Stantec

2070 Scott Street

Transportation Impact Assessment

Strategy Report

November 1st, 2019

Prepared for:

Azure Urban Developments Inc.

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1.0 SCREENING

1.1 SUMMARY OF DEVELOPMENT

Municipal Address	**2070 Scott Street**
Description of Location	Southeast quadrant of the Churchill Avenue N at Scott Street intersection
Land Use Classification	Residential and Retail
Development Size (units)	241 apartment units
Development Size (ft^2)	5,500 ft^2 of retail
Number of Accesses and Locations	1 access to the underground parking garage on Winona Avenue
Phase of Development	1 of 1 total
Buildout Year	2022

If available, please attach a sketch of the development or site plan to this form.

1.2 TRIP GENERATION TRIGGER

Considering the development's land use type and size (as filled out in the previous section), please refer to the Trip Generation Trigger checks below.

Land Use Type	Minimum Development Size	Triggered
Single-family homes	40 units	✘
Townhomes or apartments	90 units	✓
Office	3,500 m^2	✘
Industrial	5,000 m^2	✘
Fast-food restaurant or coffee shop	100 m^2	✘
Destination retail	1,000 m^2	✘
Gas station or convenience market	75 m^2	✘

** If the development has a land use type other than what is presented in the table above, estimates of person-trip generation may be made based on average trip generation characteristics represented in the current edition of the Institute of Transportation Engineers (ITE) Trip Generation Manual.*

If the proposed development size is greater than the sizes identified above, the Trip Generation Trigger is satisfied.

1.3 LOCATION TRIGGERS

	Yes	No
Does the development propose a new driveway to a boundary street that is designated as part of the City's Transit Priority, Rapid Transit or Spine Bicycle Networks?		✘
Is the development in a Design Priority Area (DPA) or Transit-oriented Development (TOD) zone? *	✓	

**DPA and TOD are identified in the City of Ottawa Official Plan (DPA in Section 2.5.1 and Schedules A and B; TOD in Annex 6). See Chapter 4 for a list of City of Ottawa Planning and Engineering documents that support the completion of TIA).*

If any of the above questions were answered with 'Yes,' the Location Trigger is satisfied.

1.4 SAFETY TRIGGERS

	Yes	No
Are posted speed limits on a boundary street 80 km/hr or greater?		✘
Are there any horizontal/vertical curvatures on a boundary street limits sight lines at a proposed driveway?		✘
Is the proposed driveway within the area of influence of an adjacent traffic signal or roundabout (i.e. within 300 m of intersection in rural conditions, or within 150 m of intersection in urban/ suburban conditions)?		✘
Is the proposed driveway within auxiliary lanes of an intersection?		✘
Does the proposed driveway make use of an existing median break that serves an existing site?		✘
Is there a documented history of traffic operations or safety concerns on the boundary streets within 500 m of the development?		✘
Does the development include a drive-thru facility?		✘

If any of the above questions were answered with 'Yes,' the Safety Trigger is satisfied.

1.5 SUMMARY

	Yes	No
Does the development satisfy the Trip Generation Trigger?	✓	
Does the development satisfy the Location Trigger?	✓	
Does the development satisfy the Safety Trigger?		✘

If none of the triggers are satisfied, the TIA Study is complete. If one or more of the triggers is satisfied, the TIA Study must continue into the next stage (Screening and Scoping).

2.0 SCOPING

2.1 EXISTING AND PLANNED CONDITIONS

2.1.1 Proposed Development

Azure Urban Developments Inc. (Azure) is proceeding with a Zoning By-Law Amendment and Site Plan Control for a proposed 23-storey tower located at 2070 Scott Street in the Westboro community of Ottawa, Ontario. The site is located at the southeast quadrant of the Churchill Avenue N and Scott Street intersection. The site is bound by Churchill Avenue N to the west, Scott Street to the north, Winona Avenue to the east, and existing residential to the south.

Figure 1 illustrates the location of the proposed site.

The subject site is currently zoned as Traditional Mainstreet (TM) Zone; the purpose of the TM Zone, according to the City of Ottawa's Official Plan, is to:

- *"Accommodate a broad range of uses including retail, service commercial, office, residential and institutional uses, including mixed-use buildings but excluding auto-related uses, in areas designated Traditional Mainstreet in the Official Plan;*
- *Foster and promote compact, mixed-use, pedestrian-oriented development that provide for access by foot, cycle, transit and automobile;*
- *Recognize the function of Business Improvement Areas as primary business or shopping areas; and*
- *Impose development standards that will ensure that street continuity, scale and character is maintained, and that the uses are compatible and complement surrounding land uses."*

Figure 2 illustrates the proposed site plan.

Table 1 outlines the land uses assumed for the analysis to forecast the trips generated by the proposed development. The *TRANS Trip Generation Residential Trip Rates Study Report* was used for the residential land use and the *Institute of Transportation Engineers (10th Edition)* was used for the retail land use.

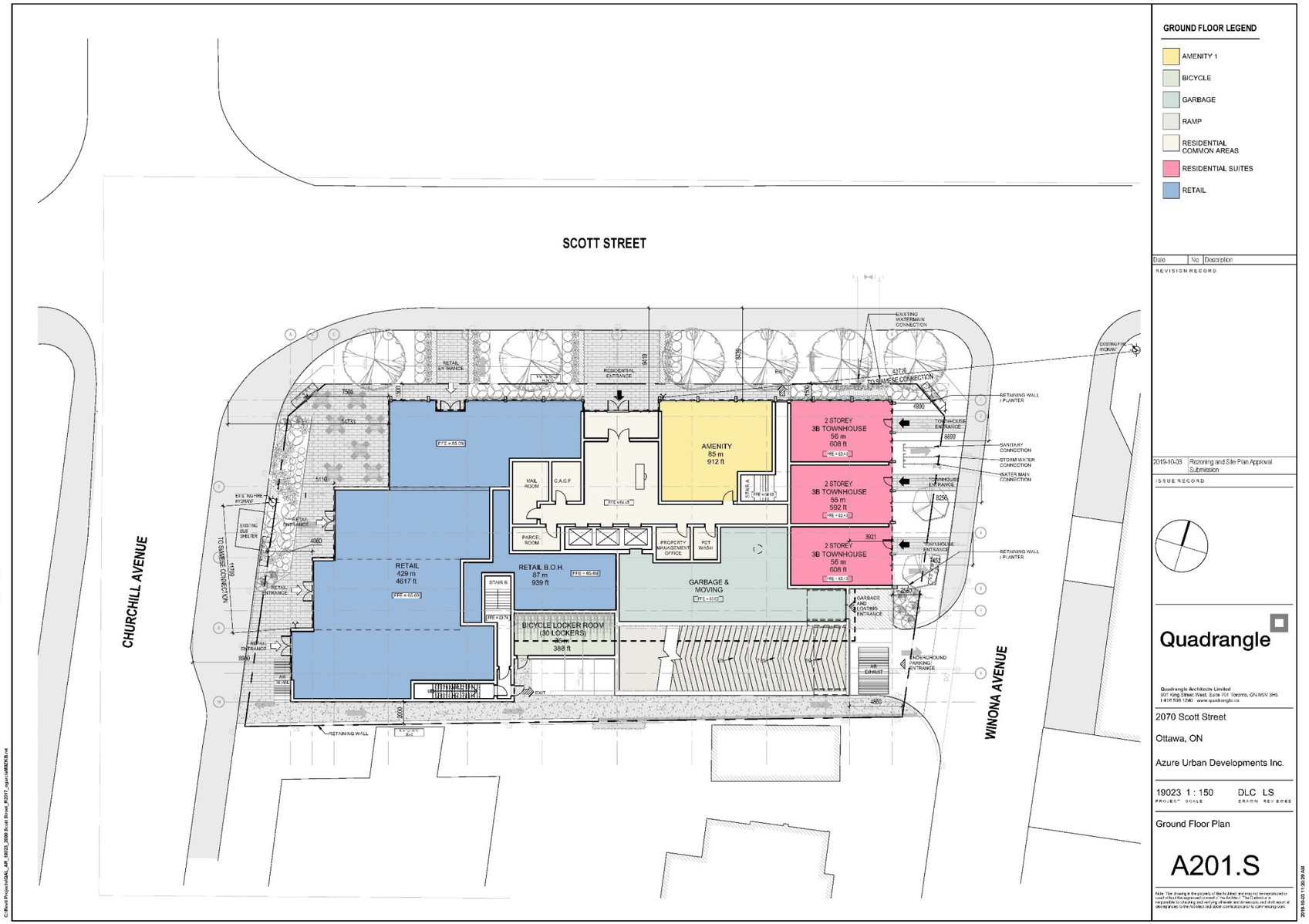
Table 1 - Proposed Land Uses / Land Use Codes

Land Use	Size	Land Use Code (LUC)
Residential	241 units	232 – High-Rise Condominiums
Retail	5,500 ft^2	820 – Shopping Centre

The subject site includes an underground parking garage with access off Winona Avenue on the east side of the building. This will be a full movements access and there will be no turning restrictions.

Figure 1 - Site Location

Figure 2 - Proposed Site Plan



2.1.2 Existing Conditions

2.1.2.1 Roads and Traffic Control

The roadways under consideration in the study area are described as follows:

Richmond Road — In the vicinity of the subject site, Richmond Road is a two-lane municipally owned arterial roadway with dedicated parking lanes on both sides. In the absence of a posted speed limit, the default speed limit is 50 km/hr. Sidewalks are provided along both sides of Richmond Road.

Churchill Avenue N — North of Richmond Road, Churchill Road N is a two-lane municipally owned arterial roadway with dedicated parking lanes on both sides. In the absence of a posted speed limit, the default speed limit is 50 km/hr. Sidewalks are provided along both sides of Churchill Avenue N. The intersection with Richmond Road is signalized with eastbound and westbound left turn auxiliary lanes. It should be noted that the pavement width on the north and south legs are wide enough to accommodate two lanes of traffic in the northbound and southbound directions.

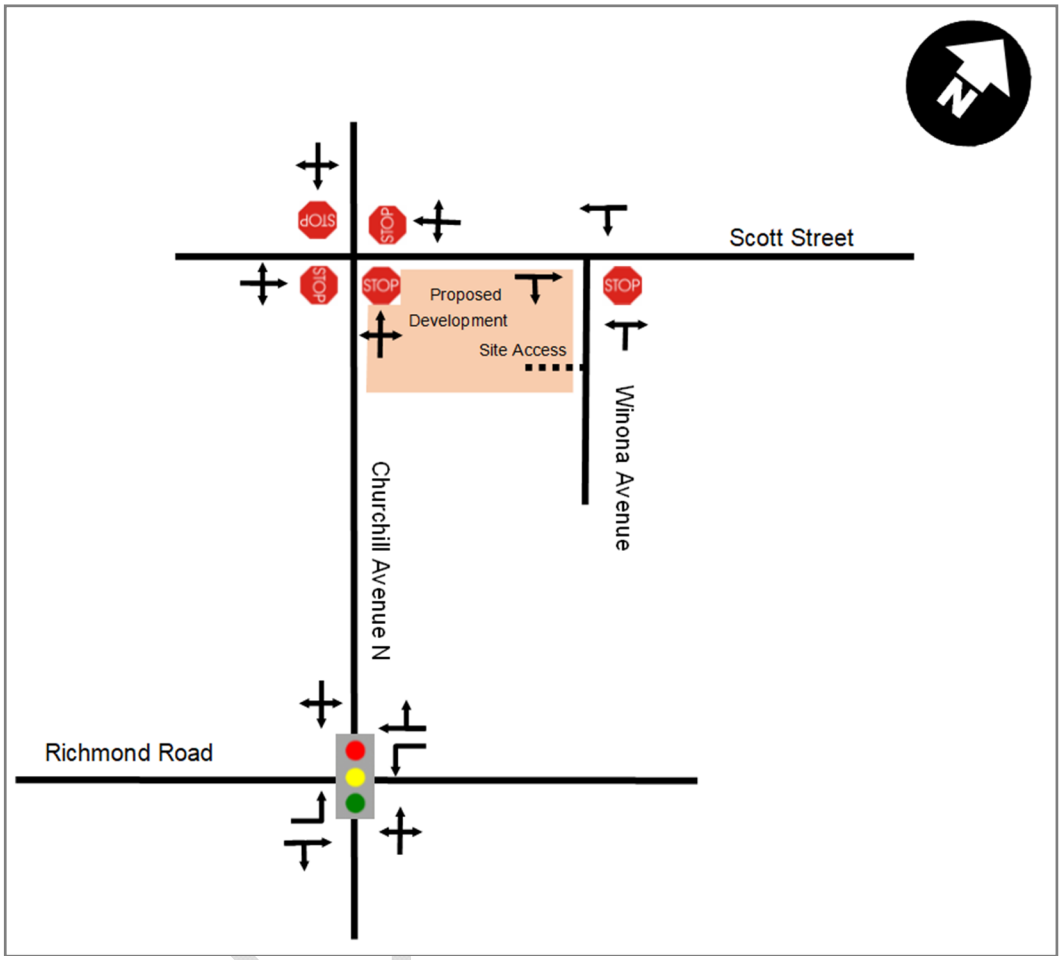
Scott Street — Scott Street is a two-lane municipally owned arterial roadway with a posted speed limit of 50 km/h. There are on-street bicycle lanes on both sides of the road and a sidewalk along the south side of the road. Scott Street is designated as a Traditional Mainstreet within the City of Ottawa's Official Plan. The intersection with Churchill Avenue N is an all-way stop-controlled intersection.

Winona Avenue — Winona Avenue is a two-lane municipally owned local roadway. In the absence of a posted speed limit, the default speed limit is 50 km/hr. The intersection with Scott Street is stop-controlled along the Winona Avenue approach.

Access to the parking garage is proposed to be located on Winona Avenue, just south of Scott Street. Within 200m of the proposed access, there are numerous existing residential buildings and driveways along Winona Avenue. In addition, Ashton Avenue, Elmgrove Avenue, and Whitby Avenue are all within 200m of the proposed site access.

Figure 3 illustrates the existing lane configuration and traffic control.

Figure 3 - Existing Lane Configuration and Traffic Control



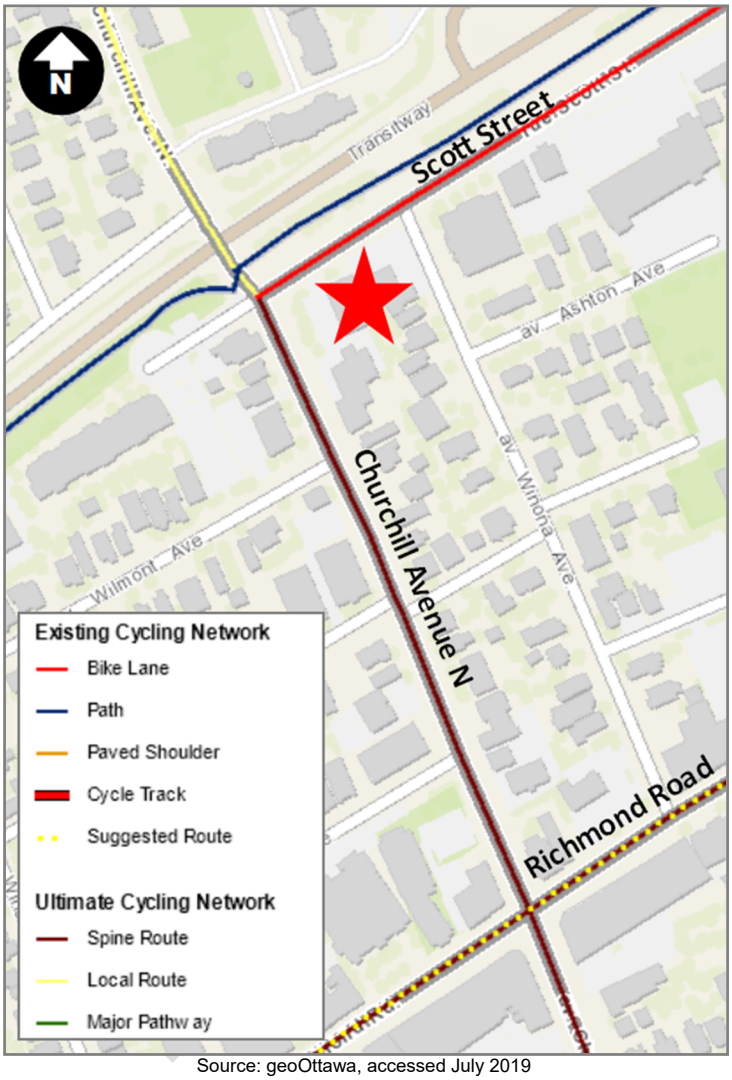
2.1.2.2 Walking and Cycling

In general, the Westboro community is well serviced by pedestrian facilities. There are sidewalks along both sides of Richmond Road and Churchill Avenue N as well as along the south side of Scott Street. Just north of Scott Street, there is a pathway that connects to the Sir John A Macdonald Parkway used by both pedestrians and cyclists.

In terms of cycling facilities, Scott Street has on-street bicycle lanes along both sides of the road and Richmond Road is designated as a suggested cycling route. The City of Ottawa's Ultimate Cycling Network designates Churchill Avenue N, south of Scott Street, as a spine cycling route.

Figure 4 illustrates the existing and planned pedestrian and cycling facilities within the vicinity of the subject site.

Figure 4 - Existing and Planned Active Modes Facilities



Source: geoOttawa, accessed July 2019

2.1.2.3 Transit

The subject site is well serviced by transit, both along the Transitway as well as with local transit routes. The subject site is located approximately 40m south of the Transitway, 270m west of Westboro Station and 400m east of Dominion Station. There are numerous transit routes along the Transitway, including routes 57, 58, 61, 62, 63, 64, 66, 73, 74, 75, 82, 83, 84, 87, 153, 164, 251, 252 and 266.

There is a transit stop at the intersection of Churchill Avenue N at Scott Street which are served by routes 16, 50 and 153. There is also a transit stop at the intersection of Richmond Road at Churchill Avenue N which is served by route 11.

Figure 5 illustrates nearby transit routes and bus stop shelter locations.

Figure 5 - Study Area Transit

Source: OC Transpo System Map, accessed October 22, 2019

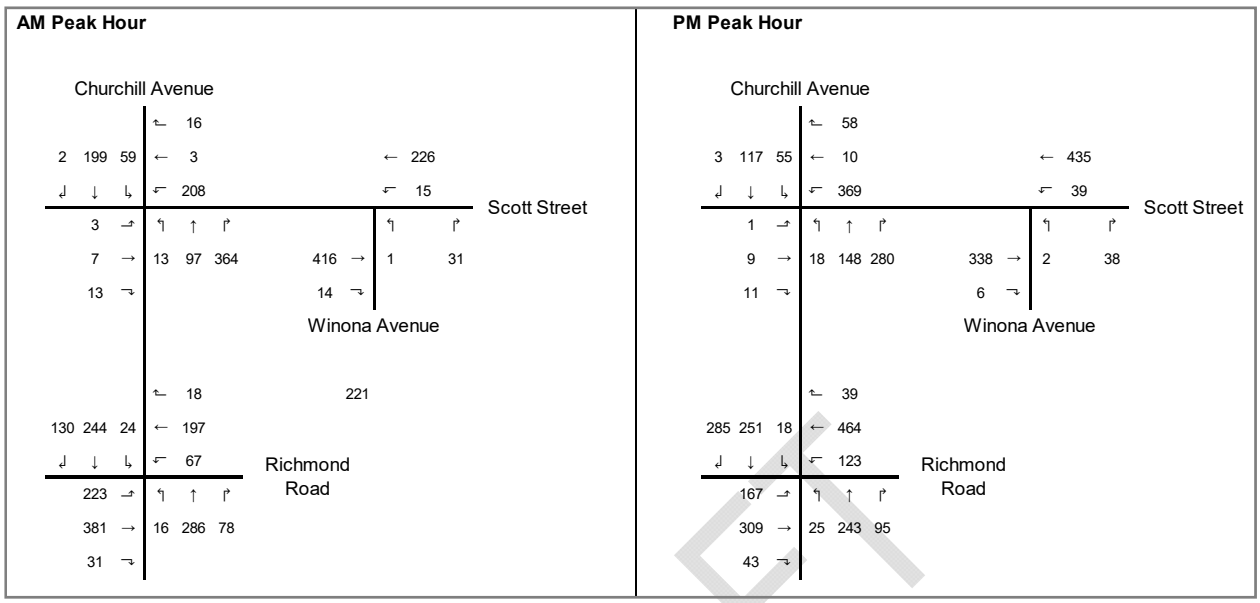
2.1.2.4 Traffic Management Measures

Along Churchill Avenue N, there are intersection narrowings at the intersections with Whitby Avenue, Wilmont Avenue, and Scott Street. These intersection narrowings help physically delineate the parking areas as well as reduce the pavement width in these areas which acts as a form of traffic calming.

2.1.2.5 Traffic Volumes

Turning movement counts at the study area intersections were collected by the City of Ottawa in August of 2019. **Figure 6** below illustrates the traffic counts during the AM and PM peak hours. **Appendix A** contains the traffic data and is provided for reference.

Figure 6 - 2019 Existing Traffic Volumes



2.1.2.6 Collision History

Collision data was provided by the City of Ottawa for the period January 2014 to December 2018 in the vicinity of the subject site. The data was reviewed to determine if any intersections or road segments exhibited an identifiable collision pattern during the five (5) year period.

Table 2 summarizes the collision class and impact types for each road segment and intersection in the study area.

Table 2 - Collision Summary

LOCATION	CLASS	IMPACT TYPE				
		Sideswipe	Angle / Turning	Rear End	Single Vehicle	Other
Churchill Ave N between Scott St and Wilmont Ave	Property Damage					
	Non-Fatal Injury				1	
Churchill Ave N between Whitby Ave and Madison Ave	Property Damage		2		2	1
	Non-Fatal Injury					
Churchill Ave N between Wilmont Ave and Whitby Ave	Property Damage				1	
	Non-Fatal Injury					
Churchill Ave N at Madison Ave	Property Damage		2			
	Non-Fatal Injury				1	
Churchill Ave N at Richmond Rd	Property Damage	5	11	6	2	
	Non-Fatal Injury			3	4	
Churchill Ave N at Scott St	Property Damage	1			2	
	Non-Fatal Injury				1	
	Property Damage		3			

LOCATION	CLASS	IMPACT TYPE				
		Sideswipe	Angle / Turning	Rear End	Single Vehicle	Other
Churchill Ave N at Whitby Ave	Non-Fatal Injury					
Churchill Ave N at Wilmont Ave	Property Damage	1		1		
	Non-Fatal Injury					
Scott St at Winona Ave	Property Damage	1				
	Non-Fatal Injury					
Scott St between Churchill Ave N and Winona Ave	Property Damage					1
	Non-Fatal Injury					
Total	**Property Damage**	**8**	**18**	**7**	**7**	**2**
	Non-Fatal Injury	**0**	**0**	**1**	**7**	**0**

Based on the collision data summarized in **Table 2** above it was found that the majority of the collisions resulted in property damage only (84%), which suggests that the collisions occurred at low enough speeds to not cause serious injury to people. The Churchill Avenue N at Richmond Road intersection experienced the highest number of collisions. These collisions were further reviewed to determine if there are any discernable patters and can be seen in **Table 3** below.

Table 3 - Collision Summary at Churchill Avenue N at Richmond Road

		Churchill Avenue N at Richmond Road
Event	Other Motor Vehicle	25
	Unattended Vehicle	2
	Pedestrian	4
Environment	Clear	25
	Rain	2
	Snow	4
Surface Condition	Dry	19
	Wet	8
	Slush	1
	Loose Snow	2
	Ice	1

The majority of the collisions occurred during clear environmental conditions (81%) on dry surface conditions (61%). It should be noted that there were four collisions involving pedestrians.

2.1.3 Planned Conditions

2.1.3.1 Road Network Modifications

Table 4 identifies the City of Ottawa Transportation Master Plan (TMP) projects located in the vicinity of the subject site.

Table 4 - City of Ottawa Transportation Master Plan Projects

Project	Description	TMP Phase
Western Light Rail Transit	Conversion of the West Transitway to LRT between Tunney's Pasture Station and Baseline Station	2023
Richmond Road / Wellington Street / Somerset Street	Transit signal priority between Woodroffe Avenue and Bank Street	2031 Affordable Network

There are two other transportation improvements that are scheduled to occur within the vicinity of the subject site that are not captured within the City's TMP: upgrades to Scott Street and the signalization of the intersection of Scott Street at Churchill Avenue N. As Scott Street will be a bus detour route during the construction of the Stage 2 LRT, the intersection of Scott at Churchill requires signalization in order to accommodate the future bus volumes. As per direction from the City of Ottawa, the signalization of the Scott at Churchill intersection is anticipated to occur by 2021.

As part of the signalzation work, Scott Street will be upgraded to include a buffered bicycle lane on the south side. In addition, a cycle track is planned across the frontage of the subject site. **Figure 7** below illustrates the interim design for Scott Street across the frontage of the subject site, including the signalization of Scott Street at Churchill Avenue, as provided by the City of Ottawa.

Ultimately, Street will be improved to include cycle tracks and bicycle lanes along both sides of the road between Churchill Avenue and Island Park Drive. This improvement will occur once the bus detour no longer operates on Scott Street. As per direction from the City of Ottawa, this ultimate design will likely be implemented by 2027. **Figure 8** below illustrates the ultimate cross-section for Scott Street across the frontage of the subject site, as provided by the City of Ottawa. It should be noted that although this ultimate design does not include the signals at the Scott Street at Churchill Avenue intersection, per direction from the City of Ottawa, the signals that are being implemented by 2021 are permanent and will remain even once the bus detour no longer operates.

Figure 7 - Interim Design for Scott Street

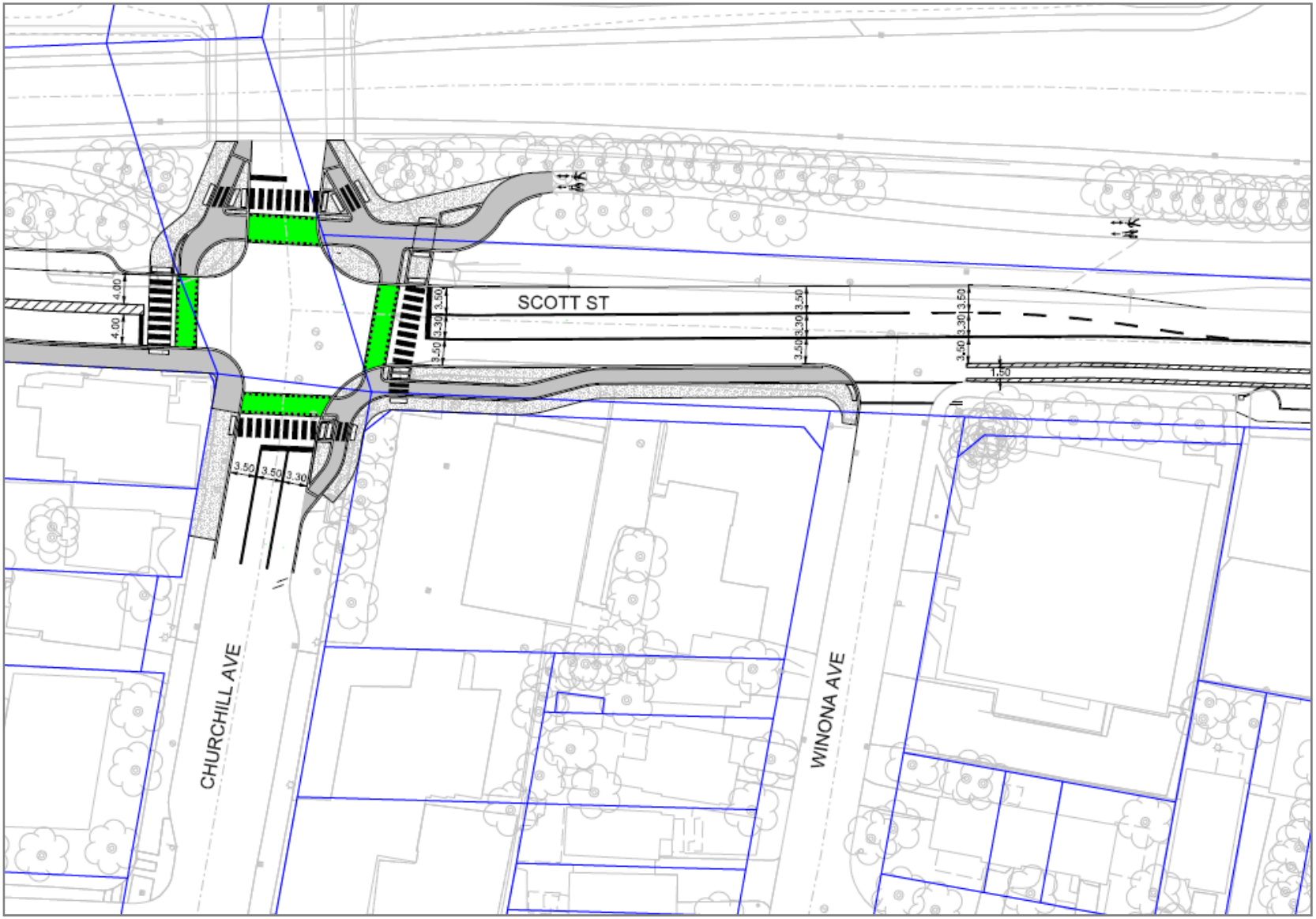
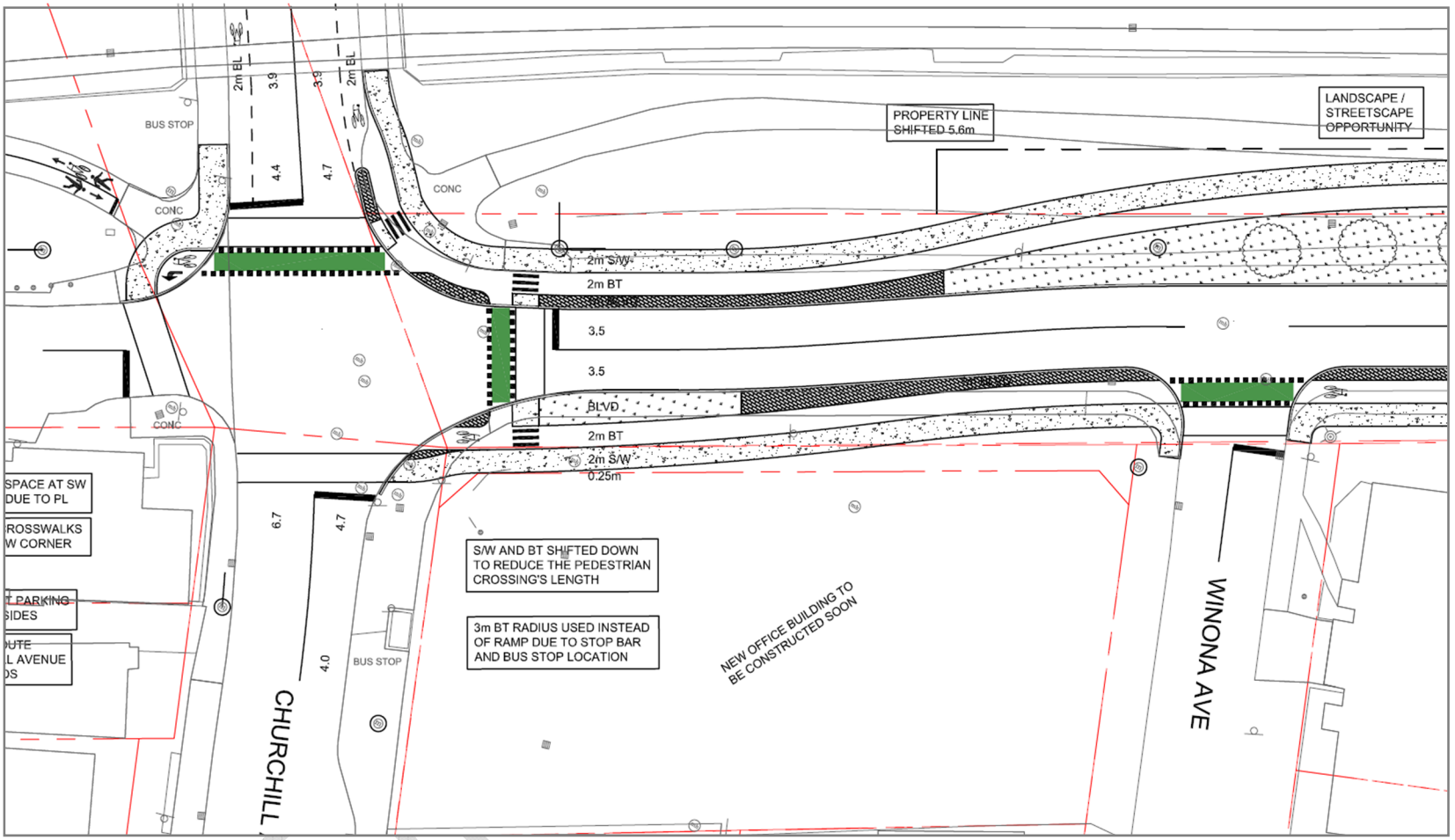


Figure 8 - Scott Street Ultimate Design



2.1.3.2 Future Background Developments

There are numerous developments scheduled to occur in the vicinity of the subject site as described in

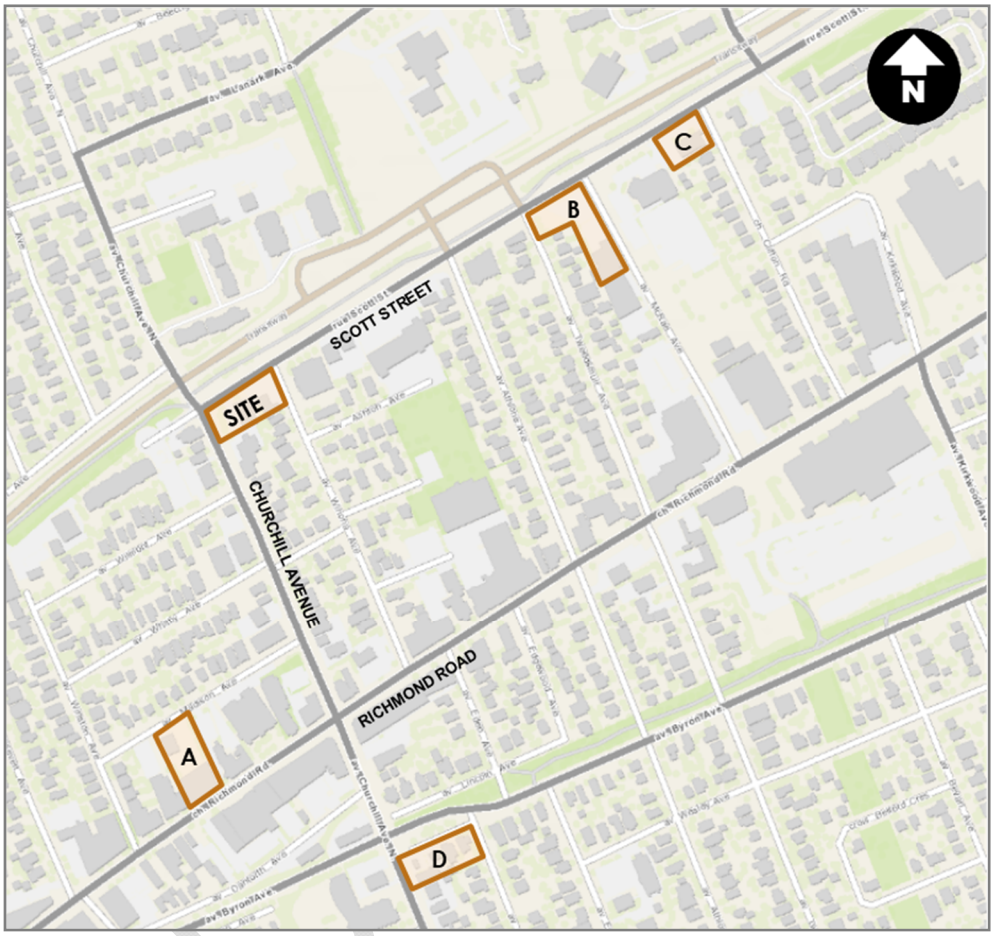
Table 5 and depicted in **Figure 9.**

Table 5 - Background Developments

Key Plan Reference	Development	Location	Description	Assumed Build-Out Year
A	371 Richmond Road	North side of Richmond Road, approximately 150 m west of Churchill Avenue.	9 storey high-rise condominium development, consisting of approximately 100 dwelling units	Unknown[1]
B	320 McRae/1976 Scott Street	Southwest corner of the McRae/Scott intersection	Mixed-use development consisting of approximately 242 residential dwelling units, 11,200 ft^2 of office and 23,000 ft^2 of retail type land uses	2017[2]
C	1960-1950 Scott Street	Southwest corner of Scott Street and Clifton Avenue	Residential development with approximately 141 condominium/apartment units	2020
D	433-435 Churchill Avenue and 468-472 Byron Place (Byron Place Apartments)	Bound by Byron Place/Byron Avenue to the north, existing development to the south, Highcroft Avenue to the east and Churchhill Avenue to the west.	76 apartment units and two retail units with a combined gross floor area (GFA) of approximately 3,450ft^2	2020

Notes:
1. Occupancy is assumed to take place prior to 2022 (full build-out horizon for 2070 Scott Street); site-generate trips have been included as future background growth. Source: 371 Richmond Road Transportation Brief (July 2014) prepared by Parsons.
2. Same as 1. Source: 320 McRae/1976 Scott Redevelopment Community Transportation Study by Parsons (December 2015).

Figure 9 - Background Developments Key Plan



2.2 STUDY AREA AND TIME PERIODS

2.2.1 Study Area

The proposed study area is limited to the following intersections:

1. Churchill Avenue N at Scott Street,
2. Richmond Road at Scott Street; and
3. Winona Avenue at Scott Street.

2.2.2 Time Periods

The proposed scope of the transportation assessment includes the following analysis time periods:

- Weekday AM peak hour of roadway; and
- Weekday PM peak hour of roadway.

2.2.3 Horizon Years

The scope of the transportation assessment proposes the following horizon years:

- 2019 existing conditions;
- 2022 future background conditions;
- 2022 total future conditions (site build-out); and
- 2027 total future conditions (5 years beyond build-out).

2.3 EXEMPTIONS REVIEW

Table 6 summarizes the Exemptions Review table from the City of Ottawa's *2017 Transportation Impact Assessment Guidelines*.

Table 6 - Exemptions Review

Module	Element	Exemption Considerations	Exempted?
Design Review Component			
4.1 Development Design	4.1.2 Circulation and Access	Only required for site plans	No
	4.1.3 New Street Networks	Only required for plans of subdivision	Yes
4.2 Parking	4.2.1 Parking Supply	Only required for site plans	No
	4.2.2 Spillover Parking	Only required for site plans where parking supply is 15% below unconstrained demand	Yes
Network Impact Component			
4.5 Transportation Demand Management	All Elements	Not required for site plans expected to have fewer than 60 employees and/or students on location at any given time	No
4.6 Neighbourhood Traffic Management	4.6.1 Adjacent Neighbourhoods	Only required when the development relies on local or collector streets for access and total volumes exceed ATM capacity thresholds	No
4.8 Network Concept		Only required when proposed development generates more than 200 person-trips during the peak hour in excess of the equivalent volume permitted by established zoning	Yes
4.9 Intersection Design	All Elements	Not required if site generation trigger is not met.	No

3.0 FORECASTING

3.1 DEVELOPMENT GENERATED TRAVEL DEMAND

3.1.1 Trip Generation and Mode Shares

The *TRANS Trip Generation Residential Trip Rates Study Report* was used for the residential land use and the *Institute of Transportation Engineers (10th Edition)* was used for the commercial land use. **Table 7** outlines the assumed land uses and the trip generation rates for each land use.

As per the City of Ottawa's 2017 TIA Guidelines, the auto trip generation rates of the residential portion of the development were converted to person trips using the auto mode share rates outlined in Table 3.13 in the *TRANS Residential Trip Generation Residential Trip Rates Study Report* (*August 2009*). The auto trip generation rates of the commercial portion of the development were converted to person trips using a conversion factor of 1.28 as outlined in the *City of Ottawa's 2017 TIA Guidelines.*

Table 8 shows development-generated person trips for each land use.

Table 7 - Land Uses and Trip Generation Rates

LUC	Land Use	Size	Weekday AM Peak Hour			Weekday PM Peak Hour		
			In	Out	Rate	In	Out	Rate
232	High-Rise Condos	241 Units	28%	72%	0.38	58%	42%	0.34
820	Shopping Centre	5,500 ft² GFA	62%	38%	0.94	48%	52%	3.81

Table 8 - Person Trips Generated by Land Use

LUC	Land Use	Trip Conversion	Weekday AM Peak Hour			Weekday PM Peak Hour		
			In	Out	Total	In	Out	Total
232	High-Rise Condos	Auto Trips	26	66	92	48	34	82
		Auto Mode Share	37%	37%	37%	40%	40%	40%
		Person Trips	70	178	249	120	85	205
820	Shopping Centre	Auto Trips	3	2	5	10	11	21
		Conversion Factor	1.28	1.28	1.28	1.28	1.28	1.28
		Person Trips	4	3	6	13	14	27
Total		**Auto Trips**	**29**	**68**	**97**	**58**	**45**	**103**
		Person Trips	**74**	**181**	**255**	**133**	**99**	**232**

The subject site is located within 600m of two transit stations; Westboro Station and Dominion Station, as shown in **Figure 10** below. The Transitway is located just north of the subject site, less than 40m away, therefore, the subject site can be classified as being in a Transit Oriented Development (TOD) zone. As outlined in the City's *Transit-Oriented Development (TOD) Plans* (January 2014), TOD zones have a transit modal share target of 65%, an active modal share target of 15%, an auto driver modal share target of 15%, and an auto passenger modal share target of 5%. These modal share targets were used in the development of the trip generation potential for the subject site and have been vetted by City staff during the Step 1 and 2 TIA.

Figure 10 - Proximity to Transit Stations

Table 9 outlines the anticipated trip generation potential of the proposed development by travel mode. As outlined in the table below, the proposed development is anticipated to generate 38 and 35 net new auto trips during the AM and PM peak hours, respectively, which is considered negligible as compared to the existing traffic volumes on the boundary roads.

Table 9 - Trips Generated by Travel Mode

LUC	Land Use	Trip Conversion		Weekday AM Peak Hour			Weekday PM Peak Hour		
				In	**Out**	**Total**	**In**	**Out**	**Total**
232	High-Rise Condos	Auto	15%	11	27	37	18	13	31
		Passenger	5%	4	9	12	6	4	10
		Walk / Bike	15%	11	27	37	18	13	31
		Transit	65%	46	116	162	78	55	133
820	Shopping Centre	Auto	15%	1	0	1	2	2	4
		Passenger	5%	0	0	0	1	1	1
		Walk / Bike	15%	1	0	1	2	2	4
		Transit	65%	3	2	4	8	9	18
Total Development		**Auto**		**12**	**27**	**38**	**20**	**15**	**35**
		Passenger		**4**	**9**	**12**	**7**	**5**	**11**
		Walk / Bike		**12**	**27**	**38**	**20**	**15**	**35**
		Transit		**49**	**118**	**166**	**86**	**64**	**151**

3.1.2 Trip Distribution

The distribution of traffic to / from the proposed development was developed using the *Trans Committee's 2011 NCR Household Origin-Destination Survey* (January 2013) and by looking at the surrounding transportation network.

Table 10 summarizes the assumed trip distribution for the proposed development.

Table 10 - Trip Distribution

Direction		Via (to / from)		
		Scott Street (East)	**Churchill Avenue N (South)**	**Richmond Road (West)**
North	5%	5%	-	-
East	35%	35%	-	-
South	15%	-	15%	-
West	10%	-	-	10%
Internal *	35%	10%	20%	5%
Total	**100%**	**50%**	**35%**	**15%**

* Refers to trip origins/destinations within the same O-D Ward.

3.1.3 Trip Assignment

Site generated trips were assigned to the study area road network based on the trip distribution assumptions outlined above in **Table 10** and can be seen in **Figure 11** below.

Figure 12 illustrates the site generated trips for the proposed development during the AM and PM peak hours.

Figure 11 - Site Traffic Assignment

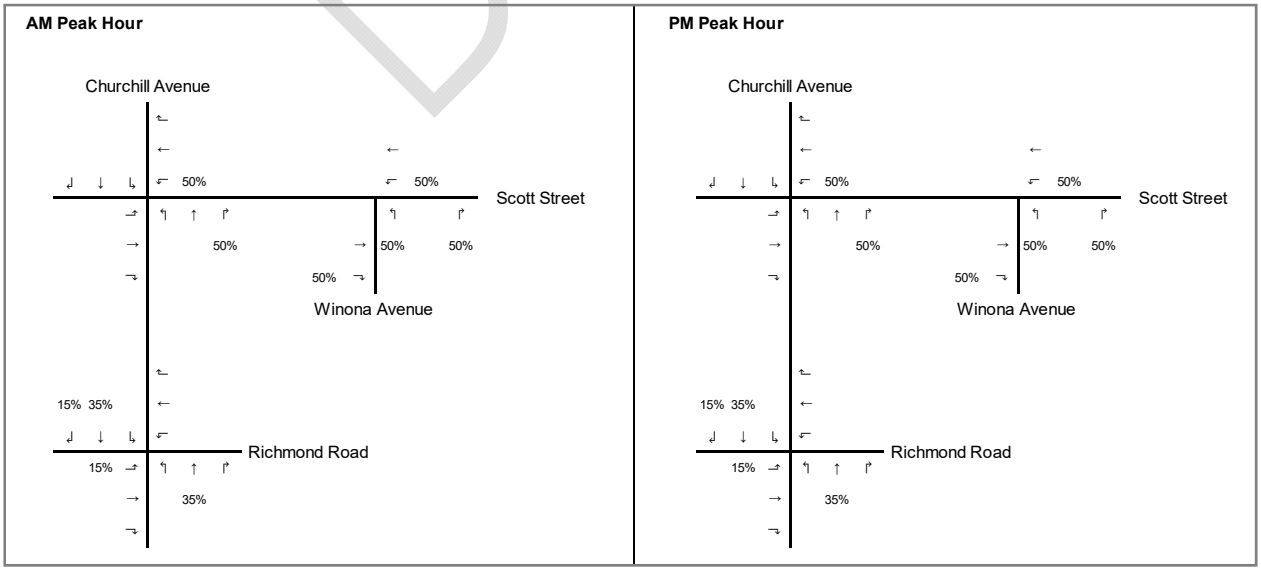
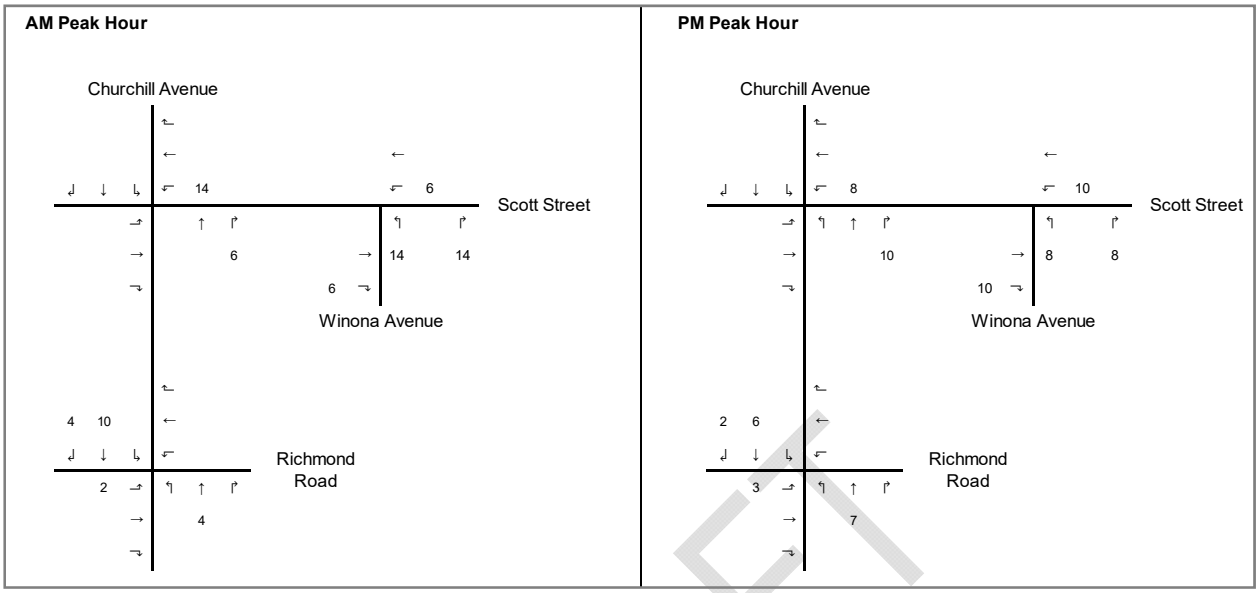


Figure 12 - Site Trips



3.2 BACKGROUND NETWORK TRAVEL DEMAND

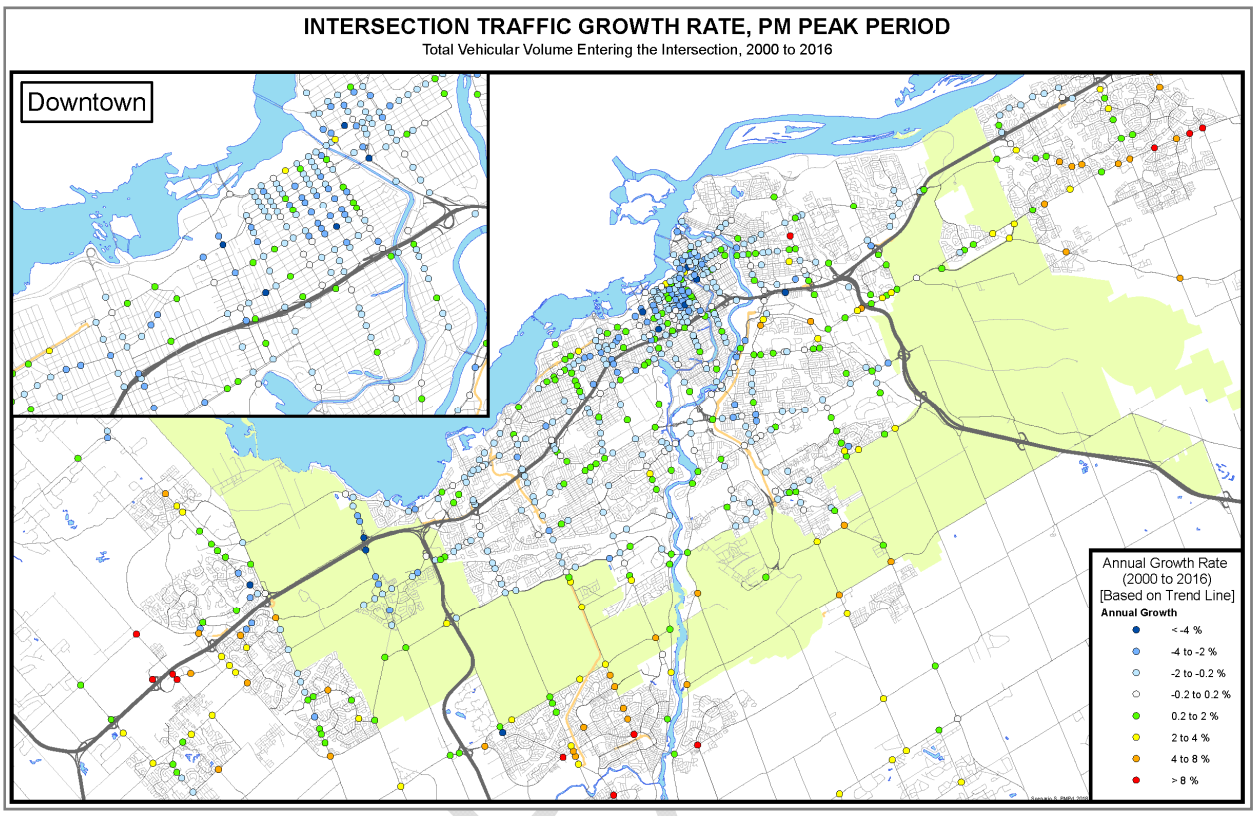
3.2.1 Transportation Network Plans

As outlined in **Table 4** in **Section 2.1.3.1**, there are two transit projects that are expected to occur within the vicinity of the proposed development; Western Light Rail Transit and the Richmond Road Transit Signal Priority. Based on direction from the City of Ottawa, the Western LRT is planned to be implemented by the 2027 ultimate horizon of the subject development.

3.2.2 Background Growth

The City of Ottawa provided **Figure 13** below, which outlines the average annual growth rates based on trend lines. As illustrated in this figure, the average annual growth in the Westboro neighbourhood is in the range of 0.2% - 2.0%. To be conservative, a 2% annual background growth rate was used in the subject analysis.

Figure 13 - Annual Growth Rates



3.2.3 Other Developments

In addition to the nominal 2% background growth rate, as outlined in **Section 0**, there are a few background developments that are planned to be constructed by the 2027 ultimate horizon. These site trips were obtained from various completed traffic studies and were explicitly accounted for in the subject study as background traffic.

Appendix C below contains excerpts of the aforementioned traffic studies that were used in the subject analysis.

3.3 DEMAND RATIONALIZATION

The traffic forecasts indicate that the demand in the study area is anticipated to exceed the available capacity. As traffic volumes start to increase, delays at intersections will subsequently start to increase. Motorists will start to see their commute times increase which may lead to some changes in their behaviours with the intention of reducing commute times. The following subsections outline the potential ways in which motorists could change their bevahiours, which would in turn help to reduce traffic volumes on the roads during peak hours, thus assisting with rationalizing the demands.

3.3.1 Rerouting of Traffic

Motorists may alter their regular route in order to select a route with less delays to reduce their overall commute time. A portion of the traffic in the subject study area is destined to / originating from the downtown core. An alternate route that motorists could take to travel to / from downtown is the Sir John A. Macdonald Parkway.

3.3.2 Change in Travel Times

Motorists may start to alter their travel times to travel outside of the peak hour. This would reduce the demand on the network during the peak hour and subsequently increase the demand on the network just before and just after the peak hour, which is referred to as peak spreading.

3.3.3 Reduction in Auto Modal Share

As a last effort to reduce the traffic demands, motorists may alter their mode of transportation and opt to use public transit. This would reduce number of vehicles on the road during the peak hours, thus improving the operations along in the study area. This is only a feasible option for residents if they have reliable and frequent public transit service within close proximity to their house. The existing Transitway is located approximately 350m north of Richmond Road and is well serviced by transit, as outlined previously in **Section 2.1.2.3**. In addition, this transitway is planned to be converted to Light Rail Transit (LRT), per **Section 2.1.3.1**, which will increase the capacity of the transit system. As such, motorists may choose to alter their mode of transportation from their vehicle to transit.

3.3.4 Total Demand Rationalization

Based on the aforementioned, the traffic volumes in the study area were reduced by 25%, however, it is recognized that this reduction does not eliminate the capacity concerns, it merely reduces it. **Section 4.9** includes the future traffic volumes with the 25% reduction to account for demand rationalization.

4.0 STRATEGY REPORT

4.1 DEVELOPMENT DESIGN

4.1.1 Design for Sustainable Modes

Under existing conditions, Scott Street currently includes a sidewalk along the south side of the road and a multi-use pathway along the north side of the road. There are also dedicated bicycle lanes in both directions along Scott Street.

As per direction from the City of Ottawa, across the frontage of the subject development, Scott Street will be upgraded to include a separated bicycle facility between Churchill Avenue and Winona Avenue. In addition, with the signalization of the Scott Street at Churchill Avenue intersection, there are proposed pedestrian crosswalks as well as cyclist cross-rides at the intersection.

The subject site is presently well serviced by transit, both along the Transitway as well as with local transit routes. With the conversion to LRT in the near future (i.e. by 2023), the transit capacity will increase in the study area, thus increasing the viability for people to choose to use transit.

These features, coupled with the existing facilities, will help promote and accommodate sustainable modes of transportation in the vicinity of the subject development.

Figure 7 and **Figure 8** in **Section 2.1.3.1** illustrate the sustainable modes facilities that are planned as part of the interim and ultimate design for Scott Street, as provided by the City of Ottawa.

4.1.2 Circulation and Access

A site access is proposed along Winona Avenue, approximately 30m south of Scott Street. The access will be stopped-controlled along the site access approach and will allow all movements with no turning restrictions.

Pedestrian access to the proposed development is facilitated through the existing sidewalks along Scott Street and Churchill Avenue. Sidewalk connections are proposed between Scott Street and Churchill Avenue and the north and west facades of the proposed building to facilitate pedestrian access to and from the proposed development. A sidewalk is included as part of the subject site along the Winona frontage, on the east side of the proposed building.

4.1.3 New Street Networks

Not applicable; exempted during screening and scoping.

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4.2 PARKING

4.2.1 Parking Supply

Auto Parking – As per Schedule 1A of the City of Ottawa's Official Plan, the subject site is located within Area Y – Inner Urban Mainstreet. Based on this designation, the City of Ottawa's Zoning By-law 2008-250 (Section 101 and 102) was consulted to determine the minimum parking space requirement for the proposed development. It was found that the minimum parking requirement for the proposed development is: 0.5 per dwelling unit (standard space), 0.1 per dwelling unit for visitor parking, and 1.25 per 100m^2 of retail (gross floor area). As per City of Ottawa Zoning By-Law 2008-250 (Section 101 (4) (b), where a residential use is located within a building of five or more storeys, no off-street motor vehicle parking is required for the first twelve residential units. As such, the proposed development is required to provide 115 vehicle parking spaces for the residents, 23 vehicle parking spaces for the visitors, and 6 vehicle parking spaces for the retail component, for a total of 144 vehicle parking spaces.

In accordance with City of Ottawa Zoning By-law 2008-250 (Section 103), where a lot is located within 600m of a rapid transit station shown, the number of motor vehicle parking spaces provided for a use on that lot must not exceed the maximum limits. The proposed development is located within approximately 300m of Westboro Station and 500m of Dominion Station (both existing and designated Phase 2 LRT). Therefore, vehicular parking for the proposed development (situation in Official Plan Area B) cannot exceed 1.75 per dwelling unit for a combined total of resident and visitor parking area and 3.6 per 100m^2 of retail (gross floor area). As such, the proposed development can only provide a maximum of 401 vehicle parking spaces for the residents and 18 vehicle parking spaces for the retail component, for a total of 420 vehicle parking spaces.

The proposed site plan indicates there will be 115 vehicle parking spaces for the residents, 23 vehicle parking spaces for the visitors, and 6 vehicle parking spaces for the retail component. These values fall within the minimum and maximum ranges as outlined above.

Bicycle Parking – As per City of Ottawa Zoning By-law 2008-250 (Section 111), the minimum bicycle parking rate of 0.50 bicycle parking spaces per dwelling unit and 1 bicycle parking space per 250m^2 of retail (gross floor area).

Based on the proposed land uses, a minimum of 121 bicycle spaces are required for the residential component and 2 bicycle spaces are required for the retail component.

The proposed site plan indicates there will be 123 bicycle spaces provided, which meets the minimum requirements.

4.2.2 Spillover Parking

Not applicable; exempted during screening and scoping.

4.3 BOUNDARY STREET DESIGN

4.3.1 Multi Modal Level of Service

The multi-modal level of service (MMLOS) was evaluated for Scott Street, Churchill Avenue North, and Winona Avenue to assist with developing a design concept that maximizes the achievement of the MMLOS objectives. Based on the

proximity of these three roads to the surrounding community, it was determined that all subject roads fall under the 'within 600m of a rapid transit station' Policy Area designation. This Policy Area dictates the following MMLOS targets that will be applied to the three roadway segments.

Table 11 presents the MMLOS for the roadway segments.

Scott Street

As Scott Street (arterial Traditional Mainstreet) is within 600m of two rapid transit stations (Dominion and Westboro), this roadway segment is subject to a pedestrian level of service (PLOS) target of A. The 2013 Ottawa Transportation Master Plan designates Scott Street as a cycling spine route and cross-town bikeway. As cross-town bikeway MMLOS targets are more stringent, they are to be adopted. As such, Scott Street is subject to a bicycle level of service (BLOS) target of A. Scott Street includes isolated transit priority measures and thus has a TLOS target of D. Scott Road is designated as full load truck route and therefore the Truck Level of Service (TkLOS) target for this roadway segment is D.

Scott Street, fronting the proposed development, currently operates a PLOS of D, which does not meet the desired target. The Scott Street design, as illustrated in **Figure 8**, will not improve the PLOS for Scott Street, across the frontage of the subject site. To achieve the PLOS target while maintaining the existing cross-section and traffic volumes, the posted speed limit would need to be reduced to 30km/hr. A reduction in the average daily curb lane traffic volume to less than 3,000 vehicles per day while maintaining the existing speed limit and roadway geometry will also achieve the MMLOS target. Both of these options are not feasible given that Scott Street is an arterial roadway.

Scott Street, fronting the proposed development, currently operates at a BLOS of B, which does not meet the desired target. As illustrated in **Figure 8**, Scott Street will be upgraded to include cycle tracks across the frontage of the subject site by 2021, as per direction from the City of Ottawa (this road improvement project corresponds to the signalization of the Scott Street at Churchill Avenue intersection). This cycling facility will allow the BLOS target of A to be met across the frontage of the subject site

Transit service along Scott Street operates in mixed traffic which allows it to meet the TLOS target across the frontage of the subject site under both existing and build-out conditions.

Existing lane widths along Scott Street are sufficiently wide to accommodate truck turning movements, thus, Scott Street along the frontage of the subject site meets the TkLOS target.

Churchill Avenue

As Churchill Avenue North (arterial) is within 600m of two rapid transit stations (Dominion and Westboro), this roadway segment is subject to a pedestrian level of service (PLOS) target of A. The 2013 Ottawa Transportation Master Plan designates Churchill Avenue North as a cycling spine route and cross-town bikeway. As cross-town bikeway MMLOS targets are more stringent, they are to be adopted. As such, Churchill Avenue North is subject to a bicycle level of service (BLOS) target of A. For transit, Churchill Avenue North has a TLOS target of D. Churchill Avenue North is designated as a full load truck route and therefore the Truck Level of Service (TkLOS) target for this roadway segment is D.

The existing conditions along Churchill Avenue fronting the proposed development achieve a PLOS of B, which does not meet the desired target. To achieve the PLOS target of A, a reduction in traffic volumes before 3000 vehicles per day is required while maintaining the existing roadway geometry. Another way to meet the PLOS target would be to decrease the speed limit to 30 km/hr while maintaining the existing geometry and traffic volumes. Both of these items are not feasible given that Churchill Avenue is an arterial roadway.

As the cyclists along Churchill Avenue operate in mixed traffic, the BLOS currently operates as a D which does not meet the desired target. Reducing the speed limit to 40 km/hr while maintaining the existing roadway geometry would allow the BLOS target to be met along Churchill Avenue. The addition of a curbside bike lane would achieve the BLOS target although this would have property constraints.

Transit service along Churchill Avenue operates in mixed traffic scoring a TLOS of D, which meets the desired target.

Existing lane widths along Churchill Avenue are sufficiently wide enough to accommodate a truck route designation scoring a TkLOS of B which meets the TkLOS target of D.

Winona Avenue

As Winona Avenue (local) is located within 600m of two rapid transit stations (Dominion and Westboro), this roadway segment is subject to a pedestrian level of service (PLOS) target of A. Winona Avenue has no cycling designation under the 2013 Ottawa Cycling Plan and as such, it is subject to a BLOS target of D. There is currently no transit service operating along Winona Avenue nor is it designated as a truck route, and as such, the transit and truck levels of service do not apply to this roadway segment.

Given the lack of pedestrian and cycling facilities along Winona Avenue, it is not surprising that this facility does not meet the targets for pedestrian and bicycle level of service. At full build-out, a sidewalk along Winona Avenue fronting the east façade of the development will be constructed, improving the PLOS to a B but ultimately, it still will not meet the PLOS target. Implementing a 0.5m boulevard between the proposed sidewalk and the road would allow the PLOS target to be met, however, this would have property constraints and is likely not a feasible option. A reduction in the posted speed limit to 30 km/hr would achieve PLOS target, however, ensuring that a local road operates at 30 km/hr requires a multitude of traffic calming features which have property and financial constraints.

The number of lanes on Winona Avenue and the lower operating speed are adequate to achieve the BLOS target of D. As Winona Avenue is not a designated transit or truck route, there is no TLOS or TkLOS targets for the road.

Appendix D contains the detailed MMLOS analysis for roadway segments.

Table 11 - Multi-Modal Level of Service Assessment - Roadway Segments

Roadway Segment/ Level of Service	Scott Street along property line			Churchill Avenue North along property line			Winona Avenue along property line		
	2019 Existing	2022 Build-Out	Target	2019 Existing	2022 Build-Out	Target	2019 Existing	2022 Build-Out	Target
PLOS	D	**	A	B	**	A	F	C	A
BLOS	B	A	A	B	**	A	B	**	D
TLOS	D	**	D	D	**	D	N/A	N/A	N/A
TkLOS	C	**	D	B	C	D	N/A	N/A	N/A

Notes: ** indicates no change between horizons
N/A indicates the MMLOS criteria does not apply

4.4 ACCESS INTERSECTION DESIGN

4.4.1 Access Location

One site access is proposed off Winona Avenue, approximately 30m south of Scott Street. The site access will be stop-controlled alogn the site access approach and will be a full movement access without any turning restrictions.

4.4.2 Intersection Control

Scott Street and Churchill Avenue

The existing intersection at Scott Street and Churchill Avenue North is four-way stop controlled. Under city direction, the intersection will be signalized by 2021 in order to accommodate the bus detours during the LRT Stage 2 construction. As illustrated in **Figure 7**, the intersection will include auxiliary left turn lanes in the northbound and westbound directions. As part of this design, protected cycle tracks will be implemented along the south side of Scott Street, between Churchill Avenue and Winona Avenue, which requires the intersection to have cross-rides.

Churchill Avenue and Richmond Avenue

The existing intersection of Churchill Avenue and Richmond Avenue is signalized with auxiliary left turn lanes in the eastbound and westbound directions. As stated in **Section 2.1.2.1**, the pavement width along the north and south legs of this intersection are sufficient to accommodate two lanes of traffic. As such, the analysis was completed assuming there are auxiliary left turn lanes in all four directions.

Scott Street and Winona Avenue

The existing intersection of Scott Street and Winona Avenue is stop-controlled along the Winona Avenue approach.

4.5 TRANSPORTATION DEMAND MANAGEMENT

The proposed development is in a Design Priority Area (DPA) and Transit-Oriented Development (TOD) due to proximity to Westboro and Dominion Stations.

The proposed development consists 241 residential units and 5,500 ft^2 of commercial space as indicated on the Site Plan prepared by Quadrangle Architects Limited dated October 10, 2019. City of Ottawa TDM Checklists were used to determine what TDM measures could be implemented based on the available information.

The TDM checklists are contained in **Appendix E.**

4.6 NEIGHBHOURHOOD TRAFFIC MANAGEMENT

4.6.1 Adjacent Neighbourhoods

As only one site access is proposed on Winona Avenue, all subject development traffic will use Winona Avenue to access the surrounding transportation network. **Table 12** summarizes the AM and PM peak two-way traffic volume forecasts for Winona Avenue at the build-out of the subject site.

Table 12 - AM & PM 2022 Traffic Volume Forecasts for Winona Avenue

Road	2022 Total Traffic Volume AM Peak	2022 Total Traffic Volume PM Peak
Winona Avenue	80 veh/hr	95 veh/hr

The traffic volumes along Winona Avenue at the build-out of the subject development are not projected to exceed the threshold of 185 vehicles/hour (veh/hr) for local roadways.

4.7 TRANSIT

4.7.1 Route Capacity

An assumed transit modal share of 65% was adopted for the two land uses contained within the proposed development. The forecasted transit trips for the proposed development is 166 and 151 total transit trips during the AM and PM peak hours, respectively.

The subject site is well serviced by transit, both along the Transitway as well as with local transit routes. The subject site is located approximately 40m south of the Transitway, 270m west of Westboro Station and 400m east of Dominion Station. There are numerous transit routes along the Transitway, including routes 61, 62, 63, 64, 66, 73, 74, 75, 82, 83, 84, 87, 153, 164, 251, 252 and 266.

The peak hour one-way passenger volume for the OC Transpo Transitway was 9,000 riders served in 2017[2]. Given that the forecasted transit trips for the proposed development, the subject site represents at most 2% of current passenger volumes and thus is not expected to pose capacity issues for the existing Transitway.

There are three OC Transpo local routes: 16, 50 and 153 that service the intersection of Churchill Avenue N at Scott Street which is in closest proximity to the subject site.

Route 16 is a local route that extends to Westboro Station and operates with approximately 30-minute headways during the weekday morning and afternoon peak periods. Route 50 is a local route that operates at approximately 30-minute headways during the weekday morning and afternoon peak periods. Route 153 is a local route that operates at approximately 120-minute headways during the weekday morning and afternoon peak periods. Routes 16, 50 and 153 operate with 40-foot buses during the weekday AM and PM peak periods[3]. Standard buses in OCT Transpo Vehicle Fleet have seated capacities of 38 to 55 seats[4] depending on the transit bus manufacturer and therefore, the seated hourly transit capacity is expected to be between 190 – 275 people during the AM and PM peak hour.

If all transit users opted to use local transit over the more attractive transitway, the proposed development could account for as much as 55% to 80% of local transit capacity during the AM peak hour and PM peak hours without utilizing the standing room on a transit vehicle. However, given that the transitway is located directly beside the subject

[2] OC Transpo. *About Us: Stats*. 2019. <https://www.octranspo.com/en/about-us/stats/>.
[3] Parsons. (2012). *320 McRae/1976 Scott Redevelopment Community Transportation Study (CTS)*. Ottawa: City of Ottawa.
[4] OC Transpo. (2019, October 15). *Vehicles*. Retrieved from Our Services, Bus & O-Train Network: http://www.octranspo.com/en/our-services/bus-o-train-network/vehicles/

development, it is highly unlikely that the transit users from the subject development will all chose local transit over the transitway.

4.8 REVIEW OF NETWORK CONCEPT

Not applicable; exempted during screening and scoping.

4.9 INTERSECTION DESIGN

4.9.1 Intersection Control

The intersection controls for the three study area intersections were discussed in **Section 4.4.2** and the analysis of the intersections can be found in **Section 4.9.2**.

4.9.2 Intersection Design

An assessment of the study area intersections was undertaken to determine the operational characteristics under the various horizons years as identified in the Screening and Scoping report. Intersection operational analysis was performed using Synchro 10.0™ software package. The MMLOS analysis was completed for all modes and compared against the City of Ottawa's MMLOS targets, where applicable.

4.9.2.1 2019 Existing Conditions

Figure 6 illustrates 2019 existing AM and PM peak hour traffic volumes at the study area intersections.

Intersection Capacity Analysis

Table 13 summarizes the results of the Synchro analysis for 2019 existing intersection operations.

The northbound and southbound shared through / right turn lanes at the intersection of Churchill Avenue North at Richmond Road currently operate at or above capacity with significant delays during the PM peak hour. This is not surprising given that Richmond Road is a more pedestrian focused roadway and, as per the City of Ottawa's signal timing for this intersection, a significant amount of time at this intersection is dedicated to pedestrians via two pedestrian advanced walk phases. As the intersection is constrained geometrically, increasing the number of lanes is not a feasible option. Increasing the amount of time that is dedicated for vehicles would reduce the time for pedestrians, therefore, it is also not a feasible solution.

The remaining study area intersections currently operate satisfactorily, and as such, no improvements are required to supplement existing conditions.

Figure 3 illustrates the intersection control and lane configuration under 2019 existing conditions.

Appendix F contains detailed intersection performance worksheets.

Table 13 - 2019 Existing Intersection Operations

Intersection	Intersection Control	Approach / Movement		LOS	V/C	Delay (s)	Queue 95th (veh)
Churchill Avenue North at Richmond Road	Signalized	EB	Left	A (A)	0.50 (0.60)	13.6 (16.6)	32.0 (23.0)
			Through / Right	A (A)	0.56 (0.44)	16.6 (11.6)	75.0 (44.9)
		WB	Left	A (B)	0.29 (0.70)	23.5 (39.9)	17.8 (#45.3)
			Through / Right	A (C)	0.43 (0.75)	24.2 (28.1)	43.9 (108.9)
		NB	Left	A (A)	0.13 (0.35)	22.3 (40.3)	6.6 (11.8)
			Through / Right	A (E)	0.78 (0.92)	36.7 (61.7)	#88.5 (#103.6)
		SB	Left	A (A)	0.17 (0.20)	23.2 (31.5)	8.7 (8.5)
			Through / Right	D (F)	0.83 (1.70)	42.1 (364.1)	#94.3 (#189.3)
		Overall Intersection		**B (F)**	**0.66 (1.01)**	**27.6 (118.1)**	**- (-)**
Scott Street at Churchill Avenue	Four Way Stop Controlled	EB	Left / Through / Right	A (B)	0.05 (0.04)	9.7 (10.3)	0.6 (0.6)
		WB	Left / Through / Right	B (D)	0.43 (0.82)	13.8 (30.1)	13.2 (48.6)
		NB	Left / Through / Right	C (D)	0.71 (0.77)	18.6 (25.6)	35.4 (44.4)
		SB	Left / Through / Right	B (B)	0.45 (0.35)	13.1 (13.2)	13.8 (9.6)
		Overall Intersection		**C (D)**	**- (-)**	**15.8 (25.1)**	**- (-)**
Scott Street at Winona Avenue	Minor Stop Controlled	EB	Through / Right	A (A)	- (-)	0.0 (0.0)	- (-)
		WB	Through / Left	A (A)	0.02 (0.04)	8.4 (8.2)	0.0 (0.6)
		NB	Left / Right	(B) (B)	0.06 (0.07)	11.6 (11.2)	1.2 (1.2)
		Overall Intersection		**A (A)**	**- (-)**	**0.7 (0.9)**	**- (-)**

Notes:
1. Table format: AM (PM)
2. v/c – represents the anticipated volume divided by the predicted capacity
3. # 95th percentile volume exceeds capacity; queue may be longer. Queue shown is maximum after two cycles.

Multi-Modal Level of Service Assessment

Churchill Avenue North at Richmond Road

Based on the proximity of this intersection to the existing Transitway, it was determined that the intersection falls under the 'within 600m of a rapid transit station' Policy Area designation. Accordingly, the subject intersection has a Pedestrian Level of Service (PLOS) target of A. The 2013 Ottawa Transportation Master Plan designates Churchill Avenue North and Richmond Road as spine routes in the Ultimate Cycling Network. Two legs of the intersection: (1) Churchill Avenue North and (2) Richmond Road east of Churchill Avenue are also designated as cross-town bikeways with more stringent, governing MMLOS requirements. As such, the Churchill Avenue at Richmond Road intersection has a Bicycle Level of Service (BLOS) target of A. Although Churchill Avenue North does not have a transit designation, Richmond Avenue is designated as a Transit Priority corridor with isolated measures and as such, the TLOS target for the intersection is D. Churchill Avenue North and Richmond Avenue are designated as full load truck routes and therefore the Truck Level of Service (TkLOS) targets for these roads is D.

The intersection of Richmond Road at Churchill Avenue North currently operates with a PLOS of B, which does not meet the desired target. The PLOS at this intersection is governed by the average pedestrian crossing delay. To meet the PLOS target of A, the cycle length would need to be greatly reduced in conjunction with an associated increase in pedestrian effective walk time. This would be at the detriment of the vehicle level of service and is therefore not recommended.

The Bicycle Level of Service at the intersection of Richmond Road at Churchill Avenue North currently operates with a BLOS of B, which does not meet the desired target. Based on the MMLOS guidelines, intersection BLOS is influenced by the availability of dedicated cycling amenities, number of lanes cyclists must cross to negotiate a turn at intersections, and roadway operating speeds. Implementing a higher order bicycle facility (i.e. two-stage left turn bike box) would allow the BLOS to meet the target, however, the existing on-street parking forces spatial constraints that result in mutual exclusivity between on-street parking and bike lanes. The feasibility of reducing on-street parking to accommodate two-stage left turn bike boxes at this intersection could be further examined but is outside the scope of the subject study.

The Transit Level of Service at the intersection of Richmond Road at Churchill Avenue North currently operates with a TLOS of F, which does not meet the desired target of D. Based on the MMLOS guidelines, intersection transit level of service is governed by the delay at the intersection. The TLOS performance of the intersection can be improved by increasing the intersection capacity through road widening or providing signal priority for transit. Due to encroaching properties, road widening and signal priority upgrades are not feasible solutions to improve the TLOS at this intersection.

The intersection of Richmond Road at Churchill Avenue North currently operates with a Truck Level of Service (TkLOS) of E, which does not meet the desired target of D. An increase in the number of receiving lanes would allow the TkLOS target to be met but is not feasible due to spatial constraints.

Table 14 - Existing Signalized Intersection MMLOS

Signalized Intersection	PLOS		BLOS		TLOS		TkLOS	
	Actual	Target	Actual	Target	Actual	Target	Actual	Target
Richmond Road at Churchill Avenue North	D	A	B	A	F	D	E	D

4.9.2.2 2022 Future Background Conditions

Figure 14 illustrates 2022 future background AM and PM peak hour traffic volumes at the study area intersections.

Intersection Capacity Anlaysis

Table 15 summarizes the results of the Synchro analysis under 2022 future background conditions.

Despite the demand rationalization that was considered for the 2022 future background traffic volumes, as outlined in **Section 3.3**, the intersection of Richmond Road at Churchill Avenue is projected to continue to operate at or above capacity with significant delays and queues during the PM peak hour. As stated in the analysis of the existing conditions in **Section 4.9.2**, due to spatial constraints, increasing the capacity of the intersection via additional lanes is not feasible. Decreasing the pedestrian walk time to reallocate time for vehicles would have a negative impact on the pedestrians, therefore, this is also not a feasible solution.

All remaining study area intersections are anticipated to operate acceptably under 2022 future background conditions.

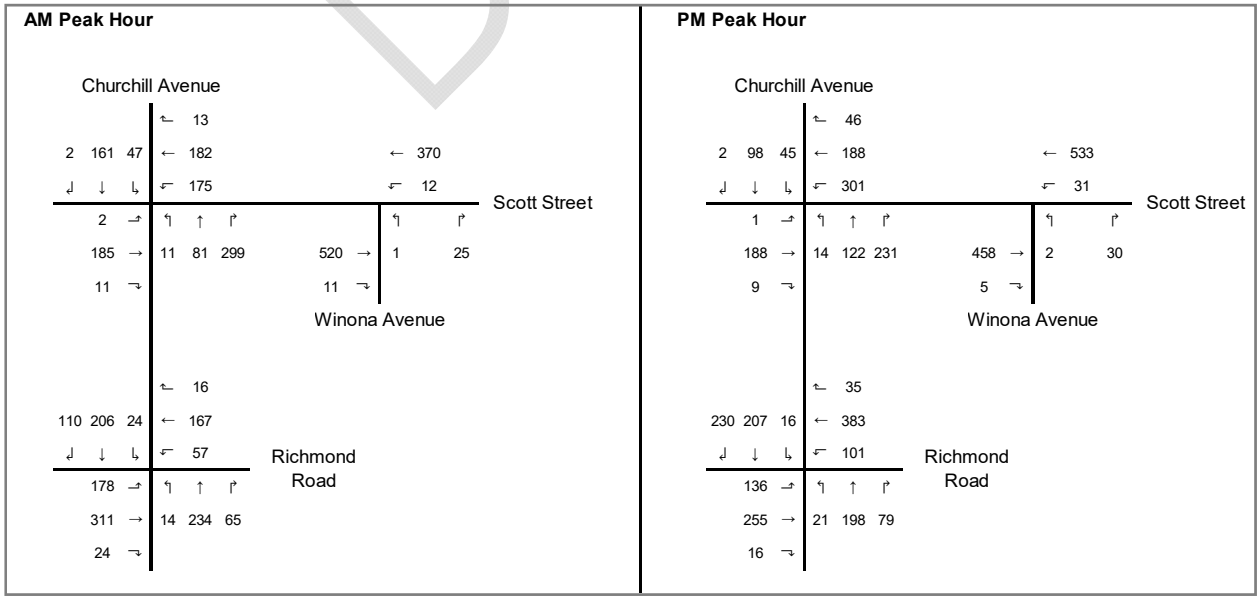
Appendix F contains detailed intersection performance worksheets.

Table 15 - 2022 Future Background Intersection Operations

Intersection	Intersection Control	Approach / Movement		LOS	V/C	Delay (s)	Queue 95th (veh)
Churchill Avenue North at Richmond Road	Signalized	EB	Left	A (A)	0.35 (0.36)	12.6 (12.4)	24.2 (17.2)
			Through / Right	A (A)	0.40 (0.28)	13.5 (10.3)	40.0 (29.0)
		WB	Left	A (A)	0.29 (0.58)	24.4 (32.7)	15.1 (#32.6)
			Through / Right	A (A)	0.33 (0.56)	22.6 (22.2)	33.7 (73.6)
		NB	Left	A (A)	0.07 (0.27)	20.8 (35.7)	5.3 (9.3)
			Through / Right	A (B)	0.57 (0.67)	28.3 (39.5)	55.5 (61.6)
		SB	Left	A (A)	0.10 (0.10)	21.2 (27.6)	7.5 (6.8)
			Through / Right	B (F)	0.62 (1.21)	30.3 (152.6)	58.4 (#129.1)
		Overall Intersection		**A (C)**	**0.51 (0.74)**	**22.1 (57.2)**	**- (-)**
Scott Street at Churchill Avenue	Signalized	EB	Left / Through / Right	D (C)	0.84 (0.78)	68.1 (57.2)	#72.1 (#67.8)
		WB	Left	C (D)	0.77 (0.89)	60.2 (65.6)	#58.8 (#98.1)
			Through / Right	A (A)	0.48 (0.48)	26.2 (20.0)	45.2 (46.4)
		NB	Left	A (A)	0.24 (0.30)	55.1 (56.2)	7.5 (8.7)
			Through / Right	B (C)	0.66 (0.77)	33.6 (46.8)	94.7 (#107.3)
		SB	Left / Through / Right	A (A)	0.45 (0.49)	33.5 (42.9)	55.4 (45.0)
		Overall Intersection		**C (D)**	**0.76 (0.82)**	**42.4 (47.6)**	**- (-)**
Scott Street at Winona Avenue	Minor Stop Controlled	EB	Through / Right	A (A)	0.00 (0.00)	0.0 (-)	- (-)
		WB	Through / Left	A (A)	0.01 (0.03)	8.5 (8.4)	0.0 (0.6)
		NB	Left / Right	A (A)	0.05 (0.06)	12.1 (12.0)	1.2 (1.2)
		Overall Intersection		**A (A)**	**- (-)**	**0.5 (0.6)**	**- (-)**

Notes:
1. Table format: AM (PM)
2. v/c – represents the anticipated volume divided by the predicted capacity
3. # 95th percentile volume exceeds capacity; queue may be longer. Queue shown is maximum after two cycles.

Figure 14 - 2022 Future Background Volumes



Multi-Modal Level of Service Assessment

Churchill Avenue North at Richmond Road

Based on the proximity of this intersection to the existing Transitway, it was determined that the intersection falls under the 'within 600m of a rapid transit station' Policy Area designation. Accordingly, the subject intersection has a Pedestrian Level of Service (PLOS) target of A. The 2013 Ottawa Transportation Master Plan designates Churchill Avenue North and Richmond Road as spine routes in the Ultimate Cycling Network. Two legs of the intersection: (1) Churchill Avenue North and (2) Richmond Road east of Churchill Avenue are also designated as cross-town bikeways with more stringent, governing MMLOS requirements. As such, the Churchill Avenue at Richmond Road intersection has a Bicycle Level of Service (BLOS) target of A. Although Churchill Avenue North does not have a transit designation, Richmond Avenue is designated as a Transit Priority corridor with isolated measures and as such, the TLOS target for the intersection is D. Churchill Avenue North and Richmond Avenue are designated as full load truck routes and therefore the Truck Level of Service (TkLOS) targets for these roads is D.

The intersection of Richmond Road at Churchill Avenue North is projected to operate with a PLOS of B, which does not meet the desired target. The PLOS at this intersection is governed by the average pedestrian crossing delay. To meet the PLOS target of A, the cycle length would need to be greatly reduced in conjunction with an associated increase in pedestrian effective walk time. This would be at the detriment of the vehicle level of service and is therefore not recommended.

The Bicycle Level of Service at the intersection of Richmond Road at Churchill Avenue North is projected to operate with a BLOS of B, which does not meet the desired target. Based on the MMLOS guidelines, intersection BLOS is influenced by the availability of dedicated cycling amenities, number of lanes cyclists must cross to negotiate a turn at intersections, and roadway operating speeds. Implementing a higher order bicycle facility (i.e. two-stage left turn bike box) would allow the BLOS to meet the target, however, the existing on-street parking forces spatial constraints that result in mutual exclusivity between on-street parking and bike lanes. The feasibility of reducing on-street parking to accommodate two-stage left turn bike boxes at this intersection could be further examined but is outside the scope of the subject study.

The Transit Level of Service at the intersection of Richmond Road at Churchill Avenue North is projected to operate with a TLOS of F, which does not meet the desired target of D. Based on the MMLOS guidelines, intersection transit level of service is governed by the delay at the intersection. The TLOS performance of the intersection can be improved by increasing the intersection capacity through road widening or providing signal priority for transit. Due to encroaching properties, road widening and signal priority upgrades are not feasible solutions to improve the TLOS at this intersection.

The intersection of Richmond Road at Churchill Avenue North is projected to operate with a Truck Level of Service (TkLOS) of E, which does not meet the desired target of D. An increase in the number of receiving lanes would allow the TkLOS target to be met but is not feasible due to spatial constraints.

Scott Street at Churchill Avenue North

As outlined in **11 2.1.3.1**, this intersection is scheduled to be upgraded to traffic signals by 2021 per direction from the City of Ottawa. As such, the multi-modal level of service assessment applies to this intersection for all future horizons.

As Scott Street (arterial Traditional Mainstreet) and Churchill Avenue North (arterial) are both within 600m of two rapid transit stations (Dominion and Westboro), this intersection is subject to a pedestrian level of service (PLOS) target of A. The 2013 Ottawa Transportation Master Plan designates Scott Street and Churchill Avenue North as a cycling spine route and cross-town bikeway. As cross-town bikeway MMLOS targets are more stringent, they are to be adopted. As such, the intersection is subject to a bicycle level of service (BLOS) target of A. Scott Street includes isolated transit priority measures and is within 600m of two rapid transit stations (Dominion and Westboro) and thus the intersection has a TLOS target of D. The Scott Street at Churchill Avenue North intersection is designated as full load truck route and therefore the Truck Level of Service (TkLOS) target for this intersection is D.

During the preparation of the subject TIA, the City of Ottawa was consulted to determine the signal timing's future operational parameters once this intersection is signalized. As per direction from the City, a signal timing plan has not yet been developed for this intersection, therefore, a signal timing plan was developed as part of the subject TIA. Using the developed signal timing plan, the intersection of Scott Street at Churchill Avenue North is projected to operate with a PLOS of D, which does not meet the desired target. The PLOS at this intersection is governed by the average pedestrian crossing delay. To achieve the PLOS target, the cycle length would need to be reduced, which would be to the detriment of the vehicle level of service and is therefore not recommended. As part of the detailed design for this intersection, the City should consider implementing a signal timing plan that allows all modes of transportation of operate acceptably.

Strictly basing the Bicycle Level of Service off the City of Ottawa's MMLOS Guidelines, the intersection of Scott Street at Churchill Avenue North is projected to operate with a BLOS of B, which does not meet the desired target. The Scott Street design prepared by the City of Ottawa, as depicted in **Figure 7,** proposes designated cyclist cross-rides that eliminate the need for a left turn approach in mixed traffic. As such, the BLOS is believed to have been maximized at the intersection and thereby, the achievement of a BLOS target of A has been assumed.

The Transit Level of Service (TLOS) at the intersection of Scott Street at Churchill Avenue North is projected to operate with a TLOS of F, which does not meet the desired target of D. Based on the MMLOS guidelines, intersection transit level of service is governed by the delay at the intersection. The TLOS performance of the intersection can be improved by increasing the intersection capacity through road widening or providing signal priority for transit. Due to encroaching properties, road widening and signal priority upgrades appear unlikely potential solutions to improve the TLOS.

The intersection of Scott Street at Churchill Avenue North is projected to operate at a Truck Level of Service (TkLOS) of E, which does not meet the desired target of D. An increase in the number of receiving lanes would allow the TkLOS target to be met but is not feasible due to spatial constraints.

Appendix D contains the detailed MMLOS analysis for subject intersections.

Table 16 – 2022 Future Background Signalized Intersection MMLOS

Signalized Intersection	PLOS		BLOS		TLOS		TkLOS	
	Actual	Target	Actual	Target	Actual	Target	Actual	Target
Richmond Road at Churchill Avenue North	D	A	B	A	F	D	E	D
Scott Street and Churchill Avenue North	D	A	A	A	F	D	E	D

4.9.2.3 2022 Total Future Conditions

Figure 15 illustrates 2022 total future AM and PM peak hour traffic volumes at the study area intersections.

Intersection Capacity Analysis

Table 17 summarizes the results of the Synchro analysis for 2022 total future intersection operations.

Despite the demand rationalization that was considered for the 2022 total future traffic volumes, as outlined in **Section 3.3**, the intersection of Richmond Road at Churchill Avenue is projected to continue to operate at or above capacity with significant delays and queues during the PM peak hour. As stated in the analysis of the existing conditions in **Section 4.9.2**, due to spatial constraints, increasing the capacity of the intersection via additional lanes is not feasible. Decreasing the pedestrian walk time to reallocate time for vehicles would have a negative impact on the pedestrians, therefore, this is also not a feasible solution.

All remaining study area intersections are anticipated to operate acceptably under 2022 total future conditions.

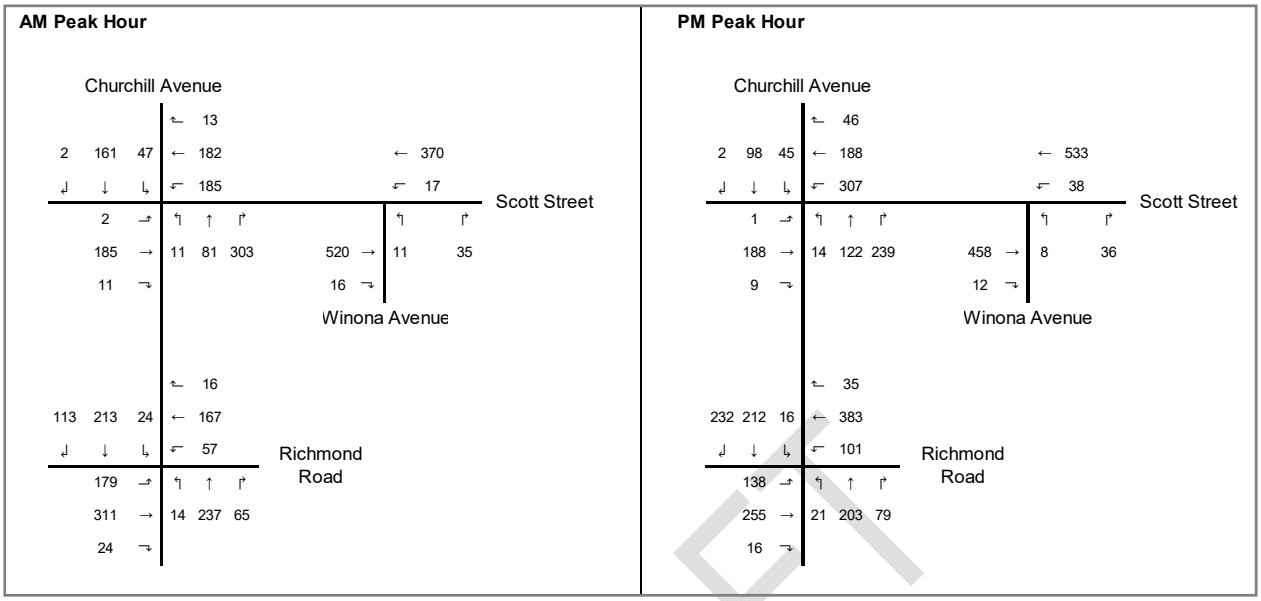
Appendix F contains detailed intersection performance worksheets.

Table 17 - 2022 Total Future Intersection Operations

Intersection	Intersection Control	Approach / Movement		LOS	V/C	Delay (s)	Queue 95th (veh)
Churchill Avenue North at Richmond Road	Signalized	EB	Left	A (A)	0.35 (0.34)	12.6 (11.4)	24.3 (17.5)
			Through / Right	A (A)	0.40 (0.28)	13.5 (10.3)	40.0 (29)
		WB	Left	A (A)	0.29 (0.58)	24.4 (32.7)	15.1 (#32.6)
			Through / Right	A (A)	0.33 (0.56)	22.6 (22.2)	33.7 (73.6)
		NB	Left	A (A)	0.07 (0.27)	20.8 (35.7)	5.3 (9.3)
			Through / Right	A (B)	0.57 (0.68)	28.4 (39.9)	56.1 (#63.2)
		SB	Left	A (A)	0.10 (0.10)	21.2 (27.7)	7.5 (6.8)
			Through / Right	A (F)	0.64 (1.23)	31.0 (160.8)	60.5 (#131.7)
		Overall Intersection		**A (C)**	**0.52 (0.75)**	**22.4 (59.5)**	**- (-)**
Scott Street at Churchill Avenue North	Signalized	EB	Left / Through / Right	D (D)	0.87 (0.80)	74.0 (60.5)	#73.8 (#69.5)
		WB	Left	C (D)	0.77 (0.88)	59.6 (63.7)	#61.0 (#97.8)
			Through / Right	A (A)	0.48 (0.48)	26.2 (20.0)	45.2 (46.4)
		NB	Left	A (A)	0.24 (0.24)	55.1 (53.9)	7.5 (8.6)
			Through / Right	B (C)	0.67 (0.79)	33.9 (48.2)	95.8 (#111.2)
		SB	Left / Through / Right	A (A)	0.45 (0.51)	33.5 (44.3)	55.4 (45.8)
		Overall Intersection		**C (D)**	**0.77 (0.83)**	**43.5 (48.3)**	**- (-)**
Scott Street at Winona Avenue	Minor Stop Controlled	EB	Through / Right	A (A)	0.00 (0.00)	- (-)	- (-)
		WB	Through / Left	A (A)	0.02 (0.04)	8.5 (8.4)	0.6 (0.6)
		NB	Left / Right	A (A)	0.10 (0.10)	13.8 (13.5)	1.8 (1.8)
		Overall Intersection		**A (A)**	**- (-)**	**0.8 (0.9)**	**- (-)**

Notes:
1. Table format: AM (PM)
2. v/c – represents the anticipated volume divided by the predicted capacity
3. # 95th percentile volume exceeds capacity; queue may be longer. Queue shown is maximum after two cycles.

Figure 15 - 2022 Total Future Volumes



Multi-Modal Level of Service Assessment

Churchill Avenue North at Richmond Road

Based on the proximity of this intersection to the existing Transitway, it was determined that the intersection falls under the 'within 600m of a rapid transit station' Policy Area designation. Accordingly, the subject intersection has a Pedestrian Level of Service (PLOS) target of A. The 2013 Ottawa Transportation Master Plan designates Churchill Avenue North and Richmond Road as spine routes in the Ultimate Cycling Network. Two legs of the intersection: (1) Churchill Avenue North and (2) Richmond Road east of Churchill Avenue are also designated as cross-town bikeways with more stringent, governing MMLOS requirements. As such, the Churchill Avenue at Richmond Road intersection has a Bicycle Level of Service (BLOS) target of A. Although Churchill Avenue North does not have a transit designation, Richmond Avenue is designated as a Transit Priority corridor with isolated measures and as such, the TLOS target for the intersection is D. Churchill Avenue North and Richmond Avenue are designated as full load truck routes and therefore the Truck Level of Service (TkLOS) targets for these roads is D.

The intersection of Richmond Road at Churchill Avenue North is projected to operate with a PLOS of B, which does not meet the desired target. The PLOS at this intersection is governed by the average pedestrian crossing delay. To meet the PLOS target of A, the cycle length would need to be greatly reduced in conjunction with an associated increase in pedestrian effective walk time. This would be at the detriment of the vehicle level of service and is therefore not recommended.

The Bicycle Level of Service at the intersection of Richmond Road at Churchill Avenue North is projected to operate with a BLOS of B, which does not meet the desired target. Based on the MMLOS guidelines, intersection BLOS is influenced by the availability of dedicated cycling amenities, number of lanes cyclists must cross to negotiate a turn at intersections, and roadway operating speeds. Implementing a higher order bicycle facility (i.e. two-stage left turn bike box) would allow the BLOS to meet the target, however, the existing on-street parking forces spatial constraints that

result in mutual exclusivity between on-street parking and bike lanes. The feasibility of reducing on-street parking to accommodate two-stage left turn bike boxes at this intersection could be further examined but is outside the scope of the subject study.

The Transit Level of Service at the intersection of Richmond Road at Churchill Avenue North is projected to operate with a TLOS of F, which does not meet the desired target of D. Based on the MMLOS guidelines, intersection transit level of service is governed by the delay at the intersection. The TLOS performance of the intersection can be improved by increasing the intersection capacity through road widening or providing signal priority for transit. Due to encroaching properties, road widening and signal priority upgrades are not feasible solutions to improve the TLOS at this intersection.

The intersection of Richmond Road at Churchill Avenue North is projected to operate with a Truck Level of Service (TkLOS) of E, which does not meet the desired target of D. An increase in the number of receiving lanes would allow the TkLOS target to be met but is not feasible due to spatial constraints.

Scott Street at Churchill Avenue North

As outlined in **Section 2.1.3.1**, this intersection is scheduled to be upgraded to traffic signals by 2021 per direction from the City of Ottawa. As such, the multi-modal level of service assessment applies to this intersection for all future horizons.

As Scott Street (arterial Traditional Mainstreet) and Churchill Avenue North (arterial) are both within 600m of two rapid transit stations (Dominion and Westboro), this intersection is subject to a pedestrian level of service (PLOS) target of A. The 2013 Ottawa Transportation Master Plan designates Scott Street and Churchill Avenue North as a cycling spine route and cross-town bikeway. As cross-town bikeway MMLOS targets are more stringent, they are to be adopted. As such, the intersection is subject to a bicycle level of service (BLOS) target of A. Scott Street includes isolated transit priority measures and is within 600m of two rapid transit stations (Dominion and Westboro) and thus the intersection has a TLOS target of D. The Scott Street at Churchill Avenue North intersection is designated as full load truck route and therefore the Truck Level of Service (TkLOS) target for this intersection is D.

During the preparation of the subject TIA, the City of Ottawa was consulted to determine what the signal timing plan will look like in the future once this intersection is signalized. As per direction from the City, a signal timing plan has not yet been developed for this intersection, therefore, a signal timing plan was developed as part of the subject TIA. Using the developed signal timing plan, the intersection of Scott Street at Churchill Avenue North is projected to operate with a PLOS of D, which does not meet the desired target. The PLOS at this intersection is governed by the average pedestrian crossing delay. To achieve the PLOS target, the cycle length would need to be reduced, which would be to the detriment of the vehicle level of service and is therefore not recommended. As part of the detailed design for this intersection, the City should consider implementing a signal timing plan that allows all modes of transportation of operate acceptably.

Strictly basing the Bicycle Level of Service off the City of Ottawa's MMLOS Guidelines, the intersection of Scott Street at Churchill Avenue North is projected to operate with a BLOS of B, which does not meet the desired target. The Scott Street design prepared by the City of Ottawa, as depicted in **Figure 7,** proposes designated cyclist cross-rides that eliminate the need for a left turn approach in mixed traffic. As such, the BLOS is believed to have been maximized at the intersection and thereby, the achievement of a BLOS target of A has been assumed.

The Transit Level of Service (TLOS) at the intersection of Scott Street at Churchill Avenue North is projected to operate with a TLOS of F, which does not meet the desired target of D. Based on the MMLOS guidelines, intersection transit level of service is governed by the delay at the intersection. The TLOS performance of the intersection can be improved by increasing the intersection capacity through road widening or providing signal priority for transit. Due to encroaching properties, road widening and signal priority upgrades appear unlikely potential solutions to improve the TLOS.

The intersection of Scott Street at Churchill Avenue North is projected to operate at a Truck Level of Service (TkLOS) of E, which does not meet the desired target of D. An increase in the number of receiving lanes would allow the TkLOS target to be met but is not feasible due to spatial constraints.

Appendix D contains the detailed MMLOS analysis for subject intersections.

Table 18 – 2022 Total Future Signalized Intersection MMLOS

Signalized Intersection	PLOS		BLOS		TLOS		TkLOS	
	Actual	Target	Actual	Target	Actual	Target	Actual	Target
Richmond Road at Churchill Avenue North	D	A	B	A	F	D	E	D
Scott Street and Churchill Avenue North	D	A	A	A	F	D	E	D

4.9.2.4 2027 Ultimate Conditions

Figure 16 illustrates the 2027 ultimate AM and PM peak hour traffic volumes at the study area intersections.

Intersection Capacity Analysis

Table 19 summarizes the results of the Synchro analysis for 2027 ultimate intersection operations.

Despite the demand rationalization that was considered for the 2027 ultimate traffic volumes, as outlined in **Section 3.3**, the intersection of Richmond Road at Churchill Avenue is projected to continue to operate at or above capacity with significant delays and queues during the PM peak hour. As stated in the analysis of the existing conditions in **Section 4.9.2**, due to spatial constraints, increasing the capacity of the intersection via additional lanes is not feasible. Decreasing the pedestrian walk time to reallocate time for vehicles would have a negative impact on the pedestrians, therefore, this is also not a feasible solution.

All remaining study area intersections are anticipated to operate acceptably under 2027 ultimate conditions.

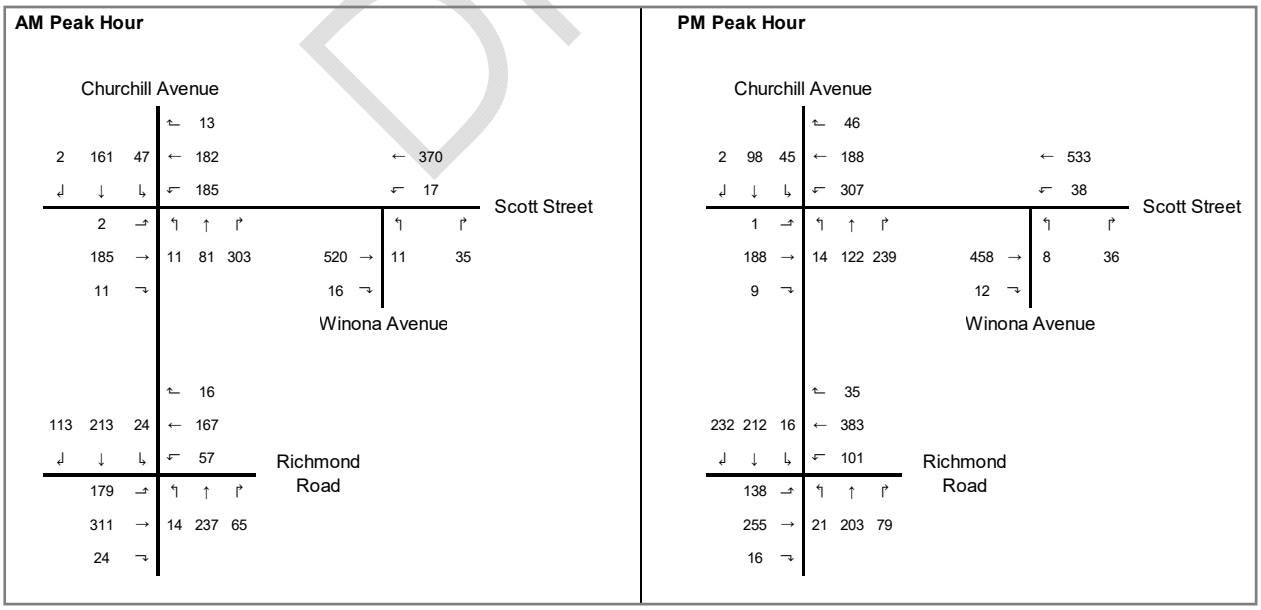
Appendix F contains detailed intersection performance worksheets.

Table 19 - 2027 Ultimate Intersection Operations

Intersection	Intersection Control	Approach / Movement		LOS	V/C	Delay (s)	Queue 95th (veh)
Churchill Avenue North at Richmond Road	Signalized	EB	Left	A (A)	0.42 (0.42)	14.2 (13.1)	28.2 (19.0)
			Through / Right	A (A)	0.47 (0.35)	15.3 (10.9)	47.7 (34.6)
		WB	Left	A (A)	0.36 (0.60)	28.9 (33.1)	17.3 (#35.1)
			Through / Right	A (B)	0.40 (0.61)	26.0 (23.4)	38.9 (81.8)
		NB	Left	A (A)	0.08 (0.29)	19.5 (36.9)	5.5 (10.0)
			Through / Right	A (C)	0.57 (0.74)	26.8 (43.4)	58.8 (#76.2)
		SB	Left	A (A)	0.11 (0.12)	19.9 (28.2)	7.7 (7.2)
			Through / Right	B (F)	0.65 (1.35)	29.5 (212.3)	64.4 (#147.5)
		Overall Intersection		**A (D)**	**0.57 (0.82)**	**22.9 (73.6)**	**- (-)**
Scott Street at Churchill Avenue	Signalized	EB	Left / Through / Right	A (A)	0.11 (0.10)	44.4 (43.6)	10.1 (10.1)
		WB	Left	C (D)	0.73 (0.83)	53.3 (52.7)	57.3 (86.9)
			Through / Right	A (A)	0.04 (0.12)	24.3 (19.7)	6.4 (14.1)
		NB	Left	A (A)	0.26 (0.31)	55.4 (55.5)	8.1 (9.6)
			Through / Right	A (B)	0.59 (0.64)	24.0 (31.8)	89.9 (94.8)
		SB	Left / Through / Right	A (A)	0.38 (0.35)	24.8 (30.9)	52.1 (42.5)
		Overall Intersection		**A (B)**	**0.53 (0.61)**	**31.7 (38.7)**	**- (-)**
Scott Street at Winona Avenue	Minor Stop Controlled	EB	Through / Right	A (A)	0 (0)	0 (0)	- (-)
		WB	Through / Left	A (A)	0.02 (0.03)	8.1 (8.0)	0 (0.6)
		NB	Left / Right	B (B)	0.08 (0.08)	11.5 (11.3)	1.8 (1.2)
		Overall Intersection		**A (A)**	**- (-)**	**1.1 (1.1)**	**- (-)**

Notes:
1. Table format: AM (PM)
2. v/c – represents the anticipated volume divided by the predicted capacity
3. # 95th percentile volume exceeds capacity; queue may be longer. Queue shown is maximum after two cycles.

Figure 16 - 2027 Ultimate Traffic Volumes



Multi-Modal Level of Service Assessment

Churchill Avenue North at Richmond Road

Based on the proximity of this intersection to the existing Transitway, it was determined that the intersection falls under the 'within 600m of a rapid transit station' Policy Area designation. Accordingly, the subject intersection has a Pedestrian Level of Service (PLOS) target of A. The 2013 Ottawa Transportation Master Plan designates Churchill Avenue North and Richmond Road as spine routes in the Ultimate Cycling Network. Two legs of the intersection: (1) Churchill Avenue North and (2) Richmond Road east of Churchill Avenue are also designated as cross-town bikeways with more stringent, governing MMLOS requirements. As such, the Churchill Avenue at Richmond Road intersection has a Bicycle Level of Service (BLOS) target of A. Although Churchill Avenue North does not have a transit designation, Richmond Avenue is designated as a Transit Priority corridor with isolated measures and as such, the TLOS target for the intersection is D. Churchill Avenue North and Richmond Avenue are designated as full load truck routes and therefore the Truck Level of Service (TkLOS) targets for these roads is D.

The intersection of Richmond Road at Churchill Avenue North is projected to operate with a PLOS of B, which does not meet the desired target. The PLOS at this intersection is governed by the average pedestrian crossing delay. To meet the PLOS target of A, the cycle length would need to be greatly reduced in conjunction with an associated increase in pedestrian effective walk time. This would be at the detriment of the vehicle level of service and is therefore not recommended.

The Bicycle Level of Service at the intersection of Richmond Road at Churchill Avenue North is projected to operate with a BLOS of B, which does not meet the desired target. Based on the MMLOS guidelines, intersection BLOS is influenced by the availability of dedicated cycling amenities, number of lanes cyclists must cross to negotiate a turn at intersections, and roadway operating speeds. Implementing a higher order bicycle facility (i.e. two-stage left turn bike box) would allow the BLOS to meet the target, however, the existing on-street parking forces spatial constraints that result in mutual exclusivity between on-street parking and bike lanes. The feasibility of reducing on-street parking to accommodate two-stage left turn bike boxes at this intersection could be further examined but is outside the scope of the subject study.

The Transit Level of Service at the intersection of Richmond Road at Churchill Avenue North is projected to operate with a TLOS of F, which does not meet the desired target of D. Based on the MMLOS guidelines, intersection transit level of service is governed by the delay at the intersection. The TLOS performance of the intersection can be improved by increasing the intersection capacity through road widening or providing signal priority for transit. Due to encroaching properties, road widening and signal priority upgrades are not feasible solutions to improve the TLOS at this intersection.

The intersection of Richmond Road at Churchill Avenue North is projected to operate with a Truck Level of Service (TkLOS) of E, which does not meet the desired target of D. An increase in the number of receiving lanes would allow the TkLOS target to be met but is not feasible due to spatial constraints.

Scott Street at Churchill Avenue North

As outlined in **11 2.1.3.1**, this intersection is scheduled to be upgraded to traffic signals by 2021 per direction from the City of Ottawa. As such, the multi-modal level of service assessment applies to this intersection for all future horizons.

As Scott Street (arterial Traditional Mainstreet) and Churchill Avenue North (arterial) are both within 600m of two rapid transit stations (Dominion and Westboro), this intersection is subject to a pedestrian level of service (PLOS) target of A. The 2013 Ottawa Transportation Master Plan designates Scott Street and Churchill Avenue North as a cycling spine route and cross-town bikeway. As cross-town bikeway MMLOS targets are more stringent, they are to be adopted. As such, the intersection is subject to a bicycle level of service (BLOS) target of A. Scott Street includes isolated transit priority measures and is within 600m of two rapid transit stations (Dominion and Westboro) and thus the intersection has a TLOS target of D. The Scott Street at Churchill Avenue North intersection is designated as full load truck route and therefore the Truck Level of Service (TkLOS) target for this intersection is D.

During the preparation of the subject TIA, the City of Ottawa was consulted to determine what the signal timing plan will look like in the future once this intersection is signalized. As per direction from the City, a signal timing plan has not yet been developed for this intersection, therefore, a signal timing plan was developed as part of the subject TIA. Using the developed signal timing plan, the intersection of Scott Street at Churchill Avenue North is projected to operate with a PLOS of D, which does not meet the desired target. The PLOS at this intersection is governed by the average pedestrian crossing delay. To achieve the PLOS target, the cycle length would need to be reduced, which would be to the detriment of the vehicle level of service and is therefore not recommended. As part of the detailed design for this intersection, the City should consider implementing a signal timing plan that allows all modes of transportation of operate acceptably.

Strictly basing the Bicycle Level of Service off the City of Ottawa's MMLOS Guidelines, the intersection of Scott Street at Churchill Avenue North is projected to operate with a BLOS of B, which does not meet the desired target. The Scott Street design prepared by the City of Ottawa, as depicted in **Figure 7,** proposes designated cyclist cross-rides that eliminate the need for a left turn approach in mixed traffic. As such, the BLOS is believed to have been maximized at the intersection and thereby, the achievement of a BLOS target of A has been assumed.

The Transit Level of Service (TLOS) at the intersection of Scott Street at Churchill Avenue North is projected to operate with a TLOS of F, which does not meet the desired target of D. Based on the MMLOS guidelines, intersection transit level of service is governed by the delay at the intersection. The TLOS performance of the intersection can be improved by increasing the intersection capacity through road widening or providing signal priority for transit. Due to encroaching properties, road widening and signal priority upgrades appear unlikely potential solutions to improve the TLOS.

The intersection of Scott Street at Churchill Avenue North is projected to operate at a Truck Level of Service (TkLOS) of E, which does not meet the desired target of D. An increase in the number of receiving lanes would allow the TkLOS target to be met but is not feasible due to spatial constraints.

Appendix D contains the detailed MMLOS analysis for subject intersections.

Table 20 – 2027 Ultimate Signalized Intersection MMLOS

Signalized Intersection	PLOS		BLOS		TLOS		TkLOS	
	Actual	Target	Actual	Target	Actual	Target	Actual	Target
Richmond Road at Churchill Avenue North	D	A	B	A	F	D	E	D
Scott Street and Churchill Avenue North	E	A	A	A	F	D	E	D

5.0 SUMMARY AND CONCLUSIONS

This Transportation Impact Assessment (TIA) was prepared in support of a Zoning By-Law Amendment and Site Plan Control for a proposed 23-storey tower located at 2070 Scott Street in the Westboro community of Ottawa, Ontario. The site is located at the southeast quadrant of the Churchill Avenue N (North) and Scott Street intersection. The site is bound by Churchill Avenue N to the west, Scott Street to the north, Winona Avenue to the east, and existing residential to the south.

The proposed development is anticipated to generate 38 and 35 two-way auto trips during the AM and PM peak hours, respectively. The AM and PM peak hour traffic volumes were assessed for the existing 2019, 2022, and 2027 horizons years and the following can be concluded about the intersection performance:

2019 Existing Conditions

- The northbound and southbound shared through / right turn lanes at the intersection of Churchill Avenue North at Richmond Road currently operate at or above capacity with significant delays during the PM peak hour. Current signal timing features two pedestrian walk lead green intervals and to improve pedestrian operations. Geometric improvementsmay not be feasibledue to spatial constraints. Increasing intersection capacity through increasing intersection cycle length is expected to deteriorate pedestrian level of service.

- The remaining study area intersections currently operate satisfactorily, and as such, no improvements are required to supplement existing conditions.

2022 Future Background

- As in the 2019 existing conditions, the intersection of Richmond Road at Churchill Avenue is projected to continue to operate at or above capacity with significant delays and queues during the PM peak hour, despite demand rationalization that was considered for the 2022 future background traffic volumes. As the intersection is highly constrained, potential proposed improvements are expected to result in adverse impacts on the competing Multi-Modal intersection operations.

- The remaining study area intersections currently operate satisfactorily, and as such, no improvements are required to supplement future background conditions. The analysis considers the signalization of the Scott Street at Churchill Avenue North intersection that is anticipated to take place by 2021. Furthermore, the bus detours anticipated during the construction of the Stage 2 LRT were taken into account as per direction from the City of Ottawa.

2022 Total Future and 2025 Ultimate Conditions

- Consistent with the 2022 future background horizon, demand rationalization was included to reflect the anticipated changes in travel behavior. Despite this, congestion persists at the intersection of Richmond Road at Churchill Avenue during the PM peak hour in the 2022 Total Future and 2025 Ultimate conditions for which, no gratuitous mitigation strategies exist. Capacity issues and delays at the Richmond Road at Churchill Avenue intersection are consistent across all study horizons and are extraneuous to the addition of the subject development to the traffic network.

- The remaining study area intersections currently operate satisfactorily, and as such, no improvements are required to supplement 2022 Total Future and 2027 Ultimate conditions outside of the upgrades along Scott Street presently proposed by the City of Ottawa.

The Multi-Modal Level of Service (MMLOS) assessment for roadway segments found that the following improvements would allow the MMLOS targets to be met along Scott Street:

- Reducing the speed limit of all subject to 30 km/hr would allow the PLOS target to be met;
- A reduction in the average daily curb lane traffic volume to less than 3,000 AADT while maintaining the existing speed limit and roadway geometry will also achieve the PLOS target; and,
- Cycle track proposed by the City of Ottawa anticipated to be constructed across the frontage of the subject site by 2021, as per direction from the City of Ottawa. This cycling facility will allow the BLOS target of A to be met across the frontage of the subject site.

The Multi-Modal Level of Service (MMLOS) assessment for roadway segments found that the following improvements would allow the MMLOS targets to be met along Churchill Avenue:

- Reducing the speed limit of Churchill Avenue to 30 km/hr would allow the PLOS target to be met;
- Alternatively, a reduction in traffic volumes to less than 3,000 AADT is required while maintaining the existing roadway geometry would allow the PLOS target to be met;
- Reducing the speed limit to 40 km/hr while maintaining the existing roadway geometry would allow the BLOS target to be met along Churchill Avenue; and,
- The addition of a curbside bike lane along Churchill Avenue would achieve the BLOS target although this may have property constraints.

The Multi-Modal Level of Service (MMLOS) assessment for roadway segments found that the following improvements would allow the MMLOS targets to be met along Winona Avenue:

- At full build-out, a sidewalk along Winona Avenue fronting the east façade of the development will be constructed, improving the PLOS to a B. However, PLOS desirable target of A will not be met;
- Implementing a 0.5m boulevard between the proposed sidewalk and the road would allow the PLOS target to be met, however, this might have property constraints; and,
- A reduction in the posted speed limit to 30 km/hr would achieve PLOS target, however, ensuring that a local road operates at 30 km/hr requires a multitude of traffic calming features which have property and financial constraints.

Based on the transportation evaluation presented in this study, the proposed development located at 2070 Scott Street can be supported and should be permitted to proceed from a transportation perspective.

Appendix A TRAFFIC DATA

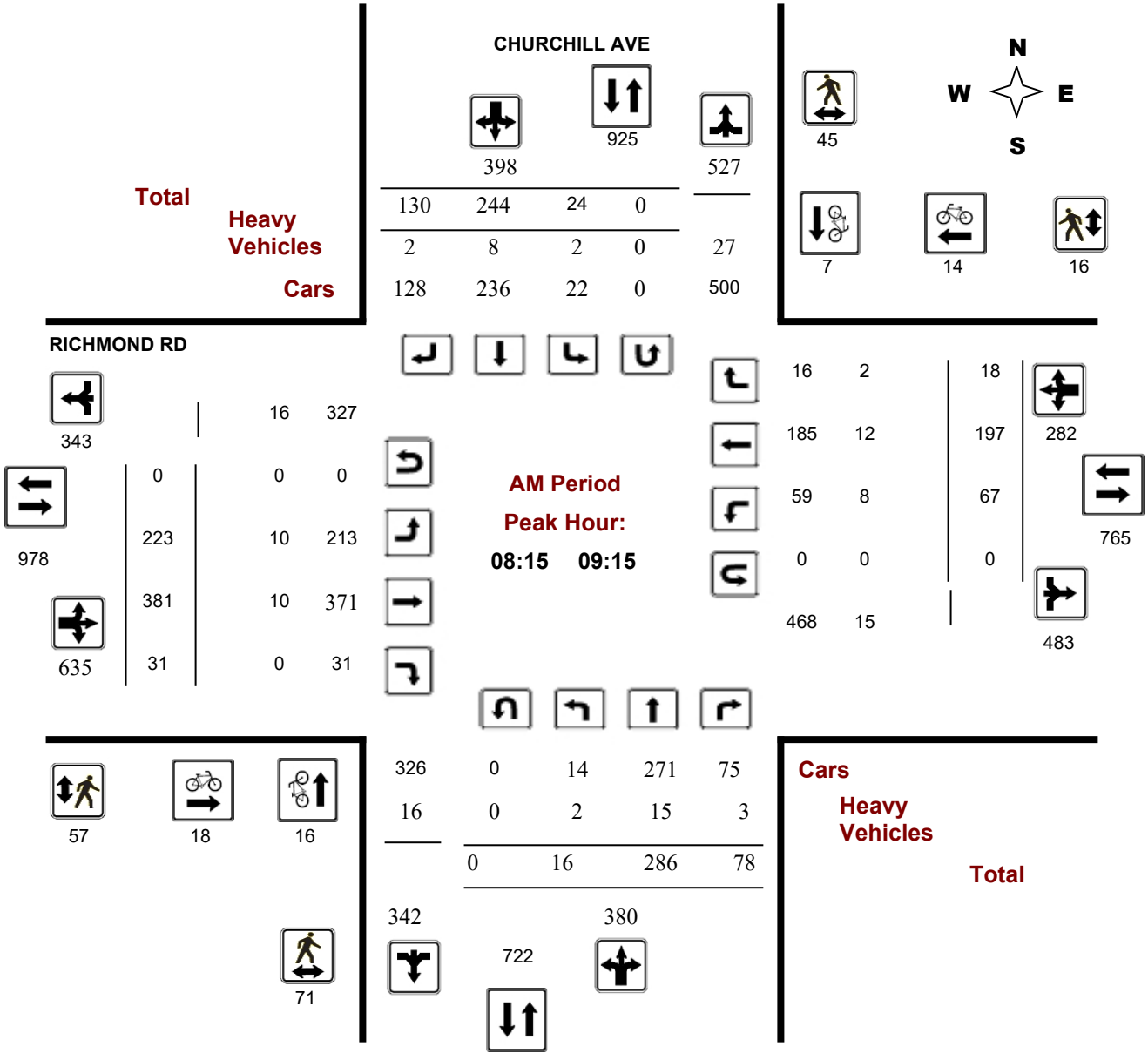
Transportation Services - Traffic Services

Turning Movement Count - Full Study Peak Hour Diagram

CHURCHILL AVE @ RICHMOND RD

Survey Date: Thursday, August 01, 2019 **WO No:** 38640

Start Time: 07:00 **Device:** Miovision



Comments

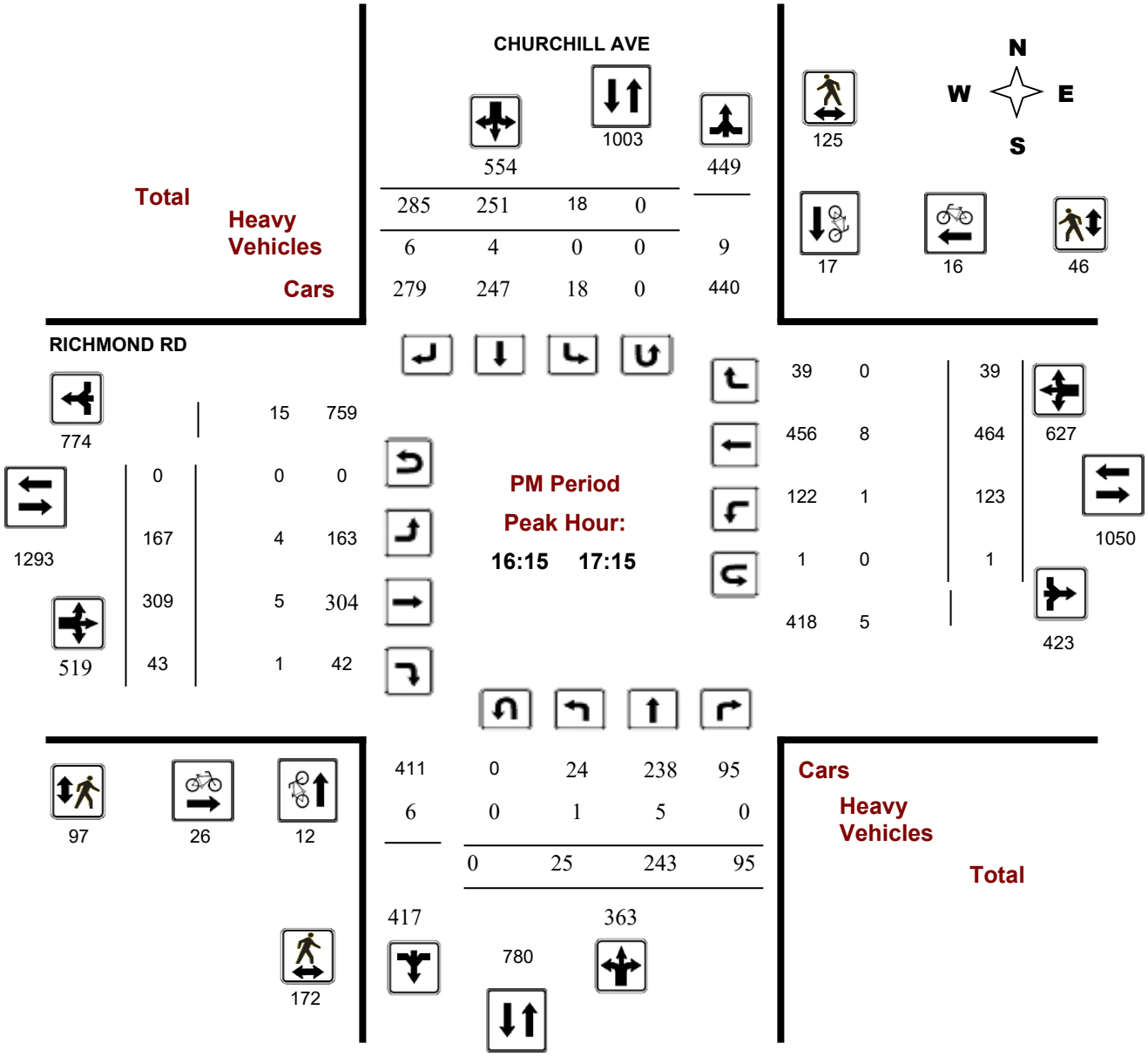
Transportation Services - Traffic Services

Turning Movement Count - Full Study Peak Hour Diagram

CHURCHILL AVE @ RICHMOND RD

Survey Date: Thursday, August 01, 2019 **WO No:** 38640

Start Time: 07:00 **Device:** Miovision



Comments

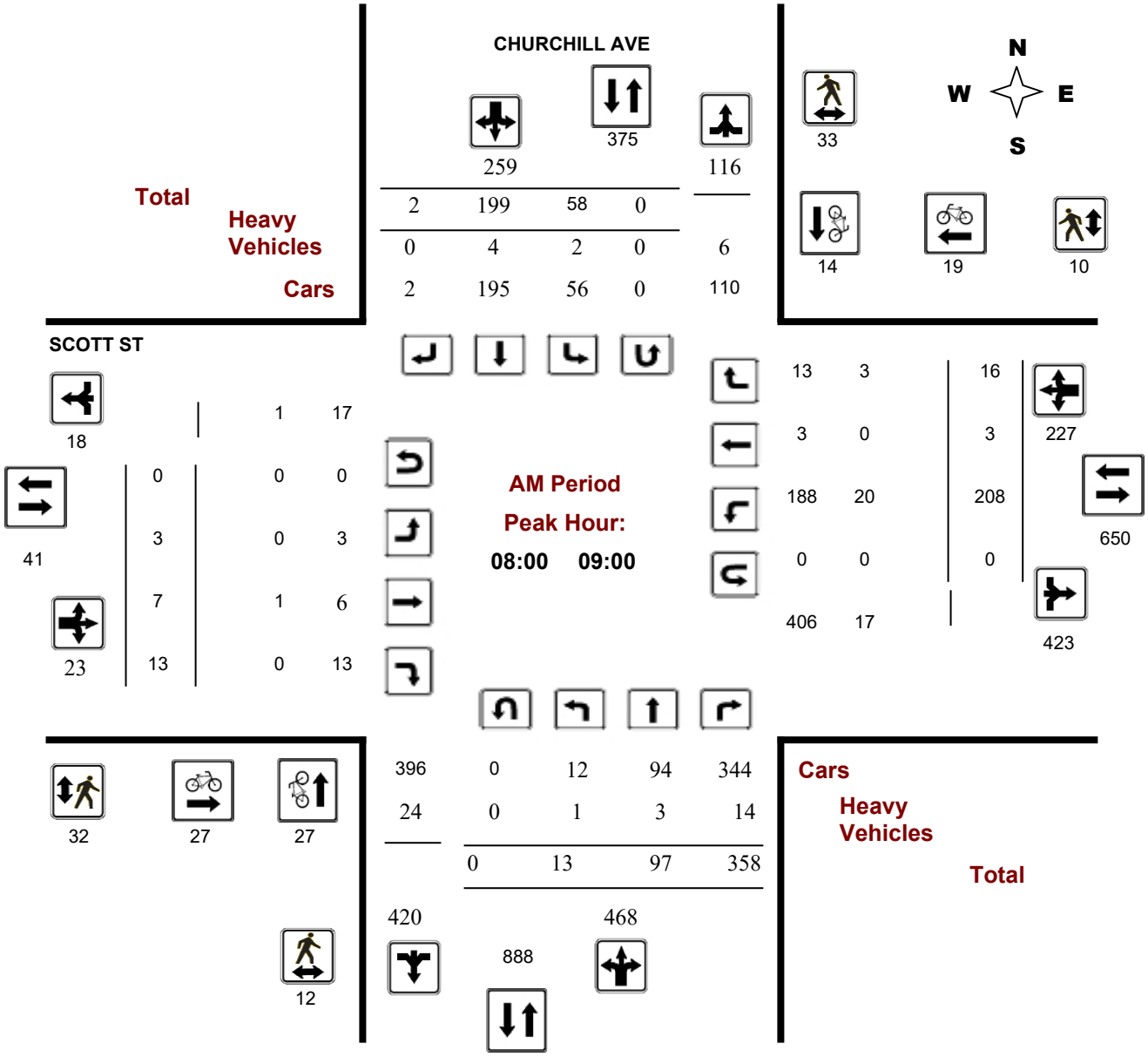
Transportation Services - Traffic Services

Turning Movement Count - Full Study Peak Hour Diagram

CHURCHILL AVE @ SCOTT ST

Survey Date: Tuesday, August 13, 2019 **WO No:** 38699

Start Time: 07:00 **Device:** Miovision



Comments

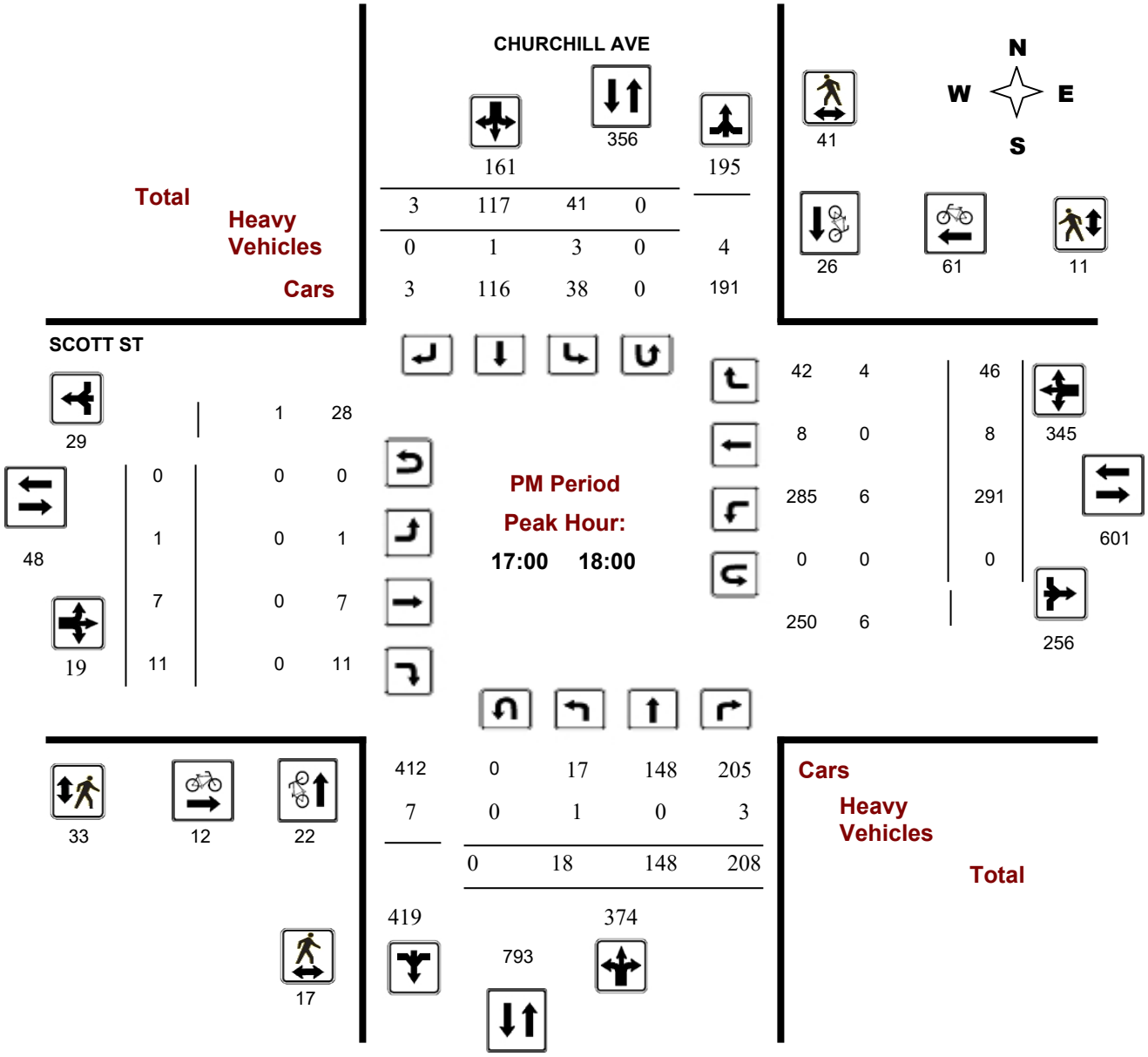
Transportation Services - Traffic Services

Turning Movement Count - Full Study Peak Hour Diagram

CHURCHILL AVE @ SCOTT ST

Survey Date: Tuesday, August 13, 2019 **WO No:** 38699

Start Time: 07:00 **Device:** Miovision



Comments

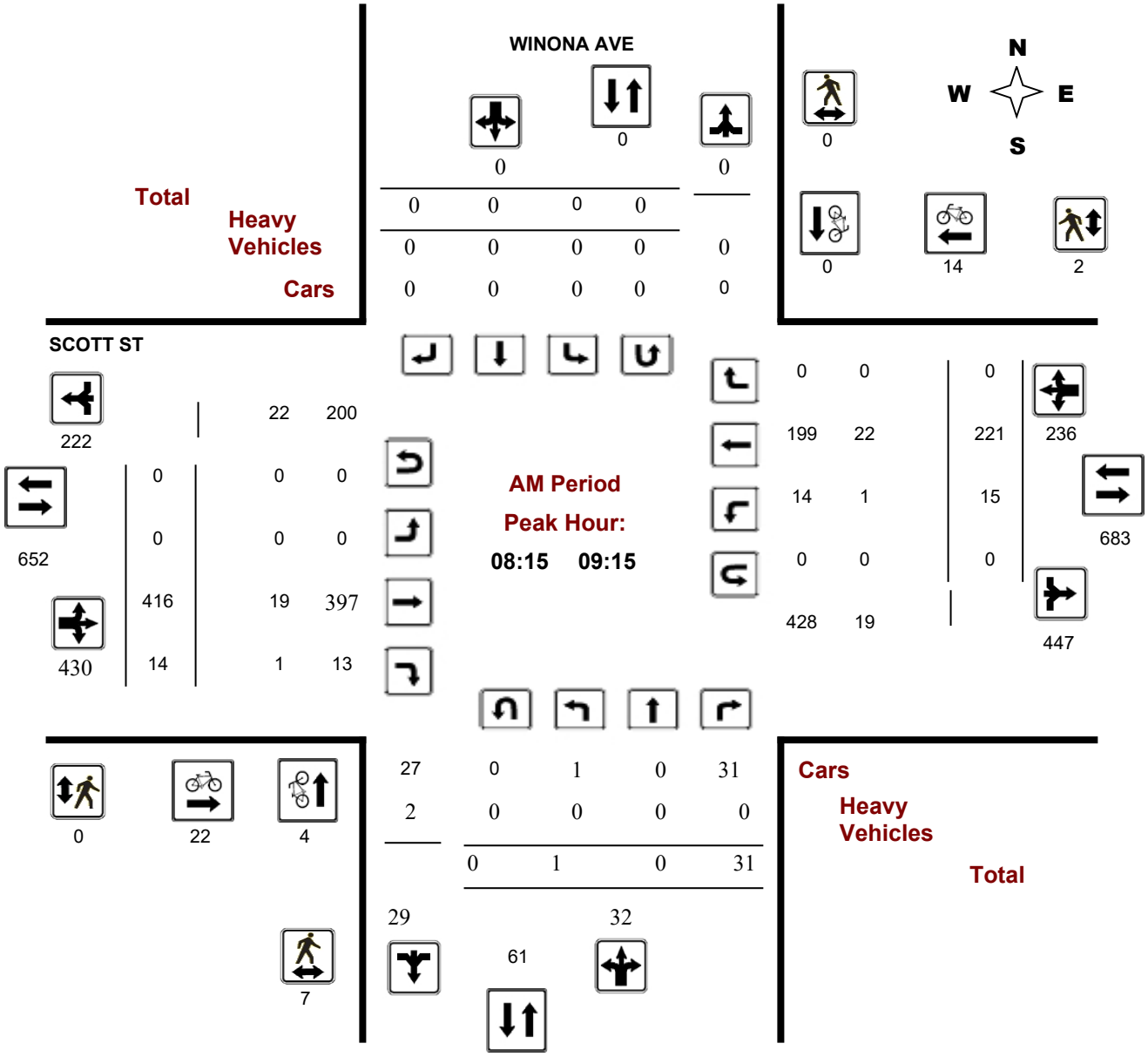
Transportation Services - Traffic Services

Turning Movement Count - Full Study Peak Hour Diagram

SCOTT ST @ WINONA AVE

Survey Date: Wednesday, October 16, 2019 **WO No:** 38864

Start Time: 07:00 **Device:** Miovision



Comments

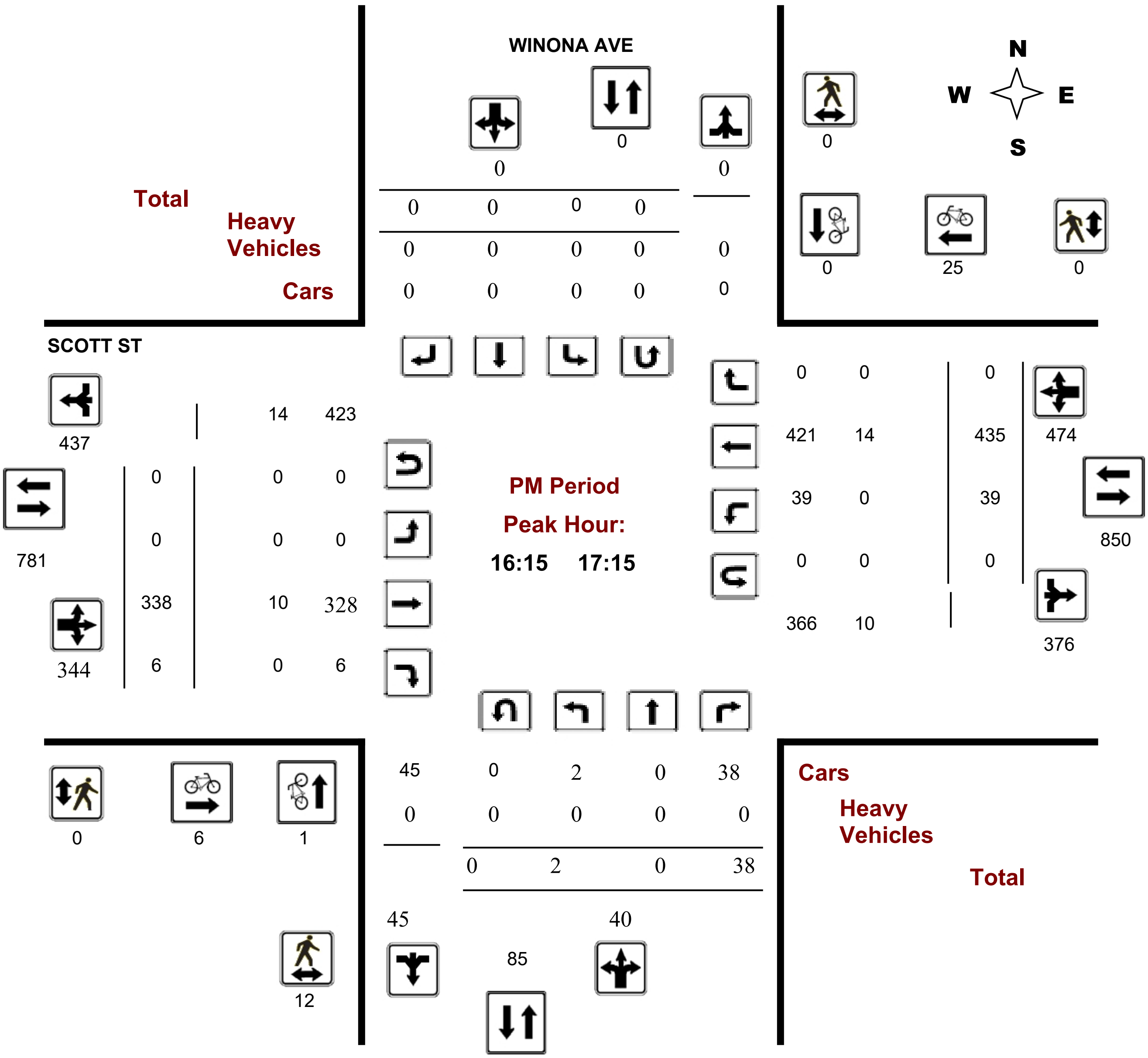
Transportation Services - Traffic Services

Turning Movement Count - Full Study Peak Hour Diagram

SCOTT ST @ WINONA AVE

Survey Date: Wednesday, October 16, 2019 **WO No:** 38864

Start Time: 07:00 **Device:** Miovision



Comments

Appendix B COMMENT RESPONSE CORRESPONDENCE

From: O"Grady, Lauren
To: Dubyk, Wally
Cc: McCreight, Andrew; "Mike.Giampa@ottawa.ca"
Subject: RE: 2070 Scott St - Forecasting Response
Date: Thursday, October 3, 2019 9:50:00 AM

Good morning Wally,

Thank you for your comments.

Please see my responses in pink below.

I've summarized what Stantec still requires from the City:

1. Can you please send me the design for the signals at Scott Street at Churchill intersection. We will need this information to proceed with our analysis.
2. Can you please let me know when the improvements along Scott are scheduled to occur (i.e. cycle tracks and sidewalks)?

Thank you,
Lauren

**** Vacation Alert: Please note I will be on vacation the week of October 14th ****

Lauren O'Grady P.Eng.
Transportation Engineer

Direct: 613-784-2264
lauren.o'grady@stantec.com

Stantec
400 - 1331 Clyde Avenue
Ottawa ON K2C 3G4

From: Dubyk, Wally <Wally.Dubyk@ottawa.ca>
Sent: Friday, September 27, 2019 9:04 AM
To: O'Grady, Lauren <Lauren.OGrady@stantec.com>
Cc: McCreight, Andrew <Andrew.McCreight@ottawa.ca>
Subject: RE: 2070 Scott St - Forecasting Response

Lauren,

Please see our response to your questions in red.

Wally Dubyk
Project Manager - Transportation Approvals
Development Review, Central & South Branches
613-580-2424 x13783

From: O'Grady, Lauren <Lauren.OGrady@stantec.com>
Sent: September 26, 2019 12:17 PM
To: Dubyk, Wally <Wally.Dubyk@ottawa.ca>
Cc: McCreight, Andrew <Andrew.McCreight@ottawa.ca>; Meloshe, Nancy <Nancy.Meloshe@stantec.com>
Subject: RE: 2070 Scott St - Forecasting Response

Good morning Wally,

Thank you for providing your comments on the Step 3 TIA for the development at 2070 Scott Street.

Please see my comment responses in green below. I've requested clarification on a few of the city's comments, which are highlighted in **bold**.

Please let me know if you concur with these responses. In addition, if you could provide clarification on the comment responses in bold, that would be greatly appreciated.

Thank you very much,

Lauren O'Grady P.Eng.
Transportation Engineer

Direct: 613-784-2264
lauren.o'grady@stantec.com

Stantec
400 - 1331 Clyde Avenue
Ottawa ON K2C 3G4

From: Dubyk, Wally <Wally.Dubyk@ottawa.ca>
Sent: Thursday, September 19, 2019 7:17 AM
To: O'Grady, Lauren <Lauren.OGrady@stantec.com>

Cc: McCreight, Andrew <Andrew.McCreight@ottawa.ca>
Subject: 2070 Scott St - Forecasting Response

Lauren,

Please review the following comments;

2070 Scott Street

Transportation

Update the build-out and future horizon years. A build-out year of 2020 will be difficult to achieve for a 23-story building. As a result, O-Train line 2 may be operational by the future horizon year. The build-out horizon was incorrectly stated as 2020. The actual build-out year for the proposed building is 2022. This will be corrected in subsequent submissions of the TIA. **What year will the O-Train Line 2 (extension to the west end of Ottawa) be complete?**
Stage 2 Light Rail is a package of three extensions that represent the next phase of rail rapid transit investment in Ottawa. By 2023, Stage 2 will add a total of 30 kilometres of rail and 19 new stations to the O-Train system from Bayshore to Place d'Orleans, and south to Bowesville at Riverside South. Further information is available on the City's website We will assume the LRT extension to Bayshore will be in place by 2023.

There are 4 developments that are planned or under construction surrounding the intersection of Scott Street and McRae Avenue (350 m east of the site). When three of these developments are combined (320 McRae / 1976 Scott, 1960 Scott, and 1950 Scott), they are projected to generate approximately 60 new vehicle trips to/from the west towards the 2070 Scott Street site. Other active developments within 400 m of the site, or with projected impacts to study area sites are 371 Richmond Road, and 433-435 Churchill Avenue and 468-472 Byron Place. The above-mentioned developments should be considered in the review and their generated vehicle trips added to background traffic.

Looking at the City's development applications website, the following information was found:

- 320 McRae / 1976 Scott
    - Per Figure 8 of the 320 McRae / 1976 Scott Redevelopment CTS, there are 5 and 6 auto trips to / from the west on Scott Street during the AM and PM peak hours, respectively. In addition, there are 10 and 16 auto trips to / from the west on Richmond during the AM and PM peak hours, respectively.
- 1960 Scott
    - The only thing on dev apps is an Addendum, which doesn't show the cars on the transportation network.
- 1950 Scott

Per Figure 9 of the 1950 Scott Street Strategy Report, there are 10 and 9 auto trips to / from the west towards 2070 Scott Street during the AM and PM peak hours, respectively.

- 371 Richmond
    - Per Figure 4 of the 371 Richmond Transportation Brief, there are 18 and 11 auto trips at the Richmond / Churchill intersection during the AM and PM peak hours, respectively. In addition, there are 14 and 12 auto trips that would affect the Churchill / Scott intersection during the AM and PM peak hours.
- 433 – 435 Churchill and 468-472 Byron Place
    - Per Figure 4 of the 433 – 435 Churchill Avenue and 468 – 472 Byron Place TIA, there are 8 and 10 auto trips at the Richmond / Churchill intersection during the AM and PM peak hours, respectively.

Have there been more recent traffic studies that haven't been posted to the City's dev apps website that you can send me? Otherwise, I can include the trips that I've outlined above as background trips as part of my Step 4. All developments that are available for public review are on dev apps. As the above noted traffic volumes were based on the TIAs on dev apps, we will include these in our background developments for the subject TIA.

Include the intersections of Winona Avenue and Scott Street and Winona Avenue/ Richmond Road in the analysis since the only access is onto Winona Avenue. In addition, as 50% of the development trips are assigned to/from the east/north via Scott Street, it is recommended that the pedestrian signals at Scott/Athlone and Scott/Tweedsmuir be included, as well as the Scott/McRae intersection. All these intersections are within 400 m of the 2070 Scott Street site. Update Figures 6, 8 and 9, as well as Table 9.

The intersection of Scott Street at Winona Avenue will be included in the analysis as the access to the proposed development is located on Winona.

As Richmond Road at Winona Avenue is stop-controlled, no subject traffic has been assigned to this intersection. It was assumed that residents would use the Richmond / Churchill intersection instead since there are signals and it will be easier for motorists to access Richmond Road. For this reason, the intersection of Richmond Road at Winona Avenue will not be included in the analysis.

The number of trips that the development is anticipated to generate that will head east on Scott Street is 18 (12 outbound and 6 inbound) and 17 (7 outbound and 10 inbound) during the AM and PM peaks, respectively. This amount of traffic is considered negligible and therefore will not have any adverse implications on the Scott / Althone, Scott / Tweedsmuir, and Scott / McRae intersections. In addition, based on the email correspondence between me and yourself dated August 26, 2019, there was concurrence with our rationale for not expanding the proposed study area. For these reasons, the three aforementioned Scott intersections will not be included in the subject TIA. Please ensure that your rational relating to this development is include in the TIA report. Noted.

Figures 6, 8, 9, 11, 12, 13 will be updated to include the Scott Street at Winona Avenue intersection.

Include the Neighbourhood Traffic Management module in the strategy report given the only access is onto a local street (Winona Avenue). Fifty percent of trips (those to/from the

north/east) are not shown because intersections on Scott Street east of the development are not included (see 2.2.1 comment). Some trips, especially those to the west, are likely to use Winona Avenue southbound to Richmond Avenue. Update Table 9 and Figures to address Winona Avenue and Scott Street from the development site to McRae Avenue.

Module 4.6 Neighbourhood Traffic Management will be included in the Step 4 TIA. See comment response above regarding expanding the study area intersections. Ok

Section 2.1.2.2: Indicate that the pathway north of Scott Street connects to the Sir John A Macdonald multi-use pathway (used by both pedestrians and cyclists).

Section 2.1.2.2 indicates that the pathway north of Scott Street connects to the Sir John A Macdonald pathway. It will be updated to include “used by both pedestrians and cyclists”. Ok

Section 2.1.2.3: the transit stop north of the intersection of Churchill Avenue N and Scott Street is served by route 16.

Section 2.1.2.3 will be updated accordingly. Ok

Note that use of the City of Ottawa TOD Plans mode share targets must be accompanied by acceptable design for sustainable modes and TDM measures as part of Step 4 to ensure that targets are met.

As per the Functional design Ultimate Cycling Facility from Churchill to Island Park Drive, the ultimate cross-section of Scott Street across the subject development has already been planned. It includes cycle tracks and sidewalks along both sides of Scott Street as well as cross-rides at each intersecting street. TDM checklists will be included as part of the Step 4 TIA. Ok Stantec requests information regarding what year the Scott Street improvements are scheduled to occur.

Stage 2 of Ottawa's LRT includes a western extension of Line 1 that is targeted to be completed by 2025. As part of construction of the LRT extension, Transitway buses will be detoured to Scott Street, and Scott Street adjacent to the development will be reconstructed as a complete street. Consider this project and its impacts to the 2070 Scott Street site.

Stantec requests more information regarding the number of buses that will be added to Scott Street as part of the detour. Without this information, it cannot be determined what the impacts will be. Please contact Transit Services Branch, octdevelopmentreview@ottawa.ca. Per email from Graham Rathwell, we will assume the bus detour will start in 2022 and last until 2025. We will add 180 buses per hour per direction during the peak hours on Scott Street.

Construction of the LRT extension may impact development timing. Construction access and any ROW needs must be reviewed by City transportation staff prior to approvals.

Noted.

Traffic Signal Operations

Westbound Scott Street in the afternoon peak period regular has queues extending pass

Winona Avenue.

Step 4 includes the analysis and will confirm the queues. Ok

Scott Street and Churchill Avenue will be converted to a full traffic signal for Stage 2 LRT construction.

When should we assume the signals will be implemented? Early 2020 as stated in the City's comments. Stantec requests the intersection design for the Scott / Churchill intersection so we can include the appropriate geometrics in the subject TIA.

The report does not state number of parking spaces, If the desire is to reach a 65% modal share for transit, consider reducing the parking the development.

Step 4 will outline the proposed parking spaces. Ok

Conversion to LRT will happen in early 2020 not 2031.

Which segment of LRT is this referring to? This is in reference to your description in Table 4 Noted

Provide details on the capacity of the existing transportation network without any modifications in the event that modal share targets are not met.

Please provide additional clarification. The location is a TOD which means that the objective is to have 65% of the person trips travel by transit and only 15% by car. Review the impact on the road network if a higher vehicle mode share (existing is shown as 40%) is the outcome and if the TOD target modal share isn't achieved. Given that a large number of parking spaces is proposed there is concern that the targets won't be met. The number of parking spaces will be determined as part of the Step 4 TIA. Given that the subject development is located 30m from the Transitway, achieving the 65% transit modal share will likely not be an issue. Particularly with the improvements slated to occur on Scott Street (i.e., sidewalks and cycle tracks). Increasing the auto modal share from 15% to 40% (as per existing) results in roughly 80 two-way auto trips during each of the AM and PM peak hours. This volume is still considered negligible as compared to the existing traffic on the surrounding transportation network.

Given the above, it is our understanding that re-running the analysis with an alternate scenario using lower transit modal shares would not add value and is therefore not required.

With the conversion to a full signal and vehicle/bus detour along Scott Street for the construction of LRT in early 2020, there will be minimal opportunity to make a westbound left turn onto Winona Avenue from Scott Street.

Step 4 will include the analysis of Scott at Winona and will confirm the viability of the westbound left. Ok

Thank you,

Wally Dubyk
Project Manager - Transportation Approvals

Development Review, Central & South Branches
613-580-2424 x13783

From: O'Grady, Lauren <Lauren.OGrady@stantec.com>
Sent: September 06, 2019 9:25 AM
To: Dubyk, Wally <Wally.Dubyk@ottawa.ca>
Cc: Meloshe, Nancy <Nancy.Meloshe@stantec.com>
Subject: 2070 Scott Street - Step 3 TIA

Good morning Wally,

Please see attached the Step 3 TIA for the proposed development located at 2070 Scott Street in Westboro. Please let me know if you have any questions or comments or if I can proceed with Step 4.

Have a great weekend,

Lauren O'Grady P.Eng.
Transportation Engineer

Direct: 613-784-2264
lauren.o'grady@stantec.com

Stantec
400 - 1331 Clyde Avenue
Ottawa ON K2C 3G4

'

From: Inwood, Campbell
To: O"Grady, Lauren
Cc: Giampa, Mike; Renna, Sabrina; Franklin, Carol; Afaneh, Ammar
Subject: RE: Scott Street Signals
Date: Wednesday, October 30, 2019 12:47:27 PM

Hi Lauren,

I can't confirm timing for the ultimate design of Scott, no, but I can say that by the end of 2021, the interim concept you attached should be built. The bus detour will run from Q2 2022 through 2025, so the earliest that ultimate concept could go ahead is 2026, meaning that 2027 looks to be a reasonable guess.

The signals at Scott/Churchill will remain post-revenue service of Stage 2 LRT; it is described in our contract as a "new, permanent, traffic signal".

Please let me know if you have additional questions.

Thanks,
Campbell

From: O'Grady, Lauren <Lauren.OGrady@stantec.com>
Sent: October 30, 2019 12:38 PM
To: Inwood, Campbell <Campbell.Inwood@ottawa.ca>
Cc: Giampa, Mike <Mike.Giampa@ottawa.ca>; Renna, Sabrina <Sabrina.Renna@stantec.com>
Subject: Scott Street Signals

Hi Campbell,

I'm working with a developer for a proposed residential tower at 2070 Scott Street. Through the TIA process, we've been informed that as part of the LRT Stage 2, there will be a bus detour that runs down Scott Street. As part of this, the intersection of Scott Street at Churchill will be signalized and there will be revised bicycle facilities on Scott Street (see attachment 1). We've been informed that these two improvements will likely occur by 2021, per direction from Carol Franklin.

We've also received an 'ultimate' design of Scott Street (see attachment 2), that includes cycle tracks and sidewalks along both sides, however, this ultimate design does not include signals at Scott and Churchill. We've been informed that this ultimate design will likely be in place by 2027.

Can you confirm the above noted timing for the interim and ultimate design of Scott Street and also confirm what will happen to the signals at Scott / Churchill once the bus detour is no longer in operation?

Feel free to give me a call if you'd like more information or you'd like to discuss.

Thank you,

Lauren O'Grady P.Eng.
Transportation Engineer

Direct: 613-784-2264
lauren.o'grady@stantec.com

Stantec
400 - 1331 Clyde Avenue
Ottawa ON K2C 3G4

'

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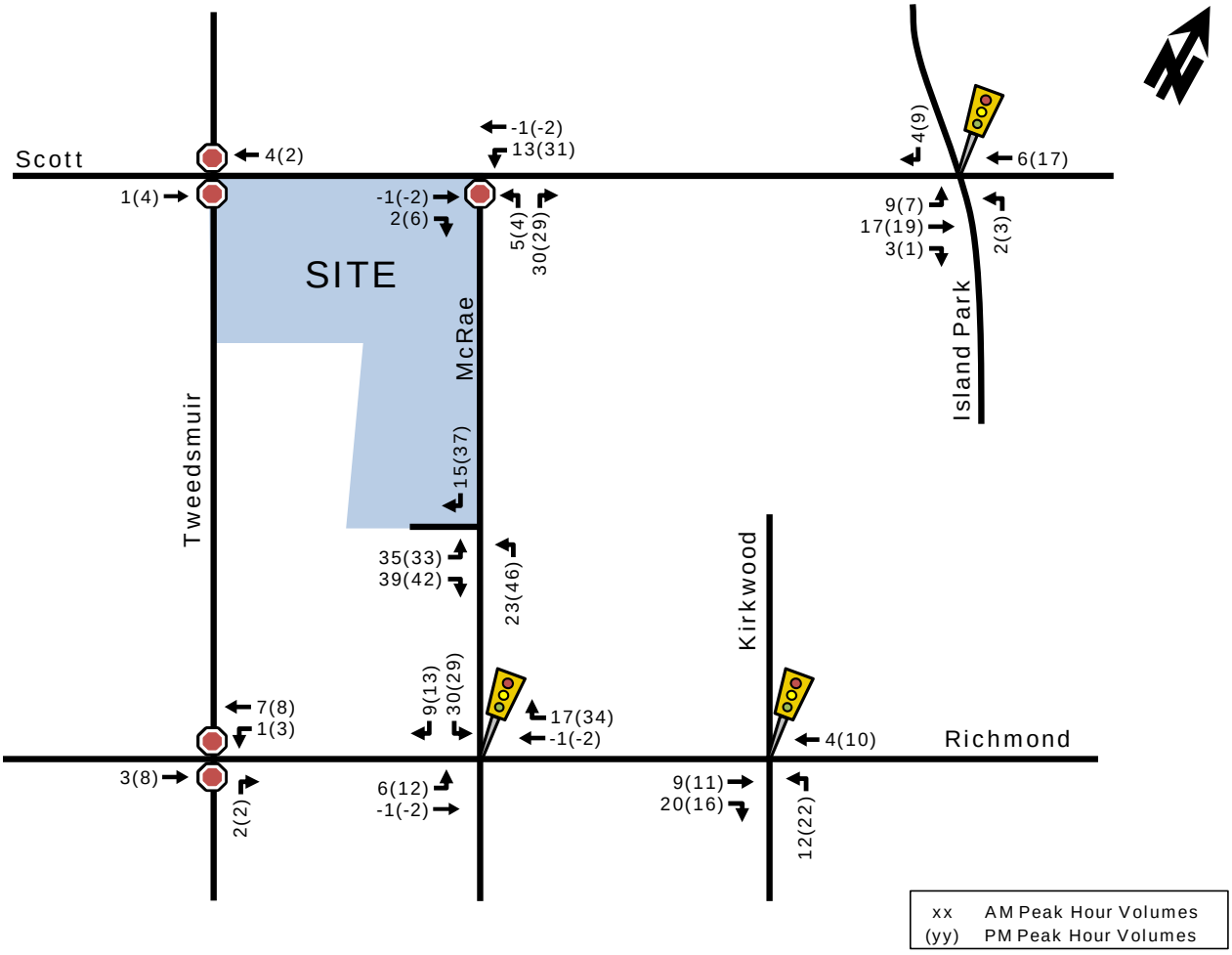
Appendix C BACKGROUND TRAFFIC VOLUMES

Figure 8: 'New' and 'Pass-by' Site-Generated Traffic Volumes



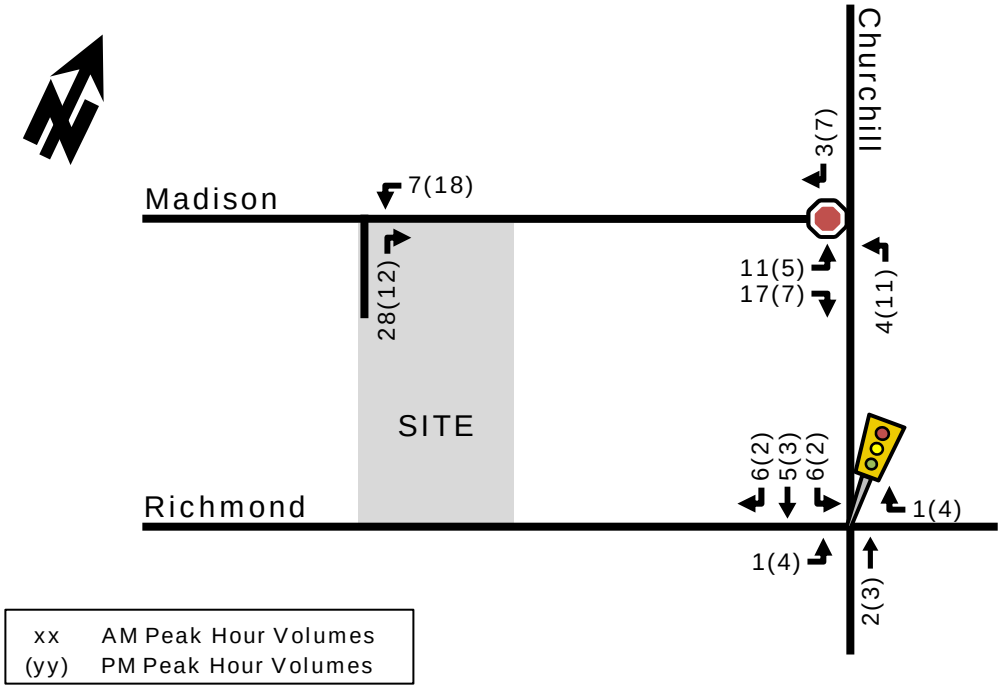
4. Future Traffic Operations

4.1 Projected 2017 Conditions at Full Site Development

The total projected 2017 volumes associated with the proposed development were derived by superimposing 'new' and 'pass-by' site-generated traffic volumes (Figure 8) onto projected 2017 background traffic volumes (Figure 6). The resulting total projected 2017 volumes are illustrated as Figure 9.

The following Table 11 provides a projected performance summary for study area intersections, based on total projected 2017 traffic volumes. The signal timing was optimized at the Richmond/McRae and Richmond/Kirkwood intersections based on the projected background conditions (prior to any development of the proposed site). The detailed SYNCHRO model output of projected conditions is provided within Appendix G.

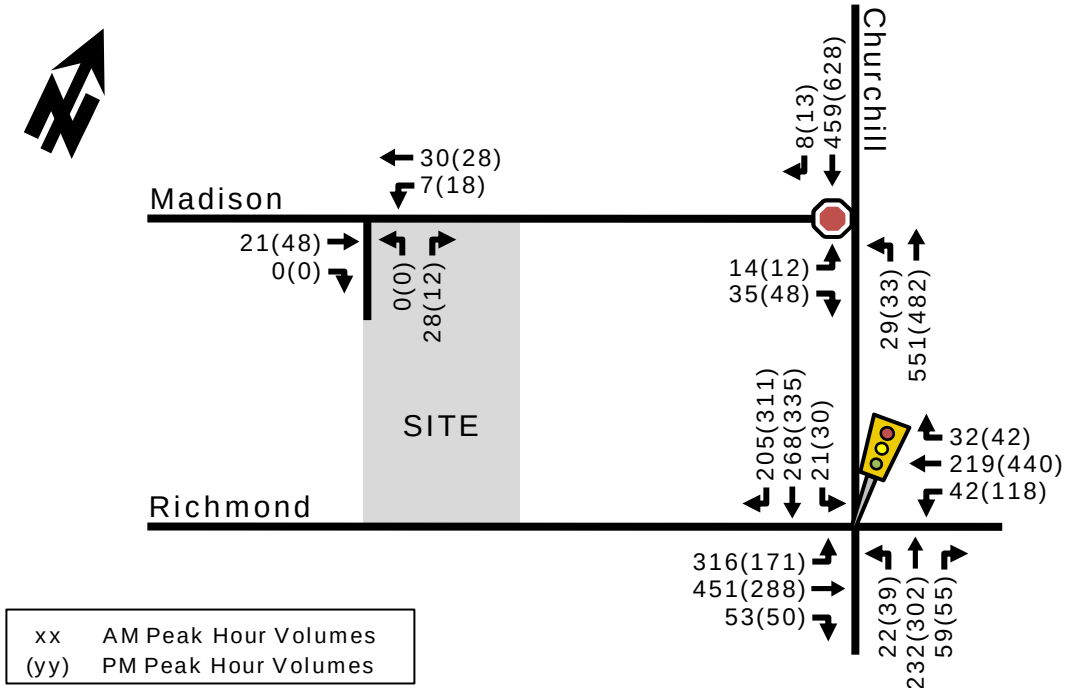
Figure 4: 'New' Site-Generated Traffic Volumes



4. Future Traffic Operations

For the purpose of this study, the total projected traffic volumes were derived by superimposing 'new' site-generated traffic (Figure 4) onto existing volumes (Figure 3). As the amount of site traffic generation does not require any traffic analysis based on the City guidelines, we have not accounted for any potential background growth. The resulting total projected traffic volumes used in the subsequent analysis are illustrated as Figure 5.

Figure 5: Projected Traffic Volumes



4.1.2 Trip Distribution

The assumed distribution of trips generated by the proposed development has been derived from existing traffic patterns on the roadways within the study area. As the proposed development is predominantly residential, the majority of peak hour trips are anticipated to be to/from work. It is appropriate for the assumed trip distribution to be based on the distribution of existing traffic volumes exiting the study area during the AM peak hour and arriving to the study area during the PM peak hour. The projected distribution of trips is summarized as follows:

- 35% to/from the east via either Byron Avenue or Richmond Road
- 30% to/from the west via either Byron Avenue or Richmond Road
- 20% to/from the north via Churchill Avenue
- 15% to/from the south via Churchill Avenue

Site generated traffic volumes are shown in **Figure 4**.

Figure 4: Site Generated Traffic

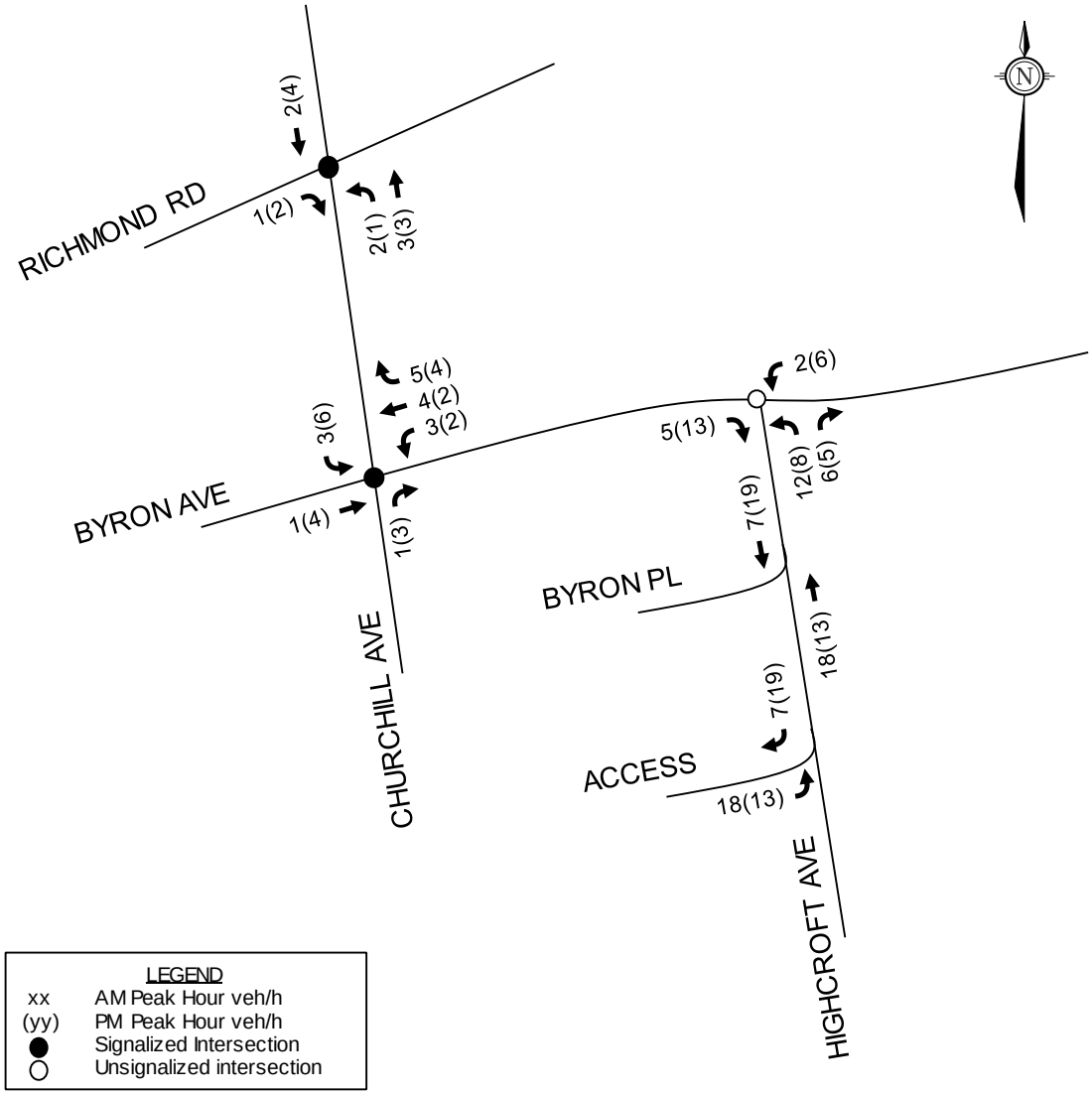
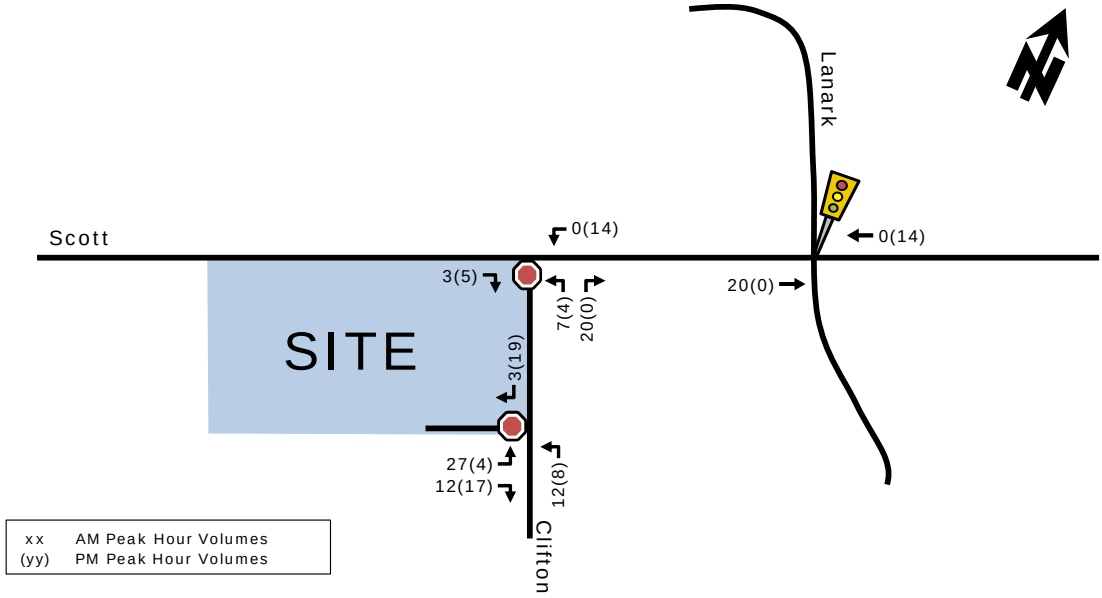


Figure 9: 'New' Site-Generated Traffic



It is noteworthy that the existing turn restrictions are understood to be in place to help prevent cut-through traffic through the neighbourhood. Based on the existing count data at the Clifton/Scott intersection, there are a number of drivers that do not comply with these existing turn restrictions. Some site-generated traffic originating/destined from/to the east will be required to travel along the southern portion on Clifton Road during the peak hours to comply with the existing turn restrictions. This is represented in Figure 9.

3.2. BACKGROUND NETWORK TRAVEL DEMANDS

3.2.1. TRANSPORTATION NETWORK PLANS

Refer to section 2.1.3 Planned Conditions – Planned Study Area Transportation Network Changes.

3.2.2. BACKGROUND GROWTH

Background traffic growth for the area is expected to grow based on significant planned area developments. However, given Stage 2 LRT construction, the City is expecting to see negative vehicle growth along Scott Street in the future (see map attached as Appendix E). As such, for background traffic projections, the projected vehicle volumes from the planned area developments (1960 Scott Street and 320 McRae) were layered onto the existing traffic volumes for the build out year 2020. As the City expects to see a significant increase in transit modes once Stage 2 LRT is constructed in this area (2023) and a decline in traffic volumes, and as there is likely to be continued development growth in the area, the vehicle traffic volumes for horizon year 2025 is assumed to be the same as year 2020.

Appendix D MULTI-MODAL LEVEL OF SERVICE ASSESSMENT

Multi-Modal Level of Service - Segments Form

Consultant	**Stantec**	**Project**	**2070 Scott St.**
Scenario	**2019 Existing**	**Date**	**28-Oct-19**
Comments			

SEGMENTS			Scott Street along PL	Churchill Ave along PL	Winona Ave along PL
Pedestrian	Sidewalk Width Boulevard Width	**F**	≥ 2 m 0.5 - 2 m	≥ 2 m > 2 m	no sidewalk n/a
	Avg Daily Curb Lane Traffic Volume		> 3000	> 3000	≤ 3000
	Operating Speed On-Street Parking		> 50 to 60 km/h no	> 50 to 60 km/h yes	> 50 to 60 km/h no
	Level of Service		**D**	**B**	**F**
Bicycle	Type of Cycling Facility	**B**	Curbside Bike Lane	Mixed Traffic	Mixed Traffic
	Number of Travel Lanes		≤ 1 each direction	≤ 2 (no centreline)	≤ 2 (no centreline)
	Operating Speed		≤ 50 km/h	>40 to <50 km/h	>40 to <50 km/h
	# of Lanes & Operating Speed LoS		**A**	**B**	**B**
	Bike Lane (+ Parking Lane) Width		≥1.5 to <1.8 m		
	Bike Lane Width LoS		**B**	-	-
	Bike Lane Blockages		Rare		
	Blockage LoS		**A**	-	-
	Level of Service		**B**	**B**	**B**
Transit	Facility Type	**D**	Mixed Traffic	Mixed Traffic	
	Friction or Ratio Transit:Posted Speed		Vt/Vp ≥ 0.8	Vt/Vp ≥ 0.8	
	Level of Service		**D**	**D**	**-**
Truck	Truck Lane Width	**C**	≤ 3.5 m	> 3.7 m	
	Travel Lanes per Direction		1	1	
	Level of Service		**C**	**B**	**-**

Multi-Modal Level of Service - Segments Form

Consultant	**Stantec**	**Project**	**2070 Scott St.**
Scenario	**2022 Build-Out**	**Date**	**28-Oct-19**
Comments	**Geometry reflects 2022 FBG and TF horizons**		

SEGMENTS			Scott Street along PL	Churchill Ave along PL	Winona Ave along PL
Pedestrian	Sidewalk Width Boulevard Width	**D**	≥ 2 m 0.5 - 2 m	≥ 2 m > 2 m	≥ 2 m < 0.5
	Avg Daily Curb Lane Traffic Volume		> 3000	> 3000	≤ 3000
	Operating Speed On-Street Parking		> 50 to 60 km/h no	> 50 to 60 km/h yes	> 50 to 60 km/h yes
	Level of Service		**D**	**B**	**C**
Bicycle	Type of Cycling Facility	**B**	Physically Separated	Mixed Traffic	Mixed Traffic
	Number of Travel Lanes			≤ 2 (no centreline)	≤ 2 (no centreline)
	Operating Speed			>40 to <50 km/h	>40 to <50 km/h
	# of Lanes & Operating Speed LoS		-	**B**	**B**
	Bike Lane (+ Parking Lane) Width				
	Bike Lane Width LoS		-	-	-
	Bike Lane Blockages				
	Blockage LoS		-	-	-
	Level of Service		**A**	**B**	**B**
Transit	Facility Type	**D**	Mixed Traffic	Mixed Traffic	
	Friction or Ratio Transit:Posted Speed		Vt/Vp ≥ 0.8	Vt/Vp ≥ 0.8	
	Level of Service		**D**	**D**	**-**
Truck	Truck Lane Width	**C**	≤ 3.5 m	≤ 3.5 m	
	Travel Lanes per Direction		1	1	
	Level of Service		**C**	**C**	**-**

Multi-Modal Level of Service - Intersections Form

Consultant	**Stantec**	**Project**	**2070 Scott St.**
Scenario	**2019 Existing**	**Date**	**1-Oct-19**
Comments			

INTERSECTIONS		Richmond Road at Churchill Avenue North			
	Crossing Side	**NORTH**	**SOUTH**	**EAST**	**WEST**
Pedestrian	Lanes	3	3	3	3
	Median	No Median - 2.4 m	No Median - 2.4 m	No Median - 2.4 m	No Median - 2.4 m
	Conflicting Left Turns	Protected/ Permissive	Permissive	Permissive	Permissive
	Conflicting Right Turns	Permissive or yield control	Permissive or yield control	Permissive or yield control	Permissive or yield control
	Right Turns on Red (RToR) ?	RTOR allowed	RTOR allowed	RTOR allowed	RTOR allowed
	Ped Signal Leading Interval?	Yes	Yes	Yes	Yes
	Right Turn Channel	No Channel	No Channel	No Channel	No Channel
	Corner Radius	10-15m	10-15m	10-15m	10-15m
	Crosswalk Type	Zebra stripe hi-vis markings	Zebra stripe hi-vis markings	Zebra stripe hi-vis markings	Zebra stripe hi-vis markings
	PETSI Score	**75**	**75**	**75**	**75**
	Ped. Exposure to Traffic LoS	**B**	**B**	**B**	**B**
	Cycle Length	90	90	90	90
	Effective Walk Time	45	45	33	33
	Average Pedestrian Delay	**11**	**11**	**18**	**18**
	Pedestrian Delay LoS	**B**	**B**	**B**	**B**
	Level of Service	**B**	**B**	**B**	**B**
		B			
	Approach From	**NORTH**	**SOUTH**	**EAST**	**WEST**
Bicycle	Bicycle Lane Arrangement on Approach	Mixed Traffic	Mixed Traffic	Mixed Traffic	Mixed Traffic
	IF Dedicated Right Turn Lane, THEN Right Turn Configuration, ELSE <blank>				
	Dedicated Right Turning Speed				
	Cyclist Through Movement				
	Separated or Mixed Traffic	**Mixed Traffic**	**Mixed Traffic**	**Mixed Traffic**	**Mixed Traffic**
	Left Turn Approach	No lane crossed	No lane crossed	No lane crossed	No lane crossed
	Operating Speed	> 40 to ≤ 50 km/h	> 40 to ≤ 50 km/h	> 40 to ≤ 50 km/h	> 40 to ≤ 50 km/h
	Left Turning Cyclist	**B**	**B**	**B**	**B**
	Level of Service	**B**	**B**	**B**	**B**
		B			
Transit	Average Signal Delay	> 40 sec	> 40 sec	≤ 40 sec	> 40 sec
	Level of Service	**F**	**F**	**E**	**F**
		F			
Truck	Effective Corner Radius	10 - 15 m	10 - 15 m	10 - 15 m	10 - 15 m
	Number of Receiving Lanes on Departure from Intersection	1	1	1	1
	Level of Service	**E**	**E**	**E**	**E**
		E			

Multi-Modal Level of Service - Intersections Form

Consultant	**Stantec**	**Project**	**2070 Scott St.**
Scenario	**2022 Future Background**	**Date**	**1-Oct-19**
Comments			

	INTERSECTIONS	**Richmond Road at Churchill Avenue North**				**Scott Street and Churchill Avenue North**			
	Crossing Side	**NORTH**	**SOUTH**	**EAST**	**WEST**	**NORTH**	**SOUTH**	**EAST**	**WEST**
Pedestrian	Lanes	3	3	3	3	0 - 2	3	3	0 - 2
	Median	No Median - 2.4 m	No Median - 2.4 m	No Median - 2.4 m	No Median - 2.4 m	No Median - 2.4 m	No Median - 2.4 m	No Median - 2.4 m	No Median - 2.4 m
	Conflicting Left Turns	Protected/ Permissive	Permissive	Permissive	Permissive	Protected/ Permissive	Permissive	Permissive	Protected/ Permissive
	Conflicting Right Turns	Permissive or yield control	Permissive or yield control	Permissive or yield control	Permissive or yield control	Permissive or yield control	Permissive or yield control	Permissive or yield control	Permissive or yield control
	Right Turns on Red (RToR) ?	RTOR allowed	RTOR allowed	RTOR allowed	RTOR allowed	RTOR prohibited	RTOR prohibited	RTOR prohibited	RTOR prohibited
	Ped Signal Leading Interval?	Yes	Yes	Yes	Yes	No	No	No	No
	Right Turn Channel	No Channel	No Channel	No Channel	No Channel	No Channel	No Channel	No Channel	No Channel
	Corner Radius	10-15m	10-15m	10-15m	10-15m	10-15m	10-15m	10-15m	10-15m
	Crosswalk Type	Zebra stripe hi-vis markings	Zebra stripe hi-vis markings	Zebra stripe hi-vis markings	Zebra stripe hi-vis markings	Zebra stripe hi-vis markings	Zebra stripe hi-vis markings	Zebra stripe hi-vis markings	Zebra stripe hi-vis markings
	PETSI Score	**75**	**75**	**75**	**75**	**91**	**76**	**76**	**91**
	Ped. Exposure to Traffic LoS	**B**	**B**	**B**	**B**	**A**	**B**	**B**	**A**
	Cycle Length	90	90	90	90	110	110	110	110
	Effective Walk Time	45	45	33	33	22	22	24	24
	Average Pedestrian Delay	**11**	**11**	**18**	**18**	**35**	**35**	**34**	**34**
	Pedestrian Delay LoS	**B**	**B**	**B**	**B**	**D**	**D**	**D**	**D**
	Level of Service	**B**	**B**	**B**	**B**	**D**	**D**	**D**	**D**
		B				**D**			
	Approach From	**NORTH**	**SOUTH**	**EAST**	**WEST**	**NORTH**	**SOUTH**	**EAST**	**WEST**
Bicycle	Bicycle Lane Arrangement on Approach	Mixed Traffic	Mixed Traffic	Mixed Traffic	Mixed Traffic	Curb Bike Lane, Cycletrack or MUP	Curb Bike Lane, Cycletrack or MUP	Curb Bike Lane, Cycletrack or MUP	Curb Bike Lane, Cycletrack or MUP
	IF Dedicated Right Turn Lane, THEN Right Turn Configuration, ELSE <blank>								
	Dedicated Right Turning Speed								
	Cyclist Through Movement					**Not Applicable**	**Not Applicable**	**Not Applicable**	**Not Applicable**
	Separated or Mixed Traffic	**Mixed Traffic**	**Mixed Traffic**	**Mixed Traffic**	**Mixed Traffic**	**Separated**	**Separated**	**Separated**	**Separated**
	Left Turn Approach	No lane crossed	No lane crossed	No lane crossed	No lane crossed	No lane crossed	No lane crossed	No lane crossed	No lane crossed
	Operating Speed	> 40 to ≤ 50 km/h	> 40 to ≤ 50 km/h	> 40 to ≤ 50 km/h	> 40 to ≤ 50 km/h	> 40 to ≤ 50 km/h	> 40 to ≤ 50 km/h	> 40 to ≤ 50 km/h	> 40 to ≤ 50 km/h
	Left Turning Cyclist	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**
	Level of Service	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**
		B				**B**			
Transit	Average Signal Delay	≤ 20 sec	> 40 sec	≤ 40 sec	> 40 sec	> 40 sec	> 40 sec	> 40 sec	> 40 sec
	Level of Service	**C**	**F**	**E**	**F**	**F**	**F**	**F**	**F**
		F				**F**			
Truck	Effective Corner Radius	10 - 15 m	10 - 15 m	10 - 15 m	10 - 15 m	10 - 15 m	10 - 15 m	10 - 15 m	10 - 15 m
	Number of Receiving Lanes on Departure from Intersection	1	1	1	1	1	1	1	1
	Level of Service	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**
		E				**E**			

Multi-Modal Level of Service - Intersections Form

Consultant	**Stantec**	**Project**	**2070 Scott St.**
Scenario	**2022 Total Future**	**Date**	**1-Oct-19**
Comments			

	INTERSECTIONS	**Richmond Road at Churchill Avenue North**				**Scott Street and Churchill Avenue North**			
	Crossing Side	**NORTH**	**SOUTH**	**EAST**	**WEST**	**NORTH**	**SOUTH**	**EAST**	**WEST**
Pedestrian	Lanes	0 - 2	0 - 2	3	3	0 - 2	3	3	0 - 2
	Median	No Median - 2.4 m	No Median - 2.4 m	No Median - 2.4 m	No Median - 2.4 m	No Median - 2.4 m	No Median - 2.4 m	No Median - 2.4 m	No Median - 2.4 m
	Conflicting Left Turns	Protected/ Permissive	Permissive	Permissive	Permissive	Protected/ Permissive	Permissive	Permissive	Protected/ Permissive
	Conflicting Right Turns	Permissive or yield control	Permissive or yield control	Permissive or yield control	Permissive or yield control	Permissive or yield control	Permissive or yield control	Permissive or yield control	Permissive or yield control
	Right Turns on Red (RToR) ?	RTOR allowed	RTOR allowed	RTOR allowed	RTOR allowed	RTOR prohibited	RTOR prohibited	RTOR prohibited	RTOR prohibited
	Ped Signal Leading Interval?	Yes	Yes	Yes	Yes	No	No	No	No
	Right Turn Channel	No Channel	No Channel	No Channel	No Channel	No Channel	No Channel	No Channel	No Channel
	Corner Radius	10-15m	10-15m	10-15m	10-15m	10-15m	10-15m	10-15m	10-15m
	Crosswalk Type	Zebra stripe hi-vis markings	Zebra stripe hi-vis markings	Zebra stripe hi-vis markings	Zebra stripe hi-vis markings	Zebra stripe hi-vis markings	Zebra stripe hi-vis markings	Zebra stripe hi-vis markings	Zebra stripe hi-vis markings
	PETSI Score	**90**	**90**	**75**	**75**	**91**	**76**	**76**	**91**
	Ped. Exposure to Traffic LoS	**A**	**A**	**B**	**B**	**A**	**B**	**B**	**A**
	Cycle Length	90	90	90	90	110	110	110	110
	Effective Walk Time	45	45	33	33	21	21	24	24
	Average Pedestrian Delay	**11**	**11**	**18**	**18**	**36**	**36**	**34**	**34**
	Pedestrian Delay LoS	**B**	**B**	**B**	**B**	**D**	**D**	**D**	**D**
	Level of Service	**B**	**B**	**B**	**B**	**D**	**D**	**D**	**D**
		B				**D**			
	Approach From	**NORTH**	**SOUTH**	**EAST**	**WEST**	**NORTH**	**SOUTH**	**EAST**	**WEST**
Bicycle	Bicycle Lane Arrangement on Approach	Mixed Traffic	Mixed Traffic	Mixed Traffic	Mixed Traffic	Curb Bike Lane, Cycletrack or MUP	Curb Bike Lane, Cycletrack or MUP	Curb Bike Lane, Cycletrack or MUP	Curb Bike Lane, Cycletrack or MUP
	IF Dedicated Right Turn Lane, THEN Right Turn Configuration, ELSE <blank>								
	Dedicated Right Turning Speed								
	Cyclist Through Movement					**Not Applicable**	**Not Applicable**	**Not Applicable**	**Not Applicable**
	Separated or Mixed Traffic	**Mixed Traffic**	**Mixed Traffic**	**Mixed Traffic**	**Mixed Traffic**	**Separated**	**Separated**	**Separated**	**Separated**
	Left Turn Approach	No lane crossed	No lane crossed	No lane crossed	No lane crossed	No lane crossed	No lane crossed	No lane crossed	No lane crossed
	Operating Speed	> 40 to ≤ 50 km/h	> 40 to ≤ 50 km/h	> 40 to ≤ 50 km/h	> 40 to ≤ 50 km/h	> 40 to ≤ 50 km/h	> 40 to ≤ 50 km/h	> 40 to ≤ 50 km/h	> 40 to ≤ 50 km/h
	Left Turning Cyclist	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**
	Level of Service	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**
		B				**B**			
Transit	Average Signal Delay	≤ 20 sec	> 40 sec	≤ 30 sec	> 40 sec	> 40 sec	> 40 sec	> 40 sec	> 40 sec
	Level of Service	**C**	**F**	**D**	**F**	**F**	**F**	**F**	**F**
		F				**F**			
Truck	Effective Corner Radius	10 - 15 m	10 - 15 m	10 - 15 m	10 - 15 m	10 - 15 m	10 - 15 m	10 - 15 m	10 - 15 m
	Number of Receiving Lanes on Departure from Intersection	1	1	1	1	1	1	1	1
	Level of Service	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**
		E				**E**			

Multi-Modal Level of Service - Intersections Form

Consultant	**Stantec**	**Project**	**2070 Scott St.**
Scenario	**2027 Ultimate**	**Date**	**1-Oct-19**
Comments			

	INTERSECTIONS	**Richmond Road at Churchill Avenue North**				**Scott Street and Churchill Avenue North**			
	Crossing Side	**NORTH**	**SOUTH**	**EAST**	**WEST**	**NORTH**	**SOUTH**	**EAST**	**WEST**
Pedestrian	Lanes	0 - 2	0 - 2	3	3	0 - 2	3	3	0 - 2
	Median	No Median - 2.4 m	No Median - 2.4 m	No Median - 2.4 m	No Median - 2.4 m	No Median - 2.4 m	No Median - 2.4 m	No Median - 2.4 m	No Median - 2.4 m
	Conflicting Left Turns	Protected/ Permissive	Permissive	Permissive	Permissive	Protected/ Permissive	Permissive	Permissive	Protected/ Permissive
	Conflicting Right Turns	Permissive or yield control	Permissive or yield control	Permissive or yield control	Permissive or yield control	Permissive or yield control	Permissive or yield control	Permissive or yield control	Permissive or yield control
	Right Turns on Red (RToR) ?	RTOR allowed	RTOR allowed	RTOR allowed	RTOR allowed	RTOR prohibited	RTOR prohibited	RTOR prohibited	RTOR prohibited
	Ped Signal Leading Interval?	Yes	Yes	Yes	Yes	No	No	No	No
	Right Turn Channel	No Channel	No Channel	No Channel	No Channel	No Channel	No Channel	No Channel	No Channel
	Corner Radius	10-15m	10-15m	10-15m	10-15m	10-15m	10-15m	10-15m	10-15m
	Crosswalk Type	Zebra stripe hi-vis markings	Zebra stripe hi-vis markings	Zebra stripe hi-vis markings	Zebra stripe hi-vis markings	Zebra stripe hi-vis markings	Zebra stripe hi-vis markings	Zebra stripe hi-vis markings	Zebra stripe hi-vis markings
	PETSI Score	**90**	**90**	**75**	**75**	**91**	**76**	**76**	**91**
	Ped. Exposure to Traffic LoS	**A**	**A**	**B**	**B**	**A**	**B**	**B**	**A**
	Cycle Length	90	90	90	90	110	110	110	110
	Effective Walk Time	45	45	33	33	4	4	35	35
	Average Pedestrian Delay	**11**	**11**	**18**	**18**	**51**	**51**	**26**	**26**
	Pedestrian Delay LoS	**B**	**B**	**B**	**B**	**E**	**E**	**C**	**C**
	Level of Service	**B**	**B**	**B**	**B**	**E**	**E**	**C**	**C**
		B				**E**			
	Approach From	**NORTH**	**SOUTH**	**EAST**	**WEST**	**NORTH**	**SOUTH**	**EAST**	**WEST**
Bicycle	Bicycle Lane Arrangement on Approach	Mixed Traffic	Mixed Traffic	Mixed Traffic	Mixed Traffic	Curb Bike Lane, Cycletrack or MUP	Curb Bike Lane, Cycletrack or MUP	Curb Bike Lane, Cycletrack or MUP	Curb Bike Lane, Cycletrack or MUP
	IF Dedicated Right Turn Lane, THEN Right Turn Configuration, ELSE <blank>								
	Dedicated Right Turning Speed								
	Cyclist Through Movement					**Not Applicable**	**Not Applicable**	**Not Applicable**	**Not Applicable**
	Separated or Mixed Traffic	**Mixed Traffic**	**Mixed Traffic**	**Mixed Traffic**	**Mixed Traffic**	**Separated**	**Separated**	**Separated**	**Separated**
	Left Turn Approach	No lane crossed	No lane crossed	No lane crossed	No lane crossed	No lane crossed	No lane crossed	No lane crossed	No lane crossed
	Operating Speed	> 40 to ≤ 50 km/h	> 40 to ≤ 50 km/h	> 40 to ≤ 50 km/h	> 40 to ≤ 50 km/h	> 40 to ≤ 50 km/h	> 40 to ≤ 50 km/h	> 40 to ≤ 50 km/h	> 40 to ≤ 50 km/h
	Left Turning Cyclist	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**
	Level of Service	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**
		B				**B**			
Transit	Average Signal Delay	≤ 30 sec	> 40 sec	≤ 30 sec	> 40 sec	> 40 sec	> 40 sec	≤ 40 sec	≤ 40 sec
	Level of Service	**D**	**F**	**D**	**F**	**F**	**F**	**E**	**E**
		F				**F**			
Truck	Effective Corner Radius	10 - 15 m	10 - 15 m	10 - 15 m	10 - 15 m	10 - 15 m	10 - 15 m	10 - 15 m	10 - 15 m
	Number of Receiving Lanes on Departure from Intersection	1	1	1	1	1	1	1	1
	Level of Service	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**
		E				**E**			

Appendix E TRANSPORTATION DEMAND MANAGEMENT CHECKLIST

TDM-Supportive Development Design and Infrastructure Checklist:
Non-Residential Developments (office, institutional, retail or industrial)

Legend

REQUIRED	The Official Plan or Zoning By-law provides related guidance that must be followed
BASIC	The measure is generally feasible and effective, and in most cases would benefit the development and its users
BETTER	The measure could maximize support for users of sustainable modes, and optimize development performance

		TDM-supportive design & infrastructure measures: *Non-residential developments*	Check if completed & add descriptions, explanations or plan/drawing references
	1.	**WALKING & CYCLING: ROUTES**	
	1.1	**Building location & access points**	
BASIC	1.1.1	Locate building close to the street, and do not locate parking areas between the street and building entrances	☐
BASIC	1.1.2	Locate building entrances in order to minimize walking distances to sidewalks and transit stops/stations	☐
BASIC	1.1.3	Locate building doors and windows to ensure visibility of pedestrians from the building, for their security and comfort	☐
	1.2	**Facilities for walking & cycling**	
REQUIRED	1.2.1	Provide convenient, direct access to stations or major stops along rapid transit routes within 600 metres; minimize walking distances from buildings to rapid transit; provide pedestrian-friendly, weather-protected (where possible) environment between rapid transit accesses and building entrances; ensure quality linkages from sidewalks through building entrances to integrated stops/stations *(see Official Plan policy 4.3.3)*	☑
REQUIRED	1.2.2	Provide safe, direct and attractive pedestrian access from public sidewalks to building entrances through such measures as: reducing distances between public sidewalks and major building entrances; providing walkways from public streets to major building entrances; within a site, providing walkways along the front of adjoining buildings, between adjacent buildings, and connecting areas where people may congregate, such as courtyards and transit stops; and providing weather protection through canopies, colonnades, and other design elements wherever possible *(see Official Plan policy 4.3.12)*	☑

	TDM-supportive design & infrastructure measures: *Non-residential developments*		Check if completed & add descriptions, explanations or plan/drawing references
REQUIRED	1.2.3	Provide sidewalks of smooth, well-drained walking surfaces of contrasting materials or treatments to differentiate pedestrian areas from vehicle areas, and provide marked pedestrian crosswalks at intersection sidewalks *(see Official Plan policy 4.3.10)*	☑
REQUIRED	1.2.4	Make sidewalks and open space areas easily accessible through features such as gradual grade transition, depressed curbs at street corners and convenient access to extra-wide parking spaces and ramps *(see Official Plan policy 4.3.10)*	☑
REQUIRED	1.2.5	Include adequately spaced inter-block/street cycling and pedestrian connections to facilitate travel by active transportation. Provide links to the existing or planned network of public sidewalks, multi-use pathways and on-road cycle routes. Where public sidewalks and multi-use pathways intersect with roads, consider providing traffic control devices to give priority to cyclists and pedestrians *(see Official Plan policy 4.3.11)*	☑
BASIC	1.2.6	Provide safe, direct and attractive walking routes from building entrances to nearby transit stops	☐
BASIC	1.2.7	Ensure that walking routes to transit stops are secure, visible, lighted, shaded and wind-protected wherever possible	☐
BASIC	1.2.8	Design roads used for access or circulation by cyclists using a target operating speed of no more than 30 km/h, or provide a separated cycling facility	☐
	1.3	**Amenities for walking & cycling**	
BASIC	1.3.1	Provide lighting, landscaping and benches along walking and cycling routes between building entrances and streets, sidewalks and trails	☐
BASIC	1.3.2	Provide wayfinding signage for site access (where required, e.g. when multiple buildings or entrances exist) and egress (where warranted, such as when directions to reach transit stops/stations, trails or other common destinations are not obvious)	☐

		TDM-supportive design & infrastructure measures: *Non-residential developments*	Check if completed & add descriptions, explanations or plan/drawing references
	2.	**WALKING & CYCLING: END-OF-TRIP FACILITIES**	
	2.1	**Bicycle parking**	
REQUIRED	2.1.1	Provide bicycle parking in highly visible and lighted areas, sheltered from the weather wherever possible *(see Official Plan policy 4.3.6)*	☑
REQUIRED	2.1.2	Provide the number of bicycle parking spaces specified for various land uses in different parts of Ottawa; provide convenient access to main entrances or well-used areas *(see Zoning By-law Section 111)*	☑
REQUIRED	2.1.3	Ensure that bicycle parking spaces and access aisles meet minimum dimensions; that no more than 50% of spaces are vertical spaces; and that parking racks are securely anchored *(see Zoning By-law Section 111)*	☑
BASIC	2.1.4	Provide bicycle parking spaces equivalent to the expected number of commuter cyclists (assuming the cycling mode share target is met), plus the expected peak number of customer/visitor cyclists	☐
BETTER	2.1.5	Provide bicycle parking spaces equivalent to the expected number of commuter and customer/visitor cyclists, plus an additional buffer (e.g. 25 percent extra) to encourage other cyclists and ensure adequate capacity in peak cycling season	☐
	2.2	**Secure bicycle parking**	
REQUIRED	2.2.1	Where more than 50 bicycle parking spaces are provided for a single office building, locate at least 25% of spaces within a building/structure, a secure area (e.g. supervised parking lot or enclosure) or bicycle lockers *(see Zoning By-law Section 111)*	☐
BETTER	2.2.2	Provide secure bicycle parking spaces equivalent to the expected number of commuter cyclists (assuming the cycling mode share target is met)	☐
	2.3	**Shower & change facilities**	
BASIC	2.3.1	Provide shower and change facilities for the use of active commuters	☐
BETTER	2.3.2	In addition to shower and change facilities, provide dedicated lockers, grooming stations, drying racks and laundry facilities for the use of active commuters	☐
	2.4	**Bicycle repair station**	
BETTER	2.4.1	Provide a permanent bike repair station, with commonly used tools and an air pump, adjacent to the main bicycle parking area (or secure bicycle parking area, if provided)	☐

		TDM-supportive design & infrastructure measures: *Non-residential developments*	Check if completed & add descriptions, explanations or plan/drawing references
	3.	**TRANSIT**	
	3.1	**Customer amenities**	
BASIC	3.1.1	Provide shelters, lighting and benches at any on-site transit stops	☐
BASIC	3.1.2	Where the site abuts an off-site transit stop and insufficient space exists for a transit shelter in the public right-of-way, protect land for a shelter and/or install a shelter	☐
BETTER	3.1.3	Provide a secure and comfortable interior waiting area by integrating any on-site transit stops into the building	☐
	4.	**RIDESHARING**	
	4.1	**Pick-up & drop-off facilities**	
BASIC	4.1.1	Provide a designated area for carpool drivers (plus taxis and ride-hailing services) to drop off or pick up passengers without using fire lanes or other no-stopping zones	☐
	4.2	**Carpool parking**	
BASIC	4.2.1	Provide signed parking spaces for carpools in a priority location close to a major building entrance, sufficient in number to accommodate the mode share target for carpools	☐
BETTER	4.2.2	At large developments, provide spaces for carpools in a separate, access-controlled parking area to simplify enforcement	☐
	5.	**CARSHARING & BIKESHARING**	
	5.1	**Carshare parking spaces**	
BETTER	5.1.1	Provide carshare parking spaces in permitted non-residential zones, occupying either required or provided parking spaces *(see Zoning By-law Section 94)*	☐
	5.2	**Bikeshare station location**	
BETTER	5.2.1	Provide a designated bikeshare station area near a major building entrance, preferably lighted and sheltered with a direct walkway connection	☐

		TDM-supportive design & infrastructure measures: *Non-residential developments*	Check if completed & add descriptions, explanations or plan/drawing references
	6.	**PARKING**	
	6.1	**Number of parking spaces**	
REQUIRED	6.1.1	Do not provide more parking than permitted by zoning, nor less than required by zoning, unless a variance is being applied for	☑
BASIC	6.1.2	Provide parking for long-term and short-term users that is consistent with mode share targets, considering the potential for visitors to use off-site public parking	☐
BASIC	6.1.3	Where a site features more than one use, provide shared parking and reduce the cumulative number of parking spaces accordingly *(see Zoning By-law Section 104)*	☐
BETTER	6.1.4	Reduce the minimum number of parking spaces required by zoning by one space for each 13 square metres of gross floor area provided as shower rooms, change rooms, locker rooms and other facilities for cyclists in conjunction with bicycle parking *(see Zoning By-law Section 111)*	☐
	6.2	**Separate long-term & short-term parking areas**	
BETTER	6.2.1	Separate short-term and long-term parking areas using signage or physical barriers, to permit access controls and simplify enforcement (i.e. to discourage employees from parking in visitor spaces, and vice versa)	☐
	7.	**OTHER**	
	7.1	**On-site amenities to minimize off-site trips**	
BETTER	7.1.1	Provide on-site amenities to minimize mid-day or mid-commute errands	☐

TDM Measures Checklist:
Non-Residential Developments (office, institutional, retail or industrial)

Legend

BASIC — The measure is generally feasible and effective, and in most cases would benefit the development and its users

BETTER — The measure could maximize support for users of sustainable modes, and optimize development performance

★ — The measure is one of the most dependably effective tools to encourage the use of sustainable modes

		TDM measures: *Non-residential developments*	Check if proposed & add descriptions
	1.	**TDM PROGRAM MANAGEMENT**	
	1.1	**Program coordinator**	
BASIC ★	1.1.1	Designate an internal coordinator, or contract with an external coordinator	☐
	1.2	**Travel surveys**	
BETTER	1.2.1	Conduct periodic surveys to identify travel-related behaviours, attitudes, challenges and solutions, and to track progress	☐
	2.	**WALKING AND CYCLING**	
	2.1	**Information on walking/cycling routes & destinations**	
BASIC	2.1.1	Display local area maps with walking/cycling access routes and key destinations at major entrances	☐
	2.2	**Bicycle skills training**	
		Commuter travel	
BETTER ★	2.2.1	Offer on-site cycling courses for commuters, or subsidize off-site courses	☐
	2.3	**Valet bike parking**	
		Visitor travel	
BETTER	2.3.1	Offer secure valet bike parking during public events when demand exceeds fixed supply (e.g. for festivals, concerts, games)	☐

			TDM measures: *Non-residential developments*	Check if proposed & add descriptions
		3.	**TRANSIT**	
		3.1	**Transit information**	
BASIC		3.1.1	Display relevant transit schedules and route maps at entrances	☐
BASIC		3.1.2	Provide online links to OC Transpo and STO information	☐
BETTER		3.1.3	Provide real-time arrival information display at entrances	☐
		3.2	**Transit fare incentives**	
			Commuter travel	
BETTER		3.2.1	Offer preloaded PRESTO cards to encourage commuters to use transit	☐
BETTER	★	3.2.2	Subsidize or reimburse monthly transit pass purchases by employees	☐
			Visitor travel	
BETTER		3.2.3	Arrange inclusion of same-day transit fare in price of tickets (e.g. for festivals, concerts, games)	☐
		3.3	**Enhanced public transit service**	
			Commuter travel	
BETTER		3.3.1	Contract with OC Transpo to provide enhanced transit services (e.g. for shift changes, weekends)	☐
			Visitor travel	
BETTER		3.3.2	Contract with OC Transpo to provide enhanced transit services (e.g. for festivals, concerts, games)	☐
		3.4	**Private transit service**	
			Commuter travel	
BETTER		3.4.1	Provide shuttle service when OC Transpo cannot offer sufficient quality or capacity to serve demand (e.g. for shift changes, weekends)	☐
			Visitor travel	
BETTER		3.4.2	Provide shuttle service when OC Transpo cannot offer sufficient quality or capacity to serve demand (e.g. for festivals, concerts, games)	☐

			TDM measures: *Non-residential developments*	Check if proposed & add descriptions
		4.	**RIDESHARING**	
		4.1	**Ridematching service**	
			Commuter travel	
BASIC	★	4.1.1	Provide a dedicated ridematching portal at OttawaRideMatch.com	☐
		4.2	**Carpool parking price incentives**	
			Commuter travel	
BETTER		4.2.1	Provide discounts on parking costs for registered carpools	☐
		4.3	**Vanpool service**	
			Commuter travel	
BETTER		4.3.1	Provide a vanpooling service for long-distance commuters	☐
		5.	**CARSHARING & BIKESHARING**	
		5.1	**Bikeshare stations & memberships**	
BETTER		5.1.1	Contract with provider to install on-site bikeshare station for use by commuters and visitors	☐
			Commuter travel	
BETTER		5.1.2	Provide employees with bikeshare memberships for local business travel	☐
		5.2	**Carshare vehicles & memberships**	
			Commuter travel	
BETTER		5.2.1	Contract with provider to install on-site carshare vehicles and promote their use by tenants	☐
BETTER		5.2.2	Provide employees with carshare memberships for local business travel	☐
		6.	**PARKING**	
		6.1	**Priced parking**	
			Commuter travel	
BASIC	★	6.1.1	Charge for long-term parking (daily, weekly, monthly)	☐
BASIC		6.1.2	Unbundle parking cost from lease rates at multi-tenant sites	☐
			Visitor travel	
BETTER		6.1.3	Charge for short-term parking (hourly)	☐

		TDM measures: *Non-residential developments*	Check if proposed & add descriptions
		7. TDM MARKETING & COMMUNICATIONS	
		7.1 Multimodal travel information	
		Commuter travel	
BASIC	★	7.1.1 Provide a multimodal travel option information package to new/relocating employees and students	☐
		Visitor travel	
BETTER	★	7.1.2 Include multimodal travel option information in invitations or advertising that attract visitors or customers (e.g. for festivals, concerts, games)	☐
		7.2 Personalized trip planning	
		Commuter travel	
BETTER	★	7.2.1 Offer personalized trip planning to new/relocating employees	☐
		7.3 Promotions	
		Commuter travel	
BETTER		7.3.1 Deliver promotions and incentives to maintain awareness, build understanding, and encourage trial of sustainable modes	☐
		8. OTHER INCENTIVES & AMENITIES	
		8.1 Emergency ride home	
		Commuter travel	
BETTER	★	8.1.1 Provide emergency ride home service to non-driving commuters	☐
		8.2 Alternative work arrangements	
		Commuter travel	
BASIC	★	8.2.1 Encourage flexible work hours	☐
BETTER		8.2.2 Encourage compressed workweeks	☐
BETTER	★	8.2.3 Encourage telework	☐
		8.3 Local business travel options	
		Commuter travel	
BASIC	★	8.3.1 Provide local business travel options that minimize the need for employees to bring a personal car to work	☐
		8.4 Commuter incentives	
		Commuter travel	
BETTER		8.4.1 Offer employees a taxable, mode-neutral commuting allowance	☐
		8.5 On-site amenities	
		Commuter travel	
BETTER		8.5.1 Provide on-site amenities/services to minimize mid-day or mid-commute errands	☐

TDM-Supportive Development Design and Infrastructure Checklist:
Residential Developments (multi-family or condominium)

Legend

REQUIRED	The Official Plan or Zoning By-law provides related guidance that must be followed
BASIC	The measure is generally feasible and effective, and in most cases would benefit the development and its users
BETTER	The measure could maximize support for users of sustainable modes, and optimize development performance

		TDM-supportive design & infrastructure measures: *Residential developments*	Check if completed & add descriptions, explanations or plan/drawing references
	1.	**WALKING & CYCLING: ROUTES**	
	1.1	**Building location & access points**	
BASIC	1.1.1	Locate building close to the street, and do not locate parking areas between the street and building entrances	☐
BASIC	1.1.2	Locate building entrances in order to minimize walking distances to sidewalks and transit stops/stations	☐
BASIC	1.1.3	Locate building doors and windows to ensure visibility of pedestrians from the building, for their security and comfort	☐
	1.2	**Facilities for walking & cycling**	
REQUIRED	1.2.1	Provide convenient, direct access to stations or major stops along rapid transit routes within 600 metres; minimize walking distances from buildings to rapid transit; provide pedestrian-friendly, weather-protected (where possible) environment between rapid transit accesses and building entrances; ensure quality linkages from sidewalks through building entrances to integrated stops/stations *(see Official Plan policy 4.3.3)*	☑
REQUIRED	1.2.2	Provide safe, direct and attractive pedestrian access from public sidewalks to building entrances through such measures as: reducing distances between public sidewalks and major building entrances; providing walkways from public streets to major building entrances; within a site, providing walkways along the front of adjoining buildings, between adjacent buildings, and connecting areas where people may congregate, such as courtyards and transit stops; and providing weather protection through canopies, colonnades, and other design elements wherever possible *(see Official Plan policy 4.3.12)*	☑

		TDM-supportive design & infrastructure measures: *Residential developments*	Check if completed & add descriptions, explanations or plan/drawing references
REQUIRED	1.2.3	Provide sidewalks of smooth, well-drained walking surfaces of contrasting materials or treatments to differentiate pedestrian areas from vehicle areas, and provide marked pedestrian crosswalks at intersection sidewalks *(see Official Plan policy 4.3.10)*	☑
REQUIRED	1.2.4	Make sidewalks and open space areas easily accessible through features such as gradual grade transition, depressed curbs at street corners and convenient access to extra-wide parking spaces and ramps *(see Official Plan policy 4.3.10)*	☑
REQUIRED	1.2.5	Include adequately spaced inter-block/street cycling and pedestrian connections to facilitate travel by active transportation. Provide links to the existing or planned network of public sidewalks, multi-use pathways and on-road cycle routes. Where public sidewalks and multi-use pathways intersect with roads, consider providing traffic control devices to give priority to cyclists and pedestrians *(see Official Plan policy 4.3.11)*	☑
BASIC	1.2.6	Provide safe, direct and attractive walking routes from building entrances to nearby transit stops	☐
BASIC	1.2.7	Ensure that walking routes to transit stops are secure, visible, lighted, shaded and wind-protected wherever possible	☐
BASIC	1.2.8	Design roads used for access or circulation by cyclists using a target operating speed of no more than 30 km/h, or provide a separated cycling facility	☐
	1.3	**Amenities for walking & cycling**	
BASIC	1.3.1	Provide lighting, landscaping and benches along walking and cycling routes between building entrances and streets, sidewalks and trails	☐
BASIC	1.3.2	Provide wayfinding signage for site access (where required, e.g. when multiple buildings or entrances exist) and egress (where warranted, such as when directions to reach transit stops/stations, trails or other common destinations are not obvious)	☐

		TDM-supportive design & infrastructure measures: *Residential developments*	Check if completed & add descriptions, explanations or plan/drawing references
	2.	**WALKING & CYCLING: END-OF-TRIP FACILITIES**	
	2.1	**Bicycle parking**	
REQUIRED	2.1.1	Provide bicycle parking in highly visible and lighted areas, sheltered from the weather wherever possible *(see Official Plan policy 4.3.6)*	☑
REQUIRED	2.1.2	Provide the number of bicycle parking spaces specified for various land uses in different parts of Ottawa; provide convenient access to main entrances or well-used areas *(see Zoning By-law Section 111)*	☑
REQUIRED	2.1.3	Ensure that bicycle parking spaces and access aisles meet minimum dimensions; that no more than 50% of spaces are vertical spaces; and that parking racks are securely anchored *(see Zoning By-law Section 111)*	☑
BASIC	2.1.4	Provide bicycle parking spaces equivalent to the expected number of resident-owned bicycles, plus the expected peak number of visitor cyclists	☐
	2.2	**Secure bicycle parking**	
REQUIRED	2.2.1	Where more than 50 bicycle parking spaces are provided for a single residential building, locate at least 25% of spaces within a building/structure, a secure area (e.g. supervised parking lot or enclosure) or bicycle lockers *(see Zoning By-law Section 111)*	☑
BETTER	2.2.2	Provide secure bicycle parking spaces equivalent to at least the number of units at condominiums or multi-family residential developments	☐
	2.3	**Bicycle repair station**	
BETTER	2.3.1	Provide a permanent bike repair station, with commonly used tools and an air pump, adjacent to the main bicycle parking area (or secure bicycle parking area, if provided)	☐
	3.	**TRANSIT**	
	3.1	**Customer amenities**	
BASIC	3.1.1	Provide shelters, lighting and benches at any on-site transit stops	☐
BASIC	3.1.2	Where the site abuts an off-site transit stop and insufficient space exists for a transit shelter in the public right-of-way, protect land for a shelter and/or install a shelter	☐
BETTER	3.1.3	Provide a secure and comfortable interior waiting area by integrating any on-site transit stops into the building	☐

		TDM-supportive design & infrastructure measures: *Residential developments*	Check if completed & add descriptions, explanations or plan/drawing references
	4.	**RIDESHARING**	
	4.1	**Pick-up & drop-off facilities**	
BASIC	4.1.1	Provide a designated area for carpool drivers (plus taxis and ride-hailing services) to drop off or pick up passengers without using fire lanes or other no-stopping zones	☐
	5.	**CARSHARING & BIKESHARING**	
	5.1	**Carshare parking spaces**	
BETTER	5.1.1	Provide up to three carshare parking spaces in an R3, R4 or R5 Zone for specified residential uses *(see Zoning By-law Section 94)*	☐
	5.2	**Bikeshare station location**	
BETTER	5.2.1	Provide a designated bikeshare station area near a major building entrance, preferably lighted and sheltered with a direct walkway connection	☐
	6.	**PARKING**	
	6.1	**Number of parking spaces**	
REQUIRED	6.1.1	Do not provide more parking than permitted by zoning, nor less than required by zoning, unless a variance is being applied for	☑
BASIC	6.1.2	Provide parking for long-term and short-term users that is consistent with mode share targets, considering the potential for visitors to use off-site public parking	☐
BASIC	6.1.3	Where a site features more than one use, provide shared parking and reduce the cumulative number of parking spaces accordingly *(see Zoning By-law Section 104)*	☐
BETTER	6.1.4	Reduce the minimum number of parking spaces required by zoning by one space for each 13 square metres of gross floor area provided as shower rooms, change rooms, locker rooms and other facilities for cyclists in conjunction with bicycle parking *(see Zoning By-law Section 111)*	☐
	6.2	**Separate long-term & short-term parking areas**	
BETTER	6.2.1	Provide separate areas for short-term and long-term parking (using signage or physical barriers) to permit access controls and simplify enforcement (i.e. to discourage residents from parking in visitor spaces, and vice versa)	☐

TDM Measures Checklist:
Residential Developments (multi-family, condominium or subdivision)

Legend

BASIC — The measure is generally feasible and effective, and in most cases would benefit the development and its users

BETTER — The measure could maximize support for users of sustainable modes, and optimize development performance

★ — The measure is one of the most dependably effective tools to encourage the use of sustainable modes

		TDM measures: *Residential developments*	Check if proposed & add descriptions
	1.	**TDM PROGRAM MANAGEMENT**	
	1.1	**Program coordinator**	
BASIC ★	1.1.1	Designate an internal coordinator, or contract with an external coordinator	☐
	1.2	**Travel surveys**	
BETTER	1.2.1	Conduct periodic surveys to identify travel-related behaviours, attitudes, challenges and solutions, and to track progress	☐
	2.	**WALKING AND CYCLING**	
	2.1	**Information on walking/cycling routes & destinations**	
BASIC	2.1.1	Display local area maps with walking/cycling access routes and key destinations at major entrances *(multi-family, condominium)*	☐
	2.2	**Bicycle skills training**	
BETTER	2.2.1	Offer on-site cycling courses for residents, or subsidize off-site courses	☐

			TDM measures: *Residential developments*	Check if proposed & add descriptions
		3.	**TRANSIT**	
		3.1	**Transit information**	
BASIC		3.1.1	Display relevant transit schedules and route maps at entrances *(multi-family, condominium)*	☐
BETTER		3.1.2	Provide real-time arrival information display at entrances *(multi-family, condominium)*	☐
		3.2	**Transit fare incentives**	
BASIC	★	3.2.1	Offer PRESTO cards preloaded with one monthly transit pass on residence purchase/move-in, to encourage residents to use transit	☐
BETTER		3.2.2	Offer at least one year of free monthly transit passes on residence purchase/move-in	☐
		3.3	**Enhanced public transit service**	
BETTER	★	3.3.1	Contract with OC Transpo to provide early transit services until regular services are warranted by occupancy levels *(subdivision)*	☐
		3.4	**Private transit service**	
BETTER		3.4.1	Provide shuttle service for seniors homes or lifestyle communities (e.g. scheduled mall or supermarket runs)	☐
		4.	**CARSHARING & BIKESHARING**	
		4.1	**Bikeshare stations & memberships**	
BETTER		4.1.1	Contract with provider to install on-site bikeshare station (*multi-family)*	☐
BETTER		4.1.2	Provide residents with bikeshare memberships, either free or subsidized *(multi-family)*	☐
		4.2	**Carshare vehicles & memberships**	
BETTER		4.2.1	Contract with provider to install on-site carshare vehicles and promote their use by residents	☐
BETTER		4.2.2	Provide residents with carshare memberships, either free or subsidized	☐
		5.	**PARKING**	
		5.1	**Priced parking**	
BASIC	★	5.1.1	Unbundle parking cost from purchase price *(condominium)*	☐
BASIC	★	5.1.2	Unbundle parking cost from monthly rent *(multi-family)*	☐

			TDM measures: *Residential developments*	Check if proposed & add descriptions
		6.	**TDM MARKETING & COMMUNICATIONS**	
		6.1	**Multimodal travel information**	
BASIC	★	6.1.1	Provide a multimodal travel option information package to new residents	☐
		6.2	**Personalized trip planning**	
BETTER	★	6.2.1	Offer personalized trip planning to new residents	☐

Appendix F INTERSECTION PERFORMANCE WORKSHEETS

Queues
1: Richmond Avenue & Churchill Avenue

10/28/2019

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	248	457	74	239	18	405	27	415
v/c Ratio	0.49	0.62	0.29	0.43	0.13	0.78	0.17	0.84
Control Delay	15.2	22.2	24.7	24.3	23.4	37.1	24.3	41.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	15.2	22.2	24.7	24.3	23.4	37.1	24.3	41.7
Queue Length 50th (m)	18.9	47.6	7.8	25.7	1.8	49.4	2.8	49.9
Queue Length 95th (m)	32.0	75.0	17.8	43.9	6.6	#88.5	8.7	#94.3
Internal Link Dist (m)		21.0		171.0		33.1		286.6
Turn Bay Length (m)	37.5		37.5		37.5		37.5	
Base Capacity (vph)	508	742	259	552	143	518	157	493
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	0.49	0.62	0.29	0.43	0.13	0.78	0.17	0.84

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis
1: Richmond Avenue & Churchill Avenue

10/28/2019

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	223	381	31	67	197	18	16	286	78	24	244	130
Future Volume (vph)	223	381	31	67	197	18	16	286	78	24	244	130
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	4.5	6.1		6.1	6.1		6.2	6.2		6.2	6.2	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	0.99		1.00	0.93	
Flpb, ped/bikes	0.98	1.00		0.92	1.00		0.94	1.00		0.98	1.00	
Frt	1.00	0.99		1.00	0.99		1.00	0.97		1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1655	1744		1568	1746		1596	1702		1666	1579	
Flt Permitted	0.47	1.00		0.50	1.00		0.29	1.00		0.30	1.00	
Satd. Flow (perm)	818	1744		824	1746		483	1702		528	1579	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	248	423	34	74	219	20	18	318	87	27	271	144
RTOR Reduction (vph)	0	3	0	0	4	0	0	13	0	0	24	0
Lane Group Flow (vph)	248	454	0	74	235	0	18	392	0	27	391	0
Confl. Peds. (#/hr)	45		71	71		45	57		16	16		57
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	5	2 11			6			4			8	
Permitted Phases	2 11			6			4			8		
Actuated Green, G (s)	38.9	38.9		25.1	25.1		23.8	23.8		23.8	23.8	
Effective Green, g (s)	38.9	36.9		25.1	25.1		23.8	23.8		23.8	23.8	
Actuated g/C Ratio	0.49	0.46		0.31	0.31		0.30	0.30		0.30	0.30	
Clearance Time (s)	4.5			6.1	6.1		6.2	6.2		6.2	6.2	
Vehicle Extension (s)	3.0			3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	495	804		258	547		143	506		157	469	
v/s Ratio Prot	c0.06	c0.26			0.13			0.23			c0.25	
v/s Ratio Perm	0.19			0.09			0.04			0.05		
v/c Ratio	0.50	0.56		0.29	0.43		0.13	0.78		0.17	0.83	
Uniform Delay, d1	12.8	15.7		20.7	21.8		20.5	25.7		20.8	26.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.8	0.9		2.8	2.5		1.8	11.1		2.4	15.9	
Delay (s)	13.6	16.6		23.5	24.2		22.3	36.7		23.2	42.1	
Level of Service	B	B		C	C		C	D		C	D	
Approach Delay (s)		15.5			24.0			36.1			41.0	
Approach LOS		B			C			D			D	

Intersection Summary

HCM 2000 Control Delay	27.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	18.8
Intersection Capacity Utilization	79.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM 6th AWSC
2: Churchill Avenue & Scott Street

10/28/2019

Intersection

Intersection Delay, s/veh	15.8
Intersection LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	3	7	13	208	3	16	13	97	364	58	199	2
Future Vol, veh/h	3	7	13	208	3	16	13	97	364	58	199	2
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	3	8	14	231	3	18	14	108	404	64	221	2
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	9.7	13.8	18.6	13.1
HCM LOS	A	B	C	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	3%	13%	92%	22%
Vol Thru, %	20%	30%	1%	77%
Vol Right, %	77%	57%	7%	1%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	474	23	227	259
LT Vol	13	3	208	58
Through Vol	97	7	3	199
RT Vol	364	13	16	2
Lane Flow Rate	527	26	252	288
Geometry Grp	1	1	1	1
Degree of Util (X)	0.704	0.045	0.43	0.446
Departure Headway (Hd)	4.815	6.27	6.136	5.583
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	748	567	585	642
Service Time	2.863	4.354	4.189	3.638
HCM Lane V/C Ratio	0.705	0.046	0.431	0.449
HCM Control Delay	18.6	9.7	13.8	13.1
HCM Lane LOS	C	A	B	B
HCM 95th-tile Q	5.9	0.1	2.2	2.3

HCM 6th TWSC
3: Winona Avenue & Scott Street

10/28/2019

Intersection

Int Delay, s/veh	0.7

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	416	14	15	226	1	31
Future Vol, veh/h	416	14	15	226	1	31
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	462	16	17	251	1	34

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	478	0	755	470
Stage 1	-	-	-	-	470	-
Stage 2	-	-	-	-	285	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1084	-	376	594
Stage 1	-	-	-	-	629	-
Stage 2	-	-	-	-	763	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1084	-	369	594
Mov Cap-2 Maneuver	-	-	-	-	369	-
Stage 1	-	-	-	-	629	-
Stage 2	-	-	-	-	749	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.5	11.6
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	583	-	-	1084	-
HCM Lane V/C Ratio	0.061	-	-	0.015	-
HCM Control Delay (s)	11.6	-	-	8.4	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.2	-	-	0	-

Queues
1: Richmond Avenue & Churchill Avenue

10/28/2019

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	186	391	137	559	28	376	20	596
v/c Ratio	0.60	0.41	0.70	0.75	0.35	0.92	0.20	1.62
Control Delay	18.8	10.3	43.5	28.7	42.8	61.5	33.1	314.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	18.8	10.3	43.5	28.7	42.8	61.5	33.1	314.2
Queue Length 50th (m)	13.5	28.2	17.2	71.7	3.7	55.5	2.6	~131.4
Queue Length 95th (m)	23.0	44.9	#45.3	108.9	11.8	#103.6	8.5	#189.3
Internal Link Dist (m)		21.0		171.0		33.1		286.6
Turn Bay Length (m)	37.5		37.5		37.5		37.5	
Base Capacity (vph)	309	957	195	748	79	409	101	369
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	0.60	0.41	0.70	0.75	0.35	0.92	0.20	1.62

Intersection Summary

~ 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.

HCM Signalized Intersection Capacity Analysis
1: Richmond Avenue & Churchill Avenue

10/28/2019

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	167	309	43	123	464	39	25	243	95	18	251	285
Future Volume (vph)	167	309	43	123	464	39	25	243	95	18	251	285
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	6.1	2.0		6.1	6.1		6.2	6.2		6.2	6.2	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.89		1.00	0.98		1.00	0.95		1.00	0.81	
Flpb, ped/bikes	1.00	1.00		0.48	1.00		1.00	1.00		0.95	1.00	
Frt	1.00	0.98		1.00	0.99		1.00	0.96		1.00	0.92	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1695	1558		809	1724		1695	1624		1608	1337	
Flt Permitted	0.22	1.00		0.53	1.00		0.18	1.00		0.25	1.00	
Satd. Flow (perm)	396	1558		452	1724		327	1624		417	1337	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	186	343	48	137	516	43	28	270	106	20	279	317
RTOR Reduction (vph)	0	6	0	0	3	0	0	16	0	0	45	0
Lane Group Flow (vph)	186	385	0	137	556	0	28	360	0	20	551	0
Confl. Peds. (#/hr)	125		172	172		125	97		46	46		97
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	5	11 2			6			4			8	
Permitted Phases	11 2			6			4			8		
Actuated Green, G (s)	50.9	50.9		38.9	38.9		21.8	21.8		21.8	21.8	
Effective Green, g (s)	50.9	50.9		38.9	38.9		21.8	21.8		21.8	21.8	
Actuated g/C Ratio	0.57	0.57		0.43	0.43		0.24	0.24		0.24	0.24	
Clearance Time (s)	6.1			6.1	6.1		6.2	6.2		6.2	6.2	
Vehicle Extension (s)	3.0			3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	309	881		195	745		79	393		101	323	
v/s Ratio Prot	c0.04	c0.25			c0.32			0.22			c0.41	
v/s Ratio Perm	0.30			0.30			0.09			0.05		
v/c Ratio	0.60	0.44		0.70	0.75		0.35	0.92		0.20	1.70	
Uniform Delay, d1	13.4	11.3		20.8	21.4		28.3	33.2		27.1	34.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	3.3	0.3		19.1	6.7		12.0	28.5		4.3	330.0	
Delay (s)	16.6	11.6		39.9	28.1		40.3	61.7		31.5	364.1	
Level of Service	B	B		D	C		D	E		C	F	
Approach Delay (s)		13.2			30.4			60.2			353.3	
Approach LOS		B			C			E			F	

Intersection Summary

HCM 2000 Control Delay	118.1	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	20.4
Intersection Capacity Utilization	89.4%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

HCM 6th AWSC
2: Churchill Avenue & Scott Street

10/28/2019

Intersection	
Intersection Delay, s/veh	25.1
Intersection LOS	D

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	1	9	11	369	10	58	18	148	280	55	117	3
Future Vol, veh/h	1	9	11	369	10	58	18	148	280	55	117	3
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	1	10	12	410	11	64	20	164	311	61	130	3
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	10.3	30.1	25.6	13.2
HCM LOS	B	D	D	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	4%	5%	84%	31%
Vol Thru, %	33%	43%	2%	67%
Vol Right, %	63%	52%	13%	2%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	446	21	437	175
LT Vol	18	1	369	55
Through Vol	148	9	10	117
RT Vol	280	11	58	3
Lane Flow Rate	496	23	486	194
Geometry Grp	1	1	1	1
Degree of Util (X)	0.778	0.045	0.81	0.356
Departure Headway (Hd)	5.651	6.893	6.129	6.586
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	644	519	592	548
Service Time	3.651	4.943	4.129	4.605
HCM Lane V/C Ratio	0.77	0.044	0.821	0.354
HCM Control Delay	25.6	10.3	30.1	13.2
HCM Lane LOS	D	B	D	B
HCM 95th-tile Q	7.4	0.1	8.1	1.6

HCM 6th TWSC
3: Winona Avenue & Scott Street

10/28/2019

Intersection	
Int Delay, s/veh	0.9

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	338	6	39	435	2	38
Future Vol, veh/h	338	6	39	435	2	38
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	376	7	43	483	2	42

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	383	0	949	380
Stage 1	-	-	-	-	380	-
Stage 2	-	-	-	-	569	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1175	-	289	667
Stage 1	-	-	-	-	691	-
Stage 2	-	-	-	-	566	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1175	-	275	667
Mov Cap-2 Maneuver	-	-	-	-	275	-
Stage 1	-	-	-	-	691	-
Stage 2	-	-	-	-	538	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.7	11.2
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	623	-	-	1175	-
HCM Lane V/C Ratio	0.071	-	-	0.037	-
HCM Control Delay (s)	11.2	-	-	8.2	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.2	-	-	0.1	-

Queues
1: Richmond Avenue & Churchill Avenue 10/28/2019

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	178	335	57	183	14	299	24	316
v/c Ratio	0.36	0.37	0.29	0.33	0.07	0.58	0.10	0.64
Control Delay	14.1	11.8	25.9	22.5	21.4	27.6	21.9	28.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.1	11.8	25.9	22.5	21.4	27.6	21.9	28.6
Queue Length 50th (m)	13.6	24.5	6.0	18.8	1.4	33.0	2.4	33.9
Queue Length 95th (m)	24.2	40.0	15.1	33.7	5.3	55.5	7.5	58.4
Internal Link Dist (m)		21.0		171.0		33.1		286.6
Turn Bay Length (m)	37.5		37.5		37.5		37.5	
Base Capacity (vph)	501	911	196	550	208	518	235	493
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	0.36	0.37	0.29	0.33	0.07	0.58	0.10	0.64

Intersection Summary

HCM Signalized Intersection Capacity Analysis
1: Richmond Avenue & Churchill Avenue 10/28/2019

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	178	311	24	57	167	16	14	234	65	24	206	110
Future Volume (vph)	178	311	24	57	167	16	14	234	65	24	206	110
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	6.1	2.0		6.1	6.1		6.2	6.2		6.2	6.2	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.96		1.00	0.99		1.00	0.99		1.00	0.93	
Flpb, ped/bikes	0.97	1.00		0.63	1.00		0.91	1.00		0.97	1.00	
Frt	1.00	0.99		1.00	0.99		1.00	0.97		1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1646	1690		1068	1744		1546	1701		1651	1578	
Flt Permitted	0.51	1.00		0.56	1.00		0.43	1.00		0.46	1.00	
Satd. Flow (perm)	891	1690		628	1744		701	1701		793	1578	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	178	311	24	57	167	16	14	234	65	24	206	110
RTOR Reduction (vph)	0	4	0	0	4	0	0	13	0	0	24	0
Lane Group Flow (vph)	178	331	0	57	179	0	14	286	0	24	292	0
Confl. Peds. (#/hr)	45		71	71		45	57		16	16		57
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	5	11 2			6			4			8	
Permitted Phases	11 2			6			4			8		
Actuated Green, G (s)	38.9	38.9		25.1	25.1		23.8	23.8		23.8	23.8	
Effective Green, g (s)	38.9	38.9		25.1	25.1		23.8	23.8		23.8	23.8	
Actuated g/C Ratio	0.49	0.49		0.31	0.31		0.30	0.30		0.30	0.30	
Clearance Time (s)	6.1			6.1	6.1		6.2	6.2		6.2	6.2	
Vehicle Extension (s)	3.0			3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	505	821		197	547		208	506		235	469	
v/s Ratio Prot	0.03	c0.20			0.10			0.17			c0.19	
v/s Ratio Perm	0.14			0.09			0.02			0.03		
v/c Ratio	0.35	0.40		0.29	0.33		0.07	0.57		0.10	0.62	
Uniform Delay, d1	12.1	13.1		20.7	21.0		20.1	23.7		20.4	24.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.4	0.3		3.7	1.6		0.6	4.5		0.9	6.1	
Delay (s)	12.6	13.5		24.4	22.6		20.8	28.3		21.2	30.3	
Level of Service	B	B		C	C		C	C		C	C	
Approach Delay (s)		13.1			23.0			27.9			29.7	
Approach LOS		B			C			C			C	

Intersection Summary				
HCM 2000 Control Delay	22.1	HCM 2000 Level of Service	C	
HCM 2000 Volume to Capacity ratio	0.51			
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	20.4	
Intersection Capacity Utilization	70.4%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				

Queues
2: Churchill Avenue & Scott Street 10/28/2019

Lane Group	EBT	WBL	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	198	175	195	11	380	210
v/c Ratio	0.80	0.77	0.47	0.14	0.69	0.45
Control Delay	61.8	67.7	25.4	54.7	37.1	35.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	61.8	67.7	25.4	54.7	37.1	35.1
Queue Length 50th (m)	36.8	33.2	26.0	2.1	62.7	34.5
Queue Length 95th (m)	#72.1	#58.8	45.2	7.5	94.7	55.4
Internal Link Dist (m)	23.4		59.9		286.6	30.0
Turn Bay Length (m)				30.0		
Base Capacity (vph)	249	252	419	77	549	468
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	0.80	0.69	0.47	0.14	0.69	0.45

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

HCM Signalized Intersection Capacity Analysis
2: Churchill Avenue & Scott Street 10/28/2019

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	2	185	11	175	182	13	11	81	299	47	161	2
Future Volume (vph)	2	185	11	175	182	13	11	81	299	47	161	2
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)		4.6		4.6	4.6		4.6	4.6			4.6	
Lane Util. Factor		1.00		1.00	1.00		1.00	1.00			1.00	
Frpb, ped/bikes		0.99		1.00	0.99		1.00	0.94			1.00	
Flpb, ped/bikes		1.00		1.00	1.00		1.00	1.00			0.99	
Frt		0.99		1.00	0.99		1.00	0.88			1.00	
Flt Protected		1.00		0.95	1.00		0.95	1.00			0.99	
Satd. Flow (prot)		936		1695	927		1695	1475			1748	
Flt Permitted		1.00		0.95	1.00		0.95	1.00			0.85	
Satd. Flow (perm)		934		1695	927		1695	1475			1503	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	2	185	11	175	182	13	11	81	299	47	161	2
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	198	0	175	195	0	11	380	0	0	210	0
Confl. Peds. (#/hr)	33		12	12		33	32		10	10		32
Heavy Vehicles (%)	2%	98%	2%	2%	98%	2%	2%	2%	2%	2%	2%	2%
Turn Type	Perm	NA		Prot	NA		Prot	NA		Perm	NA	
Protected Phases		4		3	8		5	2			6	
Permitted Phases	4									6		
Actuated Green, G (s)		27.7		14.8	48.0		3.0	42.8			34.2	
Effective Green, g (s)		27.7		14.8	48.0		3.0	42.8			34.2	
Actuated g/C Ratio		0.25		0.13	0.44		0.03	0.39			0.31	
Clearance Time (s)		4.6		4.6	4.6		4.6	4.6			4.6	
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0			3.0	
Lane Grp Cap (vph)		235		228	404		46	573			467	
v/s Ratio Prot				c0.10	c0.21		c0.01	c0.26				
v/s Ratio Perm		c0.21									0.14	
v/c Ratio		0.84		0.77	0.48		0.24	0.66			0.45	
Uniform Delay, d1		39.1		45.9	22.1		52.4	27.7			30.4	
Progression Factor		1.00		1.00	1.00		1.00	1.00			1.00	
Incremental Delay, d2		29.1		14.3	4.1		2.7	6.0			3.1	
Delay (s)		68.1		60.2	26.2		55.1	33.6			33.5	
Level of Service		E		E	C		E	C			C	
Approach Delay (s)		68.1			42.3			34.2			33.5	
Approach LOS		E			D			C			C	

Intersection Summary				
HCM 2000 Control Delay	42.4	HCM 2000 Level of Service	D	
HCM 2000 Volume to Capacity ratio	0.76			
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	22.4	
Intersection Capacity Utilization	79.1%	ICU Level of Service	D	
Analysis Period (min)	15			
c Critical Lane Group				

HCM 6th TWSC
3: Winona Avenue & Scott Street 10/28/2019

Intersection	
Int Delay, s/veh	0.5

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	520	11	12	370	1	25
Future Vol, veh/h	520	11	12	370	1	25
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	520	11	12	370	1	25

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	531	0	920	526
Stage 1	-	-	-	-	526	-
Stage 2	-	-	-	-	394	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1036	-	301	552
Stage 1	-	-	-	-	593	-
Stage 2	-	-	-	-	681	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1036	-	296	552
Mov Cap-2 Maneuver	-	-	-	-	296	-
Stage 1	-	-	-	-	593	-
Stage 2	-	-	-	-	671	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.3	12.1
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	534	-	-	1036	-
HCM Lane V/C Ratio	0.049	-	-	0.012	-
HCM Control Delay (s)	12.1	-	-	8.5	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.2	-	-	0	-

Queues
1: Richmond Avenue & Churchill Avenue 10/31/2019

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	136	271	101	418	21	277	16	437
v/c Ratio	0.38	0.26	0.58	0.56	0.27	0.68	0.10	1.18
Control Delay	12.6	8.7	35.4	22.5	37.9	38.1	28.4	136.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.6	8.7	35.4	22.5	37.9	38.1	28.4	136.2
Queue Length 50th (m)	9.5	17.8	11.8	47.6	2.7	37.0	2.0	~77.1
Queue Length 95th (m)	17.2	29.0	#32.6	73.6	9.3	61.6	6.8	#129.1
Internal Link Dist (m)		21.0		171.0		33.1		286.6
Turn Bay Length (m)	37.5		37.5		37.5		37.5	
Base Capacity (vph)	360	1025	175	745	79	408	167	369
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	0.38	0.26	0.58	0.56	0.27	0.68	0.10	1.18

Intersection Summary
~ 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.

HCM Signalized Intersection Capacity Analysis
1: Richmond Avenue & Churchill Avenue 10/31/2019

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	136	255	16	101	383	35	21	198	79	16	207	230
Future Volume (vph)	136	255	16	101	383	35	21	198	79	16	207	230
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	6.1	2.0		6.1	6.1		6.2	6.2		6.2	6.2	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.95		1.00	0.98		1.00	0.95		1.00	0.82	
Flpb, ped/bikes	0.97	1.00		0.38	1.00		1.00	1.00		0.92	1.00	
Frt	1.00	0.99		1.00	0.99		1.00	0.96		1.00	0.92	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1647	1674		648	1718		1695	1622		1555	1342	
Flt Permitted	0.33	1.00		0.59	1.00		0.18	1.00		0.42	1.00	
Satd. Flow (perm)	575	1674		404	1718		327	1622		690	1342	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	136	255	16	101	383	35	21	198	79	16	207	230
RTOR Reduction (vph)	0	3	0	0	3	0	0	16	0	0	45	0
Lane Group Flow (vph)	136	268	0	101	415	0	21	261	0	16	392	0
Confl. Peds. (#/hr)	125		172	172		125	97		46	46		97
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	5	11 2			6			4			8	
Permitted Phases	11 2			6			4			8		
Actuated Green, G (s)	50.9	50.9		38.9	38.9		21.8	21.8		21.8	21.8	
Effective Green, g (s)	48.9	50.9		38.9	38.9		21.8	21.8		21.8	21.8	
Actuated g/C Ratio	0.54	0.57		0.43	0.43		0.24	0.24		0.24	0.24	
Clearance Time (s)	6.1			6.1	6.1		6.2	6.2		6.2	6.2	
Vehicle Extension (s)	3.0			3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	382	946		174	742		79	392		167	325	
v/s Ratio Prot	c0.02	c0.16			0.24			0.16			c0.29	
v/s Ratio Perm	0.17			c0.25			0.06			0.02		
v/c Ratio	0.36	0.28		0.58	0.56		0.27	0.67		0.10	1.21	
Uniform Delay, d1	11.8	10.1		19.4	19.1		27.6	30.8		26.5	34.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.6	0.2		13.4	3.0		8.1	8.7		1.1	118.5	
Delay (s)	12.4	10.3		32.7	22.2		35.7	39.5		27.6	152.6	
Level of Service	B	B		C	C		D	D		C	F	
Approach Delay (s)		11.0			24.2			39.2			148.2	
Approach LOS		B			C			D			F	

Intersection Summary			
HCM 2000 Control Delay	57.2	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	20.4
Intersection Capacity Utilization	76.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Queues
2: Churchill Avenue & Scott Street 10/31/2019

Lane Group	EBT	WBL	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	198	301	234	14	353	145
v/c Ratio	0.73	0.89	0.46	0.18	0.82	0.49
Control Delay	53.2	70.0	19.3	56.1	53.1	44.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	53.2	70.0	19.3	56.1	53.1	44.9
Queue Length 50th (m)	35.5	57.3	27.0	2.7	64.9	26.0
Queue Length 95th (m)	#67.8	#98.1	46.4	8.7	#107.3	45.0
Internal Link Dist (m)	23.4		59.9		286.6	30.0
Turn Bay Length (m)				30.0		
Base Capacity (vph)	270	360	504	77	433	297
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	0.73	0.84	0.46	0.18	0.82	0.49

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

HCM Signalized Intersection Capacity Analysis
2: Churchill Avenue & Scott Street

10/31/2019

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	1	188	9	301	188	46	14	122	231	45	98	2
Future Volume (vph)	1	188	9	301	188	46	14	122	231	45	98	2
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)		4.6		4.6	4.6		4.6	4.6			4.6	
Lane Util. Factor		1.00		1.00	1.00		1.00	1.00			1.00	
Frpb, ped/bikes		0.99		1.00	0.95		1.00	0.94			1.00	
Flpb, ped/bikes		1.00		1.00	1.00		1.00	1.00			0.99	
Frt		0.99		1.00	0.97		1.00	0.90			1.00	
Flt Protected		1.00		0.95	1.00		0.95	1.00			0.98	
Satd. Flow (prot)		930		1695	935		1695	1519			1733	
Flt Permitted		1.00		0.95	1.00		0.95	1.00			0.76	
Satd. Flow (perm)		930		1695	935		1695	1519			1331	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	1	188	9	301	188	46	14	122	231	45	98	2
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	198	0	301	234	0	14	353	0	0	145	0
Confl. Peds. (#/hr)	41		17	17		41	33		11	11		33
Heavy Vehicles (%)	2%	98%	2%	2%	98%	2%	2%	2%	2%	2%	2%	2%
Turn Type	Perm	NA		Prot	NA		Prot	NA		Perm	NA	
Protected Phases		4		3	8		5	2			6	
Permitted Phases	4									6		
Actuated Green, G (s)		30.2		22.1	57.6		3.0	33.2			24.6	
Effective Green, g (s)		30.2		22.1	57.6		3.0	33.2			24.6	
Actuated g/C Ratio		0.27		0.20	0.52		0.03	0.30			0.22	
Clearance Time (s)		4.6		4.6	4.6		4.6	4.6			4.6	
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0			3.0	
Lane Grp Cap (vph)		255		340	489		46	458			297	
v/s Ratio Prot				c0.18	c0.25		c0.01	c0.23				
v/s Ratio Perm		0.21									0.11	
v/c Ratio		0.78		0.89	0.48		0.30	0.77			0.49	
Uniform Delay, d1		36.8		42.7	16.7		52.5	34.9			37.2	
Progression Factor		1.00		1.00	1.00		1.00	1.00			1.00	
Incremental Delay, d2		20.4		22.9	3.3		3.7	11.9			5.6	
Delay (s)		57.2		65.6	20.0		56.2	46.8			42.9	
Level of Service		E		E	B		E	D			D	
Approach Delay (s)		57.2			45.6			47.1			42.9	
Approach LOS		E			D			D			D	

Intersection Summary				
HCM 2000 Control Delay	47.6	HCM 2000 Level of Service	D	
HCM 2000 Volume to Capacity ratio	0.82			
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	22.4	
Intersection Capacity Utilization	83.2%	ICU Level of Service	E	
Analysis Period (min)	15			

c Critical Lane Group

HCM 6th TWSC
3: Winona Avenue & Scott Street

10/31/2019

Intersection	
Int Delay, s/veh	0.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	458	5	31	533	2	30
Future Vol, veh/h	458	5	31	533	2	30
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	458	5	31	533	2	30

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	463	0	1056	461
Stage 1	-	-	-	-	461	-
Stage 2	-	-	-	-	595	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1098	-	250	600
Stage 1	-	-	-	-	635	-
Stage 2	-	-	-	-	551	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1098	-	240	600
Mov Cap-2 Maneuver	-	-	-	-	240	-
Stage 1	-	-	-	-	635	-
Stage 2	-	-	-	-	529	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.5	12
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	549	-	-	1098	-
HCM Lane V/C Ratio	0.058	-	-	0.028	-
HCM Control Delay (s)	12	-	-	8.4	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.2	-	-	0.1	-

Queues
1: Richmond Avenue & Churchill Avenue

10/28/2019

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	179	335	57	183	14	302	24	325
v/c Ratio	0.36	0.37	0.29	0.33	0.07	0.58	0.10	0.66
Control Delay	14.1	11.8	25.9	22.5	21.4	27.8	21.9	29.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.1	11.8	25.9	22.5	21.4	27.8	21.9	29.4
Queue Length 50th (m)	13.7	24.5	6.0	18.8	1.4	33.5	2.4	35.3
Queue Length 95th (m)	24.3	40.0	15.1	33.7	5.3	56.1	7.5	60.5
Internal Link Dist (m)		21.0		171.0		33.1		286.6
Turn Bay Length (m)	37.5		37.5		37.5		37.5	
Base Capacity (vph)	501	911	196	550	202	518	233	493
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	0.36	0.37	0.29	0.33	0.07	0.58	0.10	0.66

Intersection Summary

HCM Signalized Intersection Capacity Analysis
1: Richmond Avenue & Churchill Avenue

10/28/2019

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	179	311	24	57	167	16	14	237	65	24	212	113
Future Volume (vph)	179	311	24	57	167	16	14	237	65	24	212	113
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	6.1	2.0		6.1	6.1		6.2	6.2		6.2	6.2	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.96		1.00	0.99		1.00	0.99		1.00	0.93	
Flpb, ped/bikes	0.97	1.00		0.63	1.00		0.91	1.00		0.97	1.00	
Frt	1.00	0.99		1.00	0.99		1.00	0.97		1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1646	1690		1068	1744		1551	1701		1651	1578	
Flt Permitted	0.51	1.00		0.56	1.00		0.42	1.00		0.45	1.00	
Satd. Flow (perm)	891	1690		628	1744		681	1701		785	1578	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	179	311	24	57	167	16	14	237	65	24	212	113
RTOR Reduction (vph)	0	4	0	0	4	0	0	13	0	0	24	0
Lane Group Flow (vph)	179	331	0	57	179	0	14	289	0	24	301	0
Confl. Peds. (#/hr)	45		71	71		45	57		16	16		57
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	5	11 2			6			4			8	
Permitted Phases	11 2			6			4			8		
Actuated Green, G (s)	38.9	38.9		25.1	25.1		23.8	23.8		23.8	23.8	
Effective Green, g (s)	38.9	38.9		25.1	25.1		23.8	23.8		23.8	23.8	
Actuated g/C Ratio	0.49	0.49		0.31	0.31		0.30	0.30		0.30	0.30	
Clearance Time (s)	6.1			6.1	6.1		6.2	6.2		6.2	6.2	
Vehicle Extension (s)	3.0			3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	505	821		197	547		202	506		233	469	
v/s Ratio Prot	0.03	c0.20			0.10			0.17			c0.19	
v/s Ratio Perm	0.14			0.09			0.02			0.03		
v/c Ratio	0.35	0.40		0.29	0.33		0.07	0.57		0.10	0.64	
Uniform Delay, d1	12.1	13.1		20.7	21.0		20.2	23.8		20.4	24.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.4	0.3		3.7	1.6		0.7	4.6		0.9	6.6	
Delay (s)	12.6	13.5		24.4	22.6		20.8	28.4		21.2	31.0	
Level of Service	B	B		C	C		C	C		C	C	
Approach Delay (s)		13.1			23.0			28.1			30.3	
Approach LOS		B			C			C			C	

Intersection Summary				
HCM 2000 Control Delay	22.4	HCM 2000 Level of Service	C	
HCM 2000 Volume to Capacity ratio	0.52			
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	20.4	
Intersection Capacity Utilization	70.4%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				

Queues
2: Churchill Avenue & Scott Street

10/28/2019

Lane Group	EBT	WBL	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	198	185	195	11	384	210
v/c Ratio	0.82	0.77	0.47	0.14	0.70	0.45
Control Delay	65.7	66.3	25.4	54.7	37.4	35.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	65.7	66.3	25.4	54.7	37.4	35.1
Queue Length 50th (m)	37.3	35.0	26.0	2.1	63.6	34.5
Queue Length 95th (m)	#73.8	#61.0	45.2	7.5	95.8	55.4
Internal Link Dist (m)	23.4		59.9		286.6	30.0
Turn Bay Length (m)				30.0		
Base Capacity (vph)	242	268	419	77	549	467
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	0.82	0.69	0.47	0.14	0.70	0.45

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis
2: Churchill Avenue & Scott Street

10/28/2019

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	2	185	11	185	182	13	11	81	303	47	161	2
Future Volume (vph)	2	185	11	185	182	13	11	81	303	47	161	2
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)		4.6		4.6	4.6		4.6	4.6			4.6	
Lane Util. Factor		1.00		1.00	1.00		1.00	1.00			1.00	
Frpb, ped/bikes		0.99		1.00	0.99		1.00	0.94			1.00	
Flpb, ped/bikes		1.00		1.00	1.00		1.00	1.00			0.99	
Frt		0.99		1.00	0.99		1.00	0.88			1.00	
Flt Protected		1.00		0.95	1.00		0.95	1.00			0.99	
Satd. Flow (prot)		936		1695	927		1695	1474			1749	
Flt Permitted		1.00		0.95	1.00		0.95	1.00			0.85	
Satd. Flow (perm)		934		1695	927		1695	1474			1501	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	2	185	11	185	182	13	11	81	303	47	161	2
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	198	0	185	195	0	11	384	0	0	210	0
Confl. Peds. (#/hr)	33		12	12		33	32		10	10		32
Heavy Vehicles (%)	2%	98%	2%	2%	98%	2%	2%	2%	2%	2%	2%	2%
Turn Type	Perm	NA		Prot	NA		Prot	NA		Perm	NA	
Protected Phases		4		3	8		5	2			6	
Permitted Phases	4									6		
Actuated Green, G (s)		26.8		15.6	48.0		3.0	42.8			34.2	
Effective Green, g (s)		26.8		15.6	48.0		3.0	42.8			34.2	
Actuated g/C Ratio		0.24		0.14	0.44		0.03	0.39			0.31	
Clearance Time (s)		4.6		4.6	4.6		4.6	4.6			4.6	
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0			3.0	
Lane Grp Cap (vph)		227		240	404		46	573			466	
v/s Ratio Prot				c0.11	c0.21		c0.01	c0.26				
v/s Ratio Perm		c0.21									0.14	
v/c Ratio		0.87		0.77	0.48		0.24	0.67			0.45	
Uniform Delay, d1		40.0		45.5	22.1		52.4	27.8			30.4	
Progression Factor		1.00		1.00	1.00		1.00	1.00			1.00	
Incremental Delay, d2		34.0		14.2	4.1		2.7	6.1			3.1	
Delay (s)		74.0		59.6	26.2		55.1	33.9			33.5	
Level of Service		E		E	C		E	C			C	
Approach Delay (s)		74.0			42.5			34.5			33.5	
Approach LOS		E			D			C			C	

Intersection Summary

HCM 2000 Control Delay	43.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	22.4
Intersection Capacity Utilization	79.3%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

HCM 6th TWSC
3: Winona Avenue & Scott Street

10/28/2019

Intersection	
Int Delay, s/veh	0.8

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	520	16	17	370	11	35
Future Vol, veh/h	520	16	17	370	11	35
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	520	16	17	370	11	35

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	536	0	932	528
Stage 1	-	-	-	-	528	-
Stage 2	-	-	-	-	404	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1032	-	296	550
Stage 1	-	-	-	-	592	-
Stage 2	-	-	-	-	674	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1032	-	290	550
Mov Cap-2 Maneuver	-	-	-	-	290	-
Stage 1	-	-	-	-	592	-
Stage 2	-	-	-	-	660	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.4	13.8
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	453	-	-	1032	-
HCM Lane V/C Ratio	0.102	-	-	0.016	-
HCM Control Delay (s)	13.8	-	-	8.5	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.3	-	-	0.1	-

Queues
1: Richmond Avenue & Churchill Avenue

10/29/2019

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	138	271	101	418	21	282	16	443
v/c Ratio	0.36	0.26	0.58	0.56	0.27	0.69	0.10	1.20
Control Delay	12.0	8.7	35.4	22.5	37.9	38.7	28.5	142.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.0	8.7	35.4	22.5	37.9	38.7	28.5	142.4
Queue Length 50th (m)	9.7	17.8	11.8	47.6	2.7	37.9	2.0	~79.4
Queue Length 95th (m)	17.5	29.0	#32.6	73.6	9.3	#63.2	6.8	#131.7
Internal Link Dist (m)		21.0		171.0		33.1		286.6
Turn Bay Length (m)	37.5		37.5		37.5		37.5	
Base Capacity (vph)	385	1025	175	745	79	409	163	369
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	0.36	0.26	0.58	0.56	0.27	0.69	0.10	1.20

Intersection Summary

~ 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.

HCM Signalized Intersection Capacity Analysis
1: Richmond Avenue & Churchill Avenue

10/29/2019

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	138	255	16	101	383	35	21	203	79	16	211	232
Future Volume (vph)	138	255	16	101	383	35	21	203	79	16	211	232
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	6.1	2.0		6.1	6.1		6.2	6.2		6.2	6.2	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.95		1.00	0.98		1.00	0.95		1.00	0.82	
Flpb, ped/bikes	0.97	1.00		0.38	1.00		1.00	1.00		0.92	1.00	
Frt	1.00	0.99		1.00	0.99		1.00	0.96		1.00	0.92	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1645	1674		648	1718		1695	1625		1558	1344	
Flt Permitted	0.34	1.00		0.59	1.00		0.18	1.00		0.41	1.00	
Satd. Flow (perm)	589	1674		404	1718		327	1625		677	1344	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	138	255	16	101	383	35	21	203	79	16	211	232
RTOR Reduction (vph)	0	3	0	0	3	0	0	16	0	0	44	0
Lane Group Flow (vph)	138	268	0	101	415	0	21	266	0	16	399	0
Confl. Peds. (#/hr)	125		172	172		125	97		46	46		97
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	5	11 2			6			4			8	
Permitted Phases	11 2			6			4			8		
Actuated Green, G (s)	50.9	50.9		38.9	38.9		21.8	21.8		21.8	21.8	
Effective Green, g (s)	50.9	50.9		38.9	38.9		21.8	21.8		21.8	21.8	
Actuated g/C Ratio	0.57	0.57		0.43	0.43		0.24	0.24		0.24	0.24	
Clearance Time (s)	6.1			6.1	6.1		6.2	6.2		6.2	6.2	
Vehicle Extension (s)	3.0			3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	402	946		174	742		79	393		163	325	
v/s Ratio Prot	c0.02	c0.16			0.24			0.16			c0.30	
v/s Ratio Perm	0.17			c0.25			0.06			0.02		
v/c Ratio	0.34	0.28		0.58	0.56		0.27	0.68		0.10	1.23	
Uniform Delay, d1	10.8	10.1		19.4	19.1		27.6	30.9		26.5	34.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.5	0.2		13.4	3.0		8.1	9.0		1.2	126.7	
Delay (s)	11.4	10.3		32.7	22.2		35.7	39.9		27.7	160.8	
Level of Service	B	B		C	C		D	D		C	F	
Approach Delay (s)		10.6			24.2			39.7			156.1	
Approach LOS		B			C			D			F	

Intersection Summary				
HCM 2000 Control Delay	59.5	HCM 2000 Level of Service	E	
HCM 2000 Volume to Capacity ratio	0.75			
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	20.4	
Intersection Capacity Utilization	77.3%	ICU Level of Service	D	
Analysis Period (min)	15			

c Critical Lane Group

Queues
2: Churchill Avenue & Scott Street

10/29/2019

Lane Group	EBT	WBL	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	198	307	234	14	361	145
v/c Ratio	0.75	0.88	0.46	0.15	0.84	0.51
Control Delay	55.7	68.1	19.3	53.1	55.1	46.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	55.7	68.1	19.3	53.1	55.1	46.7
Queue Length 50th (m)	36.0	58.1	27.0	2.7	66.9	26.5
Queue Length 95th (m)	#69.5	#97.8	46.4	8.6	#111.2	45.8
Internal Link Dist (m)	23.4		59.9		286.6	30.0
Turn Bay Length (m)				30.0		
Base Capacity (vph)	264	375	504	98	432	285
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	0.75	0.82	0.46	0.14	0.84	0.51

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

HCM Signalized Intersection Capacity Analysis
2: Churchill Avenue & Scott Street

10/29/2019

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	1	188	9	307	188	46	14	122	239	45	98	2
Future Volume (vph)	1	188	9	307	188	46	14	122	239	45	98	2
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)		4.6		4.6	4.6		4.6	4.6			4.6	
Lane Util. Factor		1.00		1.00	1.00		1.00	1.00			1.00	
Frpb, ped/bikes		0.99		1.00	0.95		1.00	0.94			1.00	
Flpb, ped/bikes		1.00		1.00	1.00		1.00	1.00			0.99	
Frt		0.99		1.00	0.97		1.00	0.90			1.00	
Flt Protected		1.00		0.95	1.00		0.95	1.00			0.98	
Satd. Flow (prot)		930		1695	935		1695	1516			1733	
Flt Permitted		1.00		0.95	1.00		0.95	1.00			0.75	
Satd. Flow (perm)		930		1695	935		1695	1516			1321	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	1	188	9	307	188	46	14	122	239	45	98	2
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	198	0	307	234	0	14	361	0	0	145	0
Confl. Peds. (#/hr)	41		17	17		41	33		11	11		33
Heavy Vehicles (%)	2%	98%	2%	2%	98%	2%	2%	2%	2%	2%	2%	2%
Turn Type	Perm	NA		Prot	NA		Prot	NA		Perm	NA	
Protected Phases		4		3	8		5	2			6	
Permitted Phases	4									6		
Actuated Green, G (s)		29.4		22.7	57.6		3.8	33.2			23.8	
Effective Green, g (s)		29.4		22.7	57.6		3.8	33.2			23.8	
Actuated g/C Ratio		0.27		0.21	0.52		0.03	0.30			0.22	
Clearance Time (s)		4.6		4.6	4.6		4.6	4.6			4.6	
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0			3.0	
Lane Grp Cap (vph)		248		349	489		58	457			285	
v/s Ratio Prot				c0.18	c0.25		c0.01	c0.24				
v/s Ratio Perm		0.21									0.11	
v/c Ratio		0.80		0.88	0.48		0.24	0.79			0.51	
Uniform Delay, d1		37.5		42.3	16.7		51.7	35.2			38.0	
Progression Factor		1.00		1.00	1.00		1.00	1.00			1.00	
Incremental Delay, d2		22.9		21.4	3.3		2.2	13.0			6.4	
Delay (s)		60.5		63.7	20.0		53.9	48.2			44.3	
Level of Service		E		E	B		D	D			D	
Approach Delay (s)		60.5			44.8			48.4			44.3	
Approach LOS		E			D			D			D	

Intersection Summary				
HCM 2000 Control Delay	48.3	HCM 2000 Level of Service	D	
HCM 2000 Volume to Capacity ratio	0.83			
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	22.4	
Intersection Capacity Utilization	84.1%	ICU Level of Service	E	
Analysis Period (min)	15			

c Critical Lane Group

HCM 6th TWSC
3: Winona Avenue & Scott Street

10/29/2019

Intersection	
Int Delay, s/veh	0.9

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	458	12	38	533	8	36
Future Vol, veh/h	458	12	38	533	8	36
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	458	12	38	533	8	36

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	470	0	1073	464
Stage 1	-	-	-	-	464	-
Stage 2	-	-	-	-	609	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1092	-	244	598
Stage 1	-	-	-	-	633	-
Stage 2	-	-	-	-	543	-
Platoon blocked, %	-	-			-	
Mov Cap-1 Maneuver	-	-	1092	-	232	598
Mov Cap-2 Maneuver	-	-	-	-	232	-
Stage 1	-	-	-	-	633	-
Stage 2	-	-	-	-	516	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.6	13.5
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	465	-	-	1092	-
HCM Lane V/C Ratio	0.095	-	-	0.035	-
HCM Control Delay (s)	13.5	-	-	8.4	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.3	-	-	0.1	-

Queues
1: Richmond Avenue & Churchill Avenue

10/28/2019

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	197	368	62	199	16	326	26	354
v/c Ratio	0.43	0.42	0.36	0.41	0.08	0.58	0.11	0.67
Control Delay	16.3	13.8	30.6	26.0	20.2	26.3	20.5	28.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	16.3	13.8	30.6	26.0	20.2	26.3	20.5	28.1
Queue Length 50th (m)	16.1	29.4	7.0	22.0	1.5	35.5	2.5	38.1
Queue Length 95th (m)	28.2	47.7	17.3	38.9	5.5	58.8	7.7	64.4
Internal Link Dist (m)		21.0		171.0		33.1		286.6
Turn Bay Length (m)	37.5		37.5		37.5		37.5	
Base Capacity (vph)	466	866	173	488	211	561	245	532
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	0.42	0.42	0.36	0.41	0.08	0.58	0.11	0.67

Intersection Summary

HCM Signalized Intersection Capacity Analysis
1: Richmond Avenue & Churchill Avenue

10/28/2019

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	197	340	28	62	182	17	16	256	70	26	231	123
Future Volume (vph)	197	340	28	62	182	17	16	256	70	26	231	123
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	6.1	2.0		6.1	6.1		6.2	6.2		6.2	6.2	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.95		1.00	0.99		1.00	0.99		1.00	0.93	
Flpb, ped/bikes	0.98	1.00		0.65	1.00		0.92	1.00		0.98	1.00	
Frt	1.00	0.99		1.00	0.99		1.00	0.97		1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1653	1684		1096	1745		1563	1702		1654	1579	
Flt Permitted	0.47	1.00		0.54	1.00		0.40	1.00		0.44	1.00	
Satd. Flow (perm)	821	1684		625	1745		656	1702		761	1579	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	197	340	28	62	182	17	16	256	70	26	231	123
RTOR Reduction (vph)	0	4	0	0	4	0	0	12	0	0	24	0
Lane Group Flow (vph)	197	364	0	62	195	0	16	314	0	26	330	0
Confl. Peds. (#/hr)	45		71	71		45	57		16	16		57
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	5	11 2			6			4			8	
Permitted Phases	11 2			6			4			8		
Actuated Green, G (s)	36.9	36.9		22.2	22.2		25.8	25.8		25.8	25.8	
Effective Green, g (s)	36.9	36.9		22.2	22.2		25.8	25.8		25.8	25.8	
Actuated g/C Ratio	0.46	0.46		0.28	0.28		0.32	0.32		0.32	0.32	
Clearance Time (s)	6.1			6.1	6.1		6.2	6.2		6.2	6.2	
Vehicle Extension (s)	3.0			3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	468	776		173	484		211	548		245	509	
v/s Ratio Prot	0.05	c0.22			0.11			0.18			c0.21	
v/s Ratio Perm	0.15			0.10			0.02			0.03		
v/c Ratio	0.42	0.47		0.36	0.40		0.08	0.57		0.11	0.65	
Uniform Delay, d1	13.6	14.8		23.2	23.5		18.8	22.5		19.0	23.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.6	0.4		5.7	2.5		0.7	4.3		0.9	6.3	
Delay (s)	14.2	15.3		28.9	26.0		19.5	26.8		19.9	29.5	
Level of Service	B	B		C	C		B	C		B	C	
Approach Delay (s)		14.9			26.7			26.5			28.8	
Approach LOS		B			C			C			C	

Intersection Summary				
HCM 2000 Control Delay	22.9	HCM 2000 Level of Service	C	
HCM 2000 Volume to Capacity ratio	0.57			
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	20.4	
Intersection Capacity Utilization	74.0%	ICU Level of Service	D	
Analysis Period (min)	15			
c Critical Lane Group				

Queues
2: Churchill Avenue & Scott Street

10/28/2019

Lane Group	EBT	WBL	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	19	201	16	12	419	229
v/c Ratio	0.09	0.73	0.04	0.16	0.61	0.38
Control Delay	45.5	58.7	23.4	55.2	26.5	26.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	45.5	58.7	23.4	55.2	26.5	26.1
Queue Length 50th (m)	3.4	38.1	2.0	2.3	59.9	32.7
Queue Length 95th (m)	10.1	57.3	6.4	8.1	89.9	52.1
Internal Link Dist (m)	23.4		59.9		286.6	30.0
Turn Bay Length (m)				30.0		
Base Capacity (vph)	202	360	449	77	689	605
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	0.09	0.56	0.04	0.16	0.61	0.38

Intersection Summary

HCM Signalized Intersection Capacity Analysis
2: Churchill Avenue & Scott Street

10/28/2019

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	2	6	11	201	2	14	12	89	330	51	176	2
Future Volume (vph)	2	6	11	201	2	14	12	89	330	51	176	2
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)		4.6		4.6	4.6		4.6	4.6			4.6	
Lane Util. Factor		1.00		1.00	1.00		1.00	1.00			1.00	
Frpb, ped/bikes		0.95		1.00	0.81		1.00	0.94			1.00	
Flpb, ped/bikes		0.98		1.00	1.00		1.00	1.00			0.99	
Frt		0.92		1.00	0.87		1.00	0.88			1.00	
Flt Protected		0.99		0.95	1.00		0.95	1.00			0.99	
Satd. Flow (prot)		1517		1695	1255		1695	1475			1749	
Flt Permitted		0.98		0.95	1.00		0.95	1.00			0.84	
Satd. Flow (perm)		1495		1695	1255		1695	1475			1492	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	2	6	11	201	2	14	12	89	330	51	176	2
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	19	0	201	16	0	12	419	0	0	229	0
Confl. Peds. (#/hr)	33		12	12		33	32		10	10		32
Turn Type	Perm	NA		Prot	NA		Prot	NA		Perm	NA	
Protected Phases		4		3	8		5	2			6	
Permitted Phases	4									6		
Actuated Green, G (s)		13.1		17.9	37.6		3.0	53.2			44.6	
Effective Green, g (s)		13.1		17.9	37.6		3.0	53.2			44.6	
Actuated g/C Ratio		0.12		0.16	0.34		0.03	0.48			0.41	
Clearance Time (s)		4.6		4.6	4.6		4.6	4.6			4.6	
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0			3.0	
Lane Grp Cap (vph)		178		275	428		46	713			604	
v/s Ratio Prot				c0.12	c0.01		c0.01	c0.28				
v/s Ratio Perm		c0.01									0.15	
v/c Ratio		0.11		0.73	0.04		0.26	0.59			0.38	
Uniform Delay, d1		43.2		43.8	24.1		52.4	20.5			23.0	
Progression Factor		1.00		1.00	1.00		1.00	1.00			1.00	
Incremental Delay, d2		1.2		9.6	0.2		3.0	3.5			1.8	
Delay (s)		44.4		53.3	24.3		55.4	24.0			24.8	
Level of Service		D		D	C		E	C			C	
Approach Delay (s)		44.4			51.2			24.9			24.8	
Approach LOS		D			D			C			C	

Intersection Summary				
HCM 2000 Control Delay	31.7	HCM 2000 Level of Service	C	
HCM 2000 Volume to Capacity ratio	0.53			
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	22.4	
Intersection Capacity Utilization	73.8%	ICU Level of Service	D	
Analysis Period (min)	15			
c Critical Lane Group				

HCM 6th TWSC
3: Winona Avenue & Scott Street 10/28/2019

Intersection	
Int Delay, s/veh	1.1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	371	17	17	206	11	38
Future Vol, veh/h	371	17	17	206	11	38
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	371	17	17	206	11	38

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	388	0	620	380
Stage 1	-	-	-	-	380	-
Stage 2	-	-	-	-	240	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1170	-	452	667
Stage 1	-	-	-	-	691	-
Stage 2	-	-	-	-	800	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1170	-	445	667
Mov Cap-2 Maneuver	-	-	-	-	445	-
Stage 1	-	-	-	-	691	-
Stage 2	-	-	-	-	787	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.6	11.5
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	600	-	-	1170	-
HCM Lane V/C Ratio	0.082	-	-	0.015	-
HCM Control Delay (s)	11.5	-	-	8.1	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.3	-	-	0	-

Queues
1: Richmond Avenue & Churchill Avenue 10/29/2019

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	151	317	110	455	23	307	17	484
v/c Ratio	0.43	0.33	0.60	0.61	0.29	0.75	0.12	1.31
Control Delay	13.5	9.3	36.1	23.8	39.2	42.5	29.1	186.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	13.5	9.3	36.1	23.8	39.2	42.5	29.1	186.3
Queue Length 50th (m)	10.7	21.3	13.0	53.5	3.0	42.3	2.1	~93.4
Queue Length 95th (m)	19.0	34.6	#35.1	81.8	10.0	#76.2	7.2	#147.5
Internal Link Dist (m)		21.0		171.0		33.1		286.6
Turn Bay Length (m)	37.5		37.5		37.5		37.5	
Base Capacity (vph)	349	955	184	745	79	409	147	369
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	0.43	0.33	0.60	0.61	0.29	0.75	0.12	1.31

Intersection Summary
~ 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.

HCM Signalized Intersection Capacity Analysis
1: Richmond Avenue & Churchill Avenue 10/29/2019

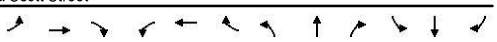
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	151	278	39	110	417	38	23	221	86	17	230	254
Future Volume (vph)	151	278	39	110	417	38	23	221	86	17	230	254
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	6.1	2.0		6.1	6.1		6.2	6.2		6.2	6.2	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.89		1.00	0.98		1.00	0.95		1.00	0.82	
Flpb, ped/bikes	0.98	1.00		0.42	1.00		1.00	1.00		0.93	1.00	
Frt	1.00	0.98		1.00	0.99		1.00	0.96		1.00	0.92	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1657	1557		713	1718		1695	1625		1572	1343	
Flt Permitted	0.30	1.00		0.57	1.00		0.18	1.00		0.37	1.00	
Satd. Flow (perm)	522	1557		426	1718		327	1625		608	1343	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	151	278	39	110	417	38	23	221	86	17	230	254
RTOR Reduction (vph)	0	6	0	0	3	0	0	16	0	0	44	0
Lane Group Flow (vph)	151	311	0	110	452	0	23	291	0	17	440	0
Confl. Peds. (#/hr)	125		172	172		125	97		46	46		97
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	5	11 2			6			4			8	
Permitted Phases	11 2			6			4			8		
Actuated Green, G (s)	50.9	50.9		38.9	38.9		21.8	21.8		21.8	21.8	
Effective Green, g (s)	48.9	50.9		38.9	38.9		21.8	21.8		21.8	21.8	
Actuated g/C Ratio	0.54	0.57		0.43	0.43		0.24	0.24		0.24	0.24	
Clearance Time (s)	6.1			6.1	6.1		6.2	6.2		6.2	6.2	
Vehicle Extension (s)	3.0			3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	358	880		184	742		79	393		147	325	
v/s Ratio Prot	0.03	c0.20			c0.26			0.18			c0.33	
v/s Ratio Perm	0.20			0.26			0.07			0.03		
v/c Ratio	0.42	0.35		0.60	0.61		0.29	0.74		0.12	1.35	
Uniform Delay, d1	12.3	10.6		19.6	19.7		27.8	31.5		26.6	34.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.8	0.2		13.5	3.7		9.1	11.9		1.6	178.2	
Delay (s)	13.1	10.9		33.1	23.4		36.9	43.4		28.2	212.3	
Level of Service	B	B		C	C		D	D		C	F	
Approach Delay (s)		11.6			25.3			42.9			206.1	
Approach LOS		B			C			D			F	

Intersection Summary			
HCM 2000 Control Delay	73.6	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	20.4
Intersection Capacity Utilization	82.6%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Queues
2: Churchill Avenue & Scott Street 10/29/2019

Lane Group	EBT	WBL	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	19	335	59	16	392	159
v/c Ratio	0.09	0.83	0.11	0.19	0.67	0.35
Control Delay	45.4	56.5	18.9	55.1	34.9	32.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	45.4	56.5	18.9	55.1	34.9	32.6
Queue Length 50th (m)	3.4	62.5	6.7	3.1	63.3	25.1
Queue Length 95th (m)	10.1	86.9	14.1	9.6	94.8	42.5
Internal Link Dist (m)	23.4		59.9		286.6	30.0
Turn Bay Length (m)				30.0		
Base Capacity (vph)	214	499	531	87	584	449
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	0.09	0.67	0.11	0.18	0.67	0.35

Intersection Summary



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	1	8	10	335	9	50	16	132	260	50	107	2
Future Volume (vph)	1	8	10	335	9	50	16	132	260	50	107	2
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)		4.6		4.6	4.6		4.6	4.6			4.6	
Lane Util. Factor		1.00		1.00	1.00		1.00	1.00			1.00	
Frpb, ped/bikes		0.94		1.00	0.77		1.00	0.94			1.00	
Flpb, ped/bikes		0.99		1.00	1.00		1.00	1.00			0.99	
Frt		0.93		1.00	0.87		1.00	0.90			1.00	
Flt Protected		1.00		0.95	1.00		0.95	1.00			0.98	
Satd. Flow (prot)		1528		1695	1207		1695	1515			1733	
Flt Permitted		0.99		0.95	1.00		0.95	1.00			0.80	
Satd. Flow (perm)		1517		1695	1207		1695	1515			1405	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	1	8	10	335	9	50	16	132	260	50	107	2
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	19	0	335	59	0	16	392	0	0	159	0
Confl. Peds. (#/hr)	41		17	17		41	33		11	11		33
Turn Type	Perm	NA		Prot	NA		Prot	NA		Perm	NA	
Protected Phases		4		3	8		5	2			6	
Permitted Phases	4									6		
Actuated Green, G (s)		13.8		26.3	46.6		3.4	44.2			35.2	
Effective Green, g (s)		13.8		26.3	46.6		3.4	44.2			35.2	
Actuated g/C Ratio		0.13		0.24	0.42		0.03	0.40			0.32	
Clearance Time (s)		4.6		4.6	4.6		4.6	4.6			4.6	
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0			3.0	
Lane Grp Cap (vph)		190		405	511		52	608			449	
v/s Ratio Prot				c0.20	c0.05		c0.01	c0.26				
v/s Ratio Perm		0.01									0.11	
v/c Ratio		0.10		0.83	0.12		0.31	0.64			0.35	
Uniform Delay, d1		42.6		39.7	19.2		52.1	26.6			28.7	
Progression Factor		1.00		1.00	1.00		1.00	1.00			1.00	
Incremental Delay, d2		1.0		13.0	0.5		3.3	5.2			2.2	
Delay (s)		43.6		52.7	19.7		55.5	31.8			30.9	
Level of Service		D		D	B		E	C			C	
Approach Delay (s)		43.6			47.7			32.7			30.9	
Approach LOS		D			D			C			C	

Intersection Summary				
HCM 2000 Control Delay	38.7	HCM 2000 Level of Service	D	
HCM 2000 Volume to Capacity ratio	0.61			
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	22.4	
Intersection Capacity Utilization	79.4%	ICU Level of Service	D	
Analysis Period (min)	15			
c Critical Lane Group				

Intersection	
Int Delay, s/veh	1.1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	304	13	41	386	8	39
Future Vol, veh/h	304	13	41	386	8	39
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	304	13	41	386	8	39

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	317	0	779	311
Stage 1	-	-	-	-	311	-
Stage 2	-	-	-	-	468	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1243	-	364	729
Stage 1	-	-	-	-	743	-
Stage 2	-	-	-	-	630	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1243	-	349	729
Mov Cap-2 Maneuver	-	-	-	-	349	-
Stage 1	-	-	-	-	743	-
Stage 2	-	-	-	-	604	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.8	11.3
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	615	-	-	1243	-
HCM Lane V/C Ratio	0.076	-	-	0.033	-
HCM Control Delay (s)	11.3	-	-	8	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.2	-	-	0.1	-