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Memorandum

To	Roderick Weersing Georgetown Township	Page	1
CC			
Subject	**Baldwin Street/Cottonwood Drive Intersection** **Traffic Analysis Memo**		
From	Dan Robyns, PE PTOE Nick LaCroix, PE PTOE Sean Kelsch, PE		
Date	January 10, 2017		

INTRODUCTION

Georgetown Township has contracted AECOM to analyze roadway improvements proposed by the Ottawa County Road Commission (OCRC) for the Baldwin Street/Cottonwood Drive intersection. The Baldwin Street/Cottonwood Drive intersection services a large volume of commuter traffic between suburban Ottawa County and the Grand Rapids metropolitan area to the east. As a result, the intersection experiences heavy congestion, with lengthy delays and queues, during the weekday morning and afternoon peak periods.

Due to the traffic congestion, the OCRC has proposed roadway improvements along the Baldwin Street corridor, including laneage additions along the approaches to the Baldwin Street/Cottonwood Drive intersection.

This memo summarizes an existing conditions analysis of the Baldwin Street/Cottonwood Drive intersection, as well as an analysis of the intersection with proposed roadway improvements. Also included are analyses of alternate laneage and/or phasing at the intersection.

EXISTING CONDITIONS

Roadway Geometry

Baldwin Street at Cottonwood Drive is a four-leg intersection, with the north leg skewed approximately 45 degrees to the west creating a southeast-bound approach for southbound Cottonwood Drive traffic. The current approach laneage is as follows:

- Eastbound – one left-turn lane, one thru lane, and one shared thru/right-turn lane
- Westbound – one left-turn lane, two thru lanes, and one right-turn lane
- Northbound – one left-turn lane, one thru lane, and one shared thru/right-turn lane
- Southbound – one left-turn lane and one shared thru/right-turn lane

The posted speed limit along Baldwin Street is 35 mph. The posted speed limit on Cottonwood Drive is 35 mph south of the intersection, and 45 mph north of the intersection. There is no on-street parking on any of the intersection approaches.

Signal Timing

The Baldwin Street/Cottonwood Drive intersection is controlled by a four-phase traffic signal. The signal currently operates with a 100-second cycle length during with weekday morning and afternoon peak periods, and an 80-second cycle length during non-peak periods. The current signal phase sequencing is as follows:

- East/west protected left-turns
- East/west thrus and right-turns
- North/south protected left-turns (with concurrent westbound right-turn green arrow)
- North/south thrus and right-turns (with north/south left-turns permitted)

East/west left-turn movements operate as protected-only, and are not permitted during the east/west thru and right-turn phases. North/south left-turns are allowed to proceed permissively after yielding to north/south thru and right-turn vehicles. The permissive north/south left-turn operation is beneficial to southbound left-turns during the morning peak-hour, when there is little opposing northbound thru and right-turn traffic.

All four left-turn phases are actuated, and these phases can be shortened or skipped if no left-turn traffic is present – which rarely occurs during peak periods. There are pedestrian crossings of all four approaches, with countdown pedestrian signal heads controlling the four crossings.

Data Collection

AECOM collected traffic counts at the Baldwin Street/Cottonwood Drive intersection on Tuesday, December 6, 2016. Vehicle and pedestrian counts were collected during the weekday morning (7-9AM) and afternoon (4-6PM) peak periods of traffic. The field data determined that the weekday morning peak-hour occurred from 7:15-8:15AM, and the weekday afternoon peak-hour occurred from 5-6PM. The weekday peak-hour traffic counts are shown in **Table 1** on the next page.

As shown in Table 1, there is a large traffic flow along eastbound Baldwin Street and southbound Cottonwood Drive during the morning peak-hour. Conversely, there is a large traffic flow along westbound Baldwin Street and northbound Cottonwood Drive during the afternoon peak-hour. Also, there is very limited pedestrian activity at this intersection during the peak-hours.

A turning movement count summary is included in **Appendix A**.

Table 1. Existing (2016) Peak-Hour Traffic Counts

Intersection Approach	Turning Movement	AM Peak-Hour Volume	PM Peak-Hour Volume
Eastbound Baldwin	Left	23	129
	Thru	**1357**	859
	Right	37	138
	Pedestrians	0	1
Westbound Baldwin	Left	45	78
	Thru	354	**1032**
	Right	241	**639**
	Pedestrians	0	0
Northbound Cottonwood	Left	70	230
	Thru	179	**539**
	Right	73	64
	Pedestrians	0	0
Southbound Cottonwood	Left	**434**	262
	Thru	335	367
	Right	17	36
	Pedestrians	0	1

Capacity Analysis

A capacity analysis of the Baldwin Street/Cottonwood Drive intersection was conducted using the Synchro 9.0 analysis software. Traffic models were created for the weekday morning and afternoon peak-hours of traffic, utilizing the existing roadway geometry, traffic volumes, and signal timings.

The Synchro software uses the methodology of the Highway Capacity Manual (HCM) to perform a capacity analysis at signalized intersections. Conventional analysis of signalized intersections involves the determination of a "Level-of-Service" (LOS). Levels-of-Service range from "A" to "F", similar to an alphabetic grading system, with each level describing a different set of operational characteristics. LOS "A" describes operational performance under light traffic volumes and minimal delay to motorists. LOS "F" describes a high density of traffic resulting in intersection failure with extensive delays and long vehicular queues. LOS "C" or "D" is considered acceptable for peak-hour traffic operations in urbanized areas.

The average delays (in seconds per vehicle) and LOS for the traffic movements at the existing Baldwin Street/Cottonwood Drive intersection are shown in **Table 2** on page 5.

As shown in Table 2, during the morning peak-hour, the eastbound movements and the southbound left-turn movement currently operate with significant delay. During the afternoon peak-hour, the southbound movements and all left-turn movements currently operate with significant delay. The overall intersection is currently operating at a LOS E during both peak-hours.

All delay and LOS results for this project are included in **Appendix B**.

PROPOSED CONDITIONS (OCRC)

Proposed Laneage

For the proposed conditions analysis, the laneage recommended by the OCRC was added to the traffic models.

The proposed OCRC layout would add a second left-turn lane to the northbound and southbound approaches. In addition, a second thru lane would be added to the southbound approach. On the eastbound approach, an exclusive right-turn bay would be added, separating right-turn traffic from the thru lanes. No changes were proposed to the westbound approach.

The proposed approach laneage would be as follows:

- Eastbound – one left-turn lane, two thru lanes, and one right-turn lane
- Westbound – one left-turn lane, two thru lanes, and one right-turn lane
- Northbound – two left-turn lanes, one thru lane, and one shared thru/right-turn lane
- Southbound – two left-turn lanes, one thru lane, and one shared thru/right-turn lane

The signal phasing under the proposed OCRC laneage would remain identical to the current signal phasing, with two exceptions:

- With the addition of a second left-turn lane on the northbound and southbound approaches, left-turns would no longer be allowed to turn permissively during the northbound/southbound thru and right-turn phases. For safety purposes, permissive left-turn movements are typically not allowed from approaches with dual left-turn lanes.
- With the addition of the eastbound right-turn bay, an eastbound right-turn green arrow would be added, to operate during the northbound left-turn phase. The existing westbound right-turn green arrow would be maintained.

A capacity analysis of the Baldwin Street/Cottonwood Drive intersection was conducted with the proposed laneage. The signal timing splits were adjusted to optimize the intersection under the new configuration and signal phasing. The average delays and LOS for the traffic movements at the proposed intersection are shown in Table 2 on the next page.

As shown in Table 2, during the morning peak-hour, the eastbound left-turn and thru movements continue to operate with significant delay, but with less delay than when compared to existing conditions. The southbound left-turn movement also continues to operate with significant delay. The overall intersection delay is reduced from existing conditions.

During the afternoon peak-hour, the eastbound and westbound left-turn movements continue to operate with significant delay, but with less delay when compared to existing conditions. These left-turn movements are lower volume movements where a LOS “E” could be considered acceptable during peak periods. The overall intersection delay has been lowered to an acceptable level under proposed conditions.

North/South Actuation

Under proposed conditions, the additional laneage on the north/south Cottonwood approaches allows for more flexibility in distributing signal phase time for all approaches. However, this timing flexibility is limited because the north/south phases must provide enough time to accommodate pedestrians crossing Baldwin Street. The intersection could operate more efficiently if the north/south phases could be shortened. This is particularly true for northbound Cottonwood Drive during the morning peak-hour, when traffic volumes are relatively low.

AECOM analyzed the addition of pedestrian push-buttons for the Baldwin Street crosswalks, which would allow the north/south thru phases to be shortened. The pedestrian volumes at this intersection are low (only one pedestrian during the afternoon peak-hour), and push-button activation would be rare. Along with pedestrian actuation, the north/south thru and right-turn phases could be actuated, allowing these phases to be shortened or skipped, adding more signal time to other phases.

A capacity analysis of the Baldwin Street/Cottonwood Drive intersection was conducted under the proposed OCRC laneage, with north/south vehicle and pedestrian actuation in place. The signal timing splits were adjusted to optimize the intersection under the new signal phasing. The average delays and LOS for the traffic movements at the proposed intersection (with north/south actuation) are shown in Table 2 below.

As shown in Table 2, the addition of north/south vehicle and pedestrian actuation significantly improves the operation of the intersection during the weekday morning peak-hour. This is due to the fact that less signal time is allotted for the northbound thru and right-turn phase, and more signal time is given to the southbound left-turn and eastbound thru phases. The overall intersection delay has been lowered to an acceptable level.

During the afternoon peak-hour, the operation of the intersection also slightly improves. The eastbound and westbound left-turn movements continue to operate with significant delay. However, these are lower volume movements, and providing these left-turn phases with more green time would reduce the overall operation of the intersection.

Table 2. Existing and Proposed Peak-Hour Delay and LOS

Intersection Approach	Turning Movement	Existing Conditions Delay / LOS		Proposed Conditions Delay / LOS		Proposed Conditions (with N/S actuation) Delay / LOS	
		AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Eastbound	Left	**62.7 / E**	**228.4 / F**	**62.7 / E**	**78.1 / E**	53.4 / D	**78.1 / E**
	Thru	**126.9 / F**	32.3 / C	**97.3 / F**	29.3 / C	37.0 / D	28.8 / C
	Right			16.9 / B	14.7 / B	13.1 / B	14.2 / B
Westbound	Left	50.0 / D	**74.2 / E**	**60.7 / E**	**57.0 / E**	52.1 / D	**57.0 / E**
	Thru	22.2 / C	33.0 / C	22.2 / C	38.6 / D	16.7 / B	37.6 / D
	Right	12.8 / B	29.5 / C	12.8 / B	33.8 / C	7.9 / A	32.8 / C
Northbound	Left	27.9 / C	**89.3 / F**	45.9 / D	49.4 / D	47.2 / D	46.9 / D
	Thru/Right	35.1 / D	48.9 / D	35.2 / D	53.9 / D	52.7 / D	54.0 / D
Southbound	Left	**76.9 / E**	**124.1 / F**	**82.7 / F**	53.3 / D	51.2 / D	53.3 / D
	Thru/Right	41.7 / D	**99.6 / F**	29.8 / C	38.8 / D	35.6 / D	37.7 / D
Overall Intersection		**77.1 / E**	**55.6 / E**	**63.7 / E**	40.4 / D	35.5 / D	39.7 / D

OTHER ALTERNATIVES

Additional laneage options that would expand the intersection beyond the OCRC proposal were considered for the Baldwin Street/Cottonwood Drive intersection. A summary of these options is as follows:

- Add a third thru lane along Baldwin: Three eastbound/westbound thru lanes would improve the operation of the intersection. However, this option would involve purchasing a large amount of property, and is not a practical alternative.

- Provide two westbound right-turn lanes: The westbound right-turn movement is currently operating at LOS C or better. While a second westbound right-turn lane would improve the operation of the right-turn movement, it is not a necessary improvement.

- Provide two eastbound/westbound left-turn lanes: The traffic volumes for the eastbound and westbound left-turn movements are not at levels where dual left-turn lanes are needed.

In addition, prohibiting eastbound/westbound left-turns was considered, as these are lower volume movements at the intersection. Eliminating these left-turns would improve the operation of the intersection by removing a signal phase. However, this turn prohibition would not be preferable, particularly for the eastbound left-turn movement which has a lack of alternate routes. Also, prohibiting these left-turn movements would encourage cut-thru traffic on local roads and business properties.

AECOM examined several other alternatives for the intersection based on comments provided by Georgetown Township. These alternatives included:

- Alternative A: Widening southbound Cottonwood Drive to include three approach lanes, as opposed to the four lanes proposed by the OCRC. This option would reduce the cost of intersection improvements. The southbound approach would include two left-turn lanes and one shared thru/right-turn lane.
- Alternative B: Widening southbound Cottonwood Drive to three lanes, and utilizing a split-phase operation for the northbound and southbound Cottonwood approaches. This option allows for more flexibility with proposed lane configurations along the northbound and southbound approaches, as left-turn lanes can be shared with thru lanes under a split-phase operation. The southbound approach would include one left-turn lane, one shared thru/left-turn lane, and one shared thru/right-turn lane.
- Alternative C: Replacing the intersection with a dual lane roundabout. The roundabout includes two entry and two exit lanes on each approach.

It should be noted that no significant improvement to the operation of the intersection could be achieved without widening the southbound Cottonwood Drive approach to at least three lanes.

A capacity analysis of the Baldwin Street/Cottonwood Drive intersection was conducted for the proposed alternatives. The signal timing splits were adjusted to optimize the intersection under the various configurations and signal phasing. The average delays and LOS for the traffic movements under the proposed alternatives are shown in **Table 3**.

As shown in Table 3, Alternative A allows the intersection to operate with an acceptable overall LOS during the morning and afternoon peak-hours. However, limiting the southbound approach to three lanes would result in greater delay and queuing along southbound Cottonwood Drive and eastbound Baldwin Street during the morning and afternoon peak-hours compared to the proposed OCRC laneage with north/south actuation and pedestrian push-buttons.

As shown in Table 3, split-phasing the north/south signal phases (Alternative B) would result in greater delay and queuing for both the eastbound Baldwin Street and both Cottonwood Drive approaches during the morning and afternoon peak-hours compared to the proposed OCRC laneage with north/south actuation and pedestrian push-buttons.

The dual lane roundabout option (Alternative C) failed from a capacity standpoint during both the morning and afternoon peak-hours, and should not be considered a viable solution.

Table 3. Other Proposed Alternatives Peak-Hour Delay and LOS

Intersection Approach	Turning Movement	Alternative A Delay / LOS		Alternative B Delay / LOS		Alternative C Delay / LOS	
		AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Eastbound	Left	53.4 / D	**78.1 / E**	53.4 / D	**78.1 / E**	**166.7 / F**	**46.2 / E**
	Thru	51.3 / D	34.1 / C	52.6 / D	33.6 / C		
	Right	14.8 / B	17.2 / B	12.7 / B	12.0 / B		
Westbound	Left	52.1 / D	**57.0 / E**	52.1 / D	**57.0 / E**	9.6 / A	**340.4 / F**
	Thru	18.7 / B	54.0 / D	18.8 / B	52.0 / D		
	Right	8.5 / A	36.2 / D	7.8 / A	29.5 / C		
Northbound	Left	47.2 / D	53.4 / D	44.6 / D	46.9 / D	**43.8 / E**	**96.1 / F**
	Thru/Right	46.4 / D	46.7 / D	**55.7 / E**	**71.3 / E**		
Southbound	Left	44.3 / D	43.2 / D	**59.1 / E**	**74.5 / E**	14.9 / B	**56.8 / F**
	Thru/Right	51.0 / D	**57.8 / E**	49.3 / D	**58.5 / E**		
Overall Intersection		41.9 / D	45.8 / D	44.4 / D	48.9 / D	**82.0 / F**	**174.7 / F**

FUTURE TRAFFIC GROWTH

AECOM examined two of the above alternatives based on an estimated percentage traffic growth at the intersection. For this analysis, it was assumed traffic would grow by 10%, equating to an approximate 0.5% annual growth rate for the next 20 years.

The proposed OCRC laneage with north/south actuation and pedestrian push-buttons alternative was compared to Alternative A as these two options provided the best overall LOS at the intersection under existing conditions.

As shown in **Table 4**, the proposed OCRC laneage with north/south actuation and pedestrian push-buttons alternative performs with less overall delay than Alternative A considering future growth at the intersection. The elimination of one southbound lane in Alternative A, as compared to the OCRC geometry, requires additional green time be allocated to the north/south movements at the intersection. While this improves the southbound left-turn movement, the high volume eastbound and westbound thru movements experience significantly more delay and queuing as a result.

The proposed OCRC laneage with north/south actuation and pedestrian push-buttons would be operating near capacity, with several movements operating at or over capacity under future conditions.

Table 4. Future Proposed Peak-Hour Delay and LOS

Intersection Approach	Turning Movement	Proposed ORRC Conditions (with N/S actuation) Delay / LOS		Alternative A Delay / LOS	
		AM Peak	PM Peak	AM Peak	PM Peak
Eastbound	Left	**69.3 / E**	**97.7 / F**	**56.3 / E**	**97.7 / F**
	Thru	47.5 / D	31.8 / C	**86.9 / F**	41.4 / D
	Right	12.5 / B	14.5 / B	14.9 / B	18.1 / B
Westbound	Left	**70.3 / E**	**63.4 / E**	55.4 / E	**63.4 / E**
	Thru	16.4 / B	49.7 / D	19.2 / B	**99.5 / F**
	Right	8.0 / A	47.4 / D	8.4 / A	54.0 / D
Northbound	Left	47.5 / D	48.7 / D	47.5 / D	**58.3 / E**
	Thru/Right	**59.9 / E**	**67.2 / E**	**53.4 / E**	**55.1 / E**
Southbound	Left	**69.1 / E**	**58.7 / E**	45.3 / D	42.5 / D
	Thru/Right	37.0 / D	38.6 / D	**63.9 / E**	**66.2 / E**
Overall Intersection		43.4 / D	48.3 / D	**58.9 / E**	**63.4 / E**

CONCLUSIONS AND RECOMMENDATIONS

Based on the analyses performed, the proposed OCRC laneage provides the most capacity and least delay of the alternatives examined for both existing and future conditions. The proposed dual left-turn lanes on the northbound and southbound approaches, as well as the second thru lane on the southbound approach, are appropriate and necessary to accommodate existing and future traffic volumes. Also, the proposed eastbound right-turn bay would separate right-turn traffic from the thru lanes, adding capacity for the eastbound thru movement.

If the proposed OCRC laneage were to be implemented at the intersection, AECOM recommends providing north/south vehicle actuation and pedestrian push-buttons to the signal operation. During the widening of the intersection, the traffic signal would likely be modernized, and the north/south vehicle actuation and pedestrian push-buttons could be added at that time. The proposed OCRC laneage with north/south actuation and pedestrian push-buttons is anticipated to operate at an overall acceptable LOS “D” under both existing and future conditions. However, several movements would be anticipated to operate near capacity under future conditions.

Additional laneage options that would expand the intersection beyond the OCRC proposal were considered, but not found to be practical or necessary. For example, providing three thru lanes along Baldwin Street would involve purchasing a large amount of property, and is not a feasible alternative.

Lower-cost alternatives could provide improved operations when compared to existing conditions. However, these alternatives would result in greater delays and queuing, especially along southbound Cottonwood Drive and eastbound Baldwin Street, when compared to the OCRC proposal. The proposed OCRC laneage provides greater capability to accommodate future traffic volume growth in this suburban area, when compared to the lower-cost alternatives.

AECOM

Appendix A

Turning Movement Count Data
(December 6, 2016)

URS Corp
3950 Sparks Drive SE

Grand Rapids, Michigan, United States 49546
(616) 574-8500

Count Name: Baldwin St @ Cottonwood Dr
Site Code:
Start Date: 12/06/2016

Turning Movement Data

Start Time	Baldwin Eastbound					Baldwin Westbound					Cottonwood Northbound					Cottonwood Southbound					
	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
7:00 AM	3	343	8	0	354	4	61	43	0	108	5	11	14	0	30	137	73	1	0	211	703
7:15 AM	8	352	4	0	364	10	79	53	0	142	13	42	22	0	77	116	91	4	0	211	794
7:30 AM	4	352	7	0	363	10	84	63	0	157	16	53	25	0	94	102	92	2	0	196	810
7:45 AM	7	324	10	0	341	16	116	58	0	190	23	45	16	0	84	108	93	2	0	203	818
Hourly Total	22	1371	29	0	1422	40	340	217	0	597	57	151	77	0	285	463	349	9	0	821	3125
8:00 AM	4	329	16	0	349	9	75	67	0	151	18	39	10	0	67	108	59	9	0	176	743
8:15 AM	0	260	21	0	281	13	107	53	0	173	23	34	14	0	71	112	54	7	0	173	698
8:30 AM	9	275	25	0	309	10	127	56	0	193	25	35	13	0	73	103	65	9	0	177	752
8:45 AM	7	297	31	0	335	6	80	56	0	142	21	34	8	0	63	112	68	10	0	190	730
Hourly Total	20	1161	93	0	1274	38	389	232	0	659	87	142	45	0	274	435	246	35	0	716	2923
9:00 AM	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hourly Total	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
4:00 PM	23	207	49	1	279	24	207	118	0	349	56	88	19	0	163	67	94	7	0	168	959
4:15 PM	26	199	33	0	258	28	237	127	0	392	68	97	17	0	182	81	77	8	0	166	998
4:30 PM	31	178	49	0	258	26	232	134	1	392	54	110	11	1	175	64	71	8	0	143	968
4:45 PM	28	185	48	0	261	26	236	146	0	408	57	152	15	0	224	59	88	10	0	157	1050
Hourly Total	108	769	179	1	1056	104	912	525	1	1541	235	447	62	1	744	271	330	33	0	634	3975
5:00 PM	34	207	29	0	270	14	254	162	0	430	60	142	13	0	215	65	87	8	0	160	1075
5:15 PM	30	204	39	1	273	18	258	175	0	451	56	150	18	0	224	64	95	8	1	167	1115
5:30 PM	27	234	31	0	292	22	255	165	0	442	55	124	18	0	197	66	93	8	0	167	1098
5:45 PM	38	214	39	0	291	24	265	137	0	426	59	123	15	0	197	67	92	12	0	171	1085
Hourly Total	129	859	138	1	1126	78	1032	639	0	1749	230	539	64	0	833	262	367	36	1	665	4373
Grand Total	280	4160	439	2	4879	260	2673	1613	1	4546	609	1279	248	1	2136	1431	1292	113	1	2836	14397
Approach %	5.7	85.3	9.0	-	-	5.7	58.8	35.5	-	-	28.5	59.9	11.6	-	-	50.5	45.6	4.0	-	-	-
Total %	1.9	28.9	3.0	-	33.9	1.8	18.6	11.2	-	31.6	4.2	8.9	1.7	-	14.8	9.9	9.0	0.8	-	19.7	-
Lights	274	4115	434	-	4823	255	2642	1579	-	4476	599	1263	244	-	2106	1408	1279	111	-	2798	14203
% Lights	97.9	98.9	98.9	-	98.9	98.1	98.8	97.9	-	98.5	98.4	98.7	98.4	-	98.6	98.4	99.0	98.2	-	98.7	98.7
Buses	4	10	3	-	17	1	7	8	-	16	5	10	0	-	15	6	5	1	-	12	60
% Buses	1.4	0.2	0.7	-	0.3	0.4	0.3	0.5	-	0.4	0.8	0.8	0.0	-	0.7	0.4	0.4	0.9	-	0.4	0.4
Trucks	2	35	2	-	39	4	24	26	-	54	5	6	4	-	15	17	8	1	-	26	134
% Trucks	0.7	0.8	0.5	-	0.8	1.5	0.9	1.6	-	1.2	0.8	0.5	1.6	-	0.7	1.2	0.6	0.9	-	0.9	0.9
Bicycles on Crosswalk	-	-	-	0	-	-	-	-	0	-	-	-	-	1	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	0.0	-	-	-	-	0.0	-	-	-	-	100.0	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	2	-	-	-	-	1	-	-	-	-	0	-	-	-	-	1	-	-
% Pedestrians	-	-	-	100.0	-	-	-	-	100.0	-	-	-	-	0.0	-	-	-	-	100.0	-	-

URS Corp
3950 Sparks Drive SE

Grand Rapids, Michigan, United States 49546
(616) 574-8500

Count Name: Baldwin St @ Cottonwood Dr
Site Code:
Start Date: 12/06/2016

Turning Movement Peak Hour Data (7:15 AM)

Start Time	Baldwin Eastbound					Baldwin Westbound					Cottonwood Northbound					Cottonwood Southbound					
	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
7:15 AM	8	352	4	0	364	10	79	53	0	142	13	42	22	0	77	116	91	4	0	211	794
7:30 AM	4	352	7	0	363	10	84	63	0	157	16	53	25	0	94	102	92	2	0	196	810
7:45 AM	7	324	10	0	341	16	116	58	0	190	23	45	16	0	84	108	93	2	0	203	818
8:00 AM	4	329	16	0	349	9	75	67	0	151	18	39	10	0	67	108	59	9	0	176	743
Total	23	1357	37	0	1417	45	354	241	0	640	70	179	73	0	322	434	335	17	0	786	3165
Approach %	1.6	95.8	2.6	-	-	7.0	55.3	37.7	-	-	21.7	55.6	22.7	-	-	55.2	42.6	2.2	-	-	-
Total %	0.7	42.9	1.2	-	44.8	1.4	11.2	7.6	-	20.2	2.2	5.7	2.3	-	10.2	13.7	10.6	0.5	-	24.8	-
PHF	0.719	0.964	0.578	-	0.973	0.703	0.763	0.899	-	0.842	0.761	0.844	0.730	-	0.856	0.935	0.901	0.472	-	0.931	0.967
Lights	21	1343	35	-	1399	41	346	234	-	621	66	175	71	-	312	430	328	15	-	773	3105
% Lights	91.3	99.0	94.6	-	98.7	91.1	97.7	97.1	-	97.0	94.3	97.8	97.3	-	96.9	99.1	97.9	88.2	-	98.3	98.1
Buses	1	3	1	-	5	1	1	2	-	4	2	3	0	-	5	2	4	1	-	7	21
% Buses	4.3	0.2	2.7	-	0.4	2.2	0.3	0.8	-	0.6	2.9	1.7	0.0	-	1.6	0.5	1.2	5.9	-	0.9	0.7
Trucks	1	11	1	-	13	3	7	5	-	15	2	1	2	-	5	2	3	1	-	6	39
% Trucks	4.3	0.8	2.7	-	0.9	6.7	2.0	2.1	-	2.3	2.9	0.6	2.7	-	1.6	0.5	0.9	5.9	-	0.8	1.2
Bicycles on Crosswalk	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

URS Corp
3950 Sparks Drive SE

Grand Rapids, Michigan, United States 49546
(616) 574-8500

Count Name: Baldwin St @ Cottonwood Dr
Site Code:
Start Date: 12/06/2016

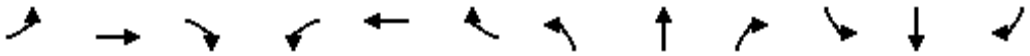
Turning Movement Peak Hour Data (5:00 PM)

Start Time	Baldwin Eastbound					Baldwin Westbound					Cottonwood Northbound					Cottonwood Southbound					
	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
5:00 PM	34	207	29	0	270	14	254	162	0	430	60	142	13	0	215	65	87	8	0	160	1075
5:15 PM	30	204	39	1	273	18	258	175	0	451	56	150	18	0	224	64	95	8	1	167	1115
5:30 PM	27	234	31	0	292	22	255	165	0	442	55	124	18	0	197	66	93	8	0	167	1098
5:45 PM	38	214	39	0	291	24	265	137	0	426	59	123	15	0	197	67	92	12	0	171	1085
Total	129	859	138	1	1126	78	1032	639	0	1749	230	539	64	0	833	262	367	36	1	665	4373
Approach %	11.5	76.3	12.3	-	-	4.5	59.0	36.5	-	-	27.6	64.7	7.7	-	-	39.4	55.2	5.4	-	-	-
Total %	2.9	19.6	3.2	-	25.7	1.8	23.6	14.6	-	40.0	5.3	12.3	1.5	-	19.0	6.0	8.4	0.8	-	15.2	-
PHF	0.849	0.918	0.885	-	0.964	0.813	0.974	0.913	-	0.970	0.958	0.898	0.889	-	0.930	0.978	0.966	0.750	-	0.972	0.980
Lights	127	855	137	-	1119	78	1031	637	-	1746	229	539	64	-	832	258	364	36	-	658	4355
% Lights	98.4	99.5	99.3	-	99.4	100.0	99.9	99.7	-	99.8	99.6	100.0	100.0	-	99.9	98.5	99.2	100.0	-	98.9	99.6
Buses	1	0	0	-	1	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	1
% Buses	0.8	0.0	0.0	-	0.1	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-	0.0	0.0
Trucks	1	4	1	-	6	0	1	2	-	3	1	0	0	-	1	4	3	0	-	7	17
% Trucks	0.8	0.5	0.7	-	0.5	0.0	0.1	0.3	-	0.2	0.4	0.0	0.0	-	0.1	1.5	0.8	0.0	-	1.1	0.4
Bicycles on Crosswalk	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	1	-	-	-	-	0	-	-	-	-	0	-	-	-	-	1	-	-
% Pedestrians	-	-	-	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100.0	-	-

AECOM

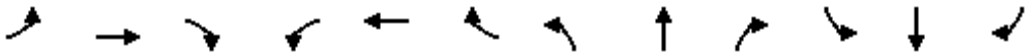
Appendix B

Capacity Analysis Results
(Synchro 9.0)



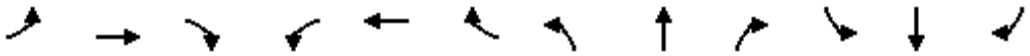
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	23	1357	37	45	354	241	70	179	73	434	335	17
Future Volume (vph)	23	1357	37	45	354	241	70	179	73	434	335	17
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.3	6.3	6.3		6.3	6.3	
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	0.95		1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.96		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3525		1752	3505	1568	1752	3352		1770	1849	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.38	1.00		0.42	1.00	
Satd. Flow (perm)	1770	3525		1752	3505	1568	704	3352		777	1849	
Peak-hour factor, PHF	0.95	0.95	0.95	0.84	0.84	0.84	0.86	0.86	0.86	0.93	0.93	0.93
Adj. Flow (vph)	24	1428	39	54	421	287	81	208	85	467	360	18
RTOR Reduction (vph)	0	2	0	0	0	138	0	43	0	0	1	0
Lane Group Flow (vph)	24	1465	0	54	421	149	81	250	0	467	377	0
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	3%	3%	3%	2%	2%	2%
Turn Type	Prot	NA		Prot	NA	pm+ov	pm+pt	NA		pm+pt	NA	
Protected Phases	1	6		5	2	4	8	3		4	7	
Permitted Phases						2	3			7		
Actuated Green, G (s)	2.4	34.9		5.8	38.3	52.0	27.9	21.0		41.0	27.8	
Effective Green, g (s)	2.4	34.9		5.8	38.3	52.0	27.9	21.0		41.0	27.8	
Actuated g/C Ratio	0.02	0.35		0.06	0.38	0.52	0.28	0.21		0.41	0.28	
Clearance Time (s)	6.0	6.0		6.0	6.0	6.3	6.3	6.3		6.3	6.3	
Vehicle Extension (s)	2.5	0.2		2.5	0.2	2.5	2.5	0.2		2.5	0.2	
Lane Grp Cap (vph)	42	1230		101	1342	815	268	703		454	514	
v/s Ratio Prot	0.01	c0.42		c0.03	c0.12	0.03	0.02	0.07		c0.14	0.20	
v/s Ratio Perm						0.07	0.06			c0.28		
v/c Ratio	0.57	1.19		0.53	0.31	0.18	0.30	0.35		1.03	0.73	
Uniform Delay, d1	48.3	32.5		45.8	21.6	12.7	27.5	33.7		27.1	32.7	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	14.5	94.3		4.2	0.6	0.1	0.5	1.4		49.8	8.9	
Delay (s)	62.7	126.9		50.0	22.2	12.8	27.9	35.1		76.9	41.7	
Level of Service	E	F		D	C	B	C	D		E	D	
Approach Delay (s)		125.8			20.7			33.6			61.1	
Approach LOS		F			C			C			E	

Intersection Summary			
HCM 2000 Control Delay	77.1	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.13		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	24.6
Intersection Capacity Utilization	86.6%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			



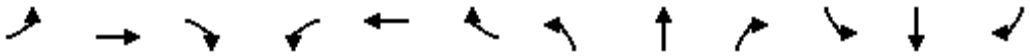
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	129	859	138	78	1032	639	230	539	64	262	367	36
Future Volume (vph)	129	859	138	78	1032	639	230	539	64	262	367	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.3	6.3	6.3		6.3	6.3	
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	0.95		1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.98		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3459		1770	3539	1583	1769	3483		1770	1835	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.18	1.00		0.18	1.00	
Satd. Flow (perm)	1770	3459		1770	3539	1583	343	3483		343	1835	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.93	0.93	0.93	0.95	0.95	0.95
Adj. Flow (vph)	136	904	145	82	1086	673	247	580	69	276	386	38
RTOR Reduction (vph)	0	13	0	0	0	53	0	9	0	0	4	0
Lane Group Flow (vph)	136	1036	0	82	1086	620	247	640	0	276	420	0
Confl. Peds. (#/hr)			1				1					1
Turn Type	Prot	NA		Prot	NA	pm+ov	pm+pt	NA		pm+pt	NA	
Protected Phases	1	6		5	2	4	8	3		4	7	
Permitted Phases						2	3			7		
Actuated Green, G (s)	6.0	38.0		6.0	38.0	47.7	31.4	21.7		31.4	21.7	
Effective Green, g (s)	6.0	38.0		6.0	38.0	47.7	31.4	21.7		31.4	21.7	
Actuated g/C Ratio	0.06	0.38		0.06	0.38	0.48	0.31	0.22		0.31	0.22	
Clearance Time (s)	6.0	6.0		6.0	6.0	6.3	6.3	6.3		6.3	6.3	
Vehicle Extension (s)	2.5	0.2		2.5	0.2	2.5	2.5	0.2		2.5	0.2	
Lane Grp Cap (vph)	106	1314		106	1344	755	246	755		246	398	
v/s Ratio Prot	c0.08	0.30		0.05	0.31	c0.08	0.10	0.18		c0.11	0.23	
v/s Ratio Perm						0.31	0.22			c0.24		
v/c Ratio	1.28	0.79		0.77	0.81	0.82	1.00	0.85		1.12	1.06	
Uniform Delay, d1	47.0	27.4		46.3	27.7	22.5	30.9	37.6		30.0	39.1	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	181.4	4.9		27.9	5.3	7.0	58.4	11.3		94.1	60.5	
Delay (s)	228.4	32.3		74.2	33.0	29.5	89.3	48.9		124.1	99.6	
Level of Service	F	C		E	C	C	F	D		F	F	
Approach Delay (s)		54.8			33.6			60.0			109.3	
Approach LOS		D			C			E			F	

Intersection Summary			
HCM 2000 Control Delay	55.6	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	24.6
Intersection Capacity Utilization	90.4%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			



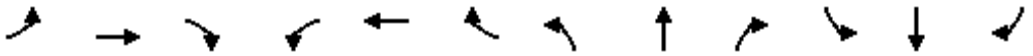
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	23	1357	37	45	354	241	70	179	73	434	335	17
Future Volume (vph)	23	1357	37	45	354	241	70	179	73	434	335	17
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.3	6.0	6.0	6.3	6.3	6.3		6.3	6.3	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.97	0.95		0.97	0.95	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3539	1583	1752	3505	1568	3400	3352		3433	3514	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3539	1583	1752	3505	1568	3400	3352		3433	3514	
Peak-hour factor, PHF	0.95	0.95	0.95	0.84	0.84	0.84	0.86	0.86	0.86	0.93	0.93	0.93
Adj. Flow (vph)	24	1428	39	54	421	287	81	208	85	467	360	18
RTOR Reduction (vph)	0	0	23	0	0	137	0	44	0	0	3	0
Lane Group Flow (vph)	24	1428	16	54	421	150	81	249	0	467	375	0
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	3%	3%	3%	2%	2%	2%
Turn Type	Prot	NA	pm+ov	Prot	NA	pm+ov	Prot	NA		Prot	NA	
Protected Phases	1	6	8	5	2	4	8	3		4	7	
Permitted Phases			6			2						
Actuated Green, G (s)	2.4	36.0	42.2	4.8	38.4	52.1	6.2	20.9		13.7	28.4	
Effective Green, g (s)	2.4	36.0	42.2	4.8	38.4	52.1	6.2	20.9		13.7	28.4	
Actuated g/C Ratio	0.02	0.36	0.42	0.05	0.38	0.52	0.06	0.21		0.14	0.28	
Clearance Time (s)	6.0	6.0	6.3	6.0	6.0	6.3	6.3	6.3		6.3	6.3	
Vehicle Extension (s)	2.5	0.2	2.5	2.5	0.2	2.5	2.5	0.2		2.5	0.2	
Lane Grp Cap (vph)	42	1274	668	84	1345	816	210	700		470	997	
v/s Ratio Prot	0.01	c0.40	0.00	c0.03	0.12	0.03	0.02	0.07		c0.14	c0.11	
v/s Ratio Perm			0.01			0.07						
v/c Ratio	0.57	1.12	0.02	0.64	0.31	0.18	0.39	0.36		0.99	0.38	
Uniform Delay, d1	48.3	32.0	16.9	46.8	21.6	12.7	45.1	33.8		43.1	28.7	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	14.5	65.3	0.0	13.9	0.6	0.1	0.9	1.4		39.6	1.1	
Delay (s)	62.7	97.3	16.9	60.7	22.2	12.8	45.9	35.2		82.7	29.8	
Level of Service	E	F	B	E	C	B	D	D		F	C	
Approach Delay (s)		94.6			21.4			37.5			59.1	
Approach LOS		F			C			D			E	

Intersection Summary			
HCM 2000 Control Delay	63.7	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	24.6
Intersection Capacity Utilization	73.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			



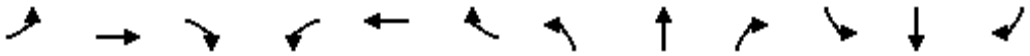
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	129	859	138	78	1032	639	230	539	64	262	367	36
Future Volume (vph)	129	859	138	78	1032	639	230	539	64	262	367	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.3	6.0	6.0	6.3	6.3	6.3		6.3	6.3	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.97	0.95		0.97	0.95	
Frpb, ped/bikes	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3539	1566	1770	3539	1583	3433	3483		3433	3487	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3539	1566	1770	3539	1583	3433	3483		3433	3487	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.93	0.93	0.93	0.95	0.95	0.95
Adj. Flow (vph)	136	904	145	82	1086	673	247	580	69	276	386	38
RTOR Reduction (vph)	0	0	53	0	0	55	0	9	0	0	7	0
Lane Group Flow (vph)	136	904	92	82	1086	618	247	640	0	276	417	0
Confl. Peds. (#/hr)			1									1
Turn Type	Prot	NA	pm+ov	Prot	NA	pm+ov	Prot	NA		Prot	NA	
Protected Phases	1	6	8	5	2	4	8	3		4	7	
Permitted Phases			6			2						
Actuated Green, G (s)	9.0	37.3	47.5	7.0	35.3	45.7	10.2	20.7		10.4	20.9	
Effective Green, g (s)	9.0	37.3	47.5	7.0	35.3	45.7	10.2	20.7		10.4	20.9	
Actuated g/C Ratio	0.09	0.37	0.48	0.07	0.35	0.46	0.10	0.21		0.10	0.21	
Clearance Time (s)	6.0	6.0	6.3	6.0	6.0	6.3	6.3	6.3		6.3	6.3	
Vehicle Extension (s)	2.5	0.2	2.5	2.5	0.2	2.5	2.5	0.2		2.5	0.2	
Lane Grp Cap (vph)	159	1320	743	123	1249	723	350	720		357	728	
v/s Ratio Prot	c0.08	0.26	0.01	0.05	c0.31	c0.09	0.07	c0.18		0.08	0.12	
v/s Ratio Perm			0.05			0.30						
v/c Ratio	0.86	0.68	0.12	0.67	0.87	0.85	0.71	0.89		0.77	0.57	
Uniform Delay, d1	44.9	26.4	14.6	45.4	30.2	24.2	43.4	38.5		43.7	35.5	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	33.2	2.9	0.1	11.6	8.4	9.6	5.9	15.3		9.6	3.3	
Delay (s)	78.1	29.3	14.7	57.0	38.6	33.8	49.4	53.9		53.3	38.8	
Level of Service	E	C	B	E	D	C	D	D		D	D	
Approach Delay (s)		33.1			37.7			52.6			44.5	
Approach LOS		C			D			D			D	

Intersection Summary			
HCM 2000 Control Delay	40.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	24.6
Intersection Capacity Utilization	80.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			



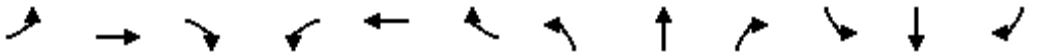
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	23	1357	37	45	354	241	70	179	73	434	335	17
Future Volume (vph)	23	1357	37	45	354	241	70	179	73	434	335	17
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.3	6.0	6.0	6.3	6.3	6.3		6.3	6.3	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.97	0.95		0.97	0.95	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3539	1583	1752	3505	1568	3400	3352		3433	3514	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3539	1583	1752	3505	1568	3400	3352		3433	3514	
Peak-hour factor, PHF	0.95	0.95	0.95	0.84	0.84	0.84	0.86	0.86	0.86	0.93	0.93	0.93
Adj. Flow (vph)	24	1428	39	54	421	287	81	208	85	467	360	18
RTOR Reduction (vph)	0	0	20	0	0	107	0	44	0	0	3	0
Lane Group Flow (vph)	24	1428	19	54	421	180	81	249	0	467	375	0
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	3%	3%	3%	2%	2%	2%
Turn Type	Prot	NA	pm+ov	Prot	NA	pm+ov	Prot	NA		Prot	NA	
Protected Phases	1	6	8	5	2	4	8	3		4	7	
Permitted Phases			6			2						
Actuated Green, G (s)	2.8	43.8	49.1	5.5	46.5	62.7	5.3	9.9		16.2	20.8	
Effective Green, g (s)	2.8	43.8	49.1	5.5	46.5	62.7	5.3	9.9		16.2	20.8	
Actuated g/C Ratio	0.03	0.44	0.49	0.06	0.46	0.63	0.05	0.10		0.16	0.21	
Clearance Time (s)	6.0	6.0	6.3	6.0	6.0	6.3	6.3	6.3		6.3	6.3	
Vehicle Extension (s)	2.5	0.2	2.5	2.5	0.2	2.5	2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)	49	1550	777	96	1629	983	180	331		556	730	
v/s Ratio Prot	0.01	c0.40	0.00	c0.03	c0.12	0.03	0.02	c0.07		c0.14	0.11	
v/s Ratio Perm			0.01			0.09						
v/c Ratio	0.49	0.92	0.02	0.56	0.26	0.18	0.45	0.75		0.84	0.51	
Uniform Delay, d1	47.9	26.5	13.1	46.1	16.3	7.9	45.9	43.9		40.6	35.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	5.5	10.5	0.0	6.0	0.4	0.1	1.3	8.9		10.6	0.5	
Delay (s)	53.4	37.0	13.1	52.1	16.7	7.9	47.2	52.7		51.2	35.6	
Level of Service	D	D	B	D	B	A	D	D		D	D	
Approach Delay (s)		36.6			15.9			51.5			44.2	
Approach LOS		D			B			D			D	

Intersection Summary			
HCM 2000 Control Delay	35.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	24.6
Intersection Capacity Utilization	72.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			



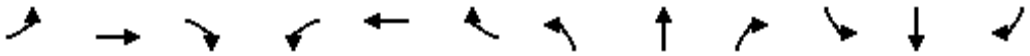
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	129	859	138	78	1032	639	230	539	64	262	367	36
Future Volume (vph)	129	859	138	78	1032	639	230	539	64	262	367	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.3	6.0	6.0	6.3	6.3	6.3		6.3	6.3	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.97	0.95		0.97	0.95	
Frpb, ped/bikes	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3539	1566	1770	3539	1583	3433	3483		3433	3487	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3539	1566	1770	3539	1583	3433	3483		3433	3487	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.93	0.93	0.93	0.95	0.95	0.95
Adj. Flow (vph)	136	904	145	82	1086	673	247	580	69	276	386	38
RTOR Reduction (vph)	0	0	52	0	0	54	0	9	0	0	7	0
Lane Group Flow (vph)	136	904	93	82	1086	619	247	640	0	276	417	0
Confl. Peds. (#/hr)			1									1
Turn Type	Prot	NA	pm+ov	Prot	NA	pm+ov	Prot	NA		Prot	NA	
Protected Phases	1	6	8	5	2	4	8	3		4	7	
Permitted Phases			6			2						
Actuated Green, G (s)	9.0	37.7	48.5	7.0	35.7	46.1	10.8	20.3		10.4	19.9	
Effective Green, g (s)	9.0	37.7	48.5	7.0	35.7	46.1	10.8	20.3		10.4	19.9	
Actuated g/C Ratio	0.09	0.38	0.48	0.07	0.36	0.46	0.11	0.20		0.10	0.20	
Clearance Time (s)	6.0	6.0	6.3	6.0	6.0	6.3	6.3	6.3		6.3	6.3	
Vehicle Extension (s)	2.5	0.2	2.5	2.5	0.2	2.5	2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)	159	1334	759	123	1263	729	370	707		357	693	
v/s Ratio Prot	c0.08	0.26	0.01	0.05	c0.31	c0.09	0.07	c0.18		0.08	0.12	
v/s Ratio Perm			0.05			0.30						
v/c Ratio	0.86	0.68	0.12	0.67	0.86	0.85	0.67	0.91		0.77	0.60	
Uniform Delay, d1	44.9	26.1	14.1	45.4	29.8	23.9	42.9	38.9		43.7	36.4	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	33.2	2.8	0.1	11.6	7.8	8.9	4.1	15.1		9.6	1.2	
Delay (s)	78.1	28.8	14.2	57.0	37.6	32.8	46.9	54.0		53.3	37.7	
Level of Service	E	C	B	E	D	C	D	D		D	D	
Approach Delay (s)		32.7			36.7			52.1			43.8	
Approach LOS		C			D			D			D	

Intersection Summary			
HCM 2000 Control Delay	39.7	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	24.6
Intersection Capacity Utilization	80.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			



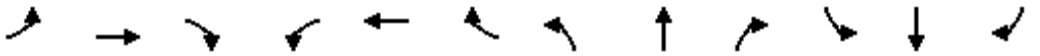
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	23	1357	37	45	354	241	70	179	73	434	335	17
Future Volume (vph)	23	1357	37	45	354	241	70	179	73	434	335	17
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.3	6.0	6.0	6.3	6.3	6.3		6.3	6.3	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.97	0.95		0.97	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3539	1583	1752	3505	1568	3400	3352		3433	1849	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3539	1583	1752	3505	1568	3400	3352		3433	1849	
Peak-hour factor, PHF	0.95	0.95	0.95	0.84	0.84	0.84	0.86	0.86	0.86	0.93	0.93	0.93
Adj. Flow (vph)	24	1428	39	54	421	287	81	208	85	467	360	18
RTOR Reduction (vph)	0	0	21	0	0	111	0	43	0	0	2	0
Lane Group Flow (vph)	24	1428	18	54	421	176	81	250	0	467	376	0
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	3%	3%	3%	2%	2%	2%
Turn Type	Prot	NA	pm+ov	Prot	NA	pm+ov	Prot	NA		Prot	NA	
Protected Phases	1	6	8	5	2	4	8	3		4	7	
Permitted Phases			6			2						
Actuated Green, G (s)	2.8	40.7	46.0	5.5	43.4	61.3	5.3	11.3		17.9	23.9	
Effective Green, g (s)	2.8	40.7	46.0	5.5	43.4	61.3	5.3	11.3		17.9	23.9	
Actuated g/C Ratio	0.03	0.41	0.46	0.06	0.43	0.61	0.05	0.11		0.18	0.24	
Clearance Time (s)	6.0	6.0	6.3	6.0	6.0	6.3	6.3	6.3		6.3	6.3	
Vehicle Extension (s)	2.5	0.2	2.5	2.5	0.2	2.5	2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)	49	1440	728	96	1521	961	180	378		614	441	
v/s Ratio Prot	0.01	c0.40	0.00	c0.03	c0.12	0.03	0.02	0.07		c0.14	c0.20	
v/s Ratio Perm			0.01			0.08						
v/c Ratio	0.49	0.99	0.02	0.56	0.28	0.18	0.45	0.66		0.76	0.85	
Uniform Delay, d1	47.9	29.5	14.7	46.1	18.2	8.4	45.9	42.5		39.0	36.4	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	5.5	21.8	0.0	6.0	0.5	0.1	1.3	3.9		5.3	14.6	
Delay (s)	53.4	51.3	14.8	52.1	18.7	8.5	47.2	46.4		44.3	51.0	
Level of Service	D	D	B	D	B	A	D	D		D	D	
Approach Delay (s)		50.4			17.2			46.6			47.3	
Approach LOS		D			B			D			D	

Intersection Summary			
HCM 2000 Control Delay	41.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	24.6
Intersection Capacity Utilization	75.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			



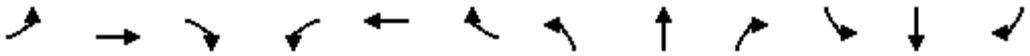
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	129	859	138	78	1032	639	230	539	64	262	367	36
Future Volume (vph)	129	859	138	78	1032	639	230	539	64	262	367	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.3	6.0	6.0	6.3	6.3	6.3		6.3	6.3	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.97	0.95		0.97	1.00	
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3539	1555	1770	3539	1583	3433	3483		3433	1835	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3539	1555	1770	3539	1583	3433	3483		3433	1835	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.93	0.93	0.93	0.95	0.95	0.95
Adj. Flow (vph)	136	904	145	82	1086	673	247	580	69	276	386	38
RTOR Reduction (vph)	0	0	57	0	0	56	0	9	0	0	4	0
Lane Group Flow (vph)	136	904	88	82	1086	617	247	640	0	276	420	0
Confl. Peds. (#/hr)			1									1
Turn Type	Prot	NA	pm+ov	Prot	NA	pm+ov	Prot	NA		Prot	NA	
Protected Phases	1	6	8	5	2	4	8	3		4	7	
Permitted Phases			6			2						
Actuated Green, G (s)	9.0	33.7	43.2	7.0	31.7	44.8	9.5	21.6		13.1	25.2	
Effective Green, g (s)	9.0	33.7	43.2	7.0	31.7	44.8	9.5	21.6		13.1	25.2	
Actuated g/C Ratio	0.09	0.34	0.43	0.07	0.32	0.45	0.10	0.22		0.13	0.25	
Clearance Time (s)	6.0	6.0	6.3	6.0	6.0	6.3	6.3	6.3		6.3	6.3	
Vehicle Extension (s)	2.5	0.2	2.5	2.5	0.2	2.5	2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)	159	1192	671	123	1121	709	326	752		449	462	
v/s Ratio Prot	c0.08	0.26	0.01	0.05	c0.31	c0.11	0.07	0.18		0.08	c0.23	
v/s Ratio Perm			0.04			0.28						
v/c Ratio	0.86	0.76	0.13	0.67	0.97	0.87	0.76	0.85		0.61	0.91	
Uniform Delay, d1	44.9	29.5	17.1	45.4	33.7	25.0	44.1	37.7		41.1	36.3	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	33.2	4.5	0.1	11.6	20.3	11.3	9.2	9.1		2.1	21.5	
Delay (s)	78.1	34.1	17.2	57.0	54.0	36.2	53.4	46.7		43.2	57.8	
Level of Service	E	C	B	E	D	D	D	D		D	E	
Approach Delay (s)		37.1			47.6			48.6			52.1	
Approach LOS		D			D			D			D	

Intersection Summary			
HCM 2000 Control Delay	45.8	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	24.6
Intersection Capacity Utilization	84.2%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	23	1357	37	45	354	241	70	179	73	434	335	17
Future Volume (vph)	23	1357	37	45	354	241	70	179	73	434	335	17
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.3	6.0	6.0	6.3	6.3	6.3		6.3	6.3	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95		0.91	0.91	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96		1.00	1.00	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	0.98	
Satd. Flow (prot)	1770	3539	1583	1752	3505	1568	1752	3352		1610	3318	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	0.98	
Satd. Flow (perm)	1770	3539	1583	1752	3505	1568	1752	3352		1610	3318	
Peak-hour factor, PHF	0.95	0.95	0.95	0.84	0.84	0.84	0.86	0.86	0.86	0.93	0.93	0.93
Adj. Flow (vph)	24	1428	39	54	421	287	81	208	85	467	360	18
RTOR Reduction (vph)	0	0	20	0	0	106	0	44	0	0	2	0
Lane Group Flow (vph)	24	1428	20	54	421	181	81	249	0	276	567	0
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	3%	3%	3%	2%	2%	2%
Turn Type	Prot	NA	pm+ov	Prot	NA	pm+ov	Split	NA		Split	NA	
Protected Phases	1	6	3	5	2	7	3	3		7	7	
Permitted Phases			6			2						
Actuated Green, G (s)	2.8	40.5	50.0	5.5	43.2	63.1	9.5	9.5		19.9	19.9	
Effective Green, g (s)	2.8	40.5	50.0	5.5	43.2	63.1	9.5	9.5		19.9	19.9	
Actuated g/C Ratio	0.03	0.40	0.50	0.06	0.43	0.63	0.10	0.10		0.20	0.20	
Clearance Time (s)	6.0	6.0	6.3	6.0	6.0	6.3	6.3	6.3		6.3	6.3	
Vehicle Extension (s)	2.5	0.2	2.5	2.5	0.2	2.5	2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)	49	1433	791	96	1514	989	166	318		320	660	
v/s Ratio Prot	0.01	c0.40	0.00	c0.03	c0.12	0.04	0.05	c0.07		c0.17	0.17	
v/s Ratio Perm			0.01			0.08						
v/c Ratio	0.49	1.00	0.02	0.56	0.28	0.18	0.49	0.78		0.86	0.86	
Uniform Delay, d1	47.9	29.7	12.7	46.1	18.3	7.7	42.9	44.2		38.7	38.7	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	5.5	23.0	0.0	6.0	0.5	0.1	1.6	11.4		20.4	10.6	
Delay (s)	53.4	52.6	12.7	52.1	18.8	7.8	44.6	55.7		59.1	49.3	
Level of Service	D	D	B	D	B	A	D	E		E	D	
Approach Delay (s)		51.6			17.0			53.3			52.5	
Approach LOS		D			B			D			D	

Intersection Summary			
HCM 2000 Control Delay	44.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	24.6
Intersection Capacity Utilization	75.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	129	859	138	78	1032	639	230	539	64	262	367	36
Future Volume (vph)	129	859	138	78	1032	639	230	539	64	262	367	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.3	6.0	6.0	6.3	6.3	6.3		6.3	6.3	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95		0.91	0.91	
Frpb, ped/bikes	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3539	1569	1770	3539	1583	1770	3483		1610	3329	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3539	1569	1770	3539	1583	1770	3483		1610	3329	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.93	0.93	0.93	0.95	0.95	0.95
Adj. Flow (vph)	136	904	145	82	1086	673	247	580	69	276	386	38
RTOR Reduction (vph)	0	0	48	0	0	53	0	9	0	0	6	0
Lane Group Flow (vph)	136	904	97	82	1086	620	247	640	0	229	465	0
Confl. Peds. (#/hr)			1									1
Turn Type	Prot	NA	pm+ov	Prot	NA	pm+ov	Split	NA		Split	NA	
Protected Phases	1	6	3	5	2	7	3	3		7	7	
Permitted Phases			6			2						
Actuated Green, G (s)	9.0	34.0	52.7	7.0	32.0	47.7	18.7	18.7		15.7	15.7	
Effective Green, g (s)	9.0	34.0	52.7	7.0	32.0	47.7	18.7	18.7		15.7	15.7	
Actuated g/C Ratio	0.09	0.34	0.53	0.07	0.32	0.48	0.19	0.19		0.16	0.16	
Clearance Time (s)	6.0	6.0	6.3	6.0	6.0	6.3	6.3	6.3		6.3	6.3	
Vehicle Extension (s)	2.5	0.2	2.5	2.5	0.2	2.5	2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)	159	1203	826	123	1132	755	330	651		252	522	
v/s Ratio Prot	c0.08	0.26	0.02	0.05	c0.31	0.13	0.14	c0.18		c0.14	0.14	
v/s Ratio Perm			0.04			0.26						
v/c Ratio	0.86	0.75	0.12	0.67	0.96	0.82	0.75	0.98		0.91	0.89	
Uniform Delay, d1	44.9	29.3	11.9	45.4	33.4	22.5	38.4	40.5		41.4	41.3	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	33.2	4.4	0.0	11.6	18.6	7.0	8.5	30.8		33.1	17.2	
Delay (s)	78.1	33.6	12.0	57.0	52.0	29.5	46.9	71.3		74.5	58.5	
Level of Service	E	C	B	E	D	C	D	E		E	E	
Approach Delay (s)		36.1			44.0			64.6			63.7	
Approach LOS		D			D			E			E	

Intersection Summary			
HCM 2000 Control Delay	48.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	24.6
Intersection Capacity Utilization	85.8%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Intersection Delay, s/veh	82.0
Intersection LOS	F

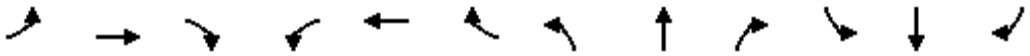
Approach	EB	WB	NB	SB
Entry Lanes	2	2	2	2
Conflicting Circle Lanes	2	2	2	2
Adj Approach Flow, veh/h	1491	762	374	845
Demand Flow Rate, veh/h	1521	786	385	861
Vehicles Circulating, veh/h	899	321	1957	573
Vehicles Exiting, veh/h	535	2021	463	534
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	166.7	9.6	43.8	14.9
Approach LOS	F	A	E	B

Lane	Left	Right	Left	Right	Left	Right	Left	Right
Designated Moves	LT	TR	LT	TR	LT	TR	LT	TR
Assumed Moves	LT	TR	LT	TR	LT	TR	L	TR
RT Channelized								
Lane Util	0.470	0.530	0.469	0.531	0.470	0.530	0.553	0.447
Critical Headway, s	4.293	4.113	4.293	4.113	4.293	4.113	4.293	4.113
Entry Flow, veh/h	715	806	369	417	181	204	476	385
Cap Entry Lane, veh/h	576	602	888	903	260	287	735	757
Entry HV Adj Factor	0.980	0.981	0.971	0.969	0.971	0.971	0.981	0.981
Flow Entry, veh/h	701	790	358	404	176	198	467	378
Cap Entry, veh/h	564	591	862	875	253	279	721	742
V/C Ratio	1.242	1.338	0.415	0.462	0.695	0.710	0.647	0.509
Control Delay, s/veh	146.6	184.5	9.2	9.9	44.8	42.8	16.9	12.3
LOS	F	F	A	A	E	E	C	B
95th %tile Queue, veh	27	34	2	2	5	5	5	3

Intersection	
Intersection Delay, s/veh	174.7
Intersection LOS	F

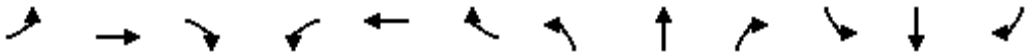
Approach	EB	WB	NB	SB
Entry Lanes	2	2	2	2
Conflicting Circle Lanes	2	2	2	2
Adj Approach Flow, veh/h	1185	1841	896	700
Demand Flow Rate, veh/h	1209	1878	914	715
Vehicles Circulating, veh/h	760	983	1343	1444
Vehicles Exiting, veh/h	1399	1274	626	1417
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	1	0	1	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	46.2	340.4	96.1	56.8
Approach LOS	E	F	F	F

Lane	Left	Right	Left	Right	Left	Right	Left	Right
Designated Moves	LT	TR	LT	TR	LT	TR	LT	TR
Assumed Moves	LT	TR	LT	TR	LT	TR	LT	TR
RT Channelized								
Lane Util	0.470	0.530	0.470	0.530	0.470	0.530	0.470	0.530
Critical Headway, s	4.293	4.113	4.293	4.113	4.293	4.113	4.293	4.113
Entry Flow, veh/h	568	641	883	995	430	484	336	379
Cap Entry Lane, veh/h	639	664	541	568	413	441	383	411
Entry HV Adj Factor	0.980	0.980	0.980	0.981	0.980	0.982	0.980	0.979
Flow Entry, veh/h	557	628	865	976	421	475	329	371
Cap Entry, veh/h	626	650	530	557	404	433	375	403
V/C Ratio	0.889	0.966	1.633	1.752	1.042	1.097	0.878	0.922
Control Delay, s/veh	39.3	52.4	313.4	364.4	88.6	102.7	54.0	59.3
LOS	E	F	F	F	F	F	F	F
95th %tile Queue, veh	11	14	49	59	14	16	9	10



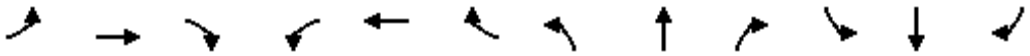
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	25	1493	41	50	389	265	77	197	80	477	369	19
Future Volume (vph)	25	1493	41	50	389	265	77	197	80	477	369	19
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.3	6.0	6.0	6.3	6.3	6.3		6.3	6.3	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.97	0.95		0.97	0.95	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3539	1583	1752	3505	1568	3400	3353		3433	3514	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3539	1583	1752	3505	1568	3400	3353		3433	3514	
Peak-hour factor, PHF	0.95	0.95	0.95	0.84	0.84	0.84	0.86	0.86	0.86	0.93	0.93	0.93
Adj. Flow (vph)	26	1572	43	60	463	315	90	229	93	513	397	20
RTOR Reduction (vph)	0	0	21	0	0	101	0	43	0	0	3	0
Lane Group Flow (vph)	26	1572	22	60	463	214	90	279	0	513	414	0
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	3%	3%	3%	2%	2%	2%
Turn Type	Prot	NA	pm+ov	Prot	NA	pm+ov	Prot	NA		Prot	NA	
Protected Phases	1	6	8	5	2	4	8	3		4	7	
Permitted Phases			6			2						
Actuated Green, G (s)	2.4	44.9	50.3	4.8	47.3	63.0	5.4	10.0		15.7	20.3	
Effective Green, g (s)	2.4	44.9	50.3	4.8	47.3	63.0	5.4	10.0		15.7	20.3	
Actuated g/C Ratio	0.02	0.45	0.50	0.05	0.47	0.63	0.05	0.10		0.16	0.20	
Clearance Time (s)	6.0	6.0	6.3	6.0	6.0	6.3	6.3	6.3		6.3	6.3	
Vehicle Extension (s)	2.5	0.2	2.5	2.5	0.2	2.5	2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)	42	1589	796	84	1657	987	183	335		538	713	
v/s Ratio Prot	0.01	c0.44	0.00	c0.03	0.13	0.03	0.03	c0.08		c0.15	0.12	
v/s Ratio Perm			0.01			0.10						
v/c Ratio	0.62	0.99	0.03	0.71	0.28	0.22	0.49	0.83		0.95	0.58	
Uniform Delay, d1	48.3	27.3	12.5	46.9	16.0	7.9	46.0	44.2		41.8	36.0	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	21.0	20.2	0.0	23.4	0.4	0.1	1.5	15.7		27.4	1.0	
Delay (s)	69.3	47.5	12.5	70.3	16.4	8.0	47.5	59.9		69.1	37.0	
Level of Service	E	D	B	E	B	A	D	E		E	D	
Approach Delay (s)		46.9			17.1			57.2			54.7	
Approach LOS		D			B			E			D	

Intersection Summary			
HCM 2000 Control Delay	43.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	24.6
Intersection Capacity Utilization	78.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			



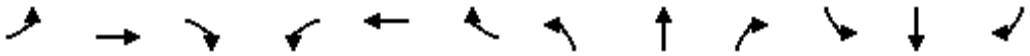
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	142	945	152	86	1135	703	253	593	70	288	404	40
Future Volume (vph)	142	945	152	86	1135	703	253	593	70	288	404	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.3	6.0	6.0	6.3	6.3	6.3		6.3	6.3	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.97	0.95		0.97	0.95	
Frpb, ped/bikes	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3539	1566	1770	3539	1583	3433	3483		3433	3487	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3539	1566	1770	3539	1583	3433	3483		3433	3487	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.93	0.93	0.93	0.95	0.95	0.95
Adj. Flow (vph)	149	995	160	91	1195	740	272	638	75	303	425	42
RTOR Reduction (vph)	0	0	52	0	0	55	0	9	0	0	7	0
Lane Group Flow (vph)	149	995	108	91	1195	685	272	704	0	303	460	0
Confl. Peds. (#/hr)			1									1
Turn Type	Prot	NA	pm+ov	Prot	NA	pm+ov	Prot	NA		Prot	NA	
Protected Phases	1	6	8	5	2	4	8	3		4	7	
Permitted Phases			6			2						
Actuated Green, G (s)	9.0	37.0	48.1	7.1	35.1	45.7	11.1	20.7		10.6	20.2	
Effective Green, g (s)	9.0	37.0	48.1	7.1	35.1	45.7	11.1	20.7		10.6	20.2	
Actuated g/C Ratio	0.09	0.37	0.48	0.07	0.35	0.46	0.11	0.21		0.11	0.20	
Clearance Time (s)	6.0	6.0	6.3	6.0	6.0	6.3	6.3	6.3		6.3	6.3	
Vehicle Extension (s)	2.5	0.2	2.5	2.5	0.2	2.5	2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)	159	1309	753	125	1242	723	381	720		363	704	
v/s Ratio Prot	c0.08	0.28	0.02	0.05	c0.34	c0.10	0.08	c0.20		0.09	0.13	
v/s Ratio Perm			0.05			0.33						
v/c Ratio	0.94	0.76	0.14	0.73	0.96	0.95	0.71	0.98		0.83	0.65	
Uniform Delay, d1	45.2	27.6	14.5	45.5	31.8	26.0	42.9	39.4		43.8	36.7	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	52.5	4.2	0.1	17.9	17.9	21.4	5.8	27.8		14.9	1.9	
Delay (s)	97.7	31.8	14.5	63.4	49.7	47.4	48.7	67.2		58.7	38.6	
Level of Service	F	C	B	E	D	D	D	E		E	D	
Approach Delay (s)		37.2			49.5			62.1			46.5	
Approach LOS		D			D			E			D	

Intersection Summary			
HCM 2000 Control Delay	48.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	24.6
Intersection Capacity Utilization	86.6%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	25	1493	41	50	389	265	77	197	80	477	369	19
Future Volume (vph)	25	1493	41	50	389	265	77	197	80	477	369	19
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.3	6.0	6.0	6.3	6.3	6.3		6.3	6.3	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.97	0.95		0.97	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3539	1583	1752	3505	1568	3400	3353		3433	1849	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3539	1583	1752	3505	1568	3400	3353		3433	1849	
Peak-hour factor, PHF	0.95	0.95	0.95	0.84	0.84	0.84	0.86	0.86	0.86	0.93	0.93	0.93
Adj. Flow (vph)	26	1572	43	60	463	315	90	229	93	513	397	20
RTOR Reduction (vph)	0	0	23	0	0	120	0	43	0	0	2	0
Lane Group Flow (vph)	26	1572	20	60	463	195	90	279	0	513	415	0
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	3%	3%	3%	2%	2%	2%
Turn Type	Prot	NA	pm+ov	Prot	NA	pm+ov	Prot	NA		Prot	NA	
Protected Phases	1	6	8	5	2	4	8	3		4	7	
Permitted Phases			6			2						
Actuated Green, G (s)	2.8	40.3	45.7	5.6	43.1	61.9	5.4	10.7		18.8	24.1	
Effective Green, g (s)	2.8	40.3	45.7	5.6	43.1	61.9	5.4	10.7		18.8	24.1	
Actuated g/C Ratio	0.03	0.40	0.46	0.06	0.43	0.62	0.05	0.11		0.19	0.24	
Clearance Time (s)	6.0	6.0	6.3	6.0	6.0	6.3	6.3	6.3		6.3	6.3	
Vehicle Extension (s)	2.5	0.2	2.5	2.5	0.2	2.5	2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)	49	1426	723	98	1510	970	183	358		645	445	
v/s Ratio Prot	0.01	c0.44	0.00	c0.03	c0.13	0.04	0.03	0.08		c0.15	c0.22	
v/s Ratio Perm			0.01			0.09						
v/c Ratio	0.53	1.10	0.03	0.61	0.31	0.20	0.49	0.78		0.80	0.93	
Uniform Delay, d1	48.0	29.9	14.9	46.1	18.7	8.3	46.0	43.5		38.8	37.2	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	8.3	57.0	0.0	9.3	0.5	0.1	1.5	9.9		6.5	26.7	
Delay (s)	56.3	86.9	14.9	55.4	19.2	8.4	47.5	53.4		45.3	63.9	
Level of Service	E	F	B	E	B	A	D	D		D	E	
Approach Delay (s)		84.5			17.7			52.1			53.6	
Approach LOS		F			B			D			D	

Intersection Summary			
HCM 2000 Control Delay	58.9	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.03		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	24.6
Intersection Capacity Utilization	81.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	142	945	152	86	1135	703	253	593	70	288	404	40
Future Volume (vph)	142	945	152	86	1135	703	253	593	70	288	404	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.3	6.0	6.0	6.3	6.3	6.3		6.3	6.3	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.97	0.95		0.97	1.00	
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3539	1555	1770	3539	1583	3433	3483		3433	1835	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3539	1555	1770	3539	1583	3433	3483		3433	1835	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.93	0.93	0.93	0.95	0.95	0.95
Adj. Flow (vph)	149	995	160	91	1195	740	272	638	75	303	425	42
RTOR Reduction (vph)	0	0	59	0	0	56	0	9	0	0	4	0
Lane Group Flow (vph)	149	995	101	91	1195	684	272	704	0	303	463	0
Confl. Peds. (#/hr)			1									1
Turn Type	Prot	NA	pm+ov	Prot	NA	pm+ov	Prot	NA		Prot	NA	
Protected Phases	1	6	8	5	2	4	8	3		4	7	
Permitted Phases			6			2						
Actuated Green, G (s)	9.0	32.2	41.9	7.1	30.3	44.5	9.7	21.9		14.2	26.4	
Effective Green, g (s)	9.0	32.2	41.9	7.1	30.3	44.5	9.7	21.9		14.2	26.4	
Actuated g/C Ratio	0.09	0.32	0.42	0.07	0.30	0.44	0.10	0.22		0.14	0.26	
Clearance Time (s)	6.0	6.0	6.3	6.0	6.0	6.3	6.3	6.3		6.3	6.3	
Vehicle Extension (s)	2.5	0.2	2.5	2.5	0.2	2.5	2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)	159	1139	651	125	1072	704	333	762		487	484	
v/s Ratio Prot	c0.08	0.28	0.02	0.05	c0.34	c0.14	0.08	0.20		0.09	c0.25	
v/s Ratio Perm			0.05			0.29						
v/c Ratio	0.94	0.87	0.16	0.73	1.11	0.97	0.82	0.92		0.62	0.96	
Uniform Delay, d1	45.2	32.0	18.1	45.5	34.9	27.1	44.3	38.2		40.4	36.2	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	52.5	9.4	0.1	17.9	64.7	26.8	14.0	16.8		2.1	30.0	
Delay (s)	97.7	41.4	18.1	63.4	99.5	54.0	58.3	55.1		42.5	66.2	
Level of Service	F	D	B	E	F	D	E	E		D	E	
Approach Delay (s)		44.9			81.3			56.0			56.9	
Approach LOS		D			F			E			E	

Intersection Summary			
HCM 2000 Control Delay	63.4	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.07		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	24.6
Intersection Capacity Utilization	90.7%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			