2070 Scott Street

Transportation Impact Assessment

Final Report

May 2020

Prepared for:

Azure Urban Developments Inc.

Prepared by:

Stantec Consulting Ltd.

Certification

1. I have reviewed and have a sound understanding of the objectives, needs and requirements of the City of Ottawa's Official Plan, Transportation Master Plan and the Transportation Impact Assessment (2017) Guidelines;

2. I have a sound knowledge of industry standard practice with respect to the preparation of transportation impact assessment reports, including multi modal level of service review;

3. I have substantial experience (more than 5 years) in undertaking and delivering transportation impact studies (analysis, reporting and geometric design) with strong background knowledge in transportation planning, engineering or traffic operations; and

4. I am either a licensed[1] or registered[1] professional in good standing, whose field of expertise is either transportation engineering or transportation planning.

Signature of individual certifier that s/he meets the above four criteria.

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[1] License of registration body that oversees the profession is required to have a code of conduct and ethics guidelines that will ensure appropriate conduct and representation for transportation planning and/or transportation engineering works

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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, <u>please attach a sketch of the development or site plan</u> 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, <u>the Trip Generation Trigger is satisfied.</u>

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. It should be noted that as the site plan has been evolving, the number of residential units used in the subject analysis differs slightly from the most current site plan. However, the difference is negligible and does not affect the outcome of this study.

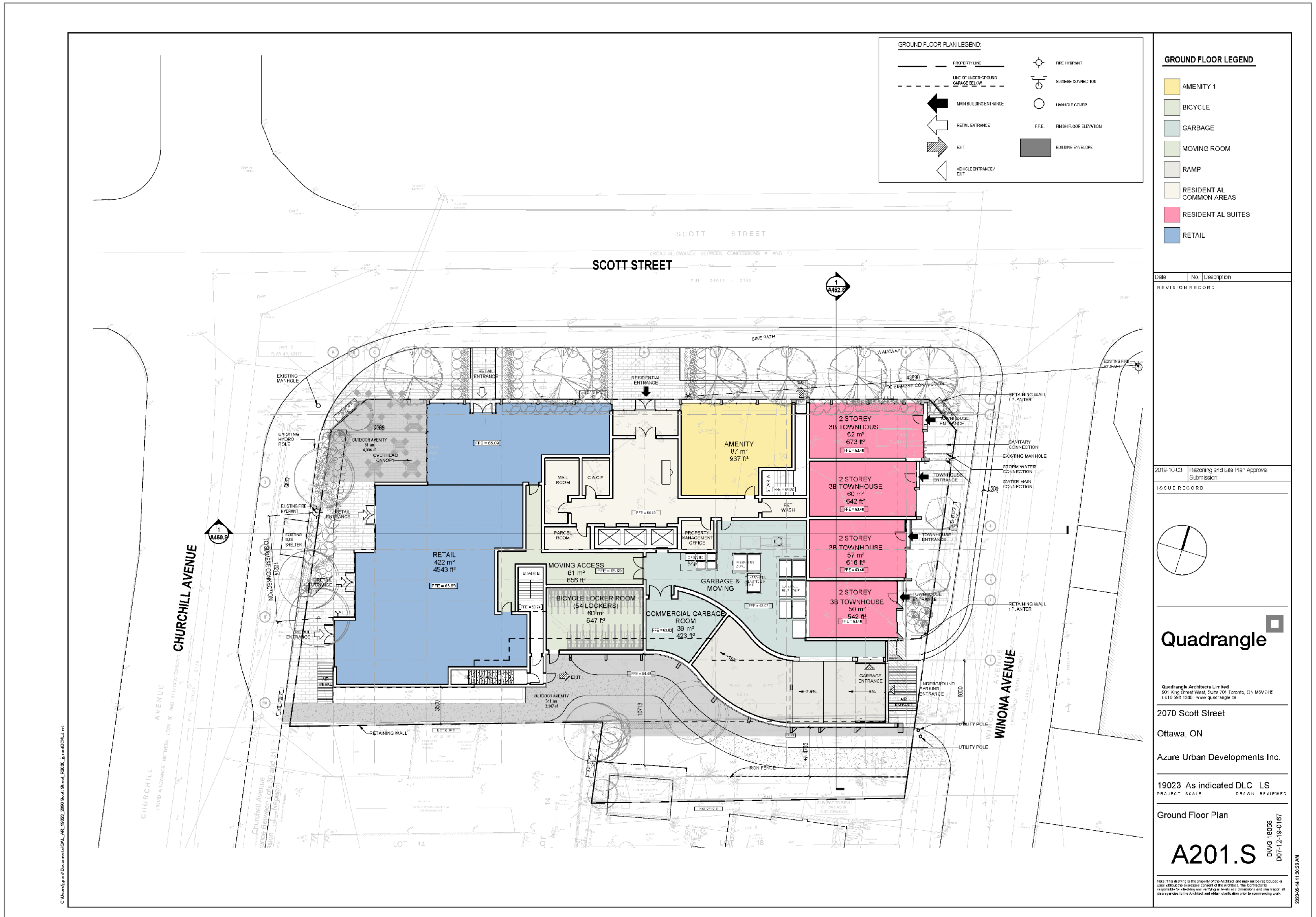
Table 1 - Proposed Land Uses / Land Use Codes

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

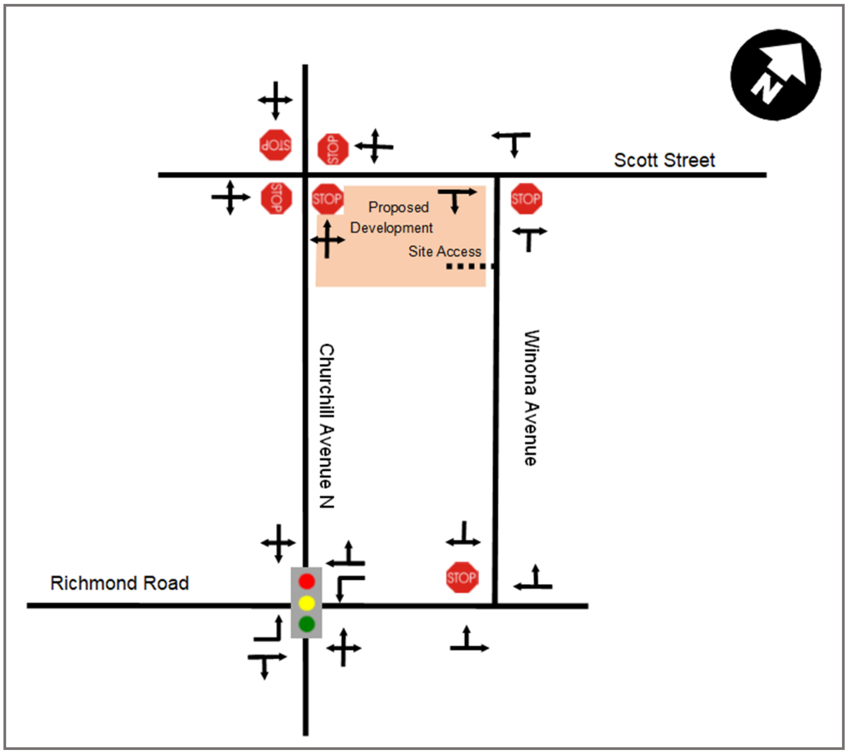
The roadways under consideration in the study area are described as follows:

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 40 km/hr. The intersection with Scott Street is stop-controlled along the Winona Avenue approach. The intersection with Richmond Road is also 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



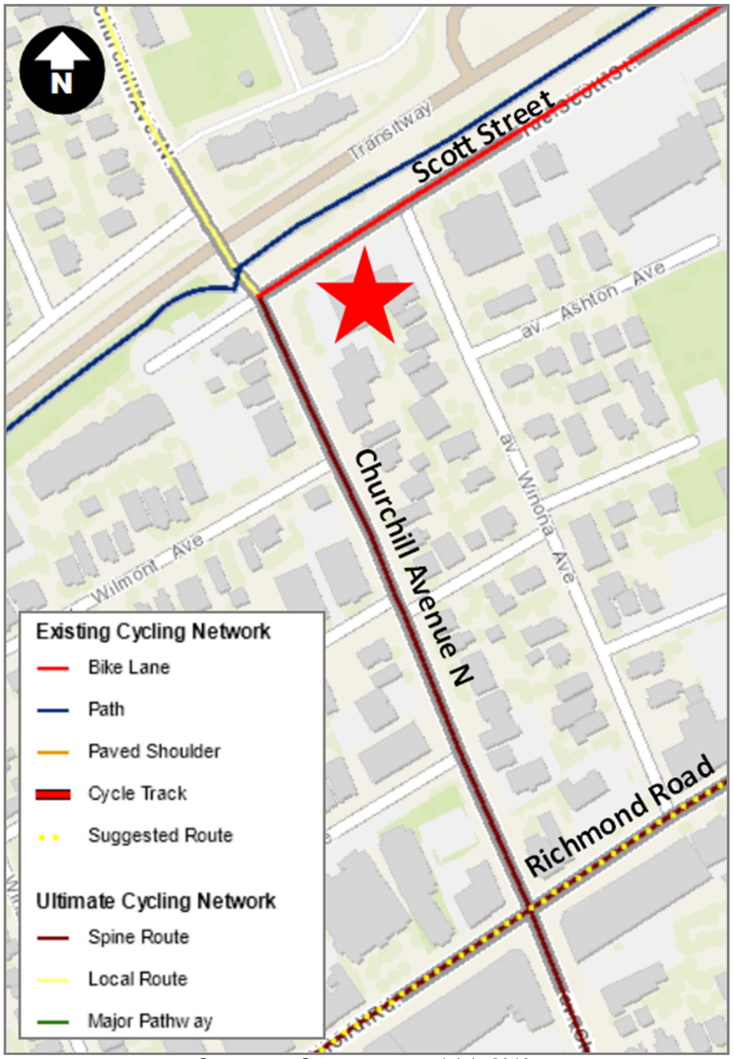
2.1.2.2 Walking and Cycling

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.

Figure 5 - Study Area Transit

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

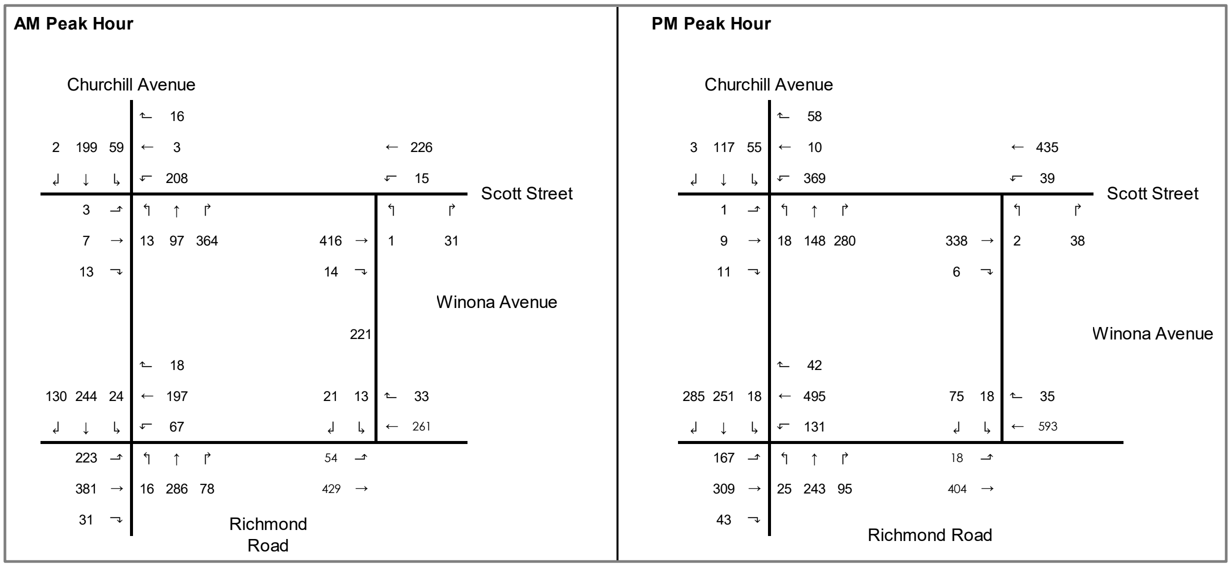
2.1.2.4 Traffic Management Measures

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	2025
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, Scott 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

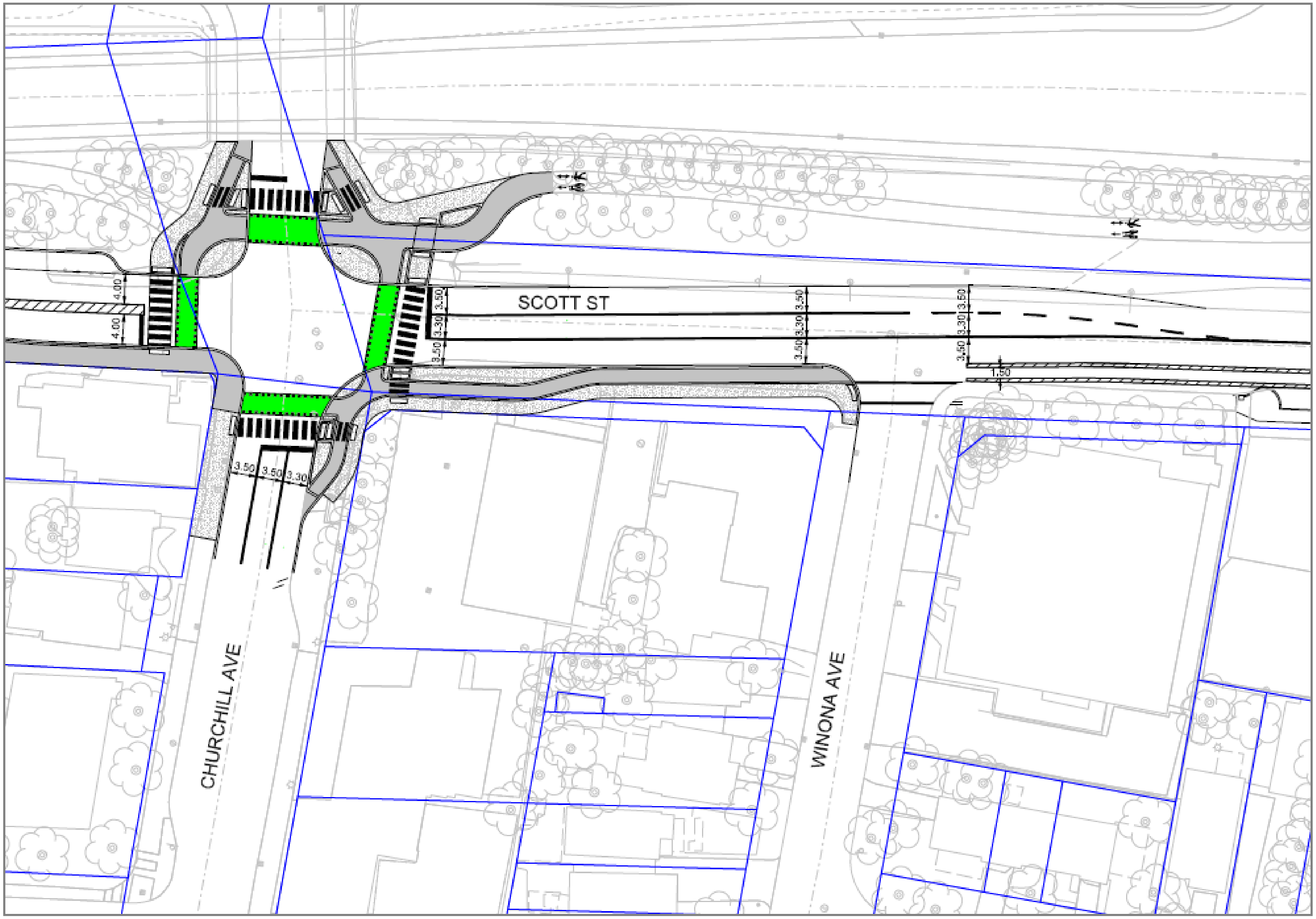
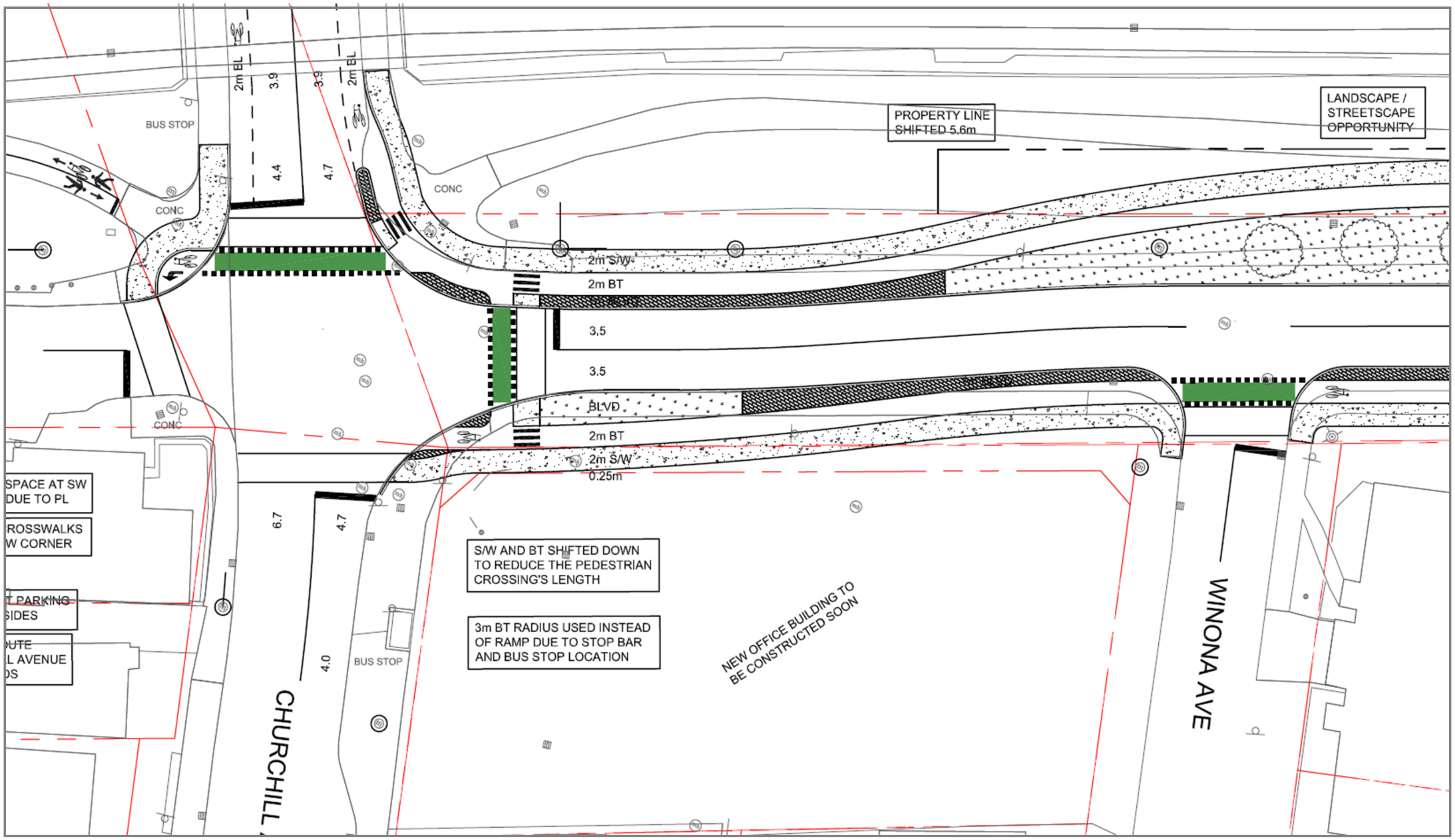


Figure 8 - Scott Street Ultimate Design



2.1.3.2 Future Background Developments

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

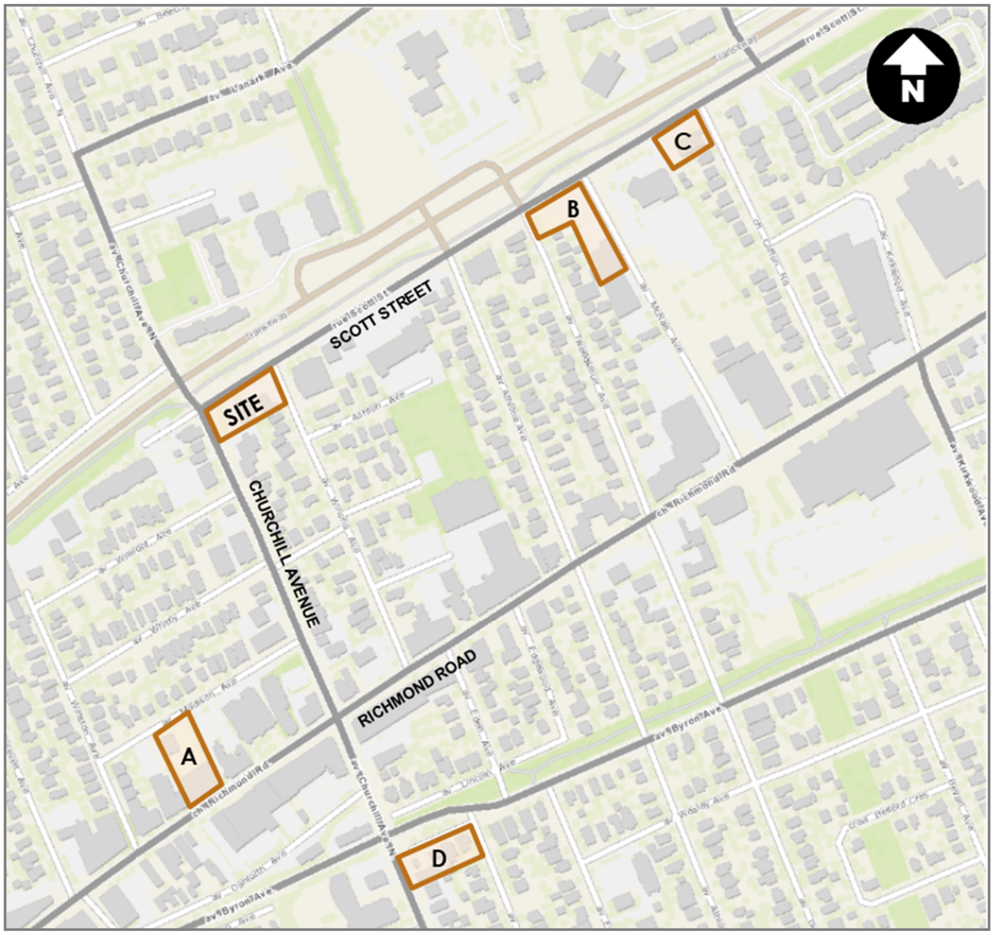
Table 5 and depicted in **Figure 9.**

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 250 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:

- Churchill Avenue N at Scott Street,
- Richmond Road at Churhcill Avenue N;
- Winona Avenue at Scott Street; and
- Richmond Road at Winona Avenue.

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.

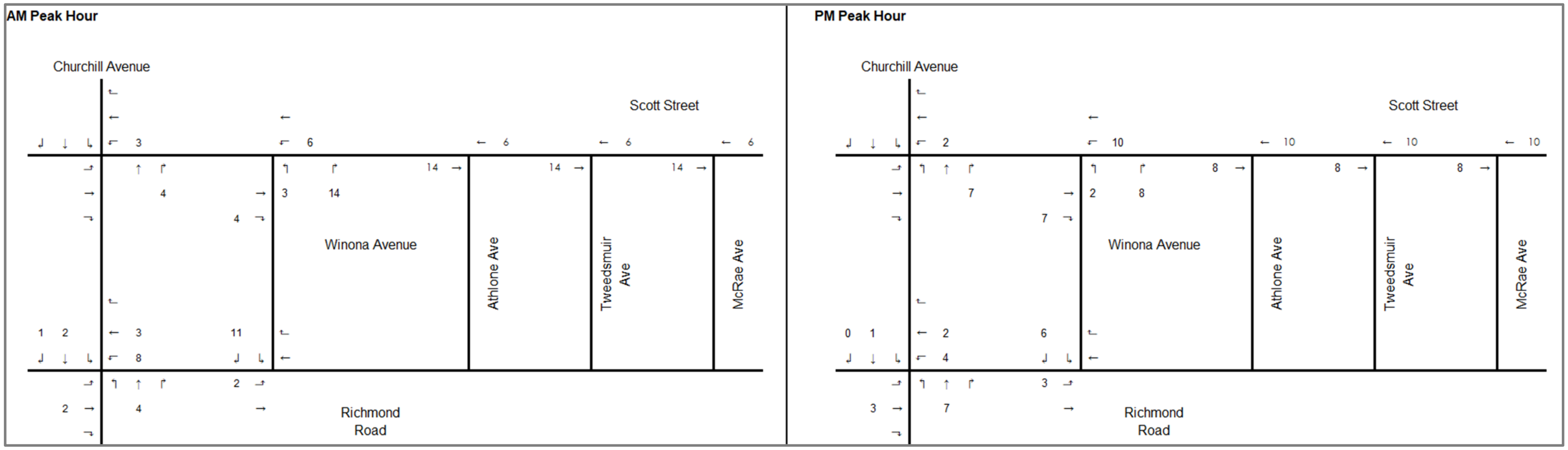
3.1.3 Trip Assignment

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

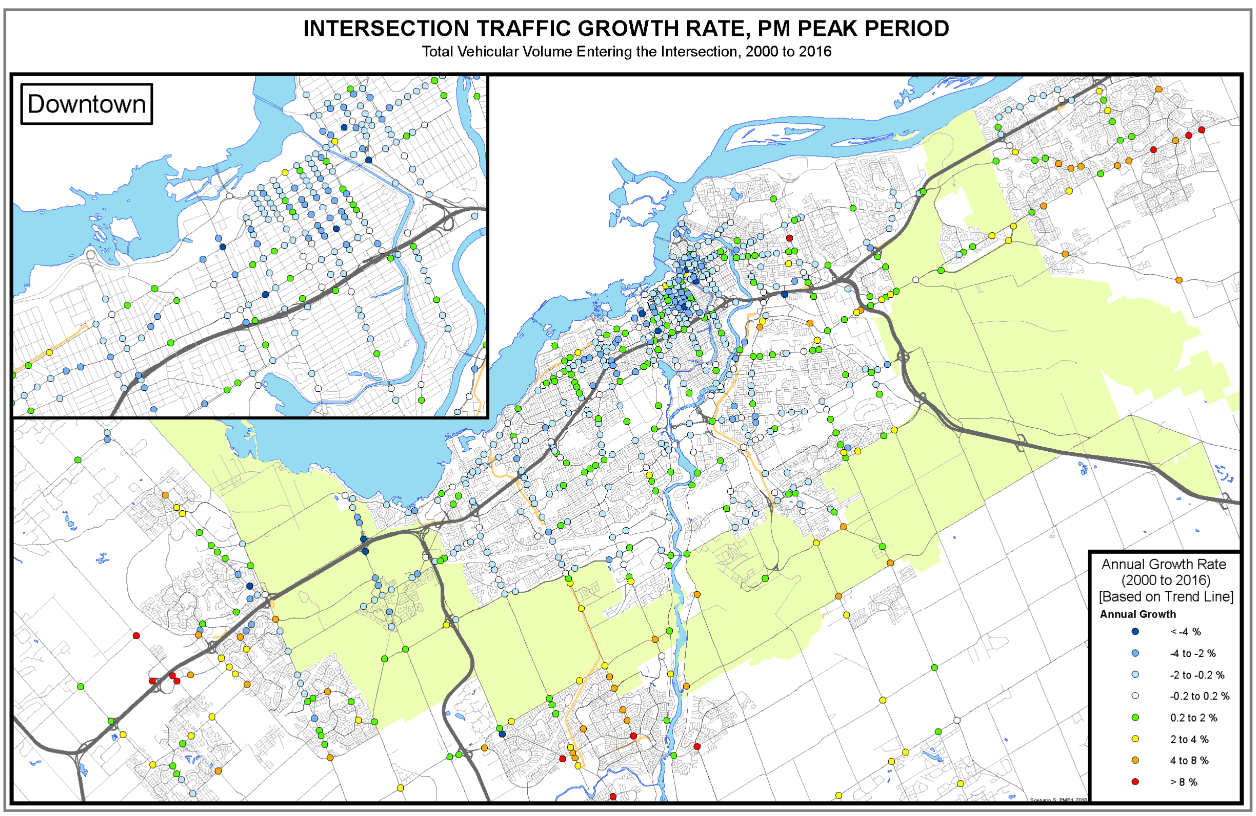
3.2.1 Transportation Network Plans

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 3.2.2**, 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. It should be noted that should the traffic volumes not reduce by 25%, as assumed in this subject study, the operations at the study area intersections are projected to deteriorate into the future, with particular concerns at the Richmond Road at Churchill Avenue North intersection under all horizons and the Churchill Avenue North at Scott Street intersection while the LRT bus detour is operating. However, the subject development is anticipated to have a negligible effect on the study area intersections and surrounding transportation environment with or without the 25% reduction in traffic volumes.

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 2025), 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.

Bicycle parking is located within the building and can be accessed from the south side of the building via a pathway that directly joins to the surrounding roads on the east and west sides of the development. The mezzanine level houses a bicycle locker room providing a total number of 92 bike lockers while the ground floor of the building encompasses a bicycle locker room providing a total number of 54 bike lockers.

4.1.3 New Street Networks

Not applicable; exempted during screening and scoping.

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 110 vehicle parking spaces for the residents, 22 vehicle parking spaces for the visitors, and 6 vehicle parking spaces for the retail component, for a total of 138 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 406 vehicle parking spaces for the residents and 19 vehicle parking spaces for the retail component, for a total of 425 vehicle parking spaces.

The proposed site plan indicates there will be 96 vehicle parking spaces for the residents, 28 vehicle parking spaces for the visitors, and 4 vehicle parking spaces for the retail component for a total of 128 vehicle parking spaces. 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 116 bicycle spaces are required for the residential component and 2 bicycle spaces are required for the retail component for a total of 118 bicycle parking spaces.

The proposed site plan indicates there will be 146 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 7**, 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 7**, Scott Street will be upgraded to include buffered 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 to less 3,000 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 implementations are not feasible given that Churchill Avenue N is an arterial roadway.

As the cyclists along Churchill Avenue operate in mixed traffic, the BLOS currently operates at LOS E which does not meet the desired target. Reducing the speed limit to 40 km/hr while maintaining the existing roadway geometry would also not allow the BLOS target to be met along Churchill Avenue. The addition of a physically separated 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 existing pedestrian facilities along Winona Avenue, the roadway segment does not currently meet the PLOS target. At full build-out, a sidewalk along Winona Avenue fronting the east façade of the development will be constructed including a 0.5m boulevard. This will allow the PLOS target of A to be met along Winona Avenue. Given the low traffic volumes and posted speed, the segment currently operates with a BLOS B, thereby meeting the specified target.

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	A	A
BLOS	B	A	A	E	**	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. The proposed access is 6m wide and has a varying grade between 5% and 15%.

There are numerous residential driveways on both sides of Winona Avenue within close proximity of the subject access, including one access on the east side of Winona Avenue, roughly opposite from the proposed access.

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

4.5.1 Context for TDM Measures

The proposed development is currently owned by Azure Urban Developments Inc. The site consists of apartments units as well as ground floor retail and is expected to be built and occupied by 2022. The tenants for the retail component are not yet known. As outlined in **Section 3.1.1**, the subject site is located within 600m of two transit stations; Westboro Station and Dominion Station and is therefore considered to be 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. In addition to the current transitway being located roughly 40m away from the subject site, by 2025, the transitway will be converted to Light Rail Transit, which will further support this 65% transit modal share as the capacity of the transit system will increase. In addition, the developer is prepared to implement certain Transportation Demand Management (TDM) measures as part of this development, which will be outlined in **Section 4.5.3** below.

To support the active modal share of 15%, the development proposes 146 bicycle parking spaces in addition to supplemental TDM measures, which will be outlined in **Section 4.5.3** below.

As the proposed development is not anticipated to generate a substantial amount of vehicle traffic as compared to the traffic that is already on the boundary road network, the auto modal shares are not anticipated to be an issue.

4.5.2 Need and Opportunity

According to the 2011 TRANS OD-Survey, the transit modal share for trips made from the district during the AM peak hour is 31% and the transit modal share for trips made to the district during the PM peak hour is 24%, for an average transit modal share of 28%. As per the TOD guidelines, developments within a TOD Zone have a transit modal share target of 65%, which is an increase of 37% as compared to the OD Survey. If the 65% transit split is not met and residents commuted in a manner similar to the statistics outlined in the OD Survey, this would equate to an additional 90 vehicle trips during the AM peak hour and 80 vehicle trips during the PM peak hour that would need to be assigned to the transportation network per the assignment outlined in **Figure 11.**

It is ancitipated that the traffic operations would not deteriorate as to fall short of the City of Ottawa vehicular LOS requirements for the area, as the majority of movements in the study area during the year 2022 are anticipated to operate with LOS B or higher. The effect on the most critical movement (southbound at the Richmond Road and Churchill Avenue intersection) is anticipated to be negligible given the traffic assignment.

It is difficult to measure the effect that an unsubstantiated increase in vehicular traffic will have on the development owner or future tenants. However, certain TDM measures / programs can be implemented to incentivize the use of public transit, as described in **Section 4.5.3** below.

4.5.3 TDM Program

The City of Ottawa's TDM Checklists were used to determine what TDM measures could be implemented based on the available information. Based on the checklists, the following TDM measures hve been agreed upon by the developer:

- Locate building close to the street, and do not locate parking areas between the street and building entrances
- Locate building entrances in order to minimize walking distances to sidewalks and transit stops / stations
- Locate building doors and windows to ensure visibility of pedestrians from the building, for their security and comfort
- Provide convenient, direct access to stations or major stops along rapid transit routes within 600m
- Provide safe, direct and attractive pedestrian access from public sidewalks to building entrances

- Provide sidewalks of smooth, well-drained walking surfaces of contrasting materials or treatments to differentiate pedestrian areas from vehicle areas
- Make sidewalks and open space easily accessible through features such as gradual grade transition, depessed curbs at street corners
- Include adequately spaced inter-block / street cycling and pedestrian connections to facilitate travel by active transportation
- Provide safe, direct and attractive walking routes from building entrances to nearby transit stops
- Provide lighting, landscaping and benches along walking and cycling routes between entrances and streets, sidewalks and trails
- Provide bicycle parking in highly visible and lighted areas, sheltered from the weather wherever possible
- Provide the number of bicycle parking spaces identified for various land uses in different parts of Ottawa
- Ensure that bicycle parking spaces and access aisles meet minimum dimensions
- Provide a permanent bike repair station, with commonly used tools and an air pump, adjacent to the main bicycle parking area
- Do not provide more parking than permitted by zoning, nor less than required by zoning
- Display local area maps with walking / cycling access routes and key destinations at major entrances
- Display relevant transit schedules and route maps at entrances
- Where more than 50 bicycle parking spaces are provided for a residential building ,locate at least 25% within a building
- Offer PRESTO cards preloaded with one monthly transit pass on residence purchase / move-in to encourage residents to use transit
- Prepare a multimodal travel option information package to new residents

The TDM checklists are included 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 average two-way traffic volume forecasts for Winona Avenue across the subject development 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	70 veh/hr	90 veh/hr

The traffic volumes along Winona Avenue, across the subject site, at the build-out of the subject development are not projected to exceed the threshold of 120 vehicles/hour (veh/hr) during peak periods 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^{TM} 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 southbound shared through / right turn lane at the intersection of Churchill Avenue North at Richmond Road currently operates at or above capacity with significant delays during the PM peak hour. This is attributed to Richmond Road being a more pedestrian focused roadway and, as per the City of Ottawa's signal timing for this intersection, a significant amount of time 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 from the advanced walk time for pedestrians, therefore, it is also not a feasible solution.

The remaining study area intersections currently meet the LOS operational standards outlined by the City of Ottawa for the area, 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 (B)	0.56 (0.66)	16 (20)	35 (#25)
			Through / Right	A (A)	0.60 (0.44)	19 (12)	79 (45)
		WB	Left	A (C)	0.33 (0.75)	27 (44)	19 (#49)
			Through / Right	A (C)	0.49 (0.80)	28 (31)	47 (#131)
		NB	Left	A (A)	0.11 (0.35)	20 (40)	6 (12)
			Through / Right	C (E)	0.72 (0.92)	32 (62)	#77 (#104)
		SB	Left	A (A)	0.15 (0.20)	21 (32)	8 (9)
			Through / Right	C (F)	0.77 (1.7)	35 (365)	#88 (#189)
		Overall Intersection		**B (F)**	**0.68 (1.05)**	**26 (118)**	**- (-)**
Scott Street at Churchill Avenue	Four Way Stop Controlled	EB	Left / Through / Right	A (A)	0.04 (0.04)	10 (10)	- (-)
		WB	Left / Through / Right	B (D)	0.43 (0.82)	14 (31)	- (-)
		NB	Left / Through / Right	C (C)	0.71 (0.78)	19 (25)	- (-)
		SB	Left / Through / Right	B (B)	0.45 (0.36)	13 (13)	- (-)
		Overall Intersection		**C (D)**	**0.71 (0.73)**	**16 (26)**	**- (-)**
Scott Street at Winona Avenue	Minor Stop Controlled	EB	Through / Right	A (A)	0.28 (0.23)	0 (0)	0 (0)
		WB	Through / Left	A (A)	0.02 (0.04)	1 (1)	0 (1)
		NB	Left / Right	B (B)	0.06 (0.07)	12 (11)	1 (2)
		Overall Intersection		**A (A)**	**0.36 (0.59)**	**1 (1)**	**- (-)**
Richmond Road at Winona Avenue	Minor Stop Controlled	EB	Through / Left	A (A)	0.05 (0.03)	2 (1)	1 (1)
		WB	Through / Right	A (A)	0.19 (0.41)	0 (0)	0 (0)
		SB	Left / Right	B (D)	0.09 (0.37)	15 (26)	2 (12)
		Overall Intersection		**A (A)**	**0.57 (0.51)**	**2 (2)**	**- (-)**

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

<u>Churchill Avenue North at Richmond Road</u>

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 D, 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		Auto	
	Actual	Target	Actual	Target	Actual	Target	Actual	Target	Actual	Target
Richmond Road at Churchill Avenue North	B	A	D	A	F	D	E	D	F	E

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 southbound thru/right movement at 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.

It is noted that the 95th percentile westbound left turn queue lengths at the intersection of Scott Street and Chuchill Avenue are projected to spill back across the intersection of Scott Street and Winona Avenue during the PM peak hour by approximately 5m. The volume of cars making the northbound left at the Scott / Winona intersection is negligible, therefore the queue spillback likely won't affect those vehicles. As the queue spillback from the Scott / Churchill intersection is only anticipated to extend roughly 5m beyond the Winona intersection, the vehicles making the westbound left onto Winona Avenue will likely not experience a substantial amount of delay either before they are able to complete their movement.

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

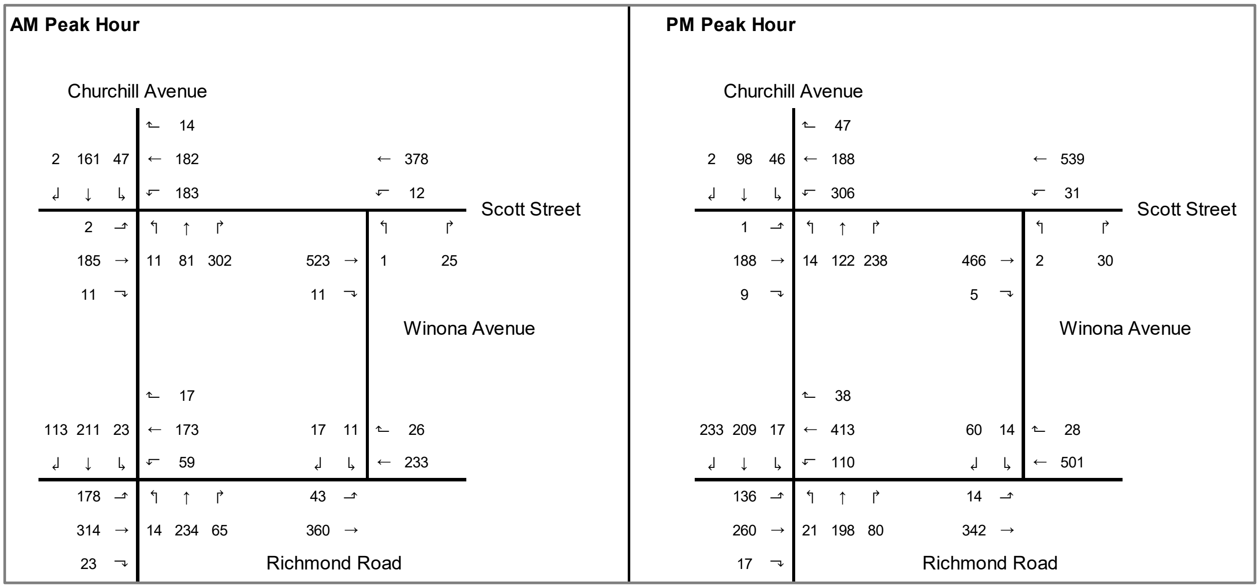
Appendix F contains detailed intersection performance worksheets.

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)	0.36 (0.36)	13 (12)	24 (17)
			Through / Right	A (A)	0.41 (0.28)	14 (10)	40 (29)
		WB	Left	A (A)	0.30 (0.58)	25 (33)	16 (#33)
			Through / Right	A (A)	0.34 (0.56)	23 (22)	35 (74)
		NB	Left	A (A)	0.07 (0.27)	21 (36)	5 (9)
			Through / Right	A (B)	0.57 (0.67)	28 (40)	56 (62)
		SB	Left	A (A)	0.10 (0.10)	7 (28)	m2 (7)
			Through / Right	B (F)	0.64 (1.21)	15 (153)	m29 (#129)
		Overall Intersection		**A (C)**	**0.52 (0.74)**	**18 (57)**	**- (-)**
Scott Street at Churchill Avenue	Signalized	EB	Left / Through / Right	D (E)	0.86 (0.95)	62 (80)	#55 (#60)
		WB	Left	D (D)	0.84 (0.89)	58 (54)	#56 (#80)
			Through / Right	A (A)	0.49 (0.51)	21 (18)	34 (38)
		NB	Left	A (A)	0.26 (0.22)	38 (39)	m3 (7)
			Through / Right	C (D)	0.78 (0.84)	28 (46)	#91 (#92)
		SB	Left / Through / Right	B (B)	0.62 (0.64)	36 (44)	#61 (#47)
		Overall Intersection		**D (E)**	**0.85 (0.92)**	**39 (48)**	**- (-)**
Scott Street at Winona Avenue	Minor Stop Controlled	EB	Through / Right	A (A)	0.3 (0.27)	0 (0)	0 (0)
		WB	Through / Left	A (A)	0.01 (0.03)	0 (1)	0 (1)
		NB	Left / Right	B (B)	0.05 (0.06)	12 (12)	1 (1)
		Overall Intersection		**A (A)**	**0.41 (0.66)**	**1 (1)**	**- (-)**
Richmond Road at Winona Avenue	Minor Stop Controlled	EB	Through / Left	A (A)	0.04 (0.02)	1 (1)	1 (0)
		WB	Through / Right	A (A)	0.15 (0.31)	0 (0)	0 (0)
		SB	Left / Right	B (C)	0.06 (0.29)	13 (25)	1 (8)
		Overall Intersection		**A (A)**	**0.53 (0.42)**	**1 (2)**	**- (-)**

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

<u>Churchill Avenue North at Richmond Road</u>

No changes to the MMLOS from existing conditions.

<u>Scott Street at Churchill Avenue North</u>

As outlined in **12 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. The timing plan was designed to provide an acceptable balance between vehicular levels of service, transit delay, and pedestrian walk times. With a cycle length of 80 seconds (similar to the intersection of Richmond and Churchill), 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. Given the preliminary configuration of the interim Scott Street and Churchill Avenue intersection and the surrounding MUPs (thus requiring protected left turns where possible), further lowering the cycle length from 80 seconds to reduce pedestrian delays would be detrimental to the other modes of transportation utilizing the intersection. As part of the detailed design for this intersection, the City should consider implementing a signal timing plan that provides a balanced operation between all desired modes of transportation, with an emphasis on some more than others if desired.

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 A, which meets the desired target. The Scott Street design prepared by the City of Ottawa, as depicted in **Figure 7,** proposes designated cyclist cross-rides (which act similar to a left turn box) that eliminate the need for a left turn approach in mixed traffic. As such, the BLOS is believe 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 and the interim design configuration in **Figure 7**, 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		Auto	
	Actual	Target	Actual	Target	Actual	Target	Actual	Target	Actual	Target
Richmond Road at Churchill Avenue North	B	A	D	A	F	D	E	D	C	E
Scott Street and Churchill Avenue North	D	A	A	A	F	D	E	D	E	E

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 southbound thru/right movement at 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.

It is noted that the 95th percentile westbound left turn queue lengths at the intersection of Scott Street and Chuchill Avenue are projected to spill back across the intersection of Scott Street and Winona Avenue during the PM peak hour by approximately 5m. The volume of cars making the northbound left at the Scott / Winona intersection is negligible, therefore the queue spillback likely won't affect those vehicles. As the queue spillback from the Scott / Churchill intersection is only anticipated to extend roughly 5m beyond the Winona intersection, the vehicles making the westbound left onto Winona will likely not experience a substantial amount of delay either before they are able to complete their movement. However, it should be noted that the anticipated queue spillback is essentially unchanged between the 2022 future background horizon and the 2022 total future horizon, suggesting that the subject development has a negligible impact.

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

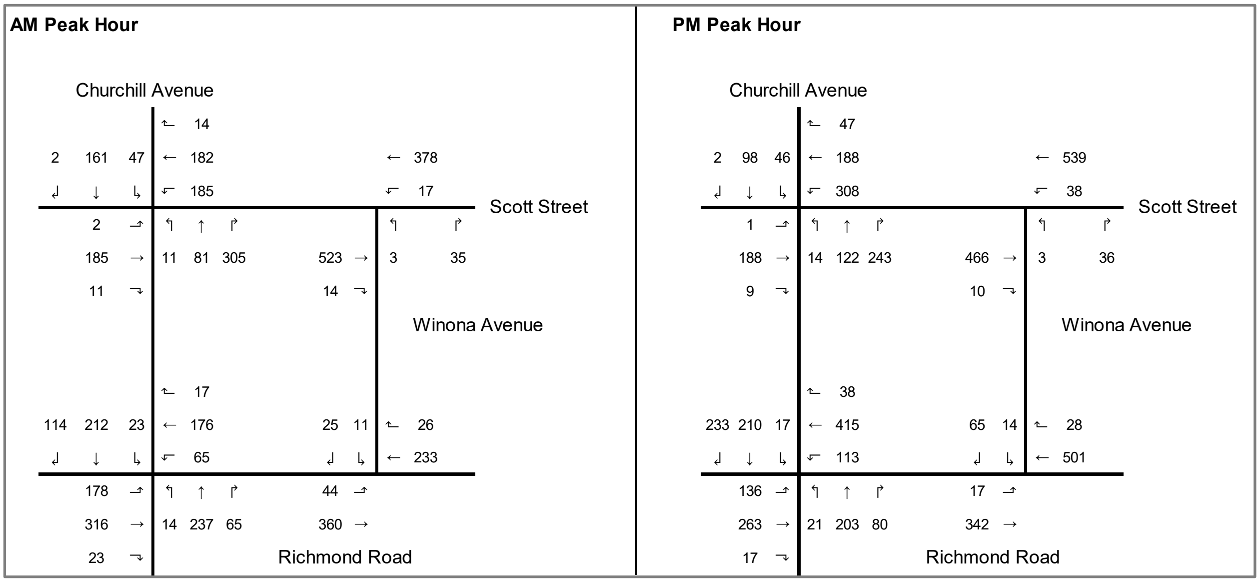
Appendix F contains detailed intersection performance worksheets.

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)	0.36 (0.36)	13 (12)	24 (17)
			Through / Right	A (A)	0.41 (0.29)	14 (10)	41 (30)
		WB	Left	A (B)	0.33 (0.64)	25 (37)	17 (#38)
			Through / Right	A (B)	0.35 (0.61)	23 (23)	35 (81)
		NB	Left	A (A)	0.07 (0.27)	21 (36)	5 (9)
			Through / Right	A (B)	0.57 (0.68)	28 (40)	56 (#64)
		SB	Left	A (A)	0.10 (0.10)	7 (28)	m2 (7)
			Through / Right	B (F)	0.64 (1.23)	15 (160)	m30 (#132)
		Overall Intersection		**A (C)**	**0.52 (0.78)**	**19 (59)**	**- (-)**
Scott Street at Churchill Avenue	Signalized	EB	Left / Through / Right	D (E)	0.86 (0.97)	62 (87)	#55 (#61)
		WB	Left	D (D)	0.85 (0.90)	59 (57)	#57 (#82)
			Through / Right	A (A)	0.49 (0.51)	21 (18)	34 (39)
		NB	Left	A (A)	0.26 (0.22)	43 (39)	m3 (7)
			Through / Right	C (D)	0.79 (0.86)	30 (47)	#92 (#95)
		SB	Left / Through / Right	B (B)	0.62 (0.65)	36 (44)	#61 (#48)
		Overall Intersection		**D (E)**	**0.86 (0.94)**	**39 (50)**	**- (-)**
Scott Street at Winona Avenue	Minor Stop Controlled	EB	Through / Right	A (A)	0.32 (0.28)	0 (0)	0 (0)
		WB	Through / Left	A (A)	0.02 (0.03)	1 (1)	0 (1)
		NB	Left / Right	B (B)	0.07 (0.07)	13 (12)	2 (2)
		Overall Intersection		**A (A)**	**0.46 (0.66)**	**1 (1)**	**- (-)**
Richmond Road at Winona Avenue	Minor Stop Controlled	EB	Through / Left	A (A)	0.04 (0.02)	1 (1)	1 (0)
		WB	Through / Right	A (A)	0.15 (0.31)	0 (0)	0 (0)
		SB	Left / Right	B (C)	0.07 (0.21)	13 (17)	2 (5)
		Overall Intersection		**A (A)**	**0.51 (0.45)**	**1 (2)**	**- (-)**

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

No changes from 2022 future background scenario.

Scott Street at Churchill Avenue North

No changes from 2022 future background scenario.

Appendix D contains the detailed MMLOS analysis for subject intersections.

Table 18 – 2022 Total Future Signalized Intersection MMLOS

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

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 total future traffic volumes, as outlined in **Section 3.3**, the southbound thru/right movement at 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.

With the removal of the buses from Scott Street, once the Western LRT is constructed, the operations at the Scott Street at Churchill Avenue North intersection are anticipated to improve. It is noted that the 95th percentile westbound left turn queue lengths at the intersection of Scott Street and Chuchill Avenue are still projected to spill back across the intersection of Scott Street and Winona Avenue during the PM peak hour by approximately 5m. The volume of cars making the northbound left at the Scott / Winona intersection is negligible, therefore the queue spillback likely won’t affect those vehicles. As the queue spillback from the Scott / Churchill intersection is only anticipated to extend roughly 5m beyond the Winona intersection, the vehicles making the westbound left onto Winona will likely not experience a substantial amount of delay either before they are able to complete their movement.

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

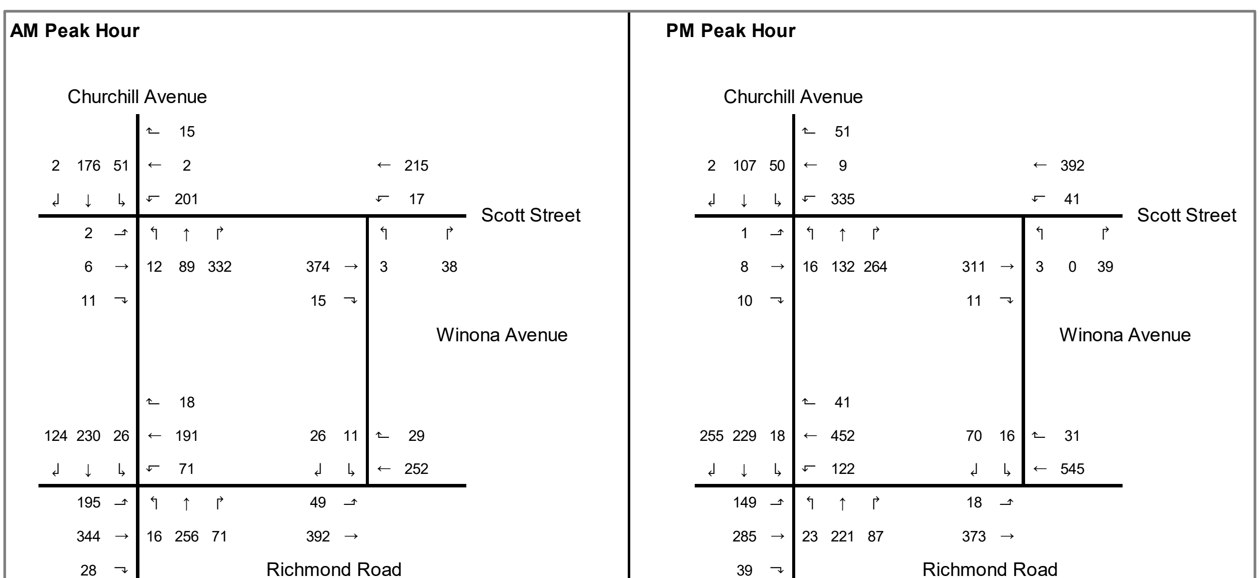
Appendix F contains detailed intersection performance worksheets.

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 (0.45)	14 (14)	28 (19)
			Through / Right	A (A)	0.47 (0.36)	15 (11)	48 (35)
		WB	Left	A (B)	0.41 (0.66)	31 (37)	20 (#40)
			Through / Right	A (B)	0.42 (0.66)	26 (25)	41 (91)
		NB	Left	A (A)	0.08 (0.29)	20 (37)	6 (10)
			Through / Right	A (C)	0.57 (0.74)	27 (44)	59 (#77)
		SB	Left	A (A)	0.11 (0.12)	10 (28)	m4 (7.5)
			Through / Right	B (F)	0.65 (1.36)	20 (213)	51 (#147)
		Overall Intersection		**A (D)**	**0.57 (0.84)**	**21 (73)**	**- (-)**
Scott Street at Churchill Avenue	Signalized	EB	Left / Through / Right	A (A)	0.12 (0.11)	34 (33)	7.7 (8)
		WB	Left	C (D)	0.71 (0.85)	40 (45)	45 (#80)
			Through / Right	A (A)	0.04 (0.11)	18 (15)	5 (11)
		NB	Left	A (A)	0.29 (0.25)	55 (40)	m3.5 (8)
			Through / Right	B (D)	0.68 (0.75)	28 (32)	#93 (#91)
		SB	Left / Through / Right	A (A)	0.49 (0.48)	26 (31)	#48 (37)
		Overall Intersection		**A (B)**	**0.59 (0.68)**	**30 (35)**	**- (-)**
Scott Street at Winona Avenue	Minor Stop Controlled	EB	Through / Right	A (A)	0.23 (0.19)	0 (0)	0 (0)
		WB	Through / Left	A (A)	0.01 (0.03)	1 (1)	0 (1)
		NB	Left / Right	B (B)	0.06 (0.06)	11 (11)	1 (1)
		Overall Intersection		**A (A)**	**0.37 (0.55)**	**1 (1)**	**- (-)**
Richmond Road at Winona Avenue	Minor Stop Controlled	EB	Through / Left	A (A)	0.04 (0.02)	1 (1)	1 (1)
		WB	Through / Right	A (A)	0.17 (0.34)	0 (0)	0 (0)
		SB	Left / Right	C (C)	0.10 (0.25)	16 (19)	2 (7)
		Overall Intersection		**A (A)**	**0.54 (0.48)**	**2 (2)**	**- (-)**

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

No changes from the 2022 Total Future Conditions scenario.

Scott Street at Churchill Avenue North

No changes from the 2022 Total Future Conditions scenario.

Appendix D contains the detailed MMLOS analysis for subject intersections.

Table 20 – 2027 Ultimate Signalized Intersection MMLOS

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

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:

<u>2019 Existing Conditions</u>

- The southbound shared through / right turn lane at the intersection of Churchill Avenue North at Richmond Road currently operates 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 improvements may not be feasible due 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.

<u>2022 Future Background</u>

- As in the 2019 existing conditions, the southbound shared through / right turn lane at 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.
- It is noted that the 95th percentile westbound left turn queue lengths at the intersection of Scott Street and Chuchill Avenue are projected to spill back across the intersection of Scott Street and Winona Avenue during the PM peak hour by approximately 5m. The volume of cars making the northbound left at the Scott / Winona intersection is negligible, therefore the queue spillback likely won't affect those vehicles. As the queue spillback from the Scott / Churchill intersection is only anticipated to extend roughly 5m beyond the Winona intersection, the vehicles making the westbound left onto Winona Avenue will likely not experience a substantial amount of delay either before they are able to complete their movement.
- All remaining study area intersections are anticipated to operate acceptably under 2022 future background conditions.

<u>2022 Total Future Conditions</u>

- Consistent with the 2022 future background horizon, demand rationalization was included to reflect the anticipated changes in travel behavior. Despite this, congestion is projecyed to persist at the southbound shared through / right turn lane at the intersection of Richmond Road at Churchill Avenue during the PM peak hour in the 2022 Total Future horizon for which no mitigation strategies exist due to the constrained geometry (thus precluding road widening) and the high requirement for pedestrian LOS at the intersection. Capacity issues and delays at the Richmond Road at Churchill Avenue intersection are consistent across all study horizons and are extraneous to the addition of the subject development to the traffic network.
- It is noted that the 95th percentile westbound left turn queue lengths at the intersection of Scott Street and Chuchill Avenue are projected to spill back across the intersection of Scott Street and Winona Avenue during the PM peak hour by approximately 5m. The volume of cars making the northbound left at the Scott / Winona intersection is negligible, therefore the queue spillback likely won't affect those vehicles. As the queue spillback from the Scott / Churchill intersection is only anticipated to extend roughly 5m beyond the Winona intersection, the vehicles making the westbound left onto Winona will likely not experience a substantial amount of delay either before they are able to complete their movement. However, it should be noted that the anticipated queue spillback is essentially unchanged between the 2022 future background horizon and the 2022 total future horizon, suggesting that the subject development has a negligible impact.
- All remaining study area intersections are anticipated to operate acceptably under 2022 total future traffic conditions.

<u>2027 Ultimate Conditions</u>

- The results from the 2027 ultimate horizon analysis are consistent with those from the 2022 total future horizon, although slightly worse due to an increase in background growth.

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 North:

- 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; and,

- The addition of a physically separated 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 at full build-out of the subject site, all MMLOS targets along Winona Avenue will be met.

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

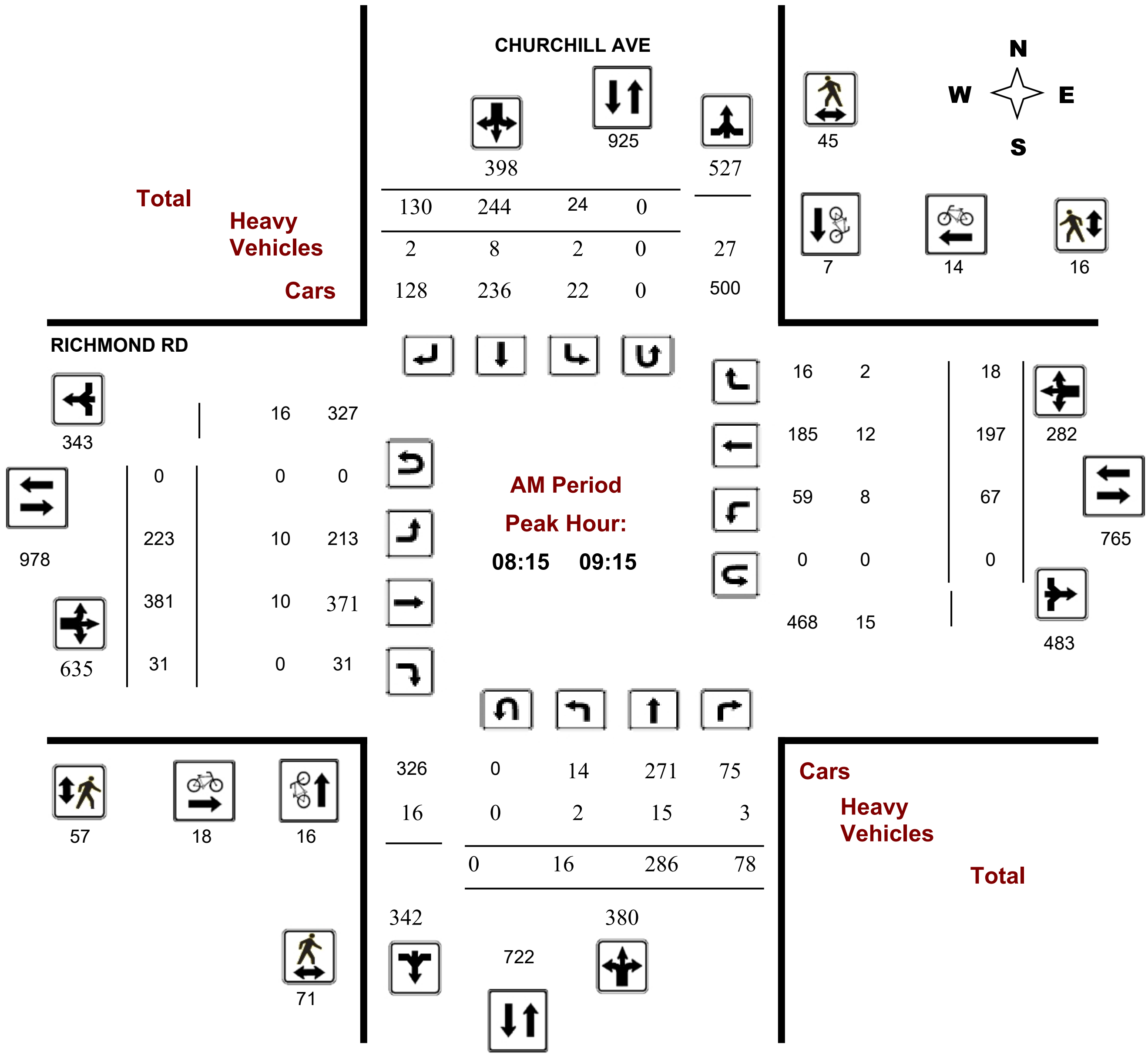
Transportation Services - Traffic Services

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

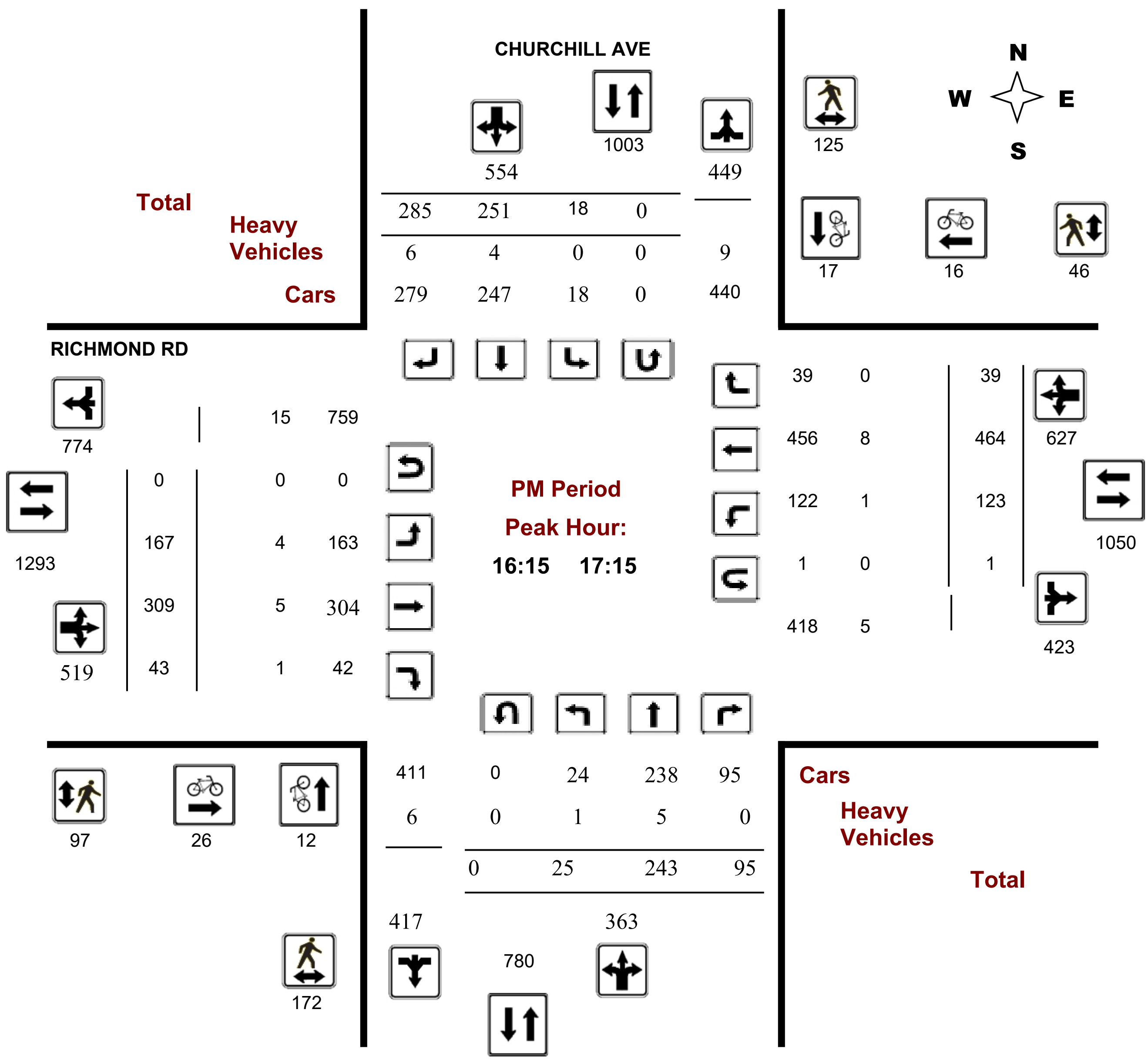
Transportation Services - Traffic Services

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

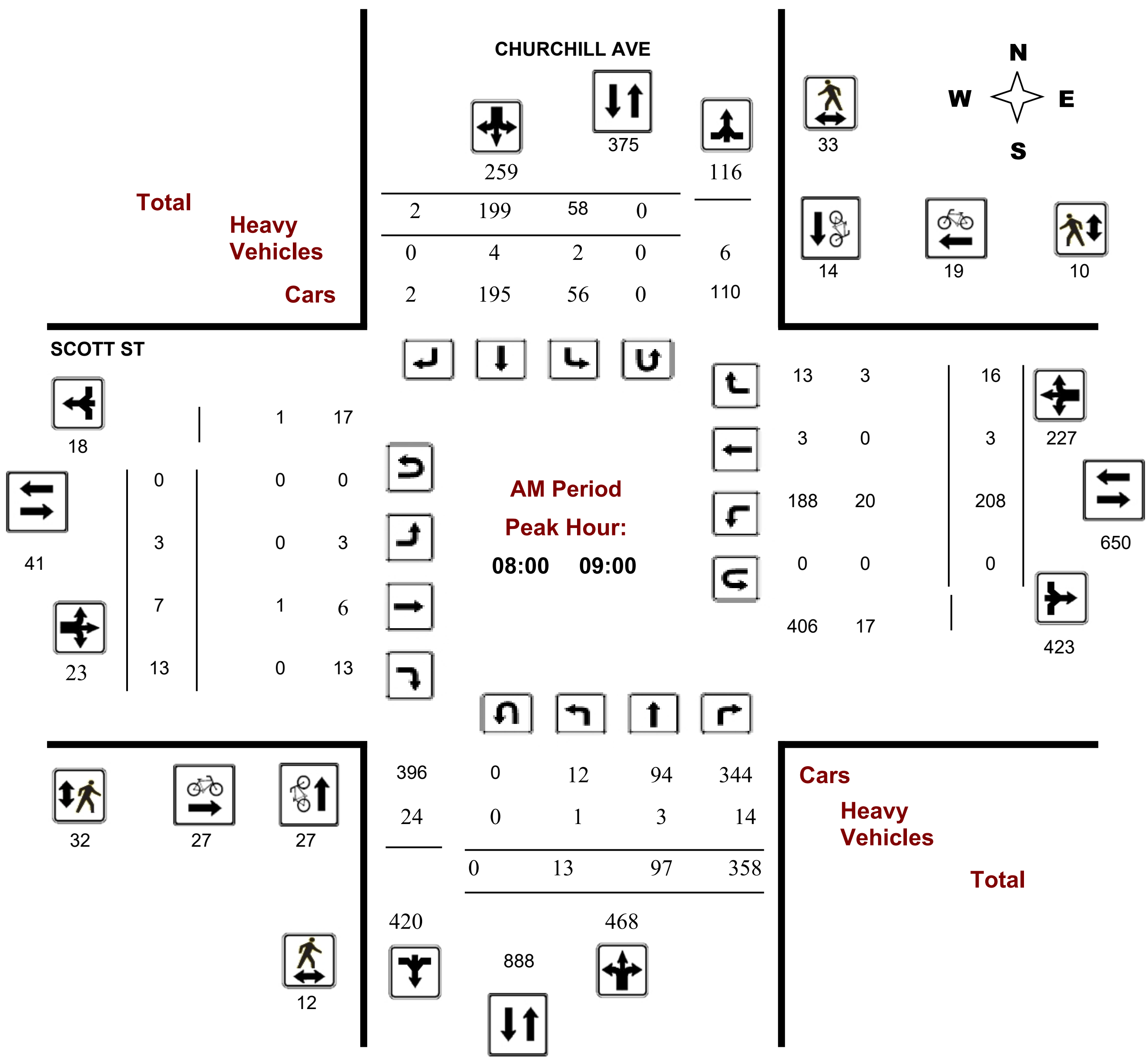
Transportation Services - Traffic Services

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

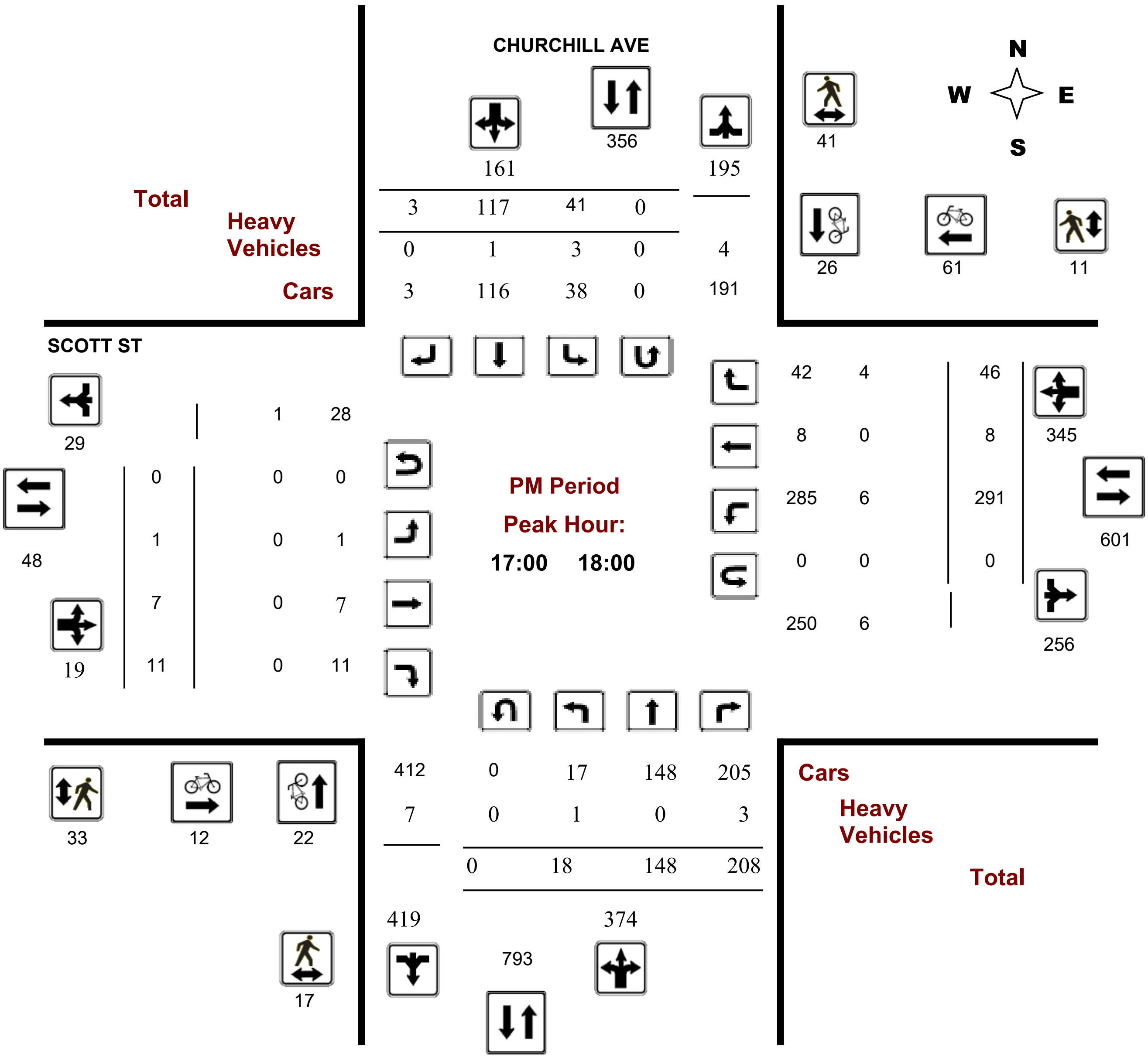
CHURCHILL AVE @ SCOTT ST

Survey Date: Tuesday, August 13, 2019

Start Time: 07:00

WO No: 38699

Device: Miovision



Comments

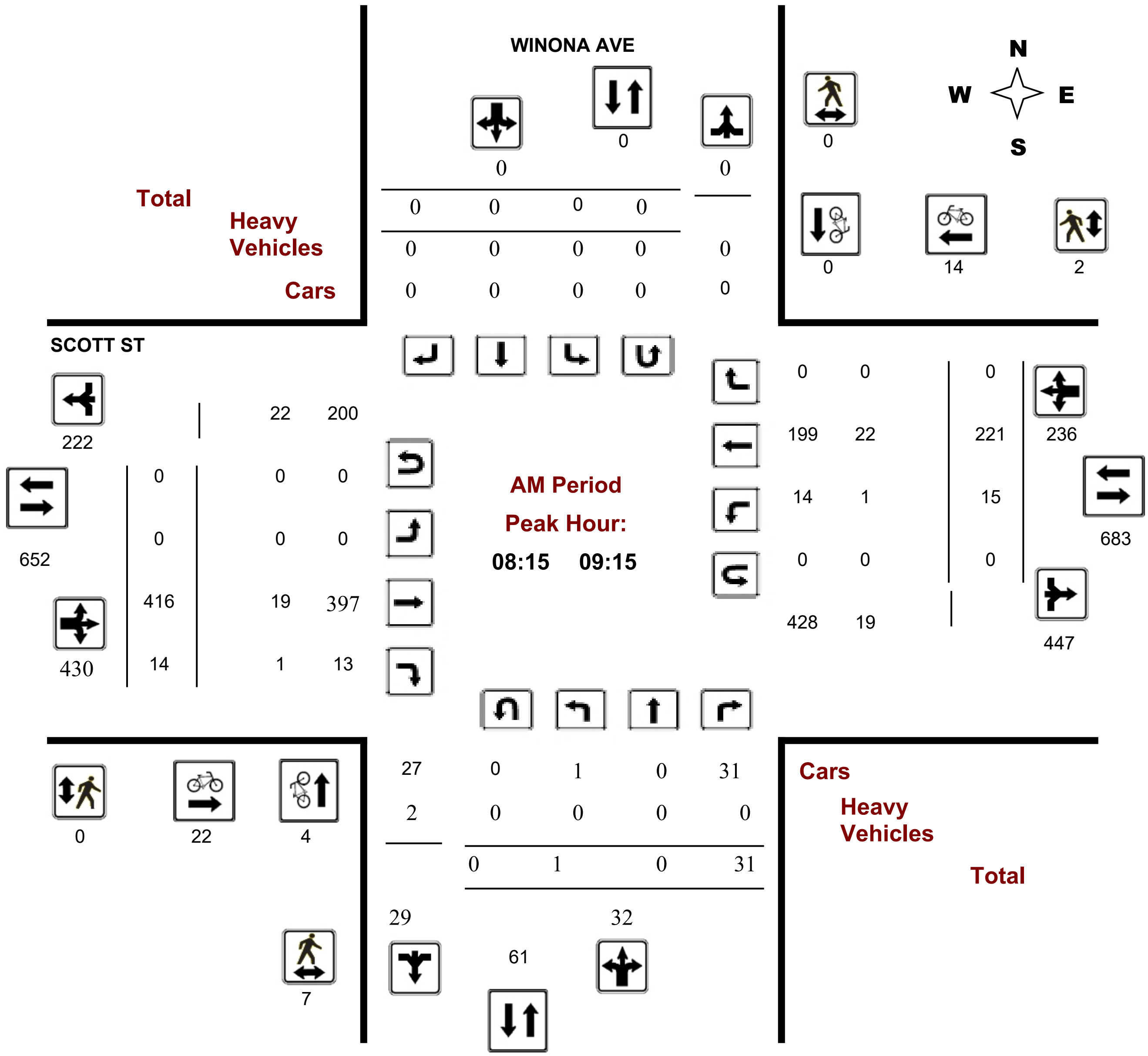
Transportation Services - Traffic Services

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

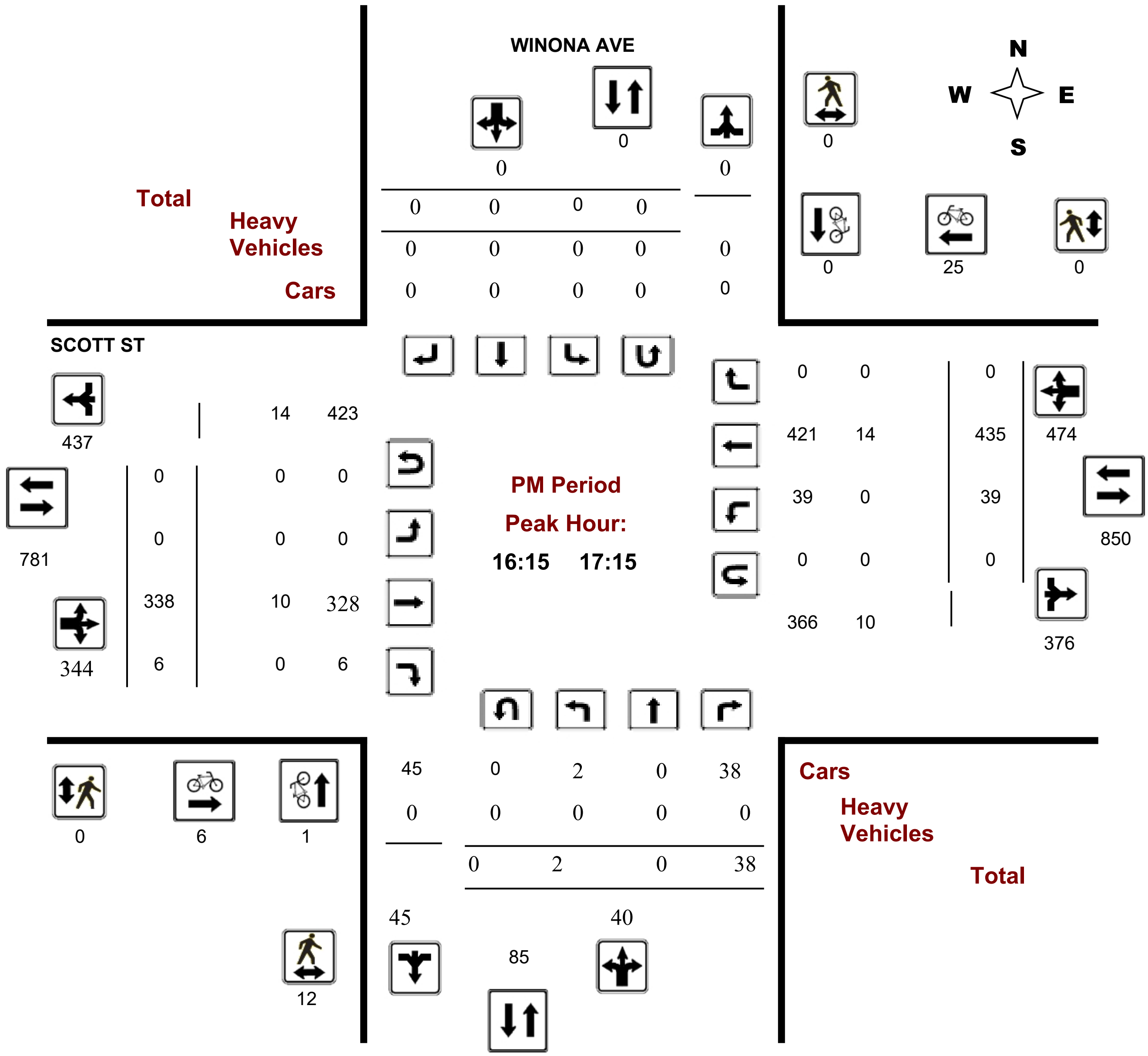
Transportation Services - Traffic Services

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

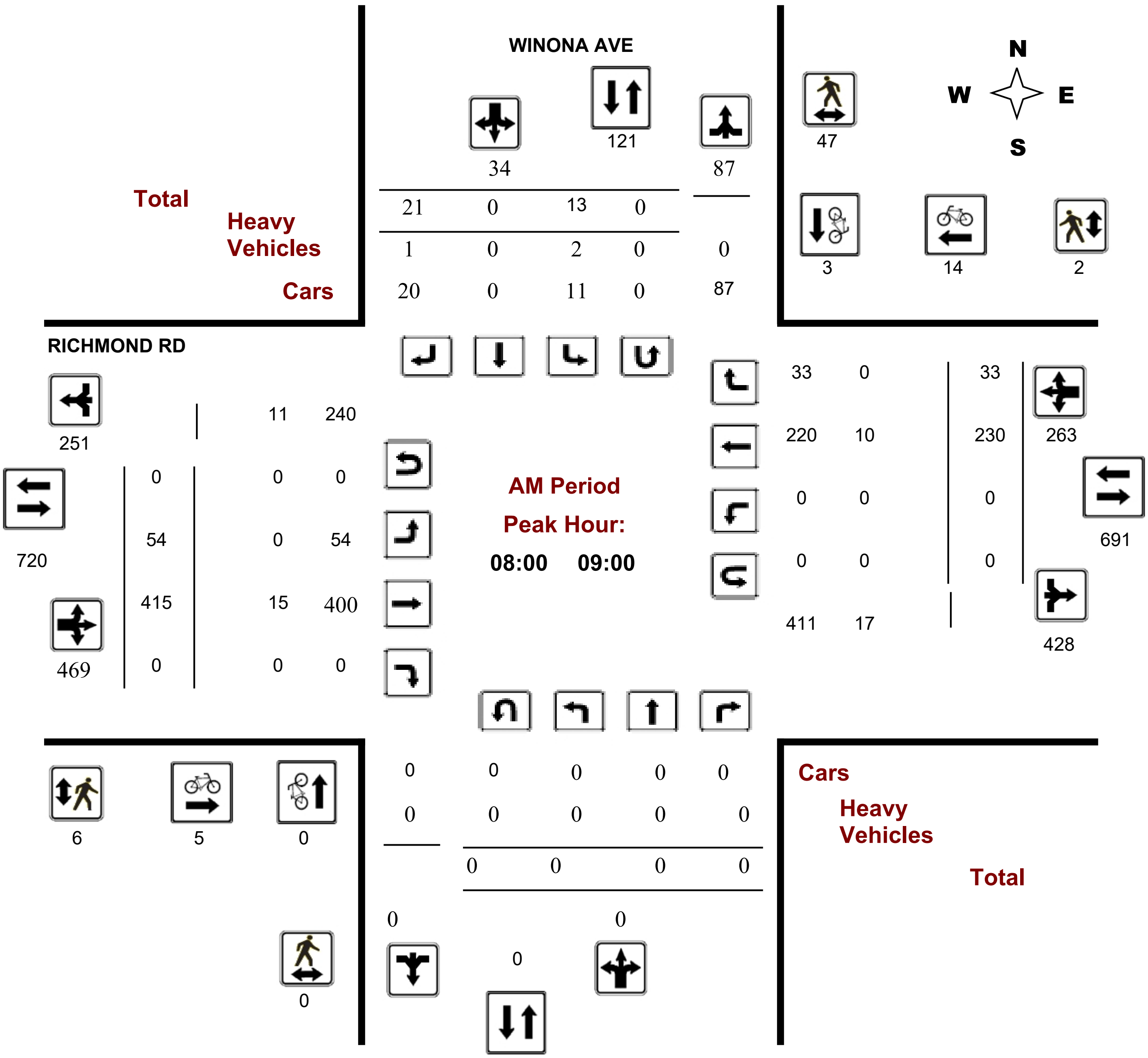
Transportation Services - Traffic Services

Turning Movement Count - Full Study Peak Hour Diagram

RICHMOND RD @ WINONA AVE

Survey Date: Wednesday, October 02, 2019 **WO No:** 38817

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



Comments

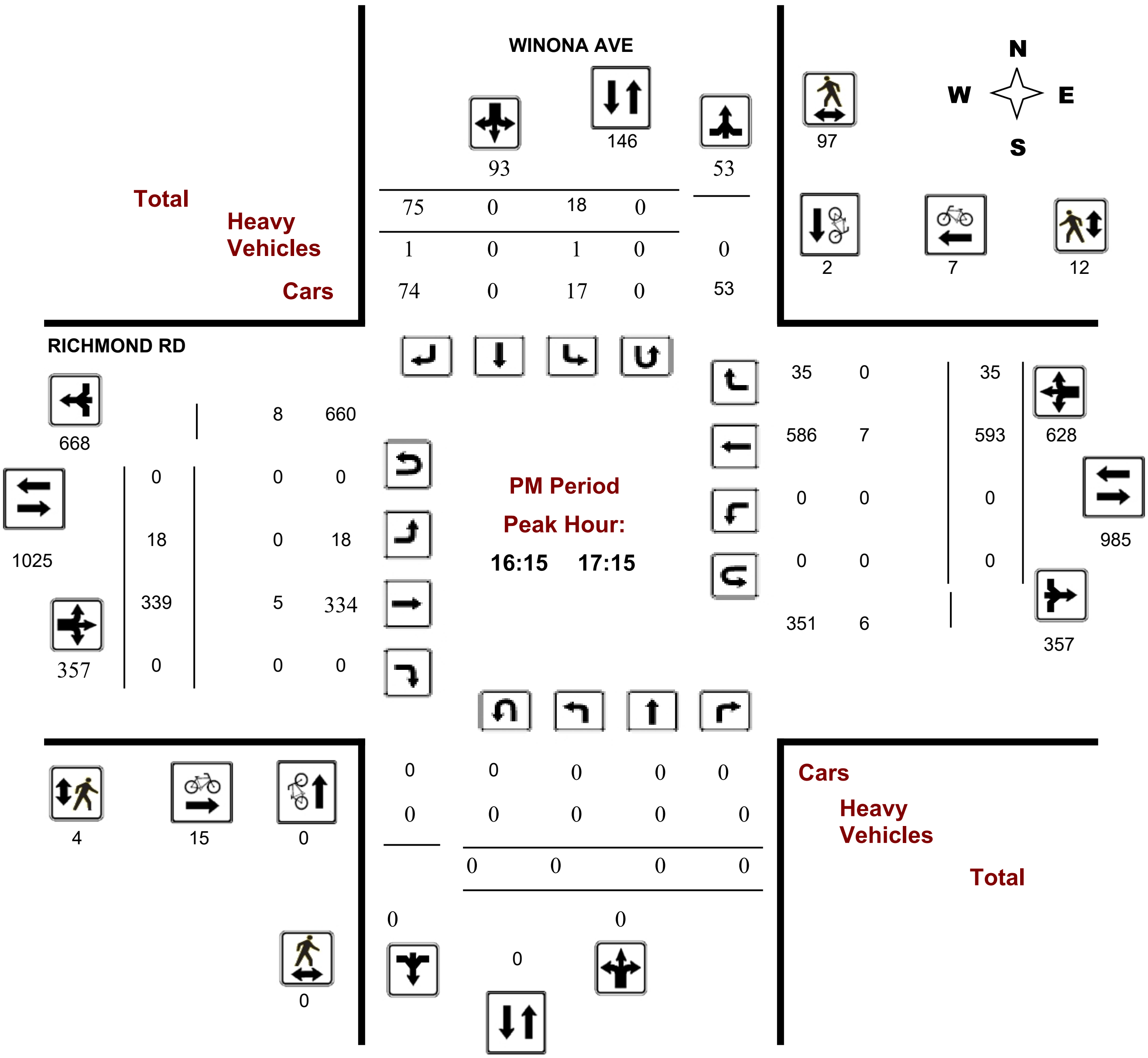
Transportation Services - Traffic Services

Turning Movement Count - Full Study Peak Hour Diagram

RICHMOND RD @ WINONA AVE

Survey Date: Wednesday, October 02, 2019 **WO No:** 38817

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

Stantec

Memo

To:	Wally Dubyk	From:	Lauren O'Grady, P.Eng.
	110 Laurier Avenue West, 4th Floor Ottawa, ON K1P 1J1		400 – 1331 Clyde Avenue Ottawa, ON K2C 3G4
File:	2070 Scott Street	Date:	May 14, 2020

Reference: 163601293 – 2070 Scott Street

In November 2019 Stantec Consulting Ltd. (Stantec) prepared the *2070 Scott Street Transportation Impact Assessment Strategy Report* on behalf of Azure Urban Developments Inc. for a proposed development located at 2070 Scott Street in the City of Ottawa. In December 2019 Stantec received comments from the City of Ottawa. **Table 1** below includes the comments from the City of Ottawa along with the accompanying responses by Stantec.

	City of Ottawa Comment	Stantec Response
General		
1	Scott Street is designated as an Arterial road within the City's Official Plan with a ROW protection limit of 26.0 metres. The ROW protection limit and the offset distance (13.0 metres) are to be dimensioned from the existing centerline of pavement and shown on the drawings.	Noted.
2	The concrete sidewalks should be 2.0 metres in width and be continuous and depressed through the proposed accesses	Noted.
3	The 2.0 metres concrete sidewalk is required along Winona Avenue for all developments within 600 metres of a transit station.	Noted.
4	The Tactile Walking Surface Indicator (TWSI) should be provided at pedestrian crossings. Under the Integrated Accessibility Standards of the Accessibility for Ontarians with Disabilities Act, 2005, and the City of Ottawa Accessibility Design Standards, TWSI's are required for new construction and the redevelopment of elements in public spaces, such as for exterior paths of travel (e.g. sidewalks and at the top of stairs).	Noted.
5	Permanent structures such as curbing, stairs, retaining walls, and underground parking foundation also bicycle parking racks are not to extend into the City's right-of-way and sight triangle limits.	Noted.
6	The closure of an existing private approach shall reinstate the sidewalk, shoulder, curb and boulevard to City standards.	Noted.
7	For the precast concrete pavers on City's road right-of-way, the developer shall sign a "Maintenance and Liability Agreement" with the City to cover any claims.	Noted.
8	Ensure that the end of the curb return at the proposed driveway on Winona Avenue does not encroach within the frontage of the adjacent property.	Noted.

Reference: 163601293 – 2070 Scott Street

9	The 'DRAFT' wet mark is to be removed from the TIA report.	Noted. The watermark has been removed from the Final TIA.
10	The TIA report is to be signed and stamped by a qualified professional.	Noted. The Step 5 TIA will be signed and stamped.
Transportation Engineering		
11	2.1.2.1 Roads and Traffic Control: Winona Avenue has a posted speed limit of 40 km/h.	Noted. This was revised in the Step 5 TIA.
12	2.1.2.3 Transit: Correct Figure 5 reference to read: "Figure 5 illustrates nearby transit routes" (bus stop shelter locations not illustrated in Figure 5).	Noted. This was revised in the Step 5 TIA.
13	2.1.3.1 Road Network Modifications: Correct the last paragraph of this section to add "Scott" - "Ultimately, Scott Street".	Noted. This was revised in the Step 5 TIA.
14	2.1.3.2 Future Background Developments - Key Plan Reference C is 1950 Scott Street (does not include 1960 Scott Street). 1960 Scott Street at the southeast corner of Scott Street and McRae Avenue should also be included as a background development. Vehicle trip generation for this development may be found by combining revised trip generation from Addendum #1 (dated July 31, 2017 and available in Dev Apps under the Site Plan Control D07-12-17-0106) with the trip generation and assignment of the original TIS (dated June 17, 2016 and available in Dev Apps under the Zoning By-Law Amendment D02-02-16-0052.	Noted. The future 1960 Scott Street development was added in the Step 5 TIA.
15	2.2.1 Study Area: As previously asked for during forecasting review, please include the intersection of Richmond Road / Winona Avenue in your analysis. The rational for not including this intersection is stated in Appendix B as follows: "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". This rational is not considered reasonable because use of Winona Avenue south to Richmond Road would be much more attractive for those coming from the development going to the west (southbound right turn from Winona Avenue onto Richmond Road, low delay westbound at Churchill Avenue traffic signal VERSUS northbound left turn from Winona Avenue onto Scott Street, long-delay for westbound left-turn from Scott Street to Churchill Avenue, long-delay for southbound right-turn from Churchill Avenue onto Richmond Road). Please revise study area, trip distribution, and trip assignment to include some Site traffic using Winona Avenue southbound to bypass long southbound delay at Richmond Road/ Churchill Avenue.	Noted. The traffic was re-distributed accordingly and the Richmond at Winona intersection was added to the Step 5 TIA.

Reference: 163601293 – 2070 Scott Street

16	In addition, please include Scott Avenue / Athlone Avenue, Scott Avenue / Tweedsmuir Avenue, and Scott Avenue / McRae Avenue in the study area. Appendix B states that there was previously concurrence that these three intersections would not need to be included. Therefore, it is conceded that traffic/MMLOS analysis does not need to occur for these three intersections. However, please include the aforementioned intersections in Figure 11 and Figure 12. The purpose of this is to make it easier for future, upcoming developments along Scott Street (such as the Granite Curling Club of West Ottawa redevelopment and others) to include 2070 Scott Street as a future background development and include traffic generated by 2070 Scott Street in their analysis.	Noted. Figures 11 and 12 have been updated accordingly in the Step 5 TIA.
17	3.3 Demand Rationalization: Provide justification for the 25% vehicle mode share shift. Provide the existing mode share for the area.	As stated in Section 3.3, the 25% reduction in traffic accounts for rerouting of traffic, change in travel times, in addition to a reduction in auto mode share. The 25% demand rationalization is not only attributed to vehicle mode share shift. As per the Trans 2011 OD Survey, the existing transit modal split for the Ottawa West District is 35% during the AM peak period (from the district) and 25% during the PM peak period (to the district). With the development being located in a TOD Zone, the transit modal share target is 65%. In order to go from the current transit modal share to the 65% modal share target, it involves needing to reduce the traffic volumes on the road. Based on the OD Survey, the existing transit modal share would need to increase by 30% during the AM peak period and 40% during the PM peak period. This requires the traffic volumes to be reduced by this amount. To remain slightly conservative, it was assumed that the traffic volumes would be reduced by 25%.
18	4.1 Development Design: The western extension of the Confederation Line to Baseline Road and Moodie Drive is expected to be completed in 2025 (not 2023).	Section 4.1.1 and Table 4 now reflect the year 2025 as the completion year for the LRT.
19	Reference the completed TDM-Supportive Development Design and Infrastructure Checklist included in Appendix E in the report text.	Noted. The TDM measures are discussed in sections 4.5.1 – 4.5.3 in the Step 5 TIA.
20	Include a description of the location and design of site access/parking for cyclists.	Noted. Section 4.2.1 was revised in the Step 5 TIA.
21	4.3 Boundary Street Design: Justify why multiple PLOS and BLOS calculations in Appendix D use operating speeds that do not match the posted speed + 10 km/h guideline. For example: Scott Street BLOS calculation shows operating speed of <=50, Churchill BLOS calculation shows operating speed of >40 to <50, Winona PLOS calculation shows operating speed of >50 to 60.	As per the City's MMLOS Addendum, the posted speed for the PLOS is calculated as posted speed + 10 km/h. This rationale was adapted for the subject TIA. The MMLOS Addendum does not apply this same rationale to the BLOS, therefore, the BLOS was taken to be the posted speed limit. Should the City

Reference: 163601293 – 2070 Scott Street

		wish to have both the PLOS and BLOS speeds the same, consideration should be given to releasing another Addendum to the MMLOS guidelines.
22	Scott Street segment MMLOS: reference Figure 7 not Figure 8, as the interim design is what will be constructed by 2021.	The write up in section 4.3.1 now correctly references the interim Scott St configuration depicted in Figure 7.
23	Churchill Avenue segment MMLOS: Justify why the BLOS calculation in Appendix D states Churchill Avenue has no centreline.	Noted. The MMLOS has been revised in the Step 5 TIA.
24	Winona Avenue segment MMLOS: The second paragraph of the description of Winona Avenue states that lack of cycling facilities means the road does not meet the targets for bicycle level of service, which is inconsistent with the third paragraph which states the number of lanes on Winona Avenue and the lower operating speed are adequate to achieve the BLOS target of D. Please revise the second paragraph to be consistent with the third paragraph.	Noted. The MMLOS write up has been revised in the Step 5 TIA.
25	Further justification is required as to why a 0.5 m or greater boulevard cannot be provided on Winona Avenue in front of the site. It is not apparent based on the site plan what property implications would occur as a result of this improvement.	The site plan has been revised to include a 0.5m boulevard between the sidewalk and Winona Avenue.
26	Identify what traffic calming measures could be employed on Winona Avenue in front of the site to reduce operating speeds, and what potential there is to implement these measures either as part of the Site development or as part of the ultimate design of Scott Street.	It is our understanding that this comment is being driven by the PLOS in that it was not being met along Winona as part of the Step 4 TIA. As a 0.5m boulevard is now being proposed by the developer along Winona Avenue across the frontage of the subject site, the PLOS target will be met therefore eliminating the need to reduce the operating speeds along Winona. However, should the City still wish to reduce the operating speeds along Winona as part of the ultimate design of Scott Street, an intersection narrowing could be explored at the intersection of Scott and Winona. This would slow traffic down as vehicles turn onto Winona from Scott. It would also have the added benefit of reducing the crossing distance for both pedestrians and cyclists.
27	4.4.1 Location and Design of Access: Provide the location of existing, nearby driveways on either side of Winona Avenue. Provide design parameters (grade, width, etc.) of access. The site plan references City of Ottawa standard detail SC7.1 for the access, but it is unclear whether concrete sidewalk is continuous through the access. Please verify this is the case.	Noted. Section 4.4.1 was updated to include details on the proposed access as well as existing accesses along Winona. As there is not an existing sidewalk along the west side of Winona Avenue, the proposed sidewalk will terminate at the garage entrance (i.e. it will not be continuous through the access).
28	4.5 Transportation Demand Management: Element 4.5.1 Context for TDM and Element 4.5.2 Need and Opportunity (per the TIA Guidelines) have not been completed.	Noted. Sections 4.5.1 and 4.5.2 have been added to the Step 5 TIA.
29	Provide a summary list of proposed measures based on the TDM checklists completed in Appendix E.	Section 4.5 has been revised in the Step 5 TIA.

Reference: 163601293 – 2070 Scott Street

30	Propose an implementation plan for post-occupancy TDM program measures that addresses planning and coordination, funding and human resources, timelines for action, performance targets, and monitoring requirements.	Section 4.5 has been revised in the Step 5 TIA.
31	4.6.1 Adjacent Neighbourhoods: Provide a source for the stated 185 veh/hr threshold. The threshold for local roadways within the TIA Guidelines is 120 veh/hr or 1000 veh/day.	This was an error. Section 4.6.1 has been revised accordingly to include the threshold of 120 veh/hr.
32	4.9.2 Intersection Design: Justify the operating speed of >40 to <=50 used in the intersection BLOS calculations.	This was an error. The MMLOS has been revised in the Step 5 TIA.
33	Include vehicle LOS actual/target columns in Tables 14, 16, 18, and 20.	This has been revised in the Step 5 TIA.
34	Do not highlight a vehicle LOS of E in red if the VLOS target is E for the area (traditional main street, within 600m of rapid transit).	This has been revised in the Step 5 TIA.
35	In the eastbound and westbound direction on Richmond Road, the BLOS calculation should state that 1 lane is crossed to reach the left turn lane.	This has been revised in the Step 5 TIA.
36	Tables 14, 16, 18, and 20 show PLOS at Churchill/Richmond as 'D', whereas the description above these tables and Appendix D reports a PLOS of 'B'.	This has been revised in the Step 5 TIA.
37	Suggest that if MMLOS analysis does not change from existing to future (2022, 2027), then future descriptions of MMLOS results may simply state "no change from existing" or similar.	This has been revised in the Step 5 TIA.
38	Churchill Avenue / Scott Street: Given that the Churchill/Scott intersection has a high PLOS target and that transit should be prioritized during the Transitway detour, suggest a lower cycle length (closer to 80s to match Churchill/Richmond) may be appropriate to improve PLOS and transit delay.	The cycle length has been revised to 80s and the associated MMLOS analyses have been revised in the Step 5 TIA.
39	Summary and Conclusions: Change "2025 Ultimate Conditions" to "2027" Ultimate Conditions" wherever this error occurs.	This has been revised in the Step 5 TIA.
40	Modifications to the site frontage should include the proposed sidewalk and cycle track shown in the Scott Street design between Churchill Avenue and Winona Avenue.	Noted.
Traffic Signal Operations		
41	Section 1.4: Scott/Churchill is planned to be signalized for Stage 2 LRT detour. The westbound left turn lane at Scott/Churchill will likely back through the intersection of Scott/Winona.	Based on the analysis of the 2022 future background condition, the addition of the buses along Scott Street result in the WBL queue at the Scott / Churchill intersection backing up past Winona Avenue. This is not a result of the subject development, but a result of the LRT detour plans. As the subject site is not anticipated to add a substantial amount of traffic to either intersection (i.e. less than 3% per intersection), the subject development has a negligible impact on the operations of both intersections. The volume of cars making the northbound left at the Scott / Winona intersection is negligible,

Reference: 163601293 – 2070 Scott Street

		therefore the queue spillback likely won't affect those vehicles. As the queue spillback from the Scott / Churchill intersection is only anticipated to extend roughly 5m beyond the Winona intersection, the vehicles making the westbound left onto Winona will likely not experience a substantial amount of delay either before they are able to complete their movement.
42	If the 65% transit mode is not met, please summarize the potential implications on the road network. Similarly summarize the potential implications on the road network if the existing traffic volumes are not reduced by 25%.	Section 4.5 has been revised in the Step 5 TIA to include potential implications should the 65% transit modal share not be met. Section 3.3 has been revised in the Step 5 TIA to include potential impacts should the 25% traffic reduction not occur.
43	If the desire is to attain a 65% transit mode share, then developments in the area should provide supporting TDM measures. The applicant is encouraged to reduce the amount of parking provided to residents/visitors/customers.	The proposed number of parking spaces is within the permitted by-laws, however, section 4.5 has been revised in the Step 5 TIA to include additional TDM measures.
44	Richmond/Churchill the north-south direction currently operates as shared thru/left and share thru/right.	Based on site observations, intersection geometry, and parking locations, it was found that the northbound and southbound movements operate as a left turn lane and a shared through / right turn lane.
45	Table 12 shows a higher volume than what is illustrated stated in Figure 15.	This has been revised in the Step 5 TIA.
46	Provide supporting traffic calming measures to support reducing the posted speed limit.	Refer to comment response #26 above.
47	Signal timing changes will not sufficiently mitigate the need for additional road capacity.	Noted.
Traffic Signal Design		
48	The proponent and involved consultant are advised to proceed with consideration to future Scott St and Churchill Ave interim and ultimate modifications, particularly along the property's N side ROW line (i.e. new trees, shrubs, landscape work).	Noted.
49	Traffic Signal Design and Specification reserves the right to make future comments based on potential subsequent submissions.	Noted.
Street Lighting		
50	Any queries such as required light levels or approved materials can be directed to the If the proposed TIA approved please contact Barrie Forrester (613) 580-2424 ext. 23332 (Barrie.Forrester@ottawa.ca) to setup cost recovery for Street Lighting review/coordination.	Noted.

51	Please advise the developer the following: Full roadway lighting as per City of Ottawa policy is required if the road geometry impacted/charged or if there is any Traffic work. The developer will be 100% responsible for all associated street light costs. PO or payment must be setup with the City of Ottawa Street Light Group. City Street Lighting will require commencement of work notification so that we can inspect construction at all stages. Any queries such as required light levels or approved materials can be directed to the assigned Street Lighting Project Coordinator.	Noted.
Transit Services		
52	Please check item 3.2.1 in the 'TDM Measures: Residential Developments' checklist. OC Transpo has been working with PIED to include the purchase of pre-loaded Presto cards with ePurse for future residents of residential developments within 600m of LRT and rapid transit stations. A similar arrangement is currently being implemented via draft conditions for the project situated on 1960 Scott Street. A similar comment has been produced for the site of 90 Champagne. Discussions are still being held to clarify official policy, but it is expected that developers shall purchase a Presto card for each future owner/tenant. The Presto cards will be preloaded with a certain amount of money in ePurse format and will require a 6$ activation fee. For any questions regarding this, please contact Erica Springate, Team Lead of Network Service Design at 613-580-2424 ext. 52184.	Through discussions with the developer, they have agreed to offer a one-month PRESTO card to all residents upon move in of the building. This will help encourage the use of the transit facility and reduce the reliance on personal vehicles. Section 4.5 of the Step 5 TIA has been revised to include this as well as various other TDM measures that will be implemented.

We trust that the above addresses the City's outstanding comments and concerns. Should you have any further questions or concerns related to the above please feel free to contact the undersigned.

Regards,

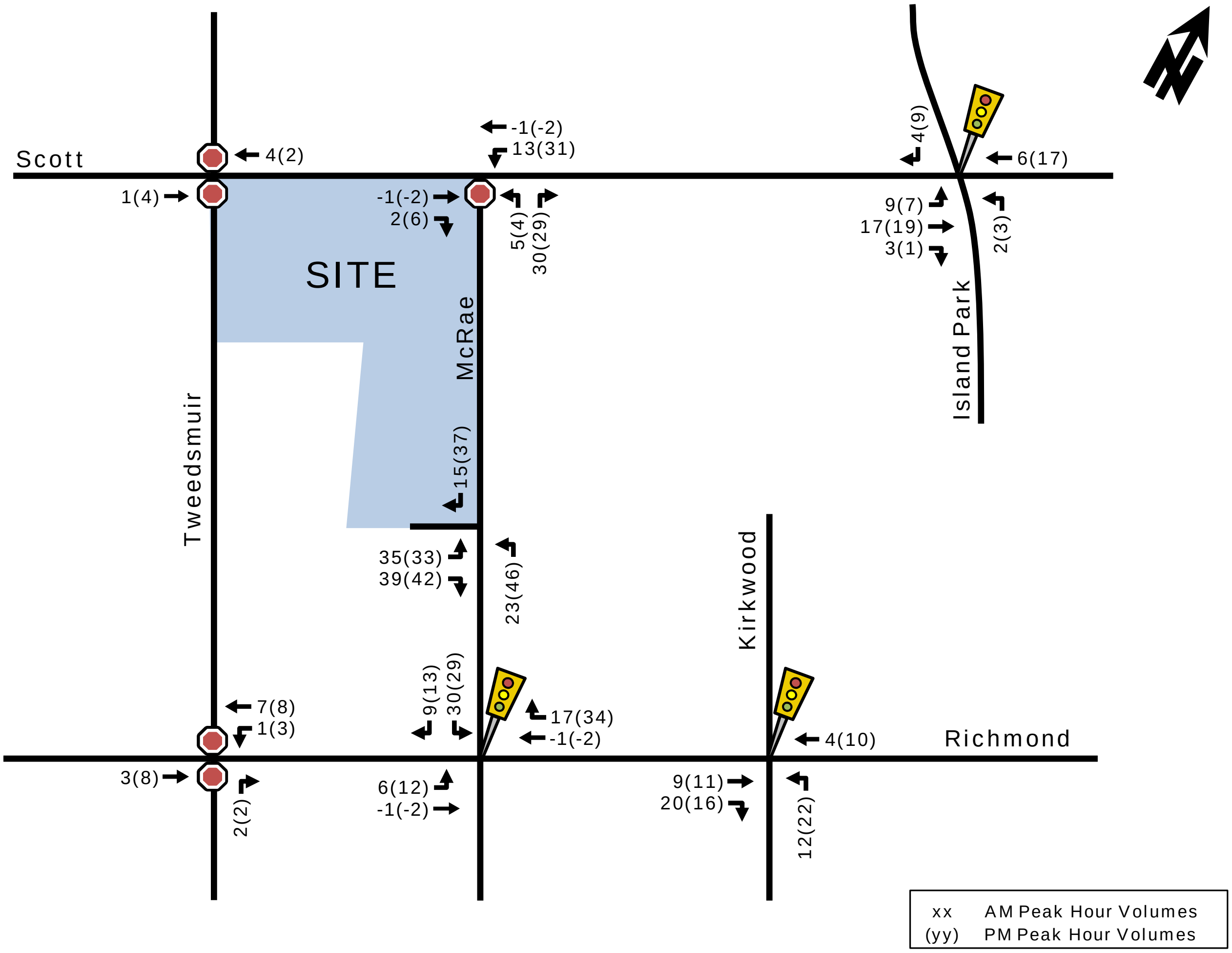
Stantec Consulting Ltd.

L O'Grady

Lauren O'Grady P.Eng.
Transportation Engineer
Phone: 613-784-2264
lauren.o'grady@stantec.com

Appendix C BACKGROUND TRAFFIC VOLUMES

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



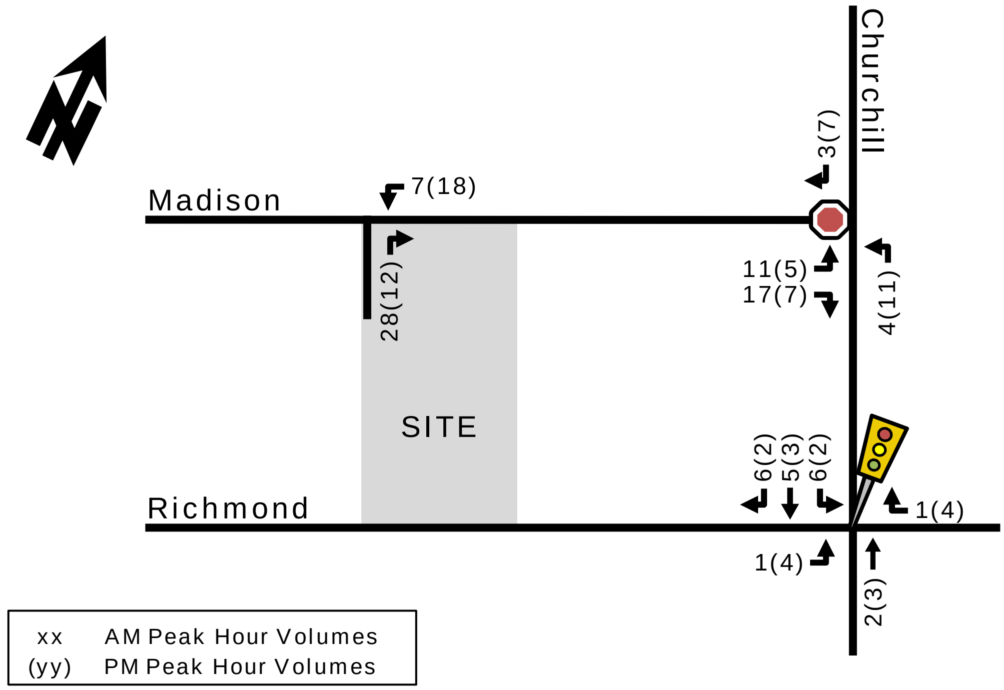
4. Future Traffic Operations

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.

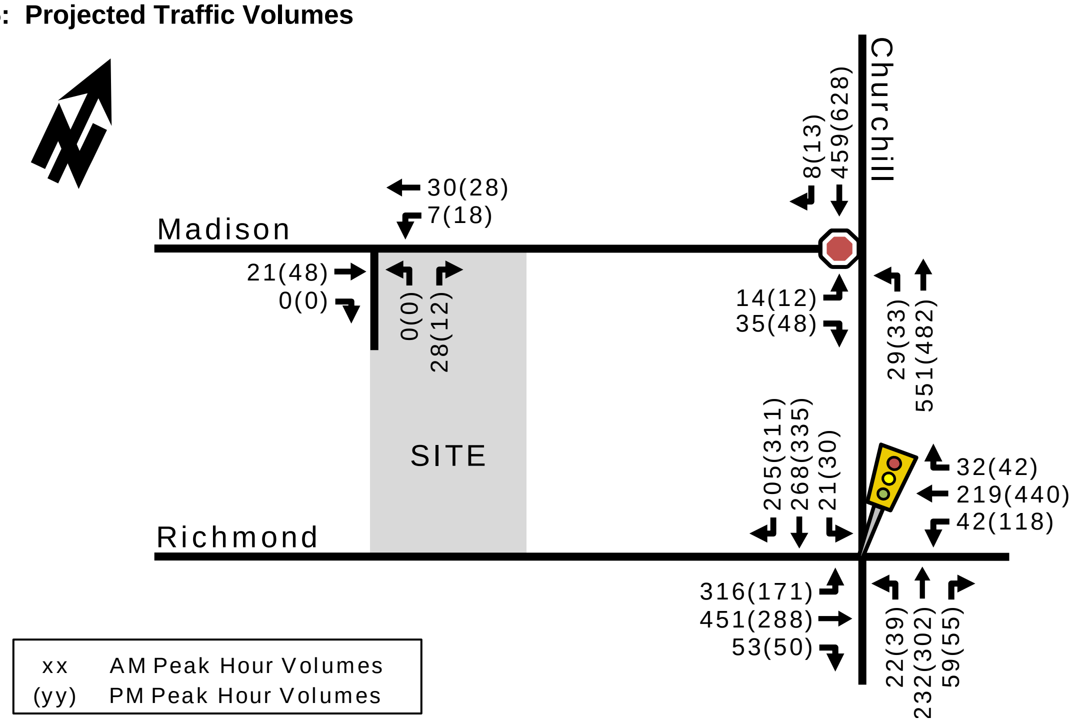
Figure 4: 'New' Site-Generated Traffic Volumes



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

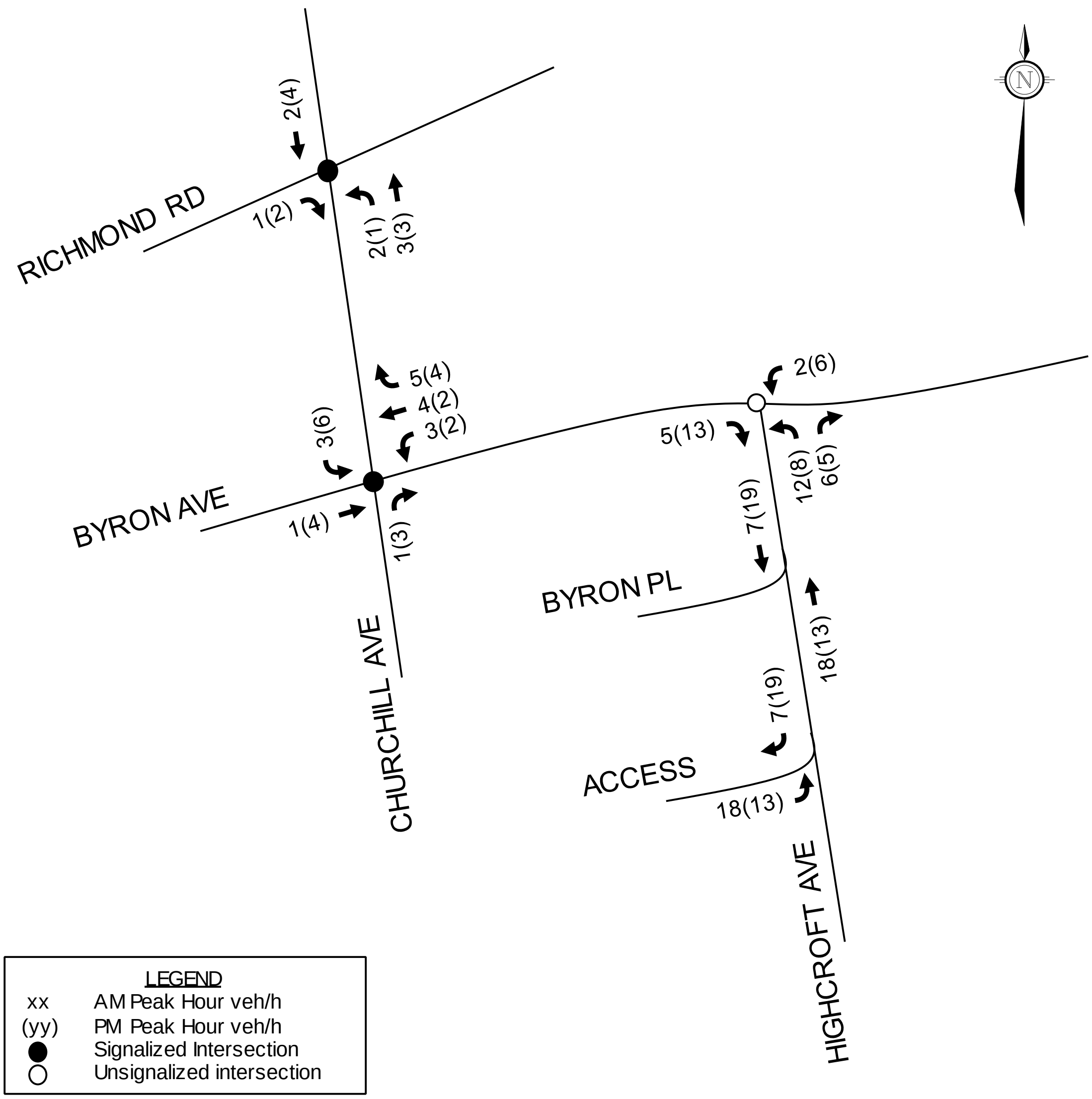
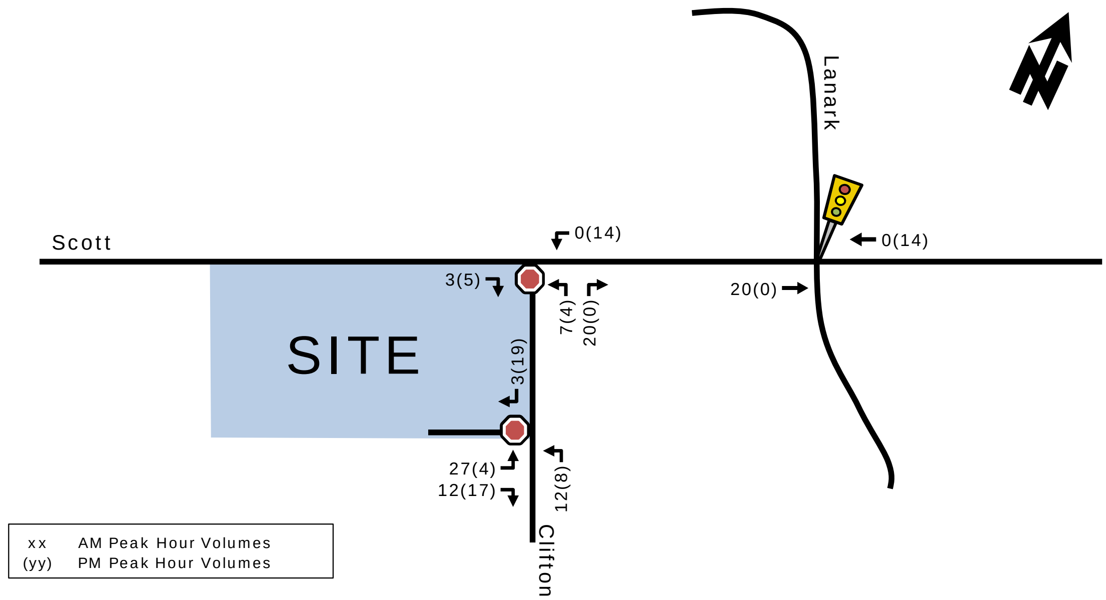


Figure 9: 'New' Site-Generated Traffic



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	> 30 to 50 km/h yes
	Level of Service		**D**	**B**	**F**
Bicycle	Type of Cycling Facility	**E**	Curbside Bike Lane	Mixed Traffic	Mixed Traffic
	Number of Travel Lanes		≤ 1 each direction	2-3 lanes total	≤ 2 (no centreline)
	Operating Speed		≤ 50 km/h	≥ 50 to 60 km/h	≤ 40 km/h
	# of Lanes & Operating Speed LoS		**A**	**E**	**A**
	Level of Service		**B**	**E**	**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 - 2 m
	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	> 30 to 50 km/h yes
	Level of Service		**D**	**B**	**A**
Bicycle	Type of Cycling Facility	**E**	Physically Separated	Mixed Traffic	Mixed Traffic
	Number of Travel Lanes			2-3 lanes total	≤ 2 (no centreline)
	Operating Speed			≥ 50 to 60 km/h	≤ 40 km/h
	# of Lanes & Operating Speed LoS		**-**	**E**	**A**
	Level of Service		**A**	**E**	**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	31	45	33	33
	Average Pedestrian Delay	**19**	**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	One lane crossed	One 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**	**D**	**D**
	Level of Service	**B**	**B**	**D**	**D**
		D			
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	Permissive	Protected	Permissive	Protected
	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	Yes	Yes	Yes	Yes
	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**	**93**	**86**	**78**	**101**
	Ped. Exposure to Traffic LoS	**B**	**B**	**B**	**B**	**A**	**B**	**B**	**A**
	Cycle Length	90	90	90	90	80	80	80	80
	Effective Walk Time	31	45	33	33	35	18	18	9
	Average Pedestrian Delay	**19**	**11**	**18**	**18**	**13**	**24**	**24**	**32**
	Pedestrian Delay LoS	**B**	**B**	**B**	**B**	**B**	**C**	**C**	**D**
	Level of Service	**B**	**B**	**B**	**B**	**B**	**C**	**C**	**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	One lane crossed	One lane crossed	2-stage, LT box	2-stage, LT box	2-stage, LT box	2-stage, LT box
	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	D	D	A	A	A	A
	Level of Service	**B**	**B**	**D**	**D**	**A**	**A**	**A**	**A**
		D				**A**			
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	Permissive	Protected	Permissive	Protected
	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	Yes	Yes	Yes	Yes
	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**	**93**	**86**	**78**	**101**
	Ped. Exposure to Traffic LoS	**A**	**A**	**B**	**B**	**A**	**B**	**B**	**A**
	Cycle Length	90	90	90	90	80	80	80	80
	Effective Walk Time	31	45	33	33	35	18	18	9
	Average Pedestrian Delay	**19**	**11**	**18**	**18**	**13**	**24**	**24**	**32**
	Pedestrian Delay LoS	**B**	**B**	**B**	**B**	**B**	**C**	**C**	**D**
	Level of Service	**B**	**B**	**B**	**B**	**B**	**C**	**C**	**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	One lane crossed	One lane crossed	2-stage, LT box	2-stage, LT box	2-stage, LT box	2-stage, LT box
	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**	**D**	**D**	**A**	**A**	**A**	**A**
	Level of Service	**B**	**B**	**D**	**D**	**A**	**A**	**A**	**A**
		D				**A**			
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	Permissive	Protected	Permissive	Protected
	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	Yes	Yes	Yes	Yes
	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**	**93**	**86**	**78**	**101**
	Ped. Exposure to Traffic LoS	**A**	**A**	**B**	**B**	**A**	**B**	**B**	**A**
	Cycle Length	90	90	90	90	80	80	80	80
	Effective Walk Time	31	45	33	33	28	8	23	14
	Average Pedestrian Delay	**19**	**11**	**18**	**18**	**17**	**32**	**20**	**27**
	Pedestrian Delay LoS	**B**	**B**	**B**	**B**	**B**	**D**	**C**	**C**
	Level of Service	**B**	**B**	**B**	**B**	**B**	**D**	**C**	**C**
		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	One lane crossed	One lane crossed	2-stage, LT box	2-stage, LT box	2-stage, LT box	2-stage, LT box
	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	D	D	A	A	A	A
	Level of Service	**B**	**B**	**D**	**D**	**A**	**A**	**A**	**A**
		D				**A**			
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 Road & Churchill Avenue

04/16/2020

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	0.57	0.65	0.33	0.49	0.11	0.72	0.15	0.78
Control Delay	19.6	24.7	28.2	27.9	21.1	31.6	21.8	34.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.6	24.7	28.2	27.9	21.1	31.6	21.8	34.6
Queue Length 50th (m)	21.0	50.0	8.2	27.3	1.7	47.4	2.7	47.8
Queue Length 95th (m)	35.4	78.7	18.9	46.6	6.2	#77.0	8.2	#88.2
Internal Link Dist (m)		21.0		59.4		33.1		286.6
Turn Bay Length (m)	37.5		37.5		37.5		37.5	
Base Capacity (vph)	436	699	226	484	171	561	186	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	0.57	0.65	0.33	0.49	0.11	0.72	0.15	0.78

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 Road & Churchill Avenue

04/16/2020

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)	6.1	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)	1662	1744		1568	1746		1593	1702		1665	1579	
Flt Permitted	0.42	1.00		0.50	1.00		0.32	1.00		0.33	1.00	
Satd. Flow (perm)	730	1744		824	1746		532	1702		579	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	12	0	0	24	0
Lane Group Flow (vph)	248	454	0	74	235	0	18	393	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)	36.9	36.9		22.0	22.0		25.8	25.8		25.8	25.8	
Effective Green, g (s)	36.9	34.9		22.0	22.0		25.8	25.8		25.8	25.8	
Actuated g/C Ratio	0.46	0.44		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)	439	760		226	480		171	548		186	509	
v/s Ratio Prot	0.06	c0.26			0.13			0.23			c0.25	
v/s Ratio Perm	0.20			0.09			0.03			0.05		
v/c Ratio	0.56	0.60		0.33	0.49		0.11	0.72		0.15	0.77	
Uniform Delay, d1	14.3	17.2		23.1	24.3		19.0	23.9		19.3	24.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.7	1.3		3.8	3.5		1.2	7.8		1.6	10.7	
Delay (s)	16.0	18.5		26.9	27.8		20.2	31.7		20.9	35.1	
Level of Service	B	B		C	C		C	C		C	D	
Approach Delay (s)		17.6			27.6			31.2			34.2	
Approach LOS		B			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	26.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	20.4
Intersection Capacity Utilization	79.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

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

04/16/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	3	7	13	208	3	16	13	97	364	59	199	2
Future Volume (vph)	3	7	13	208	3	16	13	97	364	59	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
Hourly flow rate (vph)	3	8	14	231	3	18	14	108	404	66	221	2

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	25	252	526	289
Volume Left (vph)	3	231	14	66
Volume Right (vph)	14	18	404	2
Hadj (s)	-0.28	0.17	-0.42	0.08
Departure Headway (s)	6.3	6.2	4.8	5.6
Degree Utilization, x	0.04	0.43	0.71	0.45
Capacity (veh/h)	465	533	716	605
Control Delay (s)	9.6	13.8	18.7	13.2
Approach Delay (s)	9.6	13.8	18.7	13.2
Approach LOS	A	B	C	B

Intersection Summary			
Delay	15.9		
Level of Service	C		
Intersection Capacity Utilization	70.6%	ICU Level of Service	C
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
3: Winona Avenue & Scott Street

04/16/2020

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	416	14	15	226	1	31
Future Volume (Veh/h)	416	14	15	226	1	31
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	462	16	17	251	1	34
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			478		755	470
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			478		755	470
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			98		100	94
cM capacity (veh/h)			1084		371	594

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	478	268	35
Volume Left	0	17	1
Volume Right	16	0	34
cSH	1700	1084	583
Volume to Capacity	0.28	0.02	0.06
Queue Length 95th (m)	0.0	0.3	1.3
Control Delay (s)	0.0	0.7	11.6
Lane LOS		A	B
Approach Delay (s)	0.0	0.7	11.6
Approach LOS			B

Intersection Summary			
Average Delay	0.7		
Intersection Capacity Utilization	35.5%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
10: Richmond Road & Winona Ave

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	54	429	261	33	13	21
Future Volume (Veh/h)	54	429	261	33	13	21
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	60	477	290	37	14	23
Pedestrians			2		47	
Lane Width (m)			3.7		3.7	
Walking Speed (m/s)			1.0		1.0	
Percent Blockage			0		5	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)		84				
pX, platoon unblocked					0.81	
vC, conflicting volume	374				954	356
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	374				824	356
tC, single (s)	4.1				6.5	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.6	3.3
p0 queue free %	95				94	97
cM capacity (veh/h)	1138				236	660

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	537	327	37
Volume Left	60	0	14
Volume Right	0	37	23
cSH	1138	1700	393
Volume to Capacity	0.05	0.19	0.09
Queue Length 95th (m)	1.2	0.0	2.2
Control Delay (s)	1.5	0.0	15.1
Lane LOS	A		C
Approach Delay (s)	1.5	0.0	15.1
Approach LOS			C

Intersection Summary			
Average Delay	1.5		
Intersection Capacity Utilization	57.4%	ICU Level of Service	B
Analysis Period (min)	15		

Queues
1: Richmond Road & Churchill Avenue

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	186	391	146	597	28	376	20	596
v/c Ratio	0.66	0.41	0.75	0.80	0.35	0.92	0.20	1.62
Control Delay	22.7	10.3	48.1	31.8	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	22.7	10.3	48.1	31.8	42.8	61.5	33.1	314.2
Queue Length 50th (m)	13.5	28.2	18.9	79.2	3.7	55.5	2.6	~131.4
Queue Length 95th (m)	#25.2	44.9	#49.3	#130.8	11.8	#103.6	8.5	#189.3
Internal Link Dist (m)		21.0		59.9		33.1		286.6
Turn Bay Length (m)	37.5		37.5		37.5		37.5	
Base Capacity (vph)	282	957	195	747	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	0.66	0.41	0.75	0.80	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 Road & Churchill Avenue

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	167	309	43	131	495	42	25	243	95	18	251	285
Future Volume (vph)	167	309	43	131	495	42	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	1722		1695	1624		1608	1337	
Flt Permitted	0.19	1.00		0.53	1.00		0.18	1.00		0.25	1.00	
Satd. Flow (perm)	342	1558		452	1722		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	146	550	47	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	146	594	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)	282	881		195	744		79	393		101	323	
v/s Ratio Prot	c0.04	c0.25			c0.34			0.22			c0.41	
v/s Ratio Perm	0.33			0.32			0.09			0.05		
v/c Ratio	0.66	0.44		0.75	0.80		0.35	0.92		0.20	1.70	
Uniform Delay, d1	14.2	11.3		21.4	22.1		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	5.5	0.3		22.9	8.7		12.0	28.5		4.3	330.0	
Delay (s)	19.7	11.6		44.3	30.9		40.3	61.7		31.5	364.1	
Level of Service	B	B		D	C		D	E		C	F	
Approach Delay (s)		14.2			33.5			60.2			353.3	
Approach LOS		B			C			E			F	

Intersection Summary			
HCM 2000 Control Delay	117.5	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.05		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	20.4
Intersection Capacity Utilization	91.3%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	1	9	11	369	10	58	18	148	280	55	117	3
Future Volume (vph)	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
Hourly flow rate (vph)	1	10	12	410	11	64	20	164	311	61	130	3

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	23	485	495	194
Volume Left (vph)	1	410	20	61
Volume Right (vph)	12	64	311	3
Hadj (s)	-0.27	0.12	-0.33	0.09
Departure Headway (s)	6.9	6.1	5.6	6.6
Degree Utilization, x	0.04	0.82	0.78	0.36
Capacity (veh/h)	440	575	618	489
Control Delay (s)	10.3	31.1	25.4	13.2
Approach Delay (s)	10.3	31.1	25.4	13.2
Approach LOS	B	D	D	B

Intersection Summary			
Delay	25.5		
Level of Service	D		
Intersection Capacity Utilization	73.2%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	338	6	39	435	2	38
Future Volume (Veh/h)	338	6	39	435	2	38
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	376	7	43	483	2	42
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			383		948	380
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			383		948	380
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			96		99	94
cM capacity (veh/h)			1175		279	667

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	383	526	44
Volume Left	0	43	2
Volume Right	7	0	42
cSH	1700	1175	628
Volume to Capacity	0.23	0.04	0.07
Queue Length 95th (m)	0.0	0.8	1.6
Control Delay (s)	0.0	1.1	11.2
Lane LOS		A	B
Approach Delay (s)	0.0	1.1	11.2
Approach LOS			B

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	58.9%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	18	404	593	35	18	75
Future Volume (Veh/h)	18	404	593	35	18	75
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	20	449	659	39	20	83
Pedestrians			12		97	
Lane Width (m)			3.7		3.7	
Walking Speed (m/s)			1.0		1.0	
Percent Blockage			1		10	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)		84				
pX, platoon unblocked					0.88	
vC, conflicting volume	795				1276	776
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	795				1245	776
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	97				86	77
cM capacity (veh/h)	752				144	354

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	469	698	103
Volume Left	20	0	20
Volume Right	0	39	83
cSH	752	1700	275
Volume to Capacity	0.03	0.41	0.37
Queue Length 95th (m)	0.6	0.0	11.6
Control Delay (s)	0.8	0.0	25.7
Lane LOS	A		D
Approach Delay (s)	0.8	0.0	25.7
Approach LOS			D

Intersection Summary			
Average Delay	2.4		
Intersection Capacity Utilization	50.5%	ICU Level of Service	A
Analysis Period (min)	15		

Queues
1: Richmond Road & Churchill Avenue

04/17/2020

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	178	337	59	190	14	299	23	324
v/c Ratio	0.36	0.37	0.30	0.35	0.07	0.58	0.10	0.66
Control Delay	14.1	11.9	26.1	22.7	21.4	27.6	7.0	14.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.1	11.9	26.1	22.7	21.4	27.6	7.0	14.0
Queue Length 50th (m)	13.6	24.7	6.2	19.7	1.4	33.0	1.7	21.6
Queue Length 95th (m)	24.2	40.4	15.7	34.9	5.3	55.5	m1.8	m29.3
Internal Link Dist (m)		21.0		79.5		33.1		286.6
Turn Bay Length (m)	37.5		37.5		37.5		37.5	
Base Capacity (vph)	496	913	196	550	203	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	0.30	0.35	0.07	0.58	0.10	0.66

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

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

04/17/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	178	314	23	59	173	17	14	234	65	23	211	113
Future Volume (vph)	178	314	23	59	173	17	14	234	65	23	211	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)	1648	1694		1070	1743		1550	1701		1651	1578	
Flt Permitted	0.51	1.00		0.56	1.00		0.42	1.00		0.46	1.00	
Satd. Flow (perm)	877	1694		628	1743		684	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	314	23	59	173	17	14	234	65	23	211	113
RTOR Reduction (vph)	0	4	0	0	4	0	0	13	0	0	24	0
Lane Group Flow (vph)	178	333	0	59	186	0	14	286	0	23	300	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)	500	823		197	546		203	506		235	469	
v/s Ratio Prot	0.03	c0.20			0.11			0.17			c0.19	
v/s Ratio Perm	0.14			0.09			0.02			0.03		
v/c Ratio	0.36	0.41		0.30	0.34		0.07	0.57		0.10	0.64	
Uniform Delay, d1	12.1	13.1		20.8	21.1		20.2	23.7		20.3	24.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		0.31	0.42	
Incremental Delay, d2	0.4	0.3		3.9	1.7		0.7	4.5		0.5	4.4	
Delay (s)	12.6	13.5		24.7	22.8		20.8	28.3		6.8	14.7	
Level of Service	B	B		C	C		C	C		A	B	
Approach Delay (s)		13.2			23.2			27.9			14.2	
Approach LOS		B			C			C			B	

Intersection Summary			
HCM 2000 Control Delay	18.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	20.4
Intersection Capacity Utilization	69.9%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Queues
2: Churchill Avenue & Scott Street

04/17/2020

Lane Group	EBT	WBL	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	198	183	196	11	383	210
v/c Ratio	0.76	0.84	0.45	0.10	0.88	0.63
Control Delay	47.4	67.1	18.6	38.8	42.7	40.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	47.4	67.1	18.6	38.8	42.7	40.1
Queue Length 50th (m)	25.2	25.4	17.7	1.0	46.7	25.3
Queue Length 95th (m)	#55.3	#55.8	33.8	m2.8	#89.9	#60.6
Internal Link Dist (m)	23.4		59.9		286.6	30.0
Turn Bay Length (m)				30.0		
Base Capacity (vph)	261	220	435	105	437	335
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	0.76	0.83	0.45	0.10	0.88	0.63

Intersection Summary

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

m Volume for 95th percentile queue is metered by upstream signal.

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

04/17/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	2	185	11	183	182	14	11	81	302	47	161	2
Future Volume (vph)	2	185	11	183	182	14	11	81	302	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		1.00		1.00	0.99		1.00	0.95			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)		937		1695	931		1695	1494			1750	
Flt Permitted		1.00		0.95	1.00		0.95	1.00			0.84	
Satd. Flow (perm)		935		1695	931		1695	1494			1488	
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	183	182	14	11	81	302	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	183	196	0	11	383	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)		19.6		10.3	34.6		2.0	26.2			18.1	
Effective Green, g (s)		19.6		10.3	34.6		2.0	26.2			18.1	
Actuated g/C Ratio		0.25		0.13	0.43		0.02	0.33			0.23	
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)		229		218	402		42	489			336	
v/s Ratio Prot				c0.11	c0.21		c0.01	c0.26				
v/s Ratio Perm		c0.21									0.14	
v/c Ratio		0.86		0.84	0.49		0.26	0.78			0.62	
Uniform Delay, d1		28.9		34.0	16.3		38.3	24.3			27.9	
Progression Factor		1.00		1.00	1.00		1.03	0.77			1.00	
Incremental Delay, d2		32.7		23.7	4.2		3.0	10.7			8.5	
Delay (s)		61.6		57.7	20.5		42.6	29.4			36.4	
Level of Service		E		E	C		D	C			D	
Approach Delay (s)		61.6			38.5			29.8			36.4	
Approach LOS		E			D			C			D	

Intersection Summary			
HCM 2000 Control Delay	39.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	22.4
Intersection Capacity Utilization	74.5%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	523	11	12	378	1	25
Future Volume (Veh/h)	523	11	12	378	1	25
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	523	11	12	378	1	25
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)	84					
pX, platoon unblocked						
vC, conflicting volume			534		930	528
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			534		930	528
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		100	95
cM capacity (veh/h)			1034		293	550

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	534	390	26
Volume Left	0	12	1
Volume Right	11	0	25
cSH	1700	1034	532
Volume to Capacity	0.31	0.01	0.05
Queue Length 95th (m)	0.0	0.2	1.1
Control Delay (s)	0.0	0.4	12.1
Lane LOS		A	B
Approach Delay (s)	0.0	0.4	12.1
Approach LOS			B

Intersection Summary			
Average Delay	0.5		
Intersection Capacity Utilization	41.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	43	360	233	26	11	17
Future Volume (Veh/h)	43	360	233	26	11	17
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	43	360	233	26	11	17
Pedestrians		6	2		47	
Lane Width (m)		3.7	3.7		3.7	
Walking Speed (m/s)		1.0	1.0		1.0	
Percent Blockage		1	0		5	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)		104				
pX, platoon unblocked					0.89	
vC, conflicting volume	306				741	299
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	306				643	299
tC, single (s)	4.1				6.4	6.4
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.4
p0 queue free %	96				97	97
cM capacity (veh/h)	1205				351	672

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	403	259	28
Volume Left	43	0	11
Volume Right	0	26	17
cSH	1205	1700	495
Volume to Capacity	0.04	0.15	0.06
Queue Length 95th (m)	0.8	0.0	1.3
Control Delay (s)	1.2	0.0	12.7
Lane LOS	A		B
Approach Delay (s)	1.2	0.0	12.7
Approach LOS			B

Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	52.6%	ICU Level of Service	A
Analysis Period (min)	15		

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		84.7		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.

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

Lane Group	EBT	WBL	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	198	301	234	14	353	145
v/c Ratio	0.86	0.89	0.48	0.13	0.92	0.64
Control Delay	64.2	61.1	17.0	38.5	61.3	48.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	64.2	61.1	17.0	38.5	61.3	48.4
Queue Length 50th (m)	26.5	41.0	20.1	1.9	48.1	20.0
Queue Length 95th (m)	#60.0	#79.6	38.0	6.9	#92.2	#47.4
Internal Link Dist (m)	23.4		59.9		286.6	30.0
Turn Bay Length (m)				30.0		
Base Capacity (vph)	230	347	483	105	384	228
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	0.86	0.87	0.48	0.13	0.92	0.64

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

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		1.00		1.00	0.96		1.00	0.96			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)		932		1695	948		1695	1538			1734	
Flt Permitted		1.00		0.95	1.00		0.95	1.00			0.78	
Satd. Flow (perm)		931		1695	948		1695	1538			1378	
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)		18.0		16.0	39.0		3.0	21.8			13.2	
Effective Green, g (s)		18.0		16.0	39.0		3.0	21.8			13.2	
Actuated g/C Ratio		0.22		0.20	0.49		0.04	0.27			0.16	
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)		209		339	462		63	419			227	
v/s Ratio Prot				c0.18	c0.25		c0.01	c0.23				
v/s Ratio Perm		c0.21									0.11	
v/c Ratio		0.95		0.89	0.51		0.22	0.84			0.64	
Uniform Delay, d1		30.5		31.1	14.0		37.4	27.5			31.2	
Progression Factor		1.00		1.00	1.00		1.00	1.00			1.00	
Incremental Delay, d2		49.9		23.3	3.9		1.8	18.3			13.0	
Delay (s)		80.4		54.4	17.9		39.2	45.7			44.2	
Level of Service		F		D	B		D	D			D	
Approach Delay (s)		80.4			38.4			45.5			44.2	
Approach LOS		F			D			D			D	

Intersection Summary			
HCM 2000 Control Delay	47.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	22.4
Intersection Capacity Utilization	74.9%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
3: Winona Avenue & Scott Street

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	458	5	31	533	2	30
Future Volume (Veh/h)	458	5	31	533	2	30
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	458	5	31	533	2	30
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)	84					
pX, platoon unblocked						
vC, conflicting volume			463		1056	460
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			463		1056	460
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			97		99	95
cM capacity (veh/h)			1098		243	601

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	463	564	32
Volume Left	0	31	2
Volume Right	5	0	30
cSH	1700	1098	550
Volume to Capacity	0.27	0.03	0.06
Queue Length 95th (m)	0.0	0.6	1.3
Control Delay (s)	0.0	0.8	11.9
Lane LOS		A	B
Approach Delay (s)	0.0	0.8	11.9
Approach LOS			B

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	66.4%	ICU Level of Service	C
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
10: Richmond Road & Winona Avenue

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	14	342	501	28	60	14
Future Volume (Veh/h)	14	342	501	28	60	14
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	14	342	501	28	60	14
Pedestrians			12		97	
Lane Width (m)			3.7		3.7	
Walking Speed (m/s)			1.0		1.0	
Percent Blockage			1		10	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)		109				
pX, platoon unblocked					0.93	
vC, conflicting volume	626				994	612
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	626				957	612
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	98				74	97
cM capacity (veh/h)	869				230	446

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	356	529	74
Volume Left	14	0	60
Volume Right	0	28	14
cSH	869	1700	253
Volume to Capacity	0.02	0.31	0.29
Queue Length 95th (m)	0.3	0.0	8.2
Control Delay (s)	0.5	0.0	25.0
Lane LOS	A		C
Approach Delay (s)	0.5	0.0	25.0
Approach LOS			C

Intersection Summary			
Average Delay	2.1		
Intersection Capacity Utilization	42.1%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	178	339	65	193	14	302	23	326
v/c Ratio	0.36	0.37	0.33	0.35	0.07	0.58	0.10	0.66
Control Delay	14.2	11.9	27.0	22.8	21.4	27.8	6.9	14.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.2	11.9	27.0	22.8	21.4	27.8	6.9	14.0
Queue Length 50th (m)	13.6	24.9	6.9	20.0	1.4	33.5	1.7	21.6
Queue Length 95th (m)	24.2	40.6	17.0	35.4	5.3	56.1	m1.8	m29.1
Internal Link Dist (m)		21.0		77.4		33.1		286.6
Turn Bay Length (m)	37.5		37.5		37.5		37.5	
Base Capacity (vph)	494	914	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	0.33	0.35	0.07	0.58	0.10	0.66

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	178	316	23	65	176	17	14	237	65	23	212	114
Future Volume (vph)	178	316	23	65	176	17	14	237	65	23	212	114
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		0.92	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)	1649	1695		1071	1744		1551	1701		1651	1577	
Flt Permitted	0.50	1.00		0.56	1.00		0.42	1.00		0.45	1.00	
Satd. Flow (perm)	871	1695		628	1744		679	1701		785	1577	
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	316	23	65	176	17	14	237	65	23	212	114
RTOR Reduction (vph)	0	4	0	0	4	0	0	13	0	0	24	0
Lane Group Flow (vph)	178	335	0	65	189	0	14	289	0	23	302	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)	498	824		197	547		202	506		233	469	
v/s Ratio Prot	0.03	c0.20			0.11			0.17			c0.19	
v/s Ratio Perm	0.14			0.10			0.02			0.03		
v/c Ratio	0.36	0.41		0.33	0.35		0.07	0.57		0.10	0.64	
Uniform Delay, d1	12.2	13.2		21.0	21.1		20.2	23.8		20.3	24.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		0.30	0.42	
Incremental Delay, d2	0.4	0.3		4.4	1.7		0.7	4.6		0.6	4.4	
Delay (s)	12.6	13.5		25.4	22.9		20.8	28.4		6.7	14.7	
Level of Service	B	B		C	C		C	C		A	B	
Approach Delay (s)		13.2			23.5			28.1			14.2	
Approach LOS		B			C			C			B	

Intersection Summary			
HCM 2000 Control Delay	18.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	20.4
Intersection Capacity Utilization	70.2%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBT	WBL	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	198	185	196	11	386	210
v/c Ratio	0.76	0.85	0.45	0.10	0.89	0.63
Control Delay	47.4	68.2	18.6	38.9	43.8	40.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	47.4	68.2	18.6	38.9	43.8	40.1
Queue Length 50th (m)	25.2	25.7	17.7	1.0	47.3	25.3
Queue Length 95th (m)	#55.3	#56.7	33.8	m2.8	#91.1	#60.6
Internal Link Dist (m)	23.4		59.9		286.6	30.0
Turn Bay Length (m)				30.0		
Base Capacity (vph)	261	220	435	105	436	335
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	0.76	0.84	0.45	0.10	0.89	0.63

Intersection Summary

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

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	2	185	11	185	182	14	11	81	305	47	161	2
Future Volume (vph)	2	185	11	185	182	14	11	81	305	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		1.00		1.00	0.99		1.00	0.95			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)		937		1695	931		1695	1494			1751	
Flt Permitted		1.00		0.95	1.00		0.95	1.00			0.84	
Satd. Flow (perm)		935		1695	931		1695	1494			1486	
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	14	11	81	305	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	196	0	11	386	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)		19.6		10.3	34.6		2.0	26.2			18.1	
Effective Green, g (s)		19.6		10.3	34.6		2.0	26.2			18.1	
Actuated g/C Ratio		0.25		0.13	0.43		0.02	0.33			0.23	
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)		229		218	402		42	489			336	
v/s Ratio Prot				c0.11	c0.21		c0.01	c0.26				
v/s Ratio Perm		c0.21									0.14	
v/c Ratio		0.86		0.85	0.49		0.26	0.79			0.62	
Uniform Delay, d1		28.9		34.1	16.3		38.3	24.4			27.9	
Progression Factor		1.00		1.00	1.00		1.04	0.77			1.00	
Incremental Delay, d2		32.7		25.2	4.2		3.0	11.0			8.5	
Delay (s)		61.6		59.2	20.5		42.7	29.7			36.4	
Level of Service		E		E	C		D	C			D	
Approach Delay (s)		61.6			39.3			30.0			36.4	
Approach LOS		E			D			C			D	

Intersection Summary			
HCM 2000 Control Delay	39.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	22.4
Intersection Capacity Utilization	74.7%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
3: Winona Avenue & Scott Street

04/17/2020

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	523	14	17	378	3	35
Future Volume (Veh/h)	523	14	17	378	3	35
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	523	14	17	378	3	35
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)	84					
pX, platoon unblocked						
vC, conflicting volume			537		942	530
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			537		942	530
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			98		99	94
cM capacity (veh/h)			1031		287	549

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	537	395	38
Volume Left	0	17	3
Volume Right	14	0	35
cSH	1700	1031	512
Volume to Capacity	0.32	0.02	0.07
Queue Length 95th (m)	0.0	0.4	1.7
Control Delay (s)	0.0	0.5	12.6
Lane LOS		A	B
Approach Delay (s)	0.0	0.5	12.6
Approach LOS			B

Intersection Summary			
Average Delay	0.7		
Intersection Capacity Utilization	45.6%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
10: Richmond Road & Winona Avenue

04/17/2020

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	44	360	233	26	11	25
Future Volume (Veh/h)	44	360	233	26	11	25
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	44	360	233	26	11	25
Pedestrians			2		47	
Lane Width (m)			3.7		3.7	
Walking Speed (m/s)			1.0		1.0	
Percent Blockage			0		5	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)		101				
pX, platoon unblocked					0.88	
vC, conflicting volume	306				743	293
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	306				644	293
tC, single (s)	4.1				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.2				3.6	3.4
p0 queue free %	96				97	96
cM capacity (veh/h)	1205				338	693

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	404	259	36
Volume Left	44	0	11
Volume Right	0	26	25
cSH	1205	1700	524
Volume to Capacity	0.04	0.15	0.07
Queue Length 95th (m)	0.8	0.0	1.5
Control Delay (s)	1.2	0.0	12.4
Lane LOS	A		B
Approach Delay (s)	1.2	0.0	12.4
Approach LOS			B

Intersection Summary			
Average Delay	1.3		
Intersection Capacity Utilization	50.9%	ICU Level of Service	A
Analysis Period (min)	15		

Queues
1: Richmond Road & Churchill Avenue

04/16/2020

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	136	280	113	453	21	283	17	443
v/c Ratio	0.37	0.27	0.64	0.61	0.27	0.69	0.10	1.20
Control Delay	12.4	8.8	40.2	23.7	37.9	38.8	28.6	142.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.4	8.8	40.2	23.7	37.9	38.8	28.6	142.4
Queue Length 50th (m)	9.5	18.4	13.7	53.2	2.7	38.1	2.1	~79.1
Queue Length 95th (m)	17.2	29.9	#38.0	81.4	9.3	#63.7	7.1	#131.5
Internal Link Dist (m)		21.0		79.3		33.1		286.6
Turn Bay Length (m)	37.5		37.5		37.5		37.5	
Base Capacity (vph)	364	1023	176	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	0.37	0.27	0.64	0.61	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 Road & Churchill Avenue

04/16/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	136	263	17	113	415	38	21	203	80	17	210	233
Future Volume (vph)	136	263	17	113	415	38	21	203	80	17	210	233
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	0.98	1.00		0.39	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)	1655	1671		661	1718		1695	1624		1559	1342	
Flt Permitted	0.31	1.00		0.59	1.00		0.18	1.00		0.41	1.00	
Satd. Flow (perm)	540	1671		409	1718		327	1624		674	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	263	17	113	415	38	21	203	80	17	210	233
RTOR Reduction (vph)	0	3	0	0	3	0	0	16	0	0	45	0
Lane Group Flow (vph)	136	277	0	113	450	0	21	267	0	17	398	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)	378	945		176	742		79	393		163	325	
v/s Ratio Prot	c0.02	c0.17			0.26			0.16			c0.30	
v/s Ratio Perm	0.18			c0.28			0.06			0.03		
v/c Ratio	0.36	0.29		0.64	0.61		0.27	0.68		0.10	1.23	
Uniform Delay, d1	11.2	10.2		20.1	19.7		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	0.6	0.2		16.6	3.7		8.1	9.1		1.3	125.8	
Delay (s)	11.8	10.4		36.7	23.3		35.7	40.1		27.8	159.9	
Level of Service	B	B		D	C		D	D		C	F	
Approach Delay (s)		10.8			26.0			39.8			155.0	
Approach LOS		B			C			D			F	

Intersection Summary			
HCM 2000 Control Delay	58.8	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	20.4
Intersection Capacity Utilization	79.1%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Queues
2: Churchill Avenue & Scott Street

04/16/2020

Lane Group	EBT	WBL	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	198	308	235	14	365	146
v/c Ratio	0.88	0.90	0.49	0.13	0.94	0.65
Control Delay	68.1	63.0	17.5	38.5	63.8	48.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	68.1	63.0	17.5	38.5	63.8	48.8
Queue Length 50th (m)	26.7	42.2	20.5	1.9	49.9	20.2
Queue Length 95th (m)	#60.7	#82.3	38.6	6.9	#95.4	#47.7
Internal Link Dist (m)	23.4		59.9		286.6	30.0
Turn Bay Length (m)				30.0		
Base Capacity (vph)	225	347	478	105	390	226
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	0.88	0.89	0.49	0.13	0.94	0.65

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

04/16/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	1	188	9	308	188	47	14	122	243	46	98	2
Future Volume (vph)	1	188	9	308	188	47	14	122	243	46	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		1.00		1.00	0.96		1.00	0.95			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)		932		1695	948		1695	1534			1735	
Flt Permitted		1.00		0.95	1.00		0.95	1.00			0.75	
Satd. Flow (perm)		931		1695	948		1695	1534			1330	
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	308	188	47	14	122	243	46	98	2
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	198	0	308	235	0	14	365	0	0	146	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)		17.6		16.1	38.6		3.0	22.2			13.6	
Effective Green, g (s)		17.6		16.1	38.6		3.0	22.2			13.6	
Actuated g/C Ratio		0.22		0.20	0.48		0.04	0.28			0.17	
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)		204		341	457		63	425			226	
v/s Ratio Prot				c0.18	c0.25		c0.01	c0.24				
v/s Ratio Perm		c0.21									0.11	
v/c Ratio		0.97		0.90	0.51		0.22	0.86			0.65	
Uniform Delay, d1		30.9		31.2	14.2		37.4	27.4			31.0	
Progression Factor		1.00		1.00	1.00		1.00	1.00			1.00	
Incremental Delay, d2		55.8		25.9	4.1		1.8	19.7			13.4	
Delay (s)		86.8		57.1	18.3		39.2	47.1			44.4	
Level of Service		F		E	B		D	D			D	
Approach Delay (s)		86.8			40.3			46.8			44.4	
Approach LOS		F			D			D			D	

Intersection Summary			
HCM 2000 Control Delay	50.0	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	22.4
Intersection Capacity Utilization	76.1%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
3: Winona Avenue & Scott Street

04/16/2020

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	466	10	38	539	3	36
Future Volume (Veh/h)	466	10	38	539	3	36
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	466	10	38	539	3	36
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)	84					
pX, platoon unblocked						
vC, conflicting volume			476		1086	471
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			476		1086	471
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			97		99	94
cM capacity (veh/h)			1086		231	593

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	476	577	39
Volume Left	0	38	3
Volume Right	10	0	36
cSH	1700	1086	529
Volume to Capacity	0.28	0.03	0.07
Queue Length 95th (m)	0.0	0.8	1.7
Control Delay (s)	0.0	1.0	12.3
Lane LOS		A	B
Approach Delay (s)	0.0	1.0	12.3
Approach LOS			B

Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	72.0%	ICU Level of Service	C
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
10: Richmond Road & Winona Avenue

04/16/2020

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	17	342	501	28	14	65
Future Volume (Veh/h)	17	342	501	28	14	65
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	17	342	501	28	14	65
Pedestrians			12		97	
Lane Width (m)			3.7		3.7	
Walking Speed (m/s)			1.0		1.0	
Percent Blockage			1		10	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)		103				
pX, platoon unblocked					0.93	
vC, conflicting volume	626				1000	612
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	626				961	612
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	98				94	85
cM capacity (veh/h)	869				227	446

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	359	529	79
Volume Left	17	0	14
Volume Right	0	28	65
cSH	869	1700	381
Volume to Capacity	0.02	0.31	0.21
Queue Length 95th (m)	0.4	0.0	5.4
Control Delay (s)	0.7	0.0	16.9
Lane LOS	A		C
Approach Delay (s)	0.7	0.0	16.9
Approach LOS			C

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	45.3%	ICU Level of Service	A
Analysis Period (min)	15		

Queues
1: Richmond Road & Churchill Avenue
04/17/2020

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	195	368	71	209	16	327	26	354
v/c Ratio	0.43	0.42	0.41	0.43	0.08	0.58	0.11	0.67
Control Delay	16.4	13.8	32.5	26.4	20.2	26.4	10.7	19.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	16.4	13.8	32.5	26.4	20.2	26.4	10.7	19.3
Queue Length 50th (m)	15.9	29.4	8.1	23.3	1.5	35.6	1.9	23.1
Queue Length 95th (m)	27.9	47.7	19.7	40.8	5.5	59.0	m3.6	50.5
Internal Link Dist (m)		21.0		84.1		33.1		286.6
Turn Bay Length (m)	37.5		37.5		37.5		37.5	
Base Capacity (vph)	459	866	173	488	211	560	244	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	0.41	0.43	0.08	0.58	0.11	0.67

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis
1: Richmond Road & Churchill Avenue
04/17/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	195	340	28	71	191	18	16	256	71	26	230	124
Future Volume (vph)	195	340	28	71	191	18	16	256	71	26	230	124
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)	1655	1684		1096	1745		1563	1701		1654	1577	
Flt Permitted	0.46	1.00		0.54	1.00		0.40	1.00		0.44	1.00	
Satd. Flow (perm)	799	1684		625	1745		656	1701		759	1577	
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)	195	340	28	71	191	18	16	256	71	26	230	124
RTOR Reduction (vph)	0	4	0	0	4	0	0	12	0	0	24	0
Lane Group Flow (vph)	195	364	0	71	205	0	16	315	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)	460	776		173	484		211	548		244	508	
v/s Ratio Prot	0.05	c0.22			0.12			0.19			c0.21	
v/s Ratio Perm	0.15			0.11			0.02			0.03		
v/c Ratio	0.42	0.47		0.41	0.42		0.08	0.57		0.11	0.65	
Uniform Delay, d1	13.6	14.8		23.6	23.7		18.8	22.5		19.0	23.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		0.50	0.64	
Incremental Delay, d2	0.6	0.4		7.1	2.7		0.7	4.3		0.7	5.4	
Delay (s)	14.2	15.3		30.6	26.4		19.5	26.9		10.3	20.2	
Level of Service	B	B		C	C		B	C		B	C	
Approach Delay (s)		14.9			27.4			26.5			19.5	
Approach LOS		B			C			C			B	

Intersection Summary			
HCM 2000 Control Delay	20.8	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
04/17/2020

Lane Group	EBT	WBL	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	19	201	17	12	421	229
v/c Ratio	0.09	0.71	0.03	0.11	0.74	0.49
Control Delay	31.9	45.5	15.9	50.5	33.9	27.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	31.9	45.5	15.9	50.5	33.9	27.9
Queue Length 50th (m)	2.4	26.3	1.5	1.7	61.4	24.3
Queue Length 95th (m)	7.7	45.1	5.0	m3.5	#92.9	48.4
Internal Link Dist (m)	23.4		59.9		286.6	30.0
Turn Bay Length (m)				30.0		
Base Capacity (vph)	213	326	503	105	568	466
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	0.62	0.03	0.11	0.74	0.49

Intersection Summary

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

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis
2: Churchill Avenue & Scott Street
04/17/2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	2	6	11	201	2	15	12	89	332	51	176	2
Future Volume (vph)	2	6	11	201	2	15	12	89	332	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		0.96		1.00	0.86		1.00	0.95			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)		1544		1695	1324		1695	1494			1751	
Flt Permitted		0.97		0.95	1.00		0.95	1.00			0.84	
Satd. Flow (perm)		1511		1695	1324		1695	1494			1491	
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	15	12	89	332	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	17	0	12	421	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)		8.4		13.4	27.6		2.0	33.2			25.1	
Effective Green, g (s)		8.4		13.4	27.6		2.0	33.2			25.1	
Actuated g/C Ratio		0.11		0.17	0.35		0.02	0.42			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)		158		283	456		42	620			467	
v/s Ratio Prot				c0.12	c0.01		c0.01	c0.28				
v/s Ratio Perm		c0.01									0.15	
v/c Ratio		0.12		0.71	0.04		0.29	0.68			0.49	
Uniform Delay, d1		32.5		31.5	17.4		38.3	19.1			22.3	
Progression Factor		1.00		1.00	1.00		1.36	1.18			1.00	
Incremental Delay, d2		1.6		8.1	0.2		3.3	5.2			3.7	
Delay (s)		34.0		39.6	17.5		55.2	27.6			25.9	
Level of Service		C		D	B		E	C			C	
Approach Delay (s)		34.0			37.9			28.3			25.9	
Approach LOS		C			D			C			C	

Intersection Summary			
HCM 2000 Control Delay	30.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	22.4
Intersection Capacity Utilization	70.2%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
3: Winona Avenue & Scott Street

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	374	15	17	215	3	38
Future Volume (Veh/h)	374	15	17	215	3	38
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	374	15	17	215	3	38
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)	84					
pX, platoon unblocked						
vC, conflicting volume			389		630	382
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			389		630	382
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		99	94
cM capacity (veh/h)			1170		439	666

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	389	232	41
Volume Left	0	17	3
Volume Right	15	0	38
cSH	1700	1170	641
Volume to Capacity	0.23	0.01	0.06
Queue Length 95th (m)	0.0	0.3	1.4
Control Delay (s)	0.0	0.7	11.0
Lane LOS		A	B
Approach Delay (s)	0.0	0.7	11.0
Approach LOS			B

Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	36.7%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
10: Richmond Road & Winona Avenue

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	49	392	252	29	26	11
Future Volume (Veh/h)	49	392	252	29	26	11
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	49	392	252	29	26	11
Pedestrians			2		47	
Lane Width (m)			3.7		3.7	
Walking Speed (m/s)			1.0		1.0	
Percent Blockage			0		5	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)		108				
pX, platoon unblocked					0.86	
vC, conflicting volume	328				806	314
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	328				696	314
tC, single (s)	4.1				6.5	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.6	3.3
p0 queue free %	96				91	98
cM capacity (veh/h)	1183				306	685

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	441	281	37
Volume Left	49	0	26
Volume Right	0	29	11
cSH	1183	1700	366
Volume to Capacity	0.04	0.17	0.10
Queue Length 95th (m)	0.9	0.0	2.3
Control Delay (s)	1.3	0.0	15.9
Lane LOS	A		C
Approach Delay (s)	1.3	0.0	15.9
Approach LOS			C

Intersection Summary			
Average Delay	1.5		
Intersection Capacity Utilization	54.2%	ICU Level of Service	A
Analysis Period (min)	15		

Queues
1: Richmond Road & Churchill Avenue

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	149	324	122	493	23	308	18	484
v/c Ratio	0.46	0.34	0.66	0.66	0.29	0.75	0.12	1.31
Control Delay	14.2	9.4	40.7	25.3	39.2	42.7	29.3	186.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.2	9.4	40.7	25.3	39.2	42.7	29.3	186.3
Queue Length 50th (m)	10.5	21.9	15.0	59.8	3.0	42.5	2.2	~93.2
Queue Length 95th (m)	18.7	35.4	#40.3	91.3	10.0	#76.9	7.5	#147.3
Internal Link Dist (m)		21.0		86.0		33.1		286.6
Turn Bay Length (m)	37.5		37.5		37.5		37.5	
Base Capacity (vph)	325	958	185	746	79	409	146	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	0.46	0.34	0.66	0.66	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 Road & Churchill Avenue

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	149	285	39	122	452	41	23	221	87	18	229	255
Future Volume (vph)	149	285	39	122	452	41	23	221	87	18	229	255
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		0.43	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)	1667	1562		722	1719		1695	1624		1572	1341	
Flt Permitted	0.27	1.00		0.56	1.00		0.18	1.00		0.37	1.00	
Satd. Flow (perm)	468	1562		429	1719		327	1624		605	1341	
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)	149	285	39	122	452	41	23	221	87	18	229	255
RTOR Reduction (vph)	0	6	0	0	3	0	0	16	0	0	45	0
Lane Group Flow (vph)	149	318	0	122	490	0	23	292	0	18	439	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)	332	883		185	742		79	393		146	324	
v/s Ratio Prot	0.03	c0.20			c0.28			0.18			c0.33	
v/s Ratio Perm	0.21			0.28			0.07			0.03		
v/c Ratio	0.45	0.36		0.66	0.66		0.29	0.74		0.12	1.36	
Uniform Delay, d1	12.8	10.7		20.3	20.3		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	1.0	0.3		17.0	4.6		9.1	12.0		1.7	179.1	
Delay (s)	13.8	10.9		37.3	24.9		36.9	43.5		28.4	213.2	
Level of Service	B	B		D	C		D	D		C	F	
Approach Delay (s)		11.8			27.3			43.1			206.5	
Approach LOS		B			C			D			F	

Intersection Summary			
HCM 2000 Control Delay	73.0	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	20.4
Intersection Capacity Utilization	84.6%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Queues
2: Churchill Avenue & Scott Street

04/16/2020

Lane Group	EBT	WBL	WBT	NBL	NBT	SBT
Lane Group Flow (vph)	19	335	59	16	396	159
v/c Ratio	0.09	0.85	0.10	0.15	0.80	0.48
Control Delay	32.2	50.1	14.1	39.0	38.9	33.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	32.2	50.1	14.1	39.0	38.9	33.2
Queue Length 50th (m)	2.4	43.8	4.7	2.2	49.9	20.1
Queue Length 95th (m)	7.8	#79.9	11.0	7.5	#90.5	37.3
Internal Link Dist (m)	23.4		59.9		286.6	30.0
Turn Bay Length (m)				30.0		
Base Capacity (vph)	208	425	565	105	496	332
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	0.79	0.10	0.15	0.80	0.48

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

04/16/2020

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	264	50	107	2
Future Volume (vph)	1	8	10	335	9	50	16	132	264	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		0.95		1.00	0.83		1.00	0.95			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)		1557		1695	1295		1695	1533			1736	
Flt Permitted		0.99		0.95	1.00		0.95	1.00			0.79	
Satd. Flow (perm)		1540		1695	1295		1695	1533			1389	
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	264	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	396	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)		9.0		18.7	33.1		3.0	27.7			19.1	
Effective Green, g (s)		9.0		18.7	33.1		3.0	27.7			19.1	
Actuated g/C Ratio		0.11		0.23	0.41		0.04	0.35			0.24	
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)		173		396	535		63	530			331	
v/s Ratio Prot				c0.20	c0.05		c0.01	c0.26				
v/s Ratio Perm		0.01									0.11	
v/c Ratio		0.11		0.85	0.11		0.25	0.75			0.48	
Uniform Delay, d1		31.9		29.3	14.4		37.4	23.1			26.2	
Progression Factor		1.00		1.00	1.00		1.00	1.00			1.00	
Incremental Delay, d2		1.3		15.2	0.4		2.1	9.3			4.9	
Delay (s)		33.2		44.5	14.8		39.5	32.3			31.1	
Level of Service		C		D	B		D	C			C	
Approach Delay (s)		33.2			40.1			32.6			31.1	
Approach LOS		C			D			C			C	

Intersection Summary			
HCM 2000 Control Delay	35.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	22.4
Intersection Capacity Utilization	72.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
3: Winona Avenue & Scott Street

04/16/2020

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	311	11	41	392	3	39
Future Volume (Veh/h)	311	11	41	392	3	39
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	311	11	41	392	3	39
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)	84					
pX, platoon unblocked						
vC, conflicting volume			322		790	316
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			322		790	316
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			97		99	95
cM capacity (veh/h)			1238		347	724

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	322	433	42
Volume Left	0	41	3
Volume Right	11	0	39
cSH	1700	1238	672
Volume to Capacity	0.19	0.03	0.06
Queue Length 95th (m)	0.0	0.7	1.4
Control Delay (s)	0.0	1.1	10.7
Lane LOS		A	B
Approach Delay (s)	0.0	1.1	10.7
Approach LOS			B

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	55.5%	ICU Level of Service	B
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
10: Richmond Road & Winona Avenue

04/16/2020

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	18	373	545	31	16	70
Future Volume (Veh/h)	18	373	545	31	16	70
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	18	373	545	31	16	70
Pedestrians			12		97	
Lane Width (m)			3.7		3.7	
Walking Speed (m/s)			1.0		1.0	
Percent Blockage			1		10	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)		110				
pX, platoon unblocked					0.91	
vC, conflicting volume	673				1078	658
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	673				1039	658
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	98				92	83
cM capacity (veh/h)	835				201	420

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	391	576	86
Volume Left	18	0	16
Volume Right	0	31	70
cSH	835	1700	349
Volume to Capacity	0.02	0.34	0.25
Queue Length 95th (m)	0.5	0.0	6.7
Control Delay (s)	0.7	0.0	18.7
Lane LOS	A		C
Approach Delay (s)	0.7	0.0	18.7
Approach LOS			C

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	48.3%	ICU Level of Service	A
Analysis Period (min)	15		