

Hunder Developments Limited

**ADDENDUM:  
TRAFFIC OPERATIONAL REVIEW - HUNSBERGER PIT**

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TECHNICAL ADDENDUM

FEBRUARY 2010



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### APPENDIX

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## 1. INTRODUCTION

IBI Group completed a *Traffic Operational Review* for the proposed Hunder Developments Ltd. Hunsberger Pit in May 2008. That review included a traffic impact study and an assessment of road user safety. However, changes to the proposed operations of the Hunsberger Pit and uncertainty related to future market demand have necessitated this addendum.

The revised proposal for pit operations has resulted in an increase in the trip generation potential for the site. Current projections have increased the number of per-hour trips generated from twelve (12) to eighteen (18). The trip distribution for the development is dependant on the market demand for the extracted materials. Currently, there is no fixed market for the future extracted materials. Therefore, as a part of this study addendum, several trip distribution scenarios were developed and analyzed.

Additionally, a study was completed by Stantec Consulting Inc. in November of 2008 for the proposed West Montrose Pit, to be located off of Katherine Street, north of the Hunsberger Pit. The assumptions used for this study have shown that approximately ten (10) hourly trips from this pit could travel towards the intersection of Sawmill Road at Katherine Street/Crowsfoot Road. This information was not incorporated into the previous traffic impact analysis, but it is accounted for in this study addendum.

The purpose of this addendum is to update the previous study, completed by IBI Group, for the Hunsberger Pit to reflect the above mentioned information.

### 1.1 Model Assumptions

The following assumptions were incorporated into the traffic impact analysis (i.e., the Synchro and SimTraffic analysis models):

- **Sawmill Road at Northfield Drive:** Given the width for the northbound approach to the intersection, it was suspected that the motorists often treated this as a two lane approach. Field investigations confirmed that vehicles do treat the northbound approach as two lanes. It was observed that left turning vehicles would use the painted median as a storage lane, which would permit vehicles travelling through or making a right-turn at the intersection to by-pass the stopped left-turning vehicles. Thus, the northbound approach to this intersection was modelled with a short left-turn storage lane and a shared through/right-turn lane; and
- **Sawmill Road at Katherine Street/Crowsfoot Road:** The intersection of Sawmill Road and Crowsfoot Road at Katherine Street forms a skewed four legged junction. The intersection is stop controlled on the Katherine Street and Crowsfoot Road approaches. The unique geometry of this intersection created challenges in accurately modelling the observed traffic operations in Synchro. Due to limitations of the Synchro analysis software in modelling stop controlled intersections with non-standard geometry, the intersection was modelled as a T-intersection for the purpose of this study. The redistribution of traffic is described below.

The conflicting traffic volumes related to turning movements to/from Crowsfoot Road were incorporated into the traffic volumes on Sawmill Road to account for their impacts on delay. This

was done to avoid adding disproportionately to the volumes, and subsequently the queues, on Katherine Street. To provide a representative model, the right-turns from Crowsfoot Road were considered as through traffic, and added to the westbound through movement volume on Sawmill Road, and the southbound left-turns onto Crowsfoot were added to the southbound left-turns onto Katherine Street. Right-turns onto Crowsfoot Road and left-turns from Crowsfoot Road were not included in the analysis, as they do not conflict with movements from Katherine Street.

## 2. EXISTING CONDITIONS

Signal timings were provided by the Region of Waterloo for the intersection of Sawmill Road at Northfield Drive (refer to **Appendix A**). Additionally, IBI Group retained Pyramid Traffic Inc. to conduct weekday, eight-hour turning movement counts (provided in **Appendix B**) for the following intersections:

- Sawmill Road at Northfield Drive East;
- Sawmill Road at Katherine Street/Crowsfoot Road; and
- Sawmill Road at St. Charles Street.

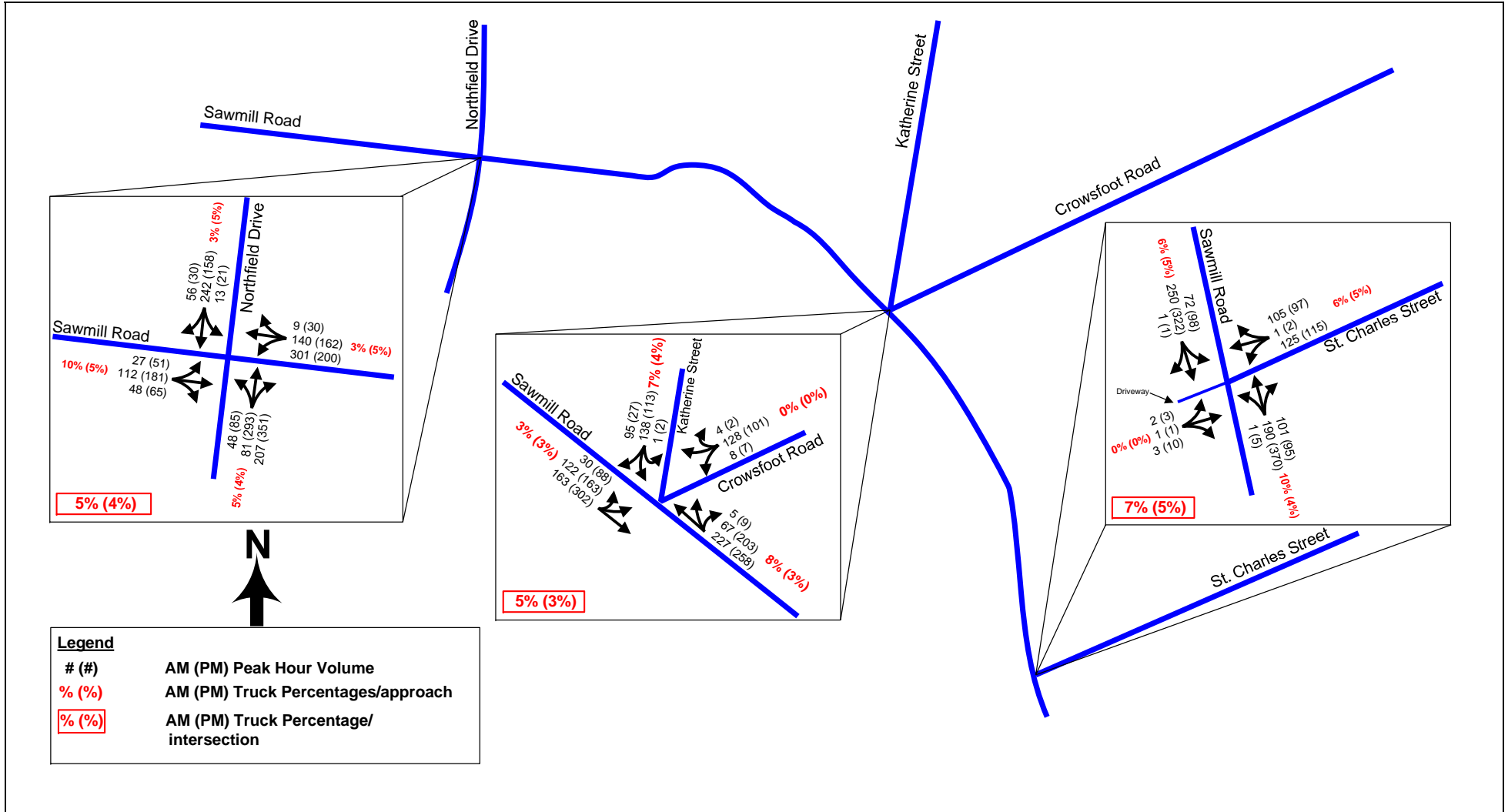
**Exhibit 2-1** lists the dates on which the counts were conducted for the three study intersections, and it identifies the AM and PM peak hours for each intersection.

**Exhibit 2-1: Intersection Counts**

Intersection	AM Peak Hour	PM Peak Hour	Date
Sawmill Road at Northfield Drive	7:30 – 8:30	4:45 – 5:45	November 16, 2009
Sawmill Road at Katherine Street/Crowsfoot Road	8:00 – 9:00	4:45 – 5:45	November 17, 2009
Sawmill Road at St. Charles Street	7:45 – 8:45	4:45 – 5:45	November 18, 2009

A volume balancing exercise was completed for the existing volumes prior to conducting the capacity analysis. **Exhibit 2-2** illustrates the resulting volumes.

Exhibit 2-2: 2009 Existing Volume



## 2.1 Existing Conditions – Operational Analysis

Based on the above volumes, a capacity analysis was conducted for the existing conditions using Highway Capacity Manual (HCM) methodology, specifically, the Synchro 7.0 modelling/analysis software package. The results of the analysis under the existing conditions are summarized in **Exhibit 2-3**. Full Synchro Reports are provided in **Appendix C**.

**Exhibit 2-3: Operational Analysis – 2009 Existing Conditions**

Intersection	Period	Overall			Critical Movement				Available Storage Length (m)
		LOS	Delay (s)	v/c	Movement	v/c	Delay (s)	Queue Length (95 <sup>th</sup> percentile) (m)	
Sawmill Road/ Northfield Drive	AM	C	26	0.64	-	-	-	-	-
	PM	D	52	0.94	WB (LOS E) NBTR (LOS D)	1.03 0.97	76 50	140 183	- - -
Sawmill Road/ Katherine Street/ Crowsfoot Road	AM	-	14	-	-	-	-	-	-
	PM	-	27	-	SB (LOS F)	1.22	219	73	-
Sawmill Road/ St. Charles Street	AM	-	7.5	-	-	-	-	-	-
	PM	-	16.3	-	WB (LOS F)	0.92	78	62	-

### 2.1.1 SAWMILL ROAD AT NORTHFIELD DRIVE

For the signalized intersection of Sawmill Road at Northfield Drive, the analysis indicates that the intersection is operating near its theoretical capacity during the PM peak hour. Contrary to what the analysis suggests, during field investigations, there was no indication that the westbound or eastbound movements were operating at capacity. However, field investigations confirmed that the northbound approach does experience significant queues. This can be attributed to left-turning vehicles impeding through and right-turning vehicles, although (as described in **Section 1.1**), vehicles often treat this approach as two lanes (dedicated left-turn, and a shared/through right-turn lane). Nonetheless, three or more consecutive left-turning vehicles can block through and right-turning traffic from entering the intersection.

### 2.1.2 SAWMILL ROAD AT KATHERINE STREET/CROWSFOOT ROAD

Under the existing conditions, the analysis indicates that the unsignalized intersection of Sawmill Road at Katherine Street/Crowsfoot Road operates well, with the exception of the southbound movement during the PM peak hour. According to the analysis, the southbound approach is operating at capacity with a delay of approximately 219 seconds/vehicle. However, based on field investigations, the model appears to overestimate the per vehicle delay that is typically experienced at this intersection. Furthermore, SimTraffic was used to simulate the traffic operations for this intersection, and the results of this simulation (refer to **Appendix C** for SimTraffic Reports) have shown that the expected delays are approximately 112 seconds per vehicle for the left turning

movement, and 70 seconds for the right-turning vehicles, which are more representative of the observed traffic operations for this intersection.

As previously stated, modelling stopped controlled intersections in Synchro has its limitations. With respect to those limitations, Trafficware (the maker of Synchro and SimTraffic) notes that for its HCM unsignalized intersection analysis, “[the company] believes that there are still fundamental problems with the upstream signals methodology and in fact with the entire two-way stop procedure in general. The basic gap acceptance formula does not work well with large volumes on the main street and may be underestimating available capacity” (Trafficware, 2003). This underestimation of capacity is why the delay reported in Synchro does not always correspond to the SimTraffic results or field observations.

### 2.1.3 SAWMILL ROAD AT ST. CHARLES STREET

The above analysis summary also indicates that the westbound movement at the intersection of Sawmill Road at St. Charles Street is operating at level of service (LOS) F. Similar to the intersection of Sawmill Road at Northfield Drive, SimTraffic was used to simulate the traffic operation at the St. Charles Street intersection. The SimTraffic simulations suggest that the westbound movement from St. Charles Street is expected to operate with delays that range from 15 seconds to 22 seconds, which does not reflect a movement operating at LOS F, but rather LOS B or C.

An explanation for the disparity between the two sets of results, at the St. Charles Street intersection, is provided in **Section 2.1.2**.

## 3. FUTURE CONDITIONS

The future conditions address the impact of the expected background growth for the study area, and separately the trips generated by the proposed aggregate pits (i.e., Hunsberger, West Montrose, and Jigs Hollow). Based on the anticipated timeframe for peak operation (i.e., when the proposed pit will be able to produce the maximum allowable extraction limit), a 2020 horizon year was used for future analysis.

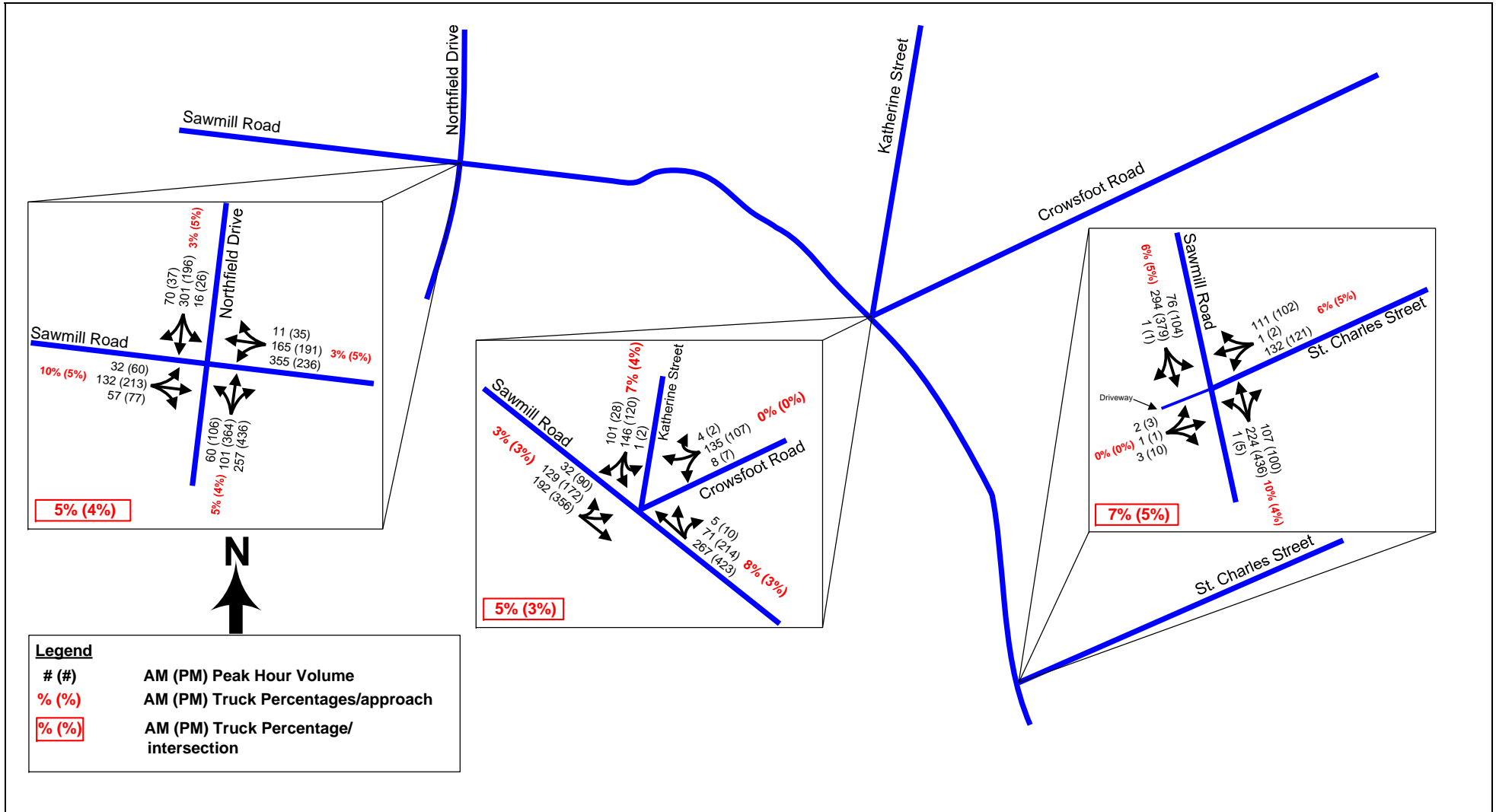
### 3.1 Background Growth Rates

Confirmation was provided by the Region that the proposed growth rates used in the study completed in May of 2008 were consistent with the available information at the time. However, recent information gathered by the Region of Waterloo has suggested that the growth rate for Sawmill Road east of Northfield Drive has increased from 0.5 percent per annum to 1.5 percent per annum. This analysis assumed the following growth rates:

- Sawmill Road from Northfield Drive to St. Charles Street at 1.5% per annum;
- Northfield Drive from King Street to east of the study area at 2% per annum;
- Katherine Street from Sawmill Road to Regional Road 86 at 0.5% per annum;
- Crowsfoot Road north of Sawmill Road at 0.5% per annum; and
- St. Charles Street from Sawmill Road to Maryhill Rd at 0.5% per annum.

The resulting traffic volumes from only the background growth are illustrated in **Exhibit 3-1**. The operational analysis for this scenario is summarized in **Exhibit 3-2**. Full Synchro Reports are provided in **Appendix D**.

Exhibit 3-1: 2020 Background Growth Volumes



**Exhibit 3-2: Operation Analysis – 2020 Future Background Growth**

Intersection	Period	Overall			Critical Movement				Available Storage Length (m)
		LOS	Delay (s)	v/c	Movement	v/c	Delay (s)	Queue Length (95 <sup>th</sup> percentile) (m)	
Sawmill Road/ Northfield Drive	AM	C	31	0.69	WB (LOS D)	0.94	42	139	-
	PM	E	77	1.04	EB (LOS D)	0.89	54	111	-
					WB (LOS F)	1.11	104	160	-
					NBTR( LOS F)	1.09	85	223	-
SB (LOS E)	0.90	61	97	-					
Sawmill Road/ Katherine Street/ Crowsfoot Road	AM	-	12	-	-	-	-	-	-
	PM	-	32	-	SB (LOS F)	1.39	296	80	-
Sawmill Road/ Charles Street	AM	-	7	-	-	-	-	-	-
	PM	-	15.1	-	WB (LOS F)	0.90	77	59	-

**3.1.1 SAWMILL ROAD AT NORTHFIELD DRIVE**

With the anticipated background growth for the study area, the intersection of Sawmill Road at Northfield Drive is expected to be the most negatively impacted of the three study intersections. As shown in the analysis summary, under the future background conditions, the intersection is expected to experience demand that is beyond its current capacity. The existing signal timings and lane configurations may not be adequate to support the additional traffic generated by the background growth.

The inclusion of a dedicated left-turn lane is justified because the left-turning volume is approximately 67% and 51% of the total westbound approach volume for the AM and PM peak hours, respectively. However, given the land constraints on Sawmill Road within the community of Conestogo, the implementation of a dedicated left-turn lane may not be feasible. Therefore, the existing intersection geometry was maintained for the remaining analysis; this approach assumes that the left-turn lane will not be constructed within the study horizon, representing a worst-case scenario.

**3.1.2 SAWMILL ROAD AT KATHERINE STREE/CROWSFOOT ROAD**

For the intersection of Sawmill Road at Katherine Street/Crowsfoot Road, the results of the capacity analysis (**Exhibit 3-2**) have shown that the delay for the southbound movement (i.e., from Katherine Street) is expected to be approximately 296 seconds/vehicle. The 296 seconds of delay reported by Synchro is likely an overestimation (similar to what is described in **Section 2.1.2**); however, it indicates that a significant degradation in traffic operations can be expected as a result of background traffic growth. The increase in delay can be largely attributed to the growth in traffic volumes along Sawmill Road during the study period. It is expected that within the study period, the volume on Sawmill Road will increase by approximately 18 percent. As a result, vehicles turning onto Sawmill Road from Katherine Street or Crowsfoot Road would be required to wait longer for acceptable gaps in the traffic stream. Mitigation (e.g., signalization of the intersection) may be required to reduce the delay to side street traffic.

The future conditions analysis (**Exhibit 3-2**) indicates that this intersection is expected to operate at a better overall intersection delay, during the AM peak hour, than was observed for the existing

conditions. Generally, it is expected that future conditions analysis will produce a similar or worse LOS, when compared to the existing conditions. However, the Region requires that peak hour factors (PHF) of 1.0 and 0.9 be applied to the future and existing conditions, respectively. Given that there was minimal growth on the side streets (i.e., Katherine Street/Crowsfoot Road) within the analysis period, the adjusted volumes obtained for the future conditions were lower than those used of the existing conditions after the PHFs were applied. As a result, traffic operations appear to have improved marginally with the additional vehicles for the Katherine Street/Crowsfoot Road intersection.

### 3.1.3 SAWMILL ROAD AT ST. CHARLES STREET

According to the future conditions analysis (**Exhibit 3-2**) the unsignalized intersection of Sawmill Road at St. Charles Street is expected to operate at a better overall intersection delay, during both the AM and PM peak hours, than was observed for the existing conditions scenario. This is due to the peak hour factor requirements by the Region (as discussed in the previous section) and the minimal growth experienced on St. Charles Street within the analysis period.

Simulations were completed using SimTraffic for the intersection to observe traffic operations under the future background conditions. Comparison of the simulation results under the future background conditions with those of the existing conditions suggests that the delay for the St. Charles Street approach will increase (refer to **Appendix C** for the SimTraffic Report), as would be expected given the increase in traffic volumes. The per-vehicle delays for the westbound movements are expected to range from 19 seconds (left-turns) to 14 seconds (right-turn) and 33 seconds (left-turn) to 23 seconds (right-turn) during the AM and PM peak hours, respectively. These delays correspond to LOS D and E, respectively.

## 3.2 Mitigating Measures

Although the intersection of Sawmill Road at Northfield Drive is expected to operate poorly under the future background scenario, given the specific geometric constraints at the intersection, there are limited opportunities to implement physical measures that would help accommodate the projected volumes. Therefore, in an effort to increase capacity and accommodate the additional traffic due to background growth, the existing cycle lengths for both the AM and PM peak hour were increased to 95 seconds.

Signal warrants were conducted at the intersection of Sawmill Road and Katherine Street/Crowsfoot Road using the methodology presented in the Ontario Traffic Manual (OTM) Book 12. Under future conditions, a signal warrant must be met by at least 120 % in order for signalization of an intersection to be justified. As shown in **Exhibit 3-3**, the signal warrant was met at the 120 percent threshold for Justification 1 – Minimum Vehicular Volume.

**Exhibit 3-3: Signal Warrant – Sawmill Road at Katherine Street/Crowsfoot Road**

Justification	Description	Minimum Requirements - 1 lane highways	Compliance		
			Sectional		Entire %
		Free Flow	Numerical	%	
<b>1. Minimum Vehicular Volume</b>	A. Vehicle volume, all approaches (average hour)	480	653	136%	<b>136%</b>
	B. Vehicle volume, all minor streets (average hour)	120	163	136%	
<b>2. Delay to Cross Traffic</b>	A. Vehicle volume, major street (average hour)	480	490	102%	102%
	B. Combined vehicle and pedestrian volume crossing artery from minor streets (average hour)	50	70	141%	

Based on the signal warrants being met, the analysis for the intersection of Sawmill Road at Katherine Street/Crowsfoot Road was recalculated for the future background conditions, assuming signalized operation (**Exhibit 3-4**). Given the unique geometry of the intersection, a split phase mode of control was used for the Katherine Street and Crowsfoot Road approaches. A split phase was used on these side streets to avoid conflicts between competing movements on Katherine Street and Crowsfoot Road. Additionally, right-turns on red (RTOR) are prohibited on all of the approaches, and an eastbound dedicated left-turn lane (60 m storage) was incorporated. It is important to note that with the proposed construction of an eastbound storage lane on Sawmill Road, the shoulder width must be maintained to provide a path for the horse drawn buggies that travel along area roads.

A summary of the capacity analysis (incorporating all of the mitigating measures discussed in **Section 3.2**) is provided in **Exhibit 3-4** (refer to **Appendix D** for the full Synchro Reports).

**Exhibit 3-4: Capacity Analysis – 2020 Future Background Conditions with Mitigating Measures**

Intersection	Period	Overall			Critical Movement				Comments
		LOS	Delay (s)	v/c	Movement	v/c	Delay (s)	Queue Length (95 <sup>th</sup> percentile) (m)	
Sawmill Road/ Northfield Drive	AM	C	32	0.68	-	-	-	-	95 second cycle length
	PM	E	77	0.99	WB (LOS F) NBTR (LOS E)	1.19 1.05	134 73	164 221	95 second cycle length
Sawmill Road/ Katherine Street/ Crowsfoot Road	AM	C	30	0.55	SE (LOS D)	0.74	50	79	AM – 100 second cycle length PM – 120 second cycle length
	PM	D	38	0.77	EBL (LOS D) WB (LOS D) SE (LOS E)	0.84 0.87 0.66	43 41 63	55 204 59	Construction of dedicated EBL turn lane (60 m)

The above analysis shows that the proposed mitigating measures are expected to improve traffic operations at the highlighted intersections, especially with the signalization and construction of a dedicated eastbound left-turn lane at the intersection of Sawmill Road at Katherine Street/Crowsfoot Road. As shown, signalization of the intersection is expected to significantly reduce the delay experienced from Katherine Street (296 seconds to 50 seconds). Also, given that there is excess capacity at the signalized Crowsfoot Corners intersection, much of the delay is control delay caused by the split phase operation.

All of the mitigation measures, described above, are assumed to be present in all future analysis scenarios.

### 3.3 Site Development

The proposed Hunsberger Pit site is located on Katherine Street South (Regional Road 23), and the site spans Hunsberger Road (Conestogo-Winterbourn Road). The proposed site access is located approximately 350 metres north of the intersection of Katherine Street South and Hunsberger Road. There would also be a crossing of Hunsberger Road.

As previously stated, the anticipated number of trips generated by this development will be 18 trucks per hour (9 inbound, 9 outbound) for each hour of operation. However, for the purpose of simplifying the analysis, it is assumed that the Hunsberger Pit will generate 20 truck trips per hour (10 inbound, 10 outbound). All site generated truck traffic will travel south from the Katherine Street access; beyond that, the distribution of haul traffic is discussed in **Section 3.5**.

### 3.4 Additional Developments

#### 3.4.1 JIGGS HOLLOW PIT

The proposed Jigs Hollow Pit may be developed near the intersection of Jigs Hollow Road and Northfield Drive (northwest of the Hunsberger Pit). The site is estimated to produce an additional

twelve (12) heavy vehicle trips per hour (six inbound, six outbound) that will feed into the study area. The additional vehicles that the proposed Jigs Hollow Pit will produce have been incorporated into future total volumes.

The trips generated by the proposed Jigs Hollow Pit were distributed at the Northfield Drive and Sawmill Road intersection in the following manner:

- Five (5) additional heavy truck trips for northbound and southbound through movements;
- One (1) right-turn movement from Northfield Drive onto Sawmill Road; and
- One (1) left-turn movement from Sawmill Road onto Northfield Drive, heading towards Jigs Hollow Road.

#### 3.4.2 WEST MONTROSE PIT

As previously noted, the proposed location for development of the West Montrose Pit is south of the community of West Montrose, north of the proposed Hunsberger Pit site. Katherine Street will serve as the main access road for the development.

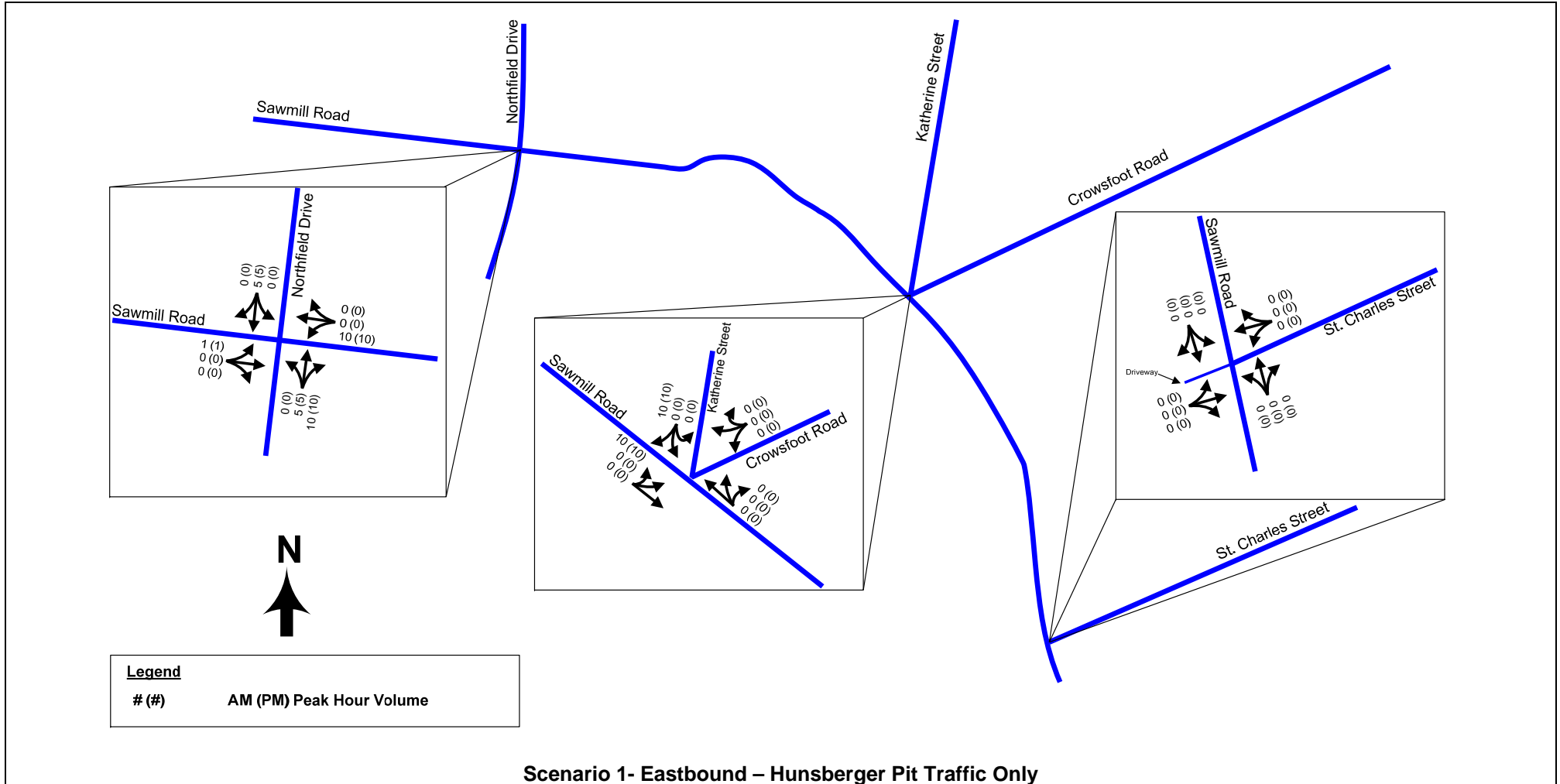
It is expected that the pit will generate approximately 27 trucks per hour. For the purpose of this addendum, the focus will be on the southbound trips towards Sawmill Road. Based on the impact study conducted by Stantec (*West Montrose Pit Traffic Impact Study*, 2008), it is expected that approximately 40% of the truck traffic will travel west to Sawmill Road, which translates to approximately 10 trucks per hour (assumed 10 inbound trips and 10 outbound trips). Additionally, the Stantec study considered a scenario where all the anticipated truck traffic travelled north on Katherine Street to Regional Road 86.

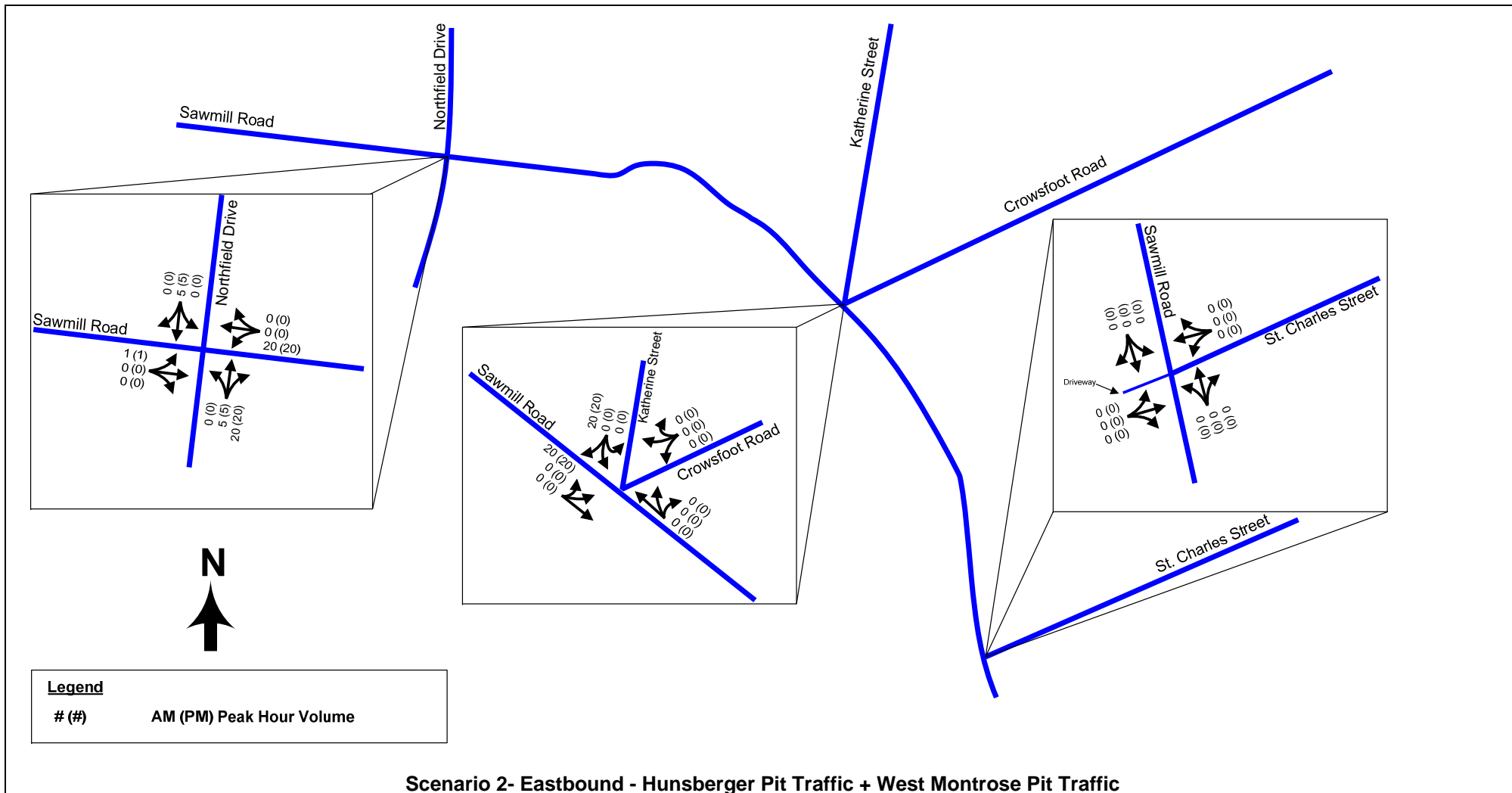
Both scenarios were reflected in the following analysis.

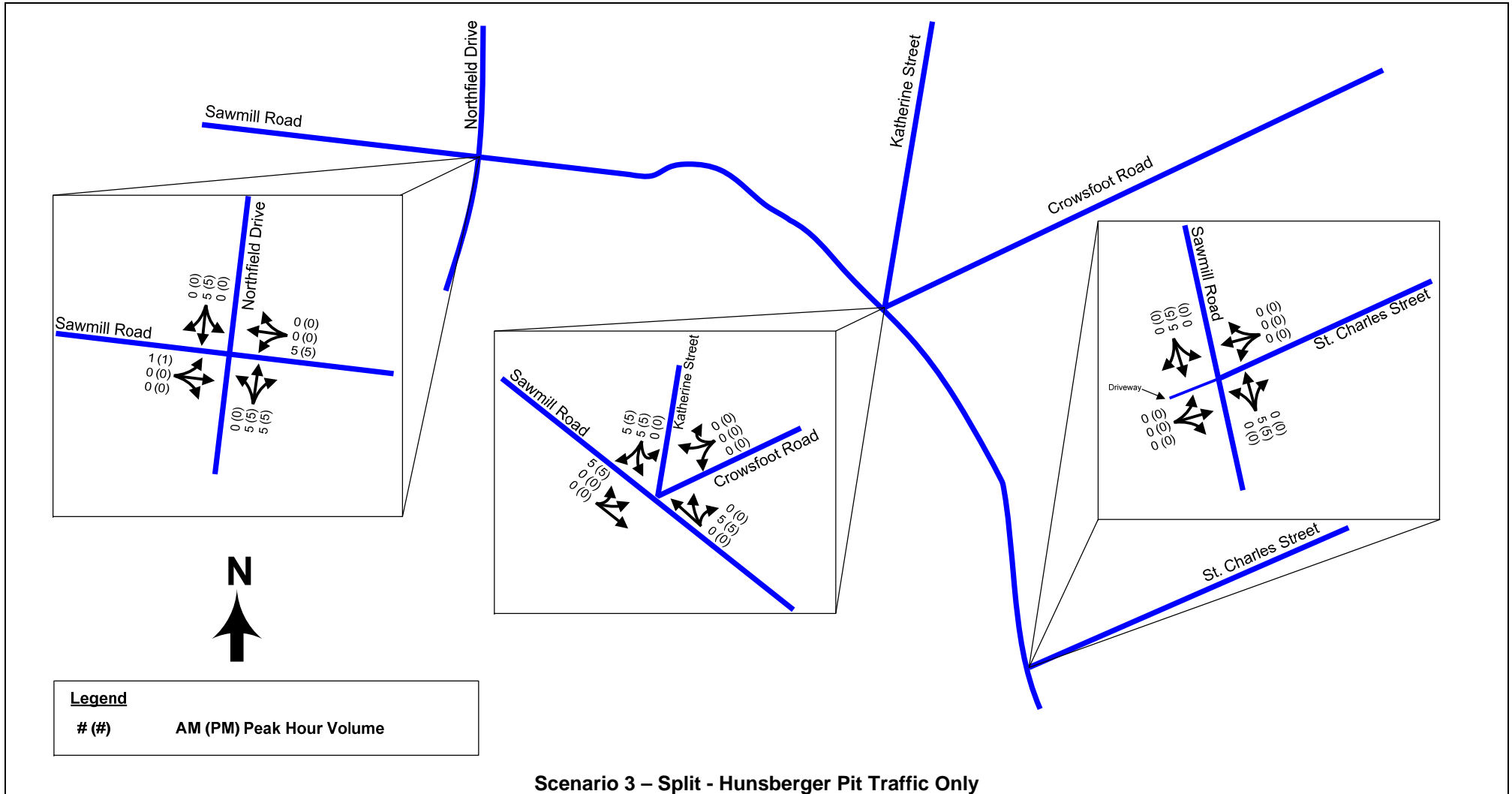
### 3.5 Truck Routes and Volumes

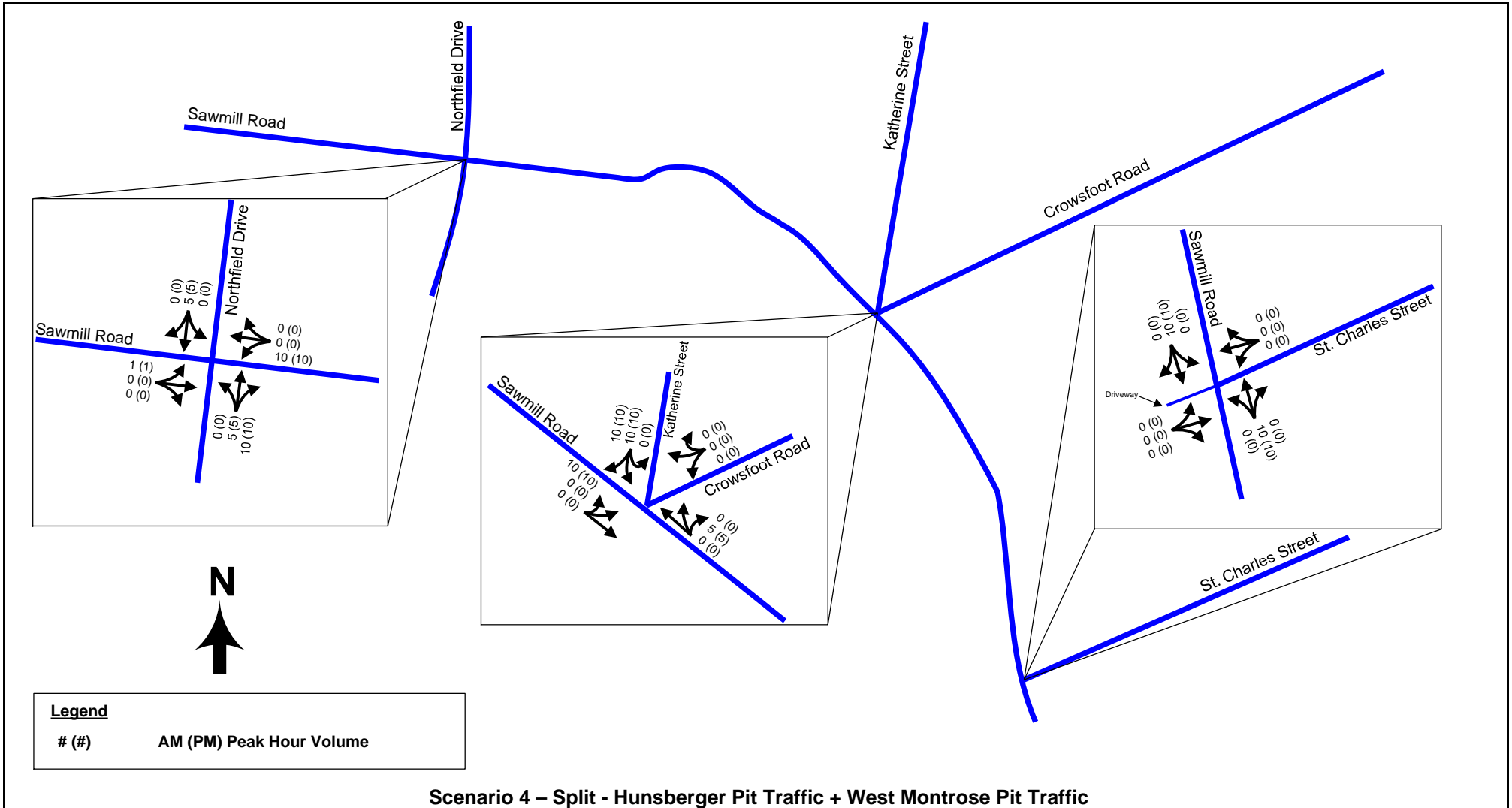
At the intersection of Sawmill Road at Katherine Street, it is expected that trucks will either proceed westbound to access the Conestoga Parkway via Northfield Drive, or eastbound towards the community of Bloomingdale. Given that market demand for the extracted materials is not certain or fixed, a number of trip distribution scenarios were analyzed. The following scenarios (refer to Exhibit 3-5) were developed to take into consideration the possible combinations of trip generations (by all proposed pits) and trip distributions. In total, six (6) scenarios were analyzed. In **Exhibit 3-5**, the scenario names reflect the inbound haul traffic trips at the intersection of Sawmill Road at Katherine Street.

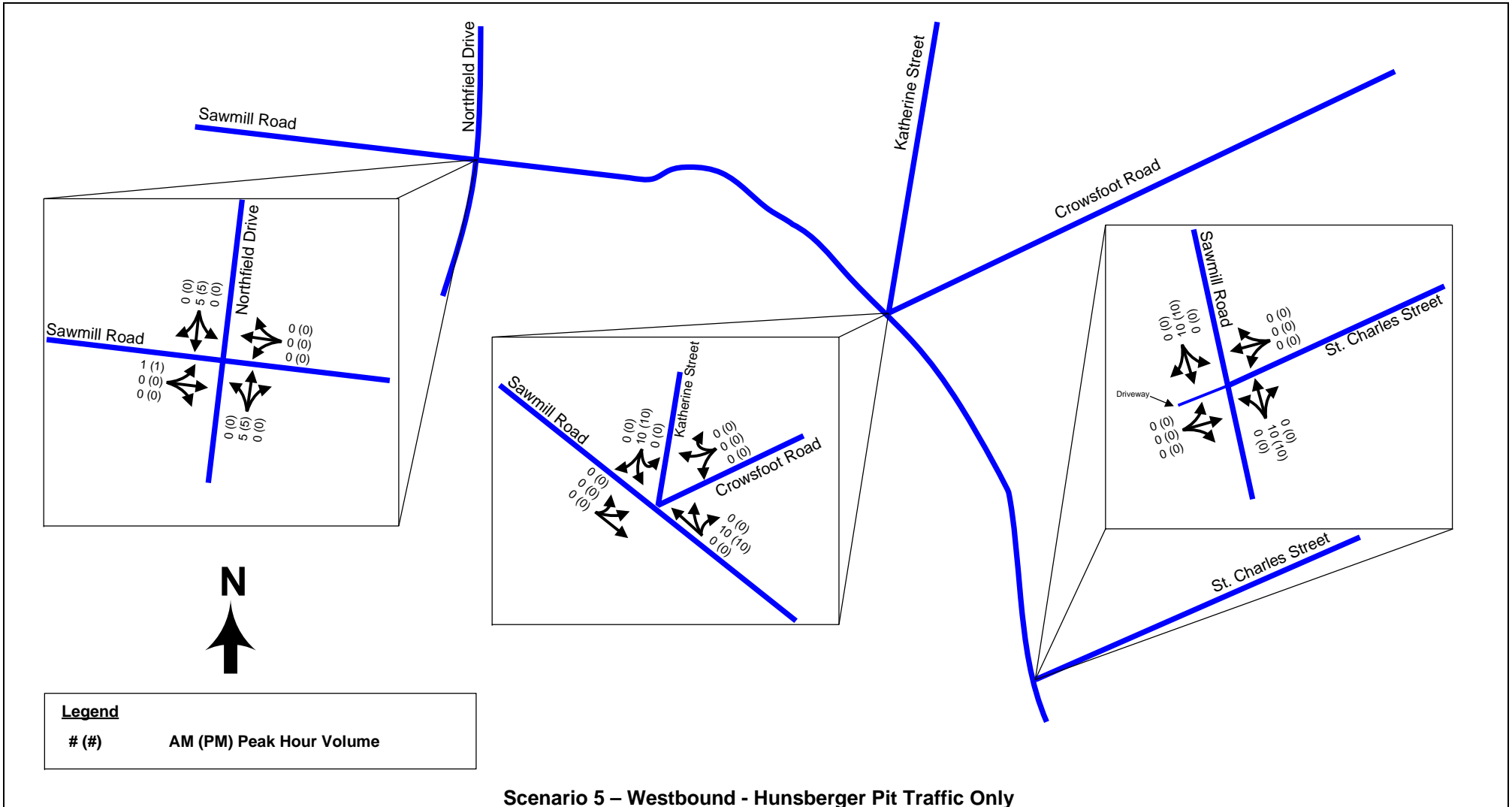
**Exhibit 3-5: Anticipated Truck Routes and Volumes**

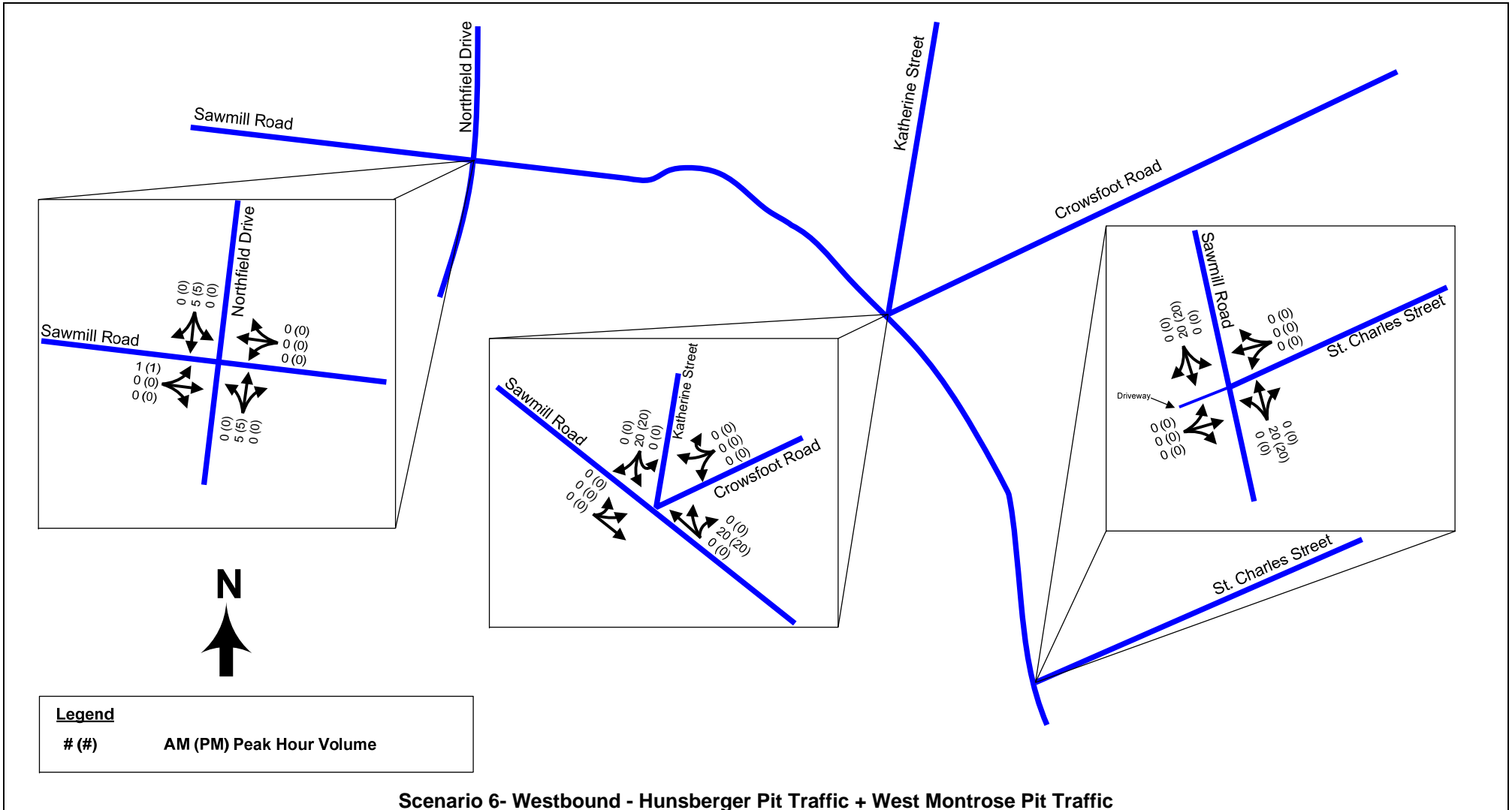












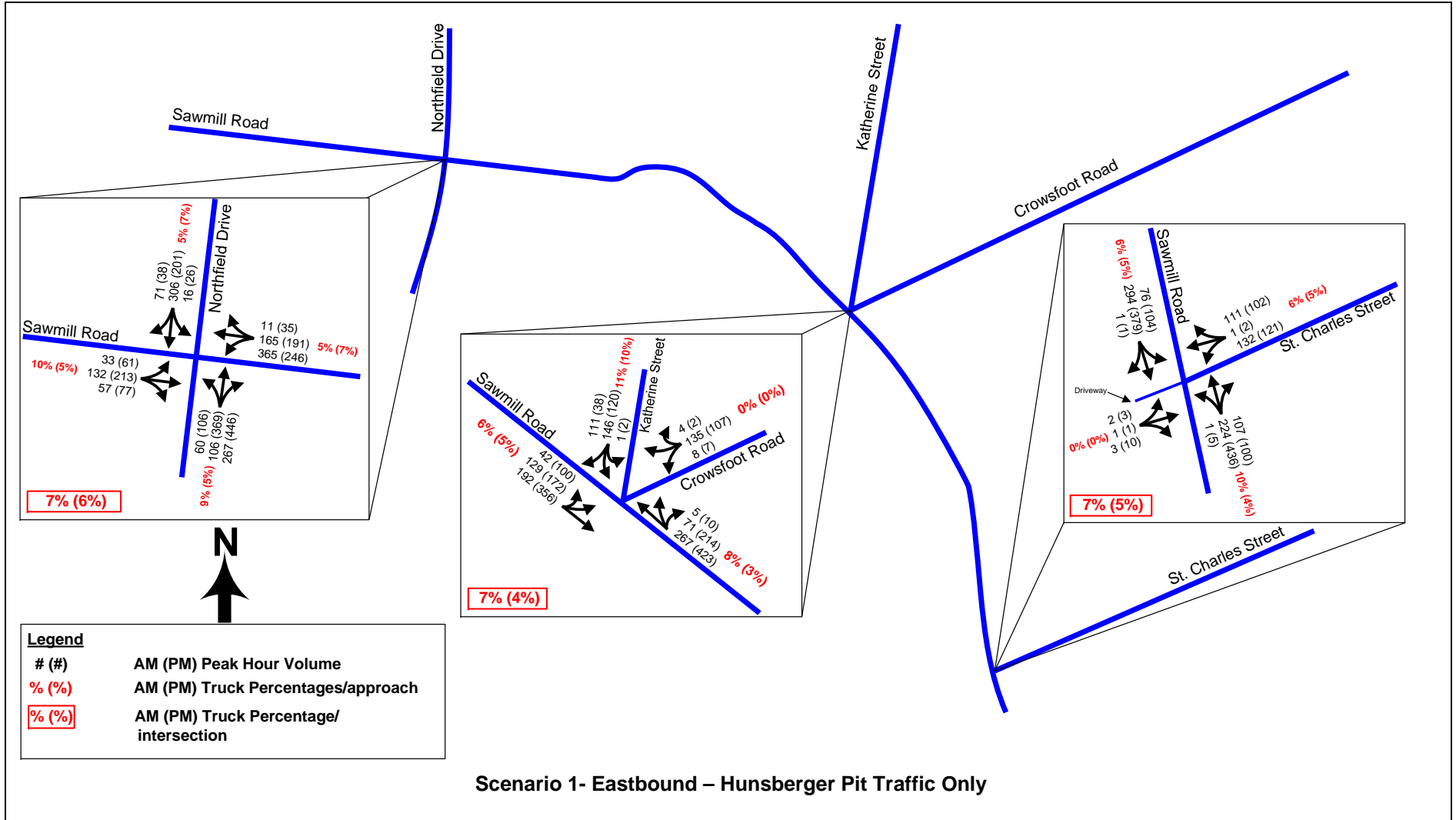
## 4. FUTURE TOTAL OPERATIONAL ANALYSIS

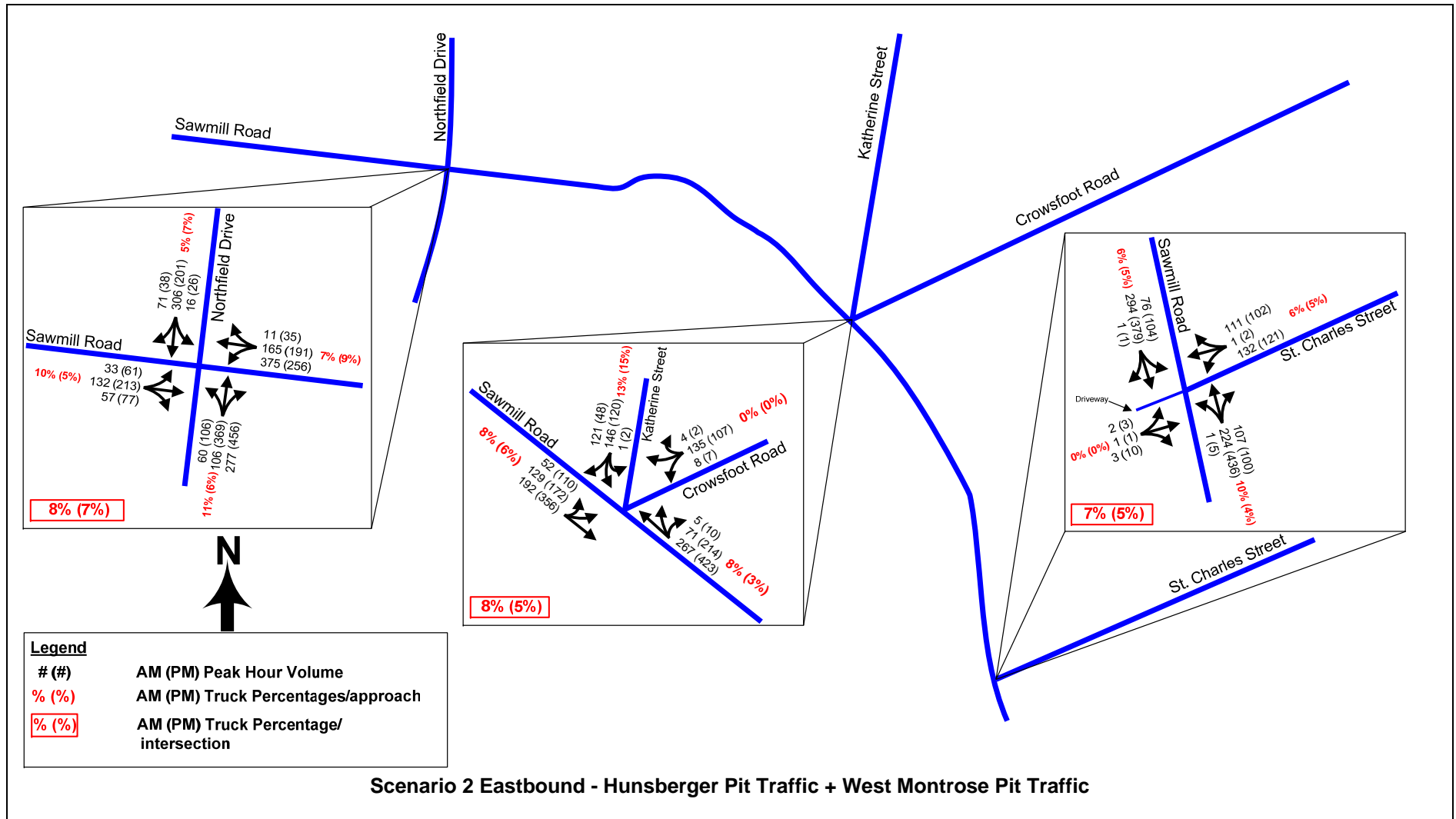
The following sections provide the traffic volumes and the operational analysis under each scenario.

### 4.1 Westbound Towards Conestogo

Scenario 1 and Scenario 2 consider the impact that the truck traffic generated by the proposed aggregate pits will have on the road network if all the traffic accesses Conestoga Parkway via Northfield Drive (i.e., inbound truck traffic turns left at Crowsfoot Corners). **Exhibit 4-1** illustrates the total traffic volumes for Scenarios 1 and 2.

Exhibit 4-1: Scenario 1 & 2- Total Traffic Volumes





The operational analyses for Scenario 1 and Scenario 2 are summarized in **Exhibit 4-2** and **Exhibit 4-3**, respectively. Synchro reports are provided in **Appendix E**.

**Exhibit 4-2: Scenario 1 - Operational Analysis**

Intersection	Period	Overall			Critical Movement				Available Storage Length (m)
		LOS	Delay (s)	v/c	Movement	v/c	Delay (s)	Queue Length (95 <sup>th</sup> percentile) (m)	
Sawmill Road/ Northfield Drive	AM	C	35	0.71	WB (LOS D) SB (LOS D)	0.90 0.89	36 54	137 120	-
	PM	F	90	1.02	WB (LOS F) NBTR (LOS F) SB (LOS E)	1.25 1.09 0.92	159 86 68	171 231 93	
Sawmill Road/ Katherine Street/ Crowsfoot Road	AM	C	31	0.57	SE (LOS D)	0.79	55	86	EBL – 60 m
	PM	D	41	0.79	EBL (LOS D) WB (LOS D) SE (LOS E)	0.91 0.87 0.75	53 41 71	64 204 69	
Sawmill Road/ St. Charles Street	AM	-	7	-	-	-	-	-	
	PM	-	15.1	-	WB (LOS F)	0.90	76	59	-

**Exhibit 4-3: Scenario 2 - Operational Analysis**

Intersection	Period	Overall			Critical Movement				Available Storage Length (m)
		LOS	Delay (s)	v/c	Movement	v/c	Delay (s)	Queue Length (95 <sup>th</sup> percentile) (m)	
Sawmill Road/ Northfield Drive	AM	D	45	0.72	WB (LOS D) SB (LOS C)	0.93 0.65	40 34	151 114	-
	PM	F	101	1.04	WB (LOS F) NBTR (LOS F) SB (LOS E)	1.31 1.11 0.97	183 95 78	177 236 96	
Sawmill Road/ Katherine Street/ Crowsfoot Road	AM	C	33	0.60	SE (LOS E)	0.85	61	93	EBL – 60 m
	PM	D	44	0.83	EBL (LOS E) SE (LOS E) SW (LOS D)	0.97 0.77 0.51	67 74 55	73 71 45	
Sawmill Road/ St. Charles Street	AM	-	7	-	-	-	-	-	
	PM	-	15.1	-	WB (LOS F)	0.90	76	59	-

#### 4.1.1 SAWMILL ROAD AT NORTHFIELD DRIVE

Under Scenario 1, the intersection is expected to operate at a similar LOS for the AM peak hour when compared to the future background conditions with mitigation. However, as shown in **Exhibit 4-2**, the expected overall intersection delay for the PM peak hour has increased from 80 seconds to 90 seconds due to the additional heavy vehicles proceeding through the intersection.

The results summarized in **Exhibit 4-3** show that the greatest impact to the intersection would occur when there are 20 heavy vehicles travelling westbound towards Northfield Drive to access the Conestoga Parkway (Scenario 2). The impact that the trucks are expected to have is most noticeable during the PM peak hour, where the overall intersection delay increased from 77 seconds under the future background with mitigation scenario to 101 seconds under Scenario 2. During the PM peak hour, the westbound delays have increased by 49 seconds (from 134 seconds for the future background with mitigation conditions to 183 seconds) for Scenario 2. Given that there are physical restrictions created by the surrounding land uses, mitigating measures at this intersection are largely limited to signal timing adjustments. However, further signal modifications without geometric improvements are not likely to provide significant benefits to the traffic operations.

#### **Other Traffic Implications**

Notwithstanding the incremental increases in delay, under both Scenario 1 and Scenario 2, the changes to traffic composition in the community of Conestogo, due to the truck trips generated by the proposed aggregate pits, may not be significant. When compared to the existing conditions or the future background conditions, the overall truck percentages at the Sawmill Road and Northfield Drive intersection have only increased by 2% during both peak hours under Scenario 1, and 3% during both peak hours under Scenario 2.

#### 4.1.2 SAWMILL ROAD AT KATHERINE STREET/CROWSFOOT ROAD

The intersection of Sawmill Road at Katherine Street/Crowsfoot Road is expected to operate at a similar LOS when compared to the future background conditions with mitigation, during the AM peak hour, under Scenario 1 and Scenario 2. However, during PM peak hour for Scenario 2, the analysis indicates that the delay for the Sawmill Road left-turn is expected to increase by 24 seconds (from 43 seconds to 67 seconds). This increase in delay for the eastbound left-turn can be partially attributed to the slower turning speeds and accelerations of the heavy vehicles. As a result, heavy vehicles turning from Sawmill Road require larger gaps in the opposing traffic to perform their turning movements, and delay is incurred while they wait for those gaps to occur.

Additionally, based on the capacity analysis, the eastbound left-turn queue may occasionally exceed the presumed storage length of 60 metres under Scenario 2. To further approximate the 95<sup>th</sup> percentile queue lengths for this movement, the intersection was simulated using SimTraffic. The results of the simulation indicated that the approximate 95<sup>th</sup> percentile queue length for the eastbound left-turn movement is expected to be 70 metres. As such, it is recommended that the storage length be extended to 80 metres to accommodate 95<sup>th</sup> percentile queue length.

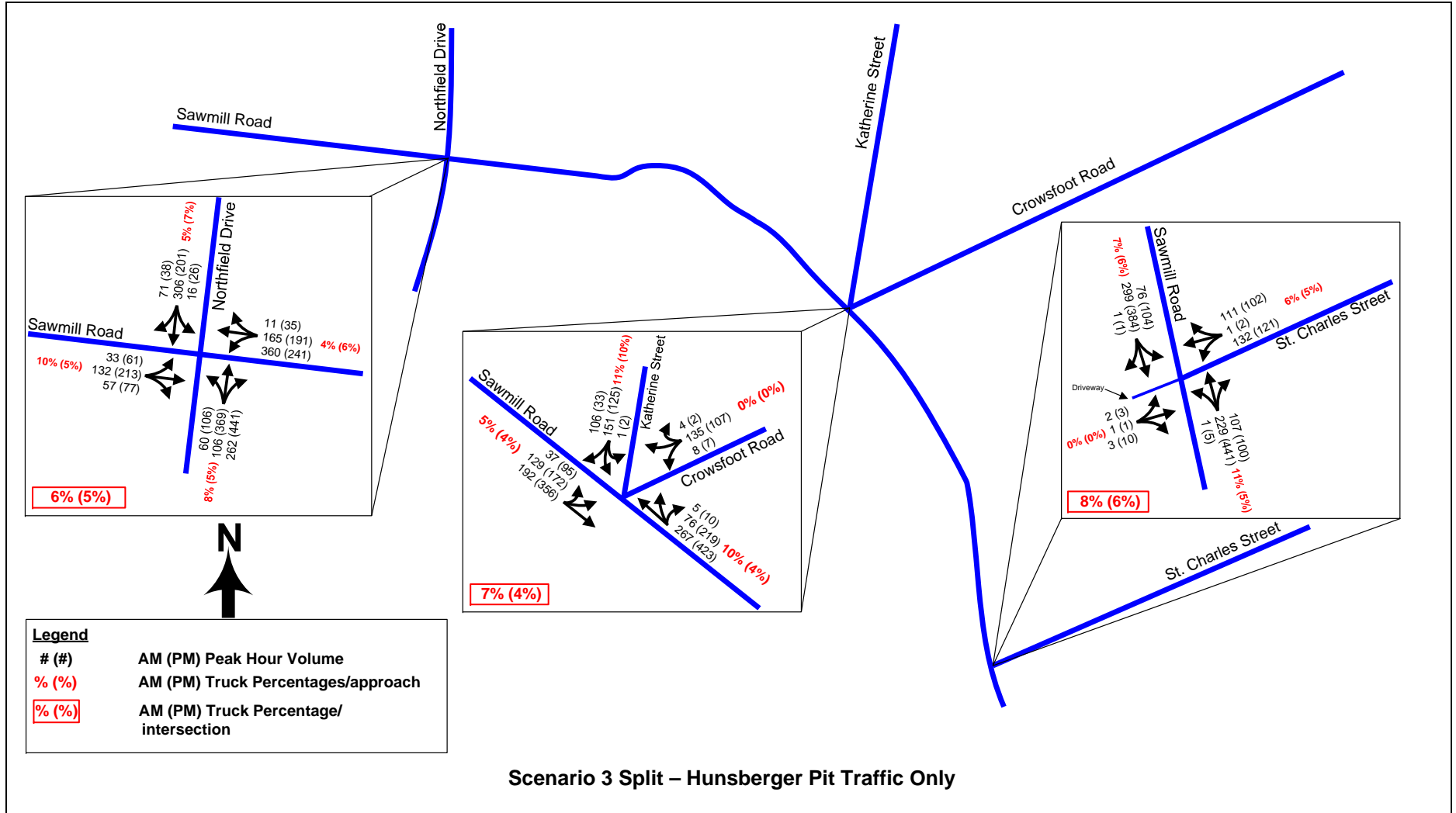
#### 4.1.3 SAWMILL ROAD AT ST.CHARLES STREET

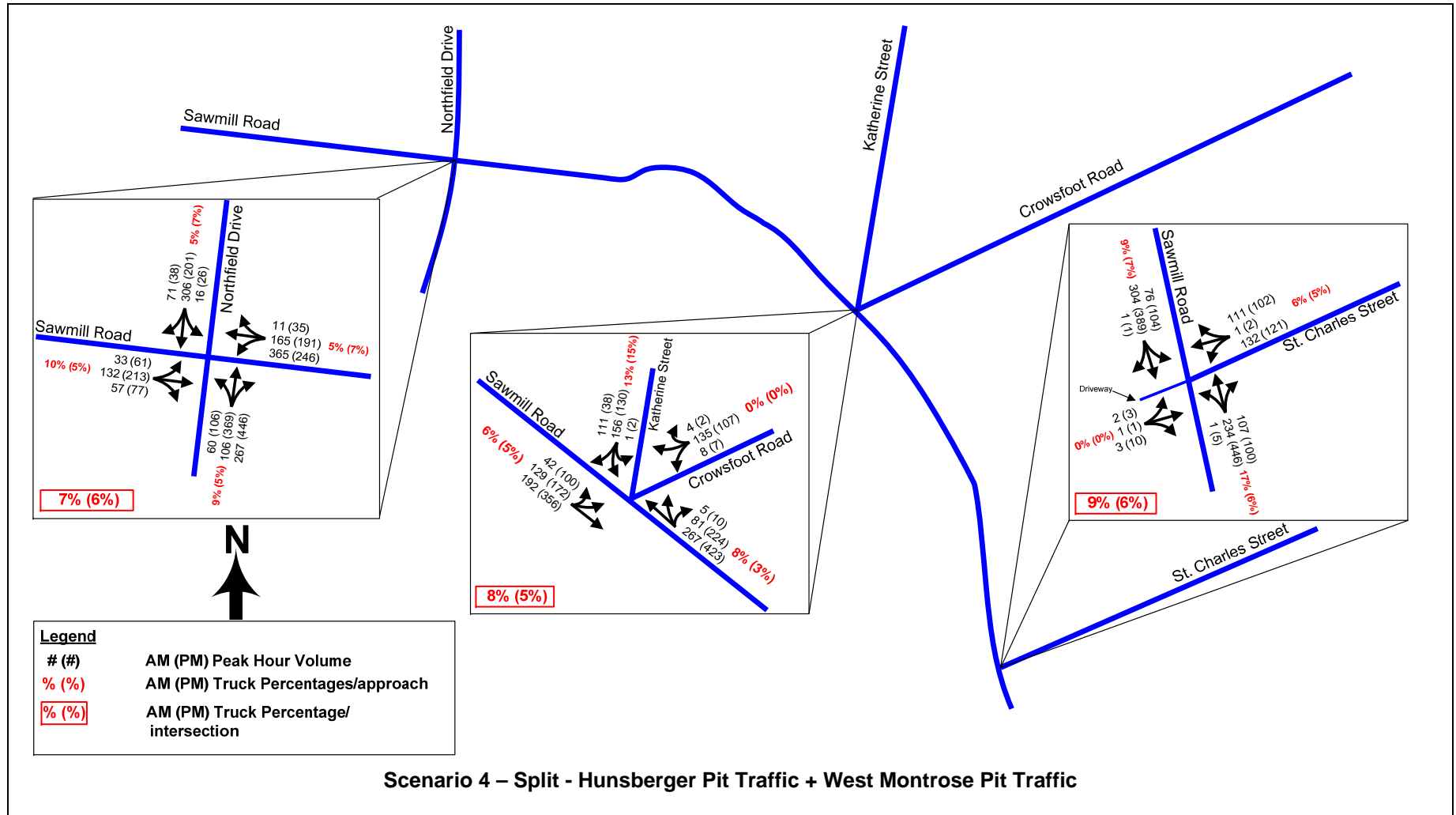
Under Scenario 1 and Scenario 2, the intersection of Sawmill Road at St. Charles Street is expected to be unaffected. Traffic operations will be the same as the future background conditions.

## 4.2 50/50 Split

The following scenarios reflect half of the traffic volume generated by the Hunsberger Pit and West Montrose Pit travelling westbound on Sawmill Road towards Conestogo, and the remaining traffic travelling eastbound towards Bloomingdale. The corresponding traffic volumes for Scenario 3 and Scenario 4 are presented in **Exhibit 4-4**. The operational analysis for the Scenario 3 and Scenario 4 are summarized in **Exhibit 4-5** and **Exhibit 4-6**, respectively. Full Synchro reports are provided in **Appendix F**.

Exhibit 4-4: Scenario 3 & 4 - Traffic Volumes





**Exhibit 4-5: Scenario 3 - Operational Analysis**

Intersection	Period	Overall			Critical Movement				Available Storage Length (m)
		LOS	Delay (s)	v/c	Movement	v/c	Delay (s)	Queue Length (95 <sup>th</sup> percentile) (m)	
Sawmill Road/ Northfield Drive	AM	C	34	0.70	-	-	-	-	-
	PM	F	85	1.01	WB (LOS F) NBTR (LOS F) SB (LOS E)	1.22 1.08 0.91	147 81 64	168 228 92	
Sawmill Road/ Katherine Street/ Crowsfoot Road	AM	C	30	0.58	SE (LOS D)	0.46	36	73	EBL – 60 m
	PM	D	44	0.85	EBL (LOS E) WB (LOS E) SE (LOS E)	1.03 0.94 0.77	67 48 64	27 183 60	
Sawmill Road/ St. Charles Street	AM	-	7.1	-	-	-	-	-	-
	PM	-	15.7	-	WB (LOS F)	0.92	81.1	61	-

**Exhibit 4-6: Scenario 4 - Operational Analysis**

Intersection	Period	Overall			Critical Movement				Available Storage Length (m)
		LOS	Delay (s)	v/c	Movement	v/c	Delay (s)	Queue Length (95 <sup>th</sup> percentile) (m)	
Sawmill Road/ Northfield Drive	AM	C	35	0.71	WB (LOS D) SB (LOS D)	0.90 0.83	36 45	137 114	-
	PM	F	90	1.02	WB (LOS F) NBTR (LOS F) SB (LOS E)	1.25 1.09 0.92	159 86 68	171 231 93	
Sawmill Road/ Katherine Street/ Crowsfoot Road	AM	C	31	0.61	SE (LOS D)	0.76	46	79	EBL – 60 m
	PM	D	50	0.90	EBL (LOS F) WB (LOS D) SE (LOS E)	1.09 0.96 0.86	86 51 76	32 185 66	
Sawmill Road/ St. Charles Street	AM	-	7.2	-	-	-	-	-	-
	PM	-	16.2	-	WB (LOS F)	0.93	84.7	62	-

**4.2.1 SAWMILL ROAD AT NORTHFIELD DRIVE**

The addition of 5 heavy vehicles to the intersection of Sawmill Road at Northfield Drive in Scenario 3 is expected to have negligible effects on the overall intersection operations during both peak hours (summarized in **Exhibit 4-5**)

The analysis completed for Scenario 4 (refer to **Exhibit 4-6**) indicated that the intersection of Sawmill Road at Northfield Drive is expected to operate similar to Scenario 1. As previously stated, further signal timing modifications may not provide significant benefits to traffic operations.

#### **Other Traffic Implications**

Similar to Scenario 1 and Scenario 2, it is anticipated that the increase in truck volume for this intersection will not have a significant effect on the community of Conestogo. When compared to the future background conditions, there are marginal increases in the overall truck percentages for the intersection.

#### 4.2.2 SAWMILL ROAD AT KATHERINE STREET/CROWSFOOT ROAD

Comparing the results obtained for Scenario 3 to the results of Scenario 1 shows that the traffic operations of the Sawmill Road at Katherine Street/Crowsfoot Road intersection are expected to operate at similar LOS under both scenarios. This is not unexpected given that both scenarios involve the addition of 10 truck trips to the intersection.

The operational analysis shown in **Exhibit 4-6** indicates that Scenario 4 is expected to operate with similar LOS to Scenario 2 during the AM peak hour. During the AM peak hour, the traffic analysis shows that the overall intersection delay is expected to be slightly better than the delay calculated for the intersection under Scenario 2. This is due to the decrease in demand for the eastbound left-turn in Scenario 4. Also, the westbound movement under Scenario 4 is expected to operate near capacity during the PM peak hour due to the trucks travelling from Bloomingdale and making the right-turn on to Katherine Street. The expected increase in delay for this movement when compared to the future background conditions with mitigating measures is 10 seconds (from 41 seconds to 51 seconds).

#### 4.2.3 SAWMILL ROAD AT ST. CHARLES STREET

Under Scenario 3, it is expected that traffic operations at the study intersections will be similar to the future background conditions during the AM peak hour. During the PM peak hour, the analysis shows that the westbound movement at the intersection of Sawmill Road and St. Charles Street is anticipated to operate at LOS F. However, when compared to the future background conditions, there is only a 4 second increase in delay (77 seconds – 81 seconds) for this approach. With the additional 5 heavy vehicles introduced in Scenario 4, the westbound movement delay at the intersection is again marginally increased to 85 seconds.

#### **Other Traffic Implications**

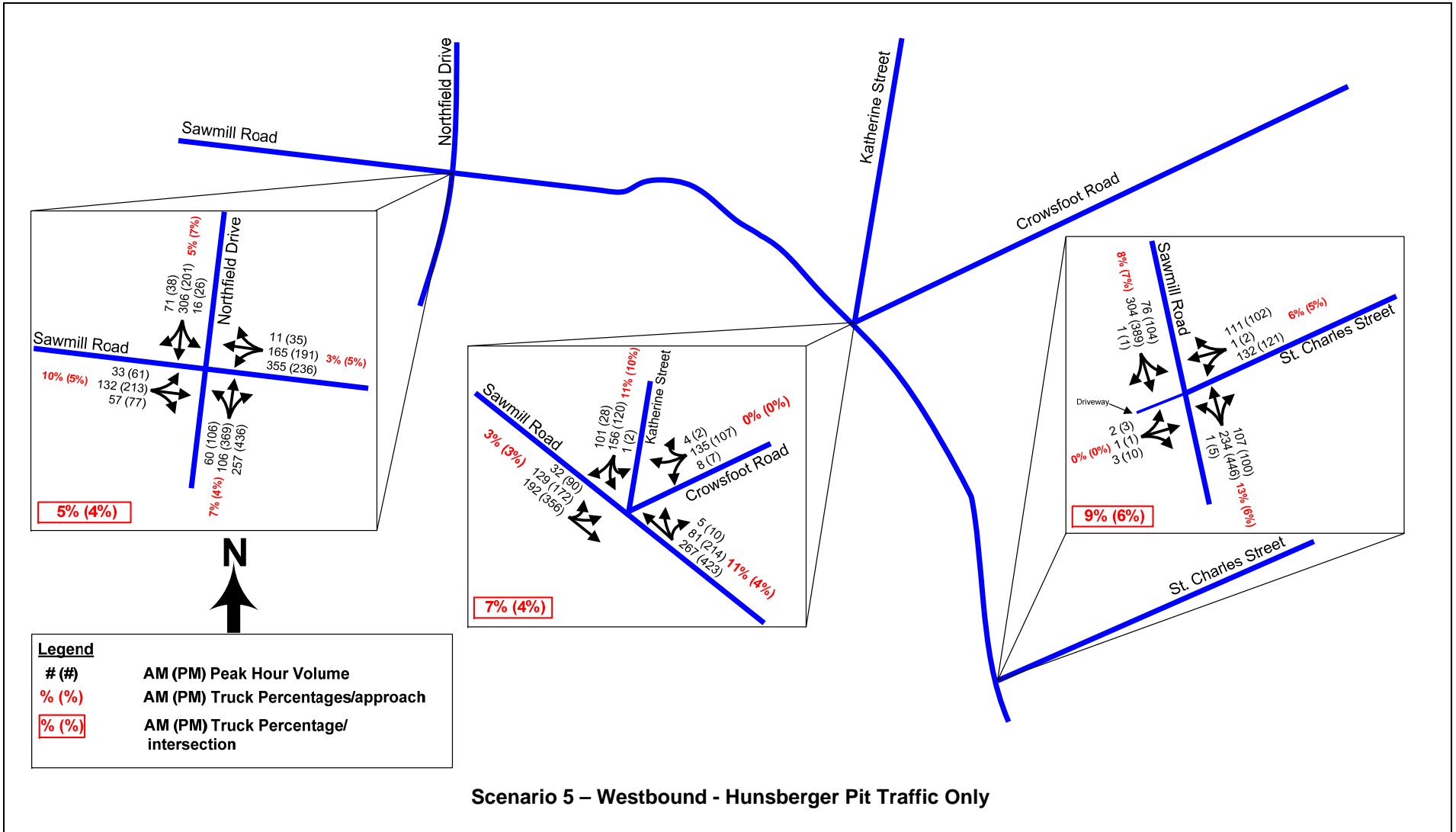
Trucks from the Preston Sand & Gravel Pit used to travel through the community of Bloomingdale. However, with the closure of this pit, the community has become accustomed to the lower heavy vehicle volumes. As shown in **Exhibit 4-4**, there are expected to be marginal increases in the overall truck percentages under Scenario 3 and Scenario 4 for the intersection Sawmill Road at St. Charles Street (1-2% depending on the scenario and peak hour). As such, the additional traffic generated by the aggregate pits should not have a significant impact on the community.

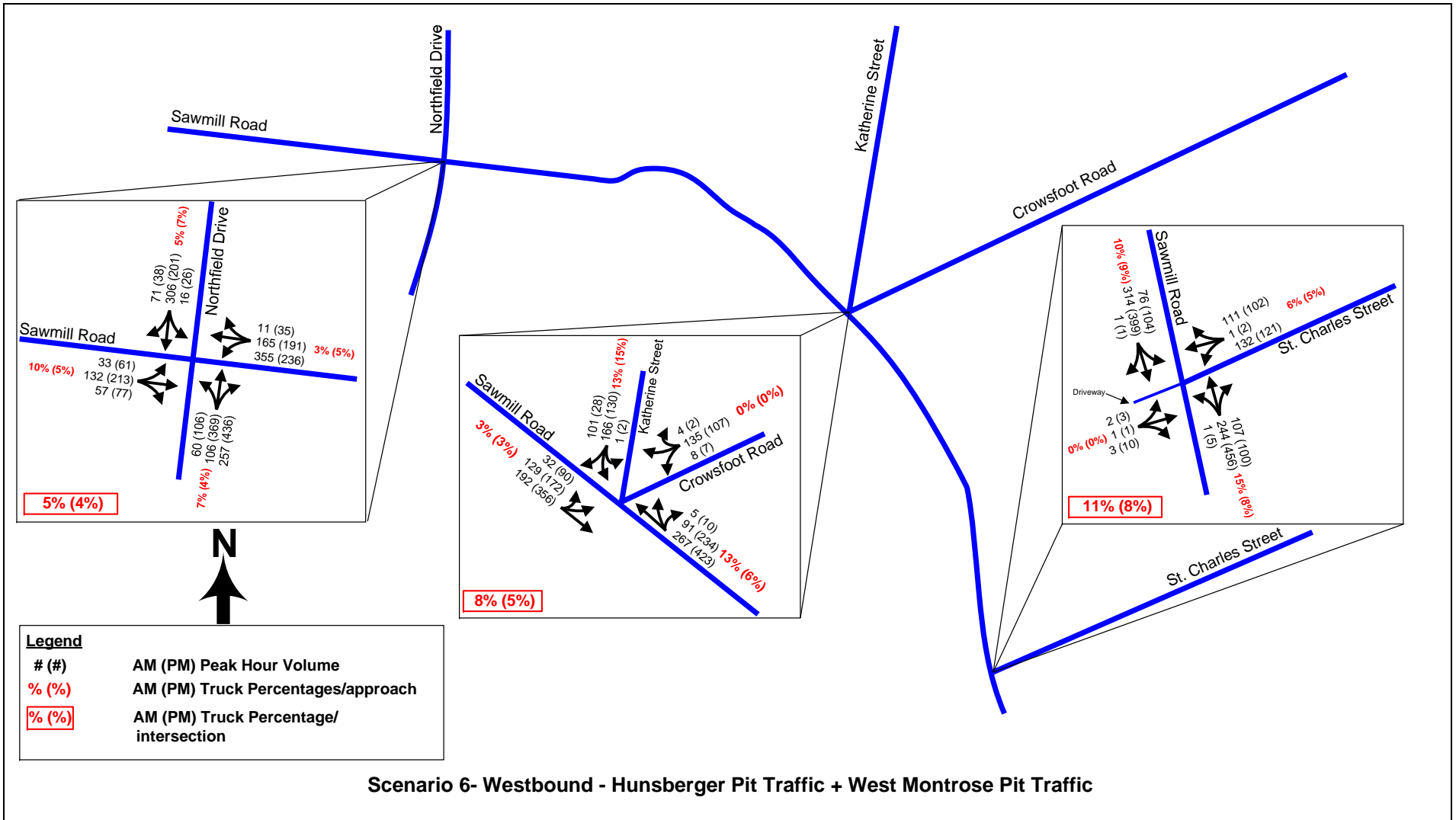
### 4.3 Eastbound Towards Bloomingdale

The remaining scenarios reflect the effects of all of the truck traffic generated by the Hunsberger Pit and West Montrose Pit travelling towards the intersection of Sawmill Road and Katherine

Street/Crowsfoot Road on Katherine Street. From this intersection the trucks will make the left turn on to Sawmill Road and proceed towards the community of Bloomingdale. The volumes for both scenarios are presented in **Exhibit 4-7**. The operational analysis for Scenario 5 and Scenario 6 are summarized in **Exhibit 4-8** and **Exhibit 4-9**, respectively. Full Synchro reports are provided in **Appendix F**.

Exhibit 4-7: Scenario 5 & 6 – Traffic Volumes





**Exhibit 4-8: Scenario 5 - Operational Analysis**

Intersection	Period	Overall			Critical Movement				Available Storage Length (m)
		LOS	Delay (s)	v/c	Movement	v/c	Delay (s)	Queue Length (95 <sup>th</sup> percentile) (m)	
Sawmill Road/ Northfield Drive	AM	C	33	0.69	-	-	-	-	-
	PM	E	80	1.00	WB (LOS F) NBTR (LOS E) SB (LOS E)	1.19 1.06 0.89	135 77 61	165 225 91	-
Sawmill Road/ Katherine Street/ Crowsfoot Road	AM	C	30	0.59	-	-	-	-	EBL – 60 m
	PM	D	44	0.84	EBL (LOS E) WB (LOS D) SE (LOS E)	1.01 0.96 0.77	60 51 63	26 185 60	
Sawmill Road/ St. Charles Street	AM	-	7.2	-	-	-	-	-	-
	PM	-	16.2	-	WB (LOS F)	0.93	84.7	62	-

**Exhibit 4-9: Scenario 6 - Operational Analysis**

Intersection	Period	Overall			Critical Movement				Available Storage Length (m)
		LOS	Delay (s)	v/c	Movement	v/c	Delay (s)	Queue Length (95 <sup>th</sup> percentile) (m)	
Sawmill Road/ Northfield Drive	AM	C	33	0.69	-	-	-	-	-
	PM	E	80	1.00	WB (LOS F) NBTR (LOS E) SB (LOS E)	1.19 1.06 0.89	135 77 61	165 225 91	-
Sawmill Road/ Katherine Street/ Crowsfoot Road	AM	C	31	0.62	SE (LOS D)	0.76	46	79	EBL – 60 m
	PM	D	50	0.87	EBL (LOS E) WB (LOS E) SE (LOS E)	1.04 0.99 0.86	68 58 76	34 192 67	
Sawmill Road/ St. Charles Street	AM	-	7.4	-	-	-	-	-	-
	PM	-	17.3	-	WB (LOS F)	0.96	93	65	-

**4.3.1 SAWMILL ROAD AT NORTHFIELD DRIVE**

Under Scenario 5 and Scenario 6, the intersection of Sawmill Road at Northfield Drive is expected to operate at similar LOS during both AM and PM peak hours, when compared to the future background conditions.

4.3.2 SAWMILL ROAD AT KATHERINE STREET/CROWSFOOT ROAD

Under Scenario 5, the intersection of Sawmill Road and Katherine Street is expected to operate at a similar LOS to Scenario 3 during both peak hours.

The analysis completed for Scenario 6 indicates that the overall traffic operations will be similar to Scenario 4. As shown in the analysis, the westbound movement at Katherine Street is expected to operate at LOS E, which is largely the result of the green time allocated to this movement. Under the proposed signal timing plan, the time provided for this movement may not be adequate to accommodate the additional heavy vehicles returning from the direction of Bloomingdale. However, due to the split phase operation required at this intersection, signal timing changes that would allot more green time to the westbound phase would be too detrimental to the other approaches. As such, the proposed signal timings were maintained.

4.3.3 SAWMILL ROAD AT ST. CHARLES STREET

The traffic operations for Scenario 5 are expected to be similar to the traffic operations for Scenario 4 during both AM and PM peak hours.

Under Scenario 6, traffic operations will be similar to the traffic operations for Scenario 4 during the AM peak hour only. During the PM peak hour, it is expected that the delay for the westbound movement at the intersection will increase to 93 seconds, from 77 seconds under the future background conditions, and 85 seconds under Scenario 4. This is due to the increase in truck traffic proceeding through the intersection on Sawmill Road. Side street vehicles are required to wait longer for acceptable gaps to merge on to Sawmill Road.

A signal warrant was conducted at this intersection under Scenario 6. As shown in **Exhibit 4-10**, the installation of traffic signals at this intersection is not justified, since neither Justification 1 nor Justification 2 is satisfied at the 120% level.

**Exhibit 4-10: Scenario 6 Signal Warrant – Sawmill Road at St. Charles Street**

Justification	Description	Minimum Requirements - 1 lane highways	Compliance		
			Sectional		Entire %
		Free Flow	Numerical	%	
<b>1. Minimum Vehicular Volume</b>	A. Vehicle volume, all approaches (average hour)	480	574	120%	<b>102%</b>
	B. Vehicle volume, all minor streets (average hour)	120	1122	102%	
<b>2. Delay to Cross Traffic</b>	A. Vehicle volume, major street (average hour)	480	452	94%	94%
	B. Combined vehicle and pedestrian volume crossing artery from minor streets (average hour)	50	65	130%	

### **Other Traffic Implications**

The community disturbance to Bloomingdale is the most evident under Scenario 6. Under this scenario, the overall truck percentages at the intersection of Sawmill Road at St. Charles Street are expected to increase from 7% and 5 % in the future background conditions to 11% and 8 % for the AM and PM peak hours, respectively.

## **4.4 Mitigating Measures – with Site Traffic**

As previously indicated in the above analysis, the eastbound left-turn queues are expected to exceed the initially assumed 60-metre storage lane at the intersection of Sawmill Road at Katherine Street/Crowsfoot Road for Scenario 2. The SimTraffic simulation has shown that the 95<sup>th</sup> percentile queues is expected to be approximately 70 metres. Therefore, it was determined that the storage lane be extended from 60 metres to 80 metres. The Synchro analysis (refer to **Appendix E**) indicates that lengthening the left-turn lane would offer no benefits with respect to the traffic operations intersection. Instead, the extension only helps to mitigate potential encroachment/queue blocking issues.

## **5. CONCLUSIONS AND RECOMMENDATIONS**

Based on this study, the following can be concluded:

### **Traffic Operations**

- The Synchro analysis has indicated that the intersections of Sawmill Road at Northfield Drive and Sawmill Road at Katherine Street/Crowsfoot Road are operating poorly during the PM peak hour under existing conditions. However, the field investigations do not support these results. Field observations showed that the study intersections are operating well under the existing traffic volumes;
- Under the future background conditions, it is expected that the intersections of Sawmill Road at Northfield Drive and Sawmill Road at Katherine Street/Crowsfoot Road will operate poorly during the PM peak hour;
- To address the degradation in traffic operations caused by background traffic growth, mitigating measures were assumed prior to including the site traffic into the analysis:
  - With the proposed growth in the area, it is expected that the intersection of Sawmill Road at Northfield Drive will operate near or above capacity during the AM and PM peak hours. At this intersection, mitigating these capacity issues is a challenge due to the narrow right-of-way and adjacent buildings. Therefore, the existing lane configurations on all approaches were maintained for the various analysis scenarios. Signal modifications to both AM and PM peak hours were analyzed, and they showed slight improvements in traffic operations; and
  - The signalization of the intersection in conjunction with constructing a dedicated left-turn lane on the eastbound approach resulted in improved traffic operations at the intersection of Sawmill Road at Katherine Street.

- The Sawmill Road at St. Charles intersection is not expected to require any mitigating measures.
- Traffic operations under the future scenarios (beyond the future background conditions) are not expected to be significantly impacted by the traffic generated by the proposed Hunsberger Pit. Similar to the previous study, the focus would be more on the impact that the pit will have on the adjacent communities through changes to the traffic composition (i.e., overall percent of truck traffic).

### **Community Impacts**

Generally, under any of the Scenarios analysed, it is felt that the impact that the site traffic will have on the surrounding communities will be confined to Regional Roads, which are intended for the movement of goods, often via heavy trucks; however:

- The community impact (change to traffic compositions) would be greatest when all the proposed site traffic generated by both the West Montrose Pit and the Hunsberger Pit is travelling in a single direction (i.e., **Scenario 2** and **6**);
  - It is expected that the total truck traffic travelling through Conestogo will increase by 3% under **Scenario 2**. The total truck volume would be less with only the Hunsberger Pit development (**Scenario 1**);
  - Truck traffic travelling through Bloomingdale is expected to increase by 4% under **Scenario 6**;
- **Scenario 3** is expected to have the least combined impact on communities of Conestogo and Bloomingdale.

### **Recommendations**

As proposed in the analysis for the future conditions, to address operational issues caused by background traffic growth, it is recommended that the intersection of Sawmill Road at Katherine Street/Crowsfoot Road be signalized. Under the existing geometry of the intersection, the side streets (Katherine Street and Crowsfoot Road) will have to operate under a split phase mode of control.

Under Scenario 2, the analysis indicates that the eastbound left-turn queues are expected to exceed the 50 metre storage length. Therefore, to accommodate the 95<sup>th</sup> percentile queue length, extension of storage bay to 80 metres is recommended.

## APPENDIX A

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### SIGNAL TIMING – SAWMILL ROAD AT NORTHFIELD DRIVE

Fixed time operation

**Signal timing in effect:** 16:00-19:00 Mon-Fri

**Northfield Dr.**

NB Green Arrow - 7.0 sec  
NB Amber arrow - 3.0 sec  
All Red - 1.0 sec  
Green - 29.0 sec Walk - 22.0 sec  
Amber - 4.0 sec FDW - 7.0 sec  
All Red - 2.0 sec

**Sawmill Rd.**

WB flashing arrow - 8.0 sec  
Amber arrow - 3.0 sec  
All Red - 1.0 sec  
Green - 26.0 sec Walk - 10.0 sec  
Amber - 4.0 sec FDW - 16.0 sec  
All Red - 2.0 sec  
**TOTAL 90.0 seconds**

**Signal timing in effect:** 07:00-10:00 Mon-Fri

**Northfield Dr.**

Green - 26.0 sec Walk - 19.0 sec  
Amber - 4.0 sec FDW - 7.0 sec  
All Red - 2.0 sec

**Sawmill Rd.**

WB flashing arrow - 8.0 sec  
Amber arrow - 3.0 sec  
All Red - 1.0 sec  
Green - 30.0 sec Walk - 14.0 sec  
Amber - 4.0 sec FDW - 16.0 sec  
All Red - 2.0 sec  
**TOTAL 80.0 seconds**

**Signal timing in effect:** All Other Times

**Northfield Dr.**

Green - 24.0 sec Walk - 17.0 sec  
Amber - 4.0 sec FDW - 7.0 sec  
All Red - 2.0 sec

**Sawmill Rd.**

Green - 24.0 sec Walk - 8.0 sec  
Amber - 4.0 sec FDW - 16.0 sec  
All Red - 2.0 sec  
**TOTAL 60.0 seconds**

APPENDIX B

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**2009 TURNING MOVEMENT COUNTS**

# Northfield Dr @ Sawmill Rd

## Morning Peak Diagram

### Specified Period

**From:** 7:00:00

**To:** 9:00:00

### One Hour Peak

**From:** 7:30:00

**To:** 8:30:00

**Municipality:** Waterloo  
**Site #:** 000000001  
**Intersection:** Northfield Dr & Sawmill Rd  
**TFR File #:** 1  
**Count date:** 16-Nov-2009

**Weather conditions:**  
 Sun  
**Person(s) who counted:**  
 Jean

**\*\* Signalized Intersection \*\***

**Major Road:** Northfield Dr runs N/S

North Leg Total: 428  
 North Entering: 311  
 North Peds: 0  
 Peds Cross:  $\times$

Heavys	2	5	1	8
Trucks	2	1	0	3
Cars	52	236	12	300
<b>Totals</b>	<b>56</b>	<b>242</b>	<b>13</b>	



Heavys	4
Trucks	10
Cars	103
<b>Totals</b>	<b>117</b>

East Leg Total: 782  
 East Entering: 450  
 East Peds: 0  
 Peds Cross:  $\times$

Heavys	Trucks	Cars	Totals
9	6	229	244



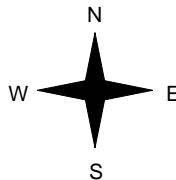
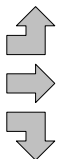
Northfield Dr

Cars	Trucks	Heavys	Totals
8	1	0	9
132	3	5	140
294	5	2	301
<b>434</b>	<b>9</b>	<b>7</b>	



Sawmill Rd

Heavys	Trucks	Cars	Totals
4	4	19	27
6	2	104	112
1	1	46	48
<b>11</b>	<b>7</b>	<b>169</b>	



Northfield Dr



Cars	Trucks	Heavys	Totals
312	8	12	332



Peds Cross:  $\times$   
 West Peds: 0  
 West Entering: 187  
 West Leg Total: 431

Cars	576
Trucks	7
Heavys	8
<b>Totals</b>	<b>591</b>



Cars	45	76	196	317
Trucks	1	5	6	12
Heavys	2	0	5	7
<b>Totals</b>	<b>48</b>	<b>81</b>	<b>207</b>	

Peds Cross:  $\times$   
 South Peds: 2  
 South Entering: 336  
 South Leg Total: 927

## Comments

# Northfield Dr @ Sawmill Rd

## Mid-day Peak Diagram

### Specified Period

**From:** 11:00:00

**To:** 14:00:00

### One Hour Peak

**From:** 13:00:00

**To:** 14:00:00

**Municipality:** Waterloo  
**Site #:** 000000001  
**Intersection:** Northfield Dr & Sawmill Rd  
**TFR File #:** 1  
**Count date:** 16-Nov-2009

**Weather conditions:**  
 Sun  
**Person(s) who counted:**  
 Jean

**\*\* Signalized Intersection \*\***

**Major Road:** Northfield Dr runs N/S

North Leg Total: 272  
 North Entering: 118  
 North Peds: 1  
 Peds Cross:  $\times$

Heavys	4	2	0	6
Trucks	1	4	1	6
Cars	15	83	8	106
<b>Totals</b>	<b>20</b>	<b>89</b>	<b>9</b>	



Heavys	6
Trucks	7
Cars	141
<b>Totals</b>	<b>154</b>

East Leg Total: 402  
 East Entering: 185  
 East Peds: 0  
 Peds Cross:  $\times$

Heavys	Trucks	Cars	Totals
8	4	107	119



Northfield Dr

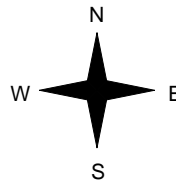
Cars	Trucks	Heavys	Totals
14	1	0	15
61	2	3	66
100	1	3	104
<b>175</b>	<b>4</b>	<b>6</b>	



Sawmill Rd



Heavys	Trucks	Cars	Totals
0	1	26	27
8	4	71	83
0	0	40	40
<b>8</b>	<b>5</b>	<b>137</b>	



Northfield Dr



Cars	Trucks	Heavys	Totals
197	11	9	217

Peds Cross:  $\times$   
 West Peds: 0  
 West Entering: 150  
 West Leg Total: 269

Cars	223
Trucks	5
Heavys	5
<b>Totals</b>	<b>233</b>

Cars	31	101	118	250
Trucks	1	5	6	12
Heavys	1	6	1	8
<b>Totals</b>	<b>33</b>	<b>112</b>	<b>125</b>	



Peds Cross:  $\times$   
 South Peds: 0  
 South Entering: 270  
 South Leg Total: 503

## Comments

# Northfield Dr @ Sawmill Rd

## Afternoon Peak Diagram

### Specified Period

**From:** 15:00:00  
**To:** 18:00:00

### One Hour Peak

**From:** 16:45:00  
**To:** 17:45:00

**Municipality:** Waterloo  
**Site #:** 000000001  
**Intersection:** Northfield Dr & Sawmill Rd  
**TFR File #:** 1  
**Count date:** 16-Nov-2009

**Weather conditions:**  
Sun  
**Person(s) who counted:**  
Jean

**\*\* Signalized Intersection \*\***

**Major Road:** Northfield Dr runs N/S

North Leg Total: 583  
North Entering: 209  
North Peds: 5  
Peds Cross:  $\times$

Heavys	0	3	2	5
Trucks	1	4	1	6
Cars	29	151	18	198
Totals	30	158	21	



Heavys	3
Trucks	9
Cars	362
Totals	374

East Leg Total: 945  
East Entering: 392  
East Peds: 0  
Peds Cross:  $\times$

Heavys	7
Trucks	10
Cars	260
Totals	277

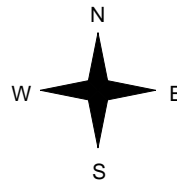


Northfield Dr

Cars	29	0	1	30
Trucks	151	7	4	162
Heavys	194	3	3	200
Totals	374	10	8	



Sawmill Rd



Heavys	1
Trucks	0
Cars	50
Totals	51
Heavys	7
Trucks	5
Cars	169
Totals	181
Heavys	1
Trucks	0
Cars	64
Totals	65



Sawmill Rd



Peds Cross:  $\times$   
West Peds: 2  
West Entering: 297  
West Leg Total: 574

Cars	409
Trucks	7
Heavys	7
Totals	423



Northfield Dr

Cars	80	283	336	699
Trucks	2	9	7	18
Heavys	3	1	8	12
Totals	85	293	351	

Peds Cross:  $\times$   
South Peds: 1  
South Entering: 729  
South Leg Total: 1152

## Comments

# Northfield Dr @ Sawmill Rd

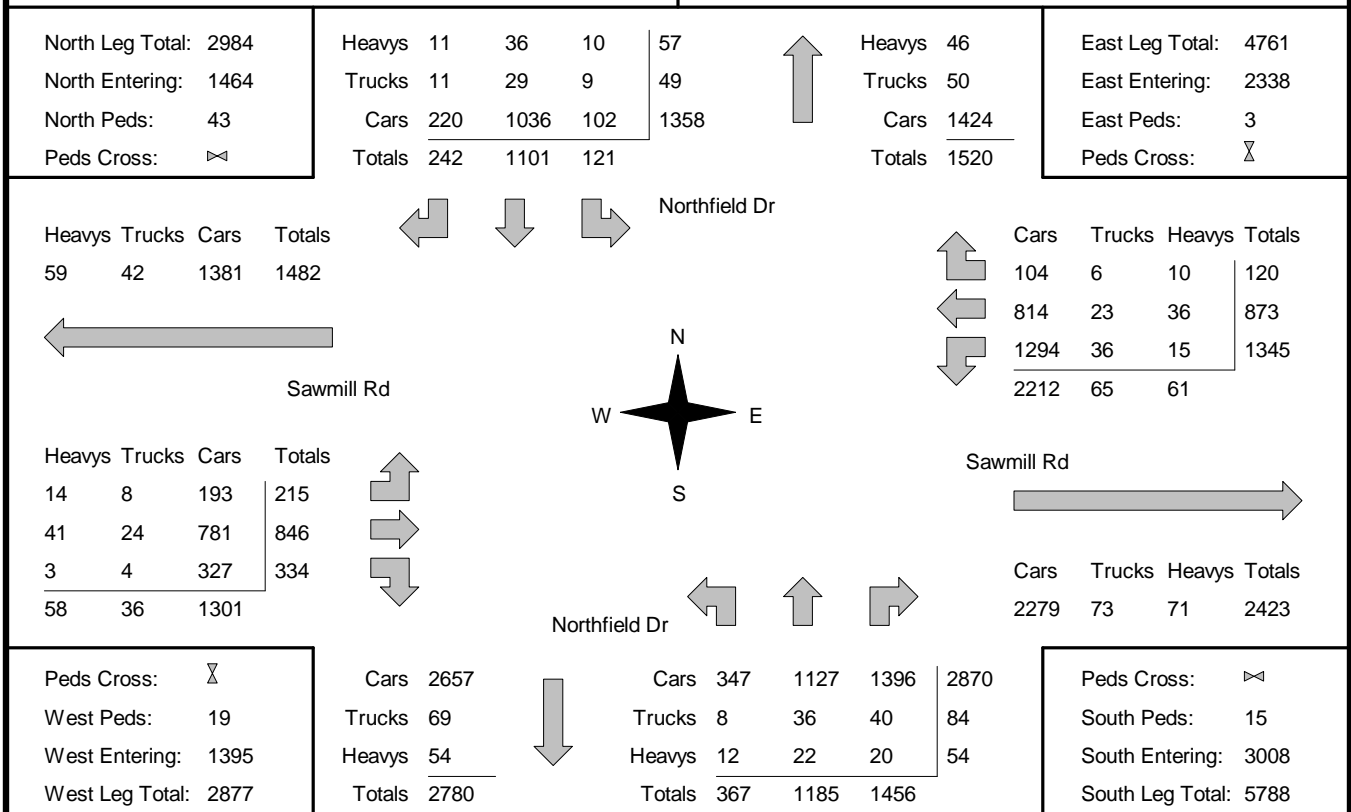
## Total Count Diagram

**Municipality:** Waterloo  
**Site #:** 000000001  
**Intersection:** Northfield Dr & Sawmill Rd  
**TFR File #:** 1  
**Count date:** 16-Nov-2009

**Weather conditions:**  
 Sun  
**Person(s) who counted:**  
 Jean

**\*\* Signalized Intersection \*\***

**Major Road:** Northfield Dr runs N/S



### Comments

# Sawmill Rd @ Katherine St

## Morning Peak Diagram

### Specified Period

**From:** 7:00:00

**To:** 9:00:00

### One Hour Peak

**From:** 8:00:00

**To:** 9:00:00

**Municipality:** Waterloo  
**Site #:** 0000000002  
**Intersection:** Sawmill Rd & Katherine St  
**TFR File #:** 2  
**Count date:** 17-Nov-2009

**Weather conditions:**  
Sun  
**Person(s) who counted:**  
Jean

**\*\* Non-Signalized Intersection \*\***

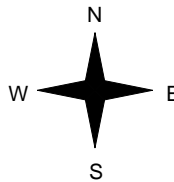
**Major Road:** Sawmill Rd runs N/S

North Leg Total: 440  
 North Entering: 193  
 North Peds: 0  
 Peds Cross:  $\times$

Heavys	5	0	5
Trucks	4	1	5
Cars	154	29	183
<b>Totals</b>	<b>163</b>	<b>30</b>	

Heavys	12
Trucks	13
Cars	222
<b>Totals</b>	<b>247</b>

East Leg Total: 293  
 East Entering: 196  
 East Peds: 0  
 Peds Cross:  $\times$



	Cars	Trucks	Heavys	Totals
↖	53	4	1	58
↙	130	5	3	138
	183	9	4	

Katherine St



Sawmill Rd

Cars	284
Trucks	9
Heavys	8
<b>Totals</b>	<b>301</b>

Cars	169	62	231
Trucks	9	4	13
Heavys	11	1	12
<b>Totals</b>	<b>189</b>	<b>67</b>	

Cars	Trucks	Heavys	Totals
91	5	1	97

Peds Cross:  $\times$   
 South Peds: 0  
 South Entering: 256  
 South Leg Total: 557

## Comments

# Sawmill Rd @ Katherine St

## Mid-day Peak Diagram

### Specified Period

**From:** 11:00:00  
**To:** 14:00:00

### One Hour Peak

**From:** 13:00:00  
**To:** 14:00:00

**Municipality:** Waterloo  
**Site #:** 0000000002  
**Intersection:** Sawmill Rd & Katherine St  
**TFR File #:** 2  
**Count date:** 17-Nov-2009

**Weather conditions:**  
Sun  
**Person(s) who counted:**  
Jean

**\*\* Non-Signalized Intersection \*\***

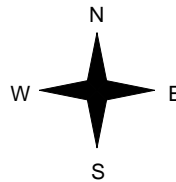
**Major Road:** Sawmill Rd runs N/S

North Leg Total: 251  
North Entering: 125  
North Peds: 0  
Peds Cross:  $\times$

Heavys	11	3	14
Trucks	3	3	6
Cars	88	17	105
Totals	102	23	

Heavys	13
Trucks	5
Cars	108
Totals	126

East Leg Total: 164  
East Entering: 91  
East Peds: 0  
Peds Cross:  $\times$



	Cars	Trucks	Heavys	Totals
↖	25	0	3	28
↙	57	3	3	63
	82	3	6	

Katherine St



Sawmill Rd

Cars	145	Cars	83	45	128
Trucks	6	Trucks	5	3	8
Heavys	14	Heavys	10	2	12
Totals	165	Totals	98	50	

Cars	Trucks	Heavys	Totals
62	6	5	73

Peds Cross:  $\times$   
South Peds: 0  
South Entering: 148  
South Leg Total: 313

## Comments

# Sawmill Rd @ Katherine St

## Afternoon Peak Diagram

### Specified Period

**From:** 15:00:00

**To:** 18:00:00

### One Hour Peak

**From:** 16:45:00

**To:** 17:45:00

**Municipality:** Waterloo  
**Site #:** 0000000002  
**Intersection:** Sawmill Rd & Katherine St  
**TFR File #:** 2  
**Count date:** 17-Nov-2009

**Weather conditions:**  
 Sun  
**Person(s) who counted:**  
 Jean

**\*\* Non-Signalized Intersection \*\***

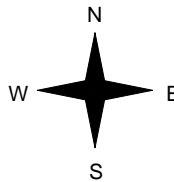
**Major Road:** Sawmill Rd runs N/S

North Leg Total: 611  
 North Entering: 326  
 North Peds: 0  
 Peds Cross:  $\times$

Heavys	12	1	13
Trucks	2	1	3
Cars	253	57	310
Totals	267	59	

Heavys	9
Trucks	4
Cars	272
Totals	285

East Leg Total: 402  
 East Entering: 140  
 East Peds: 0  
 Peds Cross:  $\times$



	Cars	Trucks	Heavys	Totals
	27	0	0	27
	107	1	5	113
	134	1	5	

Katherine St



Cars	Trucks	Heavys	Totals
257	3	2	262

Cars	360
Trucks	3
Heavys	17
Totals	380

Cars	245	200	445
Trucks	4	2	6
Heavys	9	1	10
Totals	258	203	

Peds Cross:  $\times$   
 South Peds: 0  
 South Entering: 461  
 South Leg Total: 841

## Comments

# Sawmill Rd @ Katherine St

## Total Count Diagram

**Municipality:** Waterloo  
**Site #:** 0000000002  
**Intersection:** Sawmill Rd & Katherine St  
**TFR File #:** 2  
**Count date:** 17-Nov-2009

**Weather conditions:**  
 Sun  
**Person(s) who counted:**  
 Jean

**\*\* Non-Signalized Intersection \*\***

**Major Road:** Sawmill Rd runs N/S

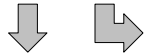
North Leg Total: 2821  
 North Entering: 1388  
 North Peds: 0  
 Peds Cross:  $\nabla$

Heavys	67	10	77
Trucks	35	7	42
Cars	1051	218	1269
Totals	1153	235	

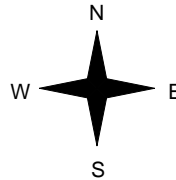


Heavys	73
Trucks	52
Cars	1308
Totals	1433

East Leg Total: 2003  
 East Entering: 1038  
 East Peds: 0  
 Peds Cross:  $\nabla$



Sawmill Rd



	Cars	Trucks	Heavys	Totals
	240	9	10	259
	737	18	24	779
	977	27	34	

Katherine St



Cars	Trucks	Heavys	Totals
911	30	24	965

Cars	1788
Trucks	53
Heavys	91
Totals	1932



Sawmill Rd

Cars	1068	693	1761
Trucks	43	23	66
Heavys	63	14	77
Totals	1174	730	

Peds Cross:  $\nabla$   
 South Peds: 0  
 South Entering: 1904  
 South Leg Total: 3836

### Comments

Sawmill @ Katherine St/ Crowsfoot  
Traffic to and from Crowsfoot

	IN			OUT		
	Left from Katherine	SB Left from Sawmill	NB Right from Sawmill	Right to Katherine	Right to Sawmill NB	Left to Sawmill SB
7:15		20			17	
7:30		28	3		21	4
7:45	1	36		1	19	2
8:00		27	2		32	1
8:15	1	39	2	1	28	1
8:30		34	1	2	40	3
8:45		30			33	2
9:00		19	2	1	27	2
11:15		10	1		10	
11:30		7	1		10	
11:45		10	2		19	
12:00		14	1		8	1
12:15		6	3		8	2
12:30		5	1		9	2
12:45		9	2		7	
13:00		11			10	
13:15		9		1	8	1
13:30	1	13	1		11	
13:45		9	1		9	2
14:00		11			11	
3:15		18	2		8	2
3:30		14		1	14	1
3:45		18			21	
4:00		27		1	15	1
4:15		17	1	2	18	1
4:30		20	1	1	19	
4:45		20	3	1	17	2
5:00		38	1	2	22	
5:15		34	3		26	3
5:30		48	3		23	2
5:45	2	43	2		30	2
6:00	1	29	2		21	2

# Sawmill Rd St Charles St / Driveway

## Morning Peak Diagram

### Specified Period

**From:** 7:00:00

**To:** 9:00:00

### One Hour Peak

**From:** 7:45:00

**To:** 8:45:00

**Municipality:** Waterloo  
**Site #:** 0000000003  
**Intersection:** Sawmill Rd & St Charles St / Driveway  
**TFR File #:** 3  
**Count date:** 18-Nov-2009

**Weather conditions:**  
 Sun  
**Person(s) who counted:**  
 Jean

**\*\* Non-Signalized Intersection \*\***

**Major Road:** Sawmill Rd runs N/S

North Leg Total: 620  
 North Entering: 323  
 North Peds: 0  
 Peds Cross:  $\times$

Heavys	0	9	1	10
Trucks	0	6	2	8
Cars	1	235	69	305
<b>Totals</b>	<b>1</b>	<b>250</b>	<b>72</b>	



Heavys	18
Trucks	14
Cars	265
<b>Totals</b>	<b>297</b>

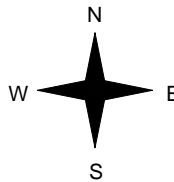
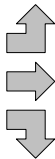
East Leg Total: 405  
 East Entering: 231  
 East Peds: 0  
 Peds Cross:  $\times$

Heavys	Trucks	Cars	Totals
0	0	3	3



Driveway

Heavys	Trucks	Cars	Totals
0	0	2	2
0	0	1	1
0	0	3	3
0	0	6	



Sawmill Rd



Cars	Trucks	Heavys	Totals
97	4	4	105
1	0	0	1
120	1	4	125
218	5	8	



St Charles St



Cars	Trucks	Heavys	Totals
167	4	3	174

Peds Cross:  $\times$   
 West Peds: 0  
 West Entering: 6  
 West Leg Total: 9

Cars	358
Trucks	7
Heavys	13
<b>Totals</b>	<b>378</b>



Cars	1	166	97	264
Trucks	0	10	2	12
Heavys	0	14	2	16
<b>Totals</b>	<b>1</b>	<b>190</b>	<b>101</b>	

Peds Cross:  $\times$   
 South Peds: 0  
 South Entering: 292  
 South Leg Total: 670

## Comments

# Sawmill Rd St Charles St / Driveway

## Mid-day Peak Diagram

### Specified Period

**From:** 11:00:00

**To:** 14:00:00

### One Hour Peak

**From:** 11:15:00

**To:** 12:15:00

**Municipality:** Waterloo  
**Site #:** 0000000003  
**Intersection:** Sawmill Rd & St Charles St / Driveway  
**TFR File #:** 3  
**Count date:** 18-Nov-2009

### Weather conditions:

Sun

### Person(s) who counted:

Jean

### \*\* Non-Signalized Intersection \*\*

**Major Road:** Sawmill Rd runs N/S

North Leg Total: 348

North Entering: 168

North Peds: 0

Peds Cross:  $\times$

Heavys	0	12	3	15
Trucks	0	7	2	9
Cars	1	123	20	144
<b>Totals</b>	<b>1</b>	<b>142</b>	<b>25</b>	



Heavys 10

Trucks 9

Cars 161

Totals 180

East Leg Total: 129

East Entering: 69

East Peds: 0

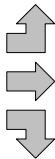
Peds Cross:  $\times$

Heavys	0	0	2	2
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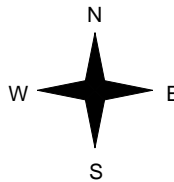


Driveway

Heavys	0	0	1	1
Trucks	0	0	0	0
Cars	0	0	1	1
<b>Totals</b>	<b>0</b>	<b>0</b>	<b>2</b>	



Sawmill Rd



Cars	26	3	1	30
Trucks	1	0	0	1
Heavys	33	1	4	38
<b>Totals</b>	<b>60</b>	<b>4</b>	<b>5</b>	

St Charles St



Cars	51	2	7	60
------	----	---	---	----

Peds Cross:  $\times$

West Peds: 0

West Entering: 2

West Leg Total: 4

Cars	157	0	134	31	165
Trucks	8	0	6	0	6
Heavys	16	0	9	4	13
<b>Totals</b>	<b>181</b>	<b>0</b>	<b>149</b>	<b>35</b>	



Peds Cross:  $\times$

South Peds: 0

South Entering: 184

South Leg Total: 365

## Comments

# Sawmill Rd St Charles St / Driveway

## Afternoon Peak Diagram

### Specified Period

**From:** 15:00:00

**To:** 18:00:00

### One Hour Peak

**From:** 16:45:00

**To:** 17:45:00

**Municipality:** Waterloo  
**Site #:** 0000000003  
**Intersection:** Sawmill Rd & St Charles St / Driveway  
**TFR File #:** 3  
**Count date:** 18-Nov-2009

**Weather conditions:**  
 Sun  
**Person(s) who counted:**  
 Jean

**\*\* Non-Signalized Intersection \*\***

**Major Road:** Sawmill Rd runs N/S

North Leg Total: 825  
 North Entering: 421  
 North Peds: 0  
 Peds Cross:  $\times$

Heavys	0	10	4	14
Trucks	0	7	3	10
Cars	1	305	91	397
<b>Totals</b>	<b>1</b>	<b>322</b>	<b>98</b>	



Heavys	12
Trucks	5
Cars	387
<b>Totals</b>	<b>404</b>

East Leg Total: 385  
 East Entering: 191  
 East Peds: 0  
 Peds Cross:  $\times$

Heavys	Trucks	Cars	Totals
0	0	8	8

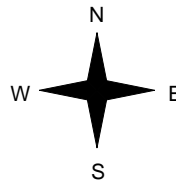


Sawmill Rd

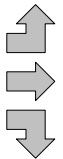
Cars	Trucks	Heavys	Totals
71	1	2	74
2	0	0	2
107	1	7	115
<b>180</b>	<b>2</b>	<b>9</b>	



Driveway



Heavys	Trucks	Cars	Totals
0	0	3	3
0	0	1	1
0	0	10	10
<b>0</b>	<b>0</b>	<b>14</b>	



St Charles St



Sawmill Rd



Cars	Trucks	Heavys	Totals
182	4	8	194

Peds Cross:  $\times$   
 West Peds: 0  
 West Entering: 14  
 West Leg Total: 22

Cars	422
Trucks	8
Heavys	17
<b>Totals</b>	<b>447</b>



Cars	5	313	90	408
Trucks	0	4	1	5
Heavys	0	10	4	14
<b>Totals</b>	<b>5</b>	<b>327</b>	<b>95</b>	

Peds Cross:  $\times$   
 South Peds: 0  
 South Entering: 427  
 South Leg Total: 874

## Comments

# Sawmill Rd St Charles St / Driveway

## Total Count Diagram

**Municipality:** Waterloo  
**Site #:** 0000000003  
**Intersection:** Sawmill Rd & St Charles St / Driveway  
**TFR File #:** 3  
**Count date:** 18-Nov-2009

**Weather conditions:**  
 Sun  
**Person(s) who counted:**  
 Jean

**\*\* Non-Signalized Intersection \*\***

**Major Road:** Sawmill Rd runs N/S

North Leg Total: 4175  
 North Entering: 2134  
 North Peds: 0  
 Peds Cross:  $\times$

Heavys	0	76	20	96
Trucks	0	49	14	63
Cars	13	1567	395	1975
<b>Totals</b>	<b>13</b>	<b>1692</b>	<b>429</b>	



Heavys	93
Trucks	60
Cars	1888
<b>Totals</b>	<b>2041</b>

East Leg Total: 2039  
 East Entering: 1104  
 East Peds: 4  
 Peds Cross:  $\times$

Heavys	Trucks	Cars	Totals
0	1	43	44

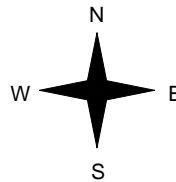


Sawmill Rd

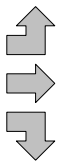
Cars	Trucks	Heavys	Totals
445	13	21	479
8	0	0	8
578	9	30	617
<b>1031</b>	<b>22</b>	<b>51</b>	



Driveway



Heavys	Trucks	Cars	Totals
0	1	9	10
0	0	8	8
0	0	27	27
0	1	44	



St Charles St



Sawmill Rd



Cars	Trucks	Heavys	Totals
863	24	48	935

Peds Cross:  $\times$   
 West Peds: 3  
 West Entering: 45  
 West Leg Total: 89

Cars	2172	Cars	22	1434	460	1916
Trucks	58	Trucks	1	46	10	57
Heavys	106	Heavys	0	72	28	100
<b>Totals</b>	<b>2336</b>	<b>Totals</b>	<b>23</b>	<b>1552</b>	<b>498</b>	



Peds Cross:  $\times$   
 South Peds: 3  
 South Entering: 2073  
 South Leg Total: 4409

### Comments

## APPENDIX C

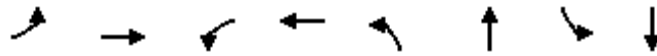
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### **SYNCHRO WORKSHEETS – 2009 EXISTING CONDITIONS**

# Timings

## 3: Sawmill Road & Northfield Drive

1/29/2010

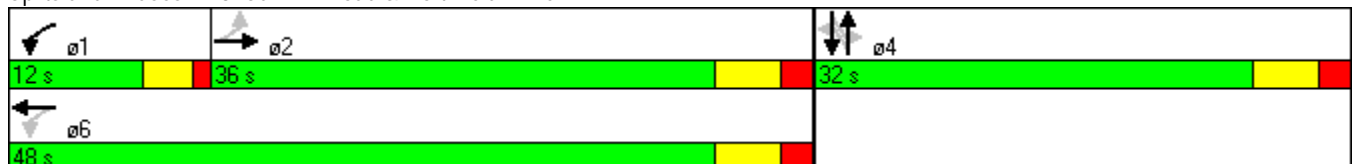


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		↕		↕	↗	↖		↕
Volume (vph)	27	112	301	140	48	81	13	242
Turn Type	Perm		pm+pt		Perm		Perm	
Protected Phases		2	1	6		4		4
Permitted Phases	2		6		4		4	
Detector Phase	2	2	1	6	4	4	4	4
Switch Phase								
Minimum Initial (s)	8.0	8.0	5.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	36.0	36.0	9.0	36.0	32.0	32.0	32.0	32.0
Total Split (s)	36.0	36.0	12.0	48.0	32.0	32.0	32.0	32.0
Total Split (%)	45.0%	45.0%	15.0%	60.0%	40.0%	40.0%	40.0%	40.0%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	0.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Act Effect Green (s)		32.0		44.0	28.0	28.0		28.0
Actuated g/C Ratio		0.40		0.55	0.35	0.35		0.35
v/c Ratio		0.41		0.87	0.21	0.52		0.66
Control Delay		17.9		33.4	21.2	12.5		28.4
Queue Delay		0.0		0.0	0.0	0.0		0.0
Total Delay		17.9		33.4	21.2	12.5		28.4
LOS		B		C	C	B		C
Approach Delay		17.9		33.4		13.8		28.4
Approach LOS		B		C		B		C

### Intersection Summary

Cycle Length: 80  
 Actuated Cycle Length: 80  
 Offset: 68 (85%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green  
 Natural Cycle: 80  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.87  
 Intersection Signal Delay: 24.8  
 Intersection LOS: C  
 Intersection Capacity Utilization 98.2%  
 ICU Level of Service F  
 Analysis Period (min) 15

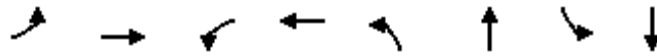
Splits and Phases: 3: Sawmill Road & Northfield Drive



# Phasings

## 3: Sawmill Road & Northfield Drive

1/29/2010



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Protected Phases		2	1	6		4		4
Permitted Phases	2		6		4		4	
Minimum Initial (s)	8.0	8.0	5.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	36.0	36.0	9.0	36.0	32.0	32.0	32.0	32.0
Total Split (s)	36.0	36.0	12.0	48.0	32.0	32.0	32.0	32.0
Total Split (%)	45.0%	45.0%	15.0%	60.0%	40.0%	40.0%	40.0%	40.0%
Maximum Green (s)	30.0	30.0	8.0	42.0	26.0	26.0	26.0	26.0
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	2.0	2.0
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Walk Time (s)	14.0	14.0		14.0	19.0	19.0	19.0	19.0
Flash Dont Walk (s)	16.0	16.0		16.0	7.0	7.0	7.0	7.0
Pedestrian Calls (#/hr)	0	0		0	0	0	0	0
90th %ile Green (s)	30.0	30.0	8.0	42.0	26.0	26.0	26.0	26.0
90th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
70th %ile Green (s)	30.0	30.0	8.0	42.0	26.0	26.0	26.0	26.0
70th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
50th %ile Green (s)	30.0	30.0	8.0	42.0	26.0	26.0	26.0	26.0
50th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
30th %ile Green (s)	30.0	30.0	8.0	42.0	26.0	26.0	26.0	26.0
30th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
10th %ile Green (s)	30.0	30.0	8.0	42.0	26.0	26.0	26.0	26.0
10th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR

### Intersection Summary

Cycle Length: 80

Actuated Cycle Length: 80

Offset: 68 (85%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Pretimed

## Queues

### 3: Sawmill Road & Northfield Drive

1/29/2010



Lane Group	EBT	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	207	500	53	320	345
v/c Ratio	0.41	0.87	0.21	0.52	0.66
Control Delay	17.9	33.4	21.2	12.5	28.4
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	17.9	33.4	21.2	12.5	28.4
Queue Length 50th (m)	18.9	47.9	5.6	15.5	41.7
Queue Length 95th (m)	36.2	#109.7	14.0	38.4	70.4
Internal Link Dist (m)	1940.2	1158.8		681.9	899.0
Turn Bay Length (m)			7.0		
Base Capacity (vph)	508	572	248	610	519
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	0.41	0.87	0.21	0.52	0.66

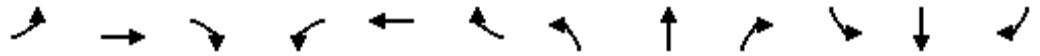
#### Intersection Summary

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

# HCM Signalized Intersection Capacity Analysis

## 3: Sawmill Road & Northfield Drive

1/29/2010



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↕	↕			↕	
Volume (vph)	27	112	48	301	140	9	48	81	207	13	242	56
Ideal Flow (vphpl)	1900	1550	1900	1900	1550	1900	1775	1650	1900	1900	1550	1900
Total Lost time (s)		4.0			4.0		4.0	4.0			4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00			1.00	
Frbp, ped/bikes		0.99			1.00		1.00	1.00			1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00			1.00	
Frt		0.97			1.00		1.00	0.89			0.98	
Flt Protected		0.99			0.97		0.95	1.00			1.00	
Satd. Flow (prot)		1363			1461		1608	1414			1480	
Flt Permitted		0.90			0.63		0.42	1.00			0.98	
Satd. Flow (perm)		1233			945		709	1414			1454	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	30	124	53	334	156	10	53	90	230	14	269	62
RTOR Reduction (vph)	0	16	0	0	1	0	0	115	0	0	10	0
Lane Group Flow (vph)	0	191	0	0	499	0	53	205	0	0	335	0
Confl. Peds. (#/hr)			2	2								
Heavy Vehicles (%)	30%	7%	4%	2%	6%	11%	6%	6%	5%	8%	2%	7%
Turn Type	Perm			pm+pt			Perm			Perm		
Protected Phases		2		1	6			4			4	
Permitted Phases	2			6			4			4		
Actuated Green, G (s)		30.0			42.0		26.0	26.0			26.0	
Effective Green, g (s)		32.0			44.0		28.0	28.0			28.0	
Actuated g/C Ratio		0.40			0.55		0.35	0.35			0.35	
Clearance Time (s)		6.0			6.0		6.0	6.0			6.0	
Lane Grp Cap (vph)		493			584		248	495			509	
v/s Ratio Prot					c0.11			0.14				
v/s Ratio Perm		0.16			0.36		0.07				c0.23	
v/c Ratio		0.39			0.85		0.21	0.41			0.66	
Uniform Delay, d1		17.0			15.3		18.3	19.8			22.0	
Progression Factor		1.00			1.00		1.00	1.00			1.00	
Incremental Delay, d2		2.3			14.8		2.0	2.5			6.5	
Delay (s)		19.3			30.1		20.2	22.3			28.5	
Level of Service		B			C		C	C			C	
Approach Delay (s)		19.3			30.1			22.0			28.5	
Approach LOS		B			C			C			C	

### Intersection Summary

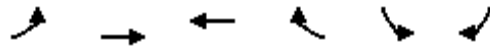
HCM Average Control Delay	26.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	98.2%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

# HCM Unsignalized Intersection Capacity Analysis

## 10: Sawmill Road & Katherine Street

1/29/2010



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	152	163	355	67	138	95
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	169	181	394	74	153	106
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	469				951	432
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	469				951	432
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	85				36	83
cM capacity (veh/h)	1098				241	624

















Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	350	469	259
Volume Left	169	0	153
Volume Right	0	74	106
cSH	1098	1700	321
Volume to Capacity	0.15	0.28	0.81
Queue Length 95th (m)	4.1	0.0	50.9
Control Delay (s)	5.1	0.0	49.7
Lane LOS	A		E
Approach Delay (s)	5.1	0.0	49.7
Approach LOS			E

Intersection Summary			
Average Delay		13.6	
Intersection Capacity Utilization		70.3%	ICU Level of Service C
Analysis Period (min)		15	

# HCM Unsignalized Intersection Capacity Analysis

## 13: Driveway & Sawmill Road

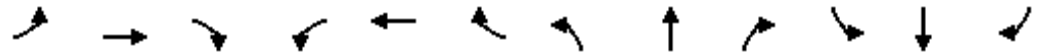
1/29/2010

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	1	3	125	1	105	1	190	101	72	250	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	2	1	3	139	1	117	1	211	112	80	278	1
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	825	764	278	712	708	267	279			323		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	825	764	278	712	708	267	279			323		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.3	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.4	2.2			2.2		
p0 queue free %	99	100	100	57	100	85	100			94		
cM capacity (veh/h)	236	314	765	325	338	757	1295			1231		
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>WB 1</b>	<b>NB 1</b>	<b>SB 1</b>								
Volume Total	7	257	324	359								
Volume Left	2	139	1	80								
Volume Right	3	117	112	1								
cSH	385	439	1295	1231								
Volume to Capacity	0.02	0.58	0.00	0.06								
Queue Length 95th (m)	0.4	27.6	0.0	1.6								
Control Delay (s)	14.5	24.1	0.0	2.3								
Lane LOS	B	C	A	A								
Approach Delay (s)	14.5	24.1	0.0	2.3								
Approach LOS	B	C										
<b>Intersection Summary</b>												
Average Delay			7.5									
Intersection Capacity Utilization			73.1%		ICU Level of Service					D		
Analysis Period (min)			15									

Volume

3: Sawmill Road & Northfield Drive

1/29/2010



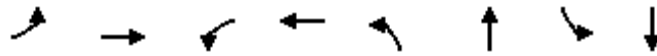
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Volume (vph)	51	181	65	200	162	30	85	293	351	21	158	30
Confl. Peds. (#/hr)	5		1	1		5	2					2
Confl. Bikes (#/hr)												
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	7%	2%	3%	7%	3%	6%	3%	4%	14%	4%	3%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	57	201	72	222	180	33	94	326	390	23	176	33
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	330	0	0	435	0	94	716	0	0	232	0

Intersection Summary

# Timings

## 3: Sawmill Road & Northfield Drive

1/29/2010

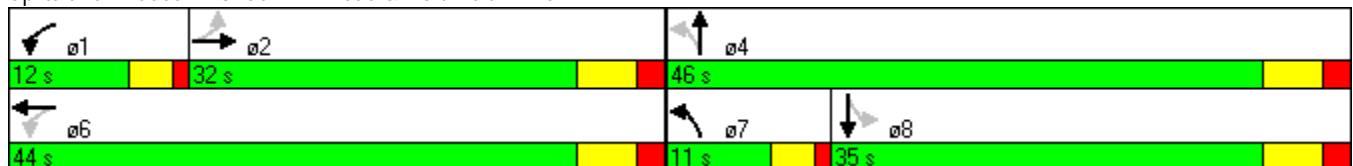


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		↕		↕	↗	↖		↕
Volume (vph)	51	181	200	162	85	293	21	158
Turn Type	Perm		pm+pt		pm+pt		Perm	
Protected Phases		2	1	6	7	4		8
Permitted Phases	2		6		4		8	
Detector Phase	2	2	1	6	7	4	8	8
Switch Phase								
Minimum Initial (s)	8.0	8.0	5.0	8.0	4.0	8.0	8.0	8.0
Minimum Split (s)	32.0	32.0	9.0	34.0	8.0	38.0	35.0	35.0
Total Split (s)	32.0	32.0	12.0	44.0	11.0	46.0	35.0	35.0
Total Split (%)	35.6%	35.6%	13.3%	48.9%	12.2%	51.1%	38.9%	38.9%
Yellow Time (s)	4.0	4.0	3.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	0.0	-2.0	0.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lead		Lead		Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes		Yes		Yes	Yes
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Act Effect Green (s)		28.0		40.0	42.0	42.0		31.0
Actuated g/C Ratio		0.31		0.44	0.47	0.47		0.34
v/c Ratio		0.83		1.07	0.22	0.97		0.59
Control Delay		46.9		88.4	15.0	48.9		30.4
Queue Delay		0.0		0.0	0.0	0.0		0.0
Total Delay		46.9		88.4	15.0	48.9		30.4
LOS		D		F	B	D		C
Approach Delay		46.9		88.4		45.0		30.4
Approach LOS		D		F		D		C

### Intersection Summary

Cycle Length: 90  
 Actuated Cycle Length: 90  
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green  
 Natural Cycle: 85  
 Control Type: Pretimed  
 Maximum v/c Ratio: 1.07  
 Intersection Signal Delay: 53.9  
 Intersection LOS: D  
 Intersection Capacity Utilization 100.5%  
 ICU Level of Service G  
 Analysis Period (min) 15

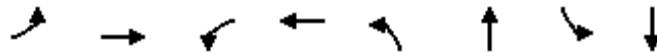
### Splits and Phases: 3: Sawmill Road & Northfield Drive



# Phasings

## 3: Sawmill Road & Northfield Drive

1/29/2010



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Protected Phases		2	1	6	7	4		8
Permitted Phases	2		6		4		8	
Minimum Initial (s)	8.0	8.0	5.0	8.0	4.0	8.0	8.0	8.0
Minimum Split (s)	32.0	32.0	9.0	34.0	8.0	38.0	35.0	35.0
Total Split (s)	32.0	32.0	12.0	44.0	11.0	46.0	35.0	35.0
Total Split (%)	35.6%	35.6%	13.3%	48.9%	12.2%	51.1%	38.9%	38.9%
Maximum Green (s)	26.0	26.0	8.0	38.0	7.0	40.0	29.0	29.0
Yellow Time (s)	4.0	4.0	3.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	1.0	2.0	2.0	2.0
Lead/Lag	Lag	Lag	Lead		Lead		Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes		Yes		Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Walk Time (s)	10.0	10.0		10.0		22.0	22.0	22.0
Flash Dont Walk (s)	16.0	16.0		16.0		7.0	7.0	7.0
Pedestrian Calls (#/hr)	0	0		0		0	0	0
90th %ile Green (s)	26.0	26.0	8.0	38.0	7.0	40.0	29.0	29.0
90th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
70th %ile Green (s)	26.0	26.0	8.0	38.0	7.0	40.0	29.0	29.0
70th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
50th %ile Green (s)	26.0	26.0	8.0	38.0	7.0	40.0	29.0	29.0
50th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
30th %ile Green (s)	26.0	26.0	8.0	38.0	7.0	40.0	29.0	29.0
30th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
10th %ile Green (s)	26.0	26.0	8.0	38.0	7.0	40.0	29.0	29.0
10th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR

### Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Pretimed

# Queues

## 3: Sawmill Road & Northfield Drive

1/29/2010



Lane Group	EBT	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	330	435	94	716	232
v/c Ratio	0.83	1.07	0.22	0.97	0.59
Control Delay	46.9	88.4	15.0	48.9	30.4
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	46.9	88.4	15.0	48.9	30.4
Queue Length 50th (m)	50.3	~64.2	8.9	105.5	31.2
Queue Length 95th (m)	#95.9	#139.9	17.5	#183.3	55.3
Internal Link Dist (m)	1940.2	1158.8		838.0	899.0
Turn Bay Length (m)			7.0		
Base Capacity (vph)	398	408	432	738	395
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	0.83	1.07	0.22	0.97	0.59

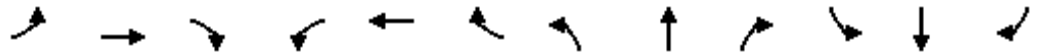
### Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

# HCM Signalized Intersection Capacity Analysis

## 3: Sawmill Road & Northfield Drive

1/29/2010



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↕	↕			↕	
Volume (vph)	51	181	65	200	162	30	85	293	351	21	158	30
Ideal Flow (vphpl)	1900	1550	1900	1900	1550	1900	1775	1650	1900	1900	1550	1900
Total Lost time (s)		4.0			4.0		4.0	4.0			4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00			1.00	
Frbp, ped/bikes		1.00			1.00		1.00	1.00			1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00			1.00	
Frt		0.97			0.99		1.00	0.92			0.98	
Flt Protected		0.99			0.98		0.95	1.00			1.00	
Satd. Flow (prot)		1428			1442		1607	1480			1454	
Flt Permitted		0.86			0.53		0.47	1.00			0.77	
Satd. Flow (perm)		1242			779		791	1480			1126	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	57	201	72	222	180	33	94	326	390	23	176	33
RTOR Reduction (vph)	0	11	0	0	3	0	0	48	0	0	7	0
Lane Group Flow (vph)	0	319	0	0	432	0	94	668	0	0	225	0
Confl. Peds. (#/hr)	5		1	1		5	2					2
Heavy Vehicles (%)	2%	7%	2%	3%	7%	3%	6%	3%	4%	14%	4%	3%
Turn Type	Perm			pm+pt			pm+pt			Perm		
Protected Phases		2		1	6		7	4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)		26.0			38.0		40.0	40.0			29.0	
Effective Green, g (s)		28.0			40.0		40.0	42.0			31.0	
Actuated g/C Ratio		0.31			0.44		0.44	0.47			0.34	
Clearance Time (s)		6.0			6.0		4.0	6.0			6.0	
Lane Grp Cap (vph)		386			420		415	691			388	
v/s Ratio Prot					c0.11		0.02	c0.45				
v/s Ratio Perm		c0.26			0.34		0.08				0.20	
v/c Ratio		0.83			1.03		0.23	0.97			0.58	
Uniform Delay, d1		28.7			25.0		15.6	23.3			24.2	
Progression Factor		1.00			1.00		1.00	1.00			1.00	
Incremental Delay, d2		18.0			51.2		1.3	27.0			6.2	
Delay (s)		46.8			76.2		16.9	50.3			30.4	
Level of Service		D			E		B	D			C	
Approach Delay (s)		46.8			76.2			46.4			30.4	
Approach LOS		D			E			D			C	

### Intersection Summary

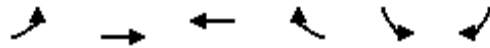
HCM Average Control Delay	51.6	HCM Level of Service	D
HCM Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	100.5%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Volume

10: Sawmill Road & Katherine Street

1/29/2010

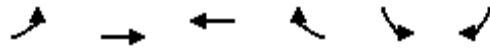


Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Volume (vph)	251	302	359	205	113	27
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	1%	5%	5%	1%	5%	0%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)		0%	0%		0%	
Adj. Flow (vph)	279	336	399	228	126	30
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	615	627	0	156	0
<b>Intersection Summary</b>						

# HCM Unsignalized Intersection Capacity Analysis

## 10: Sawmill Road & Katherine Street

1/29/2010



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Volume (veh/h)	251	302	359	205	113	27
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	279	336	399	228	126	30
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	627				1406	513
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	627				1406	513
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	71				0	95
cM capacity (veh/h)	960				107	565

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	614	627	156
Volume Left	279	0	126
Volume Right	0	228	30
cSH	960	1700	127
Volume to Capacity	0.29	0.37	1.22
Queue Length 95th (m)	9.2	0.0	73.2
Control Delay (s)	6.7	0.0	218.8
Lane LOS	A		F
Approach Delay (s)	6.7	0.0	218.8
Approach LOS			F

Intersection Summary			
Average Delay		27.3	
Intersection Capacity Utilization		89.0%	ICU Level of Service E
Analysis Period (min)		15	

Volume

13: Driveway & Sawmill Road

1/29/2010



















Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Volume (vph)	3	1	10	115	2	97	5	370	95	98	322	1
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	0%	0%	0%	7%	0%	3%	0%	4%	5%	7%	5%	0%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	3	1	11	128	2	108	6	411	106	109	358	1
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	15	0	0	238	0	0	523	0	0	468	0

Intersection Summary

# HCM Unsignalized Intersection Capacity Analysis

## 13: Driveway & Sawmill Road

1/29/2010

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	3	1	10	115	2	97	5	370	95	98	322	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	3	1	11	128	2	108	6	411	106	109	358	1
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1160	1104	358	1063	1052	464	359			517		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1160	1104	358	1063	1052	464	359			517		
tC, single (s)	7.1	6.5	6.2	7.2	6.5	6.2	4.1			4.2		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.6	4.0	3.3	2.2			2.3		
p0 queue free %	97	99	98	28	99	82	100			89		
cM capacity (veh/h)	129	189	690	176	203	596	1211			1024		
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>WB 1</b>	<b>NB 1</b>	<b>SB 1</b>								
Volume Total	16	238	522	468								
Volume Left	3	128	6	109								
Volume Right	11	108	106	1								
cSH	326	260	1211	1024								
Volume to Capacity	0.05	0.92	0.00	0.11								
Queue Length 95th (m)	1.1	62.2	0.1	2.7								
Control Delay (s)	16.6	77.9	0.1	3.0								
Lane LOS	C	F	A	A								
Approach Delay (s)	16.6	77.9	0.1	3.0								
Approach LOS	C	F										
<b>Intersection Summary</b>												
Average Delay			16.3									
Intersection Capacity Utilization			89.7%		ICU Level of Service				E			
Analysis Period (min)			15									

Summary of All Intervals

Run Number	1	2	3	4	5	28	Avg
Start Time	6:57	6:57	6:57	6:57	6:57	6:57	6:57
End Time	8:07	8:07	8:07	8:07	8:07	8:07	8:07
Total Time (min)	70	70	70	70	70	70	70
Time Recorded (min)	60	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2	2
# of Recorded Intvls	1	1	1	1	1	1	1
Vehs Entered	2362	2417	2408	2312	2322	2399	2370
Vehs Exited	2342	2428	2388	2326	2316	2397	2367
Starting Vehs	136	163	148	175	138	138	152
Ending Vehs	156	152	168	161	144	140	156
Denied Entry Before	0	0	0	0	0	0	0
Denied Entry After	0	1	0	0	0	0	0
Travel Distance (km)	6609	6849	6894	6542	6546	6921	6727
Travel Time (hr)	145.5	151.8	152.2	144.2	144.7	152.3	148.4
Total Delay (hr)	17.4	18.8	18.6	17.2	17.9	18.0	18.0
Total Stops	1637	1748	1724	1651	1683	1702	1690
Fuel Used (l)	490.5	500.1	507.0	483.4	480.3	505.3	494.4

Interval #0 Information Seeding

Start Time	6:57
End Time	7:07
Total Time (min)	10
Volumes adjusted by Growth Factors.	
No data recorded this interval.	

Interval #1 Information Recording

Start Time	7:07
End Time	8:07
Total Time (min)	60
Volumes adjusted by Growth Factors.	

Run Number	1	2	3	4	5	28	Avg
Vehs Entered	2362	2417	2408	2312	2322	2399	2370
Vehs Exited	2342	2428	2388	2326	2316	2397	2367
Starting Vehs	136	163	148	175	138	138	152
Ending Vehs	156	152	168	161	144	140	156
Denied Entry Before	0	0	0	0	0	0	0
Denied Entry After	0	1	0	0	0	0	0
Travel Distance (km)	6609	6849	6894	6542	6546	6921	6727
Travel Time (hr)	145.5	151.8	152.2	144.2	144.7	152.3	148.4
Total Delay (hr)	17.4	18.8	18.6	17.2	17.9	18.0	18.0
Total Stops	1637	1748	1724	1651	1683	1702	1690
Fuel Used (l)	490.5	500.1	507.0	483.4	480.3	505.3	494.4

**3: Sawmill Road & Northfield Drive Performance by movement**

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay (hr)	0.2	0.8	0.2	2.8	1.3	0.1	0.5	0.7	1.0	0.1	2.0	0.4
Delay / Veh (s)	27.7	24.2	16.8	33.1	29.6	31.9	42.3	29.6	16.3	44.2	30.1	23.1
Total Stops	22	74	35	325	118	10	46	65	168	11	180	44
Travel Dist (km)	54.4	231.4	92.8	355.5	170.2	12.6	29.9	56.2	150.6	9.6	224.6	51.3
Travel Time (hr)	1.3	5.5	2.2	10.2	4.7	0.4	1.2	1.8	4.3	0.3	6.7	1.5
Avg Speed (kph)	40	42	43	35	36	35	26	31	35	29	33	35

**3: Sawmill Road & Northfield Drive Performance by movement**

Movement	All
Total Delay (hr)	10.1
Delay / Veh (s)	27.7
Total Stops	1098
Travel Dist (km)	1439.1
Travel Time (hr)	40.2
Avg Speed (kph)	36

**10: Sawmill Road & Katherine Street Performance by movement**

Movement	EBL	EBT	WBT	WBR	SBL	SBR	All
Total Delay (hr)	0.4	0.5	0.4	0.0	0.9	0.4	2.6
Delay / Veh (s)	9.0	8.8	3.7	1.9	23.4	15.1	9.2
Total Stops	72	22	0	1	139	99	333
Travel Dist (km)	134.4	153.3	242.4	47.0	169.5	120.5	867.0
Travel Time (hr)	2.5	2.7	4.3	0.9	4.0	2.7	16.9
Avg Speed (kph)	54	57	57	54	43	46	51

**13: Driveway & Sawmill Road Performance by movement**

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay (hr)	0.0	0.0	0.0	0.5	0.0	0.3	0.0	0.1	0.0	0.1	0.1	0.0
Delay / Veh (s)	9.5		4.5	14.6		10.1		1.8	1.3	4.0	1.7	3.4
Total Stops	2	0	4	117	0	110	0	0	0	21	5	0
Travel Dist (km)	0.1	0.0	0.3	188.7	0.3	176.9	0.2	90.7	49.6	24.3	87.7	0.4
Travel Time (hr)	0.0	0.0	0.0	4.4	0.0	4.0	0.0	2.1	1.2	0.6	2.1	0.0
Avg Speed (kph)	13	18	18	43	35	44	42	44	42	38	43	39

**13: Driveway & Sawmill Road Performance by movement**

Movement	All
Total Delay (hr)	1.1
Delay / Veh (s)	4.9
Total Stops	259
Travel Dist (km)	619.3
Travel Time (hr)	14.4
Avg Speed (kph)	43

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Total Network Performance

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<hr/>	
Total Delay (hr)	18.0
Delay / Veh (s)	27.3
Total Stops	1690
Travel Dist (km)	6726.7
Travel Time (hr)	148.4
Avg Speed (kph)	45

Queuing and Blocking Report  
Baseline

1/29/2010

Intersection: 3: Sawmill Road & Northfield Drive

Movement	EB	WB	NB	NB	SB
Directions Served	LTR	LTR	L	TR	LTR
Maximum Queue (m)	60.1	122.5	19.0	105.0	94.6
Average Queue (m)	26.7	61.1	7.1	39.9	43.5
95th Queue (m)	49.1	103.4	14.5	82.1	74.1
Link Distance (m)	1956.3	1170.5		699.7	916.9
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (m)			7.0		
Storage Blk Time (%)			26	36	
Queuing Penalty (veh)			75	18	

Intersection: 10: Sawmill Road & Katherine Street

Movement	EB	WB	SB
Directions Served	LT	TR	LR
Maximum Queue (m)	46.7	4.3	63.0
Average Queue (m)	15.8	0.1	26.0
95th Queue (m)	34.3	1.7	49.9
Link Distance (m)	851.7	679.6	1216.4
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (m)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 13: Driveway & Sawmill Road

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (m)	9.0	51.4	0.9	21.6
Average Queue (m)	1.8	21.4	0.0	5.6
95th Queue (m)	7.7	37.8	0.7	16.6
Link Distance (m)	66.6	1612.4	484.4	357.0
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (m)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Network Summary

Network wide Queuing Penalty: 92



Summary of All Intervals

Run Number	1	2	3	4	5	28	Avg
Start Time	6:57	6:57	6:57	6:57	6:57	6:57	6:57
End Time	8:07	8:07	8:07	8:07	8:07	8:07	8:07
Total Time (min)	70	70	70	70	70	70	70
Time Recorded (min)	60	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2	2
# of Recorded Intvls	1	1	1	1	1	1	1
Vehs Entered	3143	3060	2996	3100	3065	2922	3046
Vehs Exited	3058	2986	2907	2985	3032	2917	2980
Starting Vehs	187	207	194	193	220	191	196
Ending Vehs	272	281	283	308	253	196	265
Denied Entry Before	0	1	1	0	0	0	0
Denied Entry After	0	1	39	6	2	2	8
Travel Distance (km)	8455	8489	8058	8119	8476	8138	8289
Travel Time (hr)	238.7	221.7	252.9	221.2	239.9	202.7	229.5
Total Delay (hr)	73.6	56.6	95.1	62.3	74.9	44.1	67.8
Total Stops	4782	3503	5609	4171	4779	3079	4319
Fuel Used (l)	668.2	652.2	656.8	633.3	665.2	616.6	648.7

Interval #0 Information Seeding

Start Time	6:57
End Time	7:07
Total Time (min)	10
Volumes adjusted by Growth Factors.	
No data recorded this interval.	

Interval #1 Information Recording

Start Time	7:07
End Time	8:07
Total Time (min)	60
Volumes adjusted by Growth Factors.	

Run Number	1	2	3	4	5	28	Avg
Vehs Entered	3143	3060	2996	3100	3065	2922	3046
Vehs Exited	3058	2986	2907	2985	3032	2917	2980
Starting Vehs	187	207	194	193	220	191	196
Ending Vehs	272	281	283	308	253	196	265
Denied Entry Before	0	1	1	0	0	0	0
Denied Entry After	0	1	39	6	2	2	8
Travel Distance (km)	8455	8489	8058	8119	8476	8138	8289
Travel Time (hr)	238.7	221.7	252.9	221.2	239.9	202.7	229.5
Total Delay (hr)	73.6	56.6	95.1	62.3	74.9	44.1	67.8
Total Stops	4782	3503	5609	4171	4779	3079	4319
Fuel Used (l)	668.2	652.2	656.8	633.3	665.2	616.6	648.7

**3: Sawmill Road & Northfield Drive Performance by movement**

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay (hr)	0.7	2.7	0.8	3.6	2.9	0.6	4.8	15.2	19.4	0.3	1.6	0.3
Delay / Veh (s)	51.5	52.5	44.0	68.4	68.6	62.8	209.9	204.8	199.0	45.8	35.7	27.9
Total Stops	52	182	70	290	187	43	324	968	1281	23	126	29
Travel Dist (km)	95.9	361.2	130.6	224.8	179.5	37.3	71.4	230.9	300.2	18.7	149.9	32.5
Travel Time (hr)	2.7	10.1	3.6	8.3	6.5	1.3	6.3	20.1	26.0	0.7	4.7	1.0
Avg Speed (kph)	36	36	37	27	28	28	12	12	12	29	32	33

**3: Sawmill Road & Northfield Drive Performance by movement**

Movement	All
Total Delay (hr)	52.8
Delay / Veh (s)	119.2
Total Stops	3575
Travel Dist (km)	1832.9
Travel Time (hr)	91.2
Avg Speed (kph)	20

**10: Sawmill Road & Katherine Street Performance by movement**

Movement	EBL	EBT	WBT	WBR	SBL	SBR	All
Total Delay (hr)	1.4	1.5	0.6	0.2	3.4	0.6	7.5
Delay / Veh (s)	19.7	17.3	5.8	3.1	111.7	88.8	21.6
Total Stops	201	109	0	12	110	24	456
Travel Dist (km)	211.2	255.8	223.5	133.4	134.5	28.7	987.0
Travel Time (hr)	4.7	5.2	4.2	2.6	5.8	1.1	23.5
Avg Speed (kph)	45	49	54	52	23	26	42

**13: Driveway & Sawmill Road Performance by movement**

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay (hr)	0.0	0.0	0.0	0.6	0.0	0.4	0.0	0.3	0.1	0.2	0.3	0.0
Delay / Veh (s)	15.5	15.8	5.3	21.6	14.3	14.5	4.0	2.8	2.0	5.8	3.0	1.5
Total Stops	2	1	9	102	2	101	2	1	1	48	19	0
Travel Dist (km)	0.2	0.1	0.6	163.4	2.5	163.2	2.2	176.2	45.2	35.5	112.7	0.6
Travel Time (hr)	0.0	0.0	0.0	4.0	0.1	3.9	0.1	4.1	1.1	1.0	2.7	0.0
Avg Speed (kph)	12	12	16	41	42	42	40	44	41	36	42	39

**13: Driveway & Sawmill Road Performance by movement**

Movement	All
Total Delay (hr)	1.8
Delay / Veh (s)	6.0
Total Stops	288
Travel Dist (km)	702.3
Travel Time (hr)	17.0
Avg Speed (kph)	42

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Total Network Performance

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<hr/>	
Total Delay (hr)	67.8
Delay / Veh (s)	80.9
Total Stops	4319
Travel Dist (km)	8289.2
Travel Time (hr)	229.5
Avg Speed (kph)	36

## Queuing and Blocking Report Baseline

1/29/2010

### Intersection: 3: Sawmill Road & Northfield Drive

Movement	EB	WB	NB	NB	SB
Directions Served	LTR	LTR	L	TR	LTR
Maximum Queue (m)	128.3	192.2	18.3	639.1	82.0
Average Queue (m)	59.2	83.6	7.7	411.7	36.8
95th Queue (m)	109.9	157.1	14.5	785.4	67.0
Link Distance (m)	1956.0	1170.5		855.4	916.9
Upstream Blk Time (%)				5	
Queuing Penalty (veh)				0	
Storage Bay Dist (m)			7.0		
Storage Blk Time (%)			23	54	
Queuing Penalty (veh)			149	46	

### Intersection: 10: Sawmill Road & Katherine Street

Movement	EB	WB	SB
Directions Served	LT	TR	LR
Maximum Queue (m)	111.2	9.8	98.3
Average Queue (m)	40.2	2.2	40.6
95th Queue (m)	86.7	7.9	98.1
Link Distance (m)	851.7	634.9	1216.4
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (m)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

### Intersection: 13: Driveway & Sawmill Road

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (m)	11.1	51.9	10.7	44.8
Average Queue (m)	3.1	23.2	0.9	11.9
95th Queue (m)	10.3	41.6	5.4	31.1
Link Distance (m)	66.6	1612.4	484.4	357.0
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (m)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

### Network Summary

Network wide Queuing Penalty: 195



APPENDIX D

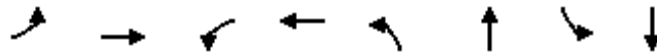
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**SYNCHRO WORKSHEETS – 2020 FUTURE BACKGROUND CONDITIONS**

# Timings

## 3: Sawmill Road & Northfield Drive

1/29/2010

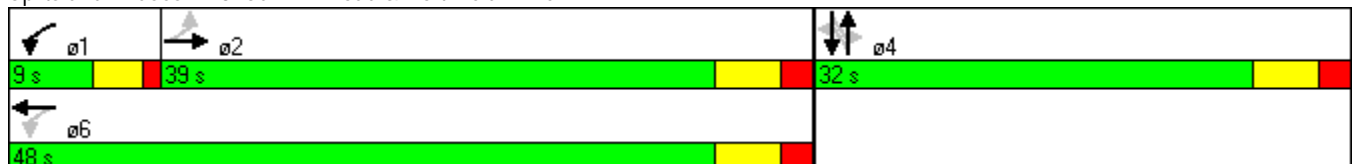


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		↕		↕	↗	↖		↕
Volume (vph)	32	132	355	165	60	101	16	301
Turn Type	Perm		pm+pt		Perm		Perm	
Protected Phases		2	1	6		4		4
Permitted Phases	2		6		4		4	
Detector Phase	2	2	1	6	4	4	4	4
Switch Phase								
Minimum Initial (s)	8.0	8.0	5.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	36.0	36.0	9.0	36.0	32.0	32.0	32.0	32.0
Total Split (s)	39.0	39.0	9.0	48.0	32.0	32.0	32.0	32.0
Total Split (%)	48.8%	48.8%	11.3%	60.0%	40.0%	40.0%	40.0%	40.0%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	0.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Act Effect Green (s)		35.0		44.0	28.0	28.0		28.0
Actuated g/C Ratio		0.44		0.55	0.35	0.35		0.35
v/c Ratio		0.40		0.96	0.27	0.59		0.75
Control Delay		15.9		48.7	22.6	15.0		32.9
Queue Delay		0.0		0.0	0.0	0.0		0.0
Total Delay		15.9		48.7	22.6	15.0		32.9
LOS		B		D	C	B		C
Approach Delay		15.9		48.7		16.1		32.9
Approach LOS		B		D		B		C

### Intersection Summary

Cycle Length: 80  
 Actuated Cycle Length: 80  
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green  
 Natural Cycle: 90  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.96  
 Intersection Signal Delay: 31.4  
 Intersection LOS: C  
 Intersection Capacity Utilization 111.5%  
 ICU Level of Service H  
 Analysis Period (min) 15

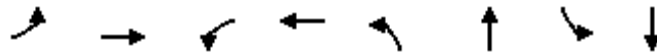
Splits and Phases: 3: Sawmill Road & Northfield Drive



# Phasings

## 3: Sawmill Road & Northfield Drive

1/29/2010



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Protected Phases		2	1	6		4		4
Permitted Phases	2		6		4		4	
Minimum Initial (s)	8.0	8.0	5.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	36.0	36.0	9.0	36.0	32.0	32.0	32.0	32.0
Total Split (s)	39.0	39.0	9.0	48.0	32.0	32.0	32.0	32.0
Total Split (%)	48.8%	48.8%	11.3%	60.0%	40.0%	40.0%	40.0%	40.0%
Maximum Green (s)	33.0	33.0	5.0	42.0	26.0	26.0	26.0	26.0
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	2.0	2.0
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Walk Time (s)	14.0	14.0		14.0	19.0	19.0	19.0	19.0
Flash Dont Walk (s)	16.0	16.0		16.0	7.0	7.0	7.0	7.0
Pedestrian Calls (#/hr)	0	0		0	0	0	0	0
90th %ile Green (s)	33.0	33.0	5.0	42.0	26.0	26.0	26.0	26.0
90th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
70th %ile Green (s)	33.0	33.0	5.0	42.0	26.0	26.0	26.0	26.0
70th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
50th %ile Green (s)	33.0	33.0	5.0	42.0	26.0	26.0	26.0	26.0
50th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
30th %ile Green (s)	33.0	33.0	5.0	42.0	26.0	26.0	26.0	26.0
30th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
10th %ile Green (s)	33.0	33.0	5.0	42.0	26.0	26.0	26.0	26.0
10th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR

### Intersection Summary

Cycle Length: 80

Actuated Cycle Length: 80

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Pretimed

## Queues

### 3: Sawmill Road & Northfield Drive

1/29/2010



Lane Group	EBT	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	221	531	60	358	387
v/c Ratio	0.40	0.96	0.27	0.59	0.75
Control Delay	15.9	48.7	22.6	15.0	32.9
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	15.9	48.7	22.6	15.0	32.9
Queue Length 50th (m)	19.0	52.6	6.4	20.7	49.0
Queue Length 95th (m)	36.2	#139.4	16.0	47.3	#90.2
Internal Link Dist (m)	1940.2	1158.8		681.9	899.0
Turn Bay Length (m)			7.0		
Base Capacity (vph)	552	553	226	609	517
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	0.40	0.96	0.27	0.59	0.75

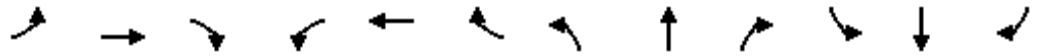
#### Intersection Summary

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

# HCM Signalized Intersection Capacity Analysis

## 3: Sawmill Road & Northfield Drive

1/29/2010



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↗	↘			↕	
Volume (vph)	32	132	57	355	165	11	60	101	257	16	301	70
Ideal Flow (vphpl)	1900	1550	1900	1900	1550	1900	1775	1650	1900	1900	1550	1900
Total Lost time (s)		4.0			4.0		4.0	4.0			4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00			1.00	
Frbp, ped/bikes		0.99			1.00		1.00	1.00			1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00			1.00	
Frt		0.97			1.00		1.00	0.89			0.98	
Flt Protected		0.99			0.97		0.95	1.00			1.00	
Satd. Flow (prot)		1363			1461		1608	1414			1479	
Flt Permitted		0.89			0.63		0.38	1.00			0.98	
Satd. Flow (perm)		1226			946		646	1414			1450	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	32	132	57	355	165	11	60	101	257	16	301	70
RTOR Reduction (vph)	0	16	0	0	1	0	0	114	0	0	10	0
Lane Group Flow (vph)	0	205	0	0	530	0	60	244	0	0	377	0
Confl. Peds. (#/hr)			2	2								
Heavy Vehicles (%)	30%	7%	4%	2%	6%	11%	6%	6%	5%	8%	2%	7%
Turn Type	Perm			pm+pt			Perm			Perm		
Protected Phases		2		1	6			4			4	
Permitted Phases	2			6			4			4		
Actuated Green, G (s)		33.0			42.0		26.0	26.0			26.0	
Effective Green, g (s)		35.0			44.0		28.0	28.0			28.0	
Actuated g/C Ratio		0.44			0.55		0.35	0.35			0.35	
Clearance Time (s)		6.0			6.0		6.0	6.0			6.0	
Lane Grp Cap (vph)		536			565		226	495			508	
v/s Ratio Prot					c0.08			0.17				
v/s Ratio Perm		0.17			0.43		0.09				c0.26	
v/c Ratio		0.38			0.94		0.27	0.49			0.74	
Uniform Delay, d1		15.2			16.7		18.6	20.4			22.8	
Progression Factor		1.00			1.00		1.00	1.00			1.00	
Incremental Delay, d2		2.1			25.3		2.9	3.5			9.5	
Delay (s)		17.3			42.1		21.5	23.9			32.3	
Level of Service		B			D		C	C			C	
Approach Delay (s)		17.3			42.1			23.5			32.3	
Approach LOS		B			D			C			C	

### Intersection Summary

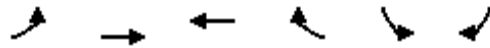
HCM Average Control Delay	31.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	111.5%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

# HCM Unsignalized Intersection Capacity Analysis

## 10: Sawmill Road & Katherine Street

1/29/2010



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	161	192	402	71	146	101
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	161	192	402	71	146	101
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	473				952	438
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	473				952	438
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	85				40	84
cM capacity (veh/h)	1094				243	619

















Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	353	473	247
Volume Left	161	0	146
Volume Right	0	71	101
cSH	1094	1700	323
Volume to Capacity	0.15	0.28	0.76
Queue Length 95th (m)	3.9	0.0	45.5
Control Delay (s)	4.8	0.0	44.7
Lane LOS	A		E
Approach Delay (s)	4.8	0.0	44.7
Approach LOS			E

Intersection Summary			
Average Delay		11.9	
Intersection Capacity Utilization		76.6%	ICU Level of Service D
Analysis Period (min)		15	

# HCM Unsignalized Intersection Capacity Analysis

## 13: Driveway & Sawmill Road

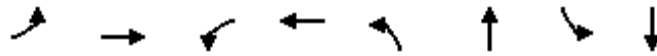
1/29/2010

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	1	3	132	1	111	1	224	107	76	294	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour 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
Hourly flow rate (vph)	2	1	3	132	1	111	1	224	107	76	294	1
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	838	780	294	730	726	278	295			331		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	838	780	294	730	726	278	295			331		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.3	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.4	2.2			2.2		
p0 queue free %	99	100	100	58	100	85	100			94		
cM capacity (veh/h)	233	309	750	317	331	747	1278			1223		
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>WB 1</b>	<b>NB 1</b>	<b>SB 1</b>								
Volume Total	6	244	332	371								
Volume Left	2	132	1	76								
Volume Right	3	111	107	1								
cSH	379	430	1278	1223								
Volume to Capacity	0.02	0.57	0.00	0.06								
Queue Length 95th (m)	0.4	26.1	0.0	1.5								
Control Delay (s)	14.6	23.8	0.0	2.2								
Lane LOS	B	C	A	A								
Approach Delay (s)	14.6	23.8	0.0	2.2								
Approach LOS	B	C										
<b>Intersection Summary</b>												
Average Delay			7.0									
Intersection Capacity Utilization			79.7%		ICU Level of Service					D		
Analysis Period (min)			15									

# Timings

## 3: Sawmill Road & Northfield Drive

1/29/2010

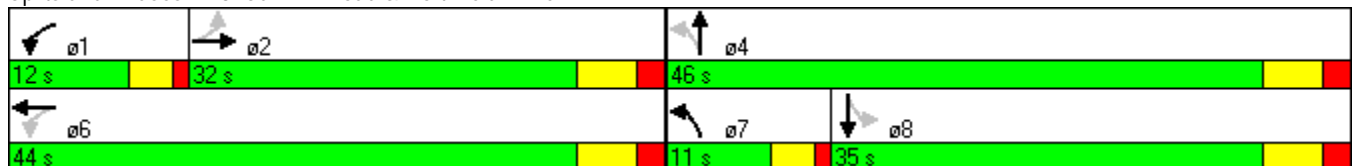


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		↕		↕	↗	↖		↕
Volume (vph)	60	213	236	191	106	364	26	196
Turn Type	Perm		pm+pt		pm+pt		Perm	
Protected Phases		2	1	6	7	4		8
Permitted Phases	2		6		4		8	
Detector Phase	2	2	1	6	7	4	8	8
Switch Phase								
Minimum Initial (s)	8.0	8.0	5.0	8.0	5.0	8.0	8.0	8.0
Minimum Split (s)	32.0	32.0	9.0	34.0	9.0	38.0	35.0	35.0
Total Split (s)	32.0	32.0	12.0	44.0	11.0	46.0	35.0	35.0
Total Split (%)	35.6%	35.6%	13.3%	48.9%	12.2%	51.1%	38.9%	38.9%
Yellow Time (s)	4.0	4.0	3.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	0.0	-2.0	0.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lead		Lead		Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes		Yes		Yes	Yes
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Act Effect Green (s)		28.0		40.0	42.0	42.0		31.0
Actuated g/C Ratio		0.31		0.44	0.47	0.47		0.34
v/c Ratio		0.89		1.16	0.26	1.08		0.90
Control Delay		54.6		119.2	15.5	81.5		62.3
Queue Delay		0.0		0.0	0.0	0.0		0.0
Total Delay		54.6		119.2	15.5	81.5		62.3
LOS		D		F	B	F		E
Approach Delay		54.6		119.2		73.7		62.3
Approach LOS		D		F		E		E

### Intersection Summary

Cycle Length: 90  
 Actuated Cycle Length: 90  
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green  
 Natural Cycle: 85  
 Control Type: Pretimed  
 Maximum v/c Ratio: 1.16  
 Intersection Signal Delay: 79.5  
 Intersection LOS: E  
 Intersection Capacity Utilization 117.4%  
 ICU Level of Service H  
 Analysis Period (min) 15

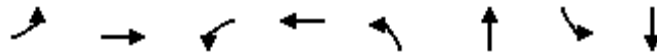
### Splits and Phases: 3: Sawmill Road & Northfield Drive



# Phasings

## 3: Sawmill Road & Northfield Drive

1/29/2010



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Protected Phases		2	1	6	7	4		8
Permitted Phases	2		6		4		8	
Minimum Initial (s)	8.0	8.0	5.0	8.0	5.0	8.0	8.0	8.0
Minimum Split (s)	32.0	32.0	9.0	34.0	9.0	38.0	35.0	35.0
Total Split (s)	32.0	32.0	12.0	44.0	11.0	46.0	35.0	35.0
Total Split (%)	35.6%	35.6%	13.3%	48.9%	12.2%	51.1%	38.9%	38.9%
Maximum Green (s)	26.0	26.0	8.0	38.0	7.0	40.0	29.0	29.0
Yellow Time (s)	4.0	4.0	3.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	1.0	2.0	2.0	2.0
Lead/Lag	Lag	Lag	Lead		Lead		Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes		Yes		Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Walk Time (s)	10.0	10.0		10.0		22.0	22.0	22.0
Flash Dont Walk (s)	16.0	16.0		16.0		7.0	7.0	7.0
Pedestrian Calls (#/hr)	0	0		0		0	0	0
90th %ile Green (s)	26.0	26.0	8.0	38.0	7.0	40.0	29.0	29.0
90th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
70th %ile Green (s)	26.0	26.0	8.0	38.0	7.0	40.0	29.0	29.0
70th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
50th %ile Green (s)	26.0	26.0	8.0	38.0	7.0	40.0	29.0	29.0
50th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
30th %ile Green (s)	26.0	26.0	8.0	38.0	7.0	40.0	29.0	29.0
30th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
10th %ile Green (s)	26.0	26.0	8.0	38.0	7.0	40.0	29.0	29.0
10th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR

### Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Pretimed

# Queues

## 3: Sawmill Road & Northfield Drive

1/29/2010



Lane Group	EBT	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	350	462	106	800	259
v/c Ratio	0.89	1.16	0.26	1.08	0.90
Control Delay	54.6	119.2	15.5	81.5	62.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	54.6	119.2	15.5	81.5	62.3
Queue Length 50th (m)	54.9	~79.6	10.1	~148.0	40.6
Queue Length 95th (m)	#105.5	#152.8	19.4	#216.7	#86.4
Internal Link Dist (m)	1940.2	1158.8		838.0	899.0
Turn Bay Length (m)			7.0		
Base Capacity (vph)	394	400	415	738	288
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	0.89	1.16	0.26	1.08	0.90

### Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

# HCM Signalized Intersection Capacity Analysis

## 3: Sawmill Road & Northfield Drive

1/29/2010



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↗	↘			↕	
Volume (vph)	60	213	77	236	191	35	106	364	436	26	196	37
Ideal Flow (vphpl)	1900	1550	1900	1900	1550	1900	1775	1650	1900	1900	1550	1900
Total Lost time (s)		4.0			4.0		4.0	4.0			4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00			1.00	
Frbp, ped/bikes		1.00			1.00		1.00	1.00			1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00			1.00	
Frt		0.97			0.99		1.00	0.92			0.98	
Flt Protected		0.99			0.98		0.95	1.00			1.00	
Satd. Flow (prot)		1427			1442		1607	1479			1454	
Flt Permitted		0.86			0.51		0.44	1.00			0.56	
Satd. Flow (perm)		1232			754		746	1479			817	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	60	213	77	236	191	35	106	364	436	26	196	37
RTOR Reduction (vph)	0	11	0	0	3	0	0	48	0	0	7	0
Lane Group Flow (vph)	0	339	0	0	459	0	106	752	0	0	252	0
Confl. Peds. (#/hr)	5		1	1		5	2					2
Heavy Vehicles (%)	2%	7%	2%	3%	7%	3%	6%	3%	4%	14%	4%	3%
Turn Type	Perm			pm+pt			pm+pt			Perm		
Protected Phases		2		1	6		7	4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)		26.0			38.0		40.0	40.0			29.0	
Effective Green, g (s)		28.0			40.0		40.0	42.0			31.0	
Actuated g/C Ratio		0.31			0.44		0.44	0.47			0.34	
Clearance Time (s)		6.0			6.0		4.0	6.0			6.0	
Lane Grp Cap (vph)		383			412		399	690			281	
v/s Ratio Prot					c0.12		0.02	c0.51				
v/s Ratio Perm		c0.28			0.37		0.10				0.31	
v/c Ratio		0.89			1.11		0.27	1.09			0.90	
Uniform Delay, d1		29.5			25.0		15.9	24.0			28.0	
Progression Factor		1.00			1.00		1.00	1.00			1.00	
Incremental Delay, d2		24.5			78.8		1.6	61.3			32.9	
Delay (s)		54.0			103.8		17.5	85.3			60.9	
Level of Service		D			F		B	F			E	
Approach Delay (s)		54.0			103.8			77.4			60.9	
Approach LOS		D			F			E			E	

### Intersection Summary

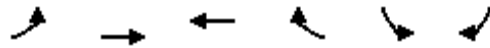
HCM Average Control Delay	77.3	HCM Level of Service	E
HCM Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	117.4%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

# HCM Unsignalized Intersection Capacity Analysis

## 10: Sawmill Road & Katherine Street

1/29/2010



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	262	356	530	214	120	28
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	262	356	530	214	120	28
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	744				1517	637
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	744				1517	637
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	70				0	94
cM capacity (veh/h)	868				90	481

















Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	618	744	148
Volume Left	262	0	120
Volume Right	0	214	28
cSH	868	1700	107
Volume to Capacity	0.30	0.44	1.39
Queue Length 95th (m)	9.7	0.0	79.6
Control Delay (s)	7.0	0.0	296.1
Lane LOS	A		F
Approach Delay (s)	7.0	0.0	296.1
Approach LOS			F

Intersection Summary			
Average Delay		31.9	
Intersection Capacity Utilization		104.4%	ICU Level of Service
Analysis Period (min)		15	G

# HCM Unsignalized Intersection Capacity Analysis

## 13: Driveway & Sawmill Road

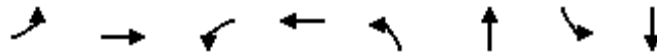
1/29/2010

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	3	1	10	121	2	102	5	436	100	104	379	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour 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
Hourly flow rate (vph)	3	1	10	121	2	102	5	436	100	104	379	1
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1186	1134	380	1094	1084	486	380			536		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1186	1134	380	1094	1084	486	380			536		
tC, single (s)	7.1	6.5	6.2	7.2	6.5	6.2	4.1			4.2		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.6	4.0	3.3	2.2			2.3		
p0 queue free %	98	99	99	28	99	82	100			90		
cM capacity (veh/h)	125	183	672	169	195	579	1190			1007		
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>WB 1</b>	<b>NB 1</b>	<b>SB 1</b>								
Volume Total	14	225	541	484								
Volume Left	3	121	5	104								
Volume Right	10	102	100	1								
cSH	316	249	1190	1007								
Volume to Capacity	0.04	0.90	0.00	0.10								
Queue Length 95th (m)	1.1	59.4	0.1	2.6								
Control Delay (s)	16.9	77.5	0.1	2.9								
Lane LOS	C	F	A	A								
Approach Delay (s)	16.9	77.5	0.1	2.9								
Approach LOS	C	F										
<b>Intersection Summary</b>												
Average Delay			15.1									
Intersection Capacity Utilization			99.2%		ICU Level of Service				F			
Analysis Period (min)			15									

# Timings

## 3: Sawmill Road & Northfield Drive

1/29/2010

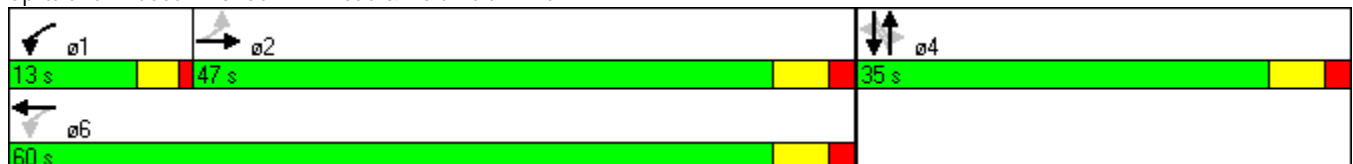


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		↕		↕	↗	↖		↕
Volume (vph)	32	132	355	165	60	101	16	301
Turn Type	Perm		pm+pt		Perm		Perm	
Protected Phases		2	1	6		4		4
Permitted Phases	2		6		4		4	
Detector Phase	2	2	1	6	4	4	4	4
Switch Phase								
Minimum Initial (s)	8.0	8.0	4.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	36.0	36.0	9.0	36.0	32.0	32.0	32.0	32.0
Total Split (s)	47.0	47.0	13.0	60.0	35.0	35.0	35.0	35.0
Total Split (%)	49.5%	49.5%	13.7%	63.2%	36.8%	36.8%	36.8%	36.8%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	0.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Act Effect Green (s)		43.0		56.0	31.0	31.0		31.0
Actuated g/C Ratio		0.45		0.59	0.33	0.33		0.33
v/c Ratio		0.39		0.88	0.31	0.64		0.80
Control Delay		17.8		33.5	29.7	22.1		43.0
Queue Delay		0.0		0.0	0.0	0.0		0.0
Total Delay		17.8		33.5	29.7	22.1		43.0
LOS		B		C	C	C		D
Approach Delay		17.8		33.5		23.2		43.0
Approach LOS		B		C		C		D

### Intersection Summary

Cycle Length: 95  
 Actuated Cycle Length: 95  
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green  
 Natural Cycle: 90  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.88  
 Intersection Signal Delay: 30.9  
 Intersection LOS: C  
 Intersection Capacity Utilization 111.5%  
 ICU Level of Service H  
 Analysis Period (min) 15

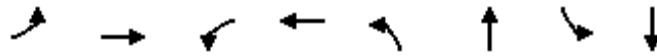
Splits and Phases: 3: Sawmill Road & Northfield Drive



# Phasings

## 3: Sawmill Road & Northfield Drive

1/29/2010



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Protected Phases		2	1	6		4		4
Permitted Phases	2		6		4		4	
Minimum Initial (s)	8.0	8.0	4.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	36.0	36.0	9.0	36.0	32.0	32.0	32.0	32.0
Total Split (s)	47.0	47.0	13.0	60.0	35.0	35.0	35.0	35.0
Total Split (%)	49.5%	49.5%	13.7%	63.2%	36.8%	36.8%	36.8%	36.8%
Maximum Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	2.0	2.0
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Walk Time (s)	14.0	14.0		14.0	19.0	19.0	19.0	19.0
Flash Dont Walk (s)	16.0	16.0		16.0	7.0	7.0	7.0	7.0
Pedestrian Calls (#/hr)	0	0		0	0	0	0	0
90th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
90th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
70th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
70th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
50th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
50th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
30th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
30th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
10th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
10th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR

### Intersection Summary

Cycle Length: 95

Actuated Cycle Length: 95

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Pretimed

## Queues

### 3: Sawmill Road & Northfield Drive

1/29/2010



Lane Group	EBT	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	221	531	60	358	387
v/c Ratio	0.39	0.88	0.31	0.64	0.80
Control Delay	17.8	33.5	29.7	22.1	43.0
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	17.8	33.5	29.7	22.1	43.0
Queue Length 50th (m)	23.0	57.9	8.2	32.9	62.4
Queue Length 95th (m)	41.2	#122.0	19.3	63.6	#108.9
Internal Link Dist (m)	1940.2	1158.8		681.9	899.0
Turn Bay Length (m)			7.0		
Base Capacity (vph)	567	604	192	557	481
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	0.39	0.88	0.31	0.64	0.80

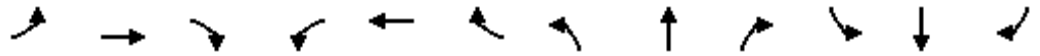
#### Intersection Summary

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

# HCM Signalized Intersection Capacity Analysis

## 3: Sawmill Road & Northfield Drive

1/29/2010



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↗	↘			↕	
Volume (vph)	32	132	57	355	165	11	60	101	257	16	301	70
Ideal Flow (vphpl)	1900	1550	1900	1900	1550	1900	1775	1650	1900	1900	1550	1900
Total Lost time (s)		4.0			4.0		4.0	4.0			4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00			1.00	
Frbp, ped/bikes		0.99			1.00		1.00	1.00			1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00			1.00	
Frt		0.97			1.00		1.00	0.89			0.98	
Flt Protected		0.99			0.97		0.95	1.00			1.00	
Satd. Flow (prot)		1363			1461		1608	1414			1479	
Flt Permitted		0.89			0.62		0.35	1.00			0.98	
Satd. Flow (perm)		1224			941		588	1414			1449	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	32	132	57	355	165	11	60	101	257	16	301	70
RTOR Reduction (vph)	0	13	0	0	1	0	0	96	0	0	8	0
Lane Group Flow (vph)	0	208	0	0	530	0	60	262	0	0	379	0
Confl. Peds. (#/hr)			2	2								
Heavy Vehicles (%)	30%	7%	4%	2%	6%	11%	6%	6%	5%	8%	2%	7%
Turn Type	Perm			pm+pt			Perm			Perm		
Protected Phases		2		1	6			4			4	
Permitted Phases	2			6			4			4		
Actuated Green, G (s)		41.0			54.0		29.0	29.0			29.0	
Effective Green, g (s)		43.0			56.0		31.0	31.0			31.0	
Actuated g/C Ratio		0.45			0.59		0.33	0.33			0.33	
Clearance Time (s)		6.0			6.0		6.0	6.0			6.0	
Lane Grp Cap (vph)		554			615		192	461			473	
v/s Ratio Prot					c0.10			0.19				
v/s Ratio Perm		0.17			0.41		0.10				c0.26	
v/c Ratio		0.38			0.86		0.31	0.57			0.80	
Uniform Delay, d1		17.1			16.3		24.0	26.5			29.2	
Progression Factor		1.00			1.00		1.00	1.00			1.00	
Incremental Delay, d2		1.9			14.8		4.2	5.0			13.3	
Delay (s)		19.1			31.1		28.2	31.5			42.5	
Level of Service		B			C		C	C			D	
Approach Delay (s)		19.1			31.1			31.0			42.5	
Approach LOS		B			C			C			D	

### Intersection Summary

HCM Average Control Delay	32.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	111.5%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

# Timings

## 10: Sawmill Road & Crowsfoot Road

1/29/2010

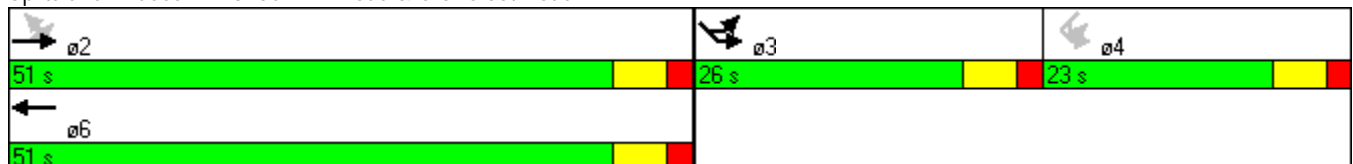


Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Lane Configurations						
Volume (vph)	32	129	192	267	146	8
Turn Type	Perm	Perm				
Protected Phases			2	6	3	
Permitted Phases	2	2		6		4
Detector Phase	2	2	2	6	3	4
Switch Phase						
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	22.0	22.0	22.0	22.0	22.0	22.0
Total Split (s)	51.0	51.0	51.0	51.0	26.0	23.0
Total Split (%)	51.0%	51.0%	51.0%	51.0%	26.0%	23.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag					Lead	Lag
Lead-Lag Optimize?					Yes	Yes
Recall Mode	Max	Max	Max	Max	Max	Max
Act Effect Green (s)		47.0	47.0	47.0	22.0	19.0
Actuated g/C Ratio		0.47	0.47	0.47	0.22	0.19
v/c Ratio		0.42	0.26	0.49	0.74	0.51
Control Delay		21.9	17.2	21.2	50.8	43.3
Queue Delay		0.0	0.0	0.0	0.0	0.0
Total Delay		21.9	17.2	21.2	50.8	43.3
LOS		C	B	C	D	D
Approach Delay			19.3	21.2	50.8	43.3
Approach LOS			B	C	D	D

### Intersection Summary

Cycle Length: 100  
 Actuated Cycle Length: 100  
 Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green  
 Natural Cycle: 70  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.74  
 Intersection Signal Delay: 30.3  
 Intersection LOS: C  
 Intersection Capacity Utilization 69.5%  
 ICU Level of Service C  
 Analysis Period (min) 15

Splits and Phases: 10: Sawmill Road & Crowsfoot Road



# Phasings

## 10: Sawmill Road & Crowsfoot Road

1/29/2010



Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Protected Phases			2	6	3	
Permitted Phases	2	2		6		4
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	22.0	22.0	22.0	22.0	22.0	22.0
Total Split (s)	51.0	51.0	51.0	51.0	26.0	23.0
Total Split (%)	51.0%	51.0%	51.0%	51.0%	26.0%	23.0%
Maximum Green (s)	45.0	45.0	45.0	45.0	20.0	17.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lead/Lag					Lead	Lag
Lead-Lag Optimize?					Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max
Walk Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0	0	0	0	0
90th %ile Green (s)	45.0	45.0	45.0	45.0	20.0	17.0
90th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
70th %ile Green (s)	45.0	45.0	45.0	45.0	20.0	17.0
70th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
50th %ile Green (s)	45.0	45.0	45.0	45.0	20.0	17.0
50th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
30th %ile Green (s)	45.0	45.0	45.0	45.0	20.0	17.0
30th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
10th %ile Green (s)	45.0	45.0	45.0	45.0	20.0	17.0
10th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR

### Intersection Summary

Cycle Length: 100

Actuated Cycle Length: 100

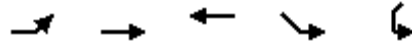
Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Pretimed

# Queues

## 10: Sawmill Road & Crowsfoot Road

1/29/2010



Lane Group	EBL	EBT	WBT	SEL	SWL
Lane Group Flow (vph)	161	192	343	248	147
v/c Ratio	0.42	0.26	0.49	0.74	0.51
Control Delay	21.9	17.2	21.2	50.8	43.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	21.9	17.2	21.2	50.8	43.3
Queue Length 50th (m)	20.0	21.7	44.2	45.0	25.8
Queue Length 95th (m)	37.4	36.2	68.9	#78.8	45.1
Internal Link Dist (m)		209.3	244.6	967.8	525.7
Turn Bay Length (m)	60.0				
Base Capacity (vph)	382	740	701	337	290
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	0.42	0.26	0.49	0.74	0.51

### Intersection Summary

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

# HCM Signalized Intersection Capacity Analysis

## 10: Sawmill Road & Crowsfoot Road

1/29/2010



Movement	EBL2	EBL	EBT	WBT	WBR	WBR2	SEL2	SEL	SER	SWL	SWR	SWR2
Lane Configurations												
Volume (vph)	32	129	192	267	71	5	1	146	101	8	135	4
Ideal Flow (vphpl)	1900	1775	1650	1650	1900	1900	1900	1765	1900	1765	1900	1900
Total Lost time (s)		4.0	4.0	4.0				4.0		4.0		
Lane Util. Factor		1.00	1.00	1.00				1.00		1.00		
Frt		1.00	1.00	0.97				0.95		0.87		
Flt Protected		0.95	1.00	1.00				0.97		1.00		
Satd. Flow (prot)		1695	1574	1492				1534		1553		
Flt Permitted		0.45	1.00	1.00				0.97		0.98		
Satd. Flow (perm)		811	1574	1492				1534		1527		
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	32	129	192	267	71	5	1	146	101	8	135	4
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	161	192	343	0	0	0	248	0	147	0	0
Heavy Vehicles (%)	3%	0%	6%	9%	7%	0%	0%	6%	8%	0%	0%	0%
Turn Type	Perm	Perm					Split					
Protected Phases			2	6			3	3				
Permitted Phases	2	2		6						4		
Actuated Green, G (s)		45.0	45.0	45.0				20.0		17.0		
Effective Green, g (s)		47.0	47.0	47.0				22.0		19.0		
Actuated g/C Ratio		0.47	0.47	0.47				0.22		0.19		
Clearance Time (s)		6.0	6.0	6.0				6.0		6.0		
Lane Grp Cap (vph)		381	740	701				337		290		
v/s Ratio Prot			0.12	c0.23				c0.16				
v/s Ratio Perm		0.20								c0.10		
v/c Ratio		0.42	0.26	0.49				0.74		0.51		
Uniform Delay, d1		17.5	16.0	18.2				36.3		36.3		
Progression Factor		1.00	1.00	1.00				1.00		1.00		
Incremental Delay, d2		3.4	0.9	2.4				13.4		6.2		
Delay (s)		20.9	16.8	20.7				49.7		42.5		
Level of Service		C	B	C				D		D		
Approach Delay (s)			18.7	20.7				49.7		42.5		
Approach LOS			B	C				D		D		

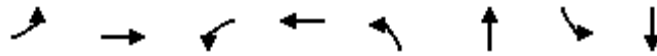
### Intersection Summary

HCM Average Control Delay	29.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	69.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

# Timings

## 3: Sawmill Road & Northfield Drive

1/29/2010

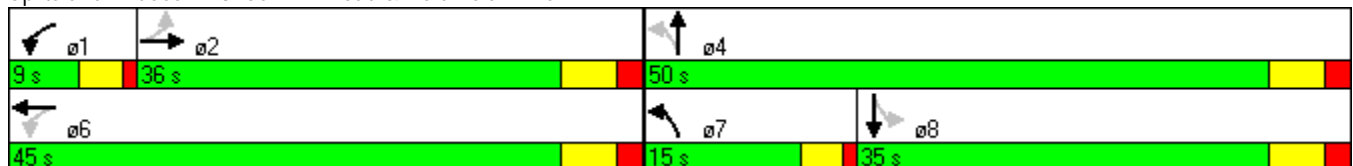


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		↕		↕	↗	↖		↕
Volume (vph)	60	213	236	191	106	364	26	196
Turn Type	Perm		pm+pt		pm+pt		Perm	
Protected Phases		2	1	6	7	4		8
Permitted Phases	2		6		4		8	
Detector Phase	2	2	1	6	7	4	8	8
Switch Phase								
Minimum Initial (s)	8.0	8.0	4.0	8.0	4.0	8.0	8.0	8.0
Minimum Split (s)	32.0	32.0	9.0	34.0	8.0	35.0	35.0	35.0
Total Split (s)	36.0	36.0	9.0	45.0	15.0	50.0	35.0	35.0
Total Split (%)	37.9%	37.9%	9.5%	47.4%	15.8%	52.6%	36.8%	36.8%
Yellow Time (s)	4.0	4.0	3.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	0.0	-2.0	0.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lead		Lead		Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes		Yes		Yes	Yes
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Act Effect Green (s)		32.0		41.0	46.0	46.0		31.0
Actuated g/C Ratio		0.34		0.43	0.48	0.48		0.33
v/c Ratio		0.82		1.23	0.24	1.05		0.84
Control Delay		45.3		151.8	15.0	70.0		53.3
Queue Delay		0.0		0.0	0.0	0.0		0.0
Total Delay		45.3		151.8	15.0	70.0		53.3
LOS		D		F	B	E		D
Approach Delay		45.3		151.8		63.6		53.3
Approach LOS		D		F		E		D

### Intersection Summary

Cycle Length: 95  
 Actuated Cycle Length: 95  
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green  
 Natural Cycle: 85  
 Control Type: Pretimed  
 Maximum v/c Ratio: 1.23  
 Intersection Signal Delay: 79.6  
 Intersection LOS: E  
 Intersection Capacity Utilization 117.3%  
 ICU Level of Service H  
 Analysis Period (min) 15

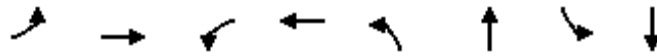
### Splits and Phases: 3: Sawmill Road & Northfield Drive



# Phasings

## 3: Sawmill Road & Northfield Drive

1/29/2010



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Protected Phases		2	1	6	7	4		8
Permitted Phases	2		6		4		8	
Minimum Initial (s)	8.0	8.0	4.0	8.0	4.0	8.0	8.0	8.0
Minimum Split (s)	32.0	32.0	9.0	34.0	8.0	35.0	35.0	35.0
Total Split (s)	36.0	36.0	9.0	45.0	15.0	50.0	35.0	35.0
Total Split (%)	37.9%	37.9%	9.5%	47.4%	15.8%	52.6%	36.8%	36.8%
Maximum Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
Yellow Time (s)	4.0	4.0	3.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	1.0	2.0	2.0	2.0
Lead/Lag	Lag	Lag	Lead		Lead		Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes		Yes		Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Walk Time (s)	10.0	10.0		10.0		22.0	22.0	22.0
Flash Dont Walk (s)	16.0	16.0		16.0		7.0	7.0	7.0
Pedestrian Calls (#/hr)	0	0		0		0	0	0
90th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
90th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
70th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
70th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
50th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
50th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
30th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
30th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
10th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
10th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR

### Intersection Summary

Cycle Length: 95

Actuated Cycle Length: 95

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Pretimed

## Queues

### 3: Sawmill Road & Northfield Drive

1/29/2010



Lane Group	EBT	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	350	462	106	800	259
v/c Ratio	0.82	1.23	0.24	1.05	0.84
Control Delay	45.3	151.8	15.0	70.0	53.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	45.3	151.8	15.0	70.0	53.3
Queue Length 50th (m)	55.9	~93.5	10.3	~152.4	42.3
Queue Length 95th (m)	#102.9	#164.6	19.5	#221.9	#86.0
Internal Link Dist (m)	1940.2	1158.8		681.9	899.0
Turn Bay Length (m)			7.0		
Base Capacity (vph)	426	375	451	762	310
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	0.82	1.23	0.24	1.05	0.84

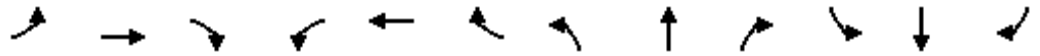
#### Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

# HCM Signalized Intersection Capacity Analysis

## 3: Sawmill Road & Northfield Drive

1/29/2010



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↗	↘			↕	
Volume (vph)	60	213	77	236	191	35	106	364	436	26	196	37
Ideal Flow (vphpl)	1900	1550	1900	1900	1550	1900	1775	1650	1900	1900	1550	1900
Total Lost time (s)		4.0			4.0		4.0	4.0			4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00			1.00	
Frbp, ped/bikes		0.99			1.00		1.00	1.00			1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00			1.00	
Frt		0.97			0.99		1.00	0.92			0.98	
Flt Protected		0.99			0.98		0.95	1.00			1.00	
Satd. Flow (prot)		1428			1445		1608	1479			1458	
Flt Permitted		0.86			0.53		0.43	1.00			0.63	
Satd. Flow (perm)		1235			783		720	1479			929	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	60	213	77	236	191	35	106	364	436	26	196	37
RTOR Reduction (vph)	0	11	0	0	3	0	0	45	0	0	6	0
Lane Group Flow (vph)	0	339	0	0	459	0	106	755	0	0	253	0
Confl. Peds. (#/hr)			2	2								
Heavy Vehicles (%)	2%	7%	2%	3%	7%	3%	6%	3%	4%	14%	4%	3%
Turn Type	Perm			pm+pt			pm+pt			Perm		
Protected Phases		2		1	6		7	4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)		30.0			39.0		44.0	44.0			29.0	
Effective Green, g (s)		32.0			41.0		44.0	46.0			31.0	
Actuated g/C Ratio		0.34			0.43		0.46	0.48			0.33	
Clearance Time (s)		6.0			6.0		4.0	6.0			6.0	
Lane Grp Cap (vph)		416			387		436	716			303	
v/s Ratio Prot					c0.09		0.03	c0.51				
v/s Ratio Perm		c0.27			0.43		0.08				0.27	
v/c Ratio		0.82			1.19		0.24	1.05			0.83	
Uniform Delay, d1		28.8			27.0		15.8	24.5			29.6	
Progression Factor		1.00			1.00		1.00	1.00			1.00	
Incremental Delay, d2		16.1			107.1		1.3	48.7			22.9	
Delay (s)		44.9			134.1		17.1	73.2			52.6	
Level of Service		D			F		B	E			D	
Approach Delay (s)		44.9			134.1			66.7			52.6	
Approach LOS		D			F			E			D	

### Intersection Summary

HCM Average Control Delay	76.7	HCM Level of Service	E
HCM Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	117.3%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

# Timings

## 10: Sawmill Road & Crowsfoot Road

1/29/2010

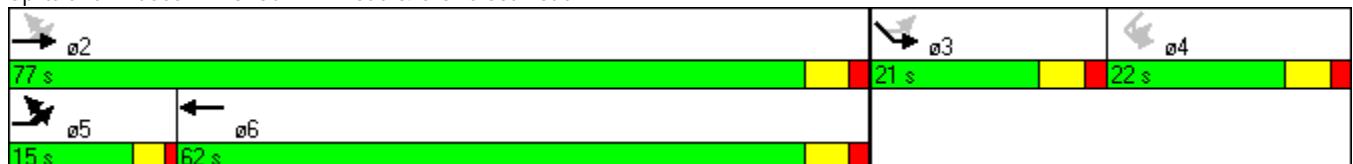


Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Lane Configurations						
Volume (vph)	90	172	356	423	120	7
Turn Type	pm+pt	pm+pt				
Protected Phases	5	5	2	6	3	
Permitted Phases	2	2		6		4
Detector Phase	5	5	2	6	3	4
Switch Phase						
Minimum Initial (s)	5.0	5.0	8.0	8.0	8.0	8.0
Minimum Split (s)	9.0	9.0	22.0	22.0	22.0	22.0
Total Split (s)	15.0	15.0	77.0	62.0	21.0	22.0
Total Split (%)	12.5%	12.5%	64.2%	51.7%	17.5%	18.3%
Yellow Time (s)	3.0	3.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead		Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes
Recall Mode	Max	Max	Max	Max	Max	Max
Act Effct Green (s)		73.0	73.0	58.0	17.0	18.0
Actuated g/C Ratio		0.61	0.61	0.48	0.14	0.15
v/c Ratio		0.83	0.37	0.87	0.66	0.51
Control Delay		34.9	13.2	42.2	63.5	55.8
Queue Delay		0.0	0.0	0.0	0.0	0.0
Total Delay		34.9	13.2	42.2	63.5	55.8
LOS		C	B	D	E	E
Approach Delay			22.4	42.2	63.5	55.8
Approach LOS			C	D	E	E

### Intersection Summary

Cycle Length: 120  
 Actuated Cycle Length: 120  
 Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green  
 Natural Cycle: 100  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.87  
 Intersection Signal Delay: 37.3  
 Intersection LOS: D  
 Intersection Capacity Utilization 87.0%  
 ICU Level of Service E  
 Analysis Period (min) 15

Splits and Phases: 10: Sawmill Road & Crowsfoot Road



# Phasings

## 10: Sawmill Road & Crowsfoot Road

1/29/2010



Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Protected Phases	5	5	2	6	3	
Permitted Phases	2	2		6		4
Minimum Initial (s)	5.0	5.0	8.0	8.0	8.0	8.0
Minimum Split (s)	9.0	9.0	22.0	22.0	22.0	22.0
Total Split (s)	15.0	15.0	77.0	62.0	21.0	22.0
Total Split (%)	12.5%	12.5%	64.2%	51.7%	17.5%	18.3%
Maximum Green (s)	11.0	11.0	71.0	56.0	15.0	16.0
Yellow Time (s)	3.0	3.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	2.0	2.0	2.0	2.0
Lead/Lag	Lead	Lead		Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max
Walk Time (s)			5.0	5.0	5.0	5.0
Flash Dont Walk (s)			11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)			0	0	0	0
90th %ile Green (s)	11.0	11.0	71.0	56.0	15.0	16.0
90th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	MaxR
70th %ile Green (s)	11.0	11.0	71.0	56.0	15.0	16.0
70th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	MaxR
50th %ile Green (s)	11.0	11.0	71.0	56.0	15.0	16.0
50th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	MaxR
30th %ile Green (s)	11.0	11.0	71.0	56.0	15.0	16.0
30th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	MaxR
10th %ile Green (s)	11.0	11.0	71.0	56.0	15.0	16.0
10th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	MaxR

### Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 120

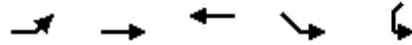
Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Pretimed

# Queues

## 10: Sawmill Road & Crowsfoot Road

1/29/2010



Lane Group	EBL	EBT	WBT	SEL	SWL
Lane Group Flow (vph)	262	356	647	150	116
v/c Ratio	0.83	0.37	0.87	0.66	0.51
Control Delay	34.9	13.2	42.2	63.5	55.8
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	34.9	13.2	42.2	63.5	55.8
Queue Length 50th (m)	26.9	39.7	132.3	33.9	25.5
Queue Length 95th (m)	#54.9	58.4	#204.4	#58.9	44.6
Internal Link Dist (m)		209.3	244.6	967.8	1075.3
Turn Bay Length (m)	60.0				
Base Capacity (vph)	316	967	742	228	227
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	0.83	0.37	0.87	0.66	0.51

### Intersection Summary

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

# HCM Signalized Intersection Capacity Analysis

## 10: Sawmill Road & Crowsfoot Road

1/29/2010



Movement	EBL2	EBL	EBT	WBT	WBR	WBR2	SEL2	SEL	SER	SWL	SWR	SWR2
Lane Configurations												
Volume (vph)	90	172	356	423	214	10	2	120	28	7	107	2
Ideal Flow (vphpl)	1900	1775	1650	1650	1900	1900	1900	1765	1900	1765	1900	1900
Total Lost time (s)		4.0	4.0	4.0				4.0		4.0		
Lane Util. Factor		1.00	1.00	1.00				1.00		1.00		
Frt		1.00	1.00	0.95				0.97		0.87		
Flt Protected		0.95	1.00	1.00				0.96		1.00		
Satd. Flow (prot)		1688	1589	1535				1607		1554		
Flt Permitted		0.18	1.00	1.00				0.96		0.97		
Satd. Flow (perm)		313	1589	1535				1607		1515		
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	90	172	356	423	214	10	2	120	28	7	107	2
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	262	356	647	0	0	0	150	0	116	0	0
Heavy Vehicles (%)	3%	0%	5%	5%	1%	0%	0%	5%	0%	0%	0%	0%
Turn Type	pm+pt	pm+pt						Perm				
Protected Phases	5	5	2	6				3				
Permitted Phases	2	2		6			3			4		
Actuated Green, G (s)		71.0	71.0	56.0				15.0		16.0		
Effective Green, g (s)		71.0	73.0	58.0				17.0		18.0		
Actuated g/C Ratio		0.59	0.61	0.48				0.14		0.15		
Clearance Time (s)		4.0	6.0	6.0				6.0		6.0		
Lane Grp Cap (vph)		311	967	742				228		227		
v/s Ratio Prot		c0.08	0.22	c0.42								
v/s Ratio Perm		0.42						0.09		c0.08		
v/c Ratio		0.84	0.37	0.87				0.66		0.51		
Uniform Delay, d1		19.6	11.9	27.7				48.7		46.9		
Progression Factor		1.00	1.00	1.00				1.00		1.00		
Incremental Delay, d2		23.3	1.1	13.4				13.9		8.0		
Delay (s)		42.9	12.9	41.1				62.7		54.9		
Level of Service		D	B	D				E		D		
Approach Delay (s)			25.6	41.1				62.7		54.9		
Approach LOS			C	D				E		D		

### Intersection Summary

HCM Average Control Delay	38.0	HCM Level of Service	D
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	87.0%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

# APPENDIX E

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## SYNCHRO WORKSHEETS – SCENARIO 1 AND SCENARIO 2

Volume

3: Sawmill Road & Northfield Drive

1/29/2010



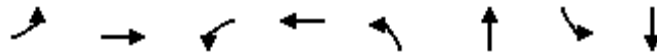
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Volume (vph)	33	132	57	365	165	11	60	106	267	16	306	71
Confl. Peds. (#/hr)			2	2								
Confl. Bikes (#/hr)												
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	32%	7%	4%	5%	6%	11%	6%	10%	9%	8%	4%	8%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	33	132	57	365	165	11	60	106	267	16	306	71
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	222	0	0	541	0	60	373	0	0	393	0

Intersection Summary

# Timings

## 3: Sawmill Road & Northfield Drive

1/29/2010

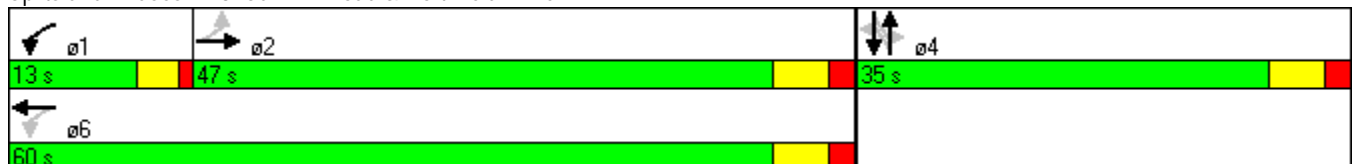


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		↕		↕	↗	↖		↕
Volume (vph)	33	132	365	165	60	106	16	306
Turn Type	Perm		pm+pt		Perm		Perm	
Protected Phases		2	1	6		4		4
Permitted Phases	2		6		4		4	
Detector Phase	2	2	1	6	4	4	4	4
Switch Phase								
Minimum Initial (s)	8.0	8.0	4.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	36.0	36.0	9.0	36.0	32.0	32.0	32.0	32.0
Total Split (s)	47.0	47.0	13.0	60.0	35.0	35.0	35.0	35.0
Total Split (%)	49.5%	49.5%	13.7%	63.2%	36.8%	36.8%	36.8%	36.8%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	0.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Act Effect Green (s)		43.0		56.0	31.0	31.0		31.0
Actuated g/C Ratio		0.45		0.59	0.33	0.33		0.33
v/c Ratio		0.40		0.92	0.32	0.69		0.83
Control Delay		17.9		39.1	29.9	24.5		45.6
Queue Delay		0.0		0.0	0.0	0.0		0.0
Total Delay		17.9		39.1	29.9	24.5		45.6
LOS		B		D	C	C		D
Approach Delay		17.9		39.1		25.3		45.6
Approach LOS		B		D		C		D

### Intersection Summary

Cycle Length: 95  
 Actuated Cycle Length: 95  
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green  
 Natural Cycle: 90  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.92  
 Intersection Signal Delay: 34.0  
 Intersection LOS: C  
 Intersection Capacity Utilization 112.6%  
 ICU Level of Service H  
 Analysis Period (min) 15

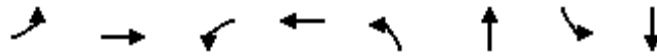
### Splits and Phases: 3: Sawmill Road & Northfield Drive



# Phasings

## 3: Sawmill Road & Northfield Drive

1/29/2010



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Protected Phases		2	1	6		4		4
Permitted Phases	2		6		4		4	
Minimum Initial (s)	8.0	8.0	4.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	36.0	36.0	9.0	36.0	32.0	32.0	32.0	32.0
Total Split (s)	47.0	47.0	13.0	60.0	35.0	35.0	35.0	35.0
Total Split (%)	49.5%	49.5%	13.7%	63.2%	36.8%	36.8%	36.8%	36.8%
Maximum Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	2.0	2.0
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Walk Time (s)	14.0	14.0		14.0	19.0	19.0	19.0	19.0
Flash Dont Walk (s)	16.0	16.0		16.0	7.0	7.0	7.0	7.0
Pedestrian Calls (#/hr)	0	0		0	0	0	0	0
90th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
90th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
70th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
70th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
50th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
50th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
30th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
30th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
10th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
10th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR

### Intersection Summary

Cycle Length: 95

Actuated Cycle Length: 95

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Pretimed

## Queues

### 3: Sawmill Road & Northfield Drive

1/29/2010



Lane Group	EBT	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	222	541	60	373	393
v/c Ratio	0.40	0.92	0.32	0.69	0.83
Control Delay	17.9	39.1	29.9	24.5	45.6
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	17.9	39.1	29.9	24.5	45.6
Queue Length 50th (m)	23.2	60.3	8.2	36.5	64.2
Queue Length 95th (m)	41.5	#137.3	19.3	69.7	#113.6
Internal Link Dist (m)	1940.2	1158.8		681.9	899.0
Turn Bay Length (m)			7.0		
Base Capacity (vph)	562	591	189	540	473
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	0.40	0.92	0.32	0.69	0.83

#### Intersection Summary

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

# HCM Signalized Intersection Capacity Analysis

## 3: Sawmill Road & Northfield Drive

1/29/2010



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↕	↕			↕	
Volume (vph)	33	132	57	365	165	11	60	106	267	16	306	71
Ideal Flow (vphpl)	1900	1550	1900	1900	1550	1900	1775	1650	1900	1900	1550	1900
Total Lost time (s)		4.0			4.0		4.0	4.0			4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00			1.00	
Frbp, ped/bikes		0.99			1.00		1.00	1.00			1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00			1.00	
Frt		0.97			1.00		1.00	0.89			0.98	
Flt Protected		0.99			0.97		0.95	1.00			1.00	
Satd. Flow (prot)		1358			1433		1608	1363			1455	
Flt Permitted		0.89			0.62		0.34	1.00			0.98	
Satd. Flow (perm)		1213			919		579	1363			1425	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	33	132	57	365	165	11	60	106	267	16	306	71
RTOR Reduction (vph)	0	13	0	0	1	0	0	96	0	0	8	0
Lane Group Flow (vph)	0	209	0	0	540	0	60	277	0	0	385	0
Confl. Peds. (#/hr)			2	2								
Heavy Vehicles (%)	32%	7%	4%	5%	6%	11%	6%	10%	9%	8%	4%	8%
Turn Type	Perm			pm+pt			Perm			Perm		
Protected Phases		2		1	6			4			4	
Permitted Phases	2			6			4			4		
Actuated Green, G (s)		41.0			54.0		29.0	29.0			29.0	
Effective Green, g (s)		43.0			56.0		31.0	31.0			31.0	
Actuated g/C Ratio		0.45			0.59		0.33	0.33			0.33	
Clearance Time (s)		6.0			6.0		6.0	6.0			6.0	
Lane Grp Cap (vph)		549			601		189	445			465	
v/s Ratio Prot					c0.10			0.20				
v/s Ratio Perm		0.17			0.43		0.10				c0.27	
v/c Ratio		0.38			0.90		0.32	0.62			0.83	
Uniform Delay, d1		17.2			17.0		24.0	27.1			29.5	
Progression Factor		1.00			1.00		1.00	1.00			1.00	
Incremental Delay, d2		2.0			18.8		4.4	6.4			15.5	
Delay (s)		19.2			35.8		28.4	33.5			45.0	
Level of Service		B			D		C	C			D	
Approach Delay (s)		19.2			35.8			32.8			45.0	
Approach LOS		B			D			C			D	

### Intersection Summary













HCM Average Control Delay	35.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	112.6%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Volume

13: Driveway & Sawmill Road

















1/29/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Volume (vph)	2	1	3	132	1	111	1	224	107	76	294	1
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour 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
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	0%	0%	0%	4%	0%	8%	0%	7%	4%	4%	5%	0%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	2	1	3	132	1	111	1	224	107	76	294	1
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	6	0	0	244	0	0	332	0	0	371	0
Intersection Summary												

# HCM Unsignalized Intersection Capacity Analysis

## 13: Driveway & Sawmill Road

1/29/2010

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	1	3	132	1	111	1	224	107	76	294	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour 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
Hourly flow rate (vph)	2	1	3	132	1	111	1	224	107	76	294	1
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	838	780	294	730	726	278	295			331		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	838	780	294	730	726	278	295			331		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.3	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.4	2.2			2.2		
p0 queue free %	99	100	100	58	100	85	100			94		
cM capacity (veh/h)	233	308	750	317	331	747	1278			1217		
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>WB 1</b>	<b>NB 1</b>	<b>SB 1</b>								
Volume Total	6	244	332	371								
Volume Left	2	132	1	76								
Volume Right	3	111	107	1								
cSH	379	430	1278	1217								
Volume to Capacity	0.02	0.57	0.00	0.06								
Queue Length 95th (m)	0.4	26.1	0.0	1.5								
Control Delay (s)	14.6	23.8	0.0	2.2								
Lane LOS	B	C	A	A								
Approach Delay (s)	14.6	23.8	0.0	2.2								
Approach LOS	B	C										
<b>Intersection Summary</b>												
Average Delay			7.0									
Intersection Capacity Utilization			79.7%		ICU Level of Service					D		
Analysis Period (min)			15									

# Timings

## 10: Sawmill Road & Crowsfoot Road

1/29/2010

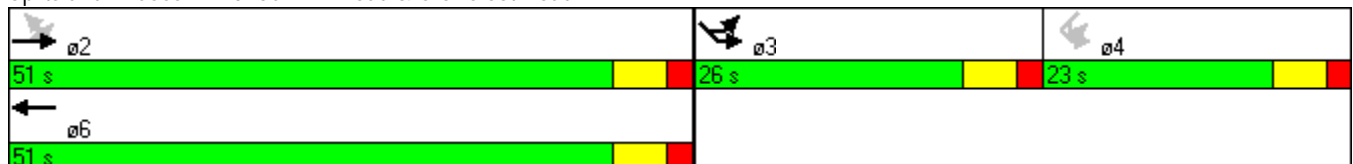


Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Lane Configurations						
Volume (vph)	42	129	192	267	146	8
Turn Type	Perm	Perm				
Protected Phases			2	6	3	
Permitted Phases	2	2		6		4
Detector Phase	2	2	2	6	3	4
Switch Phase						
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	22.0	22.0	22.0	22.0	22.0	22.0
Total Split (s)	51.0	51.0	51.0	51.0	26.0	23.0
Total Split (%)	51.0%	51.0%	51.0%	51.0%	26.0%	23.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag					Lead	Lag
Lead-Lag Optimize?					Yes	Yes
Recall Mode	Max	Max	Max	Max	Max	Max
Act Effect Green (s)		47.0	47.0	47.0	22.0	19.0
Actuated g/C Ratio		0.47	0.47	0.47	0.22	0.19
v/c Ratio		0.47	0.26	0.49	0.79	0.51
Control Delay		23.6	17.2	21.2	55.8	43.3
Queue Delay		0.0	0.0	0.0	0.0	0.0
Total Delay		23.6	17.2	21.2	55.8	43.3
LOS		C	B	C	E	D
Approach Delay			20.2	21.2	55.8	43.3
Approach LOS			C	C	E	D

### Intersection Summary

Cycle Length: 100  
 Actuated Cycle Length: 100  
 Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green  
 Natural Cycle: 70  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.79  
 Intersection Signal Delay: 31.8  
 Intersection LOS: C  
 Intersection Capacity Utilization 70.8%  
 ICU Level of Service C  
 Analysis Period (min) 15

Splits and Phases: 10: Sawmill Road & Crowsfoot Road



# Phasings

## 10: Sawmill Road & Crowsfoot Road

1/29/2010



Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Protected Phases			2	6	3	
Permitted Phases	2	2		6		4
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	22.0	22.0	22.0	22.0	22.0	22.0
Total Split (s)	51.0	51.0	51.0	51.0	26.0	23.0
Total Split (%)	51.0%	51.0%	51.0%	51.0%	26.0%	23.0%
Maximum Green (s)	45.0	45.0	45.0	45.0	20.0	17.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lead/Lag					Lead	Lag
Lead-Lag Optimize?					Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max
Walk Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0	0	0	0	0
90th %ile Green (s)	45.0	45.0	45.0	45.0	20.0	17.0
90th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
70th %ile Green (s)	45.0	45.0	45.0	45.0	20.0	17.0
70th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
50th %ile Green (s)	45.0	45.0	45.0	45.0	20.0	17.0
50th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
30th %ile Green (s)	45.0	45.0	45.0	45.0	20.0	17.0
30th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
10th %ile Green (s)	45.0	45.0	45.0	45.0	20.0	17.0
10th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR

### Intersection Summary

Cycle Length: 100

Actuated Cycle Length: 100

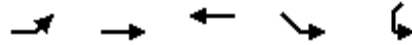
Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Pretimed

# Queues

## 10: Sawmill Road & Crowsfoot Road

1/29/2010



Lane Group	EBL	EBT	WBT	SEL	SWL
Lane Group Flow (vph)	171	192	343	258	147
v/c Ratio	0.47	0.26	0.49	0.79	0.51
Control Delay	23.6	17.2	21.2	55.8	43.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	23.6	17.2	21.2	55.8	43.3
Queue Length 50th (m)	21.8	21.7	44.2	47.5	25.8
Queue Length 95th (m)	41.4	36.2	68.9	#86.0	45.1
Internal Link Dist (m)		209.3	244.6	967.8	525.7
Turn Bay Length (m)	60.0				
Base Capacity (vph)	361	740	701	326	290
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	0.47	0.26	0.49	0.79	0.51

### Intersection Summary

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

# HCM Signalized Intersection Capacity Analysis

## 10: Sawmill Road & Crowsfoot Road

1/29/2010



Movement	EBL2	EBL	EBT	WBT	WBR	WBR2	SEL2	SEL	SER	SWL	SWR	SWR2
Lane Configurations												
Volume (vph)	42	129	192	267	71	5	1	146	111	8	135	4
Ideal Flow (vphpl)	1900	1775	1650	1650	1900	1900	1900	1765	1900	1765	1900	1900
Total Lost time (s)		4.0	4.0	4.0				4.0		4.0		
Lane Util. Factor		1.00	1.00	1.00				1.00		1.00		
Frt		1.00	1.00	0.97				0.94		0.87		
Flt Protected		0.95	1.00	1.00				0.97		1.00		
Satd. Flow (prot)		1603	1574	1492				1482		1553		
Flt Permitted		0.45	1.00	1.00				0.97		0.98		
Satd. Flow (perm)		767	1574	1492				1482		1527		
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	42	129	192	267	71	5	1	146	111	8	135	4
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	171	192	343	0	0	0	258	0	147	0	0
Heavy Vehicles (%)	26%	0%	6%	9%	7%	0%	0%	6%	16%	0%	0%	0%
Turn Type	Perm	Perm					Split					
Protected Phases			2	6			3	3				
Permitted Phases	2	2		6						4		
Actuated Green, G (s)		45.0	45.0	45.0				20.0		17.0		
Effective Green, g (s)		47.0	47.0	47.0				22.0		19.0		
Actuated g/C Ratio		0.47	0.47	0.47				0.22		0.19		
Clearance Time (s)		6.0	6.0	6.0				6.0		6.0		
Lane Grp Cap (vph)		360	740	701				326		290		
v/s Ratio Prot			0.12	c0.23				c0.17				
v/s Ratio Perm		0.22								c0.10		
v/c Ratio		0.48	0.26	0.49				0.79		0.51		
Uniform Delay, d1		18.1	16.0	18.2				36.8		36.3		
Progression Factor		1.00	1.00	1.00				1.00		1.00		
Incremental Delay, d2		4.4	0.9	2.4				17.6		6.2		
Delay (s)		22.5	16.8	20.7				54.5		42.5		
Level of Service		C	B	C				D		D		
Approach Delay (s)			19.5	20.7				54.5		42.5		
Approach LOS			B	C				D		D		

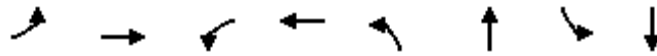
### Intersection Summary

HCM Average Control Delay	31.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	70.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

# Timings

## 3: Sawmill Road & Northfield Drive

1/29/2010

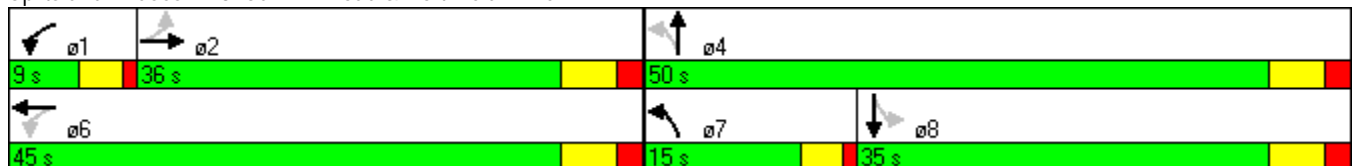


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		↕		↕	↗	↖		↕
Volume (vph)	61	213	246	191	106	369	26	201
Turn Type	Perm		pm+pt		pm+pt		Perm	
Protected Phases		2	1	6	7	4		8
Permitted Phases	2		6		4		8	
Detector Phase	2	2	1	6	7	4	8	8
Switch Phase								
Minimum Initial (s)	8.0	8.0	5.0	8.0	5.0	8.0	8.0	8.0
Minimum Split (s)	32.0	32.0	9.0	34.0	9.0	38.0	35.0	35.0
Total Split (s)	36.0	36.0	9.0	45.0	15.0	50.0	35.0	35.0
Total Split (%)	37.9%	37.9%	9.5%	47.4%	15.8%	52.6%	36.8%	36.8%
Yellow Time (s)	4.0	4.0	3.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	0.0	-2.0	0.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lead		Lead		Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes		Yes		Yes	Yes
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Act Effect Green (s)		32.0		41.0	46.0	46.0		31.0
Actuated g/C Ratio		0.34		0.43	0.48	0.48		0.33
v/c Ratio		0.83		1.29	0.24	1.09		0.93
Control Delay		46.0		176.7	15.0	81.9		69.7
Queue Delay		0.0		0.0	0.0	0.0		0.0
Total Delay		46.0		176.7	15.0	81.9		69.7
LOS		D		F	B	F		E
Approach Delay		46.0		176.7		74.2		69.7
Approach LOS		D		F		E		E

### Intersection Summary

Cycle Length: 95  
 Actuated Cycle Length: 95  
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green  
 Natural Cycle: 85  
 Control Type: Pretimed  
 Maximum v/c Ratio: 1.29  
 Intersection Signal Delay: 92.8  
 Intersection LOS: F  
 Intersection Capacity Utilization 119.1%  
 ICU Level of Service H  
 Analysis Period (min) 15

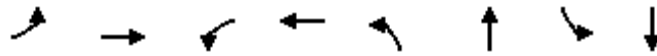
### Splits and Phases: 3: Sawmill Road & Northfield Drive



# Phasings

## 3: Sawmill Road & Northfield Drive

1/29/2010



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Protected Phases		2	1	6	7	4		8
Permitted Phases	2		6		4		8	
Minimum Initial (s)	8.0	8.0	5.0	8.0	5.0	8.0	8.0	8.0
Minimum Split (s)	32.0	32.0	9.0	34.0	9.0	38.0	35.0	35.0
Total Split (s)	36.0	36.0	9.0	45.0	15.0	50.0	35.0	35.0
Total Split (%)	37.9%	37.9%	9.5%	47.4%	15.8%	52.6%	36.8%	36.8%
Maximum Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
Yellow Time (s)	4.0	4.0	3.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	1.0	2.0	2.0	2.0
Lead/Lag	Lag	Lag	Lead		Lead		Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes		Yes		Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Walk Time (s)	10.0	10.0		10.0		22.0	22.0	22.0
Flash Dont Walk (s)	16.0	16.0		16.0		7.0	7.0	7.0
Pedestrian Calls (#/hr)	0	0		0		0	0	0
90th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
90th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
70th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
70th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
50th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
50th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
30th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
30th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
10th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
10th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR

### Intersection Summary

Cycle Length: 95

Actuated Cycle Length: 95

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Pretimed

# Queues

## 3: Sawmill Road & Northfield Drive

1/29/2010



Lane Group	EBT	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	351	472	106	815	265
v/c Ratio	0.83	1.29	0.24	1.09	0.93
Control Delay	46.0	176.7	15.0	81.9	69.7
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	46.0	176.7	15.0	81.9	69.7
Queue Length 50th (m)	56.2	~103.0	10.3	~160.2	45.3
Queue Length 95th (m)	#104.1	#170.9	19.5	#230.5	#93.4
Internal Link Dist (m)	1940.2	1158.8		838.0	899.0
Turn Bay Length (m)			7.0		
Base Capacity (vph)	424	365	447	751	286
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	0.83	1.29	0.24	1.09	0.93

### Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

# HCM Signalized Intersection Capacity Analysis

## 3: Sawmill Road & Northfield Drive

1/29/2010



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↕	↕			↕	
Volume (vph)	61	213	77	246	191	35	106	369	446	26	201	38
Ideal Flow (vphpl)	1900	1550	1900	1900	1550	1900	1775	1650	1900	1900	1550	1900
Total Lost time (s)		4.0			4.0		4.0	4.0			4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00			1.00	
Frbp, ped/bikes		1.00			1.00		1.00	1.00			1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00			1.00	
Frt		0.97			0.99		1.00	0.92			0.98	
Flt Protected		0.99			0.97		0.95	1.00			1.00	
Satd. Flow (prot)		1423			1414		1607	1457			1427	
Flt Permitted		0.85			0.52		0.42	1.00			0.60	
Satd. Flow (perm)		1227			760		709	1457			858	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	61	213	77	246	191	35	106	369	446	26	201	38
RTOR Reduction (vph)	0	11	0	0	3	0	0	46	0	0	6	0
Lane Group Flow (vph)	0	340	0	0	469	0	106	769	0	0	259	0
Confl. Peds. (#/hr)	5		1	1		5	2					2
Heavy Vehicles (%)	4%	7%	2%	7%	7%	3%	6%	4%	6%	14%	6%	6%
Turn Type	Perm			pm+pt			pm+pt			Perm		
Protected Phases		2		1	6		7	4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)		30.0			39.0		44.0	44.0			29.0	
Effective Green, g (s)		32.0			41.0		44.0	46.0			31.0	
Actuated g/C Ratio		0.34			0.43		0.46	0.48			0.33	
Clearance Time (s)		6.0			6.0		4.0	6.0			6.0	
Lane Grp Cap (vph)		413			376		432	705			280	
v/s Ratio Prot					c0.09		0.03	c0.53				
v/s Ratio Perm		c0.28			0.45		0.09				0.30	
v/c Ratio		0.82			1.25		0.25	1.09			0.92	
Uniform Delay, d1		28.9			27.0		15.8	24.5			30.9	
Progression Factor		1.00			1.00		1.00	1.00			1.00	
Incremental Delay, d2		16.8			131.9		1.3	61.3			37.5	
Delay (s)		45.8			158.9		17.2	85.8			68.4	
Level of Service		D			F		B	F			E	
Approach Delay (s)		45.8			158.9			77.9			68.4	
Approach LOS		D			F			E			E	

### Intersection Summary

















HCM Average Control Delay	90.1	HCM Level of Service	F
HCM Volume to Capacity ratio	1.02		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	119.1%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

# HCM Unsignalized Intersection Capacity Analysis

## 13: Driveway & Sawmill Road

1/29/2010

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	3	1	10	121	2	102	5	436	100	104	379	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour 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
Hourly flow rate (vph)	3	1	10	121	2	102	5	436	100	104	379	1
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1186	1134	380	1094	1084	486	380			536		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1186	1134	380	1094	1084	486	380			536		
tC, single (s)	7.1	6.5	6.2	7.2	6.5	6.2	4.1			4.2		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.6	4.0	3.3	2.2			2.3		
p0 queue free %	98	99	99	28	99	82	100			90		
cM capacity (veh/h)	125	183	672	169	195	579	1190			1007		
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>WB 1</b>	<b>NB 1</b>	<b>SB 1</b>								
Volume Total	14	225	541	484								
Volume Left	3	121	5	104								
Volume Right	10	102	100	1								
cSH	316	249	1190	1007								
Volume to Capacity	0.04	0.90	0.00	0.10								
Queue Length 95th (m)	1.1	59.4	0.1	2.6								
Control Delay (s)	16.9	77.5	0.1	2.9								
Lane LOS	C	F	A	A								
Approach Delay (s)	16.9	77.5	0.1	2.9								
Approach LOS	C	F										
<b>Intersection Summary</b>												
Average Delay			15.1									
Intersection Capacity Utilization			99.2%		ICU Level of Service				F			
Analysis Period (min)			15									

# Timings

## 10: Sawmill Road & Crowsfoot Road

1/29/2010

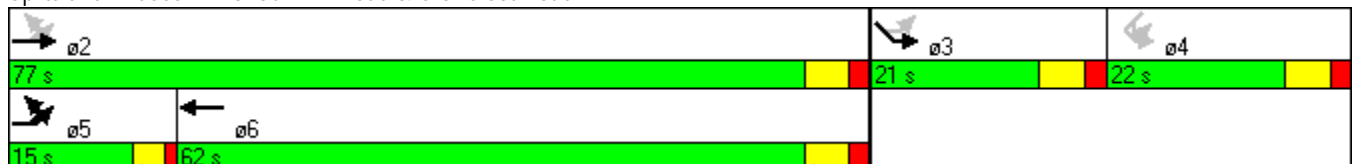


Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Lane Configurations						
Volume (vph)	100	172	356	423	120	7
Turn Type	pm+pt	pm+pt				
Protected Phases	5	5	2	6	3	
Permitted Phases	2	2		6		4
Detector Phase	5	5	2	6	3	4
Switch Phase						
Minimum Initial (s)	5.0	5.0	8.0	8.0	8.0	8.0
Minimum Split (s)	9.0	9.0	22.0	22.0	22.0	22.0
Total Split (s)	15.0	15.0	77.0	62.0	21.0	22.0
Total Split (%)	12.5%	12.5%	64.2%	51.7%	17.5%	18.3%
Yellow Time (s)	3.0	3.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead		Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes
Recall Mode	Max	Max	Max	Max	Max	Max
Act Effct Green (s)		73.0	73.0	58.0	17.0	18.0
Actuated g/C Ratio		0.61	0.61	0.48	0.14	0.15
v/c Ratio		0.89	0.37	0.87	0.75	0.51
Control Delay		44.8	13.2	42.2	71.3	55.8
Queue Delay		0.0	0.0	0.0	0.0	0.0
Total Delay		44.8	13.2	42.2	71.3	55.8
LOS		D	B	D	E	E
Approach Delay			26.9	42.2	71.3	55.8
Approach LOS			C	D	E	E

### Intersection Summary

Cycle Length: 120  
 Actuated Cycle Length: 120  
 Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green  
 Natural Cycle: 100  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.89  
 Intersection Signal Delay: 40.0  
 Intersection LOS: D  
 Intersection Capacity Utilization 88.3%  
 ICU Level of Service E  
 Analysis Period (min) 15

Splits and Phases: 10: Sawmill Road & Crowsfoot Road



# Phasings

## 10: Sawmill Road & Crowsfoot Road

1/29/2010



Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Protected Phases	5	5	2	6	3	
Permitted Phases	2	2		6		4
Minimum Initial (s)	5.0	5.0	8.0	8.0	8.0	8.0
Minimum Split (s)	9.0	9.0	22.0	22.0	22.0	22.0
Total Split (s)	15.0	15.0	77.0	62.0	21.0	22.0
Total Split (%)	12.5%	12.5%	64.2%	51.7%	17.5%	18.3%
Maximum Green (s)	11.0	11.0	71.0	56.0	15.0	16.0
Yellow Time (s)	3.0	3.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	2.0	2.0	2.0	2.0
Lead/Lag	Lead	Lead		Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max
Walk Time (s)			5.0	5.0	5.0	5.0
Flash Dont Walk (s)			11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)			0	0	0	0
90th %ile Green (s)	11.0	11.0	71.0	56.0	15.0	16.0
90th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	MaxR
70th %ile Green (s)	11.0	11.0	71.0	56.0	15.0	16.0
70th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	MaxR
50th %ile Green (s)	11.0	11.0	71.0	56.0	15.0	16.0
50th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	MaxR
30th %ile Green (s)	11.0	11.0	71.0	56.0	15.0	16.0
30th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	MaxR
10th %ile Green (s)	11.0	11.0	71.0	56.0	15.0	16.0
10th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	MaxR

### Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Pretimed

# Queues

## 10: Sawmill Road & Crowsfoot Road

1/29/2010



Lane Group	EBL	EBT	WBT	SEL	SWL
Lane Group Flow (vph)	272	356	647	160	116
v/c Ratio	0.89	0.37	0.87	0.75	0.51
Control Delay	44.8	13.2	42.2	71.3	55.8
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	44.8	13.2	42.2	71.3	55.8
Queue Length 50th (m)	28.3	39.7	132.3	36.6	25.5
Queue Length 95th (m)	#64.3	58.4	#204.4	#68.5	44.6
Internal Link Dist (m)		209.3	244.6	967.8	1075.3
Turn Bay Length (m)	60.0				
Base Capacity (vph)	305	967	742	214	227
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	0.89	0.37	0.87	0.75	0.51

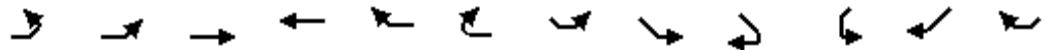
### Intersection Summary

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

# HCM Signalized Intersection Capacity Analysis

## 10: Sawmill Road & Crowsfoot Road

1/29/2010



Movement	EBL2	EBL	EBT	WBT	WBR	WBR2	SEL2	SEL	SER	SWL	SWR	SWR2
Lane Configurations												
Volume (vph)	100	172	356	423	214	10	2	120	38	7	107	2
Ideal Flow (vphpl)	1900	1775	1650	1650	1900	1900	1900	1765	1900	1765	1900	1900
Total Lost time (s)		4.0	4.0	4.0				4.0		4.0		
Lane Util. Factor		1.00	1.00	1.00				1.00		1.00		
Frt		1.00	1.00	0.95				0.97		0.87		
Flt Protected		0.95	1.00	1.00				0.96		1.00		
Satd. Flow (prot)		1627	1589	1535				1514		1554		
Flt Permitted		0.18	1.00	1.00				0.96		0.97		
Satd. Flow (perm)		302	1589	1535				1514		1514		
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	100	172	356	423	214	10	2	120	38	7	107	2
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	272	356	647	0	0	0	160	0	116	0	0
Heavy Vehicles (%)	13%	0%	5%	5%	1%	0%	0%	5%	26%	0%	0%	0%
Turn Type	pm+pt	pm+pt						Perm				
Protected Phases	5	5	2	6				3				
Permitted Phases	2	2		6			3			4		
Actuated Green, G (s)		71.0	71.0	56.0				15.0		16.0		
Effective Green, g (s)		71.0	73.0	58.0				17.0		18.0		
Actuated g/C Ratio		0.59	0.61	0.48				0.14		0.15		
Clearance Time (s)		4.0	6.0	6.0				6.0		6.0		
Lane Grp Cap (vph)		300	967	742				214		227		
v/s Ratio Prot		c0.08	0.22	0.42								
v/s Ratio Perm		c0.45						0.11		c0.08		
v/c Ratio		0.91	0.37	0.87				0.75		0.51		
Uniform Delay, d1		20.1	11.9	27.7				49.4		46.9		
Progression Factor		1.00	1.00	1.00				1.00		1.00		
Incremental Delay, d2		32.7	1.1	13.4				21.0		8.0		
Delay (s)		52.9	12.9	41.1				70.5		54.9		
Level of Service		D	B	D				E		D		
Approach Delay (s)			30.2	41.1				70.5		54.9		
Approach LOS			C	D				E		D		

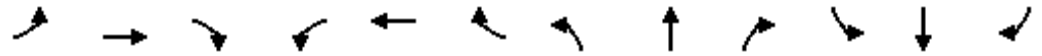
### Intersection Summary

HCM Average Control Delay	40.8	HCM Level of Service	D
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	88.3%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Volume

3: Sawmill Road & Northfield Drive

1/29/2010



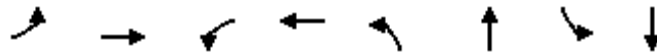
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Volume (vph)	33	132	57	375	165	11	60	106	277	16	306	71
Confl. Peds. (#/hr)			2	2								
Confl. Bikes (#/hr)												
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	32%	7%	4%	7%	6%	11%	6%	10%	12%	8%	4%	8%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	33	132	57	375	165	11	60	106	277	16	306	71
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	222	0	0	551	0	60	383	0	0	393	0

Intersection Summary

# Timings

## 3: Sawmill Road & Northfield Drive

1/29/2010

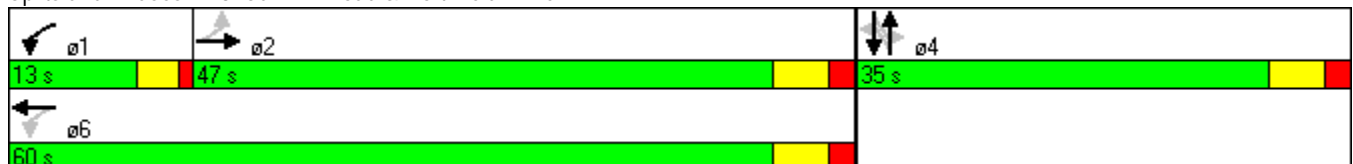


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		↕		↕	↗	↖		↕
Volume (vph)	33	132	375	165	60	106	16	306
Turn Type	Perm		pm+pt		Perm		Perm	
Protected Phases		2	1	6		4		4
Permitted Phases	2		6		4		4	
Detector Phase	2	2	1	6	4	4	4	4
Switch Phase								
Minimum Initial (s)	8.0	8.0	5.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	36.0	36.0	9.0	36.0	32.0	32.0	32.0	32.0
Total Split (s)	47.0	47.0	13.0	60.0	35.0	35.0	35.0	35.0
Total Split (%)	49.5%	49.5%	13.7%	63.2%	36.8%	36.8%	36.8%	36.8%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	0.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Act Effect Green (s)		43.0		56.0	31.0	31.0		31.0
Actuated g/C Ratio		0.45		0.59	0.33	0.33		0.33
v/c Ratio		0.40		0.95	0.32	0.72		0.83
Control Delay		17.9		44.9	29.9	25.6		45.6
Queue Delay		0.0		0.0	0.0	0.0		0.0
Total Delay		17.9		44.9	29.9	25.6		45.6
LOS		B		D	C	C		D
Approach Delay		17.9		44.9		26.2		45.6
Approach LOS		B		D		C		D

### Intersection Summary

Cycle Length: 95  
 Actuated Cycle Length: 95  
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green  
 Natural Cycle: 90  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.95  
 Intersection Signal Delay: 36.2  
 Intersection LOS: D  
 Intersection Capacity Utilization 113.3%  
 ICU Level of Service H  
 Analysis Period (min) 15

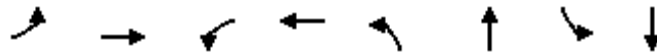
### Splits and Phases: 3: Sawmill Road & Northfield Drive



# Phasings

## 3: Sawmill Road & Northfield Drive

1/29/2010



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Protected Phases		2	1	6		4		4
Permitted Phases	2		6		4		4	
Minimum Initial (s)	8.0	8.0	5.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	36.0	36.0	9.0	36.0	32.0	32.0	32.0	32.0
Total Split (s)	47.0	47.0	13.0	60.0	35.0	35.0	35.0	35.0
Total Split (%)	49.5%	49.5%	13.7%	63.2%	36.8%	36.8%	36.8%	36.8%
Maximum Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	2.0	2.0
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Walk Time (s)	14.0	14.0		14.0	19.0	19.0	19.0	19.0
Flash Dont Walk (s)	16.0	16.0		16.0	7.0	7.0	7.0	7.0
Pedestrian Calls (#/hr)	0	0		0	0	0	0	0
90th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
90th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
70th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
70th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
50th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
50th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
30th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
30th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
10th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
10th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR

### Intersection Summary

Cycle Length: 95

Actuated Cycle Length: 95

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Pretimed

## Queues

### 3: Sawmill Road & Northfield Drive

1/29/2010



Lane Group	EBT	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	222	551	60	383	393
v/c Ratio	0.40	0.95	0.32	0.72	0.83
Control Delay	17.9	44.9	29.9	25.6	45.6
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	17.9	44.9	29.9	25.6	45.6
Queue Length 50th (m)	23.2	62.6	8.2	37.9	64.2
Queue Length 95th (m)	41.5	#150.7	19.3	72.7	#113.6
Internal Link Dist (m)	1940.2	1158.8		681.9	899.0
Turn Bay Length (m)			7.0		
Base Capacity (vph)	561	582	189	535	473
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	0.40	0.95	0.32	0.72	0.83

#### Intersection Summary

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

# HCM Signalized Intersection Capacity Analysis

## 3: Sawmill Road & Northfield Drive

1/29/2010



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↗	↘			↕	
Volume (vph)	33	132	57	375	165	11	60	106	277	16	306	71
Ideal Flow (vphpl)	1900	1550	1900	1900	1550	1900	1775	1650	1900	1900	1550	1900
Total Lost time (s)		4.0			4.0		4.0	4.0			4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00			1.00	
Frbp, ped/bikes		0.99			1.00		1.00	1.00			1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00			1.00	
Frt		0.97			1.00		1.00	0.89			0.98	
Flt Protected		0.99			0.97		0.95	1.00			1.00	
Satd. Flow (prot)		1358			1414		1608	1335			1455	
Flt Permitted		0.89			0.62		0.34	1.00			0.98	
Satd. Flow (perm)		1211			905		579	1335			1424	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	33	132	57	375	165	11	60	106	277	16	306	71
RTOR Reduction (vph)	0	13	0	0	1	0	0	99	0	0	8	0
Lane Group Flow (vph)	0	209	0	0	550	0	60	284	0	0	385	0
Confl. Peds. (#/hr)			2	2								
Heavy Vehicles (%)	32%	7%	4%	7%	6%	11%	6%	10%	12%	8%	4%	8%
Turn Type	Perm			pm+pt			Perm			Perm		
Protected Phases		2		1	6			4			4	
Permitted Phases	2			6			4			4		
Actuated Green, G (s)		41.0			54.0		29.0	29.0			29.0	
Effective Green, g (s)		43.0			56.0		31.0	31.0			31.0	
Actuated g/C Ratio		0.45			0.59		0.33	0.33			0.33	
Clearance Time (s)		6.0			6.0		6.0	6.0			6.0	
Lane Grp Cap (vph)		548			592		189	436			465	
v/s Ratio Prot					c0.11			0.21				
v/s Ratio Perm		0.17			0.44		0.10				c0.27	
v/c Ratio		0.38			0.93		0.32	0.65			0.83	
Uniform Delay, d1		17.2			17.7		24.0	27.4			29.5	
Progression Factor		1.00			1.00		1.00	1.00			1.00	
Incremental Delay, d2		2.0			23.1		4.4	7.4			15.5	
Delay (s)		19.2			40.9		28.4	34.7			45.0	
Level of Service		B			D		C	C			D	
Approach Delay (s)		19.2			40.9			33.9			45.0	
Approach LOS		B			D			C			D	

### Intersection Summary

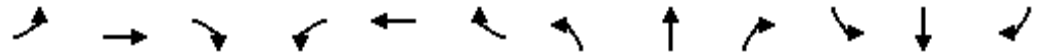
HCM Average Control Delay	37.0	HCM Level of Service	D
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	113.3%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Volume

13: Driveway & Sawmill Road

1/29/2010



















Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Volume (vph)	2	1	3	132	1	111	1	224	107	76	294	1
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour 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
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	0%	0%	0%	4%	0%	8%	0%	7%	4%	4%	5%	0%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	2	1	3	132	1	111	1	224	107	76	294	1
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	6	0	0	244	0	0	332	0	0	371	0

Intersection Summary

# HCM Unsignalized Intersection Capacity Analysis

## 13: Driveway & Sawmill Road

1/29/2010

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	1	3	132	1	111	1	224	107	76	294	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour 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
Hourly flow rate (vph)	2	1	3	132	1	111	1	224	107	76	294	1
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	838	780	294	730	726	278	295			331		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	838	780	294	730	726	278	295			331		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.3	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.4	2.2			2.2		
p0 queue free %	99	100	100	58	100	85	100			94		
cM capacity (veh/h)	233	308	750	317	331	747	1278			1217		
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>WB 1</b>	<b>NB 1</b>	<b>SB 1</b>								
Volume Total	6	244	332	371								
Volume Left	2	132	1	76								
Volume Right	3	111	107	1								
cSH	379	430	1278	1217								
Volume to Capacity	0.02	0.57	0.00	0.06								
Queue Length 95th (m)	0.4	26.1	0.0	1.5								
Control Delay (s)	14.6	23.8	0.0	2.2								
Lane LOS	B	C	A	A								
Approach Delay (s)	14.6	23.8	0.0	2.2								
Approach LOS	B	C										
<b>Intersection Summary</b>												
Average Delay			7.0									
Intersection Capacity Utilization			79.7%		ICU Level of Service					D		
Analysis Period (min)			15									

# Timings

## 10: Sawmill Road & Crowsfoot Road

1/29/2010

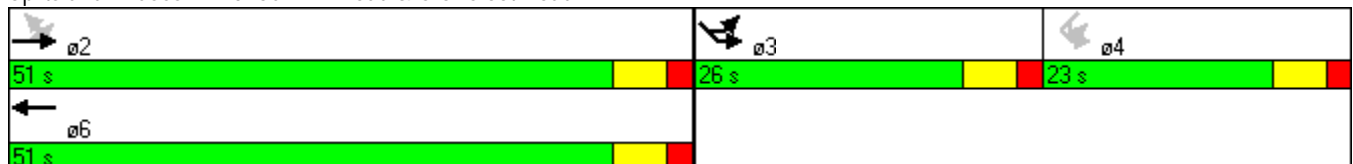


Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Lane Configurations						
Volume (vph)	52	129	192	267	146	8
Turn Type	Perm	Perm				
Protected Phases			2	6	3	
Permitted Phases	2	2		6		4
Detector Phase	2	2	2	6	3	4
Switch Phase						
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	22.0	22.0	22.0	22.0	22.0	22.0
Total Split (s)	51.0	51.0	51.0	51.0	26.0	23.0
Total Split (%)	51.0%	51.0%	51.0%	51.0%	26.0%	23.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag					Lead	Lag
Lead-Lag Optimize?					Yes	Yes
Recall Mode	Max	Max	Max	Max	Max	Max
Act Effct Green (s)		47.0	47.0	47.0	22.0	19.0
Actuated g/C Ratio		0.47	0.47	0.47	0.22	0.19
v/c Ratio		0.53	0.26	0.49	0.85	0.51
Control Delay		25.6	17.2	21.2	62.5	43.3
Queue Delay		0.0	0.0	0.0	0.0	0.0
Total Delay		25.6	17.2	21.2	62.5	43.3
LOS		C	B	C	E	D
Approach Delay			21.3	21.2	62.5	43.3
Approach LOS			C	C	E	D

### Intersection Summary

Cycle Length: 100  
 Actuated Cycle Length: 100  
 Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green  
 Natural Cycle: 70  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.85  
 Intersection Signal Delay: 33.9  
 Intersection LOS: C  
 Intersection Capacity Utilization 72.0%  
 ICU Level of Service C  
 Analysis Period (min) 15

Splits and Phases: 10: Sawmill Road & Crowsfoot Road



# Phasings

## 10: Sawmill Road & Crowsfoot Road

1/29/2010



Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Protected Phases			2	6	3	
Permitted Phases	2	2		6		4
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	22.0	22.0	22.0	22.0	22.0	22.0
Total Split (s)	51.0	51.0	51.0	51.0	26.0	23.0
Total Split (%)	51.0%	51.0%	51.0%	51.0%	26.0%	23.0%
Maximum Green (s)	45.0	45.0	45.0	45.0	20.0	17.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lead/Lag					Lead	Lag
Lead-Lag Optimize?					Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max
Walk Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0	0	0	0	0
90th %ile Green (s)	45.0	45.0	45.0	45.0	20.0	17.0
90th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
70th %ile Green (s)	45.0	45.0	45.0	45.0	20.0	17.0
70th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
50th %ile Green (s)	45.0	45.0	45.0	45.0	20.0	17.0
50th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
30th %ile Green (s)	45.0	45.0	45.0	45.0	20.0	17.0
30th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
10th %ile Green (s)	45.0	45.0	45.0	45.0	20.0	17.0
10th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR

### Intersection Summary

Cycle Length: 100

Actuated Cycle Length: 100

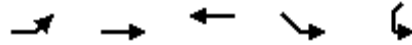
Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Pretimed

## Queues

### 10: Sawmill Road & Crowsfoot Road

1/29/2010



Lane Group	EBL	EBT	WBT	SEL	SWL
Lane Group Flow (vph)	181	192	343	268	147
v/c Ratio	0.53	0.26	0.49	0.85	0.51
Control Delay	25.6	17.2	21.2	62.5	43.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	25.6	17.2	21.2	62.5	43.3
Queue Length 50th (m)	23.9	21.7	44.2	50.1	25.8
Queue Length 95th (m)	45.8	36.2	68.9	#92.9	45.1
Internal Link Dist (m)		209.3	244.6	967.8	525.7
Turn Bay Length (m)	60.0				
Base Capacity (vph)	344	740	701	316	290
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	0.53	0.26	0.49	0.85	0.51

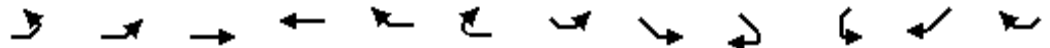
#### Intersection Summary

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

# HCM Signalized Intersection Capacity Analysis

## 10: Sawmill Road & Crowsfoot Road

1/29/2010



Movement	EBL2	EBL	EBT	WBT	WBR	WBR2	SEL2	SEL	SER	SWL	SWR	SWR2
Lane Configurations												
Volume (vph)	52	129	192	267	71	5	1	146	121	8	135	4
Ideal Flow (vphpl)	1900	1775	1650	1650	1900	1900	1900	1765	1900	1765	1900	1900
Total Lost time (s)		4.0	4.0	4.0				4.0		4.0		
Lane Util. Factor		1.00	1.00	1.00				1.00		1.00		
Frt		1.00	1.00	0.97				0.94		0.87		
Flt Protected		0.95	1.00	1.00				0.97		1.00		
Satd. Flow (prot)		1529	1574	1492				1435		1553		
Flt Permitted		0.45	1.00	1.00				0.97		0.98		
Satd. Flow (perm)		732	1574	1492				1435		1526		
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	52	129	192	267	71	5	1	146	121	8	135	4
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	181	192	343	0	0	0	268	0	147	0	0
Heavy Vehicles (%)	40%	0%	6%	9%	7%	0%	0%	6%	23%	0%	0%	0%
Turn Type	Perm	Perm					Split					
Protected Phases			2	6			3	3				
Permitted Phases	2	2		6						4		
Actuated Green, G (s)		45.0	45.0	45.0				20.0		17.0		
Effective Green, g (s)		47.0	47.0	47.0				22.0		19.0		
Actuated g/C Ratio		0.47	0.47	0.47				0.22		0.19		
Clearance Time (s)		6.0	6.0	6.0				6.0		6.0		
Lane Grp Cap (vph)		344	740	701				316		290		
v/s Ratio Prot			0.12	0.23				c0.19				
v/s Ratio Perm		c0.25								c0.10		
v/c Ratio		0.53	0.26	0.49				0.85		0.51		
Uniform Delay, d1		18.7	16.0	18.2				37.4		36.3		
Progression Factor		1.00	1.00	1.00				1.00		1.00		
Incremental Delay, d2		5.7	0.9	2.4				23.6		6.2		
Delay (s)		24.3	16.8	20.7				61.0		42.5		
Level of Service		C	B	C				E		D		
Approach Delay (s)			20.5	20.7				61.0		42.5		
Approach LOS			C	C				E		D		

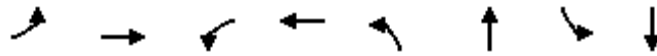
### Intersection Summary

HCM Average Control Delay	33.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	72.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

# Timings

## 3: Sawmill Road & Northfield Drive

1/29/2010



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		↕		↕	↗	↖		↕
Volume (vph)	61	213	256	191	106	369	26	201
Turn Type	Perm		pm+pt		pm+pt		Perm	
Protected Phases		2	1	6	7	4		8
Permitted Phases	2		6		4		8	
Detector Phase	2	2	1	6	7	4	8	8
Switch Phase								
Minimum Initial (s)	8.0	8.0	5.0	8.0	4.0	8.0	8.0	8.0
Minimum Split (s)	32.0	32.0	9.0	34.0	8.0	38.0	35.0	35.0
Total Split (s)	36.0	36.0	9.0	45.0	15.0	50.0	35.0	35.0
Total Split (%)	37.9%	37.9%	9.5%	47.4%	15.8%	52.6%	36.8%	36.8%
Yellow Time (s)	4.0	4.0	3.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	0.0	-2.0	0.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lead		Lead		Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes		Yes		Yes	Yes
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Act Effect Green (s)		32.0		41.0	46.0	46.0		31.0
Actuated g/C Ratio		0.34		0.43	0.48	0.48		0.33
v/c Ratio		0.83		1.35	0.24	1.11		0.97
Control Delay		46.0		202.1	15.0	90.5		79.7
Queue Delay		0.0		0.0	0.0	0.0		0.0
Total Delay		46.0		202.1	15.0	90.5		79.7
LOS		D		F	B	F		E
Approach Delay		46.0		202.1		81.9		79.7
Approach LOS		D		F		F		E

### Intersection Summary

Cycle Length: 95

Actuated Cycle Length: 95

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Natural Cycle: 85

Control Type: Pretimed

Maximum v/c Ratio: 1.35

Intersection Signal Delay: 104.0

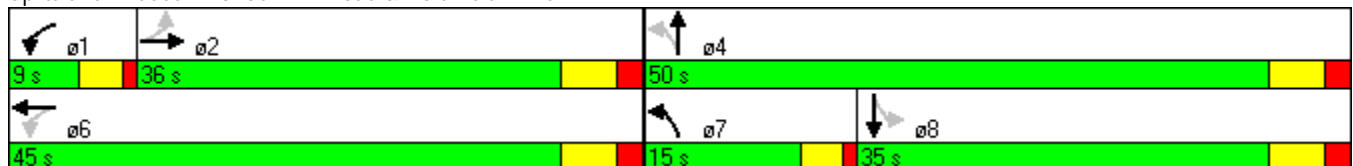
Intersection LOS: F

Intersection Capacity Utilization 120.5%

ICU Level of Service H

Analysis Period (min) 15

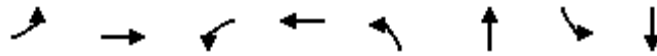
### Splits and Phases: 3: Sawmill Road & Northfield Drive



# Phasings

## 3: Sawmill Road & Northfield Drive

1/29/2010



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Protected Phases		2	1	6	7	4		8
Permitted Phases	2		6		4		8	
Minimum Initial (s)	8.0	8.0	5.0	8.0	4.0	8.0	8.0	8.0
Minimum Split (s)	32.0	32.0	9.0	34.0	8.0	38.0	35.0	35.0
Total Split (s)	36.0	36.0	9.0	45.0	15.0	50.0	35.0	35.0
Total Split (%)	37.9%	37.9%	9.5%	47.4%	15.8%	52.6%	36.8%	36.8%
Maximum Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
Yellow Time (s)	4.0	4.0	3.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	1.0	2.0	2.0	2.0
Lead/Lag	Lag	Lag	Lead		Lead		Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes		Yes		Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Walk Time (s)	10.0	10.0		10.0		22.0	22.0	22.0
Flash Dont Walk (s)	16.0	16.0		16.0		7.0	7.0	7.0
Pedestrian Calls (#/hr)	0	0		0		0	0	0
90th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
90th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
70th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
70th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
50th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
50th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
30th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
30th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
10th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
10th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR

### Intersection Summary

Cycle Length: 95

Actuated Cycle Length: 95

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Pretimed

## Queues

### 3: Sawmill Road & Northfield Drive

1/29/2010



Lane Group	EBT	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	351	482	106	825	265
v/c Ratio	0.83	1.35	0.24	1.11	0.97
Control Delay	46.0	202.1	15.0	90.5	79.7
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	46.0	202.1	15.0	90.5	79.7
Queue Length 50th (m)	56.2	~112.9	10.3	~165.4	46.2
Queue Length 95th (m)	#104.1	#177.1	19.5	#235.7	#95.8
Internal Link Dist (m)	1940.2	1158.8		838.0	899.0
Turn Bay Length (m)			7.0		
Base Capacity (vph)	424	356	447	744	274
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	0.83	1.35	0.24	1.11	0.97

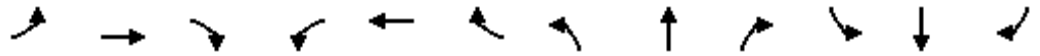
#### Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

# HCM Signalized Intersection Capacity Analysis

## 3: Sawmill Road & Northfield Drive

1/29/2010



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↗	↘			↕	
Volume (vph)	61	213	77	256	191	35	106	369	456	26	201	38
Ideal Flow (vphpl)	1900	1550	1900	1900	1550	1900	1775	1650	1900	1900	1550	1900
Total Lost time (s)		4.0			4.0		4.0	4.0			4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00			1.00	
Frbp, ped/bikes		1.00			1.00		1.00	1.00			1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00			1.00	
Frt		0.97			0.99		1.00	0.92			0.98	
Flt Protected		0.99			0.97		0.95	1.00			1.00	
Satd. Flow (prot)		1423			1386		1607	1441			1427	
Flt Permitted		0.86			0.52		0.42	1.00			0.57	
Satd. Flow (perm)		1228			739		709	1441			822	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	61	213	77	256	191	35	106	369	456	26	201	38
RTOR Reduction (vph)	0	11	0	0	3	0	0	47	0	0	6	0
Lane Group Flow (vph)	0	340	0	0	479	0	106	778	0	0	259	0
Confl. Peds. (#/hr)	5		1	1		5	2					2
Heavy Vehicles (%)	4%	7%	2%	11%	7%	3%	6%	4%	8%	14%	6%	6%
Turn Type	Perm			pm+pt			pm+pt				Perm	
Protected Phases		2		1	6		7	4				8
Permitted Phases	2			6			4			8		
Actuated Green, G (s)		30.0			39.0		44.0	44.0				29.0
Effective Green, g (s)		32.0			41.0		44.0	46.0				31.0
Actuated g/C Ratio		0.34			0.43		0.46	0.48				0.33
Clearance Time (s)		6.0			6.0		4.0	6.0				6.0
Lane Grp Cap (vph)		414			367		432	698				268
v/s Ratio Prot					c0.10		0.03	c0.54				
v/s Ratio Perm		c0.28			0.47		0.09					0.32
v/c Ratio		0.82			1.31		0.25	1.11				0.97
Uniform Delay, d1		28.9			27.0		15.8	24.5				31.5
Progression Factor		1.00			1.00		1.00	1.00				1.00
Incremental Delay, d2		16.6			156.0		1.3	70.1				47.0
Delay (s)		45.5			183.0		17.2	94.6				78.4
Level of Service		D			F		B	F				E
Approach Delay (s)		45.5			183.0			85.8				78.4
Approach LOS		D			F			F				E

### Intersection Summary

















HCM Average Control Delay	100.9	HCM Level of Service	F
HCM Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	120.5%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

# HCM Unsignalized Intersection Capacity Analysis

## 13: Driveway & Sawmill Road

1/29/2010

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	3	1	10	121	2	102	5	436	100	104	379	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour 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
Hourly flow rate (vph)	3	1	10	121	2	102	5	436	100	104	379	1
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1186	1134	380	1094	1084	486	380			536		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1186	1134	380	1094	1084	486	380			536		
tC, single (s)	7.1	6.5	6.2	7.2	6.5	6.2	4.1			4.2		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.6	4.0	3.3	2.2			2.3		
p0 queue free %	98	99	99	28	99	82	100			90		
cM capacity (veh/h)	125	183	672	169	195	579	1190			1007		
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>WB 1</b>	<b>NB 1</b>	<b>SB 1</b>								
Volume Total	14	225	541	484								
Volume Left	3	121	5	104								
Volume Right	10	102	100	1								
cSH	316	249	1190	1007								
Volume to Capacity	0.04	0.90	0.00	0.10								
Queue Length 95th (m)	1.1	59.4	0.1	2.6								
Control Delay (s)	16.9	77.5	0.1	2.9								
Lane LOS	C	F	A	A								
Approach Delay (s)	16.9	77.5	0.1	2.9								
Approach LOS	C	F										
<b>Intersection Summary</b>												
Average Delay			15.1									
Intersection Capacity Utilization			99.2%		ICU Level of Service					F		
Analysis Period (min)			15									

# Timings

## 10: Sawmill Road & Crowsfoot Road

1/29/2010

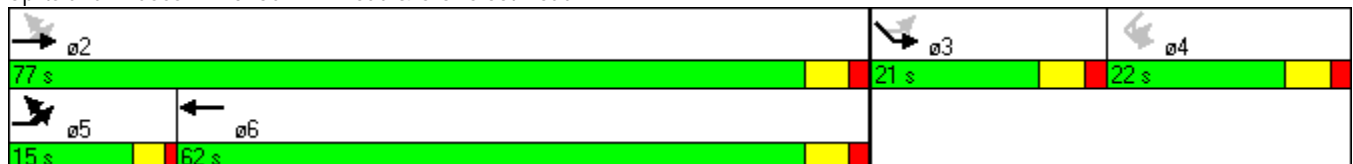


Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Lane Configurations						
Volume (vph)	110	172	356	423	120	7
Turn Type	pm+pt	pm+pt				
Protected Phases	5	5	2	6	3	
Permitted Phases	2	2		6		4
Detector Phase	5	5	2	6	3	4
Switch Phase						
Minimum Initial (s)	5.0	5.0	8.0	8.0	8.0	8.0
Minimum Split (s)	9.0	9.0	22.0	22.0	22.0	22.0
Total Split (s)	15.0	15.0	77.0	62.0	21.0	22.0
Total Split (%)	12.5%	12.5%	64.2%	51.7%	17.5%	18.3%
Yellow Time (s)	3.0	3.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead		Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes
Recall Mode	Max	Max	Max	Max	Max	Max
Act Effect Green (s)		73.0	73.0	58.0	17.0	18.0
Actuated g/C Ratio		0.61	0.61	0.48	0.14	0.15
v/c Ratio		0.96	0.37	0.87	0.79	0.51
Control Delay		58.4	13.2	42.2	71.0	55.8
Queue Delay		0.0	0.0	0.0	0.0	0.0
Total Delay		58.4	13.2	42.2	71.0	55.8
LOS		E	B	D	E	E
Approach Delay			33.2	42.2	71.0	55.8
Approach LOS			C	D	E	E

### Intersection Summary

Cycle Length: 120  
 Actuated Cycle Length: 120  
 Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green  
 Natural Cycle: 110  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.96  
 Intersection Signal Delay: 42.6  
 Intersection LOS: D  
 Intersection Capacity Utilization 89.5%  
 ICU Level of Service E  
 Analysis Period (min) 15

Splits and Phases: 10: Sawmill Road & Crowsfoot Road



# Phasings

## 10: Sawmill Road & Crowsfoot Road

1/29/2010



Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Protected Phases	5	5	2	6	3	
Permitted Phases	2	2		6		4
Minimum Initial (s)	5.0	5.0	8.0	8.0	8.0	8.0
Minimum Split (s)	9.0	9.0	22.0	22.0	22.0	22.0
Total Split (s)	15.0	15.0	77.0	62.0	21.0	22.0
Total Split (%)	12.5%	12.5%	64.2%	51.7%	17.5%	18.3%
Maximum Green (s)	11.0	11.0	71.0	56.0	15.0	16.0
Yellow Time (s)	3.0	3.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	2.0	2.0	2.0	2.0
Lead/Lag	Lead	Lead		Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max
Walk Time (s)			5.0	5.0	5.0	5.0
Flash Dont Walk (s)			11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)			0	0	0	0
90th %ile Green (s)	11.0	11.0	71.0	56.0	15.0	16.0
90th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	MaxR
70th %ile Green (s)	11.0	11.0	71.0	56.0	15.0	16.0
70th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	MaxR
50th %ile Green (s)	11.0	11.0	71.0	56.0	15.0	16.0
50th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	MaxR
30th %ile Green (s)	11.0	11.0	71.0	56.0	15.0	16.0
30th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	MaxR
10th %ile Green (s)	11.0	11.0	71.0	56.0	15.0	16.0
10th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	MaxR

### Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 120

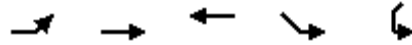
Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Pretimed

Queues

10: Sawmill Road & Crowsfoot Road

1/29/2010



Lane Group	EBL	EBT	WBT	SEL	SWL
Lane Group Flow (vph)	282	356	647	170	116
v/c Ratio	0.96	0.37	0.87	0.79	0.51
Control Delay	58.4	13.2	42.2	71.0	55.8
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	58.4	13.2	42.2	71.0	55.8
Queue Length 50th (m)	29.7	39.7	132.3	36.0	25.5
Queue Length 95th (m)	#72.7	58.4	#204.4	#70.9	44.6
Internal Link Dist (m)		209.3	244.6	967.8	1075.3
Turn Bay Length (m)	60.0				
Base Capacity (vph)	295	967	742	216	227
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	0.96	0.37	0.87	0.79	0.51

Intersection Summary

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

# HCM Signalized Intersection Capacity Analysis

## 10: Sawmill Road & Crowsfoot Road

1/29/2010



Movement	EBL2	EBL	EBT	WBT	WBR	WBR2	SEL2	SEL	SER	SWL	SWR	SWR2
Lane Configurations												
Volume (vph)	110	172	356	423	214	10	2	120	48	7	107	2
Ideal Flow (vphpl)	1900	1775	1650	1650	1900	1900	1900	1765	1900	1765	1900	1900
Total Lost time (s)		4.0	4.0	4.0				4.0		4.0		
Lane Util. Factor		1.00	1.00	1.00				1.00		1.00		
Frt		1.00	1.00	0.95				0.96		0.87		
Flt Protected		0.95	1.00	1.00				0.97		1.00		
Satd. Flow (prot)		1576	1589	1535				1440		1554		
Flt Permitted		0.18	1.00	1.00				0.97		0.97		
Satd. Flow (perm)		292	1589	1535				1440		1513		
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	110	172	356	423	214	10	2	120	48	7	107	2
RTOR Reduction (vph)	0	0	0	0	0	0	0	12	0	0	0	0
Lane Group Flow (vph)	0	282	356	647	0	0	0	158	0	116	0	0
Heavy Vehicles (%)	21%	0%	5%	5%	1%	0%	0%	5%	41%	0%	0%	0%
Turn Type	pm+pt	pm+pt						Perm				
Protected Phases	5	5	2	6				3				
Permitted Phases	2	2		6			3			4		
Actuated Green, G (s)		71.0	71.0	56.0				15.0		16.0		
Effective Green, g (s)		71.0	73.0	58.0				17.0		18.0		
Actuated g/C Ratio		0.59	0.61	0.48				0.14		0.15		
Clearance Time (s)		4.0	6.0	6.0				6.0		6.0		
Lane Grp Cap (vph)		290	967	742				204		227		
v/s Ratio Prot		c0.09	0.22	0.42								
v/s Ratio Perm		c0.49						0.11		c0.08		
v/c Ratio		0.97	0.37	0.87				0.77		0.51		
Uniform Delay, d1		20.7	11.9	27.7				49.7		46.9		
Progression Factor		1.00	1.00	1.00				1.00		1.00		
Incremental Delay, d2		46.3	1.1	13.4				24.4		8.0		
Delay (s)		66.9	12.9	41.1				74.1		54.9		
Level of Service		E	B	D				E		D		
Approach Delay (s)			36.8	41.1				74.1		54.9		
Approach LOS			D	D				E		D		

### Intersection Summary

HCM Average Control Delay	43.9	HCM Level of Service	D
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	89.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

# Timings

## 10: Sawmill Road & Crowsfoot Road

2/1/2010

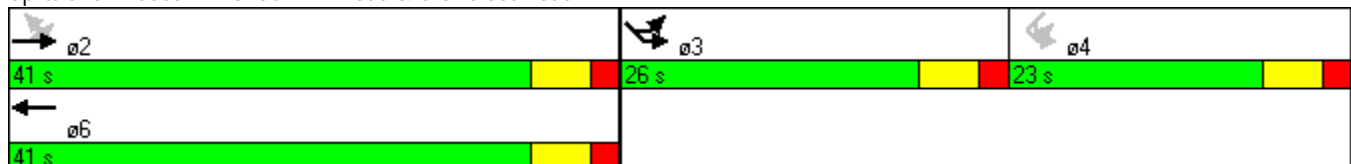


Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Lane Configurations						
Volume (vph)	52	129	192	267	146	8
Turn Type	Perm	Perm				
Protected Phases			2	6	3	
Permitted Phases	2	2		6		4
Detector Phase	2	2	2	6	3	4
Switch Phase						
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	22.0	22.0	22.0	22.0	22.0	22.0
Total Split (s)	41.0	41.0	41.0	41.0	26.0	23.0
Total Split (%)	45.6%	45.6%	45.6%	45.6%	28.9%	25.6%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	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
Lead/Lag					Lead	Lag
Lead-Lag Optimize?					Yes	Yes
Recall Mode	Max	Max	Max	Max	Max	Max
Act Effect Green (s)		35.0	35.0	35.0	20.0	17.0
Actuated g/C Ratio		0.39	0.39	0.39	0.22	0.19
v/c Ratio		0.65	0.31	0.59	0.84	0.51
Control Delay		35.7	20.9	27.0	57.9	40.0
Queue Delay		0.0	0.0	0.0	0.0	0.0
Total Delay		35.7	20.9	27.0	57.9	40.0
LOS		D	C	C	E	D
Approach Delay			28.1	27.0	57.9	40.0
Approach LOS			C	C	E	D

### Intersection Summary

Cycle Length: 90  
 Actuated Cycle Length: 90  
 Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green  
 Natural Cycle: 75  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.84  
 Intersection Signal Delay: 36.4  
 Intersection LOS: D  
 Intersection Capacity Utilization 78.7%  
 ICU Level of Service D  
 Analysis Period (min) 15

Splits and Phases: 10: Sawmill Road & Crowsfoot Road



# Phasings

## 10: Sawmill Road & Crowsfoot Road

2/1/2010



Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Protected Phases			2	6	3	
Permitted Phases	2	2		6		4
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	22.0	22.0	22.0	22.0	22.0	22.0
Total Split (s)	41.0	41.0	41.0	41.0	26.0	23.0
Total Split (%)	45.6%	45.6%	45.6%	45.6%	28.9%	25.6%
Maximum Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lead/Lag					Lead	Lag
Lead-Lag Optimize?					Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max
Walk Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0	0	0	0	0
90th %ile Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
90th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
70th %ile Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
70th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
50th %ile Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
50th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
30th %ile Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
30th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
10th %ile Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
10th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR

### Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

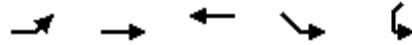
Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Pretimed

## Queues

### 10: Sawmill Road & Crowsfoot Road

2/1/2010



Lane Group	EBL	EBT	WBT	SEL	SWL
Lane Group Flow (vph)	181	192	343	268	147
v/c Ratio	0.65	0.31	0.59	0.84	0.51
Control Delay	35.7	20.9	27.0	57.9	40.0
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	35.7	20.9	27.0	57.9	40.0
Queue Length 50th (m)	25.1	22.7	46.1	44.5	23.0
Queue Length 95th (m)	#54.4	38.7	73.7	#85.2	41.5
Internal Link Dist (m)		209.3	244.6	967.8	525.7
Turn Bay Length (m)	80.0				
Base Capacity (vph)	278	612	580	319	287
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	0.65	0.31	0.59	0.84	0.51

#### Intersection Summary

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

# HCM Signalized Intersection Capacity Analysis

## 10: Sawmill Road & Crowsfoot Road

2/1/2010



Movement	EBL2	EBL	EBT	WBT	WBR	WBR2	SEL2	SEL	SER	SWL	SWR	SWR2	
Lane Configurations													
Volume (vph)	52	129	192	267	71	5	1	146	121	8	135	4	
Ideal Flow (vphpl)	1900	1775	1650	1650	1900	1900	1900	1765	1900	1765	1900	1900	
Total Lost time (s)		6.0	6.0	6.0				6.0		6.0			
Lane Util. Factor		1.00	1.00	1.00				1.00		1.00			
Frt		1.00	1.00	0.97				0.94		0.87			
Flt Protected		0.95	1.00	1.00				0.97		1.00			
Satd. Flow (prot)		1529	1574	1492				1435		1553			
Flt Permitted		0.44	1.00	1.00				0.97		0.98			
Satd. Flow (perm)		716	1574	1492				1435		1523			
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Adj. Flow (vph)	52	129	192	267	71	5	1	146	121	8	135	4	
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0	
Lane Group Flow (vph)	0	181	192	343	0	0	0	268	0	147	0	0	
Heavy Vehicles (%)	40%	0%	6%	9%	7%	0%	0%	6%	23%	0%	0%	0%	
Turn Type	Perm	Perm					Split						
Protected Phases			2	6			3	3					
Permitted Phases	2	2		6						4			
Actuated Green, G (s)		35.0	35.0	35.0				20.0		17.0			
Effective Green, g (s)		35.0	35.0	35.0				20.0		17.0			
Actuated g/C Ratio		0.39	0.39	0.39				0.22		0.19			
Clearance Time (s)		6.0	6.0	6.0				6.0		6.0			
Lane Grp Cap (vph)		278	612	580				319		288			
v/s Ratio Prot			0.12	0.23				c0.19					
v/s Ratio Perm		c0.25								c0.10			
v/c Ratio		0.65	0.31	0.59				0.84		0.51			
Uniform Delay, d1		22.5	19.1	21.8				33.5		32.8			
Progression Factor		1.00	1.00	1.00				1.00		1.00			
Incremental Delay, d2		11.3	1.3	4.4				22.6		6.3			
Delay (s)		33.8	20.5	26.2				56.0		39.1			
Level of Service		C	C	C				E		D			
Approach Delay (s)			26.9	26.2				56.0		39.1			
Approach LOS			C	C				E		D			
<b>Intersection Summary</b>													
HCM Average Control Delay			35.2		HCM Level of Service						D		
HCM Volume to Capacity ratio			0.67										
Actuated Cycle Length (s)			90.0		Sum of lost time (s)						18.0		
Intersection Capacity Utilization			78.7%		ICU Level of Service						D		
Analysis Period (min)			15										
c	Critical Lane Group												

# Timings

## 10: Sawmill Road & Crowsfoot Road

2/1/2010

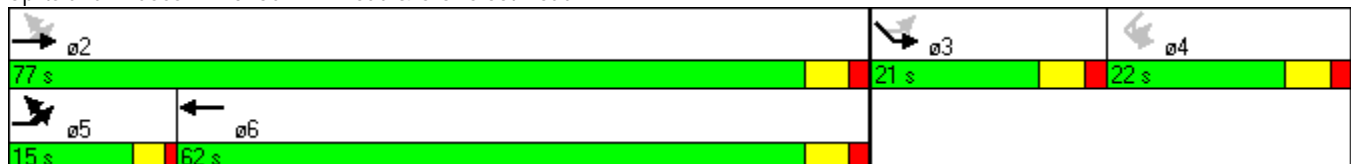


Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Lane Configurations						
Volume (vph)	110	172	356	423	120	7
Turn Type	pm+pt	pm+pt				
Protected Phases	5	5	2	6	3	
Permitted Phases	2	2		6		4
Detector Phase	5	5	2	6	3	4
Switch Phase						
Minimum Initial (s)	5.0	5.0	8.0	8.0	8.0	8.0
Minimum Split (s)	9.0	9.0	22.0	22.0	22.0	22.0
Total Split (s)	15.0	15.0	77.0	62.0	21.0	22.0
Total Split (%)	12.5%	12.5%	64.2%	51.7%	17.5%	18.3%
Yellow Time (s)	3.0	3.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead		Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes
Recall Mode	Max	Max	Max	Max	Max	Max
Act Effect Green (s)		73.0	73.0	58.0	17.0	18.0
Actuated g/C Ratio		0.61	0.61	0.48	0.14	0.15
v/c Ratio		0.96	0.37	0.87	0.79	0.51
Control Delay		58.4	13.2	42.2	71.0	55.8
Queue Delay		0.0	0.0	0.0	0.0	0.0
Total Delay		58.4	13.2	42.2	71.0	55.8
LOS		E	B	D	E	E
Approach Delay			33.2	42.2	71.0	55.8
Approach LOS			C	D	E	E

### Intersection Summary

Cycle Length: 120  
 Actuated Cycle Length: 120  
 Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green  
 Natural Cycle: 110  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.96  
 Intersection Signal Delay: 42.6  
 Intersection LOS: D  
 Intersection Capacity Utilization 89.5%  
 ICU Level of Service E  
 Analysis Period (min) 15

Splits and Phases: 10: Sawmill Road & Crowsfoot Road



# Phasings

## 10: Sawmill Road & Crowsfoot Road

2/1/2010



Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Protected Phases	5	5	2	6	3	
Permitted Phases	2	2		6		4
Minimum Initial (s)	5.0	5.0	8.0	8.0	8.0	8.0
Minimum Split (s)	9.0	9.0	22.0	22.0	22.0	22.0
Total Split (s)	15.0	15.0	77.0	62.0	21.0	22.0
Total Split (%)	12.5%	12.5%	64.2%	51.7%	17.5%	18.3%
Maximum Green (s)	11.0	11.0	71.0	56.0	15.0	16.0
Yellow Time (s)	3.0	3.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	2.0	2.0	2.0	2.0
Lead/Lag	Lead	Lead		Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max
Walk Time (s)			5.0	5.0	5.0	5.0
Flash Dont Walk (s)			11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)			0	0	0	0
90th %ile Green (s)	11.0	11.0	71.0	56.0	15.0	16.0
90th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	MaxR
70th %ile Green (s)	11.0	11.0	71.0	56.0	15.0	16.0
70th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	MaxR
50th %ile Green (s)	11.0	11.0	71.0	56.0	15.0	16.0
50th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	MaxR
30th %ile Green (s)	11.0	11.0	71.0	56.0	15.0	16.0
30th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	MaxR
10th %ile Green (s)	11.0	11.0	71.0	56.0	15.0	16.0
10th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	MaxR

### Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Pretimed

# Queues

## 10: Sawmill Road & Crowsfoot Road

2/1/2010



Lane Group	EBL	EBT	WBT	SEL	SWL
Lane Group Flow (vph)	282	356	647	170	116
v/c Ratio	0.96	0.37	0.87	0.79	0.51
Control Delay	58.4	13.2	42.2	71.0	55.8
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	58.4	13.2	42.2	71.0	55.8
Queue Length 50th (m)	29.7	39.7	132.3	36.0	25.5
Queue Length 95th (m)	#72.7	58.4	#204.4	#70.9	44.6
Internal Link Dist (m)		209.3	244.6	967.8	1075.3
Turn Bay Length (m)	80.0				
Base Capacity (vph)	295	967	742	216	227
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	0.96	0.37	0.87	0.79	0.51

### Intersection Summary

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

# HCM Signalized Intersection Capacity Analysis

## 10: Sawmill Road & Crowsfoot Road

2/1/2010



Movement	EBL2	EBL	EBT	WBT	WBR	WBR2	SEL2	SEL	SER	SWL	SWR	SWR2
Lane Configurations												
Volume (vph)	110	172	356	423	214	10	2	120	48	7	107	2
Ideal Flow (vphpl)	1900	1775	1650	1650	1900	1900	1900	1765	1900	1765	1900	1900
Total Lost time (s)		4.0	4.0	4.0				4.0		4.0		
Lane Util. Factor		1.00	1.00	1.00				1.00		1.00		
Frt		1.00	1.00	0.95				0.96		0.87		
Flt Protected		0.95	1.00	1.00				0.97		1.00		
Satd. Flow (prot)		1576	1589	1535				1440		1554		
Flt Permitted		0.18	1.00	1.00				0.97		0.97		
Satd. Flow (perm)		292	1589	1535				1440		1513		
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	110	172	356	423	214	10	2	120	48	7	107	2
RTOR Reduction (vph)	0	0	0	0	0	0	0	12	0	0	0	0
Lane Group Flow (vph)	0	282	356	647	0	0	0	158	0	116	0	0
Heavy Vehicles (%)	21%	0%	5%	5%	1%	0%	0%	5%	41%	0%	0%	0%
Turn Type	pm+pt	pm+pt						Perm				
Protected Phases	5	5	2	6				3				
Permitted Phases	2	2		6			3			4		
Actuated Green, G (s)		71.0	71.0	56.0				15.0		16.0		
Effective Green, g (s)		71.0	73.0	58.0				17.0		18.0		
Actuated g/C Ratio		0.59	0.61	0.48				0.14		0.15		
Clearance Time (s)		4.0	6.0	6.0				6.0		6.0		
Lane Grp Cap (vph)		290	967	742				204		227		
v/s Ratio Prot		c0.09	0.22	0.42								
v/s Ratio Perm		c0.49						0.11		c0.08		
v/c Ratio		0.97	0.37	0.87				0.77		0.51		
Uniform Delay, d1		20.7	11.9	27.7				49.7		46.9		
Progression Factor		1.00	1.00	1.00				1.00		1.00		
Incremental Delay, d2		46.3	1.1	13.4				24.4		8.0		
Delay (s)		66.9	12.9	41.1				74.1		54.9		
Level of Service		E	B	D				E		D		
Approach Delay (s)			36.8	41.1				74.1		54.9		
Approach LOS			D	D				E		D		

### Intersection Summary

HCM Average Control Delay	43.9	HCM Level of Service	D
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	89.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

# APPENDIX F

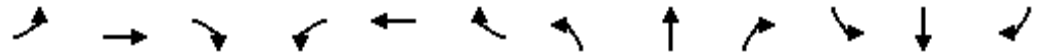
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## SYNCHRO WORKSHEETS – SCENARIO 3 AND SCENARIO 4

Volume

3: Sawmill Road & Northfield Drive

1/31/2010



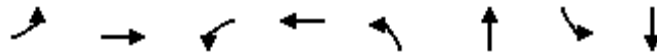
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Volume (vph)	33	132	57	360	165	11	60	106	262	16	306	71
Confl. Peds. (#/hr)			2	2								
Confl. Bikes (#/hr)												
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	32%	7%	4%	3%	6%	11%	6%	10%	7%	8%	4%	8%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	33	132	57	360	165	11	60	106	262	16	306	71
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	222	0	0	536	0	60	368	0	0	393	0

Intersection Summary

# Timings

## 3: Sawmill Road & Northfield Drive

1/31/2010

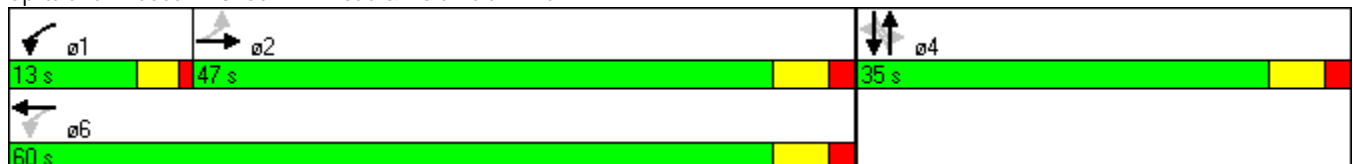


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		↕		↕	↗	↖		↕
Volume (vph)	33	132	360	165	60	106	16	306
Turn Type	Perm		pm+pt		Perm		Perm	
Protected Phases		2	1	6		4		4
Permitted Phases	2		6		4		4	
Detector Phase	2	2	1	6	4	4	4	4
Switch Phase								
Minimum Initial (s)	8.0	8.0	4.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	36.0	36.0	9.0	36.0	32.0	32.0	32.0	32.0
Total Split (s)	47.0	47.0	13.0	60.0	35.0	35.0	35.0	35.0
Total Split (%)	49.5%	49.5%	13.7%	63.2%	36.8%	36.8%	36.8%	36.8%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	0.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Act Effct Green (s)		43.0		56.0	31.0	31.0		31.0
Actuated g/C Ratio		0.45		0.59	0.33	0.33		0.33
v/c Ratio		0.39		0.89	0.32	0.68		0.83
Control Delay		17.9		35.7	29.9	24.0		45.6
Queue Delay		0.0		0.0	0.0	0.0		0.0
Total Delay		17.9		35.7	29.9	24.0		45.6
LOS		B		D	C	C		D
Approach Delay		17.9		35.7		24.8		45.6
Approach LOS		B		D		C		D

### Intersection Summary

Cycle Length: 95  
 Actuated Cycle Length: 95  
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green  
 Natural Cycle: 90  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.89  
 Intersection Signal Delay: 32.7  
 Intersection LOS: C  
 Intersection Capacity Utilization 112.3%  
 ICU Level of Service H  
 Analysis Period (min) 15

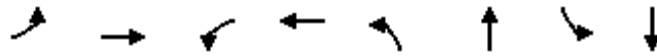
### Splits and Phases: 3: Sawmill Road & Northfield Drive



# Phasings

## 3: Sawmill Road & Northfield Drive

1/31/2010



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Protected Phases		2	1	6		4		4
Permitted Phases	2		6		4		4	
Minimum Initial (s)	8.0	8.0	4.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	36.0	36.0	9.0	36.0	32.0	32.0	32.0	32.0
Total Split (s)	47.0	47.0	13.0	60.0	35.0	35.0	35.0	35.0
Total Split (%)	49.5%	49.5%	13.7%	63.2%	36.8%	36.8%	36.8%	36.8%
Maximum Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	2.0	2.0
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Walk Time (s)	14.0	14.0		14.0	19.0	19.0	19.0	19.0
Flash Dont Walk (s)	16.0	16.0		16.0	7.0	7.0	7.0	7.0
Pedestrian Calls (#/hr)	0	0		0	0	0	0	0
90th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
90th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
70th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
70th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
50th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
50th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
30th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
30th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
10th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
10th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR

### Intersection Summary

Cycle Length: 95

Actuated Cycle Length: 95

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Pretimed

## Queues

### 3: Sawmill Road & Northfield Drive

1/31/2010



Lane Group	EBT	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	222	536	60	368	393
v/c Ratio	0.39	0.89	0.32	0.68	0.83
Control Delay	17.9	35.7	29.9	24.0	45.6
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	17.9	35.7	29.9	24.0	45.6
Queue Length 50th (m)	23.2	59.0	8.2	35.9	64.2
Queue Length 95th (m)	41.5	#128.2	19.3	68.2	#113.6
Internal Link Dist (m)	1940.2	1158.8		681.9	899.0
Turn Bay Length (m)			7.0		
Base Capacity (vph)	563	599	189	544	473
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	0.39	0.89	0.32	0.68	0.83

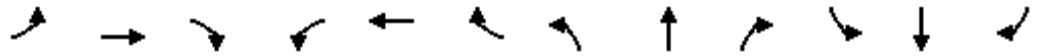
#### Intersection Summary

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

# HCM Signalized Intersection Capacity Analysis

## 3: Sawmill Road & Northfield Drive

1/31/2010



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↗	↘			↕	
Volume (vph)	33	132	57	360	165	11	60	106	262	16	306	71
Ideal Flow (vphpl)	1900	1550	1900	1900	1550	1900	1775	1650	1900	1900	1550	1900
Total Lost time (s)		4.0			4.0		4.0	4.0			4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00			1.00	
Frbp, ped/bikes		0.99			1.00		1.00	1.00			1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00			1.00	
Frt		0.97			1.00		1.00	0.89			0.98	
Flt Protected		0.99			0.97		0.95	1.00			1.00	
Satd. Flow (prot)		1358			1452		1608	1382			1455	
Flt Permitted		0.89			0.62		0.34	1.00			0.98	
Satd. Flow (perm)		1214			932		579	1382			1425	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	33	132	57	360	165	11	60	106	262	16	306	71
RTOR Reduction (vph)	0	13	0	0	1	0	0	94	0	0	8	0
Lane Group Flow (vph)	0	209	0	0	535	0	60	274	0	0	385	0
Confl. Peds. (#/hr)			2	2								
Heavy Vehicles (%)	32%	7%	4%	3%	6%	11%	6%	10%	7%	8%	4%	8%
Turn Type	Perm			pm+pt			Perm			Perm		
Protected Phases		2		1	6			4			4	
Permitted Phases	2			6			4			4		
Actuated Green, G (s)		41.0			54.0		29.0	29.0			29.0	
Effective Green, g (s)		43.0			56.0		31.0	31.0			31.0	
Actuated g/C Ratio		0.45			0.59		0.33	0.33			0.33	
Clearance Time (s)		6.0			6.0		6.0	6.0			6.0	
Lane Grp Cap (vph)		549			610		189	451			465	
v/s Ratio Prot					c0.10			0.20				
v/s Ratio Perm		0.17			0.42		0.10				c0.27	
v/c Ratio		0.38			0.88		0.32	0.61			0.83	
Uniform Delay, d1		17.2			16.6		24.0	26.9			29.5	
Progression Factor		1.00			1.00		1.00	1.00			1.00	
Incremental Delay, d2		2.0			16.3		4.4	6.0			15.5	
Delay (s)		19.2			32.9		28.4	32.9			45.0	
Level of Service		B			C		C	C			D	
Approach Delay (s)		19.2			32.9			32.3			45.0	
Approach LOS		B			C			C			D	

### Intersection Summary

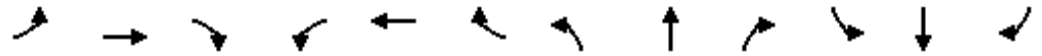
HCM Average Control Delay	33.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	112.3%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Volume

13: Driveway & Sawmill Road

1/31/2010



















Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Volume (vph)	2	1	3	132	1	111	1	229	107	76	299	1
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour 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
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	0%	0%	0%	4%	0%	8%	0%	15%	4%	4%	8%	0%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	2	1	3	132	1	111	1	229	107	76	299	1
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	6	0	0	244	0	0	337	0	0	376	0

Intersection Summary

# HCM Unsignalized Intersection Capacity Analysis

## 13: Driveway & Sawmill Road

1/31/2010

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	1	3	132	1	111	1	229	107	76	299	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour 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
Hourly flow rate (vph)	2	1	3	132	1	111	1	229	107	76	299	1
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	848	790	300	740	736	282	300			336		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	848	790	300	740	736	282	300			336		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.3	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.4	2.2			2.2		
p0 queue free %	99	100	100	58	100	85	100			94		
cM capacity (veh/h)	229	304	745	312	327	742	1273			1212		
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>WB 1</b>	<b>NB 1</b>	<b>SB 1</b>								
Volume Total	6	244	337	376								
Volume Left	2	132	1	76								
Volume Right	3	111	107	1								
cSH	374	424	1273	1212								
Volume to Capacity	0.02	0.58	0.00	0.06								
Queue Length 95th (m)	0.4	26.7	0.0	1.5								
Control Delay (s)	14.8	24.4	0.0	2.1								
Lane LOS	B	C	A	A								
Approach Delay (s)	14.8	24.4	0.0	2.1								
Approach LOS	B	C										
<b>Intersection Summary</b>												
Average Delay			7.1									
Intersection Capacity Utilization			80.3%		ICU Level of Service					D		
Analysis Period (min)			15									

# Timings

## 10: Sawmill Road & Crowsfoot Road

1/31/2010

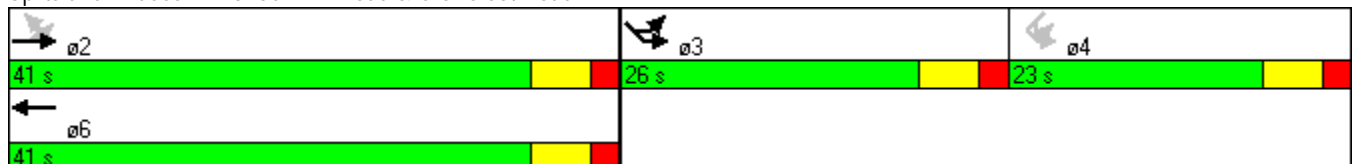


Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Lane Configurations						
Volume (vph)	37	129	192	267	151	8
Turn Type	Perm	Perm				
Protected Phases			2	6	3	
Permitted Phases	2	2		6		4
Detector Phase	2	2	2	6	3	4
Switch Phase						
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	22.0	22.0	22.0	22.0	22.0	22.0
Total Split (s)	41.0	41.0	41.0	41.0	26.0	23.0
Total Split (%)	45.6%	45.6%	45.6%	45.6%	28.9%	25.6%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag					Lead	Lag
Lead-Lag Optimize?					Yes	Yes
Recall Mode	Max	Max	Max	Max	Max	Max
Act Effect Green (s)		37.0	37.0	37.0	22.0	19.0
Actuated g/C Ratio		0.41	0.41	0.41	0.24	0.21
v/c Ratio		0.55	0.30	0.57	0.71	0.46
Control Delay		28.7	19.4	25.1	43.5	36.3
Queue Delay		0.0	0.0	0.0	0.0	0.0
Total Delay		28.7	19.4	25.1	43.5	36.3
LOS		C	B	C	D	D
Approach Delay			23.7	25.1	43.5	36.3
Approach LOS			C	C	D	D

### Intersection Summary

Cycle Length: 90  
 Actuated Cycle Length: 90  
 Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green  
 Natural Cycle: 70  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.71  
 Intersection Signal Delay: 30.4  
 Intersection LOS: C  
 Intersection Capacity Utilization 70.8%  
 ICU Level of Service C  
 Analysis Period (min) 15

### Splits and Phases: 10: Sawmill Road & Crowsfoot Road



# Phasings

## 10: Sawmill Road & Crowsfoot Road

1/31/2010



Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Protected Phases			2	6	3	
Permitted Phases	2	2		6		4
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	22.0	22.0	22.0	22.0	22.0	22.0
Total Split (s)	41.0	41.0	41.0	41.0	26.0	23.0
Total Split (%)	45.6%	45.6%	45.6%	45.6%	28.9%	25.6%
Maximum Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lead/Lag					Lead	Lag
Lead-Lag Optimize?					Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max
Walk Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0	0	0	0	0
90th %ile Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
90th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
70th %ile Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
70th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
50th %ile Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
50th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
30th %ile Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
30th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
10th %ile Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
10th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR

### Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

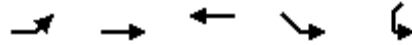
Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Pretimed

# Queues

## 10: Sawmill Road & Crowsfoot Road

1/31/2010



Lane Group	EBL	EBT	WBT	SEL	SWL
Lane Group Flow (vph)	166	192	348	258	147
v/c Ratio	0.55	0.30	0.57	0.71	0.46
Control Delay	28.7	19.4	25.1	43.5	36.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	28.7	19.4	25.1	43.5	36.3
Queue Length 50th (m)	21.3	21.7	45.2	40.9	22.3
Queue Length 95th (m)	42.5	37.1	72.5	#73.2	40.3
Internal Link Dist (m)		209.3	244.6	967.8	525.7
Turn Bay Length (m)	60.0				
Base Capacity (vph)	301	647	606	363	322
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	0.55	0.30	0.57	0.71	0.46

### Intersection Summary

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

# HCM Signalized Intersection Capacity Analysis

## 10: Sawmill Road & Crowsfoot Road

1/31/2010



Movement	EBL2	EBL	EBT	WBT	WBR	WBR2	SEL2	SEL	SER	SWL	SWR	SWR2
Lane Configurations												
Volume (vph)	37	129	192	267	76	5	1	151	106	8	135	4
Ideal Flow (vphpl)	1900	1775	1650	1650	1900	1900	1900	1765	1900	1765	1900	1900
Total Lost time (s)		4.0	4.0	4.0				4.0		4.0		
Lane Util. Factor		1.00	1.00	1.00				1.00		1.00		
Frt		1.00	1.00	0.97				0.94		0.87		
Flt Protected		0.95	1.00	1.00				0.97		1.00		
Satd. Flow (prot)		1646	1574	1472				1486		1553		
Flt Permitted		0.42	1.00	1.00				0.97		0.98		
Satd. Flow (perm)		732	1574	1472				1486		1528		
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	37	129	192	267	76	5	1	151	106	8	135	4
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	166	192	348	0	0	0	258	0	147	0	0
Heavy Vehicles (%)	16%	0%	6%	9%	13%	0%	0%	9%	12%	0%	0%	0%
Turn Type	Perm	Perm					Split					
Protected Phases			2	6			3	3				
Permitted Phases	2	2		6						4		
Actuated Green, G (s)		35.0	35.0	35.0				20.0		17.0		
Effective Green, g (s)		37.0	37.0	37.0				22.0		19.0		
Actuated g/C Ratio		0.41	0.41	0.41				0.24		0.21		
Clearance Time (s)		6.0	6.0	6.0				6.0		6.0		
Lane Grp Cap (vph)		301	647	605				363		323		
v/s Ratio Prot			0.12	c0.24				c0.17				
v/s Ratio Perm		0.23								c0.10		
v/c Ratio		0.55	0.30	0.58				0.71		0.46		
Uniform Delay, d1		20.2	17.8	20.4				31.1		31.0		
Progression Factor		1.00	1.00	1.00				1.00		1.00		
Incremental Delay, d2		7.1	1.2	3.9				11.2		4.6		
Delay (s)		27.3	18.9	24.4				42.3		35.6		
Level of Service		C	B	C				D		D		
Approach Delay (s)			22.8	24.4				42.3		35.6		
Approach LOS			C	C				D		D		

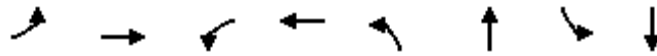
### Intersection Summary

HCM Average Control Delay	29.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	70.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

# Timings

## 3: Sawmill Road & Northfield Drive

2/16/2010

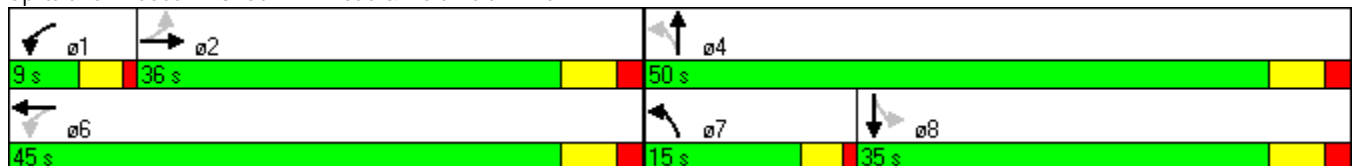


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		↕		↕	↗	↖		↕
Volume (vph)	61	213	241	191	106	369	26	201
Turn Type	Perm		pm+pt		pm+pt		Perm	
Protected Phases		2	1	6	7	4		8
Permitted Phases	2		6		4		8	
Detector Phase	2	2	1	6	7	4	8	8
Switch Phase								
Minimum Initial (s)	8.0	8.0	5.0	8.0	4.0	8.0	8.0	8.0
Minimum Split (s)	32.0	32.0	9.0	34.0	8.0	38.0	35.0	35.0
Total Split (s)	36.0	36.0	9.0	45.0	15.0	50.0	35.0	35.0
Total Split (%)	37.9%	37.9%	9.5%	47.4%	15.8%	52.6%	36.8%	36.8%
Yellow Time (s)	4.0	4.0	3.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	0.0	-2.0	0.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lead		Lead		Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes		Yes		Yes	Yes
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Act Effect Green (s)		32.0		41.0	46.0	46.0		31.0
Actuated g/C Ratio		0.34		0.43	0.48	0.48		0.33
v/c Ratio		0.83		1.26	0.24	1.07		0.91
Control Delay		46.2		164.0	15.0	77.6		65.6
Queue Delay		0.0		0.0	0.0	0.0		0.0
Total Delay		46.2		164.0	15.0	77.6		65.6
LOS		D		F	B	E		E
Approach Delay		46.2		164.0		70.4		65.6
Approach LOS		D		F		E		E

### Intersection Summary

Cycle Length: 95  
 Actuated Cycle Length: 95  
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green  
 Natural Cycle: 85  
 Control Type: Pretimed  
 Maximum v/c Ratio: 1.26  
 Intersection Signal Delay: 87.4  
 Intersection LOS: F  
 Intersection Capacity Utilization 118.4%  
 ICU Level of Service H  
 Analysis Period (min) 15

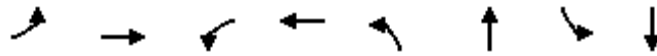
### Splits and Phases: 3: Sawmill Road & Northfield Drive



# Phasings

## 3: Sawmill Road & Northfield Drive

2/16/2010



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Protected Phases		2	1	6	7	4		8
Permitted Phases	2		6		4		8	
Minimum Initial (s)	8.0	8.0	5.0	8.0	4.0	8.0	8.0	8.0
Minimum Split (s)	32.0	32.0	9.0	34.0	8.0	38.0	35.0	35.0
Total Split (s)	36.0	36.0	9.0	45.0	15.0	50.0	35.0	35.0
Total Split (%)	37.9%	37.9%	9.5%	47.4%	15.8%	52.6%	36.8%	36.8%
Maximum Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
Yellow Time (s)	4.0	4.0	3.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	1.0	2.0	2.0	2.0
Lead/Lag	Lag	Lag	Lead		Lead		Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes		Yes		Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Walk Time (s)	10.0	10.0		10.0		22.0	22.0	22.0
Flash Dont Walk (s)	16.0	16.0		16.0		7.0	7.0	7.0
Pedestrian Calls (#/hr)	0	0		0		0	0	0
90th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
90th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
70th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
70th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
50th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
50th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
30th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
30th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
10th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
10th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR

### Intersection Summary

Cycle Length: 95

Actuated Cycle Length: 95

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Pretimed

## Queues

### 3: Sawmill Road & Northfield Drive

2/16/2010



Lane Group	EBT	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	351	467	106	810	265
v/c Ratio	0.83	1.26	0.24	1.07	0.91
Control Delay	46.2	164.0	15.0	77.6	65.6
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	46.2	164.0	15.0	77.6	65.6
Queue Length 50th (m)	56.2	~98.4	10.3	~157.7	44.8
Queue Length 95th (m)	#104.3	#167.6	19.5	#227.6	#92.3
Internal Link Dist (m)	1940.2	1158.8		838.0	899.0
Turn Bay Length (m)			7.0		
Base Capacity (vph)	423	370	447	755	292
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	0.83	1.26	0.24	1.07	0.91

#### Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

# HCM Signalized Intersection Capacity Analysis

## 3: Sawmill Road & Northfield Drive

2/16/2010



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↗	↘			↕	
Volume (vph)	61	213	77	241	191	35	106	369	441	26	201	38
Ideal Flow (vphpl)	1900	1550	1900	1900	1550	1900	1775	1650	1900	1900	1550	1900
Total Lost time (s)		4.0			4.0		4.0	4.0			4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00			1.00	
Frbp, ped/bikes		1.00			1.00		1.00	1.00			1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00			1.00	
Frt		0.97			0.99		1.00	0.92			0.98	
Flt Protected		0.99			0.97		0.95	1.00			1.00	
Satd. Flow (prot)		1423			1428		1607	1465			1427	
Flt Permitted		0.85			0.53		0.42	1.00			0.61	
Satd. Flow (perm)		1226			771		709	1465			876	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	61	213	77	241	191	35	106	369	441	26	201	38
RTOR Reduction (vph)	0	11	0	0	3	0	0	45	0	0	6	0
Lane Group Flow (vph)	0	340	0	0	464	0	106	765	0	0	259	0
Confl. Peds. (#/hr)	5		1	1		5	2					2
Heavy Vehicles (%)	4%	7%	2%	5%	7%	3%	6%	4%	5%	14%	6%	6%
Turn Type	Perm			pm+pt			pm+pt			Perm		
Protected Phases		2		1	6		7	4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)		30.0			39.0		44.0	44.0			29.0	
Effective Green, g (s)		32.0			41.0		44.0	46.0			31.0	
Actuated g/C Ratio		0.34			0.43		0.46	0.48			0.33	
Clearance Time (s)		6.0			6.0		4.0	6.0			6.0	
Lane Grp Cap (vph)		413			381		432	709			286	
v/s Ratio Prot					c0.09		0.03	c0.52				
v/s Ratio Perm		c0.28			0.44		0.09				0.30	
v/c Ratio		0.82			1.22		0.25	1.08			0.91	
Uniform Delay, d1		28.9			27.0		15.8	24.5			30.6	
Progression Factor		1.00			1.00		1.00	1.00			1.00	
Incremental Delay, d2		16.8			119.8		1.3	56.9			33.6	
Delay (s)		45.8			146.8		17.2	81.4			64.2	
Level of Service		D			F		B	F			E	
Approach Delay (s)		45.8			146.8			74.0			64.2	
Approach LOS		D			F			E			E	

### Intersection Summary

















HCM Average Control Delay	84.8	HCM Level of Service	F
HCM Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	118.4%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

# HCM Unsignalized Intersection Capacity Analysis

## 13: Driveway & Sawmill Road

2/16/2010

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	3	1	10	121	2	102	5	441	100	104	384	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour 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
Hourly flow rate (vph)	3	1	10	121	2	102	5	441	100	104	384	1
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1196	1144	384	1104	1094	491	385			541		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1196	1144	384	1104	1094	491	385			541		
tC, single (s)	7.1	6.5	6.2	7.2	6.5	6.2	4.1			4.2		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.6	4.0	3.3	2.2			2.3		
p0 queue free %	98	99	99	27	99	82	100			90		
cM capacity (veh/h)	123	180	668	166	193	575	1185			1003		
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>WB 1</b>	<b>NB 1</b>	<b>SB 1</b>								
Volume Total	14	225	546	489								
Volume Left	3	121	5	104								
Volume Right	10	102	100	1								
cSH	312	245	1185	1003								
Volume to Capacity	0.04	0.92	0.00	0.10								
Queue Length 95th (m)	1.1	60.8	0.1	2.6								
Control Delay (s)	17.1	81.1	0.1	2.9								
Lane LOS	C	F	A	A								
Approach Delay (s)	17.1	81.1	0.1	2.9								
Approach LOS	C	F										
<b>Intersection Summary</b>												
Average Delay			15.7									
Intersection Capacity Utilization			99.8%		ICU Level of Service				F			
Analysis Period (min)			15									

Phasings

10: Sawmill Road & Crowsfoot Road

1/31/2010



Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Protected Phases	5	5	2	6	3	
Permitted Phases	2	2		6		4
Minimum Initial (s)	5.0	5.0	8.0	8.0	8.0	8.0
Minimum Split (s)	9.0	9.0	22.0	22.0	22.0	22.0
Total Split (s)	12.0	12.0	59.0	47.0	17.0	19.0
Total Split (%)	12.6%	12.6%	62.1%	49.5%	17.9%	20.0%
Maximum Green (s)	8.0	8.0	53.0	41.0	11.0	13.0
Yellow Time (s)	3.0	3.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	2.0	2.0	2.0	2.0
Lead/Lag	Lead	Lead		Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max
Walk Time (s)			5.0	5.0	5.0	5.0
Flash Dont Walk (s)			11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)			0	0	0	0
90th %ile Green (s)	8.0	8.0	53.0	41.0	11.0	13.0
90th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	Ped
70th %ile Green (s)	8.0	8.0	53.0	41.0	11.0	13.0
70th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	Ped
50th %ile Green (s)	8.0	8.0	53.0	41.0	11.0	13.0
50th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	Ped
30th %ile Green (s)	8.0	8.0	53.0	41.0	11.0	13.0
30th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	Ped
10th %ile Green (s)	8.0	8.0	53.0	41.0	11.0	13.0
10th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	Ped

Intersection Summary

Cycle Length: 95

Actuated Cycle Length: 95

Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Pretimed

# Queues

## 10: Sawmill Road & Crowsfoot Road

1/31/2010



Lane Group	EBL	EBT	WBT	SEL	SWL
Lane Group Flow (vph)	267	356	652	160	116
v/c Ratio	1.02	0.39	0.94	0.77	0.49
Control Delay	56.4	12.9	49.7	65.2	44.2
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	56.4	12.9	49.7	65.2	44.2
Queue Length 50th (m)	~28.3	32.2	110.6	28.7	19.6
Queue Length 95th (m)	m#27.4	m33.7	#182.6	#59.7	36.6
Internal Link Dist (m)		209.3	244.6	967.8	1075.3
Turn Bay Length (m)	60.0				
Base Capacity (vph)	263	920	690	207	239
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	1.02	0.39	0.94	0.77	0.49

### Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

# Simulation Settings

## 10: Sawmill Road & Crowsfoot Road

1/31/2010



Lane Group	EBL2	EBL	EBT	WBT	WBR	WBR2	SEL2	SEL	SER	SWL	SWR	SWR2
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Left	Right	Right	Left	Left	Right	Left	Right	Right
Median Width(m)			3.7	3.7				3.7		3.7		
Link Offset(m)			0.0	0.0				0.0		0.0		
Crosswalk Width(m)			1.6	1.6				1.6		1.6		
Two way Left Turn Lane												
Headway Factor	0.99	1.08	1.18	1.18	0.99	0.99	0.99	1.08	0.99	1.08	0.99	0.99
Turning Speed (k/h)	24	24			14	14	24	24	14	24	14	14

### Intersection Summary

# HCM Signalized Intersection Capacity Analysis

## 10: Sawmill Road & Crowsfoot Road

1/31/2010



Movement	EBL2	EBL	EBT	WBT	WBR	WBR2	SEL2	SEL	SER	SWL	SWR	SWR2
Lane Configurations												
Volume (vph)	95	172	356	423	219	10	2	125	33	7	107	2
Ideal Flow (vphpl)	1900	1775	1650	1650	1900	1900	1900	1765	1900	1765	1900	1900
Total Lost time (s)		4.0	4.0	4.0				4.0		4.0		
Lane Util. Factor		1.00	1.00	1.00				1.00		1.00		
Frt		1.00	1.00	0.95				0.97		0.87		
Flt Protected		0.95	1.00	1.00				0.96		1.00		
Satd. Flow (prot)		1658	1589	1524				1515		1554		
Flt Permitted		0.14	1.00	1.00				0.96		0.97		
Satd. Flow (perm)		250	1589	1524				1515		1512		
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	95	172	356	423	219	10	2	125	33	7	107	2
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	267	356	652	0	0	0	160	0	116	0	0
Heavy Vehicles (%)	8%	0%	5%	5%	3%	0%	0%	9%	15%	0%	0%	0%
Turn Type	pm+pt	pm+pt						Perm				
Protected Phases	5	5	2	6				3				
Permitted Phases	2	2		6			3			4		
Actuated Green, G (s)		53.0	53.0	41.0				11.0		13.0		
Effective Green, g (s)		53.0	55.0	43.0				13.0		15.0		
Actuated g/C Ratio		0.56	0.58	0.45				0.14		0.16		
Clearance Time (s)		4.0	6.0	6.0				6.0		6.0		
Lane Grp Cap (vph)		258	920	690				207		239		
v/s Ratio Prot		c0.09	0.22	0.43								
v/s Ratio Perm		c0.49						0.11		c0.08		
v/c Ratio		1.03	0.39	0.94				0.77		0.49		
Uniform Delay, d1		18.8	10.9	24.9				39.6		36.5		
Progression Factor		1.44	1.12	1.00				1.00		1.00		
Incremental Delay, d2		40.2	0.4	23.1				24.0		6.9		
Delay (s)		67.3	12.5	48.0				63.6		43.4		
Level of Service		E	B	D				E		D		
Approach Delay (s)			36.0	48.0				63.6		43.4		
Approach LOS			D	D				E		D		

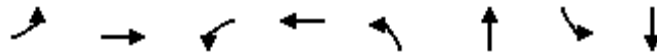
### Intersection Summary

HCM Average Control Delay	44.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	88.3%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

# Timings

## 3: Sawmill Road & Northfield Drive

1/31/2010

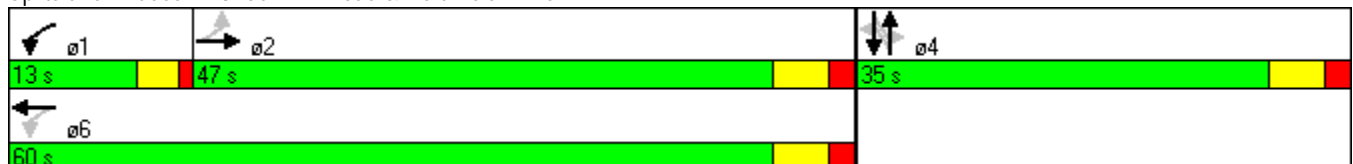


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		↕		↕	↗	↖		↕
Volume (vph)	33	132	365	165	60	106	16	306
Turn Type	Perm		pm+pt		Perm		Perm	
Protected Phases		2	1	6		4		4
Permitted Phases	2		6		4		4	
Detector Phase	2	2	1	6	4	4	4	4
Switch Phase								
Minimum Initial (s)	8.0	8.0	4.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	36.0	36.0	9.0	36.0	32.0	32.0	32.0	32.0
Total Split (s)	47.0	47.0	13.0	60.0	35.0	35.0	35.0	35.0
Total Split (%)	49.5%	49.5%	13.7%	63.2%	36.8%	36.8%	36.8%	36.8%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	0.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Act Effct Green (s)		43.0		56.0	31.0	31.0		31.0
Actuated g/C Ratio		0.45		0.59	0.33	0.33		0.33
v/c Ratio		0.40		0.92	0.32	0.69		0.83
Control Delay		17.9		39.1	29.9	24.5		45.6
Queue Delay		0.0		0.0	0.0	0.0		0.0
Total Delay		17.9		39.1	29.9	24.5		45.6
LOS		B		D	C	C		D
Approach Delay		17.9		39.1		25.3		45.6
Approach LOS		B		D		C		D

### Intersection Summary

Cycle Length: 95  
 Actuated Cycle Length: 95  
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green  
 Natural Cycle: 90  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.92  
 Intersection Signal Delay: 34.0  
 Intersection LOS: C  
 Intersection Capacity Utilization 112.6%  
 ICU Level of Service H  
 Analysis Period (min) 15

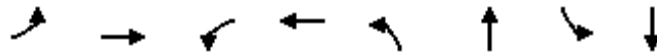
### Splits and Phases: 3: Sawmill Road & Northfield Drive



# Phasings

## 3: Sawmill Road & Northfield Drive

1/31/2010



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Protected Phases		2	1	6		4		4
Permitted Phases	2		6		4		4	
Minimum Initial (s)	8.0	8.0	4.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	36.0	36.0	9.0	36.0	32.0	32.0	32.0	32.0
Total Split (s)	47.0	47.0	13.0	60.0	35.0	35.0	35.0	35.0
Total Split (%)	49.5%	49.5%	13.7%	63.2%	36.8%	36.8%	36.8%	36.8%
Maximum Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	2.0	2.0
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Walk Time (s)	14.0	14.0		14.0	19.0	19.0	19.0	19.0
Flash Dont Walk (s)	16.0	16.0		16.0	7.0	7.0	7.0	7.0
Pedestrian Calls (#/hr)	0	0		0	0	0	0	0
90th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
90th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
70th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
70th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
50th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
50th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
30th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
30th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
10th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
10th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR

### Intersection Summary

Cycle Length: 95

Actuated Cycle Length: 95

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Pretimed

## Queues

### 3: Sawmill Road & Northfield Drive

1/31/2010



Lane Group	EBT	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	222	541	60	373	393
v/c Ratio	0.40	0.92	0.32	0.69	0.83
Control Delay	17.9	39.1	29.9	24.5	45.6
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	17.9	39.1	29.9	24.5	45.6
Queue Length 50th (m)	23.2	60.3	8.2	36.5	64.2
Queue Length 95th (m)	41.5	#137.3	19.3	69.7	#113.6
Internal Link Dist (m)	1940.2	1158.8		681.9	899.0
Turn Bay Length (m)			7.0		
Base Capacity (vph)	562	591	189	540	473
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	0.40	0.92	0.32	0.69	0.83

#### Intersection Summary

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

# HCM Signalized Intersection Capacity Analysis

## 3: Sawmill Road & Northfield Drive

1/31/2010



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↗	↘			↕	
Volume (vph)	33	132	57	365	165	11	60	106	267	16	306	71
Ideal Flow (vphpl)	1900	1550	1900	1900	1550	1900	1775	1650	1900	1900	1550	1900
Total Lost time (s)		4.0			4.0		4.0	4.0			4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00			1.00	
Frbp, ped/bikes		0.99			1.00		1.00	1.00			1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00			1.00	
Frt		0.97			1.00		1.00	0.89			0.98	
Flt Protected		0.99			0.97		0.95	1.00			1.00	
Satd. Flow (prot)		1358			1433		1608	1363			1455	
Flt Permitted		0.89			0.62		0.34	1.00			0.98	
Satd. Flow (perm)		1213			919		579	1363			1425	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	33	132	57	365	165	11	60	106	267	16	306	71
RTOR Reduction (vph)	0	13	0	0	1	0	0	96	0	0	8	0
Lane Group Flow (vph)	0	209	0	0	540	0	60	277	0	0	385	0
Confl. Peds. (#/hr)			2	2								
Heavy Vehicles (%)	32%	7%	4%	5%	6%	11%	6%	10%	9%	8%	4%	8%
Turn Type	Perm			pm+pt			Perm			Perm		
Protected Phases		2		1	6			4			4	
Permitted Phases	2			6			4			4		
Actuated Green, G (s)		41.0			54.0		29.0	29.0			29.0	
Effective Green, g (s)		43.0			56.0		31.0	31.0			31.0	
Actuated g/C Ratio		0.45			0.59		0.33	0.33			0.33	
Clearance Time (s)		6.0			6.0		6.0	6.0			6.0	
Lane Grp Cap (vph)		549			601		189	445			465	
v/s Ratio Prot					c0.10			0.20				
v/s Ratio Perm		0.17			0.43		0.10				c0.27	
v/c Ratio		0.38			0.90		0.32	0.62			0.83	
Uniform Delay, d1		17.2			17.0		24.0	27.1			29.5	
Progression Factor		1.00			1.00		1.00	1.00			1.00	
Incremental Delay, d2		2.0			18.8		4.4	6.4			15.5	
Delay (s)		19.2			35.8		28.4	33.5			45.0	
Level of Service		B			D		C	C			D	
Approach Delay (s)		19.2			35.8			32.8			45.0	
Approach LOS		B			D			C			D	

### Intersection Summary

















HCM Average Control Delay	35.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	112.6%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

# HCM Unsignalized Intersection Capacity Analysis

## 13: Driveway & Sawmill Road

1/31/2010

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	1	3	132	1	111	1	234	107	76	304	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour 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
Hourly flow rate (vph)	2	1	3	132	1	111	1	234	107	76	304	1
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	858	800	304	750	746	288	305			341		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	858	800	304	750	746	288	305			341		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.3	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.4	2.2			2.2		
p0 queue free %	99	100	100	57	100	85	100			94		
cM capacity (veh/h)	225	300	740	307	322	738	1267			1207		
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>WB 1</b>	<b>NB 1</b>	<b>SB 1</b>								
Volume Total	6	244	342	381								
Volume Left	2	132	1	76								
Volume Right	3	111	107	1								
cSH	369	419	1267	1207								
Volume to Capacity	0.02	0.58	0.00	0.06								
Queue Length 95th (m)	0.4	27.4	0.0	1.5								
Control Delay (s)	14.9	24.9	0.0	2.1								
Lane LOS	B	C	A	A								
Approach Delay (s)	14.9	24.9	0.0	2.1								
Approach LOS	B	C										
<b>Intersection Summary</b>												
Average Delay			7.2									
Intersection Capacity Utilization			81.0%		ICU Level of Service					D		
Analysis Period (min)			15									

# Timings

## 10: Sawmill Road & Crowsfoot Road

1/31/2010

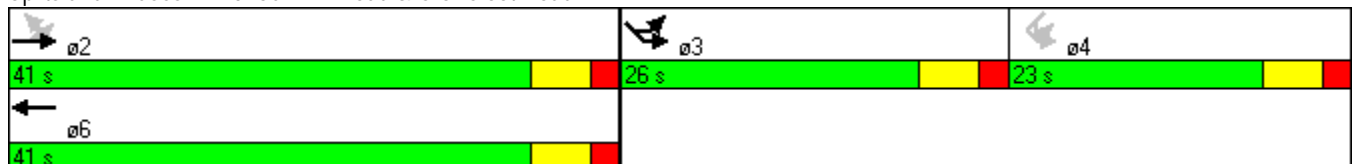


Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Lane Configurations						
Volume (vph)	42	129	192	267	156	8
Turn Type	Perm	Perm				
Protected Phases			2	6	3	
Permitted Phases	2	2		6		4
Detector Phase	2	2	2	6	3	4
Switch Phase						
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	22.0	22.0	22.0	22.0	22.0	22.0
Total Split (s)	41.0	41.0	41.0	41.0	26.0	23.0
Total Split (%)	45.6%	45.6%	45.6%	45.6%	28.9%	25.6%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag					Lead	Lag
Lead-Lag Optimize?					Yes	Yes
Recall Mode	Max	Max	Max	Max	Max	Max
Act Effect Green (s)		37.0	37.0	37.0	22.0	19.0
Actuated g/C Ratio		0.41	0.41	0.41	0.24	0.21
v/c Ratio		0.59	0.30	0.59	0.76	0.46
Control Delay		30.8	19.4	25.6	47.4	36.3
Queue Delay		0.0	0.0	0.0	0.0	0.0
Total Delay		30.8	19.4	25.6	47.4	36.3
LOS		C	B	C	D	D
Approach Delay			24.8	25.6	47.4	36.3
Approach LOS			C	C	D	D

### Intersection Summary

Cycle Length: 90  
 Actuated Cycle Length: 90  
 Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green  
 Natural Cycle: 70  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.76  
 Intersection Signal Delay: 31.9  
 Intersection LOS: C  
 Intersection Capacity Utilization 72.1%  
 ICU Level of Service C  
 Analysis Period (min) 15

Splits and Phases: 10: Sawmill Road & Crowsfoot Road



# Phasings

## 10: Sawmill Road & Crowsfoot Road

1/31/2010



Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Protected Phases			2	6	3	
Permitted Phases	2	2		6		4
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	22.0	22.0	22.0	22.0	22.0	22.0
Total Split (s)	41.0	41.0	41.0	41.0	26.0	23.0
Total Split (%)	45.6%	45.6%	45.6%	45.6%	28.9%	25.6%
Maximum Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lead/Lag					Lead	Lag
Lead-Lag Optimize?					Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max
Walk Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0	0	0	0	0
90th %ile Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
90th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
70th %ile Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
70th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
50th %ile Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
50th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
30th %ile Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
30th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
10th %ile Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
10th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR

### Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Pretimed

# Queues

## 10: Sawmill Road & Crowsfoot Road

1/31/2010



Lane Group	EBL	EBT	WBT	SEL	SWL
Lane Group Flow (vph)	171	192	353	268	147
v/c Ratio	0.59	0.30	0.59	0.76	0.46
Control Delay	30.8	19.4	25.6	47.4	36.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	30.8	19.4	25.6	47.4	36.3
Queue Length 50th (m)	22.4	21.7	46.3	43.1	22.3
Queue Length 95th (m)	45.1	37.1	74.1	#79.2	40.3
Internal Link Dist (m)		209.3	244.6	967.8	525.7
Turn Bay Length (m)	60.0				
Base Capacity (vph)	289	647	597	352	322
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	0.59	0.30	0.59	0.76	0.46

### Intersection Summary

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

# HCM Signalized Intersection Capacity Analysis

## 10: Sawmill Road & Crowsfoot Road

1/31/2010



Movement	EBL2	EBL	EBT	WBT	WBR	WBR2	SEL2	SEL	SER	SWL	SWR	SWR2
Lane Configurations												
Volume (vph)	42	129	192	267	81	5	1	156	111	8	135	4
Ideal Flow (vphpl)	1900	1775	1650	1650	1900	1900	1900	1765	1900	1765	1900	1900
Total Lost time (s)		4.0	4.0	4.0				4.0		4.0		
Lane Util. Factor		1.00	1.00	1.00				1.00		1.00		
Frt		1.00	1.00	0.97				0.94		0.87		
Flt Protected		0.95	1.00	1.00				0.97		1.00		
Satd. Flow (prot)		1603	1574	1451				1441		1553		
Flt Permitted		0.42	1.00	1.00				0.97		0.98		
Satd. Flow (perm)		704	1574	1451				1441		1527		
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	42	129	192	267	81	5	1	156	111	8	135	4
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	171	192	353	0	0	0	268	0	147	0	0
Heavy Vehicles (%)	26%	0%	6%	9%	19%	0%	0%	12%	16%	0%	0%	0%
Turn Type	Perm	Perm					Split					
Protected Phases			2	6			3	3				
Permitted Phases	2	2		6						4		
Actuated Green, G (s)		35.0	35.0	35.0				20.0		17.0		
Effective Green, g (s)		37.0	37.0	37.0				22.0		19.0		
Actuated g/C Ratio		0.41	0.41	0.41				0.24		0.21		
Clearance Time (s)		6.0	6.0	6.0				6.0		6.0		
Lane Grp Cap (vph)		289	647	597				352		322		
v/s Ratio Prot			0.12	c0.24				c0.19				
v/s Ratio Perm		0.24								c0.10		
v/c Ratio		0.59	0.30	0.59				0.76		0.46		
Uniform Delay, d1		20.6	17.8	20.6				31.6		31.0		
Progression Factor		1.00	1.00	1.00				1.00		1.00		
Incremental Delay, d2		8.6	1.2	4.3				14.4		4.6		
Delay (s)		29.2	18.9	24.9				46.0		35.6		
Level of Service		C	B	C				D		D		
Approach Delay (s)			23.8	24.9				46.0		35.6		
Approach LOS			C	C				D		D		

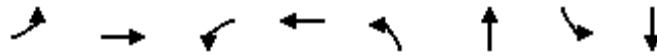
### Intersection Summary

HCM Average Control Delay	30.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	72.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

# Timings

## 3: Sawmill Road & Northfield Drive

2/16/2010

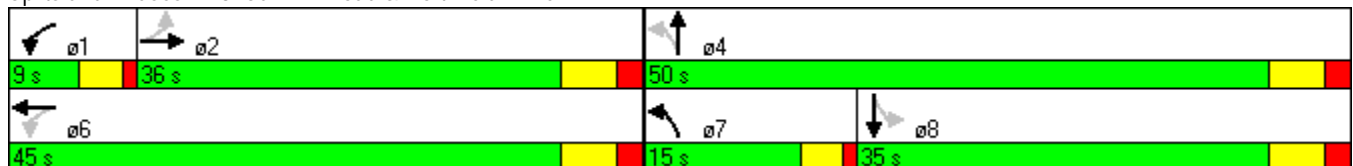


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		↕		↕	↗	↖		↕
Volume (vph)	61	213	246	191	106	369	26	201
Turn Type	Perm		pm+pt		pm+pt		Perm	
Protected Phases		2	1	6	7	4		8
Permitted Phases	2		6		4		8	
Detector Phase	2	2	1	6	7	4	8	8
Switch Phase								
Minimum Initial (s)	8.0	8.0	5.0	8.0	4.0	8.0	8.0	8.0
Minimum Split (s)	32.0	32.0	9.0	34.0	8.0	38.0	35.0	35.0
Total Split (s)	36.0	36.0	9.0	45.0	15.0	50.0	35.0	35.0
Total Split (%)	37.9%	37.9%	9.5%	47.4%	15.8%	52.6%	36.8%	36.8%
Yellow Time (s)	4.0	4.0	3.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	0.0	-2.0	0.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lead		Lead		Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes		Yes		Yes	Yes
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Act Effect Green (s)		32.0		41.0	46.0	46.0		31.0
Actuated g/C Ratio		0.34		0.43	0.48	0.48		0.33
v/c Ratio		0.83		1.29	0.24	1.09		0.93
Control Delay		46.0		176.7	15.0	81.9		69.7
Queue Delay		0.0		0.0	0.0	0.0		0.0
Total Delay		46.0		176.7	15.0	81.9		69.7
LOS		D		F	B	F		E
Approach Delay		46.0		176.7		74.2		69.7
Approach LOS		D		F		E		E

### Intersection Summary

Cycle Length: 95  
 Actuated Cycle Length: 95  
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green  
 Natural Cycle: 85  
 Control Type: Pretimed  
 Maximum v/c Ratio: 1.29  
 Intersection Signal Delay: 92.8  
 Intersection LOS: F  
 Intersection Capacity Utilization 119.1%  
 ICU Level of Service H  
 Analysis Period (min) 15

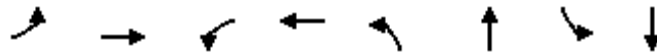
### Splits and Phases: 3: Sawmill Road & Northfield Drive



# Phasings

## 3: Sawmill Road & Northfield Drive

2/16/2010



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Protected Phases		2	1	6	7	4		8
Permitted Phases	2		6		4		8	
Minimum Initial (s)	8.0	8.0	5.0	8.0	4.0	8.0	8.0	8.0
Minimum Split (s)	32.0	32.0	9.0	34.0	8.0	38.0	35.0	35.0
Total Split (s)	36.0	36.0	9.0	45.0	15.0	50.0	35.0	35.0
Total Split (%)	37.9%	37.9%	9.5%	47.4%	15.8%	52.6%	36.8%	36.8%
Maximum Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
Yellow Time (s)	4.0	4.0	3.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	1.0	2.0	2.0	2.0
Lead/Lag	Lag	Lag	Lead		Lead		Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes		Yes		Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Walk Time (s)	10.0	10.0		10.0		22.0	22.0	22.0
Flash Dont Walk (s)	16.0	16.0		16.0		7.0	7.0	7.0
Pedestrian Calls (#/hr)	0	0		0		0	0	0
90th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
90th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
70th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
70th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
50th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
50th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
30th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
30th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
10th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
10th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR

### Intersection Summary

Cycle Length: 95

Actuated Cycle Length: 95

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Pretimed

## Queues

### 3: Sawmill Road & Northfield Drive

2/16/2010



Lane Group	EBT	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	351	472	106	815	265
v/c Ratio	0.83	1.29	0.24	1.09	0.93
Control Delay	46.0	176.7	15.0	81.9	69.7
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	46.0	176.7	15.0	81.9	69.7
Queue Length 50th (m)	56.2	~103.0	10.3	~160.2	45.3
Queue Length 95th (m)	#104.1	#170.9	19.5	#230.5	#93.4
Internal Link Dist (m)	1940.2	1158.8		838.0	899.0
Turn Bay Length (m)			7.0		
Base Capacity (vph)	424	365	447	751	286
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	0.83	1.29	0.24	1.09	0.93

#### Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

# HCM Signalized Intersection Capacity Analysis

## 3: Sawmill Road & Northfield Drive

2/16/2010



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↗	↘			↕	
Volume (vph)	61	213	77	246	191	35	106	369	446	26	201	38
Ideal Flow (vphpl)	1900	1550	1900	1900	1550	1900	1775	1650	1900	1900	1550	1900
Total Lost time (s)		4.0			4.0		4.0	4.0			4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00			1.00	
Frbp, ped/bikes		1.00			1.00		1.00	1.00			1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00			1.00	
Frt		0.97			0.99		1.00	0.92			0.98	
Flt Protected		0.99			0.97		0.95	1.00			1.00	
Satd. Flow (prot)		1423			1414		1607	1457			1427	
Flt Permitted		0.85			0.52		0.42	1.00			0.60	
Satd. Flow (perm)		1227			760		709	1457			858	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	61	213	77	246	191	35	106	369	446	26	201	38
RTOR Reduction (vph)	0	11	0	0	3	0	0	46	0	0	6	0
Lane Group Flow (vph)	0	340	0	0	469	0	106	769	0	0	259	0
Confl. Peds. (#/hr)	5		1	1		5	2					2
Heavy Vehicles (%)	4%	7%	2%	7%	7%	3%	6%	4%	6%	14%	6%	6%
Turn Type	Perm			pm+pt			pm+pt			Perm		
Protected Phases		2		1	6		7	4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)		30.0			39.0		44.0	44.0			29.0	
Effective Green, g (s)		32.0			41.0		44.0	46.0			31.0	
Actuated g/C Ratio		0.34			0.43		0.46	0.48			0.33	
Clearance Time (s)		6.0			6.0		4.0	6.0			6.0	
Lane Grp Cap (vph)		413			376		432	705			280	
v/s Ratio Prot					c0.09		0.03	c0.53				
v/s Ratio Perm		c0.28			0.45		0.09				0.30	
v/c Ratio		0.82			1.25		0.25	1.09			0.92	
Uniform Delay, d1		28.9			27.0		15.8	24.5			30.9	
Progression Factor		1.00			1.00		1.00	1.00			1.00	
Incremental Delay, d2		16.8			131.9		1.3	61.3			37.5	
Delay (s)		45.8			158.9		17.2	85.8			68.4	
Level of Service		D			F		B	F			E	
Approach Delay (s)		45.8			158.9			77.9			68.4	
Approach LOS		D			F			E			E	

### Intersection Summary

















HCM Average Control Delay	90.1	HCM Level of Service	F
HCM Volume to Capacity ratio	1.02		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	119.1%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

# HCM Unsignalized Intersection Capacity Analysis

## 13: Driveway & Sawmill Road

2/16/2010

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	3	1	10	121	2	102	5	446	100	104	389	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour 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
Hourly flow rate (vph)	3	1	10	121	2	102	5	446	100	104	389	1
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1206	1154	390	1114	1104	496	390			546		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1206	1154	390	1114	1104	496	390			546		
tC, single (s)	7.1	6.5	6.2	7.2	6.5	6.2	4.1			4.2		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.6	4.0	3.3	2.2			2.3		
p0 queue free %	98	99	98	26	99	82	100			90		
cM capacity (veh/h)	121	177	663	163	190	572	1180			999		
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>WB 1</b>	<b>NB 1</b>	<b>SB 1</b>								
Volume Total	14	225	551	494								
Volume Left	3	121	5	104								
Volume Right	10	102	100	1								
cSH	308	242	1180	999								
Volume to Capacity	0.05	0.93	0.00	0.10								
Queue Length 95th (m)	1.1	62.3	0.1	2.6								
Control Delay (s)	17.3	84.7	0.1	2.9								
Lane LOS	C	F	A	A								
Approach Delay (s)	17.3	84.7	0.1	2.9								
Approach LOS	C	F										
<b>Intersection Summary</b>												
Average Delay			16.2									
Intersection Capacity Utilization			100.5%		ICU Level of Service				G			
Analysis Period (min)			15									

# Timings

## 10: Sawmill Road & Crowsfoot Road

1/31/2010



Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Lane Configurations						
Volume (vph)	100	172	356	423	130	7
Turn Type	pm+pt	pm+pt				
Protected Phases	5	5	2	6	3	
Permitted Phases	2	2		6		4
Detector Phase	5	5	2	6	3	4
Switch Phase						
Minimum Initial (s)	5.0	5.0	8.0	8.0	8.0	8.0
Minimum Split (s)	9.0	9.0	22.0	22.0	22.0	22.0
Total Split (s)	12.0	12.0	59.0	47.0	17.0	19.0
Total Split (%)	12.6%	12.6%	62.1%	49.5%	17.9%	20.0%
Yellow Time (s)	3.0	3.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead		Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes
Recall Mode	Max	Max	Max	Max	Max	Max
Act Effect Green (s)		55.0	55.0	43.0	13.0	15.0
Actuated g/C Ratio		0.58	0.58	0.45	0.14	0.16
v/c Ratio		1.07	0.39	0.96	0.86	0.49
Control Delay		72.7	12.9	52.6	77.6	44.2
Queue Delay		0.0	0.0	0.0	0.0	0.0
Total Delay		72.7	12.9	52.6	77.6	44.2
LOS		E	B	D	E	D
Approach Delay			38.8	52.6	77.6	44.2
Approach LOS			D	D	E	D

### Intersection Summary

Cycle Length: 95  
 Actuated Cycle Length: 95  
 Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green  
 Natural Cycle: 110  
 Control Type: Pretimed  
 Maximum v/c Ratio: 1.07  
 Intersection Signal Delay: 49.2  
 Intersection LOS: D  
 Intersection Capacity Utilization 89.6%  
 ICU Level of Service E  
 Analysis Period (min) 15

Splits and Phases: 10: Sawmill Road & Crowsfoot Road



# Phasings

## 10: Sawmill Road & Crowsfoot Road

1/31/2010



Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Protected Phases	5	5	2	6	3	
Permitted Phases	2	2		6		4
Minimum Initial (s)	5.0	5.0	8.0	8.0	8.0	8.0
Minimum Split (s)	9.0	9.0	22.0	22.0	22.0	22.0
Total Split (s)	12.0	12.0	59.0	47.0	17.0	19.0
Total Split (%)	12.6%	12.6%	62.1%	49.5%	17.9%	20.0%
Maximum Green (s)	8.0	8.0	53.0	41.0	11.0	13.0
Yellow Time (s)	3.0	3.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	2.0	2.0	2.0	2.0
Lead/Lag	Lead	Lead		Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max
Walk Time (s)			5.0	5.0	5.0	5.0
Flash Dont Walk (s)			11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)			0	0	0	0
90th %ile Green (s)	8.0	8.0	53.0	41.0	11.0	13.0
90th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	Ped
70th %ile Green (s)	8.0	8.0	53.0	41.0	11.0	13.0
70th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	Ped
50th %ile Green (s)	8.0	8.0	53.0	41.0	11.0	13.0
50th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	Ped
30th %ile Green (s)	8.0	8.0	53.0	41.0	11.0	13.0
30th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	Ped
10th %ile Green (s)	8.0	8.0	53.0	41.0	11.0	13.0
10th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	Ped

### Intersection Summary

Cycle Length: 95

Actuated Cycle Length: 95

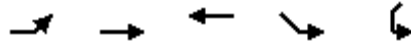
Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Pretimed

# Queues

## 10: Sawmill Road & Crowsfoot Road

1/31/2010



Lane Group	EBL	EBT	WBT	SEL	SWL
Lane Group Flow (vph)	272	356	657	170	116
v/c Ratio	1.07	0.39	0.96	0.86	0.49
Control Delay	72.7	12.9	52.6	77.6	44.2
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	72.7	12.9	52.6	77.6	44.2
Queue Length 50th (m)	-26.8	32.2	112.7	30.9	19.6
Queue Length 95th (m)	m#31.9	m33.7	#185.4	#66.4	36.7
Internal Link Dist (m)		209.3	244.6	967.8	1075.3
Turn Bay Length (m)	60.0				
Base Capacity (vph)	255	920	685	198	239
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	1.07	0.39	0.96	0.86	0.49

### Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

# HCM Signalized Intersection Capacity Analysis

## 10: Sawmill Road & Crowsfoot Road

1/31/2010



Movement	EBL2	EBL	EBT	WBT	WBR	WBR2	SEL2	SEL	SER	SWL	SWR	SWR2
Lane Configurations												
Volume (vph)	100	172	356	423	224	10	2	130	38	7	107	2
Ideal Flow (vphpl)	1900	1775	1650	1650	1900	1900	1900	1765	1900	1765	1900	1900
Total Lost time (s)		4.0	4.0	4.0				4.0		4.0		
Lane Util. Factor		1.00	1.00	1.00				1.00		1.00		
Frt		1.00	1.00	0.95				0.97		0.87		
Flt Protected		0.95	1.00	1.00				0.96		1.00		
Satd. Flow (prot)		1627	1589	1514				1449		1554		
Flt Permitted		0.14	1.00	1.00				0.96		0.97		
Satd. Flow (perm)		239	1589	1514				1449		1512		
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	100	172	356	423	224	10	2	130	38	7	107	2
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	272	356	657	0	0	0	170	0	116	0	0
Heavy Vehicles (%)	13%	0%	5%	5%	5%	0%	0%	12%	26%	0%	0%	0%
Turn Type	pm+pt	pm+pt						Perm				
Protected Phases	5	5	2	6				3				
Permitted Phases	2	2		6			3			4		
Actuated Green, G (s)		53.0	53.0	41.0				11.0		13.0		
Effective Green, g (s)		53.0	55.0	43.0				13.0		15.0		
Actuated g/C Ratio		0.56	0.58	0.45				0.14		0.16		
Clearance Time (s)		4.0	6.0	6.0				6.0		6.0		
Lane Grp Cap (vph)		250	920	685				198		239		
v/s Ratio Prot		c0.09	0.22	0.43								
v/s Ratio Perm		c0.52						0.12		c0.08		
v/c Ratio		1.09	0.39	0.96				0.86		0.49		
Uniform Delay, d1		19.3	10.9	25.1				40.1		36.5		
Progression Factor		1.42	1.12	1.00				1.00		1.00		
Incremental Delay, d2		58.1	0.4	25.7				35.4		6.9		
Delay (s)		85.5	12.5	50.9				75.5		43.4		
Level of Service		F	B	D				E		D		
Approach Delay (s)			44.1	50.9				75.5		43.4		
Approach LOS			D	D				E		D		

### Intersection Summary

HCM Average Control Delay	50.3	HCM Level of Service	D
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	89.6%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

APPENDIX G

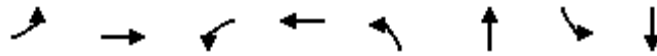
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**SYNCHRO WORKSHEETS – SCENARIO 5 AND SCENARIO 6**

# Timings

## 3: Sawmill Road & Northfield Drive

1/31/2010

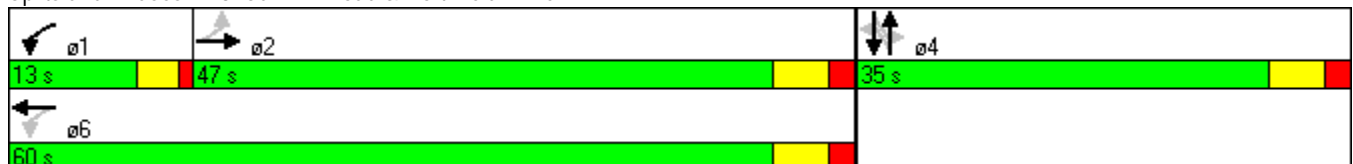


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		↕		↕	↗	↖		↕
Volume (vph)	33	132	355	165	60	106	16	306
Turn Type	Perm		pm+pt		Perm		Perm	
Protected Phases		2	1	6		4		4
Permitted Phases	2		6		4		4	
Detector Phase	2	2	1	6	4	4	4	4
Switch Phase								
Minimum Initial (s)	8.0	8.0	4.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	36.0	36.0	9.0	36.0	32.0	32.0	32.0	32.0
Total Split (s)	47.0	47.0	13.0	60.0	35.0	35.0	35.0	35.0
Total Split (%)	49.5%	49.5%	13.7%	63.2%	36.8%	36.8%	36.8%	36.8%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	0.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Act Effect Green (s)		43.0		56.0	31.0	31.0		31.0
Actuated g/C Ratio		0.45		0.59	0.33	0.33		0.33
v/c Ratio		0.39		0.88	0.32	0.66		0.83
Control Delay		17.9		33.7	29.9	23.5		45.6
Queue Delay		0.0		0.0	0.0	0.0		0.0
Total Delay		17.9		33.7	29.9	23.5		45.6
LOS		B		C	C	C		D
Approach Delay		17.9		33.7		24.4		45.6
Approach LOS		B		C		C		D

### Intersection Summary

Cycle Length: 95  
 Actuated Cycle Length: 95  
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green  
 Natural Cycle: 80  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.88  
 Intersection Signal Delay: 31.9  
 Intersection LOS: C  
 Intersection Capacity Utilization 111.9%  
 ICU Level of Service H  
 Analysis Period (min) 15

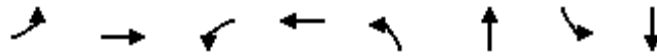
### Splits and Phases: 3: Sawmill Road & Northfield Drive



# Phasings

## 3: Sawmill Road & Northfield Drive

1/31/2010



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Protected Phases		2	1	6		4		4
Permitted Phases	2		6		4		4	
Minimum Initial (s)	8.0	8.0	4.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	36.0	36.0	9.0	36.0	32.0	32.0	32.0	32.0
Total Split (s)	47.0	47.0	13.0	60.0	35.0	35.0	35.0	35.0
Total Split (%)	49.5%	49.5%	13.7%	63.2%	36.8%	36.8%	36.8%	36.8%
Maximum Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	2.0	2.0
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Walk Time (s)	14.0	14.0		14.0	19.0	19.0	19.0	19.0
Flash Dont Walk (s)	16.0	16.0		16.0	7.0	7.0	7.0	7.0
Pedestrian Calls (#/hr)	0	0		0	0	0	0	0
90th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
90th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
70th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
70th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
50th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
50th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
30th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
30th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
10th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
10th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR

### Intersection Summary

Cycle Length: 95

Actuated Cycle Length: 95

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Pretimed

## Queues

### 3: Sawmill Road & Northfield Drive

1/31/2010



Lane Group	EBT	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	222	531	60	363	393
v/c Ratio	0.39	0.88	0.32	0.66	0.83
Control Delay	17.9	33.7	29.9	23.5	45.6
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	17.9	33.7	29.9	23.5	45.6
Queue Length 50th (m)	23.2	57.9	8.2	35.2	64.2
Queue Length 95th (m)	41.5	#122.3	19.3	66.7	#113.6
Internal Link Dist (m)	1940.2	1158.8		681.9	899.0
Turn Bay Length (m)			7.0		
Base Capacity (vph)	563	603	189	549	473
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	0.39	0.88	0.32	0.66	0.83

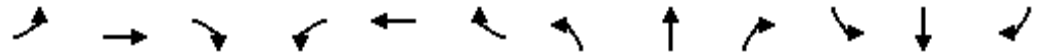
#### Intersection Summary

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

# HCM Signalized Intersection Capacity Analysis

## 3: Sawmill Road & Northfield Drive

1/31/2010



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↕	↕			↕	
Volume (vph)	33	132	57	355	165	11	60	106	257	16	306	71
Ideal Flow (vphpl)	1900	1550	1900	1900	1550	1900	1775	1650	1900	1900	1550	1900
Total Lost time (s)		4.0			4.0		4.0	4.0			4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00			1.00	
Frbp, ped/bikes		0.99			1.00		1.00	1.00			1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00			1.00	
Frt		0.97			1.00		1.00	0.89			0.98	
Flt Protected		0.99			0.97		0.95	1.00			1.00	
Satd. Flow (prot)		1358			1461		1608	1401			1455	
Flt Permitted		0.89			0.62		0.34	1.00			0.98	
Satd. Flow (perm)		1215			940		579	1401			1426	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	33	132	57	355	165	11	60	106	257	16	306	71
RTOR Reduction (vph)	0	13	0	0	1	0	0	92	0	0	8	0
Lane Group Flow (vph)	0	209	0	0	530	0	60	271	0	0	385	0
Confl. Peds. (#/hr)			2	2								
Heavy Vehicles (%)	32%	7%	4%	2%	6%	11%	6%	10%	5%	8%	4%	8%
Turn Type	Perm			pm+pt			Perm			Perm		
Protected Phases		2		1	6			4			4	
Permitted Phases	2			6			4			4		
Actuated Green, G (s)		41.0			54.0		29.0	29.0			29.0	
Effective Green, g (s)		43.0			56.0		31.0	31.0			31.0	
Actuated g/C Ratio		0.45			0.59		0.33	0.33			0.33	
Clearance Time (s)		6.0			6.0		6.0	6.0			6.0	
Lane Grp Cap (vph)		550			614		189	457			465	
v/s Ratio Prot					c0.10			0.19				
v/s Ratio Perm		0.17			0.41		0.10				c0.27	
v/c Ratio		0.38			0.86		0.32	0.59			0.83	
Uniform Delay, d1		17.2			16.3		24.0	26.7			29.5	
Progression Factor		1.00			1.00		1.00	1.00			1.00	
Incremental Delay, d2		2.0			14.9		4.4	5.6			15.5	
Delay (s)		19.2			31.2		28.4	32.3			45.0	
Level of Service		B			C		C	C			D	
Approach Delay (s)		19.2			31.2			31.8			45.0	
Approach LOS		B			C			C			D	

### Intersection Summary

















HCM Average Control Delay	33.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	111.9%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

# HCM Unsignalized Intersection Capacity Analysis

## 13: Driveway & Sawmill Road

1/31/2010

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	1	3	132	1	111	1	234	107	76	304	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour 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
Hourly flow rate (vph)	2	1	3	132	1	111	1	234	107	76	304	1
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	858	800	304	750	746	288	305			341		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	858	800	304	750	746	288	305			341		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.3	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.4	2.2			2.2		
p0 queue free %	99	100	100	57	100	85	100			94		
cM capacity (veh/h)	225	300	740	307	322	738	1267			1207		
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>WB 1</b>	<b>NB 1</b>	<b>SB 1</b>								
Volume Total	6	244	342	381								
Volume Left	2	132	1	76								
Volume Right	3	111	107	1								
cSH	369	419	1267	1207								
Volume to Capacity	0.02	0.58	0.00	0.06								
Queue Length 95th (m)	0.4	27.4	0.0	1.5								
Control Delay (s)	14.9	24.9	0.0	2.1								
Lane LOS	B	C	A	A								
Approach Delay (s)	14.9	24.9	0.0	2.1								
Approach LOS	B	C										
<b>Intersection Summary</b>												
Average Delay			7.2									
Intersection Capacity Utilization			81.0%		ICU Level of Service					D		
Analysis Period (min)			15									

# Timings

## 10: Sawmill Road & Crowsfoot Road

1/31/2010

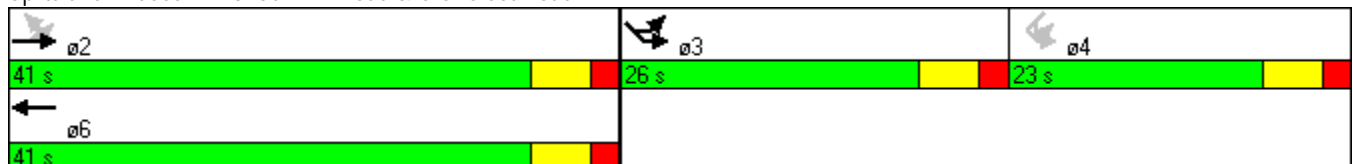


Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Lane Configurations						
Volume (vph)	32	129	192	267	156	8
Turn Type	Perm	Perm				
Protected Phases			2	6	3	
Permitted Phases	2	2		6		4
Detector Phase	2	2	2	6	3	4
Switch Phase						
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	22.0	22.0	22.0	22.0	22.0	22.0
Total Split (s)	41.0	41.0	41.0	41.0	26.0	23.0
Total Split (%)	45.6%	45.6%	45.6%	45.6%	28.9%	25.6%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag					Lead	Lag
Lead-Lag Optimize?					Yes	Yes
Recall Mode	Max	Max	Max	Max	Max	Max
Act Effect Green (s)		37.0	37.0	37.0	22.0	19.0
Actuated g/C Ratio		0.41	0.41	0.41	0.24	0.21
v/c Ratio		0.53	0.30	0.59	0.71	0.46
Control Delay		27.6	19.4	25.6	43.5	36.3
Queue Delay		0.0	0.0	0.0	0.0	0.0
Total Delay		27.6	19.4	25.6	43.5	36.3
LOS		C	B	C	D	D
Approach Delay			23.1	25.6	43.5	36.3
Approach LOS			C	C	D	D

### Intersection Summary

Cycle Length: 90  
 Actuated Cycle Length: 90  
 Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green  
 Natural Cycle: 70  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.71  
 Intersection Signal Delay: 30.4  
 Intersection LOS: C  
 Intersection Capacity Utilization 70.8%  
 ICU Level of Service C  
 Analysis Period (min) 15

### Splits and Phases: 10: Sawmill Road & Crowsfoot Road



# Phasings

## 10: Sawmill Road & Crowsfoot Road

1/31/2010



Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Protected Phases			2	6	3	
Permitted Phases	2	2		6		4
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	22.0	22.0	22.0	22.0	22.0	22.0
Total Split (s)	41.0	41.0	41.0	41.0	26.0	23.0
Total Split (%)	45.6%	45.6%	45.6%	45.6%	28.9%	25.6%
Maximum Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lead/Lag					Lead	Lag
Lead-Lag Optimize?					Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max
Walk Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0	0	0	0	0
90th %ile Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
90th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
70th %ile Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
70th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
50th %ile Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
50th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
30th %ile Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
30th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
10th %ile Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
10th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR

### Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

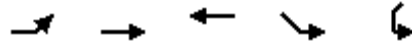
Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Pretimed

## Queues

### 10: Sawmill Road & Crowsfoot Road

1/31/2010



Lane Group	EBL	EBT	WBT	SEL	SWL
Lane Group Flow (vph)	161	192	353	258	147
v/c Ratio	0.53	0.30	0.59	0.71	0.46
Control Delay	27.6	19.4	25.6	43.5	36.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	27.6	19.4	25.6	43.5	36.3
Queue Length 50th (m)	20.4	21.7	46.3	40.9	22.3
Queue Length 95th (m)	40.7	37.1	74.1	#73.2	40.3
Internal Link Dist (m)		209.3	244.6	967.8	525.7
Turn Bay Length (m)	60.0				
Base Capacity (vph)	306	647	597	363	323
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	0.53	0.30	0.59	0.71	0.46

#### Intersection Summary

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

# HCM Signalized Intersection Capacity Analysis

## 10: Sawmill Road & Crowsfoot Road

1/31/2010



Movement	EBL2	EBL	EBT	WBT	WBR	WBR2	SEL2	SEL	SER	SWL	SWR	SWR2
Lane Configurations												
Volume (vph)	32	129	192	267	81	5	1	156	101	8	135	4
Ideal Flow (vphpl)	1900	1775	1650	1650	1900	1900	1900	1765	1900	1765	1900	1900
Total Lost time (s)		4.0	4.0	4.0				4.0		4.0		
Lane Util. Factor		1.00	1.00	1.00				1.00		1.00		
Frt		1.00	1.00	0.97				0.95		0.87		
Flt Protected		0.95	1.00	1.00				0.97		1.00		
Satd. Flow (prot)		1695	1574	1451				1486		1553		
Flt Permitted		0.42	1.00	1.00				0.97		0.98		
Satd. Flow (perm)		744	1574	1451				1486		1528		
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	32	129	192	267	81	5	1	156	101	8	135	4
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	161	192	353	0	0	0	258	0	147	0	0
Heavy Vehicles (%)	3%	0%	6%	9%	19%	0%	0%	12%	8%	0%	0%	0%
Turn Type	Perm	Perm					Split					
Protected Phases			2	6			3	3				
Permitted Phases	2	2		6						4		
Actuated Green, G (s)		35.0	35.0	35.0				20.0		17.0		
Effective Green, g (s)		37.0	37.0	37.0				22.0		19.0		
Actuated g/C Ratio		0.41	0.41	0.41				0.24		0.21		
Clearance Time (s)		6.0	6.0	6.0				6.0		6.0		
Lane Grp Cap (vph)		306	647	597				363		323		
v/s Ratio Prot			0.12	c0.24				c0.17				
v/s Ratio Perm		0.22								c0.10		
v/c Ratio		0.53	0.30	0.59				0.71		0.46		
Uniform Delay, d1		19.9	17.8	20.6				31.1		31.0		
Progression Factor		1.00	1.00	1.00				1.00		1.00		
Incremental Delay, d2		6.3	1.2	4.3				11.2		4.6		
Delay (s)		26.3	18.9	24.9				42.3		35.6		
Level of Service		C	B	C				D		D		
Approach Delay (s)			22.3	24.9				42.3		35.6		
Approach LOS			C	C				D		D		

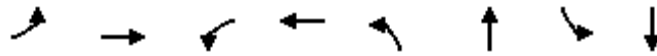
### Intersection Summary

HCM Average Control Delay	29.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	70.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

# Timings

## 3: Sawmill Road & Northfield Drive

2/16/2010

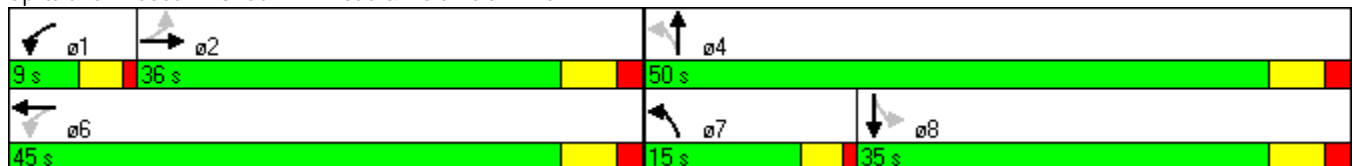


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		↕		↕	↗	↖		↕
Volume (vph)	61	213	236	191	106	369	26	201
Turn Type	Perm		pm+pt		pm+pt		Perm	
Protected Phases		2	1	6	7	4		8
Permitted Phases	2		6		4		8	
Detector Phase	2	2	1	6	7	4	8	8
Switch Phase								
Minimum Initial (s)	8.0	8.0	5.0	8.0	4.0	8.0	8.0	8.0
Minimum Split (s)	32.0	32.0	9.0	34.0	8.0	38.0	35.0	35.0
Total Split (s)	36.0	36.0	9.0	45.0	15.0	50.0	35.0	35.0
Total Split (%)	37.9%	37.9%	9.5%	47.4%	15.8%	52.6%	36.8%	36.8%
Yellow Time (s)	4.0	4.0	3.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	0.0	-2.0	0.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lead		Lead		Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes		Yes		Yes	Yes
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Act Effect Green (s)		32.0		41.0	46.0	46.0		31.0
Actuated g/C Ratio		0.34		0.43	0.48	0.48		0.33
v/c Ratio		0.83		1.23	0.24	1.06		0.89
Control Delay		45.8		151.8	15.0	73.5		61.9
Queue Delay		0.0		0.0	0.0	0.0		0.0
Total Delay		45.8		151.8	15.0	73.5		61.9
LOS		D		F	B	E		E
Approach Delay		45.8		151.8		66.7		61.9
Approach LOS		D		F		E		E

### Intersection Summary

Cycle Length: 95  
 Actuated Cycle Length: 95  
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green  
 Natural Cycle: 85  
 Control Type: Pretimed  
 Maximum v/c Ratio: 1.23  
 Intersection Signal Delay: 82.2  
 Intersection LOS: F  
 Intersection Capacity Utilization 117.7%  
 ICU Level of Service H  
 Analysis Period (min) 15

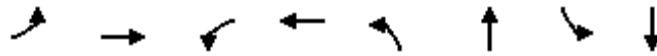
### Splits and Phases: 3: Sawmill Road & Northfield Drive



# Phasings

## 3: Sawmill Road & Northfield Drive

2/16/2010



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Protected Phases		2	1	6	7	4		8
Permitted Phases	2		6		4		8	
Minimum Initial (s)	8.0	8.0	5.0	8.0	4.0	8.0	8.0	8.0
Minimum Split (s)	32.0	32.0	9.0	34.0	8.0	38.0	35.0	35.0
Total Split (s)	36.0	36.0	9.0	45.0	15.0	50.0	35.0	35.0
Total Split (%)	37.9%	37.9%	9.5%	47.4%	15.8%	52.6%	36.8%	36.8%
Maximum Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
Yellow Time (s)	4.0	4.0	3.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	1.0	2.0	2.0	2.0
Lead/Lag	Lag	Lag	Lead		Lead		Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes		Yes		Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Walk Time (s)	10.0	10.0		10.0		22.0	22.0	22.0
Flash Dont Walk (s)	16.0	16.0		16.0		7.0	7.0	7.0
Pedestrian Calls (#/hr)	0	0		0		0	0	0
90th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
90th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
70th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
70th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
50th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
50th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
30th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
30th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
10th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
10th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR

### Intersection Summary

Cycle Length: 95

Actuated Cycle Length: 95

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Pretimed

## Queues

### 3: Sawmill Road & Northfield Drive

2/16/2010



Lane Group	EBT	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	351	462	106	805	265
v/c Ratio	0.83	1.23	0.24	1.06	0.89
Control Delay	45.8	151.8	15.0	73.5	61.9
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	45.8	151.8	15.0	73.5	61.9
Queue Length 50th (m)	56.2	~93.8	10.3	~155.1	44.4
Queue Length 95th (m)	#104.0	#164.6	19.5	#225.0	#91.1
Internal Link Dist (m)	1940.2	1158.8		838.0	899.0
Turn Bay Length (m)			7.0		
Base Capacity (vph)	425	375	447	759	298
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	0.83	1.23	0.24	1.06	0.89

#### Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

# HCM Signalized Intersection Capacity Analysis

## 3: Sawmill Road & Northfield Drive

2/16/2010



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↗	↘			↕	
Volume (vph)	61	213	77	236	191	35	106	369	436	26	201	38
Ideal Flow (vphpl)	1900	1550	1900	1900	1550	1900	1775	1650	1900	1900	1550	1900
Total Lost time (s)		4.0			4.0		4.0	4.0			4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00			1.00	
Frbp, ped/bikes		1.00			1.00		1.00	1.00			1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00			1.00	
Frt		0.97			0.99		1.00	0.92			0.98	
Flt Protected		0.99			0.98		0.95	1.00			1.00	
Satd. Flow (prot)		1425			1442		1607	1474			1427	
Flt Permitted		0.86			0.53		0.42	1.00			0.62	
Satd. Flow (perm)		1229			781		709	1474			893	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	61	213	77	236	191	35	106	369	436	26	201	38
RTOR Reduction (vph)	0	11	0	0	3	0	0	45	0	0	6	0
Lane Group Flow (vph)	0	340	0	0	459	0	106	760	0	0	259	0
Confl. Peds. (#/hr)	5		1	1		5	2					2
Heavy Vehicles (%)	3%	7%	2%	3%	7%	3%	6%	4%	4%	14%	6%	6%
Turn Type	Perm			pm+pt			pm+pt			Perm		
Protected Phases		2		1	6		7	4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)		30.0			39.0		44.0	44.0			29.0	
Effective Green, g (s)		32.0			41.0		44.0	46.0			31.0	
Actuated g/C Ratio		0.34			0.43		0.46	0.48			0.33	
Clearance Time (s)		6.0			6.0		4.0	6.0			6.0	
Lane Grp Cap (vph)		414			386		432	714			291	
v/s Ratio Prot					c0.09		0.03	c0.52				
v/s Ratio Perm		c0.28			0.43		0.09				0.29	
v/c Ratio		0.82			1.19		0.25	1.06			0.89	
Uniform Delay, d1		28.9			27.0		15.8	24.5			30.4	
Progression Factor		1.00			1.00		1.00	1.00			1.00	
Incremental Delay, d2		16.6			108.3		1.3	52.2			30.8	
Delay (s)		45.5			135.3		17.2	76.7			61.2	
Level of Service		D			F		B	E			E	
Approach Delay (s)		45.5			135.3			69.8			61.2	
Approach LOS		D			F			E			E	

### Intersection Summary

HCM Average Control Delay	79.6	HCM Level of Service	E
HCM Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	117.7%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

# Timings

## 10: Sawmill Road & Crowsfoot Road

1/31/2010

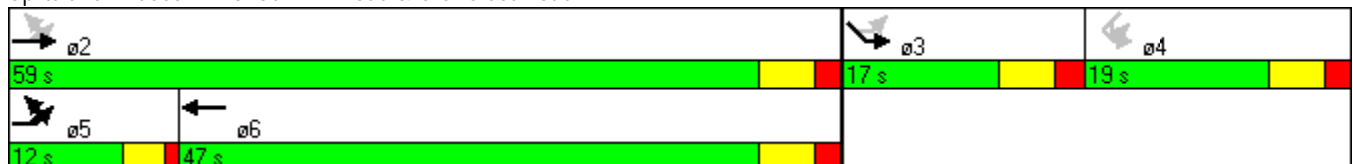


Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Lane Configurations						
Volume (vph)	90	172	356	423	130	7
Turn Type	pm+pt	pm+pt				
Protected Phases	5	5	2	6	3	
Permitted Phases	2	2		6		4
Detector Phase	5	5	2	6	3	4
Switch Phase						
Minimum Initial (s)	5.0	5.0	8.0	8.0	8.0	8.0
Minimum Split (s)	9.0	9.0	22.0	22.0	22.0	22.0
Total Split (s)	12.0	12.0	59.0	47.0	17.0	19.0
Total Split (%)	12.6%	12.6%	62.1%	49.5%	17.9%	20.0%
Yellow Time (s)	3.0	3.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead		Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes
Recall Mode	Max	Max	Max	Max	Max	Max
Act Effect Green (s)		55.0	55.0	43.0	13.0	15.0
Actuated g/C Ratio		0.58	0.58	0.45	0.14	0.16
v/c Ratio		0.99	0.39	0.96	0.77	0.49
Control Delay		50.6	12.9	52.6	64.2	44.2
Queue Delay		0.0	0.0	0.0	0.0	0.0
Total Delay		50.6	12.9	52.6	64.2	44.2
LOS		D	B	D	E	D
Approach Delay			28.9	52.6	64.2	44.2
Approach LOS			C	D	E	D

### Intersection Summary

Cycle Length: 95  
 Actuated Cycle Length: 95  
 Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green  
 Natural Cycle: 100  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.99  
 Intersection Signal Delay: 43.7  
 Intersection LOS: D  
 Intersection Capacity Utilization 88.3%  
 ICU Level of Service E  
 Analysis Period (min) 15

Splits and Phases: 10: Sawmill Road & Crowsfoot Road



# Phasings

## 10: Sawmill Road & Crowsfoot Road

1/31/2010



Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Protected Phases	5	5	2	6	3	
Permitted Phases	2	2		6		4
Minimum Initial (s)	5.0	5.0	8.0	8.0	8.0	8.0
Minimum Split (s)	9.0	9.0	22.0	22.0	22.0	22.0
Total Split (s)	12.0	12.0	59.0	47.0	17.0	19.0
Total Split (%)	12.6%	12.6%	62.1%	49.5%	17.9%	20.0%
Maximum Green (s)	8.0	8.0	53.0	41.0	11.0	13.0
Yellow Time (s)	3.0	3.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	2.0	2.0	2.0	2.0
Lead/Lag	Lead	Lead		Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max
Walk Time (s)			5.0	5.0	5.0	5.0
Flash Dont Walk (s)			11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)			0	0	0	0
90th %ile Green (s)	8.0	8.0	53.0	41.0	11.0	13.0
90th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	Ped
70th %ile Green (s)	8.0	8.0	53.0	41.0	11.0	13.0
70th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	Ped
50th %ile Green (s)	8.0	8.0	53.0	41.0	11.0	13.0
50th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	Ped
30th %ile Green (s)	8.0	8.0	53.0	41.0	11.0	13.0
30th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	Ped
10th %ile Green (s)	8.0	8.0	53.0	41.0	11.0	13.0
10th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	Ped

### Intersection Summary

Cycle Length: 95

Actuated Cycle Length: 95

Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Pretimed

# Queues

## 10: Sawmill Road & Crowsfoot Road

1/31/2010



Lane Group	EBL	EBT	WBT	SEL	SWL
Lane Group Flow (vph)	262	356	657	160	116
v/c Ratio	0.99	0.39	0.96	0.77	0.49
Control Delay	50.6	12.9	52.6	64.2	44.2
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	50.6	12.9	52.6	64.2	44.2
Queue Length 50th (m)	26.6	32.2	112.7	28.7	19.6
Queue Length 95th (m)	m#25.6	m33.7	#185.4	#59.5	36.6
Internal Link Dist (m)		209.3	244.6	967.8	1075.3
Turn Bay Length (m)	60.0				
Base Capacity (vph)	264	920	685	209	239
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	0.99	0.39	0.96	0.77	0.49

### Intersection Summary

# 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.

# HCM Signalized Intersection Capacity Analysis

## 10: Sawmill Road & Crowsfoot Road

1/31/2010



Movement	EBL2	EBL	EBT	WBT	WBR	WBR2	SEL2	SEL	SER	SWL	SWR	SWR2
Lane Configurations												
Volume (vph)	90	172	356	423	224	10	2	130	28	7	107	2
Ideal Flow (vphpl)	1900	1775	1650	1650	1900	1900	1900	1765	1900	1765	1900	1900
Total Lost time (s)		4.0	4.0	4.0				4.0		4.0		
Lane Util. Factor		1.00	1.00	1.00				1.00		1.00		
Frt		1.00	1.00	0.95				0.98		0.87		
Flt Protected		0.95	1.00	1.00				0.96		1.00		
Satd. Flow (prot)		1688	1589	1514				1525		1554		
Flt Permitted		0.14	1.00	1.00				0.96		0.97		
Satd. Flow (perm)		248	1589	1514				1525		1513		
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	90	172	356	423	224	10	2	130	28	7	107	2
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	262	356	657	0	0	0	160	0	116	0	0
Heavy Vehicles (%)	3%	0%	5%	5%	5%	0%	0%	12%	0%	0%	0%	0%
Turn Type	pm+pt	pm+pt						Perm				
Protected Phases	5	5	2	6				3				
Permitted Phases	2	2		6			3			4		
Actuated Green, G (s)		53.0	53.0	41.0				11.0		13.0		
Effective Green, g (s)		53.0	55.0	43.0				13.0		15.0		
Actuated g/C Ratio		0.56	0.58	0.45				0.14		0.16		
Clearance Time (s)		4.0	6.0	6.0				6.0		6.0		
Lane Grp Cap (vph)		260	920	685				209		239		
v/s Ratio Prot		c0.09	0.22	0.43								
v/s Ratio Perm		c0.48						0.10		c0.08		
v/c Ratio		1.01	0.39	0.96				0.77		0.49		
Uniform Delay, d1		19.3	10.9	25.1				39.5		36.5		
Progression Factor		1.41	1.12	1.00				1.00		1.00		
Incremental Delay, d2		32.7	0.4	25.7				23.1		6.9		
Delay (s)		59.9	12.5	50.9				62.6		43.4		
Level of Service		E	B	D				E		D		
Approach Delay (s)			32.6	50.9				62.6		43.4		
Approach LOS			C	D				E		D		

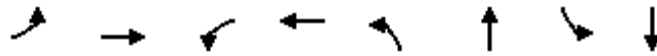
### Intersection Summary

HCM Average Control Delay	44.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	88.3%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

# Timings

## 3: Sawmill Road & Northfield Drive

1/31/2010

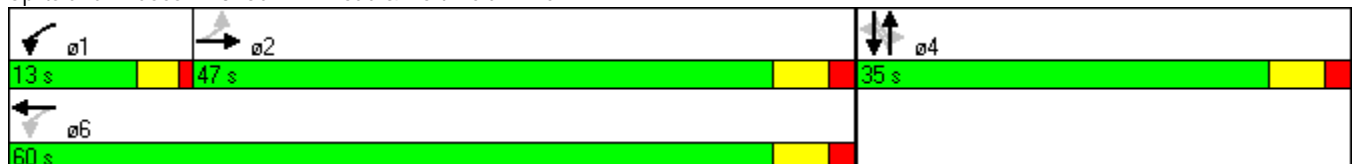


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		↕		↕	↗	↖		↕
Volume (vph)	33	132	355	165	60	106	16	306
Turn Type	Perm		pm+pt		Perm		Perm	
Protected Phases		2	1	6		4		4
Permitted Phases	2		6		4		4	
Detector Phase	2	2	1	6	4	4	4	4
Switch Phase								
Minimum Initial (s)	8.0	8.0	4.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	36.0	36.0	9.0	36.0	32.0	32.0	32.0	32.0
Total Split (s)	47.0	47.0	13.0	60.0	35.0	35.0	35.0	35.0
Total Split (%)	49.5%	49.5%	13.7%	63.2%	36.8%	36.8%	36.8%	36.8%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	0.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Act Effct Green (s)		43.0		56.0	31.0	31.0		31.0
Actuated g/C Ratio		0.45		0.59	0.33	0.33		0.33
v/c Ratio		0.39		0.88	0.32	0.66		0.83
Control Delay		17.9		33.7	29.9	23.5		45.6
Queue Delay		0.0		0.0	0.0	0.0		0.0
Total Delay		17.9		33.7	29.9	23.5		45.6
LOS		B		C	C	C		D
Approach Delay		17.9		33.7		24.4		45.6
Approach LOS		B		C		C		D

### Intersection Summary

Cycle Length: 95  
 Actuated Cycle Length: 95  
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green  
 Natural Cycle: 80  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.88  
 Intersection Signal Delay: 31.9  
 Intersection LOS: C  
 Intersection Capacity Utilization 111.9%  
 ICU Level of Service H  
 Analysis Period (min) 15

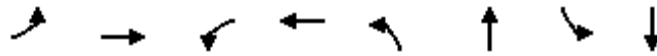
### Splits and Phases: 3: Sawmill Road & Northfield Drive



# Phasings

## 3: Sawmill Road & Northfield Drive

1/31/2010



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Protected Phases		2	1	6		4		4
Permitted Phases	2		6		4		4	
Minimum Initial (s)	8.0	8.0	4.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	36.0	36.0	9.0	36.0	32.0	32.0	32.0	32.0
Total Split (s)	47.0	47.0	13.0	60.0	35.0	35.0	35.0	35.0
Total Split (%)	49.5%	49.5%	13.7%	63.2%	36.8%	36.8%	36.8%	36.8%
Maximum Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	2.0	2.0
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Walk Time (s)	14.0	14.0		14.0	19.0	19.0	19.0	19.0
Flash Dont Walk (s)	16.0	16.0		16.0	7.0	7.0	7.0	7.0
Pedestrian Calls (#/hr)	0	0		0	0	0	0	0
90th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
90th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
70th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
70th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
50th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
50th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
30th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
30th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
10th %ile Green (s)	41.0	41.0	9.0	54.0	29.0	29.0	29.0	29.0
10th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR

### Intersection Summary

Cycle Length: 95

Actuated Cycle Length: 95

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Pretimed

## Queues

### 3: Sawmill Road & Northfield Drive

1/31/2010



Lane Group	EBT	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	222	531	60	363	393
v/c Ratio	0.39	0.88	0.32	0.66	0.83
Control Delay	17.9	33.7	29.9	23.5	45.6
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	17.9	33.7	29.9	23.5	45.6
Queue Length 50th (m)	23.2	57.9	8.2	35.2	64.2
Queue Length 95th (m)	41.5	#122.3	19.3	66.7	#113.6
Internal Link Dist (m)	1940.2	1158.8		681.9	899.0
Turn Bay Length (m)			7.0		
Base Capacity (vph)	563	603	189	549	473
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	0.39	0.88	0.32	0.66	0.83

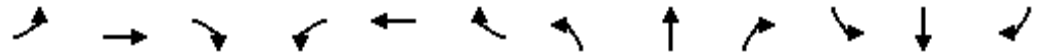
#### Intersection Summary

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

# HCM Signalized Intersection Capacity Analysis

## 3: Sawmill Road & Northfield Drive

1/31/2010



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↕	↕			↕	
Volume (vph)	33	132	57	355	165	11	60	106	257	16	306	71
Ideal Flow (vphpl)	1900	1550	1900	1900	1550	1900	1775	1650	1900	1900	1550	1900
Total Lost time (s)		4.0			4.0		4.0	4.0			4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00			1.00	
Frbp, ped/bikes		0.99			1.00		1.00	1.00			1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00			1.00	
Frt		0.97			1.00		1.00	0.89			0.98	
Flt Protected		0.99			0.97		0.95	1.00			1.00	
Satd. Flow (prot)		1358			1461		1608	1401			1455	
Flt Permitted		0.89			0.62		0.34	1.00			0.98	
Satd. Flow (perm)		1215			940		579	1401			1426	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	33	132	57	355	165	11	60	106	257	16	306	71
RTOR Reduction (vph)	0	13	0	0	1	0	0	92	0	0	8	0
Lane Group Flow (vph)	0	209	0	0	530	0	60	271	0	0	385	0
Confl. Peds. (#/hr)			2	2								
Heavy Vehicles (%)	32%	7%	4%	2%	6%	11%	6%	10%	5%	8%	4%	8%
Turn Type	Perm			pm+pt			Perm			Perm		
Protected Phases		2		1	6			4			4	
Permitted Phases	2			6			4			4		
Actuated Green, G (s)		41.0			54.0		29.0	29.0			29.0	
Effective Green, g (s)		43.0			56.0		31.0	31.0			31.0	
Actuated g/C Ratio		0.45			0.59		0.33	0.33			0.33	
Clearance Time (s)		6.0			6.0		6.0	6.0			6.0	
Lane Grp Cap (vph)		550			614		189	457			465	
v/s Ratio Prot					c0.10			0.19				
v/s Ratio Perm		0.17			0.41		0.10				c0.27	
v/c Ratio		0.38			0.86		0.32	0.59			0.83	
Uniform Delay, d1		17.2			16.3		24.0	26.7			29.5	
Progression Factor		1.00			1.00		1.00	1.00			1.00	
Incremental Delay, d2		2.0			14.9		4.4	5.6			15.5	
Delay (s)		19.2			31.2		28.4	32.3			45.0	
Level of Service		B			C		C	C			D	
Approach Delay (s)		19.2			31.2			31.8			45.0	
Approach LOS		B			C			C			D	

### Intersection Summary

















HCM Average Control Delay	33.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	111.9%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

# HCM Unsignalized Intersection Capacity Analysis

## 13: Driveway & Sawmill Road

1/31/2010

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	1	3	132	1	111	1	244	107	76	314	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour 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
Hourly flow rate (vph)	2	1	3	132	1	111	1	244	107	76	314	1
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	878	820	314	770	766	298	315			351		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	878	820	314	770	766	298	315			351		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.3	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.4	2.2			2.2		
p0 queue free %	99	100	100	56	100	85	100			94		
cM capacity (veh/h)	218	292	731	298	314	728	1257			1197		
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>WB 1</b>	<b>NB 1</b>	<b>SB 1</b>								
Volume Total	6	244	352	391								
Volume Left	2	132	1	76								
Volume Right	3	111	107	1								
cSH	359	407	1257	1197								
Volume to Capacity	0.02	0.60	0.00	0.06								
Queue Length 95th (m)	0.4	28.7	0.0	1.5								
Control Delay (s)	15.2	26.2	0.0	2.1								
Lane LOS	C	D	A	A								
Approach Delay (s)	15.2	26.2	0.0	2.1								
Approach LOS	C	D										
<b>Intersection Summary</b>												
Average Delay			7.4									
Intersection Capacity Utilization			82.3%		ICU Level of Service				E			
Analysis Period (min)			15									

# Timings

## 10: Sawmill Road & Crowsfoot Road

1/31/2010

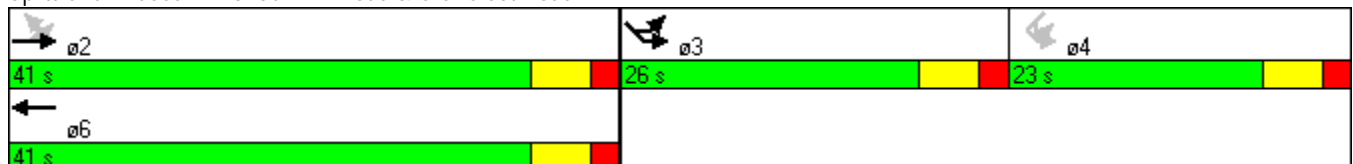


Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Lane Configurations						
Volume (vph)	32	129	192	267	166	8
Turn Type	Perm	Perm				
Protected Phases			2	6	3	
Permitted Phases	2	2		6		4
Detector Phase	2	2	2	6	3	4
Switch Phase						
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	22.0	22.0	22.0	22.0	22.0	22.0
Total Split (s)	41.0	41.0	41.0	41.0	26.0	23.0
Total Split (%)	45.6%	45.6%	45.6%	45.6%	28.9%	25.6%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag					Lead	Lag
Lead-Lag Optimize?					Yes	Yes
Recall Mode	Max	Max	Max	Max	Max	Max
Act Effect Green (s)		37.0	37.0	37.0	22.0	19.0
Actuated g/C Ratio		0.41	0.41	0.41	0.24	0.21
v/c Ratio		0.54	0.30	0.62	0.76	0.46
Control Delay		28.4	19.4	26.7	47.0	36.3
Queue Delay		0.0	0.0	0.0	0.0	0.0
Total Delay		28.4	19.4	26.7	47.0	36.3
LOS		C	B	C	D	D
Approach Delay			23.5	26.7	47.0	36.3
Approach LOS			C	C	D	D

### Intersection Summary

Cycle Length: 90  
 Actuated Cycle Length: 90  
 Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green  
 Natural Cycle: 70  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.76  
 Intersection Signal Delay: 31.8  
 Intersection LOS: C  
 Intersection Capacity Utilization 72.1%  
 ICU Level of Service C  
 Analysis Period (min) 15

Splits and Phases: 10: Sawmill Road & Crowsfoot Road



# Phasings

## 10: Sawmill Road & Crowsfoot Road

1/31/2010



Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Protected Phases			2	6	3	
Permitted Phases	2	2		6		4
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	22.0	22.0	22.0	22.0	22.0	22.0
Total Split (s)	41.0	41.0	41.0	41.0	26.0	23.0
Total Split (%)	45.6%	45.6%	45.6%	45.6%	28.9%	25.6%
Maximum Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lead/Lag					Lead	Lag
Lead-Lag Optimize?					Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max
Walk Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0	0	0	0	0
90th %ile Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
90th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
70th %ile Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
70th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
50th %ile Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
50th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
30th %ile Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
30th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR
10th %ile Green (s)	35.0	35.0	35.0	35.0	20.0	17.0
10th %ile Term Code	Coord	Coord	Coord	Coord	MaxR	MaxR

### Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Pretimed

# Queues

## 10: Sawmill Road & Crowsfoot Road

1/31/2010



Lane Group	EBL	EBT	WBT	SEL	SWL
Lane Group Flow (vph)	161	192	363	268	147
v/c Ratio	0.54	0.30	0.62	0.76	0.46
Control Delay	28.4	19.4	26.7	47.0	36.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	28.4	19.4	26.7	47.0	36.3
Queue Length 50th (m)	20.5	21.7	48.5	43.1	22.3
Queue Length 95th (m)	41.3	37.1	77.9	#78.9	40.3
Internal Link Dist (m)		209.3	244.6	967.8	525.7
Turn Bay Length (m)	60.0				
Base Capacity (vph)	298	647	583	354	323
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	0.54	0.30	0.62	0.76	0.46

### Intersection Summary

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

# HCM Signalized Intersection Capacity Analysis

## 10: Sawmill Road & Crowsfoot Road

1/31/2010



Movement	EBL2	EBL	EBT	WBT	WBR	WBR2	SEL2	SEL	SER	SWL	SWR	SWR2
Lane Configurations												
Volume (vph)	32	129	192	267	91	5	1	166	101	8	135	4
Ideal Flow (vphpl)	1900	1775	1650	1650	1900	1900	1900	1765	1900	1765	1900	1900
Total Lost time (s)		4.0	4.0	4.0				4.0		4.0		
Lane Util. Factor		1.00	1.00	1.00				1.00		1.00		
Frt		1.00	1.00	0.96				0.95		0.87		
Flt Protected		0.95	1.00	1.00				0.97		1.00		
Satd. Flow (prot)		1695	1574	1419				1447		1553		
Flt Permitted		0.41	1.00	1.00				0.97		0.98		
Satd. Flow (perm)		725	1574	1419				1447		1528		
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	32	129	192	267	91	5	1	166	101	8	135	4
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	161	192	363	0	0	0	268	0	147	0	0
Heavy Vehicles (%)	3%	0%	6%	9%	27%	0%	0%	17%	8%	0%	0%	0%
Turn Type	Perm	Perm					Split					
Protected Phases			2	6			3	3				
Permitted Phases	2	2		6						4		
Actuated Green, G (s)		35.0	35.0	35.0				20.0		17.0		
Effective Green, g (s)		37.0	37.0	37.0				22.0		19.0		
Actuated g/C Ratio		0.41	0.41	0.41				0.24		0.21		
Clearance Time (s)		6.0	6.0	6.0				6.0		6.0		
Lane Grp Cap (vph)		298	647	583				354		323		
v/s Ratio Prot			0.12	c0.26				c0.19				
v/s Ratio Perm		0.22								c0.10		
v/c Ratio		0.54	0.30	0.62				0.76		0.46		
Uniform Delay, d1		20.1	17.8	21.0				31.5		31.0		
Progression Factor		1.00	1.00	1.00				1.00		1.00		
Incremental Delay, d2		6.9	1.2	5.0				14.0		4.6		
Delay (s)		26.9	18.9	25.9				45.6		35.6		
Level of Service		C	B	C				D		D		
Approach Delay (s)			22.6	25.9				45.6		35.6		
Approach LOS			C	C				D		D		

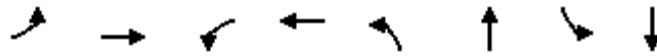
### Intersection Summary

HCM Average Control Delay	30.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	72.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

# Timings

## 3: Sawmill Road & Northfield Drive

2/16/2010

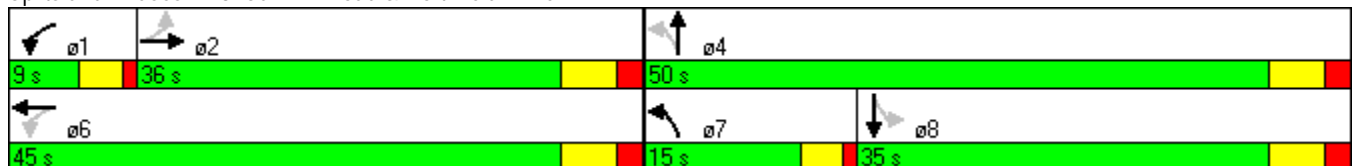


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		↕		↕	↗	↖		↕
Volume (vph)	61	213	236	191	106	369	26	201
Turn Type	Perm		pm+pt		pm+pt		Perm	
Protected Phases		2	1	6	7	4		8
Permitted Phases	2		6		4		8	
Detector Phase	2	2	1	6	7	4	8	8
Switch Phase								
Minimum Initial (s)	8.0	8.0	5.0	8.0	4.0	8.0	8.0	8.0
Minimum Split (s)	32.0	32.0	9.0	34.0	8.0	38.0	35.0	35.0
Total Split (s)	36.0	36.0	9.0	45.0	15.0	50.0	35.0	35.0
Total Split (%)	37.9%	37.9%	9.5%	47.4%	15.8%	52.6%	36.8%	36.8%
Yellow Time (s)	4.0	4.0	3.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	0.0	-2.0	0.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lead		Lead		Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes		Yes		Yes	Yes
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Act Effect Green (s)		32.0		41.0	46.0	46.0		31.0
Actuated g/C Ratio		0.34		0.43	0.48	0.48		0.33
v/c Ratio		0.83		1.23	0.24	1.06		0.89
Control Delay		45.8		151.8	15.0	73.5		61.9
Queue Delay		0.0		0.0	0.0	0.0		0.0
Total Delay		45.8		151.8	15.0	73.5		61.9
LOS		D		F	B	E		E
Approach Delay		45.8		151.8		66.7		61.9
Approach LOS		D		F		E		E

### Intersection Summary

Cycle Length: 95  
 Actuated Cycle Length: 95  
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green  
 Natural Cycle: 85  
 Control Type: Pretimed  
 Maximum v/c Ratio: 1.23  
 Intersection Signal Delay: 82.2  
 Intersection LOS: F  
 Intersection Capacity Utilization 117.7%  
 ICU Level of Service H  
 Analysis Period (min) 15

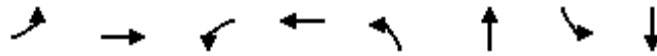
### Splits and Phases: 3: Sawmill Road & Northfield Drive



# Phasings

## 3: Sawmill Road & Northfield Drive

2/16/2010



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Protected Phases		2	1	6	7	4		8
Permitted Phases	2		6		4		8	
Minimum Initial (s)	8.0	8.0	5.0	8.0	4.0	8.0	8.0	8.0
Minimum Split (s)	32.0	32.0	9.0	34.0	8.0	38.0	35.0	35.0
Total Split (s)	36.0	36.0	9.0	45.0	15.0	50.0	35.0	35.0
Total Split (%)	37.9%	37.9%	9.5%	47.4%	15.8%	52.6%	36.8%	36.8%
Maximum Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
Yellow Time (s)	4.0	4.0	3.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	1.0	2.0	2.0	2.0
Lead/Lag	Lag	Lag	Lead		Lead		Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes		Yes		Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Walk Time (s)	10.0	10.0		10.0		22.0	22.0	22.0
Flash Dont Walk (s)	16.0	16.0		16.0		7.0	7.0	7.0
Pedestrian Calls (#/hr)	0	0		0		0	0	0
90th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
90th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
70th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
70th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
50th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
50th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
30th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
30th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR
10th %ile Green (s)	30.0	30.0	5.0	39.0	11.0	44.0	29.0	29.0
10th %ile Term Code	Coord	Coord	MaxR	Coord	MaxR	MaxR	MaxR	MaxR

### Intersection Summary

Cycle Length: 95

Actuated Cycle Length: 95

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Pretimed

## Queues

### 3: Sawmill Road & Northfield Drive

2/16/2010



Lane Group	EBT	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	351	462	106	805	265
v/c Ratio	0.83	1.23	0.24	1.06	0.89
Control Delay	45.8	151.8	15.0	73.5	61.9
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	45.8	151.8	15.0	73.5	61.9
Queue Length 50th (m)	56.2	~93.8	10.3	~155.1	44.4
Queue Length 95th (m)	#104.0	#164.6	19.5	#225.0	#91.1
Internal Link Dist (m)	1940.2	1158.8		838.0	899.0
Turn Bay Length (m)			7.0		
Base Capacity (vph)	425	375	447	759	298
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	0.83	1.23	0.24	1.06	0.89

#### Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

# HCM Signalized Intersection Capacity Analysis

## 3: Sawmill Road & Northfield Drive

2/16/2010



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↗	↘			↕	
Volume (vph)	61	213	77	236	191	35	106	369	436	26	201	38
Ideal Flow (vphpl)	1900	1550	1900	1900	1550	1900	1775	1650	1900	1900	1550	1900
Total Lost time (s)		4.0			4.0		4.0	4.0			4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00			1.00	
Frbp, ped/bikes		1.00			1.00		1.00	1.00			1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00			1.00	
Frt		0.97			0.99		1.00	0.92			0.98	
Flt Protected		0.99			0.98		0.95	1.00			1.00	
Satd. Flow (prot)		1425			1442		1607	1474			1427	
Flt Permitted		0.86			0.53		0.42	1.00			0.62	
Satd. Flow (perm)		1229			781		709	1474			893	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	61	213	77	236	191	35	106	369	436	26	201	38
RTOR Reduction (vph)	0	11	0	0	3	0	0	45	0	0	6	0
Lane Group Flow (vph)	0	340	0	0	459	0	106	760	0	0	259	0
Confl. Peds. (#/hr)	5		1	1		5	2					2
Heavy Vehicles (%)	3%	7%	2%	3%	7%	3%	6%	4%	4%	14%	6%	6%
Turn Type	Perm			pm+pt			pm+pt			Perm		
Protected Phases		2		1	6		7	4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)		30.0			39.0		44.0	44.0			29.0	
Effective Green, g (s)		32.0			41.0		44.0	46.0			31.0	
Actuated g/C Ratio		0.34			0.43		0.46	0.48			0.33	
Clearance Time (s)		6.0			6.0		4.0	6.0			6.0	
Lane Grp Cap (vph)		414			386		432	714			291	
v/s Ratio Prot					c0.09		0.03	c0.52				
v/s Ratio Perm		c0.28			0.43		0.09				0.29	
v/c Ratio		0.82			1.19		0.25	1.06			0.89	
Uniform Delay, d1		28.9			27.0		15.8	24.5			30.4	
Progression Factor		1.00			1.00		1.00	1.00			1.00	
Incremental Delay, d2		16.6			108.3		1.3	52.2			30.8	
Delay (s)		45.5			135.3		17.2	76.7			61.2	
Level of Service		D			F		B	E			E	
Approach Delay (s)		45.5			135.3			69.8			61.2	
Approach LOS		D			F			E			E	

### Intersection Summary

















HCM Average Control Delay	79.6	HCM Level of Service	E
HCM Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	117.7%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

# HCM Unsignalized Intersection Capacity Analysis

## 13: Driveway & Sawmill Road

2/16/2010

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	3	1	10	121	2	102	5	456	100	104	399	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour 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
Hourly flow rate (vph)	3	1	10	121	2	102	5	456	100	104	399	1
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1226	1174	400	1134	1124	506	400			556		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1226	1174	400	1134	1124	506	400			556		
tC, single (s)	7.1	6.5	6.2	7.2	6.5	6.2	4.1			4.2		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.6	4.0	3.3	2.2			2.3		
p0 queue free %	97	99	98	23	99	82	100			89		
cM capacity (veh/h)	117	172	655	158	185	564	1170			990		
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>WB 1</b>	<b>NB 1</b>	<b>SB 1</b>								
Volume Total	14	225	561	504								
Volume Left	3	121	5	104								
Volume Right	10	102	100	1								
cSH	299	235	1170	990								
Volume to Capacity	0.05	0.96	0.00	0.11								
Queue Length 95th (m)	1.1	65.3	0.1	2.7								
Control Delay (s)	17.6	92.7	0.1	2.9								
Lane LOS	C	F	A	A								
Approach Delay (s)	17.6	92.7	0.1	2.9								
Approach LOS	C	F										
<b>Intersection Summary</b>												
Average Delay			17.3									
Intersection Capacity Utilization			101.8%		ICU Level of Service				G			
Analysis Period (min)			15									

# Timings

## 10: Sawmill Road & Crowsfoot Road

1/31/2010



Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Lane Configurations						
Volume (vph)	90	172	356	423	140	7
Turn Type	pm+pt	pm+pt				
Protected Phases	5	5	2	6	3	
Permitted Phases	2	2		6		4
Detector Phase	5	5	2	6	3	4
Switch Phase						
Minimum Initial (s)	5.0	5.0	8.0	8.0	8.0	8.0
Minimum Split (s)	9.0	9.0	22.0	22.0	22.0	22.0
Total Split (s)	12.0	12.0	59.0	47.0	17.0	19.0
Total Split (%)	12.6%	12.6%	62.1%	49.5%	17.9%	20.0%
Yellow Time (s)	3.0	3.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead		Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes
Recall Mode	Max	Max	Max	Max	Max	Max
Act Effect Green (s)		55.0	55.0	43.0	13.0	15.0
Actuated g/C Ratio		0.58	0.58	0.45	0.14	0.16
v/c Ratio		1.02	0.39	0.99	0.86	0.49
Control Delay		57.2	12.9	59.4	77.6	44.2
Queue Delay		0.0	0.0	0.0	0.0	0.0
Total Delay		57.2	12.9	59.4	77.6	44.2
LOS		E	B	E	E	D
Approach Delay			31.7	59.4	77.6	44.2
Approach LOS			C	E	E	D

### Intersection Summary

Cycle Length: 95

Actuated Cycle Length: 95

Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Natural Cycle: 100

Control Type: Pretimed

Maximum v/c Ratio: 1.02

Intersection Signal Delay: 49.3

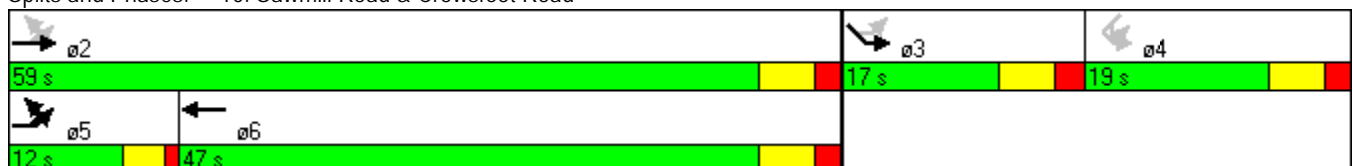
Intersection LOS: D

Intersection Capacity Utilization 89.6%

ICU Level of Service E

Analysis Period (min) 15

Splits and Phases: 10: Sawmill Road & Crowsfoot Road



# Phasings

## 10: Sawmill Road & Crowsfoot Road

1/31/2010



Lane Group	EBL2	EBL	EBT	WBT	SEL	SWL
Protected Phases	5	5	2	6	3	
Permitted Phases	2	2		6		4
Minimum Initial (s)	5.0	5.0	8.0	8.0	8.0	8.0
Minimum Split (s)	9.0	9.0	22.0	22.0	22.0	22.0
Total Split (s)	12.0	12.0	59.0	47.0	17.0	19.0
Total Split (%)	12.6%	12.6%	62.1%	49.5%	17.9%	20.0%
Maximum Green (s)	8.0	8.0	53.0	41.0	11.0	13.0
Yellow Time (s)	3.0	3.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	2.0	2.0	2.0	2.0
Lead/Lag	Lead	Lead		Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	Max	Max	Max	Max	Max	Max
Walk Time (s)			5.0	5.0	5.0	5.0
Flash Dont Walk (s)			11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)			0	0	0	0
90th %ile Green (s)	8.0	8.0	53.0	41.0	11.0	13.0
90th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	Ped
70th %ile Green (s)	8.0	8.0	53.0	41.0	11.0	13.0
70th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	Ped
50th %ile Green (s)	8.0	8.0	53.0	41.0	11.0	13.0
50th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	Ped
30th %ile Green (s)	8.0	8.0	53.0	41.0	11.0	13.0
30th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	Ped
10th %ile Green (s)	8.0	8.0	53.0	41.0	11.0	13.0
10th %ile Term Code	MaxR	MaxR	Coord	Coord	Ped	Ped

### Intersection Summary

Cycle Length: 95

Actuated Cycle Length: 95

Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Pretimed

# Queues

## 10: Sawmill Road & Crowsfoot Road

1/31/2010



Lane Group	EBL	EBT	WBT	SEL	SWL
Lane Group Flow (vph)	262	356	667	170	116
v/c Ratio	1.02	0.39	0.99	0.86	0.49
Control Delay	57.2	12.9	59.4	77.6	44.2
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	57.2	12.9	59.4	77.6	44.2
Queue Length 50th (m)	-28.4	32.2	117.2	30.9	19.6
Queue Length 95th (m)	m#33.5	m33.7	#191.6	#66.5	36.6
Internal Link Dist (m)		209.3	244.6	967.8	1075.3
Turn Bay Length (m)	60.0				
Base Capacity (vph)	258	920	675	198	239
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	1.02	0.39	0.99	0.86	0.49

### Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

# HCM Signalized Intersection Capacity Analysis

## 10: Sawmill Road & Crowsfoot Road

1/31/2010



Movement	EBL2	EBL	EBT	WBT	WBR	WBR2	SEL2	SEL	SER	SWL	SWR	SWR2
Lane Configurations												
Volume (vph)	90	172	356	423	234	10	2	140	28	7	107	2
Ideal Flow (vphpl)	1900	1775	1650	1650	1900	1900	1900	1765	1900	1765	1900	1900
Total Lost time (s)		4.0	4.0	4.0				4.0		4.0		
Lane Util. Factor		1.00	1.00	1.00				1.00		1.00		
Frt		1.00	1.00	0.95				0.98		0.87		
Flt Protected		0.95	1.00	1.00				0.96		1.00		
Satd. Flow (prot)		1688	1589	1492				1448		1554		
Flt Permitted		0.13	1.00	1.00				0.96		0.97		
Satd. Flow (perm)		234	1589	1492				1448		1513		
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	90	172	356	423	234	10	2	140	28	7	107	2
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	262	356	667	0	0	0	170	0	116	0	0
Heavy Vehicles (%)	3%	0%	5%	5%	9%	0%	0%	19%	0%	0%	0%	0%
Turn Type	pm+pt	pm+pt						Perm				
Protected Phases	5	5	2	6				3				
Permitted Phases	2	2		6			3			4		
Actuated Green, G (s)		53.0	53.0	41.0				11.0		13.0		
Effective Green, g (s)		53.0	55.0	43.0				13.0		15.0		
Actuated g/C Ratio		0.56	0.58	0.45				0.14		0.16		
Clearance Time (s)		4.0	6.0	6.0				6.0		6.0		
Lane Grp Cap (vph)		253	920	675				198		239		
v/s Ratio Prot		c0.09	0.22	0.45								
v/s Ratio Perm		c0.49						0.12		c0.08		
v/c Ratio		1.04	0.39	0.99				0.86		0.49		
Uniform Delay, d1		20.2	10.9	25.7				40.1		36.5		
Progression Factor		1.36	1.12	1.00				1.00		1.00		
Incremental Delay, d2		40.7	0.4	31.9				35.4		6.9		
Delay (s)		68.2	12.5	57.6				75.5		43.4		
Level of Service		E	B	E				E		D		
Approach Delay (s)			36.1	57.6				75.5		43.4		
Approach LOS			D	E				E		D		

### Intersection Summary

HCM Average Control Delay	50.1	HCM Level of Service	D
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	89.6%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			