

APPENDIX A
Study Advisory Members

Study Advisory Members

Subregional Priority Roadway Study: Route 9 in Brookline

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*Served from November 2018 to February 2019.

APPENDIX B

**Intersection Capacity Analyses
Weekday AM Peak Hour
2019 Existing Conditions**

Intersection Capacity Analysis
Cypress St & Route 9

07/16/2019



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	267	868	145	42	753	64	99	363	25	31	180	268
Future Volume (vph)	267	868	145	42	753	64	99	363	25	31	180	268
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	12	11	11	12	11	11	11	11	11	10	11
Storage Length (ft)	200		0	150		0	0		0	0		0
Storage Lanes	1		0	1		0	1		0	0		1
Taper Length (ft)	100			100			0			0		
Satd. Flow (prot)	1678	3373	0	1745	3323	0	1662	1743	0	0	1677	1516
Flt Permitted	0.950			0.950			0.390				0.260	
Satd. Flow (perm)	1660	3373	0	1745	3323	0	605	1743	0	0	440	1516
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		16			8			4				323
Link Speed (mph)		30			30			30				30
Link Distance (ft)		614			1044			573				420
Travel Time (s)		14.0			23.7			13.0				9.5
Confl. Peds. (#/hr)	16					16	155		15	15		155
Peak Hour Factor	0.87	0.90	0.74	0.75	0.87	0.67	0.73	0.95	0.57	0.55	0.92	0.83
Heavy Vehicles (%)	4%	4%	6%	0%	7%	2%	5%	2%	16%	10%	3%	3%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	307	1160	0	56	962	0	136	426	0	0	252	323
Turn Type	Prot	NA		Prot	NA		Perm	NA		Perm	NA	pt+ov
Protected Phases	5	2		1	6			8			4	4 5
Permitted Phases							8			4		
Detector Phase	5	2		1	6		8	8		4	4	4 5
Switch Phase												
Minimum Initial (s)	5.0	10.0		6.0	10.0		6.0	6.0		6.0	6.0	
Minimum Split (s)	10.0	16.0		11.0	16.0		11.0	11.0		11.0	11.0	
Total Split (s)	35.0	51.0		35.0	51.0		40.0	40.0		40.0	40.0	
Total Split (%)	23.0%	33.6%		23.0%	33.6%		26.3%	26.3%		26.3%	26.3%	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	1.0	2.0		1.0	2.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0			0.0	
Total Lost Time (s)	5.0	6.0		5.0	6.0		5.0	5.0			5.0	
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Recall Mode	None	Min		None	Min		None	None		None	None	
Act Effect Green (s)	28.4	65.1		9.3	43.1		35.6	35.6			35.6	69.1
Actuated g/C Ratio	0.20	0.46		0.07	0.30		0.25	0.25			0.25	0.49
v/c Ratio	0.91	0.74		0.49	0.95		0.89	0.97			2.29	0.36
Control Delay	88.1	37.1		81.7	66.4		103.8	88.2			631.4	3.4
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0			0.0	0.0
Total Delay	88.1	37.1		81.7	66.4		103.8	88.2			631.4	3.4
LOS	F	D		F	E		F	F			F	A
Approach Delay		47.8			67.2			92.0			278.6	
Approach LOS		D			E			F			F	
Queue Length 50th (ft)	298	497		54	485		133	~446			~407	0
Queue Length 95th (ft)	#451	620		83	#587		#198	#666			#590	35
Internal Link Dist (ft)		534			964			493			340	

Intersection Capacity Analysis

Cypress St & Route 9

07/16/2019

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Heavy Vehicles (%)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	20.0
Minimum Split (s)	26.0
Total Split (s)	26.0
Total Split (%)	17%
Yellow Time (s)	2.0
All-Red Time (s)	2.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Recall Mode	None
Act Effect Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	

Intersection Capacity Analysis Cypress St & Route 9

07/16/2019



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Bay Length (ft)	200			150								
Base Capacity (vph)	362	1559		377	1081		152	441			110	923
Starvation Cap Reductn	0	0		0	0		0	0			0	0
Spillback Cap Reductn	0	0		0	0		0	0			0	0
Storage Cap Reductn	0	0		0	0		0	0			0	0
Reduced v/c Ratio	0.85	0.74		0.15	0.89		0.89	0.97			2.29	0.35

Intersection Summary

Area Type:	Other
Cycle Length:	152
Actuated Cycle Length:	141.5
Natural Cycle:	150
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	2.29
Intersection Signal Delay:	96.8
Intersection LOS:	F
Intersection Capacity Utilization	87.2%
ICU Level of Service	E
Analysis Period (min)	15
Description:	155 / 99 / 53
~ 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.	

Splits and Phases: 2: Cypress St & Route 9

Ø1 35 s	Ø2 51 s	Ø9 26 s	Ø4 40 s
Ø5 35 s	Ø6 51 s		Ø8 40 s

Intersection Capacity Analysis
Warren St/Sumner Rd & Route 9

07/16/2019



Lane Group	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations												
Traffic Volume (vph)	6	247	1199	4	19	17	1006	16	55	355	19	31
Future Volume (vph)	6	247	1199	4	19	17	1006	16	55	355	19	31
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	11	11	11	12	11	11	11	11	11
Storage Length (ft)		150		150		150		0	0		0	0
Storage Lanes		1		1		1		0	0		0	0
Taper Length (ft)		100				100			0			0
Right Turn on Red				Yes				Yes			Yes	
Link Speed (mph)			30				30			30		
Link Distance (ft)			635				1295			738		
Travel Time (s)			14.4				29.4			16.8		
Confl. Peds. (#/hr)	16	9		2	10	2		9	16		10	10
Peak Hour Factor	0.38	0.91	0.89	0.50	0.53	0.61	0.87	0.57	0.76	0.85	0.68	0.70
Heavy Vehicles (%)	0%	4%	5%	25%	0%	0%	6%	6%	2%	0%	5%	13%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	287	1347	8	0	64	1184	0	0	518	0	0
Turn Type	Prot	Prot	NA	Perm	Prot	Prot	NA		Perm	NA		Perm
Protected Phases	5	5	2		1	1	6			8		
Permitted Phases				2					8			4
Detector Phase	5	5	2	2	1	1	6		8	8		4
Switch Phase												
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0	6.0	40.0		6.0	6.0		6.0
Minimum Split (s)	11.0	11.0	46.0	46.0	11.0	11.0	46.0		23.0	23.0		23.0
Total Split (s)	25.0	25.0	71.0	71.0	20.0	20.0	66.0		35.0	35.0		35.0
Total Split (%)	15.5%	15.5%	44.1%	44.1%	12.4%	12.4%	41.0%		21.7%	21.7%		21.7%
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	2.0	2.0	1.0	1.0	2.0		1.0	1.0		1.0
Lost Time Adjust (s)		0.0	0.0	0.0			0.0	0.0		0.0		
Total Lost Time (s)		5.0	6.0	6.0			5.0	6.0		5.0		
Lead/Lag	Lead	Lead	Lag	Lag	Lead	Lead	Lag					
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes					
Recall Mode	None	None	Min	Min	None	None	Min		None	None		None
Act Effect Green (s)		20.7	63.8	63.8		10.4	50.7			31.1		
Actuated g/C Ratio		0.16	0.49	0.49		0.08	0.39			0.24		
v/c Ratio		1.07	0.80	0.01		0.46	0.90			1.63		
Control Delay		128.1	36.2	0.0		73.6	48.8			330.9		
Queue Delay		0.0	0.0	0.0		0.0	0.0			0.0		
Total Delay		128.1	36.2	0.0		73.6	48.8			330.9		
LOS		F	D	A		E	D			F		
Approach Delay			52.1				50.1			330.9		
Approach LOS			D				D			F		
Queue Length 50th (ft)		213	404	0		45	398			-530		
Queue Length 95th (ft)		#595	#870	0		78	698			#1025		
Internal Link Dist (ft)			555				1215			658		
Turn Bay Length (ft)		150		150		150						
Base Capacity (vph)		267	1784	666		207	1617			317		
Starvation Cap Reductn		0	0	0		0	0			0		
Spillback Cap Reductn		0	0	0		0	0			0		

Intersection Capacity Analysis

Warren St/Sumner Rd & Route 9

07/16/2019

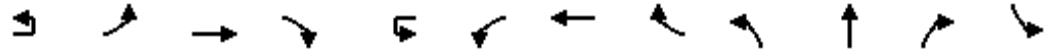


Lane Group	SBT	SBR	Ø9
Lane Configurations	↕	↗	
Traffic Volume (vph)	98	196	
Future Volume (vph)	98	196	
Ideal Flow (vphpl)	1900	1900	
Lane Width (ft)	11	11	
Storage Length (ft)		150	
Storage Lanes		1	
Taper Length (ft)			
Right Turn on Red		Yes	
Link Speed (mph)	30		
Link Distance (ft)	625		
Travel Time (s)	14.2		
Confl. Peds. (#/hr)		16	
Peak Hour Factor	0.64	0.91	
Heavy Vehicles (%)	4%	2%	
Shared Lane Traffic (%)			
Lane Group Flow (vph)	197	215	
Turn Type	NA	Perm	
Protected Phases	4		9
Permitted Phases		4	
Detector Phase	4	4	
Switch Phase			
Minimum Initial (s)	6.0	6.0	6.0
Minimum Split (s)	23.0	23.0	35.0
Total Split (s)	35.0	35.0	35.0
Total Split (%)	21.7%	21.7%	22%
Yellow Time (s)	4.0	4.0	2.0
All-Red Time (s)	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	
Total Lost Time (s)	5.0	5.0	
Lead/Lag			
Lead-Lag Optimize?			
Recall Mode	None	None	None
Act Effct Green (s)	31.1	31.1	
Actuated g/C Ratio	0.24	0.24	
v/c Ratio	0.86	0.42	
Control Delay	83.7	10.0	
Queue Delay	0.0	0.0	
Total Delay	83.7	10.0	
LOS	F	B	
Approach Delay	45.2		
Approach LOS	D		
Queue Length 50th (ft)	135	3	
Queue Length 95th (ft)	#233	82	
Internal Link Dist (ft)	545		
Turn Bay Length (ft)		150	
Base Capacity (vph)	228	511	
Starvation Cap Reductn	0	0	
Spillback Cap Reductn	0	0	

Intersection Capacity Analysis

Warren St/Sumner Rd & Route 9

07/16/2019

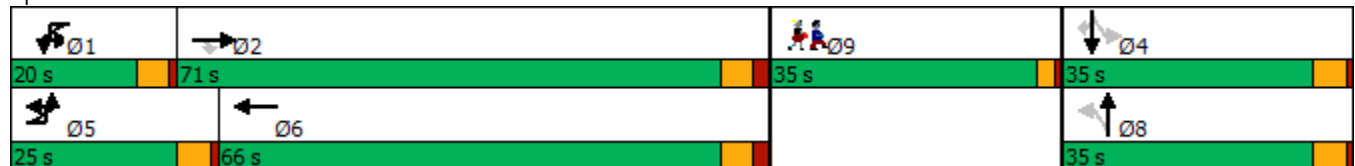


Lane Group	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Storage Cap Reductn		0	0	0		0	0			0		
Reduced v/c Ratio		1.07	0.76	0.01		0.31	0.73			1.63		

Intersection Summary

Area Type:	Other
Cycle Length:	161
Actuated Cycle Length:	130.4
Natural Cycle:	145
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	1.63
Intersection Signal Delay:	88.5
Intersection LOS:	F
Intersection Capacity Utilization	101.5%
ICU Level of Service	G
Analysis Period (min)	15
Description:	16 / 7 / 16
~ 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.	

Splits and Phases: 4: Warren St/Sumner Rd & Route 9



Intersection Capacity Analysis
Lee St & Route 9

07/16/2019



Lane Group	EBT	EBR	WBU	WBL	WBT	NBL	NBR	Ø1	Ø2
Lane Configurations	↑↑	↑		↓	↑↑	↓			
Traffic Volume (vph)	1228	404	2	126	1065	892	249		
Future Volume (vph)	1228	404	2	126	1065	892	249		
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900		
Lane Width (ft)	12	11	11	11	12	11	11		
Storage Length (ft)		150		150		0	0		
Storage Lanes		1		1		2	0		
Taper Length (ft)				100		0			
Right Turn on Red		Yes					Yes		
Link Speed (mph)	30				30	30			
Link Distance (ft)	363				323	214			
Travel Time (s)	8.3				7.3	4.9			
Peak Hour Factor	0.94	0.90	0.50	0.81	0.94	0.84	0.90		
Heavy Vehicles (%)	5%	5%	50%	2%	5%	4%	3%		
Shared Lane Traffic (%)									
Lane Group Flow (vph)	1306	449	0	160	1133	1339	0		
Turn Type	NA	pt+ov	Prot	Prot	NA	Prot			
Protected Phases	1 2	1 2 4	3	3	1 2 3	4		1	2
Permitted Phases									
Detector Phase	1 2	1 2 4	3	3	1 2 3	4			
Switch Phase									
Minimum Initial (s)			5.0	5.0		6.0		5.0	10.0
Minimum Split (s)			10.0	10.0		29.0		10.0	19.0
Total Split (s)			14.0	14.0		44.0		23.0	19.0
Total Split (%)			14.0%	14.0%		44.0%		23%	19%
Yellow Time (s)			4.0	4.0		4.0		4.0	4.0
All-Red Time (s)			1.0	1.0		1.0		1.0	1.0
Lost Time Adjust (s)				0.0		0.0			
Total Lost Time (s)				5.0		5.0			
Lead/Lag			Lead	Lead		Lag		Lead	Lag
Lead-Lag Optimize?			Yes	Yes		Yes			
Recall Mode			None	None		None		None	C-Max
Act Effect Green (s)	37.0	81.0		9.0	51.0	39.0			
Actuated g/C Ratio	0.37	0.81		0.09	0.51	0.39			
v/c Ratio	1.03	0.37		1.05	0.65	1.05			
Control Delay	45.3	2.1		133.3	20.1	51.7			
Queue Delay	28.4	0.7		25.1	50.5	15.8			
Total Delay	73.7	2.7		158.4	70.6	67.5			
LOS	E	A		F	E	E			
Approach Delay	55.5				81.4	67.5			
Approach LOS	E				F	E			
Queue Length 50th (ft)	~360	17		~112	265	~114			
Queue Length 95th (ft)	m#547	m68		#207	336	#330			
Internal Link Dist (ft)	283				243	134			
Turn Bay Length (ft)		150		150					
Base Capacity (vph)	1272	1225		152	1753	1272			
Starvation Cap Reductn	120	439		0	0	46			
Spillback Cap Reductn	0	5		55	889	10			
Storage Cap Reductn	0	0		0	0	0			

Intersection Capacity Analysis

Lee St & Route 9

07/16/2019

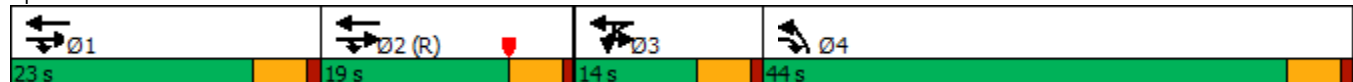


Lane Group	EBT	EBR	WBU	WBL	WBT	NBL	NBR	Ø1	Ø2
Reduced v/c Ratio	1.13	0.57		1.65	1.31	1.09			

Intersection Summary

Area Type:	Other
Cycle Length:	100
Actuated Cycle Length:	100
Offset:	93 (93%), Referenced to phase 2:EBWB, Start of Yellow
Natural Cycle:	120
Control Type:	Actuated-Coordinated
Maximum v/c Ratio:	1.05
Intersection Signal Delay:	66.8
Intersection LOS:	E
Intersection Capacity Utilization	86.8%
ICU Level of Service	E
Analysis Period (min)	15
Description:	Ø2 (NB): 0 / 1 / 3
	Ø4 (WB): 0 / 1 / 3
~	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.
m	Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 5: Lee St & Route 9



Intersection Capacity Analysis
Lee St & Lee Street Extension

07/16/2019



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø1
Lane Configurations							
Traffic Volume (vph)	230	8	5	966	531	1	
Future Volume (vph)	230	8	5	966	531	1	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Right Turn on Red		Yes				Yes	
Link Speed (mph)	30			30	30		
Link Distance (ft)	617			535	214		
Travel Time (s)	14.0			12.2	4.9		
Confl. Peds. (#/hr)		1					
Peak Hour Factor	0.83	0.67	0.62	0.89	0.89	0.25	
Heavy Vehicles (%)	3%	0%	0%	4%	5%	0%	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	289	0	0	1093	601	0	
Turn Type	Prot		Perm	NA	NA		
Protected Phases	2			3	1 3	1	
Permitted Phases			3				
Detector Phase	2		3	3	1 3		
Switch Phase							
Minimum Initial (s)	6.0		10.0	10.0		5.0	
Minimum Split (s)	20.0		15.0	15.0		10.0	
Total Split (s)	29.0		46.0	46.0		25.0	
Total Split (%)	29.0%		46.0%	46.0%		25%	
Yellow Time (s)	4.0		4.0	4.0		4.0	
All-Red Time (s)	1.0		1.0	1.0		1.0	
Lost Time Adjust (s)	0.0			0.0			
Total Lost Time (s)	5.0			5.0			
Lead/Lag	Lag					Lead	
Lead-Lag Optimize?	Yes					Yes	
Recall Mode	None		None	None		C-Max	
Act Effct Green (s)	20.3			40.1	69.7		
Actuated g/C Ratio	0.20			0.40	0.70		
v/c Ratio	0.84			0.86	0.26		
Control Delay	58.8			35.1	9.6		
Queue Delay	0.0			2.1	0.8		
Total Delay	58.8			37.2	10.4		
LOS	E			D	B		
Approach Delay	58.8			37.2	10.4		
Approach LOS	E			D	B		
Queue Length 50th (ft)	174			306	98		
Queue Length 95th (ft)	236			405	m154		
Internal Link Dist (ft)	537			455	134		
Turn Bay Length (ft)							
Base Capacity (vph)	407			1324	2287		
Starvation Cap Reductn	0			0	1309		
Spillback Cap Reductn	0			118	0		
Storage Cap Reductn	0			0	0		
Reduced v/c Ratio	0.71			0.91	0.61		

Intersection Summary

Existing AM

Intersection Capacity Analysis Lee St & Lee Street Extension

07/16/2019

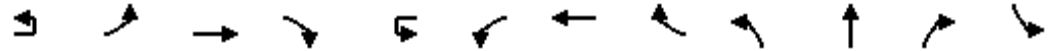
Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 71 (71%), Referenced to phase 1:SBT, Start of Yellow
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.86
Intersection Signal Delay: 32.2 Intersection LOS: C
Intersection Capacity Utilization 51.8% ICU Level of Service A
Analysis Period (min) 15
Description: 1 / 0 / 2
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 6: Lee St & Lee Street Extension



Intersection Capacity Analysis
 Heath St/Chestnut Hill Ave & Route 9

07/16/2019



Lane Group	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations		↔	↕↕			↔	↕↕	↗				↖
Traffic Volume (vph)	15	298	1203	0	3	92	1153	756	0	0	0	418
Future Volume (vph)	15	298	1203	0	3	92	1153	756	0	0	0	418
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	11	11	11	12	11	11	11	11	11
Storage Length (ft)		250		0		175		225	0		0	125
Storage Lanes		1		0		1		1	0		0	1
Taper Length (ft)		100				100			0			100
Right Turn on Red				Yes				Yes			Yes	
Link Speed (mph)			30				30			30		
Link Distance (ft)			495				363			179		
Travel Time (s)			11.3				8.3			4.1		
Confl. Peds. (#/hr)	9	12						12				
Peak Hour Factor	0.42	0.94	0.95	0.92	0.38	0.88	0.94	0.86	0.92	0.92	0.92	0.89
Heavy Vehicles (%)	0%	8%	5%	2%	0%	2%	4%	3%	2%	2%	2%	5%
Shared Lane Traffic (%)												10%
Lane Group Flow (vph)	0	353	1266	0	0	113	1227	879	0	0	0	423
Turn Type	Prot	Prot	NA		Prot	Prot	NA	custom				Split
Protected Phases	4	4	1 4 5		2	2	1 2 5	1 2 3				3
Permitted Phases												
Detector Phase	4	4	1 4 5		2	2	1 2 5	1 2 3				3
Switch Phase												
Minimum Initial (s)	5.0	5.0			5.0	5.0						5.0
Minimum Split (s)	10.0	10.0			10.0	10.0						23.0
Total Split (s)	23.0	23.0			18.0	18.0						30.0
Total Split (%)	23.0%	23.0%			18.0%	18.0%						30.0%
Yellow Time (s)	4.0	4.0			4.0	4.0						4.0
All-Red Time (s)	1.0	1.0			1.0	1.0						1.0
Lost Time Adjust (s)		0.0				0.0						0.0
Total Lost Time (s)		5.0				5.0						5.0
Lead/Lag	Lag	Lag			Lag	Lag						Lead
Lead-Lag Optimize?	Yes	Yes			Yes	Yes						Yes
Recall Mode	None	None			Max	Max						None
Act Effect Green (s)		18.0	47.0			13.0	42.0	53.0				25.0
Actuated g/C Ratio		0.18	0.47			0.13	0.42	0.53				0.25
v/c Ratio		1.20	0.78			0.51	0.84	0.82				1.07
Control Delay		157.1	26.6			50.7	35.0	12.8				103.7
Queue Delay		0.0	10.7			0.0	47.9	7.6				0.0
Total Delay		157.1	37.3			50.7	82.9	20.4				103.7
LOS		F	D			D	F	C				F
Approach Delay			63.4				56.5					
Approach LOS			E				E					
Queue Length 50th (ft)		~275	344			74	418	198				~316
Queue Length 95th (ft)		#450	433			m94	m448	m223				#505
Internal Link Dist (ft)			415				283			99		
Turn Bay Length (ft)		250				175		225				125
Base Capacity (vph)		293	1615			222	1457	1070				394
Starvation Cap Reductn		0	0			0	347	158				0
Spillback Cap Reductn		0	338			0	0	0				0

Intersection Capacity Analysis
 Heath St/Chestnut Hill Ave & Route 9

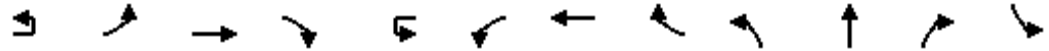
07/16/2019



Lane Group	SBT	SBR	Ø1	Ø5
Lane Configurations	↕			
Traffic Volume (vph)	37	272		
Future Volume (vph)	37	272		
Ideal Flow (vphpl)	1900	1900		
Lane Width (ft)	11	11		
Storage Length (ft)		100		
Storage Lanes		0		
Taper Length (ft)				
Right Turn on Red		Yes		
Link Speed (mph)	30			
Link Distance (ft)	916			
Travel Time (s)	20.8			
Confl. Peds. (#/hr)		9		
Peak Hour Factor	0.71	0.80		
Heavy Vehicles (%)	5%	3%		
Shared Lane Traffic (%)				
Lane Group Flow (vph)	439	0		
Turn Type	NA			
Protected Phases	3		1	5
Permitted Phases				
Detector Phase	3			
Switch Phase				
Minimum Initial (s)	5.0		1.0	5.0
Minimum Split (s)	23.0		6.0	19.0
Total Split (s)	30.0		10.0	19.0
Total Split (%)	30.0%		10%	19%
Yellow Time (s)	4.0		4.0	2.0
All-Red Time (s)	1.0		1.0	1.0
Lost Time Adjust (s)	0.0			
Total Lost Time (s)	5.0			
Lead/Lag	Lead		Lead	
Lead-Lag Optimize?	Yes		Yes	
Recall Mode	None		C-Max	None
Act Effect Green (s)	25.0			
Actuated g/C Ratio	0.25			
v/c Ratio	0.90			
Control Delay	46.2			
Queue Delay	2.7			
Total Delay	49.0			
LOS	D			
Approach Delay	75.8			
Approach LOS	E			
Queue Length 50th (ft)	187			
Queue Length 95th (ft)	206			
Internal Link Dist (ft)	836			
Turn Bay Length (ft)				
Base Capacity (vph)	487			
Starvation Cap Reductn	0			
Spillback Cap Reductn	15			

Intersection Capacity Analysis
 Heath St/Chestnut Hill Ave & Route 9

07/16/2019

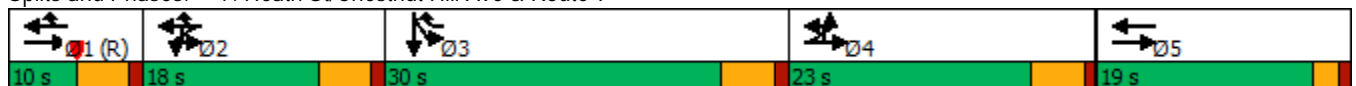


Lane Group	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Storage Cap Reductn		0	0			0	0	0				0
Reduced v/c Ratio		1.20	0.99			0.51	1.11	0.96				1.07

Intersection Summary

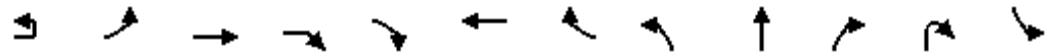
Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 0 (0%), Referenced to phase 1:EBWB, Start of Yellow, Master Intersection
 Natural Cycle: 120
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 1.20
 Intersection Signal Delay: 62.4
 Intersection LOS: E
 Intersection Capacity Utilization 82.9%
 ICU Level of Service E
 Analysis Period (min) 15
 Description: ø3 (EB+WB): 9 / 2 / 2
 ø5 (SB): 12 / 2 / 2
 ~ 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.
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 7: Heath St/Chestnut Hill Ave & Route 9



Intersection Capacity Analysis
Reservoir Rd & Route 9

07/16/2019



Lane Group	EBU	EBL	EBT	EBR	EBR2	WBT	WBR	NBL	NBT	NBR	NBR2	SBL2
Lane Configurations												
Traffic Volume (vph)	11	78	1407	32	24	1404	29	18	22	16	4	11
Future Volume (vph)	11	78	1407	32	24	1404	29	18	22	16	4	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)		250		0			0	0		0		
Storage Lanes		1		0			0	0		0		
Taper Length (ft)		100						0				
Right Turn on Red					Yes		Yes				Yes	
Link Speed (mph)			30			30			30			
Link Distance (ft)			977			709			527			
Travel Time (s)			22.2			16.1			12.0			
Confl. Peds. (#/hr)	11	6		6	9		6	11		32	6	32
Peak Hour Factor	0.55	0.59	0.97	0.89	0.67	0.97	0.52	0.75	0.61	0.80	0.50	0.55
Heavy Vehicles (%)	0%	1%	5%	6%	0%	4%	0%	22%	0%	38%	0%	9%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	152	1523	0	0	1503	0	0	88	0	0	0
Turn Type	Prot	Prot	NA			NA		Perm	NA			Perm
Protected Phases	5	5	2			6			8			
Permitted Phases								8				4
Detector Phase	5	5	2			6		8	8			4
Switch Phase												
Minimum Initial (s)	6.0	6.0	6.0			6.0		6.0	6.0			6.0
Minimum Split (s)	12.0	12.0	12.0			12.0		11.0	11.0			11.0
Total Split (s)	20.0	20.0	46.0			26.0		25.0	25.0			25.0
Total Split (%)	20.0%	20.0%	46.0%			26.0%		25.0%	25.0%			25.0%
Yellow Time (s)	4.0	4.0	4.0			4.0		4.0	4.0			4.0
All-Red Time (s)	2.0	2.0	2.0			2.0		1.0	1.0			1.0
Lost Time Adjust (s)		0.0	0.0			0.0			0.0			
Total Lost Time (s)		6.0	6.0			6.0			5.0			
Lead/Lag	Lead	Lead				Lag						
Lead-Lag Optimize?	Yes	Yes				Yes						
Recall Mode	None	None	C-Min			C-Min		None	None			None
Act Effect Green (s)		13.6	63.5			42.7			11.6			
Actuated g/C Ratio		0.14	0.64			0.43			0.12			
v/c Ratio		0.65	0.73			1.05			0.56			
Control Delay		53.4	22.6			72.6			52.2			
Queue Delay		0.0	0.0			0.0			0.0			
Total Delay		53.4	22.6			72.6			52.2			
LOS		D	C			E			D			
Approach Delay			25.4			72.6			52.2			
Approach LOS			C			E			D			
Queue Length 50th (ft)		93	471			~728			51			
Queue Length 95th (ft)		95	#708			#970			62			
Internal Link Dist (ft)			897			629			447			
Turn Bay Length (ft)		250										
Base Capacity (vph)		261	2095			1426			271			
Starvation Cap Reductn		0	0			0			0			
Spillback Cap Reductn		0	0			0			0			
Storage Cap Reductn		0	0			0			0			

Intersection Capacity Analysis
Reservoir Rd & Route 9

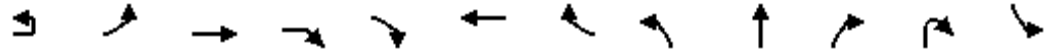
07/16/2019



Lane Group	SBL	SBT	SBR	NWR2	Ø9
Lane Configurations					
Traffic Volume (vph)	9	3	16	10	
Future Volume (vph)	9	3	16	10	
Ideal Flow (vphpl)	1900	1900	1900	1900	
Storage Length (ft)	0		0		
Storage Lanes	0		0		
Taper Length (ft)	0				
Right Turn on Red			Yes	Yes	
Link Speed (mph)		30			
Link Distance (ft)		854			
Travel Time (s)		19.4			
Confl. Peds. (#/hr)	6		11	32	
Peak Hour Factor	0.75	0.38	0.57	0.50	
Heavy Vehicles (%)	0%	0%	0%	0%	
Shared Lane Traffic (%)					
Lane Group Flow (vph)	0	68	0	20	
Turn Type	Perm	NA		Perm	
Protected Phases		4			9
Permitted Phases	4			2 4	
Detector Phase	4	4		2 4	
Switch Phase					
Minimum Initial (s)	6.0	6.0			5.0
Minimum Split (s)	11.0	11.0			29.0
Total Split (s)	25.0	25.0			29.0
Total Split (%)	25.0%	25.0%			29%
Yellow Time (s)	4.0	4.0			2.0
All-Red Time (s)	1.0	1.0			0.0
Lost Time Adjust (s)		0.0			
Total Lost Time (s)		5.0			
Lead/Lag					
Lead-Lag Optimize?					
Recall Mode	None	None			None
Act Effect Green (s)		11.5			79.0
Actuated g/C Ratio		0.12			0.79
v/c Ratio		0.40			0.01
Control Delay		32.3			0.0
Queue Delay		0.0			0.0
Total Delay		32.3			0.0
LOS		C			A
Approach Delay		32.3			
Approach LOS		C			
Queue Length 50th (ft)		24			0
Queue Length 95th (ft)		16			0
Internal Link Dist (ft)		774			
Turn Bay Length (ft)					
Base Capacity (vph)		277			1447
Starvation Cap Reductn		0			0
Spillback Cap Reductn		0			0
Storage Cap Reductn		0			0

Intersection Capacity Analysis
Reservoir Rd & Route 9

07/16/2019

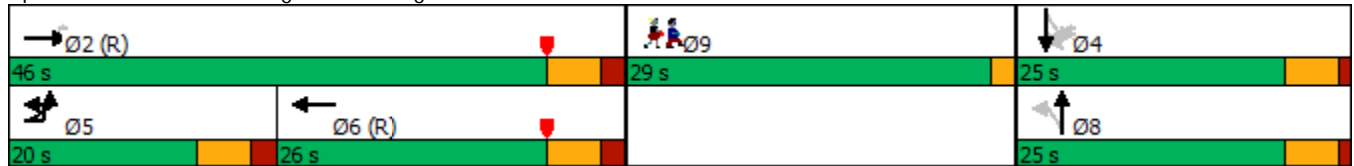


Lane Group	EBU	EBL	EBT	EBR	EBR2	WBT	WBR	NBL	NBT	NBR	NBR2	SBL2
Reduced v/c Ratio		0.58	0.73			1.05			0.32			

Intersection Summary

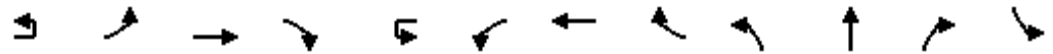
Area Type:	Other
Cycle Length:	100
Actuated Cycle Length:	100
Offset:	75 (75%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow
Natural Cycle:	110
Control Type:	Actuated-Coordinated
Maximum v/c Ratio:	1.05
Intersection Signal Delay:	47.3
Intersection LOS:	D
Intersection Capacity Utilization	77.1%
ICU Level of Service	D
Analysis Period (min)	15
Description:	43 / 13 / 1
~ 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.	

Splits and Phases: 9: Longwood Parking Lot & Reservoir Rd & Route 9



Intersection Capacity Analysis
Hammond St & Route 9

07/16/2019



Lane Group	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations												
Traffic Volume (vph)	1	155	1082	22	1	180	1182	42	107	410	51	122
Future Volume (vph)	1	155	1082	22	1	180	1182	42	107	410	51	122
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	11	11	11	12	11	11	11	11	11
Storage Length (ft)		550		0		300		150	0		0	125
Storage Lanes		1		0		1		1	0		0	1
Taper Length (ft)		100				100			0			100
Right Turn on Red				Yes				Yes			Yes	
Link Speed (mph)			30				30			30		
Link Distance (ft)			726				711			307		
Travel Time (s)			16.5				16.2			7.0		
Confl. Peds. (#/hr)	26	8		5	19	5		8	26		19	19
Peak Hour Factor	0.25	0.90	0.96	0.79	0.25	0.90	0.92	0.75	0.64	0.91	0.75	0.78
Heavy Vehicles (%)	0%	6%	7%	18%	0%	6%	3%	7%	5%	2%	22%	6%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	176	1155	0	0	204	1285	56	0	686	0	156
Turn Type	Prot	Prot	NA		Prot	Prot	NA	Prot	Perm	NA		Perm
Protected Phases	1	1	6		5	5	2	2		4		
Permitted Phases										4		8
Detector Phase	1	1	6		5	5	2	2	4	4		8
Switch Phase												
Minimum Initial (s)	6.0	6.0	6.0		6.0	6.0	10.0	10.0	6.0	6.0		6.0
Minimum Split (s)	12.0	12.0	31.0		12.0	12.0	33.0	33.0	30.0	30.0		29.0
Total Split (s)	19.0	19.0	51.0		19.0	19.0	51.0	51.0	30.0	30.0		30.0
Total Split (%)	14.6%	14.6%	39.2%		14.6%	14.6%	39.2%	39.2%	23.1%	23.1%		23.1%
Yellow Time (s)	4.0	4.0	4.0		4.0	4.0	4.0	4.0	3.0	3.0		3.0
All-Red Time (s)	2.0	2.0	2.0		2.0	2.0	2.0	2.0	3.0	3.0		3.0
Lost Time Adjust (s)		0.0	0.0			0.0	0.0	0.0		0.0		0.0
Total Lost Time (s)		6.0	6.0			6.0	6.0	6.0		6.0		6.0
Lead/Lag	Lead	Lead	Lag		Lead	Lead	Lag	Lag				
Lead-Lag Optimize?	Yes	Yes	Yes		Yes	Yes	Yes	Yes				
Recall Mode	None	None	C-Min		None	None	C-Min	C-Min	None	None		None
Act Effect Green (s)		13.0	45.0			13.0	45.0	45.0		24.0		24.0
Actuated g/C Ratio		0.10	0.35			0.10	0.35	0.35		0.18		0.18
v/c Ratio		1.07	1.00			1.24	1.06	0.10		2.78dl		1.27
Control Delay		145.4	67.8			197.7	84.1	0.3		478.6		212.8
Queue Delay		0.0	0.0			0.0	0.0	0.0		0.0		0.0
Total Delay		145.4	67.8			197.7	84.1	0.3		478.6		212.8
LOS		F	E			F	F	A		F		F
Approach Delay			78.0				96.1			478.6		
Approach LOS			E				F			F		
Queue Length 50th (ft)		~164	508			~213	~625	0		~477		~165
Queue Length 95th (ft)		#314	#667			#372	#764	0		#604		#253
Internal Link Dist (ft)			646				631			227		
Turn Bay Length (ft)		550				300		150				125
Base Capacity (vph)		164	1160			164	1213	587		346		123
Starvation Cap Reductn		0	0			0	0	0		0		0
Spillback Cap Reductn		0	0			0	0	0		0		0

Intersection Capacity Analysis

Hammond St & Route 9

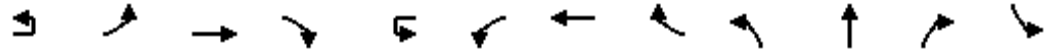
07/16/2019



Lane Group	SBT	SBR
Lane Configurations	↑	↗
Traffic Volume (vph)	252	116
Future Volume (vph)	252	116
Ideal Flow (vphpl)	1900	1900
Lane Width (ft)	11	11
Storage Length (ft)		125
Storage Lanes		1
Taper Length (ft)		
Right Turn on Red		Yes
Link Speed (mph)	30	
Link Distance (ft)	575	
Travel Time (s)	13.1	
Confl. Peds. (#/hr)		26
Peak Hour Factor	0.78	0.85
Heavy Vehicles (%)	5%	2%
Shared Lane Traffic (%)		
Lane Group Flow (vph)	323	136
Turn Type	NA	custom
Protected Phases	8	8
Permitted Phases		1
Detector Phase	8	8
Switch Phase		
Minimum Initial (s)	6.0	6.0
Minimum Split (s)	29.0	29.0
Total Split (s)	30.0	30.0
Total Split (%)	23.1%	23.1%
Yellow Time (s)	3.0	3.0
All-Red Time (s)	3.0	3.0
Lost Time Adjust (s)	0.0	0.0
Total Lost Time (s)	6.0	6.0
Lead/Lag		
Lead-Lag Optimize?		
Recall Mode	None	None
Act Effect Green (s)	24.0	37.0
Actuated g/C Ratio	0.18	0.28
v/c Ratio	1.00	0.27
Control Delay	103.7	11.9
Queue Delay	0.0	0.0
Total Delay	103.7	11.9
LOS	F	B
Approach Delay	111.1	
Approach LOS	F	
Queue Length 50th (ft)	~275	22
Queue Length 95th (ft)	#372	62
Internal Link Dist (ft)	495	
Turn Bay Length (ft)		125
Base Capacity (vph)	322	497
Starvation Cap Reductn	0	0
Spillback Cap Reductn	0	0

Intersection Capacity Analysis
Hammond St & Route 9

07/16/2019

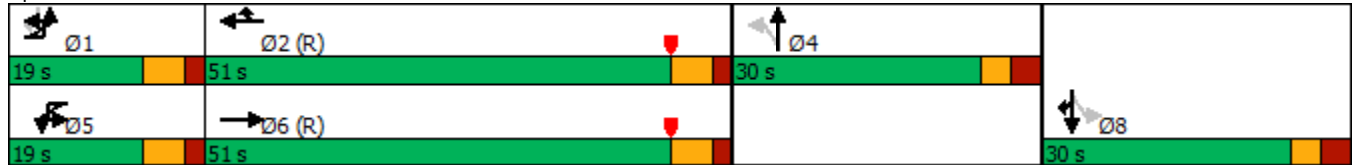


Lane Group	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Storage Cap Reductn		0	0			0	0	0		0		0
Reduced v/c Ratio		1.07	1.00			1.24	1.06	0.10		1.98		1.27

Intersection Summary

Area Type: Other
 Cycle Length: 130
 Actuated Cycle Length: 130
 Offset: 0 (0%), Referenced to phase 2:WBT and 6:EBT, Start of Yellow
 Natural Cycle: 145
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 1.98
 Intersection Signal Delay: 155.3
 Intersection LOS: F
 Intersection Capacity Utilization 96.0%
 ICU Level of Service F
 Analysis Period (min) 15
 Description: ø2 (SB): 8 / 7 / 11
 ø4 (WB): 19 / 23 / 18
 ø6 (NB): 5 / 15 / 7
 ø8 (EB): 26 / 28 / 19
 ~ 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.
 dl Defacto Left Lane. Recode with 1 though lane as a left lane.

Splits and Phases: 13: Hammond St & Route 9



Intersection Capacity Analysis
Hammond St & Heath St

07/16/2019



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↔			↔			↔	
Traffic Volume (vph)	0	0	0	69	27	131	10	430	90	30	411	17
Future Volume (vph)	0	0	0	69	27	131	10	430	90	30	411	17
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		436			675			648			307	
Travel Time (s)		9.9			15.3			14.7			7.0	
Confl. Peds. (#/hr)						8	17		6	6		17
Peak Hour Factor	0.92	0.92	0.92	0.75	0.52	0.73	0.50	0.93	0.64	0.62	0.84	0.61
Heavy Vehicles (%)	2%	2%	2%	1%	0%	2%	0%	4%	9%	10%	4%	24%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	323	0	0	623	0	0	565	0
Turn Type				Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases					8			2		1	6	
Permitted Phases				8			2			6		
Detector Phase				8	8		2	2		1	6	
Switch Phase												
Minimum Initial (s)				6.0	6.0		6.0	6.0		6.0	6.0	
Minimum Split (s)				26.0	26.0		19.0	19.0		13.0	20.0	
Total Split (s)				31.0	31.0		50.0	50.0		49.0	99.0	
Total Split (%)				23.8%	23.8%		38.5%	38.5%		37.7%	76.2%	
Yellow Time (s)				3.0	3.0		4.0	4.0		4.0	4.0	
All-Red Time (s)				3.0	3.0		3.0	3.0		3.0	3.0	
Lost Time Adjust (s)					0.0			0.0			0.0	
Total Lost Time (s)					6.0			7.0			7.0	
Lead/Lag							Lead	Lead		Lag		
Lead-Lag Optimize?							Yes	Yes		Yes		
Recall Mode				None	None		C-Min	C-Min		None	C-Min	
Act Effct Green (s)					29.3			87.7			87.7	
Actuated g/C Ratio					0.23			0.67			0.67	
v/c Ratio					0.81			0.31			0.31	
Control Delay					56.7			9.3			13.1	
Queue Delay					0.0			0.0			0.6	
Total Delay					56.7			9.3			13.7	
LOS					E			A			B	
Approach Delay					56.7			9.3			13.7	
Approach LOS					E			A			B	
Queue Length 50th (ft)					225			101			105	
Queue Length 95th (ft)					147			150			m81	
Internal Link Dist (ft)		356			595			568			227	
Turn Bay Length (ft)												
Base Capacity (vph)					408			1985			1955	
Starvation Cap Reductn					0			0			962	
Spillback Cap Reductn					0			0			0	
Storage Cap Reductn					0			0			0	
Reduced v/c Ratio					0.79			0.31			0.57	

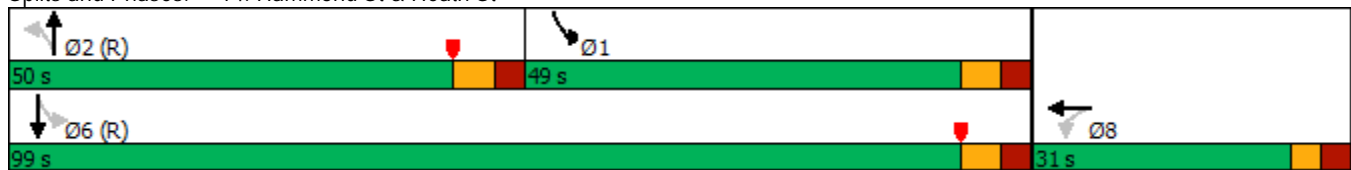
Intersection Summary

Intersection Capacity Analysis Hammond St & Heath St

07/16/2019

Area Type: Other
 Cycle Length: 130
 Actuated Cycle Length: 130
 Offset: 92 (71%), Referenced to phase 2:NBTL and 6:SBTL, Start of Yellow
 Natural Cycle: 60
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.81
 Intersection Signal Delay: 21.1 Intersection LOS: C
 Intersection Capacity Utilization 59.1% ICU Level of Service B
 Analysis Period (min) 15
 Description: ø2 (WB): 6 / 6 / 9
 ø6 (EB): 17 / 19 / 12
 ø8 (SB): 8 / 6 / 22
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 14: Hammond St & Heath St



Intersection Capacity Analysis

Tully St & Route 9

07/16/2019



Lane Group	EBU	EBT	EBR	WBU	WBL	WBT	NBL	NBR	Ø9
Lane Configurations									
Traffic Volume (vph)	44	1307	73	5	9	1262	25	44	
Future Volume (vph)	44	1307	73	5	9	1262	25	44	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	
Lane Width (ft)	11	12	11	11	11	12	11	11	
Storage Length (ft)	250		0		150		0	0	
Storage Lanes	1		0		1		1	0	
Taper Length (ft)	100				100		0		
Right Turn on Red			Yes					Yes	
Link Speed (mph)		30				30	30		
Link Distance (ft)		898				297	462		
Travel Time (s)		20.4				6.8	10.5		
Confl. Peds. (#/hr)			16		16				
Peak Hour Factor	0.73	0.87	0.55	0.42	0.75	0.93	0.89	0.79	
Heavy Vehicles (%)	0%	6%	1%	0%	0%	3%	12%	14%	
Shared Lane Traffic (%)									
Lane Group Flow (vph)	60	1635	0	0	24	1357	84	0	
Turn Type	Prot	NA		Prot	Prot	NA	Prot		
Protected Phases	5	2		1	1	6	8	9	
Permitted Phases									
Detector Phase	5	2		1	1	6	8		
Switch Phase									
Minimum Initial (s)	6.0	10.0		6.0	6.0	10.0	1.0	5.0	
Minimum Split (s)	12.0	23.0		12.0	12.0	23.0	7.0	32.0	
Total Split (s)	18.0	61.0		18.0	18.0	61.0	19.0	32.0	
Total Split (%)	13.8%	46.9%		13.8%	13.8%	46.9%	14.6%	25%	
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	3.0	2.0	
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	3.0	1.0	
Lost Time Adjust (s)	0.0	0.0			0.0	0.0	0.0		
Total Lost Time (s)	6.0	6.0			6.0	6.0	6.0		
Lead/Lag	Lead	Lag		Lead	Lead	Lag			
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes			
Recall Mode	None	C-Min		None	None	C-Min	None	None	
Act Effect Green (s)	8.9	95.1			6.8	90.6	8.5		
Actuated g/C Ratio	0.07	0.73			0.05	0.70	0.07		
v/c Ratio	0.50	0.66			0.26	0.56	0.57		
Control Delay	72.3	15.3			66.0	15.2	38.8		
Queue Delay	0.0	0.0			0.0	8.7	0.0		
Total Delay	72.3	15.3			66.0	23.9	38.8		
LOS	E	B			E	C	D		
Approach Delay		17.3				24.6	38.8		
Approach LOS		B				C	D		
Queue Length 50th (ft)	50	302			20	233	23		
Queue Length 95th (ft)	76	#892			41	#706	74		
Internal Link Dist (ft)		818				217	382		
Turn Bay Length (ft)	250				150				
Base Capacity (vph)	161	2465			161	2442	195		
Starvation Cap Reductn	0	0			0	1054	0		
Spillback Cap Reductn	0	0			0	0	0		

Intersection Capacity Analysis

Tully St & Route 9

07/16/2019



Lane Group	EBU	EBT	EBR	WBU	WBL	WBT	NBL	NBR	Ø9
Storage Cap Reductn	0	0			0	0	0		
Reduced v/c Ratio	0.37	0.66			0.15	0.98	0.43		

Intersection Summary

Area Type:	Other
Cycle Length:	130
Actuated Cycle Length:	130
Offset:	0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow
Natural Cycle:	110
Control Type:	Actuated-Coordinated
Maximum v/c Ratio:	0.66
Intersection Signal Delay:	21.1
Intersection LOS:	C
Intersection Capacity Utilization	52.6%
ICU Level of Service	A
Analysis Period (min)	15
Description:	0 / 5 / 13
#	95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.

Splits and Phases: 15: Tully St & Route 9



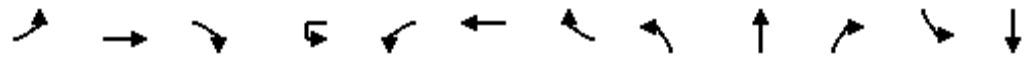
APPENDIX C

**Intersection Capacity Analyses
Weekday PM Peak Hour
2019 Existing Conditions**

Intersection Capacity Analysis

Cypress St & Route 9

07/16/2019



Lane Group	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Traffic Volume (vph)	294	753	100	2	81	896	54	65	194	30	20	234
Future Volume (vph)	294	753	100	2	81	896	54	65	194	30	20	234
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	12	11	11	11	12	11	11	11	11	11	10
Storage Length (ft)	200		0		150		0	0		0	0	
Storage Lanes	1		0		1		0	1		0	0	
Taper Length (ft)	100				100			0			0	
Right Turn on Red			Yes				Yes			Yes		
Link Speed (mph)		30				30			30			30
Link Distance (ft)		614				1044			573			420
Travel Time (s)		14.0				23.7			13.0			9.5
Confl. Peds. (#/hr)	8		5	28	5		8	99		28	28	
Peak Hour Factor	0.98	0.95	0.78	0.50	0.56	0.96	0.84	0.77	0.88	0.68	0.50	0.90
Heavy Vehicles (%)	1%	3%	2%	0%	0%	2%	2%	8%	0%	0%	5%	2%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	300	921	0	0	149	997	0	84	264	0	0	300
Turn Type	Prot	NA		Prot	Prot	NA		Perm	NA		Perm	NA
Protected Phases	5	2		1	1	6			8			4
Permitted Phases								8				4
Detector Phase	5	2		1	1	6		8	8		4	4
Switch Phase												
Minimum Initial (s)	6.0	10.0		6.0	6.0	10.0		6.0	6.0		6.0	6.0
Minimum Split (s)	11.0	16.0		11.0	11.0	16.0		11.0	11.0		11.0	11.0
Total Split (s)	35.0	51.0		35.0	35.0	51.0		40.0	40.0		40.0	40.0
Total Split (%)	23.0%	33.6%		23.0%	23.0%	33.6%		26.3%	26.3%		26.3%	26.3%
Maximum Green (s)	30.0	45.0		30.0	30.0	45.0		35.0	35.0		35.0	35.0
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0		4.0	4.0		4.0	4.0
All-Red Time (s)	1.0	2.0		1.0	1.0	2.0		1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0			0.0	0.0		0.0	0.0			0.0
Total Lost Time (s)	5.0	6.0			5.0	6.0		5.0	5.0			5.0
Lead/Lag	Lead	Lag		Lead	Lead	Lag						
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes						
Vehicle Extension (s)	2.0	2.0		2.0	2.0	2.0		2.0	2.0		2.0	2.0
Recall Mode	None	Min		None	None	Min		None	None		None	None
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)	27.3	53.5		16.6	42.8		35.8	35.8				35.8
Actuated g/C Ratio	0.19	0.38		0.12	0.31		0.26	0.26				0.26
v/c Ratio	0.89	0.70		0.72	0.93		0.65	0.58				0.90
Control Delay	84.9	41.2		81.4	63.4		76.5	53.8				83.6
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0				0.0
Total Delay	84.9	41.2		81.4	63.4		76.5	53.8				83.6
LOS	F	D		F	E		E	D				F
Approach Delay		52.0			65.7			59.2				46.3
Approach LOS		D			E			E				D
Queue Length 50th (ft)	288	391		143	502		76	229				295
Queue Length 95th (ft)	#453	505		125	#639		#127	322				#495

Intersection Capacity Analysis

Cypress St & Route 9

07/16/2019

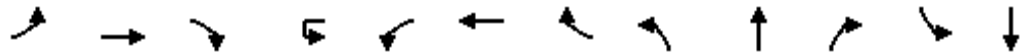
Lane Group	SBR	Ø9
Lane Configurations		
Traffic Volume (vph)	240	
Future Volume (vph)	240	
Ideal Flow (vphpl)	1900	
Lane Width (ft)	11	
Storage Length (ft)	0	
Storage Lanes	1	
Taper Length (ft)		
Right Turn on Red	Yes	
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Confl. Peds. (#/hr)	99	
Peak Hour Factor	0.92	
Heavy Vehicles (%)	1%	
Shared Lane Traffic (%)		
Lane Group Flow (vph)	261	
Turn Type	pt+ov	
Protected Phases	4 5	9
Permitted Phases		
Detector Phase	4 5	
Switch Phase		
Minimum Initial (s)		20.0
Minimum Split (s)		26.0
Total Split (s)		26.0
Total Split (%)		17%
Maximum Green (s)		22.0
Yellow Time (s)		2.0
All-Red Time (s)		2.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Vehicle Extension (s)		2.0
Recall Mode		None
Walk Time (s)		7.0
Flash Dont Walk (s)		10.0
Pedestrian Calls (#/hr)		60
Act Effct Green (s)	68.2	
Actuated g/C Ratio	0.49	
v/c Ratio	0.29	
Control Delay	3.4	
Queue Delay	0.0	
Total Delay	3.4	
LOS	A	
Approach Delay		
Approach LOS		
Queue Length 50th (ft)	0	
Queue Length 95th (ft)	50	

Existing PM

Intersection Capacity Analysis

Cypress St & Route 9

07/16/2019

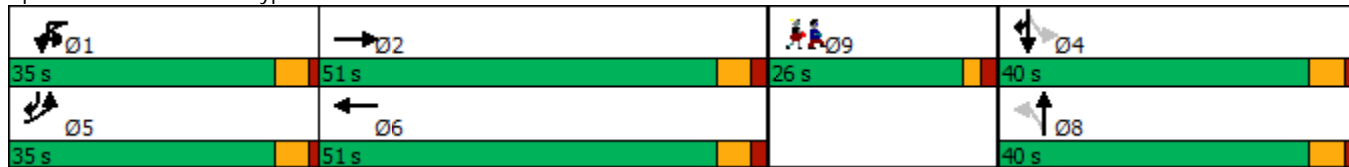


Lane Group	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Internal Link Dist (ft)		534				964			493			340
Turn Bay Length (ft)	200				150							
Base Capacity (vph)	377	1327			382	1150		129	458			332
Starvation Cap Reductn	0	0			0	0		0	0			0
Spillback Cap Reductn	0	0			0	0		0	0			0
Storage Cap Reductn	0	0			0	0		0	0			0
Reduced v/c Ratio	0.80	0.69			0.39	0.87		0.65	0.58			0.90

Intersection Summary

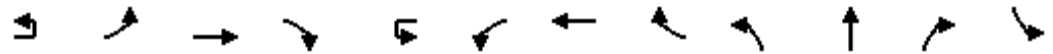
Area Type:	Other
Cycle Length:	152
Actuated Cycle Length:	140.2
Natural Cycle:	130
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	0.93
Intersection Signal Delay:	56.6
Intersection LOS:	E
Intersection Capacity Utilization	86.1%
ICU Level of Service	E
Analysis Period (min)	15
Description:	155 / 99 / 53
# 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.	

Splits and Phases: 2: Cypress St & Route 9



Intersection Capacity Analysis
Warren St/Sumner Rd & Route 9

07/16/2019



Lane Group	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations												
Traffic Volume (vph)	4	197	1090	55	14	42	1155	18	41	193	6	67
Future Volume (vph)	4	197	1090	55	14	42	1155	18	41	193	6	67
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	11	11	11	12	11	11	11	11	11
Storage Length (ft)		150		150		150		0	0		0	0
Storage Lanes		1		1		1		0	0		0	0
Taper Length (ft)		100				100			0			0
Right Turn on Red				Yes				Yes			Yes	
Link Speed (mph)			30				30			30		
Link Distance (ft)			635				1295			738		
Travel Time (s)			14.4				29.4			16.8		
Confl. Peds. (#/hr)	3	5			7			5	3		7	7
Peak Hour Factor	0.50	0.91	0.94	0.76	0.58	0.66	0.89	0.90	0.60	0.93	0.50	0.80
Heavy Vehicles (%)	0%	1%	2%	0%	0%	5%	2%	6%	0%	2%	0%	0%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	224	1160	72	0	88	1318	0	0	288	0	0
Turn Type	Prot	Prot	NA	Perm	Prot	Prot	NA		Perm	NA		Perm
Protected Phases	5	5	2		1	1	6			8		
Permitted Phases				2					8			4
Detector Phase	5	5	2	2	1	1	6		8	8		4
Switch Phase												
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0	6.0	40.0		6.0	6.0		6.0
Minimum Split (s)	11.0	11.0	46.0	46.0	11.0	11.0	46.0		23.0	23.0		23.0
Total Split (s)	25.0	25.0	71.0	71.0	20.0	20.0	66.0		35.0	35.0		35.0
Total Split (%)	15.5%	15.5%	44.1%	44.1%	12.4%	12.4%	41.0%		21.7%	21.7%		21.7%
Maximum Green (s)	20.0	20.0	65.0	65.0	15.0	15.0	60.0		30.0	30.0		30.0
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	2.0	2.0	1.0	1.0	2.0		1.0	1.0		1.0
Lost Time Adjust (s)		0.0	0.0	0.0		0.0	0.0			0.0		
Total Lost Time (s)		5.0	6.0	6.0		5.0	6.0			5.0		
Lead/Lag	Lead	Lead	Lag	Lag	Lead	Lead	Lag					
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes					
Vehicle Extension (s)	3.0	3.0	2.0	2.0	3.0	3.0	2.0		3.0	3.0		3.0
Recall Mode	None	None	Min	Min	None	None	Min		None	None		None
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		20.2	66.7	66.7		11.6	58.1			30.4		
Actuated g/C Ratio		0.15	0.51	0.51		0.09	0.45			0.23		
v/c Ratio		0.84	0.64	0.09		0.59	0.84			2.10		
Control Delay		80.3	27.6	6.1		76.0	38.9			543.2		
Queue Delay		0.0	0.0	0.0		0.0	0.0			0.0		
Total Delay		80.3	27.6	6.1		76.0	38.9			543.2		
LOS		F	C	A		E	D			F		
Approach Delay			34.6				41.2			543.2		
Approach LOS			C				D			F		
Queue Length 50th (ft)		175	326	1		68	461			-363		
Queue Length 95th (ft)		#433	662	24		110	#880			#710		

Intersection Capacity Analysis

Warren St/Sumner Rd & Route 9

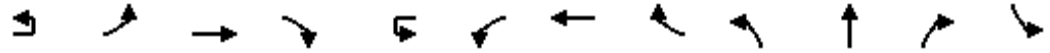
07/16/2019



Lane Group	SBT	SBR	Ø9
Lane Configurations	↕	↗	
Traffic Volume (vph)	250	128	
Future Volume (vph)	250	128	
Ideal Flow (vphpl)	1900	1900	
Lane Width (ft)	11	11	
Storage Length (ft)		0	
Storage Lanes		1	
Taper Length (ft)			
Right Turn on Red		Yes	
Link Speed (mph)	30		
Link Distance (ft)	625		
Travel Time (s)	14.2		
Confl. Peds. (#/hr)		3	
Peak Hour Factor	0.93	0.86	
Heavy Vehicles (%)	1%	2%	
Shared Lane Traffic (%)			
Lane Group Flow (vph)	353	149	
Turn Type	NA	Perm	
Protected Phases	4		9
Permitted Phases		4	
Detector Phase	4	4	
Switch Phase			
Minimum Initial (s)	6.0	6.0	6.0
Minimum Split (s)	23.0	23.0	35.0
Total Split (s)	35.0	35.0	35.0
Total Split (%)	21.7%	21.7%	22%
Maximum Green (s)	30.0	30.0	32.0
Yellow Time (s)	4.0	4.0	2.0
All-Red Time (s)	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	
Total Lost Time (s)	5.0	5.0	
Lead/Lag			
Lead-Lag Optimize?			
Vehicle Extension (s)	3.0	3.0	3.0
Recall Mode	None	None	None
Walk Time (s)			7.0
Flash Dont Walk (s)			25.0
Pedestrian Calls (#/hr)			7
Act Effct Green (s)	30.4	30.4	
Actuated g/C Ratio	0.23	0.23	
v/c Ratio	1.20	0.33	
Control Delay	159.6	13.3	
Queue Delay	0.0	0.0	
Total Delay	159.6	13.3	
LOS	F	B	
Approach Delay	116.2		
Approach LOS	F		
Queue Length 50th (ft)	~332	13	
Queue Length 95th (ft)	#721	76	

Intersection Capacity Analysis
Warren St/Sumner Rd & Route 9

07/16/2019



Lane Group	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Internal Link Dist (ft)			555				1215				658	
Turn Bay Length (ft)		150		150		150						
Base Capacity (vph)		267	1809	831		195	1642				137	
Starvation Cap Reductn		0	0	0		0	0				0	
Spillback Cap Reductn		0	0	0		0	0				0	
Storage Cap Reductn		0	0	0		0	0				0	
Reduced v/c Ratio		0.84	0.64	0.09		0.45	0.80				2.10	

Intersection Summary

Area Type:	Other
Cycle Length:	161
Actuated Cycle Length:	130.5
Natural Cycle:	145
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	2.10
Intersection Signal Delay:	88.5
Intersection LOS:	F
Intersection Capacity Utilization	91.6%
ICU Level of Service	F
Analysis Period (min)	15
Description:	16 / 7 / 16
~ 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.	

Splits and Phases: 4: Warren St/Sumner Rd & Route 9



Intersection Capacity Analysis
Lee St & Route 9

07/16/2019



Lane Group	EBT	EBR	WBU	WBL	WBT	NBL	NBR	Ø1	Ø2
Lane Configurations	↑↑	↑		↓	↑↑	↓			
Traffic Volume (vph)	1182	592	2	201	1063	487	174		
Future Volume (vph)	1182	592	2	201	1063	487	174		
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900		
Lane Width (ft)	12	11	11	11	12	11	11		
Storage Length (ft)		150		150		0	0		
Storage Lanes		1		1		2	0		
Taper Length (ft)				100		0			
Right Turn on Red		Yes					Yes		
Link Speed (mph)	30				30	30			
Link Distance (ft)	363				323	214			
Travel Time (s)	8.3				7.3	4.9			
Confl. Peds. (#/hr)		1	1	1			1		
Peak Hour Factor	0.91	0.99	0.50	0.93	0.93	0.94	0.93		
Heavy Vehicles (%)	2%	2%	0%	2%	2%	2%	2%		
Shared Lane Traffic (%)									
Lane Group Flow (vph)	1299	598	0	220	1143	705	0		
Turn Type	NA	pt+ov	Prot	Prot	NA	Prot			
Protected Phases	1 2	1 2 4	3	3	1 2 3	4		1	2
Permitted Phases									
Detector Phase	1 2	1 2 4	3	3	1 2 3	4			
Switch Phase									
Minimum Initial (s)			5.0	5.0		6.0		5.0	10.0
Minimum Split (s)			10.0	10.0		29.0		10.0	19.0
Total Split (s)			20.0	20.0		47.0		34.0	19.0
Total Split (%)			16.7%	16.7%		39.2%		28%	16%
Maximum Green (s)			15.0	15.0		42.0		29.0	14.0
Yellow Time (s)			4.0	4.0		4.0		4.0	4.0
All-Red Time (s)			1.0	1.0		1.0		1.0	1.0
Lost Time Adjust (s)				0.0		0.0			
Total Lost Time (s)				5.0		5.0			
Lead/Lag			Lead	Lead		Lag		Lead	Lag
Lead-Lag Optimize?			Yes	Yes		Yes			
Vehicle Extension (s)			3.0	3.0		3.0		3.0	3.0
Recall Mode			None	None		None		None	C-Max
Walk Time (s)						17.0			10.0
Flash Dont Walk (s)						7.0			4.0
Pedestrian Calls (#/hr)						1			1
Act Effct Green (s)	51.8	95.0		15.0	71.8	38.2			
Actuated g/C Ratio	0.43	0.79		0.12	0.60	0.32			
v/c Ratio	0.85	0.48		1.03	0.54	0.67			
Control Delay	25.8	1.7		121.9	16.2	8.8			
Queue Delay	17.8	0.8		24.4	1.1	4.0			
Total Delay	43.6	2.6		146.3	17.3	12.8			
LOS	D	A		F	B	B			
Approach Delay	30.7				38.1	12.8			
Approach LOS	C				D	B			
Queue Length 50th (ft)	525	19		~182	281	139			
Queue Length 95th (ft)	m552	m23		#342	347	77			

Existing PM

Intersection Capacity Analysis

Lee St & Route 9

07/16/2019

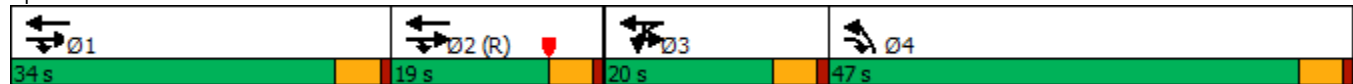


Lane Group	EBT	EBR	WBU	WBL	WBT	NBL	NBR	Ø1	Ø2
Internal Link Dist (ft)	283				243	134			
Turn Bay Length (ft)		150		150					
Base Capacity (vph)	1527	1223		213	2117	1157			
Starvation Cap Reductn	256	339		0	0	360			
Spillback Cap Reductn	0	2		31	674	8			
Storage Cap Reductn	0	0		0	0	0			
Reduced v/c Ratio	1.02	0.68		1.21	0.79	0.88			

Intersection Summary

Area Type: Other
 Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 115 (96%), Referenced to phase 2:EBWB, Start of Yellow
 Natural Cycle: 80
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 1.03
 Intersection Signal Delay: 30.0
 Intersection LOS: C
 Intersection Capacity Utilization 75.8%
 ICU Level of Service D
 Analysis Period (min) 15
 Description: Ø2 (NB): 0 / 1 / 3
 Ø4 (WB): 0 / 1 / 3
 ~ 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.
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 5: Lee St & Route 9



Intersection Capacity Analysis

Lee St & Lee Street Extension

07/16/2019



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø1
Lane Configurations							
Traffic Volume (vph)	79	11	42	602	818	7	
Future Volume (vph)	79	11	42	602	818	7	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Right Turn on Red		Yes				Yes	
Link Speed (mph)	30			30	30		
Link Distance (ft)	617			535	214		
Travel Time (s)	14.0			12.2	4.9		
Peak Hour Factor	0.90	0.69	0.66	0.84	0.87	0.58	
Heavy Vehicles (%)	3%	0%	0%	2%	2%	0%	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	104	0	0	781	952	0	
Turn Type	Prot		Perm	NA	NA		
Protected Phases	2			3	1 3		1
Permitted Phases			3				
Detector Phase	2		3	3	1 3		
Switch Phase							
Minimum Initial (s)	6.0		10.0	10.0			5.0
Minimum Split (s)	20.0		15.0	15.0			10.0
Total Split (s)	20.0		50.0	50.0			50.0
Total Split (%)	16.7%		41.7%	41.7%			42%
Maximum Green (s)	15.0		45.0	45.0			45.0
Yellow Time (s)	4.0		4.0	4.0			4.0
All-Red Time (s)	1.0		1.0	1.0			1.0
Lost Time Adjust (s)	0.0			0.0			
Total Lost Time (s)	5.0			5.0			
Lead/Lag	Lag						Lead
Lead-Lag Optimize?	Yes						Yes
Vehicle Extension (s)	2.0		2.0	2.0			2.0
Recall Mode	None		None	None			C-Max
Walk Time (s)	5.0						
Flash Dont Walk (s)	5.0						
Pedestrian Calls (#/hr)	0						
Act Effect Green (s)	11.1			43.1	98.9		
Actuated g/C Ratio	0.09			0.36	0.82		
v/c Ratio	0.65			0.83	0.34		
Control Delay	67.4			43.4	2.4		
Queue Delay	0.0			2.9	0.6		
Total Delay	67.4			46.4	3.0		
LOS	E			D	A		
Approach Delay	67.4			46.4	3.0		
Approach LOS	E			D	A		
Queue Length 50th (ft)	74			275	32		
Queue Length 95th (ft)	130			327	m117		
Internal Link Dist (ft)	537			455	134		
Turn Bay Length (ft)							
Base Capacity (vph)	215			995	2802		
Starvation Cap Reductn	0			0	1356		
Spillback Cap Reductn	0			124	0		

Intersection Capacity Analysis
Lee St & Lee Street Extension

07/16/2019

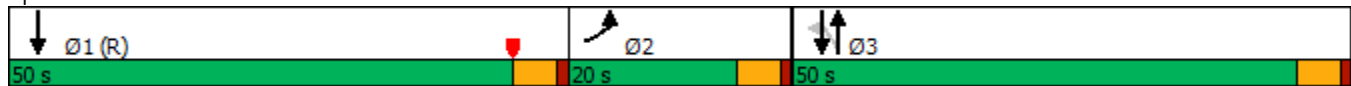


Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø1
Storage Cap Reductn	0			0	0		
Reduced v/c Ratio	0.48			0.90	0.66		

Intersection Summary

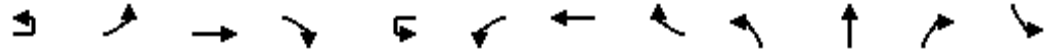
Area Type: Other
 Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 105 (88%), Referenced to phase 1:SBT, Start of Yellow
 Natural Cycle: 55
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.83
 Intersection Signal Delay: 25.1
 Intersection LOS: C
 Intersection Capacity Utilization 58.2%
 ICU Level of Service B
 Analysis Period (min) 15
 Description: 1 / 0 / 2
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 6: Lee St & Lee Street Extension



Intersection Capacity Analysis
 Heath St/Chestnut Hill Ave & Route 9

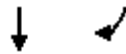
07/16/2019



Lane Group	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations		↔	↕			↔	↕	↔				↕
Traffic Volume (vph)	9	308	1190	0	1	117	1127	391	0	0	0	601
Future Volume (vph)	9	308	1190	0	1	117	1127	391	0	0	0	601
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	11	11	11	12	11	11	11	11	11
Storage Length (ft)		250		0		175		225	0		0	125
Storage Lanes		1		0		1		1	0		0	1
Taper Length (ft)		100				100			0			100
Right Turn on Red				Yes				Yes			Yes	
Link Speed (mph)			30				30			30		
Link Distance (ft)			495				363			179		
Travel Time (s)			11.3				8.3			4.1		
Confl. Peds. (#/hr)	2	2				2		2				
Peak Hour Factor	0.75	0.81	0.90	0.92	0.25	0.75	0.89	0.91	0.92	0.92	0.92	0.94
Heavy Vehicles (%)	0%	0%	2%	2%	0%	0%	2%	1%	2%	2%	2%	2%
Shared Lane Traffic (%)												32%
Lane Group Flow (vph)	0	392	1322	0	0	160	1266	430	0	0	0	435
Turn Type	Prot	Prot	NA		Prot	Prot	NA	custom				Split
Protected Phases	4	4	1 4 5		2	2	1 2 5	1 2 3				3
Permitted Phases												
Detector Phase	4	4	1 4 5		2	2	1 2 5	1 2 3				3
Switch Phase												
Minimum Initial (s)	5.0	5.0			5.0	5.0						5.0
Minimum Split (s)	10.0	10.0			10.0	10.0						23.0
Total Split (s)	28.0	28.0			15.0	15.0						35.0
Total Split (%)	23.3%	23.3%			12.5%	12.5%						29.2%
Maximum Green (s)	23.0	23.0			10.0	10.0						30.0
Yellow Time (s)	4.0	4.0			4.0	4.0						4.0
All-Red Time (s)	1.0	1.0			1.0	1.0						1.0
Lost Time Adjust (s)		0.0				0.0						0.0
Total Lost Time (s)		5.0				5.0						5.0
Lead/Lag	Lag	Lag			Lag	Lag						Lead
Lead-Lag Optimize?	Yes	Yes			Yes	Yes						Yes
Vehicle Extension (s)	3.0	3.0			3.0	3.0						3.0
Recall Mode	None	None			Max	Max						None
Walk Time (s)												13.0
Flash Dont Walk (s)												5.0
Pedestrian Calls (#/hr)												2
Act Effct Green (s)		23.0	65.0			10.0	52.0	68.0				30.0
Actuated g/C Ratio		0.19	0.54			0.08	0.43	0.57				0.25
v/c Ratio		1.17	0.69			1.10	0.83	0.40				1.07
Control Delay		148.1	22.5			150.6	34.5	4.9				108.2
Queue Delay		0.0	13.9			0.0	7.7	0.7				0.0
Total Delay		148.1	36.4			150.6	42.2	5.6				108.2
LOS		F	D			F	D	A				F
Approach Delay			61.9				43.1					
Approach LOS			E				D					
Queue Length 50th (ft)		~362	377			~142	486	77				~393
Queue Length 95th (ft)		#475	458			#219	565	137				#607

Intersection Capacity Analysis
 Heath St/Chestnut Hill Ave & Route 9

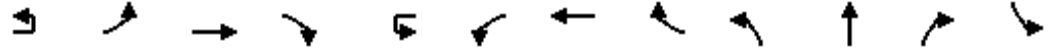
07/16/2019



Lane Group	SBT	SBR	Ø1	Ø5
Lane Configurations	↕			
Traffic Volume (vph)	56	119		
Future Volume (vph)	56	119		
Ideal Flow (vphpl)	1900	1900		
Lane Width (ft)	11	11		
Storage Length (ft)		100		
Storage Lanes		0		
Taper Length (ft)				
Right Turn on Red		Yes		
Link Speed (mph)	30			
Link Distance (ft)	916			
Travel Time (s)	20.8			
Confl. Peds. (#/hr)		2		
Peak Hour Factor	0.64	0.88		
Heavy Vehicles (%)	4%	2%		
Shared Lane Traffic (%)				
Lane Group Flow (vph)	427	0		
Turn Type	NA			
Protected Phases	3		1	5
Permitted Phases				
Detector Phase	3			
Switch Phase				
Minimum Initial (s)	5.0		5.0	5.0
Minimum Split (s)	23.0		15.0	19.0
Total Split (s)	35.0		23.0	19.0
Total Split (%)	29.2%		19%	16%
Maximum Green (s)	30.0		18.0	16.0
Yellow Time (s)	4.0		4.0	2.0
All-Red Time (s)	1.0		1.0	1.0
Lost Time Adjust (s)	0.0			
Total Lost Time (s)	5.0			
Lead/Lag	Lead		Lead	
Lead-Lag Optimize?	Yes		Yes	
Vehicle Extension (s)	3.0		3.0	3.0
Recall Mode	None		C-Max	None
Walk Time (s)	13.0			6.0
Flash Dont Walk (s)	5.0			10.0
Pedestrian Calls (#/hr)	2			2
Act Effct Green (s)	30.0			
Actuated g/C Ratio	0.25			
v/c Ratio	1.05			
Control Delay	99.4			
Queue Delay	1.7			
Total Delay	101.2			
LOS	F			
Approach Delay	104.7			
Approach LOS	F			
Queue Length 50th (ft)	~367			
Queue Length 95th (ft)	304			

Intersection Capacity Analysis
 Heath St/Chestnut Hill Ave & Route 9

07/16/2019



Lane Group	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Internal Link Dist (ft)			415				283			99		
Turn Bay Length (ft)		250				175		225				125
Base Capacity (vph)		334	1916			145	1533	1062				406
Starvation Cap Reductn		0	0			0	237	330				0
Spillback Cap Reductn		0	599			0	0	0				0
Storage Cap Reductn		0	0			0	0	0				0
Reduced v/c Ratio		1.17	1.00			1.10	0.98	0.59				1.07

Intersection Summary

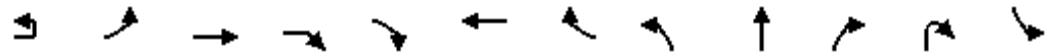
Area Type: Other
 Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 0 (0%), Referenced to phase 1:EBWB, Start of Yellow, Master Intersection
 Natural Cycle: 120
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 1.17
 Intersection Signal Delay: 62.3
 Intersection LOS: E
 Intersection Capacity Utilization 83.0%
 ICU Level of Service E
 Analysis Period (min) 15
 Description: ø3 (EB+WB): 9 / 2 / 2
 ø5 (SB): 12 / 2 / 2
 ~ 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.

Splits and Phases: 7: Heath St/Chestnut Hill Ave & Route 9

ø1 (R)	ø2	ø3	ø4	ø5
23 s	15 s	35 s	28 s	19 s

Intersection Capacity Analysis
Reservoir Rd & Route 9

07/16/2019



Lane Group	EBU	EBL	EBT	EBR	EBR2	WBT	WBR	NBL	NBT	NBR	NBR2	SBL2
Lane Configurations												
Traffic Volume (vph)	18	21	1479	17	1	1261	21	58	11	12	3	24
Future Volume (vph)	18	21	1479	17	1	1261	21	58	11	12	3	24
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)		250		0			0	0		0		
Storage Lanes		1		0			0	0		0		
Taper Length (ft)		100						0				
Right Turn on Red					Yes		Yes				Yes	
Link Speed (mph)			30			30			30			
Link Distance (ft)			977			709			527			
Travel Time (s)			22.2			16.1			12.0			
Confl. Peds. (#/hr)	5	1		2	11		1	5		8	2	8
Peak Hour Factor	0.75	0.58	0.94	0.61	0.25	0.96	0.66	0.63	0.69	0.60	0.75	0.75
Heavy Vehicles (%)	0%	0%	1%	0%	0%	1%	0%	7%	0%	33%	0%	0%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	60	1605	0	0	1346	0	0	132	0	0	0
Turn Type	Prot	Prot	NA			NA		Perm	NA			Perm
Protected Phases	5	5	2			6			8			
Permitted Phases								8				4
Detector Phase	5	5	2			6		8	8			4
Switch Phase												
Minimum Initial (s)	6.0	6.0	6.0			6.0		6.0	6.0			6.0
Minimum Split (s)	12.0	12.0	12.0			12.0		11.0	11.0			11.0
Total Split (s)	25.0	25.0	66.0			41.0		25.0	25.0			25.0
Total Split (%)	20.8%	20.8%	55.0%			34.2%		20.8%	20.8%			20.8%
Maximum Green (s)	19.0	19.0	60.0			35.0		20.0	20.0			20.0
Yellow Time (s)	4.0	4.0	4.0			4.0		4.0	4.0			4.0
All-Red Time (s)	2.0	2.0	2.0			2.0		1.0	1.0			1.0
Lost Time Adjust (s)		0.0	0.0			0.0			0.0			
Total Lost Time (s)		6.0	6.0			6.0			5.0			
Lead/Lag	Lead	Lead				Lag						
Lead-Lag Optimize?	Yes	Yes				Yes						
Vehicle Extension (s)	3.0	3.0	2.0			2.0		3.0	3.0			3.0
Recall Mode	None	None	C-Min			C-Min		None	None			None
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effect Green (s)		9.5	80.8			67.7			16.6			
Actuated g/C Ratio		0.08	0.67			0.56			0.14			
v/c Ratio		0.43	0.69			0.69			0.76			
Control Delay		61.6	18.5			26.8			75.4			
Queue Delay		0.0	0.0			0.0			0.0			
Total Delay		61.6	18.5			26.8			75.4			
LOS		E	B			C			E			
Approach Delay			20.1			26.8			75.4			
Approach LOS			C			C			E			
Queue Length 50th (ft)		45	252			310			98			
Queue Length 95th (ft)		55	#770			#786			122			
Internal Link Dist (ft)			897			629			447			

Intersection Capacity Analysis
Reservoir Rd & Route 9

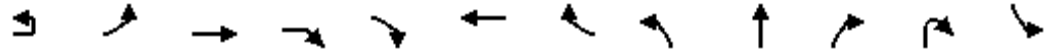
07/16/2019



Lane Group	SBL	SBT	SBR	NWR2	Ø9
Lane Configurations					
Traffic Volume (vph)	7	1	7	6	
Future Volume (vph)	7	1	7	6	
Ideal Flow (vphpl)	1900	1900	1900	1900	
Storage Length (ft)	0		0		
Storage Lanes	0		0		
Taper Length (ft)	0				
Right Turn on Red			Yes	Yes	
Link Speed (mph)		30			
Link Distance (ft)		854			
Travel Time (s)		19.4			
Confl. Peds. (#/hr)	2		5	8	
Peak Hour Factor	0.44	0.25	0.58	0.38	
Heavy Vehicles (%)	0%	0%	0%	0%	
Shared Lane Traffic (%)					
Lane Group Flow (vph)	0	64	0	16	
Turn Type	Perm	NA		Perm	
Protected Phases		4		9	
Permitted Phases	4			2 4	
Detector Phase	4	4		2 4	
Switch Phase					
Minimum Initial (s)	6.0	6.0		5.0	
Minimum Split (s)	11.0	11.0		29.0	
Total Split (s)	25.0	25.0		29.0	
Total Split (%)	20.8%	20.8%		24%	
Maximum Green (s)	20.0	20.0		27.0	
Yellow Time (s)	4.0	4.0		2.0	
All-Red Time (s)	1.0	1.0		0.0	
Lost Time Adjust (s)		0.0			
Total Lost Time (s)		5.0			
Lead/Lag					
Lead-Lag Optimize?					
Vehicle Extension (s)	3.0	3.0		3.0	
Recall Mode	None	None		None	
Walk Time (s)				5.0	
Flash Dont Walk (s)				22.0	
Pedestrian Calls (#/hr)				13	
Act Effect Green (s)		16.6		106.0	
Actuated g/C Ratio		0.14		0.88	
v/c Ratio		0.35		0.01	
Control Delay		44.9		0.0	
Queue Delay		0.0		0.0	
Total Delay		44.9		0.0	
LOS		D		A	
Approach Delay		44.9			
Approach LOS		D			
Queue Length 50th (ft)		39		0	
Queue Length 95th (ft)		17		0	
Internal Link Dist (ft)		774			

Intersection Capacity Analysis
Reservoir Rd & Route 9

07/16/2019

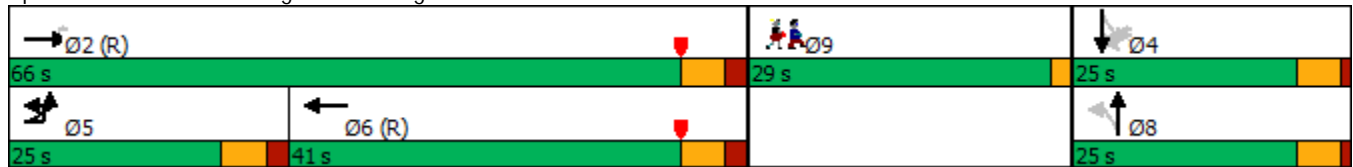


Lane Group	EBU	EBL	EBT	EBR	EBR2	WBT	WBR	NBL	NBT	NBR	NBR2	SBL2
Turn Bay Length (ft)		250										
Base Capacity (vph)		276	2318			1940			209			
Starvation Cap Reductn		0	0			0			0			
Spillback Cap Reductn		0	0			0			0			
Storage Cap Reductn		0	0			0			0			
Reduced v/c Ratio		0.22	0.69			0.69			0.63			

Intersection Summary

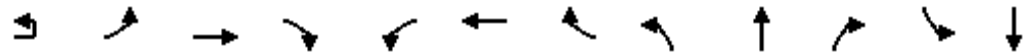
Area Type: Other
 Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 25 (21%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow
 Natural Cycle: 100
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.76
 Intersection Signal Delay: 25.5
 Intersection LOS: C
 Intersection Capacity Utilization 65.7%
 ICU Level of Service C
 Analysis Period (min) 15
 Description: 43 / 13 / 1
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 9: Longwood Parking Lot & Reservoir Rd & Route 9



Intersection Capacity Analysis
Hammond St & Route 9

07/16/2019



Lane Group	EBU	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Traffic Volume (vph)	2	158	1137	38	146	1248	47	160	225	52	129	374
Future Volume (vph)	2	158	1137	38	146	1248	47	160	225	52	129	374
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	11	11	12	11	11	11	11	11	11
Storage Length (ft)		550		0	300		150	0		0	125	
Storage Lanes		1		0	1		1	0		0	1	
Taper Length (ft)		100			100			0			100	
Right Turn on Red				Yes			Yes			Yes		
Link Speed (mph)			30			30			30			30
Link Distance (ft)			726			711			307			892
Travel Time (s)			16.5			16.2			7.0			20.3
Confl. Peds. (#/hr)	28	7		15	15		7	28		23	23	
Peak Hour Factor	0.50	0.92	0.95	0.79	0.73	0.95	0.84	0.95	0.88	0.76	0.90	0.92
Heavy Vehicles (%)	0%	2%	2%	0%	1%	2%	2%	1%	2%	0%	2%	1%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	176	1245	0	200	1314	56	0	492	0	143	407
Turn Type	Prot	Prot	NA		Prot	NA	Prot	Perm	NA		Perm	NA
Protected Phases	1	1	6		5	2	2		4			8
Permitted Phases									4			8
Detector Phase	1	1	6		5	2	2	4	4		8	8
Switch Phase												
Minimum Initial (s)	6.0	6.0	6.0		6.0	10.0	10.0	6.0	6.0		6.0	6.0
Minimum Split (s)	12.0	12.0	31.0		12.0	33.0	33.0	30.0	30.0		29.0	29.0
Total Split (s)	20.0	20.0	43.0		27.0	50.0	50.0	30.0	30.0		30.0	30.0
Total Split (%)	15.4%	15.4%	33.1%		20.8%	38.5%	38.5%	23.1%	23.1%		23.1%	23.1%
Maximum Green (s)	14.0	14.0	37.0		21.0	44.0	44.0	24.0	24.0		24.0	24.0
Yellow Time (s)	4.0	4.0	4.0		4.0	4.0	4.0	3.0	3.0		3.0	3.0
All-Red Time (s)	2.0	2.0	2.0		2.0	2.0	2.0	3.0	3.0		3.0	3.0
Lost Time Adjust (s)		0.0	0.0		0.0	0.0	0.0		0.0		0.0	0.0
Total Lost Time (s)		6.0	6.0		6.0	6.0	6.0		6.0		6.0	6.0
Lead/Lag	Lead	Lead	Lag		Lead	Lag	Lag					
Lead-Lag Optimize?	Yes	Yes	Yes		Yes	Yes	Yes					
Vehicle Extension (s)	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0		2.0	2.0
Recall Mode	None	None	C-Min		None	C-Min	C-Min	None	None		None	None
Walk Time (s)			5.0			5.0	5.0	5.0	5.0		5.0	5.0
Flash Dont Walk (s)			20.0			22.0	22.0	19.0	19.0		18.0	18.0
Pedestrian Calls (#/hr)			15			7	7	23	23		28	28
Act Effct Green (s)		14.0	39.8		18.2	44.0	44.0		24.0		24.0	24.0
Actuated g/C Ratio		0.11	0.31		0.14	0.34	0.34		0.18		0.18	0.18
v/c Ratio		0.96	1.15		0.83	1.10	0.09		2.58dl		0.93	1.21
Control Delay		113.4	120.9		81.0	97.5	0.3		194.3		109.8	165.6
Queue Delay		0.0	0.0		0.0	0.0	0.0		0.0		0.0	0.0
Total Delay		113.4	120.9		81.0	97.5	0.3		194.3		109.8	165.6
LOS		F	F		F	F	A		F		F	F
Approach Delay			120.0			91.9			194.3			112.2
Approach LOS			F			F			F			F
Queue Length 50th (ft)		150	~669		164	~658	0		~280		120	~419
Queue Length 95th (ft)		#297	#827		195	#797	0		#383		#254	#624

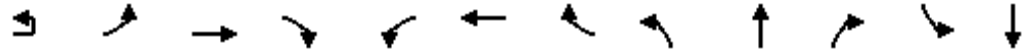
Intersection Capacity Analysis
Hammond St & Route 9

07/16/2019

Lane Group	SBR
Lane Configurations	T
Traffic Volume (vph)	158
Future Volume (vph)	158
Ideal Flow (vphpl)	1900
Lane Width (ft)	11
Storage Length (ft)	125
Storage Lanes	1
Taper Length (ft)	
Right Turn on Red	Yes
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	28
Peak Hour Factor	0.71
Heavy Vehicles (%)	1%
Shared Lane Traffic (%)	
Lane Group Flow (vph)	223
Turn Type	custom
Protected Phases	8
Permitted Phases	1
Detector Phase	8
Switch Phase	
Minimum Initial (s)	6.0
Minimum Split (s)	29.0
Total Split (s)	30.0
Total Split (%)	23.1%
Maximum Green (s)	24.0
Yellow Time (s)	3.0
All-Red Time (s)	3.0
Lost Time Adjust (s)	0.0
Total Lost Time (s)	6.0
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	2.0
Recall Mode	None
Walk Time (s)	5.0
Flash Dont Walk (s)	18.0
Pedestrian Calls (#/hr)	28
Act Effct Green (s)	38.0
Actuated g/C Ratio	0.29
v/c Ratio	0.42
Control Delay	16.4
Queue Delay	0.0
Total Delay	16.4
LOS	B
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	58
Queue Length 95th (ft)	76

Intersection Capacity Analysis Hammond St & Route 9

07/16/2019

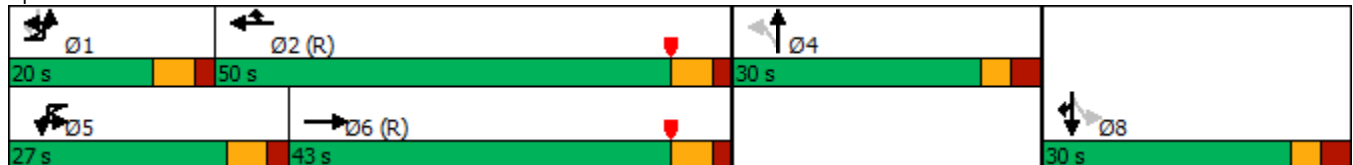


Lane Group	EBU	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Internal Link Dist (ft)			646			631			227			812
Turn Bay Length (ft)		550			300		150				125	
Base Capacity (vph)		184	1078		279	1197	601		374		153	335
Starvation Cap Reductn		0	0		0	0	0		0		0	0
Spillback Cap Reductn		0	0		0	0	0		0		0	0
Storage Cap Reductn		0	0		0	0	0		0		0	0
Reduced v/c Ratio		0.96	1.15		0.72	1.10	0.09		1.32		0.93	1.21

Intersection Summary

Area Type: Other
 Cycle Length: 130
 Actuated Cycle Length: 130
 Offset: 0 (0%), Referenced to phase 2:WBT and 6:EBT, Start of Yellow, Master Intersection
 Natural Cycle: 145
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 1.32
 Intersection Signal Delay: 116.8
 Intersection LOS: F
 Intersection Capacity Utilization 99.7%
 ICU Level of Service F
 Analysis Period (min) 15
 Description: ø2 (SB): 8 / 7 / 11
 ø4 (WB): 19 / 23 / 18
 ø6 (NB): 5 / 15 / 7
 ø8 (EB): 26 / 28 / 19
 ~ 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.
 dl Defacto Left Lane. Recode with 1 though lane as a left lane.

Splits and Phases: 13: Hammond St & Route 9



Intersection Capacity Analysis
Hammond St & Heath St

07/16/2019



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↕			↕			↕	
Traffic Volume (vph)	0	0	0	148	71	124	14	306	124	16	513	31
Future Volume (vph)	0	0	0	148	71	124	14	306	124	16	513	31
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		436			675			648			307	
Travel Time (s)		9.9			15.3			14.7			7.0	
Confl. Peds. (#/hr)						6	19		6	6		19
Peak Hour Factor	0.92	0.92	0.92	0.84	0.93	0.76	0.70	0.97	0.91	0.80	0.84	0.86
Heavy Vehicles (%)	2%	2%	2%	1%	1%	4%	0%	1%	0%	0%	1%	3%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	415	0	0	471	0	0	667	0
Turn Type				Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases					8			2		1	6	
Permitted Phases				8			2			6		
Detector Phase				8	8		2	2		1	6	
Switch Phase												
Minimum Initial (s)				6.0	6.0		6.0	6.0		6.0	6.0	
Minimum Split (s)				26.0	26.0		19.0	19.0		13.0	20.0	
Total Split (s)				37.0	37.0		50.0	50.0		43.0	93.0	
Total Split (%)				28.5%	28.5%		38.5%	38.5%		33.1%	71.5%	
Maximum Green (s)				31.0	31.0		43.0	43.0		36.0	86.0	
Yellow Time (s)				3.0	3.0		4.0	4.0		4.0	4.0	
All-Red Time (s)				3.0	3.0		3.0	3.0		3.0	3.0	
Lost Time Adjust (s)					0.0			0.0			0.0	
Total Lost Time (s)					6.0			7.0			7.0	
Lead/Lag							Lead	Lead		Lag		
Lead-Lag Optimize?							Yes	Yes		Yes		
Vehicle Extension (s)				2.0	2.0		2.0	2.0		2.0	2.0	
Recall Mode				None	None		C-Min	C-Min		None	C-Min	
Walk Time (s)				7.0	7.0		7.0	7.0			7.0	
Flash Dont Walk (s)				13.0	13.0		5.0	5.0			6.0	
Pedestrian Calls (#/hr)				6	6		6	6			19	
Act Effct Green (s)					39.6			77.4			77.4	
Actuated g/C Ratio					0.30			0.60			0.60	
v/c Ratio					0.80			0.26			0.35	
Control Delay					51.6			11.8			14.7	
Queue Delay					0.0			0.0			0.7	
Total Delay					51.6			11.8			15.4	
LOS					D			B			B	
Approach Delay					51.6			11.8			15.4	
Approach LOS					D			B			B	
Queue Length 50th (ft)					305			84			111	
Queue Length 95th (ft)					423			121			m88	
Internal Link Dist (ft)		356			595			568			227	
Turn Bay Length (ft)												
Base Capacity (vph)					519			1784			2096	
Starvation Cap Reductn					0			0			1009	

Intersection Capacity Analysis Hammond St & Heath St

07/16/2019

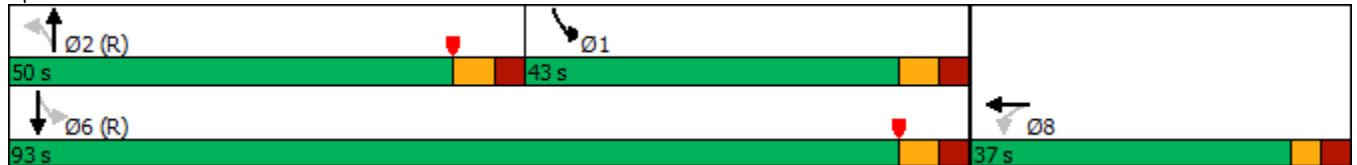


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Spillback Cap Reductn					0			0			0	
Storage Cap Reductn					0			0			0	
Reduced v/c Ratio					0.80			0.26			0.61	

Intersection Summary

Area Type: Other
 Cycle Length: 130
 Actuated Cycle Length: 130
 Offset: 90 (69%), Referenced to phase 2:NBTL and 6:SBTL, Start of Yellow
 Natural Cycle: 60
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.80
 Intersection Signal Delay: 24.0
 Intersection LOS: C
 Intersection Capacity Utilization 57.5%
 ICU Level of Service B
 Analysis Period (min) 15
 Description: ø2 (WB): 6 / 6 / 9
 ø6 (EB): 17 / 19 / 12
 ø8 (SB): 8 / 6 / 22
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 14: Hammond St & Heath St



Intersection Capacity Analysis

Tully St & Route 9

07/16/2019



Lane Group	EBU	EBT	EBR	WBU	WBL	WBT	NBL	NBR	Ø9
Lane Configurations									
Traffic Volume (vph)	106	1383	40	10	10	1309	67	37	
Future Volume (vph)	106	1383	40	10	10	1309	67	37	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	
Lane Width (ft)	11	12	11	11	11	12	11	11	
Storage Length (ft)	250		0		150		0	0	
Storage Lanes	1		0		1		1	0	
Taper Length (ft)	100				100		0		
Right Turn on Red			Yes					Yes	
Link Speed (mph)		30				30	30		
Link Distance (ft)		898				297	462		
Travel Time (s)		20.4				6.8	10.5		
Confl. Peds. (#/hr)	5		30		30		5		
Peak Hour Factor	0.83	0.95	0.71	0.62	0.42	0.97	0.84	0.77	
Heavy Vehicles (%)	0%	2%	0%	10%	0%	2%	0%	3%	
Shared Lane Traffic (%)									
Lane Group Flow (vph)	128	1512	0	0	40	1349	128	0	
Turn Type	Prot	NA		Prot	Prot	NA	Prot		
Protected Phases	5	2		1	1	6	8	9	
Permitted Phases									
Detector Phase	5	2		1	1	6	8		
Switch Phase									
Minimum Initial (s)	6.0	10.0		6.0	6.0	10.0	1.0	5.0	
Minimum Split (s)	12.0	23.0		12.0	12.0	23.0	7.0	32.0	
Total Split (s)	18.0	55.0		18.0	18.0	55.0	25.0	32.0	
Total Split (%)	13.8%	42.3%		13.8%	13.8%	42.3%	19.2%	25%	
Maximum Green (s)	12.0	49.0		12.0	12.0	49.0	19.0	29.0	
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	3.0	2.0	
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	3.0	1.0	
Lost Time Adjust (s)	0.0	0.0			0.0	0.0	0.0		
Total Lost Time (s)	6.0	6.0			6.0	6.0	6.0		
Lead/Lag	Lead	Lag		Lead	Lead	Lag			
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes			
Vehicle Extension (s)	2.0	2.0		2.0	2.0	2.0	3.0	3.0	
Recall Mode	None	C-Min		None	None	C-Min	None	None	
Walk Time (s)								7.0	
Flash Dont Walk (s)								22.0	
Pedestrian Calls (#/hr)								15	
Act Effct Green (s)	12.7	80.0			7.9	72.8	13.7		
Actuated g/C Ratio	0.10	0.62			0.06	0.56	0.11		
v/c Ratio	0.75	0.70			0.40	0.68	0.66		
Control Delay	83.2	24.8			69.5	27.1	63.3		
Queue Delay	0.0	0.0			0.0	49.4	0.0		
Total Delay	83.2	24.8			69.5	76.5	63.3		
LOS	F	C			E	E	E		
Approach Delay		29.3				76.3	63.3		
Approach LOS		C				E	E		
Queue Length 50th (ft)	105	323			33	324	89		
Queue Length 95th (ft)	#188	#911			32	#767	140		

Intersection Capacity Analysis

Tully St & Route 9

07/16/2019

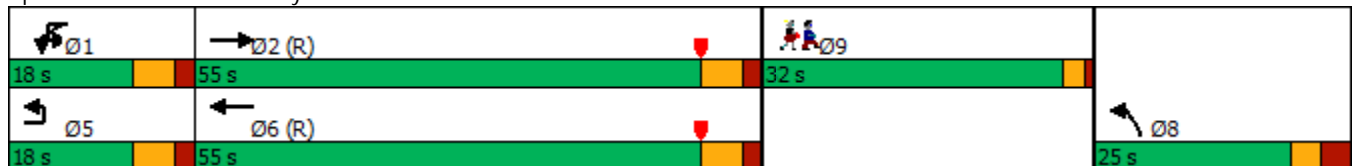


Lane Group	EBU	EBT	EBR	WBU	WBL	WBT	NBL	NBR	Ø9
Internal Link Dist (ft)		818				217	382		
Turn Bay Length (ft)	250				150				
Base Capacity (vph)	177	2163			154	1981	260		
Starvation Cap Reductn	0	0			0	915	0		
Spillback Cap Reductn	0	0			0	0	0		
Storage Cap Reductn	0	0			0	0	0		
Reduced v/c Ratio	0.72	0.70			0.26	1.27	0.49		

Intersection Summary

Area Type:	Other
Cycle Length:	130
Actuated Cycle Length:	130
Offset:	8 (6%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow
Natural Cycle:	100
Control Type:	Actuated-Coordinated
Maximum v/c Ratio:	0.75
Intersection Signal Delay:	51.4
Intersection LOS:	D
Intersection Capacity Utilization	65.6%
ICU Level of Service	C
Analysis Period (min)	15
Description:	0 / 5 / 13
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

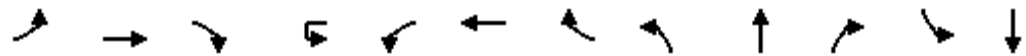
Splits and Phases: 15: Tully St & Route 9



APPENDIX D
Intersection Capacity Analyses
Saturday Peak Hour
2019 Existing Conditions

Intersection Capacity Analysis
Cypress St & Route 9

07/16/2019



Lane Group	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Traffic Volume (vph)	310	649	71	3	56	637	73	53	177	37	51	194
Future Volume (vph)	310	649	71	3	56	637	73	53	177	37	51	194
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	12	11	11	11	12	11	11	11	11	11	10
Storage Length (ft)	200		0		150		0	0		0	0	
Storage Lanes	1		0		1		0	1		0	0	
Taper Length (ft)	100				100			0				0
Right Turn on Red			Yes				Yes			Yes		
Link Speed (mph)		30				30			30			30
Link Distance (ft)		614				1044			573			420
Travel Time (s)		14.0				23.7			13.0			9.5
Confl. Peds. (#/hr)	33		6	39	6		33	53		39	39	
Peak Hour Factor	0.83	0.85	0.74	0.75	0.67	0.90	0.79	0.88	0.89	0.84	0.55	0.81
Heavy Vehicles (%)	1%	3%	6%	0%	0%	3%	3%	11%	2%	5%	8%	3%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	373	860	0	0	88	800	0	60	243	0	0	333
Turn Type	Prot	NA		Prot	Prot	NA		Perm	NA		Perm	NA
Protected Phases	5	2		1	1	6			8			4
Permitted Phases								8				4
Detector Phase	5	2		1	1	6		8	8		4	4
Switch Phase												
Minimum Initial (s)	5.0	10.0		6.0	6.0	10.0		6.0	6.0		6.0	6.0
Minimum Split (s)	10.0	16.0		11.0	11.0	16.0		11.0	11.0		11.0	11.0
Total Split (s)	35.0	51.0		35.0	35.0	51.0		40.0	40.0		40.0	40.0
Total Split (%)	23.0%	33.6%		23.0%	23.0%	33.6%		26.3%	26.3%		26.3%	26.3%
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0		4.0	4.0		4.0	4.0
All-Red Time (s)	1.0	2.0		1.0	1.0	2.0		1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0			0.0	0.0		0.0	0.0			0.0
Total Lost Time (s)	5.0	6.0			5.0	6.0		5.0	5.0			5.0
Lead/Lag	Lead	Lag		Lead	Lead	Lag						
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes						
Recall Mode	None	Min		None	None	Min		None	None		None	None
Act Effect Green (s)	30.7	55.9			11.4	36.7		35.8	35.8			35.8
Actuated g/C Ratio	0.23	0.42			0.09	0.28		0.27	0.27			0.27
v/c Ratio	0.93	0.59			0.59	0.84		0.48	0.52			1.23
Control Delay	82.8	33.1			77.6	54.2		62.8	48.3			171.7
Queue Delay	0.0	0.0			0.0	0.0		0.0	0.0			0.0
Total Delay	82.8	33.1			77.6	54.2		62.8	48.3			171.7
LOS	F	C			E	D		E	D			F
Approach Delay		48.1				56.5			51.2			93.1
Approach LOS		D				E			D			F
Queue Length 50th (ft)	~375	334			81	373		49	196			~410
Queue Length 95th (ft)	#540	398			104	454		105	300			#551
Internal Link Dist (ft)		534				964			493			340
Turn Bay Length (ft)	200				150							
Base Capacity (vph)	400	1451			404	1192		125	470			271
Starvation Cap Reductn	0	0			0	0		0	0			0
Spillback Cap Reductn	0	0			0	0		0	0			0

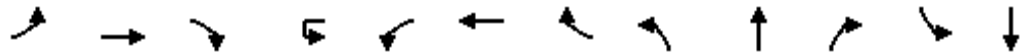
Intersection Capacity Analysis
Cypress St & Route 9

07/16/2019

Lane Group	SBR	Ø9
Lane Configurations		
Traffic Volume (vph)	259	
Future Volume (vph)	259	
Ideal Flow (vphpl)	1900	
Lane Width (ft)	11	
Storage Length (ft)	0	
Storage Lanes	1	
Taper Length (ft)		
Right Turn on Red	Yes	
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Confl. Peds. (#/hr)	53	
Peak Hour Factor	0.89	
Heavy Vehicles (%)	2%	
Shared Lane Traffic (%)		
Lane Group Flow (vph)	291	
Turn Type	pt+ov	
Protected Phases	4 5	9
Permitted Phases		
Detector Phase	4 5	
Switch Phase		
Minimum Initial (s)		20.0
Minimum Split (s)		26.0
Total Split (s)		26.0
Total Split (%)		17%
Yellow Time (s)		2.0
All-Red Time (s)		2.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Recall Mode		None
Act Effect Green (s)	71.5	
Actuated g/C Ratio	0.54	
v/c Ratio	0.30	
Control Delay	3.2	
Queue Delay	0.0	
Total Delay	3.2	
LOS	A	
Approach Delay		
Approach LOS		
Queue Length 50th (ft)	0	
Queue Length 95th (ft)	49	
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)	960	
Starvation Cap Reductn	0	
Spillback Cap Reductn	0	

Intersection Capacity Analysis Cypress St & Route 9

07/16/2019



Lane Group	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Storage Cap Reductn	0	0			0	0		0	0			0
Reduced v/c Ratio	0.93	0.59			0.22	0.67		0.48	0.52			1.23

Intersection Summary

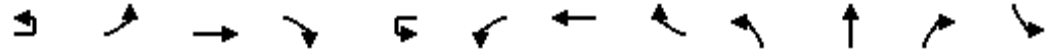
Area Type:	Other
Cycle Length:	152
Actuated Cycle Length:	132.4
Natural Cycle:	150
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	1.23
Intersection Signal Delay:	60.1
Intersection LOS:	E
Intersection Capacity Utilization	80.1%
ICU Level of Service	D
Analysis Period (min)	15
Description:	155 / 99 / 53
~ 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.	

Splits and Phases: 2: Cypress St & Route 9

01 35 s	02 51 s	09 26 s	04 40 s
05 35 s	06 51 s		08 40 s

Intersection Capacity Analysis
Warren St/Sumner Rd & Route 9

07/16/2019



Lane Group	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations												
Traffic Volume (vph)	3	193	1011	59	10	22	913	9	94	93	7	26
Future Volume (vph)	3	193	1011	59	10	22	913	9	94	93	7	26
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	11	11	11	12	11	11	11	11	11
Storage Length (ft)		150		150		150		0	0		0	0
Storage Lanes		1		1		1		0	0		0	0
Taper Length (ft)		100				100			0			0
Right Turn on Red				Yes				Yes			Yes	
Link Speed (mph)			30				30			30		
Link Distance (ft)			635				1295			738		
Travel Time (s)			14.4				29.4			16.8		
Confl. Peds. (#/hr)	16	9		8	9	8		9	16		9	9
Peak Hour Factor	0.38	0.82	0.91	0.87	0.83	0.61	0.95	0.38	0.84	0.73	0.58	0.72
Heavy Vehicles (%)	0%	1%	2%	5%	0%	5%	3%	0%	2%	2%	0%	4%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	243	1111	68	0	48	985	0	0	251	0	0
Turn Type	Prot	Prot	NA	Perm	Prot	Prot	NA		Perm	NA		Perm
Protected Phases	5	5	2		1	1	6			8		
Permitted Phases				2					8			4
Detector Phase	5	5	2	2	1	1	6		8	8		4
Switch Phase												
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0	6.0	40.0		6.0	6.0		6.0
Minimum Split (s)	11.0	11.0	46.0	46.0	11.0	11.0	46.0		11.0	11.0		11.0
Total Split (s)	20.0	20.0	71.0	71.0	15.0	15.0	66.0		25.0	25.0		25.0
Total Split (%)	13.7%	13.7%	48.6%	48.6%	10.3%	10.3%	45.2%		17.1%	17.1%		17.1%
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	2.0	2.0	1.0	1.0	2.0		1.0	1.0		1.0
Lost Time Adjust (s)		0.0	0.0	0.0			0.0	0.0		0.0		
Total Lost Time (s)		5.0	6.0	6.0			5.0	6.0		5.0		
Lead/Lag	Lead	Lead	Lag	Lag	Lead	Lead	Lag					
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes					
Recall Mode	None	None	Min	Min	None	None	Min		None	None		None
Act Effect Green (s)		15.6	55.2	55.2		8.2	45.2			20.8		
Actuated g/C Ratio		0.14	0.50	0.50		0.07	0.41			0.19		
v/c Ratio		0.99	0.62	0.09		0.38	0.68			1.07		
Control Delay		103.6	25.6	4.9		63.6	31.3			121.2		
Queue Delay		0.0	0.0	0.0		0.0	0.0			0.0		
Total Delay		103.6	25.6	4.9		63.6	31.3			121.2		
LOS		F	C	A		E	C			F		
Approach Delay			37.9				32.8			121.2		
Approach LOS			D				C			F		
Queue Length 50th (ft)		138	225	0		26	225			142		
Queue Length 95th (ft)		#407	529	23		59	482			#369		
Internal Link Dist (ft)			555				1215			658		
Turn Bay Length (ft)		150		150		150						
Base Capacity (vph)		246	2187	921		159	1992			235		
Starvation Cap Reductn		0	0	0		0	0			0		
Spillback Cap Reductn		0	0	0		0	0			0		

Intersection Capacity Analysis
Warren St/Sumner Rd & Route 9

07/16/2019

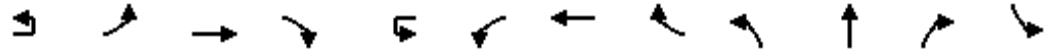


Lane Group	SBT	SBR	Ø9
Lane Configurations	↕	↗	
Traffic Volume (vph)	75	140	
Future Volume (vph)	75	140	
Ideal Flow (vphpl)	1900	1900	
Lane Width (ft)	11	11	
Storage Length (ft)		150	
Storage Lanes		1	
Taper Length (ft)			
Right Turn on Red		Yes	
Link Speed (mph)	30		
Link Distance (ft)	625		
Travel Time (s)	14.2		
Confl. Peds. (#/hr)		16	
Peak Hour Factor	0.75	0.88	
Heavy Vehicles (%)	1%	1%	
Shared Lane Traffic (%)			
Lane Group Flow (vph)	136	159	
Turn Type	NA	Perm	
Protected Phases	4		9
Permitted Phases		4	
Detector Phase	4	4	
Switch Phase			
Minimum Initial (s)	6.0	6.0	6.0
Minimum Split (s)	11.0	11.0	35.0
Total Split (s)	25.0	25.0	35.0
Total Split (%)	17.1%	17.1%	24%
Yellow Time (s)	4.0	4.0	2.0
All-Red Time (s)	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	
Total Lost Time (s)	5.0	5.0	
Lead/Lag			
Lead-Lag Optimize?			
Recall Mode	None	None	None
Act Effct Green (s)	20.8	20.8	
Actuated g/C Ratio	0.19	0.19	
v/c Ratio	0.48	0.39	
Control Delay	51.9	10.9	
Queue Delay	0.0	0.0	
Total Delay	51.9	10.9	
LOS	D	B	
Approach Delay	29.8		
Approach LOS	C		
Queue Length 50th (ft)	68	0	
Queue Length 95th (ft)	159	62	
Internal Link Dist (ft)	545		
Turn Bay Length (ft)		150	
Base Capacity (vph)	281	409	
Starvation Cap Reductn	0	0	
Spillback Cap Reductn	0	0	

Intersection Capacity Analysis

Warren St/Sumner Rd & Route 9

07/16/2019

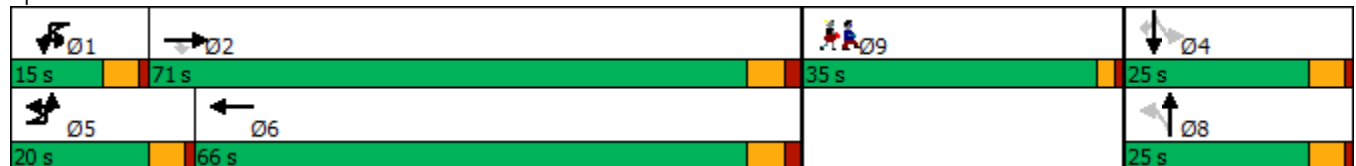


Lane Group	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Storage Cap Reductn		0	0	0		0	0			0		
Reduced v/c Ratio		0.99	0.51	0.07		0.30	0.49			1.07		

Intersection Summary

Area Type:	Other
Cycle Length:	146
Actuated Cycle Length:	109.5
Natural Cycle:	135
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	1.07
Intersection Signal Delay:	42.3
Intersection LOS:	D
Intersection Capacity Utilization	82.5%
ICU Level of Service	E
Analysis Period (min)	15
Description:	16 / 7 / 16
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

Splits and Phases: 4: Warren St/Sumner Rd & Route 9



Intersection Capacity Analysis
Lee St & Route 9

07/16/2019



Lane Group	EBT	EBR	WBU	WBL	WBT	NBL	NBR	Ø1	Ø2
Lane Configurations	↑↑	↑		↓	↑↑	↓			
Traffic Volume (vph)	1029	293	4	126	980	351	229		
Future Volume (vph)	1029	293	4	126	980	351	229		
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900		
Lane Width (ft)	12	11	11	11	12	11	11		
Storage Length (ft)		150		150		0	0		
Storage Lanes		1		1		2	0		
Taper Length (ft)				100		0			
Right Turn on Red		Yes					Yes		
Link Speed (mph)	30				30	30			
Link Distance (ft)	363				323	214			
Travel Time (s)	8.3				7.3	4.9			
Confl. Peds. (#/hr)		3	3	3			3		
Peak Hour Factor	0.89	0.85	0.50	0.95	0.94	0.88	0.88		
Heavy Vehicles (%)	2%	2%	0%	2%	3%	3%	2%		
Shared Lane Traffic (%)									
Lane Group Flow (vph)	1156	345	0	141	1043	659	0		
Turn Type	NA	pt+ov	Prot	Prot	NA	Prot			
Protected Phases	1 2	1 2 4	3	3	1 2 3	4		1	2
Permitted Phases									
Detector Phase	1 2	1 2 4	3	3	1 2 3	4			
Switch Phase									
Minimum Initial (s)			5.0	5.0		6.0		5.0	10.0
Minimum Split (s)			10.0	10.0		29.0		10.0	19.0
Total Split (s)			14.0	14.0		44.0		23.0	19.0
Total Split (%)			14.0%	14.0%		44.0%		23%	19%
Yellow Time (s)			4.0	4.0		4.0		4.0	4.0
All-Red Time (s)			1.0	1.0		1.0		1.0	1.0
Lost Time Adjust (s)				0.0		0.0			
Total Lost Time (s)				5.0		5.0			
Lead/Lag			Lead	Lead		Lag		Lead	Lag
Lead-Lag Optimize?			Yes	Yes		Yes			
Recall Mode			None	None		None		None	C-Max
Act Effect Green (s)	48.2	81.0		9.0	62.2	27.8			
Actuated g/C Ratio	0.48	0.81		0.09	0.62	0.28			
v/c Ratio	0.68	0.27		0.92	0.48	0.65			
Control Delay	12.3	1.0		100.0	12.4	19.2			
Queue Delay	0.4	0.4		0.0	0.5	4.6			
Total Delay	12.6	1.4		100.0	12.9	23.7			
LOS	B	A		F	B	C			
Approach Delay	10.0				23.3	23.7			
Approach LOS	B				C	C			
Queue Length 50th (ft)	150	8		91	173	179			
Queue Length 95th (ft)	#317	m14		#207	296	227			
Internal Link Dist (ft)	283				243	134			
Turn Bay Length (ft)		150		150					
Base Capacity (vph)	1704	1269		154	2178	1341			
Starvation Cap Reductn	159	493		0	0	594			
Spillback Cap Reductn	0	0		0	631	33			

Intersection Capacity Analysis

Lee St & Route 9

07/16/2019

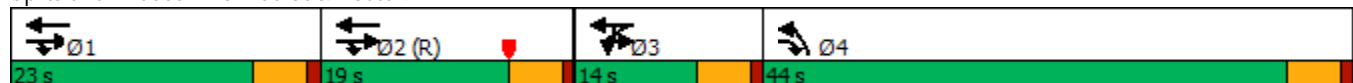


Lane Group	EBT	EBR	WBU	WBL	WBT	NBL	NBR	Ø1	Ø2
Storage Cap Reductn	0	0		0	0	0			
Reduced v/c Ratio	0.75	0.44		0.92	0.67	0.88			

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 93 (93%), Referenced to phase 2:EBWB, Start of Yellow
 Natural Cycle: 70
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.92
 Intersection Signal Delay: 17.4
 Intersection LOS: B
 Intersection Capacity Utilization 65.8%
 ICU Level of Service C
 Analysis Period (min) 15
 Description: Ø2 (NB): 0 / 1 / 3
 Ø4 (WB): 0 / 1 / 3
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 5: Lee St & Route 9



Intersection Capacity Analysis
Lee St & Lee Street Extension

07/16/2019



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø1
Lane Configurations							
Traffic Volume (vph)	46	3	5	415	385	3	
Future Volume (vph)	46	3	5	415	385	3	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Right Turn on Red		Yes				Yes	
Link Speed (mph)	30			30	30		
Link Distance (ft)	617			535	214		
Travel Time (s)	14.0			12.2	4.9		
Confl. Peds. (#/hr)	2						
Peak Hour Factor	0.82	0.75	0.62	0.95	0.90	0.75	
Heavy Vehicles (%)	4%	0%	0%	3%	2%	0%	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	60	0	0	445	432	0	
Turn Type	Prot		Perm	NA	NA		
Protected Phases	2			3	1 3		1
Permitted Phases			3				
Detector Phase	2		3	3	1 3		
Switch Phase							
Minimum Initial (s)	6.0		10.0	10.0			5.0
Minimum Split (s)	20.0		15.0	15.0			10.0
Total Split (s)	29.0		46.0	46.0			25.0
Total Split (%)	29.0%		46.0%	46.0%			25%
Yellow Time (s)	4.0		4.0	4.0			4.0
All-Red Time (s)	1.0		1.0	1.0			1.0
Lost Time Adjust (s)	0.0			0.0			
Total Lost Time (s)	5.0			5.0			
Lead/Lag	Lag						Lead
Lead-Lag Optimize?	Yes						Yes
Recall Mode	None		None	None			C-Max
Act Effect Green (s)	8.2			20.2	85.0		
Actuated g/C Ratio	0.08			0.20	0.85		
v/c Ratio	0.43			0.69	0.15		
Control Delay	50.9			42.1	3.4		
Queue Delay	0.0			0.8	0.3		
Total Delay	50.9			42.9	3.7		
LOS	D			D	A		
Approach Delay	50.9			42.9	3.7		
Approach LOS	D			D	A		
Queue Length 50th (ft)	35			139	42		
Queue Length 95th (ft)	67			176	m56		
Internal Link Dist (ft)	537			455	134		
Turn Bay Length (ft)							
Base Capacity (vph)	404			1312	2906		
Starvation Cap Reductn	0			0	1870		
Spillback Cap Reductn	10			554	0		
Storage Cap Reductn	0			0	0		
Reduced v/c Ratio	0.15			0.59	0.42		

Intersection Summary

Intersection Capacity Analysis Lee St & Lee Street Extension

07/16/2019

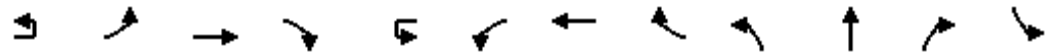
Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 71 (71%), Referenced to phase 1:SBT, Start of Yellow
Natural Cycle: 45
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.69
Intersection Signal Delay: 25.3 Intersection LOS: C
Intersection Capacity Utilization 28.3% ICU Level of Service A
Analysis Period (min) 15
Description: 1 / 0 / 2
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 6: Lee St & Lee Street Extension



Intersection Capacity Analysis
 Heath St/Chestnut Hill Ave & Route 9

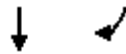
07/16/2019



Lane Group	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations		↔	↕↕			↔	↕↕	↗				↖
Traffic Volume (vph)	13	294	983	0	2	48	1059	321	0	0	0	315
Future Volume (vph)	13	294	983	0	2	48	1059	321	0	0	0	315
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	11	11	11	12	11	11	11	11	11
Storage Length (ft)		250		0		175		225	0		0	125
Storage Lanes		1		0		1		1	0		0	1
Taper Length (ft)		100				100			0			100
Right Turn on Red				Yes				Yes			Yes	
Link Speed (mph)			30				30			30		
Link Distance (ft)			495				363			179		
Travel Time (s)			11.3				8.3			4.1		
Confl. Peds. (#/hr)	2	2				2		2				
Peak Hour Factor	0.46	0.94	0.91	0.92	0.50	0.75	0.95	0.94	0.92	0.92	0.92	0.88
Heavy Vehicles (%)	0%	1%	1%	2%	0%	0%	2%	5%	2%	2%	2%	5%
Shared Lane Traffic (%)												10%
Lane Group Flow (vph)	0	341	1080	0	0	68	1115	341	0	0	0	322
Turn Type	Prot	Prot	NA		Prot	Prot	NA	custom				Split
Protected Phases	4	4	1 4 5		2	2	1 2 5	1 2 3				3
Permitted Phases												
Detector Phase	4	4	1 4 5		2	2	1 2 5	1 2 3				3
Switch Phase												
Minimum Initial (s)	5.0	5.0			5.0	5.0						5.0
Minimum Split (s)	10.0	10.0			10.0	10.0						23.0
Total Split (s)	23.0	23.0			18.0	18.0						30.0
Total Split (%)	23.0%	23.0%			18.0%	18.0%						30.0%
Yellow Time (s)	4.0	4.0			4.0	4.0						4.0
All-Red Time (s)	1.0	1.0			1.0	1.0						1.0
Lost Time Adjust (s)		0.0				0.0						0.0
Total Lost Time (s)		5.0				5.0						5.0
Lead/Lag	Lag	Lag			Lag	Lag						Lead
Lead-Lag Optimize?	Yes	Yes			Yes	Yes						Yes
Recall Mode	None	None			Max	Max						None
Act Effect Green (s)		19.7	48.7			13.0	42.0	51.3				23.3
Actuated g/C Ratio		0.20	0.49			0.13	0.42	0.51				0.23
v/c Ratio		1.00	0.62			0.30	0.75	0.37				0.88
Control Delay		92.5	21.3			42.9	29.0	8.0				61.5
Queue Delay		0.0	0.1			0.0	2.4	0.5				0.0
Total Delay		92.5	21.4			42.9	31.5	8.6				61.5
LOS		F	C			D	C	A				E
Approach Delay			38.4				26.8					
Approach LOS			D				C					
Queue Length 50th (ft)		~247	265			43	344	51				204
Queue Length 95th (ft)		#421	336			71	427	135				#338
Internal Link Dist (ft)			415				283			99		
Turn Bay Length (ft)		250				175		225				125
Base Capacity (vph)		340	1738			226	1486	948				394
Starvation Cap Reductn		0	0			0	243	286				0
Spillback Cap Reductn		0	92			0	0	0				0

Intersection Capacity Analysis
 Heath St/Chestnut Hill Ave & Route 9

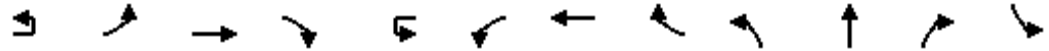
07/16/2019



Lane Group	SBT	SBR	Ø1	Ø5
Lane Configurations	↕			
Traffic Volume (vph)	27	285		
Future Volume (vph)	27	285		
Ideal Flow (vphpl)	1900	1900		
Lane Width (ft)	11	11		
Storage Length (ft)		100		
Storage Lanes		0		
Taper Length (ft)				
Right Turn on Red		Yes		
Link Speed (mph)	30			
Link Distance (ft)	916			
Travel Time (s)	20.8			
Confl. Peds. (#/hr)		2		
Peak Hour Factor	0.75	0.90		
Heavy Vehicles (%)	11%	1%		
Shared Lane Traffic (%)				
Lane Group Flow (vph)	389	0		
Turn Type	NA			
Protected Phases	3		1	5
Permitted Phases				
Detector Phase	3			
Switch Phase				
Minimum Initial (s)	5.0		1.0	5.0
Minimum Split (s)	23.0		6.0	19.0
Total Split (s)	30.0		10.0	19.0
Total Split (%)	30.0%		10%	19%
Yellow Time (s)	4.0		4.0	2.0
All-Red Time (s)	1.0		1.0	1.0
Lost Time Adjust (s)	0.0			
Total Lost Time (s)	5.0			
Lead/Lag	Lead		Lead	
Lead-Lag Optimize?	Yes		Yes	
Recall Mode	None		C-Max	None
Act Effct Green (s)	23.3			
Actuated g/C Ratio	0.23			
v/c Ratio	0.77			
Control Delay	27.0			
Queue Delay	0.1			
Total Delay	27.2			
LOS	C			
Approach Delay	42.7			
Approach LOS	D			
Queue Length 50th (ft)	109			
Queue Length 95th (ft)	149			
Internal Link Dist (ft)	836			
Turn Bay Length (ft)				
Base Capacity (vph)	526			
Starvation Cap Reductn	0			
Spillback Cap Reductn	5			

Intersection Capacity Analysis
 Heath St/Chestnut Hill Ave & Route 9

07/16/2019

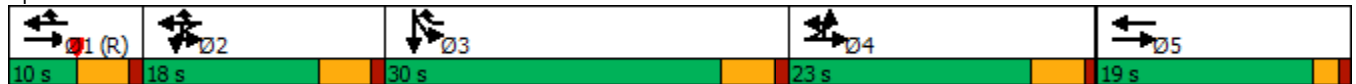


Lane Group	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Storage Cap Reductn		0	0			0	0	0				0
Reduced v/c Ratio		1.00	0.66			0.30	0.90	0.52				0.82

Intersection Summary

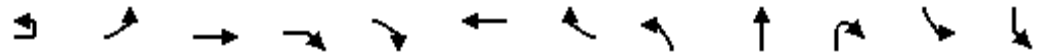
Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 0 (0%), Referenced to phase 1:EBWB, Start of Yellow, Master Intersection
 Natural Cycle: 80
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 1.00
 Intersection Signal Delay: 34.4
 Intersection LOS: C
 Intersection Capacity Utilization 77.0%
 ICU Level of Service D
 Analysis Period (min) 15
 Description: ø3 (EB+WB): 9 / 2 / 2
 ø5 (SB): 12 / 2 / 2
 ~ 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.

Splits and Phases: 7: Heath St/Chestnut Hill Ave & Route 9



Intersection Capacity Analysis
Reservoir Rd & Route 9

07/16/2019



Lane Group	EBU	EBL	EBT	EBR	EBR2	WBT	WBR	NBL	NBT	NBR2	SBL2	SBL
Lane Configurations												
Traffic Volume (vph)	10	17	1363	14	4	1328	14	4	0	1	9	4
Future Volume (vph)	10	17	1363	14	4	1328	14	4	0	1	9	4
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)		250		0			0	0				0
Storage Lanes		1		0			0	0				0
Taper Length (ft)		100						0				0
Right Turn on Red					Yes		Yes			Yes		
Link Speed (mph)			30			30			30			
Link Distance (ft)			977			709			527			
Travel Time (s)			22.2			16.1			12.0			
Confl. Peds. (#/hr)		3		4	1		3			4	1	4
Peak Hour Factor	0.62	0.71	0.96	0.70	0.33	0.96	0.70	0.50	0.92	0.25	0.75	0.50
Heavy Vehicles (%)	0%	0%	1%	0%	0%	2%	0%	0%	0%	0%	0%	0%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	40	1452	0	0	1403	0	0	12	0	0	0
Turn Type	Prot	Prot	NA			NA		Perm	NA		Perm	Perm
Protected Phases	5	5	2			6			8			
Permitted Phases								8			4	4
Detector Phase	5	5	2			6		8	8		4	4
Switch Phase												
Minimum Initial (s)	6.0	6.0	6.0			6.0		6.0	6.0		6.0	6.0
Minimum Split (s)	12.0	12.0	12.0			12.0		11.0	11.0		11.0	11.0
Total Split (s)	20.0	20.0	46.0			26.0		25.0	25.0		25.0	25.0
Total Split (%)	20.0%	20.0%	46.0%			26.0%		25.0%	25.0%		25.0%	25.0%
Yellow Time (s)	4.0	4.0	4.0			4.0		4.0	4.0		4.0	4.0
All-Red Time (s)	2.0	2.0	2.0			2.0		1.0	1.0		1.0	1.0
Lost Time Adjust (s)		0.0	0.0			0.0			0.0			
Total Lost Time (s)		6.0	6.0			6.0			5.0			
Lead/Lag	Lead	Lead				Lag						
Lead-Lag Optimize?	Yes	Yes				Yes						
Recall Mode	None	None	C-Min			C-Min		None	None		None	None
Act Effect Green (s)		7.9	84.0			75.0			6.0			
Actuated g/C Ratio		0.08	0.84			0.75			0.06			
v/c Ratio		0.29	0.50			0.55			0.06			
Control Delay		48.2	6.8			13.6			0.6			
Queue Delay		0.0	0.0			0.0			0.0			
Total Delay		48.2	6.8			13.6			0.6			
LOS		D	A			B			A			
Approach Delay			8.0			13.6			0.6			
Approach LOS			A			B			A			
Queue Length 50th (ft)		25	101			215			0			
Queue Length 95th (ft)		44	460			#674			0			
Internal Link Dist (ft)			897			629			447			
Turn Bay Length (ft)		250										
Base Capacity (vph)		244	2893			2561			417			
Starvation Cap Reductn		0	0			0			0			
Spillback Cap Reductn		0	0			0			0			
Storage Cap Reductn		0	0			0			0			

Intersection Capacity Analysis
Reservoir Rd & Route 9

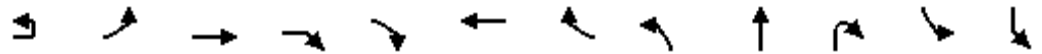
07/16/2019



Lane Group	SBT	SBR	NWR2	Ø9
Lane Configurations	↕		↗	
Traffic Volume (vph)	0	6	8	
Future Volume (vph)	0	6	8	
Ideal Flow (vphpl)	1900	1900	1900	
Storage Length (ft)		0		
Storage Lanes		0		
Taper Length (ft)				
Right Turn on Red		Yes	Yes	
Link Speed (mph)	30			
Link Distance (ft)	854			
Travel Time (s)	19.4			
Confl. Peds. (#/hr)			1	
Peak Hour Factor	0.92	0.50	0.50	
Heavy Vehicles (%)	0%	0%	0%	
Shared Lane Traffic (%)				
Lane Group Flow (vph)	32	0	16	
Turn Type	NA		Perm	
Protected Phases	4			9
Permitted Phases			2 4	
Detector Phase	4		2 4	
Switch Phase				
Minimum Initial (s)	6.0			5.0
Minimum Split (s)	11.0			29.0
Total Split (s)	25.0			29.0
Total Split (%)	25.0%			29%
Yellow Time (s)	4.0			2.0
All-Red Time (s)	1.0			0.0
Lost Time Adjust (s)	0.0			
Total Lost Time (s)	5.0			
Lead/Lag				
Lead-Lag Optimize?				
Recall Mode	None			None
Act Effect Green (s)	6.0		93.0	
Actuated g/C Ratio	0.06		0.93	
v/c Ratio	0.16		0.01	
Control Delay	1.6		0.0	
Queue Delay	0.0		0.0	
Total Delay	1.6		0.0	
LOS	A		A	
Approach Delay	1.6			
Approach LOS	A			
Queue Length 50th (ft)	0		0	
Queue Length 95th (ft)	0		0	
Internal Link Dist (ft)	774			
Turn Bay Length (ft)				
Base Capacity (vph)	408		1535	
Starvation Cap Reductn	0		0	
Spillback Cap Reductn	0		0	
Storage Cap Reductn	0		0	

Intersection Capacity Analysis Reservoir Rd & Route 9

07/16/2019

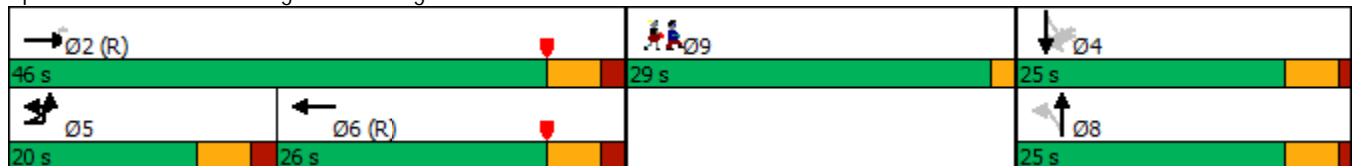


Lane Group	EBU	EBL	EBT	EBR	EBR2	WBT	WBR	NBL	NBT	NBR2	SBL2	SBL
Reduced v/c Ratio		0.16	0.50			0.55			0.03			

Intersection Summary

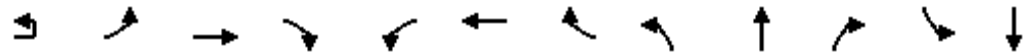
Area Type:	Other
Cycle Length:	100
Actuated Cycle Length:	100
Offset:	75 (75%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow
Natural Cycle:	90
Control Type:	Actuated-Coordinated
Maximum v/c Ratio:	0.55
Intersection Signal Delay:	10.5
Intersection LOS:	B
Intersection Capacity Utilization	62.4%
ICU Level of Service	B
Analysis Period (min)	15
Description:	43 / 13 / 1
# 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.	

Splits and Phases: 9: Longwood Parking Lot & Reservoir Rd & Route 9



Intersection Capacity Analysis
Hammond St & Route 9

07/16/2019



Lane Group	EBU	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Traffic Volume (vph)	9	158	1058	45	145	1175	59	152	197	62	118	231
Future Volume (vph)	9	158	1058	45	145	1175	59	152	197	62	118	231
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	11	11	12	11	11	11	11	11	11
Storage Length (ft)		550		0	300		150	0		0	125	
Storage Lanes		1		0	1		1	0		0	1	
Taper Length (ft)		100			100			0			100	
Right Turn on Red				Yes			Yes			Yes		
Link Speed (mph)			30			30			30			30
Link Distance (ft)			726			711			307			575
Travel Time (s)			16.5			16.2			7.0			13.1
Confl. Peds. (#/hr)	19	11		7	7		11	19		18	18	
Peak Hour Factor	0.56	0.96	0.88	0.87	0.93	0.96	0.78	0.97	0.83	0.74	0.78	0.86
Heavy Vehicles (%)	0%	1%	1%	0%	3%	1%	3%	1%	3%	2%	3%	2%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	181	1254	0	156	1224	76	0	478	0	151	269
Turn Type	Prot	Prot	NA		Prot	NA	Prot	Perm	NA		Perm	NA
Protected Phases	1	1	6		5	2	2		4			8
Permitted Phases									4			8
Detector Phase	1	1	6		5	2	2	4	4		8	8
Switch Phase												
Minimum Initial (s)	6.0	6.0	6.0		6.0	10.0	10.0	6.0	6.0		6.0	6.0
Minimum Split (s)	12.0	12.0	31.0		12.0	33.0	33.0	30.0	30.0		29.0	29.0
Total Split (s)	19.0	19.0	51.0		19.0	51.0	51.0	30.0	30.0		30.0	30.0
Total Split (%)	14.6%	14.6%	39.2%		14.6%	39.2%	39.2%	23.1%	23.1%		23.1%	23.1%
Yellow Time (s)	4.0	4.0	4.0		4.0	4.0	4.0	3.0	3.0		3.0	3.0
All-Red Time (s)	2.0	2.0	2.0		2.0	2.0	2.0	3.0	3.0		3.0	3.0
Lost Time Adjust (s)		0.0	0.0		0.0	0.0	0.0		0.0		0.0	0.0
Total Lost Time (s)		6.0	6.0		6.0	6.0	6.0		6.0		6.0	6.0
Lead/Lag	Lead	Lead	Lag		Lead	Lag	Lag					
Lead-Lag Optimize?	Yes	Yes	Yes		Yes	Yes	Yes					
Recall Mode	None	None	C-Min		None	C-Min	C-Min	None	None		None	None
Act Effect Green (s)		13.0	45.0		13.0	45.0	45.0		24.0		24.0	24.0
Actuated g/C Ratio		0.10	0.35		0.10	0.35	0.35		0.18		0.18	0.18
v/c Ratio		1.05	1.02		0.92	0.99	0.13		2.28dl		0.97	0.81
Control Delay		138.5	72.3		109.4	65.5	1.1		187.5		118.7	70.3
Queue Delay		0.0	0.0		0.0	0.0	0.0		0.0		0.0	0.0
Total Delay		138.5	72.3		109.4	65.5	1.1		187.5		118.7	70.3
LOS		F	E		F	E	A		F		F	E
Approach Delay			80.6			66.8			187.5			65.1
Approach LOS			F			E			F			E
Queue Length 50th (ft)		~166	~586		132	537	0		~265		128	220
Queue Length 95th (ft)		#316	#699		#268	#696	0		#337		#214	#327
Internal Link Dist (ft)			646			631			227			495
Turn Bay Length (ft)		550			300		150				125	
Base Capacity (vph)		172	1231		169	1237	607		372		155	332
Starvation Cap Reductn		0	0		0	0	0		0		0	0
Spillback Cap Reductn		0	0		0	0	0		0		0	0

Intersection Capacity Analysis

Hammond St & Route 9

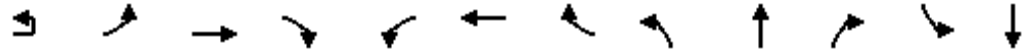
07/16/2019

Lane Group	SBR
Lane Configurations	
Traffic Volume (vph)	156
Future Volume (vph)	156
Ideal Flow (vphpl)	1900
Lane Width (ft)	11
Storage Length (ft)	125
Storage Lanes	1
Taper Length (ft)	
Right Turn on Red	Yes
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	19
Peak Hour Factor	0.81
Heavy Vehicles (%)	1%
Shared Lane Traffic (%)	
Lane Group Flow (vph)	193
Turn Type	custom
Protected Phases	8
Permitted Phases	1
Detector Phase	8
Switch Phase	
Minimum Initial (s)	6.0
Minimum Split (s)	29.0
Total Split (s)	30.0
Total Split (%)	23.1%
Yellow Time (s)	3.0
All-Red Time (s)	3.0
Lost Time Adjust (s)	0.0
Total Lost Time (s)	6.0
Lead/Lag	
Lead-Lag Optimize?	
Recall Mode	None
Act Effect Green (s)	37.0
Actuated g/C Ratio	0.28
v/c Ratio	0.38
Control Delay	16.0
Queue Delay	0.0
Total Delay	16.0
LOS	B
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	48
Queue Length 95th (ft)	90
Internal Link Dist (ft)	
Turn Bay Length (ft)	125
Base Capacity (vph)	513
Starvation Cap Reductn	0
Spillback Cap Reductn	0

Existing Saturday

Intersection Capacity Analysis Hammond St & Route 9

07/16/2019

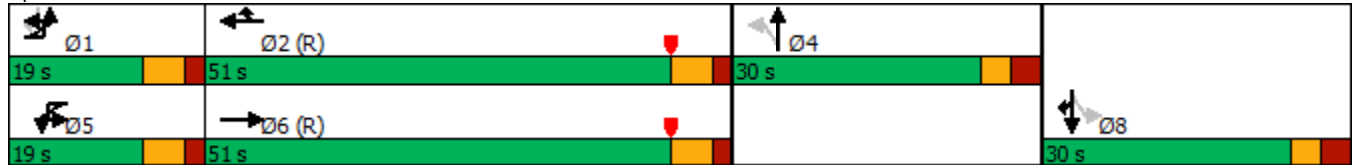


Lane Group	EBU	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Storage Cap Reductn		0	0		0	0	0		0		0	0
Reduced v/c Ratio		1.05	1.02		0.92	0.99	0.13		1.28		0.97	0.81

Intersection Summary

Area Type: Other
 Cycle Length: 130
 Actuated Cycle Length: 130
 Offset: 0 (0%), Referenced to phase 2:WBT and 6:EBT, Start of Yellow
 Natural Cycle: 135
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 1.28
 Intersection Signal Delay: 86.0
 Intersection LOS: F
 Intersection Capacity Utilization 92.8%
 ICU Level of Service F
 Analysis Period (min) 15
 Description: ø2 (SB): 8 / 7 / 11
 ø4 (WB): 19 / 23 / 18
 ø6 (NB): 5 / 15 / 7
 ø8 (EB): 26 / 28 / 19
 ~ 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.
 dl Defacto Left Lane. Recode with 1 though lane as a left lane.

Splits and Phases: 13: Hammond St & Route 9



Intersection Capacity Analysis
Hammond St & Heath St

07/16/2019



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↔			↔			↔	
Traffic Volume (vph)	0	0	0	45	15	64	14	345	98	22	384	24
Future Volume (vph)	0	0	0	45	15	64	14	345	98	22	384	24
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		436			675			648			307	
Travel Time (s)		9.9			15.3			14.7			7.0	
Confl. Peds. (#/hr)						22	12		9	9		12
Peak Hour Factor	0.92	0.92	0.92	0.75	0.75	0.84	0.70	0.94	0.63	0.79	0.92	0.50
Heavy Vehicles (%)	2%	2%	2%	2%	0%	3%	0%	1%	1%	14%	2%	4%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	156	0	0	543	0	0	493	0
Turn Type				Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases					8			2		1	6	
Permitted Phases				8			2			6		
Detector Phase				8	8		2	2		1	6	
Switch Phase												
Minimum Initial (s)				6.0	6.0		6.0	6.0		6.0	6.0	
Minimum Split (s)				16.0	16.0		17.0	17.0		13.0	17.0	
Total Split (s)				35.0	35.0		50.0	50.0		45.0	95.0	
Total Split (%)				26.9%	26.9%		38.5%	38.5%		34.6%	73.1%	
Yellow Time (s)				3.0	3.0		4.0	4.0		4.0	4.0	
All-Red Time (s)				3.0	3.0		3.0	3.0		3.0	3.0	
Lost Time Adjust (s)					0.0			0.0			0.0	
Total Lost Time (s)					6.0			7.0			7.0	
Lead/Lag							Lead	Lead		Lag		
Lead-Lag Optimize?							Yes	Yes		Yes		
Recall Mode				None	None		C-Min	C-Min		None	C-Min	
Act Effct Green (s)					14.7			102.3			102.3	
Actuated g/C Ratio					0.11			0.79			0.79	
v/c Ratio					0.75			0.23			0.21	
Control Delay					64.6			3.9			8.0	
Queue Delay					0.0			0.0			1.0	
Total Delay					64.6			3.9			8.9	
LOS					E			A			A	
Approach Delay					64.6			3.9			8.9	
Approach LOS					E			A			A	
Queue Length 50th (ft)					101			46			107	
Queue Length 95th (ft)					132			83			m118	
Internal Link Dist (ft)		356			595			568			227	
Turn Bay Length (ft)												
Base Capacity (vph)					376			2360			2341	
Starvation Cap Reductn					0			0			1527	
Spillback Cap Reductn					0			0			0	
Storage Cap Reductn					0			0			0	
Reduced v/c Ratio					0.41			0.23			0.61	

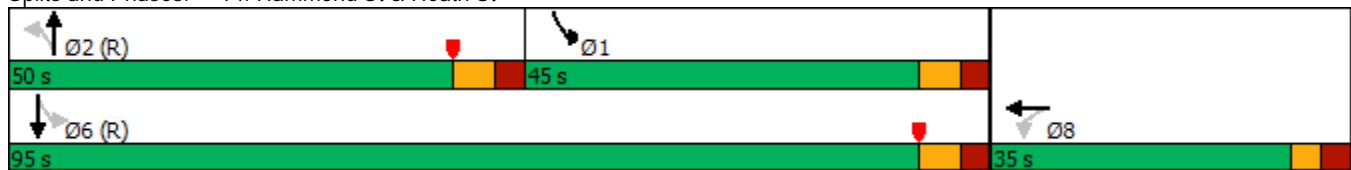
Intersection Summary

Intersection Capacity Analysis Hammond St & Heath St

07/16/2019

Area Type: Other
 Cycle Length: 130
 Actuated Cycle Length: 130
 Offset: 90 (69%), Referenced to phase 2:NBTL and 6:SBTL, Start of Yellow
 Natural Cycle: 50
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.75
 Intersection Signal Delay: 13.9 Intersection LOS: B
 Intersection Capacity Utilization 47.1% ICU Level of Service A
 Analysis Period (min) 15
 Description: ø2 (WB): 6 / 6 / 9
 ø6 (EB): 17 / 19 / 12
 ø8 (SB): 8 / 6 / 22
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 14: Hammond St & Heath St



Intersection Capacity Analysis
Tully St & Route 9

07/16/2019



Lane Group	EBU	EBT	EBR	WBU	WBL	WBT	NBL	NBR	Ø9
Lane Configurations									
Traffic Volume (vph)	151	1395	21	6	6	1258	16	16	
Future Volume (vph)	151	1395	21	6	6	1258	16	16	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	
Lane Width (ft)	11	12	11	11	11	12	11	11	
Storage Length (ft)	250		0		150		0	0	
Storage Lanes	1		0		1		1	0	
Taper Length (ft)	100				100		0		
Right Turn on Red			Yes					Yes	
Link Speed (mph)		30				30	30		
Link Distance (ft)		898				297	462		
Travel Time (s)		20.4				6.8	10.5		
Confl. Peds. (#/hr)	13		20		20		13		
Peak Hour Factor	0.94	0.92	0.66	0.50	0.38	0.89	0.67	0.67	
Heavy Vehicles (%)	1%	1%	0%	0%	0%	2%	0%	6%	
Shared Lane Traffic (%)									
Lane Group Flow (vph)	161	1548	0	0	28	1413	48	0	
Turn Type	Prot	NA		Prot	Prot	NA	Prot		
Protected Phases	5	2		1	1	6	8		9
Permitted Phases									
Detector Phase	5	2		1	1	6	8		
Switch Phase									
Minimum Initial (s)	6.0	10.0		6.0	6.0	10.0	1.0		5.0
Minimum Split (s)	12.0	23.0		12.0	12.0	23.0	7.0		32.0
Total Split (s)	19.0	59.0		19.0	19.0	59.0	20.0		32.0
Total Split (%)	14.6%	45.4%		14.6%	14.6%	45.4%	15.4%		25%
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	3.0		2.0
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	3.0		1.0
Lost Time Adjust (s)	0.0	0.0			0.0	0.0	0.0		
Total Lost Time (s)	6.0	6.0			6.0	6.0	6.0		
Lead/Lag	Lead	Lag		Lead	Lead	Lag			
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes			
Recall Mode	None	C-Min		None	None	C-Min	Min		None
Act Effect Green (s)	16.6	89.2			7.1	74.8	7.7		
Actuated g/C Ratio	0.13	0.69			0.05	0.58	0.06		
v/c Ratio	0.73	0.63			0.30	0.69	0.40		
Control Delay	73.8	18.9			66.7	25.9	44.2		
Queue Delay	0.0	0.0			0.0	49.3	0.0		
Total Delay	73.8	18.9			66.7	75.2	44.2		
LOS	E	B			E	E	D		
Approach Delay		24.1				75.0	44.3		
Approach LOS		C				E	D		
Queue Length 50th (ft)	130	258			23	328	20		
Queue Length 95th (ft)	#242	#813			23	#760	39		
Internal Link Dist (ft)		818				217	382		
Turn Bay Length (ft)	250				150				
Base Capacity (vph)	221	2443			174	2036	196		
Starvation Cap Reductn	0	0			0	934	0		
Spillback Cap Reductn	0	0			0	0	0		

Intersection Capacity Analysis

Tully St & Route 9

07/16/2019

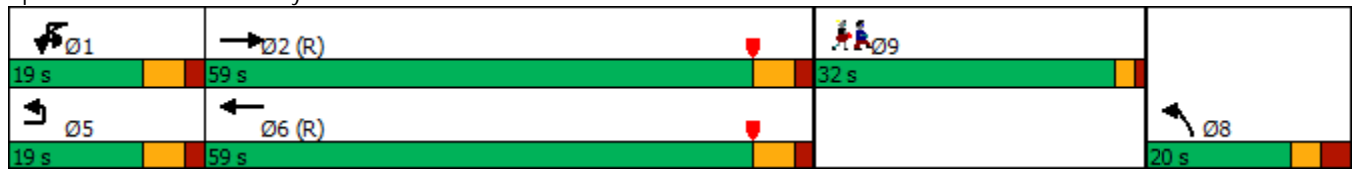


Lane Group	EBU	EBT	EBR	WBU	WBL	WBT	NBL	NBR	Ø9
Storage Cap Reductn	0	0			0	0	0		
Reduced v/c Ratio	0.73	0.63			0.16	1.28	0.24		

Intersection Summary

Area Type:	Other
Cycle Length:	130
Actuated Cycle Length:	130
Offset:	4 (3%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow
Natural Cycle:	100
Control Type:	Actuated-Coordinated
Maximum v/c Ratio:	0.73
Intersection Signal Delay:	47.3
Intersection LOS:	D
Intersection Capacity Utilization	62.6%
ICU Level of Service	B
Analysis Period (min)	15
Description:	0 / 5 / 13
# 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.	

Splits and Phases: 15: Tully St & Route 9



APPENDIX E

**Route 9 On-Street Parking Signage and Estimated Spaces
March 2019**

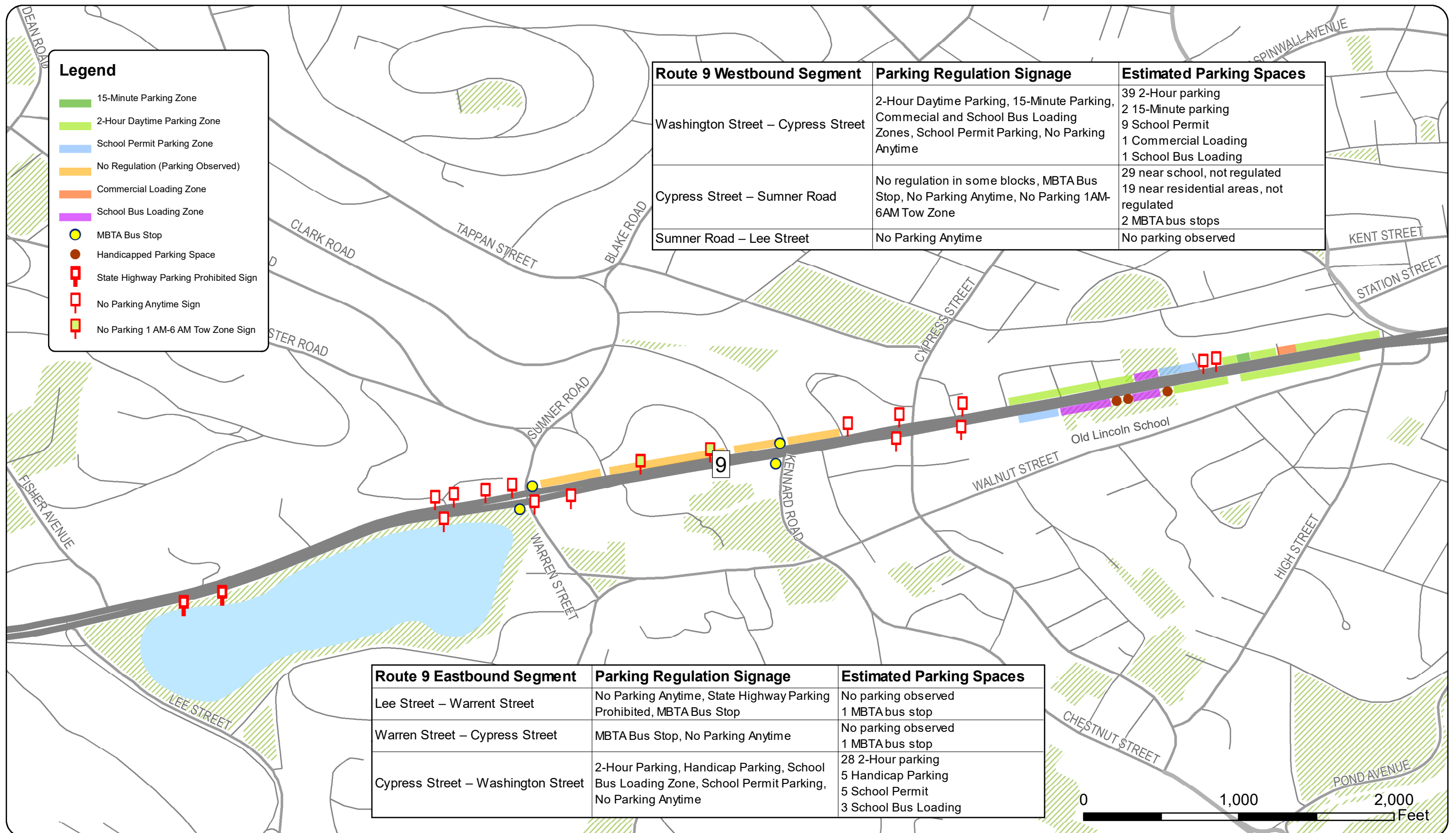
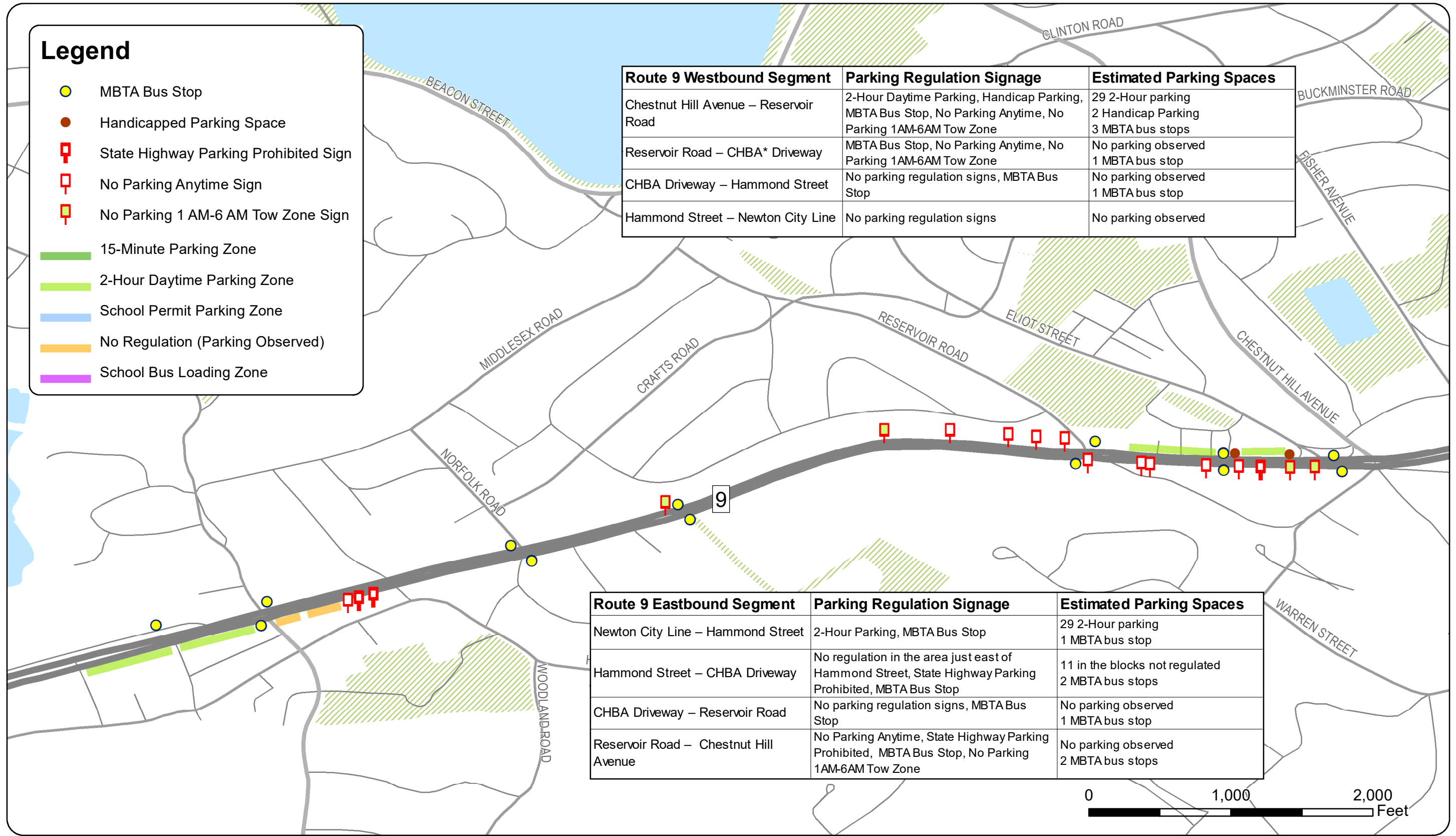


Figure E-1
Observed On-Street Parking Signage and Estimated parking Spaces (March, 2019)
Route 9 in Brookline



Legend

- MBTA Bus Stop
- Handicapped Parking Space
- ⏏ State Highway Parking Prohibited Sign
- ⏏ No Parking Anytime Sign
- ⏏ No Parking 1 AM-6 AM Tow Zone Sign
- 15-Minute Parking Zone
- 2-Hour Daytime Parking Zone
- School Permit Parking Zone
- No Regulation (Parking Observed)
- School Bus Loading Zone

Route 9 Westbound Segment	Parking Regulation Signage	Estimated Parking Spaces
Chestnut Hill Avenue – Reservoir Road	2-Hour Daytime Parking, Handicap Parking, MBTA Bus Stop, No Parking Anytime, No Parking 1AM-6AM Tow Zone	29 2-Hour parking 2 Handicap Parking 3 MBTA bus stops
Reservoir Road – CHBA* Driveway	MBTA Bus Stop, No Parking Anytime, No Parking 1AM-6AM Tow Zone	No parking observed 1 MBTA bus stop
CHBA Driveway – Hammond Street	No parking regulation signs, MBTA Bus Stop	No parking observed 1 MBTA bus stop
Hammond Street – Newton City Line	No parking regulation signs	No parking observed

Route 9 Eastbound Segment	Parking Regulation Signage	Estimated Parking Spaces
Newton City Line – Hammond Street	2-Hour Parking, MBTA Bus Stop	29 2-Hour parking 1 MBTA bus stop
Hammond Street – CHBA Driveway	No regulation in the area just east of Hammond Street, State Highway Parking Prohibited, MBTA Bus Stop	11 in the blocks not regulated 2 MBTA bus stops
CHBA Driveway – Reservoir Road	No parking regulation signs, MBTA Bus Stop	No parking observed 1 MBTA bus stop
Reservoir Road – Chestnut Hill Avenue	No Parking Anytime, State Highway Parking Prohibited, MBTA Bus Stop, No Parking 1AM-6AM Tow Zone	No parking observed 2 MBTA bus stops



Figure E-2
Observed Parking Signage and Estimated Parking Spaces (March, 2019)
Route 9 in Brookline

APPENDIX F

Corridor and Intersection Crash Rate Worksheets

SEGMENT CRASH RATE WORKSHEET

CITY/TOWN : Brookline COUNT DATE : 11/29/2018

DISTRICT : 6

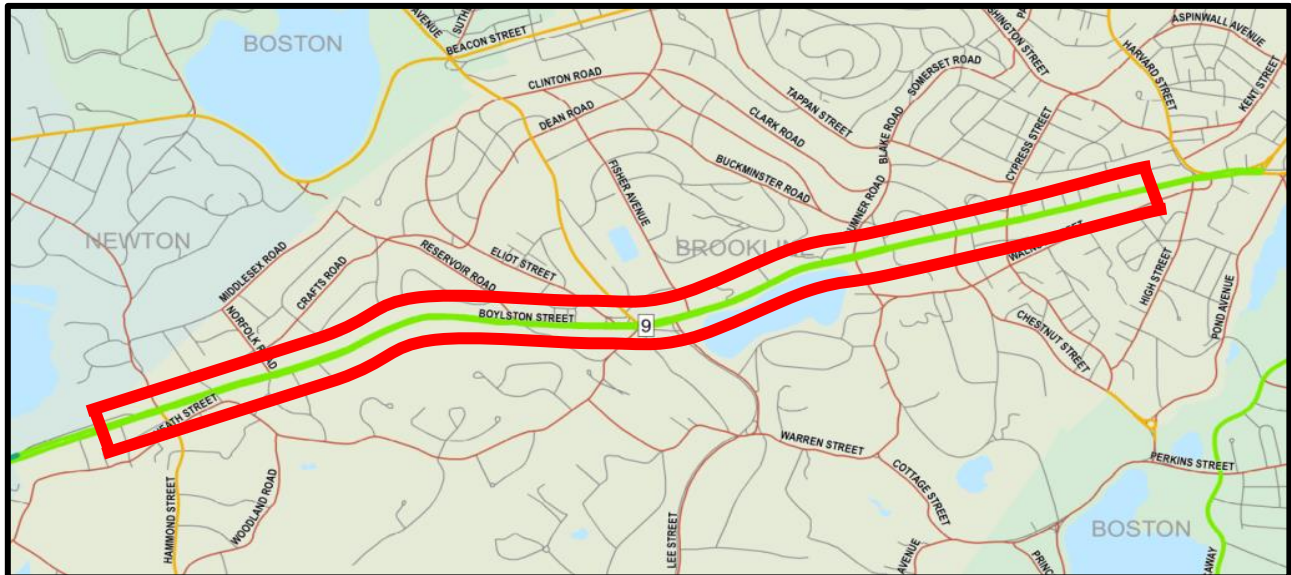
~ SEGMENT DATA ~

ROADWAY NAME: Boylston Street (Route 9)

START POINT: West of High Street

END POINT: Newton Town Line

FUNCTIONAL CLASSIFICATION OF ROADWAY: Principal Arterial - Other



SEGMENT LENGTH IN MILES (L): **2.64**

AVERAGE DAILY TRAFFIC VOLUME (V): **37,700**

TOTAL # OF CRASHES: **269** # OF YEARS : **5.67** AVERAGE # OF CRASHES PER YEAR (A): **47.47**

CRASH RATE CALCULATION : **1.31** RATE = $\frac{(A * 1,000,000)}{(L * V * 365)}$

Comments : 2016 State Average for Urban Principal Arterial - Other = 3.49

Project Title & Date: Route 9 Priority Roadways Improvement Study

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Brookline COUNT DATE : 11/29/2018

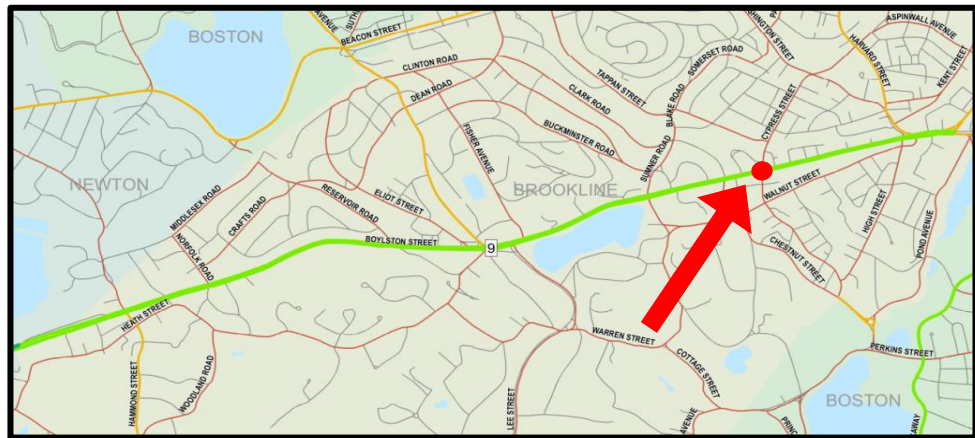
DISTRICT : 6 UNSIGNALIZED : SIGNALIZED :

~ INTERSECTION DATA ~

MAJOR STREET : Route 9 (Boylston Street)

MINOR STREET(S) : Cypress Street

**INTERSECTION
DIAGRAM**



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	EB	WB	NB	SB		
PEAK HOURLY VOLUMES (AM/PM) :	1,214	946	388	487		3,034

" K " FACTOR : INTERSECTION ADT (V) = TOTAL DAILY APPROACH VOLUME :

TOTAL # OF CRASHES :	<input type="text" value="25"/>	# OF YEARS :	<input type="text" value="5.67"/>	AVERAGE # OF CRASHES PER YEAR (A) :	<input type="text" value="4.41"/>
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CRASH RATE CALCULATION : RATE = $\frac{(A * 1,000,000)}{(V * 365)}$

Comments : 2016 District 6 average for signalized intersections = 0.71
 Project Title & Date: Route 9 Priority Roadways Improvement Study

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Brookline COUNT DATE : 11/29/2018

DISTRICT : 6 UNSIGNALIZED : SIGNALIZED :

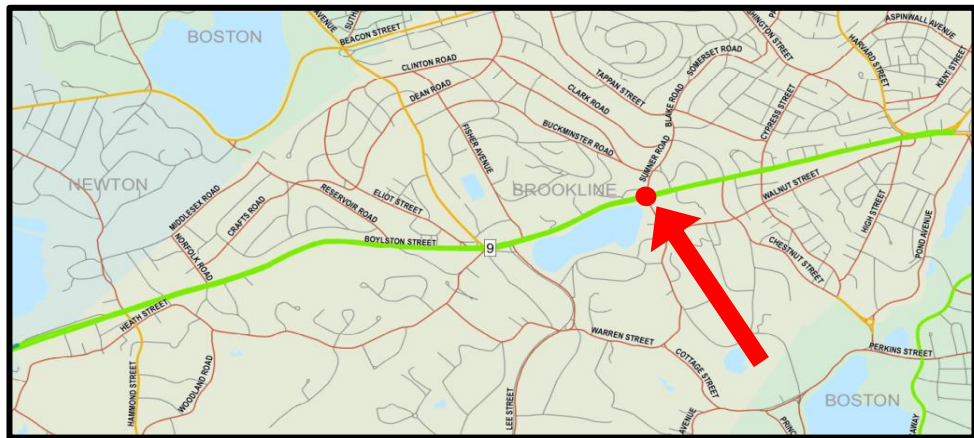
~ INTERSECTION DATA ~

MAJOR STREET : Route 9 (Boylston Street)

MINOR STREET(S) : Warren Street

Sumner Road

**INTERSECTION
DIAGRAM**



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	EB	WB	NB	SB		
PEAK HOURLY VOLUMES (AM/PM) :	1,401	1,144	335	385		3,264

" K " FACTOR : INTERSECTION ADT (V) = TOTAL DAILY APPROACH VOLUME :

TOTAL # OF CRASHES : # OF YEARS : AVERAGE # OF CRASHES PER YEAR (A) :

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

Comments : 2016 District 6 average for signalized intersections = 0.71
 Project Title & Date: Route 9 Priority Roadways Improvement Study

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Brookline COUNT DATE : 11/29/2018

DISTRICT : 6 UNSIGNALIZED : SIGNALIZED :

~ INTERSECTION DATA ~

MAJOR STREET : Route 9 (Boylston Street)

MINOR STREET(S) : Lee Street

**INTERSECTION
DIAGRAM**



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	EB	WB	NB			
PEAK HOURLY VOLUMES (AM/PM) :	1,703	1,230	901			3,834

" K " FACTOR : INTERSECTION ADT (V) = TOTAL DAILY APPROACH VOLUME :

TOTAL # OF CRASHES : # OF YEARS : AVERAGE # OF CRASHES PER YEAR (A) :

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

Comments : 2016 District 6 average for signalized intersections = 0.71
 Project Title & Date: Route 9 Priority Roadways Improvement Study

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Brookline COUNT DATE : 11/29/2018

DISTRICT : 6 UNSIGNALIZED : SIGNALIZED :

~ INTERSECTION DATA ~

MAJOR STREET : Route 9 (Boylston Street)

MINOR STREET(S) : Chestnut Hill Avenue

INTERSECTION
DIAGRAM



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	EB	WB	SB			
PEAK HOURLY VOLUMES (AM/PM) :	1,524	1,820	752			4,096

" K " FACTOR : **0.090** INTERSECTION ADT (V) = TOTAL DAILY APPROACH VOLUME : **45,506**

TOTAL # OF CRASHES :	27	# OF YEARS :	5.67	AVERAGE # OF CRASHES PER YEAR (A) :	4.76
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CRASH RATE CALCULATION : **0.29** RATE = $\frac{(A * 1,000,000)}{(V * 365)}$

Comments : 2016 District 6 average for signalized intersections = 0.71
 Project Title & Date: Route 9 Priority Roadways Improvement Study

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Brookline COUNT DATE : 11/29/2018

DISTRICT : 6 UNSIGNALIZED : SIGNALIZED :

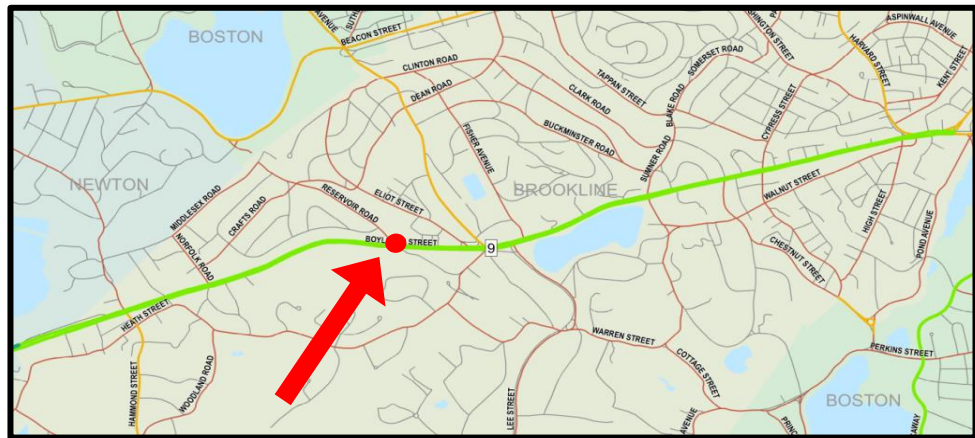
~ INTERSECTION DATA ~

MAJOR STREET : Route 9 (Boylston Street)

MINOR STREET(S) : Reservoir Road

Medical Center Driveway

INTERSECTION
DIAGRAM



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	EB	WB	NB	SB	NE	
PEAK HOURLY VOLUMES (AM/PM) :	1,544	1,358	8	39	72	3,021

" K " FACTOR : **0.090** INTERSECTION ADT (V) = TOTAL DAILY APPROACH VOLUME : **33,561**

TOTAL # OF CRASHES : **16** # OF YEARS : **5.67** AVERAGE # OF CRASHES PER YEAR (A) : **2.82**

CRASH RATE CALCULATION : **0.23** RATE = $\frac{(A * 1,000,000)}{(V * 365)}$

Comments : 2016 District 6 average for signalized intersections = 0.71

Project Title & Date: Route 9 Priority Roadways Improvement Study

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Brookline

COUNT DATE : 11/29/2018

DISTRICT : 6

UNSIGNALIZED :

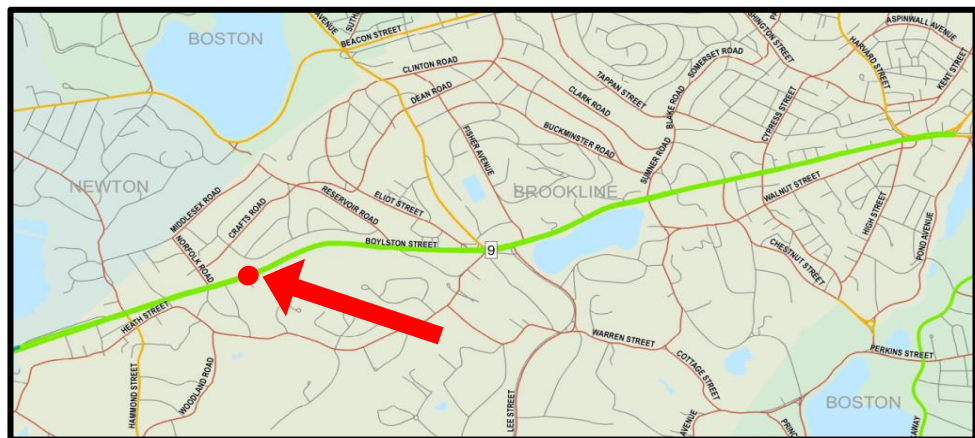
SIGNALIZED :

~ INTERSECTION DATA ~

MAJOR STREET : Route 9 (Boylston Street)

MINOR STREET(S) : Chestnut Hill Benevolent Association Driveway

**INTERSECTION
DIAGRAM**



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	EB	WB	NB			
PEAK HOURLY VOLUMES (AM/PM) :	1,554	1,378	10			2,941

" K " FACTOR : INTERSECTION ADT (V) = TOTAL DAILY APPROACH VOLUME :

TOTAL # OF CRASHES :	<input type="text" value="8"/>	# OF YEARS :	<input type="text" value="5.67"/>	AVERAGE # OF CRASHES PER YEAR (A) :	<input type="text" value="1.41"/>
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CRASH RATE CALCULATION : RATE =
$$\frac{(A * 1,000,000)}{(V * 365)}$$

Comments : 2016 District 6 average for unsignalized intersections = 0.52

Project Title & Date: Route 9 Priority Roadways Improvement Study

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Brookline COUNT DATE : 11/29/2018

DISTRICT : 6 UNSIGNALIZED : SIGNALIZED :

~ INTERSECTION DATA ~

MAJOR STREET : Route 9 Westbound (Boylston Street)

MINOR STREET(S) : Dunster Road

**INTERSECTION
DIAGRAM**



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	WB	SB				
PEAK HOURLY VOLUMES (AM/PM) :	1,462	15				1,477

" K " FACTOR : INTERSECTION ADT (V) = TOTAL DAILY APPROACH VOLUME :

TOTAL # OF CRASHES :	13	# OF YEARS :	5.67	AVERAGE # OF CRASHES PER YEAR (A) :	2.29
----------------------	----	--------------	------	---------------------------------------	-------------

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

Comments : 2016 District 6 average for unsignalized intersections = 0.52
 Project Title & Date: Route 9 Priority Roadways Improvement Study

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Brookline COUNT DATE : 11/29/2018

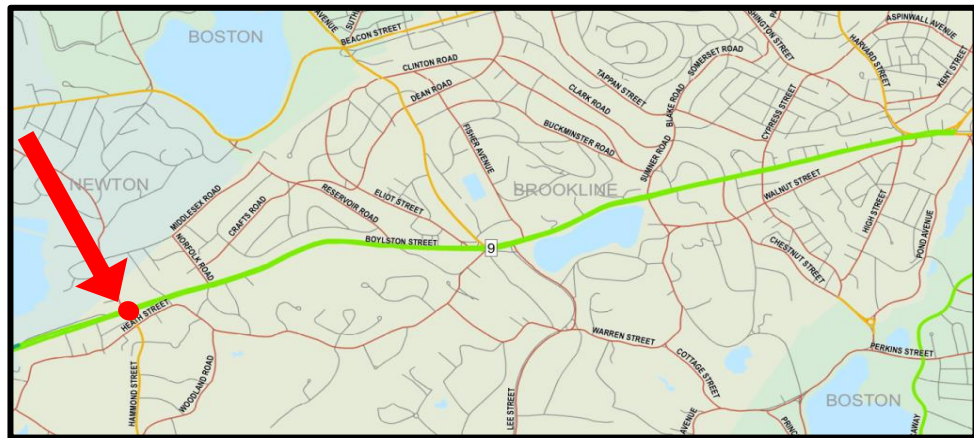
DISTRICT : 6 UNSIGNALIZED : SIGNALIZED :

~ INTERSECTION DATA ~

MAJOR STREET : Route 9 (Boylston Street)

MINOR STREET(S) : Hammond Street

**INTERSECTION
DIAGRAM**



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	EB	WB	NB	SB		
PEAK HOURLY VOLUMES (AM/PM) :	1,298	1,423	503	576		3,799

" K " FACTOR : INTERSECTION ADT (V) = TOTAL DAILY APPROACH VOLUME :

TOTAL # OF CRASHES : # OF YEARS : AVERAGE # OF CRASHES PER YEAR (A) :

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

Comments : 2016 District 6 average for signalized intersections = 0.71
 Project Title & Date: Route 9 Priority Roadways Improvement Study

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Brookline COUNT DATE : 11/29/2018

DISTRICT : 6 UNSIGNALIZED : SIGNALIZED :

~ INTERSECTION DATA ~

MAJOR STREET : Route 9 (Boylston Street)

MINOR STREET(S) : Tully Street

INTERSECTION
DIAGRAM



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	EB	WB	NB			
PEAK HOURLY VOLUMES (AM/PM) :	1,477	1,303	87			

" K " FACTOR : **0.090** INTERSECTION ADT (V) = TOTAL DAILY APPROACH VOLUME : **31,839**

TOTAL # OF CRASHES :	14	# OF YEARS :	5.67	AVERAGE # OF CRASHES PER YEAR (A) :	2.47
----------------------	----	--------------	------	---------------------------------------	-------------

CRASH RATE CALCULATION : **0.21** RATE = $\frac{(A * 1,000,000)}{(V * 365)}$

Comments : 2016 District 6 average for signalized intersections = 0.71
Project Title & Date: Route 9 Priority Roadways Improvement Study

APPENDIX G

Collision Diagrams and Crash Look-Up Tables Nine Contiguous Segments in the Study Corridor

NOTE: The numbers next to each collision can be used to look up crash record information in the associated crash lookup table.



Symbols		Types of Crash		Severity	
Moving Vehicle	Parked Vehicle	Head On	Sideswipe	Injury Accident	Fatal Accident
Backing Vehicle	Fixed Object	Angle	Out of Control		
Pedestrian	Bicycle	Rear End			
Non-Involved Pedestrian	Animal				



Figure G-1
Collision Diagram: Route 9 between Washington Street and Cypress Street
Brookline Police Department Crash Data: January 2013–August 2018

NOTE: The numbers next to each collision can be used to look up crash record information in the associated crash lookup table.


















Symbols		Types of Crash		Severity	
	Moving Vehicle		Parked Vehicle		Injury Accident
	Backing Vehicle		Fixed Object		Fatal Accident
	Pedestrian		Bicycle		
	Non-Involved Pedestrian		Animal		
			Head On		Sideswipe
			Angle		Out of Control
			Rear End		



Figure G-2
Collision Diagram: Route 9 at Cypress Street and Clark Road/Kennard Road
Brookline Police Department Crash Data: January 2013–August 2018

NOTE: The numbers next to each collision can be used to look up crash record information in the associated crash lookup table.



Symbols		Types of Crash		Severity	
Moving Vehicle	Parked Vehicle	Head On	Sideswipe	Injury Accident	Fatal Accident
Backing Vehicle	Fixed Object	Angle	Out of Control		
Pedestrian	Bicycle	Rear End			
Non-Involved Pedestrian	Animal				



Figure G-3
Collision Diagram: Route 9 at Sumner Road/Warren Street and Adjacent Sections
Brookline Police Department Crash Data: January 2013–August 2018

NOTE: The numbers next to each collision can be used to look up crash record information in the associated crash lookup table.


















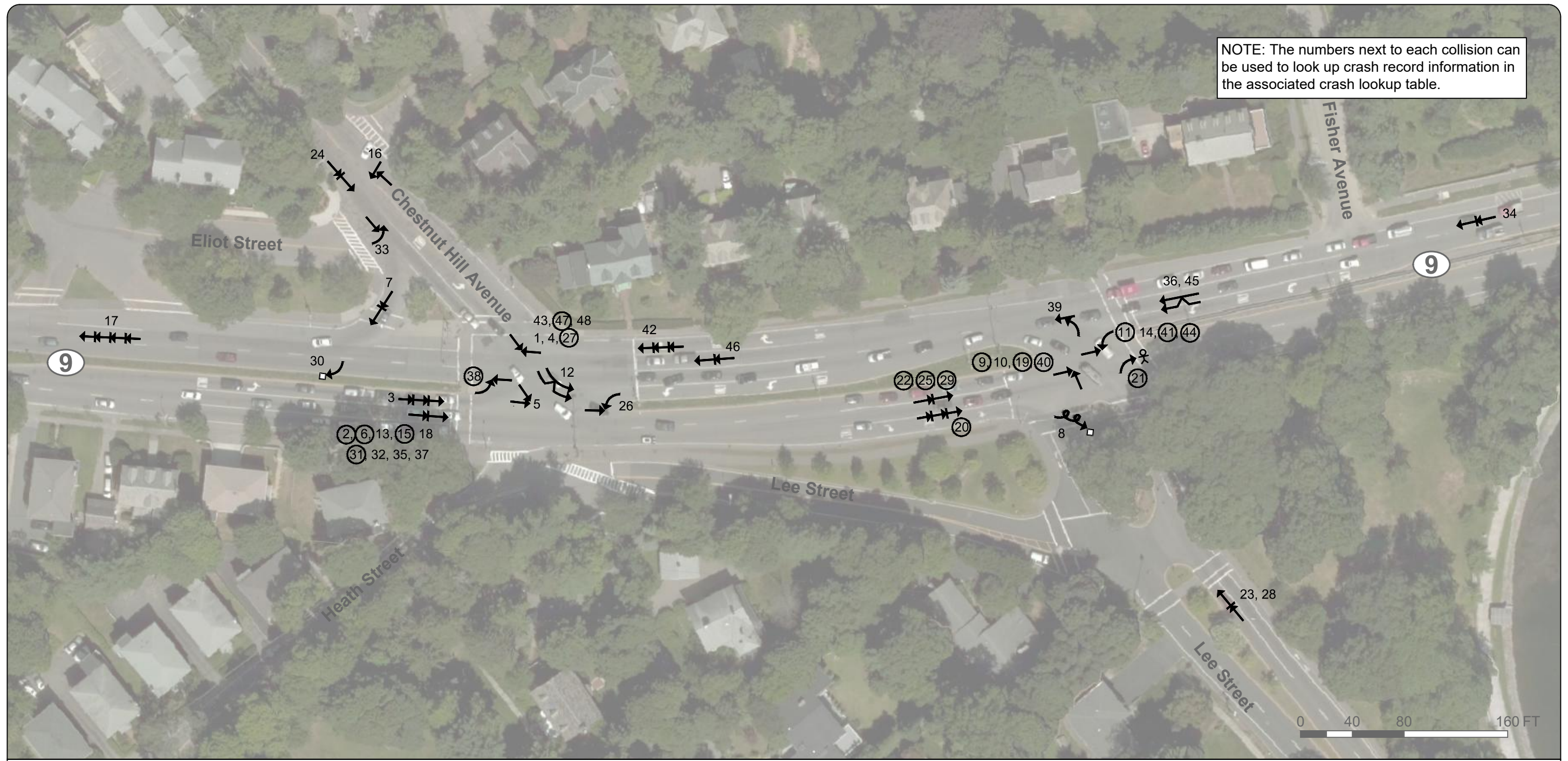
Symbols		Types of Crash		Severity	
	Moving Vehicle		Parked Vehicle		Injury Accident
	Backing Vehicle		Fixed Object		Fatal Accident
	Pedestrian		Bicycle		
	Non-Involved Pedestrian		Animal		
			Head On		Sideswipe
			Angle		Out of Control
			Rear End		



Figure G-4
Collision Diagram: Route 9 between Sumner Road/Warren Street and Lee Street
Brookline Police Department Crash Data: January 2013–August 2018

NOTE: The numbers next to each collision can be used to look up crash record information in the associated crash lookup table.



Symbols		Types of Crash		Severity	
	Moving Vehicle		Head On		Injury Accident
	Backing Vehicle		Angle		Fatal Accident
	Pedestrian		Rear End		
	Non-Involved Pedestrian				
	Parked Vehicle		Sideswipe		
	Fixed Object		Out of Control		
	Bicycle				
	Animal				



Figure G-5
Collision Diagram: Route 9 at Lee Street and Chestnut Hill Avenue
Brookline Police Department Crash Data: January 2013–August 2018

NOTE: The numbers next to each collision can be used to look up crash record information in the associated crash lookup table.



Symbols		Types of Crash		Severity	
Moving Vehicle	Parked Vehicle	Head On	Sideswipe	Injury Accident	Fatal Accident
Backing Vehicle	Fixed Object	Angle	Out of Control		
Pedestrian	Bicycle	Rear End			
Non-Involved Pedestrian	Animal				



Figure G-6
Collision Diagram: Route 9 at Reservoir Road and Adjacent Streets
Brookline Police Department Crash Data: January 2013–August 2018

NOTE: The numbers next to each collision can be used to look up crash record information in the associated crash lookup table.


















Symbols		Types of Crash		Severity	
	Moving Vehicle		Parked Vehicle		Injury Accident
	Backing Vehicle		Fixed Object		Fatal Accident
	Pedestrian		Bicycle		
	Non-Involved Pedestrian		Animal		
			Head On		Sideswipe
			Angle		Out of Control
			Rear End		



Figure G-7
Collision Diagram: Route 9 between Reservoir Road and Dunster Road
Brookline Police Department Crash Data: January 2013–August 2018

NOTE: The numbers next to each collision can be used to look up crash record information in the associated crash lookup table.



Symbols		Types of Crash		Severity	
Moving Vehicle	Parked Vehicle	Head On	Sideswipe	Injury Accident	Fatal Accident
Backing Vehicle	Fixed Object	Angle	Out of Control		
Pedestrian	Bicycle	Rear End			
Non-Involved Pedestrian	Animal				

Figure G-8
Collision Diagram: Route 9 at Dunster Road and Hammond Street
Brookline Police Department Crash Data: January 2013–August 2018



NOTE: The numbers next to each collision can be used to look up crash record information in the associated crash lookup table.

Symbols		Types of Crash		Severity	
Moving Vehicle	Parked Vehicle	Head On	Sideswipe	Injury Accident	Fatal Accident
Backing Vehicle	Fixed Object	Angle	Out of Control		
Pedestrian	Bicycle	Rear End			
Non-Involved Pedestrian	Animal				



Figure G-9
Collision Diagram: Route 9 between Newton City Line and Hammond Street
Brookline Police Department Crash Data: January 2013–August 2018

Table G-1
Crash Lookup Table: Route 9 between Washington Street and Cypress Street

Index	Crash Date	Day	Time	Peak Hour	# Veh	# Injured	Crash Severity	Manner of Collision	Road Surface Conditions	Ambient Light Conditions	Weather Conditions	Vehicle Action	Most Harmful Event	Driver Contributing Code	Notes
1	2013-08-30	Fri	1:41 AM	Off-peak	2	0		Sideswipe, same direction	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Motor vehicle in traffic		Distracted / Swerving due to wind, slippery surface, or
2	2013-10-24	Thu	8:15 AM	Peak	2	1	Possible	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic		Other improper action
3	2013-12-12	Thu	7:43 AM	Peak	4	2	Possible	Sideswipe, same direction	Dry	Daylight	Clear	Travelling straight ahead	Other fixed object (wall, building, tunnel)		Unknown
4	2014-10-30	Thu	6:05 PM	Peak	3	0	Property damage only	Single vehicle crash	Dry	Dusk	Clear	Parked	Motor vehicle in traffic		No improper action
5	2014-11-01	Sat	10:45 PM	Off-peak	3	0	Property damage only	Rear-end	Wet	Dark - lighted roadway	Rain	Travelling straight ahead	Parked motor vehicle		Unknown
6	2015-03-08	Sun	6:15 PM	Peak	2	0	Property damage only	Sideswipe, same direction	Dry	Daylight	Clear	Travelling straight ahead	Parked motor vehicle		Glare / Visibility obstructed
7	2015-08-29	Sat	7:35 AM	Peak	1	0	Possible	Single vehicle crash	Dry	Daylight	Clear	Parked	Cyclist		Other improper action Cyclist
8	2015-10-30	Fri	1:40 PM	Off-peak	5	0	Property damage only	Single vehicle crash	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic		Failure to keep in proper lane
9	2015-12-23	Wed	7:00 PM	Peak	4	2	Possible	Single vehicle crash	Wet	Dark - lighted roadway	Rain	Travelling straight ahead	Motor vehicle in traffic		Failure to keep in proper lane
10	2015-12-25	Fri	12:46 AM	Off-peak	1	0	Property damage only	Single vehicle crash	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Light pole or other post/support		Distracted
11	2016-02-05	Fri	11:25 AM	Off-peak	2	0	Possible	Rear-end	Snow	Daylight	Snow	Slowing or stopped	Motor vehicle in traffic		No improper action Work zone
12	2016-02-12	Fri	9:06 PM	Off-peak	2	0	Property damage only	Rear-end	Dry	Dark - lighted roadway	Clear	Slowing or stopped	Motor vehicle in traffic		No improper action
13	2016-04-12	Tue	2:10 PM	Off-peak	3	0	Property damage only	Single vehicle crash	Wet	Daylight	Rain	Travelling straight ahead	Parked motor vehicle		Failure to keep in proper lane
14	2016-06-01	Wed	2:00 PM	Off-peak	2	0	Property damage only	Sideswipe, same direction	Dry	Daylight	Clear	Turning right	Motor vehicle in traffic		No improper action
15	2016-06-04	Sat	2:15 PM	Off-peak	3	1	Non-fatal injury	Single vehicle crash	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic		Failure to keep in proper lane
16	2016-07-30	Sat	7:01 AM	Peak	1	1	Incapacitating	Single vehicle crash	Dry	Daylight	Clear	Changing lanes	Light pole or other post/support		Failure to keep in proper lane / Other improper action
17	2016-09-21	Wed	2:45 PM	Off-peak	1	0	Property damage only	Single vehicle crash	Dry	Daylight	Clear	Leaving traffic lane	Light pole or other post/support		Disregarding traffic signs School bus
18	2016-10-13	Thu	3:16 PM	Peak	2	0	Property damage only	Sideswipe, same direction	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic		No improper action
19	2017-01-31	Tue	6:30 PM	Peak	2	0	Property damage only	Sideswipe, same direction	Wet	Dark - lighted roadway	Rain	Changing lanes	Motor vehicle in traffic		No improper action
20	2017-04-27	Thu	10:06 PM	Off-peak	2	0		Single vehicle crash	Dry	Dark - unknown roadway lighting	Clear	Travelling straight ahead	Impact attenuator/crash		Exceeding speed limit
21	2017-07-10	Mon	7:10 AM	Peak	2	0	Property damage only	Sideswipe, same direction	Dry	Daylight	Clear	Parked	Parked motor vehicle		Unknown

Table G-1
Crash Lookup Table: Route 9 between Washington Street and Cypress Street

Index	Crash Date	Day	Time	Peak Hour	# Veh	# Injured	Crash Severity	Manner of Collision	Road Surface Conditions	Ambient Light Conditions	Weather Conditions	Vehicle Action	Most Harmful Event	Driver Contributing Code	Notes
22	2017-08-03	Thu	12:31 AM	Off-peak	2	0	Property damage only	Sideswipe, same direction	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Parked motor vehicle	Fatigued/Sleep	
23	2017-08-05	Sat	11:31 PM	Off-peak	2	0	Property damage only	Single vehicle crash	Dry	Dark - lighted roadway	Clear	Parked	Parked motor vehicle	No improper action	
24	2017-09-11	Mon	6:51 AM	Peak	2	1	Non-fatal injury	Single vehicle crash	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	Illness	
25	2018-01-05	Fri	6:18 PM	Peak	20	0	Property damage only	Rear-end	Wet	Dark - lighted roadway	Clear	Travelling straight ahead	Motor vehicle in traffic	Follow too closely	
26	2018-01-22	Mon	6:47 AM	Peak	2	0	Property damage only	Sideswipe, same direction	Wet	Daylight	Rain	Changing lanes	Parked motor vehicle	No improper action	
27	2018-03-25	Sun	12:30 PM	Off-peak	2	1	Incapacitating	Sideswipe, same direction	Dry	Daylight	Clear	Entering traffic lane	Parked motor vehicle	Driving too fast for conditions	
28	2018-03-30	Fri	10:21 PM	Off-peak	3	2	Non-fatal injury	Sideswipe, same direction	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Parked motor vehicle	Failure to keep in proper lane	

Table G-2
Crash Lookup Table: Route 9 at Cypress Street and Clark Road/Kennard Road

Index	Crash Date	Day	Time	Peak Hour	# Veh	# Injured	Crash Severity	Manner of Collision	Road Surface Conditions	Ambient Light Conditions	Weather Conditions	Vehicle Action	Most Harmful Event	Driver Contributing Code	Notes
1	2013-01-04	Fri	10:00 AM	Peak	2	0	Property damage only	Sideswipe, same direction	Dry	Daylight	Clear	Travelling straight ahead	Parked motor vehicle	No improper action	
2	2013-02-07	Thu	1:32 PM	Off-peak	3	1	Possible	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
3	2013-05-22	Wed	5:15 PM	Peak	2	0	Property damage only	Angle	Dry	Daylight	Cloudy	Turning right	Motor vehicle in traffic	No improper action	
4	2013-06-13	Thu	4:00 PM	Peak	2	0	Property damage only	Angle	Wet	Daylight	Rain	Turning left	Motor vehicle in traffic	No improper action	
5	2013-10-08	Tue	7:48 AM	Peak	2	0	Property damage only	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
6	2013-10-16	Wed	11:00 PM	Off-peak	2	0		Rear-end	Dry	Dark - lighted roadway	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
7	2013-10-22	Tue	9:00 AM	Peak	3	2	Possible	Angle	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	Erratic or reckless operation / Failure to keep	
8	2013-11-18	Mon	11:35 AM	Off-peak	2	0	Property damage only	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
9	2013-11-30	Sat	10:44 AM	Off-peak	2	1	Non-fatal injury	Angle	Dry	Daylight	Clear	Turning left	Cyclist	Glare	Cyclist
10	2013-12-04	Wed	11:05 AM	Off-peak	2	0	Property damage only	Sideswipe, same direction	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
11	2014-02-16	Sun	5:50 PM	Peak	3	2	Property damage only	Rear-end	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Motor vehicle in traffic	Follow too closely	
12	2014-04-08	Tue	1:42 PM	Off-peak	2	0	Unknown	Sideswipe, same direction	Dry	Daylight	Cloudy	Travelling straight ahead	Parked motor vehicle	Unknown	
13	2014-05-07	Wed	8:20 AM	Peak	2	0	Possible	Angle	Dry	Daylight	Clear	Changing lanes	Motor vehicle in traffic	Follow too closely / Fail to yield right of way	
14	2014-09-04	Thu	6:20 PM	Peak	2	0	Possible	Rear-end	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	No improper action	
15	2014-09-22	Mon	12:15 PM	Off-peak	2	0	Property damage only	Sideswipe, same direction	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic		
16	2014-11-03	Mon	5:45 PM	Peak	3	1	Possible	Rear-end	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Motor vehicle in traffic	Follow too closely	
17	2015-01-03	Sat	5:25 PM	Peak	2	1	Possible	Angle	Snow	Dark - lighted roadway	Snow	Travelling straight ahead	Motor vehicle in traffic	No improper action	
18	2015-02-28	Sat	4:11 PM	Peak	2	0	Property damage only	Sideswipe, same direction	Wet	Daylight	Clear	Changing lanes	Motor vehicle in traffic	Fail to yield right of way / Erratic or reckless	Work zone
19	2015-07-24	Fri	6:43 PM	Peak	2	0	Property damage only	Angle	Dry	Daylight	Clear	Travelling straight ahead	Immersion	No improper action	
20	2015-10-04	Sun	5:00 AM	Off-peak	1	0	Property damage only	Single vehicle crash	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Parked motor vehicle	Fatigued/Sleep	
21	2015-10-12	Mon	10:40 PM	Off-peak	2	0	Property damage only	Sideswipe, same direction	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Motor vehicle in traffic	No improper action	

Table G-2
Crash Lookup Table: Route 9 at Cypress Street and Clark Road/Kennard Road

Index	Crash Date	Day	Time	Peak Hour	# Veh	# Injured	Crash Severity	Manner of Collision	Road Surface Conditions	Ambient Light Conditions	Weather Conditions	Vehicle Action	Most Harmful Event	Driver Contributing Code	Notes
22	2015-10-15	Thu	7:15 PM	Off-peak	3	1	Non-fatal injury	Rear-end	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Motor vehicle in traffic	Erratic or reckless operation	
23	2016-07-01	Fri	4:15 PM	Peak	1	1	Possible	Rear-end	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	Follow too closely	
24	2016-09-17	Sat	1:34 AM	Off-peak	2	0	Property damage only	Sideswipe, same direction	Dry	Dark - lighted roadway	Clear	Turning left	Motor vehicle in traffic	Made improper turn	
25	2016-12-12	Mon	7:10 PM	Off-peak	2	0	Property damage only	Sideswipe, same direction	Wet	Dark - lighted roadway	Cloudy	Travelling straight ahead	Motor vehicle in traffic	No improper action	
26	2017-01-16	Mon	7:35 AM	Peak	4	0		Single vehicle crash	Dry	Dark - lighted roadway	Clear	Turning right	Parked motor vehicle	Made improper turn / Driving too fast for	
27	2017-04-08	Sat	12:29 AM	Off-peak	2	0	Property damage only	Single vehicle crash	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Parked motor vehicle	Fatigued/Sleep	
28	2017-06-02	Fri	9:06 AM	Peak	2	0	Property damage only	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
29	2017-06-24	Sat	6:55 PM	Peak	1	0	Property damage only	Single vehicle crash	Dry	Daylight	Clear	Turning left	Light pole or other post/support	Glare	
30	2017-07-07	Fri	11:50 AM	Off-peak	2	0	Possible	Sideswipe, same direction	Wet	Daylight	Rain	Changing lanes	Motor vehicle in traffic	Failure to keep in proper lane	
31	2018-01-05	Fri	8:27 AM	Peak	2	0	Property damage only	Rear-end	Snow	Daylight	Cloudy	Slowing or stopped	Motor vehicle in traffic	No improper action	
32	2018-05-03	Thu	1:45 PM	Off-peak	2	0	Property damage only	Rear-end	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	No improper action	
33	2018-07-13	Fri	1:30 PM	Off-peak	2	1	Non-fatal injury	Sideswipe, same direction	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	Inattention	
34	2018-08-13	Mon	6:50 AM	Peak	4	1	Non-fatal injury	Single vehicle crash	Dry	Daylight	Clear	Travelling straight ahead	Parked motor vehicle	Failure to keep in proper lane / Inattention	

**Table G-3
Crash Lookup Table: Route 9 at Sumner Road/Warren Street and Adjacent Sections**

Index	Crash Date	Day	Time	Peak Hour	# Veh	# Injured	Crash Severity	Manner of Collision	Road Surface Conditions	Ambient Light Conditions	Weather Conditions	Vehicle Action	Most Harmful Event	Driver Contributing Code	Notes
1	2013-01-16	Wed	5:49 PM	Peak	1	0	Property damage only	Single vehicle crash	Wet	Dark - lighted roadway	Cloudy	Travelling straight ahead	Cyclist	Fail to yield right of way	Cyclist
2	2013-01-19	Sat	3:05 AM	Off-peak	1	0	Property damage only	Single vehicle crash	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Light pole or other post/support	Failure to keep in proper lane / Fatigued/Sleep	
3	2013-03-07	Thu	7:25 PM	Off-peak	3	2	Non-fatal injury	Rear-end	Wet	Dark - lighted roadway	Rain	Travelling straight ahead	Motor vehicle in traffic	Failure to keep in proper lane / Other improper action	
4	2013-06-07	Fri	8:00 AM	Peak	2	0	Property damage only	Rear-end	Wet	Daylight	Rain	Slowing or stopped	Motor vehicle in traffic	No improper action	
5	2013-10-10	Thu	7:02 PM	Off-peak	3	1	Property damage only	Rear-end	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Motor vehicle in traffic	Follow too closely	
6	2013-11-16	Sat	4:00 AM	Off-peak	1	0	Property damage only	Single vehicle crash	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Median barrier	Exceeding speed limit / Failure to keep in proper	
7	2013-12-09	Mon	6:30 AM	Peak	1	1	Property damage only	Single vehicle crash	Ice	Dawn	Rain	Travelling straight ahead	Curb	No improper action	
8	2014-01-04	Sat	11:20 AM	Off-peak	2	0	Property damage only	Angle	Snow	Daylight	Clear	Changing lanes	Motor vehicle in traffic	Made improper turn	
9	2014-02-02	Sun	11:55 AM	Off-peak	1	1	Possible	Single vehicle crash	Dry	Daylight	Clear	Travelling straight ahead	Cross median/centerline		
10	2014-03-23	Sun	2:30 AM	Off-peak	2	1	Non-fatal injury	Angle	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Motor vehicle in traffic	No improper action	
11	2014-06-18	Wed	2:39 PM	Off-peak	2	1	Property damage only	Rear-end	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	Follow too closely	
12	2014-09-19	Fri	8:30 AM	Peak	4	0	Property damage only	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
13	2014-09-22	Mon	2:00 PM	Off-peak	2	1	Possible	Rear-end	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	Erratic or reckless operation / Inattention	Work zone
14	2014-12-24	Wed	9:40 PM	Off-peak	3	0	Property damage only	Single vehicle crash	Wet	Dark - lighted roadway	Rain	Travelling straight ahead	Parked motor vehicle	Swerving due to wind, slippery surface, or object	
15	2015-06-11	Thu	3:15 PM	Peak	3	0	Property damage only	Sideswipe, same direction	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	No improper action	
16	2015-09-21	Mon	7:20 PM	Off-peak	3	1	Property damage only	Rear-end	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Motor vehicle in traffic	Follow too closely	
17	2015-10-30	Fri	5:28 PM	Peak	3	1	Possible	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
18	2015-12-01	Tue	5:25 PM	Peak	2	0	Property damage only	Rear-end	Wet	Dark - lighted roadway	Cloudy	Slowing or stopped	Motor vehicle in traffic	No improper action	
19	2016-02-11	Thu	4:41 PM	Peak	3	0	Property damage only	Rear-end	Dry	Dark - lighted roadway	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
20	2016-04-01	Fri	9:35 PM	Off-peak	2	0	Possible	Angle	Wet	Dark - lighted roadway	Rain	Travelling straight ahead	Motor vehicle in traffic	Disregarding traffic signs / Fail to yield right of way	
21	2017-02-03	Fri	1:30 PM	Off-peak	2	0	Property damage only	Head on	Dry	Daylight	Clear	Turning left	Motor vehicle in traffic	Failure to keep in proper lane	

**Table G-3
Crash Lookup Table: Route 9 at Sumner Road/Warren Street and Adjacent Sections**

Index	Crash Date	Day	Time	Peak Hour	# Veh	# Injured	Crash Severity	Manner of Collision	Road Surface Conditions	Ambient Light Conditions	Weather Conditions	Vehicle Action	Most Harmful Event	Driver Contributing Code	Notes
22	2017-02-17	Fri	7:38 AM	Peak	2	0	Property damage only	Angle	Dry	Daylight	Clear	Turning left	Motor vehicle in traffic	No improper action	
23	2017-03-22	Wed	8:08 PM	Off-peak	2	2	Possible	Angle	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Motor vehicle in traffic	No improper action	
24	2017-09-16	Sat	2:16 AM	Off-peak	1	0	Property damage only	Single vehicle crash	Wet	Dark - lighted roadway	Rain	Travelling straight ahead	Guardrail	Fatigued/Sleep / Failure to keep in proper lane	
25	2017-10-27	Fri	6:45 PM	Peak	2	0	Property damage only	Sideswipe, same direction	Dry	Dusk	Clear	Travelling straight ahead	Motor vehicle in traffic	No improper action	
26	2017-12-08	Fri	2:28 PM	Off-peak	3	0	Property damage only	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
27	2017-12-30	Sat	2:45 PM	Off-peak	2	1	Non-fatal injury	Rear-end	Dry	Daylight	Cloudy	Slowing or stopped	Motor vehicle in traffic	No improper action	
28	2018-03-14	Wed	4:00 PM	Peak	2	0	Non-fatal injury	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
29	2018-05-17	Thu	8:30 AM	Peak	2	0	Property damage only	Head on	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic		
30	2018-06-18	Mon	10:25 AM	Off-peak	1	0	Property damage only	Single vehicle crash	Dry	Daylight	Clear	Turning right		No improper action	Tractor trailer
31	2018-07-23	Mon	3:00 AM	Off-peak	1	0	Unknown	Angle	Wet	Dark - lighted roadway	Rain	Travelling straight ahead	Light pole or other post/support	Unknown	

Table G-4
Crash Lookup Table: Route 9 between Sumner Road/Warren Street and Lee Street

Index	Crash Date	Day	Time	Peak Hour	# Veh	# Injured	Crash Severity	Manner of Collision	Road Surface Conditions	Ambient Light Conditions	Weather Conditions	Vehicle Action	Most Harmful Event	Driver Contributing Code	Notes
1	2014-03-15	Sat	4:45 PM	Peak	1	0	Property damage only	Single vehicle crash	Dry	Daylight	Clear	Travelling straight ahead	Curb	No improper action	
2	2014-06-20	Fri	4:05 PM	Peak	2	1	Non-fatal injury	Rear-end	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	No improper action	
3	2015-02-26	Thu	7:00 PM	Peak	2	1	Property damage only	Angle	Dry	Dark - lighted roadway	Clear	Turning right	Motor vehicle in traffic	Fail to yield right of way	
4	2017-04-01	Sat	4:09 AM	Off-peak	1	0	Property damage only	Single vehicle crash	Wet	Dark - lighted roadway	Rain	Travelling straight ahead	Ran off road left		
5	2018-01-03	Wed	4:23 PM	Peak	2	0	Property damage only	Sideswipe, same direction	Dry	Dusk	Cloudy	Travelling straight ahead	Motor vehicle in traffic		
6	2018-01-09	Tue	6:55 PM	Peak	2	0	Property damage only	Rear-end	Dry	Dark - lighted roadway	Cloudy	Travelling straight ahead	Motor vehicle in traffic		

**Table G-5
Crash Lookup Table: Route 9 at Lee Street and Chestnut Hill Avenue**

Index	Crash Date	Day	Time	Peak Hour	# Veh	# Injured	Crash Severity	Manner of Collision	Road Surface Conditions	Ambient Light Conditions	Weather Conditions	Vehicle Action	Most Harmful Event	Driver Contributing Code	Notes
1	2013-01-27	Sun	12:01 AM	Off-peak	2	0	Property damage only	Sideswipe, opposite direction	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Motor vehicle in traffic	Unknown	
2	2013-03-08	Fri	11:20 AM	Off-peak	2	1	Possible	Rear-end	Snow	Daylight	Snow	Slowing or stopped	Motor vehicle in traffic	No improper action	
3	2013-04-05	Fri	5:55 PM	Peak	3	0	Property damage only	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
4	2013-05-25	Sat	2:00 AM	Off-peak	2	0	Property damage only	Angle	Wet	Dark - lighted roadway	Rain	Travelling straight ahead	Motor vehicle in traffic	Unknown	
5	2013-06-18	Tue	3:12 PM	Peak	2	0	Property damage only	Angle	Wet	Daylight	Rain	Travelling straight ahead	Motor vehicle in traffic	Unknown	
6	2013-11-22	Fri	6:30 AM	Peak	2	0	Possible	Rear-end	Wet	Dawn	Rain	Slowing or stopped	Motor vehicle in traffic	Unknown	
7	2013-12-28	Sat	12:40 PM	Off-peak	3	0	Property damage only	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
8	2014-01-03	Fri	8:30 AM	Peak	1	0	Property damage only	Single vehicle crash	Ice	Dawn	Snow	Turning right	Ran off road left	Driving too fast for conditions	
9	2014-02-10	Mon	12:40 PM	Off-peak	2	1	Non-fatal injury	Angle	Dry	Daylight	Clear	Turning left	Motor vehicle in traffic	Disregarding traffic signs	
10	2014-04-29	Tue	8:10 PM	Off-peak	2	0	Property damage only	Angle	Dry	Dark - lighted roadway	Cloudy	Turning left	Motor vehicle in traffic	Unknown	
11	2014-07-28	Mon	4:39 PM	Peak	2	1	Non-fatal injury	Angle	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	Disregarding traffic signs	
12	2014-11-12	Wed	4:10 PM	Peak	2	0	Property damage only	Sideswipe, same direction	Dry	Daylight	Clear	Turning left	Motor vehicle in traffic	No improper action	
13	2014-11-14	Fri	6:26 AM	Peak	2	0	Property damage only	Rear-end	Snow	Daylight	Snow	Slowing or stopped	Motor vehicle in traffic	No improper action	
14	2014-12-04	Thu	12:00 AM	Off-peak	2	0	Property damage only	Angle	Dry	Daylight	Cloudy	Turning left	Motor vehicle in traffic	No improper action	
15	2015-01-06	Tue	1:00 PM	Off-peak	2	1	Non-fatal injury	Rear-end	Snow	Daylight	Snow	Slowing or stopped	Motor vehicle in traffic	Driving too fast for conditions	
16	2015-03-14	Sat	8:30 PM	Off-peak	2	0	Property damage only	Sideswipe, same direction	Dry	Dark - lighted roadway	Clear	Entering traffic lane	Motor vehicle in traffic	Wrong side or wrong way	
17	2015-05-09	Sat	3:20 PM	Peak	4	2	Property damage only	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
18	2015-05-09	Sat	10:20 PM	Off-peak	2	0	Property damage only	Rear-end	Dry	Dark - lighted roadway	Clear	Slowing or stopped		No improper action	
19	2015-06-09	Tue	5:40 AM	Off-peak	2	1	Non-fatal injury	Angle	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	No improper action	
20	2015-09-17	Thu	2:45 PM	Off-peak	3	2	Non-fatal injury	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
21	2015-09-30	Wed	12:33 PM	Off-peak	1	1	Non-fatal injury	Single vehicle crash	Wet	Daylight	Cloudy	Turning right	Pedestrian	Fail to yield right of way	Pedestrian

**Table G-5
Crash Lookup Table: Route 9 at Lee Street and Chestnut Hill Avenue**

Index	Crash Date	Day	Time	Peak Hour	# Veh	# Injured	Crash Severity	Manner of Collision	Road Surface Conditions	Ambient Light Conditions	Weather Conditions	Vehicle Action	Most Harmful Event	Driver Contributing Code	Notes
22	2015-11-01	Sun	10:24 PM	Off-peak	2	1	Non-fatal injury	Rear-end	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Motor vehicle in traffic	Other improper action	
23	2015-11-02	Mon	9:30 AM	Peak	2	0	Property damage only	Rear-end	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	Follow too closely	
24	2015-11-29	Sun	12:30 AM	Off-peak	2	0	Property damage only	Rear-end	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Motor vehicle in traffic	Unknown	
25	2016-01-27	Wed	12:14 PM	Off-peak	2	1	Non-fatal injury	Rear-end	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	Unknown	
26	2016-03-24	Thu	11:50 PM	Off-peak	2	0	Property damage only	Angle	Wet	Dark - lighted roadway	Rain	Turning left	Motor vehicle in traffic	Unknown	
27	2016-03-28	Mon	9:20 AM	Peak	2	2	Non-fatal injury	Angle	Wet	Daylight	Rain	Travelling straight ahead	Motor vehicle in traffic	Disregarding traffic signs	
28	2016-06-03	Fri	8:09 AM	Peak	2	0	Property damage only	Rear-end	Dry	Daylight	Cloudy	Slowing or stopped	Motor vehicle in traffic	No improper action	
29	2016-06-29	Wed	5:30 AM	Off-peak	2	1	Non-fatal injury	Rear-end	Wet	Dawn	Cloudy	Slowing or stopped	Motor vehicle in traffic	No improper action	
30	2016-07-28	Thu	7:00 PM	Peak	1	1	Property damage only	Single vehicle crash	Dry	Daylight	Clear	Turning right	Motor vehicle in traffic	Failure to keep in proper lane / Made improper turn	
31	2016-09-11	Sun	3:15 PM	Peak	2	1	Possible	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
32	2016-10-26	Wed	8:12 PM	Off-peak	2	0	Property damage only	Rear-end	Dry	Dark - lighted roadway	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
33	2016-11-14	Mon	9:35 AM	Peak	2	0	Property damage only	Angle	Dry	Daylight	Clear	Turning left	Motor vehicle in traffic	Unknown	Transit bus
34	2016-11-26	Sat	7:09 PM	Off-peak	2	0	Property damage only	Rear-end	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Motor vehicle in traffic	No improper action	
35	2017-01-03	Tue	6:59 PM	Peak	2	0	Property damage only	Rear-end	Wet	Dark - lighted roadway	Rain	Slowing or stopped	Separation of units	No improper action	
36	2017-01-04	Wed	10:22 AM	Off-peak	3	0	Property damage only	Sideswipe, same direction	Wet	Daylight	Cloudy	Changing lanes	Motor vehicle in traffic	Fail to yield right of way	
37	2017-01-10	Tue	12:15 PM	Off-peak	2	0	Property damage only	Rear-end	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	No improper action	
38	2017-03-19	Sun	8:50 PM	Off-peak	2	1	Possible	Angle	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Motor vehicle in traffic	Disregarding traffic signs	
39	2017-05-19	Fri	1:43 PM	Off-peak	2	0	Property damage only	Angle	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	Unknown	
40	2017-05-23	Tue	5:50 AM	Off-peak	2	1	Possible	Angle	Wet	Daylight	Cloudy	Travelling straight ahead	Motor vehicle in traffic	No improper action	
41	2017-09-07	Thu	5:20 PM	Peak	2	1	Non-fatal injury	Head on	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	Disregarding traffic signs	
42	2017-10-02	Mon	8:52 AM	Peak	3	1	Property damage only	Rear-end	Dry	Daylight	Clear	Changing lanes	Motor vehicle in traffic		

**Table G-5
Crash Lookup Table: Route 9 at Lee Street and Chestnut Hill Avenue**

Index	Crash Date	Day	Time	Peak Hour	# Veh	# Injured	Crash Severity	Manner of Collision	Road Surface Conditions	Ambient Light Conditions	Weather Conditions	Vehicle Action	Most Harmful Event	Driver Contributing Code	Notes
43	2017-10-04	Wed	10:14 AM	Off-peak	3	0	Property damage only	Angle	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	Disregarding traffic signs	
44	2017-10-26	Thu	2:59 PM	Off-peak	2	0	Non-fatal injury	Angle	Dry	Daylight	Cloudy	Travelling straight ahead	Motor vehicle in traffic	No improper action	
45	2018-01-09	Tue	3:30 PM	Peak	3	1	Property damage only	Angle	Dry	Daylight	Cloudy	Changing lanes	Motor vehicle in traffic		
46	2018-02-07	Wed	1:15 PM	Off-peak	2	0	Property damage only	Rear-end	Snow	Daylight	Snow	Slowing or stopped	Motor vehicle in traffic	No improper action	
47	2018-04-17	Tue	6:47 AM	Peak	2	1	Non-fatal injury	Angle	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	Unknown	
48	2018-07-25	Wed	2:24 PM	Off-peak	2	0	Property damage only	Angle	Dry	Daylight	Cloudy	Travelling straight ahead	Motor vehicle in traffic	Disregarding traffic signs	

**Table G-6
Crash Lookup Table: Route 9 at Reservoir Road and Adjacent Streets**

Index	Crash Date	Day	Time	Peak Hour	# Veh	# Injured	Crash Severity	Manner of Collision	Road Surface Conditions	Ambient Light Conditions	Weather Conditions	Vehicle Action	Most Harmful Event	Driver Contributing Code	Notes
1	2013-04-15	Mon	9:53 AM	Peak	2	0	Property damage only	Sideswipe, same direction	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	No improper action	
2	2013-05-21	Tue	3:57 PM	Peak	1	1	Non-fatal injury	Head on	Dry	Daylight	Clear				
3	2013-06-06	Thu	11:39 AM	Off-peak	2	1	Non-fatal injury	Rear-end	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	No improper action	
4	2013-08-07	Wed	2:00 PM	Off-peak	2	2	Possible	Single vehicle crash	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
5	2013-08-08	Thu	2:10 PM	Off-peak	11	1	Possible	Single vehicle crash	Dry	Daylight	Clear	Backing	Parked motor vehicle	Erratic or reckless operation / Illness	
6	2013-11-19	Tue	2:49 PM	Off-peak	2	0	Property damage only	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
7	2014-04-24	Thu	9:00 AM	Peak	2	1	Possible	Angle	Dry	Daylight	Clear	Turning left	Motor vehicle in traffic	Inattention	
8	2014-08-26	Tue	9:30 AM	Peak	3	1	Property damage only	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
9	2014-09-04	Thu	10:30 AM	Off-peak	1	1	Possible	Single vehicle crash	Dry	Daylight	Clear	Backing	Tree	Inattention / Other improper action	
10	2014-10-03	Fri	9:10 AM	Peak	1	0	Property damage only	Single vehicle crash	Dry	Daylight	Cloudy	Turning right	Other	Failure to keep in proper lane	
11	2014-10-09	Thu	8:40 AM	Peak	1	0	Possible	Single vehicle crash	Dry	Daylight	Clear	Travelling straight ahead	Other fixed object (wall, building, tunnel)	Operating defective equipment	
12	2014-10-23	Thu	12:04 AM	Off-peak	1	0	Property damage only	Single vehicle crash	Wet	Dark - lighted roadway	Rain	Travelling straight ahead	Guardrail	No improper action	
13	2014-10-23	Thu	6:09 PM	Peak	2	0	Possible	Rear-end	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Motor vehicle in traffic	Follow too closely	
14	2014-11-11	Tue	9:50 AM	Peak	3	0	Property damage only	Single vehicle crash	Dry	Daylight	Clear	Turning right	Parked motor vehicle	Inattention	
15	2014-12-11	Thu	7:04 PM	Off-peak	2	0	Property damage only	Angle	Wet	Dark - lighted roadway	Cloudy	Travelling straight ahead	Motor vehicle in traffic	Unknown	
16	2015-01-29	Thu	6:09 PM	Peak	1	0	Property damage only	Angle	Wet	Dark - lighted roadway	Clear	Travelling straight ahead	Motor vehicle in traffic	Disregarding traffic signs	
17	2015-03-12	Thu	9:00 PM	Off-peak	4	0	Property damage only	Single vehicle crash	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Motor vehicle in traffic	Swerving due to wind, slippery surface, or object	
18	2015-05-14	Thu	12:30 PM	Off-peak	2	0	Property damage only	Sideswipe, same direction	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	Failure to keep in proper lane	
19	2015-06-02	Tue	3:01 PM	Peak	2	0	Property damage only	Rear-end	Dry	Daylight	Cloudy	Travelling straight ahead	Parked motor vehicle	Erratic or reckless operation	
20	2015-12-03	Thu	7:45 AM	Peak	2	0	Property damage only	Rear-end	Dry	Daylight	Cloudy	Slowing or stopped	Motor vehicle in traffic	No improper action	
21	2016-09-04	Sun	4:15 PM	Peak	4	0	Property damage only	Rear-end	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	Follow too closely / Failure to keep in proper lane	

**Table G-6
Crash Lookup Table: Route 9 at Reservoir Road and Adjacent Streets**

Index	Crash Date	Day	Time	Peak Hour	# Veh	# Injured	Crash Severity	Manner of Collision	Road Surface Conditions	Ambient Light Conditions	Weather Conditions	Vehicle Action	Most Harmful Event	Driver Contributing Code	Notes
22	2017-03-08	Wed	3:17 PM	Peak	3	0	Property damage only	Single vehicle crash	Dry	Daylight	Clear	Travelling straight ahead	Parked motor vehicle	Unknown	
23	2017-05-25	Thu	12:17 PM	Off-peak	3	0	Property damage only	Rear-end	Wet	Daylight	Rain	Slowing or stopped	Impact attenuator/crash	No improper action	
24	2017-08-06	Sun	5:36 AM	Off-peak	1	0	Property damage only	Single vehicle crash	Dry	Dawn	Clear	Travelling straight ahead	Other	Failure to keep in proper lane / Fatigued/Sleep	
25	2018-04-18	Wed	6:25 PM	Peak	2	1	Possible	Angle	Dry	Daylight	Cloudy	Changing lanes	Motor vehicle in traffic	Fail to yield right of way	
26	2018-06-06	Wed	7:39 AM	Peak	2	0	Property damage only	Sideswipe, same direction	Dry	Daylight	Cloudy	Travelling straight ahead	Motor vehicle in traffic	Unknown	

Table G-7
Crash Lookup Table: Route 9 between Reservoir Road and Dunster Road

Index	Crash Date	Day	Time	Peak Hour	# Veh	# Injured	Crash Severity	Manner of Collision	Road Surface Conditions	Ambient Light Conditions	Weather Conditions	Vehicle Action	Most Harmful Event	Driver Contributing Code	Notes
1	2013-01-23	Wed	8:12 PM	Off-peak	1	1	Property damage only	Single vehicle crash	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Cyclist	No improper action	Cyclist
2	2013-03-11	Mon	8:40 AM	Peak	1	0	Property damage only	Single vehicle crash	Ice	Daylight	Cloudy	Travelling straight ahead	Utility pole	No improper action	
3	2013-05-31	Fri	3:00 AM	Off-peak	2	1	Non-fatal injury	Rear-end	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	No improper action	
4	2014-03-01	Sat	3:15 PM	Peak	3	0	Non-fatal injury	Rear-end	Dry	Daylight	Cloudy	Slowing or stopped	Motor vehicle in traffic	No improper action	
5	2014-05-08	Thu	10:00 PM	Off-peak	1	0	Possible	Single vehicle crash	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Guardrail	No improper action	
6	2014-08-14	Thu	5:45 PM	Peak	2	0	Property damage only	Rear-end	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	Follow too closely / Inattention	
7	2014-10-17	Fri	2:04 AM	Off-peak	1	1	Possible	Single vehicle crash	Wet	Dark - lighted roadway	Cloudy	Travelling straight ahead	Utility pole	Exceeding speed limit	
8	2015-01-18	Sun	7:00 AM	Peak	1	0	Property damage only	Single vehicle crash	Wet	Dawn	Cloudy	Travelling straight ahead	Guardrail	Over-correcting/over-steering	
9	2015-01-20	Tue	12:20 PM	Off-peak	1	1	Incapacitating	Single vehicle crash	Dry	Daylight	Clear	Travelling straight ahead	Utility pole	Unknown	Work zone
10	2015-01-21	Wed	5:00 PM	Peak	2	0	Property damage only	Rear-end	Dry	Dusk	Clear	Travelling straight ahead	Motor vehicle in traffic	Follow too closely	
11	2015-02-06	Fri	10:15 AM	Off-peak	2	1	Possible	Rear-end	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	Follow too closely	
12	2015-04-05	Sun	6:56 PM	Peak	1	0	Non-fatal injury	Single vehicle crash	Dry	Daylight	Clear	Travelling straight ahead	Pedestrian	Fail to yield right of way	Pedestrian
13	2015-04-23	Thu	4:30 PM	Peak	3	0	Possible	Rear-end	Unknown	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	Follow too closely	
14	2016-05-18	Wed	3:05 PM	Peak	3	1	Property damage only	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
15	2016-06-19	Sun	2:30 PM	Off-peak	2	0	Property damage only	Sideswipe, same direction	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	Failure to keep in proper lane / Inattention	
16	2016-08-08	Mon	7:42 AM	Peak	1	1	Possible	Single vehicle crash	Dry	Daylight	Clear	Travelling straight ahead	Guardrail	Inattention	
17	2016-11-26	Sat	1:52 AM	Off-peak	1	1	Possible	Single vehicle crash	Wet	Dark - lighted roadway	Cloudy	Travelling straight ahead	Motor vehicle in traffic	Unknown	
18	2016-11-26	Sat	8:35 AM	Peak	1	0	Property damage only	Single vehicle crash	Dry	Daylight	Clear	Travelling straight ahead	Guardrail	Failure to keep in proper lane / Erratic or reckless	
19	2016-12-11	Sun	2:20 AM	Off-peak	1	1	Non-fatal injury	Head on	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Utility pole	Fatigued/Sleep	
20	2017-05-05	Fri	9:45 AM	Peak	2	0	Property damage only	Rear-end	Dry	Daylight	Cloudy	Slowing or stopped	Motor vehicle in traffic	No improper action	
21	2017-05-26	Fri	5:35 PM	Peak	3	0	Property damage only	Rear-end	Wet	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	No improper action	

Table G-7
Crash Lookup Table: Route 9 between Reservoir Road and Dunster Road

Index	Crash Date	Day	Time	Peak Hour	# Veh	# Injured	Crash Severity	Manner of Collision	Road Surface Conditions	Ambient Light Conditions	Weather Conditions	Vehicle Action	Most Harmful Event	Driver Contributing Code	Notes
22	2017-06-08	Thu	12:49 PM	Off-peak	2	1	Non-fatal injury	Single vehicle crash	Dry	Daylight	Clear	Travelling straight ahead	Utility pole	Fatigued/Sleep / Failure to keep in proper lane	
23	2017-06-14	Wed	9:00 AM	Peak	2	0	Property damage only	Rear-end	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	Follow too closely	
24	2017-09-22	Fri	11:20 PM	Off-peak	1	0	Property damage only	Single vehicle crash	Wet	Dark - lighted roadway	Rain	Travelling straight ahead		Driving too fast for conditions	
25	2017-09-28	Thu	11:00 AM	Off-peak	1	1	Non-fatal injury	Angle	Dry	Daylight	Clear	Turning right	Cyclist	No improper action	Cyclist
26	2017-12-15	Fri	10:29 AM	Off-peak	2	2	Non-fatal injury	Angle	Dry	Daylight	Clear	Making U-turn	Motor vehicle in traffic	Fail to yield right of way	
27	2018-03-23	Fri	4:36 PM	Peak	4	0	Property damage only	Head on	Dry	Daylight	Cloudy	Travelling straight ahead	Motor vehicle in traffic	Follow too closely	
28	2018-05-23	Wed	12:25 AM	Off-peak	1	0	Property damage only	Single vehicle crash	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Guardrail	Other improper action	
29	2018-06-29	Fri	10:30 AM	Off-peak	4	0	Property damage only	Rear-end	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	No improper action	
30	2018-07-12	Thu	9:55 AM	Peak	2	0	Property damage only	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	

**Table G-8
Crash Lookup Table: Route 9 at Dunster Road and Hammond Street**

Index	Crash Date	Day	Time	Peak Hour	# Veh	# Injured	Crash Severity	Manner of Collision	Road Surface Conditions	Ambient Light Conditions	Weather Conditions	Vehicle Action	Most Harmful Event	Driver Contributing Code	Notes
1	2013-03-22	Fri	8:13 PM	Off-peak	3	1	Non-fatal injury	Angle	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Motor vehicle in traffic	Disregarding traffic signs	
2	2013-04-04	Thu	2:50 PM	Off-peak	1	0	Property damage only	Single vehicle crash	Dry	Daylight	Clear	Turning right	Light pole or other post/support	Inattention	
3	2013-08-14	Wed	9:53 PM	Off-peak	2	2	Non-fatal injury	Angle	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Motor vehicle in traffic	No improper action	
4	2013-08-28	Wed	4:37 PM	Peak	1	1	Non-fatal injury	Single vehicle crash	Dry	Daylight	Clear	Travelling straight ahead	Pedestrian	Disregarding traffic signs	Pedestrian
5	2013-09-24	Tue	4:25 PM	Peak	3	0	Property damage only	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
6	2013-12-30	Mon	12:45 PM	Off-peak	2	0	Property damage only	Sideswipe, same direction	Dry	Daylight	Clear	Turning left	Motor vehicle in traffic	Unknown	
7	2014-01-14	Tue	5:48 PM	Peak	2	0	Property damage only	Angle	Wet	Dark - lighted roadway	Unknown	Turning right	Motor vehicle in traffic	Disregarding traffic signs	
8	2014-04-03	Thu	11:05 AM	Off-peak	5	3	Possible	Rear-end	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	Driving too fast for conditions / Follow too	
9	2014-04-11	Fri	9:05 PM	Off-peak	2	0	Property damage only	Angle	Dry	Dark - lighted roadway	Cloudy	Turning right	Motor vehicle in traffic	No improper action	
10	2014-04-17	Thu	12:20 PM	Off-peak	3	2	Incapacitating	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
11	2014-06-24	Tue	12:00 PM	Off-peak	2	0	Property damage only	Sideswipe, same direction	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
12	2014-08-19	Tue	6:10 PM	Peak	6	1	Non-fatal injury	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
13	2014-09-24	Wed	7:18 PM	Off-peak	2	0	Possible	Rear-end	Dry	Dark - lighted roadway	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
14	2014-11-06	Thu	1:04 PM	Off-peak	3	3	Non-fatal injury	Rear-end	Wet	Daylight	Rain	Travelling straight ahead	Motor vehicle in traffic	Follow too closely / Failure to keep in proper lane	
15	2014-12-18	Thu	4:18 PM	Peak	2	1	Possible	Rear-end	Dry	Dusk	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
16	2015-04-13	Mon	1:45 PM	Off-peak	2	1	Possible	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
17	2015-05-26	Tue	11:00 PM	Off-peak	3	0	Property damage only	Rear-end	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Motor vehicle in traffic	Follow too closely	
18	2015-05-28	Thu	9:00 PM	Off-peak	3	1	Possible	Rear-end	Dry	Dark - roadway not lighted	Clear	Travelling straight ahead	Motor vehicle in traffic	Follow too closely	
19	2015-07-01	Wed	6:55 AM	Peak	2	1	Possible	Rear-end	Wet	Daylight	Rain	Slowing or stopped	Motor vehicle in traffic	No improper action	
20	2015-08-09	Sun	1:46 PM	Off-peak	2	0	Property damage only	Angle	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	No improper action	
21	2015-08-20	Thu	7:30 PM	Off-peak	2	0	Property damage only	Sideswipe, same direction	Dry	Dusk	Clear	Turning left	Motor vehicle in traffic	No improper action	

**Table G-8
Crash Lookup Table: Route 9 at Dunster Road and Hammond Street**

Index	Crash Date	Day	Time	Peak Hour	# Veh	# Injured	Crash Severity	Manner of Collision	Road Surface Conditions	Ambient Light Conditions	Weather Conditions	Vehicle Action	Most Harmful Event	Driver Contributing Code	Notes
22	2015-11-11	Wed	6:48 PM	Peak	3	0	Property damage only	Rear-end	Wet	Dark - lighted roadway	Cloudy	Slowing or stopped	Separation of units	No improper action	
23	2015-12-21	Mon	11:30 PM	Off-peak	2	0	Property damage only	Angle	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Motor vehicle in traffic	No improper action	
24	2016-01-26	Tue	3:01 PM	Peak	2	1	Non-fatal injury	Rear-end	Wet	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	Unknown	
25	2016-02-05	Fri	11:36 AM	Off-peak	2	0	Property damage only	Rear-end	Snow	Daylight	Snow	Travelling straight ahead		No improper action	
26	2016-05-19	Thu	6:40 PM	Peak	2	1	Possible	Rear-end	Dry	Daylight	Clear	Slowing or stopped		No improper action	
27	2016-05-22	Sun	4:00 PM	Peak	2	1	Possible	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic	Erratic or reckless operation	
28	2016-06-23	Thu	7:00 PM	Peak	1	0	Property damage only	Rear-end	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	Follow too closely	
29	2016-06-30	Thu	4:57 PM	Peak	3	1	Non-fatal injury	Rear-end	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	Follow too closely / Heart Condition/Epilepsy/Fainting	
30	2016-07-11	Mon	6:27 PM	Peak	3	0	Property damage only	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Separation of units	No improper action	
31	2016-10-02	Sun	11:30 AM	Off-peak	3	0	Property damage only	Rear-end	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	Inattention	
32	2016-10-07	Fri	11:10 AM	Off-peak	2	0	Property damage only	Rear-end	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	No improper action	
33	2016-10-14	Fri	8:45 PM	Off-peak	1	2	Non-fatal injury	Single vehicle crash	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Pedestrian	No improper action	Pedestrian
34	2016-11-04	Fri	10:05 AM	Off-peak	2	0	Possible	Sideswipe, same direction	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	No improper action	
35	2016-11-28	Mon	5:00 PM	Peak	4	0	Possible	Rear-end	Dry	Dark - lighted roadway	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
36	2016-12-15	Thu	12:10 PM	Off-peak	1	0		Single vehicle crash	Dry	Daylight	Clear	Turning right	Pedestrian		Pedestrian
37	2016-12-23	Fri	4:15 PM	Peak	2	0	Property damage only	Rear-end	Dry	Dusk	Clear	Travelling straight ahead	Fence	Fatigued/Sleep	
38	2017-08-05	Sat	12:04 PM	Off-peak	1	1	Incapacitating	Single vehicle crash	Wet	Daylight	Rain	Travelling straight ahead	Pedestrian	Fail to yield right of way	Pedestrian
39	2017-10-19	Thu	4:10 PM	Peak	2	0	Property damage only	Sideswipe, same direction	Dry	Daylight	Clear	Changing lanes	Motor vehicle in traffic	Fail to yield right of way	School bus
40	2017-10-23	Mon	7:35 AM	Peak	2	0	Property damage only	Sideswipe, same direction	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	No improper action	
41	2017-12-08	Fri	12:25 PM	Off-peak	1	0	Property damage only	Single vehicle crash	Dry	Daylight	Clear	Changing lanes	Fence	Unknown	
42	2018-01-20	Sat	3:17 PM	Peak	2	0	Property damage only	Sideswipe, same direction	Dry	Daylight	Clear	Turning left	Motor vehicle in traffic	Made improper turn	

**Table G-8
Crash Lookup Table: Route 9 at Dunster Road and Hammond Street**

Index	Crash Date	Day	Time	Peak Hour	# Veh	# Injured	Crash Severity	Manner of Collision	Road Surface Conditions	Ambient Light Conditions	Weather Conditions	Vehicle Action	Most Harmful Event	Driver Contributing Code	Notes
43	2018-03-09	Fri	10:10 AM	Off-peak	2	0	Property damage only	Rear-end	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	No improper action	
44	2018-05-15	Tue	8:00 AM	Peak	3	1	Property damage only	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	

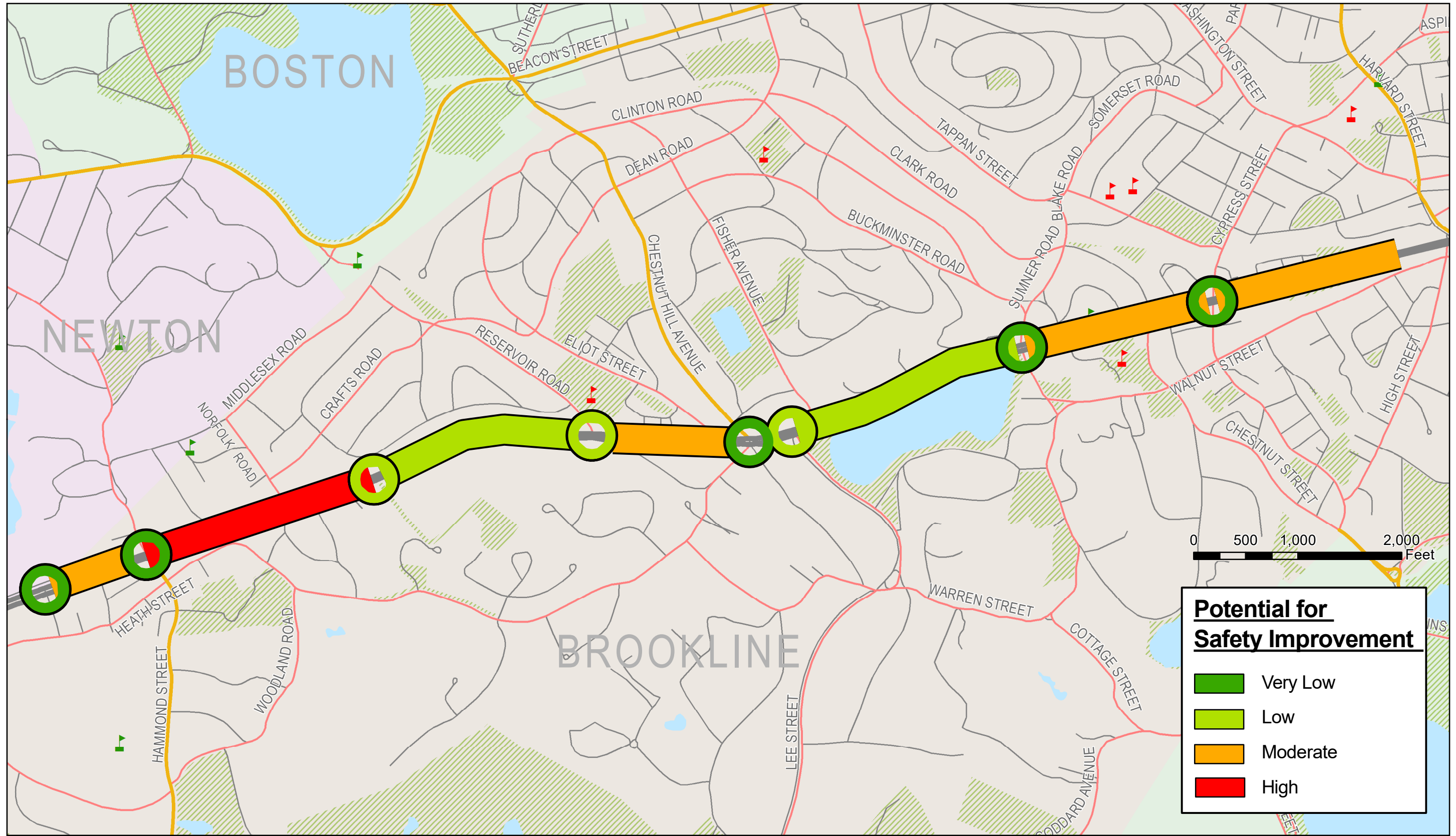
Table G-9
Crash Lookup Table: Route 9 between Newton City Line and Hammond Street

Index	Crash Date	Day	Time	Peak Hour	# Veh	# Injured	Crash Severity	Manner of Collision	Road Surface Conditions	Ambient Light Conditions	Weather Conditions	Vehicle Action	Most Harmful Event	Driver Contributing Code	Notes
1	2013-01-04	Fri	7:55 AM	Peak	3	0	Property damage only	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Other	No improper action	
2	2013-05-25	Sat	1:05 AM	Off-peak	2	1	Non-fatal injury	Rear-end	Wet	Dark - lighted roadway	Rain	Travelling straight ahead	Parked motor vehicle	Driving too fast for conditions / Other improper	
3	2013-07-26	Fri	12:35 PM	Off-peak	3	1	Property damage only	Rear-end	Wet	Daylight	Rain	Slowing or stopped	Motor vehicle in traffic	No improper action	
4	2013-08-16	Fri	6:00 PM	Peak	2	0	Property damage only	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
5	2013-12-10	Tue	3:40 PM	Peak	2	2	Possible	Rear-end	Wet	Daylight	Snow	Slowing or stopped	Motor vehicle in traffic	No improper action	
6	2014-02-12	Wed	5:29 PM	Peak	2	0	Possible	Rear-end	Dry	Dusk	Clear	Slowing or stopped	Motor vehicle in traffic	Follow too closely	
7	2014-02-18	Tue	2:31 PM	Off-peak	4	0	Property damage only	Rear-end	Snow	Daylight	Snow	Slowing or stopped	Motor vehicle in traffic	No improper action	
8	2014-03-04	Tue	9:38 PM	Off-peak	2	0	Property damage only	Angle	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Motor vehicle in traffic	No improper action	
9	2014-04-28	Mon	8:15 PM	Off-peak	2	0	Property damage only	Rear-end	Dry	Dark - lighted roadway	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
10	2014-05-14	Wed	2:20 PM	Off-peak	2	1	Property damage only	Rear-end	Dry	Daylight	Cloudy	Travelling straight ahead	Pedestrian	Follow too closely	Pedestrian
11	2014-09-22	Mon	1:30 PM	Off-peak	3	1	Possible	Rear-end	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	No improper action	
12	2014-12-02	Tue	10:15 AM	Off-peak	2	1	Non-fatal injury	Sideswipe, same direction	Wet	Dark - lighted roadway	Rain	Changing lanes	Motor vehicle in traffic	Failure to keep in proper lane	
13	2014-12-13	Sat	12:40 PM	Off-peak	2	0	Property damage only	Rear-end	Dry	Daylight	Cloudy	Slowing or stopped	Motor vehicle in traffic	No improper action	
14	2015-04-30	Thu	11:15 PM	Off-peak	2	0	Property damage only	Rear-end	Dry	Dark - lighted roadway	Clear	Changing lanes	Motor vehicle in traffic	Made improper turn	
15	2015-05-20	Wed	12:19 PM	Off-peak	2	1	Non-fatal injury	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
16	2015-12-05	Sat	1:40 AM	Off-peak	1	0	Property damage only	Single vehicle crash	Dry	Dark - lighted roadway	Clear	Turning left		No improper action	
17	2015-12-17	Thu	11:20 AM	Off-peak	3	0	Possible	Rear-end	Dry	Daylight	Cloudy	Slowing or stopped	Motor vehicle in traffic	No improper action	
18	2016-01-26	Tue	12:00 PM	Off-peak	2	2	Possible	Rear-end	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	Unknown	
19	2016-03-02	Wed	1:26 PM	Off-peak	3	0	Property damage only	Rear-end	Dry	Daylight	Cloudy	Slowing or stopped	Motor vehicle in traffic	No improper action	
20	2016-03-09	Wed	11:50 AM	Off-peak	2	1	Possible	Head on	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Other	Other improper action / Wrong side or wrong way	
21	2016-04-19	Tue	8:10 AM	Peak	4	2	Possible	Rear-end	Dry	Daylight	Cloudy	Slowing or stopped	Motor vehicle in traffic	No improper action	

Table G-9
Crash Lookup Table: Route 9 between Newton City Line and Hammond Street

Index	Crash Date	Day	Time	Peak Hour	# Veh	# Injured	Crash Severity	Manner of Collision	Road Surface Conditions	Ambient Light Conditions	Weather Conditions	Vehicle Action	Most Harmful Event	Driver Contributing Code	Notes
22	2016-08-11	Thu	1:25 PM	Off-peak	2	0	Property damage only	Sideswipe, same direction	Dry	Daylight	Clear	Travelling straight ahead	Parked motor vehicle	Failure to keep in proper lane	Work zone
23	2016-09-07	Wed	8:18 AM	Peak	2	0	Possible	Rear-end	Wet	Daylight	Rain	Travelling straight ahead	Motor vehicle in traffic	No improper action	
24	2016-09-07	Wed	12:30 PM	Off-peak	0	0	Property damage only	Rear-end	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	No improper action	
25	2016-09-22	Thu	10:00 AM	Peak	2	0	Property damage only	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
26	2016-12-05	Mon	7:30 PM	Off-peak	3	0	Property damage only	Rear-end	Dry	Dark - lighted roadway	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
27	2017-03-27	Mon	1:45 PM	Off-peak	3	0	Property damage only	Rear-end	Wet	Daylight	Rain	Slowing or stopped	Motor vehicle in traffic	No improper action	
28	2017-04-25	Tue	6:20 PM	Peak	2	0	Property damage only	Rear-end	Wet	Daylight	Rain	Travelling straight ahead	Motor vehicle in traffic	Follow too closely	
29	2017-04-26	Wed	9:18 AM	Peak	4	0	Possible	Rear-end	Wet	Daylight	Rain	Slowing or stopped	Motor vehicle in traffic	No improper action	
30	2017-06-14	Wed	5:15 PM	Peak	2	0	Property damage only	Rear-end	Dry	Daylight	Clear	Travelling straight ahead	Motor vehicle in traffic	Follow too closely	
31	2017-09-22	Fri	6:57 AM	Peak	2	0	Property damage only	Rear-end	Wet	Dawn	Rain	Slowing or stopped	Motor vehicle in traffic	No improper action / No improper action	
32	2017-12-10	Sun	5:53 PM	Peak	2	1	Possible	Rear-end	Wet	Dark - lighted roadway	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	
33	2018-01-10	Wed	7:30 PM	Off-peak	3	0	Property damage only	Rear-end	Dry	Dark - lighted roadway	Clear	Slowing or stopped	Motor vehicle in traffic	No improper action	

APPENDIX H
Highway Safety Manual Crash Analysis



BOSTON
REGION
MPO



Figure H-1
Corridor Observed Crashes and Potential for Safety Improvement (PSI)
Route 9 in Brookline

*Addressing Safety,
 Mobility, and Access on
 Subregional Priority Roadways*

Table H-1
Summary of Expected Crashes Analysis for Existing Conditions
Route 9 in Brookline

Location	Analysis Type	Total observed crashes	Average observed crashes	Average predicted crashes	Total expected crashes	Average expected crashes	Potential for Safety Improvement (PSI)	High-Risk Site	Observed crashes > Expected Crashes	FI Crash Rate	PDO Crash Rate	FI Cost	PDO Cost	Total Cost
West of High Street to Sumner Road	Segment	31	5.5	1.96	22.1	3.90	1.94	-	Y	1.24	2.66	\$323,751	\$41,537	\$365,300
Route 9 at Cypress Street	Intersection	25	4.4	8.73	29.4	5.19	-3.54	N	N	1.70	3.49	\$444,055	\$54,402	\$498,500
Cypress Street to Sumner Road	Segment	15	2.6	1.86	12.5	2.21	0.35	-	Y	0.62	1.59	\$160,903	\$24,805	\$185,700
Route 9 at Sumner Street and Warren Street	Intersection	19	3.4	10.23	24.8	4.37	-5.86	N	N	1.64	2.73	\$427,583	\$42,576	\$470,200
Sumner Road to Lee Street	Segment	9	1.6	2.71	7.9	1.40	-1.31	-	Y	0.39	1.01	\$100,687	\$15,739	\$116,400
Route 9 at Lee Street	Intersection	18	3.2	5.38	20.1	3.55	-1.83	N	N	1.29	2.26	\$335,762	\$35,299	\$371,100
Route 9 at Chestnut Hill Avenue	Intersection	27	4.8	12.97	35.3	6.22	-6.74	N	N	2.04	4.18	\$532,504	\$65,238	\$597,700
Chestnut Hill Avenue to Reservoir Road	Segment	6	1.1	0.83	5.9	1.05	0.21	-	Y	0.29	0.75	\$76,443	\$11,761	\$88,200
Route 9 at Reservoir Road	Intersection	16	2.8	4.79	17.6	3.10	-1.69	N	N	1.02	2.08	\$265,083	\$32,476	\$297,600
Reservoir Road to Benevolent Association Driveway	Segment	8	1.4	1.83	4.6	0.81	-1.02	-	Y	0.23	0.59	\$58,720	\$9,155	\$67,900
Route 9 at Benevolent Association Driveway	Intersection	8	1.4	1.06	3.8	0.67	-0.40	N	Y	0.21	0.45	\$55,159	\$7,093	\$62,300
Benevolent Association Driveway to Hammond Street	Segment	33	5.8	2.62	31.1	5.49	2.87	-	Y	1.53	3.96	\$398,836	\$61,725	\$460,600
Route 9 at Hammond Street	Intersection	21	3.7	9.14	26.9	4.75	-4.39	N	N	1.56	3.19	\$406,683	\$49,823	\$456,500
Hammond Street to Tully Street	Segment	19	3.4	1.67	18.1	3.19	1.52	-	Y	0.89	2.29	\$232,786	\$35,793	\$268,600
Route 9 at Tully Street	Intersection	14	2.5	4.82	15.7	2.77	-2.05	N	N	0.89	1.88	\$231,807	\$29,347	\$261,200
Entire Route 9 Corridor		269	47.5	70.58	275.7	48.66	5 of 15	0 of 8	8 of 15	15.5	33.1	\$4,050,762	\$516,767	\$4,567,800

Notes:

Analysis Type = Highway Safety Manual (HSM) method of analysis. Intersection analyses use MassDOT corrected formulas.

Total observed crashes = total number of crashes reported to Brookline Police between January 2013 and August 2018

Average observed crashes = observed crashes / (5.67 years)

Average predicted crashes = number of crashes per year predicted for an average facility with similar geometric and traffic characteristics

Total expected crashes = predicted crashes corrected using Empirical Bayes correlation and observed crashes

Average expected crashes = expected crashes / (5.67 years)

Potential for Safety Improvement (PSI) = (average expected crashes) - (average predicted crashes).

Represents the number of crashes per year occurring in excess of the predicted number

High-Risk Site = MassDOT designation for intersections with high safety risk

Observed crashes > Expected Crashes = shows if recent crash history is above average

Fatal or Injury (FI) Crash Rate = number of expected crashes per year that result in a fatality or injury

Property Damage Only (PDO) Crash Rate = number of expected crashes per year that only result in property damage in excess of \$1,000

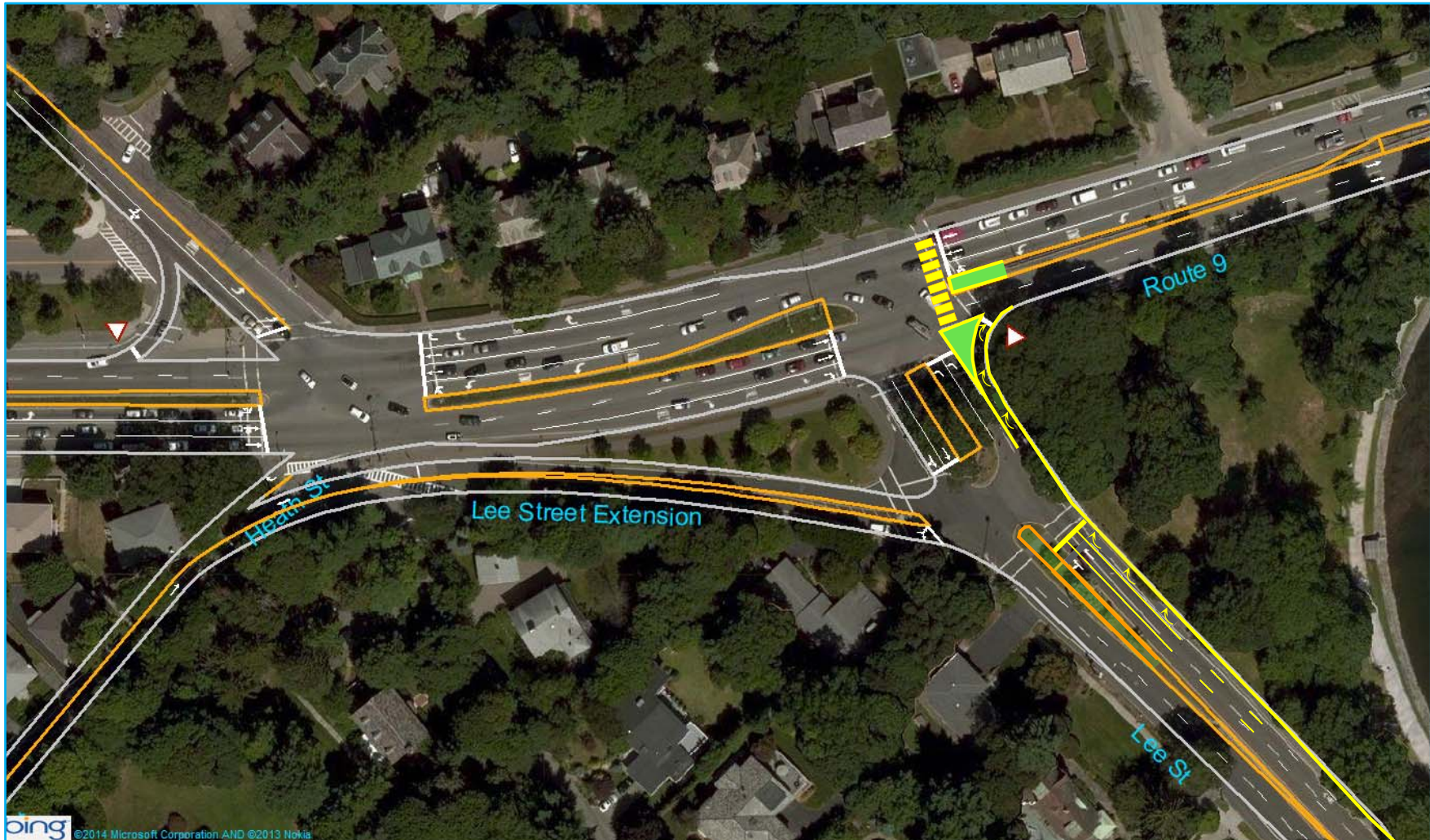
FI Cost = annual cost of expected FI crashes. Uses MassDOT comprehensive crash cost of \$260,800 per FI crash

PDO Cost = annual cost of expected PDO crashes. Uses MassDOT comprehensive crash cost of \$15,600 per PDO crash

Total Cost = FI Cost + PDO Cost

APPENDIX I
Conceptual Sketch
Proposed Modification at Route 9/Lee Street Intersection

Conceptual Sketch of Proposed Modification at Route 9/Lee Street Intersection Synchro 2030 Traffic Model



APPENDIX J
Intersection Capacity Analyses
Weekday AM Peak Hour
Proposed Long-Term Improvements under 2030 Traffic Conditions

Intersection Capacity Analysis
Cypress St & Route 9

07/16/2019



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	267	868	145	42	753	64	99	363	25	31	180	268
Future Volume (vph)	267	868	145	42	753	64	99	363	25	31	180	268
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	12	11	11	12	11	11	11	11	11	10	11
Storage Length (ft)	350		0	150		0	0		0	0		0
Storage Lanes	1		0	1		0	1		0	0		1
Taper Length (ft)	100			100			0			0		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			30				30
Link Distance (ft)		614			1044			573				420
Travel Time (s)		14.0			23.7			13.0				9.5
Confl. Peds. (#/hr)	16					16	155		15	15		155
Peak Hour Factor	0.87	0.90	0.74	0.75	0.87	0.67	0.73	0.95	0.57	0.55	0.92	0.83
Growth Factor	103%	103%	103%	103%	103%	103%	103%	103%	103%	103%	103%	103%
Heavy Vehicles (%)	4%	4%	6%	0%	7%	2%	5%	2%	16%	10%	3%	3%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	316	1195	0	58	989	0	140	439	0	0	260	333
Turn Type	Prot	NA		Prot	NA		Perm	NA		Perm	NA	pt+ov
Protected Phases	5	2		1	6			8			4	4 5
Permitted Phases							8			4		
Detector Phase	5	2		1	6		8	8		4	4	4 5
Switch Phase												
Minimum Initial (s)	5.0	10.0		5.0	10.0		6.0	6.0		6.0	6.0	
Minimum Split (s)	10.0	16.0		10.0	16.0		11.0	11.0		11.0	11.0	
Total Split (s)	36.0	62.0		20.0	46.0		42.0	42.0		42.0	42.0	
Total Split (%)	24.0%	41.3%		13.3%	30.7%		28.0%	28.0%		28.0%	28.0%	
Maximum Green (s)	31.0	56.0		15.0	40.0		37.0	37.0		37.0	37.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	1.0	2.0		1.0	2.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	5.0	6.0		5.0	6.0		5.0	5.0		5.0	5.0	
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Recall Mode	None	Min		None	Min		None	None		None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)	28.9	62.7		9.1	40.4		37.4	37.4			37.4	71.3
Actuated g/C Ratio	0.20	0.44		0.06	0.29		0.26	0.26			0.26	0.50
v/c Ratio	0.92	0.79		0.52	1.03		0.86	0.94			2.11	0.36
Control Delay	88.1	40.5		82.3	87.3		94.7	81.8			555.6	3.1
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0			0.0	0.0
Total Delay	88.1	40.5		82.3	87.3		94.7	81.8			555.6	3.1
LOS	F	D		F	F		F	F			F	A
Approach Delay		50.5			87.0			84.9			245.3	
Approach LOS		D			F			F			F	
Queue Length 50th (ft)	300	534		55	-563		132	424			-404	0

Intersection Capacity Analysis

Cypress St & Route 9

07/16/2019

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future 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)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	20.0
Minimum Split (s)	26.0
Total Split (s)	26.0
Total Split (%)	17%
Maximum Green (s)	22.0
Yellow Time (s)	2.0
All-Red Time (s)	2.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	2.0
Recall Mode	None
Walk Time (s)	7.0
Flash Dont Walk (s)	10.0
Pedestrian Calls (#/hr)	70
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	

Intersection Capacity Analysis Cypress St & Route 9

07/16/2019

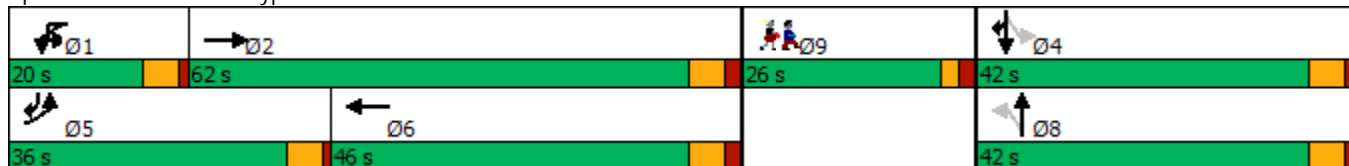


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 95th (ft)	#449	#667		85	#663		#191	#657			#588	33
Internal Link Dist (ft)		534			964			493			340	
Turn Bay Length (ft)	350			150								
Base Capacity (vph)	372	1507		187	956		162	465			123	951
Starvation Cap Reductn	0	0		0	0		0	0			0	0
Spillback Cap Reductn	0	0		0	0		0	0			0	0
Storage Cap Reductn	0	0		0	0		0	0			0	0
Reduced v/c Ratio	0.85	0.79		0.31	1.03		0.86	0.94			2.11	0.35

Intersection Summary

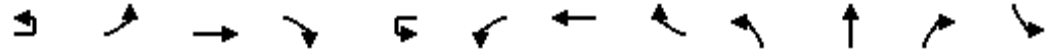
Area Type: Other
 Cycle Length: 150
 Actuated Cycle Length: 141.2
 Natural Cycle: 150
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 2.11
 Intersection Signal Delay: 97.1
 Intersection LOS: F
 Intersection Capacity Utilization 89.3%
 ICU Level of Service E
 Analysis Period (min) 15
 Description: 155 / 99 / 53
 ~ 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.

Splits and Phases: 2: Cypress St & Route 9



Intersection Capacity Analysis
Warren St/Sumner Rd & Route 9

07/16/2019



Lane Group	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations												
Traffic Volume (vph)	6	247	1199	4	19	17	1006	16	55	355	19	31
Future Volume (vph)	6	247	1199	4	19	17	1006	16	55	355	19	31
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	11	11	11	12	11	11	11	11	11
Storage Length (ft)		350		150		150		0	0		0	0
Storage Lanes		1		0		1		0	1		0	0
Taper Length (ft)		100				100			0			0
Right Turn on Red				Yes				Yes			Yes	
Link Speed (mph)			30				30			30		
Link Distance (ft)			635				1295			738		
Travel Time (s)			14.4				29.4			16.8		
Confl. Peds. (#/hr)	16	9		2	10	2		9	16		10	10
Peak Hour Factor	0.38	0.91	0.89	0.50	0.53	0.61	0.87	0.57	0.76	0.85	0.68	0.70
Growth Factor	103%	103%	103%	103%	103%	103%	103%	103%	103%	103%	103%	103%
Heavy Vehicles (%)	0%	4%	5%	25%	0%	0%	6%	6%	2%	0%	5%	13%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	296	1396	0	0	66	1220	0	75	459	0	0
Turn Type	Prot	Prot	NA		Prot	Prot	NA		Perm	NA		Perm
Protected Phases	5	5	2		1	1	6			8		
Permitted Phases									8			4
Detector Phase	5	5	2		1	1	6		8	8		4
Switch Phase												
Minimum Initial (s)	6.0	6.0	6.0		6.0	6.0	40.0		6.0	6.0		6.0
Minimum Split (s)	11.0	11.0	46.0		11.0	11.0	46.0		23.0	23.0		23.0
Total Split (s)	27.0	27.0	65.0		15.0	15.0	53.0		44.0	44.0		44.0
Total Split (%)	18.0%	18.0%	43.3%		10.0%	10.0%	35.3%		29.3%	29.3%		29.3%
Maximum Green (s)	22.0	22.0	59.0		10.0	10.0	47.0		39.0	39.0		39.0
Yellow Time (s)	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	2.0		1.0	1.0	2.0		1.0	1.0		1.0
Lost Time Adjust (s)		0.0	0.0				0.0	0.0	0.0	0.0		
Total Lost Time (s)		5.0	6.0				5.0	6.0	5.0	5.0		
Lead/Lag	Lead	Lead	Lag		Lead	Lead	Lag					
Lead-Lag Optimize?	Yes	Yes	Yes		Yes	Yes	Yes					
Vehicle Extension (s)	3.0	3.0	2.0		3.0	3.0	2.0		3.0	3.0		3.0
Recall Mode	None	None	Min		None	None	Min		None	None		None
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		22.2	63.1			9.0	47.4		39.3	39.3		
Actuated g/C Ratio		0.17	0.47			0.07	0.35		0.29	0.29		
v/c Ratio		1.07	0.87			0.56	1.02		0.28	0.86		
Control Delay		125.7	41.0			82.3	73.9		43.6	63.2		
Queue Delay		0.0	0.0			0.0	0.0		0.0	0.0		
Total Delay		125.7	41.0			82.3	73.9		43.6	63.2		
LOS		F	D			F	E		D	E		
Approach Delay			55.8				74.3			60.4		
Approach LOS			E				E			E		
Queue Length 50th (ft)		239	507			51	493		45	336		

Intersection Capacity Analysis

Warren St/Sumner Rd & Route 9

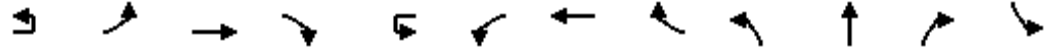
07/16/2019



Lane Group	SBT	SBR	Ø9
Lane Configurations	↕	↗	
Traffic Volume (vph)	98	196	
Future Volume (vph)	98	196	
Ideal Flow (vphpl)	1900	1900	
Lane Width (ft)	11	11	
Storage Length (ft)		0	
Storage Lanes		1	
Taper Length (ft)			
Right Turn on Red		Yes	
Link Speed (mph)	30		
Link Distance (ft)	625		
Travel Time (s)	14.2		
Confl. Peds. (#/hr)		16	
Peak Hour Factor	0.64	0.91	
Growth Factor	103%	103%	
Heavy Vehicles (%)	4%	2%	
Shared Lane Traffic (%)			
Lane Group Flow (vph)	204	222	
Turn Type	NA	Perm	
Protected Phases	4		9
Permitted Phases		4	
Detector Phase	4	4	
Switch Phase			
Minimum Initial (s)	6.0	6.0	6.0
Minimum Split (s)	23.0	23.0	26.0
Total Split (s)	44.0	44.0	26.0
Total Split (%)	29.3%	29.3%	17%
Maximum Green (s)	39.0	39.0	23.0
Yellow Time (s)	4.0	4.0	2.0
All-Red Time (s)	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	
Total Lost Time (s)	5.0	5.0	
Lead/Lag			
Lead-Lag Optimize?			
Vehicle Extension (s)	3.0	3.0	3.0
Recall Mode	None	None	None
Walk Time (s)			7.0
Flash Dont Walk (s)			16.0
Pedestrian Calls (#/hr)			16
Act Effct Green (s)	39.3	39.3	
Actuated g/C Ratio	0.29	0.29	
v/c Ratio	1.05	0.38	
Control Delay	125.8	7.1	
Queue Delay	0.0	0.0	
Total Delay	125.8	7.1	
LOS	F	A	
Approach Delay	63.9		
Approach LOS	E		
Queue Length 50th (ft)	162	0	

Intersection Capacity Analysis
Warren St/Sumner Rd & Route 9

07/16/2019

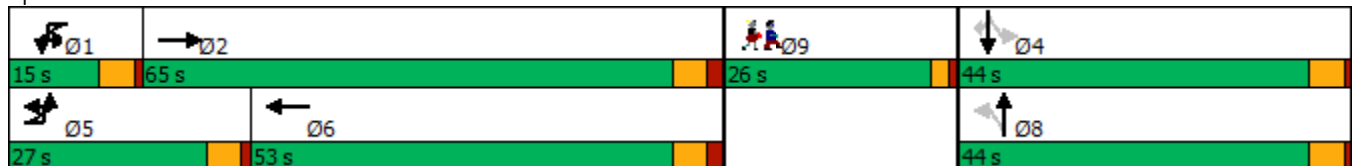


Lane Group	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Queue Length 95th (ft)		#545	#892			78	#829		91	#610		
Internal Link Dist (ft)			555				1215			658		
Turn Bay Length (ft)		350				150						
Base Capacity (vph)		277	1609			130	1196		264	531		
Starvation Cap Reductn		0	0			0	0		0	0		
Spillback Cap Reductn		0	0			0	0		0	0		
Storage Cap Reductn		0	0			0	0		0	0		
Reduced v/c Ratio		1.07	0.87			0.51	1.02		0.28	0.86		

Intersection Summary








Area Type: Other
 Cycle Length: 150
 Actuated Cycle Length: 134.4
 Natural Cycle: 150
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 1.07
 Intersection Signal Delay: 63.4
 Intersection LOS: E
 Intersection Capacity Utilization 99.8%
 ICU Level of Service F
 Analysis Period (min) 15
 Description: 16 / 7 / 16
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 4: Warren St/Sumner Rd & Route 9



Intersection Capacity Analysis
Lee St & Route 9

07/16/2019

								Ø1	Ø2
Lane Group	EBT	EBR	WBU	WBL	WBT	NBL	NBR		
Lane Configurations	↑↑	↑		↓	↑↑	↑↓	↑		
Traffic Volume (vph)	1228	404	2	126	1065	892	249		
Future Volume (vph)	1228	404	2	126	1065	892	249		
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900		
Lane Width (ft)	12	11	11	11	12	11	11		
Storage Length (ft)		225		350		0	0		
Storage Lanes		1		1		2	1		
Taper Length (ft)				100		0			
Right Turn on Red		Yes					Yes		
Link Speed (mph)	30				30	30			
Link Distance (ft)	363				323	214			
Travel Time (s)	8.3				7.3	4.9			
Peak Hour Factor	0.94	0.90	0.50	0.81	0.94	0.84	0.90		
Growth Factor	103%	103%	103%	103%	103%	103%	103%		
Heavy Vehicles (%)	5%	5%	50%	2%	5%	4%	3%		
Shared Lane Traffic (%)									
Lane Group Flow (vph)	1346	462	0	164	1167	1094	285		
Turn Type	NA	pt+ov	Prot	Prot	NA	Prot	Perm		
Protected Phases	1 2	1 2 4	3	3	1 2 3	4		1	2
Permitted Phases							4		
Detector Phase	1 2	1 2 4	3	3	1 2 3	4	4		
Switch Phase									
Minimum Initial (s)			5.0	5.0		6.0	6.0	5.0	10.0
Minimum Split (s)			10.0	10.0		29.0	29.0	10.0	19.0
Total Split (s)			14.0	14.0		44.0	44.0	23.0	19.0
Total Split (%)			14.0%	14.0%		44.0%	44.0%	23%	19%
Maximum Green (s)			9.0	9.0		39.0	39.0	18.0	14.0
Yellow Time (s)			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
Lost Time Adjust (s)				0.0		0.0	0.0		
Total Lost Time (s)				5.0		5.0	5.0		
Lead/Lag			Lead	Lead		Lag	Lag	Lead	Lag
Lead-Lag Optimize?			Yes	Yes		Yes	Yes		
Vehicle Extension (s)			3.0	3.0		3.0	3.0	3.0	3.0
Recall Mode			None	None		None	None	None	C-Max
Walk Time (s)						7.0	7.0		10.0
Flash Dont Walk (s)						17.0	17.0		4.0
Pedestrian Calls (#/hr)						0	0		0
Act Effct Green (s)	37.0	81.0		9.0	51.0	39.0	39.0		
Actuated g/C Ratio	0.37	0.81		0.09	0.51	0.39	0.39		
v/c Ratio	1.06	0.38		1.08	0.67	0.86	0.39		
Control Delay	55.8	2.2		140.4	20.5	21.4	2.8		
Queue Delay	17.3	0.7		18.0	50.8	5.8	1.4		
Total Delay	73.0	3.0		158.3	71.3	27.2	4.1		
LOS	E	A		F	E	C	A		
Approach Delay	55.1				82.0	22.4			
Approach LOS	E				F	C			
Queue Length 50th (ft)	~482	21		~117	277	369	8		
Queue Length 95th (ft)	m#567	m73		#212	351	387	m15		

Intersection Capacity Analysis
Lee St & Route 9

07/16/2019

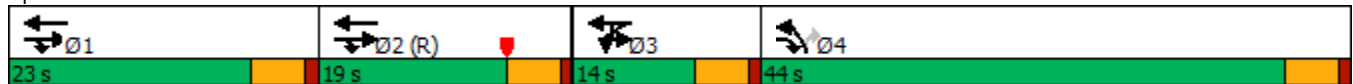


Lane Group	EBT	EBR	WBU	WBL	WBT	NBL	NBR	Ø1	Ø2
Internal Link Dist (ft)	283				243	134			
Turn Bay Length (ft)		225		350					
Base Capacity (vph)	1272	1224		152	1753	1269	732		
Starvation Cap Reductn	119	440		0	0	134	267		
Spillback Cap Reductn	0	5		60	940	4	0		
Storage Cap Reductn	0	0		0	0	0	0		
Reduced v/c Ratio	1.17	0.59		1.78	1.44	0.96	0.61		

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 93 (93%), Referenced to phase 2:EBWB, Start of Yellow
 Natural Cycle: 90
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 1.08
 Intersection Signal Delay: 53.1 Intersection LOS: D
 Intersection Capacity Utilization 81.0% ICU Level of Service D
 Analysis Period (min) 15
 Description: ø2 (NB): 0 / 1 / 3
 ø4 (WB): 0 / 1 / 3
 ~ 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.
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 5: Lee St & Route 9



Intersection Capacity Analysis
Lee St & Lee Street Extension

07/16/2019



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø1
Lane Configurations							
Traffic Volume (vph)	230	8	5	966	531	1	
Future Volume (vph)	230	8	5	966	531	1	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Right Turn on Red		Yes				Yes	
Link Speed (mph)	30			30	30		
Link Distance (ft)	617			340	214		
Travel Time (s)	14.0			7.7	4.9		
Confl. Peds. (#/hr)		1					
Peak Hour Factor	0.83	0.67	0.62	0.89	0.89	0.25	
Growth Factor	103%	103%	103%	103%	103%	103%	
Heavy Vehicles (%)	3%	0%	0%	4%	5%	0%	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	297	0	0	1126	619	0	
Turn Type	Prot		Perm	NA	NA		
Protected Phases	2			3	1 3		1
Permitted Phases			3				
Detector Phase	2		3	3	1 3		
Switch Phase							
Minimum Initial (s)	6.0		10.0	10.0			5.0
Minimum Split (s)	20.0		15.0	15.0			10.0
Total Split (s)	29.0		46.0	46.0			25.0
Total Split (%)	29.0%		46.0%	46.0%			25%
Maximum Green (s)	24.0		41.0	41.0			20.0
Yellow Time (s)	4.0		4.0	4.0			4.0
All-Red Time (s)	1.0		1.0	1.0			1.0
Lost Time Adjust (s)	0.0			0.0			
Total Lost Time (s)	5.0			5.0			
Lead/Lag	Lag						Lead
Lead-Lag Optimize?	Yes						Yes
Vehicle Extension (s)	2.0		2.0	2.0			2.0
Recall Mode	None		None	None			C-Max
Walk Time (s)	5.0						
Flash Dont Walk (s)	5.0						
Pedestrian Calls (#/hr)	1						
Act Effct Green (s)	20.6			36.1	69.4		
Actuated g/C Ratio	0.21			0.36	0.69		
v/c Ratio	0.85			0.69	0.27		
Control Delay	59.4			29.3	9.7		
Queue Delay	0.0			0.6	0.8		
Total Delay	59.4			29.9	10.5		
LOS	E			C	B		
Approach Delay	59.4			29.9	10.5		
Approach LOS	E			C	B		
Queue Length 50th (ft)	179			217	113		
Queue Length 95th (ft)	243			245	m156		
Internal Link Dist (ft)	537			260	134		
Turn Bay Length (ft)							
Base Capacity (vph)	408			1848	2266		

Intersection Capacity Analysis

Lee St & Lee Street Extension

07/16/2019



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø1
Starvation Cap Reductn	0			0	1277		
Spillback Cap Reductn	0			331	0		
Storage Cap Reductn	0			0	0		
Reduced v/c Ratio	0.73			0.74	0.63		

Intersection Summary

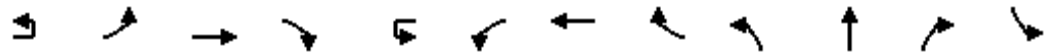
Area Type:	Other
Cycle Length:	100
Actuated Cycle Length:	100
Offset:	71 (71%), Referenced to phase 1:SBT, Start of Yellow
Natural Cycle:	55
Control Type:	Actuated-Coordinated
Maximum v/c Ratio:	0.85
Intersection Signal Delay:	28.3
Intersection LOS:	C
Intersection Capacity Utilization	44.7%
ICU Level of Service	A
Analysis Period (min)	15
Description:	1 / 0 / 2
m Volume for 95th percentile queue is metered by upstream signal.	

Splits and Phases: 6: Lee St & Lee Street Extension



Intersection Capacity Analysis
 Heath St/Chestnut Hill Ave & Route 9

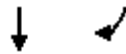
07/16/2019



Lane Group	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations		↔	↕↕			↔	↕↕	↗				↖
Traffic Volume (vph)	15	298	1203	0	3	92	1153	756	0	0	0	418
Future Volume (vph)	15	298	1203	0	3	92	1153	756	0	0	0	418
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	11	11	11	12	11	11	11	11	11
Storage Length (ft)		375		0		175		225	0		0	250
Storage Lanes		1		0		1		1	0		0	1
Taper Length (ft)		100				100			0			100
Right Turn on Red				Yes				Yes			Yes	
Link Speed (mph)			30				30			30		
Link Distance (ft)			571				363			179		
Travel Time (s)			13.0				8.3			4.1		
Confl. Peds. (#/hr)	9	12						12				
Peak Hour Factor	0.42	0.94	0.95	0.92	0.38	0.88	0.94	0.86	0.92	0.92	0.92	0.89
Growth Factor	103%	103%	103%	103%	103%	103%	103%	103%	103%	103%	103%	103%
Heavy Vehicles (%)	0%	8%	5%	2%	0%	2%	4%	3%	2%	2%	2%	5%
Shared Lane Traffic (%)												10%
Lane Group Flow (vph)	0	364	1304	0	0	116	1263	905	0	0	0	436
Turn Type	Prot	Prot	NA		Prot	Prot	NA	custom				Split
Protected Phases	4	4	1 4 5		2	2	1 2 5	1 2 3				3
Permitted Phases												
Detector Phase	4	4	1 4 5		2	2	1 2 5	1 2 3				3
Switch Phase												
Minimum Initial (s)	5.0	5.0			5.0	5.0						5.0
Minimum Split (s)	10.0	10.0			10.0	10.0						23.0
Total Split (s)	23.0	23.0			18.0	18.0						30.0
Total Split (%)	23.0%	23.0%			18.0%	18.0%						30.0%
Maximum Green (s)	18.0	18.0			13.0	13.0						25.0
Yellow Time (s)	4.0	4.0			4.0	4.0						4.0
All-Red Time (s)	1.0	1.0			1.0	1.0						1.0
Lost Time Adjust (s)		0.0				0.0						0.0
Total Lost Time (s)		5.0				5.0						5.0
Lead/Lag	Lag	Lag			Lag	Lag						Lead
Lead-Lag Optimize?	Yes	Yes			Yes	Yes						Yes
Vehicle Extension (s)	3.0	3.0			3.0	3.0						3.0
Recall Mode	None	None			Max	Max						None
Walk Time (s)												13.0
Flash Dont Walk (s)												5.0
Pedestrian Calls (#/hr)												9
Act Effct Green (s)		18.0	47.0			13.0	42.0	53.0				25.0
Actuated g/C Ratio		0.18	0.47			0.13	0.42	0.53				0.25
v/c Ratio		1.24	0.81			0.52	0.87	0.85				1.11
Control Delay		171.0	27.5			53.0	38.2	13.9				114.0
Queue Delay		0.0	27.7			0.0	47.5	2.7				0.1
Total Delay		171.0	55.3			53.0	85.7	16.6				114.1
LOS		F	E			D	F	B				F
Approach Delay			80.5				56.7					
Approach LOS			F				E					
Queue Length 50th (ft)		~290	361			76	435	176				~334

Intersection Capacity Analysis
 Heath St/Chestnut Hill Ave & Route 9

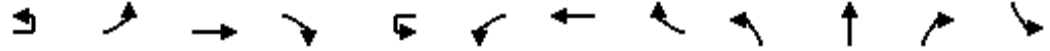
07/16/2019



Lane Group	SBT	SBR	Ø1	Ø5
Lane Configurations	↕			
Traffic Volume (vph)	37	272		
Future Volume (vph)	37	272		
Ideal Flow (vphpl)	1900	1900		
Lane Width (ft)	11	11		
Storage Length (ft)		100		
Storage Lanes		0		
Taper Length (ft)				
Right Turn on Red		Yes		
Link Speed (mph)	30			
Link Distance (ft)	916			
Travel Time (s)	20.8			
Confl. Peds. (#/hr)		9		
Peak Hour Factor	0.71	0.80		
Growth Factor	103%	103%		
Heavy Vehicles (%)	5%	3%		
Shared Lane Traffic (%)				
Lane Group Flow (vph)	452	0		
Turn Type	NA			
Protected Phases	3		1	5
Permitted Phases				
Detector Phase	3			
Switch Phase				
Minimum Initial (s)	5.0		1.0	5.0
Minimum Split (s)	23.0		6.0	19.0
Total Split (s)	30.0		10.0	19.0
Total Split (%)	30.0%		10%	19%
Maximum Green (s)	25.0		5.0	16.0
Yellow Time (s)	4.0		4.0	2.0
All-Red Time (s)	1.0		1.0	1.0
Lost Time Adjust (s)	0.0			
Total Lost Time (s)	5.0			
Lead/Lag	Lead		Lead	
Lead-Lag Optimize?	Yes		Yes	
Vehicle Extension (s)	3.0		3.0	3.0
Recall Mode	None		C-Max	None
Walk Time (s)	13.0			6.0
Flash Dont Walk (s)	5.0			10.0
Pedestrian Calls (#/hr)	9			12
Act Effct Green (s)	25.0			
Actuated g/C Ratio	0.25			
v/c Ratio	0.93			
Control Delay	50.9			
Queue Delay	7.2			
Total Delay	58.0			
LOS	E			
Approach Delay	85.6			
Approach LOS	F			
Queue Length 50th (ft)	200			

Intersection Capacity Analysis
 Heath St/Chestnut Hill Ave & Route 9

07/16/2019

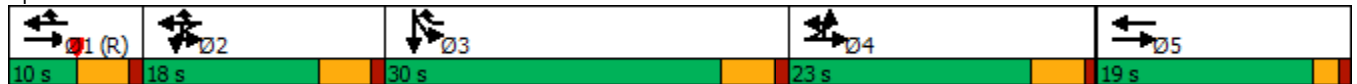


Lane Group	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Queue Length 95th (ft)		#468	454			m104	518	286				#524
Internal Link Dist (ft)			491				283			99		
Turn Bay Length (ft)		375				175		225				250
Base Capacity (vph)		293	1615			222	1457	1069				394
Starvation Cap Reductn		0	0			0	350	83				0
Spillback Cap Reductn		0	372			0	0	0				4
Storage Cap Reductn		0	0			0	0	0				0
Reduced v/c Ratio		1.24	1.05			0.52	1.14	0.92				1.12

Intersection Summary

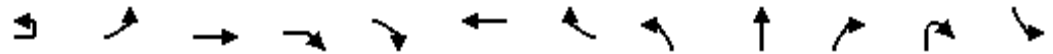
Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 0 (0%), Referenced to phase 1:EBWB, Start of Yellow, Master Intersection
 Natural Cycle: 120
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 1.24
 Intersection Signal Delay: 70.2 Intersection LOS: E
 Intersection Capacity Utilization 85.0% ICU Level of Service E
 Analysis Period (min) 15
 Description: ø3 (EB+WB): 9 / 2 / 2
 ø5 (SB): 12 / 2 / 2
 ~ 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.
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 7: Heath St/Chestnut Hill Ave & Route 9



Intersection Capacity Analysis
Reservoir Rd & Route 9

07/16/2019



Lane Group	EBU	EBL	EBT	EBR	EBR2	WBT	WBR	NBL	NBT	NBR	NBR2	SBL2
Lane Configurations												
Traffic Volume (vph)	11	78	1407	32	24	1404	29	18	22	16	4	11
Future Volume (vph)	11	78	1407	32	24	1404	29	18	22	16	4	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)		250		0			0	0		0		
Storage Lanes		1		0			0	1		0		
Taper Length (ft)		100						0				
Right Turn on Red					Yes		Yes				Yes	
Link Speed (mph)			30			30			30			
Link Distance (ft)			977			709			527			
Travel Time (s)			22.2			16.1			12.0			
Confl. Peds. (#/hr)	11	6		6	9		6	11		32	6	32
Peak Hour Factor	0.55	0.59	0.97	0.89	0.67	0.97	0.52	0.75	0.61	0.80	0.50	0.55
Growth Factor	103%	103%	103%	103%	103%	103%	103%	103%	103%	103%	103%	103%
Heavy Vehicles (%)	0%	1%	5%	6%	0%	4%	0%	22%	0%	38%	0%	9%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	157	1568	0	0	1548	0	25	66	0	0	0
Turn Type	Prot	Prot	NA			NA		Perm	NA			Perm
Protected Phases	5	5	2			6			8			
Permitted Phases								8				4
Detector Phase	5	5	2			6		8	8			4
Switch Phase												
Minimum Initial (s)	6.0	6.0	1.0			6.0		6.0	6.0			6.0
Minimum Split (s)	12.0	12.0	12.0			12.0		11.0	11.0			11.0
Total Split (s)	14.0	14.0	53.0			39.0		18.0	18.0			18.0
Total Split (%)	14.0%	14.0%	53.0%			39.0%		18.0%	18.0%			18.0%
Maximum Green (s)	8.0	8.0	47.0			33.0		13.0	13.0			13.0
Yellow Time (s)	4.0	4.0	4.0			4.0		4.0	4.0			4.0
All-Red Time (s)	2.0	2.0	2.0			2.0		1.0	1.0			1.0
Lost Time Adjust (s)		0.0	0.0			0.0		0.0	0.0			
Total Lost Time (s)		6.0	6.0			6.0		5.0	5.0			
Lead/Lag	Lead	Lead				Lag						
Lead-Lag Optimize?	Yes	Yes				Yes						
Vehicle Extension (s)	3.0	3.0	2.0			2.0		3.0	3.0			3.0
Recall Mode	None	None	C-Min			C-Min		None	None			None
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		13.1	65.4			45.2		9.6	9.6			
Actuated g/C Ratio		0.13	0.65			0.45		0.10	0.10			
v/c Ratio		0.69	0.73			1.03		0.24	0.47			
Control Delay		61.7	21.0			61.3		45.9	49.3			
Queue Delay		0.0	0.0			0.0		0.0	0.0			
Total Delay		61.7	21.0			61.3		45.9	49.3			
LOS		E	C			E		D	D			
Approach Delay			24.7			61.3			48.4			
Approach LOS			C			E			D			
Queue Length 50th (ft)		99	475			~704		15	37			
Queue Length 95th (ft)		#129	#695			#843		33	50			

Intersection Capacity Analysis
Reservoir Rd & Route 9

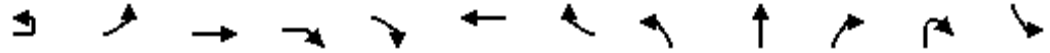
07/16/2019



Lane Group	SBL	SBT	SBR	NWR2	Ø9
Lane Configurations					
Traffic Volume (vph)	9	3	16	10	
Future Volume (vph)	9	3	16	10	
Ideal Flow (vphpl)	1900	1900	1900	1900	
Storage Length (ft)	0		0		
Storage Lanes	0		0		
Taper Length (ft)	0				
Right Turn on Red			Yes	Yes	
Link Speed (mph)		30			
Link Distance (ft)		854			
Travel Time (s)		19.4			
Confl. Peds. (#/hr)	6		11	32	
Peak Hour Factor	0.75	0.38	0.57	0.50	
Growth Factor	103%	103%	103%	103%	
Heavy Vehicles (%)	0%	0%	0%	0%	
Shared Lane Traffic (%)					
Lane Group Flow (vph)	0	70	0	21	
Turn Type	Perm	NA		Perm	
Protected Phases		4			9
Permitted Phases	4			2 4	
Detector Phase	4	4		2 4	
Switch Phase					
Minimum Initial (s)	6.0	6.0			5.0
Minimum Split (s)	11.0	11.0			29.0
Total Split (s)	18.0	18.0			29.0
Total Split (%)	18.0%	18.0%			29%
Maximum Green (s)	13.0	13.0			26.0
Yellow Time (s)	4.0	4.0			2.0
All-Red Time (s)	1.0	1.0			1.0
Lost Time Adjust (s)		0.0			
Total Lost Time (s)		5.0			
Lead/Lag					
Lead-Lag Optimize?					
Vehicle Extension (s)	3.0	3.0			3.0
Recall Mode	None	None			None
Walk Time (s)					5.0
Flash Dont Walk (s)					21.0
Pedestrian Calls (#/hr)					35
Act Effect Green (s)		9.6		79.0	
Actuated g/C Ratio		0.10		0.79	
v/c Ratio		0.48		0.01	
Control Delay		37.7		0.0	
Queue Delay		0.0		0.0	
Total Delay		37.7		0.0	
LOS		D		A	
Approach Delay		37.7			
Approach LOS		D			
Queue Length 50th (ft)		25		0	
Queue Length 95th (ft)		17		0	

Intersection Capacity Analysis Reservoir Rd & Route 9

07/16/2019

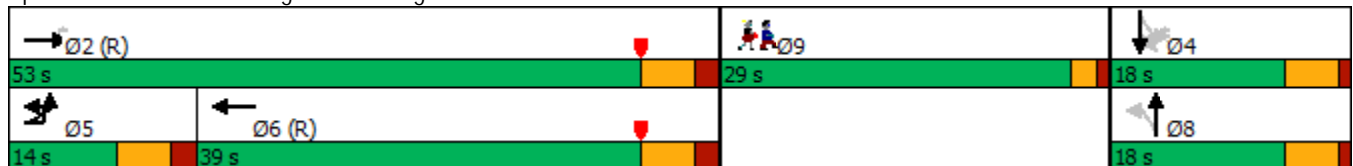


Lane Group	EBU	EBL	EBT	EBR	EBR2	WBT	WBR	NBL	NBT	NBR	NBR2	SBL2
Internal Link Dist (ft)			897			629			447			
Turn Bay Length (ft)		250										
Base Capacity (vph)		226	2159			1508		144	189			
Starvation Cap Reductn		0	0			0		0	0			
Spillback Cap Reductn		0	0			0		0	0			
Storage Cap Reductn		0	0			0		0	0			
Reduced v/c Ratio		0.69	0.73			1.03		0.17	0.35			

Intersection Summary

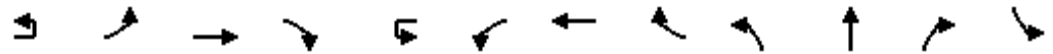
Area Type:	Other
Cycle Length:	100
Actuated Cycle Length:	100
Offset:	47 (47%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow
Natural Cycle:	110
Control Type:	Actuated-Coordinated
Maximum v/c Ratio:	1.03
Intersection Signal Delay:	41.9
Intersection LOS:	D
Intersection Capacity Utilization	82.9%
ICU Level of Service	E
Analysis Period (min)	15
Description:	43 / 13 / 1
~ 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.	

Splits and Phases: 9: Longwood Parking Lot & Reservoir Rd & Route 9



Intersection Capacity Analysis
Hammond St & Route 9

07/16/2019



Lane Group	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations		↔	↕			↔	↕	↔	↕	↕		↕
Traffic Volume (vph)	1	155	1082	22	1	180	1182	42	107	410	51	122
Future Volume (vph)	1	155	1082	22	1	180	1182	42	107	410	51	122
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	11	11	11	12	11	11	11	11	11
Storage Length (ft)		550		0		300		150	0		0	125
Storage Lanes		1		0		1		1	1		0	1
Taper Length (ft)		100				100			20			100
Right Turn on Red				Yes				Yes			Yes	
Link Speed (mph)			30				30			30		
Link Distance (ft)			726				711			307		
Travel Time (s)			16.5				16.2			7.0		
Confl. Peds. (#/hr)	26	8		5	19	5		8	26		19	19
Peak Hour Factor	0.25	0.90	0.96	0.79	0.25	0.90	0.92	0.75	0.64	0.91	0.75	0.78
Growth Factor	103%	103%	103%	103%	103%	103%	103%	103%	103%	103%	103%	103%
Heavy Vehicles (%)	0%	6%	7%	18%	0%	6%	3%	7%	5%	2%	22%	6%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	181	1190	0	0	210	1323	58	172	534	0	161
Turn Type	Prot	Prot	NA		Prot	Prot	NA	Prot	Prot	NA		Prot
Protected Phases	1	1	6		5	5	2	2	3	8		7
Permitted Phases												
Detector Phase	1	1	6		5	5	2	2	3	8		7
Switch Phase												
Minimum Initial (s)	6.0	6.0	6.0		6.0	6.0	10.0	10.0	5.0	6.0		5.0
Minimum Split (s)	12.0	12.0	33.0		12.0	12.0	33.0	33.0	10.0	33.0		10.0
Total Split (s)	21.0	21.0	53.0		23.0	23.0	55.0	55.0	19.0	35.0		19.0
Total Split (%)	16.2%	16.2%	40.8%		17.7%	17.7%	42.3%	42.3%	14.6%	26.9%		14.6%
Maximum Green (s)	15.0	15.0	47.0		17.0	17.0	49.0	49.0	14.0	29.0		14.0
Yellow Time (s)	4.0	4.0	4.0		4.0	4.0	4.0	4.0	3.0	3.0		3.0
All-Red Time (s)	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	3.0		2.0
Lost Time Adjust (s)		0.0	0.0			0.0	0.0	0.0	0.0	0.0		0.0
Total Lost Time (s)		6.0	6.0			6.0	6.0	6.0	5.0	6.0		5.0
Lead/Lag	Lead	Lead	Lag		Lead	Lead	Lag	Lag	Lead	Lag		Lead
Lead-Lag Optimize?	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes		Yes
Vehicle Extension (s)	2.0	2.0	2.0		2.0	2.0	2.0	2.0	3.0	2.0		3.0
Recall Mode	None	None	C-Min		None	None	C-Min	C-Min	None	None		None
Walk Time (s)			7.0				7.0	7.0		7.0		
Flash Dont Walk (s)			20.0				20.0	20.0		20.0		
Pedestrian Calls (#/hr)			5				8	8		26		
Act Effct Green (s)		15.6	48.1			17.9	50.4	50.4	14.0	27.0		14.0
Actuated g/C Ratio		0.12	0.37			0.14	0.39	0.39	0.11	0.21		0.11
v/c Ratio		0.91	0.96			0.93	0.97	0.09	0.97	0.78		0.91
Control Delay		101.6	58.0			99.0	58.6	0.3	109.6	50.9		104.7
Queue Delay		0.0	0.0			0.0	0.0	0.0	0.0	5.6		0.0
Total Delay		101.6	58.0			99.0	58.6	0.3	109.6	56.5		104.7
LOS		F	E			F	E	A	F	E		F
Approach Delay			63.8				61.8			69.4		
Approach LOS			E				E			E		
Queue Length 50th (ft)		154	518			179	~584	0	145	225		136

Intersection Capacity Analysis

Hammond St & Route 9

07/16/2019



Lane Group	SBT	SBR
Lane Configurations	↑	↗
Traffic Volume (vph)	252	116
Future Volume (vph)	252	116
Ideal Flow (vphpl)	1900	1900
Lane Width (ft)	11	11
Storage Length (ft)		125
Storage Lanes		1
Taper Length (ft)		
Right Turn on Red		Yes
Link Speed (mph)	30	
Link Distance (ft)	575	
Travel Time (s)	13.1	
Confl. Peds. (#/hr)		26
Peak Hour Factor	0.78	0.85
Growth Factor	103%	103%
Heavy Vehicles (%)	5%	2%
Shared Lane Traffic (%)		
Lane Group Flow (vph)	333	141
Turn Type	NA	Perm
Protected Phases	4	
Permitted Phases		4
Detector Phase	4	4
Switch Phase		
Minimum Initial (s)	6.0	6.0
Minimum Split (s)	33.0	33.0
Total Split (s)	35.0	35.0
Total Split (%)	26.9%	26.9%
Maximum Green (s)	29.0	29.0
Yellow Time (s)	3.0	3.0
All-Red Time (s)	3.0	3.0
Lost Time Adjust (s)	0.0	0.0
Total Lost Time (s)	6.0	6.0
Lead/Lag	Lag	Lag
Lead-Lag Optimize?	Yes	Yes
Vehicle Extension (s)	2.0	2.0
Recall Mode	None	None
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	20.0	20.0
Pedestrian Calls (#/hr)	26	26
Act Effct Green (s)	27.0	27.0
Actuated g/C Ratio	0.21	0.21
v/c Ratio	0.92	0.36
Control Delay	80.5	13.5
Queue Delay	0.0	0.0
Total Delay	80.5	13.5
LOS	F	B
Approach Delay	71.7	
Approach LOS	E	
Queue Length 50th (ft)	271	16

Intersection Capacity Analysis Hammond St & Route 9

07/16/2019



Lane Group	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Queue Length 95th (ft)		#301	#677			#340	#749	0	#159	290		#214
Internal Link Dist (ft)			646				631			227		
Turn Bay Length (ft)		550				300		150				125
Base Capacity (vph)		198	1239			227	1358	636	178	734		177
Starvation Cap Reductn		0	0			0	0	0	0	145		0
Spillback Cap Reductn		0	0			0	0	0	0	0		0
Storage Cap Reductn		0	0			0	0	0	0	0		0
Reduced v/c Ratio		0.91	0.96			0.93	0.97	0.09	0.97	0.91		0.91

Intersection Summary

Area Type: Other

Cycle Length: 130

Actuated Cycle Length: 130

Offset: 0 (0%), Referenced to phase 2:WBT and 6:EBT, Start of Yellow, Master Intersection

Natural Cycle: 110

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.97

Intersection Signal Delay: 65.2

Intersection LOS: E

Intersection Capacity Utilization 86.6%

ICU Level of Service E

Analysis Period (min) 15

Description: ø2 (SB): 8 / 7 / 11

ø4 (WB): 19 / 23 / 18

ø6 (NB): 5 / 15 / 7

ø8 (EB): 26 / 28 / 19

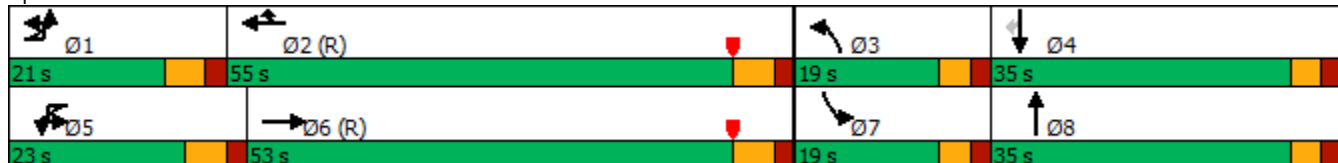
~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 13: Hammond St & Route 9



Intersection Capacity Analysis
Hammond St & Heath St

07/16/2019



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↕			↕			↕	
Traffic Volume (vph)	0	0	0	69	27	131	10	430	90	30	411	17
Future Volume (vph)	0	0	0	69	27	131	10	430	90	30	411	17
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	0		0	50		0
Storage Lanes	0		0	0		0	0		0	0		0
Taper Length (ft)	0			0			0			20		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			30				30
Link Distance (ft)		436			675			648				307
Travel Time (s)		9.9			15.3			14.7				7.0
Confl. Peds. (#/hr)						8	17		6	6		17
Peak Hour Factor	0.92	0.92	0.92	0.75	0.52	0.73	0.50	0.93	0.64	0.62	0.84	0.61
Growth Factor	103%	103%	103%	103%	103%	103%	103%	103%	103%	103%	103%	103%
Heavy Vehicles (%)	2%	2%	2%	1%	0%	2%	0%	4%	9%	10%	4%	24%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	333	0	0	642	0	0	583	0
Turn Type				Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases					8			2		1	6	
Permitted Phases				8			2			6		
Detector Phase				8	8		2	2		1	6	
Switch Phase												
Minimum Initial (s)				6.0	6.0		6.0	6.0		6.0	6.0	
Minimum Split (s)				26.0	26.0		19.0	19.0		13.0	20.0	
Total Split (s)				31.0	31.0		50.0	50.0		49.0	99.0	
Total Split (%)				23.8%	23.8%		38.5%	38.5%		37.7%	76.2%	
Maximum Green (s)				25.0	25.0		43.0	43.0		42.0	92.0	
Yellow Time (s)				3.0	3.0		4.0	4.0		4.0	4.0	
All-Red Time (s)				3.0	3.0		3.0	3.0		3.0	3.0	
Lost Time Adjust (s)					0.0			0.0			0.0	
Total Lost Time (s)					6.0			7.0			7.0	
Lead/Lag							Lead	Lead		Lag		
Lead-Lag Optimize?							Yes	Yes		Yes		
Vehicle Extension (s)				2.0	2.0		2.0	2.0		2.0	2.0	
Recall Mode				None	None		C-Min	C-Min		None	C-Min	
Walk Time (s)				7.0	7.0		7.0	7.0			7.0	
Flash Dont Walk (s)				13.0	13.0		5.0	5.0			6.0	
Pedestrian Calls (#/hr)				8	8		6	6			17	
Act Effct Green (s)					30.8			86.2			86.2	
Actuated g/C Ratio					0.24			0.66			0.66	
v/c Ratio					0.80			0.33			0.32	
Control Delay					54.8			9.9			2.0	
Queue Delay					0.1			0.0			0.3	
Total Delay					54.9			10.0			2.3	
LOS					D			A			A	
Approach Delay					54.9			10.0			2.3	
Approach LOS					D			A			A	
Queue Length 50th (ft)					232			109			27	
Queue Length 95th (ft)					151			158			m15	

Intersection Capacity Analysis Hammond St & Heath St

07/16/2019

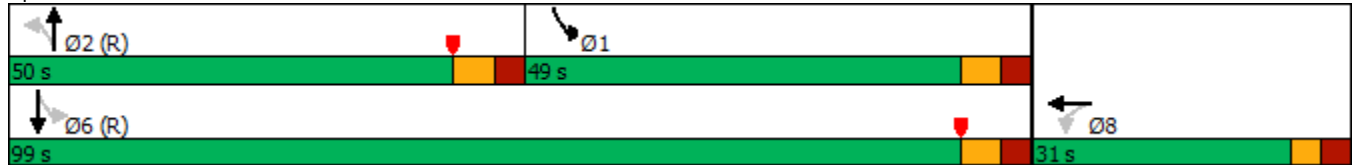


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Internal Link Dist (ft)		356			595			568			227	
Turn Bay Length (ft)												
Base Capacity (vph)					421			1948			1932	
Starvation Cap Reductn					0			0			698	
Spillback Cap Reductn					1			90			0	
Storage Cap Reductn					0			0			0	
Reduced v/c Ratio					0.79			0.35			0.47	

Intersection Summary

Area Type: Other
 Cycle Length: 130
 Actuated Cycle Length: 130
 Offset: 105 (81%), Referenced to phase 2:NBTL and 6:SBTL, Start of Yellow
 Natural Cycle: 60
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.80
 Intersection Signal Delay: 16.7
 Intersection LOS: B
 Intersection Capacity Utilization 60.2%
 ICU Level of Service B
 Analysis Period (min) 15
 Description: ø2 (WB): 6 / 6 / 9
 ø6 (EB): 17 / 19 / 12
 ø8 (SB): 8 / 6 / 22
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 14: Hammond St & Heath St



Intersection Capacity Analysis

Tully St & Route 9

07/16/2019



Lane Group	EBU	EBT	EBR	WBU	WBL	WBT	NBL	NBR	Ø9
Lane Configurations									
Traffic Volume (vph)	44	1307	73	5	9	1262	25	44	
Future Volume (vph)	44	1307	73	5	9	1262	25	44	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	
Lane Width (ft)	11	12	11	11	11	12	11	11	
Storage Length (ft)	250		0		150		0	0	
Storage Lanes	1		0		1		1	0	
Taper Length (ft)	100				100		0		
Right Turn on Red			Yes					Yes	
Link Speed (mph)		30				30	30		
Link Distance (ft)		898				297	462		
Travel Time (s)		20.4				6.8	10.5		
Confl. Peds. (#/hr)			16		16				
Peak Hour Factor	0.73	0.87	0.55	0.42	0.75	0.93	0.89	0.79	
Growth Factor	103%	103%	103%	103%	103%	103%	103%	103%	
Heavy Vehicles (%)	0%	6%	1%	0%	0%	3%	12%	14%	
Shared Lane Traffic (%)									
Lane Group Flow (vph)	62	1684	0	0	24	1398	86	0	
Turn Type	Prot	NA		Prot	Prot	NA	Prot		
Protected Phases	5	2		1	1	6	8	9	
Permitted Phases									
Detector Phase	5	2		1	1	6	8		
Switch Phase									
Minimum Initial (s)	6.0	10.0		6.0	6.0	10.0	1.0	5.0	
Minimum Split (s)	12.0	23.0		12.0	12.0	23.0	7.0	32.0	
Total Split (s)	18.0	61.0		18.0	18.0	61.0	19.0	32.0	
Total Split (%)	13.8%	46.9%		13.8%	13.8%	46.9%	14.6%	25%	
Maximum Green (s)	12.0	55.0		12.0	12.0	55.0	13.0	29.0	
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	3.0	2.0	
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	3.0	1.0	
Lost Time Adjust (s)	0.0	0.0			0.0	0.0	0.0		
Total Lost Time (s)	6.0	6.0			6.0	6.0	6.0		
Lead/Lag	Lead	Lag		Lead	Lead	Lag			
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes			
Vehicle Extension (s)	2.0	2.0		2.0	2.0	2.0	3.0	3.0	
Recall Mode	None	C-Min		None	None	C-Min	None	None	
Walk Time (s)								7.0	
Flash Dont Walk (s)								22.0	
Pedestrian Calls (#/hr)								8	
Act Effct Green (s)	9.0	95.0			6.8	90.4	8.6		
Actuated g/C Ratio	0.07	0.73			0.05	0.70	0.07		
v/c Ratio	0.52	0.68			0.26	0.57	0.58		
Control Delay	72.8	15.7			66.0	15.5	39.2		
Queue Delay	0.0	0.0			0.0	11.4	0.0		
Total Delay	72.8	15.7			66.0	27.0	39.2		
LOS	E	B			E	C	D		
Approach Delay		17.7				27.6	39.2		
Approach LOS		B				C	D		
Queue Length 50th (ft)	51	322			20	247	24		

Intersection Capacity Analysis

Tully St & Route 9

07/16/2019



Lane Group	EBU	EBT	EBR	WBU	WBL	WBT	NBL	NBR	Ø9
Queue Length 95th (ft)	78	#936				41	#745	75	
Internal Link Dist (ft)		818					217	382	
Turn Bay Length (ft)	250				150				
Base Capacity (vph)	161	2463			161	2438	196		
Starvation Cap Reductn	0	0			0	1031	0		
Spillback Cap Reductn	0	0			0	0	0		
Storage Cap Reductn	0	0			0	0	0		
Reduced v/c Ratio	0.39	0.68			0.15	0.99	0.44		

Intersection Summary

Area Type: Other

Cycle Length: 130

Actuated Cycle Length: 130

Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow

Natural Cycle: 110

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.68

Intersection Signal Delay: 22.6

Intersection LOS: C

Intersection Capacity Utilization 53.9%

ICU Level of Service A

Analysis Period (min) 15

Description: 0 / 5 / 13

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 15: Tully St & Route 9

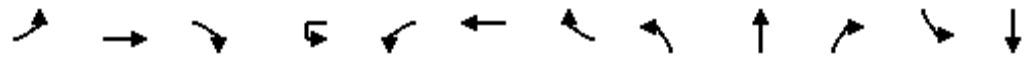


APPENDIX K
Intersection Capacity Analyses
Weekday PM Peak Hour
Proposed Long-Term Improvements under 2030 Traffic Conditions

Intersection Capacity Analysis

Cypress St & Route 9

07/16/2019



Lane Group	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Traffic Volume (vph)	294	753	100	2	81	896	54	65	194	30	20	234
Future Volume (vph)	294	753	100	2	81	896	54	65	194	30	20	234
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	12	11	11	11	12	11	11	11	11	11	10
Storage Length (ft)	350		0		150		0	0		0	0	
Storage Lanes	1		0		1		0	1		0	0	
Taper Length (ft)	100				100			0				0
Right Turn on Red			Yes				Yes			Yes		
Link Speed (mph)		30				30			30			30
Link Distance (ft)		614				1044			573			420
Travel Time (s)		14.0				23.7			13.0			9.5
Confl. Peds. (#/hr)	8		5	28	5		8	99		28	28	
Peak Hour Factor	0.98	0.95	0.78	0.50	0.56	0.96	0.84	0.77	0.88	0.68	0.50	0.90
Growth Factor	104%	104%	104%	104%	104%	104%	104%	104%	104%	104%	104%	104%
Heavy Vehicles (%)	1%	3%	2%	0%	0%	2%	2%	8%	0%	0%	5%	2%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	312	957	0	0	154	1038	0	88	275	0	0	312
Turn Type	Prot	NA		Prot	Prot	NA		Perm	NA		Perm	NA
Protected Phases	5	2		1	1	6			8			4
Permitted Phases								8				4
Detector Phase	5	2		1	1	6		8	8			4
Switch Phase												
Minimum Initial (s)	6.0	10.0		6.0	6.0	10.0		6.0	6.0			6.0
Minimum Split (s)	11.0	16.0		11.0	11.0	16.0		11.0	11.0			11.0
Total Split (s)	32.0	60.0		22.0	22.0	50.0		42.0	42.0			42.0
Total Split (%)	21.3%	40.0%		14.7%	14.7%	33.3%		28.0%	28.0%			28.0%
Maximum Green (s)	27.0	54.0		17.0	17.0	44.0		37.0	37.0			37.0
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0		4.0	4.0			4.0
All-Red Time (s)	1.0	2.0		1.0	1.0	2.0		1.0	1.0			1.0
Lost Time Adjust (s)	0.0	0.0			0.0	0.0		0.0	0.0			0.0
Total Lost Time (s)	5.0	6.0			5.0	6.0		5.0	5.0			5.0
Lead/Lag	Lead	Lag		Lead	Lead	Lag						
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes						
Vehicle Extension (s)	2.0	2.0		2.0	2.0	2.0		2.0	2.0			2.0
Recall Mode	None	Min		None	None	Min		None	None			None
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)	27.1	56.1			15.3	44.2		37.2	37.2			37.2
Actuated g/C Ratio	0.19	0.39			0.11	0.31		0.26	0.26			0.26
v/c Ratio	0.95	0.71			0.83	0.96		0.70	0.59			0.96
Control Delay	97.1	41.4			96.5	68.1		79.7	52.8			94.5
Queue Delay	0.0	0.0			0.0	0.0		0.0	0.0			0.0
Total Delay	97.1	41.4			96.5	68.1		79.7	52.8			94.5
LOS	F	D			F	E		E	D			F
Approach Delay		55.1				71.7			59.3			52.2
Approach LOS		E				E			E			D
Queue Length 50th (ft)	304	421			147	526		78	232			303

Intersection Capacity Analysis

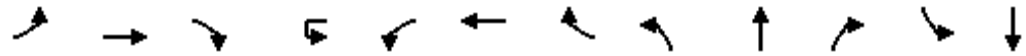
Cypress St & Route 9

07/16/2019

Lane Group	SBR	Ø9
Lane Configurations		
Traffic Volume (vph)	240	
Future Volume (vph)	240	
Ideal Flow (vphpl)	1900	
Lane Width (ft)	11	
Storage Length (ft)	0	
Storage Lanes	1	
Taper Length (ft)		
Right Turn on Red	Yes	
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Confl. Peds. (#/hr)	99	
Peak Hour Factor	0.92	
Growth Factor	104%	
Heavy Vehicles (%)	1%	
Shared Lane Traffic (%)		
Lane Group Flow (vph)	271	
Turn Type	pt+ov	
Protected Phases	4 5	9
Permitted Phases		
Detector Phase	4 5	
Switch Phase		
Minimum Initial (s)		20.0
Minimum Split (s)		26.0
Total Split (s)		26.0
Total Split (%)		17%
Maximum Green (s)		22.0
Yellow Time (s)		2.0
All-Red Time (s)		2.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Vehicle Extension (s)		2.0
Recall Mode		None
Walk Time (s)		7.0
Flash Dont Walk (s)		10.0
Pedestrian Calls (#/hr)		60
Act Effct Green (s)	69.3	
Actuated g/C Ratio	0.48	
v/c Ratio	0.31	
Control Delay	3.4	
Queue Delay	0.0	
Total Delay	3.4	
LOS	A	
Approach Delay		
Approach LOS		
Queue Length 50th (ft)	0	

Intersection Capacity Analysis Cypress St & Route 9

07/16/2019



Lane Group	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Queue Length 95th (ft)	#505	505			135	#681		#130	325			#508
Internal Link Dist (ft)		534				964			493			340
Turn Bay Length (ft)	350				150							
Base Capacity (vph)	327	1348			208	1082		126	465			324
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	0.95	0.71			0.74	0.96		0.70	0.59			0.96

Intersection Summary

Area Type: Other

Cycle Length: 150

Actuated Cycle Length: 143.2

Natural Cycle: 150

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.96

Intersection Signal Delay: 60.9

Intersection LOS: E

Intersection Capacity Utilization 88.8%

ICU Level of Service E

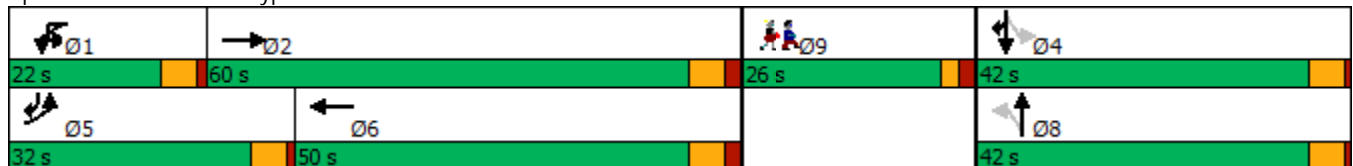
Analysis Period (min) 15

Description: 155 / 99 / 53

95th percentile volume exceeds capacity, queue may be longer.

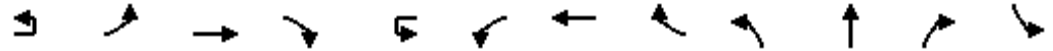
Queue shown is maximum after two cycles.

Splits and Phases: 2: Cypress St & Route 9



Intersection Capacity Analysis
Warren St/Sumner Rd & Route 9

07/16/2019



Lane Group	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations												
Traffic Volume (vph)	4	197	1090	55	14	42	1155	18	41	193	6	67
Future Volume (vph)	4	197	1090	55	14	42	1155	18	41	193	6	67
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	11	11	11	12	11	11	11	11	11
Storage Length (ft)		350		150		150		0	100		0	0
Storage Lanes		1		0		1		0	1		0	0
Taper Length (ft)		100				100			50			0
Right Turn on Red				Yes				Yes			Yes	
Link Speed (mph)			30				30			30		
Link Distance (ft)			635				1295			738		
Travel Time (s)			14.4				29.4			16.8		
Confl. Peds. (#/hr)	3	5			7			5	3		7	7
Peak Hour Factor	0.50	0.91	0.94	0.76	0.58	0.66	0.89	0.90	0.60	0.93	0.50	0.80
Growth Factor	104%	104%	104%	104%	104%	104%	104%	104%	104%	104%	104%	104%
Heavy Vehicles (%)	0%	1%	2%	0%	0%	5%	2%	6%	0%	2%	0%	0%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	233	1281	0	0	91	1371	0	71	228	0	0
Turn Type	Prot	Prot	NA		Prot	Prot	NA		Perm	NA		Perm
Protected Phases	5	5	2		1	1	6			8		
Permitted Phases									8			4
Detector Phase	5	5	2		1	1	6		8	8		4
Switch Phase												
Minimum Initial (s)	6.0	6.0	6.0		6.0	6.0	40.0		6.0	6.0		6.0
Minimum Split (s)	11.0	11.0	46.0		11.0	11.0	46.0		23.0	23.0		23.0
Total Split (s)	22.0	22.0	57.0		17.0	17.0	52.0		40.0	40.0		40.0
Total Split (%)	15.7%	15.7%	40.7%		12.1%	12.1%	37.1%		28.6%	28.6%		28.6%
Maximum Green (s)	17.0	17.0	51.0		12.0	12.0	46.0		35.0	35.0		35.0
Yellow Time (s)	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	2.0		1.0	1.0	2.0		1.0	1.0		1.0
Lost Time Adjust (s)		0.0	0.0				0.0	0.0	0.0	0.0		
Total Lost Time (s)		5.0	6.0				5.0	6.0	5.0	5.0		
Lead/Lag	Lead	Lead	Lag		Lead	Lead	Lag					
Lead-Lag Optimize?	Yes	Yes	Yes		Yes	Yes	Yes					
Vehicle Extension (s)	3.0	3.0	2.0		3.0	3.0	2.0		3.0	3.0		3.0
Recall Mode	None	None	Min		None	None	Min		None	None		None
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		17.1	52.8			10.6	46.3		35.2	35.2		
Actuated g/C Ratio		0.14	0.44			0.09	0.39		0.30	0.30		
v/c Ratio		0.94	0.82			0.61	1.00		0.47	0.43		
Control Delay		95.3	35.6			71.1	61.0		49.4	38.3		
Queue Delay		0.0	0.0			0.0	0.0		0.0	0.0		
Total Delay		95.3	35.6			71.1	61.0		49.4	38.3		
LOS		F	D			E	E		D	D		
Approach Delay			44.8				61.6			40.9		
Approach LOS			D				E			D		
Queue Length 50th (ft)		170	415			64	507		42	131		

Intersection Capacity Analysis

Warren St/Sumner Rd & Route 9

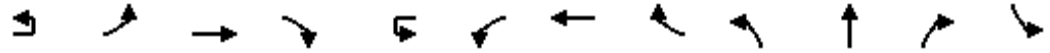
07/16/2019



Lane Group	SBT	SBR	Ø9
Lane Configurations	↕	↗	
Traffic Volume (vph)	250	128	
Future Volume (vph)	250	128	
Ideal Flow (vphpl)	1900	1900	
Lane Width (ft)	11	11	
Storage Length (ft)		0	
Storage Lanes		1	
Taper Length (ft)			
Right Turn on Red		Yes	
Link Speed (mph)	30		
Link Distance (ft)	625		
Travel Time (s)	14.2		
Confl. Peds. (#/hr)		3	
Peak Hour Factor	0.93	0.86	
Growth Factor	104%	104%	
Heavy Vehicles (%)	1%	2%	
Shared Lane Traffic (%)			
Lane Group Flow (vph)	367	155	
Turn Type	NA	Perm	
Protected Phases	4		9
Permitted Phases		4	
Detector Phase	4	4	
Switch Phase			
Minimum Initial (s)	6.0	6.0	6.0
Minimum Split (s)	23.0	23.0	26.0
Total Split (s)	40.0	40.0	26.0
Total Split (%)	28.6%	28.6%	19%
Maximum Green (s)	35.0	35.0	23.0
Yellow Time (s)	4.0	4.0	2.0
All-Red Time (s)	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	
Total Lost Time (s)	5.0	5.0	
Lead/Lag			
Lead-Lag Optimize?			
Vehicle Extension (s)	3.0	3.0	3.0
Recall Mode	None	None	None
Walk Time (s)			5.0
Flash Dont Walk (s)			18.0
Pedestrian Calls (#/hr)			7
Act Effct Green (s)	35.2	35.2	
Actuated g/C Ratio	0.30	0.30	
v/c Ratio	0.96	0.28	
Control Delay	79.9	7.0	
Queue Delay	0.0	0.0	
Total Delay	79.9	7.0	
LOS	E	A	
Approach Delay	58.2		
Approach LOS	E		
Queue Length 50th (ft)	260	0	

Intersection Capacity Analysis
Warren St/Sumner Rd & Route 9

07/16/2019

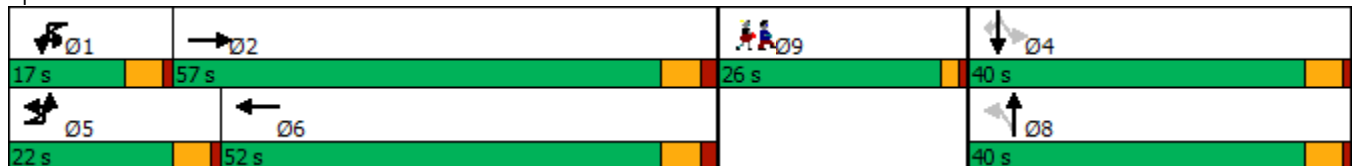


Lane Group	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Queue Length 95th (ft)		#414	#776			103	#914		70	265		
Internal Link Dist (ft)			555				1215			658		
Turn Bay Length (ft)		350				150			100			
Base Capacity (vph)		247	1558			170	1371		151	529		
Starvation Cap Reductn		0	0			0	0		0	0		
Spillback Cap Reductn		0	0			0	0		0	0		
Storage Cap Reductn		0	0			0	0		0	0		
Reduced v/c Ratio		0.94	0.82			0.54	1.00		0.47	0.43		

Intersection Summary

Area Type: Other
 Cycle Length: 140
 Actuated Cycle Length: 119.2
 Natural Cycle: 150
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 1.00
 Intersection Signal Delay: 52.8
 Intersection LOS: D
 Intersection Capacity Utilization 91.4%
 ICU Level of Service F
 Analysis Period (min) 15
 Description: 16 / 7 / 16
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 4: Warren St/Sumner Rd & Route 9



Intersection Capacity Analysis
Lee St & Route 9

07/16/2019



Lane Group	EBT	EBR	WBU	WBL	WBT	NBL	NBR	Ø1	Ø2
Lane Configurations	↑↑	↑		↓	↑↑	↑↑	↑		
Traffic Volume (vph)	1182	592	2	201	1063	487	174		
Future Volume (vph)	1182	592	2	201	1063	487	174		
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900		
Lane Width (ft)	12	11	11	11	12	11	11		
Storage Length (ft)		225		350		0	0		
Storage Lanes		1		1		2	1		
Taper Length (ft)				100		0			
Right Turn on Red		Yes					Yes		
Link Speed (mph)	30				30	30			
Link Distance (ft)	363				323	214			
Travel Time (s)	8.3				7.3	4.9			
Confl. Peds. (#/hr)		1	1	1			1		
Peak Hour Factor	0.91	0.99	0.50	0.93	0.93	0.94	0.93		
Growth Factor	104%	104%	104%	104%	104%	104%	104%		
Heavy Vehicles (%)	2%	2%	0%	2%	2%	2%	2%		
Shared Lane Traffic (%)									
Lane Group Flow (vph)	1351	622	0	229	1189	539	195		
Turn Type	NA	pt+ov	Prot	Prot	NA	Prot	Perm		
Protected Phases	1 2	1 2 4	3	3	1 2 3	4		1	2
Permitted Phases									4
Detector Phase	1 2	1 2 4	3	3	1 2 3	4			4
Switch Phase									
Minimum Initial (s)			5.0	5.0		6.0	6.0	5.0	10.0
Minimum Split (s)			10.0	10.0		29.0	29.0	10.0	19.0
Total Split (s)			20.0	20.0		47.0	47.0	34.0	19.0
Total Split (%)			16.7%	16.7%		39.2%	39.2%	28%	16%
Maximum Green (s)			15.0	15.0		42.0	42.0	29.0	14.0
Yellow Time (s)			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
Lost Time Adjust (s)				0.0		0.0	0.0		
Total Lost Time (s)				5.0		5.0	5.0		
Lead/Lag			Lead	Lead		Lag	Lag	Lead	Lag
Lead-Lag Optimize?			Yes	Yes		Yes	Yes		
Vehicle Extension (s)			3.0	3.0		3.0	3.0	3.0	3.0
Recall Mode			None	None		None	None	None	C-Max
Walk Time (s)						17.0	17.0		10.0
Flash Dont Walk (s)						7.0	7.0		4.0
Pedestrian Calls (#/hr)						1	1		1
Act Effct Green (s)	54.4	95.0		15.0	74.4	35.6	35.6		
Actuated g/C Ratio	0.45	0.79		0.12	0.62	0.30	0.30		
v/c Ratio	0.84	0.50		1.08	0.54	0.55	0.33		
Control Delay	23.8	1.8		132.6	15.2	9.6	3.1		
Queue Delay	17.3	0.9		11.6	1.6	1.0	1.3		
Total Delay	41.1	2.7		144.2	16.9	10.5	4.4		
LOS	D	A		F	B	B	A		
Approach Delay	29.0				37.4	8.9			
Approach LOS	C				D	A			
Queue Length 50th (ft)	537	21		~197	274	137	18		

Intersection Capacity Analysis
Lee St & Route 9

07/16/2019

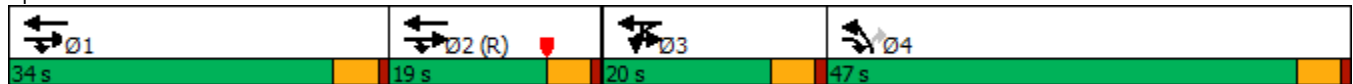


Lane Group	EBT	EBR	WBU	WBL	WBT	NBL	NBR	Ø1	Ø2
Queue Length 95th (ft)	m#562	m25		#358	366	73	5		
Internal Link Dist (ft)	283				243	134			
Turn Bay Length (ft)		225		350					
Base Capacity (vph)	1603	1230		213	2193	1161	655		
Starvation Cap Reductn	279	339		0	0	357	284		
Spillback Cap Reductn	0	2		36	774	0	0		
Storage Cap Reductn	0	0		0	0	0	0		
Reduced v/c Ratio	1.02	0.70		1.29	0.84	0.67	0.53		

Intersection Summary

Area Type: Other
 Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 115 (96%), Referenced to phase 2:EBWB, Start of Yellow
 Natural Cycle: 90
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 1.08
 Intersection Signal Delay: 28.3
 Intersection LOS: C
 Intersection Capacity Utilization 72.8%
 ICU Level of Service C
 Analysis Period (min) 15
 Description: Ø2 (NB): 0 / 1 / 3
 Ø4 (WB): 0 / 1 / 3
 ~ 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.
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 5: Lee St & Route 9



Intersection Capacity Analysis

Lee St & Lee Street Extension

07/16/2019



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø1
Lane Configurations							
Traffic Volume (vph)	79	11	42	602	818	7	
Future Volume (vph)	79	11	42	602	818	7	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Right Turn on Red		Yes				Yes	
Link Speed (mph)	30			30	30		
Link Distance (ft)	617			340	214		
Travel Time (s)	14.0			7.7	4.9		
Peak Hour Factor	0.90	0.69	0.66	0.84	0.87	0.58	
Growth Factor	104%	104%	104%	104%	104%	104%	
Heavy Vehicles (%)	3%	0%	0%	2%	2%	0%	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	108	0	0	811	991	0	
Turn Type	Prot		Perm	NA	NA		
Protected Phases	2			3	1 3		1
Permitted Phases			3				
Detector Phase	2		3	3	1 3		
Switch Phase							
Minimum Initial (s)	6.0		10.0	10.0			5.0
Minimum Split (s)	20.0		15.0	15.0			10.0
Total Split (s)	20.0		50.0	50.0			50.0
Total Split (%)	16.7%		41.7%	41.7%			42%
Maximum Green (s)	15.0		45.0	45.0			45.0
Yellow Time (s)	4.0		4.0	4.0			4.0
All-Red Time (s)	1.0		1.0	1.0			1.0
Lost Time Adjust (s)	0.0			0.0			
Total Lost Time (s)	5.0			5.0			
Lead/Lag	Lag						Lead
Lead-Lag Optimize?	Yes						Yes
Vehicle Extension (s)	2.0		2.0	2.0			2.0
Recall Mode	None		None	None			C-Max
Walk Time (s)	5.0						
Flash Dont Walk (s)	5.0						
Pedestrian Calls (#/hr)	0						
Act Effect Green (s)	11.3			38.2	98.7		
Actuated g/C Ratio	0.09			0.32	0.82		
v/c Ratio	0.66			0.68	0.35		
Control Delay	68.3			38.2	2.7		
Queue Delay	0.0			0.2	0.6		
Total Delay	68.3			38.4	3.3		
LOS	E			D	A		
Approach Delay	68.3			38.4	3.3		
Approach LOS	E			D	A		
Queue Length 50th (ft)	77			197	33		
Queue Length 95th (ft)	136			206	m138		
Internal Link Dist (ft)	537			260	134		
Turn Bay Length (ft)							
Base Capacity (vph)	215			1407	2791		
Starvation Cap Reductn	0			0	1320		

Intersection Capacity Analysis
Lee St & Lee Street Extension

07/16/2019



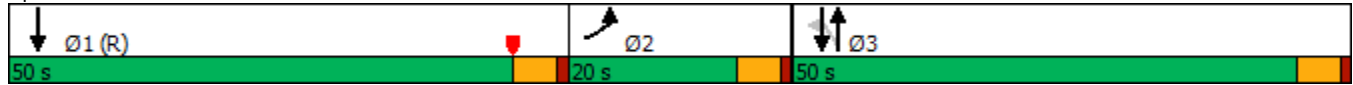
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø1
Spillback Cap Reductn	0			116	0		
Storage Cap Reductn	0			0	0		
Reduced v/c Ratio	0.50			0.63	0.67		

Intersection Summary

Area Type:	Other
Cycle Length:	120
Actuated Cycle Length:	120
Offset:	105 (88%), Referenced to phase 1:SBT, Start of Yellow
Natural Cycle:	50
Control Type:	Actuated-Coordinated
Maximum v/c Ratio:	0.68
Intersection Signal Delay:	21.9
Intersection LOS:	C
Intersection Capacity Utilization	54.5%
ICU Level of Service	A
Analysis Period (min)	15
Description:	1 / 0 / 2

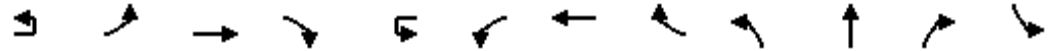
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 6: Lee St & Lee Street Extension



Intersection Capacity Analysis
 Heath St/Chestnut Hill Ave & Route 9

07/16/2019

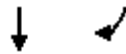


Lane Group	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations		↔	↕			↔	↕	↔				↔
Traffic Volume (vph)	9	308	1190	0	1	117	1127	391	0	0	0	601
Future Volume (vph)	9	308	1190	0	1	117	1127	391	0	0	0	601
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	11	11	11	12	11	11	11	11	11
Storage Length (ft)		400		0		175		225	0		0	250
Storage Lanes		1		0		1		1	0		0	1
Taper Length (ft)		100				100			0			100
Right Turn on Red				Yes				Yes			Yes	
Link Speed (mph)			30				30			30		
Link Distance (ft)			584				363			179		
Travel Time (s)			13.3				8.3			4.1		
Confl. Peds. (#/hr)	2	2				2		2				
Peak Hour Factor	0.75	0.81	0.90	0.92	0.25	0.75	0.89	0.91	0.92	0.92	0.92	0.94
Growth Factor	104%	104%	104%	104%	104%	104%	104%	104%	104%	104%	104%	104%
Heavy Vehicles (%)	0%	0%	2%	2%	0%	0%	2%	1%	2%	2%	2%	2%
Shared Lane Traffic (%)												32%
Lane Group Flow (vph)	0	407	1375	0	0	166	1317	447	0	0	0	452
Turn Type	Prot	Prot	NA		Prot	Prot	NA	custom				Split
Protected Phases	4	4	1 4 5		2	2	1 2 5	1 2 3				3
Permitted Phases												
Detector Phase	4	4	1 4 5		2	2	1 2 5	1 2 3				3
Switch Phase												
Minimum Initial (s)	5.0	5.0			5.0	5.0						5.0
Minimum Split (s)	10.0	10.0			10.0	10.0						23.0
Total Split (s)	28.0	28.0			15.0	15.0						35.0
Total Split (%)	23.3%	23.3%			12.5%	12.5%						29.2%
Maximum Green (s)	23.0	23.0			10.0	10.0						30.0
Yellow Time (s)	4.0	4.0			4.0	4.0						4.0
All-Red Time (s)	1.0	1.0			1.0	1.0						1.0
Lost Time Adjust (s)		0.0				0.0						0.0
Total Lost Time (s)		5.0				5.0						5.0
Lead/Lag	Lag	Lag			Lag	Lag						Lead
Lead-Lag Optimize?	Yes	Yes			Yes	Yes						Yes
Vehicle Extension (s)	3.0	3.0			3.0	3.0						3.0
Recall Mode	None	None			Max	Max						None
Walk Time (s)												13.0
Flash Dont Walk (s)												5.0
Pedestrian Calls (#/hr)												2
Act Effct Green (s)		23.0	65.0			10.0	52.0	68.0				30.0
Actuated g/C Ratio		0.19	0.54			0.08	0.43	0.57				0.25
v/c Ratio		1.22	0.72			1.14	0.86	0.42				1.11
Control Delay		164.0	23.3			164.9	38.3	4.8				121.0
Queue Delay		0.0	16.1			0.0	17.0	0.6				0.0
Total Delay		164.0	39.4			164.9	55.3	5.4				121.0
LOS		F	D			F	E	A				F
Approach Delay			67.8				53.2					
Approach LOS			E				D					
Queue Length 50th (ft)		~386	402			~151	514	73				~422

Intersection Capacity Analysis

Heath St/Chestnut Hill Ave & Route 9

07/16/2019

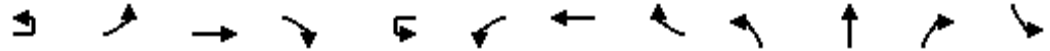


Lane Group	SBT	SBR	Ø1	Ø5
Lane Configurations	↕			
Traffic Volume (vph)	56	119		
Future Volume (vph)	56	119		
Ideal Flow (vphpl)	1900	1900		
Lane Width (ft)	11	11		
Storage Length (ft)		100		
Storage Lanes		0		
Taper Length (ft)				
Right Turn on Red		Yes		
Link Speed (mph)	30			
Link Distance (ft)	916			
Travel Time (s)	20.8			
Confl. Peds. (#/hr)		2		
Peak Hour Factor	0.64	0.88		
Growth Factor	104%	104%		
Heavy Vehicles (%)	4%	2%		
Shared Lane Traffic (%)				
Lane Group Flow (vph)	445	0		
Turn Type	NA			
Protected Phases	3		1	5
Permitted Phases				
Detector Phase	3			
Switch Phase				
Minimum Initial (s)	5.0		5.0	5.0
Minimum Split (s)	23.0		15.0	19.0
Total Split (s)	35.0		23.0	19.0
Total Split (%)	29.2%		19%	16%
Maximum Green (s)	30.0		18.0	16.0
Yellow Time (s)	4.0		4.0	2.0
All-Red Time (s)	1.0		1.0	1.0
Lost Time Adjust (s)	0.0			
Total Lost Time (s)	5.0			
Lead/Lag	Lead		Lead	
Lead-Lag Optimize?	Yes		Yes	
Vehicle Extension (s)	3.0		3.0	3.0
Recall Mode	None		C-Max	None
Walk Time (s)	13.0			6.0
Flash Dont Walk (s)	5.0			10.0
Pedestrian Calls (#/hr)	2			2
Act Effct Green (s)	30.0			
Actuated g/C Ratio	0.25			
v/c Ratio	1.09			
Control Delay	112.1			
Queue Delay	2.1			
Total Delay	114.2			
LOS	F			
Approach Delay	117.6			
Approach LOS	F			
Queue Length 50th (ft)	~396			

Intersection Capacity Analysis

Heath St/Chestnut Hill Ave & Route 9

07/16/2019



Lane Group	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Queue Length 95th (ft)		#499	487			#228	596	130				#640
Internal Link Dist (ft)			504				283			99		
Turn Bay Length (ft)		400				175		225				250
Base Capacity (vph)		334	1916			145	1533	1069				406
Starvation Cap Reductn		0	138			0	242	296				0
Spillback Cap Reductn		0	559			0	0	0				0
Storage Cap Reductn		0	0			0	0	0				0
Reduced v/c Ratio		1.22	1.01			1.14	1.02	0.58				1.11

Intersection Summary

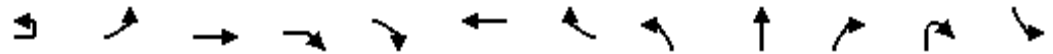
Area Type: Other
 Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 0 (0%), Referenced to phase 1:EBWB, Start of Yellow, Master Intersection
 Natural Cycle: 130
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 1.22
 Intersection Signal Delay: 71.4
 Intersection LOS: E
 Intersection Capacity Utilization 85.8%
 ICU Level of Service E
 Analysis Period (min) 15
 Description: ø3 (EB+WB): 9 / 2 / 2
 ø5 (SB): 12 / 2 / 2
 ~ 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.

Splits and Phases: 7: Heath St/Chestnut Hill Ave & Route 9



Intersection Capacity Analysis
Reservoir Rd & Route 9

07/16/2019



Lane Group	EBU	EBL	EBT	EBR	EBR2	WBT	WBR	NBL	NBT	NBR	NBR2	SBL2
Lane Configurations												
Traffic Volume (vph)	18	21	1479	17	1	1261	21	58	11	12	3	24
Future Volume (vph)	18	21	1479	17	1	1261	21	58	11	12	3	24
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)		250		0			0	0		0		
Storage Lanes		1		0			0	1		0		
Taper Length (ft)		100						0				
Right Turn on Red					Yes		Yes				Yes	
Link Speed (mph)			30			30			30			
Link Distance (ft)			977			709			527			
Travel Time (s)			22.2			16.1			12.0			
Confl. Peds. (#/hr)	5	1		2	11		1	5		8	2	8
Peak Hour Factor	0.75	0.58	0.94	0.61	0.25	0.96	0.66	0.63	0.69	0.60	0.75	0.75
Growth Factor	104%	104%	104%	104%	104%	104%	104%	104%	104%	104%	104%	104%
Heavy Vehicles (%)	0%	0%	1%	0%	0%	1%	0%	7%	0%	33%	0%	0%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	63	1669	0	0	1399	0	96	42	0	0	0
Turn Type	Prot	Prot	NA			NA		Perm	NA			Perm
Protected Phases	5	5	2			6			8			
Permitted Phases								8				4
Detector Phase	5	5	2			6		8	8			4
Switch Phase												
Minimum Initial (s)	6.0	6.0	6.0			6.0		6.0	6.0			6.0
Minimum Split (s)	12.0	12.0	12.0			12.0		11.0	11.0			11.0
Total Split (s)	12.0	12.0	71.0			59.0		20.0	20.0			20.0
Total Split (%)	10.0%	10.0%	59.2%			49.2%		16.7%	16.7%			16.7%
Maximum Green (s)	6.0	6.0	65.0			53.0		15.0	15.0			15.0
Yellow Time (s)	4.0	4.0	4.0			4.0		4.0	4.0			4.0
All-Red Time (s)	2.0	2.0	2.0			2.0		1.0	1.0			1.0
Lost Time Adjust (s)		0.0	0.0			0.0		0.0	0.0			
Total Lost Time (s)		6.0	6.0			6.0		5.0	5.0			
Lead/Lag	Lead	Lead				Lag						
Lead-Lag Optimize?	Yes	Yes				Yes						
Vehicle Extension (s)	3.0	3.0	2.0			2.0		3.0	3.0			3.0
Recall Mode	None	None	C-Min			C-Min		None	None			None
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		7.6	84.5			73.4		12.9	12.9			
Actuated g/C Ratio		0.06	0.70			0.61		0.11	0.11			
v/c Ratio		0.58	0.69			0.66		0.71	0.27			
Control Delay		75.9	16.2			21.9		77.9	49.2			
Queue Delay		0.0	0.0			0.5		0.0	0.0			
Total Delay		75.9	16.2			22.4		77.9	49.2			
LOS		E	B			C		E	D			
Approach Delay			18.4			22.4			69.2			
Approach LOS			B			C			E			
Queue Length 50th (ft)		47	232			309		72	27			
Queue Length 95th (ft)		61	703			#680		88	47			

Intersection Capacity Analysis

Reservoir Rd & Route 9

07/16/2019

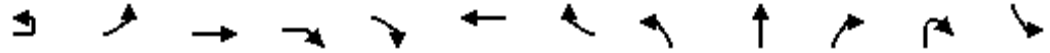


Lane Group	SBL	SBT	SBR	NWR2	Ø9
Lane Configurations		↕		↗	
Traffic Volume (vph)	7	1	7	6	
Future Volume (vph)	7	1	7	6	
Ideal Flow (vphpl)	1900	1900	1900	1900	
Storage Length (ft)	0		0		
Storage Lanes	0		0		
Taper Length (ft)	0				
Right Turn on Red			Yes	Yes	
Link Speed (mph)		30			
Link Distance (ft)		854			
Travel Time (s)		19.4			
Confl. Peds. (#/hr)	2		5	8	
Peak Hour Factor	0.44	0.25	0.58	0.38	
Growth Factor	104%	104%	104%	104%	
Heavy Vehicles (%)	0%	0%	0%	0%	
Shared Lane Traffic (%)					
Lane Group Flow (vph)	0	67	0	16	
Turn Type	Perm	NA		Perm	
Protected Phases		4		9	
Permitted Phases	4			2 4	
Detector Phase	4	4		2 4	
Switch Phase					
Minimum Initial (s)	6.0	6.0		5.0	
Minimum Split (s)	11.0	11.0		29.0	
Total Split (s)	20.0	20.0		29.0	
Total Split (%)	16.7%	16.7%		24%	
Maximum Green (s)	15.0	15.0		26.0	
Yellow Time (s)	4.0	4.0		2.0	
All-Red Time (s)	1.0	1.0		1.0	
Lost Time Adjust (s)		0.0			
Total Lost Time (s)		5.0			
Lead/Lag					
Lead-Lag Optimize?					
Vehicle Extension (s)	3.0	3.0		3.0	
Recall Mode	None	None		None	
Walk Time (s)				5.0	
Flash Dont Walk (s)				21.0	
Pedestrian Calls (#/hr)				13	
Act Effect Green (s)		12.9		106.0	
Actuated g/C Ratio		0.11		0.88	
v/c Ratio		0.46		0.01	
Control Delay		53.5		0.0	
Queue Delay		0.0		0.0	
Total Delay		53.5		0.0	
LOS		D		A	
Approach Delay		53.5			
Approach LOS		D			
Queue Length 50th (ft)		43		0	
Queue Length 95th (ft)		19		0	

Intersection Capacity Analysis

Reservoir Rd & Route 9

07/16/2019

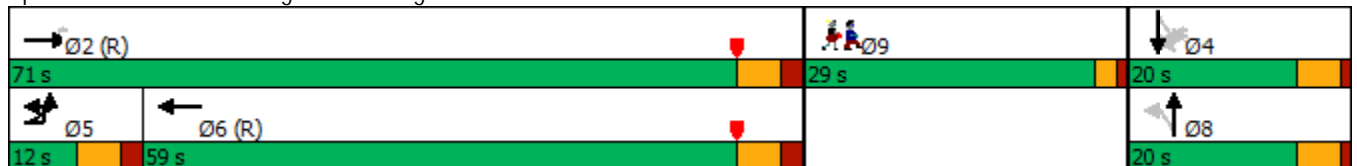


Lane Group	EBU	EBL	EBT	EBR	EBR2	WBT	WBR	NBL	NBT	NBR	NBR2	SBL2
Internal Link Dist (ft)			897			629			447			
Turn Bay Length (ft)		250										
Base Capacity (vph)		109	2423			2106		158	176			
Starvation Cap Reductn		0	0			294		0	0			
Spillback Cap Reductn		0	0			0		0	0			
Storage Cap Reductn		0	0			0		0	0			
Reduced v/c Ratio		0.58	0.69			0.77		0.61	0.24			

Intersection Summary

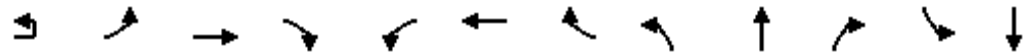
Area Type:	Other
Cycle Length:	120
Actuated Cycle Length:	120
Offset:	0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow
Natural Cycle:	90
Control Type:	Actuated-Coordinated
Maximum v/c Ratio:	0.71
Intersection Signal Delay:	22.8
Intersection LOS:	C
Intersection Capacity Utilization	71.3%
ICU Level of Service	C
Analysis Period (min)	15
Description:	43 / 13 / 1
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

Splits and Phases: 9: Longwood Parking Lot & Reservoir Rd & Route 9



Intersection Capacity Analysis
Hammond St & Route 9

07/16/2019



Lane Group	EBU	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Traffic Volume (vph)	2	158	1137	38	146	1248	47	160	225	52	129	374
Future Volume (vph)	2	158	1137	38	146	1248	47	160	225	52	129	374
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	11	11	12	11	11	11	11	11	11
Storage Length (ft)		550		0	300		150	0		0	125	
Storage Lanes		1		0	1		1	1		0	1	
Taper Length (ft)		100			100			0			100	
Right Turn on Red				Yes			Yes			Yes		
Link Speed (mph)			30			30			30			30
Link Distance (ft)			726			711			307			892
Travel Time (s)			16.5			16.2			7.0			20.3
Confl. Peds. (#/hr)	28	7		15	15		7	28		23	23	
Peak Hour Factor	0.50	0.92	0.95	0.79	0.73	0.95	0.84	0.95	0.88	0.76	0.90	0.92
Growth Factor	104%	104%	104%	104%	104%	104%	104%	104%	104%	104%	104%	104%
Heavy Vehicles (%)	0%	2%	2%	0%	1%	2%	2%	1%	2%	0%	2%	1%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	183	1295	0	208	1366	58	175	337	0	149	423
Turn Type	Prot	Prot	NA		Prot	NA	Prot	Prot	NA		Prot	NA
Protected Phases	1	1	6		5	2	2	3	8		7	4
Permitted Phases												
Detector Phase	1	1	6		5	2	2	3	8		7	4
Switch Phase												
Minimum Initial (s)	6.0	6.0	6.0		6.0	10.0	10.0	5.0	6.0		5.0	6.0
Minimum Split (s)	12.0	12.0	31.0		12.0	33.0	33.0	10.0	29.0		10.0	29.0
Total Split (s)	20.0	20.0	54.0		22.0	56.0	56.0	19.0	33.0		21.0	35.0
Total Split (%)	15.4%	15.4%	41.5%		16.9%	43.1%	43.1%	14.6%	25.4%		16.2%	26.9%
Maximum Green (s)	14.0	14.0	48.0		16.0	50.0	50.0	15.0	27.0		17.0	29.0
Yellow Time (s)	4.0	4.0	4.0		4.0	4.0	4.0	3.0	3.0		3.0	3.0
All-Red Time (s)	2.0	2.0	2.0		2.0	2.0	2.0	1.0	3.0		1.0	3.0
Lost Time Adjust (s)		0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)		6.0	6.0		6.0	6.0	6.0	4.0	6.0		4.0	6.0
Lead/Lag	Lead	Lead	Lag		Lead	Lag	Lag	Lead	Lag		Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes		Yes	Yes
Vehicle Extension (s)	2.0	2.0	2.0		2.0	2.0	2.0	3.0	2.0		3.0	2.0
Recall Mode	None	None	C-Min		None	C-Min	C-Min	None	None		None	None
Walk Time (s)			5.0			5.0	5.0		5.0			5.0
Flash Dont Walk (s)			20.0			22.0	22.0		18.0			18.0
Pedestrian Calls (#/hr)			15			7	7		28			28
Act Effct Green (s)		14.0	48.0		16.0	50.0	50.0	14.8	28.9		15.1	29.2
Actuated g/C Ratio		0.11	0.37		0.12	0.38	0.38	0.11	0.22		0.12	0.22
v/c Ratio		0.99	1.00		0.98	1.00	0.09	0.89	0.45		0.75	1.04
Control Delay		122.6	64.9		113.8	65.2	0.3	96.2	35.0		78.4	103.0
Queue Delay		0.0	0.0		0.0	0.0	0.0	0.0	0.5		0.0	0.0
Total Delay		122.6	64.9		113.8	65.2	0.3	96.2	35.5		78.4	103.0
LOS		F	E		F	E	A	F	D		E	F
Approach Delay			72.0			69.1			56.3			76.6
Approach LOS			E			E			E			E
Queue Length 50th (ft)		157	568		177	~605	0	134	132		122	~386

Intersection Capacity Analysis

Hammond St & Route 9

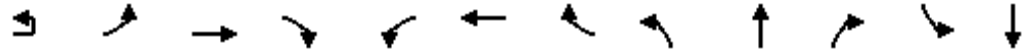
07/16/2019



Lane Group	SBR
Lane Configurations	T
Traffic Volume (vph)	158
Future Volume (vph)	158
Ideal Flow (vphpl)	1900
Lane Width (ft)	11
Storage Length (ft)	125
Storage Lanes	1
Taper Length (ft)	
Right Turn on Red	Yes
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	28
Peak Hour Factor	0.71
Growth Factor	104%
Heavy Vehicles (%)	1%
Shared Lane Traffic (%)	
Lane Group Flow (vph)	231
Turn Type	Perm
Protected Phases	
Permitted Phases	4
Detector Phase	4
Switch Phase	
Minimum Initial (s)	6.0
Minimum Split (s)	29.0
Total Split (s)	35.0
Total Split (%)	26.9%
Maximum Green (s)	29.0
Yellow Time (s)	3.0
All-Red Time (s)	3.0
Lost Time Adjust (s)	0.0
Total Lost Time (s)	6.0
Lead/Lag	Lag
Lead-Lag Optimize?	Yes
Vehicle Extension (s)	2.0
Recall Mode	None
Walk Time (s)	5.0
Flash Dont Walk (s)	18.0
Pedestrian Calls (#/hr)	28
Act Effct Green (s)	29.2
Actuated g/C Ratio	0.22
v/c Ratio	0.55
Control Delay	27.2
Queue Delay	0.0
Total Delay	27.2
LOS	C
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	84

Intersection Capacity Analysis Hammond St & Route 9

07/16/2019

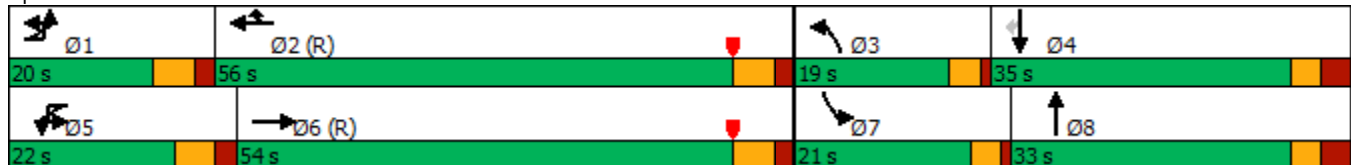


Lane Group	EBU	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Queue Length 95th (ft)		#311	#734		#239	#770	0	m#264	m137		#207	#592
Internal Link Dist (ft)			646				631		227			812
Turn Bay Length (ft)		550			300		150				125	
Base Capacity (vph)		184	1300		212	1361	655	199	749		223	408
Starvation Cap Reductn		0	0		0	0	0	0	145		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		0.99	1.00		0.98	1.00	0.09	0.88	0.56		0.67	1.04

Intersection Summary

Area Type: Other
 Cycle Length: 130
 Actuated Cycle Length: 130
 Offset: 0 (0%), Referenced to phase 2:WBT and 6:EBT, Start of Yellow, Master Intersection
 Natural Cycle: 125
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 1.04
 Intersection Signal Delay: 70.0
 Intersection LOS: E
 Intersection Capacity Utilization 93.1%
 ICU Level of Service F
 Analysis Period (min) 15
 Description: ø2 (SB): 8 / 7 / 11
 ø4 (WB): 19 / 23 / 18
 ø6 (NB): 5 / 15 / 7
 ø8 (EB): 26 / 28 / 19
 ~ 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.
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 13: Hammond St & Route 9



Intersection Capacity Analysis
Hammond St & Heath St

07/16/2019



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↔			↔			↔	
Traffic Volume (vph)	0	0	0	148	71	124	14	306	124	16	513	31
Future Volume (vph)	0	0	0	148	71	124	14	306	124	16	513	31
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		436			675			648			307	
Travel Time (s)		9.9			15.3			14.7			7.0	
Confl. Peds. (#/hr)						6	19		6	6		19
Peak Hour Factor	0.92	0.92	0.92	0.84	0.93	0.76	0.70	0.97	0.91	0.80	0.84	0.86
Growth Factor	104%	104%	104%	104%	104%	104%	104%	104%	104%	104%	104%	104%
Heavy Vehicles (%)	2%	2%	2%	1%	1%	4%	0%	1%	0%	0%	1%	3%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	432	0	0	491	0	0	693	0
Turn Type				Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases					8			2		1	6	
Permitted Phases				8			2			6		
Detector Phase				8	8		2	2		1	6	
Switch Phase												
Minimum Initial (s)				6.0	6.0		6.0	6.0		6.0	6.0	
Minimum Split (s)				26.0	26.0		19.0	19.0		13.0	20.0	
Total Split (s)				37.0	37.0		50.0	50.0		43.0	93.0	
Total Split (%)				28.5%	28.5%		38.5%	38.5%		33.1%	71.5%	
Maximum Green (s)				31.0	31.0		43.0	43.0		36.0	86.0	
Yellow Time (s)				3.0	3.0		4.0	4.0		4.0	4.0	
All-Red Time (s)				3.0	3.0		3.0	3.0		3.0	3.0	
Lost Time Adjust (s)					0.0			0.0			0.0	
Total Lost Time (s)					6.0			7.0			7.0	
Lead/Lag							Lead	Lead		Lag		
Lead-Lag Optimize?							Yes	Yes		Yes		
Vehicle Extension (s)				2.0	2.0		2.0	2.0		2.0	2.0	
Recall Mode				None	None		C-Min	C-Min		None	C-Min	
Walk Time (s)				7.0	7.0		7.0	7.0			7.0	
Flash Dont Walk (s)				13.0	13.0		5.0	5.0			6.0	
Pedestrian Calls (#/hr)				6	6		6	6			19	
Act Effct Green (s)					42.3			74.7			74.7	
Actuated g/C Ratio					0.33			0.57			0.57	
v/c Ratio					0.78			0.29			0.38	
Control Delay					48.6			13.0			2.4	
Queue Delay					0.0			0.0			0.3	
Total Delay					48.6			13.0			2.7	
LOS					D			B			A	
Approach Delay					48.6			13.0			2.7	
Approach LOS					D			B			A	
Queue Length 50th (ft)					315			92			23	
Queue Length 95th (ft)					442			129			m21	
Internal Link Dist (ft)		356			595			568			227	
Turn Bay Length (ft)												
Base Capacity (vph)					553			1716			2092	

Intersection Capacity Analysis
Hammond St & Heath St

07/16/2019

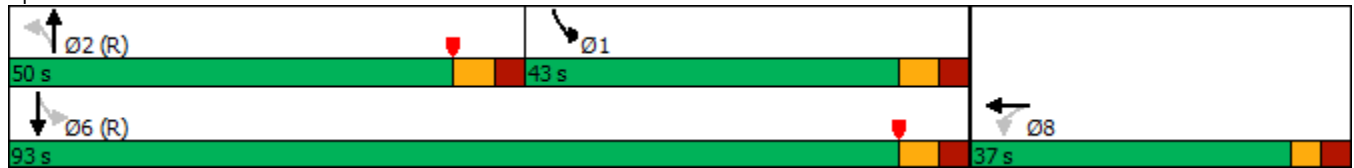


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Starvation Cap Reductn					0			0			753	
Spillback Cap Reductn					0			0			0	
Storage Cap Reductn					0			0			0	
Reduced v/c Ratio					0.78			0.29			0.52	

Intersection Summary

Area Type:	Other
Cycle Length:	130
Actuated Cycle Length:	130
Offset:	105 (81%), Referenced to phase 2:NBTL and 6:SBTL, Start of Yellow
Natural Cycle:	60
Control Type:	Actuated-Coordinated
Maximum v/c Ratio:	0.78
Intersection Signal Delay:	18.1
Intersection LOS:	B
Intersection Capacity Utilization	59.3%
ICU Level of Service	B
Analysis Period (min)	15
Description:	ø2 (WB): 6 / 6 / 9
	ø6 (EB): 17 / 19 / 12
	ø8 (SB): 8 / 6 / 22
m Volume for 95th percentile queue is metered by upstream signal.	

Splits and Phases: 14: Hammond St & Heath St



Intersection Capacity Analysis

Tully St & Route 9

07/16/2019



Lane Group	EBU	EBT	EBR	WBU	WBL	WBT	NBL	NBR	Ø9
Lane Configurations									
Traffic Volume (vph)	106	1383	40	10	10	1309	67	37	
Future Volume (vph)	106	1383	40	10	10	1309	67	37	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	
Lane Width (ft)	11	12	11	11	11	12	11	11	
Storage Length (ft)	250		0		150		0	0	
Storage Lanes	1		0		1		1	0	
Taper Length (ft)	100				100		0		
Right Turn on Red			Yes					Yes	
Link Speed (mph)		30				30	30		
Link Distance (ft)		898				297	462		
Travel Time (s)		20.4				6.8	10.5		
Confl. Peds. (#/hr)	5		30		30		5		
Peak Hour Factor	0.83	0.95	0.71	0.62	0.42	0.97	0.84	0.77	
Growth Factor	104%	104%	104%	104%	104%	104%	104%	104%	
Heavy Vehicles (%)	0%	2%	0%	10%	0%	2%	0%	3%	
Shared Lane Traffic (%)									
Lane Group Flow (vph)	133	1573	0	0	42	1403	133	0	
Turn Type	Prot	NA		Prot	Prot	NA	Prot		
Protected Phases	5	2		1	1	6	8		9
Permitted Phases									
Detector Phase	5	2		1	1	6	8		
Switch Phase									
Minimum Initial (s)	6.0	10.0		6.0	6.0	10.0	1.0		5.0
Minimum Split (s)	12.0	23.0		12.0	12.0	23.0	7.0		32.0
Total Split (s)	18.0	55.0		18.0	18.0	55.0	25.0		32.0
Total Split (%)	13.8%	42.3%		13.8%	13.8%	42.3%	19.2%		25%
Maximum Green (s)	12.0	49.0		12.0	12.0	49.0	19.0		29.0
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	3.0		2.0
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	3.0		1.0
Lost Time Adjust (s)	0.0	0.0			0.0	0.0	0.0		
Total Lost Time (s)	6.0	6.0			6.0	6.0	6.0		
Lead/Lag	Lead	Lag		Lead	Lead	Lag			
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes			
Vehicle Extension (s)	2.0	2.0		2.0	2.0	2.0	3.0		3.0
Recall Mode	None	C-Min		None	None	C-Min	None		None
Walk Time (s)									7.0
Flash Dont Walk (s)									22.0
Pedestrian Calls (#/hr)									15
Act Effct Green (s)	13.0	79.7			8.0	72.3	13.9		
Actuated g/C Ratio	0.10	0.61			0.06	0.56	0.11		
v/c Ratio	0.76	0.73			0.41	0.71	0.68		
Control Delay	83.8	25.7			69.8	28.0	63.8		
Queue Delay	0.0	0.0			0.0	49.2	0.0		
Total Delay	83.8	25.7			69.8	77.3	63.8		
LOS	F	C			E	E	E		
Approach Delay		30.2				77.1	63.8		
Approach LOS		C				E	E		
Queue Length 50th (ft)	109	352			35	354	93		

Intersection Capacity Analysis

Tully St & Route 9

07/16/2019



Lane Group	EBU	EBT	EBR	WBU	WBL	WBT	NBL	NBR	Ø9
Queue Length 95th (ft)	#197	#969			33	#817	144		
Internal Link Dist (ft)		818				217	382		
Turn Bay Length (ft)	250				150				
Base Capacity (vph)	180	2154			154	1968	261		
Starvation Cap Reductn	0	0			0	880	0		
Spillback Cap Reductn	0	0			0	0	0		
Storage Cap Reductn	0	0			0	0	0		
Reduced v/c Ratio	0.74	0.73			0.27	1.29	0.51		

Intersection Summary

Area Type: Other
 Cycle Length: 130
 Actuated Cycle Length: 130
 Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow
 Natural Cycle: 110
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.76
 Intersection Signal Delay: 52.2
 Intersection LOS: D
 Intersection Capacity Utilization 67.4%
 ICU Level of Service C
 Analysis Period (min) 15
 Description: 0 / 5 / 13
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 15: Tully St & Route 9



APPENDIX L
MassDOT Project Development Process

Overview of the Project Development Process

Transportation decision-making is complex and can be influenced by legislative mandates, environmental regulations, financial limitations, agency programmatic commitments, and partnering opportunities. Decision-makers and reviewing agencies, when consulted early and often throughout the project development process, can ensure that all participants understand the potential impact these factors can have on project implementation. Project development is the process that takes a transportation improvement from concept through construction.

The MassDOT Highway Division has developed a comprehensive project development process which is contained in Chapter 2 of the *MassDOT Highway Division's Project Development and Design Guide*. The eight-step process covers a range of activities extending from identification of a project need, through completion of a set of finished contract plans, to construction of the project. The sequence of decisions made through the project development process progressively narrows the project focus and, ultimately, leads to a project that addresses the identified needs. The descriptions provided below are focused on the process for a highway project, but the same basic process will need to be followed for non-highway projects as well.

1. Needs Identification

For each of the locations at which an improvement is to be implemented, MassDOT leads an effort to define the problem, establishes project goals and objectives, and defines the scope of the planning needed for implementation. To that end, it has to complete a Project Need Form (PNF), which states in general terms the deficiencies or needs related to the transportation facility or location. The PNF documents the problems and explains why corrective action is needed. For this study, the information defining the need for the project will be drawn primarily, perhaps exclusively, from the present report. Also, at this point in the process, MassDOT meets with potential participants, such as the Metropolitan Planning Organization (MPO) and community members, to allow for an informal review of the project.

The PNF is reviewed by the MassDOT Highway Division district office whose jurisdiction includes the location of the proposed project. MassDOT also sends the PNF to the MPO, for informational purposes. The outcome of this step determines whether the project requires further planning, whether it is already well supported by prior planning studies, and, therefore, whether it is ready to move forward into the design phase, or whether it should be dismissed from further consideration.

2. Planning

This phase will likely not be required for the implementation of the improvements proposed in this planning study, as this planning report should constitute the outcome of this step. However, in general, the purpose of this implementation step is for the project proponent to identify issues, impacts, and approvals that may need to be obtained, so that the subsequent design and permitting processes are understood.

The level of planning needed will vary widely, based on the complexity of the project. Typical tasks include: define the existing context, confirm project need, establish goals and objectives, initiate public outreach, define the project, collect data, develop and analyze alternatives, make

recommendations, and provide documentation. Likely outcomes include consensus on the project definition to enable it to move forward into environmental documentation (if needed) and design, or a recommendation to delay the project or dismiss it from further consideration.

3. Project Initiation

At this point in the process, the proponent, MassDOT Highway Division, fills out a Project Initiation Form (PIF) for each improvement, which is reviewed by its Project Review Committee (PRC) and the MPO. The PRC is composed of the Chief Engineer, each District Highway Director, and representatives of the Project Management, Environmental, Planning, Right-of-Way, Traffic, and Bridge departments, and the MassDOT Federal Aid Program Office (FAPO). The PIF documents the project type and description, summarizes the project planning process, identifies likely funding and project management responsibility, and defines a plan for interagency and public participation. First the PRC reviews and evaluates the proposed project based on the MassDOT's statewide priorities and criteria. If the result is positive, MassDOT Highway Division moves the project forward to the design phase, and to programming review by the MPO. The PRC may provide a Project Management Plan to define roles and responsibilities for subsequent steps. The MPO review includes project evaluation based on the MPO's regional priorities and criteria. The MPO may assign project evaluation criteria score, a Transportation Improvement Program (TIP) year, a tentative project category, and a tentative funding category.

4. Environmental Permitting, Design, and Right-of-Way Process

This step has four distinct but closely integrated elements: public outreach, environmental documentation and permitting (if required), design, and right-of-way acquisition (if required). The outcome of this step is a fully designed and permitted project ready for construction. However, a project does not have to be fully designed in order for the MPO to program it in the TIP. The sections below provide more detailed information on the four elements of this step of the project development process.

Public Outreach

Continued public outreach in the design and environmental process is essential to maintain public support for the project and to seek meaningful input on the design elements. The public outreach is often in the form of required public hearings, but can also include less formal dialogues with those interested in and affected by a proposed project.

Environmental Documentation and Permitting

The project proponent, in coordination with the Environmental Services section of the MassDOT Highway Division, will be responsible for identifying and complying with all applicable federal, state, and local environmental laws and requirements. This includes determining the appropriate project category for both the Massachusetts Environmental Protection Act (MEPA) and the National Environmental Protection Act (NEPA). Environmental documentation and permitting is often completed in conjunction with the **Preliminary Design** phase described below.

Design

There are three major phases of design. The first is **Preliminary Design**, which is also referred to as the 25-percent submission. The major components of this phase include full survey of the project area, preparation of base plans, development of basic geometric layout, development of preliminary cost estimates, and submission of a functional design report. Preliminary Design, although not required to, is often completed in conjunction with the Environmental Documentation and Permitting. The next phase is **Final Design**, which is also referred to as the 75-percent and 100-percent submission. The major components of this phase include preparation of a subsurface exploratory plan (if required), coordination of utility relocations, development of traffic management plans through construction zones, development of final cost estimates, and refinement and finalization of the construction plans. Once Final Design is complete, a full set of **Plans, Specifications, and Estimates (PS&E)** is developed for the project.

Right-of-Way Acquisition

A separate set of Right-of-Way plans are required for any project that requires land acquisition or easements. The plans must identify the existing and proposed layout lines, easements, property lines, names of property owners, and the dimensions and areas of estimated takings and easements.

5. Programming (Identification of Funding)

Programming, which typically begins during the design phase, can actually occur at any time during the process, from planning to design. In this step, which is distinct from project initiation, the proponent requests that the MPO place the project in the region's Transportation Improvement Program (TIP). The proponent requesting the project's listing on the TIP can be the community or it can be one of the MPO member agencies (the Regional Planning Agency, MassDOT, and the Regional Transit Authority). The MPO then considers the project in terms of state and regional needs, evaluation criteria, and compliance with the regional Transportation Plan and decides whether to place it in the draft TIP for public review and then in the final TIP.

6. Procurement

Following project design and programming of a highway project, the MassDOT Highway Division publishes a request for proposals. It then reviews the bids and awards the contract to the qualified bidder with the lowest bid.

7. Construction

After a construction contract is awarded, MassDOT Highway Division and the contractor develop a public participation plan and a management plan for the construction process.

8. Project Assessment

The purpose of this step is to receive constituents' comments on the project development process and the project's design elements. MassDOT Highway Division can apply what is learned in this process to future projects.

Project Development Schematic Timetable

Description	Schedule Influence	Typical Duration
<p>Step I: Problem/Need/Opportunity Identification The proponent completes a Project Need Form (PNF). This form is then reviewed by the MassDOT Highway District office which provides guidance to the proponent on the subsequent steps of the process.</p>	<p>The Project Need Form has been developed so that it can be prepared quickly by the proponent, including any supporting data that is readily available. The District office shall return comments to the proponent within one month of PNF submission.</p>	<p>1 to 3 months</p>
<p>Step II: Planning Project planning can range from agreement that the problem should be addressed through a clear solution to a detailed analysis of alternatives and their impacts.</p>	<p>For some projects, no planning beyond preparation of the Project Need Form is required. Some projects require a planning study centered on specific project issues associated with the proposed solution or a narrow family of alternatives. More complex projects will likely require a detailed alternatives analysis.</p>	<p>Project Planning Report: 3 to 24+ months</p>
<p>Step III: Project Initiation The proponent prepares and submits a Project Initiation Form (PIF) and a Transportation Evaluation Criteria (TEC) form in this step. The PIF and TEC are informally reviewed by the Metropolitan Planning Organization (MPO) and MassDOT Highway District office, and formally reviewed by the PRC.</p>	<p>The PIF includes refinement of the preliminary information contained in the PNF. Additional information summarizing the results of the planning process, such as the Project Planning Report, are included with the PIF and TEC. The schedule is determined by PRC staff review (dependent on project complexity) and meeting schedule.</p>	<p>1 to 4 months</p>
<p>Step IV: Design, Environmental, and Right of Way The proponent completes the project design. Concurrently, the proponent completes necessary environmental permitting analyses and files applications for permits. Any right of way needed for the project is identified and the acquisition process begins.</p>	<p>The schedule for this step is dependent upon the size of the project and the complexity of the design, permitting, and right-of-way issues. Design review by the MassDOT Highway district and appropriate sections is completed in this step.</p>	<p>3 to 48+ months</p>
<p>Step V: Programming The MPO considers the project in terms of its regional priorities and determines whether or not to include the project in the draft Regional Transportation Improvement Program (TIP) which is then made available for public comment. The TIP includes a project description and funding source.</p>	<p>The schedule for this step is subject to each MPO's programming cycle and meeting schedule. It is also possible that the MPO will not include a project in its Draft TIP based on its review and approval procedures.</p>	<p>3 to 12+ months</p>
<p>Step VI: Procurement The project is advertised for construction and a contract awarded.</p>	<p>Administration of competing projects can influence the advertising schedule.</p>	<p>1 to 12 months</p>
<p>Step VII: Construction The construction process is initiated including public notification and any anticipated public involvement. Construction continues to project completion.</p>	<p>The duration for this step is entirely dependent upon project complexity and phasing.</p>	<p>3 to 60+ months</p>
<p>Step VIII: Project Assessment The construction period is complete and project elements and processes are evaluated on a voluntary basis.</p>	<p>The duration for this step is dependent upon the proponent's approach to this step and any follow-up required.</p>	<p>1 month</p>

Source: MassDOT Highway Division Project Development and Design Guide