



November 19, 2012

MEMORANDUM 111912

To: Mark Makuch, CTDOT
Robert Chatfield, Mayor, Town of Prospect
Scott Roberts, CTDOT

From: Joe Perrelli, Senior Planner

Subject: Route 69 and Scott Road Intersection Operation Study, Town of Prospect

Introduction

At the request of the Town of Prospect, COGCV staff performed turning movement counts at the intersection of Route 69 and Scott Road in March 2012. Residents have reported long delays at the traffic light in the SB direction on Route 69. Through the collection and analysis of current traffic volumes at this location, improvements are proposed for possible programming. There is a project on the region's STP-Urban schedule for the Waterbury UA that terminates at this intersection. The project is Phase III of a reconstruction project that extends to the Prospect-Waterbury line. It is scheduled for construction in FFY 2019. If funding becomes available through safety projects, some minor mitigation strategies may be made to improve safety and enhance traffic flow at the intersection.

Study Area

Route 69 is functionally-classified as an Urban Principal Arterial, while Scott Road is classified as a Minor Arterial. Route 69 serves traffic between Waterbury and New Haven and locally between Waterbury and Prospect, while Scott Road serves as a connection to I-84 in Waterbury. A recent connection with Austin Road in Waterbury, under project #114-080, made for more convenient access between Route 69 and I-84, increasing traffic volumes through this intersection. A map of the intersection is shown in Figure 1.

Land uses in the vicinity are primarily commercial and medium-density residential with an athletic field located at the intersection. A relatively new age-restricted community on Scott Road has also added traffic to Scott Road and Route 69. Half of the planned 488 units have been built.

Figure 1. Route 69 and Scott Road Intersection



Traffic Volumes

Manual turning movement counts were conducted on a typical weekday morning (7:00 a.m. - 9:00 a.m.) and afternoon (4:00 p.m. - 6:00 p.m.) during peak periods in March. The peak hours are 7:30 a.m. to 8:30 a.m and 4:30 p.m. - 5:30 p.m. The morning and afternoon peak hour traffic volumes are presented in Appendix A. In addition to turning movement counts, average daily traffic (ADT) counts were obtained from CTDOT. In 2009, the ADTs on Route 69 were 11,800 vehicles per day to the north of the intersection and 15,300 to the south. The ADT on Scott Road was 4,400 vehicles.

Accident Records

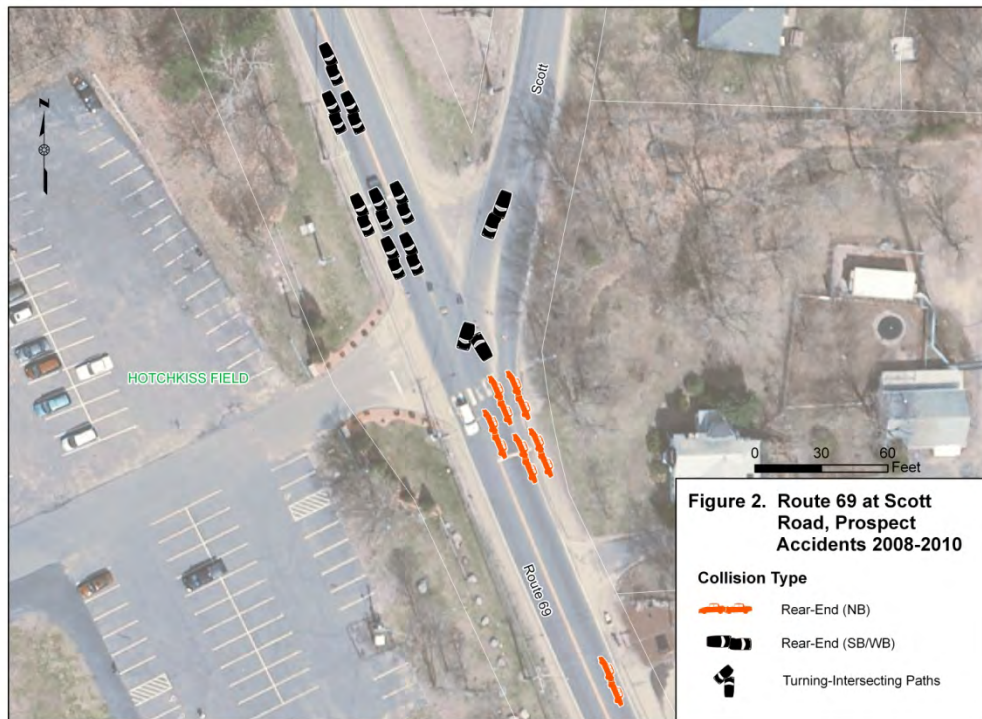
The intersection of Route 69 and Scott Road does not appear on CTDOT's most current Suggested List of Surveillance Study Sites (SLOSSS), which covers the years from 2006 to 2008. SLOSSS identifies intersections and road segments that have more than 15 accidents during the three-year period and an actual accident rate above a statistically-derived improbable accident rate. The actual accident rate is computed with the actual rate per million vehicles. The

improbable accident rate is generated from accident rate data for similar locations in Connecticut.¹

To get a more complete understanding of the types, severity, and patterns of accidents, detailed accident records from 2008-2010 were obtained from CTDOT. During this period, there were a total of 16 accidents at the intersection. The predominant accident types were rear-end collisions (94%) with only a single accident categorized as turning-intersecting paths. The majority of the accidents occurred in clear (75%) and dry (69%) weather conditions in daylight (88%). Eight of the fifteen rear-end collisions involve SB vehicles, while six involved NB vehicles and one involved WB vehicles. Tables 1 to 3 summarize accident characteristics based on type, contributing factor, and injury severity.

Almost every rear-end collision can be attributed to vehicles following too closely. However, based on CTDOT's volume-capacity ratio for this segment (0.72 in 2009), traffic on Route 69 has not reached full capacity in this area. The problem may be related to inattentive drivers, who are surprised as they approach vehicles stopped at the intersection, causing rear-end collisions. Figure 2 shows a collision diagram for the intersection.

Figure 2. Collision Diagram



Source: Accident History: 2008-2010, CTDOT Crash Data and Analysis Unit

¹ TASR and SLOSS data are privileged information and not admissible in court, pursuant to Title 23 USC Section 409.

Table 1. Accidents by Collision Type: 2008-2010

Type of Collision	Count	Percent
Rear-End	15	94
Turning-Intersecting Paths	1	6
Total	16	100

Table 2. Accidents by Contributing Factor: 2008-2010

Contributing Factor	Count	Percent
Following Too Closely	14	88
Violated Traffic Control	1	6
Speed Too Fast for Conditions	1	6
Total	16	100

Table 3. Accidents by Injury Severity: 2008-2010

Injury Severity	Count	Percent
B-Injury <i>(Non-incapacitating Evident Injury)</i>	1	6
C-Injury <i>(Possible Injury)</i>	4	25
Property Damage Only	11	69
Total	16	100

Analysis of Existing Operations

Level of Service (LOS) analyses were performed at the intersection to measure delay and volume-to-capacity ratios for both the morning and afternoon peak hours. Level of Service for signalized intersections is defined in terms of vehicle delay, which is a measure of driver discomfort, frustration, fuel consumption, and lost travel time. The delay experienced by a motorist relates to signal control, geometry, traffic flow, and incidents. Delay is a complex measure and is dependent on a number of variables, including the quality of progression, the cycle length, the green ratio, and the volume-to-capacity ratio for the lane group in question.

There are six defined Levels of Service, with “A” being the most favorable and “F” being the worst. Based on our analysis of existing operations, the intersection operates at LOS C during

both morning and evening peak periods. According to the Highway Capacity Manual, LOS C indicates operations with delays between 20 to 35 seconds per vehicle. The number of vehicles stopping is significant at this level, though many still pass through the intersection without stopping. Tables 4 and 5 provide a summary of LOS and delay by approach. Refer to Appendix B for reports on the analysis of existing operations.

Table 4. Morning Peak Hour LOS Analysis

Approach	Lane Group	v/c Ratio	Delay by Lane Group (sec/veh)	LOS by Lane Group
NB	LTR	0.53	10.0	B
SB	LTR	0.71	32.6	C
WB	LTR	0.72	44.4	D
EB	LTR	0.06	23.3	C
Intersection		0.72	23.4	C

LTR - Shared lane for Left, Thru, and Right turns

Table 5. Evening Peak Hour LOS Analysis

Approach	Lane Group	v/c Ratio	Delay by Lane Group (sec/veh)	LOS by Lane Group
NB	LTR	0.83	23.4	C
SB	LTR	0.85	36.0	D
WB	LTR	0.80	48.5	D
EB	LTR	0.14	26.4	C
Intersection		0.85	31.8	C

LTR - Shared lane for Left, Thru, and Right turns

Proposed Improvements

Based on our observations in the field, the intersection seems to function efficiently in maintaining traffic flow. There is an issue with SB left-turning vehicles on Route 69 getting stuck at the light as they await a break in oncoming traffic. Due to the geometry of the intersection, there is virtually no shoulder and no room for through vehicles to maneuver around left-turning vehicles. Also, this maneuver does not receive exclusive green time under the current timing plan.

While there are few left-turning vehicles in the SB direction (a total of 5 during the peak hour), staff observed long delays and queuing caused by their inability to find a sufficient gap in oncoming traffic. Long delays and queuing tend to heighten the level of anxiety, causing drivers to lose patience. Vehicles that are stuck in the queue may decide to pull up over the curb to pass, since there are minimal shoulders. Evidence of vehicles riding over the curb was observed in the field. Figure 3 shows views of the intersection from CTDOT's 2010 Photolog that seems to confirm this problem at the intersection.

Figure 3. Views at the Intersection of Route 69 & Scott Road: 2010



Looking NB on Route 69



Looking SB on Route 69

Improvement Option A: Minimizing Operational Deficiencies

Signal timing/optimization was considered as a near-term improvement option for the intersection, which currently operates at LOS C. The intersection does not experience severe congestion, but there is a problem caused by left-turning SB vehicles holding up through traffic on Route 69. In order to address this issue, phasing at the intersection needs to be changed from a sequential phasing to a dual-ring structure.

There is currently a leading left-turn phase available for NB vehicles on Route 69, which can be supplemented by a lagging left-turn phase for SB vehicles. Lag may offer a better level of service and help clear the queue of left-turning vehicles that are waiting for a break in oncoming traffic. However, it may also create driving conflicts for the opposing lanes, which should be taken into consideration. The proposed timing plan is included in Appendix C. In addition to adding green time for SB vehicles, the plan also adds an All-Red phase of 2.0 seconds following the Scott Road phase. This should help to ensure that left-turning vehicles from Scott Road are able to clear the intersection before the start of the next phase. There is negligible impact on the intersection LOS or delay as a result of this change.

Improvement Option B: Left-Turn Prohibition

Given the low-volume of SB left-turn maneuvers at this intersection (less than 0.5% of all movements), the restrictive geometry and the considerable delay caused by these vehicles, a left-turn prohibition for SB traffic on Route 69 may be worth considering. There are five successive streets before the intersection that provide access to Scott Road from Route 69; two of which can be seen in Figure 1. Given the low-volume of left-turning SB vehicles at this intersection, it is likely that most motorists are already using these alternate routes to get to Scott Road rather than getting stuck at the intersection. The restriction is likely to receive some opposition from those, who normally make left-turns, so it can be limited to peak hours in the morning and evening to



reduce the impact on these drivers. There are negligible improvements in the analysis of delay at the intersection with a left-turn prohibition. It may be worth considering as a means of maintaining traffic flow on Route 69.

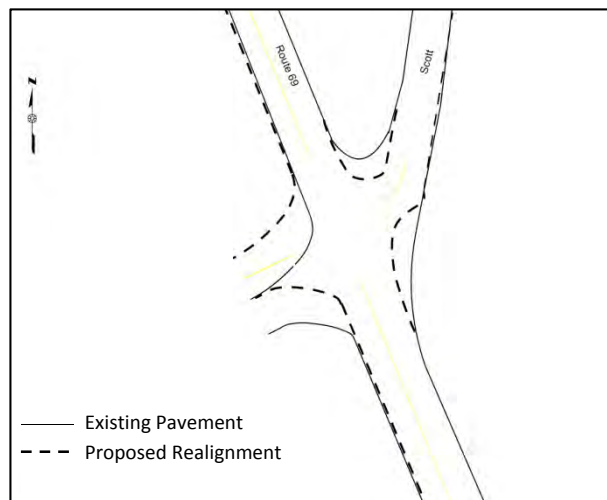
Improvement Option C: Minimizing Geometric Deficiencies

The long-term solution would involve widening the shoulder in the SB direction. The existing geometry severely limits the ability to maintain traffic flow for through vehicles while accommodating SB left-turning vehicles on Route 69. There should be sufficient rights-of-way at the intersection to accommodate widening of the shoulder in the SB direction as a long-term solution. A utility pole creates an obstacle that will need to be addressed.

The existing conditions do not warrant additional widening to accommodate NB vehicles. The NB protected left-turn in the signal timing plan provides adequate opportunity to clear any queues caused by left-turning vehicles, ensuring that traffic flow is restored within the next cycle. In addition, the geometry of the intersection already allows through vehicles to bypass stopped left-turning vehicles. From a safety perspective, widening the shoulder in the NB direction might also encourage vehicles to pass on the right without exercising appropriate caution.

Addressing the intersection skew may also be considered as a long-term improvement. Scott Road currently comes in at an acute-angle, which impacts sight lines and creates a potential safety hazard. Accident records over the past few years do not show a trend in “turning” accidents due to the skew, but accident patterns should be monitored to ensure that it doesn’t create a problem in the future. Realigning Scott Road with the driveway to Hotchkiss Field should also improve traffic flow, since the two minor approach phases could be run simultaneously. The phases are run separately under the existing timing plan to avoid conflicts. Figure 4 shows the proposed realignment within the state and town rights-of-way.

Figure 4. Proposed Realignment of Route 69 at Scott Road



Source: Council of Governments Central Naugatuck Valley
Not to scale.

Appendix A:

Peak Period

Traffic Counts: AM/PM

Route 69 at Scott Road, Prospect

Wednesday, March 7, 2012

7:00 - 9:00 A.M.

Time	Rte 69 SB					Scott Road WB				Rte 69 NB					Hotchkiss Field EB				Int. Total
	Right	Thru	Left	Trucks	Approach Total	Right	Thru	Left	Approach Total	Right	Thru	Left	Trucks	Approach Total	Right	Thru	Left	Approach Total	
7:00	1	65	1	0	67	0	2	34	36	45	62	2	0	109	3	1	0	4	216
7:15	1	68	0	0	69	0	1	39	40	50	50	1	0	101	1	0	1	2	212
7:30	0	93	1	0	94	1	0	40	41	41	71	3	0	115	2	0	0	2	252
7:45	0	88	1	0	89	2	1	52	55	48	100	3	0	151	1	0	1	2	297
8:00	0	87	1	1	88	0	0	37	37	33	68	3	0	104	2	0	0	2	231
8:15	0	75	1	0	76	1	0	43	44	38	95	3	1	136	1	1	1	3	259
8:30	4	79	0	0	83	3	0	48	51	23	79	1	0	103	1	1	2	4	241
8:45	1	76	2	0	79	0	1	22	23	35	81	0	0	116	2	1	0	3	221

Route 69 at Scott Road, Prospect

Thursday, March 29, 2012

Time	Rte 69 SB				Scott Road WB				Rte 69 NB					Hotchkiss Field EB				Int. Total
	Right	Thru	Left	Approach Total	Right	Thru	Left	Approach Total	Right	Thru	Left	Trucks	Approach Total	Right	Thru	Left	Approach Total	
4:00	2	140	1	143	2	0	50	52	56	114	4	0	174	3	0	2	5	374
4:15	2	119	1	122	2	0	43	45	42	126	0	0	168	1	0	1	2	337
4:30	3	139	3	145	4	0	38	42	84	127	1	1	212	2	0	5	7	406
4:45	3	113	0	116	2	3	52	57	67	115	3	0	185	1	0	3	4	362
5:00	2	121	2	125	1	9	62	72	55	134	8	0	197	3	1	1	5	399
5:15	4	126	0	130	2	4	57	63	65	129	7	1	201	1	2	1	4	398
5:30	2	114	3	119	1	4	49	54	62	132	7	0	201	4	2	0	6	380
5:45	0	105	1	106	2	2	36	40	58	121	4	0	183	3	3	1	7	336

 Peak Hour

Appendix B:

Synchro Analysis
of Existing Operations: AM/PM

Lanes, Volumes, Timings
3: Route 69 & Hotchkiss Field/Scott Rd

Baseline
3/29/2012 7:30 am



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (vph)	2	1	6	172	1	4	12	334	160	4	343	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	10	10	10	10	10	10	10	10	10
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Fr _t		0.910			0.997			0.957				
Fl _t Protected		0.988			0.954			0.999			0.999	
Satd. Flow (prot)	0	1708	0	0	1687	0	0	1684	0	0	1754	0
Fl _t Permitted		0.988			0.954						0.993	
Satd. Flow (perm)	0	1708	0	0	1687	0	0	1686	0	0	1744	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		8			1			41				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		283			878			949			919	
Travel Time (s)		6.4			20.0			21.6			20.9	
Peak Hour Factor	0.75	0.75	0.75	0.80	0.80	0.80	0.84	0.84	0.84	0.92	0.92	0.92
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	1%	0%
Adj. Flow (vph)	3	1	8	215	1	5	14	398	190	4	373	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	12	0	0	221	0	0	602	0	0	377	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		0			0			16			0	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	3		1	3		1	1		1	1	
Detector Template	Left			Left			Left			Left		
Leading Detector (ft)	20	22		20	22		20	0		20	0	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	300		0	325	
Detector 1 Size(ft)	20	6		20	6		20	0		20	0	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Call		Cl+Ex	Call	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	2.0		0.0	2.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	2.0		0.0	2.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		8			8							
Detector 2 Size(ft)		6			6							
Detector 2 Type		Cl+Ex			Cl+Ex							
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0							
Detector 3 Position(ft)		16			16							
Detector 3 Size(ft)		6			6							
Detector 3 Type		Cl+Ex			Cl+Ex							
Detector 3 Channel												
Detector 3 Extend (s)		0.0			0.0							

Lanes, Volumes, Timings
3: Route 69 & Hotchkiss Field/Scott Rd

Baseline
3/29/2012 7:30 am

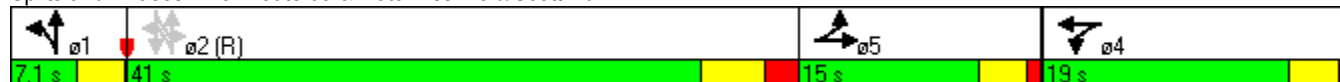


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Split	NA		Split	NA		custom	NA		custom	NA	
Protected Phases	5	5		4	4		1	1				
Permitted Phases							2	2		2	2	
Detector Phase	5	5		4	4		1	1		2	2	
Switch Phase												
Minimum Initial (s)	9.0	9.0		9.0	9.0		3.0	3.0		15.0	15.0	
Minimum Split (s)	15.0	15.0		13.0	13.0		6.1	6.1		22.0	22.0	
Total Split (s)	15.0	15.0		19.0	19.0		7.1	7.1		41.0	41.0	
Total Split (%)	18.3%	18.3%		23.1%	23.1%		8.6%	8.6%		49.9%	49.9%	
Maximum Green (s)	11.0	11.0		15.0	15.0		4.0	4.0		35.0	35.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0		4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		0.1	0.1		2.0	2.0	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		4.0			4.0			3.1			6.0	
Lead/Lag							Lead	Lead		Lag	Lag	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Vehicle Extension (s)	2.0	2.0		2.0	2.0		0.2	0.2		5.0	5.0	
Recall Mode	None	None		None	None		Max	Max		C-Min	C-Min	
Walk Time (s)	10.0	10.0										
Flash Dont Walk (s)	1.0	1.0										
Pedestrian Calls (#/hr)	0	0										
Act Effct Green (s)		9.0			14.9			54.4			24.9	
Actuated g/C Ratio		0.11			0.18			0.66			0.30	
v/c Ratio		0.06			0.72			0.53			0.71	
Control Delay		23.3			44.4			10.0			32.6	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		23.3			44.4			10.0			32.6	
LOS		C			D			B			C	
Approach Delay		23.3			44.4			10.0			32.6	
Approach LOS		C			D			B			C	

Intersection Summary

Area Type: Other
 Cycle Length: 82.1
 Actuated Cycle Length: 82.1
 Offset: 0 (0%), Referenced to phase 2:NBSB, Start of Green
 Natural Cycle: 65
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.72
 Intersection Signal Delay: 23.4
 Intersection Capacity Utilization 58.0%
 Analysis Period (min) 15
 Intersection LOS: C
 ICU Level of Service B

Splits and Phases: 3: Route 69 & Hotchkiss Field/Scott Rd



Lanes, Volumes, Timings
3: Route 69 & Hotchkiss Field/Scott Rd

Baseline
3/29/2012 4:30 pm



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (vph)	10	3	7	209	16	9	19	505	271	5	499	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	10	10	10	10	10	10	10	10	10
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Fr _t		0.952			0.995			0.954			0.997	
Fl _t Protected		0.976			0.957			0.999			0.999	
Satd. Flow (prot)	0	1765	0	0	1689	0	0	1679	0	0	1749	0
Fl _t Permitted		0.976			0.957			0.987			0.991	
Satd. Flow (perm)	0	1765	0	0	1689	0	0	1659	0	0	1735	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		10			2			46			2	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		283			878			949			919	
Travel Time (s)		6.4			20.0			21.6			20.9	
Peak Hour Factor	0.71	0.71	0.71	0.81	0.81	0.81	0.94	0.94	0.94	0.89	0.89	0.89
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	1%	0%
Adj. Flow (vph)	14	4	10	258	20	11	20	537	288	6	561	13
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	28	0	0	289	0	0	845	0	0	580	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		0			0			16			0	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	3		1	3		1	1		1	1	
Detector Template	Left			Left			Left			Left		
Leading Detector (ft)	20	22		20	22		20	0		20	0	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	300		0	325	
Detector 1 Size(ft)	20	6		20	6		20	0		20	0	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Call		Cl+Ex	Call	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	2.0		0.0	2.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	2.0		0.0	2.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		8			8							
Detector 2 Size(ft)		6			6							
Detector 2 Type		Cl+Ex			Cl+Ex							
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0							
Detector 3 Position(ft)		16			16							
Detector 3 Size(ft)		6			6							
Detector 3 Type		Cl+Ex			Cl+Ex							
Detector 3 Channel												
Detector 3 Extend (s)		0.0			0.0							

Lanes, Volumes, Timings
3: Route 69 & Hotchkiss Field/Scott Rd

Baseline
3/29/2012 4:30 pm



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Split	NA		Split	NA		custom	NA		custom	NA	
Protected Phases	5	5		4	4		1	1				
Permitted Phases							2	2		2	2	
Detector Phase	5	5		4	4		1	1		2	2	
Switch Phase												
Minimum Initial (s)	9.0	9.0		9.0	9.0		3.0	3.0		15.0	15.0	
Minimum Split (s)	15.0	15.0		13.0	13.0		6.1	6.1		21.0	21.0	
Total Split (s)	15.0	15.0		19.0	19.0		7.1	7.1		41.0	41.0	
Total Split (%)	18.3%	18.3%		23.1%	23.1%		8.6%	8.6%		49.9%	49.9%	
Maximum Green (s)	11.0	11.0		15.0	15.0		4.0	4.0		35.0	35.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0		4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		0.1	0.1		2.0	2.0	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		4.0			4.0			3.1			6.0	
Lead/Lag	Lag	Lag		Lead	Lead		Lead	Lead		Lag	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	2.0	2.0		2.0	2.0		0.2	0.2		5.0	5.0	
Recall Mode	None	None		None	None		Max	Max		Min	Min	
Walk Time (s)	10.0	10.0										
Flash Dont Walk (s)	1.0	1.0										
Pedestrian Calls (#/hr)	0	0										
Act Effct Green (s)		9.4			14.9			34.2			26.9	
Actuated g/C Ratio		0.15			0.23			0.54			0.42	
v/c Ratio		0.10			0.73			0.93			0.79	
Control Delay		24.6			40.2			32.7			26.2	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		24.6			40.2			32.7			26.2	
LOS		C			D			C			C	
Approach Delay		24.6			40.2			32.7			26.2	
Approach LOS		C			D			C			C	

Intersection Summary

Area Type: Other
 Cycle Length: 82.1
 Actuated Cycle Length: 63.9
 Natural Cycle: 90
 Control Type: Semi Act-Uncoord
 Maximum v/c Ratio: 0.93
 Intersection Signal Delay: 31.6
 Intersection Capacity Utilization 81.9%
 Analysis Period (min) 15
 Intersection LOS: C
 ICU Level of Service D

Splits and Phases: 3: Route 69 & Hotchkiss Field/Scott Rd



Appendix C:

Results of Signal
Optimization Analyses: AM/PM

Lanes, Volumes, Timings
3: Route 69 & Hotchkiss Field/Scott Rd

Alternative Phasing/Timing
11/1/2012 7:30 am



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (vph)	2	1	6	172	1	4	12	334	160	4	343	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	10	10	10	10	10	10	10	10	10
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Fr _t		0.910			0.997			0.957				
Fl _t Protected		0.988			0.954			0.999			0.999	
Satd. Flow (prot)	0	1708	0	0	1687	0	0	1684	0	0	1754	0
Fl _t Permitted		0.988			0.954			0.992			0.994	
Satd. Flow (perm)	0	1708	0	0	1687	0	0	1672	0	0	1745	0
Right Turn on Red			Yes			Yes			No			Yes
Satd. Flow (RTOR)		8			1							
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		283			878			949			919	
Travel Time (s)		6.4			20.0			21.6			20.9	
Peak Hour Factor	0.71	0.71	0.71	0.81	0.81	0.81	0.94	0.94	0.94	0.89	0.89	0.89
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	1%	0%
Adj. Flow (vph)	3	1	8	212	1	5	13	355	170	4	385	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	12	0	0	218	0	0	538	0	0	389	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		0			0			16			0	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	3		1	3		1	1		1	1	
Detector Template	Left			Left			Left			Left		
Leading Detector (ft)	20	22		20	22		20	0		20	0	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	300		0	325	
Detector 1 Size(ft)	20	6		20	6		20	0		20	0	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Call		Cl+Ex	Call	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	2.0		0.0	2.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	2.0		0.0	2.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		8			8							
Detector 2 Size(ft)		6			6							
Detector 2 Type		Cl+Ex			Cl+Ex							
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0							
Detector 3 Position(ft)		16			16							
Detector 3 Size(ft)		6			6							
Detector 3 Type		Cl+Ex			Cl+Ex							
Detector 3 Channel												
Detector 3 Extend (s)		0.0			0.0							

Lanes, Volumes, Timings
3: Route 69 & Hotchkiss Field/Scott Rd

Alternative Phasing/Timing
11/1/2012 7:30 am

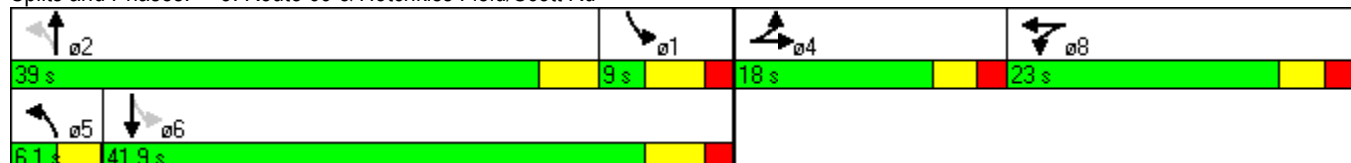


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Split	NA		Split	NA		pm+pt	NA		pm+pt	NA	
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases							2			6		
Detector Phase	4	4		8	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0		9.0	9.0		3.0	15.0		3.0	15.9	
Minimum Split (s)	16.0	16.0		15.0	15.0		6.1	22.0		9.0	22.0	
Total Split (s)	18.0	18.0		23.0	23.0		6.1	39.0		9.0	41.9	
Total Split (%)	20.2%	20.2%		25.8%	25.8%		6.9%	43.8%		10.1%	47.1%	
Maximum Green (s)	13.0	13.0		18.0	18.0		3.0	34.9		3.0	35.9	
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		0.1	0.1		2.0	2.0	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		5.0			5.0			4.1			6.0	
Lead/Lag							Lead	Lead		Lag	Lag	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Vehicle Extension (s)	2.0	2.0		2.0	2.0		3.0	5.0		3.0	5.0	
Recall Mode	None	None		None	None		Max	Min		None	Min	
Walk Time (s)	10.0	10.0										
Flash Dont Walk (s)	1.0	1.0										
Pedestrian Calls (#/hr)	0	0										
Act Effct Green (s)		8.5			12.1			28.7			20.2	
Actuated g/C Ratio		0.16			0.23			0.55			0.39	
v/c Ratio		0.04			0.56			0.58			0.58	
Control Delay		19.2			25.8			12.5			17.7	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		19.2			25.8			12.5			17.7	
LOS		B			C			B			B	
Approach Delay		19.2			25.8			12.5			17.7	
Approach LOS		B			C			B			B	

Intersection Summary

Area Type: Other
 Cycle Length: 89
 Actuated Cycle Length: 52.1
 Natural Cycle: 70
 Control Type: Semi Act-Uncoord
 Maximum v/c Ratio: 0.58
 Intersection Signal Delay: 16.8
 Intersection LOS: B
 Intersection Capacity Utilization 58.9%
 ICU Level of Service B
 Analysis Period (min) 15

Splits and Phases: 3: Route 69 & Hotchkiss Field/Scott Rd



Lanes, Volumes, Timings
3: Route 69 & Hotchkiss Field/Scott Rd

Alternative Phasing/Timing
6/6/2012 4:30 pm



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (vph)	10	3	7	209	16	9	19	505	271	5	499	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	10	10	10	10	10	10	10	10	10
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.952			0.995			0.954			0.997	
Flt Protected		0.976			0.957			0.999			0.999	
Satd. Flow (prot)	0	1765	0	0	1689	0	0	1679	0	0	1749	0
Flt Permitted		0.976			0.957			0.985			0.991	
Satd. Flow (perm)	0	1765	0	0	1689	0	0	1656	0	0	1735	0
Right Turn on Red			Yes			Yes			No			Yes
Satd. Flow (RTOR)		10			2							2
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		283			878			949			919	
Travel Time (s)		6.4			20.0			21.6			20.9	
Peak Hour Factor	0.71	0.71	0.71	0.81	0.81	0.81	0.94	0.94	0.94	0.89	0.89	0.89
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	1%	0%
Adj. Flow (vph)	14	4	10	258	20	11	20	537	288	6	561	13
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	28	0	0	289	0	0	845	0	0	580	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		0			0			16			0	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	3		1	3		1	1		1	1	
Detector Template	Left			Left			Left			Left		
Leading Detector (ft)	20	22		20	22		20	0		20	0	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	300		0	325	
Detector 1 Size(ft)	20	6		20	6		20	0		20	0	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Call		Cl+Ex	Call	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	2.0		0.0	2.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	2.0		0.0	2.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		8			8							
Detector 2 Size(ft)		6			6							
Detector 2 Type		Cl+Ex			Cl+Ex							
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0							
Detector 3 Position(ft)		16			16							
Detector 3 Size(ft)		6			6							
Detector 3 Type		Cl+Ex			Cl+Ex							
Detector 3 Channel												
Detector 3 Extend (s)		0.0			0.0							

Lanes, Volumes, Timings
3: Route 69 & Hotchkiss Field/Scott Rd

Alternative Phasing/Timing
6/6/2012 4:30 pm



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Split	NA		Split	NA		pm+pt	NA		pm+pt	NA	
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases							2			6		
Detector Phase	4	4		8	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0		9.0	9.0		3.0	15.0		3.0	15.9	
Minimum Split (s)	15.0	15.0		15.0	15.0		6.1	22.0		9.0	22.0	
Total Split (s)	18.0	18.0		23.0	23.0		6.1	39.0		9.0	41.9	
Total Split (%)	20.2%	20.2%		25.8%	25.8%		6.9%	43.8%		10.1%	47.1%	
Maximum Green (s)	14.0	14.0		19.0	19.0		3.0	34.9		3.0	35.9	
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	4.0		4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		0.1	0.1		2.0	2.0	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		4.0			4.0			4.1			6.0	
Lead/Lag							Lead	Lead		Lag	Lag	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Vehicle Extension (s)	2.0	2.0		2.0	2.0		3.0	5.0		3.0	5.0	
Recall Mode	None	None		None	None		Max	Min		None	Min	
Walk Time (s)	10.0	10.0										
Flash Dont Walk (s)	1.0	1.0										
Pedestrian Calls (#/hr)	0	0										
Act Effct Green (s)		8.3			15.5			39.5			31.2	
Actuated g/C Ratio		0.12			0.23			0.59			0.46	
v/c Ratio		0.12			0.74			0.87			0.72	
Control Delay		26.5			38.8			26.7			22.8	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		26.5			38.8			26.7			22.8	
LOS		C			D			C			C	
Approach Delay		26.5			38.8			26.7			22.8	
Approach LOS		C			D			C			C	

Intersection Summary

Area Type: Other
 Cycle Length: 89
 Actuated Cycle Length: 67.3
 Natural Cycle: 100
 Control Type: Semi Act-Uncoord
 Maximum v/c Ratio: 0.87
 Intersection Signal Delay: 27.4
 Intersection LOS: C
 Intersection Capacity Utilization 82.0%
 ICU Level of Service D
 Analysis Period (min) 15

Splits and Phases: 3: Route 69 & Hotchkiss Field/Scott Rd

