65 Glenn Street | Lawrence, MA 01843
tel 978.794.1792 | fax 978.794.1793
www.tecmass.com

Mr. Jeffrey Wheeler, AICP
Planning Coordinator
Office of Community Development
Town of Belmont
19 Moore Street
Belmont, MA 02478

January 17, 2013

TEC Ref. T0376.01

RE: Cushing Village Redevelopment Project - Trapelo Road and Common Street, Belmont, MA
Full Build-Out Analysis – Cushing Square Overlay District

Dear Mr. Wheeler,

On behalf of Smith Legacy Partners, LLC, TEC, Inc. has prepared the following analysis of full build-out of the Cushing Square Overlay District based on comments received from the Town of Belmont's peer review consultant, Howard/Stein-Hudson Associates, Inc. (HSH), on the subject project. This analysis was prepared in accordance with the assumptions and guidelines outlined in the *Cushing Village Peer Review – Proposed Guidelines for CSOD Full Buildout Analysis (Guidelines)* memorandum written by Steve Heiken of ICON Architecture dated December 5, 2012. These guidelines were developed in coordination with Keri Pyke, PE, PTOE of HSH, Town of Belmont Planner, Jeffrey Wheeler, and Planning Board Chair, Sami Baghdady, and are summarized below.

<u>Analysis Assumptions</u>

- The Full Build-Out analysis includes all land parcels within the Cushing Square Overlay District with the exception of 63, 67, 125, 130, and 131-133 Trapelo Road; 3-5 Williston Road; and 448 Common Street as defined in Steve Heiken's *Guidelines* memo. These include small properties that do not permit much additional development, as well as buildings that already exceed the FAR allowed within the overlay district. A summary of the land parcels included in the analysis is provided as Attachment A of this letter.

- The sizes and land uses on each of the subject land parcels were determined utilizing the Town of Belmont's Assessor's Department Online Database and conducting a field visit to confirm the land uses. A summary of the existing parcel and building sizes and land uses within each subject parcel is provided in Attachment A of this letter.

- Based on provisions for public space, parking, and vehicle access, an FAR of 2.0 was determined to be appropriate for the Full Build-Out analysis of each of the subject land parcels as outlined in Steve Heiken's *Guidelines* memo.

- It was assumed that each land parcel would be occupied by a three-story building with retail space on the first floor and residential space on the second and third floors. The retail space potential for each subject land parcel was estimated by multiplying the total land area of the parcel by the FAR of 2.0 to estimate the total building square footage and multiplying by 1/3 to calculate the maximum first floor space. The residential space potential for each land parcel was similarly estimated by multiply the total potential building square footage by 2/3 to calculate the maximum second and third floor space. The number of potential residential units were

estimated based on a similar square footage per residential unit to the proposed Cushing Village project of approximately 1,000 SF per unit. These assumptions resulted in a total development of subject parcels within the overlay district to include 121,079 SF of retail space and 244 residential units. This is an increase in development of 69,758 SF of retail space and 227 residential units with a decrease in office / commercial space of22,935 SF.

- The existing land uses on the subject land parcels consist of retail, office / commercial space, residential units, two gas stations, and a funeral home. Institute of Transportation Engineers (ITE) trip generation information contained in the publication *Trip Generation, 9th Edition* for Land Use Codes (LUC) 820 (Shopping Center), 710 (General Office Building), 220 (Apartments), 944 (Gasoline / Service Station), and 560 (Church), respectively, were used to estimate the trips generated by the existing land uses in the overlay district. ITE does not contain trip generation data for a funeral home. However, a church was determined to be the most similar land use as churches regularly host funeral services. Therefore, this land use was used to estimate the trips generated by the existing funeral home in the overlay district. The detailed trip generation calculations are included as Attachment B.

- ITE trip rates for LUC 820 (Shopping Center) and LUC 220 (Apartments) were utilized to estimate the trips generated by the redevelopment of the subject land parcels in the Full Build-Out of the overlay district. The detailed trip generation calculations are included as Attachment C.

- Similar to the analysis prepared for the Cushing Square Redevelopment project, TEC applied a multi-use trip credit to both the Existing and the Full Build-Out trips. Additionally, a pass-by credit of 26-34% was applied to retail trips, and a pass-by credit of 58% was applied to gas station trips based on ITE data contained in the *Trip Generation Handbook, 2nd Edition*. The detailed calculation worksheets are included in Attachment B and C for the Existing and Full Build-Out conditions, respectively.

- The site-generated trips were distributed to the roadway network utilizing the same trip distribution percentages as utilized within the *Traffic Impact, Access, and Parking Study* (TIAPS) prepared for the Cushing Village Redevelopment project. The resulting Full Build-Out Trip Increase traffic volumes are depicted in Figures 1, 2, and 3 for the weekday morning, weekday evening, and Saturday midday peak hours, respectively.

- The trips generated by the Full Build-Out of the Cushing Square Overlay District were added to the 2017 No-Build and 2017 Build traffic-volume networks contained the TIAPS for the Cushing Village Redevelopment project to obtain the 2017 Full Build-Out without Cushing Village and 2017 Full Build-Out with Cushing Village traffic-volume networks as shown in Figures 4 and 5, respectively.

Analysis Results

Based on the assumptions discussed above, TEC conducted a capacity and queue analysis of the 2017 Full Build-Out conditions with and without the proposed Cushing Village Redevelopment Project utilizing Synchro 7.0 software. This analysis was conducted at the signalized intersections of Trapelo Road / Common Street / Cushing Avenue (Cushing Square) and Common Street / Belmont Street. The results of this analysis are summarized in Table 1 and are discussed in the following sections.

Table 1 – Signalized Intersection Capacity and Queue Analysis Summary

	2010 Existing				2017 No-Build				2017 Build			
Intersection / Lane Group	V/C[a]	Delay[b]	LOS[c]	Queue[d]	V/C	Delay	LOS	Queue	V/C	Delay	LOS	Queue
Trapelo Road / Common Street / Cushing Avenue												
Weekday Morning												
Trapelo Road EB approach	0.77	25.3	C	228/344	-	-	-	-	-	-	-	-
Trapelo Road EB LT	-	-	-	-	0.52	21.8	C	32/68	0.44	20.1	C	35/70
Trapelo Road EB TH / RT	-	-	-	-	1.08	86.1	F	621/946	1.07	81.2	F	659/964
Trapelo Road WB approach	0.46	18.3	B	127/172	-	-	-	-	-	-	-	-
Trapelo Road WB LT	-	-	-	-	0.37	26.8	C	<25/26	0.53	27.4	C	<25/39
Trapelo Road WB TH / RT	-	-	-	-	0.88	39.3	D	357/500	0.81	32.3	C	356/478
Common Street NB LT / TH	0.56	37.8	D	108/151	-	-	-	-	-	-	-	-
Common Street NB RT	0.03	32.4	C	<25/<25	-	-	-	-	-	-	-	-
Common Street NB LT	-	-	-	-	0.28	49.8	D	<25/45	0.56	49.2	D	79/122
Common Street NB TH / RT	-	-	-	-	0.54	40.4	D	129/170	0.66	45.7	D	151/194
Common Street SB LT	0.54	32.8	C	134/234	0.86	67.3	E	169/336	0.88	70.5	E	179/348
Common Street SB TH / RT	0.81	46.3	D	195/388	-	-	-	-	-	-	-	-
Common Street SB TH	-	-	-	-	0.53	32.7	C	160/254	0.68	43.5	D	178/271
Common Street SB RT	-	-	-	-	0.12	28.2	C	<25/61	0.15	34.4	C	25/66
Overall Intersection	**0.74**	**28.5**	**C**	**-**	**0.88**	**56.1**	**E**	**-**	**0.88**	**54.4**	**D**	**-**
Weekday Evening												
Trapelo Road EB approach	-	-	-	-	-	-	-	-	-	-	-	-
Trapelo Road EB LT	0.44	22.6	C	42/77	0.74	41.5	D	43/126	0.73	40.6	D	43/130
Trapelo Road EB TH / RT	0.80	32.3	C	321/473	0.80	32.2	C	403/637	0.84	36.3	D	419/665
Trapelo Road WB approach	0.94	52.4	D	290/434	-	-	-	-	-	-	-	-
Trapelo Road WB LT	-	-	-	-	0.14	22.1	C	<25/26	0.27	22.1	C	<25/42
Trapelo Road WB TH / RT	-	-	-	-	1.23	147.3	F	826/1073	1.22	144.3	F	814/1062
Common Street NB LT / TH	0.85	55.8	E	216/363	-	-	-	-	-	-	-	-
Common Street NB RT	0.07	32.8	C	<25/39	-	-	-	-	-	-	-	-
Common Street NB LT	-	-	-	-	0.51	52.2	D	63/109	0.72	59.6	E	110/188
Common Street NB TH / RT	-	-	-	-	0.83	56.1	E	257/390	0.88	61.9	E	278/418
Common Street SB LT	0.34	34.7	C	80/140	0.69	56.9	E	115/185	0.74	61.0	E	118/206
Common Street SB TH / RT	0.99	86.0	F	244/447	-	-	-	-	-	-	-	-
Common Street SB TH	-	-	-	-	0.67	42.3	D	201/321	0.74	47.9	D	207/302
Common Street SB RT	-	-	-	-	0.16	31.8	C	30/73	0.19	33.6	C	34/77
Overall Intersection	**0.93**	**50.7**	**D**	**-**	**1.04**	**76.7**	**E**	**-**	**1.07**	**76.9**	**E**	**-**

Table 1 Continued – Signalized Intersection Capacity and Queue Analysis Summary

	2010 Existing				2017 No-Build				2017 Build			
Intersection / Lane Group	V/C[a]	Delay[b]	LOS[c]	Queue[d]	V/C	Delay	LOS	Queue	V/C	Delay	LOS	Queue
Trapelo Road / Common Street / Cushing Avenue (continued)												
Saturday Midday												
Trapelo Road EB approach	0.69	24.5	C	143/218	-	-	-	-	-	-	-	-
Trapelo Road EB LT	-	-	-	-	0.62	25.6	C	41/73	0.62	26.0	C	44/76
Trapelo Road EB TH / RT	-	-	-	-	0.78	29.2	C	304/449	0.82	32.4	C	324/487
Trapelo Road WB approach	0.49	20.4	B	121/180	-	-	-	-	-	-	-	-
Trapelo Road WB LT	-	-	-	-	0.23	19.6	B	<25/35	0.49	24.0	C	32/60
Trapelo Road WB TH / RT	-	-	-	-	0.87	36.9	D	339/509	0.85	36.1	D	329/492
Common Street NB LT / TH	0.62	34.1	C	120/234	-	-	-	-	-	-	-	-
Common Street NB RT	0.10	27.6	C	<25/52	-	-	-	-	-	-	-	-
Common Street NB LT	-	-	-	-	0.54	44.2	D	62/119	0.78	52.9	D	134/268
Common Street NB TH / RT	-	-	-	-	0.71	40.1	C	180/314	0.82	47.7	D	212/386
Common Street SB LT	0.27	25.8	C	54/116	0.64	45.6	D	98/156	0.61	43.1	D	96/153
Common Street SB TH / RT	0.74	36.5	D	153/313	-	-	-	-	-	-	-	-
Common Street SB TH	-	-	-	-	0.54	32.5	C	138/208	0.70	40.7	D	155/226
Common Street SB RT	-	-	-	-	0.18	28.7	C	26/64	0.22	32.0	C	30/69
Overall Intersection	**0.69**	**26.8**	**C**	**-**	**0.81**	**34.4**	**C**	**-**	**0.79**	**38.0**	**D**	**-**
Common Street / Belmont Street												
Weekday Morning												
Belmont Street EB approach	0.62	6.2	A	124/260	0.66	8.1	A	153/388	0.69	8.7	A	160/415
Belmont Street WB LT / TH	0.32	4.0	A	51/102	0.34	4.9	A	62/151	0.35	5.0	A	63/155
Belmont Street WB RT	0.01	3.0	A	<25/<25	0.01	3.6	A	<25/<25	0.01	3.7	A	<25/<25
Belmont Street NB LT / TH	0.46	27.5	C	57/57	0.58	29.1	C	61/61	0.63	32.0	C	64/64
Belmont Street NB RT	0.01	24.4	C	<25/<25	0.01	23.7	C	<25/<25	0.01	23.6	C	<25/<25
Common Street SB LT / TH	0.31	26.5	C	31/65	-	-	-	-	-	-	-	-
Common Street SB RT	0.15	25.3	C	<25/46	-	-	-	-	-	-	-	-
Common Street SB LT	-	-	-	-	0.15	25.0	C	<25/35	0.21	25.1	C	<25/38
Common Street SB TH / RT	-	-	-	-	0.52	29.5	C	53/123	0.59	29.8	C	55/126
Overall Intersection	**0.59**	**11.3**	**B**	**-**	**0.64**	**13.5**	**B**	**-**	**0.67**	**14.2**	**B**	**-**

Table 1 Continued – Signalized Intersection Capacity and Queue Analysis Summary

	2010 Existing				2017 No-Build				2017 Build			
Intersection / Lane Group	V/C[a]	Delay[b]	LOS[c]	Queue[d]	V/C	Delay	LOS	Queue	V/C	Delay	LOS	Queue
Common Street / Belmont Street (continued)												
Weekday Evening												
Belmont Street EB approach	0.58	8.5	A	124/263	0.77	15.7	B	190/483	0.89	26.9	C	234/574
Belmont Street WB LT / TH	0.52	7.6	A	115/241	0.58	10.1	B	147/321	0.59	10.9	B	153/342
Belmont Street WB RT	0.02	4.8	A	<25/<25	0.02	6.1	A	<25/<25	0.04	6.7	A	<25/<25
Belmont Street NB LT / TH	0.67	28.3	C	122/182	0.69	28.6	C	136/198	0.69	28.2	C	142/205
Belmont Street NB RT	0.08	20.7	C	<25/29	0.08	19.8	B	<25/31	0.08	19.4	B	<25/31
Common Street SB LT / TH	0.56	25.3	C	87/149	-	-	-	-	-	-	-	-
Common Street SB RT	0.17	21.3	C	<25/49	-	-	-	-	-	-	-	-
Common Street SB LT	-	-	-	-	0.13	20.4	C	<25/<25	0.24	21.1	C	<25/40
Common Street SB TH / RT	-	-	-	-	0.74	31.2	C	138/225	0.76	31.4	C	149/240
Overall Intersection	**0.61**	**14.8**	**B**	**-**	**0.76**	**19.0**	**B**		**0.84**	**22.7**	**C**	**-**
Saturday Midday												
Belmont Street EB approach	0.55	8.9	A	54/145	0.60	11.6	B	93/234	0.64	13.3	B	129/255
Belmont Street WB LT / TH	0.35	7.5	A	33/91	0.36	9.0	A	53/134	0.34	9.6	A	65/129
Belmont Street WB RT	0.01	6.1	A	<25/<25	0.02	7.3	A	<25/<25	0.03	7.9	A	<25/<25
Belmont Street NB LT / TH	0.32	9.9	A	31/92	0.34	12.7	B	50/132	0.36	15.3	B	68/163
Belmont Street NB RT	0.03	8.6	A	<25/<25	0.04	11.0	B	<25/<25	0.04	13.3	B	<25/26
Common Street SB LT / TH	0.40	10.4	B	35/97	-	-	-	-	-	-	-	-
Common Street SB RT	0.10	8.9	A	<25/28	-	-	-	-	-	-	-	-
Common Street SB LT	-	-	-	-	0.12	11.5	B	<25/31	0.19	14.3	B	<25/51
Common Street SB TH / RT	-	-	-	-	0.56	15.0	B	76/182	0.63	19.1	B	110/238
Overall Intersection	**0.48**	**9.0**	**A**	**-**	**0.59**	**11.9**	**B**	**-**	**0.63**	**14.2**	**B**	**-**

[a] Volume-to-capacity ratio
[b] Delay expressed in seconds per vehicle (average)
[c] Level of service
[d] 50th / 95th Percentile Queue (in feet)
* Trapelo Road EB analyzed as an exclusive left-turn lane and shared through/right-turn lane due to de facto left-turn lane on this approach during the weekday evening peak period.

Trapelo Road / Common Street / Cushing Avenue (Cushing Square)

Several movements at this intersection are anticipated to operate at LOS E or F under the 2017 Full Build-Out conditions. These reduced levels of service are the result of a reduction in capacity created by the Trapelo Road Improvement Project currently under design, which will reduce the number of lanes through the intersection, creating capacity constrictions for eastbound commuter traffic flow during the weekday morning peak and for westbound commuter traffic flow during the weekday evening peak period. The additional traffic generated by the Cushing Village project is not anticipated to increase overall intersection delay by more than four seconds per vehicle.

Common Street / Belmont Street

All movements at this intersection are anticipated to operate at acceptable levels of service under Full Build-Out conditions. The additional traffic generated by the Cushing Village Redevelopment Project is not anticipated to increase overall intersection delay by more than four seconds per vehicle.

Conclusions

An analysis of the Full Build-Out of the Cushing Square Overlay District has been prepared to address comments raised by HSH on the Traffic Impact, Access, and Parking Study prepared for Cushing Village. This analysis indicates that the proposed Cushing Village Redevelopment project will have minimal impact on the operations of the study area intersections, as evidenced by the less than four second increase in overall intersection delay per vehicle at any of the study area intersections.

The documented capacity constrictions for commuter flow on Trapelo Road are directly attributable to the Town's propose lane use changes. However, the proposed changes are expected to enhance the multi-modal transportation options and complement the sustainable build-out of the District.

The mitigation measures proposed within the original TIAPS will improve the safety of the Common Street / Belmont Street intersection and will be sufficient to mitigate the limited traffic impacts of this redevelopment project.

We hope that this analysis adequately addresses your comments. Please do not hesitate to contact me at the office at (978) 794-1792 x145 if you have any questions regarding our response. Thank you for your consideration.

Sincerely,
TEC, Inc.

Rebecca L. Brown, PE
Senior Transportation Engineer

cc: Keri Pyke, PE, PTOE, Howard/Stein-Hudson Associates, Inc.
Steve Heiken, ICON Architecture, Inc.

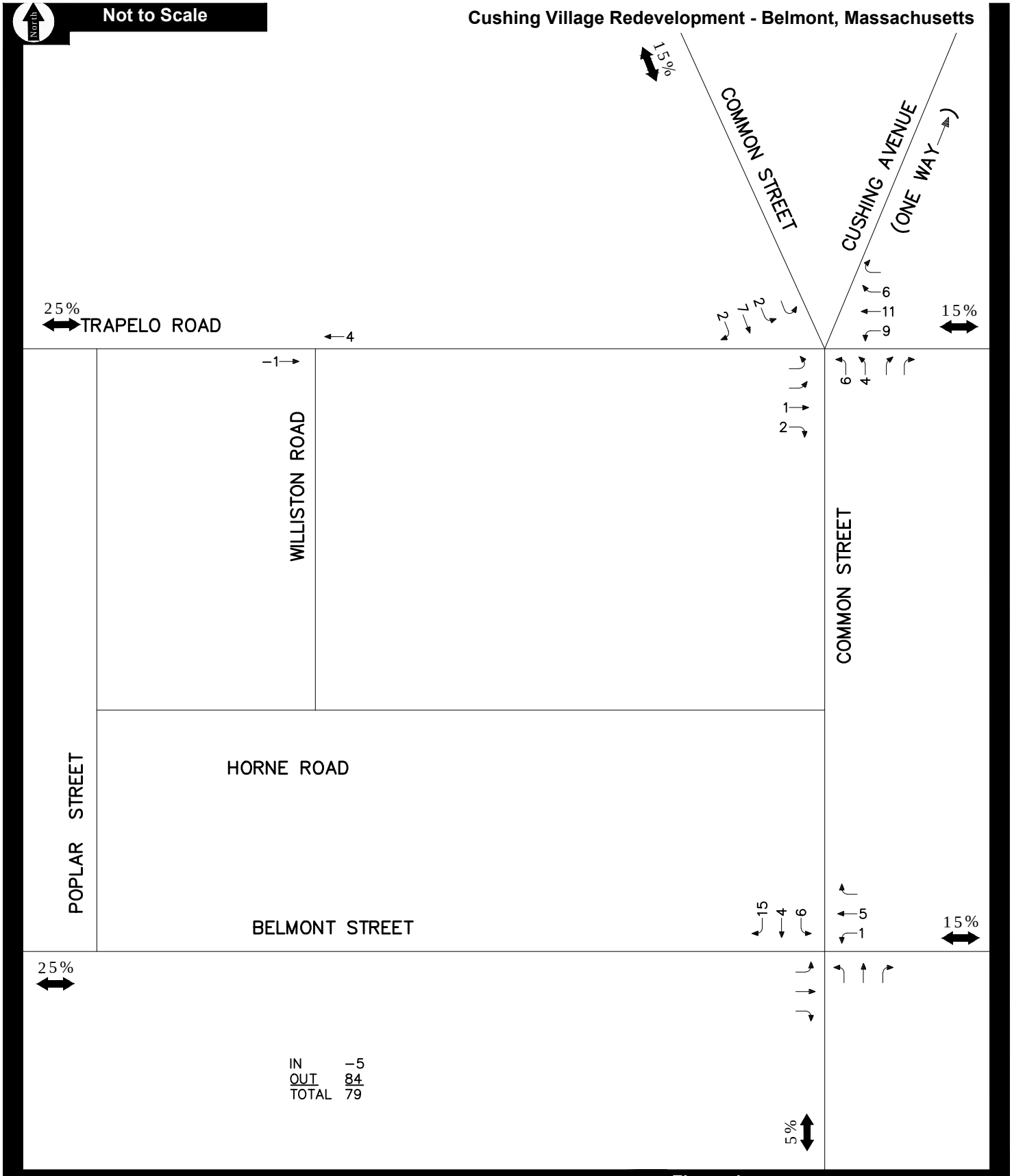


Figure 1

Full Build-Out Overlay District
Site-Generated Trip Assignment
Weekday Morning
Peak Hour Traffic Volumes

T:\T0376.01\CAD\Civil\Graphics\Full Build Analysis-011513\T0376.01_Traffic Networks.dwg 1/15/2013 11:09:04 AM

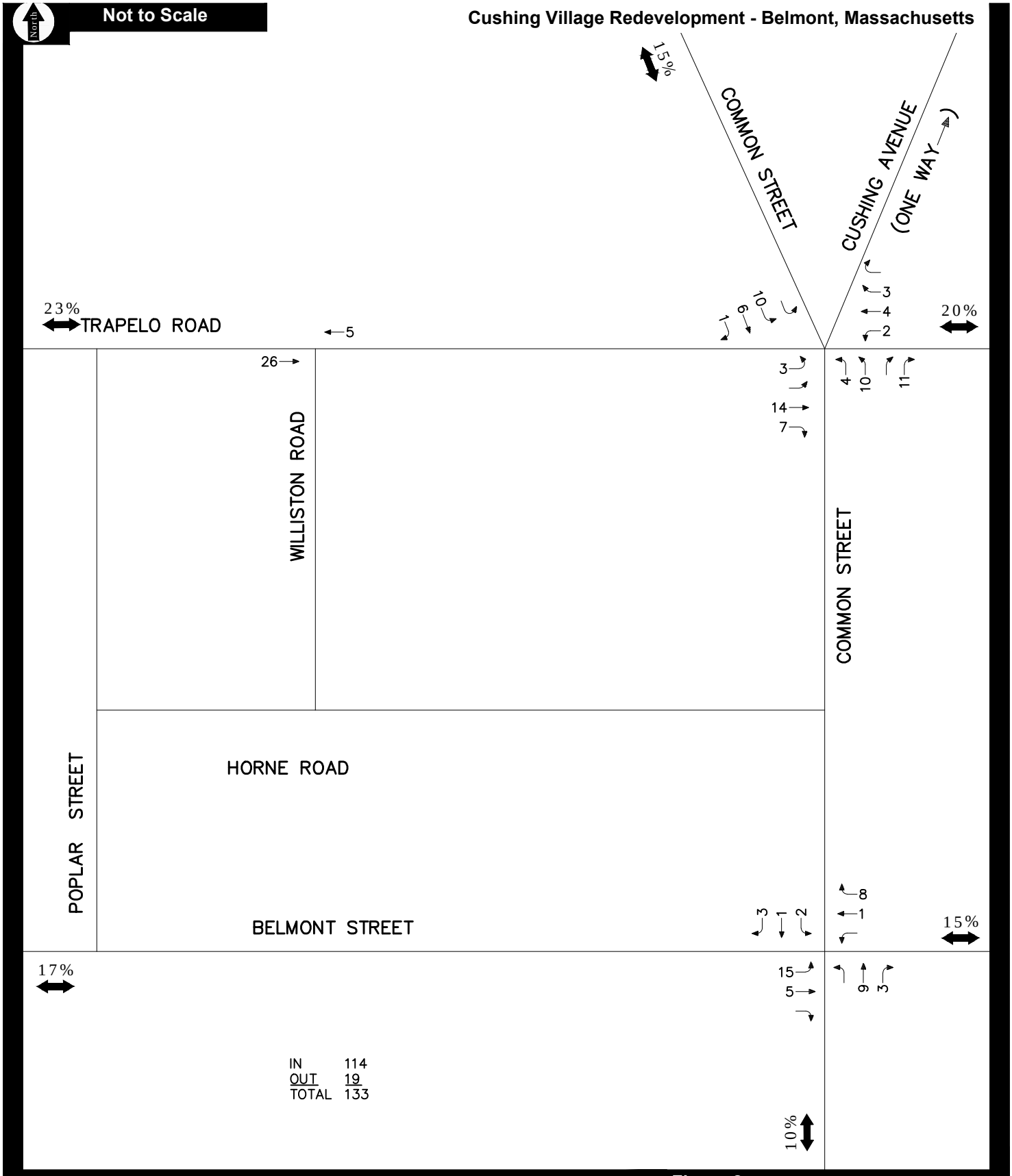


Figure 2

Full Build-Out Overlay District
Site-Generated Trip Assignment
Weekday Evening
Peak Hour Traffic Volumes

TEC, Inc.

T:\T0376.01\CAD\Civil\Graphics\Full Build Analysis-011513\T0376.01_Traffic Networks.dwg 1/15/2013 11:09:04 AM

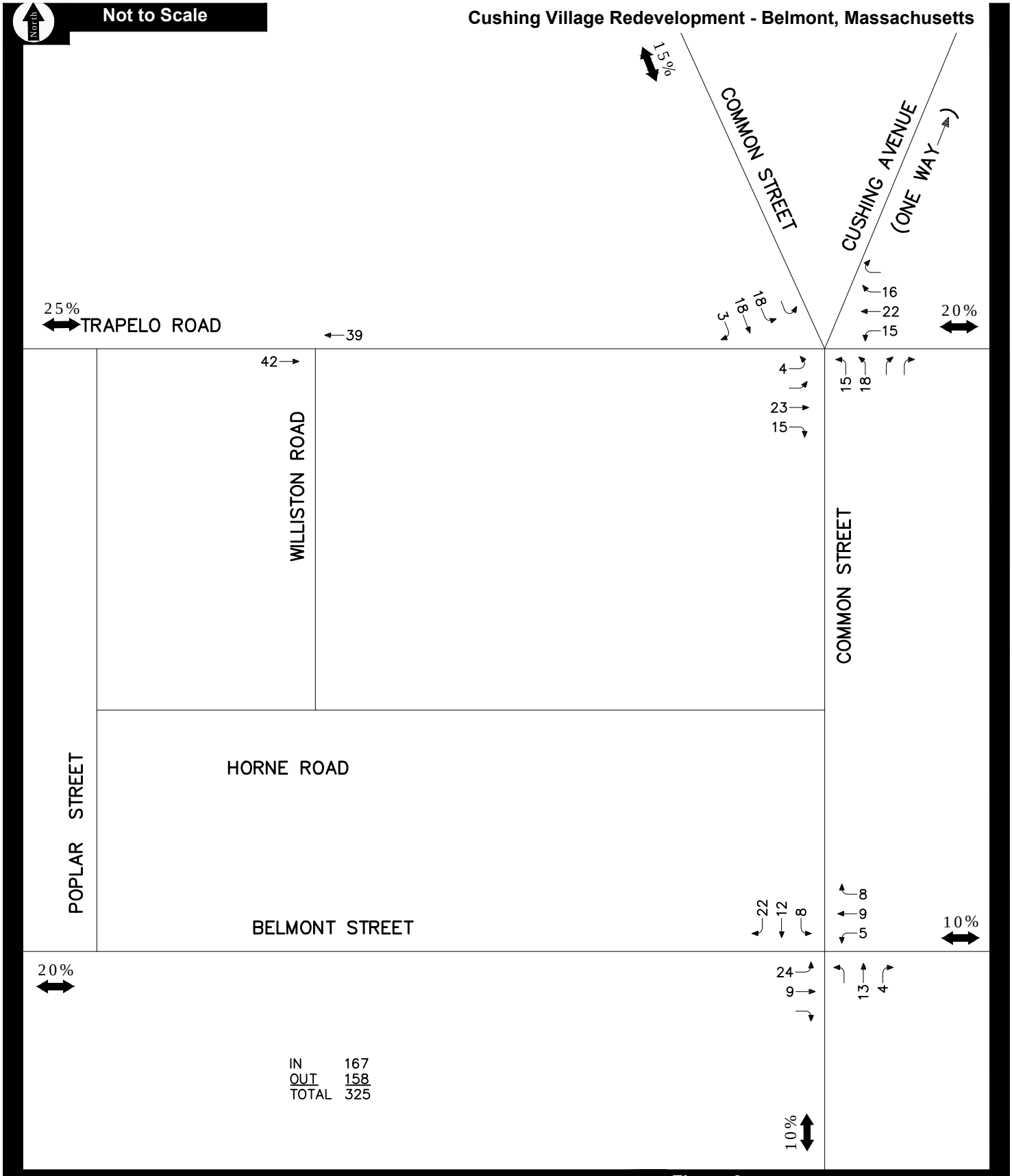


Figure 3

Full Build-Out Overlay District
Site-Generated Trip Assignment
Saturday Midday
Peak Hour Traffic Volumes

TEC, Inc.

T:\T0376.01\CAD\Civil\Graphics\Full Build Analysis-011513\T0376.01_Traffic Networks.dwg 1/15/2013 11:09:04 AM

Not to Scale

Cushing Village Redevelopment - Belmont, Massachusetts

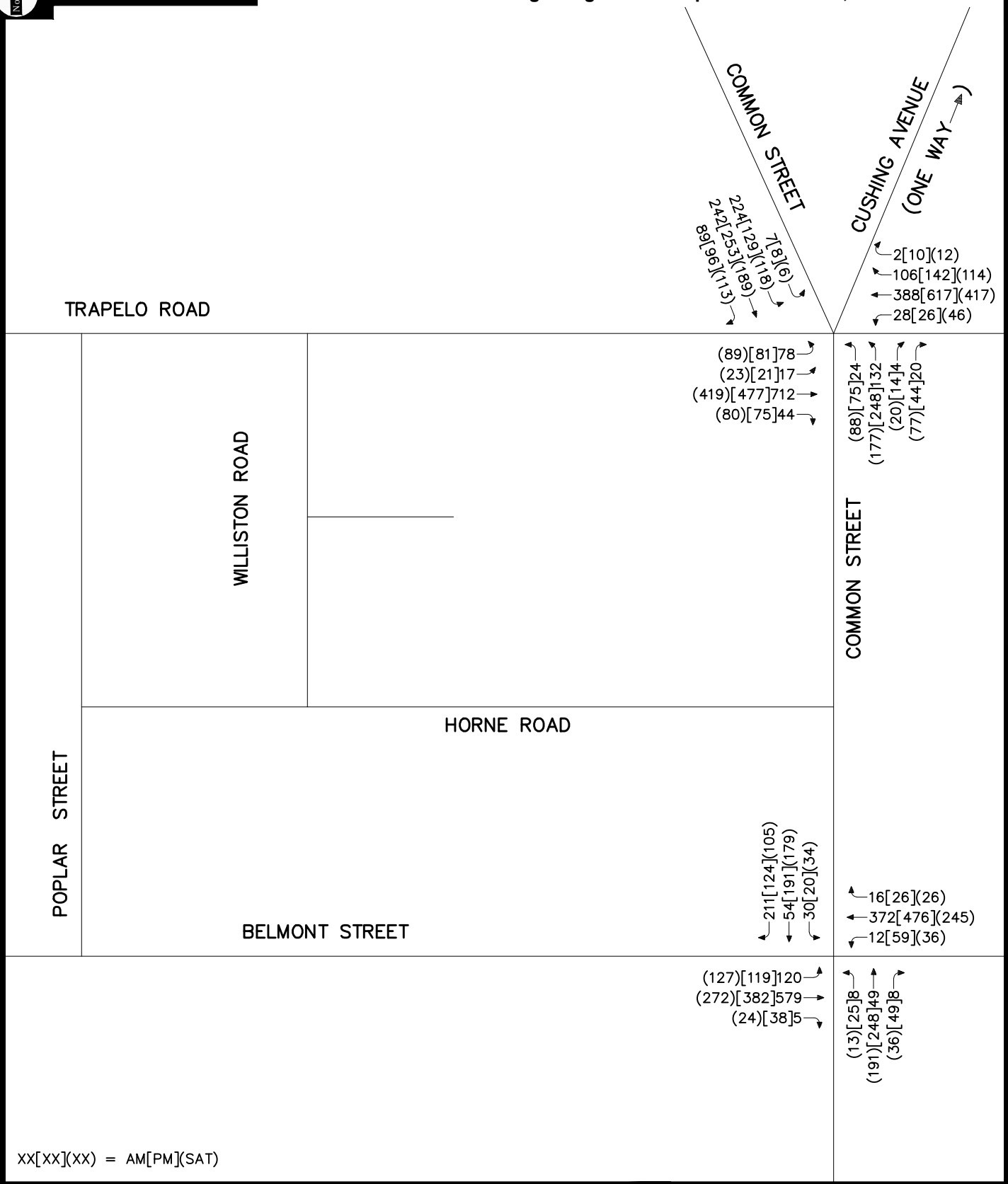


Figure 4

2017 Full Build-Out Without Cushing Village
Weekday Morning,
Weekday Evening, and
Saturday Midday
Peak Hour Traffic Volumes

TEC, Inc.

T:\T0376.01\CAD\Civil\Graphics\Full Build Analysis-011513\T0376.01_Traffic Networks.dwg 1/15/2013 11:09:04 AM

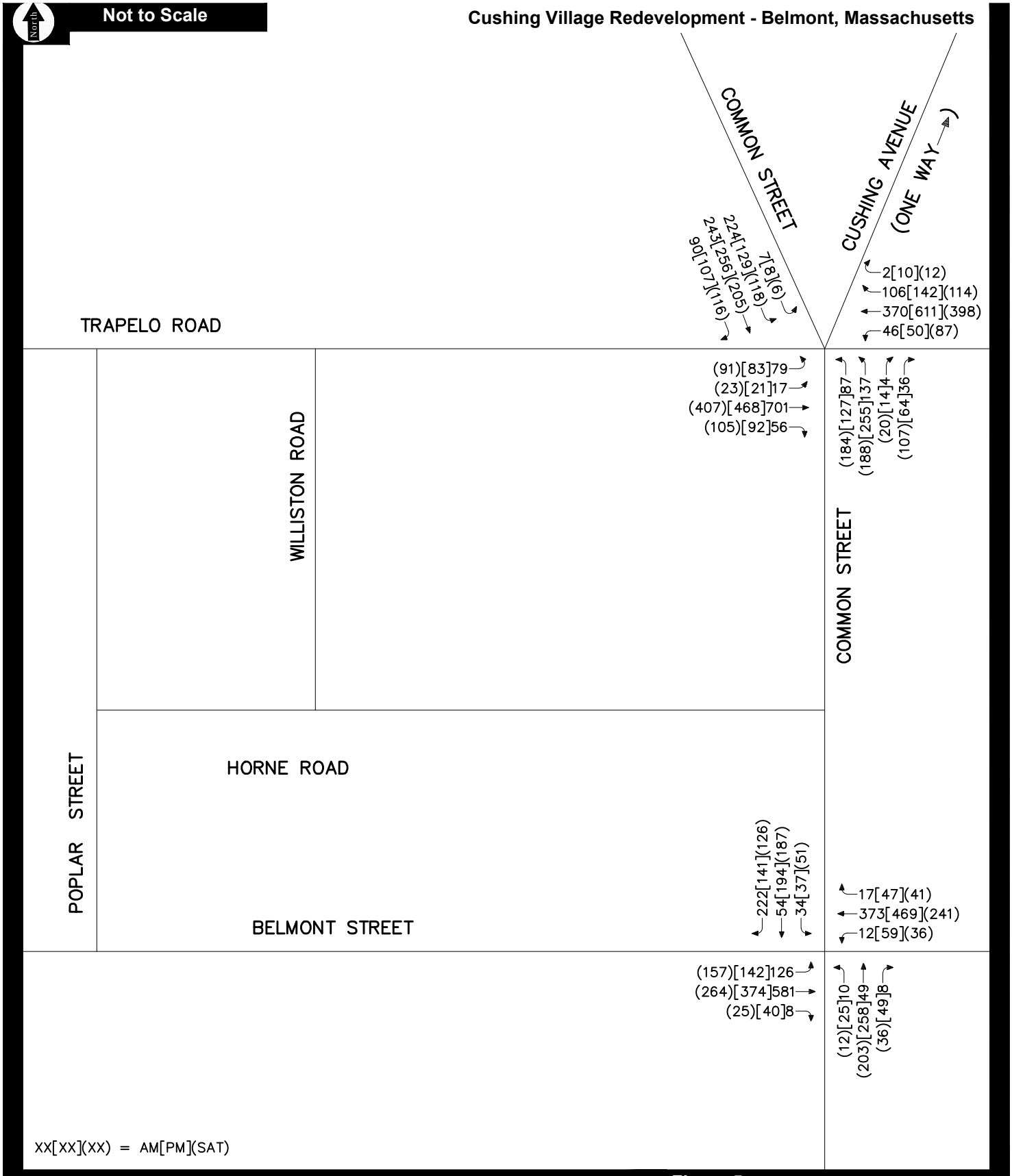


Figure 5

2017 Full Build-Out with Cushing Village
Weekday Morning,
Weekday Evening, and
Saturday Midday
Peak Hour Traffic Volumes

TEC, Inc.

T:\T0376.01\CAD\Civil\Graphics\Full Build Analysis-011513\T0376.01_Traffic Networks.dwg 1/15/2013 11:09:04 AM

Attachment A

Land Use Summary

					Existing Development Size						Proposed Development Potential			Increase in Development			
Label	Address Street	Quadrant	Lot Size (SF)	Storeys	Retail SF	Office SF	Residential Units	Gas Station Positions	Funeral Home SF	Total	Retail SF	Residential Units	Total SF	Retail SF	Residential Units	Total SF	
A	117 - 121 Trapelo Road	NW	5,691	1	3,357					3,357	3,794	8	11,382	437	8	8,025	
B	105 - 115 Trapelo Road	NW	9,668	1	7,900					7,900	6,445	13	19,336	-1,455	13	11,436	
C	441 - 449 Common Street	NW	9,450	1	7,930					7,930	6,300	13	18,900	-1,630	13	10,970	
D	93 - 97 Trapelo Road	NE	11,064	1	7,675					7,675	7,376	15	22,128	-299	15	14,453	
E	90 Trapelo Road	SE	5,993	1				4		1,045	3,995	8	11,986	3,995	8	10,941	
F	85 - 91 Trapelo Road	NE	11,111	1	6,578					6,578	7,407	15	22,222	829	15	15,644	
G	79 - 81 Trapelo Road	NE	5,661	2		1,196	1			2,392	3,774	8	11,322	3,774	7	8,930	
H	75 - 77 Trapelo Road	NE	5,698	2		2,392				2,392	3,799	8	11,396	3,799	8	9,004	
I	68 - 70 Trapelo Road	SE	3,794	3		3,575				3,575	2,529	5	7,588	2,529	5	4,013	
J	72 - 86 Trapelo Road	SE	11,118	2	3,110	3,110	4			12,440	7,412	15	22,236	4,302	11	9,796	
K	71 - 73 Trapelo Road	NE	7,628	2		2,392				2,392	5,085	10	15,256	5,085	10	12,864	
L	64 - 66 Trapelo Road	SE	3,670	2		1,210	1			2,420	2,447	5	7,340	2,447	4	4,920	
M	60 Trapelo Road	SE	12,951	2			5			3,895	8,634	17	25,902	8,634	12	22,007	
N	52 - 54 Trapelo Road	SE	13,470	1.5					4,988	4,988	8,980	18	26,940	8,980	18	21,952	
O	48 - 50 Trapelo Road	SE	6,385	2		2,626				2,626	4,257	9	12,770	4,257	9	10,144	
P	439 Common Street	NW	2,510	1	936					936	1,673	3	5,020	737	3	4,084	
Q	432 - 444 Common Street	NC	12,121	1	8,099					8,099	8,081	16	24,242	-18	16	16,143	
R	454 - 464 Common Street	NC	7,645	1	5,736					5,736	5,097	10	15,290	-639	10	9,554	
T	486 - 488 Common Street	SE	3,429	2		1,446	2			2,851	2,286	5	6,858	2,286	3	4,007	
S	490 - 492 Common Street	SE	6,922	2			2			2,388	4,615	9	13,844	4,615	7	11,456	
U	494 - 500 Common Street	SE	21,139	1				4		2,950	14,093	28	42,278	14,093	28	39,328	
V	531R Belmont Street	SE	4,500	2			2			2,248	3,000	6	9,000	3,000	4	6,752	
Total			**181,618**		**51,321**	**17,947**	**17**	**8**	**4,988**	**96,813**	**121,079**	**244**	**363,236**	**69,758**	**227**	**266,423**	
Development by Quadrant																	
	Northwest Quad	NW	27,319		20,123	0	0	0	0	20,123	18,213	37	54,638	-1,910	37	34,515	13%
	North Central Quad	NC	19,766		13,835	0	0	0	0	13,835	13,177	26	39,532	-658	26	25,697	10%
	Northeast Quad	NE	41,162		14,253	5,980	1	0	0	21,429	27,441	56	82,324	13,188	55	60,895	23%
	Southeast Quad	SE	93,371		3,110	11,967	16	8	4,988	41,426	62,247	125	186,742	59,137	109	145,316	55%
	Total		**181,618**		**51,321**	**17,947**	**17**	**8**	**4,988**	**96,813**	**121,079**	**244**	**363,236**	**69,758**	**227**	**266,423**	**100%**

Attachment B

Existing Trip Generation Calculations

Site Generated Trip Assessment - EXISTING

Project: Cushing Village Redevelopment - Belmont, MA - Full Build Analysis
Date: January 14, 2013
Analyst: TEC, Inc. / Rebecca L. Brown, P.E.
Source: Institute of Transportation Engineers - Trip Generation , 9th Edition

ITE Land Use Code (LUC) 710 - General Office Building

Average Vehicle Trips Ends vs: 1,000 Sq. Feet Gross Floor Area
Independent Variable (X): 17.947

AVERAGE WEEKDAY DAILY

Ln T = 0.76 Ln (X) + 3.68
Ln T = 0.76 Ln 17.947 + 3.68
Ln T = 5.87
T = **356** vehicle trips
with 50% (178 vph) entering and 50% (178 vph) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

Ln T = 0.80 Ln (X) + 1.57
Ln T = 0.80 Ln 17.947 + 1.57
Ln T = 3.88
T = **48** vehicle trips
with 88% (42 vph) entering and 12% (6 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 1.12 * (X) + 78.45
T = 1.12 * 17.947 + 78.45
T = **99** vehicle trips
with 17% (17 vph) entering and 83% (82 vph) exiting.

SATURDAY DAILY

T = 2.03 * (X) + 31.75
T = 2.03 * 17.947 + 31.75
T = **68** vehicle trips
with 50% (34 vpd) entering and 50% (34 vpd) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

T = 0.43 * (X)
T = 0.43 * 17.947
T = **8** vehicle trips
with 54% (4 vph) entering and 46% (4 vph) exiting.

Site Generated Trip Assessment - EXISTING

Project: Cushing Village Redevelopment - Belmont, MA - Full Build Analysis
Date: January 14, 2013
Analyst: TEC, Inc. / Rebecca L. Brown, P.E.
Source: Institute of Transportation Engineers - Trip Generation , 9th Edition

ITE Land Use Code (LUC) 820 - Shopping Center

Average Vehicle Trips vs: 1,000 Sq. Feet Gross Leasable Area
Independent Variable (X): 51.32

AVERAGE WEEKDAY DAILY

Ln T = 0.65 Ln (X) + 5.83
Ln T = 0.65 Ln(51.32) + 5.83
Ln T = 8.390
T = **4,402** vehicle trips
with 50% (2,201 vpd) entering and 50% (2,201 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

Ln T = 0.61 Ln (X) + 2.24
Ln T = 0.61 Ln(51.32) + 2.24
Ln T = 4.642
T = **104** vehicle trips
with 62% (64 vpd) entering and 38% (40 vpd) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

Ln T = 0.67 Ln (X) + 3.31
Ln T = 0.67 Ln(51.32) + 3.31
Ln T = 5.949
T = **383** vehicle trips
with 48% (184 vpd) entering and 52% (199 vpd) exiting.

SATURDAY DAILY

Ln T = 0.63 Ln(X) + 6.23
Ln T = 0.63 Ln(51.32) + 6.23
Ln T = 8.711
T = **6,069** vehicle trips
with 50% (3,035 vpd) entering and 50% (3,034 vpd) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

Ln T = 0.65 Ln(X) + 3.78
Ln T = 0.65 Ln(51.32) + 3.78
Ln T = 6.340
T = **567** vehicle trips
with 52% (295 vpd) entering and 48% (272 vpd) exiting.

Site Generated Trip Assessment - EXISTING

Project: Cushing Village Redevelopment - Belmont, MA - Full Build Analysis
Date: January 14, 2013
Analyst: TEC, Inc. / Rebecca L. Brown, P.E.
Source: Institute of Transportation Engineers - Trip Generation , 9th Edition

ITE Land Use Code (LUC) 944 - Gasoline / Service Station

Average Vehicle Trips Ends vs: Vehicle Fueling Positions
Independent Variable (X): 8 Position

WEEKDAY DAILY

T = 168.56 * (X)
T = 168.56 * 8.00
T = **1,348** vehicle trips
with 50% (674 vph) entering and 50% (674 vph) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 10.27 * (X) + 13.89
T = 10.27 * 8.00 + 13.89
T = **96** vehicle trips
with 51% (49 vph) entering and 49% (47 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 13.87 * (X)
T = 13.87 * 8.00
T = **111** vehicle trips
with 50% (56 vph) entering and 50% (55 vph) exiting.

SATURDAY DAILY

$$\frac{\text{ITE LUC 853 Saturday Daily Trip Rate}}{\text{ITE LUC 853 Weekday Daily Trip Rate}} = \frac{\text{ITE LUC 944 Saturday Daily Trip Rate}}{\text{ITE LUC 944 Weekday Daily Trip Rate}}$$

$$\frac{204.47}{542.60} = \frac{(Y)}{168.56} \qquad Y = 63.519099$$

T = Y * 8.000
T = **508** vehicle trips
with 50% (254 vph) entering and 50% (254 vph) exiting.

SATURDAY MIDDAY PEAK HOUR

$$\frac{\text{ITE LUC 946 Saturday Midday Trip Rate}}{\text{ITE LUC 946 Weekday Evening Trip Rate}} = \frac{\text{ITE LUC 944 Saturday Midday Trip Rate}}{\text{ITE LUC 944 Weekday Evening Trip Rate}}$$

$$\frac{19.46}{13.86} = \frac{(Y)}{13.87} \qquad Y = 19.47404$$

T = Y * 8.000
T = **156** vehicle trips
with 50% (78 vph) entering and 50% (78 vph) exiting.
(same distribution split as ITE LUC 946 during the Saturday midday peak hour of generator)

Site Generated Trip Assessment - EXISTING

Project: Cushing Village Redevelopment - Belmont, MA - Full Build Analysis
Date: January 14, 2013
Analyst: TEC / Rebecca L. Brown, P.E. / Samuel W. Gregorio, E.I.T.
Source: Institute of Transportation Engineers - Trip Generation - 9th Ed.

Institute of Transportation Engineers (ITE)
Land Use Code (LUC) 220 - Apartment

Average Vehicle Trips vs: Dwelling Units
Independent Variable (X): 17

AVERAGE WEEKDAY DAILY

T = 6.65 * (X)
T = 6.65 * 17
T = **113** vehicle trips
with 50% (57 vpd) entering and 50% (56 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.51 * (X)
T = 0.51 * 17
T = **9** vehicle trips
with 20% (2 vph) entering and 80% (7 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.62 * (X)
T = 0.62 * 17
T = **11** vehicle trips
with 65% (7 vph) entering and 35% (4 vph) exiting.

SATURDAY DAILY

T = 6.39 * (X)
T = 6.39 * 17
T = **109** vehicle trips
with 50% (55 vpd) entering and 50% (54 vpd) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

T = 0.52 * (X)
T = 0.52 * 17
T = **9** vehicle trips
with 50% (5 vph) entering and 50% (4 vph) exiting.

Site Generated Trip Assessment

Project: Cushing Village Redevelopment - Belmont, MA - Full Build Analysis
Date: January 14, 2013
Analyst: TEC, Inc. / Rebecca L. Brown, P.E.
Source: Institute of Transportation Engineers - Trip Generation , 9th Edition

ITE Land Use Code (LUC) 560 - Church

Average Vehicle Trips Ends vs: 1,000 SF Gross Floor Area
Independent Variable (X): 5.0 ksf

AVERAGE WEEKDAY DAILY

T = 9.11 * (X)
T = 9.11 * 5
T = 45.44
T = **46** vehicle trips
with 50% (23 vph) entering and 50% (23 vph) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.56 * (X)
T = 0.56 * 5
T = 2.79
T = **3** vehicle trips
with 62% (2 vph) entering and 38% (1 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.34 * (X) + 5.24
T = 0.34 * 4.99 + 5.24
T = 6.94
T = **7** vehicle trips
with 48% (3 vph) entering and 52% (4 vph) exiting.

SATURDAY DAILY

T = 10.37 * (X)
T = 10.37 * 0
T = 51.73
T = **52** vehicle trips
with 50% (26 vph) entering and 50% (26 vph) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

T = 3.54 * (X)
T = 3.54 * 0
T = 17.66
T = **18** vehicle trips
with 71% (13 vph) entering and 29% (5 vph) exiting.

Multi-Use Trip Generation Calculation

Analyst: RLB
Date: 1/14/2013

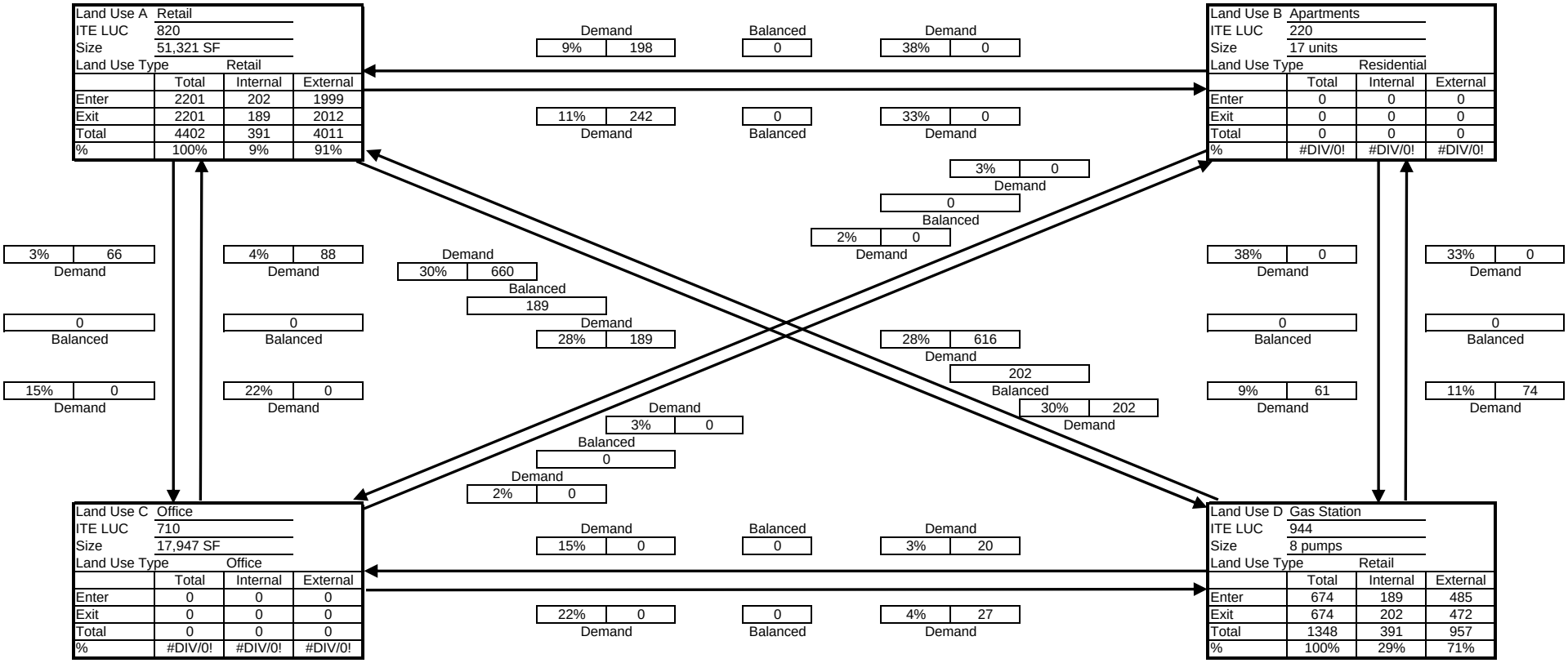
Project Name: Cushing Village - Full Build Existir
Time Period: Weekday Daily

Land Use A	Retail		
ITE LUC	820		
Size	51,321 SF		
Land Use Type	Retail		
	Total	Internal	External
Enter	2201	202	1999
Exit	2201	189	2012
Total	4402	391	4011
%	100%	9%	91%

Land Use B	Apartments		
ITE LUC	220		
Size	17 units		
Land Use Type	Residential		
	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%	#DIV/0!	#DIV/0!	#DIV/0!

Land Use C	Office		
ITE LUC	710		
Size	17,947 SF		
Land Use Type	Office		
	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%	#DIV/0!	#DIV/0!	#DIV/0!

Land Use D	Gas Station		
ITE LUC	944		
Size	8 pumps		
Land Use Type	Retail		
	Total	Internal	External
Enter	674	189	485
Exit	674	202	472
Total	1348	391	957
%	100%	29%	71%



Net External Trips for Multi-Use Development						
Land Use	A	B	C	D	Total	
Enter	1999	0	0	485	2484	
Exit	2012	0	0	472	2484	
Total External Trips	**4011**	**0**	**0**	**957**	**4968**	***Internal Capture***
Single-Use Trip Gen. Est.	4402	0	0	1348	5750	**14%**
Net Internal Trips	**391**	**0**	**0**	**391**	**782**	

Multi-Use Trip Generation Calculation

Analyst: RLB
Date: 1/14/2013

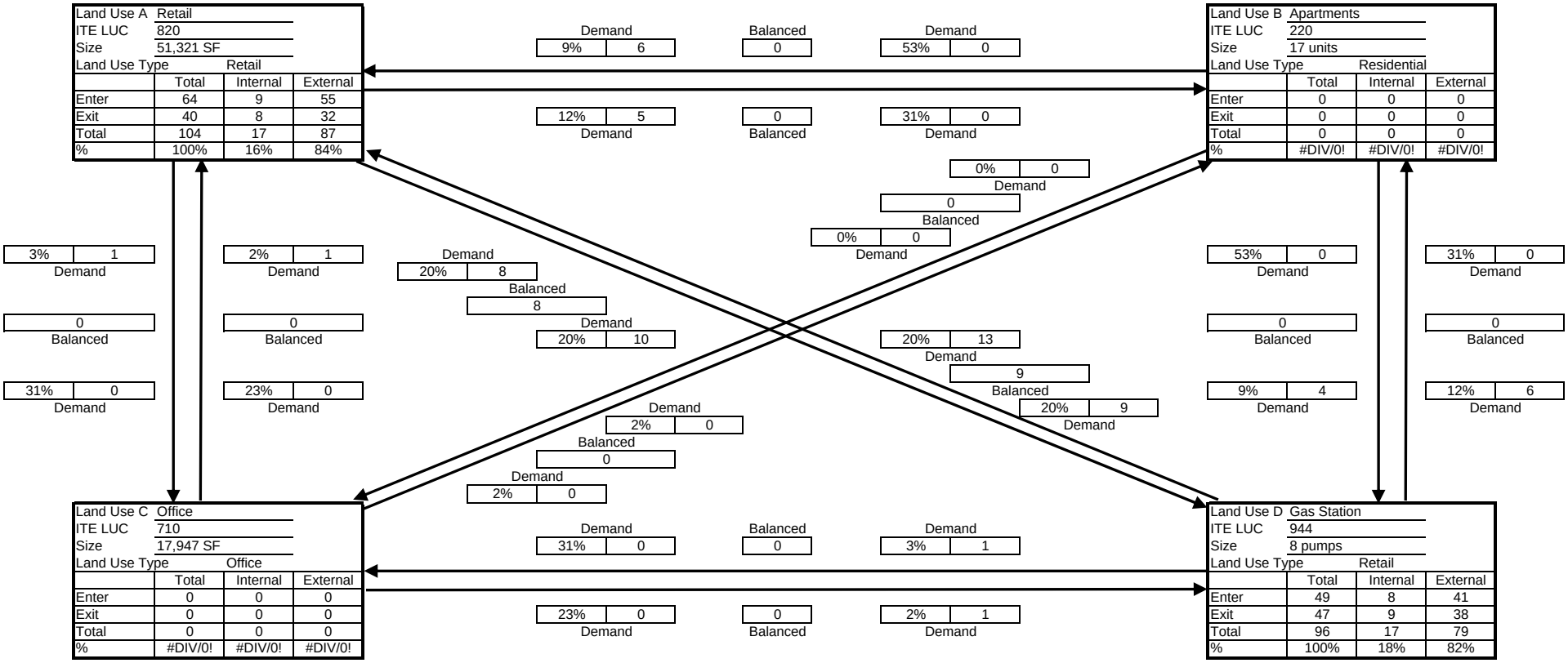
Project Name: Cushing Village - Full Build Existir
Time Period: Weekday AM Peak Hour

Land Use A	Retail		
ITE LUC	820		
Size	51,321 SF		
Land Use Type	Retail		
	Total	Internal	External
Enter	64	9	55
Exit	40	8	32
Total	104	17	87
%	100%	16%	84%

Land Use B	Apartments		
ITE LUC	220		
Size	17 units		
Land Use Type	Residential		
	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%	#DIV/0!	#DIV/0!	#DIV/0!

Land Use C	Office		
ITE LUC	710		
Size	17,947 SF		
Land Use Type	Office		
	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%	#DIV/0!	#DIV/0!	#DIV/0!

Land Use D	Gas Station		
ITE LUC	944		
Size	8 pumps		
Land Use Type	Retail		
	Total	Internal	External
Enter	49	8	41
Exit	47	9	38
Total	96	17	79
%	100%	18%	82%



Net External Trips for Multi-Use Development						
Land Use	A	B	C	D	Total	
Enter	55	0	0	41	96	
Exit	32	0	0	38	70	
Total External Trips	**87**	**0**	**0**	**79**	**166**	***Internal Capture***
Single-Use Trip Gen. Est.	104	0	0	96	200	**17%**
Net Internal Trips	**17**	**0**	**0**	**17**	**34**	

Multi-Use Trip Generation Calculation

Analyst: RLB
Date: 1/14/2013

Project Name: Cushing Village - Full Build Existir
Time Period: Weekday PM Peak Hour

Land Use A Retail
ITE LUC 820
Size 51,321 SF
Land Use Type Retail

	Total	Internal	External
Enter	184	11	173
Exit	199	11	188
Total	383	22	361
%	100%	6%	94%

Land Use B Apartments
ITE LUC 220
Size 17 units
Land Use Type Residential

	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%	#DIV/0!	#DIV/0!	#DIV/0!

Land Use C Office
ITE LUC 710
Size 17,947 SF
Land Use Type Office

	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%	#DIV/0!	#DIV/0!	#DIV/0!

Land Use D Gas Station
ITE LUC 944
Size 8 pumps
Land Use Type Retail

	Total	Internal	External
Enter	56	11	45
Exit	55	11	44
Total	111	22	89
%	100%	20%	80%

	Demand	Balanced	Demand
A → B	9% 17	0	53% 0
A → C	12% 24	0	31% 0
A → D	3% 6	0	31% 0
B → A	2% 4	0	53% 0
B → C	20% 40	11	20% 37
B → D	0% 0	0	9% 5
C → A	31% 0	0	23% 0
C → B	20% 11	0	2% 0
C → D	31% 0	0	3% 2
D → A	0% 0	0	2% 1
D → B	20% 11	11	12% 7
D → C	23% 0	0	2% 1

Net External Trips for Multi-Use Development

Land Use	A	B	C	D	Total	
Enter	173	0	0	45	218	
Exit	188	0	0	44	232	
Total External Trips	**361**	**0**	**0**	**89**	**450**	***Internal Capture***
Single-Use Trip Gen. Est.	383	0	0	111	494	**9%**
Net Internal Trips	**22**	**0**	**0**	**22**	**44**	

Multi-Use Trip Generation Calculation

Analyst: RLB
Date: 1/14/2013

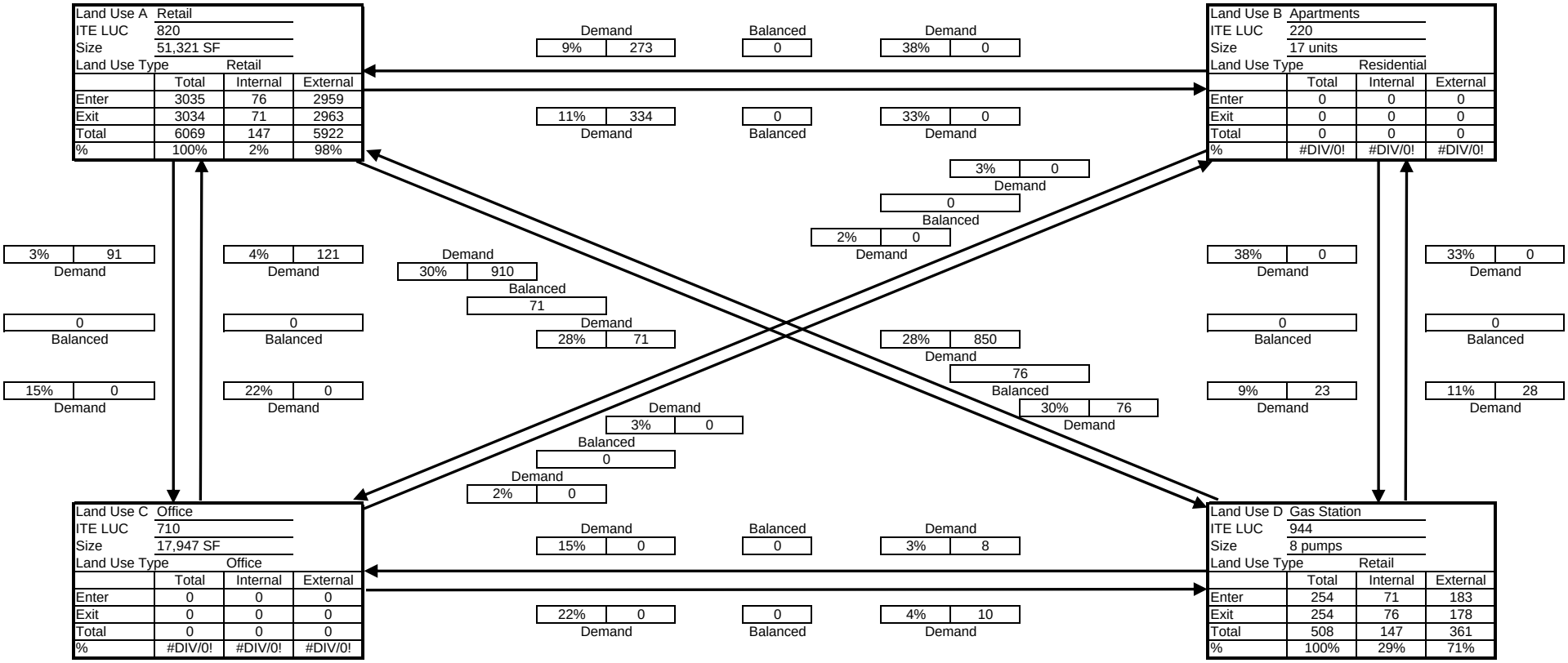
Project Name: Cushing Village - Full Build Existir
Time Period: Saturday Daily

Land Use A	Retail		
ITE LUC	820		
Size	51,321 SF		
Land Use Type	Retail		
	Total	Internal	External
Enter	3035	76	2959
Exit	3034	71	2963
Total	6069	147	5922
%	100%	2%	98%

Land Use B	Apartments		
ITE LUC	220		
Size	17 units		
Land Use Type	Residential		
	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%	#DIV/0!	#DIV/0!	#DIV/0!

Land Use C	Office		
ITE LUC	710		
Size	17,947 SF		
Land Use Type	Office		
	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%	#DIV/0!	#DIV/0!	#DIV/0!

Land Use D	Gas Station		
ITE LUC	944		
Size	8 pumps		
Land Use Type	Retail		
	Total	Internal	External
Enter	254	71	183
Exit	254	76	178
Total	508	147	361
%	100%	29%	71%



Net External Trips for Multi-Use Development						
Land Use	A	B	C	D	Total	
Enter	2959	0	0	183	3142	
Exit	2963	0	0	178	3141	
Total External Trips	**5922**	**0**	**0**	**361**	**6283**	***Internal Capture***
Single-Use Trip Gen. Est.	6069	0	0	508	6577	**4%**
Net Internal Trips	**147**	**0**	**0**	**147**	**294**	

Multi-Use Trip Generation Calculation

Analyst: RLB
Date: 1/14/2013

Project Name: Cushing Village - Full Build Existir
Time Period: Saturday Midday

Land Use A	Retail		
ITE LUC	820		
Size	51,321 SF		
Land Use Type	Retail		
	Total	Internal	External
Enter	295	23	272
Exit	272	24	248
Total	567	47	520
%	100%	8%	92%

Land Use B	Apartments		
ITE LUC	220		
Size	17 units		
Land Use Type	Residential		
	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%	#DIV/0!	#DIV/0!	#DIV/0!

Land Use C	Office		
ITE LUC	710		
Size	17,947 SF		
Land Use Type	Office		
	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%	#DIV/0!	#DIV/0!	#DIV/0!

Land Use D	Gas Station		
ITE LUC	944		
Size	8 pumps		
Land Use Type	Retail		
	Total	Internal	External
Enter	78	24	54
Exit	78	23	55
Total	156	47	109
%	100%	30%	70%

	Demand	Balanced	Demand
A → B	5% 15	0	34% 0
B → A	7% 19	0	37% 0
A → C	3% 8	0	38% 0
C → A	4% 12	0	20% 0
A → D	29% 79	24	31% 24
D → A	31% 91	23	29% 23
B → C	0% 0	0	0% 0
C → B	0% 0	0	0% 0
B → D	34% 0	0	5% 4
D → B	37% 0	0	7% 5
C → D	38% 0	0	3% 2
D → C	20% 0	0	4% 3

Net External Trips for Multi-Use Development						
Land Use	A	B	C	D	Total	
Enter	272	0	0	54	326	
Exit	248	0	0	55	303	
Total External Trips	**520**	**0**	**0**	**109**	**629**	***Internal Capture***
Single-Use Trip Gen. Est.	567	0	0	156	723	**13%**
Net Internal Trips	**47**	**0**	**0**	**47**	**94**	

Multi-Use Trip Generation Calculation

Analyst: RLB
Date: 1/14/2013

Project Name: Cushing Village - Full Build Existir
Time Period: Weekday Daily

Land Use A	Retail		
ITE LUC	Various		
Size	55,316 SF		
Land Use Type	Retail		
	Total	Internal	External
Enter	2484	60	2424
Exit	2484	46	2438
Total	4968	106	4862
%	100%	2%	98%

Land Use B	Apartments		
ITE LUC	220		
Size	17 units		
Land Use Type	Residential		
	Total	Internal	External
Enter	57	21	36
Exit	56	23	33
Total	113	44	69
%	100%	39%	61%

Land Use C	Office		
ITE LUC	710		
Size	17,947 SF		
Land Use Type	Office		
	Total	Internal	External
Enter	178	29	149
Exit	178	41	137
Total	356	70	286
%	100%	20%	80%

Land Use D	0		
ITE LUC	0		
Size	0		
Land Use Type	Retail		
	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%	#DIV/0!	#DIV/0!	#DIV/0!

Demand	9%	224	Balanced 21	Demand 38%	21
Demand	11%	273	Balanced 19	Demand 33%	19
Demand	3%	75	Demand 4%	99	Demand 30% 745
Balanced	27	Balanced 39	Balanced 0	Demand 28%	0
Demand	15%	27	Demand 22%	39	Demand 3% 2
Balanced	2	Demand 2%	4	Demand 2%	4
Demand	3%	2	Balanced 2	Demand 2%	4
Demand 38%	21	Demand 33%	19	Balanced 0	Demand 28% 696
Balanced 0	Balanced 0	Demand 9%	0	Demand 11%	0
Balanced 0	Demand 30%	0	Demand 15%	27	Balanced 0
Demand 22%	39	Balanced 0	Demand 4%	0	

Net External Trips for Multi-Use Development

Land Use	A	B	C	D	Total	
Enter	2424	36	149	0	2609	
Exit	2438	33	137	0	2608	
Total External Trips	**4862**	**69**	**286**	**0**	**5217**	***Internal Capture***
Single-Use Trip Gen. Est.	4968	113	356	0	5437	**4%**
Net Internal Trips	**106**	**44**	**70**	**0**	**220**	

Multi-Use Trip Generation Calculation

Analyst: RLB
Date: 1/14/2013

Project Name: Cushing Village - Full Build Existir
Time Period: Weekday AM Peak Hour

Land Use A Retail
ITE LUC: Various
Size: 55,316 SF
Land Use Type: Retail

	Total	Internal	External
Enter	96	5	91
Exit	70	3	67
Total	166	8	158
%	100%	5%	95%

Land Use B Apartments
ITE LUC: 220
Size: 17 units
Land Use Type: Residential

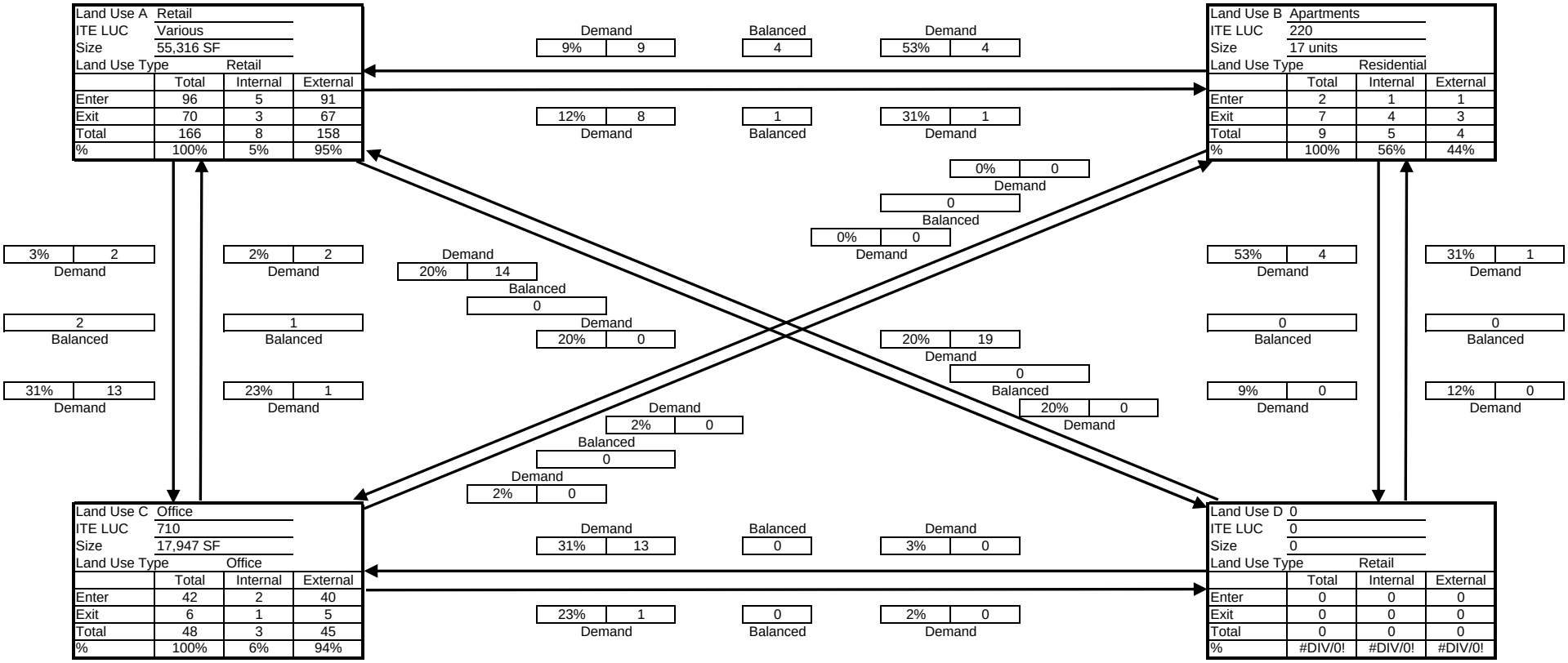
	Total	Internal	External
Enter	2	1	1
Exit	7	4	3
Total	9	5	4
%	100%	56%	44%

Land Use C Office
ITE LUC: 710
Size: 17,947 SF
Land Use Type: Office

	Total	Internal	External
Enter	42	2	40
Exit	6	1	5
Total	48	3	45
%	100%	6%	94%

Land Use D 0
ITE LUC: 0
Size: 0
Land Use Type: Retail

	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%	#DIV/0!	#DIV/0!	#DIV/0!



Net External Trips for Multi-Use Development

Land Use	A	B	C	D	Total	
Enter	91	1	40	0	132	
Exit	67	3	5	0	75	
Total External Trips	**158**	**4**	**45**	**0**	**207**	***Internal Capture***
Single-Use Trip Gen. Est.	166	9	48	0	223	**7%**
Net Internal Trips	**8**	**5**	**3**	**0**	**16**	

Multi-Use Trip Generation Calculation

Analyst: RLB
Date: 1/14/2013

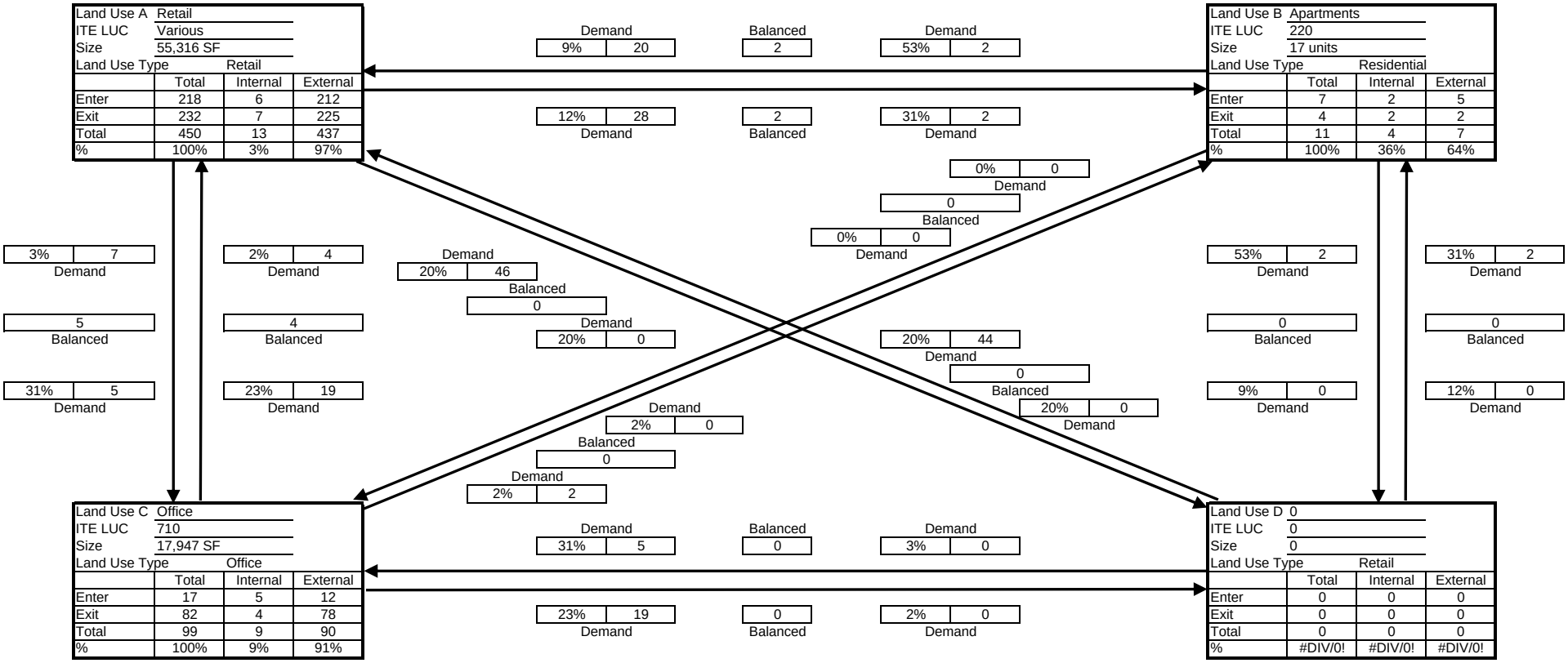
Project Name: Cushing Village - Full Build Existir
Time Period: Weekday PM Peak Hour

Land Use A	Retail		
ITE LUC	Various		
Size	55,316 SF		
Land Use Type	Retail		
	Total	Internal	External
Enter	218	6	212
Exit	232	7	225
Total	450	13	437
%	100%	3%	97%

Land Use B	Apartments		
ITE LUC	220		
Size	17 units		
Land Use Type	Residential		
	Total	Internal	External
Enter	7	2	5
Exit	4	2	2
Total	11	4	7
%	100%	36%	64%

Land Use C	Office		
ITE LUC	710		
Size	17,947 SF		
Land Use Type	Office		
	Total	Internal	External
Enter	17	5	12
Exit	82	4	78
Total	99	9	90
%	100%	9%	91%

Land Use D	0		
ITE LUC	0		
Size	0		
Land Use Type	Retail		
	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%	#DIV/0!	#DIV/0!	#DIV/0!



Net External Trips for Multi-Use Development						
Land Use	A	B	C	D	Total	
Enter	212	5	12	0	229	
Exit	225	2	78	0	305	
Total External Trips	**437**	**7**	**90**	**0**	**534**	***Internal Capture***
Single-Use Trip Gen. Est.	450	11	99	0	560	**5%**
Net Internal Trips	**13**	**4**	**9**	**0**	**26**	

Multi-Use Trip Generation Calculation

Analyst: RLB
Date: 1/14/2013

Project Name: Cushing Village - Full Build Existir
Time Period: Saturday Daily

Land Use A	Retail		
ITE LUC	Various		
Size	55,316 SF		
Land Use Type		Retail	
	Total	Internal	External
Enter	3142	28	3114
Exit	3141	23	3118
Total	6283	51	6232
%	100%	1%	99%

Land Use B	Apartments		
ITE LUC	220		
Size	17 units		
Land Use Type		Residential	
	Total	Internal	External
Enter	55	19	36
Exit	54	22	32
Total	109	41	68
%	100%	38%	62%

Land Use C	Office		
ITE LUC	710		
Size	17,947 SF		
Land Use Type		Office	
	Total	Internal	External
Enter	34	6	28
Exit	34	8	26
Total	68	14	54
%	100%	21%	79%

Land Use D	0		
ITE LUC	0		
Size	0		
Land Use Type		Retail	
	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%	#DIV/0!	#DIV/0!	#DIV/0!

	Demand	Balanced	Demand
A → B	9% 283	21	38% 21
B → A	11% 346	18	33% 18
A → C	3% 94	5	15% 5
C → A	4% 126	7	22% 7
B → C	30% 942	0	28% 0
C → B	2% 1	1	3% 2
A → D	3% 2	1	2% 1
D → A	38% 21	0	9% 0
B → D	33% 18	0	11% 0
D → B	28% 880	0	30% 0
C → D	15% 5	0	3% 0
D → C	22% 7	0	4% 0

Net External Trips for Multi-Use Development

Land Use	A	B	C	D	Total	
Enter	3114	36	28	0	3178	
Exit	3118	32	26	0	3176	
Total External Trips	**6232**	**68**	**54**	**0**	**6354**	***Internal Capture***
Single-Use Trip Gen. Est.	6283	109	68	0	6460	**2%**
Net Internal Trips	**51**	**41**	**14**	**0**	**106**	

Multi-Use Trip Generation Calculation

Analyst: RLB
Date: 1/14/2013

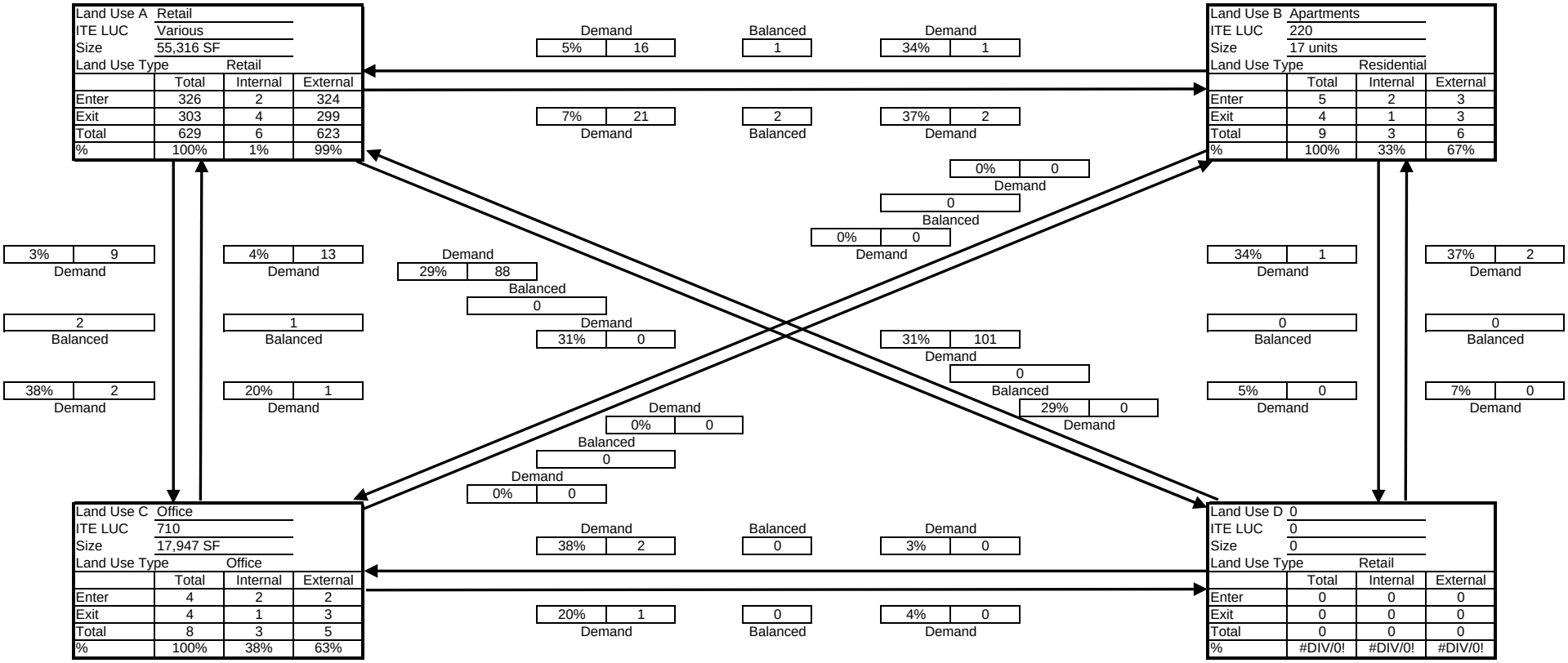
Project Name: Cushing Village - Full Build Existir
Time Period: Saturday Midday

Land Use A	Retail		
ITE LUC	Various		
Size	55,316 SF		
Land Use Type	Retail		
	Total	Internal	External
Enter	326	2	324
Exit	303	4	299
Total	629	6	623
%	100%	1%	99%

Land Use B	Apartments		
ITE LUC	220		
Size	17 units		
Land Use Type	Residential		
	Total	Internal	External
Enter	5	2	3
Exit	4	1	3
Total	9	3	6
%	100%	33%	67%

Land Use C	Office		
ITE LUC	710		
Size	17,947 SF		
Land Use Type	Office		
	Total	Internal	External
Enter	4	2	2
Exit	4	1	3
Total	8	3	5
%	100%	38%	63%

Land Use D	0		
ITE LUC	0		
Size	0		
Land Use Type	Retail		
	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%	#DIV/0!	#DIV/0!	#DIV/0!



Net External Trips for Multi-Use Development						
Land Use	A	B	C	D	Total	
Enter	324	3	2	0	329	
Exit	299	3	3	0	305	
Total External Trips	**623**	**6**	**5**	**0**	**634**	***Internal Capture***
Single-Use Trip Gen. Est.	629	9	8	0	646	**2%**
Net Internal Trips	**6**	**3**	**3**	**0**	**12**	

Attachment C

Full Build-Out Trip Generation Worksheets

Trip Generation Assessment - Cushing Square Development

Project: Proposed Mixed Use Development - Trapelo Road & Common Street, Belmont, MA
Date: January 11, 2012
Analyst: TEC, Inc. / Rebecca L. Brown, P.E.
Source: Institute of Transportation Engineers - Trip Generation - 8th Ed.

Proposed Development

Apartment (ITE LUC 220)

Units: 244 Units

	Total Trips		**Total**	% Distribution		Multi-Use Trips		**Total New**	**Total New**	# Passby Trips		# Primary Trips	
	IN	OUT	**Trips**	IN	OUT	IN	OUT	**Pass-by Trips**	**Primary Trips**	IN	OUT	IN	OUT
Weekday Daily	812	811	**1623**	50%	50%	268	308	0	**1047**	0	0	544	503
Weekday AM PH	25	99	**124**	20%	80%	8	10	0	**106**	0	0	17	89
Weekday PM PH	98	53	**151**	65%	35%	30	28	0	**93**	0	0	68	25
Saturday Daily	780	779	**1559**	50%	50%	257	296	0	**1006**	0	0	523	483
Sat Midday PH	64	63	**127**	50%	50%	24	21	0	**82**	0	0	40	42

Retail (ITE LUC 820)

Size: 121.079 KSF

	Total Trips		**Total**	% Distribution		Multi-Use Trips		**Total New**	**Total New**	# Passby Trips		# Primary Trips	
	IN	OUT	**Trips**	IN	OUT	IN	OUT	**Pass-by Trips**	**Primary Trips**	IN	OUT	IN	OUT
Weekday Daily	3845	3845	**7690**	50%	50%	308	268	**1850**	**5264**	925	925	2612	2652
Weekday AM PH	109	66	**175**	62%	38%	10	8	**40**	**117**	20	20	79	38
Weekday PM PH	327	354	**681**	48%	52%	28	30	**212**	**411**	106	106	193	218
Saturday Daily	5212	5211	**10423**	50%	50%	296	257	**2566**	**7304**	1283	1283	3633	3671
Sat Midday PH	515	475	**990**	52%	48%	21	24	**246**	**699**	123	123	371	328

Assumed 34% pass-by rate for weekday PM and 26% pass-by rate for all others (LUC 820 - Shopping Center - Trip Generation Handbook, 2nd Edition).

Total Proposed Development

Size: 363.236 KSF

	Total Trips		**Total**	% Distribution		Multi-Use Trips		**Total New**	**Total New**	# Passby Trips		# Primary Trips	
	IN	OUT	**Trips**	IN	OUT	IN	OUT	**Pass-by Trips**	**Primary Trips**	IN	OUT	IN	OUT
Weekday Daily	4657	4656	**9313**	50%	50%	576	576	**1850**	**6311**	925	925	3156	3155
Weekday AM PH	134	165	**299**	45%	55%	18	18	**40**	**223**	20	20	96	127
Weekday PM PH	425	407	**832**	51%	49%	58	58	**212**	**504**	106	106	261	243
Saturday Daily	5992	5990	**11982**	50%	50%	553	553	**2566**	**8310**	1283	1283	4156	4154
Sat Midday PH	579	538	**1117**	52%	48%	45	45	**246**	**781**	123	123	411	370

Trip Generation Assessment - Cushing Square Development

Project: Proposed Mixed Use Development - Trapelo Road & Common Street, Belmont, MA
Date: January 11, 2012
Analyst: TEC, Inc. / Rebecca L. Brown, P.E.
Source: Institute of Transportation Engineers - Trip Generation - 8th Ed.

Existing Uses (For reference only - No credit applied to project)

Office (ITE LUC 710)

Size: 17.947 KSF

	Total Trips		Total	% Distribution		Multi-Use Trips		Total New	Total New	# Passby Trips		# Primary Trips	
	IN	OUT	**Trips**	IN	OUT	IN	OUT	**Pass-by Trips**	**Primary Trips**	IN	OUT	IN	OUT
Weekday Daily	178	178	**356**	50%	50%	29	41	**0**	**286**	0	0	149	137
Weekday AM PH	42	6	**48**	88%	12%	2	1	**0**	**45**	0	0	40	5
Weekday PM PH	17	82	**99**	17%	83%	5	4	**0**	**90**	0	0	12	78
Saturday Daily	34	34	**68**	49%	51%	6	8	**0**	**54**	0	0	28	26
Sat Midday PH	4	4	**8**	54%	46%	2	1	**0**	**5**	0	0	2	3

Retail (ITE LUC 820)

Size: 51.321 KSF

	Total Trips		Total	% Distribution		Multi-Use Trips		Total New	Total New	# Passby Trips		# Primary Trips	
	IN	OUT	**Trips**	IN	OUT	IN	OUT	**Pass-by Trips**	**Primary Trips**	IN	OUT	IN	OUT
Weekday Daily	2201	2201	**4402**	50%	50%	250	226	**1020**	**2906**	510	510	1441	1465
Weekday AM PH	64	40	**104**	62%	38%	12	9	**22**	**61**	11	11	41	20
Weekday PM PH	184	199	**383**	48%	52%	16	17	**120**	**230**	60	60	108	122
Saturday Daily	3035	3034	**6069**	50%	50%	102	93	**1528**	**4346**	764	764	2169	2177
Sat Midday PH	295	272	**567**	52%	48%	25	27	**134**	**381**	67	67	203	178

Assumed 34% pass-by rate for weekday PM and 26% pass-by rate for all others (LUC 820 - Shopping Center - Trip Generation Handbook, 2nd Edition).

Gas Station (ITE LUC 944)

Size: 8 Fueling Positions

	Total Trips		Total	% Distribution		Multi-Use Trips		Total New	Total New	# Passby Trips		# Primary Trips	
	IN	OUT	**Trips**	IN	OUT	IN	OUT	**Pass-by Trips**	**Primary Trips**	IN	OUT	IN	OUT
Weekday Daily	674	674	**1348**	50%	50%	201	211	**542**	**394**	271	271	202	192
Weekday AM PH	49	47	**96**	51%	49%	10	11	**44**	**31**	22	22	17	14
Weekday PM PH	56	55	**111**	50%	50%	12	12	**50**	**37**	25	25	19	18
Saturday Daily	254	254	**508**	50%	50%	73	77	**208**	**150**	104	104	77	73
Sat Midday PH	78	78	**156**	50%	50%	24	24	**62**	**46**	31	31	23	23

Assumed 58% pass-by rate (LUC 944 - Gasoline / Service Station - Trip Generation Handbook, 2nd Edition).

Residential (ITE LUC 220)

Size: 17 Units

	Total Trips		Total	% Distribution		Multi-Use Trips		Total New	Total New	# Passby Trips		# Primary Trips	
	IN	OUT	**Trips**	IN	OUT	IN	OUT	**Pass-by Trips**	**Primary Trips**	IN	OUT	IN	OUT
Weekday Daily	57	56	**113**	50%	50%	21	23	**0**	**69**	0	0	36	33
Weekday AM PH	2	7	**9**	20%	80%	1	4	**0**	**4**	0	0	1	3
Weekday PM PH	7	4	**11**	65%	35%	2	2	**0**	**7**	0	0	5	2
Saturday Daily	55	54	**109**	50%	50%	19	22	**0**	**68**	0	0	36	32
Sat Midday PH	5	4	**9**	50%	50%	2	1	**0**	**6**	0	0	3	3

Trip Generation Assessment - Cushing Square Development

Project: Proposed Mixed Use Development - Trapelo Road & Common Street, Belmont, MA
Date: January 11, 2012
Analyst: TEC, Inc. / Rebecca L. Brown, P.E.
Source: Institute of Transportation Engineers - Trip Generation - 8th Ed.

Funeral Home (ITE LUC 560)

Size: 4.988 KSF

	Total Trips		**Total**	% Distribution		Multi-Use Trips		**Total New**	**Total New**	# Passby Trips		# Primary Trips	
	IN	OUT	**Trips**	IN	OUT	IN	OUT	**Pass-by Trips**	**Primary Trips**	IN	OUT	IN	OUT
Weekday Daily	23	23	**46**	50%	50%	0	0	**0**	**46**	0	0	23	23
Weekday AM PH	2	1	**3**	62%	38%	0	0	**0**	**3**	0	0	2	1
Weekday PM PH	3	4	**7**	48%	52%	0	0	**0**	**7**	0	0	3	4
Saturday Daily	26	26	**52**	50%	50%	0	0	**0**	**52**	0	0	26	26
Sat Midday PH	13	5	**18**	71%	29%	0	0	**0**	**18**	0	0	13	5

Total Existing

Size: 96.81 KSF

	Total Trips		**Total**	% Distribution		Multi-Use Trips		**Total New**	**Total New**	# Passby Trips		# Primary Trips	
	IN	OUT	**Trips**	IN	OUT	IN	OUT	**Pass-by Trips**	**Primary Trips**	IN	OUT	IN	OUT
Weekday Daily	3133	3132	**6265**	50%	50%	501	501	**1562**	**3701**	781	781	1851	1850
Weekday AM PH	159	101	**260**	61%	39%	25	25	**66**	**144**	33	33	101	43
Weekday PM PH	267	344	**611**	44%	56%	35	35	**170**	**371**	85	85	147	224
Saturday Daily	3404	3402	**6806**	50%	50%	200	200	**1736**	**4670**	868	868	2336	2334
Sat Midday PH	395	363	**758**	52%	48%	53	53	**196**	**456**	98	98	244	212

Net Increase	***Total Trips***		***Total***			***Total Multi-Use Trips***		***Total New***	***Total New***	***Total Pass-by Trips***		***Total Primary Trips***	
	In	***Out***	***Trips***			***In***	***Out***	***Pass-by Trips***	***Primary Trips***	***In***	***Out***	***In***	***Out***
Weekday Daily	**1524**	**1524**	**3048**			**75**	**75**	**288**	**2610**	**144**	**144**	**1305**	**1305**
Weekday AM Peak Hour	**-25**	**64**	**39**			**-7**	**-7**	**-26**	**79**	**-13**	**-13**	**-5**	**84**
Weekday PM Peak Hour	**158**	**63**	**221**			**23**	**23**	**42**	**133**	**21**	**21**	**114**	**19**
Saturday Daily	**2588**	**2588**	**5176**			**353**	**353**	**830**	**3640**	**415**	**415**	**1820**	**1820**
Sat Midday Peak Hour	**184**	**175**	**359**			**-8**	**-8**	**50**	**325**	**25**	**25**	**167**	**158**

Site Generated Trip Assessment - PROPOSED

Project: Cushing Village Redevelopment - Belmont, MA - Full Build Analysis
Date: January 14, 2013
Analyst: TEC, Inc. / Rebecca L. Brown, P.E.
Source: Institute of Transportation Engineers - Trip Generation , 9th Edition

ITE Land Use Code (LUC) 820 - Shopping Center

Average Vehicle Trips vs: 1,000 Sq. Feet Gross Leasable Area
Independent Variable (X): 121.08

AVERAGE WEEKDAY DAILY

Ln T = 0.65 Ln (X) + 5.83
Ln T = 0.65 Ln(121.08) + 5.83
Ln T = 8.948
T = **7,690** vehicle trips
with 50% (3,845 vpd) entering and 50% (3,845 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

Ln T = 0.61 Ln (X) + 2.24
Ln T = 0.61 Ln(121.08) + 2.24
Ln T = 5.166
T = **175** vehicle trips
with 62% (109 vpd) entering and 38% (66 vpd) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

Ln T = 0.67 Ln (X) + 3.31
Ln T = 0.67 Ln(121.08) + 3.31
Ln T = 6.524
T = **681** vehicle trips
with 48% (327 vpd) entering and 52% (354 vpd) exiting.

SATURDAY DAILY

Ln T = 0.63 Ln(X) + 6.23
Ln T = 0.63 Ln(121.08) + 6.23
Ln T = 9.252
T = **10,423** vehicle trips
with 50% (5,212 vpd) entering and 50% (5,211 vpd) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

Ln T = 0.65 Ln(X) + 3.78
Ln T = 0.65 Ln(121.08) + 3.78
Ln T = 6.898
T = **990** vehicle trips
with 52% (515 vpd) entering and 48% (475 vpd) exiting.

Site Generated Trip Assessment - PROPOSED

Project: Cushing Village Redevelopment - Belmont, MA - Full Build Analysis
Date: January 14, 2013
Analyst: TEC / Rebecca L. Brown, P.E. / Samuel W. Gregorio, E.I.T.
Source: Institute of Transportation Engineers - Trip Generation - 9th Ed.

Institute of Transportation Engineers (ITE)
Land Use Code (LUC) 220 - Apartment

Average Vehicle Trips vs: Dwelling Units
Independent Variable (X): 244

AVERAGE WEEKDAY DAILY

T = 6.65 * (X)
T = 6.65 * 244
T = **1623** vehicle trips
with 50% (812 vpd) entering and 50% (811 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.51 * (X)
T = 0.51 * 244
T = **124** vehicle trips
with 20% (25 vph) entering and 80% (99 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.62 * (X)
T = 0.62 * 244
T = **151** vehicle trips
with 65% (98 vph) entering and 35% (53 vph) exiting.

SATURDAY DAILY

T = 6.39 * (X)
T = 6.39 * 244
T = **1559** vehicle trips
with 50% (780 vpd) entering and 50% (779 vpd) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

T = 0.52 * (X)
T = 0.52 * 244
T = **127** vehicle trips
with 50% (64 vph) entering and 50% (63 vph) exiting.

Multi-Use Trip Generation Calculation

Analyst: RLB
Date: 1/14/2013

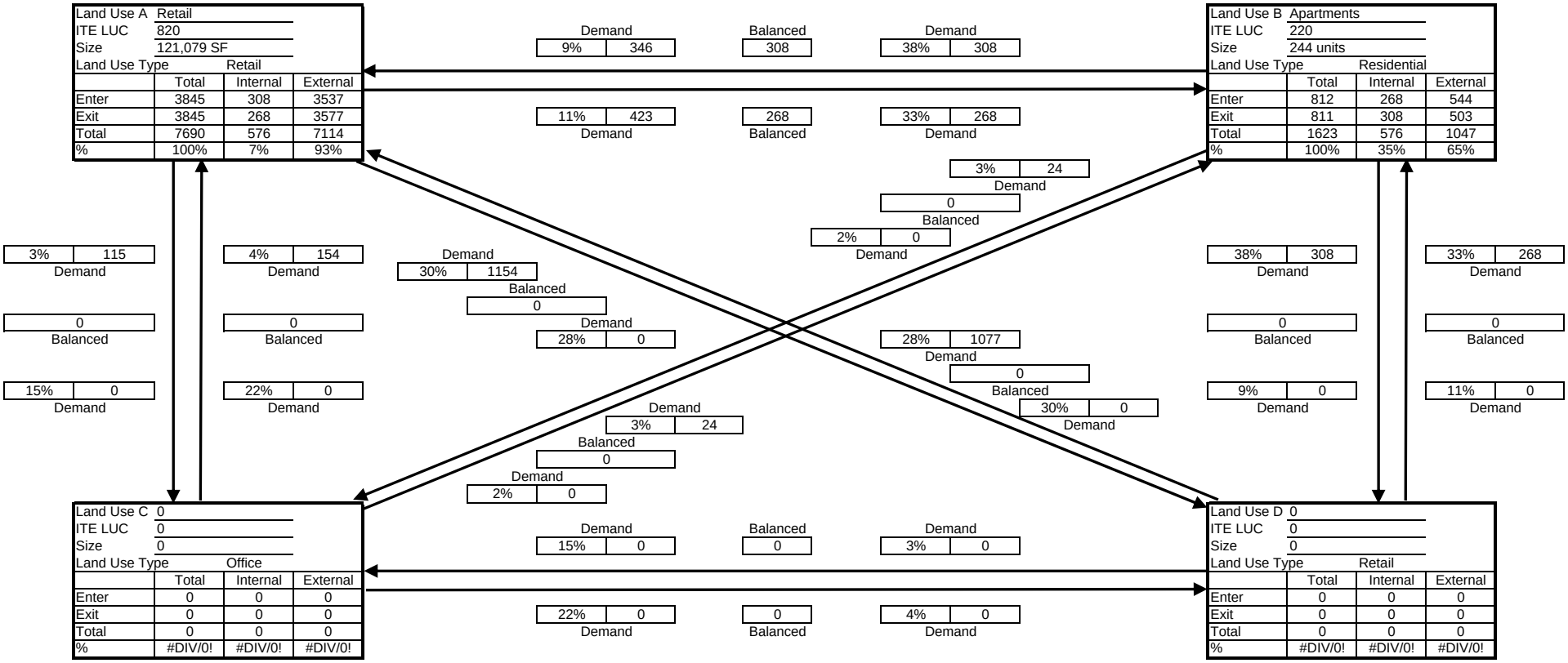
Project Name: Cushing Village - Full Build Propo
Time Period: Weekday Daily

Land Use A	Retail		
ITE LUC	820		
Size	121,079 SF		
Land Use Type	Retail		
	Total	Internal	External
Enter	3845	308	3537
Exit	3845	268	3577
Total	7690	576	7114
%	100%	7%	93%

Land Use B	Apartments		
ITE LUC	220		
Size	244 units		
Land Use Type	Residential		
	Total	Internal	External
Enter	812	268	544
Exit	811	308	503
Total	1623	576	1047
%	100%	35%	65%

Land Use C	0		
ITE LUC	0		
Size	0		
Land Use Type	Office		
	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%	#DIV/0!	#DIV/0!	#DIV/0!

Land Use D	0		
ITE LUC	0		
Size	0		
Land Use Type	Retail		
	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%	#DIV/0!	#DIV/0!	#DIV/0!



Net External Trips for Multi-Use Development						
Land Use	A	B	C	D	Total	
Enter	3537	544	0	0	4081	
Exit	3577	503	0	0	4080	
Total External Trips	**7114**	**1047**	**0**	**0**	**8161**	***Internal Capture***
Single-Use Trip Gen. Est.	7690	1623	0	0	9313	**12%**
Net Internal Trips	**576**	**576**	**0**	**0**	**1152**	

Multi-Use Trip Generation Calculation

Analyst: RLB
Date: 1/14/2013

Project Name: Cushing Village - Full Build Propo
Time Period: Weekday AM Peak Hour

Land Use A	Retail		
ITE LUC	820		
Size	121,079 SF		
Land Use Type	Retail		
	Total	Internal	External
Enter	109	10	99
Exit	66	8	58
Total	175	18	157
%	100%	10%	90%

Land Use B	Apartments		
ITE LUC	220		
Size	244 units		
Land Use Type	Residential		
	Total	Internal	External
Enter	25	8	17
Exit	99	10	89
Total	124	18	106
%	100%	15%	85%

Land Use C	0		
ITE LUC	0		
Size	0		
Land Use Type	Office		
	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%	#DIV/0!	#DIV/0!	#DIV/0!

Land Use D	0		
ITE LUC	0		
Size	0		
Land Use Type	Retail		
	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%	#DIV/0!	#DIV/0!	#DIV/0!

Demand	9%	10	Balanced	10	Demand
Demand	12%	8	Balanced	8	Demand
Demand	53%	52	Demand	31%	8
Demand	0%	0	Demand	0%	0
Balanced	0				
Demand	3%	2	Demand	2%	2
Demand	20%	13	Balanced	0	
Demand	20%	0	Demand	20%	22
Balanced	0				
Demand	31%	0	Demand	23%	0
Demand	2%	1	Balanced	0	
Demand	2%	0			
Demand	31%	0	Balanced	0	Demand
Demand	23%	0	Balanced	0	Demand
Demand	53%	52	Demand	31%	8
Balanced	0				
Demand	9%	0	Demand	12%	0
Demand	20%	0			

Net External Trips for Multi-Use Development						
Land Use	A	B	C	D	Total	
Enter	99	17	0	0	116	
Exit	58	89	0	0	147	
Total External Trips	**157**	**106**	**0**	**0**	**263**	***Internal Capture***
Single-Use Trip Gen. Est.	175	124	0	0	299	**12%**
Net Internal Trips	**18**	**18**	**0**	**0**	**36**	

Multi-Use Trip Generation Calculation

Analyst: RLB
Date: 1/14/2013

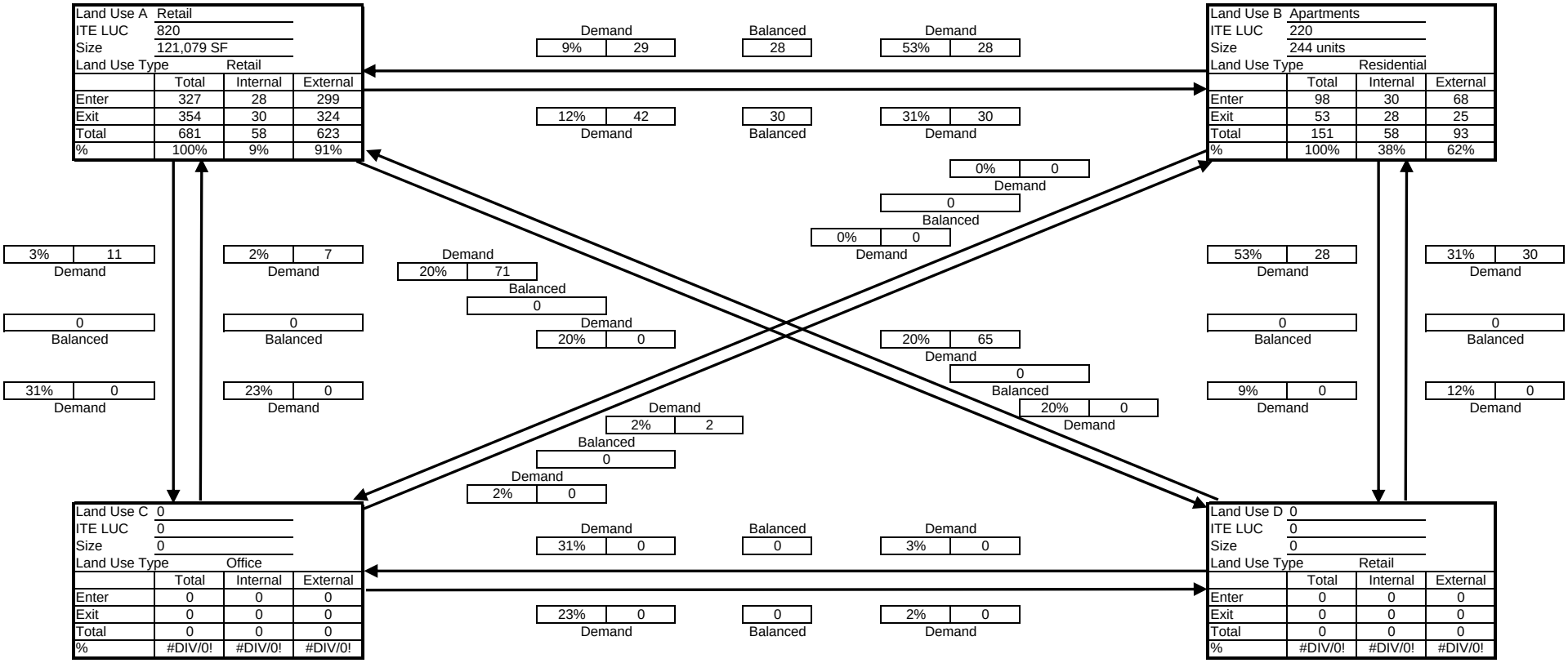
Project Name: Cushing Village - Full Build Propo
Time Period: Weekday PM Peak Hour

Land Use A	Retail		
ITE LUC	820		
Size	121,079 SF		
Land Use Type	Retail		
	Total	Internal	External
Enter	327	28	299
Exit	354	30	324
Total	681	58	623
%	100%	9%	91%

Land Use B	Apartments		
ITE LUC	220		
Size	244 units		
Land Use Type	Residential		
	Total	Internal	External
Enter	98	30	68
Exit	53	28	25
Total	151	58	93
%	100%	38%	62%

Land Use C	0		
ITE LUC	0		
Size	0		
Land Use Type	Office		
	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%	#DIV/0!	#DIV/0!	#DIV/0!

Land Use D	0		
ITE LUC	0		
Size	0		
Land Use Type	Retail		
	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%	#DIV/0!	#DIV/0!	#DIV/0!



Net External Trips for Multi-Use Development						
Land Use	A	B	C	D	Total	
Enter	299	68	0	0	367	
Exit	324	25	0	0	349	
Total External Trips	**623**	**93**	**0**	**0**	**716**	***Internal Capture***
Single-Use Trip Gen. Est.	681	151	0	0	832	**14%**
Net Internal Trips	**58**	**58**	**0**	**0**	**116**	

Multi-Use Trip Generation Calculation

Analyst: RLB
Date: 1/14/2013

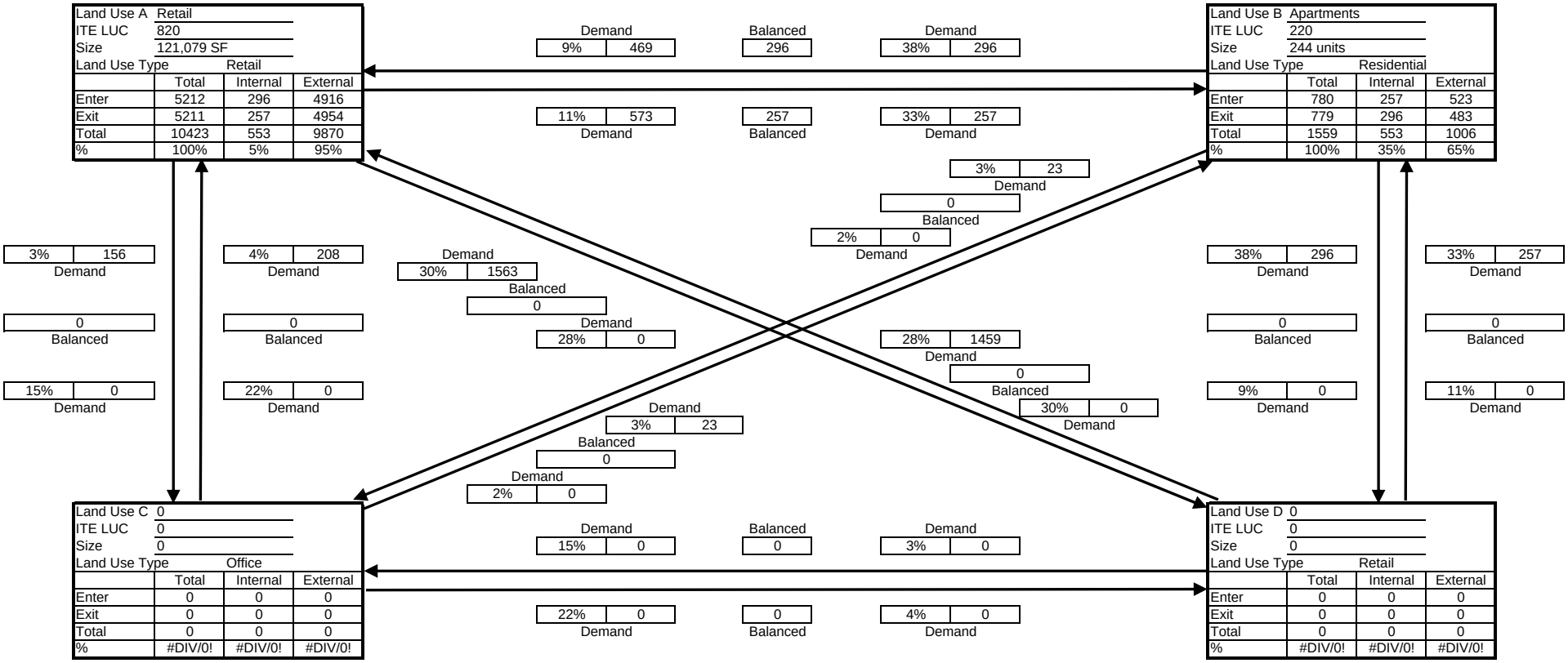
Project Name: Cushing Village - Full Build Propo
Time Period: Saturday Daily

Land Use A	Retail		
ITE LUC	820		
Size	121,079 SF		
Land Use Type	Retail		
	Total	Internal	External
Enter	5212	296	4916
Exit	5211	257	4954
Total	10423	553	9870
%	100%	5%	95%

Land Use B	Apartments		
ITE LUC	220		
Size	244 units		
Land Use Type	Residential		
	Total	Internal	External
Enter	780	257	523
Exit	779	296	483
Total	1559	553	1006
%	100%	35%	65%

Land Use C	0		
ITE LUC	0		
Size	0		
Land Use Type	Office		
	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%	#DIV/0!	#DIV/0!	#DIV/0!

Land Use D	0		
ITE LUC	0		
Size	0		
Land Use Type	Retail		
	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%	#DIV/0!	#DIV/0!	#DIV/0!



Net External Trips for Multi-Use Development						
Land Use	A	B	C	D	Total	
Enter	4916	523	0	0	5439	
Exit	4954	483	0	0	5437	
Total External Trips	**9870**	**1006**	**0**	**0**	**10876**	***Internal Capture***
Single-Use Trip Gen. Est.	10423	1559	0	0	11982	**9%**
Net Internal Trips	**553**	**553**	**0**	**0**	**1106**	

Multi-Use Trip Generation Calculation

Analyst: RLB
Date: 1/14/2013

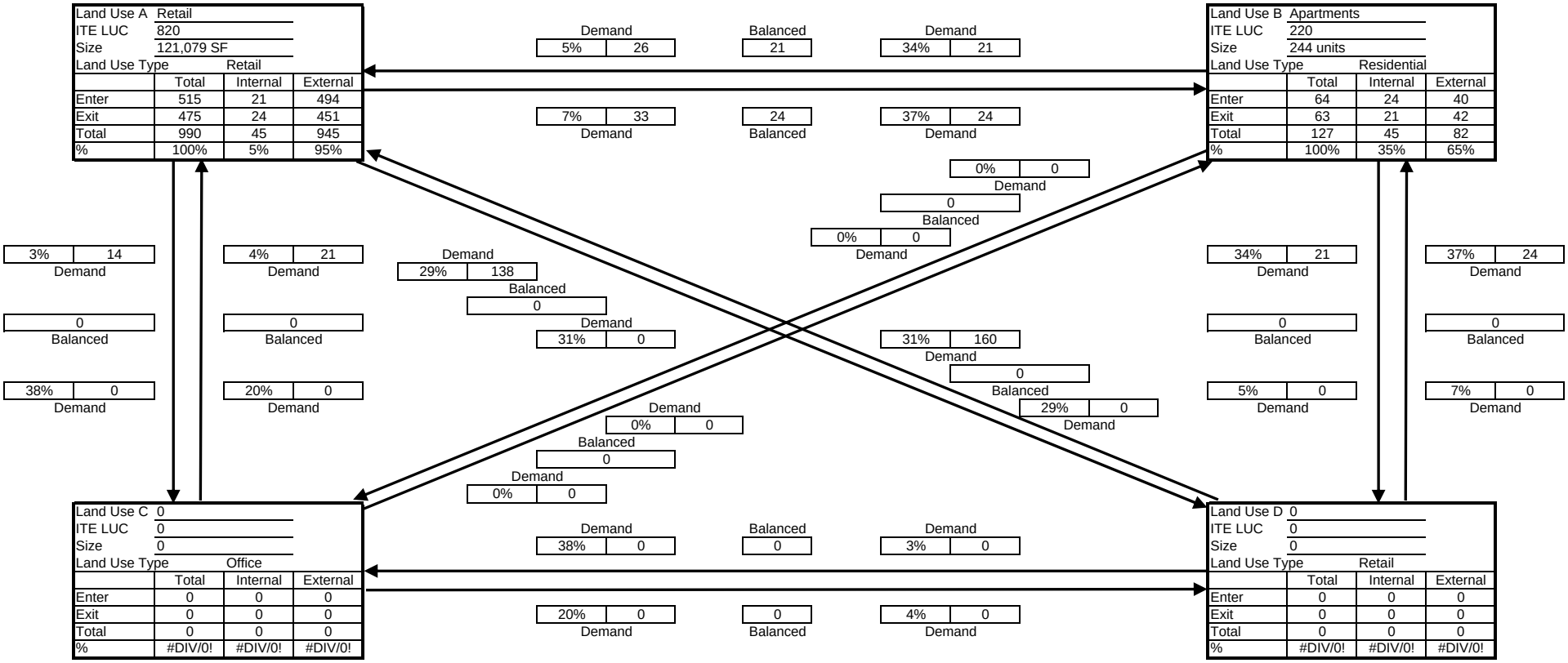
Project Name: Cushing Village - Full Build Propo
Time Period: Saturday Midday

Land Use A	Retail		
ITE LUC	820		
Size	121,079 SF		
Land Use Type	Retail		
	Total	Internal	External
Enter	515	21	494
Exit	475	24	451
Total	990	45	945
%	100%	5%	95%

Land Use B	Apartments		
ITE LUC	220		
Size	244 units		
Land Use Type	Residential		
	Total	Internal	External
Enter	64	24	40
Exit	63	21	42
Total	127	45	82
%	100%	35%	65%

Land Use C	0		
ITE LUC	0		
Size	0		
Land Use Type	Office		
	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%	#DIV/0!	#DIV/0!	#DIV/0!

Land Use D	0		
ITE LUC	0		
Size	0		
Land Use Type	Retail		
	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%	#DIV/0!	#DIV/0!	#DIV/0!



Net External Trips for Multi-Use Development						
Land Use	A	B	C	D	Total	
Enter	494	40	0	0	534	
Exit	451	42	0	0	493	
Total External Trips	**945**	**82**	**0**	**0**	**1027**	***Internal Capture***
Single-Use Trip Gen. Est.	990	127	0	0	1117	**8%**
Net Internal Trips	**45**	**45**	**0**	**0**	**90**	

Not to Scale

Cushing Village Redevelopment - Belmont, Massachusetts

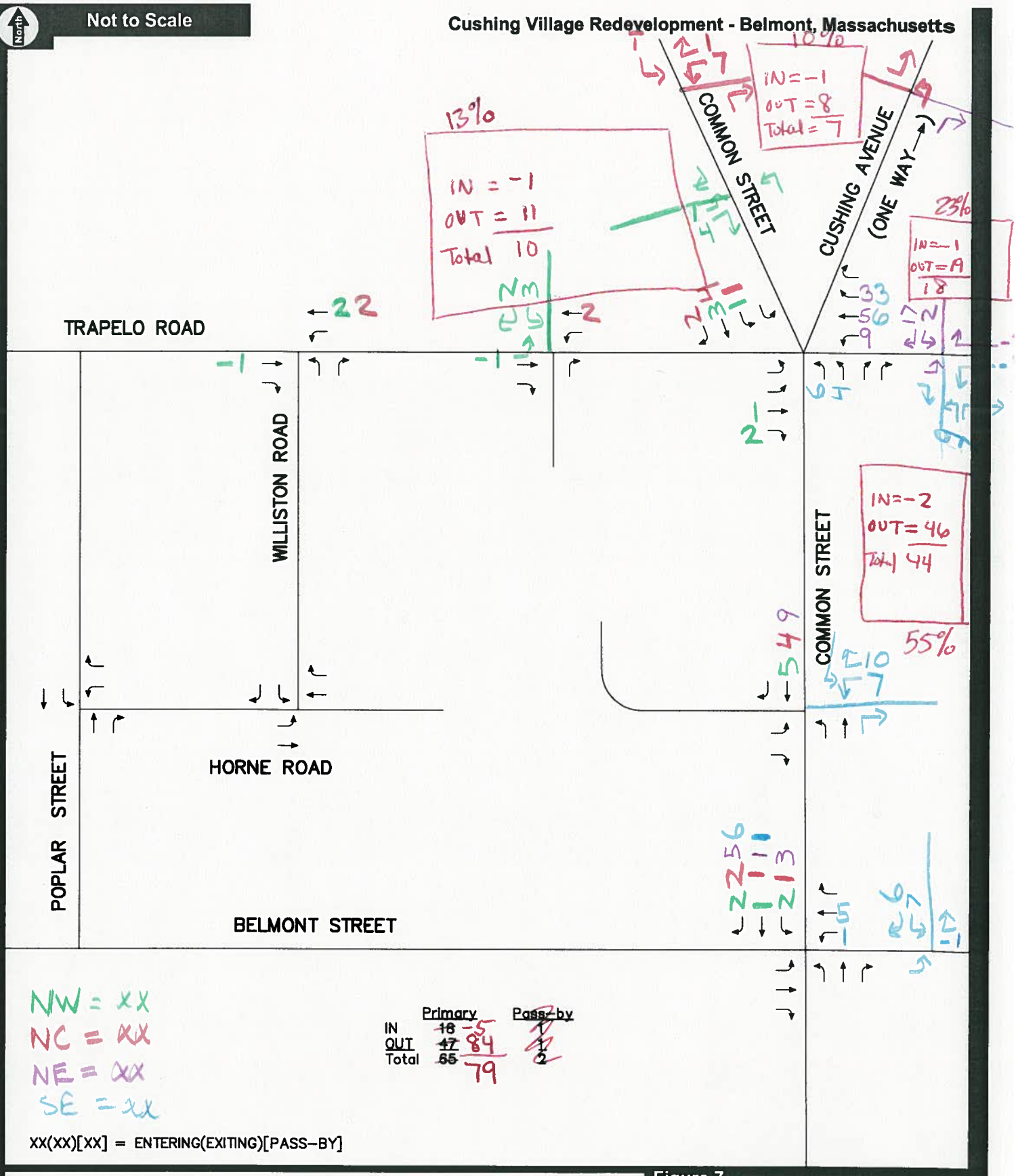


Figure 7

Site Generated Trip Assignment
Weekday Morning
Peak Hour Traffic Volumes

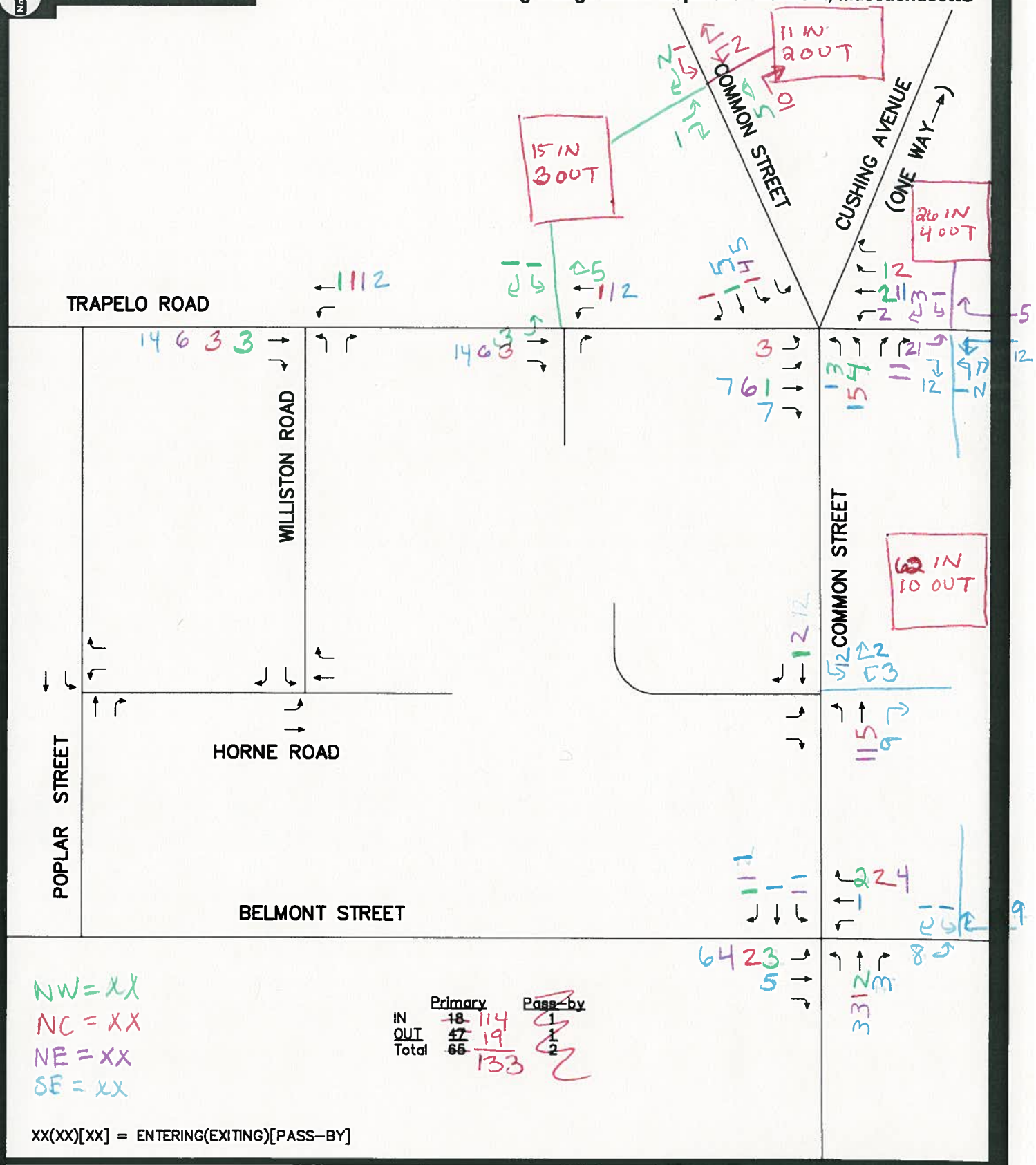
TEC

TEC, Inc.

T:\T0376.01\CAD\Civil\Graphics\Updated TIAS - October 2012\T0376.01_TrafficNetworks.dwg 10/1/2012 10:58:50 AM EDT

Not to Scale

Cushing Village Redevelopment - Belmont, Massachusetts



	Primary	Pass-by
IN	~~18~~ 114	~~1~~
OUT	~~47~~ 19	~~1~~
Total	~~65~~ 133	~~2~~

Figure 7

Site Generated Trip Assignment
Weekday ~~Morning~~ Evening
Peak Hour Traffic Volumes

TEC, Inc.

T:\T0376.01\CAD\Civil\Graphics\Updated TIAS - October 2012\T0376.01_TrafficNetworks.dwg 10/1/2012 10:58:50 AM EDT

Not to Scale

Cushing Village Redevelopment - Belmont, Massachusetts

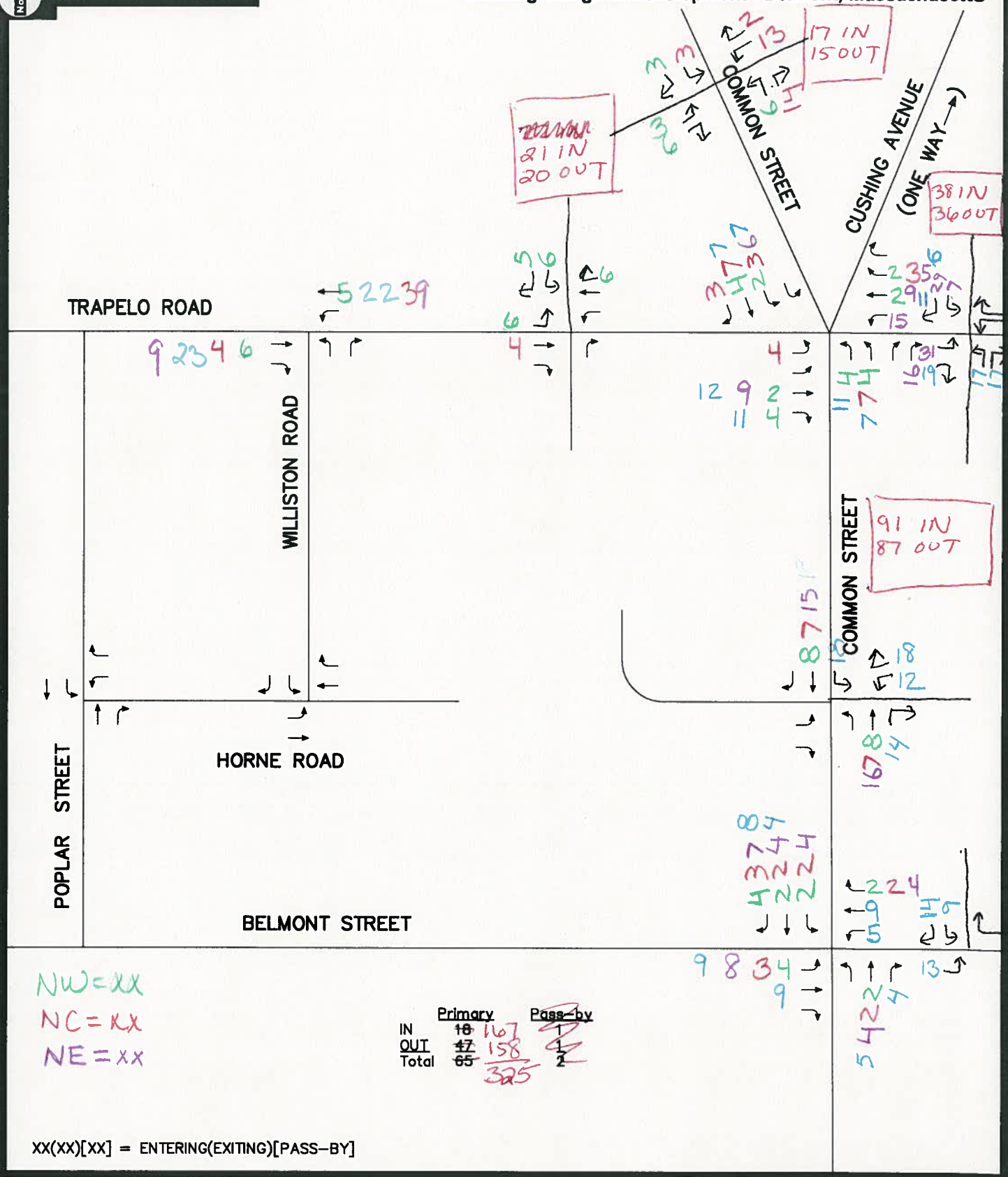


Figure 7

Site Generated Trip Assignment
~~Weekday Morning~~ Saturday Midday
Peak Hour Traffic Volumes

TEC

TEC, Inc.

T:\T0376.01\CAD\Civil\Graphics\Updated TIAS - October 2012\T0376.01_TrafficNetworks.dwg 10/1/2012 10:58:50 AM EDT

Attachment D

Intersection Capacity Analyses

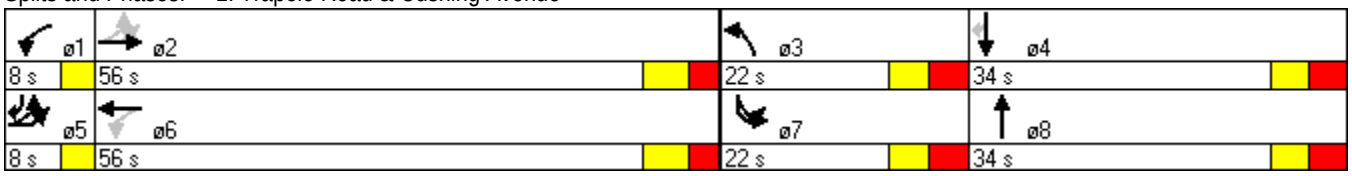
2017 No-Build

Lane Group	EBL2	EBL	EBT	EBR	WBL	WBT	WBR	WBR2	NBL	NBT	NBR	NBR2
Lane Configurations												
Volume (vph)	78	17	712	44	28	388	106	2	24	132	4	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	11	11	10	11	11	11	10	11	11	11
Storage Length (ft)		0		0	105		0		0		0	
Storage Lanes		1		0	1		0		1		0	
Taper Length (ft)		25		25	25		25		25		25	
Right Turn on Red				Yes				Yes				Yes
Link Speed (mph)			30			30				30		
Link Distance (ft)			300			221				274		
Travel Time (s)			6.8			5.0				6.2		
Peak Hour Factor	0.95	0.95	0.95	0.95	0.82	0.82	0.82	0.82	0.77	0.77	0.77	0.77
Heavy Vehicles (%)	1%	0%	2%	5%	0%	2%	1%	0%	0%	2%	0%	0%
Parking (#/hr)			5	5		5	5	5				
Shared Lane Traffic (%)												
Turn Type	pm+pt	pm+pt			pm+pt				Prot			
Protected Phases	5	5	2		1	6			3	8		
Permitted Phases	2	2			6							
Detector Phase	5	5	2		1	6			3	8		
Switch Phase												
Minimum Initial (s)	3.0	3.0	12.0		3.0	12.0			6.0	12.0		
Minimum Split (s)	6.0	6.0	30.0		6.0	30.0			13.0	28.5		
Total Split (s)	8.0	8.0	56.0	0.0	8.0	56.0	0.0	0.0	22.0	34.0	0.0	0.0
Total Split (%)	6.7%	6.7%	46.7%	0.0%	6.7%	46.7%	0.0%	0.0%	18.3%	28.3%	0.0%	0.0%
Yellow Time (s)	3.0	3.0	4.0		3.0	4.0			3.5	3.5		
All-Red Time (s)	0.0	0.0	3.0		0.0	3.0			3.5	3.5		
Lost Time Adjust (s)	1.0	1.0	-3.0	0.0	1.0	-3.0	0.0	0.0	-3.0	-3.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead	Lag		Lead	Lag			Lead	Lag		
Lead-Lag Optimize?	Yes	Yes	Yes		Yes	Yes			Yes	Yes		
Recall Mode	None	None	Min		None	Min			None	None		

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 107
Natural Cycle: 120
Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Trapelo Road & Cushing Avenue



Lane Group	SBL2	SBL	SBT	SBR
Lane Configurations				
Volume (vph)	7	224	242	89
Ideal Flow (vphpl)	1900	1900	1900	1900
Lane Width (ft)	11	11	11	16
Storage Length (ft)		0		50
Storage Lanes		1		1
Taper Length (ft)		25		25
Right Turn on Red				Yes
Link Speed (mph)			30	
Link Distance (ft)			873	
Travel Time (s)			19.8	
Peak Hour Factor	0.94	0.94	0.94	0.94
Heavy Vehicles (%)	0%	0%	1%	0%
Parking (#/hr)			2	2
Shared Lane Traffic (%)				
Turn Type	Prot	Prot		pm+ov
Protected Phases	7	7	4	5
Permitted Phases				4
Detector Phase	7	7	4	5
Switch Phase				
Minimum Initial (s)	6.0	6.0	12.0	3.0
Minimum Split (s)	13.0	13.0	28.5	6.0
Total Split (s)	22.0	22.0	34.0	8.0
Total Split (%)	18.3%	18.3%	28.3%	6.7%
Yellow Time (s)	3.5	3.5	3.5	3.0
All-Red Time (s)	3.5	3.5	3.5	0.0
Lost Time Adjust (s)	-3.0	-3.0	-3.0	1.0
Total Lost Time (s)	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead	Lag	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None

Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	100	795	34	604	31	202	245	257	95
v/c Ratio	0.48	1.04	0.26	0.86	0.20	0.61	0.83	0.51	0.14
Control Delay	22.6	72.0	17.8	41.1	50.2	47.4	68.3	36.8	14.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	22.6	72.0	17.8	41.1	50.2	47.4	68.3	36.8	14.2
Queue Length 50th (ft)	32	~621	11	357	21	129	169	160	22
Queue Length 95th (ft)	68	#946	26	500	45	170	#336	254	61
Internal Link Dist (ft)		220		141		194		793	
Turn Bay Length (ft)			105						50
Base Capacity (vph)	208	766	134	746	285	502	295	515	664
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.48	1.04	0.25	0.81	0.11	0.40	0.83	0.50	0.14

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

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

Movement	EBL2	EBL	EBT	EBR	WBL	WBT	WBR	WBR2	NBL	NBT	NBR	NBR2
Lane Configurations												
Volume (vph)	78	17	712	44	28	388	106	2	24	132	4	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	10	10	11	11	10	11	11	11	10	11	11	11
Total Lost time (s)		4.0	4.0		4.0	4.0			4.0	4.0		
Lane Util. Factor		1.00	1.00		1.00	1.00			1.00	1.00		
Frt		1.00	0.99		1.00	0.97			1.00	0.98		
Flt Protected		0.95	1.00		0.95	1.00			0.95	1.00		
Satd. Flow (prot)		1671	1559		1685	1528			1685	1765		
Flt Permitted		0.17	1.00		0.09	1.00			0.95	1.00		
Satd. Flow (perm)		307	1559		154	1528			1685	1765		
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.82	0.82	0.82	0.82	0.77	0.77	0.77	0.77
Adj. Flow (vph)	82	18	749	46	34	473	129	2	31	171	5	26
RTOR Reduction (vph)	0	0	2	0	0	0	0	0	0	5	0	0
Lane Group Flow (vph)	0	100	793	0	34	604	0	0	31	197	0	0
Heavy Vehicles (%)	1%	0%	2%	5%	0%	2%	1%	0%	0%	2%	0%	0%
Parking (#/hr)			5	5		5	5	5				
Turn Type	pm+pt	pm+pt			pm+pt				Prot			
Protected Phases	5	5	2		1	6			3	8		
Permitted Phases	2	2			6							
Actuated Green, G (s)		54.4	49.4		50.0	47.2			4.4	19.9		
Effective Green, g (s)		52.4	52.4		48.0	50.2			7.4	22.9		
Actuated g/C Ratio		0.47	0.47		0.43	0.45			0.07	0.21		
Clearance Time (s)		3.0	7.0		3.0	7.0			7.0	7.0		
Vehicle Extension (s)		2.0	2.0		2.0	2.0			2.0	2.0		
Lane Grp Cap (vph)		194	735		91	690			112	363		
v/s Ratio Prot		c0.02	c0.51		0.01	0.40			0.02	0.11		
v/s Ratio Perm		0.22			0.16							
v/c Ratio		0.52	1.08		0.37	0.88			0.28	0.54		
Uniform Delay, d1		20.9	29.4		25.8	27.7			49.4	39.5		
Progression Factor		1.00	1.00		1.00	1.00			1.00	1.00		
Incremental Delay, d2		1.0	56.7		0.9	11.6			0.5	0.9		
Delay (s)		21.8	86.1		26.8	39.3			49.8	40.4		
Level of Service		C	F		C	D			D	D		
Approach Delay (s)			78.9			38.6				41.6		
Approach LOS			E			D				D		

Intersection Summary

HCM Average Control Delay	56.1	HCM Level of Service	E
HCM Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	111.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	79.6%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	SBL2	SBL	SBT	SBR
Lane Configurations				
Volume (vph)	7	224	242	89
Ideal Flow (vphpl)	1900	1900	1900	1900
Lane Width	11	11	11	16
Total Lost time (s)		4.0	4.0	4.0
Lane Util. Factor		1.00	1.00	1.00
Frt		1.00	1.00	0.85
Flt Protected		0.95	1.00	1.00
Satd. Flow (prot)		1745	1618	1629
Flt Permitted		0.95	1.00	1.00
Satd. Flow (perm)		1745	1618	1629
Peak-hour factor, PHF	0.94	0.94	0.94	0.94
Adj. Flow (vph)	7	238	257	95
RTOR Reduction (vph)	0	0	0	34
Lane Group Flow (vph)	0	245	257	61
Heavy Vehicles (%)	0%	0%	1%	0%
Parking (#/hr)			2	2
Turn Type	Prot	Prot		pm+ov
Protected Phases	7	7	4	5
Permitted Phases				4
Actuated Green, G (s)		15.1	30.6	35.6
Effective Green, g (s)		18.1	33.6	33.6
Actuated g/C Ratio		0.16	0.30	0.30
Clearance Time (s)		7.0	7.0	3.0
Vehicle Extension (s)		2.0	2.0	2.0
Lane Grp Cap (vph)		284	489	492
v/s Ratio Prot		c0.14	c0.16	0.00
v/s Ratio Perm				0.03
v/c Ratio		0.86	0.53	0.12
Uniform Delay, d1		45.3	32.2	28.1
Progression Factor		1.00	1.00	1.00
Incremental Delay, d2		22.0	0.5	0.0
Delay (s)		67.3	32.7	28.2
Level of Service		E	C	C
Approach Delay (s)			46.2	
Approach LOS			D	

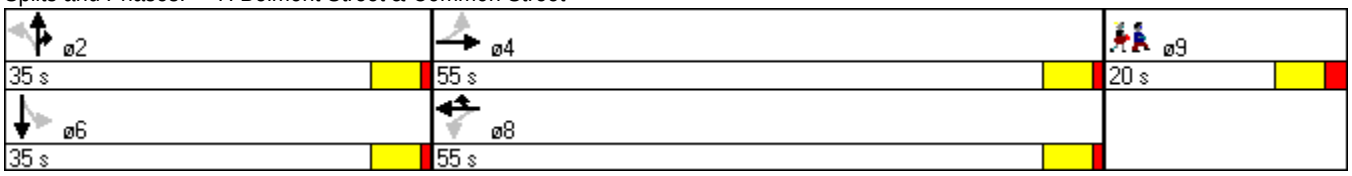
Intersection Summary

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	120	579	5	12	372	16	8	49	8	30	54	211
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	11	11	11	12	12	12	10	11	11
Storage Length (ft)	0		0	0		80	0		60	50		0
Storage Lanes	0		0	0		1	0		1	1		1
Taper Length (ft)	25		25	25		25	25		25	25		25
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		736			971			731			211	
Travel Time (s)		16.7			22.1			16.6			4.8	
Peak Hour Factor	0.94	0.94	0.94	0.89	0.89	0.89	0.39	0.39	0.39	0.86	0.86	0.86
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	1%
Parking (#/hr)										2	2	2
Shared Lane Traffic (%)												
Turn Type	Perm			Perm		Prot	Perm		Prot	Perm		
Protected Phases		4			8	8		2	2		6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8	8	2	2	2	6	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	
Minimum Split (s)	15.0	15.0		15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	
Total Split (s)	55.0	55.0	0.0	55.0	55.0	55.0	35.0	35.0	35.0	35.0	35.0	0.0
Total Split (%)	50.0%	50.0%	0.0%	50.0%	50.0%	50.0%	31.8%	31.8%	31.8%	31.8%	31.8%	0.0%
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	-1.0	-1.0	0.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	Min	Min		Min	Min	Min	None	None	None	None	None	

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 74.2
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Belmont Street & Common Street



Lane Group	ø9
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Right Turn on Red	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Parking (#/hr)	
Shared Lane Traffic (%)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	4.0
Minimum Split (s)	20.0
Total Split (s)	20.0
Total Split (%)	18%
Yellow Time (s)	4.0
All-Red Time (s)	2.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Recall Mode	None

Intersection Summary

Lane Group	EBT	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	749	431	18	147	21	35	308
v/c Ratio	0.67	0.35	0.02	0.56	0.06	0.18	0.72
Control Delay	11.5	6.4	3.5	34.8	10.5	26.0	21.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	11.5	6.4	3.5	34.8	10.5	26.0	21.7
Queue Length 50th (ft)	153	62	1	61	0	13	53
Queue Length 95th (ft)	388	151	8	44	3	35	123
Internal Link Dist (ft)	656	891		651			131
Turn Bay Length (ft)			80		60	50	
Base Capacity (vph)	1121	1228	1080	550	690	402	702
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.67	0.35	0.02	0.27	0.03	0.09	0.44

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	120	579	5	12	372	16	8	49	8	30	54	211
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	11	11	11	12	12	12	10	11	11
Total Lost time (s)		4.0			4.0	4.0		4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Frt		1.00			1.00	0.85		1.00	0.85	1.00	0.88	
Flt Protected		0.99			1.00	1.00		0.99	1.00	0.95	1.00	
Satd. Flow (prot)		1882			1816	1561		1870	1615	1499	1428	
Flt Permitted		0.86			0.98	1.00		0.70	1.00	0.61	1.00	
Satd. Flow (perm)		1626			1778	1561		1310	1615	959	1428	
Peak-hour factor, PHF	0.94	0.94	0.94	0.89	0.89	0.89	0.39	0.39	0.39	0.86	0.86	0.86
Adj. Flow (vph)	128	616	5	13	418	18	21	126	21	35	63	245
RTOR Reduction (vph)	0	0	0	0	0	3	0	0	17	0	141	0
Lane Group Flow (vph)	0	749	0	0	431	15	0	147	4	35	167	0
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	1%
Parking (#/hr)										2	2	2
Turn Type	Perm			Perm		Prot	Perm		Prot	Perm		
Protected Phases		4			8	8		2	2		6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		50.2			50.2	50.2		14.0	14.0	14.0	14.0	
Effective Green, g (s)		51.2			51.2	51.2		15.0	15.0	15.0	15.0	
Actuated g/C Ratio		0.69			0.69	0.69		0.20	0.20	0.20	0.20	
Clearance Time (s)		5.0			5.0	5.0		5.0	5.0	5.0	5.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		1122			1227	1077		265	326	194	289	
v/s Ratio Prot						0.01			0.00		c0.12	
v/s Ratio Perm		c0.46			0.24			0.11		0.04		
v/c Ratio		0.67			0.35	0.01		0.55	0.01	0.18	0.58	
Uniform Delay, d1		6.6			4.7	3.6		26.6	23.7	24.5	26.7	
Progression Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Incremental Delay, d2		1.5			0.2	0.0		2.5	0.0	0.4	2.8	
Delay (s)		8.1			4.9	3.6		29.1	23.7	25.0	29.5	
Level of Service		A			A	A		C	C	C	C	
Approach Delay (s)		8.1			4.8			28.4			29.1	
Approach LOS		A			A			C			C	

Intersection Summary

HCM Average Control Delay	13.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	74.2	Sum of lost time (s)	8.0
Intersection Capacity Utilization	83.5%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL2	EBL	EBT	EBR	WBL	WBT	WBR	WBR2	NBL	NBT	NBR	NBR2
Lane Configurations												
Volume (vph)	81	21	477	75	26	617	142	10	75	248	14	44
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	11	11	10	11	11	11	10	11	11	11
Storage Length (ft)		0		0	105		0		0		0	
Storage Lanes		1		0	1		0		1		0	
Taper Length (ft)		25		25	25		25		25		25	
Right Turn on Red				Yes				Yes				Yes
Link Speed (mph)			30			30				30		
Link Distance (ft)			300			221				274		
Travel Time (s)			6.8			5.0				6.2		
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.87	0.87	0.87	0.87
Heavy Vehicles (%)	1%	0%	1%	0%	0%	1%	0%	0%	0%	1%	0%	0%
Parking (#/hr)			5	5		5	5	5				
Shared Lane Traffic (%)												
Turn Type	pm+pt	pm+pt			pm+pt				Prot			
Protected Phases	5	5	2		1	6			3	8		
Permitted Phases	2	2			6							
Detector Phase	5	5	2		1	6			3	8		
Switch Phase												
Minimum Initial (s)	3.0	3.0	12.0		3.0	12.0			6.0	12.0		
Minimum Split (s)	6.0	6.0	30.0		6.0	30.0			13.0	28.5		
Total Split (s)	11.0	11.0	56.0	0.0	11.0	56.0	0.0	0.0	21.0	32.0	0.0	0.0
Total Split (%)	9.2%	9.2%	46.7%	0.0%	9.2%	46.7%	0.0%	0.0%	17.5%	26.7%	0.0%	0.0%
Yellow Time (s)	3.0	3.0	4.0		3.0	4.0			3.5	3.5		
All-Red Time (s)	0.0	0.0	3.0		0.0	3.0			3.5	3.5		
Lost Time Adjust (s)	1.0	1.0	-3.0	0.0	1.0	-3.0	0.0	0.0	-3.0	-3.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead	Lag		Lead	Lag			Lead	Lag		
Lead-Lag Optimize?	Yes	Yes	Yes		Yes	Yes			Yes	Yes		
Recall Mode	None	None	Min		None	Min			None	None		

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 117
Natural Cycle: 120
Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Trapelo Road & Cushing Avenue

ø1	ø2	ø3	ø4
11 s	56 s	21 s	32 s
ø5	ø6	ø7	ø8
11 s	56 s	21 s	32 s

Lane Group	SBL2	SBL	SBT	SBR
Lane Configurations				
Volume (vph)	8	129	253	96
Ideal Flow (vphpl)	1900	1900	1900	1900
Lane Width (ft)	11	11	11	16
Storage Length (ft)		0		50
Storage Lanes		1		1
Taper Length (ft)		25		25
Right Turn on Red				Yes
Link Speed (mph)			30	
Link Distance (ft)			873	
Travel Time (s)			19.8	
Peak Hour Factor	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	0%	0%	1%	1%
Parking (#/hr)			2	2
Shared Lane Traffic (%)				
Turn Type	Prot	Prot		pm+ov
Protected Phases	7	7	4	5
Permitted Phases				4
Detector Phase	7	7	4	5
Switch Phase				
Minimum Initial (s)	6.0	6.0	12.0	3.0
Minimum Split (s)	13.0	13.0	28.5	6.0
Total Split (s)	21.0	21.0	32.0	11.0
Total Split (%)	17.5%	17.5%	26.7%	9.2%
Yellow Time (s)	3.5	3.5	3.5	3.0
All-Red Time (s)	3.5	3.5	3.5	0.0
Lost Time Adjust (s)	-3.0	-3.0	-3.0	1.0
Total Lost Time (s)	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead	Lag	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None

Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	112	606	29	845	86	352	156	288	109
v/c Ratio	0.71	0.78	0.12	1.22	0.45	0.86	0.68	0.66	0.18
Control Delay	43.9	35.1	15.0	144.9	56.5	64.5	63.9	47.9	16.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	43.9	35.1	15.0	144.9	56.5	64.5	63.9	47.9	16.7
Queue Length 50th (ft)	43	403	10	~826	63	257	115	201	30
Queue Length 95th (ft)	#126	#637	26	#1073	109	#390	185	#321	73
Internal Link Dist (ft)		220		141		194		793	
Turn Bay Length (ft)			105						50
Base Capacity (vph)	162	772	282	690	246	430	254	439	622
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.69	0.78	0.10	1.22	0.35	0.82	0.61	0.66	0.18

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

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

Movement	EBL2	EBL	EBT	EBR	WBL	WBT	WBR	WBR2	NBL	NBT	NBR	NBR2
Lane Configurations												
Volume (vph)	81	21	477	75	26	617	142	10	75	248	14	44
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	10	10	11	11	10	11	11	11	10	11	11	11
Total Lost time (s)		4.0	4.0		4.0	4.0			4.0	4.0		
Lane Util. Factor		1.00	1.00		1.00	1.00			1.00	1.00		
Frt		1.00	0.98		1.00	0.97			1.00	0.97		
Flt Protected		0.95	1.00		0.95	1.00			0.95	1.00		
Satd. Flow (prot)		1671	1561		1685	1547			1685	1770		
Flt Permitted		0.08	1.00		0.23	1.00			0.95	1.00		
Satd. Flow (perm)		132	1561		406	1547			1685	1770		
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.87	0.87	0.87	0.87
Adj. Flow (vph)	89	23	524	82	29	678	156	11	86	285	16	51
RTOR Reduction (vph)	0	0	4	0	0	1	0	0	0	5	0	0
Lane Group Flow (vph)	0	112	602	0	29	844	0	0	86	347	0	0
Heavy Vehicles (%)	1%	0%	1%	0%	0%	1%	0%	0%	0%	1%	0%	0%
Parking (#/hr)			5	5		5	5	5				
Turn Type	pm+pt	pm+pt			pm+pt				Prot			
Protected Phases	5	5	2		1	6			3	8		
Permitted Phases	2	2			6							
Actuated Green, G (s)		61.0	54.5		53.8	50.3			8.9	25.2		
Effective Green, g (s)		60.0	57.5		51.8	53.3			11.9	28.2		
Actuated g/C Ratio		0.50	0.48		0.43	0.45			0.10	0.24		
Clearance Time (s)		3.0	7.0		3.0	7.0			7.0	7.0		
Vehicle Extension (s)		2.0	2.0		2.0	2.0			2.0	2.0		
Lane Grp Cap (vph)		152	750		202	689			168	417		
v/s Ratio Prot		c0.04	0.39		0.00	c0.55			0.05	c0.20		
v/s Ratio Perm		0.33			0.06							
v/c Ratio		0.74	0.80		0.14	1.23			0.51	0.83		
Uniform Delay, d1		26.8	26.3		22.0	33.2			51.1	43.5		
Progression Factor		1.00	1.00		1.00	1.00			1.00	1.00		
Incremental Delay, d2		14.7	5.9		0.1	114.1			1.1	12.7		
Delay (s)		41.5	32.2		22.1	147.3			52.2	56.1		
Level of Service		D	C		C	F			D	E		
Approach Delay (s)			33.6			143.2				55.4		
Approach LOS			C			F				E		

Intersection Summary

HCM Average Control Delay	76.7	HCM Level of Service	E
HCM Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	119.7	Sum of lost time (s)	20.0
Intersection Capacity Utilization	84.9%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	SBL2	SBL	SBT	SBR
Lane Configurations				
Volume (vph)	8	129	253	96
Ideal Flow (vphpl)	1900	1900	1900	1900
Lane Width	11	11	11	16
Total Lost time (s)		4.0	4.0	4.0
Lane Util. Factor		1.00	1.00	1.00
Frt		1.00	1.00	0.85
Flt Protected		0.95	1.00	1.00
Satd. Flow (prot)		1745	1618	1613
Flt Permitted		0.95	1.00	1.00
Satd. Flow (perm)		1745	1618	1613
Peak-hour factor, PHF	0.88	0.88	0.88	0.88
Adj. Flow (vph)	9	147	288	109
RTOR Reduction (vph)	0	0	0	36
Lane Group Flow (vph)	0	156	288	73
Heavy Vehicles (%)	0%	0%	1%	1%
Parking (#/hr)			2	2
Turn Type	Prot	Prot		pm+ov
Protected Phases	7	7	4	5
Permitted Phases				4
Actuated Green, G (s)		12.5	28.8	36.5
Effective Green, g (s)		15.5	31.8	34.5
Actuated g/C Ratio		0.13	0.27	0.29
Clearance Time (s)		7.0	7.0	3.0
Vehicle Extension (s)		2.0	2.0	2.0
Lane Grp Cap (vph)		226	430	465
v/s Ratio Prot		c0.09	c0.18	0.01
v/s Ratio Perm				0.04
v/c Ratio		0.69	0.67	0.16
Uniform Delay, d1		49.8	39.3	31.8
Progression Factor		1.00	1.00	1.00
Incremental Delay, d2		7.1	3.1	0.1
Delay (s)		56.9	42.3	31.8
Level of Service		E	D	C
Approach Delay (s)			44.4	
Approach LOS			D	

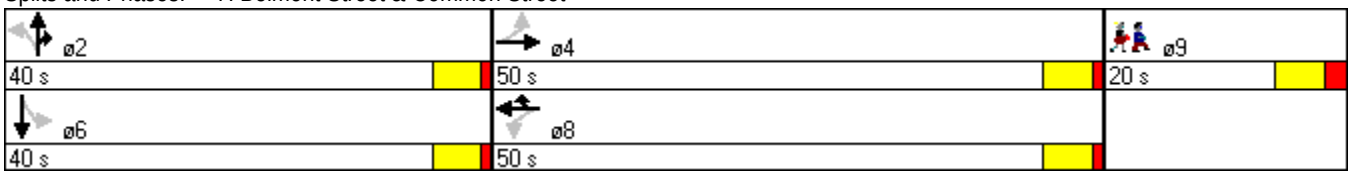
Intersection Summary

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	119	382	38	59	476	26	25	248	49	20	191	124
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	11	11	11	12	12	12	10	11	11
Storage Length (ft)	0		0	0		80	0		60	50		0
Storage Lanes	0		0	0		1	0		1	1		1
Taper Length (ft)	25		25	25		25	25		25	25		25
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		736			971			731			211	
Travel Time (s)		16.7			22.1			16.6			4.8	
Peak Hour Factor	0.89	0.89	0.89	0.94	0.94	0.94	0.84	0.84	0.84	0.89	0.89	0.89
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	1%
Parking (#/hr)										2	2	2
Shared Lane Traffic (%)												
Turn Type	Perm			Perm		Prot	Perm		Prot	Perm		
Protected Phases		4			8	8		2	2		6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8	8	2	2	2	6	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	
Minimum Split (s)	15.0	15.0		15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	
Total Split (s)	50.0	50.0	0.0	50.0	50.0	50.0	40.0	40.0	40.0	40.0	40.0	0.0
Total Split (%)	45.5%	45.5%	0.0%	45.5%	45.5%	45.5%	36.4%	36.4%	36.4%	36.4%	36.4%	0.0%
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	-1.0	-1.0	0.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	Min	Min		Min	Min	Min	None	None	None	None	None	

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 76.7
Natural Cycle: 120
Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Belmont Street & Common Street



Lane Group	ø9
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Right Turn on Red	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Parking (#/hr)	
Shared Lane Traffic (%)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	4.0
Minimum Split (s)	20.0
Total Split (s)	20.0
Total Split (%)	18%
Yellow Time (s)	4.0
All-Red Time (s)	2.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Recall Mode	None

Intersection Summary

Lane Group	EBT	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	606	569	28	325	58	22	354
v/c Ratio	0.77	0.58	0.03	0.69	0.12	0.13	0.76
Control Delay	21.8	13.7	6.1	32.1	11.4	21.0	33.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	21.8	13.7	6.1	32.1	11.4	21.0	33.1
Queue Length 50th (ft)	190	147	3	136	10	8	138
Queue Length 95th (ft)	#483	321	16	198	31	24	225
Internal Link Dist (ft)	656	891		651			131
Turn Bay Length (ft)			80		60	50	
Base Capacity (vph)	788	980	947	761	779	271	740
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.77	0.58	0.03	0.43	0.07	0.08	0.48

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	119	382	38	59	476	26	25	248	49	20	191	124
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	11	11	11	12	12	12	10	11	11
Total Lost time (s)		4.0			4.0	4.0		4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Frt		0.99			1.00	0.85		1.00	0.85	1.00	0.94	
Flt Protected		0.99			0.99	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1861			1810	1561		1874	1615	1499	1532	
Flt Permitted		0.69			0.89	1.00		0.85	1.00	0.36	1.00	
Satd. Flow (perm)		1302			1623	1561		1609	1615	572	1532	
Peak-hour factor, PHF	0.89	0.89	0.89	0.94	0.94	0.94	0.84	0.84	0.84	0.89	0.89	0.89
Adj. Flow (vph)	134	429	43	63	506	28	30	295	58	22	215	139
RTOR Reduction (vph)	0	2	0	0	0	5	0	0	21	0	22	0
Lane Group Flow (vph)	0	604	0	0	569	23	0	325	37	22	332	0
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	1%
Parking (#/hr)										2	2	2
Turn Type	Perm			Perm		Prot	Perm		Prot	Perm		
Protected Phases		4			8	8		2	2		6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		45.3			45.3	45.3		21.3	21.3	21.3	21.3	
Effective Green, g (s)		46.3			46.3	46.3		22.3	22.3	22.3	22.3	
Actuated g/C Ratio		0.60			0.60	0.60		0.29	0.29	0.29	0.29	
Clearance Time (s)		5.0			5.0	5.0		5.0	5.0	5.0	5.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		787			981	944		468	470	167	446	
v/s Ratio Prot						0.01			0.02		c0.22	
v/s Ratio Perm		c0.46			0.35			0.20		0.04		
v/c Ratio		0.77			0.58	0.02		0.69	0.08	0.13	0.74	
Uniform Delay, d1		11.2			9.2	6.1		24.1	19.7	20.0	24.6	
Progression Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Incremental Delay, d2		4.5			0.9	0.0		4.4	0.1	0.4	6.6	
Delay (s)		15.7			10.1	6.1		28.6	19.8	20.4	31.2	
Level of Service		B			B	A		C	B	C	C	
Approach Delay (s)		15.7			9.9			27.2			30.6	
Approach LOS		B			A			C			C	

Intersection Summary

HCM Average Control Delay	19.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	76.6	Sum of lost time (s)	8.0
Intersection Capacity Utilization	101.2%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL2	EBL	EBT	EBR	WBL	WBT	WBR	WBR2	NBL	NBT	NBR	NBR2
Lane Configurations												
Volume (vph)	89	23	419	80	46	417	114	12	88	177	20	77
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	11	11	10	11	11	11	10	11	11	11
Storage Length (ft)		0		0	105		0		0		0	
Storage Lanes		1		0	1		0		1		0	
Taper Length (ft)		25		25	25		25		25		25	
Right Turn on Red				Yes				Yes				Yes
Link Speed (mph)			30			30				30		
Link Distance (ft)			300			221				274		
Travel Time (s)			6.8			5.0				6.2		
Peak Hour Factor	0.91	0.91	0.91	0.91	0.94	0.94	0.94	0.94	0.91	0.91	0.91	0.91
Heavy Vehicles (%)	0%	0%	1%	0%	0%	0%	1%	0%	2%	0%	0%	0%
Parking (#/hr)			5	5		5	5	5				
Shared Lane Traffic (%)												
Turn Type	pm+pt	pm+pt			pm+pt				Prot			
Protected Phases	5	5	2		1	6			3	8		
Permitted Phases	2	2			6							
Detector Phase	5	5	2		1	6			3	8		
Switch Phase												
Minimum Initial (s)	3.0	3.0	12.0		3.0	12.0			6.0	12.0		
Minimum Split (s)	6.0	6.0	30.0		6.0	30.0			13.0	28.5		
Total Split (s)	8.0	8.0	55.0	0.0	8.0	55.0	0.0	0.0	18.5	28.5	0.0	0.0
Total Split (%)	7.3%	7.3%	50.0%	0.0%	7.3%	50.0%	0.0%	0.0%	16.8%	25.9%	0.0%	0.0%
Yellow Time (s)	3.0	3.0	4.0		3.0	4.0			3.5	3.5		
All-Red Time (s)	0.0	0.0	3.0		0.0	3.0			3.5	3.5		
Lost Time Adjust (s)	1.0	1.0	-3.0	0.0	1.0	-3.0	0.0	0.0	-3.0	-3.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead	Lag		Lead	Lag			Lead	Lag		
Lead-Lag Optimize?	Yes	Yes	Yes		Yes	Yes			Yes	Yes		
Recall Mode	None	None	Min		None	Min			None	None		

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 98.2
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Trapelo Road & Cushing Avenue

ø1	ø2	ø3	ø4
8 s	55 s	18.5 s	28.5 s
ø5	ø6	ø7	ø8
8 s	55 s	18.5 s	28.5 s

Lane Group	SBL2	SBL	SBT	SBR
Lane Configurations				
Volume (vph)	6	118	189	113
Ideal Flow (vphpl)	1900	1900	1900	1900
Lane Width (ft)	11	11	11	16
Storage Length (ft)		0		50
Storage Lanes		1		1
Taper Length (ft)		25		25
Right Turn on Red				Yes
Link Speed (mph)			30	
Link Distance (ft)			873	
Travel Time (s)			19.8	
Peak Hour Factor	0.82	0.82	0.82	0.82
Heavy Vehicles (%)	0%	0%	0%	0%
Parking (#/hr)			2	2
Shared Lane Traffic (%)				
Turn Type	Prot	Prot		pm+ov
Protected Phases	7	7	4	5
Permitted Phases				4
Detector Phase	7	7	4	5
Switch Phase				
Minimum Initial (s)	6.0	6.0	12.0	3.0
Minimum Split (s)	13.0	13.0	28.5	6.0
Total Split (s)	18.5	18.5	28.5	8.0
Total Split (%)	16.8%	16.8%	25.9%	7.3%
Yellow Time (s)	3.5	3.5	3.5	3.0
All-Red Time (s)	3.5	3.5	3.5	0.0
Lost Time Adjust (s)	-3.0	-3.0	-3.0	1.0
Total Lost Time (s)	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead	Lag	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None

Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	123	548	49	578	97	302	151	230	138
v/c Ratio	0.58	0.77	0.20	0.86	0.46	0.76	0.63	0.53	0.22
Control Delay	26.8	31.7	14.3	40.1	50.6	49.2	55.4	40.2	13.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	26.8	31.7	14.3	40.1	50.6	49.2	55.4	40.2	13.5
Queue Length 50th (ft)	41	304	16	339	62	180	98	138	26
Queue Length 95th (ft)	73	449	35	#509	119	#314	156	208	64
Internal Link Dist (ft)		220		141		194		793	
Turn Bay Length (ft)			105						50
Base Capacity (vph)	211	833	251	824	250	457	264	443	626
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.58	0.66	0.20	0.70	0.39	0.66	0.57	0.52	0.22

Intersection Summary

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

Movement	EBL2	EBL	EBT	EBR	WBL	WBT	WBR	WBR2	NBL	NBT	NBR	NBR2
Lane Configurations												
Volume (vph)	89	23	419	80	46	417	114	12	88	177	20	77
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	10	10	11	11	10	11	11	11	10	11	11	11
Total Lost time (s)		4.0	4.0		4.0	4.0			4.0	4.0		
Lane Util. Factor		1.00	1.00		1.00	1.00			1.00	1.00		
Frt		1.00	0.98		1.00	0.97			1.00	0.95		
Flt Protected		0.95	1.00		0.95	1.00			0.95	1.00		
Satd. Flow (prot)		1685	1555		1685	1548			1652	1739		
Flt Permitted		0.18	1.00		0.24	1.00			0.95	1.00		
Satd. Flow (perm)		317	1555		417	1548			1652	1739		
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.94	0.94	0.94	0.94	0.91	0.91	0.91	0.91
Adj. Flow (vph)	98	25	460	88	49	444	121	13	97	195	22	85
RTOR Reduction (vph)	0	0	7	0	0	1	0	0	0	12	0	0
Lane Group Flow (vph)	0	123	541	0	49	577	0	0	97	290	0	0
Heavy Vehicles (%)	0%	0%	1%	0%	0%	0%	1%	0%	2%	0%	0%	0%
Parking (#/hr)			5	5		5	5	5				
Turn Type	pm+pt	pm+pt			pm+pt				Prot			
Protected Phases	5	5	2		1	6			3	8		
Permitted Phases	2	2			6							
Actuated Green, G (s)		46.6	41.5		44.0	40.2			7.8	20.5		
Effective Green, g (s)		44.6	44.5		42.0	43.2			10.8	23.5		
Actuated g/C Ratio		0.44	0.44		0.42	0.43			0.11	0.23		
Clearance Time (s)		3.0	7.0		3.0	7.0			7.0	7.0		
Vehicle Extension (s)		2.0	2.0		2.0	2.0			2.0	2.0		
Lane Grp Cap (vph)		197	690		210	667			178	407		
v/s Ratio Prot		c0.03	0.35		0.01	c0.37			0.06	c0.17		
v/s Ratio Perm		0.25			0.09							
v/c Ratio		0.62	0.78		0.23	0.87			0.54	0.71		
Uniform Delay, d1		21.2	23.8		19.4	25.9			42.4	35.3		
Progression Factor		1.00	1.00		1.00	1.00			1.00	1.00		
Incremental Delay, d2		4.4	5.4		0.2	11.0			1.8	4.8		
Delay (s)		25.6	29.2		19.6	36.9			44.2	40.1		
Level of Service		C	C		B	D			D	D		
Approach Delay (s)			28.5			35.6				41.1		
Approach LOS			C			D				D		

Intersection Summary

HCM Average Control Delay	34.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	100.3	Sum of lost time (s)	20.0
Intersection Capacity Utilization	71.2%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	SBL2	SBL	SBT	SBR
Lane Configurations				
Volume (vph)	6	118	189	113
Ideal Flow (vphpl)	1900	1900	1900	1900
Lane Width	11	11	11	16
Total Lost time (s)		4.0	4.0	4.0
Lane Util. Factor		1.00	1.00	1.00
Frt		1.00	1.00	0.85
Flt Protected		0.95	1.00	1.00
Satd. Flow (prot)		1745	1635	1629
Flt Permitted		0.95	1.00	1.00
Satd. Flow (perm)		1745	1635	1629
Peak-hour factor, PHF	0.82	0.82	0.82	0.82
Adj. Flow (vph)	7	144	230	138
RTOR Reduction (vph)	0	0	0	62
Lane Group Flow (vph)	0	151	230	76
Heavy Vehicles (%)	0%	0%	0%	0%
Parking (#/hr)			2	2
Turn Type	Prot	Prot		pm+ov
Protected Phases	7	7	4	5
Permitted Phases				4
Actuated Green, G (s)		10.5	23.2	28.3
Effective Green, g (s)		13.5	26.2	26.3
Actuated g/C Ratio		0.13	0.26	0.26
Clearance Time (s)		7.0	7.0	3.0
Vehicle Extension (s)		2.0	2.0	2.0
Lane Grp Cap (vph)		235	427	427
v/s Ratio Prot		c0.09	c0.14	0.01
v/s Ratio Perm				0.04
v/c Ratio		0.64	0.54	0.18
Uniform Delay, d1		41.1	31.9	28.6
Progression Factor		1.00	1.00	1.00
Incremental Delay, d2		4.4	0.7	0.1
Delay (s)		45.6	32.5	28.7
Level of Service		D	C	C
Approach Delay (s)			35.3	
Approach LOS			D	

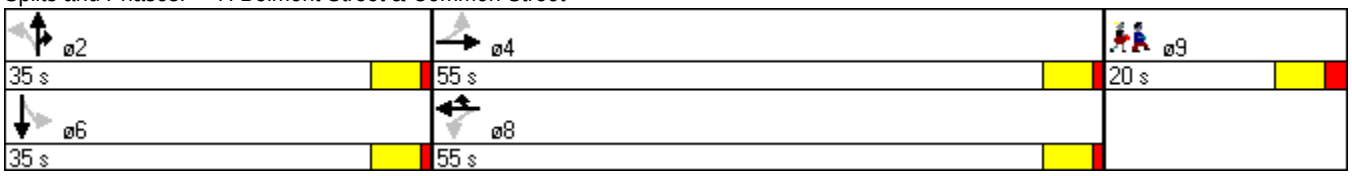
Intersection Summary

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	127	272	24	36	245	26	13	191	36	34	179	105
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	11	11	11	12	12	12	10	11	11
Storage Length (ft)	0		0	0		80	0		60	50		0
Storage Lanes	0		0	0		1	0		1	1		1
Taper Length (ft)	25		25	25		25	25		25	25		25
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		736			971			731			211	
Travel Time (s)		16.7			22.1			16.6			4.8	
Peak Hour Factor	0.94	0.94	0.94	0.96	0.96	0.96	0.90	0.90	0.90	0.84	0.84	0.84
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	0%
Parking (#/hr)										2	2	2
Shared Lane Traffic (%)												
Turn Type	Perm			Perm		Prot	Perm		Prot	Perm		
Protected Phases		4			8	8		2	2		6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8	8	2	2	2	6	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	
Minimum Split (s)	15.0	15.0		15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	
Total Split (s)	55.0	55.0	0.0	55.0	55.0	55.0	35.0	35.0	35.0	35.0	35.0	0.0
Total Split (%)	50.0%	50.0%	0.0%	50.0%	50.0%	50.0%	31.8%	31.8%	31.8%	31.8%	31.8%	0.0%
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	-1.0	-1.0	0.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	Min	Min		Min	Min	Min	None	None	None	None	None	

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 55.3
Natural Cycle: 80
Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Belmont Street & Common Street



Lane Group	ø9
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Right Turn on Red	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Parking (#/hr)	
Shared Lane Traffic (%)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	4.0
Minimum Split (s)	20.0
Total Split (s)	20.0
Total Split (%)	18%
Yellow Time (s)	4.0
All-Red Time (s)	2.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Recall Mode	None

Intersection Summary

Lane Group	EBT	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	450	293	27	226	40	40	338
v/c Ratio	0.61	0.37	0.04	0.34	0.07	0.12	0.58
Control Delay	15.4	11.3	4.7	16.0	8.3	15.1	19.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	15.4	11.3	4.7	16.0	8.3	15.1	19.2
Queue Length 50th (ft)	93	53	1	50	3	8	76
Queue Length 95th (ft)	234	134	12	132	23	31	182
Internal Link Dist (ft)	656	891		651			131
Turn Bay Length (ft)			80		60	50	
Base Capacity (vph)	1343	1459	1369	1122	1002	571	958
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.34	0.20	0.02	0.20	0.04	0.07	0.35

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	127	272	24	36	245	26	13	191	36	34	179	105
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	11	11	11	12	12	12	10	11	11
Total Lost time (s)		4.0			4.0	4.0		4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Frt		0.99			1.00	0.85		1.00	0.85	1.00	0.94	
Flt Protected		0.99			0.99	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1857			1809	1561		1877	1615	1499	1544	
Flt Permitted		0.81			0.92	1.00		0.97	1.00	0.59	1.00	
Satd. Flow (perm)		1534			1668	1561		1828	1615	929	1544	
Peak-hour factor, PHF	0.94	0.94	0.94	0.96	0.96	0.96	0.90	0.90	0.90	0.84	0.84	0.84
Adj. Flow (vph)	135	289	26	38	255	27	14	212	40	40	213	125
RTOR Reduction (vph)	0	2	0	0	0	12	0	0	17	0	17	0
Lane Group Flow (vph)	0	448	0	0	293	15	0	226	23	40	321	0
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	0%
Parking (#/hr)										2	2	2
Turn Type	Perm			Perm		Prot	Perm		Prot	Perm		
Protected Phases		4			8	8		2	2		6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		25.3			25.3	25.3		19.0	19.0	19.0	19.0	
Effective Green, g (s)		26.3			26.3	26.3		20.0	20.0	20.0	20.0	
Actuated g/C Ratio		0.48			0.48	0.48		0.37	0.37	0.37	0.37	
Clearance Time (s)		5.0			5.0	5.0		5.0	5.0	5.0	5.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		743			808	756		673	595	342	569	
v/s Ratio Prot						0.01			0.01		c0.21	
v/s Ratio Perm		c0.29			0.18			0.12		0.04		
v/c Ratio		0.60			0.36	0.02		0.34	0.04	0.12	0.56	
Uniform Delay, d1		10.2			8.8	7.3		12.4	11.0	11.3	13.7	
Progression Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Incremental Delay, d2		1.4			0.3	0.0		0.3	0.0	0.2	1.3	
Delay (s)		11.6			9.0	7.3		12.7	11.0	11.5	15.0	
Level of Service		B			A	A		B	B	B	B	
Approach Delay (s)		11.6			8.9			12.4			14.6	
Approach LOS		B			A			B			B	

Intersection Summary

HCM Average Control Delay	11.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	54.3	Sum of lost time (s)	8.0
Intersection Capacity Utilization	75.9%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

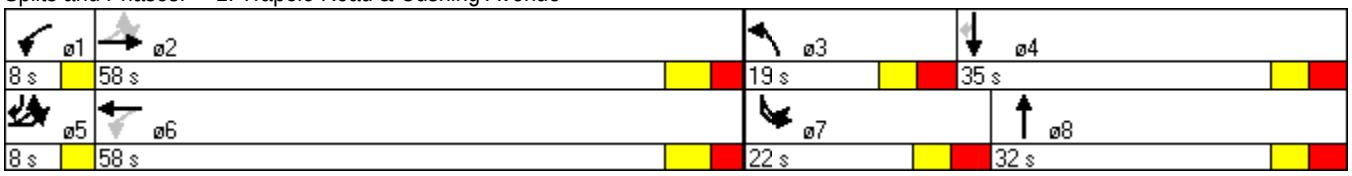
2017 Build

Lane Group	EBL2	EBL	EBT	EBR	WBL	WBT	WBR	WBR2	NBL	NBT	NBR	NBR2
Lane Configurations												
Volume (vph)	79	17	701	56	46	370	106	2	87	137	4	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	11	11	10	11	11	11	10	11	11	11
Storage Length (ft)		0		0	105		0		0		0	
Storage Lanes		1		0	1		0		1		0	
Taper Length (ft)		25		25	25		25		25		25	
Right Turn on Red				Yes				Yes				Yes
Link Speed (mph)			30			30				30		
Link Distance (ft)			157			221				274		
Travel Time (s)			3.6			5.0				6.2		
Peak Hour Factor	0.95	0.95	0.95	0.95	0.82	0.82	0.82	0.82	0.77	0.77	0.77	0.77
Heavy Vehicles (%)	1%	0%	2%	5%	0%	2%	1%	0%	0%	2%	0%	0%
Parking (#/hr)			5	5		5	5	5				
Shared Lane Traffic (%)												
Turn Type	pm+pt	pm+pt			pm+pt				Prot			
Protected Phases	5	5	2		1	6			3	8		
Permitted Phases	2	2			6							
Detector Phase	5	5	2		1	6			3	8		
Switch Phase												
Minimum Initial (s)	3.0	3.0	12.0		3.0	12.0			6.0	12.0		
Minimum Split (s)	6.0	6.0	30.0		6.0	30.0			13.0	28.5		
Total Split (s)	8.0	8.0	58.0	0.0	8.0	58.0	0.0	0.0	19.0	32.0	0.0	0.0
Total Split (%)	6.7%	6.7%	48.3%	0.0%	6.7%	48.3%	0.0%	0.0%	15.8%	26.7%	0.0%	0.0%
Yellow Time (s)	3.0	3.0	4.0		3.0	4.0			3.5	3.5		
All-Red Time (s)	0.0	0.0	3.0		0.0	3.0			3.5	3.5		
Lost Time Adjust (s)	1.0	1.0	-3.0	0.0	1.0	-3.0	0.0	0.0	-3.0	-3.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead	Lag		Lead	Lag			Lead	Lag		
Lead-Lag Optimize?	Yes	Yes	Yes		Yes	Yes			Yes	Yes		
Recall Mode	None	None	Min		None	Min			None	None		

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 112.5
Natural Cycle: 120
Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Trapelo Road & Cushing Avenue



Lane Group	SBL2	SBL	SBT	SBR
Lane Configurations				
Volume (vph)	7	224	243	90
Ideal Flow (vphpl)	1900	1900	1900	1900
Lane Width (ft)	11	11	11	16
Storage Length (ft)		0		50
Storage Lanes		1		1
Taper Length (ft)		25		25
Right Turn on Red				Yes
Link Speed (mph)			30	
Link Distance (ft)			873	
Travel Time (s)			19.8	
Peak Hour Factor	0.94	0.94	0.94	0.94
Heavy Vehicles (%)	0%	0%	1%	0%
Parking (#/hr)			2	2
Shared Lane Traffic (%)				
Turn Type	Prot	Prot		pm+ov
Protected Phases	7	7	4	5
Permitted Phases				4
Detector Phase	7	7	4	5
Switch Phase				
Minimum Initial (s)	6.0	6.0	12.0	3.0
Minimum Split (s)	13.0	13.0	28.5	6.0
Total Split (s)	22.0	22.0	35.0	8.0
Total Split (%)	18.3%	18.3%	29.2%	6.7%
Yellow Time (s)	3.5	3.5	3.5	3.0
All-Red Time (s)	3.5	3.5	3.5	0.0
Lost Time Adjust (s)	-3.0	-3.0	-3.0	1.0
Total Lost Time (s)	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead	Lag	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None

Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	101	797	56	582	113	230	245	259	96
v/c Ratio	0.42	1.06	0.44	0.82	0.56	0.66	0.87	0.68	0.18
Control Delay	20.4	80.1	24.9	37.9	59.5	49.9	77.4	49.7	16.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.4	80.1	24.9	37.9	59.5	49.9	77.4	49.7	16.6
Queue Length 50th (ft)	35	~659	19	356	79	151	179	178	25
Queue Length 95th (ft)	70	#964	39	478	122	194	#348	271	66
Internal Link Dist (ft)		77		141		194		793	
Turn Bay Length (ft)			105						50
Base Capacity (vph)	241	752	127	736	226	445	281	448	535
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.42	1.06	0.44	0.79	0.50	0.52	0.87	0.58	0.18

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

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

Movement	EBL2	EBL	EBT	EBR	WBL	WBT	WBR	WBR2	NBL	NBT	NBR	NBR2
Lane Configurations												
Volume (vph)	79	17	701	56	46	370	106	2	87	137	4	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	10	10	11	11	10	11	11	11	10	11	11	11
Total Lost time (s)		4.0	4.0		4.0	4.0			4.0	4.0		
Lane Util. Factor		1.00	1.00		1.00	1.00			1.00	1.00		
Frt		1.00	0.99		1.00	0.97			1.00	0.97		
Flt Protected		0.95	1.00		0.95	1.00			0.95	1.00		
Satd. Flow (prot)		1671	1555		1685	1526			1685	1747		
Flt Permitted		0.22	1.00		0.08	1.00			0.95	1.00		
Satd. Flow (perm)		382	1555		144	1526			1685	1747		
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.82	0.82	0.82	0.82	0.77	0.77	0.77	0.77
Adj. Flow (vph)	83	18	738	59	56	451	129	2	113	178	5	47
RTOR Reduction (vph)	0	0	2	0	0	0	0	0	0	8	0	0
Lane Group Flow (vph)	0	101	795	0	56	582	0	0	113	222	0	0
Heavy Vehicles (%)	1%	0%	2%	5%	0%	2%	1%	0%	0%	2%	0%	0%
Parking (#/hr)			5	5		5	5	5				
Turn Type	pm+pt	pm+pt			pm+pt				Prot			
Protected Phases	5	5	2		1	6			3	8		
Permitted Phases	2	2			6							
Actuated Green, G (s)		56.2	51.2		54.0	50.1			10.4	18.8		
Effective Green, g (s)		54.2	54.2		52.0	53.1			13.4	21.8		
Actuated g/C Ratio		0.48	0.48		0.46	0.47			0.12	0.19		
Clearance Time (s)		3.0	7.0		3.0	7.0			7.0	7.0		
Vehicle Extension (s)		2.0	2.0		2.0	2.0			2.0	2.0		
Lane Grp Cap (vph)		229	746		106	717			200	337		
v/s Ratio Prot		c0.02	c0.51		0.01	0.38			0.07	0.13		
v/s Ratio Perm		0.20			0.23							
v/c Ratio		0.44	1.07		0.53	0.81			0.56	0.66		
Uniform Delay, d1		19.6	29.4		25.2	25.7			47.0	42.2		
Progression Factor		1.00	1.00		1.00	1.00			1.00	1.00		
Incremental Delay, d2		0.5	51.8		2.2	6.6			2.2	3.5		
Delay (s)		20.1	81.2		27.4	32.3			49.2	45.7		
Level of Service		C	F		C	C			D	D		
Approach Delay (s)			74.4			31.8				46.8		
Approach LOS			E			C				D		

Intersection Summary

HCM Average Control Delay	54.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	113.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	79.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	SBL2	SBL	SBT	SBR
Lane Configurations				
Volume (vph)	7	224	243	90
Ideal Flow (vphpl)	1900	1900	1900	1900
Lane Width	11	11	11	16
Total Lost time (s)		4.0	4.0	4.0
Lane Util. Factor		1.00	1.00	1.00
Frt		1.00	1.00	0.85
Flt Protected		0.95	1.00	1.00
Satd. Flow (prot)		1745	1618	1629
Flt Permitted		0.95	1.00	1.00
Satd. Flow (perm)		1745	1618	1629
Peak-hour factor, PHF	0.94	0.94	0.94	0.94
Adj. Flow (vph)	7	238	259	96
RTOR Reduction (vph)	0	0	0	38
Lane Group Flow (vph)	0	245	259	58
Heavy Vehicles (%)	0%	0%	1%	0%
Parking (#/hr)			2	2
Turn Type	Prot	Prot		pm+ov
Protected Phases	7	7	4	5
Permitted Phases				4
Actuated Green, G (s)		15.1	23.5	28.5
Effective Green, g (s)		18.1	26.5	26.5
Actuated g/C Ratio		0.16	0.23	0.23
Clearance Time (s)		7.0	7.0	3.0
Vehicle Extension (s)		2.0	2.0	2.0
Lane Grp Cap (vph)		280	379	382
v/s Ratio Prot		c0.14	c0.16	0.01
v/s Ratio Perm				0.03
v/c Ratio		0.88	0.68	0.15
Uniform Delay, d1		46.3	39.4	34.3
Progression Factor		1.00	1.00	1.00
Incremental Delay, d2		24.1	4.0	0.1
Delay (s)		70.5	43.5	34.4
Level of Service		E	D	C
Approach Delay (s)			53.0	
Approach LOS			D	

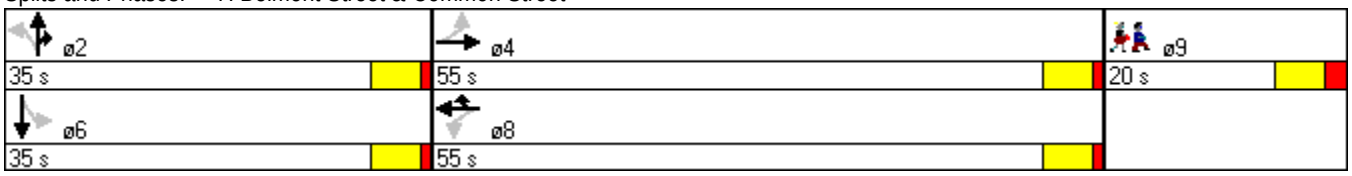
Intersection Summary

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	126	581	8	12	373	17	10	49	8	34	54	222
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	11	11	11	12	12	12	10	11	11
Storage Length (ft)	0		0	0		80	0		60	50		0
Storage Lanes	0		0	0		1	0		1	1		1
Taper Length (ft)	25		25	25		25	25		25	25		25
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		736			971			731			211	
Travel Time (s)		16.7			22.1			16.6			4.8	
Peak Hour Factor	0.94	0.94	0.94	0.89	0.89	0.89	0.39	0.39	0.39	0.86	0.86	0.86
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	1%
Parking (#/hr)										2	2	2
Shared Lane Traffic (%)												
Turn Type	Perm			Perm		Prot	Perm		Prot	Perm		
Protected Phases		4			8	8		2	2		6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8	8	2	2	2	6	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	
Minimum Split (s)	15.0	15.0		15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	
Total Split (s)	55.0	55.0	0.0	55.0	55.0	55.0	35.0	35.0	35.0	35.0	35.0	0.0
Total Split (%)	50.0%	50.0%	0.0%	50.0%	50.0%	50.0%	31.8%	31.8%	31.8%	31.8%	31.8%	0.0%
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	-1.0	-1.0	0.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	Min	Min		Min	Min	Min	None	None	None	None	None	

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 74.5
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Belmont Street & Common Street



Lane Group	ø9
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Right Turn on Red	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Parking (#/hr)	
Shared Lane Traffic (%)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	4.0
Minimum Split (s)	20.0
Total Split (s)	20.0
Total Split (%)	18%
Yellow Time (s)	4.0
All-Red Time (s)	2.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Recall Mode	None

Intersection Summary

Lane Group	EBT	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	761	432	19	152	21	40	321
v/c Ratio	0.69	0.35	0.02	0.63	0.06	0.21	0.73
Control Delay	12.2	6.6	3.6	38.8	10.2	26.5	21.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.2	6.6	3.6	38.8	10.2	26.5	21.8
Queue Length 50th (ft)	160	63	1	64	0	15	55
Queue Length 95th (ft)	415	155	9	46	3	38	126
Internal Link Dist (ft)	656	891		651			131
Turn Bay Length (ft)			80		60	50	
Base Capacity (vph)	1109	1221	1076	492	687	393	704
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.69	0.35	0.02	0.31	0.03	0.10	0.46

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	126	581	8	12	373	17	10	49	8	34	54	222
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	11	11	11	12	12	12	10	11	11
Total Lost time (s)		4.0			4.0	4.0		4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Frt		1.00			1.00	0.85		1.00	0.85	1.00	0.88	
Flt Protected		0.99			1.00	1.00		0.99	1.00	0.95	1.00	
Satd. Flow (prot)		1880			1816	1561		1868	1615	1499	1426	
Flt Permitted		0.85			0.98	1.00		0.62	1.00	0.60	1.00	
Satd. Flow (perm)		1614			1778	1561		1177	1615	943	1426	
Peak-hour factor, PHF	0.94	0.94	0.94	0.89	0.89	0.89	0.39	0.39	0.39	0.86	0.86	0.86
Adj. Flow (vph)	134	618	9	13	419	19	26	126	21	40	63	258
RTOR Reduction (vph)	0	0	0	0	0	3	0	0	17	0	149	0
Lane Group Flow (vph)	0	761	0	0	432	16	0	152	4	40	172	0
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	1%
Parking (#/hr)										2	2	2
Turn Type	Perm			Perm		Prot	Perm		Prot	Perm		
Protected Phases		4			8	8		2	2		6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		50.2			50.2	50.2		14.3	14.3	14.3	14.3	
Effective Green, g (s)		51.2			51.2	51.2		15.3	15.3	15.3	15.3	
Actuated g/C Ratio		0.69			0.69	0.69		0.21	0.21	0.21	0.21	
Clearance Time (s)		5.0			5.0	5.0		5.0	5.0	5.0	5.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		1109			1222	1073		242	332	194	293	
v/s Ratio Prot						0.01			0.00		0.12	
v/s Ratio Perm		c0.47			0.24			c0.13		0.04		
v/c Ratio		0.69			0.35	0.01		0.63	0.01	0.21	0.59	
Uniform Delay, d1		6.9			4.8	3.7		27.0	23.6	24.6	26.8	
Progression Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Incremental Delay, d2		1.8			0.2	0.0		5.0	0.0	0.5	3.0	
Delay (s)		8.7			5.0	3.7		32.0	23.6	25.1	29.8	
Level of Service		A			A	A		C	C	C	C	
Approach Delay (s)		8.7			4.9			31.0			29.2	
Approach LOS		A			A			C			C	

Intersection Summary

HCM Average Control Delay	14.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	74.5	Sum of lost time (s)	8.0
Intersection Capacity Utilization	84.8%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL2	EBL	EBT	EBR	WBL	WBT	WBR	WBR2	NBL	NBT	NBR	NBR2
Lane Configurations												
Volume (vph)	83	21	468	92	50	611	142	10	127	255	14	64
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	11	11	10	11	11	11	10	11	11	11
Storage Length (ft)		0		0	105		0		0		0	
Storage Lanes		1		0	1		0		1		0	
Taper Length (ft)		25		25	25		25		25		25	
Right Turn on Red				Yes				Yes				Yes
Link Speed (mph)			30			30				30		
Link Distance (ft)			157			221				274		
Travel Time (s)			3.6			5.0				6.2		
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.87	0.87	0.87	0.87
Heavy Vehicles (%)	1%	0%	1%	0%	0%	1%	0%	0%	0%	1%	0%	0%
Parking (#/hr)			5	5		5	5	5				
Shared Lane Traffic (%)												
Turn Type	pm+pt	pm+pt			pm+pt				Prot			
Protected Phases	5	5	2		1	6			3	8		
Permitted Phases	2	2			6							
Detector Phase	5	5	2		1	6			3	8		
Switch Phase												
Minimum Initial (s)	3.0	3.0	12.0		3.0	12.0			6.0	12.0		
Minimum Split (s)	6.0	6.0	30.0		6.0	30.0			13.0	28.5		
Total Split (s)	11.0	11.0	56.0	0.0	11.0	56.0	0.0	0.0	19.0	34.0	0.0	0.0
Total Split (%)	9.2%	9.2%	46.7%	0.0%	9.2%	46.7%	0.0%	0.0%	15.8%	28.3%	0.0%	0.0%
Yellow Time (s)	3.0	3.0	4.0		3.0	4.0			3.5	3.5		
All-Red Time (s)	0.0	0.0	3.0		0.0	3.0			3.5	3.5		
Lost Time Adjust (s)	1.0	1.0	-3.0	0.0	1.0	-3.0	0.0	0.0	-3.0	-3.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead	Lag		Lead	Lag			Lead	Lag		
Lead-Lag Optimize?	Yes	Yes	Yes		Yes	Yes			Yes	Yes		
Recall Mode	None	None	Min		None	Min			None	None		

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 117.9
Natural Cycle: 130
Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Trapelo Road & Cushing Avenue

Lane Group	SBL2	SBL	SBT	SBR
Lane Configurations				
Volume (vph)	8	129	256	107
Ideal Flow (vphpl)	1900	1900	1900	1900
Lane Width (ft)	11	11	11	16
Storage Length (ft)		0		50
Storage Lanes		1		1
Taper Length (ft)		25		25
Right Turn on Red				Yes
Link Speed (mph)			30	
Link Distance (ft)			873	
Travel Time (s)			19.8	
Peak Hour Factor	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	0%	0%	1%	1%
Parking (#/hr)			2	2
Shared Lane Traffic (%)				
Turn Type	Prot	Prot		pm+ov
Protected Phases	7	7	4	5
Permitted Phases				4
Detector Phase	7	7	4	5
Switch Phase				
Minimum Initial (s)	6.0	6.0	12.0	3.0
Minimum Split (s)	13.0	13.0	28.5	6.0
Total Split (s)	19.0	19.0	34.0	11.0
Total Split (%)	15.8%	15.8%	28.3%	9.2%
Yellow Time (s)	3.5	3.5	3.5	3.0
All-Red Time (s)	3.5	3.5	3.5	0.0
Lost Time Adjust (s)	-3.0	-3.0	-3.0	1.0
Total Lost Time (s)	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead	Lag	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None

Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	114	615	55	838	146	383	156	291	122
v/c Ratio	0.72	0.84	0.24	1.23	0.71	0.88	0.73	0.74	0.21
Control Delay	45.1	40.7	16.7	145.1	69.9	64.4	70.8	53.7	16.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	45.1	40.7	16.7	145.1	69.9	64.4	70.8	53.7	16.3
Queue Length 50th (ft)	43	419	20	~814	110	278	118	207	34
Queue Length 95th (ft)	#130	#665	42	#1062	#188	#418	#206	302	77
Internal Link Dist (ft)		77		141		194		793	
Turn Bay Length (ft)			105						50
Base Capacity (vph)	162	733	255	684	215	456	222	413	582
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.70	0.84	0.22	1.23	0.68	0.84	0.70	0.70	0.21

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

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

Movement	EBL2	EBL	EBT	EBR	WBL	WBT	WBR	WBR2	NBL	NBT	NBR	NBR2
Lane Configurations												
Volume (vph)	83	21	468	92	50	611	142	10	127	255	14	64
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	10	10	11	11	10	11	11	11	10	11	11	11
Total Lost time (s)		4.0	4.0		4.0	4.0			4.0	4.0		
Lane Util. Factor		1.00	1.00		1.00	1.00			1.00	1.00		
Frt		1.00	0.98		1.00	0.97			1.00	0.96		
Flt Protected		0.95	1.00		0.95	1.00			0.95	1.00		
Satd. Flow (prot)		1671	1555		1685	1547			1685	1758		
Flt Permitted		0.08	1.00		0.20	1.00			0.95	1.00		
Satd. Flow (perm)		138	1555		350	1547			1685	1758		
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.87	0.87	0.87	0.87
Adj. Flow (vph)	91	23	514	101	55	671	156	11	146	293	16	74
RTOR Reduction (vph)	0	0	5	0	0	1	0	0	0	8	0	0
Lane Group Flow (vph)	0	114	610	0	55	837	0	0	146	375	0	0
Heavy Vehicles (%)	1%	0%	1%	0%	0%	1%	0%	0%	0%	1%	0%	0%
Parking (#/hr)			5	5		5	5	5				
Turn Type	pm+pt	pm+pt			pm+pt				Prot			
Protected Phases	5	5	2		1	6			3	8		
Permitted Phases	2	2			6							
Actuated Green, G (s)		59.9	52.1		54.9	49.6			11.3	25.6		
Effective Green, g (s)		57.9	55.1		52.9	52.6			14.3	28.6		
Actuated g/C Ratio		0.49	0.47		0.45	0.44			0.12	0.24		
Clearance Time (s)		3.0	7.0		3.0	7.0			7.0	7.0		
Vehicle Extension (s)		2.0	2.0		2.0	2.0			2.0	2.0		
Lane Grp Cap (vph)		156	724		205	687			204	425		
v/s Ratio Prot		c0.04	0.39		0.01	c0.54			0.09	c0.21		
v/s Ratio Perm		0.32			0.11							
v/c Ratio		0.73	0.84		0.27	1.22			0.72	0.88		
Uniform Delay, d1		26.6	27.8		21.9	32.9			50.1	43.3		
Progression Factor		1.00	1.00		1.00	1.00			1.00	1.00		
Incremental Delay, d2		14.0	8.4		0.3	111.4			9.5	18.6		
Delay (s)		40.6	36.3		22.1	144.3			59.6	61.9		
Level of Service		D	D		C	F			E	E		
Approach Delay (s)			36.9			136.8				61.2		
Approach LOS			D			F				E		

Intersection Summary

HCM Average Control Delay	76.9	HCM Level of Service	E
HCM Volume to Capacity ratio	1.07		
Actuated Cycle Length (s)	118.4	Sum of lost time (s)	20.0
Intersection Capacity Utilization	86.2%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	SBL2	SBL	SBT	SBR
Lane Configurations				
Volume (vph)	8	129	256	107
Ideal Flow (vphpl)	1900	1900	1900	1900
Lane Width	11	11	11	16
Total Lost time (s)		4.0	4.0	4.0
Lane Util. Factor		1.00	1.00	1.00
Frt		1.00	1.00	0.85
Flt Protected		0.95	1.00	1.00
Satd. Flow (prot)		1745	1618	1613
Flt Permitted		0.95	1.00	1.00
Satd. Flow (perm)		1745	1618	1613
Peak-hour factor, PHF	0.88	0.88	0.88	0.88
Adj. Flow (vph)	9	147	291	122
RTOR Reduction (vph)	0	0	0	42
Lane Group Flow (vph)	0	156	291	80
Heavy Vehicles (%)	0%	0%	1%	1%
Parking (#/hr)			2	2
Turn Type	Prot	Prot		pm+ov
Protected Phases	7	7	4	5
Permitted Phases				4
Actuated Green, G (s)		11.4	25.7	33.5
Effective Green, g (s)		14.4	28.7	31.5
Actuated g/C Ratio		0.12	0.24	0.27
Clearance Time (s)		7.0	7.0	3.0
Vehicle Extension (s)		2.0	2.0	2.0
Lane Grp Cap (vph)		212	392	429
v/s Ratio Prot		c0.09	0.18	0.01
v/s Ratio Perm				0.04
v/c Ratio		0.74	0.74	0.19
Uniform Delay, d1		50.2	41.4	33.6
Progression Factor		1.00	1.00	1.00
Incremental Delay, d2		10.8	6.5	0.1
Delay (s)		61.0	47.9	33.6
Level of Service		E	D	C
Approach Delay (s)			48.5	
Approach LOS			D	

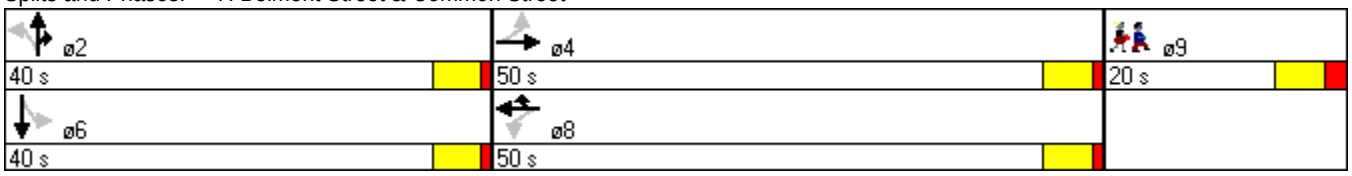
Intersection Summary

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	142	374	40	59	469	47	25	258	49	37	194	141
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	11	11	11	12	12	12	10	11	11
Storage Length (ft)	0		0	0		80	0		60	50		0
Storage Lanes	0		0	0		1	0		1	1		1
Taper Length (ft)	25		25	25		25	25		25	25		25
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		736			971			731			211	
Travel Time (s)		16.7			22.1			16.6			4.8	
Peak Hour Factor	0.89	0.89	0.89	0.94	0.94	0.94	0.84	0.84	0.84	0.89	0.89	0.89
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	1%
Parking (#/hr)										2	2	2
Shared Lane Traffic (%)												
Turn Type	Perm			Perm		Prot	Perm		Prot	Perm		
Protected Phases		4			8	8		2	2		6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8	8	2	2	2	6	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	
Minimum Split (s)	15.0	15.0		15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	
Total Split (s)	50.0	50.0	0.0	50.0	50.0	50.0	40.0	40.0	40.0	40.0	40.0	0.0
Total Split (%)	45.5%	45.5%	0.0%	45.5%	45.5%	45.5%	36.4%	36.4%	36.4%	36.4%	36.4%	0.0%
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	-1.0	-1.0	0.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	Min	Min		Min	Min	Min	None	None	None	None	None	

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 78.2
Natural Cycle: 130
Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Belmont Street & Common Street



Lane Group	ø9
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Right Turn on Red	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Parking (#/hr)	
Shared Lane Traffic (%)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	4.0
Minimum Split (s)	20.0
Total Split (s)	20.0
Total Split (%)	18%
Yellow Time (s)	4.0
All-Red Time (s)	2.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Recall Mode	None

Intersection Summary

Lane Group	EBT	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	625	562	50	337	58	42	376
v/c Ratio	0.89	0.59	0.05	0.69	0.11	0.24	0.77
Control Delay	34.1	14.8	6.3	31.6	11.6	23.4	33.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	34.1	14.8	6.3	31.6	11.6	23.4	33.1
Queue Length 50th (ft)	234	153	5	142	10	15	149
Queue Length 95th (ft)	#574	342	25	205	31	40	240
Internal Link Dist (ft)	656	891		651			131
Turn Bay Length (ft)			80		60	50	
Base Capacity (vph)	701	957	933	739	763	262	726
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.89	0.59	0.05	0.46	0.08	0.16	0.52

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	142	374	40	59	469	47	25	258	49	37	194	141
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	11	11	11	12	12	12	10	11	11
Total Lost time (s)		4.0			4.0	4.0		4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Frt		0.99			1.00	0.85		1.00	0.85	1.00	0.94	
Flt Protected		0.99			0.99	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1858			1810	1561		1875	1615	1499	1525	
Flt Permitted		0.63			0.89	1.00		0.85	1.00	0.36	1.00	
Satd. Flow (perm)		1182			1615	1561		1595	1615	566	1525	
Peak-hour factor, PHF	0.89	0.89	0.89	0.94	0.94	0.94	0.84	0.84	0.84	0.89	0.89	0.89
Adj. Flow (vph)	160	420	45	63	499	50	30	307	58	42	218	158
RTOR Reduction (vph)	0	2	0	0	0	9	0	0	19	0	24	0
Lane Group Flow (vph)	0	623	0	0	562	41	0	337	39	42	352	0
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	1%
Parking (#/hr)										2	2	2
Turn Type	Perm			Perm		Prot	Perm		Prot	Perm		
Protected Phases		4			8	8		2	2		6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		45.3			45.3	45.3		22.8	22.8	22.8	22.8	
Effective Green, g (s)		46.3			46.3	46.3		23.8	23.8	23.8	23.8	
Actuated g/C Ratio		0.59			0.59	0.59		0.30	0.30	0.30	0.30	
Clearance Time (s)		5.0			5.0	5.0		5.0	5.0	5.0	5.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		701			957	925		486	492	172	465	
v/s Ratio Prot						0.03			0.02		c0.23	
v/s Ratio Perm		c0.53			0.35			0.21		0.07		
v/c Ratio		0.89			0.59	0.04		0.69	0.08	0.24	0.76	
Uniform Delay, d1		13.7			9.9	6.7		23.9	19.3	20.4	24.5	
Progression Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Incremental Delay, d2		13.2			0.9	0.0		4.3	0.1	0.7	6.9	
Delay (s)		26.9			10.9	6.7		28.2	19.4	21.1	31.4	
Level of Service		C			B	A		C	B	C	C	
Approach Delay (s)		26.9			10.5			26.9			30.4	
Approach LOS		C			B			C			C	

Intersection Summary

HCM Average Control Delay	22.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	78.1	Sum of lost time (s)	8.0
Intersection Capacity Utilization	102.3%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL2	EBL	EBT	EBR	WBL	WBT	WBR	WBR2	NBL	NBT	NBR	NBR2
Lane Configurations												
Volume (vph)	91	23	407	105	87	398	114	12	184	188	20	107
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	11	11	10	11	11	11	10	11	11	11
Storage Length (ft)		0		0	105		0		0		0	
Storage Lanes		1		0	1		0		1		0	
Taper Length (ft)		25		25	25		25		25		25	
Right Turn on Red				Yes				Yes				Yes
Link Speed (mph)			30			30				30		
Link Distance (ft)			157			221				274		
Travel Time (s)			3.6			5.0				6.2		
Peak Hour Factor	0.91	0.91	0.91	0.91	0.94	0.94	0.94	0.94	0.91	0.91	0.91	0.91
Heavy Vehicles (%)	0%	0%	1%	0%	0%	0%	1%	0%	2%	0%	0%	0%
Parking (#/hr)			5	5		5	5	5				
Shared Lane Traffic (%)												
Turn Type	pm+pt	pm+pt			pm+pt				Prot			
Protected Phases	5	5	2		1	6			3	8		
Permitted Phases	2	2			6							
Detector Phase	5	5	2		1	6			3	8		
Switch Phase												
Minimum Initial (s)	3.0	3.0	12.0		3.0	12.0			6.0	12.0		
Minimum Split (s)	6.0	6.0	30.0		6.0	30.0			13.0	28.5		
Total Split (s)	8.0	8.0	53.5	0.0	8.0	53.5	0.0	0.0	20.0	28.5	0.0	0.0
Total Split (%)	7.3%	7.3%	48.6%	0.0%	7.3%	48.6%	0.0%	0.0%	18.2%	25.9%	0.0%	0.0%
Yellow Time (s)	3.0	3.0	4.0		3.0	4.0			3.5	3.5		
All-Red Time (s)	0.0	0.0	3.0		0.0	3.0			3.5	3.5		
Lost Time Adjust (s)	1.0	1.0	-3.0	0.0	1.0	-3.0	0.0	0.0	-3.0	-3.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead	Lag		Lead	Lag			Lead	Lag		
Lead-Lag Optimize?	Yes	Yes	Yes		Yes	Yes			Yes	Yes		
Recall Mode	None	None	Min		None	Min			None	None		

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 99.5
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Trapelo Road & Cushing Avenue

ø1	ø2	ø3	ø4
8 s	53.5 s	20 s	28.5 s
ø5	ø6	ø7	ø8
8 s	53.5 s	20 s	28.5 s

Lane Group	SBL2	SBL	SBT	SBR
Lane Configurations				
Volume (vph)	6	118	205	116
Ideal Flow (vphpl)	1900	1900	1900	1900
Lane Width (ft)	11	11	11	16
Storage Length (ft)		0		50
Storage Lanes		1		1
Taper Length (ft)		25		25
Right Turn on Red				Yes
Link Speed (mph)			30	
Link Distance (ft)			873	
Travel Time (s)			19.8	
Peak Hour Factor	0.82	0.82	0.82	0.82
Heavy Vehicles (%)	0%	0%	0%	0%
Parking (#/hr)			2	2
Shared Lane Traffic (%)				
Turn Type	Prot	Prot		pm+ov
Protected Phases	7	7	4	5
Permitted Phases				4
Detector Phase	7	7	4	5
Switch Phase				
Minimum Initial (s)	6.0	6.0	12.0	3.0
Minimum Split (s)	13.0	13.0	28.5	6.0
Total Split (s)	20.0	20.0	28.5	8.0
Total Split (%)	18.2%	18.2%	25.9%	7.3%
Yellow Time (s)	3.5	3.5	3.5	3.0
All-Red Time (s)	3.5	3.5	3.5	0.0
Lost Time Adjust (s)	-3.0	-3.0	-3.0	1.0
Total Lost Time (s)	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead	Lag	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None

Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	125	562	93	557	202	347	151	250	141
v/c Ratio	0.59	0.82	0.41	0.86	0.77	0.82	0.60	0.69	0.26
Control Delay	28.2	36.4	19.9	41.6	63.9	53.0	53.1	48.4	15.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.2	36.4	19.9	41.6	63.9	53.0	53.1	48.4	15.1
Queue Length 50th (ft)	44	324	32	329	134	212	96	155	30
Queue Length 95th (ft)	76	#487	60	#492	#268	#386	153	226	69
Internal Link Dist (ft)		77		141		194		793	
Turn Bay Length (ft)			105						50
Base Capacity (vph)	211	791	226	785	271	450	286	411	548
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.59	0.71	0.41	0.71	0.75	0.77	0.53	0.61	0.26

Intersection Summary

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

Movement	EBL2	EBL	EBT	EBR	WBL	WBT	WBR	WBR2	NBL	NBT	NBR	NBR2
Lane Configurations												
Volume (vph)	91	23	407	105	87	398	114	12	184	188	20	107
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	10	10	11	11	10	11	11	11	10	11	11	11
Total Lost time (s)		4.0	4.0		4.0	4.0			4.0	4.0		
Lane Util. Factor		1.00	1.00		1.00	1.00			1.00	1.00		
Frt		1.00	0.97		1.00	0.96			1.00	0.94		
Flt Protected		0.95	1.00		0.95	1.00			0.95	1.00		
Satd. Flow (prot)		1685	1545		1685	1546			1652	1726		
Flt Permitted		0.19	1.00		0.21	1.00			0.95	1.00		
Satd. Flow (perm)		334	1545		377	1546			1652	1726		
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.94	0.94	0.94	0.94	0.91	0.91	0.91	0.91
Adj. Flow (vph)	100	25	447	115	93	423	121	13	202	207	22	118
RTOR Reduction (vph)	0	0	8	0	0	1	0	0	0	17	0	0
Lane Group Flow (vph)	0	125	554	0	93	556	0	0	202	330	0	0
Heavy Vehicles (%)	0%	0%	1%	0%	0%	0%	1%	0%	2%	0%	0%	0%
Parking (#/hr)			5	5		5	5	5				
Turn Type	pm+pt	pm+pt			pm+pt				Prot			
Protected Phases	5	5	2		1	6			3	8		
Permitted Phases	2	2			6							
Actuated Green, G (s)		45.6	40.5		43.0	39.2			12.7	20.4		
Effective Green, g (s)		43.6	43.5		41.0	42.2			15.7	23.4		
Actuated g/C Ratio		0.44	0.44		0.41	0.42			0.16	0.23		
Clearance Time (s)		3.0	7.0		3.0	7.0			7.0	7.0		
Vehicle Extension (s)		2.0	2.0		2.0	2.0			2.0	2.0		
Lane Grp Cap (vph)		201	673		191	653			260	404		
v/s Ratio Prot		c0.03	0.36		0.01	c0.36			c0.12	c0.19		
v/s Ratio Perm		0.25			0.19							
v/c Ratio		0.62	0.82		0.49	0.85			0.78	0.82		
Uniform Delay, d1		21.7	24.8		23.3	26.0			40.4	36.2		
Progression Factor		1.00	1.00		1.00	1.00			1.00	1.00		
Incremental Delay, d2		4.3	7.6		0.7	10.1			12.4	11.5		
Delay (s)		26.0	32.4		24.0	36.1			52.9	47.7		
Level of Service		C	C		C	D			D	D		
Approach Delay (s)			31.3			34.4				49.6		
Approach LOS			C			C				D		

Intersection Summary

HCM Average Control Delay	38.0	HCM Level of Service	D
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	99.9	Sum of lost time (s)	12.0
Intersection Capacity Utilization	72.8%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	SBL2	SBL	SBT	SBR
Lane Configurations				
Volume (vph)	6	118	205	116
Ideal Flow (vphpl)	1900	1900	1900	1900
Lane Width	11	11	11	16
Total Lost time (s)		4.0	4.0	4.0
Lane Util. Factor		1.00	1.00	1.00
Frt		1.00	1.00	0.85
Flt Protected		0.95	1.00	1.00
Satd. Flow (prot)		1745	1635	1629
Flt Permitted		0.95	1.00	1.00
Satd. Flow (perm)		1745	1635	1629
Peak-hour factor, PHF	0.82	0.82	0.82	0.82
Adj. Flow (vph)	7	144	250	141
RTOR Reduction (vph)	0	0	0	62
Lane Group Flow (vph)	0	151	250	79
Heavy Vehicles (%)	0%	0%	0%	0%
Parking (#/hr)			2	2
Turn Type	Prot	Prot		pm+ov
Protected Phases	7	7	4	5
Permitted Phases				4
Actuated Green, G (s)		11.2	18.9	24.0
Effective Green, g (s)		14.2	21.9	22.0
Actuated g/C Ratio		0.14	0.22	0.22
Clearance Time (s)		7.0	7.0	3.0
Vehicle Extension (s)		2.0	2.0	2.0
Lane Grp Cap (vph)		248	358	359
v/s Ratio Prot		0.09	0.15	0.01
v/s Ratio Perm				0.04
v/c Ratio		0.61	0.70	0.22
Uniform Delay, d1		40.2	36.0	31.9
Progression Factor		1.00	1.00	1.00
Incremental Delay, d2		2.9	4.7	0.1
Delay (s)		43.1	40.7	32.0
Level of Service		D	D	C
Approach Delay (s)			39.1	
Approach LOS			D	

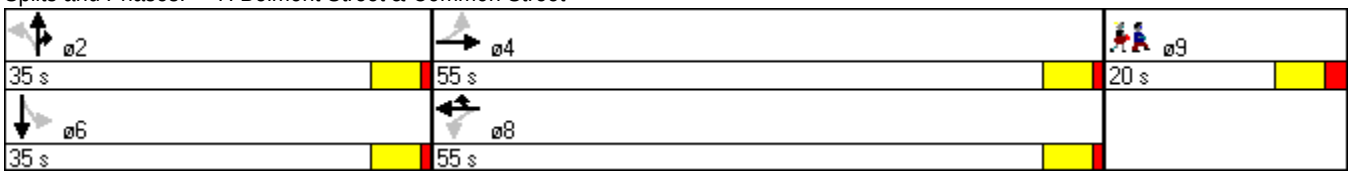
Intersection Summary

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	157	264	25	36	241	41	12	203	36	51	187	126
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	11	11	11	12	12	12	10	11	11
Storage Length (ft)	0		0	0		80	0		60	50		0
Storage Lanes	0		0	0		1	0		1	1		1
Taper Length (ft)	25		25	25		25	25		25	25		25
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		736			971			731			211	
Travel Time (s)		16.7			22.1			16.6			4.8	
Peak Hour Factor	0.94	0.94	0.94	0.96	0.96	0.96	0.90	0.90	0.90	0.84	0.84	0.84
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	0%
Parking (#/hr)										2	2	2
Shared Lane Traffic (%)												
Turn Type	Perm			Perm		Prot	Perm		Prot	Perm		
Protected Phases		4			8	8		2	2		6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8	8	2	2	2	6	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	
Minimum Split (s)	15.0	15.0		15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	
Total Split (s)	55.0	55.0	0.0	55.0	55.0	55.0	35.0	35.0	35.0	35.0	35.0	0.0
Total Split (%)	50.0%	50.0%	0.0%	50.0%	50.0%	50.0%	31.8%	31.8%	31.8%	31.8%	31.8%	0.0%
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	-1.0	-1.0	0.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	Min	Min		Min	Min	Min	None	None	None	None	None	

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 65.5
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Belmont Street & Common Street



Lane Group	ø9
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Right Turn on Red	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Parking (#/hr)	
Shared Lane Traffic (%)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	4.0
Minimum Split (s)	20.0
Total Split (s)	20.0
Total Split (%)	18%
Yellow Time (s)	4.0
All-Red Time (s)	2.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Recall Mode	None

Intersection Summary

Lane Group	EBT	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	475	289	43	239	40	61	373
v/c Ratio	0.64	0.34	0.05	0.36	0.07	0.19	0.65
Control Delay	17.0	11.5	3.9	19.3	10.0	19.2	23.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.0	11.5	3.9	19.3	10.0	19.2	23.9
Queue Length 50th (ft)	129	65	1	68	4	16	110
Queue Length 95th (ft)	255	129	15	163	26	51	238
Internal Link Dist (ft)	656	891		651			131
Turn Bay Length (ft)			80		60	50	
Base Capacity (vph)	1149	1309	1239	939	840	446	802
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.41	0.22	0.03	0.25	0.05	0.14	0.47

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	157	264	25	36	241	41	12	203	36	51	187	126
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	11	11	11	12	12	12	10	11	11
Total Lost time (s)		4.0			4.0	4.0		4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Frt		0.99			1.00	0.85		1.00	0.85	1.00	0.94	
Flt Protected		0.98			0.99	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1853			1809	1561		1877	1615	1499	1536	
Flt Permitted		0.77			0.91	1.00		0.97	1.00	0.55	1.00	
Satd. Flow (perm)		1457			1660	1561		1833	1615	870	1536	
Peak-hour factor, PHF	0.94	0.94	0.94	0.96	0.96	0.96	0.90	0.90	0.90	0.84	0.84	0.84
Adj. Flow (vph)	167	281	27	38	251	43	13	226	40	61	223	150
RTOR Reduction (vph)	0	2	0	0	0	19	0	0	16	0	20	0
Lane Group Flow (vph)	0	473	0	0	289	24	0	239	24	61	353	0
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	0%
Parking (#/hr)										2	2	2
Turn Type	Perm			Perm		Prot	Perm		Prot	Perm		
Protected Phases		4			8	8		2	2		6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		32.1			32.1	32.1		22.7	22.7	22.7	22.7	
Effective Green, g (s)		33.1			33.1	33.1		23.7	23.7	23.7	23.7	
Actuated g/C Ratio		0.51			0.51	0.51		0.37	0.37	0.37	0.37	
Clearance Time (s)		5.0			5.0	5.0		5.0	5.0	5.0	5.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		744			848	797		670	591	318	562	
v/s Ratio Prot						0.02			0.01		c0.23	
v/s Ratio Perm		c0.32			0.17			0.13		0.07		
v/c Ratio		0.64			0.34	0.03		0.36	0.04	0.19	0.63	
Uniform Delay, d1		11.5			9.4	7.9		15.0	13.2	14.0	16.9	
Progression Factor		1.00			1.00	1.00		1.00	1.00	1.00	1.00	
Incremental Delay, d2		1.8			0.2	0.0		0.3	0.0	0.3	2.2	
Delay (s)		13.3			9.6	7.9		15.3	13.3	14.3	19.1	
Level of Service		B			A	A		B	B	B	B	
Approach Delay (s)		13.3			9.4			15.0			18.5	
Approach LOS		B			A			B			B	

Intersection Summary

HCM Average Control Delay	14.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	64.8	Sum of lost time (s)	8.0
Intersection Capacity Utilization	81.0%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group