SALVINI CONSULTING
Transportation Engineering and Planning

Westmount Road and Conservation Drive

Intersection Operations Assessment

Summary Report

Prepared for:
2115881 Ontario Limited

June 2016

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Project Overview and Background

This Intersection Operations Assessment has been prepared in support of an application for a Draft Plan of Subdivision by 2115881 Ontario Limited. The application is for lands located generally north and west of the intersection of Conservation Drive and Beaver Creek Road within the Beaver Creek Meadows District Plan area in north Waterloo. A Class Environmental Assessment (Class EA) was recently completed by Stantec Consulting Ltd. for Beaver Creek Road and for Conservation Drive west of Westmount Road. The scope of this assessment was agreed to with City of Waterloo staff and provides greater detail related to the operation of the intersection at Westmount Road and Conservation Drive (the subject intersection) which falls outside the Class EA primary study area. The intersection currently operates under all-way stop control. There are single lane approaches both southbound and westbound. On the eastbound approach, there is an exclusive right turn lane and a shared left turn and through lane. On the northbound approach there is an exclusive left turn lane and a shared through and right turn lane.

The Draft Plan is located within the lands known as both N2 and the Mixed Use Node in the Beaver Creek Meadows District Plan. A copy of the proposed Draft Plan is included in Appendix A. A copy of the Community Structure for the Beaver Creek Meadows District Plan is included in Appendix B. Both the Beaver Creek Meadows District Plan and the Conservation Drive/Beaver Creek Road Class EA were approved by City Council in January of 2016.

This Draft Plan includes for the development of 258 single detached homes and 220 townhouses for a total of 478 residential units. In addition, a parcel has been set aside for a public elementary school intended to serve approximately 500 students. The school catchment area is the Beaver Creek Meadows District Plan area.

Existing Traffic Operations

A turning movement count at the Westmount/Conservation intersection was undertaken on Wednesday, March 23, 2016 during the weekday morning and afternoon peak periods to determine existing traffic volumes. The volumes are illustrated in Appendix C. The measured traffic volumes were compared to several historical traffic counts at the intersection in order to verify the validity of the data. Since the last traffic count was undertaken by the City, Laurelwood Drive has been extended easterly to Westmount Road, resulting in a redistribution of traffic through the subject intersection. In particular, the eastbound right turn and northbound left turn movements have decreased significantly in both the morning and afternoon peak hours.

The other area network change that is impacting traffic at the subject intersection is the construction on Northfield Drive near Highway 85. Construction in that area has limited the number of through lanes on Northfield Drive and the width of the available lanes, along with the full closure of the interchange ramps. In the morning peak hour at the Westmount/Conservation intersection, the eastbound left turn volumes have increased likely as a result of traffic diverting to the northerly ramps at King Street to Highway 85. When the construction is complete, the capacity along Northfield Drive will generally be restored, but only half of the interchange movements will be included in the modified design.

Later in this assessment, high volumes of traffic from the District Plan area are forecast for west to south and south to west movements at the Westmount/Conservation intersection. The diversion of eastbound traffic along Conservation Drive to Westmount Road due to the Northfield Drive construction represents the likely long term diversion once traffic volumes from the District Plan development emerge on the network.

The traffic volumes on all the other movements were consistent with previous traffic counts.

In discussion with City staff, the March 2016 traffic count was chosen to represent the base condition with the Laurelwood Drive extension for assessment and what is considered to be the long term diversion of traffic to the northerly King Street ramps to Highway 85. The intersection operations were analyzed using Synchro 9 software and the results are summarized in Table 1 below. Details of the analysis are included in Appendix D.

	AM Peak Hour				PM Peak Hour				Available Storage (m)
Lane Group	v/c	Delay (s)	LOS	95% Q (m)	v/c	Delay (s)	LOS	95% Q (m)	
NBL	0.098	10.7	B	0.3	0.338	12.2	B	1.5	30
NBTR	0.365	13.0	B	1.6	0.472	13.4	B	2.5	-
EBLT	0.397	14.1	B	1.9	0.161	11.4	B	0.6	-
EBR	0.372	11.9	B	1.7	0.116	9.9	A	0.4	50
WBLTR	0.175	11.8	B	0.6	0.116	11.2	B	0.4	-
SBLTR	0.562	17.5	C	3.5	0.658	19.0	C	4.9	-
Intersection	-	14.0	B	-	-	14.8	B	-	-

Table 1: Existing Traffic Operations – All-way Stop Control

The analysis indicates that the Westmount/Conservation intersection is operating at acceptable levels in both the weekday morning and afternoon peak hours.

Beaver Creek Meadows District Plan Traffic

The Beaver Creek Meadows District Plan includes for the development of a mix of land uses including the following:

- Approximately 2400 residential units with a mix of single detached homes and townhouses,
- 8,500 s.m. of retail in the mixed use node at the Beaver Creek/Conservation intersection,
- A public elementary school for 500 students in the subject Draft Plan area, and
- Three recreation fields in the N4 zone.

The 2115881 Ontario Limited Draft Plan represents a build out of approximately 20 percent of the District Plan residential units along with the elementary school.



A trip generation and distribution assessment was undertaken by Poulos + Chung Ltd. and adapted to the plan by Stantec for the purposes of the Beaver Creek Road and Conservation Drive Class EA. This assessment builds on the methodologies and assumptions in those studies with the following adjustments for the subject intersection:

- School site traffic was not included because the catchment area is the Beaver Creek Meadows District Plan area. School traffic will be generated internally to the District Plan area with the exception of a small number of staff trips in the morning peak hour.
- Retail traffic was reduced by 75% to account for the fact that the retail will be neighborhood related and predominantly serve the local population. Most of the traffic will be pass-by traffic or generated within the Beaver Creek Meadows District Plan with reduced impact at the subject intersection.
- Traffic that is currently generated by the Green Acre Park RV Park on Beaver Creek Road was estimated in the Stantec Study. The RV Park is open 10 months of the year, closed in January and February. Traffic generated in zone N4 in the Stantec study was reduced by the amount of traffic generated by the RV Park to account for the closure of the RV Park when N4 is built-out.

The mix of uses and the Institute of Transportation Engineers (ITE) trip generation rates used in the Stantec Class EA were included in this assessment. The distribution outlined in the Poulos + Chung study and used in the Stantec Class EA were also incorporated. The traffic for each zone included in this study with the modifications described above is summarized in Table 2 below.

Peak Hour	Direction	Zone							
		N1	N2	N3	N4	N5	N6	N7	MU
AM	In	14	54	21	72	42	60	12	49
	Out	60	168	81	233	135	194	35	181
	Total	74	222	102	306	177	254	47	230
PM	In	59	183	82	241	145	209	38	206
	Out	31	111	45	151	86	124	24	124
	Total	90	294	127	392	231	333	62	331

Table 2: Beaver Creek Meadows District Plan Traffic Generation by Zone

Future Traffic Assessment

Traffic Volumes

Two future horizons were chosen for study to be consistent with build-out assumptions in the Stantec Class EA. The first interim horizon is 2021 and represents 50% build-out of zones N2, N3, N5 and N6. The entire District Plan area was included in a second 2035 build-out scenario. Traffic generated in the mixed use node was split evenly between zones N2, N3, N4 and N5. A background growth rate of 1.5% per year of the existing traffic volumes at the intersection was incorporated into the traffic projections to be consistent with the Stantec Class EA (and verified with Region of Waterloo staff.

The future traffic volumes are illustrated in Appendix C.

The volumes at the subject intersection are lower than in the Stantec Class EA for the 2021 and 2035 scenarios for the following reasons:

- The base traffic volumes reflect redistributed traffic measured after the Laurelwood Drive extension to Westmount Road and with the long term diversion of traffic from the Northfield Drive interchange to the northerly King Street interchange with Highway 85.
- School traffic was not included given that the student population is local to the Beaver Creek Meadows District Plan.
- The retail traffic was reduced by 75% given that the retail will be neighborhood related with reduced impacts at the subject intersection.
- Existing traffic from Green Acre Park was subtracted from the 2035 numbers to reflect the fact that the Park will be redeveloped with the completion of zone N4.

Even with the lower traffic volumes in this assessment, several of the turning movements at the intersection are forecast at very high levels with full development of the District Plan in 2035. The morning eastbound right turn and evening northbound left turn movements are forecast at over 700 vehicles in the peak hour while the morning eastbound left turn and the evening southbound right turn are forecast at just over 400 vehicles per hour. Turning movement volumes in these ranges, in particular over 700 vehicles per hour, are uncommon at intersections. Generally, traffic will redistribute over the network to find a better balance in traffic flow. This assessment recognizes, however, that the options for traffic generated in the Beaver Creek Meadows District Plan area are limited to Erbsville Road, Beaver Creek Road and Westmount Road, and that traffic operations entering and exiting the District Plan area at Erbsville Road and Beaver Creek Road are also forecast to operate with high traffic volumes and some operational constraints (levels of service E and F on some movements, according to the Stantec Class EA). As a result, the traffic volumes were not redistributed.

There is the opportunity for the displacement of some existing traffic on Conservation Drive. A review of the existing traffic patterns from the Stantec Class EA suggests that 200 to 300 peak hour trips are generated along Conservation Drive eastbound leading to Westmount Road in the morning and returning westbound on Conservation Drive west of Westmount Road in the evening, which is the peak direction of travel through the subject intersection. The March 2016 traffic volumes indicate that an additional 100 to 150 vehicles per hour in the peak direction (eastbound on Conservation Drive in the morning and westbound in the afternoon) could be displaced elsewhere in the transportation network as the subject intersection becomes more congested. Traffic was not displaced for the purposes of this assessment, but the possible displacement of traffic over time is recognized.

Operations Analysis

The 2021 and 2035 intersection operations were analyzed using Synchro 9 software and the results are summarized in Table 3. Details of the analysis are included in Appendix D.

Lane Group	AM Peak Hour				PM Peak Hour				Available Storage (m)
	v/c	Delay (s)	LOS	95% Q (m)	v/c	Delay (s)	LOS	95% Q (m)	
Future Total 2021									
NBL	0.231	13.4	B	0.9	0.787	32.8	D	7.2	30
NBTR	0.452	16.6	C	2.3	0.610	19.7	C	4.1	-
EBLT	0.618	21.9	C	4.1	0.305	14.8	B	1.3	-
EBR	0.730	24.8	C	6.2	0.354	14.0	B	1.6	50
WBLTR	0.219	13.9	B	0.8	0.155	13.7	B	0.5	-
SBLTR	0.730	28.0	D	6.0	0.971	59.8	F	13.4	-
Intersection	-	22.3	C	-	-	34.8	D	-	-
Future Total 2035									
NBL	0.500	20.2	C	2.7	1.723	72.6	F	12.7	30
NBTR	0.585	22.2	C	3.7	0.827	39.6	E	8.3	-
EBLT	1.099	72.8	F	12.6	0.556	21.5	C	3.3	-
EBR	1.514	67.3	F	13.6	0.794	33.1	D	7.2	50
WBLTR	0.301	16.9	C	1.2	0.207	15.5	C	0.8	-
SBLTR	1.011	70.7	F	13.0	1.589	69.2	F	13.3	-
Intersection	-	57.4	F	-	-	54.5	F	-	-

Table 3: Future Traffic Operations – All-way Stop Control

The analysis indicates that the intersection will become congested with the southbound movements at level of service F in the weekday afternoon peak hour under 2021 traffic conditions. By 2035 with the full build-out of the District Plan, several movements are expected to operate at level of service F in both the weekday morning and afternoon peak hours.

The southbound approach to the intersection is wide and could be restriped to allow for two southbound lanes: an exclusive right turn lane and a shared through and left turn lane. This intersection modification would facilitate the growing southbound right turn movement over time and open up capacity at the intersection for improved operations. Under this modified intersection configuration, acceptable operations would be maintained in the interim 2021 scenario, but the 2035 traffic levels would still result in high delays as outlined in Table 4. Details of the analysis are included in Appendix E.



Lane Group	AM Peak Hour				PM Peak Hour				Available Storage (m)
	v/c	Delay (s)	LOS	95% Q (m)	v/c	Delay (s)	LOS	95% Q (m)	
Future Total 2021									
NBL	0.230	13.3	B	0.9	0.776	31.2	D	7.0	30
NBTR	0.451	16.4	C	2.3	0.599	19.1	C	4.0	-
EBLT	0.610	21.3	C	4.0	0.298	14.4	B	1.2	-
EBR	0.719	23.9	C	6.0	0.346	13.6	B	1.5	50
WBLTR	0.214	13.6	B	0.8	0.146	12.9	B	0.5	-
SBLT	0.629	22.6	C	4.3	0.559	18.6	C	3.4	-
SBR	0.113	10.5	B	0.4	0.433	13.9	B	2.2	
Intersection	-	20.1	C	-	-	19.9	C	-	-
Future Total 2035									
NBL	0.502	20.4	C	2.7	1.850	76.2	F	12.1	30
NBTR	0.588	22.3	C	3.7	0.908	54.8	F	10.0	-
EBLT	1.099	73.0	F	12.6	0.603	25.2	D	3.8	-
EBR	1.514	67.4	F	13.6	0.869	46.0	E	9.0	50
WBLTR	0.292	16.3	C	1.2	0.208	15.6	C	0.8	-
SBLT	0.833	42.3	E	8.1	0.807	39.3	E	7.4	-
SBR	0.232	12.8	B	0.9	0.917	53.7	F	10.6	
Intersection	-	50.3	F	-	-	53.7	F	-	-

Table 4: Future Traffic Operations – All-way Stop Control Additional SB Lane

In order to accommodate traffic volumes for the full build-out of the Beaver Creek Meadows District Plan, the City will need to consider a change in intersection control either to install traffic signals or a roundabout at the intersection.

Traffic Signal Warrant

The Ontario Traffic Manual (OTM Book 12) provides a tool for assessing when to install traffic signals at intersections using seven possible justifications. Justification 7 is used for intersections where the traffic is from planned development and only peak hour forecasts are available. Consideration is given to installing traffic signals when the volumes for Justification 1 (1A and 1B) or 2 (2A and 2B) reach 120% compliance.

When 8-hour volume projections are not available, Justification 7 relies on Average Hourly Volumes, defined as one quarter of the weekday morning and afternoon peak hours combined. The future assessment of the intersections compliance with the Justifications for traffic signals outlined in OTM Book 12 is summarized in Table 5.

Justification	Average Hourly Volume = (AM+PM)/4				
	Volume	Minimum	Compliance		Justification 7 met
			Sectional	Entire	
2021					
1A Total Volume	769	720	107%	107%	No
1B Minor Volume	291	170	171%		
2A Major Volume	477	720	66%	66%	No
2B Crossing Volume	126	75	168%		
2035					
1A Total Volume	1220	720	169%	169%	Yes
1B Minor Volume	513	170	302%		
2A Major Volume	707	720	98%	98%	No
2B Crossing Volume	295	75	393%		

Table 5: Traffic Signal Assessment - OTM Book 12 Justification 7

The traffic signal assessment indicates that Justification 7 will be met under 2035 traffic conditions. In addition, the assessment indicates that in 2021, Justification 1 would be met based on the average hourly volume. Given that the Region of Waterloo (who operates traffic signals within the City of Waterloo) practice is to investigate and/or install traffic signals when they are within one year of being justified, it is recommended that the City of Waterloo begin monitoring the intersection for traffic signal justification when development levels in the District Plan area reach 2020 forecast levels. Given that the District Plan area appears to be on track for 2021 development levels, the City should begin monitoring the subject intersection for traffic signal justification in 2020.

Future Intersection Operations – Traffic Signal or Roundabout

The Region of Waterloo requires that any intersection considered for traffic signal control also be evaluated under roundabout operation and that an assessment of the relative benefits of both control options be undertaken in an Intersection Control Study (ICS). The ICS is typically undertaken at the time when the justifications in OTM Book 12 are met for traffic signals based on existing traffic conditions.

A high level concept of a roundabout at the intersection was developed in partnership with Meritech Engineering for the purposes of understanding whether or not there is enough space within the intersection right-of-way for a standard roundabout. The concept is included in Appendix F. The concept illustrates that a roundabout with a 45 metre diameter could fit in the right-of-way at the Westmount/Conservation intersection and should be considered when traffic signals are justified at the intersection.

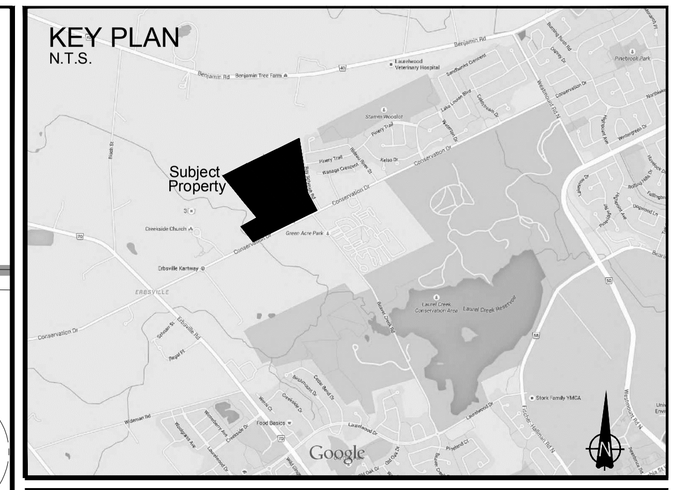
Conclusions and Recommendations

This assessment includes the following conclusions and recommendations related to the intersection of Westmount Road and Conservation Drive (the subject intersection).

- The base traffic levels included in this assessment reflect the redistribution of traffic related to both the extension of Laurelwood Drive easterly to Westmount Road as well as the construction on Northfield Drive. The diversion of traffic due to the construction on Northfield Drive reflects the long-term diversion related to increased traffic from the Beaver Creek Meadows District Plan.
- The intersection is currently operating at acceptable levels.
- District Plan traffic included in this assessment is lower than in the Stantec Class EA due to the following modifications:
    - School traffic was not included given that the student population is local to the Beaver Creek Meadows District Plan.
    - The retail traffic was reduced by 75% given that the retail will be neighborhood related with reduced impacts at the Westmount/Conservation intersection.
    - Existing traffic from Green Acre Park was subtracted from the 2035 numbers to reflect the fact that the Park will be redeveloped with the completion of zone N4.
- The intersection will become congested with the southbound movements at level of service F in the weekday afternoon peak hour under 2021 traffic conditions. By 2035 with the full build-out of the District Plan, several movements will operate at level of service F in both the weekday morning and afternoon peak hours.
- The City could restripe the southbound approach to the intersection to allow for two southbound lanes: an exclusive right turn lane and a shared through and left turn lane. Under this modified intersection configuration, acceptable operations would be maintained in the interim 2021 scenario, but the 2035 traffic levels would still result in high delays.
- The intersection meets OTM Book 12 Justification 7 for traffic signal control under 2035 traffic conditions. However, the assessment indicates that it will meet Justification 1 under 2021 traffic conditions using Average Hourly Volumes.
- It is recommended that the City of Waterloo begin monitoring the intersection for traffic signal justification in 2020.
- A roundabout with a 45 metre diameter could fit in the right-of-way at the intersection and should be considered by the City of Waterloo when traffic signals are justified.

Appendix A: Proposed Draft Plan





DRAFT PLAN OF SUBDIVISION

Part of Lot 28
German Company Tract
City of Waterloo
Regional Municipality of Waterloo

LAND USE SCHEDULE

DESCRIPTION	LOTS/BLKS.	UNITS	AREA (ha.)
Residential (single detached)	1-258	258	8.62
Street Townhouses	259-301, 414-478	108	2.22
Back-to-Back Townhouses	302-413	112	1.14
School	479		2.88
Park	480		1.22
Parkette	481-483		0.12
Open Space	484-486		4.75
Stormwater Management	487		1.06
Trail	488		0.31
Walkway	489-492		0.07
Road Widening	493		0.20
0.3m Reserve	494-496		0.00
Roads			6.05
Total		478	28.64

ADDITIONAL INFORMATION

(UNDER SECTION 51(17) OF THE PLANNING ACT)

INFORMATION REQUIRED BY CLAUSES a,b,c,d,e,f,g,j and I ARE AS SHOWN ON THE DRAFT PLAN.
h) Municipal water supply
i) Well-drained sandy loam on lacustrine deposits
k) All sanitary and storm sewers as required

OWNER'S CERTIFICATE

I AUTHORIZE THE GSP GROUP INC. TO PREPARE AND SUBMIT THIS DRAFT PLAN OF SUBDIVISION TO THE REGIONAL MUNICIPALITY OF WATERLOO.

OWNER _____ DATE _____

SURVEYOR'S CERTIFICATE

I CERTIFY THAT THE BOUNDARIES OF THE LAND TO BE SUBDIVIDED AND THEIR RELATIONSHIP TO THE ADJACENT LANDS ARE CORRECTLY SHOWN.

SURVEYOR _____ DATE _____

GSP group
PLANNING I URBAN DESIGN I LANDSCAPE ARCHITECTURE
gspgroup.ca

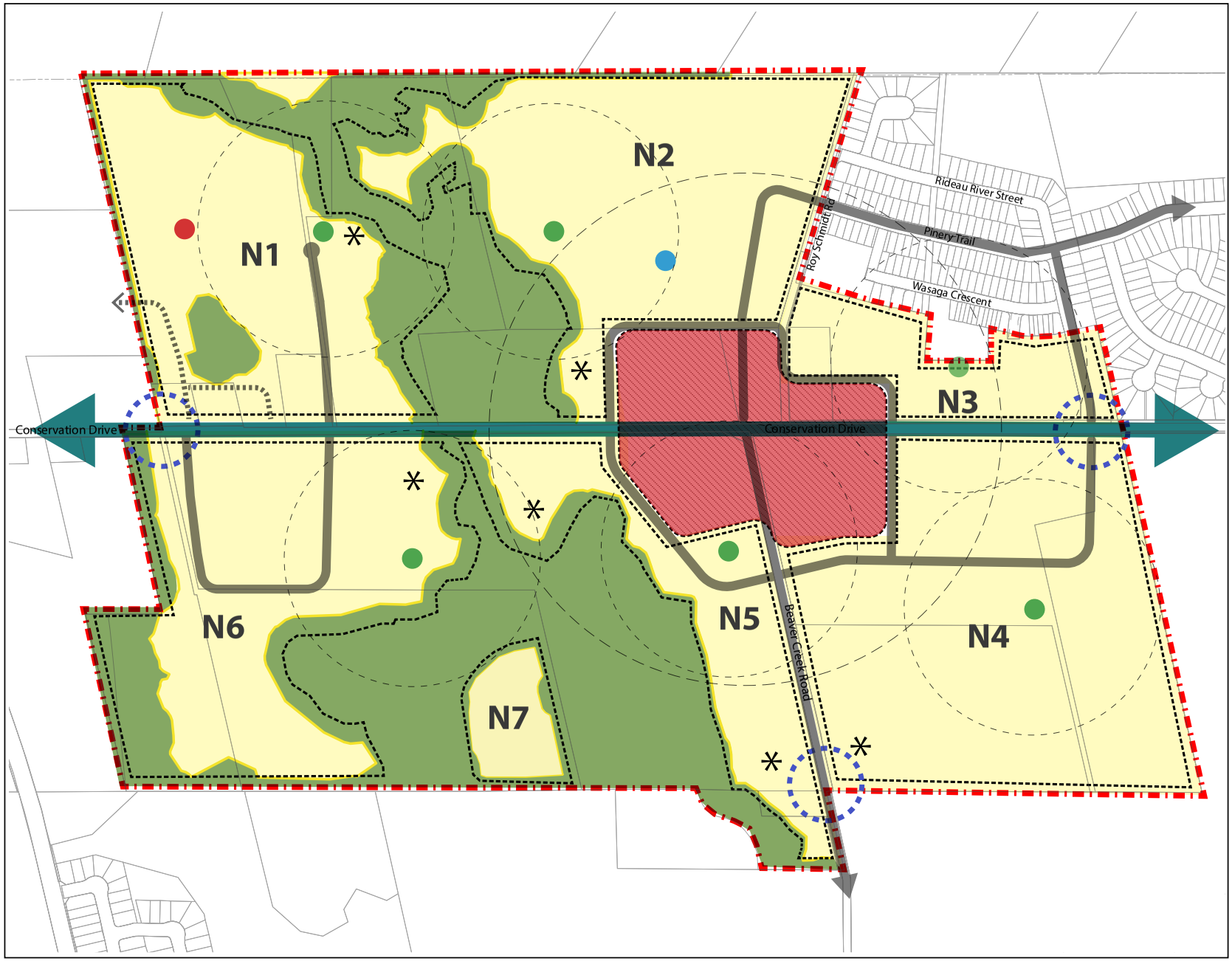
REVISIONS
February 1, 2016
March 3, 2016
March 30, 2016
May 2, 2016

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Appendix B: Beaver Creek Meadows District Plan – Community Structure

BEAVER CREEK MEADOWS DISTRICT PLAN

MAP 2
COMMUNITY STRUCTURE



LEGEND

- District Plan Boundary
- Neighbourhood
- Mixed Use Node
- Natural System (including buffers)
- Minor Collector Road
- Major Collector Road
- Potential Road Connection
- Potential Stormwater Management Facility
- Potential Park
- Potential Elementary School
- Spiritual Use
- 2-minute Walk (200-metre radius)
- 5-minute Walk (400-metre radius)
- Gateway
- Development Limit

0 50 100 200 300 metres

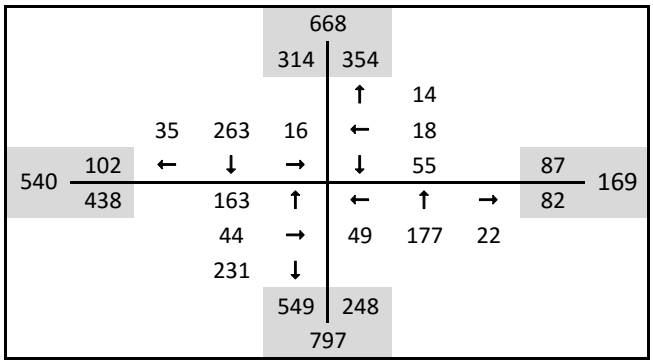
Last Updated: January 19, 2016

Appendix C: Traffic Volumes

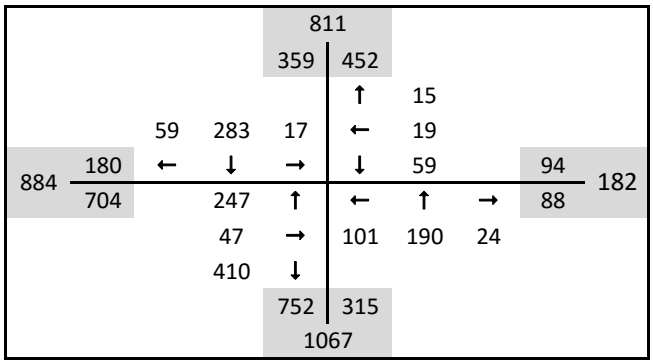
AM Peak Hour

Existing Traffic

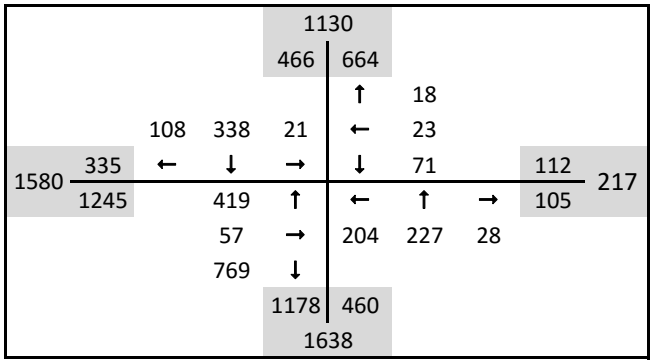
March 23, 2016



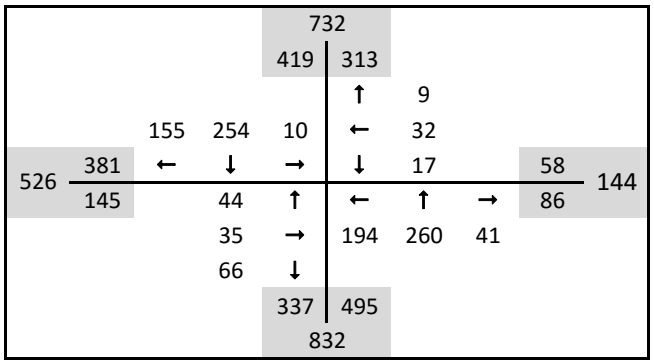
Future Total 2021

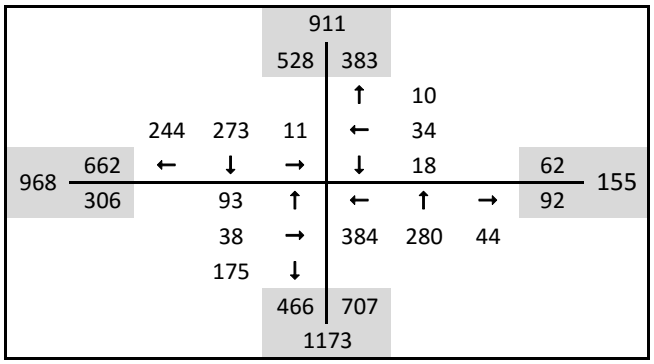


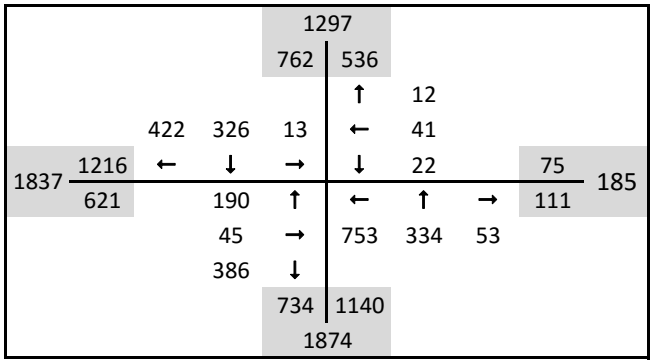
Future Total 2035



PM Peak Hour







Appendix D: Synchro Analysis Worksheets

Intersection	
Intersection Delay, s/veh	14
Intersection LOS	B

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Traffic Vol, veh/h	0	163	44	231	0	55	18	14	0	49	177	22
Future Vol, veh/h	0	163	44	231	0	55	18	14	0	49	177	22
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	163	44	231	0	55	18	14	0	49	177	22
Number of Lanes	0	0	1	1	0	0	1	0	0	1	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	2	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	2	2
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	2	1	1
HCM Control Delay	12.9	11.8	12.5
HCM LOS	B	B	B

Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	SBLn1
Vol Left, %	100%	0%	79%	0%	63%	5%
Vol Thru, %	0%	89%	21%	0%	21%	84%
Vol Right, %	0%	11%	0%	100%	16%	11%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	49	199	207	231	87	314
LT Vol	49	0	163	0	55	16
Through Vol	0	177	44	0	18	263
RT Vol	0	22	0	231	14	35
Lane Flow Rate	49	199	207	231	87	314
Geometry Grp	7	7	7	7	6	6
Degree of Util (X)	0.097	0.362	0.395	0.369	0.173	0.562
Departure Headway (Hd)	7.143	6.554	6.87	5.758	7.174	6.438
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes
Cap	499	545	522	621	496	559
Service Time	4.921	4.332	4.64	3.527	5.273	4.505
HCM Lane V/C Ratio	0.098	0.365	0.397	0.372	0.175	0.562
HCM Control Delay	10.7	13	14.1	11.9	11.8	17.5
HCM Lane LOS	B	B	B	B	B	C
HCM 95th-tile Q	0.3	1.6	1.9	1.7	0.6	3.5

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Traffic Vol, veh/h	0	16	263	35
Future Vol, veh/h	0	16	263	35
Peak Hour Factor	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2
Mvmt Flow	0	16	263	35
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	2
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	2
HCM Control Delay	17.5
HCM LOS	C

Lane

Intersection	
Intersection Delay, s/veh	14.8
Intersection LOS	B

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Traffic Vol, veh/h	0	44	35	66	0	17	32	9	0	194	260	41
Future Vol, veh/h	0	44	35	66	0	17	32	9	0	194	260	41
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	44	35	66	0	17	32	9	0	194	260	41
Number of Lanes	0	0	1	1	0	0	1	0	0	1	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	2	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	2	2
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	2	1	1
HCM Control Delay	10.7	11.2	12.9
HCM LOS	B	B	B

Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	SBLn1
Vol Left, %	100%	0%	56%	0%	29%	2%
Vol Thru, %	0%	86%	44%	0%	55%	61%
Vol Right, %	0%	14%	0%	100%	16%	37%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	194	301	79	66	58	419
LT Vol	194	0	44	0	17	10
Through Vol	0	260	35	0	32	254
RT Vol	0	41	0	66	9	155
Lane Flow Rate	194	301	79	66	58	419
Geometry Grp	7	7	7	7	6	6
Degree of Util (X)	0.337	0.473	0.16	0.115	0.116	0.658
Departure Headway (Hd)	6.257	5.654	7.276	6.277	7.187	5.655
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes
Cap	574	638	492	570	498	637
Service Time	3.996	3.393	5.03	4.03	5.251	3.692
HCM Lane V/C Ratio	0.338	0.472	0.161	0.116	0.116	0.658
HCM Control Delay	12.2	13.4	11.4	9.9	11.2	19
HCM Lane LOS	B	B	B	A	B	C
HCM 95th-tile Q	1.5	2.5	0.6	0.4	0.4	4.9

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Traffic Vol, veh/h	0	10	254	155
Future Vol, veh/h	0	10	254	155
Peak Hour Factor	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2
Mvmt Flow	0	10	254	155
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	2
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	2
HCM Control Delay	19
HCM LOS	C

Lane

Intersection	
Intersection Delay, s/veh	22.3
Intersection LOS	C

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Traffic Vol, veh/h	0	247	47	410	0	59	19	15	0	101	190	24
Future Vol, veh/h	0	247	47	410	0	59	19	15	0	101	190	24
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	247	47	410	0	59	19	15	0	101	190	24
Number of Lanes	0	0	1	1	0	0	1	0	0	1	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	2	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	2	2
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	2	1	1
HCM Control Delay	23.6	13.9	15.6
HCM LOS	C	B	C

Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	SBLn1
Vol Left, %	100%	0%	84%	0%	63%	5%
Vol Thru, %	0%	89%	16%	0%	20%	79%
Vol Right, %	0%	11%	0%	100%	16%	16%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	101	214	294	410	93	359
LT Vol	101	0	247	0	59	17
Through Vol	0	190	47	0	19	283
RT Vol	0	24	0	410	15	59
Lane Flow Rate	101	214	294	410	93	359
Geometry Grp	7	7	7	7	6	6
Degree of Util (X)	0.23	0.453	0.619	0.732	0.218	0.732
Departure Headway (Hd)	8.212	7.617	7.575	6.429	8.441	7.345
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes
Cap	437	473	476	562	425	492
Service Time	5.961	5.366	5.317	4.171	6.506	5.386
HCM Lane V/C Ratio	0.231	0.452	0.618	0.73	0.219	0.73
HCM Control Delay	13.4	16.6	21.9	24.8	13.9	28
HCM Lane LOS	B	C	C	C	B	D
HCM 95th-tile Q	0.9	2.3	4.1	6.2	0.8	6

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Traffic Vol, veh/h	0	17	283	59
Future Vol, veh/h	0	17	283	59
Peak Hour Factor	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2
Mvmt Flow	0	17	283	59
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	2
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	2
HCM Control Delay	28
HCM LOS	D

Lane

Intersection	
Intersection Delay, s/veh	34.8
Intersection LOS	D

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Traffic Vol, veh/h	0	93	38	175	0	18	34	10	0	384	280	44
Future Vol, veh/h	0	93	38	175	0	18	34	10	0	384	280	44
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	93	38	175	0	18	34	10	0	384	280	44
Number of Lanes	0	0	1	1	0	0	1	0	0	1	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	2	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	2	2
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	2	1	1
HCM Control Delay	14.3	13.7	26.8
HCM LOS	B	B	D

Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	SBLn1
Vol Left, %	100%	0%	71%	0%	29%	2%
Vol Thru, %	0%	86%	29%	0%	55%	52%
Vol Right, %	0%	14%	0%	100%	16%	46%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	384	324	131	175	62	528
LT Vol	384	0	93	0	18	11
Through Vol	0	280	38	0	34	273
RT Vol	0	44	0	175	10	244
Lane Flow Rate	384	324	131	175	62	528
Geometry Grp	7	7	7	7	6	6
Degree of Util (X)	0.79	0.612	0.305	0.355	0.154	0.98
Departure Headway (Hd)	7.409	6.799	8.386	7.296	8.969	6.682
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes
Cap	488	531	430	494	399	544
Service Time	5.15	4.54	6.125	5.035	7.033	4.716
HCM Lane V/C Ratio	0.787	0.61	0.305	0.354	0.155	0.971
HCM Control Delay	32.8	19.7	14.8	14	13.7	59.8
HCM Lane LOS	D	C	B	B	B	F
HCM 95th-tile Q	7.2	4.1	1.3	1.6	0.5	13.4

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Traffic Vol, veh/h	0	11	273	244
Future Vol, veh/h	0	11	273	244
Peak Hour Factor	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2
Mvmt Flow	0	11	273	244
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	2
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	2
HCM Control Delay	59.8
HCM LOS	F

Lane

Intersection	
Intersection Delay, s/veh	57.4
Intersection LOS	F

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Traffic Vol, veh/h	0	419	57	769	0	71	23	18	0	204	227	28
Future Vol, veh/h	0	419	57	769	0	71	23	18	0	204	227	28
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	419	57	769	0	71	23	18	0	204	227	28
Number of Lanes	0	0	1	1	0	0	1	0	0	1	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	2	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	2	2
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	2	1	1
HCM Control Delay	69.4	16.9	21.3
HCM LOS	F	C	C

Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	SBLn1
Vol Left, %	100%	0%	88%	0%	63%	4%
Vol Thru, %	0%	89%	12%	0%	21%	72%
Vol Right, %	0%	11%	0%	100%	16%	23%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	204	255	476	769	112	467
LT Vol	204	0	419	0	71	21
Through Vol	0	227	57	0	23	338
RT Vol	0	28	0	769	18	108
Lane Flow Rate	204	255	476	769	112	467
Geometry Grp	7	7	7	7	6	6
Degree of Util (X)	0.502	0.587	1	1	0.301	1
Departure Headway (Hd)	8.865	8.288	8.536	7.358	9.671	7.884
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes
Cap	408	436	433	508	372	462
Service Time	6.603	6.026	6.138	4.999	7.722	5.947
HCM Lane V/C Ratio	0.5	0.585	1.099	1.514	0.301	1.011
HCM Control Delay	20.2	22.2	72.8	67.3	16.9	70.7
HCM Lane LOS	C	C	F	F	C	F
HCM 95th-tile Q	2.7	3.7	12.6	13.6	1.2	13

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Traffic Vol, veh/h	0	21	338	108
Future Vol, veh/h	0	21	338	108
Peak Hour Factor	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2
Mvmt Flow	0	21	338	108
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	2
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	2
HCM Control Delay	70.7
HCM LOS	F

Lane

Intersection	
Intersection Delay, s/veh	54.5
Intersection LOS	F

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Traffic Vol, veh/h	0	190	45	386	0	22	41	12	0	753	334	53
Future Vol, veh/h	0	190	45	386	0	22	41	12	0	753	334	53
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	190	45	386	0	22	41	12	0	753	334	53
Number of Lanes	0	0	1	1	0	0	1	0	0	1	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	2	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	2	2
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	2	1	1
HCM Control Delay	28.7	15.5	61.4
HCM LOS	D	C	F

Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	SBLn1
Vol Left, %	100%	0%	81%	0%	29%	2%
Vol Thru, %	0%	86%	19%	0%	55%	43%
Vol Right, %	0%	14%	0%	100%	16%	55%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	753	387	235	386	75	761
LT Vol	753	0	190	0	22	13
Through Vol	0	334	45	0	41	326
RT Vol	0	53	0	386	12	422
Lane Flow Rate	753	387	235	386	75	761
Geometry Grp	7	7	7	7	6	6
Degree of Util (X)	1	0.839	0.554	0.792	0.207	1
Departure Headway (Hd)	8.405	7.808	8.6	7.496	9.94	7.624
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes
Cap	437	468	423	486	363	479
Service Time	6.111	5.514	6.3	5.196	7.94	5.632
HCM Lane V/C Ratio	1.723	0.827	0.556	0.794	0.207	1.589
HCM Control Delay	72.6	39.6	21.5	33.1	15.5	69.2
HCM Lane LOS	F	E	C	D	C	F
HCM 95th-tile Q	12.7	8.3	3.3	7.2	0.8	13.3

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Traffic Vol, veh/h	0	13	326	422
Future Vol, veh/h	0	13	326	422
Peak Hour Factor	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2
Mvmt Flow	0	13	326	422
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	2
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	2
HCM Control Delay	69.2
HCM LOS	F

Lane

Appendix E: Synchro Analysis Worksheets – Modified Intersection Configuration

Intersection	
Intersection Delay, s/veh	20.1
Intersection LOS	C

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Traffic Vol, veh/h	0	247	47	410	0	59	19	15	0	101	190	24
Future Vol, veh/h	0	247	47	410	0	59	19	15	0	101	190	24
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	247	47	410	0	59	19	15	0	101	190	24
Number of Lanes	0	0	1	1	0	0	1	0	0	1	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	2	2
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	2	2	2
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	2	2	1
HCM Control Delay	22.8	13.6	15.4
HCM LOS	C	B	C

Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	SBLn1	SBLn2
Vol Left, %	100%	0%	84%	0%	63%	6%	0%
Vol Thru, %	0%	89%	16%	0%	20%	94%	0%
Vol Right, %	0%	11%	0%	100%	16%	0%	100%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	101	214	294	410	93	300	59
LT Vol	101	0	247	0	59	17	0
Through Vol	0	190	47	0	19	283	0
RT Vol	0	24	0	410	15	0	59
Lane Flow Rate	101	214	294	410	93	300	59
Geometry Grp	7	7	7	7	6	7	7
Degree of Util (X)	0.229	0.451	0.611	0.722	0.213	0.633	0.112
Departure Headway (Hd)	8.176	7.58	7.483	6.34	8.262	7.598	6.849
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	439	475	482	570	434	477	523
Service Time	5.921	5.325	5.222	4.079	6.321	5.341	4.591
HCM Lane V/C Ratio	0.23	0.451	0.61	0.719	0.214	0.629	0.113
HCM Control Delay	13.3	16.4	21.3	23.9	13.6	22.6	10.5
HCM Lane LOS	B	C	C	C	B	C	B
HCM 95th-tile Q	0.9	2.3	4	6	0.8	4.3	0.4

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Traffic Vol, veh/h	0	17	283	59
Future Vol, veh/h	0	17	283	59
Peak Hour Factor	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2
Mvmt Flow	0	17	283	59
Number of Lanes	0	0	1	1

Approach	SB
Opposing Approach	NB
Opposing Lanes	2
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	2
HCM Control Delay	20.6
HCM LOS	C

Lane

Intersection	
Intersection Delay, s/veh	19.9
Intersection LOS	C

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Traffic Vol, veh/h	0	93	38	175	0	18	34	10	0	384	280	44
Future Vol, veh/h	0	93	38	175	0	18	34	10	0	384	280	44
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	93	38	175	0	18	34	10	0	384	280	44
Number of Lanes	0	0	1	1	0	0	1	0	0	1	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	2	2
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	2	2	2
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	2	2	1
HCM Control Delay	13.9	12.9	25.7
HCM LOS	B	B	D

Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	SBLn1	SBLn2
Vol Left, %	100%	0%	71%	0%	29%	4%	0%
Vol Thru, %	0%	86%	29%	0%	55%	96%	0%
Vol Right, %	0%	14%	0%	100%	16%	0%	100%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	384	324	131	175	62	284	244
LT Vol	384	0	93	0	18	11	0
Through Vol	0	280	38	0	34	273	0
RT Vol	0	44	0	175	10	0	244
Lane Flow Rate	384	324	131	175	62	284	244
Geometry Grp	7	7	7	7	6	7	7
Degree of Util (X)	0.778	0.602	0.299	0.347	0.145	0.561	0.432
Departure Headway (Hd)	7.297	6.689	8.211	7.128	8.444	7.117	6.381
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	495	541	439	506	425	508	564
Service Time	5.032	4.424	5.947	4.864	6.491	4.855	4.118
HCM Lane V/C Ratio	0.776	0.599	0.298	0.346	0.146	0.559	0.433
HCM Control Delay	31.2	19.1	14.4	13.6	12.9	18.6	13.9
HCM Lane LOS	D	C	B	B	B	C	B
HCM 95th-tile Q	7	4	1.2	1.5	0.5	3.4	2.2

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Traffic Vol, veh/h	0	11	273	244
Future Vol, veh/h	0	11	273	244
Peak Hour Factor	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2
Mvmt Flow	0	11	273	244
Number of Lanes	0	0	1	1

Approach	SB
Opposing Approach	NB
Opposing Lanes	2
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	2
HCM Control Delay	16.4
HCM LOS	C

Lane

Intersection	
Intersection Delay, s/veh	50.3
Intersection LOS	F

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Traffic Vol, veh/h	0	419	57	769	0	71	23	18	0	204	227	28
Future Vol, veh/h	0	419	57	769	0	71	23	18	0	204	227	28
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	419	57	769	0	71	23	18	0	204	227	28
Number of Lanes	0	0	1	1	0	0	1	0	0	1	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	2	2
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	2	2	2
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	2	2	1
HCM Control Delay	69.5	16.3	21.5
HCM LOS	F	C	C

Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	SBLn1	SBLn2
Vol Left, %	100%	0%	88%	0%	63%	6%	0%
Vol Thru, %	0%	89%	12%	0%	21%	94%	0%
Vol Right, %	0%	11%	0%	100%	16%	0%	100%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	204	255	476	769	112	359	108
LT Vol	204	0	419	0	71	21	0
Through Vol	0	227	57	0	23	338	0
RT Vol	0	28	0	769	18	0	108
Lane Flow Rate	204	255	476	769	112	359	108
Geometry Grp	7	7	7	7	6	7	7
Degree of Util (X)	0.503	0.588	1	1	0.293	0.84	0.231
Departure Headway (Hd)	8.881	8.304	8.481	7.306	9.418	8.428	7.7
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	406	434	433	508	384	431	465
Service Time	6.646	6.069	6.186	5.012	7.418	6.19	5.461
HCM Lane V/C Ratio	0.502	0.588	1.099	1.514	0.292	0.833	0.232
HCM Control Delay	20.4	22.3	73	67.4	16.3	42.3	12.8
HCM Lane LOS	C	C	F	F	C	E	B
HCM 95th-tile Q	2.7	3.7	12.6	13.6	1.2	8.1	0.9

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Traffic Vol, veh/h	0	21	338	108
Future Vol, veh/h	0	21	338	108
Peak Hour Factor	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2
Mvmt Flow	0	21	338	108
Number of Lanes	0	0	1	1

Approach	SB
Opposing Approach	NB
Opposing Lanes	2
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	2
HCM Control Delay	35.5
HCM LOS	E

Lane

Intersection	
Intersection Delay, s/veh	53.7
Intersection LOS	F

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Traffic Vol, veh/h	0	190	45	386	0	22	41	12	0	753	334	53
Future Vol, veh/h	0	190	45	386	0	22	41	12	0	753	334	53
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	190	45	386	0	22	41	12	0	753	334	53
Number of Lanes	0	0	1	1	0	0	1	0	0	1	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	2	2
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	2	2	2
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	2	2	1
HCM Control Delay	38.1	15.6	68.9
HCM LOS	E	C	F

Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	SBLn1	SBLn2
Vol Left, %	100%	0%	81%	0%	29%	4%	0%
Vol Thru, %	0%	86%	19%	0%	55%	96%	0%
Vol Right, %	0%	14%	0%	100%	16%	0%	100%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	753	387	235	386	75	339	422
LT Vol	753	0	190	0	22	13	0
Through Vol	0	334	45	0	41	326	0
RT Vol	0	53	0	386	12	0	422
Lane Flow Rate	753	387	235	386	75	339	422
Geometry Grp	7	7	7	7	6	7	7
Degree of Util (X)	1	0.916	0.604	0.874	0.208	0.811	0.925
Departure Headway (Hd)	9.139	8.521	9.256	8.153	9.972	8.614	7.892
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	407	426	390	444	361	420	460
Service Time	6.892	6.274	7.001	5.898	8.002	6.357	5.635
HCM Lane V/C Ratio	1.85	0.908	0.603	0.869	0.208	0.807	0.917
HCM Control Delay	76.2	54.8	25.2	46	15.6	39.3	53.7
HCM Lane LOS	F	F	D	E	C	E	F
HCM 95th-tile Q	12.1	10	3.8	9	0.8	7.4	10.6

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Traffic Vol, veh/h	0	13	326	422
Future Vol, veh/h	0	13	326	422
Peak Hour Factor	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2
Mvmt Flow	0	13	326	422
Number of Lanes	0	0	1	1

Approach	SB
Opposing Approach	NB
Opposing Lanes	2
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	2
HCM Control Delay	47.3
HCM LOS	E

Lane

Appendix F: Roundabout Concept



DRAWING:	Roundabout (Conservation @ Westmount) ----				
DRAWN BY:	JEL	CHECKED BY:	CHT	SCALE:	1:500
FILE NAME:	1279	DATE:	May 30, 2016		1279-1

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