City of Niagara Falls

Northwest Secondary Plan

Transportation Impact Study Existing Conditions Report

November 14, 2024



Northwest Secondary Plan, City of Niagara Falls

Transportation Impact Study Existing Conditions Report

City of Niagara Falls

FINAL

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WSP

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A Synchro Output

1 Introduction

1.1 Overview

The City of Niagara Falls is preparing Secondary Plans for lands recently added to the City's serviced urban area by Niagara Region, following their Municipal Comprehensive Review and Land Needs Assessment work prepared as part of their new Official Plan. The City is required to undertake secondary planning for greenfield lands added through the expansion process. Background studies are required to be completed as part of the secondary planning process.

WSP was commissioned to undertake the analysis of the potential transportation needs of the Secondary Plan.

The Northwest Secondary Plan Area is located west of the Queen Elizabeth Way (QEW), south of Mountain Road (Regional Road 101) and east of Kalar Road, (Regional Road 98, which also includes Montrose Road as Regional Road 98). The southerly limit of the existing hydro corridor represents the southern boundary limit of the Plan Area.

The existing land uses include a place of worship, a hospitality and event centre (Club Italia), the Regency Athletic Resort and Restaurant, the Shady Oaks Mobile Home Park, and Niagara Sports Centre. In the interim, large portions of the Plan Area are being used for agricultural cash crop with some areas of natural vegetation. The total gross Plan Area is approximately 101 ha. **Figure 1-1** shows the extent of the Study Area.

1.2 Study Approach

This Transportation Impact Study (TIS) follows a three (3) phase methodology agreed to between the City of Niagara Falls and WSP. This Report represents the outcome of the Phase 1 component of the overall study approach. The City was required to consult with Niagara Region on the Terms of Reference prior to commencing this study work. The TIS approach will include the following:

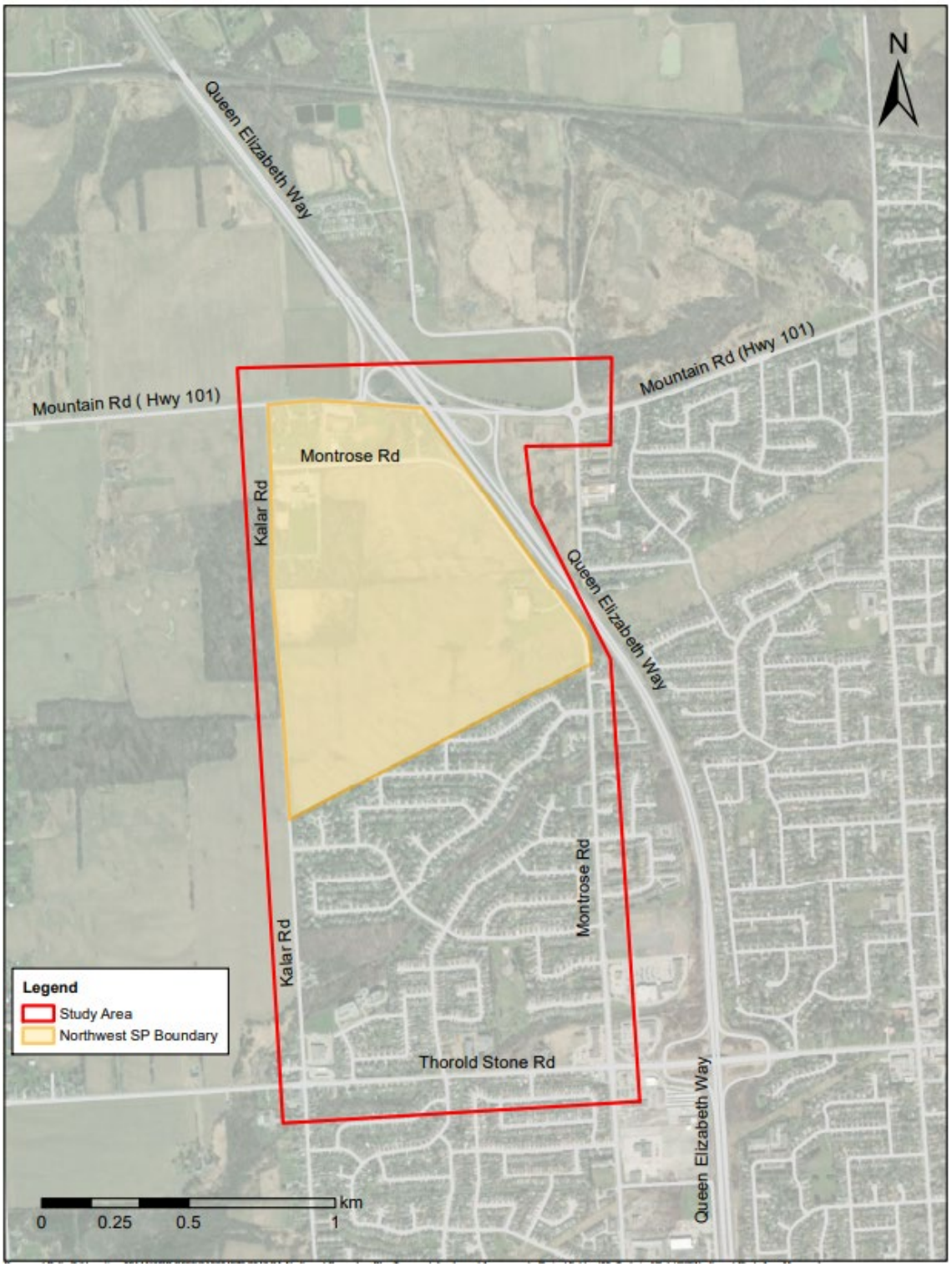
Existing Conditions (This Phase 1 Reporting)

A comprehensive review of the existing conditions will be undertaken. This will include an analysis of the existing road network, transit routes and active transportation infrastructure. This section will provide the 2024 existing lane configuration of the Study Area intersections, the available existing traffic volumes, and the existing capacity analysis of the intersections.

Niagara Region Activity Based Model

The Niagara Region Activity Based Model (NRABM) will be a key tool used to identify the roadway infrastructure requirements for the growth scenarios. The 2024 base year mode will be used. Subsequent phases and reporting of this assignment will then focus on the Year 2031 Model which will look at the volume forecasts and roadway network

Figure 1-1 Study Area



performance and finally the 2051 Model focusing on the volume forecasts and roadway network performance. This section will include the 2024 existing lane configuration of the Study Area intersections, the available existing traffic volumes, and the existing capacity analysis of the intersections.

Land Use Options Assessment (Phase 2)

Land Use Options Assessment are part of the second phase of this study and will be subject of Phase 2 reporting at a later date, following the City's required agency consultations, public and stakeholder/partner engagement, and the preparation of options for further assessment. This section will include the information on the assessment criteria, and evaluation of two land use options.

Future Background Conditions (Phase 3)

Phase 3 of the TIS (once a preferred land use option has been determined) will consider the three planning horizons of 2031, 2041, and 2051. This section will focus on planned roadway improvements and background traffic conditions and background intersection performance for all three planning horizons. This section will conclude with the findings of the future background analysis.

Study Area Generated Traffic (Phase 3)

The Phase 3 analysis will focus on the Study Area generated traffic by focusing on the preferred land use, trip generation, the preferred land use plan roadway network, as well as the trip distribution and assignment.

Future Travel Conditions (Phase 3)

The Phase 3 analysis will focus on the future travel conditions taking into account the three planning horizons of 2031, 2041, and 2051. The future total traffic conditions and future total intersection performance for all three horizons will be reported in this section, concluding with the findings of the future total analysis that will inform on improvements required over the horizon.

Transit & Active Transportation (Phase 3)

The Phase 3 analysis will take into account the future transit and active transportation potential and identify opportunities for improved pedestrian connectivity internally and with the broader area, supporting multi-modal options with anticipated transit needs to serve the new community. This section will include the suggested transit and active transportation improvements in the Study Area.

Transportation Improvements (Phase 3)

The Phase 3 section will detail transportation improvements needed to support the new community, including roadway and intersection improvements, transit and active transportation improvements, policy recommendations, and an implementation plan that will provide cost estimates.

Conclusions (Phase 3)

On completing all three phases of this assignment, the Conclusions section will provide a comprehensive summary of the noted transportation observations and proposed improvements as part of the Northwest Secondary Plan TIS serving to guide the capital planning and development process over the course of the planned future community implementation.

2 Existing Conditions

2.1 Road Network

There are presently six main/arterial roads in the Study Area.

- **Mountain Road** is a Regional two-lane east-west arterial road that forms the northern boundary of the Study Area. It provides a connection to the Queen Elizabeth Way. The posted speed is 60km/h.
- **Kalar Road** is a Regional two lane north-south arterial road that forms the western boundary of the Study Area. The posted speed is 70 km/h between Mountain Road and Montrose Road, 80 km/h between Montrose Road and Mount Carmel Boulevard, 60 km/h south of Mount Carmel Boulevard to approximately 350m north of Thorold Stone Road, and then 50 km/h to Thorold Stone Road.
- **Queen Elizabeth Way** is a Provincial 400 Series Highway that connects from the Canada / United States border at Fort Erie through to Toronto with various other connecting 400 Series highway along that identified stretch. The highway includes two lanes in each direction but transitions to three lanes in each direction north of Mountain Road and the posted speed is 110 km/h.
- **Mewburn Road** is a City two lane road located to the northeast of the Study Area which connects to Mountain Road. The posted speed is 60km/h.
- **Montrose Road** is a Regional two lane north south arterial road that passes through the Study Area, in part, before becoming adjacent and parallel to the QEW, which forms the eastern boundary of the Study Area. The posted speed is 70 km/h from Kalar Road to the hydro corridor, then 50km/h south of it.
- **Thorold Stone Road** is a Regional four lane arterial east-west road located approximately 1 km to the south of the Study Area. The road has a connection to the Queen Elizabeth Way to the east and transitions into Provincial Highway 58 several kilometre to the west, where it crosses the Welland Canal and ultimately merging with Highway 406. The posted speed is 50km/h for the stretch of roadway between the Kalar and Montrose Road intersections.

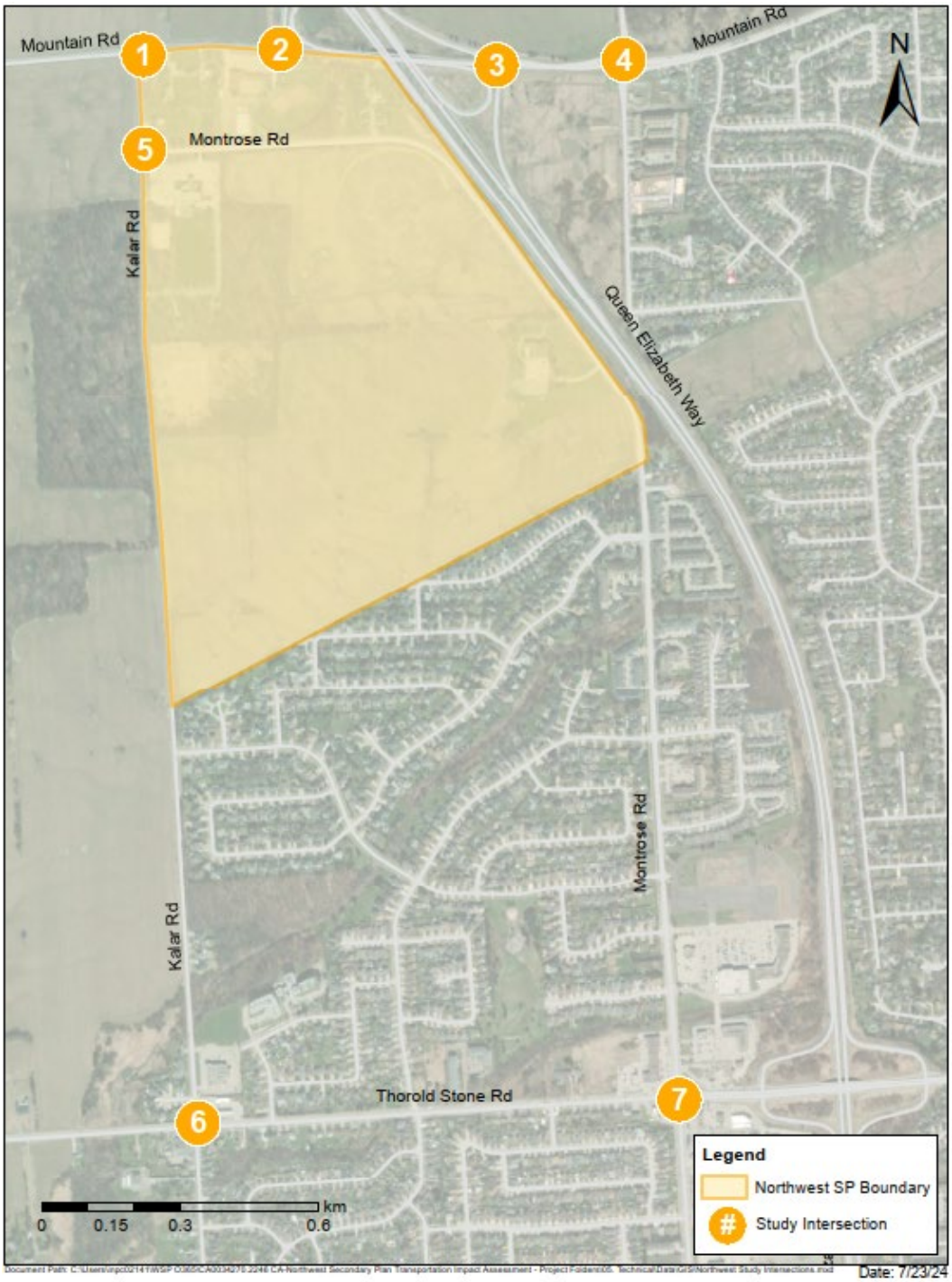
Figure 2-1 shows the road network in the vicinity of the Study Area**.**

2.2 Study Area Intersections

The seven intersections included in the intersection capacity analysis are:

1. Mountain Road & Kalar Road
2. Mountain Road & Queen Elizabeth Way SB off ramp
3. Mountain Road & Queen Elizabeth Way NB off ramp
4. Mountain Road & Mewburn Road

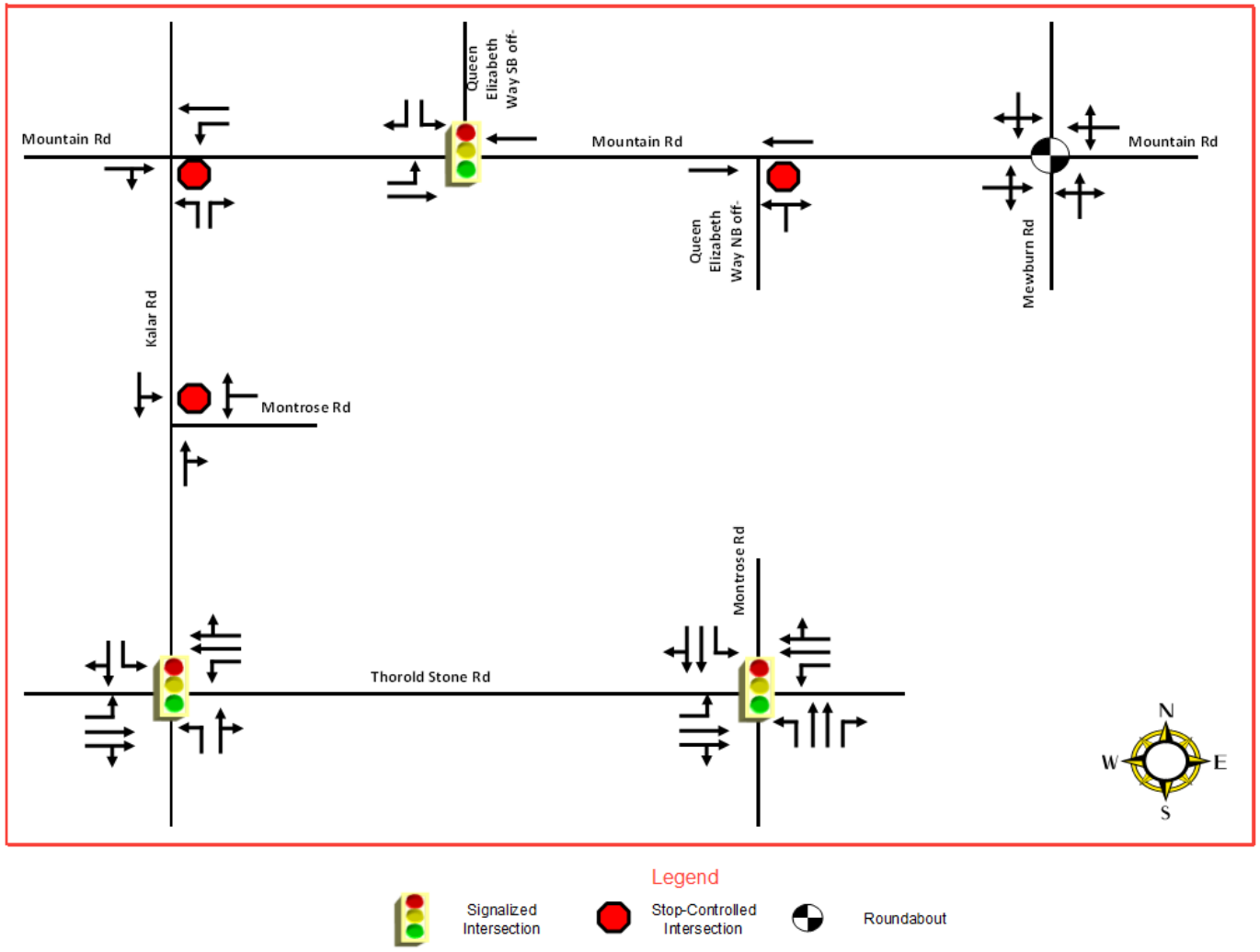
Figure 2-1 Study Intersections



5 Kalar Road & Montrose Road
6 Kalar Road & Thorold Stone Road
7 Montrose Road & Thorold Stone Road

The Study Area intersections are shown in **Figure 2-1**. **Figure 3** shows the existing lane configuration at these study intersections.

Figure 2-2 Existing Lane Configuration



2.3 Traffic Volumes

Turning Movement Counts (TMCs) for the study intersections were provided by Niagara Region and Ministry of Transportation Ontario (MTO) and were undertaken between May 2006 and August 2023. The count dates and the peak hours of traffic for each surveyed intersection has been included in **Table 2-1**.

Table 2-1 Turning Movement Count Summary

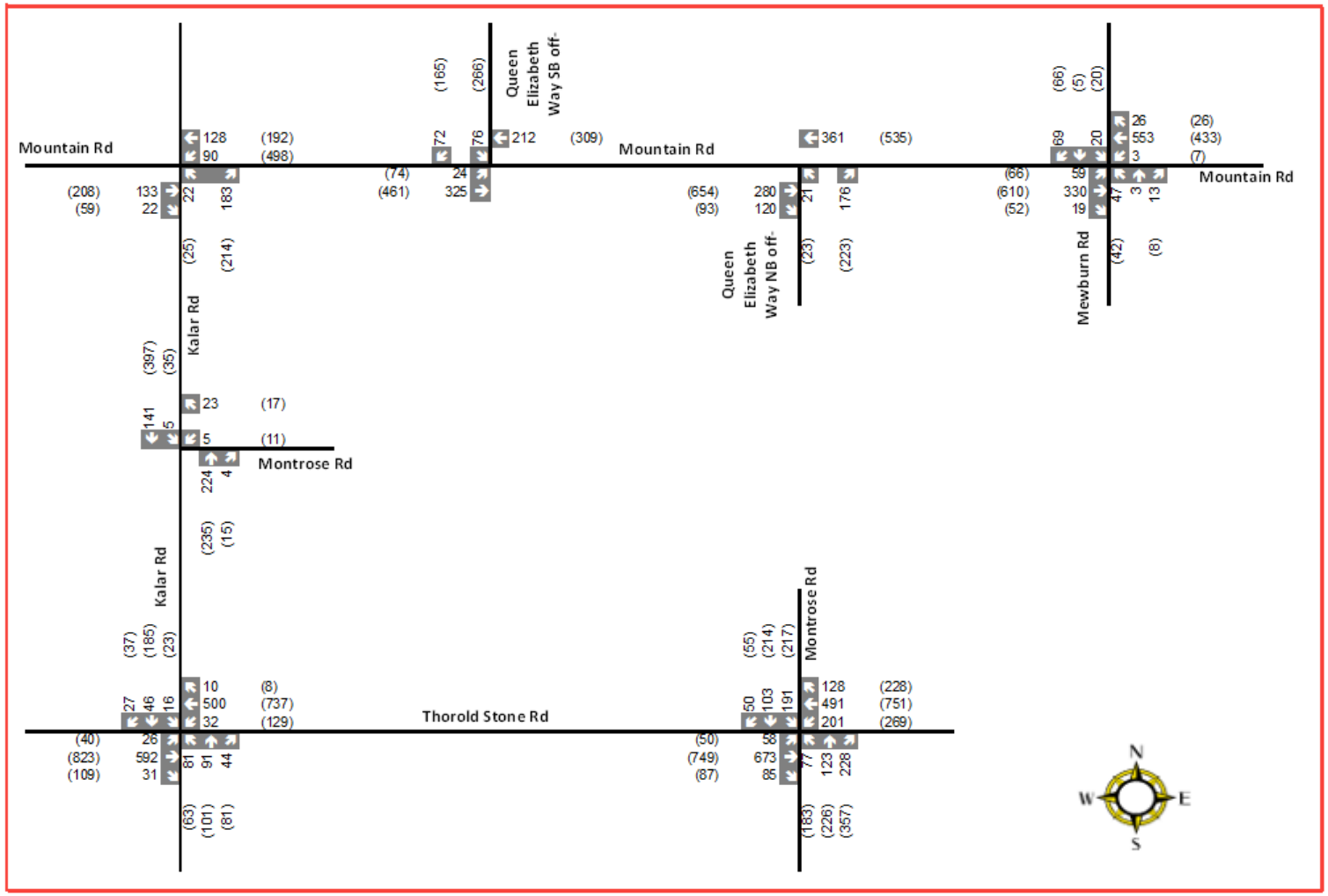
Intersection	Traffic Control Type	Count Date	Weekday	
			AM Peak Hour	PM Peak Hour
Mountain Road & Kalar Road	SSSC	3/15/2021	8:00 - 9:00 AM	4:00 - 5:00 PM
Mountain Road & Queen Elizabeth Way southbound off ramp	Signal	8/26/2022	8:15 - 9:15 AM	4:15 - 5:15 PM
Mountain Road & Queen Elizabeth Way northbound off ramp	SSSC	8/26/2022	8:15 - 9:15 AM	4:00 - 5:00 PM
Mountain Road & Mewburn Road	Roundabout	5/16/2006	8:00 - 9:00 AM	4:00 - 5:00 PM
Kalar Road & Montrose Road	SSSC	7/12/2023	8:00 - 9:00 AM	4:00 - 5:00 PM
Kalar Road & Thorold Stone Road	Signal	8/8/2023	7:45 - 8:45 AM	4:15 - 5:15 PM
Montrose Road & Thorold Stone Road	Signal	8/15/2023	8:00 - 9:00 AM	4:15 - 5:15 PM

Note: SSSC – Side Street Stop Control (stop controlled on minor street, typically at a T-intersection), AWSC – All Way Stop Control (stop controlled on all approaches)

Figure 2-3 shows the traffic counts available at the study intersections. To develop year 2024 traffic volumes, growth factors were calculated using the year 2019 and 2022 peak hour counts at Mountain Road and the Queen Elizabeth Way ramp intersections. An annual growth rate of 1% and 2% were applied to all intersections the AM and PM peak hour volumes, respectively.

Figure 2-4 shows the balanced year 2024 traffic volumes used to conduct the existing conditions traffic analysis.

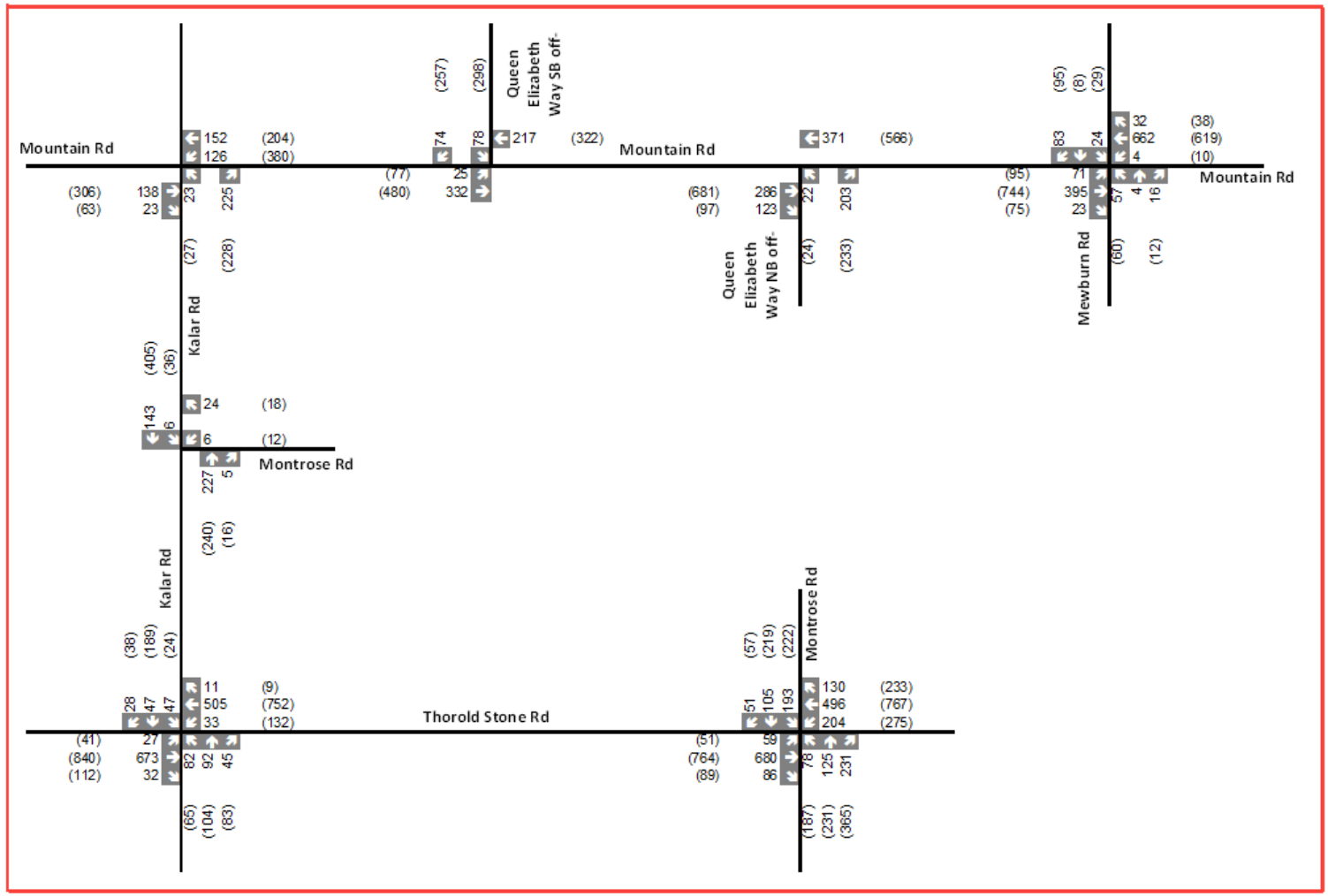
Figure 2-3 Available Existing Traffic Volumes



Legend

xx A.M. Peak Hour Traffic Volumes (xx) P.M. Peak Hour Traffic Volumes

Figure 2-4 Year 2024 Traffic Volumes



Legend

xx A.M. Peak Hour Traffic Volumes (xx) P.M. Peak Hour Traffic Volumes

2.4 Transit

The Study Area lies approximately 7km west of the Niagara Falls Bus Terminal and GO Train Station. This transit terminal connects Niagara Falls to Union Station, Toronto on the Lakeshore West GO Line running between Toronto and Niagara Falls and Burlington on the GO bus network. The Bus Terminal is also served by the Niagara Region Transit (NRT).

Transit in the City is served primarily by NRT and GO Transit as well as WEGO (operated by Niagara Parks Commission). On January 1, 2023, City-operated transit services were consolidated to be part of the NRT network as part of the Region's vision for a single transit system and operator across the Region.

Figure 2-5 shows the Study Area in relation to the existing transit route and coverage. The figure also shows a 400m buffer zone which equates to a 5-minute walk for potential users. The Study Area is not presently within the buffer zone for any transit route service.

2.5 Active Transportation

No major multi-use trail facilities exist in the Study Area. The closest trail is to the south of the Study Area connecting Kalar Road and Mount Carmel Boulevard through Shriner's Woodlot Park. There is a dedicated cycle lane on Mountain Road which terminates as it approaches the Mewburn Road roundabout from the east. There is a sidewalk on Mountain Road on the southside as it approaches the Mewburn Road intersection. **Figure 2-6** shows the existing active transportation network.

Figure 2-5 Northwest Secondary Plan Area & Existing Transit Routes

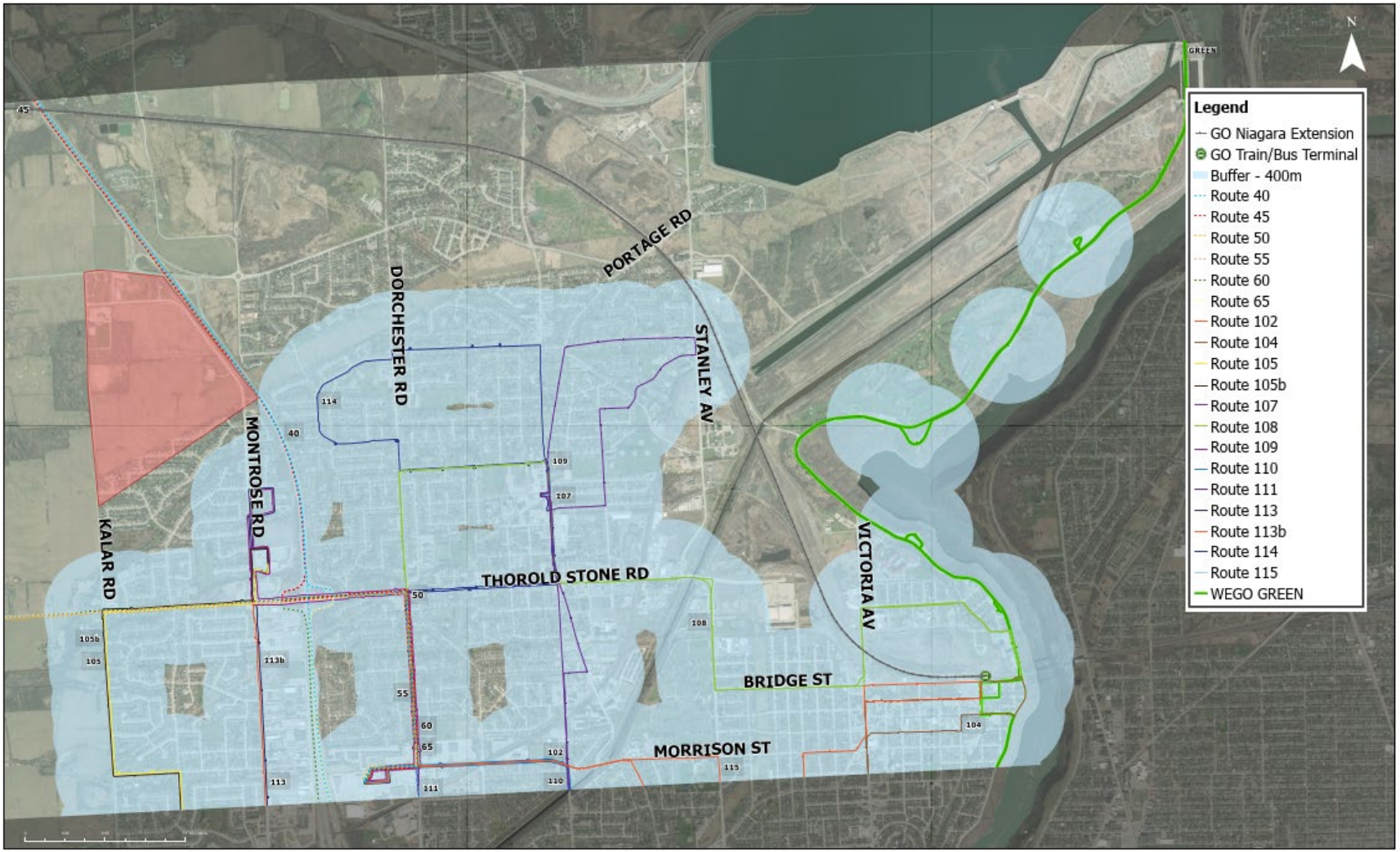
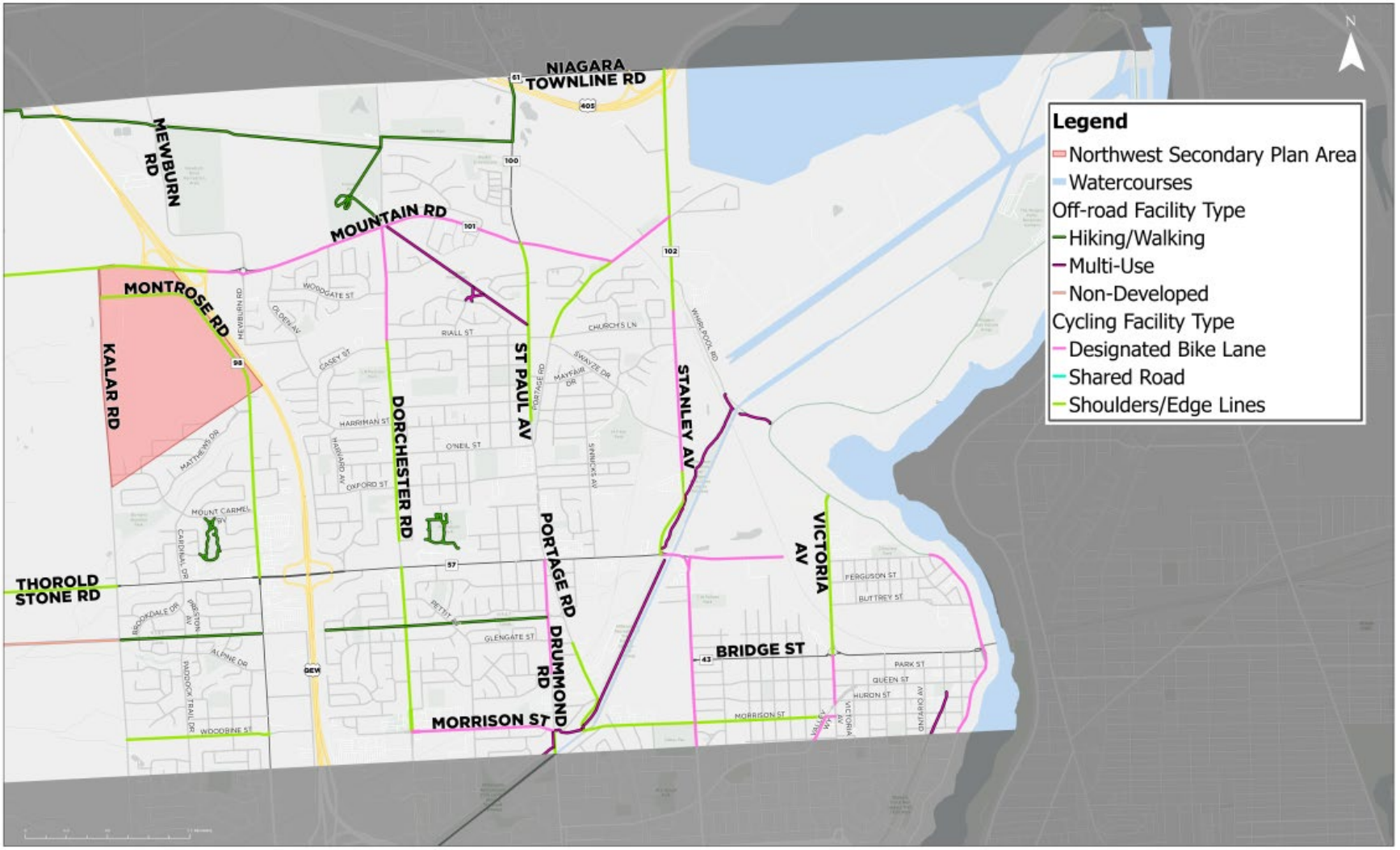


Figure 2-6 Existing Active Transportation Network



2.6 Existing Condition Capacity Analysis

2.6.1 Methodology

The intersection capacity analysis was completed using the traffic modeling software program Synchro (Version 11), a traffic analysis software based on Highway Capacity Manual (HCM) methodology, and SIDRA (Version 9) for roundabout capacity analysis. The traffic analysis is based on the busiest hour at each intersection assessed to reflect the worst-case scenario. The results of the analysis presented are based on HCM 2000 reports from Synchro.

The Level of Service (LOS) of a transportation facility is a performance measure that represents quality of service from the vehicle user's perspective. The HCM defines six levels of services, ranging from 'A' to 'F' where 'A' represents the best operating conditions and 'F' represents the worst. The assigned LOS is based on the ranges of delay identified in **Table 2-2.**

Table 2-2 LOS Criteria for Intersections

Level of service	Signalized Intersection Delay (S)	Stop Controlled Intersection Delay (s)
A	≤10	≤10
B	>10-20	>10-15
C	>20-35	>15-25
D	>35-55	>25-35
E	>55-80	>35-50
F	>80	>50

The existing conditions operational analysis is summarized in **Table 2-3** and includes the delays at the intersection, and Volume to Capacity (V/C) ratios. Critical movements are identified when the V/C ratios are greater than 0.85. The detailed analysis outputs are provided in **Appendix A**. The existing traffic assessment serves as a benchmark for all assessments of future scenarios.

Table 2-3 Intersection Capacity Analysis Results – Existing (2024) Traffic

Intersection	Traffic Control	AM Peak Hour					PM Peak Hour				
		Delay (s)	LOS	Critical Movement	v/c*	95%le Queue Length (m)	Delay (s)	LOS	Critical Movement	v/c*	95%le Queue Length (m)
Mountain Road & Kalar Road	SSSC	12.7	B	-	0.05	NBL - 1.3 NBR - 9.5	33.1	D	-	0.37	NBL - 5.2 NBR - 13.7
Mountain Road & Queen Elizabeth Way southbound off ramp	Signal	16.8	B	-	0.41	EBL - 6.6	22.2	C	WBT	0.86	EBL - 15.0
Mountain Road & Queen Elizabeth Way Northbound off ramp	SSSC	16.8	C	-	0.33	NBR - 11.8	35.2	**E**	-	0.66	NBR - 36.0
Mountain Road & Mewburn Road	Round-about	4.0	A	-	0.51	WB - 30.3	3.9	A	-	0.63	EB - 57.9
Kalar Road & Montrose Road	SSSC	10.2	B	-	0.05	WB - 1.1	12	B	-	0.06	WB - 1.4
Kalar Road & Thorold Stone Road	Signal	10.1	B	-	0.55	EBL - 8.1 WBL - 5.6 NBL - 25.4 SBL - 16.1	18	B	-	0.71	EBL - 13.2 WBL - 22.4 NBL - 22.9 SBL - 10.2
Montrose Road & Thorold Stone Road	Signal	26.7	C	-	0.76	EBL - 12.9 WBL - #54.3 NBL - 23.9 SBL - 55.3	34.3	C	EBTR WBL	**0.86** **0.89**	EBL - 12.7 WBL - #104.8 NBL - 50.0 SBL - 59.3

* v/c reported for the overall intersection for signalized intersections and worst stop-controlled movement at stop-controlled intersections.
# 95th percentile volume exceeds capacity; queue may be longer.
Note: SSSC – Side Street Stop Control, AWSC – All Way Stop Control, NB – Northbound, SB – Southbound, EB – Eastbound, WB – Westbound, L – Left, T – Through, R - Right

As shown in **Table 2-3** most of the study intersections are operating at an acceptable level of service (LOS) of ‘C’ or better under existing weekday AM peak hour conditions. However, in the PM peak hour, the northbound left turn movement at the stop-controlled intersection of Mountain Road and Queen Elizabeth Way northbound off-ramp is operating at LOS of ‘E’. This movement has only 26 vehicles in the PM peak hour but is experiencing a delay of 35.2 seconds due to few gaps in the eastbound / westbound traffic. However, it is to be noted that this is only 0.2 seconds greater than 35 seconds delay which would otherwise be LOS ‘D’. The signalized intersection at Montrose Road and Thorold Stone Road intersection is operating at LOS ‘C’, however, the eastbound through-right movement and westbound left movements are operating with a V/C ratio slightly greater than 0.85 because of high turning volumes.

2.7 Next Steps

The completion of the Phase 1 Existing Conditions will move the project into Phase 2 which will focus on the Lane Use Options and would include the City’s required agency consultation, public and stakeholder / partner engagement, as well as the preparation of options for further assessment.

APPENDIX

A Synchro Output

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	138	23	126	152	23	225
Future Volume (Veh/h)	138	23	126	152	23	225
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	153	26	140	169	26	250
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)				319		
pX, platoon unblocked						
vC, conflicting volume			179		615	166
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			179		615	166
tC, single (s)			4.2		*5.2	6.2
tC, 2 stage (s)						
tF (s)			2.3		3.6	3.3
p0 queue free %			90		95	71
cM capacity (veh/h)			1373		492	873

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	NB 2
Volume Total	179	140	169	26	250
Volume Left	0	140	0	26	0
Volume Right	26	0	0	0	250
cSH	1700	1373	1700	492	873
Volume to Capacity	0.11	0.10	0.10	0.05	0.29
Queue Length 95th (m)	0.0	2.7	0.0	1.3	9.5
Control Delay (s)	0.0	7.9	0.0	12.7	10.8
Lane LOS		A		B	B
Approach Delay (s)	0.0	3.6		11.0	
Approach LOS				B	

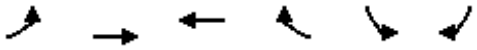
Intersection Summary			
Average Delay	5.4		
Intersection Capacity Utilization	29.3%	ICU Level of Service	A
Analysis Period (min)	15		

* User Entered Value



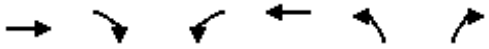
Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	27	361	236	85	80
v/c Ratio	0.10	0.68	0.40	0.16	0.19
Control Delay	12.2	22.3	14.7	13.5	5.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	12.2	22.3	14.7	13.5	5.3
Queue Length 50th (m)	1.9	33.0	18.4	5.4	0.0
Queue Length 95th (m)	6.1	58.0	33.4	16.8	8.2
Internal Link Dist (m)		294.7	130.1	123.2	
Turn Bay Length (m)	60.0				
Base Capacity (vph)	527	1027	1121	541	416
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.05	0.35	0.21	0.16	0.19

Intersection Summary



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	25	332	217	0	78	74
Future Volume (vph)	25	332	217	0	78	74
Ideal Flow (vphpl)	1454	1579	1579	1900	1454	1301
Total Lost time (s)	6.5	6.5	5.5		5.9	5.9
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	1.00		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1114	1397	1490		1328	906
Flt Permitted	0.61	1.00	1.00		0.95	1.00
Satd. Flow (perm)	717	1397	1490		1328	906
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	27	361	236	0	85	80
RTOR Reduction (vph)	0	0	0	0	0	47
Lane Group Flow (vph)	27	361	236	0	85	33
Heavy Vehicles (%)	24%	13%	6%	0%	4%	22%
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		4	8		6	
Permitted Phases	4					6
Actuated Green, G (s)	22.8	22.8	23.8		24.2	24.2
Effective Green, g (s)	22.8	22.8	23.8		24.2	24.2
Actuated g/C Ratio	0.38	0.38	0.40		0.41	0.41
Clearance Time (s)	6.5	6.5	5.5		5.9	5.9
Vehicle Extension (s)	4.0	4.0	4.0		3.0	3.0
Lane Grp Cap (vph)	275	536	597		541	369
v/s Ratio Prot		c0.26	0.16		c0.06	
v/s Ratio Perm	0.04					0.04
v/c Ratio	0.10	0.67	0.40		0.16	0.09
Uniform Delay, d1	11.7	15.2	12.7		11.1	10.8
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.2	3.6	0.6		0.6	0.5
Delay (s)	11.9	18.8	13.3		11.8	11.3
Level of Service	B	B	B		B	B
Approach Delay (s)		18.4	13.3		11.5	
Approach LOS		B	B		B	

Intersection Summary			
HCM 2000 Control Delay	15.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.41		
Actuated Cycle Length (s)	59.4	Sum of lost time (s)	12.4
Intersection Capacity Utilization	45.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	286	123	0	371	22	203
Future Volume (Veh/h)	286	123	0	371	22	203
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	311	134	0	403	24	221
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			445		781	378
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			445		781	378
tC, single (s)			4.1		6.7	6.3
tC, 2 stage (s)						
tF (s)			2.2		3.8	3.4
p0 queue free %			100		93	67
cM capacity (veh/h)			1126		329	660

Direction, Lane #	EB 1	WB 1	NB 1	NB 2
Volume Total	445	403	24	221
Volume Left	0	0	24	0
Volume Right	134	0	0	221
cSH	1700	1700	329	660
Volume to Capacity	0.26	0.24	0.07	0.33
Queue Length 95th (m)	0.0	0.0	1.9	11.8
Control Delay (s)	0.0	0.0	16.8	13.2
Lane LOS			C	B
Approach Delay (s)	0.0	0.0	13.5	
Approach LOS			B	

Intersection Summary			
Average Delay	3.0		
Intersection Capacity Utilization	41.8%	ICU Level of Service	A
Analysis Period (min)	15		

MOVEMENT SUMMARY

Site: 101 [Mewburn & Mountain_Exst AM Peak (Site Folder: General)]

Mewburn & Mountain Roundabout Analysis
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Mewburn Rd														
1	L2	57	0.0	61	0.0	0.076	9.7	LOS A	0.4	3.1	0.58	0.63	0.58	48.1
2	T1	4	0.0	4	0.0	0.076	3.5	LOS A	0.4	3.1	0.58	0.63	0.58	47.1
3	R2	16	19.0	17	19.0	0.076	4.5	LOS A	0.4	3.1	0.58	0.63	0.58	45.5
Approach		77	3.9	82	3.9	0.076	8.3	LOS A	0.4	3.1	0.58	0.63	0.58	47.5
East: Mountain Rd														
4	L2	4	50.0	4	50.0	0.510	11.2	LOS B	4.1	30.3	0.45	0.38	0.45	54.0
5	T1	662	5.0	704	5.0	0.510	3.8	LOS A	4.1	30.3	0.45	0.38	0.45	53.3
6	R2	32	29.0	34	29.0	0.510	4.3	LOS A	4.1	30.3	0.45	0.38	0.45	51.2
Approach		698	6.4	743	6.4	0.510	3.9	LOS A	4.1	30.3	0.45	0.38	0.45	53.2
North: Mewburn Rd														
7	L2	24	34.0	26	34.0	0.154	14.8	LOS B	1.0	8.4	0.77	0.75	0.77	51.9
8	T1	1	0.0	1	0.0	0.154	7.0	LOS A	1.0	8.4	0.77	0.75	0.77	51.0
9	R2	83	20.0	88	20.0	0.154	7.8	LOS A	1.0	8.4	0.77	0.75	0.77	49.1
Approach		108	22.9	115	22.9	0.154	9.3	LOS A	1.0	8.4	0.77	0.75	0.77	49.7
West: Mountain Rd														
10	L2	71	22.0	76	22.0	0.326	7.8	LOS A	2.5	19.3	0.19	0.24	0.19	51.4
11	T1	395	11.0	420	11.0	0.326	1.4	LOS A	2.5	19.3	0.19	0.24	0.19	50.5
12	R2	23	9.0	24	9.0	0.326	2.0	LOS A	2.5	19.3	0.19	0.24	0.19	48.7
Approach		489	12.5	520	12.5	0.326	2.4	LOS A	2.5	19.3	0.19	0.24	0.19	50.5
All Vehicles		1372	9.7	1460	9.7	0.510	4.0	LOS A	4.1	30.3	0.39	0.37	0.39	51.6

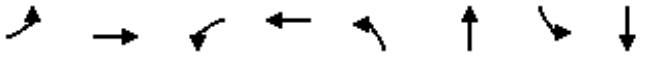
Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	6	24	227	5	6	143
Future Volume (Veh/h)	6	24	227	5	6	143
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	7	26	249	5	7	157
Pedestrians	4					
Lane Width (m)	3.6					
Walking Speed (m/s)	1.2					
Percent Blockage	0					
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	426	256			258	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	426	256			258	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	99	97			99	
cM capacity (veh/h)	584	785			1314	

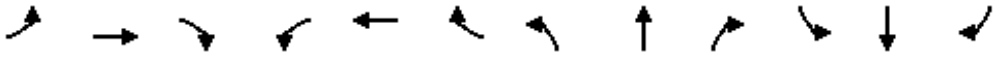
Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	33	254	164
Volume Left	7	0	7
Volume Right	26	5	0
cSH	732	1700	1314
Volume to Capacity	0.05	0.15	0.01
Queue Length 95th (m)	1.1	0.0	0.1
Control Delay (s)	10.2	0.0	0.4
Lane LOS	B		A
Approach Delay (s)	10.2	0.0	0.4
Approach LOS	B		

Intersection Summary			
Average Delay		0.9	
Intersection Capacity Utilization		22.4%	ICU Level of Service A
Analysis Period (min)		15	



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	30	784	37	573	91	152	52	83
v/c Ratio	0.09	0.47	0.09	0.31	0.30	0.41	0.18	0.21
Control Delay	12.0	11.9	6.0	6.3	23.1	21.2	21.7	15.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.0	11.9	6.0	6.3	23.1	21.2	21.7	15.4
Queue Length 50th (m)	1.1	19.2	1.3	12.8	6.0	8.5	3.3	3.3
Queue Length 95th (m)	8.1	66.2	5.6	29.2	25.4	35.0	16.1	18.0
Internal Link Dist (m)		418.0		1022.4		246.1		2088.7
Turn Bay Length (m)	30.0		37.0		25.0		95.0	
Base Capacity (vph)	457	2394	457	2617	703	827	660	876
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.07	0.33	0.08	0.22	0.13	0.18	0.08	0.09

Intersection Summary



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	27	673	32	33	505	11	82	92	45	47	47	28
Future Volume (vph)	27	673	32	33	505	11	82	92	45	47	47	28
Ideal Flow (vphpl)	1454	1579	1338	1454	1579	1338	1454	1338	1338	1454	1338	1338
Total Lost time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	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	
Frt	1.00	0.99		1.00	1.00		1.00	0.95		1.00	0.94	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1201	2884		1222	2840		1381	1188		1380	1257	
Flt Permitted	0.44	1.00		0.26	1.00		0.70	1.00		0.66	1.00	
Satd. Flow (perm)	552	2884		340	2840		1022	1188		959	1257	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	30	748	36	37	561	12	91	102	50	52	52	31
RTOR Reduction (vph)	0	3	0	0	1	0	0	21	0	0	25	0
Lane Group Flow (vph)	30	781	0	37	572	0	91	131	0	52	58	0
Confl. Peds. (#/hr)			3	3			1		2	2		1
Heavy Vehicles (%)	15%	3%	7%	13%	5%	19%	0%	4%	12%	0%	0%	0%
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		4		3	8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	25.7	25.7		32.5	32.5		10.1	10.1		10.1	10.1	
Effective Green, g (s)	25.7	25.7		32.5	32.5		10.1	10.1		10.1	10.1	
Actuated g/C Ratio	0.50	0.50		0.63	0.63		0.20	0.20		0.20	0.20	
Clearance Time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5	
Vehicle Extension (s)	4.5	4.5		4.5	4.5		3.2	3.2		3.2	3.2	
Lane Grp Cap (vph)	274	1436		253	1788		200	232		187	246	
v/s Ratio Prot		c0.27		0.01	c0.20			c0.11			0.05	
v/s Ratio Perm	0.05			0.09			0.09			0.05		
v/c Ratio	0.11	0.54		0.15	0.32		0.46	0.57		0.28	0.24	
Uniform Delay, d1	6.9	8.9		4.3	4.4		18.3	18.8		17.6	17.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.3	0.6		0.5	0.2		1.8	3.2		0.9	0.5	
Delay (s)	7.2	9.6		4.7	4.6		20.1	22.0		18.5	18.0	
Level of Service	A	A		A	A		C	C		B	B	
Approach Delay (s)		9.5			4.6			21.3			18.2	
Approach LOS		A			A			C			B	

Intersection Summary			
HCM 2000 Control Delay	10.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	51.6	Sum of lost time (s)	13.5
Intersection Capacity Utilization	63.8%	ICU Level of Service	B
Analysis Period (min)	15		

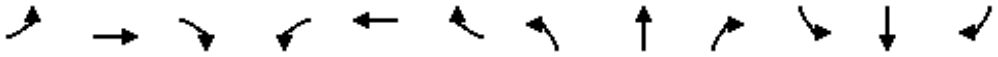
c Critical Lane Group



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	64	832	222	680	85	136	251	210	169
v/c Ratio	0.21	0.83	0.71	0.55	0.31	0.38	0.72	0.60	0.29
Control Delay	11.4	34.8	25.8	20.0	25.5	40.8	17.6	31.7	24.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	11.4	34.8	25.8	20.0	25.5	40.8	17.6	31.7	24.7
Queue Length 50th (m)	4.6	68.4	18.3	44.0	10.7	12.4	0.0	29.5	9.4
Queue Length 95th (m)	12.9	#114.8	#54.3	77.3	23.9	23.0	25.5	55.3	21.1
Internal Link Dist (m)		1022.4		138.4		313.7			260.6
Turn Bay Length (m)	27.0		85.0		50.0		35.0	55.0	
Base Capacity (vph)	445	1268	362	1339	369	924	506	368	879
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.66	0.61	0.51	0.23	0.15	0.50	0.57	0.19

Intersection Summary

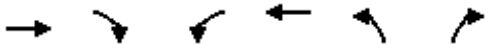
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	59	680	86	204	496	130	78	125	231	193	105	51
Future Volume (vph)	59	680	86	204	496	130	78	125	231	193	105	51
Ideal Flow (vphpl)	1454	1579	1338	1454	1579	1338	1454	1579	1301	1454	1579	1338
Total Lost time (s)	3.0	5.6		3.0	5.6		3.0	5.4	5.4	3.0	5.4	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	0.99	1.00	0.99	
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	0.97		1.00	1.00	0.85	1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1267	2799		1315	2719		1288	2885	1047	1314	2630	
Flt Permitted	0.39	1.00		0.19	1.00		0.65	1.00	1.00	0.53	1.00	
Satd. Flow (perm)	524	2799		259	2719		875	2885	1047	734	2630	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	64	739	93	222	539	141	85	136	251	210	114	55
RTOR Reduction (vph)	0	8	0	0	17	0	0	0	217	0	44	0
Lane Group Flow (vph)	64	824	0	222	663	0	85	136	34	210	125	0
Confl. Peds. (#/hr)	2		4	4		2	4		3	3		4
Heavy Vehicles (%)	9%	5%	7%	5%	7%	5%	7%	4%	4%	5%	6%	12%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	37.7	31.8		48.4	39.5		19.7	11.8	11.8	29.0	18.1	
Effective Green, g (s)	37.7	31.8		48.4	39.5		19.7	11.8	11.8	29.0	18.1	
Actuated g/C Ratio	0.43	0.36		0.55	0.45		0.22	0.13	0.13	0.33	0.20	
Clearance Time (s)	3.0	5.6		3.0	5.6		3.0	5.4	5.4	3.0	5.4	
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	273	1006		304	1214		231	385	139	333	538	
v/s Ratio Prot	0.02	c0.29		c0.11	0.24		0.03	0.05		c0.10	0.05	
v/s Ratio Perm	0.08			0.29			0.05		0.03	c0.11		
v/c Ratio	0.23	0.82		0.73	0.55		0.37	0.35	0.24	0.63	0.23	
Uniform Delay, d1	15.3	25.7		13.5	17.9		28.6	34.8	34.3	23.8	29.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.3	5.2		8.2	0.4		0.7	0.4	0.7	3.4	0.2	
Delay (s)	15.6	30.8		21.7	18.3		29.3	35.2	34.9	27.2	29.5	
Level of Service	B	C		C	B		C	D	C	C	C	
Approach Delay (s)		29.8			19.1			34.0			28.2	
Approach LOS		C			B			C			C	

Intersection Summary			
HCM 2000 Control Delay	26.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	88.4	Sum of lost time (s)	17.0
Intersection Capacity Utilization	78.7%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	306	63	380	204	27	228
Future Volume (Veh/h)	306	63	380	204	27	228
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	333	68	413	222	29	248
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)				319		
pX, platoon unblocked						
vC, conflicting volume			401		1415	367
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			401		1415	367
tC, single (s)			4.1		*5.2	6.3
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.4
p0 queue free %			64		82	63
cM capacity (veh/h)			1147		157	669

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	NB 2
Volume Total	401	413	222	29	248
Volume Left	0	413	0	29	0
Volume Right	68	0	0	0	248
cSH	1700	1147	1700	157	669
Volume to Capacity	0.24	0.36	0.13	0.18	0.37
Queue Length 95th (m)	0.0	13.3	0.0	5.2	13.7
Control Delay (s)	0.0	9.9	0.0	33.1	13.5
Lane LOS		A		D	B
Approach Delay (s)	0.0	6.4		15.6	
Approach LOS				C	

Intersection Summary			
Average Delay	6.4		
Intersection Capacity Utilization	54.3%	ICU Level of Service	A
Analysis Period (min)	15		

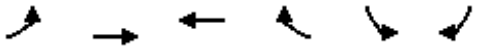
* User Entered Value



Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	84	522	350	324	279
v/c Ratio	0.29	0.77	0.51	0.62	0.48
Control Delay	14.1	23.9	15.4	25.9	6.0
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	14.1	23.9	15.4	25.9	6.0
Queue Length 50th (m)	6.5	53.0	29.8	31.1	0.0
Queue Length 95th (m)	15.0	85.1	48.9	#86.5	18.6
Internal Link Dist (m)		294.7	130.1	123.2	
Turn Bay Length (m)	60.0				
Base Capacity (vph)	465	1073	1066	520	582
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.18	0.49	0.33	0.62	0.48

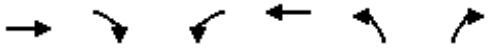
Intersection Summary

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



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	77	480	322	0	298	257
Future Volume (vph)	77	480	322	0	298	257
Ideal Flow (vphpl)	1454	1579	1579	1900	1454	1301
Total Lost time (s)	6.5	6.5	5.5		5.9	5.9
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	1.00		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1328	1579	1533		1381	1084
Flt Permitted	0.49	1.00	1.00		0.95	1.00
Satd. Flow (perm)	684	1579	1533		1381	1084
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	84	522	350	0	324	279
RTOR Reduction (vph)	0	0	0	0	0	174
Lane Group Flow (vph)	84	522	350	0	324	105
Heavy Vehicles (%)	4%	0%	3%	0%	0%	2%
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		4	8		6	
Permitted Phases	4					6
Actuated Green, G (s)	27.9	27.9	28.9		24.4	24.4
Effective Green, g (s)	27.9	27.9	28.9		24.4	24.4
Actuated g/C Ratio	0.43	0.43	0.45		0.38	0.38
Clearance Time (s)	6.5	6.5	5.5		5.9	5.9
Vehicle Extension (s)	4.0	4.0	4.0		3.0	3.0
Lane Grp Cap (vph)	294	680	684		520	408
v/s Ratio Prot		c0.33	0.23		c0.23	
v/s Ratio Perm	0.12					0.10
v/c Ratio	0.29	0.77	0.51		0.62	0.26
Uniform Delay, d1	11.9	15.6	12.8		16.4	13.9
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.7	5.5	0.9		5.5	1.5
Delay (s)	12.7	21.2	13.7		21.9	15.4
Level of Service	B	C	B		C	B
Approach Delay (s)		20.0	13.7		18.9	
Approach LOS		B	B		B	

Intersection Summary			
HCM 2000 Control Delay	18.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	64.7	Sum of lost time (s)	12.4
Intersection Capacity Utilization	73.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	681	97	0	566	24	233
Future Volume (Veh/h)	681	97	0	566	24	233
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	740	105	0	615	26	253
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			845		1408	792
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			845		1408	792
tC, single (s)			4.1		6.5	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.6	3.3
p0 queue free %			100		82	34
cM capacity (veh/h)			800		145	386

Direction, Lane #	EB 1	WB 1	NB 1	NB 2
Volume Total	845	615	26	253
Volume Left	0	0	26	0
Volume Right	105	0	0	253
cSH	1700	1700	145	386
Volume to Capacity	0.50	0.36	0.18	0.66
Queue Length 95th (m)	0.0	0.0	5.0	36.0
Control Delay (s)	0.0	0.0	35.2	30.5
Lane LOS			E	D
Approach Delay (s)	0.0	0.0	30.9	
Approach LOS			D	

Intersection Summary			
Average Delay	5.0		
Intersection Capacity Utilization	62.8%	ICU Level of Service	B
Analysis Period (min)	15		

MOVEMENT SUMMARY

Site: 101 [Mewburn & Mountain_Exst PM Peak (Site Folder: General)]

Mewburn & Mountain Roundabout Analysis
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Mewburn Rd														
1	L2	60	4.0	68	4.0	0.125	14.4	LOS B	0.9	6.7	0.87	0.80	0.87	45.4
2	T1	1	0.0	1	0.0	0.125	8.0	LOS A	0.9	6.7	0.87	0.80	0.87	44.5
3	R2	12	25.0	14	25.0	0.125	9.6	LOS A	0.9	6.7	0.87	0.80	0.87	43.1
Approach		73	7.4	83	7.4	0.125	13.5	LOS B	0.9	6.7	0.87	0.80	0.87	45.0
East: Mountain Rd														
4	L2	4	0.0	5	0.0	0.553	10.5	LOS B	4.8	34.2	0.52	0.41	0.52	54.2
5	T1	662	3.0	752	3.0	0.553	4.0	LOS A	4.8	34.2	0.52	0.41	0.52	52.9
6	R2	32	8.0	36	8.0	0.553	4.3	LOS A	4.8	34.2	0.52	0.41	0.52	50.9
Approach		698	3.2	793	3.2	0.553	4.1	LOS A	4.8	34.2	0.52	0.41	0.52	52.8
North: Mewburn Rd														
7	L2	29	0.0	33	0.0	0.190	14.1	LOS B	1.4	9.8	0.82	0.78	0.82	52.0
8	T1	8	0.0	9	0.0	0.190	7.6	LOS A	1.4	9.8	0.82	0.78	0.82	50.8
9	R2	95	4.0	108	4.0	0.190	7.9	LOS A	1.4	9.8	0.82	0.78	0.82	49.0
Approach		132	2.9	150	2.9	0.190	9.2	LOS A	1.4	9.8	0.82	0.78	0.82	49.7
West: Mountain Rd														
10	L2	95	4.0	108	4.0	0.634	7.8	LOS A	7.8	57.9	0.34	0.24	0.34	51.0
11	T1	744	8.0	845	8.0	0.634	1.6	LOS A	7.8	57.9	0.34	0.24	0.34	49.9
12	R2	75	3.0	85	3.0	0.634	2.1	LOS A	7.8	57.9	0.34	0.24	0.34	48.2
Approach		914	7.2	1039	7.2	0.634	2.3	LOS A	7.8	57.9	0.34	0.24	0.34	49.9
All Vehicles		1817	5.3	2065	5.3	0.634	3.9	LOS A	7.8	57.9	0.47	0.37	0.47	50.7

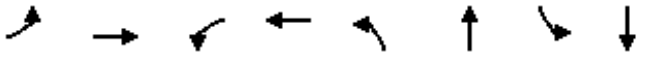
Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	12	18	240	16	36	405
Future Volume (Veh/h)	12	18	240	16	36	405
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	12	18	245	16	37	413
Pedestrians	3					
Lane Width (m)	3.6					
Walking Speed (m/s)	1.2					
Percent Blockage	0					
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	743	256			264	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	743	256			264	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	97	98			97	
cM capacity (veh/h)	374	786			1309	

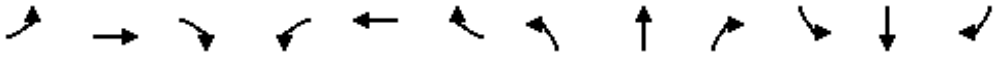
Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	30	261	450
Volume Left	12	0	37
Volume Right	18	16	0
cSH	545	1700	1309
Volume to Capacity	0.06	0.15	0.03
Queue Length 95th (m)	1.4	0.0	0.7
Control Delay (s)	12.0	0.0	0.9
Lane LOS	B		A
Approach Delay (s)	12.0	0.0	0.9
Approach LOS	B		

Intersection Summary			
Average Delay		1.0	
Intersection Capacity Utilization		50.3%	ICU Level of Service A
Analysis Period (min)		15	



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	43	1002	139	801	68	196	25	239
v/c Ratio	0.20	0.78	0.50	0.44	0.39	0.58	0.14	0.71
Control Delay	18.2	24.1	14.3	9.1	33.5	28.4	26.5	39.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	18.2	24.1	14.3	9.1	33.5	28.4	26.5	39.5
Queue Length 50th (m)	4.0	67.0	8.1	30.1	9.1	21.4	3.1	33.6
Queue Length 95th (m)	13.2	113.0	22.4	57.9	22.9	46.4	10.2	64.4
Internal Link Dist (m)		418.0		1022.4		246.1		2088.7
Turn Bay Length (m)	30.0		37.0		25.0		95.0	
Base Capacity (vph)	281	1691	294	2235	286	527	304	542
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.15	0.59	0.47	0.36	0.24	0.37	0.08	0.44

Intersection Summary



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	41	840	112	132	752	9	65	104	83	24	189	38
Future Volume (vph)	41	840	112	132	752	9	65	104	83	24	189	38
Ideal Flow (vphpl)	1454	1579	1338	1454	1579	1338	1454	1338	1338	1454	1338	1338
Total Lost time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	0.99		1.00	1.00	
Flpb, ped/bikes	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		1.00	0.93		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1316	2896		1341	2930		1381	1212		1266	1291	
Flt Permitted	0.35	1.00		0.16	1.00		0.47	1.00		0.55	1.00	
Satd. Flow (perm)	483	2896		219	2930		690	1212		734	1291	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	43	884	118	139	792	9	68	109	87	25	199	40
RTOR Reduction (vph)	0	11	0	0	1	0	0	32	0	0	8	0
Lane Group Flow (vph)	43	991	0	139	800	0	68	164	0	25	231	0
Confl. Peds. (#/hr)									2	2		
Heavy Vehicles (%)	5%	2%	0%	3%	2%	23%	0%	2%	3%	9%	0%	6%
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		4		3	8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	34.8	34.8		49.2	49.2		19.9	19.9		19.9	19.9	
Effective Green, g (s)	34.8	34.8		49.2	49.2		19.9	19.9		19.9	19.9	
Actuated g/C Ratio	0.45	0.45		0.63	0.63		0.25	0.25		0.25	0.25	
Clearance Time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5	
Vehicle Extension (s)	4.5	4.5		4.5	4.5		3.2	3.2		3.2	3.2	
Lane Grp Cap (vph)	215	1290		280	1845		175	308		187	328	
v/s Ratio Prot		c0.34		0.06	c0.27			0.14			c0.18	
v/s Ratio Perm	0.09			0.25			0.10			0.03		
v/c Ratio	0.20	0.77		0.50	0.43		0.39	0.53		0.13	0.70	
Uniform Delay, d1	13.2	18.3		9.1	7.4		24.1	25.1		22.5	26.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.8	3.2		2.4	0.3		1.5	1.9		0.4	6.8	
Delay (s)	14.0	21.4		11.5	7.6		25.6	26.9		22.8	33.2	
Level of Service	B	C		B	A		C	C		C	C	
Approach Delay (s)		21.1			8.2			26.6			32.2	
Approach LOS		C			A			C			C	

Intersection Summary			
HCM 2000 Control Delay	18.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	78.1	Sum of lost time (s)	13.5
Intersection Capacity Utilization	80.9%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	53	880	284	1031	193	238	376	229	285
v/c Ratio	0.25	0.88	0.87	0.77	0.61	0.54	0.79	0.67	0.61
Control Delay	14.7	42.0	48.0	27.9	33.4	43.6	17.7	35.5	41.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.7	42.0	48.0	27.9	33.4	43.6	17.7	35.5	41.1
Queue Length 50th (m)	4.4	85.0	36.3	87.6	30.3	24.6	1.3	36.9	27.1
Queue Length 95th (m)	12.7	#144.1	#104.8	#160.8	50.0	37.2	35.4	59.3	40.9
Internal Link Dist (m)		1022.4		138.4		313.7			260.6
Turn Bay Length (m)	27.0		85.0		50.0		35.0	55.0	
Base Capacity (vph)	348	1141	326	1340	338	814	564	356	804
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.15	0.77	0.87	0.77	0.57	0.29	0.67	0.64	0.35

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	51	764	89	275	767	233	187	231	365	222	219	57
Future Volume (vph)	51	764	89	275	767	233	187	231	365	222	219	57
Ideal Flow (vphpl)	1454	1579	1338	1454	1579	1338	1454	1579	1301	1454	1579	1338
Total Lost time (s)	3.0	5.6		3.0	5.6		3.0	5.4	5.4	3.0	5.4	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	0.99	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	0.97		1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1303	2884		1354	2808		1302	2913	1069	1340	2807	
Flt Permitted	0.23	1.00		0.15	1.00		0.52	1.00	1.00	0.54	1.00	
Satd. Flow (perm)	321	2884		220	2808		714	2913	1069	767	2807	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	53	788	92	284	791	240	193	238	376	229	226	59
RTOR Reduction (vph)	0	8	0	0	20	0	0	0	313	0	23	0
Lane Group Flow (vph)	53	872	0	284	1011	0	193	238	63	229	262	0
Confl. Peds. (#/hr)	2		5	5		2	2		2	2		2
Heavy Vehicles (%)	6%	2%	4%	2%	3%	2%	6%	3%	2%	3%	2%	8%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	40.3	34.6		54.9	46.2		29.2	15.0	15.0	30.6	15.7	
Effective Green, g (s)	40.3	34.6		54.9	46.2		29.2	15.0	15.0	30.6	15.7	
Actuated g/C Ratio	0.41	0.35		0.56	0.47		0.30	0.15	0.15	0.31	0.16	
Clearance Time (s)	3.0	5.6		3.0	5.6		3.0	5.4	5.4	3.0	5.4	
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	187	1009		320	1313		295	442	162	323	446	
v/s Ratio Prot	0.02	0.30		c0.16	0.36		0.09	0.08		c0.11	0.09	
v/s Ratio Perm	0.10			c0.34			0.10		0.06	c0.11		
v/c Ratio	0.28	0.86		0.89	0.77		0.65	0.54	0.39	0.71	0.59	
Uniform Delay, d1	18.2	29.9		21.7	21.9		28.8	38.7	37.8	28.4	38.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.6	7.8		24.2	2.7		4.6	1.0	1.1	6.5	1.6	
Delay (s)	18.8	37.7		45.9	24.6		33.4	39.7	38.9	34.9	40.2	
Level of Service	B	D		D	C		C	D	D	C	D	
Approach Delay (s)		36.6			29.2			37.8			37.8	
Approach LOS		D			C			D			D	

Intersection Summary			
HCM 2000 Control Delay	34.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	98.8	Sum of lost time (s)	17.0
Intersection Capacity Utilization	90.7%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group