

Old Colony Planning Council



Robert G. Moran, Jr.
President

70 School Street
Brockton, MA 02301-4097

Pasquale Ciaramella
Executive Director

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September 26, 2011

Mr. Sid Kashi, P.E., MPS
Plymouth Department of Public Works – Engineering Division
11 Lincoln Street
Plymouth, MA 02360

Re: Samoset Street at Pilgrim Hill Road Traffic Signal Analysis

Dear Mr. Kashi,

Per a request received from Mr. James Downey, the Old Colony Planning Council has conducted an operational analysis of the traffic signals at the intersection of Samoset Street at Pilgrim Hill Road and the Walgreens / Comfort Inn Driveway. Scenarios included in the analysis are existing 2011 conditions, forecast 2016 conditions with no changes in traffic signal phasing, and forecast 2016 conditions with the proposed splitting of the northbound (Pilgrim Hill Road) and southbound (Driveway) phases. Traffic volumes for 2016 were estimated based on 1% annual growth in volumes from 2011. Intersection turning movement count data, level of service analysis reports, and the crash rate calculation worksheet are enclosed.

Table 1 summarizes the results of the existing conditions and forecast conditions traffic signal analyses.

Table 1: Level of Service Analyses, Samoset Street at Pilgrim Hill Road

		Existing 2011		Forecast 2016, No Changes		Forecast 2016, Split NB/SB Phases	
		Delay	LOS	Delay	LOS	Delay	LOS
Samoset Street, Eastbound	AM Peak (8:00-9:00 AM)	24.0	C	24.7	C	18.0	B
	PM Peak (4:30-5:30 PM)	24.1	C	28.6	C	55.4	E
Samoset Street, Westbound	AM Peak (8:00-9:00 AM)	18.1	B	18.5	B	15.3	B
	PM Peak (4:30-5:30 PM)	15.9	B	16.5	B	27.1	C
Pilgrim Hill Road, Northbound	AM Peak (8:00-9:00 AM)	12.3	B	12.9	B	26.9	C
	PM Peak (4:30-5:30 PM)	27.6	C	27.8	C	41.0	D
Driveway, Southbound	AM Peak (8:00-9:00 AM)	17.9	B	18.7	B	35.7	D
	PM Peak (4:30-5:30 PM)	29.6	C	30.0	C	40.5	D
Overall	AM Peak (8:00-9:00 AM)	19.0	B	19.5	B	19.3	B
Intersection LOS	PM Peak (4:30-5:30 PM)	21.6	C	24.1	C	42.9	D

Delay is given in seconds (average delay per vehicle)

2016 Conditions represent 1% annual growth and assumes optimal signal phase timing

The level of service analysis indicates that reconfiguring the signal phasing and timing plan to split the northbound and southbound phases would have negative impacts on the level of service of the intersection, particularly during the afternoon peak hour.

According to MassDOT crash data, there were 15 reported crashes occurring at the intersection from 2007 through 2009. Table 2 summarizes the reported crash data. Based on the reported crash data, the intersection has a crash rate of 0.50 crashes per million entering vehicles (MEV), below the MassDOT District 5 regional average of 0.77 per MEV for signalized intersections.

Table 2: Summary of MassDOT 2007 – 2009 Crash Data for Samoset Street at Pilgrim Hill Road

Summary of Crashes Occurring at Intersection of Samoset Street at Pilgrim Hill Road, 2007-2009					
Total # Crashes:	15			Average Per Year:	3.75
Type of Collision	3-Year Total	% of Total	Time Of Crash	3-Year Total	% of Total
Rear End	9	60.00%	12:00-6:00 AM	0	0.00%
Angled	3	20.00%	6:00 AM-12:00 PM	6	40.00%
Sideswipe, Same Direction	2	13.33%	12:00-6:00 PM	7	46.67%
Single Vehicle Crash	1	6.67%	6:00 PM-12:00 AM	2	13.33%
			Morning Peak (7:00-9:00)	3	20.00%
			Afternoon Peak (4:00-6:00)	1	6.67%
Crashes With Injury:	2	13.33%		Crash Rate:	0.5/MEV
Crashes With Fatality:	0	0.00%		% Difference from MassDOT District 5 Average:	-35.06%
<i>2011 MassDOT District 5 Average Crash Rate for Signalized Intersections = 0.77 per Million Entering Vehicles (MEV)</i>					

This intersection is included in the Major Bottleneck Study for Samoset Street at Route 3 Study, currently in its final stages of development. Please refer to the final report for the Bottleneck Study for detailed analysis and recommendations for traffic flow improvements in the area.

Should you have any questions regarding this analysis or require further assistance, please contact Bill McNulty at wmcnulty@ocpcrpa.org or at (508) 583-1833 x207.

Sincerely,

Charles Kilmer
Transportation Program Manager

Cc:
Mr. William Hallisey, Jr., Chairman Plymouth Board of Selectmen
Mr. Jonathan Beder, Director, Plymouth Department of Public Works
Chief Michael Botieri, Plymouth Police Department
Mr. James Downey, Plymouth Department of Public Works – Engineering Division

Mr. Lee Hartmann, AICP, Plymouth Director of Planning and Development
Ms. Pamela Haznar, P.E., Project Development Engineer, MassDOT District 5
Mr. Paul Maloney, P.E., Transportation Planning Engineer, FHWA
Mr. Andrew Lehmann, MPO Liaison, MassDOT Office of Transportation Planning

Enclosures:

2011 AM and PM Turning Movement Counts for Samoset Street at Pilgrim Hill Road
2011 Existing Conditions AM and PM Peak Hour LOS
2016 Forecast AM and PM LOS – No Changes
2016 Forecast AM and PM LOS – Split Northbound and Southbound Phases
Crash Rate – Samoset Street at Pilgrim Hill Road



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 Page No : 1

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Start Time	Walgreens Driveway Southbound					Samoset Street Westbound					Pilgrim Hill Road Northbound					Samoset Street Eastbound					Int. Total
	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:00 AM	0	0	0	0	0	35	53	2	2	92	5	0	89	0	94	0	107	15	0	122	308
07:15 AM	0	0	0	0	0	61	66	2	2	131	3	1	97	0	101	0	148	13	0	161	393
07:30 AM	0	0	0	0	0	61	97	5	0	163	8	4	93	0	105	0	148	8	0	156	424
07:45 AM	2	1	2	0	5	68	118	11	1	198	14	2	87	0	103	3	138	23	0	164	470
Total	2	1	2	0	5	225	334	20	5	584	30	7	366	0	403	3	541	59	0	603	1595
08:00 AM	1	1	0	0	2	55	92	5	0	152	8	2	107	0	117	2	156	9	0	167	438
08:15 AM	2	4	0	0	6	59	117	5	0	181	10	3	99	0	112	1	154	22	0	177	476
08:30 AM	6	0	0	0	6	45	104	10	0	159	11	3	95	0	109	4	132	20	0	156	430
08:45 AM	3	2	0	0	5	73	114	9	1	197	19	2	87	0	108	4	173	27	0	204	514
Total	12	7	0	0	19	232	427	29	1	689	48	10	388	0	446	11	615	78	0	704	1858
Grand Total	14	8	2	0	24	457	761	49	6	1273	78	17	754	0	849	14	1156	137	0	1307	3453
Apprch %	58.3	33.3	8.3	0		35.9	59.8	3.8	0.5		9.2	2	88.8	0		1.1	88.4	10.5	0		
Total %	0.4	0.2	0.1	0	0.7	13.2	22	1.4	0.2	36.9	2.3	0.5	21.8	0	24.6	0.4	33.5	4	0	37.9	
FHWA Class 1-3	13	8	2	0	23	422	718	48	0	1188	77	17	678	0	772	14	1113	133	0	1260	3243
% FHWA Class 1-3	92.9	100	100	0	95.8	92.3	94.3	98	0	93.3	98.7	100	89.9	0	90.9	100	96.3	97.1	0	96.4	93.9
FHWA Class 4	0	0	0	0	0	3	4	0	3	10	1	0	5	0	6	0	6	1	0	7	23
% FHWA Class 4	0	0	0	0	0	0.7	0.5	0	50	0.8	1.3	0	0.7	0	0.7	0	0.5	0.7	0	0.5	0.7
FHWA Class 5-13	1	0	0	0	1	32	39	1	3	75	0	0	71	0	71	0	37	3	0	40	187
% FHWA Class 5-13	7.1	0	0	0	4.2	7	5.1	2	50	5.9	0	0	9.4	0	8.4	0	3.2	2.2	0	3.1	5.4

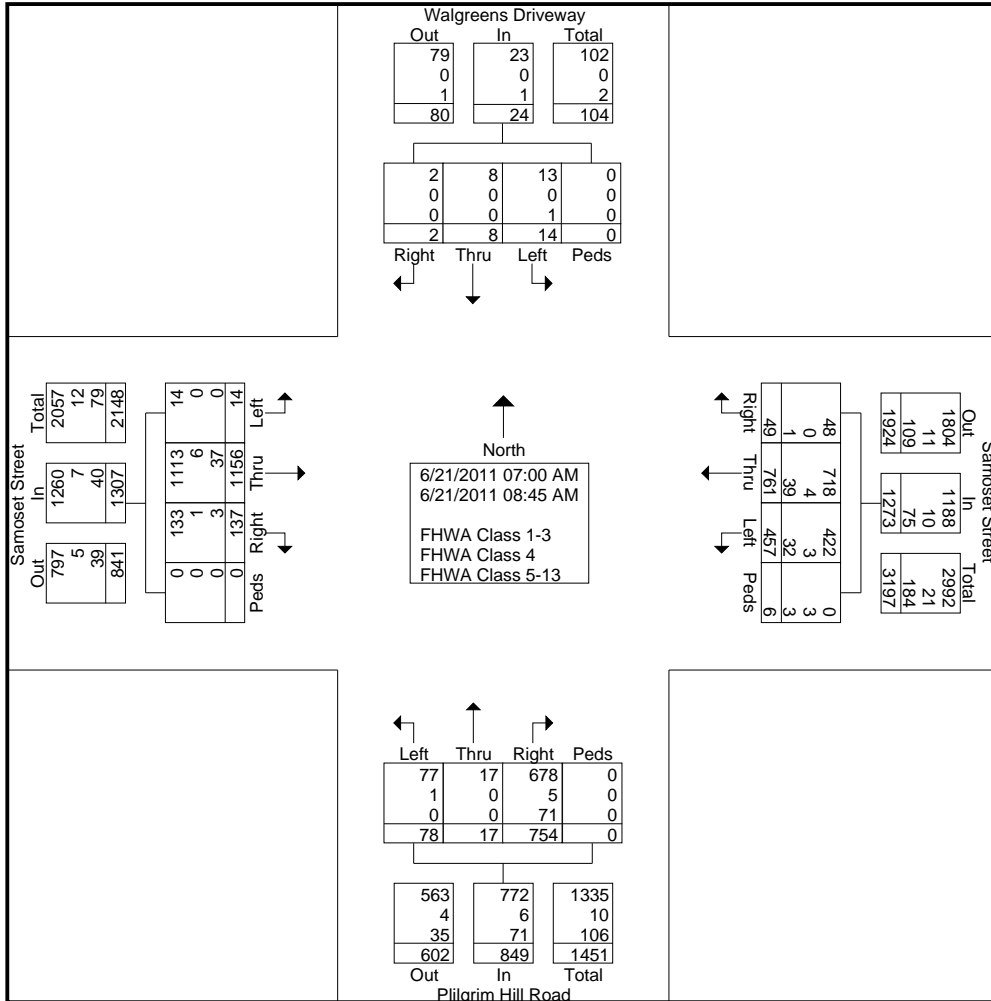


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 Page No : 2



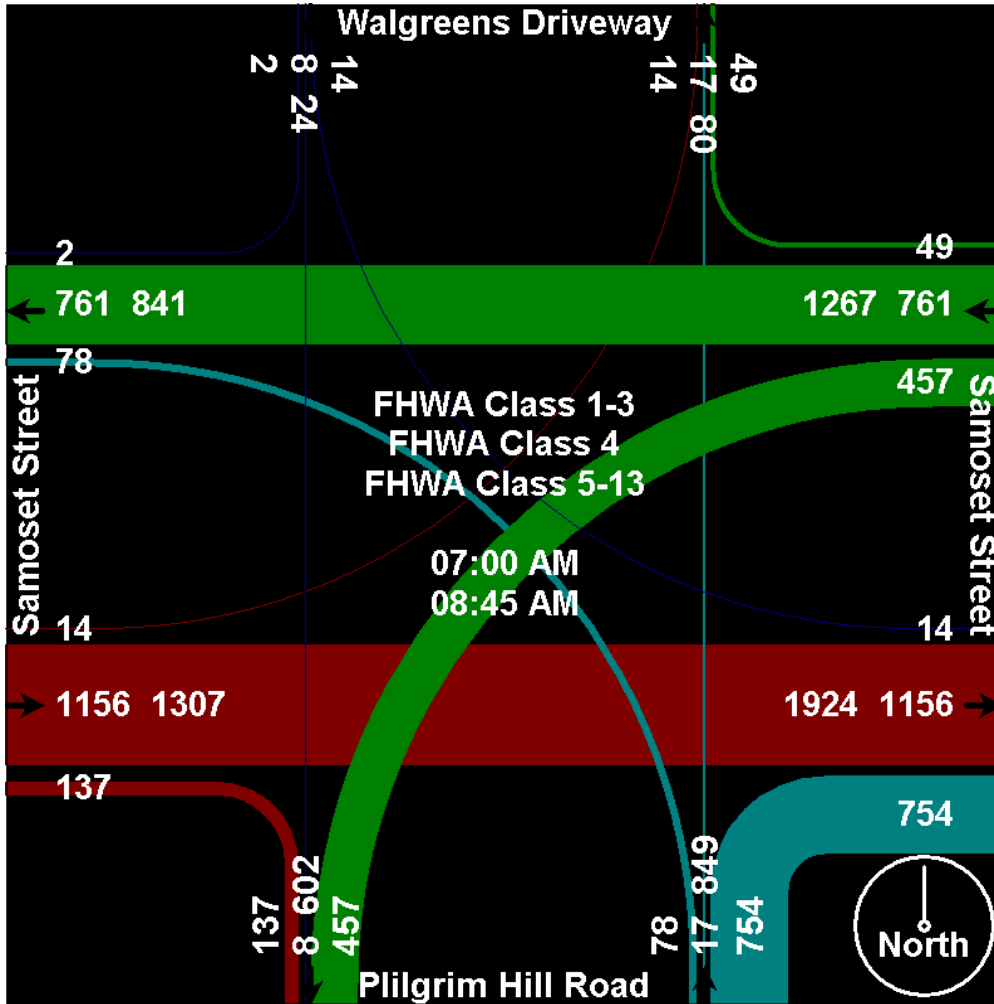


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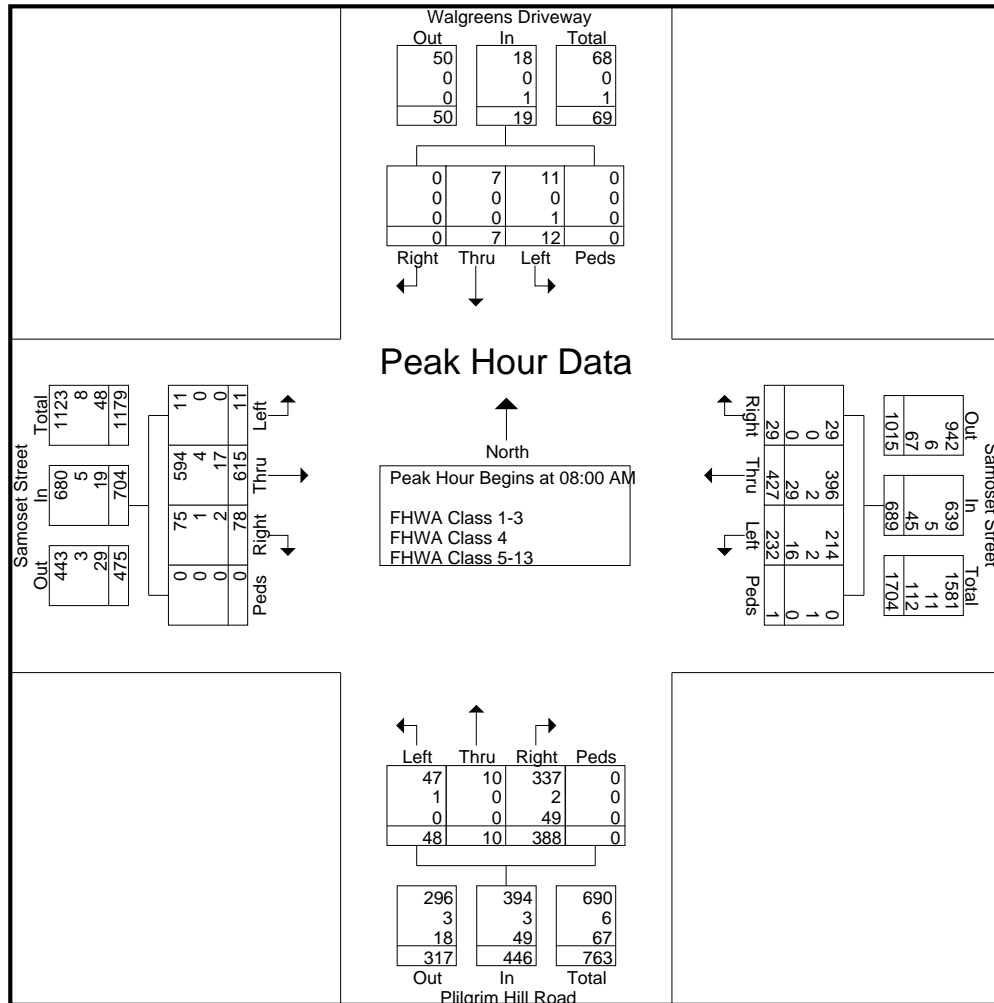
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	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 08:00 AM																					
08:00 AM	1	1	0	0	2	55	92	5	0	152	8	2	107	0	117	2	156	9	0	167	438
08:15 AM	2	4	0	0	6	59	117	5	0	181	10	3	99	0	112	1	154	22	0	177	476
08:30 AM	6	0	0	0	6	45	104	10	0	159	11	3	95	0	109	4	132	20	0	156	430
08:45 AM	3	2	0	0	5	73	114	9	1	197	19	2	87	0	108	4	173	27	0	204	514
Total Volume	12	7	0	0	19	232	427	29	1	689	48	10	388	0	446	11	615	78	0	704	1858
% App. Total	63.2	36.8	0	0		33.7	62	4.2	0.1		10.8	2.2	87	0		1.6	87.4	11.1	0		
PHF	.500	.438	.000	.000	.792	.795	.912	.725	.250	.874	.632	.833	.907	.000	.953	.688	.889	.722	.000	.863	.904
FHWA Class 1-3	11	7	0	0	18	214	396	29	0	639	47	10	337	0	394	11	594	75	0	680	1731
% FHWA Class 1-3	91.7	100	0	0	94.7	92.2	92.7	100	0	92.7	97.9	100	86.9	0	88.3	100	96.6	96.2	0	96.6	93.2
FHWA Class 4	0	0	0	0	0	2	2	0	1	5	1	0	2	0	3	0	4	1	0	5	13
% FHWA Class 4	0	0	0	0	0	0.9	0.5	0	100	0.7	2.1	0	0.5	0	0.7	0	0.7	1.3	0	0.7	0.7
FHWA Class 5-13	1	0	0	0	1	16	29	0	0	45	0	0	49	0	49	0	17	2	0	19	114
% FHWA Class 5-13	8.3	0	0	0	5.3	6.9	6.8	0	0	6.5	0	0	12.6	0	11.0	0	2.8	2.6	0	2.7	6.1



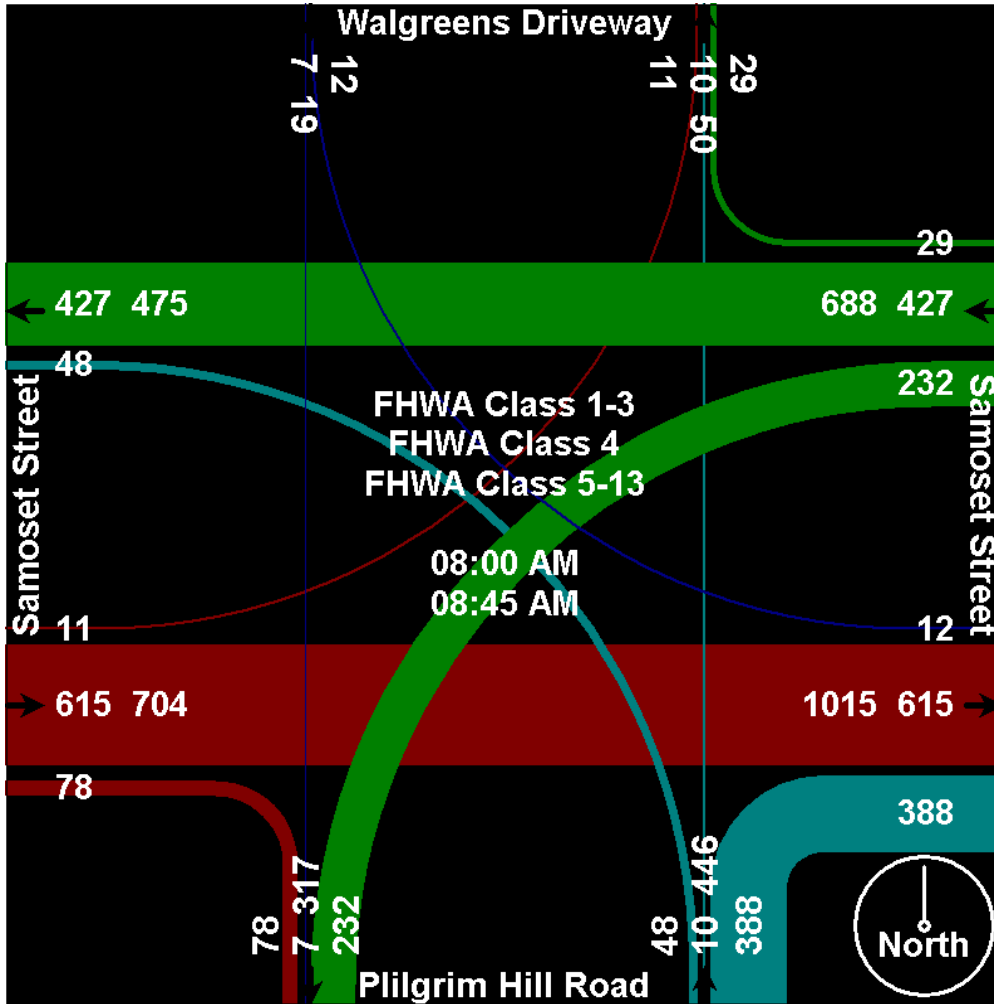


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Page No : 5





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Page No : 6

Image 1





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	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
04:00 PM	10	3	1	0	14	70	195	16	0	281	34	1	91	0	126	2	135	35	0	172	593
04:15 PM	9	1	1	0	11	77	172	10	0	259	22	1	112	0	135	5	150	32	3	190	595
04:30 PM	15	3	3	0	21	103	212	13	2	330	26	2	102	0	130	3	129	25	0	157	638
04:45 PM	8	5	0	0	13	90	204	9	2	305	23	3	95	0	121	4	149	28	0	181	620
Total	42	12	5	0	59	340	783	48	4	1175	105	7	400	0	512	14	563	120	3	700	2446
05:00 PM	11	3	0	0	14	91	191	12	2	296	30	4	103	0	137	2	108	23	0	133	580
05:15 PM	4	2	2	1	9	104	224	12	3	343	24	2	88	0	114	0	136	32	0	168	634
05:30 PM	7	5	0	2	14	78	215	5	0	298	18	2	74	0	94	4	134	22	0	160	566
05:45 PM	4	5	2	2	13	85	195	6	0	286	24	2	66	0	92	3	143	26	0	172	563
Total	26	15	4	5	50	358	825	35	5	1223	96	10	331	0	437	9	521	103	0	633	2343
Grand Total	68	27	9	5	109	698	1608	83	9	2398	201	17	731	0	949	23	1084	223	3	1333	4789
Apprch %	62.4	24.8	8.3	4.6		29.1	67.1	3.5	0.4		21.2	1.8	77	0		1.7	81.3	16.7	0.2		
Total %	1.4	0.6	0.2	0.1	2.3	14.6	33.6	1.7	0.2	50.1	4.2	0.4	15.3	0	19.8	0.5	22.6	4.7	0.1	27.8	
FHWA Class 1-3	68	27	9	0	104	677	1556	83	0	2316	201	17	712	0	930	23	1069	222	0	1314	4664
% FHWA Class 1-3	100	100	100	0	95.4	97	96.8	100	0	96.6	100	100	97.4	0	98	100	98.6	99.6	0	98.6	97.4
FHWA Class 4	0	0	0	4	4	3	7	0	7	17	0	0	5	0	5	0	1	0	3	4	30
% FHWA Class 4	0	0	0	80	3.7	0.4	0.4	0	77.8	0.7	0	0	0.7	0	0.5	0	0.1	0	100	0.3	0.6
FHWA Class 5-13	0	0	0	1	1	18	45	0	2	65	0	0	14	0	14	0	14	1	0	15	95
% FHWA Class 5-13	0	0	0	20	0.9	2.6	2.8	0	22.2	2.7	0	0	1.9	0	1.5	0	1.3	0.4	0	1.1	2

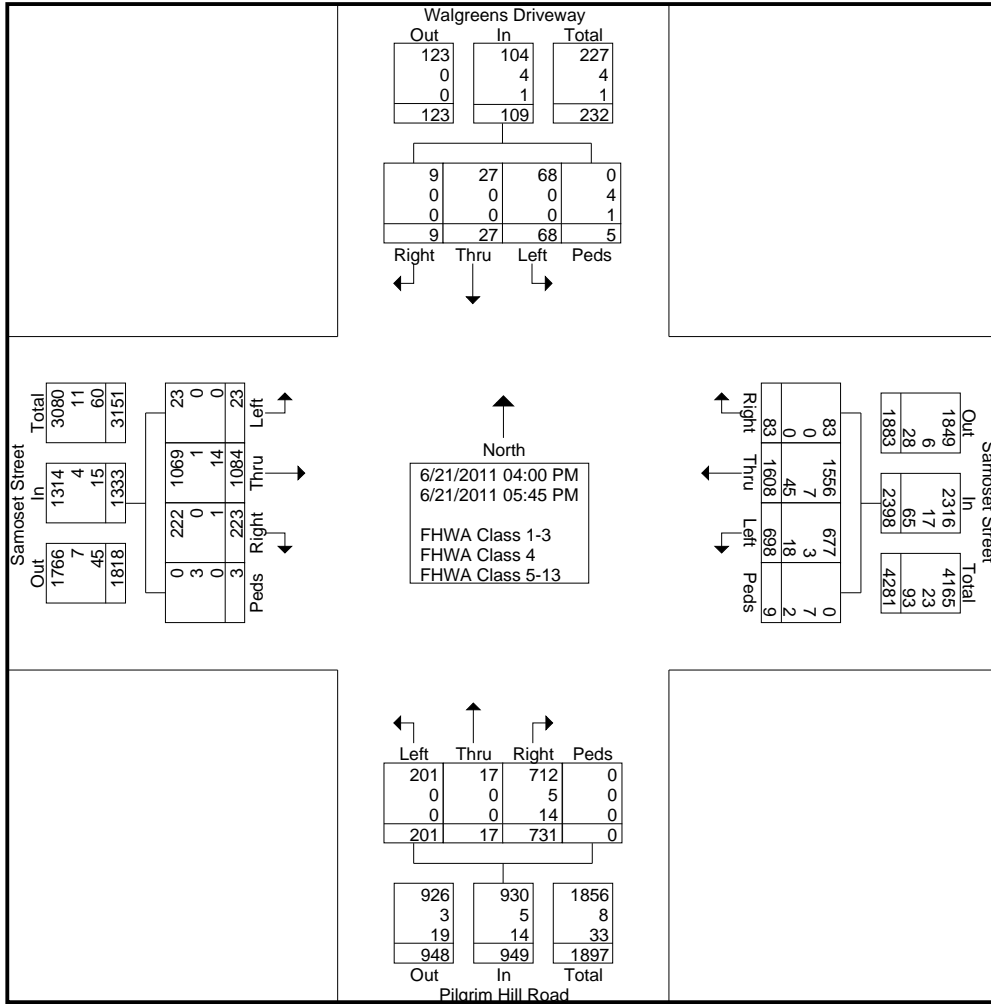


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 Page No : 2



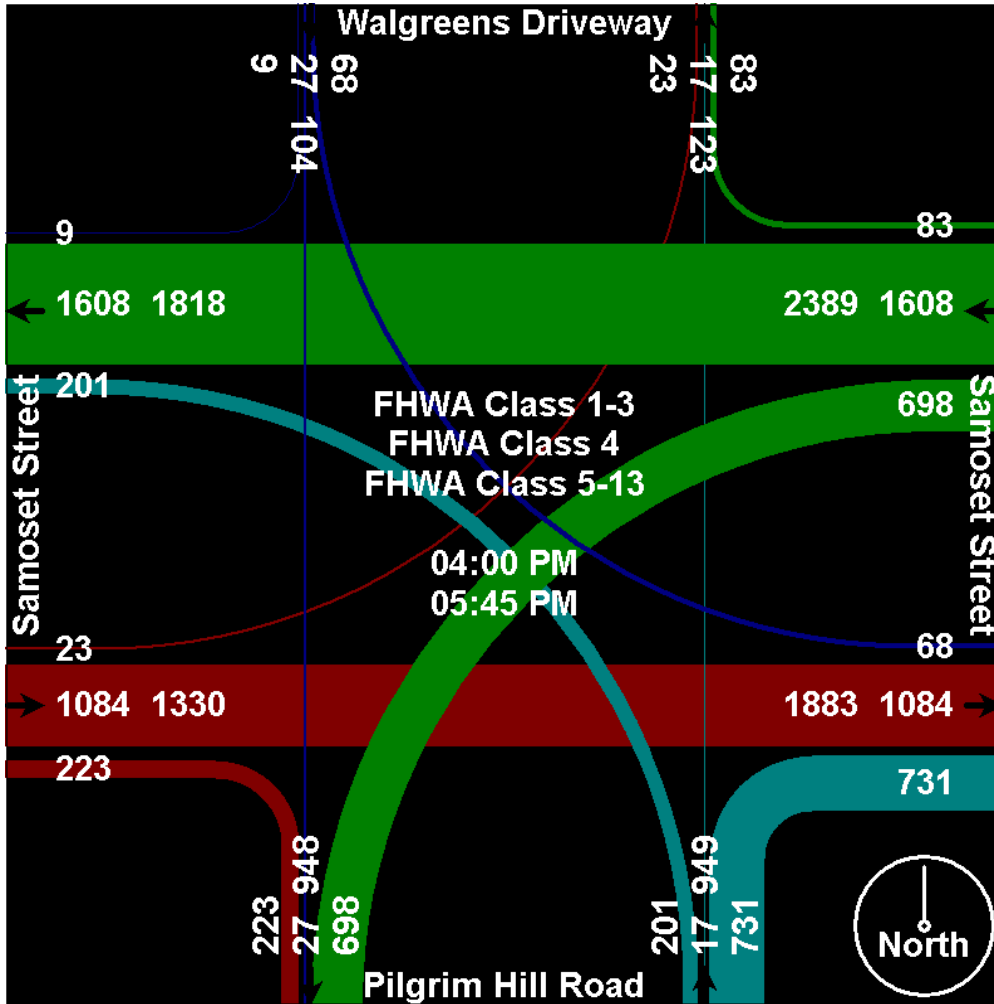


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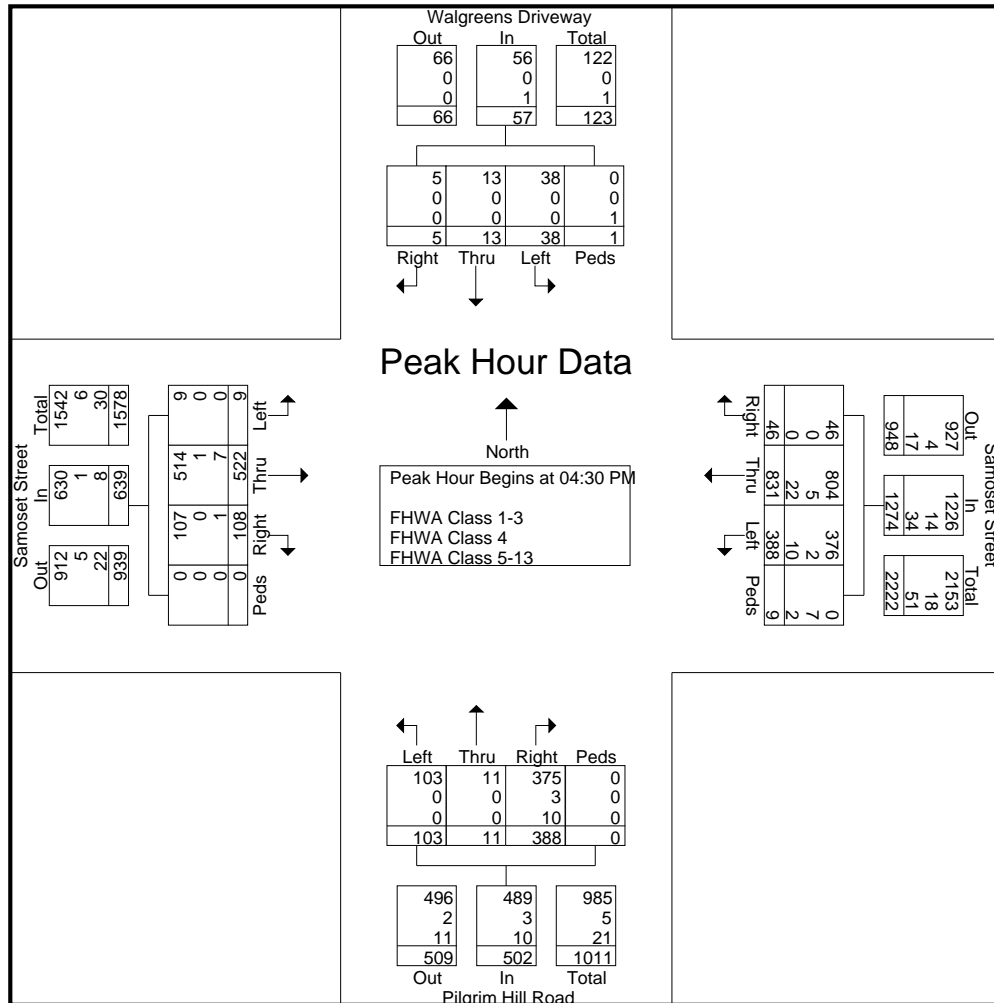
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04:30 PM	15	3	3	0	21	103	212	13	2	330	26	2	102	0	130	3	129	25	0	157	638
04:45 PM	8	5	0	0	13	90	204	9	2	305	23	3	95	0	121	4	149	28	0	181	620
05:00 PM	11	3	0	0	14	91	191	12	2	296	30	4	103	0	137	2	108	23	0	133	580
05:15 PM	4	2	2	1	9	104	224	12	3	343	24	2	88	0	114	0	136	32	0	168	634
Total Volume	38	13	5	1	57	388	831	46	9	1274	103	11	388	0	502	9	522	108	0	639	2472
% App. Total	66.7	22.8	8.8	1.8		30.5	65.2	3.6	0.7		20.5	2.2	77.3	0		1.4	81.7	16.9	0		
PHF	.633	.650	.417	.250	.679	.933	.927	.885	.750	.929	.858	.688	.942	.000	.916	.563	.876	.844	.000	.883	.969
FHWA Class 1-3	38	13	5	0	56	376	804	46	0	1226	103	11	375	0	489	9	514	107	0	630	2401
% FHWA Class 1-3	100	100	100	0	98.2	96.9	96.8	100	0	96.2	100	100	96.6	0	97.4	100	98.5	99.1	0	98.6	97.1
FHWA Class 4	0	0	0	0	0	2	5	0	7	14	0	0	3	0	3	0	1	0	0	1	18
% FHWA Class 4	0	0	0	0	0	0.5	0.6	0	77.8	1.1	0	0	0.8	0	0.6	0	0.2	0	0	0.2	0.7
FHWA Class 5-13	0	0	0	1	1	10	22	0	2	34	0	0	10	0	10	0	7	1	0	8	53
% FHWA Class 5-13	0	0	0	100	1.8	2.6	2.6	0	22.2	2.7	0	0	2.6	0	2.0	0	1.3	0.9	0	1.3	2.1



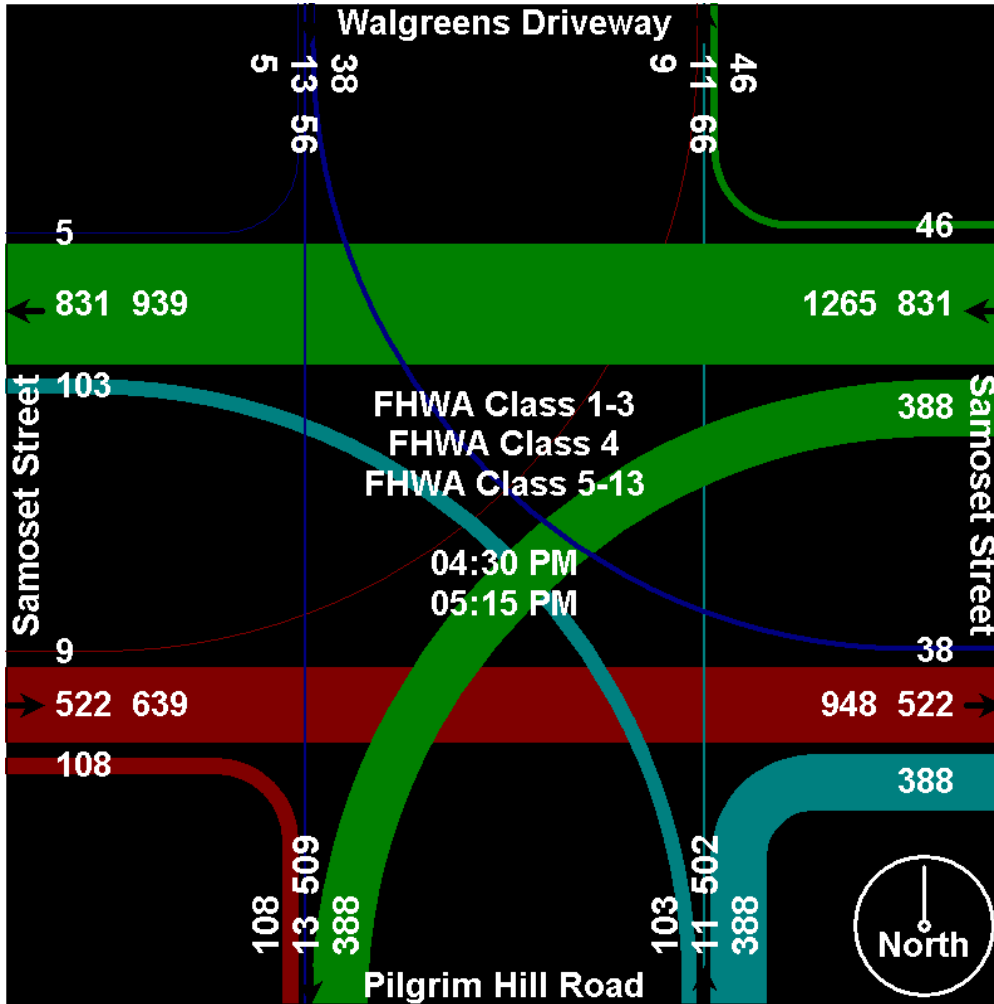


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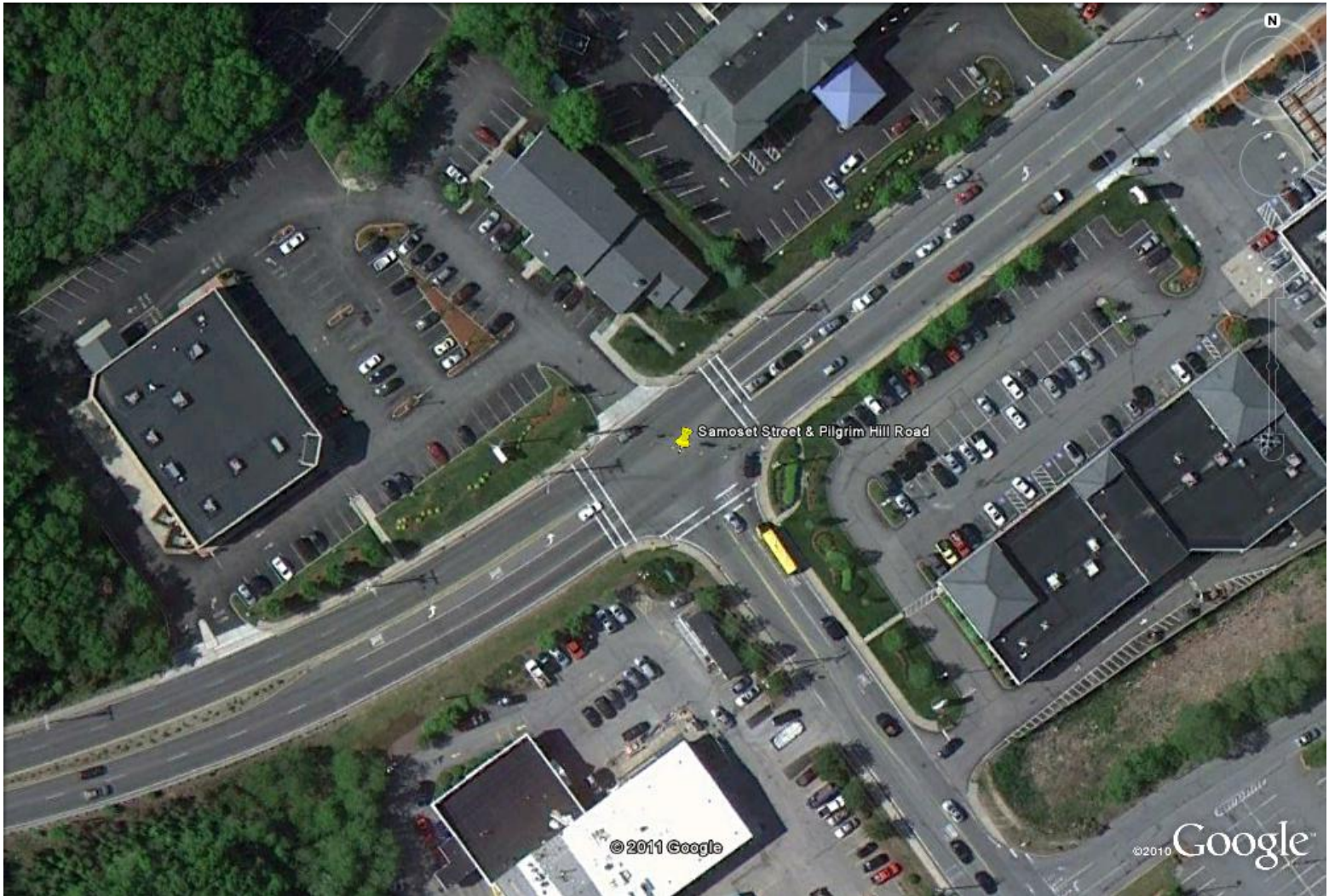
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Image 1



Samoset Street @ Pilgrim Hill Road Analysis

17: Samoset Street &

Existing 2011 AM Peak Hour LOS




















Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0	4.0		4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00	1.00		1.00	
Frbp, ped/bikes	1.00	1.00		1.00	1.00			1.00	0.99		1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Frt	1.00	0.98		1.00	0.99			1.00	0.85		1.00	
Flt Protected	0.95	1.00		0.95	1.00			0.96	1.00		0.97	
Satd. Flow (prot)	1770	3471		1770	3500			1788	1569		1805	
Flt Permitted	0.95	1.00		0.95	1.00			0.81	1.00		0.89	
Satd. Flow (perm)	1770	3471		1770	3500			1504	1569		1657	
Volume (vph)	11	615	78	232	427	29	48	10	388	12	7	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	12	668	85	252	464	32	52	11	422	13	8	0
RTOR Reduction (vph)	0	12	0	0	4	0	0	0	31	0	0	0
Lane Group Flow (vph)	12	741	0	252	492	0	0	63	391	0	21	0
Conf. Peds. (#/hr)			1	3		2	1		3	2		2
Turn Type	Prot			Prot			Perm		pm+ov		Perm	
Protected Phases	5	2		1	6			8	1		4	
Permitted Phases							8		8		4	
Actuated Green, G (s)	1.2	23.8		15.4	38.0			23.5	38.9		23.5	
Effective Green, g (s)	1.2	23.8		15.4	38.0			23.5	38.9		23.5	
Actuated g/C Ratio	0.02	0.32		0.21	0.51			0.31	0.52		0.31	
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0	4.0		4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0		3.0	
Lane Grp Cap (vph)	28	1106		365	1780			473	901		521	
v/s Ratio Prot	0.01	c0.21		c0.14	0.14				c0.09			
v/s Ratio Perm								0.04	0.16		0.01	
v/c Ratio	0.43	0.67		0.69	0.28			0.13	0.43		0.04	
Uniform Delay, d1	36.4	22.1		27.4	10.5			18.3	11.1		17.8	
Progression Factor	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Incremental Delay, d2	10.2	1.6		5.5	0.1			0.1	0.3		0.1	
Delay (s)	46.6	23.7		33.0	10.6			18.4	11.4		17.9	
Level of Service	D	C		C	B			B	B		B	
Approach Delay (s)		24.0			18.1			12.3			17.9	
Approach LOS		C			B			B			B	
Intersection Summary												
HCM Average Control Delay			19.0			HCM Level of Service				B		
HCM Volume to Capacity ratio			0.57									
Actuated Cycle Length (s)			74.7			Sum of lost time (s)			8.0			
Intersection Capacity Utilization			73.0%			ICU Level of Service			D			
Analysis Period (min)			15									

c Critical Lane Group

Samoset Street @ Pilgrim Hill Road Analysis

17: Samoset Street & Pilgrim Hill Road

Existing 2011 PM Peak Hour LOS

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0	4.0		4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00	1.00		1.00	
Frt	1.00	0.99		1.00	0.99			1.00	0.85		0.95	
Flt Protected	0.95	1.00		0.95	1.00			0.97	1.00		0.98	
Satd. Flow (prot)	1770	3518		1770	3510			1800	1583		1742	
Flt Permitted	0.95	1.00		0.95	1.00			0.68	1.00		0.84	
Satd. Flow (perm)	1770	3518		1770	3510			1275	1583		1491	
Volume (vph)	40	1210	50	100	840	50	70	30	100	50	40	50
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	43	1315	54	109	913	54	76	33	109	54	43	54
RTOR Reduction (vph)	0	5	0	0	7	0	0	0	92	0	40	0
Lane Group Flow (vph)	43	1364	0	109	960	0	0	109	17	0	111	0
Turn Type	Prot		Prot		Perm		Perm		Perm			
Protected Phases	7	4		3	8			2				6
Permitted Phases							2		2		6	
Actuated Green, G (s)	12.5	26.0		12.5	26.0			9.5	9.5		9.5	
Effective Green, g (s)	12.5	26.0		12.5	26.0			9.5	9.5		9.5	
Actuated g/C Ratio	0.21	0.43		0.21	0.43			0.16	0.16		0.16	
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0	4.0		4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0		3.0	
Lane Grp Cap (vph)	369	1524		369	1521			202	251		236	
v/s Ratio Prot	0.02	c0.39		c0.06	0.27							
v/s Ratio Perm								c0.09	0.01		0.07	
v/c Ratio	0.12	0.89		0.30	0.63			0.54	0.07		0.47	
Uniform Delay, d1	19.3	15.7		20.0	13.3			23.2	21.5		23.0	
Progression Factor	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Incremental Delay, d2	0.6	8.5		2.0	2.0			10.0	0.5		6.6	
Delay (s)	19.9	24.3		22.1	15.3			33.2	22.0		29.6	
Level of Service	B	C		C	B			C	C		C	
Approach Delay (s)		24.1			15.9			27.6			29.6	
Approach LOS		C			B			C			C	
Intersection Summary												
HCM Average Control Delay			21.6			HCM Level of Service					C	
HCM Volume to Capacity ratio			0.67									
Actuated Cycle Length (s)			60.0			Sum of lost time (s)			12.0			
Intersection Capacity Utilization			65.2%			ICU Level of Service					C	
Analysis Period (min)			15									
c	Critical Lane Group											

Samoset Street @ Pilgrim Hill Road Analysis

17: Samoset Street & Pilgrim Hill Road

Forecast 2016 AM Peak Hour LOS (no change)



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0	4.0		4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00	1.00		1.00	
Frbp, ped/bikes	1.00	1.00		1.00	1.00			1.00	0.99		1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Frt	1.00	0.98		1.00	0.99			1.00	0.85		1.00	
Flt Protected	0.95	1.00		0.95	1.00			0.96	1.00		0.97	
Satd. Flow (prot)	1770	3471		1770	3500			1787	1569		1803	
Flt Permitted	0.95	1.00		0.95	1.00			0.80	1.00		0.88	
Satd. Flow (perm)	1770	3471		1770	3500			1492	1569		1644	
Volume (vph)	11	615	78	232	427	29	48	10	388	12	7	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Growth Factor (vph)	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%
Adj. Flow (vph)	13	702	89	265	487	33	55	11	443	14	8	0
RTOR Reduction (vph)	0	11	0	0	4	0	0	0	27	0	0	0
Lane Group Flow (vph)	13	780	0	265	516	0	0	66	416	0	22	0
Confl. Peds. (#/hr)			1	3		2	1		3	2		2
Turn Type	Prot		Prot		Perm		pm+ov		Perm			
Protected Phases	5	2	1	6			8	1		4		
Permitted Phases						8		8		4		
Actuated Green, G (s)	1.3	24.7		16.1	39.5			23.5	39.6		23.5	
Effective Green, g (s)	1.3	24.7		16.1	39.5			23.5	39.6		23.5	
Actuated g/C Ratio	0.02	0.32		0.21	0.52			0.31	0.52		0.31	
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0	4.0		4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0		3.0	
Lane Grp Cap (vph)	30	1124		373	1812			460	897		506	
v/s Ratio Prot	0.01	c0.22		c0.15	0.15				c0.10			
v/s Ratio Perm								0.04	0.17		0.01	
v/c Ratio	0.43	0.69		0.71	0.28			0.14	0.46		0.04	
Uniform Delay, d1	37.1	22.5		27.9	10.4			19.1	11.6		18.5	
Progression Factor	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Incremental Delay, d2	9.7	1.9		6.3	0.1			0.1	0.4		0.2	
Delay (s)	46.9	24.4		34.2	10.5			19.3	12.0		18.7	
Level of Service	D	C		C	B			B	B		B	
Approach Delay (s)		24.7			18.5			12.9			18.7	
Approach LOS		C			B			B			B	




















Intersection Summary

HCM Average Control Delay	19.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	76.3	Sum of lost time (s)	8.0
Intersection Capacity Utilization	75.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Samoset Street @ Pilgrim Hill Road Analysis

17: Samoset Street & Pilgrim Hill Road

Forecast 2016 PM Peak Hour LOS (no change)

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0	4.0		4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00	1.00		1.00	
Frt	1.00	0.99		1.00	0.99			1.00	0.85		0.95	
Flt Protected	0.95	1.00		0.95	1.00			0.97	1.00		0.98	
Satd. Flow (prot)	1770	3518		1770	3509			1800	1583		1742	
Flt Permitted	0.95	1.00		0.95	1.00			0.67	1.00		0.84	
Satd. Flow (perm)	1770	3518		1770	3509			1246	1583		1489	
Volume (vph)	40	1210	50	100	840	50	70	30	100	50	40	50
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Growth Factor (vph)	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%
Adj. Flow (vph)	46	1381	57	114	959	57	80	34	114	57	46	57
RTOR Reduction (vph)	0	5	0	0	7	0	0	0	95	0	38	0
Lane Group Flow (vph)	46	1433	0	114	1009	0	0	114	19	0	122	0
Turn Type	Prot		Prot		Perm		Perm		Perm			
Protected Phases	7	4		3	8			2				6
Permitted Phases							2		2		6	
Actuated Green, G (s)	12.2	26.0		12.2	26.0			9.8	9.8		9.8	
Effective Green, g (s)	12.2	26.0		12.2	26.0			9.8	9.8		9.8	
Actuated g/C Ratio	0.20	0.43		0.20	0.43			0.16	0.16		0.16	
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0	4.0		4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0		3.0	
Lane Grp Cap (vph)	360	1524		360	1521			204	259		243	
v/s Ratio Prot	0.03	c0.41		c0.06	0.29							
v/s Ratio Perm								c0.09	0.01		0.08	
v/c Ratio	0.13	0.94		0.32	0.66			0.56	0.07		0.50	
Uniform Delay, d1	19.5	16.3		20.4	13.5			23.1	21.2		22.9	
Progression Factor	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Incremental Delay, d2	0.7	12.6		2.3	2.3			10.6	0.5		7.2	
Delay (s)	20.3	28.9		22.7	15.8			33.7	21.8		30.0	
Level of Service	C	C		C	B			C	C		C	
Approach Delay (s)		28.6			16.5			27.8			30.0	
Approach LOS		C			B			C			C	
Intersection Summary												
HCM Average Control Delay			24.1	HCM Level of Service				C				
HCM Volume to Capacity ratio			0.70									
Actuated Cycle Length (s)			60.0	Sum of lost time (s)				12.0				
Intersection Capacity Utilization			67.6%	ICU Level of Service				C				
Analysis Period (min)			15									

c Critical Lane Group

Samoset Street @ Pilgrim Hill Road Analysis

17: Samoset Street & Pilgrim Hill Road

Forecast 2016 AM Peak Hour LOS (phase change)



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0	4.0		4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00	1.00		1.00	
Frbp, ped/bikes	1.00	1.00		1.00	1.00			1.00	0.99		1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Frt	1.00	0.98		1.00	0.99			1.00	0.85		1.00	
Flt Protected	0.95	1.00		0.95	1.00			0.96	1.00		0.97	
Satd. Flow (prot)	1770	3471		1770	3500			1788	1560		1805	
Flt Permitted	0.95	1.00		0.95	1.00			0.96	1.00		0.97	
Satd. Flow (perm)	1770	3471		1770	3500			1788	1560		1805	
Volume (vph)	11	615	78	232	427	29	48	10	388	12	7	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Growth Factor (vph)	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%
Adj. Flow (vph)	13	702	89	265	487	33	55	11	443	14	8	0
RTOR Reduction (vph)	0	7	0	0	3	0	0	0	381	0	0	0
Lane Group Flow (vph)	13	784	0	265	517	0	0	66	62	0	22	0
Confl. Peds. (#/hr)			1	3		2	1		3	2		2
Turn Type	Prot		Prot		Split		Perm		Split			
Protected Phases	5	2	1	6	8	8				4	4	
Permitted Phases								8				
Actuated Green, G (s)	1.0	25.9		14.3	39.2			9.5	9.5		2.3	
Effective Green, g (s)	1.0	25.9		14.3	39.2			9.5	9.5		2.3	
Actuated g/C Ratio	0.01	0.38		0.21	0.58			0.14	0.14		0.03	
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0	4.0		4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0		3.0	
Lane Grp Cap (vph)	26	1322		372	2018			250	218		61	
v/s Ratio Prot	0.01	c0.23		c0.15	0.15			0.04			c0.01	
v/s Ratio Perm									c0.04			
v/c Ratio	0.50	0.59		0.71	0.26			0.26	0.28		0.36	
Uniform Delay, d1	33.3	16.8		24.9	7.2			26.1	26.2		32.1	
Progression Factor	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Incremental Delay, d2	14.3	0.7		6.3	0.1			0.6	0.7		3.6	
Delay (s)	47.6	17.6		31.3	7.2			26.7	26.9		35.7	
Level of Service	D	B		C	A			C	C		D	
Approach Delay (s)		18.0			15.3			26.9			35.7	
Approach LOS		B			B			C			D	
Intersection Summary												
HCM Average Control Delay			19.3			HCM Level of Service				B		
HCM Volume to Capacity ratio			0.56									
Actuated Cycle Length (s)			68.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			60.4%			ICU Level of Service			B			
Analysis Period (min)			15									
c Critical Lane Group												

Samoset Street @ Pilgrim Hill Road Analysis

17: Samoset Street & Pilgrim Hill Road

Forecast 2016 PM Peak Hour LOS (phase change)

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0	4.0		4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00	1.00		1.00	
Frt	1.00	0.99		1.00	0.99			1.00	0.85		0.95	
Flt Protected	0.95	1.00		0.95	1.00			0.97	1.00		0.98	
Satd. Flow (prot)	1770	3518		1770	3509			1800	1583		1742	
Flt Permitted	0.95	1.00		0.95	1.00			0.97	1.00		0.98	
Satd. Flow (perm)	1770	3518		1770	3509			1800	1583		1742	
Volume (vph)	40	1210	50	100	840	50	70	30	100	50	40	50
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Growth Factor (vph)	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%
Adj. Flow (vph)	46	1381	57	114	959	57	80	34	114	57	46	57
RTOR Reduction (vph)	0	3	0	0	5	0	0	0	100	0	23	0
Lane Group Flow (vph)	46	1435	0	114	1011	0	0	114	14	0	137	0
Turn Type	Prot		Prot		Split		Perm		Split			
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases							2					
Actuated Green, G (s)	15.2	36.0		15.2	36.0		10.8	10.8		12.0		
Effective Green, g (s)	15.2	36.0		15.2	36.0		10.8	10.8		12.0		
Actuated g/C Ratio	0.17	0.40		0.17	0.40		0.12	0.12		0.13		
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0		
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0		
Lane Grp Cap (vph)	299	1407		299	1404		216	190		232		
v/s Ratio Prot	0.03	c0.41		c0.06	0.29		c0.06			c0.08		
v/s Ratio Perm							0.01					
v/c Ratio	0.15	1.02		0.38	0.72		0.53	0.07		0.59		
Uniform Delay, d1	31.9	27.0		33.2	22.8		37.2	35.2		36.7		
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00		
Incremental Delay, d2	1.1	29.1		3.7	3.2		8.9	0.7		3.8		
Delay (s)	33.0	56.1		36.9	26.0		46.1	35.9		40.5		
Level of Service	C	E		D	C		D	D		D		
Approach Delay (s)		55.4			27.1		41.0			40.5		
Approach LOS		E			C		D			D		
Intersection Summary												
HCM Average Control Delay			42.9		HCM Level of Service				D			
HCM Volume to Capacity ratio			0.75									
Actuated Cycle Length (s)			90.0		Sum of lost time (s)				16.0			
Intersection Capacity Utilization			67.6%		ICU Level of Service				C			
Analysis Period (min)			15									

c Critical Lane Group

MassDOT

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Plymouth COUNT DATE : Jun-11

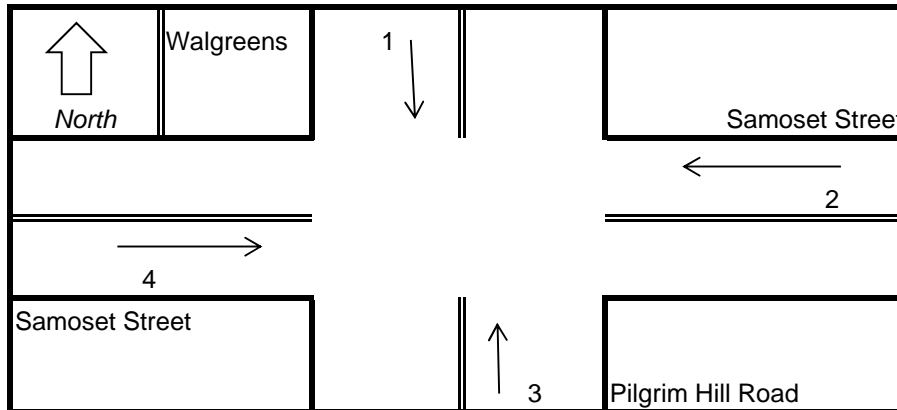
DISTRICT : 5 UNSIGNALIZED : SIGNALIZED :

~ INTERSECTION DATA ~

MAJOR STREET : Samoset Street

MINOR STREET(S) : Pilgrim Hill Road / Driveway (Walgreens / Comfort Inn)

**INTERSECTION
DIAGRAM
(Label Approaches)**



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	SB	WB	NB	EB		
PEAK HOURLY VOLUMES (AM/PM) :	57	1,274	502	639		2,472

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

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

CRASH RATE CALCULATION :

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

Comments : _____

Project Title & Date: _____