

Memorandum

TEC Engineering, Inc.

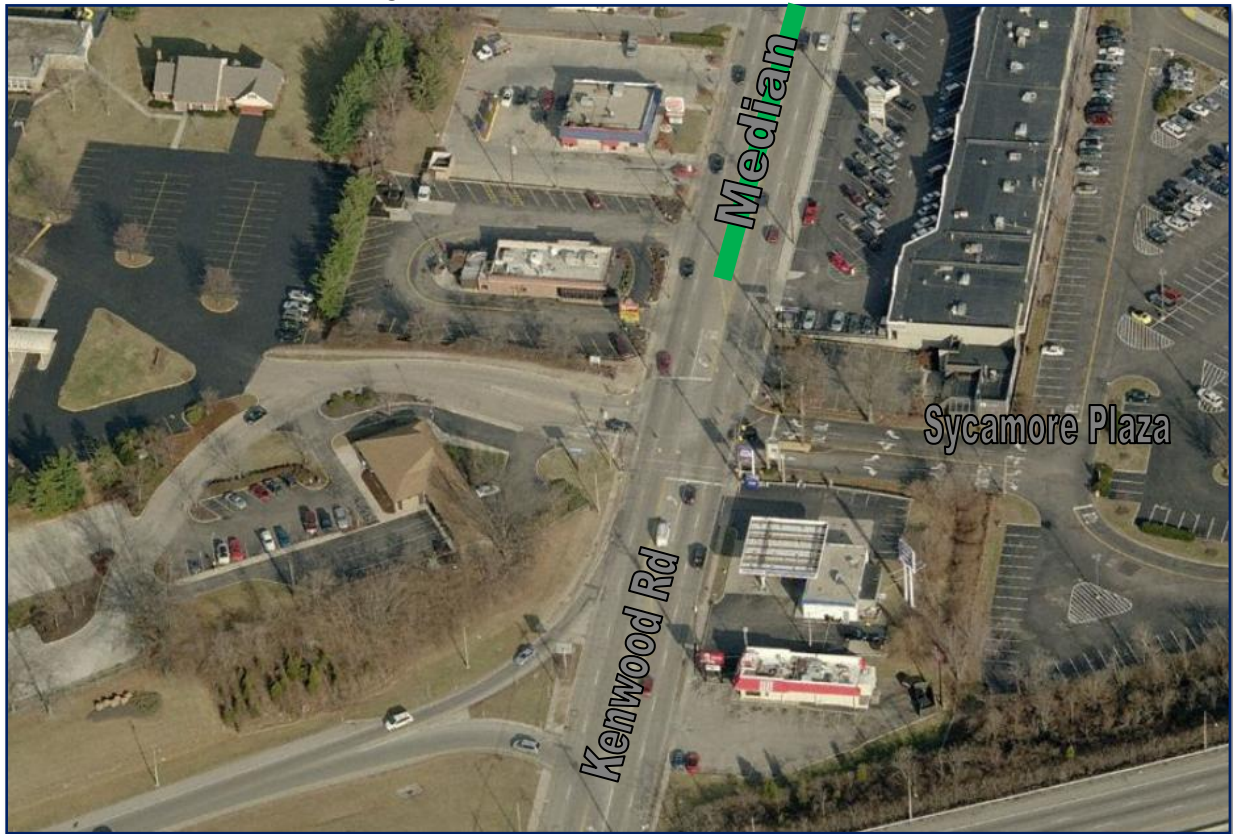
Date: 2/20/2014
Project: Sycamore Plaza U-Turn Analysis
Subject: U-Turn Analysis
Prepared by: Edward Williams, P.E., P.T.O.E., TEC Engineering, Inc.
Kellie Linville, E.I. TEC Engineering, Inc.
Prepared for: Project Review Team

1. Introduction

TEC was asked to analyze the effects of the installed median along Kenwood Road between Montgomery Road and Sycamore Plaza as part of the access management project. Specifically TEC will look into the volume of traffic that is making a u-turn movement at the intersection of Kenwood Road and Sycamore Plaza due to the median restricting turn further north in the corridor. A proposed roundabout is to be located within Sycamore Plaza just east of Kenwood Road. The memorandum will look into the increase of southbound left turning volume into Sycamore Plaza that then make a westbound right turn to travel north on Kenwood Road.

An aerial of the intersection of Kenwood Road and Sycamore Plaza is presented in *Figure 1.1*.

Figure 1.1: Intersection Aerial with Median



2. Count Data

TEC performed turning movement counts at the intersection of Kenwood Road and Sycamore Plaza in February of 2013 before the median was installed and in November of 2013 after the median was installed during the Midday and PM Peak. Counts during the holiday season were also collected during the 2013 holiday shopping season (between Thanksgiving and Christmas) during the PM Peak and the Weekend Peak. The counts for each peak hour are shown in the table below. The full peak hour counts are included in *Appendix A*.

Table 2.1: Kenwood Rd/Sycamore Plaza Turning Movement Counts

Peak	Southbound			Westbound			Northbound			Eastbound		
	Right	Thru	Left	Right	Thru	Left	Right	Thru	Left	Right	Thru	Left
Feb MID	0	745	35	50	0	10	27	783	0	3	0	4
Nov MID	38	684	144	74	7	110	116	730	18	22	9	51
Feb PM	0	1033	36	45	1	12	21	838	0	2	0	3
Nov PM	45	963	69	28	7	126	101	780	27	67	5	60
Hol PM	38	869	96	51	45	124	107	783	27	57	49	47
Hol WE	1	695	153	62	2	178	168	956	23	22	5	43

As seen in *Table 2.1*, volumes increased for some approaches from February to November, especially the southbound left movement and westbound left movement. This is due to the median installation on Kenwood Road north of the intersection. Southbound left volumes increase from vehicles either performing a u-turn to travel north on the corridor to access their destination or vehicles turning into Sycamore Plaza to access their destination via the parking areas behind the strip center along Kenwood Road. Westbound left turning volumes likely increased from vehicles exiting the strip center and traveling south on Kenwood Road. Since the left turn is restricted out of the strip center, vehicles are navigating to the signalized intersection at Kenwood Road and Sycamore Plaza to turn left.

November turning movement counts include u-turning vehicles in the southbound left volumes. A u-turning vehicle is considered to be a vehicle that completed a southbound left turn movement shortly followed by a westbound right turn movement. Typically vehicles would turn around in the Sycamore Plaza parking lot at the proposed location of the roundabout. *Table 2.2* separates the left turns from the u-turns for the Midday and PM counts from November and *Table 2.3* shows the left turns and u turns for the holiday peak hours.

Table 2.2: November SB Left and U-turn Volume (Midday and PM)

	November Counts	
	SB Left	SB U-Turn
12:00	24	13
12:15	21	14
12:30	25	14
12:45	22	11
4:45	8	7
5:00	5	5
5:15	12	6
5:30	21	5

Table 2.3: Holiday SB Left and U-turn Volume (PM and Weekend)

	Holiday Counts	
	SB Left	SB U-Turn
12:45	38	8
1:00	39	5
1:15	39	4
1:30	29	9
4:45	27	5
5:00	20	7
5:15	20	8
5:30	29	6

3. Capacity Analysis for Signalized Intersection

Traffic conditions were modeled for February, November and Holiday conditions in *Synchro*. Appropriate timing plans were modeled for each intersection for the Midday peak (12:00 pm – 1:00 pm), the PM peak (4:45 pm – 5:45 pm) and the Weekend Peak (12:45 pm – 1:45 pm) where applicable. The *Synchro* models reflect the most up to date timing received by TEC for the intersection of Kenwood Road and Sycamore Plaza.

For signalized intersections, the Level of Service for the intersection is directly related to the average total delay per vehicle. The total delay is the sum of control delay and queue delay. Control delay is the component of delay caused by the downstream control device and is calculated using the Percentile Delay Method. Queue delay is an analysis of the affects of queues and blocking on short links and short turning bays. LOS is defined in terms of delay and is a measure of driver discomfort and intersection performance with respect to vehicular capacity and quality of service provided to road users. Delay refers to total average stopped delay experienced by motorists at the referenced intersection. The level of service is classified into six different levels, ranging from A to F. *Table* shows the definitions of each level.

Table 3.1: Level of Service Classifications

Level of Service	Description	Delay
A	Very low delay	<10 seconds per vehicle
B	Good progression	10-20 seconds per vehicle
C	Limit of acceptable delay	20-35 seconds per vehicle
D	Start of traffic breakdown	35-55 seconds per vehicle
E	High delay	55-80 seconds per vehicle
F	Congested conditions, unacceptable delay	>80 seconds per vehicle

The delay and level of service for each intersection during each peak analyzed can be found in Table 3.2 and the output can be found in Appendix B.

Table 3.2: Pre-Study Synchro Results (Delays are in Seconds)

Intersection	MID PEAK			
	February Volumes		November Volumes	
	LOS	Delay	LOS	Delay
Kenwood Road/Sycamore Plaza	A	6.7	B	11.2

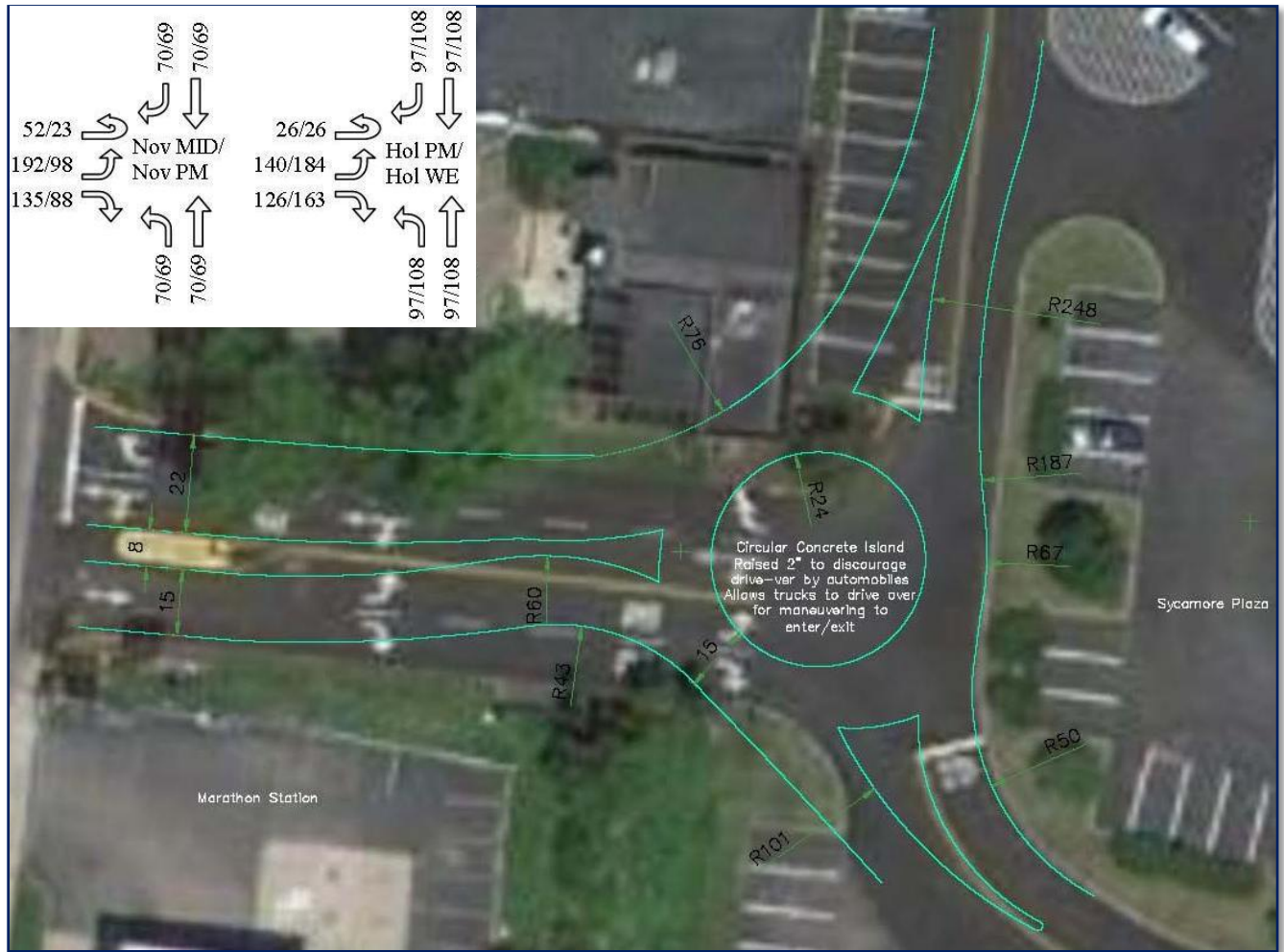
Intersection	PM PEAK			
	February Volumes		November Volumes	
	LOS	Delay	LOS	Delay
Kenwood Road/Sycamore Plaza	A	2.6	B	12.6

Intersection	Holiday			
	Holiday PM		Holiday WE	
	LOS	Delay	LOS	Delay
Kenwood Road/Sycamore Plaza	B	13.8	B	16.5

4. Capacity Analysis for Proposed Roundabout

The median along Kenwood Road has caused an increase in traffic turning around in the Sycamore Plaza parking lot. To improve access and create a safer place for vehicles to turn around, TEC has designed a mini-roundabout located within the Sycamore Plaza parking lot just east of Kenwood Road. This is a small roundabout within one approach lane in each direction. The schematic of the proposed roundabout is shown in the following figure.

Figure 4.1: Proposed Roundabout Schematic



A capacity analysis was performed for this roundabout using the software *Sidra*. Roundabout volumes were derived from the combination of counts performed by TEC and driving patterns in the area. *Sidra* output is included in *Appendix C* and the average control delay in seconds is included in the table below.

Table 4.1: Proposed Roundabout Schematic

Intersection	November MID		November PM		Holiday PM		Holiday WE	
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
Proposed Roundabout	A	5.8	A	5.1	A	5.4	A	5.7

5. Queue Analysis

The proposed roundabout is to be located approximately 140 feet east of Kenwood Road in the Sycamore Plaza as shown in *Figure 4.1*. A queue analysis was performed to determine if queuing issues would arise in the section of roadway between the signalized intersection and the roundabout. For the Roundabout, Sidra was used to determine the queue for the eastbound approach of the roundabout. Sidra reports the worst case for queue length. For the signalized intersection, Synchro, along with a SimTraffic model was used for the queue analysis. The queue analysis was performed for November Midday and PM scenarios as well as holiday conditions for PM and Weekend Peaks. SimTraffic reports the 95th percentile queue length by approach. The westbound approach was analyzed since this is the only approach with potential to affect the roundabout. The results are as follows:

Table 5.1: Sidra Worst Case Queue Length for Roundabout

Queue Length (feet)			
Nov MID	Nov PM	Hol PM	Hol WE
69.5'	33.5'	53.6'	75.4'

Table 5.2: SimTraffic 95th Percentile Queue Length for WB Approach

	Queue Length (feet)			
	Nov MID	Nov PM	Hol PM	Hol WE
WBT	101'	110'	133'	151'
WBR	31'	19'	24'	28'

As seen in tables 5.1 and 5.2, the longest queue length is 151' which occurs in the westbound thru/left lane during the holiday weekend peak. This is the 95th percentile queue length which represents the worst case scenario for the signal. With the worst case occurring during the holiday peak, it would be unlikely to back up into the roundabout during non-holiday shopping times. Typical non-holiday peaks result in a maximum queue length of 110'. This would allow enough room for the queue before entering the roundabout.

To further analyze how far/often the queue will back up into the proposed roundabout, the SimTraffic queuing and blocking report was used to determine the percentage of time the queue would actually be blocking the roundabout. Since the worst case was the holiday weekend peak and holiday PM peak, these scenarios were analyzed. The results showed that during the peak hours on the holiday weekend, the westbound thru/left lane would back up to the roundabout **1%** of the time. During the holiday PM peak, the percentage of time the backup would reach the roundabout is **2%**. **This shows that the vehicles would stack into the roundabout for less than 2 minutes of the 4 Fridays/Saturdays of the holiday shopping season. The maximum queue extends only 11' into the roundabout, which is less than one car length.** The queue and blocking report is included in *Appendix D*.

Index of Appendices

Appendix A: Turning Movement Counts

Appendix B: Synchro Outputs

Appendix C: Sidra Output

Appendix D: Queue and Blocking Report

Appendix A: Turning Movement Counts

TEC Engineering, Inc.
 7288 Central Parke Blvd.
 Mason, Ohio 45040

File Name : sycamore plaza midday
 Site Code : 04444444
 Start Date : 2/26/2013
 Page No : 1

Groups Printed- Unshifted

Start Time	Kenwood Rd From North					Sycamore Plaza From East					Kenwood Rd From South					St Vincent From West					Int. Total
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
11:30 AM	0	189	12	0	201	12	0	4	0	16	8	194	0	0	202	0	0	0	0	0	419
11:45 AM	0	192	13	0	205	12	0	3	0	15	9	237	0	0	246	2	0	3	0	5	471
Total	0	381	25	0	406	24	0	7	0	31	17	431	0	0	448	2	0	3	0	5	890
12:00 PM	0	168	9	0	177	7	0	2	0	9	4	182	0	0	186	0	0	1	0	1	373
12:15 PM	0	174	7	0	181	10	0	1	0	11	7	190	0	0	197	1	0	3	0	4	393
12:30 PM	0	183	11	0	194	16	0	3	0	19	9	205	0	0	214	2	0	0	0	2	429
12:45 PM	0	220	8	0	228	17	0	4	0	21	7	206	0	0	213	0	0	0	0	0	462
Total	0	745	35	0	780	50	0	10	0	60	27	783	0	0	810	3	0	4	0	7	1657
01:00 PM	0	168	9	0	177	19	0	5	0	24	10	222	0	0	232	2	0	0	0	2	435
01:15 PM	0	169	9	0	178	15	0	5	0	20	3	205	0	0	208	0	0	3	0	3	409
Grand Total	0	1463	78	0	1541	108	0	27	0	135	57	1641	0	0	1698	7	0	10	0	17	3391
Apprch %	0.0	94.9	5.1	0.0		80.0	0.0	20.0	0.0		3.4	96.6	0.0	0.0		41.2	0.0	58.8	0.0		
Total %	0.0	43.1	2.3	0.0	45.4	3.2	0.0	0.8	0.0	4.0	1.7	48.4	0.0	0.0	50.1	0.2	0.0	0.3	0.0	0.5	

TEC Engineering, Inc.
7288 Central Parke Blvd.
Mason, Ohio 45040

File Name : sycamore plaza PM
Site Code : 55555555
Start Date : 2/26/2013
Page No : 1

Groups Printed- Unshifted

Start Time	Kenwood Rd From North					Sycamore Plaza From East					Kenwood Rd From South					St Vincent From West					Int. Total
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
04:00 PM	0	205	7	0	212	4	0	1	0	5	5	202	0	0	207	4	0	0	0	4	428
04:15 PM	0	211	8	0	219	8	0	5	0	13	8	176	0	0	184	0	0	1	0	1	417
04:30 PM	0	206	8	0	214	5	0	5	0	10	7	147	0	0	154	0	0	1	0	1	379
04:45 PM	0	233	9	0	242	11	0	4	0	15	3	212	0	0	215	2	0	1	0	3	475
Total	0	855	32	0	887	28	0	15	0	43	23	737	0	0	760	6	0	3	0	9	1699
05:00 PM	0	232	10	0	242	14	0	0	0	14	8	197	0	0	205	0	0	0	0	0	461
05:15 PM	0	306	8	0	314	10	1	1	0	12	6	223	0	0	229	0	0	0	0	0	555
05:30 PM	0	262	9	0	271	10	0	7	0	17	4	206	0	0	210	0	0	2	0	2	500
05:45 PM	0	236	7	0	243	5	0	2	0	7	6	201	0	0	207	1	0	1	0	2	459
Total	0	1036	34	0	1070	39	1	10	0	50	24	827	0	0	851	1	0	3	0	4	1975
Grand Total	0	1891	66	0	1957	67	1	25	0	93	47	1564	0	0	1611	7	0	6	0	13	3674
Apprch %	0.0	96.6	3.4	0.0		72.0	1.1	26.9	0.0		2.9	97.1	0.0	0.0		53.8	0.0	46.2	0.0		
Total %	0.0	51.5	1.8	0.0	53.3	1.8	0.0	0.7	0.0	2.5	1.3	42.6	0.0	0.0	43.8	0.2	0.0	0.2	0.0	0.4	

TEC Engineering, Inc.
Turning Movement Counts
7288 Central Parke Blvd
Mason, Ohio 45040 (513) 771-8828

Kenwood Rd & St Vincent
MID Peak

Filename: Kenwood & St Vincent MID ES.xlsm
Site Code: 00000000
Start Date: 11/14/2013

	Kenwood Rd Southbound					St. Vincent Westbound					Kenwood Rd Northbound					St. Vincent Eastbound						
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total	
12:00 PM	7	151	37	0	195	23	3	15	0	41	31	204	5	0	240	5	1	10	0	16	492	
12:15 PM	8	183	35	0	226	14	0	20	0	34	32	188	2	0	222	4	3	12	1	20	502	
12:30 PM	13	187	39	0	239	20	2	34	1	57	30	193	4	0	227	9	1	16	0	26	549	
12:45 PM	10	163	33	1	207	17	2	41	0	60	23	145	7	0	175	4	4	13	0	21	463	
Total	38	684	144	1	867	74	7	110	1	192	116	730	18	0	864	22	9	51	1	83	2006	
1:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	38	684	144	1	867	74	7	110	1	192	116	730	18	0	864	22	9	51	1	83	2006	
Apprch %	4.4%	78.9%	16.6%	0.1%		38.5%	3.6%	57.3%	0.5%		13.4%	84.5%	2.1%	0.0%		26.5%	10.8%	61.4%	1.2%			
Total %	1.9%	34.1%	7.2%	0.0%	43.2%	3.7%	0.3%	5.5%	0.0%	9.6%	5.8%	36.4%	0.9%	0.0%	43.1%	1.1%	0.4%	2.5%	0.0%	4.1%		

Kenwood Rd & St Vincent
Peak

TEC Engineering, Inc.
Turning Movement Counts
7288 Central Parke Blvd
Mason, Ohio 45040 (513) 771-8828

Filename: Kenwood & St Vincent PM ES.xlsm
Site Code: 00000000
Start Date: 11/14/2013

Start Time	Kenwood Rd Southbound					St. Vincent Westbound					Kenwood Rd Northbound					St. Vincent Eastbound					Int. Total
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
4:00 PM	8	188	13	0	209	6	0	15	0	21	22	186	5	0	213	12	0	8	0	20	463
4:15 PM	6	198	12	0	216	11	0	26	0	37	18	176	10	0	204	8	0	13	0	21	478
4:30 PM	12	196	17	0	225	7	0	40	0	47	16	194	3	0	213	13	0	13	0	26	511
4:45 PM	15	212	15	2	244	8	2	29	0	39	21	182	9	0	212	16	1	24	0	41	536
Total	41	794	57	2	894	32	2	110	0	144	77	738	27	0	842	49	1	58	0	108	1988
5:00 PM	8	274	10	0	292	5	1	30	6	42	30	201	6	1	238	23	2	13	1	39	611
5:15 PM	11	244	18	0	273	10	3	34	3	50	37	201	6	0	244	15	2	16	0	33	600
5:30 PM	11	233	26	0	270	5	1	33	0	39	13	196	6	0	215	13	0	7	0	20	544
5:45 PM	11	204	18	0	233	12	0	27	0	39	26	203	10	0	239	12	0	8	1	21	532
Total	41	955	72	0	1068	32	5	124	9	170	106	801	28	1	936	63	4	44	2	113	2287
6:00 PM	6	267	13	0	286	6	1	31	0	38	27	238	8	0	273	8	0	9	0	17	614
6:15 PM	8	225	17	0	250	10	0	19	0	29	31	222	5	0	258	8	1	11	1	21	558
6:30 PM	6	175	23	0	204	12	0	28	0	40	11	153	2	0	166	8	1	11	0	20	430
6:45 PM	7	207	17	1	232	4	0	24	0	28	11	156	3	0	170	2	0	5	0	7	437
Total	27	874	70	1	972	32	1	102	0	135	80	769	18	0	867	26	2	36	1	65	2039
Grand Total	109	2623	199	3	2934	96	8	336	9	449	263	2308	73	1	2645	138	7	138	3	286	6314
Apprch %	3.7%	89.4%	6.8%	0.1%		21.4%	1.8%	74.8%	2.0%		9.9%	87.3%	2.8%	0.0%		48.3%	2.4%	48.3%	1.0%		
Total %	1.7%	41.5%	3.2%	0.0%	46.5%	1.5%	0.1%	5.3%	0.1%	7.1%	4.2%	36.6%	1.2%	0.0%	41.9%	2.2%	0.1%	2.2%	0.0%	4.5%	

KENWOOD RD AND ST.VINCENT
PM Peak

TEC Engineering, Inc.
Turning Movement Counts
7288 Central Parke Boulevard
Mason, OH 45040 (513) 771-8828

Filename: kenwood and st.vincent pm count
Site Code: 00000000
Start Date: 12/10/2013

	KENWOOD RD Southbound					ST. VINCENT Westbound					KENWOOD RD Northbound					SYCAMORE PLAZA Eastbound					
Start Time	Right	Thru	Left	Peds	App-Total	Right	Thru	Left	Peds	App-Total	Right	Thru	Left	Peds	App-Total	Right	Thru	Left	Peds	App-Total	Int. Total
4:00 PM	12	203	26	2	243	15	1	27	1	44	23	154	10	0	187	15	1	10	1	27	501
4:15 PM	9	186	25	0	220	19	22	30	0	71	30	191	6	0	227	14	12	10	0	36	554
4:30 PM	6	218	26	0	250	16	0	44	1	61	36	234	10	1	281	11	1	12	0	24	616
4:45 PM	8	205	27	0	240	13	0	44	0	57	24	218	8	1	251	12	2	11	0	25	573
Total	35	812	104	2	953	63	23	145	2	233	113	797	34	2	946	52	16	43	1	112	2244
5:00 PM	8	201	20	0	229	18	25	28	0	71	30	182	8	0	220	24	23	17	0	64	584
5:15 PM	10	212	20	0	242	13	16	30	0	59	24	170	4	5	203	12	23	12	0	47	551
5:30 PM	12	245	29	0	286	6	2	22	0	30	29	207	7	0	243	8	1	7	0	16	575
5:45 PM	10	205	24	1	240	14	8	26	3	51	25	193	4	0	222	10	26	9	2	47	560
Total	40	863	93	1	997	51	51	106	3	211	108	752	23	5	888	54	73	45	2	174	2270
6:00 PM	5	229	20	0	254	13	1	46	0	60	37	211	10	0	258	7	0	5	0	12	584
6:15 PM	4	238	29	0	271	13	0	27	1	41	21	192	3	0	216	4	1	12	0	17	545
6:30 PM	7	225	22	1	255	13	2	29	0	44	26	160	5	2	193	4	0	3	0	7	499
6:45 PM	8	253	40	0	301	17	0	38	0	55	34	232	5	0	271	3	1	3	0	7	634
Total	24	945	111	1	1081	56	3	140	1	200	118	795	23	2	938	18	2	23	0	43	2262
Grand Total	99	2620	308	4	3031	170	77	391	6	644	339	2344	80	9	2772	124	91	111	3	329	6776
Apprch %	3.3%	86.4%	10.2%	0.1%		26.4%	12.0%	60.7%	0.9%		12.2%	84.6%	2.9%	0.3%		37.7%	27.7%	33.7%	0.9%		
Total %	1.5%	38.7%	4.5%	0.1%	44.7%	2.5%	1.1%	5.8%	0.1%	9.5%	5.0%	34.6%	1.2%	0.1%	40.9%	1.8%	1.3%	1.6%	0.0%	4.9%	

Kenwood & St Vincent
WE Peak

TEC Engineering, Inc.
Turning Movement Counts
7288 Central Parke Blvd
Mason, Ohio 45040 (513) 771-8828

Filename: Kenwood & St. Vincent ES.xlsm
Site Code: 13033-001
Start Date: 12/07/2013

	Kenwood Rd Southbound					St Vincent Westbound					Kenwood Rd Northbound					St Vincent Eastbound					
Start Time	Right	Thru	Left	Peds	App-Total	Right	Thru	Left	Peds	App-Total	Right	Thru	Left	Peds	App-Total	Right	Thru	Left	Peds	App-Total	Int. Total
12:00 PM	0	150	34	0	184	14	1	25	0	40	42	230	6	0	278	10	1	12	0	23	525
12:15 PM	1	178	31	0	210	19	1	34	0	54	28	237	5	0	270	6	3	9	0	18	552
12:30 PM	2	183	39	0	224	23	1	27	0	51	38	240	8	0	286	9	0	8	0	17	578
12:45 PM	1	185	38	0	224	19	1	34	0	54	48	263	7	0	318	10	1	14	0	25	621
Total	4	696	142	0	842	75	4	120	0	199	156	970	26	0	1152	35	5	43	0	83	2276
1:00 PM	0	161	39	0	200	13	0	46	0	59	49	245	2	0	296	4	1	11	0	16	571
1:15 PM	0	167	29	0	196	16	1	55	0	72	34	222	8	0	264	4	3	8	0	15	547
1:30 PM	0	182	47	0	229	14	0	43	0	57	37	226	6	0	269	4	0	10	0	14	569
1:45 PM	0	189	27	0	216	22	1	38	0	61	35	253	6	0	294	6	3	8	0	17	588
Total	0	699	142	0	841	65	2	182	0	249	155	946	22	0	1123	18	7	37	0	62	2275
2:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	4	1395	284	0	1683	140	6	302	0	448	311	1916	48	0	2275	53	12	80	0	145	4551
Apprch %	0.2%	82.9%	16.9%	0.0%		31.3%	1.3%	67.4%	0.0%		13.7%	84.2%	2.1%	0.0%		36.6%	8.3%	55.2%	0.0%		
Total %	0.1%	30.7%	6.2%	0.0%	37.0%	3.1%	0.1%	6.6%	0.0%	9.8%	6.8%	42.1%	1.1%	0.0%	50.0%	1.2%	0.3%	1.8%	0.0%	3.2%	

Appendix B: Synchro Outputs

Lanes, Volumes, Timings
10: Sycamore Plaza 1 & Kenwood Rd

Timing Plan: MID
February 2013



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	38	5	24	92	4	15	24	869	125	17	739	41
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	110		0	105		0
Storage Lanes	1		0	0		1	1		0	1		0
Taper Length (ft)	25		25	25		25	25		25	25		25
Satd. Flow (prot)	1770	1628	0	0	1777	1583	1770	3472	0	1770	3511	0
Flt Permitted	0.655				0.712		0.320			0.243		
Satd. Flow (perm)	1220	1628	0	0	1326	1583	596	3472	0	453	3511	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		26				16		23			8	
Link Speed (mph)		30			30			35			35	
Link Distance (ft)		372			613			209			530	
Travel Time (s)		8.5			13.9			4.1			10.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Shared Lane Traffic (%)												
Lane Group Flow (vph)	41	31	0	0	104	16	26	1081	0	18	848	0
Turn Type	Perm			Perm		Perm	Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2			6		
Detector Phase	4	4		8	8	8	2	2		6	6	
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Minimum Split (s)	22.0	22.0		22.0	22.0	22.0	22.0	22.0		22.0	22.0	
Total Split (s)	46.0	46.0	0.0	46.0	46.0	46.0	66.0	66.0	0.0	66.0	66.0	0.0
Total Split (%)	41.1%	41.1%	0.0%	41.1%	41.1%	41.1%	58.9%	58.9%	0.0%	58.9%	58.9%	0.0%
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0	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	0.0	-2.0	-2.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	None	None		None	None	None	Max	Max		Max	Max	
Act Effect Green (s)	13.5	13.5			13.8	13.8	68.1	68.1		68.1	68.1	
Actuated g/C Ratio	0.16	0.16			0.16	0.16	0.79	0.79		0.79	0.79	
v/c Ratio	0.22	0.11			0.49	0.06	0.06	0.39		0.05	0.31	
Control Delay	33.2	14.2			40.5	14.1	4.0	4.4		4.1	4.0	
Queue Delay	0.0	0.0			0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	33.2	14.2			40.5	14.1	4.0	4.4		4.1	4.0	
LOS	C	B			D	B	A	A		A	A	
Approach Delay		25.0			37.0			4.4			4.0	
Approach LOS		C			D			A			A	

Intersection Summary

Area Type: Other
 Cycle Length: 112
 Actuated Cycle Length: 86.3
 Natural Cycle: 45
 Control Type: Semi Act-Uncoord

Lanes, Volumes, Timings
10: Sycamore Plaza 1 & Kenwood Rd

Timing Plan: MID
February 2013

Maximum v/c Ratio: 0.49

Intersection Signal Delay: 6.7

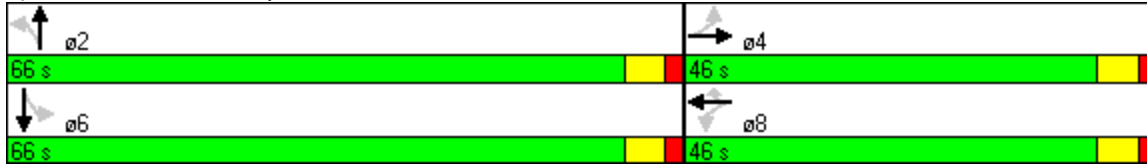
Intersection LOS: A

Intersection Capacity Utilization 46.6%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 10: Sycamore Plaza 1 & Kenwood Rd



Lanes, Volumes, Timings
10: Sycamore Plaza 1 & Kenwood Rd

Timing Plan: PM
February 2013



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗			↖	↗	↖	↕		↖	↕	
Volume (vph)	3	0	2	12	1	45	0	838	21	36	1033	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	110		0	105		0
Storage Lanes	1		0	0		1	1		0	1		0
Taper Length (ft)	25		25	25		25	25		25	25		25
Satd. Flow (prot)	1770	1583	0	0	1781	1583	1863	3525	0	1770	3539	0
Flt Permitted	0.748				0.740					0.301		
Satd. Flow (perm)	1393	1583	0	0	1378	1583	1863	3525	0	561	3539	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		73				49		4				
Link Speed (mph)		30			30			35				35
Link Distance (ft)		372			194			209				530
Travel Time (s)		8.5			4.4			4.1				10.3
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Shared Lane Traffic (%)												
Lane Group Flow (vph)	3	2	0	0	14	49	0	934	0	39	1123	0
Turn Type	Perm			Perm		Perm	Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2			6		
Detector Phase	4	4		8	8	8	2	2		6	6	
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Minimum Split (s)	22.0	22.0		22.0	22.0	22.0	22.0	22.0		22.0	22.0	
Total Split (s)	46.0	46.0	0.0	46.0	46.0	46.0	66.0	66.0	0.0	66.0	66.0	0.0
Total Split (%)	41.1%	41.1%	0.0%	41.1%	41.1%	41.1%	58.9%	58.9%	0.0%	58.9%	58.9%	0.0%
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0	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	0.0	-2.0	-2.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	None	None		None	None	None	Max	Max		Max	Max	
Act Effect Green (s)	8.4	8.4			8.5	8.5		75.5		75.5	75.5	
Actuated g/C Ratio	0.10	0.10			0.10	0.10		0.88		0.88	0.88	
v/c Ratio	0.02	0.01			0.10	0.24		0.30		0.08	0.36	
Control Delay	34.3	0.0			36.6	13.9		1.9		2.1	2.1	
Queue Delay	0.0	0.0			0.0	0.0		0.0		0.0	0.2	
Total Delay	34.3	0.0			36.6	13.9		1.9		2.1	2.3	
LOS	C	A			D	B		A		A	A	
Approach Delay		20.6			18.9			1.9			2.3	
Approach LOS		C			B			A			A	

Intersection Summary

Area Type: Other
 Cycle Length: 112
 Actuated Cycle Length: 85.4
 Natural Cycle: 45
 Control Type: Semi Act-Uncoord

Lanes, Volumes, Timings
10: Sycamore Plaza 1 & Kenwood Rd

Timing Plan: PM
February 2013

Maximum v/c Ratio: 0.36

Intersection Signal Delay: 2.6

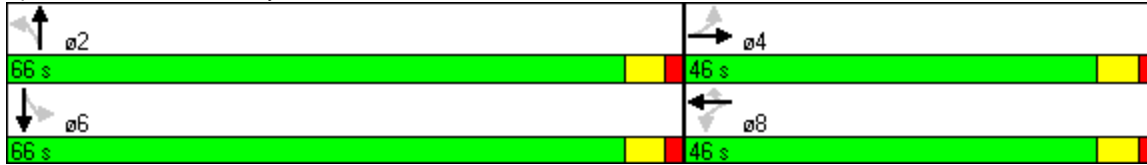
Intersection LOS: A

Intersection Capacity Utilization 44.0%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 10: Sycamore Plaza 1 & Kenwood Rd



Lanes, Volumes, Timings
10: Sycamore Plaza 1 & Kenwood Rd

Timing Plan: MID
November 2013



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	51	9	22	110	7	74	18	730	116	144	684	38
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	110		0	105		0
Storage Lanes	1		0	0		1	1		0	1		0
Taper Length (ft)	25		25	25		25	25		25	25		25
Satd. Flow (prot)	1770	1665	0	0	1779	1583	1770	3465	0	1770	3511	0
Flt Permitted	0.649				0.715		0.355			0.234		
Satd. Flow (perm)	1209	1665	0	0	1332	1583	661	3465	0	436	3511	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		24				80		23			8	
Link Speed (mph)		30			30			35			35	
Link Distance (ft)		372			207			209			530	
Travel Time (s)		8.5			4.7			4.1			10.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Shared Lane Traffic (%)												
Lane Group Flow (vph)	55	34	0	0	128	80	20	919	0	157	784	0
Turn Type	Perm			Perm		Perm	pm+pt			pm+pt		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8		8	2			6		
Detector Phase	4	4		8	8	8	5	2		1	6	
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Minimum Split (s)	22.0	22.0		22.0	22.0	22.0	8.0	22.0		8.0	22.0	
Total Split (s)	36.0	36.0	0.0	36.0	36.0	36.0	10.0	38.0	0.0	16.0	44.0	0.0
Total Split (%)	40.0%	40.0%	0.0%	40.0%	40.0%	40.0%	11.1%	42.2%	0.0%	17.8%	48.9%	0.0%
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	3.5	4.0		3.5	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	0.5	2.0		0.5	2.0	
Lost Time Adjust (s)	-2.0	-2.0	0.0	-2.0	-2.0	-2.0	-2.0	-2.0	0.0	-2.0	-2.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	2.0	4.0	4.0	2.0	4.0	4.0
Lead/Lag							Lead	Lag		Lead	Lag	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Recall Mode	None	None		None	None	None	None	Max		None	Max	
Act Effect Green (s)	14.0	14.0			14.0	14.0	46.2	36.5		50.1	46.3	
Actuated g/C Ratio	0.20	0.20			0.20	0.20	0.66	0.52		0.71	0.66	
v/c Ratio	0.23	0.10			0.48	0.21	0.04	0.51		0.32	0.34	
Control Delay	25.2	12.7			30.8	7.6	4.1	12.8		5.5	6.9	
Queue Delay	0.0	0.0			0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	25.2	12.7			30.8	7.6	4.1	12.8		5.5	6.9	
LOS	C	B			C	A	A	B		A	A	
Approach Delay		20.5			21.9			12.6			6.6	
Approach LOS		C			C			B			A	

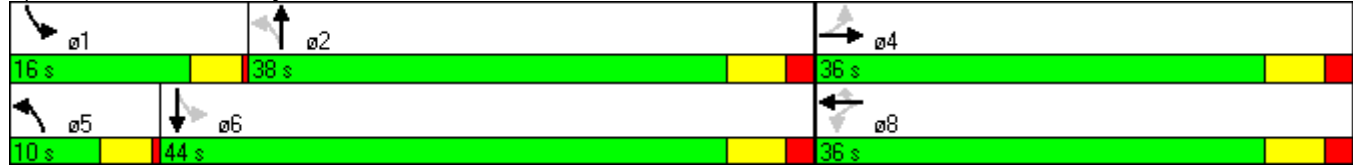
Intersection Summary
 Area Type: Other
 Cycle Length: 90
 Actuated Cycle Length: 70.1
 Natural Cycle: 55
 Control Type: Semi Act-Uncoord

Lanes, Volumes, Timings
 10: Sycamore Plaza 1 & Kenwood Rd

Timing Plan: MID
 November 2013

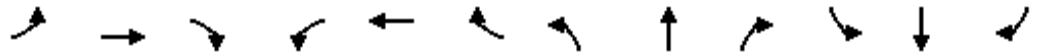
Maximum v/c Ratio: 0.51	Intersection LOS: B
Intersection Signal Delay: 11.2	ICU Level of Service A
Intersection Capacity Utilization 55.0%	
Analysis Period (min) 15	

Splits and Phases: 10: Sycamore Plaza 1 & Kenwood Rd



Lanes, Volumes, Timings
10: Sycamore Plaza 1 & Kenwood Rd

Timing Plan: PM
November 2013



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	60	5	67	126	7	28	27	780	101	69	963	45
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	110		0	105		0
Storage Lanes	1		0	0		1	1		0	1		0
Taper Length (ft)	25		25	25		25	25		25	25		25
Satd. Flow (prot)	1770	1602	0	0	1779	1583	1770	3479	0	1770	3514	0
Flt Permitted	0.616				0.682		0.216			0.224		
Satd. Flow (perm)	1147	1602	0	0	1270	1583	402	3479	0	417	3514	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		73				30		18			6	
Link Speed (mph)		30			30			35			35	
Link Distance (ft)		372			207			209			530	
Travel Time (s)		8.5			4.7			4.1			10.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Shared Lane Traffic (%)												
Lane Group Flow (vph)	65	78	0	0	145	30	29	958	0	75	1096	0
Turn Type	Perm			Perm		Perm	pm+pt			pm+pt		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8		8	2			6		
Detector Phase	4	4		8	8	8	5	2		1	6	
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Minimum Split (s)	22.0	22.0		22.0	22.0	22.0	8.0	22.0		8.0	22.0	
Total Split (s)	36.0	36.0	0.0	36.0	36.0	36.0	12.0	38.0	0.0	16.0	42.0	0.0
Total Split (%)	40.0%	40.0%	0.0%	40.0%	40.0%	40.0%	13.3%	42.2%	0.0%	17.8%	46.7%	0.0%
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	3.5	4.0		3.5	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	0.5	2.0		0.5	2.0	
Lost Time Adjust (s)	-2.0	-2.0	0.0	-2.0	-2.0	-2.0	-2.0	-2.0	0.0	-2.0	-2.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	2.0	4.0	4.0	2.0	4.0	4.0
Lead/Lag							Lead	Lag		Lead	Lag	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Recall Mode	None	None		None	None	None	None	Max		None	Max	
Act Effect Green (s)	15.2	15.2			15.2	15.2	47.6	39.1		49.4	43.8	
Actuated g/C Ratio	0.21	0.21			0.21	0.21	0.67	0.55		0.70	0.62	
v/c Ratio	0.26	0.20			0.53	0.08	0.07	0.50		0.17	0.50	
Control Delay	25.4	8.0			31.9	9.0	4.7	12.4		5.1	10.5	
Queue Delay	0.0	0.0			0.0	0.0	0.0	0.0		0.0	0.1	
Total Delay	25.4	8.0			31.9	9.0	4.7	12.4		5.1	10.6	
LOS	C	A			C	A	A	B		A	B	
Approach Delay		15.9			28.0			12.1			10.2	
Approach LOS		B			C			B			B	

Intersection Summary

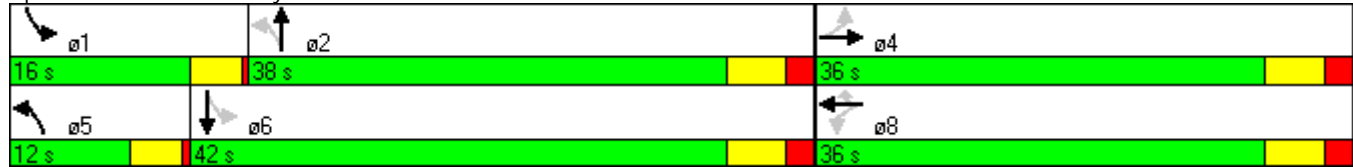
Area Type: Other
 Cycle Length: 90
 Actuated Cycle Length: 71
 Natural Cycle: 55
 Control Type: Semi Act-Uncoord

Lanes, Volumes, Timings
 10: Sycamore Plaza 1 & Kenwood Rd

Timing Plan: PM
 November 2013

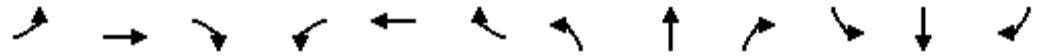
Maximum v/c Ratio: 0.53	
Intersection Signal Delay: 12.6	Intersection LOS: B
Intersection Capacity Utilization 55.4%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 10: Sycamore Plaza 1 & Kenwood Rd



Lanes, Volumes, Timings
10: Sycamore Plaza 1 & Kenwood Rd

Timing Plan: PM
Holiday 2013



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↗	↘			↖	↗	↖	↕		↖	↗	
Volume (vph)	47	49	57	124	45	51	27	783	107	96	869	38
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	110		0	105		0
Storage Lanes	1		0	0		1	1		0	1		0
Taper Length (ft)	25		25	25		25	25		25	25		25
Satd. Flow (prot)	1770	1712	0	0	1798	1583	1770	3476	0	1770	3518	0
Flt Permitted	0.553				0.711		0.250			0.209		
Satd. Flow (perm)	1030	1712	0	0	1324	1583	466	3476	0	389	3518	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		62				55		18			6	
Link Speed (mph)		30			30			35			35	
Link Distance (ft)		372			207			209			530	
Travel Time (s)		8.5			4.7			4.1			10.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Shared Lane Traffic (%)												
Lane Group Flow (vph)	51	115	0	0	184	55	29	967	0	104	986	0
Turn Type	Perm			Perm		Perm	pm+pt			pm+pt		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8		8	2			6		
Detector Phase	4	4		8	8	8	5	2		1	6	
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Minimum Split (s)	22.0	22.0		22.0	22.0	22.0	8.0	22.0		8.0	22.0	
Total Split (s)	38.0	38.0	0.0	38.0	38.0	38.0	12.0	36.0	0.0	16.0	40.0	0.0
Total Split (%)	42.2%	42.2%	0.0%	42.2%	42.2%	42.2%	13.3%	40.0%	0.0%	17.8%	44.4%	0.0%
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	3.5	4.0		3.5	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	0.5	2.0		0.5	2.0	
Lost Time Adjust (s)	-2.0	-2.0	0.0	-2.0	-2.0	-2.0	-2.0	-2.0	0.0	-2.0	-2.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	2.0	4.0	4.0	2.0	4.0	4.0
Lead/Lag							Lead	Lag		Lead	Lag	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Recall Mode	None	None		None	None	None	None	Max		None	Max	
Act Effect Green (s)	16.7	16.7		16.7	16.7	44.3	35.9			46.8	41.1	
Actuated g/C Ratio	0.24	0.24		0.24	0.24	0.64	0.52			0.67	0.59	
v/c Ratio	0.21	0.25		0.58	0.13	0.06	0.54			0.24	0.48	
Control Delay	23.0	12.5		31.0	7.1	5.4	14.3			6.3	11.2	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0			0.0	0.0	
Total Delay	23.0	12.5		31.0	7.1	5.4	14.3			6.3	11.2	
LOS	C	B		C	A	A	B			A	B	
Approach Delay		15.7		25.5			14.1				10.7	
Approach LOS		B		C			B				B	




Intersection Summary	
Area Type:	Other
Cycle Length:	90
Actuated Cycle Length:	69.7
Natural Cycle:	55
Control Type:	Semi Act-Uncoord

Lanes, Volumes, Timings
 10: Sycamore Plaza 1 & Kenwood Rd

Timing Plan: PM
 Holiday 2013

Maximum v/c Ratio: 0.58	
Intersection Signal Delay: 13.8	Intersection LOS: B
Intersection Capacity Utilization 56.3%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 10: Sycamore Plaza 1 & Kenwood Rd

 ø1	 ø2	 ø4
16 s	36 s	38 s
 ø5	 ø6	 ø8
12 s	40 s	38 s

Lanes, Volumes, Timings
10: Sycamore Plaza 1 & Kenwood Rd

Timing Plan: Weekend
Holiday 2013



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	43	5	22	178	2	62	23	956	168	153	695	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	110		0	105		0
Storage Lanes	1		0	0		1	1		0	1		0
Taper Length (ft)	25		25	25		25	25		25	25		25
Satd. Flow (prot)	1770	1632	0	0	1775	1583	1770	3461	0	1770	3539	0
Flt Permitted	0.518				0.707		0.365			0.125		
Satd. Flow (perm)	965	1632	0	0	1317	1583	680	3461	0	233	3539	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		24				67		28				
Link Speed (mph)		30			30			35				35
Link Distance (ft)		372			207			209				530
Travel Time (s)		8.5			4.7			4.1				10.3
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Shared Lane Traffic (%)												
Lane Group Flow (vph)	47	29	0	0	195	67	25	1222	0	166	756	0
Turn Type	Perm			Perm		Perm	pm+pt			pm+pt		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8		8	2			6		
Detector Phase	4	4		8	8	8	5	2		1	6	
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Minimum Split (s)	22.0	22.0		22.0	22.0	22.0	8.0	22.0		8.0	22.0	
Total Split (s)	34.0	34.0	0.0	34.0	34.0	34.0	12.0	42.0	0.0	14.0	44.0	0.0
Total Split (%)	37.8%	37.8%	0.0%	37.8%	37.8%	37.8%	13.3%	46.7%	0.0%	15.6%	48.9%	0.0%
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	3.5	4.0		3.5	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	0.5	2.0		0.5	2.0	
Lost Time Adjust (s)	-2.0	-2.0	0.0	-2.0	-2.0	-2.0	-2.0	-2.0	0.0	-2.0	-2.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	2.0	4.0	4.0	2.0	4.0	4.0
Lead/Lag							Lead	Lag		Lead	Lag	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Recall Mode	None	None		None	None	None	None	Max		None	Max	
Act Effect Green (s)	18.5	18.5		18.5	18.5	18.5	48.3	38.3		52.5	46.7	
Actuated g/C Ratio	0.24	0.24		0.24	0.24	0.63	0.50			0.68	0.61	
v/c Ratio	0.20	0.07		0.62	0.16	0.05	0.71			0.46	0.35	
Control Delay	25.2	11.0		35.0	7.0	5.7	18.8			10.9	10.2	
Queue Delay	0.0	0.0		0.5	0.0	0.0	0.0			0.0	0.0	
Total Delay	25.2	11.0		35.5	7.0	5.7	18.8			10.9	10.2	
LOS	C	B		D	A	A	B			B	B	
Approach Delay		19.8		28.2			18.5				10.3	
Approach LOS		B		C			B				B	

Intersection Summary

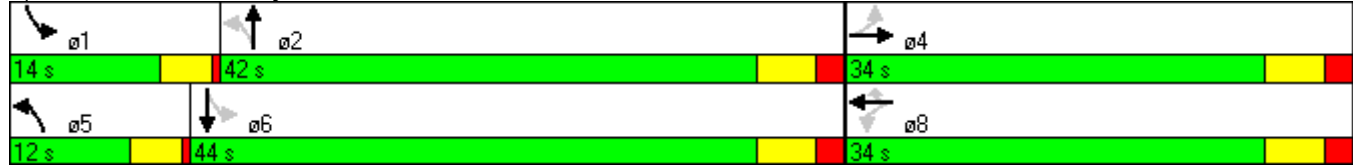
Area Type: Other
 Cycle Length: 90
 Actuated Cycle Length: 77.1
 Natural Cycle: 60
 Control Type: Semi Act-Uncoord

Lanes, Volumes, Timings
 10: Sycamore Plaza 1 & Kenwood Rd

Timing Plan: Weekend
 Holiday 2013

Maximum v/c Ratio: 0.71	
Intersection Signal Delay: 16.5	Intersection LOS: B
Intersection Capacity Utilization 66.9%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 10: Sycamore Plaza 1 & Kenwood Rd



Appendix C: Sidra Output

INTERSECTION SUMMARY

Site: Prop Roundabout Nov MID
Peak

Prop Roundabout
Roundabout

Intersection Performance - Hourly Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	716 veh/h	860 pers/h
Percent Heavy Vehicles	2.0 %	
Degree of Saturation	0.369	
Practical Spare Capacity	130.4 %	
Effective Intersection Capacity	1942 veh/h	
Control Delay (Total)	1.15 veh-h/h	1.38 pers-h/h
Control Delay (Average)	5.8 sec	5.8 sec
Control Delay (Worst Lane)	6.4 sec	
Control Delay (Worst Movement)	8.6 sec	8.6 sec
Level of Service (Aver. Int. Delay)	LOS A	
Level of Service (Worst Movement)	LOS A	
Level of Service (Worst Lane)	LOS A	
95% Back of Queue - Vehicles (Worst Lane)	2.7 veh	
95% Back of Queue - Distance (Worst Lane)	69.5 ft	
Total Effective Stops	388 veh/h	466 pers/h
Effective Stop Rate	0.54 per veh	0.54 per pers
Proportion Queued	0.33	0.33
Performance Index	14.6	14.6
Travel Distance (Total)	244.7 veh-mi/h	293.6 pers-mi/h
Travel Distance (Average)	1804 ft	1804 ft
Travel Time (Total)	11.0 veh-h/h	13.2 pers-h/h
Travel Time (Average)	55.5 sec	55.5 sec
Travel Speed	22.2 mph	22.2 mph
Cost (Total)	152.79 \$/h	152.79 \$/h
Fuel Consumption (Total)	10.3 gal/h	
Carbon Dioxide (Total)	97.5 kg/h	
Hydrocarbons (Total)	0.157 kg/h	
Carbon Monoxide (Total)	5.79 kg/h	
NOx (Total)	0.172 kg/h	

LOS (Aver. Int. Delay) for Vehicles is based on average delay for all vehicle movements. LOS Method: Delay (HCM).

LOS Method for individual vehicle movements and lanes: Delay (HCM).

Roundabout LOS Method: Same as Signalised Intersections.

Roundabout Capacity Model: SIDRA Standard.

Intersection Performance - Annual Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	343,826 veh/y	412,591 pers/y
Delay	551 veh-h/y	661 pers-h/y
Effective Stops	186,260 veh/y	223,512 pers/y
Travel Distance	117,453 veh-mi/y	140,944 pers-mi/y
Travel Time	5,297 veh-h/y	6,356 pers-h/y
Cost	73,338 \$/y	73,338 \$/y
Fuel Consumption	4,942 gal/y	
Carbon Dioxide	46,806 kg/y	
Hydrocarbons	75 kg/y	
Carbon Monoxide	2,778 kg/y	
NOx	83 kg/y	

INTERSECTION SUMMARY

Site: Prop Roundabout Nov PM
Peak

Prop Roundabout
Roundabout

Intersection Performance - Hourly Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	527 veh/h	633 pers/h
Percent Heavy Vehicles	2.0 %	
Degree of Saturation	0.214	
Practical Spare Capacity	298.1 %	
Effective Intersection Capacity	2469 veh/h	
Control Delay (Total)	0.75 veh-h/h	0.90 pers-h/h
Control Delay (Average)	5.1 sec	5.1 sec
Control Delay (Worst Lane)	6.0 sec	
Control Delay (Worst Movement)	7.6 sec	7.6 sec
Level of Service (Aver. Int. Delay)	LOS A	
Level of Service (Worst Movement)	LOS A	
Level of Service (Worst Lane)	LOS A	
95% Back of Queue - Vehicles (Worst Lane)	1.3 veh	
95% Back of Queue - Distance (Worst Lane)	33.5 ft	
Total Effective Stops	264 veh/h	317 pers/h
Effective Stop Rate	0.50 per veh	0.50 per pers
Proportion Queued	0.27	0.27
Performance Index	10.4	10.4
Travel Distance (Total)	179.3 veh-mi/h	215.2 pers-mi/h
Travel Distance (Average)	1796 ft	1796 ft
Travel Time (Total)	8.0 veh-h/h	9.6 pers-h/h
Travel Time (Average)	54.6 sec	54.6 sec
Travel Speed	22.4 mph	22.4 mph
Cost (Total)	110.61 \$/h	110.61 \$/h
Fuel Consumption (Total)	7.5 gal/h	
Carbon Dioxide (Total)	70.6 kg/h	
Hydrocarbons (Total)	0.113 kg/h	
Carbon Monoxide (Total)	4.13 kg/h	
NOx (Total)	0.123 kg/h	

LOS (Aver. Int. Delay) for Vehicles is based on average delay for all vehicle movements. LOS Method: Delay (HCM).

LOS Method for individual vehicle movements and lanes: Delay (HCM).

Roundabout LOS Method: Same as Signalised Intersections.

Roundabout Capacity Model: SIDRA Standard.

Intersection Performance - Annual Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	253,044 veh/y	303,652 pers/y
Delay	358 veh-h/y	430 pers-h/y
Effective Stops	126,623 veh/y	151,948 pers/y
Travel Distance	86,061 veh-mi/y	103,273 pers-mi/y
Travel Time	3,835 veh-h/y	4,602 pers-h/y
Cost	53,091 \$/y	53,091 \$/y
Fuel Consumption	3,576 gal/y	
Carbon Dioxide	33,870 kg/y	
Hydrocarbons	54 kg/y	
Carbon Monoxide	1,982 kg/y	
NOx	59 kg/y	

INTERSECTION SUMMARY

Site: Prop Roundabout Hol PM
Peak

Prop Roundabout
Roundabout

Intersection Performance - Hourly Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	739 veh/h	887 pers/h
Percent Heavy Vehicles	2.0 %	
Degree of Saturation	0.308	
Practical Spare Capacity	176.1 %	
Effective Intersection Capacity	2400 veh/h	
Control Delay (Total)	1.11 veh-h/h	1.33 pers-h/h
Control Delay (Average)	5.4 sec	5.4 sec
Control Delay (Worst Lane)	6.2 sec	
Control Delay (Worst Movement)	8.1 sec	8.1 sec
Level of Service (Aver. Int. Delay)	LOS A	
Level of Service (Worst Movement)	LOS A	
Level of Service (Worst Lane)	LOS A	
95% Back of Queue - Vehicles (Worst Lane)	2.1 veh	
95% Back of Queue - Distance (Worst Lane)	53.6 ft	
Total Effective Stops	392 veh/h	471 pers/h
Effective Stop Rate	0.53 per veh	0.53 per pers
Proportion Queued	0.35	0.35
Performance Index	14.9	14.9
Travel Distance (Total)	251.3 veh-mi/h	301.5 pers-mi/h
Travel Distance (Average)	1795 ft	1795 ft
Travel Time (Total)	11.3 veh-h/h	13.5 pers-h/h
Travel Time (Average)	54.9 sec	54.9 sec
Travel Speed	22.3 mph	22.3 mph
Cost (Total)	156.07 \$/h	156.07 \$/h
Fuel Consumption (Total)	10.5 gal/h	
Carbon Dioxide (Total)	99.7 kg/h	
Hydrocarbons (Total)	0.160 kg/h	
Carbon Monoxide (Total)	5.89 kg/h	
NOx (Total)	0.175 kg/h	

LOS (Aver. Int. Delay) for Vehicles is based on average delay for all vehicle movements. LOS Method: Delay (HCM).

LOS Method for individual vehicle movements and lanes: Delay (HCM).

Roundabout LOS Method: Same as Signalised Intersections.

Roundabout Capacity Model: SIDRA Standard.

Intersection Performance - Annual Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	354,783 veh/y	425,739 pers/y
Delay	533 veh-h/y	639 pers-h/y
Effective Stops	188,357 veh/y	226,029 pers/y
Travel Distance	120,607 veh-mi/y	144,729 pers-mi/y
Travel Time	5,408 veh-h/y	6,490 pers-h/y
Cost	74,915 \$/y	74,915 \$/y
Fuel Consumption	5,052 gal/y	
Carbon Dioxide	47,849 kg/y	
Hydrocarbons	77 kg/y	
Carbon Monoxide	2,829 kg/y	
NOx	84 kg/y	

INTERSECTION SUMMARY

Site: Prop Roundabout Hol WE
Peak

Prop Roundabout
Roundabout

Intersection Performance - Hourly Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	875 veh/h	1050 pers/h
Percent Heavy Vehicles	2.0 %	
Degree of Saturation	0.394	
Practical Spare Capacity	115.9 %	
Effective Intersection Capacity	2222 veh/h	
Control Delay (Total)	1.38 veh-h/h	1.65 pers-h/h
Control Delay (Average)	5.7 sec	5.7 sec
Control Delay (Worst Lane)	6.3 sec	
Control Delay (Worst Movement)	8.5 sec	8.5 sec
Level of Service (Aver. Int. Delay)	LOS A	
Level of Service (Worst Movement)	LOS A	
Level of Service (Worst Lane)	LOS A	
95% Back of Queue - Vehicles (Worst Lane)	3.0 veh	
95% Back of Queue - Distance (Worst Lane)	75.4 ft	
Total Effective Stops	484 veh/h	581 pers/h
Effective Stop Rate	0.55 per veh	0.55 per pers
Proportion Queued	0.40	0.40
Performance Index	18.0	18.0
Travel Distance (Total)	297.5 veh-mi/h	357.0 pers-mi/h
Travel Distance (Average)	1795 ft	1795 ft
Travel Time (Total)	13.4 veh-h/h	16.1 pers-h/h
Travel Time (Average)	55.2 sec	55.2 sec
Travel Speed	22.2 mph	22.2 mph
Cost (Total)	185.76 \$/h	185.76 \$/h
Fuel Consumption (Total)	12.5 gal/h	
Carbon Dioxide (Total)	118.7 kg/h	
Hydrocarbons (Total)	0.191 kg/h	
Carbon Monoxide (Total)	7.07 kg/h	
NOx (Total)	0.210 kg/h	

LOS (Aver. Int. Delay) for Vehicles is based on average delay for all vehicle movements. LOS Method: Delay (HCM).

LOS Method for individual vehicle movements and lanes: Delay (HCM).

Roundabout LOS Method: Same as Signalised Intersections.

Roundabout Capacity Model: SIDRA Standard.

Intersection Performance - Annual Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	420,000 veh/y	504,000 pers/y
Delay	660 veh-h/y	792 pers-h/y
Effective Stops	232,380 veh/y	278,856 pers/y
Travel Distance	142,804 veh-mi/y	171,365 pers-mi/y
Travel Time	6,434 veh-h/y	7,721 pers-h/y
Cost	89,164 \$/y	89,164 \$/y
Fuel Consumption	6,017 gal/y	
Carbon Dioxide	56,986 kg/y	
Hydrocarbons	92 kg/y	
Carbon Monoxide	3,392 kg/y	
NOx	101 kg/y	

Appendix D: Queue and Blocking Report

Intersection: 10: Sycamore Plaza 1 & Kenwood Rd

Movement	EB	EB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	TR	LT	R	L	T	TR	L	T	TR
Maximum Queue (ft)	114	73	160	54	53	179	162	93	406	460
Average Queue (ft)	36	50	94	23	15	119	132	42	120	228
95th Queue (ft)	78	77	147	49	43	192	188	80	283	424
Link Distance (ft)	315	315	144	144		142	142		450	450
Upstream Blk Time (%)			2			4	11			3
Queuing Penalty (veh)			2			21	51			15
Storage Bay Dist (ft)					110			105		
Storage Blk Time (%)						9		0	3	
Queuing Penalty (veh)						2		0	3	

Intersection: 10: Sycamore Plaza 1 & Kenwood Rd

Movement	EB	EB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	TR	LT	R	L	T	TR	L	T	TR
Maximum Queue (ft)	94	52	154	73	49	159	163	129	190	323
Average Queue (ft)	35	18	95	29	16	112	127	62	53	139
95th Queue (ft)	77	48	143	61	42	172	177	111	127	248
Link Distance (ft)	315	315	141	141		142	142		450	450
Upstream Blk Time (%)			1			4	8			
Queuing Penalty (veh)			2			17	36			
Storage Bay Dist (ft)					110			105		
Storage Blk Time (%)						6		1	1	
Queuing Penalty (veh)						1		4	2	