Vanasse & Associates, Inc.
Transportation Engineers & Planners

35 New England Business Center Drive
Suite 140
Andover, MA 01810
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Ref: 7413

November 26, 2018

Ms. Rachna D. Balakrishna
Mason & Murphy, Inc.
1299 Beacon Street
Brookline, MA 02446

Re: Responses to Comments
1299 Beacon Street
Brookline, Massachusetts

Dear Rachna:

Vanasse & Associates, Inc. (VAI) is pleased to submit our responses to comments following our November 20, 2018 meeting with Town staff. For ease of review we have listed the comments followed by our response.

Comment 1: ***"VAI should coordinate with Simon Design Engineering."***

Response: VAI has coordinated the updated comments with Simon Design Engineering. The revised restaurant transit/walk reduction has been reduced from 50 percent to 38 percent, as discussed.

Comment 2: ***"Utilize Quality Restaurant land use code (not retail) and reduce the transit/walk reduction from 50 percent to 38 percent.***

Response: The trip generation table has been revised to reflect a quality restaurant and is attached. The level of service analysis was updated for the higher Saturday midday condition and is also attached. The weekday morning and evening peak hour volume changes are minimal and do not warrant any further analysis.

Table 3
TRIP-GENERATION SUMMARY (UPDATE)

	Residential Trips[a]	Residential Transit Reduction[b]	Retail[c] 7,125 sf	Retail[c] Transit Reduction[d]	Restaurant[f] 3,500 sf	Restaurant[f] Transit Reduction[e]	**Total New Trips**
Weekday Morning Peak Hour:							
Entering	6	-4	4	-2	2	-1	**5**
Exiting	10	-7	3	-1	1	0	**6**
Total	16	-11	7	-3	3	-1	**11**
Weekday Evening Peak Hour:							
Entering	12	-8	13	-6	18	-7	**22**
Exiting	9	-6	14	-7	9	-3	**16**
Total	21	-14	27	-13	27	-10	**38**
Saturday Midday Peak Hour:							
Entering	16	-11	17	-9	22	-8	**27**
Exiting	10	-6	15	-7	16	-6	**22**
Total	26	-17	32	-16	38	-14	**49**
Weekday Daily	296	-192	**268**	**-134**	294	-112	**420**
Saturday Daily	258	-168	**328**	**-164**	316	-120	**450**

Source: *Institute of Transportation Engineers – Trip Generation Ninth Edition.*
[a]Based on ITE trip generation rates for LUC 252 applied to 80 apartments.
[b]Based on 65% percent transit usage for residential use.
[c]Based on ITE trip generation rates for LUC 820 applied to 7,125 sf retail space.
[d]Based on 50% percent transit usage for retail use.
[e]Based on ITE trip generation rates for LUC 931 applied to 3,500 sf quality restaurant space.
[f]Based on 38% percent transit usage for restaurant use.

Comment 3: ***"Provide changes to on-street parking."***

Response: Currently, 4-5 vehicles can park on-street along Sewall Avenue between the site driveway and Longwood Avenue. With the new driveway and sight line restrictions, this parking should be removed. The proposed signage plan restricting parking is attached.

Comment 4: ***"The project proponent should meet with the Fire Department to review the plans."***

Response: The project architect will be meeting with the Fire Department.

If you should have any questions or require additional information, please feel free to contact me.

Sincerely,

VANASSE & ASSOCIATES, INC.

F. Giles Ham, P.E.
Managing Principal

FGH/mef

APPENDIX

TRIP-GENERATION
ANALYSIS WORK SHEETS
ON-STREET SIGNAGE

TRIP-GENERATION

Institute of Transportation Engineers (ITE)
Trip Generation, 10th Edition
Land Use Code (LUC) 252 - Senior Adult Housing - Attached

Average Vehicle Trips Ends vs: Dwelling Units
Independent Variable (X): 80

R^2

0.99 AVERAGE WEEKDAY DAILY
T = 4.02 * (X)-25.37
T = 4.02 * 80 -25.370
T = 296.23
T = 296 ✓ vehicle trips
with 50% (148 vph) entering and 50% (148 vph) exiting.

AVERAGE WEEKDAY DAILY
T = 3.70 * (X)
T = 3.70 * 80
T = 296.00
T = 296 vehicle trips
with 50% (148 vph) entering and 50% (148 vph) exiting.

0.98 WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC
T = 0.20 * (X) -0.18
T = 0.20 * 80 -0.18
T = 15.82
T = 16 ✓ vehicle trips
with 35% (6 vph) entering and 65% (10 vph) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC
T = 0.20 * (X)
T = 0.20 * 80
T = 16.00
T = 16 vehicle trips
with 35% (6 vph) entering and 65% (10 vph) exiting.

0.96 WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC
T = 0.24* (X)+2.26
T = 0.24 * 80 +2.26
T = 21.46
T = 21 ✓ vehicle trips
with 54% (11 vph) entering and 46% (10 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC
T = 0.26 * (X)
T = 0.26 * 80
T = 20.80
T = 21 vehicle trips
with 55% (12 vph) entering and 45% (9 vph) exiting.

0.99 SATURDAY DAILY
T = 3.97 * (X)-60.09
T = 3.97 * 80 -60.09
T = 257.51
T = 258 ✓ vehicle trips
with 50% (129 vph) entering and 50% (129 vph) exiting.

SATURDAY DAILY
T = 3.23 * (X)
T = 3.23* 80
T = 258.40
T = 258 vehicle trips
with 50% (129 vph) entering and 50% (129 vph) exiting.

0.99 SATURDAY MIDDAY PEAK HOUR OF GENERATOR
T = 035 * (X)-1.67
T = 0.35 * 80 -1.67
T = 26.33
T = 26 ✓ vehicle trips
with 62% (16 vph) entering and 38% (10 vph) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR
T = 0.33 * (X)
T = 0.33 * 80
T = 26.40
T = 26 vehicle trips
with 62% (16 vph) entering and 38% (10 vph) exiting.

Institute of Transportation Engineers (ITE)
Trip Generation, 10 th Edition
Land Use Code (LUC) 931 - Quality Restaurant

Average Vehicle Trips Ends vs: 1000 SF Gross Floor Area
Independent Variable (X): 3.5

AVERAGE WEEKDAY DAILY

T = 83.84 * (X)
T = 83.84 * 3.5
T = 293.44
T = 294 vehicle trips
with 50% (147 vpd) entering and 50% (147 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.73 * (X)
T = 0.73 * 3.5
T = 2.56
T = 3 vehicle trips
Dircetional Distribution Not Available

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 7.80 * (X)
T = 7.80 * 3.5
T = 27.30
T = 27 vehicle trips
with 67% (18 vph) entering and 33% (9 vph) exiting.

SATURDAY DAILY

T = 90.04 * (X)
T = 90.04 * 3.5
T = 315.14
T = 316 vehicle trips
with 50% (158 vpd) entering and 50% (158 vpd) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

T = 10.68 * (X)
T = 10.68 * 3.5
T = 37.38
T = 38 vehicle trips
with 59% (22 vph) entering and 41% (16 vph) exiting.

Institute of Transportation Engineers (ITE)
*Trip Generation, 10*th Edition
Land Use Code (LUC) 820 - Shopping Center

Average Vehicle Trips Ends vs: 1,000 Square Feet Gross Leasable Area
Independent Variable (X): 7.125

AVERAGE WEEKDAY DAILY

T = 37.75 * X
T = 37.75 * 7.125
T = 268.97
T = 268 vehicle trips
with 50% (134 vpd) entering and 50% (134 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.94 * (X)
T = 0.94 * 7.125
T = 6.70
T = 7 vehicle trips
with 62% (4 vph) entering and 38% (3 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 3.81 * X
T = 3.81 * 7.125
T = 27.15
T = 27 vehicle trips
with 48% (13 vph) entering and 52% (14 vph) exiting.

SATURDAY DAILY

T = 46.12 * X
T = 46.12 7.125
T = 328.61
T = 328 vehicle trips
with 50% (164 vph) entering and 50% (164 vph) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

T = 4.50 * X
T = 4.50 * 7.125
T = 32.06
T = 32 vehicle trips
with 52% (17 vph) entering and 48% (15 vph) exiting.

SUNDAY DAILY

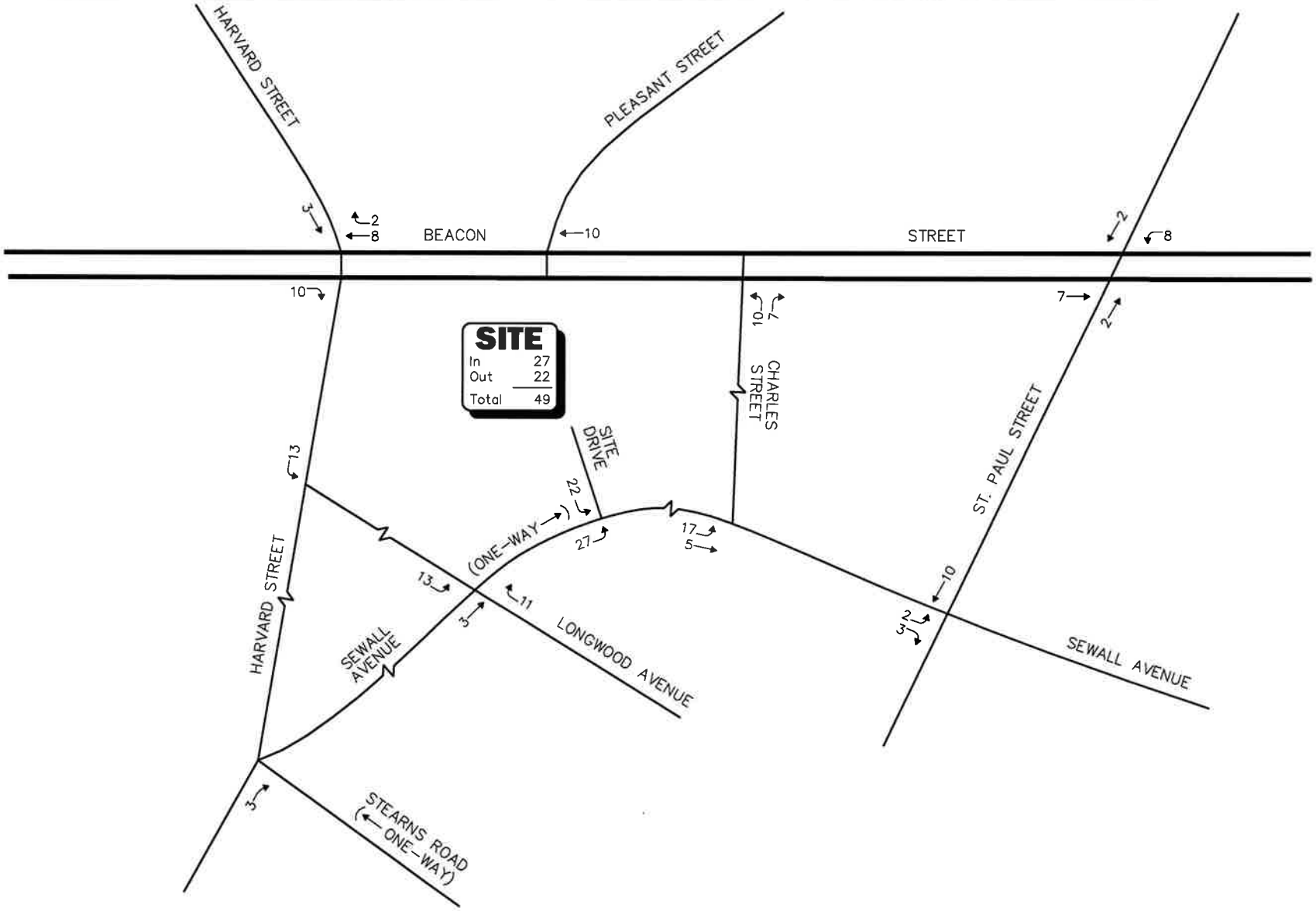
T = 21.10 * X
T = 21.10 * 7.125

T = 150.34
T = 150 vehicle trips
with 50% (75 vph) entering and 50% (75 vph) exiting.

SUNDAY MIDDAY PEAK HOUR OF GENERATOR

T = 2.79 * X
T = 2.79 * 7.125
T = 19.88
T = 20 vehicle trips
with 49% (10 vph) entering and 51% (10 vph) exiting.

ANALYSIS WORK SHEETS



Not To Scale

Figure 12

Site Generated (Updated)
Saturday Midday
Peak Hour Traffic Volumes

Vanasse & Associates, Inc.
Transportation Engineers & Planners

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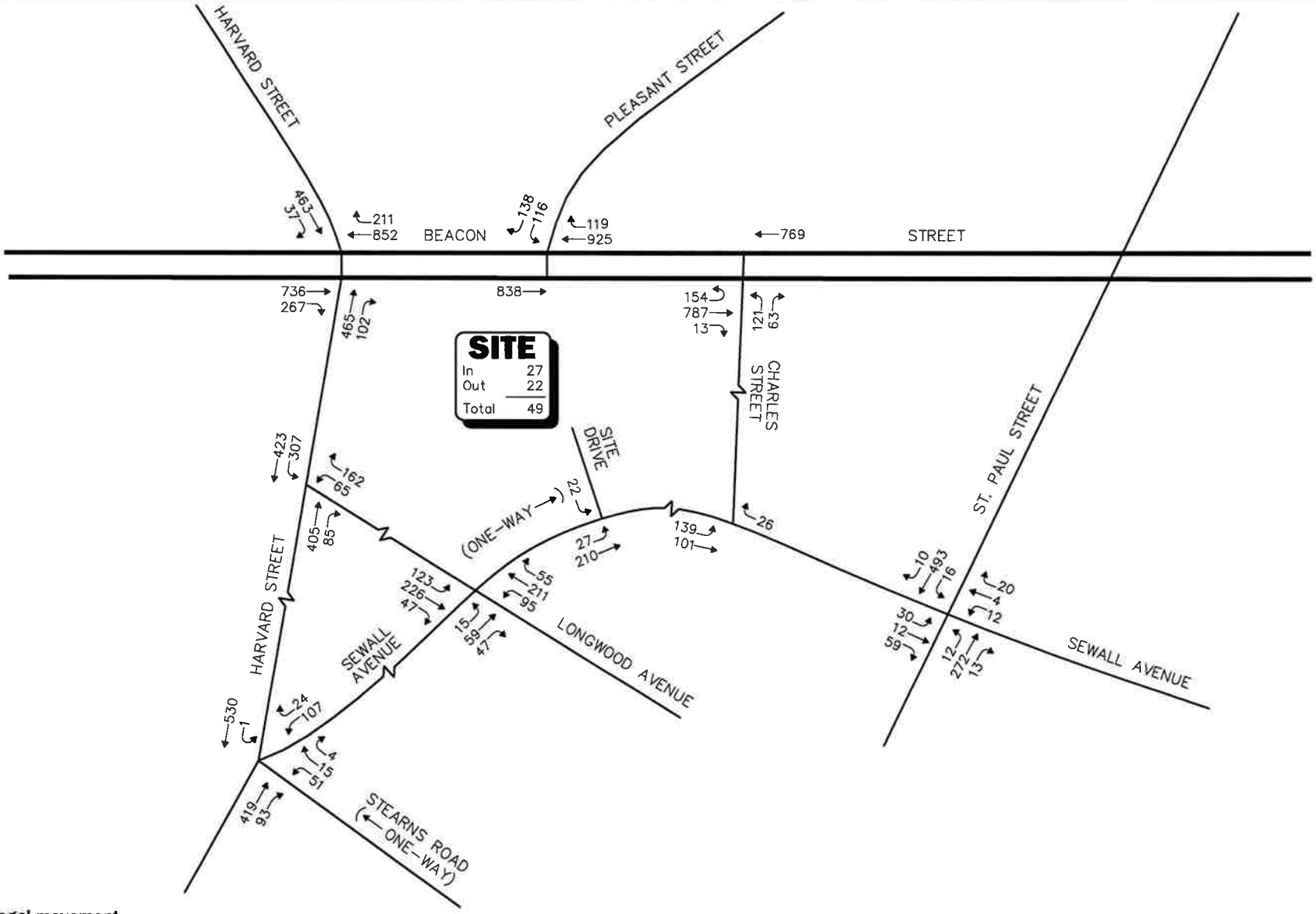

* Illegal movement.

Not To Scale

Figure 15

2025 Build (Updated)
Saturday Midday
Peak Hour Traffic Volumes

Vanasse & Associates, Inc.
Transportation Engineers & Planners

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Table 8
UNSIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND QUEUE SUMMARY

Signalized Intersection/ Peak Hour	2025 Build			
	Demand	Delay	LOS	Queue
Harvard Street at Longwood Avenue				
Saturday Midday				
Longwood Avenue WB LT/RT	227	128.9	F	10.4
Harvard Street at Stearns Road				
Saturday Midday				
Stearns Road WB LT	158	46.0	E	4.5
Sewall Avenue at Longwood Avenue				
Saturday Midday				
Sewall Avenue NB LT/TH/RT	121	15.1	C	1.1
Sewall Avenue at Site Drive				
Saturday Midday				
Site Drive SB LT	22	10.8	B	0.1
Charles Street at Sewall Avenue				
Saturday Midday				
Sewall Avenue EB LT TH	240	4.7	A	0.3
St. Paul Street at Sewall Avenue				
Saturday Midday				
Sewall Avenue EB LT/TH/RT	101	18.6	C	1.2
Sewall Avenue WB LT/TH/RT	36	16.0	C	0.4

[a]Volume-to-capacity ratio.
[b]Control (signal) delay per vehicle in seconds.
[c]Level-of-Service.
[d]Queue length in Vehicle.
[e]Includes signal timing modifications under 2024 conditions.
NB = northbound; SB = southbound; EB = eastbound; WB = westbound;
LT = left-turning movements; TH = through movements; RT = right-turning movements.

Table 7
SIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND QUEUE SUMMARY

Signalized Intersection/ Peak Hour	2025 Build			
	V/C	Delay	LOS	Queue
Beacon Street at Harvard Street				
Saturday Midday				
Beacon Street EB TH	0.43	13.5	B	119/191
Beacon Street EB RT	0.47	16.7	B	85/178
Beacon Street WB TH	0.52	9.7	A	73/113
Beacon Street WB RT	0.45	11.0	B	35/68
Harvard Street NB TH/RT	0.73	34.4	C	163/202
Harvard Street SB TH/RT	0.62	31.0	C	145/180
Overall	**0.73**	**19.2**	**B**	--
Beacon Street at Pleasant Street				
Saturday Midday				
Beacon Street EB TH	0.43	4.4	A	36/42
Beacon Street WB TH/RT	0.48	10.0	A	136/232
Pleasant Street SB LT	0.42	34.3	C	63/104
Pleasant Street SB RT	0.71	51.4	D	80/132
Overall	**0.71**	**12.1**	**B**	--
Beacon Street at Charles Street				
Saturday Midday				
Beacon Street EB LT	0.78	71.9	E	88/188
Beacon Street EB TH/RT	0.30	2.4	A	36/42
Beacon Street WB TH	0.37	8.9	A	111/146
Charles Street NB LT/RT	0.58	20.7	C	26/90
Overall	**0.78**	**12.4**	**B**	--

[a]Volume-to-capacity ratio.
[b]Control (signal) delay per vehicle in seconds.
[c]Level-of-Service.
[d]Queue length in feet.
[e]Includes signal timing modifications under 2024 conditions.
NB = northbound; SB = southbound; EB = eastbound; WB = westbound;
LT = left-turning movements; TH = through movements; RT = right-turning movements.

CAPACITY ANALYSIS

Beacon Street at Harvard Street
Beacon Street at Pleasant Street
Beacon Street at Charles Street
Harvard Street at Longwood Avenue
Harvard Street at Stearns Road
Longwood Avenue at Sewall Avenue
Sewall Avenue at Site Drive
Sewall Avenue at Charles Street
Sewall Avenue at St. Paul Street

Beacon Street at Harvard Street

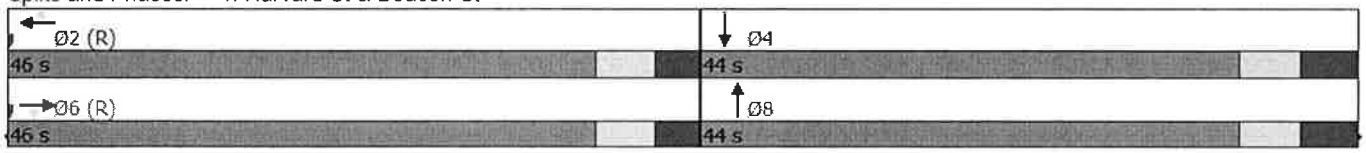
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	736	267	0	852	211	0	465	102	0	463	37
Future Volume (vph)	0	736	267	0	852	211	0	465	102	0	463	37
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		100	0		80	0		0	0		0
Storage Lanes	0		1	0		1	0		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Ped Bike Factor			0.74			0.64		0.92			0.97	
Frt			0.850			0.850		0.973			0.989	
Flt Protected												
Satd. Flow (prot)	0	3249	1439	0	3249	1454	0	2826	0	0	3037	0
Flt Permitted												
Satd. Flow (perm)	0	3249	1066	0	3249	936	0	2826	0	0	3037	0
Right Turn on Red			No			No			No			No
Satd. Flow (RTOR)												
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		514			279			308			204	
Travel Time (s)		11.7			6.3			7.0			4.6	
Confl. Peds. (#/hr)			357			450			741			467
Confl. Bikes (#/hr)			17			134			87			48
Peak Hour Factor	0.97	0.97	0.97	0.93	0.93	0.93	0.96	0.96	0.96	0.92	0.92	0.92
Heavy Vehicles (%)	0%	0%	1%	0%	0%	0%	0%	1%	0%	0%	1%	0%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	10	10	0	10	10
Adj. Flow (vph)	0	759	275	0	916	227	0	484	106	0	503	40
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	759	275	0	916	227	0	590	0	0	543	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		40			40			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.17	1.14	1.14	1.17	1.14
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors		2	1		2	1		2			2	
Detector Template		Thru	Right		Thru	Right		Thru			Thru	
Leading Detector (ft)		100	20		100	20		100			100	
Trailing Detector (ft)		0	0		0	0		0			0	
Detector 1 Position(ft)		0	0		0	0		0			0	
Detector 1 Size(ft)		6	20		6	20		6			6	
Detector 1 Type		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex			Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)		0.0	0.0		0.0	0.0		0.0			0.0	
Detector 1 Queue (s)		0.0	0.0		0.0	0.0		0.0			0.0	
Detector 1 Delay (s)		0.0	0.0		0.0	0.0		0.0			0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type		NA	Perm		NA	Perm		NA			NA	
Protected Phases		6			2			8			4	
Permitted Phases			6			2						
Detector Phase		6	6		2	2		8			4	
Switch Phase												
Minimum Initial (s)		10.0	10.0		10.0	10.0		10.0			10.0	
Minimum Split (s)		38.0	38.0		38.0	38.0		29.0			32.0	
Total Split (s)		46.0	46.0		46.0	46.0		44.0			44.0	
Total Split (%)		51.1%	51.1%		51.1%	51.1%		48.9%			48.9%	
Maximum Green (s)		39.0	39.0		39.0	39.0		36.0			36.0	
Yellow Time (s)		4.0	4.0		4.0	4.0		4.0			4.0	
All-Red Time (s)		3.0	3.0		3.0	3.0		4.0			4.0	
Lost Time Adjust (s)		0.0	0.0		0.0	0.0		0.0			0.0	
Total Lost Time (s)		7.0	7.0		7.0	7.0		8.0			8.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)		3.0	3.0		3.0	3.0		2.0			2.0	
Recall Mode		C-Min	C-Min		C-Min	C-Min		None			None	
Walk Time (s)					21.0	21.0		18.0			21.0	
Flash Dont Walk (s)					10.0	10.0		3.0			3.0	
Pedestrian Calls (#/hr)					450	450		500			500	
Act Effct Green (s)		49.1	49.1		49.1	49.1		25.9			25.9	
Actuated g/C Ratio		0.55	0.55		0.55	0.55		0.29			0.29	
v/c Ratio		0.43	0.47		0.52	0.45		0.73			0.62	
Control Delay		13.5	16.7		9.5	10.6		34.4			31.0	
Queue Delay		0.0	0.0		0.2	0.4		0.0			0.0	
Total Delay		13.5	16.7		9.7	11.0		34.4			31.0	
LOS		B	B		A	B		C			C	
Approach Delay		14.3			10.0			34.4			31.0	
Approach LOS		B			A			C			C	

Intersection Summary

Area Type: CBD
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 14 (16%), Referenced to phase 2:WBT and 6:EBT, Start of Green
Natural Cycle: 70
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.73
Intersection Signal Delay: 19.2 — Intersection LOS: B
Intersection Capacity Utilization 59.9% — ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 1: Harvard St & Beacon St



1: Harvard St & Beacon St

Lane Group	EBT	EBR	WBT	WBR	NBT	SBT
Lane Group Flow (vph)	759	275	916	227	590	543
v/c Ratio	0.43	0.47	0.52	0.45	0.73	0.62
Control Delay	13.5	16.7	9.5	10.6	34.4	31.0
Queue Delay	0.0	0.0	0.2	0.4	0.0	0.0
Total Delay	13.5	16.7	9.7	11.0	34.4	31.0
Queue Length 50th (ft)	119	85	73	35	163	145
Queue Length 95th (ft)	191	178	113	68	202	180
Internal Link Dist (ft)	434		199		228	124
Turn Bay Length (ft)		100		80		
Base Capacity (vph)	1773	581	1773	510	1130	1214
Starvation Cap Reductn	0	0	273	68	0	0
Spillback Cap Reductn	57	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.44	0.47	0.61	0.51	0.52	0.45

Intersection Summary

Beacon Street at Pleasant Street

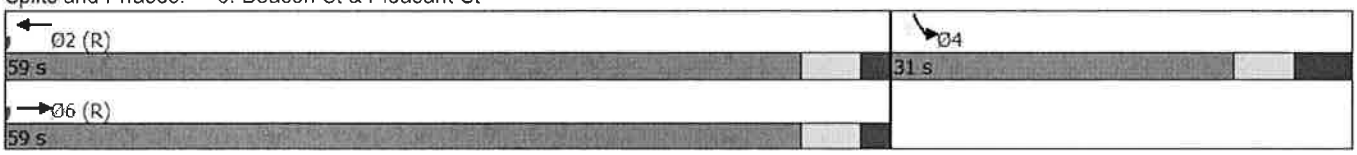
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↰	↱
Traffic Volume (vph)	0	838	920	0	116	138
Future Volume (vph)	0	838	920	0	116	138
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	10	10
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	1.00
Ped Bike Factor					0.99	0.78
Frt						0.850
Flt Protected					0.950	
Satd. Flow (prot)	0	3046	3249	0	1516	1357
Flt Permitted					0.950	
Satd. Flow (perm)	0	3046	3249	0	1506	1063
Right Turn on Red				No		No
Satd. Flow (RTOR)						
Link Speed (mph)		30	30		30	
Link Distance (ft)		279	213		160	
Travel Time (s)		6.3	4.8		3.6	
Confl. Peds. (#/hr)					6	168
Confl. Bikes (#/hr)						19
Peak Hour Factor	0.98	0.98	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%
Parking (#/hr)		5				
Adj. Flow (vph)	0	855	1000	0	126	150
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	855	1000	0	126	150
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		40	40		10	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.14	1.24	1.14	1.14	1.25	1.25
Turning Speed (mph)	15			9	15	9
Number of Detectors		2	2		1	1
Detector Template		Thru	Thru		Left	Right
Leading Detector (ft)		100	100		20	20
Trailing Detector (ft)		0	0		0	0
Detector 1 Position(ft)		0	0		0	0
Detector 1 Size(ft)		6	6		20	20
Detector 1 Type		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)		0.0	0.0		0.0	0.0
Detector 1 Queue (s)		0.0	0.0		0.0	0.0
Detector 1 Delay (s)		0.0	0.0		0.0	0.0
Detector 2 Position(ft)		94	94			
Detector 2 Size(ft)		6	6			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Turn Type		NA	NA		Prot	Perm
Protected Phases		6	2		4	
Permitted Phases						4
Detector Phase		6	2		4	4
Switch Phase						
Minimum Initial (s)		10.0	10.0		6.0	6.0
Minimum Split (s)		24.0	24.0		26.0	26.0
Total Split (s)		59.0	59.0		31.0	31.0
Total Split (%)		65.6%	65.6%		34.4%	34.4%
Maximum Green (s)		53.0	53.0		23.0	23.0
Yellow Time (s)		4.0	4.0		4.0	4.0
All-Red Time (s)		2.0	2.0		4.0	4.0
Lost Time Adjust (s)		0.0	0.0		0.0	0.0
Total Lost Time (s)		6.0	6.0		8.0	8.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Recall Mode		C-Min	C-Min		Min	Min
Walk Time (s)		7.0	7.0			
Flash Dont Walk (s)		10.0	11.0			
Pedestrian Calls (#/hr)		168	192			
Act Effct Green (s)		58.2	58.2		17.8	17.8
Actuated g/C Ratio		0.65	0.65		0.20	0.20
v/c Ratio		0.43	0.48		0.42	0.71
Control Delay		4.4	10.0		34.3	51.4
Queue Delay		0.1	0.0		0.0	0.0
Total Delay		4.4	10.0		34.3	51.4
LOS		A	A		C	D
Approach Delay		4.4	10.0		43.6	
Approach LOS		A	A		D	

Intersection Summary

Area Type: CBD
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 25 (28%), Referenced to phase 2:WBT and 6:EBT, Start of Green
Natural Cycle: 50
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.71
Intersection Signal Delay: 12.1 Intersection LOS: B
Intersection Capacity Utilization 56.8% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 6: Beacon St & Pleasant St



Lane Group	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	855	1000	126	150
v/c Ratio	0.43	0.48	0.42	0.71
Control Delay	4.4	10.0	34.3	51.4
Queue Delay	0.1	0.0	0.0	0.0
Total Delay	4.4	10.0	34.3	51.4
Queue Length 50th (ft)	36	136	63	80
Queue Length 95th (ft)	42	232	104	132
Internal Link Dist (ft)	199	133	80	
Turn Bay Length (ft)				
Base Capacity (vph)	1987	2120	396	277
Starvation Cap Reductn	199	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.48	0.47	0.32	0.54

Intersection Summary

Beacon Street at Charles Street

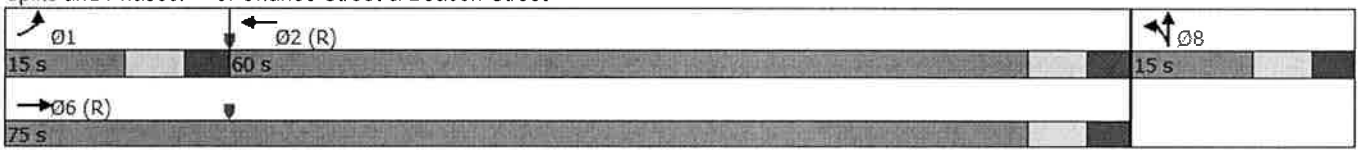
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	154	787	13	0	769	0	121	0	63	0	0	0
Future Volume (vph)	154	787	13	0	769	0	121	0	63	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	11	12	12	12	12	12	14	12	12	12	12
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.998						0.954				
Flt Protected	0.950							0.968				
Satd. Flow (prot)	1685	3483	0	0	3610	0	0	1872	0	0	0	0
Flt Permitted	0.950							0.968				
Satd. Flow (perm)	1685	3483	0	0	3610	0	0	1872	0	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		6						133				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		295			905			220			87	
Travel Time (s)		6.7			20.6			5.0			2.0	
Peak Hour Factor	0.97	0.97	0.97	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	159	811	13	0	836	0	132	0	68	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	159	824	0	0	836	0	0	200	0	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		10			10			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.09	1.04	1.00	1.00	1.00	1.00	1.00	0.92	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2			2		1	2				
Detector Template	Left	Thru			Thru		Left	Thru				
Leading Detector (ft)	20	100			100		20	100				
Trailing Detector (ft)	0	0			0		0	0				
Detector 1 Position(ft)	0	0			0		0	0				
Detector 1 Size(ft)	20	6			6		20	6				
Detector 1 Type	Cl+Ex	Cl+Ex			Cl+Ex		Cl+Ex	Cl+Ex				
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0			0.0		0.0	0.0				
Detector 1 Queue (s)	0.0	0.0			0.0		0.0	0.0				
Detector 1 Delay (s)	0.0	0.0			0.0		0.0	0.0				
Detector 2 Position(ft)		94			94			94				
Detector 2 Size(ft)		6			6			6				
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex				
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0				
Turn Type	Prot	NA			NA		Split	NA				
Protected Phases	1	6			2		8	8				
Permitted Phases												
Detector Phase	1	6			2		8	8				

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Switch Phase												
Minimum Initial (s)	6.0	10.0			10.0		6.0	6.0				
Minimum Split (s)	25.0	63.0			63.0		53.0	53.0				
Total Split (s)	15.0	75.0			60.0		15.0	15.0				
Total Split (%)	16.7%	83.3%			66.7%		16.7%	16.7%				
Maximum Green (s)	8.0	68.0			53.0		8.0	8.0				
Yellow Time (s)	4.0	4.0			4.0		4.0	4.0				
All-Red Time (s)	3.0	3.0			3.0		3.0	3.0				
Lost Time Adjust (s)	-3.0	-3.0			-3.0			-3.0				
Total Lost Time (s)	4.0	4.0			4.0			4.0				
Lead/Lag	Lead				Lag							
Lead-Lag Optimize?	Yes				Yes							
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0				
Recall Mode	None	C-Max			C-Max		Max	Max				
Walk Time (s)	7.0	45.0			45.0		7.0	7.0				
Flash Dont Walk (s)	8.0	8.0			8.0		5.0	5.0				
Pedestrian Calls (#/hr)	40	40			40		40	40				
Act Effct Green (s)	11.0	71.0			56.0			11.0				
Actuated g/C Ratio	0.12	0.79			0.62			0.12				
v/c Ratio	0.78	0.30			0.37			0.58				
Control Delay	71.9	2.3			8.9			20.7				
Queue Delay	0.0	0.2			0.0			0.0				
Total Delay	71.9	2.4			8.9			20.7				
LOS	E	A			A			C				
Approach Delay		13.7			8.9			20.7				
Approach LOS		B			A			C				

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 10 (11%), Referenced to phase 2:WBT and 6:EBT, Start of Green
Natural Cycle: 145
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.78
Intersection Signal Delay: 12.4 — Intersection LOS: B
Intersection Capacity Utilization 50.3% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 8: Charles Street & Beacon Street



Lane Group	EBL	EBT	WBT	NBT
Lane Group Flow (vph)	159	824	836	200
v/c Ratio	0.78	0.30	0.37	0.58
Control Delay	71.9	2.3	8.9	20.7
Queue Delay	0.0	0.2	0.0	0.0
Total Delay	71.9	2.4	8.9	20.7
Queue Length 50th (ft)	88	36	111	26
Queue Length 95th (ft)	#188	42	146	90
Internal Link Dist (ft)		215	825	140
Turn Bay Length (ft)				
Base Capacity (vph)	205	2748	2246	345
Starvation Cap Reductn	0	946	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.78	0.46	0.37	0.58

Intersection Summary

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

Harvard Street at Longwood Avenue

Intersection	
Int Delay, s/veh	21.8

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	65	162	405	85	307	423
Future Vol, veh/h	65	162	405	85	307	423
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	0	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	97	97	93	93	95	95
Heavy Vehicles, %	0	1	1	0	0	2
Mvmt Flow	67	167	435	91	323	445

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1572	481	0	0	526	0
Stage 1	481	-	-	-	-	-
Stage 2	1091	-	-	-	-	-
Critical Hdwy	6.4	6.21	-	-	4.1	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.309	-	-	2.2	-
Pot Cap-1 Maneuver	123	587	-	-	1051	-
Stage 1	626	-	-	-	-	-
Stage 2	325	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	85	587	-	-	1051	-
Mov Cap-2 Maneuver	85	-	-	-	-	-
Stage 1	434	-	-	-	-	-
Stage 2	325	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	128.9	0	4.2
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	218	1051	-
HCM Lane V/C Ratio	-	-	1.073	0.307	-
HCM Control Delay (s)	-	-	128.9	9.9	-
HCM Lane LOS	-	-	F	A	-
HCM 95th %tile Q(veh)	-	-	10.4	1.3	-

Harvard Street at Stearns Road

Intersection	
Int Delay, s/veh	6.3

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	158	39	419	93	1	530
Future Vol, veh/h	158	39	419	93	1	530
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	96	96
Heavy Vehicles, %	0	0	3	0	0	1
Mvmt Flow	172	42	455	101	1	552

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1060	506	0	0	556	0
Stage 1	506	-	-	-	-	-
Stage 2	554	-	-	-	-	-
Critical Hdwy	6.4	6.2	-	-	4.1	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-	2.2	-
Pot Cap-1 Maneuver	250	570	-	-	1025	-
Stage 1	610	-	-	-	-	-
Stage 2	580	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	250	570	-	-	1025	-
Mov Cap-2 Maneuver	250	-	-	-	-	-
Stage 1	609	-	-	-	-	-
Stage 2	580	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	39.2	0	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	250	570	1025	-
HCM Lane V/C Ratio	-	-	0.687	0.074	0.001	-
HCM Control Delay (s)	-	-	46	11.8	8.5	0
HCM Lane LOS	-	-	E	B	A	A
HCM 95th %tile Q(veh)	-	-	4.5	0.2	0	-

Longwood Avenue at Sewall Avenue

Intersection	
Int Delay, s/veh	4.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Vol, veh/h	123	226	47	95	211	55	15	59	47	0	0	0
Future Vol, veh/h	123	226	47	95	211	55	15	59	47	0	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	0	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	-	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	94	94	94	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	0	1	0	0	1	0	0	0	0	0	0	0
Mvmt Flow	131	240	50	103	229	60	16	64	51	0	0	0

Major/Minor	Major1			Major2			Minor1		
Conflicting Flow All	289	0	0	290	0	0	992	1022	265
Stage 1	-	-	-	-	-	-	527	527	-
Stage 2	-	-	-	-	-	-	465	495	-
Critical Hdwy	4.1	-	-	4.1	-	-	6.4	6.5	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	5.4	5.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	5.4	5.5	-
Follow-up Hdwy	2.2	-	-	2.2	-	-	3.5	4	3.3
Pot Cap-1 Maneuver	1284	-	-	1283	-	-	275	238	779
Stage 1	-	-	-	-	-	-	596	532	-
Stage 2	-	-	-	-	-	-	636	549	-
Platoon blocked, %		-	-		-	-			
Mov Cap-1 Maneuver	1284	-	-	1283	-	-	223	0	779
Mov Cap-2 Maneuver	-	-	-	-	-	-	223	0	-
Stage 1	-	-	-	-	-	-	484	0	-
Stage 2	-	-	-	-	-	-	636	0	-

Approach	EB	WB	NE
HCM Control Delay, s	2.5	2.1	15.1
HCM LOS			C

Minor Lane/Major Mvmt	NELn1	EBL	EBT	EBR	WBL	WBT	WBR
Capacity (veh/h)	486	1284	-	-	1283	-	-
HCM Lane V/C Ratio	0.271	0.102	-	-	0.08	-	-
HCM Control Delay (s)	15.1	8.1	-	-	8.1	0	-
HCM Lane LOS	C	A	-	-	A	A	-
HCM 95th %tile Q(veh)	1.1	0.3	-	-	0.3	-	-

Sewall Avenue at Site Drive

Movement	WBL	WBR	SEL	SER	NEL	NER
Lane Configurations						
Traffic Volume (veh/h)	0	0	22	0	27	210
Future Volume (Veh/h)	0	0	22	0	27	210
Sign Control	Stop		Stop		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	24	0	29	228
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	184	172	286	0	0	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	184	172	286	0	0	
tC, single (s)	7.1	6.5	*6.0	6.2	4.1	
tC, 2 stage (s)						
tF (s)	3.5	4.0	4.0	3.3	2.2	
p0 queue free %	100	100	96	100	98	
cM capacity (veh/h)	749	712	641	1091	1636	

Direction, Lane #	SE 1	NE 1
Volume Total	24	257
Volume Left	0	29
Volume Right	0	228
cSH	641	1636
Volume to Capacity	0.04	0.02
Queue Length 95th (ft)	3	1
Control Delay (s)	10.8	0.9
Lane LOS	B	A
Approach Delay (s)	10.8	0.9
Approach LOS	B	

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	24.5%	ICU Level of Service	A
Analysis Period (min)	15		

* User Entered Value

Sewall Avenue at Charles Street

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	139	101	0	26	0	0
Future Volume (Veh/h)	139	101	0	26	0	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.90	0.90	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	154	112	0	28	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	28				420	0
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	28				420	0
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	90				100	100
cM capacity (veh/h)	1599				537	1091

Direction, Lane #	EB 1	WB 1
Volume Total	266	28
Volume Left	154	0
Volume Right	0	28
cSH	1599	1700
Volume to Capacity	0.10	0.02
Queue Length 95th (ft)	8	0
Control Delay (s)	4.7	0.0
Lane LOS	A	
Approach Delay (s)	4.7	0.0
Approach LOS		

Intersection Summary			
Average Delay	4.2		
Intersection Capacity Utilization	23.0%	ICU Level of Service	A
Analysis Period (min)	15		

Sewall Avenue at St. Paul Street

Intersection	
Int Delay, s/veh	2.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Vol, veh/h	30	12	59	12	4	20	12	272	13	16	493	10
Future Vol, veh/h	30	12	59	12	4	20	12	272	13	16	493	10
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	96	96	96
Heavy Vehicles, %	0	0	0	0	0	0	0	0	0	0	0	0
Mvmt Flow	33	13	64	13	4	22	13	296	14	17	514	10

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	895	889	519	921	887	303	524	0	0	310	0	0
Stage 1	553	553	-	329	329	-	-	-	-	-	-	-
Stage 2	342	336	-	592	558	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.1	6.5	6.2	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	264	285	561	253	285	741	1053	-	-	1262	-	-
Stage 1	521	518	-	688	650	-	-	-	-	-	-	-
Stage 2	677	645	-	496	515	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	247	275	561	210	275	741	1053	-	-	1262	-	-
Mov Cap-2 Maneuver	247	275	-	210	275	-	-	-	-	-	-	-
Stage 1	513	508	-	678	640	-	-	-	-	-	-	-
Stage 2	643	635	-	420	505	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	18.6	16	0.3	0.2
HCM LOS	C	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1053	-	-	374	365	1262	-	-
HCM Lane V/C Ratio	0.012	-	-	0.294	0.107	0.013	-	-
HCM Control Delay (s)	8.5	0	-	18.6	16	7.9	0	-
HCM Lane LOS	A	A	-	C	C	A	A	-
HCM 95th %tile Q(veh)	0	-	-	1.2	0.4	0	-	-

ON-STREET SIGNAGE

Vanasse & Associates, Inc.
Transportation Engineers & Planners

Signage Plan

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