Appendix B

Transportation

DILLON CONSULTING

Transportation Report

for the

Sixth Concession Road / North Talbot Road Municipal Class Environmental Assessment

Final Report
October 2014

Submitted to:

City of Windsor

Project No. 13-8295

Submitted by:

Dillon Consulting Limited

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1.0 INTRODUCTION

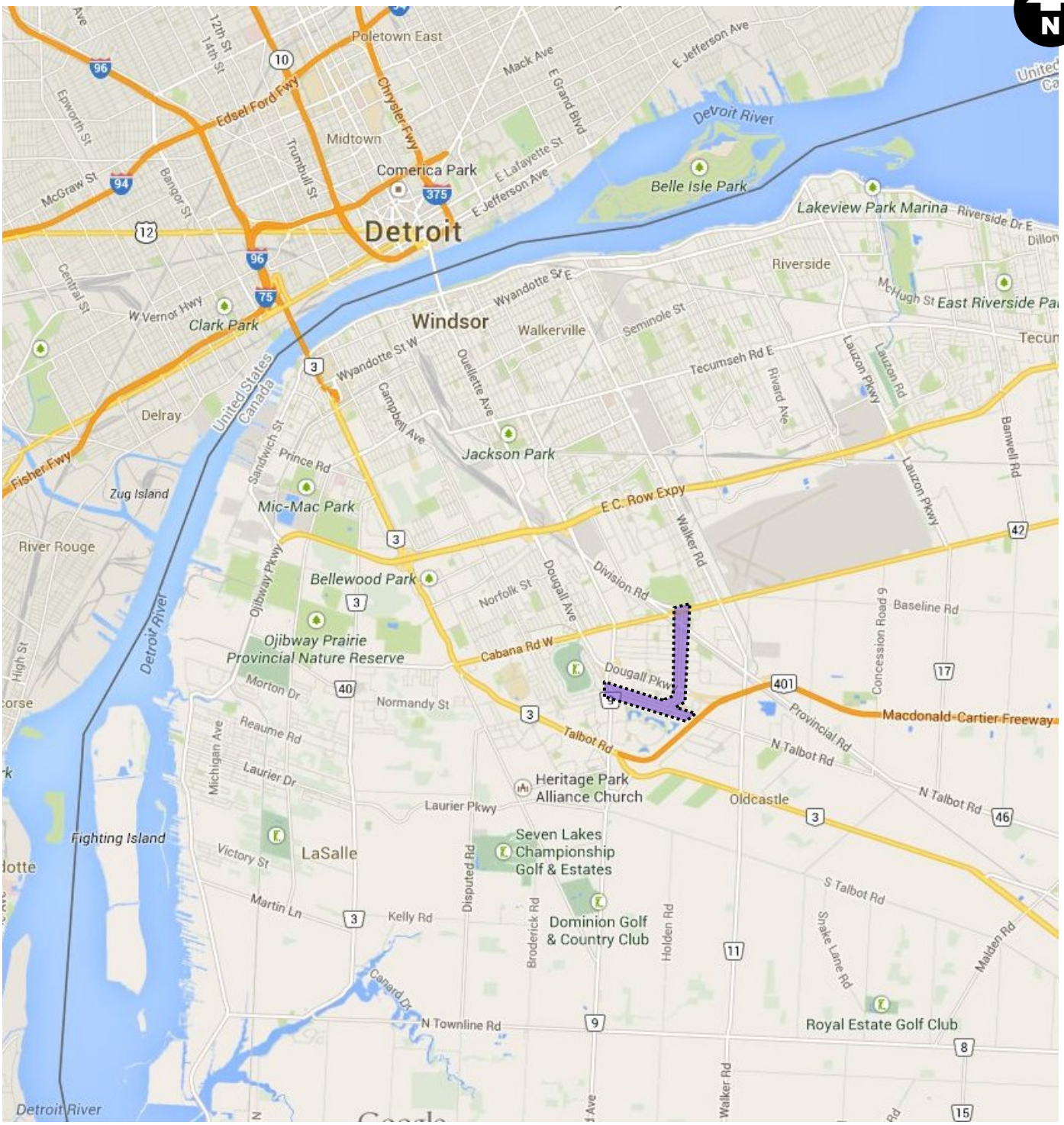
1.1 Purpose

The City of Windsor retained Dillon Consulting Limited to undertake a Municipal Class Environmental Assessment (EA) to identify potential improvements to the Sixth Concession Road and North Talbot Road corridors. The purpose of this report is to summarize the transportation assessment, including existing conditions, projected future conditions and provide a summary of the future transportation infrastructure required within the study area.

1.2 Key Map and Study Area

The study area is situated at the southern limits of the City of Windsor. A key map is shown in **Figure 1**.

The limits of the study area are Sixth Concession Road, from Cabana Road East to North Talbot Road (approximate distance of 2.1 km) and North Talbot Road from Howard Avenue to the east City limits (approximate distance of 1.9 km). The study area is shown in **Figure 2**.



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Study Area

Source: Google Maps, December 2013

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Figure 1: Key Map

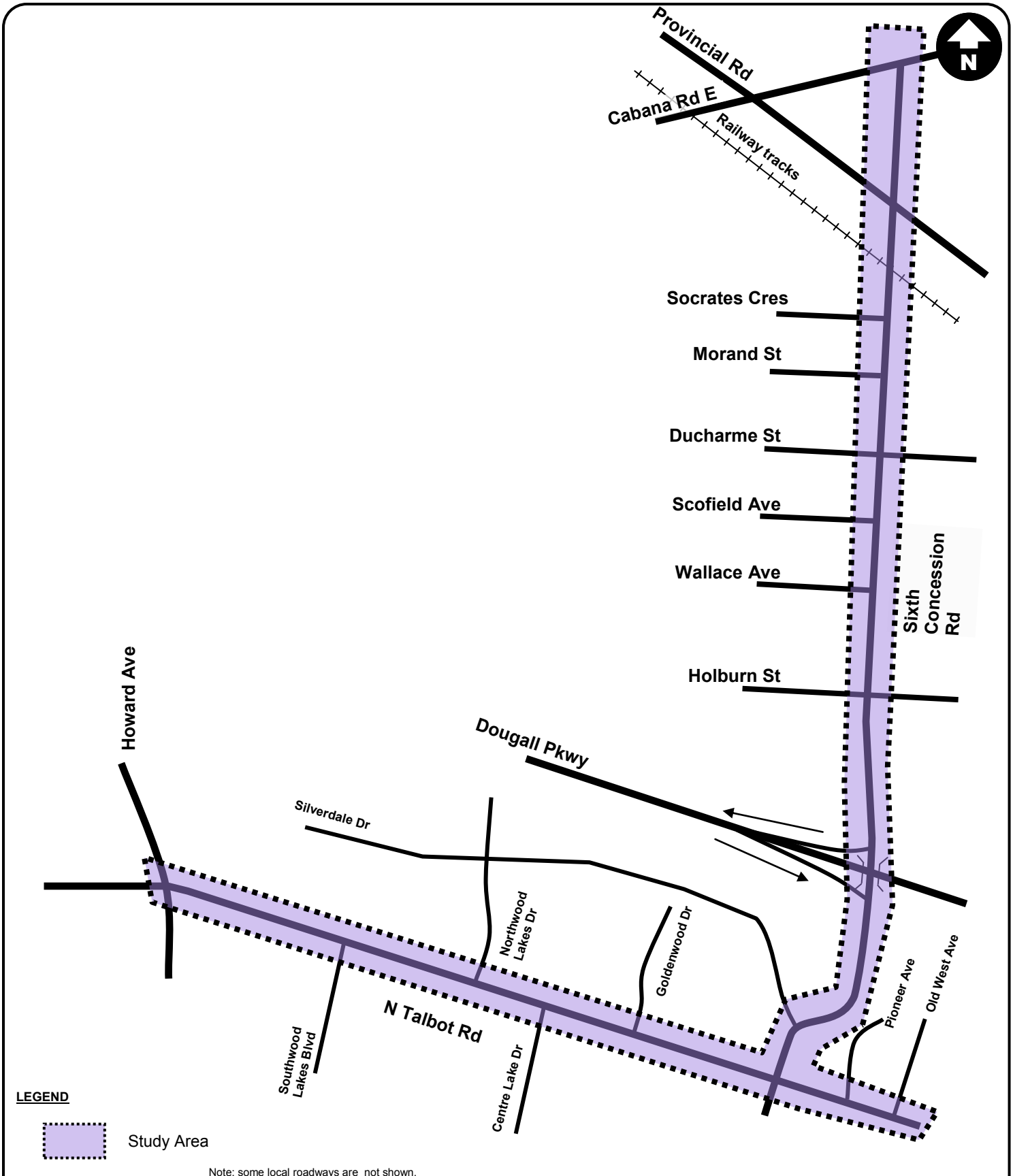

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Figure 2: Study Area

2.0 SCOPE OF ANALYSIS

2.1 Study Horizons

Two time horizons were reviewed in the preparation of this study, these are:

Horizon Year 1: 2013 (Existing Traffic Operations)
Horizon Year 2: 2035 (Approximately 20 years from the completion of the EA)

2.2 Time Periods

The study area roadways primarily service residential land uses, along with a school and some community commercial properties. As such, peak traffic flow within the study area occurs during the AM and PM peak weekday commuter hours. The following analysis was undertaken for the AM and PM peak weekday commuter hours.

2.3 General Parameters and Methods

This Transportation Report has been prepared in accordance with industry accepted practices and methodologies. Intersection Operational Level of Service (LOS) analysis was completed using Trafficware's *Synchro Software* version 6.0. The roundabout analysis was completed using version 8.0 utilizing *Highway Capacity Manual (HCM)* 2010 methodology.

3.0 EXISTING CONDITIONS

3.1 Road Network

Both North Talbot Road and Sixth Concession Road are designated *Class 1 Collector Roads*, as defined by the City of Windsor's Official Plan. *Class I Collector Roads* are designed to carry moderate volumes of traffic (up to 8,000 vehicles per day), with a minimum right-of-way width of 28 metres. Direct property access may be permitted with some controls.

North Talbot Road is a two lane road running east/west, with one travel lane in each direction. There are 505 meters of sidewalk on the north side of North Talbot Road over its 1.8 km length however the sidewalk is not continuous along its length. The posted speed limit is 50 km/h. North Talbot Road is currently closed at the Highway 401 overpass.

The road is designated as a Class 1 Collector Road. The existing right-of-way varies throughout the study area however the Official Plan required ROW width is:

- Howard Ave to Sixth Concession Road – 26.2m
- Sixth Concession Road to Pioneer Ave – 26m
- Pioneer Ave to Highway 401 – 25.3m

The OP indicates that bike lane facilities are to be provided along the corridor.

Sixth Concession Road is a two lane road running north/south, with one travel lane for each direction. The posted speed limit is 50 km/h. Within the Study Area, traffic signals are located at the intersections of:

- Sixth Concession Road and the Dougall Parkway off-ramp; and
- Sixth Concession Road and Provincial Road

The road is designated as a Class 1 Collector Road. The existing right-of-way varies throughout the study area however the Official Plan required ROW width is:

- Cabana Road to Holburn Street – 24m
- Holburn Street to Dougall Parkway EB Off Ramp – 26m
- Dougall Parkway EB Off Ramp to North Talbot Road – 24.4m

The OP indicates that bike lane facilities are to be provided along the corridor.

Dougall Parkway is a designated Expressway that connects to/from the west at Sixth Concession Road. It is a four lane divided roadway with a posted speed limit of 80 km/h.

Cabana Road East is a two lane, Class II Arterial roadway that runs east/west with a posted speed limit of 50 km/h. There are no sidewalks on Cabana Road East at Sixth Concession Road.

Provincial Road is a two lane, Class II Arterial roadway that runs northwest/southeast and intersects Cabana Road East and Sixth Concession Road. It has a posted speed limit of 60 km/h.

Howard Avenue is a two lane, Class II Arterial roadway with a posted speed limit of 50 km/h. It runs north/south through the study area. There are sidewalks on both sides of Howard Avenue from North Talbot Road to the Dougall Parkway, and on the east side of the road from the Dougall Parkway to Division Road. There are no sidewalks on the Dougall Parkway Overpass.

Holburn Street is a two lane, Class II Collector with a posted speed limit of 50 km/h. There are cycling lanes and sidewalks on both sides of the roadway west of Sixth Concession Road. A sidewalk is provided on the south side of Holburn Street east of Sixth Concession Road to Ducharme Street.

Ducharme Street runs from Walker Road on the east to Howard Avenue on the west. From Walker Road to Sixth Concession Road, Ducharme Street is a two lane, Class II Collector with cycling lanes and sidewalks on both sides of the roadway and a posted speed limit of 50 km/h. West of Sixth Concession Road, Ducharme Street is considered a local road.

The following local streets intersect Sixth Concession Road or North Talbot Road within the study area:

- Socrates Crescent
- Silverdale Drive
- Centre Lake Drive
- Morand Street
- Old West Avenue
- Northwood Lakes Drive
- Scofield Avenue
- Pioneer Avenue
- Southwood Lakes Drive
- Wallace Avenue
- Goldenwood Drive

Existing intersection geometry and traffic controls for the study area intersections are illustrated in **Figure 3**.

Southwoods Lakes Boulevard intersects North Talbot Road opposite Sixth Concession Road and at a point approximately 900m to the west. For the purposes of this study, all references to the intersection of North Talbot Road / Southwoods Lakes Boulevard refers to the western intersection.

3.2 Transit Network

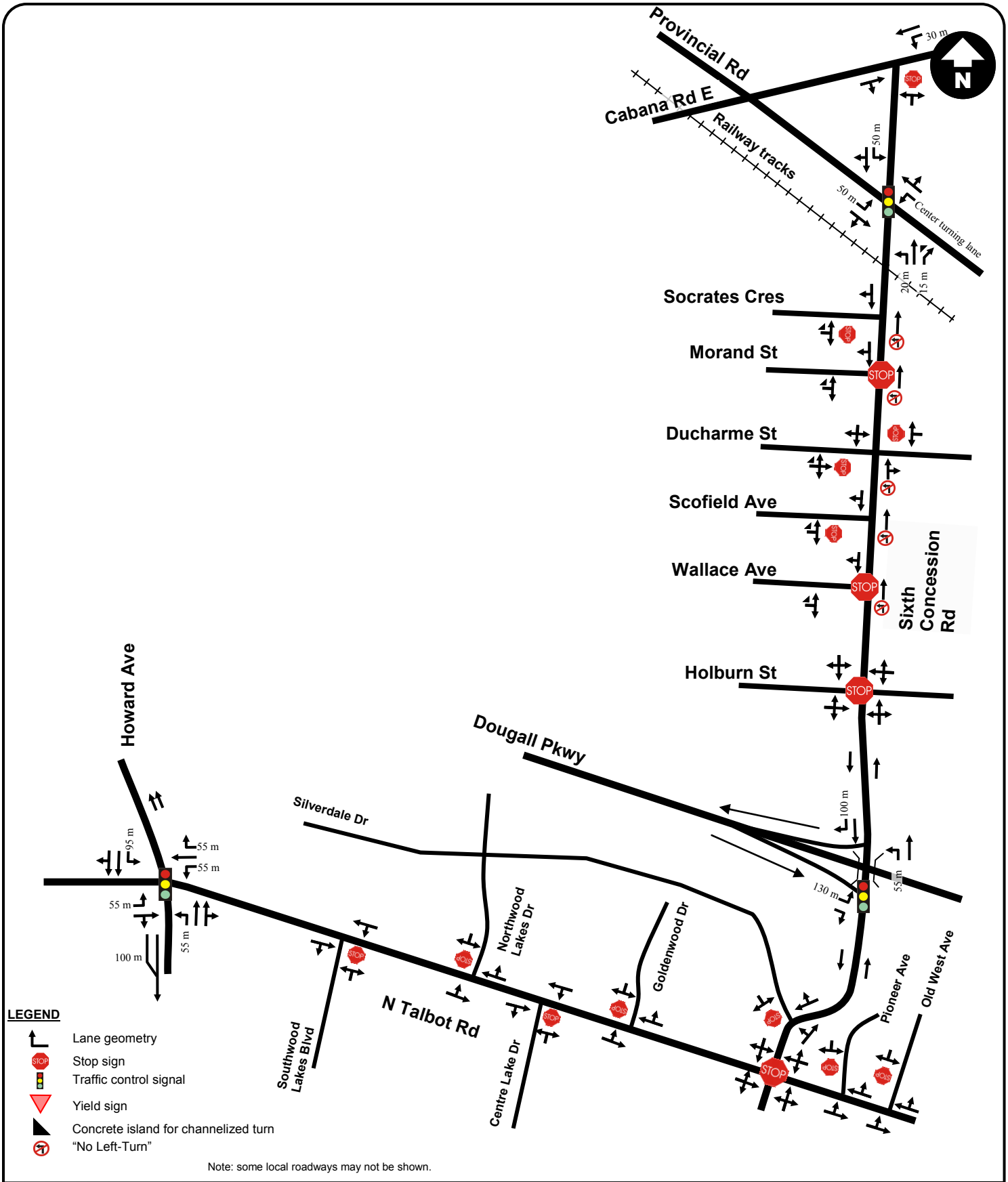
The Walkerville #8 bus route services a portion of Sixth Concession Road from Holburn Street, south to North Talbot Road and travels east on North Talbot Road to Walker Road. Route #7 and Route #6 also pass at the outer edges of the study area. The existing routes are presented in **Figure 4**.

The Talbot Trail Public School is serviced by private school buses.

3.3 Active Transportation Modes

Table 1 outlines the existing sidewalk and bicycle facilities within the study area. Existing pedestrian and bicycle facilities are illustrated in **Figure 5**. There is a paved shoulder on the south side of North Talbot Road over the majority of its length. This paved shoulder is not designated for any specific use however traffic signage is present indicating "Do Not Drive On Paved Shoulder". The paved shoulder is approximately the same width as a typical bicycle lane (~1.5m) and pedestrians are often observed walking in this space.

Table 1: Pedestrian and Bicycle Facilities				
Roadway	**Limits**	**Sidewalks**	**Bicycle Facilities**	**Paved Shoulder**
Sixth Concession Road	North Talbot Road to Holburn Street	Both Sides	Both Sides	None
Sixth Concession Road	Holburn Street to Cabana Road E.	None	None	None
North Talbot Road	Howard Avenue to 150m east	South Side	Both Sides	None
North Talbot Road	150m east of Howard Avenue to 80 m west of Northwood Lakes Drive	None	None	South Side
North Talbot Road	80 m west of Northwood Lakes Drive to 50m east of Northwood Lakes Drive	North Side	None	South Side
North Talbot Road	50 m east of Northwood Lakes Drive to Goldenwood Drive	None	None	South Side
North Talbot Road	Goldenwood Drive to 6th Concession	North Side	None	South Side
North Talbot Road	Sixth Concession to Pioneer Avenue	None	None	South Side
North Talbot Road	Pioneer Avenue to Old West Avenue	North Side	None	South Side
North Talbot Road	Old West Avenue to Extendicare Southwood Lakes Driveway	None	None	South Side
North Talbot Road	Extendicare Southwood Lakes Driveway to eastern limits	None	None	None



Note: some local roadways may not be shown.

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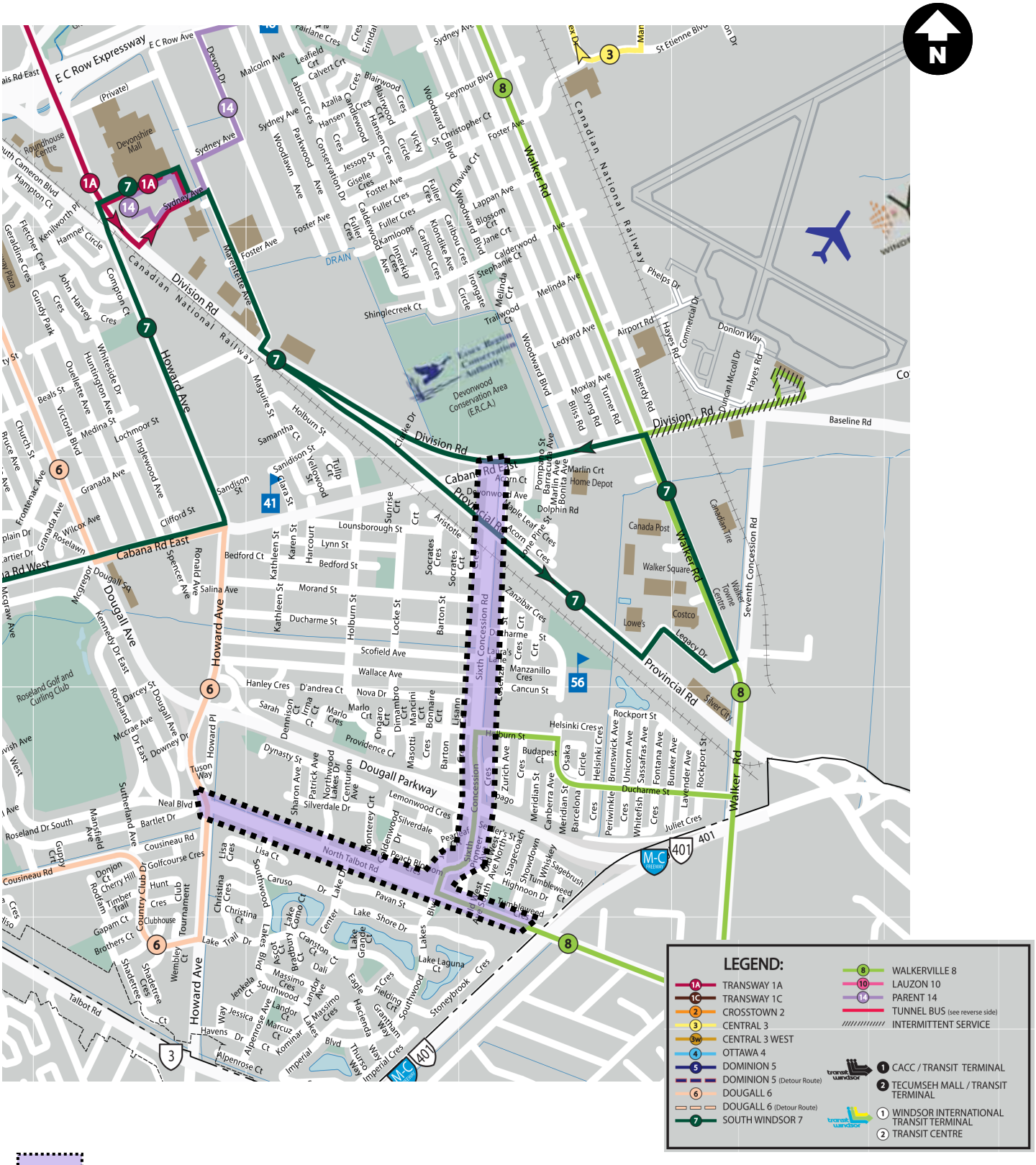
Figure 3: Existing Traffic Controls and Intersection Geometry



Source: citywindsor.ca, January 2014

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Figure 4: Existing Transit Network

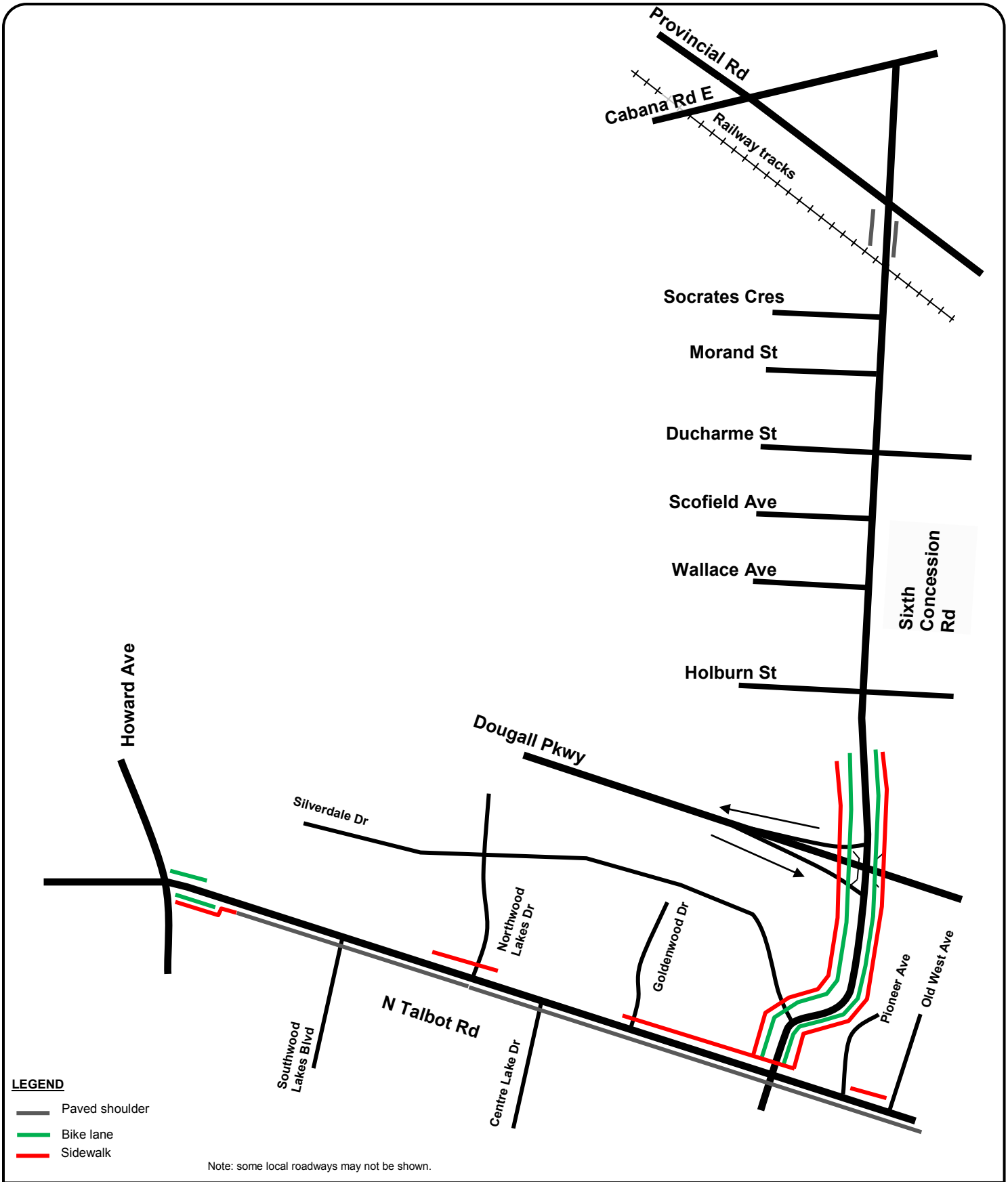

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Figure 5: Existing Pedestrian and Bicycle Facilities

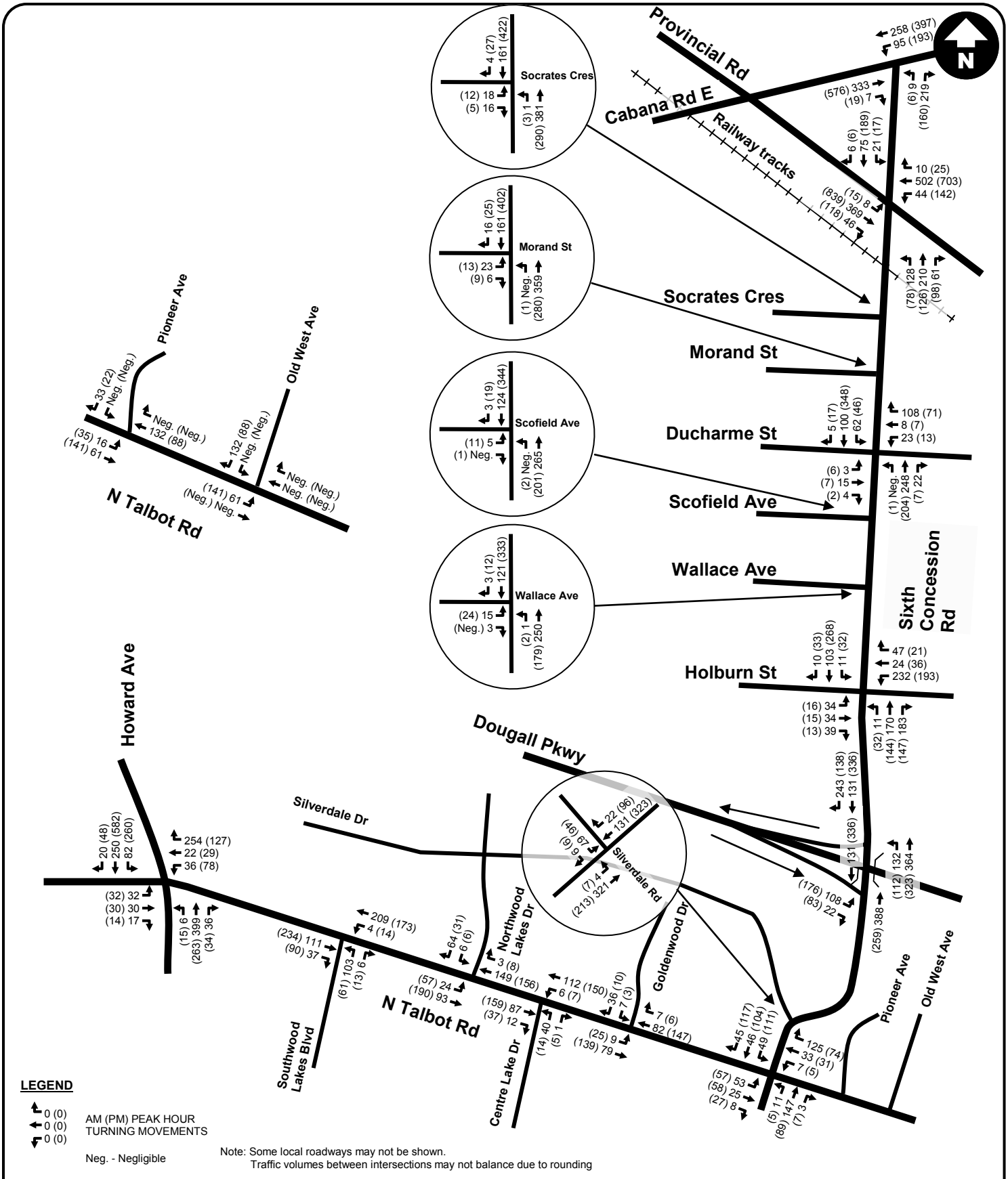
3.4 Existing Traffic Volumes

Historical turning movement count (TMC) data, automatic traffic recorder (ATR) data, and speed data within the study area was obtained from the City of Windsor. This data was supplemented by traffic counts undertaken by Dillon in December 2013. Descriptions of the traffic count data are indicated in **Table 2** and **Table 3**. It should be noted that the North Talbot Road bridge overpass of Highway 401 was closed at the time traffic counts were undertaken in December 2013. Timing of the reopening was unknown at the time that the traffic counts were undertaken. The bridge reopened in May 2014.

Table 2: TMC Count Data and Sources

Intersection	Date of Count	Peak Periods	Origin
Sixth Concession Rd & Dougall Pkwy	Tues, Oct 25, 2005	AM, Noon, PM	Ontario Traffic Inc.
Sixth Concession Rd & Dougall Pkwy Off-Ramp	Thurs, Dec 5, 2013	AM and PM	Dillon
Sixth Concession Rd & Provincial Rd	Thurs, Oct 12, 2006	AM, Noon, PM	Ontario Traffic Inc.
Sixth Concession Rd & Provincial Rd	Wed, Dec 4, 2013	AM and PM	Dillon
North Talbot Rd & Howard Ave	Tues, Nov 14, 2006	AM, Noon, PM	Ontario Traffic Inc.
North Talbot Rd & Howard Ave	Tues, Dec 3, 2013	AM and PM	Dillon
Sixth Concession Rd & Cabana Rd E	Tues, Dec 3, 2013	AM and PM	Dillon
Sixth Concession Rd & Socrates Cres	Tues, Dec 3, 2013	AM and PM	Dillon
Sixth Concession Rd & Morand St	Wed, Dec 4, 2013	AM and PM	Dillon
Sixth Concession Rd & Ducharme St	Thurs, Dec 5, 2013	AM and PM	Dillon
Sixth Concession Rd & Scofield Ave	Wed, Dec 4, 2013	AM and PM	Dillon
Sixth Concession Rd & Wallace Ave	Thurs, Dec 5, 2013	AM and PM	Dillon
Sixth Concession Rd & Holburn St	Tues, Dec 3, 2013	AM and PM	Dillon
Sixth Concession Rd & Silverdale Dr	Thurs, Dec 19, 2013	AM and PM	Dillon
North Talbot Rd & Howard Ave	Tues, Dec 3, 2013	AM and PM	Dillon
North Talbot Rd & Sixth Concession Rd	Thurs, Dec 5, 2013	AM and PM	Dillon
North Talbot Rd & Southwood Lakes Blvd	Thurs, Dec 19, 2013	AM and PM	Dillon
North Talbot Rd & Northwood Lakes Dr	Thurs, Dec 19, 2013	AM and PM	Dillon
North Talbot Rd & Centre Lakes Blvd	Thurs, Dec 19, 2013	AM and PM	Dillon
North Talbot Rd & Goldenwood Dr	Thurs, Dec 19, 2013	AM and PM	Dillon

The existing peak hour traffic volume counts reflect the current traffic patterns due to the closure of the North Talbot Road overpass at Highway 401, as illustrated in **Figure 6.** The Average Daily Traffic (ADT) volumes based on the 2013 turning movement counts and the historic traffic volumes from the 2006 ATR data (when the North Talbot Road bridge overpass of Highway 401 was open to traffic) are illustrated in **Figure 7** for comparison purposes.


Provincial Rd
Cabana Rd E
Railway tracks
Socrates Cres
Morand St
Ducharme St
Scofield Ave
Wallace Ave
Holburn St
Sixth Concession Rd
Dougall Pkwy
Silverdale Dr
Silverdale Rd
Howard Ave
N Talbot Rd
Pioneer Ave
Old West Ave
Northwood Lakes Dr
Goldenwood Dr
Southwood Lakes Blvd
Centre Lake Dr
Socrates Cres
4 (27)
161 (422)
(12) 18
(5) 16
(3) 1
(290) 381
Morand St
16 (25)
161 (402)
(13) 23
(9) 6
(1) Neg.
(280) 359
Scofield Ave
3 (19)
124 (344)
(11) 5
(1) Neg.
(2) Neg.
(201) 265
Wallace Ave
3 (12)
121 (333)
(24) 15
(Neg.) 3
(2) 1
(179) 250
258 (397)
95 (193)
(576) 333
(19) 7
(6) 9
(160) 219
6 (6)
75 (189)
21 (17)
10 (25)
502 (703)
44 (142)
(15) 8
(839) 369
(118) 46
(78) 128
(126) 210
(98) 61
108 (71)
8 (7)
23 (13)
5 (17)
100 (348)
62 (46)
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(7) 15
(2) 4
(1) Neg.
(204) 248
(7) 22
47 (21)
24 (36)
232 (193)
10 (33)
103 (268)
11 (32)
(16) 34
(15) 34
(13) 39
(32) 11
(144) 170
(147) 183
243 (138)
131 (336)
131 (336)
22 (96)
131 (323)
(46) 67
(9) 9
(7) 4
(213) 321
(176) 108
(83) 22
(112) 132
(323) 364
(259) 388
Howard Ave
20 (48)
250 (582)
82 (260)
254 (127)
22 (29)
36 (78)
(32) 32
(30) 30
(14) 17
(15) 6
(263) 399
(34) 36
(234) 111
(90) 37
209 (173)
4 (14)
(61) 103
(13) 6
64 (31)
6 (6)
3 (8)
149 (156)
112 (150)
6 (7)
36 (10)
7 (3)
7 (6)
82 (147)
(57) 24
(190) 93
(159) 87
(37) 12
(14) 40
(5) 1
(25) 9
(139) 79
45 (117)
46 (104)
49 (111)
125 (74)
33 (31)
7 (5)
(57) 53
(58) 25
(27) 8
(5) 11
(89) 147
(7) 3
N Talbot Rd
Pioneer Ave
Old West Ave
33 (22)
Neg. (Neg.)
Neg. (Neg.)
132 (88)
Neg. (Neg.)
132 (88)
Neg. (Neg.)
(35) 16
(141) 61
(141) 61
(Neg.) Neg.
Neg. (Neg.)
Neg. (Neg.)
LEGEND
0 (0)
0 (0)
0 (0)
AM (PM) PEAK HOUR
TURNING MOVEMENTS
Neg. - Negligible
Note: Some local roadways may not be shown.
Traffic volumes between intersections may not balance due to rounding
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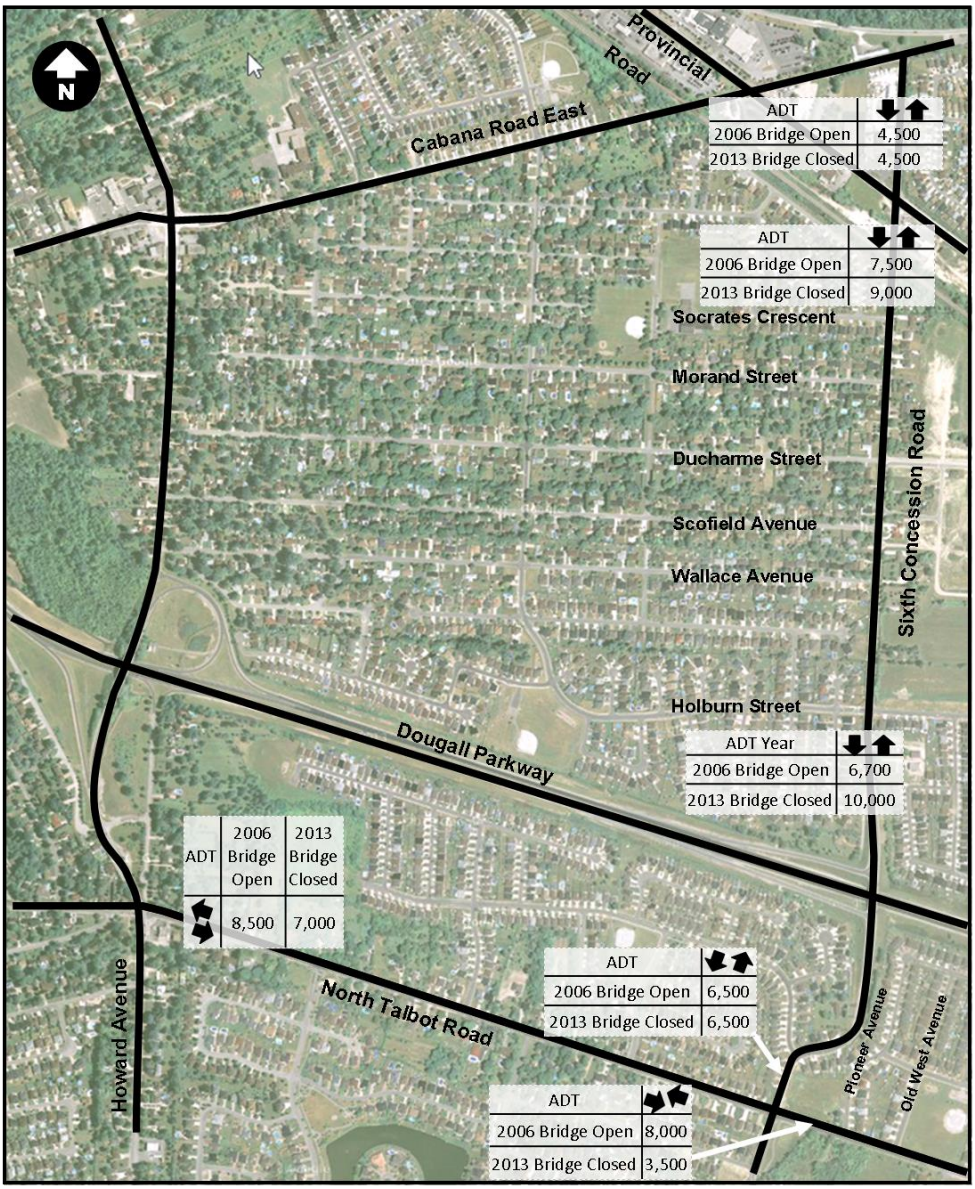
Figure 6: Existing Peak Hour Traffic Volumes - Bridge Closed Condition

Figure 7: Average Daily Traffic Volume



Source: Google Earth, December 2013

Table 3: ATR Count Data and Sources			
Location	**Start of count**	**End of count**	**Origin**
North Talbot Rd, east of Sixth Concession Rd	Nov 12, 2006	Nov 18, 2006	City
Sixth Concession Rd, north of North Talbot Rd	Nov 5, 2006	Nov 18, 2006	City
Sixth Concession Rd, south of Provincial Rd	Nov 5, 2006	Nov 18, 2006	City
Sixth Concession Rd, south of Holburn Rd	Nov 5, 2006	Nov 18, 2006	City
North Talbot Rd, east of Howard Ave (Overpass closed)	Dec 9, 2012	Dec 22, 2012	City

The existing traffic volumes as counted in December, 2013 do not reflect conditions when the North Talbot Road overpass at Highway 401 is open to traffic. The City was unable to provide historic traffic turning movement counts within the study area; however, they were able to provide limited ATR data.

The City of Windsor provided historical Average Annual Daily Traffic (AADT) volumes at various locations in the southern portion of the City. Generally, the historical AADT volume data indicates that traffic volume growth has remained flat to negative since 2001. Thus, AADT volumes in the study area should have remained consistent with the 2006 AADT volumes. It is however noted that the Walker Gates Subdivision has continued to develop and the Talbot Trail Public School has opened within the subdivision. Refer to **Appendix C** for a summary of the historical AADT volume data.

The closure of North Talbot Road at the Highway 401 overpass resulted in a reduction of traffic on North Talbot Road by approximately 1,500 vehicles over the average day just east of Howard Avenue, or approximately 100 to 120 bi-directional vehicle trips in the peak hour. This reduction is fairly minor in nature, equivalent to approximately 2 vehicles per minute during the peak hour.

Traffic volumes east of Sixth Concession Road were significantly lower, as would be expected, as compared to when the North Talbot Road overpass at Highway 401 was open to traffic. Daily traffic volume was approximately 4,500 vehicles lower than 2006 daily traffic volumes just east of Sixth Concession Road.

Sixth Concession Road between North Talbot Road and Silverdale Drive has remained consistent between 2006 and 2013 at approximately 6,500 Average Daily Traffic (ADT). This indicates that traffic volumes between North Talbot Road and the Dougall Parkway have remained at similar levels as when the North Talbot Road overpass at Highway 401 was open to traffic.

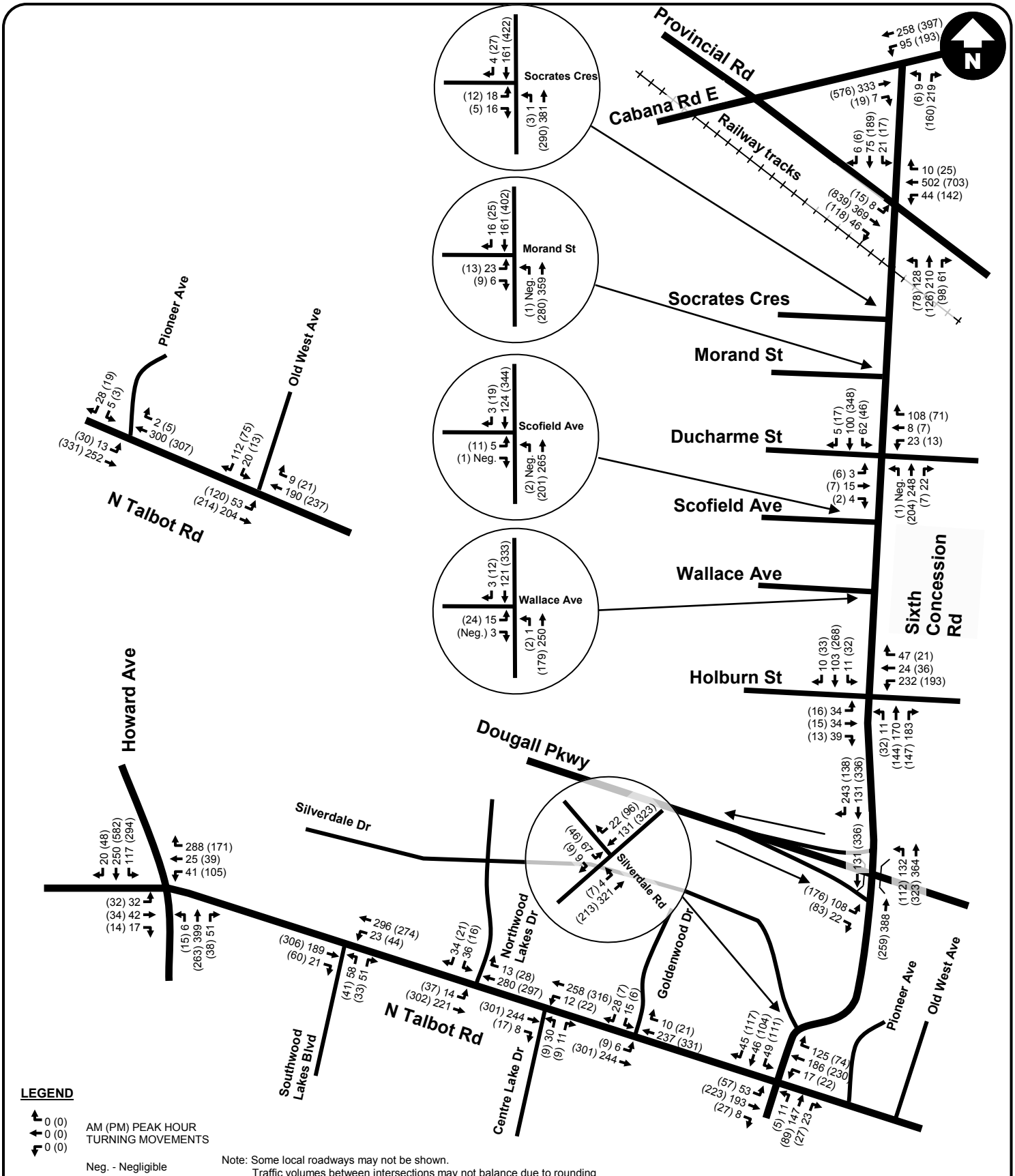
Sixth Concession Road between the Dougall Parkway and Holburn Street has experienced a significant increase in traffic since 2006. ADT traffic volumes are currently 10,000 vehicles per day. In 2006, the ADT was 6,700 vehicles per day. This growth in traffic can be directly attributed to the development within the Walker Gates Subdivision and the new Talbot Trail Public School.

Sixth Concession Road south of Provincial Road has experienced an increase of approximately 1,500 ADT since 2006. In December 2013, Sixth Concession Road experienced an ADT of 9,000 vehicles. The 2006 ADT was 7,500 vehicles. Again, this volume can be attributed to the growth within the Walker Gates subdivision.

Traffic volume on Sixth Concession Road between Cabana Road East and Provincial Road has stayed consistent at approximately 4,500 AADT and has not been affected by the closure of the North Talbot Road overpass at Highway 401.

The limited historical data was insufficient to accurately calibrate existing conditions at the intersection level throughout the study area to reflect North Talbot Road being open to traffic across the Highway 401 overpass. To account for the North Talbot Road Bridge being open to traffic, we have assumed that traffic along Sixth Concession Road has not been affected by the bridge closure, and that traffic volume growth is directly attributable to development within the Walker Gates subdivision. Traffic volumes along North Talbot Road however have been affected by the bridge closure, thus requiring adjustment to reflect bridge open conditions. To reflect bridge open conditions, we have calibrated the 2013 bridge closed traffic volumes with that of historical ADT volume data and assumed a redistribution of local traffic patterns from the various side streets along North Talbot Road.

Figure 8 illustrates the existing traffic volumes adjusted for the Highway 401 bridge open to traffic condition.


Provincial Rd
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Ducharme St
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Wallace Ave
Holburn St
Sixth Concession Rd
Pioneer Ave
Old West Ave
N Talbot Rd
Howard Ave
Dougall Pkwy
Silverdale Dr
Silverdale Rd
Northwood Lakes Dr
Goldenwood Dr
Southwood Lakes Blvd
Centre Lake Dr
LEGEND
0 (0)
0 (0)
0 (0)
AM (PM) PEAK HOUR TURNING MOVEMENTS
Neg. - Negligible
Note: Some local roadways may not be shown.
Traffic volumes between intersections may not balance due to rounding
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Figure 8: Adjusted Existing Traffic Volumes - Bridge Open Condition

3.5 Existing Traffic Operations

Table 4 and **Table 5**, respectively, indicate the existing signalized and unsignalized intersection operations in the study area during the AM and PM peak hours based on the adjusted existing traffic volumes to reflect traffic conditions with the North Talbot Road overpass at Highway 401 open to traffic.

The intersection Level of Service (LOS) definitions are provided in **Appendix A**. Detailed intersection performance worksheets are included in **Appendix B**.

Table 4: 2013 Signalized Intersection Operations

Intersection	Peak Hour	Overall LOS	Overall v/c	Overall Delay (s)	v/c > 0.90
Sixth Concession Rd and Provincial Rd	AM	B	0.46	18.7	None
	PM	C	0.91	30.8	**EBT 0.96**
Sixth Concession Rd and Dougall Pkwy EB Off-Ramp	AM	A	0.37	8.3	None
	PM	A	0.39	9.2	None
North Talbot Rd & Howard Ave	AM	B)	0.26	13.5	None
	PM	A (B)	0.44	11.8	None

Note: Values in red indicate low levels of service, indicating the potential need to improve the intersection traffic control and/or lane geometry.

Sixth Concession Road / Provincial Road
The intersection is currently operating at an acceptable LOS 'C' however the eastbound through movement is near capacity. The intersection operation could be improved by adding additional eastbound and westbound through travel lanes, as indicated in the Provincial Road/Division Road Class EA (2007).

Table 5: 2013 Unsignalized Intersection Operations

Intersection	Approach/ Movement	AM			PM		
		LOS	Delay (s/veh)	95th Queue (m)	LOS	Delay (s/veh)	95th Queue (m)
Sixth Concession Rd and Cabana Rd E	WBL	A	8.5	2.3	A	9.9	6.7
	NB	B	13.7	13.7	C	19.1	15.9
Sixth Concession Rd and Socrates Cres	EB	B	11.9	1.8	B	14.6	1.2
	NB	A	0.0	0.0	A	0.1	0.1
Sixth Concession Rd and Morand St	EB	A	8.9	--	A	8.9	--
	NB	B	12.7	--	A	10.0	--
	SB	A	9.3	--	B	12.0	--
Sixth Concession Rd and Ducharme St	EB	C	16.3	2.0	C	20.5	2.0
	WB	B	14.0	9.9	B	13.6	6.7

Table 5: 2013 Unsignalized Intersection Operations							
Intersection	**Approach/ Movement**	**AM**			**PM**		
		LOS	**Delay (s/veh)**	**95th Queue (m)**	**LOS**	**Delay (s/veh)**	**95th Queue (m)**
	SB	A	3.4	1.6	A	1.3	1.2
Sixth Concession Rd and Scofield Ave	EB	B	11.5	0.3	B	13.1	0.7
Sixth Concession Rd and Wallace Ave	EB	A	8.3	--	A	8.5	--
	NB	A	9.9	--	A	8.7	--
	SB	A	8.7	--	B	10.3	--
Sixth Concession Rd and Holburn St	EB	B	12.3	--	A	9.9	--
	WB	C	23.5	--	B	13.8	--
	NB	D	26.5	--	B	13.6	--
	SB	B	13.1	--	B	14.6	--
Sixth Concession Rd and Silverdale Dr	EB	B	14.7	6.3	B	14.3	3.8
	NB	A	0.1	0.1	A	0.3	0.2
Sixth Concession Rd and North Talbot Rd	EB	B	12.6	--	C	21.2	--
	WB	B	13.5	--	C	21.7	--
	NB	B	12.0	--	B	13.1	--
	SB	B	11.1	--	C	22.9	--
North Talbot Rd and Southwood Lakes Blvd	NB	B	12.6	5.8	C	15.5	5.9
North Talbot Rd and Northwood Lakes Blvd	SB	B	13.3	4.5	B	13.0	2.2
North Talbot Rd and Centre Lake Dr	NB	B	12.9	2.3	B	12.6	1.0
North Talbot Rd and Goldenwood Dr	SB	B	11.4	2.2	B	12.9	0.8
North Talbot Rd and Pioneer Ave.	SB	B	10.8	1.4	B	11.0	1.0
North Talbot Rd and Old West Ave.	SB	B	11.0	5.7	B	11.5	4.1

Each of the unsignalized intersections operate at acceptable levels, no immediate modifications are required to address capacity constraints.

3.6 Traffic Speeds

The posted speed limit is 50 km/h on both North Talbot Road and Sixth Concession Road.

Table 6 summarizes the observed operating speeds along both corridors, as observed by the City of Windsor.

Table 6: Existing Traffic Speeds			
Road	**Posted Speed**	**Average Speed**	**85th Percentile[1]**
North Talbot Road	50 km/h	55 km/h	62 km/h
Sixth Concession Road	50 km/h	58 km/h	65 km/h

[1] 85th Percentile Speed is the speed at which 15% of drivers exceed. 85% of drivers drive at or below the 85th Percentile Speed.

A section of roadway can be evaluated as a candidate for traffic calming based on a number of criteria including speed, traffic volume, collisions, proximity to pedestrian generators, bicycle routes and residential frontage in the area. The evaluation is based on point scoring in which the speed criterion receives points when the 85th percentile speed exceeds 10km/h above the posted speed limit as is the case on both North Talbot Road and Sixth Concession Road. Existing traffic calming along Sixth Concession Road includes turn prohibitions and channelization islands as indicated on **Figure 3**.

Refer to **Appendix F** for additional traffic calming considerations.

3.7 Collision History

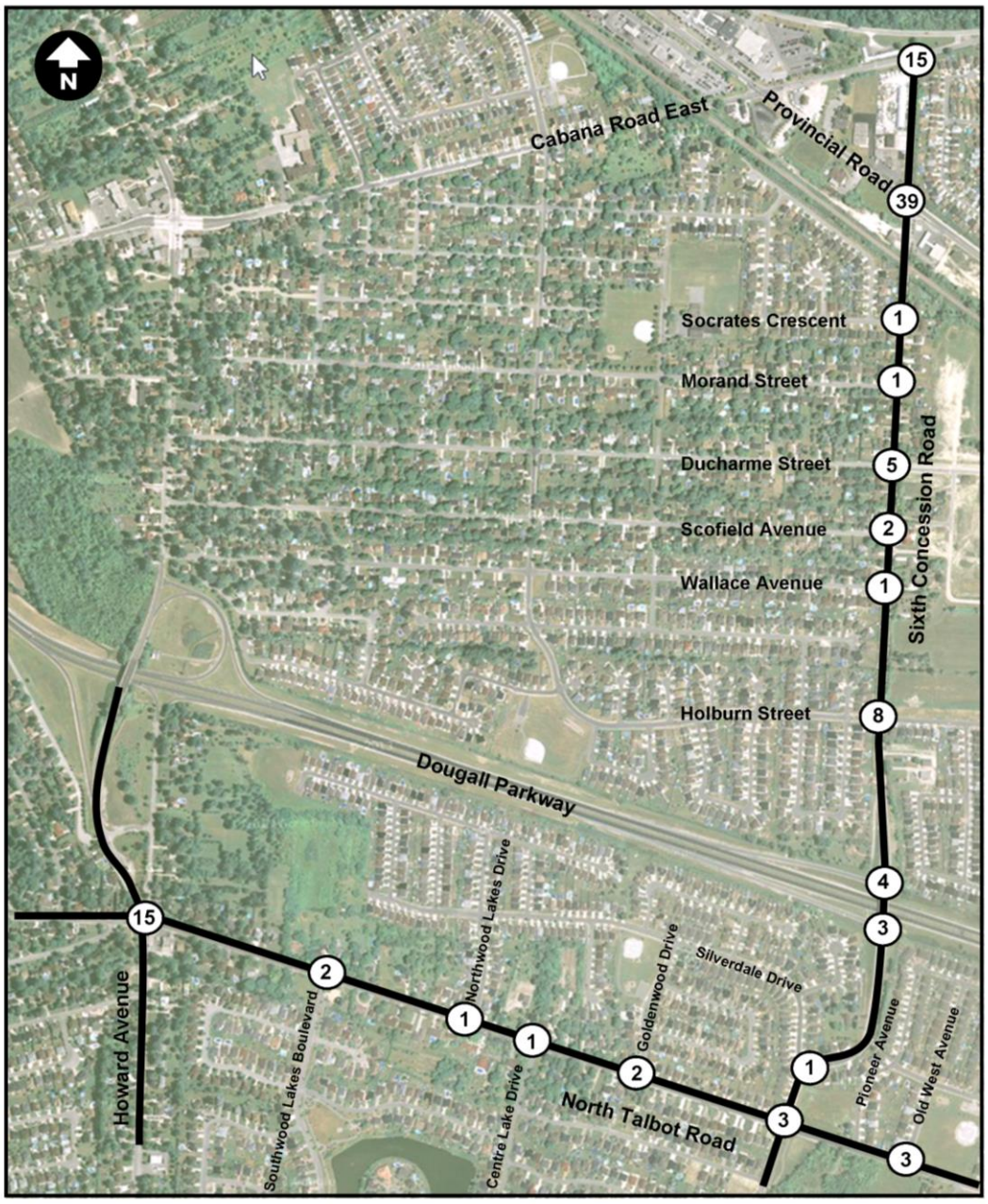
Collision data for Sixth Concession Road and North Talbot Road for the period of July 1, 2008 to July 1, 2012, was provided by the City of Windsor. As shown on **Figure 9**, a total of 107 vehicle collisions were reported at intersections within the Study Area. An additional 11 midblock collisions were reported during the same period.

3.7.1 Intersection Collisions

At intersections within the Study Area, rear-end collisions are largely represented, followed by angle and turning collisions. **Table 7** summarizes percentage of typical collision types occurring at intersections within the Study Area.

Personal injuries were reported in nearly a third (31%) of all collisions occurring within the Study Area, for a total of 36 collisions.

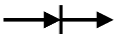
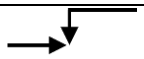
Figure 9: Vehicle Collision Summary - July 1, 2008 to July 1, 2013



Source: Google Maps, 2013

According to the City of Windsor's *2012 Road Safety Report* (May 2013), the intersection of Provincial Road / Sixth Concession Road is ranked 7th overall within the City for highest collisions at a signalized intersection (2008-2012), with a collision rate of 1.15 per million vehicles. The intersection of Cabana Road and Sixth Concession Road is ranked 17th overall within the City for the highest number of collisions occurring at unsignalized intersections (2008-2012), with a total of 15 collisions between 2008 and 2012. No fatalities occurred within the Study Area during the period reviewed.

Table 7: Intersection Collision Type

Intersection Collision Type	Percentage of Collision Type Occurring at Intersections	Collision Symbol
Rear End	37	
Angle	21	
Turning	21	
Approaching	9	
Sideswipe	6	
Other	6	

Sixth Concession Road / Cabana Road East

A total of 15 collisions occurred over the 5 year analysis period, of which 11 were rear end collisions. More recently, intersection modifications occurred which added a westbound left turn lane. It is recommended that the intersection collision rate be monitored over time to determine if recent modifications have reduced the number of annual collisions. Alternatively, a safety audit could be undertaken to identify other potential improvements which may include but not limited to improved traffic signage; and, an improved pavement friction course.

Sixth Concession Road / Provincial Road

A total of 39 collisions occurred over the 5 year analysis period, of which 20 were rear end collisions. More recently, intersection modifications occurred, which added northbound and southbound left turn lanes. It is recommended that the intersection collision rate be monitored over time to determine if recent modifications have reduced the number of annual collisions. Alternatively, a safety audit could be undertaken to identify other potential improvements which may include but not limited to modified traffic signal timing; lighting levels; traffic signage; and, an improved pavement friction course.

Sixth Concession Road / Ducharme Street

A total of 5 collisions occurred over the 5 year analysis period, of which all were classified as an angled or turning collision type. It is recommended that vehicle sight lines be reviewed and/or consider alternative traffic controls.

Sixth Concession Road / Holburn Street

A total of 8 collisions occurred over the 5 year analysis period, of which 6 were classified as an angled or turning collision type. It is recommended that vehicle sight lines be reviewed and/or consider alternative traffic controls.

North Talbot Road / Howard Avenue
A total of 15 collisions occurred over the 5 year analysis period, involving a mix of collision types. A safety audit could be undertaken to identify potential improvements which may include but not limited to modified traffic signal timing and phasing; traffic signage; and, an improved pavement friction course.

3.7.2 Mid-Block Collisions

According to the City of Windsor's *2012 Road Safety Report* (May 2013), there are no road segments along Sixth Concession Road or North Talbot Road that are experiencing an unusually high collision rate. The study area is not ranked within the top 25 locations mid-block collision locations.

Table 8 summarizes the mid-block collision data from July 2008 to July 2013.

Table 8: Mid-Block Collision History, 2008 to 2013

Road	Between	No. of Collisions	Average No. of Collisions per Year
Sixth Concession	Cabana Road & Provincial Road	1	0.2
Sixth Concession	Provincial Road & Socrates Crescent	2	0.4
Sixth Concession	Dougall Parkway EB Off Ramp & Silverdale Road	4	0.8
North Talbot	Old West Ave & North Talbot Road	1	0.2
North Talbot	Howard Avenue & Southwood Lakes Boulevard	3	0.6
Total		11	

There are no identifiable collision patterns based on the information available. The frequency of collisions per road segment over a five year period does not indicate a mid-block collision problem within the study area.

4.0 PLANNED CONDITIONS

4.1 Road Network

There have been two Environmental Assessments recently completed which affect the study area, the Cabana Road/Division Road Class EA (November 2005) and the Provincial Road/Division Road Class EA (March 2007). Following the recommended design of these Environmental Assessments, the following changes are expected to occur:

- Cabana Road / Division Road will be widened to four lanes with bike lanes plus curbs and gutters;
- Division Road will be widened to five lanes (four through lanes and one continuous two-way left-turn lane) from north of Sydney Avenue to Marentette Avenue;
- Provincial Road will be widened to five lanes from the junction with Division Road, near Marentette Avenue, to Walker Road, to include a centre turn lane;
- Cabana Road East will be widened from two lanes to four lanes from the DRTP rail to Barracuda Avenue;
- Division Road will be improved from Cabana Road East to Marentette Avenue; and,
- Sixth Concession Road will be improved between the DRTP rail and Cabana Road East.

4.2 Transit Network

The Transit Master Plan (TMP) (July 2006) outlines the proposed route and service changes in central, west, south and east areas of Windsor. The TMP identifies a short term service implementation plan (from 2007 to 2011) and a long term service implementation plan (from 2012 to 2016).

Within the study area, the Walkerville #8 route is to remain unchanged. The TMP calls for additional short term transit routes 101B and Dominion 5, which would service Sixth Concession Road and North Talbot Road, respectively, within the study area. There were no long term service route changes identified. As of the writing of this report, these transit routes have not been implemented.

4.3 Active Transportation Facilities

As shown on *Schedule F, Roads and Bikeways*, to the City of Windsor Official Plan, North Talbot Road between Howard Ave and Provincial Highway 401 and Sixth Concession Road between Dougall Parkway and Cabana Road are designated as a "Proposed Bikeway". Sixth Concession Road between North Talbot Road and Dougall Parkway Road is designated as "Bikeway' and the bikeways are existing.

The City of Windsor's *Bicycle Use Master Plan* (May 2001) aims to expand the City's existing cycling network, promote awareness, improve the cycling-transit link and provide end-of-trip facilities. According to the Recommended Primary Cycling Network, bike lanes are recommended along North Talbot Road and Sixth Concession Road. The Master Plan identifies these bike lanes as achievable in the longer term (years 5 through 20).

5.0 DEMAND FORECASTING

5.1 Anticipated Future Development Trip Generation

There are several vacant lands in proximity of the study area which may be developed in the future. These future developments are expected to have some impact on the study area road network. **Figure 10** illustrates the location of these developments.

Table 9 and **Table 10** identify the anticipated development characteristics of the various residential, commercial and industrial developments expected to develop and have an impact on the study area within the 2035 time horizon. The Institute of Transportation Engineers (ITE) Trip Generation Manual, 8th Edition was utilized to identify the number of vehicle trips generated by each potential development.

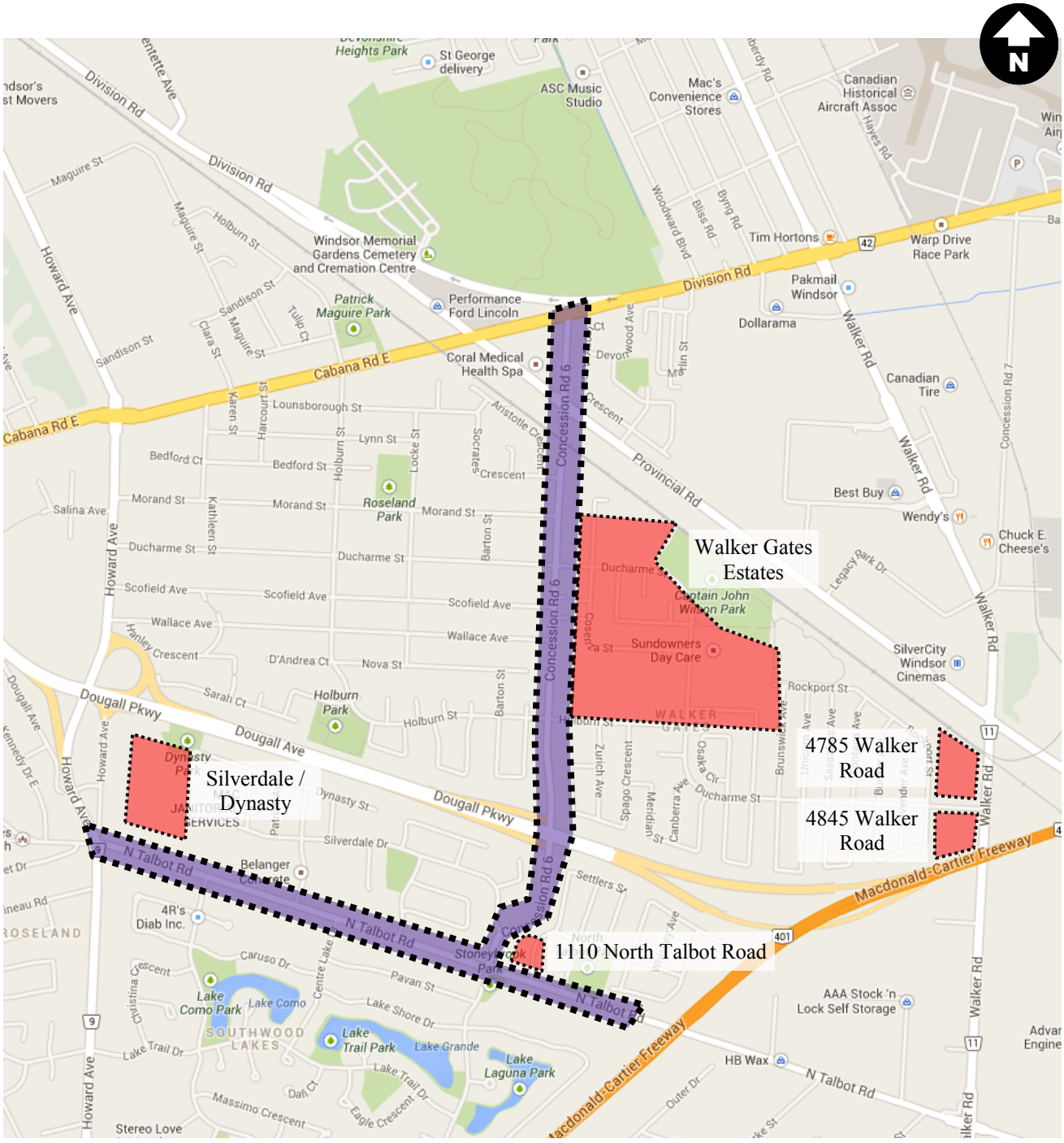
Table 9: Anticipated Future Residential Land Uses

Property	Type	ITE LUC	ITE LUC Description	Units
Walker Gates Estates	Detached dwellings	210	Single-Family Detached Housing	350
Silverdale / Dynasty	Detached dwellings	210	Single-Family Detached Housing	150
1110 North Talbot	Detached dwellings	210	Single-Family Detached Housing	5
			Total	**505**

Table 10: Anticipated Commercial and Industrial Land Uses

Property	Type	ITE LUC	ITE LUC Description	Lot Area	Assumed Coverage	Estimated Gross Floor Area (GFA)
1110 North Talbot	Commercial	820	Shopping Centre	0.8 ha	40%	34,000 sq.ft.
4785 Walker Road	Industrial	110	General Light Industrial	2.3 ha	40%	101,000 sq.ft.
4845 Walker Road	Industrial	110	General Light Industrial	1.4 ha	40%	60,600 sq.ft.
					Total	**195,600 sq.ft.**

Table 11 indicates the automobile trip rates anticipated to be generated by the proposed land uses as identified by the ITE Trip Generation Manual. **Table 12** indicates the number of automobile trips anticipated to be generated by each proposed land use anticipated to be developed in proximity to the study area.



Development Site Locations

Study Area

Source: Google Maps, January 2014

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Environmental Assessment
Sixth Concession Road / North Talbot Road
June 2014

Figure 10: Anticipated Future Developments

Table 11: ITE Trip Generation Rate					
ITE LUC	**ITE LUC Description**	**Time of Day**	**Trip Generation Rate**	**% IN**	**% OUT**
210	Single-Family Detached Housing (trip generation rate per unit)	AM	0.75	25%	75%
		PM	1.01	63%	37%
820	Shopping Center (trip generation rate per 1,000 sq.ft. GFA)	AM	1.00	61%	39%
		PM	3.73	49%	51%
110	General Light Industrial (trip generation rate per 1,000 sq.ft. GFA)	AM	0.92	88%	12%
		PM	0.97	12%	88%

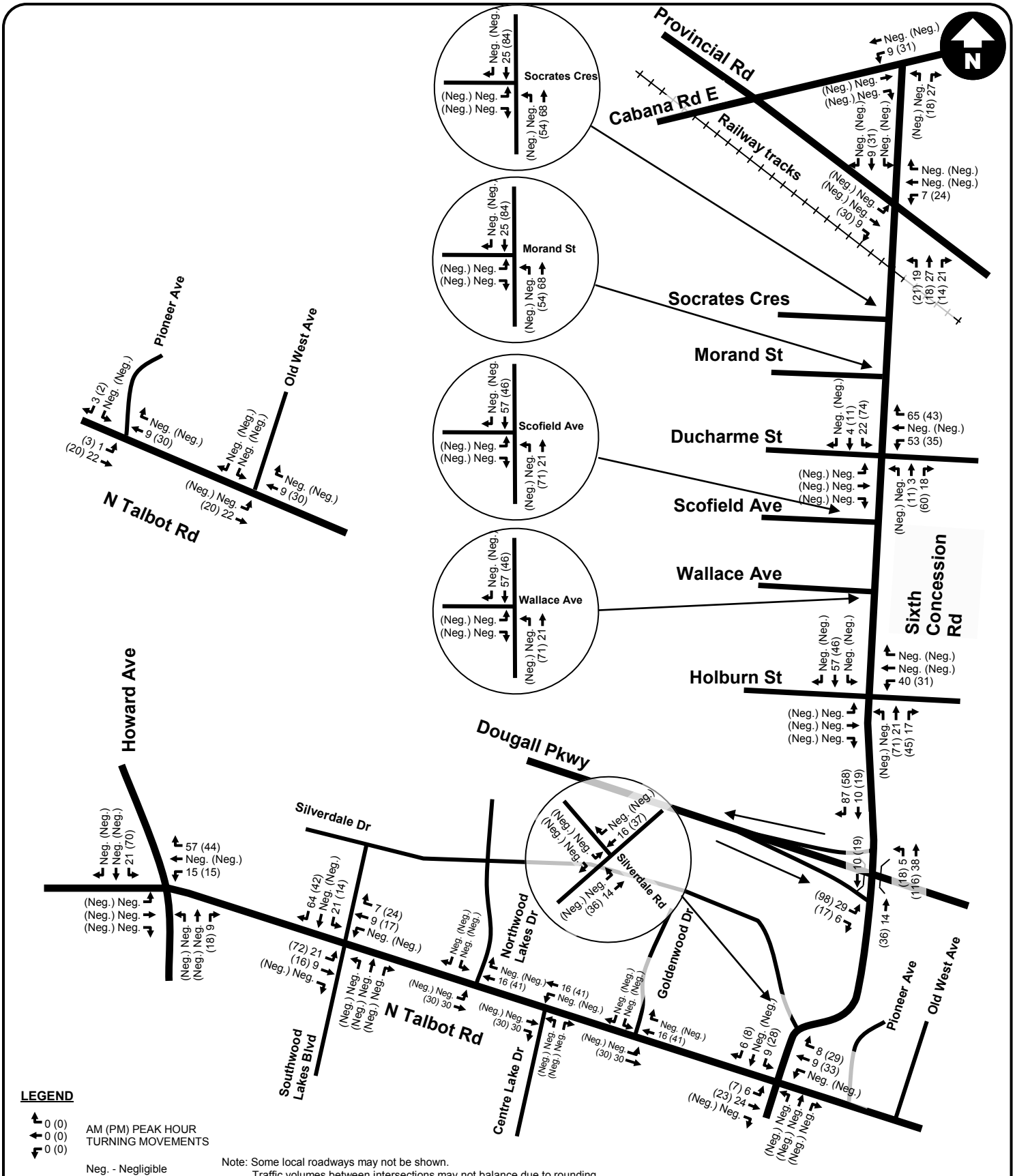
Note: LUC = Land Use Code

Table 12: Total Automobile Trips Generated						
Property	**AM Peak Hour**			**PM Peak Hour**		
	In	**Out**	**Total**	**In**	**Out**	**Total**
Walker Gates Estates	66	197	263	223	131	354
Silverdale / Dynasty	28	85	113	96	56	152
1110 North Talbot	22	16	38	65	67	132
4785 Walker Road	82	11	93	12	86	98
4845 Walker Road	49	7	56	7	52	59
Total	**247**	**316**	**563**	**403**	**392**	**795**

5.2 Trip Distribution & Assignment

The trips generated by each anticipated land use, as identified in **Table 12**, were distributed to the road network based on travel characteristics of the existing neighbourhood. **Table 13** summarizes the trip distribution. Trips were assigned to the road network based the trip distribution and the location of the development. The shopping centre land use at 1110 North Talbot Road was reduced by 35% to account for pass-by traffic. We have assumed that the trips generated by the Silverdale / Dynasty subdivision will have access via a new connection to North Talbot Road opposite Southwood Lakes Boulevard. **Figure 11** illustrates the total assignment of the anticipated future development site generated auto trips.

Table 13: Trip Distribution by Cardinal Direction	
Property	**Percentage**
North / West	70%
East	25%
South	5%


Provincial Rd
Cabana Rd E
Railway tracks
Socrates Cres
Morand St
Scofield Ave
Wallace Ave
Ducharme St
Holburn St
Sixth Concession Rd
Howard Ave
Dougall Pkwy
Silverdale Dr
Silverdale Rd
Northwood Lakes Dr
Goldenwood Dr
Southwood Lakes Blvd
Centre Lake Dr
N Talbot Rd
Pioneer Ave
Old West Ave
LEGEND
0 (0)
0 (0)
0 (0)
AM (PM) PEAK HOUR TURNING MOVEMENTS
Neg. - Negligible
Note: Some local roadways may not be shown.
Traffic volumes between intersections may not balance due to rounding
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Environmental Assessment
Sixth Concession Road / North Talbot Road
June 2014
Figure 11: Total Future Development Site Generated Auto Trips

6.0 2035 FUTURE CONDITIONS

6.1 Future Background Traffic Volumes

As indicated in Section 3.4, the City of Windsor provided historical Annual Average Daily Traffic (AADT) volumes at various locations in the southern portion of the City. Generally, the historical AADT volumes indicate that traffic volume growth has remained flat to negative since 2001. For this analysis, we have assumed a conservative 0.5% annual growth in background traffic volumes from 2013 to the 2035 future horizon year.

6.2 Total 2035 Future Traffic Volumes

Total future traffic volumes include background traffic volume growth (2013 traffic volumes grown out to 2035 at 0.5%) plus the addition of the anticipated future development site generated auto trips.

Figure 12 illustrates the anticipated total future 2035 peak hour traffic volume estimate for the bridge open condition. **Figure 13** illustrates the total future 2035 ADT volumes and the 2013 ADT volumes estimated for the bridge being open to traffic.

6.3 2035 Intersection Performance – Existing Traffic Control & Lane Geometry

Table 14 indicates the future 2035 traffic control signalized intersection operations based on the existing roadway geometry and traffic controls, which is referred to the "Do Nothing" scenario.

Table 14: "Do Nothing" Future 2035 Signalized Intersection Operations

Intersection	Peak Hour	Overall LOS	Overall v/c	Overall Delay (s)	Movement v/c > 0.90
Sixth Concession Rd and Provincial Rd	AM	C	0.53	20.6	None
	PM	**E**	1.11	67.8	**EBT 1.19, WBL 0.90, NBL 0.99**
Sixth Concession Rd and Dougall Pkwy EB Off-Ramp	AM	A	0.45	9.2	None
	PM	B	0.54	11.2	None
North Talbot Rd and Howard Ave	AM	B	0.30	15.3	None
	PM	B	0.59	13.1	None

Table 15 indicates the future 2035 unsignalized intersection operations based on the existing roadway geometry and traffic controls.

The number of through travel lanes on an urban roadway is typically governed by its intersection capacity and its hierarchical roadway classification. Given the Class 1 Collector designation, the residential character of the study area, and the intersection operations, a single through lane in each direction along North Talbot Road and Sixth Concession is expected to accommodate the future forecast traffic volumes.

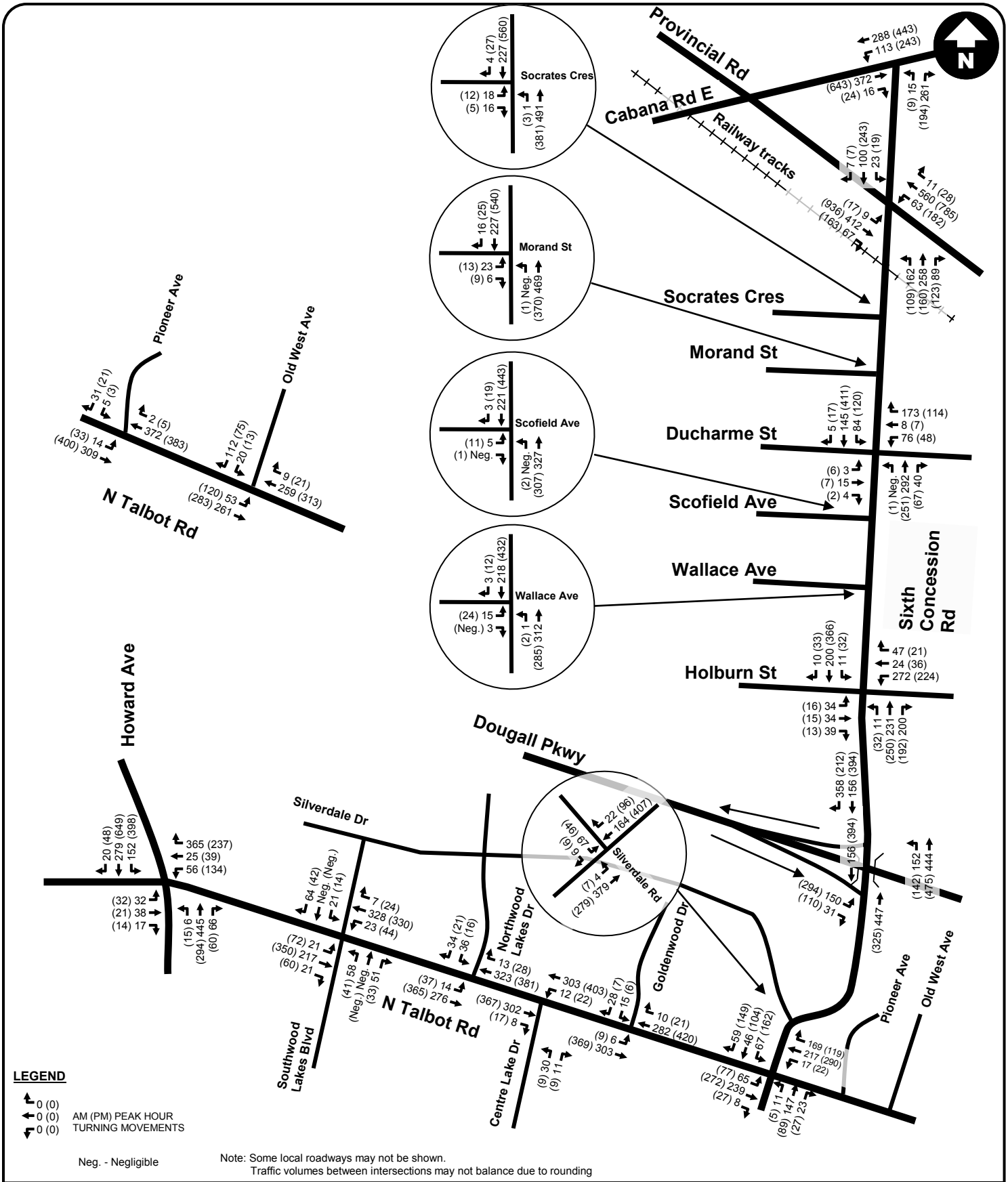
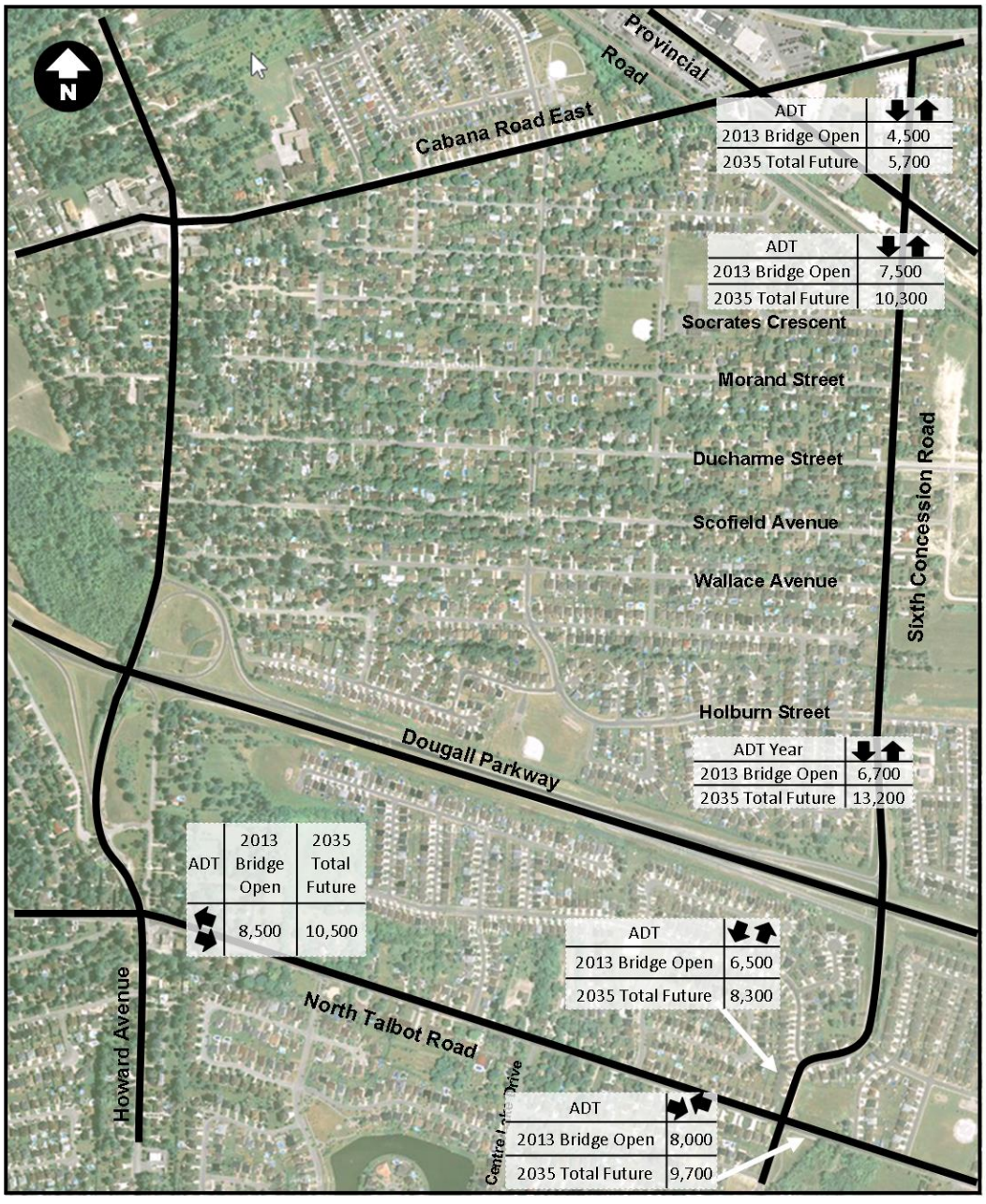

Provincial Rd
Cabana Rd E
Railway tracks
Socrates Cres
Morand St
Ducharme St
Scofield Ave
Wallace Ave
Holburn St
Sixth Concession Rd
Pioneer Ave
Old West Ave
N Talbot Rd
Howard Ave
Dougall Pkwy
Silverdale Dr
Silverdale Rd
Northwood Lakes Dr
Goldenwood Dr
Southwood Lakes Blvd
Centre Lake Dr
LEGEND
0 (0)
0 (0) AM (PM) PEAK HOUR
0 (0) TURNING MOVEMENTS
Neg. - Negligible
Note: Some local roadways may not be shown.
Traffic volumes between intersections may not balance due to rounding
NOT TO SCALE
DILLON CONSULTING
Environmental Assessment
Sixth Concession Road / North Talbot Road
June 2014
Figure 12: Total Future 2035 Peak Hour Traffic Volumes

Figure 13: Total Future 2035 ADT Volumes



Source: Google Earth, December 2013

Table 15: "Do Nothing" Future 2035 Unsignalized Intersection Operations							
Intersection	**Approach/ Movement**	**AM**			**PM**		
		LOS	**Delay (s/veh)**	**95th Queue (m)**	**LOS**	**Delay (s/veh)**	**95th Queue (m)**
Sixth Concession Rd and Cabana Rd E	WBL	A	8.7	3.0	B	10.7	9.8
	NB	C	16.7	21.7	D	29.4	30.6
Sixth Concession Rd and Socrates Cres	EB	B	13.8	2.3	C	19.2	1.7
	NB	A	0.0	0.0	A	0.1	0.1
Sixth Concession Rd and Morand St	EB	A	9.5	--	A	9.5	--
	NB	C	19.7	--	B	12.2	--
	SB	B	10.9	--	C	18.0	--
Sixth Concession Rd and Ducharme St	EB	C	21.7	2.9	D	32.6	3.2
	WB	D	33.8	46.9	D	30.1	28.8
	SB	A	3.6	2.4	A	3.0	3.3
Sixth Concession Rd and Scofield Ave	EB	B	13.4	0.3	C	16.0	1.0
	NB	A	0.0	0.0	A	0.1	0.0
Sixth Concession Rd and Wallace Ave	EB	A	8.8	--	A	9.1	--
	NB	B	11.8	--	B	10.3	--
	SB	B	10.5	--	B	12.9	--
Sixth Concession Rd and Holburn St	EB	B	13.7	--	B	11.6	--
	WB	D	32.0	--	C	19.3	--
	NB	E	46.6	--	D	32.3	--
	SB	C	18.5	--	D	28.7	--
Sixth Concession Rd and Silverdale Dr	EB	C	16.8	7.6	C	17.1	4.9
	NB	A	0.1	0.1	A	0.3	0.2
North Talbot Rd and Southwood Lakes Blvd	NB	C	17.3	9.1	D	32.1	14.3
	SB	B	13.2	4.9	C	17.7	5.4
	EB	A	0.8	0.4	A	2.0	1.9
	WB	A	0.7	0.5	A	1.4	1.2
North Talbot Rd and Northwood Lakes Blvd	SB	B	14.6	4.3	B	14.9	2.8
	EB	A	0.6	0.4	A	1.2	0.9
North Talbot Rd and Centre Lake Dr	NB	B	14.2	2.7	B	14.8	1.0
	WB	A	0.4	0.3	A	0.6	0.5
North Talbot Rd and Goldenwood Dr	SB	B	12.2	2.4	B	11.4	0.7
	EB	A	0.2	0.1	A	0.3	0.2
Sixth Concession Rd and North Talbot Rd	EB	C	16.3	--	E	37.2	--
	WB	C	18.9	--	E	47.1	--
	NB	B	13.9	--	C	15.4	--
	SB	B	10.8	--	E	44.5	--
North Talbot Rd and Pioneer Ave.	SB	B	11.6	1.7	B	11.8	1.2
	EB	A	0.5	0.3	A	1.0	0.8

Table 15: "Do Nothing" Future 2035 Unsignalized Intersection Operations							
Intersection	**Approach/ Movement**	**AM**			**PM**		
		LOS	**Delay (s/veh)**	**95th Queue (m)**	**LOS**	**Delay (s/veh)**	**95th Queue (m)**
North Talbot Rd and Old West Ave.	SB	B	11.9	6.6	B	12.7	4.9
	EB	A	1.7	1.1	A	3.3	2.9

Note: Values in red indicate low levels of service, indicating the need to modify the intersection traffic control and/or lane geometry.

6.4 Intersection Performance – Mitigated Lane Geometry and/or Traffic Control

Table 16 indicates the 2035 intersection performance of those locations where the "Do Nothing" scenario indicated a LOS E or worse. The City of Windsor considers a LOS E as requiring mitigation. Potential intersection modifications have also been listed in **Table 16** below for reference and may be desirable as a potential traffic calming device.

Table 16: Mitigated Future 2035 Intersection Operations						
Intersection	**Peak Hour**	**Overall LOS**	**Overall or Movement v/c**	**Overall or Movement Delay (s/veh)**	**Movement v/c > 0.90**	**Mitigation Measures (included within analysis)**
Intersection Mitigation Required						
Sixth Concession Rd and Provincial Rd	AM	B	0.36	18.0	None	Add a WB and EB through lane on Provincial; Add NB permitted/protected left turn signal phase. Lengthen NB LT to 30m storage Provide NB RT parallel length of 35m.
	PM	C	0.76	23.6	None	
Sixth Concession Rd and Holburn St (Roundabout)	AM	B	--	10.7	None	Implement a Roundabout
	PM	B	--	10.5	None	
Sixth Concession Rd and Holburn St (Traffic Signal)	AM	B	0.60	16.3	None	Install Traffic Control Signal; Add a NB 25 m right turn parallel lane
	PM	B	0.61	11.9	None	
Sixth Concession Rd and North Talbot Rd (Roundabout)	AM	A	--	9.4	None	Implement a Roundabout
	PM	B	--	12.3	None	
Sixth Concession Rd and North Talbot Rd (Traffic Signal)	AM	B	0.43	15.1	None	Install Traffic Control Signal, no turn lanes
	PM	C	0.75	21.8	None	

Table 16: Mitigated Future 2035 Intersection Operations						
Intersection	**Peak Hour**	**Overall LOS**	**Overall or Movement v/c**	**Overall or Movement Delay (s/veh)**	**Movement v/c > 0.90**	**Mitigation Measures (included within analysis)**
Potential Intersection Mitigating Measures						
Sixth Concession Rd and Ducharme St (Roundabout)	AM	A	--	8.6	None	Implement a Roundabout
	PM	A	--	10.0	None	
North Talbot Road and Southwood Lakes Blvd (Roundabout)	AM	A	--	6.8	None	Implement a Roundabout
	PM	A	--	9.3	None	
North Talbot Road and Northwood Lakes Blvd (Roundabout)	AM	A	--	6.9	None	Implement a Roundabout
	PM	A	--	7.7	None	
North Talbot Road and Goldenwood Drive (Roundabout)	AM	A	--	6.8	None	Implement a Roundabout
	PM	A	--	8.0	None	

Note: -- indicates that this measure of performance is not available for this type of intersection control.

Sixth Concession Road and Provincial Road

The intersection is forecast to operate at a LOS 'E' in the 2035 time horizon if there are no changes in the intersection geometry. The Provincial Road / Division Road EA identified the need to modify the intersection to include a five lane cross section along Provincial Road and to lengthen the northbound Sixth Concession Road left turn lane. It is recommended that 30m of northbound left turn storage be provided, along with 35m of northbound right turn parallel lane length. These recommendations improve the intersection performance to an acceptable LOS 'C' during the critical PM peak period.

Sixth Concession Road and Ducharme Street

The intersection is capable of supporting the future forecast 2035 traffic volumes at a LOS 'D' during the PM peak period, thus no improvement is required from a LOS perspective. If maintained as a two-way Stop controlled intersection with Stop signs facing Ducharme Street, a southbound left turn lane with 25m of storage is warranted based on the MTO left turn lane warrant for a two-lane unsignalized roadway. The intersection could also be modified as a roundabout, which would assist in reducing vehicle travel speeds while accommodating future traffic volume growth.

Sixth Concession Road and Holburn Street

The intersection is forecast to operate at a LOS 'E' and 'D' during the AM and PM peak period respectively based on the existing lane geometry and All-Way Stop traffic control. The intersection will require modifications to accommodate forecast future traffic volume.

The intersection could be modified to a roundabout, which would assist in reducing vehicle travel speeds; or as a traffic control signalized intersection with a 25m northbound right turn parallel lane.

Sixth Concession Road and North Talbot Road
The intersection will need to be improved to a roundabout or a traffic control signal by 2035 based on LOS projections. Roundabouts are a traffic calming feature which keep the traffic moving and reduce stop time, pollution and noise, while reducing the severity of collisions at intersections. Alternatively, the traffic control may be converted to a traffic control signal, auxiliary lanes are not required.

North Talbot Road and Northwood Lakes Blvd
Based on the forecast 2035 traffic volumes, an eastbound left turn lane with 15 m of storage is warranted. The intersection could be a candidate for conversion to a mini-roundabout as a traffic calming feature.

North Talbot Road and Southwood Lakes Blvd
Access to the proposed 150 residential dwelling units on the north side of North Talbot Road at the west end of Silverdale Drive has been assumed to gain access primarily by an extension of Southwood Lakes Boulevard. The additional traffic volume added to the intersection is expected to reduce the LOS of the northbound turning movements to a LOS 'D' in the future. Intersection improvements may not be required from a traffic capacity perspective however a traffic calming feature such as a roundabout would reduce vehicle speeds along North Talbot Road.

Based on the forecast 2035 traffic volumes an eastbound and westbound left turn lane with 15 m of storage is warranted based on the MTO left turn warrants for two-lane roadways. If a connection to the proposed subdivision is not made at Southwood Lake Boulevard, the eastbound left turn lane would not be required.

The intersection could be a candidate for conversion to a mini-roundabout as a traffic calming feature.

North Talbot Road and Goldenwood Drive
The intersection could be a candidate for conversion to a mini-roundabout as a traffic calming feature.

North Talbot Road and Old West Ave
Based on the forecast 2035 traffic volumes, an eastbound left turn lane with 15 m of storage is warranted.

7.0 TRAFFIC CALMING

A traffic calming memorandum under separate cover was completed by Intus Road Safety Engineering Incorporated. This memorandum deals specifically with the traffic calming elements of the study and are contained within **Appendix E** of this report. The following is a summary of the Intus memorandum.

Along Sixth Concession Road, many of the intersections between Provincial Road and the Dougall Parkway have, in recent years, been retrofit with diverter islands and northbound "No Left Turn" traffic signage which restricts vehicle movements into the residential subdivision west of Sixth Concession Road, thus reducing shortcutting traffic. The traffic calming memorandum recommends that the intersection islands be retained until the Sixth Concession Road is reconstructed. At that time, the islands should be removed to ease access for residents and emergency services. If shortcutting in the Old Roseland neighbourhood becomes an issue after reconstruction, then the City should undertake a neighbourhood traffic calming study complete with public participation.

The memorandum also recommends reduced through lane widths to reduce vehicle speeds along Sixth Concession Road and along North Talbot Road. It is recommended that through vehicle travel lane widths of 3.25 to 3.30m for a collector roadway is provided. The addition of roadside features such as trees and furniture increase the detail in the driver's peripheral field of view, which has been shown to reduce travel speeds.

Roundabouts or mini-roundabouts are recommended as traffic calming devices at the intersections of Sixth Concession / Ducharme Street, Sixth Concession / Holburn Street, North Talbot Road / Southwood Lakes Blvd, North Talbot Road / Centre Lake Drive intersections. These locations may be revised depending on the outcome of the traffic operational analysis.

8.0 CONCLUSIONS AND RECOMMENDATIONS

The study area is located at the south east limits of the City of Windsor, bounded by North Talbot Road to the south, to the west by Howard Avenue, to the north by Cabana Road East and to the east by the City Limits.

Based on historic traffic volume data, the existing traffic volumes as counted in December 2013 were forecast to grow by 0.5% annually to the 2035 future time horizon. In addition, there are a number of vacant lands within close proximity of the study area which could be developed. The Walker Gates Estates is expected to develop with an additional 350 single family residential dwelling units. At the west end of Silverdale Drive, vacant lands are expected to yield 150 single family dwelling units, with a new access provided opposite Southwood Lakes Boulevard. A neighbourhood commercial development plus 5 single family dwelling units are expected to be developed at 1110 North Talbot Road. The lands at 4785 Walker Road and 4845 Walker Road are also expected to develop, with an industrial use. In total, 563 new trips during the AM peak period and 795 trips during the PM peak period can be expected based on new development in proximity to the study area.

Conclusions

The intersection of Sixth Concession Road and Provincial Road is currently operating near capacity with some delay experienced at the intersection. Future forecasts indicate the intersection will operate at a LOS 'E' by the 2035 time horizon if no changes are made to the intersection geometry. In addition, the intersection experiences one of the higher collision rates within the City. The Provincial Road / Division Road EA recommended modifications to the intersection that included additional through lane capacity along Provincial Road and an extension of the northbound left turn lane, consistent with the findings of this study. The intersection is ranked 7th overall within the City for highest collisions at a signalized intersection (2008-2012), with a collision rate of 1.15 per million vehicles entering.

Increased development within the Walker Gates subdivision is expected to continue to increase traffic volume on Sixth Concession Road between Cabana Road East and the Dougall Parkway. Intersection modifications at Ducharme Street / Sixth Concession Road and at Holburn Street / Sixth Concession Road will be required over time. These intersection modifications could include adding turning lanes; converting to roundabouts/mini-roundabouts; or, the installation of traffic control signals. Modifying the intersections to roundabouts would accommodate future traffic volumes while acting as a traffic calming feature.

The increased traffic volume is also expected to impact the operation of the North Talbot Road and Sixth Concession Road intersection. Over time, the intersection will need to be modified to improve traffic operations. Modifications could include converting the intersection to a roundabout or implementing a traffic control signal. Modifying the intersections to a roundabout would accommodate future traffic volumes while acting as a traffic calming feature.

The new residential development proposed at the west end of Silverdale Drive is expected to gain access at a new intersection at North Talbot Road and Southwood Lakes Blvd. The increased traffic volume will decrease the northbound turning movement to a LOS 'D' during the PM peak period. The access

assumptions should be re-examined and a traffic impact study prepared in conjunction with the future plan of subdivision.

Traffic speeds along North Talbot Road and Sixth Concession Road exceed the posted speed limit. Average vehicle speeds were recorded at 55-58 km/h. 85th percentile speeds were observed between 62-65km/h. A number of residents have expressed concerns regarding vehicle travel speeds in the study area.

Facilities for Active Transportation Modes are lacking within the study area. Sidewalks and bicycle lanes should be provided to improve the liveability of the community.

Existing traffic calming measures (diverter islands) at the various intersections along Sixth Concession Road should be maintained until Sixth Concession Road is reconstructed. At that time, the islands should be removed to ease access for residents and emergency services. If shortcutting in the Old Roseland neighbourhood becomes an issue after reconstruction, then the City should undertake a neighbourhood traffic calming study complete with public participation.

Lane widths should be no more than 3.30m in order to reduce vehicle operating speeds. Roundabouts or mini-roundabouts should be considered at the intersections of Sixth Concession / Ducharme Street, Sixth Concession / Holburn Street, North Talbot Road / Southwood Lakes Blvd, North Talbot Road / Northwood Lakes Drive, North Talbot Road / Goldenwood Drive and at North Talbot Road / Sixth Concession Road to provide traffic calming effects.

Recommendations

The existing rural road cross-section should be improved to including sidewalks and bicycle facilities. The design of the roadway should consider the residential nature of the area and should include complete street design features to improve the operation of all transportation modes while creating a more liveable community. Specific intersection recommendations include:

Sixth Concession Road and Cabana Road East

- That the intersection collision rate be monitored over time to determine if recent modifications have reduced the number of annual collisions; and,
- Undertake a safety audit to determine if any further improvements are required to reduce collision frequency.

Sixth Concession Road and Provincial Road

- Add additional eastbound and westbound through travel lanes, as identified in previous EA studies;
- Add a northbound protected/permissive traffic signal phase;
- Extend the northbound left turn lane to provide 30m of vehicle storage;
- Provide a northbound right turn parallel lane length of 35 m plus the taper; and,
- That the intersection collision rate be monitored over time to determine if recent modifications have reduced the number of annual collisions; and,

- Undertake a safety audit to determine if any further improvements are required to reduce collision frequency.

Sixth Concession Road and Ducharme Street

- If maintained as a two-way Stop controlled intersection, a southbound left turn lane with 25m of storage will be warranted by 2035;
- Consider modifying the intersection to a mini-roundabout to accommodate future traffic volumes while providing a traffic calming feature; and,
- Review vehicle sight lines and/or consider alternative traffic controls to improve the intersection safety performance.

Sixth Concession Road and Holburn Street

- Consider modifying the intersection to a roundabout or mini-roundabout; or
- Implement a traffic control signal with a northbound right turn lane parallel lane length of 25m;
- Review vehicle sight lines and/or consider alternative traffic controls to improve the intersection safety performance.

Sixth Concession Road and North Talbot Road

- Consider modifying the intersection to a roundabout to accommodate future traffic volumes while providing a traffic calming feature; or
- Implement a traffic control signal, auxiliary lanes are not required.

North Talbot Road and Old West Avenue

- Provide an eastbound left turn lane with 15m of storage.

North Talbot Road / Goldenwood Drive

- Consider implementing a mini-roundabout as a traffic calming feature.

North Talbot Road and Northwood Lakes Blvd

- Provide an eastbound left turn lane with 15m of storage; or
- Provide a mini-roundabout.

North Talbot Road and Southwood Lakes Blvd

- This report has considered a future road connection to the proposed subdivision located north of North Talbot Road, at the west end of Silverdale Drive. Further traffic analysis should be conducted in support of the subdivision plan when the proposed development comes forward in order to determine local traffic impacts.
- With the proposed subdivision connection opposite Southwood Lakes Boulevard, eastbound and westbound left turn lanes with 15 m of storage is warranted based on the MTO left turn warrants for two-lane roadways with side street Stop sign control.
- Consider implementing a mini-roundabout to accommodate traffic volumes and reduce travel speeds on North Talbot Road.

North Talbot Road / Howard Avenue

- Undertake a safety audit to identify measures to improve the intersection safety performance.

APPENDIX A

LOS Definitions

LEVEL OF SERVICE ANALYSIS AT UNSIGNALIZED INTERSECTIONS[1]

The term "level of service" implies a qualitative measure of traffic flow at an intersection. It is dependent upon the vehicle delay and vehicle queue lengths at approaches. The level of service at unsignalized intersections is often related to the delay accumulated by flows on the minor streets, caused by all other conflicting movements. The following table describes the characteristics of each level.

Level of Service	Features
A	Little or no traffic delay occurs. Approaches appear open, turning movements are easily made, and drivers have freedom of operation.
B	Short traffic delays occur. Many drivers begin to feel somewhat restricted in terms of freedom of operation.
C	Average traffic delays occur. Operations are generally stable, but drivers emerging from the minor street may experience difficulty in completing their movement. This may occasionally impact on the stability of flow on the major street.
D	Long traffic delays occur. Motorists emerging from the minor street experience significant restriction and frustration. Drivers on the major street will experience congestion and delay as drivers emerging from the minor street interfere with the major through movements.
E	Very long traffic delays occur. Operations approach the capacity of the intersection.
F	Saturation occurs, with vehicle demand exceeding the available capacity. Very long traffic delays occur.

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(1) Highway Capacity Manual - Special Report No. 209, Transportation Research Board, 1985.

Levels of Service

To assist in clarifying the arithmetic analysis associated with traffic engineering, it is often useful to refer to "Level of Service". The term Level of Service implies a qualitative measure of traffic flow at an intersection. It is dependent upon vehicle delay and vehicle queue lengths at the approaches. The Level of Service is usually calculated in terms of the ratio between traffic volumes and approach capacity of "V/C" ratio. The following table describes the characteristics of each level:

Level of Service	Features	V/C Ratio
A	At this level of service, almost no signal phase is fully utilized by traffic. Very seldom does a vehicle wait longer than one red indication. The approach appears open, turning movements are easily made and drivers have freedom of operation.	0-0.59
B	At this level, an occasional signal phase is fully utilized and many phases approach full use. Many drivers begin to feel somewhat restricted within platoons of vehicles approaching the intersection.	0.60-0.69
C	At this level, the operation is stable though with more frequent fully utilized signal phases. Drivers feel more restricted and occasionally may have to wait more than one red signal indication, and queues may develop behind turning vehicles. This level is normally employed in urban intersection design.	0.70-0.79
D	At this level, the motorist experiences increasing restriction and instability of flow. There are substantial delays to approaching vehicles during short peaks within the peak period, but there are enough cycles with lower demand to permit occasional clearance of developing queues and prevent excessive backups.	0.80-0.89
E	At this level, capacity is reaches. There are long queues of vehicles waiting upstream of the intersection and delays to vehicles may extend to several signal cycles.	0.90-0.99
F	At this level, saturation occurs, with vehicle demand exceeding the available capacity.	1.00 or greater

APPENDIX B

Existing Intersection

Performance Worksheets

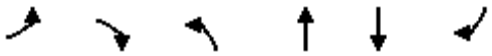
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	333	7	95	258	9	219
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	354	7	101	274	10	233
Pedestrians	1			1		
Lane Width (m)	3.6			3.6		
Walking Speed (m/s)	1.2			1.2		
Percent Blockage	0			0		
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			362		836	359
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			362		836	359
tC, single (s)			4.2		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.3		3.5	3.3
p0 queue free %			91		97	66
cM capacity (veh/h)			1144		310	685

Direction, Lane #	EB 1	WB 1	WB 2	NB 1
Volume Total	362	101	274	243
Volume Left	0	101	0	10
Volume Right	7	0	0	233
cSH	1700	1144	1700	654
Volume to Capacity	0.21	0.09	0.16	0.37
Queue Length 95th (m)	0.0	2.3	0.0	13.7
Control Delay (s)	0.0	8.5	0.0	13.7
Lane LOS		A		B
Approach Delay (s)	0.0	2.3		13.7
Approach LOS				B

Intersection Summary			
Average Delay	4.3		
Intersection Capacity Utilization	47.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		4.0	5.0		5.0	5.0	5.0	5.0	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	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	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		0.99	1.00	1.00	1.00	1.00	
Frt	1.00	0.98		1.00	1.00		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1805	1682		1770	1751		1704	1863	1583	1719	1708	
Flt Permitted	0.47	1.00		0.43	1.00		0.70	1.00	1.00	0.42	1.00	
Satd. Flow (perm)	889	1682		810	1751		1261	1863	1583	755	1708	
Volume (vph)	8	369	46	44	502	10	128	210	61	21	75	6
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)	8	380	47	45	518	10	132	216	63	22	77	6
RTOR Reduction (vph)	0	3	0	0	1	0	0	0	36	0	3	0
Lane Group Flow (vph)	8	424	0	45	527	0	132	216	27	22	80	0
Confl. Peds. (#/hr)							1					1
Heavy Vehicles (%)	0%	12%	4%	2%	8%	20%	5%	2%	2%	5%	8%	33%
Turn Type	Perm			pm+pt			Perm		Perm	Perm		
Protected Phases		2		1	6			4			4	
Permitted Phases	2			6			4		4	4		
Actuated Green, G (s)	63.2	63.2		71.5	71.5		18.5	18.5	18.5	18.5	18.5	
Effective Green, g (s)	63.2	63.2		72.5	71.5		18.5	18.5	18.5	18.5	18.5	
Actuated g/C Ratio	0.63	0.63		0.72	0.72		0.18	0.18	0.18	0.18	0.18	
Clearance Time (s)	5.0	5.0		4.0	5.0		5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	4.0	4.0		3.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Grp Cap (vph)	562	1063		629	1252		233	345	293	140	316	
v/s Ratio Prot		0.25		0.00	c0.30			c0.12			0.05	
v/s Ratio Perm	0.01			0.05			0.10		0.02	0.03		
v/c Ratio	0.01	0.40		0.07	0.42		0.57	0.63	0.09	0.16	0.25	
Uniform Delay, d1	6.8	9.1		4.5	5.8		37.1	37.6	33.8	34.2	34.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.0	1.1		0.0	1.0		3.8	4.0	0.2	0.7	0.6	
Delay (s)	6.9	10.2		4.5	6.9		40.9	41.6	34.0	34.9	35.4	
Level of Service	A	B		A	A		D	D	C	C	D	
Approach Delay (s)		10.1			6.7			40.2			35.3	
Approach LOS		B			A			D			D	

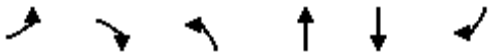
Intersection Summary			
HCM Average Control Delay	18.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	62.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	18	16	1	381	161	4
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86
Hourly flow rate (vph)	21	19	1	443	187	5
Pedestrians	3			2	2	
Lane Width (m)	3.6			3.6	3.6	
Walking Speed (m/s)	1.2			1.2	1.2	
Percent Blockage	0			0	0	
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (m)					233	
pX, platoon unblocked						
vC, conflicting volume	640	195	195			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	640	195	195			
tC, single (s)	6.4	6.4	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.5	2.2			
p0 queue free %	95	98	100			
cM capacity (veh/h)	441	807	1387			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	40	444	192
Volume Left	21	1	0
Volume Right	19	0	5
cSH	560	1387	1700
Volume to Capacity	0.07	0.00	0.11
Queue Length 95th (m)	1.8	0.0	0.0
Control Delay (s)	11.9	0.0	0.0
Lane LOS	B	A	
Approach Delay (s)	11.9	0.0	0.0
Approach LOS	B		

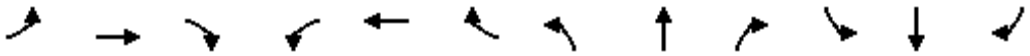
Intersection Summary			
Average Delay	0.7		
Intersection Capacity Utilization	31.5%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Stop	Stop	
Volume (vph)	23	6	0	359	161	16
Peak Hour Factor	0.76	0.76	0.76	0.76	0.76	0.76
Hourly flow rate (vph)	30	8	0	472	212	21

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total (vph)	38	472	233
Volume Left (vph)	30	0	0
Volume Right (vph)	8	0	21
Hadj (s)	0.15	0.03	-0.01
Departure Headway (s)	5.6	4.3	4.5
Degree Utilization, x	0.06	0.56	0.29
Capacity (veh/h)	569	826	777
Control Delay (s)	8.9	12.7	9.3
Approach Delay (s)	8.9	12.7	9.3
Approach LOS	A	B	A

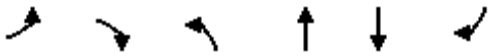
Intersection Summary			
Delay	11.4		
HCM Level of Service	B		
Intersection Capacity Utilization	28.9%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	3	15	4	23	8	108	0	248	22	62	100	5
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Hourly flow rate (vph)	4	18	5	28	10	130	0	299	27	75	120	6
Pedestrians		1			18							
Lane Width (m)		3.6			3.6							
Walking Speed (m/s)		1.2			1.2							
Percent Blockage		0			2							
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	721	617	124	617	607	330	128			343		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	721	617	124	617	607	330	128			343		
tC, single (s)	7.4	7.0	6.5	7.3	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.8	4.4	3.5	3.7	4.0	3.3	2.2			2.2		
p0 queue free %	98	94	99	92	97	81	100			94		
cM capacity (veh/h)	229	324	867	331	382	694	1470			1197		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	27	167	325	201
Volume Left	4	28	0	75
Volume Right	5	130	27	6
cSH	344	565	1470	1197
Volume to Capacity	0.08	0.30	0.00	0.06
Queue Length 95th (m)	2.0	9.9	0.0	1.6
Control Delay (s)	16.3	14.0	0.0	3.4
Lane LOS	C	B		A
Approach Delay (s)	16.3	14.0	0.0	3.4
Approach LOS	C	B		

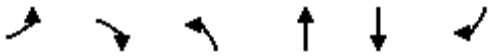
Intersection Summary			
Average Delay	4.8		
Intersection Capacity Utilization	45.6%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	5	0	0	265	124	3
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84
Hourly flow rate (vph)	6	0	0	315	148	4
Pedestrians					1	
Lane Width (m)					3.6	
Walking Speed (m/s)					1.2	
Percent Blockage					0	
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	466	149	151			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	466	149	151			
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	100	100			
cM capacity (veh/h)	558	902	1442			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	6	315	151
Volume Left	6	0	0
Volume Right	0	0	4
cSH	558	1442	1700
Volume to Capacity	0.01	0.00	0.09
Queue Length 95th (m)	0.3	0.0	0.0
Control Delay (s)	11.5	0.0	0.0
Lane LOS	B		
Approach Delay (s)	11.5	0.0	0.0
Approach LOS	B		

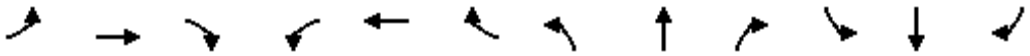
Intersection Summary			
Average Delay	0.1		
Intersection Capacity Utilization	23.9%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Stop	Stop	
Volume (vph)	15	3	1	250	121	3
Peak Hour Factor	0.73	0.73	0.73	0.73	0.73	0.73
Hourly flow rate (vph)	21	4	1	342	166	4

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total (vph)	25	344	170
Volume Left (vph)	21	1	0
Volume Right (vph)	4	0	4
Hadj (s)	0.07	0.02	0.21
Departure Headway (s)	5.1	4.2	4.5
Degree Utilization, x	0.03	0.40	0.21
Capacity (veh/h)	637	850	773
Control Delay (s)	8.3	9.9	8.7
Approach Delay (s)	8.3	9.9	8.7
Approach LOS	A	A	A

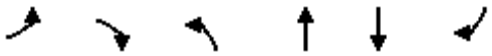
Intersection Summary			
Delay	9.4		
HCM Level of Service	A		
Intersection Capacity Utilization	24.0%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	34	34	39	232	24	47	11	170	183	11	103	10
Peak Hour Factor	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
Hourly flow rate (vph)	45	45	51	305	32	62	14	224	241	14	136	13

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	141	399	479	163
Volume Left (vph)	45	305	14	14
Volume Right (vph)	51	62	241	13
Hadj (s)	-0.12	0.14	-0.23	0.18
Departure Headway (s)	6.8	6.4	5.9	7.0
Degree Utilization, x	0.27	0.71	0.78	0.32
Capacity (veh/h)	456	536	592	446
Control Delay (s)	12.3	23.5	26.5	13.1
Approach Delay (s)	12.3	23.5	26.5	13.1
Approach LOS	B	C	D	B

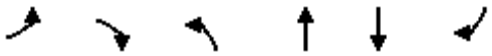
Intersection Summary			
Delay	21.9		
HCM Level of Service	C		
Intersection Capacity Utilization	53.2%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1553		1863	1863	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1553		1863	1863	
Volume (vph)	108	22	0	388	131	0
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	123	25	0	441	149	0
RTOR Reduction (vph)	0	21	0	0	0	0
Lane Group Flow (vph)	123	4	0	441	149	0
Heavy Vehicles (%)	2%	4%	2%	2%	2%	2%
Turn Type		Perm				
Protected Phases	4			2	6	
Permitted Phases		4				
Actuated Green, G (s)	10.0	10.0		37.2	37.2	
Effective Green, g (s)	10.0	10.0		37.2	37.2	
Actuated g/C Ratio	0.17	0.17		0.65	0.65	
Clearance Time (s)	5.0	5.0		5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	309	272		1212	1212	
v/s Ratio Prot	c0.07			c0.24	0.08	
v/s Ratio Perm		0.00				
v/c Ratio	0.40	0.02		0.36	0.12	
Uniform Delay, d1	20.9	19.5		4.6	3.8	
Progression Factor	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.8	0.0		0.8	0.2	
Delay (s)	21.8	19.6		5.4	4.0	
Level of Service	C	B		A	A	
Approach Delay (s)	21.4			5.4	4.0	
Approach LOS	C			A	A	

Intersection Summary			
HCM Average Control Delay	8.3	HCM Level of Service	A
HCM Volume to Capacity ratio	0.37		
Actuated Cycle Length (s)	57.2	Sum of lost time (s)	10.0
Intersection Capacity Utilization	35.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	67	9	4	321	131	22
Peak Hour Factor	0.77	0.77	0.77	0.77	0.77	0.77
Hourly flow rate (vph)	87	12	5	417	170	29
Pedestrians	4			2		
Lane Width (m)	3.6			3.6		
Walking Speed (m/s)	1.2			1.2		
Percent Blockage	0			0		
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (m)					327	
pX, platoon unblocked						
vC, conflicting volume	616	190	203			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	616	190	203			
tC, single (s)	6.4	6.7	4.3			
tC, 2 stage (s)						
tF (s)	3.5	3.8	2.4			
p0 queue free %	81	98	100			
cM capacity (veh/h)	448	739	1239			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	99	422	199
Volume Left	87	5	0
Volume Right	12	0	29
cSH	470	1239	1700
Volume to Capacity	0.21	0.00	0.12
Queue Length 95th (m)	6.3	0.1	0.0
Control Delay (s)	14.7	0.1	0.0
Lane LOS	B	A	
Approach Delay (s)	14.7	0.1	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	2.1		
Intersection Capacity Utilization	31.6%	ICU Level of Service	A
Analysis Period (min)	15		

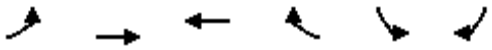
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0		4.0	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.96		1.00	1.00	0.85	1.00	0.98		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1752	1782		1751	1810	1583	1538	3303		1640	3306	
Flt Permitted	0.74	1.00		0.71	1.00	1.00	0.56	1.00		0.42	1.00	
Satd. Flow (perm)	1363	1782		1315	1810	1583	915	3303		723	3306	
Volume (vph)	32	42	17	41	25	288	6	399	51	117	250	20
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	36	48	19	47	28	327	7	453	58	133	284	23
RTOR Reduction (vph)	0	16	0	0	0	276	0	9	0	0	5	0
Lane Group Flow (vph)	36	51	0	47	28	51	7	502	0	133	302	0
Confl. Peds. (#/hr)			1	1			3		1	1		3
Heavy Vehicles (%)	3%	0%	6%	3%	5%	2%	17%	5%	24%	10%	8%	5%
Turn Type	Perm			Perm		Perm	Perm			pm+pt		
Protected Phases		4			8			2		1	6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)	11.5	11.5		11.5	11.5	11.5	42.2	42.2		52.5	52.5	
Effective Green, g (s)	11.5	11.5		11.5	11.5	11.5	42.2	42.2		53.5	52.5	
Actuated g/C Ratio	0.16	0.16		0.16	0.16	0.16	0.57	0.57		0.72	0.71	
Clearance Time (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0		4.0	5.0	
Vehicle Extension (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		3.0	4.0	
Lane Grp Cap (vph)	212	277		204	281	246	522	1884		601	2345	
v/s Ratio Prot		0.03			0.02			c0.15		c0.02	0.09	
v/s Ratio Perm	0.03			c0.04		0.03	0.01			0.14		
v/c Ratio	0.17	0.18		0.23	0.10	0.21	0.01	0.27		0.22	0.13	
Uniform Delay, d1	27.1	27.2		27.4	26.8	27.3	6.9	8.1		3.3	3.4	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.5	0.4		0.8	0.2	0.6	0.0	0.3		0.2	0.1	
Delay (s)	27.6	27.6		28.2	27.0	27.8	6.9	8.4		3.4	3.6	
Level of Service	C	C		C	C	C	A	A		A	A	
Approach Delay (s)		27.6			27.8			8.4			3.5	
Approach LOS		C			C			A			A	

Intersection Summary			
HCM Average Control Delay	13.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.26		
Actuated Cycle Length (s)	74.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	57.8%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	189	21	23	296	58	51
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	199	22	24	312	61	54
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)	355					
pX, platoon unblocked						
vC, conflicting volume			221		570	210
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			221		570	210
tC, single (s)			4.3		6.4	6.4
tC, 2 stage (s)						
tF (s)			2.4		3.5	3.5
p0 queue free %			98		87	93
cM capacity (veh/h)			1223		475	794

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	221	336	115
Volume Left	0	24	61
Volume Right	22	0	54
cSH	1700	1223	585
Volume to Capacity	0.13	0.02	0.20
Queue Length 95th (m)	0.0	0.5	5.8
Control Delay (s)	0.0	0.8	12.6
Lane LOS		A	B
Approach Delay (s)	0.0	0.8	12.6
Approach LOS			B

Intersection Summary			
Average Delay	2.5		
Intersection Capacity Utilization	44.4%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	14	221	280	13	36	34
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	16	260	329	15	42	40
Pedestrians		1				
Lane Width (m)		3.6				
Walking Speed (m/s)		1.2				
Percent Blockage		0				
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	345				630	338
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	345				630	338
tC, single (s)	4.3				6.6	6.3
tC, 2 stage (s)						
tF (s)	2.4				3.7	3.4
p0 queue free %	99				90	94
cM capacity (veh/h)	1135				416	695

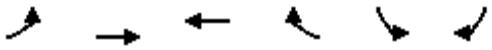
Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	276	345	82
Volume Left	16	0	42
Volume Right	0	15	40
cSH	1135	1700	517
Volume to Capacity	0.01	0.20	0.16
Queue Length 95th (m)	0.4	0.0	4.5
Control Delay (s)	0.6	0.0	13.3
Lane LOS	A		B
Approach Delay (s)	0.6	0.0	13.3
Approach LOS			B

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	34.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	244	8	12	258	30	11
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	262	9	13	277	32	12
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			271		570	267
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			271		570	267
tC, single (s)			4.4		6.6	6.2
tC, 2 stage (s)						
tF (s)			2.5		3.7	3.3
p0 queue free %			99		93	98
cM capacity (veh/h)			1133		444	777

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	271	290	44
Volume Left	0	13	32
Volume Right	9	0	12
cSH	1700	1133	502
Volume to Capacity	0.16	0.01	0.09
Queue Length 95th (m)	0.0	0.3	2.3
Control Delay (s)	0.0	0.5	12.9
Lane LOS		A	B
Approach Delay (s)	0.0	0.5	12.9
Approach LOS			B

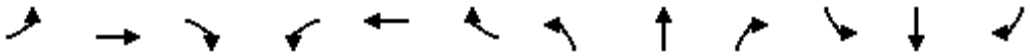
Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	33.3%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	6	244	237	10	15	28
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84
Hourly flow rate (vph)	7	290	282	12	18	33
Pedestrians		1	7			
Lane Width (m)		3.6	3.6			
Walking Speed (m/s)		1.2	1.2			
Percent Blockage		0	1			
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	294				600	289
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	294				600	289
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				96	96
cM capacity (veh/h)	1279				462	754

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	298	294	51
Volume Left	7	0	18
Volume Right	0	12	33
cSH	1279	1700	618
Volume to Capacity	0.01	0.17	0.08
Queue Length 95th (m)	0.1	0.0	2.2
Control Delay (s)	0.2	0.0	11.4
Lane LOS	A		B
Approach Delay (s)	0.2	0.0	11.4
Approach LOS			B

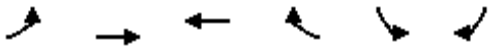
Intersection Summary			
Average Delay	1.0		
Intersection Capacity Utilization	28.0%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	53	193	8	17	186	125	11	147	23	49	46	45
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	55	201	8	18	194	130	11	153	24	51	48	47

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	265	342	189	146
Volume Left (vph)	55	18	11	51
Volume Right (vph)	8	130	24	47
Hadj (s)	0.13	-0.13	0.27	0.11
Departure Headway (s)	5.6	5.3	6.1	6.1
Degree Utilization, x	0.41	0.50	0.32	0.25
Capacity (veh/h)	593	642	523	519
Control Delay (s)	12.6	13.5	12.0	11.1
Approach Delay (s)	12.6	13.5	12.0	11.1
Approach LOS	B	B	B	B

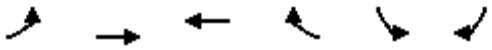
Intersection Summary			
Delay	12.6		
HCM Level of Service	B		
Intersection Capacity Utilization	59.4%	ICU Level of Service	B
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	13	252	300	2	5	28
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	14	274	326	2	5	30
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	328				629	327
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	328				629	327
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				99	96
cM capacity (veh/h)	1231				441	714

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	288	328	36
Volume Left	14	0	5
Volume Right	0	2	30
cSH	1231	1700	653
Volume to Capacity	0.01	0.19	0.05
Queue Length 95th (m)	0.3	0.0	1.4
Control Delay (s)	0.5	0.0	10.8
Lane LOS	A		B
Approach Delay (s)	0.5	0.0	10.8
Approach LOS			B

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	33.9%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	53	204	190	9	20	112
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	58	222	207	10	22	122
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	216				548	211
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	216				548	211
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	96				95	85
cM capacity (veh/h)	1353				476	829

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	279	216	143
Volume Left	58	0	22
Volume Right	0	10	122
cSH	1353	1700	745
Volume to Capacity	0.04	0.13	0.19
Queue Length 95th (m)	1.1	0.0	5.7
Control Delay (s)	1.9	0.0	11.0
Lane LOS	A		B
Approach Delay (s)	1.9	0.0	11.0
Approach LOS			B

Intersection Summary			
Average Delay	3.3		
Intersection Capacity Utilization	42.2%	ICU Level of Service	A
Analysis Period (min)	15		

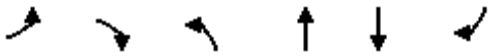
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	576	19	193	397	6	160
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	619	20	208	427	6	172
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			640		1472	630
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			640		1472	630
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			78		94	65
cM capacity (veh/h)			949		110	486

Direction, Lane #	EB 1	WB 1	WB 2	NB 1
Volume Total	640	208	427	178
Volume Left	0	208	0	6
Volume Right	20	0	0	172
cSH	1700	949	1700	432
Volume to Capacity	0.38	0.22	0.25	0.41
Queue Length 95th (m)	0.0	6.7	0.0	15.9
Control Delay (s)	0.0	9.9	0.0	19.1
Lane LOS		A		C
Approach Delay (s)	0.0	3.2		19.1
Approach LOS				C

Intersection Summary			
Average Delay	3.7		
Intersection Capacity Utilization	62.4%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		4.0	5.0		5.0	5.0	5.0	5.0	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	0.97	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	0.99	1.00	
Frt	1.00	0.98		1.00	0.99		1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1685	1792		1805	1793		1570	1557	1294	1601	1871	
Flt Permitted	0.34	1.00		0.06	1.00		0.39	1.00	1.00	0.58	1.00	
Satd. Flow (perm)	600	1792		109	1793		639	1557	1294	985	1871	
Volume (vph)	15	839	118	142	703	25	78	126	98	17	189	6
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	16	922	130	156	773	27	86	138	108	19	208	7
RTOR Reduction (vph)	0	4	0	0	1	0	0	0	83	0	1	0
Lane Group Flow (vph)	16	1048	0	156	799	0	86	138	25	19	214	0
Confl. Peds. (#/hr)	1		1	1		1	1		1	1		1
Heavy Vehicles (%)	7%	4%	2%	0%	5%	16%	15%	22%	21%	12%	1%	0%
Turn Type	Perm			pm+pt			Perm		Perm	Perm		
Protected Phases		2		1	6			4			4	
Permitted Phases	2			6			4		4	4		
Actuated Green, G (s)	64.7	64.7		77.8	77.8		18.2	18.2	18.2	18.2	18.2	
Effective Green, g (s)	64.7	64.7		78.8	77.8		18.2	18.2	18.2	18.2	18.2	
Actuated g/C Ratio	0.61	0.61		0.74	0.73		0.17	0.17	0.17	0.17	0.17	
Clearance Time (s)	5.0	5.0		4.0	5.0		5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	366	1094		227	1316		110	267	222	169	321	
v/s Ratio Prot		c0.58		0.06	c0.45			0.09			0.11	
v/s Ratio Perm	0.03			0.45			c0.13		0.02	0.02		
v/c Ratio	0.04	0.96		0.69	0.61		0.78	0.52	0.11	0.11	0.67	
Uniform Delay, d1	8.3	19.4		29.9	6.8		42.0	39.9	37.1	37.1	41.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.2	18.8		8.4	2.1		29.4	1.7	0.2	0.3	5.2	
Delay (s)	8.5	38.1		38.3	8.9		71.4	41.6	37.3	37.4	46.2	
Level of Service	A	D		D	A		E	D	D	D	D	
Approach Delay (s)		37.7			13.7			47.9			45.5	
Approach LOS		D			B			D			D	

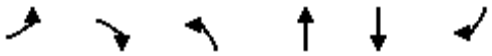
Intersection Summary			
HCM Average Control Delay	30.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	106.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	98.4%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	12	5	3	290	422	27
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	13	5	3	309	449	29
Pedestrians				1		
Lane Width (m)				3.6		
Walking Speed (m/s)				1.2		
Percent Blockage				0		
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (m)					233	
pX, platoon unblocked	0.92	0.92	0.92			
vC, conflicting volume	778	464	478			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	758	416	430			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	96	99	100			
cM capacity (veh/h)	345	587	1045			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	18	312	478
Volume Left	13	3	0
Volume Right	5	0	29
cSH	393	1045	1700
Volume to Capacity	0.05	0.00	0.28
Queue Length 95th (m)	1.2	0.1	0.0
Control Delay (s)	14.6	0.1	0.0
Lane LOS	B	A	
Approach Delay (s)	14.6	0.1	0.0
Approach LOS	B		

Intersection Summary			
Average Delay		0.4	
Intersection Capacity Utilization	34.2%	ICU Level of Service	A
Analysis Period (min)		15	



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Stop	Stop	
Volume (vph)	13	9	1	280	402	25
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	14	9	1	295	423	26

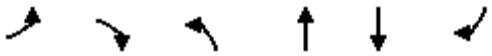
Direction, Lane #	EB 1	NB 1	SB 1
Volume Total (vph)	23	296	449
Volume Left (vph)	14	1	0
Volume Right (vph)	9	0	26
Hadj (s)	0.18	0.03	-0.02
Departure Headway (s)	5.7	4.5	4.3
Degree Utilization, x	0.04	0.37	0.53
Capacity (veh/h)	556	790	829
Control Delay (s)	8.9	10.0	12.0
Approach Delay (s)	8.9	10.0	12.0
Approach LOS	A	A	B

Intersection Summary			
Delay	11.1		
HCM Level of Service	B		
Intersection Capacity Utilization	33.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	6	7	2	13	7	71	1	204	7	46	348	17
Peak Hour Factor	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Hourly flow rate (vph)	8	9	3	17	9	92	1	265	9	60	452	22
Pedestrians		2			3						1	
Lane Width (m)		3.6			3.6						3.6	
Walking Speed (m/s)		1.2			1.2						1.2	
Percent Blockage		0			0						0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	954	864	465	865	871	273	476			277		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	954	864	465	865	871	273	476			277		
tC, single (s)	7.1	6.5	6.7	7.1	6.6	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.8	3.5	4.1	3.3	2.2			2.2		
p0 queue free %	96	97	99	93	97	88	100			95		
cM capacity (veh/h)	197	279	509	257	263	765	1095			1283		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	19	118	275	534
Volume Left	8	17	1	60
Volume Right	3	92	9	22
cSH	252	535	1095	1283
Volume to Capacity	0.08	0.22	0.00	0.05
Queue Length 95th (m)	2.0	6.7	0.0	1.2
Control Delay (s)	20.5	13.6	0.1	1.3
Lane LOS	C	B	A	A
Approach Delay (s)	20.5	13.6	0.1	1.3
Approach LOS	C	B		

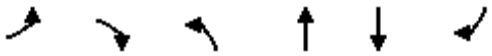
Intersection Summary			
Average Delay	2.9		
Intersection Capacity Utilization	49.4%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	11	1	2	201	344	19
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	12	1	2	221	378	21
Pedestrians	1				1	
Lane Width (m)	3.6				3.6	
Walking Speed (m/s)	1.2				1.2	
Percent Blockage	0				0	
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	616	389	400			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	616	389	400			
tC, single (s)	6.4	7.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	4.2	2.2			
p0 queue free %	97	100	100			
cM capacity (veh/h)	456	489	1169			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	13	223	399
Volume Left	12	2	0
Volume Right	1	0	21
cSH	458	1169	1700
Volume to Capacity	0.03	0.00	0.23
Queue Length 95th (m)	0.7	0.0	0.0
Control Delay (s)	13.1	0.1	0.0
Lane LOS	B	A	
Approach Delay (s)	13.1	0.1	0.0
Approach LOS	B		

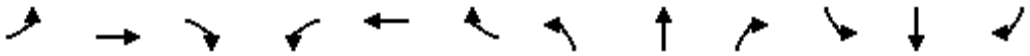
Intersection Summary			
Average Delay		0.3	
Intersection Capacity Utilization		29.3%	ICU Level of Service A
Analysis Period (min)		15	



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Stop	Stop	
Volume (vph)	24	0	2	179	333	12
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	26	0	2	195	362	13

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total (vph)	26	197	375
Volume Left (vph)	26	2	0
Volume Right (vph)	0	0	13
Hadj (s)	0.20	0.00	-0.02
Departure Headway (s)	5.3	4.3	4.2
Degree Utilization, x	0.04	0.24	0.43
Capacity (veh/h)	605	807	848
Control Delay (s)	8.5	8.7	10.3
Approach Delay (s)	8.5	8.7	10.3
Approach LOS	A	A	B

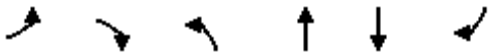
Intersection Summary			
Delay	9.7		
HCM Level of Service	A		
Intersection Capacity Utilization	28.6%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	16	15	13	193	36	21	32	144	147	32	268	33
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	17	16	14	208	39	23	34	155	158	34	288	35

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	47	269	347	358
Volume Left (vph)	17	208	34	34
Volume Right (vph)	14	23	158	35
Hadj (s)	-0.10	0.13	-0.22	-0.02
Departure Headway (s)	6.3	6.0	5.3	5.4
Degree Utilization, x	0.08	0.45	0.51	0.54
Capacity (veh/h)	456	551	641	630
Control Delay (s)	9.9	13.8	13.6	14.6
Approach Delay (s)	9.9	13.8	13.6	14.6
Approach LOS	A	B	B	B

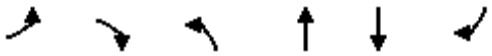
Intersection Summary			
Delay	13.8		
HCM Level of Service	B		
Intersection Capacity Utilization	51.7%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1787	1615		1863	1863	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1787	1615		1863	1863	
Volume (vph)	176	83	0	259	336	0
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	196	92	0	288	373	0
RTOR Reduction (vph)	0	73	0	0	0	0
Lane Group Flow (vph)	196	19	0	288	373	0
Heavy Vehicles (%)	1%	0%	2%	2%	2%	2%
Turn Type		Perm				
Protected Phases	4			2	6	
Permitted Phases		4				
Actuated Green, G (s)	9.6	9.6		27.0	27.0	
Effective Green, g (s)	9.6	9.6		27.0	27.0	
Actuated g/C Ratio	0.21	0.21		0.58	0.58	
Clearance Time (s)	5.0	5.0		5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	368	333		1079	1079	
v/s Ratio Prot	c0.11			0.15	c0.20	
v/s Ratio Perm		0.01				
v/c Ratio	0.53	0.06		0.27	0.35	
Uniform Delay, d1	16.5	14.9		4.9	5.2	
Progression Factor	1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.5	0.1		0.6	0.9	
Delay (s)	18.0	14.9		5.5	6.0	
Level of Service	B	B		A	A	
Approach Delay (s)	17.0			5.5	6.0	
Approach LOS	B			A	A	

Intersection Summary			
HCM Average Control Delay	9.2	HCM Level of Service	A
HCM Volume to Capacity ratio	0.39		
Actuated Cycle Length (s)	46.6	Sum of lost time (s)	10.0
Intersection Capacity Utilization	52.7%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	46	9	7	213	323	96
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	51	10	8	237	359	107
Pedestrians	1			5	1	
Lane Width (m)	3.6			3.6	3.6	
Walking Speed (m/s)	1.2			1.2	1.2	
Percent Blockage	0			0	0	
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (m)					327	
pX, platoon unblocked						
vC, conflicting volume	666	418	467			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	666	418	467			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	88	98	99			
cM capacity (veh/h)	424	636	1105			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	61	244	466
Volume Left	51	8	0
Volume Right	10	0	107
cSH	448	1105	1700
Volume to Capacity	0.14	0.01	0.27
Queue Length 95th (m)	3.8	0.2	0.0
Control Delay (s)	14.3	0.3	0.0
Lane LOS	B	A	
Approach Delay (s)	14.3	0.3	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	34.4%	ICU Level of Service	A
Analysis Period (min)	15		

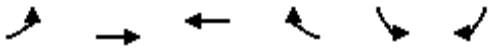
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0		4.0	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.96		1.00	1.00	0.85	1.00	0.98		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1752	1811		1801	1900	1568	1804	3416		1804	3467	
Flt Permitted	0.73	1.00		0.72	1.00	1.00	0.37	1.00		0.50	1.00	
Satd. Flow (perm)	1342	1811		1366	1900	1568	709	3416		941	3467	
Volume (vph)	32	34	14	105	39	171	15	263	38	294	582	48
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	37	40	16	122	45	199	17	306	44	342	677	56
RTOR Reduction (vph)	0	13	0	0	0	166	0	11	0	0	5	0
Lane Group Flow (vph)	37	43	0	122	45	33	17	339	0	342	728	0
Confl. Peds. (#/hr)			3	3			1		2	2		1
Heavy Vehicles (%)	3%	0%	0%	0%	0%	3%	0%	3%	6%	0%	3%	0%
Turn Type	Perm			Perm		Perm	Perm			pm+pt		
Protected Phases		4			8			2		1	6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)	13.3	13.3		13.3	13.3	13.3	41.6	41.6		56.7	56.7	
Effective Green, g (s)	13.3	13.3		13.3	13.3	13.3	41.6	41.6		57.7	56.7	
Actuated g/C Ratio	0.17	0.17		0.17	0.17	0.17	0.52	0.52		0.72	0.71	
Clearance Time (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0		4.0	5.0	
Vehicle Extension (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		3.0	4.0	
Lane Grp Cap (vph)	223	301		227	316	261	369	1776		798	2457	
v/s Ratio Prot		0.02			0.02			0.10		c0.06	0.21	
v/s Ratio Perm	0.03			c0.09		0.02	0.02			c0.25		
v/c Ratio	0.17	0.14		0.54	0.14	0.13	0.05	0.19		0.43	0.30	
Uniform Delay, d1	28.6	28.5		30.5	28.5	28.4	9.4	10.2		4.0	4.3	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.5	0.3		3.1	0.3	0.3	0.2	0.2		0.4	0.3	
Delay (s)	29.1	28.8		33.6	28.8	28.7	9.7	10.5		4.4	4.6	
Level of Service	C	C		C	C	C	A	B		A	A	
Approach Delay (s)		28.9			30.4			10.4			4.5	
Approach LOS		C			C			B			A	

Intersection Summary			
HCM Average Control Delay	11.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.44		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	63.8%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	306	60	44	274	41	33
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86
Hourly flow rate (vph)	356	70	51	319	48	38
Pedestrians	3			1		
Lane Width (m)	3.6			3.6		
Walking Speed (m/s)	1.2			1.2		
Percent Blockage	0			0		
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)	355					
pX, platoon unblocked						
vC, conflicting volume			426		815	392
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			426		815	392
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			96		86	94
cM capacity (veh/h)			1145		333	661

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	426	370	86
Volume Left	0	51	48
Volume Right	70	0	38
cSH	1700	1145	428
Volume to Capacity	0.25	0.04	0.20
Queue Length 95th (m)	0.0	1.1	5.9
Control Delay (s)	0.0	1.5	15.5
Lane LOS		A	C
Approach Delay (s)	0.0	1.5	15.5
Approach LOS			C

Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	51.2%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	37	302	297	28	16	21
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	42	343	338	32	18	24
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	369				781	353
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	369				781	353
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	96				95	97
cM capacity (veh/h)	1200				354	695

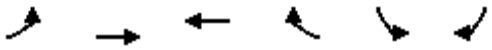
Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	385	369	42
Volume Left	42	0	18
Volume Right	0	32	24
cSH	1200	1700	490
Volume to Capacity	0.04	0.22	0.09
Queue Length 95th (m)	0.9	0.0	2.2
Control Delay (s)	1.2	0.0	13.0
Lane LOS	A		B
Approach Delay (s)	1.2	0.0	13.0
Approach LOS			B

Intersection Summary			
Average Delay	1.3		
Intersection Capacity Utilization	48.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	301	17	22	316	9	9
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	327	18	24	343	10	10
Pedestrians					5	
Lane Width (m)					3.6	
Walking Speed (m/s)					1.2	
Percent Blockage					0	
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			351		733	341
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			351		733	341
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			98		97	99
cM capacity (veh/h)			1214		382	703

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	346	367	20
Volume Left	0	24	10
Volume Right	18	0	10
cSH	1700	1214	495
Volume to Capacity	0.20	0.02	0.04
Queue Length 95th (m)	0.0	0.5	1.0
Control Delay (s)	0.0	0.7	12.6
Lane LOS		A	B
Approach Delay (s)	0.0	0.7	12.6
Approach LOS			B

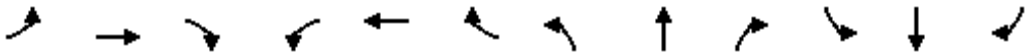
Intersection Summary			
Average Delay	0.7		
Intersection Capacity Utilization	44.7%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	9	301	331	21	6	7
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84
Hourly flow rate (vph)	11	358	394	25	7	8
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	419				786	407
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	419				786	407
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				98	99
cM capacity (veh/h)	1151				360	649

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	369	419	15
Volume Left	11	0	7
Volume Right	0	25	8
cSH	1151	1700	474
Volume to Capacity	0.01	0.25	0.03
Queue Length 95th (m)	0.2	0.0	0.8
Control Delay (s)	0.3	0.0	12.9
Lane LOS	A		B
Approach Delay (s)	0.3	0.0	12.9
Approach LOS			B

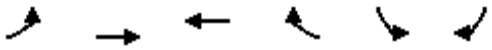
Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	33.1%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	57	223	27	22	230	74	5	89	27	111	104	117
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Hourly flow rate (vph)	66	256	31	25	264	85	6	102	31	128	120	134

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	353	375	139	382
Volume Left (vph)	66	25	6	128
Volume Right (vph)	31	85	31	134
Hadj (s)	0.02	-0.12	-0.13	-0.14
Departure Headway (s)	6.6	6.5	7.3	6.5
Degree Utilization, x	0.65	0.67	0.28	0.69
Capacity (veh/h)	507	521	391	382
Control Delay (s)	21.2	21.7	13.1	22.9
Approach Delay (s)	21.2	21.7	13.1	22.9
Approach LOS	C	C	B	C

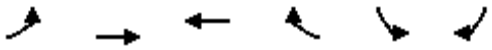
Intersection Summary			
Delay	21.0		
HCM Level of Service	C		
Intersection Capacity Utilization	64.1%	ICU Level of Service	C
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	30	331	307	5	3	19
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	33	360	334	5	3	21
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	339				761	336
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	339				761	336
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	97				99	97
cM capacity (veh/h)	1220				363	706

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	392	339	24
Volume Left	33	0	3
Volume Right	0	5	21
cSH	1220	1700	625
Volume to Capacity	0.03	0.20	0.04
Queue Length 95th (m)	0.7	0.0	1.0
Control Delay (s)	0.9	0.0	11.0
Lane LOS	A		B
Approach Delay (s)	0.9	0.0	11.0
Approach LOS			B

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	48.9%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	120	214	237	21	13	75
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	130	233	258	23	14	82
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	280				762	269
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	280				762	269
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	90				96	89
cM capacity (veh/h)	1282				335	770

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	363	280	96
Volume Left	130	0	14
Volume Right	0	23	82
cSH	1282	1700	646
Volume to Capacity	0.10	0.16	0.15
Queue Length 95th (m)	2.7	0.0	4.1
Control Delay (s)	3.5	0.0	11.5
Lane LOS	A		B
Approach Delay (s)	3.5	0.0	11.5
Approach LOS			B

Intersection Summary			
Average Delay	3.2		
Intersection Capacity Utilization	47.0%	ICU Level of Service	A
Analysis Period (min)	15		

APPENDIX C

Historical AADT Summary

Street		Howard Ave.			North Talbot Rd.		Sixth Concession Rd.		
Cross Reference		N of North Talbot Rd.	S of North Talbot Rd.	S of Country Club Dr.	E of Howard Ave.	E of Sixth Concession Rd	S of Provincial Rd.	N of North Talbot Rd.	S of Holburn St.
Year	2001		17,300				8,000	6,200	
	2002	24,700		16,200					
	2003				11,400				
	2004					10,200	7,800	7,300	6,300
	2005		15,100						
	2006			13,500	8,300	8,600	7,100	6,500	6,800
	2007	19,800							
	2008								
	2009								
	2010								
	2011								
	2012				8,900				

APPENDIX D

2035 Future Intersection

Performance Worksheets

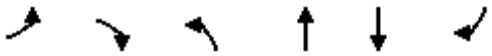
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	372	16	113	288	15	261
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	396	17	120	306	16	278
Pedestrians	1			1		
Lane Width (m)	3.6			3.6		
Walking Speed (m/s)	1.2			1.2		
Percent Blockage	0			0		
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			413		952	405
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			413		952	405
tC, single (s)			4.2		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.3		3.5	3.3
p0 queue free %			89		94	57
cM capacity (veh/h)			1094		258	645

Direction, Lane #	EB 1	WB 1	WB 2	NB 1
Volume Total	413	120	306	294
Volume Left	0	120	0	16
Volume Right	17	0	0	278
cSH	1700	1094	1700	596
Volume to Capacity	0.24	0.11	0.18	0.49
Queue Length 95th (m)	0.0	3.0	0.0	21.7
Control Delay (s)	0.0	8.7	0.0	16.7
Lane LOS		A		C
Approach Delay (s)	0.0	2.5		16.7
Approach LOS				C

Intersection Summary			
Average Delay	5.3		
Intersection Capacity Utilization	53.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		4.0	5.0		5.0	5.0	5.0	5.0	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	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	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		0.99	1.00	1.00	1.00	1.00	
Frt	1.00	0.98		1.00	1.00		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1805	1678		1770	1751		1704	1863	1583	1719	1714	
Flt Permitted	0.44	1.00		0.37	1.00		0.68	1.00	1.00	0.36	1.00	
Satd. Flow (perm)	831	1678		692	1751		1225	1863	1583	651	1714	
Volume (vph)	9	412	67	63	560	11	162	258	89	23	100	7
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)	9	425	69	65	577	11	167	266	92	24	103	7
RTOR Reduction (vph)	0	5	0	0	1	0	0	0	41	0	3	0
Lane Group Flow (vph)	9	489	0	65	587	0	167	266	51	24	107	0
Confl. Peds. (#/hr)							1					1
Heavy Vehicles (%)	0%	12%	4%	2%	8%	20%	5%	2%	2%	5%	8%	33%
Turn Type	Perm			pm+pt			Perm		Perm	Perm		
Protected Phases		2		1	6			4			4	
Permitted Phases	2			6			4		4	4		
Actuated Green, G (s)	58.6	58.6		68.3	68.3		21.7	21.7	21.7	21.7	21.7	
Effective Green, g (s)	58.6	58.6		69.3	68.3		21.7	21.7	21.7	21.7	21.7	
Actuated g/C Ratio	0.59	0.59		0.69	0.68		0.22	0.22	0.22	0.22	0.22	
Clearance Time (s)	5.0	5.0		4.0	5.0		5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	4.0	4.0		3.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Grp Cap (vph)	487	983		541	1196		266	404	344	141	372	
v/s Ratio Prot		0.29		0.01	c0.34			c0.14			0.06	
v/s Ratio Perm	0.01			0.08			0.14		0.03	0.04		
v/c Ratio	0.02	0.50		0.12	0.49		0.63	0.66	0.15	0.17	0.29	
Uniform Delay, d1	8.7	12.1		6.1	7.6		35.5	35.8	31.7	31.8	32.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.1	1.8		0.1	1.4		5.2	4.3	0.3	0.8	0.6	
Delay (s)	8.7	13.9		6.2	9.0		40.7	40.0	32.0	32.6	33.3	
Level of Service	A	B		A	A		D	D	C	C	C	
Approach Delay (s)		13.8			8.7			38.8			33.2	
Approach LOS		B			A			D			C	

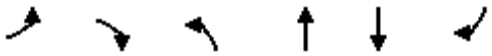
Intersection Summary			
HCM Average Control Delay	20.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	70.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	18	16	1	491	227	4
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86
Hourly flow rate (vph)	21	19	1	571	264	5
Pedestrians	3			2	2	
Lane Width (m)	3.6			3.6	3.6	
Walking Speed (m/s)	1.2			1.2	1.2	
Percent Blockage	0			0	0	
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (m)					233	
pX, platoon unblocked						
vC, conflicting volume	845	271	272			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	845	271	272			
tC, single (s)	6.4	6.4	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.5	2.2			
p0 queue free %	94	97	100			
cM capacity (veh/h)	334	730	1300			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	40	572	269
Volume Left	21	1	0
Volume Right	19	0	5
cSH	449	1300	1700
Volume to Capacity	0.09	0.00	0.16
Queue Length 95th (m)	2.3	0.0	0.0
Control Delay (s)	13.8	0.0	0.0
Lane LOS	B	A	
Approach Delay (s)	13.8	0.0	0.0
Approach LOS	B		

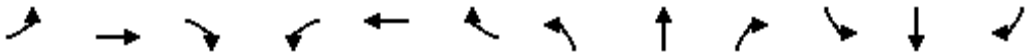
Intersection Summary			
Average Delay	0.6		
Intersection Capacity Utilization	37.3%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Stop	Stop	
Volume (vph)	23	6	0	469	227	16
Peak Hour Factor	0.76	0.76	0.76	0.76	0.76	0.76
Hourly flow rate (vph)	30	8	0	617	299	21

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total (vph)	38	617	320
Volume Left (vph)	30	0	0
Volume Right (vph)	8	0	21
Hadj (s)	0.15	0.03	0.00
Departure Headway (s)	6.1	4.4	4.7
Degree Utilization, x	0.06	0.76	0.41
Capacity (veh/h)	532	801	749
Control Delay (s)	9.5	19.7	10.9
Approach Delay (s)	9.5	19.7	10.9
Approach LOS	A	C	B

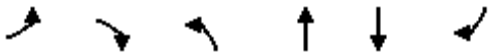
Intersection Summary			
Delay	16.4		
HCM Level of Service	C		
Intersection Capacity Utilization	34.7%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	3	15	4	76	8	173	0	292	40	84	145	5
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Hourly flow rate (vph)	4	18	5	92	10	208	0	352	48	101	175	6
Pedestrians		1			18							
Lane Width (m)		3.6			3.6							
Walking Speed (m/s)		1.2			1.2							
Percent Blockage		0			2							
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	970	799	179	788	778	394	182			418		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	970	799	179	788	778	394	182			418		
tC, single (s)	7.4	7.0	6.5	7.3	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.8	4.4	3.5	3.7	4.0	3.3	2.2			2.2		
p0 queue free %	97	93	99	62	97	67	100			91		
cM capacity (veh/h)	124	244	808	243	295	639	1405			1124		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	27	310	400	282
Volume Left	4	92	0	101
Volume Right	5	208	48	6
cSH	242	421	1405	1124
Volume to Capacity	0.11	0.74	0.00	0.09
Queue Length 95th (m)	2.9	46.9	0.0	2.4
Control Delay (s)	21.7	33.8	0.0	3.6
Lane LOS	C	D		A
Approach Delay (s)	21.7	33.8	0.0	3.6
Approach LOS	C	D		

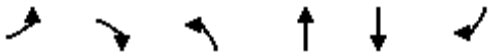
Intersection Summary			
Average Delay	11.8		
Intersection Capacity Utilization	62.6%	ICU Level of Service	B
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	5	0	0	327	221	3
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84
Hourly flow rate (vph)	6	0	0	389	263	4
Pedestrians					1	
Lane Width (m)					3.6	
Walking Speed (m/s)					1.2	
Percent Blockage					0	
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	655	265	267			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	655	265	267			
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	100	100			
cM capacity (veh/h)	434	779	1309			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	6	389	267
Volume Left	6	0	0
Volume Right	0	0	4
cSH	434	1309	1700
Volume to Capacity	0.01	0.00	0.16
Queue Length 95th (m)	0.3	0.0	0.0
Control Delay (s)	13.4	0.0	0.0
Lane LOS	B		
Approach Delay (s)	13.4	0.0	0.0
Approach LOS	B		

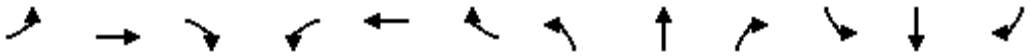
Intersection Summary			
Average Delay	0.1		
Intersection Capacity Utilization	27.2%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Stop	Stop	
Volume (vph)	15	3	1	312	218	3
Peak Hour Factor	0.73	0.73	0.73	0.73	0.73	0.73
Hourly flow rate (vph)	21	4	1	427	299	4

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total (vph)	25	429	303
Volume Left (vph)	21	1	0
Volume Right (vph)	4	0	4
Hadj (s)	0.07	0.02	0.22
Departure Headway (s)	5.6	4.3	4.6
Degree Utilization, x	0.04	0.51	0.39
Capacity (veh/h)	567	821	759
Control Delay (s)	8.8	11.8	10.5
Approach Delay (s)	8.8	11.8	10.5
Approach LOS	A	B	B

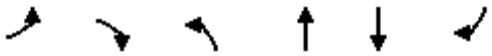
Intersection Summary			
Delay	11.2		
HCM Level of Service	B		
Intersection Capacity Utilization	27.2%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	34	34	39	272	24	47	11	231	200	11	200	10
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	40	40	46	320	28	55	13	272	235	13	235	12

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	126	404	520	260
Volume Left (vph)	40	320	13	13
Volume Right (vph)	46	55	235	12
Hadj (s)	-0.12	0.16	-0.21	0.18
Departure Headway (s)	7.8	7.1	6.4	7.4
Degree Utilization, x	0.27	0.79	0.92	0.53
Capacity (veh/h)	404	404	552	457
Control Delay (s)	13.7	32.0	46.6	18.5
Approach Delay (s)	13.7	32.0	46.6	18.5
Approach LOS	B	D	E	C

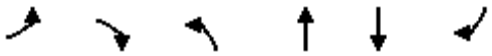
Intersection Summary			
Delay	33.4		
HCM Level of Service	D		
Intersection Capacity Utilization	60.8%	ICU Level of Service	B
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1553		1863	1863	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1553		1863	1863	
Volume (vph)	150	31	0	447	156	0
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	170	35	0	508	177	0
RTOR Reduction (vph)	0	28	0	0	0	0
Lane Group Flow (vph)	170	7	0	508	177	0
Heavy Vehicles (%)	2%	4%	2%	2%	2%	2%
Turn Type		Perm				
Protected Phases	4			2	6	
Permitted Phases		4				
Actuated Green, G (s)	10.4	10.4		32.4	32.4	
Effective Green, g (s)	10.4	10.4		32.4	32.4	
Actuated g/C Ratio	0.20	0.20		0.61	0.61	
Clearance Time (s)	5.0	5.0		5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	349	306		1143	1143	
v/s Ratio Prot	c0.10			c0.27	0.10	
v/s Ratio Perm		0.00				
v/c Ratio	0.49	0.02		0.44	0.15	
Uniform Delay, d1	18.8	17.1		5.4	4.4	
Progression Factor	1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.1	0.0		1.3	0.3	
Delay (s)	19.9	17.1		6.7	4.6	
Level of Service	B	B		A	A	
Approach Delay (s)	19.4			6.7	4.6	
Approach LOS	B			A	A	

Intersection Summary			
HCM Average Control Delay	9.2	HCM Level of Service	A
HCM Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	52.8	Sum of lost time (s)	10.0
Intersection Capacity Utilization	40.2%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	67	9	4	379	164	22
Peak Hour Factor	0.77	0.77	0.77	0.77	0.77	0.77
Hourly flow rate (vph)	87	12	5	492	213	29
Pedestrians	4			2		
Lane Width (m)	3.6			3.6		
Walking Speed (m/s)	1.2			1.2		
Percent Blockage	0			0		
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (m)					327	
pX, platoon unblocked						
vC, conflicting volume	734	233	246			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	734	233	246			
tC, single (s)	6.4	6.7	4.3			
tC, 2 stage (s)						
tF (s)	3.5	3.8	2.4			
p0 queue free %	77	98	100			
cM capacity (veh/h)	381	697	1193			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	99	497	242
Volume Left	87	5	0
Volume Right	12	0	29
cSH	403	1193	1700
Volume to Capacity	0.24	0.00	0.14
Queue Length 95th (m)	7.6	0.1	0.0
Control Delay (s)	16.8	0.1	0.0
Lane LOS	C	A	
Approach Delay (s)	16.8	0.1	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	2.1		
Intersection Capacity Utilization	34.7%	ICU Level of Service	A
Analysis Period (min)	15		

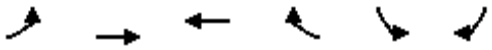
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0		4.0	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.95		1.00	1.00	0.85	1.00	0.98		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1752	1773		1751	1810	1583	1538	3285		1641	3309	
Flt Permitted	0.74	1.00		0.72	1.00	1.00	0.55	1.00		0.38	1.00	
Satd. Flow (perm)	1363	1773		1321	1810	1583	886	3285		656	3309	
Volume (vph)	32	38	17	56	25	365	6	445	66	152	279	20
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	36	43	19	64	28	415	7	506	75	173	317	23
RTOR Reduction (vph)	0	16	0	0	0	343	0	10	0	0	4	0
Lane Group Flow (vph)	36	46	0	64	28	72	7	571	0	173	336	0
Confl. Peds. (#/hr)			1	1			3		1	1		3
Heavy Vehicles (%)	3%	0%	6%	3%	5%	2%	17%	5%	24%	10%	8%	5%
Turn Type	Perm			Perm		Perm	Perm			pm+pt		
Protected Phases		4			8			2		1	6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)	12.5	12.5		12.5	12.5	12.5	45.1	45.1		57.5	57.5	
Effective Green, g (s)	12.5	12.5		12.5	12.5	12.5	45.1	45.1		58.5	57.5	
Actuated g/C Ratio	0.16	0.16		0.16	0.16	0.16	0.56	0.56		0.73	0.72	
Clearance Time (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0		4.0	5.0	
Vehicle Extension (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		3.0	4.0	
Lane Grp Cap (vph)	213	277		206	283	247	499	1852		583	2378	
v/s Ratio Prot		0.03			0.02			0.17		c0.03	0.10	
v/s Ratio Perm	0.03			c0.05		0.05	0.01			c0.19		
v/c Ratio	0.17	0.17		0.31	0.10	0.29	0.01	0.31		0.30	0.14	
Uniform Delay, d1	29.2	29.2		29.9	28.9	29.8	7.7	9.2		3.5	3.5	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.5	0.4		1.2	0.2	0.9	0.1	0.4		0.3	0.1	
Delay (s)	29.8	29.6		31.1	29.1	30.7	7.7	9.6		3.8	3.6	
Level of Service	C	C		C	C	C	A	A		A	A	
Approach Delay (s)		29.7			30.7			9.6			3.7	
Approach LOS		C			C			A			A	

Intersection Summary			
HCM Average Control Delay	15.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.30		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	62.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	21	217	21	23	328	7	58	0	51	21	0	64
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	22	228	22	24	345	7	61	0	54	22	0	67
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)		355										
pX, platoon unblocked												
vC, conflicting volume	353			251			748	685	239	735	692	349
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	353			251			748	685	239	735	692	349
tC, single (s)	4.1			4.3			7.1	6.5	6.4	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.4			3.5	4.0	3.5	3.5	4.0	3.3
p0 queue free %	98			98			79	100	93	93	100	90
cM capacity (veh/h)	1206			1192			289	357	764	303	353	694

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	273	377	115	89
Volume Left	22	24	61	22
Volume Right	22	7	54	67
cSH	1206	1192	407	526
Volume to Capacity	0.02	0.02	0.28	0.17
Queue Length 95th (m)	0.4	0.5	9.1	4.9
Control Delay (s)	0.8	0.7	17.3	13.2
Lane LOS	A	A	C	B
Approach Delay (s)	0.8	0.7	17.3	13.2
Approach LOS			C	B

Intersection Summary			
Average Delay	4.3		
Intersection Capacity Utilization	42.6%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	14	276	323	13	36	34
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	16	325	380	15	42	40
Pedestrians		1				
Lane Width (m)		3.6				
Walking Speed (m/s)		1.2				
Percent Blockage		0				
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	395				745	389
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	395				745	389
tC, single (s)	4.3				6.6	6.3
tC, 2 stage (s)						
tF (s)	2.4				3.7	3.4
p0 queue free %	98				88	94
cM capacity (veh/h)	1086				355	650

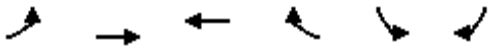
Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	341	395	82
Volume Left	16	0	42
Volume Right	0	15	40
cSH	1086	1700	455
Volume to Capacity	0.02	0.23	0.18
Queue Length 95th (m)	0.4	0.0	5.2
Control Delay (s)	0.6	0.0	14.6
Lane LOS	A		B
Approach Delay (s)	0.6	0.0	14.6
Approach LOS			B

Intersection Summary			
Average Delay	1.7		
Intersection Capacity Utilization	37.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	302	8	12	303	30	11
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	325	9	13	326	32	12
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			333		681	329
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			333		681	329
tC, single (s)			4.4		6.6	6.2
tC, 2 stage (s)						
tF (s)			2.5		3.7	3.3
p0 queue free %			99		92	98
cM capacity (veh/h)			1071		381	717

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	333	339	44
Volume Left	0	13	32
Volume Right	9	0	12
cSH	1700	1071	436
Volume to Capacity	0.20	0.01	0.10
Queue Length 95th (m)	0.0	0.3	2.7
Control Delay (s)	0.0	0.4	14.2
Lane LOS		A	B
Approach Delay (s)	0.0	0.4	14.2
Approach LOS			B

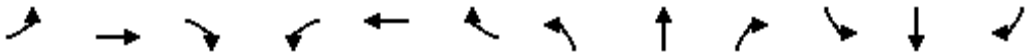
Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	35.7%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	6	303	282	10	15	28
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84
Hourly flow rate (vph)	7	361	336	12	18	33
Pedestrians		1	7			
Lane Width (m)		3.6	3.6			
Walking Speed (m/s)		1.2	1.2			
Percent Blockage		0	1			
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	348				724	343
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	348				724	343
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				95	95
cM capacity (veh/h)	1223				391	704

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	368	348	51
Volume Left	7	0	18
Volume Right	0	12	33
cSH	1223	1700	550
Volume to Capacity	0.01	0.20	0.09
Queue Length 95th (m)	0.1	0.0	2.4
Control Delay (s)	0.2	0.0	12.2
Lane LOS	A		B
Approach Delay (s)	0.2	0.0	12.2
Approach LOS			B

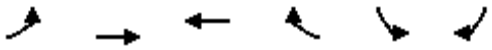
Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	31.1%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	65	239	8	17	217	169	11	147	23	67	46	59
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	68	249	8	18	226	176	11	153	24	70	48	61

Direction, Lane #	EB 1	WB 1	NB 1	SB 1	SB 2
Volume Total (vph)	325	420	189	70	109
Volume Left (vph)	68	18	11	70	0
Volume Right (vph)	8	176	24	0	61
Hadj (s)	0.13	-0.16	0.27	0.70	-0.14
Departure Headway (s)	6.1	5.7	7.0	7.9	7.0
Degree Utilization, x	0.55	0.66	0.36	0.15	0.21
Capacity (veh/h)	556	611	458	404	443
Control Delay (s)	16.3	18.9	13.9	11.1	10.7
Approach Delay (s)	16.3	18.9	13.9	10.8	
Approach LOS	C	C	B	B	

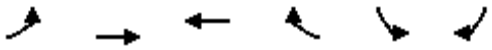
Intersection Summary				
Delay	16.0			
HCM Level of Service	C			
Intersection Capacity Utilization	67.7%	ICU Level of Service	C	
Analysis Period (min)	15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	14	309	372	2	5	31
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	15	336	404	2	5	34
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	407				772	405
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	407				772	405
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				99	95
cM capacity (veh/h)	1152				363	645

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	351	407	39
Volume Left	15	0	5
Volume Right	0	2	34
cSH	1152	1700	582
Volume to Capacity	0.01	0.24	0.07
Queue Length 95th (m)	0.3	0.0	1.7
Control Delay (s)	0.5	0.0	11.6
Lane LOS	A		B
Approach Delay (s)	0.5	0.0	11.6
Approach LOS			B

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	37.6%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	53	261	259	9	20	112
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	58	284	282	10	22	122
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	291				685	286
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	291				685	286
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	95				94	84
cM capacity (veh/h)	1270				395	753

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	341	291	143
Volume Left	58	0	22
Volume Right	0	10	122
cSH	1270	1700	662
Volume to Capacity	0.05	0.17	0.22
Queue Length 95th (m)	1.1	0.0	6.6
Control Delay (s)	1.7	0.0	11.9
Lane LOS	A		B
Approach Delay (s)	1.7	0.0	11.9
Approach LOS			B

Intersection Summary			
Average Delay	3.0		
Intersection Capacity Utilization	48.9%	ICU Level of Service	A
Analysis Period (min)	15		

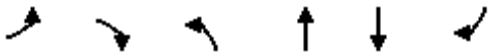
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	643	24	243	443	9	194
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	691	26	261	476	10	209
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			717		1703	704
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			717		1703	704
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			71		87	53
cM capacity (veh/h)			888		72	440

Direction, Lane #	EB 1	WB 1	WB 2	NB 1
Volume Total	717	261	476	218
Volume Left	0	261	0	10
Volume Right	26	0	0	209
cSH	1700	888	1700	359
Volume to Capacity	0.42	0.29	0.28	0.61
Queue Length 95th (m)	0.0	9.8	0.0	30.6
Control Delay (s)	0.0	10.7	0.0	29.4
Lane LOS		B		D
Approach Delay (s)	0.0	3.8		29.4
Approach LOS				D

Intersection Summary			
Average Delay	5.5		
Intersection Capacity Utilization	71.3%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		4.0	5.0		5.0	5.0	5.0	5.0	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	0.97	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	0.99		1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1687	1785		1805	1792		1570	1557	1294	1604	1872	
Flt Permitted	0.25	1.00		0.06	1.00		0.34	1.00	1.00	0.53	1.00	
Satd. Flow (perm)	445	1785		117	1792		555	1557	1294	903	1872	
Volume (vph)	17	936	163	182	785	28	109	160	123	19	243	7
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	19	1029	179	200	863	31	120	176	135	21	267	8
RTOR Reduction (vph)	0	6	0	0	1	0	0	0	77	0	1	0
Lane Group Flow (vph)	19	1202	0	200	893	0	120	176	58	21	274	0
Confl. Peds. (#/hr)	1		1	1		1	1		1	1		1
Heavy Vehicles (%)	7%	4%	2%	0%	5%	16%	15%	22%	21%	12%	1%	0%
Turn Type	Perm			pm+pt			Perm		Perm	Perm		
Protected Phases		2		1	6			4			4	
Permitted Phases	2			6			4		4	4		
Actuated Green, G (s)	60.1	60.1		72.9	72.9		23.1	23.1	23.1	23.1	23.1	
Effective Green, g (s)	60.1	60.1		73.9	72.9		23.1	23.1	23.1	23.1	23.1	
Actuated g/C Ratio	0.57	0.57		0.70	0.69		0.22	0.22	0.22	0.22	0.22	
Clearance Time (s)	5.0	5.0		4.0	5.0		5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	252	1012		222	1232		121	339	282	197	408	
v/s Ratio Prot		c0.67		c0.07	0.50			0.11			0.15	
v/s Ratio Perm	0.04			0.56			c0.22		0.05	0.02		
v/c Ratio	0.08	1.19		0.90	0.72		0.99	0.52	0.21	0.11	0.67	
Uniform Delay, d1	10.4	22.9		34.9	10.3		41.4	36.6	33.9	33.2	38.0	
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	94.5		34.8	3.7		79.0	1.3	0.4	0.2	4.3	
Delay (s)	11.0	117.5		69.7	14.0		120.3	37.9	34.3	33.4	42.3	
Level of Service	B	F		E	B		F	D	C	C	D	
Approach Delay (s)		115.8			24.2			59.7			41.7	
Approach LOS		F			C			E			D	

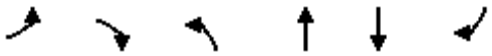
Intersection Summary			
HCM Average Control Delay	67.8	HCM Level of Service	E
HCM Volume to Capacity ratio	1.11		
Actuated Cycle Length (s)	106.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	110.0%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	12	5	3	381	560	27
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	13	5	3	405	596	29
Pedestrians				1		
Lane Width (m)				3.6		
Walking Speed (m/s)				1.2		
Percent Blockage				0		
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (m)					233	
pX, platoon unblocked	0.88	0.88	0.88			
vC, conflicting volume	1022	611	624			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1025	559	574			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	94	99	100			
cM capacity (veh/h)	231	469	890			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	18	409	624
Volume Left	13	3	0
Volume Right	5	0	29
cSH	271	890	1700
Volume to Capacity	0.07	0.00	0.37
Queue Length 95th (m)	1.7	0.1	0.0
Control Delay (s)	19.2	0.1	0.0
Lane LOS	C	A	
Approach Delay (s)	19.2	0.1	0.0
Approach LOS	C		

Intersection Summary			
Average Delay		0.4	
Intersection Capacity Utilization	41.4%	ICU Level of Service	A
Analysis Period (min)		15	



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Stop	Stop	
Volume (vph)	13	9	1	370	540	25
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	14	9	1	389	568	26

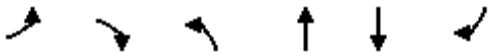
Direction, Lane #	EB 1	NB 1	SB 1
Volume Total (vph)	23	391	595
Volume Left (vph)	14	1	0
Volume Right (vph)	9	0	26
Hadj (s)	0.18	0.03	-0.01
Departure Headway (s)	6.2	4.6	4.4
Degree Utilization, x	0.04	0.50	0.72
Capacity (veh/h)	518	763	810
Control Delay (s)	9.5	12.2	18.0
Approach Delay (s)	9.5	12.2	18.0
Approach LOS	A	B	C

Intersection Summary			
Delay	15.6		
HCM Level of Service	C		
Intersection Capacity Utilization	40.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	6	7	2	48	7	114	1	251	67	120	411	17
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	7	8	2	56	8	134	1	295	79	141	484	20
Pedestrians		2			3						1	
Lane Width (m)		3.6			3.6						3.6	
Walking Speed (m/s)		1.2			1.2						1.2	
Percent Blockage		0			0						0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1254	1157	496	1122	1128	339	506			377		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1254	1157	496	1122	1128	339	506			377		
tC, single (s)	7.1	6.5	6.7	7.1	6.6	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.8	3.5	4.1	3.3	2.2			2.2		
p0 queue free %	93	95	100	65	95	81	100			88		
cM capacity (veh/h)	106	173	488	160	170	703	1068			1178		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	18	199	375	645
Volume Left	7	56	1	141
Volume Right	2	134	79	20
cSH	148	336	1068	1178
Volume to Capacity	0.12	0.59	0.00	0.12
Queue Length 95th (m)	3.2	28.8	0.0	3.3
Control Delay (s)	32.6	30.1	0.0	3.0
Lane LOS	D	D	A	A
Approach Delay (s)	32.6	30.1	0.0	3.0
Approach LOS	D	D		

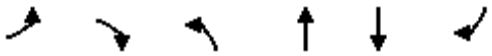
Intersection Summary			
Average Delay	6.9		
Intersection Capacity Utilization	68.6%	ICU Level of Service	C
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	11	1	2	307	443	19
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	12	1	2	337	487	21
Pedestrians	1				1	
Lane Width (m)	3.6				3.6	
Walking Speed (m/s)	1.2				1.2	
Percent Blockage	0				0	
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	841	498	509			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	841	498	509			
tC, single (s)	6.4	7.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	4.2	2.2			
p0 queue free %	96	100	100			
cM capacity (veh/h)	336	417	1066			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	13	340	508
Volume Left	12	2	0
Volume Right	1	0	21
cSH	342	1066	1700
Volume to Capacity	0.04	0.00	0.30
Queue Length 95th (m)	1.0	0.0	0.0
Control Delay (s)	16.0	0.1	0.0
Lane LOS	C	A	
Approach Delay (s)	16.0	0.1	0.0
Approach LOS	C		

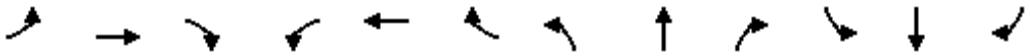
Intersection Summary			
Average Delay		0.3	
Intersection Capacity Utilization		34.5%	ICU Level of Service A
Analysis Period (min)		15	



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Stop	Stop	
Volume (vph)	24	0	2	285	432	12
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	26	0	2	310	470	13

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total (vph)	26	312	483
Volume Left (vph)	26	2	0
Volume Right (vph)	0	0	13
Hadj (s)	0.20	0.00	-0.02
Departure Headway (s)	5.8	4.5	4.3
Degree Utilization, x	0.04	0.39	0.58
Capacity (veh/h)	542	787	824
Control Delay (s)	9.1	10.3	12.9
Approach Delay (s)	9.1	10.3	12.9
Approach LOS	A	B	B

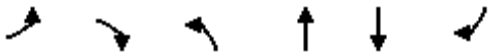
Intersection Summary			
Delay	11.8		
HCM Level of Service	B		
Intersection Capacity Utilization	33.8%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	16	15	13	224	36	21	32	250	192	32	366	33
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	17	16	14	241	39	23	34	269	206	34	394	35

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	47	302	510	463
Volume Left (vph)	17	241	34	34
Volume Right (vph)	14	23	206	35
Hadj (s)	-0.10	0.14	-0.19	-0.01
Departure Headway (s)	7.8	7.0	5.9	6.2
Degree Utilization, x	0.10	0.59	0.84	0.79
Capacity (veh/h)	398	484	583	564
Control Delay (s)	11.6	19.3	32.3	28.7
Approach Delay (s)	11.6	19.3	32.3	28.7
Approach LOS	B	C	D	D

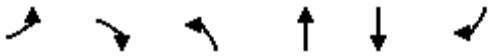
Intersection Summary			
Delay	27.3		
HCM Level of Service	D		
Intersection Capacity Utilization	62.9%	ICU Level of Service	B
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1787	1615		1863	1863	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1787	1615		1863	1863	
Volume (vph)	294	110	0	325	394	0
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	327	122	0	361	438	0
RTOR Reduction (vph)	0	86	0	0	0	0
Lane Group Flow (vph)	327	36	0	361	438	0
Heavy Vehicles (%)	1%	0%	2%	2%	2%	2%
Turn Type		Perm				
Protected Phases	4			2	6	
Permitted Phases		4				
Actuated Green, G (s)	13.1	13.1		21.4	21.4	
Effective Green, g (s)	13.1	13.1		21.4	21.4	
Actuated g/C Ratio	0.29	0.29		0.48	0.48	
Clearance Time (s)	5.0	5.0		5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	526	475		896	896	
v/s Ratio Prot	c0.18			0.19	c0.24	
v/s Ratio Perm		0.02				
v/c Ratio	0.62	0.08		0.40	0.49	
Uniform Delay, d1	13.6	11.3		7.4	7.8	
Progression Factor	1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.3	0.1		1.3	1.9	
Delay (s)	15.8	11.4		8.8	9.7	
Level of Service	B	B		A	A	
Approach Delay (s)	14.6			8.8	9.7	
Approach LOS	B			A	A	

Intersection Summary			
HCM Average Control Delay	11.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	44.5	Sum of lost time (s)	10.0
Intersection Capacity Utilization	65.8%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	46	9	7	279	407	96
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	51	10	8	310	452	107
Pedestrians	1			5	1	
Lane Width (m)	3.6			3.6	3.6	
Walking Speed (m/s)	1.2			1.2	1.2	
Percent Blockage	0			0	0	
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (m)					327	
pX, platoon unblocked	0.99	0.99	0.99			
vC, conflicting volume	833	512	560			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	831	504	553			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	85	98	99			
cM capacity (veh/h)	334	560	1011			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	61	318	559
Volume Left	51	8	0
Volume Right	10	0	107
cSH	358	1011	1700
Volume to Capacity	0.17	0.01	0.33
Queue Length 95th (m)	4.9	0.2	0.0
Control Delay (s)	17.1	0.3	0.0
Lane LOS	C	A	
Approach Delay (s)	17.1	0.3	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	38.8%	ICU Level of Service	A
Analysis Period (min)	15		

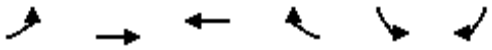
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0		4.0	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.99		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.94		1.00	1.00	0.85	1.00	0.97		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1752	1776		1801	1900	1568	1804	3386		1804	3470	
Flt Permitted	0.73	1.00		0.73	1.00	1.00	0.35	1.00		0.45	1.00	
Satd. Flow (perm)	1342	1776		1386	1900	1568	656	3386		852	3470	
Volume (vph)	32	21	14	134	39	237	15	294	60	398	649	48
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	37	24	16	156	45	276	17	342	70	463	755	56
RTOR Reduction (vph)	0	13	0	0	0	224	0	18	0	0	4	0
Lane Group Flow (vph)	37	27	0	156	45	52	17	394	0	463	807	0
Confl. Peds. (#/hr)			3	3			1		2	2		1
Heavy Vehicles (%)	3%	0%	0%	0%	0%	3%	0%	3%	6%	0%	3%	0%
Turn Type	Perm			Perm		Perm	Perm			pm+pt		
Protected Phases		4			8			2		1	6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)	15.2	15.2		15.2	15.2	15.2	36.3	36.3		54.8	54.8	
Effective Green, g (s)	15.2	15.2		15.2	15.2	15.2	36.3	36.3		55.8	54.8	
Actuated g/C Ratio	0.19	0.19		0.19	0.19	0.19	0.45	0.45		0.70	0.68	
Clearance Time (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0		4.0	5.0	
Vehicle Extension (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		3.0	4.0	
Lane Grp Cap (vph)	255	337		263	361	298	298	1536		767	2377	
v/s Ratio Prot		0.02			0.02			0.12		c0.11	0.23	
v/s Ratio Perm	0.03			c0.11		0.03	0.03			c0.31		
v/c Ratio	0.15	0.08		0.59	0.12	0.18	0.06	0.26		0.60	0.34	
Uniform Delay, d1	27.0	26.7		29.6	26.9	27.2	12.3	13.5		5.2	5.2	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.4	0.1		4.2	0.2	0.4	0.4	0.4		1.3	0.4	
Delay (s)	27.3	26.8		33.7	27.1	27.5	12.6	13.9		6.6	5.6	
Level of Service	C	C		C	C	C	B	B		A	A	
Approach Delay (s)		27.1			29.5			13.9			5.9	
Approach LOS		C			C			B			A	

Intersection Summary			
HCM Average Control Delay	13.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	71.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	72	350	60	44	330	24	41	0	33	14	0	42
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Hourly flow rate (vph)	84	407	70	51	384	28	48	0	38	16	0	49
Pedestrians		3			1							
Lane Width (m)		3.6			3.6							
Walking Speed (m/s)		1.2			1.2							
Percent Blockage		0			0							
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)		355										
pX, platoon unblocked				0.98			0.98	0.98	0.98	0.98	0.98	
vC, conflicting volume	412			477			1161	1123	443	1149	1144	401
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	412			466			1164	1126	432	1152	1147	401
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	93			95			67	100	94	89	100	92
cM capacity (veh/h)	1147			1084			142	177	615	146	172	648

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	560	463	86	65
Volume Left	84	51	48	16
Volume Right	70	28	38	49
cSH	1147	1084	217	349
Volume to Capacity	0.07	0.05	0.40	0.19
Queue Length 95th (m)	1.9	1.2	14.3	5.4
Control Delay (s)	2.0	1.4	32.1	17.7
Lane LOS	A	A	D	C
Approach Delay (s)	2.0	1.4	32.1	17.7
Approach LOS			D	C

Intersection Summary			
Average Delay	4.8		
Intersection Capacity Utilization	53.7%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	37	365	381	28	16	21
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	42	415	433	32	18	24
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	465				948	449
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	465				948	449
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	96				94	96
cM capacity (veh/h)	1107				281	614

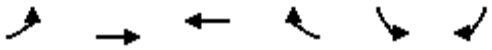
Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	457	465	42
Volume Left	42	0	18
Volume Right	0	32	24
cSH	1107	1700	406
Volume to Capacity	0.04	0.27	0.10
Queue Length 95th (m)	0.9	0.0	2.8
Control Delay (s)	1.2	0.0	14.9
Lane LOS	A		B
Approach Delay (s)	1.2	0.0	14.9
Approach LOS			B

Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	56.3%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	367	17	22	403	9	9
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	399	18	24	438	10	10
Pedestrians					5	
Lane Width (m)					3.6	
Walking Speed (m/s)					1.2	
Percent Blockage					0	
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			422		899	413
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			422		899	413
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			98		97	98
cM capacity (veh/h)			1143		304	641

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	417	462	20
Volume Left	0	24	10
Volume Right	18	0	10
cSH	1700	1143	413
Volume to Capacity	0.25	0.02	0.05
Queue Length 95th (m)	0.0	0.5	1.2
Control Delay (s)	0.0	0.6	14.2
Lane LOS		A	B
Approach Delay (s)	0.0	0.6	14.2
Approach LOS			B

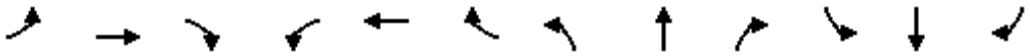
Intersection Summary			
Average Delay	0.6		
Intersection Capacity Utilization	49.2%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	9	369	420	21	6	7
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84
Hourly flow rate (vph)	11	439	500	25	7	8
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	525				973	512
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	525				973	512
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				97	99
cM capacity (veh/h)	1052				279	566

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	450	525	15
Volume Left	11	0	7
Volume Right	0	25	8
cSH	1052	1700	384
Volume to Capacity	0.01	0.31	0.04
Queue Length 95th (m)	0.2	0.0	1.0
Control Delay (s)	0.3	0.0	14.8
Lane LOS	A		B
Approach Delay (s)	0.3	0.0	14.8
Approach LOS			B

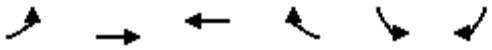
Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	36.7%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	77	272	27	22	290	119	5	89	27	162	104	149
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	81	286	28	23	305	125	5	94	28	171	109	157

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	396	454	127	437
Volume Left (vph)	81	23	5	171
Volume Right (vph)	28	125	28	157
Hadj (s)	0.04	-0.16	-0.13	-0.14
Departure Headway (s)	7.5	7.2	8.7	7.3
Degree Utilization, x	0.83	0.91	0.31	0.89
Capacity (veh/h)	459	490	372	477
Control Delay (s)	37.2	47.1	15.4	44.5
Approach Delay (s)	37.2	47.1	15.4	44.5
Approach LOS	E	E	C	E

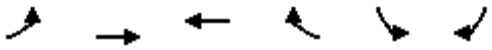
Intersection Summary			
Delay	40.7		
HCM Level of Service	E		
Intersection Capacity Utilization	82.7%	ICU Level of Service	E
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	33	400	383	5	3	21
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	36	435	416	5	3	23
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	422				926	419
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	422				926	419
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	97				99	96
cM capacity (veh/h)	1137				289	634

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	471	422	26
Volume Left	36	0	3
Volume Right	0	5	23
cSH	1137	1700	552
Volume to Capacity	0.03	0.25	0.05
Queue Length 95th (m)	0.8	0.0	1.2
Control Delay (s)	1.0	0.0	11.8
Lane LOS	A		B
Approach Delay (s)	1.0	0.0	11.8
Approach LOS			B

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	56.7%	ICU Level of Service	B
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	120	283	313	21	13	75
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	130	308	340	23	14	82
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	363				920	352
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	363				920	352
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	89				95	88
cM capacity (veh/h)	1196				268	692

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	438	363	96
Volume Left	130	0	14
Volume Right	0	23	82
cSH	1196	1700	561
Volume to Capacity	0.11	0.21	0.17
Queue Length 95th (m)	2.9	0.0	4.9
Control Delay (s)	3.3	0.0	12.7
Lane LOS	A		B
Approach Delay (s)	3.3	0.0	12.7
Approach LOS			B

Intersection Summary			
Average Delay	3.0		
Intersection Capacity Utilization	54.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	372	16	113	288	15	261
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	396	17	120	306	16	278
Pedestrians	1			1		
Lane Width (m)	3.6			3.6		
Walking Speed (m/s)	1.2			1.2		
Percent Blockage	0			0		
Right turn flare (veh)						4
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			413		952	405
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			413		952	405
tC, single (s)			4.2		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.3		3.5	3.3
p0 queue free %			89		94	57
cM capacity (veh/h)			1094		258	645

Direction, Lane #	EB 1	WB 1	WB 2	NB 1
Volume Total	413	120	306	294
Volume Left	0	120	0	16
Volume Right	17	0	0	278
cSH	1700	1094	1700	682
Volume to Capacity	0.24	0.11	0.18	0.43
Queue Length 95th (m)	0.0	3.0	0.0	17.4
Control Delay (s)	0.0	8.7	0.0	15.0
Lane LOS		A		C
Approach Delay (s)	0.0	2.5		15.0
Approach LOS				C

Intersection Summary			
Average Delay	4.8		
Intersection Capacity Utilization	43.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		4.0	5.0		4.0	5.0	5.0	5.0	5.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	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	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.98		1.00	1.00		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1805	3187		1770	3326		1717	1863	1583	1719	1715	
Flt Permitted	0.43	1.00		0.42	1.00		0.50	1.00	1.00	0.60	1.00	
Satd. Flow (perm)	817	3187		779	3326		904	1863	1583	1077	1715	
Volume (vph)	9	412	67	63	560	11	162	258	89	23	100	7
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)	9	425	69	65	577	11	167	266	92	24	103	7
RTOR Reduction (vph)	0	10	0	0	1	0	0	0	69	0	3	0
Lane Group Flow (vph)	9	484	0	65	587	0	167	266	23	24	107	0
Confl. Peds. (#/hr)							1					1
Heavy Vehicles (%)	0%	12%	4%	2%	8%	20%	5%	2%	2%	5%	8%	33%
Turn Type	Perm			pm+pt			pm+pt		Perm	Perm		
Protected Phases		2		1	6		3	8			4	
Permitted Phases	2			6			8		8	4		
Actuated Green, G (s)	51.4	51.4		60.9	60.9		24.1	24.1	24.1	11.4	11.4	
Effective Green, g (s)	51.4	51.4		61.9	60.9		25.1	24.1	24.1	11.4	11.4	
Actuated g/C Ratio	0.54	0.54		0.65	0.64		0.26	0.25	0.25	0.12	0.12	
Clearance Time (s)	5.0	5.0		4.0	5.0		4.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	442	1724		565	2132		313	473	402	129	206	
v/s Ratio Prot		0.15		0.01	c0.18		0.05	c0.14			0.06	
v/s Ratio Perm	0.01			0.07			c0.09		0.01	0.02		
v/c Ratio	0.02	0.28		0.12	0.28		0.53	0.56	0.06	0.19	0.52	
Uniform Delay, d1	10.1	11.8		6.2	7.4		28.6	30.9	26.9	37.6	39.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.1	0.4		0.1	0.3		1.7	1.5	0.1	0.7	2.4	
Delay (s)	10.2	12.2		6.3	7.8		30.4	32.4	26.9	38.3	41.6	
Level of Service	B	B		A	A		C	C	C	D	D	
Approach Delay (s)		12.2			7.6			30.8			41.0	
Approach LOS		B			A			C			D	

Intersection Summary			
HCM Average Control Delay	18.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.36		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	55.8%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0			5.0		5.0	5.0	
Lane Util. Factor		1.00			1.00			1.00		1.00	1.00	
Frpb, ped/bikes		1.00			1.00			1.00		1.00	1.00	
Flpb, ped/bikes		1.00			1.00			1.00		0.99	1.00	
Frt		0.97			0.91			0.98		1.00	1.00	
Flt Protected		0.99			0.99			1.00		0.95	1.00	
Satd. Flow (prot)		1306			1549			1834		1751	1807	
Flt Permitted		0.95			0.89			1.00		0.51	1.00	
Satd. Flow (perm)		1247			1400			1834		947	1807	
Volume (vph)	3	15	4	76	8	173	0	292	40	84	145	5
Peak-hour factor, PHF	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Adj. Flow (vph)	4	18	5	92	10	208	0	352	48	101	175	6
RTOR Reduction (vph)	0	4	0	0	161	0	0	8	0	0	2	0
Lane Group Flow (vph)	0	23	0	0	149	0	0	392	0	101	179	0
Confl. Peds. (#/hr)							1		18	18		1
Heavy Vehicles (%)	33%	47%	25%	22%	0%	5%	0%	1%	5%	2%	4%	20%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		9.3			9.3			21.6		21.6	21.6	
Effective Green, g (s)		9.3			9.3			21.6		21.6	21.6	
Actuated g/C Ratio		0.23			0.23			0.53		0.53	0.53	
Clearance Time (s)		5.0			5.0			5.0		5.0	5.0	
Vehicle Extension (s)		0.2			0.2			0.2		0.2	0.2	
Lane Grp Cap (vph)		284			318			969		500	954	
v/s Ratio Prot								c0.21			0.10	
v/s Ratio Perm		0.02			c0.11					0.11		
v/c Ratio		0.08			0.47			0.41		0.20	0.19	
Uniform Delay, d1		12.4			13.7			5.8		5.1	5.1	
Progression Factor		1.00			1.00			1.00		1.00	1.00	
Incremental Delay, d2		0.0			0.4			1.3		0.9	0.4	
Delay (s)		12.5			14.1			7.1		6.0	5.5	
Level of Service		B			B			A		A	A	
Approach Delay (s)		12.5			14.1			7.1			5.7	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM Average Control Delay	8.9	HCM Level of Service	A
HCM Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	40.9	Sum of lost time (s)	10.0
Intersection Capacity Utilization	69.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0			5.0	5.0		5.0	
Lane Util. Factor		1.00			1.00			1.00	1.00		1.00	
Frpb, ped/bikes		0.99			1.00			1.00	0.98		1.00	
Flpb, ped/bikes		1.00			1.00			1.00	1.00		1.00	
Frt		0.95			0.98			1.00	0.85		0.99	
Flt Protected		0.98			0.96			1.00	1.00		1.00	
Satd. Flow (prot)		1726			1699			1853	1506		1685	
Flt Permitted		0.83			0.69			0.98	1.00		0.98	
Satd. Flow (perm)		1462			1214			1824	1506		1655	
Volume (vph)	34	34	39	272	24	47	11	231	200	11	200	10
Peak-hour factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Adj. Flow (vph)	40	40	46	320	28	55	13	272	235	13	235	12
RTOR Reduction (vph)	0	29	0	0	12	0	0	0	137	0	3	0
Lane Group Flow (vph)	0	97	0	0	391	0	0	285	98	0	257	0
Confl. Peds. (#/hr)	1		5	5		1			1	1		
Heavy Vehicles (%)	3%	0%	3%	5%	13%	0%	9%	2%	5%	18%	11%	20%
Turn Type	Perm			Perm			Perm		Perm	Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)		17.9			17.9			20.1	20.1		20.1	
Effective Green, g (s)		17.9			17.9			20.1	20.1		20.1	
Actuated g/C Ratio		0.37			0.37			0.42	0.42		0.42	
Clearance Time (s)		5.0			5.0			5.0	5.0		5.0	
Vehicle Extension (s)		3.0			3.0			3.0	3.0		3.0	
Lane Grp Cap (vph)		545			453			764	631		693	
v/s Ratio Prot												
v/s Ratio Perm		0.07			c0.32			c0.16	0.07		0.15	
v/c Ratio		0.18			0.86			0.37	0.16		0.37	
Uniform Delay, d1		10.1			13.9			9.6	8.7		9.6	
Progression Factor		1.00			1.00			1.00	1.00		1.00	
Incremental Delay, d2		0.2			15.5			1.4	0.5		1.5	
Delay (s)		10.3			29.5			11.0	9.2		11.1	
Level of Service		B			C			B	A		B	
Approach Delay (s)		10.3			29.5			10.2			11.1	
Approach LOS		B			C			B			B	

Intersection Summary			
HCM Average Control Delay	16.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	48.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	54.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0			5.0			5.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		1.00			0.99			1.00			0.99	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		1.00			0.94			0.98			0.95	
Flt Protected		0.99			1.00			1.00			0.98	
Satd. Flow (prot)		1768			1693			1552			1550	
Flt Permitted		0.81			0.98			0.98			0.84	
Satd. Flow (perm)		1454			1656			1531			1322	
Volume (vph)	65	239	8	17	217	169	11	147	23	67	46	59
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	68	249	8	18	226	176	11	153	24	70	48	61
RTOR Reduction (vph)	0	2	0	0	53	0	0	7	0	0	26	0
Lane Group Flow (vph)	0	323	0	0	367	0	0	181	0	0	153	0
Confl. Peds. (#/hr)	1		8	8		1	4		1	1		4
Heavy Vehicles (%)	9%	4%	38%	43%	3%	3%	27%	17%	33%	12%	17%	13%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		15.9			15.9			23.3			23.3	
Effective Green, g (s)		15.9			15.9			23.3			23.3	
Actuated g/C Ratio		0.32			0.32			0.47			0.47	
Clearance Time (s)		5.0			5.0			5.0			5.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		470			535			725			626	
v/s Ratio Prot												
v/s Ratio Perm		c0.22			0.22			c0.12			0.12	
v/c Ratio		0.69			0.69			0.25			0.24	
Uniform Delay, d1		14.5			14.5			7.7			7.7	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		4.2			3.6			0.8			0.9	
Delay (s)		18.6			18.1			8.6			8.6	
Level of Service		B			B			A			A	
Approach Delay (s)		18.6			18.1			8.6			8.6	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM Average Control Delay	15.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.43		
Actuated Cycle Length (s)	49.2	Sum of lost time (s)	10.0
Intersection Capacity Utilization	82.3%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	643	24	243	443	9	194
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	691	26	261	476	10	209
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						4
Median type					None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			717		1703	704
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			717		1703	704
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			71		87	53
cM capacity (veh/h)			888		72	440

Direction, Lane #	EB 1	WB 1	WB 2	NB 1
Volume Total	717	261	476	218
Volume Left	0	261	0	10
Volume Right	26	0	0	209
cSH	1700	888	1700	461
Volume to Capacity	0.42	0.29	0.28	0.47
Queue Length 95th (m)	0.0	9.8	0.0	20.0
Control Delay (s)	0.0	10.7	0.0	22.2
Lane LOS		B		C
Approach Delay (s)	0.0	3.8		22.2
Approach LOS				C

Intersection Summary			
Average Delay	4.6		
Intersection Capacity Utilization	62.1%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0	5.0	5.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	0.99	1.00	
Frt	1.00	0.98		1.00	0.99		1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1685	3391		1805	3405		1570	1557	1310	1603	1873	
Flt Permitted	0.32	1.00		0.13	1.00		0.23	1.00	1.00	0.65	1.00	
Satd. Flow (perm)	565	3391		254	3405		383	1557	1310	1090	1873	
Volume (vph)	17	936	163	182	785	28	109	160	123	19	243	7
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	19	1029	179	200	863	31	120	176	135	21	267	8
RTOR Reduction (vph)	0	12	0	0	2	0	0	0	97	0	1	0
Lane Group Flow (vph)	19	1196	0	200	892	0	120	176	38	21	274	0
Confl. Peds. (#/hr)	1		1	1		1	1		1	1		1
Heavy Vehicles (%)	7%	4%	2%	0%	5%	16%	15%	22%	21%	12%	1%	0%
Turn Type	Perm			pm+pt			pm+pt		Perm	Perm		
Protected Phases		2		1	6		3	8			4	
Permitted Phases	2			6			8		8	4		
Actuated Green, G (s)	60.1	60.1		71.1	71.1		31.7	31.7	31.7	20.7	20.7	
Effective Green, g (s)	61.1	60.1		72.1	71.1		32.7	31.7	31.7	20.7	20.7	
Actuated g/C Ratio	0.54	0.53		0.64	0.63		0.29	0.28	0.28	0.18	0.18	
Clearance Time (s)	5.0	5.0		4.0	5.0		4.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	306	1807		259	2146		185	438	368	200	344	
v/s Ratio Prot		0.35		c0.05	0.26		c0.04	0.11			c0.15	
v/s Ratio Perm	0.03			c0.45			0.15		0.03	0.02		
v/c Ratio	0.06	0.66		0.77	0.42		0.65	0.40	0.10	0.10	0.80	
Uniform Delay, d1	12.3	19.0		14.5	10.4		32.0	32.9	30.0	38.3	44.0	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.4	1.9		13.3	0.6		7.6	0.6	0.1	0.2	12.1	
Delay (s)	12.6	20.9		27.8	11.0		39.6	33.5	30.1	38.6	56.1	
Level of Service	B	C		C	B		D	C	C	D	E	
Approach Delay (s)		20.8			14.1			34.1			54.9	
Approach LOS		C			B			C			D	

Intersection Summary			
HCM Average Control Delay	23.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	112.8	Sum of lost time (s)	13.0
Intersection Capacity Utilization	80.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0			5.0		5.0	5.0	
Lane Util. Factor		1.00			1.00			1.00		1.00	1.00	
Frpb, ped/bikes		1.00			0.99			1.00		1.00	1.00	
Flpb, ped/bikes		1.00			1.00			1.00		1.00	1.00	
Frt		0.98			0.91			0.97		1.00	0.99	
Flt Protected		0.98			0.99			1.00		0.95	1.00	
Satd. Flow (prot)		1730			1657			1757		1766	1887	
Flt Permitted		0.88			0.90			1.00		0.59	1.00	
Satd. Flow (perm)		1548			1510			1756		1103	1887	
Volume (vph)	6	7	2	48	7	114	1	251	67	120	411	17
Peak-hour factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Adj. Flow (vph)	7	8	2	56	8	134	1	295	79	141	484	20
RTOR Reduction (vph)	0	2	0	0	111	0	0	12	0	0	2	0
Lane Group Flow (vph)	0	15	0	0	87	0	0	363	0	141	502	0
Confl. Peds. (#/hr)	1					1	2		3	3		2
Heavy Vehicles (%)	0%	0%	50%	0%	14%	1%	0%	2%	14%	2%	0%	0%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		7.6			7.6			27.6		27.6	27.6	
Effective Green, g (s)		7.6			7.6			27.6		27.6	27.6	
Actuated g/C Ratio		0.17			0.17			0.61		0.61	0.61	
Clearance Time (s)		5.0			5.0			5.0		5.0	5.0	
Vehicle Extension (s)		0.2			0.2			0.2		0.2	0.2	
Lane Grp Cap (vph)		260			254			1072		674	1152	
v/s Ratio Prot											c0.27	
v/s Ratio Perm		0.01			c0.06			0.21		0.13		
v/c Ratio		0.06			0.34			0.34		0.21	0.44	
Uniform Delay, d1		15.8			16.6			4.3		3.9	4.7	
Progression Factor		1.00			1.00			1.00		1.00	1.00	
Incremental Delay, d2		0.0			0.3			0.9		0.7	1.2	
Delay (s)		15.8			16.9			5.2		4.6	5.9	
Level of Service		B			B			A		A	A	
Approach Delay (s)		15.8			16.9			5.2			5.6	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM Average Control Delay	7.4	HCM Level of Service	A
HCM Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	45.2	Sum of lost time (s)	10.0
Intersection Capacity Utilization	64.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0			5.0	5.0		5.0	
Lane Util. Factor		1.00			1.00			1.00	1.00		1.00	
Frpb, ped/bikes		0.99			1.00			1.00	0.98		1.00	
Flpb, ped/bikes		1.00			1.00			1.00	1.00		1.00	
Frt		0.96			0.99			1.00	0.85		0.99	
Flt Protected		0.98			0.96			0.99	1.00		1.00	
Satd. Flow (prot)		1780			1776			1840	1550		1850	
Flt Permitted		0.85			0.74			0.93	1.00		0.96	
Satd. Flow (perm)		1548			1363			1713	1550		1786	
Volume (vph)	16	15	13	224	36	21	32	250	192	32	366	33
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	17	16	14	241	39	23	34	269	206	34	394	35
RTOR Reduction (vph)	0	10	0	0	7	0	0	0	105	0	5	0
Lane Group Flow (vph)	0	37	0	0	296	0	0	303	101	0	458	0
Confl. Peds. (#/hr)	1		1	1		1			1	1		
Heavy Vehicles (%)	0%	0%	0%	1%	3%	5%	0%	3%	2%	6%	1%	0%
Turn Type	Perm			Perm			Perm		Perm	Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)		12.5			12.5			21.8	21.8		21.8	
Effective Green, g (s)		12.5			12.5			21.8	21.8		21.8	
Actuated g/C Ratio		0.28			0.28			0.49	0.49		0.49	
Clearance Time (s)		5.0			5.0			5.0	5.0		5.0	
Vehicle Extension (s)		0.2			0.2			0.2	0.2		0.2	
Lane Grp Cap (vph)		437			385			843	763		879	
v/s Ratio Prot												
v/s Ratio Perm		0.02			c0.22			0.18	0.07		c0.26	
v/c Ratio		0.08			0.77			0.36	0.13		0.52	
Uniform Delay, d1		11.7			14.6			6.9	6.1		7.7	
Progression Factor		1.00			1.00			1.00	1.00		1.00	
Incremental Delay, d2		0.0			8.1			1.2	0.4		2.2	
Delay (s)		11.7			22.6			8.1	6.5		9.9	
Level of Service		B			C			A	A		A	
Approach Delay (s)		11.7			22.6			7.5			9.9	
Approach LOS		B			C			A			A	

Intersection Summary			
HCM Average Control Delay	11.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	44.3	Sum of lost time (s)	10.0
Intersection Capacity Utilization	74.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0			5.0			5.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		1.00			0.99			1.00			0.99	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.99			0.96			0.97			0.95	
Flt Protected		0.99			1.00			1.00			0.98	
Satd. Flow (prot)		1814			1813			1830			1756	
Flt Permitted		0.75			0.97			0.98			0.81	
Satd. Flow (perm)		1382			1762			1799			1454	
Volume (vph)	77	272	27	22	290	119	5	89	27	162	104	149
Peak-hour factor, PHF	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Adj. Flow (vph)	89	313	31	25	333	137	6	102	31	186	120	171
RTOR Reduction (vph)	0	5	0	0	25	0	0	16	0	0	31	0
Lane Group Flow (vph)	0	428	0	0	470	0	0	123	0	0	446	0
Confl. Peds. (#/hr)	1		3	3		1	5		1	1		5
Heavy Vehicles (%)	5%	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		19.8			19.8			26.2			26.2	
Effective Green, g (s)		19.8			19.8			26.2			26.2	
Actuated g/C Ratio		0.35			0.35			0.47			0.47	
Clearance Time (s)		5.0			5.0			5.0			5.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		489			623			842			680	
v/s Ratio Prot												
v/s Ratio Perm		c0.31			0.27			0.07			c0.31	
v/c Ratio		0.87			0.76			0.15			0.66	
Uniform Delay, d1		16.9			16.0			8.5			11.4	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		15.9			5.2			0.4			4.9	
Delay (s)		32.8			21.2			8.9			16.3	
Level of Service		C			C			A			B	
Approach Delay (s)		32.8			21.2			8.9			16.3	
Approach LOS		C			C			A			B	

Intersection Summary			
HCM Average Control Delay	21.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	56.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	84.4%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Intersection Delay, s/veh	8.6
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	27	306	400	282
Demand Flow Rate, veh/h	37	335	406	292
Vehicles Circulating, veh/h	392	361	134	117
Vehicles Exiting, veh/h	17	179	295	579
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	1	18	0	0
Ped Cap Adj	1.000	0.998	1.000	1.000
Approach Delay, s/veh	7.1	10.8	8.3	6.7
Approach LOS	A	B	A	A

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	37	335	406	292
Cap Entry Lane, veh/h	764	788	988	1005
Entry HV Adj Factor	0.721	0.913	0.986	0.966
Flow Entry, veh/h	27	306	400	282
Cap Entry, veh/h	551	718	975	971
V/C Ratio	0.048	0.426	0.411	0.290
Control Delay, s/veh	7.1	10.8	8.3	6.7
LOS	A	B	A	A
95th %tile Queue, veh	0	2	2	1

Intersection	
Intersection Delay, s/veh	10.7
Intersection LOS	B

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	126	403	520	260
Demand Flow Rate, veh/h	128	423	538	290
Vehicles Circulating, veh/h	612	332	96	382
Vehicles Exiting, veh/h	60	302	644	373
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	1	5	1
Ped Cap Adj	1.000	1.000	0.999	1.000
Approach Delay, s/veh	8.6	12.2	10.2	10.2
Approach LOS	A	B	B	B

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	128	423	538	290
Cap Entry Lane, veh/h	613	811	1027	771
Entry HV Adj Factor	0.984	0.953	0.966	0.897
Flow Entry, veh/h	126	403	520	260
Cap Entry, veh/h	603	773	991	692
V/C Ratio	0.209	0.522	0.524	0.376
Control Delay, s/veh	8.6	12.2	10.2	10.2
LOS	A	B	B	B
95th %tile Queue, veh	1	3	3	2

Intersection	
Intersection Delay, s/veh	6.8
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	272	376	115	89
Demand Flow Rate, veh/h	286	392	125	90
Vehicles Circulating, veh/h	52	84	286	447
Vehicles Exiting, veh/h	485	327	52	29
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	6.1	7.7	6.1	6.4
Approach LOS	A	A	A	A

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	286	392	125	90
Cap Entry Lane, veh/h	1073	1039	849	723
Entry HV Adj Factor	0.952	0.958	0.920	0.989
Flow Entry, veh/h	272	376	115	89
Cap Entry, veh/h	1021	996	781	715
V/C Ratio	0.267	0.377	0.147	0.125
Control Delay, s/veh	6.1	7.7	6.1	6.4
LOS	A	A	A	A
95th %tile Queue, veh	1	2	1	0

Intersection	
Intersection Delay, s/veh	6.9
Intersection LOS	A

Approach	EB	WB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	341	395	82
Demand Flow Rate, veh/h	354	406	91
Vehicles Circulating, veh/h	49	19	391
Vehicles Exiting, veh/h	433	384	34
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	6.8	7.1	6.5
Approach LOS	A	A	A

Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	354	406	91
Cap Entry Lane, veh/h	1076	1109	764
Entry HV Adj Factor	0.964	0.972	0.901
Flow Entry, veh/h	341	395	82
Cap Entry, veh/h	1037	1078	689
V/C Ratio	0.329	0.366	0.119
Control Delay, s/veh	6.8	7.1	6.5
LOS	A	A	A
95th %tile Queue, veh	1	2	0

Intersection	
Intersection Delay, s/veh	6.8
Intersection LOS	A

Approach	EB	WB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	368	348	51
Demand Flow Rate, veh/h	400	363	51
Vehicles Circulating, veh/h	18	7	349
Vehicles Exiting, veh/h	382	411	21
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	7.3	6.6	5.1
Approach LOS	A	A	A

Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	400	363	51
Cap Entry Lane, veh/h	1110	1122	797
Entry HV Adj Factor	0.919	0.958	1.000
Flow Entry, veh/h	368	348	51
Cap Entry, veh/h	1020	1074	797
V/C Ratio	0.360	0.324	0.064
Control Delay, s/veh	7.3	6.6	5.1
LOS	A	A	A
95th %tile Queue, veh	2	1	0

Intersection	
Intersection Delay, s/veh	9.4
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	325	420	188	179
Demand Flow Rate, veh/h	344	440	225	203
Vehicles Circulating, veh/h	160	267	411	273
Vehicles Exiting, veh/h	316	369	93	434
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	4	1	8	1
Ped Cap Adj	0.999	1.000	0.999	1.000
Approach Delay, s/veh	7.9	11.3	9.7	7.4
Approach LOS	A	B	A	A

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	344	440	225	203
Cap Entry Lane, veh/h	963	865	749	860
Entry HV Adj Factor	0.945	0.955	0.836	0.881
Flow Entry, veh/h	325	420	188	179
Cap Entry, veh/h	909	826	625	758
V/C Ratio	0.357	0.509	0.301	0.236
Control Delay, s/veh	7.9	11.3	9.7	7.4
LOS	A	B	A	A
95th %tile Queue, veh	2	3	1	1

Intersection	
Intersection Delay, s/veh	10.0
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	17	198	375	645
Demand Flow Rate, veh/h	18	200	392	648
Vehicles Circulating, veh/h	684	309	159	66
Vehicles Exiting, veh/h	30	242	543	443
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	2	3	0	1
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	7.1	7.0	8.6	11.7
Approach LOS	A	A	A	B

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	18	200	392	648
Cap Entry Lane, veh/h	570	830	964	1058
Entry HV Adj Factor	0.944	0.989	0.957	0.995
Flow Entry, veh/h	17	198	375	645
Cap Entry, veh/h	538	821	922	1053
V/C Ratio	0.032	0.241	0.407	0.613
Control Delay, s/veh	7.1	7.0	8.6	11.7
LOS	A	A	A	B
95th %tile Queue, veh	0	1	2	4

Intersection	
Intersection Delay, s/veh	10.5
Intersection LOS	B

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	47	303	509	463
Demand Flow Rate, veh/h	47	307	521	469
Vehicles Circulating, veh/h	677	328	69	317
Vehicles Exiting, veh/h	109	262	655	318
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	1	1	1
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	7.2	9.1	9.3	13.0
Approach LOS	A	A	A	B

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	47	307	521	469
Cap Entry Lane, veh/h	574	814	1055	823
Entry HV Adj Factor	1.000	0.986	0.977	0.987
Flow Entry, veh/h	47	303	509	463
Cap Entry, veh/h	574	803	1030	812
V/C Ratio	0.082	0.377	0.494	0.570
Control Delay, s/veh	7.2	9.1	9.3	13.0
LOS	A	A	A	B
95th %tile Queue, veh	0	2	3	4

Intersection	
Intersection Delay, s/veh	9.3
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	561	463	86	65
Demand Flow Rate, veh/h	567	468	86	66
Vehicles Circulating, veh/h	67	134	513	487
Vehicles Exiting, veh/h	486	465	121	115
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	10.0	9.3	6.7	6.3
Approach LOS	B	A	A	A

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	567	468	86	66
Cap Entry Lane, veh/h	1057	988	676	694
Entry HV Adj Factor	0.989	0.990	1.000	0.985
Flow Entry, veh/h	561	463	86	65
Cap Entry, veh/h	1045	978	676	684
V/C Ratio	0.537	0.474	0.127	0.095
Control Delay, s/veh	10.0	9.3	6.7	6.3
LOS	B	A	A	A
95th %tile Queue, veh	3	3	0	0

Intersection	
Intersection Delay, s/veh	7.7
Intersection LOS	A

Approach	EB	WB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	457	465	42
Demand Flow Rate, veh/h	461	465	42
Vehicles Circulating, veh/h	18	42	433
Vehicles Exiting, veh/h	457	437	74
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	7.7	7.9	5.5
Approach LOS	A	A	A

Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	461	465	42
Cap Entry Lane, veh/h	1110	1083	733
Entry HV Adj Factor	0.991	1.000	1.000
Flow Entry, veh/h	457	465	42
Cap Entry, veh/h	1100	1083	733
V/C Ratio	0.415	0.429	0.057
Control Delay, s/veh	7.7	7.9	5.5
LOS	A	A	A
95th %tile Queue, veh	2	2	0

APPENDIX E

Traffic Calming Considerations

Intus Road Safety Incorporated

Memorandum

Client: John Zangari, Project Manager
Dillon Consulting Limited

Project: Sixth Concession Road/North Talbot Road
Municipal Class Environmental Assessment
Windsor, ON

Date: August 26, 2014

Author: Gerry Forbes, President
Intus Road Safety Engineering Incorporated

1. INTRODUCTION

The purpose of this technical memorandum is to provide input to the study team concerning the traffic calming and speed management elements of the Sixth Concession Road / North Talbot Road Municipal Class Environmental Assessment (EA) being undertaken in Windsor, Ontario.

The broader objectives of the EA study are to address:

- Existing and future roadway operations for a 20 year horizon considering impacts of proposed alternatives on the adjacent arterial/collector road network and existing/future land uses;
- Provisions for active transportation including pedestrian and bikeway connections and transit;
- Traffic calming measures; and
- Drainage along both corridors.

This memorandum deals specifically with the traffic calming element of the study.

The memorandum was completed for Dillon Consulting Limited by Gerry Forbes of ***Intus Road Safety Engineering Incorporated.***

The study area is Sixth Concession Road from Cabana Road East to North Talbot Road and North Talbot Road from Howard Avenue to the east City limits (see Figure 1).

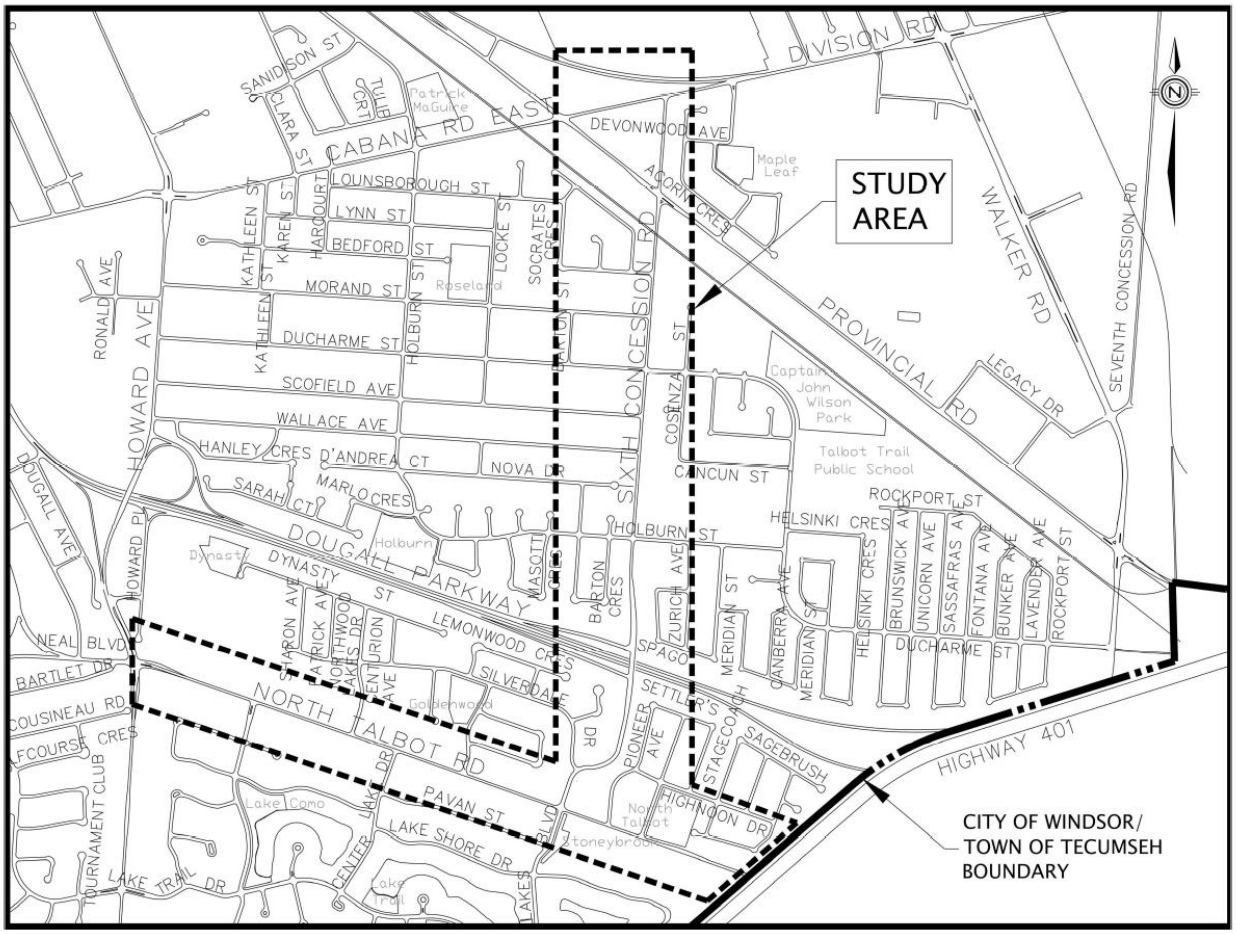


FIGURE 1: Study Area

2. MEANS AND METHODS

Traffic calming is the act of mitigating the negative effects of motorized traffic (usually excessive speeds and high traffic volumes) through the implementation of mainly physical measures. Developing a traffic calming plan or scheme is generally a collaborative process between the road authority and its designers, and the residents and businesses located in the neighbourhood. At its core, the planning and design process for traffic calming is simply a matter of establishing well-

defined traffic problems and developing targeted solutions. The process is ordinarily skewed towards gathering information and defining problems, as solutions naturally flow from problem definition. Besides, public input is a critical component in each step of the plan development.

The main objectives of this memorandum are to provide a clear problem statement for the study area, to outline general principles that should be followed in developing traffic calming plans, and to develop an initial traffic calming plan for consideration by the study team and the interested public.

3. PARAMETERS AND CONSTRAINTS

The parameters and constraints for this project are as follows:

- The ***functional classification*** of the streets. Every street in the Windsor street network has been classified according to the function that the street serves (i.e., access to adjacent properties, or mobility). Sixth Concession Road and North Talbot Road are both classified as Class I collector roads with a function of providing both land access and mobility. These roads are expected to carry moderate volumes of traffic. Both Holburn Street and Ducharme Street are Class II collector roads, with also with a stated purpose of providing land access and mobility. In this latter instance, the mobility function is generally restricted to trips that either start or end in the neighbourhood (but not necessarily on the street).

- The Windsor Bicycle Use Master Plan calls for ***bicycle lanes*** on Sixth Concession Road and North Talbot Road throughout the study area, and signed ***bicycle routes*** on Ducharme and Holburn Streets.

- The Windsor Area Long Range Transportation Study (WALTS) recommends ***sidewalks*** on both sides of all collector roads.

- With respect to the raised islands that have been constructed at many of the study area intersections on Sixth Concession Road, the WALTS states that channelized right-turn lanes should only be used after careful consideration of site-specific traffic conditions. Experience shows that motorists may not yield the right-of-way to pedestrians at these locations.

- The WALTS optimizes existing transportation infrastructure by using LoS “E” to identify capacity deficiencies on collector roadways. This generally means that improvements to the street system should not be undertaken to improve traffic flow unless LoS “E” has been reached.

Any traffic calming plans (and other modifications to the study streets) must be cognizant of, and generally consistent with the above constraints and recommendations.

4. PROBLEMS TO BE ADDRESSED

Based on a review of the existing and future conditions, the traffic and collision analysis, and issues / concerns identified by the public, the following transportation-related problems were identified.

- ***Speeds on Sixth Concession***: The posted, average, and 85th percentile speeds on Sixth Concession Road are 50 km/h, 58 km/h, and 65 km/h, respectively. The 85th percentile speed should, in most instances, match the posted speed limit (i.e., it is expected about 15% of traffic will exceed the posted speed limit). An 85th percentile speed that is 10 km/h or more over the posted speed limit is ordinarily identified as a problem.

- ***Speeds on North Talbot Road***: The posted, average, and 85th percentile speeds on North Talbot Road are 50 km/h, 55 km/h, and 62 km/h, respectively. The 85th percentile speed should, in most instances, match the posted speed limit (i.e., it is expected about 15% of traffic will exceed the posted speed limit). An 85th percentile speed that is 10 km/h or more over the posted speed limit is ordinarily identified as a problem.

- ***Shortcutting traffic in the Old Roseland neighbourhood***: Attendees at the April 1, 2014 workshop clearly indicated that motorists were using the local streets in the Old Roseland neighbourhood as a short cut (to avoid the level rail crossing on Sixth Concession Road and the congested intersection at Provincial Road). Given the configuration of raised islands that have already been constructed at several of the study area intersections, the concern is with northbound traffic on Sixth Concession Road, and westbound traffic from the North Roseland neighbourhood.

- ***Pedestrian safety concerns***: The majority of the study area is missing sidewalks and other pedestrian amenities.

- ***Cyclist safety concerns***: Cyclists must mix with motorized traffic in the majority of the study area.

- ***Traffic volumes on Sixth Concession Road***: As a Class I collector road, this facility is intended to carry up to 9,000 vpd, whereas up to 13,200 vpd is expected in some sections by 2035.

- ***Traffic volumes on North Talbot Road***: As a Class I collector road, this facility is intended to carry up to 9,000 vpd, whereas up to 10,500 vpd is expected in some sections by 2035.

- ***Collision severity***: While the number of collisions is as expected given the volume of traffic in the study area, casualty collisions are over-represented. Thirty-two percent (32%) of the collisions in the study area are casualty collisions, whereas the expected percentage is 23%[1].

Before leaving the topic of problem identification, a couple of important points should be raised:

1. The concern expressed over ***cyclist safety*** is mainly related to cyclists moving along the study area roads (as opposed to crossing movements). Given the Windsor BUMP has recommended that bike lanes be provided along both streets, there is no real merit in analyzing this problem any further. Bike lanes are an appropriate solution for this problem and are consistent with the guidance provided in Ontario Traffic Manual Book 18 – Cycling Facilities.

2. The concern expressed over ***pedestrian safety*** is mainly related to pedestrians walking along the study area roads (as opposed to crossing the road). Given the Windsor policy to provide sidewalks on both sides of all collector roads, there is no real merit in analyzing the problem of safety while walking along the road any further. Sidewalks are an appropriate solution for this problem. With respect to pedestrians crossing the road, the development contiguous and vicinal to the study roads is general low-density residential and does not indicate that there is any concentrations of pedestrian crossing activity outside of at-grade intersections (which are the ordinary points of crossing). Pedestrian crossing safety will be one of the objectives when making choices concerning intersection control type, and intersection design. There is no need for an explicit consideration of pedestrian crossing safety outside of the ordinary design process.

3. The issue of ***collision severity*** is a rather broad issue. Generally, an increased collision severity results from higher operating speeds, and/or fixed obstacles and other hazards near the edge of the road (e.g., deep ditches that cause vehicle rollovers). Obstacles within the clear zone of the study area roads will be identified and evaluated during the design phase of this project – it is a routine assessment undertaken in municipal road design. This means that any calming measures to address collision severity will also address operating speed. Since speed is already an identified problem on both study area roads, there is no need to develop separate traffic calming solutions for collision severity.

[1] Based on 2006 to 2012 collision data from the City of Windsor.

4. Both Sixth Concession Road and North Talbot Road have been identified as streets that are expected to experience ***traffic volumes*** that are higher than the threshold for Class I collector roads in Windsor. At this time, it is recommended that no action be taken to address this concern. The general rule concerning traffic calming to mitigate high traffic volumes is that the best approach to reducing traffic is to improve the arterial street network (rather than placing restrictions or mobility inhibitors on the subject streets). The City has completed several improvements to the surrounding arterial street network and is in the process of making others. It is prudent to finish the improvements to the arterial street network, before considering any traffic calming measures on Sixth Concession Road or North Talbot Road to reduce traffic volumes.

Given the above, the focus of the traffic calming on Sixth Concession Road is to better manage operating speeds and to address shortcutting through the Old Roseland neighbourhood. The focus of traffic calming on North Talbot Road is to manage operating speed.

5. TRAFFIC CALMING AS AN OPTION

The City of Windsor has a policy concerning traffic calming titled ***Traffic Calming Policy for Residential Areas*** (September 2005). It is our understanding that this policy is in the process of being revised to address a number of issues. Nonetheless, it is good a solid starting point from which to consider the need for traffic calming. Hence, an analysis of Sixth Concession Road and North Talbot Road using the existing policy is undertaken below.

In essence, the Windsor policy takes into consideration a number of traffic-related and land use factors which are ordinarily linked to neighbourhood traffic problems, and assesses the magnitude of the potential issues using a rating or scoring system. In general, the policy recommends that the level of traffic calming implemented (if any) be matched to the severity of the problems identified. Locations with faster motor vehicle speeds, higher volumes of motorized traffic, and higher volumes of vulnerable road users (i.e., pedestrians and cyclist) require more extensive and more restrictive traffic calming measures. The policy is consistent with good practice in traffic engineering and helps manage the limited financial and staff resources of the City.

Within the traffic calming policy Class I Collector streets (i.e., Sixth Concession Road and North Talbot Road) are assessed and ranked on a scale of 90 points. If the conditions along the street do not garner at least 31 points, then traffic calming is not considered to be warranted. If this minimum level is exceeded, then there are three levels of intervention: signing, horizontal deflections, and vertical deflections and diversions, with more restrictive measures being warranted for more severe problems.

The conditions on Sixth Concession Road and North Talbot Road (using 2035 traffic volumes) were subject to the Windsor warrant analysis for traffic calming with results shown in Tables 1 and 2. It is evident from the analysis that traffic calming is warranted on both Sixth Concession Road and North Talbot Road, with the most severe traffic issues being on Sixth Concession Road between Holburn Street and Provincial Road. In all cases, the conditions warrant some form a physical traffic calming beyond changes to signing.

6. EVALUATION OF OPTIONS

Speed Management

Speed management is required along both Sixth Concession Road and North Talbot Road, except for Sixth Concession Road between Dougall Avenue and North Talbot Road. In this latter section of Sixth Concession Road the horizontal alignment of the road is generally sufficient to manage speed. The existing curves have an advisory speed of 30 km/h, and there is plan to modify the alignment to allow faster speeds. *Having stated that, it was noted during the site visit that the existing traffic control devices for these curves are not in compliance with the guidance provided in the Ontario Traffic Manual, and they should be upgraded immediately*[2] *(see Figure 2).*

FIGURE 2: Noncompliant Warning Signs on Sixth Concession Road

[2] The warning signs in both directions are too close to the start of the curves and should be checked to ensure compliance with all aspects of the Ontario Traffic Manual.

TABLE 1: Traffic Calming Warrant for Sixth Concession Road

	Sixth Concession Road			
	North Talbot to Dougall	Dougall to Holburn	Holburn to Ducharme	Ducharme to Provincial
Excessive Speed If 85th percentile speed = 10km/h over Posted Limit then 10 Points Awarded. One additional point for every km/h additional to a max of 20 points.	15	15	15	15
Excessive Volume If Vehicles Per Day meets threshold for Class I Collector Road then 12 points awarded. For every 500 vehicles per day additional 2 points awarded to a maximum of 20 Points.	0	20	18	15
Bicycle Route If road has on street bicycle lanes or is a signed route award 10 points.	10	10	10	10
Collisions Collect number of accidents in past 3 years. Divide by length of street. If result = 0 then 0 Points Awarded. If Result 0 > 1 then 5 Points Awarded. If Result 1 > 3 then 10 Points Awarded. If Result 3 < then 15 Points Awarded.	15	0	15	15
Pedestrian Generators Parks = 5 Points, Elementary School = 5 Points, High School = 4 Points, University = 3 Points, Religious Building = 3 Points, Community Centre / Library = 3 Points, Neighbourhood Commercial = 3 Points. To a maximum of 15 Points.	10	10	10	10
Residential Frontage 100% = 10 Points, 90% = 9 Points … 10 % = 1 Point, 0% = 0 Points.	4	4	6	6
TOTAL SCORE	**54**	**59**	**74**	**71**
Level of Traffic Calming Warranted	2 - Horizontal	2 - Horizontal	2 - Horizontal	2 - Horizontal

TABLE 2: Traffic Calming Warrant for North Talbot Road

	North Talbot Road	
	Howard to Sixth Concession	Sixth Concession To City Limits
Excessive Speed If 85th percentile speed = 10km/h over Posted Limit then 10 Points Awarded. One additional point for every km/h additional to a max of 20 points.	12	12
Excessive Volume If Vehicles Per Day meets threshold for Class I Collector Road then 12 points awarded. For every 500 vehicles per day additional 2 points awarded to a maximum of 20 Points.	16	14
Bicycle Route If road has on street bicycle lanes or is a signed route award 10 points.	10	10
Collisions Collect number of accidents in past 3 years. Divide by length of street. If result = 0 then 0 Points Awarded. If Result 0 > 1 then 5 Points Awarded. If Result 1 > 3 then 10 Points Awarded. If Result 3 < then 15 Points Awarded.	5	0
Pedestrian Generators Parks = 5 Points, Elementary School = 5 Points, High School = 4 Points, University = 3 Points, Religious Building = 3 Points, Community Centre / Library = 3 Points, Neighbourhood Commercial = 3 Points. To a maximum of 15 Points.	10	10
Residential Frontage 100% = 10 Points, 90% = 9 Points … 10 % = 1 Point, 0% = 0 Points.	9	4
TOTAL SCORE	**62**	**50**
Level of Traffic Calming Warranted	2 - Horizontal	2 - Horizontal

According to the TAC Canadian Guide to Neighbourhood Traffic Calming, the most effective physical measures for speed reduction are:

- Vertical deflections – speed humps, raised crossings, elevated intersections, etc.
- Horizontal deflections – chicanes
- Road narrowings – curb extensions, raised medians, and lane narrowings
- Obstacles in the road – traffic circles and mini-roundabouts

The following general principles should assist in developing speed management measures for the study area roads:

- The identified issue of excessive speed on Sixth Concession Road is in a very real sense at odds with the issue of neighbourhood shortcutting. Motorist shortcut because they perceive the shortcut to result in less delay than the primary route. Hence, any measures that increase delay on the primary route (like reducing travel speed) will make shortcutting a more attractive option. The key to resolving this conflict is to manage operating speeds on the collector roads at a subconscious level (so that motorists do not perceive any change in delay). For example, lowering the speed limit to 40 km/h, or placing speed humps on Sixth Concession Road will be noticeable to motorists, and create a disincentive to use these collector roads. The measures used to manage speed must be more subtle, or the risk of shortcutting increases.

- If *point* traffic calming measures (e.g., speed humps) are to be used to manage speed along a street, then it is important to consider the spacing or density of the measures in order to maintain the speed reduction. Failure to provide an adequate spacing between measures will result in undue accelerating and decelerating between measures. The general rule is for traffic calming devices to be a maximum of 125 metres apart to maintain an operating speed of 50 km/h[3]. When moderating speed, it is preferable to have a continuous form of traffic calming to overcome the "spacing" issue.

- Speed and safety have an apparent paradoxical relationship. It is well-established that collision risk increases as speed increases. However, research also tells us that modifications to the elements of a street design that are undertaken to reduce collision risk also increase speed. For example, flattened a sharp curve will reduce collision frequency, but will also increase operating speeds. The paradox is troubling, and can lead to vehement disagreements between experienced professionals – especially concerning traffic calming where the goal is usually to moderate speeds without compromising safety.

[3] Page 3-13 of the Canadian Guide to Neighbourhood Traffic Calming, Transportation Association of Canada and the Canadian Institute of Transportation Engineers, December 1998.

Resolution of the speed-safety paradox is resolved by providing consistency in design, and accommodating driver expectations and limitations. Consistent design features result in uniform travel speeds and reduced collision risk. More importantly, any traffic calming measures that are implemented should be expected by motorists so that they can detect and react appropriately. To this end, it is ideal to provide a *gateway* to a traffic calming area as a visual cue that the nature of the road has changed. Gateways are usually placed at or near intersection or other points where motorists are already traveling more slowly – this prevents motorists from gaining speed before entering a traffic calmed area.

Recommendations for speed management:

- Place mini-roundabouts or raised intersections at the Holburn Street and Ducharme Street intersections with Sixth Concession Road.

- Place mini-roundabouts or raised intersections at the Southwood Lakes Boulevard and Centre Lake Drive intersections with North Talbot Road.

- Use a roundabout or a raised intersection at the intersection of Sixth Concession Road and North Talbot Road.

- Do not add lanes to either road beyond what is strictly necessary by municipal policy and good practice, and allow the slowest vehicle in the traffic stream to set the "pace". On a related note, the above recommendations concerning roundabout and mini-roundabout locations do not consider the traffic operations analysis conducted as part of this study. If left-turn lanes are required at some of the study intersections, the mini-roundabouts may be relocated to minimize the addition of auxiliary lanes and still achieve the speed management objective.

- Use the narrowest through lane widths possible – research shows that collision risk is relatively insensitive to lane widths between 3.0 and 3.7 metres on urban streets. A lane width of 3.25 or 3.30 metres seems appropriate for through lanes on a collector street classification.

- ***If lanes of 3.5 metres or wider are desired***, consider implementing 3.0 metre lanes, and painting a 1.0 metre wide median with hatching. This allows motorists to edge onto the median when passing cyclists and maintains a narrow lane.

- Convert the roads to an urban cross-section: A rural cross-section is ordinarily associated with posted speeds of 60 km/h to 80 km/h, whereas an urban cross-section is usually

paired with a posted speed limit of 40 km/h, 50 km/h, or 60 km/h. As a result, there is an *a priori* expectation among motorists that slower speeds are expected on streets that have raised curbs. This being the case, it is a desirable to convert the cross-section from open ditch to curb-and-gutter from a speed management perspective.

Finally, research has shown that an individual's estimation of self-speed is most strongly influenced by the "optical flow" of objects passing through the motorist's peripheral field of view. One of the ways that speeds can be subconsciously managed along both Sixth Concession Road and North Talbot Road is to plant street trees at regular intervals, and use other street furniture to add detail to the street scene.

Shortcutting from Sixth Concession Road

In conjunction with the planning for the North Roseland community, the residents of the Old Roseland neighbourhood expressed concerns over the potential for traffic to use the local streets in the Old Roseland neighbourhood as opposed to staying on the arterial street system. In response to this concern, the City implemented a series of raised islands at many of the intersections on Sixth Concession Road that effectively prohibits northbound left turns, and westbound through movements at these locations. At present, the Old Roseland community appears to be somewhat conflicted about the need and effectiveness of the islands. Some residents extol the success of the islands in mitigating shortcutting; others doubt the need for the islands and express a desire to remove the islands.

It is simply not possible to determine either the success of the islands in reducing/preventing shortcutting traffic ***or*** identify the magnitude of the shortcutting problem that would exist in the absence of the islands. The data that was collected by the City, and provided to the study team for this study, does not include any information on the volume or percentage of shortcutting traffic on the local streets. Having stated that, it is noted that City staff did investigate shortcutting before the islands were installed and concluded that shortcutting was not an issue at that time[4]. However, the development in North Roseland occurred after the islands were installed (i.e., the City was proactive). Hence, whether the islands are preventing shortcutting or whether there just isn't a demand to shortcut through the Old Roseland neighbourhood is uncertain.

The success of the islands in preventing traffic from the North Roseland community shortcutting through the Old Roseland neighbourhood is unknown and cannot be determined without

[4] "Traffic counts were undertaken in 2001 and in 2004 and the results indicate that there is no evidence of traffic shortcutting through the existing Roseland neighbourhood to access/egress homes occupied in the North Roseland development. Any action at this time to deter shortcutting traffic would be premature in the absence of any evidence." – Report to Mayor and Members of City Council RE: NORTH ROSELAND/OLD ROSELAND TRAFFIC CONCERNS, Report No. 10751, report dated August 30, 2004.

physically removing the islands and undertaking a new round of data collection. Regardless of the above, the residents have expressed a concern with shortcutting traffic and this concern is addressed below.

The primary issue facing the study team is whether the islands that were installed in 2005 should remain in the reconstructed Sixth Concession Road, or whether they should be removed. Either option impacts on the ability to shortcut in the Old Roseland neighbourhood, emergency vehicle response times, resident access, etc. There are clearly advantages and disadvantages with each option.

The only information that is available concerning the demand for shortcutting is provided by the City in their report to Council on this matter in 2004. In the staff report it is noted that an independent traffic impact study was undertaken for the North Roseland development which concluded that shortcutting through the Old Roseland neighbourhood would not be an issue. Staff preformed a critical review of the study and concurred with the conclusion. In the interim, some of the North Roseland neighbourhood has been constructed. However, since the islands were constructed before development began there is no way to determine if this conclusion that shortcutting is a *non-issue* was correct. In light of the above, the only information that the study team has on which to base a decision is the analysis and conclusions of the professionals who conducted and reviewed the initial traffic impact study[5]. This being the case, it is concluded that the raised traffic islands located at the local street intersections along Sixth Concession Road are not required and may be removed during the reconstruction.

Having stated the above, it is noted that with any shortcutting traffic issue improving traffic operations on the arterial roadway system in order to reduce undue delay is always preferable to inhibiting movements in the local street system. This is mainly because restrictions on traffic movement are nondiscriminatory, and the increased delay that is intended for through traffic also affects emergency vehicle response times, transit routes, and the convenience of travel for the neighbourhood residents. In this regard, the City of Windsor has already made strides to reduce neighbourhood shortcutting through arterial road improvements, and will continue to do so with the reconstruction of Sixth Concession Road and North Talbot Road.

It is recommended that the islands implemented by Windsor be retained until such time as Sixth Concession Road is reconstructed. The islands should be removed during the reconstruction effort, easing access for area residents and emergency services.

If shortcutting through the Old Roseland neighbourhood becomes an issue at any time after reconstruction, then it is recommended that a neighbourhood traffic calming study be undertaken

[5] It is our understanding that the North Roseland development is proceeding as per plan, and there is no reason to adjust (or doubt) the conclusions from the initial traffic impact study.

to identify the scope and magnitude of the problem, and appropriate solutions. Public participation should be an integral part of any traffic calming study.

7. CONCLUSIONS

The main objectives of this memorandum are to provide a clear problem statement for the Sixth Concession Road / North Talbot Road Municipal Class EA study area, to outline general principles that should be followed in developing traffic calming plans, and to develop an initial traffic calming plan for consideration by the study team and the interested public. Traffic calming is the act of mitigating the negative effects of motorized traffic (usually excessive speeds and high traffic volumes) through the implementation of mainly physical measures.

The parameters and constraints for this project include the functional classification and requirements of the involved streets, the recommendations of the Windsor Bicycle Use Master Plan, and the recommendations in the WALTS. Any traffic calming plans (and other modifications to the study streets) must be cognizant of, and generally consistent with these constraints and recommendations.

The transportation-related problems identified in the study area are high operating speeds on Sixth Concession Road and North Talbot Road, shortcutting traffic in the Old Roseland neighbourhood, pedestrian and cyclist safety concerns, excessive traffic volumes on Sixth Concession Road and North Talbot Road, and increased collision severity. The focus of this analysis was on travel speeds and neighbourhood shortcutting.

Under the City of Windsor ***Traffic Calming Policy for Residential Areas*** (September 2005), some form of physical traffic calming is warranted on both Sixth Concession Road and North Talbot Road, with the most severe traffic issues being on Sixth Concession Road between Holburn Street and Provincial Road. With respect to speed management, the data suggest that speed management is required along both Sixth Concession Road and North Talbot Road, except for Sixth Concession Road between Dougall Avenue and North Talbot Road. In developing solutions to the speed issue, the team should consider:

- Managing operating speeds on the collector roads at a subconscious level, so that motorists do not perceive any change in delay and exacerbate the shortcutting issue.

- It is preferable to have a continuous form of traffic calming rather than using discrete measures. If discrete or "point" measures are used, device spacing must be appropriate to minimize acceleration and deceleration between measures.

- All traffic calming measures should provide consistency in design, and accommodate driver expectations and limitations.

Recommendations for speed management:

- Place mini-roundabouts or raised intersections at the Holburn Street and Ducharme Street intersections with Sixth Concession Road, and the Southwood Lakes Boulevard and Centre Lake Drive intersections with North Talbot Road. These locations may be revised depending on the outcome of the traffic operations analysis.

- Use a roundabout or a raised intersection at the intersection of Sixth Concession Road and North Talbot Road.

- Do not add lanes to either road beyond what is strictly necessary by municipal policy and allow the slowest vehicle in the traffic stream to set the "pace".

- Use the narrowest through lane widths possible – research shows that collision risk is relatively insensitive to lane widths between 3.0 and 3.7 metres on urban streets. A 3.25 to 3.30 metre through lane width is appropriate for a collector roadway.

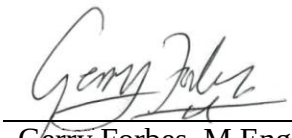
- ***If lanes of 3.5 metres or wider are desired***, consider implementing 3.0 metre lanes, and painting a 1.0 metre wide median with hatching. This allows motorists to edge onto the median when passing cyclists and maintains a narrow lane.

- Convert the roads to an urban cross-section.

- Add roadside features to increase detail in the driver's peripheral field of view.

- Review the curve warning signing on Sixth Concession Road north of North Talbot Road to ensure compliance with the recommendations of the OTM.

With respect to shortcutting in the Old Roseland neighbourhood, it is recommended that the recently-implemented intersection islands be retained until the Sixth Concession Road is reconstructed. At that time, the islands should be removed to ease access for residents and emergency services. If shortcutting in the Old Roseland neighbourhood becomes an issue after reconstruction, then the City should undertake a neighbourhood traffic calming study complete with public participation.



Gerry Forbes, M.Eng, P.Eng, PTOE
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Intus Road Safety Engineering Inc.

APPENDIX A: MATERIAL AVAILABLE FOR THE ANALYSIS

1. City of Windsor ***Traffic Calming Policy for Residential Areas*** (September 2005). 67 pages.

2. City of Windsor ***Bicycle Use Master Plan***, April 2001.

3. ***Windsor Area Long Range Transportation Study***, Section 4.0 Transportation Master Plan, August 1999, 51 pages.

4. City of Windsor ***2012 Road Safety Report***, dated May 7, 2013, Office of the City Engineer, Engineering Department, Transportation Planning Division. 48 pages.

5. Intersection Collisions for the Sixth Concession Road / North Talbot Road Municipal Class Environmental Assessment study area, From: 01/07/2008 To: 01/07/2013, author unknown, print out dated: November 19, 2013. 41 pages.

6. Midblock Collisions for the Sixth Concession Road / North Talbot Road Municipal Class Environmental Assessment study area, From: 01/07/2008 To: 01/07/2013, author unknown, print out dated: November 19, 2013. 21 pages.

7. Sixth Concession Road / North Talbot Road Municipal Class Environmental Assessment, Public Information Centre #1(February 26, 2014) Display Panels – 24 panels

8. Memorandum to Jennifer Leitzinger of the City of Windsor, from Paula Neto of Dillon Consulting Limited, dated: April 2, 2014, Re: Workshop Summary - Sixth Concession Road/North Talbot Road Class EA, 3 pages.

9. Ontario Traffic Manual and other technical documents that may be cited in this memorandum.