Appendix A

Transportation and Safety Assessment Report

PARSONS

TRANSPORTATION & SAFETY ASSESSMENT REPORT

Environmental Assessment Study for Ken Whillans Drive Extension (South of Church Street)

September 2022

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1	September 2021	Draft for Review
2	October 2021	Revised Draft
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1 Introduction

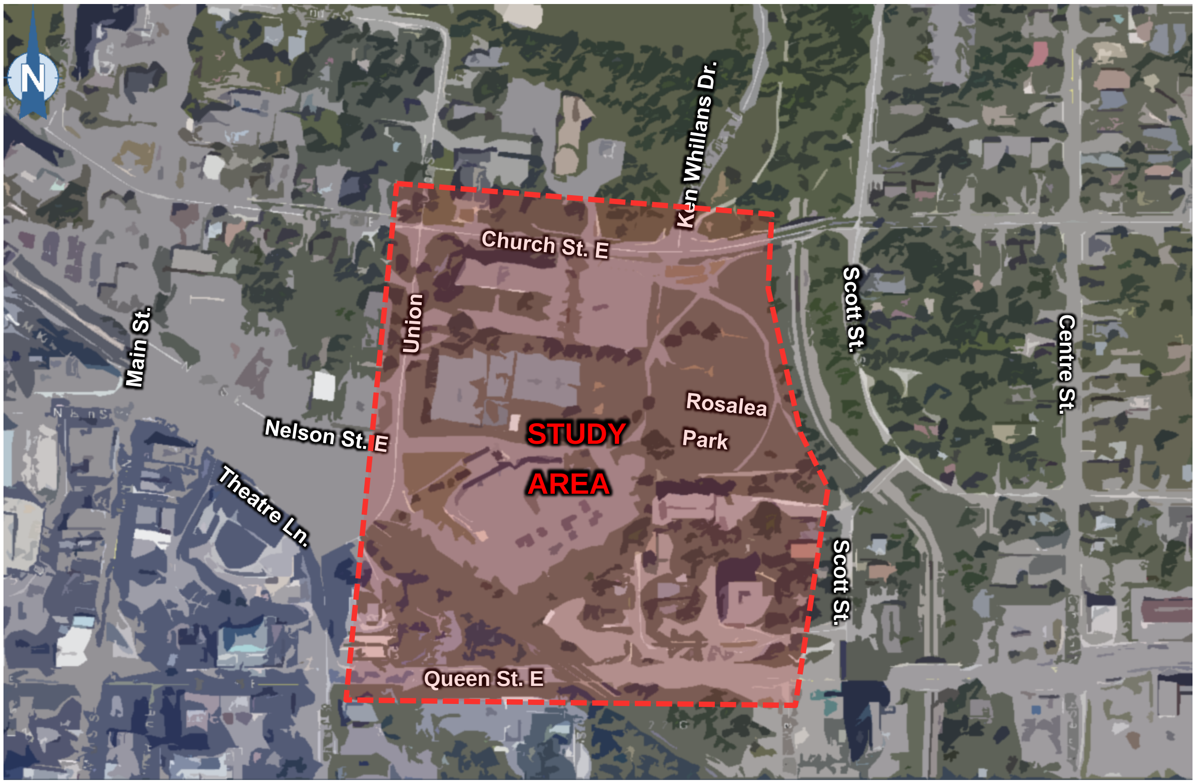
1.1 Overview

The City of Brampton (the City) has retained Parsons Inc. to conduct Ken Whillans Drive Extension MCEA (the MCEA) study. The extension is proposed to the south of Church Street. The proposed extension will support the envisioned redevelopment of Rosalea Park, development of innovation district and Rosalea Plaza as well as add to the revitalization of the Downtown Brampton, by:

- Providing improved and direct accessibility from the Downtown core and the transit terminal thus supporting future use of Rosalea Park and Rosalea Plaza as a major urban amenity space as well as acting as Downtown gateway.
- Creating a safer and more comfortable multi-modal environment for accessing not only the Rosalea Park amenities and other landmarks in the area including YMCA and Tennis Club, but also connecting to the wider network of the Riverwalk parks and open spaces.
- Providing a vibrant public realm that creates a unique character for the City's Downtown open space system.
- Leveraging other public and private initiatives such as future innovation district and university envisaged on the lands to the west of Rosalea Park.
- Accommodating and encouraging sustainable development.

The Transportation and Safety Assessment Report is a supporting technical report for the MCEA. The MCEA study area is presented in **Figure 1-1**.

FIGURE 1-1: STUDY AREA



1.2 Planning Context

The City has established a planning vision and conducted various studies and plans that support revitalization of the Downtown Brampton and Etobicoke Creek area. Such initiatives amongst others include the Brampton Vision 2040, the Downtown Etobicoke Creek Revitalization / Riverwalk Area Feasibility Studies, the Downtown Brampton Flood Protection Environmental Assessment (DBFP EA), the Riverwalk Area Urban Design Master Plan (UDMP) studies. The UDMP builds upon the DBFP EA provisions with the overall goal to produce an open space and public realm master plan for the Etobicoke Creek valley. The UDMP envisions Rosalea Park as a major attraction for the city and revitalization stimulus for the downtown area. The proposed redevelopment includes Rosalea Park as a flexible, major use amenity for major events, open air theaters and gathering space for show, and the planned innovation district as well as Rosalea Plaza on lands to the west of Rosalea Park

1.3 Study Objectives

The study objectives of this transportation assessment include:

- Review the existing (2021) transportation infrastructure conditions within the study area to establish the transportation context for the study.
- Perform transportation network analysis to determine a Ken Whillans Drive extension scenario that most closely aligns with and complements the planning context of the study area. The analysis to be based on the city's EMME demand model outputs for 2031 and 2041 horizons implementing the various potential extension scenarios in the model.
- Develop traffic forecasts for 2031 and 2041 horizons for Do-Nothing and preferred extension scenarios. The forecasts to be based on the corridor annual growth rates determined by comparing 2031 and 2041 EMME projections with the respective corridor volumes in the Base 2011 EMME model. Apply growth rates to the existing 2021 traffic data to estimate 2031 and 2041 traffic forecasts.
- Conduct traffic operations assessment and multi-modal level of service (MMLOS) analysis for pedestrians and bicyclists for the future Do-Nothing and the preferred extension scenarios to identify deficiencies in the study area transportation network and recommend mitigation measures.
- Conduct road safety performance assessment based on collision history and undertake a safety impact assessment of the extension scenarios.
- Evaluate various street types in terms of their ability to support the envisioned characterization of Rosalea Park and the allied facilities in UDMP as described in Section 1.2 above. Recommend a preferred street type and its functional components to inform subsequent preliminary design process.

1.4 Assumptions and Analysis Methodologies

1.4.1 ANALYSIS HORIZON AND TIME PERIOD

The analysis has been conducted for 2021 existing traffic conditions and 2031 and 2041 future traffic conditions as specified by the city in RFP. Existing traffic data has been collected for the AM and PM peak periods and the analysis has been completed for the respective peak periods. Future traffic demand was estimated by applying growth rates determined from the city's EMME model forecasts for 2031 and 2041 horizons. The model was run by the city and outputs were provided to Parsons.

1.4.2 INTERSECTION OPERATION ANALYSIS – CAPACITY AND LOS

Intersection operations have been analyzed using the procedures of the Highway Capacity Manual (HCM) methodologies for signalized and unsignalized intersections, as implemented in the Synchro / SimTraffic 10 software developed by Trafficware.

Level of Service (LOS) can be characterized for each intersection approach and each lane group. Control delay and volume-to-capacity (V/C) ratio are used to characterize LOS for a lane group. Control delay alone is used to characterize LOS for the entire intersection or an approach. Delay quantifies the variations in travel time due to traffic signal control. It is also a surrogate measure of driver discomfort and fuel consumption. The volume-to-capacity (V/C) ratio quantifies the degree to which the capacity of each signal phase is utilized by a defined lane group. **Table 1-1** summarizes the characteristics of each level of service at signalized intersections.

TABLE 1-1. SIGNALIZED INTERSECTION LEVEL OF SERVICE CHARACTERISTICS

Level Service	Features	Control delay (sec/veh)
A	Describes operations with very low control delay, up to 10 seconds / vehicle. This level of service occurs when progression is extremely favorable, and most vehicles arrive during the green phase. Most vehicles do not stop at all at this LOS. Short cycle lengths may also contribute to low delay.	≤ 10
B	Describes operations with control delay greater than 10 seconds and up to 20 seconds /vehicle. This level generally occurs with good progression, short cycle lengths, or both. More vehicles stop at this level than at LOS A, causing longer average delays.	> 10 to 20
C	Describes operations with control delay greater than 20 seconds and up to 35 seconds/vehicle. These higher delays may result from fair progression, longer cycle lengths, or both. Individual cycle failures may begin to appear at this level. The number of vehicles stopping is significant, though many still pass through the intersection without stopping.	> 20 to 35
D	Describes operations with control delay greater than 35 seconds and up to 55 seconds/vehicle. At level D, the influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavourable progression, long cycle lengths, or high V/C ratios. Many vehicles stop, and the proportion of vehicles not stopping declines. Individual cycle failures become noticeable.	> 35 to 55
E	Describes operations with control delay greater than 55 seconds and up to 80 seconds/vehicle. This level is considered by many agencies to be the limit of acceptable delay. These high delay values generally indicate poor progression, long cycle lengths, and high V/C ratios. Individual cycle failures are frequent occurrences.	> 55 to 80
F	LOS F describes operations with control delay in excess of 80 seconds/vehicle. This oversaturation, considered to be unacceptable to most drivers, occurs when arrival flow rates exceed the design capacity of the intersection. It may also occur at high V/C ratios below 1.0 with many individual cycle failures. Poor progression and long cycle lengths may also be major contributing factors to such high delay levels.	> 80

Source: Highway Capacity Manual (HCM) 2000

The LOS criteria for unsignalized intersections are somewhat different from the criteria for signalized intersections because the perceptions of facility users differ. The expectation is that a signalized intersection is designed to carry higher traffic volumes and will present greater delay than an unsignalized intersection. Unsignalized intersections are also associated with more uncertainty for users, as delays are less predictable than at signalized junctions. This uncertainty can reduce driver's delay tolerance. **Table 1-2** summarizes the characteristics of each level of service at unsignalized intersections.

TABLE 1-2. UNSIGNALIZED INTERSECTION LEVEL OF SERVICE CHARACTERISTICS

Level of Service	Expected Delay to Minor Street Traffic	Average Control Delay 'd' (sec/veh)
A	Little or no delays	0 ≤ 10

Level of Service	Expected Delay to Minor Street Traffic	Average Control Delay ‘d’ (sec/veh)
B	Short traffic delays	10 ≤ 15
C	Average traffic delays	15 ≤ 25
D	Long traffic delays	25 ≤ 35
E	Very long traffic delays	35 ≤ 50
F	Extreme delays with queuing which may cause congestion affecting other traffic movements in the intersection	> 50

Source: Highway Capacity Manual (HCM) 2000

The following parameters specified in the City’s Traffic Impact and Parking Study Terms of Reference 2019 (the TIS Guidelines) have been used in Synchro/SimTraffic:

- Saturation flow rate of 1,900 vehicles per hour per lane
- 3.7 m lane width on Regional roads
- 3.5 m lane width on the city’s roadways

The following has been identified for the signalized and unsignalized intersections in accordance with the TIS Guidelines:

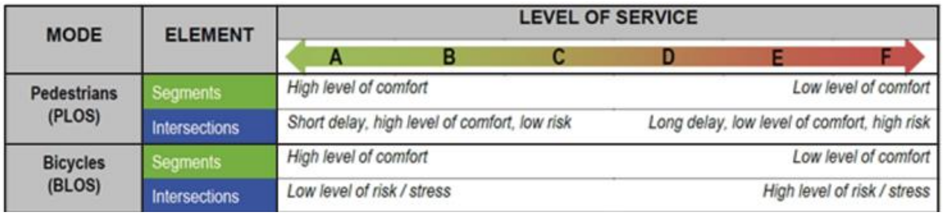
- Volume/Capacity (V/C) ratios for overall intersection operations, through movements or shared through/turning movements increased to 0.90 or above.
- V/C ratios for exclusive movements exceeding 1.00
- 95th percentile queue lengths for individual movements exceeding the existing storage capacity

As required by the TIS Guidelines V/C ratios have been reported from Synchro analysis while delays and queue lengths have been reported from SimTraffic analysis.

1.4.3 MULTI-MODAL LEVEL OF SERVICE (MMLOS)

Pedestrian LOS (PLOS) and Bicycle LOS (BLOS) for the street segments and intersections has been determined utilizing the City of Ottawa’s MMLOS methodology. The methodology determines the LOS for signalized intersections only while unsignalized intersections are included within the street segments. A level of service is represented by a letter value based on the inputs provided for each mode. An overview of the different LOS for pedestrian and bicycle modes is shown in **Figure 1-2** below. The figure has been sourced from the City of Ottawa’s MMLOS methodology.

FIGURE 1-2: CITY OF OTTAWA – MMLOS RANKING SCALES



MODE	ELEMENT	LEVEL OF SERVICE	
		A B C D E F	
Pedestrians (PLOS)	Segments	*High level of comfort*	*Low level of comfort*
	Intersections	*Short delay, high level of comfort, low risk*	*Long delay, low level of comfort, high risk*
Bicycles (BLOS)	Segments	*High level of comfort*	*Low level of comfort*
	Intersections	*Low level of risk / stress*	*High level of risk / stress*

The following provides a brief description of the PLOS and BLOS analysis methodology. Detailed methodology is included in **Appendix A**.

1.4.3.1 Pedestrian LOS

Level of service along segments is determined based on the Pedestrian Exposure to Traffic (PETSI) and crowding on sidewalks. Exposure to traffic is influenced by factors such as sidewalk widths, boulevard widths, roadway operating speeds and average daily traffic on curb lane. Crowding LOS is based on sidewalk widths and pedestrian/hour volume. Overall PLOS is measured by selecting the worst condition as the final score. The overall PLOS of a street is the PLOS of the segment with the lowest PLOS. For detailed methodology see **Appendix A**.

Pedestrian Level of Service at intersections is measured by considering both the Pedestrian Exposure to Traffic (PETSI) and Pedestrian Crossing delay. PETSI is dependent on physical conditions such as number of lanes to be crossed, medians, presence of refuge islands, corner radii, crosswalk treatments and signal phasing and timing design features. Crossing delay is calculated from the traffic cycle length and effective walk time. Detailed methodology is presented in **Appendix A**. Overall Pedestrian Level of service is measured by selecting the worst condition as the final score, either PETSI score or delay score.

1.4.3.2 Bicycle LOS

Factors which influence bicycle level of service at intersections include facility type on approaches and requirements to turn left and right (number of lanes crossed and operating speeds). Level of service along segments are influenced by facility type and operating speeds. Intersections which provide protected designs for turning cyclists (e.g. channels or bike boxes) and separated cycling facilities along roadway segments typically result in higher levels of bicycle service. The ranking scales for BLOS for intersections and segments are provided in **Appendix A**.

2 Existing Conditions

2.1 Active Transportation Network

Existing cycling facilities in the study area consist of a signed route (green colour) along Union Street and Church Street as shown in **Figure 2-1**. This route connects the recreational trail (blue colour) along Etobicoke Creek at Mary Street in the south and at Ken Whillans Drive in the north. The City's Cycling Map defines a signed route as a as quiet residential street preferred for bicycling. As such cyclist must be in a mix traffic without any dedicated or priority facility.

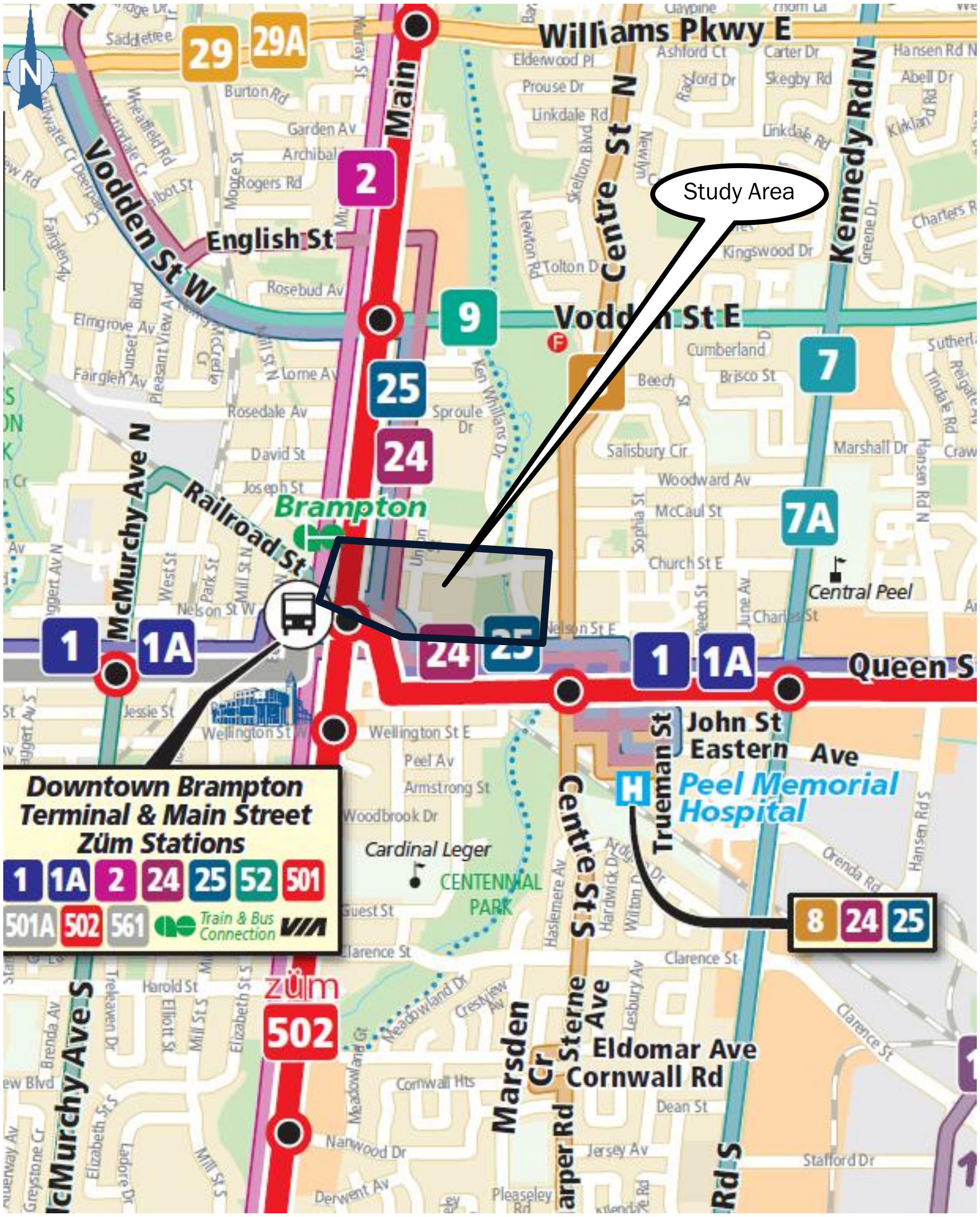
All streets within the study area have sidewalks on both sides except Nelson Street East where the sidewalk exists on south side only which is directly adjacent to traffic. Likewise, sidewalk is only available to the south side of Theatre Lane directly adjacent to traffic. The sidewalks along Union Street to the north of Nelson Street East are adjacent to traffic as well. All other streets within the study area have sidewalks with good separation from traffic lanes in form of concrete or grass boulevard.

FIGURE 2-1: EXISTING BIKE FACILITIES *(SOURCE: BRAMPTONS'S CYCLING MAP)*

2.2 Transit Network

The existing transit network serving the study area is shown in **Figure 2-2**. The Figure has been sources from Brampton Transit (BT) System Map November 2020, downloaded in September 2021. The BT consists of regular bus routes as well express bus routes named as Zum Bus on Mian Street and Queen Street. The Zum buses operate in mixed traffic with transit priority signals at major intersections on these corridors. The Zum buses operate with 10-12 minutes frequency during peak times and 15-30 minutes frequency during off-peak times. Regular buses operate with less than 30 minutes frequency during peak times while 30–60-minute frequency during off-peak times.

FIGURE 2-2: EXISTING TRANST NETWORK



The Downtown Brampton Terminal connects BT with the regional GO train and bus service. The Brampton GO Station is served by Kitchener GO rail route with Toronto bound trains during the AM peak periods and Kitchener bound trains during the PM peak periods. With the implementation of GO Regional Express Rail service the route will have two-way all-day service with 15-minute frequency. It is noted no transit service currently available along Union Street and Church Street.

2.3 Road Network

Ken Whillans Drive

Ken Whillans Drive is a city's two-lane north-south local road serving primarily residential and institutional land uses. It connects Vodden Street to Church Street parallel to the Etobicoke Creek. In the absence of a posted speed sign, it is assumed to operate at a speed of 50 km/h.

Main Street

Main Street between Church Street and Queen Street is currently a city'snorth-south four-lane arterial roadway with an urban cross-section and speed limit of 50 km/hr. Between Queen Street and Nelson Street/Theatre Lane, two of the lanes are used for street parking, and thus there are effectively a single traffic lane in each direction. From Nelston Street/Theatre Lane to Queen Street, there are stopping and parking restrictions between 6:00 AM and 9:00 AM in the southbound curb lane. There are no auxiliary turning lanes at any intersection along this section of Main Street, and left turns are prohibited in all directions at Queen Street. Immediately south of Nelson Street/Theatre Lane, there is an overpass hosting a bi-directional rail track.

Church Street

Church Street is a city'stwo-lane east-west collector road with a posted speed limit of 40 km/hr primarily serving residential land use. Church Street at Main Street and Centre Street are signalized intersections, while the intersections between are stop-controlled.

Nelson Street East

Nelson Street East is a city's two-lane east-west local road with a posted speed limit of 40 km/h, serving primarily commercial land use. Within the study area, the west leg of Nelson Street East connects Union Street to Main Street .

Theatre Lane

Theatre Lane is a city's City of Brampton local road serving commercial establishments connecting Main Street and Queen Street via Union Street. Theatre Lane has a two-lane cross section with a posted speed limit of 40 km/h.

Union Street

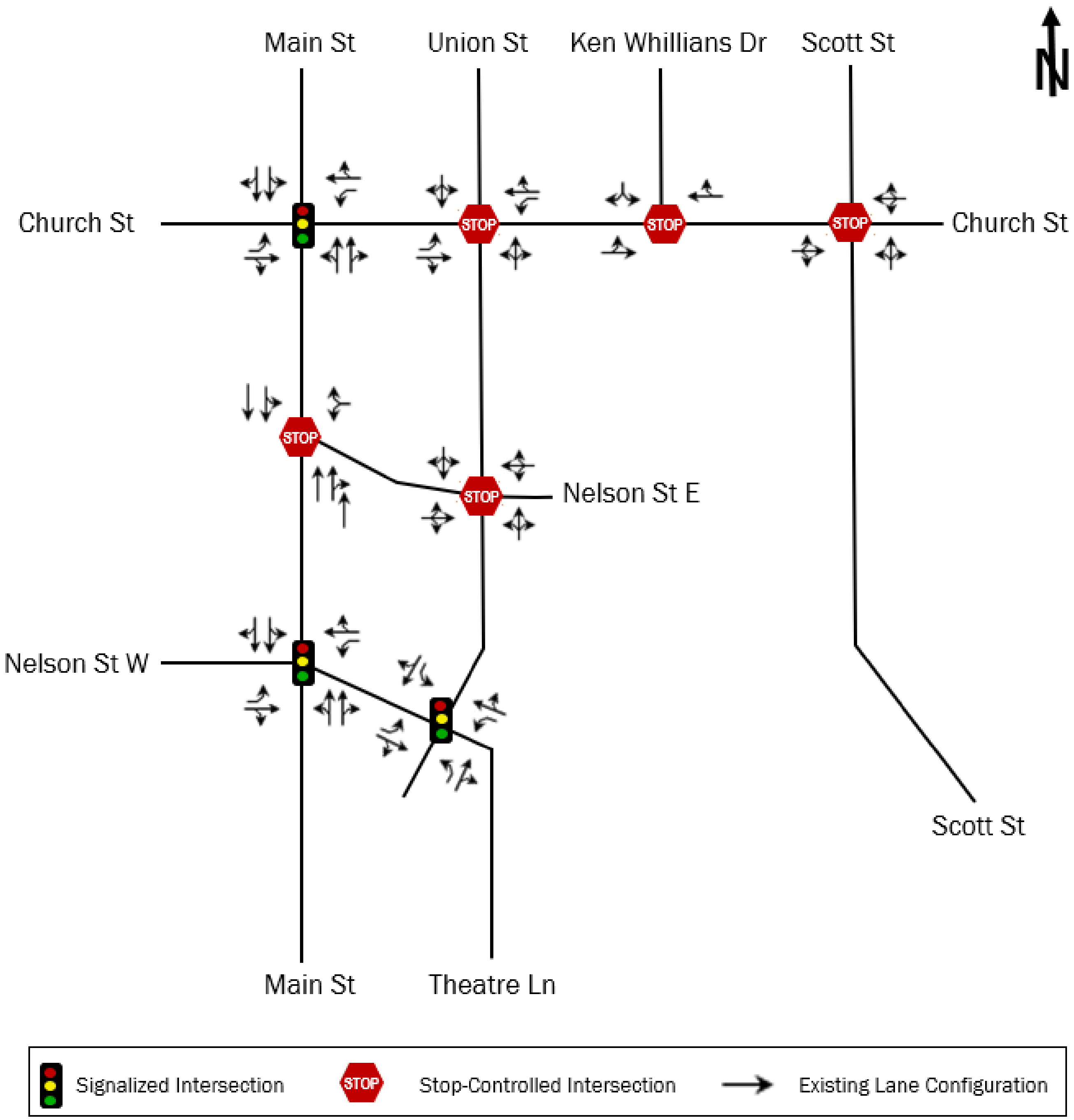
Union Street is a two-lane north-south local road with a posted speed limit of 40 km/h. Union Street primarily serves a mix of residential and institutional land uses.

Scott Street

Scott Street is a single-lane north south local road with a speed limit of 40 km/h. North of Church Street, Scott Street is a one-way street with traffic flowing northbound. South of Church Street, Scott Street operates with one lane for each direction.

The existing lane configurations and traffic are presented in **Figure 2-3**.

FIGURE 2-3: EXISTING LANE CONFIGURATIONS



2.4 Traffic Data

Traffic counts were conducted at in March 2021 for the intersections within the study area. Due to the Covid-19 pandemic, traffic demand on roads in 2021 was low and did not represent the normal peak conditions. The City has determined through traffic count studies that traffic volumes are generally 20% lower than the pre-pandemic conditions, therefore any traffic counts conducted during the current pandemic should be increased by 20% before using in analyses. Accordingly, the collected TMCs were increased by 20%. After increasing volumes by 20%, any movement with volumes that are still higher in available historic City of Brampton counts are increased to match those counts. Intersections along with the count dates and the source are listed in **Table 2-1**. Signal timing plans for the signalized intersections were provided by the City of Brampton. The TMCs and signal timing plans are included in **Appendix B**.

Turning movement diagrams showing existing raw volumes and existing (2021) balanced (approximately) volumes are provided in **Appendix B**.

TABLE 2-1. INTERSECTION TURNING MOVEMENT COUNTS – COUNT DATES AND SOURCES

Intersection	Source	Count date
Signalized Intersections		
Main Street and Church Street	City of Brampton Parsons	June 28, 2018 March 24, 2021
Main Street and Nelson Street West/Theatre Lane	Parsons	March 24, 2021
Union Street and Theatre Lane	Parsons	March 24, 2021
Unsignalized Intersections		
Scott Street and Church Street	City of Brampton Parsons	January 12, 2016 March 24, 2021
Main Street and Nelson Street	Parsons	March 24, 2021
Ken Whillians Drive and Church Street	Parsons	March 24, 2021
Union Street and Church Street	Parsons	March 24, 2021
Union Street and Nelson Street East	Parsons	March 24, 2021

2.5 Intersection Operation Analysis

2.5.1 SIGNALIZED INTERSECTIONS

A summary of the Synchro results for the signalized intersection operations is presented in **Table 2-2.** Detailed Synchro reports are provided in **Appendix C.**

The v/c ratio is based on Synchro analysis while delay, LOS and queues are reported from SimTraffic analysis in accordance with the City of Brampton's TIS and Parking Study Terms of Reference. SimTraffic results are based off of a five-run simulation, of which each run consists of a one-hour simulation and a 30-minute seeding period. The movements with LOS 'F" and queues exceeding existing storage length or the link length are identified in red font.

Under existing conditions, the three signalized intersections in the study area perform well within capacity and acceptable LOS. During the PM peak hour, the northbound left shared with through movement at the Main Street & Church Street intersection is shown to have LOS 'F" with queue exceeding the link length. The northbound left shared with through and southbound through movements at Main Street & Theatre Lane intersection are also forecast to exceed the link length during the PM peak hour. All other queues are contained within the available storage space.

TABLE 2-2. SIGNALIZED INTERSECTION CAPACITY ANALYSIS – EXISTING (2021) CONDITIONS

Intersection	AM Peak Hour									PM Peak Hour								
	Overall			Critical Movements						Overall			Critical Movements					
	V/C	Delay (s)	LOS	Dir	V/C	Delay (s)	LOS	Queue (m)		V/C	Delay (s)	LOS	Dir	V/C	Delay (s)	LOS	Queue (m)	
								Avg	95th								Avg	95th
Main Street & Church Street	0.41	9	A	EBL	0.13	13	B	5	13	0.65	34	C	EBL	0.22	12	B	8	17
				EBTR	0.22	9	B	8	17				EBTR	0.24	10	B	11	22
				WBL	0.10	17	B	4	12				WBL	0.16	17	B	7	16
				WBTR	0.26	12	B	9	19				WBTR	0.61	13	B	20	33
				NBLT	0.34	19	B	19	34				NBLT	0.75	135	F	74	112
				NBTR		9	A	15	28				NBTR		51	D	73	112
				SBLT	0.52	10	B	20	25				SBLT	0.62	35	C	22	28
				SBTR		10	B	18	26				SBTR		26	C	22	28
Main Street & Nelson Street W/Theatre Lane	0.35	13	B	EBL	0.27	33	C	13	30	0.61	37	D	EBL	0.51	30	C	23	40
				EBTR	0.28	30	C	21	43				EBTR	0.21	26	C	25	54
				WBL	0.05	46	D	1	6				WBL	0.10	43	D	9	34
				WBTR	0.25	34	C	10	24				WBTR	0.77	45	D	46	81
				NBLT	0.18	16	B	22	41				NBLT	0.45	65	E	92	162
				NBTR		10	B	6	21				NBTR		47	D	41	65
				SBLT	0.36	13	B	22	34				SBLT	0.55	43	D	33	40
				SBTR		9	A	20	33				SBTR		29	C	34	46
Union Street & Theatre Lane	0.30	8	A	EBL	0.03	12	B	2	10	0.55	9	A	EBL	0.09	15	B	3	13
				EBTR	0.32	9	A	13	33				EBTR	0.28	8	A	12	31
				WBL	0.05	9	A	3	9				WBL	0.01	11	B	1	7
				WBTR	0.22	7	A	10	21				WBTR	0.74	9	A	23	45
				NBL	-	-	-	-	-				NBL	0.01	12	B	0	2
				NBTR	0.01	4.2	A	1	3				NBTR	0.05	15	B	3	8
				SBL	0.27	12	B	9	19				SBL	0.30	16	B	11	19
				SBTR	0.04	11	B	3	9				SBTR	0.02	5	A	4	12

2.5.2 UNSIGNALIZED INTERSECTIONS

All unsignalized intersections are operating acceptably with sufficient residual capacity. As such no operational concern is noted except the westbound approach at the Main Street & Nelson Street East intersection showing LOS 'F" during the PM peak hour. The southbound approach queue at this intersection exceeds the available link length as well during the PM peak hour. Synchro results are summarized in **Table 2-3**. Like the signalized intersections, the 95th queue is reported from SimTraffic analysis. Detailed Synchro reports are provided in **Appendix C.**

TABLE 2-3: UNSIGNALIZED INTERSECTION CAPACITY ANALYSIS – EXISTING (2021) CONDITIONS

Intersection	AM Peak Hour					PM Peak Hour				
	Dir	Delay (s)	95th Queue	V/C	LOS	Dir	Delay (s)	95th Queue	V/C	LOS
Scott Street & Church Street	EBLTR	4	4	0.01	A	EBLTR	7	17	0.06	A
	WBLTR	3	7	0.01	A	WBLTR	4	9	0.00	A
	NBLTR	7	7	0.04	A	NBLTR	11	10	0.19	B

Intersection	AM Peak Hour					PM Peak Hour				
	Dir	Delay (s)	95th Queue	V/C	LOS	Dir	Delay (s)	95th Queue	V/C	LOS
Ken Whillians Drive & Church Street	EBLT	9	17	0.25	A	EBLT	9	23	0.45	A
	WBTR	6	16	0.19	A	WBTR	8	28	0.53	A
	SBLR	5	12	0.13	A	SBLR	5	12	0.11	A
Union Street & Church Street	EBL	5	3	0.0	A	EBL	8	3	0.00	A
	EBTR	8	16	0.20	A	EBTR	9	21	0.30	A
	WBL	6	14	0.08	A	WBL	8	14	0.10	B
	WBTR	8	14	0.16	A	WBTR	9	17	0.49	A
	NBLTR	4	14	0.07	A	NBLTR	6	16	0.19	A
	SBLTR	5	12	0.03	A	SBLTR	5	14	0.07	A
Main Street & Nelson Street	WBLR	12	5	0.02	B	WBLR	63	7	0.03	F
	NBT	1	2	0.17	A	NBT	7	36	0.37	A
	NBTR	1	4	0.09	A	NBTR	3	36	0.19	A
	SBLT	6	25	0.02	A	SBLT	25	93	0.03	C
	SBT	4	20	0.25	A	SBT	17	38	0.21	C
Union Street & Nelson Street E	EBLTR	5	11	0.03	A	EBLTR	6	13	0.04	A
	WBLTR	0	2	0.00	A	WBLTR	3	3	0.00	A
	NBLTR	2	3	0.01	A	NBLTR	2	2	0.01	A
	SBLTR	2	3	0.01	A	SBLTR	2	2	0.00	A

2.6 Bicycle LOS

Bicycle LOS was determined for Church Street, Union Street, Nelson Street East and Ken Whillans Drive segments within the study area as directly connecting to the potential Ken Whillans extension. The LOS is summarized in **Table 2-4**. It is highlighted that BLOS does not depend on traffic and bicycle volumes rather it is established based on type of cycling facility, geometrics, and operating speed (see Section 1.4.3 for details). As discussed in Section 2.1 no dedicated cycling facilities exist and therefore bikes must operate in mixed traffic conditions. Also, the lane configurations of the above-mentioned roads are similar and fall within the same BLOS thresholds and therefore the BLOS for all these roads are same as LOS “D”. Detailed BLOS calculations are provided in **Appendix D**.

Ken Whillans Drive has physically separated multi-use path therefore its BLOS is ‘A”.

TABLE 2-4: EXISTING (2021) BLOS

Street and Segments	Bicycle Level of Service	
Church St.	**Eastbound**	**Westbound**
Overall BLOS	D	D
Main St. to Union St	D	D
Union St. to Ken Whillans Dr.	D	D
Ken Whillans Dr. to Scott St.	D	D
Union St.	**Northbound**	**Southbound**
Overall BLOS	D	D

Street and Segments	Bicycle Level of Service	
Theatre Ln. to Nelson St. E	D	D
Nelson St. E to Church St	D	D
Nelson St. E.	**Eastbound**	**Westbound**
Overall BLOS	D	D
Main St. to Union St.	D	D
Ken Whillans Dr. (Immediately North of Church St.)	**Northbound**	**Southbound**
Overall BLOS	A	A

2.7 Pedestrian LOS

Like BLOS, the pedestrian LOS (PLOS) was also determined for Church Street, Union Street, Nelson Street E and Ken Whillans Drive segments within the study area as directly connecting to the potential Ken Whillans extension and is summarized in **Table 2-5**. Detailed PLOS calculations are provided in **Appendix D**. As explained in Section 1.4.3 the PLOS depends upon exposure to traffic and pedestrian volume on sidewalks. Exposure to traffic mainly depends on the average daily curb lane traffic volume (less than 3000 or greater than 3000) and the boulevard separation.

From review of the traffic data discussed in Section 2.4, the average daily curb lane traffic is less than 3000. The boulevard separation varies from less than 0.5 m to 2 m. The locations where the sidewalks are adjacent to the traffic lane a boulevard width of less than 0.5 m is applicable as well. For detailed PLOS calculations, please see **Appendix D**.

The lowest threshold for pedestrian volume considered in the calculations is 250 ped/h. From review of the TMCs discussed in Section 2.4 and attached as **Appendix B**, the pedestrian volume is less than 250 ped/h on all the sidewalks.

TABLE 2-5: EXISTING (2021) PLOS

Street and Segments	Pedestrian Level of Service	
Church St.	**Eastbound**	**Westbound**
Overall PLOS	E	E
Main St. to Union St	E	E
Union St. to Ken Whillans Dr.	E	C
Ken Whillans Dr. to Scott St.	C	E
Union St.	**Northbound**	**Southbound**
Overall PLOS	E	E
Theatre Ln. to Nelson St. E	E	E
Nelson St. E to Church St	E	E
Nelson St. E.	**Eastbound**	**Westbound**
Overall PLOS	E	F
Main St. to Union St.	E	No Sidewalk Exists

3 Future 2031 & 2041 Conditions

3.1 Future Planning Initiatives

3.1.1 RIVERWALK URBAN DESIGN MASTER PLAN (UDMP)

The City of Brampton is currently undertaking Riverwalk Urban Design Master Plan (UDMP) study to redefine and re-integrate the Etobicoke Creek into Brampton's urban fabric. The goal of UDMP is to produce an open space and public realm mater plan for the Etobicoke Creek valley. Rosalea Park is one of the five (5) character areas identified by the study. Rosalea Park will be developed as a flexible, major use amenity for major events, open air theatres and gathering spaces for show. The current Tennis Club lands along with the privately owned land to the west of the park are envisaged to be developed as innovation district and Rosalea Plaza with patios, fountains, planters, and public art.

UDMP supports developing the proposed Ken Whillans extension as a new connection to Downtown Brampton. To improve the connection between Rosalea Park and Garden Square, UDMP identifies Union and Nelson Streets as pedestrian priority streets as well. UDMP further proposes Ken Whillans extension to be a complete and pedestrian priority street with enhanced paving materials, bollards and rolled curbs to provide a seamless extension of the Rosalea Park and Plaza that can be closed to vehicular traffic during community events.

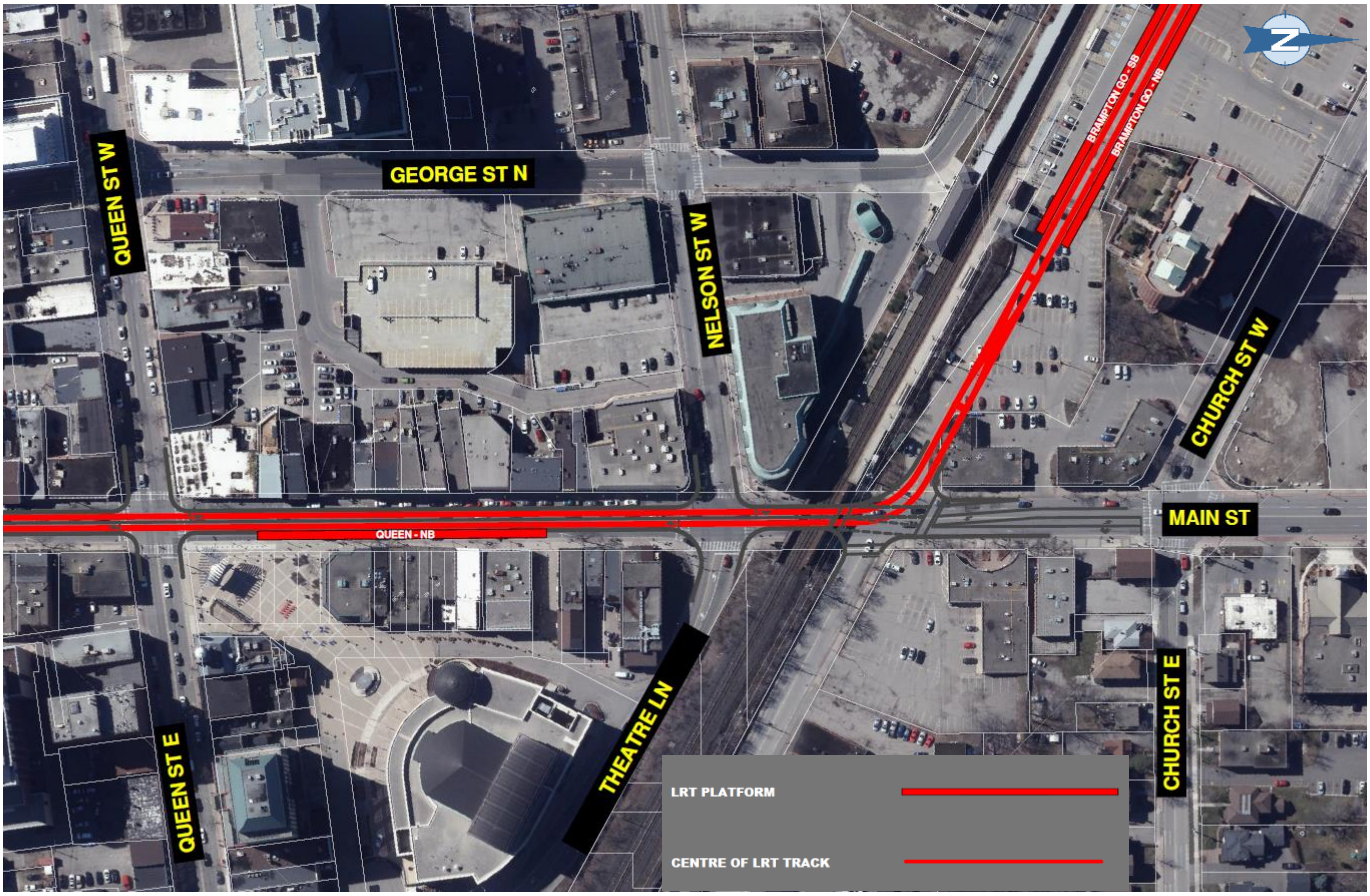
3.1.2 TRANSIT DEVELOPMENTS

To support and achieve the projected transit ridership growth, various transit projects have been identified in the City's Transportation Master Plan completed in 2015. The transit projects withing the study area include:

- **Main Street LRT**: The Hurontario Street LRT project is proposed to be extended on Main Street from Steeles Avenue to Brampton Downtown Bus terminal and GO station. The City is conducting an EA and the project is at the stage where preferred options have been chosen. The City is taking two preferred options (the surface and tunnel preferred option) to the 30 % preliminary design stage. The City has provided a copy of the roll plan for the preferred surface option shown to the public at the project's April 22 to May 13, 2021 Virtual Public Information Centre. The surface option will have LRT in shared lanes from Wellington Street to Nelson Street and therefore the Main Street segment from Queen Street to Nelson Street West in the study area, as shown in **Figure 3-1**, will be a reduced from two lanes per direction to a single shared lane per direction. The same lane configuration has been assumed for the analysis of the future traffic conditions.
- **Queen Street BRT**: The City of Brampton in partnership with Metrolinx is advancing BRT project along the Queen Street-Highway 7 corridor. Metrolinx has completed Initial Business Case and next steps include developing the scope for the Preliminary Design Business Case. The stop at the intersection of Queen Street and Center Street has been identified as a Major Transit Station Area (MTSA) in Brampton Queen Street Corridor MTSA Study (2019).

In addition to the initiative described above, Metrolinx is currently undertaking an expansion of GO service through GO Regional Express Rail (RER) project. GO RER program is envisioned to be the backbone of an integrated regional rapid transit network connecting subways, light rail transit and bus rapid transit across the Region. The RER project is planned to be completed by 2025. The Brampton GO station is on Kitchener GO line which is at a walking distance from Rosalea Park. Under the RER program the Kitchener GO line is programmed for 15 minutes or better service in both directions.

FIGURE 3-1: MAIN STREET LRT – SURFACE PREFERRED OPTION *(SOURCE: PROVIDED BY THE CITY)*



3.2 Projected Growth

The City's Travel Demand Model (the model) reflects planned population and employed growth impact on the traffic demand. Therefore, the projected traffic growth for the study area was estimated by comparing 2031 and 2041 corridor volumes with those of the base 2011 model. The city provided the auto mode EMME plots of the base 2011 year and the future 2031 and 2041 horizons for Do Nothing (DN) scenarios without the Ken Whillans Drive extension implemented. Before modelling the future scenarios, the existing model network was reviewed, and minor refinements were made to accurately represent the study area network within the model. The EMME plots are included in **Appendix E**.

The model projects 30-31% traffic growth in the study area for 2031 over 2011 traffic volumes. The traffic projection is 31-33% for 2041 over 2011. Therefore, the traffic growth is not significant from 2031 to 2041 horizons.

At corridor level the compound annual growth rate (CAGR) is presented in **Table 3-1**. Comparison of 2011, 2031 and 2041 corridor volumes are presented in **Figure 3-2** through **Figure 3-6.**

Main Street has been projected to show negative growth. This is attributed to the planned Main Street LRT project along Main Street. Both Centre Street and Church Street are forecast to experience significantly higher demand which is caused by the traffic shifting from Main Street to Centre Street and using Church Street to access Brampton GO station and LRT station. Ken Whillans Drive also shows similar high traffic growth.

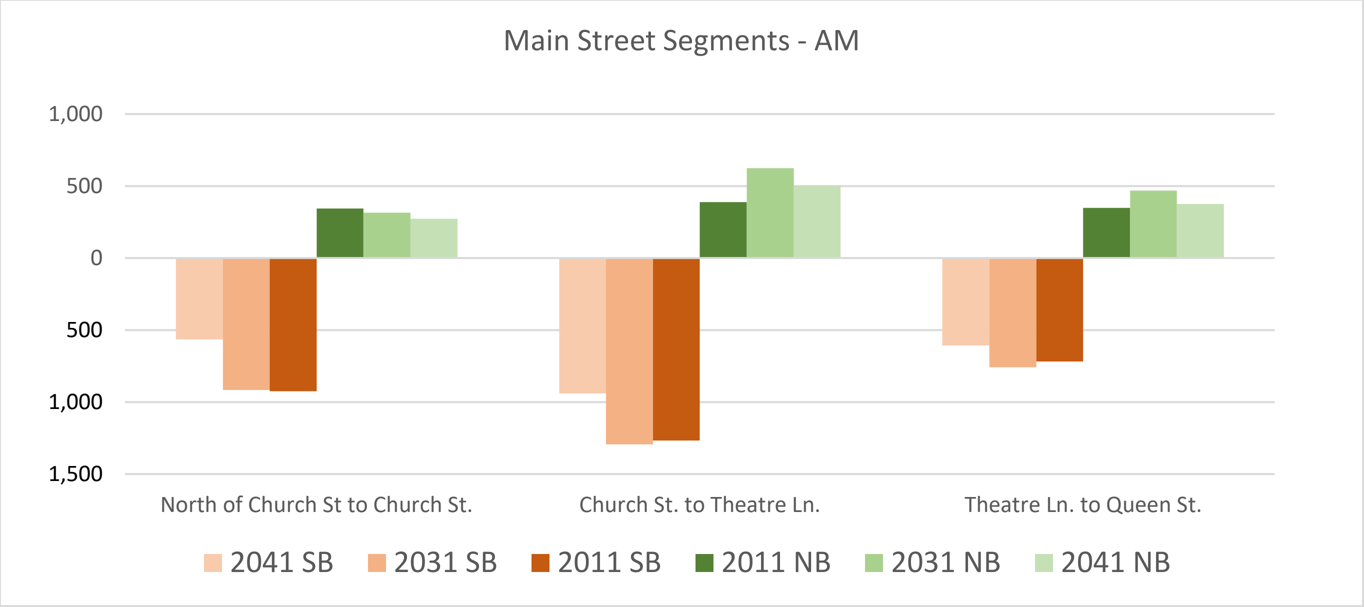
Queen Street shows moderate growth up to 2031 and steady demand from 2031 to 2041. This steady demand is attributed to Bus Rapid Transit planned along Queen Street.

TABLE 3-1: 2031 AND 2041 CORRIDOR GROWTH PROJECTIONS – DO NOTHING SCENARIOS

Street	2031 Do Nothing (CAGR over 2011)				2041 Do Nothing (CAGR over 2031)			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
Main Street	**NB**	**SB**	**NB**	**SB**	**NB**	**SB**	**NB**	**SB**
North of Church St.	-0.5%	-0.1%	0.2%	-0.4%	-1.4%	-4.7%	-5.0%	-3.1%
Church St. to Theatre Ln.	2.4%	0.1%	0.5%	1.3%	-2.2%	-3.1%	-2.8%	-2.0%
Ken Whillans Drive	**NB**	**SB**	**NB**	**SB**	**NB**	**SB**	**NB**	**SB**
North of Church St.	6.7%	0.8%	0.9%	4.0%	-0.9%	0.0%	1.0%	1.3%
Centre Street	**NB**	**SB**	**NB**	**SB**	**NB**	**SB**	**NB**	**SB**
North of Church St. to Church St.	1.3%	0.5%	0.8%	2.5%	5.8%	1.2%	1.6%	3.3%
Church St. to Queen St.	3.9%	1.7%	1.6%	3.9%	6.5%	1.3%	1.9%	4.4%
Queen Street	**EB**	**WB**	**EB**	**WB**	**EB**	**WB**	**EB**	**WB**
Main St. to Theatre Ln.	1.5%	1.6%	1.5%	1.5%	-0.5%	0.9%	0.3%	-0.7%
Theatre Ln. to Centre St.	0.7%	1.5%	1.2%	0.6%	-0.4%	1.3%	1.1%	-0.6%
Church Street	**EB**	**WB**	**EB**	**WB**	**EB**	**WB**	**EB**	**WB**
Centre St. to Ken Whillans Dr.	2.0%	1.5%	2.0%	1.7%	3.3%	5.8%	5.3%	3.8%
Ken Whillans Dr. to Main St.	10.5%	0.5%	2.9%	8.1%	3.0%	4.4%	3.6%	2.6%
Theatre Lane	**EB**	**WB**	**EB**	**WB**	**EB**	**WB**	**EB**	**WB**
Main St. to Union St.	2.8%	10.0%	5.8%	2.6%	-0.8%	-0.7%	0.3%	-0.9%

The 2031 and 2041 traffic forecasts based on the projected growth summarized in Table 3-1 are provided in Appendix F. A zero growth has been applied where a negative growth is forecasted by the model.

FIGURE 3-2: MAIN STREET – 2011, 2031 AND 2041 CORRIDOR VOLUME COMPARISON



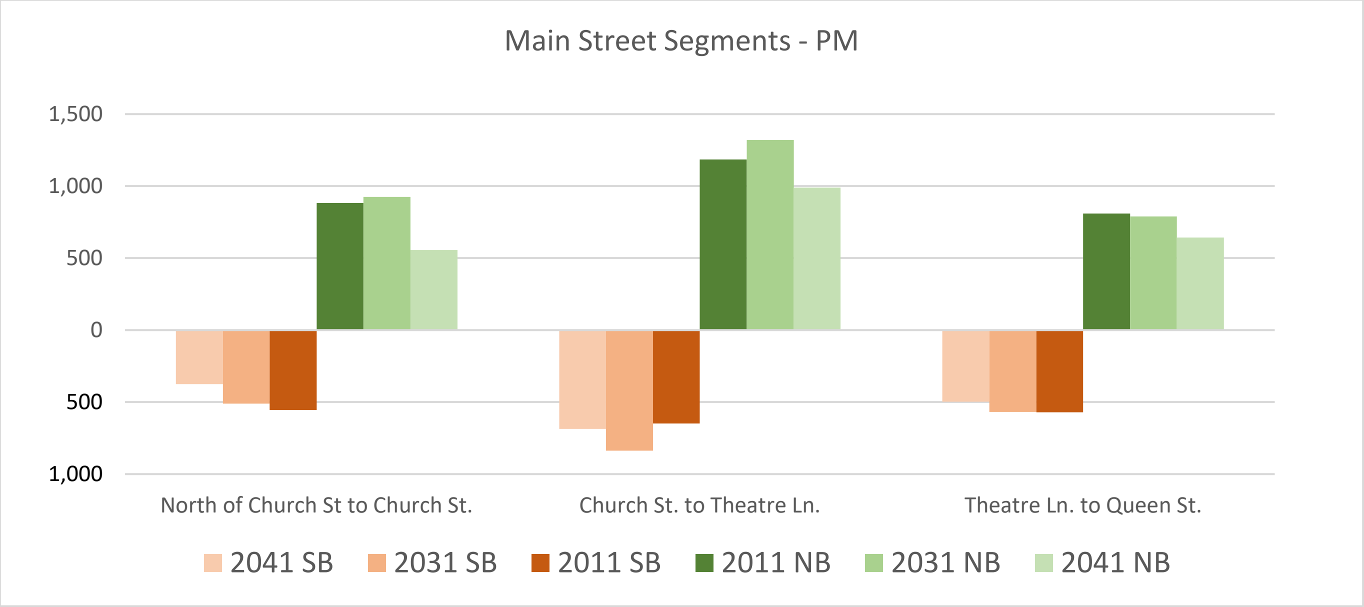
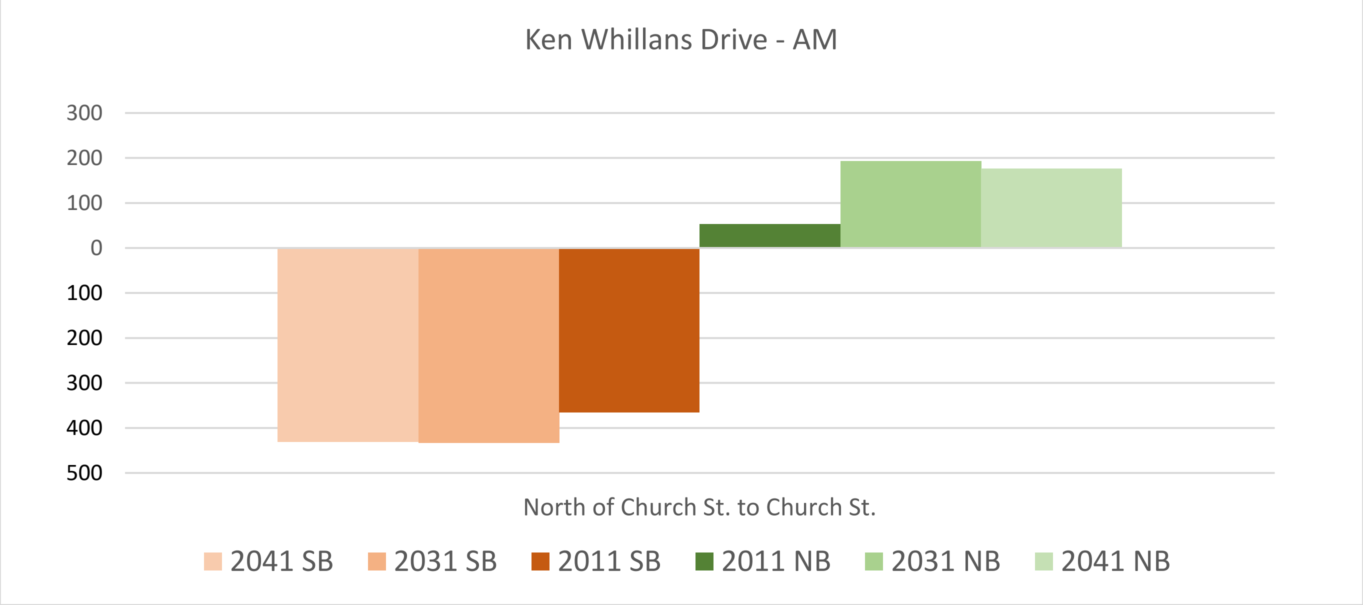


FIGURE 3-3: KEN WHILLANS DRIVE – 2011, 2031 AND 2041 CORRIDOR VOLUME COMPARISON



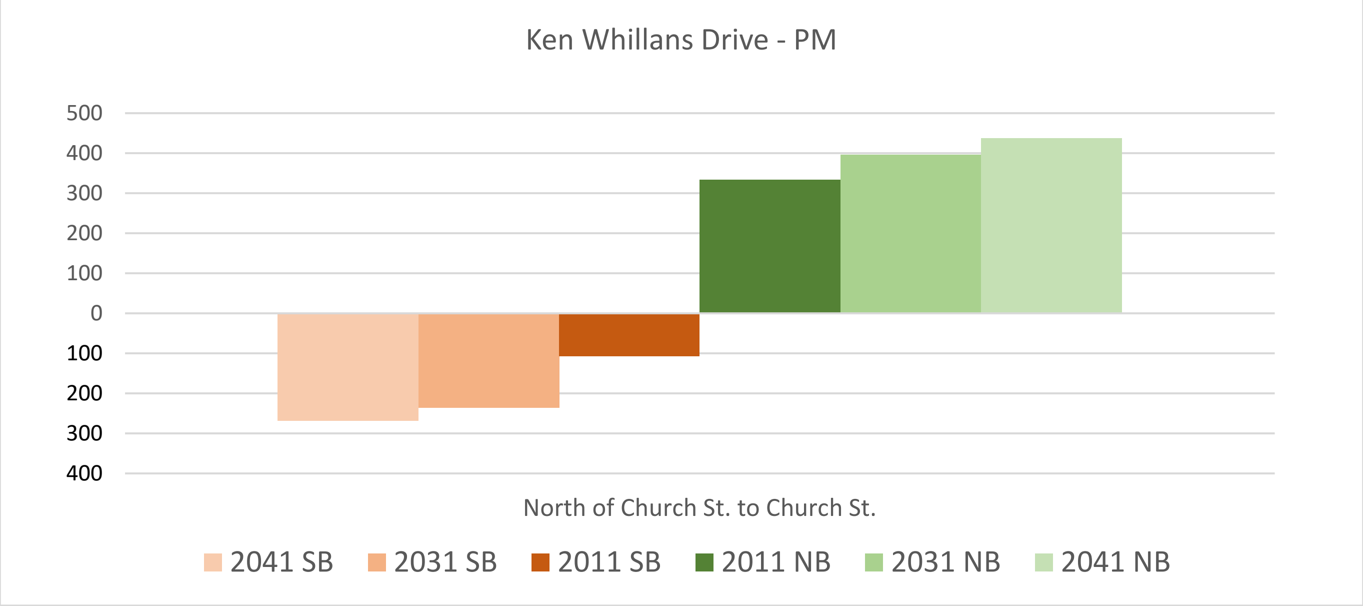
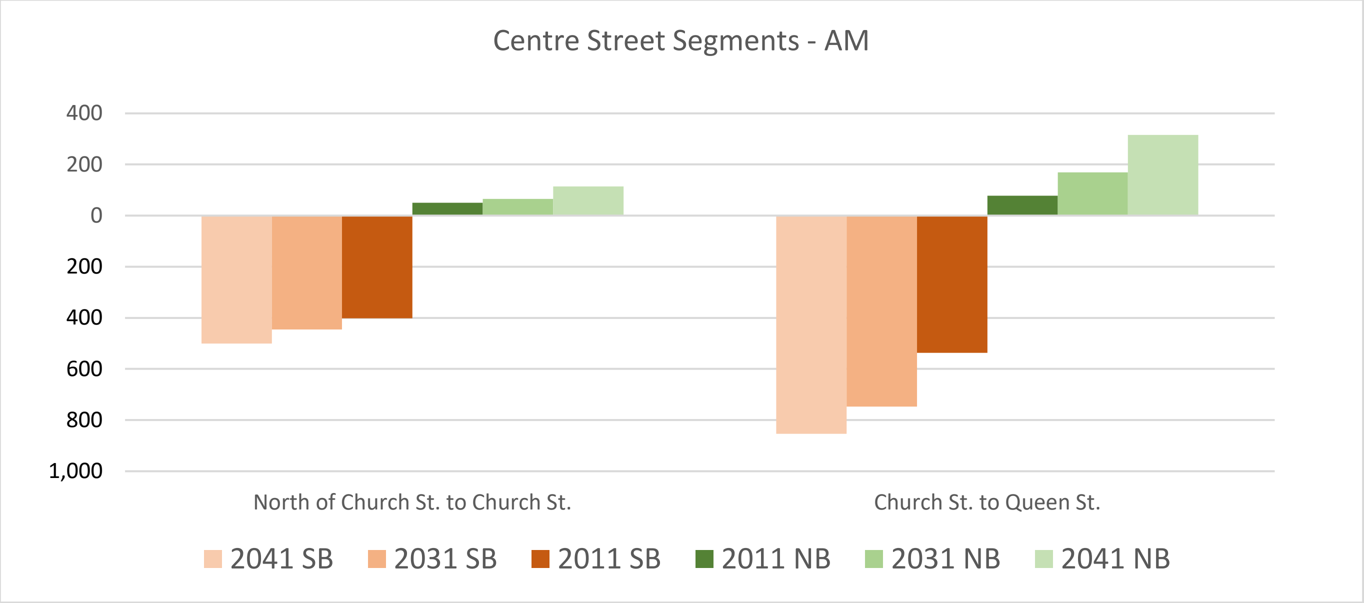


FIGURE 3-4: CENTRE STREET – 2011, 2031 AND 2041 CORRIDOR VOLUME COMPARISON



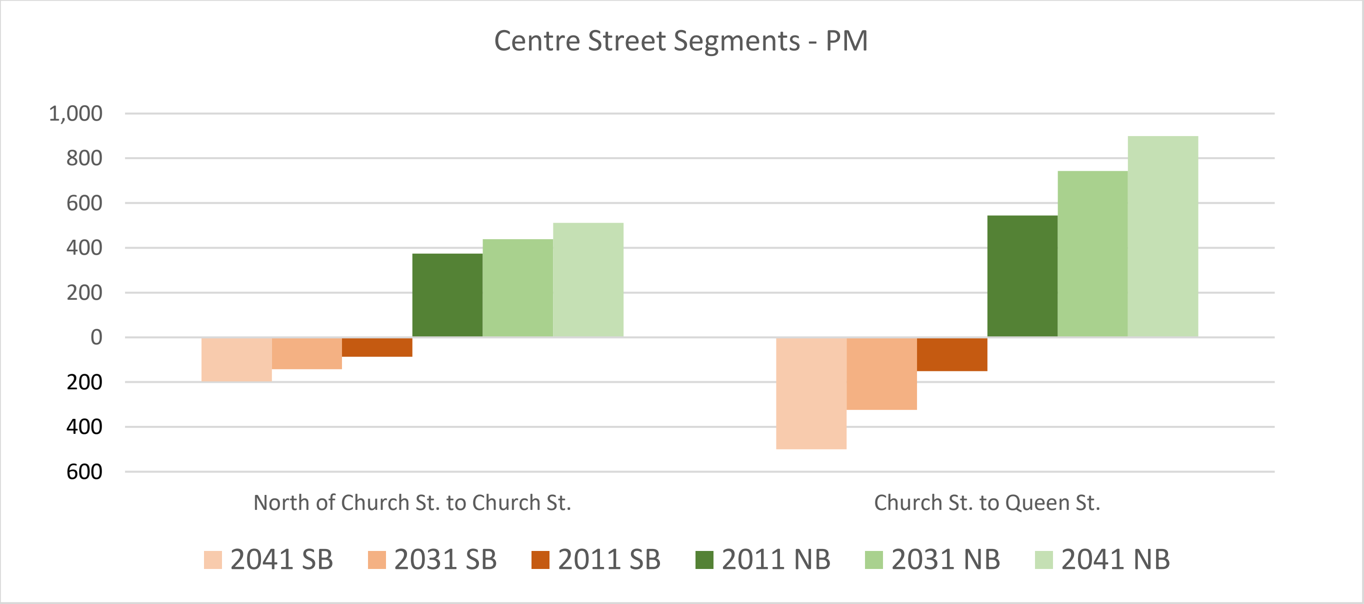
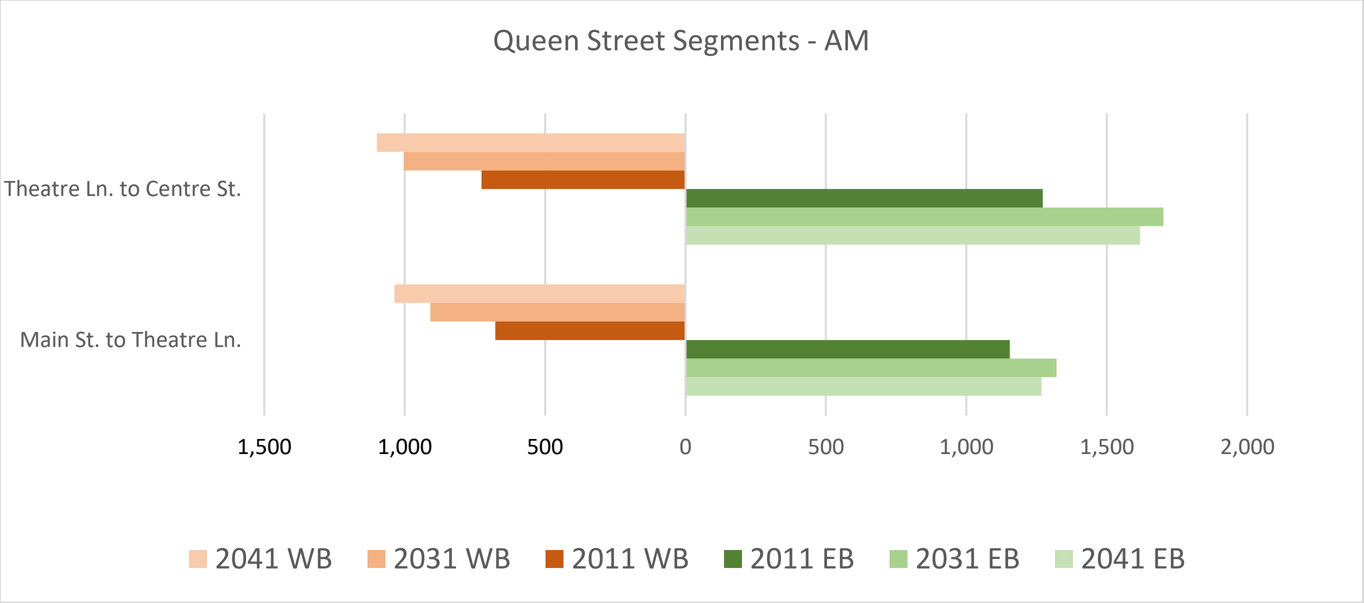


FIGURE 3-5: QUEEN STREET – 2011, 2031 AND 2041 CORRIDOR VOLUME COMPARISON



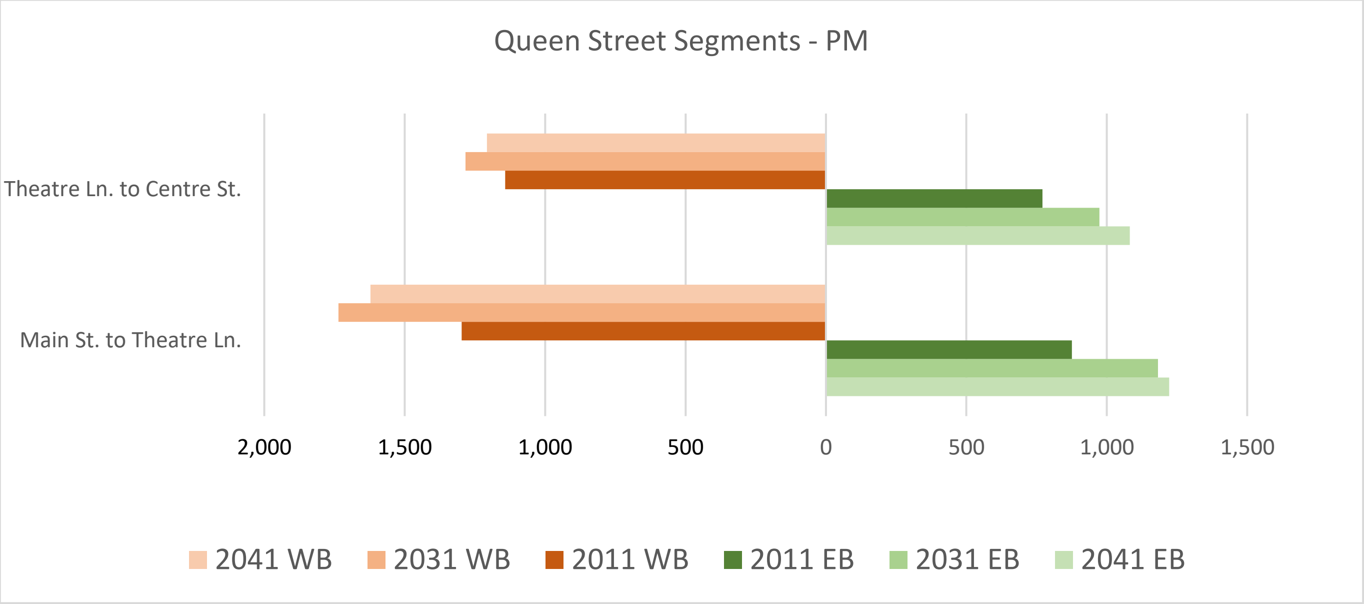
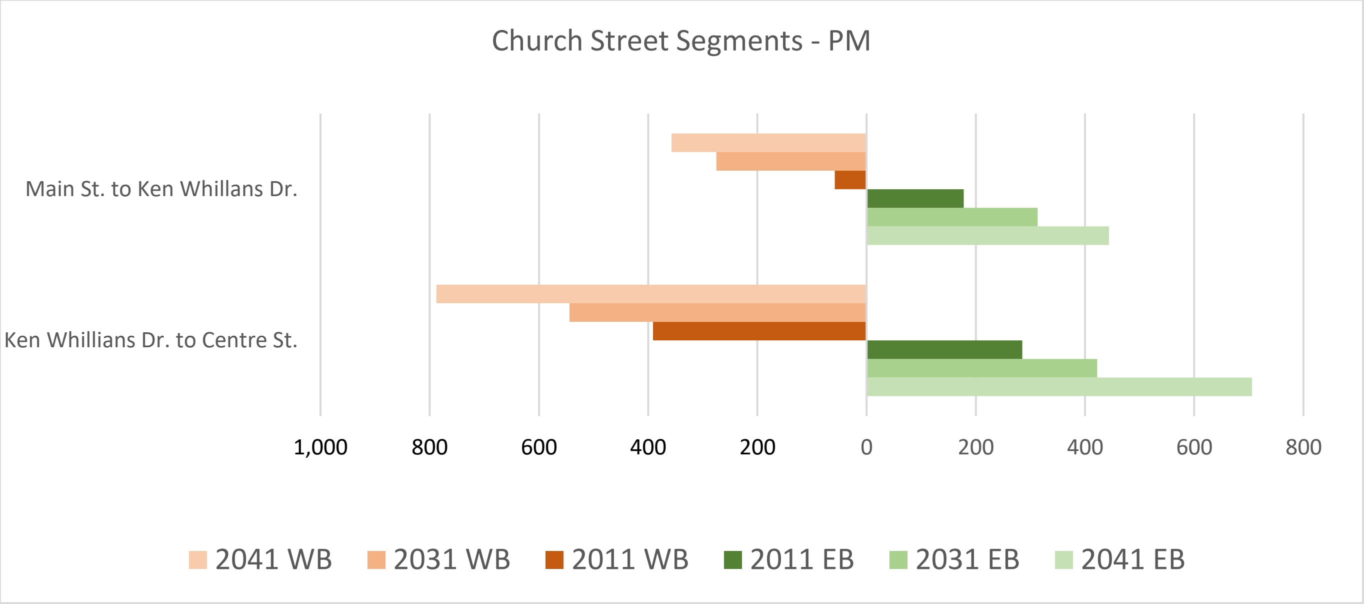


FIGURE 3-6: CHURCH STREET – 2011, 2031 AND 2041 CORRIDOR VOLUME COMPARISON



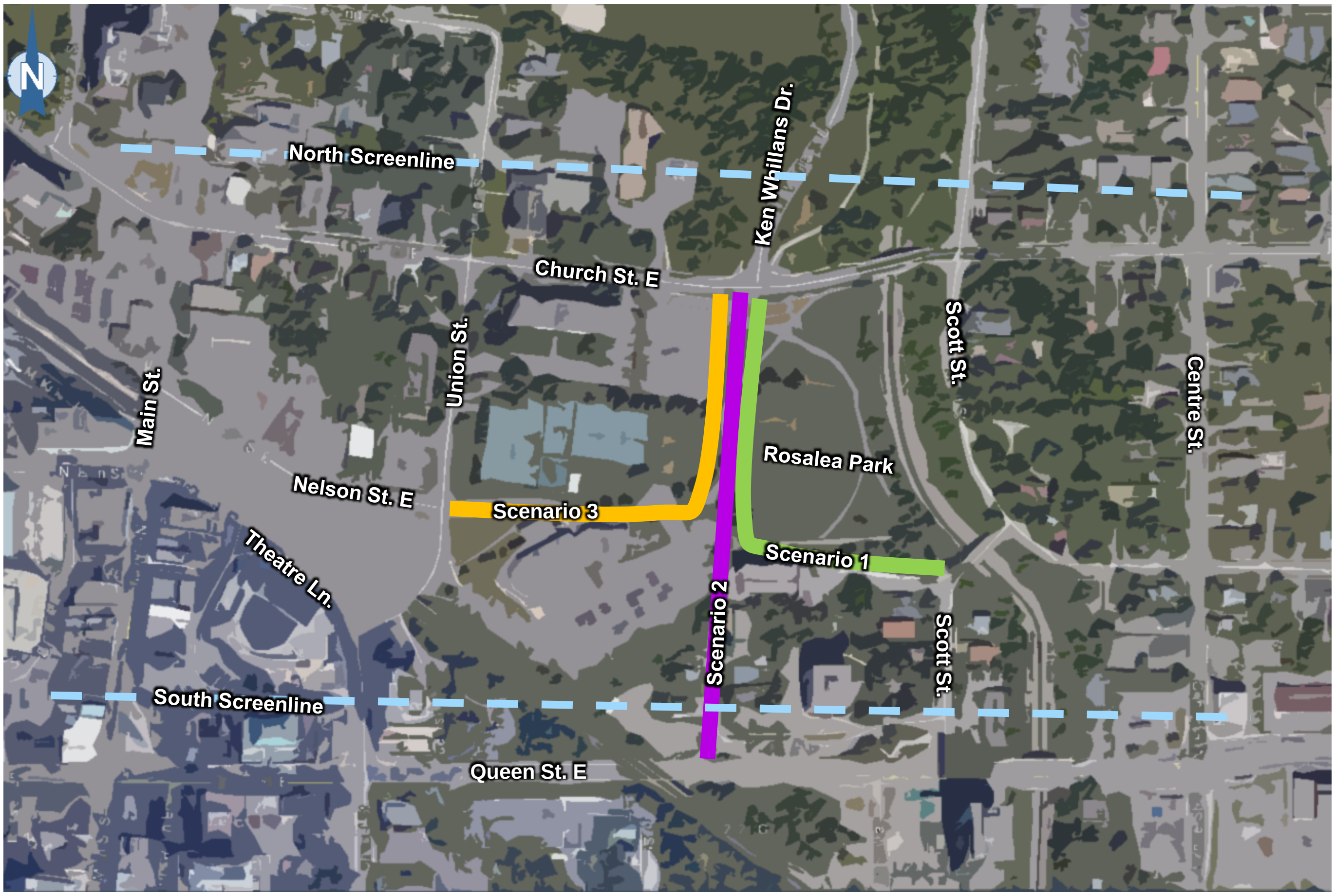
3.3 Network Analysis – Ken Whillans Extension Scenarios

This section presents the network analysis based on the model. The analysis included implementing various Ken Whillans Drive extension scenarios in the model for 2031 and 2041 horizons and extracting the resultant link traffic volumes. The City's modelling team provided traffic assignment plots from the model which were further studied for traffic redistribution pattern resulting form a particular extension option. These plots are included in **Appendix E.**

As part of this EA following three extension scenarios are being evaluated as shown in **Figure 3-7**:

- Scenario 1 – Connection with Scott Street
- Scenario 2 – Connection with Queen Street
- Scenario 3 – Connection with Nelson Street

FIGURE 3-7: KEN WHILLANS DRIVE EXTENSION SCENARIOS

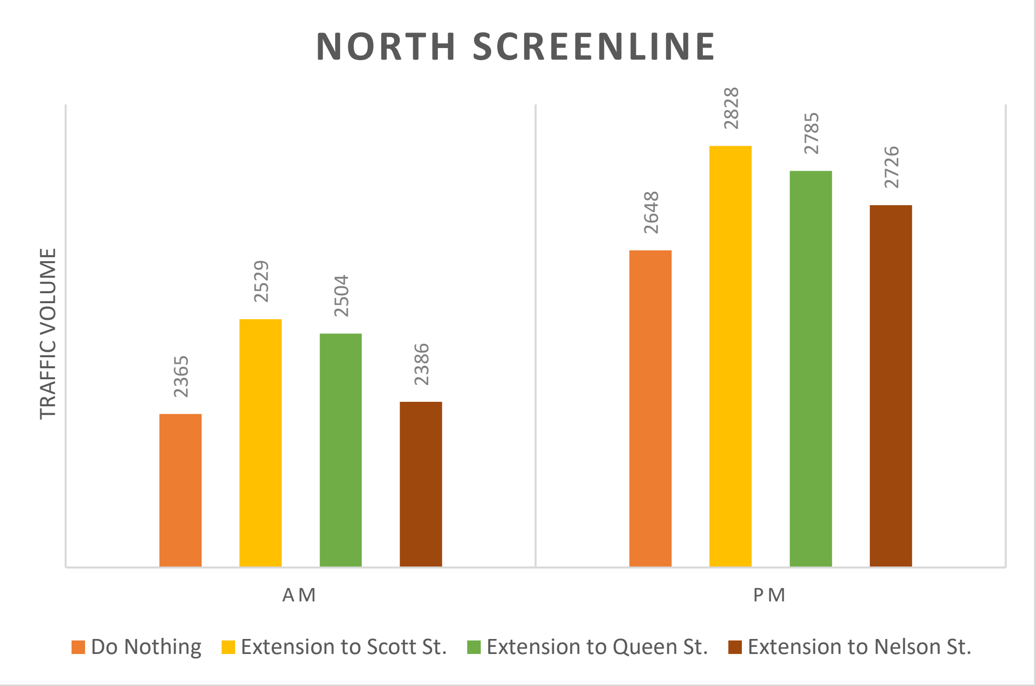


3.3.1 SCREENLINE ANALYSIS

To evaluate the relative performance of these scenarios, traffic volumes at two screenlines, as shown in **Figure 3-7**, were compared. The north screenline extends across Main Street, Ken Whillans Drive and Centre Street immediately north of Church Street. The south screenline lies immediately north of Queen Street extending across Main Street, Theatre Lane, Ken Whillans Extension (Scenario 2) and Center Street.

The comparison of screenline volumes for 2031 horizon is shown in **Figure 3-8**. The review of **Figure 3-8** suggests that all the extension scenarios will attract more car traffic within the study area when compared to “Do-Nothing” conditions. The additional traffic attraction is significantly higher for Scenario 1 and Scenario 2 than for Scenario 3. **Table 3-2** summarizes the percentage increase in the traffic within the study area for each extension scenario. The traffic increase across the screenlines ranges between 7% - 13% for Scenario 1, and between 5% - 13% for Scenario 2 during both the AM and PM peak hours. The traffic increase for Scenario 3 remains under 3% compared to Do Nothing scenario.

FIGURE 3-8: SCREENLINE VOLUME COMPRISON – 2031 HORIZON



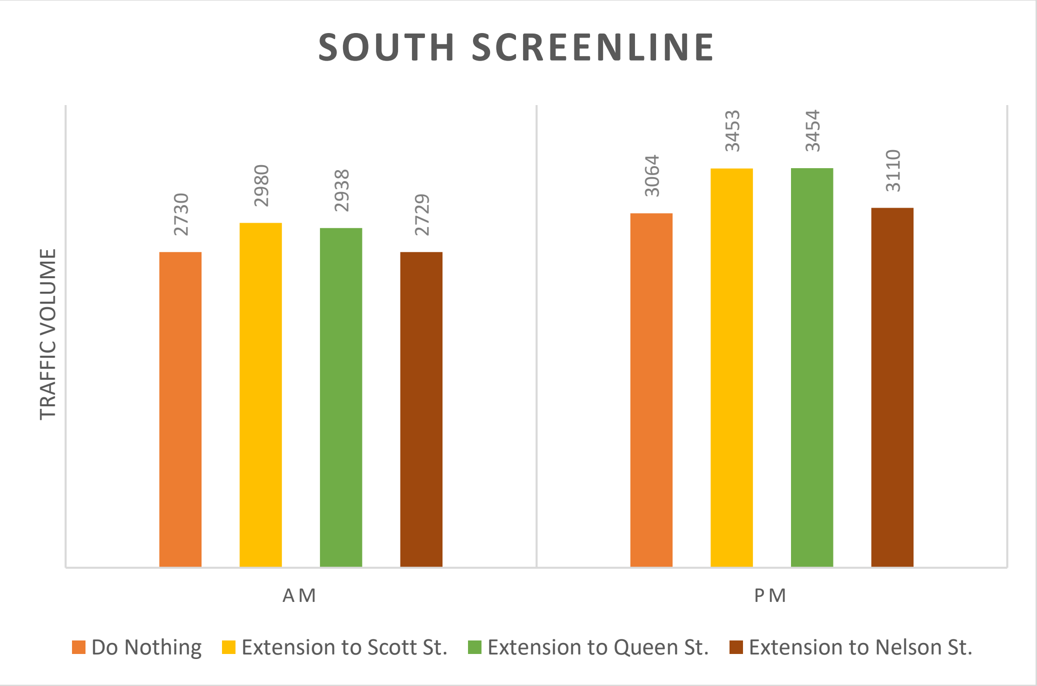


TABLE 3-2: TRAFFIC INCREASE OVER DO-NOTHING SCENARIO

Alternative	North Screenline		South Screenline	
	AM	PM	AM	PM
Scenario 1 – Extension to Scott St.	7%	7%	9%	13%
Scenario 2 – Extension to Queen St.	6%	5%	8%	13%
Scenario 3 – Extension to Nelson St.	1%	3%	0%	2%

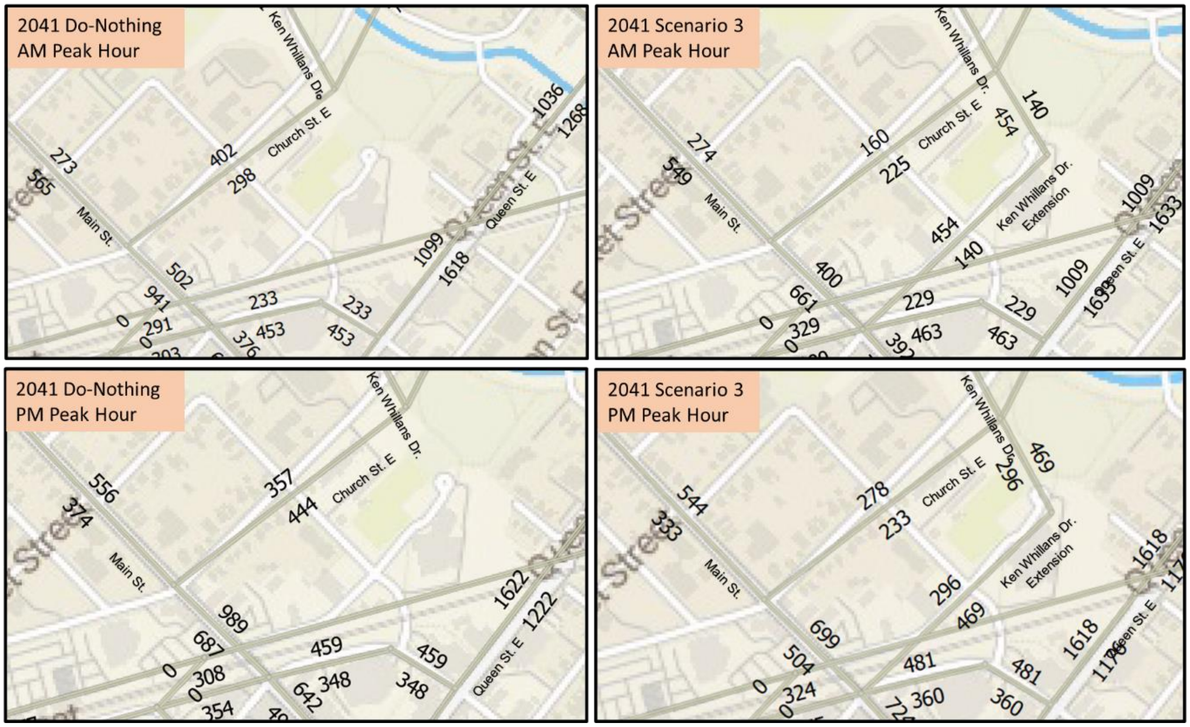
3.3.2 PREFERRRED EXTENSION SCENARIO

As discussed earlier, UDMP envisions the Ken Whillans extension to be a pedestrian friendly street, providing a seamless extension of the Rosalea Park and Plaza that can be closed to vehicular traffic during community events. These characteristics of the future Ken Whillans Drive extension need to be balanced with concerns of traffic using the extension.

The aim of this study is to develop a solution that aligns with the context of the future Ken Whillans Drive extension and surrounding land uses. All the extensions options are forecast to attract additional traffic into the study area. As such an extension will not support the UDMP vision if constructed like a conventional multi-modal complete street. Scenario 3, being a minimal traffic attractor as well as connecting to Union Street and Nelson Street East presents an opportunity to advance the UDMP objectives of a new gateway connection between Rosalea Park, Garden Square and Downtown.

Scenario 3 extends Ken Whillans Drive to Nelson Street East at Union Street. As shown in the 2041 EMME plots presented in **Figure 3-9**, the extension effectively functions as an alternate to the Church Street segment between Union Street and Ken Whillans Drive. Therefore, restricting the cut through traffic on Ken Whillans Drive extension will not adversely impact the Church Street segment which is operating within capacity under "Do-Nothing" conditions as discussed in **Section 3.2**. Directing the traffic away from the extension allows to develop the extension as a safe pedestrian priority street more suited to the intended functionality of the street in UDMP.

FIGURE 3-9: TRAFFIC ASSIGNMENT - COMPARISON OF SCENARIO 3 AND DO-NOTHING SCENARIO



3.4 Traffic Operations

This section presents the future 2031 and 2041 traffic operations analysis. As the desired purpose of the Ken Whillans Drive extension is to provide a public realm and not to serve as a mobility connection, it implies that the extension will restrict the cut through traffic thus essentially having the same traffic patterns as those in “Do Nothing” scenario. Therefore, the analysis is based on the Do-Nothing growth projections determined in Section 3.2.

As discussed in Section 3.2, the 2031 and 2041 traffic forecasts are included in **Appendix F**.

With the implementation of the Main Street LRT, the current Main Street 4-lane cross section will change to a 2-lane configuration (i.e., one shared lane for vehicles and the LRT in each direction) as shown in **Figure 3-1**. The same lane configuration has been assumed for Main Street under future 2031 and 2041 conditions. The existing unsignalized Main Street and Nelson Street East intersection was converted into a signalized intersection, to allow for the LRT vehicles to turn into the Downtown Brampton GO Station. The respective turning phases for the LRT, northbound left and eastbound right, are given a separate protected phase for the LRT. The signal phasing and timing used in this study are meant for the purposes of this analysis only as we understand a transportation impact assessment in support of the Main Street LRT EA will design the intersection in detail along with signal phasing and timings.

No details about the LRT service frequency are available, so for the analysis a headway of 10 minutes during the AM and PM peak hours was assumed. As such an hourly volume of six (6) LRT vehicles per direction was coded in Synchro.

3.4.1 SIGNALIZED INTERSECTIONS

Table 3-3 summarizes the Synchro and SimTraffic analysis for the future 2031 and 2041 conditions. Detailed analysis reports are included in **Appendix G**. All signal timings were optimized for the analysis. The critical intersections and movements, as explained in Section 1.4.2, have been identified in red. All intersections are forecast to operate acceptably during the AM peak hour.

During the PM peak hour, the Main Street existing signalized intersections are shown to be at or over capacity with LOS “F”. This is attributed to the reduction of Main Street cross-section from 4-lane to 2-lane to implement the LRT line. Although there is a zero-growth assumed along Main Street, the growth along side streets contributes to a proportionate increase in the turning movements at these intersections which is also responsible for the capacity being exceeded at these intersections. The new signalized intersection at Nelson Street East is shown to operate acceptably with the assumed LRT service frequency and signal phasing design. It is not the intent of this study to assess the impacts of the LRT on Main Street traffic operations. The analysis is based on the preliminary lane configurations provided by the city and certain assumptions as discussed above; therefore, no improvements are being recommended. We understand that the detailed traffic impact assessment and subsequent design including road cross-section and intersection will be undertaken as part of Main Street LRT EA study.

TABLE 3-3: FUTURE 2031 AND 2041 SIGNALIZED INTERSECTION ANALYSIS

Intersection	AM Peak Hour									PM Peak Hour								
	Overall			Critical Movements						Overall			Critical Movements					
	V/C	Delay (s)	LOS	Dir	V/C	Delay (s)	LOS	Queue (m)		V/C	Delay (s)	LOS	Dir	V/C	Delay (s)	LOS	Queue (m)	
								Avg	95th								Avg	95th
2031 Traffic Condition																		
Main Street & Church Street	0.66	17	B	EBL	0.11	14	B	6	21	1.09	56	F	EBL	0.56	22	B	14	39
				EBTR	0.46	18	B	23	47				EBTR	0.33	57	E	33	80
				WBL	0.09	25	C	4	11				WBL	0.46	168	F	44	74
				WBTR	0.22	13	B	11	21				WBTR	1.23	43	F	95	182
				NBL	0.04	45	D	4	21				NBL	0.11	61	E	16	60
				NBTR	0.67	20	B	47	82				NBTR	1.06	63	F	90	103
				SBLT	0.73	16	B	20	26				SBLT	0.71	47	D	14	27

Intersection	AM Peak Hour									PM Peak Hour								
	Overall			Critical Movements						Overall			Critical Movements					
	V/C	Delay (s)	LOS	Dir	V/C	Delay (s)	LOS	Queue (m)		V/C	Delay (s)	LOS	Dir	V/C	Delay (s)	LOS	Queue (m)	
								Avg	95th								Avg	95th
				SBTR		17	B	22	28				SBTR		50	D	20	26
Main Street & Nelson Street W/Theatre Lane	0.35	22	B	EBL	0.27	23	C	13	27	1.00	90	F	EBL	0.87	52	D	27	42
				EBTR	0.28	23	C	23	44				EBTR	0.57	25	C	46	91
				WBL	0.05	22	C	3	9				WBL	0.14	36	D	16	48
				WBTR	0.25	26	C	23	47				WBTR	0.98	62	E	68	127
				NBLTR	0.18	33	C	46	88				NBLTR	0.79	316	F	162	168
				SBLTR	0.36	23	C	37	42				SBLTR	1.02	47	F	36	40
Union Street & Theatre Lane	0.30	9	A	EBL	0.03	14	B	3	9	0.55	14	B	EBL	0.13	21	C	6	20
				EBTR	0.32	8	A	14	35				EBTR	0.33	11	B	18	44
				WBL	0.05	10	B	3	10				WBL	0.01	13	B	1	4
				WBTR	0.22	8	A	17	33				WBTR	0.62	15	B	33	63
				NBL	-	-	-	-	-				NBL	0.01	11	B	0	3
				NBTR	0.01	10	A	1	3				NBTR	0.05	16	B	3	8
				SBL	0.27	16	B	10	19				SBL	0.40	17	B	13	24
				SBTR	0.04	14	B	4	11				SBTR	0.03	7	A	5	13
Main Street & Nelson Street E	0.55	24	B	EBR	0.01	71	E	1	6	0.80	50	D	EBR	0.00	97	F	2	9
				WBLTR	0.01	53	D	2	6				WBLTR	0.01	27	C	2	7
				NBL	0.25	33	C	1	6				NBL	0.37	36	D	1	5
				NBTR	0.43	4	A	10	32				NBTR	0.80	16	B	32	42
				SBL	0.03	15	B	6	34				SBL	0.10	15	B	4	27
				SBT	0.59	42	D	84	112				SBT	0.73	104	F	91	103
2041 Traffic Conditions																		
Main Street & Church Street	0.73	23	C	EBL	0.10	14	B	6	17	1.13	50	F	EBL	0.56	24	C	13	36
				EBTR	0.65	18	B	31	60				EBTR	0.50	41	D	36	82
				WBL	0.27	35	C	10	20				WBL	0.51	132	F	39	67
				WBTR	0.33	15	B	13	28				WBTR	1.34	34	C	83	161
				NBL	0.04	45	D	4	24				NBL	0.11	57	E	15	58
				NBTR	0.66	32	C	61	100				NBTR	1.08	67	F	89	106
				SBLT		25	C	20	25				SBLT	0.72	53	D	14	27
				SBTR	0.71	19	B	21	26				SBTR		47	D	20	25
Main Street & Nelson Street W/Theatre Lane	0.74	22	B	EBL	0.28	25	C	14	28	1.00	99	F	EBL	0.87	57	E	27	44
				EBTR	0.38	20	C	20	43				EBTR	0.57	20	C	41	85
				WBL	0.07	19	B	4	13				WBL	0.14	49	D	15	47
				WBTR	0.63	27	C	27	51				WBTR	0.98	70	E	77	142
				NBLTR	0.54	30	C	46	85				NBLTR	0.79	396	F	162	166
				SBLTR	0.85	24	C	36	42				SBLTR	1.02	44	F	36	39
Union Street & Theatre Lane	0.51	9	A	EBL	0.05	12	B	2	6	0.55	15	B	EBL	0.13	20	B	5	15
				EBTR	0.47	9	A	14	33				EBTR	0.33	9	B	16	37
				WBL	0.06	10	A	2	9				WBL	0.01	12	B	1	11
				WBTR	0.67	8	A	19	37				WBTR	0.62	18	B	37	70
				NBL	-	-	-	-	-				NBL	0.01	33	C	1	4
				NBTR	0.01	15	B	1	3				NBTR	0.05	17	B	3	8
				SBL	0.32	14	B	12	22				SBL	0.40	18	B	14	24
				SBTR	0.04	8	A	3	9				SBTR	0.03	7	A	5	14

Intersection	AM Peak Hour									PM Peak Hour								
	Overall			Critical Movements						Overall			Critical Movements					
	V/C	Delay (s)	LOS	Dir	V/C	Delay (s)	LOS	Queue (m)		V/C	Delay (s)	LOS	Dir	V/C	Delay (s)	LOS	Queue (m)	
								Avg	95th								Avg	95th
Main Street & Nelson Street E	0.55	22	B	EBR	0.01	49	D	2	8	0.80	51	D	EBR	0.00	76	D	2	8
				WBLTR	0.01	58	E	2	6				WBLTR	0.01	85	F	2	7
				NBL	0.25	36	D	1	7				NBL	0.37	50	D	1	6
				NBTR	0.43	5	A	15	38				NBTR	0.80	17	B	32	41
				SBL	0.03	9	B	3	19				SBL	0.10	19	B	6	34
				SBT	0.59	37	D	73	116				SBT	0.73	98	F	91	102

3.4.2 UNSIGNALIZED INTERSECTIONS

Table 3-4 summarizes the Synchro and SimTraffic analysis for the future 2031 and 2041 conditions. Detailed analysis reports are included in Appendix G.

The analysis shows that the east-west movements along Church Street are constrained during the PM peak hour which is consistent with the growth projections presented in Section 3.2. The northbound movement at the Church Street and Scott Street intersection is constrained because of the free east-west movements.

No measures are recommended to improve the traffic flow along Church Street as such localized conditions are expected during peak times. It is also noted that the future forecasts are based on long term growth projections from EMME model which is deterministic in nature and does not consider the drivers' perception and behaviour that evolve over time adapting to the changing traffic conditions. The study area is a mature neighbourhood adjacent to the Downtown where physical capacity addition is mostly not feasible. We believe such conditions present a unique opportunity to influence the peoples' travel mode choice by providing them more sustainable alternatives. Such a less auto-dependent mobility environment will further reinforce the public realm planned for the study area.

TABLE 3-4: FUTURE 2031 AND 2041 UNSIGNALIZED INTERSECTION ANALYSIS

Intersection	AM Peak Hour					PM Peak Hour				
	Dir	Delay (s)	95th Queue	V/C	LOS	Dir	Delay (s)	95th Queue	V/C	LOS
2031 Traffic Condition										
Scott Street & Church Street	EBLTR	5	8	0.02	A	EBLTR	20	70	0.12	B
	WBLTR	5	12	0.01	A	WBLTR	37	180	0.00	E
	NBLTR	9	8	0.08	A	NBLTR	1133	153	0.60	F
Ken Whillians Drive & Church Street	EBLT	11	32	0.67	B	EBLT	11	32	1.24	F
	WBTR	7	17	0.21	A	WBTR	46	134	0.21	E
	SBLR	6	13	0.16	A	SBLR	18	18	0.10	C
Union Street & Church Street	EBL	8	10	0.01	A	EBL	7	4	0.01	A
	EBTR	11	34	0.57	B	EBTR	11	32	0.46	B
	WBL	7	14	0.09	A	WBL	22	60	0.22	C
	WBTR	9	12	0.18	A	WBTR	39	165	1.17	E
	NBLTR	5	16	0.14	A	NBLTR	21	45	0.31	C
	SBLTR	5	14	0.08	A	SBLTR	9	15	0.11	A
Union Street & Nelson Street E	EBLTR	6	11	0.03	A	EBLTR	7	12	0.05	A
	WBLTR	0	1	0.00	A	WBLTR	4	4	0.00	A
	NBLTR	2	2	0.01	A	NBLTR	1	3	0.01	A

Intersection	AM Peak Hour					PM Peak Hour				
	Dir	Delay (s)	95th Queue	V/C	LOS	Dir	Delay (s)	95th Queue	V/C	LOS
	SBLTR	2	2	0.01	A	SBLTR	1	3	0.01	A
2041 Traffic Condition										
Scott Street & Church Street	EBLTR	6	14	0.03	A	EBLTR	18	75	0.15	C
	WBLTR	6	12	0.01	A	WBLTR	34	178	0.00	D
	NBLTR	13	9	0.11	B	NBLTR	949	152	0.74	F
Ken Whillians Drive & Church Street	EBLT	13	47	0.92	B	EBLT	13	44	1.33	F
	WBTR	8	20	0.18	A	WBTR	43	135	0.22	E
	SBLR	6	14	0.06	A	SBLR	8	15	0.12	A
Union Street & Church Street	EBL	10	11	0.02	A	EBL	9	5	0.01	A
	EBTR	14	54	0.81	B	EBTR	14	43	0.68	B
	WBL	8	15	0.15	A	WBL	20	60	0.25	C
	WBTR	9	16	0.31	A	WBTR	31	140	1.32	F
	NBLTR	6	16	0.21	A	NBLTR	11	31	0.36	B
	SBLTR	6	15	0.12	A	SBLTR	7	17	0.16	A
Union Street & Nelson Street E	EBLTR	6	11	0.03	A	EBLTR	7	11	0.05	A
	WBLTR	0	2	0.00	A	WBLTR	5	4	0.00	A
	NBLTR	2	3	0.01	A	NBLTR	3	3	0.01	A
	SBLTR	2	2	0.01	A	SBLTR	3	3	0.01	A

3.5 MMLOS

3.5.1 BICYCLE LOS

As BLOS calculations does not consider the traffic volume, therefore the BLOS will be same as that of existing 2021 conditions (Table 2.6). The Ken Whillans Drive extension as discussed previously is not intended to serve as a mobility connection and will be pedestrian priority complete street connection, therefore a BLOS as defined in the MMLOS analysis methodology used in this study is meaningless. However, in the event a dedicated cycling facility is preferred along the future extension, the BLOS will be "A" in accordance with the MMLOS methodology.

3.5.2 PEDESTRIAN LOS

The PLOS for 2031 and 2041 conditions is summarized in **Table 3-5**. Detailed calculations are provided in **Appendix H.** Average daily curb lane traffic along Church Street is now greater than 3000 vehicles. This results into change of LOS from "C" to "E" for the westbound Union Street to Ken Whillans Drive segment and for the eastbound Ken Whillans Drive to Scott Street segment. There is no change in the LOS of the other Church Street segments and the overall LOS.

The average daily curb lane traffic along other streets remains under 3000 in both 2031 and 2041 conditions and therefore there is no change in the PLOS.

The MMLOS analysis methodology is designed to analyse PLOS on sidewalks for auto dominated streets. As such this methodology will not be applicable and as a matter of fact not needed for Ken Whillans Drive extension which is otherwise envisioned as a pedestrian priority street.

TABLE 3-5: FUTURE 2031 AND 2041 PLOS

Street and Segments	**Pedestrian Level of Service**	
Church St.	**Eastbound**	**Westbound**
Overall PLOS	E	E
Main St. to Union St	E	E
Union St. to Ken Whillans Dr.	E	E
Ken Whillans Dr. to Scott St.	E	E
Union St.	**Northbound**	**Southbound**
Overall PLOS	E	E
Theatre Ln. to Nelson St. E	E	E
Nelson St. E to Church St	E	E
Nelson St. E.	**Eastbound**	**Westbound**
Overall PLOS	E	F
Main St. to Union St.	E	No Sidewalk Exists

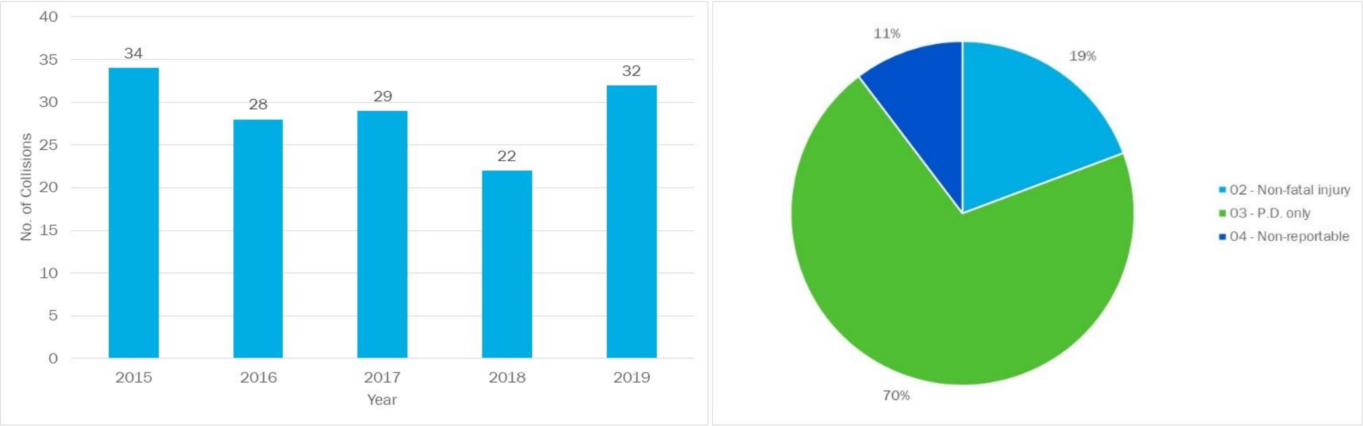
4 Safety Impact Assessment

This section presents a review of the historical intersection collision data from the past five (5) years (2015 to 2019) to determine if there are any discernable collision trends within the study area. The data was provided by the City of Brampton. The findings from this review will inform the safety impact assessment of various extension scenarios and safety considerations in preliminary design development of the proposed extension. The review included the same intersections as reviewed in the traffic analysis.

4.1 Overall Breakdown of Recorded Collisions

Based on the fine (5) years of historical data there were a total of 145 collisions. **Figure 4-1** presents the number of collisions by year and by classification.

FIGURE 4-1. COLLISIONS BY YEAR & CLASSIFICATION



The number of collisions per year generally remained similar throughout the five (5) years of historical data. The lowest number of collisions occurred in 2018 where a total of 22 collisions were recorded. The year 2015 noted the most collisions with 34 recorded.

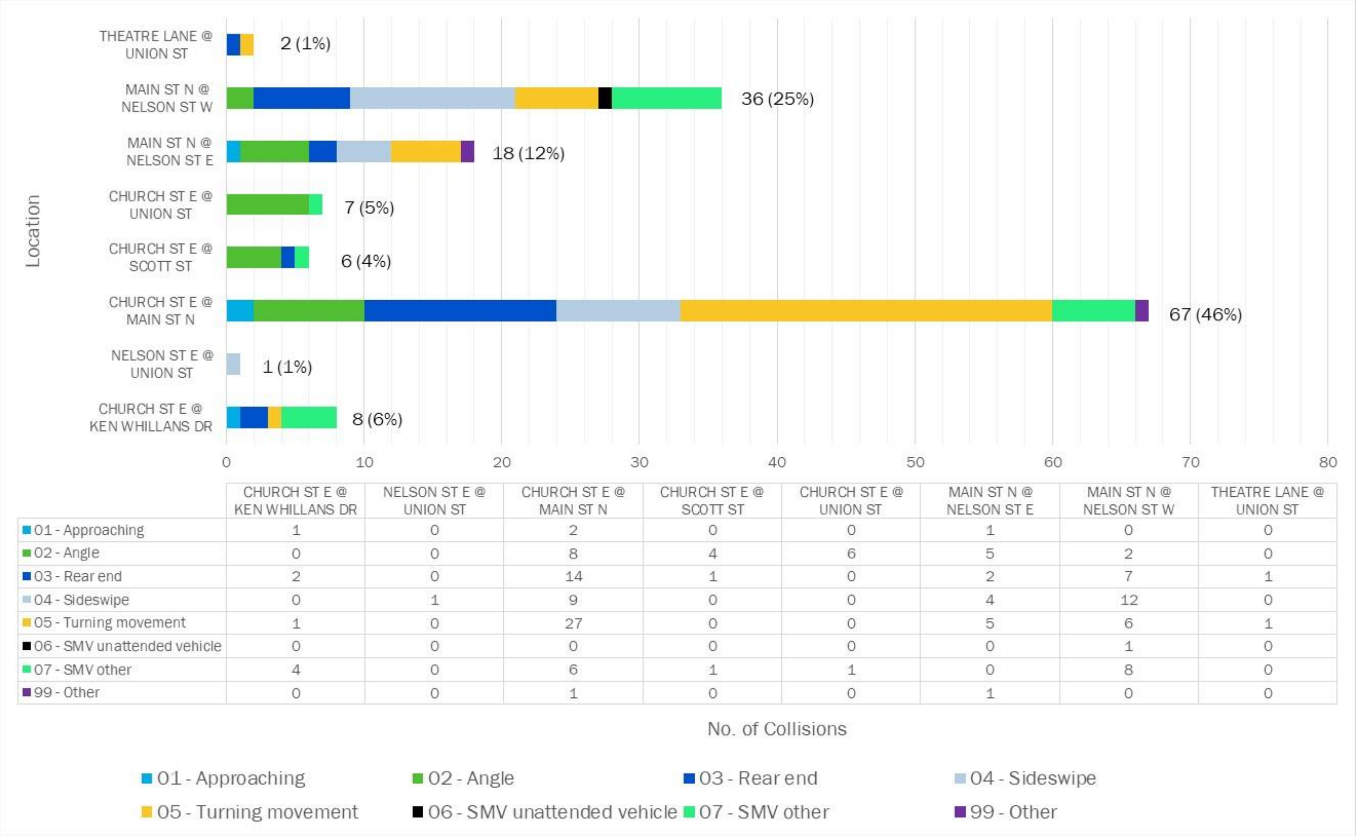
In terms of classification, 70% of the collisions were classified as property damage only and 19% of the total collisions were recorded as non-fatal injury. There were no fatal injury collisions recorded within the data. There were 11% collisions determined as non-reportable.

4.2 Collisions Summary by Intersection

Figure 4-2 presents a summary of the total collisions recorded at each intersection by impact type. The intersection of Main Street North with Church Street East accounted for 46% (67) of the total collisions within the area. While almost all collision impact types were recorded at this intersection, turning movement collisions accounted for 40% (27) of the collisions recorded.

The intersection of Main Street North with Nelson Street West contained the second greatest number of collisions with 25% (36) of the overall collisions. The predominant type of collision at this intersection was sideswipe collisions.

FIGURE 4-2. TOTAL COLLISIONS BY LOCATION AND IMPACT TYPE



	CHURCH ST E @ KEN WHILLANS DR	NELSON ST E @ UNION ST	CHURCH ST E @ MAIN ST N	CHURCH ST E @ SCOTT ST	CHURCH ST E @ UNION ST	MAIN ST N @ NELSON ST E	MAIN ST N @ NELSON ST W	THEATRE LANE @ UNION ST
01 - Approaching	1	0	2	0	0	1	0	0
02 - Angle	0	0	8	4	6	5	2	0
03 - Rear end	2	0	14	1	0	2	7	1
04 - Sideswipe	0	1	9	0	0	4	12	0
05 - Turning movement	1	0	27	0	0	5	6	1
06 - SMV unattended vehicle	0	0	0	0	0	0	1	0
07 - SMV other	4	0	6	1	1	0	8	0
99 - Other	0	0	1	0	0	1	0	0

The intersection of Ken Whillans Drive with Church Street East where the proposed extension would begin contained a total of eight (8) collisions recorded over the five years. The predominant collision type was single motor vehicle other with a total of four (4) such collisions.

The intersection of Nelson Street and Union Street which is a potential option for the terminal end of the Ken Whillans Drive extension accounted for only one (1) collision recorded over the five (5) years which was classified as a sideswipe.

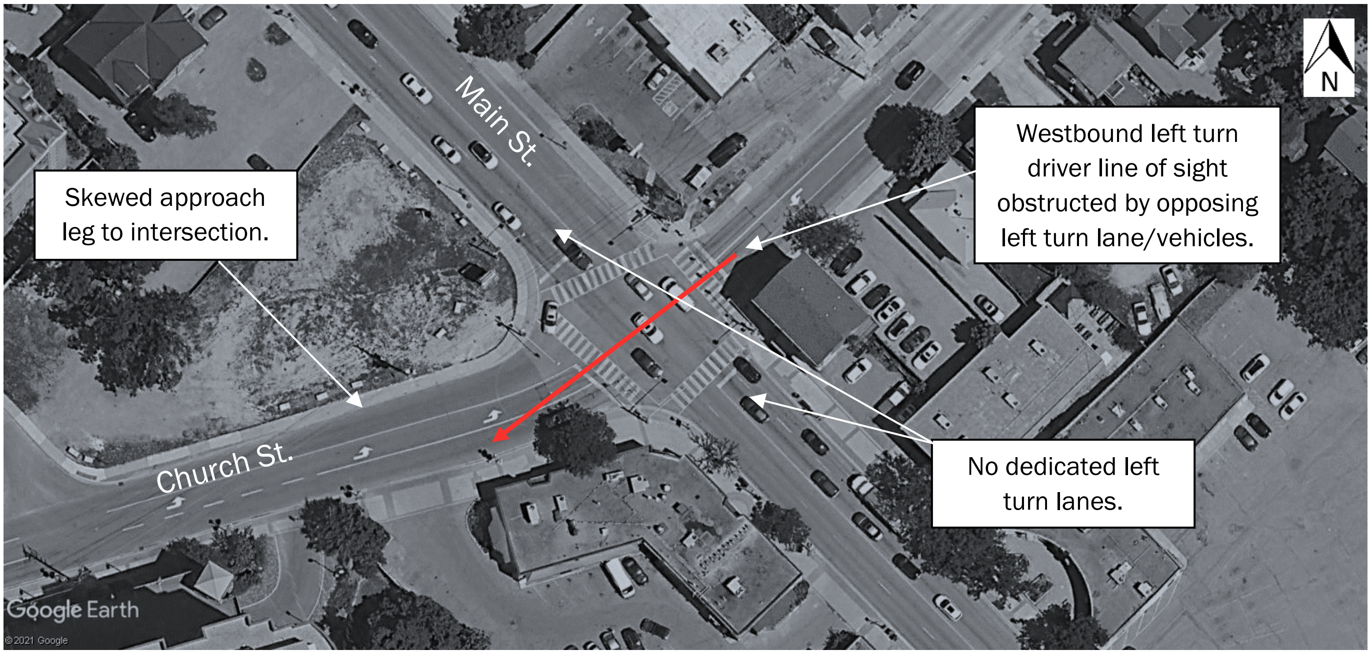
Based on the initial findings regarding collisions within the immediate area of the proposed Ken Whillans Drive extension, the intersections of Main Street with both Church Street East and Main Street West appear to have a greater number of collisions than the other intersections, turning movement and sideswipe collisions being the predominant impact types. These intersections are examined further in the following sections.

4.2.1 CHURCH STREET AND MAIN STREET INTERSECTION

Out of 67 total collisions recorded at this intersection, 27 (40%) were identified as turning movement collisions. Further review of these collisions found no other discernable trends within the data provided. Most of these collisions occurred during daylight hours and in ‘clear’ weather conditions.

A review of the physical characteristics of the intersection (approaches and sightlines) was conducted to determine if any insight into the amount of turning movement collisions could be concluded. **Figure 4-3** highlights some of the findings.

FIGURE 4-3. CHURCH STREET AND MAIN STREET INTERSECTION REVIEW



Skewed approach leg to intersection.

Westbound left turn driver line of sight obstructed by opposing left turn lane/vehicles.

No dedicated left turn lanes.

As shown in **Figure 4-3**, the west leg of the intersection is at a skewed approach to the intersection which creates sightline issues for drivers and the lack of dedicated left turn lanes on the northbound and southbound approaches may all be contributing to the significant number of turning movement collisions.

Due to the skewed westbound approach of the intersection, drivers approaching the intersection may have difficulty judging oncoming traffic as they approach the intersection and prepare to turn left at the lights. Similarly, eastbound drivers waiting to turn left may have difficulty judging oncoming westbound traffic before making their turn. Their sightline of oncoming through traffic can also be obstructed if there is an eastbound left turning vehicle within the opposing turn lane.

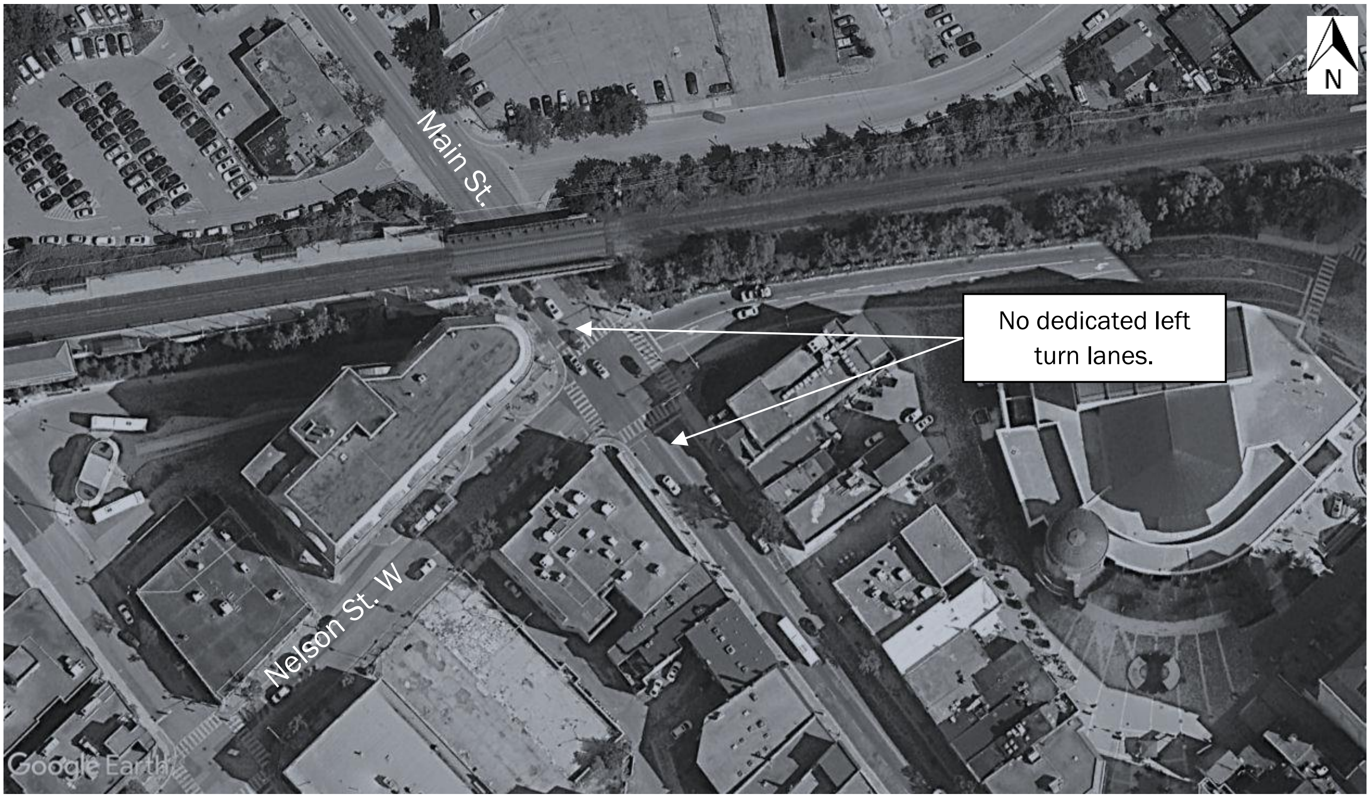
Also identified at the intersection were the lack of dedicated left turn lanes on the northbound and southbound approaches. Similar to the issues highlighted due to the skewed west leg of the intersection, if drivers are waiting to turn left from the inside shared through and left lanes of the north and south approaches, they will obstruct one another's line of sight and ability to see oncoming through traffic in the curb lanes. Offsetting dedicated left turn lanes would eliminate this obstruction and potentially reduce turn collisions.

4.2.2 MAIN STREET NORTH AND NELSON STREET WEST INTERSECTION COLLISION REVIEW

As presented previously, the intersection of Main Street and Nelson Street West recorded a total of 36 collisions over the five (5) years of data provided with 12 (33%) being recorded as sideswipes. Further review of these collisions found no other discernable trends within the data provided. Most of these collisions occurred during daylight hours and in 'clear' weather conditions.

The physical characteristics of the intersection were then reviewed to determine in any understanding good be gained into the number of sideswipe collisions at the intersection.

FIGURE 4-4. MAIN STREET AND NELSON STREET WEST INTERSECTION REVIEW



As illustrated in **Figure 4-4**, the intersection of Main Street with Nelson Street shares similar physical characteristics as Main Street and Church Street. One characteristic is the lack of dedicated left turn lanes on both the northbound and southbound approaches.

The absence of dedicated left turn lanes could be a contributing factor to the number of sideswipe collisions as through vehicles within the inside shared through and left turn lane abruptly change lanes to avoid being stuck behind a left turning vehicle at the lights. As drivers make this decision to change from the inside lane to the curb lane in a sudden moment, they neglect to check if there are vehicles adjacent resulting in sideswipe collisions.

The introduction of dedicated left turn lanes could mitigate this maneuver as drivers will become accustomed to a left turn lane ahead and position themselves in the curb lane in advance of the intersection reducing the need to abruptly change lanes.

4.3 Conclusions from Historical Collision Data Review

Based on the review of historical intersection collision data, turning movement and sideswipe collisions were prevalent at two intersections along Main Street. Through a review of the physical characteristics of these intersections, following functional issues were identified which could potentially contribute to these collision types:

- Skewed approaches to the intersections resulting in obstructed sightlines for turning movements; and
- Lack of dedicated left turn lanes resulting in obstructed sightlines for turning movements and may also contribute to sideswipe collisions.

In developing the preliminary design for the Ken Whillans Drive extension preferred alternative, efforts should be made to ensure that the proposed extension intersection is implemented in a standard arrangement and skewed approaches are avoided. Also, shared through and left turn lanes at the intersections should be avoided and dedicated left turn lanes provided where required.

4.4 Safety Assessment of the Ken Whillans Drive Extension Scenarios

The following sections examines the safety aspects of the three (3) potential extension scenarios based on the findings of the historical collision review.

4.4.1 SCENARIO 1 - CONNECTION WITH SCOTT STREET

This scenario could potentially bring vehicle trips away from intersections with higher collisions records along Main Street including Church Street and Nelson Street West as drivers make their way south through the area. Reducing the number of drivers making their way from Ken Whillans Drive to Church Street to Main Street may contribute in reducing the number of turning movement collisions which are predominant at Main Street and Church Street. However, a similar problem can be experienced at new connection intersections if not safely designed.

To connect with the existing Scott Street leg, the Ken Whillans Drive extension would need to connect at a skewed angle due to geometrical constraints and physical restrictions including the Etobicoke Creek. Creating a skewed angle intersection is undesirable as noted in the historical collision review due to its potential to impact turning movements and increase the potential for these types of collisions due to obstructed driver sightlines.

4.4.2 SCENARIO 2 - CONNECTION WITH QUEEN STREET

The potential connection with Queen Street may also have the desired effect of reducing the amount of traffic travelling south from Ken Whillans Drive to Main Street and potentially reducing the number of turning movement collisions at Main Street and Church Street. This option would also be able to connect with Queen Street at a 90° angle and avoid any skewed approaches to the intersection which may result in poor sightlines.

There are concerns though with the grade difference due to the Queen Street rail overpass retaining walls between the existing Queen Street and Maple Avenue which runs parallel to Queen Street which would serve as the connection point for the Ken Whillans Drive extension. Significant works to align the grade differences could result in a steep downward grade for the Ken Whillans Drive extension approach to Queen Street. A steep grade on an approach to an intersection is not ideal as the increased breaking required of drivers (particularly large trucks) and difficulty judging stopping distance may result in increased collisions including rear end collisions. This becomes increasingly frequent during poor weather conditions including snow, ice or even rain.

4.4.3 SCENARIO 3 - CONNECTION WITH NELSON STREET

This option would also bring vehicle trips away from intersections along Main Street with higher recorded collisions and would connect with an intersection which contained only one sideswipe collision in the five (5) years of historical data provided.

The south leg of the intersection (Union Street) does currently approach at a skewed angle which could be problematic for turning movements. During design opportunities be explored to reduce the skew to the maximum possible extent along with other appropriate mitigative measures to alleviate the impacts of the skew.

5 Street Design Concepts - Preferred Scenario

Balancing spatial quality and traffic functions based on networks for all vehicle families lead to a more balanced structure of urban public space. An innovative and emerging street design approach involves laying out desired spatial quality objectives and then deciding on the desired traffic flow. This requires classifying comparable vehicles into a family based on their size and achievable speed, a speed that a vehicle can normally reach without excessive driver's effort. This leads to defining a traffic environment for a street where a certain speed limit applies with special requirements from spatial quality. This traffic environment forms a guiding framework for the layout and design of the street.

Various previous and ongoing studies have recommended the Ken Whillans Drive extension connecting to Nelson Street. Based on the nature of the respective study, the studies envisioned the extension providing different functionality within the transportation network. The City of Brampton Transportation Master Plan Update (TMP) 2015 identified this extension as a two-lane road and recommended it for implementation in a short-term horizon. Active Transportation Master Plan (ATMP) 2019 recommended this connection to be a multi-use path/boulevard path. On the other hand, the ongoing UDMP study sees this connection as a pedestrian priority flexible street with enhanced paving materials, bollards and rolled curbs to provide a seamless extension of the Rosalea Park and Plaza that can be closed to vehicular traffic during community events.

The function of a street as a transport link requires a different design treatment from its function as a public space. Depending on which one of the two is prioritised, streets will look and feel differently. As stated above, a good street achieves a good balance between the two functions. Resultantly, as part of this EA study various street design types have been explored and evaluated to determine the most suitable street type that aligns with the street character envisioned by UDMP yet will provide the functionality to an extent desired by TMP and ATMP.

The following street design concepts were explored:

- Shared Street
- Bike Boulevard
- Active Transportation Only Street
- Conventional multi-modal street

5.1 Shared Street

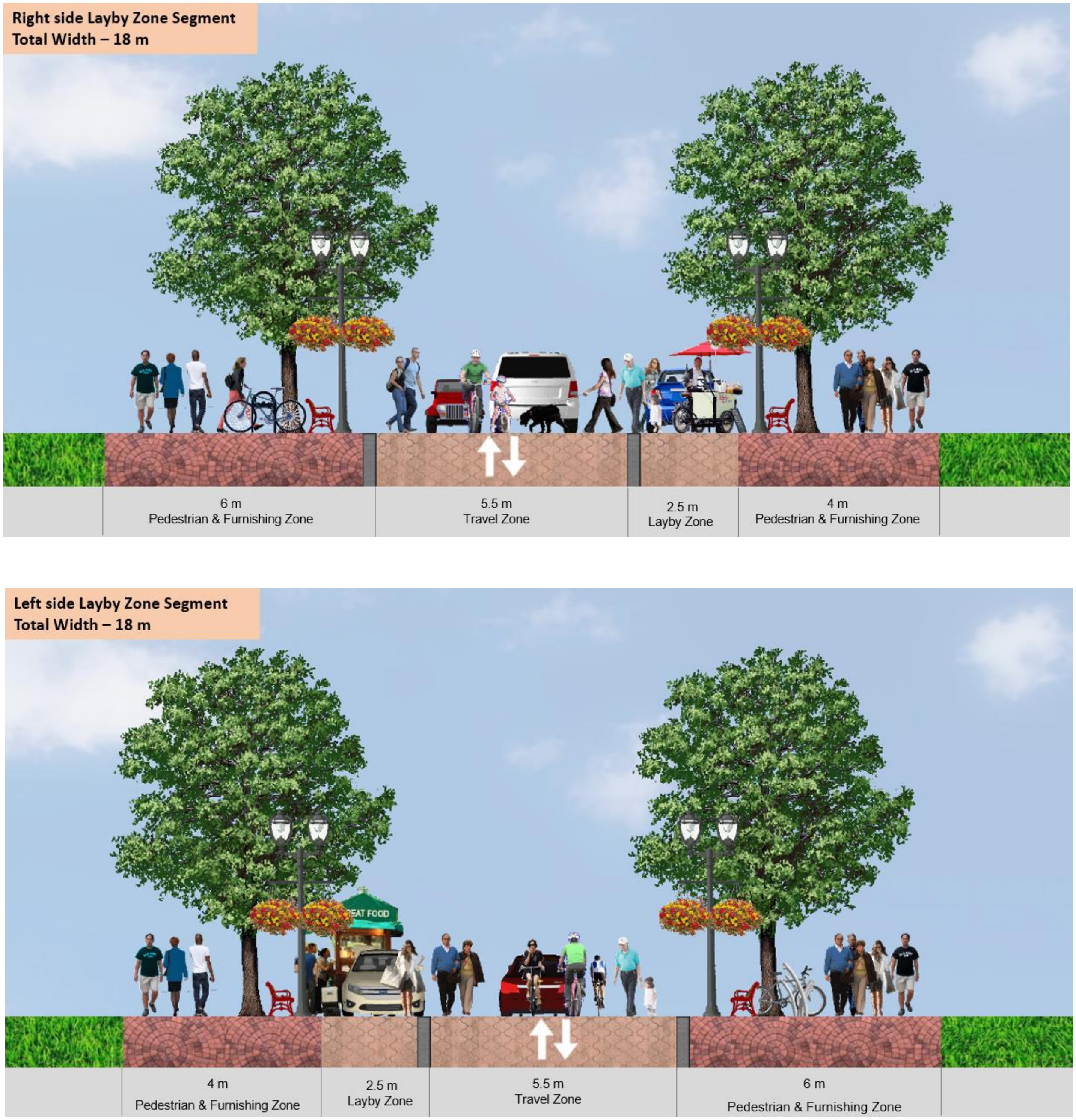
Shared street prioritizes walking and cycling. These streets play a key role in civic function with events and fairs. Commercial activity is particularly important and there are often many desire lines on these streets, therefore crossing opportunities must not be limited. Important design features of a shared street include:

- Strong Pedestrian focus
- Cars are ideally restricted. However, if allowed for access purposes speeds are very low (<15 km/h)
- These are at grade streets or with rolled curbs with no separated ROW. The absence of curbs and sidewalks indicate to motorists that entire street is used by pedestrians. It also tells the drivers that they and other road users are having the same priority.
- Even though a shared street is pedestrian-focussed, an alternative, clear pedestrian path is recommended when a vehicle access is allowed.
- Street furniture such as benches, trees, urban canopies, patios, cycle parking, bollards, and water fountains support a pedestrian friendly environment. These elements can be so organised to define the edges.
- Human scaled street lighting.
- A ramp is provided at entry to add a vertical deflection that to indicate to drivers a threshold for a changing street context. The vertical deflection slows them down as well. Small corner radii and visual narrowing are also important design feature to define the street transition.
- To naturally reinforce the pedestrian focus, the sidewalk paving materials are extended to the entire street. To reflect the human scale of the street, surface of the shared streets is more detailed than conventional streets.

The central travel can be either constructed with using a different paving material or can be defined by a continuous line of paving distinct from the surrounding paving materials. The central vehicle path must be kept narrow to slow them down. A zig-zag pattern can also be introduced to break the straight alignment and slow down the vehicles.

A conceptual cross-section for the Ken Whillans Drive extension based on the shared street design features is shown in Figure 5-1. It features wide pedestrian and furnishing zones to house landscape elements and pedestrian areas. Central travel zone is kept narrow with a layby zone on one side, alternating between right and left side of the travel path. The street furniture and trees are shown for illustrative purposes only as these elements will be designed as part of detailed streetscape design. The total cross-sectional width is 18 m.

FIGURE 5-1: PROPOSED CONCEPT – SHARED STREET CROSS-SECTION



The paving materials and other landscape elements are for illustration purposes only. Actual materials and their colours as well location and type of landscape elements will be determined during the detailed design process.

There is a consideration to use the extension as the Brampton's Farmers' Market space once a week usually on Saturdays. The 2.5 m layby zone can be used for parking the farmers' trucks. Alternatively, an additional space for farmers' trucks is provided on the side opposite to the layby zone, as part of the pedestrian and furnishing zone. This space will be available to pedestrians and for other related uses for other days of the weeks. A conceptual cross-section is shown in **Figure 5-2**. The total cross-sectional width is 20 m. The paving materials and other landscape elements are for illustration purposes only.

FIGURE 5-2: PROPOSED CONCEPT – SHARED STREET CROSS-SECTION WITH ADDITIONAL SPACE FOR FARMERS' TRUCKS

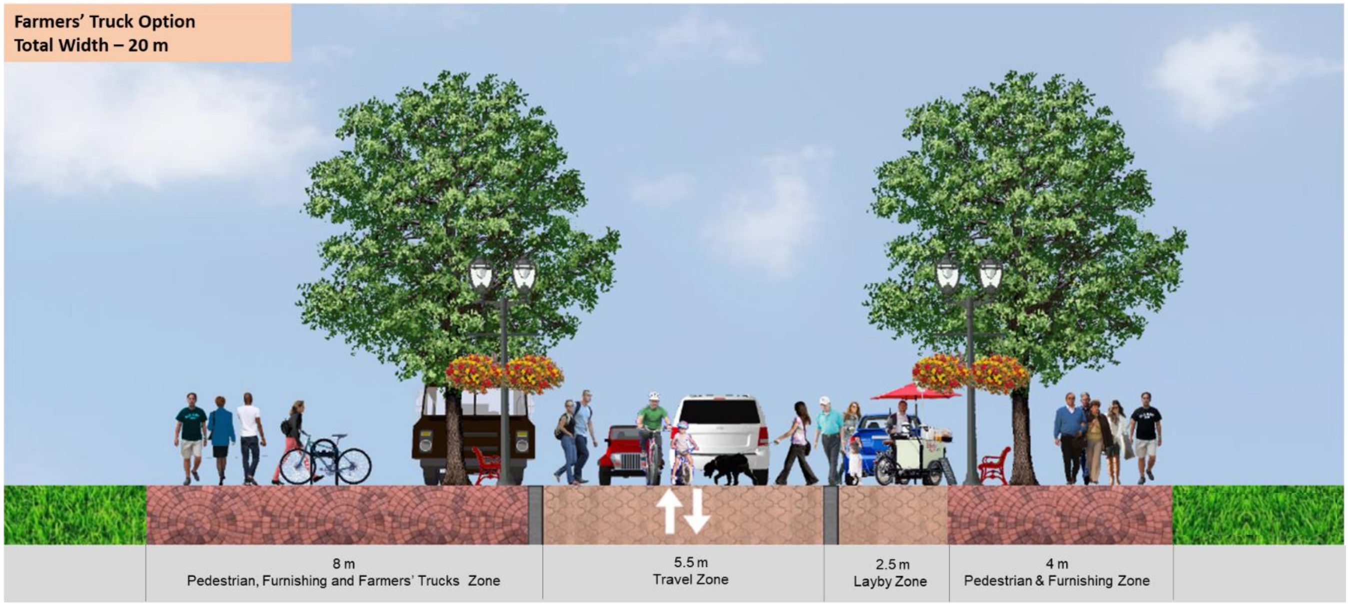


FIGURE 5-3: KEN WHILLANS DRIVE EXTENSION – A SHARED STREET CONCEPT COMPLEMENTING ROSALEA PARK

Figure 5-3 shows a conceptual rendering of the Ken Whillans Drive extension based on the shared street design. All elements in the figure are for illustrative purposes and do not represent the actual design elements. Similarly, the intersections do not represent the actual design. The view is looking west from Rosalea Park to demonstrate how well a shared street can become an extension of the future park and the facilities planned in UDMP west of the extension.

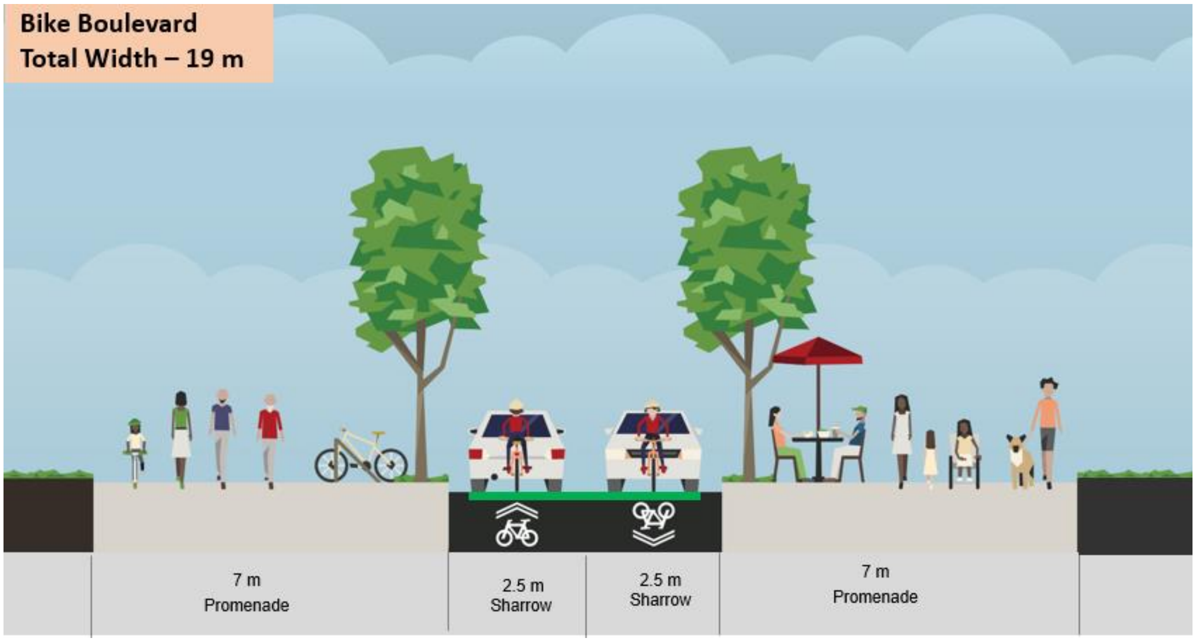
5.2 Bike Boulevard

Bike boulevards are cycle streets which are integral to a cycling network. These are constructed when cyclists using the street exceed the number of vehicles and therefore the design of the street should align with the primary function as a Bike Street. The cars can use the street for access purposes only. The design features of a bike boulevard include:

- Bicycle focus
- Medium speed environment (< 30 km/h). Cyclists dictate the pace at which vehicles travel on cycle streets. Cars are not allowed to pass the cyclists.
- Coloured asphalt or painted asphalt surface 3m to 3.5m wide in the centre giving the feel of a cycle path thus instinctively slowing the vehicles down
- Border strips around 0.75m wide, often in black or grey colour on both side of the cycle path to allow for cars to move through.
- Defined entry points with raised tables to provide vertical deflection to indicate to drives a threshold for a changing street context. And slow them down. Raised tables also allows pedestrians along the side streets to cross at grade.
- Placing raised tables at approximately every 80 m is a technique to ensure that vehicles do not exceed 30 km/h. These raised tables also allow pedestrians to cross the cycle paths when there are desire lines across the street.
- No on street parking is allowed

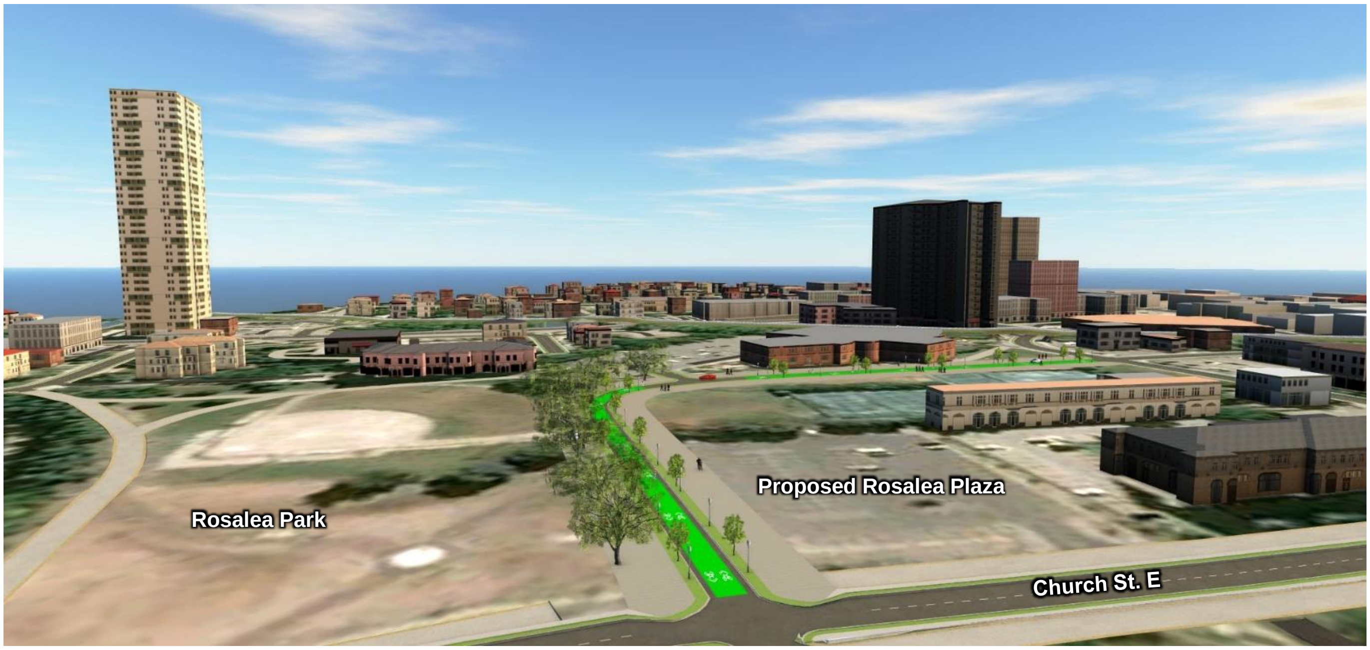
A conceptual cross-section for the Ken Whillans Drive extension based on the bike boulevard design features is shown in **Figure 5-4**. Wide promenades are proposed on both sides to develop pedestrian friendly public space complementing the future Rosalea park facilities. The street furniture and trees are shown for illustrative purposes only as these elements w ill be designed through as part of streetscape design. The total cross-sectional width is 19 m.

FIGURE 5-4: PROPOSED CONCEPT – BIKE BOULEVARD CROSS-SECTION



A conceptual rendering of the Ken Whillans Drive extension based on the bike boulevard design is shown in **Figure 5-5**. All elements in the figure including intersection configuration are for illustrative purposes and do not represent the actual design elements. The view is looking west from Rosalea Park. Wide sidewalks do have the flexibility to fuse with the Rosalea Park facilities however dedicated ROW for cyclists and vehicles breaks the interaction across the street. There is no layby zone restricting pickup and drop functionality required for the future Rosalea Park facilities. Therefore, a bike boulevard fulfills some of the objectives of Ken Whillans Drives as envisioned in UDMP.

FIGURE 5-5: KEN WHILLANS DRIVE EXTENSION – A BIKE BOULEVARD CONCEPT IN RELATION TO ROSALEA PARK



5.3 Active Transportation Connection Only

An active transportation connection is commonly known as multi-use path mostly integrated with a trail network. Multi-use paths are primarily off-road transportation routes for bikes and pedestrians that serve as a necessary extension to the roadway network. These supplement a system of on-road bike network. The design features of a multi-use path include:

- Both non motorized transport and pedestrians use these facilities. Pavement markings and signage can help to clarify how users should share the path.
- Mostly designed for two-way travel.
- Minimum width is 3 m and recommended width is 4-5 m.

A conceptual cross-section for the Ken Whillans Drive extension based on an active transportation only connection design features is shown in **Figure 5-6**. The basic design concept of multi-use path has been modified to provide separate ROW for non-motorized transport users and pedestrians. Like other street design concepts discussed earlier, wide promenades are proposed on both sides to create a public realm aligned with the future Rosalea Park facilities. With the exception of restricted car access, this design concept is same as the bike boulevard. As such it provides similar functionality as a bike boulevard in fulfilling the UDMP's desired objectives from Ken Whillans Drive extension. The street furniture and trees are shown for illustrative purposes only. The total cross-sectional width is 18 m.

FIGURE 5-6: PROPOSED CONCEPT – ACTIVE TRANSPORTATION CONNECTION CROSS-SECTION

5.4 Conventional Multimodal Street

The following typical cross-sections were developed for separately for the segment adjacent to YMCA and the segment next to the proposed Rosalea Park. The options proposed for the segment adjacent to Rosalea Park feature wider sidewalks and on-street parking lane.

- **Segment Adjacent to YMCA**: The cross-section, shown in **Figure 5-7**, features standard 3.5 m drive lanes and 1.5 m bike lanes with 1.5 m side walks on both sides. A boulevard will separate bike lanes from the drive lanes. The overall width is 17 m. No on-street parking is included because YMCA has its own dedicated parking.
- **Segment Adjacent to Rosalea Park**
    - **Option 1 – No On-street Parking:** Same as the cross-section next to YMCA but with wider sidewalk on the Rosalea Park side. The wider sidewalk is proposed to complement the Rosalea Park facilities. It is shown in **Figure 5-8.**
    - **Option 2 – On-street Parking**
        - **Option 2A:** The cross-section shown in **Figure 5-9** has 3 m drive lanes with 2.1 m parking lane on the left side. Painted buffer with planters will be provided to separate bike lanes from the drive lanes.
        - **Option 2B:** Same as Option 2A but with the right-side parking lane. Shown in **Figure 5-10.**

Although this street type provides bike connectivity and fulfills the functionality desired by TMP and ATMP, it is the least desirable from the UDMP perspective. It physically separates the park facilities by providing dedicated ROW for bikes and cars which not only restricts the free pedestrian movement but also creates unsafe environments for the pedestrians using the park facilities.

FIGURE 5-7: PROPOSED CONCEPT – CONVENTIONAL MULTIMODAL STREET CROSS-SECTION

FIGURE 5-8: PROPOSED CONCEPT – CONVENTIONAL MULTIMODAL STREET CROSS-SECTION

FIGURE 5-9: PROPOSED CONCEPT – CONVENTIONAL MULTIMODAL STREET CROSS-SECTION

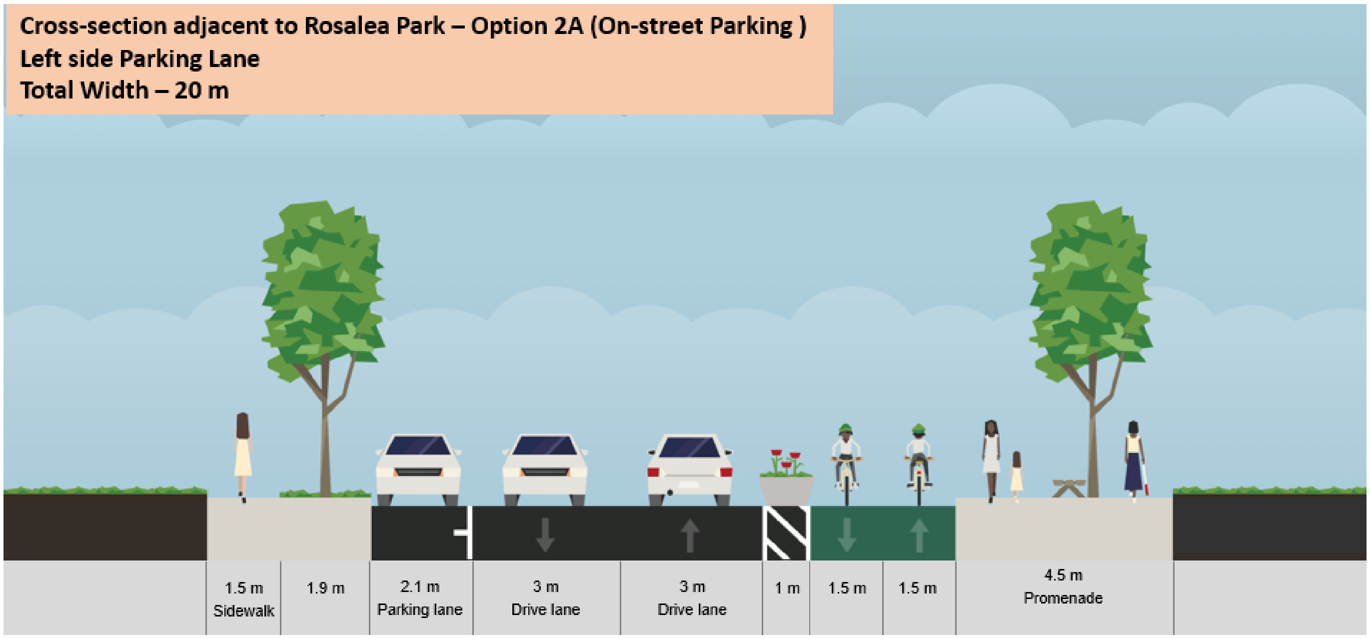
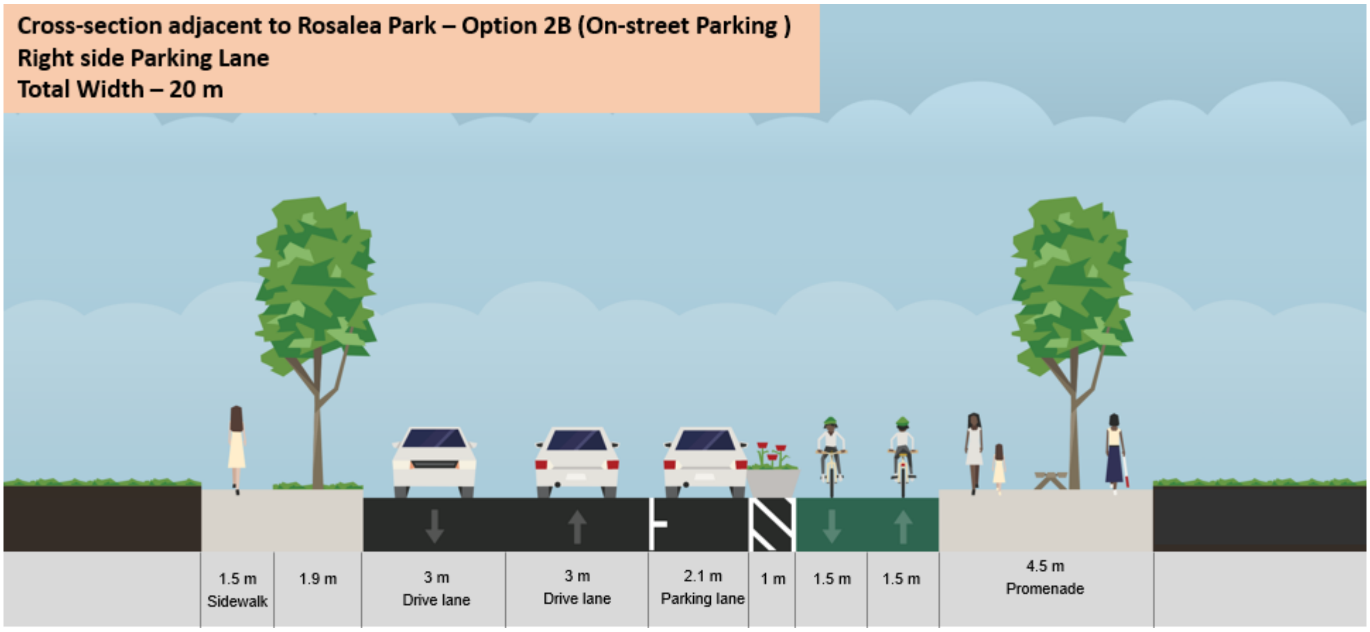


FIGURE 5-10: PROPOSED CONCEPT – CONVENTIONAL MULTIMODAL STREET CROSS-SECTION



5.5 Preferred Street Design

To comparatively evaluate the street design concepts, an evaluation matrix shown in **Figure 5-11** was developed. The evaluation criteria consist of factors that determine if a particular design option aligns with the vision of UDMP. The evaluation suggests that a shared street is the best design option fulfilling all the criteria and therefore should be the preferred street option.

FIGURE 5-11: STREET DESIGN EVALUATION

	Shared Street	Bike Boulevard	Active Transportation Only	Conventional Multi-modal
Public Realm	●	◑	◔	○
Shaping the Downtown	●	◔	○	○
Promotes Civic Functions	●	◔	◔	○
Pedestrian Focus	●	◑	◑	○
Limits Car Demand	◑	◑	●	○
Provides Car Access to Rosalea Park	◑	◔	○	●
Lay-by/On-street Parking for Rosalea Park Facilities	◑	○	○	●
Overall Alignment with the UDMP Vision	●	◔	○	○
Summary	●	◑	◔	○

○ ◔ ◑ ●

Least Desirable → **Most Desirable**

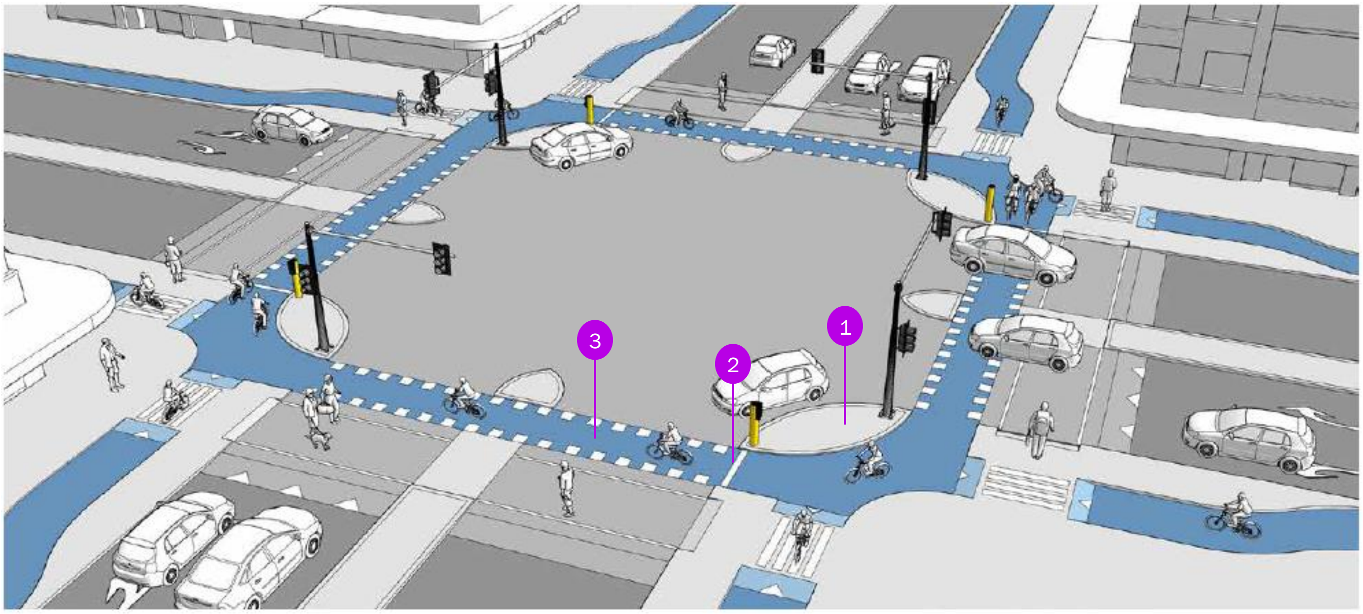
5.6 Proposed Intersection Design

As both ends of the Ken Whillans Drive extension will be a hub of non-motorised user activity, a so called "Protected Intersection" is recommended for the interfaces with the existing streets. A protected intersection design is inspired from Dutch intersection design which includes design elements that make left turns for bikers simple and secure, right turns protected and fast, and provides straight through movements that minimize or eliminate conflicts from turning cars. At protected intersections, bikers are not forced to merge into mixed traffic like a conventional intersection. They are given a dedicated path through the intersection and have the right of way over turning motor vehicles. These intersections also provide shorter and safer crossings for pedestrians.

The main elements of the intersection shown in **Figure 5-12** include:

1. **Corner Refuge Island**: It is the main element extending the protected bike lane separation as far into the intersection as possible. It physically separates the bikers from the turning cars.
2. **Forward Bicycle Stop Bar**: The forward stop location makes bikers clearly visible to drivers waiting at red light. The physical distance ahead of cars provides a head start to bicyclists and the distance to cross is significantly reduced.
3. **The Setback Crossing**: The bike lane turns away from the intersection creating a setback bicycle and pedestrian crossing. Larger setbacks provide better visibility, more space and time for everyone to react to potential conflicts.

FIGURE 5-12: MAIN DESIGN ELEMENTS OF A PROTECTED INTERSECTION. *(FIGURE SOURCE: AUKLAND'S TRANSPORT URBAN STREET AND ROAD DESIGN GUIDE)*



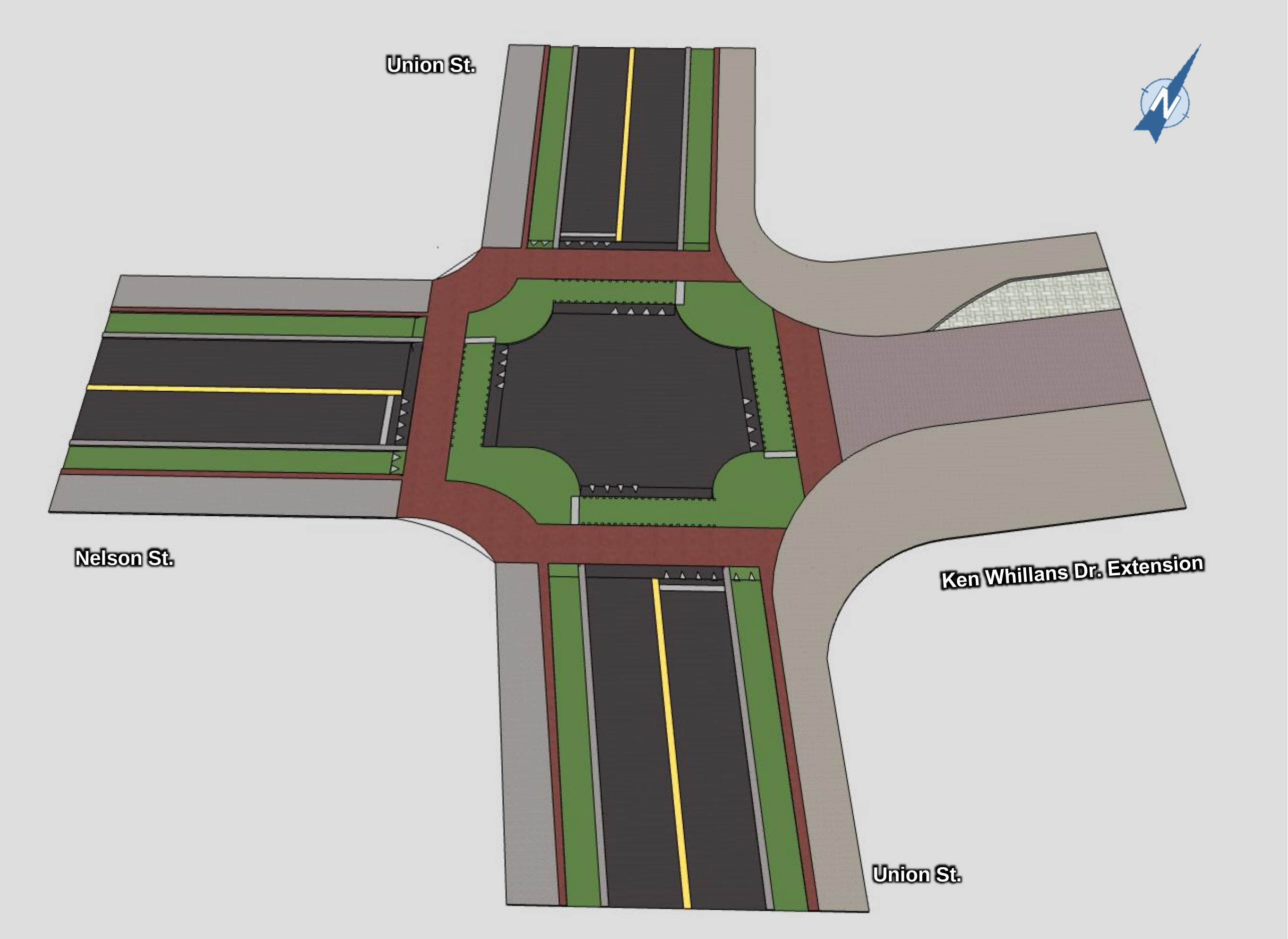
Protected intersections have been implemented across North America. In Ontario, the City of Ottawa has built at numerous locations. Toronto is constructing the first such intersection near Finch Station at the intersection of Murray Ross Boulevard and Evelyn Wiggins Drive. The recently published OTM Book 18 – Cycling Facilities has also included design recommendations about the protected intersections.

Depending on the context of a particular intersection and the space available, it is possible to implement all or some of the elements of the protected intersection concept.

Figure 5-13 presents a conceptual rendering of the protected intersection adapted to the site context of Union Street and Nelson Street interface with the proposed the Ken Whillans Drive extension. The salient features of the design include:

- The intersection generally maintains the existing centerline alignments of the existing approaches.
- Raised pedestrian and bicycle crossings to improve visibility and slow down the vehicles. The Ken Whillans Drive extension is at same level as the pedestrian and bike crossings. Similarly, sidewalks are also at the same level as the pedestrian crossings.
- Different surface materials or colours for pedestrian and bicycle crossings to alert drivers about changing context of the street.
- Single stage pedestrian crossing. Shark teeth to indicate to drivers and bikers to yield to pedestrians.
- The existing Union Street and Nelson Street do not have dedicated bike lanes. A 15 m segment of these streets has been re-designed having separated bike lanes so to guide the traffic and bike into respective areas within the protected intersection. Similar treatment has been provided for pedestrians' surfaces. A transition segment (length to be confirmed through preliminary design) will need to be designed to merge the remodelled intersection approaches with the existing street cross-section.
- The remodelled intersection approaches feature a 3 m lane width, 1.3 m wide bike lane and 2 m wide sidewalks.

FIGURE 5-13: CONCEPTUAL RENDERING OF UNION STREET INTERSECTION AT KEN WHILLANS DRIVE EXTENSION



A similar design will also be applicable to the Church Street intersection at Ken Whillans Drive. Its north approach will however need to be modified to tie-in the existing multi-use trail. As such the north approach will have a two-way bike lane along easterly edge of the Ken Whillans Drive.

The preliminary geometric design including pavement markings of the intersections will be developed according to the design guidelines contained in the newly published OTM Book 18. The streetscape design especially the gateway design for the Ken Whillans Drive Extension will be developed during the detailed design process. Proposed conceptual design can be considered during the detail design phase if the City plans to implement the bicycle facilities along the Union and Church Streets corridors.

To further calm down the traffic within the intersection, a mountable circle can be considered in the centre. The circle will not only slow down the left-turning vehicle but will also bring in the benefits of a roundabout within a four-legged intersection setting. All other features of the intersection as shown in **Figure 5-12** will remain the same except that the size of the intersection will be slightly larger to accommodate the centre circle. The mountable circle will allow a large size vehicle to negotiate the tight radii of the intersection.

6 Conclusions & Recommendations

The report summarized the work completed as apart of transportation and safety assessment in support of Ken Whillans Drive Extension MCEA. Following are the main findings and design recommendations resulting from the assessment work.

6.1 Analysis Conclusions

- The City of Brampton's currently ongoing Riverwalk Urban Design Master Plan (UDMP) study proposes Ken Whillans extension to be a complete pedestrian priority street with enhanced paving materials, bollards and rolled curbs to provide a seamless extension of the Rosalea Park and Plaza that can be closed to vehicular traffic during community events.
- The City of Brampton Transportation Master Plan Update (TMP) 2015 identified this extension as a two-lane road and recommended it for implementation in a short-term horizon. Active Transportation Master Plan (ATMP) 2019 recommended this connection to be a multi-use path/boulevard path.
- The following three Ken Whillans Drive extension scenarios were evaluated as part of this transportation assessment. The scenarios are shown in **Figure 3-7**:
    - Scenario 1 – Connection with Scott Street
    - Scenario 2 – Connection with Queen Street
    - Scenario 3 – Connection with Nelson Street
- The Network Analysis based on the 2031 horizon EMME plots provided by the City suggests that the extension will attract more traffic to the study area. The traffic increase ranges between 7% - 13% for Scenario 1, and between 5% - 13% for Scenario 2 during both the AM and PM peak hours. The traffic increase for Scenario 3 remains under 3% compared to Do Nothing scenario.
- Scenario 3 extends Ken Whillans Drive to Nelson Street East at Union Street. The Network Analysis reveals that the extension to Nelson Street effectively functions as an alternate to the Church Street segment between Union Street and Ken Whillans Drive. Therefore, restricting the cut through traffic on Ken Whillans Drive extension will not adversely impact the Church Street segment which is operating within capacity under "Do-Nothing" conditions. Therefore, directing the traffic away from the extension will allow to develop the extension as a safe pedestrian priority street that is more suited to the intended functionality of the street as outlined in UDMP.
- The future 2031 and 2041 conditions traffic analysis showed that the east-west movements along Church Street are constrained during the PM peak hour. The northbound movement at the Church Street and Scott Street intersection is constrained because of the free east-west movements.

- No measures are recommended to improve the traffic flow along Church Street as such localized conditions are expected during peak times. It is also noted that the future forecasts are based on long term growth projections from EMME model which is deterministic in nature and does not consider the drivers' perception and behaviour that evolve over time adapting to the changing traffic conditions. The study area is a mature neighbourhood adjacent to the Downtown where physical capacity addition is mostly not feasible. Such conditions present a unique opportunity to influence the peoples' travel mode choice by providing them with more sustainable alternatives. Such a less auto-dependent mobility environment will further reinforce the public realm planned for the study area.
- The review of historical intersection collision data reveals that the intersection of Ken Whillans Drive with Church Street East where the proposed extension would begin contained a total of eight (8) collisions recorded over the five years. The predominant collision type was single motor vehicle other with a total of four (4) such collisions.
- The intersection of Nelson Street and Union Street which is a potential option for the terminal end of the Ken Whillans Drive extension accounted for only one (1) collision recorded over the five (5) years which was classified as a sideswipe.
- Within the immediate area of the proposed Ken Whillans Drive extension, the intersections of Main Street with both Church Street East and Main Street West have turning movement and sideswipe collisions as predominant collision types. Through a review of the physical characteristics of these intersections, the following functional issues were identified which could potentially contribute to these collision types:
    - Skewed approaches to the intersections resulting in obstructed sightlines for turning movements; and
    - Lack of dedicated left turn lanes resulting in obstructed sightlines for turning movements and may also contribute to sideswipe collisions.
- Out of the three extension scenarios, Scenario 3 – Connection with Nelson Street has the least safety impacts and the safest option for a pedestrian friendly street.

6.2 Design Recommendations

- Scenario 3 – Connection with Nelson Street is the preferred extension scenario.
- Four street types, namely Shared Street, Bike Boulevard, Active Transportation only street and Conventional Mult-modal street were explored as design options. A shared street is the preferred street design as it provides a good balance between the function of a street as a transport link and the function as a public space. Being a pedestrian priority street playing a key role in supporting civic functions, it most suitably aligns with the street character envisioned by UDMP yet will provide the functionality to an extent desired by TMP and ATMP.
- A protected intersection is recommended for the Ken Whillans Drive extension's both interfaces with the existing streets. A protected intersection includes design elements that make left turns for cyclists simple and secure, right turns protected and fast, and provides straight through movements that minimize or eliminate conflicts from turning cars.
- A conceptual model of the Union Street intersection at Nelson Street/Ken Whillans Drive extension is shown in Figure 5-13. A similar design will be applicable to the Church Street intersection at Ken Whillans Drive with the exception that its north approach will have a two-way bike lane along easterly edge of the Ken Whillans Drive. Proposed conceptual design can be considered during the detail design phase if the City plans to implement the bicycle facilities along the Union and Church Streets corridors.
- A mountable circle can be considered at the centre of the intersection as an additional calming measure. The circle will not only slow down the left-turning vehicle but will also bring in the benefits of a roundabouts within a four-legged intersection setting. The mountable circle will allow a large size vehicle to negotiate the tight radii of the intersection.

APPENDIX A

CITY OF OTTAWS'S MMLOS METHODOLOGY

DRAFT REPORT

Multi-Modal Level of Service (MMLOS) Guidelines

Supplement to the TIA Guidelines

Prepared for City of Ottawa
by IBI Group
September 15, 2015

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1 Purpose of Guidelines & Introduction to Multimodal Level of Service

In the past, municipalities often focused on the performance of vehicular traffic in evaluating the level of service (LOS) on streets. Since no comparable LOS measures have been commonly institutionalized for other modes of travel, the tradeoffs between vehicle delay and its impacts on the quality of travel by other modes are often overlooked. That is, the typical outcome of improving level of service is wider roads with more travel lanes, higher vehicle volumes, and faster vehicle speeds. These network modifications often degrade conditions for other modes (i.e. walking and cycling), and this tradeoff is not incorporated into the standard motor vehicle LOS indicator.

However, recognition of the need to provide more multi-modal streets has marked a shift towards establishing performance measures for all modes: cycling, walking, transit and vehicular. This all-in-one evaluation tool is referred to as Multimodal Level of Service (MMLOS), and will allow comparison using similar performance metrics for each mode.

For the purposes of the report, the multimodal level of service is defined as follows:

> *A set of discrete quantitative measures used to describe the convenience and comfort experienced by all roadway users over a particular roadway segment or at a particular intersection.*

This document provides guidance on the application of the City of Ottawa's new MMLOS framework, providing an overview and step-by-step guide to the evaluation of level of service for all modes.

1.1 Background

In late 2013, the City of Ottawa completed a full update to their Transportation Master Plan (TMP). The TMP includes recommendations and actions that support the development of "Complete Streets" as a component of providing safe and efficient roads.

As part of the Complete Street Implementation Framework, one of the tools identified to support the process was the development of an MMLOS framework, which was presented as an action item in the TMP document:

> ***Action 7-3: Use multimodal levels of service to assess road designs and allocate right of way.***

The TMP provides high level direction on how multimodal level of service (MMLOS) will be considered and outlines preliminary measures for each mode – pedestrians, cycling, transit, and motor vehicles. This guideline builds upon the work of the TMP and subsequent research into Multi-Modal Level of Service Indicators to provide a detailed overview of how the multi-modal level of service indicators are to be used and interpreted as part of the transportation impact assessment process.

1.2 Application of MMLOS Guidelines

The MMLOS tools are intended to be applied across a variety of projects that require detailed analysis of transportation impacts. In other words, **whenever a project or study requires the completion of level of service analysis, MMLOS should be applied**. Scenarios that require MMLOS evaluation may include transportation environmental assessments, corridor studies, neighbourhood traffic management studies, or development projects (through the TIA process).

For the latter, the existing Transportation Impact Assessment (TIA) Guidelines provide guidance on transportation reporting requirements for development applications. Depending on the size of the development, there are three types of reports: Transportation Briefs, Transportation Impact Studies, and Community Transportation Studies that review both vehicular and non-auto modes. Only detailed level of service (LOS) procedures for auto modes have been provided in previous TIA Guidelines. This document is intended to supplement, rather than supersede, the TIA Guidelines by providing detailed guidance on the MMLOS methods. The MMLOS is to be applied in a manner consistent with the TIA Guidelines, in other words, whenever a project requires the completion of level of service analysis for a Community Transportation Study, Transportation Brief, or Transportation Impact Study, then MMLOS must also be evaluated.

This document is intended to provide guidance to practitioners (City staff, consultants, etc.) in applying the new MMLOS methodology. It is not intended to provide a detailed background on how and why the specific criteria were selected for each mode. An alternative background report, *Developing Multi-Modal Level of Service Indicators for the City of Ottawa*, provides a more detailed analysis of each evaluation tool and the individual factors used in developing the MMLOS framework.

As the first iteration of the City of Ottawa's MMLOS framework, the methodology is still evolving. Practitioners are encouraged to provide feedback on the process laid out in this report and to consider the application of other parallel processes where appropriate to address and analyze the impact of transportation projects. The City will continue to monitor the results of the framework over time and to adjust and calibrate the individual level of service tools based on experience and local conditions.

Ultimately, the MMLOS is intended to act as tool for evaluating trade-offs and to inform decisions about transportation improvements for all modes in a more thorough way than has previously been possible through conventional, vehicular-focused level of service evaluation. This shift is consistent with the TMP direction to incorporate complete streets principles into guidelines, standards and processes. Further discussion on the evaluation of trade-offs is included in Section 7.

It is important to note that this document is not intended to replace professional judgement about geometry, safety or accessibility considerations. The document is intended to provide guidance rather than to be prescriptive in articulating design elements. This document is far from all-encompassing – practitioners are encouraged to interpret the guidelines as they may relate to non-standard treatments or configurations so long as the original intent of the methodology is maintained.

1.3 Methodological Overview

For each of the travel modes identified in this document, LOS measures are proposed for road segments and signalized intersections. One exception is the vehicular level of service which is evaluated only at intersections, as laid out in the current TIA guidelines.

Road segments are defined as the roadway links between signalized intersections. In some cases it may be necessary to evaluate separate segment LOS scores for each direction of travel.

Only signalized intersections are considered for the intersection LOS measures. In the case of motor vehicle LOS, it is simple to aggregate LOS for all intersection approaches into an overall intersection LOS measure by simply determining the delay per vehicle, or the overall intersection volume to capacity ratio in the case of the City of Ottawa. For the LOS measures related to other modes, however, it is not as straightforward, and accordingly each LOS procedure outlines the strategy to be taken in presenting and evaluating intersection LOS. In many cases, each approach of the intersection will score differently for each mode, and results should be illustrated for each approach.

The MMLOS allows for comparison of modes in order to evaluate trade-offs by assessing the critical parameters that determine the relative attractiveness and comfort for particular mode along a corridor. These factors vary – an overview of each LOS range is presented in Exhibit 1.

Exhibit 1 – LOS Ranges by Mode

MODE	ELEMENT	LEVEL OF SERVICE	
Pedestrians (PLOS)	Segments	*High level of comfort*	*Low level of comfort*
	Intersections	*Short delay, high level of comfort, low risk*	*Long delay, low level of comfort, high risk*
Bicycles (BLOS)	Segments	*High level of comfort*	*Low level of comfort*
	Intersections	*Low level of risk / stress*	*High level of risk / stress*
Trucks (TkLOS)	Segments	*Unimpeded movement*	*Impeded movement*
	Intersections	*Unimpeded movement / short delay*	*Impeded movement / long delay*
Transit (TLOS)	Segments	*High level of reliability*	*Low level of reliability*
	Intersections	*Short delay*	*Long delay*
Vehicles (LOS)	Intersections	*Low lane utilization*	*High lane utilization*

Although the LOS methodology enables trade-offs to be made between modes, it is still important to consider the scales of each mode as independent from one another. In other words, because the level of service tools measure different factors, they do not necessarily cover the same spectrum of conditions. A vehicle experiencing LOS F with high lane utilization will likely encounter long delays and congested conditions. However this does not necessarily represent the lack of comfort, higher risk or stress that LOS F represents for cyclists, or lack of comfort, longer delays or higher risk that LOS F represents for pedestrians. The varying ranges are reflected in the methodologies for each mode, but also in the target table provided in Section 7.

The following sections provide a detailed explanation of the intent, data requirements, and calculation steps for each modal LOS. For further clarity, examples from the Ottawa context are included in Appendix A.

2 Pedestrian Level of Service (PLOS)

2.1 Intent

The primary intent of the Pedestrian Level of Service (PLOS) tool is to evaluate pedestrian comfort, safety and convenience. The segment analysis is based on the quality of pedestrian facilities and impact of adjacent traffic while the intersection methodology considers two factors – delay experienced by pedestrians, and Pedestrian Exposure to Traffic at Signalized Intersections (PETSI). The PETSI approach was originally based on the Charlotte NC Pedestrian LOS at Signalized Intersections methodology, although it has been adapted significantly to better suit the Ottawa context.

It should be noted that there are many additional factors that contribute to pedestrian comfort beyond the effects of the facility and adjacent traffic including lighting, land use / built form, urban design elements and streetscaping, including vegetation and trees. While it is beyond the scope of MMLOS to address all of these elements, appropriate City of Ottawa planning and design documents should be referenced in the design of the boulevard and pedestrian way. This may include specific consideration of street trees and other vegetation / bio-swale options to create Green Street Designs as per the Urban Tree Strategy, or various Road Corridor Planning & Design Guidelines. Street trees and other elements can have a positive effect on the pedestrian environment and other users of the corridor.

2.2 Data Requirements

Data required to evaluate the pedestrian level of service is summarized in Exhibit 2 below.

Exhibit 2 - Data Requirements for Pedestrian Level of Service

SEGMENTS	SIGNALIZED INTERSECTIONS
» Vehicular operating speed » Sidewalk width » Boulevard width » Motor vehicle volume (AADT / lane) » Presence of on-street parking	**Exposure to Traffic** » Street width (number of through lanes to be crossed – with or without a median) and presence of refuge island for crossing pedestrians » Right & left turn conflicts based on phasing (permitted, protected/permitted, protected, prohibited) and pedestrian-only phases (leading pedestrian interval) » Right turn on Red (RTOR) restrictions » Corner radius and type (smart right turn channel, right turn channel with receiving lane) » Crosswalk treatment (transverse marking, zebra stripe markings, textured/coloured crosswalks, raised crosswalks) **Delay** » Cycle length » Pedestrian green time (walk time)

2.3 Methodology

The methodology for evaluating PLOS at a segment level utilizes a look-up table approach based on cross-section and roadway characteristics. Judgement should be applied when determining which section of a corridor to evaluate as representative of the segment. In most cases, sidewalks on both side should be evaluated and documented, however the segment overall score can be taken from the lowest quality facility on that segment. There may be certain land-use designations or policies where sidewalks are required on one side of the street only and therefore only one side of the street is evaluated.

In rural settings where sidewalks are not typically provided and paved shoulders are available for pedestrians to use, several issues are to be considered regarding the suitability of the paved shoulders as pedestrian space:

- Maintenance – Paved shoulders may be maintained differently than sidewalks i.e. they may be partially, rather than fully cleared of snow and debris, or they may be maintained with less priority after snow fall than a sidewalk in an urban area.
- Lack of physical separation – Because paved shoulders are not separated from the travelled way, there is a greater risk of encroachment from vehicles, particularly oversized trucks or trailers can pose a greater risk to pedestrians.

- Potential blockage – Paved shoulders are intended to provide space for vehicles to pull off of a roadway in case of an emergency. As such, they are not designated for pedestrian use only in the same way as a sidewalk.
- Accessibility – Paved shoulders may not meet accessibility requirements as they relate to clear width (which can be impacted by features such as rumble strips) or cross-slope, as it is often more challenging to provide a gentle cross-slopes along rural roads.

For these reasons, paved shoulders are not considered to be a substitute for sidewalks. However, paved shoulders may be the only appropriate and/or available pedestrian facilities in rural settings where pedestrian volumes are low. In recognition of this, paved shoulders may be evaluated based on the existing methodology as if it they are sidewalks but it is recommended that the resulting score be adjusted down one grade to recognize their differences as noted above.

Note that when using the segment look-up table, the sidewalk width which is closest to the actual measured width (within reason) should be used to evaluate the PLOS. i.e. a sidewalk of 1.6m would be rounded down and evaluated as a 1.5m sidewalk.

The intersection PLOS is based on two separate measures:

1. Pedestrian Exposure to Traffic at Signalized Intersections (PETSI), adapted from the City of Charlotte’s Pedestrian LOS at Signalized Intersections – evaluated using PETSI scoring tables
2. Average delay to pedestrians crossing the street using the Highway Capacity Manual (HCM) method – evaluated based on a simple equation

The PETSI approach is the most data intensive in that points must be assigned for each element of the intersection. Each approach must be evaluated individually where conditions change and the overall intersection score will be taken from the worst approach.

An overview of the PLOS methodology is provided in Exhibit 3, with look-up and scoring tables provided in the following exhibits: Exhibit 4, Exhibit 5, Exhibit 6 and Exhibit 7.

An example illustrating the application of the PLOS methodology is provided in Appendix A.

Exhibit 3 – PLOS Evaluation Methodology

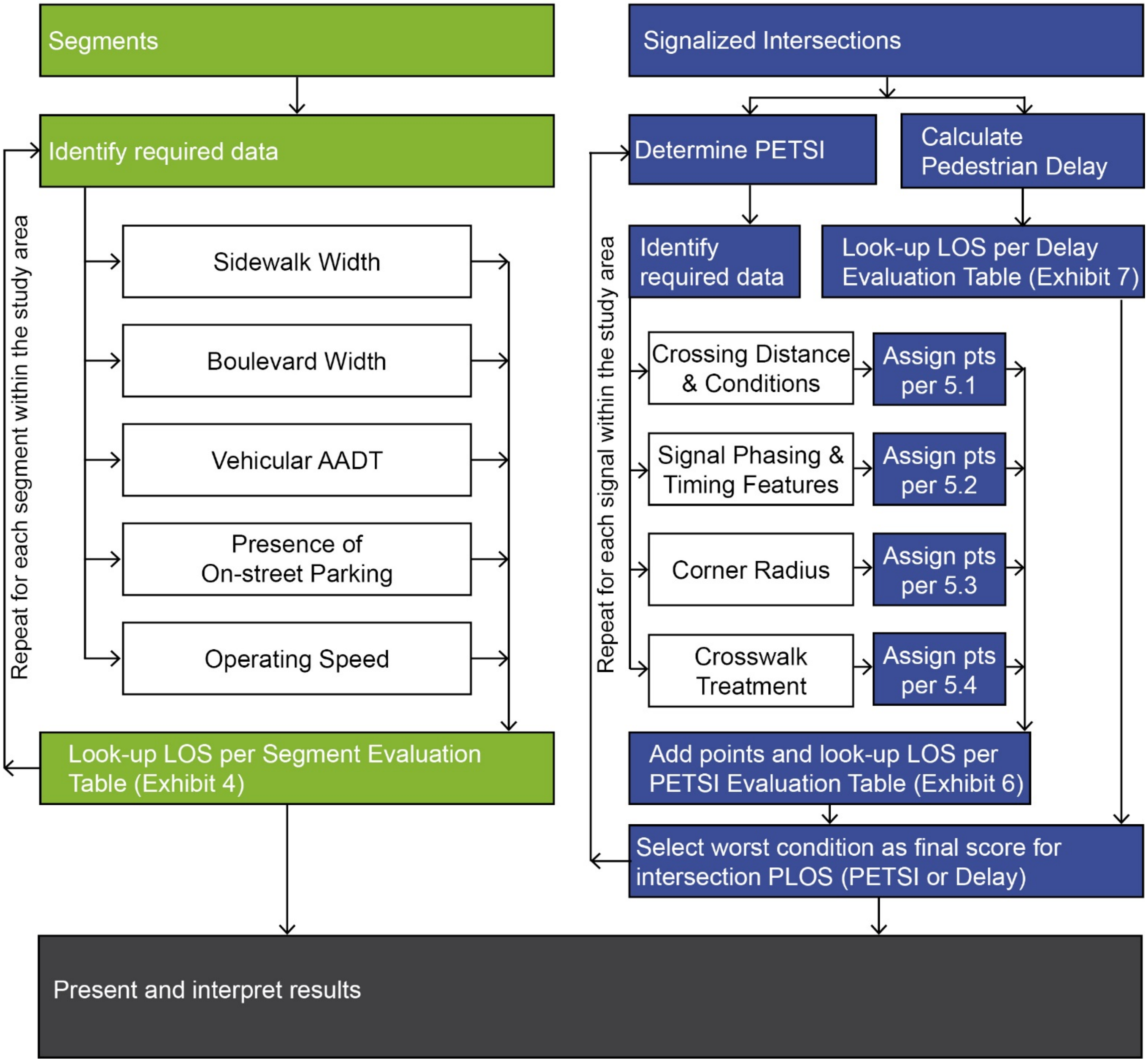


Exhibit 4 – PLOS Segment Evaluation Table

Sidewalk Width (m)	Boulevard Width (m)	Motor Vehicle Traffic Volume (AADT)	Presence of On-street Parking	Segment PLOS			
				Operating Speed (km/h)			
				≤30	>30 or 50	>50 or 60	>60[1]
2.0 or more	> 2	≤ 3000	N/A	A	A	A	B
		> 3000	Yes	A	B	B	N/A
			No	A	B	C	D
	0.5 to 2	≤ 3000	N/A	A	A	A	B
		> 3000	Yes	A	B	C	N/A
			No	A	C	D	E
	0	≤ 3000	NA	A	B	C	D
		> 3000	Yes	B	B	D	N/A
			No	B	C	E	F
1.8	> 2	≤ 3000	N/A	A	A	A	B
		> 3000	Yes	A	B	C	N/A
			No	A	C	D	E
	0.5 to 2	≤ 3000	N/A	A	B	B	D
		> 3000	Yes	A	C	C	N/A
			No	B	C	E	E
	0	≤ 3000	N/A	A	B	C	D
		> 3000	Yes	B	C	D	N/A
			No	C	D	F	F
1.5	> 2	≤ 3000	N/A	C	C	C	C
		> 3000	Yes	C	C	D	N/A
			No	C	D	E	E
	0.5 to 2	≤ 3000	N/A	C	C	C	D
		> 3000	Yes	C	C	D	N/A
			No	D	E	E	E
	0	N/A		D	E	F[2]	F[2]
<1.5	N/A			F[3]	F[3]	F[3]	F[3]
No sidewalk	N/A			C[4]	F[3]	F[3]	F[3]

Notes:
1. On-street parking not provided on roadways with posted speed of 70 km/h or more
2. Sidewalk must be 1.8 m wide if no separation is provided (curb-face sidewalk) where speeds are high
3. Sidewalk must be 1.5 m wide to meet Provincial accessiblity standards
4. Ottawa Pedestrian Plan, 2014: "all new and reconstructed urban local roads where pedestrian facilities are required in accordance with these policies but no dedicated pedestrian facility is provided, require that roads be designed for a speed of 30 km/h or lower (pending development of a new 30 km/h roadway design standard)." Where a roadway is specifically designed as 'shared space', with appropriate design controls and features, it can achieve LOS A.
5. Where a multi-use path is provided in lieu of sidewalks, the MUP can be evaluated using the same methodology.

Exhibit 5 – PETSI Point Tables

5.1 Crossing Distance & Conditions		
Total travel lanes crossed	No median	With Median (>2.4m)
2	120	120
3	105	105
4	88	90
5	72	75
6	55	60
7	39	45
8	23	30
9	6	15
10	-10	0

Island Refuge	Points
No	-4
Yes	0

5.2 Signal Phasing & Timing Features	
Left turn conflict ("Left_turns")	Points
Permissive	-8
Protected/permissive	-8
Protected	0
No left turn/prohibited	0
Right turn conflict ("Right_turns")	Points
Permissive or yield control	-5
Protected/permissive	-5
Protected	0
No right turn	0
Right turns on red ("RTOR")	Points
RTOR allowed	-3
RTOR prohibited at certain time(s)	-2
RTOR prohibited	0
Leading ped interval? ("LPI")	Points
No	-2
Yes	0

5.3 Corner Radius	
Corner radius	Points
Greater than 25m	-9
> 15m to 25m	-8
> 10m to 15m	-6
> 5m to 10m	-5
> 3m to 5m	-4
Less than/equal to 3m	-3
No right turn	0
Right turn channel with receiving	-3
Right turn "smart channel"	2

5.4 Crosswalk Treatment	
Crosswalk treatment ("Crosswalk")	Points
Standard transverse markings	-7
Textured/coloured pavement	-4
Zebra stripe hi-vis markings	-4
Raised crosswalk	0

Exhibit 6 – PETSI Evaluation Table

Pedestrian Exposure to Traffic LOS	
Points threshold	LOS
≥90	A
≥75	B
≥60	C
≥45	D
≥30	E
<30	F

Exhibit 7 – Pedestrian Delay Evaluation Table

Average Pedestrian Crossing Delay Component

$$\text{Delay} = 0.5 \times \frac{(\text{Cycle Length} - \text{Pedestrian Effective Walk Time})^2}{\text{Cycle Length}}$$

< 10 s per intersection leg	LOS A
≥10 to 20 sec	LOS B
>20 to 30 sec	LOS C
>30 to 40 sec	LOS D
>40 to 60 sec	LOS E
> 60 sec	LOS F

3 Bicycle Level of Service (BLOS)

3.1 Intent

The intent of the Bicycle Level of Service (BLOS) tool is to evaluate both roadway segments and signalized intersections for the level of traffic stress (LTS) experienced by cyclists using the corridor. The methodology, based on a recent Mineta Transportation Institute report (no. 11-19), relates the LTS on a facility to the degree of comfort experienced by a cyclist and targeted users. The City of Ottawa has adapted the tool to allow for comparison with other modes by mapping LTS to level of service A-F as shown in Exhibit 8.

Exhibit 8 – Qualitative descriptions for each LTS score (adapted from MTI Report no. 11-19)

LTS	DESCRIPTION	CATEGORY OF CYCLIST	CITY OF OTTAWA LOS
LTS 1	Presenting little traffic stress and demanding little attention from cyclists, and attractive enough for a relaxing bike ride. Suitable for almost all cyclists, including children trained to safely cross intersections. On links, cyclists are either physically separated from traffic, or are in an exclusive bicycling zone next to a slow traffic stream with no more than one lane per direction, or are on a shared road where they interact with only occasional motor vehicles (as opposed to a stream of traffic) with a low speed differential. Where cyclists ride alongside a parking lane, they have ample operating space outside the zone into which car doors are opened. Intersections are easy to approach and cross.	All ages and skill levels – both children and adults	A
LTS 2	On links, cyclists are either physically separated from traffic, or are in an exclusive bicycling zone next to a well-confined traffic stream with adequate clearance from a parking lane, or are on a shared road where they interact with only occasional motor vehicles (as opposed to a stream of traffic) with a low speed differential. Where a bike lane lies between a through lane and a right turn lane, it is configured to give cyclists unambiguous priority where cars cross the bike lane and to keep car speed in the right-turn lane comparable to bicycling speeds. Crossings are not difficult for most adults.	Most cyclists	B
LTS 3	More traffic stress than LTS 2, yet markedly less than the stress of integrating with multilane traffic, and therefore welcome to many people currently riding bikes in American cities. Offering cyclists either an exclusive riding zone (lane) next to moderate-speed traffic or shared lanes on streets that are not multilane and have moderately low speed. Crossings may be longer or across higher-speed roads than allowed by LTS 2, but are still considered acceptably safe to most adult pedestrians.	Most experienced adult cyclists	C, D based on facility characteristics
LTS 4	A level of stress beyond LTS3.	Very confident cyclists only	E, F based on facility characteristics

Since the LOS methodology is related to the type of cyclists that will be comfortable on certain roads and facilities, it provides support and justification for infrastructure improvements that may attract new riders.

3.2 Data Requirements

Data required to evaluate the bicycle level of service is dependent on the cycling facility / intersection type, as shown in Exhibit 9.

Exhibit 9 – Data Requirements for Bicycle Level of Service by Facility Type

SEGMENTS	SIGNALIZED INTERSECTIONS
Mixed Traffic (No cycling facility) » Street width (total number of lanes in both directions) » Vehicular operating speed **Bike Lanes** » Street width (number of through lanes per direction) » Bike lane width (including marked buffer and paved gutter width) » Parking lane width (where bike lane is adjacent to parking lane) » Vehicular operating speed » Qualitative assessment of commercial deliveries for commercial areas **Physically Separated Bikeway (includes cycle tracks, protected bike lanes and multi-use paths)** » No additional information needed **Unsignalized Crossings** » Presence of median refuge suitable for bicycle storage (≥1.8m wide) » Width of street being crossed (number of lanes in both directions) » Speed limit of street being crossed	**Pocket bike lanes** » Right turn lane characteristics (number of right turn lanes, length of turn lane, turning speed) » Vehicular operating speed » Left turn accommodation (presence of bike box, number of left turn lanes, number of lanes crossed) **Mixed Traffic (No cycling facility)** » Right turn lane characteristics (number of right turn lanes, length of turn lane, turning speed) » Vehicular operating speed » Left turn accommodation (presence of bike box, number of left turn lanes, number of lanes crossed)

Note that the number of lanes as defined for ‘Mixed Traffic’ is the total number of lanes (both directions), while in the cases of streets with bike lanes the number of lanes is defined in terms of the lanes per direction).

Judgement should be used when adapting the methodology to facility types or configurations not currently provided for in the methodology. Although the methodology was developed for the urban context, certain elements may be relevant in a more rural setting. For example, paved shoulders in the rural context may be evaluated as bike lanes, although they are unlikely to score high due to the high operating speeds on rural roads. This reflects more experienced adult cyclist making use of these facilities, which may be appropriate in the rural context. For unusual conditions such as shared bus / bike lanes, the more conservative conditions should be considered i.e. a shared bus-bike lane would be evaluated as mixed traffic.

3.3 Methodology

The BLOS methodology relies on a ‘weakest’ link approach. In other words, the most severe corridor / intersection will dictate the overall LOS score. As a result, it is prudent to begin the analysis with the worst section of the corridor (i.e. a street segment with cycle track along most of the corridor except for one block of bike lanes should be analyzed based on the section with the bicycle lanes), in order to understand the critical scores for a segment.

As with the PLOS evaluation, each direction or intersection approach with different facilities must be evaluated separately as part of the segment or signal analysis.

The evaluation methodology is summarized in Exhibit 10, with the corresponding segment and intersection tables provided in Exhibit 11 and Exhibit 12.

An example illustrating the application of the BLOS methodology is provided in Appendix A.

Exhibit 10 – BLOS Evaluation Methodology

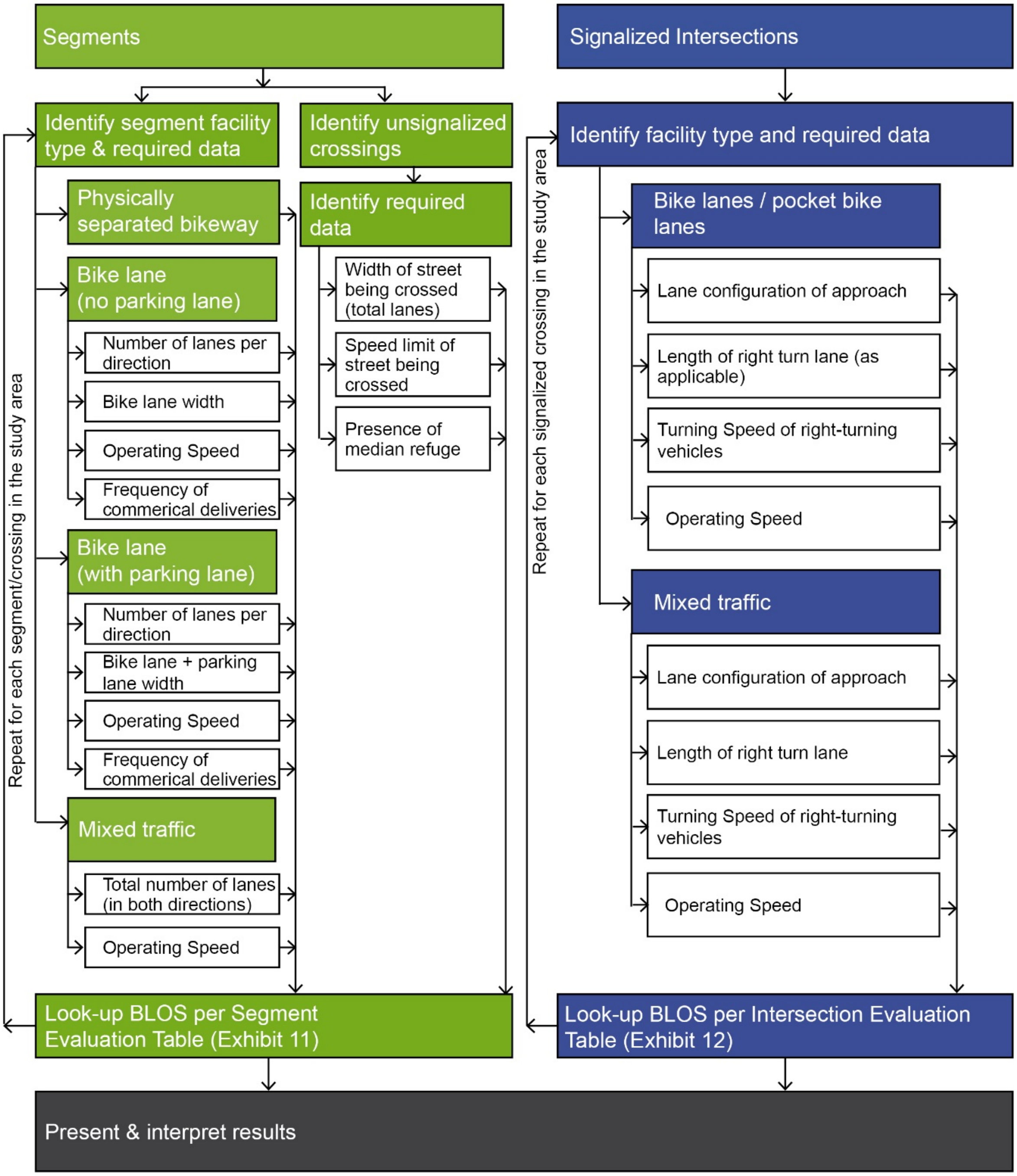


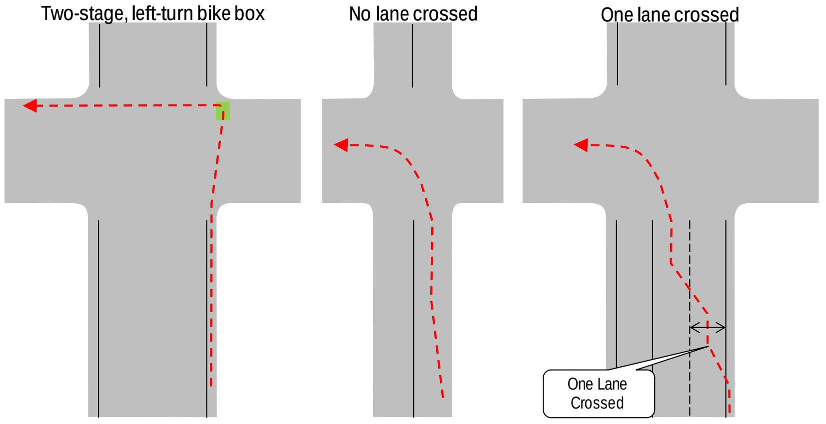
Exhibit 11 – BLOS Segment Evaluation Table

Type of Bikeway		LOS
Physically Separated Bikeway (cycle tracks, protected bike lanes and multi-use paths). Physical separation refers to, but is not limited to, curbs, raised medians, bollards and parking lanes (adjacent to the bike lane along the travelled way i.e. not curbside).		A
Bike Lanes Not Adjacent Parking Lane - Select Worst Scoring Criteria		
No. of Travel Lanes	1 travel lane in each direction	A
	2 travel lanes in each direction separated by a raised median	B
	2 travel lanes in each direction without a separating median	C
	More than 2 travel lanes in each direction	D
Bike Lane Width	≥ 1.8 m wide bike lane (includes marked buffer and paved gutter width)	A
	≥1.5 m to <1.8 m wide bike lane (includes marked buffer and paved gutter width)	B
	≥1.2 m to <1.5 m wide bike lane (includes marked buffer and paved gutter width)	C
Operating Speed	≤ 50 km/h operating speed	A
	60 km/h operating speed	C
	≥ 70 km/h operating speed	E
Bike lane blockage (commercial areas)	Rare	A
	Frequent	C
Bike Lanes Adjacent to curbside Parking Lane - Select Worst Scoring Criteria		
No. of Travel Lanes	1 travel lane in each direction	A
	2 or more travel lanes in each direction	C
Bike Lane and Parking Lane Width	4.5 m wide bike lane plus parking lane (includes marked buffer and paved gutter width)	A
	4.25 m wide bike lane plus parking lane (includes marked buffer and paved gutter width)	B
	≤ 4.0 m wide bike lane plus parking lane (includes marked buffer and paved gutter width)	C
Operating Speed	≤ 40 km/h operating speed	A
	50 km/h operating speed	B
	60 km/h operating speed	D
	≥ 70 km/h operating speed	F
Bike lane blockage (commercial areas)	Rare	A
	Frequent	C
Mixed Traffic		
No. of Travel Lanes and Operating Speed	2 travel lanes; ≤ 40 km/h; no marked centerline or classified as residential	A
	2 to 3 travel lanes; ≤ 40 km/h	B
	2 travel lanes; 50 km/h; no marked centerline or classified as residential	B
	2 to 3 travel lanes; 50 km/h	D
	4 to 5 travel lanes; ≤ 40 km/h	D
	4 to 5 travel lanes; ≥ 50 km/h	E
	6 or more travel lanes; ≤ 40 km/h	E
	≥ 60 km/h	F
Unsignalized Crossing along Route: no median refuge		
No. of Travel Lanes on Side Street and Operating Speed	3 or less lanes being crossed; ≤ 40 km/h	A
	4 to 5 lanes being crossed; ≤ 40 km/h	B
	3 or less lanes being crossed; 50 km/h	B
	4 to 5 lanes being crossed; 50 km/h	C
	3 or less lanes being crossed; 60 km/h	C
	4 to 5 lanes being crossed; 60 km/h	D
	6 or more lanes being crossed; ≤ 40 km/h	E
	3 or less lanes being crossed; ≥ 65 km/h	E
	6 or more lanes being crossed; ≥ 50 km/h	F
	4 to 5 lanes being crossed; ≥ 65 km/h	F
Unsignalized Crossing along Route: with median refuge (≥ 1.8 m wide)		
No. of Travel Lanes on Side Street and Operating Speed	5 or less lanes being crossed; ≤ 40 km/h	A
	3 or less lanes being crossed; 50 km/h	A
	6 or more lanes being crossed; ≤ 40 km/h	B
	4 to 5 lanes being crossed; 50 km/h	B
	3 or less lanes being crossed; 60 km/h	B
	6 or more lanes being crossed; 50 km/h	C
	4 to 5 lanes being crossed; 60 km/h	C
	3 or less lanes being crossed; ≥ 65 km/h	D
	6 or more lanes being crossed; 60 km/h	E
	4 to 5 lanes being crossed; ≥ 65 km/h	E
	6 or more lanes being crossed; ≥ 65 km/h	F

Exhibit 12 – BLOS Signalized Intersection Evaluation Table

Bikeway and Intersection Type		LOS
Bike Lanes or higher order facility on a Signalized Intersection Approach		
Right-turn Lane and Turning Speed of Motorists	No impact on LTS (as long as cycling facility remains to the right of any turn lane - otherwise see pocket bike lanes below)	
Cyclist Making a Left-turn and Operating Speed of Motorists (refer to figure)	Two-stage, left-turn bike box; ≤ 50 km/h	A
	No lane crossed, ≤ 50 km/h	B
	1 lane crossed, ≤ 40 km/h	B
	No lane crossed, ≥ 60 km/h	C
	1 lane crossed, 50 km/h	C
	2 or more lanes crossed, ≤ 40 km/h	D
	1 lane crossed, ≥ 60 km/h	E
	2 or more lanes crossed, ≥ 50 km/h	F
	All other single left-turn lane configurations	F
	Dual left-turn lanes (shared or exclusive)	F
Pocket Bike Lanes on a Signalized Intersection Approach		
Right-turn Lane and Turning Speed of Motorists	Right-turn lane introduced to the right of the bike lane and ≤ 50 m long, turning speed ≤ 25 km/h (based on curb radii and angle of intersection)	B
	Right-turn lane introduced to the right of the bike lane and > 50 m long, turning speed ≤ 30 km/h (based on curb radii and angle of intersection)	D
	Bike lane shifts to the left of the right-turn lane, turning speed ≤ 25 km/h (based on curb radii and angle of intersection)	D
	Right-turn lane with any other configurations	F
	Dual right-turn lanes (shared or exclusive)	F
Cyclist Making a Left-turn and Operating Speed of Motorists (refer to figure)	Two-stage, left-turn bike box; ≤ 50 km/h	A
	No lane crossed, ≤ 50 km/h	B
	1 lane crossed, ≤ 40 km/h	B
	No lane crossed, ≥ 60 km/h	C
	1 lane crossed, 50 km/h	C
	2 or more lanes crossed, ≤ 40 km/h	D
	1 lane crossed, ≥ 60 km/h	E
	2 or more lanes crossed, ≥ 50 km/h	F
	All other single left-turn lane configurations	F
	Dual left-turn lanes (shared or exclusive)	F
Mixed Traffic on a Signalized Intersection Approach		
Right-turn Lane and Turning Speed of Motorists	Right-turn lane 25 to 50 m long, turning speed ≤ 25 km/h (based on curb radii and angle of intersection)	D
	Right-turn lane 25 to 50 m long, turning speed > 25 km/h (based on curb radii and angle of intersection)	E
	Right-turn lane longer than 50 m	F
	Dual right-turn lanes (shared or exclusive)	F
Cyclist Making a Left-turn and Operating Speed of Motorists (refer to figure)	Two-stage, left-turn bike box; ≤ 50 km/h	A
	No lane crossed, ≤ 50 km/h	B
	1 lane crossed, ≤ 40 km/h	B
	No lane crossed, ≥ 60 km/h	D
	1 lane crossed, 50 km/h	D
	2 or more lanes crossed, ≤ 40 km/h	D
	1 lane crossed, ≥ 60 km/h	F
	2 or more lanes crossed, ≥ 50 km/h	F
	All other single left-turn lane configurations	F
	Dual left-turn lanes (shared or exclusive)	F

Left-turn Configurations



Notes:

1. Pocket bike lanes are defined as bike lanes that develop near intersections between vehicular right turn lanes on the right side and vehicular through or left lanes on the left side. All other configurations of bike lanes or separated facility that remain against the edge of the curb/parking lane and require right turning vehicles to yield to through cyclists will not impact the level of traffic stress (i.e. are considered to be LOS A).

4 Transit Level of Service (TLOS)

4.1 Intent

The intent of the transit level of service (TLOS) is to evaluate the relative attractiveness of transit in support of the City's aim to ultimately increase transit mode share. The relative attractiveness, for the purposes of TLOS, is evaluated based on transit travel time and the transit priority afforded to transit vehicles based on varying facility types and conditions.

4.2 Data Requirements

The data required to evaluate TLOS is shown in Exhibit 13.

Exhibit 13 – Data Requirements for Transit Level of Service

SEGMENTS	SIGNALIZED INTERSECTIONS
» Level/exposure to congestion delay, friction, and incidents (qualitative assessment) » Average transit travel speed » Posted speed limit » Number of driveways along corridor and approximate crossing volume	» Average Signal Delay

The data source for these attributes may vary depending on the type of project. For existing corridors, free flow and actual speeds could be measured through travel time surveys. For new corridors, or for evaluating modal trade-offs, actual transit speed would need to be modelled through micro-simulations.

In terms of evaluating delay at intersections, the estimation/measurement method (in order of preference) is: field measurement, microscopic simulation (VISSIM, AIMSUM), or macroscopic simulation (Synchro, HCS, analytical/graphical methods e.g. deterministic queuing model).

4.3 Methodology

The TLOS methodology is intended primarily to be applied only along corridors with existing or planned rapid transit or transit priority measures. However, corridors with regular bus routes (without transit priority) can still be evaluated with the current methodology. The extent of analysis required should be determined at the time of the project or development application.

A summary of the methodology is provided in Exhibit 14, with the segment and signal evaluation tables shown in Exhibit 15 and Exhibit 16, respectively.

Note that since the calibration of the methodology is ongoing, thresholds may be subject to future iterations.

An example illustrating the application of the TLOS methodology is provided in Appendix A.

Exhibit 14 – TLOS Evaluation Methodology

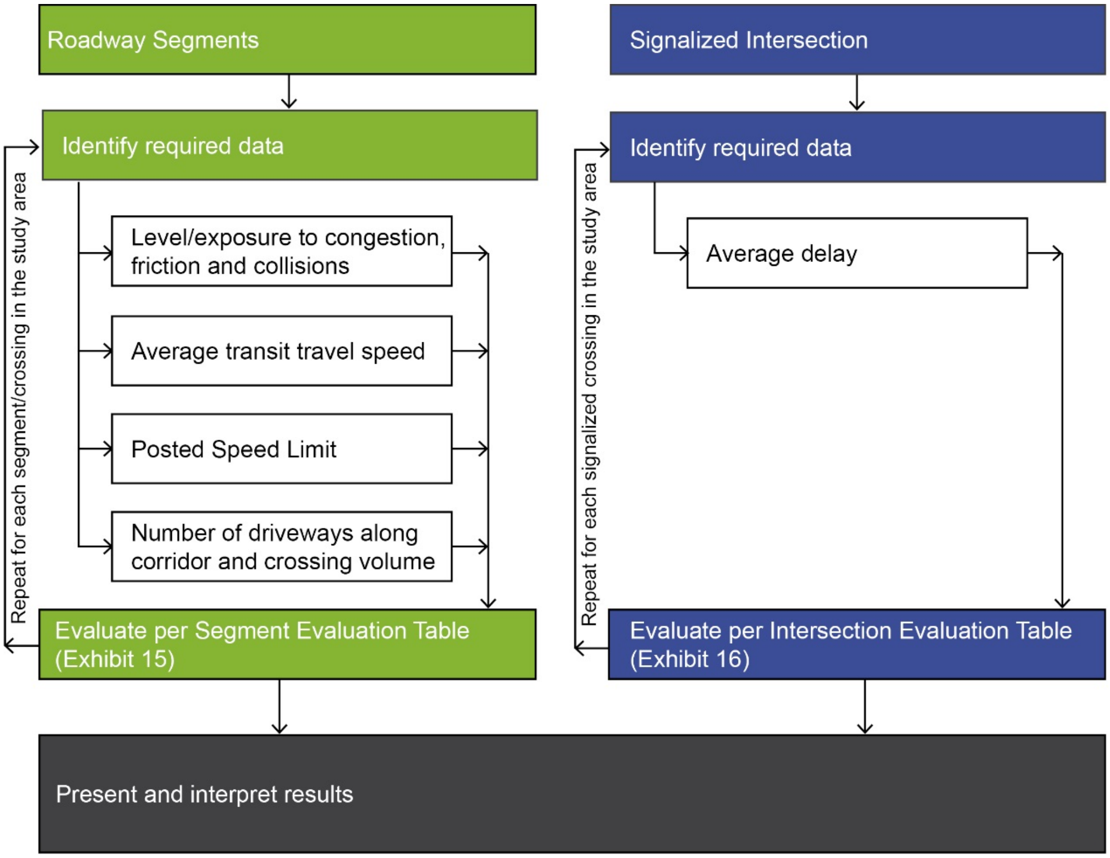


Exhibit 15 - TLOS Segment Evaluation Table

Facility Type		Level/exposure to congestion delay, friction and incidents			Quantitative Measurement	LOS
		Congestion	Friction	Incident Potential		
Segregated ROW		No	No	No	N/A	A
Bus lane	No/limited parking/driveway friction	No	Low	Low	$C_f \leq 60$	B
	Frequent parking/driveway friction	No	Medium	Medium	$C_f > 60$	C
Mixed Traffic	Limited parking/driveway friction	Yes	Low	Medium	$Vt/Vp \geq 0.8$	D
	Moderate parking/driveway friction	Yes	Medium	Medium	$Vt/Vp \leq 0.6$	E
	Frequent parking/driveway friction	Yes	High	High	$Vt/Vp < 0.4$	F

Notes:

Cf, Conflict Factor = = (Number of driveways x crossing volume) / 1 km

Vt/Vp is the ratio of average transit travel speed to posted speed limit

Exhibit 16 – TLOS Signalized Intersection Evaluation Table

Delay	Typical Location	LOS
0	Grade Separation	A
≤10 sec	High Level TSP	B
≤20 sec		C
≤30 sec		D
≤40 sec	TSP & long cycle length	E
>40 sec	No TSP & long cycle length	F

Note: Delay includes travel time from end of queue to entering the intersection

5 Truck Level of Service (TkLOS)

5.1 Intent

Motor vehicle LOS accounts for trucks by considering the percent of trucks and buses in the traffic volume. However, some elements of roadway segments and intersections clearly affect the ability of trucks to operate with ease. The intent of the truck level of service (TkLOS) is to complement motor vehicle LOS by considering the physical space available for trucks to negotiate corners quickly and easily, and to operate safely within travelled lanes.

The objective of evaluating TkLOS is to facilitate goods movement within the City of Ottawa – however, unlike other modes, the TkLOS need only be applied along truck routes, arterial roads and key delivery access routes, since trucks are not intended to operate on every street. An exception would be within employment or enterprise areas where targets are set for trucks on all streets in these areas, as laid out in Section 7.

Care should be taken when considering the trade-offs between truck level of service and pedestrian/bicycle level of service with respect to the corner radii and turning speed. There is potential for trucks to encroach on pedestrian and cycling facilities if trucks are not accommodated appropriately, which can put vulnerable users at risk. As mentioned in Section 1.2, the MMLOS guidelines do not replace safety or geometric guidance.

5.2 Data Requirements

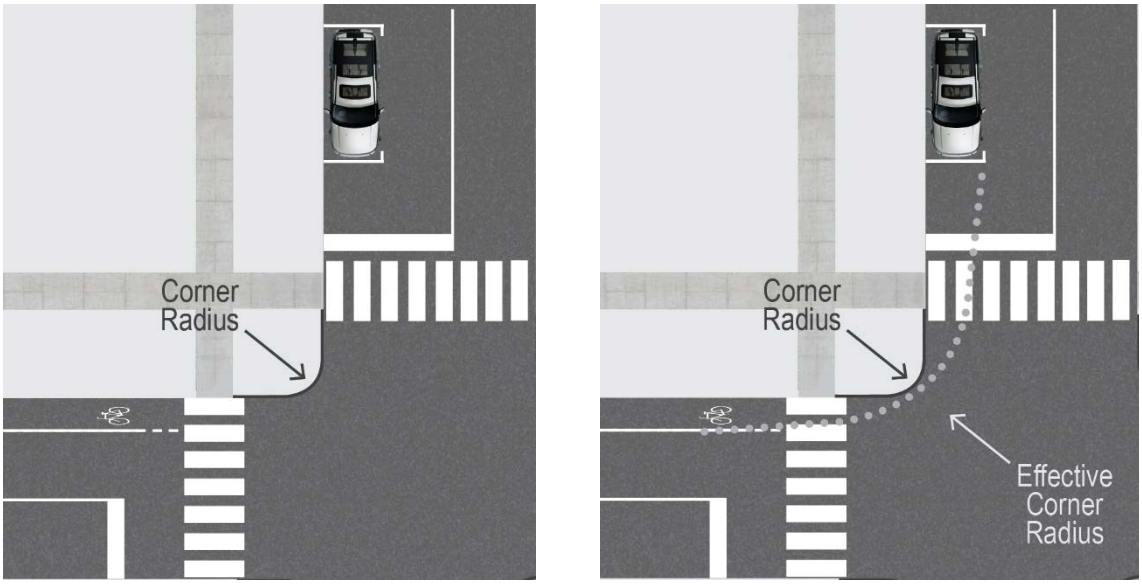
A summary of the data required to evaluate the truck level of service is provided in Exhibit 17.

Exhibit 17 - Data Requirements for Truck Level of Service

SEGMENTS	SIGNALIZED INTERSECTIONS
» Street width (number of through lanes per direction) » Curb lane width (m)	» Effective radius » Number of receiving lanes on departing leg

Note that effective radius is the same as corner radius where trucks must turn from the curbside lane into a departing curbside lane, however where parking lanes or on-street parking lanes are provided adjacent to the travel / turn lanes the effective radius can be determined by placing a simple or compound radius between the edge of the travel lane on the approach and departing legs – refer to Exhibit 18 below.

Exhibit 18 – Effective curb radius



5.3 Methodology

The methodology for evaluating Truck Level of Service is illustrated in Exhibit 19.

For segments, lane width considered in the evaluation should be the curb lane width where lane widths vary between outer and inner lanes. An exception could be made where two major truck routes meet, resulting in heavy truck turning volumes at intersections. In these cases, it may be more conservative to consider the narrowest travel lane, as trucks will need to negotiate across lanes to turning lanes at intersections. If lane widths fall outside of the given threshold, they can be rounded down to the most conservative width i.e. a lane width of 3.25 would be rounded down to 3.2m for the look-up table.

An example illustrating the application of the TkLOS methodology is provided in Appendix A.

Exhibit 19 – TkLOS Evaluation Methodology

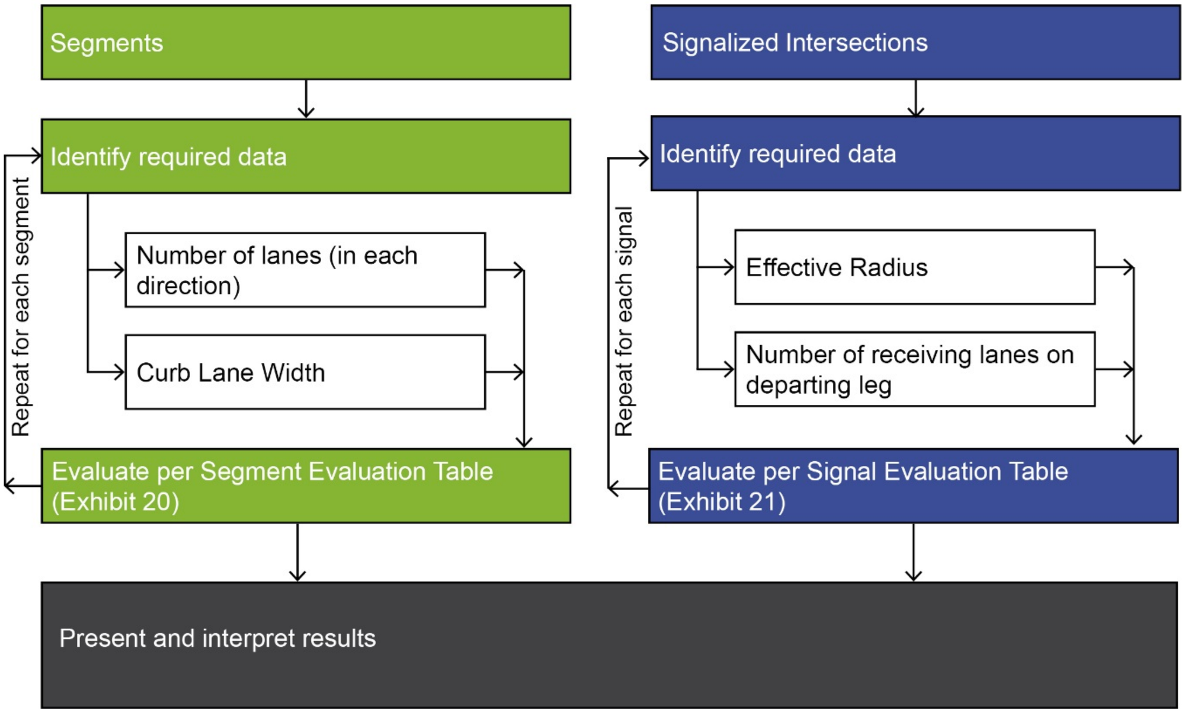


Exhibit 20 – TkLOS Segment Evaluation Table

Curb Lane Width (m)	Only two travel lanes (one in each direction)	More than two travel lanes
>3.7	B	A
≤3.5	C	A
≤3.3	D	C
≤3.2	E	D
≤3	F	E

Exhibit 21 – TkLOS Signalized Intersection Evaluation Table

Effective Corner Radius	One receiving lane on departure from intersection	More than one receiving lane on departure from intersection
< 10m	F	D
10 to 15m	E	B
> 15m	C	A

6 Vehicular Level of Service (LOS)

The following details outlining the evaluation of Vehicular Level of Service are extracted from the 2009 Transportation Impact Assessment Guidelines. As the TIA update is carried out, these parameters may be updated.

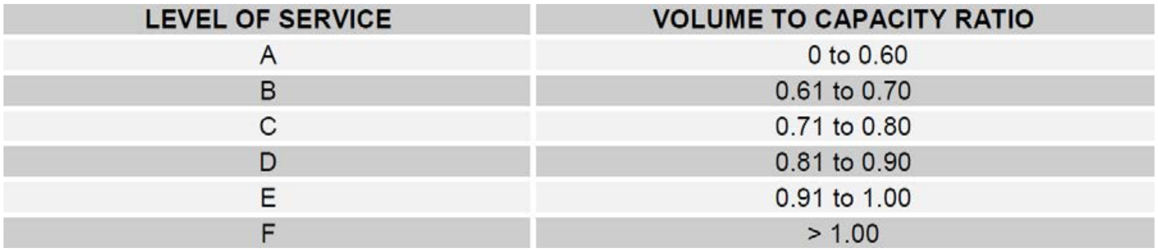
6.1 Intersection Capacity Analysis

An evaluation is required of any critical intersection within the study area that will potentially be affected by site generated traffic volumes during any or all of the relevant time periods and scenarios. Summaries are to be provided in tabular format clearly identifying intersection performance under existing and future traffic conditions. Where development is anticipated to proceed in phases or stages, projected performance for all intersections must be documented for the end of each phase.

Detailed output from analysis software is to be provided in an appendix to the report and copies of the electronic files should be provided on CD. Appendix B outlines parameters to be used in operational analysis of signalized intersections.

All volume to capacity (V/C) calculations relating to future conditions should be determined using signal timing optimized for the volume conditions being studied. The V/C ratio for an intersection is defined as the sum of equivalent volumes for all critical movements divided by the sum of capacities for all critical movements assuming that the V/C ratios for critical movements can be equalized. In cases where minimum pedestrian phase times prevent equalizing the level of service for critical movements, then the V/C ratio for the most heavily saturated critical movement should be considered as the V/C ratio for the intersection. Adjustment for the impact of pedestrian activated control is permitted provided detailed supporting analysis including projected pedestrian volumes is provided and discussed in advance with traffic engineering staff.

In the case of planning level or functional design projects, practitioners should undertake a two and a half hour peak period observation of volumes (typically 6:30 – 9:00 AM) to verify that the traffic volumes through the intersections reflect existing demands and to identify unusual operating conditions. For operational studies, peak hour observations are acceptable. Timing of observations and conditions observed should be documented in writing in the report.



LEVEL OF SERVICE	VOLUME TO CAPACITY RATIO
A	0 to 0.60
B	0.61 to 0.70
C	0.71 to 0.80
D	0.81 to 0.90
E	0.91 to 1.00
F	> 1.00

Intersection evaluations should identify:

- Signalized Intersections – V/C ratios for the overall intersection, as defined above, and individual movements; and
- Unsignalized Intersections - Level of service (LOS) where the LOS is between A and E; V/C where capacity is based on gap analysis if intersection LOS is F.

Existing signal timing information such as phasing, pedestrian minimums and clearance intervals must be used as a base to analyze the existing capacity of signalized intersections. This signal timing data should be obtained from the City of Ottawa Traffic Operations Division. Operational design of the signals analyzed should be in accordance with City of Ottawa signal operation practices.

In cases where roadways have closely spaced signals and especially when there are heavy turning movements, the analysis should confirm that storage limitations will not prevent signalized intersections from operating at the predicted V/C ratio.

The City of Ottawa prefers that analysis be completed using the Highway Capacity Software (HCS version 4d or later), or Synchro (version 5 or later). Should a consultant wish to utilize a software package other than those listed above, prior approval must be obtained from the City's Traffic Operations Division.

7 Level of Service Targets

The ultimate objective of developing a MMLOS program is to enable designers, City staff and the public to evaluate and understand transportation choices. The MMLOS framework is not complete until the MMLOS tools are used and presented in relation to each other. Different streets and roads with associated land-use contexts will have varying levels of service for each mode – it is neither possible nor desirable to achieve LOS A for all modes on every street due to finite land resources and limited funding. LOS targets exist as a way to quantify on-the-ground conditions and to identify where higher or lower levels of services are appropriate.

Towards this end, modal level of service targets have been developed. In order to introduce a measure of local context, these targets are presented based on various City of Ottawa Official Plan (OP) land-use designation / policy areas and road classes. The OP designations provide a sense of the surrounding land use, density, commercial activity and in certain cases the function of the roadway (i.e. arterial mainstreet), while road classifications provide a proxy for the vehicular volume and speed of the roadways.

7.1 Modal Targets by Official Plan Designation/Policy Area

In the following Exhibit 22, targets for the **minimum desirable** level of service are presented by mode. Efforts should be made to exceed these minimum targets whenever possible, without negatively impacting the ability to achieve the minimum targets for other modes. As noted in Section 1.3, although the LOS methodology enables trade-offs to be made between modes, it is still important to consider the scales of each mode as independent from one another. In other words, because the level of service tools measure different factors, they do not necessarily cover the same spectrum of conditions. A vehicle experiencing LOS F with high lane utilization will likely encounter long delays and congested conditions. However this does not necessarily represent the lack of comfort, higher risk or stress that LOS F represents for cyclists, or lack of comfort, longer delays or higher risk that LOS F represents for pedestrians. Accordingly, targets may appear to be more generous for some modes than for others.

These targets refer to a number of City of Ottawa plans and schedules including:

- Official Plan Amendment #150, Schedules and Secondary Plans
- Transportation Master Plan
- Ottawa Pedestrian Plan
- Ottawa Cycling Plan
- City of Ottawa Truck Routes

The most up to date version of these documents can be referenced online through the City's website when considering the targets.

It is important to reiterate that these targets must cover a wide range of conditions (i.e. varying built form and context) and therefore should be considered to provide broad guidance rather than absolute cut-offs. At the same time, these targets represent a best effort at encapsulating City policies and plans, and provide a more realized vision for future street planning and design. Over time these targets are likely to shift as they are better calibrated to reflect outcomes and initiatives.

In applying the targets, the most specific targets always apply where there is overlap between designations and policy areas. For example, where a traditional main street runs through an area that is also designated in the general urban area, the traditional main street targets will apply along that corridor. In any case where a specific policy area applies, it will override the targets for the land use designation.

Where the targets cannot be achieved, a summary or rationale for why the targets are not achieved should be documented for a project or study. Mitigation measures may be required as appropriate.

7.2 Making Trade-offs & Interpretation of Results

The target-setting process builds in the opportunity to understand how trade-offs can be made to support the goals and policies laid out in the OP. There are two outcomes to consider when trying to meet or exceed the minimum targets:

- Targets are not intended to create excessively wide corridors along new or relatively unconstrained rights-of-way. The implementation of MMLOS must also be considered in relation to many other factors driving street and roadway design, including urban design considerations and built form characteristics. Extremely wide roads throughout the city that achieve LOS A for all modes are neither desirable nor achievable.
- In constrained environments, the MMLOS framework is intended to enable decisions to be made about which modes are prioritized. It will help guide, support and justify decisions to provide high quality facilities for certain modes, even at the expense of LOS for others.

In addition to examples illustrating the application individual level of service methodologies, examples are provided in Appendix A to demonstrate how results from the MMLOS can be interpreted and trade-offs considered. Note that these hypothetical examples are intended to be illustrative only, and should not be considered to provide design guidance. Professional technical knowledge, judgement and site specific context should always be primary considerations in determining facility types along a given route.

7.3 Presentation of Results

Results should be presented in tabular form, summarizing results for each mode by intersection approach and roadway segment or direction, as appropriate. The results are not intended to be amalgamated into one overall intersection, segment or corridor score, since some of the modes require a more fine-grained analysis than traditional vehicular LOS. Instead, the results are presented for each mode, broken down to varying levels of detail based on the methodological requirements.

A sample summary table is included in Appendix C.

Exhibit 22 – Minimum Desirable MMLOS Targets by Official Plan Policy/Designation & Road Class

			Bicycle - BLOS				Transit - TLOS[3]			Truck - TrLOS		
OP Designation / Policy Area	Road Class	PLOS	Cross-town Bikeway	Spine Route	Local Route	Elsewhere	Rapid Transit Corridor	TP - Continuous Lanes	TP - Isolated Measures	Truck Route	Other	Auto - LOS[4]
Land-Use Designation												
Central Area	Arterial	A	A	C	B	D	A	C	D	D	E	E
	Collector	A	A	B	B	D	A	C	D	D	No target	E
	Local	A	A	B	B	D	A	C	D	E	No target	E
Developing Community	Arterial	C	B	C	B	D	B	C	D	D	No target	D
	Collector	C	B	C	B	D	B	C	D	D	No target	D
	Local	C	B	C	B	D	B	C	D	N/A	No target	D
Employment Area	Arterial	C	B	C	C	E	B	C	D	B	D	D
	Collector	C	B	C	C	E	B	C	D	B	D	D
	Local	C	B	D	C	No target	B	C	D	D	E	D
Entreprise Area	Arterial	C	B	C	B	D	B	C	D	B	E	D
	Collector	C	B	C	B	D	B	C	D	B	E	D
	Local	C	B	C	B	No target	B	C	D	D	No target	D
General Rural Area	Arterial	No target	N/A	D	D	No target	N/A	N/A	N/A	C	E	D
	Collector	No target	N/A	D	D	No target	N/A	N/A	N/A	C	No target	D
	Local	No target	N/A	D	D	No target	N/A	N/A	N/A	No target	No target	D
General Urban Area	Arterial	C	B	C	B	D	B	C	D	D	E	D
	Collector	C	B	C	B	D	B	C	D	D	No target	D
	Local	C	B	C	B	D	B	C	D	N/A	No target	D
Mixed Use Centre	Arterial	C	A	C	B	D	B	C	D	D	E	D
	Collector	C	A	B	B	D	B	C	D	D	No target	D
	Local	C	A	B	B	D	B	C	D	N/A	No target	D
Village	Arterial	C	B	C	B	D	N/A	N/A	N/A	D	No target	D
	Collector	C	B	C	B	D	N/A	N/A	N/A	D	No target	D
	Local	C	B		B	D	N/A	N/A	N/A	N/A	No target	D
Traditional Main Street	Arterial	B	A	C	C	D	B	C	D	D	E	D
	Collector	B	A	C	C	D	B	C	D	D	No target	D
Arterial Main Street	Arterial	C	B	C	D	D	B	C	D	D	E	D
All Other Designations	Arterial	D	B	C	C	D	B	C	D	D	No target	D
	Collector	D	B	C	C	D	B	C	D	D	No target	D
	Local	D	B	C	C	D	B	C	D	N/A	No target	D
Policy Area[2]												
Within 600m of a rapid transit station	Arterial	A	A	C	B	D	A	C	D	D	E	E
	Collector	A	A	B	B	D	A	C	D	D	No target	E
	Local	A	A	B	B	D	A	C	D	N/A	No target	E
Within 300m of a school	Arterial	A	A	C	B	D	A	C	D	D	E	E
	Collector	A	A	B	B	D	A	C	D	D	No target	E
	Local	A	A	B	B	D	A	C	D	N/A	No target	E

1. This table indicates the minimum desirable target. Efforts should be made to exceed these minimum targets whenever possible, without negatively impacting the ability to achieve the minimum targets for other modes .
2. Where a policy area applies to a project or area, the modal targets should reflect the policy area targets regardless of the land use designation.
3. Transit targets are intended to be applied only for streets with a proposed or existing transit route.
4. Auto LOS is based on the two and a half hour peak period.
5. Minimum guidelines as dictated by City policy must be maintained, regardless of MMLOS targets.

N/A - Not applicable

8 Glossary

Bike Lane Width – The bike lane width is defined as a measurement taken perpendicular to the curb from the center of the bike lane pavement marking to the face of curb, i.e. includes the gutter width. In the case where a bike lane is adjacent to a parking lane, the measurement will be taken from the centre of the parking lane pavement marking. In cases where a painted buffer is provided, the width of the buffer is added to the width of the bike lane used in the evaluation.

Boulevard width – Boulevard width is measured as the distance between the back of the curb and the nearest edge of the sidewalk.

Effective Corner Radius – The effective corner radius considers the additional space afforded to turning vehicles by non-vehicular travel lanes between the turn lane on the departing and receiving legs of an intersections (refer to Section 5.3).

Vehicular operating speed – The operating speed is the actual operating speed of vehicles travelling along a corridor. This is often assumed to be equivalent to the posted speed, however depending on the operating conditions and design controls, the operating speed can be significantly higher or lower than the posted speed.

Peak Period – For the purposes of evaluating vehicular level of service (LOS), a two and a half hour peak period is to be used. The peak period typically considered is the morning peak period between 6:30 AM & 9:00 AM.

Physically Separated Bikeway - A separated bicycle facility can be delineated with a number of treatments including bollards, curbs, grade separation or parking lanes located between the bikeway and adjacent travel lanes. Note that small sections without physical separation may be acceptable where they are provided to allow cyclists to access turning / travel lanes in advance of intersections or at driveways where appropriate conflict markings are provided.

Pocket Bike Lane – A pocket bike lane is a small section of bike lane that develops near an intersection between vehicular right turn lanes on the right side and vehicular through or left lanes on the left side. As a result of traffic on both sides, these pocket bike lanes are considered to be more stressful for cyclists than bicycle lanes adjacent to the curb or parking lanes.

Segregated ROW (as referenced in the Transit Level of Service) – A segregated right of way for transit implies some physical separation is provided between transit travel lanes and general purpose travel lanes – whether it is through curb barriers or planting or separated by grade. An example of a segregated ROW for transit within the road ROW is Chapman Mills between Beatrice Drive and Woodroffe Avenue.

Shared Space – "A street or place designed to improve pedestrian movement and comfort by reducing the dominance of motor vehicles and enabling all users to share the space rather than follow the clearly design rules implied by more conventional designs." (UK Department for Transport Local Transport Note 1/11 – Shared Space, 2011, p. 6).

Sidewalk Width – For the purposes of PLOS, sidewalk width should be measured as the clear width available for pedestrian space. While spot encroachments may be acceptable, any repeating fixed feature, such as hydro poles, within the sidewalk will narrow the space available. The clear width is the wider portion of the sidewalk to one side of the fixed feature.

Appendix A: Examples

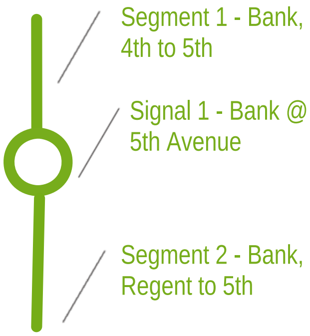
MMLOS Modal Summary Page

Project: PLOS Example Illustration

Corridor: Bank Street (Glebe)

Year / Scenario: 2012

Study Area:



Overall Route Score

D

Segment Summary

Segment 1

Street	Bank
From	4th
To	5th
Year / Condition	2012
Direction	Northbound-Southbound
MMLOS Mode	PLOS

Segment 1 Score

C

Segment 2

Street	Bank
From	Regent
To	5th
Year / Condition	2012
Direction	Northbound-Southbound
MMLOS Mode	PLOS

Segment 2 Score

C

Signal Summary

Signal

Street	Bank Street
@	5th Street
Approach	
Year / Condition	2012 - After implementation of cycle tracks
MMLOS Mode	PLOS

Signal 1 Score

D

Notes:
Segments have the same treatment in both the northbound and southbound directions, so only one segment evaluation is needed for each block.

MMLOS Segment Evaluation

Street	Bank
From	4th
To	5th
Year / Condition	2012
Direction	Northbound-Southbound
MMLOS Mode	PLOS

Segment Score

C

Photo / Proposed Cross-Section (where available):

Evaluation Criteria:

Sidewalk Width (m)	Boulevard Width (m)	Motor Vehicle Traffic Volume (AADT)	Presence of On-street Parking	Segment PLOS			
				Operating Speed (km/h)			
				≤30	>30 or 50	>50 or 60	>60[1]
2.0 or more	> 2	≤ 3000	N/A	A	A	A	B
		> 3000	Yes	A	B	B	N/A
			No	A	B	C	D
	0.5 to 2	≤ 3000	N/A	A	A	A	B
		> 3000	Yes	A	B	C	N/A
			No	A	C	D	E
	0	≤ 3000	NA	A	B	C	D
		> 3000	Yes	B	B	D	N/A
			No	B	C	E	F
1.8	> 2	≤ 3000	N/A	A	A	A	B
		> 3000	Yes	A	B	C	N/A
			No	A	C	D	E
	0.5 to 2	≤ 3000	N/A	A	B	B	D
		> 3000	Yes	A	C	C	N/A
			No	B	C	E	E
	0	≤ 3000	N/A	A	B	C	D
		> 3000	Yes	B	C	D	N/A
			No	C	D	F	F
1.5	> 2	≤ 3000	N/A	C	C	C	C
		> 3000	Yes	C	C	D	N/A
			No	C	D	E	E
	0.5 to 2	≤ 3000	N/A	C	C	C	D
		> 3000	Yes	C	C	D	N/A
			No	D	E	E	E
	0	N/A		D	E	F[2]	F[2]
<1.5	N/A			F[3]	F[3]	F[3]	F[3]
No sidewalk	N/A			C[4]	F[3]	F[3]	F[3]

Notes:
Example is intended to be illustrative only and may not reflect actual conditions. Both directions are evaluated at once since the cross-section is consistent across the corridor. Sidewalk width is based on the effective width after accounting for hydro poles, etc.

MMLOS Segment Evaluation

Street	Bank
From	Regent
To	5th
Year / Condition	2012
Direction	Northbound-Southbound
MMLOS Mode	PLOS

Segment Score

C

Photo / Proposed Cross-Section (where available):

Evaluation Criteria:

Sidewalk Width (m)	Boulevard Width (m)	Motor Vehicle Traffic Volume (AADT)	Presence of On-street Parking	Segment PLOS			
				Operating Speed (km/h)			
				≤30	>30 or 50	>50 or 60	>60[1]
2.0 or more	> 2	≤ 3000	N/A	A	A	A	B
		> 3000	Yes	A	B	B	N/A
			No	A	B	C	D
	0.5 to 2	≤ 3000	N/A	A	A	A	B
		> 3000	Yes	A	B	C	N/A
			No	A	C	D	E
	0	≤ 3000	NA	A	B	C	D
		> 3000	Yes	B	B	D	N/A
			No	B	C	E	F
1.8	> 2	≤ 3000	N/A	A	A	A	B
		> 3000	Yes	A	B	C	N/A
			No	A	C	D	E
	0.5 to 2	≤ 3000	N/A	A	B	B	D
		> 3000	Yes	A	C	C	N/A
			No	B	C	E	E
	0	≤ 3000	N/A	A	B	C	D
		> 3000	Yes	B	C	D	N/A
			No	C	D	F	F
1.5	> 2	≤ 3000	N/A	C	C	C	C
		> 3000	Yes	C	C	D	N/A
			No	C	D	E	E
	0.5 to 2	≤ 3000	N/A	C	C	C	D
		> 3000	Yes	C	C	D	N/A
			No	D	E	E	E
	0	N/A		D	E	F[2]	F[2]
<1.5	N/A			F[3]	F[3]	F[3]	F[3]
No sidewalk	N/A			C[4]	F[3]	F[3]	F[3]

Notes:
Example is intended to be illustrative only and may not reflect actual conditions. Both directions are evaluated at once since the cross-section is consistent across the corridor. Sidewalk width is based on the effective width after accounting for hydro poles, etc.

MMLOS Signal Evaluation

Main Street	Bank Street
Minor Street	5th Street
Approaches	All (see below)
Year / Condition	2012
Direction	All (see below)
MMLOS Mode	PLOS

Overall Intersection Score

D

	North		East Approach		South Approach		West Approach	
								
5.1 Crossing Distance & Conditions								
Median?	N		N		N		N	
Total Travel lanes crossed	4	88 pts	3	105 pts	4	88 pts	2	120 pts
Island refuge?	N	-4 pts	N	-4 pts	N	-4 pts	N	-4 pts
5.2 Signal Phasing & Timing Features								
Left turn conflict	Permissive	-8 pts	Permissive	-8 pts	Permissive	-8 pts	Permissive	-8 pts
Right turn conflict	Permissive or yield control	-5 pts	Permissive or yield control	-5 pts	Permissive or yield control	-5 pts	Permissive or yield control	-5 pts
Right turns on Red	RTOR allowed	-3 pts	RTOR allowed	-3 pts	RTOR allowed	-3 pts	RTOR allowed	-3 pts
Leading ped interval	No	-2 pts	No	-2 pts	No	-2 pts	No	-2 pts
5.3 Corner Radius	> 3m to 5m	-4 pts	> 3m to 5m	-4 pts	> 3m to 5m	-4 pts	> 3m to 5m	-4 pts
Right turn	No channelization	0 pts	No channelization	0 pts	No channelization	0 pts	No channelization	0 pts
5.4 Crosswalk Treatment	Standard transvervse markings	-7 pts	Standard transvervse markings	-7 pts	Standard transvervse markings	-7 pts	Standard transvervse markings	-7 pts
TOTAL PETSI SCORE		55 pts		72 pts		55 pts		87 pts
DELAY SCORE		4.8 sec		17.64 sec		4.8 sec		17.64 sec
Cycle length	60		60		60		60	
Pedestrian Effective Walk Time	36		14		36		14	
PETSI Score	D		C		D		B	
Delay Score	A		B		A		B	
Overall Approach Score	D		C		D		B	

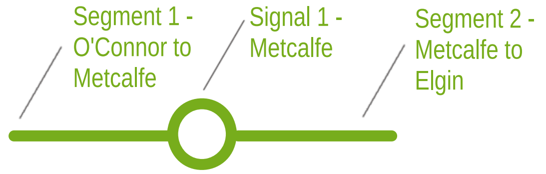
Notes:
Example is intended to be illustrative only and may not reflect actual conditions.

MMLOS Modal Summary Page

Project: BLOS Example Illustration
Corridor: Laurier Avenue
Year / Scenario: 2012 - After implementation of cycle tracks
Study Area:

Overall Route Score

A



Segment Summary

Segment 1

Street	Laurier Avenue
From	O'Connor
To	Metcalfe
Year / Condition	2012 - After implementation of cycle tracks
Direction	Eastbound / Westbound
MMLOS Mode	BLOS

Segment 1 Score

A

Segment 2

Street	Laurier Avenue
From	Metcalfe
To	Elgin
Year / Condition	2012 - After implementation of cycle tracks
Direction	Eastbound / Westbound
MMLOS Mode	BLOS

Segment 1 Score

A

Signal Summary

Signal 1

Street	Laurier Avenue
@	Metcalfe Street
Approach	Eastbound / Westbound
Year / Condition	2012 - After implementation of cycle tracks
MMLOS Mode	BLOS

Signal 1 Score

A

MMLOS Segment Evaluation

Street	Laurier Avenue
From	O'Connor Street
To	Metcalfe Street
Year / Condition	2012 - After implementation of cycle tracks
Direction	Eastbound / Westbound
MMLOS Mode	BLOS

Segment Score

A

Photo / Proposed Cross-Section (where available):

Evaluation Criteria:

Type of Bikeway		LOS
Physically Separated Bikeway (cycle tracks, protected bike lanes and multi-use paths). Physical separation refers to, but is not limited to, curbs, raised medians, bollards and parking lanes (adjacent to the bike lane along the travelled way i.e. not curbside).		A
Bike Lanes Not Adjacent Parking Lane - Select Worst Scoring Criteria		
No. of Travel Lanes	1 travel lane in each direction	A
	2 travel lanes in each direction separated by a raised median	B
	2 travel lanes in each direction without a separating median	C
	More than 2 travel lanes in each direction	D
Bike Lane Width	≥ 1.8 m wide bike lane (includes marked buffer and paved gutter width) Not applicable - physically separated bikeway provided along the segment	A
	≥ 1.5 m to <1.8 m wide bike lane (includes marked buffer and paved gutter width)	B
	≥ 1.2 m to <1.5 m wide bike lane (includes marked buffer and paved gutter width)	C
Operating Speed	≤ 50 km/h operating speed	A
	60 km/h operating speed	C
	≥ 70 km/h operating speed	E
Bike lane blockage (commercial areas)	Rare	A
	Frequent	C
Bike Lanes Adjacent to curbside Parking Lane - Select Worst Scoring Criteria		
No. of Travel Lanes	1 travel lane in each direction	A
	2 or more travel lanes in each direction	C
Bike Lane and Parking Lane Width	4.5 m wide bike lane plus parking lane (includes marked buffer and paved gutter width)	A
	4.25 m wide bike lane plus parking lane (includes marked buffer and paved gutter width)	B
	≤ 4.0 m wide bike lane plus parking lane (includes marked buffer and paved gutter width) Not applicable - physically separated bikeway provided along the segment	C
Operating Speed	≤ 40 km/h operating speed	A
	50 km/h operating speed	B
	60 km/h operating speed	D
	≥ 70 km/h operating speed	F
Bike lane blockage (commercial areas)	Rare	A
	Frequent	C
Mixed Traffic		
No. of Travel Lanes and Operating Speed	2 travel lanes; ≤ 40 km/h; no marked centerline or classified as residential	A
	2 to 3 travel lanes; ≤ 40 km/h	B
	2 travel lanes; 50 km/h; no marked centerline or classified as residential	B
	2 to 3 travel lanes; 50 km/h	D
	4 to 5 travel lanes; ≤ 40 km/h Not applicable - physically separated bikeway provided along the segment	D
	4 to 5 travel lanes; ≥ 50 km/h	E
	6 or more travel lanes; ≤ 40 km/h	E
	≥ 60 km/h	F
Unsignalized Crossing along Route: no median refuge		
No. of Travel Lanes on Side Street and Operating Speed	3 or less lanes being crossed; ≤ 40 km/h	A
	4 to 5 lanes being crossed; ≤ 40 km/h	B
	3 or less lanes being crossed; 50 km/h	B
	4 to 5 lanes being crossed; 50 km/h Not applicable - no unsignalized crossings along the corridor	C
	3 or less lanes being crossed; 60 km/h	C
	4 to 5 lanes being crossed; 60 km/h	D
	6 or more lanes being crossed; ≤ 40 km/h	E
	3 or less lanes being crossed; ≥ 65 km/h	E
	6 or more lanes being crossed; ≥ 50 km/h	F
	4 to 5 lanes being crossed; ≥ 65 km/h	F
Unsignalized Crossing along Route: with median refuge (≥ 1.8 m wide)		
No. of Travel Lanes on Side Street and Operating Speed	5 or less lanes being crossed; ≤ 40 km/h	A
	3 or less lanes being crossed; 50 km/h	A
	6 or more lanes being crossed; ≤ 40 km/h Not applicable - no unsignalized crossings along the corridor	B
	4 to 5 [illegible]	B
	3 or less [illegible]	B
	6 or more lanes being crossed; 50 km/h	C
	4 to 5 lanes being crossed; 60 km/h	C
	3 or less lanes being crossed; ≥ 65 km/h	D
	6 or more lanes being crossed; 60 km/h	E
	4 to 5 lanes being crossed; ≥ 65 km/h	E
	6 or more lanes being crossed; ≥ 65 km/h	F

Notes:

Segment has the same treatment in both the eastbound and westbound directions, so only one evaluation is needed. Although the physical barrier of the separated cycling facility is dropped at certain points along the corridor, these treatments occur only at isolated spots (i.e. driveways) in order to highlight conflict zones and over short segments, therefore the section is considered to be a physically separated facility. This illustrates the need for judgement in applying the evaluation criteria.

MMLOS Segment Evaluation

Street	Laurier Avenue
From	Metcalfe Street
To	Elgin Street
Year / Condition	2012 - After implementation of cycle tracks
Direction	Eastbound / Westbound
MMLOS Mode	BLOS

Segment Score

A

Photo / Proposed Cross-Section (where available):

Evaluation Criteria:

Type of Bikeway		LOS
Physically Separated Bikeway (cycle tracks, protected bike lanes and multi-use paths). Physical separation refers to, but is not limited to, curbs, raised medians, bollards and parking lanes (adjacent to the bike lane along the travelled way i.e. not curbside).		A
Bike Lanes Not Adjacent Parking Lane - Select Worst Scoring Criteria		
No. of Travel Lanes	1 travel lane in each direction	A
	2 travel lanes in each direction separated by a raised median	B
	2 travel lanes in each direction without a separating median	C
	More than 2 travel lanes in each direction	D
Bike Lane Width	> 1.8 m wide bike lane (includes marked buffer and paved gutter width)	A
	≥ 1.5 m to <1.8 m wide bike lane (includes marked buffer and paved gutter width)	B
	≥ 1.2 m to <1.5 m wide bike lane (includes marked buffer and paved gutter width)	C
Operating Speed	≤ 50 km/h operating speed	A
	60 km/h operating speed	C
	> 70 km/h operating speed	E
Bike lane blockage (commercial areas)	Rare	A
	Frequent	C

Not applicable - physically separated bikeway provided along the segment

Bike Lanes Adjacent to curbside Parking Lane - Select Worst Scoring Criteria		
No. of Travel Lanes	1 travel lane in each direction	A
	2 or more travel lanes in each direction	C
Bike Lane and Parking Lane Width	4.5 m wide bike lane plus parking lane (includes marked buffer and paved gutter width)	A
	4.25 m wide bike lane plus parking lane (includes marked buffer and paved gutter width)	B
	≤ 4.0 m wide bike lane plus parking lane (includes marked buffer and paved gutter width)	C
Operating Speed	< 40 km/h operating speed	A
	50 km/h operating speed	B
	60 km/h operating speed	D
	> 70 km/h operating speed	F
Bike lane blockage (commercial areas)	Rare	A
	Frequent	C

Not applicable - physically separated bikeway provided along the segment

Mixed Traffic		
No. of Travel Lanes and Operating Speed	2 travel lanes; ≤ 40 km/h; no marked centerline or classified as residential	A
	2 to 3 travel lanes; ≤ 40 km/h	B
	2 travel lanes; 50 km/h; no marked centerline or classified as residential	B
	2 to 3 travel lanes; 50 km/h	D
	4 to 5 travel lanes; ≤ 40 km/h	D
	4 to 5 travel lanes; ≥ 50 km/h	E
	6 or more travel lanes; ≤ 40 km/h	E
	≥ 60 km/h	F

Not applicable - physically separated bikeway provided along the segment

Unsignalized Crossing along Route: no median refuge		
No. of Travel Lanes on Side Street and Operating Speed	3 or less lanes being crossed; ≤ 40 km/h	A
	4 to 5 lanes being crossed; ≤ 40 km/h	B
	3 or less lanes being crossed; 50 km/h	B
	4 to 5 lanes being crossed; 50 km/h	C
	3 or less lanes being crossed; 60 km/h	C
	4 to 5 lanes being crossed; 60 km/h	D
	6 or more lanes being crossed; ≤ 40 km/h	E
	3 or less lanes being crossed; ≥ 65 km/h	E
	6 or more lanes being crossed; ≥ 50 km/h	F
	4 to 5 lanes being crossed; ≥ 65 km/h	F

Not applicable - no unsignalized crossings along the corridor

Unsignalized Crossing along Route: with median refuge (> 1.8 m wide)		
No. of Travel Lanes on Side Street and Operating Speed	5 or less lanes being crossed; ≤ 40 km/h	A
	3 or less lanes being crossed; 50 km/h	A
	6 or more lanes being crossed; ≤ 40 km/h	B
	4 to 5 [illegible]	B
	3 or less [illegible] /h	B
	6 or more lanes being crossed; 50 km/h	C
	4 to 5 lanes being crossed; 60 km/h	C
	3 or less lanes being crossed; ≥ 65 km/h	D
	6 or more lanes being crossed; 60 km/h	E
	4 to 5 lanes being crossed; ≥ 65 km/h	E
	6 or more lanes being crossed; ≥ 65 km/h	F

Not applicable - no unsignalized crossings along the corridor

Notes:

Segment has the same treatment in both the eastbound and westbound directions, so only one evaluation is needed.

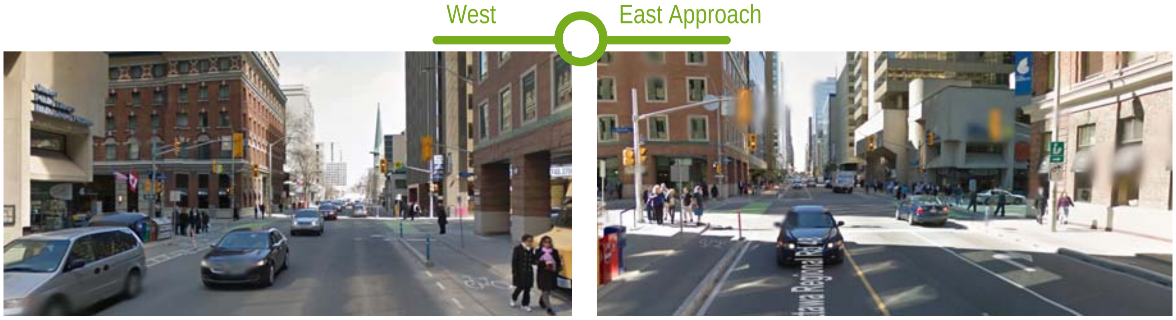
MMLOS Signal Evaluation

Main Street	Laurier Avenue
Minor Street	Metcalfe Street
Approaches	East / West
Year / Condition	2012 - After implementation of cycle tracks
Direction	Eastbound / Westbound
MMLOS Mode	BLOS

Signal Score

A

Photo / Proposed Cross-Section (where available):



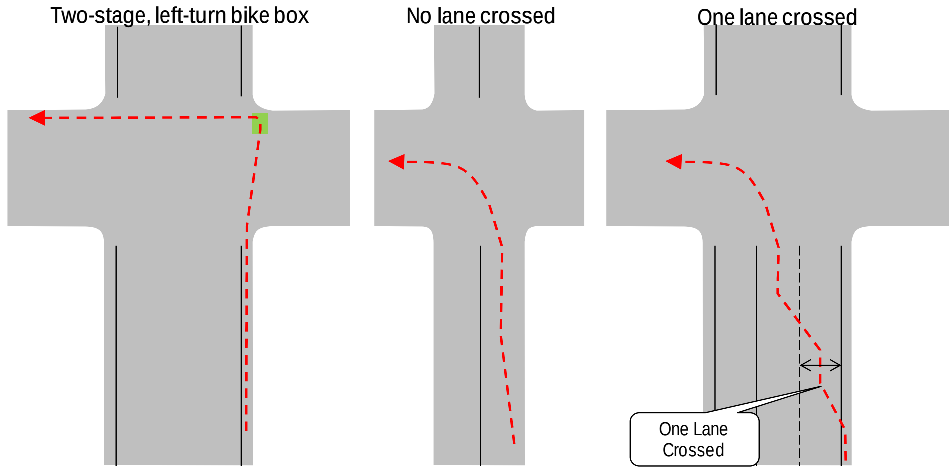
West Approach

East Approach

Bikeway and Intersection Type		LOS
Bike Lanes or higher order facility on a Signalized Intersection Approach		
Right-turn Lane and Turning Speed of Motorists	No impact on LTS (as long as cycling facility remains to the right of any turn lane - otherwise see pocket bike lanes below)	
Cyclist Making a Left-turn and Operating Speed of Motorists (refer to figure)	Two-stage, left-turn bike box; ≤ 50 km/h	[✓ A]
	No lane crossed, ≤ 50 km/h	B
	1 lane crossed, ≤ 40 km/h	B
	No lane crossed, ≥ 60 km/h	C
	1 lane crossed, 50 km/h	C
	2 or more lanes crossed, ≤ 40 km/h	D
	1 lane crossed, ≥ 60 km/h	E
	2 or more lanes crossed, ≥ 50 km/h	F
	All other single left-turn lane configurations	F
	Dual left-turn lanes (shared or exclusive)	F

Right turn lane is provided to the left of the cycling facility

Left-turn Configurations



Notes:

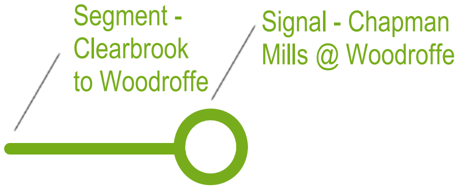
Note that although cyclists have the option of using the bike boxes or making a vehicular left, the segment is evaluated using the bike boxes since this is an option for less confident riders. Both directions have the same treatment, so both directions are evaluated at the same time.

MMLOS Modal Summary Page

Project: TLOS Example Illustration

Corridor: Chapman Mills

Study Area: Clearbrook to Woodroffe



Overall Route Score

B

Segment Summary

Segment 1

Street	Chapman Mills
From	Clearbrook
To	Woodroffe
Year / Condition	2015
Direction	Eastbound / Westbound
MMLOS Mode	TLOS

Segment 1 Score

A

Signal Summary

Signal 1

Street	Chapman Mills
@	Woodroffe
Approach	Eastbound / Westbound
Year / Condition	2015
MMLOS Mode	TLOS

Signal 1 Score

B

Notes:
Segment has the same treatment in both the eastbound and westbound directions, so only one evaluation is needed.

MMLOS Segment Evaluation

Street	Chapman Mills
From	Clearbrook
To	Woodroffe
Year / Condition	2015
Direction	Eastbound / Westbound
MMLOS Mode	TLOS

Segment Score

A

Photo / Proposed Cross-Section (where available):

Evaluation Criteria:

Facility Type		Level/exposure to congestion delay, friction and incidents			Quantitative Measurement	LOS
		Congestion	Friction	Incident Potential		
Segregated ROW		No	No	No	N/A	A
Bus lane	No/limited parking/driveway friction	No	Low	Low	$C_f \leq 60$	B
	Frequent parking/driveway friction	No	Medium	Medium	$C_f > 60$	C
Mixed Traffic	Limited parking/driveway friction	Yes	Low	Medium	$Vt/Vp \geq 0.8$	D
	Moderate parking/driveway friction	Yes	Medium	Medium	$Vt/Vp \leq 0.6$	E
	Frequent parking/driveway friction	Yes	High	High	$Vt/Vp < 0.4$	F

Notes:
Example is intended to be illustrative only and may not reflect actual conditions. Both directions are evaluated at once since both directions have the same facility.

MMLOS Signal Evaluation

Main Street	Chapman Mills
Minor Street	Woodroffe
Approaches	Eastbound / Westbound
Year / Condition	2015
MMLOS Mode	TLOS

Signal Score

B

East Approach

Delay	Typical Location	LOS
0	Grade Separation	A
≤10 sec	High Level TSP	B
≤20 sec		C
≤30 sec		D
≤40 sec	TSP & long cycle length	E
>40 sec	No TSP & long cycle length	F

Note: Delay includes travel time from end of queue to entering the intersection

West Approach

Delay	Typical Location	LOS
0	Grade Separation	A
≤10 sec	High Level TSP	B
≤20 sec		C
≤30 sec		D
≤40 sec	TSP & long cycle length	E
>40 sec	No TSP & long cycle length	F

Note: Delay includes travel time from end of queue to entering the intersection

Notes:
Example is intended to be illustrative only and may not reflect actual conditions. Both eastbound and westbound directions are evaluated at once since both directions experience the same delay.

MMLOS Modal Summary Page

Project: TkLOS Example Illustration

Corridor: Merivale

Year / Scenario: 2015

Study Area:

Overall Route Score

A

Segment Summary

Street	Merivale
From	Jamie Avenue
To	Hunt Club Road
Year / Condition	2015
Direction	Northbound-Southbound
MMLOS Mode	PLOS

Segment 1 Score

A

Signal Summary

Street	Merivale
@	Hunt Club
Approach	All (see below)
Year / Condition	2015
MMLOS Mode	TkLOS

Signal 1 Score

A

Notes:
Segments have the same treatment in both the northbound and southbound directions, so only one segment evaluation is needed for each block.

MMLOS Segment Evaluation

Street	Merivale
From	Jamie
To	Hunt Club
Year / Condition	2015
Direction	Northbound-Southbound
MMLOS Mode	TkLOS

Segment Score

A

Photo / Proposed Cross-Section (where available):

Evaluation Criteria:

Curb Lane Width (m)	Only two travel lanes (one in each direction)	More than two travel lanes
>3.7	B	[✓ A]
≤3.5	C	A
≤3.3	D	C
≤3.2	E	D
≤3	F	E

Notes:
Example is intended to be illustrative only and may not reflect actual conditions. Both directions are evaluated at once since the lane widths are consistent across the corridor.

MMLOS Signal Evaluation

Main Street	Merivale
Minor Street	Hunt Club
Approaches	All (see below)
Year / Condition	2015
MMLOS Mode	TkLOS

Overall Intersection Score

A

North Approach

Effective Corner Radius	One receiving lane on departure from intersection	More than one receiving lane on departure from intersection
< 10m	F	D
10 to 15m	E	B
> 15m	C	A

Overall Approach Score

A

East Approach

Effective Corner Radius	One receiving lane on departure from intersection	More than one receiving lane on departure from intersection
< 10m	F	D
10 to 15m	E	B
> 15m	C	A

Overall Approach Score

A

South

Effective Corner Radius	One receiving lane on departure from intersection	More than one receiving lane on departure from intersection
< 10m	F	D
10 to 15m	E	B
> 15m	C	A

Overall Approach Score

A

West Approach

Effective Corner Radius	One receiving lane on departure from intersection	More than one receiving lane on departure from intersection
< 10m	F	D
10 to 15m	E	B
> 15m	C	A

Overall Approach Score

A

Notes:

Example is intended to be illustrative only and may not reflect actual conditions.

Trade-off Evaluation Scenario A: Centre Street Revitalization

As part of the City’s ongoing capital program, ten blocks of a main artery in the heart of a thriving commercial district, Centre Street, are due for reconstruction. In order to determine which modes the new cross-section should prioritize, an analysis is carried out of the existing conditions, and the MMLOS targets are reviewed for cross-section requirements.

A summary of the site conditions and basic context are provided in Exhibit 23**.**

Exhibit 23 – Centre Street Site Context

ROADWAY	DESIGNATION	SPEED	CONSIDERATIONS
Centre Street	Traditional Mainstreet	50 km/hr	▪ Centre street is an arterial road with one lane in each direction plus a parking lane on both sides ▪ Centre Street is identified as part of the cycling spine network ▪ This segment of Centre Street is located within 500m of a rapid transit station ▪ A parallel rapid transit route exists within 500m of the segment ▪ A feeder transit route with isolated transit priority measures is identified along the corridor ▪ A laneway is available off the main thoroughfare to facilitate deliveries to businesses (Centre is not designated as a truck route)

Based on a thorough analysis of current conditions on segments and at intersections, the following conditions are shown to exist for the prevailing peak period of analysis (refer to Exhibit 24).

Exhibit 24 – Centre Street Existing Conditions

PLOS	BLOS	TLOS	TKLOS	LOS
C	F	D	E	C

Referring to the MMLOS target table presented in Section 7.1, the following are the modal targets based on the prevailing conditions (refer to Exhibit 25).

Exhibit 25 – Centre Street Modal Targets & Sample Facilities Required

PLOS	BLOS	TLOS	TKLOS	LOS
B	C	D	E	D

After developing an ‘ideal’ cross-section based on the above targets , it becomes obvious that not all of the targeted conditions can be accommodated within existing right-of-way and pavement width constraints while maintaining or exceeding the existing LOS for each mode. Given the need for trade-offs, MMLOS can assist in the development of alternative options.

A variety of scenarios are identified for the reconstruction in an effort to achieve the minimum desired targets:

- Traffic calming – Lanes are narrowed slightly, and corner radii are reduced – as a result, the operating speed of the road is reduced. Additional boulevard width is provided to allow for improved street furniture to be provided.
- Road diet – In this scenario, bike lanes are added to the cross-section. In order to accommodate the bike lanes, a parking lane is removed, and lanes are narrowed slightly. Pedestrians are provided with additional sidewalk width and boulevard.
- Intersection improvements – In this scenario, intersection improvements are provided to enhance the pedestrian crossing experience and to accommodate bicycle turning movements more comfortably. The package of improvements includes prohibiting RTOR, but due to better signal coordination of the corridor, the vehicular and transit delays are minimized.

Exhibit 26 – Impacts of various scenarios for Centre Street reconstruction

SCENARIO	PLOS	BLOS	TLOS	TKLOS	LOS
Existing	C	E	D	E	C
Targeted LOS	B	C	D	E	D
Traffic Calming	B	C	D	E	D
Road Diet	B	B	E	E	E
Signal Modifications	B	D	D	E	D

With the following summary of the impacts of each scenario, a decision can be made that is based on a complete picture of the desired improvements. In this case, the traffic calming scenario achieves or exceeds the minimum desirable targets for every mode.

The MMLOS acts as a tool for understanding how improvements impact all moves – but the framework is not intended to dictate one particular design or treatment option to be applied everywhere. As shown in Exhibit 26, there are a variety of techniques that can be used to compromise in the development of the cross-section elements, and the MMLOS framework provides a realized tool for assessing trade-offs.

Trade-off Evaluation Scenario A: Centre Street Revitalization

As part of the City's ongoing capital program, ten blocks of a main artery in the heart of a thriving commercial district, Centre Street, are due for reconstruction. In order to determine which modes the new cross-section should prioritize, an analysis is carried out of the existing conditions, and the MMLOS targets are reviewed for cross-section requirements.

A summary of the site conditions and basic context are provided in Exhibit 23**.**

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C	F	D	E	C

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Exhibit 25 – Centre Street Modal Targets & Sample Facilities Required

PLOS	BLOS	TLOS	TKLOS	LOS
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After developing an 'ideal' cross-section based on the above targets , it becomes obvious that not all of the targeted conditions can be accommodated within existing right-of-way and pavement width constraints while maintaining or exceeding the existing LOS for each mode. Given the need for trade-offs, MMLOS can assist in the development of alternative options.

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Exhibit 26 – Impacts of various scenarios for Centre Street reconstruction

SCENARIO	PLOS	BLOS	TLOS	TKLOS	LOS
Existing	C	E	D	E	C
Targeted LOS	B	C	D	E	D
Traffic Calming	**B**	**C**	**D**	**E**	**D**
Road Diet	B	B	E	E	E
Signal Modifications	B	D	D	E	D

With the following summary of the impacts of each scenario, a decision can be made that is based on a complete picture of the desired improvements. In this case, the traffic calming scenario achieves or exceeds the minimum desirable targets for every mode.

The MMLOS acts as a tool for understanding how improvements impact all moves – but the framework is not intended to dictate one particular design or treatment option to be applied everywhere. As shown in Exhibit 26, there are a variety of techniques that can be used to compromise in the development of the cross-section elements, and the MMLOS framework provides a realized tool for assessing trade-offs.

Appendix B: Acceptable Parameters for Operational Analysis of Signalized Intersections

B1 Operational and Timing Standards for Signalized Intersections

GENERAL TIMING STANDARDS	
Maximum cycle length for analysis	• 120 sec
Minimum green time	• 10 sec for side street through movements • 5 sec for left-turn phases
Vehicle clearance	• Must consist of amber and all red display. Duration in accordance with Ontario Traffic Manual Book 12.
PEDESTRIAN PHASES	
Minimum walk time	• 7 sec
Walking speed	• 1.2 m/sec; 1.1 m/sec if near old age home, school or shopping centre
Pedestrian clearance	• Must be sufficient to allow crossing from curb to curb (including central medians). Includes vehicle clearance time in accordance with Ontario Traffic Manual Book 12.
Median storage	• If centre median storage for pedestrians is provided, then the minimum walk time must be of sufficient duration to allow a crossing from the curb to the far side of the median plus one lane. The pedestrian clearance interval must be of sufficient duration to permit the longest crossing from the median to the curb. Use of the median for pedestrian refuge shall only be considered in consultation with TPO staff.
AUXILIARY TURN LANE PHASING	
Overlap left-turn	• In cases where left-turn phasing is required for opposing left-turn movements and one of the movements is much heavier than the opposing movement, consideration should be given to early termination of the arrow indication for the lighter left-turn movement in order to permit an earlier commencement of the conflicting through movement. Appropriate vehicle clearance displays must be provided for all left-turn phases. Proper account must be made for lost time resulting from these clearances.
Protected only left-turn phasing	• Protected only left-turn phasing must be used when conditions are such that an undue hazard might result if permissive phasing were used. This is normally considered to be the case with a double left turn.
Shared lane operation	• All movements permitted from a shared use lane must operate on the same signal phase.
Dual right/left-turn movements	• Conflicting pedestrian movements should not be permitted simultaneously with dual right/left-turn movements. Normally, dual right turns will also require signalization.
Right/Left-turn arrows	• A right/left-turn arrow shall not be displayed at the same time that a conflicting pedestrian movement is permitted.
INTERSECTION SPACING AND MINIMUM STORAGE LENGTHS	
Visibility	• As per the requirements of the Ontario Traffic Manual, Book 12, signalized intersections should be a minimum of 120 metres apart, centreline to centreline, to ensure adequate visibility of the signal heads.
Through vehicle storage between intersections	• Signalized intersections must be sufficiently spaced to ensure that storage is available to accommodate 1.5 times the average number of vehicles arriving on each red indication during the heaviest hour (assuming an average vehicle length of 7 metres).
Storage lane lengths	• Left-turn storage lanes must be long enough to accommodate 1.5 times the average number of arrivals per cycle in the heaviest hour. Where double left turn lanes are in use, calculations should assume a 45%/ 55% distribution of traffic between the lanes. • Right-turn storage lanes must be long enough to permit right-turning traffic to clear the maximum queue of through vehicles that is anticipated to accumulate during the red indication. All calculations must assume an average vehicle length of 7 metres.
PARAMETERS FOR INTERSECTION ANALYSIS	
Heavy vehicle equivalent	• Heavy vehicles or buses 1.7
Saturation flow rate	• The maximum assumed ideal unadjusted saturation flow rate shall not exceed 1800 passenger cars per hour of green per lane, unless a higher or lower rate can be justified by the Consultant through data.

Appendix C: Sample MMLOS Summary Table

Multi-Modal Level of Service Data Entry Form
Project Example 1
Major Street Corridor - 2015 Existing Conditions

INTERSECTIONS		Street A				Street B				Street C				Street D			
		NORTH	SOUTH	EAST	WEST	NORTH	SOUTH	EAST	WEST	NORTH	SOUTH	EAST	WEST	NORTH	SOUTH	EAST	WEST
Pedesrian	Lanes	5	3	6	6	2	2	4	4		2	5	5	3	3	5	5
	Median	No	No	No	No	No	No	No	No		No	No	No	No	No	No	No
	Island Refuge	No	No	No	No	No	No	No	No		No	No	No	No	No	No	No
	Conflicting Left Turns	Prot+Perm	Permitted	Prot+Perm	Permitted	Permitted	Permitted	Permitted	Permitted		Permitted	Permitted	Permitted	Permitted	Permitted	Permitted	Permitted
	Conflicting Right Turns	Permitted	Permitted	Permitted	Permitted	Permitted	Permitted	Permitted	Permitted		Permitted	Permitted	Permitted	Permitted	Permitted	Permitted	Permitted
	RTOR?	Allowed	Allowed	Allowed	Allowed	Allowed	Allowed	Allowed	Allowed		Allowed	Allowed	Allowed	Allowed	Allowed	Allowed	Allowed
	Ped Leading Interval?	no	no	no	no	no	no	yes	yes		no	no	no	no	no	no	no
	Corner Radius (largest)	10-15m	5-10m	10-15m	10-15m	10-15m	5-10m	10-15m	5-10m		5-10m	5-10m	5-10m	5-10m	5-10m	5-10m	5-10m
	Crosswalk Type	Zebra Stripe Markings	Zebra Stripe Markings	Zebra Stripe Markings	Zebra Stripe Markings	Zebra Stripe Markings	Zebra Stripe Markings	Zebra Stripe Markings	Zebra Stripe Markings		Zebra Stripe Markings	Zebra Stripe Markings	Zebra Stripe Markings	Zebra Stripe Markings	Zebra Stripe Markings	Zebra Stripe Markings	Zebra Stripe Markings
	Level of Service	**E (40)**	**C (74)**	**F (23)**	**F (23)**	**B (88)**	**B (89)**	**D (56)**	**D (57)**		**B (89)**	**E (41)**	**E (41)**	**C (74)**	**C (74)**	**E (41)**	**E (41)**
		F				**D**				**E**				**E**			
Cyclist	Type of Bikeway	Mixed Traffic	Mixed Traffic	Mixed Traffic	Mixed Traffic	Mixed Traffic	Mixed Traffic	Mixed Traffic	Mixed Traffic		Mixed Traffic	Mixed Traffic	Mixed Traffic	Mixed Traffic	Mixed Traffic	Mixed Traffic	Mixed Traffic
	Turning Speed (25km to 80km/h)	Slow	Slow	Slow	Slow	Slow	Slow	Slow	Slow		Slow	Slow	Slow	Slow	Slow	Slow	Slow
	Right Turn Storage Length	>50m	0-25m	25-50m	25-50m	0m	0m	0m	0m		0m	0m	0m	0m	0m	0m	0m
	Dual Right Turn?	no	no	no	no	no	no	no	no		no	no	no	no	no	no	no
	Shared Through-Right?	no	yes	no	no	yes	yes	yes	yes		yes	yes	yes	yes	yes	yes	yes
	Bike Box?	no	no	no	no	no	no	no	no		no	no	no	no	no	no	no
	Number of Lanes Crossed for Left Turns	2+	1	2+	2+	0	0	1	1		0	2+	1	1	1	2+	2+
	Operating Speed on Approach	50-59km/h	<=40 km/h	50-59km/h	50-59km/h	41-49 km/h	41-49 km/h	50-59km/h	50-59km/h		41-49 km/h	50-59km/h	50-59km/h	41-49 km/h	41-49 km/h	50-59km/h	50-59km/h
	Dual Left Turn Lanes?	no	no	no	no	no	no	no	no		no	no	no	no	no	no	no
	Level of Service	**F**	**F**	**F**	**F**	**B**	**B**	**D**	**D**		**B**	**F**	**D**	**D**	**D**	**F**	**F**
		F				**D**				**F**				**F**			
Transit	Average Signal Delay	20 Sec	20 Sec	10 Sec	10 Sec	10 Sec	20 Sec	20 Sec	20 Sec		30 Sec	40 Sec	30 Sec	30 Sec	30 Sec	30 Sec	30 Sec
	Level of Service	**F**	**B**	**F**	**D**	**A**	**A**	**A**	**A**		**D**	**E**	**D**	**D**	**D**	**D**	**D**
		F				**A**				**E**				**D**			
Truck	Turning Radius (smallest)	10-15m	<10m	>15m	<10m	<10m	<10m	<10m	<10m		<10m	<10m	<10m	<10m	<10m	<10m	<10m
	Number of Receiving Lanes	2+	2+	2+	2+	2+	2+	1	1		2+	1	1	2+	2+	1	1
	Level of Service	**B**	**D**	**A**	**D**	**D**	**D**	**F**	**F**		**D**	**F**	**F**	**D**	**D**	**F**	**F**
		D				**F**				**F**				**F**			
Auto	**Level of Service**	**C**				**E**				**D**				**D**			

SEGMENTS		Street A	Section			Street B	Section			Street C	Section			Street D	Section		
			1	2	3		1	2	3		1	2	3		1	2	3
Pedesrian	Sidewalk Width		2.0m+	2.0m+	2.0m+			2.0m+	2.0m+		2.0m+				2.0m+	2.0m+	1.8m
	Boulevard Width		0.5-2m	2m+	0.5-2m			0.5-2m	0.5-2m		0.5-2m				0.5-2m	2m+	0.5-2m
	AADT		>3000	>3000	>3000			>3000	>3000		>3000				>3000	>3000	>3000
	On-Street Parking		no	yes	yes			yes	yes		yes				yes	yes	no
	Operating Speed		<= 30 km/h	31-50 km/h	51-60 km/h			31-50 km/h	31-50 km/h		31-50 km/h				51-60 km/h	51-60 km/h	51-60 km/h
	Level of Service		**A**	**B**	**C**			**B**	**C**		**B**				**C**	**B**	**E**
			C				**C**				**B**				**E**		
Cyclist	Number of Travel Lanes (per direction)		2				2				2				2		
	Type of Bikeway		Mixed Traffic	Mixed Traffic			Mixed Traffic				Mixed Traffic				Mixed Traffic		
	Bike Lane Width		N/A	N/A			N/A				N/A				N/A		
	Operating Speed		<= 40 km/h	50 km/h			50 km/h				50 km/h				50 km/h		
	Bike Lane Blockages																
	Unsignalized Lane Crossings (no median)		2	2			2				2				2		
	Unsignalized Lane Crossings (median >1.8m)																
	Sidestreet Operating Speed		41-49 km/h	41-49 km/h			41-49 km/h				41-49 km/h				41-49 km/h		
	Level of Service		**B**	**D**	**F**		**D**				**D**				**D**		
			D				**D**				**D**				**D**		
Transit	Facility Type		Mixed Traffic				Bus lane				Mixed Traffic				Mixed Traffic		
	Friction / Congestion / Incident Potential		Vt/Vp ≥ 0.8				Cf ≤ 60				Vt/Vp ≥ 0.8				Vt/Vp ≤ 0.6		
	Level of Service		**D**				**B**				**D**				**E**		
			D				**B**				**D**				**E**		
Truck	Lane Width (3, 3.3, 3.5, >3.7)		3.5m	3.5m	3.5m		3.5m				3.5m				3.5m		
	Travel Lanes per Direction		2+	2+	2+		2+				2+				2+		
	Level of Service		**A**	**A**	**A**		**A**				**A**				**A**		
			A				**A**				**A**				**A**		
Auto	**Level of Service**	**B**				**C**				**C**				**D**			

*Applies only where conditions are the same in both directions

Report to
Rapport au:

Transportation Committee
Comité des transports
3 May 2017 / 3 mai 2017

Submitted on April 18, 2017
Soumis le 18 avril 2017

Submitted by
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Ward: CITY WIDE / À L'ÉCHELLE DE LA VILLE

File Number: ACS2017-TSD-PLN-0004

SUBJECT: **Applying the Complete Street Lens to Projects in 2016 and 2017**

OBJET: **Application de l’optique de rue complète aux projets de 2016 et 2017**

REPORT RECOMMENDATION

That the Transportation Committee receive this report for information.

RECOMMANDATION DU RAPPORT

Que le Comité des transports prenne connaissance du présent rapport, à titre informatif.

EXECUTIVE SUMMARY

Complete Streets incorporate the physical elements that allow a street to offer safety, comfort and mobility for all users of the street regardless of their age, ability, or mode of transportation. The application of a “Complete Street lens” uses every transportation project as a catalyst for improvements within the scope of that project.

On October 14, 2015, Council directed staff to report back to the Transportation Committee on projects that have been examined and implemented through the Complete Streets lens for 2016 and those planned for 2017. This report is in response to Council’s directive.

Public Consultation/Input

No direct public consultation was undertaken for the preparation of this report. Consultation occurred during the preparation of the Complete Streets Implementation Framework.

RÉSUMÉ

Les rues complètes intègrent les éléments physiques qui permettent d’offrir sécurité, confort et mobilité à tous les usagers, quel que soit leur âge, leur capacité ou le mode de transport utilisé. L’application d’une « optique de rue complète » sert de catalyseur pour apporter des améliorations dans le cadre de chaque projet de transport.

Le 14 octobre 2015, le Conseil a chargé le personnel de rendre compte au Comité des transports au sujet des projets qui ont été examinés et mis en œuvre selon l’optique de rue complète en 2016 et de ceux qui devraient l’être en 2017. Le présent rapport fait suite à cette directive du Conseil.

Consultation publique et commentaires

Aucune consultation publique directe n’a été entreprise pour élaborer le présent rapport. Une consultation a eu lieu lors de la préparation du Cadre de mise en œuvre des rues complètes.

BACKGROUND

On November 26, 2013, Council approved an update to the City’s Transportation Master Plan (TMP) as part of the Building a Liveable Ottawa Initiative which directed the City to design and build complete streets by:

- Adopting a “complete streets” policy for road design, operation and maintenance;

- Updating road design guidelines, standards and processes to reflect complete streets principles; and,

- Using multi-modal levels of service to assess road designs and allocate right of way.

On October 14, 2015 Council approved the Complete Streets Implementation Framework report (ACS2015-PAI-PGM-0159). Council also directed staff to report back to the Transportation Committee to identify the projects that have been examined and implemented through the “Complete Street lens” for 2016 and those planned for 2017.

DISCUSSION

The objective of the Complete Streets policy is to build an urban form within an affordable fiscal framework that supports multi-modal transportation and the increased use of sustainable transportation modes (i.e. walking, cycling, transit, and car pooling). This report highlights how the “Complete Street lens” is being applied to Capital Infrastructure projects, Area Traffic Management studies and projects, planning projects and policy initiatives, and also identifies education and promotion related to Complete Streets. In 2016, 10 major new road and integrated road renewal projects included Complete Street features and in 2017 a further nine projects will progress to design and construction.

Capital Infrastructure Projects

Major New Road and Integrated Renewal Projects:

Major new roads such as collector and arterial roads in new communities are planned and designed by following up-to-date policies and plans to meet the needs of a growing community. While these streets are often built to be phased and expanded over time, the application of a “Complete Street lens” can be seen in the early stages of corridor development. Examples include: Campeau Drive Extension (Huntmar to Didsbury) and Robert Grant Avenue (Abbott to Fernbank).

All Integrated Road Renewal projects are scoped using the Complete Street lens. Noteworthy examples of projects that demonstrate the features of Complete Streets include:

- Under construction in 2016: Main Street (Pretoria to McIlraith Bridge); and,

- For planning: Elgin Street (Laurier Avenue West to Queen Elizabeth Drive); Bank Street (Riverside Drive to Ledbury Avenue), and St. Laurent Boulevard (Industrial to Smyth).

Light Rail Transit (LRT) related street improvements – O-Train Confederation Line and Stage 2 LRT:

The implementation of the LRT creates opportunities for complete streets and improved connectivity for walking and cycling.

As part of the construction of the O-Train Confederation Line, the renewal of Queen Street and Rideau Street was initiated in 2016 and will be completed in time with the Light Rail Transit opening. These street designs will facilitate a seamless high-quality level-of-service for a greater number of transit riders between the O-Train Confederation Line stations, local bus stops and downtown destinations. Further, the wider sidewalks and streetscaping not only allow for additional capacity but will also provide a more pleasant experience for pedestrians.

As part of the Confederation Line West Extension between Tunney's Pasture and Baseline and Bayshore Stations, O-Train Planning has studied the design options for the reconstruction of Richmond Road after the construction of the Western LRT in the area. The Richmond Road Complete Street study has generated a complete street design concept for the corridor between the Sir John A. Macdonald Parkway in the west and Berkley Avenue in the east. The objective is to include: improved sidewalks, crosswalks, and pathways; safe and convenient cycling; promotion of "place making" opportunities; and enhancements to the public realm with landscaping amenities.

A list of projects in this category is attached as Document 1.

Road Renewal/Resurfacing Projects:

Infrastructure Services has an annual program for the resurfacing of roads. The list of projects to be implemented in 2016 was reviewed with a Complete Street lens and consideration was given to enhance the pedestrian, cycling and transit operations and environment. The focus was on affordable measures, within the context and scope of the annual renewal program, and included such measures as painted bicycle lanes, bike boxes, enhanced crosswalks, improved bus stop areas, and paved shoulders along rural roads and in villages for cyclists and pedestrians. As a result, 18 projects included complete street elements and there were some notable enhancements coordinated in the urban area, villages and in the rural area.

The list of candidate roads for the 2017 renewal and resurfacing program has been reviewed to identify opportunities to enhance the level of service for road users such as cyclists and pedestrians through paved shoulders, line painting, signage other measures. There are 11 noteworthy projects. A full list of these projects with Complete Street elements is included in Document 2.

Stand Alone Cycling and Pedestrian Projects:

The Cycling Facilities program implements cycling improvements across the city to fill in gaps and further implement the overall network identified in the 2013 Ottawa Cycling Plan (OCP). Cycle tracks, cross rides, separated cycling lanes, and advisory lanes are among the diversity of treatments used to improve cycling along city streets. A separate report to Transportation Committee in March 2017 provided a mid-term review of progress on the OCP.

The Pedestrian Facilities program addresses gaps in the City's pedestrian network by implementing missing sidewalk links. The 2013 Ottawa Pedestrian Plan (OPP) sets objectives, priorities and guidance to improve the quality and continuity of the pedestrian environment throughout the City. A separate report to Transportation Committee in March 2017 provided a mid-term review of progress on the OPP.

Traffic Services Branch's Pedestrian Crossover Pilot Program enhances the pedestrian crossings along many roads by providing new pedestrian crossovers. Crossovers were implemented at fifty-nine locations as part of this program in 2016 (as listed on the City's website) and a further 30 locations are currently planned for 2017.

Area Traffic Management Studies and Projects

The objective of the City's Area Traffic Management (ATM) program is to minimize the negative impacts of motorized vehicles on neighbourhoods, and improve safety and quality of life for all street users.

The ATM program has a number of concurrent studies and projects that are being implemented across the city. These include two on-going studies, five completed studies and the construction of 12 ATM projects in 2016 with four more ATM projects scheduled for construction in 2017. These projects are listed in Document 3. Noteworthy among these is the Byron Avenue traffic calming design. Extensive public consultation (including over 800 responses to an on-line questionnaire) and the exploration of innovative best practices is resulting in a solution that calms the street, improves travel for cyclists and enhances pedestrian access to the walkway within the

Byron Linear Park. Improvements along Byron Avenue are anticipated to be implemented in 2017 and 2018.

Planning Projects

Environmental Assessments:

Environmental Assessment studies create an opportunity to apply a Complete Street lens early in the consultation, planning and design of road and transit projects. Two studies were completed in 2016 and a remaining eight are in progress. A list of these studies can be found in Document 4.

Community Design Plans and Area Studies:

While Community Design Plans (CDP) generally focus on land use and development, they also address the planning and design of the physical environment and provide guidance regarding transportation and elements of the public realm, including parks and streetscapes. The application of a Complete Street lens can be seen in the many previously approved CDPs and it continues to be applied to those recently approved or those in progress during 2016 and into 2017. Examples include the recently approved Rockcliffe Airbase CDP and Secondary Plan (November 2015) and the Kanata North CDP (July 2016), as well as those CDPs in progress for: Riverside South; Barrhaven South; East Urban Community Phase 1 and 2 Areas; and the Mer Bleue Expansion Area.

Policy Initiatives

Traffic Impact Assessment Guidelines Updates:

The City’s 2006 Transportation Impact Assessment (TIA) Guidelines are being updated to reflect the objectives of the current Official Plan (OP) and Transportation Master Plan (TMP) and to improve guidance to practitioners in the application of the guidelines. The updates to the TIA Guidelines will recognize the Complete Streets policy and will incorporate the City’s Multi-Modal Level of Service (MMLOS) Guidelines. The update will be completed in 2017.

Also based on experience to date some clarifications and minor revisions to the MMLOS Guidelines are warranted to ensure their consistent application and intended results. In order to ensure that the Guidelines are supporting the City’s Complete Streets policy and implementation framework as intended, an addendum to the MMLOS Guidelines has been prepared and is included as Document 5.

Building Better and Smarter Suburbs:

On March 10, 2015, Planning Committee approved the report titled Building Better and Smarter Suburbs (BBSS): Strategic Directions and Action Plan. The report speaks to the challenge of supporting land efficiency and functionality in new suburban subdivisions, while at the same time improving urban design and long-term cost effectiveness. A key strategic direction for BBSS is to “ensure components of a ‘complete street’ are provided in the Right of Way (ROW), such as: pedestrian facilities; cycling facilities; on-street parking; traffic calming features; trees on both sides of the street, including canopy trees; and utility placement and operational considerations that do not interfere with the attributes of complete streets.” The BBSS Streets Working Group is reviewing existing and developing new road right-of-way cross-sections that address the above listed elements. Recommendations and solutions will be implemented as they become available.

Education and Promotion

Finally, internal and external promotion and communications about Complete Street policies and initiatives is essential for shared understanding and coordinated implementation. There have been a number of initiatives led by City staff and these are listed in Document 6.

RURAL IMPLICATIONS

A Complete Street lens is applied to all transportation projects, including those in the rural area. For instance several rural road surface renewal projects include paved shoulders to accommodate pedestrians and cyclists.

CONSULTATION

No direct public consultation was undertaken for the preparation of this report. Consultation occurred during the preparation of the Complete Streets Implementation Framework.

COMMENTS BY THE WARD COUNCILLOR(S)

Not applicable.

ADVISORY COMMITTEE(S) COMMENTS

Not applicable.

LEGAL IMPLICATIONS

There are no legal impediments to receiving this report for information.

RISK MANAGEMENT IMPLICATIONS

There are no risk management implications.

ASSET MANAGEMENT IMPLICATIONS

The information documented in this report is consistent with the City's Comprehensive Asset Management (CAM) Program (City of Ottawa Comprehensive Asset Management Program) objectives. The approved Complete Streets Implementation Framework supports the Comprehensive Asset Management Program's integrated planning framework. It assists to fulfil the City's obligation to deliver quality services to the community in a way that balances service levels, risk, and affordability.

Ongoing long term operation, maintenance and capital renewal cost will increase in order to sustain the upgraded and new assets (where applicable) required to support the expected level of service. Including the scope of work with planned renewal projects is an effective means of coordinating delivery of the targeted enhancement and changes in level of service to the community. In some cases, depending on the nature of the work, this impacts the extent of funding and work directed to the intended lifecycle renewal objectives. Moving forward, there is a need to assess the impacts to renewal funding and objectives as a result of the coordinated enhancement construction. These impacts (reduced scope of renewal, These impacts (reduced scope of renewal, ongoing operation and maintenance costs, future renewal costs of these new assess) and the strategies to maintain these assets should be reflected in Long Range Financial Plan and Asset Management Plan updates.

FINANCIAL IMPLICATIONS

There are no financial implications with receiving this report.

ACCESSIBILITY IMPACTS

The Complete Streets Implementation Framework provides guidance to staff to plan, design, construct, operate and maintain roads with a more enhanced focus on the most vulnerable users, including the goal of barrier-free access for all users. The implementation of transportation projects will continue to meet the Accessibility for Ontarians with Disabilities Act (AODA) and the City of Ottawa Accessibility Design Standards.

ENVIRONMENTAL IMPLICATIONS

Complete streets is a process to ensure people have more transportation mode choices by providing more certainty that the basic needs of each mode are accommodated through the planning, design, construction, operation and maintenance of roads. Providing more alternative and sustainable transportation infrastructure – such as sidewalks, crosswalks, public lighting and bike lanes – helps to grow the city's sustainable transportation mode share, which in turn improves the environment and public health over the long-term.

TERM OF COUNCIL PRIORITIES

The application of a Complete Street lens is supportive of the following Term of Council Priorities:

TM2 – Provide and promote infrastructure to support safe mobility choices

TM3 – Integrate the rapid transit and transit priority network into the community

TM4 – Improve safety for all road users

TM5 – Ensure reliable, safe, accessible, and affordable transit services

ES1 – Support an environmentally sustainable Ottawa

SUPPORTING DOCUMENTATION

Document 1 – Capital Infrastructure Projects: Major New Road and Integrated Renewal Projects

Document 2 – Capital Infrastructure Projects: Road Renewal/Resurfacing Projects

Document 3 – Area Traffic Management Studies and Projects

Document 4 – Environmental Assessments (EAs)

Document 5 – Addendum to the City's Multi-Modal Level of Service Guidelines

Document 6 – Education and Promotion

DISPOSITION

The Complete Street lens will continue to be applied to all transportation infrastructure projects.

DOCUMENT 1

Capital Infrastructure Projects: Major New Road and Integrated Renewal Projects

Examples of major new road and integrated renewal projects which demonstrate the features of Complete Streets, and that were either recently completed or in construction in 2016, include:

- Campeau Drive Extension – Huntmar Drive to Didsbury Road – new community street with roundabouts, wide sidewalks, landscaped boulevards and cycle tracks;
- Robert Grant Avenue – Abbott Street to Fernbank Road – two of four travel lanes constructed, with roundabouts, separate cycle tracks and sidewalks, and planning for future median transit lanes;
- Chapman Mills Drive – Beatrice Drive to Longfields Drive – median bus lane and cycle tracks;
- Queen Street – Lyon Street to O’Connor Street (to be extended to Elgin Street) – coordinated with LRT construction (completion in 2018);
- Rideau Street – Sussex Drive to Dalhousie Street – street renewal coordinated with the Rideau Centre expansion and LRT construction (2016-2018); and,
- Main Street – Pretoria Avenue to the McIlraith Bridge over the Rideau River – cycle tracks, wide sidewalks, transit stops, parking bays, street furniture and trees, and restoration of heritage elements (completion in 2017).

Projects in the planning, design or construction phase:

A complete street lens was applied to four projects in the planning, design or construction phase in 2016 and resulted in enhanced level-of-service for all road users. They include:

- Greenbank Road widening – Malvern Drive to Strandherd Drive – sidewalks, on-road cycling, multi-use pathways and landscaping (constructed in 2016);
- Gladstone Avenue reconstruction – Bank Street to Cartier Street – reconstruction with wide sidewalks, calmed traffic for shared vehicle and cycle lanes, and bulb outs to organize parking and create landscaping opportunities (constructed in 2015-2016);

- Strandherd Drive widening – Fallowfield Drive to Maravista Drive – front ending agreement for widening from two to four lanes including sidewalks and cycle lanes (construction in 2016-2017); and,
- Brian Coburn Boulevard – Navan Road to Mer Bleue Road – two of four travel lanes to be constructed, with multi-use pathway, cycling lanes, and roundabouts (construction in 2016-2017).

Projects in the works into 2017:

- Dynes Road – Prince of Wales Drive to Fisher Avenue and Prince of Wales Drive – Forest Hill Avenue to Dynes Road – reconstruction will include new sidewalks, cycle lanes, cycle tracks, protected-intersections designs at Dynes and Fisher, and Dynes and Prince of Wales, on-street parking defined by bulb outs; (construction 2017-2019);
- Kinburn Side Road – Donald B. Monroe Drive to Loggers Way – new sidewalks, pedestrian refuges, paved shoulders, and on-street parking defined by bulb outs (construction 2017);
- Imperial Avenue from Bronson Avenue to Renfrew Avenue – removal of lane channelization and conversion to a “T”-intersection at Renfrew and Imperial to improve pedestrian connections; (construction 2017-2018);
- Elgin Street – Laurier Avenue West to the Queen Elizabeth Driveway – design study underway (2016-2017);
- Bank Street – Riverside Drive to Ledbury Avenue – scoping and design study underway for future integrated with major utility renewals (2016-2017);
- St. Laurent Boulevard – Industrial Avenue to Smyth Road – road corridor reconstruction with transit improvements and new cycling facilities, AODA compliant sidewalks and general traffic improvements (design in 2016 and construction in 2017);
- Main Street – Pretoria Avenue to Echo Drive – continuation of complete street (design 2017);
- Jockvale Road – Cambrian Drive to Prince of Wales Drive – multi-use pathways on each side and roundabouts at major intersections (design to be completed in 2017); and,
- Albert Street, Slater Street and the Mackenzie-King Bridge – (Empress Avenue to Waller Street) – planning and design for the decommissioning of the downtown Bus Rapid Transit (BRT) and reallocation of space to other street users and functions (design in 2017, construction in 2018-2020).

Although completed before the 2015 policy, several other streets have unique complete street features. Examples include:

- Churchill Avenue – Byron Avenue to Carling Avenue – street renewed with wide accessible sidewalks, cycle tracks and landscaping (2015);
- Gladstone Avenue – Bank Street to Elgin Street – renewed with wide sidewalks, traffic calming for shared vehicle and cycle lanes and bulb outs to organize parking and create landscaping opportunities (2015);
- Chapman Mills Drive – Woodroffe Avenue to Beatrice Drive – dedicated median bus lanes to improve transit service (2013-2014);
- Queen Elizabeth Driveway and Fifth Avenue intersection and Colonel By Drive and Clegg Avenue intersection – enhanced intersections with pedestrian and cycling crossing signals improving community connections to the Rideau Canal pathways (2015);
- Sussex Drive – St Patrick Street to King Edward Avenue (part of Confederation Boulevard) – street amenities and landscaping, transit facilities cycling lanes and wide sidewalks (completed in 2015);
- Trim Road widening and realignment – OR174 to Innes Road – wide sidewalk or multi-use pathway on each side, cycle lanes, extensive landscaping, and roundabouts (constructed in 2015); and,
- Strandherd Drive widening and extension – Crestway Drive to Prince of Wales Drive – wide sidewalk on south side, multi-use pathway on north side, on-road cycling lanes, and bus stop platforms (2011).

DOCUMENT 2

Capital Infrastructure Projects: Road Renewal/Resurfacing Projects

In 2016, 57 candidate road renewal projects were evaluated using a “Complete Street lens” and, where the road base and existing shoulder widths would allow, modifications to enhance the pedestrian and cycling environment were incorporated into the scope and budget for 18 resurfacing and renewal projects.

Road Renewal/Resurfacing in Villages

New or reinstatement of wider shared-use lanes or paved shoulders improve walking and cycling opportunities in these communities.

Projects include:

- Constance Bay – Len Purcell Drive (Bayview Drive to Bayview Drive);
- Kars – Rideau Valley Drive South (at Lockhead Road);
- Richmond – Ottawa Street (Fortune Street to Joy’s Road);
- Richmond – Royal York Street (Fortune Street to Fowler Street); and,
- Manotick – Bridge Street (Manotick Main Street to River Road) – bike lanes, with signage and special paving markings, providing 1.2 km of continuous bike lanes across Manotick village.

Road Renewal/Resurfacing in the Rural Area and Greenbelt

New or reinstatement of wider road surface and paved shoulders to enhance rural cycling:

- Carp Road – Highway 417 to Richardson Side Road – 1.7 km paved shoulders both sides (implementation in 2017-2018);
- Fallowfield Road – Woodroffe Avenue to Prince of Wales Drive – over 2.0 km paved shoulders;
- Lester Road – Alert Road to Bank Street – approximately 2.0 km of paved shoulders;
- Snake Island Road – Stagecoach Road to Bank Street – over 6.0 km of paved shoulders.

Road Renewal/Resurfacing in the Urban Area

Diverse range of elements including providing separated bike lanes, painted bicycle lanes, bike boxes, “sharrows”, enhancing crosswalks; improving bus stop areas:

- O’Connor Street – Somerset Street to Isabella Street – coordinated with bikeway project in 2016 (protected two-directional bike lanes, bike turn boxes, bicycle traffic signals);
- Mackenzie Avenue – Rideau Street to Murray Street – coordinated with bikeway and streetscaping project in 2016-2017 (protected two-directional bike lanes, crossride, protected bicycle signal phase);
- Klondike Road – March Road to Sandhill Road – coordinated with pedestrian/ cycling improvements in 2016 (curb-protected two-way multi-use pathway);
- Kent Street – Catherine Street to Wellington Street – new “zebra” markings at pedestrian crosswalks and red light turn prohibitions added in 2016;
- Featherston Drive – Kilborn Avenue to Kilborn Avenue – upgrading in 2017 of bus stop pads;
- Island Park Drive – Carling Avenue to Byron Avenue – reinstall bike lanes in 2016 and provide bike boxes at Byron in 2017;
- Lancaster Road – St. Laurent Boulevard to Walkley Road – bike lanes, sharrows, bike boxes, as well as a new sidewalk linking St. Laurent Blvd. to the Museum of Science and Technology, added in 2016;
- Jeanne d’Arc / North Service Road – Rossignol Crescent to Trim Road – paved shoulders in 2016; and,
- River Road – Mitch Owens Road to Lester Road – approximately 4.8 KM of paved shoulders added to the existing 1.3 km.

In 2017, some noteworthy road renewal projects that will use painted bike lanes, paved shoulders and road-edge line painting to redistribute and redefine space for a wider range of users in the urban and rural areas include:

- Bearbrook Road – Westpark Drive to Centrepark Drive south intersection;
- Blohm Drive – East of Johnston Drive to Hunt Club Road;
- Constellation Drive – Centrepointe Drive to Baseline Road;
- Kilborn Drive – Alta Vista to Haig/Canterbury;
- Kirkwood Avenue – Switzer Avenue to Devonshire Place;

- March Road – Teron Road to Campeau Drive;
- OR 174 – Cameron Street to Canaan Road;
- Prestone – St.Joseph Drive to Amiens Street; and
- Prince of Wales Drive – north of Strandherd Drive to Hunt Club Road;
- Shillington Avenue – Merivale Road to Fisher Avenue; and
- 8th Line Road – Marvelville Road to Lawrence Street.

DOCUMENT 3

Area Traffic Management (ATM) Studies and Projects

On-going Comprehensive ATM studies in 2016:

- Lowertown Community; and,
- Viewmount Community.

On-going and recently completed Local ATM studies in 2016:

- Renaud Road (west of Joshua Street to Navan Road);
- Merkley Drive;
- Centrepointe Drive (Baseline Road to Baseline Road) and Hemmingwood Way (Centrepointe Drive to Centrepointe Drive);
- Bayfield Avenue (Herzberg Road to Carling Avenue); and,
- Grey Nuns Drive (Jeanne d’Arc Boulevard to St. Joseph Boulevard).

2016 Recently constructed ATM Measures:

- Bell Street (Eccles Street to Somerset Street);
- Eccles Street (Rochester Street to Booth Street);
- MacLaren Street (Bronson Avenue to Bank Stree);
- Nepean Street at Metcalfe Street;
- Florence Street (Percy Street to Bay Street);
- Bayswater Street (Beech Street to Hickory Street);
- Crichton Street at Keefer Street;
- Anderson Street (Preston Street to Rochester Street);
- Knudson Drive (Kanata Avenue to Campeau Drive);
- Riverdale Avenue (Bank Street to Main);
- Jeanne d’Arc Boulevard (Bilberry Drive West to Champlain Street); and,
- Viseneau Drive (Boyer Road to Innes Road) & Barrington Street (Viseneau Drive to Beausejour Drive).

2017 ATM Measures anticipated for construction:

- Blossom Park West Streets within the Blossom Park West community located between Bank Street and Albion Road, including Queensdale Avenue, Kingsdale Avenue and Rosebella Avenue;
- Brittany Drive (St-Laurent Boulevard to Montreal Road);
- Lisgar Street at Metcalfe Street; and,
- Byron Avenue Traffic Calming – Sherbourne Avenue to Island Park Drive – simple traffic calming measure to de-emphasis fast auto speeds on lower volume and slower road segments and implementing cycling advisory lanes, functional design in 2016, detail design in 2017.

DOCUMENT 4

Environmental Assessments (EAs)

EAs recently completed and in progress include:

- Ottawa Road 174 – Prescott-Russell County Road 17 Widening Study – This rural arterial EA features a more context sensitive solution design through the Cumberland Village for that responds to local interests for walking and cycling along and across the highway. The EA was completed in 2016;
- Transit Priority Measures Studies for Montreal Road, Merivale Road and Carling Avenue – While these studies focus on the provision of transit priority measures to improve the level of service for transit along these specially designated corridors, the Multi-Modal Level of Service (MMLOS) is being used assess the needs of other users of the corridor. These studies started in 2016 and are scheduled to be completed in 2017;
- Baseline Road Rapid Transit Corridor (Bayshore Station to Heron Station) Planning and Environmental Assessment Study – This on-going study focuses on the provision of a transit priority corridor, and recommends median bus lanes, new cycle tracks and protected intersections, and sidewalks. This study is scheduled for completion in 2017;
- Leitrim Road Widening EA (River Road and Albion Road) – Although the timing for the road widening is beyond 2031 a study is required to identify and protect the corridor for the future widening, including facilities for active transportation. The study started in early 2017 and will be completed in 2018;
- Bank Street (Riverside Drive to Ledbury Avenue); Elgin Street (Laurier Avenue to Queen Elizabeth Drive) and Hawthorne Avenue (Pretoria Bridge to Main Street) Functional Design Studies – These studies, initiated in 2016 in advance of integrated road reconstruction and infrastructure replacement projects, will be guided by a detailed assessment of the MMLOS for pedestrians, cyclists, transit service, general traffic, and trucks for existing and future travel conditions. They are projected to be completed in late 2017;
- Chapman Mills Extension and Bus Rapid Transit Study (Longfields Drive to Cedarview Road) – Environmental Assessment documentation completed in 2016; street with median transit lanes, sidewalls, cycle tracks, protected intersections and landscaped boulevards; and,
- Earl Armstrong Road Extension (Albion Road to Hawthorne Road) Environmental Assessment Study – This study, to start in 2017, will identify the right-of-way

requirements and protect the corridor. A Complete Street lens will be used to develop the recommended plan.

DOCUMENT 5

Addendum to the City's Multi-Modal Level of Service Guidelines

This addendum documents clarifications and revisions to the City of Ottawa's Multi-Modal Level of Service (MMLOS) Guidelines (dated September 15, 2015, issued in November 2015). The addendum has been developed based on feedback from users of the Guidelines and ongoing review by City staff, and is consistent with the original intention that the Guidelines evolve over time (as noted in Section 1.2 of the Guidelines). The Guidelines document will be updated in future to reflect these clarifications and revisions, but in the meantime practitioners should be familiar with both this document and the original Guidelines document.

1. Methodological Overview

1.1 The City has developed a standardized spreadsheet that practitioners should use to calculate MMLOS scores and submit results, available from the Transportation Planning Branch. The completed sheet should be included with all MMLOS submissions to the City.

1.2 It may also be appropriate and useful to present the results of the MMLOS analysis in other ways (e.g. graphical representations), particularly for presentation to the general public. The City encourages the use of other presentation methods, however there is no specific method or template prescribed, and the standardized spreadsheet is still required for review by the City.

1.3 When there is a significant difference in conditions between different time periods (e.g. morning peak period versus afternoon peak period versus off-peak), it may be necessary to complete separate MMLOS analyses for each time period. Typically the time period selected should represent the worst conditions for the mode being evaluated (e.g. AM peak period for motor vehicles, lower traffic congestion periods for cycling). The practitioner should consult the City on what time period(s) should be analyzed.

2. Pedestrian Level of Service (PLOS)

2.1 In Exhibit 4 – PLOS Segment Evaluation Table the column "Motor Vehicle Traffic Volume (AADT)" is revised to be "Average Daily Curb Lane Traffic Volume" and refers to the estimated annual average daily motor vehicle traffic volume (passenger car equivalent) in one direction in the general purpose lane closest to the curb/ road edge. One way of estimating this value is to apply a conversion factor to observed counts. Trucks should be accounted for using a Passenger Car Equivalent value of 2.0. The practitioner may also propose alternative ways of estimating the traffic volume, which would be subject to approval by the City.

2.2 The “boulevard width” in Exhibit 4 – PLOS Segment Evaluation Table refers to the horizontal separation between pedestrians and moving motor vehicles, and therefore may be satisfied in many ways, for example by the presence of an asphalt maintenance strip, bicycle lane or cycle track. However, a parking lane should generally not be considered part of the boulevard width because it is captured elsewhere in the calculation.

2.3 The “sidewalk width” in Exhibit 4 – PLOS Segment Evaluation Table refers to the unobstructed width along the sidewalk. If there are obstructions in the sidewalk (such as utility poles, hydrants, sign posts) that reduce the clear width in more than one instance in any 30m segment[1], then that reduced width should be used as the “sidewalk width” for calculating the Segment PLOS.

2.4 For determining the “presence of on-street parking” in Exhibit 4 – PLOS Segment Evaluation Table:

- If the average length of curb edge occupied with parking stalls (or bulb-outs) during the period being evaluated is greater than 50 percent of the sidewalk length from intersection to intersection, then on-street parking should be considered to be present;
- If parking is restricted to certain days or times of day (e.g. off-peak parking only or weekend parking only) then the row corresponding to the time period being evaluated should be selected; and,
- If the parking lane is rarely used and otherwise functions as a vehicle travel lane (e.g. parking is permitted in the curb lanes on a four-lane road but observed parking occupancy is 10 percent or less) then on-street parking should be considered to be absent.

2.5 The “operating speed” in Exhibit 4 – PLOS Segment Evaluation Table should be the 85th percentile speed from a City speed survey (preferably for the direction of traffic adjacent to the sidewalk, or alternatively for both directions of traffic combined). Alternatively, the posted speed limit plus 10km/h may be used. The

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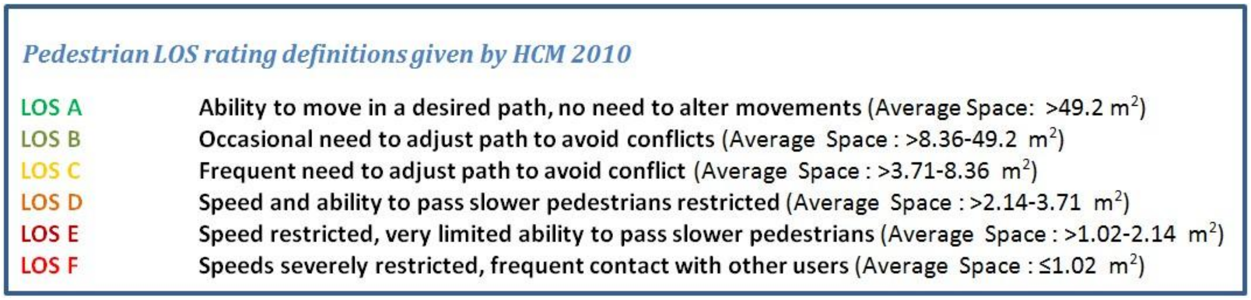
[1] City of Ottawa Accessibility Design Standards (November 2015), Section 3.3.2.

practitioner may also propose an alternative method for estimating the operating speed, which would be subject to approval by the City.

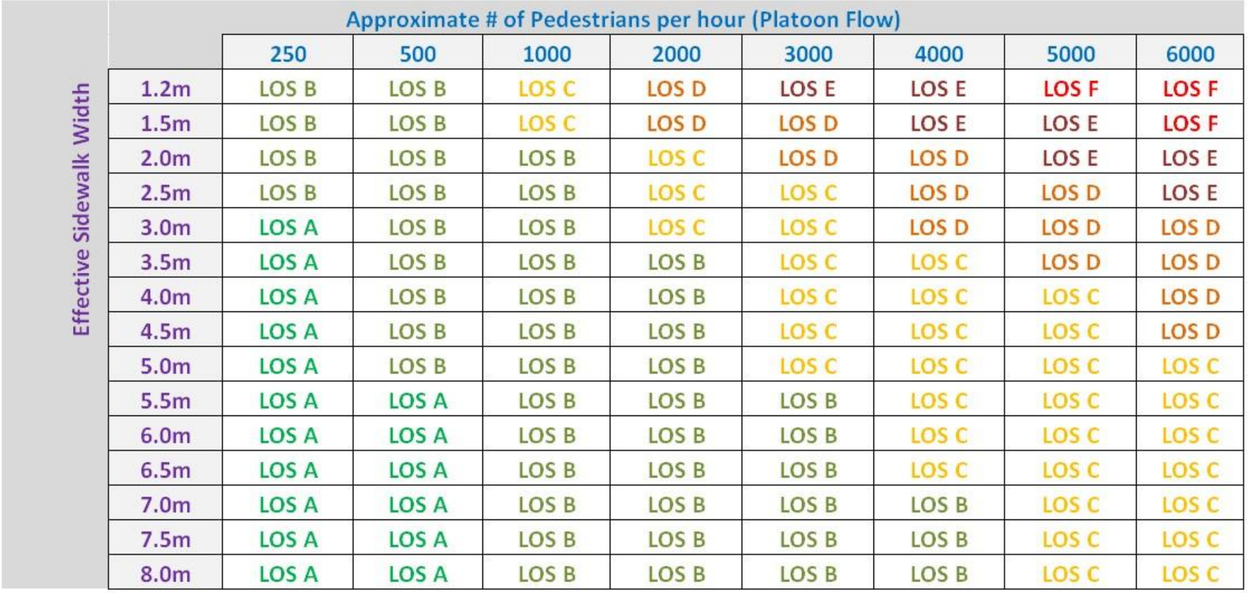
2.6 In certain cases – such as within the Central Area and in Design Priority Areas – it may be necessary to consider sidewalk crowding in determining Segment PLOS. One way to evaluate this is using the method defined in the 2010 Highway Capacity Manual (HCM). Table 1 below has been developed based on the 2010 HCM and may be used to check the Segment PLOS for crowding. Where crowding PLOS is calculated, the worst between it and the Segment PLOS should be reported for the segment.

Table 1 – Segment PLOS for Crowding (based on 2010 HCM)



Pedestrian LOS rating definitions given by HCM 2010

LOS A	**Ability to move in a desired path, no need to alter movements** (Average Space: >49.2 m^2)
LOS B	**Occasional need to adjust path to avoid conflicts** (Average Space : >8.36-49.2 m^2)
LOS C	**Frequent need to adjust path to avoid conflict** (Average Space : >3.71-8.36 m^2)
LOS D	**Speed and ability to pass slower pedestrians restricted** (Average Space : >2.14-3.71 m^2)
LOS E	**Speed restricted, very limited ability to pass slower pedestrians** (Average Space : >1.02-2.14 m^2)
LOS F	**Speeds severely restricted, frequent contact with other users** (Average Space : ≤1.02 m^2)



		Approximate # of Pedestrians per hour (Platoon Flow)							
		250	500	1000	2000	3000	4000	5000	6000
Effective Sidewalk Width	1.2m	LOS B	LOS B	LOS C	LOS D	LOS E	LOS E	LOS F	LOS F
	1.5m	LOS B	LOS B	LOS C	LOS D	LOS D	LOS E	LOS E	LOS F
	2.0m	LOS B	LOS B	LOS B	LOS C	LOS D	LOS D	LOS E	LOS E
	2.5m	LOS B	LOS B	LOS B	LOS C	LOS C	LOS D	LOS D	LOS E
	3.0m	LOS A	LOS B	LOS B	LOS C	LOS C	LOS D	LOS D	LOS D
	3.5m	LOS A	LOS B	LOS B	LOS B	LOS C	LOS C	LOS D	LOS D
	4.0m	LOS A	LOS B	LOS B	LOS B	LOS C	LOS C	LOS C	LOS D
	4.5m	LOS A	LOS B	LOS B	LOS B	LOS C	LOS C	LOS C	LOS D
	5.0m	LOS A	LOS B	LOS B	LOS B	LOS C	LOS C	LOS C	LOS C
	5.5m	LOS A	LOS A	LOS B	LOS B	LOS B	LOS C	LOS C	LOS C
	6.0m	LOS A	LOS A	LOS B	LOS B	LOS B	LOS C	LOS C	LOS C
	6.5m	LOS A	LOS A	LOS B	LOS B	LOS B	LOS C	LOS C	LOS C
	7.0m	LOS A	LOS A	LOS B	LOS B	LOS B	LOS B	LOS C	LOS C
	7.5m	LOS A	LOS A	LOS B	LOS B	LOS B	LOS B	LOS C	LOS C
	8.0m	LOS A	LOS A	LOS B	LOS B	LOS B	LOS B	LOS C	LOS C

2.7 In Exhibit 5 – PETSI Point Tables, Table 5.1 is revised as shown below to delete the point scores for “Island Refuge” and instead combine them with Table 5.3b “Right Turn Channel” (there are no other changes to the table). For crossings with a median narrower than 2.4m, or with a median that does not provide a pedestrian refuge by extending through the crosswalk (example shown in Figure 1 below), the “No median” column should be applied.

5.1 Crossing Distance & Conditions		
Total travel lanes crossed	**No median**	**With Median (>2.4m)**
2	120	120
3	105	105
4	88	90
5	72	75
6	55	60
7	39	45
8	23	30
9	6	15
10	-10	0

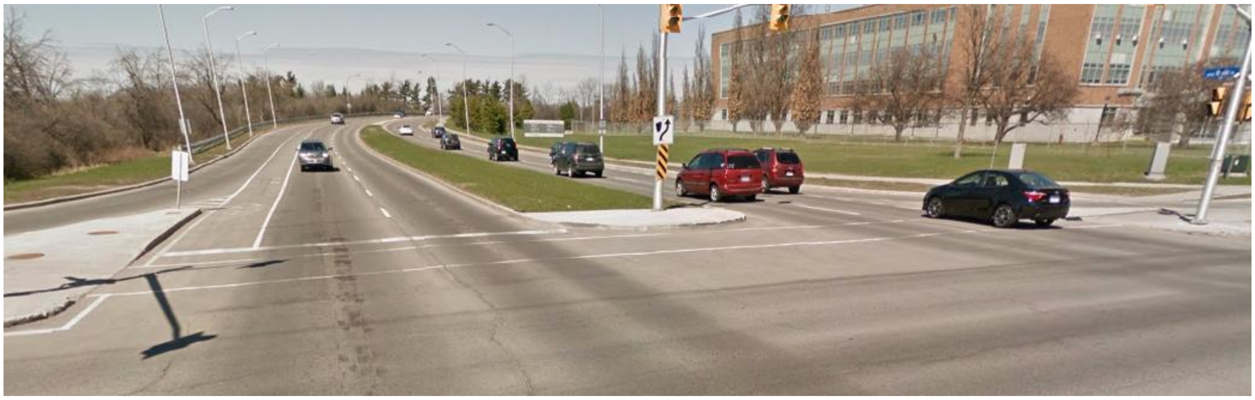


Figure 1 – Example of a centre median that does not provide a pedestrian refuge (considered “No Median” in PETSI calculation)

2.8 In Exhibit 5 – PETSI Point Tables, Table 5.1, “Total travel lanes crossed” is intended to capture the pedestrian crossing distance assuming a typical travel lane width of roughly 3.5m. If the actual crossing distance is significantly greater than 3.5m per lane (for example because of very wide travel lanes, the presence of bike lanes, large corner radius, or wide right turn channel), it may be appropriate to select a higher “Total travel lanes crossed” from the table. For instance, a “Total travel lanes crossed” of 4 lanes should correspond to a crossing distance of approximately 14m.

2.9 In Exhibit 5 – PETSI Point Tables, Table 5.2 is revised as shown below to delete “RTOR prohibited at certain time(s)”. For whatever time period the PLOS is being evaluated, the corresponding right-turn-on-red control should be selected. There are no other changes to the table.

5.2 Signal Phasing & Timing Features	
Left turn conflict ("Left_turns")	**Points**
Permissive	-8
Protected/permissive	-8
Protected	0
No left turn/prohibited	0
Right turn conflict ("Right_turns")	**Points**
Permissive or yield control	-5
Protected/permissive	-5
Protected	0
No right turn	0
Right turns on red ("RTOR")	**Points**
RTOR allowed	-3
RTOR prohibited	0
Leading ped interval? ("LPI")	**Points**
No	-2
Yes	0

2.10 In Exhibit 5 – PETSI Point Tables, Table 5.3 is revised to be two separate tables as shown below, and points assigned from both Tables 5.3a and 5.3b as appropriate. The primary criterion for a right turn “smart channel” is that the channel must intersect the street at an angle of 70^{o} or greater; Figure 2 below illustrates a typical urban “smart channel” with a 70^{o} entry angle.

5.3a Corner Radius	
Corner radius	**Points**
Greater than 25m	-9
> 15m to 25m	-8
> 10m to 15m	-6
> 5m to 10m	-5
>3m to 5m	-4
Less than/equal to 3m	-3
No right turn	0

5.3b Right Turn Channel	
Right turn channel	**Points**
Conventional right turn channel with receiving lane[(1)]	-3
Conventional right turn channel without receiving lane[(1)]	0
Right turn “smart channel” [(1)]	2
No right turn channel	-4
No right turn	0

[(1)] Right turn channels are counted as an additional “travel lane crossed” and so note that despite the points shown above overall they score lower than “No right turn channel”.

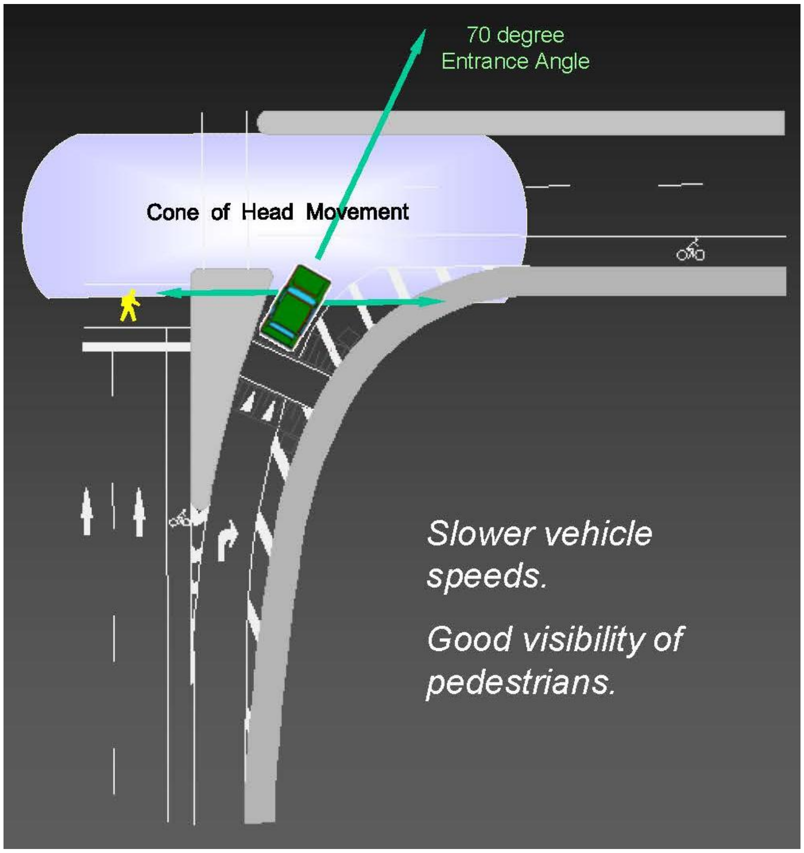
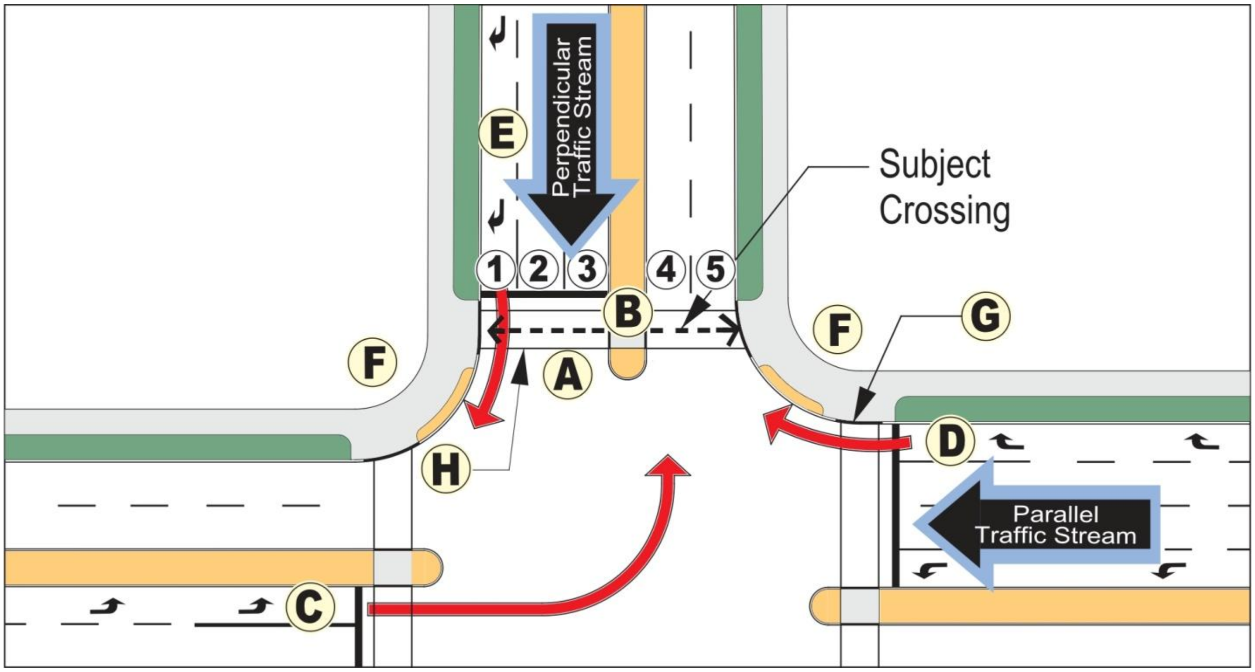


Figure 2 – Typical Urban “Smart Channel”

A full revised version of Exhibit 5 is included at the end of this document.

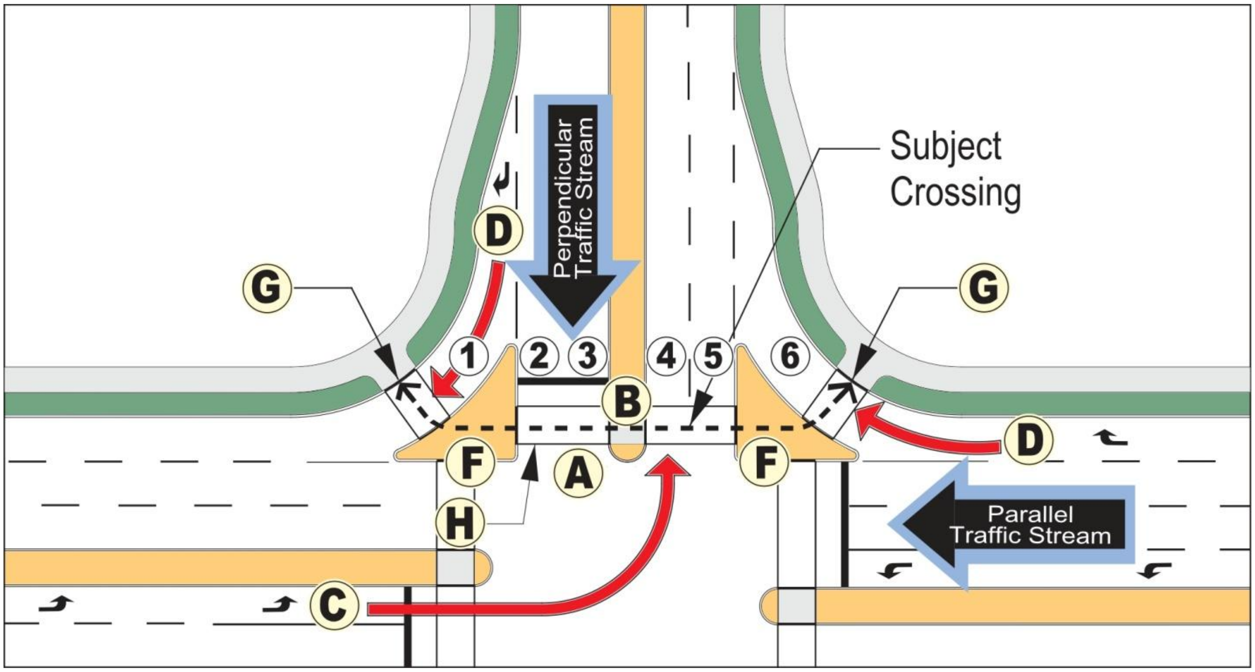
2.11 Exhibit 5 – PETSI Point Tables lists the various inputs to calculate the PETSI score. The images in Figure 3 and Figure 4 below clarify how to determine the appropriate selection for each input (based on the clarifications and revisions noted above). Note:

- For “Total travel lanes crossed”, channelized turns should be included in the total (e.g. in Figure 4, the number of lanes crossed is six);
- Some inputs (such as Corner Radius, Right Turn Conflicts, and RTOR) vary depending on the control for the right turn conflict with the pedestrian crossing. A right turn may be yield-controlled (channelized) or traffic signal-controlled. Also there are typically two right turn conflicts for each pedestrian crossing: the parallel traffic stream (shown as ‘D’ in the Figures below) and the perpendicular traffic stream (shown as ‘E’ in the Figures below):
    - Points for “Corner Radius” and “Right Turn Conflict”: These points are intended to account for right turns through the crosswalk by drivers not facing a red light; they should be applied for the parallel traffic stream (where vehicles are turning right through the crosswalk on a green light or yield control, shown as ‘D’ in the Figures below), and should also be applied for the perpendicular traffic stream when that right turn is channelized (yield control), and,
    - Points for “Right Turns On Red”: These points are intended to account for right turns through the crosswalk by drivers facing a red light; they should be applied for the perpendicular traffic stream (shown as ‘E’ in the Figures below), but should not be applied when that right turn is channelized (yield control).



A.	Crossing distance (total travel lanes crossed)	E.	Right turns on red
B.	Median	F.	Leading ped interval?
C.	Left turn conflict	G.	Corner radius
D.	Right turn conflict	H.	Crosswalk treatment

Figure 3 – PETSI Input Elements (traffic signal-controlled right turns)



A. Crossing distance (total travel lanes crossed)
B. Median
C. Left turn conflict
D. Right turn conflict
E. Right turns on red (N/A)
F. Leading ped interval?
G. Corner radius
H. Crosswalk treatment

Figure 4 – PETSI Input Elements (yield-controlled right turns)

2.12 The average intersection delay to pedestrians from Exhibit 7 – Pedestrian Delay Evaluation Table is intended to reflect the duration of the display of the solid white “walking pedestrian” symbol, which represents the “Effective Walk Time”. One way to calculate this is:

Effective Walk Time = Split – Flashing Don’t Walk – [Amber + All-red]

However, this method applies to fixed time control and may not provide correct values for non-fixed time control. In those cases, the following alternative method could be used: measure/ estimate the average walk time and the average number of cycles within a time period and use those values for the calculation.

3. Bicycle Level of Service (BLOS)

3.1 For Segment BLOS, if the curb lane can be used for on-street parking:

- If the average length of curb edge occupied with parking stalls (or bulb-outs) during the period being evaluated is greater than 50 percent of the sidewalk length from intersection to intersection, then on-street parking should be considered to be present;
- If parking is restricted to certain days or times of day (e.g. off-peak parking only or weekend parking only) then BLOS should be calculated based on whatever on-street parking occurs for the time period being evaluated; and,
- If the parking lane is rarely used and otherwise functions as a vehicle travel lane (e.g. parking is permitted in the curb lanes on a four-lane road but observed parking occupancy is 10 percent or less) then on-street parking should be considered to be absent.

4. Transit Level of Service (TLOS)

4.1 For Segment TLOS, the “average transit travel speed” can be estimated by dividing the length of the corridor by the time it takes for the transit vehicle to travel through the corridor, including any intersection delay and stopping/ dwell time.

4.2 Exhibit 16 – TLOS Signalized Intersection Evaluation Table is replaced with the revised version below which includes “Typical Locations” for LOS ‘C’ and ‘D’ and examples of “short”, “medium” and “long” cycle lengths.

Delay	Typical Location	LOS
0	Grade Separation	A
≤10 sec	High Level TSP	B
≤20 sec	TSP & short (e.g. <60 sec) to medium (e.g. 60-90 sec) cycle length	C
≤30 sec		D
≤40 sec	TSP & long cycle length (e.g. >90 sec)	E
>40 sec	No TSP & long cycle length (e.g. >90 sec)	F

5. Truck Level of Service (TkLOS)

5.1 For the “curb lane width” in Exhibit 20 – TkLOS Segment Evaluation Table, if trucks typically operate in a non-curb lane (e.g. if the curb lane is a reserved bus lane) then the width of that non-curb lane should be used.

5.2 The “curb lane width” in Exhibit 20 – TkLOS Segment Evaluation Table refers to the typical distance from the curb face to the lane edge line, or in the case of a non-curb lane the distance between lane lines.

6. Vehicular Level of Service (LOS)

6.1 The 2013 Transportation Master Plan prescribes that “planning level studies will adopt a peak period analysis approach”. To satisfy this requirement (for network and corridor planning level decisions, e.g. Environmental Assessments, functional design studies, ROW requirements, etc.), practitioners should convert the peak hour volume to a modified peak hour volume (peak period volume) by multiplying the peak hour volume by a conversion factor. The city wide average conversion factor for the morning peak hour is 0.84. This factor can be refined if more specific data on the peaking characteristics of demand is available for specific areas.

7. Level of Service Targets

7.1 Section 7.1 describes how to apply the MMLOS targets. Practitioners should be cognizant of overlapping designations at intersections, and strive to achieve the highest LOS target for each mode from among the overlapping targets. For example, a MMLOS analysis of an Arterial Main Street may include an intersection with a Traditional Main Street; for that intersection the PLOS target for instance would be ‘B’ (for Traditional Main Street) rather than ‘C’ (for Arterial Main Street).

The MMLOS was designed to capture most practical situations but there will be cases for which the method doesn’t account or which could be interpreted in different ways. In such cases the practitioner should use their best engineering judgment considering the intent of the MMLOS and confirm their interpretations and assumptions with the City.

Exhibit 5 – PETSI Point Tables (revised February 2017)

5.1 Crossing Distance & Conditions		
Total travel lanes crossed	**No median**	**With Median (>2.4m)**
2	120	120
3	105	105
4	88	90
5	72	75
6	55	60
7	39	45
8	23	30
9	6	15
10	-10	0

5.2 Signal Phasing & Timing Features	
Left turn conflict ("Left_turns")	**Points**
Permissive	-8
Protected/permissive	-8
Protected	0
No left turn/prohibited	0
Right turn conflict ("Right_turns")	**Points**
Permissive or yield control	-5
Protected/permissive	-5
Protected	0
No right turn	0
Right turns on red ("RTOR")	**Points**
RTOR allowed	-3
RTOR prohibited	0
Leading ped interval? ("LPI")	**Points**
No	-2
Yes	0

5.3a Corner Radius	
Corner radius	**Points**
Greater than 25m	-9
> 15m to 25m	-8
> 10m to 15m	-6
> 5m to 10m	-5
>3m to 5m	-4
Less than/equal to 3m	-3
No right turn	0
5.3b Right Turn Channel	
Right turn channel	**Points**
Conventional right turn channel with receiving lane(1)	-3
Conventional right turn channel without receiving lane(1)	0
Right turn “smart channel” (1)	2
No right turn channel	-4
No right turn	0

5.4 Crosswalk Treatment	
Crosswalk treatment (“Crosswalk”)	**Points**
Standard transverse markings	-7
Textured/coloured pavement	-4
Zebra stripe hi-visibility markings	-4
Raised crosswalk	0

DOCUMENT 6

Education and Promotion

There have been a number of events where City staff, consultants, and the public had the opportunity to be educated on the Complete Street approach:

- NACTO (National Association of City and Transportation Officials) workshop on the New Urban Street Design Guide for over 50 staff from Transportation Planning, Traffic Engineering, Infrastructure Services, Operations and Maintenance, Public Health, and OC Transpo (December 4, 2015);
- Transportation Planning staff presentation at the Federation of Canadian Municipalities (FCM) Sustainable Communities Conference on: Complete Streets in Action: Sustainable Streets for All Road Users (February 9, 2016);
- Transportation Planning staff presentation to the Canadian Institute for Transportation Engineers (CITE- National Capital Region), A presentation on Cycle Tracks and Protected Intersections (February19, 2016);
- Ottawa Public Health and Transportation Planning staff presentation at the EnviroCentre and the Healthy Transportation Coalition, Sustainable Transportation Summit (February 23, 2016);
- An Evening with Janette Sadik-Khan, lecture and fair hosted by Ecology Ottawa – City of Ottawa Complete Streets slideshow as part of the community information fair (April 27, 2016);
- Transportation Planning staff led workshop at AccessAbility Day, Tabletop display of accessibility initiatives along Ottawa streets (June 2016);
- Transportation Planning staff presentations at the Sustainable Mobility Summit, ACT (Association of Commuter Transportation) Canada, Complete Street Planning and Design Issues, University of Ottawa (October 2016);
- Transportation Planning staff presentation of a Transportation Association of Canada (TAC) educational webinar: “Evolution of the Complete Street Concept” (February 2017)
- Transportation Planning staff presentations to internal teams on Complete Streets, MMLOS, cycle track and intersection design throughout 2016 including:

Infrastructure Services project managers, traffic engineering managers and supervisors, and “lunch and learn” sessions for planning staff.

APPENDIX B

EXISTING (2021) TMCs, SIGNAL TIMING PLANS AND TURNING MOVEMENT DIAGRAMS

Church St E @ Scott St

Morning Peak Diagram

Specified Period
From: 7:00:00
To: 9:00:00

One Hour Peak
From: 7:30:00
To: 8:30:00

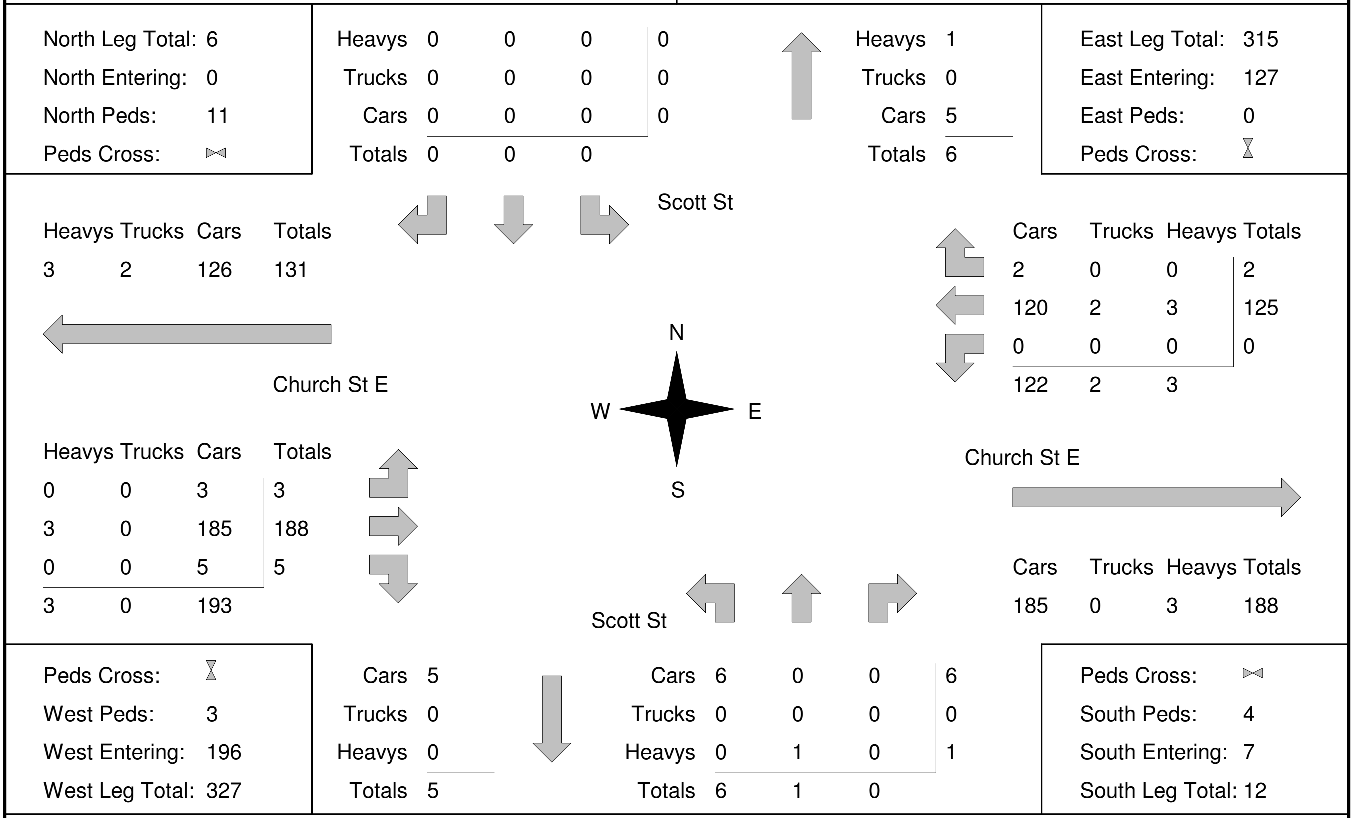
Municipality: Brampton
Site #: 0000000006
Intersection: Church St E & Scott St
TFR File #: 6
Count date: 24-Mar-2021

Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Non-Signalized Intersection ****

Major Road: Church St E runs W/E



North Leg Total: 6
North Entering: 0
North Peds: 11
Peds Cross: ⋈

Heavys	0	0	0	0
Trucks	0	0	0	0
Cars	0	0	0	0
Totals	0	0	0	

Heavys	1
Trucks	0
Cars	5
Totals	6

East Leg Total: 315
East Entering: 127
East Peds: 0
Peds Cross: ⧗

Heavys	Trucks	Cars	Totals
3	2	126	131

Cars	Trucks	Heavys	Totals
2	0	0	2
120	2	3	125
0	0	0	0
122	2	3	

Heavys	Trucks	Cars	Totals
0	0	3	3
3	0	185	188
0	0	5	5
3	0	193	

Cars	Trucks	Heavys	Totals
185	0	3	188

Peds Cross: ⧗
West Peds: 3
West Entering: 196
West Leg Total: 327

Cars	5
Trucks	0
Heavys	0
Totals	5

Cars	6	0	0	6
Trucks	0	0	0	0
Heavys	0	1	0	1
Totals	6	1	0	

Peds Cross: ⋈
South Peds: 4
South Entering: 7
South Leg Total: 12

Comments

Church St E @ Scott St

Mid-day Peak Diagram

Specified Period
From: 11:00:00
To: 14:00:00

One Hour Peak
From: 12:30:00
To: 13:30:00

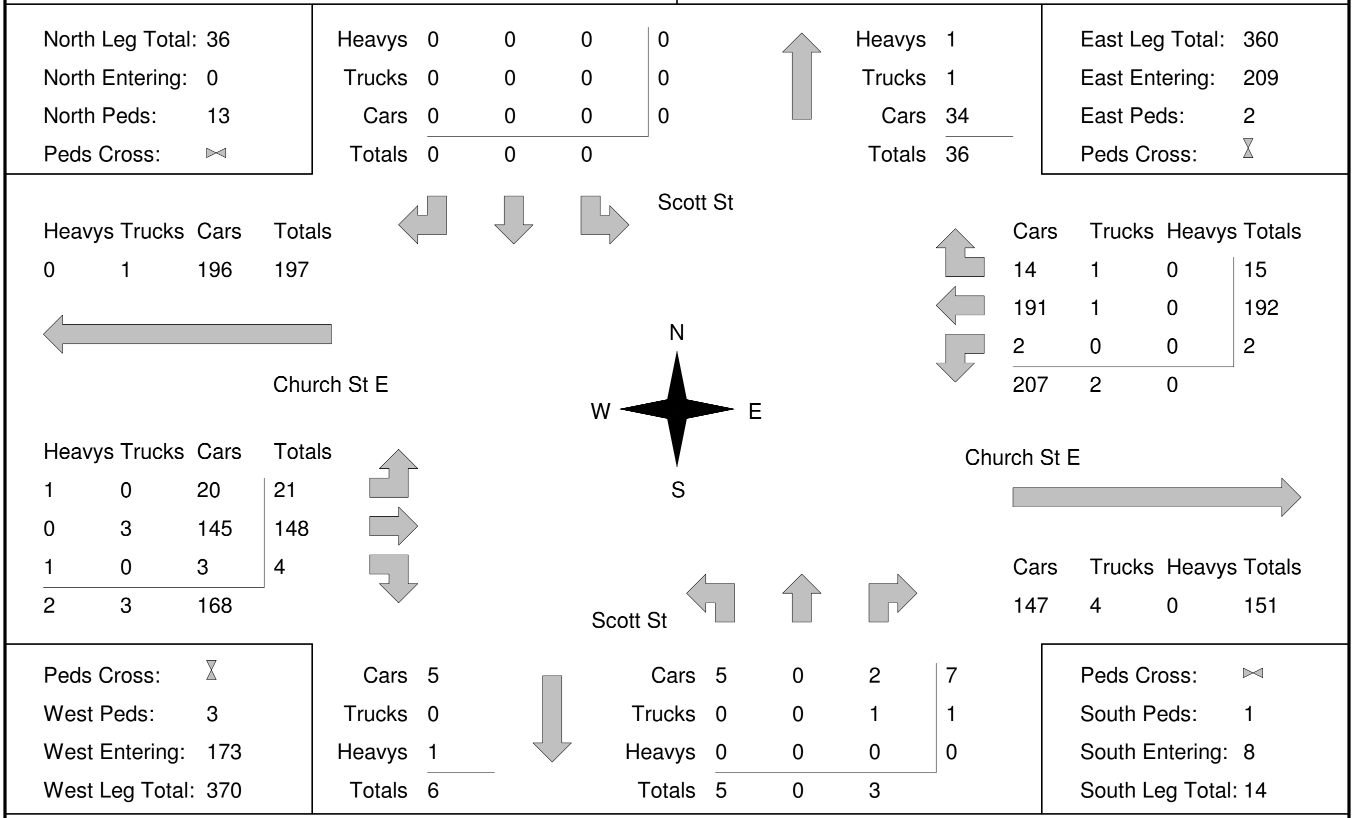
Municipality: Brampton
Site #: 0000000006
Intersection: Church St E & Scott St
TFR File #: 6
Count date: 24-Mar-2021

Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Non-Signalized Intersection ****

Major Road: Church St E runs W/E



North Leg Total: 36
North Entering: 0
North Peds: 13
Peds Cross: ⋈

Heavys	0	0	0	0
Trucks	0	0	0	0
Cars	0	0	0	0
Totals	0	0	0	

Heavys	1
Trucks	1
Cars	34
Totals	36

East Leg Total: 360
East Entering: 209
East Peds: 2
Peds Cross: ⧗

Heavys	Trucks	Cars	Totals
0	1	196	197

Cars	Trucks	Heavys	Totals
14	1	0	15
191	1	0	192
2	0	0	2
207	2	0	

Heavys	Trucks	Cars	Totals
1	0	20	21
0	3	145	148
1	0	3	4
2	3	168	

Cars	Trucks	Heavys	Totals
147	4	0	151

Peds Cross: ⧗
West Peds: 3
West Entering: 173
West Leg Total: 370

Cars	5
Trucks	0
Heavys	1
Totals	6

Cars	5	0	2	7
Trucks	0	0	1	1
Heavys	0	0	0	0
Totals	5	0	3	

Peds Cross: ⋈
South Peds: 1
South Entering: 8
South Leg Total: 14

Comments

Church St E @ Scott St

Afternoon Peak Diagram

Specified Period
From: 15:00:00
To: 18:00:00

One Hour Peak
From: 15:30:00
To: 16:30:00

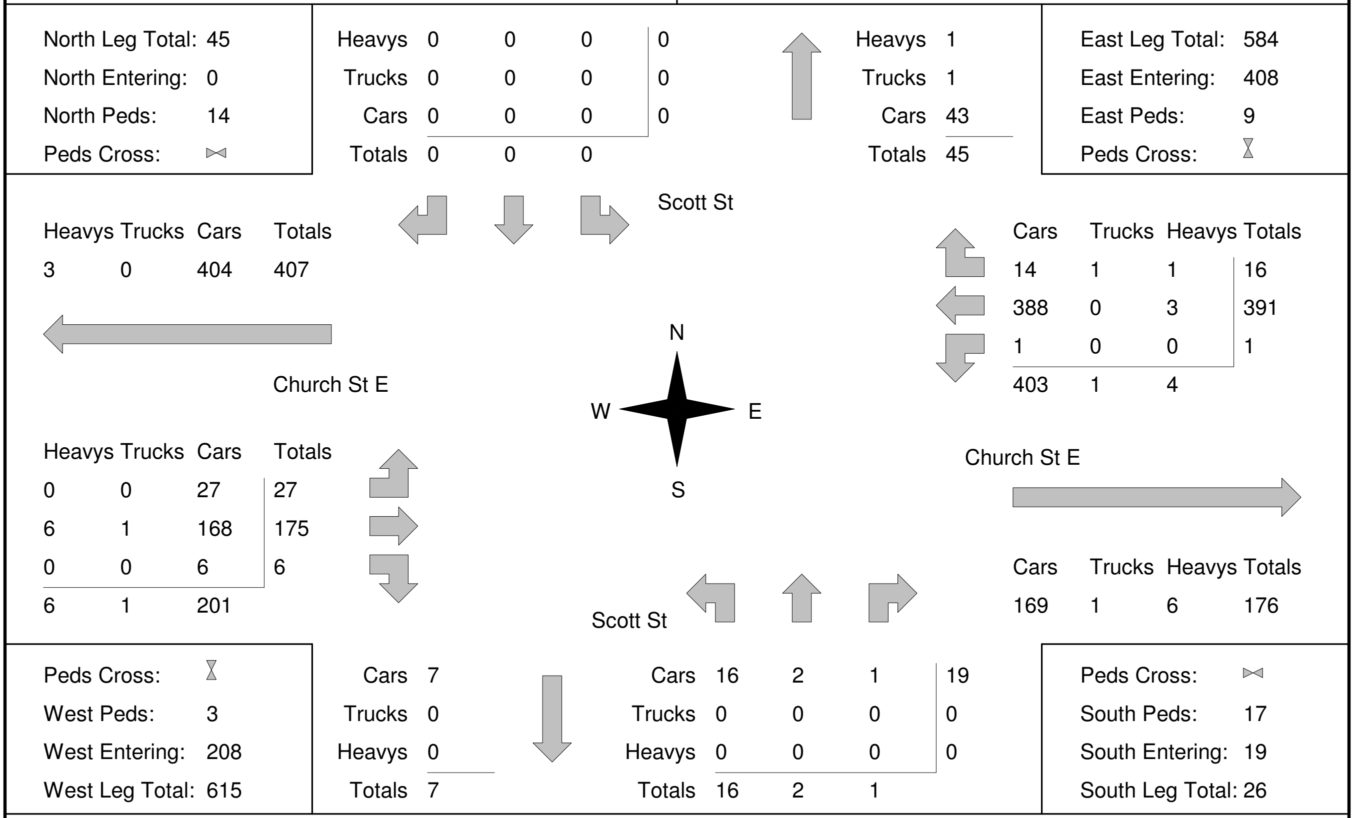
Municipality: Brampton
Site #: 0000000006
Intersection: Church St E & Scott St
TFR File #: 6
Count date: 24-Mar-2021

Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Non-Signalized Intersection ****

Major Road: Church St E runs W/E



North Leg Total: 45
North Entering: 0
North Peds: 14
Peds Cross: ⋈

Heavys	0	0	0	0
Trucks	0	0	0	0
Cars	0	0	0	0
Totals	0	0	0	

Heavys	1
Trucks	1
Cars	43
Totals	45

East Leg Total: 584
East Entering: 408
East Peds: 9
Peds Cross: ⧗

Heavys	Trucks	Cars	Totals
3	0	404	407

Cars	Trucks	Heavys	Totals
14	1	1	16
388	0	3	391
1	0	0	1
403	1	4	

Heavys	Trucks	Cars	Totals
0	0	27	27
6	1	168	175
0	0	6	6
6	1	201	

Cars	Trucks	Heavys	Totals
169	1	6	176

Peds Cross: ⧗
West Peds: 3
West Entering: 208
West Leg Total: 615

Cars	7
Trucks	0
Heavys	0
Totals	7

Cars	16	2	1	19
Trucks	0	0	0	0
Heavys	0	0	0	0
Totals	16	2	1	

Peds Cross: ⋈
South Peds: 17
South Entering: 19
South Leg Total: 26

Comments

Church St E @ Scott St

Total Count Diagram

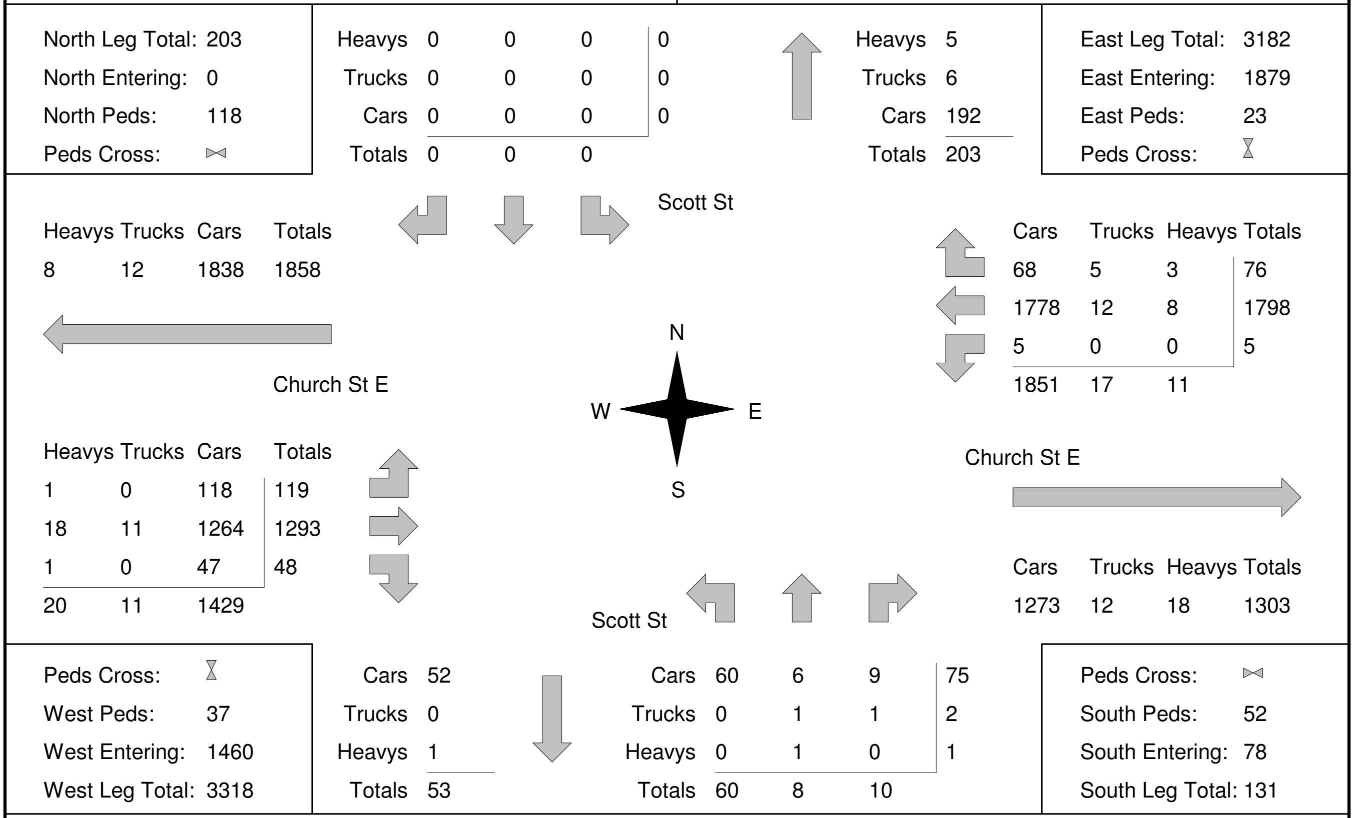
Municipality: Brampton
Site #: 0000000006
Intersection: Church St E & Scott St
TFR File #: 6
Count date: 24-Mar-2021

Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Non-Signalized Intersection ****

Major Road: Church St E runs W/E



North Leg Total:	203
North Entering:	0
North Peds:	118
Peds Cross:	⋈

Heavys	0	0	0	0
Trucks	0	0	0	0
Cars	0	0	0	0
Totals	0	0	0	

Heavys	5
Trucks	6
Cars	192
Totals	203

East Leg Total:	3182
East Entering:	1879
East Peds:	23
Peds Cross:	⧗

Heavys	Trucks	Cars	Totals
8	12	1838	1858

Cars	Trucks	Heavys	Totals
68	5	3	76
1778	12	8	1798
5	0	0	5
1851	17	11	

Heavys	Trucks	Cars	Totals
1	0	118	119
18	11	1264	1293
1	0	47	48
20	11	1429	

Cars	Trucks	Heavys	Totals
1273	12	18	1303

Peds Cross:	⧗
West Peds:	37
West Entering:	1460
West Leg Total:	3318

Cars	52
Trucks	0
Heavys	1
Totals	53

Cars	60	6	9	75
Trucks	0	1	1	2
Heavys	0	1	0	1
Totals	60	8	10	

Peds Cross:	⋈
South Peds:	52
South Entering:	78
South Leg Total:	131

Comments

Church St E @ Ken Whillans Dr

Morning Peak Diagram

Specified Period
From: 7:00:00
To: 9:00:00

One Hour Peak
From: 7:30:00
To: 8:30:00

Municipality: Brampton
Site #: 0000000005
Intersection: Church St E & Ken Whillans Dr
TFR File #: 5
Count date: 24-Mar-2021

Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Non-Signalized Intersection ****

Major Road: Church St E runs W/E

North Leg Total: 124
North Entering: 86
North Peds: 15
Peds Cross: ⋈

Heavys	0	0	0
Trucks	1	0	1
Cars	23	62	85
Totals	24	62	

Heavys	0
Trucks	1
Cars	37
Totals	38

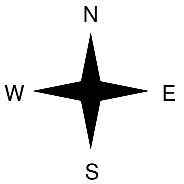
East Leg Total: 325
East Entering: 133
East Peds: 0
Peds Cross: ⧗

Ken Whillans Dr

Heavys	Trucks	Cars	Totals
3	2	123	128

Cars	Trucks	Heavys	Totals
28	1	0	29
100	1	3	104
128	2	3	

Church St E



Heavys	Trucks	Cars	Totals
0	0	9	9
3	0	127	130
3	0	136	

Church St E

Cars	Trucks	Heavys	Totals
189	0	3	192

Peds Cross: ⧗
West Peds: 6
West Entering: 139
West Leg Total: 267

Comments

Church St E @ Ken Whillans Dr

Mid-day Peak Diagram

Specified Period
From: 11:00:00
To: 14:00:00

One Hour Peak
From: 12:30:00
To: 13:30:00

Municipality: Brampton
Site #: 0000000005
Intersection: Church St E & Ken Whillans Dr
TFR File #: 5
Count date: 24-Mar-2021

Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Non-Signalized Intersection ****

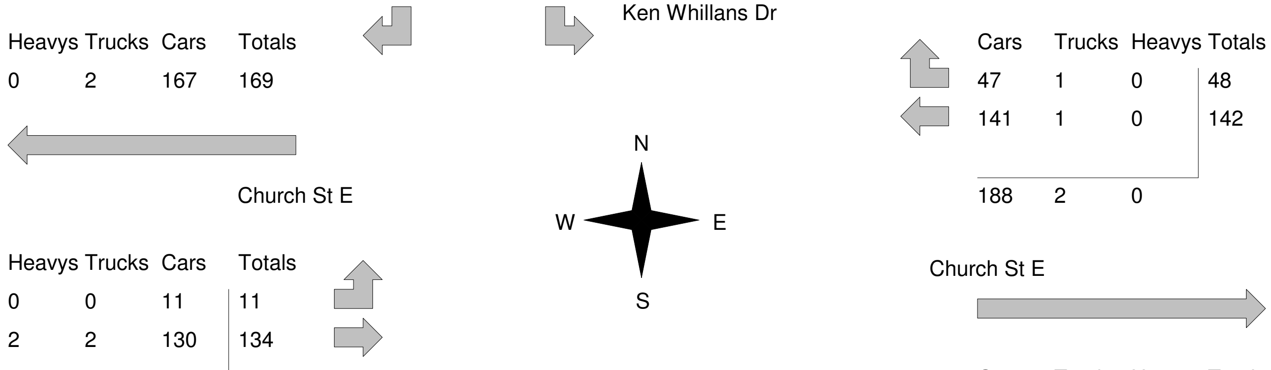
Major Road: Church St E runs W/E

North Leg Total: 122
North Entering: 63
North Peds: 20
Peds Cross: ⋈

Heavys	0	0	0
Trucks	1	1	2
Cars	26	35	61
Totals	27	36	

Heavys	0
Trucks	1
Cars	58
Totals	59

East Leg Total: 360
East Entering: 190
East Peds: 0
Peds Cross: ⧗



Heavys	Trucks	Cars	Totals
0	2	167	169

Heavys	Trucks	Cars	Totals
0	0	11	11
2	2	130	134
2	2	141	

Cars	Trucks	Heavys	Totals
47	1	0	48
141	1	0	142
188	2	0	

Cars	Trucks	Heavys	Totals
165	3	2	170

Peds Cross: ⧗
West Peds: 17
West Entering: 145
West Leg Total: 314

Comments

Church St E @ Ken Whillans Dr

Afternoon Peak Diagram

Specified Period
From: 15:00:00
To: 18:00:00

One Hour Peak
From: 15:30:00
To: 16:30:00

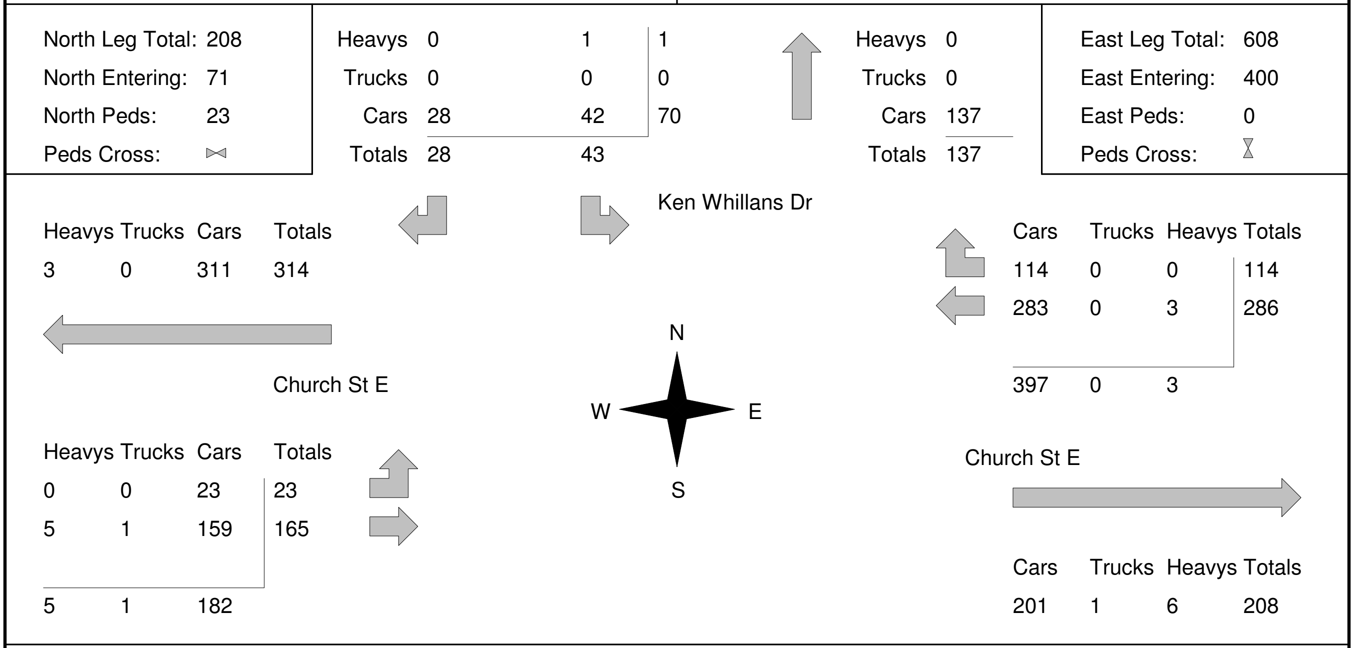
Municipality: Brampton
Site #: 0000000005
Intersection: Church St E & Ken Whillans Dr
TFR File #: 5
Count date: 24-Mar-2021

Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Non-Signalized Intersection ****

Major Road: Church St E runs W/E



North Leg Total: 208
North Entering: 71
North Peds: 23
Peds Cross: ⋈

Heavys	0	1	1
Trucks	0	0	0
Cars	28	42	70
Totals	28	43	

Heavys	0
Trucks	0
Cars	137
Totals	137

East Leg Total: 608
East Entering: 400
East Peds: 0
Peds Cross: ⧖

Ken Whillans Dr

Heavys	Trucks	Cars	Totals
3	0	311	314

Church St E

Heavys	Trucks	Cars	Totals
0	0	23	23
5	1	159	165
5	1	182	

Cars	Trucks	Heavys	Totals
114	0	0	114
283	0	3	286
397	0	3	

Church St E

Cars	Trucks	Heavys	Totals
201	1	6	208

Peds Cross: ⧖
West Peds: 16
West Entering: 188
West Leg Total: 502

Comments

Church St E @ Ken Whillans Dr

Total Count Diagram

Municipality: Brampton
Site #: 0000000005
Intersection: Church St E & Ken Whillans Dr
TFR File #: 5
Count date: 24-Mar-2021

Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Non-Signalized Intersection ****

Major Road: Church St E runs W/E

North Leg Total: 1161
North Entering: 555
North Peds: 206
Peds Cross: ⋈

Heavys	1	4	5
Trucks	3	1	4
Cars	208	338	546
Totals	212	343	

Heavys	1
Trucks	3
Cars	602
Totals	606

East Leg Total: 3328
East Entering: 1872
East Peds: 8
Peds Cross: ⧗

Ken Whillans Dr

Heavys	Trucks	Cars	Totals
8	12	1584	1604

Church St E

Heavys	Trucks	Cars	Totals
0	1	125	126
16	11	1086	1113
16	12	1211	

N

W E

S

Cars	Trucks	Heavys	Totals
477	2	1	480
1376	9	7	1392
1853	11	8	

Church St E

Cars	Trucks	Heavys	Totals
1424	12	20	1456

Peds Cross: ⧗
West Peds: 176
West Entering: 1239
West Leg Total: 2843

Comments

Church St E @ Union St

Morning Peak Diagram

Specified Period
From: 7:00:00
To: 9:00:00

One Hour Peak
From: 7:45:00
To: 8:45:00

Municipality: Brampton
Site #: 0000000004
Intersection: Church St E & Union St
TFR File #: 4
Count date: 24-Mar-2021

Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Non-Signalized Intersection ****

Major Road: Church St E runs W/E

North Leg Total: 45
North Entering: 20
North Peds: 9
Peds Cross: ⋈

Heavys	0	0	0	0
Trucks	0	0	0	0
Cars	2	8	10	20
Totals	2	8	10	

Heavys	0
Trucks	0
Cars	25
Totals	25

East Leg Total: 263
East Entering: 132
East Peds: 2
Peds Cross: ⧗

Union St

Heavys	Trucks	Cars	Totals
3	2	95	100

Church St E

Cars	Trucks	Heavys	Totals
8	0	0	8
79	2	3	84
40	0	0	40
127	2	3	

N
W
E
S

Heavys	Trucks	Cars	Totals
0	0	2	2
3	0	102	105
0	0	8	8
3	0	112	

Church St E

Cars	Trucks	Heavys	Totals
128	0	3	131

Union St

Peds Cross: ⧗
West Peds: 5
West Entering: 115
West Leg Total: 215

Cars	56
Trucks	0
Heavys	0
Totals	56

Cars	14	15	16	45
Trucks	0	0	0	0
Heavys	0	0	0	0
Totals	14	15	16	

Peds Cross: ⋈
South Peds: 1
South Entering: 45
South Leg Total: 101

Comments

Church St E @ Union St

Mid-day Peak Diagram

Specified Period
From: 11:00:00
To: 14:00:00

One Hour Peak
From: 12:30:00
To: 13:30:00

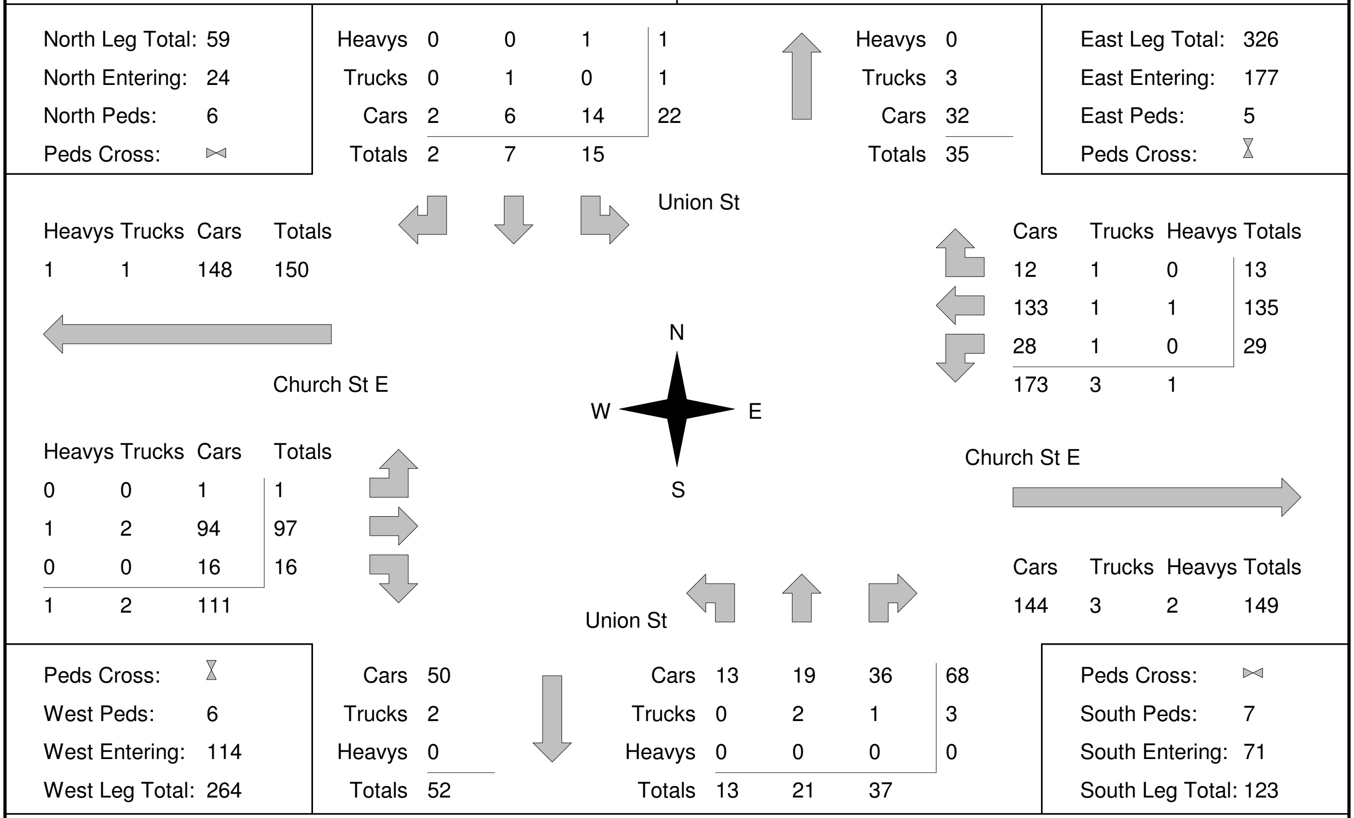
Municipality: Brampton
Site #: 0000000004
Intersection: Church St E & Union St
TFR File #: 4
Count date: 24-Mar-2021

Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Non-Signalized Intersection ****

Major Road: Church St E runs W/E



North Leg Total: 59
North Entering: 24
North Peds: 6
Peds Cross: ⋈

Heavys	0	0	1	1
Trucks	0	1	0	1
Cars	2	6	14	22
Totals	2	7	15	

Heavys	0
Trucks	3
Cars	32
Totals	35

East Leg Total: 326
East Entering: 177
East Peds: 5
Peds Cross: ⧗

Union St

Heavys	Trucks	Cars	Totals
1	1	148	150

Church St E

Cars	Trucks	Heavys	Totals
12	1	0	13
133	1	1	135
28	1	0	29
173	3	1	

Heavys	Trucks	Cars	Totals
0	0	1	1
1	2	94	97
0	0	16	16
1	2	111	

Church St E

Cars	Trucks	Heavys	Totals
144	3	2	149

Union St

Peds Cross: ⧗
West Peds: 6
West Entering: 114
West Leg Total: 264

Cars	50
Trucks	2
Heavys	0
Totals	52

Cars	13	19	36	68
Trucks	0	2	1	3
Heavys	0	0	0	0
Totals	13	21	37	

Peds Cross: ⋈
South Peds: 7
South Entering: 71
South Leg Total: 123

Comments

Church St E @ Union St

Afternoon Peak Diagram

Specified Period
From: 15:00:00
To: 18:00:00

One Hour Peak
From: 15:15:00
To: 16:15:00

Municipality: Brampton
Site #: 0000000004
Intersection: Church St E & Union St
TFR File #: 4
Count date: 24-Mar-2021

Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Non-Signalized Intersection ****

Major Road: Church St E runs W/E

North Leg Total: 104
North Entering: 34
North Peds: 11
Peds Cross: ⋈

Heavys	0	0	0	0
Trucks	0	0	0	0
Cars	2	12	20	34
Totals	2	12	20	

Heavys	1
Trucks	1
Cars	68
Totals	70

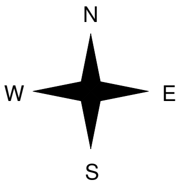
East Leg Total: 511
East Entering: 309
East Peds: 0
Peds Cross: ⧗

Union St

Heavys	Trucks	Cars	Totals
2	1	249	252

Church St E

Cars	Trucks	Heavys	Totals
24	0	1	25
235	1	2	238
46	0	0	46
305	1	3	



Heavys	Trucks	Cars	Totals
0	0	2	2
3	2	129	134
0	0	6	6
3	2	137	

Church St E

Cars	Trucks	Heavys	Totals
196	2	4	202

Union St

Peds Cross: ⧗
West Peds: 3
West Entering: 142
West Leg Total: 394

Cars	64
Trucks	0
Heavys	0
Totals	64

Cars	12	42	47	101
Trucks	0	1	0	1
Heavys	0	0	1	1
Totals	12	43	48	

Peds Cross: ⋈
South Peds: 16
South Entering: 103
South Leg Total: 167

Comments

Church St E @ Union St

Total Count Diagram

Municipality: Brampton
Site #: 0000000004
Intersection: Church St E & Union St
TFR File #: 4
Count date: 24-Mar-2021

Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Non-Signalized Intersection ****

Major Road: Church St E runs W/E

North Leg Total: 496
North Entering: 203
North Peds: 86
Peds Cross: ⋈

Heavys	0	1	2	3
Trucks	0	1	0	1
Cars	16	66	117	199
Totals	16	68	119	
	↲	↓	↳	

Union St

↑	
Heavys	2
Trucks	4
Cars	287
Totals	293

East Leg Total: 2787
East Entering: 1566
East Peds: 35
Peds Cross: ⧗

Heavys	Trucks	Cars	Totals
8	10	1278	1296

←

Church St E

	Cars	Trucks	Heavys	Totals
↰	94	1	1	96
←	1168	9	8	1185
↲	282	3	0	285
	1544	13	9	

N

W E

S

Heavys	Trucks	Cars	Totals	
1	0	13	14	↱
12	10	812	834	→
0	0	70	70	↳
13	10	895		

Church St E

→

Cars	Trucks	Heavys	Totals
1193	12	16	1221

Union St

Peds Cross: ⧗
West Peds: 33
West Entering: 918
West Leg Total: 2214

		↓
Cars	418	
Trucks	4	
Heavys	1	
Totals	423	

	↰	↑	↱	
Cars	94	180	264	538
Trucks	1	3	2	6
Heavys	0	0	2	2
Totals	95	183	268	

Peds Cross: ⋈
South Peds: 56
South Entering: 546
South Leg Total: 969

Comments

Main St N @ Church St

Morning Peak Diagram

Specified Period
From: 7:00:00
To: 9:00:00

One Hour Peak
From: 8:00:00
To: 9:00:00

Municipality:	Brampton
Site #:	0000000001
Intersection:	Main St N & Church St
TFR File #:	1
Count date:	24-Mar-2021

Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

Major Road: Main St N runs N/S

North Leg Total:	874
North Entering:	496
North Peds:	19
Peds Cross:	⋈

Heavys	1	28	2	31
Trucks	0	4	0	4
Cars	18	413	30	461
Totals	19	445	32	

Heavys	35
Trucks	4
Cars	339
Totals	378

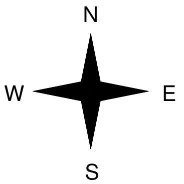
East Leg Total:	189
East Entering:	82
East Peds:	23
Peds Cross:	⧗

Main St N

Heavys	Trucks	Cars	Totals
1	0	61	62

Cars	Trucks	Heavys	Totals
29	0	0	29
37	0	0	37
15	0	1	16
81	0	1	

Church St W



Church St E

Heavys	Trucks	Cars	Totals
0	0	28	28
1	0	61	62
2	0	27	29
3	0	116	

Cars	Trucks	Heavys	Totals
104	0	3	107

Main St N

Peds Cross:	⧗
West Peds:	12
West Entering:	119
West Leg Total:	181

Cars	455
Trucks	4
Heavys	31
Totals	490

Cars	6	282	13	301
Trucks	0	4	0	4
Heavys	0	35	0	35
Totals	6	321	13	

Peds Cross:	⋈
South Peds:	8
South Entering:	340
South Leg Total:	830

Comments

Main St N @ Church St

Mid-day Peak Diagram

Specified Period
From: 11:00:00
To: 14:00:00

One Hour Peak
From: 12:30:00
To: 13:30:00

Municipality: Brampton
Site #: 0000000001
Intersection: Main St N & Church St
TFR File #: 1
Count date: 24-Mar-2021

Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

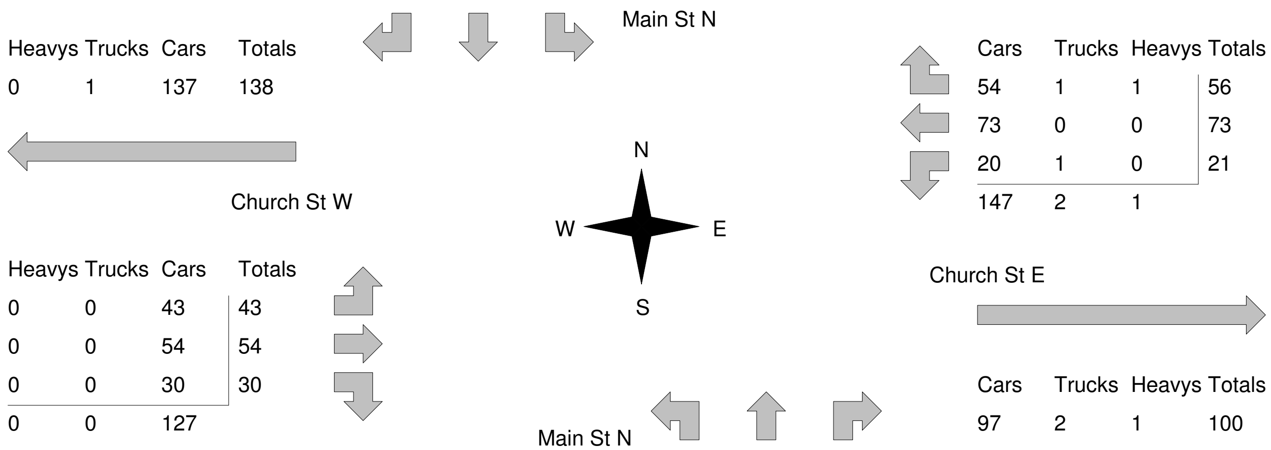
Major Road: Main St N runs N/S

North Leg Total: 1115
North Entering: 551
North Peds: 17
Peds Cross: ⋈

Heavys	0	14	1	15
Trucks	1	9	1	11
Cars	56	448	21	525
Totals	57	471	23	

Heavys	14
Trucks	10
Cars	540
Totals	564

East Leg Total: 250
East Entering: 150
East Peds: 52
Peds Cross: ⧗



Heavys	Trucks	Cars	Totals
0	1	137	138

Cars	Trucks	Heavys	Totals
54	1	1	56
73	0	0	73
20	1	0	21
147	2	1	

Heavys	Trucks	Cars	Totals
0	0	43	43
0	0	54	54
0	0	30	30
0	0	127	

Cars	Trucks	Heavys	Totals
97	2	1	100

Peds Cross: ⧗
West Peds: 35
West Entering: 127
West Leg Total: 265

Cars	498
Trucks	10
Heavys	14
Totals	522

Cars	8	443	22	473
Trucks	0	9	1	10
Heavys	0	13	0	13
Totals	8	465	23	

Peds Cross: ⋈
South Peds: 13
South Entering: 496
South Leg Total: 1018

Comments

Main St N @ Church St

Afternoon Peak Diagram

Specified Period
From: 15:00:00
To: 18:00:00

One Hour Peak
From: 16:30:00
To: 17:30:00

Municipality: Brampton
Site #: 0000000001
Intersection: Main St N & Church St
TFR File #: 1
Count date: 24-Mar-2021

Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

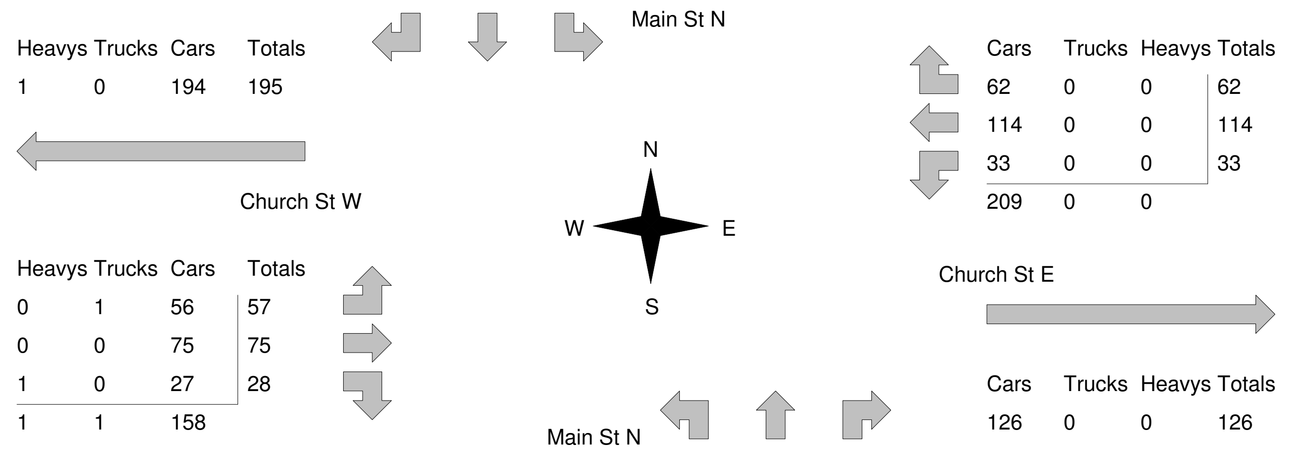
Major Road: Main St N runs N/S

North Leg Total: 1381
North Entering: 580
North Peds: 17
Peds Cross: ⋈

Heavys	0	20	0	20
Trucks	0	5	0	5
Cars	59	474	22	555
Totals	59	499	22	

Heavys	16
Trucks	3
Cars	782
Totals	801

East Leg Total: 335
East Entering: 209
East Peds: 28
Peds Cross: ⧗



Church St W

Heavys	Trucks	Cars	Totals
1	0	194	195

Heavys	Trucks	Cars	Totals
0	1	56	57
0	0	75	75
1	0	27	28
1	1	158	

Church St E

Cars	Trucks	Heavys	Totals
62	0	0	62
114	0	0	114
33	0	0	33
209	0	0	

Cars	Trucks	Heavys	Totals
126	0	0	126

Peds Cross: ⧗
West Peds: 40
West Entering: 160
West Leg Total: 355

Cars	534
Trucks	5
Heavys	21
Totals	560

Cars	21	664	29	714
Trucks	0	2	0	2
Heavys	1	16	0	17
Totals	22	682	29	

Peds Cross: ⋈
South Peds: 22
South Entering: 733
South Leg Total: 1293

Comments

Main St N @ Church St

Total Count Diagram

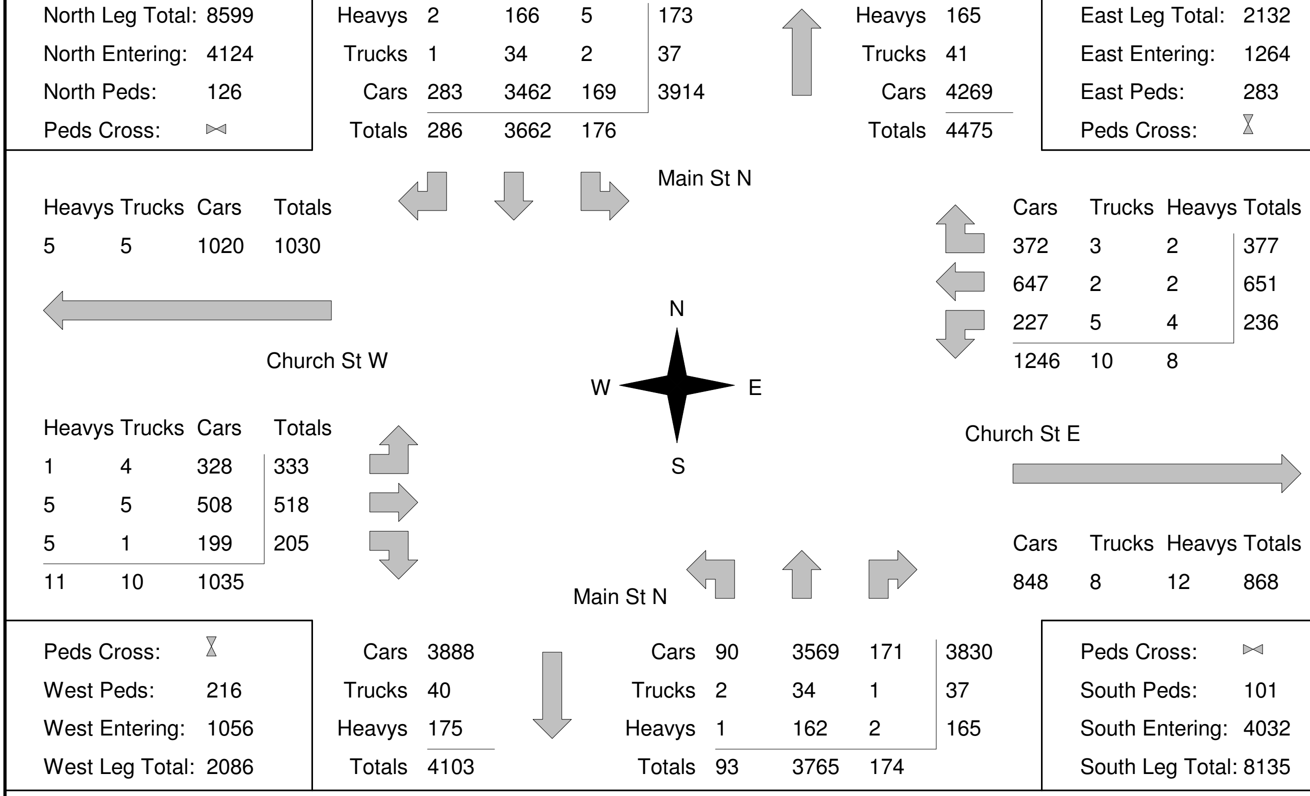
Municipality: Brampton
Site #: 0000000001
Intersection: Main St N & Church St
TFR File #: 1
Count date: 24-Mar-2021

Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

Major Road: Main St N runs N/S



North Leg Total: 8599
North Entering: 4124
North Peds: 126
Peds Cross: ⋈

Heavys	2	166	5	173
Trucks	1	34	2	37
Cars	283	3462	169	3914
Totals	286	3662	176	

Heavys	165
Trucks	41
Cars	4269
Totals	4475

East Leg Total: 2132
East Entering: 1264
East Peds: 283
Peds Cross: ⧗

Heavys	Trucks	Cars	Totals
5	5	1020	1030

Cars	Trucks	Heavys	Totals
372	3	2	377
647	2	2	651
227	5	4	236
1246	10	8	

Heavys	Trucks	Cars	Totals
1	4	328	333
5	5	508	518
5	1	199	205
11	10	1035	

Cars	Trucks	Heavys	Totals
848	8	12	868

Peds Cross: ⧗
West Peds: 216
West Entering: 1056
West Leg Total: 2086

Cars	3888
Trucks	40
Heavys	175
Totals	4103

Cars	90	3569	171	3830
Trucks	2	34	1	37
Heavys	1	162	2	165
Totals	93	3765	174	

Peds Cross: ⋈
South Peds: 101
South Entering: 4032
South Leg Total: 8135

Comments

Main St N @ Nelson St E

Morning Peak Diagram

Specified Period
From: 7:00:00
To: 9:00:00

One Hour Peak
From: 7:45:00
To: 8:45:00

Municipality: Brampton
Site #: 0000000002
Intersection: Main St N & Nelson St E
TFR File #: 2
Count date: 24-Mar-2021

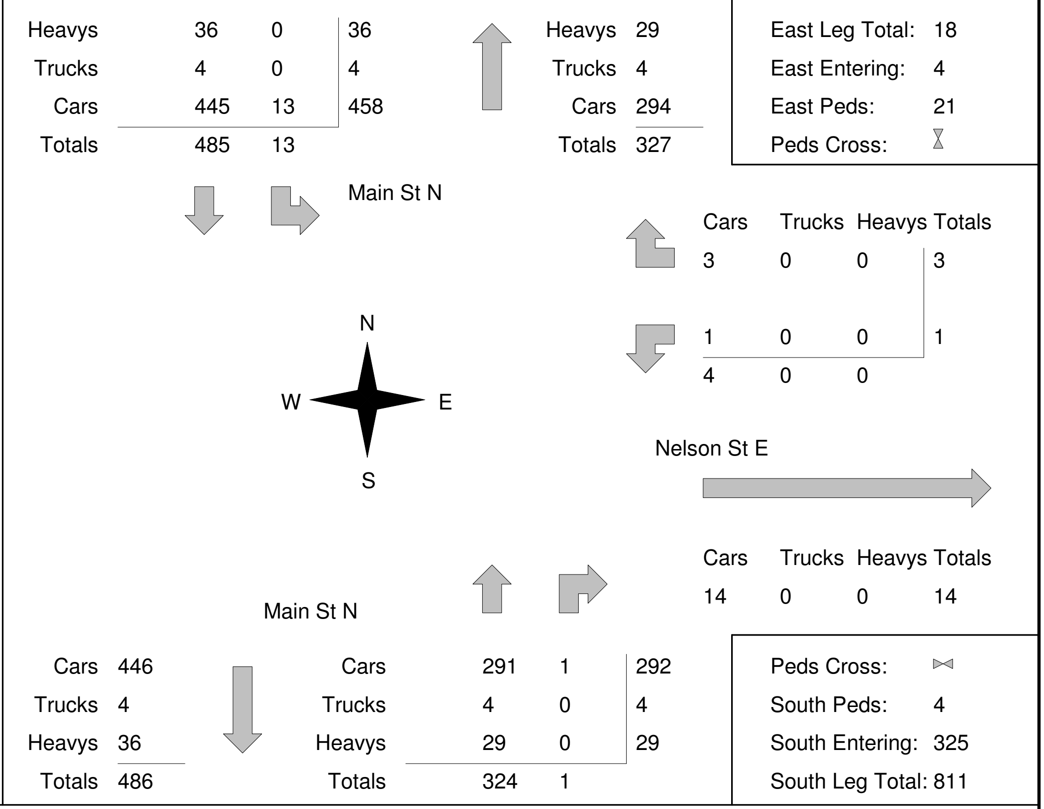
Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Non-Signalized Intersection ****

Major Road: Main St N runs N/S

North Leg Total: 825
North Entering: 498
North Peds: 0
Peds Cross: ⋈



Heavys	36	0	36
Trucks	4	0	4
Cars	445	13	458
Totals	485	13	

Heavys	29
Trucks	4
Cars	294
Totals	327

East Leg Total: 18
East Entering: 4
East Peds: 21
Peds Cross: ⧗

Cars	Trucks	Heavys	Totals
3	0	0	3
1	0	0	1
4	0	0	

Cars	Trucks	Heavys	Totals
14	0	0	14

Cars	446
Trucks	4
Heavys	36
Totals	486

Cars	291	1	292
Trucks	4	0	4
Heavys	29	0	29
Totals	324	1	

Peds Cross: ⋈
South Peds: 4
South Entering: 325
South Leg Total: 811

Comments

Main St N @ Nelson St E

Mid-day Peak Diagram

Specified Period
From: 11:00:00
To: 14:00:00

One Hour Peak
From: 12:00:00
To: 13:00:00

Municipality: Brampton
Site #: 0000000002
Intersection: Main St N & Nelson St E
TFR File #: 2
Count date: 24-Mar-2021

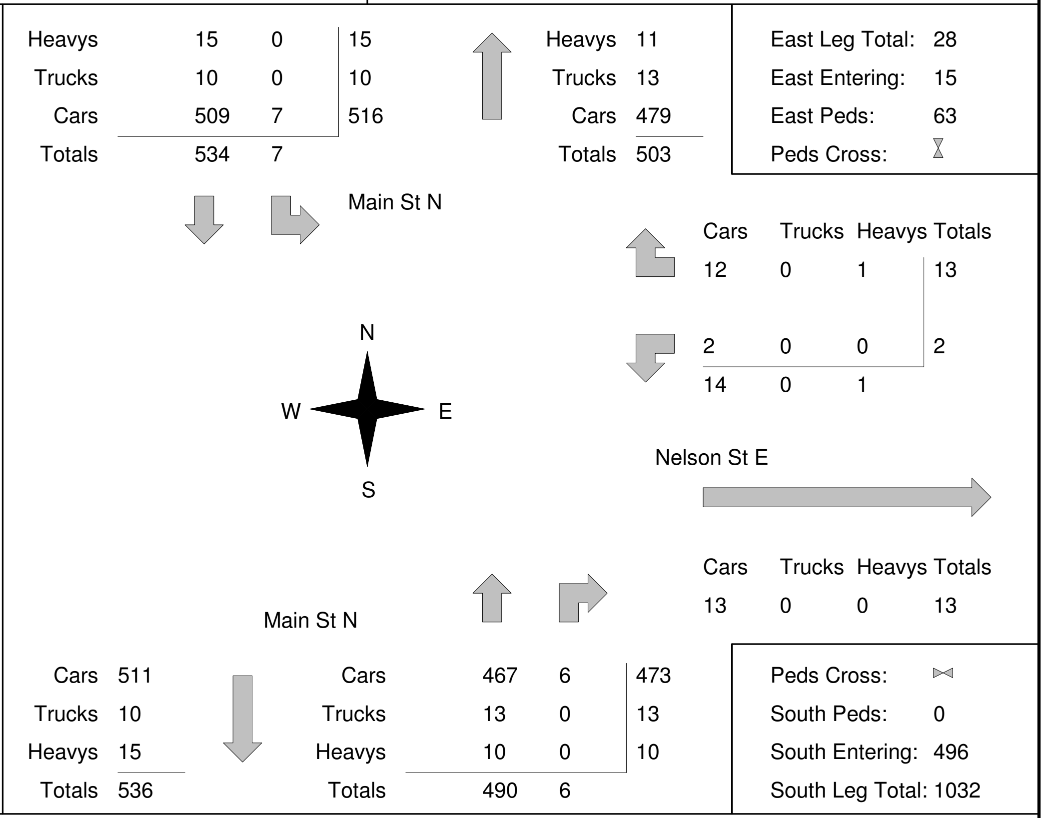
Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Non-Signalized Intersection ****

Major Road: Main St N runs N/S

North Leg Total: 1044
North Entering: 541
North Peds: 1
Peds Cross: ⋈



Heavys	15	0	15
Trucks	10	0	10
Cars	509	7	516
Totals	534	7	

Heavys	11
Trucks	13
Cars	479
Totals	503

East Leg Total: 28
East Entering: 15
East Peds: 63
Peds Cross: ⧗

Cars	Trucks	Heavys	Totals
12	0	1	13
2	0	0	2
14	0	1	

Cars	Trucks	Heavys	Totals
13	0	0	13

Cars	511
Trucks	10
Heavys	15
Totals	536

Cars	467	6	473
Trucks	13	0	13
Heavys	10	0	10
Totals	490	6	

Peds Cross: ⋈
South Peds: 0
South Entering: 496
South Leg Total: 1032

Comments

Main St N @ Nelson St E

Afternoon Peak Diagram

	Specified Period	**One Hour Peak**
From:	15:00:00	16:30:00
To:	18:00:00	17:30:00

Municipality: Brampton
Site #: 0000000002
Intersection: Main St N & Nelson St E
TFR File #: 2
Count date: 24-Mar-2021

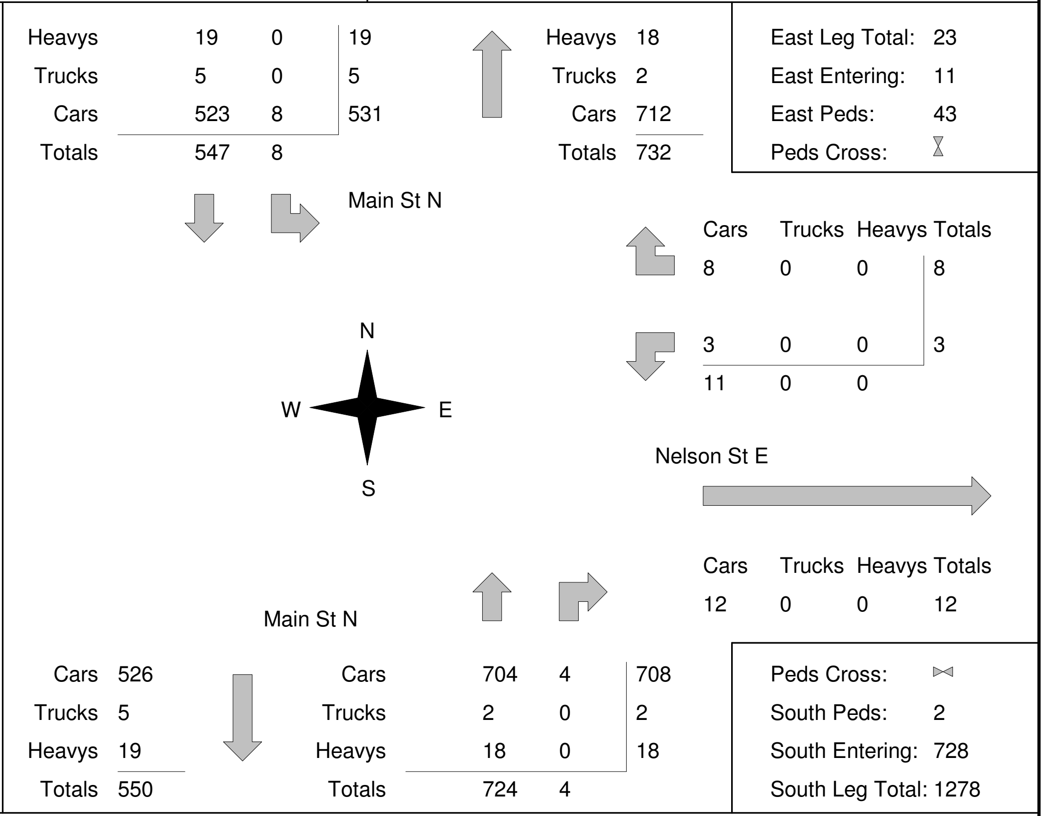
Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Non-Signalized Intersection ****

Major Road: Main St N runs N/S

North Leg Total:	1287
North Entering:	555
North Peds:	1
Peds Cross:	⋈



Heavys	19	0	19
Trucks	5	0	5
Cars	523	8	531
Totals	547	8	

Heavys	18
Trucks	2
Cars	712
Totals	732

East Leg Total:	23
East Entering:	11
East Peds:	43
Peds Cross:	⧖

Cars	Trucks	Heavys	Totals
8	0	0	8
3	0	0	3
11	0	0	

Cars	Trucks	Heavys	Totals
12	0	0	12

Cars	526
Trucks	5
Heavys	19
Totals	550

Cars	704	4	708
Trucks	2	0	2
Heavys	18	0	18
Totals	724	4	

Peds Cross:	⋈
South Peds:	2
South Entering:	728
South Leg Total:	1278

Comments

Main St N @ Nelson St E

Total Count Diagram

Municipality: Brampton
Site #: 0000000002
Intersection: Main St N & Nelson St E
TFR File #: 2
Count date: 24-Mar-2021

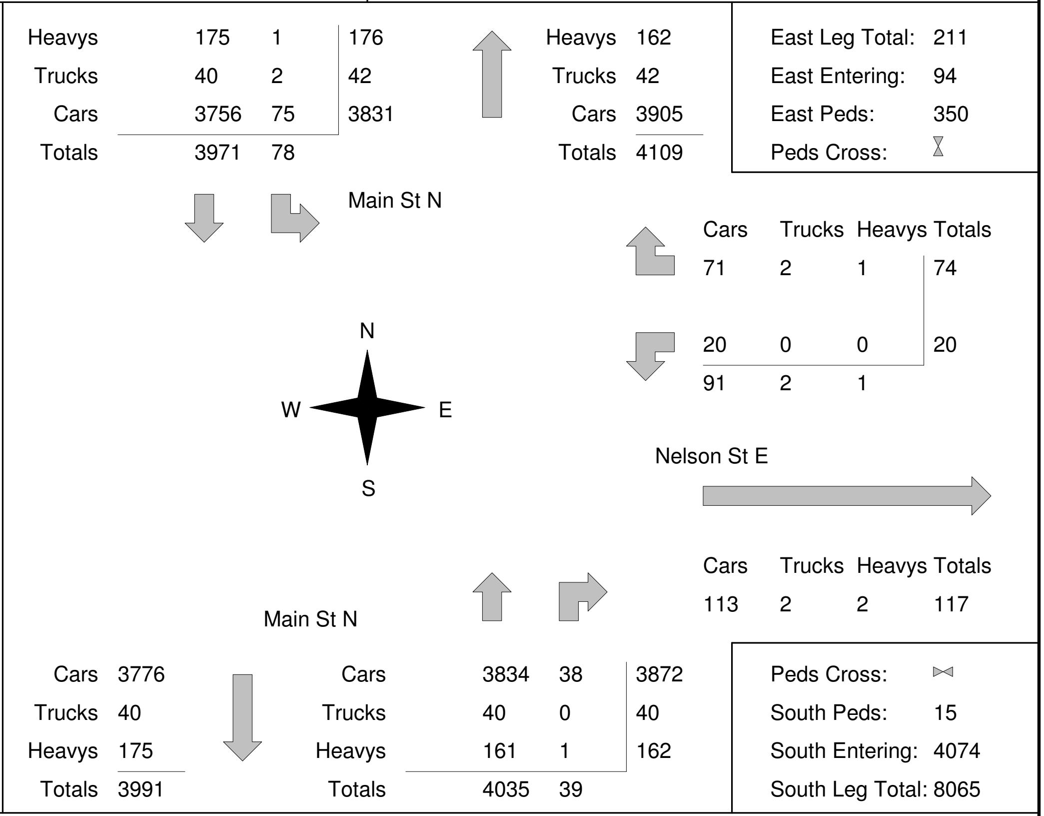
Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Non-Signalized Intersection ****

Major Road: Main St N runs N/S

North Leg Total:	8158
North Entering:	4049
North Peds:	8
Peds Cross:	⋈



Heavys	175	1	176
Trucks	40	2	42
Cars	3756	75	3831
Totals	3971	78	

Heavys	162
Trucks	42
Cars	3905
Totals	4109

East Leg Total:	211
East Entering:	94
East Peds:	350
Peds Cross:	⧗

Cars	Trucks	Heavys	Totals
71	2	1	74
20	0	0	20
91	2	1	

Cars	Trucks	Heavys	Totals
113	2	2	117

Cars	3776
Trucks	40
Heavys	175
Totals	3991

Cars	3834	38	3872
Trucks	40	0	40
Heavys	161	1	162
Totals	4035	39	

Peds Cross:	⋈
South Peds:	15
South Entering:	4074
South Leg Total:	8065

Comments

Main St N @ Theatre Ln

Morning Peak Diagram

Specified Period
From: 7:00:00
To: 9:00:00

One Hour Peak
From: 8:00:00
To: 9:00:00

Municipality: Brampton
Site #: 0000000003
Intersection: Main St N & Theatre Ln
TFR File #: 3
Count date: 24-Mar-2021

Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

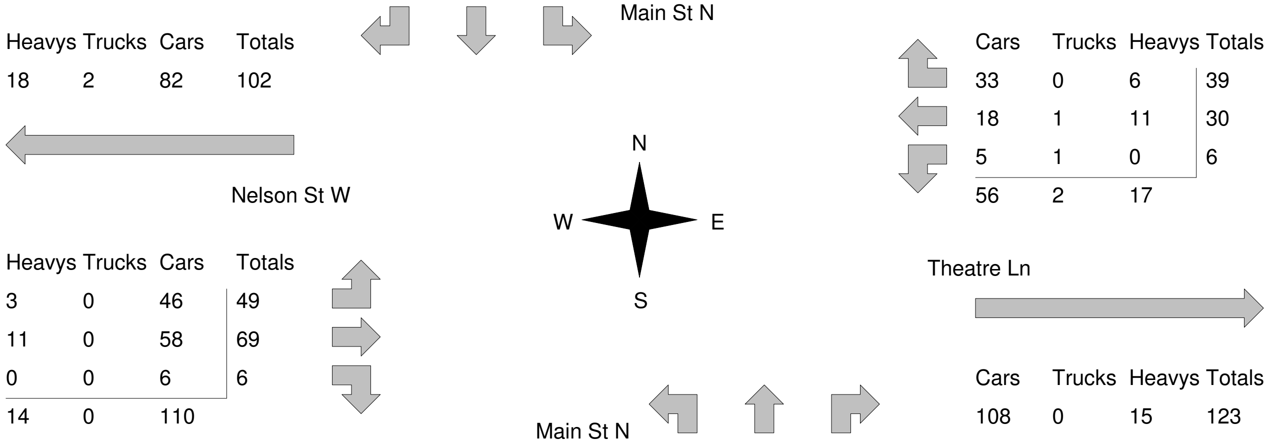
Major Road: Main St N runs N/S

North Leg Total: 819
North Entering: 469
North Peds: 47
Peds Cross: ⋈

Heavys	7	19	4	30
Trucks	1	3	0	4
Cars	55	333	47	435
Totals	63	355	51	

Heavys	36
Trucks	4
Cars	310
Totals	350

East Leg Total: 198
East Entering: 75
East Peds: 13
Peds Cross: ⧗



Heavys	Trucks	Cars	Totals
18	2	82	102

Cars	Trucks	Heavys	Totals
33	0	6	39
18	1	11	30
5	1	0	6
56	2	17	

Heavys	Trucks	Cars	Totals
3	0	46	49
11	0	58	69
0	0	6	6
14	0	110	

Cars	Trucks	Heavys	Totals
108	0	15	123

Peds Cross: ⧗
West Peds: 12
West Entering: 124
West Leg Total: 226

Cars	344
Trucks	4
Heavys	19
Totals	367

Cars	9	231	3	243
Trucks	0	4	0	4
Heavys	0	27	0	27
Totals	9	262	3	

Peds Cross: ⋈
South Peds: 4
South Entering: 274
South Leg Total: 641

Comments

Main St N @ Theatre Ln

Mid-day Peak Diagram

Specified Period
From: 11:00:00
To: 14:00:00

One Hour Peak
From: 12:15:00
To: 13:15:00

Municipality: Brampton
Site #: 0000000003
Intersection: Main St N & Theatre Ln
TFR File #: 3
Count date: 24-Mar-2021

Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

Major Road: Main St N runs N/S

North Leg Total:	1048
North Entering:	535
North Peds:	89
Peds Cross:	⋈

Heavys	4	9	0	13
Trucks	2	6	4	12
Cars	60	403	47	510
Totals	66	418	51	

Heavys	12
Trucks	12
Cars	489
Totals	513

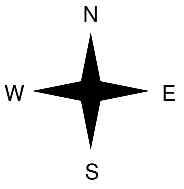
East Leg Total:	250
East Entering:	135
East Peds:	50
Peds Cross:	⧗

Main St N

Heavys	Trucks	Cars	Totals
11	4	138	153

Nelson St W

Heavys	Trucks	Cars	Totals
2	1	72	75
7	1	44	52
0	0	13	13
9	2	129	



Cars	Trucks	Heavys	Totals
49	2	3	54
64	1	7	72
9	0	0	9
122	3	10	

Theatre Ln

Cars	Trucks	Heavys	Totals
102	6	7	115

Main St N

Peds Cross:	⧗
West Peds:	40
West Entering:	140
West Leg Total:	293

Cars	425
Trucks	6
Heavys	9
Totals	440

Cars	14	368	11	393
Trucks	1	9	1	11
Heavys	0	7	0	7
Totals	15	384	12	

Peds Cross:	⋈
South Peds:	24
South Entering:	411
South Leg Total:	851

Comments

Main St N @ Theatre Ln

Afternoon Peak Diagram

Specified Period
From: 15:00:00
To: 18:00:00

One Hour Peak
From: 16:30:00
To: 17:30:00

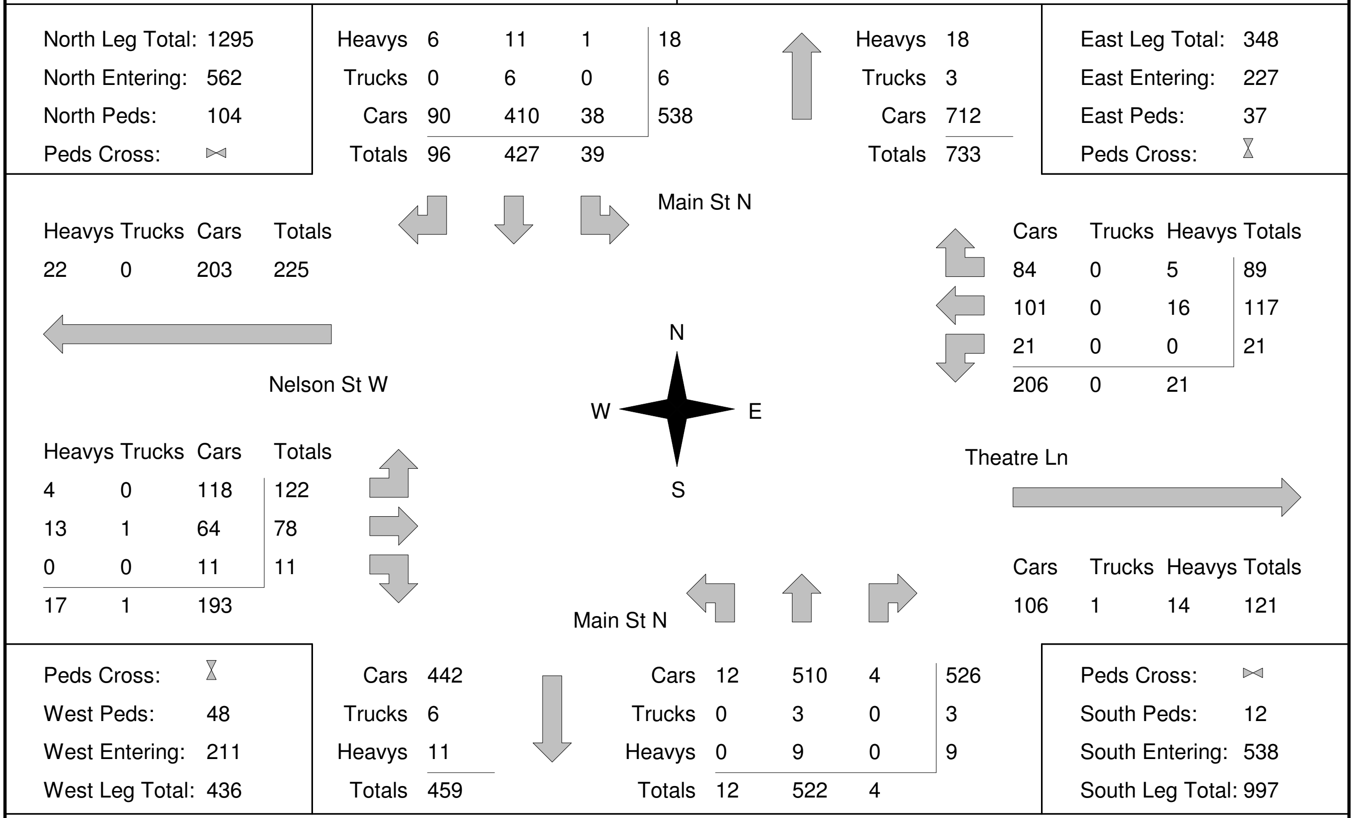
Municipality: Brampton
Site #: 0000000003
Intersection: Main St N & Theatre Ln
TFR File #: 3
Count date: 24-Mar-2021

Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

Major Road: Main St N runs N/S



North Leg Total: 1295
North Entering: 562
North Peds: 104
Peds Cross: ⋈

Heavys	6	11	1	18
Trucks	0	6	0	6
Cars	90	410	38	538
Totals	96	427	39	

Heavys	18
Trucks	3
Cars	712
Totals	733

East Leg Total: 348
East Entering: 227
East Peds: 37
Peds Cross: ⧗

Heavys	Trucks	Cars	Totals
22	0	203	225

Cars	Trucks	Heavys	Totals
84	0	5	89
101	0	16	117
21	0	0	21
206	0	21	

Heavys	Trucks	Cars	Totals
4	0	118	122
13	1	64	78
0	0	11	11
17	1	193	

Cars	Trucks	Heavys	Totals
106	1	14	121

Peds Cross: ⧗
West Peds: 48
West Entering: 211
West Leg Total: 436

Cars	442
Trucks	6
Heavys	11
Totals	459

Cars	12	510	4	526
Trucks	0	3	0	3
Heavys	0	9	0	9
Totals	12	522	4	

Peds Cross: ⋈
South Peds: 12
South Entering: 538
South Leg Total: 997

Comments

Main St N @ Theatre Ln

Total Count Diagram

Municipality: Brampton
Site #: 0000000003
Intersection: Main St N & Theatre Ln
TFR File #: 3
Count date: 24-Mar-2021

Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

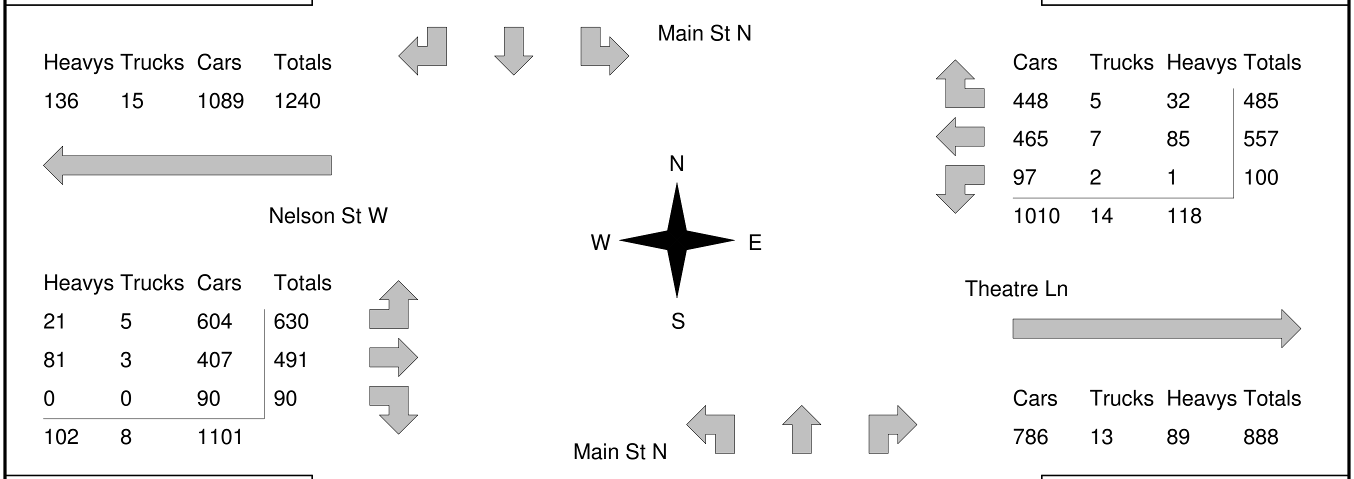
Major Road: Main St N runs N/S

North Leg Total: 8126
North Entering: 4046
North Peds: 653
Peds Cross: ⋈

Heavys	50	117	8	175
Trucks	6	28	8	42
Cars	530	2982	317	3829
Totals	586	3127	333	

Heavys	165
Trucks	38
Cars	3877
Totals	4080

East Leg Total: 2030
East Entering: 1142
East Peds: 272
Peds Cross: ⧗



Heavys	Trucks	Cars	Totals
136	15	1089	1240

Cars	Trucks	Heavys	Totals
448	5	32	485
465	7	85	557
97	2	1	100
1010	14	118	

Heavys	Trucks	Cars	Totals
21	5	604	630
81	3	407	491
0	0	90	90
102	8	1101	

Cars	Trucks	Heavys	Totals
786	13	89	888

Peds Cross: ⧗
West Peds: 298
West Entering: 1211
West Leg Total: 2451

Cars	3169
Trucks	30
Heavys	118
Totals	3317

Cars	94	2825	62	2981
Trucks	2	28	2	32
Heavys	1	112	0	113
Totals	97	2965	64	

Peds Cross: ⋈
South Peds: 113
South Entering: 3126
South Leg Total: 6443

Comments

Union St @ Nelson St E

Morning Peak Diagram

Specified Period
From: 7:00:00
To: 9:00:00

One Hour Peak
From: 8:00:00
To: 9:00:00

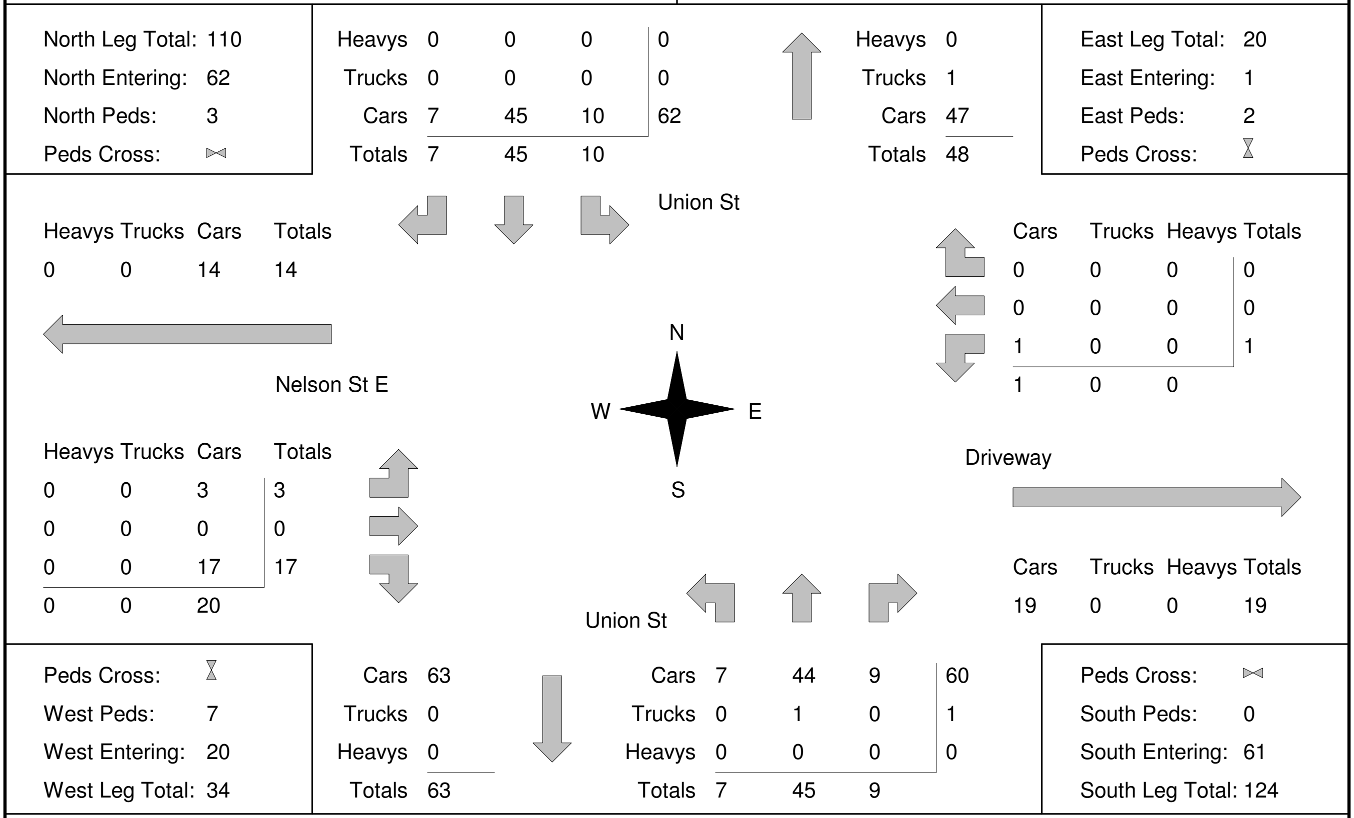
Municipality: Brampton
Site #: 0000000007
Intersection: Union St & Nelson St E
TFR File #: 7
Count date: 24-Mar-2021

Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Non-Signalized Intersection ****

Major Road: Union St runs N/S



North Leg Total: 110
North Entering: 62
North Peds: 3
Peds Cross: ⋈

Heavys	0	0	0	0
Trucks	0	0	0	0
Cars	7	45	10	62
Totals	7	45	10	

Heavys	0
Trucks	1
Cars	47
Totals	48

East Leg Total: 20
East Entering: 1
East Peds: 2
Peds Cross: ⧗

Heavys	Trucks	Cars	Totals
0	0	14	14

Cars	Trucks	Heavys	Totals
0	0	0	0
0	0	0	0
1	0	0	1
1	0	0	

Heavys	Trucks	Cars	Totals
0	0	3	3
0	0	0	0
0	0	17	17
0	0	20	

Cars	Trucks	Heavys	Totals
19	0	0	19

Peds Cross: ⧗
West Peds: 7
West Entering: 20
West Leg Total: 34

Cars	63
Trucks	0
Heavys	0
Totals	63

Cars	7	44	9	60
Trucks	0	1	0	1
Heavys	0	0	0	0
Totals	7	45	9	

Peds Cross: ⋈
South Peds: 0
South Entering: 61
South Leg Total: 124

Comments

Union St @ Nelson St E

Mid-day Peak Diagram

Specified Period
From: 11:00:00
To: 14:00:00

One Hour Peak
From: 12:45:00
To: 13:45:00

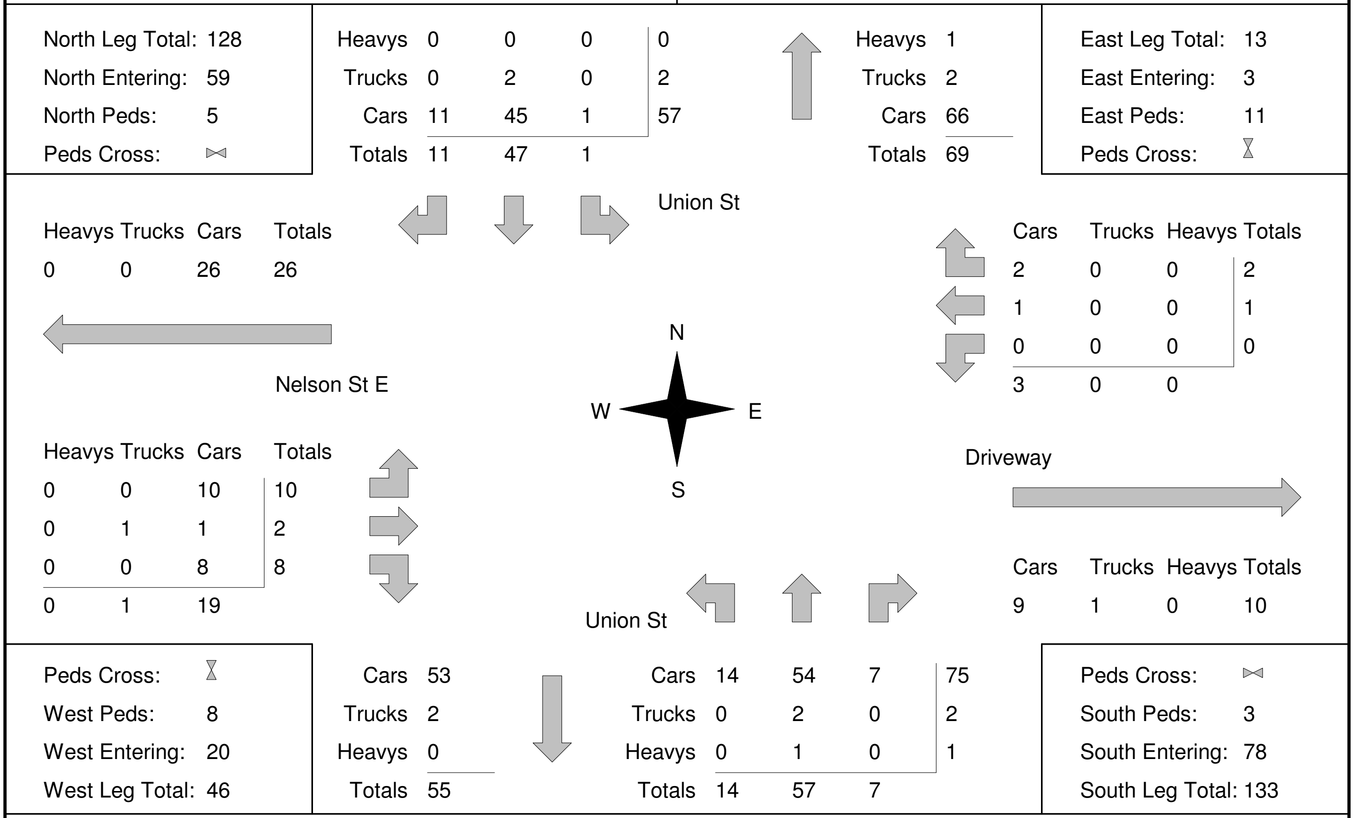
Municipality: Brampton
Site #: 0000000007
Intersection: Union St & Nelson St E
TFR File #: 7
Count date: 24-Mar-2021

Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Non-Signalized Intersection ****

Major Road: Union St runs N/S



North Leg Total: 128
North Entering: 59
North Peds: 5
Peds Cross: ⋈

Heavys	0	0	0	0
Trucks	0	2	0	2
Cars	11	45	1	57
Totals	11	47	1	

Heavys	1
Trucks	2
Cars	66
Totals	69

East Leg Total: 13
East Entering: 3
East Peds: 11
Peds Cross: ⧗

Heavys	Trucks	Cars	Totals
0	0	26	26

Cars	Trucks	Heavys	Totals
2	0	0	2
1	0	0	1
0	0	0	0
3	0	0	

Heavys	Trucks	Cars	Totals
0	0	10	10
0	1	1	2
0	0	8	8
0	1	19	

Cars	Trucks	Heavys	Totals
9	1	0	10

Peds Cross: ⧗
West Peds: 8
West Entering: 20
West Leg Total: 46

Cars	53
Trucks	2
Heavys	0
Totals	55

Cars	14	54	7	75
Trucks	0	2	0	2
Heavys	0	1	0	1
Totals	14	57	7	

Peds Cross: ⋈
South Peds: 3
South Entering: 78
South Leg Total: 133

Comments

Union St @ Nelson St E

Afternoon Peak Diagram

Specified Period
From: 15:00:00
To: 18:00:00

One Hour Peak
From: 15:00:00
To: 16:00:00

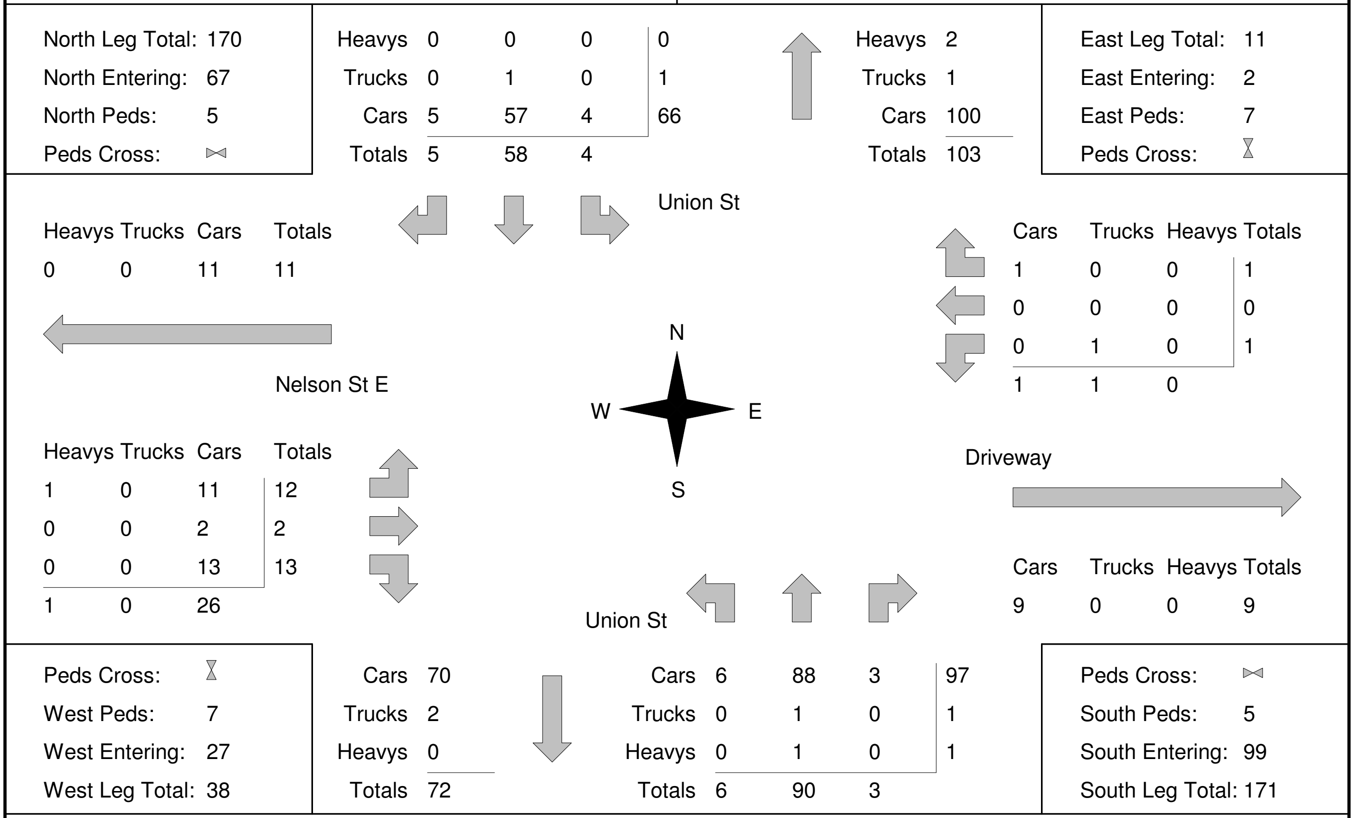
Municipality: Brampton
Site #: 0000000007
Intersection: Union St & Nelson St E
TFR File #: 7
Count date: 24-Mar-2021

Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Non-Signalized Intersection ****

Major Road: Union St runs N/S



North Leg Total: 170
North Entering: 67
North Peds: 5
Peds Cross: ⋈

Heavys	0	0	0	0
Trucks	0	1	0	1
Cars	5	57	4	66
Totals	5	58	4	

Heavys	2
Trucks	1
Cars	100
Totals	103

East Leg Total: 11
East Entering: 2
East Peds: 7
Peds Cross: ⧗

Heavys	Trucks	Cars	Totals
0	0	11	11

Cars	Trucks	Heavys	Totals
1	0	0	1
0	0	0	0
0	1	0	1
1	1	0	

Heavys	Trucks	Cars	Totals
1	0	11	12
0	0	2	2
0	0	13	13
1	0	26	

Cars	Trucks	Heavys	Totals
9	0	0	9

Peds Cross: ⧗
West Peds: 7
West Entering: 27
West Leg Total: 38

Cars	70
Trucks	2
Heavys	0
Totals	72

Cars	6	88	3	97
Trucks	0	1	0	1
Heavys	0	1	0	1
Totals	6	90	3	

Peds Cross: ⋈
South Peds: 5
South Entering: 99
South Leg Total: 171

Comments

Union St @ Nelson St E

Total Count Diagram

Municipality: Brampton
Site #: 0000000007
Intersection: Union St & Nelson St E
TFR File #: 7
Count date: 24-Mar-2021

Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Non-Signalized Intersection ****

Major Road: Union St runs N/S

North Leg Total: 970
North Entering: 430
North Peds: 46
Peds Cross: ⋈

Heavys	1	0	0	1
Trucks	0	3	1	4
Cars	60	329	36	425
Totals	61	332	37	

Heavys	3
Trucks	6
Cars	531
Totals	540

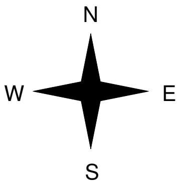
East Leg Total: 106
East Entering: 21
East Peds: 66
Peds Cross: ⧗

Union St

Heavys	Trucks	Cars	Totals
1	2	118	121

Cars	Trucks	Heavys	Totals
7	0	0	7
2	1	0	3
10	1	0	11
19	2	0	

Nelson St E



Heavys	Trucks	Cars	Totals
1	0	53	54
0	1	9	10
0	2	77	79
1	3	139	

Driveway

Cars	Trucks	Heavys	Totals
83	2	0	85

Union St

Peds Cross: ⧗
West Peds: 57
West Entering: 143
West Leg Total: 264

Cars	416
Trucks	6
Heavys	0
Totals	422

Cars	56	471	38	565
Trucks	1	6	0	7
Heavys	0	2	0	2
Totals	57	479	38	

Peds Cross: ⋈
South Peds: 26
South Entering: 574
South Leg Total: 996

Comments

Union St @ Theatre Ln

Morning Peak Diagram

Specified Period
From: 7:00:00
To: 9:00:00

One Hour Peak
From: 7:45:00
To: 8:45:00

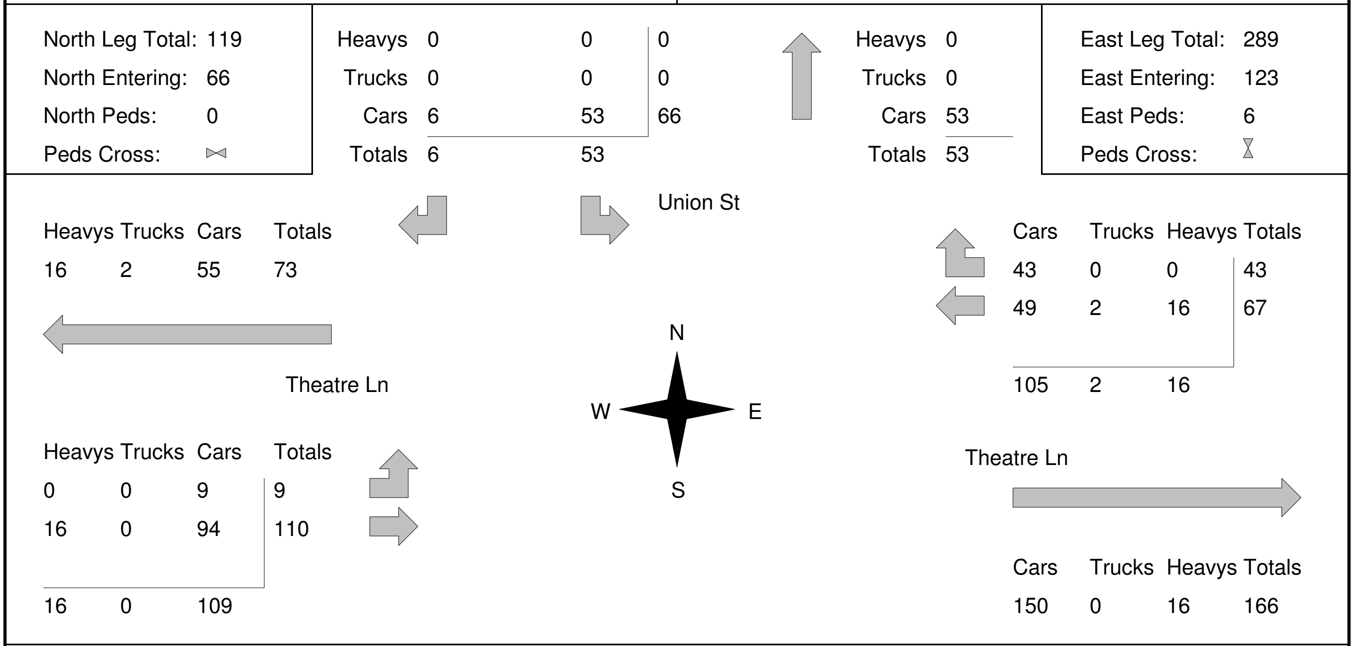
Municipality: Brampton
Site #: 0000000008
Intersection: Theatre Ln & Union St
TFR File #: 8
Count date: 24-Mar-2021

Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

Major Road: Theatre Ln runs W/E



North Leg Total: 119
North Entering: 66
North Peds: 0
Peds Cross: ⋈

Heavys	0	0	0	Heavys	0
Trucks	0	0	0	Trucks	0
Cars	6	53	66	Cars	53
Totals	6	53		Totals	53

East Leg Total: 289
East Entering: 123
East Peds: 6
Peds Cross: ⧗

Union St

Heavys	Trucks	Cars	Totals
16	2	55	73

Theatre Ln

Heavys	Trucks	Cars	Totals
0	0	9	9
16	0	94	110
16	0	109	

Cars	Trucks	Heavys	Totals
43	0	0	43
49	2	16	67
105	2	16	

Theatre Ln

Cars	Trucks	Heavys	Totals
150	0	16	166

Peds Cross: ⧗
West Peds: 2
West Entering: 125
West Leg Total: 198

Comments

Union St @ Theatre Ln

Mid-day Peak Diagram

Specified Period
From: 11:00:00
To: 14:00:00

One Hour Peak
From: 12:15:00
To: 13:15:00

Municipality: Brampton
Site #: 0000000008
Intersection: Theatre Ln & Union St
TFR File #: 8
Count date: 24-Mar-2021

Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

Major Road: Theatre Ln runs W/E

North Leg Total: 151
North Entering: 67
North Peds: 4
Peds Cross: ⋈

Heavys	0	0	0
Trucks	0	2	2
Cars	14	47	65
Totals	14	49	
	↲	↳	

Union St

↑	
Heavys	1
Trucks	4
Cars	79
Totals	84

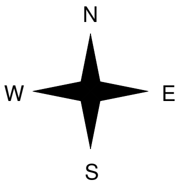
East Leg Total: 350
East Entering: 190
East Peds: 24
Peds Cross: ⧗

Heavys	Trucks	Cars	Totals
10	2	122	134

←

Theatre Ln

	Cars	Trucks	Heavys	Totals
↰	64	1	1	66
←	108	2	10	120
	176	3	11	



Heavys	Trucks	Cars	Totals	
0	3	9	12	↱
5	2	92	99	→
5	5	102		

Theatre Ln

→

Cars	Trucks	Heavys	Totals
151	4	5	160

Peds Cross: ⧗
West Peds: 6
West Entering: 112
West Leg Total: 246

Comments

Union St @ Theatre Ln

Afternoon Peak Diagram

Specified Period
From: 15:00:00
To: 18:00:00

One Hour Peak
From: 15:45:00
To: 16:45:00

Municipality: Brampton
Site #: 0000000008
Intersection: Theatre Ln & Union St
TFR File #: 8
Count date: 24-Mar-2021

Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

Major Road: Theatre Ln runs W/E

North Leg Total: 189
North Entering: 86
North Peds: 3
Peds Cross: ⋈

Heavys	0	0	0
Trucks	1	0	1
Cars	19	65	85
Totals	20	65	

Heavys	0
Trucks	1
Cars	102
Totals	103

East Leg Total: 453
East Entering: 282
East Peds: 28
Peds Cross: ⧗

Union St

Heavys	Trucks	Cars	Totals
18	1	209	228

Theatre Ln

Cars	Trucks	Heavys	Totals
71	1	0	72
188	0	18	206
263	1	18	

N
W E
S

Heavys	Trucks	Cars	Totals
0	0	20	20
14	1	81	96
14	1	102	

Theatre Ln

Cars	Trucks	Heavys	Totals
156	1	14	171

Peds Cross: ⧗
West Peds: 1
West Entering: 117
West Leg Total: 345

Comments

Union St @ Theatre Ln

Total Count Diagram

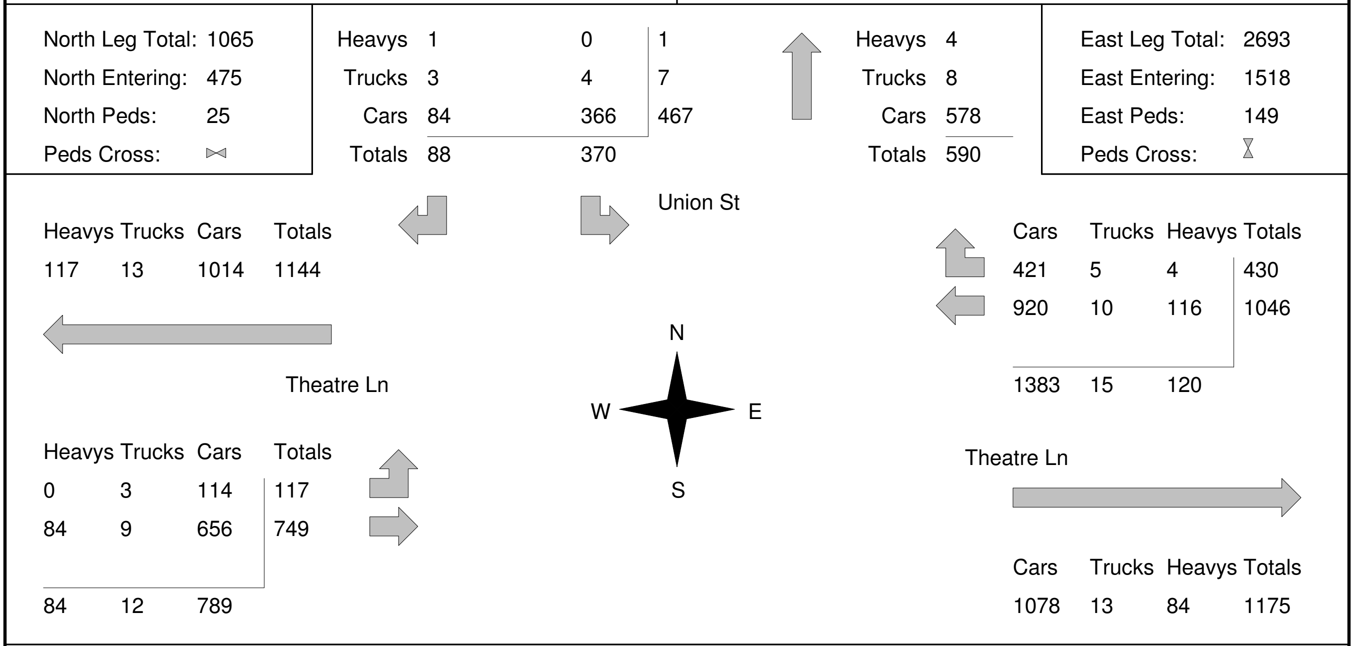
Municipality: Brampton
Site #: 0000000008
Intersection: Theatre Ln & Union St
TFR File #: 8
Count date: 24-Mar-2021

Weather conditions:
Clear/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

Major Road: Theatre Ln runs W/E



North Leg Total: 1065
North Entering: 475
North Peds: 25
Peds Cross: ⋈

Heavys	1	0	1
Trucks	3	4	7
Cars	84	366	467
Totals	88	370	

Heavys	4
Trucks	8
Cars	578
Totals	590

East Leg Total: 2693
East Entering: 1518
East Peds: 149
Peds Cross: ⧗

Heavys	Trucks	Cars	Totals
117	13	1014	1144

Cars	Trucks	Heavys	Totals
421	5	4	430
920	10	116	1046
1383	15	120	

Heavys	Trucks	Cars	Totals
0	3	114	117
84	9	656	749
84	12	789	

Cars	Trucks	Heavys	Totals
1078	13	84	1175

Peds Cross: ⧗
West Peds: 26
West Entering: 885
West Leg Total: 2029

Comments

BRAMPTON
brampton.ca Flower City

Planning and
Infrastructure Services
Maintenance and Operations

March 9, 2020

Attention:
Subject: **Request for Signal Timings**

As per your request, the traffic signal timing for the requested intersection is as follows:

Main St and Church St

				PHASE DIRECTION									
Day Plan	***Hour***	***Minute***	***Pattern***	***1 N/A***	***2 Main NB***	***3 EBLT PP***	***4 Church***	***5 N/A***	***6 Main SB***	***7 N/A***	***8 Church EB***	***Cycle Length***	***Offset***
1 -	0	0	Free	0	17	7	21	0	17	0	21	59.5	0
1 -	8	0	2 - OFF-Peak	0	65	10	45	0	65	0	55	120	30
1 -	20	0	4 -	0	80	10	30	0	80	0	40	120	30
2 -	0	0	Free	0	17	7	21	0	17	0	21	59.5	0
2 -	6	0	1 - AM-Peak	0	65	10	45	0	65	0	55	120	16
2 -	9	30	2 - OFF-Peak	0	65	10	45	0	65	0	55	120	30
2 -	15	0	3 - PM-Peak	0	80	10	30	0	80	0	40	120	4
2 -	19	0	4 -	0	80	10	30	0	80	0	40	120	30
3 -	0	0	Free	0	17	7	21	0	17	0	21	59.5	0
3 -	7	0	2 - OFF-Peak	0	65	10	45	0	65	0	55	120	30
3 -	20	0	4 -	0	80	10	30	0	80	0	40	120	30

	PHASE							
	1	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Walk	0	8	0	8	0	8	0	8
Clearance	0	16	0	14	0	16	0	14
Yellow Change	3	4	3	4	3	4	3	4
Red Clearance	0	2	0	2	0	2	0	2

Yours truly,

TIMING CARD

Intersection Name	Operation	Syst. No.	Rev.
Main Street at Nelson Street / Theatre Lane	Semi -Actuated		

PHASE DESCRIPTION

Ph1	N/A
Ph2	Main Street Northbound
Ph3	Eastbound Advance Arrow
Ph4	Theatre Lane Westbound
Ph5	N/A
PH6	Main Street Southbound
Ph7	N/A
Ph8	Nelson Street Eastbound

PHASE DATA - VEHICLE TIMINGS * - 3 - 1

Basic Timings	Phase:	1	2	3	4	5	6	7	8
Minimum Green……..	:	0	8	6	8	0	8	0	8
Passage Time /10….	:	0	50	30	50	0	50	0	50
Maximum No 1………	:	0	26	9	23	0	26	0	23
Maximum No 2………	:	0	26	9	50	0	26	0	50
Yellow Change /10….	:	40	40	30	40	40	40	40	40
Red Clearance /10…..	:	20	20	0	20	20	20	20	20

PHASE DATA - PEDESTRIAN TIMINGS & CONTROL * - 3 - 3

Pedestrian Times	Phase:	1	2	3	4	5	6	7	8
Walk………………….	:	0	8	0	8	0	8	0	8
Pedestrian Clearance.	:	0	14	0	11	0	14	0	11
Act Rest In Walk…….	:	0	0	0	0	0	0	0	0

Pedestrian Control Entry "1" = Yes & "0" = No

PHASE DATA - GENERAL CONTROL * - 3 - 4

General Control	Phase:	1	2	3	4	5	6	7	8
Initialization…………..	:	0	2	1	1	0	2	0	1
Non-Act Response…..	:	0	1	0	0	0	1	0	0

COORD DATA - TIMING PLAN * - 5 - 3

Dial………… : 1 Split………….: 1 Cycle Length……. : **120**

Level 1………:

Pat #	Off #	Tim Sec	Alt Seq	Pat Mod	Cor Mod	Spc Fun	R2 Lag	R3 Lag	R4 Lag
1	1	**5**	0	0	0	0	0	0	0
2	2	0	0	0	0	0	0	0	0
3	3	0	0	0	0	0	0	0	0

Level 2………:

Phase	1	2	3	4	5	6	7	8
Time	**0**	**70**	**15**	**35**	**0**	**70**	**0**	**50**
Mode	6	1	0	0	6	1	6	0
P. Red	0	0	0	0	0	0	0	0
P. Ext	0	0	0	0	0	0	0	0

Dial………… : 1 Split………….: 2 Cycle Length……. : 120

Level 1………:

Pat #	Off #	Tim Sec	Alt Seq	Pat Mod	Cor Mod	Spc Fun	R2 Lag	R3 Lag	R4 Lag
1	1	**30**	0	0	0	0	0	0	0
2	2	0	0	0	0	0	0	0	0
3	3	0	0	0	0	0	0	0	0

Level 2………:

Phase	1	2	3	4	5	6	7	8
Time	**0**	**70**	**15**	**35**	**0**	**70**	**0**	**50**
Mode	6	1	0	0	6	1	6	0
P. Red	0	0	0	0	0	0	0	0
P. Ext	0	0	0	0	0	0	0	0

COORD DATA - TIMING PLAN * - 5 - 3

Dial………… : 1 Split………….: 3 Cycle Length……. : 120

Level 1………:

Pat #	Off #	Tim Sec	Alt Seq	Pat Mod	Cor Mod	Spc Fun	R2 Lag	R3 Lag	R4 Lag
1	1	**11**	0	0	0	0	0	0	0
2	2	0	0	0	0	0	0	0	0
3	3	0	0	0	0	0	0	0	0

Level 2………:

Phase	1	2	3	4	5	6	7	8
Time	**0**	**60**	**25**	**35**	**0**	**60**	**0**	**60**
Mode	6	1	0	0	6	1	6	0
P. Red	0	0	0	0	0	0	0	0
P. Ext	0	0	0	0	0	0	0	0

Dial………… : 1 Split…………..: 4 Cycle Length……. :

Level 1………:

Pat #	Off #	Tim Sec	Alt Seq	Pat Mod	Cor Mod	Spc Fun	R2 Lag	R3 Lag	R4 Lag
1	1	0	0	0	0	0	0	0	0
2	2	0	0	0	0	0	0	0	0
3	3	0	0	0	0	0	0	0	0

Level 2………:

Phase	1	2	3	4	5	6	7	8
Time	0	0	0	0	0	0	0	0
Mode	0	0	0	0	0	0	0	0
P. Red	0	0	0	0	0	0	0	0
P. Ext	0	0	0	0	0	0	0	0

Dial………… : 4 Split…………..: 4 Cycle Length……. : 0

Level 1………:

Pat #	Off #	Tim Sec	Alt Seq	Pat Mod	Cor Mod	Spc Fun	R2 Lag	R3 Lag	R4 Lag
1	1	0	0	0	0	0	0	0	0
2	2	0	0	0	0	0	0	0	0
3	3	0	0	0	0	0	0	0	0

Level 2………:

Phase	1	2	3	4	5	6	7	8
Time	0	0	0	0	0	0	0	0
Mode	0	0	0	0	0	0	0	0
P. Red	0	8	1	0	0	8	0	0
P. Ext	0	0	0	9	0	0	0	9

Codes …………………….. :

Phase Mode………….. : 0-Actuated 1-Coord Phase 2-Min Rec 3-Max Rec
4-Ped Rec 5-Max+Ped Recall 6-Phase Omitted 7-Dual Coord Phase

Pattern Mode………… : 0-Normal/ 1-Perm/ 2-Yield/ 3-Perm Yield/ 4-Perm Omit/ 5-Seq Omit /6-Full Act

Alternate Sequence Values To Be Set To Zero "0"

R# LAG N/A

TIME BASE DATA - TRAFFIC EVENTS *-6-2

Refer to phase function mapping.

DAY PDAY	TIME HH:MM	PATTERN	PHASE FUNCTIONS 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
01	00:00	0/0/4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01	08:00	1/2/1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02	00:00	0/0/4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02	06:00	1/1/1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02	09:30	1/2/1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02	15:00	1/3/1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02	19:00	1/2/1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07	00:00	0/0/4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07	07:00	1/2/1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	___/___	___/___/___	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Intersection Name	**Operation**		
Theatre Lane at Union Street	Fully -Actuated		

PHASE DESCRIPTION

Ph1	N/A
Ph2	Theatre Lane Eastbound
Ph3	Performing Arts Centre Entrance Northbound
Ph4	Union Street Southbound
Ph5	N/A
PH6	Theatre Lane Westbound
Ph7	N/A
Ph8	N/A

PHASE DATA - VEHICLE TIMINGS * - 3 - 1

Basic Timings	Phase:	1	2	3	4	5	6	7	8
Minimum Green……..	:	0	8	8	8	0	8	0	8
Passage Time /10….	:	0	50	50	50	0	50	0	50
Maximum No 1………	:	0	16	25	16	0	16	0	16
Maximum No 2………	:	0	16	50	16	0	16	0	16
Yellow Change /10….	:	0	40	40	40	0	40	0	40
Red Clearance /10…..	:	0	20	20	20	0	20	0	20

PHASE DATA - PEDESTRIAN TIMINGS & CONTROL * - 3 - 3

Pedestrian Times	Phase:	1	2	3	4	5	6	7	8
Walk………………….	:	0	8	8	8	0	8	0	8
Pedestrian Clearance.	:	0	12	11	11	0	12	0	11
Act Rest In Walk…….	:	0	0	0	0	0	0	0	0

Pedestrian Control Entry "1" = Yes & "0" = No

PHASE DATA - GENERAL CONTROL * - 3 - 4

General Control	Phase:	1	2	3	4	5	6	7	8
Initialization…………..	:	0	2	1	1	0	2	0	1
Non-Act Response…..	:	0	1	0	0	0	1	0	0

COORD DATA - TIMING PLAN * - 5 - 3

Dial………… : 1 Split…………: 1 Cycle Length……. : 0

Level 1……. :	Pat #	Off #	Tim Sec	Alt Seq	Pat Mod	Cor Mod	Spc Fun	R2 Lag	R3 Lag	R4 Lag
	1	1	0	0	0	0	0	0	0	0
	2	2	0	0	0	0	0	0	0	0
	3	3	0	0	0	0	0	0	0	0

Level 2……. :	Phase	1	2	3	4	5	6	7	8
	Time	0	0	0	0	0	0	0	0
	Mode	0	0	0	0	0	0	0	0
	P. Red	0	0	0	0	0	0	0	0
	P. Ext	0	0	0	0	0	0	0	0

Dial………… : 1 Split…………: 2 Cycle Length……. : 0

Level 1……. :	Pat #	Off #	Tim Sec	Alt Seq	Pat Mod	Cor Mod	Spc Fun	R2 Lag	R3 Lag	R4 Lag
	1	1	0	0	0	0	0	0	0	0
	2	2	0	0	0	0	0	0	0	0
	3	3	0	0	0	0	0	0	0	0

Level 2……. :	Phase	1	2	3	4	5	6	7	8
	Time	0	0	0	0	0	0	0	0
	Mode	0	0	0	0	0	0	0	0
	P. Red	0	0	0	0	0	0	0	0
	P. Ext	0	0	0	0	0	0	0	0

COORD DATA - TIMING PLAN * - 5 - 3

Dial………… : 1 Split…………: 3 Cycle Length……. : 0

Level 1……. :	Pat #	Off #	Tim Sec	Alt Seq	Pat Mod	Cor Mod	Spc Fun	R2 Lag	R3 Lag	R4 Lag
	1	1	0	0	0	0	0	0	0	0
	2	2	0	0	0	0	0	0	0	0
	3	3	0	0	0	0	0	0	0	0

Level 2……. :	Phase	1	2	3	4	5	6	7	8
	Time	0	0	0	0	0	0	0	0
	Mode	0	0	0	0	0	0	0	0
	P. Red	0	0	0	0	0	0	0	0
	P. Ext	0	0	0	0	0	0	0	0

Dial............ : **1** Split............: **4** Cycle Length....... : **120**

Level 1........ :	Pat #	Off #	Tim Sec	Alt Seq	Pat Mod	Cor Mod	Spc Fun	R2 Lag	R3 Lag	R4 Lag
	1	1	**23**	0	0	0	0	0	0	0
	2	2	0	0	0	0	0	0	0	0
	3	3	0	0	0	0	0	0	0	0

Level 2........ :	Phase	1	2	3	4	5	6	7	8
	Time	**0**	**64**	**30**	**26**	**0**	**64**	**0**	**0**
	Mode	**6**	**1**	**0**	**0**	**6**	**1**	**6**	**6**
	P. Red	0	0	0	0	0	0	0	0
	P. Ext	0	0	0	0	0	0	0	0

Dial............ : 4 Split............: 4 Cycle Length....... : 0

Level 1........ :	Pat #	Off #	Tim Sec	Alt Seq	Pat Mod	Cor Mod	Spc Fun	R2 Lag	R3 Lag	R4 Lag
	1	1	0	0	0	0	0	0	0	0
	2	2	0	0	0	0	0	0	0	0
	3	3	0	0	0	0	0	0	0	0

Level 2........ :	Phase	1	2	3	4	5	6	7	8
	Time	0	0	0	0	0	0	0	0
	Mode	0	0	0	0	0	0	0	0
	P. Red	0	0	0	0	0	0	0	0
	P. Ext	0	0	0	0	0	0	0	0

Codes .... :

Phase Mode............ :	0-Actuated	1-Coord Phase	2-Min Rec	3-Max Rec
	4-Ped Rec	5-Max+Ped Recall	6-Phase Omitted	7-Dual Coord Phase

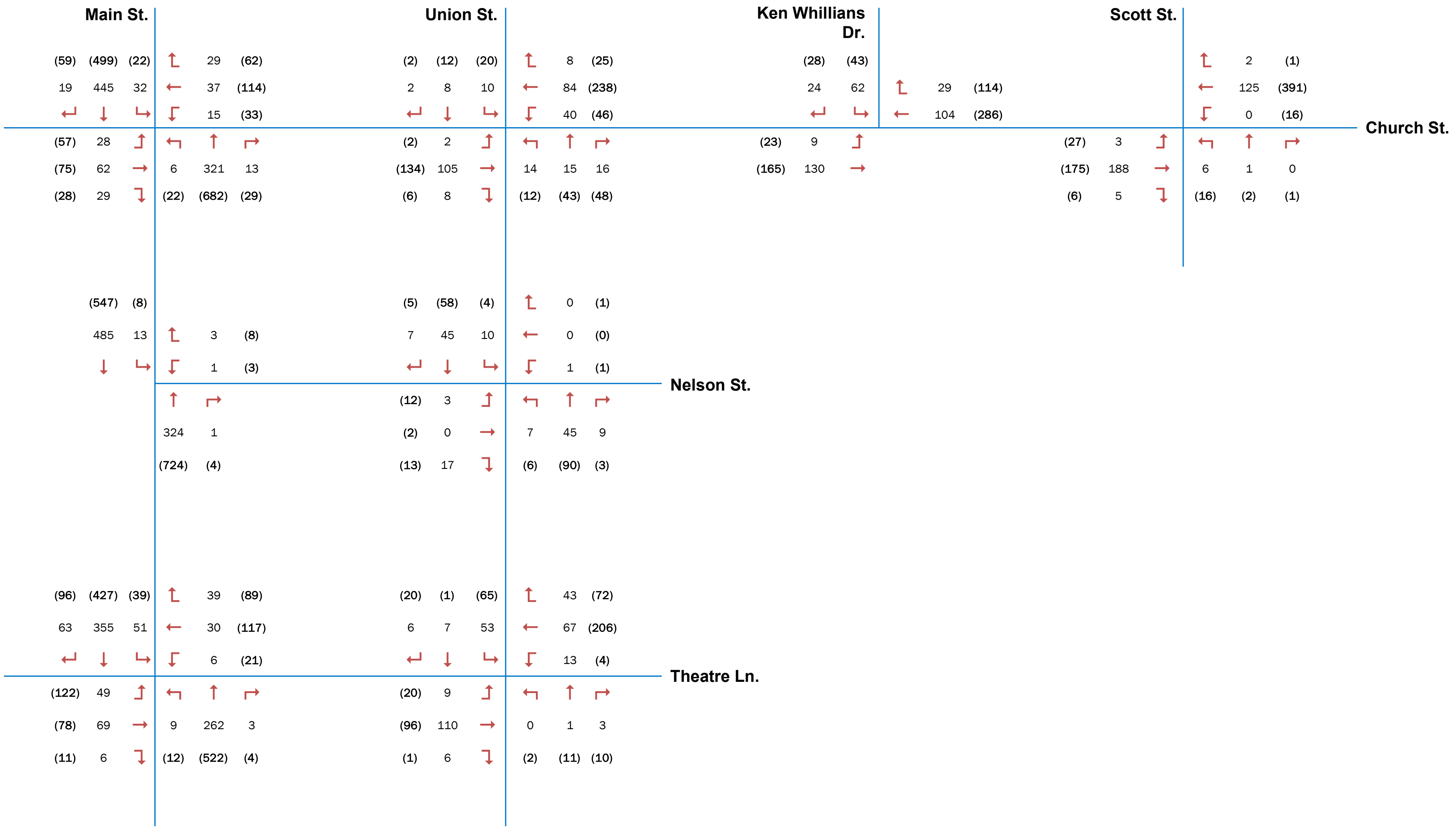
Pattern Mode........... : 0-Normal/ 1-Perm/ 2-Yield/ 3-Perm Yield/ 4-Perm Omit/ 5-Seq Omit /6-Full Act

Alternate Sequence Values To Be Set To Zero "0"

R# LAG N/A

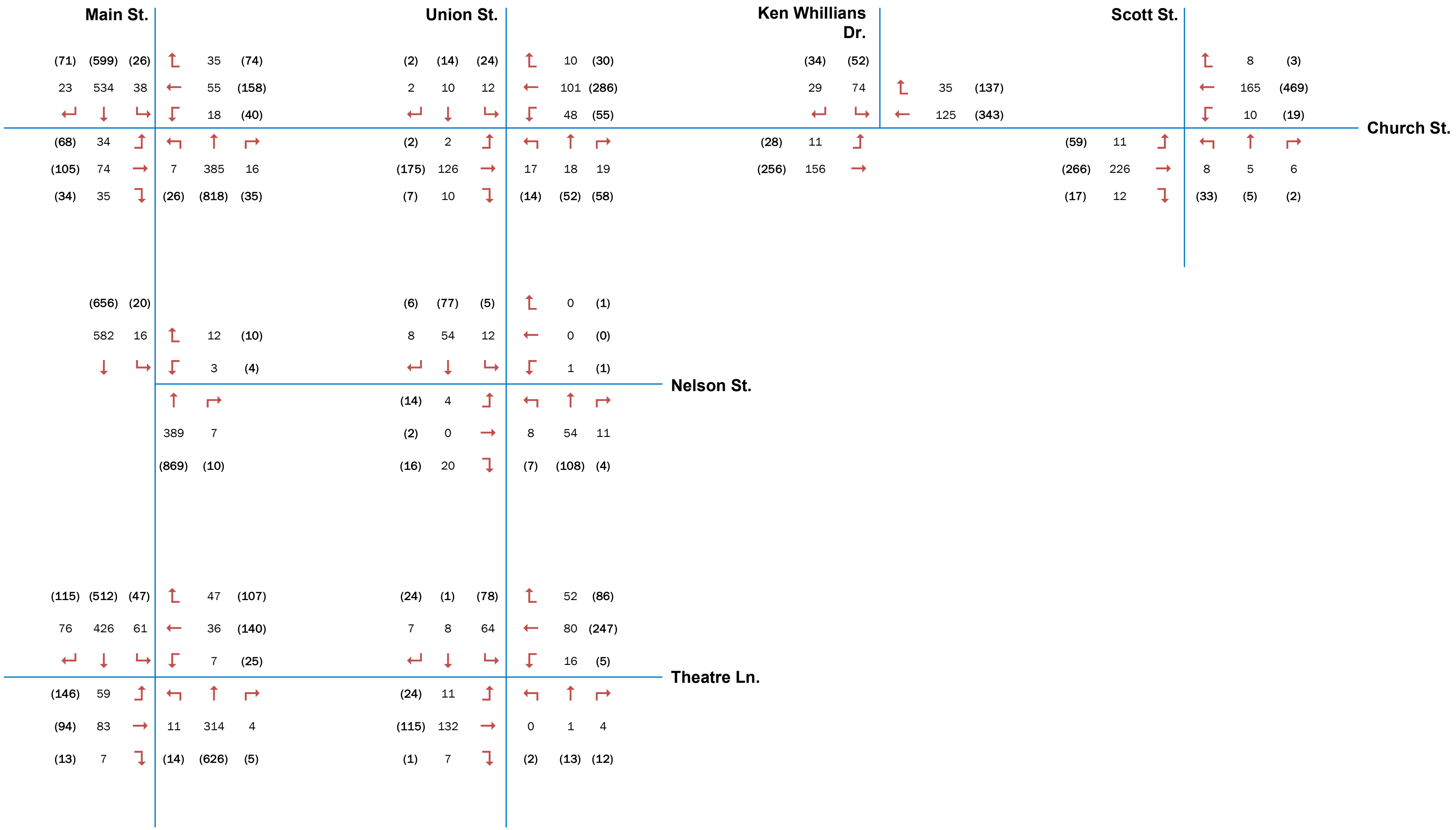
TIME BASE DATA - TRAFFIC EVENTS * - 6 - 2

DAY PDAY	TIME HH:MM	PATTERN	PHASE FUNCTIONS 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
01	00:00	0/0/4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01	18:00	0/0/0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02	00:00	0/0/4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02	16:00	0/0/0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07	00:00	0/0/4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07	**05:45**	**1/4/1**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07	**14:00**	**0/0/0**	**1**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



PARSONS

Existing AM (PM) Raw Traffic Volumes



PARSONS

Existing AM (PM) Balanced Traffic Volumes

APPENDIX C

SYNCHRO REPORTS
EXISTING (2021) CONDITIONS

PARSONS

1: Church St. & Scott St.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣				
Traffic Volume (veh/h)	11	226	12	10	165	8	8	5	6	0	0	0
Future Volume (Veh/h)	11	226	12	10	165	8	8	5	6	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	12	246	13	11	179	9	9	5	7	0	0	0
Pedestrians		3			9			17			14	
Lane Width (m)		3.5			3.5			3.5			0.0	
Walking Speed (m/s)		1.1			1.1			1.1			1.1	
Percent Blockage		0			1			2			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	202			276			502	518	278	514	520	200
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	202			276			502	518	278	514	520	200
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 %	99			99			98	99	99	100	100	100
cM capacity (veh/h)	1382			1279			463	450	748	450	449	843

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	271	199	21
Volume Left	12	11	9
Volume Right	13	9	7
cSH	1382	1279	526
Volume to Capacity	0.01	0.01	0.04
Queue Length 95th (m)	0.2	0.2	0.9
Control Delay (s)	0.4	0.5	12.1
Lane LOS	A	A	B
Approach Delay (s)	0.4	0.5	12.1
Approach LOS			B

Intersection Summary			
Average Delay	1.0		
Intersection Capacity Utilization	34.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰↑	↑	↱	↰	↱
Sign Control		Stop	Stop		Stop	
Traffic Volume (vph)	11	156	125	35	74	29
Future Volume (vph)	11	156	125	35	74	29
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	12	170	136	38	80	32

Direction, Lane #	EB 1	WB 1	WB 2	SB 1	SB 2
Volume Total (vph)	182	136	38	80	32
Volume Left (vph)	12	0	0	80	0
Volume Right (vph)	0	0	38	0	32
Hadj (s)	0.06	0.02	-0.70	0.50	-0.63
Departure Headway (s)	4.9	5.0	4.3	5.9	4.7
Degree Utilization, x	0.25	0.19	0.05	0.13	0.04
Capacity (veh/h)	719	694	808	581	710
Control Delay (s)	9.5	8.0	6.3	8.5	6.7
Approach Delay (s)	9.5	7.6		8.0	
Approach LOS	A	A		A	

Intersection Summary			
Delay	8.4		
Level of Service	A		
Intersection Capacity Utilization	34.0%	ICU Level of Service	A
Analysis Period (min)	15		

3: Union St. & Church St.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↑			✥			✥	
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	2	126	10	48	101	10	17	18	19	12	10	2
Future Volume (vph)	2	126	10	48	101	10	17	18	19	12	10	2
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	137	11	52	110	11	18	20	21	13	11	2

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total (vph)	2	148	52	121	59	26
Volume Left (vph)	2	0	52	0	18	13
Volume Right (vph)	0	11	0	11	21	2
Hadj (s)	0.50	-0.02	0.50	-0.05	-0.14	0.05
Departure Headway (s)	5.4	4.8	5.3	4.8	4.5	4.8
Degree Utilization, x	0.00	0.20	0.08	0.16	0.07	0.03
Capacity (veh/h)	657	724	654	732	738	695
Control Delay (s)	7.2	7.8	7.6	7.5	7.9	8.0
Approach Delay (s)	7.8		7.5		7.9	8.0
Approach LOS	A		A		A	A

Intersection Summary			
Delay	7.7		
Level of Service	A		
Intersection Capacity Utilization	27.9%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↰	↱	↰	↱		↰↑↱		↰↓↱
Traffic Volume (vph)	34	74	18	55	7	385	38	534
Future Volume (vph)	34	74	18	55	7	385	38	534
Lane Group Flow (vph)	37	118	20	98	0	443	0	646
Turn Type	pm+pt	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases	3	8		4		2		6
Permitted Phases	8		4		2		6	
Detector Phase	3	8	4	4	2	2	6	6
Switch Phase								
Minimum Initial (s)	5.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	10.0	28.0	28.0	28.0	30.0	30.0	30.0	30.0
Total Split (s)	10.0	55.0	45.0	45.0	65.0	65.0	65.0	65.0
Total Split (%)	8.3%	45.8%	37.5%	37.5%	54.2%	54.2%	54.2%	54.2%
Yellow Time (s)	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	0.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0		0.0		0.0
Total Lost Time (s)	3.0	6.0	6.0	6.0		6.0		6.0
Lead/Lag	Lead		Lag	Lag				
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
v/c Ratio	0.09	0.23	0.07	0.24		0.30		0.46
Control Delay	9.0	10.1	16.5	13.7		11.1		12.7
Queue Delay	0.0	0.0	0.0	0.0		0.0		0.0
Total Delay	9.0	10.1	16.5	13.7		11.1		12.7
Queue Length 50th (m)	1.5	4.6	0.9	3.4		8.1		13.0
Queue Length 95th (m)	6.3	15.0	6.1	16.3		33.1		51.7
Internal Link Dist (m)		105.2		158.0		82.5		21.1
Turn Bay Length (m)	71.0		31.0					
Base Capacity (vph)	444	1474	973	1370		2847		2679
Starvation Cap Reductn	0	0	0	0		0		0
Spillback Cap Reductn	0	0	0	0		0		0
Storage Cap Reductn	0	0	0	0		0		0
Reduced v/c Ratio	0.08	0.08	0.02	0.07		0.16		0.24

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 43.4
Natural Cycle: 70
Control Type: Semi Act-Uncoord

Splits and Phases: 4: Main St. & Church St.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱			↰↑↱			↰↑↱	
Traffic Volume (vph)	34	74	35	18	55	35	7	385	16	38	534	23
Future Volume (vph)	34	74	35	18	55	35	7	385	16	38	534	23
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.0		6.0	6.0			6.0			6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			0.95			0.95	
Frpb, ped/bikes	1.00	0.99		1.00	0.99			1.00			1.00	
Flpb, ped/bikes	1.00	1.00		0.99	1.00			1.00			1.00	
Frt	1.00	0.95		1.00	0.94			0.99			0.99	
Flt Protected	0.95	1.00		0.95	1.00			1.00			1.00	
Satd. Flow (prot)	1600	1575		1588	1578			3123			3064	
Flt Permitted	0.51	1.00		0.68	1.00			0.94			0.90	
Satd. Flow (perm)	863	1575		1138	1578			2942			2772	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	37	80	38	20	60	38	8	418	17	41	580	25
RTOR Reduction (vph)	0	17	0	0	23	0	0	3	0	0	3	0
Lane Group Flow (vph)	37	101	0	20	75	0	0	440	0	0	643	0
Confl. Peds. (#/hr)	17		22	22		17	40		28	28		40
Confl. Bikes (#/hr)			1			1						
Heavy Vehicles (%)	0%	0%	4%	0%	0%	0%	5%	2%	0%	0%	4%	0%
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	3	8			4			2			6	
Permitted Phases	8			4			2			6		
Actuated Green, G (s)	13.5	13.5		8.5	8.5			20.4			20.4	
Effective Green, g (s)	13.5	13.5		8.5	8.5			20.4			20.4	
Actuated g/C Ratio	0.29	0.29		0.19	0.19			0.44			0.44	
Clearance Time (s)	3.0	6.0		6.0	6.0			6.0			6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)	285	463		210	292			1307			1232	
v/s Ratio Prot	0.01	c0.06			0.05							
v/s Ratio Perm	0.03			0.02				0.15			c0.23	
v/c Ratio	0.13	0.22		0.10	0.26			0.34			0.52	
Uniform Delay, d1	11.8	12.2		15.5	16.0			8.3			9.2	
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Incremental Delay, d2	0.2	0.2		0.2	0.5			0.2			0.4	
Delay (s)	12.0	12.5		15.7	16.5			8.5			9.6	
Level of Service	B	B		B	B			A			A	
Approach Delay (s)		12.4			16.3			8.5			9.6	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	10.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.44		
Actuated Cycle Length (s)	45.9	Sum of lost time (s)	15.0
Intersection Capacity Utilization	65.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

	↙	↖	↑	↗	↘	↓
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	Y		↑↱			↰↑
Traffic Volume (veh/h)	3	12	389	7	16	582
Future Volume (Veh/h)	3	12	389	7	16	582
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	3	13	423	8	17	633
Pedestrians	43		2			1
Lane Width (m)	3.5		3.5			3.5
Walking Speed (m/s)	1.1		1.1			1.1
Percent Blockage	4		0			0
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)			54			106
pX, platoon unblocked	0.92	0.97			0.97	
vC, conflicting volume	822	260			474	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	472	168			389	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	99	98			98	
cM capacity (veh/h)	457	794			1099	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	16	282	149	228	422
Volume Left	3	0	0	17	0
Volume Right	13	0	8	0	0
cSH	697	1700	1700	1099	1700
Volume to Capacity	0.02	0.17	0.09	0.02	0.25
Queue Length 95th (m)	0.5	0.0	0.0	0.4	0.0
Control Delay (s)	10.3	0.0	0.0	0.8	0.0
Lane LOS	B			A	
Approach Delay (s)	10.3	0.0		0.3	
Approach LOS	B				

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	41.0%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↰	↱	↰	↱		↰↱		↰↱
Traffic Volume (vph)	59	83	7	36	11	314	61	426
Future Volume (vph)	59	83	7	36	11	314	61	426
Lane Group Flow (vph)	64	98	8	90	0	357	0	612
Turn Type	pm+pt	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases	3	8		4		2		6
Permitted Phases	8		4		2		6	
Detector Phase	3	8	4	4	2	2	6	6
Switch Phase								
Minimum Initial (s)	6.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	9.0	25.0	25.0	25.0	28.0	28.0	28.0	28.0
Total Split (s)	15.0	50.0	35.0	35.0	70.0	70.0	70.0	70.0
Total Split (%)	12.5%	41.7%	29.2%	29.2%	58.3%	58.3%	58.3%	58.3%
Yellow Time (s)	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	0.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0		0.0		0.0
Total Lost Time (s)	3.0	6.0	6.0	6.0		6.0		6.0
Lead/Lag	Lead		Lag	Lag				
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	C-Min	C-Min	C-Min	C-Min
v/c Ratio	0.24	0.30	0.05	0.40		0.18		0.36
Control Delay	34.2	36.6	43.9	27.6		8.7		10.0
Queue Delay	0.0	0.0	0.0	0.0		0.0		0.0
Total Delay	34.2	36.6	43.9	27.6		8.7		10.0
Queue Length 50th (m)	11.3	17.6	1.6	8.1		16.7		31.8
Queue Length 95th (m)	21.5	31.2	6.2	23.7		25.2		46.1
Internal Link Dist (m)		74.1		142.1		146.8		29.9
Turn Bay Length (m)	23.0		18.0					
Base Capacity (vph)	281	530	277	350		1960		1713
Starvation Cap Reductn	0	0	0	0		0		0
Spillback Cap Reductn	0	0	0	0		0		0
Storage Cap Reductn	0	0	0	0		0		0
Reduced v/c Ratio	0.23	0.18	0.03	0.26		0.18		0.36

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 5 (4%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 65

Control Type: Actuated-Coordinated

Splits and Phases: 6: Main St. & Nelson St. W./Theatre Ln.

6: Main St. & Nelson St. W./Theatre Ln.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱			↰↑↱			↰↑↱	
Traffic Volume (vph)	59	83	7	7	36	47	11	314	4	61	426	76
Future Volume (vph)	59	83	7	7	36	47	11	314	4	61	426	76
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.0		6.0	6.0			6.0			6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			0.95			0.95	
Frpb, ped/bikes	1.00	1.00		1.00	0.88			1.00			0.98	
Flpb, ped/bikes	0.91	1.00		0.98	1.00			1.00			0.99	
Frt	1.00	0.99		1.00	0.92			1.00			0.98	
Flt Protected	0.95	1.00		0.95	1.00			1.00			0.99	
Satd. Flow (prot)	1417	1441		1575	1289			3132			2947	
Flt Permitted	0.59	1.00		0.69	1.00			0.93			0.86	
Satd. Flow (perm)	886	1441		1150	1289			2918			2540	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	64	90	8	8	39	51	12	341	4	66	463	83
RTOR Reduction (vph)	0	3	0	0	44	0	0	0	0	0	7	0
Lane Group Flow (vph)	64	95	0	8	46	0	0	357	0	0	605	0
Confl. Peds. (#/hr)	104		12	12		104	48		37	37		48
Heavy Vehicles (%)	3%	17%	0%	0%	14%	0%	0%	2%	0%	3%	3%	6%
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	3	8			4			2			6	
Permitted Phases	8			4			2			6		
Actuated Green, G (s)	28.0	28.0		17.1	17.1			80.0			80.0	
Effective Green, g (s)	28.0	28.0		17.1	17.1			80.0			80.0	
Actuated g/C Ratio	0.23	0.23		0.14	0.14			0.67			0.67	
Clearance Time (s)	3.0	6.0		6.0	6.0			6.0			6.0	
Vehicle Extension (s)	3.0	5.0		5.0	5.0			5.0			5.0	
Lane Grp Cap (vph)	241	336		163	183			1945			1693	
v/s Ratio Prot	0.02	c0.07			0.04							
v/s Ratio Perm	0.04			0.01				0.12			c0.24	
v/c Ratio	0.27	0.28		0.05	0.25			0.18			0.36	
Uniform Delay, d1	37.0	37.8		44.4	45.8			7.6			8.8	
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Incremental Delay, d2	0.6	1.0		0.3	1.5			0.2			0.6	
Delay (s)	37.6	38.7		44.7	47.3			7.8			9.3	
Level of Service	D	D		D	D			A			A	
Approach Delay (s)		38.3			47.1			7.8			9.3	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	15.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.35		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	67.3%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

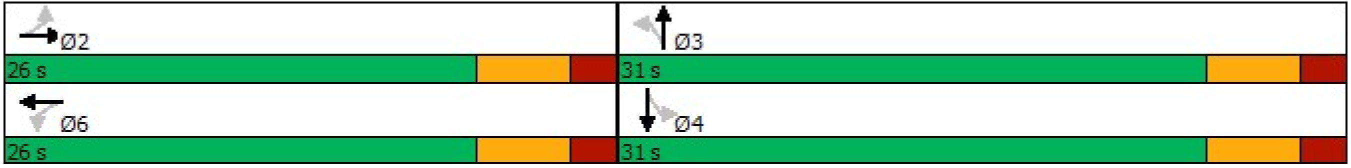
7: Theatre Ln. & Union St.

Lane Group	EBL	EBT	WBL	WBT	NBT	SBL	SBT
Lane Configurations	↰	↱	↰	↱	↱	↰	↱
Traffic Volume (vph)	11	132	16	80	1	64	8
Future Volume (vph)	11	132	16	80	1	64	8
Lane Group Flow (vph)	12	151	17	144	5	70	17
Turn Type	Perm	NA	Perm	NA	NA	Perm	NA
Protected Phases		2		6	3		4
Permitted Phases	2		6			4	
Detector Phase	2	2	6	6	3	4	4
Switch Phase							
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	26.0	26.0	26.0	26.0	25.0	25.0	25.0
Total Split (s)	26.0	26.0	26.0	26.0	31.0	31.0	31.0
Total Split (%)	45.6%	45.6%	45.6%	45.6%	54.4%	54.4%	54.4%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag							
Lead-Lag Optimize?							
Recall Mode	None	None	None	None	None	None	None
v/c Ratio	0.02	0.21	0.03	0.19	0.01	0.10	0.02
Control Delay	8.0	7.8	8.0	5.9	7.6	8.2	7.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.0	7.8	8.0	5.9	7.6	8.2	7.1
Queue Length 50th (m)	0.2	0.3	0.0	0.1	0.0	0.3	0.1
Queue Length 95th (m)	3.0	18.6	3.8	13.8	1.6	10.2	3.4
Internal Link Dist (m)		142.1		50.6	45.6		81.3
Turn Bay Length (m)	35.0		19.0			25.0	
Base Capacity (vph)	893	1169	881	1203	1198	1371	1316
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.01	0.13	0.02	0.12	0.00	0.05	0.01

Intersection Summary

Cycle Length: 57
Actuated Cycle Length: 26.6
Natural Cycle: 55
Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Theatre Ln. & Union St.



	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱		↰	↱	
Traffic Volume (vph)	11	132	7	16	80	52	0	1	4	64	8	7
Future Volume (vph)	11	132	7	16	80	52	0	1	4	64	8	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0			6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	0.99			0.97		1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00		0.98	1.00	
Frt	1.00	0.99		1.00	0.94			0.88		1.00	0.93	
Flt Protected	0.95	1.00		0.95	1.00			1.00		0.95	1.00	
Satd. Flow (prot)	1604	1467		1599	1496			1445		1580	1555	
Flt Permitted	0.67	1.00		0.66	1.00			1.00		1.00	1.00	
Satd. Flow (perm)	1123	1467		1113	1496			1445		1663	1555	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	12	143	8	17	87	57	0	1	4	70	9	8
RTOR Reduction (vph)	0	3	0	0	39	0	0	3	0	0	7	0
Lane Group Flow (vph)	12	148	0	17	105	0	0	2	0	70	10	0
Confl. Peds. (#/hr)	3		10	10		3	1		28	28		1
Confl. Bikes (#/hr)												1
Heavy Vehicles (%)	0%	15%	0%	0%	9%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			3			4	
Permitted Phases	2			6			3			4		
Actuated Green, G (s)	7.1	7.1		7.1	7.1			3.6		3.6	3.6	
Effective Green, g (s)	7.1	7.1		7.1	7.1			3.6		3.6	3.6	
Actuated g/C Ratio	0.31	0.31		0.31	0.31			0.16		0.16	0.16	
Clearance Time (s)	6.0	6.0		6.0	6.0			6.0		6.0	6.0	
Vehicle Extension (s)	5.0	5.0		5.0	5.0			5.0		5.0	5.0	
Lane Grp Cap (vph)	351	458		348	467			229		263	246	
v/s Ratio Prot		c0.10			0.07			0.00			0.01	
v/s Ratio Perm	0.01			0.02						c0.04		
v/c Ratio	0.03	0.32		0.05	0.22			0.01		0.27	0.04	
Uniform Delay, d1	5.4	6.0		5.4	5.8			8.0		8.4	8.1	
Progression Factor	1.00	1.00		1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2	0.1	0.9		0.1	0.5			0.0		1.1	0.1	
Delay (s)	5.5	6.8		5.6	6.3			8.1		9.5	8.2	
Level of Service	A	A		A	A			A		A	A	
Approach Delay (s)		6.7			6.2			8.1			9.3	
Approach LOS		A			A			A			A	

Intersection Summary			
HCM 2000 Control Delay	7.1	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.30		
Actuated Cycle Length (s)	22.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	37.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

8: Nelson St. E./Nelson St. & Union St.

Base Model (2021) - AM Peak Hour

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Volume (veh/h)	4	0	20	1	0	0	8	54	11	12	54	8
Future Volume (Veh/h)	4	0	20	1	0	0	8	54	11	12	54	8
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	4	0	22	1	0	0	9	59	12	13	59	9
Pedestrians		7			7			5			5	
Lane Width (m)		3.5			3.5			3.5			3.5	
Walking Speed (m/s)		1.1			1.1			1.1			1.1	
Percent Blockage		1			1			0			0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)								105				
pX, platoon unblocked												
vC, conflicting volume	184	192	76	206	191	77	75			78		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	184	192	76	206	191	77	75			78		
tC, single (s)	7.2	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	100	98	100	100	100	99			99		
cM capacity (veh/h)	740	687	981	716	689	979	1528			1524		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	26	1	80	81
Volume Left	4	1	9	13
Volume Right	22	0	12	9
cSH	934	716	1528	1524
Volume to Capacity	0.03	0.00	0.01	0.01
Queue Length 95th (m)	0.7	0.0	0.1	0.2
Control Delay (s)	9.0	10.0	0.9	1.2
Lane LOS	A	B	A	A
Approach Delay (s)	9.0	10.0	0.9	1.2
Approach LOS	A	B		

Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	19.7%	ICU Level of Service	A
Analysis Period (min)	15		

Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	3:30	3:30	3:30	3:30	3:30	3:30
End Time	5:00	5:00	5:00	5:00	5:00	5:00
Total Time (min)	90	90	90	90	90	90
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	1864	1728	1815	1766	1740	1780
Vehs Exited	1849	1723	1818	1765	1755	1781
Starting Vehs	21	26	30	25	36	24
Ending Vehs	36	31	27	26	21	22
Travel Distance (km)	739	709	744	717	711	724
Travel Time (hr)	29.7	27.1	28.8	28.3	27.9	28.4
Total Delay (hr)	13.1	11.2	12.0	12.1	11.8	12.0
Total Stops	2255	2145	2201	2099	2092	2162
Fuel Used (l)	87.4	81.1	85.4	83.3	81.7	83.8

Interval #0 Information Seeding

Start Time	3:30
End Time	4:00
Total Time (min)	30

Volumes adjusted by Growth Factors.

No data recorded this interval.

Interval #1 Information Recording

Start Time	4:00
End Time	5:00
Total Time (min)	60

Volumes adjusted by Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	1864	1728	1815	1766	1740	1780
Vehs Exited	1849	1723	1818	1765	1755	1781
Starting Vehs	21	26	30	25	36	24
Ending Vehs	36	31	27	26	21	22
Travel Distance (km)	739	709	744	717	711	724
Travel Time (hr)	29.7	27.1	28.8	28.3	27.9	28.4
Total Delay (hr)	13.1	11.2	12.0	12.1	11.8	12.0
Total Stops	2255	2145	2201	2099	2092	2162
Fuel Used (l)	87.4	81.1	85.4	83.3	81.7	83.8

1: Church St. & Scott St. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	0.2	0.2	0.2	0.1	0.1	0.2	0.1
Total Delay (hr)	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Total Del/Veh (s)	3.9	2.1	1.6	3.1	0.3	0.5	7.2	6.0	3.7	1.6

2: Church St. & Ken Whillians Dr. Performance by movement

Movement	EBL	EBT	WBT	WBR	SBL	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.2	4.1	0.3
Total Delay (hr)	0.0	0.4	0.2	0.0	0.1	0.0	0.8
Total Del/Veh (s)	7.4	8.5	6.0	3.2	4.9	2.6	6.4

3: Union St. & Church St. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
Total Delay (hr)	0.0	0.3	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Del/Veh (s)	5.3	7.5	3.8	6.4	8.0	5.1	4.4	4.3	2.9	4.1	4.8	3.8

3: Union St. & Church St. Performance by movement

Movement	All
Denied Delay (hr)	0.0
Denied Del/Veh (s)	0.1
Total Delay (hr)	0.7
Total Del/Veh (s)	6.5

4: Main St. & Church St. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
Denied Del/Veh (s)	3.9	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	3.6	2.1	1.6
Total Delay (hr)	0.1	0.2	0.0	0.1	0.2	0.1	0.0	1.0	0.0	0.1	1.4	0.0
Total Del/Veh (s)	13.2	8.6	5.2	17.4	11.6	7.5	18.7	9.1	4.9	9.8	9.5	5.3

4: Main St. & Church St. Performance by movement

Movement	All
Denied Delay (hr)	0.4
Denied Del/Veh (s)	1.2
Total Delay (hr)	3.3
Total Del/Veh (s)	9.4

5: Nelson St. E. & Main St. Performance by movement

Movement	WBL	WBT	WBR	NBT	NBR	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (hr)	0.0	0.0	0.0	0.1	0.0	0.0	0.6	0.8
Total Del/Veh (s)	12.3	0.1	2.4	1.1	0.7	5.5	4.0	2.8

6: Main St. & Nelson St. W./Theatre Ln. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	3.9	0.4	0.5	0.2	0.0	0.0	0.4	0.6	3.8	0.0	0.0	0.0
Total Delay (hr)	0.5	0.7	0.0	0.1	0.3	0.2	0.1	0.9	0.0	0.2	1.1	0.1
Total Del/Veh (s)	32.5	29.9	17.8	46.1	33.5	11.8	16.4	9.8	3.6	12.8	9.0	5.6

6: Main St. & Nelson St. W./Theatre Ln. Performance by movement

Movement	All
Denied Delay (hr)	0.1
Denied Del/Veh (s)	0.4
Total Delay (hr)	4.2
Total Del/Veh (s)	13.2

7: Theatre Ln. & Union St. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBR	SBL	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	3.7	0.2	0.3	0.1	0.2	0.0	0.0	0.3
Total Delay (hr)	0.0	0.3	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.0	0.9
Total Del/Veh (s)	11.5	8.8	6.3	9.4	7.1	3.2	4.2	12.4	11.1	3.9	8.3

8: Nelson St. E./Nelson St. & Union St. Performance by movement

Movement	EBL	EBR	WBL	NBL	NBT	NBR	SBL	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0		0.1	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Total Del/Veh (s)	4.9	2.3		2.1	0.6	0.4	2.3	0.8	0.7	1.1

Total Zone Performance

Denied Delay (hr)	0.6
Denied Del/Veh (s)	1.3
Total Delay (hr)	10.9
Total Del/Veh (s)	354.7

Intersection: 1: Church St. & Scott St.

Movement	EB	WB	NB
Directions Served	LTR	LTR	LTR
Maximum Queue (m)	8.7	14.3	8.5
Average Queue (m)	0.4	1.1	2.4
95th Queue (m)	3.6	6.8	7.4
Link Distance (m)	109.0	124.9	123.8
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (m)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 2: Church St. & Ken Whillians Dr.

Movement	EB	WB	WB	SB	SB
Directions Served	LT	T	R	L	R
Maximum Queue (m)	19.9	19.8	10.8	14.9	12.3
Average Queue (m)	11.0	10.4	6.4	7.5	3.6
95th Queue (m)	17.1	15.9	13.4	11.8	9.8
Link Distance (m)	163.0	109.0		116.4	
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (m)			10.0		15.0
Storage Blk Time (%)		8	2	0	0
Queuing Penalty (veh)		3	3	0	0

Intersection: 3: Union St. & Church St.

Movement	EB	EB	WB	WB	NB	SB
Directions Served	L	TR	L	TR	LTR	LTR
Maximum Queue (m)	5.5	18.7	11.8	16.6	15.5	9.3
Average Queue (m)	0.3	10.6	7.1	9.1	7.3	4.8
95th Queue (m)	3.0	16.2	13.5	13.8	14.0	12.3
Link Distance (m)		161.3		163.0	139.8	129.0
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (m)	21.0		25.0			
Storage Blk Time (%)		0		0		
Queuing Penalty (veh)		0		0		

Intersection: 4: Main St. & Church St.

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	L	TR	L	TR	LT	TR	LT	TR
Maximum Queue (m)	16.8	25.5	13.9	21.2	42.3	33.9	28.4	26.8
Average Queue (m)	4.8	8.1	3.9	9.3	19.1	14.6	20.2	18.4
95th Queue (m)	12.5	17.2	11.8	19.1	34.1	28.3	25.2	25.7
Link Distance (m)		115.2		161.3	91.1	91.1		
Upstream Blk Time (%)							0	0
Queuing Penalty (veh)							0	0
Storage Bay Dist (m)	71.0		31.0					
Storage Blk Time (%)				0				
Queuing Penalty (veh)				0				

Intersection: 5: Nelson St. E. & Main St.

Movement	WB	NB	NB	SB	SB
Directions Served	LR	T	TR	LT	T
Maximum Queue (m)	6.8	3.1	7.9	31.7	36.6
Average Queue (m)	1.5	0.1	0.3	8.6	4.3
95th Queue (m)	5.2	2.2	3.7	24.8	19.9
Link Distance (m)	168.1	26.3	26.3	91.1	91.1
Upstream Blk Time (%)			0		
Queuing Penalty (veh)			0		
Storage Bay Dist (m)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 6: Main St. & Nelson St. W./Theatre Ln.

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	L	TR	L	TR	LT	TR	LT	TR
Maximum Queue (m)	33.3	54.3	8.9	31.7	44.5	36.6	31.0	32.4
Average Queue (m)	13.0	20.8	1.4	10.3	21.6	5.9	22.2	19.9
95th Queue (m)	29.5	43.1	5.8	23.7	41.0	21.4	33.8	33.4
Link Distance (m)		88.2		132.9	156.0		26.3	26.3
Upstream Blk Time (%)		0					8	4
Queuing Penalty (veh)		0					24	13
Storage Bay Dist (m)	23.0		18.0			40.0		
Storage Blk Time (%)	2	11	0	5	1	0		
Queuing Penalty (veh)	2	6	0	0	1	0		

Intersection: 7: Theatre Ln. & Union St.

Movement	EB	EB	WB	WB	NB	SB	SB
Directions Served	L	TR	L	TR	TR	L	TR
Maximum Queue (m)	17.1	49.2	8.4	24.4	4.5	23.9	10.4
Average Queue (m)	1.6	13.2	2.5	9.5	0.5	9.3	2.6
95th Queue (m)	10.0	32.7	8.7	20.6	2.8	18.5	9.3
Link Distance (m)		132.9		64.4	56.8		86.6
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (m)	35.0		19.0			25.0	
Storage Blk Time (%)		1		1		0	
Queuing Penalty (veh)		0		0		0	

Intersection: 8: Nelson St. E./Nelson St. & Union St.

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (m)	9.9	3.6	5.4	3.5
Average Queue (m)	4.4	0.1	0.4	0.3
95th Queue (m)	11.1	1.8	3.2	2.9
Link Distance (m)	168.1	63.6	86.6	139.8
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (m)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Zone Summary

Zone wide Queuing Penalty: 54

1: Church St. & Scott St.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥				
Traffic Volume (veh/h)	59	266	17	3	469	19	33	5	2	0	0	0
Future Volume (Veh/h)	59	266	17	3	469	19	33	5	2	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	64	289	18	3	510	21	36	5	2	0	0	0
Pedestrians		3			9			17			14	
Lane Width (m)		3.5			3.5			3.5			0.0	
Walking Speed (m/s)		1.1			1.1			1.1			1.1	
Percent Blockage		0			1			2			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	545			324			972	994	324	980	992	538
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	545			324			972	994	324	980	992	538
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 %	94			100			83	98	100	100	100	100
cM capacity (veh/h)	1034			1228			216	228	705	211	228	546

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	371	534	43
Volume Left	64	3	36
Volume Right	18	21	2
cSH	1034	1228	224
Volume to Capacity	0.06	0.00	0.19
Queue Length 95th (m)	1.5	0.1	5.2
Control Delay (s)	2.0	0.1	24.8
Lane LOS	A	A	C
Approach Delay (s)	2.0	0.1	24.8
Approach LOS			C

Intersection Summary			
Average Delay	2.0		
Intersection Capacity Utilization	69.6%	ICU Level of Service	C
Analysis Period (min)	15		

	↗	→	←	↖	↘	↙
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↑	↱	↰	↱
Sign Control		Stop	Stop		Stop	
Traffic Volume (vph)	28	256	343	137	52	34
Future Volume (vph)	28	256	343	137	52	34
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	30	278	373	149	57	37

Direction, Lane #	EB 1	WB 1	WB 2	SB 1	SB 2
Volume Total (vph)	308	373	149	57	37
Volume Left (vph)	30	0	0	57	0
Volume Right (vph)	0	0	149	0	37
Hadj (s)	0.07	0.02	-0.70	0.50	-0.63
Departure Headway (s)	5.2	5.1	4.4	6.9	5.7
Degree Utilization, x	0.45	0.53	0.18	0.11	0.06
Capacity (veh/h)	667	689	796	476	561
Control Delay (s)	12.3	12.5	7.2	9.5	7.9
Approach Delay (s)	12.3	11.0		8.9	
Approach LOS	B	B		A	

Intersection Summary			
Delay	11.2		
Level of Service	B		
Intersection Capacity Utilization	54.2%	ICU Level of Service	A
Analysis Period (min)	15		

3: Union St. & Church St.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↑			✥			✥	
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	2	175	7	55	286	30	14	52	58	24	14	2
Future Volume (vph)	2	175	7	55	286	30	14	52	58	24	14	2
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	190	8	60	311	33	15	57	63	26	15	2

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total (vph)	2	198	60	344	135	43
Volume Left (vph)	2	0	60	0	15	26
Volume Right (vph)	0	8	0	33	63	2
Hadj (s)	0.50	0.00	0.50	-0.05	-0.24	0.09
Departure Headway (s)	5.9	5.4	5.7	5.2	5.2	5.7
Degree Utilization, x	0.00	0.30	0.10	0.49	0.19	0.07
Capacity (veh/h)	582	635	606	679	631	559
Control Delay (s)	7.7	9.5	8.1	11.9	9.4	9.1
Approach Delay (s)	9.5		11.3		9.4	9.1
Approach LOS	A		B		A	A

Intersection Summary			
Delay	10.4		
Level of Service	B		
Intersection Capacity Utilization	41.3%	ICU Level of Service	A
Analysis Period (min)	15		

4: Main St. & Church St.

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↰	↱	↰	↱		↰↑↱		↰↓↱
Traffic Volume (vph)	68	105	40	158	26	818	26	599
Future Volume (vph)	68	105	40	158	26	818	26	599
Lane Group Flow (vph)	74	151	43	252	0	955	0	756
Turn Type	pm+pt	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases	3	8		4		2		6
Permitted Phases	8		4		2		6	
Detector Phase	3	8	4	4	2	2	6	6
Switch Phase								
Minimum Initial (s)	5.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	10.0	28.0	28.0	28.0	30.0	30.0	30.0	30.0
Total Split (s)	10.0	40.0	30.0	30.0	80.0	80.0	80.0	80.0
Total Split (%)	8.3%	33.3%	25.0%	25.0%	66.7%	66.7%	66.7%	66.7%
Yellow Time (s)	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	0.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0		0.0		0.0
Total Lost Time (s)	3.0	6.0	6.0	6.0		6.0		6.0
Lead/Lag	Lead		Lag	Lag				
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
v/c Ratio	0.19	0.26	0.16	0.62		0.75		0.63
Control Delay	14.8	16.1	24.4	30.5		20.4		17.1
Queue Delay	0.0	0.0	0.0	0.0		0.0		0.0
Total Delay	14.8	16.1	24.4	30.5		20.4		17.1
Queue Length 50th (m)	5.5	11.6	4.4	27.3		50.6		36.3
Queue Length 95th (m)	15.3	28.2	13.5	56.9		85.6		62.9
Internal Link Dist (m)		105.2		158.0		82.5		21.1
Turn Bay Length (m)	71.0		31.0					
Base Capacity (vph)	402	896	422	642		2757		2603
Starvation Cap Reductn	0	0	0	0		0		0
Spillback Cap Reductn	0	0	0	0		0		0
Storage Cap Reductn	0	0	0	0		0		0
Reduced v/c Ratio	0.18	0.17	0.10	0.39		0.35		0.29

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 65.7

Natural Cycle: 70

Control Type: Semi Act-Uncoord

Splits and Phases: 4: Main St. & Church St.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱			↰↱			↰↱	
Traffic Volume (vph)	68	105	34	40	158	74	26	818	35	26	599	71
Future Volume (vph)	68	105	34	40	158	74	26	818	35	26	599	71
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.0		6.0	6.0			6.0			6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			0.95			0.95	
Frpb, ped/bikes	1.00	0.99		1.00	0.99			1.00			0.99	
Flpb, ped/bikes	1.00	1.00		0.97	1.00			1.00			1.00	
Frt	1.00	0.96		1.00	0.95			0.99			0.98	
Flt Protected	0.95	1.00		0.95	1.00			1.00			1.00	
Satd. Flow (prot)	1600	1592		1564	1596			3118			3029	
Flt Permitted	0.45	1.00		0.66	1.00			0.92			0.89	
Satd. Flow (perm)	750	1592		1088	1596			2858			2708	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	74	114	37	43	172	80	28	889	38	28	651	77
RTOR Reduction (vph)	0	9	0	0	13	0	0	3	0	0	11	0
Lane Group Flow (vph)	74	142	0	43	239	0	0	952	0	0	745	0
Confl. Peds. (#/hr)	17		22	22		17	40		28	28		40
Confl. Bikes (#/hr)			1			1						
Heavy Vehicles (%)	0%	0%	4%	0%	0%	0%	5%	2%	0%	0%	4%	0%
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	3	8			4			2			6	
Permitted Phases	8			4			2			6		
Actuated Green, G (s)	24.3	24.3		16.2	16.2			29.2			29.2	
Effective Green, g (s)	24.3	24.3		16.2	16.2			29.2			29.2	
Actuated g/C Ratio	0.37	0.37		0.25	0.25			0.45			0.45	
Clearance Time (s)	3.0	6.0		6.0	6.0			6.0			6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)	344	590		269	394			1274			1207	
v/s Ratio Prot	0.02	c0.09			c0.15							
v/s Ratio Perm	0.06			0.04				c0.33			0.28	
v/c Ratio	0.22	0.24		0.16	0.61			0.75			0.62	
Uniform Delay, d1	13.8	14.2		19.3	21.8			15.1			13.9	
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Incremental Delay, d2	0.3	0.2		0.3	2.6			2.4			0.9	
Delay (s)	14.1	14.4		19.6	24.5			17.5			14.8	
Level of Service	B	B		B	C			B			B	
Approach Delay (s)		14.3			23.8			17.5			14.8	
Approach LOS		B			C			B			B	

Intersection Summary

HCM 2000 Control Delay	17.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	65.5	Sum of lost time (s)	15.0
Intersection Capacity Utilization	83.0%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

5: Nelson St. E. & Main St.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					✥			↑↱			↰↑↱	
Traffic Volume (veh/h)	0	0	0	4	0	10	0	869	10	20	656	0
Future Volume (Veh/h)	0	0	0	4	0	10	0	869	10	20	656	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	0	4	0	11	0	945	11	22	713	0
Pedestrians					43			2			1	
Lane Width (m)					3.5			3.5			3.5	
Walking Speed (m/s)					1.1			1.1			1.1	
Percent Blockage					4			0			0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)								54			106	
pX, platoon unblocked	0.92	0.92	0.86	0.92	0.92	0.87	0.86			0.87		
vC, conflicting volume	1242	1756	358	1396	1750	522	713			999		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	457	1016	0	625	1010	152	330			700		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	100	99	100	98	100			97		
cM capacity (veh/h)	423	206	933	314	208	730	1063			758		

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	15	630	326	378	356
Volume Left	4	0	0	22	0
Volume Right	11	0	11	0	0
cSH	539	1700	1700	758	1700
Volume to Capacity	0.03	0.37	0.19	0.03	0.21
Queue Length 95th (m)	0.7	0.0	0.0	0.7	0.0
Control Delay (s)	11.9	0.0	0.0	0.9	0.0
Lane LOS	B			A	
Approach Delay (s)	11.9	0.0		0.5	
Approach LOS	B				

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	46.5%	ICU Level of Service	A
Analysis Period (min)	15		

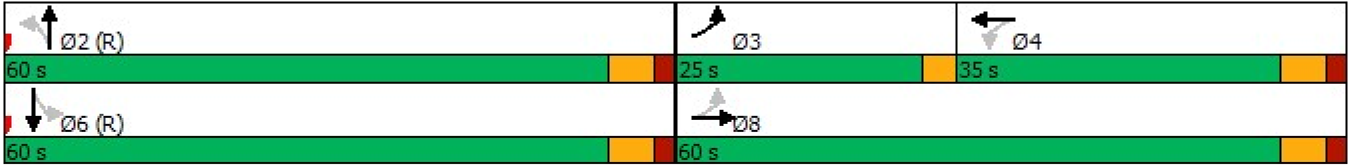
Queues
6: Main St. & Nelson St. W./Theatre Ln.

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↰	↱	↰	↱		↰↑↱		↰↑↱
Traffic Volume (vph)	146	94	25	140	14	626	47	512
Future Volume (vph)	146	94	25	140	14	626	47	512
Lane Group Flow (vph)	159	116	27	268	0	700	0	733
Turn Type	pm+pt	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases	3	8		4		2		6
Permitted Phases	8		4		2		6	
Detector Phase	3	8	4	4	2	2	6	6
Switch Phase								
Minimum Initial (s)	6.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	9.0	25.0	25.0	25.0	28.0	28.0	28.0	28.0
Total Split (s)	25.0	60.0	35.0	35.0	60.0	60.0	60.0	60.0
Total Split (%)	20.8%	50.0%	29.2%	29.2%	50.0%	50.0%	50.0%	50.0%
Yellow Time (s)	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	0.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0		0.0		0.0
Total Lost Time (s)	3.0	6.0	6.0	6.0		6.0		6.0
Lead/Lag	Lead		Lag	Lag				
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	C-Min	C-Min	C-Min	C-Min
v/c Ratio	0.49	0.22	0.10	0.79		0.45		0.56
Control Delay	28.0	23.0	33.8	54.0		20.4		22.0
Queue Delay	0.0	0.0	0.0	0.0		0.0		0.0
Total Delay	28.0	23.0	33.8	54.0		20.4		22.0
Queue Length 50th (m)	24.4	17.0	5.0	52.7		52.8		57.5
Queue Length 95th (m)	34.6	26.5	11.8	78.8		80.3		89.4
Internal Link Dist (m)		74.1		142.1		146.8		29.9
Turn Bay Length (m)	23.0		18.0					
Base Capacity (vph)	398	651	290	369		1547		1320
Starvation Cap Reductn	0	0	0	0		0		0
Spillback Cap Reductn	0	0	0	0		0		0
Storage Cap Reductn	0	0	0	0		0		0
Reduced v/c Ratio	0.40	0.18	0.09	0.73		0.45		0.56

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 5 (4%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 65
Control Type: Actuated-Coordinated

Splits and Phases: 6: Main St. & Nelson St. W./Theatre Ln.



6: Main St. & Nelson St. W./Theatre Ln.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱			↰↑↱			↰↑↱	
Traffic Volume (vph)	146	94	13	25	140	107	14	626	5	47	512	115
Future Volume (vph)	146	94	13	25	140	107	14	626	5	47	512	115
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.0		6.0	6.0			6.0			6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			0.95			0.95	
Frpb, ped/bikes	1.00	0.99		1.00	0.91			1.00			0.97	
Flpb, ped/bikes	0.97	1.00		0.97	1.00			1.00			1.00	
Frt	1.00	0.98		1.00	0.94			1.00			0.97	
Flt Protected	0.95	1.00		0.95	1.00			1.00			1.00	
Satd. Flow (prot)	1516	1435		1555	1335			3140			2932	
Flt Permitted	0.35	1.00		0.68	1.00			0.93			0.84	
Satd. Flow (perm)	558	1435		1117	1335			2928			2477	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	159	102	14	27	152	116	15	680	5	51	557	125
RTOR Reduction (vph)	0	4	0	0	23	0	0	0	0	0	12	0
Lane Group Flow (vph)	159	112	0	27	245	0	0	700	0	0	721	0
Confl. Peds. (#/hr)	104		12	12		104	48		37	37		48
Heavy Vehicles (%)	3%	17%	0%	0%	14%	0%	0%	2%	0%	3%	3%	6%
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	3	8			4			2			6	
Permitted Phases	8			4			2			6		
Actuated Green, G (s)	44.8	44.8		28.6	28.6			63.2			63.2	
Effective Green, g (s)	44.8	44.8		28.6	28.6			63.2			63.2	
Actuated g/C Ratio	0.37	0.37		0.24	0.24			0.53			0.53	
Clearance Time (s)	3.0	6.0		6.0	6.0			6.0			6.0	
Vehicle Extension (s)	3.0	5.0		5.0	5.0			5.0			5.0	
Lane Grp Cap (vph)	313	535		266	318			1542			1304	
v/s Ratio Prot	c0.06	0.08			c0.18							
v/s Ratio Perm	0.13			0.02				0.24			c0.29	
v/c Ratio	0.51	0.21		0.10	0.77			0.45			0.55	
Uniform Delay, d1	27.2	25.6		35.7	42.6			17.7			19.0	
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Incremental Delay, d2	1.3	0.4		0.4	12.7			1.0			1.7	
Delay (s)	28.5	26.0		36.0	55.4			18.6			20.7	
Level of Service	C	C		D	E			B			C	
Approach Delay (s)		27.4			53.6			18.6			20.7	
Approach LOS		C			D			B			C	

Intersection Summary			
HCM 2000 Control Delay	25.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	87.3%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

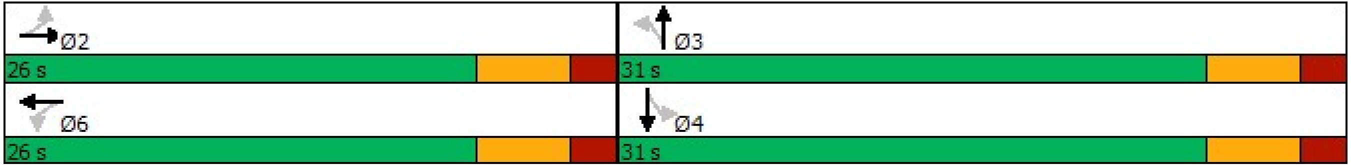
7: Theatre Ln. & Union St.

	↗	→	↙	←	↖	↑	↘	↓
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↰	↱	↰	↱	↰	↱	↰	↱
Traffic Volume (vph)	24	115	5	247	2	13	78	1
Future Volume (vph)	24	115	5	247	2	13	78	1
Lane Group Flow (vph)	26	126	5	361	2	27	85	27
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		2		6		3		4
Permitted Phases	2		6		3		4	
Detector Phase	2	2	6	6	3	3	4	4
Switch Phase								
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	26.0	26.0	26.0	26.0	25.0	25.0	25.0	25.0
Total Split (s)	26.0	26.0	26.0	26.0	31.0	31.0	31.0	31.0
Total Split (%)	45.6%	45.6%	45.6%	45.6%	54.4%	54.4%	54.4%	54.4%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	None	None	None	None
v/c Ratio	0.06	0.17	0.01	0.43	0.00	0.04	0.16	0.04
Control Delay	8.8	8.6	8.4	9.8	11.5	8.9	11.3	5.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.8	8.6	8.4	9.8	11.5	8.9	11.3	5.6
Queue Length 50th (m)	0.9	4.7	0.2	14.2	0.1	0.7	4.0	0.1
Queue Length 95th (m)	5.0	16.1	1.8	43.6	1.1	4.4	12.5	3.6
Internal Link Dist (m)		142.1		50.6		45.6		81.3
Turn Bay Length (m)	35.0		19.0		12.0		25.0	
Base Capacity (vph)	629	1004	771	1044	942	1151	905	1073
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.04	0.13	0.01	0.35	0.00	0.02	0.09	0.03

Intersection Summary

Cycle Length: 57
Actuated Cycle Length: 31.2
Natural Cycle: 55
Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Theatre Ln. & Union St.



7: Theatre Ln. & Union St.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱		↰	↱	
Traffic Volume (vph)	24	115	1	5	247	86	2	13	12	78	1	24
Future Volume (vph)	24	115	1	5	247	86	2	13	12	78	1	24
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	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	0.99		1.00	0.98		1.00	0.98	
Flpb, ped/bikes	1.00	1.00		0.99	1.00		1.00	1.00		0.98	1.00	
Frt	1.00	1.00		1.00	0.96		1.00	0.93		1.00	0.86	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1605	1470		1598	1515		1605	1540		1577	1416	
Flt Permitted	0.55	1.00		0.68	1.00		0.74	1.00		0.74	1.00	
Satd. Flow (perm)	922	1470		1137	1515		1250	1540		1228	1416	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	26	125	1	5	268	93	2	14	13	85	1	26
RTOR Reduction (vph)	0	1	0	0	24	0	0	10	0	0	20	0
Lane Group Flow (vph)	26	125	0	5	337	0	2	17	0	85	7	0
Confl. Peds. (#/hr)	3		10	10		3	1		28	28		1
Confl. Bikes (#/hr)												1
Heavy Vehicles (%)	0%	15%	0%	0%	9%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			3			4	
Permitted Phases	2			6			3			4		
Actuated Green, G (s)	7.7	7.7		7.7	7.7		5.8	5.8		5.8	5.8	
Effective Green, g (s)	7.7	7.7		7.7	7.7		5.8	5.8		5.8	5.8	
Actuated g/C Ratio	0.30	0.30		0.30	0.30		0.23	0.23		0.23	0.23	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Grp Cap (vph)	278	443		343	457		284	350		279	322	
v/s Ratio Prot		0.09			c0.22			0.01			0.00	
v/s Ratio Perm	0.03			0.00			0.00			c0.07		
v/c Ratio	0.09	0.28		0.01	0.74		0.01	0.05		0.30	0.02	
Uniform Delay, d1	6.4	6.8		6.2	8.0		7.6	7.7		8.2	7.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.3	0.7		0.0	7.4		0.0	0.1		1.3	0.1	
Delay (s)	6.7	7.5		6.3	15.4		7.6	7.8		9.5	7.7	
Level of Service	A	A		A	B		A	A		A	A	
Approach Delay (s)		7.4			15.3			7.8			9.0	
Approach LOS		A			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	12.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	25.5	Sum of lost time (s)	12.0
Intersection Capacity Utilization	44.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
8: Nelson St. E./Nelson St. & Union St.

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Volume (veh/h)	14	2	16	1	0	1	7	108	4	5	77	6
Future Volume (Veh/h)	14	2	16	1	0	1	7	108	4	5	77	6
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	15	2	17	1	0	1	8	117	4	5	84	7
Pedestrians		7			7			5			5	
Lane Width (m)		3.5			3.5			3.5			3.5	
Walking Speed (m/s)		1.1			1.1			1.1			1.1	
Percent Blockage		1			1			0			0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)								105				
pX, platoon unblocked												
vC, conflicting volume	246	248	100	262	250	131	98			128		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	246	248	100	262	250	131	98			128		
tC, single (s)	7.2	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	98	100	98	100	100	100	99			100		
cM capacity (veh/h)	677	644	951	662	643	914	1498			1461		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	34	2	129	96
Volume Left	15	1	8	5
Volume Right	17	1	4	7
cSH	788	768	1498	1461
Volume to Capacity	0.04	0.00	0.01	0.00
Queue Length 95th (m)	1.0	0.1	0.1	0.1
Control Delay (s)	9.8	9.7	0.5	0.4
Lane LOS	A	A	A	A
Approach Delay (s)	9.8	9.7	0.5	0.4
Approach LOS	A	A		

Intersection Summary			
Average Delay	1.7		
Intersection Capacity Utilization	21.5%	ICU Level of Service	A
Analysis Period (min)	15		

Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	3:30	3:30	3:30	3:30	3:30	3:30
End Time	5:00	5:00	5:00	5:00	5:00	5:00
Total Time (min)	90	90	90	90	90	90
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	2829	2826	2870	2916	2853	2858
Vehs Exited	2843	2846	2842	2941	2848	2863
Starting Vehs	70	97	72	70	78	73
Ending Vehs	56	77	100	45	83	71
Travel Distance (km)	1206	1218	1205	1233	1234	1219
Travel Time (hr)	145.0	136.3	98.7	182.8	208.4	154.2
Total Delay (hr)	117.7	108.8	71.4	155.1	180.6	126.7
Total Stops	5587	5014	4894	5048	5589	5227
Fuel Used (l)	222.4	216.6	183.8	257.7	279.1	231.9

Interval #0 Information Seeding

Start Time	3:30
End Time	4:00
Total Time (min)	30

Volumes adjusted by Growth Factors.

No data recorded this interval.

Interval #1 Information Recording

Start Time	4:00
End Time	5:00
Total Time (min)	60

Volumes adjusted by Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	2829	2826	2870	2916	2853	2858
Vehs Exited	2843	2846	2842	2941	2848	2863
Starting Vehs	70	97	72	70	78	73
Ending Vehs	56	77	100	45	83	71
Travel Distance (km)	1206	1218	1205	1233	1234	1219
Travel Time (hr)	145.0	136.3	98.7	182.8	208.4	154.2
Total Delay (hr)	117.7	108.8	71.4	155.1	180.6	126.7
Total Stops	5587	5014	4894	5048	5589	5227
Fuel Used (l)	222.4	216.6	183.8	257.7	279.1	231.9

1: Church St. & Scott St. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1
Denied Del/Veh (s)	0.0	0.0	0.0	0.3	0.5	0.5	0.1	0.2	0.1	0.3
Total Delay (hr)	0.1	0.2	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.6
Total Del/Veh (s)	6.7	3.2	2.7	3.6	0.8	0.5	10.7	10.2	4.8	2.4

2: Church St. & Ken Whillians Dr. Performance by movement

Movement	EBL	EBT	WBT	WBR	SBL	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.2	4.0	0.2
Total Delay (hr)	0.1	0.6	0.8	0.2	0.1	0.0	1.8
Total Del/Veh (s)	8.2	9.1	8.1	5.4	5.2	3.0	7.6

3: Union St. & Church St. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
Total Delay (hr)	0.0	0.4	0.0	0.1	0.8	0.1	0.0	0.1	0.1	0.0	0.0	0.0
Total Del/Veh (s)	7.9	8.5	4.7	7.5	9.3	6.4	5.3	5.6	3.7	4.9	5.3	3.8

3: Union St. & Church St. Performance by movement

Movement	All
Denied Delay (hr)	0.0
Denied Del/Veh (s)	0.0
Total Delay (hr)	1.5
Total Del/Veh (s)	7.8

4: Main St. & Church St. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	64.1	7.8
Denied Del/Veh (s)	3.8	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	340.1	367.0	369.1
Total Delay (hr)	0.2	0.3	0.1	0.2	0.7	0.2	0.8	11.6	0.3	0.2	3.8	0.3
Total Del/Veh (s)	11.8	10.1	7.9	17.2	13.4	12.6	135.1	50.9	36.4	34.6	25.7	13.8

4: Main St. & Church St. Performance by movement

Movement	All
Denied Delay (hr)	74.5
Denied Del/Veh (s)	128.4
Total Delay (hr)	18.8
Total Del/Veh (s)	33.7

5: Nelson St. E. & Main St. Performance by movement

Movement	WBL	WBR	NBT	NBR	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Total Delay (hr)	0.1	0.1	1.6	0.0	0.1	2.9	4.8
Total Del/Veh (s)	63.2	20.7	6.9	2.7	24.6	17.4	11.6

6: Main St. & Nelson St. W./Theatre Ln. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.1	0.0	0.0	0.0	0.0	0.0	0.1	3.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	3.7	0.7	0.6	0.0	0.0	0.0	28.0	17.7	22.0	2.5	0.4	0.2
Total Delay (hr)	1.2	0.7	0.1	0.3	1.9	1.1	0.2	8.1	0.1	0.6	3.7	0.5
Total Del/Veh (s)	29.8	25.9	14.2	43.2	45.3	36.5	64.8	46.8	30.5	42.7	28.5	17.5

6: Main St. & Nelson St. W./Theatre Ln. Performance by movement

Movement	All
Denied Delay (hr)	3.4
Denied Del/Veh (s)	6.9
Total Delay (hr)	18.3
Total Del/Veh (s)	36.8

7: Theatre Ln. & Union St. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	3.4	0.4	0.4	3.8	0.1	0.1	0.3	0.0	0.0
Total Delay (hr)	0.1	0.3	0.0	0.0	0.6	0.1	0.0	0.1	0.0	0.3	0.0	0.0
Total Del/Veh (s)	15.3	8.2	3.7	10.8	8.8	5.0	12.4	15.1	4.7	16.3	1.0	4.5

7: Theatre Ln. & Union St. Performance by movement

Movement	All
Denied Delay (hr)	0.1
Denied Del/Veh (s)	0.3
Total Delay (hr)	1.6
Total Del/Veh (s)	9.2

8: Nelson St. E./Nelson St. & Union St. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBR	NBL	NBT	NBR	SBL	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0		0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Total Del/Veh (s)	5.7	5.5	2.8		2.7	2.3	0.8	0.8	2.2	0.8	0.5	1.3

Total Zone Performance

Denied Delay (hr)	78.0
Denied Del/Veh (s)	94.7
Total Delay (hr)	47.5
Total Del/Veh (s)	1204.5

Intersection: 1: Church St. & Scott St.

Movement	EB	WB	NB
Directions Served	LTR	LTR	LTR
Maximum Queue (m)	23.9	18.6	12.9
Average Queue (m)	6.6	1.5	4.8
95th Queue (m)	17.3	9.0	10.4
Link Distance (m)	109.0	124.9	123.8
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (m)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 2: Church St. & Ken Whillians Dr.

Movement	EB	WB	WB	SB	SB
Directions Served	LT	T	R	L	R
Maximum Queue (m)	25.7	38.4	24.6	13.9	13.6
Average Queue (m)	14.0	16.8	12.9	6.1	4.3
95th Queue (m)	22.5	28.1	21.8	11.6	10.2
Link Distance (m)	163.0	109.0		116.4	
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (m)			10.0		15.0
Storage Blk Time (%)		25	9	0	0
Queuing Penalty (veh)		34	32	0	0

Intersection: 3: Union St. & Church St.

Movement	EB	EB	WB	WB	NB	SB
Directions Served	L	TR	L	TR	LTR	LTR
Maximum Queue (m)	5.4	25.2	11.9	20.4	19.5	10.6
Average Queue (m)	0.3	12.9	7.7	11.6	10.7	6.6
95th Queue (m)	2.9	21.1	13.5	17.4	16.2	13.5
Link Distance (m)		161.3		163.0	139.8	129.0
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (m)	21.0		25.0			
Storage Blk Time (%)		1		0		
Queuing Penalty (veh)		0		0		

Intersection: 4: Main St. & Church St.

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	L	TR	L	TR	LT	TR	LT	TR
Maximum Queue (m)	20.6	26.0	17.1	38.2	97.6	99.4	32.4	32.0
Average Queue (m)	8.4	11.0	7.4	19.8	73.5	73.0	22.3	22.0
95th Queue (m)	16.9	21.7	16.1	32.7	111.9	111.8	27.9	27.6
Link Distance (m)		115.2		161.3	87.5	87.5		
Upstream Blk Time (%)					18	18	1	2
Queuing Penalty (veh)					77	78	0	0
Storage Bay Dist (m)	71.0		31.0					
Storage Blk Time (%)				1				
Queuing Penalty (veh)				0				

Intersection: 5: Nelson St. E. & Main St.

Movement	WB	NB	NB	SB	SB
Directions Served	LTR	T	TR	LT	TR
Maximum Queue (m)	11.9	34.2	35.7	92.1	27.6
Average Queue (m)	1.8	12.6	12.2	44.2	17.0
95th Queue (m)	6.5	35.9	35.7	92.6	37.6
Link Distance (m)	169.1	27.0	27.0	87.5	
Upstream Blk Time (%)		7	8	2	
Queuing Penalty (veh)		30	36	11	
Storage Bay Dist (m)					20.0
Storage Blk Time (%)				23	4
Queuing Penalty (veh)				76	14

Intersection: 6: Main St. & Nelson St. W./Theatre Ln.

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	L	TR	L	TR	LT	TR	LT	TR
Maximum Queue (m)	37.8	73.2	48.8	100.2	158.8	47.6	37.5	45.1
Average Queue (m)	22.9	24.9	9.2	45.8	92.5	40.6	33.0	34.0
95th Queue (m)	40.3	54.1	34.3	80.6	161.5	64.5	39.9	45.6
Link Distance (m)		89.8		132.9	155.8		27.0	27.0
Upstream Blk Time (%)					9		43	31
Queuing Penalty (veh)					0		143	104
Storage Bay Dist (m)	23.0		18.0			40.0		
Storage Blk Time (%)	10	8	1	42	39	13		
Queuing Penalty (veh)	10	12	2	11	123	41		

Intersection: 7: Theatre Ln. & Union St.

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	L	TR	L	TR	L	TR	L	TR
Maximum Queue (m)	21.0	49.6	14.1	59.5	4.8	10.1	21.6	14.3
Average Queue (m)	3.4	12.1	1.0	22.9	0.3	2.7	10.5	4.3
95th Queue (m)	12.8	31.2	7.3	44.5	2.4	7.5	19.4	12.2
Link Distance (m)		132.9		64.4		56.8		86.6
Upstream Blk Time (%)				0				
Queuing Penalty (veh)				0				
Storage Bay Dist (m)	35.0		19.0		12.0		25.0	
Storage Blk Time (%)		0		8		0	0	
Queuing Penalty (veh)		0		0		0	0	

Intersection: 8: Nelson St. E./Nelson St. & Union St.

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (m)	16.7	7.1	3.6	5.3
Average Queue (m)	5.6	0.4	0.2	0.2
95th Queue (m)	13.2	3.2	2.2	2.2
Link Distance (m)	169.1	63.6	86.6	139.8
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (m)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Zone Summary

Zone wide Queuing Penalty: 835

APPENDIX D

EXISTING (2021) MMLOS CALCULATION SHEETS

Multi-Modal Level of Service - Segments Form

Consultant	**Parsons Inc.**	**Project**	**477728**
Scenario	**Church Street - Existing 2021 Conditions**	**Date**	
Comments	**Main Street to Scott Street**		
	Eastbound		

SEGMENTS			Main	Union	Ken Whillans				Section	Section	Section	Section
			Union	Ken Whillans	Scott				7	8	9	10
Pedestrian	Sidewalk Width Boulevard Width	**E**	1.5 m < 0.5 m	1.5 m < 0.5 m	1.5 m 0.5 - 2 m							
	Avg Daily Curb Lane Traffic Volume		≤ 3000	≤ 3000	≤ 3000							
	Operating Speed On-Street Parking		> 30 to 50 km/h no	> 30 to 50 km/h no	> 30 to 50 km/h no							
	Exposure to Traffic PLoS		**E**	**E**	**C**	-	-	-	-	-	-	-
	Effective Sidewalk Width		1.5 m	1.5 m	1.5 m							
	Pedestrian Volume		250 ped/hr	250 ped/hr	250 ped/hr							
	Crowding PLoS		**B**	**B**	**B**	-	-	-	-	-	-	-
	Level of Service		**E**	**E**	**C**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Bicycle	Type of Cycling Facility	**D**	Mixed Traffic	Mixed Traffic	Mixed Traffic							
	Number of Travel Lanes		2-3 lanes total	2-3 lanes total	2-3 lanes total							
	Operating Speed		>40 to <50 km/h	>40 to <50 km/h	>40 to <50 km/h							
	# of Lanes & Operating Speed LoS		**D**	**D**	**D**	-	-	-	-	-	-	-
	Bike Lane (+ Parking Lane) Width											
	Bike Lane Width LoS		-	-	-	-	-	-	-	-	-	-
	Bike Lane Blockages											
	Blockage LoS		-	-	-	-	-	-	-	-	-	-
	Median Refuge Width (no median = < 1.8 m)		< 1.8 m refuge	< 1.8 m refuge	< 1.8 m refuge							
	No. of Lanes at Unsignalized Crossing		≤ 3 lanes	≤ 3 lanes	≤ 3 lanes							
	Sidestreet Operating Speed		≤ 40 km/h	≤ 40 km/h	≤ 40 km/h							
	Unsignalized Crossing - Lowest LoS		**A**	**A**	**A**	-	-	-	-	-	-	-
	Level of Service		**D**	**D**	**D**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Transit	Facility Type	**-**										
	Friction or Ratio Transit:Posted Speed											
	Level of Service		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Truck	Truck Lane Width	**-**										
	Travel Lanes per Direction											
	Level of Service		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Multi-Modal Level of Service - Segments Form

Consultant	**Parsons Inc.**	**Project**	**477728**
Scenario	**Church Street - Existing 2021 Conditions**	**Date**	
Comments	**Main Street to Scott Street**		
	Westtbound		

SEGMENTS			Main	Union	Ken Whillans				Section	Section	Section	Section
			Union	Ken Whillans	Scott				7	8	9	10
Pedestrian	Sidewalk Width Boulevard Width	**E**	1.5 m < 0.5 m	1.5 m 0.5 - 2 m	1.5 m < 0.5 m							
	Avg Daily Curb Lane Traffic Volume		≤ 3000	≤ 3000	≤ 3000							
	Operating Speed On-Street Parking		> 30 to 50 km/h no	> 30 to 50 km/h no	> 30 to 50 km/h no							
	Exposure to Traffic PLoS		**E**	**C**	**E**	-	-	-	-	-	-	-
	Effective Sidewalk Width		1.5 m	1.5 m	1.5 m							
	Pedestrian Volume		250 ped/hr	250 ped/hr	250 ped/hr							
	Crowding PLoS		**B**	**B**	**B**	-	-	-	-	-	-	-
	Level of Service		**E**	**C**	**E**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Bicycle	Type of Cycling Facility	**D**	Mixed Traffic	Mixed Traffic	Mixed Traffic							
	Number of Travel Lanes		2-3 lanes total	2-3 lanes total	2-3 lanes total							
	Operating Speed		>40 to <50 km/h	>40 to <50 km/h	>40 to <50 km/h							
	# of Lanes & Operating Speed LoS		**D**	**D**	**D**	-	-	-	-	-	-	-
	Bike Lane (+ Parking Lane) Width											
	Bike Lane Width LoS		-	-	-	-	-	-	-	-	-	-
	Bike Lane Blockages											
	Blockage LoS		-	-	-	-	-	-	-	-	-	-
	Median Refuge Width (no median = < 1.8 m)		< 1.8 m refuge	< 1.8 m refuge	< 1.8 m refuge							
	No. of Lanes at Unsignalized Crossing		≤ 3 lanes	≤ 3 lanes	≤ 3 lanes							
	Sidestreet Operating Speed		≤ 40 km/h	≤ 40 km/h	≤ 40 km/h							
	Unsignalized Crossing - Lowest LoS		**A**	**A**	**A**	-	-	-	-	-	-	-
	Level of Service		**D**	**D**	**D**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Transit	Facility Type	**-**										
	Friction or Ratio Transit:Posted Speed											
	Level of Service		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Truck	Truck Lane Width	**-**										
	Travel Lanes per Direction											
	Level of Service		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Multi-Modal Level of Service - Segments Form

Consultant	**Parsons Inc.**	**Project**	**477728**
Scenario	**Nelson Street - Existing 2021 Conditions**	**Date**	
Comments	**Main Street to Union Street**		
	Eastbound		

SEGMENTS			Main Union							
Pedestrian	Sidewalk Width Boulevard Width	**E**	1.5 m < 0.5 m							
	Avg Daily Curb Lane Traffic Volume		≤ 3000							
	Operating Speed On-Street Parking		> 30 to 50 km/h no							
	Exposure to Traffic PLoS		**E**	-	-	-	-	-	-	-
	Effective Sidewalk Width		1.5 m							
	Pedestrian Volume		250 ped/hr							
	Crowding PLoS		**B**	-	-	-	-	-	-	-
	Level of Service		**E**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Bicycle	Type of Cycling Facility	**D**	Mixed Traffic							
	Number of Travel Lanes		2-3 lanes total							
	Operating Speed		>40 to <50 km/h							
	# of Lanes & Operating Speed LoS		**D**	-	-	-	-	-	-	-
	Bike Lane (+ Parking Lane) Width									
	Bike Lane Width LoS		-	-	-	-	-	-	-	-
	Bike Lane Blockages									
	Blockage LoS		-	-	-	-	-	-	-	-
	Median Refuge Width (no median = < 1.8 m)		< 1.8 m refuge							
	No. of Lanes at Unsignalized Crossing		≤ 3 lanes							
	Sidestreet Operating Speed		≤ 40 km/h							
	Unsignalized Crossing - Lowest LoS		**A**	-	-	-	-	-	-	-
	Level of Service		**D**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Transit	Facility Type	**-**								
	Friction or Ratio Transit:Posted Speed									
	Level of Service		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Truck	Truck Lane Width	**-**								
	Travel Lanes per Direction									
	Level of Service		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Multi-Modal Level of Service - Segments Form

Consultant	**Parsons Inc.**	**Project**	**477728**
Scenario	**Nelson Street - Existing 2021 Conditions**	**Date**	
Comments	**Main Street to Union Street**		
	Westtbound		

SEGMENTS			Union Main	Union Main						
Pedestrian	Sidewalk Width Boulevard Width	**F**	no sidewalk n/a							
	Avg Daily Curb Lane Traffic Volume		≤ 3000							
	Operating Speed On-Street Parking		> 30 to 50 km/h no							
	Exposure to Traffic PLoS		**F**	-	-	-	-	-	-	-
	Effective Sidewalk Width		1.5 m							
	Pedestrian Volume		250 ped/hr							
	Crowding PLoS		**B**	-	-	-	-	-	-	-
	Level of Service		**F**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Bicycle	Type of Cycling Facility	**D**	Mixed Traffic							
	Number of Travel Lanes		2-3 lanes total							
	Operating Speed		>40 to <50 km/h							
	# of Lanes & Operating Speed LoS		**D**	-	-	-	-	-	-	-
	Bike Lane (+ Parking Lane) Width									
	Bike Lane Width LoS		-	-	-	-	-	-	-	-
	Bike Lane Blockages									
	Blockage LoS		-	-	-	-	-	-	-	-
	Median Refuge Width (no median = < 1.8 m)		< 1.8 m refuge							
	No. of Lanes at Unsignalized Crossing		≤ 3 lanes							
	Sidestreet Operating Speed		≤ 40 km/h							
	Unsignalized Crossing - Lowest LoS		**A**	-	-	-	-	-	-	-
	Level of Service		**D**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Transit	Facility Type	**-**								
	Friction or Ratio Transit:Posted Speed									
	Level of Service		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Truck	Truck Lane Width	**-**								
	Travel Lanes per Direction									
	Level of Service		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Multi-Modal Level of Service - Segments Form

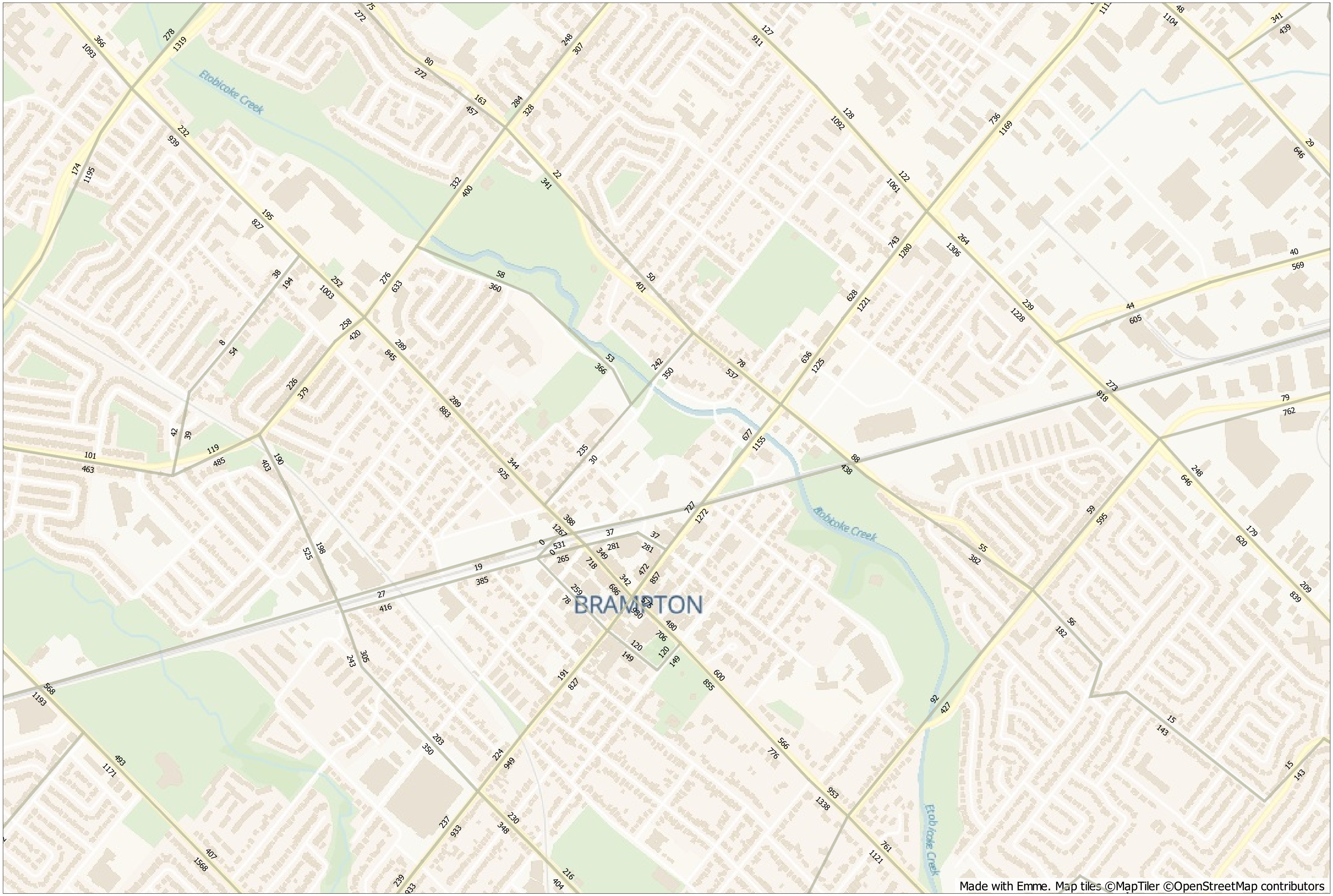
Consultant Parsons Inc.
Scenario Church Street - Existing 2021 Conditions
Comments Theatre Lane to Union Street
Nortbound/Southbound
Project 477728
Date

SEGMENTS			Theatre Ln	Nelson					Section	Section	Section	Section
			Nelson	Church					7	8	9	10
Pedestrian	Sidewalk Width Boulevard Width	**E**	1.5 m < 0.5 m	1.5 m < 0.5 m								
	Avg Daily Curb Lane Traffic Volume		≤ 3000	≤ 3000								
	Operating Speed On-Street Parking		> 30 to 50 km/h no	> 30 to 50 km/h no								
	Exposure to Traffic PLoS		E	E	-	-	-	-	-	-	-	-
	Effective Sidewalk Width		1.5 m	1.5 m								
	Pedestrian Volume		250 ped/hr	250 ped/hr								
	Crowding PLoS		B	B	-	-	-	-	-	-	-	-
	Level of Service		**E**	**E**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Bicycle	Type of Cycling Facility	**D**	Mixed Traffic	Mixed Traffic								
	Number of Travel Lanes		2-3 lanes total	2-3 lanes total								
	Operating Speed		>40 to <50 km/h	>40 to <50 km/h								
	# of Lanes & Operating Speed LoS		D	D	-	-	-	-	-	-	-	-
	Bike Lane (+ Parking Lane) Width											
	Bike Lane Width LoS		-	-	-	-	-	-	-	-	-	-
	Bike Lane Blockages											
	Blockage LoS		-	-	-	-	-	-	-	-	-	-
	Median Refuge Width (no median = < 1.8 m)		< 1.8 m refuge	< 1.8 m refuge								
	No. of Lanes at Unsignalized Crossing		≤ 3 lanes	≤ 3 lanes								
	Sidestreet Operating Speed		≤ 40 km/h	≤ 40 km/h								
	Unsignalized Crossing - Lowest LoS		A	A	-	-	-	-	-	-	-	-
	Level of Service		**D**	**D**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Transit	Facility Type	**-**										
	Friction or Ratio Transit:Posted Speed											
	Level of Service		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Truck	Truck Lane Width	**-**										
	Travel Lanes per Direction											
	Level of Service		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

APPENDIX E

CITY’S EMME MODEL TRAFFIC ASSIGNMENT PLOTS

2011_Peak Hour_Auto Volume



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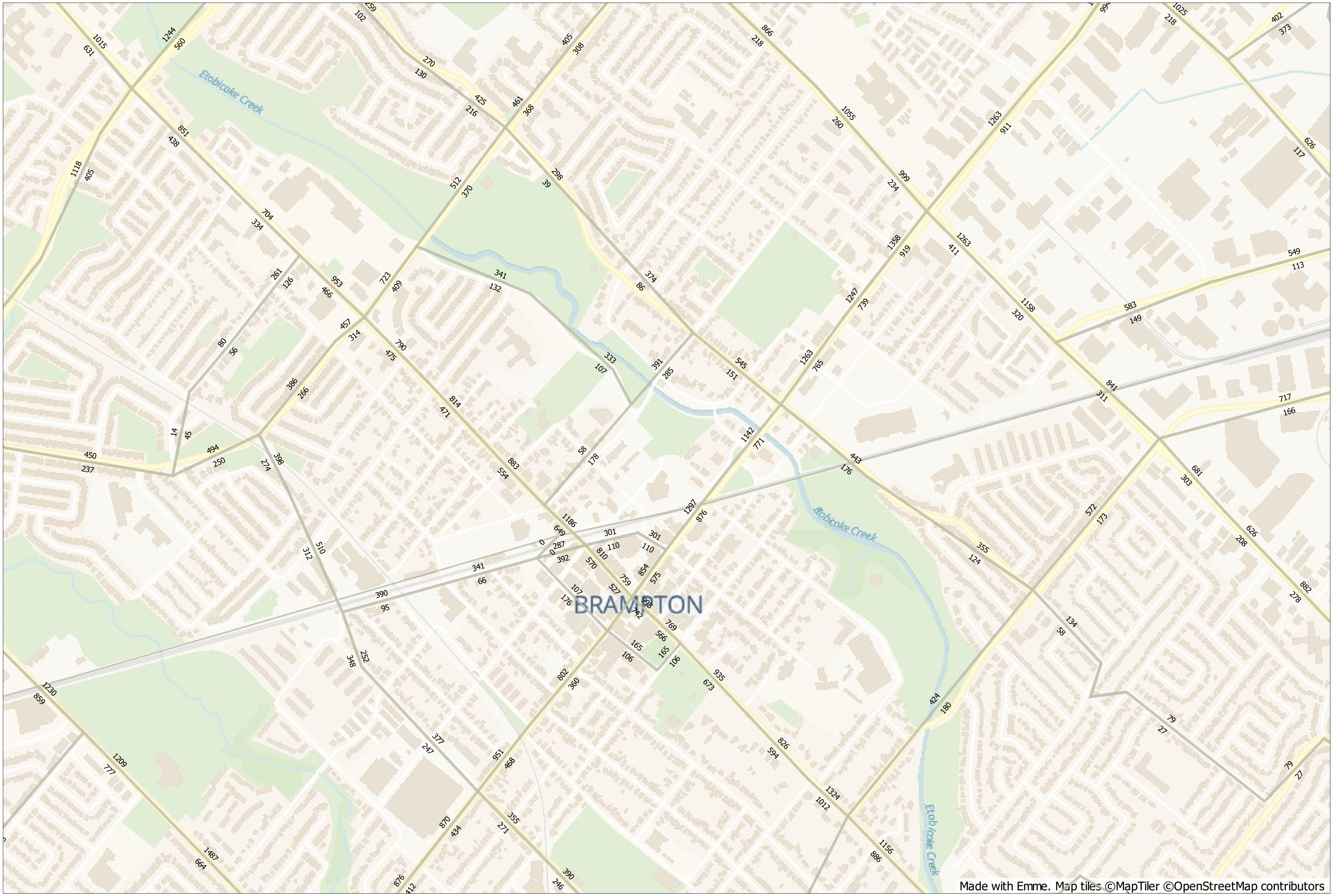
2011 (G:/TranModel/2011_Base/Database/emmebank)
Scenario 311: copy of scenario 211_AM_Ken whillans with Church Revised
2021-04-23 16:35 (lwu@COB10W-MJ03YM3B)

2011_Peak Hour_Auto Volume



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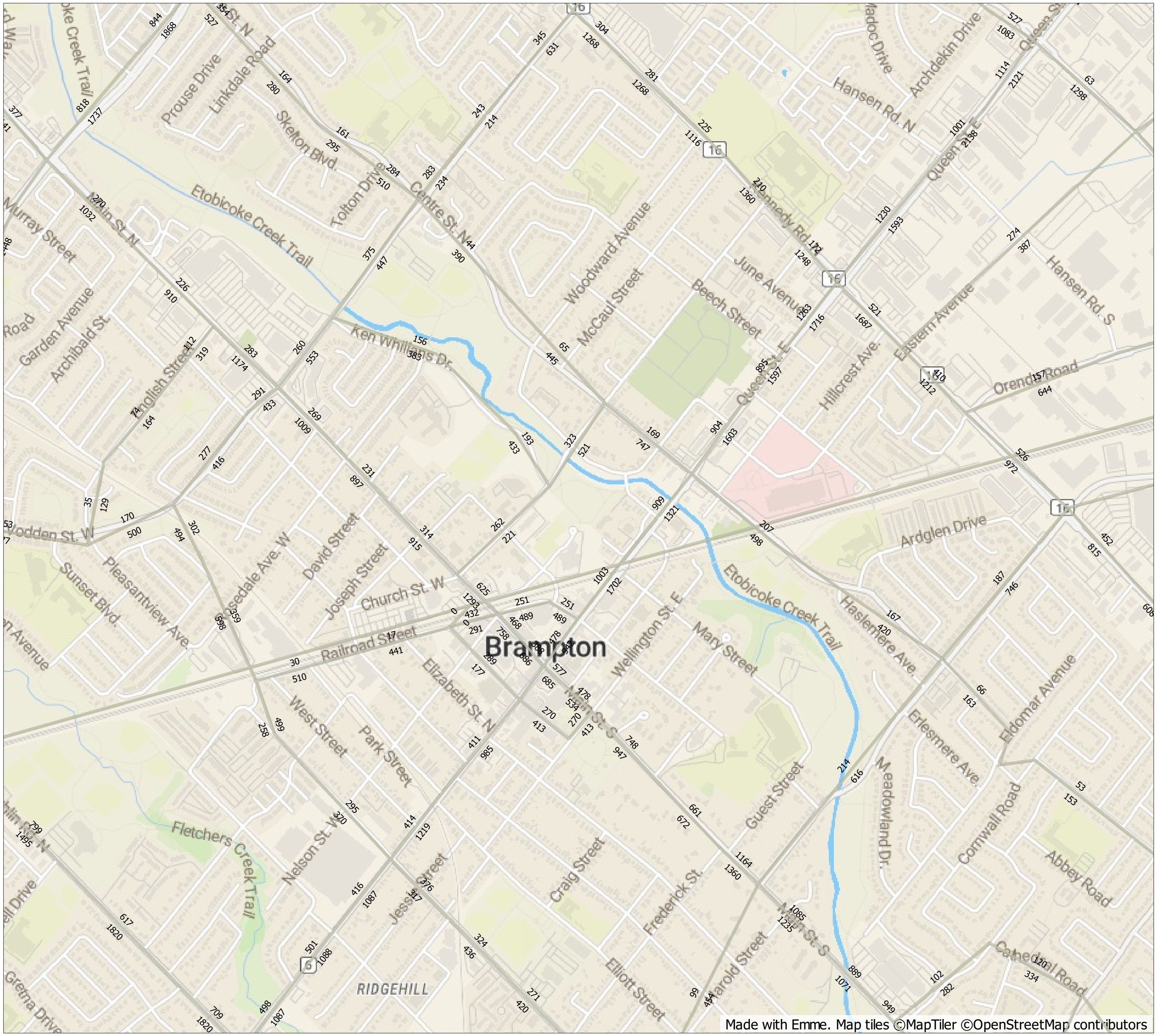
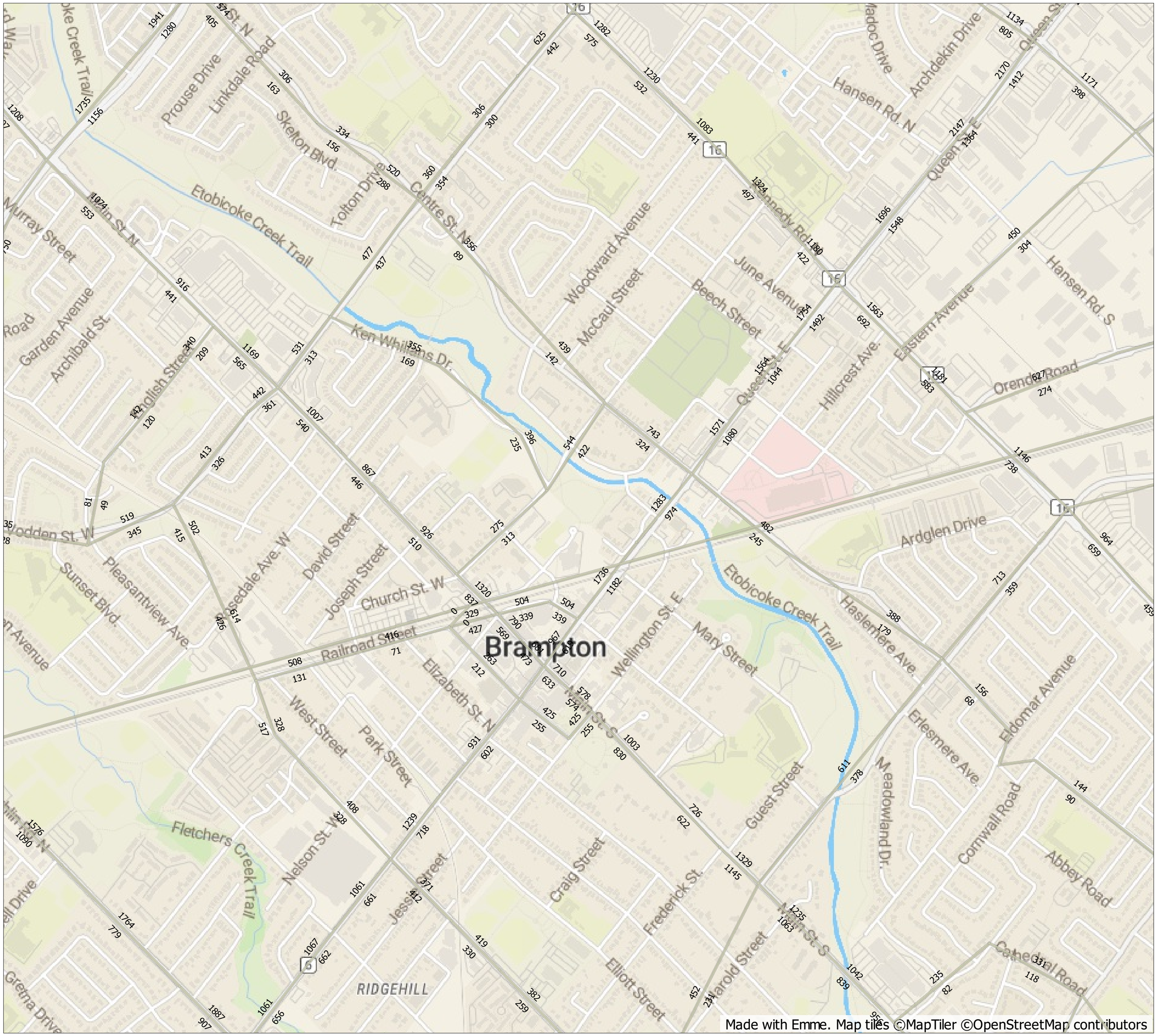
2011 (G:/TranModel/2011_Base/Database/emmebank)
Scenario 331: copy of scenario 231_PM_Ken whillans with Church Revised
2021-04-23 16:35 (lwu@COB10W-MJ03YM3B)

2031_Peak Hour_Auto Volume



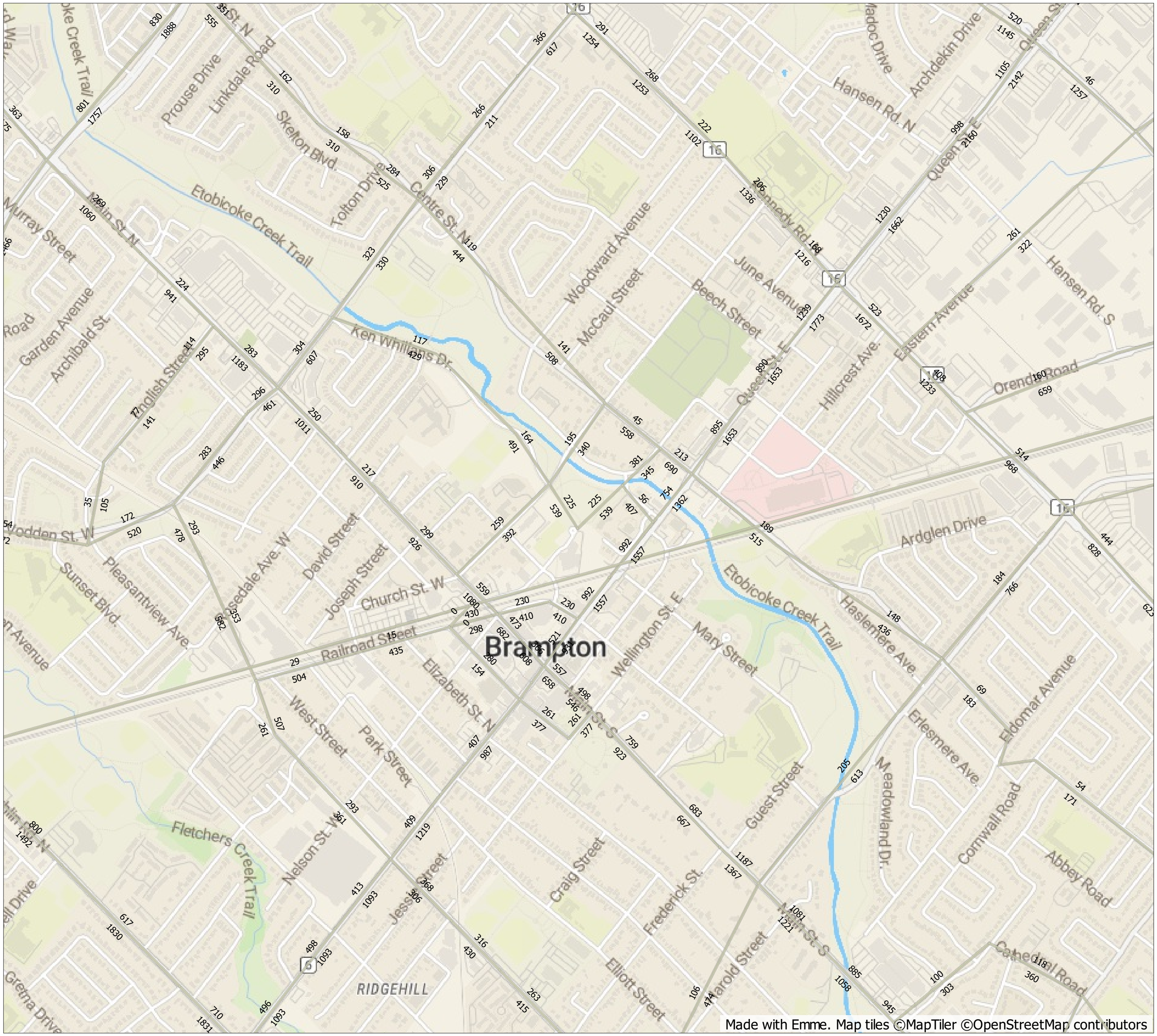
2031 with campus (G:/TranModel/2031_with_campus Base/Database/emmebank)
Scenario 811: copy of scenario 611_AM_Ken Whillans with Church Revised
2021-04-23 15:56 (lwu@COB10W-MJ03YM3B)

2031_Peak Hour_Auto Volume



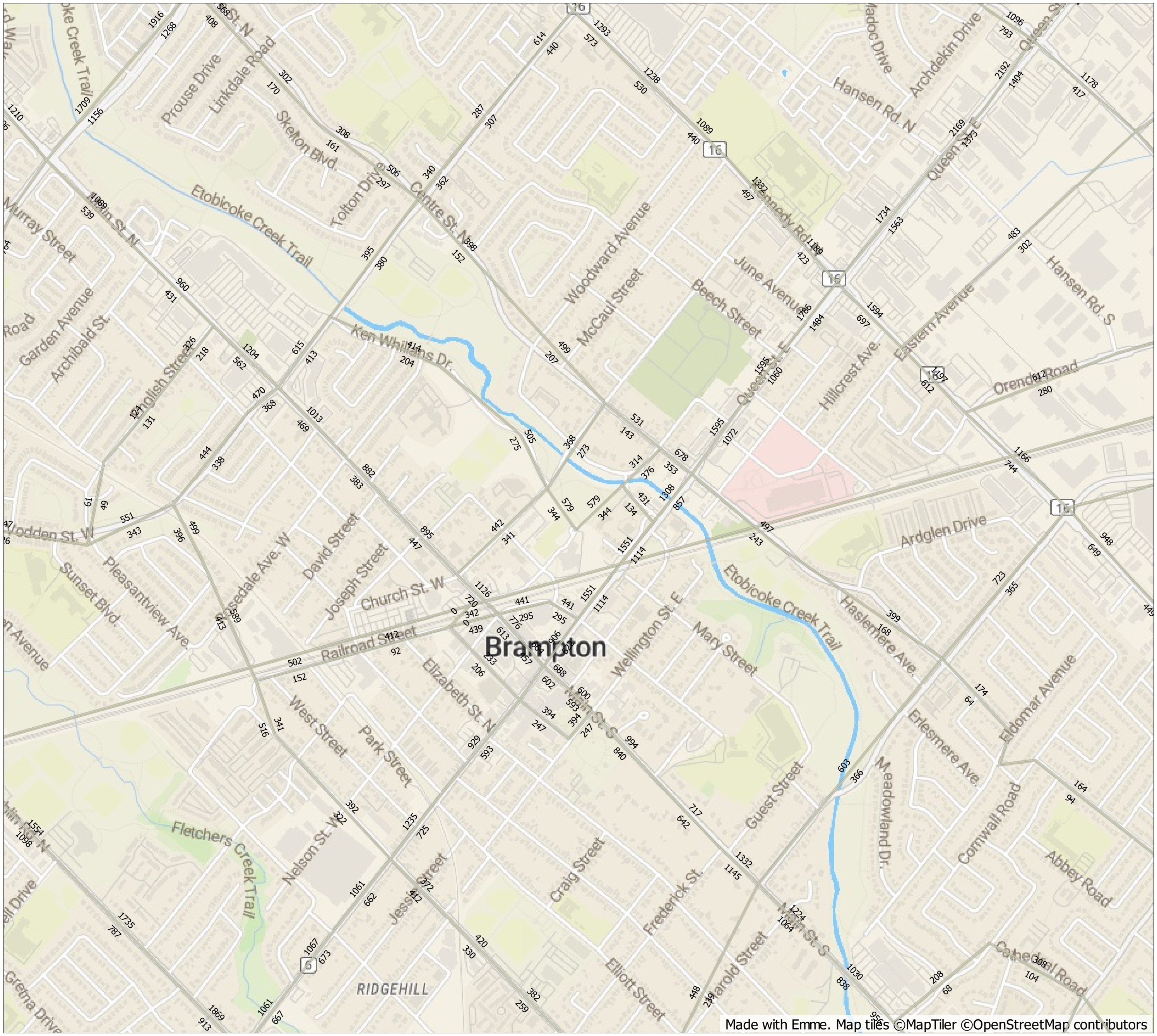
2031 with campus (G:/TranModel/2031_with_campus Base/Database/emmebank)
Scenario 831: copy of scenario 631_PM_Ken Whillans with Church Revised
2021-04-23 15:56 (lwu@COB10W-MJ03YM3B)

2031_Peak Hour_Auto Volume



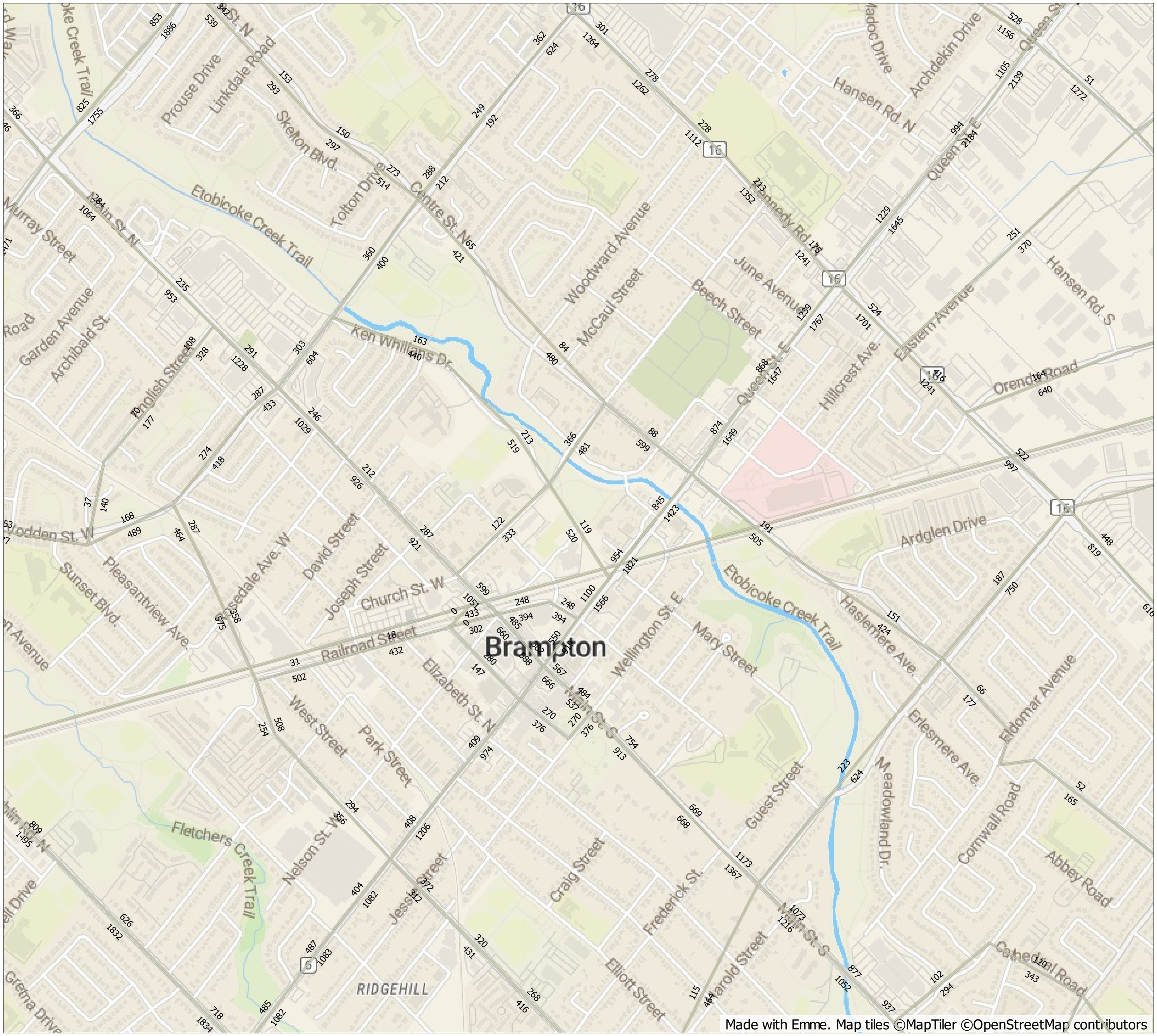
2031 with campus (G:/TranModel/2031_with_campus Base/Database/emmebank)
Scenario 1011: copy of scenario 711_AM_Ken Whillans ext Scott_Revised Chur
2021-04-23 16:00 (lwu@COB10W-MJ03YM3B)

2031_Peak Hour_Auto Volume



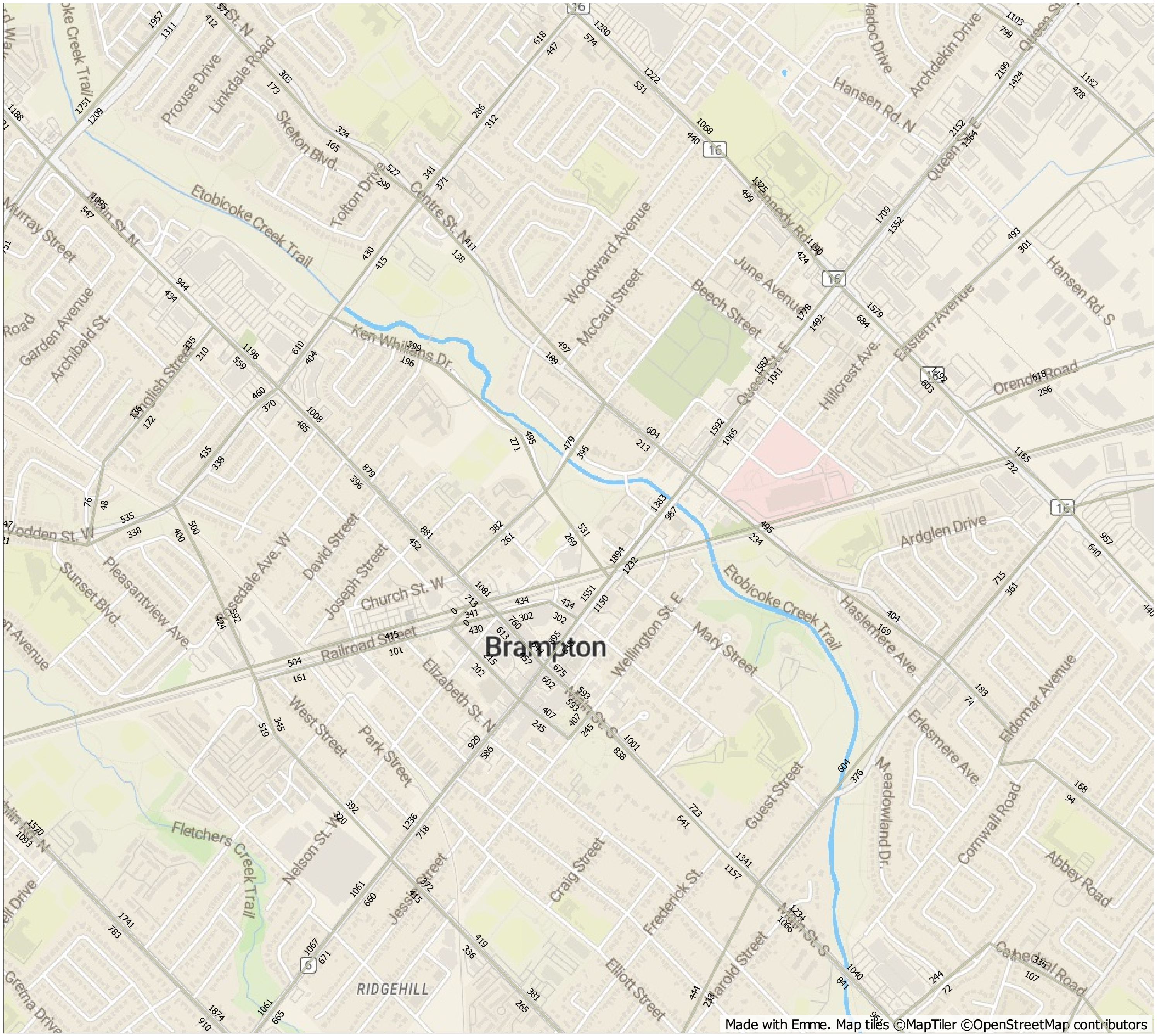
2031 with campus (G:/TranModel/2031_with_campus Base/Database/emmebank)
Scenario 1031: copy of scenario 731_PM_Ken Whillans ext Scott _Revised Chur
2021-04-23 16:01 (lwu@COB10W-MJ03YM3B)

2031_Peak Hour_Auto Volume



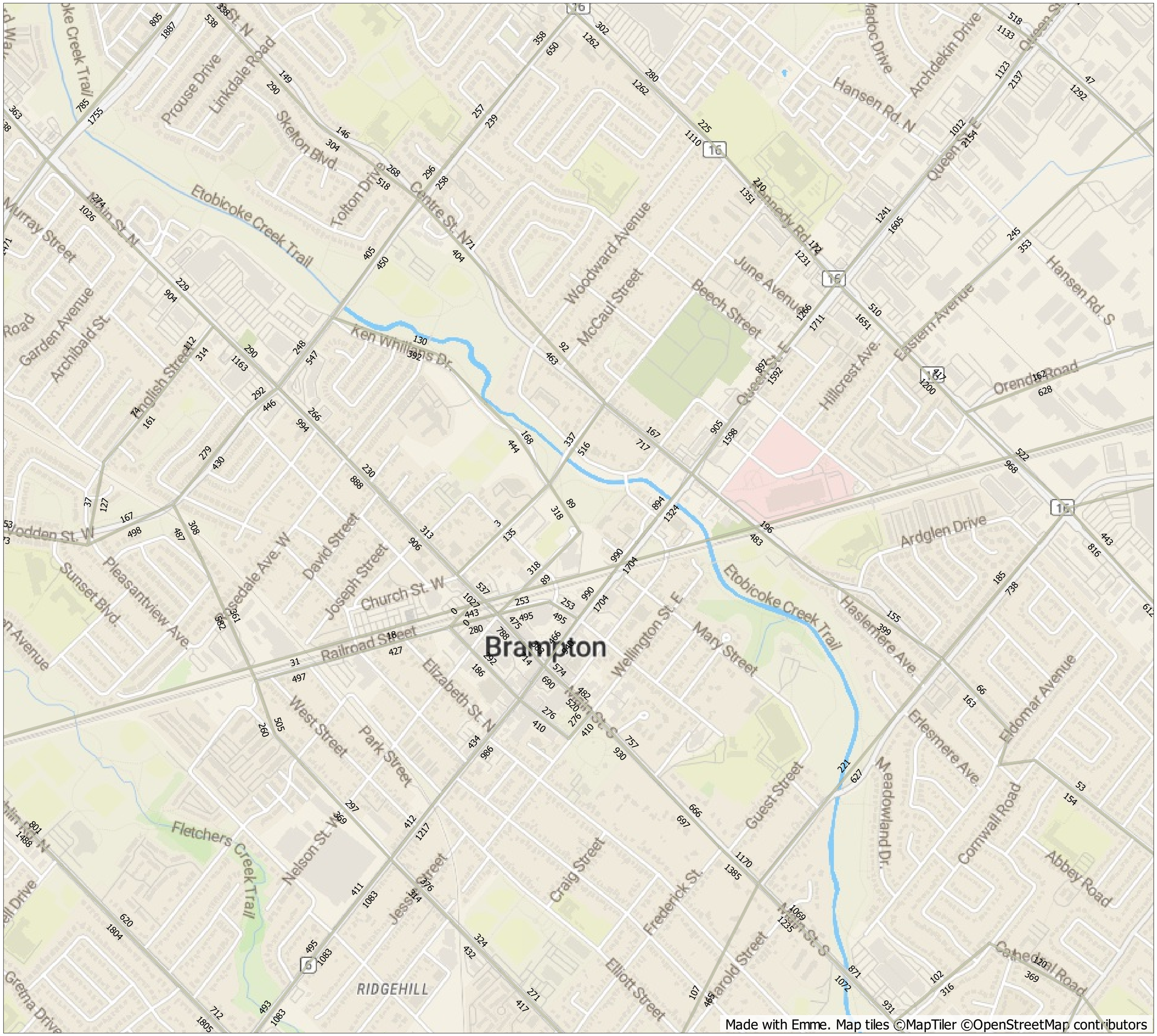
2031 with campus (G:/TranModel/2031_with_campus Base/Database/emmebank)
Scenario 911: copy of scenario 711_AM_Ken Whillans ext Queen _Revised Chur
2021-04-23 15:58 (lwu@COB10W-MJ03YM3B)

2031_Peak Hour_Auto Volume



2031 with campus (G:/TranModel/2031_with_campus Base/Database/emmebank)
Scenario 931: copy of scenario 731_PM_Ken Whillans ext Queen _Revised Chur
2021-04-23 15:59 (lwu@COB10W-MJ03YM3B)

2031_Peak Hour_Auto Volume



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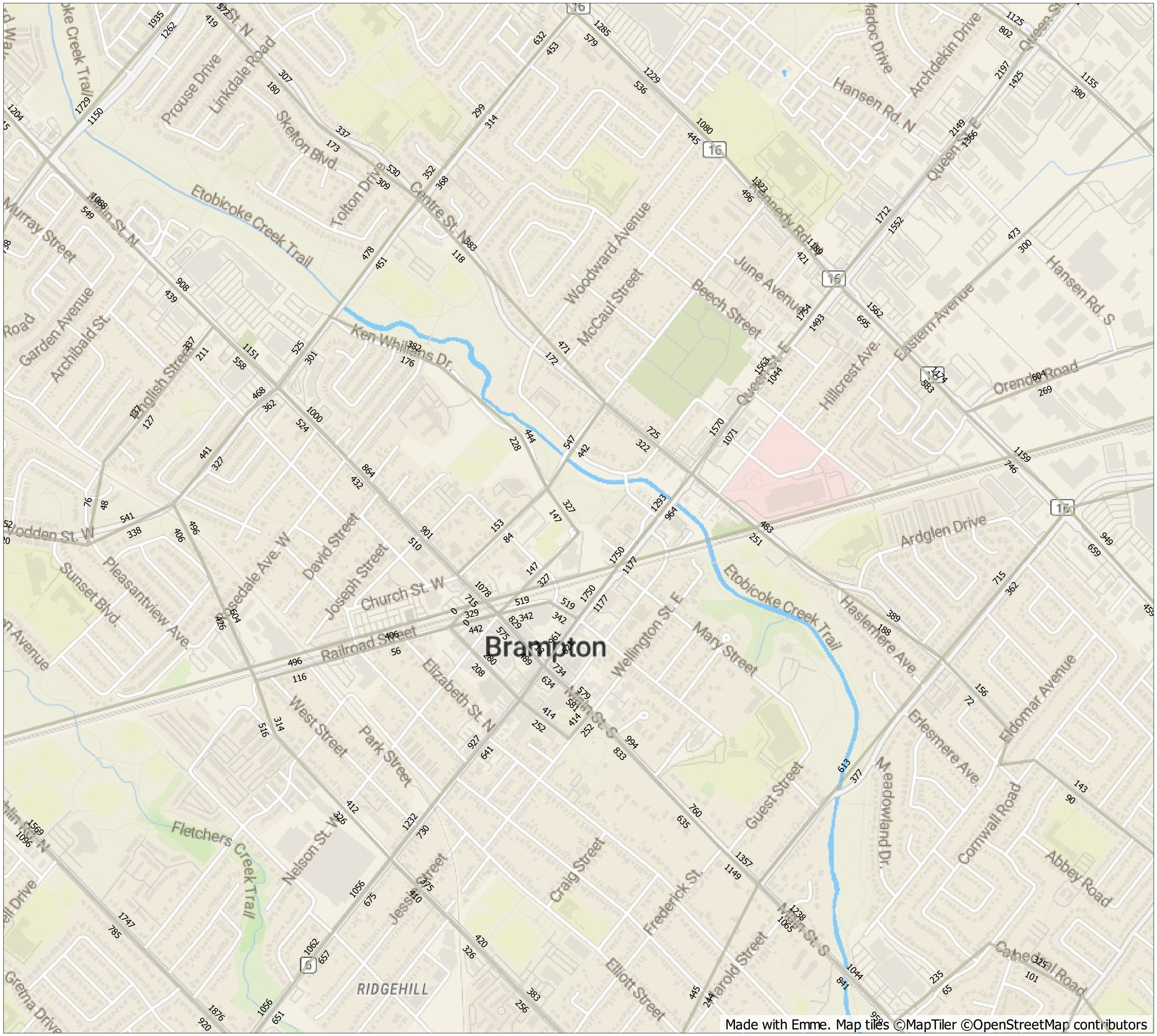
2031 with campus (G:/TranModel/2031_with_campus Base/Database/emmebank)
Scenario 1111: copy of scenario 711_AM_Ken Whillans ext Nelson_Revised Chur
2021-04-23 16:01 (lwu@COB10W-MJ03YM3B)

2031_Peak Hour_Auto Volume



2031 with campus (G:/TranModel/2031_with_campus Base/Database/emmebank)
Scenario 1131: copy of scenario 731_PM_Ken Whillans ext Nelson_Revised Chur
2021-04-23 16:01 (lwu@COB10W-MJ03YM3B)

2041_Peak Hour Auto volume

2041_WITH CAMPUS (C:/2041_GTAW1_P890240E324840/Database/emmebank)
Scenario 111: copy of scenario 11_AM_Ken Whillans with Revised Church
2021-06-04 10:58 (lwu@COB10W-MJ03YM3B)

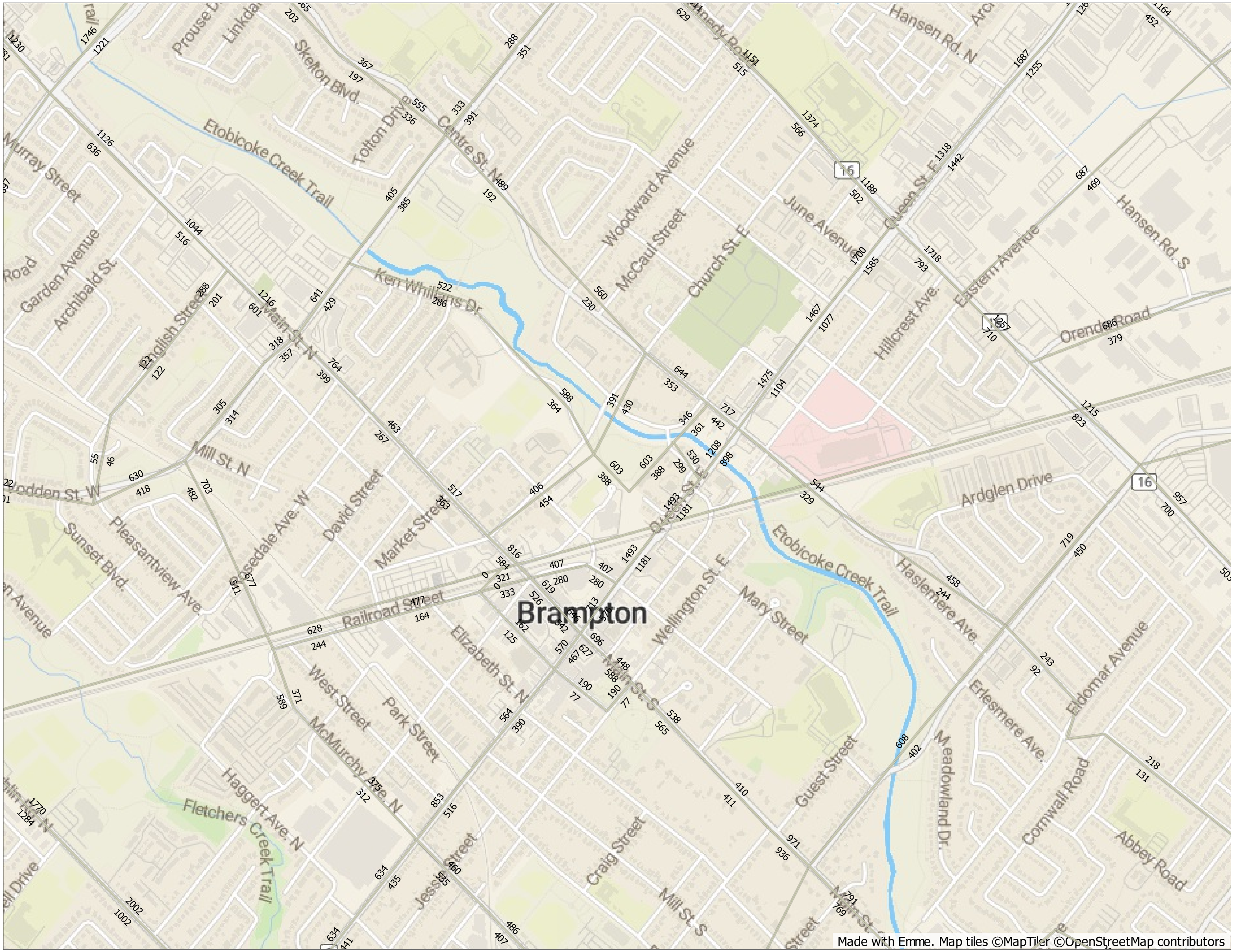
2041_Peak Hour Auto volume

2041_WITH CAMPUS (C:/2041_GTAW1_P890240E324840/Database/emmebank)
Scenario 131: copy of scenario 31_PM_Ken Whillans with Revised Church
2021-06-04 10:57 (lwu@COB10W-MJ03YM3B)

2041_Peak Hour Auto volume

2041_WITH CAMPUS (C:/2041_GTAW1_P890240E324840/Database/emmebank)
Scenario 411: copy of scenario 311_AM_Ken Whillans ext. to Scott rev. Chur
2021-06-04 10:55 (lwu@COB10W-MJ03YM3B)

2041_Peak Hour Auto volume



2041_WITH CAMPUS (C:/2041_GTAW1_P890240E324840/Database/emmebank)
Scenario 431: copy of scenario 331_PM_Ken Whillans ext. to Scott rev. Chur
2021-06-04 10:54 (lwu@COB10W-MJ03YM3B)

2041_Peak Hour Auto volume

2041_WITH CAMPUS (C:/2041_GTAW1_P890240E324840/Database/emmebank)
Scenario 311: copy of scenario 111_AM_Ken Whillans ext. to Queen rev. Chur
2021-06-04 10:56 (lwu@COB10W-MJ03YM3B)

2041_Peak Hour Auto volume

2041_WITH CAMPUS (C:/2041_GTAW1_P890240E324840/Database/emmebank)
Scenario 331: copy of scenario 111_PM_Ken Whillans ext. to Queen rev. Chur
2021-06-04 10:55 (lwu@COB10W-MJ03YM3B)

2041_Peak Hour Auto volume

2041_WITH CAMPUS (C:/2041_GTAW1_P890240E324840/Database/emmebank)
Scenario 511: copy of scenario 311_AM_Ken Whillans ext. to Nelso rev. Chur
2021-06-04 10:53 (lwu@COB10W-MJ03YM3B)

2041_Peak Hour Auto volume

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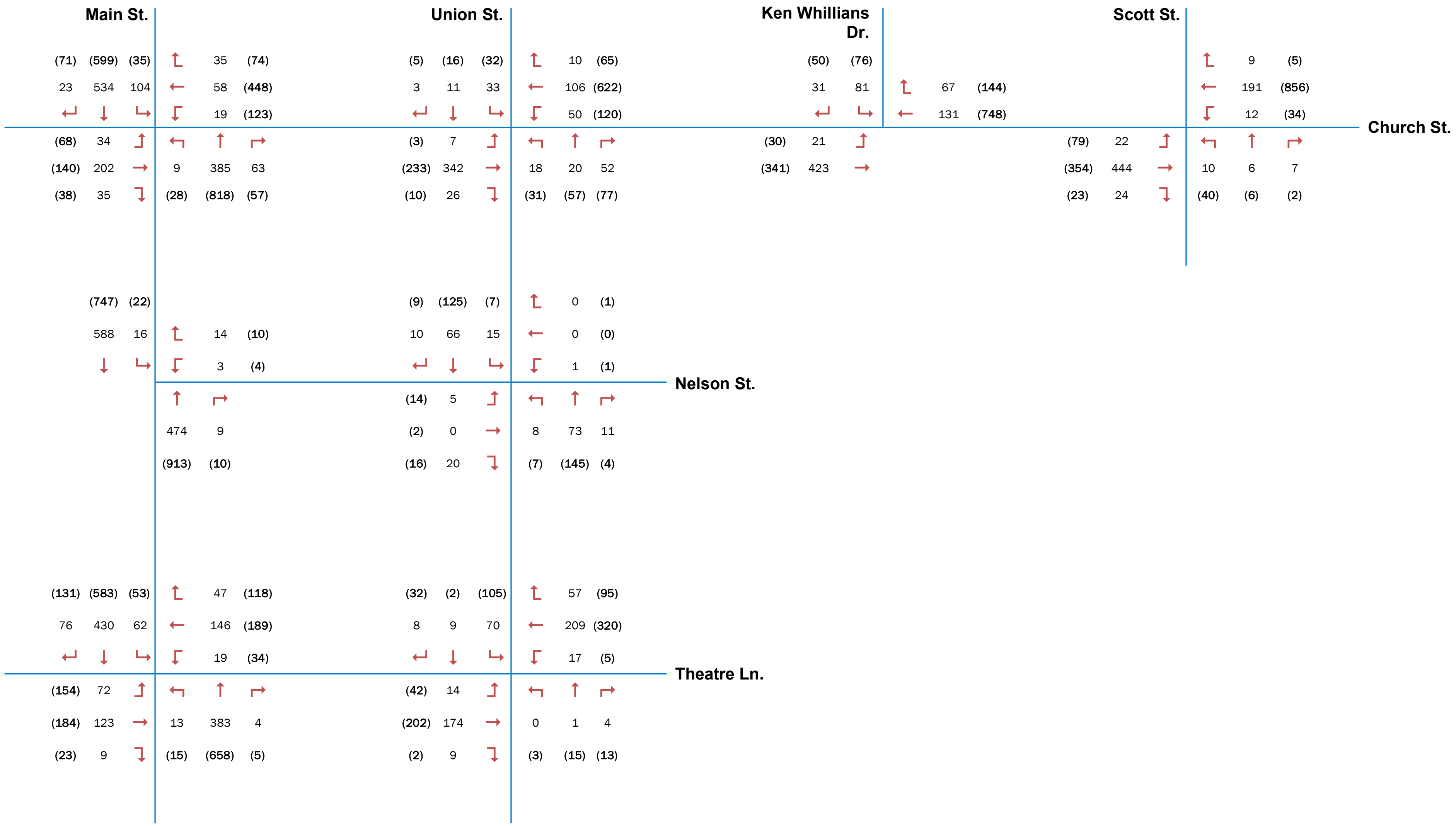
2041_WITH CAMPUS (C:/2041_GTAW1_P890240E324840/Database/emmebank)
Scenario 531: copy of scenario 331_PM_Ken Whillans ext. to Nelso rev. Chur
2021-06-04 10:53 (lwu@COB10W-MJ03YM3B)

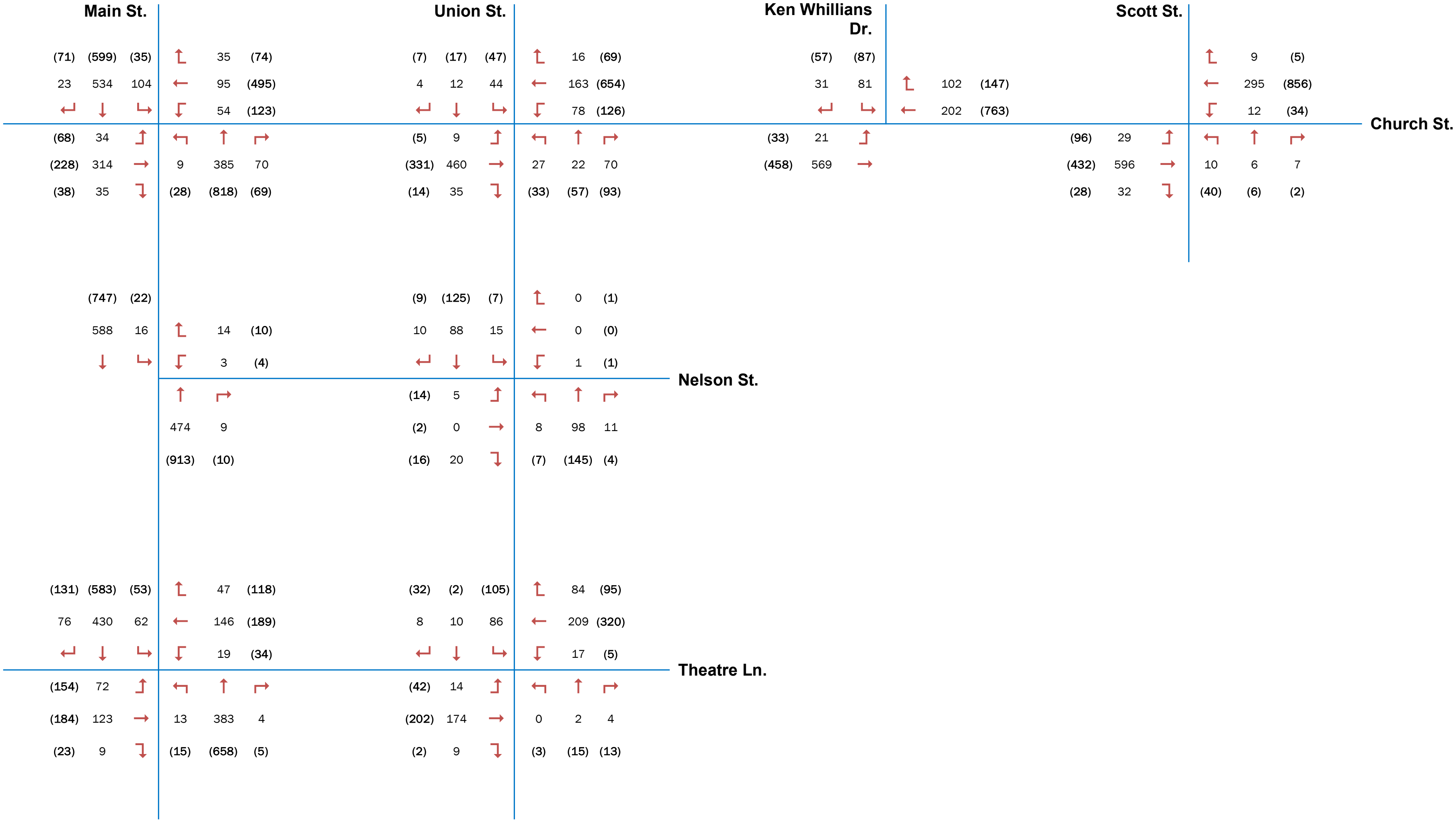
APPENDIX F

2031 & 2041 TRAFFIC FORECASTS



PARSONS

2031 AM (PM) Traffic Forecasts



PARSONS

2041 AM (PM) Traffic Forecasts

APPENDIX G

SYNCHRO REPORTS

FUTURE (2031 & 2041) CONDITIONS

1: Church St. & Scott St.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣				
Traffic Volume (veh/h)	22	444	24	12	191	9	10	6	7	0	0	0
Future Volume (Veh/h)	22	444	24	12	191	9	10	6	7	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	24	483	26	13	208	10	11	7	8	0	0	0
Pedestrians		3			9			17			14	
Lane Width (m)		3.5			3.5			3.5			0.0	
Walking Speed (m/s)		1.1			1.1			1.1			1.1	
Percent Blockage		0			1			2			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	232			526			803	819	522	818	827	230
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	232			526			803	819	522	818	827	230
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 %	98			99			96	98	99	100	100	100
cM capacity (veh/h)	1348			1035			289	298	546	276	295	812

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	533	231	26
Volume Left	24	13	11
Volume Right	26	10	8
cSH	1348	1035	341
Volume to Capacity	0.02	0.01	0.08
Queue Length 95th (m)	0.4	0.3	1.9
Control Delay (s)	0.5	0.6	16.4
Lane LOS	A	A	C
Approach Delay (s)	0.5	0.6	16.4
Approach LOS			C

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	51.7%	ICU Level of Service	A
Analysis Period (min)	15		

2: Church St. & Ken Whillians Dr.

	↗	→	←	↖	↘	↙
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰↑	↑	↱	↰	↱
Sign Control		Stop	Stop		Stop	
Traffic Volume (vph)	21	423	131	67	81	31
Future Volume (vph)	21	423	131	67	81	31
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	23	460	142	73	88	34

Direction, Lane #	EB 1	WB 1	WB 2	SB 1	SB 2
Volume Total (vph)	483	142	73	88	34
Volume Left (vph)	23	0	0	88	0
Volume Right (vph)	0	0	73	0	34
Hadj (s)	0.06	0.02	-0.70	0.50	-0.63
Departure Headway (s)	5.0	5.4	4.6	6.7	5.5
Degree Utilization, x	0.67	0.21	0.09	0.16	0.05
Capacity (veh/h)	701	643	738	493	584
Control Delay (s)	17.6	8.6	6.9	9.8	7.6
Approach Delay (s)	17.6	8.0		9.2	
Approach LOS	C	A		A	

Intersection Summary			
Delay	13.9		
Level of Service	B		
Intersection Capacity Utilization	55.2%	ICU Level of Service	B
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
3: Union St. & Church St.

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↑			✥			✥	
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	7	342	26	50	106	10	18	20	52	33	11	3
Future Volume (vph)	7	342	26	50	106	10	18	20	52	33	11	3
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	8	372	28	54	115	11	20	22	57	36	12	3

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total (vph)	8	400	54	126	99	51
Volume Left (vph)	8	0	54	0	20	36
Volume Right (vph)	0	28	0	11	57	3
Hadj (s)	0.50	-0.02	0.50	-0.05	-0.29	0.11
Departure Headway (s)	5.6	5.1	5.8	5.3	5.1	5.6
Degree Utilization, x	0.01	0.57	0.09	0.18	0.14	0.08
Capacity (veh/h)	626	692	592	654	630	570
Control Delay (s)	7.5	13.3	8.2	8.2	9.0	9.1
Approach Delay (s)	13.2		8.2		9.0	9.1
Approach LOS	B		A		A	A

Intersection Summary			
Delay	11.1		
Level of Service	B		
Intersection Capacity Utilization	43.8%	ICU Level of Service	A
Analysis Period (min)	15		

Queues

4: Main St. & Church St.

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↰	↱	↰	↱	↰	↱		↰↱
Traffic Volume (vph)	34	202	19	58	9	385	104	534
Future Volume (vph)	34	202	19	58	9	385	104	534
Lane Group Flow (vph)	37	258	21	101	10	486	0	718
Turn Type	pm+pt	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases	3	8		4		2		6
Permitted Phases	8		4		2		6	
Detector Phase	3	8	4	4	2	2	6	6
Switch Phase								
Minimum Initial (s)	5.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	10.0	28.0	28.0	28.0	30.0	30.0	30.0	30.0
Total Split (s)	10.0	44.0	34.0	34.0	76.0	76.0	76.0	76.0
Total Split (%)	8.3%	36.7%	28.3%	28.3%	63.3%	63.3%	63.3%	63.3%
Yellow Time (s)	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	0.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0		0.0
Total Lost Time (s)	3.0	6.0	6.0	6.0	6.0	6.0		6.0
Lead/Lag	Lead		Lag	Lag				
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
v/c Ratio	0.09	0.51	0.09	0.25	0.04	0.67		0.72
Control Delay	13.1	19.7	21.8	18.1	10.8	17.5		17.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0
Total Delay	13.1	19.7	21.8	18.1	10.8	17.5		17.6
Queue Length 50th (m)	2.1	17.8	1.3	4.9	0.4	28.2		23.2
Queue Length 95th (m)	8.8	47.6	8.0	21.5	3.5	86.5		64.6
Internal Link Dist (m)		105.2		158.0		82.5		21.1
Turn Bay Length (m)	71.0		31.0		37.0			
Base Capacity (vph)	437	1238	563	905	523	1556		2135
Starvation Cap Reductn	0	0	0	0	0	66		0
Spillback Cap Reductn	0	0	0	0	0	0		0
Storage Cap Reductn	0	0	0	0	0	0		0
Reduced v/c Ratio	0.08	0.21	0.04	0.11	0.02	0.33		0.34

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 53.6

Natural Cycle: 70

Control Type: Semi Act-Uncoord

Splits and Phases: 4: Main St. & Church St.

4: Main St. & Church St.

Future Do Nothing (2031) - AM Peak Hour

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱			↰↱	
Traffic Volume (vph)	34	202	35	19	58	35	9	385	63	104	534	23
Future Volume (vph)	34	202	35	19	58	35	9	385	63	104	534	23
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.0		6.0	6.0		6.0	6.0			6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00			0.95	
Frpb, ped/bikes	1.00	1.00		1.00	0.99		1.00	0.99			1.00	
Flpb, ped/bikes	0.99	1.00		0.99	1.00		0.98	1.00			1.00	
Frt	1.00	0.98		1.00	0.94		1.00	0.98			0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00			0.99	
Satd. Flow (prot)	1598	1637		1588	1580		1505	1616			3058	
Flt Permitted	0.56	1.00		0.60	1.00		0.35	1.00			0.72	
Satd. Flow (perm)	949	1637		1002	1580		549	1616			2212	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	37	220	38	21	63	38	10	418	68	113	580	25
RTOR Reduction (vph)	0	5	0	0	18	0	0	7	0	0	3	0
Lane Group Flow (vph)	37	253	0	21	83	0	10	479	0	0	715	0
Confl. Peds. (#/hr)	17		22	22		17	40		28	28		40
Confl. Bikes (#/hr)			1			1						
Heavy Vehicles (%)	0%	0%	4%	0%	0%	0%	5%	2%	0%	0%	4%	0%
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	3	8			4			2			6	
Permitted Phases	8			4			2			6		
Actuated Green, G (s)	18.4	18.4		13.3	13.3		24.2	24.2			24.2	
Effective Green, g (s)	18.4	18.4		13.3	13.3		24.2	24.2			24.2	
Actuated g/C Ratio	0.34	0.34		0.24	0.24		0.44	0.44			0.44	
Clearance Time (s)	3.0	6.0		6.0	6.0		6.0	6.0			6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0			3.0	
Lane Grp Cap (vph)	344	551		244	384		243	716			980	
v/s Ratio Prot	0.00	c0.15			0.05			0.30				
v/s Ratio Perm	0.03			0.02			0.02				c0.32	
v/c Ratio	0.11	0.46		0.09	0.22		0.04	0.67			0.73	
Uniform Delay, d1	12.4	14.2		16.0	16.5		8.6	12.0			12.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00			1.00	
Incremental Delay, d2	0.1	0.6		0.2	0.3		0.1	2.4			2.8	
Delay (s)	12.5	14.8		16.1	16.8		8.7	14.4			15.3	
Level of Service	B	B		B	B		A	B			B	
Approach Delay (s)		14.5			16.7			14.3			15.3	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	14.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	54.6	Sum of lost time (s)	15.0
Intersection Capacity Utilization	80.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

5: Nelson St. E. & Main St.

Lane Group	EBR	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↱	✥	↰	↱	↰	↱
Traffic Volume (vph)	6	0	6	474	16	588
Future Volume (vph)	6	0	6	474	16	588
Lane Group Flow (vph)	7	18	7	525	17	639
Turn Type	Prot	NA	Prot	NA	Perm	NA
Protected Phases	7	8	5	2		6
Permitted Phases					6	
Detector Phase	7	8	5	2	6	6
Switch Phase						
Minimum Initial (s)	5.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	9.5	25.0	14.0	28.0	28.0	28.0
Total Split (s)	9.5	25.0	14.0	55.5	41.5	41.5
Total Split (%)	10.6%	27.8%	15.6%	61.7%	46.1%	46.1%
Yellow Time (s)	3.5	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lead		Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes		Yes	Yes
Recall Mode	None	None	None	C-Min	C-Min	C-Min
v/c Ratio	0.01	0.06	0.05	0.37	0.03	0.47
Control Delay	0.0	0.4	38.5	5.8	9.6	11.3
Queue Delay	0.0	0.0	0.0	0.1	0.0	0.0
Total Delay	0.0	0.4	38.5	5.9	9.6	11.3
Queue Length 50th (m)	0.0	0.0	1.1	0.0	0.0	0.0
Queue Length 95th (m)	0.0	0.0	5.3	85.6	6.0	#177.4
Internal Link Dist (m)		173.6		29.9		82.5
Turn Bay Length (m)			20.0			
Base Capacity (vph)	592	437	140	1428	633	1370
Starvation Cap Reductn	0	0	0	149	0	40
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.01	0.04	0.05	0.41	0.03	0.48

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

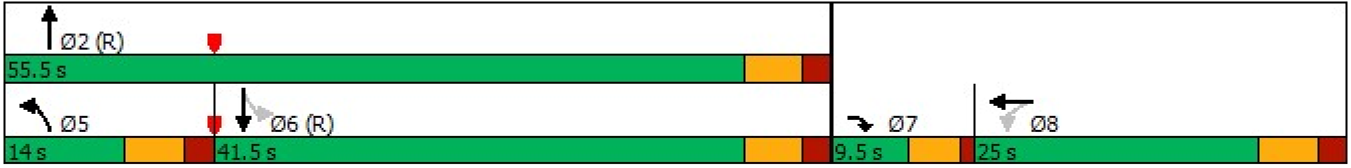
Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green

Natural Cycle: 90

Control Type: Actuated-Coordinated

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

Splits and Phases: 5: Nelson St. E. & Main St.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations			↱		✥		↰	↱		↰	↱	
Traffic Volume (vph)	0	0	6	3	0	14	6	474	9	16	588	0
Future Volume (vph)	0	0	6	3	0	14	6	474	9	16	588	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.5		6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor			1.00		1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes			1.00		0.98		1.00	1.00		1.00	1.00	
Flpb, ped/bikes			1.00		1.00		1.00	1.00		0.96	1.00	
Frt			0.86		0.89		1.00	1.00		1.00	1.00	
Flt Protected			1.00		0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)			1434		1460		1575	1650		1538	1642	
Flt Permitted			1.00		0.99		0.95	1.00		0.47	1.00	
Satd. Flow (perm)			1434		1460		1575	1650		760	1642	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	7	3	0	15	7	515	10	17	639	0
RTOR Reduction (vph)	0	0	7	0	17	0	0	1	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	1	0	7	524	0	17	639	0
Confl. Peds. (#/hr)				2		1			43	43		
Heavy Vehicles (%)	2%	2%	2%	0%	2%	0%	2%	2%	0%	0%	3%	2%
Turn Type			Prot	Perm	NA		Prot	NA		Perm	NA	
Protected Phases			7		8		5	2			6	
Permitted Phases				8						6		
Actuated Green, G (s)			1.0		5.4		1.6	67.1		59.5	59.5	
Effective Green, g (s)			1.0		5.4		1.6	67.1		59.5	59.5	
Actuated g/C Ratio			0.01		0.06		0.02	0.75		0.66	0.66	
Clearance Time (s)			4.5		6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)			3.0		3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)			15		87		28	1230		502	1085	
v/s Ratio Prot			c0.00				0.00	c0.32			c0.39	
v/s Ratio Perm					0.00					0.02		
v/c Ratio			0.01		0.01		0.25	0.43		0.03	0.59	
Uniform Delay, d1			44.0		39.8		43.6	4.3		5.3	8.5	
Progression Factor			1.00		1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2			0.1		0.1		4.7	1.1		0.1	2.3	
Delay (s)			44.1		39.8		48.3	5.4		5.4	10.8	
Level of Service			D		D		D	A		A	B	
Approach Delay (s)		44.1			39.8			5.9			10.7	
Approach LOS		D			D			A			B	

Intersection Summary			
HCM 2000 Control Delay	9.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	22.5
Intersection Capacity Utilization	59.3%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Queues
6: Main St. & Nelson St. W./Theatre Ln.

	↗	→	↙	←	↖	↑	↘	↓
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↰	↱	↰	↱		✥		✥
Traffic Volume (vph)	72	123	19	146	13	383	62	430
Future Volume (vph)	72	123	19	146	13	383	62	430
Lane Group Flow (vph)	78	144	21	210	0	434	0	617
Turn Type	pm+pt	NA	pm+pt	NA	Perm	NA	Perm	NA
Protected Phases	3	8	7	4		2		6
Permitted Phases	8		4		2		6	
Detector Phase	3	8	7	4	2	2	6	6
Switch Phase								
Minimum Initial (s)	6.0	8.0	4.5	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	9.0	25.0	9.0	25.0	28.0	28.0	28.0	28.0
Total Split (s)	9.0	25.0	9.0	25.0	46.0	46.0	46.0	46.0
Total Split (%)	11.3%	31.3%	11.3%	31.3%	57.5%	57.5%	57.5%	57.5%
Yellow Time (s)	3.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	0.0	2.0	0.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0		0.0		0.0
Total Lost Time (s)	3.0	6.0	3.0	6.0		6.0		6.0
Lead/Lag	Lead	Lag	Lead	Lag				
Lead-Lag Optimize?		Yes	Yes					
Recall Mode	None	None	None	None	C-Min	C-Min	C-Min	C-Min
v/c Ratio	0.27	0.39	0.06	0.69		0.51		0.82
Control Delay	18.8	27.1	15.8	38.5		15.5		27.7
Queue Delay	0.0	0.0	0.0	0.0		0.0		52.0
Total Delay	18.8	27.1	15.8	38.5		15.5		79.7
Queue Length 50th (m)	7.5	15.1	1.9	25.9		43.3		78.6
Queue Length 95th (m)	16.0	34.2	6.2	47.6		70.0		#146.4
Internal Link Dist (m)		74.1		142.1		146.8		29.9
Turn Bay Length (m)	23.0		18.0					
Base Capacity (vph)	285	400	374	344		845		756
Starvation Cap Reductn	0	0	0	0		0		272
Spillback Cap Reductn	0	0	0	0		0		0
Storage Cap Reductn	0	0	0	0		0		0
Reduced v/c Ratio	0.27	0.36	0.06	0.61		0.51		1.27

Intersection Summary

Cycle Length: 80

Actuated Cycle Length: 80

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 80

Control Type: Actuated-Coordinated

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

Splits and Phases: 6: Main St. & Nelson St. W./Theatre Ln.

HCM Signalized Intersection Capacity Analysis
6: Main St. & Nelson St. W./Theatre Ln.

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱			✥			✥	
Traffic Volume (vph)	72	123	9	19	146	47	13	383	4	62	430	76
Future Volume (vph)	72	123	9	19	146	47	13	383	4	62	430	76
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.0		3.0	6.0			6.0			6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Frpb, ped/bikes	1.00	1.00		1.00	0.94			1.00			0.99	
Flpb, ped/bikes	0.94	1.00		0.99	1.00			1.00			1.00	
Frt	1.00	0.99		1.00	0.96			1.00			0.98	
Flt Protected	0.95	1.00		0.95	1.00			1.00			0.99	
Satd. Flow (prot)	1459	1440		1585	1389			1572			1494	
Flt Permitted	0.48	1.00		0.67	1.00			0.98			0.91	
Satd. Flow (perm)	737	1440		1110	1389			1538			1366	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	78	134	10	21	159	51	14	416	4	67	467	83
RTOR Reduction (vph)	0	3	0	0	15	0	0	0	0	0	7	0
Lane Group Flow (vph)	78	141	0	21	195	0	0	434	0	0	610	0
Confl. Peds. (#/hr)	104		12	12		104	48		37	37		48
Heavy Vehicles (%)	3%	17%	0%	0%	14%	0%	0%	2%	0%	3%	3%	6%
Bus Blockages (#/hr)	0	0	0	0	0	0	12	12	12	12	12	12
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	3	8		7	4			2			6	
Permitted Phases	8			4			2			6		
Actuated Green, G (s)	25.5	20.5		20.3	17.9			42.1			42.1	
Effective Green, g (s)	25.5	20.5		20.3	17.9			42.1			42.1	
Actuated g/C Ratio	0.32	0.26		0.25	0.22			0.53			0.53	
Clearance Time (s)	3.0	6.0		3.0	6.0			6.0			6.0	
Vehicle Extension (s)	3.0	5.0		3.0	5.0			5.0			5.0	
Lane Grp Cap (vph)	280	369		295	310			809			718	
v/s Ratio Prot	c0.02	0.10		0.00	c0.14							
v/s Ratio Perm	0.07			0.02				0.28			c0.45	
v/c Ratio	0.28	0.38		0.07	0.63			0.54			0.85	
Uniform Delay, d1	19.8	24.5		22.6	28.1			12.5			16.2	
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Incremental Delay, d2	0.5	1.4		0.1	5.6			2.5			12.1	
Delay (s)	20.3	25.9		22.7	33.6			15.0			28.3	
Level of Service	C	C		C	C			B			C	
Approach Delay (s)		23.9			32.6			15.0			28.3	
Approach LOS		C			C			B			C	

Intersection Summary			
HCM 2000 Control Delay	24.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	96.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Queues
7: Theatre Ln. & Union St.

	↗	→	↙	←	↑	↘	↓
Lane Group	EBL	EBT	WBL	WBT	NBT	SBL	SBT
Lane Configurations	↰	↱	↰	↱	↱	↰	↱
Traffic Volume (vph)	14	174	17	209	1	70	9
Future Volume (vph)	14	174	17	209	1	70	9
Lane Group Flow (vph)	15	199	18	289	5	76	19
Turn Type	Perm	NA	Perm	NA	NA	Perm	NA
Protected Phases		2		6	3		4
Permitted Phases	2		6			4	
Detector Phase	2	2	6	6	3	4	4
Switch Phase							
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	26.0	26.0	26.0	26.0	25.0	25.0	25.0
Total Split (s)	26.0	26.0	26.0	26.0	31.0	31.0	31.0
Total Split (%)	45.6%	45.6%	45.6%	45.6%	54.4%	54.4%	54.4%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag							
Lead-Lag Optimize?							
Recall Mode	None	None	None	None	None	None	None
v/c Ratio	0.03	0.27	0.03	0.37	0.01	0.14	0.03
Control Delay	8.8	9.2	8.8	9.3	8.2	10.5	7.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.8	9.2	8.8	9.3	8.2	10.5	7.9
Queue Length 50th (m)	0.5	7.4	0.6	10.4	0.1	3.2	0.4
Queue Length 95th (m)	3.5	24.3	3.9	33.6	1.6	11.3	3.6
Internal Link Dist (m)		142.1		50.6	45.6		81.3
Turn Bay Length (m)	35.0		19.0			25.0	
Base Capacity (vph)	689	1029	742	1074	1099	948	1208
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.02	0.19	0.02	0.27	0.00	0.08	0.02

Intersection Summary

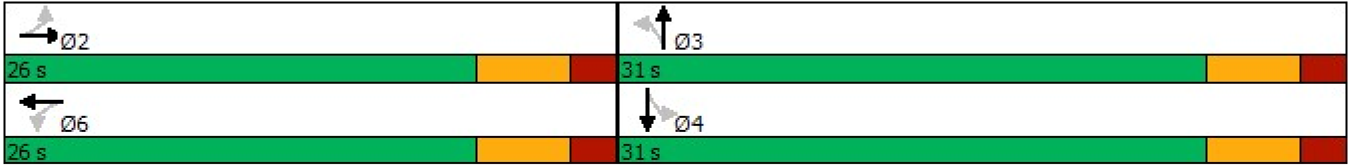
Cycle Length: 57

Actuated Cycle Length: 30

Natural Cycle: 55

Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Theatre Ln. & Union St.



7: Theatre Ln. & Union St.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱		↰	↱	
Traffic Volume (vph)	14	174	9	17	209	57	0	1	4	70	9	8
Future Volume (vph)	14	174	9	17	209	57	0	1	4	70	9	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0			6.0		6.0	6.0	
Lane Util. Factor	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			0.97		1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00		0.98	1.00	
Frt	1.00	0.99		1.00	0.97			0.88		1.00	0.93	
Flt Protected	0.95	1.00		0.95	1.00			1.00		0.95	1.00	
Satd. Flow (prot)	1604	1467		1599	1521			1443		1578	1554	
Flt Permitted	0.58	1.00		0.63	1.00			1.00		0.75	1.00	
Satd. Flow (perm)	984	1467		1065	1521			1443		1253	1554	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	15	189	10	18	227	62	0	1	4	76	10	9
RTOR Reduction (vph)	0	4	0	0	19	0	0	3	0	0	7	0
Lane Group Flow (vph)	15	195	0	18	270	0	0	2	0	76	12	0
Confl. Peds. (#/hr)	3		10	10		3	1		28	28		1
Confl. Bikes (#/hr)												1
Heavy Vehicles (%)	0%	15%	0%	0%	9%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			3			4	
Permitted Phases	2			6			3			4		
Actuated Green, G (s)	6.9	6.9		6.9	6.9			5.6		5.6	5.6	
Effective Green, g (s)	6.9	6.9		6.9	6.9			5.6		5.6	5.6	
Actuated g/C Ratio	0.28	0.28		0.28	0.28			0.23		0.23	0.23	
Clearance Time (s)	6.0	6.0		6.0	6.0			6.0		6.0	6.0	
Vehicle Extension (s)	5.0	5.0		5.0	5.0			5.0		5.0	5.0	
Lane Grp Cap (vph)	277	413		299	428			329		286	355	
v/s Ratio Prot		0.13			c0.18			0.00			0.01	
v/s Ratio Perm	0.02			0.02						c0.06		
v/c Ratio	0.05	0.47		0.06	0.63			0.01		0.27	0.03	
Uniform Delay, d1	6.4	7.3		6.4	7.7			7.3		7.8	7.3	
Progression Factor	1.00	1.00		1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2	0.2	1.8		0.2	4.1			0.0		1.0	0.1	
Delay (s)	6.6	9.1		6.6	11.8			7.3		8.8	7.4	
Level of Service	A	A		A	B			A		A	A	
Approach Delay (s)		8.9			11.5			7.3			8.5	
Approach LOS		A			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	10.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.47		
Actuated Cycle Length (s)	24.5	Sum of lost time (s)	12.0
Intersection Capacity Utilization	38.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

8: Nelson St. E./Nelson St. & Union St.

Future Do Nothing (2031) - AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Volume (veh/h)	5	0	20	1	0	0	8	73	11	15	66	10
Future Volume (Veh/h)	5	0	20	1	0	0	8	73	11	15	66	10
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	0	22	1	0	0	9	79	12	16	72	11
Pedestrians		7			7			5			5	
Lane Width (m)		3.5			3.5			3.5			3.5	
Walking Speed (m/s)		1.1			1.1			1.1			1.1	
Percent Blockage		1			1			0			0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)								105				
pX, platoon unblocked												
vC, conflicting volume	224	232	90	246	232	97	90			98		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	224	232	90	246	232	97	90			98		
tC, single (s)	7.2	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	100	98	100	100	100	99			99		
cM capacity (veh/h)	695	652	964	673	652	955	1509			1498		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	27	1	100	99
Volume Left	5	1	9	16
Volume Right	22	0	12	11
cSH	899	673	1509	1498
Volume to Capacity	0.03	0.00	0.01	0.01
Queue Length 95th (m)	0.7	0.0	0.1	0.2
Control Delay (s)	9.1	10.4	0.7	1.3
Lane LOS	A	B	A	A
Approach Delay (s)	9.1	10.4	0.7	1.3
Approach LOS	A	B		

Intersection Summary			
Average Delay	2.0		
Intersection Capacity Utilization	21.5%	ICU Level of Service	A
Analysis Period (min)	15		

Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	7:30	7:30	7:30	7:30	7:30	7:30
End Time	9:00	9:00	9:00	9:00	9:00	9:00
Total Time (min)	90	90	90	90	90	90
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	2204	2266	2276	2207	2349	2264
Vehs Exited	2226	2274	2282	2224	2349	2269
Starting Vehs	62	56	55	58	46	50
Ending Vehs	40	48	49	41	46	42
Travel Distance (km)	978	1010	1000	981	1056	1005
Travel Time (hr)	90.2	66.1	94.9	122.7	89.1	92.6
Total Delay (hr)	68.3	43.5	72.6	100.8	65.3	70.1
Total Stops	3887	3872	3906	3993	4113	3954
Fuel Used (l)	156.8	139.9	162.7	185.5	160.7	161.1

Interval #0 Information Seeding

Start Time	7:30
End Time	8:00
Total Time (min)	30

Volumes adjusted by Growth Factors.

No data recorded this interval.

Interval #1 Information Recording

Start Time	8:00
End Time	9:00
Total Time (min)	60

Volumes adjusted by Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	2204	2266	2276	2207	2349	2264
Vehs Exited	2226	2274	2282	2224	2349	2269
Starting Vehs	62	56	55	58	46	50
Ending Vehs	40	48	49	41	46	42
Travel Distance (km)	978	1010	1000	981	1056	1005
Travel Time (hr)	90.2	66.1	94.9	122.7	89.1	92.6
Total Delay (hr)	68.3	43.5	72.6	100.8	65.3	70.1
Total Stops	3887	3872	3906	3993	4113	3954
Fuel Used (l)	156.8	139.9	162.7	185.5	160.7	161.1

1: Church St. & Scott St. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	0.3	0.2	0.2	0.1	0.1	0.1	0.1
Total Delay (hr)	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
Total Del/Veh (s)	4.9	2.9	2.5	5.0	0.5	0.7	8.0	8.8	3.8	2.4

2: Church St. & Ken Whillians Dr. Performance by movement

Movement	EBL	EBT	WBT	WBR	SBL	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.2	3.9	0.2
Total Delay (hr)	0.1	1.3	0.3	0.1	0.1	0.0	1.8
Total Del/Veh (s)	10.3	11.0	6.9	3.8	5.5	2.8	8.6

3: Union St. & Church St. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.2
Total Delay (hr)	0.0	1.0	0.0	0.1	0.2	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Total Del/Veh (s)	8.0	10.5	6.6	6.9	8.1	4.7	5.0	5.4	3.7	4.8	5.1	3.0

3: Union St. & Church St. Performance by movement

Movement	All
Denied Delay (hr)	0.0
Denied Del/Veh (s)	0.0
Total Delay (hr)	1.6
Total Del/Veh (s)	8.4

4: Main St. & Church St. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.9	32.2	1.3
Denied Del/Veh (s)	3.5	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	225.0	210.4	192.9
Total Delay (hr)	0.1	0.9	0.2	0.1	0.3	0.1	0.1	2.3	0.3	0.4	2.4	0.1
Total Del/Veh (s)	14.2	17.2	18.4	25.3	13.4	8.0	44.5	20.3	17.1	15.5	16.6	10.5

4: Main St. & Church St. Performance by movement

Movement	All
Denied Delay (hr)	40.4
Denied Del/Veh (s)	93.6
Total Delay (hr)	7.3
Total Del/Veh (s)	17.4

5: Nelson St. E. & Main St. Performance by movement

Movement	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2
Denied Del/Veh (s)	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.7
Total Delay (hr)	0.1	0.0	0.0	0.0	0.1	0.5	0.0	0.1	6.6	7.4
Total Del/Veh (s)	70.6	52.6	0.1	9.3	32.9	3.5	1.0	15.3	41.8	24.1

6: Main St. & Nelson St. W./Theatre Ln. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	3.9	0.5	0.4	0.0	0.0	0.0	0.4	0.5	0.3	0.8	0.3	0.0
Total Delay (hr)	0.5	0.8	0.0	0.1	1.0	0.2	0.1	2.6	0.0	0.4	2.3	0.3
Total Del/Veh (s)	23.1	22.5	13.7	21.8	25.5	18.9	33.4	25.1	21.4	22.9	19.2	16.2

6: Main St. & Nelson St. W./Theatre Ln. Performance by movement

Movement	All
Denied Delay (hr)	0.2
Denied Del/Veh (s)	0.5
Total Delay (hr)	8.5
Total Del/Veh (s)	22.1

7: Theatre Ln. & Union St. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBT	NBR	SBL	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.3	0.0	0.0	3.4	0.4	0.3	0.1	0.1	0.0	0.0	0.0	0.3
Total Delay (hr)	0.1	0.4	0.0	0.0	0.4	0.1	0.0	0.0	0.3	0.0	0.0	1.4
Total Del/Veh (s)	13.7	8.4	5.0	9.9	7.7	4.1	9.5	4.8	15.8	13.5	3.4	8.7

8: Nelson St. E./Nelson St. & Union St. Performance by movement

Movement	EBL	EBR	WBL	NBL	NBT	NBR	SBL	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Total Del/Veh (s)	5.8	2.4		2.0	0.6	0.3	2.2	0.8	0.8	1.1

Total Zone Performance

Denied Delay (hr)	41.0
Denied Del/Veh (s)	63.7
Total Delay (hr)	28.5
Total Del/Veh (s)	648.7

Intersection: 1: Church St. & Scott St.

Movement	EB	WB	NB
Directions Served	LTR	LTR	LTR
Maximum Queue (m)	13.0	20.0	8.7
Average Queue (m)	1.6	3.1	3.2
95th Queue (m)	8.1	12.2	8.4
Link Distance (m)	109.0	124.9	123.8
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (m)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 2: Church St. & Ken Whillians Dr.

Movement	EB	WB	WB	SB	SB
Directions Served	LT	T	R	L	R
Maximum Queue (m)	37.6	25.3	19.9	15.7	9.0
Average Queue (m)	19.2	11.0	9.0	7.6	3.8
95th Queue (m)	32.0	17.2	14.6	13.3	9.0
Link Distance (m)	163.0	109.0		116.4	
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (m)			10.0		15.0
Storage Blk Time (%)		10	5	0	0
Queuing Penalty (veh)		6	6	0	0

Intersection: 3: Union St. & Church St.

Movement	EB	EB	WB	WB	NB	SB
Directions Served	L	TR	L	TR	LTR	LTR
Maximum Queue (m)	17.0	51.1	12.9	15.7	20.2	15.0
Average Queue (m)	1.7	19.7	7.3	9.4	9.8	7.7
95th Queue (m)	10.0	34.3	13.9	12.0	16.2	14.3
Link Distance (m)		160.1		163.0	139.8	129.0
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (m)	21.0		25.0			
Storage Blk Time (%)		4				
Queuing Penalty (veh)		0				

Intersection: 4: Main St. & Church St.

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	L	TR	L	TR	L	TR	LT	TR
Maximum Queue (m)	37.1	64.4	11.5	25.4	48.8	91.1	28.9	30.8
Average Queue (m)	6.0	22.6	3.6	10.6	3.7	46.8	19.9	22.0
95th Queue (m)	20.8	47.4	10.6	21.1	21.0	82.4	25.7	27.6
Link Distance (m)		114.0		160.1		86.9		
Upstream Blk Time (%)		0				2	0	1
Queuing Penalty (veh)		0				8	0	0
Storage Bay Dist (m)	71.0		31.0		37.0			
Storage Blk Time (%)	0	1		0		15		
Queuing Penalty (veh)	0	0		0		1		

Intersection: 5: Nelson St. E. & Main St.

Movement	EB	WB	NB	NB	SB	SB
Directions Served	R	LTR	L	TR	L	TR
Maximum Queue (m)	9.2	8.1	6.6	34.9	81.2	103.3
Average Queue (m)	1.2	2.0	1.3	10.2	5.9	83.9
95th Queue (m)	6.3	5.9	5.5	31.6	33.9	111.6
Link Distance (m)	53.8	169.9		28.2	86.9	86.9
Upstream Blk Time (%)				2	0	18
Queuing Penalty (veh)				12	0	53
Storage Bay Dist (m)			20.0			
Storage Blk Time (%)				4		
Queuing Penalty (veh)				0		

Intersection: 6: Main St. & Nelson St. W./Theatre Ln.

Movement	EB	EB	WB	WB	NB	SB
Directions Served	L	TR	L	TR	LTR	LTR
Maximum Queue (m)	34.8	57.8	15.2	60.1	94.1	46.8
Average Queue (m)	12.6	23.1	2.8	23.4	46.3	36.7
95th Queue (m)	27.3	44.3	9.4	46.7	88.4	41.8
Link Distance (m)		90.0		135.0	156.7	28.2
Upstream Blk Time (%)					0	49
Queuing Penalty (veh)					0	292
Storage Bay Dist (m)	23.0		18.0			
Storage Blk Time (%)	2	11	0	19		
Queuing Penalty (veh)	2	8	1	4		

Intersection: 7: Theatre Ln. & Union St.

Movement	EB	EB	WB	WB	NB	SB	SB
Directions Served	L	TR	L	TR	TR	L	TR
Maximum Queue (m)	13.8	54.1	14.9	41.6	4.6	22.1	10.4
Average Queue (m)	2.5	14.2	2.5	17.3	0.5	9.9	3.6
95th Queue (m)	8.6	34.6	9.7	33.4	2.9	19.1	10.7
Link Distance (m)		135.0		64.4	56.8		86.6
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (m)	35.0		19.0			25.0	
Storage Blk Time (%)		1	0	5		0	
Queuing Penalty (veh)		0	0	1		0	

Intersection: 8: Nelson St. E./Nelson St. & Union St.

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (m)	8.6	1.8	3.6	5.1
Average Queue (m)	4.6	0.1	0.1	0.2
95th Queue (m)	11.2	1.3	1.8	2.2
Link Distance (m)	169.9	63.6	86.6	139.8
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (m)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Zone Summary

Zone wide Queuing Penalty: 396

1: Church St. & Scott St.

Future Do Nothing (2031) - PM Peak Hour

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣				
Traffic Volume (veh/h)	79	354	23	5	856	34	40	6	2	0	0	0
Future Volume (Veh/h)	79	354	23	5	856	34	40	6	2	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	86	385	25	5	930	37	43	7	2	0	0	0
Pedestrians		3			9			17			14	
Lane Width (m)		3.5			3.5			3.5			0.0	
Walking Speed (m/s)		1.1			1.1			1.1			1.1	
Percent Blockage		0			1			2			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	981			427			1548	1578	424	1556	1572	966
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	981			427			1548	1578	424	1556	1572	966
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 %	88			100			48	93	100	100	100	100
cM capacity (veh/h)	712			1126			83	95	620	77	96	311

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	496	972	52
Volume Left	86	5	43
Volume Right	25	37	2
cSH	712	1126	87
Volume to Capacity	0.12	0.00	0.60
Queue Length 95th (m)	3.1	0.1	20.8
Control Delay (s)	3.3	0.1	94.9
Lane LOS	A	A	F
Approach Delay (s)	3.3	0.1	94.9
Approach LOS			F

Intersection Summary			
Average Delay	4.4		
Intersection Capacity Utilization	100.5%	ICU Level of Service	G
Analysis Period (min)	15		

2: Church St. & Ken Whillians Dr.

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↑	↱	↰	↱
Sign Control		Stop	Stop		Stop	
Traffic Volume (vph)	30	341	748	144	76	50
Future Volume (vph)	30	341	748	144	76	50
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	33	371	813	157	83	54

Direction, Lane #	EB 1	WB 1	WB 2	SB 1	SB 2
Volume Total (vph)	404	813	157	83	54
Volume Left (vph)	33	0	0	83	0
Volume Right (vph)	0	0	157	0	54
Hadj (s)	0.06	0.02	-0.70	0.50	-0.63
Departure Headway (s)	5.7	5.5	4.8	7.7	6.6
Degree Utilization, x	0.64	1.24	0.21	0.18	0.10
Capacity (veh/h)	616	659	743	448	521
Control Delay (s)	18.4	138.0	7.8	11.2	9.1
Approach Delay (s)	18.4	116.9		10.4	
Approach LOS	C	F		B	

Intersection Summary			
Delay	80.9		
Level of Service	F		
Intersection Capacity Utilization	62.5%	ICU Level of Service	B
Analysis Period (min)	15		

3: Union St. & Church St.

Future Do Nothing (2031) - PM Peak Hour

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↑			✥			✥	
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	3	233	10	120	622	65	31	57	77	32	16	5
Future Volume (vph)	3	233	10	120	622	65	31	57	77	32	16	5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	3	253	11	130	676	71	34	62	84	35	17	5

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total (vph)	3	264	130	747	180	57
Volume Left (vph)	3	0	130	0	34	35
Volume Right (vph)	0	11	0	71	84	5
Hadj (s)	0.50	0.00	0.50	-0.05	-0.23	0.07
Departure Headway (s)	6.7	6.2	6.2	5.6	6.2	6.9
Degree Utilization, x	0.01	0.46	0.22	1.17	0.31	0.11
Capacity (veh/h)	511	561	568	644	554	484
Control Delay (s)	8.6	13.2	9.8	112.1	12.1	10.7
Approach Delay (s)	13.1		96.9		12.1	10.7
Approach LOS	B		F		B	B

Intersection Summary			
Delay	66.1		
Level of Service	F		
Intersection Capacity Utilization	64.7%	ICU Level of Service	C
Analysis Period (min)	15		

4: Main St. & Church St.

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↰	↱	↰	↱	↰	↱		↰↱
Traffic Volume (vph)	68	140	123	448	28	818	35	599
Future Volume (vph)	68	140	123	448	28	818	35	599
Lane Group Flow (vph)	74	193	134	567	30	951	0	766
Turn Type	pm+pt	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases	3	8		4		2		6
Permitted Phases	8		4		2		6	
Detector Phase	3	8	4	4	2	2	6	6
Switch Phase								
Minimum Initial (s)	5.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	10.0	28.0	28.0	28.0	30.0	30.0	30.0	30.0
Total Split (s)	10.0	49.0	39.0	39.0	71.0	71.0	71.0	71.0
Total Split (%)	8.3%	40.8%	32.5%	32.5%	59.2%	59.2%	59.2%	59.2%
Yellow Time (s)	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	0.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0		0.0
Total Lost Time (s)	3.0	6.0	6.0	6.0	6.0	6.0		6.0
Lead/Lag	Lead		Lag	Lag				
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
v/c Ratio	0.49	0.34	0.46	1.22	0.11	1.05		0.71
Control Delay	35.2	28.3	42.0	155.1	14.9	72.4		24.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	19.8		0.0
Total Delay	35.2	28.3	42.0	155.1	14.9	92.2		24.1
Queue Length 50th (m)	11.1	30.5	26.3	~165.7	3.3	~248.5		67.2
Queue Length 95th (m)	21.5	49.6	46.0	#234.0	8.6	#325.8		91.9
Internal Link Dist (m)		105.2		158.0		82.5		21.1
Turn Bay Length (m)	71.0		31.0		37.0			
Base Capacity (vph)	153	594	292	464	267	903		1082
Starvation Cap Reductn	0	0	0	0	0	218		0
Spillback Cap Reductn	0	0	0	0	0	0		0
Storage Cap Reductn	0	0	0	0	0	0		0
Reduced v/c Ratio	0.48	0.32	0.46	1.22	0.11	1.39		0.71

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 118
Natural Cycle: 150
Control Type: Semi Act-Uncoord
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 4: Main St. & Church St.

4: Main St. & Church St.

Future Do Nothing (2031) - PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱			↰↱	
Traffic Volume (vph)	68	140	38	123	448	74	28	818	57	35	599	71
Future Volume (vph)	68	140	38	123	448	74	28	818	57	35	599	71
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.0		6.0	6.0		6.0	6.0			6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00			0.95	
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	0.99			0.99	
Flpb, ped/bikes	1.00	1.00		0.97	1.00		0.97	1.00			1.00	
Frt	1.00	0.97		1.00	0.98		1.00	0.99			0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00			1.00	
Satd. Flow (prot)	1606	1607		1563	1640		1488	1634			3017	
Flt Permitted	0.11	1.00		0.64	1.00		0.31	1.00			0.64	
Satd. Flow (perm)	188	1607		1047	1640		484	1634			1950	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	74	152	41	134	487	80	30	889	62	38	651	77
RTOR Reduction (vph)	0	8	0	0	5	0	0	2	0	0	7	0
Lane Group Flow (vph)	74	185	0	134	562	0	30	949	0	0	759	0
Confl. Peds. (#/hr)	17		22	22		17	40		28	28		40
Confl. Bikes (#/hr)			1			1						
Heavy Vehicles (%)	0%	0%	4%	0%	0%	0%	5%	2%	0%	0%	4%	0%
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	3	8			4			2			6	
Permitted Phases	8			4			2			6		
Actuated Green, G (s)	41.5	41.5		33.0	33.0		65.1	65.1			65.1	
Effective Green, g (s)	41.5	41.5		33.0	33.0		65.1	65.1			65.1	
Actuated g/C Ratio	0.35	0.35		0.28	0.28		0.55	0.55			0.55	
Clearance Time (s)	3.0	6.0		6.0	6.0		6.0	6.0			6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0			3.0	
Lane Grp Cap (vph)	131	562		291	456		265	896			1070	
v/s Ratio Prot	c0.03	0.11			c0.34			c0.58				
v/s Ratio Perm	0.17			0.13			0.06				0.39	
v/c Ratio	0.56	0.33		0.46	1.23		0.11	1.06			0.71	
Uniform Delay, d1	30.8	28.3		35.4	42.8		12.9	26.8			19.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00			1.00	
Incremental Delay, d2	5.5	0.3		1.2	122.4		0.2	46.9			2.2	
Delay (s)	36.3	28.7		36.6	165.2		13.1	73.7			21.9	
Level of Service	D	C		D	F		B	E			C	
Approach Delay (s)		30.8			140.6			71.8			21.9	
Approach LOS		C			F			E			C	

Intersection Summary			
HCM 2000 Control Delay	71.5	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.09		
Actuated Cycle Length (s)	118.6	Sum of lost time (s)	15.0
Intersection Capacity Utilization	100.8%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

5: Nelson St. E. & Main St.

	↘	←	↖	↑	↘	↓
Lane Group	EBR	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↱	✥	↰	↱	↰	↱
Traffic Volume (vph)	6	0	6	913	22	747
Future Volume (vph)	6	0	6	913	22	747
Lane Group Flow (vph)	7	15	7	1003	24	812
Turn Type	Prot	NA	Prot	NA	Perm	NA
Protected Phases	7	8	5	2		6
Permitted Phases					6	
Detector Phase	7	8	5	2	6	6
Switch Phase						
Minimum Initial (s)	6.0	8.0	6.0	8.0	8.0	8.0
Minimum Split (s)	12.0	25.0	12.0	28.0	28.0	28.0
Total Split (s)	12.0	25.0	12.0	63.0	51.0	51.0
Total Split (%)	12.0%	25.0%	12.0%	63.0%	51.0%	51.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lead		Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes		Yes	Yes
Recall Mode	None	None	None	C-Min	C-Min	C-Min
v/c Ratio	0.01	0.05	0.07	0.69	0.08	0.58
Control Delay	0.0	0.3	46.0	11.8	9.5	12.1
Queue Delay	0.0	0.0	0.0	0.2	0.0	0.1
Total Delay	0.0	0.3	46.0	12.0	9.5	12.2
Queue Length 50th (m)	0.0	0.0	1.3	0.0	0.0	0.0
Queue Length 95th (m)	0.0	0.0	5.7	#291.0	8.1	#249.2
Internal Link Dist (m)		173.6		29.9		82.5
Turn Bay Length (m)			20.0			
Base Capacity (vph)	507	413	98	1445	319	1395
Starvation Cap Reductn	0	0	0	68	0	47
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.01	0.04	0.07	0.73	0.08	0.60

Intersection Summary

Cycle Length: 100

Actuated Cycle Length: 100

Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green

Natural Cycle: 100

Control Type: Actuated-Coordinated

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

Splits and Phases: 5: Nelson St. E. & Main St.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations			↱		✥		↰	↱		↰	↱	
Traffic Volume (vph)	0	0	6	4	0	10	6	913	10	22	747	0
Future Volume (vph)	0	0	6	4	0	10	6	913	10	22	747	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)			6.0		6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor			1.00		1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes			1.00		0.98		1.00	1.00		1.00	1.00	
Flpb, ped/bikes			1.00		1.00		1.00	1.00		0.99	1.00	
Frt			0.86		0.90		1.00	1.00		1.00	1.00	
Flt Protected			1.00		0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)			1463		1477		1606	1653		1583	1642	
Flt Permitted			1.00		0.99		0.95	1.00		0.22	1.00	
Satd. Flow (perm)			1463		1477		1606	1653		370	1642	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	7	4	0	11	7	992	11	24	812	0
RTOR Reduction (vph)	0	0	7	0	14	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	1	0	7	1003	0	24	812	0
Confl. Peds. (#/hr)				2		1			43	43		
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	3%	0%
Turn Type			Prot	Perm	NA		Prot	NA		Perm	NA	
Protected Phases			7		8		5	2			6	
Permitted Phases				8						6		
Actuated Green, G (s)			1.2		5.4		1.2	75.4		68.2	68.2	
Effective Green, g (s)			1.2		5.4		1.2	75.4		68.2	68.2	
Actuated g/C Ratio			0.01		0.05		0.01	0.75		0.68	0.68	
Clearance Time (s)			6.0		6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)			3.0		3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)			17		79		19	1246		252	1119	
v/s Ratio Prot			c0.00				0.00	c0.61			0.49	
v/s Ratio Perm					0.00					0.06		
v/c Ratio			0.00		0.01		0.37	0.80		0.10	0.73	
Uniform Delay, d1			48.8		44.8		49.0	7.7		5.4	10.0	
Progression Factor			1.00		1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2			0.1		0.1		11.7	5.6		0.8	4.1	
Delay (s)			48.9		44.8		60.7	13.3		6.2	14.1	
Level of Service			D		D		E	B		A	B	
Approach Delay (s)		48.9			44.8			13.6			13.9	
Approach LOS		D			D			B			B	

Intersection Summary			
HCM 2000 Control Delay	14.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	71.1%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

6: Main St. & Nelson St. W./Theatre Ln.

	↗	→	↙	←	↖	↑	↘	↓
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↰	↱	↰	↱		✥		✥
Traffic Volume (vph)	154	184	34	189	15	658	53	583
Future Volume (vph)	154	184	34	189	15	658	53	583
Lane Group Flow (vph)	167	225	37	333	0	736	0	834
Turn Type	pm+pt	NA	pm+pt	NA	Perm	NA	Perm	NA
Protected Phases	3	8	7	4		2		6
Permitted Phases	8		4		2		6	
Detector Phase	3	8	7	4	2	2	6	6
Switch Phase								
Minimum Initial (s)	6.0	8.0	4.5	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	9.0	25.0	9.0	25.0	28.0	28.0	28.0	28.0
Total Split (s)	9.0	35.0	9.0	35.0	76.0	76.0	76.0	76.0
Total Split (%)	7.5%	29.2%	7.5%	29.2%	63.3%	63.3%	63.3%	63.3%
Yellow Time (s)	3.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	0.0	2.0	0.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0		0.0		0.0
Total Lost Time (s)	3.0	6.0	3.0	6.0		6.0		6.0
Lead/Lag	Lead	Lag	Lead	Lag				
Lead-Lag Optimize?		Yes	Yes					
Recall Mode	None	None	None	None	C-Min	C-Min	C-Min	C-Min
v/c Ratio	0.90	0.57	0.12	1.02		0.78		1.01
Control Delay	79.6	44.8	27.8	97.4		26.5		58.5
Queue Delay	0.0	0.0	0.0	0.0		0.0		34.9
Total Delay	79.6	44.8	27.8	97.4		26.5		93.4
Queue Length 50th (m)	28.9	46.8	5.8	~78.4		125.8		~189.3
Queue Length 95th (m)	#67.4	73.9	13.5	#135.2		180.7		#279.3
Internal Link Dist (m)		74.1		142.1		146.8		29.9
Turn Bay Length (m)	23.0		18.0					
Base Capacity (vph)	186	393	315	326		942		828
Starvation Cap Reductn	0	0	0	0		0		264
Spillback Cap Reductn	0	0	0	0		0		0
Storage Cap Reductn	0	0	0	0		0		0
Reduced v/c Ratio	0.90	0.57	0.12	1.02		0.78		1.48

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 110

Control Type: Actuated-Coordinated

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

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

Splits and Phases: 6: Main St. & Nelson St. W./Theatre Ln.

HCM Signalized Intersection Capacity Analysis
6: Main St. & Nelson St. W./Theatre Ln.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱			✣			✣	
Traffic Volume (vph)	154	184	23	34	189	118	15	658	5	53	583	131
Future Volume (vph)	154	184	23	34	189	118	15	658	5	53	583	131
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.0		3.0	6.0			6.0			6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Frpb, ped/bikes	1.00	0.99		1.00	0.87			1.00			0.97	
Flpb, ped/bikes	0.97	1.00		0.99	1.00			1.00			1.00	
Frt	1.00	0.98		1.00	0.94			1.00			0.98	
Flt Protected	0.95	1.00		0.95	1.00			1.00			1.00	
Satd. Flow (prot)	1518	1435		1586	1274			1653			1548	
Flt Permitted	0.27	1.00		0.53	1.00			0.98			0.91	
Satd. Flow (perm)	434	1435		892	1274			1616			1410	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	167	200	25	37	205	128	16	715	5	58	634	142
RTOR Reduction (vph)	0	4	0	0	19	0	0	0	0	0	6	0
Lane Group Flow (vph)	167	221	0	37	314	0	0	736	0	0	828	0
Confl. Peds. (#/hr)	104		12	12		104	48		37	37		48
Heavy Vehicles (%)	3%	17%	0%	0%	14%	0%	0%	2%	0%	3%	3%	6%
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	3	8		7	4			2			6	
Permitted Phases	8			4			2			6		
Actuated Green, G (s)	38.6	32.6		33.8	30.2			68.8			68.8	
Effective Green, g (s)	38.6	32.6		33.8	30.2			68.8			68.8	
Actuated g/C Ratio	0.32	0.27		0.28	0.25			0.57			0.57	
Clearance Time (s)	3.0	6.0		3.0	6.0			6.0			6.0	
Vehicle Extension (s)	3.0	5.0		3.0	5.0			5.0			5.0	
Lane Grp Cap (vph)	193	389		272	320			926			808	
v/s Ratio Prot	c0.04	0.15		0.00	c0.25							
v/s Ratio Perm	0.23			0.03				0.46			c0.59	
v/c Ratio	0.87	0.57		0.14	0.98			0.79			1.02	
Uniform Delay, d1	38.6	37.6		31.8	44.6			20.1			25.6	
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Incremental Delay, d2	30.8	3.1		0.2	45.5			7.0			38.0	
Delay (s)	69.4	40.8		32.0	90.1			27.1			63.6	
Level of Service	E	D		C	F			C			E	
Approach Delay (s)		53.0			84.3			27.1			63.6	
Approach LOS		D			F			C			E	

Intersection Summary			
HCM 2000 Control Delay	53.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	118.5%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↰	↱	↰	↱	↰	↱	↰	↱
Traffic Volume (vph)	42	202	5	320	3	15	105	2
Future Volume (vph)	42	202	5	320	3	15	105	2
Lane Group Flow (vph)	46	222	5	451	3	30	114	37
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		2		6		3		4
Permitted Phases	2		6		3		4	
Detector Phase	2	2	6	6	3	3	4	4
Switch Phase								
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	26.0	26.0	26.0	26.0	25.0	25.0	25.0	25.0
Total Split (s)	26.0	26.0	26.0	26.0	31.0	31.0	31.0	31.0
Total Split (%)	45.6%	45.6%	45.6%	45.6%	54.4%	54.4%	54.4%	54.4%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	None	None	None	None
v/c Ratio	0.12	0.33	0.01	0.63	0.01	0.06	0.30	0.08
Control Delay	9.7	10.5	8.4	15.4	11.0	8.8	14.6	5.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	9.7	10.5	8.4	15.4	11.0	8.8	14.6	5.5
Queue Length 50th (m)	1.8	9.5	0.2	21.3	0.2	1.0	6.9	0.1
Queue Length 95th (m)	7.9	27.5	1.8	#71.0	1.4	4.7	16.1	4.3
Internal Link Dist (m)		142.1		50.6		45.6		81.3
Turn Bay Length (m)	35.0		19.0		12.0		25.0	
Base Capacity (vph)	450	832	586	872	813	1009	787	945
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.27	0.01	0.52	0.00	0.03	0.14	0.04

Intersection Summary

Cycle Length: 57

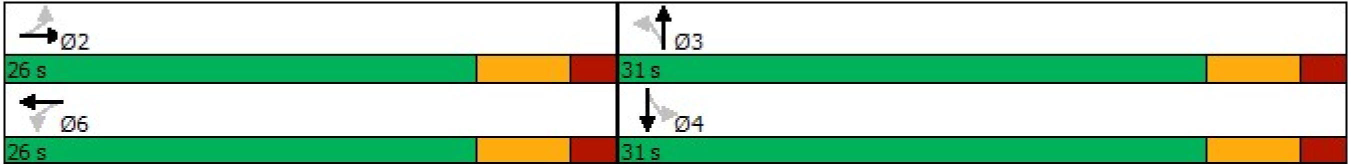
Actuated Cycle Length: 39

Natural Cycle: 55

Control Type: Actuated-Uncoordinated

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

Splits and Phases: 7: Theatre Ln. & Union St.



7: Theatre Ln. & Union St.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱		↰	↱	
Traffic Volume (vph)	42	202	2	5	320	95	3	15	13	105	2	32
Future Volume (vph)	42	202	2	5	320	95	3	15	13	105	2	32
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	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	0.99		1.00	0.98		1.00	0.98	
Flpb, ped/bikes	1.00	1.00		0.99	1.00		1.00	1.00		0.97	1.00	
Frt	1.00	1.00		1.00	0.97		1.00	0.93		1.00	0.86	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1604	1470		1595	1519		1605	1537		1562	1420	
Flt Permitted	0.47	1.00		0.62	1.00		0.73	1.00		0.74	1.00	
Satd. Flow (perm)	797	1470		1040	1519		1238	1537		1213	1420	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	46	220	2	5	348	103	3	16	14	114	2	35
RTOR Reduction (vph)	0	1	0	0	16	0	0	11	0	0	27	0
Lane Group Flow (vph)	46	221	0	5	435	0	3	19	0	114	10	0
Confl. Peds. (#/hr)	3		10	10		3	1		28	28		1
Confl. Bikes (#/hr)												1
Heavy Vehicles (%)	0%	15%	0%	0%	9%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			3			4	
Permitted Phases	2			6			3			4		
Actuated Green, G (s)	18.1	18.1		18.1	18.1		9.2	9.2		9.2	9.2	
Effective Green, g (s)	18.1	18.1		18.1	18.1		9.2	9.2		9.2	9.2	
Actuated g/C Ratio	0.46	0.46		0.46	0.46		0.23	0.23		0.23	0.23	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Grp Cap (vph)	367	677		478	699		289	359		283	332	
v/s Ratio Prot		0.15			c0.29			0.01			0.01	
v/s Ratio Perm	0.06			0.00			0.00			c0.09		
v/c Ratio	0.13	0.33		0.01	0.62		0.01	0.05		0.40	0.03	
Uniform Delay, d1	6.1	6.7		5.7	8.0		11.6	11.7		12.7	11.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.3	0.6		0.0	2.4		0.0	0.1		2.0	0.1	
Delay (s)	6.4	7.3		5.8	10.5		11.6	11.8		14.7	11.7	
Level of Service	A	A		A	B		B	B		B	B	
Approach Delay (s)		7.2			10.4			11.8			14.0	
Approach LOS		A			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	10.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	39.3	Sum of lost time (s)	12.0
Intersection Capacity Utilization	60.1%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

8: Nelson St. E./Nelson St. & Union St.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (veh/h)	14	2	16	1	0	1	7	145	4	7	125	9
Future Volume (Veh/h)	14	2	16	1	0	1	7	145	4	7	125	9
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	15	2	17	1	0	1	8	158	4	8	136	10
Pedestrians		7			7			5			5	
Lane Width (m)		3.5			3.5			3.5			3.5	
Walking Speed (m/s)		1.1			1.1			1.1			1.1	
Percent Blockage		1			1			0			0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)								105				
pX, platoon unblocked												
vC, conflicting volume	346	349	153	363	352	172	153			169		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	346	349	153	363	352	172	153			169		
tC, single (s)	7.2	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	97	100	98	100	100	100	99			99		
cM capacity (veh/h)	580	565	889	567	562	868	1431			1412		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	34	2	170	154
Volume Left	15	1	8	8
Volume Right	17	1	4	10
cSH	700	686	1431	1412
Volume to Capacity	0.05	0.00	0.01	0.01
Queue Length 95th (m)	1.2	0.1	0.1	0.1
Control Delay (s)	10.4	10.3	0.4	0.4
Lane LOS	B	B	A	A
Approach Delay (s)	10.4	10.3	0.4	0.4
Approach LOS	B	B		

Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	23.3%	ICU Level of Service	A
Analysis Period (min)	15		

Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	3:30	3:30	3:30	3:30	3:30	3:30
End Time	5:00	5:00	5:00	5:00	5:00	5:00
Total Time (min)	90	90	90	90	90	90
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	2966	2798	2718	2717	2638	2765
Vehs Exited	2976	2743	2739	2695	2625	2758
Starting Vehs	124	99	164	152	186	145
Ending Vehs	114	154	143	174	199	155
Travel Distance (km)	1476	1383	1388	1354	1289	1378
Travel Time (hr)	788.5	1131.8	959.9	1087.1	1126.0	1018.7
Total Delay (hr)	755.2	1100.7	928.7	1056.6	1096.9	987.6
Total Stops	6531	6382	6331	6583	5976	6361
Fuel Used (l)	788.4	1078.4	931.2	1036.5	1066.1	980.1

Interval #0 Information Seeding

Start Time	3:30
End Time	4:00
Total Time (min)	30

Volumes adjusted by Growth Factors.

No data recorded this interval.

Interval #1 Information Recording

Start Time	4:00
End Time	5:00
Total Time (min)	60

Volumes adjusted by Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	2966	2798	2718	2717	2638	2765
Vehs Exited	2976	2743	2739	2695	2625	2758
Starting Vehs	124	99	164	152	186	145
Ending Vehs	114	154	143	174	199	155
Travel Distance (km)	1476	1383	1388	1354	1289	1378
Travel Time (hr)	788.5	1131.8	959.9	1087.1	1126.0	1018.7
Total Delay (hr)	755.2	1100.7	928.7	1056.6	1096.9	987.6
Total Stops	6531	6382	6331	6583	5976	6361
Fuel Used (l)	788.4	1078.4	931.2	1036.5	1066.1	980.1

1: Church St. & Scott St. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.2	40.9	1.8	1.8	0.2	0.1	45.1
Denied Del/Veh (s)	0.8	0.5	2.7	154.1	168.2	177.1	173.1	194.6	203.6	119.7
Total Delay (hr)	0.4	1.0	0.1	0.0	8.7	0.4	12.3	1.5	0.7	25.0
Total Del/Veh (s)	20.1	11.1	8.2	28.3	37.7	37.1	1133.0	1105.5	896.4	68.6

2: Church St. & Ken Whillians Dr. Performance by movement

Movement	EBL	EBT	WBT	WBR	SBL	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.3	3.9	0.2
Total Delay (hr)	0.1	0.9	9.1	1.5	0.2	0.2	11.9
Total Del/Veh (s)	11.0	11.1	45.9	36.4	8.3	18.4	33.2

3: Union St. & Church St. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.4	0.0	0.0	0.1	1.2	1.6	0.0	0.0	0.0	0.1	0.1	0.1
Total Delay (hr)	0.0	0.5	0.0	0.7	6.4	0.6	0.1	0.4	0.2	0.1	0.0	0.0
Total Del/Veh (s)	7.4	11.0	5.5	22.4	38.5	38.6	17.8	20.7	9.6	6.2	6.4	9.2

3: Union St. & Church St. Performance by movement

Movement	All
Denied Delay (hr)	0.2
Denied Del/Veh (s)	0.7
Total Delay (hr)	9.1
Total Del/Veh (s)	27.8

4: Main St. & Church St. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.7	373.9	47.3
Denied Del/Veh (s)	4.1	0.8	0.8	0.0	0.0	0.0	0.0	0.0	0.0	1700.0	1776.0	1772.6
Total Delay (hr)	0.4	1.4	0.7	5.4	5.3	0.7	0.3	8.4	0.5	0.1	2.7	0.2
Total Del/Veh (s)	22.4	36.0	56.7	168.2	43.3	39.4	60.7	62.7	55.4	47.1	50.3	28.7

4: Main St. & Church St. Performance by movement

Movement	All
Denied Delay (hr)	443.1
Denied Del/Veh (s)	696.8
Total Delay (hr)	26.2
Total Del/Veh (s)	57.5

5: Nelson St. E. & Main St. Performance by movement

Movement	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.1	1.1
Denied Del/Veh (s)	0.1	0.0	0.0	0.0	0.0	0.0	0.0	14.6	11.1	4.4
Total Delay (hr)	0.1	0.1	0.0	0.1	0.0	2.2	0.0	0.1	10.2	12.8
Total Del/Veh (s)	96.8	50.4	0.1	26.7	35.8	15.5	10.7	14.6	103.8	50.3

6: Main St. & Nelson St. W./Theatre Ln. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.2	0.1	0.0	0.0	0.0	0.0	8.1	361.3	2.8	0.0	0.2	0.1
Denied Del/Veh (s)	5.8	2.4	3.7	0.0	0.0	0.0	1392.9	1576.5	1690.4	0.1	2.2	3.6
Total Delay (hr)	2.2	1.3	0.1	0.4	3.4	2.0	0.6	20.8	0.2	0.3	2.9	0.5
Total Del/Veh (s)	52.1	25.0	19.2	35.8	57.7	62.3	315.6	265.5	233.5	46.2	38.1	31.1

6: Main St. & Nelson St. W./Theatre Ln. Performance by movement

Movement	All
Denied Delay (hr)	372.8
Denied Del/Veh (s)	696.9
Total Delay (hr)	34.8
Total Del/Veh (s)	90.3

7: Theatre Ln. & Union St. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.9	0.3	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.2	0.0	0.0	3.2	10.1	12.4	4.2	0.2	0.1	0.0	0.0	0.0
Total Delay (hr)	0.2	0.5	0.0	0.0	1.3	0.3	0.0	0.1	0.0	0.5	0.0	0.0
Total Del/Veh (s)	21.4	10.1	5.7	12.7	14.5	10.7	11.1	16.3	4.8	17.3	3.9	7.2

7: Theatre Ln. & Union St. Performance by movement

Movement	All
Denied Delay (hr)	1.2
Denied Del/Veh (s)	5.6
Total Delay (hr)	3.0
Total Del/Veh (s)	13.3

8: Nelson St. E./Nelson St. & Union St. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBR	NBL	NBT	NBR	SBL	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0		0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Total Del/Veh (s)	7.4	3.1	3.0		3.9	3.2	0.9	0.9	2.4	1.0	0.8	1.3

Total Zone Performance

Denied Delay (hr)	863.6
Denied Del/Veh (s)	761.8
Total Delay (hr)	123.0
Total Del/Veh (s)	2097.8

Intersection: 1: Church St. & Scott St.

Movement	EB	WB	NB
Directions Served	LTR	LTR	LTR
Maximum Queue (m)	83.0	127.0	128.2
Average Queue (m)	24.3	94.9	95.7
95th Queue (m)	70.2	180.3	153.3
Link Distance (m)	109.0	124.9	123.8
Upstream Blk Time (%)	1	51	34
Queuing Penalty (veh)	3	0	0
Storage Bay Dist (m)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 2: Church St. & Ken Whillians Dr.

Movement	EB	WB	WB	SB	SB
Directions Served	LT	T	R	L	R
Maximum Queue (m)	40.2	116.8	25.0	24.1	21.4
Average Queue (m)	18.4	103.6	24.0	8.9	6.8
95th Queue (m)	31.9	134.2	31.7	18.0	16.7
Link Distance (m)	163.0	109.0		116.4	
Upstream Blk Time (%)		17			
Queuing Penalty (veh)		149			
Storage Bay Dist (m)			10.0		15.0
Storage Blk Time (%)		91	11	1	4
Queuing Penalty (veh)		131	79	0	3

Intersection: 3: Union St. & Church St.

Movement	EB	EB	WB	WB	NB	SB
Directions Served	L	TR	L	TR	LTR	LTR
Maximum Queue (m)	7.2	46.0	51.9	141.5	43.9	16.3
Average Queue (m)	0.5	17.1	22.6	68.1	16.6	7.6
95th Queue (m)	3.8	32.2	60.3	165.0	45.2	15.4
Link Distance (m)		162.8		163.0	139.8	129.0
Upstream Blk Time (%)				8		
Queuing Penalty (veh)				64		
Storage Bay Dist (m)	21.0		25.0			
Storage Blk Time (%)		3		43		
Queuing Penalty (veh)		0		51		

Intersection: 4: Main St. & Church St.

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	L	TR	L	TR	L	TR	LT	TR
Maximum Queue (m)	60.8	97.3	59.9	160.0	71.9	94.5	25.9	29.5
Average Queue (m)	13.6	33.3	44.3	94.5	15.5	89.7	13.9	20.4
95th Queue (m)	39.3	79.9	73.9	181.8	59.5	102.6	27.3	25.8
Link Distance (m)		114.0		162.8		87.0		
Upstream Blk Time (%)		1		12		37	0	1
Queuing Penalty (veh)		0		82		340	0	0
Storage Bay Dist (m)	71.0		31.0		37.0			
Storage Blk Time (%)	0	4	48	24		67		
Queuing Penalty (veh)	0	3	250	29		19		

Intersection: 5: Nelson St. E. & Main St.

Movement	EB	WB	NB	NB	SB	SB
Directions Served	R	LTR	L	TR	L	TR
Maximum Queue (m)	11.4	10.8	11.7	36.0	41.8	99.3
Average Queue (m)	2.0	1.9	0.7	31.5	4.1	90.9
95th Queue (m)	8.1	6.6	5.4	41.6	27.0	103.2
Link Distance (m)	45.4	169.9		28.2	87.0	87.0
Upstream Blk Time (%)			0	35	1	53
Queuing Penalty (veh)			0	325	3	203
Storage Bay Dist (m)			20.0			
Storage Blk Time (%)				43		
Queuing Penalty (veh)				3		

Intersection: 6: Main St. & Nelson St. W./Theatre Ln.

Movement	EB	EB	WB	WB	NB	SB
Directions Served	L	TR	L	TR	LTR	LTR
Maximum Queue (m)	37.8	99.0	48.9	139.7	171.5	42.2
Average Queue (m)	27.0	45.5	15.7	68.2	162.4	36.1
95th Queue (m)	41.9	91.1	47.6	127.3	167.2	39.7
Link Distance (m)		90.0		135.0	156.7	28.2
Upstream Blk Time (%)		5		3	96	70
Queuing Penalty (veh)		0		12	0	532
Storage Bay Dist (m)	23.0		18.0			
Storage Blk Time (%)	28	18	0	57		
Queuing Penalty (veh)	57	28	1	19		

Intersection: 7: Theatre Ln. & Union St.

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	L	TR	L	TR	L	TR	L	TR
Maximum Queue (m)	40.4	64.2	6.6	67.2	4.8	8.5	29.3	15.6
Average Queue (m)	6.3	17.8	0.6	32.5	0.4	3.1	13.2	4.6
95th Queue (m)	20.2	43.5	4.1	63.0	2.9	8.2	23.8	12.7
Link Distance (m)		135.0		64.4		56.8		86.6
Upstream Blk Time (%)				6				
Queuing Penalty (veh)				0				
Storage Bay Dist (m)	35.0		19.0		12.0		25.0	
Storage Blk Time (%)		1		18		1	1	
Queuing Penalty (veh)		1		1		0	0	

Intersection: 8: Nelson St. E./Nelson St. & Union St.

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (m)	14.7	9.0	6.6	6.8
Average Queue (m)	4.0	0.6	0.3	0.3
95th Queue (m)	11.7	4.3	3.2	2.8
Link Distance (m)	169.9	63.6	86.6	139.8
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (m)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Zone Summary

Zone wide Queuing Penalty: 2390

1: Church St. & Scott St.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣				
Traffic Volume (veh/h)	29	596	32	12	295	9	10	6	7	0	0	0
Future Volume (Veh/h)	29	596	32	12	295	9	10	6	7	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	32	648	35	13	321	10	11	7	8	0	0	0
Pedestrians		3			9			17			14	
Lane Width (m)		3.5			3.5			3.5			0.0	
Walking Speed (m/s)		1.1			1.1			1.1			1.1	
Percent Blockage		0			1			2			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	345			700			1102	1118	692	1116	1130	343
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	345			700			1102	1118	692	1116	1130	343
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 %	97			99			94	96	98	100	100	100
cM capacity (veh/h)	1225			893			180	198	437	169	194	702

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	715	344	26
Volume Left	32	13	11
Volume Right	35	10	8
cSH	1225	893	226
Volume to Capacity	0.03	0.01	0.11
Queue Length 95th (m)	0.6	0.3	2.9
Control Delay (s)	0.7	0.5	23.0
Lane LOS	A	A	C
Approach Delay (s)	0.7	0.5	23.0
Approach LOS			C

Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	66.1%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰↑	↑	↱	↰	↱
Sign Control		Stop	Stop		Stop	
Traffic Volume (vph)	21	569	202	102	81	31
Future Volume (vph)	21	569	202	102	81	31
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	23	618	220	111	88	34

Direction, Lane #	EB 1	WB 1	WB 2	SB 1	SB 2
Volume Total (vph)	641	220	111	88	34
Volume Left (vph)	23	0	0	88	0
Volume Right (vph)	0	0	111	0	34
Hadj (s)	0.06	0.02	-0.70	0.50	-0.63
Departure Headway (s)	5.2	5.6	4.9	7.4	6.2
Degree Utilization, x	0.92	0.34	0.15	0.18	0.06
Capacity (veh/h)	684	629	718	471	552
Control Delay (s)	40.8	10.3	7.5	10.8	8.4
Approach Delay (s)	40.8	9.4		10.1	
Approach LOS	E	A		B	

Intersection Summary			
Delay	27.8		
Level of Service	D		
Intersection Capacity Utilization	65.6%	ICU Level of Service	C
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis

3: Union St. & Church St.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↑			✥			✥	
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	9	460	35	78	163	16	27	22	70	44	12	4
Future Volume (vph)	9	460	35	78	163	16	27	22	70	44	12	4
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	10	500	38	85	177	17	29	24	76	48	13	4

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total (vph)	10	538	85	194	129	65
Volume Left (vph)	10	0	85	0	29	48
Volume Right (vph)	0	38	0	17	76	4
Hadj (s)	0.50	-0.02	0.50	-0.05	-0.29	0.11
Departure Headway (s)	6.0	5.4	6.2	5.7	5.8	6.4
Degree Utilization, x	0.02	0.81	0.15	0.31	0.21	0.12
Capacity (veh/h)	589	648	548	603	562	504
Control Delay (s)	7.9	26.6	9.1	10.0	10.4	10.2
Approach Delay (s)	26.2		9.7		10.4	10.2
Approach LOS	D		A		B	B

Intersection Summary			
Delay	18.7		
Level of Service	C		
Intersection Capacity Utilization	54.3%	ICU Level of Service	A
Analysis Period (min)	15		

	↗	→	↙	←	↖	↑	↘	↓
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↰	↱	↰	↱	↰	↱		↰↱
Traffic Volume (vph)	34	314	54	95	9	385	104	534
Future Volume (vph)	34	314	54	95	9	385	104	534
Lane Group Flow (vph)	37	379	59	141	10	494	0	718
Turn Type	pm+pt	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases	3	8		4		2		6
Permitted Phases	8		4		2		6	
Detector Phase	3	8	4	4	2	2	6	6
Switch Phase								
Minimum Initial (s)	5.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	10.0	28.0	28.0	28.0	30.0	30.0	30.0	30.0
Total Split (s)	10.0	44.0	34.0	34.0	76.0	76.0	76.0	76.0
Total Split (%)	8.3%	36.7%	28.3%	28.3%	63.3%	63.3%	63.3%	63.3%
Yellow Time (s)	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	0.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0		0.0
Total Lost Time (s)	3.0	6.0	6.0	6.0	6.0	6.0		6.0
Lead/Lag	Lead		Lag	Lag				
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
v/c Ratio	0.09	0.70	0.27	0.35	0.04	0.66		0.71
Control Delay	14.9	26.7	27.7	24.5	10.9	18.1		18.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0
Total Delay	14.9	26.7	27.7	24.5	10.9	18.1		18.2
Queue Length 50th (m)	2.4	34.3	5.7	12.5	0.6	38.0		30.6
Queue Length 95th (m)	9.6	80.3	18.5	33.2	3.4	87.0		64.4
Internal Link Dist (m)		105.2		158.0		82.5		21.1
Turn Bay Length (m)	71.0		31.0		37.0			
Base Capacity (vph)	434	1100	437	795	508	1537		2093
Starvation Cap Reductn	0	0	0	0	0	137		0
Spillback Cap Reductn	0	0	0	0	0	0		0
Storage Cap Reductn	0	0	0	0	0	0		0
Reduced v/c Ratio	0.09	0.34	0.14	0.18	0.02	0.35		0.34

Intersection Summary
Cycle Length: 120
Actuated Cycle Length: 61.3
Natural Cycle: 70
Control Type: Semi Act-Uncoord

Splits and Phases: 4: Main St. & Church St.

4: Main St. & Church St.

Future Do Nothing (2041) - AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱			↰↱	
Traffic Volume (vph)	34	314	35	54	95	35	9	385	70	104	534	23
Future Volume (vph)	34	314	35	54	95	35	9	385	70	104	534	23
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.0		6.0	6.0		6.0	6.0			6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00			0.95	
Frpb, ped/bikes	1.00	1.00		1.00	0.99		1.00	0.99			1.00	
Flpb, ped/bikes	0.99	1.00		0.99	1.00		0.98	1.00			1.00	
Frt	1.00	0.98		1.00	0.96		1.00	0.98			0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00			0.99	
Satd. Flow (prot)	1597	1654		1589	1611		1503	1611			3057	
Flt Permitted	0.56	1.00		0.54	1.00		0.34	1.00			0.71	
Satd. Flow (perm)	934	1654		898	1611		538	1611			2186	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	37	341	38	59	103	38	10	418	76	113	580	25
RTOR Reduction (vph)	0	3	0	0	11	0	0	7	0	0	3	0
Lane Group Flow (vph)	37	376	0	59	130	0	10	487	0	0	715	0
Confl. Peds. (#/hr)	17		22	22		17	40		28	28		40
Confl. Bikes (#/hr)			1			1						
Heavy Vehicles (%)	0%	0%	4%	0%	0%	0%	5%	2%	0%	0%	4%	0%
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	3	8			4			2			6	
Permitted Phases	8			4			2			6		
Actuated Green, G (s)	21.5	21.5		15.0	15.0		28.3	28.3			28.3	
Effective Green, g (s)	21.5	21.5		15.0	15.0		28.3	28.3			28.3	
Actuated g/C Ratio	0.35	0.35		0.24	0.24		0.46	0.46			0.46	
Clearance Time (s)	3.0	6.0		6.0	6.0		6.0	6.0			6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0			3.0	
Lane Grp Cap (vph)	362	575		217	391		246	737			1001	
v/s Ratio Prot	0.01	c0.23			0.08			0.30				
v/s Ratio Perm	0.03			0.07			0.02				c0.33	
v/c Ratio	0.10	0.65		0.27	0.33		0.04	0.66			0.71	
Uniform Delay, d1	13.5	17.0		19.0	19.3		9.3	13.0			13.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00			1.00	
Incremental Delay, d2	0.1	2.7		0.7	0.5		0.1	2.2			2.4	
Delay (s)	13.7	19.7		19.7	19.8		9.3	15.3			15.9	
Level of Service	B	B		B	B		A	B			B	
Approach Delay (s)		19.1			19.7			15.1			15.9	
Approach LOS		B			B			B			B	

Intersection Summary

HCM 2000 Control Delay	16.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	61.8	Sum of lost time (s)	15.0
Intersection Capacity Utilization	95.9%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBR	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↱	✥	↰	↑↱	↰	↑↱
Traffic Volume (vph)	6	0	6	474	16	588
Future Volume (vph)	6	0	6	474	16	588
Lane Group Flow (vph)	7	18	7	525	17	639
Turn Type	Prot	NA	Prot	NA	Perm	NA
Protected Phases	7	8	5	2		6
Permitted Phases					6	
Detector Phase	7	8	5	2	6	6
Switch Phase						
Minimum Initial (s)	5.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	9.5	25.0	14.0	28.0	28.0	28.0
Total Split (s)	9.5	25.0	14.0	55.5	41.5	41.5
Total Split (%)	10.6%	27.8%	15.6%	61.7%	46.1%	46.1%
Yellow Time (s)	3.5	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lead		Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes		Yes	Yes
Recall Mode	None	None	None	C-Min	C-Min	C-Min
v/c Ratio	0.01	0.06	0.05	0.37	0.03	0.47
Control Delay	0.0	0.4	38.5	5.8	9.6	11.3
Queue Delay	0.0	0.0	0.0	0.1	0.0	0.0
Total Delay	0.0	0.4	38.5	5.9	9.6	11.3
Queue Length 50th (m)	0.0	0.0	1.1	0.0	0.0	0.0
Queue Length 95th (m)	0.0	0.0	5.3	85.6	6.0	#177.4
Internal Link Dist (m)		173.6		29.9		82.5
Turn Bay Length (m)			20.0			
Base Capacity (vph)	592	437	140	1428	633	1370
Starvation Cap Reductn	0	0	0	149	0	40
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.01	0.04	0.05	0.41	0.03	0.48

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

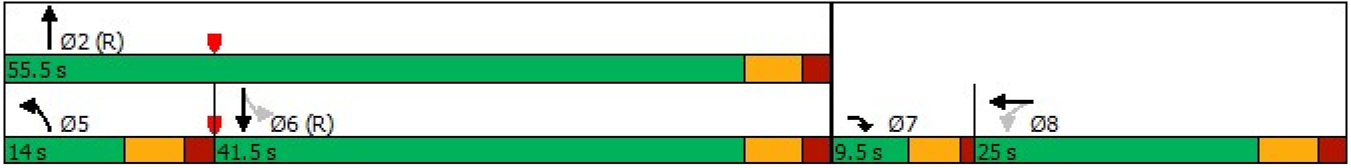
Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green

Natural Cycle: 90

Control Type: Actuated-Coordinated

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

Splits and Phases: 5: Nelson St. E. & Main St.



5: Nelson St. E. & Main St.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations			↱		✥		↰	↱		↰	↱	
Traffic Volume (vph)	0	0	6	3	0	14	6	474	9	16	588	0
Future Volume (vph)	0	0	6	3	0	14	6	474	9	16	588	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.5		6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor			1.00		1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes			1.00		0.98		1.00	1.00		1.00	1.00	
Flpb, ped/bikes			1.00		1.00		1.00	1.00		0.96	1.00	
Frt			0.86		0.89		1.00	1.00		1.00	1.00	
Flt Protected			1.00		0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)			1434		1460		1575	1650		1538	1642	
Flt Permitted			1.00		0.99		0.95	1.00		0.47	1.00	
Satd. Flow (perm)			1434		1460		1575	1650		760	1642	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	7	3	0	15	7	515	10	17	639	0
RTOR Reduction (vph)	0	0	7	0	17	0	0	1	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	1	0	7	524	0	17	639	0
Confl. Peds. (#/hr)				2		1			43	43		
Heavy Vehicles (%)	2%	2%	2%	0%	2%	0%	2%	2%	0%	0%	3%	2%
Turn Type			Prot	Perm	NA		Prot	NA		Perm	NA	
Protected Phases			7		8		5	2			6	
Permitted Phases				8						6		
Actuated Green, G (s)			1.0		5.4		1.6	67.1		59.5	59.5	
Effective Green, g (s)			1.0		5.4		1.6	67.1		59.5	59.5	
Actuated g/C Ratio			0.01		0.06		0.02	0.75		0.66	0.66	
Clearance Time (s)			4.5		6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)			3.0		3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)			15		87		28	1230		502	1085	
v/s Ratio Prot			c0.00				0.00	c0.32			c0.39	
v/s Ratio Perm					0.00					0.02		
v/c Ratio			0.01		0.01		0.25	0.43		0.03	0.59	
Uniform Delay, d1			44.0		39.8		43.6	4.3		5.3	8.5	
Progression Factor			1.00		1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2			0.1		0.1		4.7	1.1		0.1	2.3	
Delay (s)			44.1		39.8		48.3	5.4		5.4	10.8	
Level of Service			D		D		D	A		A	B	
Approach Delay (s)		44.1			39.8			5.9			10.7	
Approach LOS		D			D			A			B	

Intersection Summary			
HCM 2000 Control Delay	9.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	22.5
Intersection Capacity Utilization	59.3%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Queues

6: Main St. & Nelson St. W./Theatre Ln.

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↰	↱	↰	↱		✥		✥
Traffic Volume (vph)	72	123	19	146	13	383	62	430
Future Volume (vph)	72	123	19	146	13	383	62	430
Lane Group Flow (vph)	78	144	21	210	0	434	0	617
Turn Type	pm+pt	NA	pm+pt	NA	Perm	NA	Perm	NA
Protected Phases	3	8	7	4		2		6
Permitted Phases	8		4		2		6	
Detector Phase	3	8	7	4	2	2	6	6
Switch Phase								
Minimum Initial (s)	6.0	8.0	4.5	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	9.0	25.0	9.0	25.0	28.0	28.0	28.0	28.0
Total Split (s)	9.0	25.0	9.0	25.0	46.0	46.0	46.0	46.0
Total Split (%)	11.3%	31.3%	11.3%	31.3%	57.5%	57.5%	57.5%	57.5%
Yellow Time (s)	3.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	0.0	2.0	0.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0		0.0		0.0
Total Lost Time (s)	3.0	6.0	3.0	6.0		6.0		6.0
Lead/Lag	Lead	Lag	Lead	Lag				
Lead-Lag Optimize?		Yes	Yes					
Recall Mode	None	None	None	None	C-Min	C-Min	C-Min	C-Min
v/c Ratio	0.27	0.39	0.06	0.69		0.51		0.82
Control Delay	18.8	27.1	15.8	38.5		15.5		27.7
Queue Delay	0.0	0.0	0.0	0.0		0.0		52.0
Total Delay	18.8	27.1	15.8	38.5		15.5		79.7
Queue Length 50th (m)	7.5	15.1	1.9	25.9		43.3		78.6
Queue Length 95th (m)	16.0	34.2	6.2	47.6		70.0		#146.4
Internal Link Dist (m)		74.1		142.1		146.8		29.9
Turn Bay Length (m)	23.0		18.0					
Base Capacity (vph)	285	400	374	344		845		756
Starvation Cap Reductn	0	0	0	0		0		272
Spillback Cap Reductn	0	0	0	0		0		0
Storage Cap Reductn	0	0	0	0		0		0
Reduced v/c Ratio	0.27	0.36	0.06	0.61		0.51		1.27

Intersection Summary

Cycle Length: 80
Actuated Cycle Length: 80
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 80
Control Type: Actuated-Coordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 6: Main St. & Nelson St. W./Theatre Ln.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱			✥			✥	
Traffic Volume (vph)	72	123	9	19	146	47	13	383	4	62	430	76
Future Volume (vph)	72	123	9	19	146	47	13	383	4	62	430	76
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.0		3.0	6.0			6.0			6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Frpb, ped/bikes	1.00	1.00		1.00	0.94			1.00			0.99	
Flpb, ped/bikes	0.94	1.00		0.99	1.00			1.00			1.00	
Frt	1.00	0.99		1.00	0.96			1.00			0.98	
Flt Protected	0.95	1.00		0.95	1.00			1.00			0.99	
Satd. Flow (prot)	1459	1440		1585	1389			1572			1494	
Flt Permitted	0.48	1.00		0.67	1.00			0.98			0.91	
Satd. Flow (perm)	737	1440		1110	1389			1538			1366	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	78	134	10	21	159	51	14	416	4	67	467	83
RTOR Reduction (vph)	0	3	0	0	15	0	0	0	0	0	7	0
Lane Group Flow (vph)	78	141	0	21	195	0	0	434	0	0	610	0
Confl. Peds. (#/hr)	104		12	12		104	48		37	37		48
Heavy Vehicles (%)	3%	17%	0%	0%	14%	0%	0%	2%	0%	3%	3%	6%
Bus Blockages (#/hr)	0	0	0	0	0	0	12	12	12	12	12	12
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	3	8		7	4			2			6	
Permitted Phases	8			4			2			6		
Actuated Green, G (s)	25.5	20.5		20.3	17.9			42.1			42.1	
Effective Green, g (s)	25.5	20.5		20.3	17.9			42.1			42.1	
Actuated g/C Ratio	0.32	0.26		0.25	0.22			0.53			0.53	
Clearance Time (s)	3.0	6.0		3.0	6.0			6.0			6.0	
Vehicle Extension (s)	3.0	5.0		3.0	5.0			5.0			5.0	
Lane Grp Cap (vph)	280	369		295	310			809			718	
v/s Ratio Prot	c0.02	0.10		0.00	c0.14							
v/s Ratio Perm	0.07			0.02				0.28			c0.45	
v/c Ratio	0.28	0.38		0.07	0.63			0.54			0.85	
Uniform Delay, d1	19.8	24.5		22.6	28.1			12.5			16.2	
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Incremental Delay, d2	0.5	1.4		0.1	5.6			2.5			12.1	
Delay (s)	20.3	25.9		22.7	33.6			15.0			28.3	
Level of Service	C	C		C	C			B			C	
Approach Delay (s)		23.9			32.6			15.0			28.3	
Approach LOS		C			C			B			C	

Intersection Summary			
HCM 2000 Control Delay	24.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	96.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

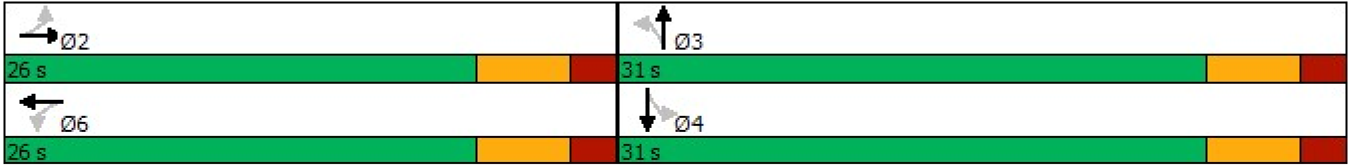
Queues
7: Theatre Ln. & Union St.

Lane Group	EBL	EBT	WBL	WBT	NBT	SBL	SBT
Lane Configurations	↰	↱	↰	↱	↱	↰	↱
Traffic Volume (vph)	14	174	17	209	2	86	10
Future Volume (vph)	14	174	17	209	2	86	10
Lane Group Flow (vph)	15	199	18	318	6	93	20
Turn Type	Perm	NA	Perm	NA	NA	Perm	NA
Protected Phases		2		6	3		4
Permitted Phases	2		6			4	
Detector Phase	2	2	6	6	3	4	4
Switch Phase							
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	26.0	26.0	26.0	26.0	25.0	25.0	25.0
Total Split (s)	26.0	26.0	26.0	26.0	31.0	31.0	31.0
Total Split (%)	45.6%	45.6%	45.6%	45.6%	54.4%	54.4%	54.4%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag							
Lead-Lag Optimize?							
Recall Mode	None	None	None	None	None	None	None
v/c Ratio	0.03	0.27	0.03	0.39	0.01	0.17	0.03
Control Delay	8.9	9.2	8.8	9.4	8.7	10.8	8.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.9	9.2	8.8	9.4	8.7	10.8	8.1
Queue Length 50th (m)	0.5	7.6	0.6	11.6	0.1	4.1	0.5
Queue Length 95th (m)	3.5	24.3	3.9	36.7	1.8	13.4	3.7
Internal Link Dist (m)		142.1		50.6	45.6		81.3
Turn Bay Length (m)	35.0		19.0			25.0	
Base Capacity (vph)	662	1016	732	1056	1117	934	1195
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.02	0.20	0.02	0.30	0.01	0.10	0.02

Intersection Summary

Cycle Length: 57
Actuated Cycle Length: 30.3
Natural Cycle: 55
Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Theatre Ln. & Union St.



	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱		↰	↱	
Traffic Volume (vph)	14	174	9	17	209	84	0	2	4	86	10	8
Future Volume (vph)	14	174	9	17	209	84	0	2	4	86	10	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0			6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	0.99			0.97		1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00		0.98	1.00	
Frt	1.00	0.99		1.00	0.96			0.90		1.00	0.93	
Flt Protected	0.95	1.00		0.95	1.00			1.00		0.95	1.00	
Satd. Flow (prot)	1605	1467		1599	1511			1483		1577	1561	
Flt Permitted	0.57	1.00		0.63	1.00			1.00		0.75	1.00	
Satd. Flow (perm)	959	1467		1065	1511			1483		1251	1561	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	15	189	10	18	227	91	0	2	4	93	11	9
RTOR Reduction (vph)	0	4	0	0	28	0	0	3	0	0	7	0
Lane Group Flow (vph)	15	195	0	18	290	0	0	3	0	93	13	0
Confl. Peds. (#/hr)	3		10	10		3	1		28	28		1
Confl. Bikes (#/hr)												1
Heavy Vehicles (%)	0%	15%	0%	0%	9%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			3			4	
Permitted Phases	2			6			3			4		
Actuated Green, G (s)	7.1	7.1		7.1	7.1			5.8		5.8	5.8	
Effective Green, g (s)	7.1	7.1		7.1	7.1			5.8		5.8	5.8	
Actuated g/C Ratio	0.29	0.29		0.29	0.29			0.23		0.23	0.23	
Clearance Time (s)	6.0	6.0		6.0	6.0			6.0		6.0	6.0	
Vehicle Extension (s)	5.0	5.0		5.0	5.0			5.0		5.0	5.0	
Lane Grp Cap (vph)	273	418		303	430			345		291	363	
v/s Ratio Prot		0.13			c0.19			0.00			0.01	
v/s Ratio Perm	0.02			0.02						c0.07		
v/c Ratio	0.05	0.47		0.06	0.67			0.01		0.32	0.04	
Uniform Delay, d1	6.5	7.3		6.5	7.9			7.3		7.9	7.4	
Progression Factor	1.00	1.00		1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2	0.2	1.7		0.2	5.4			0.0		1.3	0.1	
Delay (s)	6.6	9.1		6.6	13.3			7.4		9.2	7.5	
Level of Service	A	A		A	B			A		A	A	
Approach Delay (s)		8.9			12.9			7.4			8.9	
Approach LOS		A			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	10.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	24.9	Sum of lost time (s)	12.0
Intersection Capacity Utilization	40.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

8: Nelson St. E./Nelson St. & Union St.

Future Do Nothing (2041) - AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Volume (veh/h)	5	0	20	1	0	0	8	98	11	15	88	10
Future Volume (Veh/h)	5	0	20	1	0	0	8	98	11	15	88	10
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	0	22	1	0	0	9	107	12	16	96	11
Pedestrians		7			7			5			5	
Lane Width (m)		3.5			3.5			3.5			3.5	
Walking Speed (m/s)		1.1			1.1			1.1			1.1	
Percent Blockage		1			1			0			0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)								105				
pX, platoon unblocked												
vC, conflicting volume	276	284	114	298	284	125	114			126		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	276	284	114	298	284	125	114			126		
tC, single (s)	7.2	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	100	98	100	100	100	99			99		
cM capacity (veh/h)	642	610	935	621	610	921	1479			1464		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	27	1	128	123
Volume Left	5	1	9	16
Volume Right	22	0	12	11
cSH	862	621	1479	1464
Volume to Capacity	0.03	0.00	0.01	0.01
Queue Length 95th (m)	0.7	0.0	0.1	0.3
Control Delay (s)	9.3	10.8	0.6	1.0
Lane LOS	A	B	A	A
Approach Delay (s)	9.3	10.8	0.6	1.0
Approach LOS	A	B		

Intersection Summary			
Average Delay	1.7		
Intersection Capacity Utilization	23.0%	ICU Level of Service	A
Analysis Period (min)	15		

Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	7:30	7:30	7:30	7:30	7:30	7:30
End Time	9:00	9:00	9:00	9:00	9:00	9:00
Total Time (min)	90	90	90	90	90	90
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	2495	2437	2523	2480	2440	2473
Vehs Exited	2500	2426	2508	2482	2442	2472
Starting Vehs	69	65	56	71	52	55
Ending Vehs	64	76	71	69	50	60
Travel Distance (km)	1170	1143	1184	1178	1172	1169
Travel Time (hr)	144.5	208.6	89.6	146.2	86.9	135.2
Total Delay (hr)	118.4	183.0	63.1	120.0	60.7	109.0
Total Stops	4587	4433	4569	4690	4429	4541
Fuel Used (l)	217.1	268.2	170.3	218.7	166.7	208.2

Interval #0 Information Seeding

Start Time	7:30
End Time	8:00
Total Time (min)	30

Volumes adjusted by Growth Factors.

No data recorded this interval.

Interval #1 Information Recording

Start Time	8:00
End Time	9:00
Total Time (min)	60

Volumes adjusted by Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	2495	2437	2523	2480	2440	2473
Vehs Exited	2500	2426	2508	2482	2442	2472
Starting Vehs	69	65	56	71	52	55
Ending Vehs	64	76	71	69	50	60
Travel Distance (km)	1170	1143	1184	1178	1172	1169
Travel Time (hr)	144.5	208.6	89.6	146.2	86.9	135.2
Total Delay (hr)	118.4	183.0	63.1	120.0	60.7	109.0
Total Stops	4587	4433	4569	4690	4429	4541
Fuel Used (l)	217.1	268.2	170.3	218.7	166.7	208.2

1: Church St. & Scott St. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	0.3	0.3	0.2	0.1	0.1	0.2	0.1
Total Delay (hr)	0.0	0.5	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.7
Total Del/Veh (s)	5.8	3.3	2.6	5.6	0.6	0.3	12.6	12.8	5.7	2.7

2: Church St. & Ken Whillians Dr. Performance by movement

Movement	EBL	EBT	WBT	WBR	SBL	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.2	4.0	0.2
Total Delay (hr)	0.1	2.1	0.4	0.1	0.1	0.0	2.8
Total Del/Veh (s)	12.3	13.3	7.5	4.4	6.2	2.6	10.4

3: Union St. & Church St. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.1	0.0	0.5	0.0	0.0	0.1	0.1	0.0	0.1	0.2	0.3
Total Delay (hr)	0.0	1.7	0.1	0.2	0.4	0.0	0.0	0.0	0.1	0.1	0.0	0.0
Total Del/Veh (s)	9.7	13.8	10.3	7.7	8.5	5.1	5.2	5.8	4.2	5.1	6.4	3.7

3: Union St. & Church St. Performance by movement

Movement	All
Denied Delay (hr)	0.0
Denied Del/Veh (s)	0.1
Total Delay (hr)	2.6
Total Del/Veh (s)	10.4

4: Main St. & Church St. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.1	60.6	2.6
Denied Del/Veh (s)	3.5	0.5	0.6	0.0	0.0	0.0	0.0	0.0	0.0	392.2	392.5	352.0
Total Delay (hr)	0.1	1.5	0.2	0.5	0.4	0.1	0.1	3.7	0.5	0.6	2.4	0.1
Total Del/Veh (s)	14.0	16.9	16.3	34.8	14.6	10.0	44.5	31.7	27.0	24.4	18.5	13.4

4: Main St. & Church St. Performance by movement

Movement	All
Denied Delay (hr)	75.4
Denied Del/Veh (s)	155.5
Total Delay (hr)	10.2
Total Del/Veh (s)	22.3

5: Nelson St. E. & Main St. Performance by movement

Movement	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (hr)	0.1	0.0	0.0	0.0	0.1	0.7	0.0	0.0	5.6	6.5
Total Del/Veh (s)	48.8	58.3	0.1	10.9	35.9	4.8	3.6	8.6	37.0	21.5

6: Main St. & Nelson St. W./Theatre Ln. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	3.8	0.5	0.3	0.0	0.0	0.0	0.4	0.5	0.6	0.1	0.1	0.2
Total Delay (hr)	0.5	0.7	0.0	0.1	1.1	0.3	0.1	2.5	0.0	0.4	2.2	0.3
Total Del/Veh (s)	24.6	20.1	11.5	19.3	26.8	21.3	30.1	23.1	15.7	23.9	19.6	16.2

6: Main St. & Nelson St. W./Theatre Ln. Performance by movement

Movement	All
Denied Delay (hr)	0.2
Denied Del/Veh (s)	0.5
Total Delay (hr)	8.2
Total Del/Veh (s)	21.8

7: Theatre Ln. & Union St. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBT	NBR	SBL	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.2	0.0	0.1	3.6	0.4	0.4	0.1	0.1	0.0	0.0	0.0	0.3
Total Delay (hr)	0.0	0.4	0.0	0.0	0.4	0.1	0.0	0.0	0.4	0.0	0.0	1.4
Total Del/Veh (s)	11.8	8.3	4.6	8.9	7.9	4.2	14.9	4.3	14.3	8.4	3.6	8.5

8: Nelson St. E./Nelson St. & Union St. Performance by movement

Movement	EBL	EBR	WBL	NBL	NBT	NBR	SBL	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Total Del/Veh (s)	5.8	2.7		2.4	0.6	0.4	2.4	0.9	1.0	1.1

Total Zone Performance

Denied Delay (hr)	75.8
Denied Del/Veh (s)	105.1
Total Delay (hr)	32.5
Total Del/Veh (s)	661.9

Intersection: 1: Church St. & Scott St.

Movement	EB	WB	NB
Directions Served	LTR	LTR	LTR
Maximum Queue (m)	24.6	19.3	11.0
Average Queue (m)	3.3	3.0	3.6
95th Queue (m)	13.7	12.2	9.0
Link Distance (m)	109.0	124.9	123.8
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (m)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 2: Church St. & Ken Whillians Dr.

Movement	EB	WB	WB	SB	SB
Directions Served	LT	T	R	L	R
Maximum Queue (m)	65.8	24.2	21.2	17.5	10.5
Average Queue (m)	25.5	12.5	10.2	7.7	3.9
95th Queue (m)	47.1	19.6	16.4	14.1	9.5
Link Distance (m)	163.0	109.0		116.4	
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (m)			10.0		15.0
Storage Blk Time (%)		15	7	0	0
Queuing Penalty (veh)		15	13	0	0

Intersection: 3: Union St. & Church St.

Movement	EB	EB	WB	WB	NB	SB
Directions Served	L	TR	L	TR	LTR	LTR
Maximum Queue (m)	18.2	70.2	16.3	17.7	19.7	16.2
Average Queue (m)	2.3	30.7	9.3	10.8	10.6	8.1
95th Queue (m)	11.1	54.2	14.8	15.7	16.3	15.1
Link Distance (m)		160.1		163.0	139.8	129.0
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (m)	21.0		25.0			
Storage Blk Time (%)		16		0		
Queuing Penalty (veh)		1		0		

Intersection: 4: Main St. & Church St.

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	L	TR	L	TR	L	TR	LT	TR
Maximum Queue (m)	25.8	76.1	23.3	34.2	46.4	93.2	29.4	28.4
Average Queue (m)	5.7	30.9	9.7	13.3	4.1	60.6	20.1	21.2
95th Queue (m)	17.4	60.2	20.3	28.0	23.6	99.6	25.4	26.1
Link Distance (m)		114.0		160.1		86.9		
Upstream Blk Time (%)						6	0	0
Queuing Penalty (veh)						29	0	0
Storage Bay Dist (m)	71.0		31.0		37.0			
Storage Blk Time (%)	0	0	0	1		32		
Queuing Penalty (veh)	0	0	0	0		3		

Intersection: 5: Nelson St. E. & Main St.

Movement	EB	WB	NB	NB	SB	SB
Directions Served	R	LTR	L	TR	L	TR
Maximum Queue (m)	9.8	8.3	10.7	34.6	41.2	99.8
Average Queue (m)	2.2	1.8	1.4	14.5	2.9	73.1
95th Queue (m)	8.1	6.0	6.9	37.7	18.5	115.9
Link Distance (m)	53.8	169.9		28.2	86.9	86.9
Upstream Blk Time (%)			0	5		14
Queuing Penalty (veh)			0	25		45
Storage Bay Dist (m)			20.0			
Storage Blk Time (%)				8		
Queuing Penalty (veh)				0		

Intersection: 6: Main St. & Nelson St. W./Theatre Ln.

Movement	EB	EB	WB	WB	NB	SB
Directions Served	L	TR	L	TR	LTR	LTR
Maximum Queue (m)	33.9	57.9	22.5	66.2	113.0	46.9
Average Queue (m)	13.8	20.0	3.5	26.5	46.4	35.9
95th Queue (m)	28.1	43.0	12.6	51.0	85.4	42.1
Link Distance (m)		90.0		135.0	156.7	28.2
Upstream Blk Time (%)						46
Queuing Penalty (veh)						275
Storage Bay Dist (m)	23.0		18.0			
Storage Blk Time (%)	3	8	0	21		
Queuing Penalty (veh)	4	6	0	4		

Intersection: 7: Theatre Ln. & Union St.

Movement	EB	EB	WB	WB	NB	SB	SB
Directions Served	L	TR	L	TR	TR	L	TR
Maximum Queue (m)	7.3	49.5	11.8	47.9	4.6	27.0	12.9
Average Queue (m)	1.8	13.9	2.3	18.7	0.6	11.6	2.5
95th Queue (m)	6.4	33.0	8.8	37.3	3.2	21.5	9.4
Link Distance (m)		135.0		64.4	56.8		86.6
Upstream Blk Time (%)				0			
Queuing Penalty (veh)				0			
Storage Bay Dist (m)	35.0		19.0			25.0	
Storage Blk Time (%)		1	0	5		0	
Queuing Penalty (veh)		0	0	1		0	

Intersection: 8: Nelson St. E./Nelson St. & Union St.

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (m)	9.9	3.5	8.7	3.5
Average Queue (m)	4.4	0.1	0.3	0.2
95th Queue (m)	11.1	1.8	2.9	2.2
Link Distance (m)	169.9	63.6	86.6	139.8
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (m)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Zone Summary

Zone wide Queuing Penalty: 423

HCM Unsignalized Intersection Capacity Analysis
1: Church St. & Scott St.

Ken Whillians Dr EA, Brampton
Future Do Nothing (2041) - PM Peak Hour

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣				
Traffic Volume (veh/h)	96	432	28	5	856	34	40	6	2	0	0	0
Future Volume (Veh/h)	96	432	28	5	856	34	40	6	2	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	104	470	30	5	930	37	43	7	2	0	0	0
Pedestrians		3			9			17			14	
Lane Width (m)		3.5			3.5			3.5			0.0	
Walking Speed (m/s)		1.1			1.1			1.1			1.1	
Percent Blockage		0			1			2			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	981			517			1672	1701	511	1680	1698	966
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	981			517			1672	1701	511	1680	1698	966
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 %	85			100			35	91	100	100	100	100
cM capacity (veh/h)	712			1043			66	78	554	61	78	311

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	604	972	52
Volume Left	104	5	43
Volume Right	30	37	2
cSH	712	1043	70
Volume to Capacity	0.15	0.00	0.74
Queue Length 95th (m)	3.9	0.1	26.1
Control Delay (s)	3.8	0.1	142.0
Lane LOS	A	A	F
Approach Delay (s)	3.8	0.1	142.0
Approach LOS			F

Intersection Summary			
Average Delay	6.0		
Intersection Capacity Utilization	106.4%	ICU Level of Service	G
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰↑	↑	↱	↰	↱
Sign Control		Stop	Stop		Stop	
Traffic Volume (vph)	33	458	763	147	87	57
Future Volume (vph)	33	458	763	147	87	57
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	36	498	829	160	95	62

Direction, Lane #	EB 1	WB 1	WB 2	SB 1	SB 2
Volume Total (vph)	534	829	160	95	62
Volume Left (vph)	36	0	0	95	0
Volume Right (vph)	0	0	160	0	62
Hadj (s)	0.06	0.02	-0.70	0.50	-0.63
Departure Headway (s)	5.8	5.8	5.0	8.0	6.8
Degree Utilization, x	0.86	1.33	0.22	0.21	0.12
Capacity (veh/h)	610	634	703	438	507
Control Delay (s)	34.8	176.1	8.3	11.9	9.6
Approach Delay (s)	34.8	149.0		11.0	
Approach LOS	D	F		B	

Intersection Summary			
Delay	99.8		
Level of Service	F		
Intersection Capacity Utilization	72.3%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↑			✥			✥	
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	5	331	14	126	654	69	33	57	93	47	17	7
Future Volume (vph)	5	331	14	126	654	69	33	57	93	47	17	7
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	360	15	137	711	75	36	62	101	51	18	8

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total (vph)	5	375	137	786	199	77
Volume Left (vph)	5	0	137	0	36	51
Volume Right (vph)	0	15	0	75	101	8
Hadj (s)	0.50	0.00	0.50	-0.05	-0.25	0.07
Departure Headway (s)	7.0	6.5	6.6	6.1	6.6	7.4
Degree Utilization, x	0.01	0.68	0.25	1.32	0.36	0.16
Capacity (veh/h)	495	537	532	606	509	444
Control Delay (s)	8.9	20.8	10.6	174.1	13.3	11.7
Approach Delay (s)	20.6		149.8		13.3	11.7
Approach LOS	C		F		B	B

Intersection Summary			
Delay	94.8		
Level of Service	F		
Intersection Capacity Utilization	68.9%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↰	↱	↰	↱	↰	↱		↰↱
Traffic Volume (vph)	68	228	123	495	28	818	35	599
Future Volume (vph)	68	228	123	495	28	818	35	599
Lane Group Flow (vph)	74	289	134	618	30	964	0	766
Turn Type	pm+pt	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases	3	8		4		2		6
Permitted Phases	8		4		2		6	
Detector Phase	3	8	4	4	2	2	6	6
Switch Phase								
Minimum Initial (s)	5.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	10.0	28.0	28.0	28.0	30.0	30.0	30.0	30.0
Total Split (s)	10.0	49.0	39.0	39.0	71.0	71.0	71.0	71.0
Total Split (%)	8.3%	40.8%	32.5%	32.5%	59.2%	59.2%	59.2%	59.2%
Yellow Time (s)	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	0.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0		0.0
Total Lost Time (s)	3.0	6.0	6.0	6.0	6.0	6.0		6.0
Lead/Lag	Lead		Lag	Lag				
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
v/c Ratio	0.49	0.51	0.50	1.33	0.11	1.07		0.72
Control Delay	35.2	33.1	44.1	198.2	14.9	77.9		24.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	13.5		0.0
Total Delay	35.2	33.1	44.1	198.2	14.9	91.4		24.6
Queue Length 50th (m)	11.1	51.0	26.6	~191.2	3.3	~255.5		67.7
Queue Length 95th (m)	21.5	77.1	47.2	#260.9	8.6	#333.2		93.2
Internal Link Dist (m)		105.2		158.0		82.5		21.1
Turn Bay Length (m)	71.0		31.0		37.0			
Base Capacity (vph)	153	602	267	464	267	901		1065
Starvation Cap Reductn	0	0	0	0	0	212		0
Spillback Cap Reductn	0	0	0	0	0	0		0
Storage Cap Reductn	0	0	0	0	0	0		0
Reduced v/c Ratio	0.48	0.48	0.50	1.33	0.11	1.40		0.72

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 118

Natural Cycle: 150

Control Type: Semi Act-Uncoord

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

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

Splits and Phases: 4: Main St. & Church St.

HCM Signalized Intersection Capacity Analysis
4: Main St. & Church St.

Ken Whillians Dr EA, Brampton
Future Do Nothing (2041) - PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱			↰↱	
Traffic Volume (vph)	68	228	38	123	495	74	28	818	69	35	599	71
Future Volume (vph)	68	228	38	123	495	74	28	818	69	35	599	71
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.0		6.0	6.0		6.0	6.0			6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00			0.95	
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	0.99			0.99	
Flpb, ped/bikes	1.00	1.00		0.98	1.00		0.97	1.00			1.00	
Frt	1.00	0.98		1.00	0.98		1.00	0.99			0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00			1.00	
Satd. Flow (prot)	1606	1635		1568	1644		1488	1630			3017	
Flt Permitted	0.11	1.00		0.58	1.00		0.31	1.00			0.64	
Satd. Flow (perm)	188	1635		955	1644		484	1630			1921	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	74	248	41	134	538	80	30	889	75	38	651	77
RTOR Reduction (vph)	0	5	0	0	4	0	0	3	0	0	7	0
Lane Group Flow (vph)	74	284	0	134	614	0	30	961	0	0	759	0
Confl. Peds. (#/hr)	17		22	22		17	40		28	28		40
Confl. Bikes (#/hr)			1			1						
Heavy Vehicles (%)	0%	0%	4%	0%	0%	0%	5%	2%	0%	0%	4%	0%
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	3	8			4			2			6	
Permitted Phases	8			4			2			6		
Actuated Green, G (s)	41.5	41.5		33.0	33.0		65.1	65.1			65.1	
Effective Green, g (s)	41.5	41.5		33.0	33.0		65.1	65.1			65.1	
Actuated g/C Ratio	0.35	0.35		0.28	0.28		0.55	0.55			0.55	
Clearance Time (s)	3.0	6.0		6.0	6.0		6.0	6.0			6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0			3.0	
Lane Grp Cap (vph)	131	572		265	457		265	894			1054	
v/s Ratio Prot	c0.03	0.17			c0.37			c0.59				
v/s Ratio Perm	0.17			0.14			0.06				0.40	
v/c Ratio	0.56	0.50		0.51	1.34		0.11	1.08			0.72	
Uniform Delay, d1	30.8	30.3		35.9	42.8		12.9	26.8			20.0	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00			1.00	
Incremental Delay, d2	5.5	0.7		1.5	168.4		0.2	52.4			2.5	
Delay (s)	36.3	31.0		37.5	211.2		13.1	79.2			22.4	
Level of Service	D	C		D	F		B	E			C	
Approach Delay (s)		32.1			180.2			77.2			22.4	
Approach LOS		C			F			E			C	

Intersection Summary			
HCM 2000 Control Delay	83.9	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.13		
Actuated Cycle Length (s)	118.6	Sum of lost time (s)	15.0
Intersection Capacity Utilization	104.4%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBR	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↱	✥	↰	↑↱	↰	↑↱
Traffic Volume (vph)	6	0	6	913	22	747
Future Volume (vph)	6	0	6	913	22	747
Lane Group Flow (vph)	7	15	7	1003	24	812
Turn Type	Prot	NA	Prot	NA	Perm	NA
Protected Phases	7	8	5	2		6
Permitted Phases					6	
Detector Phase	7	8	5	2	6	6
Switch Phase						
Minimum Initial (s)	6.0	8.0	6.0	8.0	8.0	8.0
Minimum Split (s)	12.0	25.0	12.0	28.0	28.0	28.0
Total Split (s)	12.0	25.0	12.0	63.0	51.0	51.0
Total Split (%)	12.0%	25.0%	12.0%	63.0%	51.0%	51.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lead		Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes		Yes	Yes
Recall Mode	None	None	None	C-Min	C-Min	C-Min
v/c Ratio	0.01	0.05	0.07	0.69	0.08	0.58
Control Delay	0.0	0.3	46.0	11.8	9.5	12.1
Queue Delay	0.0	0.0	0.0	0.2	0.0	0.1
Total Delay	0.0	0.3	46.0	12.0	9.5	12.2
Queue Length 50th (m)	0.0	0.0	1.3	0.0	0.0	0.0
Queue Length 95th (m)	0.0	0.0	5.7	#291.0	8.1	#249.2
Internal Link Dist (m)		173.6		29.9		82.5
Turn Bay Length (m)			20.0			
Base Capacity (vph)	507	413	98	1445	319	1395
Starvation Cap Reductn	0	0	0	68	0	47
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.01	0.04	0.07	0.73	0.08	0.60

Intersection Summary

Cycle Length: 100

Actuated Cycle Length: 100

Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green

Natural Cycle: 100

Control Type: Actuated-Coordinated

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

Splits and Phases: 5: Nelson St. E. & Main St.

5: Nelson St. E. & Main St.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations			↱		✥		↰	↱		↰	↱	
Traffic Volume (vph)	0	0	6	4	0	10	6	913	10	22	747	0
Future Volume (vph)	0	0	6	4	0	10	6	913	10	22	747	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)			6.0		6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor			1.00		1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes			1.00		0.98		1.00	1.00		1.00	1.00	
Flpb, ped/bikes			1.00		1.00		1.00	1.00		0.99	1.00	
Frt			0.86		0.90		1.00	1.00		1.00	1.00	
Flt Protected			1.00		0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)			1463		1477		1606	1653		1583	1642	
Flt Permitted			1.00		0.99		0.95	1.00		0.22	1.00	
Satd. Flow (perm)			1463		1477		1606	1653		370	1642	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	7	4	0	11	7	992	11	24	812	0
RTOR Reduction (vph)	0	0	7	0	14	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	1	0	7	1003	0	24	812	0
Confl. Peds. (#/hr)				2		1			43	43		
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	3%	0%
Turn Type			Prot	Perm	NA		Prot	NA		Perm	NA	
Protected Phases			7		8		5	2			6	
Permitted Phases				8						6		
Actuated Green, G (s)			1.2		5.4		1.2	75.4		68.2	68.2	
Effective Green, g (s)			1.2		5.4		1.2	75.4		68.2	68.2	
Actuated g/C Ratio			0.01		0.05		0.01	0.75		0.68	0.68	
Clearance Time (s)			6.0		6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)			3.0		3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)			17		79		19	1246		252	1119	
v/s Ratio Prot			c0.00				0.00	c0.61			0.49	
v/s Ratio Perm					0.00					0.06		
v/c Ratio			0.00		0.01		0.37	0.80		0.10	0.73	
Uniform Delay, d1			48.8		44.8		49.0	7.7		5.4	10.0	
Progression Factor			1.00		1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2			0.1		0.1		11.7	5.6		0.8	4.1	
Delay (s)			48.9		44.8		60.7	13.3		6.2	14.1	
Level of Service			D		D		E	B		A	B	
Approach Delay (s)		48.9			44.8			13.6			13.9	
Approach LOS		D			D			B			B	

Intersection Summary			
HCM 2000 Control Delay	14.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	71.1%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

6: Main St. & Nelson St. W./Theatre Ln.

	↗	→	↙	←	↖	↑	↘	↓
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↰	↱	↰	↱		✣		✣
Traffic Volume (vph)	154	184	34	189	15	658	53	583
Future Volume (vph)	154	184	34	189	15	658	53	583
Lane Group Flow (vph)	167	225	37	333	0	736	0	834
Turn Type	pm+pt	NA	pm+pt	NA	Perm	NA	Perm	NA
Protected Phases	3	8	7	4		2		6
Permitted Phases	8		4		2		6	
Detector Phase	3	8	7	4	2	2	6	6
Switch Phase								
Minimum Initial (s)	6.0	8.0	4.5	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	9.0	25.0	9.0	25.0	28.0	28.0	28.0	28.0
Total Split (s)	9.0	35.0	9.0	35.0	76.0	76.0	76.0	76.0
Total Split (%)	7.5%	29.2%	7.5%	29.2%	63.3%	63.3%	63.3%	63.3%
Yellow Time (s)	3.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	0.0	2.0	0.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0		0.0		0.0
Total Lost Time (s)	3.0	6.0	3.0	6.0		6.0		6.0
Lead/Lag	Lead	Lag	Lead	Lag				
Lead-Lag Optimize?		Yes	Yes					
Recall Mode	None	None	None	None	C-Min	C-Min	C-Min	C-Min
v/c Ratio	0.90	0.57	0.12	1.02		0.78		1.01
Control Delay	79.6	44.8	27.8	97.4		26.5		58.5
Queue Delay	0.0	0.0	0.0	0.0		0.0		34.9
Total Delay	79.6	44.8	27.8	97.4		26.5		93.4
Queue Length 50th (m)	28.9	46.8	5.8	~78.4		125.8		~189.3
Queue Length 95th (m)	#67.4	73.9	13.5	#135.2		180.7		#279.3
Internal Link Dist (m)		74.1		142.1		146.8		29.9
Turn Bay Length (m)	23.0		18.0					
Base Capacity (vph)	186	393	315	326		942		828
Starvation Cap Reductn	0	0	0	0		0		264
Spillback Cap Reductn	0	0	0	0		0		0
Storage Cap Reductn	0	0	0	0		0		0
Reduced v/c Ratio	0.90	0.57	0.12	1.02		0.78		1.48

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 110

Control Type: Actuated-Coordinated

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

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

Splits and Phases: 6: Main St. & Nelson St. W./Theatre Ln.

HCM Signalized Intersection Capacity Analysis
6: Main St. & Nelson St. W./Theatre Ln.

Ken Whillians Dr EA, Brampton
Future Do Nothing (2041) - PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱			✥			✥	
Traffic Volume (vph)	154	184	23	34	189	118	15	658	5	53	583	131
Future Volume (vph)	154	184	23	34	189	118	15	658	5	53	583	131
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	6.0		3.0	6.0			6.0			6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Frpb, ped/bikes	1.00	0.99		1.00	0.87			1.00			0.97	
Flpb, ped/bikes	0.97	1.00		0.99	1.00			1.00			1.00	
Frt	1.00	0.98		1.00	0.94			1.00			0.98	
Flt Protected	0.95	1.00		0.95	1.00			1.00			1.00	
Satd. Flow (prot)	1518	1435		1586	1274			1653			1548	
Flt Permitted	0.27	1.00		0.53	1.00			0.98			0.91	
Satd. Flow (perm)	434	1435		892	1274			1616			1410	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	167	200	25	37	205	128	16	715	5	58	634	142
RTOR Reduction (vph)	0	4	0	0	19	0	0	0	0	0	6	0
Lane Group Flow (vph)	167	221	0	37	314	0	0	736	0	0	828	0
Confl. Peds. (#/hr)	104		12	12		104	48		37	37		48
Heavy Vehicles (%)	3%	17%	0%	0%	14%	0%	0%	2%	0%	3%	3%	6%
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	3	8		7	4			2			6	
Permitted Phases	8			4			2			6		
Actuated Green, G (s)	38.6	32.6		33.8	30.2			68.8			68.8	
Effective Green, g (s)	38.6	32.6		33.8	30.2			68.8			68.8	
Actuated g/C Ratio	0.32	0.27		0.28	0.25			0.57			0.57	
Clearance Time (s)	3.0	6.0		3.0	6.0			6.0			6.0	
Vehicle Extension (s)	3.0	5.0		3.0	5.0			5.0			5.0	
Lane Grp Cap (vph)	193	389		272	320			926			808	
v/s Ratio Prot	c0.04	0.15		0.00	c0.25							
v/s Ratio Perm	0.23			0.03				0.46			c0.59	
v/c Ratio	0.87	0.57		0.14	0.98			0.79			1.02	
Uniform Delay, d1	38.6	37.6		31.8	44.6			20.1			25.6	
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Incremental Delay, d2	30.8	3.1		0.2	45.5			7.0			38.0	
Delay (s)	69.4	40.8		32.0	90.1			27.1			63.6	
Level of Service	E	D		C	F			C			E	
Approach Delay (s)		53.0			84.3			27.1			63.6	
Approach LOS		D			F			C			E	

Intersection Summary			
HCM 2000 Control Delay	53.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	118.5%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

	↗	→	↙	←	↖	↑	↘	↓
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↰	↱	↰	↱	↰	↱	↰	↱
Traffic Volume (vph)	42	202	5	320	3	15	105	2
Future Volume (vph)	42	202	5	320	3	15	105	2
Lane Group Flow (vph)	46	222	5	451	3	30	114	37
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		2		6		3		4
Permitted Phases	2		6		3		4	
Detector Phase	2	2	6	6	3	3	4	4
Switch Phase								
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	26.0	26.0	26.0	26.0	25.0	25.0	25.0	25.0
Total Split (s)	26.0	26.0	26.0	26.0	31.0	31.0	31.0	31.0
Total Split (%)	45.6%	45.6%	45.6%	45.6%	54.4%	54.4%	54.4%	54.4%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	None	None	None	None
v/c Ratio	0.12	0.33	0.01	0.63	0.01	0.06	0.30	0.08
Control Delay	9.7	10.5	8.4	15.4	11.0	8.8	14.6	5.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	9.7	10.5	8.4	15.4	11.0	8.8	14.6	5.5
Queue Length 50th (m)	1.8	9.5	0.2	21.3	0.2	1.0	6.9	0.1
Queue Length 95th (m)	7.9	27.5	1.8	#71.0	1.4	4.7	16.1	4.3
Internal Link Dist (m)		142.1		50.6		45.6		81.3
Turn Bay Length (m)	35.0		19.0		12.0		25.0	
Base Capacity (vph)	450	832	586	872	813	1009	787	945
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.27	0.01	0.52	0.00	0.03	0.14	0.04

Intersection Summary

Cycle Length: 57

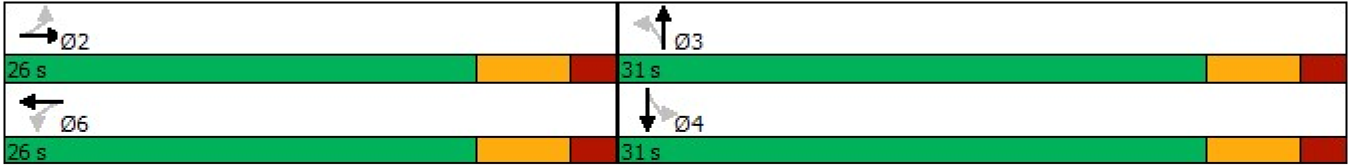
Actuated Cycle Length: 39

Natural Cycle: 55

Control Type: Actuated-Uncoordinated

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

Splits and Phases: 7: Theatre Ln. & Union St.



HCM Signalized Intersection Capacity Analysis
7: Theatre Ln. & Union St.

Ken Whillians Dr EA, Brampton
Future Do Nothing (2041) - PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱		↰	↱	
Traffic Volume (vph)	42	202	2	5	320	95	3	15	13	105	2	32
Future Volume (vph)	42	202	2	5	320	95	3	15	13	105	2	32
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	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	0.99		1.00	0.98		1.00	0.98	
Flpb, ped/bikes	1.00	1.00		0.99	1.00		1.00	1.00		0.97	1.00	
Frt	1.00	1.00		1.00	0.97		1.00	0.93		1.00	0.86	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1604	1470		1595	1519		1605	1537		1562	1420	
Flt Permitted	0.47	1.00		0.62	1.00		0.73	1.00		0.74	1.00	
Satd. Flow (perm)	797	1470		1040	1519		1238	1537		1213	1420	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	46	220	2	5	348	103	3	16	14	114	2	35
RTOR Reduction (vph)	0	1	0	0	16	0	0	11	0	0	27	0
Lane Group Flow (vph)	46	221	0	5	435	0	3	19	0	114	10	0
Confl. Peds. (#/hr)	3		10	10		3	1		28	28		1
Confl. Bikes (#/hr)												1
Heavy Vehicles (%)	0%	15%	0%	0%	9%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			3			4	
Permitted Phases	2			6			3			4		
Actuated Green, G (s)	18.1	18.1		18.1	18.1		9.2	9.2		9.2	9.2	
Effective Green, g (s)	18.1	18.1		18.1	18.1		9.2	9.2		9.2	9.2	
Actuated g/C Ratio	0.46	0.46		0.46	0.46		0.23	0.23		0.23	0.23	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Grp Cap (vph)	367	677		478	699		289	359		283	332	
v/s Ratio Prot		0.15			c0.29			0.01			0.01	
v/s Ratio Perm	0.06			0.00			0.00			c0.09		
v/c Ratio	0.13	0.33		0.01	0.62		0.01	0.05		0.40	0.03	
Uniform Delay, d1	6.1	6.7		5.7	8.0		11.6	11.7		12.7	11.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.3	0.6		0.0	2.4		0.0	0.1		2.0	0.1	
Delay (s)	6.4	7.3		5.8	10.5		11.6	11.8		14.7	11.7	
Level of Service	A	A		A	B		B	B		B	B	
Approach Delay (s)		7.2			10.4			11.8			14.0	
Approach LOS		A			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	10.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	39.3	Sum of lost time (s)	12.0
Intersection Capacity Utilization	60.1%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

8: Nelson St. E./Nelson St. & Union St.

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Volume (veh/h)	14	2	16	1	0	1	7	145	4	7	125	9
Future Volume (Veh/h)	14	2	16	1	0	1	7	145	4	7	125	9
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	15	2	17	1	0	1	8	158	4	8	136	10
Pedestrians		7			7			5			5	
Lane Width (m)		3.5			3.5			3.5			3.5	
Walking Speed (m/s)		1.1			1.1			1.1			1.1	
Percent Blockage		1			1			0			0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)								105				
pX, platoon unblocked												
vC, conflicting volume	346	349	153	363	352	172	153			169		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	346	349	153	363	352	172	153			169		
tC, single (s)	7.2	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	97	100	98	100	100	100	99			99		
cM capacity (veh/h)	580	565	889	567	562	868	1431			1412		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	34	2	170	154
Volume Left	15	1	8	8
Volume Right	17	1	4	10
cSH	700	686	1431	1412
Volume to Capacity	0.05	0.00	0.01	0.01
Queue Length 95th (m)	1.2	0.1	0.1	0.1
Control Delay (s)	10.4	10.3	0.4	0.4
Lane LOS	B	B	A	A
Approach Delay (s)	10.4	10.3	0.4	0.4
Approach LOS	B	B		

Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	23.3%	ICU Level of Service	A
Analysis Period (min)	15		

Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	3:30	3:30	3:30	3:30	3:30	3:30
End Time	5:00	5:00	5:00	5:00	5:00	5:00
Total Time (min)	90	90	90	90	90	90
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	2852	2872	2896	2904	2895	2886
Vehs Exited	2845	2849	2910	2880	2853	2866
Starting Vehs	140	133	144	126	123	132
Ending Vehs	147	156	130	150	165	147
Travel Distance (km)	1467	1451	1502	1481	1478	1476
Travel Time (hr)	967.8	1160.1	1124.1	1037.3	965.7	1051.0
Total Delay (hr)	934.8	1127.4	1090.3	1003.9	932.6	1017.8
Total Stops	6669	6527	6780	6672	6573	6646
Fuel Used (l)	940.8	1109.7	1082.3	1005.4	941.2	1015.9

Interval #0 Information Seeding

Start Time	3:30
End Time	4:00
Total Time (min)	30

Volumes adjusted by Growth Factors.

No data recorded this interval.

Interval #1 Information Recording

Start Time	4:00
End Time	5:00
Total Time (min)	60

Volumes adjusted by Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	2852	2872	2896	2904	2895	2886
Vehs Exited	2845	2849	2910	2880	2853	2866
Starting Vehs	140	133	144	126	123	132
Ending Vehs	147	156	130	150	165	147
Travel Distance (km)	1467	1451	1502	1481	1478	1476
Travel Time (hr)	967.8	1160.1	1124.1	1037.3	965.7	1051.0
Total Delay (hr)	934.8	1127.4	1090.3	1003.9	932.6	1017.8
Total Stops	6669	6527	6780	6672	6573	6646
Fuel Used (l)	940.8	1109.7	1082.3	1005.4	941.2	1015.9

1: Church St. & Scott St. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.1	18.0	0.7	3.3	0.1	0.1	22.4
Denied Del/Veh (s)	0.1	0.0	0.0	94.5	76.0	72.0	267.9	104.3	197.5	55.8
Total Delay (hr)	0.4	1.2	0.1	0.0	7.7	0.3	9.7	1.3	0.5	21.1
Total Del/Veh (s)	17.8	10.6	7.8	33.5	33.0	27.1	919.8	930.5	948.8	53.3

2: Church St. & Ken Whillians Dr. Performance by movement

Movement	EBL	EBT	WBT	WBR	SBL	SBR	All
Denied Delay (hr)	0.0	0.0	4.2	0.3	0.0	0.1	4.5
Denied Del/Veh (s)	0.0	0.0	20.6	7.8	0.3	3.9	11.4
Total Delay (hr)	0.1	1.5	8.7	1.4	0.2	0.1	12.0
Total Del/Veh (s)	12.5	13.1	43.0	35.7	7.5	6.5	29.7

3: Union St. & Church St. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	1.0	2.1	5.6	0.0	0.1	0.1	0.2	0.1	0.2
Total Delay (hr)	0.0	1.0	0.0	0.7	5.3	0.5	0.1	0.1	0.2	0.1	0.0	0.0
Total Del/Veh (s)	9.4	13.6	11.2	19.5	30.7	26.1	10.5	10.1	7.0	6.8	6.9	7.4

3: Union St. & Church St. Performance by movement

Movement	All
Denied Delay (hr)	0.5
Denied Del/Veh (s)	1.3
Total Delay (hr)	8.1
Total Del/Veh (s)	21.6

4: Main St. & Church St. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.0	380.9	49.0
Denied Del/Veh (s)	4.4	1.6	2.0	0.6	0.2	0.0	0.0	0.0	0.0	1758.7	1762.4	1745.8
Total Delay (hr)	0.4	1.8	0.5	4.2	4.6	0.6	0.2	8.4	0.5	0.2	2.7	0.2
Total Del/Veh (s)	23.5	27.6	41.0	131.6	34.4	33.0	57.2	67.1	58.3	53.0	46.7	27.4

4: Main St. & Church St. Performance by movement

Movement	All
Denied Delay (hr)	452.1
Denied Del/Veh (s)	679.3
Total Delay (hr)	24.2
Total Del/Veh (s)	50.1

5: Nelson St. E. & Main St. Performance by movement

Movement	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5
Denied Del/Veh (s)	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5	2.3
Total Delay (hr)	0.1	0.1	0.0	0.1	0.0	2.3	0.0	0.1	9.9	12.6
Total Del/Veh (s)	76.3	84.8	0.2	30.6	49.8	17.2	10.9	19.4	97.7	51.4

6: Main St. & Nelson St. W./Theatre Ln. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.3	0.3	0.0	0.0	0.0	0.0	9.8	403.4	4.0	0.1	0.3	0.1
Denied Del/Veh (s)	7.3	5.0	5.5	0.0	0.0	0.0	1755.9	1712.3	2072.4	13.4	3.4	5.9
Total Delay (hr)	2.3	1.0	0.1	0.5	3.8	2.4	0.7	21.6	0.2	0.3	2.9	0.5
Total Del/Veh (s)	56.5	20.2	18.2	49.0	70.0	69.4	356.8	330.2	395.6	43.6	37.2	28.4

6: Main St. & Nelson St. W./Theatre Ln. Performance by movement

Movement	All
Denied Delay (hr)	418.2
Denied Del/Veh (s)	772.4
Total Delay (hr)	36.4
Total Del/Veh (s)	98.6

7: Theatre Ln. & Union St. Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.2	0.0	0.0	7.9	4.5	4.3	4.8	0.2	0.1	0.0	0.0	0.0
Total Delay (hr)	0.2	0.5	0.0	0.0	1.6	0.3	0.0	0.1	0.0	0.5	0.0	0.1
Total Del/Veh (s)	20.0	8.9	5.9	11.7	17.9	12.4	32.6	16.5	4.9	17.5	7.1	7.0

7: Theatre Ln. & Union St. Performance by movement

Movement	All
Denied Delay (hr)	0.5
Denied Del/Veh (s)	2.4
Total Delay (hr)	3.3
Total Del/Veh (s)	14.6

8: Nelson St. E./Nelson St. & Union St. Performance by movement

Movement	EBL	EBT	EBR	WBR	NBL	NBT	NBR	SBL	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Total Del/Veh (s)	5.9	6.5	2.6	5.0	2.9	0.7	0.4	2.9	1.0	1.0	1.1

Total Zone Performance

Denied Delay (hr)	898.8
Denied Del/Veh (s)	758.7
Total Delay (hr)	117.9
Total Del/Veh (s)	2244.9

Intersection: 1: Church St. & Scott St.

Movement	EB	WB	NB
Directions Served	LTR	LTR	LTR
Maximum Queue (m)	107.8	137.0	109.9
Average Queue (m)	28.9	86.2	76.1
95th Queue (m)	74.9	177.6	152.3
Link Distance (m)	109.0	124.9	123.8
Upstream Blk Time (%)	0	44	32
Queuing Penalty (veh)	2	0	0
Storage Bay Dist (m)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 2: Church St. & Ken Whillians Dr.

Movement	EB	WB	WB	SB	SB
Directions Served	LT	T	R	L	R
Maximum Queue (m)	52.7	116.8	25.0	17.0	15.4
Average Queue (m)	24.1	101.6	24.4	8.8	5.9
95th Queue (m)	43.5	134.7	30.0	14.6	12.1
Link Distance (m)	163.0	109.0		116.4	
Upstream Blk Time (%)		12			
Queuing Penalty (veh)		110			
Storage Bay Dist (m)			10.0		15.0
Storage Blk Time (%)		92	11	1	1
Queuing Penalty (veh)		136	83	0	0

Intersection: 3: Union St. & Church St.

Movement	EB	EB	WB	WB	NB	SB
Directions Served	L	TR	L	TR	LTR	LTR
Maximum Queue (m)	7.3	59.2	60.9	164.7	42.9	20.3
Average Queue (m)	0.8	22.5	23.4	60.3	15.6	9.9
95th Queue (m)	5.2	43.1	60.0	140.4	30.5	17.3
Link Distance (m)		162.8		163.0	139.8	129.0
Upstream Blk Time (%)				3		
Queuing Penalty (veh)				28		
Storage Bay Dist (m)	21.0		25.0			
Storage Blk Time (%)		9		44		
Queuing Penalty (veh)		0		55		

Intersection: 4: Main St. & Church St.

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	L	TR	L	TR	L	TR	LT	TR
Maximum Queue (m)	60.9	107.2	59.9	166.8	71.8	94.2	25.7	26.5
Average Queue (m)	12.6	35.6	38.8	82.6	14.6	89.1	14.0	20.4
95th Queue (m)	35.5	81.9	68.7	160.7	58.2	105.7	27.0	24.6
Link Distance (m)		114.0		162.8		87.0		
Upstream Blk Time (%)		2		7		36	1	0
Queuing Penalty (veh)		0		47		335	0	0
Storage Bay Dist (m)	71.0		31.0		37.0			
Storage Blk Time (%)	0	6	35	25		67		
Queuing Penalty (veh)	0	4	201	31		19		

Intersection: 5: Nelson St. E. & Main St.

Movement	EB	WB	NB	NB	SB	SB
Directions Served	R	LTR	L	TR	L	TR
Maximum Queue (m)	11.6	13.5	10.7	36.0	64.3	99.0
Average Queue (m)	2.0	2.1	0.9	31.7	5.7	90.5
95th Queue (m)	7.9	7.4	5.5	40.8	33.7	101.7
Link Distance (m)	45.4	169.9		28.2	87.0	87.0
Upstream Blk Time (%)				37	0	50
Queuing Penalty (veh)				348	2	190
Storage Bay Dist (m)			20.0			
Storage Blk Time (%)				45		
Queuing Penalty (veh)				3		

Intersection: 6: Main St. & Nelson St. W./Theatre Ln.

Movement	EB	EB	WB	WB	NB	SB
Directions Served	L	TR	L	TR	LTR	LTR
Maximum Queue (m)	37.8	98.6	48.9	139.4	169.9	41.4
Average Queue (m)	27.4	40.8	15.1	76.5	161.8	36.1
95th Queue (m)	43.5	85.1	47.2	142.1	165.7	39.2
Link Distance (m)		90.0		135.0	156.7	28.2
Upstream Blk Time (%)		5		7	98	69
Queuing Penalty (veh)		0		24	0	521
Storage Bay Dist (m)	23.0		18.0			
Storage Blk Time (%)	30	13	1	60		
Queuing Penalty (veh)	63	20	3	20		

Intersection: 7: Theatre Ln. & Union St.

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	L	TR	L	TR	L	TR	L	TR
Maximum Queue (m)	24.9	54.1	27.6	70.5	6.5	13.4	26.4	15.2
Average Queue (m)	4.9	16.4	1.3	37.4	0.5	2.6	14.2	5.2
95th Queue (m)	15.0	37.1	10.6	70.0	3.7	8.0	23.9	13.6
Link Distance (m)		135.0		64.4		56.8		86.6
Upstream Blk Time (%)				9				
Queuing Penalty (veh)				0				
Storage Bay Dist (m)	35.0		19.0		12.0		25.0	
Storage Blk Time (%)		1	0	22	1	1	1	0
Queuing Penalty (veh)		0	0	1	0	0	0	0

Intersection: 8: Nelson St. E./Nelson St. & Union St.

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (m)	11.3	8.9	3.6	3.1
Average Queue (m)	3.7	0.4	0.3	0.2
95th Queue (m)	11.4	3.5	2.7	2.8
Link Distance (m)	169.9	63.6	86.6	139.8
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (m)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Zone Summary

Zone wide Queuing Penalty: 2248

APPENDIX H

FUTURE (2031 & 2041) MMLOS CALCULATION SHEETS

Multi-Modal Level of Service - Segments Form

Consultant	**Parsons Inc.**	**Project**	**477728**
Scenario	**Church Street - 2031 & 2041 Conditions**	**Date**	
Comments	**Main Street to Scott Street**		
	Eastbound		

SEGMENTS			Main	Union	Ken Whillans				Section	Section	Section	Section
			Union	Ken Whillans	Scott				7	8	9	10
Pedestrian	Sidewalk Width Boulevard Width	**E**	1.5 m < 0.5 m	1.5 m < 0.5 m	1.5 m 0.5 - 2 m							
	Avg Daily Curb Lane Traffic Volume		> 3000	> 3000	> 3000							
	Operating Speed On-Street Parking		> 30 to 50 km/h no	> 30 to 50 km/h no	> 30 to 50 km/h no							
	Exposure to Traffic PLoS		**E**	**E**	**E**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Effective Sidewalk Width		1.5 m	1.5 m	1.5 m							
	Pedestrian Volume		250 ped/hr	250 ped/hr	250 ped/hr							
	Crowding PLoS		**B**	**B**	**B**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Level of Service		**E**	**E**	**E**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Bicycle	Type of Cycling Facility	**D**	Mixed Traffic	Mixed Traffic	Mixed Traffic							
	Number of Travel Lanes		2-3 lanes total	2-3 lanes total	2-3 lanes total							
	Operating Speed		>40 to <50 km/h	>40 to <50 km/h	>40 to <50 km/h							
	# of Lanes & Operating Speed LoS		**D**	**D**	**D**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Bike Lane (+ Parking Lane) Width											
	Bike Lane Width LoS		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Bike Lane Blockages											
	Blockage LoS		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Median Refuge Width (no median = < 1.8 m)		< 1.8 m refuge	< 1.8 m refuge	< 1.8 m refuge							
	No. of Lanes at Unsignalized Crossing		≤ 3 lanes	≤ 3 lanes	≤ 3 lanes							
	Sidestreet Operating Speed		≤ 40 km/h	≤ 40 km/h	≤ 40 km/h							
	Unsignalized Crossing - Lowest LoS		**A**	**A**	**A**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Level of Service		**D**	**D**	**D**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Transit	Facility Type	**-**										
	Friction or Ratio Transit:Posted Speed											
	Level of Service		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Truck	Truck Lane Width	**-**										
	Travel Lanes per Direction											
	Level of Service		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Multi-Modal Level of Service - Segments Form

Consultant Parsons Inc.
Project 477728
Scenario Church Street - 2031 & 2041 Conditions
Date
Comments Main Street to Scott Street
Westtbound

SEGMENTS			Main	Union	Ken Whillans				Section	Section	Section	Section
			Union	Ken Whillans	Scott				7	8	9	10
Pedestrian	Sidewalk Width Boulevard Width	**E**	1.5 m < 0.5 m	1.5 m 0.5 - 2 m	1.5 m < 0.5 m							
	Avg Daily Curb Lane Traffic Volume		> 3000	> 3000	> 3000							
	Operating Speed On-Street Parking		> 30 to 50 km/h no	> 30 to 50 km/h no	> 30 to 50 km/h no							
	Exposure to Traffic PLoS		E	E	E	-	-	-	-	-	-	-
	Effective Sidewalk Width		1.5 m	1.5 m	1.5 m							
	Pedestrian Volume		250 ped/hr	250 ped/hr	250 ped/hr							
	Crowding PLoS		B	B	B	-	-	-	-	-	-	-
	Level of Service		**E**	**E**	**E**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Bicycle	Type of Cycling Facility	**D**	Mixed Traffic	Mixed Traffic	Mixed Traffic							
	Number of Travel Lanes		2-3 lanes total	2-3 lanes total	2-3 lanes total							
	Operating Speed		>40 to <50 km/h	>40 to <50 km/h	>40 to <50 km/h							
	# of Lanes & Operating Speed LoS		D	D	D	-	-	-	-	-	-	-
	Bike Lane (+ Parking Lane) Width											
	Bike Lane Width LoS		-	-	-	-	-	-	-	-	-	-
	Bike Lane Blockages											
	Blockage LoS		-	-	-	-	-	-	-	-	-	-
	Median Refuge Width (no median = < 1.8 m)		< 1.8 m refuge	< 1.8 m refuge	< 1.8 m refuge							
	No. of Lanes at Unsignalized Crossing		≤ 3 lanes	≤ 3 lanes	≤ 3 lanes							
	Sidestreet Operating Speed		≤ 40 km/h	≤ 40 km/h	≤ 40 km/h							
	Unsignalized Crossing - Lowest LoS		A	A	A	-	-	-	-	-	-	-
	Level of Service		**D**	**D**	**D**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Transit	Facility Type	**-**										
	Friction or Ratio Transit:Posted Speed											
	Level of Service		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Truck	Truck Lane Width	**-**										
	Travel Lanes per Direction											
	Level of Service		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Multi-Modal Level of Service - Segments Form

Consultant	**Parsons Inc.**	**Project**	**477728**
Scenario	**Nelson Street - 2031 & 2041 Conditions**	**Date**	
Comments	**Main Street to Union Street**		
	Eastbound		

SEGMENTS			Main Union							
Pedestrian	Sidewalk Width Boulevard Width	**E**	1.5 m < 0.5 m							
	Avg Daily Curb Lane Traffic Volume		≤ 3000							
	Operating Speed On-Street Parking		> 30 to 50 km/h no							
	Exposure to Traffic PLoS		**E**	-	-	-	-	-	-	-
	Effective Sidewalk Width		1.5 m							
	Pedestrian Volume		250 ped/hr							
	Crowding PLoS		**B**	-	-	-	-	-	-	-
	Level of Service		**E**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Bicycle	Type of Cycling Facility	**D**	Mixed Traffic							
	Number of Travel Lanes		2-3 lanes total							
	Operating Speed		>40 to <50 km/h							
	# of Lanes & Operating Speed LoS		**D**	-	-	-	-	-	-	-
	Bike Lane (+ Parking Lane) Width									
	Bike Lane Width LoS		-	-	-	-	-	-	-	-
	Bike Lane Blockages									
	Blockage LoS		-	-	-	-	-	-	-	-
	Median Refuge Width (no median = < 1.8 m)		< 1.8 m refuge							
	No. of Lanes at Unsignalized Crossing		≤ 3 lanes							
	Sidestreet Operating Speed		≤ 40 km/h							
	Unsignalized Crossing - Lowest LoS		**A**	-	-	-	-	-	-	-
	Level of Service		**D**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Transit	Facility Type	**-**								
	Friction or Ratio Transit:Posted Speed									
	Level of Service		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Truck	Truck Lane Width	**-**								
	Travel Lanes per Direction									
	Level of Service		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Multi-Modal Level of Service - Segments Form

Consultant	**Parsons Inc.**	**Project**	**477728**
Scenario	**Nelson Street - 2031 & 2041 Conditions**	**Date**	
Comments	**Main Street to Union Street**		
	Westtbound		

SEGMENTS			Union							
			Main							
Pedestrian	Sidewalk Width	**F**	no sidewalk							
	Boulevard Width		n/a							
	Avg Daily Curb Lane Traffic Volume		≤ 3000							
	Operating Speed		> 30 to 50 km/h							
	On-Street Parking		no							
	Exposure to Traffic PLoS		**F**	-	-	-	-	-	-	-
	Effective Sidewalk Width		1.5 m							
	Pedestrian Volume		250 ped/hr							
	Crowding PLoS		**B**	-	-	-	-	-	-	-
	Level of Service		**F**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Bicycle	Type of Cycling Facility	**D**	Mixed Traffic							
	Number of Travel Lanes		2-3 lanes total							
	Operating Speed		>40 to <50 km/h							
	# of Lanes & Operating Speed LoS		**D**	-	-	-	-	-	-	-
	Bike Lane (+ Parking Lane) Width									
	Bike Lane Width LoS		-	-	-	-	-	-	-	-
	Bike Lane Blockages									
	Blockage LoS		-	-	-	-	-	-	-	-
	Median Refuge Width (no median = < 1.8 m)		< 1.8 m refuge							
	No. of Lanes at Unsignalized Crossing		≤ 3 lanes							
	Sidestreet Operating Speed		≤ 40 km/h							
	Unsignalized Crossing - Lowest LoS		**A**	-	-	-	-	-	-	-
	Level of Service		**D**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Transit	Facility Type	**-**								
	Friction or Ratio Transit:Posted Speed									
	Level of Service		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Truck	Truck Lane Width	**-**								
	Travel Lanes per Direction									
	Level of Service		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Multi-Modal Level of Service - Segments Form

Consultant	**Parsons Inc.**	**Project**	**477728**
Scenario	**Nelson Street - 2031 & 2041 Conditions**	**Date**	
Comments	**Main Street to Union Street**		
	Westtbound		

SEGMENTS			Union Main							
Pedestrian	Sidewalk Width Boulevard Width	**F**	no sidewalk n/a							
	Avg Daily Curb Lane Traffic Volume		≤ 3000							
	Operating Speed On-Street Parking		> 30 to 50 km/h no							
	Exposure to Traffic PLoS		**F**	-	-	-	-	-	-	-
	Effective Sidewalk Width		1.5 m							
	Pedestrian Volume		250 ped/hr							
	Crowding PLoS		**B**	-	-	-	-	-	-	-
	Level of Service		**F**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Bicycle	Type of Cycling Facility	**D**	Mixed Traffic							
	Number of Travel Lanes		2-3 lanes total							
	Operating Speed		>40 to <50 km/h							
	# of Lanes & Operating Speed LoS		**D**	-	-	-	-	-	-	-
	Bike Lane (+ Parking Lane) Width									
	Bike Lane Width LoS		-	-	-	-	-	-	-	-
	Bike Lane Blockages									
	Blockage LoS		-	-	-	-	-	-	-	-
	Median Refuge Width (no median = < 1.8 m)		< 1.8 m refuge							
	No. of Lanes at Unsignalized Crossing		≤ 3 lanes							
	Sidestreet Operating Speed		≤ 40 km/h							
	Unsignalized Crossing - Lowest LoS		**A**	-	-	-	-	-	-	-
	Level of Service		**D**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Transit	Facility Type	**-**								
	Friction or Ratio Transit:Posted Speed									
	Level of Service		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Truck	Truck Lane Width	**-**								
	Travel Lanes per Direction									
	Level of Service		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

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