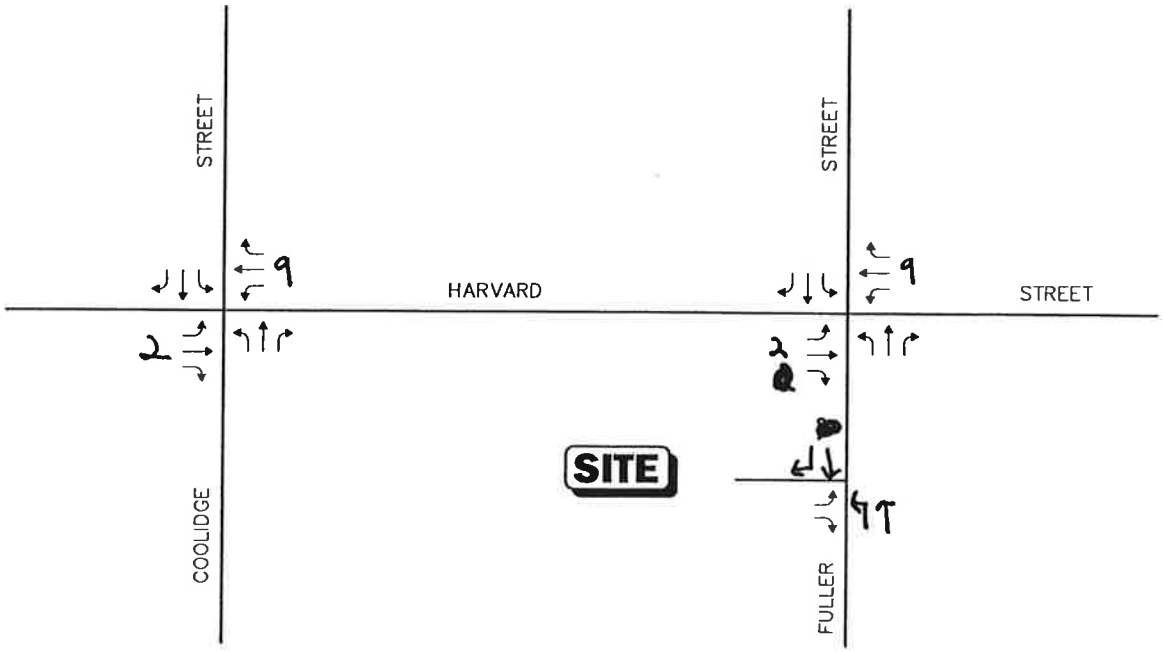
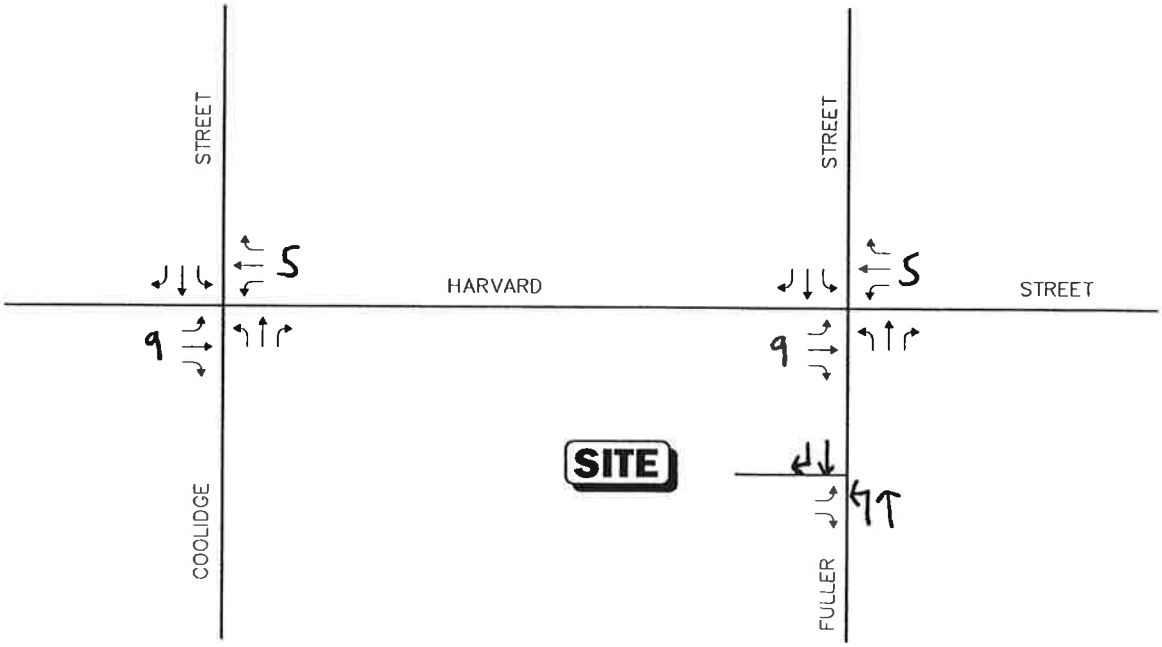
WEEKDAY MORNING PEAK HOUR



WEEKDAY EVENING PEAK HOUR



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Not To Scale

Figure -

- 40 Centre Street
- Background Development

Vanasse & Associates, Inc.
Transportation Engineers & Planners

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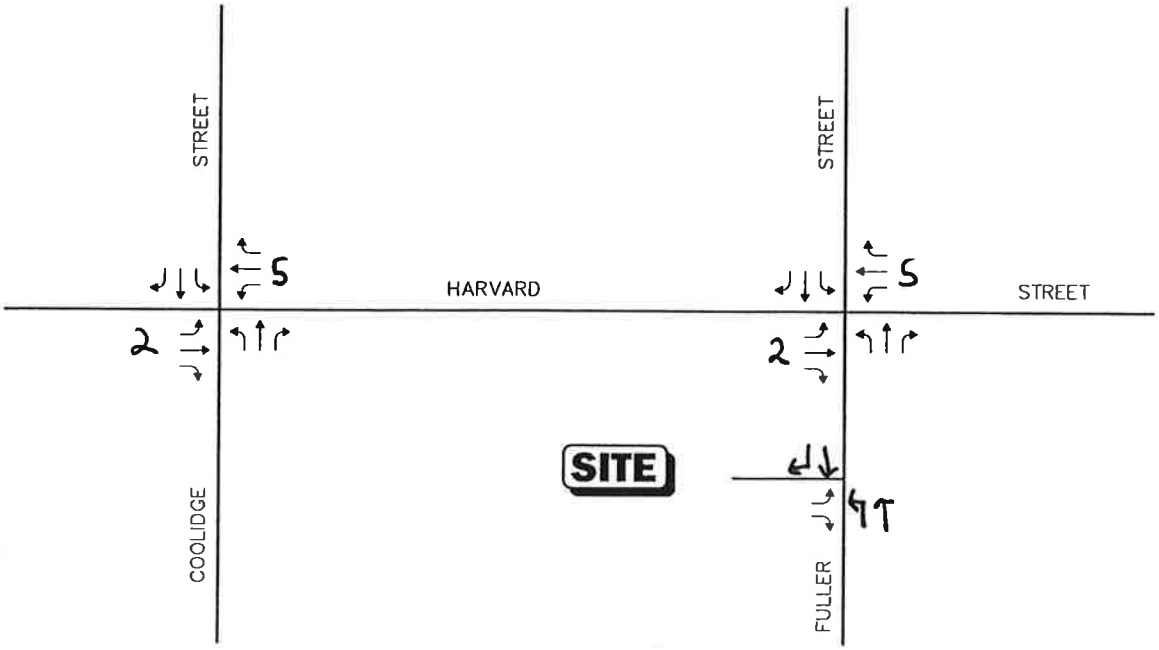
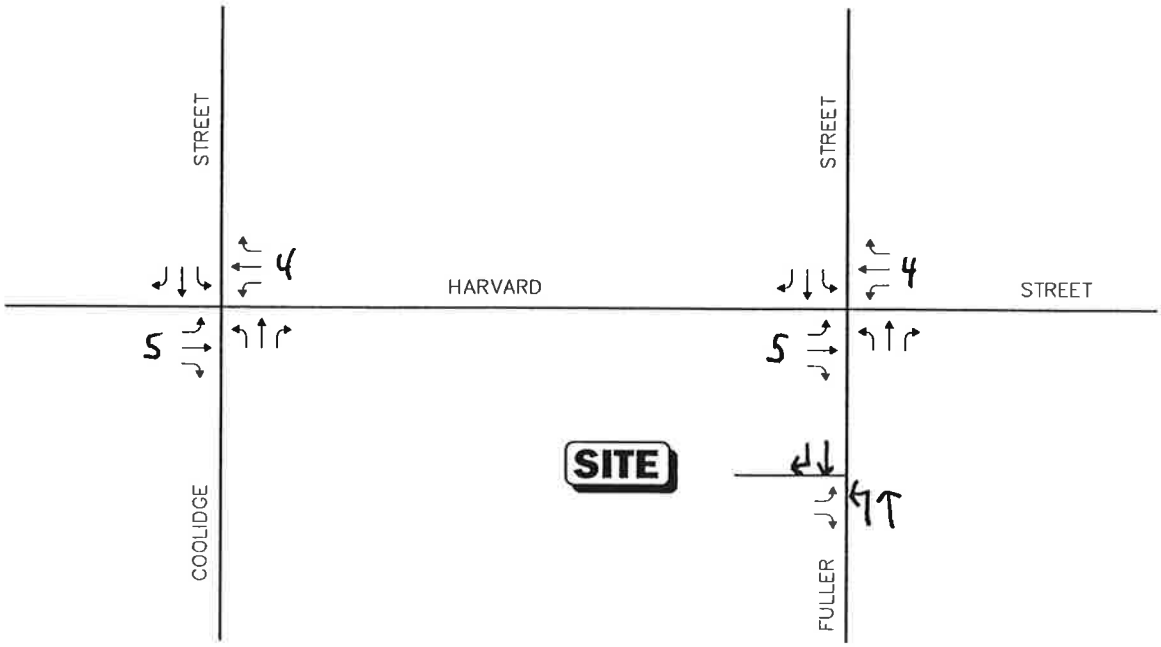
WEEKDAY MORNING PEAK HOUR



WEEKDAY EVENING PEAK HOUR



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Not To Scale

Figure -

Vanasse & Associates, Inc.
Transportation Engineers & Planners

- 1299 Beacon Street
- Background Development

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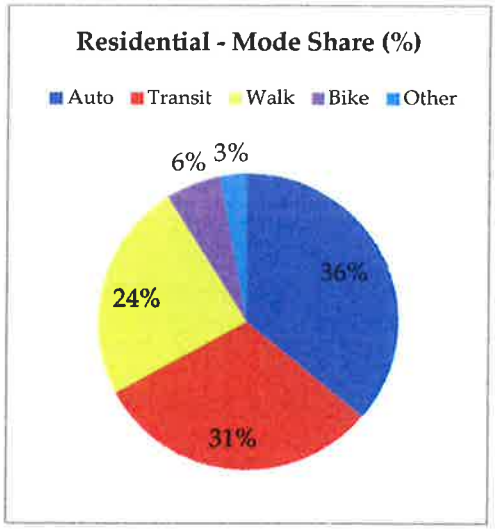
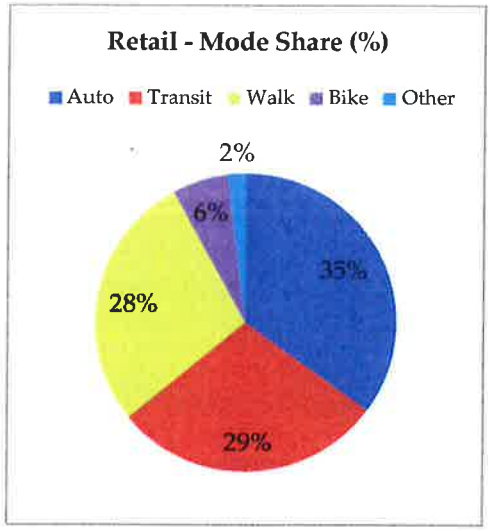
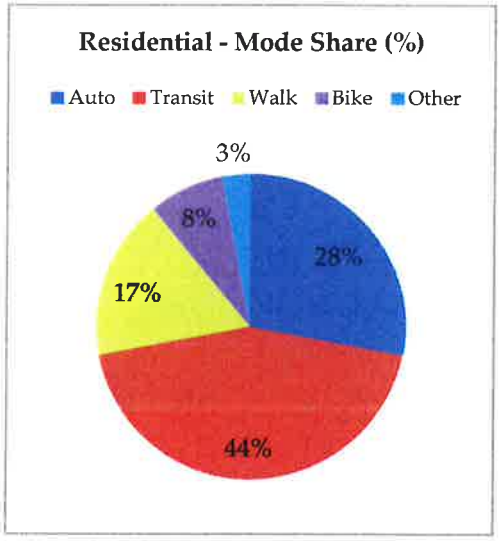
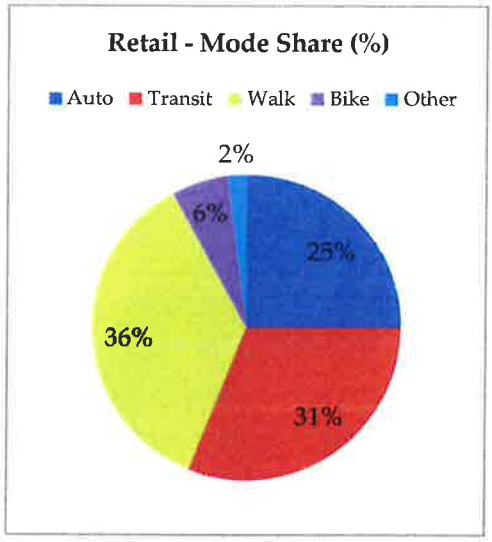




Sub-Area 6





- A vehicle occupancy factor of 1.08 to 1.19 (depending on land use) was then applied to determine the total PM vehicle automobile trips. These vehicle occupancy factors were provided by the City[3] based on U.S. Census data.
- The total PM vehicle trips were then split into arrival and departure trips using the ITE distribution percentages for each land use.

[3] Local Cambridge average from the American Community Survey 2005-2009.

Apartment
(220)

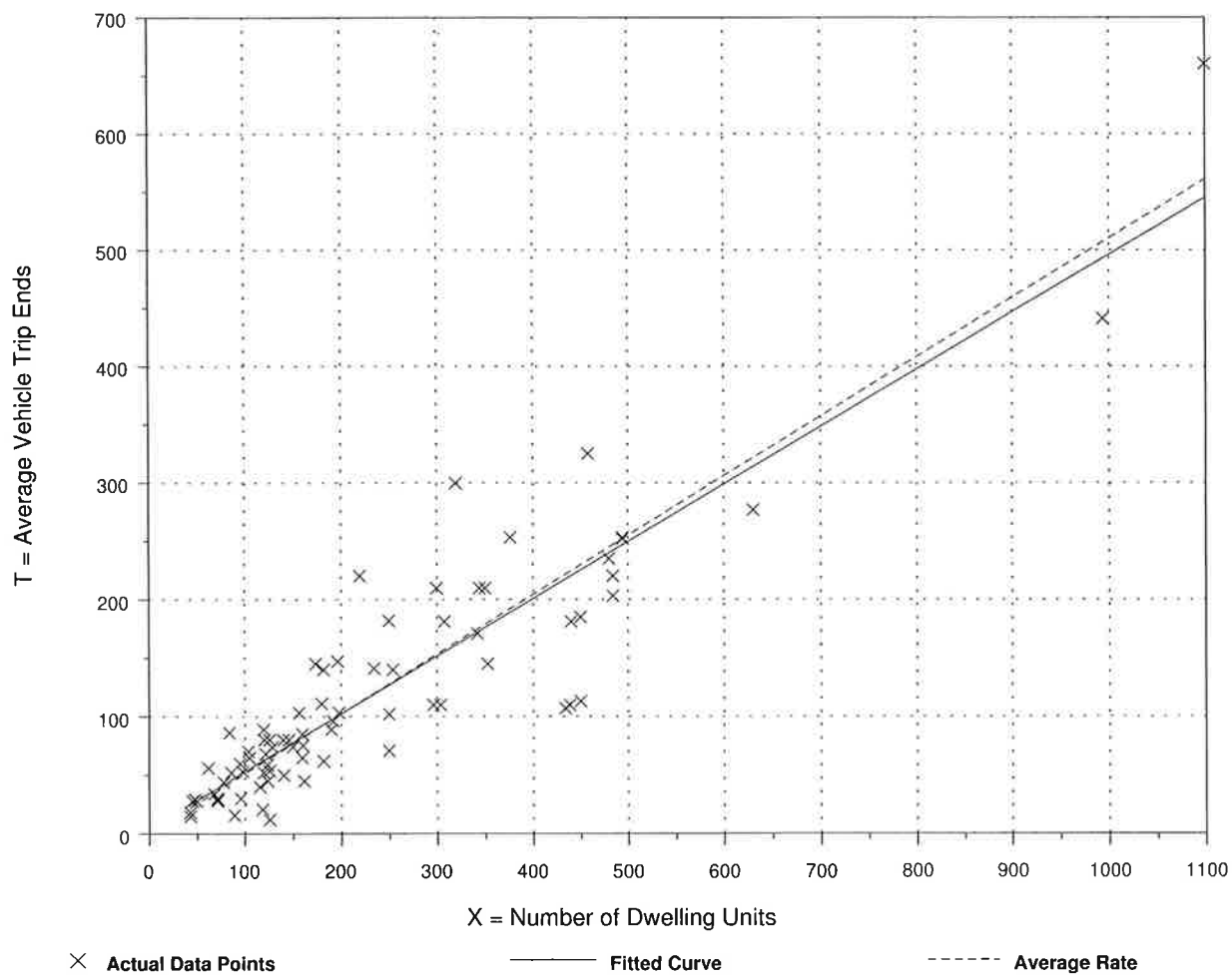
Average Vehicle Trip Ends vs: Dwelling Units
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.

Number of Studies: 78
Avg. Number of Dwelling Units: 235
Directional Distribution: 20% entering, 80% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.51	0.10 - 1.02	0.73

Data Plot and Equation



Fitted Curve Equation: T = 0.49(X) + 3.73

R^2 = 0.83

Apartment
(220)

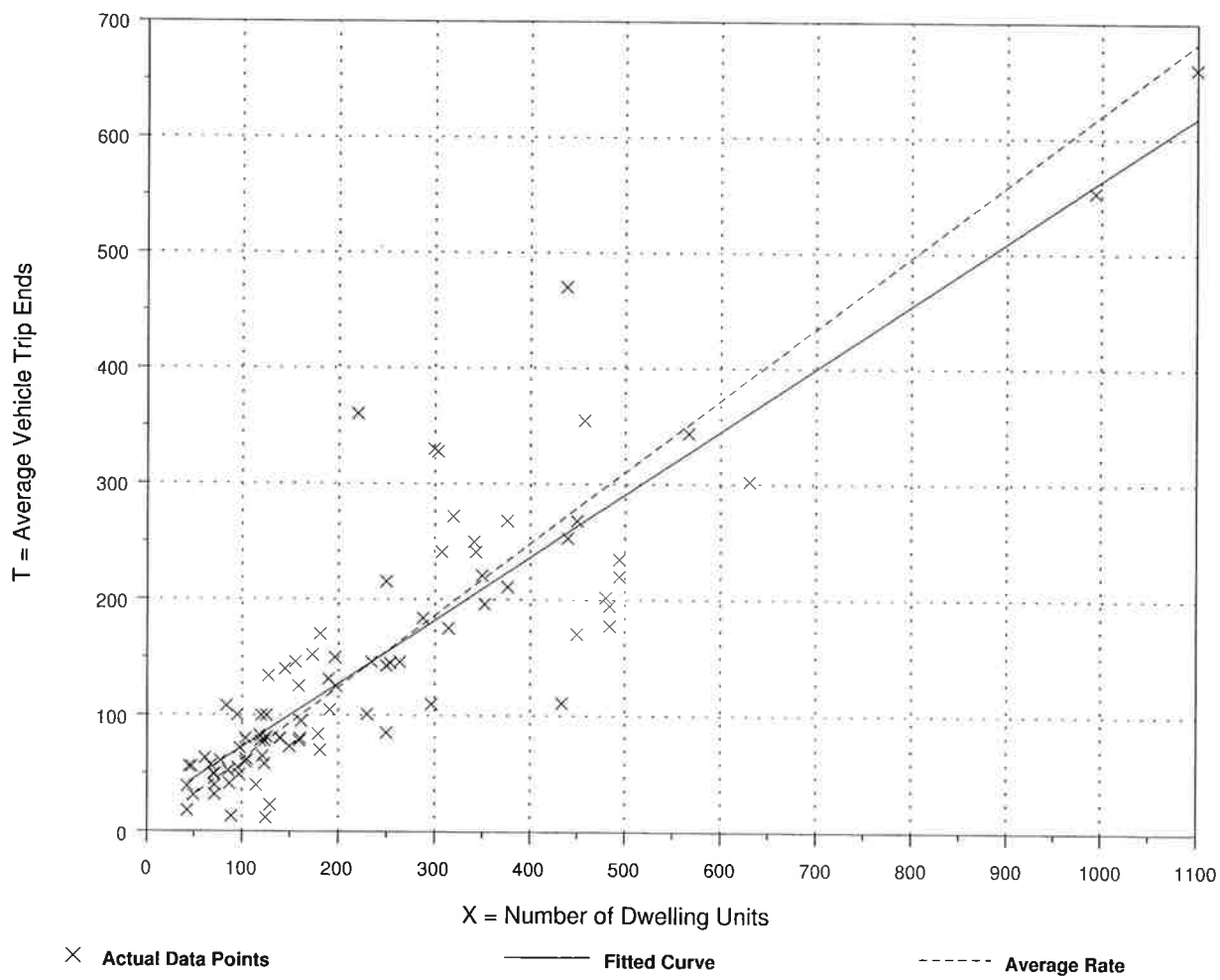
Average Vehicle Trip Ends vs: Dwelling Units
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.

Number of Studies: 90
Avg. Number of Dwelling Units: 233
Directional Distribution: 65% entering, 35% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.62	0.10 - 1.64	0.82

Data Plot and Equation



Fitted Curve Equation: T = 0.55(X) + 17.65

R^2 = 0.77

Land Use: 820
Shopping Center

Description

A shopping center is an integrated group of commercial establishments that is planned, developed, owned and managed as a unit. A shopping center's composition is related to its market area in terms of size, location and type of store. A shopping center also provides on-site parking facilities sufficient to serve its own parking demands. Specialty retail center (Land Use 826) and factory outlet center (Land Use 823) are related uses.

Additional Data

Shopping centers, including neighborhood centers, community centers, regional centers and super regional centers, were surveyed for this land use. Some of these centers contained non-merchandising facilities, such as office buildings, movie theaters, restaurants, post offices, banks, health clubs and recreational facilities (for example, ice skating rinks or indoor miniature golf courses). The centers ranged in size from 1,700 to 2.2 million square feet gross leasable area (GLA). The centers studied were located in suburban areas throughout the United States and, therefore, represent typical U.S. suburban conditions.

Many shopping centers, in addition to the integrated unit of shops in one building or enclosed around a mall, include outparcels (peripheral buildings or pads located on the perimeter of the center adjacent to the streets and major access points). These buildings are typically drive-in banks, retail stores, restaurants, or small offices. Although the data herein do not indicate which of the centers studied included peripheral buildings, it can be assumed that some of the data show their effect.

The vehicle trips generated at a shopping center are based upon the total GLA of the center. In cases of smaller centers without an enclosed mall or peripheral buildings, the GLA could be the same as the gross floor area of the building.

Separate equations have been developed for shopping centers during the Christmas shopping season. Plots were included for the weekday peak hour of adjacent street traffic and the Saturday peak hour of the generator.

Information on approximate hourly, monthly and daily variation in shopping center traffic is shown in Tables 1–3. It should be noted, however, that the information contained in these tables is based on a limited sample size. Therefore, caution should be exercised when applying the data. Also, some information provided in the tables may conflict with the results obtained by applying the average rate or regression equations. When this occurs, it is suggested that the results from the average rate or regression equations be used, as they are based on a larger number of studies.

Institute of Transportation Engineers (ITE)
Trip Generation, 9 th Edition
Land Use Code (LUC) 820 - Shopping Center

Average Vehicle Trips Ends vs: 1,000 Square Feet Gross Leasable Area
Independent Variable (X): 1.465

AVERAGE WEEKDAY DAILY

T = 42.70 * X
T = 42.70 * 1.465
T = 62.56
T = 64 vehicle trips
with 50% (32 vpd) entering and 50% (32 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.96 * (X)
T = 0.96 * 1.465
T = 1.41
T = 1 vehicle trips
with 62% (1 vph) entering and 38% (0 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 3.71 * X
T = 3.71 * 1.465
T = 5.44
T = 5 vehicle trips
with 48% (2 vph) entering and 52% (3 vph) exiting.

SATURDAY DAILY

T = 49.97 * X
T = 49.97 1.465
T = 73.21
T = 73 vehicle trips
with 50% (37 vph) entering and 50% (37 vph) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

T = 4.82 * X
T = 4.82 * 1.465
T = 7.06
T = 7 vehicle trips
with 52% (4 vph) entering and 48% (3 vph) exiting.

Land Use: 826
Specialty Retail Center

Description

Specialty retail centers are generally small strip shopping centers that contain a variety of retail shops and specialize in quality apparel, hard goods and services, such as real estate offices, dance studios, florists and small restaurants. Shopping center (Land Use 820) is a related use.

Additional Data

The sites were surveyed between the late 1970s and the 2000s in California, Florida, Georgia, New York and Pennsylvania.

Source Numbers

100, 304, 305, 367, 423, 507, 577

Institute of Transportation Engineers (ITE)
*Trip Generation, 9*th Edition
Land Use Code (LUC) 826 - Specialty Retail Center

Average Vehicle Trips Ends vs: 1,000 Sq. Feet Gross Floor Area
Independent Variable (X): 1.465

AVERAGE WEEKDAY DAILY

T = 44.32 * (X)
T = 44.32 * 1.465
T = 64.93
T = 64 vehicle trips
with 50% (32 vpd) entering and 50% (32 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$\frac{\text{ITE LUC 820 Weekday Morning Trip Rate}}{\text{ITE LUC 820 Weekday Daily Trip Rate}} = \frac{\text{ITE LUC 826 Weekday Morning Trip Rate}}{\text{ITE LUC 826 Weekday Daily Trip Rate}}$$

$$\frac{0.96}{42.70} = \frac{(Y)}{44.32} \qquad Y = 0.9964215$$

T = Y * 1.465
T = 1.46
T = 1 vehicle trips
with 61% (1 vph) entering and 39% (0 vph) exiting.

(same distribution split as ITE LUC 820 during the weekday morning peak hour of adjacent street traffic)

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 2.71 * (X)
T = 2.71 * 1.465
T = 3.97
T = 4 vehicle trips
with 44% (2 vph) entering and 56% (2 vph) exiting.

SATURDAY DAILY

T = 42.04 * (X)
T = 42.04 * 1.465
T = 61.59
T = 62 vehicle trips
with 50% (31 vpd) entering and 50% (31 vpd) exiting.

SATURDAY MIDDAY PEAK HOUR

$$\frac{\text{ITE LUC 820 Saturday Midday Trip Rate}}{\text{ITE LUC 820 Saturday Daily Trip Rate}} = \frac{\text{ITE LUC 826 Saturday Midday Trip Rate}}{\text{ITE LUC 826 Saturday Daily Trip Rate}}$$

$$\frac{4.82}{49.97} = \frac{(Y)}{42.04} \qquad Y = 4.0550891$$

T = Y * 1.465
T = 5.94
T = 6 vehicle trips
with 52% (3 vph) entering and 48% (3 vph) exiting.

(same distribution split as ITE LUC 820 during the Saturday midday peak hour of generator)

Institute of Transportation Engineers (ITE)
*Trip Generation, 9*th Edition
Land Use Code (LUC) 826 - Specialty Retail Center

Average Vehicle Trips Ends vs: 1,000 Sq. Feet Gross Floor Area
Independent Variable (X): 2.106

AVERAGE WEEKDAY DAILY

T = 44.32 * (X)
T = 44.32 * 2.106
T = 93.34
T = 94 vehicle trips
with 50% (47 vpd) entering and 50% (47 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$\frac{\text{ITE LUC 820 Weekday Morning Trip Rate}}{\text{ITE LUC 820 Weekday Daily Trip Rate}} = \frac{\text{ITE LUC 826 Weekday Morning Trip Rate}}{\text{ITE LUC 826 Weekday Daily Trip Rate}}$$

$$\frac{0.96}{42.70} = \frac{(Y)}{44.32} \qquad Y = 0.9964215$$

T = Y * 2.106
T = 2.1
T = 2 vehicle trips
with 61% (1 vph) entering and 39% (1 vph) exiting.

(same distribution split as ITE LUC 820 during the weekday morning peak hour of adjacent street traffic)

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 2.71 * (X)
T = 2.71 * 2.106
T = 5.71
T = 6 vehicle trips
with 44% (3 vph) entering and 56% (3 vph) exiting.

SATURDAY DAILY

T = 42.04 * (X)
T = 42.04 * 2.106
T = 88.54
T = 88 vehicle trips
with 50% (44 vpd) entering and 50% (44 vpd) exiting.

SATURDAY MIDDAY PEAK HOUR

$$\frac{\text{ITE LUC 820 Saturday Midday Trip Rate}}{\text{ITE LUC 820 Saturday Daily Trip Rate}} = \frac{\text{ITE LUC 826 Saturday Midday Trip Rate}}{\text{ITE LUC 826 Saturday Daily Trip Rate}}$$

$$\frac{4.82}{49.97} = \frac{(Y)}{42.04} \qquad Y = 4.0550891$$

T = Y * 2.106
T = 8.54
T = 9 vehicle trips
with 52% (4 vph) entering and 48% (5 vph) exiting.

(same distribution split as ITE LUC 820 during the Saturday midday peak hour of generator)

Institute of Transportation Engineers (ITE)
Trip Generation, 9 th Edition
Land Use Code (LUC) 820 - Shopping Center

Average Vehicle Trips Ends vs: 1,000 Square Feet Gross Leasable Area
Independent Variable (X): 2.106

AVERAGE WEEKDAY DAILY

T = 42.70 * X
T = 42.70 * 2.106
T = 89.93
T = 90 vehicle trips
with 50% (45 vpd) entering and 50% (45 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.96 * (X)
T = 0.96 * 2.106
T = 2.02
T = 2 vehicle trips
with 62% (1 vph) entering and 38% (1 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

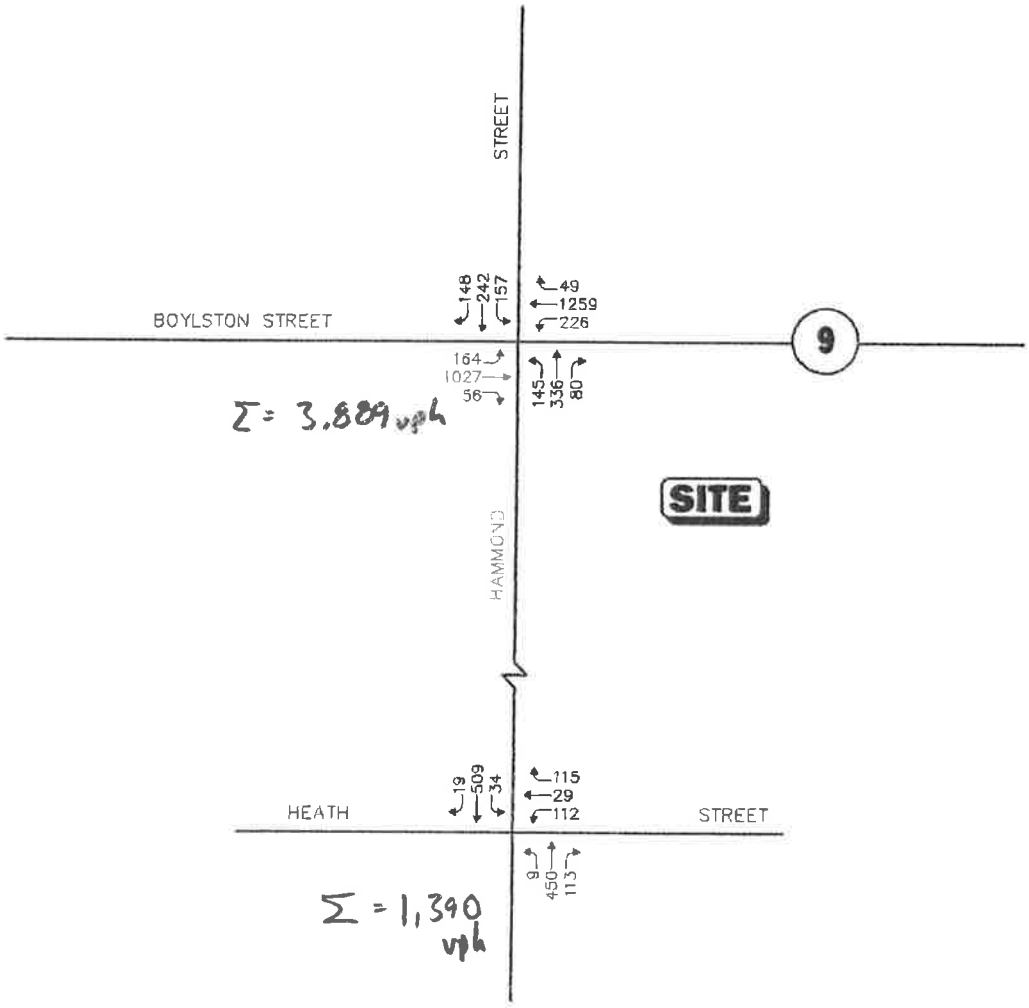
T = 3.71 * X
T = 3.71 * 2.106
T = 7.81
T = 8 vehicle trips
with 48% (4 vph) entering and 52% (4 vph) exiting.

SATURDAY DAILY

T = 49.97 * X
T = 49.97 2.106
T = 105.24
T = 105 vehicle trips
with 50% (53 vph) entering and 50% (53 vph) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

T = 4.82 * X
T = 4.82 * 2.106
T = 10.15
T = 10 vehicle trips
with 52% (5 vph) entering and 48% (5 vph) exiting.



Not To Scale

Figure 3

Vanasse & Associates, Inc.

Baseline
Weekday Morning
Peak Hour Traffic Volumes

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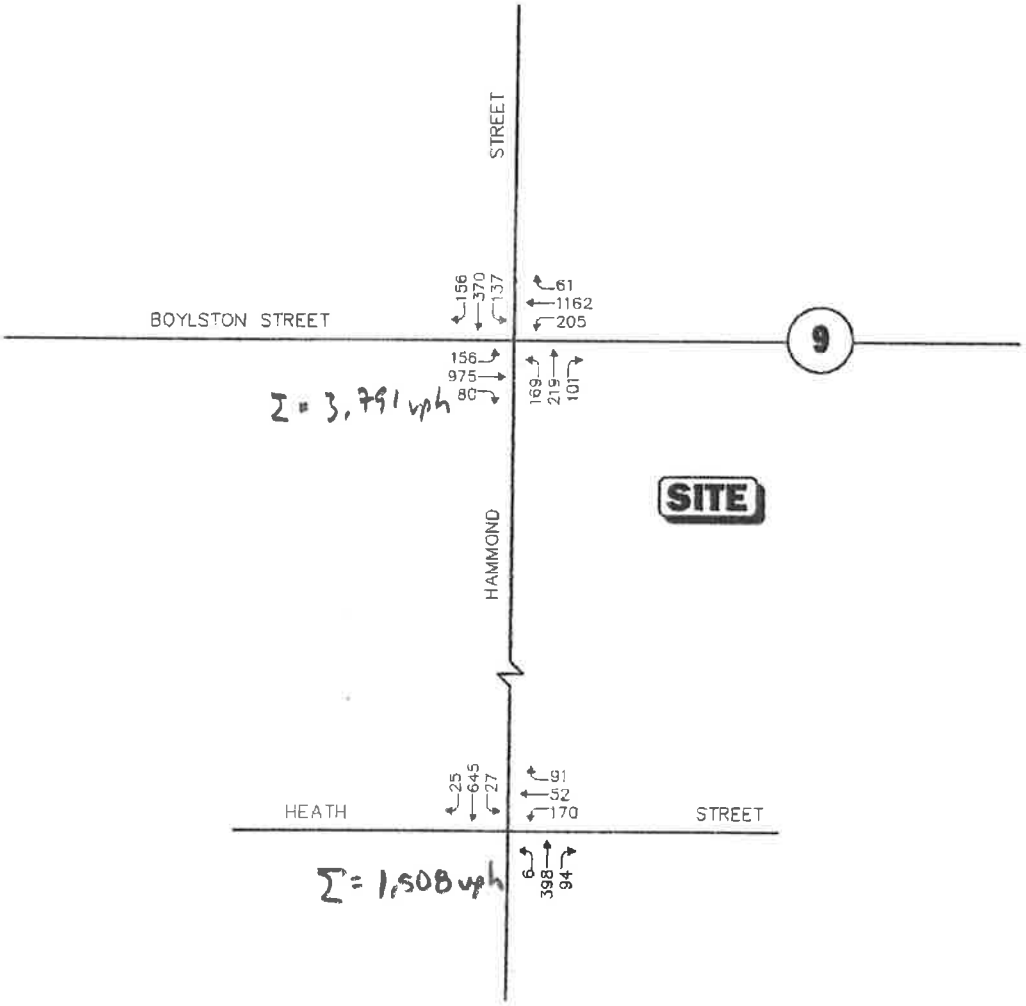

Not To Scale

Figure 4

Baseline
Weekday Evening
Peak Hour Traffic Volumes

Vanasse & Associates, Inc.

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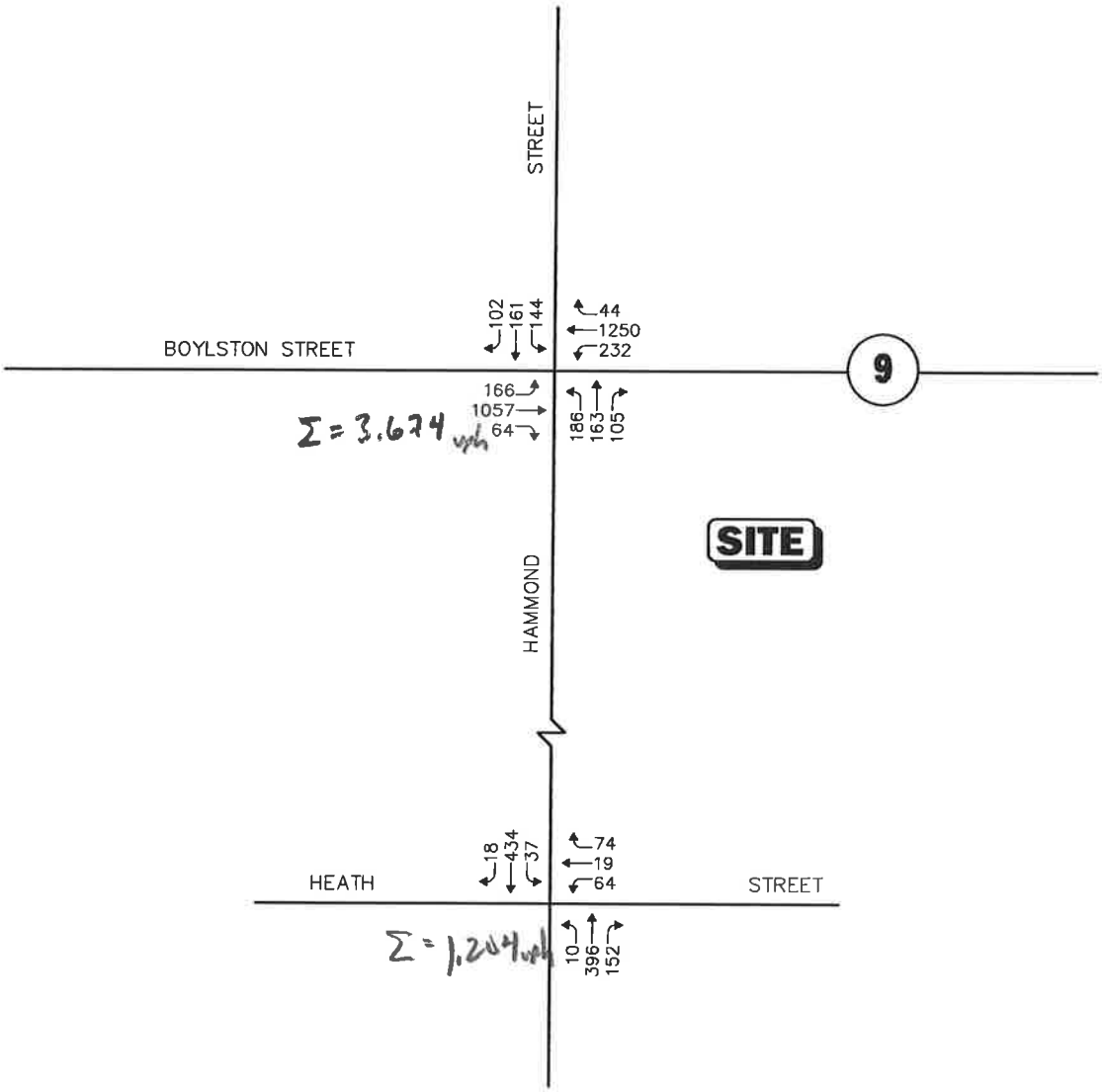

Not To Scale

Figure 5

2016 Baseline Saturday Midday Peak Hour Traffic Volumes

Vanasse & Associates, Inc.
Transportation Engineers & Planners

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Massachusetts Highway Department
H13142 Weekly Volume Report - Mon 09/12/2016 - Sun 09/18/2016

Location ID:	H13142
Located On:	I-90/MassPike
Direction	2-WAY
Community:	
AADT:	

Type:	SPOT
:	
Period:	Mon 09/12/2016 - Sun 09/18/2016

Start Time	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Avg
12:00 AM	1300	1099	1133	1592	1868	2557	2433	1712
1:00 AM	707	721	727	895	974	1645	1554	1032
2:00 AM	511	486	466	645	774	1218	1333	776
3:00 AM	712	593	607	657	737	739	761	687
4:00 AM	1535	1338	1263	1290	1434	911	678	1207
5:00 AM	4275	3931	3915	3945	3892	1690	1158	3258
6:00 AM	8436	8251	8281	8225	8185	2708	1845	6562
7:00 AM	11191	11514	11498	11582	10896	4345	2817	9120
8:00 AM	10313	10683	10956	11464	10305	5476	3999	9028
9:00 AM	8732	8672	8926	8443	8516	6161	4818	7753
10:00 AM	6882	7350	7569	8375	7438	7058	6135	7258
11:00 AM	6460	6840	6820	7499	7111	7832	6887	7064
12:00 PM	6418	6837	7100	7402	7556	7603	7419	7191
1:00 PM	6598	6920	7624	7686	8350	8937	6995	7587
2:00 PM	8220	8614	8816	9301	9549	7958	6580	8434
3:00 PM	9106	9400	9931	10292	10168	7390	6482	8967
4:00 PM	9380	10047	10739	10612	10117	7486	6870	9322
5:00 PM	9270	10520	10770	11514	9530	8092	7111	9544
6:00 PM	9507	10100	9997	11750	9978	8054	6613	9428
7:00 PM	7201	7310	7600	7705	8150	6437	5809	7173
8:00 PM	4828	5357	5525	6210	5563	5354	4612	5350
9:00 PM	4224	4842	4978	5383	4949	4767	3518	4666
10:00 PM	3970	3590	4887	4908	4902	4318	2976	4222
11:00 PM	1801	2695	2672	3827	4251	3579	2487	3045
Total	**141577**	**147710**	**152800**	**161202**	**155193**	**122315**	**101890**	
24HrTotal		141577	147710	152800	161202	155193	122315		140384
AM Pk Hr	7:00	7:00	7:00	7:00	7:00	11:00	11:00	
AM Peak	11191	11514	11498	11582	10896	7832	6887	10200
PM Pk Hr	6:00	5:00	5:00	6:00	3:00	1:00	12:00	
PM Peak	9507	10520	10770	11750	10168	8937	7419	9867
% Peak Hr	7.90%	7.80%	7.52%	7.29%	7.02%	7.31%	7.28%	7.43%
% Peak Hr		7.90%	7.80%	7.52%	7.29%	7.02%	7.31%		7.45%

Day	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Daily Volume	**141577**	**147710**	**152800**	**161202**	**155193**	**122315**	**101890**
Average Weekday					**151696.4**		
Relationship, Saturday to Average Weekday						0.806 or	81%

Vanasse & Associates, Inc.
Transportation Engineers & Planners

Job	Brookline, MA	Job #	7368
Location	S of Harvard St	Date	9/29/2016
Calculated By:	S.R.F.		
Checked By:			

Street: Fuller Street
Direction: Southbound

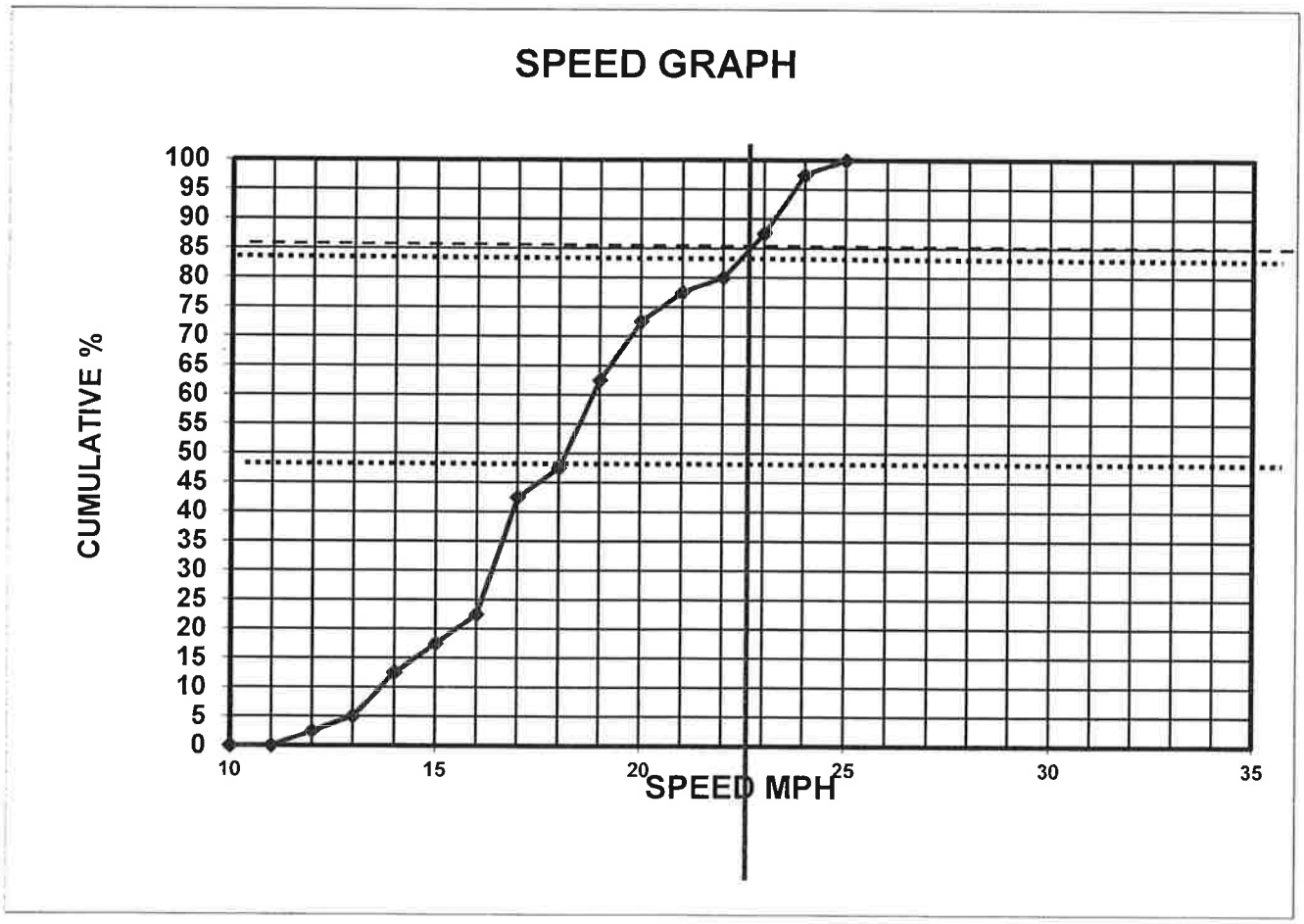
Speed Limit:
Time of Day 9:00 a.m.
Observations 40

Speed	# of Observation	CUM. # Of OBS	% OF TOTAL OBS	CUM %
45				
44				
43				
42				
41				
40				
39				
38				
37				
36				
35				
34				
33				
32				
31				
30				
29				
28				
27				
26				
25	1	1	2.5	100
24	4	5	10	97.5
23	3	8	7.5	87.5
22	1	9	2.5	80
21	2	11	5	77.5
20	4	15	10	72.5
19	6	21	15	62.5
18	2	23	5	47.5
17	8	31	20	42.5
16	2	33	5	22.5
15	2	35	5	17.5
14	3	38	7.5	12.5
13	1	39	2.5	5
12	1	40	2.5	2.5
11				
10				

Average: 18.725
Comments: 85% = 22.7 m.p.h.

Street: Fuller Street
Direction: Southbound

Job # 7368
Date 9/29/2016



736801sb

Vanasse & Associates, Inc.
Transportation Engineers & Planners

Job	Brookline, MA	Job #	7368
Location	S of Harvard St	Date	9/29/2016
Calculated By:	S.R.F.		
Checked By:			

Street: Fuller Street
Direction: Northbound

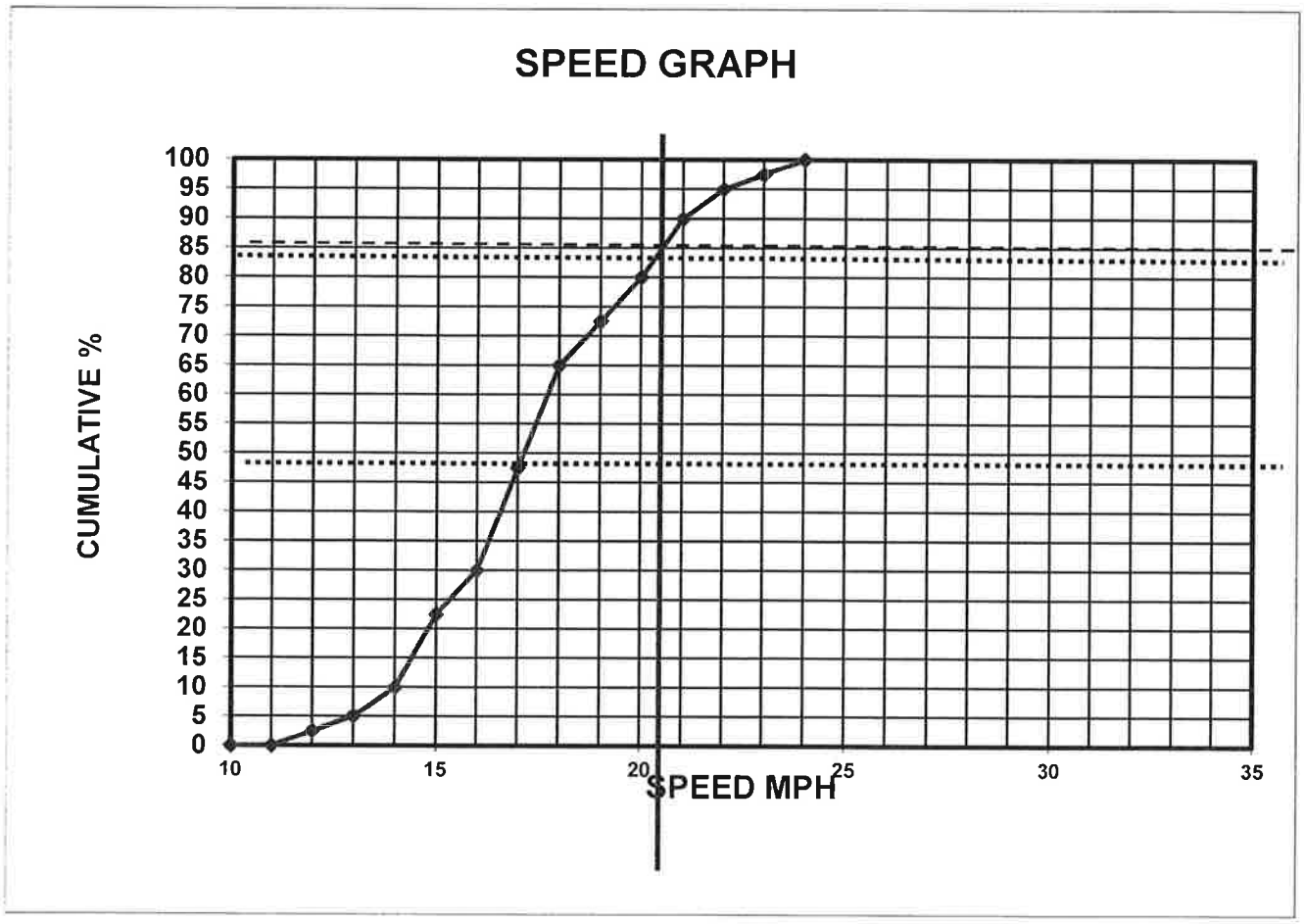
Speed Limit:
Time of Day 9:00 a.m.
Observations 40

Speed	# of Observation	CUM. # Of OBS	% OF TOTAL OBS	CUM %
45				
44				
43				
42				
41				
40				
39				
38				
37				
36				
35				
34				
33				
32				
31				
30				
29				
28				
27				
26				
25				
24	1	1	2.5	100
23	1	2	2.5	97.5
22	2	4	5	95
21	4	8	10	90
20	3	11	7.5	80
19	3	14	7.5	72.5
18	7	21	17.5	65
17	7	28	17.5	47.5
16	3	31	7.5	30
15	5	36	12.5	22.5
14	2	38	5	10
13	1	39	2.5	5
12	1	40	2.5	2.5
11				
10				

Average: 17.825
Comments: 85% = 20.5 m.p.h.

Street: Fuller Street
Direction: Northbound

Job # 7368
Date 9/29/2016



736801nb

Table 3R
TRIP GENERATION SUMMARY

Time Period	Residential Trips[a] 24 Units (A)	Public Transit/Other Travel Mode Trips B = A*54.7%[b]	Retail Trips[c] 1,465 sf (C)	Public Transit/Other Travel Mode Trips D = C*54.7%[b]	New Trips E = (A+C) – B – D
Average Weekday Daily Traffic	270	148	64	35	151
Weekday Morning Peak Hour:					
Entering					
Exiting	3	2	1	0	2
Total	12	6	0	0	6
	15	8	1	0	8
Weekday Evening Peak Hour:					
Entering	20	11	2	1	10
Exiting	11	6	2	1	6
Total	31	17	4	2	16

[a]Based on ITE LUC 220, Apartment
[b]Based on journey to work data for Brookline obtained from the United States Census Bureau, ACS 2010-2014.
[c]Based on ITE LUC 826, Specialty Retail Center

Institute of Transportation Engineers (ITE)
Trip Generation, 9 th Edition
Land Use Code (LUC) 220 - Apartment

Average Vehicle Trips Ends vs: Dwelling Units
Independent Variable (X): 24

AVERAGE WEEKDAY DAILY

T = 6.06 * (X) + 123.56
T = 6.06 * 24 + (123.56)
T = 269.00
T = 270 vehicle trips
with 50% (135 vpd) entering and 50% (135 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.49 * (X) + 3.73
T = 0.49 * 24 + (3.73)
T = 15.49
T = 15 vehicle trips
with 20% (3 vph) entering and 80% (12 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.55 * (X) + 17.65
T = 0.55 * 24 + (17.65)
T = 30.85
T = 31 vehicle trips
with 65% (20 vph) entering and 35% (11 vph) exiting.

SATURDAY DAILY

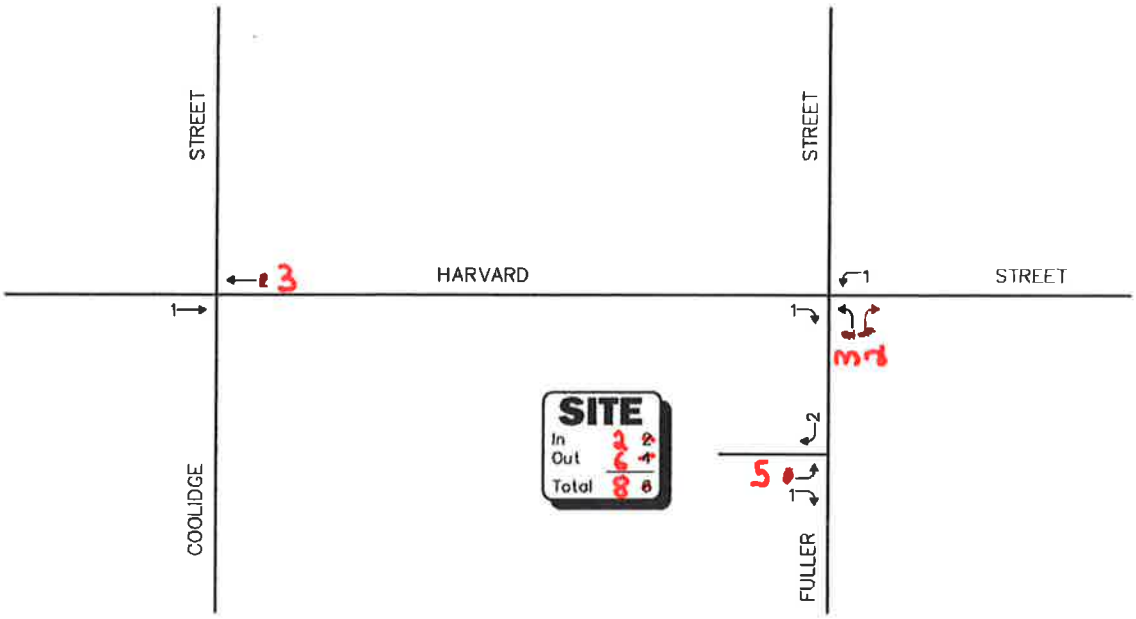
T = 6.39 * (X)
T = 6.39 * 24
T = 153.36 153
T = 154 vehicle trips
with 50% (77 vpd) entering and 50% (77 vpd) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

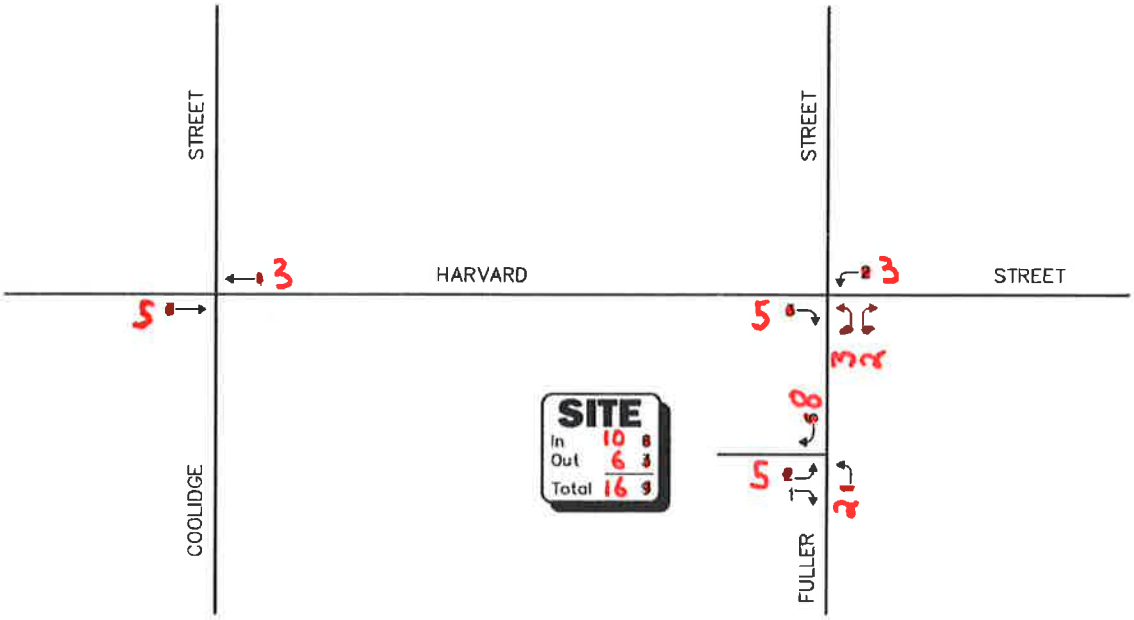
T = 0.52 * (X)
T = 0.52 * 24
T = 12.48
T = 12 vehicle trips
with 53% (6 vph) entering and 47% (6 vph) exiting.

(same distribution split as ITE LUC 210 during the Saturday midday peak hour of generator)

WEEKDAY MORNING PEAK HOUR



WEEKDAY EVENING PEAK HOUR



Not To Scale

Figure 5R

Site Generated Peak Hour Traffic Volumes

Vanasse & Associates, Inc.
Transportation Engineers & Planners

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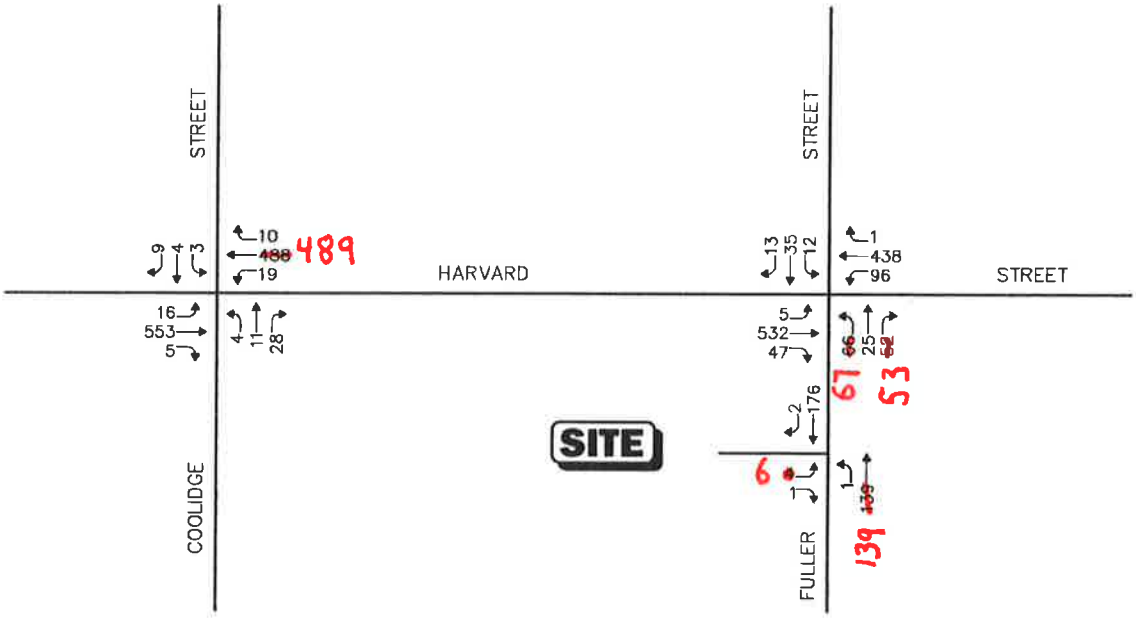
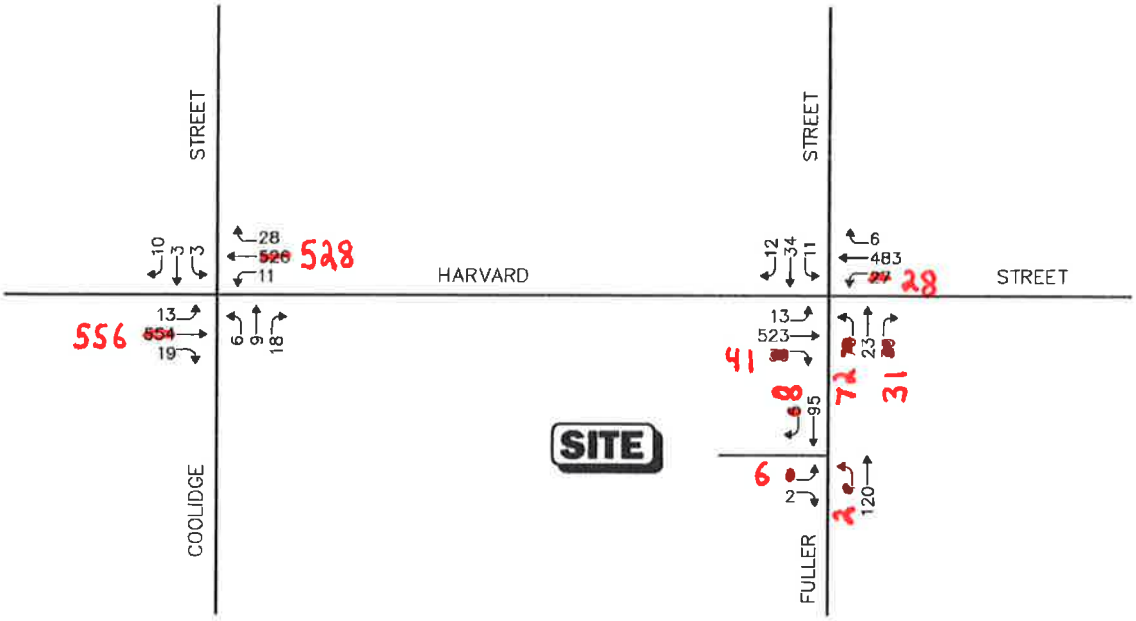
WEEKDAY MORNING PEAK HOUR



WEEKDAY EVENING PEAK HOUR



Not To Scale

Figure 6R

2023 Build
Peak Hour Traffic Volumes

Vanasse & Associates, Inc.
Transportation Engineers & Planners

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Table 9R
SIGNALIZED INTERSECTION CAPACITY ANALYSIS SUMMARY

	2016 Existing				2023 No-Build				2023 Build			
Signalized Intersection/ Peak Hour	V/C[a]	Delay[b]	LOS[c]	Queue[d] Ave/95th	V/C	Delay	LOS	Queue Ave/95th	V/C	Delay	LOS	Queue Ave/95th
Harvard Street at Fuller Street												
Weekday Morning:												
Fuller Street EB LT/TH/RT	0.71	58	E	86/162	0.71	58	E	85/173	0.73	59	E	89/182
Fuller Street WB LT/TH/RT	0.31	39	D	50/65	0.26	38	D	34/73	0.26	38	D	34/73
Harvard Street NB LT	0.21	<5	A	16/27	0.20	<5	A	14/30	0.20	<5	A	14/31
Harvard Street NB TH/RT	0.36	<5	A	78/94	0.36	<5	A	77/117	0.36	<5	A	77/117
Harvard Street SB LT	0.01	<5	A	1/3	0.01	<5	A	1/3	0.01	<5	A	1/3
Harvard Street SB TH/RT	0.43	5	A	100/149	0.48	6	A	116/174	0.48	6	A	116/173
Overall	--	**13**	**B**	--	--	**12**	**B**	--	--	**13**	**B**	--
Weekday Evening:												
Fuller Street EB LT/TH/RT	0.60	51	D	64/120	0.64	53	D	71/132	0.65	53	D	74/145
Fuller Street WB LT/TH/RT	0.27	39	D	34/66	0.26	38	D	33/70	0.25	38	D	33/70
Harvard Street NB LT	0.04	<5	A	3/9	0.05	<5	A	3/9	0.05	<5	A	4/10
Harvard Street NB TH/RT	0.35	<5	A	75/114	0.39	<5	A	89/133	0.39	<5	A	89/133
Harvard Street SB LT	0.02	<5	A	1/5	0.02	<5	A	2/6	0.02	<5	A	2/6
Harvard Street SB TH/RT	0.38	<5	A	85/128	0.43	5	A	102/151	0.43	5	A	103/153
Overall	--	**11**	**B**	--	--	**11**	**B**	--	--	**11**	**B**	--

[a]Volume to Capacity
[b]Delay in seconds per vehicle.
[c]Level of service.
[d]Queue length in feet for Average (50th percentile) and 95th percentile conditions.
NB = northbound; SB = southbound; EB = eastbound; WB = westbound; LT = left-turning movements; TH = through movements; RT = right-turning movements

Table 8R
UNSIGNALIZED INTERSECTION CAPACITY ANALYSIS SUMMARY

	2016 Existing				2023 No-Build				2023 Build			
Unsignalized Intersection/ Critical Movement/Peak Hour	Demand[a]	Delay[b]	LOS[c]	Queue[d] Ave/95th	Demand	Delay	LOS	Queue Ave/95th	Demand	Delay	LOS	Queue Ave/95th
Harvard Street at Coolidge Street												
Weekday Morning:												
Coolidge Street EB LT/TH/RT	40	18	C	--/18	43	20	C	--/15	43	20	C	--/15
Coolidge Street WB LT/TH/RT	15	19	C	--/5	16	20	C	--/5	16	20	C	--/5
Harvard Street NB LT	18	9	A	--/3	19	9	A	--/3	19	9	A	--/3
Harvard Street SB LT	15	9	A	--/0	16	9	A	--/3	16	9	A	--/3
Weekday Evening:												
Coolidge Street EB LT/TH/RT	31	20	C	--/13	33	23	C	--/13	33	23	C	--/13
Coolidge Street WB LT/TH/RT	15	18	C	--/5	16	20	C	--/5	16	20	C	--/5
Harvard Street NB LT	10	9	A	--/0	11	9	A	--/0	11	9	A	--/0
Harvard Street SB LT	12	9	A	--/0	13	9	A	--/0	13	9	A	--/0
Fuller Street at Site Drive												
Weekday Morning:												
Site Drive SB LT/RT	1	11	B	--/0	1	11	B	--/0	7	10	B	--/0
Weekday Evening:												
Site Drive SB LT/RT	2	9	A	--/0	2	9	A	--/0	8	10	A	--/0

[a]Demand in vehicles per hour
[b]Delay in seconds per vehicle.
[c]Level of service.
[d]Queue length in feet for Average (50th percentile) and 95th percentile conditions.
EB = eastbound; WB westbound; NB = northbound; SB = southbound; LT = left-turning movements; TH = thought movements; RT = right-turning movements

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	67	25	53	12	35	13	96	438	1	5	532	47
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	14	12	11	11	12	10	11	12
Storage Length (ft)	0		0	0		0	80		0	50		0
Storage Lanes	0		0	0		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.950			0.971						0.988	
Flt Protected		0.977			0.990		0.950			0.950		
Satd. Flow (prot)	0	1763	0	0	1915	0	1694	1766	0	1685	1750	0
Flt Permitted		0.856			0.924		0.381			0.467		
Satd. Flow (perm)	0	1545	0	0	1788	0	679	1766	0	828	1750	0
Right Turn on Red			No			No			No			No
Satd. Flow (RTOR)												
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		190			213			283			204	
Travel Time (s)		4.3			4.8			6.4			4.6	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	0%	0%	0%	0%	8%	3%	4%	0%	0%	4%	0%
Adj. Flow (vph)	73	27	58	13	38	14	104	476	1	5	578	51
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	158	0	0	65	0	104	477	0	5	629	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			11			11	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	0.92	1.00	1.04	1.04	1.00	1.09	1.04	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100		20	100	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	6		20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	

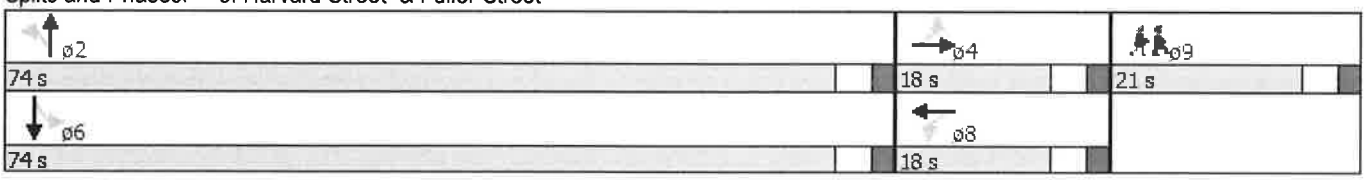
Lane Group	ø9
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (mph)	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	
Turn Type	
Protected Phases	9

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	21.0	21.0		21.0	21.0		21.0	21.0		21.0	21.0	
Total Split (s)	18.0	18.0		18.0	18.0		74.0	74.0		74.0	74.0	
Total Split (%)	15.9%	15.9%		15.9%	15.9%		65.5%	65.5%		65.5%	65.5%	
Maximum Green (s)	13.0	13.0		13.0	13.0		69.0	69.0		69.0	69.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0			0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		Max	Max		Max	Max	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		12.9			12.9		69.0	69.0		69.0	69.0	
Actuated g/C Ratio		0.14			0.14		0.75	0.75		0.75	0.75	
v/c Ratio		0.73			0.26		0.20	0.36		0.01	0.48	
Control Delay		58.8			38.3		4.5	4.8		3.0	5.9	
Queue Delay		0.0			0.0		0.0	0.0		0.0	0.0	
Total Delay		58.8			38.3		4.5	4.8		3.0	5.9	
LOS		E			D		A	A		A	A	
Approach Delay		58.8			38.3			4.7			5.9	
Approach LOS		E			D			A			A	

Intersection Summary

Area Type: Other
Cycle Length: 113
Actuated Cycle Length: 91.9
Natural Cycle: 80
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.73
Intersection Signal Delay: 12.7 — Intersection LOS: B
Intersection Capacity Utilization 63.6% — ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 3: Harvard Street & Fuller Street



Lane Group	ø9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	4.0
Minimum Split (s)	21.0
Total Split (s)	21.0
Total Split (%)	19%
Maximum Green (s)	16.0
Yellow Time (s)	3.0
All-Red Time (s)	2.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	5.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	0
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	

Intersection Summary

Lane Group	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	158	65	104	477	5	629
v/c Ratio	0.73	0.26	0.20	0.36	0.01	0.48
Control Delay	58.8	38.3	4.5	4.8	3.0	5.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	58.8	38.3	4.5	4.8	3.0	5.9
Queue Length 50th (ft)	89	34	14	77	1	116
Queue Length 95th (ft)	#182	73	31	117	3	173
Internal Link Dist (ft)	110	133		203		124
Turn Bay Length (ft)			80		50	
Base Capacity (vph)	218	252	510	1326	622	1314
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.72	0.26	0.20	0.36	0.01	0.48

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	72	23	31	11	34	12	28	483	6	13	523	41
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	14	12	11	11	12	10	11	12
Storage Length (ft)	0		0	0		0	80		0	50		0
Storage Lanes	0		0	0		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.967			0.972			0.998			0.989	
Flt Protected		0.972			0.990		0.950			0.950		
Satd. Flow (prot)	0	1786	0	0	1950	0	1745	1798	0	1685	1800	0
Flt Permitted		0.837			0.939		0.406			0.437		
Satd. Flow (perm)	0	1538	0	0	1850	0	746	1798	0	775	1800	0
Right Turn on Red			No			No			No			No
Satd. Flow (RTOR)												
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		190			213			283			204	
Travel Time (s)		4.3			4.8			6.4			4.6	
Peak Hour Factor	0.95	0.95	0.95	0.92	0.92	0.92	0.92	0.92	0.92	0.96	0.96	0.96
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	1%	0%
Adj. Flow (vph)	76	24	33	12	37	13	30	525	7	14	545	43
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	133	0	0	62	0	30	532	0	14	588	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			11			11	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	0.92	1.00	1.04	1.04	1.00	1.09	1.04	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100		20	100	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	6		20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	

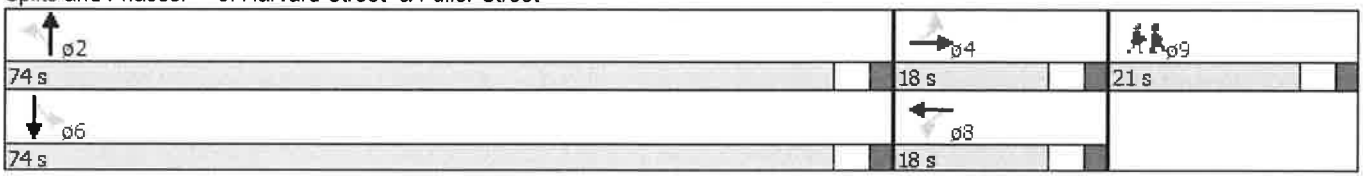
Lane Group	ø9
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (mph)	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	
Turn Type	
Protected Phases	9

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	21.0	21.0		21.0	21.0		21.0	21.0		21.0	21.0	
Total Split (s)	18.0	18.0		18.0	18.0		74.0	74.0		74.0	74.0	
Total Split (%)	15.9%	15.9%		15.9%	15.9%		65.5%	65.5%		65.5%	65.5%	
Maximum Green (s)	13.0	13.0		13.0	13.0		69.0	69.0		69.0	69.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0			0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		Max	Max		Max	Max	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		12.1			12.1		69.0	69.0		69.0	69.0	
Actuated g/C Ratio		0.13			0.13		0.76	0.76		0.76	0.76	
v/c Ratio		0.65			0.25		0.05	0.39		0.02	0.43	
Control Delay		53.4			38.2		3.2	4.9		3.1	5.3	
Queue Delay		0.0			0.0		0.0	0.0		0.0	0.0	
Total Delay		53.4			38.2		3.2	4.9		3.1	5.3	
LOS		D			D		A	A		A	A	
Approach Delay		53.4			38.2			4.8			5.2	
Approach LOS		D			D			A			A	

Intersection Summary

Area Type: Other
Cycle Length: 113
Actuated Cycle Length: 91.1
Natural Cycle: 70
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.65
Intersection Signal Delay: 11.3 — Intersection LOS: B
Intersection Capacity Utilization 52.1% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 3: Harvard Street & Fuller Street



Lane Group	ø9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	4.0
Minimum Split (s)	21.0
Total Split (s)	21.0
Total Split (%)	19%
Maximum Green (s)	16.0
Yellow Time (s)	3.0
All-Red Time (s)	2.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	5.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	0
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	

Intersection Summary

Lane Group	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	133	62	30	532	14	588
v/c Ratio	0.65	0.25	0.05	0.39	0.02	0.43
Control Delay	53.4	38.2	3.2	4.9	3.1	5.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	53.4	38.2	3.2	4.9	3.1	5.3
Queue Length 50th (ft)	74	33	4	89	2	103
Queue Length 95th (ft)	#145	70	10	133	6	153
Internal Link Dist (ft)	110	133		203		124
Turn Bay Length (ft)			80		50	
Base Capacity (vph)	219	264	564	1361	587	1363
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.61	0.23	0.05	0.39	0.02	0.43

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Intersection	
Int Delay, s/veh	1.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	4	11	28	3	4	9	19	489	10	16	553	5
Conflicting Peds, #/hr	0	0	0	3	0	4	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	0	0	4	0	0	0	6	3	0	7	3	0
Mvmt Flow	4	12	30	3	4	10	21	532	11	17	601	5

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1228	1227	604	1242	1223	541	607	0	0	546	0	0
Stage 1	639	639	-	582	582	-	-	-	-	-	-	-
Stage 2	589	588	-	660	641	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.24	7.1	6.5	6.2	4.16	-	-	4.17	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.336	3.5	4	3.3	2.254	-	-	2.263	-	-
Pot Cap-1 Maneuver	156	180	495	153	181	545	952	-	-	999	-	-
Stage 1	468	474	-	502	502	-	-	-	-	-	-	-
Stage 2	498	499	-	455	473	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	144	169	495	129	170	543	952	-	-	999	-	-
Mov Cap-2 Maneuver	144	169	-	129	170	-	-	-	-	-	-	-
Stage 1	453	462	-	484	484	-	-	-	-	-	-	-
Stage 2	469	481	-	405	461	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	19.9	20.3	0.3	0.2
HCM LOS	C	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	952	-	-	288	253	999	-	-
HCM Lane V/C Ratio	0.022	-	-	0.162	0.069	0.017	-	-
HCM Control Delay (s)	8.9	0	-	19.9	20.3	8.7	0	-
HCM Lane LOS	A	A	-	C	C	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	0.6	0.2	0.1	-	-

Intersection	
Int Delay, s/veh	1.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	6	9	18	3	3	10	11	528	28	13	556	19
Conflicting Peds, #/hr	0	0	0	3	0	4	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	93	93	93	92	92	92
Heavy Vehicles, %	0	13	0	0	0	0	0	2	0	0	2	0
Mvmt Flow	7	10	20	3	3	11	12	568	30	14	604	21

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1261	1269	615	1268	1263	587	625	0	0	602	0	0
Stage 1	643	643	-	610	610	-	-	-	-	-	-	-
Stage 2	618	626	-	658	653	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.63	6.2	7.1	6.5	6.2	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.63	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.63	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4.117	3.3	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	148	160	495	147	171	513	966	-	-	985	-	-
Stage 1	465	452	-	485	488	-	-	-	-	-	-	-
Stage 2	480	460	-	457	467	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	138	153	495	130	163	511	966	-	-	985	-	-
Mov Cap-2 Maneuver	138	153	-	130	163	-	-	-	-	-	-	-
Stage 1	456	442	-	474	477	-	-	-	-	-	-	-
Stage 2	458	450	-	420	457	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	22.8	19.7	0.2	0.2
HCM LOS	C	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	966	-	-	238	262	985	-	-
HCM Lane V/C Ratio	0.012	-	-	0.151	0.066	0.014	-	-
HCM Control Delay (s)	8.8	0	-	22.8	19.7	8.7	0	-
HCM Lane LOS	A	A	-	C	C	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.5	0.2	0	-	-

Intersection	
Int Delay, s/veh	0.3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	1	139	176	2	6	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	0	1	0	0	0
Mvmt Flow	1	151	191	2	7	1

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	193	0	-	0	345	192
Stage 1	-	-	-	-	192	-
Stage 2	-	-	-	-	153	-
Critical Hdwy	4.1	-	-	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	2.2	-	-	-	3.5	3.3
Pot Cap-1 Maneuver	1392	-	-	-	656	855
Stage 1	-	-	-	-	845	-
Stage 2	-	-	-	-	880	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1392	-	-	-	655	855
Mov Cap-2 Maneuver	-	-	-	-	655	-
Stage 1	-	-	-	-	845	-
Stage 2	-	-	-	-	879	-

Approach	EB	WB	SB
HCM Control Delay, s	0.1	0	10.4
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1392	-	-	-	678
HCM Lane V/C Ratio	0.001	-	-	-	0.011
HCM Control Delay (s)	7.6	0	-	-	10.4
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	0

Intersection	
Int Delay, s/veh	0.4

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	2	120	95	8	6	2
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	2	130	103	9	7	2

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	112	0	-	0	243	108
Stage 1	-	-	-	-	108	-
Stage 2	-	-	-	-	135	-
Critical Hdwy	4.1	-	-	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	2.2	-	-	-	3.5	3.3
Pot Cap-1 Maneuver	1490	-	-	-	750	951
Stage 1	-	-	-	-	921	-
Stage 2	-	-	-	-	896	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1490	-	-	-	749	951
Mov Cap-2 Maneuver	-	-	-	-	749	-
Stage 1	-	-	-	-	921	-
Stage 2	-	-	-	-	895	-

Approach	EB	WB	SB
HCM Control Delay, s	0.1	0	9.6
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1490	-	-	-	791
HCM Lane V/C Ratio	0.001	-	-	-	0.011
HCM Control Delay (s)	7.4	0	-	-	9.6
HCM Lane LOS	A	A	-	-	A
HCM 95th %tile Q(veh)	0	-	-	-	0